Geophysical Research Abstracts
Vol. 21, EGU2019-13419, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

# Summer North Atlantic SST and atmospheric circulation patterns in a changing climate

Efi Rousi (1), Dim Coumou (1,2), Stephan Rahmstorf (1), and Stephen Griffies (3)

(1) Potsdam Institute for Climate Impact Research, RD1 Earth System Analysis, Potsdam, Germany (rousi@pik-potsdam.de), (2) VU University of Amsterdam, Institute for Environmental Studies, Amsterdam, Netherlands, (3) NOAA Geophysical Fluid Dynamics Lab, Princeton, USA

North Atlantic oceanic and atmospheric variability is central in determining the behavior of surface climate and hence the occurrence of extremes over the Northern Hemisphere, which in turn have huge impacts on societies, economies and environment. The aim of this study is to gain further insight on the evolution of SST and atmospheric circulation patterns in the context of a changing climate.

We use the CM2.6 model, which is the latest version of a series of high-resolution global coupled climate models developed by the NOAA Geophysical Fluid Dynamics Laboratory, with a horizontal resolution of 0.1° (roughly equal to 10km) in the ocean, and a coarser resolution of 0.5°in the atmosphere (50km). Two 80-year long experiments are used, a control simulation with constant pre-industrial atmospheric $CO_2$ concentrations (CR) and a run with $CO_2$ increasing 1% per year until doubling in year 70 and held constant thereafter (2x$CO_2$).

We apply Self-Organizing Maps (SOMs), a topology preserving clustering algorithm, to obtain SST and geopotential height (gph500) patterns and we evaluate the model against observations and reanalysis data. We find that the model reproduces the observed patterns very well, even with the use of an objective clustering technique.

We then look at changes in frequency and persistence of the patterns in the 2x$CO_2$ run. As expected, the SST response to the $CO_2$ doubling is much more straightforward than the atmospheric response. However, there are patterns in both fields that differ in frequency and amplitude under a changing climate, along with some emerging patterns, which cannot be ordered in any of the CR clusters. Among the latter, a wave-like atmospheric pattern is found in summer months that resembles the one associated with severe heatwaves in Europe during the last decades. There are different possible causes behind those emergent atmospheric patterns under increasing $CO_2$, among which the role of the Arctic Amplification and the slowdown of the Atlantic Meridional Overturning Circulation, that are both prominent in recent years and are common features in future scenarios. Both processes are linked to weakening westerlies in summer over the Atlantic sector, favoring quasi-stationary wave-trains and persistent hot-dry extremes over Europe. Those emerging atmospheric patterns will be further examined regarding their SST precursors and their composites of different climate parameters over Europe.