

Reply to comments from Referee 2:

This paper reports on N₂O concentrations and sediment-water fluxes in the Yangtze River and in the plume of its estuary. This topic is relevant to BG, there has been already several works published on the same subject at other sites. The MS is written in good English, but suffers from many imprecision and contains several truisms.

Comment: The dataset of N₂O concentrations does not cover the region of low salinity, including the Estuarine Turbidity Maximum, where a maximum N₂O is expected. In fact, because no sample was taken between the river point and the plume, the objectives of the paper, both quantitative and qualitative (P3128 L7-10) cannot be fully reached.

Reply: We do agree with this and we plan to do more research work in this area in the future, especially in the inner estuary and the Turbidity Maximum Zone (TMZ). Although this study mainly focused on the outer estuary of Changjiang, we cited the results from one previously published paper by us (Zhang et al., 2008), which covered the inner estuary, to help us learn the distribution of N₂O in the whole estuary.

Comment: An original part of the work, the sediment core incubations, is not shown with enough detail, so reader cannot have a precise idea of the quality of the data. This paper provides little new insights on N₂O dynamics in estuaries in comparison with what has already been published in other sites. Its main interest is to provide the first N₂O measurements in the Yangtze River Estuary, but it is a pity the dataset is partial. The authors themselves emphasizes a "need for more measurements" P3138 L24. I doubt this reaches the BG standards.

Reply: N₂O concentrations and fluxes vary greatly in different estuarine systems, the estimates for N₂O emission from global estuaries suffered great uncertainties due to limited data available, especially for the typical large river estuaries in the world. Hence more observations at typical estuarine systems in the world are required to understand the estuarine N₂O emissions on a global scale. More detailed information about the sediment core incubation was shown in the Section of Materials and Methods. A plot (Fig. 7) was also added to show the variation of DO and N₂O with time during the incubation.

Major comments 1-Gap in the dataset. Where is the river station exactly located? The authors write “the most downstream main channel station at the further upstream

side from limit of salt water intrusion during dry season”. So I guess the point is influenced by the tide, it is located in the tidal river and is already influenced by estuarine processes? what are O₂ and turbidity at this point? I would expect a river reference station more upstream. In between that river point and the next one downstream in the plume, a large part of the salinity gradient occur. I could not find the salinity data in the MS, nor in the text, neither in tables 1&4, there is a line missing with "this study" in table 2, where salinities of other studies appear. There should be N₂O versus salinity plots in a paper with such a title. As the authors themselves write in P3132, that sampling missed the ETM and the potential max N₂O. The problem is that, if a max N₂O occurs at low to intermediate salinity (higher than the 30nM at the "river" station), it becomes necessary to plot N₂O vs salinity in order to estimate the input to the East China Sea. With their river station data, the authors compute a flux to the estuary, but the output to the coastal sea might be much larger if a max occurs at intermediate salinities. O₂ concentrations are also missing in figures and tables, and throughout the MS.

Reply: The exact location of Station Xuliujing was shown in Fig 1b, which is about 110 Km from the river mouth. It is influenced by tide, but the salinity is 0 all year around and the surface water usually contains high level of dissolved oxygen, ranging from 8.3 to 10.3 mg/L (Fan and Xu, 2007). Since it is located at the further upstream side from limit of salt water intrusion during dry seasons and at the node where the river estuary begins to become wide, Xuliujing is suitable for observing the freshwater input to the sea from the Changjiang. The text was revised accordingly.

The observed temperature, salinity and O₂ for the surface and bottom waters of all cruises were added in Table 1. Surface salinity of the Changjiang was also added in Table 2. A new figure (Fig. 3) was added to show surface N₂O concentrations versus salinity in the Changjiang Estuary. N₂O distribution in the inner estuary and relationship between N₂O and salinity in the full salinity range was discussed in the text based on the data from one of our previously published paper (Zhang et al., 2008). A new plot (Fig. 4) showing relationship between the apparent N₂O production (Δ N₂O) and apparent oxygen utilization (AOU) in the Changjiang Estuary was also added.

Major comments 2-Sediment-water fluxes. Protocol seems OK because no headspace, but many details could make it wrong, more info is needed to trust it. First, how many cores where incubated? Sediment-water fluxes always show extreme

heterogeneity at the metric scale. Second, if incubation lasted 48h and aliquot were taken every 4h, why not provide a figure with the time course (13 points) of the N₂O and other parameters (NO₃, NH₄)? Authors write P3130 L18 “the emission rates of N₂O. from the slope of the increase versus time”. How can the reader trust the increase was linear? In particular in the case of an uptake of N₂O by the sediment (DC10 station), it may follow a first order curve. What was the quantity lost in comparison with the initial value, and what was the final concentration of all parameters in comparison with initial and in situ? Also the authors used filtered seawater on top of the sediment core, N₂O might have been lost during filtration.

Reply: All incubation experiments were performed in duplicate, and the results are reported as the mean values. The incubation at Station DB6 lasted 48 hours, but the overlying water was sampled at different time intervals ranging from 4-36 hours. A new plot (Fig. 7) was added to show the variation of DO and N₂O with time during the incubation. At Station DC10, the incubation lasted only 4 hours due to time limitation. DIN was not determined during the above incubation, but the benthic fluxes of nutrients were determined by incubating the sediment core samples at Station DB6 and DC10 with bottom seawater bubbled with air or nitrogen (Qi et al., 2003) and the results were cited in the text to help us discuss the possible processes involved. Filtered seawater was used as the overlying water during the incubation to reduce the influence of in situ production in the water column.

Detail comments:

P3127 L4: "Garnier" not "Ganier".

Reply: Reworded as recommended.

P3127 L15: Specify on what criteria Yangtze is the 3rd.

Reply: Changjiang rank third in length, fifth in water discharge and fourth in sediment discharge among the world's rivers (Milliman and Syvitski, 1992) and the text was reworded accordingly.

P3127 L22-30: PON and DOC might also be a large source of N for N₂O production.

Reply: We agree with the reviewer on that DON and PN might also be a large source of N for N₂O production and the text was revised accordingly. However there are many published data about DIN in the Changjiang to show the long term variation while little data are available for DON and PN. Hence only data of DIN were shown

as an example to show the historic trend of N load, and DON and PN fluxes during 1998 to 1999 (Zhang et al., 2003) were added in the introduction.

P3127 P3131: There are many papers dealing with gas transfer velocities in estuaries, much better to use than the L&M, which is an underestimate even in the ocean.

Reply: Various empirical relationships have been derived for estimating gas transfer velocity (k). The two most widely used are those of Liss and Merlivat (1986) and Wanninkhof (1992), which are often assumed to define the upper and lower limits for k . We used them to compute k just to help comparisons with the previously published data using LM86 and W92 relationships. Considering the special characteristics of estuaries, we also choose RC01 relationship (Raymond and Cole, 2001) to calculate the air-sea N_2O fluxes and the subsequent estimation of N_2O emission from the Changjiang Estuary.

P3137 L17: the authors interpret the N_2O distribution in the plume with changes in river inputs, but it might also be due to changes in estuarine processes, in particular in the ETM.

Reply: The statement was removed from the text.