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Biogeosciences
Discussions

Interactive comment on "^{226}Ra and ^{228}Ra in the stratified estuary of the Krka River (Adriatic Sea, Croatia): implications for submarine groundwater discharge and its derived nutrients" *by* Jianan Liu et al.

Anonymous Referee #1

Received and published: 30 August 2017

This study uses three different approaches to quantify SGD fluxes in the Krka River and estuary using Ra isotopes. The study is relevant as the understanding of groundwater nutrient inputs is of growing concern particularly in developed and modified systems like the Krka. The use of 3 different methodologies provides a unique approach to quantifying fluxes and I believe as such makes it relevant to a journal such as Biogeoscience Discussions. However I felt the scientific and presentation quality of the submitted manuscript are not to the standard needed for publication in this journal in its current state.

My main concern in the manuscript is the uncertainty around the Ra concentrations. As shown by the authors, there was a great range in Ra concentrations over the tidal cycle during their time series. Using a one off survey to gather Ra data for a mass balance introduces a large amount of uncertainty into how representative the survey was. More information is needed in the methods on how the survey was conducted (ie over 1 tidal cycle? over multiple days?) and how this might affect the Ra concentrations over the survey.

The authors state that trends in Ra activities were low in freshwaters, highest at the mouth and low in the estuary based on Figure 4. While there is a clear relationship between salinity and the sampling sites, I do not believe this is evident in Figure 4 particularly for 226Ra with highest 228Ra concentrations corresponding to near the lowest 226Ra. I believe, the error bars refer to analytical uncertainties from instrumentation rather than replicate measurements so do not give an indication a sampling variability at each site which would have been useful. A salinity vs Ra concentration plot would also have been useful. This plot is presented in Figure 7 and is said to include sampling "between Krka River water and open seawater" however the estuary samples presented fall in a very narrow salinity range (10-20) which do not correspond to those seen during the survey. Also there are more estuary measurements than sampling sites along the estuary. As such, it is not clear where this data comes from. This same comment applies to the author's interpretation of time series data in figure 6 (Page 4, line 34) as I do not believe a trend is evident. Statistical analysis would help quantify any trends. Added to this is the time series took place in a location where the authors note freshwater springs are present which is suggested to be the cause of higher Ra concentrations during the survey. This would dramatically skew flux calculations based on high point source Ra concentrations using the time series. Specific comments are below.

Specific comments: Overall, I found the manuscript contains numerous grammar and structural mistakes which at times made information difficult to follow. However, I be-

lieve this can be easily rectified by a thorough professional proof read and will not include those suggests below.

Page 4 Line 3. The authors variability in Ra concentrations due to hysteresis but do not demonstrate this. Statistical analysis or including the hysteresis analysis in a figure is needed to show that relationship as it is not clear.

Page 4 Line 5. As with the Ra concentrations, the nutrient trends are not clear from the figures. Correlation analysis would help clarify if such a relationship exists.

Page 6 line 1. As queried above, it is unclear where the estuary samples come from as they fall in a very narrow salinity range and do not come from the entire survey. Therefor the mass balance is based on a very narrow range of Ra concentrations in potentially a portion of the estuary receiving point sources of Ra (freshwater springs).

Page 7 Line 5. The episodic breakdown of boundary layers (ie Simpson et al Estuar. Coast. 1990 and Scully et al Estuar. Coast. 2005) needs to be discussed. This break down of the boundary layer may deliver high concentrations of Ra and nutrients to surface waters both spatially and temporally.

Page 8 Line 20. I believe this interpretation is limited as it does not include evapotranspiration, aquifer recharge or surface storage. Further to this, I believe the fact that this analysis contains significant uncertainties and it does not add to the main scientific story of the manuscript which is the use Ra isotopes to quantify SGD and SGD nutrient fluxes, I would omit.

Page 9 Line 23. The uncertainty in combine groundwater mass balance nutrient fluxes and average wastewater treatment plant fluxes needs to be discussed. Without knowing the time specific discharge of the plant and how it affected river and estuary nutrient concentration there are large assumptions in this model.

Figure 3. Using distance on the x axis would make the plot more easily interpreted. Including the sampling points in the plots would also help show the reader how accurate

the interpolation of data points was.

Figure 4. Using distance or salinity on the x axis would be more useful.

Figure 6. This was difficult to interpret due to how the legend was presented. Using titles on the y axis and a legend on each plot would help with this.

Figure 7. As above, unclear where the estuary samples are from as they have a narrow range and there are more of them than the survey. It could be problematic for the mass balance if the samples are from the time series due to point source Ra discharge.

Figure 8. It is unclear why only the middle section survey sites are included here.

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