

Horizontal moisture transport shapes the regional moistening patterns in the Arctic

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We address the regional and seasonal trends in the horizontal moisture transport in the Arctic during the last four decades, in 1979–2018, based on data of ERA5 reanalysis.

Compared to previous studies, the advantage of our approach is that

- (1) the role of horizontal moisture transport is not only limited to transport to and from mid-latitudes across a certain latitudinal belt, e.g., 70°N,
- (2) evaporation in the Arctic is not only counted as a circumpolar mean.

Accordingly, we specifically address the regionally varying moisture transport and evaporation within the Arctic.

Regional and seasonal trends of moisture transport are large, and they are strongly associated with the changes in atmospheric circulation and mean sea level pressure.

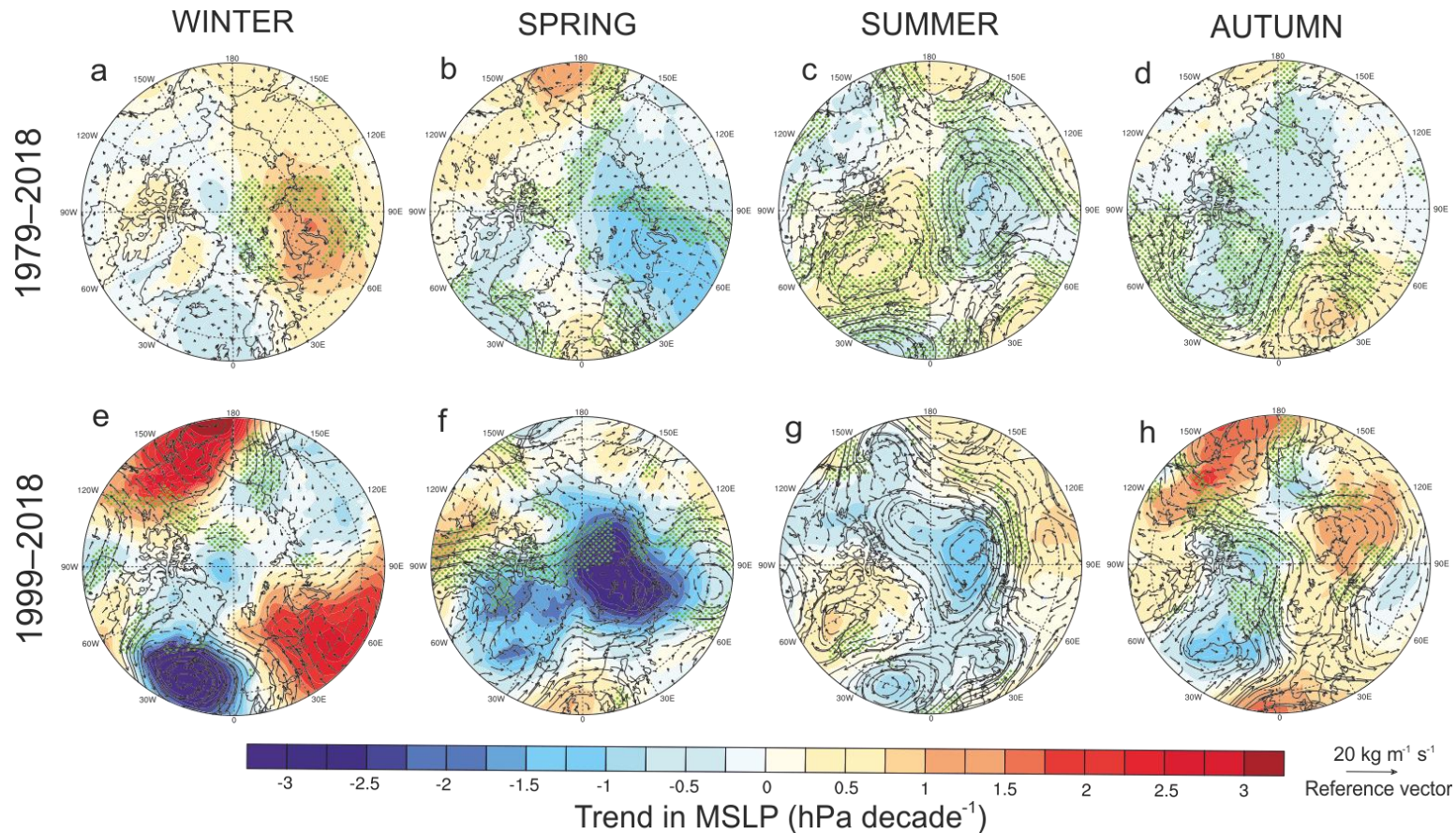


FIG. Linear trends in MSLP (in color) and horizontal net moisture transport (in vectors) in ERA5 for the periods 1979–2018 (a–d) and 1998–2018 (e–h), divided into winter (a, e), spring (b, f), summer (c, g) and autumn (d, h). The green dotted areas denote where the linear trends in meridional and/or zonal components of moisture transport are statistically significant at the 90% confidence level.

