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Long-term trends in the dynamical properties of the North Atlantic atmospheric circulation across reanalyses and model simulations

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Mid-latitude flows are characterized by chaotic dynamics and recurring patterns pointing to the existence of an atmospheric attractor. Using recent developments in dynamical systems theory, we diagnose the instantaneous dynamical properties of the atmospheric circulation over the North Atlantic for: several reanalysis datasets (20CR, ERA20CM, CERA20C, NCEP-NCAR) including all of their ensemble members; historical simulations for 26 CMIP5 models; and a 40-member ensemble of historical and future simulations (RCP 2.6 and 8.5 scenarios) for the CESM model. We measure the number of degrees of freedom (local dimension) and the persistence of daily averaged sea-level pressure (SLP). The effects of the seasonal cycle and of the AMO (Atlantic Multidecadal Oscillation) Index are also analysed.

We find some discrepancies between reanalyses. In terms of trends in the SLP the dimension decreases for both reanalyses and models except for CERA20C. The models with a coupled ocean (CERA and CESM) display a decreasing trend in local dimension, the ones with a prescribed ocean an increasing trend. The persistence remains roughly steady. We also find some changes in historical vs. future trends for models.