A method for robust estimation of snow seasonality metrics from Landsat and Sentinel-2 time series data at national scales with Google Earth Engine

Eljabiri Youssra [(1)], Htitiou Abdelaziz [(1, 2)], Boudhar Abdelghani [(1, 3)], Mostafa Bousbaa [(3)], Chehbouni Abdelghani [(3)]

(1) Water and Remote Sensing Team, Sultan Moulay Slimane University, Beni Mellal, Morocco.
(2) Julius Kühn Institute (JKI), Federal Research Centre for Cultivated Plants, Institute for Crop and Soil Science, Braunschweig, Germany
(3) Center for Remote Sensing Applications (CRSA), Mohammed VI Polytechnic University, Ben Guerir, Morocco.

yeljabiri@gmail.com

Keywords: Google Earth Engine, Landsat 8, Sentinel-2, Atlas Mountains, Snow cover, Cloud filtering, Gap filling, snow metrics.

The timing of annual snow melt and snow fall with any potential change in that timing has broad ecological implications and thus impacts human livelihoods, particularly in and around high latitudes and mountainous systems. In this context, snow cover variability can be monitored using in situ measurements, modeling studies, and remote sensing applications. However, weather stations tend to be few in number and do not provide long data records. Consequently, the use of satellite remote sensing especially medium to high resolution products such as Landsat 8 and sentinel-2 data can be an effective tool in the monitoring and mapping of snow cover, providing an opportunity for determining snow onset and melt dates across broad geographic regions. However, the use of such data has some difficulty because of their increasing volume, which creates new challenges in handling such datasets that require new methods to extract relevant information from a data science perspective. In this context, the Google earth engine as a platform that allows analyzing geospatial information has offered us the ability to calculate the first and last day of snow cover annually at a pixel level, providing the ability to track the seasonal and inter-annual variability in the timing of snowmelt toward a better understanding of how the hydrological cycles of higher latitudes and mountainous regions. Still, cloud cover is considered as a limiting factor at higher latitudes. For that, a combination of Landsat 8 and Sentinel-2 NDSI (Normalized Difference Snow Index) data, spatial and temporal filtering algorithms, the compositing and smoothing of snow cover extent over multiple days has been found to reduce the uncertainties in snow cover resulting from cloud cover. The outcome of the present study has provided a regular monitoring during the season, with a time step fine enough to follow the snow cover and melt over a large area of snow coverage. Additionally, to the to the extraction of a spatially and temporally detailed set of seasonal snow cover metrics over a semi-arid region precisely the Moroccan Atlas Mountain range from a combination of Landsat 8 and

Sentinel 2 data products using GEE platform, including snow cover duration, first day of snow and the last day of snow (snowmelt) dates.