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Biogeosciences
Discussions

Interactive comment on "Groundwater and nutrient discharge through karstic coastal springs (Castelló, Spain)" *by* E. Garcia-Solsona et al.

E. Garcia-Solsona et al.

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Anonymous Referee #2 Received and published: 12 March 2010

Overview: The authors present nutrient and radium data from the coastal ocean near Castello, Spain. The data suggests groundwater discharge from submarine karstic features is an important material vector to this section of the coastal ocean. I feel that the research topic is inline with the goals of Biogeosciences. The sampling approach is well thought out and the analytical procedures are inline with the proposed study. With this said, there are some modifications that would make this manuscript much stronger, they are highlighted below.

Main Comments:

Comment 1: While for this manuscript it seems to work, do to the short residence times of the coastal water, I would prefer that "mixing lines" be established using chloride or salinity not radium. Again, this point is somewhat irrelevant for this system as the main process affecting Ra distribution in the coastal ocean is dilution. However to be consistent with other studies with estuarine-like gradients, it would be beneficial to look at nutrient behavior relative to something other than Ra.

R1) As suggested by the reviewer, we have plotted nutrients against salinity and actually found the same mixing patterns than with nutrients vs radium. Although the graphs have not been included in the manuscript, the correlation factors for the mentioned nutrient vs salinity plots do now appear in the text as follows:

"DIN concentrations showed significant correlation with radium activities (e.g., with 226Ra: R2=0.87, Fig. 12) and salinity (R2=0.88) in the summer period, in contrast with the situation in autumn (226Ra: R2=0.32, Fig. 12; salinity: R2=0.30). The contrary trend is observed for DIP measurements, with a strong correlation with Ra (226Ra: R2=0.91) and salinity (R2=0.88) in autumn and a notably lower relationship in summer (with 226Ra: R2=0.62, Fig. 12; salinity: R2=0.45).

Comment 2: Comment 1 brings me to comment 2. Why do Ra-223 and -224 have a linear relationship with salinity? Is there an offshore source? If not, then equation 5 is probably not applicable to this system as to use it, would assume that variations in the AR and ultimately the activity of 223 and 224Ra is time, but the linear plot suggests dilution and mixing is occurring faster than decay.

R2) Both short-lived radium isotopes show linear relations with salinity given that mixing by dilution is a really important process governing their distribution throughout the plume, we agree with the reviewer on this. Also, there are no radium or salinity evidences for any significant input of groundwater far offshore from the seabed.

Certainly, it is not easy to appreciate the decay of 224Ra from the Figures showed in the manuscript because mixing probably masks it. However, the equation 5 is conceptually

correct and we consider it can be applied to calculate maxima estimates of plume water residence times. Probably, a larger set of coastal water samples would have allowed further modeling. However, the application of maxima residence times brings us to determine conservative, lower-limit, SGD fluxes in our study area.

Comment 3: Broaden the discussion. As it reads, a lot of the discussion section is simply an extension of the results.

R3) The discussion has been extended, also following comments made by Reviewer #1

Comment 4: Combining Comment 2 and 3 would make for a great discussion section. i.e. why does the radium age model not work well in karstic systems or point discharge systems. Peterson et al. 2009 recently used radon as a tracer for areas where SGD occurred as point discharge; the number of assumption used by Peterson et al. how translatable are some of these techniques to different sites.

R4) We agree with the reviewer in that discussion on Ra age models would be an interesting topic. However, it is out of the scope of the present manuscript. We have addressed this concern on responding to the precedent comments. In the revised version of the manuscript, we also cited Peterson et al., (2009) paper in the context of our work.

Minor Comments:

P 632 line 19: delete “be affected by”

The text has been modified as suggested

Figure 8 should be an inset to either Figure 1 or Figure 2.

According to the reviewer, Fig. 8 has been included as an inset in Fig. 1

Figure 9 the legend is really difficult to make out. The figure has been redone according to the comment.

Interactive comment on Biogeosciences Discuss., 7, 631, 2010.