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Simulation of tropical-temperate troughs over southern Africa: Impacts of convection schemes

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Southern African summer rainfall simulated in three versions of an atmospheric general circulation model differing only in the convection scheme is examined with a special focus on tropical temperate troughs (TTTs). All three versions provide satisfactory simulations of key aspects of the summer (November-February) rainfall, such as the spatial distribution of total rainfall and the percentage of rainfall associated with TTTs. However, one version has a large bias in the onset of the rainy season. Results from self-organizing map (SOM) analysis on daily precipitation data revealed that this is because the occurrence of TTTs is underestimated in November. This model bias is not related to westerly wind shear that provides favorable condition for the development of TTTs. Rather, it is related to excessive upper level convergence and associated subsidence over southern Africa, which is forced by strong convection in the far western tropical Pacific.

Furthermore, the models are shown to be successful in capturing drier (wetter) conditions over the southern African region in El Nino (La Nina) years. The SOM analysis reveals that nodes associated with TTTs in the southern (northern) part of the domain are observed less (more) often during El Nino years, while nodes associated with TTTs occur more frequently during La Nina years. Also, nodes with dry condition over southern Africa are more (less) frequently observed during El Nino (La Nina) years. The models tend to perform better for La Nina, because they are more successful in capturing the frequency of different synoptic patterns.

Keywords: El Nino/Southern Oscillation, Atmospheric general circulation model, Self-organizing map