Supplementary Material

CMIP5 Model	Institution	Lat/Lon Resolution
ACCESS1-0	CSIRO and BOM, Australia	0.6°x1.0°
ACCESS1-3	CSIRO and BOM, Australia	0.6°x1.0°
CAN-ESM2	Canadian Centre for Climate Modelling and Analysis	0.9°x1.4°
CCSM4	National Center for Atmospheric Research	0.5°x1.125°
CESM1-BGC	National Center for Atmospheric Research	0.5°x1.125°
CESM1-CAM5	National Center for Atmospheric Research	0.5°x1.125°
CMCC-CESM	Centro Euro-Mediterraneo per I Cambiamenti Climatici	1.1°x2.0°
CMCC-CM	Centro Euro-Mediterraneo per I Cambiamenti Climatici	1.2°x2.0°
CNRM-CM5	Centre National de Recherches Meteorologiques	0.6°x1.0°
CSIRO-MK3-6-0	CSIRO and BOM, Australia	1.0°x1.875°
GFDL-CM3	Geophysical Fluid Dynamics Laboratory	0.9°x1.0°
GFDL-ESM2G	Geophysical Fluid Dynamics Laboratory	0.9°x1.0°
GFDL-ESM2M	Geophysical Fluid Dynamics Laboratory	0.9°x1.0°
GISS-E2-H	NASA Goddard Institute for Space Studies	2.0°x2.5°
GISS-E2-R	NASA Goddard Institute for Space Studies	2.0°x2.5°
HADGEM2-AO	Hadley Centre fo Climate Science and Services	1.0°x1.0°
HADGEM2-CC	Hadley Centre fo Climate Science and Services	1.0°x1.0°
INMCM4	Institute for Numerical Mathematics	0.5°x1.0°
IPSL-CM5A-LR	Institute Pierre-Simon Laplace	1.2°x2.0°
IPSL-CM5A-MR	Institute Pierre-Simon Laplace	1.2°x2.0°
IPSL-CM5B-LR	Institute Pierre-Simon Laplace	1.2°x2.0°
MIROC-ESM	Japan Agency for Marine-Earth Science and Technology	0.5°x1.4°
MPI-ESM-LR	Max Planck Institute for Meteorology	0.8°x1.4°
MPI-ESM-MR	Max Planck Institute for Meteorology	0.8°x1.4°
NORESM1-M	Norwegian Climate Centre	0.5°x1.125°
NORESM1-ME	Norwegian Climate Centre	0.5°x1.125°

Table S1. List of CMIP5 Models, Institutions and Ocean Model Resolutions.

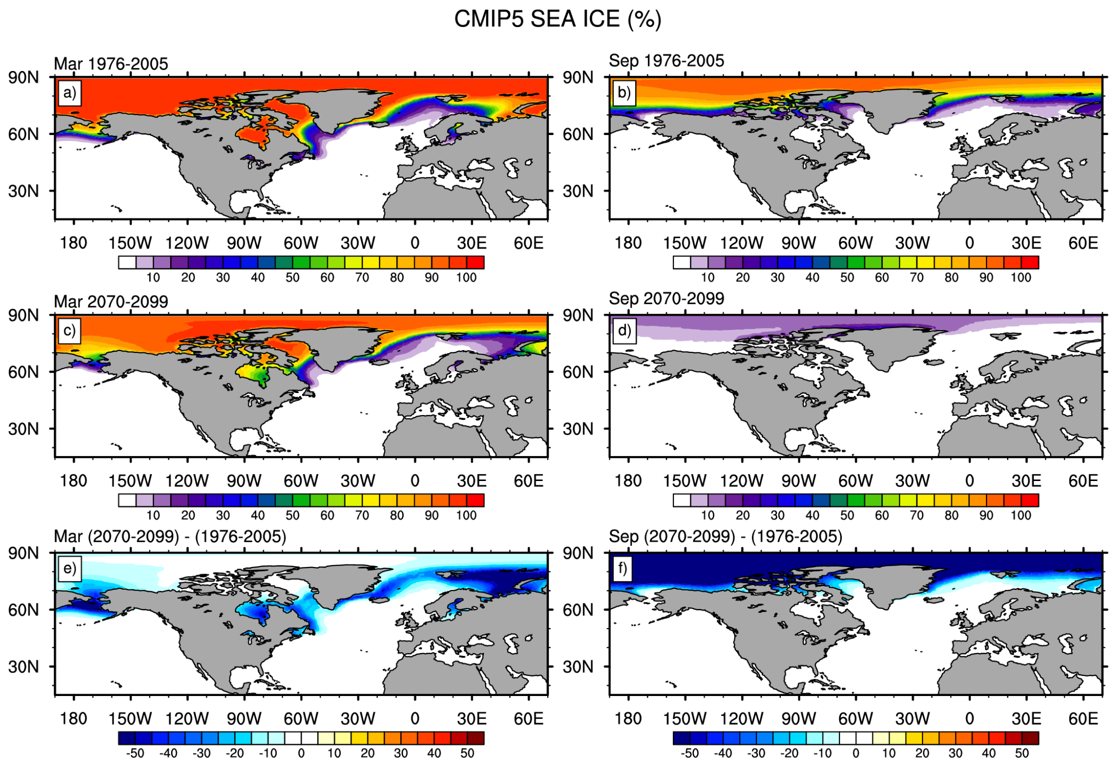

Figure S1. Sea ice Concentration (%) from the CMIP5 ensemble average. Averaged over the historical period (1976-2005) in a) March and b) September, the future period (2070-2099) in c) March and d) September and the difference between periods in e) March and September. The sea ice decreases substantially by the end of the 21^{st} century especially in summer.

