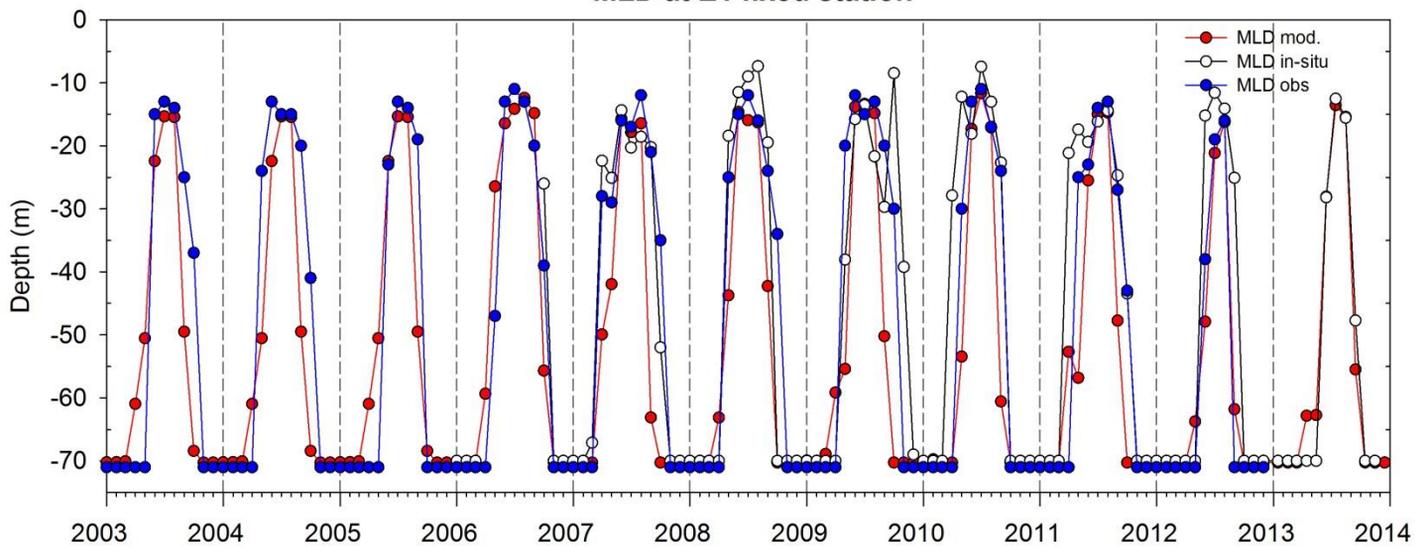


MLD at E1 fixed station



MLD in Celtic Sea

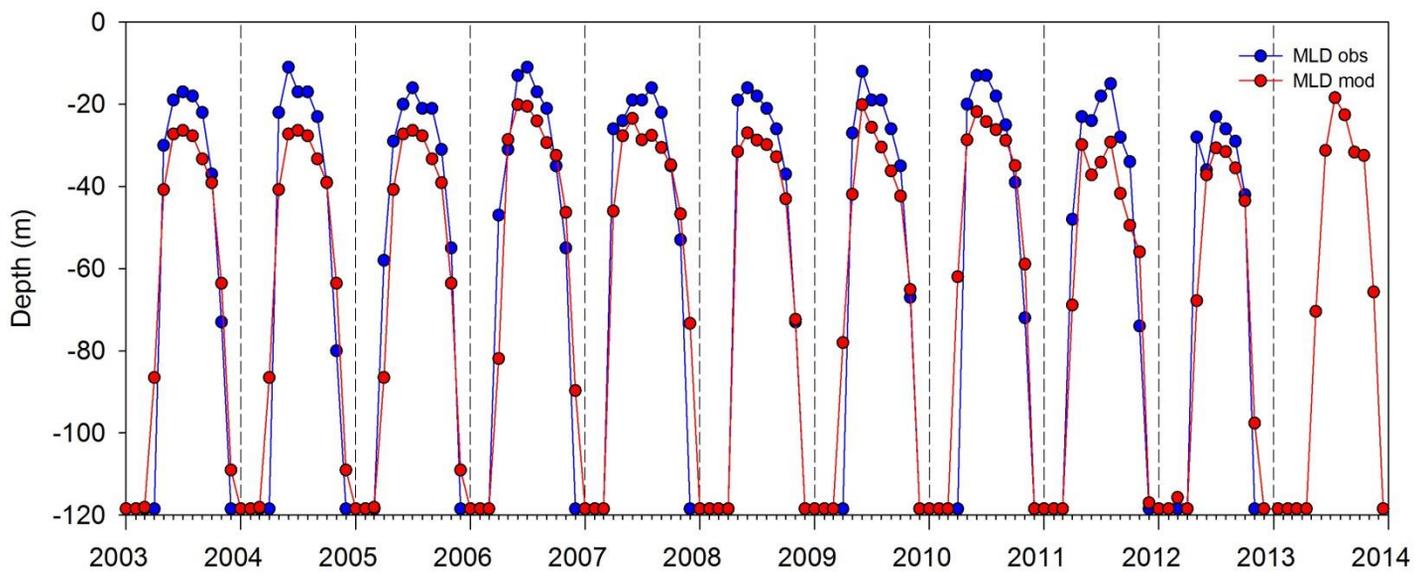


Figure S1: Mixed layer depth (MLD, in m) at (A) fixed station E1 off Plymouth (50.03°N, 4.37°W, bottom depth 75m) and in (B) the Celtic Sea (50°N, 8°W, bottom depth 120m). Red dots and lines represent the modeled MLD from the MARS3D model. Blue dots and lines represent the observed MLD from the Armor-3D L4 Analysis observation products provided by the Copernicus Marine Environment Monitoring Service. White dots and black lines represent the MLD calculated from temperature and salinity profiles made at fixed station E1.

