Supporting Online Material for

Synthesis of observed air-sea CO_2 exchange fluxes in the river-dominated East China Sea and improved estimates of annual and seasonal net mean fluxes

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This PDF file includes

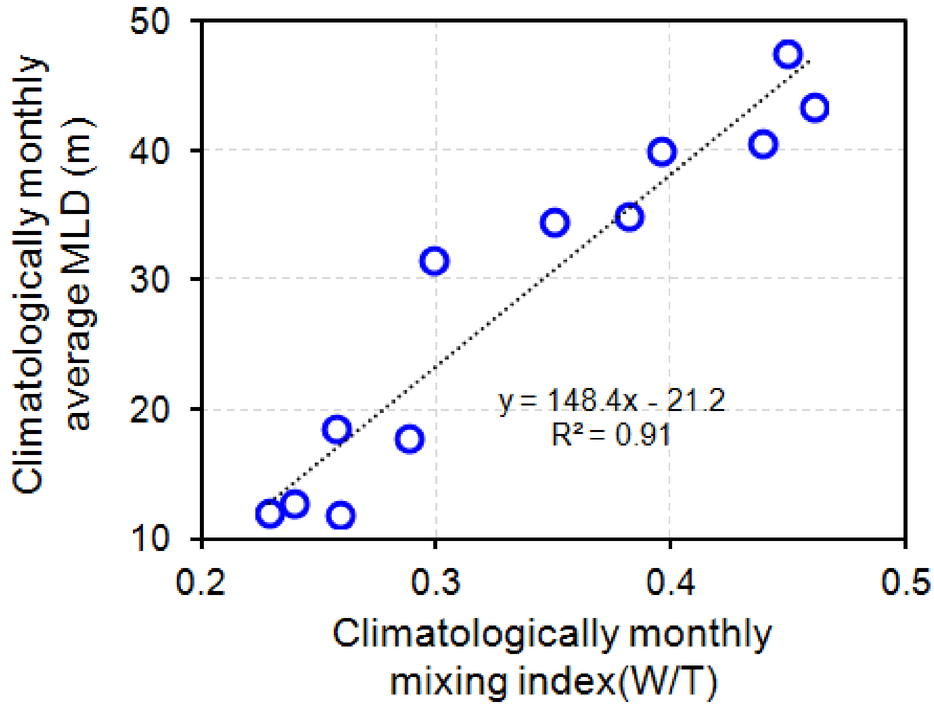
Supporting results
Figure S1, S2, S3, S4

Supplementary Online Materials

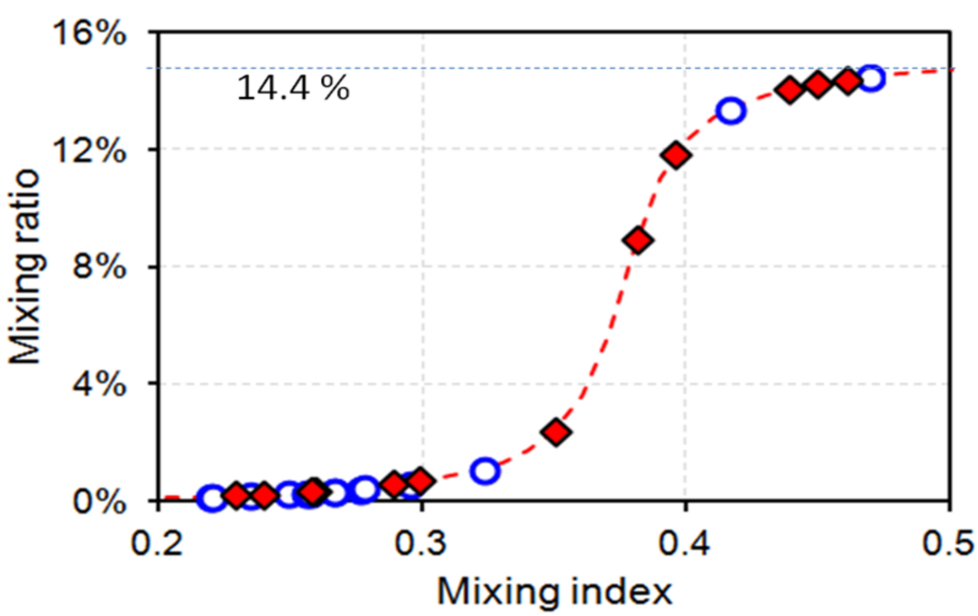
1. Seasonal contribution of vertical mixing in the ECS

