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Modelling the hydrodynamic and biogeochemical processes in tropical lagoons: a synthesis.

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A synthesis of the work completed during the last 10 years will be presented in order to improve our knowledge on hydrodynamic circulation, sediment transport and biogeochemical processes gained from model simulations performed for two tropical lagoons in New Caledonia (NC) and Suva (SU).

Circulation of the water masses is studied using a 3D hydrodynamic model controlled by tides and winds. Validation of this model is obtained by comparing model outputs with measured current profiles and drifter trajectories. Main patterns of circulation and various calculated total or local residence times are discussed. Two specific studies from NC lagoon are presented in terms of (1) water and energy fluxes above the reef resulting from the surge of ocean swells, and (2) wind-wave distribution in the lagoon which behaves as a fetch limited area.

Concerning suspended sediment transport, we measured the nature and characteristics of bottom sediments and the distribution of suspended particles in terms of concentrations and grain size. A suspended sediment transport model was developed for both sites UC and SU based on optical measurements. These were used to quantify suspended matter concentrations either in situ (monochromatic measurements) or by remote sensing (spectral measurements).

Finally, we coupled a biogeochemical process model to the 3D hydrodynamic model in order to describe the main features of spatial and temporal interactions between water motion and biology. By analysing numerical results for NC lagoon, we could conclude that the gradients of trophic states encountered in this ecosystem are largely dependent on physical processes like wind driven dispersion and residence times of the water masses.

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