North Atlantic Subpolar Gyre evolve in two distinct phases under global warming

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North Atlantic subpolar gyre (SPG) plays a crucial role in determining the regional sea level and in distributing heat throughout the ocean basin, which effects the ocean surface temperature (SST) and has profound implications on the surrounding continental and coastal climate. In spite of the profound influences, the evolution of the SPG under anthropogenic warming is unclear. Here, using observations and the Max Planck Institute-Grand Ensemble simulations, we show that as the global mean surface temperature approaches 2K warming, SPG is intensifying, causing cooling of subpolar North Atlantic SST, known as the warming hole. This intensification is initiated by the salinity-driven density reduction on the eastern side of SPG, driven by a weakening Atlantic meridional overturning circulation. However, for warming beyond 2K, the SPG intensification stops and stabilizes resulting in the cessation of the warming hole. Furthermore, a northward shift of the zonal winds leads to a northward shift of subtropical gyre. Hence, initially, the ocean and thereafter the atmosphere drives the anthropogenically forced changes in the North Atlantic gyres in two distinct phases.