Estimating submarine groundwater discharge
using numerical modeling and geomatics

Elco Luijendijk¹, Tom Gleeson¹, Grant Ferguson²
¹Department of Civil Engineering, McGill University, Montreal, Quebec, Canada
²Department of Civil and Geological Engineering, University of Saskatchewan, Saskatoon, Saskatchewan, Canada
elco.luijendijk@mcgill.ca

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ABSTRACT
Submarine groundwater discharge (SGD), the flow of fresh or saline groundwater to an ocean, may have a significant contribution to the water and chemical budgets of the world’s oceans. SGD consists of fresh, terrestrial groundwater driven by hydraulic gradients, and re-circulated seawater driven by tidal pumping, wave setup, convection and hydraulic gradients. Quantifying terrestrially-derived SGD is hampered by the fact that existing geochemical or isotopic tracers tend to provide estimates of the combined fresh and recirculated components of SGD. We couple density-dependent numerical simulations with global geomatic databases to resolve the sensitivity of terrestrially-derived SGD to coastal topography, permeability and groundwater recharge. The results show that terrestrially-derived SGD is highly sensitive to permeability, topographic gradient and concavity of the topography. In most watersheds only a small fraction of groundwater recharge contributes to SGD - most recharge contributes to base flow or evapotranspiration. Fresh SGD is only significant in watersheds with high topographic gradients, and watersheds that are underlain by highly permeable sediments such as coarse-grained siliciclastic sediments or karstic carbonates. Quantifying SGD is critical because SGD is a poorly constrained flux that may significantly contribute to eutrophication or water quality decline in coastal areas.