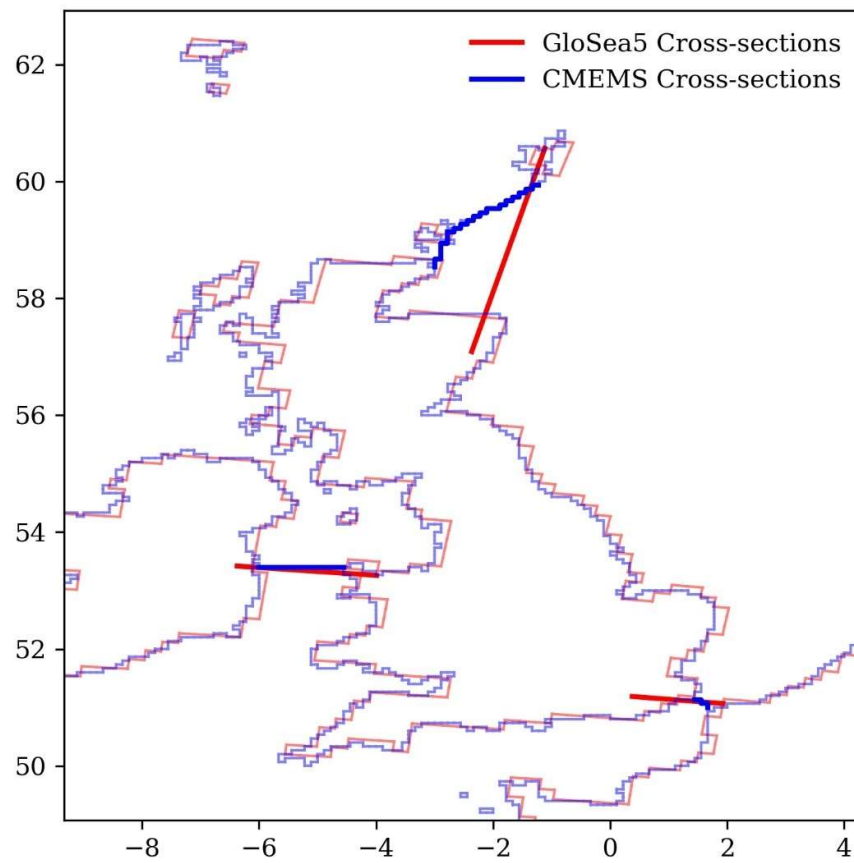
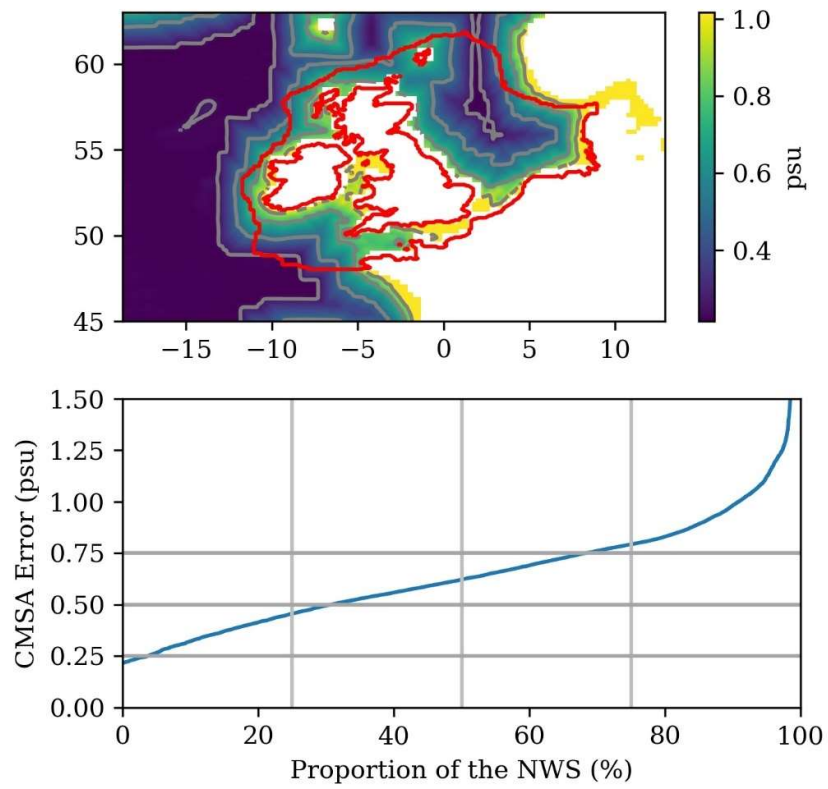


## Supplementary Figures

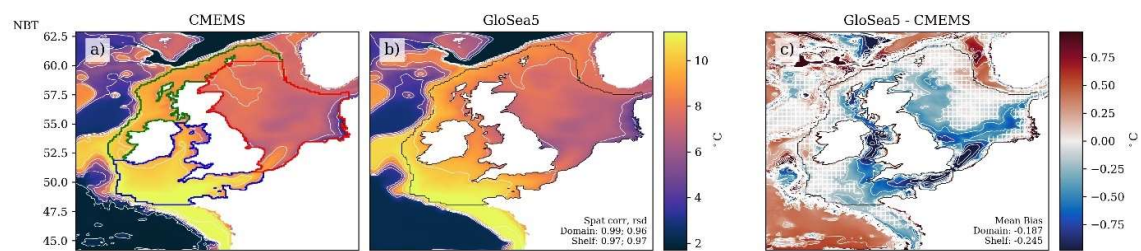


Supplementary Figure 1 Transport cross-sections on the GloSea5 and CMEMS grid, with the respective model coastlines.

