IAHS2017-370
IAHS Scientific Assembly 2017

LST assimilation in a distributed, soil moisture accounting flood forecasting model

Fabio Castelli and Giulia Ercolani
University of Florence, Department of Civil and Environmental Engineering, Florence, Italy (fabio@dicea.unifi.it)

Mass and energy fluxes at land-atmosphere interface are fundamental quantities from both the hydrological and meteorological point of view. They affect weather at the local as well as at the regional scale, and have a central role in the hydrologic balance. Estimating surface latent and sensible heat fluxes is crucial for water resources management purposes and for forecasting soil water content. However, in situ measurements of turbulent fluxes suffer spatial sparsity, and are expensive and complex to realize. As a result, surface fluxes are estimated mainly through models and observations from remote sensing. The variational assimilation of Land Surface Temperature (LST) data from satellite into surface energy balance models has been proven to be a valuable method for estimating surface turbulent fluxes (Caparrini et al., 2003; Bateni et al., 2013). Nevertheless, such approach does not consider explicitly neither the dynamics of soil moisture nor the rainfall temporal signal, and this may generate an excessive and unrealistic flexibility of the system.

This works presents a modelling framework which attempts to overcome such limitation by combining the variational assimilation of LST with a soil moisture accounting distributed hydrologic model (Castillo et al., 2015). In particular, the variational assimilation is employed to estimate the Evaporative Fraction (EF) on a daily time scale, with the cost functional to minimize including a quadratic error term for both the surface temperature and the EF itself. The first one is the error in respect to remotely sensed data of LST, while the latter evaluates the mismatch between the EF estimated by the assimilation system and the daily diurnal averages of obtained with the distributed hydrologic model. This strategy allows to include an accurate and physically based description of soil moisture dynamics in the assimilation system.

The developed framework is tested in the Arno river basin, Central Italy, employing LST data from MSG. The results obtained with and without the inclusion of the additional constraint from the distributed hydrologic model are compared, and the differences are discussed.

REFERENCES

Bateni S.M., Entekhabi D., Jeng D.-S. (2013). Variational assimilation of land surface temperature and the estimation of surface energy balance components. Journal of Hydrology, 481, 143-156.

Caparrini F., Castelli F., Entekhabi D. (2003). Mapping of land-atmosphere heat fluxes and surface parameters with remote sensing data. Boundary Layer Meteorology, 107, 605–633.

Castillo A., Castelli F., Entekhabi D. (2015). Gravitational and capillary soil moisture dynamics for distributed hydrologic models. Hydrology and Earth System Sciences, 19, 1857–1869.