

The Impact of Recent High-Resolution Global Digital Elevation Models to the Determination of Basin Hydrological Properties. An Application to Northern Greece

Recent satellite DEMs to determine basin hydrological properties

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Keywords: SRTM, ASTER, DEMs, DTMs, GIS, basin hydrological parameters

Abstract:

The combined use of Geographic Information Systems and recent high-resolution Digital Elevation Models (DEMs) from Remote Sensing imagery offers a unique opportunity to study the hydrological properties of basin and catchment dynamics and derive the hydrological features of specific regions of various spatial scales. Until recently, the availability of global DEMs was restricted to low-resolution and accuracy models, e.g., ETOPO5, ETOPO2 and GTOPO30, compared to local Digital Terrain Models (DTMs) derived from photogrammetric methods and offered usually in the form of topographic maps of various scales. The advent of the SRTM and ASTER missions, offer some new tools and opportunities in order to use their data within a GIS to study the hydrological properties of basins and consequently validate their performance both amongst each other, as well as in terms of the results derived from a local DTM. The present work focuses on the use of the recent SRTM v2 90 m and ASTER v2 30 m DEMs along with the national 500 m DTM generated by the Hellenic Military Geographic Service (HMGS), within a GIS in order to assess their performance in determining the hydrological properties of basins. To this respect, the ArcHydro extension tool of ArcGIS v9.3 and HEC-GeoRAS v4.3 have been exploited to determine the hydrographic data of the basins under study which are located in Northern Greece. The hydrological characteristics refer to stream geometry, curve number, flooding areas, etc. as well as the topographic characteristics of the basin itself, such as aspect, hillshade, slope e.t.c..

Coastal Water Quality Monitoring in Cyprus Using Satellite Remote Sensing, In-Situ Spectroradiometric and Water Sampling Measurements: The "SAT-COAST" Project

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Keywords: coastal water, remote sensing, field spectroscopy, optical properties, monitoring tool

Abstract:

This paper examines how remote sensing techniques can become a powerful tool for monitoring coastal water quality in Cyprus. Satellite images are valuable tools for environmental assessment since they can provide daily or weekly data, depending on satellite overpass frequency, rather than monthly as done by traditional sampling campaigns. Moreover the low price availability of satellite images enables the extended use of remote sensing for monitoring water quality in coastal areas. This paper aims to present the first results derived from a running project funded by the Cyprus Research Promotion Foundation. For the purposes of this project a running field sampling campaign program started during 2011. During sampling campaigns spectroradiometric field measurements are collected using a handheld GER1500 field spectroradiometer equipped with a fiber optic probe in order to retrieve the spectral signature of the examined coastal areas which are situated in Limassol District. Indeed, this will assist the development of an efficient model for monitoring purposes using satellite imagery. At the same time both surface and 10 meters below sea level (using a Niskin Sampling Bottle) water samples are collected. A number of physicochemical measurements are determined on site when collecting samples for laboratory analyses of nutrients and metals. These in situ measurements include pH, electrical conductivity, dissolved oxygen concentration and temperature. Summarizing the objective of this project focused on the development of a water quality monitoring tool for coastal areas using satellite imagery based on field spectroscopy measurements and optical properties of the water. Such techniques can be applied in coastal areas providing us with more data and helping us to examine larger areas and as a result detect and solve pollution problems. The development and improvement of satellite remote sensing technologies and applications for water quality observations rely on the needs of sustainable water strategies and new policies for water management.

Hydrological Regime of the Western Siberian Plain from Satellite and In Situ Observations: Climatic and Social Context

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Keywords: hydrology, western Siberia, radar altimetry, radiometry

Abstract:

The western Siberian plain is a large region with mostly flat relief. As a result, this leads to the formation of a multitude of interconnected natural objects - large and small rivers streams, large floodplains, lakes, bogs etc. Flooded areas and bogs act as a buffer zone, providing a dampening "sponge" effect on the water redistribution within the river system. Northern part of the Western Siberia is located in the permafrost zone and is affected by thermokarst processes. This zone is also influenced by human activity (construction of roads, gaz and oil pipelines etc) that affects the primary hydrological network. We present the results of study of variability of hydrological processes in the Western Siberia at different temporal (from multi-year to seasonal) and spatial (from local to regional) scales through a multidisciplinary approach based on in situ and remote sensing data. Radar altimetry, radiometry and optical satellite data are used in combination with the in situ observations and the recent field studies done in 2008-2011. We present the variability of water level (from radar altimetry) and wet zones extent (from altimeter waveforms parameters) for the 21 mid-size watersheds of the Ob' river system and Nadym, Pur and Taz rivers. Seasonal and interannual variability of water abundance is studied using radar altimetry and radiometry. We also estimate the role of the snow cover in the formation and seasonal distribution of runoff. We then analyse the observed changes in the hydrological regime in the context of climatic changes and human activity. This research has been done in the framework of the Russian-French cooperation GDRI "CAR-WET-SIB", French ANR "CLASSIQUE" project, PNTS Permafrost project and FP7 MONARCH-A project.

Methodological Chain for Hydrological Management with Web-GIS Applications

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Keywords: hydrological applications, satellite image classification, web GIS, web processing service

Abstract:

The use of hydrological applications is substantial in assessing catchment dynamics and in estimating several hydraulic parameters. Different areas with variant terrains and land characteristics require a wide range of needs in terms of finding and locating hydrological parameters such as catchment areas, curve number, submersion areas, flow dynamics etc. All the aforementioned are necessary for hydrological or/and hydraulic simulation modeling and numerous tools are available so as to model hydro-related procedures. Geographic Information Systems (GIS) have been successfully employed over the last several years in order to manage spatial data involved in hydrological simulation modeling processes as well as to execute typical geoprocesses, such as digital elevation model (DEM) evaluation and catchment delineation. Some of these processes may be served to internet GIS users by adopting the geoprocessing web service standard (WPS) introduced by Open Geospatial Consortium (OGS). In this study, several appropriate actions were applied in order to simulate hydrological modeling procedures by means of web GIS technology and to create a structured methodological chain incorporating remote sensing data analysis. The study focused on the hydrological characteristics of a specific area located in Northern Greece and was based on satellite and remote sensing data (LANDSAT, ASTER, SRTM). In particular, the methodological chain was determined and each procedure necessary was analyzed. Some of the tools needed were created for this purpose, while some processes were invoked from open source software. The final output may be considered as a web interface, where some processes are offered fully automated and others require user feedback and third-party software utilization (e.g. MultiSpec).

Vegetation Dynamics and Climate Change in Central Asia: Comparison of Satellite Data and Climate Model

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Keywords: central Asia, vegetation dynamics, GIMMS, MODIS, REMO, climate change

Abstract:

Climate is one of the most important factors influencing vegetation and its phenology. Besides the anthropogenic impact it is the only variable having an instant, short-term effect on the vegetation phenology. The purpose of this work is to investigate the relation between vegetation phenology and climate change using remote sensing. Phenology changes are analyzed for two different temporal and spatial scales using remote sensing: The whole of Central Asia for 25 years (1982-2006) using NOAA AVHRR GIMMS 8km datasets with a spatial resolution of and focus regions using MODIS NDVI (250 m) from 2001-2009. The focus regions are Amu Darya Delta, Bukhara and Samarkand region, Zerafshan catchment and Pamir mountains. Precipitation and temperature from the regional climate model REMO for Central Asia in version 7 (in resolution of 0.16°) were interpreted in relation to the landscape phenology within 1982-2009 timespan. The study discusses the possibilities for prediction of future vegetation changes by considering different resolutions and sources of modelled and satellite data under climate circumstances as modelled in REMO. This is done on a regional level for the whole Central Asia and particularly in different focus areas with diverse land cover.

Surface Clutter Suppression Techniques Applied to P-band Multi-Channel SAR Ice Sounder Data from East Antarctica

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Keywords: radio echo sounding, ice sheet, surface clutter suppression, multi-channel processing

Abstract:

Radar ice sounding allows for the retrieval of ice depth and provides information on basal topography, basal conditions, flow, and layering. In the prospect of a possible future satellite ice sounding mission, surface clutters are expected to severely hamper measurement of radar echoes from the depth due to the unfavourable observation geometry. Synthetic aperture radar (SAR) processing enables to attenuate surface clutters in the forward and backward directions, but not in the across-track directions. Thus, additional across-track clutter cancellation is a crucial step for extracting weaker subsurface radar echoes. ESA's P-band POLarimetric Airborne Radar Ice Sounder (POLARIS), recently upgraded with a larger antenna of 4 m length, enables simultaneous reception of up to 4 sub-aperture channels in across-track. Several datasets were acquired in the multi-channel configuration during the 2011 spring campaign over East Antarctica. Different surface clutter suppression approaches, based on topographic data, are presented and compared in this paper. Clutter rejection performance is quantified through comparison with original data.

Ocean Remote Sensing Altimetric Satellites in Support of Sea Level Anomalies and Mean Sea Surface Modelling: SLA Variations and MSS in the Mediterranean from Altimetry

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Keywords: satellite altimetry, ocean remote sensing, sea level anomalies, mean sea surface, sea variability

Abstract:

The exploitation of altimetric data sets from past and current satellite missions is crucial to both oceanographic and geodetic applications, since it allows the determination of sea level anomalies, as deviations from a static mean sea level, while it is also fundamental for marine geoid determination. In this work, altimetric data sets from the satellite remote sensing missions of JASON1 and ENVISAT have been used towards the determination of Mean Sea Surface (MSS) models in the Mediterranean Sea. The raw data used are Sea Level Anomaly (SLA) values and their total inverse barometer corrections from the respective altimetric missions acquired by the on-board altimeters. Along-track records of the SLA have been used both to derive linear trends of the SLA variation in the area under study and come to some conclusions on the Mediterranean variability at scales as short as ten days. Empirical covariance functions and the statistical analysis of the SLA along-track repeated satellite records are presented and are finally used to estimate single and multi-satellite models of the mean sea surface through least squares collocation which are then validated against the DNSC08 MSS model.

Ocean Colour Scanners Recorded the Tsunami in the Caspian Sea

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Keywords: remote sensing, ocean colour, meteorological tsunami

Abstract:

Atmospheric gravity waves impacting on sea surface can produce meteorological surface gravity waves that modulate the water leaving radiance and can be visible on level L2 (with an atmospheric correction) ocean colour scanner radiance images. At the same time under definite meteorological conditions atmospheric waves modulate the radiance return from cloud and are visible on level L1 (without the atmospheric correction) radiance images. High-amplitude meteorological waves named meteo-tsunami were registered by L2 remote sensing reflectance in the central and southern parts of the Caspian Sea sequentially by three ocean colour scanners. MODIS on EOS AM-1 Terra satellite recorded the tsunami at 7:40, MODIS on EOS AM-2 Aqua satellite at 9:20 and SeaWiFS on OrbView-2 satellite at 10:14, so that duration of the tsunami was at least 2.5 hours. Unfortunately, no of any known satellite with an altimeter on the board flew over the tsunami region that time. Registered by two MODIS scanners in the cloudless shallow part of the sea near the Apsheron Peninsular, the tsunami was represented by arched waves with a wavelength of 1.2 - 6.5 km, spreading to the west. An amplitude of tsunami waves, evaluated on the basis of the parameter $z_{90} / K_d 490$, where z_{90} is the 90 percent depth of water leaving radiance formation, and $K_d 490$ is the downwelling diffuse attenuation coefficient at 490 nm, was up to 1 m. Scanned later by SeaWiFS, characteristics of meteo-tsunami spreading in the central and southern parts of the sea, were much greater: a crest length of bow-shaped and S-shaped waves reached 620 km, wavelength changed from 23 to 54.7 km, amplitude changed from 3.9 m in the deep sea up to 5 m near the shelf. Basing on SeaWiFS remote sensing reflectance images, a number of tsunami waves changed from 5 to 7 and their position depended from sun light wavelengths of the optical range. The Caspian Sea region is known to be divided by deep faults, and is an area of high tectonic activity. But there was not registered any large-scale earthquake in the sea or in its nearest vicinity that day. Most probably, a source of the tsunami was a power arctic cyclone that was moving eastwards over the northern part of the sea with a main speed of 70 km/h. It could set in motion lithospheric blocks, separated the Alpine folded area and the Scythian-Turanian platform in the Caspian depression. As a result, large and intense atmospheric waves, recorded by SeaWiFS level L1 radiance return, had been formed in the northern Caspian Sea to the right from the western boundary of the cyclone. Atmospheric waves moved along the boundary of the cyclone, rounded it and spread to the south of the sea stimulating the meteo-tsunami.

Cross-comparison of LST Products from AVHRR and MODIS

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Keywords: LST, land surface temperature, AVHRR, MODIS

Abstract:

Two different products of land surface temperature (LST) from AVHRR and MODIS were cross-compared on a daily basis of four different years. Used pixel-pairs had to stick to certain homogeneity criteria and were selected according to a minimum acquisition time difference. Averaging the mean absolute differences for the whole dataset, mean absolute differences of 2.2 K for the daytime and 1.4 K for the nighttime scenes were found. The correlation coefficient r^2 between the LST of AVHRR and MODIS of both day and night scenes was 0.99. These values suggest a good general agreement between the two products. An expanded analysis of the differences of the two products showed that during the day scattering was higher than during the night, which was traced back to thermal anisotropy and the remaining time difference between the two scenes. Further a distinct diurnal and annual pattern was found with LST of AVHRR being higher than MODIS at high surface temperatures and LST of AVHRR being lower than MODIS LST at lower surface temperatures. In addition, some irregular patterns were identified and attributed to different algorithm approaches and cloud masking.

Study of Uncertainties from Evapotranspiration Models Applied to LANDSAT Thermal Data Over a Mediterranean Agricultural Region

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Keywords: sensible heat flux, evapotranspiration, S-SEBI, SEBAL, LANDSAT, remote sensing, thermal data, albedo, agricultural practices

Abstract:

Estimation of surface energy fluxes by remote sensing is becoming more common since it allows their monitoring over extensive areas. During the past decades, a large variety of methods have been developed to retrieve these fluxes, which are of great interest in meteorology, climatology and hydrology. Land surface temperature (LST) is indirectly related to the latent heat flux (LE) or evapotranspiration, which is also important in agricultural water resource management. The work presented here leads on the assessment of modeling uncertainties over a Mediterranean agricultural region using evapotranspiration models based on thermal data from LANDSAT 7 Enhanced Thematic Mapper Plus (ETM+). An important data set of LANDSAT 7 images were acquired between 2007 and 2010 over the Crau-Camargue region, located in southern France. This area offers an important diversity of natural and agricultural ecosystems (i.e., irrigated and dry grasslands, rice, wheat). Continuous measurements of albedo, LST and surface fluxes linked with a description of the vegetation evolution are available for several years over the Crau-Camargue, both for dry and irrigated grasslands, natural and cultivated areas. The Simplified Surface Energy Balance Index model (S-SEBI; Roerink et al., 2000) and the Surface Energy Balance Algorithm for Land (SEBAL; Bastiaanssen et al., 1998) were proposed for operational applications. Albedo, computed from mul-

tispectral data, and LST, obtained from the thermal band (10.4-12.5 μm), are key variables for these two approaches. They are obtained from several processing, including atmospheric corrections which represent an important step particularly for thermal images. Results of the models are compared with the ground data available for different surfaces. Several issues have been considered in order to analyze the error impact of inputs on evapotranspiration mapping. The study evaluates the accuracy of the atmospheric profiles used for the atmospheric correction required for the derivation of LST from thermal satellite data. Different databases of atmospheric profiles were used, such as model outputs from the European Center for Medium range Weather Forecasting (ECMWF) and from the National Centers for Environmental Prediction (NCEP), and also radiosounding measurements. Further, the consideration of several algorithms to compute albedo from LANDSAT data is carried out and then compared with actual ground measurements. The analysis showed that albedo estimations derived following Liang (2000) are generally the best results when considering all years and sites, with an error close to 10%. Different formulations were also used to estimate the soil heat flux. Various inputs can be required according to the algorithm, such as net radiation, LST, albedo, normalized difference vegetation index (NDVI), leaf area index (LAI) or fraction cover. Hence, accuracy of soil heat flux estimation varies depending on error estimation of main inputs. Finally, the consideration of homogeneous or heterogeneous climate over the studied area allowed us to analyze the forcing of atmospheric variables. The results showed a large variability for the sensible heat flux estimated over the whole area from LANDSAT data using S-SEBI or SEBAL models. Further, they proved that uncertainties linked to the main inputs can be important and must be taken into account to analyze the latent heat flux estimation over large areas. This study allowed the assessment of the most commonly algorithms applied for monitoring crop and water management. These results also highlighted the importance of the thermal data in the different methods.

Bastiaanssen, W.G.M., Menenti, M., et al. (1998). "A remote sensing surface energy balance algorithm for land (SEBAL) - 1. Formulation." *Journal of Hydrology*, 213(1-4): 198-212.

Liang, S. (2000) "Narrowband to broadband conversions of land surface albedo. I Algorithms". *Remote Sensing of Environment*, 76: 213-238.

Roerink, G. J., Su, Z., and Menenti, M. (2000). "S-SEBI: A simple remote sensing algorithm to estimate the surface energy balance." *Physics and Chemistry of the Earth Part B-Hydrology Oceans and Atmosphere*, 25(2): 147-157.

Ground and Airborne Thermal Imaging of Abandoned Coal Mines in Mpumalanga Province, South Africa

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Keywords: coal, spontaneous combustion, acid mine drainage, earth observation, dialogue

Abstract:

As part of the European FP7-funded project EO-MINERS (“Earth Observation for Monitoring and Observing Environmental and Societal Impacts of Mineral Resources Exploration and Exploitation”) thermal infrared investigations using both ground-based and airborne thermal sensors have been undertaken on a field test site located in a coal-mining area in Mpumalanga Province, South Africa. The abandoned underground coal mines in the area are characterised by fires in the underground operations, many of which are flooding, with widespread discharges of acid mine drainage occurring. Thermal surveying has been undertaken to verify the effectiveness of the technique for the detection and mapping of underground fires and the movement and discharge of groundwater, including water heated to above ambient temperature by interaction with the burning underground workings. Within the scope of the EO-MINERS Project, earth observation data are presented and interpreted with respect to impacts on surrounding communities and an attempt is made to present a standardised approach to the use of EO data in this context. Furthermore the project hopes to

link EO data to the ongoing environmental and social dialogue (Industry, Regulators & Society) surrounding mining and its impacts.

EOMINERS - The Development of Earth Observation Based TIR Tools in Identification and Monitoring of the Impacts of Abandoned Coal Mines on Nearby Communities

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Keywords: EOMINERS, TIR-tools, witbank, South Africa, underground coal fires, subsidence, acid mine drainage

Abstract:

The exploitation of natural resources in many developing countries has been considered as a vital part of economic growth, employment and infrastructure development, but it has come at a cost to the environment. Early mining operations have left a historical legacy of environmental and societal impacts that affect perception of mining. With the emergence of the concept of sustainable development it is now recognised that environmental protection is as fundamental to a healthy economy and society. The technology platform to support critical environmental monitoring is diverse, geographically inconsistent, site specific, lacks integration across technologies and is therefore far from complete. The Earth Observation for Monitoring and Observing Environmental and Societal Impacts of Mineral Resources Exploration and Exploitation (EOMINERS) project aims at

integrating new and existing Earth Observation tools to improve best practice in mining activities and to reduce the mining related environmental and societal footprint by introducing innovative remote sensing tools to the mining industry. The development of Earth Observation (EO)-based TIR-tools for monitoring and observing the impact of coal mines on the environment and society at a demonstration site in the Witbank coalfield, South Africa is the focus of this paper. Collieries in the Witbank coalfield have historically used bord and pillar mining with typically low coal recovery ratios, leaving a significant amount of coal in pillars, and as floor and roof coal. Burning underground coal fires due to spontaneous combustion in areas showing subsidence within residential areas and warm acid mine drainage and heavy metals contaminated water seeps into ground and surface water has been investigated by aerial TIR and field observations. This paper focuses on the results from the TIR-campaign and proposes recommendations regarding the hazard and potential risk to nearby residential areas.

Retrieval of Surface Currents from Geostationary Satellite Observations

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Keywords: surface currents, geostationary, monitoring, SEVIRI, GOES-R

Abstract:

The presentation describes further developments of the methodology to determine and validate vectors of surface currents determined on the basis of using the analysis of consecutive geo-stationary observations. An opportunity to track the motion of characteristic features associated with surface currents is provided by frequent monitoring of surface radiative properties. The essence of the physical basis and mathematical realization of the chosen approach is presented by two major parts. The first part selects targets on ocean surface, characterized by prominent gradients in surface brightness temperature. The second part considers those targets as tracers for the areas not obscured by cloudiness and monitors their movement between consecutive images estimating the speed and direction of identified targets related to surface currents using an algorithm based upon the Sum of Squared Distances (SSD) Method. The method to derive surface currents is complemented by extensive quality control including correlations between traced thermal features at consecutive images and the acceleration of ocean motion between images. The approach under development is intended to be applied to information provided by Advanced Baseline Imager (ABI) on GOES-R satellites and other geostationary satellites. For testing and evaluating results at the present time, full disk data from the Spinning Enhanced Visible and Infra-red Imager (SEVIRI) instrument onboard the European Meteosat Second Generation (MSG) satellite are used. The quality of ocean current vectors derived from geostationary satellite observation is estimated by comparison with direct current measurements, modeled ocean motion, and currents provided by altimeter-based techniques. Detailed estimates of quality of surface vector retrieval for different temporal resolution are used to establish an optimum strategy of data processing within a daily cycle. The comparison of preliminary surface current calculations with the system of predominant coastal ocean currents shows that proposed approach could be effectively used for near real time monitoring of ocean currents as well as for studying surface ocean circulation. It is planned to coordinate our further validation efforts with the international program HyMex to better understand the hydrological cycle in the Mediterranean including specialized studies in the South-eastern Mediterranean Target Area at different temporal scales from synoptic through inter-annual to decadal.

Indicators for Draught Monitoring in Hungary

Drought monitoring in late autumn by remote sensing

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Keywords: drought monitoring, indicator

Abstract:

Series of severe flood, waterlog and drought events have hit Hungary recently. Thus the provision of quick, objective, reliable and homogenous information about development and impact of these disasters is very imperative at local and regional scale. Remote sensing is an excellent tool for this purpose. After the waterlog descending at the beginning of year 2011, we had to face up to lack of precipitation – in comparison to the annual yearly statistics. Monitoring of summertime drought is carried out by applying the methodology elaborated earlier (Suba 2008). Precipitation during this November was extremely low as well, only 0,4 percent of the average precipitation amount for that period of the year. The remote sensing techniques applied for monitoring the vegetative period cannot be used in late autumn due to scant vegetation, which is a characteristic feature of continental climate of Carpathian basin. Therefore other indicators need to be developed for characterising spatial distribution of drought areas for the period of November. These Indicators detecting impact of drought can be produced by analysing spectral-temporal behaviour of autumn crops and pastures. In this paper we present our results and efforts for generating such indicators. Zsuzsanna Suba, Gizella Nádor, Gábor Csornai, István László, Csaba Wirnhardt : Drought monitoring with the integrated utilization of satellite images in Hungary. EARSeL Symposium, Istanbul, 2008

Assessing Soil Erosion Rate in a Catchment Area in Cyprus Using Remote Sensing and GIS

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Keywords: remote sensing, GIS, erosion, RUSLE, Cyprus

Abstract:

During the last years there has been a growing awareness of the importance of problems related to erosion in the broader Mediterranean region. The widespread occurrence and importance of accelerated erosion in the Mediterranean region has driven to the development of models at scales ranging from individual farm fields to vast catchment areas and different types of administrative areas. In some parts of the Mediterranean region, erosion has reached a stage of irreversibility while in some places there is no more soil left. Spatial and quantitative information on soil erosion contributes significantly to the soil conservation management, erosion control and general catchment areas management. The objective of this work is to develop and compare for their accuracy two different erosion models with the integrated use of Geographical Information Systems (GIS) and Satellite Remote Sensing. The first is a quantitative empirical multiparametric model which is mainly based in expert's knowledge and Analytical Hierarchical Process (AHP) and the second is the Revised Universal Soil Loss Equation (RUSLE) model which is considered to be the most contemporary approach of soil erosion assessment. These two models were implemented in a water basin in the central part of Cyprus (Yialias River) which is generally prone to erosion processes. The whole method is based in the estimation of soil loss per unit area and takes into account specific parameters such as topography, soil erodibility, erosivity and rainfall – runoff. For the implementation of the models high resolution satellite images such as IKONOS and GEOEYE were used in order to extract land cover, soil and topographical information regarding the study area. The RUSLE factors were calculated in GIS environment. Specifically the R-factor was calculated from daily precipitation data, the L-factor from a 25 m Digital Elevation Model (DEM), the C-factor from IKONOS satellite remote sensing images through the construction of detailed regional land

use /land cover maps, the P-factor from aerial photos and satellite images and the K-factor from the digital regional soil map. This study indicated that using RS and GIS technologies for erosion risk mapping, based on the methodology implemented on RUSLE model, resulted in effective and accurate assessment of soil erosion in considerable short time and low cost for large watersheds.

Inundation Monitoring of the Mekong Delta – Rainy Season Assessments Based on TerraSAR-X and Envisat ASAR Data

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Keywords: Mekong Delta, Vietnam, inundation

Abstract:

The Mekong Delta in southern Vietnam is home to some 18 Million inhabitants, often termed ‘the rice bowl’ of Southeast Asia, and is receiving increasing attention in public and scientific media. The Delta is the vulnerable end of the Mekong River, emptying via nine major channels into the South Chinese Sea. The low lying Delta is severely threatened by the negative side effects of socio-economic transformation, urbanisation and industrialization, as well as climate change-induced sea level rise. Impacts of these three, such as the decrease of mangroves along the deltas coast due to the rapid spread of aquaculture, growing water pollution in the canals and the Mekong main stem, as well as increasing intrusion of salt water into fresh-water bodies, aquifers, and soils are only some of the many challenges the local people and planning agencies have to address. The Mekong Delta underlies an accentuated dry and rainy season, lasting from December to April, and from May to November, respectively. During the rainy season large parts of the Delta are inundated. Inundation results from the immense amounts of rainwater, covering the vast agricultural landscape, but also from flood waters travelling downstream with the river and canals. Inundation at a moderate extent is welcome with rice farmers and fishermen. However, if inundation gets too severe, it can hamper transport in the Delta and affect people’s livelihoods close to the numerous waterways. Based on radar data of the sensors Envisat ASAR and TerraSAR-X we assessed patterns of inundation in the Mekong Delta for the past four years. Inundation information products are derived from this data based on automated algorithms, encapsulated in web processing services. The inundation information products are shared with Vietnamese planning authorities in the Mekong Delta, and are furthermore integrated in a water related Information System for the Mekong Delta. However, even for large, well-funded research projects undertaken by national remote sensing centres, limitations exist, as products can only be derived if data-takes are not rescheduled by data providers, or if data can be acquired despite priority requests of other users.

