Essential Role of Mid-latitude Air-Sea Interactions over the North Atlantic and North Pacific in the Occurrence of Euro-Atlantic Blocking

Ho-Nam Cheung\textsuperscript{1} and Nour-Eddine Omrani\textsuperscript{2}

\textsuperscript{1}Sun Yat-sen University, School of Atmospheric Sciences, China (zhanghlan5@mail.sysu.edu.cn)
\textsuperscript{2}Geophysical Institute, University of Bergen, Norway (Noureddine.Omrani@uib.no)

Atmospheric blocking ("blocking") is a crucial dynamic driver of extreme weather (e.g., severe/long-lasting cold spells, heat waves, drought and flood) over the extratropical region, where blocking occurs most frequently in boreal winter over the Euro-Atlantic and North Pacific sectors. In the state-of-the-art climate models, however, blocking frequency over the mid-latitude Euro-Atlantic sector is generally underestimated. Recent studies have pinpointed the importance of air-sea interactions over the North Atlantic in the formation of Euro-Atlantic blocking. In this study, we will demonstrate that the occurrence of Euro-Atlantic blocking is also related to the remote forcing from the North Pacific. Based on novel semi-idealized atmospheric general-circulation model experiments, we depict the impact of tropical and extratropical SST over different basins on the physical processes of Euro-Atlantic blocking events. We will show that the SST fronts over the mid-latitude North Atlantic and North Pacific jointly contribute to the occurrence of Euro-Atlantic blocking, whereas the contribution of tropical SST is relatively small. A budget analysis of the vorticity equation reveals that both high-frequency (< 8 days) and low-frequency (> 8 days) forcing contribute to the formation of Euro-Atlantic blocking events. The high-frequency forcing is associated with the intensification of an extratropical cyclone over the northwestern/central Atlantic, which is related to the North Atlantic storm tracks. The low-frequency forcing is associated with the eastward propagation of a Rossby wavetrain from North America to the Euro-Atlantic region. We will demonstrate how these physical processes are attributed to the North Atlantic and North Pacific SST fronts. Overall, our results provide new insights into the fundamental dynamics of Euro-Atlantic blocking events.