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Modelling carbon and water fluxes at global scale

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Modelling and predicting seasonal and inter-annual variability of terrestrial carbon and water fluxes play an important role in understanding processes and interactions between plant-atmosphere and climate. Testing the model's capability to simulate fluxes across and within the ecosystems against eddy covariance data is essential. Thanks to the existing eddy covariance (EC) networks (e.g FLUXNET), where CO_2 and water exchanges are continuously measured, it is now possible to verify the model's goodness at global scale.
This paper reports the outcomes of the verification activities of the Land Carbon Core Information Service (LC-CIS) of the Geoland2 European project. The three used land surface models are C-TESSEL from ECMWF, SURFEX from CNRM and ORCHIDEE from IPSL. These models differ in their hypotheses used to describe processes and the interactions between ecological compartments (plant, soil and atmosphere) and climate and environmental conditions. Results of the verification and model benchmarking are here presented. Surface fluxes of the models are verified against FLUXNET sites representing main worldwide Plant Functional Types (PFTs: forest, grassland and cropland). The quality and accuracy of the EC data is verified using the CarboEurope database methodology. Modelled carbon and water fluxes magnitude, daily and annual cycles, inter-annual anomalies are verified against eddy covariance data using robust statistical analysis (r, RMSE, E, BE). We also verify the performance of the models in predicting the functional responses of Gross Primary Production (GPP) and RE (Ecosystem Respiration) to the environmental driving variables (i.e. temperature, soil water content and radiation) by comparing the functional relationships obtained from the outputs and observed data. Obtained results suggest some ways of improving such models for global carbon modelling.