LDAS-Monde

Global scale satellite driven Land Data Assimilation System based on SURFEX modelling platform

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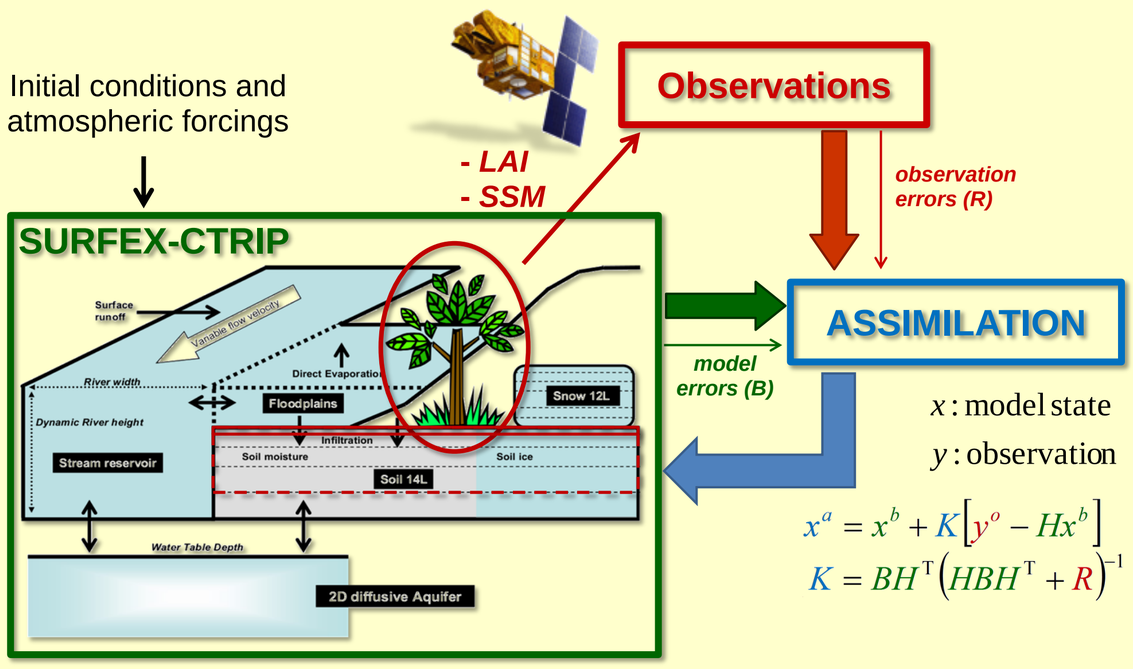
Land Surface Models (LSMs) are usually designed to represent biogeophysical variables, such as Surface and Root Zone Soil Moisture (SSM, RZSM) or Leaf Area Index (LAI), in order to simulate water, energy and carbon fluxes at the interface between land and atmosphere.

This study, which is part of the eartH2Observe European project (http://www.earth2observe.eu), presents the **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-CTRIP**). The LSM part of the model (ISBA-A-gs) simulates the diurnal cycle of water and carbon fluxes, plant growth and key vegetation variables on a daily basis. It is coupled to the routing part (CTRIP) which simulates the runoff and drainage propagation through the river network and the aquifers.

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. The simulations are conducted at the global scale at a 1 degree spatial resolution over the period 2000-2013.



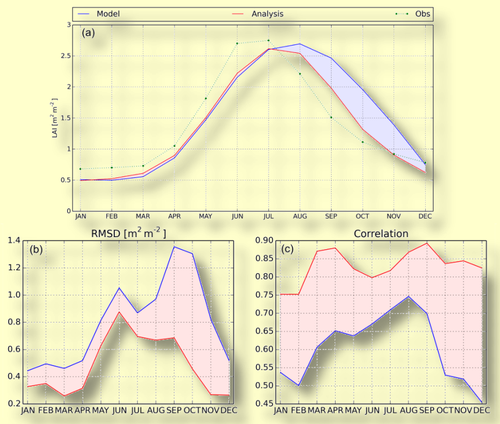
Flow chart of the LDAS-Monde data assimilation algorithm in the SURFEX modelling platform

