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The representation of north Australian rainfall in CMIP5

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As general circulation models (GCMs) are routinely used to make projections of future rainfall (for example, the simulations available as part of the 5th Coupled Model Intercomparison Project, CMIP5), it is important to assess whether the processes that cause precipitation are represented well. If those processes are poorly represented then it is important to identify and account for them in order to make the best projections. The work presented here (along with the associated papers) identifies some of the features that are important for producing rainfall over northern Australia in a selection of CMIP5 models run under Atmospheric Model Intercomparison Project (AMIP) conditions (prescribed sea surface temperatures). The diurnal cycle of the low-level flow around the north-west Australian heat low is represented well; however, the nocturnal rearrangement of the flow leads to night-time convergence and then to convective rainfall. This forced convection is unlikely to occur in the real world; however, this forced nocturnal precipitation is an important contributor the modelled total precipitation in this region. Interestingly, the occurrence of such rainfall in these simulations (associated with convergence within the heat low overnight) may not be restricted to Australia.

The models also produce precipitation too early in the day, which is associated with the early triggering of convection from surface heating. Despite these errors in the timing of precipitation, the CMIP5 models assessed here are capable of representing the synoptic features responsible for initiating rain. Moreover, there is evidence that some of these systems have their origins in the mid-latitudes. Nevertheless, errors in the modelled seasonal mean precipitation appear to be associated with both the strength of the mean northerly flow onto the continent and the vertical mass flux over the continent. Furthermore, there is also evidence that it is ultimately the representation of convection in these models that is the important contributor to the precipitation biases identified, and not the synoptic features that initiate it.