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Parameter optimisation of the ORCHIDEE model using eddy covariance measurements at European forest sites

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ORCHIDEE is a state of the art mechanistic global vegetation model that can be run at local or global scale and can be part of a general circulation model (LMDZ). ORCHIDEE is built on the concept of plant functional types (PFT) to describe vegetation distributions. Species with similar characteristics are re-grouped together (13 PFTs) and different PFTs can coexist in every grid element.

ORCHIDEE uses climate variables as drivers together with a number of ecosystem parameters that have been assessed from laboratory and in situ experiments. These parameters are still associated with a large uncertainty and may vary between and within PFTs in a way that is currently not informed or captured by the model. Recently, the development of assimilation techniques allows the objective use of eddy covariance data to improve our knowledge of these parameters in a statistically coherent approach. The scheme used in this study is an extension of the four-dimensional variational data assimilation system (4D-Var) that will make use of the recent development of the adjoint model of ORCHIDEE.

Data of European forest fluxnet sites are used and assimilated site by site. Several sites within each PFT are available within the dataset, which enables us to test if differences between sites are properly modelled with the current set of equations in the model. This study also tests if there is coherence between optimised parameter values within each PFT and if the forward model response to climate variations is similar within each PFT.

A last but not least important aspect of this study is an uncertainty analysis. This analysis directly follows from the Bayesian optimisation approach, which allows determining uncertainty on the optimised parameter values.