The Austral Summer Monsoon in the CMIP models

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Objectives

We propose to investigate the climatology, variability, and potential anthropogenic alteration of the austral summer monsoon in the CMIP2 and CMIP2+ CGCMs. The primary goal of this proposal will be to compare the monthly climatology of the austral summer monsoon between the various CMIP2 and CMIP2+ models and observations. For models that produce a reasonable monsoon climatology, we will further investigate the interannual (for CMIP2 and CMIP2+) and daily to intraseasonal (for CMIP2+) variability of the austral summer monsoon. Finally, the effect of anthropogenic forcing will be investigated using the transient CO_2 simulations provided in CMIP2 and CMIP2+.

Background

The austral summer monsoon is a dominant feature of the tropical seasonal cycle, bringing heavy precipitation to Indonesia and northern Australia during the austral summer months. The monsoon onset varies from year to year, but typical progresses in a southeastward direction from (about) October through January (see, e.g., Tanaka, 1994). Monsoon retreat generally follows the opposite path, occurring from February through April. Variability (from daily to interannual time scales) in the rate and duration of precipitation strongly influences the accumulated precipitation over the monsoon season. On interannual time scales precipitation over Indonesia during monsoon onset has been shown to be strongly affected by ENSO (Haylock and McBride, 2001).

Despite the austral summer monsoon's importance locally and in global climate, investigations of its simulation by coupled general circulation models (CGCMs) are relatively scarce (Suppiah, 1995; Meehl and Arblaster, 1998). Our own research indicates that some coupled and uncoupled models have difficulty reproducing the general features of the climatology and variability associated with the austral summer monsoon. Furthermore, the question of how the climatology and variability of the austral summer monsoon changes with anthropogenic forcing is relatively unexplored. The CMIP2+ offers an unprecedented opportunity to investigate these details of the austral summer monsoon in a suite of CGCMs. By identifying characteristics of models that realistically simulate the austral summer monsoon we hope to gain an understanding of the processes essential for this simulation, as well as the processes that accompany monsoon evolution in nature.

Methodology

The study will begin by comparing the monthly climatology of the austral summer monsoon between CMIP2 and CMIP2+ CGCMs and observations. For the CMIP2 simulations, a monthly climatology of precipitation, SLP, and surface temperature will be compared between simulations; in the CMIP2+ simulations, the variables investigated will be augmented by other appropriate variables, such as 850mb and 200mb winds (as available). For the CMIP2+ simulations that produce a reasonable monsoon climatology, details of the monsoon onset will be examined using daily data (if applicable).

Once simulations that generate a reasonable monsoon climatology are identified, the variability of the monsoon in these simulations will be investigated. For the CMIP2 simulations, this will be limited to interannual variability of monsoon precipitation, and its relation to ENSO. In the CMIP2+ simulations, examination of monsoon variability will be expanded to daily and intra-seasonal time scales (including monsoon 'break' periods) using daily data of precipitation and winds.

Finally, the effect of anthropogenic forcing on the austral summer monsoon will be examined using the transient CO_2 simulations provided in the CMIP2 and CMIP2+ data. The monsoon characteristics in the transient simulations will be compared to the control simulation of the same model.

To facilitate comparison between the CMIP simulations and observations, whenever possible we will try to use analysis techniques that are used in existing observational studies. Statistical techniques will primarily include composite differences, and regression and correlation analysis. Observational comparisons will be made with current literature, as well as calculations using the NCEP reanalysis and CMAP precipitation products, and station data where applicable.

References

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Tanaka, M., 1994: The onset and retreat dates of the austral summer monsoon over Indonesia, Australia, and New Guinea. *J. Met. Soc. Jap.* **72**, 255-266.