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Multi-Year Assessment of Surface Vegetation Atmosphere Transfer (SVAT) Modelling Uncertainties over a Mediterranean Agricultural Site

Sébastien Garrigues (1), Albert Olioso (1), Jean-Christophe Calvet (2), Sébastien Lafont (2), Eric Martin (2), André Chanzy (1), Dominique Courault (1), Olivier Marloie (1), Véronique Desfonds (1), and Nadine Bruguier (1)

(1) UMR 1114, EMMAH, INRA, Domaine St Paul-Agroparc, 84914 Avignon cedex 9, France, (sebastien.garrigues@avignon.inra.fr), (2) CNRM-GAME (Météo-France, CNRS), Météo-France, 42, Av. Coriolis, 31057 TOULOUSE CEDEX 1, France

Mediterranean regions will be particularly sensitive to the impact of climate and land use changes on the water resources and vegetation productivity. These changes will affect the functioning and the dynamic of vegetation as well as the regional water and energy balances with possible feedbacks on the regional climate. In order to analyze and predict the impact of climate and land-use changes on vegetation productivity and water balance as well as their interactions at the regional scale, a critical step is to quantify the uncertainties associated with land surface models (parametrization, processes) and the data used in these models (atmospheric forcing, vegetation and soil characteristics, crop management practises...). This paper addresses this issue and aims at assessing the modelling of Soil Vegetation Atmosphere Transfer (SVAT) of energy, water and carbon over a Mediterranean agricultural site for a large period of time encompassing several development cycles of distinct crops.
The ISBA-A-gs model (Calvet et al, 1998), developed at CNRM/Météo France in the SURFEX surface modelling platform is used in this paper. ISBA-A-gs is a CO2 responsive SVAT model which explicitly simulates photosynthesis and vegetation growing. The experiment was conducted at the INRA, Avignon (France) crop test site (CarboEurope site), for which almost 10 years of turbulent fluxes, soil moisture profiles and vegetation measurements are available for distinct types of crop. This dataset is used in this paper to analyze the multi-temporal trends and the uncertainties of the SVAT simulations, focusing on the following issues:

- The use of local versus re-analyzed forcing atmospheric variables (SAFRAN database) indicates how the uncertainties in capturing the spatial and seasonal heterogeneity of the atmospheric variables (mainly precipitation and solar irradiance) can affect the simulations.

- The impact on the SVAT simulations of the accuracy of some key surface characteristics (soil, vegetation, crop management practises) is then tested. Simulations with values derived from the ECOCLIMAP global land cover map generally used in SURFEX are compared with those based on in situ values. This work particularly brings insights on the benefits of accounting for realistic seasonal dynamic of (i) the albedo varying with soil moisture and Leaf Area Index and (ii) the Leaf Area Index and the fraction of vegetation both influenced by the crop phenology. In order to improve the representation of crop phenology in the ISBA-A-gs model, the use of the Leaf Area Index dynamic simulated by the STICS (Brisson et al, 2003) crop model, which relies on a fine description of crop functioning and agricultural management operations, is investigated.

- The lack of representation in the SVAT model of crop rotation is finally analyzed. Particularly the soil functioning of a bare soil field can substantially differ than that of a vegetation field in terms of interactions with the atmosphere and water resources, potentially affecting the temporal consistency of the evapotranspiration flux.

These results will help identifying the SVAT multi-temporal drifts and modelling gaps for croplands in terms of energy and water balance closure. At the light of this work, strategies will be discussed to improve the description of the water balance at the regional scale.