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How well do reanalyses represent the southern African precipitation?

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Monthly mean precipitation observations over southern Africa are used to evaluate the performance of eight global reanalyses: ERA-40, ERA-interim, JRA-25, MERRA, CFSR, NCEP-R1, NCEP-R2 and 20CRv2. All eight reanalyses reproduce the regionally averaged seasonal cycle fairly well; a few spatial mismatches with the observations are found in the climate mean for the rainy season. Principal component analyses show a dipole in the leading modes of all reanalyses, however with crucial differences in its spatial position.

Possible reasons for the differences between the reanalyses are discussed on the basis of the ERA-interim and 20CRv2 results. A comparison between the moisture transports shows that ERA-interim manifests a very strong moisture convergence over the eastern equatorial Atlantic, resulting in the strong precipitation here. This excessive convergence may be due to the water-vapor assimilation. Over the Indian Ocean, the ITCZ is shifted northward in ERA-interim compared to its position in 20CRv2. This discrepancy is most likely attributable to the meridional SST gradients in the Indian Ocean which are significantly larger in the ERA-interim than those in the 20CRv2, and the resulting atmospheric response prevents a southward shift of the ITCZ. Overall, the consistent description of the dynamical circulation of the atmosphere and the hydrological cycle appears as a crucial benchmark for reanalysis data.

Based on our evaluation, the preferential reanalysis for investigating the climate variability over Southern Africa is 20CRv2 that furthermore spans the longest time period, hence permitting the most precise investigations of interannual to decadal variability.