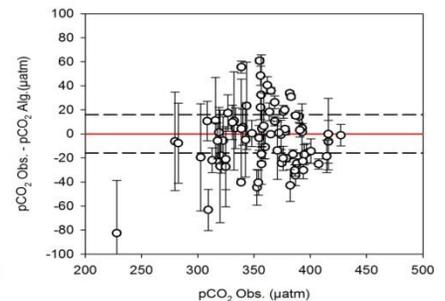
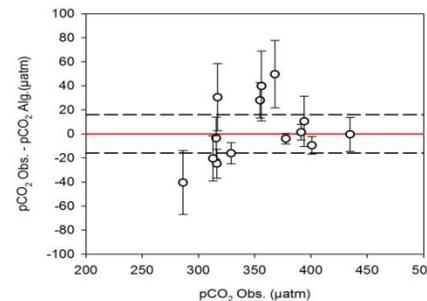
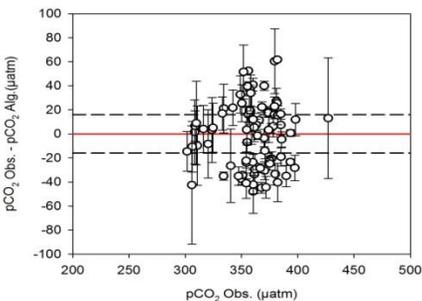
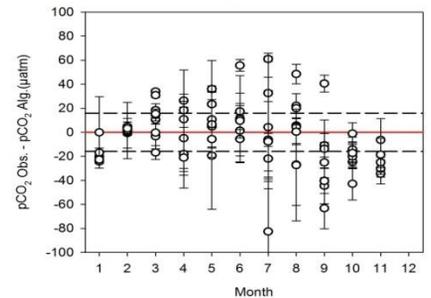
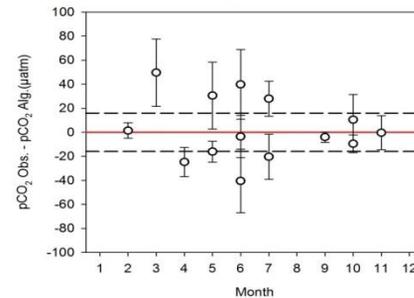
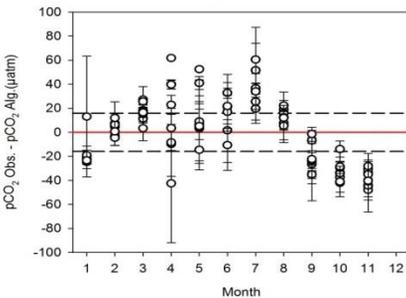
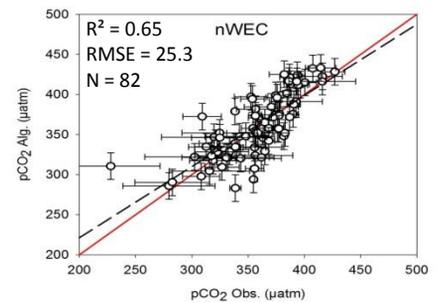
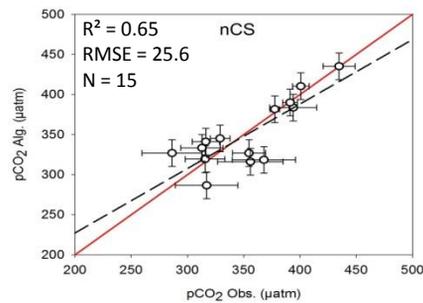
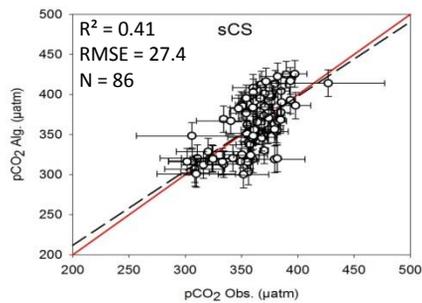
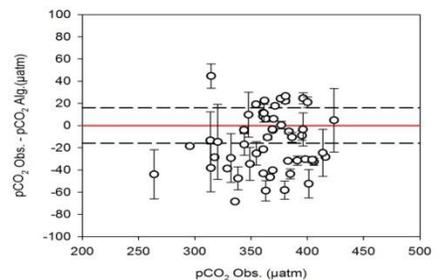
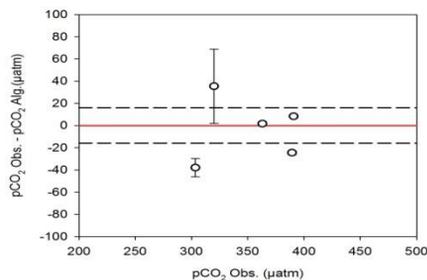
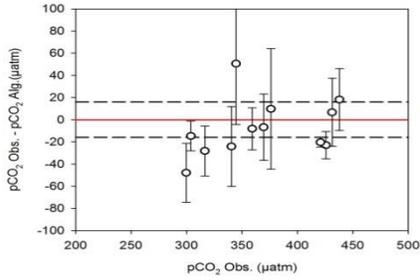
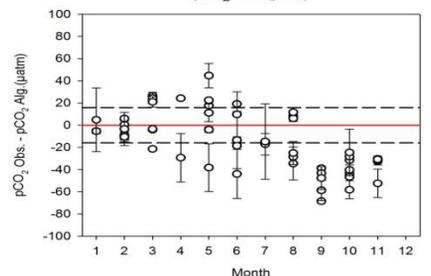
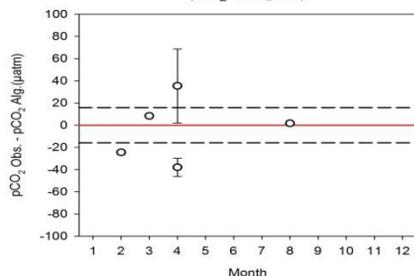
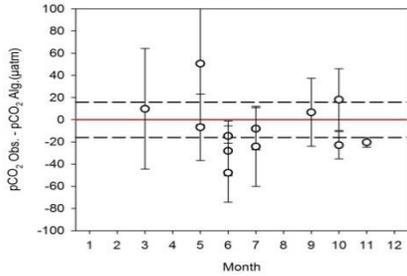
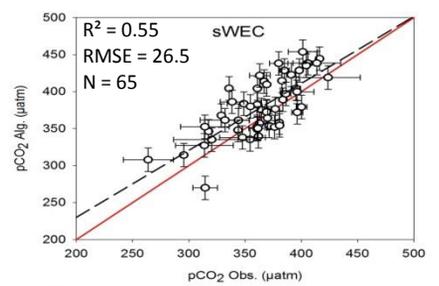
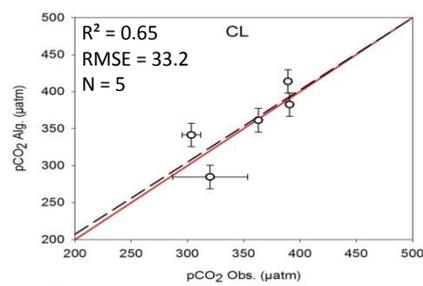
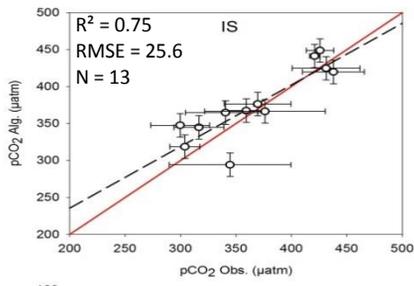


Figure S2: For each province, the top graphs represent monthly mean $p\text{CO}_2$ observation from SOCAT/LDEO databases ($p\text{CO}_{2\text{ Obs.}}$, in μatm) vs. corresponding monthly mean $p\text{CO}_2$ obtained from MLR ($p\text{CO}_{2\text{ Alg.}}$, in μatm). The red lines represent the 1:1 relationship, the dotted line are the linear regression relations with corresponding R^2 , RMSE and N the number of observations. Vertical error bar represent the uncertainties of the MLR obtained in well-mixed and seasonally stratified provinces and horizontal error bar correspond to the standard deviation of the observations for each month. The middle graphs represent observed minus algorithm based $p\text{CO}_2$ for each province, horizontal dotted lines correspond to MLR uncertainties (RMSE) and vertical error bar are the standard deviation of the observed $p\text{CO}_2$ data for each month. The bottom graphs represent the same difference as above vs. $p\text{CO}_{2\text{ Obs.}}$ (in μatm), the dotted bar are MLR RMSE and vertical error bars corresponds to the standard deviation of monthly observed $p\text{CO}_2$.

