CENTRE NATIONAL D'ÉTUDES SPATIALES

Dot Cloud, a Geospatial collaborative platform for Kalideos and the Recovery Observatory

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ABSTRACT

Over the course of the past decade, the world has seen an unprecedented number of disasters, which are growing both in number and severity. The last decade has also been witness to a series of catastrophic events that has each marked us: the deadly Indian Ocean tsunami and Haiti earthquake of 2004 and 2010; the catastrophic flood damages of Hurricane Katrina in 2005 and the Tohoku tsunami of 2011, and the astonishing extent of the environmental impact of the Deepwater Horizon explosion in 2009.
These catastrophes are on an impressive scale and have widespread and long lasting impacts. Recovery after such disasters costs billions of dollars and lasts years, even as long as a decade.
While satellite imagery is used on an ad hoc basis after many disasters to support damage assessment and track recovery efforts, there is currently no system to support the coordinated acquisition of data and its easy access. After catastrophic events of this magnitude, a coordinated approach would maximise the effectiveness of efforts and promote more widespread use of satellite data after smaller events by increasing the awareness of the benefits to be obtained through its use.

Seeking to optimise the use of collected data, and understanding the value of implementing systematic observations for several years, CNES led the creation of a platform to gather and continue to make available Earth observation data following the devastating Haiti earthquake of January 2010.
This project, called KalHaiti, has allowed CNES to identify lessons learned that underscore the importance of working before a catastrophic event takes place, and of working collectively, as a community of agencies, rather than in isolation.
These lessons have led to a proposal of the Recovery Observatory.
In April 2014, during a CEOS Plenary Session, this RO proposal was approved as part of the Disaster Risk Management Observation Strategy 2015-2017.

1. EXPERIENCE FROM KAL-HAITI PROJECT

The main projects that have been carried out thanks to KalHaiti are related to support for humanitarian actions, support to logistics operations, risk management.

For instance, the setting up of a municipal tax is foreseen as a response to the lack of Jacmel town financial autonomy.
Thanks to KalHaiti project and VHR satellite data, a GIS layer of the buildings mapping has been provided to the municipality for three different dates, thus allowing a temporal monitoringto help the census and to evaluate the tax potential income.
22000 buildings of Jacmel town were identified and classified forthree different dates in order to help the municipality to raise local taxes according to the status of the houses.

Figure 1:Jacmel buildings classification

For the French Red Cross, planned and spontaneous refugee camps have been monitored throughout one year. This long term monitoring, based of Earth Observation Data, included evaluation of access facilities for the camps, description of housings (tents or shelters), vulnerability to surface water runoff, etc.

Figure 2: Monitoring of grouping of people and camps

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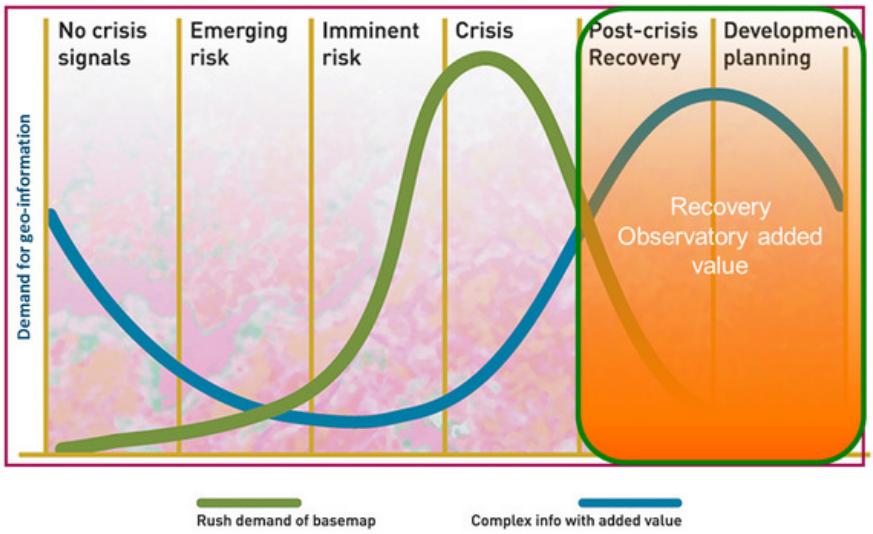

Figure 3: Evolution of geo-information demand after a disaster (source UNOSAT)

2. RECOVERY OBSERVATORY OBJECTIVES

The main objective endorsed by CEOS and other stakeholders is the **demonstration of the value of using satellite Earth Observations to support Recovery** from a major disaster.

