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Labrador Sea surface temperature control on the summer weather in the Eastern Europe

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Many studies have addressed the linkages between the Arctic Amplification and mid-latitude weather patterns. Most of them have focused on the effects of changes in sea ice, terrestrial snow or open ocean SST on the air temperature in selected mid-latitude areas. However, when analysing such potential linkages, one should be aware that from the point of view of the atmosphere it is almost the same whether the thermal forcing originates from the sea ice melt, snowmelt, or changes in SST. Most important is to quantify how the atmosphere responds to anomalies in the surface temperature and then affects weather patterns in remote areas.

For this purpose, we studied the hemispheric-scale relationships between anomalies in the Northern Hemisphere Earth surface temperature (Ts) and 2-m air temperature (T2m) in mid-latitudes (Central and Eastern Europe). Using regression analyses based on the ERA-Interim reanalysis data, we assessed the said temperature relationships with focus on the lagged monthly and inter-seasonal linkages. Technically we divided the Northern Hemisphere in equal areas with a size of 15x10 degrees and calculated correlation coefficients for the monthly mean temperatures between all defined regions from one side and the Central/East European study regions from another side over the period 1979-2014.

Using this approach, we found that the strongest links in the considered kind of relationships take place between spring sea surface temperature in the Labrador Sea and summer air (T2m) temperature in the Eastern Europe. In order to confirm the correlation results obtained, to identify thermal forcing factors and to assess their relative importance, we analysed the multiyear averages and anomalies of various meteorological parameters for 10 coldest and 10 warmest springs and summers in the period 1979-2014: surface pressure, total precipitation, sea-ice and total cloud cover, wind components, surface solar radiation downwards, surface heat fluxes and air trajectories.

The results show that the remote effects are strongest with a time lag from spring to summer. The Labrador Sea Ts variations in spring have a detectable impact on the thermodynamics of the local atmosphere in spring; particularly positive surface heat flux anomalies are larger in years with a high spring Ts. Also, there is a detectable effect on anomalies in the atmospheric pressure field and wind components. These springtime anomalies over the Labrador Sea region favour certain planetary wave patterns during summer. Thus, spring cold (warm) conditions over Labrador Sea are a precursor for summer low pressure and temperatures (high pressure and temperatures) over Eastern Europe.

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