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The North Atlantic surface layer and the shallow overturning circulation

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The sea surface salinity maximum (SSS-max) is an integral part of the shallow overturning (SOC) circulation in the North Atlantic. The temperature and salinity of the SSS-max set the density of the subducted water thus are important for the transport properties of the SOC, which has been shown to be important for the large-scale climate. The region requires a net influx of freshwater at near surface level to balance net evaporation. The processes that achieve this task likely influence the variability of SSS-max properties on various time scales in addition to the surface forcing. We are testing the hypothesis that changes in the large-scale wind field in the North Atlantic drive variability of freshwater import by ocean processes into the SSS-max, resulting in seasonal and interannual variability as previously documented.
To evaluate the role of said processes for the variability of the upper limb of the SOC, AQUARIUS sea surface salinity (SSS), eddy kinetic energy (EKE) derived from altimetry data (AVISO), sea surface temperature (SST, NOAA OI SST V2) and wind fields (NCEP reanalysis) are used. Previous studies point out the importance of mesoscale dynamics for the freshwater flux into the region which seems to be enhanced by an increased density gradient at the southern edge of the SSS-max as seen from 2012 to 2013. The interannual comparison of meridional density gradient and EKE underline the importance of baroclinic instability for the formation of mesoscale turbulence in the SSS-max in accordance with previous studies. Further analysis, using the SST gradient (extending further back in time than the SSS satellite record) reveals significant seasonal cycles of zonal wind, SST gradient and EKE within the SSS-max region. Spatial correlations between aforementioned variables within the SSS-max region are found, with the EKE peaking about 2-4 months after the large-scale temperature gradient and the zonal wind. Ekman induced set up of the meridional density gradient might be a mechanism for seasonally enhanced mesoscale turbulence, which could be important for the seasonal mixed layer budget as well as interannual variability in surface properties within the SSS-max.