

## Science Highlight

### CH<sub>4</sub> and N<sub>2</sub>O Emission from the Oxygen Deficient Region in the Yangtze River Estuary

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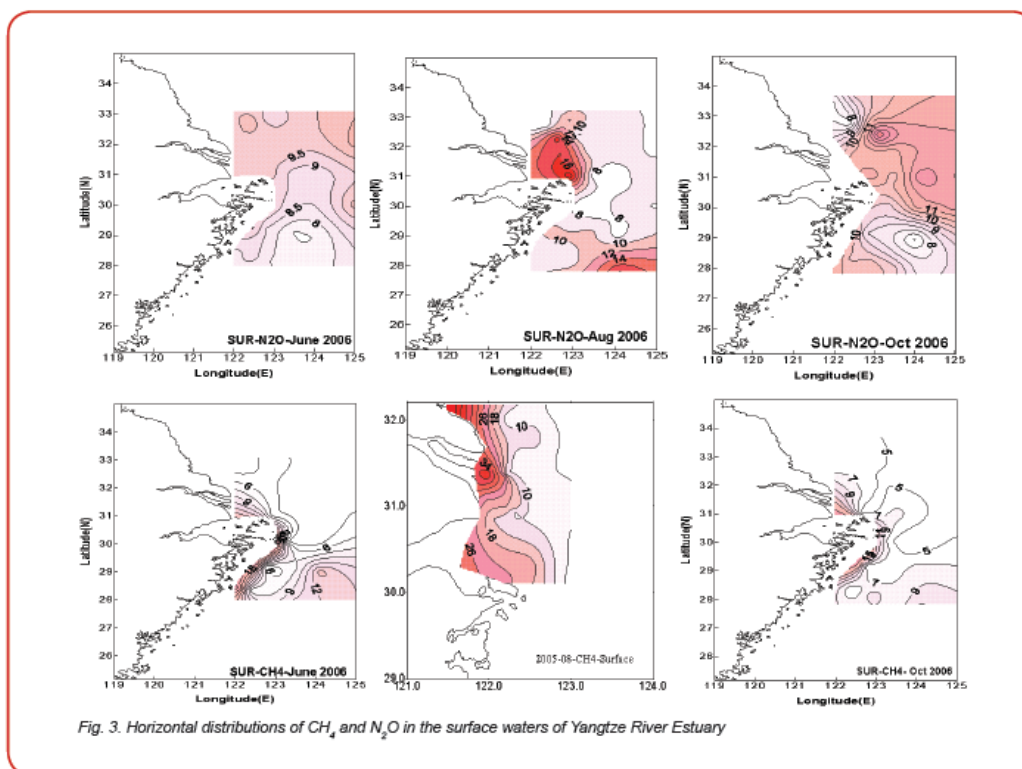
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Eutrophication of surface waters and hypoxia in bottom waters have been increasing in many coastal areas, leading to depletions of marine life in the impacted regions. For example, strong O<sub>2</sub> depletion occurs in the bottom waters off Yangtze River Estuary in summer due to increase runoff of nutrients and organic materials from land (Li et al., 2002). In this O<sub>2</sub>-deficient region the minimum O<sub>2</sub> concentration is approximately 1 mg/L and the area with O<sub>2</sub> content of less than 2 mg/L covering an area of 13700 km<sup>2</sup>, and the area with O<sub>2</sub> content of 2.0-3.5 mg/L can extend southeastward to the 100m isobath along the bottom of the continental shelf of the East China Sea (Li et al., 2002). Although the local ecological impacts have received much attention, the potential contribution of increasing hypoxia to global change is unknown.

CH<sub>4</sub> and N<sub>2</sub>O are important atmospheric trace gases, which play significant roles in global warming and atmospheric chemistry (IPCC, 2001), and the global oceans are net natural sources of atmospheric CH<sub>4</sub> and N<sub>2</sub>O. Naqvi et al. (2000) reported increased N<sub>2</sub>O production due to intensifying anoxia on the Indian continental shelf. In combination with the arrival of large amounts of organic matter and nutrients off Yangtze River Estuary, it

is reasonable to deduce that CH<sub>4</sub> and N<sub>2</sub>O production in the O<sub>2</sub>-deficient region will increase.

In August 2005, and in June, August and October 2006, cruises were conducted in the Yangtze River Estuary to evaluate the potential influence of hypoxia on the emission of CH<sub>4</sub> and N<sub>2</sub>O. CH<sub>4</sub> and N<sub>2</sub>O concentrations in the surface waters show seasonal variations, with highest values occurring in August. The most conspicuous feature observed in the horizontal distributions of CH<sub>4</sub> and N<sub>2</sub>O was the decrease in concentrations along the freshwater plume from the river mouth to the open sea (Fig. 3). In June and October 2006, oxygen saturations of approximately 60% were observed in the water column, with the vertical distributions of N<sub>2</sub>O being mirror images of O<sub>2</sub> concentrations. N<sub>2</sub>O production ( $\Delta$ N<sub>2</sub>O) was found to be positively related to the apparent oxygen utilization (AOU), which suggests that low O<sub>2</sub> may enhance the production of N<sub>2</sub>O in the water. In October 2006, CH<sub>4</sub> production ( $\Delta$ CH<sub>4</sub>) was also found to be positively related to AOU. In August 2006, lower oxygen (~50%) was observed in the water column, but no correlation was found between  $\Delta$ N<sub>2</sub>O or AOU.



$\text{CH}_4$  and  $\text{N}_2\text{O}$  were found to be supersaturated in the surface waters of Yangtze River estuary during all cruises, suggesting net sea-to-air fluxes. Higher emission of  $\text{CH}_4$  and  $\text{N}_2\text{O}$  may be caused to some extent by the low oxygen in bottom waters as well as the input of river waters rich in  $\text{CH}_4$  and  $\text{N}_2\text{O}$ .

In future cruises, bacterial processes such as methanogenesis, nitrification and denitrification in the water column and sediments should be further studied to understand the influence of hypoxia on the production and emission of  $\text{CH}_4$  and  $\text{N}_2\text{O}$  in the Yangtze River Estuary.

#### References:

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