

Seasonal variation in nitrous oxide concentration of groundwater and its emission potential in agricultural watersheds

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Distribution characteristics and seasonal change of nitrous oxide (N₂O) in an unconfined aquifer were examined, based on changes in concentrations of N₂O, nitrate-nitrogen (NO₃-N) and other chemical components in the groundwater flow of an agricultural catchment affected by significant fertilizer application. N₂O concentrations were about 0.004 mgN L⁻¹ in the upstream area, and were positively correlated with NO₃-N concentrations. These results suggest that the nitrification process influences N₂O concentrations in upstream areas. In the downstream area, N₂O concentrations in deeper groundwater (> 15 m) were significantly higher (0.013 mgN L⁻¹), but they were very low in shallower groundwater (< 15 m), below the detection limit. Spatial distributions of dissolved oxygen (DO) and dissolved organic carbon (DOC) suggest that shallower groundwater is characterized by a strong reducing condition and high organic carbon content compared to deeper groundwater. These results suggest that a complete denitrification process (NO₃⁻ to N₂) occurs in shallower groundwater, whereas an incomplete denitrification process causes the increase of N₂O concentrations found in deeper groundwater. N₂O concentrations in winter were significantly high, but N₂O concentrations in summer were low. Groundwater level in summer was higher than that in winter. These results suggest that groundwater level influences the denitrification process. N₂O discharge from groundwater to sea water was 1.95kgN. The N₂O discharge was 0.3% compared with the NO₃-N discharge.

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