

## ***Interactive comment on “Submarine groundwater discharge to a small estuary estimated from radon and salinity measurements and a box model” by J. Crusius et al.***

**Anonymous Referee #2**

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In this work, Crusius et al., have revisited a well-studied coastal pond on Cape Cod, USA, and have applied a suite of apropos tools to better evaluate the discharge of local groundwater to this system. These tools include tracers that are synoptic and broad in nature (Rn and salinity), as well as tools that are much more localized (manual seepage meters). Observed results are then compared to results obtained from a simple 2 box model.

Salt Pond is arguably one of the better studied coastal sites where a wealth of information already exists on the particular hydrogeologic setting, and as a consequence, numerical models that describe the interactions between fresh water and seawater are advanced and also well integrated in terms of the underlying geologic framework. Crusius' work can thus build on what is already known on coastal groundwater discharge

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within Salt Pond, and the authors can develop a more robust understanding of the nuances of Rn systematics as a SGD tracer.

Comparisons of Crusius' Rn- and salinity-derived SGD estimates to those obtained from numerical simulations suggest that the model results are reasonable and representative of flow conditions present not only in Salt Pond, but also in other areas of similar hydrogeologic terrain. SGD-derived nutrient flux estimates are also similar to values reported in other comparable systems. Such results/agreement suggests that the approach and interpretations by Crusius et al., are generally sound and informative.

However, as there is such a wealth of hydrogeologic information on Salt Pond, this site could be ideally used to more rigorously examine Rn systematics and address potential limitations of Rn as a groundwater tracer. For example, why is it apparently more difficult to model salinity fluctuations in the canal and pond than Rn? Why is there a much greater range in fresh water Rn activities, relative to saline water Rn activities? This fresh water variability in groundwater Rn is largely responsible for the reported 50% error on SGD estimates, and it would be informative if such variability could be tied to lithology, grain size, lateral/vertical hydraulic conductivities, permeabilities, ect., Seepage meters provide some evidence for discharge rate dependence on water depths and distance from shore. Such data are substantiated by model runs; yet it would be interesting to corroborate using additional tracers that might be more sensitive to saline groundwater Rn release, for example, 223,224Ra, CH4.

Specific comments: PAGE 3 Line 2: (SGD) may have a significant<sup>2</sup> Line 13: Ra, and nutrients). Line 19: groundwater, as Line 23: heterogeneous, and PAGE 4 Line 22: somewhat awkward, reword PAGE 5 Line 4: add Hammond reference? PAGE 6 Line 25 and throughout: 23 instead of twenty three<sup>2</sup> PAGE 7 Line 20: autoanalyzer at WHOI. PAGE 9 Line 15,16: How was seepage observed? PAGE 12 Line 16,17: Is the assumption that Nauset Marsh has constant Rn valid? PAGE 13 Line 17: Why 10-cm of low tide? Is this derived from model runs? PAGE 29 FIG 4: can you find data for water table heights for the Pond? PAGE 35 FIG 10: add mean values, as in text.

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Interactive comment on Biogeosciences Discussions, 2, 1, 2005.

**BGD**

2, S13–S15, 2005

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