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Uncertainties associated to the representation of surface processes in impact studies. A study in the Mediterranean area.

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In the framework of the assessment of the impact of climate change, the uncertainty associated to the direct effect of CO2 on plant physiology was seldom addressed, while some other sources of uncertainties have been more studied, such as those related to climate modeling or the downscaling method. A few studies are available at global or continental scale. The purpose of this study is to quantify this effect in a regional study focussed on the Mediterranean area of France. The Safran-Isba-Modcou chain was used. This chain is composed of a meteorological analysis system (SAFRAN), a land surface model describing the exchange with the atmosphere (ISBA) and a hydrogeological model (MODCOU), and has already been used in many studies in France.

The present study focuses on the uncertainties related to the representation of carbon cycle and the photosynthesis in the surface model. Two versions of ISBA were used and compared. The standard version simulates the mass and energy exchanges between the continental surface (including vegetation and snow) and the atmosphere. In this version, the LAI (Leaf Area Index) is provided by the ECOCLIMAP2 database and the vegetation is divided into 12 types. The A-gs version accounts for the process of photosynthesis taking into account the vegetation assimilation of atmospheric CO2 concentration, and simulates the evolution of the biomass and the LAI.

The domain studied is the French mediterranean basin, in which a sub domain was defined (latitude < 45 °N et height < 1000m) in order to identify the low land area pertaining to a Mediterranean climate. The study focuses on the impact of the climate change on the surface variables (LAI, water balance) and the discharges. The periods chosen to compare the changes are the end of the 20th century (1995-2005) and the end of the 21st century (2090-2099). A first comparison is made for the present climate between the versions of model and the observations of discharges, using two type of meteorological forcing : SAFRAN and data from a continuous high resolution climate scenario, based on the scenario A2, with a coupled atmosphere-mediterranean sea GCM. This scenario was further downscaled to the resolution of the study (a grid mesh of 8x8 km), using a quantile-quantile correction method.

Concerning the present climate, the comparison shows a delay of the development of the vegetation simulated by ISBA-A-gs causing an underestimation of evaporation and an overestimation of discharges in the spring compared to the observations and the standard version of ISBA. In future climate, the explicit response of vegetation to the CO2 concentration of the ISBA A-gs version gives an different answer on the surface water budget and flow from the standard version of ISBA. This difference is especially visible in the southern area, the impact on the flow is increased and impact on evaporation is decreased, showing the interest of using a CO2 responsive version of ISBA for impact studies.