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Western weather patterns and winter precipitation in the Hindu-Kush Karakoram

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In this work we study western weather patterns (WWP), westerly perturbations responsible for most of the precipitation falling over the Hindu-Kush Karakoram (HKK) during winter, and the mechanisms responsible for their regulation. WWP originate from the northeastern Atlantic and the Mediterranean, move eastward and often intensify east of about 40°E before they reach the HKK region.

Particular attention is given to the analysis of the link between the North Atlantic Oscillation (NAO) and these systems. To this end, we use 1) an ensemble of precipitation datasets, including satellite TRMM observations, three raingauge-based datasets (APHRODITE, CRU and GPCC), the ERA40 reanalyses and the global climate model EC-Earth, 2) evaporation, specific humidity, geopotential and wind data from ERA40 and EC-Earth, 3) a NAO index computed for ERA40 and EC-Earth from sea level pressure data. Our analysis shows that winter precipitation over the HKK exhibits a high interannual variability and above (below) than normal precipitation is found in correspondence of the positive (negative) NAO phase. The Persian Gulf, the northern Arabian Sea and the Red Sea are important moisture sources for winter precipitation in the HKK and enhanced evaporation from these reservoirs occurs during the positive NAO phase. We investigate the association between enhanced evaporation, changes in surface wind intensity and humidity transport towards the HKK.

EC-Earth is able to capture the NAO-precipitation signal over the HKK and the mechanisms associated with the WWP described above. Further investigations will include the possibility to repeat the WWP analysis with EC-Earth for the last century (from 1850) and for the future (until 2100) under different emission scenarios, in order to investigate possible changes that occurred and might occur in the WWP activity and the consequences for precipitation in the Karakoram.