Geospatial Tools for Olive Oil Mills' Wastes (OOMW) Disposal Areas Management

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Keywords: geospatial, olive oil wastes, management, geophysical, chemical

Abstract:

LIFE+ project "Strategies to improve and protect soil quality from the disposal of olive oil mills' wastes (OOMW) in the Mediterranean-PROSODOL", aims towards the development and application of technologies for the protection, improvement and remediation of soils which are polluted from the disposal of olive oil mill's wastes. In this effort, several geospatial application tools were presented and implemented aiming to the effective monitoring of soil quality and wastes disposal areas management. The project was based on the collection of more than 1000 soil samples throughout the course of the project which were chemically analyzed in order to indicate the most significant soil parameters that could most suitable describe soil degradation due to OOMW disposal. Based on the above results, a geospatial monitoring system application tool was implemented, where users (individuals or services) can enter measurements (spatial points) of these indicative chemical parameters at various time intervals and soil depths and monitor the fluctuation of the values through time. Results are indicated through predefined diagrams that have pre-defined zones (orange and red) depending on the degree of alert that needs to be signalled to the users. In addition, the soil parameters were mapped with respect to the depth, date and temporal variations of their spatial distribution (spatial surfaces). Furthermore, the diffusion of these parameters in the subsurface

was also studied. Interpolated surfaces were created and integrated within another geospatial web based map application tool. Interpolated surface maps can be viewed simultaneously above topographic and satellite maps, providing a possible overview of the diffusion of the parameters in the subsurface and thus the risk-level in the vicinity of the waste disposal areas to the users. A further verification of the diffusion of the underground pollution was also monitored through the application of electrical resistivity tomography (ERT) techniques. The geospatial monitoring tool application is available for free download from the Web site of the project (www.prosodol.gr). The soil parameters and organic compounds content as well as other geological, hydrological and land use features, for all disposal sites of the three main areas of interest (former municipality of Nikiforos Fokas (Greece), Albenga region and Loano comune-municipality (Italy)), form the spatial background information provided by the PROSODOL project. A prototype (ArcGIS for INSPIRE) Geoportal integrating a Geodatabase with a Schema compliant with the INSPIRE Directive was employed for carrying out the whole mapping and transforming process of PROSODOL's spatial data information to compatible INSPIRE Map (View) Services.

LANDSAT and Ground Data Analyses to Define Flood Risk

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Keywords: flood, satellite imagery, LANDSAT

Abstract:

A flood is defined as an overflow of an expanse of water that submerges land. The spatial and temporal distribution of heavy rainfall over an earth surface is very important for flood modeling which is seen as an integral part of flood management. Land surface characteristics were analyzed using remote sensing methods for the city Istanbul/Turkey and its environment by considering LANDSAT TM data between 1975 and 2010. Digital classification, slope classes, infiltration rate and run off analyses were based on digital height modeling. The average altitude of the study area above mean sea level is around 107 m, and the maximum altitude is 524 m. Farmlands cover 1304 km² and they decrease down to 565 km² in the study period because of the urbanization problem in recent years. However, forest area covers 42 percent of all the study area and there was no significant areal change during the period. Wetlands also do not show an important decrease in the study area. Higher urbanization rate was observed both at the Asian and European sides of Istanbul through north to south and from east to west. In the lowest part of Istanbul, infiltration rate is also very low. These areas are under the high flash-flood risk. As a result of this study, satellite data and ground measurements were interpreted and thus distribution of flood risk over Istanbul was defined.

Coastline Detection from Remotely Sensed Imagery: Development of a Methodology Based on Advanced Smoothing Techniques and the Canny Edge Detector

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Keywords: coastline detection, Canny edge detector, alternating sequential filtering, anisotropic diffusion, morphological levelings, K-means clustering, entropy, thresholding, morphological reconstruction

Abstract:

Coastline mapping and change detection are essential for safe navigation, environmental protection, resource management and sustainable coastal development and planning. Coastline detection is a task that has greatly concerned the scientific community in recent years. For this reason, coastline extraction is of fundamental importance. In this paper an algorithm for the semi-automatic detection of coastlines from remotely sensed data was investigated and developed. The algorithm structure involved three stages: pre-processing, processing and post-processing of each image. Data pre-processing involved a number of filtering types for enhancement, smoothing and simplification of the image, noise removal, and removal of certain elements in certain scales whereas preservation of others in certain desirable scales. Data processing was realized through the Canny edge detector. The measure of entropy, K-means clustering and thresholding in infrared bands were applied to eliminate non desirable or non real edges. However, edge detectors “suffer” from the fact that edge pixels are quite discontinuous and rarely characterize a coastline completely. Remained noise and complex texture contributed to this, as well. Restoration of this problem is a demanding procedure to estimate, even in a coarse approximation. Thus during the post-processing stage connectivity of detected elements was restored, using morphological tools. The developed methodology was applied on six high resolution QUICKBIRD (4) and WORLDVIEW-2 (2) images (0,7 and 0,5 m, respectively), one medium resolution ASTER image (15 m) and two high resolution TERRASAR-X images (3 m). Finally, quantitative and qualitative evaluation of the results took place using the completeness, correctness and quality indices. By comparing the extracted shorelines to the photo-interpreted ones using these indices, the results showed that a precise coastline extraction was possible. This conclusion was also reflected on the achieved mapping scales.

Low-Altitude Coastal Aerial Photogrammetry for High-Resolution Seabed Imaging and Habitat Mapping of Shallow Areas

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Keywords: kite aerial photography, photogrammetry, coastal zone, high-resolution

Abstract:

This paper explores the application of Kite Aerial Photography at the coastal environment along with digital photogrammetry for seabed geomorphological mapping. This method takes advantage of sea-water clearance that allows the transmission of sunlight through the water column and backscatter of seabed reflection under certain conditions of sunlight, weather and sea state. We analyze the procedure of acquisition, processing and interpretation of kite aerial imagery from the sub-littoral zone up to 5 meters depth. Using a calibrated non-metric digital compact camera we managed to acquire several vertical aerial images from two coastal sites in the Attica Peninsula (Greece) covering an area of approximately 200x100 meters. Both sites express significant geomorphological variability and they have a relatively smooth slope profile. For the photogrammetric processing we acquired topographic and bathymetric survey simultaneously with Kite Aerial Photography using a portable GPS of sub-meter accuracy. In order to deal with bottom control measurements we developed Bottom Control Points which were placed on the seabed. These act like the Ground Control Points and they can be easily deployed in the marine environment. The processing included interior and exterior orientation as well as ortho-rectification of images. This produced final orthomosaics for each site at scales 1:500 – 1:1500 with a resolution of a few centimeters. Interpretation of the seabed was based on color and texture features of certain areas with explicit seabed reflectivity and was supported by underwater photographs for ground truthing. At the final stage of image analysis, we recognized the boundaries (contrasting reflectivity) between different bottom types and digitized them as 2D objects using GIS. Concluding, this project emphasizes on the advantages and physical restrictions of Kite Aerial Photography in mapping small-scale geomorphological features in coastal, estuarine and lagoonal environments. Furthermore, this study appoints the suitability of the KAP method for mapping shallow water habitats such as soft/hard substrates, coastal reefs and sea grass meadows. Consequently, the application of low altitude digital photogrammetry is proposed for shallow water surveying as an alternative or supplementary to the side scan sonar and backscatter recorder until a maximum depth of 10 meters. It is suggested that very dense DEMs produced by LiDAR bathymetry may be utilized for ortho-rectification of high-resolution aerial imagery acquired by UAVs or remotely controlled platforms.

Shoreline Detection from Very High Resolution Satellite Images

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Keywords: object oriented, WVII, Abruzzo

Abstract:

In the present paper is shown a methodology for coastline identification from WorldView 2 images, available in 8 spectral bands, with 0.5 m of spatial resolution for panchromatic image and 1.8 m for the multispectral image. In particular, a "pixel based" multispectral classification was used to identify various types of land cover. The 8 bands allow to get good results both in the classification process and with NDVI NDWI, SAM, FM algorithms, for the identification of various land cover and in particular to separate dry sand and wet sand. Good results are obtained by an algorithm that evaluates the relative depth of the water using the coastal band. Better results surely can be obtained by using elevation data (geoid models and digital terrain models) integrated with radiometric information. Very interesting is the comparison with the extracted coastline with such methodology and a topographic map of same area. This comparison surely highlights the changes in the study area. The possible applications of the proposed techniques are varied, such as map updates, but also a coastal environment monitoring.

Observing Coastlines with Satellite Data: A Case-Study in Abruzzo (Italy)

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Keywords: coastal zone management, very high resolution, radar, optical

Abstract:

Started in 2009, the COSMOCOast project aims at exploring the potential of satellite data for the retrieval of the instantaneous shoreline. In particular, the focus has been on the exploitation of HR and VHR microwave and optical data. Retrieved information, thanks to its potential accuracy in the geolocation and intercomparability of results can be of interest for analyzing –also quantitatively– coastline variations. COSMO-SkyMed data granted by ASI, IKONOS, Kompsat and FormoSat-2 data granted by ESA and additional VHR data (Quickbird, Worldview) have been used. To increase intercomparability among products acquired with different geometries and in different coastal conditions (low coast and steep coast), they have been orthorectified and geolocation accuracy of each outcome product has been quantified. Automated extraction of the coastline has been carried out (with object oriented and neural network techniques) and the results have been compared with the outcome of manual extraction. Differences in the retrieval results at different dates are then analysed in terms of potential inaccuracies in the coastline extraction, tidal variations and potential influence of other meteomarine (eg wind and waves) factors.

Multidisciplinary Approach to the Study of Coastal Waters, Affected by Multiple Environmental Stressors, Based on Multispectral Remote Sensing and Sea-Truth Data Analysis

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Keywords: multispectral data, sea-truth observations

Abstract:

The coastal area of Civitavecchia (Central Tyrrhenian Sea, Latium, Italy) represents an important example of multiple use of the coastal zone: maritime traffic, industrial port, power plant, industries, aquaculture and freshwater outflows overlap on ecosystems characterized by high natural value, generating disturbance and damaging. This area is particularly suitable as a test area where it has been possible to develop an integrated approach to the analysis and monitoring of coastal ecosystems. The extension of the study area derives from the results of high resolution mathematical models, in order to support the analysis of the interaction between the different impact sources. This work represents the first step of a multidisciplinary strategy devoted to the characterization of a coastal area, based on simultaneous acquisitions. This work shows the results of an experimental survey where the following activities were carried out: airborne multispectral remote sensing data acquisitions, marine in situ measures and water sampling simultaneously performed by three vessels

in three different areas, new instruments testing for surface in continuous measures.

Digital Images to Estimate Degraded Pasture Levels

Land use and land cover, degradation and desertification

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Keywords: fractional cover of photosynthetic vegetation, fraction cover of non-photosynthetic vegetation, bare soil, digital camera images

Abstract:

Brazil has about 110 Mha of pasture land concentrated in the Cerrado and Amazon biomes, from which 70 Mha (63,3 per cent) are in the process of degradation or are already degraded. The adoption of good management practices improving the quality of these pastures increases the productivity of livestock with consequent release of land for food and energy crop expansion. Major causes of pasture degradation in tropical and subtropical climate are related to inadequate management of both pasture land and grazing, which are responsible for: the loss of pasture vigor, the exposure of bare soil, and the appearance of invasive plants. The assessment of pasture degradation levels using biophysical parameters and contextual information of the vegetation is not trivial, even at field level. Proximal sensing techniques might be a useful approach to assess the levels of pasture degradation. Therefore, a field campaign was carried out from September 26 to November 12, 2011, visiting 200 pasture samples in the Cerrado and Amazon biomes. For each visited sample the specie of pasture grass was identified along with measurements of biophysical parameters such as: plant height and dry biomass weight collected in three subsamples of 1 m². Also three digital camera images were captured at 2 m above ground level in vertical position. The RGB (red, green blue) images will now be transformed into intensity, hue, and saturation (IHS) components. Slicing and non supervised classification techniques should be applied on the HIS components to estimate the fractional cover of photosynthetic vegetation, non-photosynthetic vegetation and bare soil. For each digital camera images, random samples will be selected and visually interpreted to evaluate the results from the slicing and classification procedures. With the estimated fractional cover of photosynthetic vegetation, non-photosynthetic vegetation and bare soil the pasture degradation

levels should be evaluated. It is expected that this methodology will be expedite and precise to contribute in the evaluation of pasture degradation levels in tropical and subtropical climate.

Documenting Typical Land Cover Changes in Europe

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Keywords: GMES, CORINE Land Cover, land cover changes, bi-temporal satellite imagery

Abstract:

CORINE Land Cover (CLC) data provide information on the physical characteristics of the earth surface. CLC database is created by interpretation of satellite imagery with minimum mapping unit (MMU) of 25 ha. Land cover change mapping is carried out with MMU of 5 ha. The standard CLC nomenclature includes 44 classes in 5 main groups. CLC and CLC change data are widely used by the EEA and its member states in reporting, indicator development and environmental modelling. The paper relies on the results of change mapping implemented during the 3rd CLC inventory between 2006 and 2011 in 38 European countries. Considering all CLC changes in Europe between 2000 and 2006, 1.24 percent of the area has changed, covering 70 824 km². The number of change polygons is above 350 000. Most dynamic change types in terms of polygon number as well as in area were forestry changes (clearcutting and forest growth). Our main aim was to compile a “manual” which documents mapping of major CLC change types in order to support the 4th CLC inventory, which is implemented under GIO (GMES Initial Operations) between 2011 and 2013. The “knowledge base” of the work is the more than 100 verification missions the authors conducted to the participating countries of former CLC inventories. Discussions with experts of the national CLC teams were exceptionally important in shaping the content of the work. Having 44 level-3 classes in CLC, theoretically there are $44 \times 43 = 1892$ different CLC change types. Even if not all of them are possible or do actually happen, there is no way to discuss hundreds of different change types separately. Based on the statistics of CLC-Change2000-2006 database, the most frequent CLC change types – providing 90 percent of all change area - were selected. Usually several level-3 change types were grouped into a CLC change process for discussion. Altogether 27 different CLC change groups are discussed: a) Artificial surfaces (anything developed from Artificial surfaces; 2 groups), b) Agriculture areas (anything developed from Agriculture areas; 12 groups), c) Forests and semi-natural areas (anything developed from Forests and semi-natural areas; 10 groups), d) Wetlands and water (anything developed from Wetlands and water; 3 groups). Change processes are discussed in a standardized way, including textual description, interpretation example(s) and a list of frequent interpretation mistakes. Examples and mistakes are illustrated by screen-shots of real interpretation cases collected during verification missions.

Evaluation of Change Detection Methods in Remote Sensing, and Development of Relevant Open Source Algorithms in the Orfeo Toolbox Platform

Application with Ikonos imagery, in Attica region (Attiki Odos construction sites)

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Keywords: toolbox, remote sensing, change detection, C++ language, open source library

Abstract:

This paper presents the free/open source library Orfeo ToolBox and exploits its capability for change detection applications. This open source library is written in C++ programming language and contains a multitude of image processing algorithms. A presentation and evaluation of the existing change detection algorithms took place at first. The algorithm structure involved two stage, pre-processing and processing. At the pre-processing stage four image transformations were implemented: Magnitude Difference, Tasseled Cap, Color Difference and Band-Slope Difference. Then, at the processing stage, the algorithms of Normalized Ratio and Normalized Difference were programmed in order to derive the changes. All the algorithms were applied on Ikonos imagery of years 2000 and 2007, in the Attica region (Attiki Odos construction sites) and the results were judged satisfactory, based on photo interpretation.

Multifractal Analysis of Very High Spatial Resolution Satellite Data

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Keywords: multifractal formalism, classification, segmentation, Very High Resolution imagery

Abstract:

Multifractal formalism, as the generalization of the fractal geometry, is a modern tool used for description, modelling, analysis and processing of different complex shapes and signals. Multifractal decomposition has been successfully applied to the various issues and became a useful method for analysis of inhomogeneous measures and structures present on satellite images. It allows more detailed local and global characterisation) and functional description (generalized dimensions D_q and singularity spectra $f(\alpha)$). Generalized dimensions which describe inhomogeneity of considered measures can be treated as a “magnifying glass” (or filter) which brings out parts of images with different concentration of measure. Obtained values of D_q can be used to check the affinity of given element to the set (class) of objects. Therefore generalized dimensions can be used for classification and segmentation of the image into homogeneous regions. In our analysis we determined generalized dimensions D_q for images of forest in order to improve its description. In particular we consider usefulness of multifractal analysis for processing of Very High Spatial Resolution images. For a study we used number of samples cut from WorldView-2 satellite panchromatic images. Each sample has size of 4096x4096 pixels. Samples presented different forest types as well as combination of forest and other land cover types in different proportions. Preliminary results show differences of D_q depending on the analysed land cover. Hence we expect that multifractal methodology will allow us a survey of the big amount of data and its division into general classes.

Improving Ragweed Identification by Remote Sensing

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Keywords: ragweed monitoring, risk map, WorldView 2, Radarsat 2

Abstract:

The Carpathian basin is the area of Europe where the greatest ragweed pollen concentration was measured in summer period by European pollen monitoring system. The ragweed is the most allergic weed in Hungary. According to weed expert's opinion 80% of the infected areas are on arable land. Important sources of ragweed pollen are sunflower fields, non-cultivated arable spots and the stubble-fields of cereals where the infected parcels are detectable by remote sensing. The Institute of Geodesy, Cartography and Remote Sensing (FÖMI) has supported the nationwide Ragweed Control Program (NRCP) by its own developed remote sensing methodology to monitor the main ragweed infected areas using high resolution satellite image time series. The number of pollen allergic people had been increasing so that there was an imperative need for a NRCP which integrated several governmental authorities. To the efficiency of this priority program, the government amended the plant protection law in 2005. Therefore FÖMI produces countrywide ragweed risk maps focusing to the most heavily infected arable lands using high resolution optical satellite image time series. We

have to face to several problems in the course of mapping ragweed infection, which need introduction of new means of remote sensing tools. Weed coverage within the parcels is heterogeneous, patched. Therefore methodology of ground survey needs to be improved. Weed patches are varying due to law force, usually cannot be seen the same state on the ground after the date of acquisition of satellite images. Therefore daily following of weed patch changes by ground survey is necessary in the control area. On one hand spectral features of various weeds are very similar to ragweed's ones, so further remote sensing features have to be applied to improve recognition of ragweed. On the other hand demand has emerged on estimating ragweed infection of cultivated plants. In this year a pilot project was performed for increasing accuracy of mapping ragweed infection by using WorldView2 and RADARSAT2 satellite images. A new method was elaborated for ground survey which fits more to characteristics of ragweed. The number of species of weeds - which have similar spectral features to ragweed - can be narrowed remarkably by using WorldView2 satellite images. Cultivated plants usually have a rather regular geometric structure defined by distance of rows and stems. Weed infection disrupts this regularity. Our results show that such structural change can be identified by radar polarimetry. According to our first results there is a great chance to detect ragweed in sunflower which is mostly endangered by infection. Our final conclusion is that ragweed identification can be improved by applying both VHR and polarimetric radar data, so accuracy of ragweed-risk map can be increased.

Development of Methodology for the Optimization of Classification Accuracy of Landsat TM/ETM+ Imagery in a Catchment Area in Cyprus

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Keywords: GIS, remote sensing, land use, classification, Cyprus

Abstract:

An important tool for detection and quantification of land cover changes across catchment areas is the classification of multispectral satellite imagery. Land cover changes may be used to describe dynamics of urban settlements and vegetation patterns as an important indicator of urban ecological environments. In such studies classification is a common procedure to retrieve information on land use from multispectral images data. Several techniques have been reported to improve classification results in terms of land use discrimination and accuracy of resulting classes. The aim of this study is to improve classification results of multispectral satellite imagery for supporting flood risk assessment analysis in a catchment area in Cyprus. This paper describes the results obtained by integrating remote sensing techniques such as classification analysis and contemporary statistical analysis like maximum entropy for detecting urbanization activities in a catchment area in Cyprus. The results were incorporated in an integrated flood risk management model. This study aims to test different material samples in the Yialias region, to examine a) their spectral behaviour under different precipitation rates and b) to introduce an alternative methodology to optimize the classification results derived from single satellite imagery with the combined use of satellite, spectroradiometric and precipitation data. Different classification algorithms and statistical analysis are used to verify and optimize the results. Thus, object based classification and maximum entropy algorithms are simultaneously used, however, the main aim of the study is the verification of the hypothesis that the multispectral classification accuracy is improved if the land surface humidity is high. This hypothesis was tested against Landsat derived reflectance values and validated with in-situ reflectance observations with the use of high spectral resolution radiometers. In this way this study aspires to highlight the potential of medium resolution satellite images such as those of

Landsat TM/ETM+ for LULC studies under certain circumstances in the Eastern Mediterranean.

An Assessment of Agreement in Global Land Cover Maps for Regional Applications in West Africa

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Keywords: west Africa, land cover, climate modeling, LCCS

Abstract:

West Africa comprises a wide range of land cover types including rainforests, various savanna classes and the sparse shrub and grass vegetation of the Sahel. As a consequence of land use and high population density, large parts of both forest and savannas have been converted into agricultural areas in this region. The prevalent land cover determines a number of biogeophysical land surface properties and thus has considerable impact on related surface fluxes such as e.g. evaporation. Therefore, land cover usually is an important input dataset in many modeling approaches for example in the field of climate and hydrology. For instance, based on land cover maps, regional climate models assign land surface properties such as LAI, albedo, fraction of vegetation cover, or roughness length. Thus, in order to consider land surface characteristics correctly in these models, it is a requirement to provide consistent and high quality regional land cover data from remote sensing. Today, several global land cover maps are available at a medium spatial resolution (250 m to 1 km) with differences in terms of remote sensing input data, classification methodologies and legends. Especially in heterogeneous landscapes such as in the savannas of West Africa, these maps show obvious discrepancies among each other. In this study we compare four global land cover datasets in the region of West Africa which are based on SPOT-VEGETATION (GLC 2000), MERIS (Globcover), MODIS (MODIS Land Cover) and AVHRR data (IGBP DisCover). The land cover classes of the datasets are translated to a common harmonized legend based on LCCS principles. Subsequently, the maps are analyzed for agreements and disagreements between classes. Reasons for some of the discrepancies are identified which are mainly related to class definitional problems, temporal lags between data acquisition and heterogeneity of land cover classes. Finally, using the example of a regional climate model, the influence of the four different land cover datasets on the in-model attribution of land surface parameters (e.g. LAI, albedo, roughness length) is estimated and presented for the West African region.

Influence of Different Spatial Resolution on Texture-Based Classification

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Keywords: texture, land cover, object-oriented classification, OBIA

Abstract:

Object-oriented approach is an advanced classification method of satellite images. The process of classification consists of two basic steps. First, a segmentation process is performed, in which the boundaries of objects are defined. Then objects are assigned to a defined land cover classes. This is done using a variety of distinguishing characteristics; spectral values, geometry of objects and relationships between them. Classification can be performed using a supervised approach, in which information describing the classes is derived on the basis of the so-called samples, which are equivalent to training fields. Also the parametric approach can be applied in which the objects are assigned to classes using threshold values of classifiers. The sequential object-oriented classification is often used. This action is similar to the decision tree. The content of the image is divided into classes in the next, consecutive, processes. This procedure was adapted to SATChMo-K2 algorithm, developed under the SATChMo / Geoland2 European program. It has been prepared for VHR satellite images: KOMPSAT-2 and FORMOSAT-2. Basic premise here is the division of content of image into objects characterized by low and high values of the texture. This is done based on the texture image derived from the panchromatic channel using Sigma filter. Afterwards, the basic classes of the land cover are recognized with the assumption that the buildings, forests, and scattered vegetation are associated with high values of the texture and all agricultural land and water are characterized by low values of the texture. SATChMo-K2 algorithm was used for the classification of images depicting various regions of Europe. The results generally confirmed the classification assumptions. At the same time they showed greater efficiency in the use of texture produced on the basis of KOMPSAT-2 in comparison with the FORMOSAT-2 images with lower spatial resolution. It was also noted that the threshold between high and low texture is not the same for all images and depends on some extent of a geographical area. The aim of this paper is to compare the possibilities of using texture in classification of images with different resolutions. This will be done based on panchromatic images with a resolution of 1 to 64 m. The texture images are obtained with different functions: Sobel, Laplacian and Sigma filters, PanBF transformation, and Haralick functions: Correlation, Homogeneity and Entropy. Images selected for this test represent different parts of European landscapes.

Spectral Signatures of *Pinus Brutia* Post Fire Regeneration in Paphos Forest, Using Ground Spectroradiometers

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Keywords: spectral signatures, post fire regeneration, ground spectroradiometer

Abstract:

Fire constitutes the most serious danger for the forests of Cyprus. A variety of factors such as the long, hot and dry summers, the frequent strong winds, the configuration of the ground and the inflammability of the vegetation, favour the easy outbreak and quick spread of fires. Furthermore, the abandonment of rural areas due to urbanism and the increasing tourism and mass exit of population towards the forest areas, raises fire hazard to the highest level. During the last years several attempts have been made in order to monitor plant regeneration using remote sensing techniques. These techniques are mainly based on multispectral/hyperspectral satellite dataset before and after the fire. In this way satellite imagery can assessed the local authorities to map burned areas and monitor the regeneration process. The first task is based in classification techniques while the second task requires vegetation indices and ground inspections. This paper aims to develop a spectral signature library of *Pinus brutia* which will be used for the accuracy assessment of the classification of post fire regeneration using satellite images and remote sensing techniques. The area of interest is the Paphos forest which is situated in the western part of Cyprus. The predominant tree species is *Pinus brutia*. Paphos region is characterised by a Mediterranean-type climate

with a mild, subhumid winter and a long xerothermic period. Using the ground spectroradiometer Spectra Vista GER 1500 mounted on a tripod, the spectral signatures of several trees canopy were recorded. GER1500 can record electromagnetic radiation from 350nm until 1050nm covering both visible and Near Infrared spectrum. The instrument was lifted up to a height of approximately 6-7 m above ground while the field of view (FOV) was set up to 40. Emphasize was given to spectral signatures of trees which were planted as an action of post fire artificial regeneration. Such spectral signature libraries can assist local authorities to verify satellite investigations or even to improve classification techniques. Moreover spectral signature profile may be also used in order to detect different tree species.

