Geophysical Research Abstracts
Vol. 15, EGU2013-6725, 2013
EGU General Assembly 2013

Methane and nitrous oxide emissions from coastal, estuarine and freshwater systems in subtropical Australia

Ronald S. Musenze (1), Alistair Grinham (1,2), Ursula Werner (1), James Udy (3), and Zhiguo Yuan (1)

(1) Advanced Water Management Centre (AWMC). The University of Queensland, Brisbane, Qld 4072, Australia, (2) School of Civil Engineering. The University of Queensland, Brisbane, Qld 4072, Australia, (3) Healthy Waterways Ltd. P.O.Box 13086 George Street Brisbane Qld 4003, Australia

Methane (CH_4) and nitrous oxide (N_2O) are two atmospheric trace gases of great scientific interest. They are potent greenhouse gases (GHG) that together contribute nearly 30% of the global anthropogenic forcing. N_2O is also a key ozone-depleting substance. Atmospheric CH_4 concentrations have nearly tripled pre-industrial levels and N_2O is currently 20% higher than its pre-industrial level. Aquatic systems are thought to be significant sources of both gases but there are limited field measurement data from (sub)tropical systems particularly in the southern hemisphere.

During 2010 - 2012, we studied CH_4 and N_2O fluxes from a subtropical coastal embayment, an estuary and four lakes for urban water supplies, which are of different sizes (49 – 10,940 ha) and catchment characteristics. We used both indirect (based on surface water CH_4 and N_2O concentrations and gas transfer models) and direct (flux chambers and robotics) methods to quantify the fluxes.

We found that the studied lakes are net sources of CH_4 throughout the year with CH_4 saturation ranging between 2,000 – 240,000% (all ranges are 5^{th}-95^{th} percentile) measured, while they vary between weak sinks to strong sources for N_2O with 90 - 210% N_2O saturation in surface water. There were strong spatial (inter and intra-site) and temporal variations for both CH_4 and N_2O fluxes. Station averaged directly measured flux rates varied between 0.04$\pm$0.02 to 15,238$\pm$12,036 mg CH_4 m^{-2} d^{-1} and -16.8$\pm$36.8 to 743$\pm$128 μg N_2O m^{-2} d^{-1} (n=6). These lakes are high CH_4 producers. Most of the measured concentrations and fluxes are among the highest ever reported from similar systems.

The bays and estuary are net sources of both CH_4 and N_2O all year round. Surface water CH_4 saturation ranged between 680 – 3,000% and 2,400 - 20,000% while N_2O saturation ranged between 130 - 220% and 150 - 340% in the bay and estuary, respectively. Emissions (CO_2-e) from the bays and estuary are dominated by N_2O. These estuarine CH_4 levels are comparable to similar measurements from the world's highly polluted rivers.

Indirect methods grossly underestimated fluxes from the lakes in areas with ebullition but there was general agreement between indirectly and directly estimated fluxes in diffusion dominated areas.

Catchment characteristics, temperature and salinity were key factors in explaining the observed variability. But overall, different factors explained different levels of variability of both CH_4 and N_2O in the studied systems.

Our results show that subtropical systems can be significant aquatic GHG sources with strong temporal and spatial variability. More effort should be invested in quantifying emissions from these systems at large scales.

Key words: anthropogenic forcing, subtropical systems, catchment characteristics, and flux chambers.

Acknowledgements: Funded by the Australian Research Council (ARC), Healthy waterways Ltd and Seqwater (ARC Linkage project # LP100100325).