Geophysical Research Abstracts
Vol. 12, EGU2010-12624, 2010
EGU General Assembly 2010

Learning about the climate sensitivity

Katsumasa Tanaka (1,2) and Brian O'Neill (2,3)

(1) CICERO (Center for International Climate and Environmental Research – Oslo), Oslo, Norway (katsumasa.tanaka@cicero.uio.no, +47 22 85 87 51), (2) IIASA (International Institute for Applied Systems Analysis), Laxenburg, Austria, (3) NCAR (National Center for Atmospheric Research), Boulder, Colorado, USA

"Learning" is defined as a change in the estimate of an uncertain parameter and its uncertainty with the acquisition of new observations. How the estimate in climate sensitivity might change in the future is an important input to current decision-making on climate policy. To gain insights into this problem, we look into how the best estimate of climate sensitivity and its uncertainty range change over the historical period 1930-2000 as derived through our data assimilation setup described below.

The data assimilation approach has been developed from the inverse estimation setup for the reduced-complexity climate and carbon cycle model ACC2 (Aggregated Carbon Cycle, Atmospheric Chemistry, and Climate model) (Tanaka, 2008; Tanaka et al., 2009). In the inversion approach for ACC2, the best estimates of uncertain parameters are obtained by optimization against various historical observations since 1750 – i.e. we minimize the cost function consisting of the squared misfits between the model projection and observations as well as those between the parameter estimates and their prior weighted by respective prior uncertainties. The uncertainty range for climate sensitivity is indicated by a cost function curve, which consists of the values of cost function for a series of inversions in which climate sensitivity is fixed at values between 1°C and 10°C at intervals of 0.25°C. By progressively feeding historical observations (e.g. temperature records) to this data assimilation setup, we study how the estimates and uncertainty ranges of parameters (e.g. climate sensitivity) are updated over time.

Our preliminary results show that how we learn about climate sensitivity is significantly influenced by how we account for the uncertainty in radiative forcing. Furthermore, regardless of how radiative forcing uncertainty is represented, the evolution of the best estimate of climate sensitivity contains periods of both rising and falling values. This indicates that no matter what the true value turns out to be, there have been periods in which learning proceeded in the wrong direction. Better prediction skills of the decadal and multi-decadal variability in temperature would allow a faster convergence of the estimate of climate sensitivity in the future.

References

Tanaka, K. (2008) Inverse estimation for the simple earth system model ACC2 and its applications. Ph.D. thesis. Hamburg Universität, Germany. International Max Planck Research School on Earth System Modelling, Hamburg, Germany. 296 pp. http://www.sub.uni-hamburg.de/opus/volltexte/2008/3654/

Tanaka, K., T. Raddatz, B. C. O'Neill, C. Reick (2009) Insufficient forcing uncertainty underestimates the risk of high climate sensitivity. Geophysical Research Letters, 36, L16709, doi:10.1029/2009GL039642.