

## ***Interactive comment on “Timing of land–ocean groundwater nutrient fluxes from a tropical karstic region (southern Java, Indonesia)” by Till Oehler et al.***

### **Anonymous Referee #1**

Received and published: 27 December 2017

#### **Summary:**

This manuscript investigates the temporal variability of nitrate and silicate fluxes to the coastal ocean via coastal springs in Gunung Kidul, a tropical karstic region located in southern Java, Indonesia. The authors identified two major areas of groundwater discharge to the ocean using thermal infrared imaging and quantified the discharge based on continuous measurements in a gauged subsurface river dam. Multiple water samples were collected at the two coast springs during varying climatic conditions to measure nutrient concentrations and calculate groundwater-derived nutrients discharge to the ocean. The authors studied the temporal trends of groundwater nutrients

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discharge during the wet season, flood recession periods, and the dry season. Their results showed that higher nitrate concentration was found during the wet season when the discharge was at its highest, posing a potential threat to the coastal ecosystem due to excess nitrogen inputs. I think that this study is sufficiently relevant to the field of groundwater discharge to the ocean and should be considered for publication in HESS. However, a number of questions must be addressed before its publication.

#### **Major comments:**

I agree with the authors that the main uncertainties in this study are the connection between the catchment area and the nutrients discharge to the coastal ocean. These two points are basically the main goals of the study and a better job must be done to justify the lack of data in this concern:

1) As the authors mention, assuming that the discharge in Pantai Baron is the same as the flow measured in Bribin Sindon and can be directly derived from its gauge, is a major concern. In a karst system, a distance of >10Km is too large to consider a unique flow path with invariable discharge rate all the way to the coastline. Is there any flux measurement in the literature of Pantai Baron with a flow meter to be compared with the flow in Bribin Sindon? Even one measurement could give you an idea of how acceptable this assumption is.

2) A second concern is the presence of other springs along the shoreline that were not considered in this study. In section 5.3 the authors mention that other small submarine and coastal springs are present in the area. Did you identify all of them? Where are they located? I understand that the two main points of discharge are Baron and Ngrumput, but when summed together the smaller springs could represent an important portion of the groundwater discharge and nutrient fluxes in the area. They could also be included in Fig. 1. Why was Pantai Sundak not included in this study if Sir MacDonald and Partners (1984) measured a higher flow here than in Pantai Ngrumput? Were the measurements by Sir MacDonald and Partners (1984) taken during the dry

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or wet season? Is it possible that the flux measured in Bribin Sindon feeds not only Pantai Baron but also Pantai Ngrumput and the smaller springs not considered in the study? Including this is in the discussion would improve this issue. The authors mention that a general connection between Pantai Ngrumput and the aquifer system was deduced from the hydrochemistry temporal variability. How was this done exactly? Furthermore, in this type of limestone diffuse discharge is also possible through the matrix. Can this also be occurring in the study area? In Fig. 3 low SST variability can also be observed along the shoreline from Pantai Baron to Pantai Ngrumput. How do you explain this?

Minor comments:

- 1) The authors mention in section 3.1 that the thermal infrared results were validated by offshore in-situ EC and temperature measurements in November of 2015 and April of 2016, however, no data is presented from these surveys. I suggest to include these data and explain the trends in the results section.
- 2) The potential impact of excess nutrients in the coastal ocean (such as HABs) is mentioned several times in the manuscript. Has any of this issues been reported in the study area in the past by previous studies? It would be of great interest to mention in the discussion section the specific ecological implications that may arise in this particular area. For instance, is there any vulnerable biota or seagrass species... in the area?

Technical corrections:

Page 2, L 16: I suggest changing "backed" with "supported".

Page 3, L 1: I suggest adding "the" before "dry season" here and throughout the manuscript. The same for the rainy season.

Page 3, L 24: there is a typo, it should be "A decrease" not "An increase".

Page 5, L 5: I suggest mentioning the lab at which the samples were measured and delete "In Germany".

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Page 5, L 19-21: this information was already included in page 3, L 23-27.

Page 5, L 29-31: this information was already included in page 4, L 3-5.

Page 6, L 1-4: the description of Pantai Baron can be better explained. I suggest changing the part where you distinguish between the near shore area and the 500 m away from the shore.

Page 7, L 6: I suggest using mol/day as used in the figures instead of "mol per day". Please correct elsewhere.

Page 7, L18-19: this information is repeated, is it necessary to remind the reader?

Page 8, L 10: Please change "time" by "season".

Page 8, L 30: be consistent, is it "Urea" or "urea"?

Figures:

Figure 1: to improve the figure you could superimpose the ESRI World Shaded Relief layer (partially transparent) to give an idea of the topography in the area for an easier understanding. It would also be helpful to include general groundwater flow lines to indicate at least the discussed hydrogeology if possible.

Figure 3: please add a scale bar near the north arrow for reference.

Figure 4: in figures 1, 2, 3, and 5 you used a different font, please be consistent and use the same font here too. I also suggest to change the axes range so the reader can see the data better. You could plot 2H only from -55 to -30 and 18O from -7.5 to -5.0.

Figure 6: please be consistent and use the same font here too. I also suggest to change the bars order to follow the legend, where the nitrate fluxes bar would be placed first followed by the silicate flux and lastly Bribin Sindon discharge.