Proposal on Predictability Diagnostics

Xiaogu Zheng

College of Global Change and Earth System Science
Beijing Normal University

General goals: To understand the relations of "radiative forcing, general circulation, temperature-precipitation" and to validate the performance of each coupled general circulation model in simulating the relations in 20th century by the following steps

Step 1: *Validate the simulation of climate models on the variability of tropical SST.*

Principal component analysis will be applied to the observed SST and simulated SST respectively. The derived EOFs will be compared each other. If they are similar, the corresponding principal components will be further compared each other.

Step 2: *Validate the general circulation simulated by climate models.*

For a climate model with correctly simulated the spatiotemporal variability of tropical SST, we validate its performance on simulating general circulations. For this purpose, we think about a seasonal mean of the general circulation comprising three components: the component arising from radiative forcing, the component arising from low frequency oscillations of ocean and atmosphere, and the component arising from intraseasonal variability. Although each component cannot be numerically separated, but their covariance matrices can be estimated (e.g. Zheng et al. 2009).

The singular value decomposition will be applied to covariance matrices of the simulated and observed component fields. The EOFs for simulations and observations are compared each other. If they are similar, the corresponding principal components are further compared each other (Grainger et al. 2009; Zheng et al. 2009).

Whatever possible, statistical seasonal prediction schemes (e.g. Zheng et al 2008) will be developed using Compo Twentieth Century Reanalysis data and the newly established HadlSST2. The established statistical seasonal prediction scheme will be further validated using simulated data.

Step 3. Validate simulated temperature and precipitation

First, the decomposition methodology described in step 2 is applied to decompose the cross-covariance matrices between temperature (or precipitation) and circulations. In this way, we try to derive how temperature (or precipitation) changes associated with the change of general circulations.

Moreover, the partial least square regression (Martens and Naes, 1989) will be applied to study how daily variability of temperature and precipitation are associated with the variability of the dominant circulation patterns of each component.

Step 4. *Validate and improve climate models*

Base on the analysis results at step 2-3, summarize the simulated relation "radiative forcing-general circulation-temperature precipitation". Analyze reasons on why some observed relations are not well simulated, and improve models' simulation based on the reasons.

References

Martens, H. and T. Naes, 1989: Multivariate Calibration. Chichester etc. Wiley.

Grainger, S., C. S. Frederiksen, X. Zheng, D. Fereday, C. K. Folland, E. K. Jin, J. L. Kinter, J. R. Knight, S. Schubert, J. Syktus, 2009 Modes of variability of Southern Hemisphere atmospheric circulation estimated by AGCMs. *Climate Dynamics*，doi 10.1007/s00382-009-0720-7.

Zheng, X., D. Straus, and C. S. Frederiksen, 2008: A variance decomposition approach to the prediction of the seasonal mean circulation: comparison with dynamical ensemble prediction using NCEP's CFS. The Quarterly Journal of the Royal Meteorological Society, 134, 1997-2009.

Zheng, X., D. Straus, C. S. Frederiksen and S. Grainger, 2009: Potentially predictable patterns of seasonal mean geopotential heights in an Ensemble of Climate Simulations with COLA AGCM. The Quarterly Journal of the Royal Meteorological Society, 135, 1816-1829.