## CMSA Error

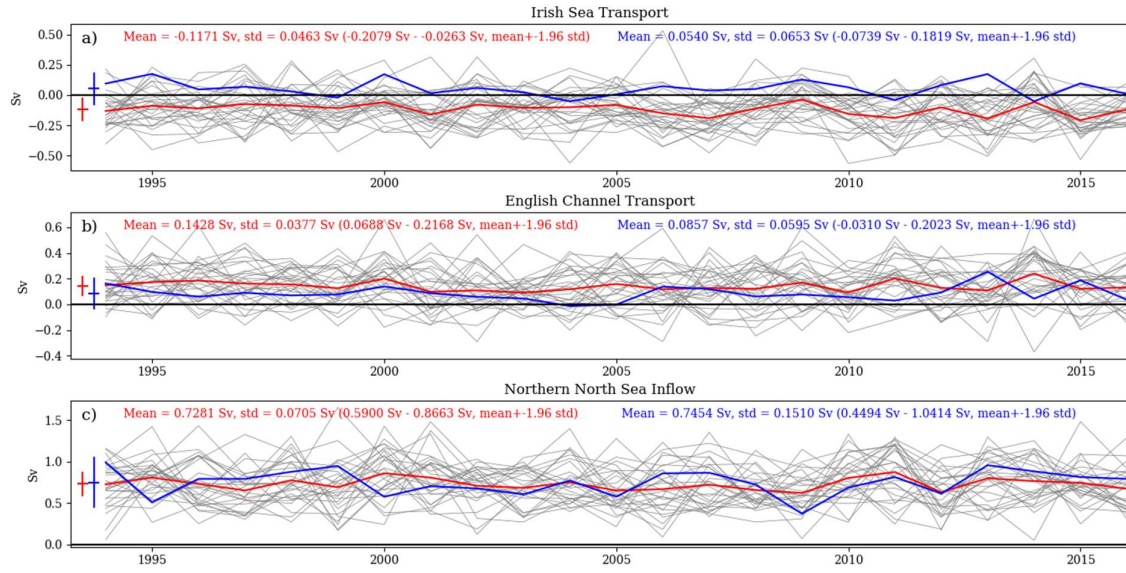


Supplementary Figure 2 a) CMSA Salinity analysis error, and b) its cumulative density function for the NWS (highlighted in red in the a).

