Biogeosciences Discuss.,
doi:10.5194/bg-2016-535-RC2, 2017

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Nitrogen transformations along a shallow subterranean estuary" *by* Mathilde Couturier et al.

Anonymous Referee #2

Received and published: 9 January 2017

This paper examines N cycling processes in the subterranean estuary of an island in the Canadian Archipelago. It employs nutrient data collected over multiple years combined with previously published estimates of groundwater flow to try and quantify N removal and addition processes in the STE as well as fluxes to the coastal ocean. Overall the paper is generally well written and the data set are valuable and unique. However, I have two main issues, one having to do with interpretation and another with flux methodology. Regarding the former, and as noted up front in the title, the study focused on the shallow portion of the STE (upper 2-2.5 m). The general lack of NO3 within this zone as compared to the relatively high NO3 measured in inland fresh groundwater is used to invoke substantial denitrification or other N removal process during groundwater transport to the coast. The problem with this is that their shallow sampling scheme did not allow them to capture the local fresh-saline groundwater in-

Printer-friendly version

Discussion paper

terface (even at the furthest seaward multi port piezometer). The authors therefore cannot rule out that a NO3 plume exists beneath the reach of their piezometers. This conclusion should be cut from the paper (or at leased tempered with much of the discussion relating to it removed). The second main issue is on the definition of Q inland vs. Q beach and how they're used to derive N fluxes through the STE. Based on the description, they should both be equivalent, but are based on different datasets? If Qbeach is an estimate of the fresh SGD, then how can the shallow circulated seawater be (and its associated N load) be included in the flux calculation? If the focus is entirely on the fresh SGD plume, then Q in should equal Q out, therefore the use of two different Q values to derive N fluxes in with N fluxes out is inappropriate. Please provide further details (even though data from other papers is used, this paper needs to stand alone even if finer details can be looked up elsewhere) and also clarify what the main focus of the mass balance is (are saline SGD N fluxes, which are typically dominant, meant to be ignored, excluded?). Overall I support the publication of this paper if these two main issues can be suitable addressed.

A few minor points:

P1 Line 23: The paper has a general issue with overuse of significant figures. For example, the N fluxes here cannot possibly be accurate to for significant figures (two is probably appropriate). Same with the concentration data (e.g. 6 sig-figs used on p 12, line 10). Please correct throughout the paper.

P. 2 Line 16: sea-level has recently been shown to be a control on mixing zone dynamics: Gonneea, M.E., A.E. Mulligan, and M.A. Charette. (2013) Climate-driven sea level anomalies modulate coastal groundwater dynamics and discharge. Geophysical Research Letters, 40, 2701-2706.

P. 3. Line 24: See Saenz et al for an example of Anammox occurrence in the STE: Sáenz, J.P., E.C. Hopmans, D. Rogers, P.B. Henderson, M.A. Charette, K. Casciotti, S. Schouten, J.S. Damsté, and T. Eglinton. (2012) Distribution of anaerobic ammonia-

Printer-friendly version

Discussion paper

oxidizing bacteria in a subterranean estuary. Marine Chemistry, 136-137, 7-13.

P5 Line 5: At what depth is the boundary between the beach (sand) aquifer and the sandstone aquifer? Was the inland well sampled within sand or the sandstone unit?

P7 Line 18: Inconsistent use of super/subscripts throughout.

Fig. 3A: concentration color bars (legend) do not match those in use on the figure/figure contours. Would be ideal if these plots could have the salinity contours as an overlay.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-535, 2016.

Printer-friendly version

Discussion paper