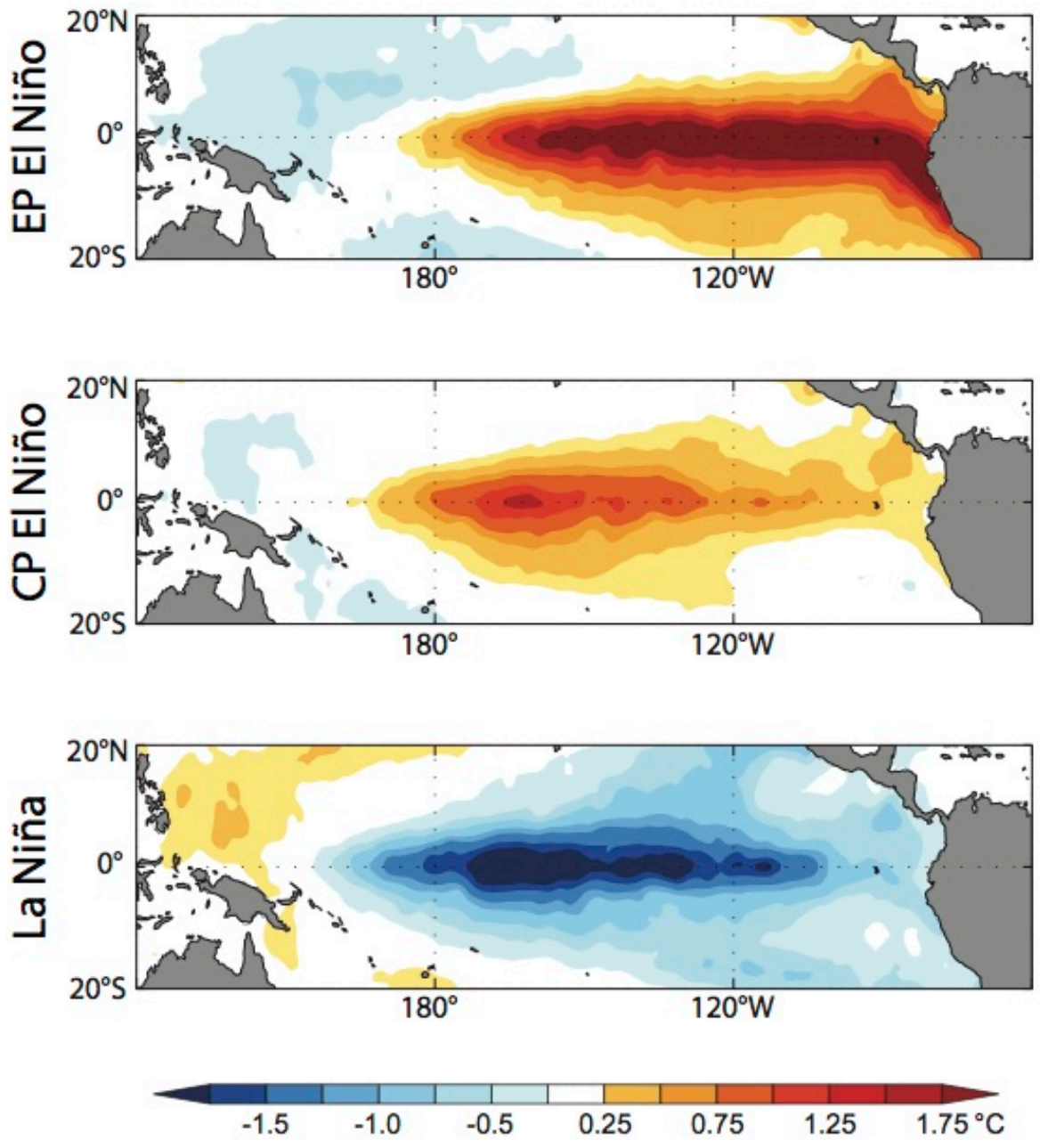
El Nino influences the formation of low pressure systems over the Gulf Stream

October 25 2016



El Niño patterns. Credit: Sebastian Schemm (UiB/ BCCR)

