

PaSim simulations in the Massif Central of France

Renáta Sándor, Catherine Picon-Cochard, Raphaël Martin, Frédérique Louault, Katja Klumpp, David Borrás, Gianni Bellocchi

French National Institute for Agricultural Research – Grassland Ecosystem Research Unit, Clermont-Ferrand (France)

PaSim (Pasture Simulation model) is a plot-scale, process-based, biogeochemical model simulating fluxes of carbon, nitrogen, water and energy at the soil-plant-animal-atmosphere interface for managed grasslands. The response to temperature is an important area for model improvement, based on the evidence that a shift in the optimum temperature for the (Farquhar-based) photosynthesis process occurs as growth temperature changes, determining a modification of the response curve of carbon assimilation. A novel implementation of the model expresses the optimum temperature at any day as a function of growth temperature, while also modulating the maximum photosynthetic rate. An assessment of the improved modelling solution was performed with a dataset from a grassland experimental site, located in the Massif Central of France (Saint Genès-Champanelle, 45° 43' N, 03° 01' E, 880 m a.s.l.), where temperature and precipitation were manipulated at the beginning of a multi-year trial (2009-2012) so as to introduce heat waves and summer water deficit (C: control; CX: control with extremes; WD: water deficit; WDX: water deficit with extremes) with two management intensification levels (Cut-: two cuts per year; Cut+: up to six cuts per year). Improvements were obtained in the estimation of harvested biomass with the modified modelling solutions, in particular with the intensively-managed trial (e.g. modelling efficiency of 0.26-0.47 against negative or near-zero values with the original implementation). In particular, the model performance was substantially improved in the hottest year (2011). These early results are a promising first step. The study is the first in a pipeline of evaluations that will roll out over the coming months against detailed datasets of carbon, water and heat fluxes from long-term observational grassland sites. Model improvements are also ongoing, namely the inclusion of a growth temperature-dependence function for plant respiration.