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# On the Assimilation of Remote Sensing Data for Soil Moisture and Leaf Area Predictions Using an Ensemble-Kalman-Filter-Based Assimilation Approach in a tree-grass Mediterranean Ecosystem

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*Data assimilation techniques allow for optimally merging remote sensing observations in ecohydrological models, guiding them for improving land surface flux predictions. Nowadays freely available remote sensing products, like those of Sentinel 1 radar, Landsat 8, and Sentinel 2 sensors, allow for monitoring land surface variables (e.g., radar backscatter for soil moisture and the normalized difference vegetation index, NDVI, for leaf area index, LAI) at unprecedented high spatial and time resolutions, appropriate for heterogeneous ecosystems, typical of semi-arid ecosystems characterized by contrasting vegetation components (grass and trees) competing for water use. An assimilation approach that assimilates radar backscatter and grass and tree NDVI in a coupled vegetation dynamic-land surface model is proposed. It is based on the Ensemble Kalman filter (EnKF), and it is not limited to assimilate remote sensing data for model predictions, but it uses assimilated data for dynamically updating key model parameters (the ENKFdc approach), the saturated hydraulic conductivity, and the grass and tree maintenance respiration coefficients, which are highly sensitive parameters of soil water balance and biomass budget models, respectively. The proposed EnKFdc assimilation approach facilitated good predictions of soil moisture in an heterogeneous ecosystem in Sardinia, for 5 years period with contrasting hydrometeorological (dry vs wet) conditions. Contrary to the EnKF-based approach, the proposed EnKFdc approach performed well for the full range of hydrometeorological conditions and parameters, even assuming extremely biased model conditions with very high or low parameter values compared to the calibrated (“true”) values. The EnKFdc approach is crucial for soil moisture and LAI predictions in winter and spring, key seasons for water resources management in Mediterranean water-limited ecosystems. The use of ENKFdc also enabled us to predict evapotranspiration and carbon flux well, with errors less than 4% and 15%, respectively, although the initial model conditions were extremely biased.*