Geophysical Research Abstracts
Vol. 12, EGU2010-1621, 2010
EGU General Assembly 2010

Energetics of IPCC4AR Climate Models: Energy Balance and Meridional Enthalpy Transports

Valerio Lucarini (1,2) and Francesco Ragone (3)

(1) Department of Meteorology, University of Reading, Reading, UK (v.lucarini@reading.ac.uk), (2) Department of Mathematics, University of Reading, Reading, UK (v.lucarini@reading.ac.uk), (3) Meteorologisches Institut, KlimaCampus, University of Hamburg, Hamburg, Germany (francesco.ragone@zmaw.de)

We consider the climate simulations performed using pre-industrial and SRESA1B scenarios and analyse the outputs of the state-of-the-art models included in IPCC4AR. For control simulations, large energy biases are present for several models both when global climate budgets and when energy budgets of the atmospheric, oceanic, and land subdomains are considered. The energy biases depend on the imperfect closure of the energy cycle in the fluid components of the climate system and on issues in the treatment of phase transitions and heat fluxes over land. Additionally, the consequence of a positive global energy bias, which is what most models feature, is the underestimation of the thermodynamic emission temperature of the planet and of the globally averaged surface temperature. This may help explaining the cold bias of climate models. Models agree on the representation of meridional enthalpy transports in terms of location of the peaks of the total and atmospheric transports, whereas quantitative disagreements of the order of 20% are present. In a warmer climate, the intensity of the transports increases, thanks to latent heat enhancement, whereas the location of the maxima are almost unchanged, except for a poleward shift of the atmospheric transport in the southern hemisphere. Large disagreements exist on the representation of the ocean transport and of its response to CO_2 increase. Advances in numerical schemes as well as in the representation of physical processes are still needed for providing a well-defined and self-consistent representation of climate as a non-equilibrium thermodynamical system. This is a key point for improving the models' skill in representing future and past climate changes and should be taken into great consideration in climate modelling initiatives.