Performances of the assimilation

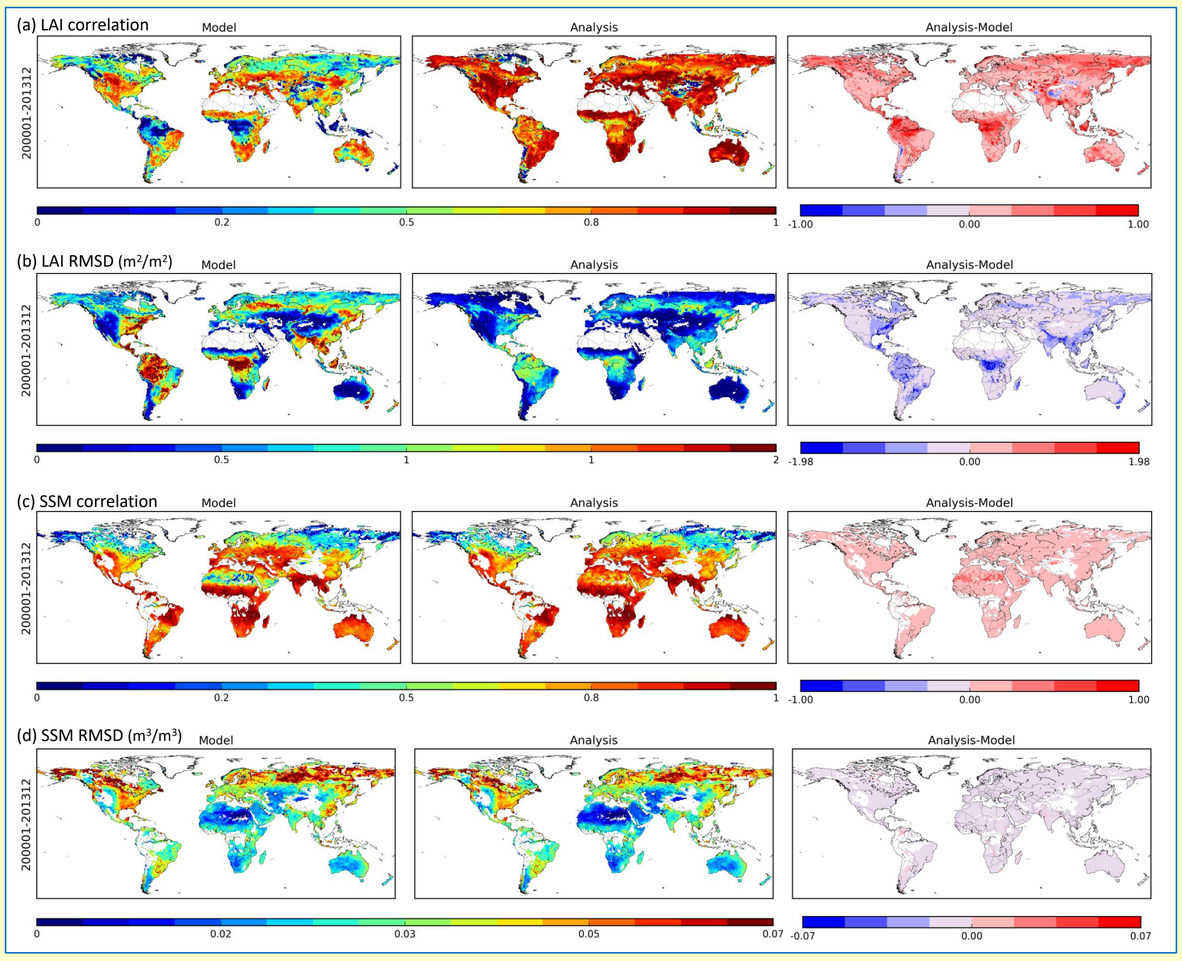
Performances of the analysis are evaluated against an open-loop simulation ('Model' in the figures) in which no satellite data are assimilated.

The assimilation has a clear impact on the LAI all over the globe, with resulting correlations close to 1 and very low RMSD compared to the open-loop. Namely, in the tropical zone and at high latitudes, the model is not able to correctly represent the vegetation dynamics, which is efficiently corrected by the assimilation. The impact on the SSM is much less important but still positive.