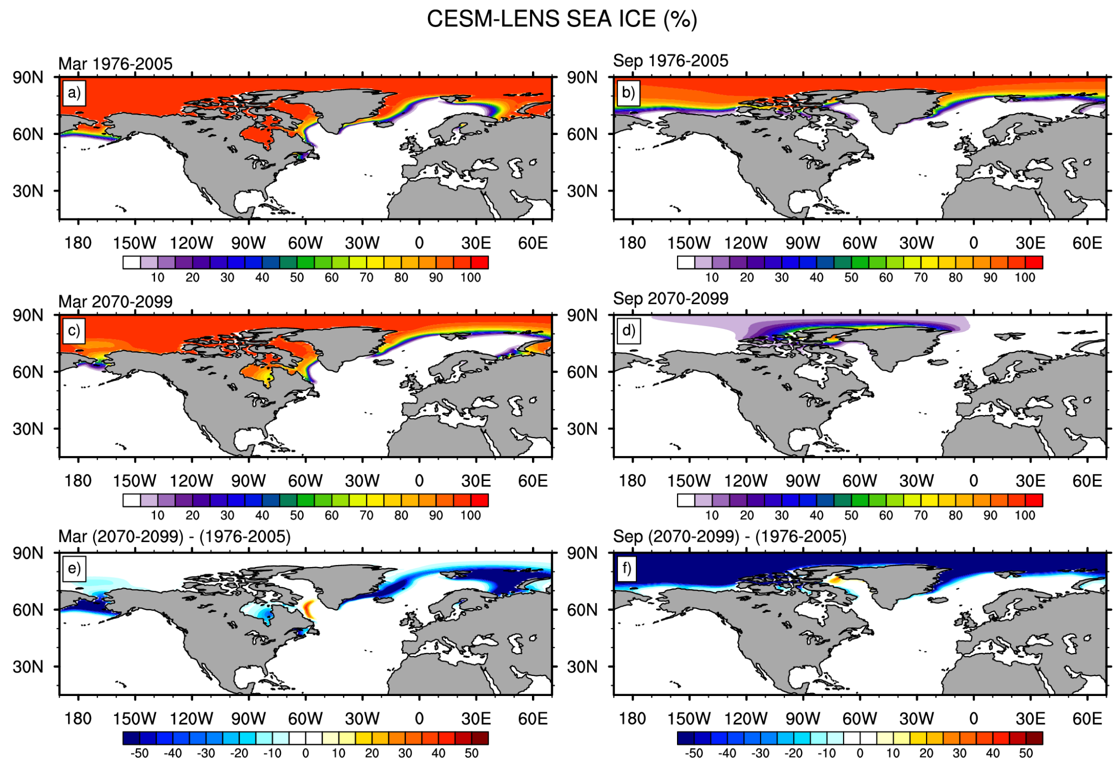

Figure S2. As in Figure S1, Sea ice Concentration (%) but from the CESM-LENS ensemble average.

