Separating ENSO and NAO signatures in the North Atlantic

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ENSO is known to affect climate in remote areas of the world, including the mid- and high-latitudes. Its impacts are evident and well-understood for some extra-tropical regions, such as the North Pacific, while the ENSO influence on the North Atlantic-European (NAE) sector is still under debate, concerning both the amplitude of the impacts and the underlying dynamics driving the teleconnection. The difficulties in detecting the ENSO-related signal in the North Atlantic are mainly due to the large internal variability of the region, and to the tendency of the ENSO signature to project on a dipole-like pattern that resembles the North Atlantic Oscillation (NAO), particularly at surface. The nature of the relationship between this "NAO-like" ENSO signal and the actual NAO is controversial, and unravelling this link represents a first step towards better understanding the ENSO-NAE teleconnection and potentially improving the seasonal prediction capabilities for this region.

The ENSO-forced signal over the NAE sector is examined in late winter (JFM), when it appears to be strongest and fully-established. The linear response to SST anomalies in the Nino3.4 region is assessed in reanalysis data extending back to the beginning of the 20th century (NOAA 20CR, ECMWF ERA-20C) for variables at both surface and upper levels, including the lower stratosphere. The resulting ENSO-related patterns are compared with the corresponding NAO signatures, computed analogously via linear regression onto the PC-based NAO index. Transient-eddy diagnostics from daily data provide additional insight into the dynamical aspects related to the two teleconnections. Outputs from AMIP-type runs of comparable length (>100 yrs) are also analyzed, considering sets of 10-member ensembles from different models (e.g. ICTP AGCM/SPEEDY, ECMWF IFS). This approach allows to better distinguish SST(ENSO)-forced signals from NAO-related internal variability, by separately examining the ensemble-mean and the residuals around it, respectively. The tropospheric and stratospheric pathways of the ENSO-NAE teleconnection are further assessed analysing 100-year long, coupled integrations of EC-EARTH3.1 with three different configurations: L91 / top at 0.01hPa, L62 / top at 5hPa, L91 with nudged stratosphere to climatology from 10hPa upwards.

Key words: ENSO teleconnections, NAO, Rossby wave dynamics, stratospheric variability