

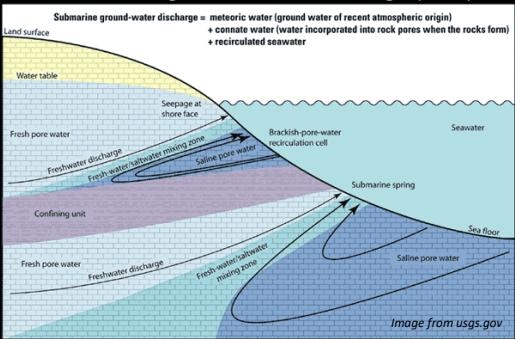
Groundwater, nitrogen, and coastal ecosystems in Saipan

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Project goals

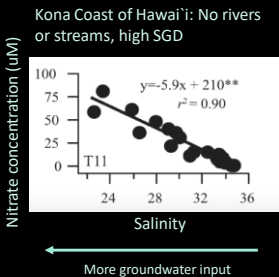
- Spatial survey of radon (a groundwater indicator)
- Estimate coastal residence time using radium isotope ratios
- Characterize discharging groundwater chemistry
- Estimate SGD and associated nutrient subsidies to the coastal ocean
- Assess variability in SGD between rainy and dry seasons
- Look at nitrogen sources with isotopes
- Investigate role of seagrasses in combatting ocean acidification and sewage pollution

Submarine groundwater discharge (SGD)



How does SGD affect the coastal ocean?

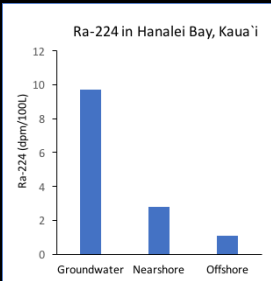
- Another hydrological connection between land and sea
- Freshwater
- Nutrients
- Metals
- Sewage pollution
- Etc. . .



From Knee et al. 2010

Measuring SGD with natural tracers

- Radium (Ra) and Radon (Rn)
- Incorporated into mass balance models
- Naturally enriched in most discharging groundwater
- Half lives 3 d – 1600 y
- Can be used as “natural clocks” to constrain coastal mixing rates



From Knee et al. 2008

Calculating SGD with a box model

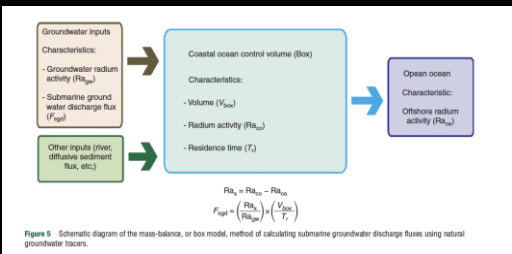
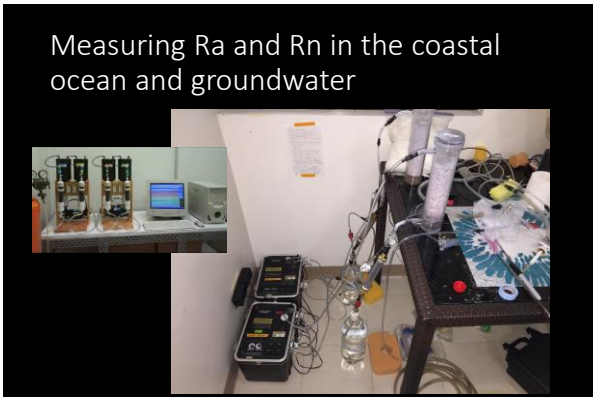


Figure 8 Schematic diagram of the mass-balance, or box model, method of calculating submarine groundwater discharge fluxes using natural groundwater tracers.

From Knee and Paytan 2011



SGD can be especially important on islands

Region	Country	Island or island group	Studies quantifying SGD	SGD (m ³ m ⁻² day ⁻¹)
Central Indian Ocean	Republic of Mauritius	Mauritius	Paytan et al. 2006	83-87
			Porvane et al. 2012	35-220
Southeast Asia	Philippines	Over 7000 islands	Taniguchi et al. 2008	12.4
			Senal et al. 2011	210-480
	Taiwan	Taiwan	Lin et al. 2011	616
	Japan	Okinawa	Bianco et al. 2011	0.2-0.3
Australia and Oceania	China	Hainan Island	Su et al. 2011	14.6-72.5
			Ji et al. 2013	13,200-28,100
	United States	Guam	Mahon 1993	2.2-110
			Johnson 2012	8.4
	France	Moorea (Society Islands)	This study	115-527
United States		Hawaiian archipelago	Garrison et al. 2003	6.43 (Oahu)
			Paytan et al. 2006	50-109 (Hawaii'), 35-114 (Maui)
			Street et al. 2008	0.75-925 (Hawaii'), 1-5.3 (Maui), 8.4-942 (Midale')
			Knee et al. 2008	1.9-11.2 (Kauai')
			Peterson et al. 2009	1200 (Hawaii')
			Knee et al. 2010	4.32-1870 (Hawaii')
			Peterson et al. 2009	28-101 (Hawaii')

from Knee et al. 2016

