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Impact of Ocean Warming and Natural Variability on the Stratification and Mixed Layer Depth around Iceland

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The ocean around Iceland witnesses some of the most important transformations of water masses that drive the Global Ocean Circulation. Here, we analyze 28 years of continuous four-yearly hydrographic sections around Iceland from 1990 to 2018. The water-mass properties around Iceland show important spatial variability. From their temperature, salinity and stratification structure, we classified the Icelandic waters in three distinct regions with similar characteristics: the Southwest, the North and Northeast regions. The warm and salty Atlantic Waters that dominate the Southwest show the deepest winter mixed layer (~500m) while the North and Northeast have relatively shallow (< 100m) to moderate (~100m) winter mixed layer depth.
Based on the decomposition of the total stratification into temperature and salt contributions, we find that the subsurface summer stratification is mainly dominated by temperature except for the North and Northwest regions where salinity dominates.

The interannual variability of the mixed layer and its water properties is also large around Iceland. Mixed layer waters were generally colder in the 90's, then warmed until approximately 2015, and became colder again from 2015 to 2018. Except for the southwestern region, the observed interannual variability seems unrelated with the North Atlantic Oscillation, and its main forcing remains an open question to address in future studies. Only in the northeastern region a multidecadal mixed layer warming trend clearly emerges from the interannual variability. This is associated with the Atlantification of the Arctic, which is also observed from the northward displacements of the isotherms derived from satellite SST. Elsewhere, rather than clear trends, we observe changes in the structure of the mixed layer temperature and salinity that compensate in

density. The present study provides an unprecedented and detailed regional description of the seasonal to decadal variability of the mixed layer depth and the stratification, and their link with the changing North Atlantic under global warming.