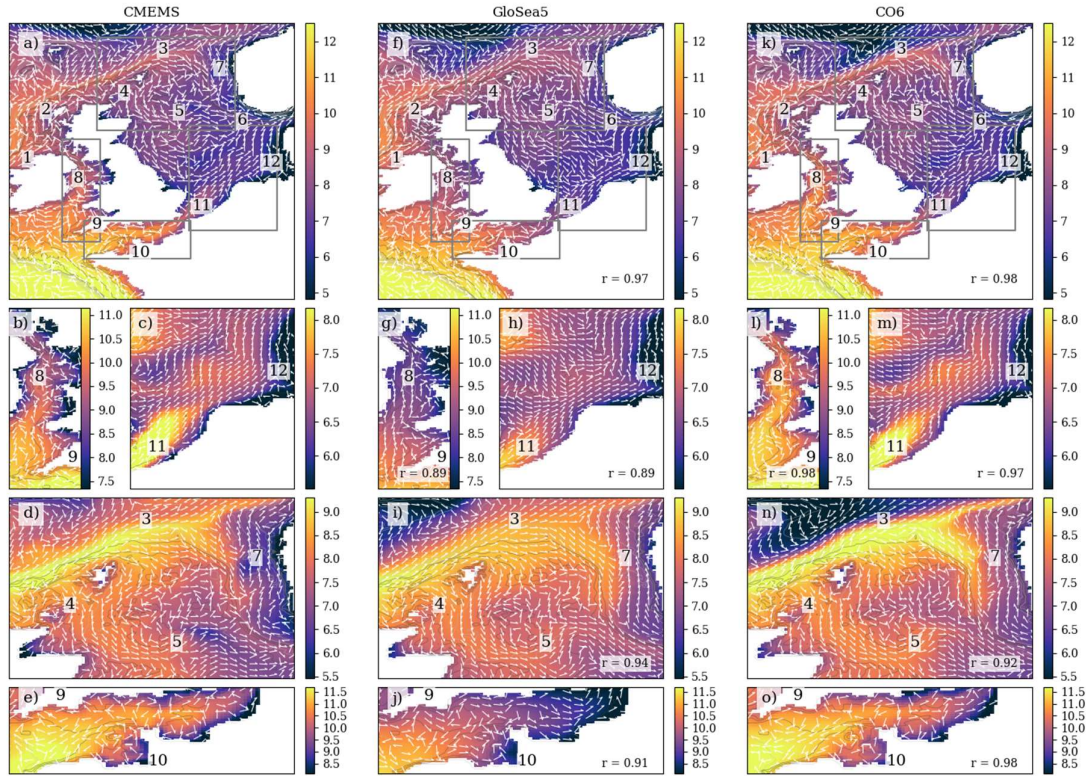


**Supplementary Figure 3 Comparison of the CMEMS and GloSea5 NBT winter climatologies. See Figure 1 for details.**

## GloSea5 Transport Cross sections (Sv)

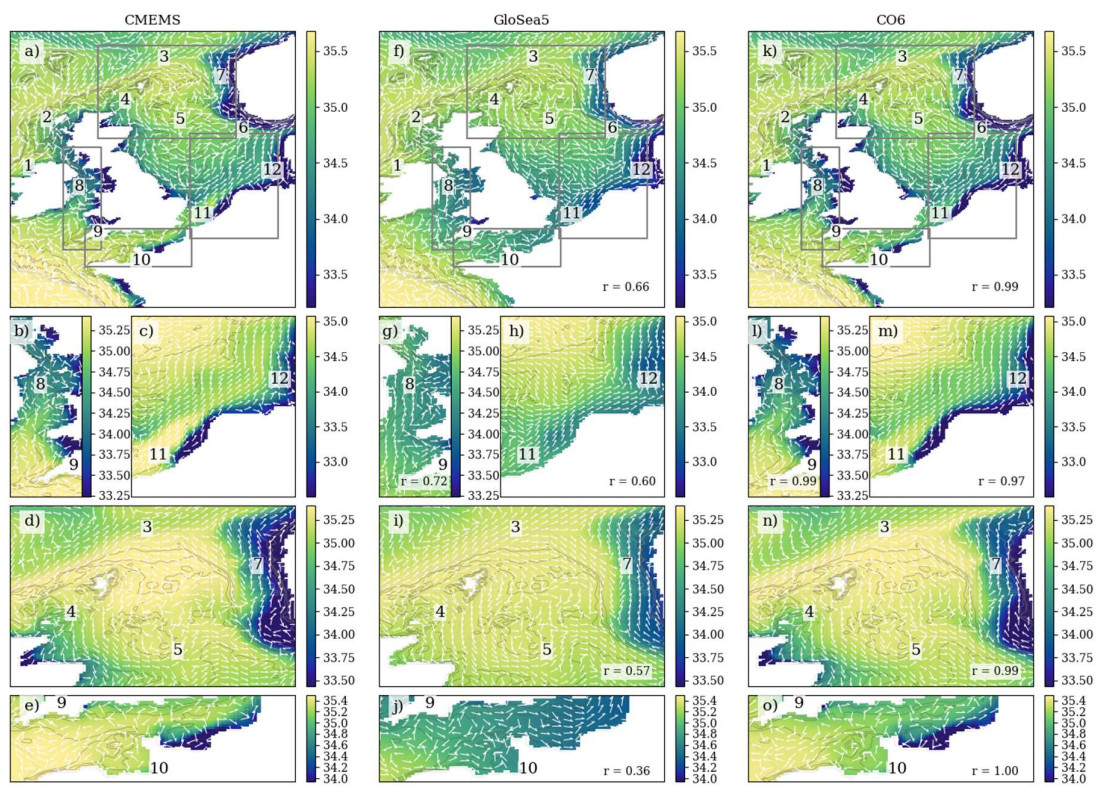


**Supplementary Figure 4** Estimated volume transport time series, for the Irish Sea (a, between Dublin and Anglesey), the English Channel (b, at Dover) and the Northern North Sea inflow (c, between the Scottish mainland and the Shetlands). Blue is CMEMS, Red is the GloSea5 ensemble mean (grey lines are the individual GloSea5 ensemble members). The mean  $\pm$  1.96 standard deviations are given as error bar to the left of the time series, and statistics of the time series is given on each panel.

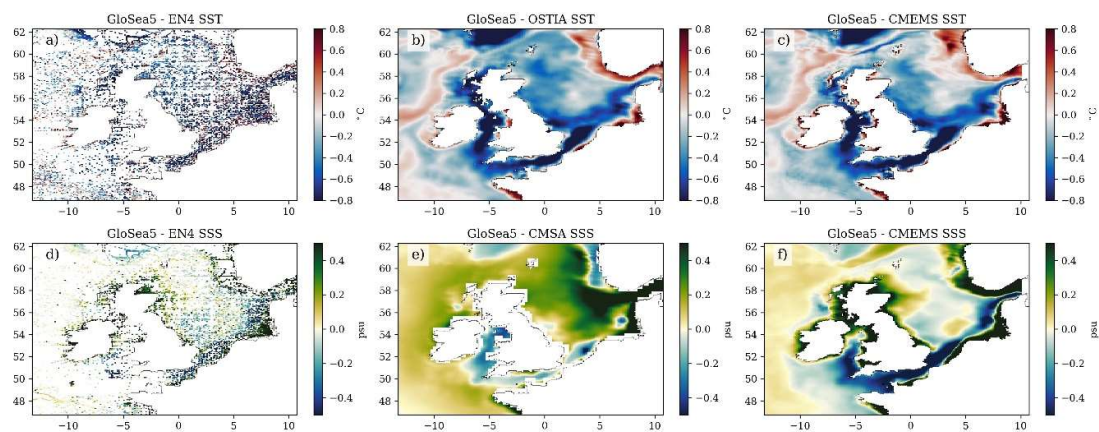


Supplementary Figure 5 Average winter mean SST for CMEMS (a-e), GloSea5 (f-j) and CO6 (k-o), based on two winters (2010/2011 and 2011/2012), with depth mean current directions. An overview of the NWS is given in a, f and k, and regional zooms are given in b-e, g-j and l-o. The spatial correlations between GloSea5/CO6 and CMEMS are given for the data on the NWS within each subdomain (lower right hand side, f-o). Important regions are numbered (see box for details). Each set of three panels (e.g. b, g and l) share a common colour range.

