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Modelling wave-induced resuspension in the Fitzroy Estuary and Keppel Bay, Australia

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Sediment transport is an essential component of nutrient cycles in many aquatic systems. Accurate simulation of sediment resuspension and transport is essential for successful prediction of changes in water quality and aquatic habitats. This has repeatedly proven to be a problematic component of modelling efforts. Often, turbulence and resuspension is dominated by the effects of wind-induced waves. Although several models exist to describe the impact of wind-induced wave dynamics and wave-current interactions on sediment resuspension and transport, examples of their integration into complete hydrodynamic models are rare. Such an integration of a hydrodynamic model with a wave model has the ability to directly simulate effects of wave dynamics on turbulence production in the ocean and water level variation and current effects on wave development.
Here, we demonstrate the application of a loosely coupled simulation tool running the third generation wave model SWAN (Simulating WAves Nearshore) together with the CSIRO hydrodynamic model SHOC (Sparse Hydrodynamic Ocean Code). This tool is applied to the well-studied Fitzroy Estuary and Keppel Bay, Queensland, Australia using a fine grid with a resolution down to 200 m nested into a coupled model for the entire Great Barrier Reef (GBR) lagoon on a 4 km grid. SHOC has been previously applied to this system without a wave model, but results for suspended sediments have been unsatisfactory. The novel model is able to quantify annual wave-induced resuspension versus tidal induced resuspension and sediment input by short-term floods. It is intended to improve the capacity for prediction of sediment transport dynamics in other estuaries and bays of the GBR lagoon during flood periods as well as for the dry season (low flood), and provide an operational tool to inform catchment management strategies around Australia. This model is integral part of the eReefs marine modelling project aiming for an operational real time model describing hydrodynamics, biogeochemistry and sediment transport in the Great Barrier Reef Lagoon and its estuaries.