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Multimodel parameter optimization with adaptive population importance sampler (APIS)

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We are optimizing key parameters in soil hydrology and forest water and carbon exchange related formulations in ecosystem model JSBACH, which is the land surface component of the Earth System model of Max Planck Institute for Meteorology (MPI-ESM). The model has been modified to use multiple stomatal/canopy conductance formulations which will vary during the optimization process. Our previous results have shown that JSBACH is lacking in its response to drought, which is the motivation to test the different conductance formulations.

The optimization is done with the adaptive population importance sampler (APIS) algorithm, that provides a global estimation of the selected JSBACH parameters, using all generated samples. Additionally APIS is able to estimate the model evidence (or partition function), which can be used to determine the optimal submodel (conductance formulation). APIS starts with a set of N randomly generated proposals (standard deviations for the parameters), with location parameters spread in the state space. We draw M samples and calculate the partial IS (importance sampler) estimators for each proposal, after which we update the location parameters and each proposal as well as the global estimator for each JSBACH parameter. This process is then repeated a number of times.

The study focuses on boreal coniferous evergreen forests. The optimization is based on site level eddy covariance flux measurements on multiple sites across the Northern Hemisphere, where the parameters are estimated by minimizing the model-data mismatch in evapotranspiration and gross primary production.