Sensitivity of Spectral Reflectance Values at Pixel Level in Respect to Different Burn and Vegetation Ratios

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Keywords: forest fires, spectral properties, burned surfaces, LANDSAT, MODIS, ASTER, IKONOS

Abstract:

The aim of our study is to explore the spectral properties of fire affected areas at pixel level using multi-source multi-resolution satellite data. Our study compares and characterizes the spectral properties of fire-scorched (burned) and non fire-scorched (vegetation) areas as well as areas with different burn/vegetation ratios. For that purpose, a study case was established in one very destructive wildfire occurred in Parnitha, Greece on July 2007 for which we acquired satellite images from MODIS, LANDSAT, ASTER, and IKONOS satellite sensors. Additionally from the basic data set we created satellite data at coarser spatial resolution using resampling techniques. To achieve the highest possible spectral and spatial resolution, the panchromatic (1 meter) and the multispectral component (4 meters) of IKONOS were merged to 1 meter using the Gram-Schmidt spectral sharpening method. The very high resolution imagery of IKONOS satellite was served as the basis for estimating the percent of cover of burnt areas, bare land and vegetation at pixel level in the coarse satellite data by applying the maximum likelihood classification algorithm. Then, the percent of cover for each type was correlated to surface reflectance values for all satellite images. Finally diagrams and histogram data plots were created and also linear regression models were fitted to characterize those relationships. The main findings of our research are (a) the NIR and MIR are the most important channels to estimate the percentage of burned area at pixel level, while the NIR and RED are the most important channels to estimate the percentage of vegetation at pixel level in fire affected areas, (b) when the bi-spectral space consists only of NIR and MIR then NIR ground reflectance value seems to play a more significant role in estimating the percent of burned at pixel level while MIR ground reflectance value seems to play a more significant role in estimating the percent of vegetation at pixel level, (c) completely burned pixels present small variance in NIR and high variance in MIR while the opposite is observed in completely vegetated areas where higher variance is observed in NIR and lower in MIR, (d) semi-burned areas consisting of 45-55 per cent burn and 45-55 per cent vegetation are more spectrally closed to burned areas in NIR channel while those areas are more spectrally closed to vegetation in MIR channel.

Very Large-Scale, High Spatial Resolution Airborne Thermal Mapping of Wildfires in Northern Canada Using the TABI-1800

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Keywords: wildfire, hotspot, mapping, airborne, mwir, near real-time, tabi-1800

Abstract:

The TABI-1800, a new high-performance, thermal imaging/mapping system, was used between May and July 2011 to operationally map active wildfire-affected regions in Northern Canada. This commercial-off-the-shelf imager, with proven high detection rate of hot spots, ability to see through most smoke, and patented 1800 across-track pixel diffraction-limited optical system, was flown under contract to the Alberta Government in a Cessna 310 aircraft in support of wildfire suppression efforts. Over 400 square kilometres of actively burning boreal forest were thermally mapped each night by a small crew at an average spatial pixel resolution of 1.5 meters/pixel. After each night's mission, fast turnaround of more than 100 gigabytes of raw TABI-1800 data to radiometrically calibrated, orthorectified, mosaicked and analyzed fire map products was typically completed in less than five hours after landing. Large scale, precision georeferenced, and GIS-compatible map products showing detailed fire front perimeters and delineated hot spots were provided to wildfire managers before the commencement of the next day's suppression efforts. These maps were used to efficiently and effectively coordinate both water-bombing air operations and mobilization of ground personnel and assets.

Assessing Forest Fire Risk and Fire Propagation in the Area of Valia Calda, National Park of North Pindos, Greece

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Keywords: forest fires, GIS, fire propagation, national parks, fire simulator scenarios

Abstract:

Fire hazards and risk are of great interest in terms of prevention and control. This study focuses on the construction of a GIS-based tool for fire growth patterns and fire propagation characteristics for modeling such hazards in the national park of Valia Calda in Pindus Mountain, Greece. At a first stage, data concerning previous fires in the region have been collected and analyzed for calibrating the parameters of the software package G-FMIS in an ARC-GIS platform that was used as a tool for simulating the fire behaviour and spread in the forest ecosystems of the Park area. Calibration was made through reconstruction of the propagation of the past fires based on observed isochrones and relevant fire growth data such as fire perimeter and burned area. Simulation of the past fires was performed for the real duration of the event using one-hour time intervals. The second stage following the calibration of the fire simulator focused on producing scenarios of eventual fire occurrence and relative analysis of their potential propagation pattern. Potential fire spots have been identified based on the distribution of the human activity in the Park. Meteorological data sets have been created, based on the prevailing values of the weather parameters in the area including less probable extreme meteorological scenarios. Based on the aforementioned scenarios a number of simulations have been performed and the fire propagation data have been analyzed in the context of fire prevention planning for the area.

Analysis of Biomass Burning, Deforestation and Carbon Monoxide Emissions in Sudamerica

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Abstract:

The biomass burning is a very important source of ozone and methane precursors and the main factor of CO emissions. High levels of carbon monoxide pollution are found around the world, and they result from different types of biomass burning in different locations. High levels of CO are linked to widespread fire activity, such as agricultural burning in central Africa in January through March, or in Central America in April through June. Carbon monoxide molecules can last from a few weeks to several months in the atmosphere, and they travel long distances, without regard for national or international boundaries. The pattern of fire occurrence in Africa and Amazonia is quite different to others regions in the planet with higher population density. The fire occurrence, in Africa and Amazonia, is dominated by the displacement of ITCZ (Inter Tropical Convergence Zone). During the winter of North hemisphere the ITCZ, and therefore the tropical rain, is located in the South of equator and Amazonia; so, the fire occurrence is stronger in the North of equator and vice versa. This work shows the relationship between CO levels, fires occurrence and deforestation data in the most important regions of Sudametira, taking into account its contribution as sources and sink of carbon.

Coastal Zone Dynamics of the Yellow River Delta - Earth Observation Based Diagnosis

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Abstract:

The Yellow River Delta is one of the three largest river deltas of China, and a coastal area, which has experienced an extreme change in the past four decades. The delta is influenced by severe land cover and landuse changes in the overall Yellow River catchment. Deforestation and afforestation, urban sprawl, intensifying landuse and irrigation upstream all have led to changed water flow- and sedimentation patterns in the delta, and therefore affected the morphology of the coastline substantially. Based on over 30 years of geocorrected and atmospherically corrected Landsat data we analysed the shift of the delta's coastline between the 1970s and today, and extracted areas of land loss and land accretion in for the past decades. Furthermore, we investigated the land cover and landuse dynamics in the costal zone of the delta for the past two decades. Landsat-, Spot- and Quickbird data were employed to assess the development of settlements, differentiating urban und rural sprawl, to quantify the development of aquaculture along the oceans shore, as well as to assess changes in wetland habitats and coastal forest cover. Furthermore, we depict the spread of the oil drilling industry present in this oil-rich coastal sediment location. The acceleration of land cover and landuse change set in with the development of the city of Dongying, which was planned and erected in the late 1980s to foster the exploration of Shengli Oilfield. The changes observed will be discussed with respect to the delta's vulnerability and adaptation options to increase its resilience against climate change induced sea level rise.

Change Detection in Wadden Sea Areas Using RapidEye Data

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Keywords: change detection, wadden sea, decision tree, RapidEye

Abstract:

The tidal area of the oceans is an important transition zone between terrestrial and marine ecosystems. In contrast to the non-marine surface of the earth, access to the tidal lands of the Wadden Sea is often difficult. For this reason, remote sensing offers important monitoring tools. In this study a new change detection approach is presented, adapted to the Wadden Sea and RapidEye satellite data. It is based on a decision tree and uses spectral characteristics in combination with GIS Information, neighborhood connections, textures and shape of objects. The spectral characteristics are derived from field visits and radiation spectrometer measurements. The Wadden Sea area is determined by using available GIS Information. For vegetation, the SAVI and different texture measurements are used. Mussel banks are located by neighborhoods and texture. In a first step, the image taken at date one is classified using the decision tree method. For the second image taken at date two the decision tree is extended based on the first classification. After classification of the second scene the detected change is calculated and displayed. This approach is fully automated no manual input is necessary to classify and to detect changes in the data. The method is transferable to other areas and other scenes in the Wadden Sea of lower Saxony. The results show an accuracy of over 70 per cent.

Integrated Use of Satellite Remote Sensing and GIS for Wetland Mapping and Change Analysis: Two Case Studies in Greece and Cyprus

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Keywords: remote sensing, GIS, wetlands, lakes, Greece, Cyprus

Abstract:

Accurate wetland mapping is an important tool for understanding wetland functions and monitoring their response to natural and anthropogenic actions. Satellite remote sensing has many advantages for inventorying and monitoring all types of wetlands. Specifically Remote sensing and Geographical Information Systems (GIS) can be used to provide a rapid or a large-scale understanding of lakes change and contribute in the development of lake management strategies. Nowadays, data collected by aerospace imagers can be used to improve wetland classification and to assess their spatial and temporal distribution. This study aims to monitor and map the diachronic extent of two major wetlands in the broader Mediterranean region: the lake of “Agia” in Western Crete (Greece) and the salt lake “Alikí” in Larnaca district in Cyprus. Land cover and the extent of inundation at each site is being determined from a multi-temporal data set of images as a base for further assessment of land use change. For this reason sophisticated image analysis methods were applied to multi-temporal Landsat TM/ETM+ satellite images in order to record the wetlands diachronic hydrological extent. False colour composites (FCC), Principal Component Analysis (PCA), sophisticated convolution filters and vegetation indices are some of the methods applied to delineate the two lakes extent in a certain period of time. In addition, spectral (Maximum Likelihood, ISODATA, Minimum Distance) and object based algorithms were applied to atmospherically corrected images in order to record the land use / land cover changes in the wetlands broader area. All these results were correlated to meteorological data (precipitation and temperature). The results of the study denoted the urgent need for diachronic, integrated and multidisciplinary study of wetlands changes in extent and land cover due to either world climate changes or anthropogenic interventions. The remote

sensing and GIS proved to be really efficient tools for that purpose. The need for information in support of wetland management is multi-scalar from global, regional and national assessments to guide policy-making.

Monitoring and Prediction of Land Cover Change Detection in the Island of Corfu in Greece

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Keywords: environmental monitoring, urban sprawl, neural network classification, Markov change detection

Abstract:

Land cover change detection has been one of the most important applications of remote sensing since 1972. The use of satellite remote sensing allows monitoring these changes, making predictions and even preventing them. It also helps using the natural resources in good effect, identifying new resources and protecting the existing ones from natural or human interference. This study examines the land cover changes in the island of Corfu in Greece using two Landsat satellite images dated back to 1990 and 2000 and a land cover change prediction is made for the future. The main analysis of this work involves a change detection modelling of the potentials through multilayer perceptron neural network classification and a dynamic change prediction process, by means of Markov chain analysis. In order to estimate the prediction accuracy, the predicted image of 2007 is compared to a Landsat satellite image of the same year. It is noticed that the urban sprawl and the economical development through tourism, is the most significant indicator of land cover change detection in the island of Corfu in Greece.

SIGRI Project: The Products Validation Approach and its Results

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Keywords: fire, burned area, satellite, risk map

Abstract:

In Italy, every year, tens thousands hectares of forest are destroyed due to fires. During the last thirty years about 12 percent of the national forests has been destroyed. The SIGRI (Sistema Integrato per la Gestione del Rischio Incendi) pilot project, funded by ASI (the Italian Space Agency), aims at developing an integrated system for the management of the wild fire events. The system should provide satellite based products capable of assisting all the phases of the fire contrasting activities: prevision, detection, and damage assessment/recovering. The SIGRI project aims at implementing consolidated methodologies and/or developing innovative tools and methods for the analysis of remote sensing data and the extraction of useful information. This article concerns the final phase of the SIGRI project: test and validation of algorithms developed. The validation of the generated products is important through which the products potential is assessed and the algorithms can be calibrated. In this paper we will discuss the results of a preliminary validation process. The products under consideration are: the MFPI(Modified Fire Potential Index), the SEVIRI based hot spots (based on the SFIDE (System for Fire Detection) algorithm) and the APF (burned areas estimate). The products validation approach will be of two types: statistical (5 years fire data) and deterministic (selection of specific days characterized by many fires). The dataset used to validate the products are: activity reports provided by fire fighting agencies (Department of Civil Protection, Corpo Forestale di Vigilanza Ambientale, CFVA, etc.) and low, high and very-high space resolutions satellite imagery. This paper aims at describing the validation approach adopted

for each product, the problems incurred in the validation phase and the results obtained.

Digital Land Cover Model DLM-DE for Germany

Land cover modeling by integration of topographic reference data with remote sensing methods

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Keywords: digital land cover model, land cover/land use change, semantic interoperability, multi-temporal satellite imagery

Abstract:

Within the surrounding frameworks of the Directive for the Infrastructure for Spatial Information in the European Community (INSPIRE) and European land monitoring activities like CORINE Land Cover (CLC) the Digital Land Cover Model for Germany's Federal Purpose (DLM-DE) can be seen as a contribution on the way to interoperability between national and pan-European geoinformation data sets. The concept of the DLM-DE embodies the integration of topographic reference data with thematic land cover information through remote sensing methods. It was developed by the German Federal Agency for Cartography and Geodesy (Bundesamt für Kartographie und Geodäsie - BKG) in corporation with the Federal Environmental Agency (Umweltbundesamt – UBA). This contribution aims at pointing out the potential benefits and constraints of the deriving of land cover data sets according to European nomenclatures such as CLC data from the DLM-DE as an enhanced alternative bottom-up approach to the conventional method proposed by the European Environmental Agency (EEA). Selected feature types of the authoritative topographic reference data ATKIS Basis-DLM function as the basic working data set. Referring to a certain reference year (2009) it now has been updated and verified by adding land cover information through semi-automated analysis and interpretation of multitemporal mid- to high resolved satellite imagery (DMC, RapidEye). In preparation of deriving the CLC data, the ATKIS feature type catalogue was compared with the CLC nomenclature by forming a semantic transformation table STT from ATKIS to CLC. After a preliminary CLC coding of all DLM-DE features according to the semantic transformation look-up table they were updated or verified through remote sensing methods. The result is a high resolved vector data set with a minimum mapping unit of 1 ha. For the next phase of CLC2012 update announced by EEA, the DLM-DE2012 will help to derive the CLC data as part of the environmental reporting duty of Germany as an EU member state. Also, it will be possible to calculate a high resolution land cover change data set by comparing the DLM-DE2009 with the DLM-DE2012.

Pleiades, First Results of the Thematic Commissioning Phase

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Keywords: very high resolution, thematic products

Abstract:

The Pléiades program is a dual program developed in cooperation between the space agencies of France, Sweden, Belgium, Spain and Austria. It has been designed to provide high resolution optical data for the benefits of civilian and defence users in term of operational capacity, rapid access and protection of defence interests. The space component is composed of two "small satellites" (mass of one ton) offering a spatial resolution at nadir of 0.7 m and a field of view of 20 km. Their great agility enables 1) a daily access all over the world, which is a critical need for defence and civil security applications, and 2) an high coverage capacity necessary for cartography applications. Moreover, to meet the needs for detailed mapping, specially in urban areas and to complement aerial photography, Pleiades will offer instantaneous stereoscopic acquisition and the capability to cover large areas by acquiring collateral stripes in the same path. Beside the Pleiades system developments, an extended accompaniment program has been operating since 2004, to prepare, accompany and promote the future exploitation of the Pléiades images. The objectives of this program are 1) to assess the thematic capability of the Pleiades system to produce the various services required by end-users for distinct thematics (defence, risks, cartography, hydrology, forestry, agriculture ...) and 2) to develop efficient tools to facilitate image information extraction by end-users. The first Pléiades satellite was successfully launched on December 16th 2011 from the Europe's spaceport in Kourou, French Guyana. The calibration phase began immediately with very promising pictures already acquired and will last two months. Then the Thematic Commissioning Phase will provide with Pléiades images the scientists and institutional users who worked on developing new products or methodologies initially based on expected images characteristics. After a brief description of the Pleiades system and the data quality, this paper will present the first results obtained in the Pleiades Thematic Commissioning phase. The strengthes and limitations of the Pléiades Preparatory Program will be discussed.

Observing and Studying the Energy and Water Cycles in the Tropics: The Megha-Tropiques Indian-French Satellite

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Keywords: water cycle, energy cycle, tropics, megha-tropiques, dryness, rainfall

Abstract:

The land cover observed by traditional optical and microwave space observing systems is primarily the physical result of complex interactions between major components of the Earth system (land, atmosphere, oceans, cryosphere) at various time and space scales through three major cycles (energy, water and carbon). This determines the environmental Earth surface conditions that drive anthropic activities, which in turn reshape the surface land use and land cover. So, Remote Sensing science and research cannot afford limiting its activity to observing and leading research on the Earth surface considered as an isolated subsystem. Focussing sharply on traditional optical and microwave space observing systems is a must, but understanding and modelling the drivers of the observed evolutions require an interdisciplinary approach and adequate specific space observation tools. A key issue is the study of the three major Earth cycles and related atmospheric circulation patterns. While the carbon cycle is important mainly in a medium term perspective, the water and energy cycles exhibit much higher spatial and temporal variability, which may impact everyday's life conditions, opportunities, constraints and disasters. Understandably, the maximum incoming solar energy impacts the intertropical area, exchanging huge amounts of energy with the water cycle and generating strongly ascending hot and wet air masses and low atmospheric pressure areas. When these wet ascending masses meet the tropopause, they migrate North and South and quickly cool down, then meet dry descending air masses from higher latitudes, such generating the heavily rainy ITCZ (InterTropical Convergence Zone). This circulation pattern (so-called "Hadley cell") is one of the main convection large cells in the atmosphere. It may exhibit strong yearly variations. Beyond this zone dry high pressure air masses lie in regions where incoming sun radiance is still high, causing desert areas. This explains the short transition from heavily rainy regions (covered among others with rainfall forests now suffering from massive deforestation) characterized by high energy events such as African and Asian monsoons (studied by large scientific programmes: AMMA, MAIRS) to deserts such as Sahara, with fluctuating buffer zones as Sahel. Natural annual variability and short term dynamics explains the variability of water regimes in tropical and "buffer zones", and in particular such adverse impacts as huge flooding and cyclones in heavily populated tropical areas, dryness and food insecurity in the "buffer zones" such as Sahel. Since studying, monitoring and modelling the water cycle and energy exchanges in the tropics is both a key scientific, economic and humanitarian task. India and France joined their forces to design, build and successful launch the Megha-Tropiques Joint Satellite Mission on Oct. 12, 2011. It will provide scientific data on the water cycle in the tropical atmosphere through information on condensed water in clouds, water vapour in the atmosphere, precipitation, and evaporation. Its main objective is to understand the life cycle of convective systems that determine the tropical weather and climate and their role in associated energy and water budgets of the atmosphere in tropical regions. . To fulfil these

goals, Megha-Tropiques carries the following four payloads on a circular orbit inclined 20 deg to the equator: • Microwave Analysis and Detection of Rain and Atmospheric Structures (MADRAS), is a conical scanning 9 channel self-calibrated microwave Imaging Radiometer developed jointly by CNES and ISRO. IT gives access to the following key parameters: rainrates over sea and land; water vapour column content; ice detection and liquid water measurement in clouds; rain convective areas over land and sea; • Sounder for Probing Vertical Profiles of Humidity (SAPHIR), from CNES, is a passive microwave humidity sounder in several channels close to 183.31 GHz, a strong water vapour absorption frequency. • Scanner for Radiation Budget (ScaRaB) is an adaptation of former instruments developed with SSSR then Russia (RESURS et METEOR missions). It is a 4 channel passive radiometer which measures the Earth radiation at the top of atmosphere in four large wavelength domains: visible channel; solar channel; thermal channel; global channel. • Radio Occultation Sensor for Vertical Profiling of Temperature and Humidity (GPS-ROS), procured by ISRO, is composed of a GPS receiver and two dual frequency antennas to pick up navigation signals from the satellites of the GPS constellation while – as seen from the observing satellite – they set through the atmospheric limb on the Earth's horizon or raise from it. From these measurements one can derive atmospheric profiles of temperature and humidity. So, Megha-Tropiques and its unique sets of instruments will dramatically increase the monitoring, understanding and modelling of water and energy cycles that strongly interact in the intertropical area.

Developing Hyperspectral LiDAR for Structural and Biochemical Analysis of Forest Data

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Keywords: hyperspectral canopy LiDAR, parameter inversion, forest structure and biochemistry

Abstract:

Single wavelength LiDAR has been used successfully for recovering structural data from forest canopies (Leuwen 2010). However, multispectral canopy LiDAR (F Morsdorf 2009) can also provide information on the vertical distribution of physiological processes which informs on actual carbon sequestration as well as existing stocks, and can disambiguate ground from canopy returns. This is critical to better understand and predict the impact of climate change, and to understand the seasonal dynamics of ecosystem carbon uptake in response to environmental drivers such as water, temperature, light and nutrient availability. We report progress to develop multispectral and hyperspectral LiDAR systems to recover structural and physiological data. This includes innovations in instrumentation, specifically the development of time-correlated photon counting LiDAR

systems (Buller 2007) to record full waveform depth profiles at many wavelengths, and in processing that data to recover the necessary forest canopy parameters. To that end we develop further a variable dimension structural model coupled to spectral simulation using the PROSPECT model. In general the problem of parameter inversion in a four dimensional data space (x,y,z,λ) is ill-posed, due to the variation in both PROSPECT parameters and material abundance, which leads us to consider the use of a greater diversity of wavelength to better constrain the problem. We evaluate both instrumental performance and parameter inversion using simulated data and by a series of measurements on conifer samples, for which we make separate manual measurements of structure and physiology to provide ground truth. A comparison of the LiDAR-derived parameters with the ground truth shows the potential for accurate structural and physiological recovery when the number of parameters is constrained, and leads us to make recommendations on the future development of multiple wavelength LiDAR systems in this context.

References

1. Buller, AM Wallace and GS. "Ranging and three-dimensional imaging using time-correlated single photon counting and point by point acquisition." *IEEE Journal of Selected Topics in Quantum Electronics* 13, no. 4 (2007): 1006-1015.
2. F Morsdorf, C Nichol, T Malthus and IH Woodhouse. "Assessing forest structural and physiological information content of multi-spectral LiDAR waveforms by radiative transfer modelling, *Remote Sensing of Environment*." 113 (2009): 2152-2163.
3. Leuwen, M Nieuwenhuis and M van. "Retrieval of forest structural parameters using LiDAR remote sensing." *European Journal of Forest Research* 129 (2010): 749-770.

EOMOUNT NG - A Satellite Data Based Near-Realtime Observing System at Local/Regional Scale

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Keywords: processing chain, SDI, INSPIRE, OGC, NPOESS, Sentinel, GMES, VIIRS

Abstract:

This paper presents the evolvement of the satellite based monitoring facility at the European Academy of Bolzano (EURAC) to the Next Generation (NG). This applied research environment takes use of an own satellite receiving system using this data as input for different applications, developed based on the demand of different users such as the Civil Protection of Bolzano, the meteorological office of the province and also the European Commission's JRC (Joint Research Center). User tailored applications like snow cover monitoring in near-real time, a daily Particulate Matter (PM) map or a meteo product based on MODIS satellite images directly received will be presented. They demonstrate the integration of satellite data and in-situ systems. The data are processed at EURAC's processing & archiving facility and elaborated with auxiliary data to develop near-real time products and composite products. Actually the data received is obtained from the Moderate Resolution Imaging Spectrometer (MODIS) from NASA's satellites AQUA and TERRA at 250m, 500m and 1km resolution. The receiving facility is actually on an upgrading process to adapt existing products to the new sensors of the NPOESS NPP mission and prepared for the Sentinel missions, which will be described. On EURAC's Webportal eomount.eurac.edu is planned to provide the obtained information with standardized OGC-Webmapping and Web-Coverage Services, which advantages will be discussed. The system is embedded in an SDI (Spatial Data Infrastructure) Environment that provide also a catalog service to manage spatially referenced resources, based on the principles of Free and Open Source Software (FOSS) and International and Open Standards. HMA (Heterogeneous Missions Accessibility) is implemented to establish harmonized access to heterogeneous earth observation (EO) missions and applied also on the product generation processes dealing with no EO-data. Finally, the paper describe the access policy to the applications that in part is "free and open" and in other parts is restricted to authenticated users.

Geoprocessing Services Over the Web

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Keywords: WPS, geospatial processing services, spatial data infrastructures

Abstract:

Spatial Data Infrastructures served through the web combined with the ever increasing network and telecommunication capabilities have made geospatial data largely available over the last several years. In addition, by providing semantic specifications to geospatial information, data sharing and interoperability has also been achieved. The next step was to combine spatial data from different sources and apply composite geoprocesses in order to produce geoinformation over the web directly available and applicable to a wide range of geo-activities of significant importance for the research and industry community. Towards this direction, the Open Geospatial Consortium has instituted the Web Processing Service standard, in order to define the rules for handling web geoprocesses as web services. In this context this paper aims to review and identify available and directly exploitable spatial data infrastructures and related geoprocesses. Furthermore, to propose potential web processes for producing valuable geoinformation focusing on those applicable to satellite images and relevant to remote sensing, such as image composition, normalized difference vegetation Index calculation, change detection, raster limitation etc.

The DMC Satellite Constellation in 2012 and Beyond: New Satellites, Sensors and Applications

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Keywords: new instruments, new satellites, optical imagery, agriculture, land cover

Abstract:

DMC International Imaging (DMCii) coordinates an international constellation of 5 satellites, each of which carries a wide swath Vis/NIR sensor. The constellation provides a daily global imaging capability at 22m-32m resolution for applications requiring large area coverage and/or rapid repeat, and from 2012 it will add a new 2.5m resolution imaging capability. This paper presents an update on the Constellation including 2 new satellites that were launched August 2011 and will enter operational service early in 2012. The paper also presents examples of how a number of organisations around the world are exploiting these powerful data sources for applications such as precision farming, tropical forest monitoring, land cover mapping, agricultural monitoring, urban monitoring and disaster response. The original DMC constellation consisted of five small satellites, each carrying a wide swath (650km) VNIR sensor with 32m resolution. In 2009 two new 22m resolution satellites, UK-DMC-2 and Deimos-1, launched into the constellation, adding much more imaging capacity to the constellation as well as enhanced resolution. Two further DMC satellites were launched on 19th August 2011: NigeriaSat-2 and NigeriaSat-X. NigeriaSat-2 adds a VHR capability to the constellation, with 2.5m panchromatic / 5m multispectral sensor as well as a wide-swath 32m sensor. NigeriaSat-X is very similar to UK-DMC-2 and Deimos-1, carrying another 22m wide swath sensor. These satellites will provide data continuity for DMC's well-established land monitoring applications as well as supporting a new set of VHR applications. The first examples of these new applications for DMC 2.5m data will be presented. In 2013 DMCii will launch a constellation of three satellites which will provide 1m PAN and 4m multispectral data. Together these highly agile satellites will provide a daily revisit opportunity at 1m resolution anywhere in the world.

