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# *Interactive comment on* "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" *by* C.-M. Tseng et al.

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Comments: The work outlined in this manuscript provides monthly estimates of in-water pCO2 and air-sea flux for the East China Sea (ECS). A rich set of ship observations and AVHRR SST satellite data spanning 14 years (1998-2011), are synthesized. From averaged regional data, in-water pCO2 and air sea flux estimates are derived and found to be robust functions of Changjiang River discharge and SST.

Although promising, the work is compromised from its dependence on empirical re-

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lationships drawn from interpolated fields. This presents several difficulties in understanding the physical, chemical and biological bases for the estimates. Exactly why do the algorithms work? How the Changjiang River actually affects solubility, net community productivity and dilution of carbonate parameters is not adequately explained, nor is the effect of winter mixing, which is addressed somewhat arbitrarily. In places the logic is hard to follow and the sentence structure awkward. The manuscript needs quite a bit of work, but should be resubmitted after major revisions.

Understanding how the world's largest rivers affect ocean ecosystems and carbon sequestration is critical work. I would appreciate a deeper exploration and analysis of this important data set. My recommendations for a resubmission include separate analyses of control regions within the ECS, better statistical analyses (only r2 is presently used) and a more theoretical approach addressing how variations in NCP, solubility and mixing of TA and DIC affect in water pCO2 and air-sea flux.

Technical comments: P13977 – L5, How was the biological sequestration identified? I could not find this.

P13979 – L29 Net community production includes the respiration term.

P13980 – L1-3, explain the processes. Heating and biological uptake of DIC drive pCO2 in different directions.

L21-22, "freshening nutrient source" Reword.

P13981 – L9, $\frac{3}{4}$ of the cruises were during the summer. How does this affect the results?

P13981 – L16, indicate depth of intake. Did it vary between cruises? This may be important, especially in shallow river lenses.

P13982 – L9, "AVHRR agreed well. . ." The AVHRR-SST (observed) relationship does not look that great in figure 2. A 1-2 degree C bias or error could translate into an estimate error of $\sim$10-30 uatm.



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P13983 – L19-22, The averaging of wind can create serious biases. See Wanninkhof et al., 2002 and Jiang et al, 2008.

P13984, Section 3.1. The SST may be representative, but certainly not the SSS. One of the main points here is that the changing discharge affects the pCO2 and a-s flux. Certainly the magnitude of CRD affects SSS distributions.

P13984-5, Section 3.2, This section does not adequately relate low summer pCO2 to CRD. The present description is too qualitative and anecdotal. Does the measured limiting nutrient flux support the apparent DIC uptake, even when the surface is warming? Please use some quantification in this section. Also, the near-coastal areas of Changjaing Plume have very high pCO2 values (see Gao et al, 2008, Peisong et al, 2013). Are these regions considered in the overall statistics? Could they change the results?

P13986, Section 3.3 How does the apparent low bias in AVHRR affect the pCO2(w) estimate in equation 5?

P13987 – L1-10, I cannot follow the link between the climatological mixing index and numerical change in TA and DIC that would lead to +57.4 uatm average difference between the algorithm and the observations. This could be evidence that entrainment is important and its interannual variability could be important factors that should be considered. How does knowledge of a 14.4% increase in the amount of deep water entrained into the surface help without knowing the change in DIC and its relative buffering arising from the mixing? It seems that the pCO2 estimates for whole period between December and April could be compromised (see mixing ratios in Fig S3) unless you had a quantitative measure of mixing on DIC and TA. This highlights another potential problem with having poor coverage during these months (only 3 cruises throughout the entire series).

P139888 – L15-20, How will changes the CRD alter the future projections of the ECS sink term? Following the reasoning presented in the manuscript, the increasing delta, must in part be due to decreasing CRD.

Citations: Gao Xuelu, Song Jinming, Li Xuegang, et al. 2008. pCO2 and carbonfluxes across sea-air interface in the Changjiang estuary and Hangzhou Bay. Chinese Journal of Oceanology and Limnology, 26: 289–295

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Jiang, L.-Q., W.-J. Cai, R. Wanninkhof, Y. Wang, and H. Luger (2008), Air-sea CO2 fluxes on the U.S. South Atlantic Bight: Spatial and seasonal variability, J. Geophys. Res., 113, C07019, doi:10.1029/2007JC004366.

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