



Atmospheric Circulation Variability in the Tropics and the Northern Hemisphere During the Past 100 Years

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Documenting the variability of the large-scale atmospheric circulation during the past is important in order to better understand – and eventually predict – interannual-to-decadal climate variability. The large-scale tropical circulation features such as the Hadley and Walker cells and the monsoon systems play a particularly important role not only because of the effects within the tropics, but also because of their teleconnections to the extratropics. Here we present time series of large-scale atmospheric circulation indices back to 1900 and compare these with output from a 9-member “all forcings” ensemble calculation by a general circulation model. The indices represent the main features of the zonal mean circulation in the northern hemisphere in boreal winter (such as the Hadley circulation and the subtropical jet) as well as aspects of the regional and large-scale circulation (the Indian monsoon and the Pacific North American pattern, PNA). Back to 1948 the indices are taken from NCEP/NCAR reanalysis and are statistically reconstructed based on historical upper-air and surface data prior to 1948. We discuss the interannual-to-decadal variability of the index time series and compare them with possible driving factors, such as El Niño/Southern Oscillation, volcanic eruptions and solar activity. The results show that the interannual variability of the Hadley cell and subtropical jet is well reproduced in the model ensemble mean (and hence potentially predictable), whereas the poleward extent of the Hadley cell and the latitude of the subtropical jet are less well predictable. For all indices, the correlation between observations and model ensemble mean agree favourably well with the correlations between individual ensemble members. We find that the source of predictability is mainly related to ENSO. On the decadal scale small but significant effects of solar variability are found.