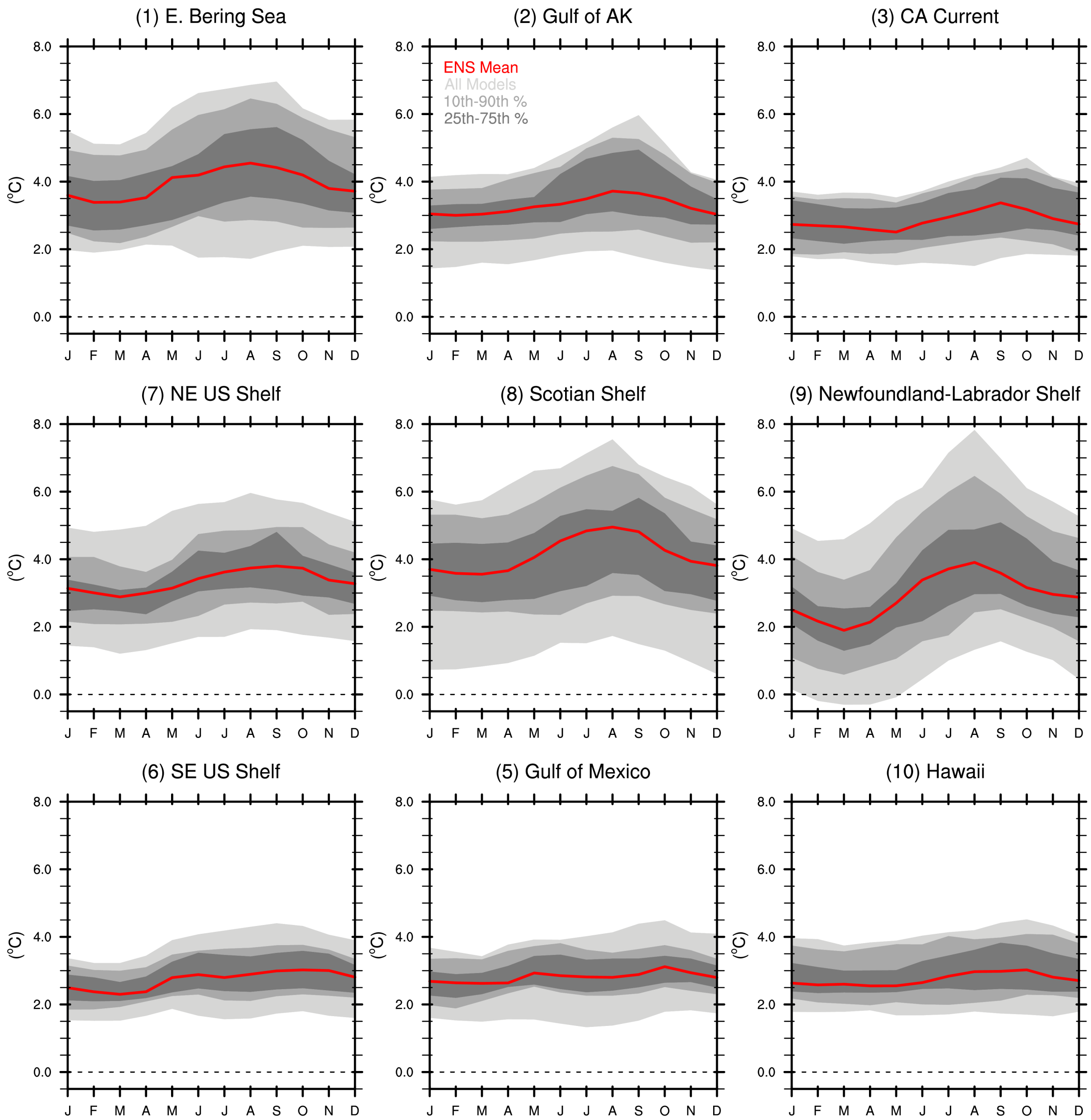

Figure S3. CMIP5 future (2070-2099) – past (1976-20050) SST seasonal cycles. The ensemble mean is in red. The gray shading represents the distribution of the CMIP5 models, with the outer envelope encompassing all models (light gray), 10^{th}-90^{th} percentiles (gray) and 25^{th}-75^{th} percentiles (dark gray). Most regions show SST in summer/early fall warming faster than winter.

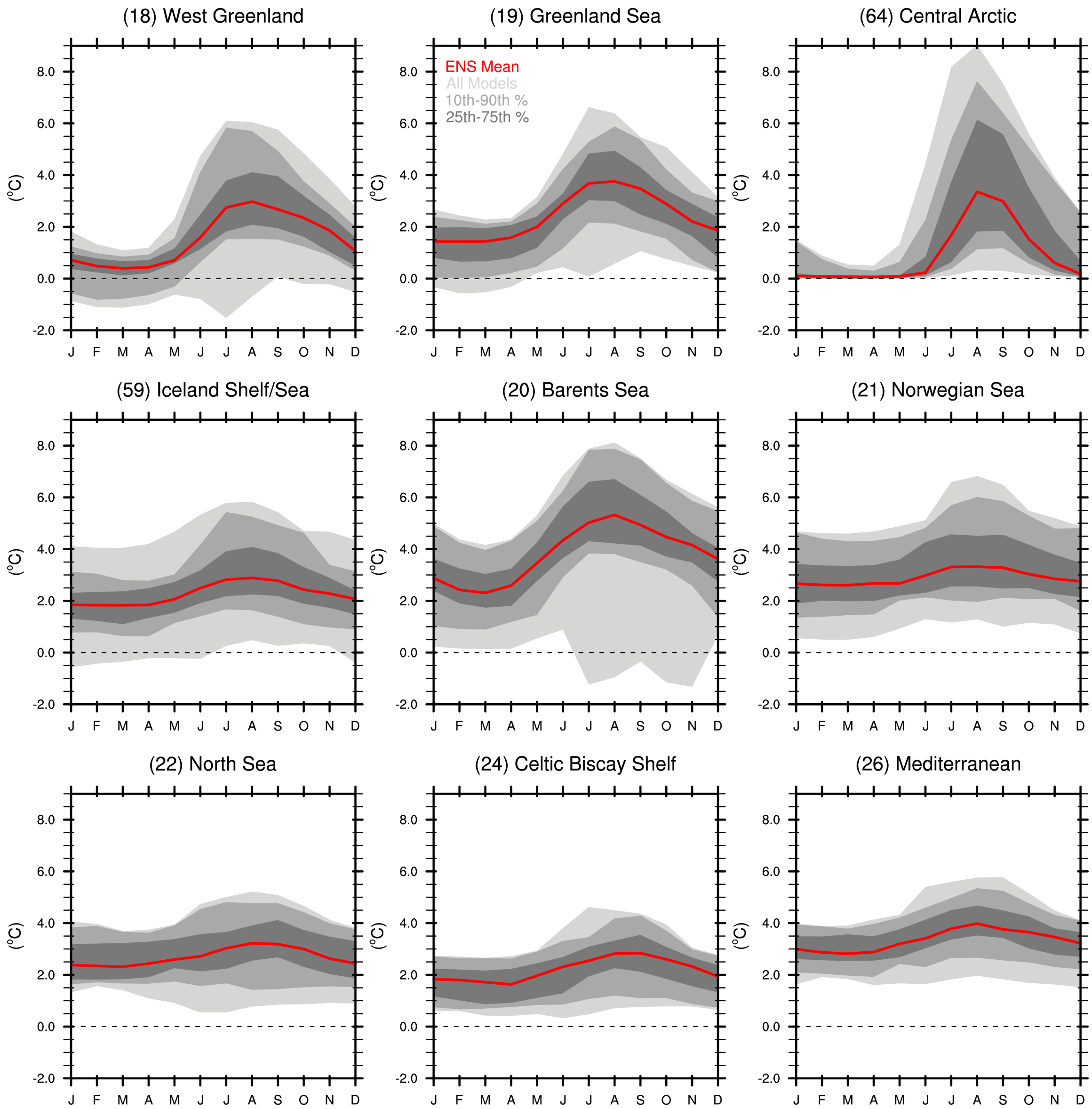

Figure S4. Same as Figure S1, except the LMEs surrounding the Arctic and European sectors.