Application of MODIS LST Data for Calculation of Evapotranspiration in the State of Espírito Santo, Brazil

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Keywords: MODIS, evapotranspiration, desertification, Brazil

Abstract:

The Areas Susceptible to Desertification in Brazil include the areas of Semiarid Climate and Dry Sub-humid Climate, as well as the surrounding areas, located in the Nordeste e Sudoeste do Brasil (the Northeast and Southeast Zones), occupying approximately 1,340 km² in all, and directly affecting 30 million people. Of this total area, 180,000 km², are already found to be in an advanced or very advanced process of desertification.

The United Nations definition of aridity is based on methodology developed by Thornthwaite (1941) and adjusted by Penman (1953), in which the aridity index (AI) is the ratio between precipitation and evapotranspiration.

The objective of this work was to analyze the correlation of monthly surface temperature data, obtained through use of the Moderate Resolution Imaging Spectrometer (MODIS), (MOD11), with the ambient air temperature, measured at seven meteorological stations in the state of Espírito Santo, averaged over monthly periods, aiming to realize an adjustment of the MODIS land surface temperature (LST) data to mathematical models enabling the estimation of air temperature over wide areas, in that way permitting the calculation of evapotranspiration and the aridity index for such areas.

In this study the mathematical functions which best fit the temperature data from the seven meteorological stations were of a linear function, having coefficients of correlation (R) of 0.818, 0.811, 0.851 and 0.708 and a quadratic function with the coefficients of correlation of $R = 0.708, 0.812$ and 0.718, thusly allowing an estimation of the air temperature data from the MODIS LST data. The equations which were developed in this study allowed using the MODIS LST data to calculate the evapotranspiration data using methodology defined by United Nations in total area of the state of Espírito Santo in Brazil.

PM 3-‘Particulate Matter Monitoring’ LIFE+ Project: Integration of Satellite Remotely Sensed Data and Ground Measurements

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Keywords: AOT, PM10, air pollution, satellite remote sensing

Abstract:

PM3 is the result of a joint effort of the Department of Labour Inspection in Cyprus , Aristotle University of Thessaloniki, ESS Austria, Cyprus University of Technology and the Atlantis Consulting Cyprus Ltd and aims to improve the air quality and on a long term basis the quality of life and health of all Cyprus's citizens. Through the project, the Department aspires to reduce level of dust in the atmosphere through targeted measures. The project is funded by LIFE+ Environment Policy & Governance. This paper presents some of the results obtained by using ground and satellite remotely sensed data. Moreover an emphasis is given to the main local emission sources, including mines and quarries, worksites and unpaved roads with high emissions. Statistical analysis between PM10 and aerosol optical thickness as retrieved from satellite images has been made. Finally NDVI maps required for the forecasting purposes of air pollution as will be further used in the model are presented.

The Potential of Long Term Territorial Experiments and Living Lab Approach to Develop Research and Applications

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Keywords: living lab, regional applications, users, GMES

Abstract:

In the beginning of the 2000s, CESBIO started to develop the so-called Observatoire Spatial Régional (OSR, Regional Space Observatory) which objective was to serve scientific research by providing long term in-situ and satellite observations at intermediate scales, from local to regional. Researches focused on agrienvironmental issues such as land cover and water and carbon fluxes. The OSR also serves the preparation or validation of SMOS, Ven μ s and Sentinel-2 missions. CESBIO started in parallel to work on web-mapping tools and SEIS (Shared Environmental Information System). Building on the scientific results obtained in the frame of the OSR, CESBIO progressively developed partnerships with a number of local and regional actors. A project, called RITA, was funded (2008-2010) by the "Regions of Knowledge" program of the EU FP7 with the aim to explore the conditions for the emergence of a European network of Living Labs dedicated to developing applications of satellite remote sensing and geographic information. RITA built upon a previous national project called Pôle d'Expérimentation et d'Application des Technologies Spatiales (PATs) developed in the French Midi-Pyrenees. These projects assumed that there is a significant potential for the application of remote sensing to land and resources management issues on geographical areas ranging from municipalities to regions. This potential remains largely untapped, particularly because of the usual top-down implementation by vertically integrated operators and non-specialized lines

of business. The second assumption is that the development of spatial data infrastructures and the provision of public data, under the leadership of the European Directive INSPIRE, constitute a favorable framework for greater use of products and services based on remote sensing. The concept of experimental territory is an original form for running a Living Lab. We started from the assumption that innovation is fostered by the proximity between research laboratories, training institutions, economic actors, policy makers, public sector organizations and users. These actors are willing to experiment services derived from space technology and to contribute to express specifications. The strategy followed by RITA and PATS relied on the development of pilot projects implementing a dynamic of co-construction of needs and products or services with users groups. Three main themes were addressed: agriculture, health, and land management. RITA led to explore new avenues for the development of uses of space technology and allowed progress in various fields, such as analysis of the value chain. We will present the experience gained in the frame of these projects and propose some ideas that might be useful to support the development of the use of GMES space missions, amongst which Sentinel-2 will probably be the most useful when dealing with regional issues.

On the Use of Enhancement Techniques for Space-Based Monitoring of Archaeological Looting

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Abstract:

Illegal excavations represent one of the main risk factors which affect the archaeological heritage all over the world, in particular in those countries, from Southern America to Middle East, where the surveillance on site is little effective and time consuming and the aerial surveillance is non practicable due to military or political restrictions. In such contexts satellite remote sensing offers a suitable chance to monitor this phenomenon. Looting phenomenon is much more dramatic during wars or armed conflicts, as occurred in Iraq during the two Gulf Wars, where “total area looted was many times greater than all the archaeological investigations ever conducted in southern Iraq” (Stone E. 2008). Media reports described the massive looting in broad daylight and destruction of the Iraqi museums and other cultural institutions. Between 2003 and 2004, several buried ancient cities have been completely eaten away by crater-like holes (<http://www.savingantiquities.org>), and many other archaeological sites would be pillaged without the valuable activity of the Italian Carabinieri, responsible for guarding archaeological sites in the region of Nassyriah. To contrast and limit this phenomenon a systematic monitoring is required. Up to now, the protection of archaeological heritage from illegal diggings is generally based on a direct or aerial surveillance, which are time consuming, expensive and not suitable for extensive areas. VHR satellite images offer a suitable chance thanks to their global coverage and frequent re-visitation times. In this paper, automatic data processing approaches, based on filtering, geospatial analysis and wavelet, have been applied to enhance spatial and spectral anomaly linked to illegal excavations to make their semiautomatic identification easier. Study areas from Middle east and Southern America have been processed and discussed.

Quality Analysis of "Structure from Motion" in Archaeological Airborne Applications

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Keywords: airborne, archaeology, structure from motion, quality assessment

Abstract:

For a few years, "Structure from Motion" has been commercially applied and interesting 3D models are discussed in recent literature. Structure from Motion is known to be a relatively fast and low-

cost technique for the generation of photo-realistic 3D models. This technique uses a series of digital images taken of an object or site from different positions. In this image series, each part of the object is recorded on at least two images. Combining these images with information from the metadata file allows to determine the different camera positions and orientations and to calculate a textured mesh or colored point set in 3D. This is based on solving a system of geometric matrices. In this article, the geometric quality of an airborne digital surface model is assessed, in order to use this model for archaeological research. An Iron Age hillfort site in the municipality of Kooigem (Belgium) is used as a test case for this research. In this area, some interesting archaeological relicts, such as walls and ditches are known and documented. These objects have a sub-meter height difference with the surrounding topography and are therefore very useful for visual and geometrical analysis of the digital elevation models. Although this fast and low-cost method results in a fair visual representation of the known relicts, a special focus is needed on less manifest objects of interest in the landscape. Besides, more research on the geometrical accuracy of the final products is required. A digital elevation model, acquired by airborne laser scanning, with an average point density of 4 points per square meter is used for the statistical quality assessment of the elevation model generated by Structure from Motion. This statistical and visual analysis of the digital elevation models, generated with Structure from Motion, allows evaluating this new technique, its results and its applicability for archeological research.

Application of Terrestrial 3D Laser Scanning in Cultural Heritage Documentation: Example of "Armenian Bath"

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Keywords: 3D laser scanning, 3D model, cultural heritage, documentation

Abstract:

Cultural heritage is the most important bridge of mankind, between past and future which has an enlightening attribute on a society's development and perspective. As long as their values are appreciated, they will continue living as a guide and inspirational resources. Anatolia is one of the leading regions for cultural heritage. Due to its location, many civilizations used it as a homeland and hosted many cultural heritage. However, necessary precautions are not taken for protecting the cultural heritage which is becoming obsolete and worn out day by day. For protection, restoration and carrying the cultural heritage to the future they should be documented with today's advanced documentation techniques. The greatest advantage of the recent technological developments enables us to prepare the most precise and accurate documentation. Precise and accurate documentation is not only important for carrying the cultural heritage and historical structures to the future of but also important for evaluating the structures and bring functionality. In this study benefits of process for digitizing 3D documentation with laser scanner tools have been discussed for the conservative architecture. Within this context, the sample architectural documentation has been taken from the county of Sivrihisar, which is located in the city of Eskişehir. Today this sample 'Armenian Bath' is out of use and it was built between 1867 - 1868 by Armenian. At the end of the study, 3D model of structure was obtained accurately and precisely.

Fundamental Tools for Photo-Interpretation in Mountainous Rocky Areas: Photogrammetry and Ground-Truthing

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Keywords: remote sensing, photo-interpretation, photogrammetry, landscape archaeology, protocol, mountainous rocky areas

Abstract:

How could we approach mountainous rocky landscapes in the absence of detailed cadastral maps, if the 1:5.000 maps do not depict hydrography to support the understanding of soil-marks and geological erosion, if crop-marks (or “scrub-marks” of the typical Mediterranean *macchia*) are undistinguishable, if the over-exposure of some military photos hides shadow-features, if a road can produce a similar signature as a wall or a fault in different geological setting a few meters away, if the monumentality of some ancient constructions means that scale does not work well as a discriminating factor, . . . ? These are amongst the challenges of creating a specific protocol in photo-interpretation of mountainous rocky areas. Taking the mountainous terrain of East Crete as a demonstration case study, a simplified cadastre has been produced according to the aerial photographic evidences with the 4th coordinate of time changes. A particularly rich network of roads, rough tracks and pathways has been digitized, underlining the high potential of areas where some paths were used for long periods. On this generated map, the known archaeological features were placed with a particular consideration of the source of the information itself: a data mining analysis is carried out to understand why a particular archaeological feature was visible from the ground and if and how their position influenced the recognition itself. The description of every single anomaly via abstraction levels groups homogeneous elements in a bigger category. On the base of these first subdivisions, the comparison of similar recurrence of combination of colour/contrast allowed the description of dubious cases or the definition of “false-features”. The availability of an extensive architectural field-survey with accurate digital measurements, such as the Digital Crete Archaeological Atlas, allowed to improve the feature recognition and to address a higher number of archaeological questions. This paper discusses some results that arose from Cantoro’s PhD research and their later enhancement through the further refinement of interpretation. A combination of remote sensing and ground-truthing was exploited for the specific geomorphology of the area of Eastern Crete, trying to extend it even further to other geographical contexts.

A GIS Based Application for the Management of Monuments and Antiquities of Cyprus

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Keywords: GIS, geospatial database, archaeology, CRM, Cyprus

Abstract:

In the past years there has been a continuous effort to develop applications that can be used for the effective management of archaeological sites and finds. This paper discusses the implementation of an integrated DB/GIS system that is used for the efficient manipulation of information regarding the ancient monuments and movable antiquities of Cyprus aiming towards the protection of the Cypriot cultural heritage. The archaeologists access the system through a client application developed using Microsoft .net framework. ESRI technologies were fully integrated into the Windows form application using Arc Engine/Arc Objects thus achieving a seamless and intuitive incorporation of the archaeological data and its metadata with the spatial data of the system stored as separate databases on Microsoft SQL Servers. The client application has a full feature set accessible accordingly after authentication and authorization of users, based on predefined permission levels. The client application also serves as a central repository and allows for the management of supplemental assets such as various image formats, AutoCAD files, etc. Within the environment, users are provided access to spatial data features including local plots "of interest", underlying cadastral data based on Cassini or LTM models, archaeological data outlined as Ancient Monuments of First and Second Schedule, Controlled Areas, Areas under Temporary Requisition, Survey Areas, and Movable Antiquities, and supplemental feature sets some of which are editable such as a "GPS" layer for points resulting from a surface survey. A key feature is the live communication via web services with the Department of Land Survey (DLS), providing access to current spatial data including administrative units, plot outlines, orthophotographic and geomorphological features. An additional feature of the client application is the ability to synchronize and identify changes between the local cadastral spatial data ("tagged" plots) with the DLS cadastral spatial data as it is subjected to frequent changes. An accompanying web application provides the public access to an approved public version of the database with summarized information of Ancient Monuments of the First Schedule and previously published ancient monuments. The web application backend is a duplicate setup (ArcGIS server and SDE server) mirroring the primary server and works as proxy service so as to protect the sensitive private data of the department while allowing access to the general public. The initial pilot phase resulted in the successful digitization of a few thousands

ancient immovable monuments and movable antiquities from the Pafos District. The implementation of «Cyprus Archaeological Digitization Program» provides a fully integrated workflow and environment where archaeological data can be recorded, archaeological assets can be managed, shared, edited, geospatially tagged and exported to be used as a prime cadastral of archaeological monuments. The program was funded through the Norwegian Financial Mechanism and was materialized under the direction of the Cyprus' Department of Antiquities and H.S. DATA Ltd and the Lab of IMS-FORTH undertook fully the implementation of the customized DB/GIS application.

Landscape Evolution in the Nile Valley: Physical and anthropogenic 3D changes in the last 40 years in Dayr al-Barsha

Physical and anthropogenic 3D changes in the last 40 years in Dayr al-Barsha

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Keywords: landscape evolution, digital surface models, CORONA, Worldview-1, Egypt, Dayr al-Barsha

Abstract:

The last four decades, worldwide, the landscape rapidly evolved in both a physical and anthropogenic sense. Here, the Nile valley is used as a prime example of how human impact may influence the physical environment. Due to its rich heritage, the cultural and environmental history of the Nile valley has already tremendously been studied. Studies focusing on the cultural history of the Nile valley are mostly field based and pinpointed towards specific target sites. These sites however were implanted in the regional landscape, and as such, information on these sites and their regional landscape are of equal importance. Digital surface models (DSMs), extracted from very high resolution stereoscopic satellite images, are a perfect tool to gain knowledge on this regional landscape aspect. In this study Corona images from 1970 and a Worldview-1 images (WV-1) from 2009 have been used in order to reveal not only environmental changes over the last four decades. In addition it also gets information on the natural landscape before the construction of the Aswan Dam, which was finished in 1970 blocking the famous natural Nile floods and major human impact could began. In this paper the challenges of DSM extraction from Corona and WV-1 images is discussed together with the detection of palaeo river channels and the evolution of anthropogenic features like villages all in the surroundings of Dayr-al Barsha (Middle-Egypt). The combination of the enhanced digital terrain extraction (eATE) module of Erdas Imagine and ground control points collected in the field provides accurate and high resolution DSMs. These surface models revealed potential palaeo river channels, and their presence has been confirmed by targeted geomorphological fieldwork in the region. Comparison between the Corona and the WV-1 DSM revealed that human impact on the landscape has been significant over the last four decades. All villages are grown in size and height. Even a number of new villages have been constructed over the last forty years. In the near future these models will be integrated with geomorphological an archaeological data in order to better understand the environmental as well as cultural evolution of the landscape in the region under study.

Remote Sensing in Archaeological Exploration of Roman Maritime Villas in the Eastern Adriatic

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Keywords: remote sensing, maritime villas, eastern Adriatic

Abstract:

Maritime villas were among the largest Roman villas in the eastern Adriatic. They had strategic, coastal or island location on the sailing routes and were situated in suitable bays or on promontories, with panoramic and controlling views of the sea. Any plans for future archaeological excavations of maritime villas have to be based first and foremost on remote sensing, using aerial photos and satellite images as the non-aggressive methods of archaeological exploration recommended by the European council for preservation of cultural heritage. So far, remote-sensing methods have been used on only a few villa sites: Katoro, Verige (Brijuni), Murter, Soline (Sv. Klement), Sreser and Tiha Bay (Cavtat). On all these sites remote sensing indicated more extensive building complexes than previously known. There are 30 known maritime villas in the eastern Adriatic, but present level of their documentation is insufficient. Some parts of maritime villas are today submerged in shallow water. In such case aerial photos are the most useful, especially in preparation of underwater investigations. On the land, the best results are obtained when aerial or satellite imagery is combined with geophysical research, including electromagnetic detection of the sites. The classical archaeological excavations are the last and the most important activity to check the preliminary results of non-invasive methods.

Use of Land-Cover Fractions Obtained from Multiple Endmember Unmixing of Chris/Proba Imagery for Distributed Recharge and Runoff Estimation

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Keywords: hydrological modeling, CHRIS/Proba imagery, multiple endmember unmixing, land-cover mapping, recharge, runoff

Abstract:

The use of remote sensing and GIS technology in hydrological modeling has strongly increased in the last decades, and has made it possible to map the spatial variability of various parameters important for recharge and runoff estimation (land cover, soil texture, slope, ...). Several studies have therefore focused on the use of multispectral satellite imagery of medium and high resolution sensors for improving hydrological modeling results. Recently, spaceborne hyperspectral sensors such as Hyperion and CHRIS/Proba (Compact High Resolution Imaging Spectrometer/Project for On Board Autonomy) have opened up new possibilities for land-cover mapping, thanks to

their increased spectral resolution. Recent work has focused on the potentiality of CHRIS/Proba data for deriving land-cover fractions at sub-pixel scale. A technique which has proven to be very effective for estimating sub-pixel land-cover fractions in urban areas is Multiple Endmember Spectral Mixture Analysis (MESMA). Compared to standard Linear Spectral Mixture Analysis (LSMA), MESMA allows endmembers to vary on a per-pixel basis and therefore allows taking full account of the heterogeneous composition of land cover in urbanized areas. The objective of this work was to integrate the results of MESMA, applied on CHRIS-Proba data, in the Wetspass model, a spatially distributed model for estimating the main water balance components: surface runoff, actual evapotranspiration and groundwater recharge. In Wetspass, the water balance is calculated at the level of raster cells. For each raster cell the water balance is split into independent water balances for the vegetated, bare soil, open water and impervious surface fractions present within the cell. Sub-pixel estimates of the fraction of four major land-cover components (impervious surfaces, bare soil, vegetation and open water), obtained from hyperspectral CHRIS/Proba imagery by applying the MESMA approach, were used in this study to improve runoff and recharge mapping with Wetspass for the Woluwe, a strongly urbanized catchment in the Brussels Capital Region. In our research, we evaluate the effects of using a fully-distributed approach for water balance modeling versus a semi-distributed approach on recharge and runoff estimation. The semi-distributed approach is based on remote sensing based estimation of the mean fraction of the four major land cover components for each land-use type used in the model. In other words, the land-cover fractions of the four land-cover components for each cell are fixed a priori, based on the land use of the specific cell. In the fully-distributed scenario the fractions of the four major land-cover components for each image pixel, obtained by MESMA, are aggregated to the model's cell resolution, so that land-cover fractions are specific for each cell defined in the model. Using the fully-distributed approach proves to have a clear impact on the runoff and recharge estimation, compared to the traditional look-up table approach where each land-use type is associated with a fixed share of the different land-cover fractions. In the distributed approach, the spatial variation of recharge and runoff can be clearly linked to the distribution pattern of the four major land-cover fraction components, resulting in more realistic estimates of total recharge/runoff at the catchment level. The study demonstrates how the use of MESMA can fully exploit the spatially distributed capability of the Wetspass model and also shows the potential of CHRIS/Proba data for recharge/runoff modeling in spatially complex urbanized areas.

Material Reflectance Retrieval in Shadow Due to Urban Vegetation from 3D Lidar Data and Hyperspectral Airborne Imagery

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Keywords: hyperspectral, 3D urban area, vegetation shadows, reflectance retrieval

Abstract:

Reflectance retrieval is a key parameter for land cover mapping from hyperspectral imagery. However most of the inverse methods to estimate these reflectances are limited in urban areas with the use of high spatial resolution sensors because they do not take into account the 3D radiative impact of the urban environment. A recent tool, ICARE [1], is able to retrieve surface reflectance in the reflective domain (0.4–2.5 μm) in the sunlit and shadow areas overcoming both slope and environmental effects. Its main inputs are atmospheric conditions and the 3D vector model of the scene. This model has proven to perform with good accuracy in shadowed areas cast by opaque structures. Nevertheless ICARE has never been tested in the shadow of vegetation because the 3D information was not available. In this paper, a new dataset including 3D lidar (0.25m) and hyperspectral (CASI 0.5m) data acquired over Norrkoping is processed demonstrating the potential of ICARE to retrieve the surface reflectance over any type of shadows. The results will be assessed by comparing the retrieved reflectance of a given material both in the sunlit and shadow areas. Further, the gain brought by ICARE compared to a flat scene assumption reflectance retrieval method will be evaluated in terms of classification performances.

[1] Lachérade, S., Miesch, C., Boldo, D., Briottet, X., Valorge, C., Le Men, H., 2008. ICARE: A physically-based model to correct atmospheric and geometric effects from high spatial and spectral remote sensing images over 3D urban areas. *Met. Atm. Phys.*, 102, pp. 209-222.

Increase in Spatial Resolution by Superimposing a Time-Series of IFOVs (MODIS Case on Cloud Cover)

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Keywords: spatial resolution, MODIS, cloud cover

Abstract:

Spatial resolution of a satellite image is defined by the angular size of an instantaneous field of view (IFOV). Spectral response is being averaged over IFOV during single satellite pass, thus objects of sub-pixel scale cannot be resolved. It is extremely unlikely, that scheme of IFOVs' projection on ground will be exactly repeated during a second and following passes: ground-projected IFOVs will be shifted and only partially overlaid. This means that each time the radiometric "input" into IFOV's value will be different. In this research the value of common part of superimposed IFOVs was exploited in order to increase the imagery spatial resolution. To demonstrate the technique MODIS Level 2 data set on cloud cover was used. The Terra and Aqua cloud masks of native 1 km/pixel resolution at nadir, were analyzed. Data covered one month of observation, meaning each location on the Earth was covered with at least 124 IFOVs, none of each repeated the footprint exactly. The final resolution of mean monthly cloud cover data was one hundred time higher (100 m/pixel), than input data. The proposed method was found to be useful for cloud cover studies over complex topography, but can be also applied to any other timely-averaged satellite data (satellite climatology) or to pseudo-stable or stable land cover (especial on a planetary bodies with solid surface but no atmosphere).

Variability of Field Spectroradiometric Measurements Using Nearly Lambertian Surfaces and Auxiliary Lidar Observations

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Keywords: spectroradiometers, accuracy assessment, lidar measurements, nearly Lambertian surfaces

Abstract:

Field spectroscopy is a technique of fundamental importance in remote sensing, since it deals with interactions between electromagnetic energy and objects in the natural environment. The most widely used methodology in field spectroscopy concerns measurement of the reflectance of composite surfaces in situ. Several authors have published practical suggestions for improving the

consistency and accuracy of field data collected using radiometers and spectroradiometers. As it is mentioned in the literature, for single beams spectroradiometers, in order to avoid any errors due to significant changes in the prevailing atmospheric conditions the measurements over the calibrated panel and the target should be taken in a short time. In this case it is assumed that irradiance is not significantly change, which is true for non hazy days. However several other factors should be taken into consideration such as the viewing geometry, sky conditions, the height of the instrument etc. This paper aims to highlight some practical considerations for field spectroradiometric measurements which should be taken into consideration. Indeed the variability of such measurements using homogenous and nearly Lambertian targets has been assessed in this study. Two identical single beam ground spectroradiometers, Spectra Vista GER 1500 (350 nm – 1050 nm) have been used simultaneously: the first one was used in order to measure reflectance from a calibrated panel (99.98% Lambertian surface) while the second one was used in order to measure reflectance from the targets. Several targets (e.g. grey homogenous asphalt) have been continually measured between 10:00-14:00 local time (1-2 minutes interval time). The analysis of the results had shown that for clear, non hazy days only small variations can be observed for the same target (less than 1%). This error is far more less than satellite observations ($\approx 5\%$) as mentioned in the literature. Furthermore the authors examined the relation between sky conditions and spectroradiometric measurements. Ideally users require clear atmospheric conditions, with low atmospheric water vapour content and low aerosol content. Such sky conditions data were provided from a Lidar system. The Lidar system provides aerosol or cloud backscatter measurements from a height beginning from 200m up to tropopause height. Lidar results were found very promising since the data had been used in order to understand some reflectance variations observed during the experiments.

Potential of Airborne Laser Scanning Data for Classification of Wadden Sea Areas

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Keywords: LIDAR, classification, conditional random fields, segmentation, water

Abstract:

Highly precise digital terrain models (DTM) of Wadden Sea areas are of great interest for several applications in the field of waterway and coast protection. The detection of morphological changes and the marine monitoring require highly accurate data, which can be obtained by airborne laser scanning. In water regions data acquisition by laser scanning is limited to the water surface because the near-infrared laser pulses hardly penetrate water. Therefore, a height model generated from laser scanner point clouds over water regions does not represent the actual terrain. The generation of a DTM thus requires the detection of water surfaces. In this study, we propose a method for the detection and classification of water and different land surfaces in airborne laser scanning data. We apply Conditional Random Fields (CRF) for that purpose, a probabilistic supervised classification framework capable of modelling context. CRF has a great significance for classification tasks especially in the field of computer vision. The aim of this paper is to investigate the potential of this approach for the classification of airborne laser scanning data and to analyse crucial classification features for the distinction between different surface types. This analysis is based on examples from the German Wadden Sea.

