Geophysical Research Abstracts
Vol. 13, EGU2011-11048, 2011
EGU General Assembly 2011

Advanced uncertainty evaluation of climate models and their future climate projections

Heikki Järvinen (1), Petri Räisänen (1), Marko Laine (1), Johanna Tamminen (1), Pirkka Ollinaho (1), Alexander Ilin (2), Erkki Oja (2), Antti Solonen (3), and Heikki Haario (3)

(1) Finnish Meteorological Institute, Helsinki, Finland (heikki.jarvinen@fmi.fi), (2) Aalto University School of Science and Technology, Espoo, Finland, (3) Lappeenranta University of Technology, Lappeenranta, Finland

Uncertainties in future climate projections are often evaluated based on the perceived spread of ensembles of multi-model climate projections, such as those generated in different phases of the Coupled Model Inter-comparison Project. In this paper we concentrate on uncertainties of a single climate model (ECHAM5) and the propagation of these uncertainties in climate projections. These are evaluated using advanced computational techniques. Specifically, we focus on the uncertainties related to model's closure parameters for which the model climate is sensitive. These parameters appear in physical parametrization schemes where some unresolved variables are expressed by predefined parameters rather than being explicitly modeled. Currently, best expert knowledge is used to specify the closure parameter values, based on observations, process studies, large eddy simulations, etc. Accumulation of new measurement data allows constraining the parameter values better than ever before. Only recently it has become possible to study the optimality of the parameters (or their uncertainty distributions, as in our case) by numerical techniques. We approach the question of uncertainty propagation from a probabilistic view point: closure parameters are associated with a posterior uncertainty distribution with respect to a chosen climate metric (sometimes called a "cost" or "objective" function). An ensemble of climate models can be drawn from this distribution and used to assess the uncertainty propagation. Model optimization, on the other hand, could be performed by selecting the model parameters corresponding to the maximum posterior values. In summary, for the evaluation of uncertainty propagation it is essential to excel in the estimation of closure parameter posterior probability distributions (and parameter identifiability) with respect to the chosen metric. For this purpose, we apply efficient adaptive Monte Carlo sampling techniques, developed in part by us. During the last decade these techniques have turned out to be very robust in solving complicated estimation problems in various areas of geophysics. The paper presents estimates of the posterior probability density of closure parameters appearing in a low-resolution version of the ECHAM5 model, related to clouds and precipitation. In our on-going work, we study how these distributions are projected onto uncertainties in ECHAM5 model's climate sensitivity.