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Arctic temperature and moisture trends during the past 2000 years – Progress from multiproxy-paleoclimate data compilations

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Instrumental climate data and climate-model projections show that Arctic-wide surface temperature and precipitation are positively correlated. Higher temperatures coincide with greater moisture by: (1) expanding the duration and source area for evaporation as sea ice retracts, (2) enhancing the poleward moisture transport, and (3) increasing the water-vapor content of the atmosphere. Higher temperature also influences evaporation rate, and therefore precipitation minus evaporation (P-E), the climate variable often sensed by paleo-hydroclimate proxies. Here, we test whether Arctic temperature and moisture also correlate on centennial timescales over the Common Era (CE). We use the new PAGES2k multiproxy-temperature dataset along with a first-pass compilation of moisture-sensitive proxy records to calculate century-scale composite timeseries, with a focus on longer records that extend back through the first millennium CE. We present a new Arctic borehole temperature reconstruction as a check on the magnitude of Little Ice Age cooling inferred from the proxy records, and we investigate the spatial pattern of centennial-scale variability. Similar to previous reconstructions, v2 of the PAGES2k proxy temperature dataset shows that, prior to the 20th century, mean annual Arctic-wide temperature decreased over the CE. The millennial-scale cooling trend is most prominent in proxy records from glacier ice, but is also registered in lake and marine sediment, and trees. In contrast, the composite of moisture-sensitive (primarily P-E) records does not exhibit a millennial-scale trend. Determining whether fluctuations in the mean state of Arctic temperature and moisture were in fact decoupled is hampered by the difficulty in detecting a significant trend within the relatively small number of spatially heterogeneous multi-proxy moisture-sensitive records. A decoupling of temperature and moisture would indicate that evaporation had a strong counterbalancing effect on precipitation and/or that shifting circulation patterns overwhelmed any multi-centennial-scale co-variability.