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Impact of precipitation intermittency on NAO-temperature signals in proxy records

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In mid and high latitudes, the stable isotope ratio in precipitation is driven by changes in temperature, which controls atmospheric distillation. This relationship forms the basis for many continental paleoclimatic reconstructions using direct (e.g. ice cores) or indirect (e.g. tree ring cellulose, speleothem calcite) archives of past precipitation. However, the archiving process is inherently biased by precipitation intermittency. Here, we use two sets of atmospheric reanalyses (NCEP and ERA-interim) to quantify this precipitation intermittency bias, by comparing seasonal (winter and summer) temperatures estimated with and without precipitation weighting. We show that this bias can reach locally 6 to 10 °C and has large inter-annual variability. We then assess the impact of precipitation intermittency on the strength and stability of temporal correlations between seasonal temperatures and the North Atlantic Oscillation. Precipitation weighting reduces the correlation between winter NAO and temperature in some areas (e.g. Québec, South-East USA, East Greenland, East Siberia, Mediterranean sector) but does not alter the main patterns of correlation. The importance of the precipitation intermittency bias with respect to other processes affecting precipitation isotopic composition is further analysed using outputs of an atmospheric general circulation model enabled with stable isotopes and nudged to reanalyses (LMDZiso). In winter, LMDZiso shows similar correlation values between the NAO and both the precipitation weighted temperature and precipitation δ18O, thus suggesting limited impacts of moisture origin. Correlations of comparable magnitude are obtained for the available observational evidence (GNIP and Greenland ice core data). Our findings support the use of archives of past precipitation δ18O for past NAO reconstructions.