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Can key vegetation parameters be retrieved at the large-scale using LAI satellite products and a generic modelling approach ?

Helene Dewaele, Jean-Christophe Calvet, Dominique Carrer, and Nabil Laanaia
CNRM, UMR3589 (Meteo-France, CNRS), Toulouse, France

In the context of climate change, the need to assess and predict the impact of droughts on vegetation and water resources increases. The generic approaches permitting the modelling of continental surfaces at large-scale has progressed in recent decades towards land surface models able to couple cycles of water, energy and carbon. A major source of uncertainty in these generic models is the maximum available water content of the soil (MaxAWC) usable by plants which is constrained by the rooting depth parameter and unobservable at the large-scale. In this study, vegetation products derived from the SPOT/VEGETATION satellite data available since 1999 are used to optimize the model rooting depth over rainfed croplands and permanent grasslands at 1 km x 1 km resolution. The inter-annual variability of the Leaf Area Index (LAI) is simulated over France using the Interactions between Soil, Biosphere and Atmosphere, CO_2-reactive (ISBA-A-gs) generic land surface model and a two-layer force–restore (FR-2L) soil profile scheme. The leaf nitrogen concentration directly impacts the modelled value of the maximum annual LAI. In a first step this parameter is estimated for the last 15 years by using an iterative procedure that matches the maximum values of LAI modelled by ISBA-A-gs to the highest satellite-derived LAI values. The Root Mean Square Error (RMSE) is used as a cost function to be minimized. In a second step, the model rooting depth is optimized in order to reproduce the inter-annual variability resulting from the drought impact on the vegetation. The evaluation of the retrieved soil rooting depth is achieved using the French agricultural statistics of Agreste. Retrieved leaf nitrogen concentrations are compared with values from previous studies. The preliminary results show a good potential of this approach to estimate these two vegetation parameters (leaf nitrogen concentration, MaxAWC) at the large-scale over grassland areas. Besides, a marked impact of the wintertime minimum value of LAI on the start of the growing season is highlighted. This parameter is oversimplified in the model (LAImin=0.3 for low vegetation) and adjustments based on LAI observations significantly improve the results. For croplands, more contrasted results are obtained in relation to the difficulty to represent crop rotation in the model. Several other configurations of the model are investigated (including multi-layer diffusion (DIF) soil profile scheme) in order to ensure the robustness of this approach. Finally this optimization method should permit to map several key vegetation parameters unobservable at the large-scale (as those listed above) over the Euro-Mediterranean area.