Combining Valley Following and Rule Based Segmentation for an Automatic Object Extraction from LiDAR Height Data

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Keywords: valley following, nDSM, single tree extraction, segmentation

Abstract:

For remote sensing data analysis, the automatic extraction of objects in natural, unstructured environments plays an important role in order to obtain a semantic world model. Due to the diversity of the object shapes, such an environment represents a serious challenge for an accurate automatic segmentation and classification, because image based data suffers from shading effects and has to be orthorectified. These effects do not occur in normalized digital surface models (nDSM), derived from LiDAR data, which represent the heights of objects, such as single trees and buildings. The algorithm that was developed to extract single trees uses a nDSM with a resolution of 0.4m per pixel. In a first segmentation step a valley following approach is used to find contours of objects. These contours are distinct for coniferous trees, whereas they are more blurred for deciduous trees. To avoid an upper bound on classification accuracy, single tree based species classification prefers over segmentation to under segmentation. Therefore, one object should not contain more than one tree. Tree tops are detected as the local maxima in the nDSM and contours containing more than one local maximum are further separated using rule based segmentation. This algorithm is validated in a testbed within the Virtual Forest project. The results are furthermore compared to a single tree detection approach, which uses prior knowledge of the tree species to find the tree positions.

Using a Production System for the Detection of Regular Patterns in Urban High Resolution SAR Datasets

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Keywords: persistent scatterer interferometry, grouping, urban, high resolution

Abstract:

Recent years have seen the advent of a new generation of space-borne high resolution SAR sensors like COSMO-SkyMed or TerraSAR-X. The latter provides a resolution in the order of one meter in the finest mode. Considering this tremendous improvement in resolution, a plethora of new mapping applications, which are particularly interesting for urban areas, becomes possible. One example for that is the exploitation of TerraSAR-X data stacks featuring very high resolution to map topography and deformation on a very dense grid. A typical method to achieve that is the Persistent Scatterer Interferometry (PSI), which provides the height and the deformation for a set of stable radar targets, referred to as Persistent Scatterers (PS). Due to the resolution, the PS density is very high in urban areas. It was shown, that a trihedral corner reflector having a side length of 6cm is enough to induce a PS. In view of this fact a large number of PS can be expected for a common building facade exhibiting structures like balconies or windows. These structures are usually arranged in a rectilinear setup, leading to a regular PS distribution in SAR data. These patterns formed by the PS contain lots of information, which is not used in current PSI processing schemes. Our research aims at extracting those patterns and use the obtained information in PSI processing. We propose here a scheme to extract horizontal groups of PS to facilitate height estimation. For that purpose a simple building model, consisting of the part of the building footprint visible to the SAR sensor and the maximum building height, is used as prior knowledge. In a first step PS, which possibly belong to the building under investigation, are selected. For that the distance in range-direction for the PS at hand to the next building outline is calculated and compared to the assumed maximum building height. In a second step the PS set is searched for regular patterns in the direction of the building outline (if the building facade consists of many parts having different orientation to the sensor, every part is investigated separately). The search is essentially conducted in one dimension for all possible rows of the facade. In every search step a starting PS - referred to as triggering PS - is chosen and a search area for a possible successor is defined based on a pre-defined spatial frequency. If a PS is found in this area, it is added to the group and a new search area is defined. Otherwise the search is terminated. This procedure is repeated until every PS has been used as triggering PS once. In case a PS is contained in several groups, it is removed from all but the biggest group. Finally the height of PS, that have been assigned to a group, is recalculated as a function

of the height of all points in this group (in the simplest case just the arithmetic mean of all points is taken as height estimate for all points). After visual inspection the results look quite promising. Currently, an evaluation of the results against ground truth is carried out, to investigate the benefit of the proposed method numerically.

Agricultural Field Border Line Retrieval Using Optical and SAR imagery

Field border lines, multi-modal matching, RapidEye, TerraSAR-X

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Abstract:

Agricultural parameter retrieval is an important task in GMES. One pre-requisite is the extraction of field border lines from remote sensing data so that change detection and surveillance of the individual agricultural fields become possible.

The presented methodology for field border line retrieval builds upon the combined usage of optical and SAR imagery. The core concept of this joint usage is to fuse the highly precise 2D geo-location accuracy from SAR images [1] with the spectral information from optical images. Then extracted border lines can then be compared to available GIS data. Therefore, a three step approach is introduced.

First, SAR images are geocoded and stored as geo-referenced image stacks. Optical images are geo-coded as well. They are additionally co-registered to remove residual geo-location inaccuracies and are radiometrically adjusted. These optical stacks are then registered to the SAR stacks by employing a multi-modal matching principle described in [2]. Therefore, the 2D geo-location accuracy of the optical imageries is adapted to the SAR images.

Second, the geometrically refined optical data stack is used to extract stable features, i.e. edge information that is stable over multi-temporal image acquisitions. These stable features are the used to iteratively extract the field border lines.

Third, a feature-based matching principle is employed to align the GIS-based border lines to the extracted ones utilizing the coherent point drift method [3].

For validation satellite data from TerraSAR-X (SAR) and RapidEye (optical) were acquired for two test sites. Results show that image matching between these SAR and optical imageries is possible with the so-called mutual-information cost function known from probability theory. Field border line extraction based on stable features is feasible and the matching to available GIS border lines is possible with high accuracy.

[1] Raggam, H.; Gutjahr, K.; Perko, R. & Schardt, M. Assessment of the Stereo-Radargrammetric Mapping Potential of TerraSAR-X Multibeam Spotlight Data IEEE Transactions on Geoscience and Remote Sensing, 2010, 48, 971-977. [2] Perko, R.; Raggam, H.; Gutjahr, K. & Schardt, M.

Using worldwide available TerraSAR-X data to calibrate the geo-location accuracy of optical sensors
IEEE International Geoscience and Remote Sensing Symposium, 2011, 2551-2554. [3] Myronenko,
A. & Song, X. (2010): "Point-Set Registration: Coherent Point Drift.", IEEE Trans. on Pattern
Analysis and Machine Intelligence, vol. 32, issue 12, pp. 2262-2275.

Estimation of Tropical Forest Biomass with Image Texture of Radar Images

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Keywords: forestry, biomass, remote sensing, radar, image texture

Abstract:

Interest in the world forests has grown to unprecedented heights, especially with growing awareness of their role in the global carbon cycle. Quantifying carbon in forests is therefore of crucial importance for estimating carbon fluxes at the regional and global scale. Carbon quantities are estimated by inferring wood biomass from forest biomass, and then converting it into carbon by using a value of approximately 0.5 ton of carbon for 1 ton of wood. In order to determine the biomass of a forest, significant relationships have therefore been established between radar mean intensity and biophysical variables. However, for mature stands (about 80 t/ha and more) increasing biomass reduces the sensitivity of the backscattering coefficient sigma/biomass relationships. Recent studies have shown that texture could be used instead of the usual intensity-age relationships, even for mature stands up to 140 t/ha, the highest biomass value observed for studied forests (monospecific, even-aged forest, subject to identical silvicultural practices and sampling covering all forest stages from sowing to harvest). The present paper aims at extending these observations to tropical forests which is a large component of the terrestrial carbon pool and the carbon sources generated by deforestation in the tropics. Radar images at P-Band were acquired during the TropiSAR experiment in 2009 over the Paracou experimental site with the SETHI ONERA airborne instrument. Paracou is located in a lowland tropical rain forest near Sinnamary, French Guiana where 15 permanent plots of 6.25 ha each were mapped and regularly measured. Three sets of treatments applied to the 15 forest stands provide biomass values from 260 to 470 T/ha. Plots were selected inside the 15th experimental stands with paying attention to the local topography. Plots with similar slopes were thus compared. Statistical features were then derived a) from gray level statistics (mean sigma, variance, skewness...) and b) the statistics of pixel pairs (energy, contrast, correlation...) for each plot on the basis of the gray level co-occurrence matrix. It is shown for radar images at P-band

and polarisation HV that despite the very homogeneous shape of this regenerating forest, linear relationships between some statistical features and forest biomass can be established which does not saturate even for biomass of more than 350 t/ha. These preliminary results are encouraging and further analysis should be carried out to explore the influence of the different treatments on the retrieval performance.

Interferometric Determination of Subsidence in the Prague City (preliminary results)

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Keywords: radar interferometry (InSAR), subsidence, permanent scatterers (PS)

Abstract:

Radar interferometry (InSAR) is a method used for deformation mapping within large areas, using radar images acquired by satellite instruments. We use four ENVISAT stacks of SAR images acquired from 2003 to 2009 in our project - track 43 (12 scenes acquired; ascending pass), track 122 (10 scenes acquired; descending pass), track 272 (13 scenes acquired; ascending pass) and track 351 (11 scenes acquired; descending pass). Unfortunately, no more scenes are available for the area due to conflicts with other projects. Processing of the whole scene would be too time- and memory-consuming, and that's why only the area of interest was cut from every scene and the process continued with these cuts. Several tunnels were finished after 2000 in Prague and some are still under construction. We are trying to find out whether there are subsidenses within these areas. The permanent scatterers (PS) method is used for deformation detection. The processing is performed by IPTA (Interferometric Point Target Analysis) package, which is a part of the GAMMA software. Only appropriate point targets are used for further processing, while the rest of points are omitted. In conventional InSAR processing, many interferograms were obtained from all possible pairs of scenes. Unfortunately, interferograms with the perpendicular baseline longer than 300m were totally incoherent, so they were excluded from further processing. The IPTA method is iterative, so it is possible to add also the pairs with longer baselines in further steps. The topography is subtracted from the interferogram by using digital elevation model (DEM). The resulted deformation map can be influenced by the atmospheric delay variation or by inaccurate DEM so we must examine the results and eliminate these kinds of artefacts to get the subsidenses. Additionally, it is possible to compare the final deformation maps from various track for better results interpretation.

Monitoring of Mining Induced Land Subsidence by InSAR Time Series Analysis

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Keywords: DInSAR, time series analysis, PALSAR, TerraSAR-X, Zonguldak, underground coal mine

Abstract:

In this study, we applied InSAR time series analysis to Zonguldak Hardcoal Basin in Republic of Turkey using ALOS/PALSAR and TerraSAR-X data in order to monitor mining induced surface displacement. Zonguldak coal area is located along the Black Sea 240 km away from Istanbul to the east. Recently, ground deformation caused by underground exploration has come to the surface, and it has been destroying roads and buildings. In the past research using JERS-1/SAR data observed on May and September 1995 and RADARSAT-1 between September 2005 and October 2006, small phase anomalies with several hundred-meter of spatial scale were clearly detected over the mining tunnels of coalfields. It was determined that these deformations were caused by the activity of coal mining. We utilized ALOS/PALSAR and TerraSAR-X data for the detail analysis on the recent mining induced land subsidence. Because the backscatter of X-band microwave adopted for TerraSAR-X sensor is disturbed by plants, urban areas near Kozlu coalfield are focused. PALSAR data in fine beam mode were obtained from an ascending orbit, TerraSAR-X data in the StripMap mode were from a descending orbit. The vertical and east-west displacement were calculated by the composition of the deformation vectors of PALSAR and TerraSAR-X. Additionally, the source depth of the main anomaly detected near the campus of Zonguldak Karaelmas University was estimated by vector analysis using the vertical and east-west displacement vectors. As a result, it was approximately 80 to 100 meters under sea level. On the other hand, the depth of coal production zones is recorded 300 to 560 meters under sea level. Thus, it was supposed that the anomaly near the university had been caused by not only mining activities but also the other factor in the shallower geological formation.

Monitoring the Change in Volume of Waste in Landfill Using SAR Interferometry

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Keywords: SAR, interferometry, InSAR, landfill, monitoring, waste

Abstract:

Waste management is one of the most critical environmental concerns. SAR interferometry has been widely used in studies related to ground subsidence or ground deformation but it is hardly found in landfill monitoring and waste management applications. In this study the potential of repeat pass SAR interferometry is investigated for extracting additional information and knowledge for landfill management. Two pairs of ENVISAT ASAR images have been used for monitoring the waste volume changes in a landfill for a specific period. For each pair, master and slave image with the minimum time lag were selected and deformations for the period between interferometric pairs were examined. Two parameters have been proved important for accurate height estimation in landfills, the orientation of the landfill area and changes of weather conditions. Changes in volume of waste and areas with intense activity of waste disposal were efficiently shown through elevation profile lines along the radar sight direction, encouraging the use of SAR interferometry for landfill monitoring applications.

Mapping Land Cover Using Polarimetric Data

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Keywords: SAR polarimetry, object-oriented classification, land cover classification

Abstract:

The land cover classification is one of the primary objectives in analysis of remote sensed data. Single-band and polarization SAR images do not provide sufficient information to carry out a highly accurate land cover classification because of a substantial degree of ambiguity among different land cover types. The fully polarimetric data contain more information about object reflectivity, shape, orientation, humidity, roughness than the single-polarized data. Hence, the object description is more complete and the land cover classification should be performed with better results. On the other hand, due to the high complexity of the SAR image the choice of the classifier to be used is essential for the classification accuracy. The aim of the study was to compare the effect of pixel and object oriented classification of the fully polarimetric data. The polarimetric data were decomposed using the coherent concept and the H/A/ α theorem. Then, the obtained parameters were classified using object oriented tools, as well as, unsupervised classification based on scattering mechanisms and Wishart classifier.

Mosaic Methods for Improving the Accuracy of Interferometric Based Digital Elevation Models

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Abstract:

The last two decades, SAR interferometry is used in order to produce Digital Elevation Model (DEM) for wide areas. However, the DEM produced by only one interferometric pair is characterized by low accuracy, due to several parameters that affect the final result. In this study the improvement of the DEM accuracy is attempted through the production of a mosaic DEM that derived from multiple interferometric-based DEMs. Two methods are used to create the mosaic DEM. According to the first, the entire height information included in the various interferometric-based DEMs is introduced in the procedure. In the second method only selected areas of the interferometric-based DEMs participate in the production of the mosaic DEM. The selection is based on the comparison between interferometric-based DEMs with another reference DEM (e.g. ASTER). For both methods the mosaic DEM generation is based on the precision file which is an output of the SARscape software. This file provides a height accuracy map which is estimated from parameters such as coherence, baseline and wavelength. Although this file is not always reliable it can be used to define weights for the height values of the different DEMs during the mosaic DEM generation. The Root Mean Square Error (RMSE) is used to estimate vertical accuracy. The validation of the DEMs is achieved by comparing them with a sufficient number of ground control points. The mosaic DEM produced by the first method does not yield improvements in accuracy, whereas the second method provides significant improvements depending on the accuracy of the used reference DEM.

Airborne or Spaceborne Images for Topographic Mapping?

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Keywords: spaceborne, airborne, optical images, topographic mapping, DEM generation

Abstract:

New airborne optical cameras as well as new very high resolution satellites are available now. With 50cm ground sampling distance (GSD) images from optical satellites are competing with airborne digital images which may take images with up to approximately 1m GSD. Analog digital aerial cameras nearly disappeared from the market as it was the case for satellites years before. The capacity of large format digital frame cameras has been extended to 250 up to 260 mega pixels as well as the swath width of the very high resolution satellites up to 40 000 pixels. In addition the imaging capacity of the optical satellites strongly has been improved. The partially very high slewing speed enables now stereo combinations from the same orbit without former restrictions. So the economic conditions and also the availability of actual images are better as before. For special projects of limited size in addition to traditional photo flights unmanned aerial vehicles (UAV) got a growing share. With the exception for countries or areas where restrictions for the use of aerial images exist, there is the question if airborne or spaceborne imagery should be preferred. The generation of topographic line maps as well as digital elevation models (DEM) are dominated by the GSD, the origin of the images are not important for the quality and accuracy. Aerial image flight for some application has the advantage of simpler higher overlap by more as two images, but the dominating aspect is the distribution and the simple access to imagery.

DSM Extraction from PRISM Stereopairs and Triplet

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Abstract:

In the present paper the phases of extraction of a DSM from Prism stereopairs and triplets are illustrated. Images represents a coastal area that spans from the city of Pescara to the city of Ortona (Abruzzo region, Italy). The availability of PRISM stereopairs and triplets is recent and in this paper accuracy of produced DEMs is compared with heights from Geodetic GPS surveys and cartography. Specific characteristic of the images acquired for this study is the possibility to compare two stereopairs between them and the stereopairs with the triplet.

Learning From the Past: Remote Sensing Based Investigations of Ancient Aqueduct Systems

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Abstract:

Satellite time series can provide valuable information to reconstruct ancient environmental changes, still fossilized in the present landscape. In particular, satellite derived moisture content and moisture pattern variations over the seasons and years may facilitate the identification of areas involved in early environmental manipulation. Up to now, only a few number of archaeological studies on spatial patterns of moisture have been carried out through the world using satellite optical data. We focus on Landsat and ASTER multitemporal data acquired for some areas near Nasca basin (Peru) to extract information on ancient irrigation systems and artificial wet agro-ecosystems. The study area is particularly interesting mainly because it was populated since millennia ago despite its drought and critical environment conditions presented serious obstacles to human occupation. Considering this extreme drought, which characterizes this area today as several centuries ago, ancient populations of the Nasca River valley devised an efficient system for retrieval water and to face the drought conditions. This system was based on underground aqueducts called puquios, which in part are still used today. Archaeological record put in evidence that during the Nasca flourishing period, the number and spatial distribution of puquios were larger than today. On the basis of satellite multitemporal moisture maps, Unknown puquios were identified and confirmed by ground survey. This information can be a basic The successful results achieved in the Nasca Basin area may be also rejoined in similar environmental conditions (in Meso-America, Middle East, North Africa, Asia) where ancient populations devised aqueducts to face drought and retrieve water for domestic, ritual and agricultural needs.

Reference Lasaponara R., Masini N., Following the Ancient Nasca Puquios from Space, in Lasaponara R. and Masini N. (Eds), *Satellite Remote Sensing: A New Tool for Archaeology* (Remote Sensing and Digital Image Processing), Springer, ISBN: 9048188008, pp. 269-290.

World HERitage monitoring by Remote sEnsing (WHERE)

A monitoring system based on EO remote sensing for UNESCO World Heritage sites in urban area

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Keywords: remote sensing, UNESCO archaeological site, EO Cosmo-SkyMed

Abstract:

In 1994, the UNESCO World Heritage Committee launched the World Heritage List that now include among the 936 properties, 725 were cultural sites and only 183 were natural and 28 mixed, and the vast majority is located in developed regions of the world, notably in Europe and in the Mediterranean area. The inscription of each site to the World Heritage list requires a specific commitment of the country on which the site is located, to monitor and preserve the site itself. These activities are carried out by local and/or national authorities that produce periodically a report on the conservation status and the actions taken to preserve the site itself. Nevertheless, the fast pace of human growth, requires a continuous monitoring of the site where urbanization poses major risks to the site preservation. This is particularly true for most of the sites that are located inside the urban area of the European cities and specifically in Italy. Factors like human activities, meteorological factors, including pollution, and structural stability of the remains due to natural degradation and the surrounding terrain (as demonstrated by the recent falls in Pompeii) affect the possibility to preserve these assets for the future generations. The monitoring of these sites is a fundamental step in the preservation and conservation of this fundamental world heritage asset. The project World HERitage monitoring by Remote sEnsing (WHERE) has the primary objective to develop and demonstrate an operational system and a cost effective service based on remote sensing to monitor UNESCO sites in urban areas. The project aims to address the following factors:

- Urbanization and human activities
- Small scale meteorological and climate change impact including pollution
- Geotechnical and structural stability of the building and the surrounding land

The above elements will be addressed by implementing three separate data processing chains: change detection, microclimate and interferometry. The human activities will be monitored by using change detection technologies applied to optical and high resolution radar images. The Microclimate will take in consideration air humidity and temperature, soil temperature and particulate (PM 2.5 and 10) while structural stability will be addressed using DInSAR interferometry techniques applied to Cosmo-SkyMed data. The data processing chains will be integrated into a GIS|WebGIS system where multi-temporal analysis is performed and final results displayed. The final products include updated risk maps (ideally produced on a monthly basis) addressing critical situations and the evolution of the parameters under monitoring. The project WHERE foresees an extended demonstration phase of 6 months on the following test sites in Italy:

- Historical center of Rome (UNESCO site from 1980);
- The "Sassi e il Parco delle Chiese Rupestri di Matera" (UNESCO site from 1993);
- Villa Adriana, Tivoli (UNESCO site from 1999) or the Ancient Harbor of Ostia.

The project WHERE has been co-funded by Italian Space Agency and is carried out by a small consortium of Italian SMEs headed by NEXTANT SpA and supported by ALMA Sistemi sas both located in Rome. The project started in January 2012 and the present article presents the results of the Preliminary Design Review.

Semi-Automatic Detection of Burial Mounds in Forested Areas

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Keywords: pattern recognition, airborne laser scanning, lidar, digital elevation model, archaeology

Abstract:

Several Norwegian municipalities are experiencing growing pressure on forested land for development, being it new residential areas, industry, tourism, or new highways. The traditional mapping of cultural heritage, mainly based on chance discovery and inaccurate positioning, has proven inadequate for land use planning. Therefore, the Norwegian Directorate for Cultural Heritage, in cooperation with some counties and municipalities, are investing in the development of new methods, using new technology, for a more systematic mapping of cultural heritage. One of the most frequent types of archaeological structure in Norway is grave mounds. We have earlier developed a method for the automatic detection of circular soil marks and crop marks in cereal fields in satellite and aerial images. Several of these detections have been confirmed to be leveled grave mounds, dating to 1500-2500 years ago. Methods based on optical images are of limited value in forested areas, since the archaeology tends to be obscured by the tree canopies. However, by using lidar data, the forest vegetation can be removed from the data, making it possible to detect archaeology automatically, provided the archaeology manifests itself as structures in the digital elevation model of the lidar ground returns, and that these structures may be described using some kind of pattern. In the majority of Norway's 19 counties, there are intact grave mounds in forested areas. This means that a semi- automatic method for the detection of grave mounds in lidar data would be an important tool in a more systematic mapping of archaeology in Norway.

Building on our previous work, we propose a processing chain for the automatic detection of heaps in lidar data:

1. Obtain lidar data from a commercial provider, in the form of LAS files. The point density must be at least 5 emitted pulses per square meter, and the discrete returns must be labeled as ground, building, vegetation, etc.
2. Convert the lidar ground returns to digital elevation models (height images) with three different resolutions: 0.2m, 0.5m, 1.0m
3. Convolve the height images with dome-shaped heap templates of varying sizes. Threshold each convolution result to obtain candidate heap detections.
4. For each candidate heap detection, compute various measures of the deviation from an ideal dome.
5. Classify each candidate heap detection as 'heap' or 'non-heap', using either a statistical classifier or a decision tree classifier.

The list of detected heaps is verified by an archaeologist, first by visual inspection of the lidar data, then by field work. The automatic method will be applied on lidar data from Larvik and Borre municipalities in Vestfold County, Norway. Preliminary results are very promising, and indicate that this will be a very useful tool for archaeologist in Norway for a more systematic mapping of cultural heritage.

Linear Spectral Un-Mixing for the Detection of Neolithic Settlements in the Thessalian Plain, North Greece

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Keywords: linear spectral un-mixing, detection of buried archaeological remains, neolithic settlements, spectral signature

Abstract:

Vegetation crop marks may be formed in areas where vegetation overlays near-surface archaeological remains. These features retain soil moisture with different percentage of moisture compared to the rest of the crops of an area. Depending of the type of feature, crop vigour may be enhanced or reduced by buried archaeological features. Satellite imagery has been already applied successfully in several archaeological investigations for the detection of buried archaeological features based on such crop marks. However, such features can only be classified when their spectral characteristics are different from their surroundings. Difficulties might occur when spatial resolution (pixel size) of the satellite sensor is low enough in order to distinguish crop marks from their surroundings. In these cases up-scaling techniques, like linear spectral un-mixing (LSU), can be used in order to improve spatial resolution and to enhance image results. The aim of this paper is to assess LSU technique for the detection of archaeological sites. LSU is based on the assumption that within a given scene, the surface is dominated by a small number of distinct materials that have relatively constant spectral properties (called endmembers). LSU technique was evaluated at several Neolithic tells (magoules) located at the Thessalian plain. Different multispectral satellite images (mainly Landsat TM/ETM+) have been used for this purpose. The final results were compared with other

standard remote sensing techniques like Principal Component Analysis, vegetation indices, Tasseled Cap and ground spectroradiometric data.

Remote Sensing as a Non-Invasive Method for Study of the Past Permafrost Features; Wielkopolska, Poland Case Study

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Keywords: remote sensing, GIS, geomorphology, periglacial, permafrost

Abstract:

Remote sensing can be very a effective tool to gather information about environment, especially in areas or conditions which are difficult to reach by direct observations. It can be also used as a non-invasive method allowing to study of geographical or archeological features without destroying them. Here, we propose a workflow to non-invasive study of the past permafrost features. Thermal-contraction cracks are one of the most widespread and convincing features, which are diagnostic of permafrost. The process leads to the development of not only vertically fissures but also horizontal polygons, which can be found on the ground surface in both contemporary and past environments. However, recognizing of these polygons is only possible with the use of high detailed aerial photographs, as they are not visible from a ground level. For the study, special methodology of taking aerial photographs was developed. Photographs were taken during different seasons in order to discover which vegetation and humidity settings are the best for wedge-polygon recognition. The photographs were taken from different altitudes, from 200m to 400m above ground level. Near-vertical photographs were georeferenced and rectified and resultant photographs are scaled 1:500 to 1:2,000. Further analysis within the GIS framework can be used relatively easily for large and remote areas and thus provide information about the spatial distribution of the permafrost features. The next step is the use of GPR soundings for the recognition of the vertical dimension of features. They can be used for assessing the dimensions of features as well as their 3D images. The proposed methods were tested in the Wielkopolska (Great Poland) region in Central-West Poland. The Last Glacial Maximum (LGM) in the region occurred around 20,000 BP. After this time the ice sheet started to retreat. Permafrost started to grow on the forefield of the receding ice sheet. Large numbers of polygon structures resembling thermal-contraction cracks were observed and analyzed. Based on aerial photographs analysis and GPR soundings a few sites were chosen to conduct of sedimentological analysis to proof the origin of studied features.

