Geophysical Research Abstracts
Vol. 18, EGU2016-18324, 2016
EGU General Assembly 2016

Amplification of El Niño by cloud longwave coupling to atmospheric circulation

Gaby Raedel (1), Thorsten Mauritsen (1), Bjorn Stevens (1), Dietmar Dommenget (2), Daniela Matei (1), Katinka Bellomo (3), and Amy Clement (4)

(1) Max Planck Institute for Meteorology, Hamburg, Germany, (2) Monash University, Melbourne, Australia, (3) Lamont-Doherty Observatory of Columbia University, New York, USA, (4) Rosenstiel School of Marine and Atmospheric Science, University of Miami, Florida, USA

The El Niño/Southern Oscillation(ENSO) is the dominant mode of inter-annual variability, with major impacts on social and ecological systems through its influence on extreme weather, droughts and floods. The ability to forecast El Niño, as well as anticipate how it may change with warming, requires an understanding of the underlying physical mechanisms that drive it. Among these, the role of atmospheric processes remains poorly understood. Here we present numerical experiments with an Earth system model, with and without coupling of cloud radiative effects to the circulation, suggesting that clouds enhance ENSO variability by a factor of two or more. Clouds induce heating in the mid and upper troposphere associated with enhanced high-level cloudiness over the El Niño region, and low-level clouds cool the lower troposphere in the surrounding regions. Together, these effects enhance the coupling of the atmospheric circulation to El Niño surface temperature anomalies, and thus strengthen the positive Bjerknes feedback mechanism between west Pacific zonal wind stress and sea surface temperature gradients. Behaviour consistent with the proposed mechanisms robustly represented in other global climate models and in satellite observations. The mechanism suggests that the response of ENSO amplitude to climate change will in part be determined by a balance between increasing cloud long wave feedback and a possible reduction in the area covered by upper-level clouds.