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Climate modelling uncertainty over southern Africa attributable to land-surface characteristics

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A database of land-surface characteristics is used to derive a land-surface classification for southern Africa as an alternative to the default USGS classification used with the NOAH land-surface scheme in the Pensylvannia State-NCAR MM5 regional climate model. The two land surface classifications are used, along with two alternative convective parameterisation schemes (together nominally encompassing the observed regional hydrological cycle), to simulate two representations of southern African climate during both a dry and a wet season.

Differences in the regional climate due to changing the land-surface characteristics are conditionally analysed, based on the synoptics of the daily circulation. Over Namibia/Angola uncertainty in land-surface characteristics leads to changes in convection, which alter the dynamics of the lower troposphere and the geopotential east-west gradient. Changes in the surface latent heat flux and advection of air at 600 hPa alters the potential instability of the atmosphere towards the east. Such changes are more apparent when the model is forced by upper-atmospheric (300 hPa) positive geopotential height anomalies and further modified by synoptic forcing in the lower atmosphere (850 hPa). Changes in dynamics and cloud cover extend over the neighbouring Atlantic Ocean and alter land-sea exchange over the west coast. The correct representation of the land surface over southern Africa is therefore important to reduce uncertainty in the simulation of regional climate. Given observed and projected changes in synoptic forcing, these results suggest that an appropriate representation of the evolving future land surface is important in credibly simulating the future climate of the region.