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Verification of the photosynthesis-driven phenology of the ISBA-A-gs model

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ISBA-A-gs is a CO_2-responsive land surface model, able to simulate the diurnal cycle of carbon and water vapour fluxes, together with LAI and soil moisture evolution. In contrast to other land surface models, no GDD-based phenology model is used in ISBA-A-gs, as the vegetation growth and senescence are entirely driven by photosynthesis. The leaf biomass is supplied with the carbon assimilated by photosynthesis, and decreased by a turnover and a respiration term. Turnover is increased by a deficit in photosynthesis. The leaf onset is triggered by sufficient photosynthesis levels and a minimum LAI value is prescribed. The maximum annual value of LAI is prognostic, i.e. it can be predicted by the model. Satellite products can be used to verify the LAI simulations. Agricultural statistics for winter/spring cereals and grasslands provide valuable information related to the interannual variability of the simulated above-ground biomass. The new Copernicus GEOV1 LAI product is compared with the simulated LAI over the Euro-Mediterranean area in terms of seasonality and interannual variability, over the 1994-2008 period. The leaf onset and the Length of the vegetation Growing Period (LGP) are derived from the satellite-derived LAI and from the modelled LAI. Overall, a good agreement between the model and the satellite observations is found, but the model tends to overestimate LGP in northern Europe. Over France, agricultural statistics over the 1994-2010 period are used to evaluate root water uptake in the model. Several experiments are made: bulk or multi-layer soil reservoir, with or without subroot base flow soil layers, for various soil depths. Overall, a better agreement of the simulations is found with the grassland dry matter production than with the cereal grain yield in relation to several factors. The latter are presented and discussed.