



Re-assessment of nitrous oxide emissions from the global inland water network

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Nitrous oxide (N₂O) emissions from inland waters remain poorly constrained at the global scale. Existing estimates of N₂O emissions are based on emission factors (EFs), defined as the proportion of the terrestrial nitrogen (N) load to a water body that is emitted as N₂O to the atmosphere. Previous studies have used very different EFs and have thus yielded estimates of global inland water N₂O emission which vary over more than one order of magnitude. The Intergovernmental Panel on Climate Change (IPCC) has proposed EFs of 0.25% and 0.75%, but studies have suggested that these values are either too high or too low.

We have developed a mechanistic modelling approach to explicitly predict N₂O production and emissions via nitrification and denitrification in rivers, reservoirs, and estuaries (Maavara et al., in press). We have recently extended this approach to include natural lakes. Nitrification and denitrification depend on the N loads received from upstream and the water residence time, which kinetically limits the extent of both processes in water bodies. This approach was applied to a global data set of 1.4 million lakes (HydroLAKES), including more >6,000 reservoirs, and >6,000 estuaries which we interconnected based on high resolution river routing schemes (Hydrosheds15s, and Hydro1K), in order to re-assess the global inland water N₂O emissions and provide the very first present-day climatology at the high spatial resolution of 0.5°.

We estimate global inland water N₂O emissions of 12.4-23.7 Gmol N yr⁻¹, with reservoirs producing most N₂O per unit area. These results indicate that IPCC EFs are likely too high by up to an order of magnitude, and that achieving the magnitude of the IPCC's EFs is kinetically improbable in most inland water systems. One of the most striking results is that although reservoirs represent only 1/10 of the global lake area, they emit in total more N₂O than natural lakes.

Maavara, T., Lauerwald, R., Laruelle, G., Akbarzadeh, Z., Bouskill, N., Van Cappellen, P. and Regnier, P.: Nitrous oxide emissions from inland waters: Are IPCC estimates too high?, *Glob. Change Biol.*, doi:10.1111/gcb.14504, in press.