Submitted Abstract

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Abstract

The Advanced Very High Resolution Radiometer (AVHRR) is a sensor that has been collecting imagery on multiple satellite platforms since the 1980s, which means its total archive exceeds the 30 years required for climate-relevant analysis. Until now, AVHRR imagery and derived information products have only been accessible via file-based access, requiring a significant time investment and expert knowledge to access and find relevant data for analysis. We have implemented a semantic Earth observation (EO) data cube using a curated subset of AVHRR imagery from the University of Bern and derived information along with Copernicus Sentinel-3 imagery, with the intention of complementing and expanding the heritage AVHRR time-series. A semantic EO data cube refers to a spatio-temporal EO data cube, where for each observation at least one nominal (i.e. categorical) interpretation is available and can be queried in the same instance. It eases spatio-temporal analysis of big EO imagery while also adding a semantic dimension to every pixel-based observation. The geographic focus of this prototypical implementation covers the COSMO-1 extent, which includes the entire European Alpine region.

Three essential climate variables (ECVs) and sub-symbolic semantic enrichment have been derived from AVHRR and Sentinel-3 imagery and included. ECVs critically contribute to the characterisation of Earth's climate system's state, interactions and developments. Remote sensing scientists at the University of Bern derived vegetation dynamics using the normalized difference vegetation index, snow cover extent and lake surface water temperature from the curated time-series from 1981 through 2020. Automated knowledge-based semantic enrichment has been applied to AVHRR imagery from 2016 through 2020 and Sentinel-3 imagery. These stable, generic, pixel-based multi-spectral "colours" (i.e. sensor-independent regions of a multi-spectral feature space) are not land cover classes, but can be considered one property of an object or land cover type. Paired with the temporal analysis that data cubes make possible, these "colours" can be used in a convergence-of-evidence approach as the basis for building a diversity of land cover classes because they are independent from any defined ontology, application or sensor. Based on the existing Sen2Cube.at infrastructure developed by the EO Analytics research group at the University of Salzburg, it is now possible to conduct ad-hoc analysis for any user-defined area or timespan using these ECVs, imagery, derived information and a digital elevation model for the entire European Alpine region. Such an implementation can be augmented with additional data, and may be useful for research in the mountain domain.