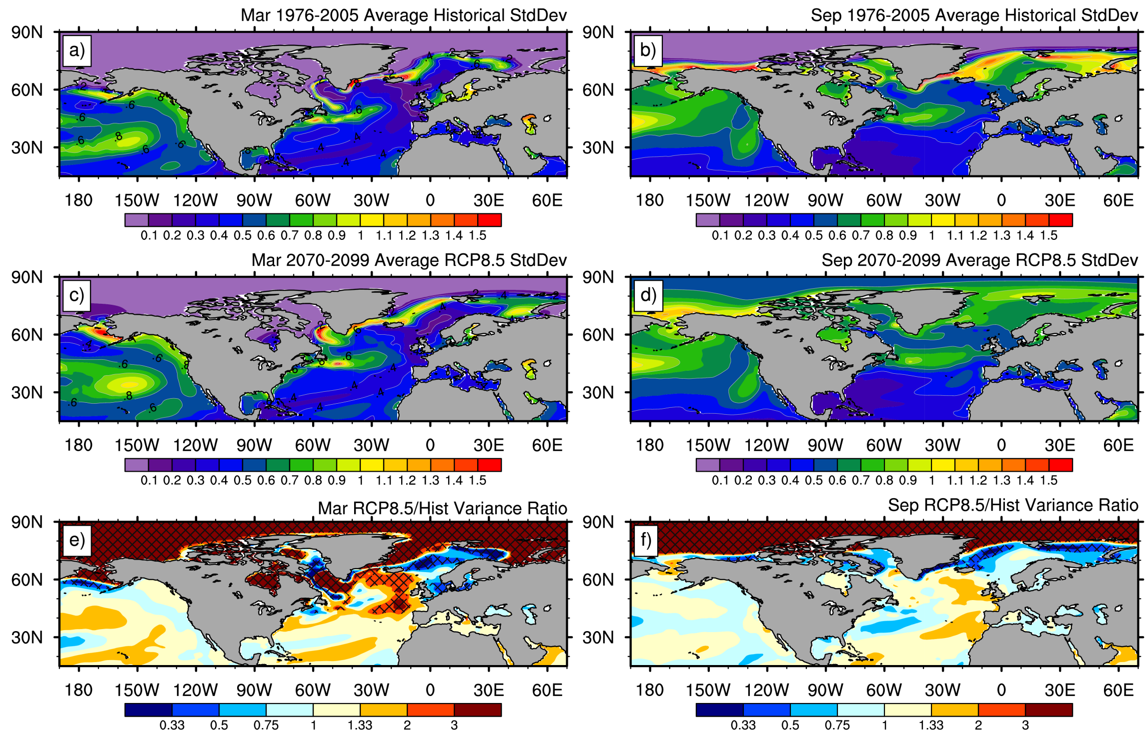

Figure S5. CESM-LENS ensemble mean de-trended SST standard deviation (σ). Shown are the (a,b) historical (1976-2005) and (c,d) future periods (2070-2099) and the (e,f) future/historical SST variance ratios for March (a,c,e) and September (b,d,f.). The SST anomalies are computed for each model separately, de-trended within their respective periods and the standard deviation (and variance $<\sigma^2>$) is computed for each individual model and then averaged together. The variance ratios are cross-hatched where >50% of the models show a significant change using an F-test at the 95% level. Significant changes to the SST variance are confined to the higher latitudes.