This demonstration shall address both the near-term (e.g. Post Disaster Needs Assessments PDNA)and the long-term (e.g. major recovery planning and implementation, estimated to be about 3 years).

The other objectives are to put in place institutional relationships between CEOS and the international recovery community; and to promote innovation around high-technology applications to support recovery.

3. RECOVERY OBSERVATORY PARTNERS

The identified partners are primarily the international stakeholders that share interest in post-disaster needs and that finance the recovery and reconstruction phase. Those institutions are the Global Facility For Disaster Reduction and Recovery(GFDRR, part of the **World Bank**) and the Development and Environment Programme (UNDP, UNEP, from the **United Nations**).

Two meetings have been held with UN and WB in November and December 2014.

The other prominent partners are as well :

- The government of affected area and ministries with mandate for recovery and reconstruction that can act as **National End Users**
- The international humanitarian GOs and NGOs with interest in reconstruction (e.g. IFRC, OCHA)
- The Satellite data providers (CEOS agencies, commercial providers)
- Value-added product generators (academia, research institutes, companies, specialised organisations (e.g. UNOSAT)

In the first weeks following a disaster, the link with the National End User will be established by the international Disaster Risks Management stakeholdersthat will support the generation of imaging requirements according to a product list established in coordination with the national end user

After the initial response phase is completed, the Observatory will work directly with the national and local end users, ensuring that products respond to needs.

Once the Observatory is established, the Oversight team will work with DRM stakeholders and national and local authorities to develop a legacy strategy, ensuring data and products can be used for long-term recovery and reconstruction efforts, and support resilient reconstruction.

4. UTILITY OF SATELLITE IMAGERY

Satellite acquisitions are remotely triggered whatever the weather conditions and can cover a wide area. The RADAR imagery is not affected by the presence of clouds.

Satellite Imagery is therefore a key source to identify the extent of the damages (geographical spread) and their intensity (completely destroyed, partially damaged, or negligibly damaged).

In addition to optical imagery, RADAR imagery is well suited to some types of damages (floods, …)

5. RO LIFECYCLE

Once a Recovery Observatory instance has been decided, the following activities take place :

- Instantiate the collaborative web IT workspace to share products and user data
- Plan coordinated image acquisitions to support first of all the final assessment of the damages (both built areas and natural resources), and then to support :
- the reconstruction planning : prioritization and sequencing both spatially and sectorally with Land use planning, Hazard mapping
- and subsequently the reconstruction monitoring : Overall progress, Progress within sectors
- For the duration of the RO, establish and maintain collaborative practices through cooperation on Post Disaster Needs Assessments (PDNA)

6. DETAILED TRIGGERING PROCESS

After the International Charter has been activated in response to a major disaster, the Recovery Observatory Oversight Team (ROOT) monitors the Charter activation. Then, each member/associate member considers whether event is a good candidate for the Observatory.

If yes, a Summary Event report will be written, to identify possible data acquisition requirements according to different scenarios; to identify commitment in kind or resources for value added support; to qualify expected government support in country; to describe the benefit to be derived from establishment of Observatory; and then to summarize pros and cons of creating an Observatory for the specific event.

If the Observatory is accepted by the Oversight Team (in consultation with the Chairs of CEOS, SIT, WG Disasters and ROOT), the Recovery Observatory Oversight Team adopts a data acquisition strategy and preliminary list of data products and put in place the IT system, possibly based on DotCloud.

7. APPLICATION DESIGN

The rationale used for the design was to reuse existing software as much as possible in order to meet the financial and planning constraints.

The chosen tools for the development are the following :

- RESTo (REstful Semantic search Toolkit for geospatial, github.com/jjrom/resto, Gasperi J. 2014): for the OpenSearch data access, metadata catalogue and user authentication;
- MapServer(mapserver.org) : for WMS server ;
- Specific development (Python using GDAL) for the ingestion subsystem (WMS tiles generation and image metadata extraction;
- iTag(github.com/jjrom/itag) for rich metadata calculation;
- Mapshup(github.com/jjrom/mapshup, Gasperi J. 2011) for the geographic Web client

The role of the subsystem « ***WEB application*** » is to provide the user interface for browsing the editorial content, navigating the cartographic map, authenticating the users and managing rights, searching, visualizing and downloading products, as well as posting messages and uploading user content.

