Geophysical Research Abstracts
Vol. 18, EGU2016-15846, 2016
EGU General Assembly 2016

Atmospheric drivers that compromise the assumed long-term stationarity between δ^{18}O-based proxy records and NAO, winter air temperature and winter precipitation amount.

Laia Comas Bru (1), Frank McDermott (1,2), and Martin Werner (3)

(1) UCD School of Earth Sciences, University College Dublin, Dublin 4, Ireland., (2) UCD Earth Institute, University College Dublin, Belfield, Dublin 4, Ireland., (3) Alfred Wegener Institute. Helmholtz Centre for Polar and Marine Research. Division Climate Science - Paleoclimate Dynamics. Bussestr. 24, D-27570 Bremerhaven, Germany

The control exerted by large scale atmospheric circulation modes on the oxygen isotopic composition of precipitation ($\delta^{18}O_p$) has been utilised to infer past atmospheric circulation states using proxies that capture $\delta^{18}O_p$ at a wide range of locations. Such reconstructions typically rely on the oxygen isotopic composition of terrestrial archives such as ice-cores, tree rings, speleothems and lacustrine carbonates and are underpinned by assumptions about a long term stationarity of the influence of the atmospheric teleconnection pattern of interest on $\delta^{18}O_p$. However, such reconstructions should also consider the uncertainties that arise from non-stationarities in the $\delta^{18}O_p$-NAO relationship during the instrumental period. Here, new insights into the causes of these temporal non-stationarities are presented for the European region using both observations (GNIP database) and the output of an isotope-enabled general circulation model (ECHAM5-wiso). The results show that, although the East Atlantic (EA) pattern is generally uncorrelated to $\delta^{18}O_p$ during the instrumental period, its polarity affects the strength of the $\delta^{18}O_p$-NAO relationship in some European locations. Non-stationarities in this relationship can be rationalised through changes in the sea-level pressure structure in the N. Atlantic region as a result of the concomitant states of the NAO and EA patterns, which affect the trajectories of the air-masses carrying moisture onto Europe and ultimately the $\delta^{18}O_p$ signal. These shifts are consistent with those reported previously for NAO-winter climate variables and the resulting non-stationarities mean that δ^{18}O-based NAO reconstructions could be compromised if the balance of positive and negative NAO/EA states differs substantially in a calibration period compared with the period of interest in the past. The same approach has been followed to assess the relationships between $\delta^{18}O_p$ and both winter total precipitation and winter mean surface air temperature, with similar results. This study also identifies regions within Europe where temporal changes in the NAO, air temperature and precipitation can be more robustly reconstructed using δ^{18}O time series from natural archives, irrespective of concomitant changes in the EA. Identification of such regions is crucial so that resources can be focused into the areas least affected by such non-stationarities.