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Oceanographic coastal currents: Small-scale and large-scale laboratory simulations and a geostrophic model

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Laboratory experiments simulating gravity-driven oceanographic coastal surface currents are described. In the natural environment such currents develop when estuarine fresh-water discharges into the ocean. Since the estuarine water may carry pollutants an understanding of the current dynamics bears direct relevance to many environmental issues. Results from two complementing experimental studies are discussed, compared to each other and to the predictions obtained from a geostrophic model[1]. The first of the two experimental studies was conducted in a small-scale (1m diameter) water-filled rotating tank. Currents were generated by releasing buoyant fresh water continuously from a small source at the fluid surface. The height, the width and the length of the currents were studied as a function of the background rotation rate, the volumetric discharge rate at the source and the density difference between the released fluid and the ambient fluid. The second of the experimental studies was carried out at the large-scale Coriolis Facility[2] (LEGI, Grenoble) utilizing its 13m-diameter tank. The large-scale experiments were designed to mirror the small-scale experiments with the overall goal being to extend the ranges of the governing experimental parameters to values closer to those encountered in the oceans. The analysis and discussion of the collected data reveals a good agreement between our theoretical model and

the experiments. However, our present model[1] only describes currents flowing along vertical boundaries and, consequently, our previous experiments only considered this particular flow configuration. We have recently begun to investigate the more realistic scenario where the currents flow along sloping coastlines. We will present first experimental data from small-scale experiments for such currents in order to highlight how their motion differs from that of currents flowing along vertical boundaries. We will finally present first preliminary results obtained from computational simulations of the currents employing codes which we are developing in collaboration with our colleagues at the Institute of Marine and Coastal Sciences[3] at Rutgers University.

References:

[1] Thomas, P. J. and Linden, P. F. (2007) 'Rotating Gravity Currents: Small-scale and large-scale experiments and a geostrophic model'. Accepted for publication in *J. Fluid Mech.*

[2] Coriolis Facility, web site http://www.coriolis-legi.org

[3] Institute of Marine and Coastal Sciences, web site http://www.marine.rutgers.edu/