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Influence of data assimilation on the reanalysis of land surface hydrological and vegetation variables for Europe and the Mediterranean basin with LDAS-Monde

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Reanalysis datasets are a very powerful instrument to analyse the evolution of rapidly changing biogeophysical systems. They are generally produced by merging numerical simulations of the studied system with observations using data assimilation. As a consequence the quality of a reanalysis depends on the quality of its components.
This work aims to study the long-term impact of data assimilation routines on the reanalysis of land surface hydrological and vegetation variables for Europe and the Mediterranean basin with LDAS-Monde, the global offline land data assimilation system developed by Météo-France's research centre (CNRM). LDAS-Monde combines the multilayer and interactive vegetation ISBA land surface model, forced by ECMWF's latest atmospheric reanalysis, ERA-5, and coupled with the CNRM version of the Total Runoff Integrating Pathways (ISBA-CTRIP) continental hydrological system, with Copernicus Global Land Service satellite derived observations of surface soil moisture and leaf area index (LAI) in order to produce reanalyses of land surface variables at a 0.25° resolution covering the period 2008 – 2017.
This study compares the effect of an Ensemble Kalman Filter (EnKF) and the Simplified Extended Kalman Filter (SEKF), that is routinely used in LDAS-Monde, on land surface variables (LSVs). While, for LAI, the SEKF and EnKF produce, on average, estimates of the same quality, the EnKF exhibits an improved performance for surface soil moisture (compared to CGLS observations) especially on the South of the Mediterranean basin. A positive impact of the EnKF is also observed on other LSVs such as evapotranspiration (compared to the satellite-derived GLEAM product), or gross primary production (compared to the satellite-derived FLUXCOM product). The positive impact is particularly strong on river discharges (compared to gauge measurements on 92 locations) showing that assimilating surface soil moisture and LAI can improve reanalyses of river discharges.
While this study focuses on a 0.25° resolution, the described approach is completely suitable for higher-resolution reanalysis as higher-resolution observations of surface soil moisture and LAI are either already available or currently under development.