

## **Fresh and recirculated submarine groundwater discharge from the Karnataka coast, southwestern India**

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Submarine Groundwater Discharge (SGD) is a source of fresh groundwater and nutrients to the coastal ocean. Since the 21<sup>st</sup> century, the phenomenon has attracted the scientific community because of the magnitude of nutrients it delivers to the global ocean. We have found large expanses of SGD zone along the coasts of Karnataka, southwestern India. In our two-year study, we used a combination of groundwater, porewater and seepage water electrical conductivity (EC) as a proxy to estimate the fresh (fSGD) and recirculated SGD (rSGD). We used porewater and seepage water EC to delineate the shifting of seepage face and upper saline plume in the subterranean estuary. Important insights from our study are: i) SGD is perennial in the study area ii) groundwater discharged in the nearshore is brackish containing 11-30% fSGD iii) the ambient temperature influences up to 2m beneath the intertidal zone iv) solar radiation can evaporate the infiltrated seawater in the upper saline plume and make the rSGD more saline. The combined estimate of fSGD and rSGD are 1925m<sup>3</sup>/m/year, 787 m<sup>3</sup>/m/year and 498 m<sup>3</sup>/m/year, for the pre-monsoon 2020, post-monsoon 2020 and pre-monsoon 2021 seasons respectively. The fSGD flux from this study area is one of the highest recorded in the world. This high discharge is due to the heavy rainfall in this region (>4000mm per year) and the extensive alluvial deposits stretching up to three kilometres inland. Seepage water shows large seasonal variations with high fSGD during post-monsoon and increasing rSGD towards pre-monsoon season. The groundwater level and the mixed-semidiurnal tides prevalent in the study area regulate the fSGD and rSGD in the study area. This high magnitude of SGD could play an important role in regulating the coastal ocean biogeochemistry and in better management of water resources.