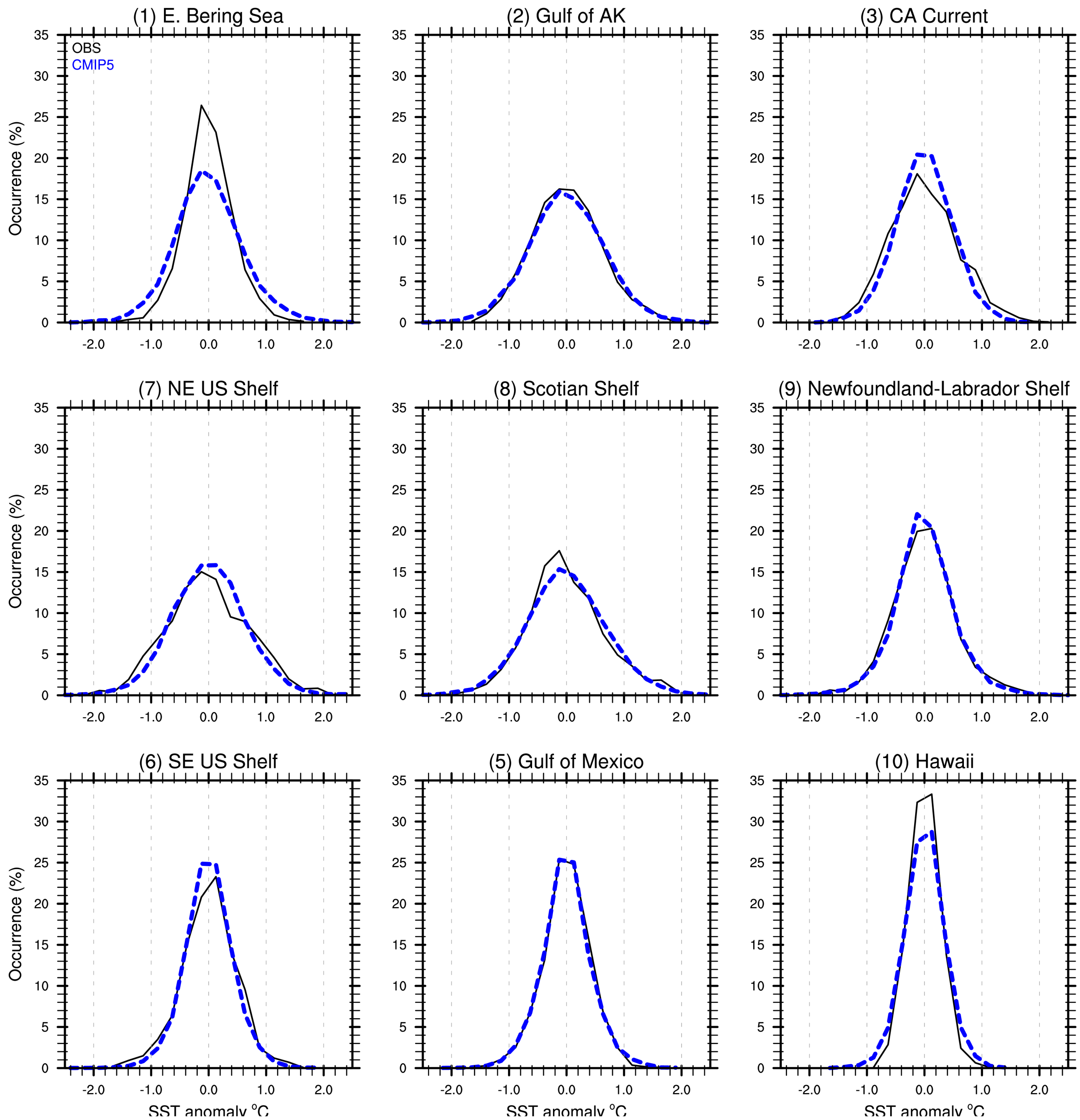

Figure S6. Probability distributions of CMIP5 monthly SST anomalies averaged over the LMEs around North America. Shown are the historical (Blue dash line, 1976-2005) and HadISST observations (black lines, 1901-2016). The SST distributions are presented without trends.

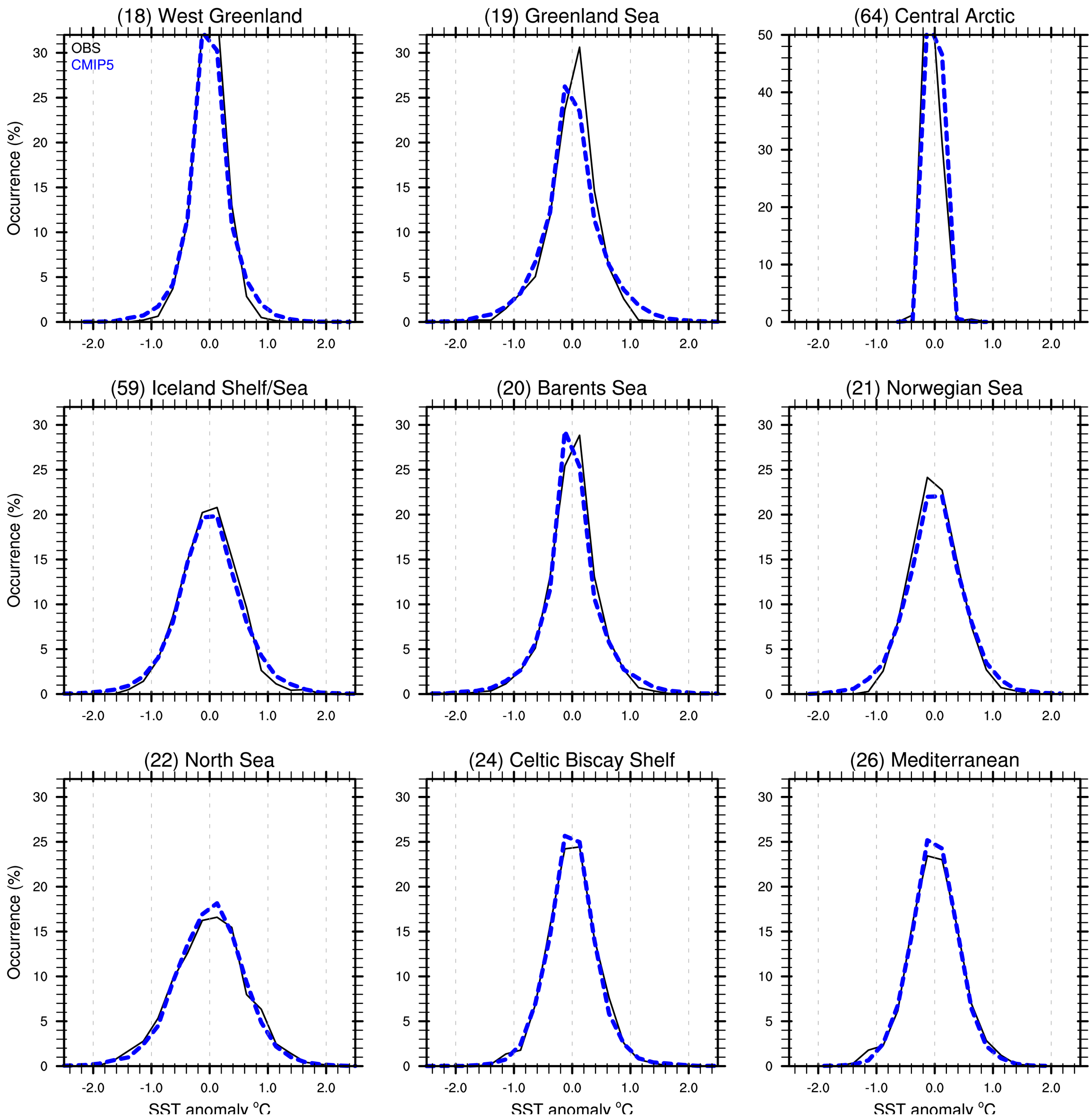

Figure S7. Same as Figure S8, except for LMEs around Europe.

