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Towards a satellite driven land surface model using SURFEX modelling platform Offline Data Assimilation: an assessment of the method over Europe and the Mediterranean basin

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Modelling platforms including Land Surface Models (LSMs), forced by gridded atmospheric variables and coupled to river routing models are necessary to increase our understanding of the terrestrial water cycle. These LSMs need to simulate biogeophysical variables like Surface and Root Zone Soil Moisture (SSM, RZSM), Leaf Area Index (LAI) in a way that is fully consistent with the representation of surface/energy fluxes and river discharge simulations. Global SSM and LAI products are now operationally available from spaceborne instruments and they can be used to constrain LSMs through Data Assimilation (DA) techniques.

In this study, an offline data assimilation system implemented in Météo-France's modelling platform (SURFEX) is tested over Europe and the Mediterranean basin to increase prediction accuracy for land surface variables. The resulting Land Data Assimilation System (LDAS) makes use of a simplified Extended Kalman Filter (SEKF). It is able to ingests information from satellite derived (i) SSM from the latest version of the ESA Climate Change Initiative as well as (ii) LAI from the Copernicus GLS project to constrain the multilayer, CO_2-responsive version of the Interactions Between Soil, Biosphere, and Atmosphere model (ISBA) coupled with Météo-France's version of the Total Runoff Integrating Pathways continental hydrological system (ISBA-CTRIP). ERA-Interim observations based atmospheric forcing with precipitations corrected from Global Precipitation Climatology Centre observations (GPCC) is used to force ISBA-CTRIP at a resolution of 0.5 degree over 2000-2015.

The model sensitivity to the assimilated observations is presented and a set of statistical diagnostics used to evaluate the impact of assimilating SSM and LAI on different model biogeophysical variables are provided. It is demonstrated that the assimilation scheme works effectively. The SEKF is able to extract useful information from the data signal at the grid scale and distribute the RZSM and LAI increments throughout the model impacting soil moisture, terrestrial vegetation and water cycle, surface carbon and energy fluxes.