

N₂O formation mechanisms in sandy unconfined coastal aquifers

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Troposphere concentrations of N₂O, a greenhouse gas with ~300 times the radiative forcing of CO₂, are estimated to increase at an annual rate of ~0.3%, with marine waters accounting for 10-33% of the global tropospheric source [1]. Coupled measurements of coastal surface water ²²²Rn concentrations and dissolved N₂O indicate submarine groundwater discharge (SGD) is a potential source of N₂O to marine waters [2]. In order to accurately model future marine N₂O contributions to the troposphere, it is important to understand the mechanisms of N₂O formation in sandy coastal aquifers prior to diffuse SGD. The goal of this study was to investigate the factors controlling dissolved N₂O production in coastal aquifers of two Long Island Sound embayments.

Results show that in systems with an upper saline plume (USP) and underlying freshwater discharge zone, N₂O was positively correlated with the formation of excess N₂. In these coastal aquifers less than 42% of freshwater sourced nitrate was denitrified, indicating N₂O formation is linked with partial denitrification processes. In coastal aquifers without an USP, N₂O formation was anti-correlated with excess N₂ production in spring and fall sampling periods. Dissolved organic carbon was strongly positively correlated with N₂O formation in all settings. These results indicate that partial denitrification, driven by dissolved organic carbon in the upper saline plume, is a likely mechanism for excess N₂O production in sandy coastal aquifers that undergo diffuse SGD

[1] Denman *et al* (2007) IPCC, Climate Change. [2] Wong *et al* (2013) *Limnology and Oceanography* **58**, 1689-1706.