Geophysical Research Abstracts
Vol. 19, EGU2017-12756-1, 2017
EGU General Assembly 2017

Mapping snow cover using multi-source satellite data on big data platforms

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Snowmelt is an important and dynamically changing water resource in mountainous regions around the world. In this framework, remote sensing data of snow cover data provides an essential input for hydrological models to model the water contribution from remote mountain areas and to understand how this water resource might alter as a result of climate change. Traditionally, however, many of these remote sensing products show a trade-off between spatial and temporal resolution (e.g., 16-day Landsat at 30m vs. daily MODIS at 500m resolution). With the advent of Sentinel-1 and 2 and the PROBA-V 100m products this trade-off can partially be tackled by having data that corresponds more closely to the spatial and temporal variations in snow cover typically observed over complex mountain areas.

This study provides first a quantitative analysis of the trade-offs between the state-of-the-art snow cover mapping methodologies for Landsat, MODIS, PROBA-V, Sentinel-1 and 2 and applies them on big data platforms such as Google Earth Engine (GEE), RSS (ESA Research Service & Support) CloudToolbox, and the PROBA-V Mission Exploitation Platform (MEP). Second, it combines the different sensor data-cubes in one multi-sensor classification approach using newly developed spatio-temporal probability classifiers within the big data platform environments.

Analysis of the spatio-temporal differences in derived snow cover areas from the different sensors reveals the importance of understanding the spatial and temporal scales at which variations occur. Moreover, it shows the importance of i) temporal resolution when monitoring highly dynamical properties such as snow cover and of ii) differences in satellite viewing angles over complex mountain areas. Finally, it highlights the potential and drawbacks of big data platforms for combining multi-source satellite data for monitoring dynamical processes such as snow cover.