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A new record of Atlantic sea surface salinity since 1896 reveals the influence of climate variability and global warming

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Sea surface salinity (SSS) is a major ocean circulation component and indicator of the hydrological cycle. Here, we investigate an unprecedented Atlantic SSS compilation from 1896–2013 and analyze the main modes of SSS decadal variability. The data are compiled from independently-validated and bias-corrected in situ datasets, including oceanographic research sections, weather ships, and ships-of-opportunity transects, and measurements from the World Ocean Database. The data are binned into 32 boxes of length scale 100–1000km, covering most of the Atlantic between 20°S–70°N with annual (1-2-1 filtered) resolution.

Using principal component analysis, we find that the low-latitude (tropical and subtropical) Atlantic and the subpolar Atlantic have distinct variability. Subpolar and low-latitude SSS are negatively correlated, with subpolar SSS anomalies leading low-latitude anomalies by about a decade. Subpolar SSS varies in phase with the Atlantic Multidecadal Oscillation (AMO), whereas low-latitude SSS varies in phase with the North Atlantic Oscillation (NAO). Additionally, northern tropical SSS is anticorrelated with Sahel rainfall, suggesting that it reflects the position of the Atlantic Intertropical Convergence Zone. The long-term SSS trend shows amplification of the mean SSS field, with subpolar freshening and low-latitude salinification. Regressing out the AMO and NAO reconciles the trend since 1970 with the long-term trend. This pattern may reflect an intensification of the hydrological cycle due to global warming, as well as Arctic cryosphere melting and Agulhas inflow.