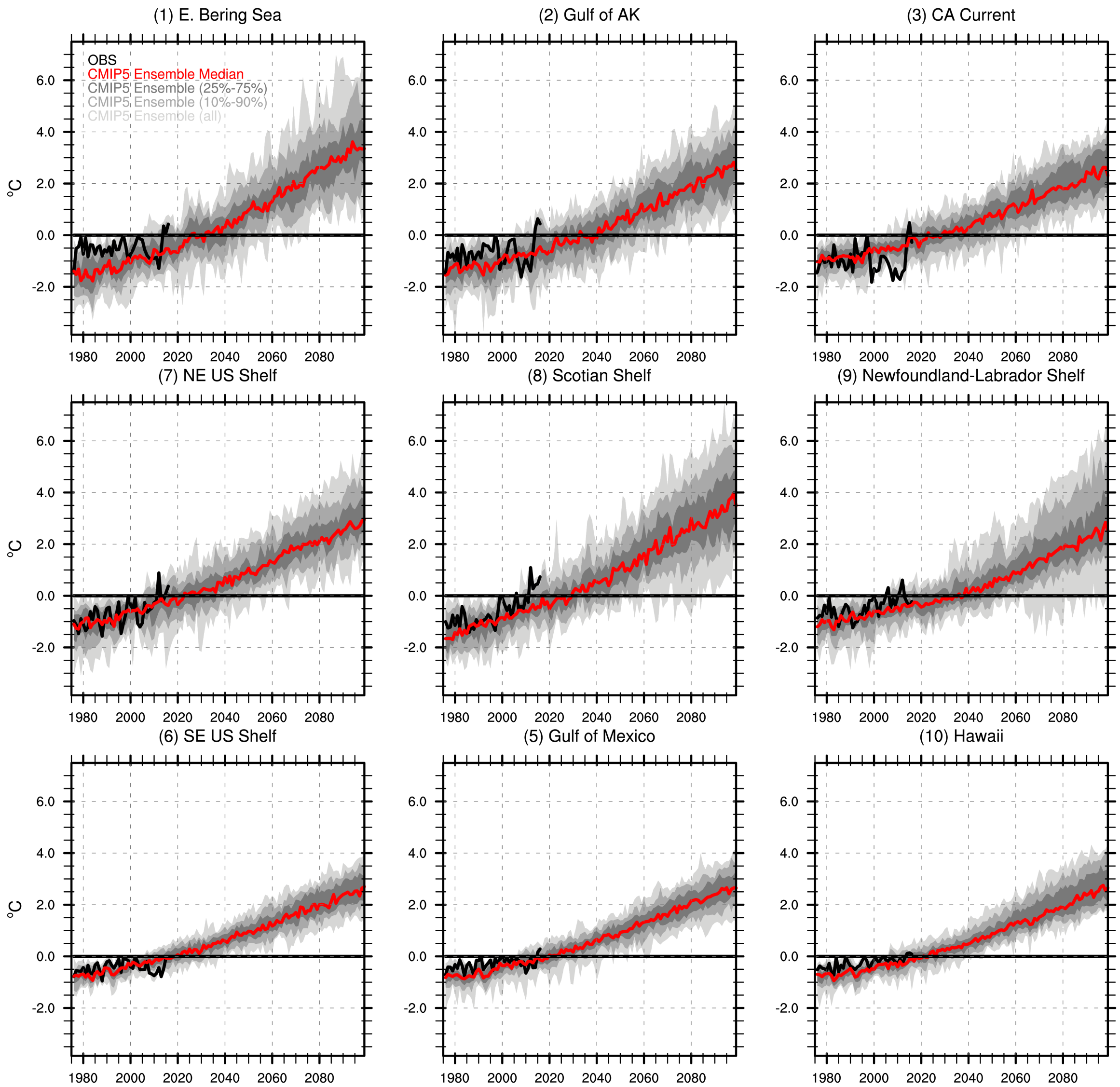

Figure S8. Time series of the annual mean SST difference from the maximum SST during the historical period (1976-2005) for LMEs around North America for the CMIP5 models. The ensemble median is red and HadISST observations are black. The outer envelope (light gray) shows the ensemble max/min range. The 2nd envelope (medium gray) shows the 10th-90th percentile range of the ensemble and the darkest gray envelope is the inter-quartile (25th-75th percentile) range.

