

RC1: ['Comment on egusphere-2024-546'](#), Anonymous Referee #1, 19 Apr 2024

The manuscript by Olivia-Guerra et al. investigates the impact of assimilating satellite-retrieved land surface temperature (LST) data into a land surface model, here 'ORCHIDEE'. The authors investigate two different optimization methods for the assimilation, a gradient descent method and a genetic algorithm. The employed methods and experiments are well presented and the results are conclusive: assimilating 3-hourly CCI-LST data into ORCHIDEE and employing GA optimization, which proved to be the consistently superior method, lead to a median reduction of 20% in LST and turbulent fluxes (data from 34 sites and for a 12 year validation period). The manuscript is well structured and written and should be published after the minor points listed below have been addressed.

Reply on RC1

We appreciate the time and effort put into reviewing the paper. We addressed all the specific points in the manuscript. They are listed below, followed by our responses in bold and the quotations we propose to add to the manuscript in italics.

Specific points:

line 102: 'The CCI-LST observations have an associated ...'

R: Done.

line 143: '..., each with increasing grid spacing ...'

R: Done.

lines 152-154: consider reformulating these two sentences - they are difficult to understand.

R: The two sentences were reformulated as follows:

“A prior spin-up simulation was performed at each site to bring soil carbon pools, vegetation state and soil moisture content to equilibrium. This procedure is applied

by running ORCHIDEE for several hundred years recycling the available forcing data with present-day CO₂ concentration.”

line 180: '... assimilations initiated with ...'

R: Corrected.

line 213: 'Based on this test, ... to represent the parameters.'

R: Done. Line 213 was corrected as:

“Based on this test, we use 20 trajectories and 10 levels to represent the parameter space well.”

line 214: '... to each site allows to identify sensitive ...'

R: Done. Line 214 was corrected as:

“The Morris method applied to each site allows to identify the most sensitive parameters for each site.”

line 217: 'For the 34 sites, ...'

R: Done.

line 219: '... in the sensitivity analysis: model parameter name, description and default values ...'

R: Done. The caption of Table 1 was corrected as:

“ORCHIDEE parameters evaluated in the sensitivity analysis: model parameter name, description and default model parameter values are shown. The 11 sensitive parameters to be optimized over the selected site for the twin DA experiment are indicated in bold.”

line 220: 'The 11 sensitive parameters to be optimized for the ES-Abr site in the twin DA ...'

R: Done.

line 235-236: A set of ... to be optimized is then used as prior data in the optimization.

R: Corrected as:

A set of random values for the 11 parameters to be optimized is then used as the prior parameters in the optimizations.

Equation 2: in my opinion there is a bracket around the terms in front of the '100' missing: currently the equation does not provide values in percent.

R: That is correct, the equation 2 was corrected as:

$$RMSD_{reduction} = \left(1 - \frac{RMSD_{post}}{RMSD_{prior}}\right) 100$$

Caption Table 2: 'Example of typical ORCHIDEE parameters optimized in the DA experiments and used to determine the optimum strategy.'

R: The caption was corrected as proposed.

line 279: '... into which specific error components are improving ...'

R: Corrected as proposed:

“Additionally, we employ the decomposition of the Mean Square Error (MSE: Kobayashi and Salam, 2000) to gain deeper insights into which specific error components are improving or degrading.”

Figures 8 and 9: in my opinion the y-axes of the sub-plots should be labelled 'RMSE' instead of 'MSE'; similarly, 'MSD' on the x-axes should be 'RMSD'. In the caption it should then also say 'root mean square difference' (RMSD), for which the definition could be repeated here for clarity.

R: The label 'MSE' was changed to 'RMSE'. The following phrase was added to the caption of Figures 8 and 9:

“For clarity, note that the square root of error components is plotted.”