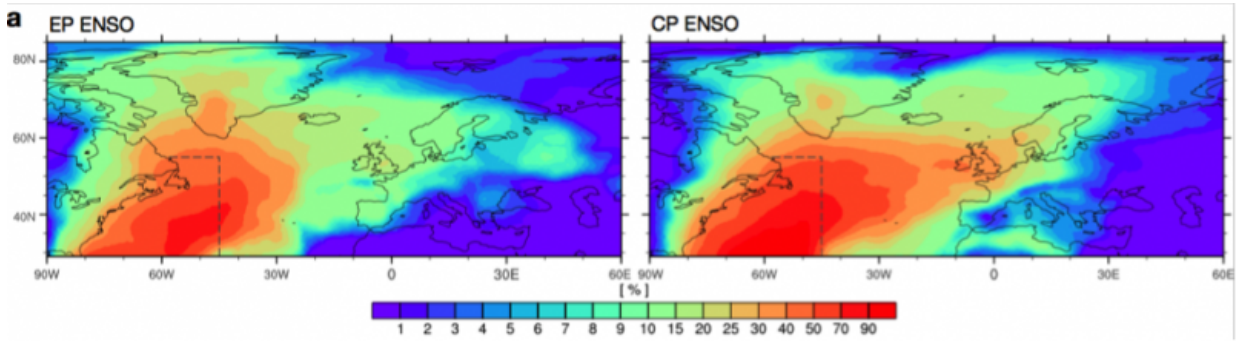
Analysis of cyclone tracks and precyclogenesis flow conditions show us that El Niño can shift the preferred cyclogenesis position over the Gulf Stream which influences the cyclone's track across the North Atlantic.

Northern Europe is located at the end of the North Atlantic storm track and the low pressure systems that bring this area precipitation typically form above the Gulf Stream or at the southern tip of Greenland. A recent study published in the Journal of the Atmospheric Sciences, by Sebastian Schemm, Laura Ciasto, Camille Li and Nils Gunnar Kvamstø reveals how ENSO affects the formation of low pressure systems over the Gulf Stream area and consequently their tracks across the North Atlantic. The results are based on the analysis of the wintertime precyclogenesis flow across North America during three ENSO variants in an observation-constrained reanalysis dataset.

Analysis is centered around a comparison of the upper-level precyclogenesis flow across North America during ENSO winters characterized by maximum warm sea surface temperature anomalies in three locations: (1) the eastern Pacific (EP El Nino); (2) central Pacific (CP El Nino); and (3) western Pacifc (La Niña).

The key results reveal a northward shift of the precyclogenesis flow during CP El Niño that is not evident during EP El Nino and La Nina winters, which are more consistent with the climatological precyclogenesis flow. Climatologically, the precyclogenesis flow follows a subtropical path from the Pacific across North America along the U.S.–Mexican border and the Gulf of Mexico and then northeastward

towards Cape Hatteras. The precyclogenesis air is guided by a large-scale trough located downstream of the Rocky Mountains (a trough is a quasi stationary southward extension of cold polar air characterized by, for example, relatively low geopotential). During La Niña winters, the flow is similar as in the climatology. During EP El Niño winters, the precyclogenesis air follows a slightly southerly path, but during both seasons Gulf Stream cyclogenesis occurs in its climatologically preferred location, which is below the right entrance of the North Atlantic jet stream. During CP El Niño winters, however, the precyclogensis flow is shifted northward.



The fraction of Gulf Stream cyclones in the North Atlantic during an (a) eastern Pacific and (b) a central Pacific El Niño-influenced winter. In (b) more cyclones veer into the Nordic Seas and affect Norway, while in (a) more cyclones track eastward towards continental Europe. The dashed lines indicate together with the coastline what was defined as the Gulf Stream area. Credit: Sebastian Schemm (UiB/BCCR)

As a result, the precyclogenesis flow heads northeastward in the lee of the Rocky Mountains, instead of eastward, and the low pressure systems form east of Nova Scotia, which is approximately 2000 km northeastward from the climatological cyclogenesis location and is

located below the left exit of the North Atlantic jet stream. The dynamics underlying the shift of the precyclogenesis is a change in the nature of the upper-level flow from wave propagation characterized by more anticyclonic shear (EP El Niño, La Nina) to more cyclonically sheared conditions (CP El Niño).

During CP El Niño winters, the tracks of Gulf Stream cyclones preferentially veer into the Nordic Seas. During EP El Niño winters, cyclones veer more zonally, affecting central Europe and the U.K (cf. Figure 1). The results indicate possible future changes in heat and moisture transport into higher latitudes by cyclones from the Gulf Stream region, depending on future changes of ENSO. Further the study points to additional linkages between tropical convection sites, the life cycle of weather systems in the North Atlantic and even the climate in Arctic regions that remain to be explored.

More information: Sebastian Schemm et al. Influence of Tropical Pacific Sea Surface Temperature on the Genesis of Gulf Stream Cyclones, *Journal of the Atmospheric Sciences* (2016). DOI: 10.1175/JAS-D-16-0072.1

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