The surface mixed layer is a layer where this turbulence is generated by winds and surface heat fluxes. So, the mixed layer depth (MLD) is generally positively related to wind speed (W) and negatively to seawater surface temperature (T), i.e., MLD $\propto$ W/T as the mixing index (W: wind speed (m/s) at PenGaYi station, T: remotely sensed SST (℃)). We further found a significant correlation between climatologically monthly average MLD data obtained from the Ifremer/Los Mixed Layer Depth Climatology website (http://www.ifremer.fr/cerweb/deboyer/mld/Surface_Mixed_Layer_Depth.php) and the mixing index (Fig. S1). It indicates the mixing index as wind versus SST shall be considered as a proper vertical mixing parameter. Additionally, Fig. S2 shows the greatest contribution of mixing replenishment is about 14.4% due to a completely vertical mixing in winter in the ECS shelf , while the contribution of the mixing tends to almost zero during warm periods due to a strong stratification (Fig. S3). So, a distinctly seasonal change in mixing contribution will occur during the monsoon transition/ season alternating from the cold to the warm periods or vice versa. The seasonal mixing ratio as a function of mixing index follows an arctan curve made by the inverse tangent function (Fig S2): Mixing ratio (%) = $(\tan^{-1}[61.2\,(W/T) - 23] + 1.5)/20$

Fig. S2 shows the mixing ratios from the surveys in the study and climatologically monthly average are well fitted in the arctan relationship with the mixing index. The seasonal variation of the mixing ratio is shown as Fig. S3 as well.



FigS1 Relationship between climatologically monthly average MLD and mixing index (W/T)



FigS2. Arctangent relationship between the mixing index and contribution ratio. Blue dot: field surveys; red dot: climatologically monthly averages

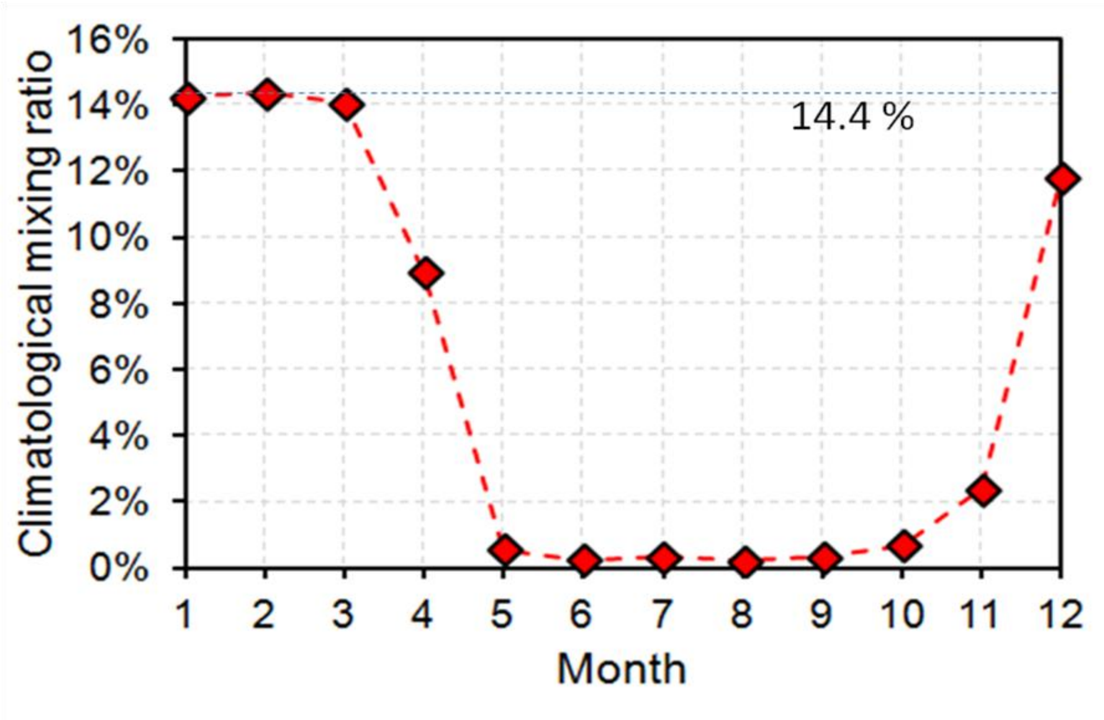


Fig. S3. Climatologically monthly variability in the contribution ratio of vertical mixing in the ECS.