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GIS-Based Analysis of Aerial Photographs to Study of the Distribution of the Past Permafrost Features in the Wielkopolska, Poland

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Keywords: permafrost, thermal-contraction cracks, photointerpretation, GIS, Wielkopolska

Abstract:

Analysis of the aerial photographs have been used for study of the past permafrost features since almost 50 years. However, this kind of research were usually conducted only for selected test fields. The purpose of this article is to present geographical information system based on remote sensing data (non-invasive method) focused on past permafrost features for a larger area of the Wielkopolska region (Poland). Genesis of surveyed area is connected with Vistulian glaciation. Created GIS allowed verification of standing opinions concerning occurrence, range and scale of permafrost features. It is based on a set of circa 2000 georeferenced oblique aerial photographs taken between 2006 and 2011. Identified permafrost features were attributed to one of three categories: 1. Regular polygons with four to eight edges. They are varied in dimension from several to a dozen metres. 2. Irregular polygons with irregular edges. They are usually founded on slopes. 3. Other structures, not polygon shaped. These belong to different types of structures. The results of the research confirmed the occurrence of permafrost features in the Wielkopolska region, but for the first time analysis of this phenomena was performed for such vast area. Procedure of taking photographs for geomorphological purposes is rather similar to methodology of aerial archaeology and is strongly dependent of seasonal weather conditions which influence vegetation and appearance of crop marks. Wide access to new technologies (e.g. GPG, GIS, GPR, LIDAR) should lead to wider use of non-destructive research methods.

Using Remote Sensing, Laser Scanning, Close Range Photogrammetry & GPS Technologies in Restoration Project of the Historical Byzantine Aydos Castle

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Keywords: castle Aydos, restoration, remote sensing, photogrammetry, GPS, laser scanning, helicopter imaging, model plane imaging, 3D model

Abstract:

Sultanbeyli district, one of the forty districts of Istanbul, is located in the Asian side of the Istanbul Metropolitan area. This district is surrounded by the Pendik district in the east and south, by Sancaktepe district in the north and west, and by the Kartal district in the southwest. Aydos Castle in the Sultanbeyli district is covering an area of 25.000 m² on a 327 meters high hill. The oval formed castle consists of inner and outsider protection walls and bastions connected to both walls. It is clear from different documents that the Aydos Castle used to be an important center in the east border of the late Byzantine Empire. During 1326-1328 Ottomans invaded a large part of the Kocaeli Peninsula and some parts of the settlements in the Asian side of Istanbul. During this period the line between Aydos and Pendik defined the border between Ottoman and Byzantine Empires. In 2009 restoration projects of the castle have been started. Firstly there was a need to determine the present situation and prepare the building survey project to run the restoration works in a proper way. For building survey, advanced documentation techniques, such as remote sensing, laser scanning, close range photogrammetry, GPS, Total-Station, imaging with a model plane and helicopter were used. But only 15% of the castle was above the ground and the surface was covered by trees. To determine the present situation, high resolution images were taken from a model plane and helicopter. The 3D model of the castle was obtained by a terrestrial Trimble GX Laser Scanner. The layout plan of the castle was produced by differential GPS system. Then, the plants and the obstructing trees on the castle were cut down, stones inside the castle were cleared and the castle became ready for archaeological excavation. During this phase, the determination works were done again by helicopter imaging, photogrammetry, laser scanning and GPS. The excavation was made by a team of 60 people under supervision of the Istanbul Archaeology Museum. Thanks to this excavation work, two big size bastions and walls were revealed. In the end of the excavation third time documentation of the castle was done. As a result of these works; building survey projects were prepared, historical sources were analyzed and a comparative restitution report was completed by examining similar castles. This paper gives terrestrial information about documentation methods used during the project.

Predicting the Spatial Distribution of Population Based on Impervious Surface Maps and Modeled Land Use Change

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Keywords: remote sensing time series, soil imperviousness, MOLAND, dasymetric mapping

Abstract:

Land use, surface impermeability and changes in the spatial distribution of population are spatially and temporally linked, and have an obvious impact on the urban environment. They influence, for example, mobility and accessibility of services and play an important role in waste water management. We have monitored changes to the impervious surface cover of Dublin for the two last decades by combining a time-series of medium-resolution images and a recent high resolution image in a multi-resolution sub-pixel classification approach. The derived historical impervious surface maps were used together with MOLAND land-use maps and census data to calibrate a multiple regression model explaining the past spatial distribution of population. In this model, the independent variables are the area covered by three generalized land use classes. This area was weighted by the spatial variable representing surface imperviousness derived from the remote sensing data. The proposed method uses normalized population masses in order to get a model that is independent of time and space. This is required for prediction and spatial extrapolation, which assumes a temporally and spatially stable relationship between land use and population density. We validated the model by population disaggregation/re-aggregation procedures. An existing calibration of the EU-MOLAND model for Dublin was first improved by means of spatial metrics derived from the time series of impervious surfaces. Land use maps that were forecasted

according to several socio-economic scenarios were then converted to impervious surface maps based on spatial-contextual knowledge and decision trees. These maps in turn served as input to the statistical model for relating population density to land use and surface imperviousness. This allowed us to predict the spatial distribution of the population of Dublin for the next 20 years.

Integrated Use of Satellite Remote Sensing and GIS for the Development of a Sophisticated Sustainability Index for Urban Areas: A Case Study of Paphos City (Cyprus)

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Keywords: GIS, urban sprawl, indicators, Cyprus

Abstract:

During the last years tremendous building development has been recorded in Cyprus and especially in Paphos district so a strategic development plan is necessary. Sustainable development is focused on developing a mutually beneficial relationship between the economic development and the environment. In practice sustainable development focuses on finding methods to promote growth that do not destroy the environment, or compromise future generations' access to natural resources. This study aims at developing a novel methodology based on an integrated database for the extraction of sustainability indicators concerning urban environment. The pilot area will be the city of Paphos at western Cyprus where during the last decades the phenomenon of urban sprawl has been recorded. Initially, multivariate spatial and attribute data will be collected after the indexing of previous relevant researches and scientific projects such as WEBAIR and AIRSPACE that are already running from the Cyprus University of Technology. These data will be organised in a multi-parametric database in GIS environment. A set of indicators will be developed to support sustainable development strategy in Cyprus such as : Economic (Gross domestic product, Employment, Life expectancy, Pollution abatement expenditure), Transport use (Car use and total passenger travel, Short journeys, Real changes in the cost of transport), Energy (Fuel prices in

real terms, Residential energy use), Land use and Land cover (Rural land cover, Green spaces in urban areas, Agricultural productivity, Designated and protected areas, House hold numbers), Water resources, Climate change (emissions of greenhouse gases), Marine and coastal areas (pollution, bathing water quality), Soil quality (heavy metal concentration in top soils), Air quality (AOD and Particle Matters measurements) and Waste indicators (household waste, energy from waste). The basic method for calculating the indicators of sustainability will be standard deviation by calculating the standardized values of each indicator over a period of time. Sustainability indicators are assessed according to coefficients which are determined on the basis of the nature of each indicator (urban/environmental, economic and social). A significant component of the current proposal is the application of sophisticated satellite remote sensing techniques for studying in detail the multi-temporal evolution of urban sprawl phenomenon in the broader area of Paphos - Cyprus. The land cover regime will be thoroughly searched through the use of satellite imagery and aerial photos and digital maps will be developed covering a period from 1963 until today. Within the frameworks of the project an innovated GIS based spatial analysis tool will be developed where all the indicators will be incorporated for planning of sustainable urban development. This tool will import, evaluate and process the indicator data and extract the final results in the form of maps, table and texts and a final sustainability index. Analytic Hierarchical Process (AHP) and Multivariate Analysis (MA) will be used in GIS environment for to calculate indicators weighting.

Semi-Automatic Object-Based Building Change Detection in Suburban Areas from Quickbird Imagery Using the ERDAS Imagine Objective Software

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Keywords: semi-automatic change detection, object-based image analysis, automatic building extraction, satellite imagery, QuickBird, ERDAS Imagine Objective, informal settlements

Abstract:

This paper aims at effectively detecting the building changes in bi-temporal very high resolution satellite images. Many applications require detecting structural changes in a scene over a period of time. Change detection of man-made objects using remote sensing images has many applications such as city planning, informal building detection and disaster management. For this paper, two bi-temporal multispectral images from the QuickBird satellite were used, depicting a region of south-eastern Attica. The implementation of the automatic change detection the two images were made in the, object-oriented, environment of the commercial software ERDAS Imagine Objective. The method was based on the comparison of two independent classifications. The independent building extractions were result of tree-processes in the Objective. The first step for every feature extraction in Objective involved the system training by defining positive and background training samples. Afterwards, Objective created a probability layer which presented the single probability of every pixel for being building, based on the training samples. Then, the creation of objects followed by a raster object operator such as segmentation. Subsequently, the created objects were processed by applying a variety of functions including probability, size or morphological filters. This was the last raster level since the next level converted the objects from raster to vector form. Consequently, the objects were processed by operators which reshaped the existing objects, eliminated these who did not meet certain criteria, combined multiple objects to a single or splitted object into multiple new vector objects. The next level performed classification on the vector objects. Vector object classification involved specifying one or more cues which were used by the Object Classifier. The cues included metrics which measured certain properties of vector objects. The Object Classifier used the cues to assign a probability to each object in a group of vector objects. Finally, the last level included operators which typically cleaned up the set of vector objects to produce a nice final output. Some Vector Cleanup Operators used the probability attribute generated by the Vector Object Processor in the operation. The implementation of the change detection was carried out by the comparison of independent building extractions using an operator that computed the probability of change for every object, taking into consideration the probabilities of the objects for both dates, and the distance of centroids of the polygons between the two dates. The results of extraction were very satisfactory since the correctness was 85.9 per cent and 85.2 per cent and the quality 67.0 per cent and 67.5 per cent for the first and second dataset respectively. The change detection did not produce proportionally successful results since the correctness was 22.3 per cent and the quality 13.4 per cent. The reasons which have contributed to the lesser accuracy of the change detection

results were primary, due to the mediocre geometric registration of two images, the limited spectral information of the data as well as the large extent and complexity of the study area.

Operational Traffic Monitoring Using Very High Resolution Satellite Imagery

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Keywords: vehicle detection, traffic statistics, very high resolution satellite imagery, blob detection

Abstract:

The increasing availability of very high resolution remote sensing imagery has opened up for new opportunities for road traffic monitoring applications. While many traffic authorities struggle to create traffic statistics for as many roads as possible with traditional mobile ground based equipment for traffic counts, vehicle detection from satellite images has a potential ability to cover large geographical areas and can provide valuable additional information to the existing methods. This is especially the case for roads in rural areas and roads with sparse traffic, where ground based measurements are seldom prioritized due to high costs, limited personnel, or related difficulties. In this paper we present a solution for the extraction of vehicle counts from very high resolution satellite imagery intended for use in an operational setting. In the proposed system, we have developed separate, fully automatic methods for each of the necessary steps: road detection, cloud detection, and finally, vehicle detection and classification. Input to the system is the satellite image and road vectors, containing geographical coordinates, including height information, as well as road descriptive parameters, such as the number of lanes, speed limit, tunnel information, etc. Since the image and road vector data are not accurately co-registered, the road segmentation is not trivial. We have developed a robust snake-based method that exploits both the road vector data and the underlying image information to precisely locate the road in the image. To detect clouds and cloud shadows in the image, we apply a classification based approach, assuming multivariate Gaussian distributed classes. To correct for the poor match between training and test data, which is often the case due to atmospheric, geographic, botanic, and phenological variations in image data, we use an approach that adapts the training data distributions to the distributions in the test domain for each new case. Finally, the vehicle detection is based on an elliptical Laplacian of Gaussian scale space methodology, where the vehicle locations are extracted at local extrema in the image response to convolution with elliptical filters at various scales. The spatial extension of the vehicle candidate blobs are defined in a region growing step. Then, several object features are derived from spatial, spectral and contextual measurements of the image objects, and followed by classification into two vehicle classes and a non-vehicle class using a K-nearest-neighbors classifier. The described modules have been put together and validated in a chain, as their performances are highly dependent on and

influenced by each other. The proposed system for extracting vehicle counts has been successfully demonstrated on a large collection of WorldView-2 and Quickbird images. The next steps include further evaluation and implementation at the Norwegian Road Authorities as a complementary system for extracting traffic statistics.

Satellite Observation of Urban Heat Island Effect

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Keywords: urban heat island, urbanization, satellite data, Bucharest, Romania

Abstract:

Remote sensing is a key application in global-change science and urban climatology. Urbanization, the conversion of other types of land to uses associated with growth of populations and economy has a great impact on both micro-climate as well as macro-climate. By integrating high-resolution and medium-resolution satellite imagery with other geospatial information, have been investigated several land surface parameters including impervious surfaces and land surface temperatures for Bucharest metropolitan area in Romania. The aim of this study is to examine the changes in land use/cover pattern in a rapidly changing area of Bucharest metropolitan area in relation to urbanization since the 1989s till 2010 and then to investigate the impact of such changes on the intensity and spatial pattern of the UHI effect in the region. Investigation of radiative properties, energy balance and heat fluxes is based on satellite data provided by various sensors Landsat TM, ETM+, MODIS and IKONOS. This paper demonstrates the potential of moderate-and high resolution, multispectral imagery to map and monitor the evolution of the physical urban environment in relation with micro and macroclimate conditions. So called effect of “urban heat island” must be considered mostly for summer periods conditions and large European scale heat waves.

Modeling the Probability of Urban Sprawl

A Comparative Study using Cellular Automata, Logistic Regression and Support Vector Machines

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Keywords: urban modeling, cellular automata, sleuth, support vector machines, svm, logistic regression

Abstract:

In recent years, one of the most striking processes of change in the socio-ecological system of Central Europe is urbanization. Having started as a concentration process of population and jobs in agglomerations at the beginning of the last century, urbanization spilled over the actual urban agglomeration borders, bequeathing a spatial footprint of sealed surface to the rural landscape since the late seventies. The quantitative and qualitative measurement, prospection and evaluation of land use and land cover change dynamics commonly known as “urban sprawl” is a part of land system science with its manifold methods and technologies. Recently, an increasing number of studies testing the use of artificial intelligence techniques for geo-oriented sciences emerged. Popular techniques among these spatially explicit simulation approaches are cellular automata. SLEUTH, being one of the best-known simulation models for urban sprawl, uses binary urban and non-urban raster cells and the situation of adjacent cells in their neighborhood during the calibration phase. Moreover, in every iteration step it compares the probability of converting a non-urban cell to an urban cell with the local slope and stochastic values. SLEUTH’s simple dynamic approach and its ability to model complex spatial processes led to numerous applications especially in studies focusing on North American cities. Besides these huge advantages for modeling the form of urban sprawl, the processes leading to these land use changes cannot be explained. Therefore, in this study the simulation ability of SLEUTH should be compared to two statistical resp. semi-statistical approaches of modeling urban sprawl. The former approach is a linear logistic regression model. Linear logistic regression models establish a statistical relationship between the variable “urban” as the dependent variable and selected driving forces, for example population density or soil quality, as explanatory variables. The model’s result is a so-called probability map showing the probable emergence of urban cells. Based on the probabilities a binary decision can be made, if a cell belongs to the urban or non-urban class. The main disadvantage of linear logistic regression models is the tendency to over-fit, especially when applied to non-linear data. The semi-statistical method called Support Vector Machines (SVM) is able to avoid this disadvantage: SVMs are suitable to work with non-linear data. It’s a machine learning concept based on statistical learning theory. The basic idea is to project input vectors on a higher-dimensional feature space, in which a specific hyperplane can be constructed for separating the data into two or more classes. With its robust and valid classification results, SVMs are a very popular classification technique for remote sensing

data. It is no wonder that plenty of studies evolved recently, dealing with the use of SVMs for modeling urban sprawl. Above all, the simulation results compared regarding their localization and quantitative simulating ability. Furthermore, the handling and the generalization ability of those popular (SLEUTH), recognized (Linear logistic Regression) and promising (SVM) urban simulation tools analyzed. Classified Landsat data of a section of North Rhine-Westphalia of the years 1975, 1984, 2001 and 2005 are used as the base dataset. The study area involves the urbanized region along the Rhine River and the rural, hilly region of Bergisches Land. Thus, it is possible to investigate the ability of simulating different types of growth in urban and rural areas.

Combining Remote Sensing and Landscape Metrics for Urban Development to Monitor Urban Spatial Variation: Examples from Growing and Shrinking Regions

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Keywords: satellite remote sensing, landscape metrics, urban regions

Abstract:

Large-scale urban development is likely to be one of the primary sources of environmental change over the next decades, and more of this development will take place in India and China than in any other two countries. Rapid urban growth can have severe consequences for environmental sustainability creating an urgent need for alternative pathways to development. Satellite data and further geo-information data are used for landscape ecological evaluations, e.g. to predict structural diversity in landscape, to derive quantitative data on open space fragmentation and on interlink of biotope structures. Satellite images are just as much used to identify compensational areas for planning of building land in conurbations or to quantify landscape metrics by means of derived medium and high resolution satellite parameters in order to calculate neighbourhood relations of objects. Within the last two decades landscape structure indices or metrics have been implemented on remote sensing image data for different mapping scales. As original input data topographic maps, aerial photographic data as well as satellite images have been used. Thus the analysis of historical samples represents the base for the comparison of current as well as of future landscape structures and enables predicates to evaluate the dynamics of the landscape. Nature, in particular in the suburban cultural landscape is described regarding indicators such as structure (line or planar expansion, cutting, island areas, etc.), dynamics (entry of the modification processes) and texture (neighbourhood relations to other land use forms). This is based on the identification and computation of static and dynamic indicators that help providing a synthetic assessment of suburban landscapes. The indicators will also allow the comparison of the environment's condition in different conurbations. The static indicator includes proportion of urban land uses at different points in time, of road network cutting land uses, but also fragmentation of recreational sites within metropolitan areas and of built-up areas within green spaces in suburban areas. Dynamic urban area indicators refer to typology of changes and the transition from one land-use class to another. A methodological approach is presented applied to different parts of Europe in growing as well as shrinking urban regions, after which monitoring and evaluation of a landscape diversity in suburban landscapes are feasible on the basis of medium and high resolution satellite data.

Urban Expansion Around the Pyramids of Giza, Egypt: 3D Change Detection Based on High Resolution Digital Surface Models

3D change detection based on high resolution digital surface models

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Keywords: digital surface models, 3D change, urban expansion, pyramids of Giza, Egypt

Abstract:

One of the biggest threats to cultural heritage is related to their rapidly changing and developing surroundings. The Giza pyramid plateau is a prime example of this phenomenon, as it is threatened by the enormous urban expansion of Cairo over the last decades. Documenting, monitoring and modeling such a pressure requires accurate and detailed geographic data, which can be derived from recent up-to-date, high resolution satellite images. Remote sensing techniques have proven to be very useful to visualize and analyze urban sprawl and land use changes in two dimensions. The impact assessment of urban sprawl near specific heritage sites, however; needs to be complemented with accurate 3D-information. In an attempt to do so, digital surface models (DSMs) from GeoEye-1 stereoscopic images from 2009 and 2011 have been computed in order to analyze recent urban changes. In this paper the challenges within the photogrammetric 3D change detection process are discussed. The combination of the enhanced digital terrain extraction (eATE) module of Erdas Imagine® and ground control points collected in the field provides accurate and high resolution DSMs. The small impact of shadow and different urban morphologies however influence the pixel-wise comparison of the two DSMs, which results in different approaches for different city districts. The resulting 3D change model clarifies not only the urban sprawl, but also the increase in building levels, directly related to pressure on the famous pyramids. In the future, an integration of population statistics can improve the model, hence allowing it to become a useful policy instrument.

Application of Remote Sensing and Geographic Information System to Elaborate Urban Environmental Index: Case of Casablanca, Morocco

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Keywords: urban environment quality index, environnement indicators, SPOT-5, GIS, Casablanca

Abstract:

Urban environmental quality is currently hard to quantify due to the overlapping of both natural and anthropogenic factors with socio-economic and environmental remarkable effects. The fast developing and uncontrolled urbanization are behind the development of numbers of side effects which affect the urban environment. Many studies demonstrate the ability of remote sensing and geographic information system to monitor urban environment quality. Casablanca, Morocco's economical capital is facing a fast growing demographic development amplified by a massive rural exodus but in the mean time in a anarchic way. This lead to the urban change, development of informal settlements and lack of green spaces. This study is made possible by using a SPOT-5 image of Casablanca city, taken March 16, 2004 merged with 2.5m spatial resolution and census data. Indicators were defined and listed in social, economic and environmental categories. An index of environmental quality in Casablanca city for the 17 urban districts was calculated after the Standardization and weighting of indicators used. The results may be useful to city managers and planners who are concerned with urban environment quality issues and sustainable development.

Introducing an Online E-learning Environment for Providing Interactive Remote Sensing Contents for School Lessons

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Keywords: remote sensing, schools, education, e-learning environment

Abstract:

The “Remote Sensing in Schools Project” (FIS = German abbreviation) devoted itself to the idea of promoting the advantages and possibilities emerging from the use of remote sensing material in school lessons. Recognizing that in-depth use of satellite imagery can only be achieved by the means of computer aided learning methods, a sizeable number of e-Learning contents have been created throughout the last 5 years since the project’s kickoff. Combining those contents into one clearly structured online resource alongside with the advantages of an e-Learning management system has been the goal of the second phase of the project which will be completed by the end of 2012. Three main sections form the backbone of the developed Online Platform. The “Teaching Materials” section provides registered teachers with interactive lessons to convey curriculum relevant topics through remote sensing. They are able to use the implemented management system to create classes and enregister pupils, keep track of their progresses and control results of the conducted lessons. Abandoning the functionalities of the management system the lessons are also available to non-registered users. Pupils and Teachers can investigate further into remote sensing in the “Research” section, where a knowledge base alongside a satellite image gallery offer general background information on remote sensing and the provided lessons in a semi interactive manner. The “Analysis Tools” section offers means to further experiment with satellite images by working with predefined sets of Images and Tools. All three sections of the platform are presented exemplary explaining the underlying didactical and technical concepts of the project, showing how they are realized and what their potentials are when put to use in school lessons.

Incorporating Free/Open Source Software in Remote Sensing Education

Pros and cons from teaching Applications in Remote Sensing

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Keywords: remote sensing education, freeware, open source software, Multispec, gvSIG

Abstract:

Students' practical training in applied disciplines as Remote Sensing involves collecting, evaluating and processing of contemporary scientific resources and data, so the use of sophisticated software is required. Whilst different software can be available over the internet which has become an invaluable source of such information, the selection of remote sensing software that will be used for the student's laboratory practical training has always been a complicated task with two main problems: (a) the cost and (b) the software's "learning curve". The cost can be a limiting factor as classes grow in numbers, which means that for commercial software more licenses need to be purchased and the use of such software is usually limited within the lab; students cannot install it on their own machines at home. On the other hand, as the total number of classes per semester is limited to 13, the use of sophisticated but complicated software, poses a serious threat to the educational procedure -that is to miss the educational target and to convert it from "Remote Sensing" to "software training". With those concepts in mind, an effort has been made to incorporate the use of free and open source software to the educational procedure in the Applied Remote Sensing classes at the Geoinformatics & Surveying Department of the Technological Educational Institution at Serres, Greece. During the past two semesters, students were trained using both the free software Multispec (Purdue Research Foundation, Purdue University, USA) combined with the open source gvSIG package and the Erdas Imagine commercial software, which has also been used for the past 10 years. The evaluation considered the capabilities that both software packages provide regarding

the remote sensing analyses procedures needed for the teaching purposes. At the end of the second semester, students gave feedback regarding the ease of use, the time spent to learn the software as compared to the time spent on the Remote Sensing applications subject itself and the prospect of using the software after graduation. The conclusions that came out for the particular case presented, favor the use of combined Multispec with gvSIG in all aspects; the students felt very comfortable with it and plan on using it as professionals as they feel confident about its effectiveness and they appreciated the fact that it's free of charge; moreover, the time they spent to learn using it was minimal so teaching time was almost completely dedicated to Remote Sensing education.

Remote Sensing in Modern Science Education – Concepts and Applications for Elementary to Secondary School

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Keywords: remote sensing education, digital geomeia, interactive learning modules, software BLIF, science education

Abstract:

Today geoinformation technologies are part of our daily life – from navigation systems and web based interactive maps up to Google Earth. Especially young people as “digital natives” are already a part of this world of digital (geo)media and technologies, but often enough without being aware of them. So, in a study at the Research Group for Earth Observation (rgeo) at the University of Education Heidelberg many boys and girls mention, that they never worked with satellite data, but most all of them have flown over our planet with Google Earth. Modern geoinformation technologies and especially remote sensing show a high potential to motivate young people to explore, analyze and explain the world. And often the work with digital geomeia in general is obligate in many national educational standards and school curricula. Yet, the situation in many schools look different, still and the use of remote sensing is often limited to some printed weather or earth observation satellite images. And still research about the use of remote sensing in school is very rare. Therefore it is necessary to create an interdisciplinary science educational concept for promoting remote sensing in a structured way – from the elementary to secondary school level. This remote sensing education must be accompanied by concrete applications to use such digital geomeia in a step by step

approach from a very simple to higher level and competence models to proof the success of the interventions. Such an educational concept for remote sensing in schools and different web based applications – from a “Satellite Image Learning Center” (SILC) and interactive Learning Modules like “Glokal Change” up to the software “BLIF” to work independently with satellite data – will be presented as well as a first competence model for “reading” satellite images.