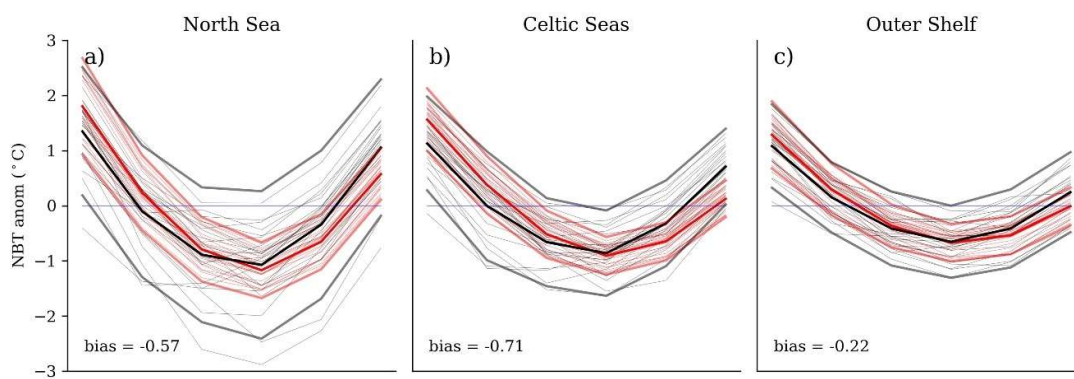




Supplementary Figure 6 as Figure 2, but showing winter SSS. See Supplementary Figure 5 for details.

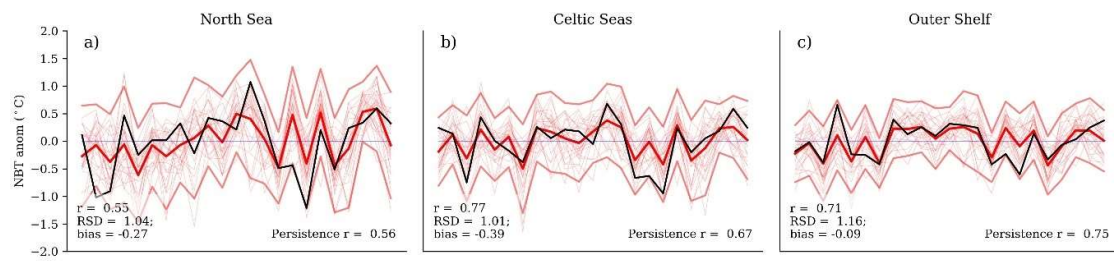


**Supplementary Figure 7 GloSea5 winter climatological bias relative to observational data sets (SST: a-c; SSS: d-f). a, d) GloSea5 minus EN4 quality-controlled temperature and salinity profiles; b, e) GloSea5 SST minus OSTIA analysis SST and (b) GloSea5 SSS minus CMSA (e) respectively; c, f) GloSea5 minus CMEMS (repeating Figure 1c and f).**

