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The influence of land warming on precipitation and atmospheric circulation change

Robin Chadwick (1), Duncan Ackerley (2), and Dietmar Dommenget (2)

(1) Met Office, Hadley Centre, Exeter, United Kingdom (robin.chadwick@metoffice.gov.uk), (2) ARC Centre of Excellence for Climate System Science, School of Earth, Atmosphere and Environment, Monash University, Australia

One robust aspect of climate change is that the land surface warms more than the ocean surface, and this is expected to influence precipitation and the atmospheric circulation. A new set of experiments are described, where the effect of land surface temperature change on precipitation and circulation change is isolated, and compared with the effects of sea-surface temperature (SST) change, direct CO_2 radiative forcing, and the plant physiological effect. Land warming generally leads to enhanced low-level convergence and precipitation over land, while SST warming leads to reduced precipitation over land and increases over the oceans. However the combination of the two effects is strongly nonlinear. Direct radiative forcing drives precipitation change both through heating of the atmosphere, and through land warming, and this is particularly important in some monsoon regions. The plant physiological effect directly drives large reductions in transpiration and precipitation over tropical forest regions, as stomata close in response to elevated CO_2 concentrations. However the plant effect also produces significant land warming, which leads to increased convergence and precipitation in some tropical forest regions. Therefore the overall result of the plant effect in each region depends on the balance between these two mechanisms.