2. Model output reliability

The empirical algorithm for calculating pCO_{2w} as a function of SST and CRD successfully simulated the annual cycles of pCO_{2w}, δpCO_2 and the CO_2 flux, which are in excellent agreement with observations (Fig. S4). Overall speaking, the modeled pCO_{2w} linearly correlate well with the observed areal mean as shown in Fig. S4. It indicates the performance of the empirical algorithm applied to the model domains (S and B) and cruise survey area of the ECS is well confirmed. Further, the model uncertainty estimated by the mean pCO_2 deviation between the model results and observations from January to November was small about -0.2± 8.5 μatm.

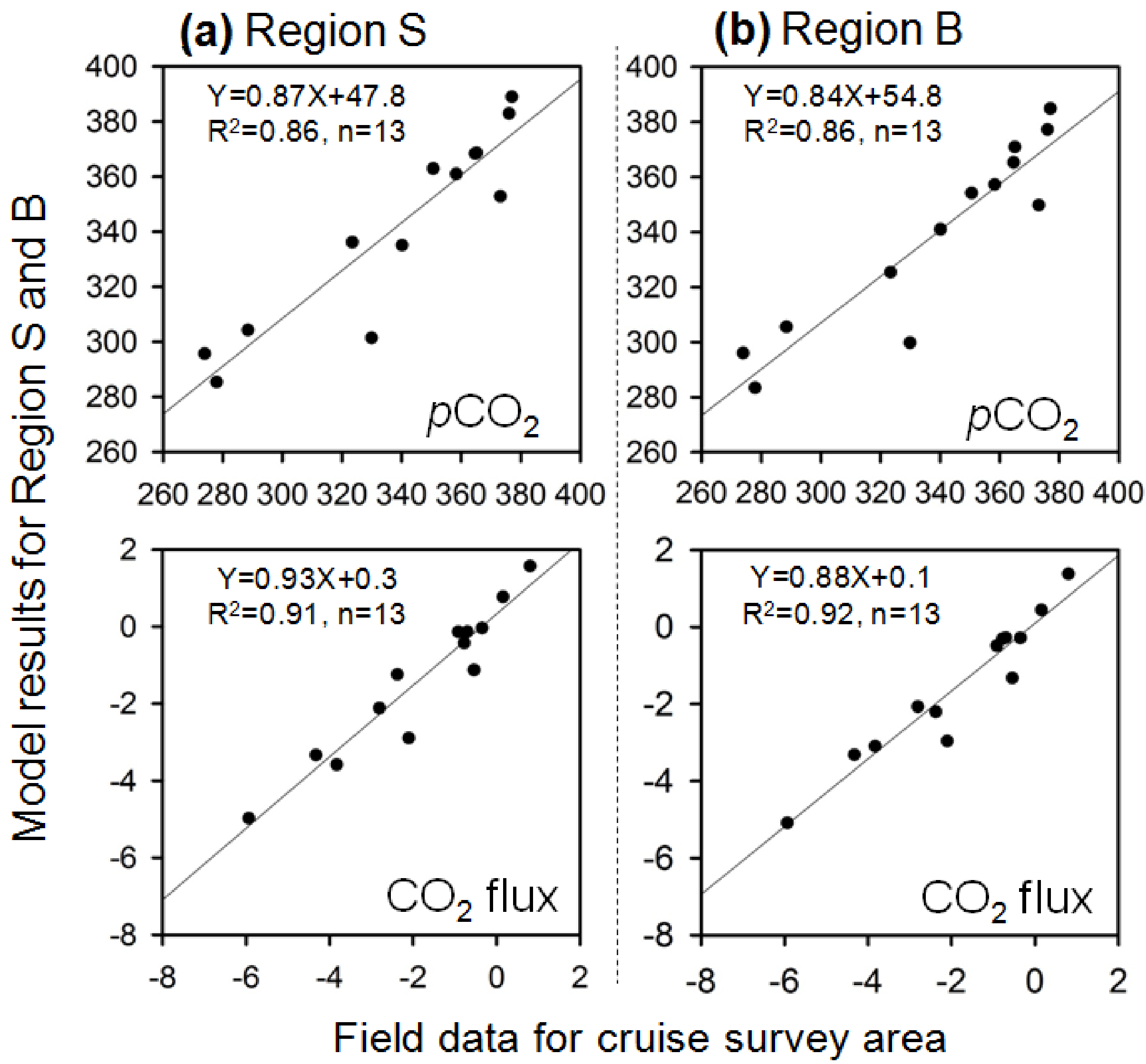


Fig. S4 Linear regression relationships between areal mean pCO_{2w} and air-sea CO_2 fluxes of model results for regions (a) S and (b) B and of field observations in cruise survey area.