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Long-term precipitation variability in Morocco and the link to the large-scale circulation in recent and future climates

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ABSTRACT: Monthly precipitation data from the Global Historical Climatology Network for 42 stations in Morocco and its vicinity are investigated with respect to baroclinicity, storm track and cyclone activity, moisture transports, North Atlantic Oscillation (NAO) variations, and different circulation types by means of correlation and composite studies. The results are related to a climate change scenario from an ECHAM4/OPYC3 transient greenhouse gas only (GHG) simulation. Precipitation in northwestern Morocco shows a clear link to the baroclinic activity over the North Atlantic during boreal winter (DJF). In large precipitation months the North Atlantic storm track is shifted southward, more westerly and northwesterly circulation situations occur and moisture transports from the Atlantic are enhanced. The occurrence of local cyclones and upper-level troughs is more frequent than in low precipitation months. The negative correlation to the NAO is relatively strong, especially with Gibraltar as a southern pole (-0.71). The northward shift of the storm track and eastward shift of the Azores High predicted by the ECHAM model for increasing GHG concentrations would therefore be associated with decreasing precipitation and potentially serious impacts for the future water supply for parts of Morocco. In the region south of the Atlas mountains, moisture transports from the Atlantic along the southern flank of the Atlas Mountains associated with cyclones west of Morocco and the Iberian Peninsula can be identified as a decisive factor for precipitation. Northeastern Morocco and Northwestern Algeria, however, is rather dominated by the influence of cyclones over the Western Mediterranean that are associated with a strong northwesterly moisture transport. As both regions appear to be less dependent on the North Atlantic storm track and more on local processes, a straight forward interpretation of the large-scale changes predicted by the ECHAM4/OPYC3 cannot be done without the application of down-scaling methods in the future.