Thanks for the constructive 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 #1

The submarine groundwater discharge is likely an important source of nutrients and pollutants to the coastal oceans but is poorly studied. This manuscript provides some long-term data and forecasts the effects of climate change on the SGD. The subject is significant and timely.

1. My major concern is on whether the conclusions are robust. The rain/snow fall varies by 30%. The estimations of ET, river outflow and groundwater discharge are also subject to large uncertainties. The authors should try to propagate the errors and find out what the uncertainty is for the estimated SGD discharge. The readers would then get a better idea whether the forecast is reasonable.

Reply: We calculate the variations of water budgets in Table 2 as the comment. The standard deviation of evapotranspiration, river runoff, groundwater usage and SGD were calculated by the variation of precipitation.

Please see the Table 2, page 12 in the revision.

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 ±12.53	11 ±2.93	28 ±7.46	2 ±0.53	6 ±1.6
1997~2015	2652 ±300	3282 ±1346	54 ±6.11	13 ±1.47	32 ±3.62	2 ±0.23	6 ±0.68
1976~2015	2473 ±516	3850 ±2110	50 ±10.43	12 ±2.5	30 ±6.26	2 ±0.42	6 ±1.25
2010~2030	2949 ±150	2573 ±987	60 ±3.05	14.4 ±0.73	36 ±1.83	2.4 ±0.12	7.2 ±0.37
2030~2050	3147 ±695	970 ±387	64 ±14.13	15.36 ±3.39	38.4 ±8.48	2.56 ±0.57	7.68 ±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.

Furthermore, the uncertainty of evapotranspiration, and SGD was discussed in section 5.3. The uncertainty was also added in the conclusions.

Please see the lines 19-25 in page 7 in the revision.

According to the terrestrial water budget, an estimated 33×10^8 m^3/yr of groundwater discharged from the continental shelf into Toyama Bay as fresh submarine groundwater discharge (Ito and Fuji, 1993; Zhang and Satake, 2003). The estimated submarine groundwater discharge is approximately 6×10^7 m^3/yr, which is 20 % of the river's outflow (30×10^7 m^3/yr) in Uozu (Kokusai Kogyo Co. Ltd., 2002) (Table 2). However, the precipitation varies under climate change, because the ratio of rainfall and snow would increase. Furthermore, the variations of meteorological parameters, e.g. temperature, humidity, may cause the changes of evapotranspiration (Cong et al., 2009; Shimizu et al., 2015), as well as river runoff, groundwater discharge in the water budget. Thus, the uncertainty of percentage of evapotranspiration, river runoff and groundwater discharge in the total water budget may exist.

lines 10-15 in page 8 in the revision

(3) SGD flux was controlled by the hydraulic gradient of the coastal groundwater. The linear regression between SGD flux and the groundwater table was established. The historic SGD flux was estimated by groundwater table variation. The upward trend of the precipitation and groundwater table may indicate an increase in SGD flux although with some uncertainty.

2. A minor issue is that reading numbers in a table does not easily give a trend. A figure replacing Table 3 would do the job more effectively.

Reply: According to this suggestion, we changed Table 3 to Figure 5 to clarify the trend of SGD flux.

Please see the figure 5 (page 17) in the revision.

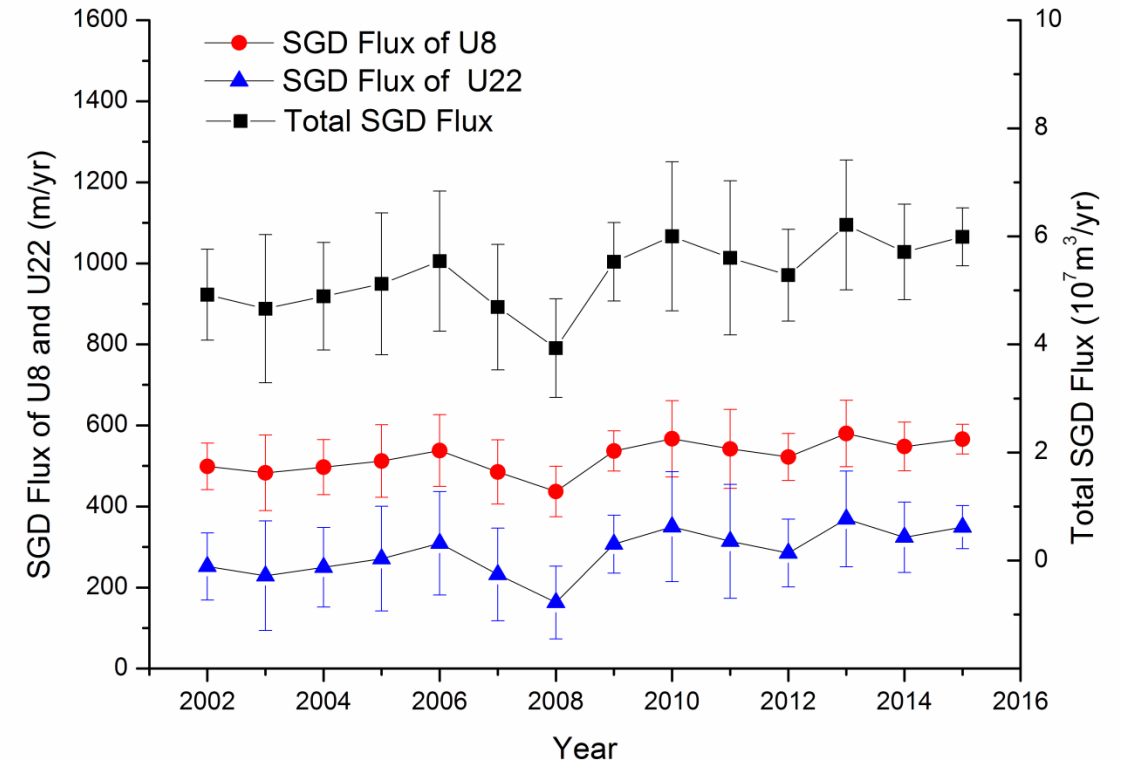

Figure 5 Estimated SGD flux by groundwater table