Geophysical Research Abstracts
Vol. 15, EGU2013-3314-1, 2013
EGU General Assembly 2013

Limiting the parameter space within the Carbon Cycle Data Assimilation System (CCDAS)

Sarah Kemp (1) and Marko Scholze (2)

(1) School of Earth Sciences, University of Bristol, United Kingdom (sarah.kemp@bristol.ac.uk), (2) Department of Physical Geography and Ecosystem Science, Lund University, Sweden (marko.scholze@nateko.lu.se)

More accurate estimates of the net exchange of CO_2 between the terrestrial biosphere and the atmosphere are crucial in improving predictions of future atmospheric CO_2 levels. Better modelling of the carbon cycle strongly depends on improving the parameterisation of the underlying processes. The carbon cycle data assimilation system (CCDAS) is an inverse modelling tool based on a terrestrial biosphere model - Biosphere Energy Transfer and Hydrology (BETHY) scheme. CCDAS is used to seek optimal model parameters consistent with assimilated carbon cycle observations.

Experiments have shown that the identified minimum may contain non-physical parameter values. The use of parameter transformations is one way to avoid this problem, where the optimisation is carried out in a transformed parameter space, thus ensuring that the minimum is in the physical domain. Another technique is to use penalty terms in the cost function that are added when the optimisation begins to search a specified region. It is also possible to use constrained optimisation and so avoid the optimiser searching non-physical regions by placing hard limits there.

We present the results of using these different methods to achieve meaningful parameter values within a simplified version of the model. Five experiments were run. One of the experiments uses a penalty term and one uses constrained optimisation to limit the parameter space of one of the parameters to positive values. Our results show that the penalty term optimisation successfully converged to a minimum, but that the specific parameter still had a slightly negative value. Conversely, our constrained optimisation experiment did not result in convergence at all. The other three experiments were run assuming different probability density functions for one of the parameters and so using different parameter transformations on that parameter, whilst keeping all others the same. For these experiments, the optimisation is successful and the optimised model parameters show no significant difference when the parameter transformation is varied between the three types, converging to the same minimum. Our results therefore suggest that parameter transformations are the most consistent method of limiting the parameter space within the model.