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MIROC-lite: a new EMIC based on MIROC

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Earth system models of intermediate complexity (EMICs), proposed in 1980s to bridge the gap between simple (box) and comprehensive models (i.e., GCMs), are becoming essential tools for investigating the uncertainty of climate projection. In IPCC's AR4, eight EMICs are listed, while the EMIC network introduces 13 models as of June 2005 (http://www.pik-potsdam.de/emics).

For uncertainty analysis with traceable model hierarchy, we are now trying to establish a new EMIC named MIROC-lite based on a Japanese GCM, MIROC. The model, originally developed in 2001 by one of the authors and his colleagues, is consists of an ocean GCM (i.e., COCO) and an energy moisture balance model (EMBM) for atmosphere, of which major characteristics are an explicit consideration of the Hadley circulation and diagnoses of wind stress and of meridional freshwater flux. Similarly to other same-type EMICs, MIROC-lite as it stands is not able to represent the North Atlantic meridional overturning circulation (NAMOC). As a preliminary experiment before incorporating freshwater flux (FWF) adjustment, we attempted the "sprinkler" freshwater cycle scheme which uniformly redistributes the terrestrial precipitation to all ocean grids and obtained an acceptable equilibrium climatology.

Using the current (sprinkler) scheme the freshwater removed from the North Atlantic is significantly less than that calculated from observation/reanalysis data or the mother GCM. Uniform return of the terrestrial freshwater to all ocean surfaces enabled the NAMOC to appear even if the total freshwater removal from the North Atlantic is insufficient.

Despite the unrealistic freshwater balance, MIROC-lite with sprinkler (6x6 degree with 15 layer ocean, after 5,000 year run with 36 hour time step) outputs a comparable equilibrium climatology to other EMICs using FWF adjustment (e.g., GENIE). The comparison to the NCEP/NCAR reanalysis and the World Ocean Atlas datasets turned out that atmospheric temperature, sea surface temperature/salinity are acceptably represented, while as a common problem of EMBMs, significant error remains in precipitation, particularly in land.