2003-2013

SST monthly means(°C)

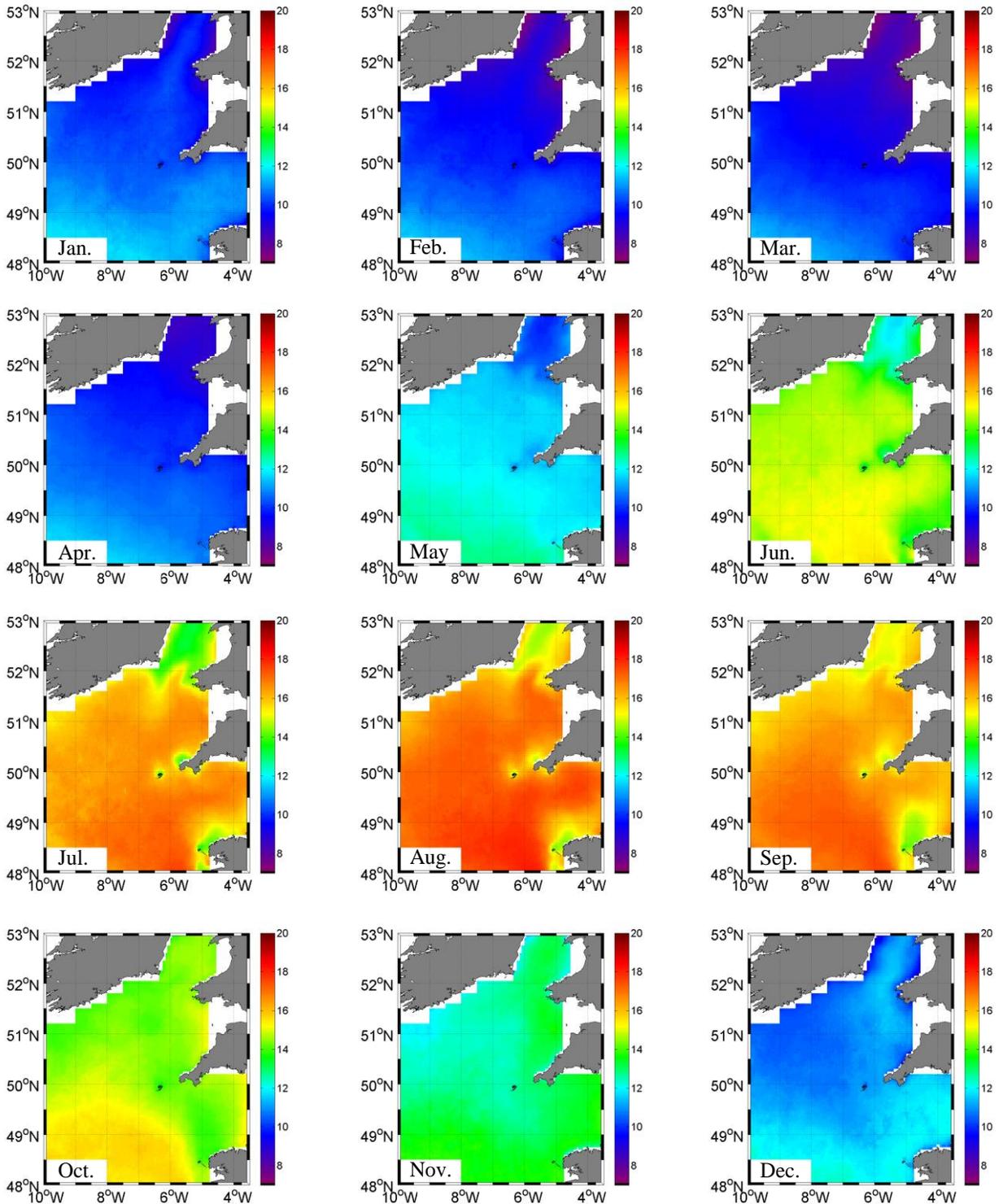


Figure S4: Monthly satellite SST (°C) averaged from 2003 to 2013 from January (top left corner) to December (bottom right corner).