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Monitoring cropland evapotranspiration using MODIS products in Southern Brazil

Anderson Ruhoff (1), Adriana Aparecida Moreira (1), Vanessa de Arruda Souza (2), and Debora Regina Roberti (2)

(1) Instituto de Pesquisas Hidraulicas, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil (anderson.ruhoff@ufrgs.br), (2) Centro de Ciencias Naturais e Exatas, Universidade Federal de Santa Maria, Santa Maria, Brazil

Evapotranspiration (ET), including water loss from plant transpiration and land evaporation, is of vital importance for understanding hydrological processes and climate dynamics. In this context, remote sensing is considered as the most important tool for estimate ET over large areas. The Moderate Resolution Imaging Spectroradiometer (MODIS) offers an interesting opportunity to evaluate ET with spatial resolution of 1 km. The MODIS global evapotranspiration algorithm (MOD16) considers both surface energy fluxes and climatic constraints on ET (water or temperature stress) to estimate plant transpiration and soil evaporation based on Penman-Monteith equation. The algorithm is driven by remotely sensed and reanalysis meteorological data. In this study, MOD16 algorithm was applied to the State of Rio Grande do Sul (in Southern Brazil) to analyse cropland and natural vegetation evapotranspiration and its impacts during drought events. We validated MOD16 estimations using eddy correlation measurements and water balance closure at monthly and annual time scales. We used observed discharge data from three large rivers in Southern Brazil (Jacuí, Taquari and Ibicuí), precipitation data from TRMM Multi-satellite Precipitation Analysis (3B43 version 7) and terrestrial water storage estimations from the Gravity Recovery and climate Experiment (GRACE). MOD16 algorithm detected evapotranspiration in different land use and land cover conditions. In cropland areas, the average evapotranspiration was 705 mm/y, while in pasture/grassland was 750 mm/y and in forest areas was 1099 mm/y. Compared to the annual water balance, evapotranspiration was underestimated, with mean relative errors between 8 and 30% and coefficients of correlation between 0.42 to 0.53. The water storage change (dS/dt) computed from the water balance closure at monthly time scales showed a significant correlation with the terrestrial water storage obtained from GRACE data, with a coefficient of correlation of 0.39 for the three basins evaluated. We also found a correspondence between evapotranspiration anomalies and the major drought events. The approach demonstrates the potential to evaluate evapotranspiration and water balance closure based on remote sensing data. Overall, MOD16 algorithm detected evapotranspiration over different land use and land cover conditions and is effective to monitor large areas.
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