Evaluation of Northern Hemisphere Snow Extent Products Using In-Situ Data Within ESA SnowPEx Project

Sari Johanna Metsämäki (sari.metsamaki@ymparisto.fi), Elisabeth Ripper, Olli-Pekka Mattila, Gabriele Schwaizer, Kari Luojus, Thomas Nagler, Richard Fernandes, Bojan Bojkov, Michael Kern
Finnish Environment Institute, Finland

Seasonal snow cover plays an important role in Earth sciences. Several snow products are internationally used for climate change assessments and predictions, hydrological forecasts, weather forecasts and for more ordinary purposes like recreation and tourism, thus giving a strong influence on decision making in regional and global scales. Given the several methodologies and data sources employed for in the production of different snow products, it is highly important to evaluate their differences and, if possible, to understand their strengths and weaknesses. SnowPEx is an international collaborative effort for evaluation and comparison of continental to hemispherical satellite snow products funded by the European Space Agency (ESA) under the Quality Assurance framework for Earth Observation (QA4EO). Here we explain the protocol for snow product validation using in-situ data and show results from the in-situ validation of Snow Extent (SE) products. The in-situ observations are distributed so that the product performance over different land covers and different snow zones can be investigated.

The snow products participating in the validation exercise are basically based on optical satellite data, but also multisensor products are involved. Here we focus on the moderate resolution NH-scale products. The investigated time period varies from two yearly seasons up to five, depending on the product. The five periods include: 2000-2001, 2003-2004, 2005-2006, 2007-2008, 2011-2012, each period starting on 01 October and ending on 30 September.

The reference in-situ data set is a compilation of a massive set of snow observation provided by different institutes and research groups in Europe, Asia and Northern America. Each in-situ observations provide information on the location, time (date) and the measured snow depth.

All products and in-situ data are treated as binary (snow/no-snow) information. The SE products featuring SCF (Snow Cover Fraction) are converted to binary using SCF=15%, SCF=25% and SCF=50% as candidates for thresholding: if SCF>threshold THEN 'snow' OTHERWISE 'no-snow'. Originally binary products are used directly in the validation. For in-situ Snow Depth (SD), binary conversion relies on three different thresholds: SD=0cm, SD=2cm and SD=15cm, which are separately analyzed. The in-situ observation is labelled 'snow' if the threshold is exceeded, otherwise it is labelled 'no-snow'.

After these conversions the in-situ observations are associated with temporally and spatially matching product pixels. From the generated dataset several validation measures are calculated, amongst them F-score, Critical Success index, Recall, Precision and False alarm rate. These are stratified according to the Sturm snow zones and additionally according to the different land-cover classes (forested and non-forested areas). Since it was expected that the performance of a snow product varies during the year, the binary measures were produced for four three-month periods. This approach benefits the interpretation of the results and helps us to comprehend when and where each product performs the best.