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Regional climate model sensitivities to parametrizations of convection and non-precipitating subgrid-scale clouds over South America

Stefan Lange (1,2), Burkhardt Rockel (3), Jan Volkholz (2), and Bodo Bookhagen (4)

(1) Department of Physics, Humboldt University, Berlin, Germany, (2) Potsdam Institute for Climate Impact Research, Germany, (3) Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Germany, (4) Department of Geography, University of California, Santa Barbara, USA

This study provides a first thorough evaluation of the COnsortium for SMall scale MOdeling weather prediction model in CLimate Mode (COSMO-CLM) over South America. Simulations are driven by ERA-Interim reanalysis data. Next to precipitation we examine the surface radiation budget, cloud cover, 2 m temperatures, and the low level circulation. We evaluate against reanalysis data as well as observations from ground stations and satellites.
Our analysis focuses on the sensitivity of results to the parametrization of non-precipitating subgrid-scale clouds in comparison to the sensitivity to the convective parametrization. Specifically, we compare simulations with a relative humidity versus a statistical subgrid-scale cloud scheme, in combination with convection schemes according to Tiedtke (1989) and from the European Centre for Medium-Range Weather Forecasts (ECMWF) Integrated Forecasting System (IFS) cycle 33r1.
The sensitivity of simulated tropical precipitation to the parametrizations of convection and subgrid-scale clouds is of similar magnitude. We show that model runs with different subgrid-scale cloud schemes produce substantially different cloud ice and liquid water contents. This impacts surface radiation budgets, and in turn convection and precipitation.
Considering all evaluated variables in synopsis, the model performs best with the (both non-default) IFS and statistical schemes for convection and subgrid-scale clouds, respectively. Despite several remaining deficiencies, such as a poor simulation of the diurnal cycle of precipitation or a substantial austral summer warm bias in northern Argentina, this new setup considerably reduces long-standing model biases, which have been a feature of COSMO-CLM across tropical domains.