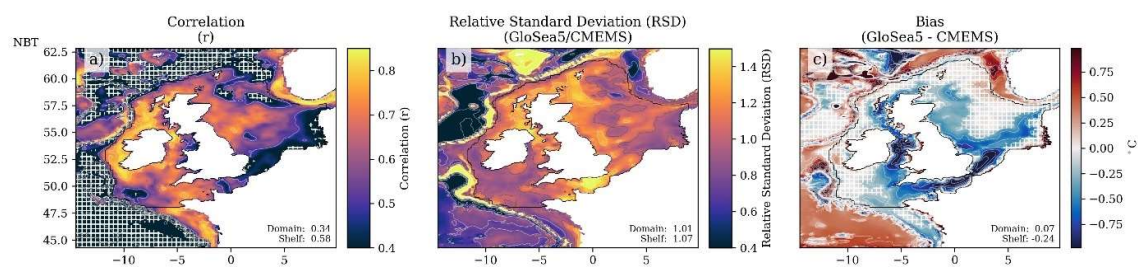


**Supplementary Figure 8** The regional mean seasonal evolution of NBT. See Figure 3 for details.



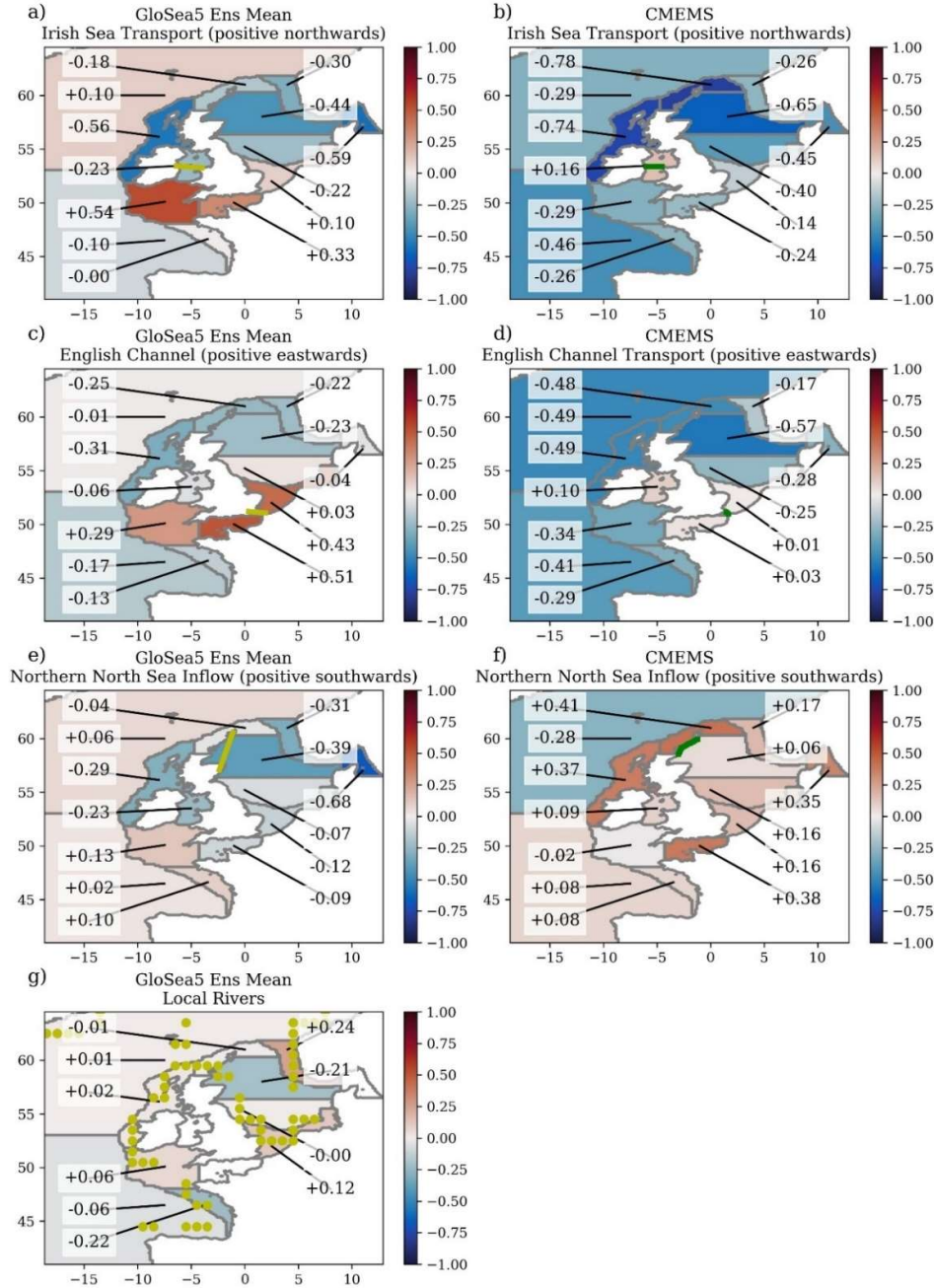


**Supplementary Figure 9 Assessment of GloSea5 predictability of the NWS winter for NBT. See Figure 4 for details.**

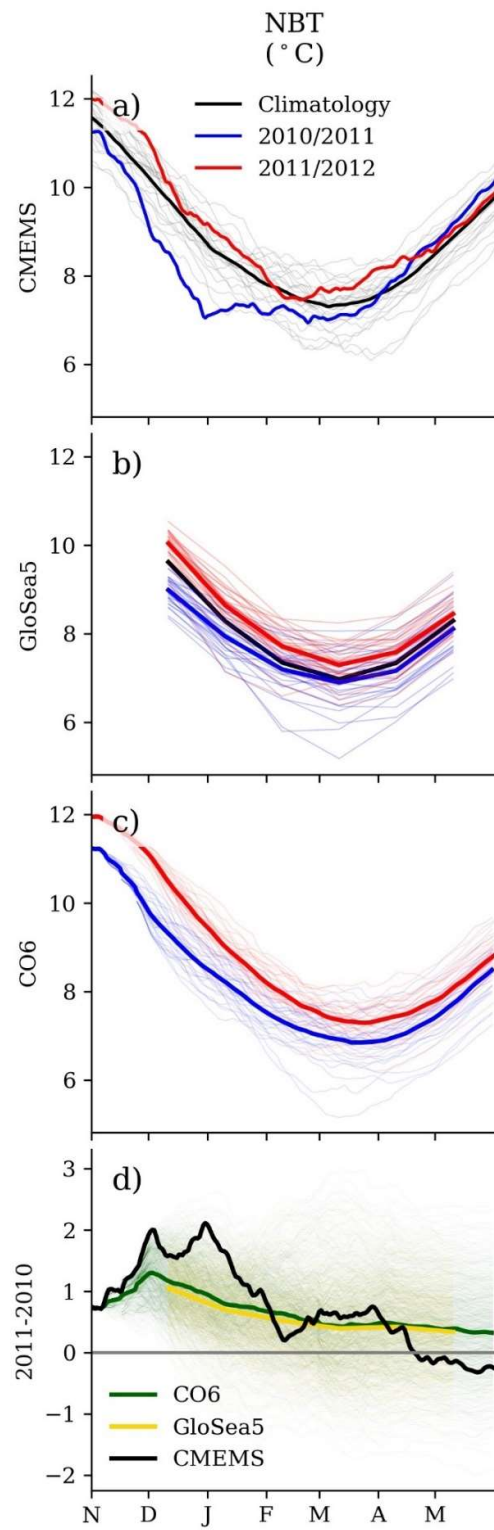


**Supplementary Figure 10** Assessment of GloSea5 forecast skill of the NWS winter for NBT. See Figure 5 for details.

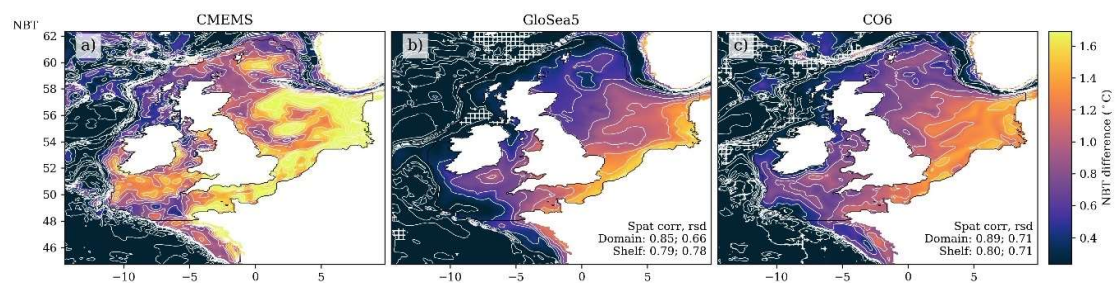
## Regional Mean SSS Correlation



**Supplementary Figure 11** Correlations between the winter interannual variability of regional mean salinity and transport, and local rivers. Correlations between GloSea5 ensemble mean winter