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Climatic impacts of stochastic air-sea fluxes in a coupled GCM

PD Williams

University of Reading, Department of Meteorology, Reading, United Kingdom (p.d.williams@reading.ac.uk)

Air-sea fluxes of heat and moisture contain structures too small to be explicitly resolved by global coupled atmosphere-ocean general circulation models (GCMs). In the air-sea moisture flux, for example, small-scale precipitation structures could be caused by unresolved clouds and small-scale evaporation structures could be caused by unresolved turbulence in the surface wind field.

In an attempt to capture the climatic impacts of such structures, coupled GCM experiments are performed in which the air-sea fluxes are stochastically perturbed. Stochastic approaches are used increasingly widely by climate modellers (e.g. Palmer and Williams, 2008). The stochasticity impacts significantly upon the simulated mean climate, especially in the tropics. A physical mechanism to explain the impacts is proposed: the ocean responds asymmetrically to random positive and negative surface buoyancy perturbations, systematically deepening the mixed layer, cooling the equatorial surface ocean, and weakening the atmospheric Hadley circulation. The experiments therefore yield a new mechanistic understanding of the detailed climatic impacts of stochastic air-sea fluxes.

Reference

Tim Palmer and Paul Williams (Editors), Stochastic Physics and Climate Modelling, special issue of *Philosophical Transactions of the Royal Society A*, **366**(1875), pp 2419–2641, 2008. http://publishing.royalsociety.org/stochastic-climate