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Time series analysis of a multi-year submarine groundwater discharge record from the Kona coast of Hawaii

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Submarine groundwater discharge (SGD) occurs globally and its magnitude varies significantly on spatial and temporal scales. Yet, there have been very few studies that measured the long-term variation of SGD to date. To address this gap, we developed and deployed a fully autonomous gamma-spectrometer for coastal radon, salinity, and temperature monitoring. The instrument has been moored in a well-characterized coastal groundwater plume in west Hawaii, where the majority of terrestrial runoff is in form of submarine groundwater discharge.

The instrument has been recording data at 1-hour intervals since 2014. We conducted thorough analysis of SGD time series, including seasonal and spectral decomposition of the data, and we examined the evolution of its filtered level and volatility (variation in the amplitude). In addition we conducted regression analysis with the following predictors: coastal groundwater level, precipitation, tides, and sea level. We found that, beyond the well-documented tidal fluctuation, there are seasonal fluctuations due to changes in precipitation and sea level as well as other processes such as tropical storms.

The significance of this research is that it provides the longest high-resolution SGD record so far. Most importantly this research advances our understanding of SGD drivers and is the first step in predicting SGD in future land use and climate scenarios.