SSS and estimates of GloSea5 ensemble mean winter transport through the Irish Sea, English Channel and the northern North Sea inflow are showing in panels a, c and e respectively, with the appropriate cross-section shown in gold. The equivalent for CMEMS is shown in b, d and f. The GloSea5 winter SSS in each region is correlated with the GloSea5 rivers in the same region (shown as gold dots) in panel g. CMEMS uses climatological rivers, and so cannot be correlated against the CMEMS interannual salinity variability.

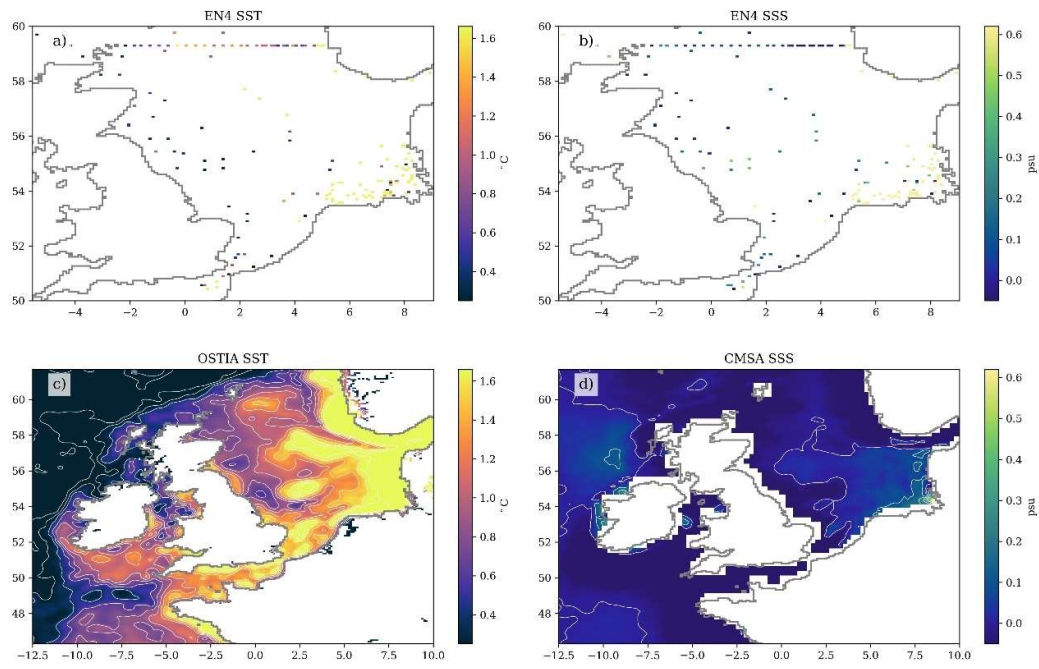


**Supplementary Figure 12** Comparison of the temporal evolution of the 2010/2011 (blue) and 2011/2012 (red) winters for the NWS for NBT. See Figure 9 for details.



