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LDAS-Monde: Global scale satellite driven Land Data Assimilation System based on SURFEX modelling platform

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In the past decades, large efforts have been made to improve our understanding of the dynamics of the terrestrial water cycle, including vertical and horizontal water fluxes as well as water stored in the biosphere. The soil water content is closely related to the development of the vegetation, which is in turn closely related to the water and energy exchanges with the atmosphere (through evapotranspiration) as well as to carbon fluxes. Land Surface Models (LSMs) are usually designed to represent biogeophysical variables, such as Surface and Root Zone Soil Moisture (SSM, RZSM) or Leaf Area Index (LAI), in order to simulate water, energy and carbon fluxes at the interface between land and atmosphere. With the recent increase of satellite missions and derived products, LSMs can benefit from Earth Observations via Data Assimilation systems to improve their representation of different biogeophysical variables.

This study, which is part of the eartH_2Observe European project (http://www.earth2observe.eu), presents LDAS-Monde, a global Land Data Assimilation System using an implementation of the Simplified Extended Kalman Filter (SEKF) in the Météo-France's modelling platform (SURFEX). SURFEX is based on the coupling of 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 (CTRIP). Two global operational datasets derived from satellite observations are assimilated simultaneously: (i) SSM from the ESA Climate Change Initiative and (ii) LAI from the Copernicus Global Land Service project. Atmospheric forcing used in SURFEX are derived from the ERA-Interim reanalysis and corrected from GPCC precipitations. The simulations are conducted at the global scale at a 1 degree spatial resolution over the period 2000-2014.

An analysis of the model sensitivity to the assimilated observations is performed over different regions of the globe under various hydro-climatic conditions. The impact of the SEKF on different biogeophysical and hydrological variables is assessed. It is shown that the assimilation scheme greatly improves the representation of the observed variables (SSM and LAI) and that it effectively affects most of the other variables related to the terrestrial water and vegetation cycles. Future developments include the optimization of LDAS-Monde in order to improve the spatial resolution and then take full advantage of the potential of Earth Observations.