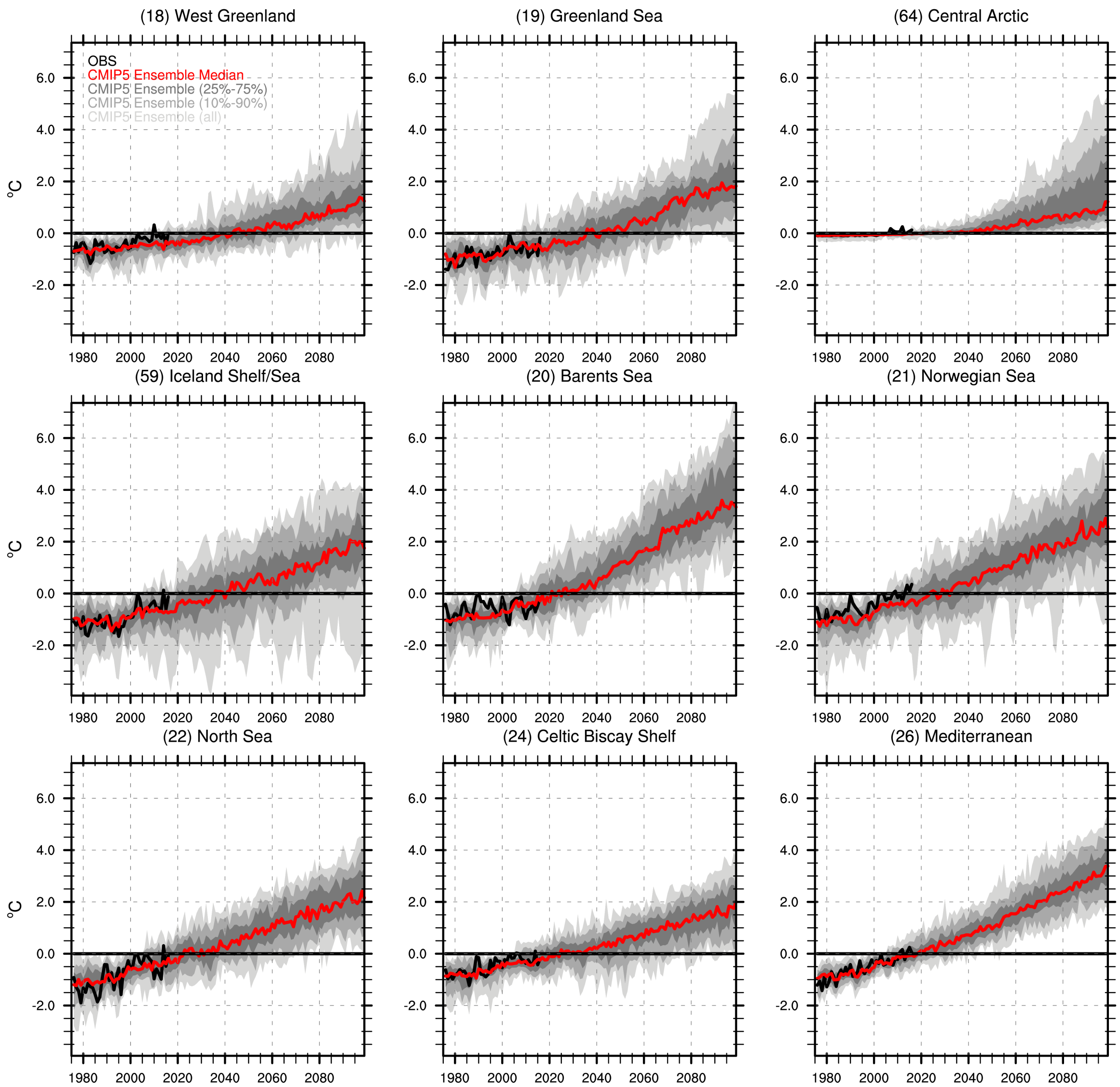

Figure S9. Same as Figure S6, except for LMEs surrounding the Arctic and European sectors.

