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Impacts of EO-based representation of the vegetation dynamics on continuous basin scale hydrological models

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Vegetation dynamics (e.g. both structural and physiological changes) retrieved from remote sensing observations can enhance the estimation of the transpiration flux, which represents the largest term of the hydrological balance in Mediterranean region during the growing seasons (GS). Interannual variation in the precipitation and solar radiation regimes can significantly alter the soil-vegetation-atmosphere water transfer and, in turn, the soil water content of the root zone as well as the groundwater recharge.
To exploit the influence of vegetation dynamic at the river basin scale, a dynamic vegetation model (DVM) has been implemented within the framework of a continuous distributed hydrological model (i.e. the Continuum model) and tested over two watersheds: Orba and Casentino, located in the north and central part of Italy, respectively.
The DVM is composed by two sequential equations: first, the LUE (Light Use Efficiency) approach, originated with Monteith, was used to derive the Net Primary Productivity (NPP) which is then inserted into the Leuning formula to find the canopy conductance. The DVM is composed by one main vegetation parameters (LUE) that specifically depends on the vegetation classes, defined by the CLC (Corine Land Cover) for each model grid (100x100m). The core vegetation variable is the FAPAR (Fraction of Absorbed Photosythetically Active Radiation) derived directly from a product of MODIS sensor, with temporal resolution of 8 days.
The results obtained by applying the DVM (ML configuration) were compared with those derived by using a prescribed canopy conductance (Static configuration); the latter annual trend was determined by running, over a long time period, an assimilation model that optimizes the energy balance at the surface to get uniform monthly values of the canopy conductance for the entire study area.
The two configurations showed very similar overall accuracies to model the observed daily maximum runoff during the growing seasons but the ML approach is slightly more precise to capture the early autumn peak discharges because it is able to better simulate the transpiration flux when it is limited by not optimal plants physiological conditions.
Vegetation dynamic affects the hydrological fluxes dampening the effects on evapotranspiration cumulative differences at the end of the growing seasons although, due to interannual variations in the meteorological forcings, plants faced completely different soil moisture and solar energy inputs.
Based on the importance to determine the initial soil moisture conditions for predicting autumn flash floods, this DVM seems to better detect these events compared to a prescribed approach even if, to completely rely on it, further validation tests should be performed in other river basins.