**Figure S1.** Mean (1993 - 2016) seasonal cycle of air-sea flux of buoyancy (Bsurf*), heat (Q) and freshwater (FWF*) averaged on the Irminger region (pink box in Fig. 1). Data origin: ERA-Interim, accumulated every 24h.
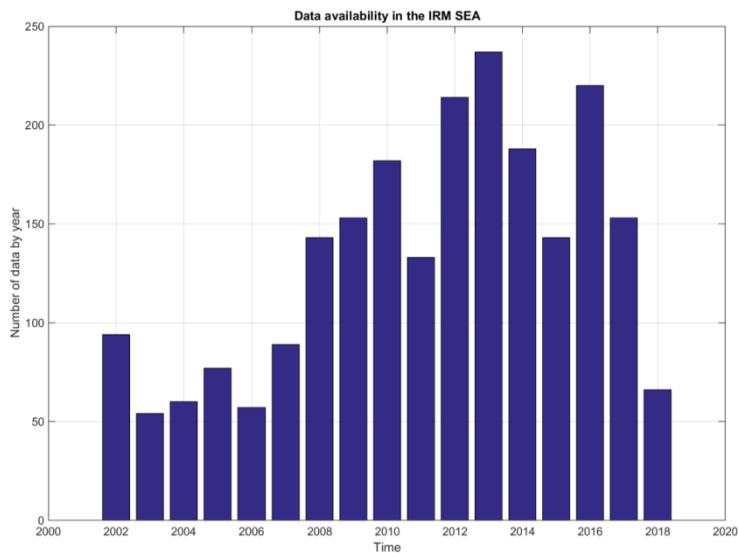
**Figure S2**. Number of Argo profiles by year used in Figure 5.
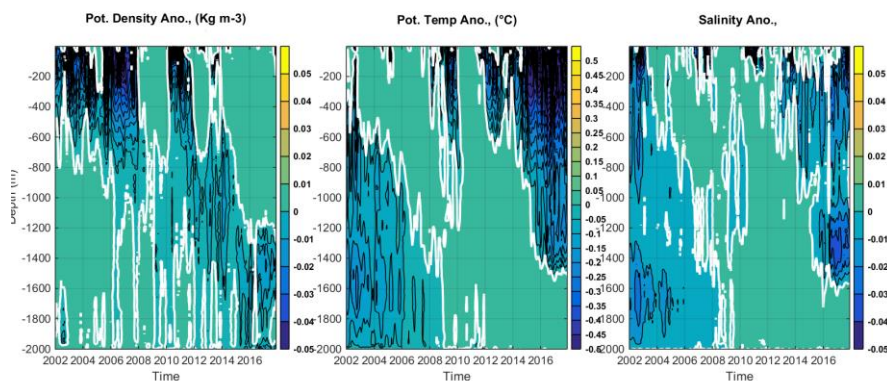
**Figure S3**. Evolution of vertical profiles of monthly anomalies of $\sigma_0$ (left panel), $\theta$ (central panel) and S (right panel), at 59°N, 40°W in the Irminger Sea. The anomalies were estimated from the ISAS database (Gaillard et al., 2016), they were referenced to the monthly mean estimated for the period 2002 – 2016. The white line represents anomaly equal to 0.
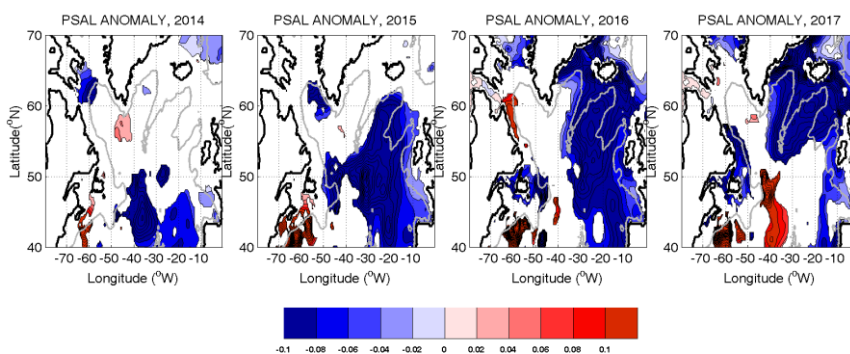
**Figure S4**. Annual anomalies of salinity in the surface layer (20 – 100 m) estimated from ISAS database. Reference period: 2002 – 2016. We represented only anomalies larger than one standard deviation of the mean.