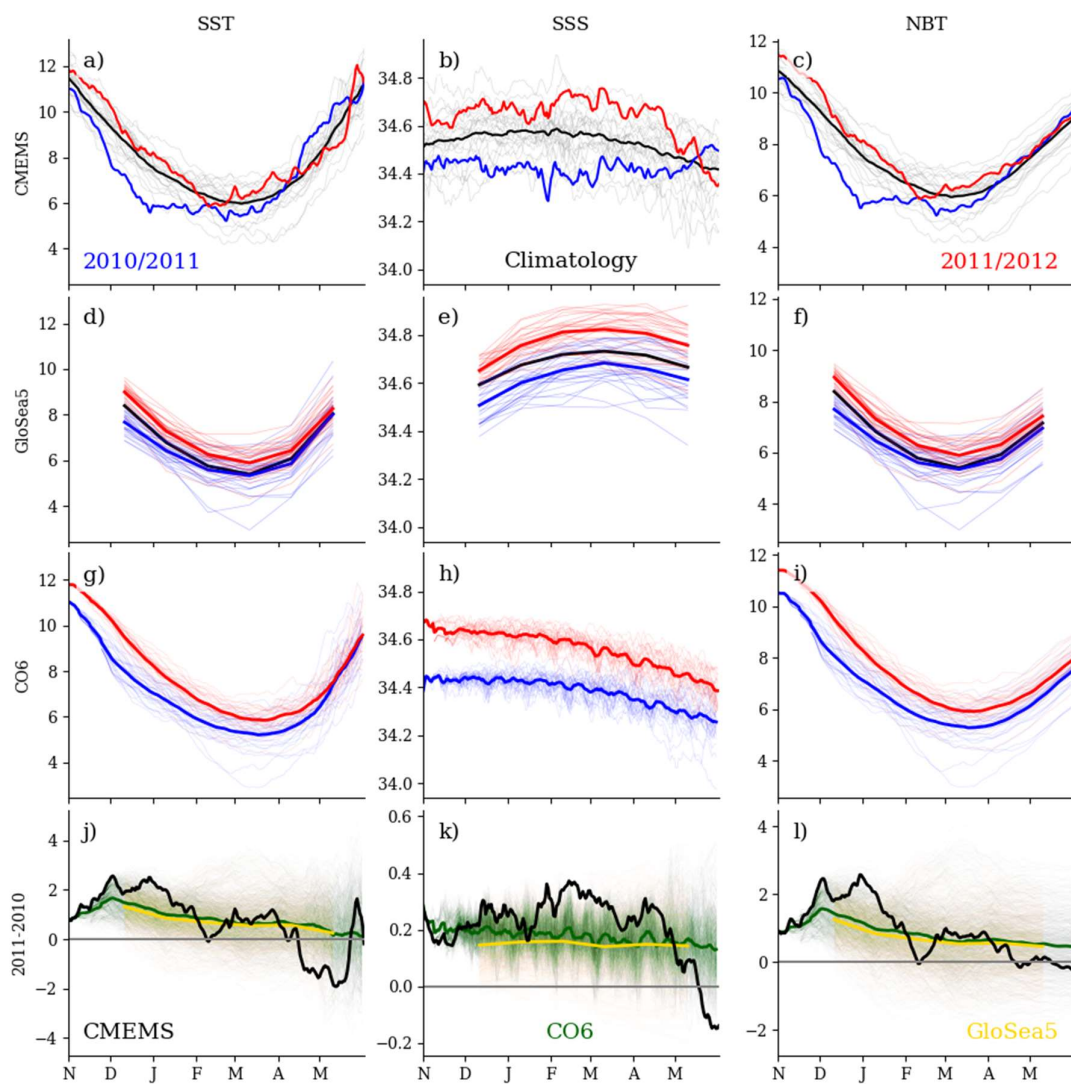
**Supplementary Figure 13** Spatial patterns of the difference of two winter (DJF, 2011/2012 minus 2010/2010) for NBT. See Figure 10 for details.