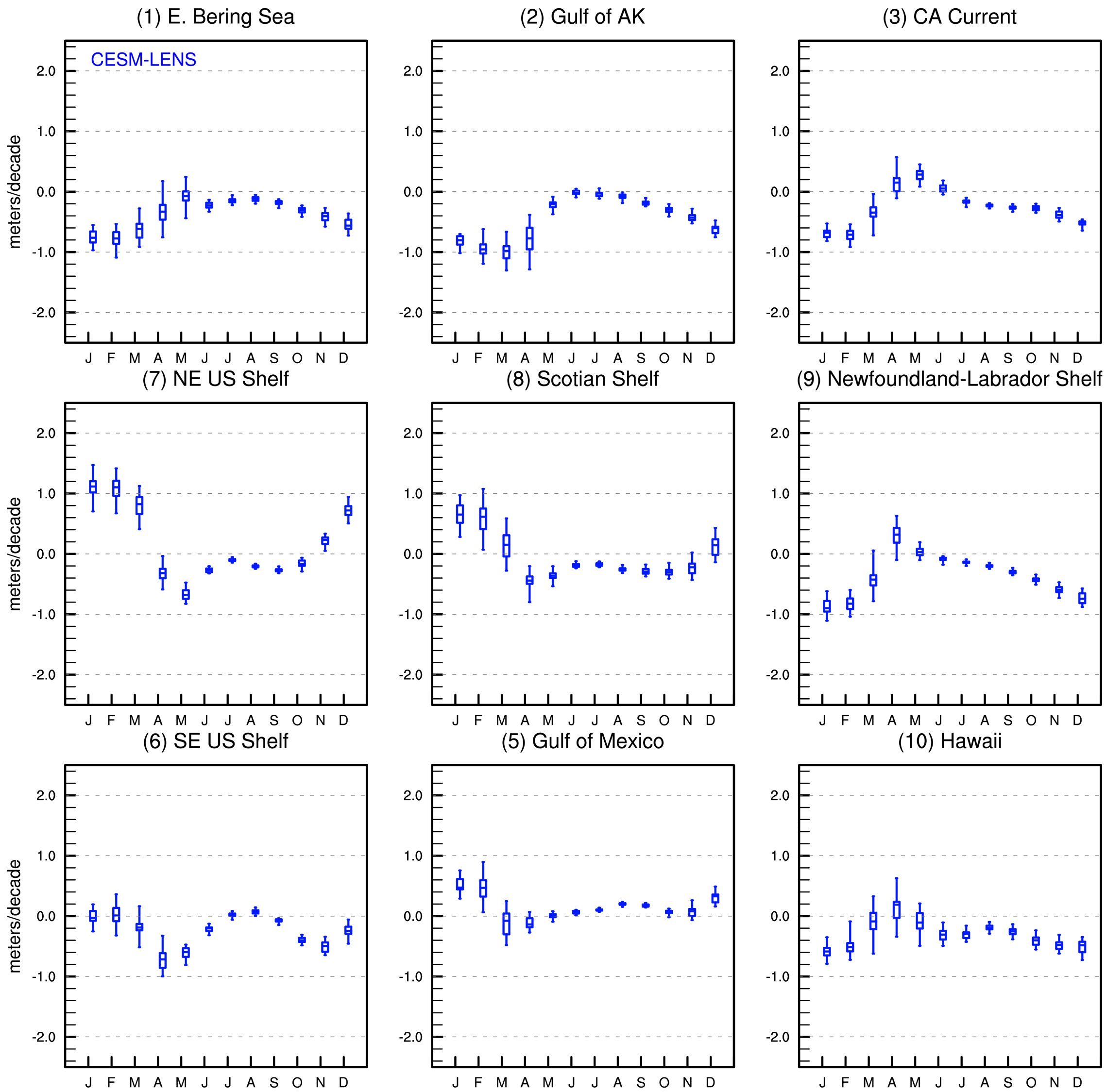

Figure S10. Ensemble distribution of monthly Mixed Layer Depth trends for LMEs around North America. Trends are computed for each model and the distribution from the CESM-LENS experiments (1976-2099) are shown in box and whiskers format, where the end points are the maximum and minimum, the box boundaries are the inter-quartile range and the median is the central line.

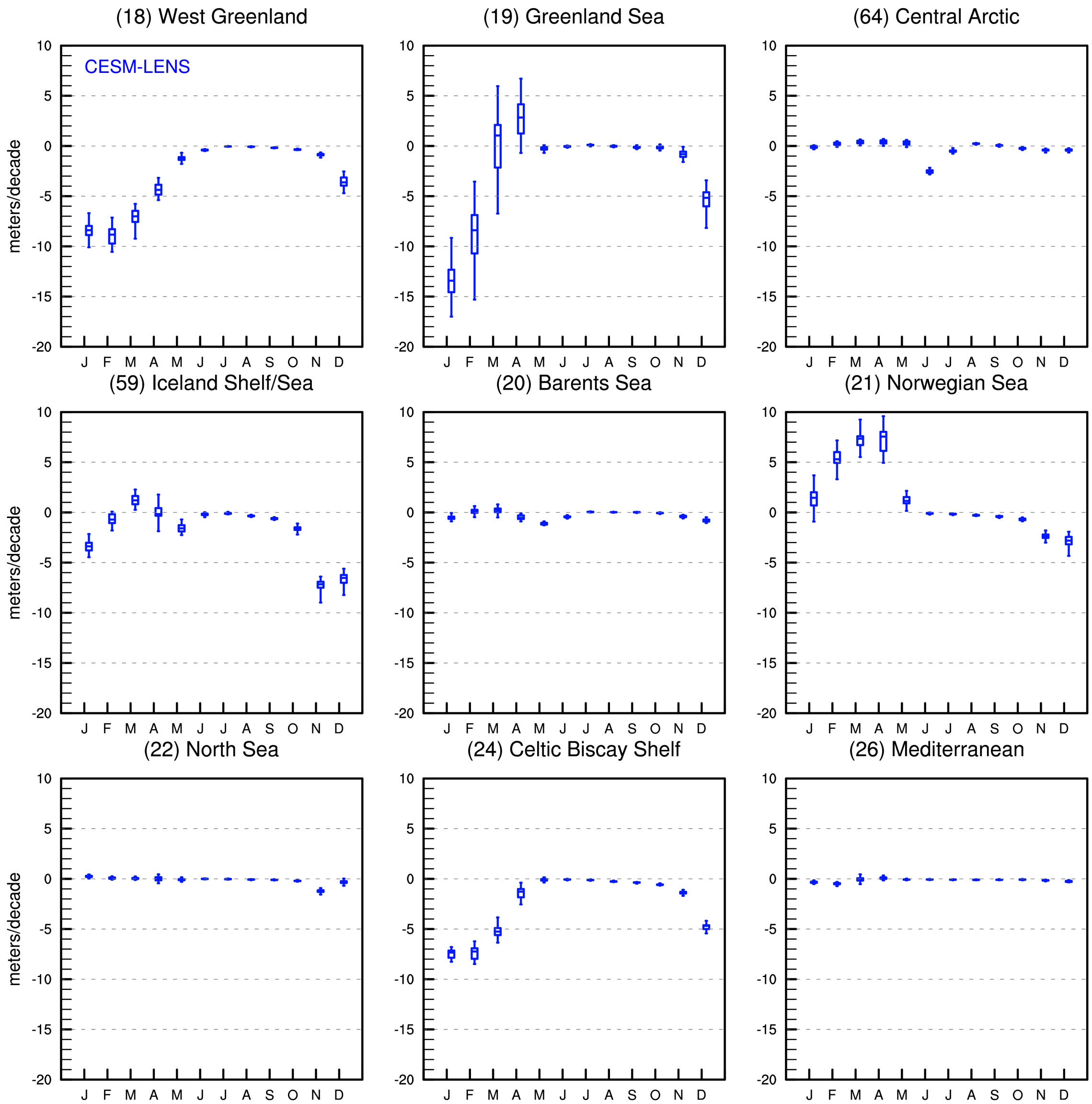

Figure S11. Same as Figure S4, except for LMEs surrounding Europe.