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Decadal-scale predictability of Eurasian summer precipitation: the role of AMV

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Climate impact of the Atlantic Multidecadal Variability (AMV) on the Northern Eurasia is poorly documented in literature due to the lack of observations in space, limited by the local fighting weather conditions, and in time, i.e. the analysed timescale is too long compared to the observational record (∼120 years). To overcome this limitation, an idealized modelling approach designed in CMIP6 Decadal Climate Prediction Project is applied, based on the CMCC-CM2-SR5 coupled model: the North Atlantic sea surface temperature are continuously nudged towards the positive (negative) AMV anomalies to simulate the warm (cold) AMV phase. An ensemble of 32 members is performed for each experiment, in which all the forcings are set at the pre-industrial values for a 10-year integration time.

Model results shows that, during Boreal summer, a positive phase of the AMV induces a circumglobal east-west wave train across the entire Northern Hemisphere. Enhanced westerly winds alters the climatological upper-troposphere circulation, advecting moisture from the North Atlantic Ocean along the northern part of the Eurasian continent. In particular, over Siberia, an anomalous geopotential dipole promotes the poleward movement of specific humidity from the Pacific Ocean, converging at high latitudes with the aforementioned westerly flux.

Moisture anomalies regionally contribute to May-to-August rainfall, intensifying multidecadal precipitation over Scandinavia and Eastern Russia. Interestingly, rainfall rises by 10% of its climatology over Siberia, where the AMV-induced moisture fluxes converges.

Furthermore, this study also points out that the AMV has a role in modulating the freshwater balance of the Arctic Ocean, due to the anomalous precipitation over the Siberian rivers' watersheds (Ob', Yenisei and Lena). Siberia is a key region for the hydrological cycle of the Arctic Ocean and the catchment areas of these three large rivers accounts for about 46% of the Arctic freshwater input provided by terrestrial sources. We find a decrease of sea surface salinity (about 12% of model climatology, broadly consistent with the anomalous river discharge) in the proximity of the river mouths during positive-AMV years.

These results disclose the potential predictability of precipitation over northern Eurasian via tropical-extratropical pathway, associated with multidecadal fluctuations of the North Atlantic sea surface temperatures, in agreement with recent observational studies.

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