Experience of Using RS and GIS Technology in Education Programs of Kyrgyz-Russian Slavic University

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Keywords: water recourses, water resources management, Kyrgyzstan, geoinformatic, hydrology

Abstract:

Experience of using RS and GIS -technology in education programs of Kyrgyz-Russian Slavic University

Water Recourses in Kyrgyzstan have always been considered as politics tool, as a basis for economic and ecological development, in different wording, as incontestable condition for people to live in. The water and land reforms aimed at economy stabilization and increasing living standards of people are being conducted in Kyrgyzstan as in the other Central Asian (CA) countries, since 1991. Under the current conditions there are wide possibilities for Sustainable Strategy Development as well as Water Resources Management in CA. That explains the necessity of close examination of rational water resources management and their utilization issues. The Department “Multipurpose use and Protection of Water Resources” is operating since 2004 in the Kyrgyz Russian Slavi University (KRSU), located in Bishkek . Within this Department future engineers are being taught. Multipurpose use and Protection of Water Resources can be considered as issues of Environmental Protection against pollution while water resources (WR) utilization aimed at solving important problems of economy, ecology and social sectors. This fact explains the necessity to prepare highly qualified specialists, who are capable to employ methods of water systems management and operations under the conditions of multipurpose use of WR, to plan and justify complicated water protection activities, to solve problems of small and large scale Water Facilities. A “specialist” means an engineer, ecologist and scientist who should consider and solve issues concerning forecasting of WR in a separate area as well as for transboundary use, forecasting and liquidation of natural calamities. Teaching and training of engineers is being conducted in the specialized Chair (Department) “Hydro Construction and Water Resources” within the Faculty of Architecture, Design and Construction of KRSU. One of up-to-date trends of training WM students is application of modern technologies like RS and GIS. They are widely used in academic courses, for instance “Geodesy and Cartography”, “World Water Balance”, “Geoinformatic”, “Hydrology and Hydraulic Measurements”, “Engineering Land Reclamation”, “Multipurpose Water Use and Water Management”, etc. GIS is used in various formats: lectures, laboratory experiments, practical and diploma work. Senior students also take part in intensive research work conducted by Professors. Currently, students conduct research within 3 International Projects, in particular: [U+F0D8] “Sustainable Water and Pasture Management in Djergital and On-Archa watershed” (jointly with the Social Fund “CAMP Ala-Too (Central Asian Mountain Partnership)”, financed by GTZ). [U+F0D8] “Development, Manufacture and Examination of low-pressure Micro Power Station Model for training students” (jointly with NCCR North-South (National Centre of Competence in Research)). [U+F0D8] “Institutional Partnership: Geoprocessing data of Natural Resource Monitoring – Capacity Strengthening in Tajikistan and Kyrgyzstan” (jointly with the Central Asia University, CDE , NCCR (project SCOPES 2009-2012)). Well-equipped GIS laboratory with up-to-date computers, GIS and RS software such as ArcView 8 GIS, gvSIG1.10, ERDAS IMAGINE, IDRISI was launched in 2009. Knowledge gained within “Geoinformatics” course is widely used by students to develop maps based on GIS-layers, to produce different interactive maps for various purposes, to identify catchment area, monitor

of hydrographic, geomorphologic characteristics of rivers and technical characteristics of irrigation system in arid zone. One of the research aspects was dynamic of glaciations in some river basins of Kyrgyzstan. Research was carried out on the basis of LANDSAT satellite images with 15 m resolution, aerial photography and topographical maps (scale 1:25000). Data obtained have been used for further research on impact of glacier melting on river flow. Students within the practical part of "Hydrology" course, on the basis of digital elevation model (DEM) and topographic maps, make analysis of geomorphologic and hydrographic characteristics of river basins (length, width, perimeter, basin area, catchment area boundaries, distribution of areas at various altitudes, slopes, exposition; length of river systems, etc). DEM extraction from ASTER satellite with resolution of 15 m and GIS calculation and interpolation from topographical map (scale 1:20000) was used for students' work. Special attention is paid to the accuracy of original data of DEM and information received on the basis of DEM. Within the framework of "Water Resource Management within Jergetal and On-Archa rivers watershed" Project students conducted a research on identification of irrigation system conditions using different satellite images and GPS receivers. Using RS and GIS technologies in education process improve skills of students and provide carrier opportunities.

Surface Fluctuation Above the Subglacial Lakes in Antarctica from ICESat

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Keywords: cascade of lakes, transition zones, spatio-temporal variance

Abstract:

Progress in understanding the surface dynamics above the subglacial lakes in Antarctica is achieved by using spatio-temporal ICESat altimetry. Morphological pattern of surface formation conforms well to the thermomechanical model of ice flowing above the subglacial lake. The surface forms concave and frontal bulge at the transition zones. Temporal variation of the elevation shows peaks and bottom of the surface around the transition zones. A identifiable surface morphological and dynamical elevation signature define the lake location and its shoreline. There is a close correspondence between Vostok shoreline defined by Radio Echo Sounding and the morphological surface signature. Experiments aim at understanding the relation between the water body and the overlying ice especially with respect to stability of subglacial lakes. Special care was taken to resolve the behaviour of transition zones at high resolution. The geometrical approach has been applied at the pattern recognition and mapping of new subglacial lakes on Recovery Ice Stream and Dome A. Deformation of the surface is accompanied with a common rise and fall. The form of the surface above subglacial lakes is not an inclined plane due to bends that are predominantly related to topography of the bedrock. We took the new approach in dealing with spatio-temporal elevation change above the lakes. Spectrogram is a time-varying spectral representation that captures most of the spatio-temporal variance. The advantage of the spectrogram: it is simple and easy to be understood. High values of oscillation are associated with the transition zones. The elevation change in the transition zones is out of phase. The transition zones exhibit large variability of elevation change in the range of -1 to 1 meter. The transition zone estimated to be somewhere between 500 – 1500 meters wide. We found that different subglacial lakes exhibit varying degree of linkages on Recovery Ice Stream and Dome A. It may be thought as consisting of cascade of subglacial lakes. Elevation displacements above the cascade of lakes are usually in phase. The abrupt changes happen and the vertical motion of the neighbouring lakes is out of phase. Ten new subglacial lakes of Recovery Glacier and around Dome A which exhibit signs of direct linkage are identified by using a new technology.

Validation and Potential Improvements of the NPP Fractional Snow Cover Product Using High Resolution Satellite Observations

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Keywords: snow cover, fraction, VIIRS, Landsat, validation, algorithm

Abstract:

The fractional snow cover EDR is generated from the Visible/Infrared Imager/Radiometer Suite (VIIRS) observations as a part of the National Polar-Orbiting Environmental Satellite System (NPOESS) Preparatory Project (NPP) and the Joint Polar Satellite System (JPSS). At the last year meeting it was preliminary demonstrated that the improved fractional snow cover retrieval can be achieved by the algorithm that takes into account the spatial and temporal variability of snow and non-snow reflectivities depending on snow state and background surface type. The potential ways of further development of the indicated approach are under consideration in this presentation. The results of fractional snow retrieval from simulated NPP VIIRS data are in the center of attention in this presentation. The analysis is currently focused on the utilization of high resolution satellite observations for both validation and improvement of the fractional snow cover product retrieved from VIIRS observations. After considering various possibilities of utilizing aircraft and different high resolution satellite data, it has been decided that Landsat observations present the best source of readily available, suitable, and effective data to use as ground truth for the assessment of the VIIRS fractional snow cover algorithm performance. Collected Landsat scenes including a wide variety of snow-covered conditions were considered to establish ground truth using binary classification of 30 m Landsat pixels as snow or snow free. Qualitative assessment of the binary classification for Landsat pixels was performed using visual inspection of classification maps with false cover images clearly identifying the distribution of snow cover. Different thresholds of the Normalized Difference Snow Index (NDSI) were tested to segregate snow covered Landsat pixels from snow free pixels to choose the best classification. Good correspondence between maps of binary (snow / non-snow) Landsat pixels classification and coregistered false color Landsat images for exactly the same projection and resolution demonstrates high quality of the classification based on a predetermined NDSI threshold. The principal approach to validate VIIRS fractional snow products consists of quantitative comparison of VIIRS NPP snow retrieval with collocated aggregated ground truth from high resolution satellite observations. The emphasis was laid to analyze simulated VIIRS proxy data during eight winter days for which several dozens of Landsat scenes without clouds were selected and processed. The study demonstrates that there is no systematic bias between estimated ground truth and derived VIIRS fractional snow product, but errors of different signs could be relatively significant. It means that a simple uniform adjustment of algorithm parameters could not lead to desirable improvements and more significant modification of the algorithm using scene-specific snow and non-snow spectral signatures (endmembers) is necessary to improve estimates of snow fraction retrievals. The results of the work outline a way to improve performance of algorithms identifying the endmembers from observations and confirm that the development of scene-based algorithms suppressing sensitivity to snow and non-snow surface properties (as well as to viewing geometry and illumination conditions) is a very powerful way to significantly improve the accuracy of fractional snow cover derivation.

The Satellite Based, Near Real Time Information on Snow Cover for General Public

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Keywords: snow cover, web services, climate change

Abstract:

Snow cover seasonally impacts everyday life in many European countries. Apart from its socio-economic importance, the snow cover is also a very fragile indicator of the climate change, as being influenced by air temperature variations and atmospheric circulation patterns. Warm winters contrast with severe storm falls bothering citizens with the issue of winter-time climate change. Moreover, the weather information is often confused with climate by the most of media. This leave the citizens with no easily accessible information of snow cover, that would be a base for scientifically correct deductions. Wishing to provide a reliable source of climatological information for general public the Space Research Centre of Polish Academy of Sciences (CBK PAN) has developed the web service on snow cover in the EU countries. The GIS analysis behind the service base on Interactive Multisensor Snow and Ice Mapping System (IMS) Daily Northern Hemisphere Snow and Ice Analysis data, issued by NOAA. Results of the analysis are published in a form of easy-to-understand plots, accompanied with detailed description for non-scientific users. Present year data are shown directly with multi-annual average, making “this year” easy to compare with “average year”, thus perform simple but very meaningful observations.

Identification of Potential Avalanching Zones in Kyrgyzstan Using RS Data and GIS Technologies

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Keywords: avalanching zones, mountains, snow cover, SRTM, slope, aspect, air temperature, GIS technique

Abstract:

The Kyrgyzstan is located in the Central Asia between 39 and 43 north altitudes and 69 and 80 east longitudes. The total area is 199.9 thousand square kilometers. Over 90 percent of Kyrgyzstan's area is 1000 meters above sea level. Altitude of snow line is 1500...2500 m during the cold period. Every year avalanches damage national economy of republic, mainly, highways and transport, communication and power lines, forestry, industrial projects in mountain. And, of course, its post hazard to life for villagers, drivers, geologists, tourists, mountain-skier, hunters. So understanding the spatial and temporal distribution of snow in this region is critical. Experts of Kyrgyzstan carry out land monitoring according to observation of 3 avalanche stations and meteorological stations located in the mountain zone, it covers only 10...15 % of avalanching areas. That is not enough, therefore researchers of spatial and temporal distribution of a snow cover and avalanching monitoring is better to conduct with RS and GIS application. For the revealing and the analysis of potential zones of avalanches the following RS data was used: AVHRR Global Land Cover Classification; Modis terra 32-day Composites Specifications, Multispectral Spatial Resolution 500m; SRTM. Using SRTM data slope and aspect of the surface were calculated with the help of ArcGIS. Slope's aspect and wind direction very important. According to observation data, avalanches are registered on slopes of northern, western and southwest aspect more often. More than 65% of area is prone to avalanches, considering only terrain criteria. Studying of avalanching on the territory is complicated due to RS data errors (especially in shadow zone) and the lack and the lack of land data. At the present time researches of avalanching zone of Kyrgyzstan on the basis of RS data and using of GIS are urgent and demand the further development. Avalanches potential zones can be used for warning people.

Capabilities of the DMC Constellation and Applications of its Imagery for Tropical Forest Mapping and Monitoring

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Keywords: forestry, imagery, monitoring, constellation

Abstract:

The Disaster Monitoring Constellation provides worldwide daily revisit capability and delivers high temporal resolution imagery for many applications including the forestry sector: monitoring of tropical forests, deforestation, degradation and illegal logging. The medium resolution 22m and 32m imagery with 650km swath and up to 4100km along track allows repeated monitoring of vast areas. The daily revisit of the satellites of the DMC Constellation increases significantly the ability to reduce the cloud contamination in the imagery, which is extremely important in tropical regions. DMCii offers an end-to-end capability from reliable image acquisition to expert image analysis, to meet the forest monitoring requirements of government authorities, international organisations and private companies. The paper presents the examples and ability of the Constellation to cover vast areas in the tropical regions with cloud free imagery, such as Amazon, Guyana, Democratic Republic of Congo, India and Malaysia. The new satellites, that joined the DMC Constellation in 2011, NigeriaSat2 and NigeriaSatX, enhanced the spatial resolution of the Constellation to 2.5m, at the same time providing the medium resolution data continuity. Now it is possible to monitor the forest at the individual tree level.

Forest Biomass Modeling by Polarimetric and Interferometric SAR Data: the Brazilian Scientific Missions

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Keywords: biomass modeling, forest inventory, SAR data, tropical forest, eucalyptus stand

Abstract:

This work presents two practical examples of polarimetric and/or interferometric attributes of microwave data to improve the knowledge of structural aspects of forest typologies. At the first, we discuss the important role of polarimetric and interferometric airborne SAR data (OrbiSAR-1 system using bands of XHH and PHH, HV, VH and VV) for the aboveground biomass estimation of *Eucalyptus* sp. stands to subsidize the operational forest management activities for the production of cellulose. This area understudy is reforested predominantly with *Eucalyptus saligna* (aged 6 years, with an average height of 23 m). The second is a contribution of polarimetric attributes of ALOS/PALSAR (L-band) for biomass modeling of tropical forest (with or without timber exploitation) from Brazilian Amazonia (Tapajós region). To perform both studies, we carried out multivariate regression technique, using variables obtained from SAR attributes and biophysical parameters collected during field surveys, which were done simultaneously to SAR imaging campaign. All SAR data from each mission were calibrated both radiometrically and geometrically to extract information during the digital processing. In summary the results were: (a) the variables combination of "Interferometry Height" - HInt2 (derived from the difference between interferometric digital elevation model in X- and P- bands) and "Canopy Scattering Index" - CSI (ratio of $\sigma^{\circ}VV$ by the sum of $\sigma^{\circ}VV$ and $\sigma^{\circ}HH$, which represents the canopy interaction) are important in this *Eucalyptus* biomass model; (b) the most significant variables for tropical forest biomass modeling were the $\sigma^{\circ}HH$ coefficient, the volume scattering component of Freeman's decomposition, the Touzi's magnitude of the second component, the phase of the second and third components and the helicity mean angle. Aiming to validate the results obtained by the models, a set of independent data from the forest inventory were generated, which indicated a prediction average error below of 10 per cent to estimate the *Eucalyptus* biomass and also to the tropical forest. These results obtained in the reforested areas and tropical forests show the importance of combining several SAR attributes, focusing on models of forest stock density.

Identification of Riparian Forests from the Physiography of the Landscape in the State of Sao Paulo, Brazil

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Keywords: permanent preservation areas, sugarcane, remote sensing, monitoring

Abstract:

Riparian forests (permanent preservation areas) are established by the Brazilian environmental legislation, i.e., the Brazilian Forestry Code (CFB) as the main form of conservation of forest fragments and other types of natural vegetation on rural properties. These areas are the main constituents of riparian ecosystems that provide various ecosystem services, such as protection of water resources, rehabilitation of ecological processes and conservation of biodiversity, and could be the only systems capable of ensuring the potential long-term conservation of areas of natural vegetation. In spite of the diverse ecosystem services that these forests provide, most Brazilian rural properties do not have riparian forests which must be delineated from parameters defined by CFB, such as the size of water courses and water bodies considering the greatest seasonal flood level and pre-established widths. In this context, the aim of this study was to map and quantify the deficits in riparian forests on sugarcane fields in the State of Sao Paulo - Brazil, the largest national producer of the crop. For this, we used remote sensing data of different spatial and temporal scales and hydrography data provided by official agencies of the country. Riparian forests were delimited throughout the entire sugarcane producing region by visual interpretation of satellite images from Landsat (Geocover mosaic) and from CBERS 2B with spatial resolution of 14.25 and 2.7 meters and by automatic object-oriented classification. The identification of these riparian ecosystems from remote sensing data is difficult and time consuming, and the quantification is often underestimated because features such as vegetation and soil types of riparian ecosystems are not considered. In this study, these parameters were defined manually after the identification of the features that were possible to detect in the images. The delimitation of riparian forests in function of the CFB parameters was carried out automatically by generating buffers of different widths

using tools available in Geographic Information Systems. The results show that it is possible to identify, to monitor and most importantly, to control riparian forests on sugarcane fields from remote sensing images. Considering a total of 5,179,536.5 hectares planted with sugarcane in 2009/2010 and 3,622,625.5 hectares of permanent preservation areas, 1.34 per cent of the sugarcane crop is found in areas that should be maintained as permanent preservation areas, resulting in a total deficit of 69,300 ha. Based on an initial analysis, from the annual mapping of different types of sugarcane harvest (i.e. green harvest and pre-harvest burning) provided by the Canasat Project of the National Institute for Space Research (INPE), we observed that in most areas of traditional cultivation and expansion of sugarcane in which deficits in permanent preservation areas were quantified, conservationist growing practices such as green harvest are also not put into effect.

Comparing Height of Individual Spruce Trees Determined on LiDAR Data with Reference Field Measurements

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Keywords: airborne laser scanning, biometric field measurements, data fusion, remote sensing

Abstract:

The paper is analyzing the possibility of biometric measurements on airborne laser scanning data in a spruce forest stand using as reference data aerial imagery (orthophotomaps) and intensive terrestrial measurement in sampling plots using FieldMap equipment, GPS and Vertex. One objective of the research was to estimate the relative difference between the LIDAR data and collected field data to ensure that there can be no confusion between trees determined in the field and on the LIDAR point cloud. Coordinates of the sample plot center were determined under canopy by GPS and from its position on LIDAR data depends the position of each tree determined in the sample area. In the areas covered by forest vegetation usually we cannot recognize the measured GPS sample plot centers on imagery or LiDAR data, so it was used an indirect method. The position of clearly visible elements and GPS measured ground control points for areas without forest canopy were compared with LiDAR data and aerial orthoimagery to determine the relative difference between them. The DTM obtained from LIDAR data and a subset of classified LiDAR points was used to measure the height of individual trees inside the plot area. The height was computed as the difference between the Z-value of the highest point (local maxima) and the Z-value of the ground level (local minima). The estimation of the height for a tree is actually the difference between Canopy Height Model and DTM for that tree. The measurements of LIDAR data correlated with field data show that relative differences between the two sets of geospatial data actually ranged up to 2-3 meters, which made possible the recognition of trees in the two data sets. The conclusion is that the center plots location determined with GPS equipment provides the accuracy needed to compare data sets of land with LIDAR data.

Application of Kolmogorov-Smirnov Test for Multilevel Object-Based Classification of Japanese Knotweed

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Keywords: invasive plants, Japanese knotweed, object based classification, Kolmogorov-Smirnov test, IDL/ENVI

Abstract:

In the last decade, invasive alien species have been considered as one of the crucial and significant response to global changes, correlated unstable functionality and vulnerability of the ecosystems. They often have an irreversible and unpredictable effect on local habitat and have to be understood as exceptionally heterogeneous and complex spatial phenomena. Once fully established in the new environment, they are likely to outcompete native species, alter ecosystem processes and threaten biological biodiversity. Systematic vulnerability analysis and cost assessment regarding the management and control strategies can therefore base only on qualitative and task-oriented data about spatial distribution and extent of the object being identified. Japanese knotweed (*Fallopia japonica*) is, listed by the World Conservation Union as one of the world's 100 worst invasive species. In this paper the application of multilevel object-oriented classification and Kolmogorov-Smirnov test for its classification will be discussed. The classification has been tested with aerial orthophoto and WorldView-2 satellite image for the study area of Ljubljana, the capital of Slovenia. In the first step the initial vegetation mask was created using vegetation indices. Next, the segmentation has been performed and rule based classification was used in order to define candidate objects of Japanese knotweed, which were then classified with Kolmogorov-Smirnov (KS) test. In KS based classification the similarity between two segments is evaluated by comparing their empirical cumulative distribution function. Therefore for the evaluation all pixels inside the segment are being considered instead of just one or two representative values which are likely to be affected by extreme values. The test was also applied to the objects that were confirmed to be Japanese knotweed but were not included in the candidate object layer. Preliminary results using orthophoto imagery showed that the proposed methodology is a promising tool for more effective classification and detection of Japanese knotweed. The achieved accuracy of classification in the study area is approximately 87%, which is considerably higher than when applying the object-based classification alone. Most of the false negative objects were not identified as Japanese knotweed because they were either too small or located under canopy. We have implemented the Kolmogorov-Smirnov test classification algorithm in the IDL programming language, which will enable more extensive testing within the ENVI.

GEO - Global Forest Observation Initiative (GFOI)

Fostering the sustained availability of satellite and in-situ observations for national forest monitoring systems and assisting countries to make the best use of these observations

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Keywords: national forest carbon monitoring, MRV, REDD, forest observations, satellite data coordination, data integration

Abstract:

In 2008, the intergovernmental organization Group on Earth Observations (GEO) launched the Forest Carbon Tracking (FCT) Task as an international cooperation framework for addressing the monitoring component of national measurement, reporting and verification (MRV) systems for forest carbon. FCT, in collaboration with 11 national demonstrators, is testing and comparing the use of various observations, models, tools and methodologies. FCT has demonstrated that coordinated Earth observations from satellites, when validated by in-situ measurements and properly linked to modeling, can provide the basis for reliable, accurate, consistent and continuous information for estimating land cover, land-cover change, forest cover, forest-cover change, and forest-carbon stocks and changes. In 2011, GEO launched the Global Forest Observation Initiative (GFOI) to build on FCT's activities and expand them to a global and operational level. Led by Australia, Canada, Norway, the United States, the Committee on Earth Observation Satellites (CEOS), and the Food and Agriculture Organization (FAO), GFOI will assist governments to plan, develop and operate their national forest carbon monitoring systems. The improvement of national forest monitoring systems will contribute to a better global knowledge of the status of forests as well as trends, including the role forests play in climate change-related carbon emissions. GFOI is responding to the decisions of the Conference of the Parties to the UNFCCC by ensuring that its work is consistent with their technical guidance and their timelines for action. It is also aligning itself with the UNFCCC approach by providing countries with their different options and supporting them in using the methodology of their choice, based on what they consider to be best suited to their specific needs and national circumstances. At the same time, GFOI will ensure that national results are complete, reliable, consistent and comparable no matter which of the agreed methodologies is used. GFOI is expected to operate by coordinating the "supply side (providers of data and of methodological and processing support)" and by facilitating the flow of data, information and resources to countries and communicating the needs of the countries to the suppliers. GFOI will work through its many partners, organized in a worldwide network and coordinated through the GFOI Project Office. GFOI's key outputs will include a coordinated, continuous and free (or at least affordable) supply of remotely sensed and in situ data; the interoperability of data from different sensors; the promotion of coordinated research and development for improving national forest information systems; and guidelines and capacity building for accessing and using Earth observation data. GFOI will also establish partnerships with other international initiatives to avoid duplications, combine different experience and strengths, and ensure the production of an end-to-end support for the countries.

A Method for Reconstructing Cylinder Model of a Single Tree from Terrestrial Laser Scanner Data

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Keywords: tree models, TLS, laser scanning, biomass determination, forest inventory, carbon budget

Abstract:

Terrestrial laser scanning (TLS) provides efficient and low cost method for measuring the 3D structure and size properties of trees. The 3D tree structure and quantitative size characteristics such as total volume and branch size distribution have applications from forest science and inventory to carbon cycle estimations. To recover the 3D structure and size characteristics from TLS data requires specific computational methods. We present a method for reconstructing a cylinder model of a single tree from large enough TLS produced point clouds that cover the surface of the tree comprehensively. The cylinder model represents the tree with thousands of small cylinders whose orientations and radii are fitted to the local details of the tree. In the method the point cloud is assumed to be a comprehensive sample of the tree's surface embedded in the real coordinate space. The idea behind the method is a topological-geometrical approach where the unknown global tree surface is reconstructed from the local analysis of the surface. This idea to assemble the global tree structure from local details is realized with covers: the point cloud and thus the unknown tree surface are randomly covered with small sets conforming to the details of the surface. Then using geometric characteristics and neighbour-relations of the cover sets, the point cloud is segmented into branches. Next each branch is reconstructed with cylinders recording the local size and orientation of the branch. Finally, because there are gaps in the TLS data, the cylinder model is improved by filling some of these gaps with suitable cylinders. From a completed cylinder model the tree structure is easily visualized and analyzed and tree characteristics are quickly computed.

Temporal Land Cover Analysis of a NATURA 2000 Wetland. The Case Study of Megalo Livari (GR 2420004) in Northern Evia, Greece

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Keywords: wetland, NATURA 2000, Megalo Livari (GR 2420004), remote sensing, GIS

Abstract:

Natural environment has been degraded both qualitative and quantitative due to human activities over the last century. The European Ecological network NATURA 2000 has been created to preserve the biodiversity in SCI and SPA areas. The selected study area of Megalo Livari in Northern Evia, a part of the NATURA 2000 network, is one of the most important wetlands for migratory birds in Greece. The aim of this work is to record the temporal land cover changes, largely affected by human activities (agriculture, tourism, fishery), by means of remote sensing and GIS analysis. The problems are identified and an analysis is made towards management measures in the study area.

Comparative Analysis of Land-Use/Land-Cover Maps for Chosen Test Areas on the Territory of Bulgaria and Romania Using Low-Resolution PROBA-V Simulated Data

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Keywords: land-use/land-cover, crops, accuracy assessment, PROBA-V

Abstract:

The timely availability of land-use/ land-cover maps of global and continental scale has become indispensable for a broad range of topics, such as ecosystem modelling, climate change, food security, and, ultimately, governance. Examples of recent global and regional land cover classifications are GlobCover, Africover, GLC 2000. On European scale, the importance of recent land-use/ land-cover data were underscored in the CORINE Land Cover project and in the GMES programme – Geoland 2 Project. The aim of the present study is to compare and assess land-use/ land-cover image classifications of low spatial resolution PROBA-V simulated data based on accuracy assessment. The PROBA-V data for the onset dates of the Tillering phenological stage were simulated by the System Performance Simulator (SPS) operated by VITO BE. The method used for land-use/ land-cover classifications is the Maximum Likelihood Classification (MLC), which is carried out over two test areas, i.e. Zhiten (Bulgaria) and Fundulea (Romania) in the Tillering phenological stage. To achieve the objective of the study, six land-use/ land-cover classifications using widely adopted unsupervised and supervised algorithms for the test areas in Bulgaria and Romania were carried out. For accuracy assessments of land-use/ land-cover classification maps, ground-truthing data were collected simultaneously within the phenological stage on both test areas during the carried out sub-satellite experiments. The spectral and spatial separability of PROBA-V simulated data was tested using unsupervised classifications with two and four classes. In the different classification schemes, the forests and settlements were masked out. The accuracy assessments of unsupervised classifications ranged between 77 per cent and 99 per cent. The lower accuracy level in crop discrimination was achieved due to the mixing of the classes in spectral and spatial space. For accuracy assessment of supervised classifications, a set of 160 randomly distributed points was used. The accuracy assessment shows an overall accuracy of 86.88 per cent, with overall kappa statistics of 0.81. The producers' accuracy for winter crops (winter wheat and rapeseed) was 90 per cent, whereas for summer crops (sunflower and maize) it was 95 per cent. For the purpose of crop identification, an arable-land mask was used to exclude the territories that do not represent crop-occupied areas. The 5 extracted arable land classes represent crop-cultivated and managed areas, which are located on the test areas. The identified crops had the following accuracies: mosaic/ cropland and other natural vegetation classes – producer accuracy of 88.89 per cent and user accuracy of 76.19 per cent; cultivated and managed areas class: Sunflower – producer accuracy of 83.33 per cent and user accuracy of 69.44 per cent; Wheat – producer accuracy of 58.82 per cent and high user accuracy; and Rapeseed – producer accuracy of 98.57 per cent and user accuracy of 82.14 per cent.