Observations 2011/2012 - 2010/2011

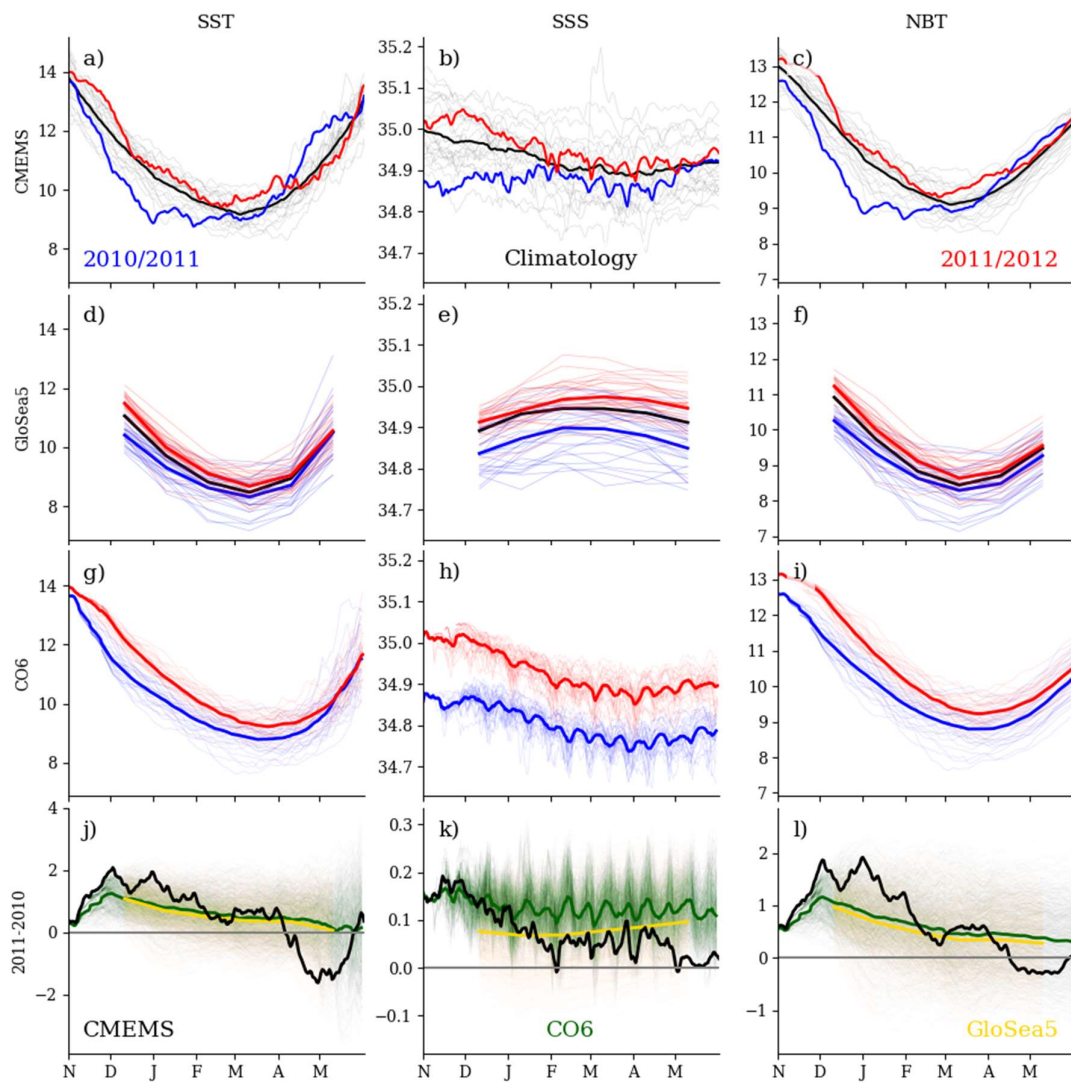


**Supplementary Figure 14** Observed difference between the winters of 2010/2011 and 2011/2012, to support the CO6 evaluation. a, b) EN4 quality controlled near surface temperature and salinity; c) OSTIA SST analysis; and d) CMSA SSS.

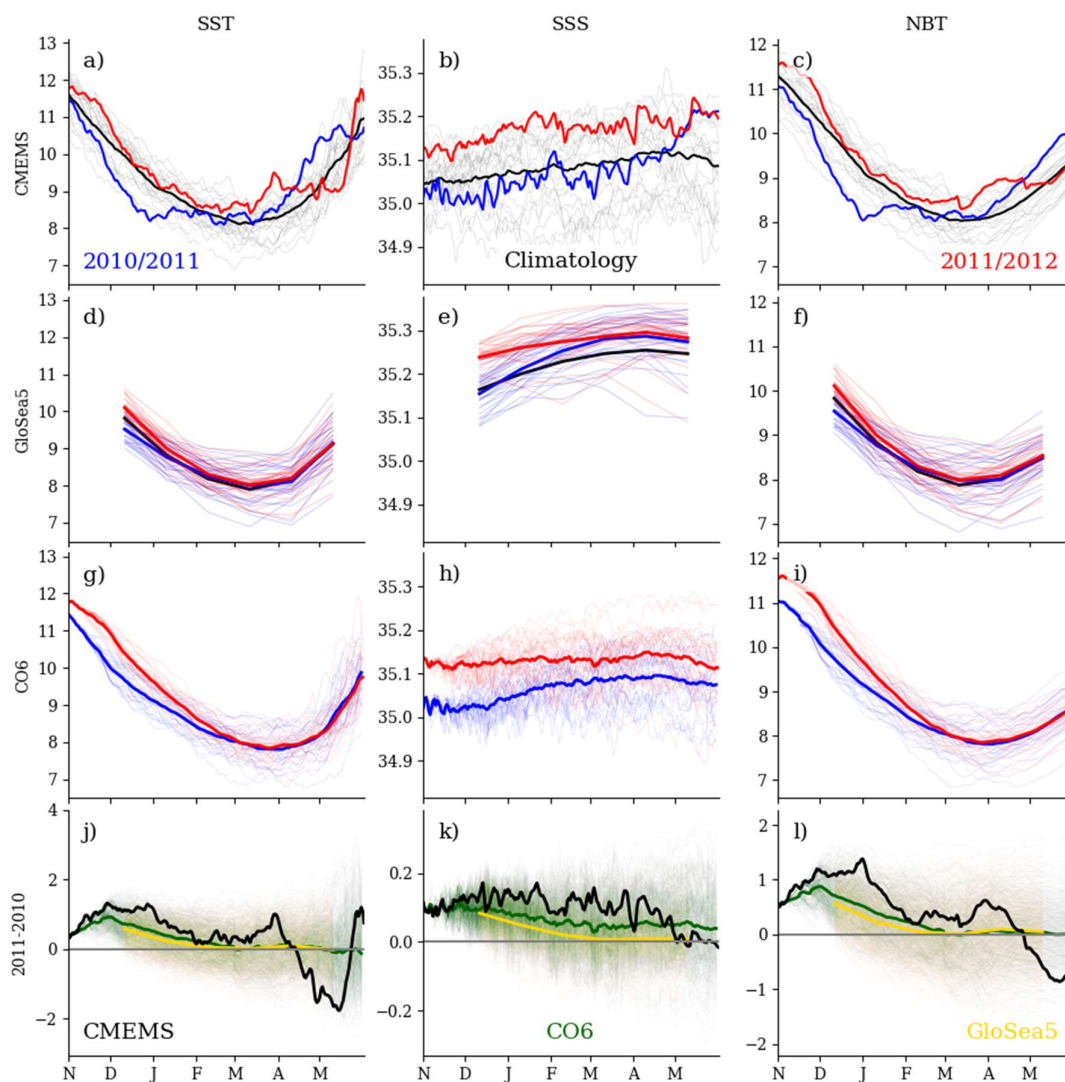




Supplementary Figure 15 as Figure 9, but for the North Sea.



Supplementary Figure 16 as Figure 9, but for the Celtic Seas (a region including the Celtic Sea, Irish Sea and English Channel).



Supplementary Figure 17 as Figure 9, but for the Outer Shelf Region (including the Irish and Shetland Shelf Regions).