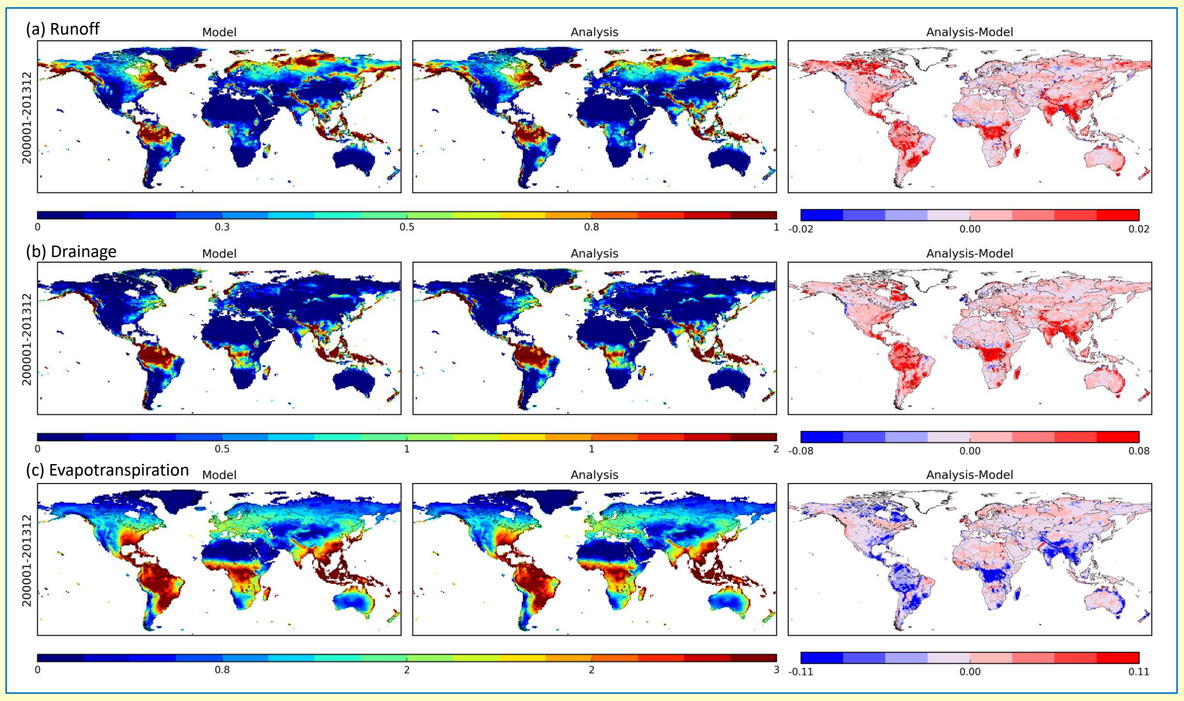
The time series over Europe show that most of the corrections occur during the second part of the year. The assimilation is able to partly correct the temporal shift of the senescence phase (decreasing LAI).



Seasonal impact of the assimilation on the LAI over Europe: spatial average of LAI (a), RMSD (b) and correlation (c)



Correlation and Root Mean Square Difference (RMSD) of LAI and SSM compared to observations for experiment without assimilation (Model) and with assimilation (Analysis)



Impact of the assimilation on the components of the water budget: runoff (a), drainage (b), evapotranspiration (c) (units are mm/day)

Impact on the water budget

Contrarily to LAI and SSM, the flux variables of the water budget (runoff, drainage and evapotranspiration) are indirectly impacted by the assimilation since these variables are not assimilated. Even though the impact is much lower than for LAI and SSM, it is not negligible and can reach 10% or more in some regions. Globally, the assimilation increases the runoff and drainage and decreases the evapotranspiration, especially in the tropical regions.

Perspectives

- Validation with ancillary data (discharge, evapotranspiration, GRACE, snow, etc.)
- Improve spatial resolution
- Assimilation of LAI disaggregated by type of vegetation (see presentation *Munier et al., BG1.8, Friday, 28 Apr*)

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