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Continental estimation of sub-pixel standing water fractions using the MODIS sensors: method development and potential application for water accounting and assessment in Australia

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Abstract:

Accurate and timely monitoring of natural and man-made water bodies is a critical input for water accounting and assessment. We aim to developing a methodology for a retrospective estimation of the area occupied by standing water in the Australian continent with a weekly to daily time-step. Available remotely sensed data present a trade-off between spatial, temporal and spectral resolution: sensors capable to map features with very high definition (a few meters) such as IKONOS or SPOT are typically available once a week or fortnightly and susceptible to cloud contamination. At the other extreme, passive microwave sensors such as AMSR scan the surface several times a day and are relatively unaffected by clouds but their coarse spatial resolution only allows them to detect only very large (hundreds of hectares) water bodies. While our long-term goal is to integrate all these sources of remote sensing data for water accounting, this paper focuses on the use of the MODerate resolution Imaging Spectroradiometer (MODIS) sensor.

MODIS scans the surface twice a day with a spatial resolution of 250 or 500 meters in the spectral bands from the visible to the shortwave infrared. In a pilot study focusing in the upper Gwydir and Condamine/Balonne catchments we applied Spectral Mixture Analysis (SMA) for estimating the fraction of the MODIS pixel occupied with water. We used high resolution LANDSAT scenes of three dates in 2004 (including two flooding events and a dry period) and an object-oriented classification algorithm for mapping water bodies. These classifications were used as "ground truth" for developing and testing the SMA on the MODIS scenes of the same dates, using the bands from 400 to 2100 nm at 500 meters. Several metrics were tested including the Count-based Endmember Selection (CoB), Endmember Average RMSE (EAR) and the Minimum Average Spectral Angle (MASA). Also, we took into account the heterogeneity in water spectra caused by sediments, chlorophyll and depth.

Preliminary results show that SMA can effectively detect the water signal within MODIS pixels occupied with as little as 20% of standing water (5 hectares in a 500m MODIS pixel) with an accuracy of ~15%. Using the 16-day Terra/Aqua composites can greatly overcome the problem of cloud contamination and therefore be the most suitable product for generating a continental time series. However fast moving floods might be lost if such product is used. These issues together with the prospects of near-real time applications and the integration of these datasets into hydrologic modeling will be further discussed in the presentation.

Keywords: *standing water, subpixel analysis, remote sensing, MODIS, LANDSAT*

Abstract only