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Understanding groundwater dynamics on barrier islands using geochronological data: An example from North Stradbroke Island, South-east Queensland

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Freshwater lenses underneath barrier islands are dynamic systems affected by changing sea levels and groundwater use. They are vulnerable to contamination and over-abstraction. Residence times of fresh groundwater in barrier islands are poorly understood and have mostly been assessed by modelling approaches and estimates without fundamental validation with geochronological data.
Assessing residence time and recharge rates will improve significantly our understanding of hydrological processes of coastal environments that will in turn allow us to make informed decisions on groundwater use and environmental protection.

This project focused on groundwater recharge rates and residence times of the fresh water aquifer system of North Stradbroke Island, south-east Queensland, Australia. Groundwater bores, wetlands and submarine groundwater discharge points in the tidal areas (wonky holes) were sampled along a transect across the island and were analysed for major ion chemistry and stable isotopes (δ2H, δ18O, δ13C) in combination with 3H and 14C analysis.

Calculated 3H using a 95% exponential-piston flow model and 14C ages range from 12 to >100 years and modern to 3770 years, respectively, indicating a highly heterogeneous aquifer system with mixing from low and high conductive areas. The major ion chemistry in combination with stable and radiogenic isotopes suggests that a significant groundwater component derives from the fractured rock basement and older sedimentary formations underlying the sand dunes of the island.

The results help refining the conceptual and numerical groundwater flow model for North Stradbroke island in this particular case but also demonstrate the possible complexity of barrier island hydrogeology.