Geophysical Research Abstracts,
Vol. 11, EGU2009-5577, 2009
EGU General Assembly 2009

North Atlantic Oscillation and European summertime heat and drought waves

G. Wang and A. J Dolman

VU University Amsterdam, Earth Science Institute, Hydrology and Geo-environment Department, Amsterdam, Netherlands (gwang@falw.vu.nl)

Theoretical research suggests that summertime heat and drought waves are preceded by reduced winter and spring precipitation and soil moisture where there is a strong land-atmosphere feedback. Due to a positive feedback, the land atmosphere system may become locked into two preferred summer modes, a dry and hot one or a cool and wet one, according to the initial spring water situation. However, this internal mechanism of land needs to be further observationally confirmed with considerable accuracy.

Precipitation and temperature observations from gridded CRU TS3.0, spanning 1901-2005, are used to study the causality between winter/spring precipitation (JFM in this study) and European summertime temperature and precipitation (JJA). We use a coupled manifold technique to produce the manifolds of summertime temperature and precipitation forced by JFM precipitation; and then the coupling modes between JFM precipitation and forced manifolds of JJA temperature and precipitation are extracted with SVD analysis. We find significant associations between JFM precipitation and summertime climate with considerable accuracy (significance level=0.01 for temperature and 0.05 for precipitation). The summertime temperature and precipitation are associated with the same JFM precipitation pattern with only one significant anomaly over Mediterranean areas. Reduced JFM precipitation around the Mediterranean triggers northward propagating summertime heat and drought waves. This emphasizes the critical role of land-atmosphere feedback in maintaining the European climate. North Atlantic Oscillation is the dominating atmospheric circulation over North Atlantic sector in winter. The resultant principal components of SVD analysis show a strong correlation with winter NAO index (JFM, correlation coefficient=0.75). NAO is a north-south shift (or vice versa) in the track of storms and depressions across the North Atlantic Ocean and into Europe. The Atlantic storms that travel into Europe control precipitation, resulting in a wet northern Europe and a dry Mediterranean Europe during a high NAO winter, and the opposite during a low NAO winter. A precipitation reduction around the Mediterranean caused by high NAO can be sustained and enhanced by positive land-atmosphere feedback, generating northward propagating hot and dry summers.