Thanks for the constructive and detailed comments on " Temporal variations of groundwater table and implications for submarine groundwater discharge: A three-decade case study in Central Japan" by Bing Zhang et al.

The responses to the comments are marked blue text as below.

Reply to Interactive comment of Anonymous Referee #2

This paper delivers important information on the link between climate change and SGD. The approaches are valid, and the manuscript is well written. However, followings should be taken into consideration before this manuscript is accepted for publication in HESS.

(1) Relationship between groundwater and SGD: authors cite the paper Zhang et al., 2005 in order to calculate SGD based on a water table. This is very critical part and thus should be clearly explained with respect to methods, assumptions, un- certainties, and limitations. In addition, the results of this approach on SGD can be compared with the salinity data from coastal waters if there are any links (of course, there are many other factors controlling seawater salinities).

Reply: Thanks for your suggestions.

1) We established the relationship between SGD flux and groundwater table by the Darcy's law, because the sand aquifer in Uozu is suitable for using Darcy equation. Also, the method and assumptions were added in the revision; the un-certainties and limitations were also added, please see Table 2.

Please see line 5 to 15 in page 6, some text in the revision is as follow:

> The Darcy's law describes the water flow through a porous medium (sand). The groundwater aquifer in Uozu is sand. …. The SGD flux we estimated is 8 m and 22 m off Uozu. However, the fresh SGD flux at 40 – 100 m is about 2 to 4 times of 0 – 40 m (Hatta and Zhang, 2013). Compared to the results of water budget (Table 2), the fresh SGD maybe underestimated. However, since the groundwater table is easy to determine, the fresh SGD flux could be estimated by the equations 2 and 3 in the coastal sand aquifer.

2) The salinity data is very useful, comparing to seawater salinities. The groundwater salinity is very low. So, the coastal groundwater and SGD is fresh. As your suggestion and advice, we will determine and monitoring the salinity in our future research.

(2) Implications for SGD: Authors state the importance of SGD on marine productivity and ecosystems. If they have dissolved inorganic nitrogen (DIN) data in groundwater, authors can strengthen this paper much more. If they do not have those data, they can use some reasonably assumed data to calculate SGD-driven nutrient fluxes and their changes for the last three decades. Then, new production supported by SGD can be inferred from these calculations and state implications on ecosystems.

Reply: Thanks for your suggestion. Since we do not have the long series data of DIN in groundwater, we added average value of DIN (NO_3^-) from a reference in the same study area in the revision. The estimated SGD flux is described in Table 2 and Figure 5. The SGD flux increase over three decades, so the DIN flux in the SGD may also elevated these years.

Please see the lines 30 in page 7 in the revision.

The average concentration of NO_3^- in fresh SGD (0.69 mg/L) is larger than riverine input (0.18 mg/L) (Hatta and Zhang, 2013). The estimated SGD flux is described in Table 2 and Figure 5. The SGD flux increase over three decades, the DIN flux in the SGD to Toyama bay may increase.

(3) Rounding off problems: authors include many values (42.72 for water table, 14.76 for rain increase, 634.9 mm, and 15.36, 7.68 in Table 2 ...) throughout the entire manuscript. I think that they cannot measure the values with such accuracies. Please take care of all significant figures.

Reply: We checked and revised the rounding off problems throughout the entire manuscript.

The accuracy of groundwater table is 1 cm, after rechecking the original data. The values for groundwater table in text and Table 1, such as 42.72 m, would be correct in the accuracy of 0.01 m.

We corrected the rounding off problems of rainfall, snowfall and water budget in the text and Table 2. The accuracy of rainfall and snow fall is 1mm and 1 cm, respectively. The values of water budget in Table 2 are calculated by percentage to precipitation. These values are rounded to 2 significant figures.

Please see line 27 in page 5, Table 2 in the revision.

There were six El Niño and six La Niña events from 1985 to 2015 (Fig. 4). The seasonal rainfall and snowfall during El Niño events were 642 mm and 155 cm, and those during La Niña events were 635 mm and 157 cm, respectively.

Table 2 Description and prediction of rainfall, snow and water budget

	Average (Mean±SD) mm/yr		Water budget* 10^7 m^3/yr				
	rainfall	snowfall	Precipitation	Evapo-transpiration	River runoff	Groundwater usages	SGD
1976~1996	2311±616	4492±2629	47±13	11±2.9	28±7.5	2.0±0.5	6.0±1.6
1997~2015	2652±300	3282±1346	54±6.1	13±1.5	32±3.6	2.0±0.2	6.0±0.68
1976~2015	2473±516	3850±2110	50±10	12±2.5	30±6.3	2.0±0.4	6.0±1.2
2010~2030	2949±150	2573±987	60±3.1	14±0.73	36±1.8	2.4±0.1	7.2±0.37
2030~2050	3147±695	970±387	64±14	15±3.4	38±8.5	2.6±0.6	7.7±1.7

*Water budget is calculated by percentage of evapotranspiration (24%), river runoff (60%), groundwater usages (4%) and submarine groundwater discharge (SGD, 12%) to precipitation from 1976 to 2015 in Uozu.

(4) References: Authors should include important original papers and latest papers in references.

Reply: We added important original papers and latest papers in references.

Please see lines 15, 30 in page6; lines 2, 30 in page 7 ; lines 42 in page 19; lines 13, 27 in page 20 in the revision.

Thanks again for carefully, scientifically and detailed review and critical suggestions.