

# Modeling of Coastal Current Using the Coupled Ocean-Wave Model with Two-Way-Nesting Considering Stokes Drift Effect on Random Waves

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## 1. Introduction

The importance of coastal current analysis has become well established in terms of assessment of coastal physical environments to determine the coastal sedimentation and ecosystem. Thus wave-current interactions is important phenomenon in coastal areas where the ocean waves are composed of such large ranges of frequency and direction as mixed swells and wind waves. This study simulates the coastal current for Tanabe Bay in Wakayama Prefecture in high-resolution regional current system using a coupled ocean-wave model with two-way-nesting to consider Stokes drift effect on random waves. Two re-analysis calculations are performed, one considering the Stokes drift on random waves and the other on regular waves, for Tanabe Bay in Wakayama. The results are compared with field observation data to evaluate the precision of the developed model.

## 2. Treatment of Stokes drift on random waves

There is a large interaction effect between currents and surface gravity waves in finite depth areas such as in the coastal ocean. The wave spectra to compute Stokes drift can be calculated by a spectrum wave model (Simulating WAVes Nearshore: SWAN) and is passed to an ocean model (Regional Ocean Modeling System: ROMS) to be considered in vortex force term of ocean model (Uchiyama et al., 2010). To reduce the computational costs in passing the wave spectra the spectra parameters of both frequency and direction is represented approximately by the two-dimensional Gaussian spectrum.

## 3. Analysis of coastal current for Tanabe Bay

Two runs are performed for Tanabe Bay in Wakayama prefecture with horizontal resolution of 2.5km on the coarse grid and 500m on the nested grid, and with 10 vertical layers. One (referred to as Wave2d) uses the model in which wave-induced transport is provided by random waves and the other (referred to as Wave1d) uses a model in which wave-induced transport is provided by regular waves. The Wave2d velocity results are more highly correlated to field observation data more than the Wave1d results.

## 4. Conclusion

This study analyzed coastal current for Tanabe Bay in Wakayama Prefecture using a newly developed coupled ocean-wave model with two-way-nesting to consider Stokes drift on random waves. It was shown that comparison in velocity between the calculated results of the Wave2d case and field observation data was highly correlated. In conclusion, the results highlight the importance of considering wave-current interaction on random waves to reproduce coastal currents in finite depth areas.

Keywords: Stokes drift, Coupled Ocean-Wave Model, Nesting