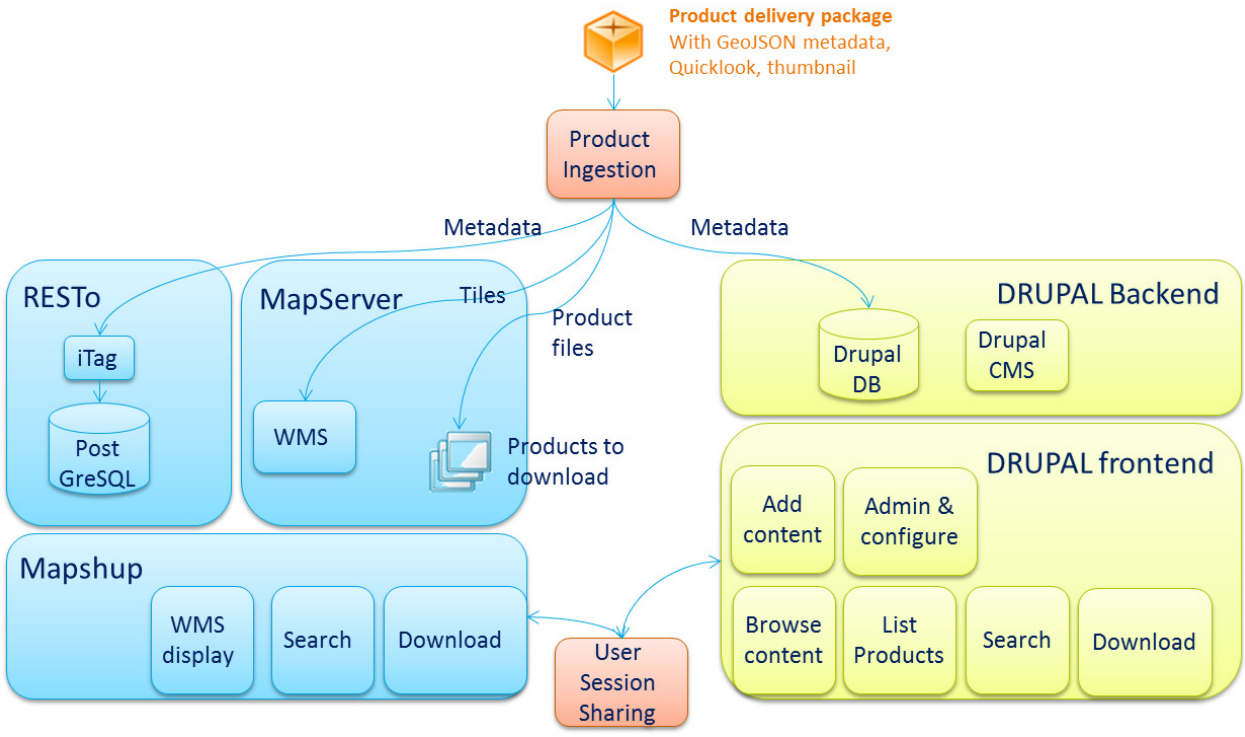

Figure 4: Architecture of Dot Cloud

For the administrator and content moderator, the subsystem « *WEB application* » allows to ingest products, and moderate content.

For granted users, this subsystem will allow the full resolution display in a cartographic map, using a WMS server and the tiles generated at ingestion time.

« *WEB application* » is made up of Drupal and Mapshup.

The «***Search service*** » implements the OpenSearch Extension for Earth Observation standard for performing searches on the ingested metadata located in the database.

The search criteria are toponyms, temporal, product type, keywords and this service is based on RESTo.

With the help of search form, users are able to perform multi criteria searches based on geographic location, product level, time interval, product level, etc.

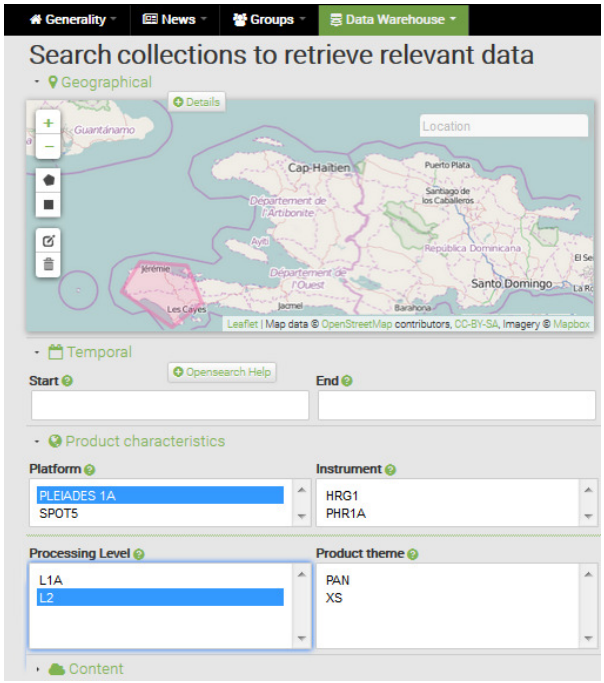

Figure 5: The search full form

Once the results are obtained, it is possible to toggle between a tiled list view and a map view. From both of them, a one click download is available, provided the user is granted to do so and has signed the product licenses.

