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題目：Distributions and water-to-air fluxes of nitrous oxide in Tamsui River Estuary and comparison with others estuaries

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Abstract

Nitrous oxide (N_2O) is one of the potent greenhouse gases and the key ozone depletion substances. According to previous research, a large amount of N_2O has been emitted through agricultural activities due to nitrogen fertilizers. Estuaries are areas that are vulnerable to anthropogenic activities, especially agriculture. Anthropogenic activities have altered the nitrogen cycle in estuarine and the coastal area, but the distribution and the emission of estuarine N_2O are still little known. Here, we present the seasonal distributions and sea-air fluxes of N_2O in Tamsui River estuary and its adjacent sea. Water samples were collected during four research cruises between 2019 November to 2021 January in both Tamsui River estuary and its adjacent sea. The seasonal variations of N_2O concentrations in the estuary were 46.78-148.48 nM in autumn, 15.88-82.52 nM in spring, 10.97-41.95 nM in summer and 13.13-120.57 nM in winter; while in the sea, seasonal variations of average surface N_2O concentrations were 10.3±0.2 nM in autumn, 11.6±1.2 nM in spring, 11.4±0.7 nM in summer and 13.8±0.9 nM in winter. A descending trend of N_2O concentration was observed from the estuary to the sea due to physical mixing. The seasonal distributions of N_2O fluxes in the estuary were 3.64-11.94 μmol m^{-2} d^{-1} in autumn, 1.54-8.49 μmol m^{-2} d^{-1}in spring, 1.39-5.57 μmol m^{-2} d^{-1}in summer and 2.23-21.69 μmol m^{-2} d^{-1} in winter. In the sea, using wind speed obtained from Taipei Port over the years, the average surface N_2O fluxes were 36.3±0.7 μmol m^{-2} d^{-1} in autumn, 25.6±2.7 μmol m^{-2} d^{-1}in spring, 20.9±1.3 μmol m^{-2} d^{-1}in summer and 46.6±3.1 μmol m^{-2} d^{-1} in winter. In estuary and its adjacent sea, water-to-air fluxes were both low in spring and summer but high in autumn and winter. However, the dominator of the seasonal distributions in both area was different. In the estuary, water-to-air fluxes were dominated by N_2O concentrations, while in the sea, they were dominated by the wind speed. Overall, the Tamsui River estuary and its adjacent sea act as a source of N_2O to the atmosphere.