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Land Surface Temperature Variational Assimilation within the ORCHIDEE Continental Surface model

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Variational data assimilation of FLUXNET soil surface temperature is applied to the energy and water budgets modules of the ORCHIDEE land surface model. This part of the model, called SECHIBA, describes the exchanges of water and energy between the surface and the atmosphere. The adjoint semi-generator software YAO is used as a framework to implement 4D-VAR assimilation. First, sensitivity analysis was performed in order to validate the adjoint and to identify the most influential parameters. Following, the results of twin experiments using synthetic observations demonstrate the robustness, consistency and flexibility of the process.
Rendundant combinations of parameters and insensitive ones can then be detected, thus allowing to document the most efficient set of parameters to calibrate. However, optimal sets of parameter vary with time of day, season, site and initial state, thus suggesting a calibration strategy based on different time windows and sites to help constrain a larger set of parameter than on a single space-time window.
Doing so on two FLUXNET sites and including initial soil water content as a parameter improves the model output. Although it proved difficult to characterize at the same time state variables and fluxes, this study puts forward the potential of land surface temperature variational data assimilation in model calibration and prediction errors reduction.