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Flood-prone area indication based on evidence from long Earth observation image time series

Martin Sudmanns (1), Dirk Tiede (1), Hannah Augustin (1), Andrea Baraldi (2), Lorenz Wendt (1), and Stefan Lang (1)

(1) University of Salzburg, Department of Geoinformatics - Z_GIS, Austria (martin.sudmanns@sbg.ac.at), (2) Italian Space Agency (ASI), Rome, Italy

Surface waters are one of the most important natural resources supporting healthy life on Earth, and they are sensitive to changes in global and local climate conditions. A temporary influx of more water than a system can handle over a given time may lead to flooding, causing severe damages and loss of life. Monitoring floods to indicate areas that are prone to being flooded is critical to improving long-term disaster management and prevention.
The presented study applies the semantic querying software called IQ (ImageQuerying), developed in-house, on a dense temporal stack of optical EO images to extract surface water through time and infer flooded areas. Within the EO image understanding subsystem, each image is pre-classified individually and automatically into information layers, e.g. a scene classification map, using a pixel-based spectral rule-based decision-tree classifier (SIAM2). The scene classification maps are based on a set of mutually exclusive and exhaustive sub-symbolic land cover classes (i.e. semi-concepts), including cloud and several water semi-concepts. The information layers are ingested into a geospatio-temporal data cube, instantiated by the array database system Rasdaman, to facilitate ad-hoc execution of spatio-temporal semantic queries. Since these pre-processing steps and the database itself are independent of any specific application domain, we consider the EO images and information layers in this setting as analysis-ready data (ARD). Questions within the physical world are therefore transferrable to database queries using IQ's Web-based graphical inference engine. The example study uses all 78 available Landsat 8 scenes until September 2016 of the Shebelle River in Somalia. During this period several instances of flooding occurred, including a major event in May 2016. However, the time-span for analysis can be interactively defined by the user. The results indicate areas that have been flooded at least once during the selected time-span and are therefore prone to being flooded in future events.
Future work includes adding further spatial queries (e.g. for the indication of cloud/cloud shadow) to support the quality assessment and the interpretation of the flood indicator, using object-based methods to indicate the sizes and shape of the individual flooded areas, reproducing the study with Sentinel-2 images, and applying the methods to larger study areas.