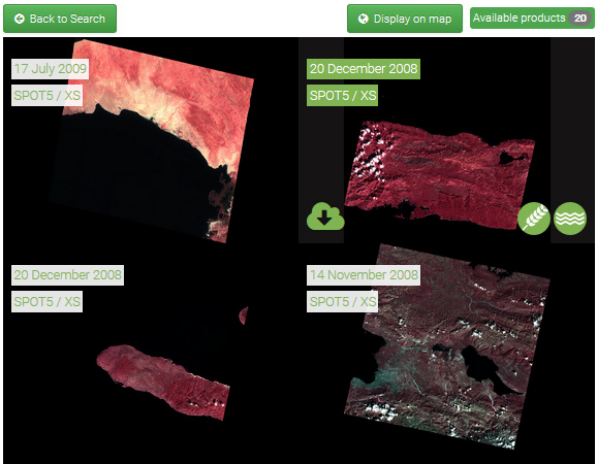

Figure 6: The search full form

Ingestion Subsystem

The system is able to ingest geospatial data, in order to add this data to the catalogue. The ingestion process is based on several steps :

1. The data has to be provided in a ZIP archive format, including a GeoJson description file. The creation of the GeoJson has to be made by the entity in charge of the ingestion activity.
2. The ingestion system sends to RESTo the metadata to be stored in the catalogue using the GeoJson format. During the ingestion RESTo will enrich the metadata thanks to iTag which performs percentage calculations for additional features (Continents, Country, Towns, Land cover, etc.) based on the product geometry only. These metadata are also stored as a Drupal content item for the list view and to provide comments and collaborative facilities to the users.
3. The WMS injector creates WMS tiles at any scale for displaying the data on the map and if required performs re-projection of the product. This step is basically done thanks to GDALsoftware.

The ingestion will be carried out either automatically with a polling process or manually upon administrator or user action.

With regards to the DotCloud system, there is no restriction on the data format itself. The system is able to support any format, provided that the GeoJsonfile, a quicklook and thumbnail are included, and assuming that it is possible to generate the WMS tiles and perform the re-projection. This can be done with minor updates as long as the data format is supported by GDAL.

8. WHAT HAS BEEN SPECIFICALLY DEVELOPPED

The ingestion system has been specifically developed as well as the session sharing based on SSO.

The configuration of the COTS (Drupal, Aquia Commons, Mapshup), selection of the proper plug-ins represented also a significant part of the job done.

9. WHAT IS BEING COMPLETED

The project is being developed with the Agile method and the last sprint is currently on its way.

During this sprint, the last main functions will be developed :

- The product license management:
  It is important to comply with the product licensing policy of the data providers. The licensing system will check if the users fulfill the requirements (in term of country, type of activity, etc.). Furthermore, some products will be reserved to dedicated groups.
- A new metadata flag in order to hide the data display if the user has not the right to download it. By default, any user can display all the data.
- The ability to a user to contribute and send a geographical product. The administrator will be then be informed and asked to ingest the data to the catalogue
- Completing the installation procedure

10. CONCLUSION

Throughout the agile development process, the team has been very reactive and the usability of DotCloud as improved a lot from the beginning.

After this first version, other functional improvements will have to be taken into account :

- new data formats have to be added like TerraSAR-X, Landsat 8, Sentinel 2, Spot 6/7, Sentinel-1, Alos-2, US VHR sensors, etc.)
- automatic harvesting of external OpenSearch catalog will allow to display data from other catalogues
- the ability to display office documents with an online viewer
- to display on the catalogue geographic data that cannot be orthorectified : digital images taken from a smartphone or a camera with GPS location, user documents related to a toponym, etc.

But whatever the functionalities, the success of the first instance of the recovery observatory will heavily rely on a person with the dedicated task to animate and trigger the discussions, and to feed the group contents on a regular purpose.

Users will contribute and visit the group board on a regular process inly if there is a steady activity in it … and emails alerts are active by default.