Centennial Timescale Variability in Euro-Mediterranean Hydroclimate Since the Little Ice Age

Serena R. Scholz[1], Richard Seager[2], Mingfang Ting[2], Yochanan Kushnir[2]

[1]University of Michigan, [2]Lamont-Doherty Earth Observatory of Columbia University

Understanding natural patterns of variability within the Earth's climate system is a crucial component of being able to predict how the climate will evolve over time. Variations in hydroclimate and drought are often difficult to reconstruct in the period before instrumental records, yet have influenced human societies. We use the recently released Old World Drought Atlas (OWDA), a tree-ring based hydroclimate reconstruction across Europe and the Mediterranean, to examine centennial timescale variations in hydroclimate modes from the Little Ice Age to the present day (1600-2012). Unexpectedly, the North Atlantic Oscillation (NAO) plays a dominant role in determining summer hydroclimate over Europe and the Mediterranean only during the 20th century. In prior centuries the leading mode of variability is centered around the English Channel with little expression in the Mediterranean region. Further, we find a marked centennial-timescale pattern of hydroclimate change across Europe, with a wet shift occurring in the British Isles and from Northern France to Germany during the late 19th century. This wet shift has the spatial pattern of the identified leading mode of interannual variability occurring in the OWDA before the 20th century. The wet shift manifests as a change to positive states of this leading mode. The change in hydroclimate is also consistent with limited historic rain gauge data. It appears connected to a hemisphere-scale atmospheric wave train, but connections to remote sea surface temperature variations are tenuous. The causes of this centennial-scale wet shift are unknown, but it does not seem to be externally forced. There is evidence within OWDA that similar shifts have occurred in past centuries as well. It will be discussed whether state-of-the-art climate models can simulate patterns of variability with this spatial pattern and low frequency behavior.