



Supplement of

Dynamics of air–sea \mathbf{CO}_2 fluxes in the northwestern European shelf based on voluntary observing ship and satellite observations

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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 pCO_2 observation from SOCAT/LDEO databases (pCO_2 _{Obs}, in µatm) vs. corresponding monthly mean pCO_2 obtained from MLR (pCO_2 _{Alg}, in µatm). The red lines represent the 1:1 relationship, the dotted line are the linear regression relations with corresponding R², 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 pCO_2 for each province, horizontal dotted lines correspond to MLR uncertainties (RMSE) and vertical error bar are the standard deviation of the observed pCO₂ data for each month. The bottom graphs represent the same difference as above vs. pCO_2 _{Obs}. (in µatm), the dotted bar are MLR RMSE and vertical error bars corresponds to the standard deviation of monthly observed pCO₂.



Figure S3: Comparison of in-situ pCO_2 data (red dots, in μ atm) computed from dissolved inorganic carbon (DIC) and total alkalinity (TA) discrete measurements performed on board a newly exploited VOS line between Roscoff (France) and Cork (Ireland) in August 2014 and in September 2014 with mean pCO_2 data along the ferry tracks calculated from our MLR from 2003 to 2013 (blue dots, in μ atm). The map shows the sampling location during each crossing (August in blue and September in red). The error bars for in-situ pCO_2 data represent the uncertainty associated to pCO_2 computation from DIC and TA (\pm 6 μ atm, Zeebe and Wolf-Gladrow (2001)) and the error bars for pCO_2 data from MLR correspond to the uncertainties of 16 μ atm and 17 μ atm relative to the MLRs developed in permanently well-mixed sWEC and seasonally stratified nWEC, respectively.

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.