Long-term changes:

WINTER: enhanced northward moisture transport in the Atlantic and Pacific sectors.

SPRING: increased moisture transport over the Laptev Sea and further towards the Canadian Archipelago.

SUMMER: intensified moisture transport along the Eurasian coast.

AUTUMN: increased moisture transport from the North Atlantic.

Moisture transport has had a dominant role for determining the regional changes in total column water vapor, whereas the role of local evaporation has been minor.

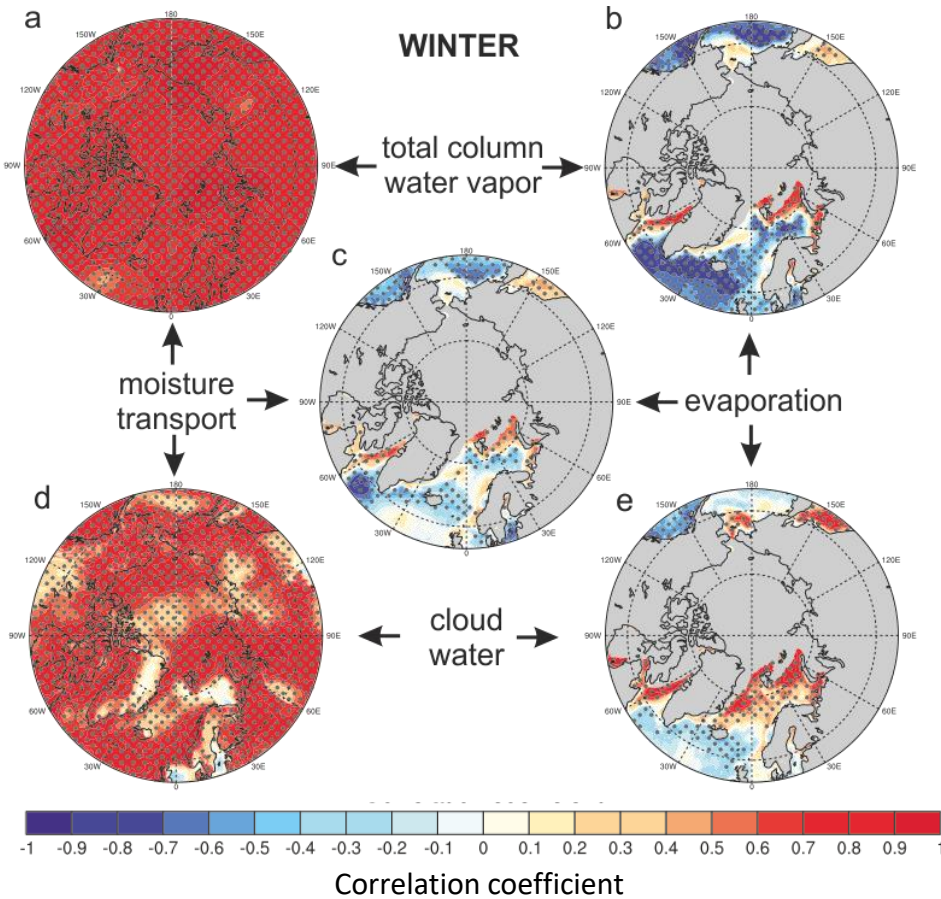


FIG. Linear correlations between annual means of variables in ERA5 during the period 1979–2018. The arrows indicate the variables included in the correlations. The dotted areas denote the correlations which are statistically significant ($p < 0.10$). The gray areas mask the regions where the seasonal mean magnitude of evaporation is smaller than 0.5 mm day^{-1} .

Increases in evaporation have been restricted to the vicinity of the sea ice margin over a limited period during the local sea ice decline.

After the sea ice has disappeared from a region, evaporation over the open sea has had negative trends due to the effect of horizontal moisture transport to suppress evaporation.