



Improved seasonal prediction of winter NAO through ensemble sub-sampling.

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Over the North Atlantic, the North Atlantic Oscillation (NAO index represented as the difference in sea level pressure between the Azores islands and Iceland) is a major mode of winter climate variability. The seasonal and shorter term variability of the NAO has widespread impacts on changes in temperature and precipitation, marine ecosystems and storm track location. Results of the seasonal prediction system based on the mixed resolution CMIP5 version of the Max Planck Institute for Meteorology Earth System Model (MPI-ESM-MR) will be presented. In our 30-member ensemble re-forecast over the period from 1982 to 2014 the correlation between the ensemble mean and ERA-Interim winter NAO index is 0.52. Moreover, based on the knowledge that the NAO index is connected with dynamical variability of the Earth system over a large geographical region through teleconnections, we investigate the impact of autumn state of the Earth system on the subsequent winter NAO. We show that the predictive skill for the winter NAO can be significantly enhanced through ensemble sub-sampling considering the physical mechanisms behind the longer term predictive potential of the autumn state and the subsequent winter NAO. By retaining only the ensemble members that show a physically coherent evolution between the the initial autumn state and the subsequent winter NAO state, the correlation coefficient between the forecasted and reanalysed winter NAO index significantly increases from the ensemble-mean to the sub-sampled ensemble-mean from 0.52 to 0.85. For the selection of the ensemble members, only observations from the initial state are taken into account, hence the presented approach is applicable in current operational (seasonal) prediction systems.