Evaluating the Potential of the PROBA-V Sensor in Estimating Forest Cover Change Over a Range of European Biogeographical Regions: The FM@PROBA-V Project

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Keywords: PROBA-V

Abstract:

The PROBA-V mission is designed to replace the VEGETATION instruments onboard the SPOT-4 and SPOT-5 satellites and ensure data continuity for the VEGETATION users until the launch of the Sentinel-3 series, as well as compliment data provision, even after the Sentinel-3 series become fully operational. In addition, the PROBA-V mission will offer data at a higher spatial resolution, while maintaining the spectral coverage and near daily global coverage of its predecessor. Amongst the various applications that the VEGETATION data have seen over the past 15 years, forest monitoring had been one of the most prominent ones. The FM@PROBA-V project, funded by Belgian Science Policy Office (BELSPO), achieved three objectives in an effort to quantify the improvements on forest monitoring brought along with the increase of the spatial resolution by the new sensor: a) it provided an estimate of European forest cover with 300, 600, and 1000 meter resolution data, b) it evaluated a number of popular classification methods on VEGETATION and MODIS 250 meter data – serving as a substitute of PROBA-V data due to the similar spatial resolution – on five test sites representing different biogeographical regions of Europe, and c) assessed the two sensors in their capacity in mapping forest cover changes caused by disastrous events, such as forest fires and wind damage. The results suggest that the increased spatial resolution will offer an opportunity for more accurate forest monitoring at global, continental, and regional scale, particularly on highly fragmented landscapes.

Extracting Urban Areas on Simulated Proba-V Data Using ANFIS

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Keywords: urban sprawl, land use, ANFIS, neuro-fuzzy, Proba-V

Abstract:

Urban sprawl is gaining interest because its intensity has been strong during the recent years as well as because it greatly affects natural ecosystems. This paper is focusing on developing a method to monitor and forecast urban sprawl using medium resolution optical data. The image source is simulated Proba-V data at a spatial resolution of 300 meters. Proba-V is designed as a continuity mission to the SPOT VEGETATION series, to be launched on 2012. Its data products will be available at a resolution of 1000m (VNIR and SWIR), 600 m (SWIR) and 300m (VNIR). It provides data in four spectral bands, blue (440-480 nm), red (620-698 nm), near infrared (790-900 nm), and SW infrared (1560-1650 nm). The simulation, that involves a change in spatial as well as in radiometric resolution, will be based on MODIS data. Urban areas are going to be extracted from mosaics of simulated Proba-V data. For the extraction ANFIS neuro-fuzzy classifier (Stathakis et al. 2006) is going to be used to segment the data into two classes, i.e. urban and not-urban. It has been found that the combination of VNIR and SWIR as an input for urban areas extraction performs efficiently (Stathakis et al, 2011). Mosaics for 3 dates are going to be constructed covering Greece. The dates are 2000, 2005 and 2010. CORINE data will be used to train, test and validate ANFIS for the dates that it exists. For 2010 visual evaluation can be based on the nationwide aerial orthophoto mosaic that is available by the Hellenic Cadastre. Accuracy assessment will be done for each date that reference (CORINE) data exists using the accuracy matrix. For that purpose CORINE is going to be resampled to 300 meters to match Proba-V's resolution. Urban areas extracted for the three dates are going to be compared to evaluate change detection. Changes are going to be quantified and explained in terms of driving forces. Having established the urban areas for the three dates (2000, 2005, 2010) these are going to be used as an input to a forecasting model in order to obtain an estimate of urbanization in the country for the next 15 years. The forecasting model will be based on a combination of Cellular Automata that operate with stochastic transition rules that are obtained by Markov Chains. Overall the objective is to investigate whether it is possible to monitor urban sprawl using medium resolution data and an automated method (supervised classification) instead of having to rely upon CORINE that requires considerable more effort as it is a product of manual photo-interpretation.

References

Schneider, A., Friedl, M. and D. Potere, 2010, Mapping global urban areas using MODIS 500-m data: New methods and datasets based on 'urban ecoregions', *Remote Sensing of Environment*, 114, 1733-1746.

Stathakis D., Perakis K. and I. Savin, 2011, Efficient segmentation of urban areas by the VIBI index, *International Journal of Remote Sensing* (accepted for publication)

Stathakis D., I. Savin and T. Negre, 2006, Neuro-fuzzy modeling for crop production estimation, *ISPRS - Mid-term Symposium, "Remote Sensing: From Pixels to Processes"*, Enschede, the Netherlands, 8-11 May.

Forest Mapping and Forest Cover Change Detection in the Mediterranean Region Using Coarse Resolution Data and Advanced Image Analysis Techniques

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Keywords: PROBA-V, forest/non-forest mapping, coarse resolution data, support vector machines, artificial neural networks, maximum likelihood, object-based image analysis

Abstract:

The availability of accurate and updated forest maps plays an important role in sustainable forest management and policymaking. The production of forest/non-forest maps as well as forest cover change maps, at national and continental level, can be fulfilled in a timely and cost effective manner when remote sensing and coarse resolution satellite imagery are employed. The aim of this research was to investigate the potential of using coarse resolution satellite imagery and advanced image analysis techniques for forest/non-forest as well as forest cover change mapping. The specific objectives were:

- to investigate the potential of Terra MODIS (250 m), SPOT-VEGETATION (VEGETATION - 1000 m) and PROBA-V (Landsat simulated satellite data at 300 m) in forest/non-forest mapping by employing different image analysis techniques such as Maximum Likelihood (ML), Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Object-based Image Analysis – Nearest Neighbourhood (OBIA-NN),
- to determine the advantages of PROBA-V over the two other sensors in forest/non-forest mapping, and
- to use the derived products from the best performing image analysis technique per sensor in order to detect changes on the forest cover.

The study area which is located in central Greece was affected by large fires in the summer of 2007. Two Landsat images, one before and one after the large fires were classified into two classes, namely, 'forest' and 'non-forest'. The classification process and the accuracy assessment of the resulted maps were assisted by the use of the JRC 2006 'Forest/Non Forest Map' and the 2009 LUCAS data. The maps resulted from the classification of the Landsat images were then used in the classification (selection of training sites, accuracy assessment) of the coarse resolution data, i.e. MODIS, VEGETATION and PROBA-V (Landsat simulation). For the production of the 'pre-fire Forest/Non forest' maps from coarse resolution data four image classification techniques were employed (ML, ANN, SVM and OBIA-NN). Following the best performing classifier per sensor was chosen to be used in the classification of the post-fire coarse resolution images for the production of the 'post-fire Forest/Non forest' maps. Finally, a simple post-classification comparison was employed in order to detect the changes on the forest cover per sensor. SVM proved to produce the most accurate 'pre-fire Forest/Non forest' maps in the case of VEGETATION (overall accuracy 86,35 percent, KIA=0.5486) and PROBA-V (overall accuracy 71,43 percent, KIA=0.4656). In the case of

MODIS, ANN produced the most accurate 'pre-fire Forest/Non forest' map (overall accuracy 89,86 percent, KIA=0.6052) with OBIA and SVM producing maps of nearly the same accuracy as ANN. In relation to the forest cover change maps which resulted from the post classification comparison between the pre-fire and the post-fire 'Forest/Non forest' maps the highest accuracy was achieved in the case of PROBA-V (83,83 percent KIA=0.7417) followed by MODIS (79 percent KIA=0.6344) and VEGETATION (74,33 percent KIA= 0.5448). In summary, the best performing classifier in the case of 'Forest/non-Forest' mapping proved to be SVM while the PROBA-V sensor proved to detect more accurately the changes introduced by the fires to the forest cover. 100 m, 250 m and 1000 m frequent observations.

Using Data Fusion Methods to Enhance Compressed PROBA-V Imagery

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Abstract:

In environmental applications, data carry a large amount of information at different resolutions. Various approaches have been used to include in models information from sources at different scales combining multi-resolution products in order to integrate the spatio-temporal variability of subpixel pattern. Often high resolution data are available only for limited areas or time periods. The aim of this study was to test data fusion methods between compressed PROBA-V images and Landsat data to obtain an image with a finer spatial resolution, while at the same time preserving the spatial structure. The methodology followed is an integration of the results obtained with a geostatistical downscaling algorithm, based on area-to-point-kriging, with a General Additive Models interpolation framework to enhance the spatio-temporal resolution of remote sensing data. The fusion aims to produce a composite product taking advantage of both sets of images to reproduce the spatial structure and pattern of the high resolution data. The information from the low resolution data serves as support in areas and periods without available high resolution data. The method was tested on synthetic data constructed to simulate the spatial pattern of real data while providing validation data. The method was implemented on images with different TER compression rates to assess the fusion capability in different situations.

The Impacts of TER Image Compression on Classification of Synthetic PROBA-V Images

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Abstract:

The aim of this study was to assess the impacts of the TER image compression algorithm on the classification results of synthetic images constructed to simulate PROBA-V bands. In order to do this, synthetic image bands were generated to reduce the variability and uncertainty of real data, and to allow us to generate rapidly a large number of different images for investigating the effects of compression. The synthetic data were constructed to simulate the spatial patterns and number of land cover classes of real image data. Analysis of the synthetic band data showed that it accurately represented real imagery, in terms of structure, pixel intensity distribution and distribution of classes. The changes due to different levels of compression were analysed, in addition to comparison between the obtained classifications on compressed and synthetic images using the kappa statistic as a measure of agreement. We used Morphological Spatial pattern Analysis (MSPA) to assess the spatial pattern of misclassification error induced by compression. The results show that there are statistical differences for different compression rates on the single bands, but these differences are not evident when band ratios, i.e. NDVI, are considered. The effects on individual bands, and the relative effects between bands, also varied with compression ratio. We found that the strongest impact of compression on the synthetic images occurred at the boundaries between classes.

Burned Area Mapping and Post-Fire Monitoring Using Time Series of Proba-V Simulated and SPOT VEGETATION Data and by Employing the BFAST Trend Analysis Method

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Keywords: PROBA-V, burned area mapping, post-fire monitoring, time series, remote sensing, trend analysis

Abstract:

This work aimed to investigate the potential of high-temporal and low-spatial resolution sensors such as the PROBA-V simulation (MODIS) and SPOT VEGETATION in burned area mapping and post-fire monitoring. The specific objectives were: • to investigate the potential of time series Proba-V simulation data (MODIS) for mapping burned areas and monitoring post-fire vegetation recovery, • to determine the advantages and disadvantages of Proba-V when compared to VEGETATION, and • to perform accuracy assessment of the burned area as well as the vegetation recovery areas, by using field data and high resolution images. MODIS 250m surface reflectance composite products and VEGETATION imagery for the period 2004 -2010 were used in this study. It should be mentioned that the MODIS dataset was used due to the similar characteristics of MODIS with the forthcoming PROBA-V sensor. The study area is located in the Peloponnese, Greece where great fires occurred during the summer of 2007. BFAST (Verbesselt et al 2010), the method employed, is a change detection approach which can be applied on time series and allows the detection and characterization of 'Breaks For Additive Seasonal and Trend'. The method iteratively decomposes time series into trend, seasonal and noise components, without the need to select a reference period, set a threshold, or define a change trajectory. The methodology followed included the calculation of three spectral indices, namely, NDVI, GEMI, and SAVI. Then, the BFAST method was implemented on the three time series leading to the detection of sudden (fires) and trend (vegetation regrowth) changes. Validation of the results with the existing reference data revealed high overall accuracies (over 90 per cent) in all cases. However, it should be noted that the MODIS derived products outperformed the VEGETATION ones and this could be mainly attributed to the difference in the spatial resolution of the two sensors.

Proba-V, a SPOT-VGT Successor Mission, Product Definition and Specifications

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Keywords: Proba-V, global vegetation monitoring, SPOT-VGT, low resolution

Abstract:

Proba-V is a new global vegetation monitoring mission, designed to ensure the continuity of SPOT-VGT 1km resolution data. SPOT-VGT has provided the world-wide remote sensing community with daily global vegetation products for more than 10 years, and is scheduled to end its services in 2013. Developed in the frame of the ESA In Orbit Demonstration (IOD) technological program, ProbaV adds a new 1/3 km resolution product to fulfill the evolving needs of the end-users. To allow continuation of time-series studies, Proba-V specifications are targeted to align closely to SPOT-VGT. With a polar orbit at 820 km altitude and a LTDN between 10:30-11:30 AM, a daily coverage is obtained for land masses at latitudes from +75° to -56° (acquisition frequency decreases for latitudes less than 35°). Spectral responses are in accordance with SPOT-VGT, differences amount to the same order of magnitude as seen between SPOT-VGT1 and SPOT-VGT2. At the time of writing, the Proba-V platform and instrument are in the phase of subsystem manufacturing and testing, and the User segment processing and image quality center implementation is near completion. Based on the characteristics of the platform/instrument and user segment, this paper will discuss the expected 1 km and 1/3 km product definitions and specifications, and how they compare to SPOT-VGT. The 1/3 km product should have the same order of magnitude SNR and MTF as SPOT VGT, while the 1km product should be much better. Geometrical accuracies are

well met for the 1 km product, while the biggest challenge for the 1/3 km product lies in guaranteeing the multi-temporal accuracies due to the thermo-elastic behavior of the platform and instrument. This requires a careful in-flight calibration to monitor periodic and seasonal changes. Proba-V data delivery will be similar to SPOT VGT: 1-day and 10-day synthesis products are available in 4 bands (Blue, Red, NIR and SWIR), derived indices and quality indicators. On top of that, similarly to SPOT-VGT, unprojected P-products can be ordered by the user for both resolutions.

Unmixing of Proba-V and SPOT-VGT Time Series for Retrieval of Crop Specific Temporal NDVI Signatures

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Keywords: PROBA-V

Abstract:

With daily observations at 300 m ground sampling distance (GSD), the upcoming Proba-V sensor will greatly enhance our current Earth observation capacity. However, the increased spatial resolution comes at the expense of a loss of available long term average (LTA) information. Such LTA is for example required to map vegetation anomalies using the z-score transform. Many current operational vegetation monitoring programs (e.g. JRC MARS) heavily rely on the interpretation of such vegetation anomalies. In order to provide a continuity of services, the current study examined the potential of different unmixing approaches for the (combined) use of SPOT-VGT data at 1km and future Proba-V data at 300m with the aim of detecting vegetation anomalies. For the purpose of the study two large data sets were consulted: (1) a completely artificially set of 44.000 scenes with 3 LC classes (data set 1), and (2) a set of 10 temporal NDVI images over an agricultural area in the state of Sao Paulo in Brazil with 9 LC classes (data set 2). In data set 2, the reference information at 30 m GSD was obtained from high resolution Landsat TM images from which the Proba-V and SPOT-VGT scenes were synthesized taking PSF and sensor/atmospheric noise into account. For this data set, a LC map for input into the unmixing algorithms was derived independently from the analysed time series. The LC map distinguishes 9 classes, with 4 different sugarcane sub-classes, and 2 agricultural sub-classes (plus forest, pasture, urban/water). Unmixings were done for data set 2 at administrative level with the aim to derive crop specific NDVI time profiles. For data set 1, the results demonstrate a clear superiority of the linear unmixing model (SM – simple model) compared to the model currently used by JRC-MARS (WM – weighting model) in terms of (1) end-member retrieval accuracy, (2) scaling issues between Proba-V and SPOT-VGT and (3) sensitivity to possible uncertainties in the reference LC map. For data set 2 it was demonstrated that the true endmembers (based on 30 m data) of various land cover classes can be retrieved with high accuracy within each administrative unit, and this for the two simulated sensors (Proba-V and SPOT-VGT) and the different unmixing algorithms. In all analysis, we found that the future Proba-V sensor will lead to increased accuracies compared to the current SPOT-VGT sensor. However, a clear preference of the SM model (compared to the WM model) was only found regarding the accuracy with which the true endmember signatures could be retrieved under different (sensor/ atmosphere) noise levels. The important scaling issue (i.e. between 300m and 1000m data) was on the other

hand better handled (in terms of linearity) by the WM algorithm, albeit this model strongly reduced the dynamics in the retrieved endmembers. For this reason, for the time being, no definitive recommendation for the most preferable algorithm can be given.

Monitoring Semiarid Agroecosystems with Products Derived from Vegetation and Future Proba-V Datasets

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Keywords: PROBA-V

Abstract:

In Argentina, livestock production is moving to marginal areas. Given that 2/3 of the land surface is covered by semiarid and arid lands, these fragile regions need to develop strategies that ensure the sustainability of these agroecosystems under increased grazing pressure. In this sense, there is a great need for long-term estimates of biophysical variables to predict Primary Productivity, and so stocking capacity of rangelands. In the framework of PROBA-V preparatory program, we conducted a project aiming to examine the potential of the upcoming PROBA-V mission to

provide time series analysis of biophysical surface parameters in semi-arid regions. Particularly, two characteristics of the PROBA-V sensor were highlighted, i.e. its improved spatial resolution (300m) combined with the daily global coverage of the imagery. The study area was located in southern part of Argentinean Dry Chaco eco-region. As study site we selected an area located in southern part of Argentinean Dry Chaco eco-region. To evaluate the satellite based data products we gathered ground data from digital hemispherical photography, ceptometer and PASTiS57, a novel technique with the potential of continuous gap fraction and Plant Area Index (PAI) monitoring. To simulate the potential of PROBA-V daily global coverage, GeoV1 biophysical parameters produced by the GEOLAND2 program were chosen as proxy for PROBA-V future data products. It was found that the GEOv1 LAI and FAPAR products are highly consistent over time and show good agreement (resp. $R^2=0.77$ and $R^2=0.87$) with the MODIS15A data products. Lower correlation coefficients were found when comparing the GeoV1 LAI to ground PAI measurements (0.529 and 0.349 for resp. PASTiS and DHP). The high temporal resolution of PASTiS data corresponds to a great extent with the GeoV1 temporal LAI profile. To investigate the improvements expected for the PROBA-V derived products due to spatial resolution enhancement, PROBA-V imagery was simulated from 3 available Landsat-5 images. GeoV2, which is currently under development at INRA, was used for the creation of LAI estimates from PROBA-V simulated imagery. The increased spatial resolution of PROBA-V revealed more detailed information specifically at the end of the study period when a significant variance in biophysical parameters was detected for one of the study sites. We can conclude that PROBA-V is expected to provide temporal consistent biophysical products similar to the results found for the GeoV1 and GeoV2 algorithms with an increased spatial resolution which can allow for a more detailed monitoring and study of key variables on ecosystem functioning. As such PROBA-V can close the gap between the existing SPOT VEGETATION and upcoming Sentinel missions.

Optimal Spatial Resolution for Agriculture Applications: From Decametric to Kilometric Observations

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Keywords: PROBA-V

Abstract:

Agriculture applications are targeting either intra-field variability for precision agriculture, individual field scale observations for management at the level of the farm or a group of farmers, and at the species level for production estimation at regional to national scales. Remote sensing observations offer a convenient way to monitor crops. However, it requires frequent observations at a spatial resolution suited to for the application targeted. Although the availability of frequent decametric observations would probably solve the problem, it is currently limited by technological and economical constraints. The PROBA-V mission offers an attractive alternative with its range of resolution from 100m, 250m and 1000m. The objective of this study is to evaluate the capacity of observations at several spatial resolution for agriculture applications. 18 sites have been considered, covering a large range of landscape patterns, mainly over agriculture and some mosaic between agriculture and forests over which SPOT images (20 m spatial resolution) were available. An object segmentation based on the canny edge identification algorithm was used. The edges were then closed to identify objects and the smallest objects were merged to the larger ones when their spectral response were close together. The landscape pattern is first described based on the distribution of area, complexity ($\text{perimeter}/(\text{area})^{1/2}$) and eccentricity ($\text{max radius} / \text{min radius}$). Then the number of objects, the purity (fraction covered by the largest object in a pixel) and the spectral variability (standard deviation of the simple ratio) were computed for pixel size ranging from 20m to 1000m. Results indicate that the main landscape feature is the distribution of the area of the objects, well described by the median value. The impact of the spatial resolution is the largest between 20m and 250m and then decreases for 1000m, particularly for the landscapes with small objects. Results are further discussed with regards to the relevancy of the future PROBA-V mission which will provide 100m, 250m and 1000m frequent observations.

Monitoring of Evapotranspiration at Sub-Kilometer Scale: Downscaling MSG/SEVIRI Images Using Moderate Resolution Remote Sensing Derived Data

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Keywords: evapotranspiration, downscaling, remote sensing, water cycle, PROBA-V

Abstract:

Within the water cycle, land evapotranspiration (ET) is a key component. Monitoring ET is still a challenge as no direct observation is possible, and only a combination of modeling and observations can help achieving that goal. Recently, EUMETSAT's LSA-SAF (<http://landsaf.meteo.pt>) has distributed two near-real time products aiming at the monitoring of the ET, instantaneous every half-hour and cumulated daily, over the full field of view of MSG/SEVIRI (Europe, Africa and Eastern South America). ET is monitored using MSG satellite data at an unprecedented rate (every 30 minutes), however, the spatial resolution is still coarse (3 km at best). For some applications, while the LSA-SAF ET products give partly the information, higher spatial resolution is required. Therefore, combining LSA-SAF ET products with higher spatial resolution data derived from remote sensing seems an interesting way to benefit from both high time and spatial sampling resolutions. In this contribution, we present a method to downscale LSA-SAF ET at a resolution of 300 m using NDVI derived from MODIS/Terra data. Results on test sites in Europe and Africa typified by heterogeneous ET regimes are shown. The methodology is then discussed in the context of a continuous monitoring using SPOT-VGT satellite and its improved successor PROBA-V.

Fusion of Sentinel-2 and Proba-V/Sentinel-3 Images for Multi-Temporal Land-Cover Map Production

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Keywords: image fusion, Proba-V, Sentinel, time series

Abstract:

One of the key features of Sentinel-2 will be the ability to provide multi-temporal image series with a high revisit frequency (5 days at best). The availability of these data opens the opportunity for the development of new applications which require to closely monitor the temporal trajectory of the characteristics of land surfaces. However, due to cloud cover and even to some rapid changes, a higher temporal resolution may be needed for some applications. One of the ways to improve the temporal resolution for these satellites is to merge their data with higher temporal resolution systems (daily revisit). For now, these other systems will fatally have a lower spatial resolution or a limited field of view. Past research works have developed fusion approaches for using the synergy between HR resolution and mid- to low-resolution images. One of the conclusions of these works was that the resolution ratio between the images to fuse need to be not too far apart and that the spectral bands had to be very similar between the HR and the LR images. Therefore, combinations like SPOT-HRV and SPOT-Végétation were not suited because of the resolution ratio. And combinations like SPOT-HRV (or Landsat TM) and ENVISAT/MERIS were not appropriate because of the differences in spectral sensitivities. The case of MODIS was even more complex, since bands are available with different ground sampling distances (GSD): 2 bands at 250 m., 5 at 500 m and the rest at 1 km. In the coming years, the Proba-V mission and after that the Sentinel-3 family of satellites will offer improved and consistent spatial resolutions with respect to SPOT-Végétation and MODIS, as well as spectral sensitivities similar to those of some of the bands of Sentinel-2. The goal of our work in this field is to assess the usefulness of this techniques for the joint use of Proba-V/Sentinel-3 data and Sentinel-2 images for land-cover monitoring. As a result, we have developed and assessed several algorithms for the generation of land-cover maps and time profiles of surface reflectances with a spatial resolution of 10 to 30 m. with an update frequency higher than the one allowed by Sentinel-2. The algorithms have been validated using simulated image time series. These simulations have been produced from Leaf Area Index time series estimated from real Formosat-2 image time series (spatial and temporal resolutions similar to Sentinel-2) coupled to vegetation reflectance and canopy models (PROSPECT and SAIL). This set-up allowed us to obtain very realistic data for our experiments. This work was funded by the Belgian Federal Science Policy under the Proba-V Preparatory Programme.

Burned Area Mapping in a Mediterranean Environment Using Time-Series VEGETATION and Simulated PROBA-V Imagery by Employing an Object-Based Change Detection Approach

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Keywords: burned area mapping, change detection, VEGETATION, MODIS, NDVI, PROBA-V, OBIA, object based, Mohalanobis

Abstract:

The aim of this study was to evaluate the performance of an object based change detection approach in accurately mapping burned areas by employing multi-temporal, PROBA-V simulated (MODIS) and VEGETATION, image datasets. Since the PROBA-V sensor is scheduled for launch at the near future, we assess its performance in burned area mapping using MODIS imagery which presents similar spatial and spectral characteristics over the respective red and NIR bands. Such an approach, based on the use of high-temporal resolution images and the adoption of objects as the primary unit of classification, could be used for minimizing errors in the discrimination of burned surfaces from other surfaces with similar spectral characteristics (e.g. shadows, urban, water). The implemented burned area mapping approach builds upon the change detection algorithm of Bontemps et al. (2008) while its efficiency was assessed over the 2007 wildfires in the Peloponnesian peninsula, Greece. The '10-day VEGETATION' and the '8-day MODIS' products were used in the calculation of NDVI images. Following, a time series dataset was generated consisting of two '40-day seasonal composites' for the year of the fire and two for the year before. Then a multi-temporal segmentation was applied, giving equal weight to the reflectance values of all four images. The spectral-temporal signature of each segment was generated and the Mahalanobis distance between its signature and the signature of the assumed unchanged reference segments was calculated. Following, a threshold was calculated for assigning an object as 'burned', so that the resulting burned area map would cover a pre-set percentage of the total study area. As a result, by changing the pre-set changed/burned area cover percentage, the methodology could be set to detect the 'mostly changed'/'severely burned' area of a study site. The accuracy of the produced maps was estimated by comparison with high resolution reference maps of the burned areas. Burned area mapping using the simulated PROBA-V images, resulted to a khat value of 0.78 and a burned area user's accuracy of 79.48 while the lower spatial resolution of the VEGETATION sensor resulted to lower accuracy (0.72 and 74.31 per cent respectively).