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EDITORIAL

Editorial—International Workshop on Modeling the Ocean (IWMO) special issue in *Ocean Dynamics*

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The first International Workshop on Modeling the Ocean (IWMO; http://phyoce.es.ntnu.edu.tw/2009WMO/) was held on Feb. 23–26, 2009 at the National Taiwan Normal University (NTNU) campus in Taipei, Taiwan. The idea for the Workshop originated when Chau-Ron Wu from NTNU visited Lie-Yauw Oey at Princeton in 2007–2008. Ocean modeling research has rapidly spread worldwide and especially in Asia since the public release of the Princeton Ocean Model (POM; http://www.aos.princeton.edu/WWWPUBLIC/htdocs.pom/) in the 1990s. The time was right, we thought, to hold a dedicated Workshop to further encourage exchange between researchers from Asia and other continents and to involve young scientists. Moreover, we wanted the first IWMO to be in a vibrant city—Taipei, Taiwan.

Approximately 150 researchers worldwide from 30 countries participated in the Workshop. There were over 60 oral presentations and posters covering a broad range of topics that included not only ocean dynamics, predictions, and data analyses, but also air, ice, sediment, and biogeochemical processes and their mutual interaction. The Workshop culminated with the Outstanding Young Scientist Awards when the Workshop recognized the very fine work of our six contestants. It was also decided at the conclusion of the Workshop, thanks to the efforts of Dr. Ezer and the encouragements from the Chief Editor Dr. Jörg-Olaf Wolff, to have some of the presented papers submitted to a special issue in *Ocean Dynamics*.

The collection of papers in this Special Issue Part 1 is but a fraction of those presented at the Workshop. These papers were among the first to be submitted after the Workshop. A follow-up Special Issue Part 2 will include the remaining, equally exciting submissions. All papers underwent the usual rigorous process of reviews and revisions. There were at least two reviewers for each paper, but a few of the submissions had three or four reviewers. Some of the reviews were from the Workshop attendees, but many were solicited from the scientific community at large.

Although the subjects are cross cutting, papers in this Special Issue may be roughly categorized into five groups: (1) numerical schemes and algorithms; (2) regional simulations with realistic bathymetry and forcing; (3) data assimilation; (4) GFD processes; and (5) model evaluations. The following provide brief synopses of these papers.

Group 1 includes three papers on numerical schemes and algorithms. Bergh and Berntsen concluded that the Neumann rather than Dirichlet condition is the appropriate boundary condition to be used for pressure in non-hydrostatic simulations. The paper also has some process simulations at very fine scales (1 ~ 10 m); these calculations will be useful for those interested in further non-hydrostatic modeling research. Berntsen and Oey concluded that simpler fourth-order schemes are not only more efficient, but they also yield very small sigma-coordinate pressure-gradient errors. Wang et al. developed an MPI-POM for simulating currents and waves and concluded that the algorithm with low-processor communication but high extra computation is most efficient especially when the number of processors is high.

Group 2 consists of three papers on regional simulations with realistic bathymetry and forcing. Xue and Du simulated a river plume with a horizontal grid ~300 m and with 22 vertical sigma levels in Casco Bay off the western coast of the Gulf of Maine, USA. Plumes with tides

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and winds have previously been extensively studied, but what distinguishes the calculation of Xue and Du is their inclusion (and improvements) of the POM wet-and-dry scheme (POM-WAD) for general three-dimensional (3-D) flows with stratification. Interestingly, they found stronger mixing of the near-shore plume when WAD processes are included. Lu et al. took on the difficult task of simulating the circulation in Sekisei Lagoon (a coral reef of approximately 20 km×20 km in the southwestern end of the Okinawa island chain, Japan) under the influences of Kuroshio eddies, winds, and tides. A triply nested grid with the finest horizontal resolution = 123 m was used, and the time-dependent exposure of the coral reef to air (due to, e.g., tides) was modeled with POM-WAD. The simulated results were compared against observations and showed encouragingly good skills. Environmental stress not only affects the tropics and subtropics (e.g., coral reefs), but also high-latitude seas that generally have strong interaction between the atmosphere, ice, and ocean. Fujisaki et al. addressed the important issue of how our incomplete knowledge of the frictional physics between air and ice and ice and water can affect ice-drift and melt in the Sea of Okhotsk (north of Hokkaido Island, Japan). An ice model is coupled to the POMgcs (generalized σz-coordinate system) at a horizontal resolution of 4 ~ 9 km and 45 σ–z vertical levels. By conducting sensitivity experiments and comparing the model results with observations, the authors found great model sensitivity to the values of air–ice drag coefficient—a conclusion that deserves further investigations in the future.

Group 3 includes two papers that address the important issues of data assimilation. Wei and Malanotte-Rizzoli tested ensemble Kalman filter using twin-experiment method (i.e., one run is assumed to be “truth” and its “data” is used for assimilation) on a barotropic tidal simulation of Selat Pauh of Singapore using FVCOM (an unstructured-grid version of POM). By perturbing the wind forcing, the authors found good ensemble spread which led to significantly reduced errors in their 48-h experiment. Wu et al. proposed to assimilate satellite SST as a correction to the surface heat flux in their ocean–ice coupled model of the Canadian eastern coast and shelves, using a simple optimal interpolation scheme. The method works well for shallow shelves where the SST is predominantly controlled by surface heat flux and gives more accurate results than satellite SST when compared against independent *in situ* measurements.

Group 4 deals with “GFD processes”; it includes two papers. Oey et al. conducted idealized experiments of a western boundary current intercepted by an abrupt turn in continental shelf break in order to understand why in winter the Kuroshio, off the northeastern coast of Taiwan, tends to intrude farther onto the East China Sea shelf. The authors found that winter cooling produced downslope flux of dense shelf water and along-slope isopycnal tilt, resulting in enhanced shelfward intrusion as well as thinning of the inertial boundary layer between the Kuroshio and the outer shelf. The overview paper by Galperin et al. on geostrophic turbulence and nonlinear waves represents an example of the wide range of topics that the attendees of the IWMO enjoyed. The authors built upon their previous works and examined the evolution of barotropic flows with a β-effect on a sphere, forced by small-scale forcing and the upscale (i.e., inverse energy cascade) energy flux absorbed by large-scale friction. A new regime of anisotropic flows consisting of slowly varying alternating zonal jets with scale-dependent meridional diffusivity was found. These “zonostrophic turbulence” gave rise to energetic nonlinear waves “zonons” resulting from nonlinear wave–wave interaction, which are basically secondary peaks around their “master” Rossby–Haurwitz waves. They also show that only quasi-isotropic, turbulence-dominated scales contribute to the diffusion of a passive scalar; large-scale, wave-dominated structures do not. This subdivision of wave- and turbulence-dominated regimes in beta-plane turbulence is analogous to that of turbulence in flows with stable stratification. The authors cited some oceanic evidences, and it would be interesting to further search for the existence of these zonostrophic turbulence and zonons in the oceans.

The last group 5 deals primarily with model evaluations. You et al. compared two storm-surge models, one based on the POM in 2-D barotropic mode and the other one based on ROMS in 3-D (but homogeneous) mode. The authors compared the simulated sea levels due to three typhoons against coastal tide-gauge data around Korea. The simpler 2-D model produced more accurate predictions for two of the three storms, suggesting perhaps that the turbulence and bottom-friction parameterizations in the 3-D model need to be improved. Saramul and Ezer evaluated POM-WAD based on the publicly released standard test of oscillatory tidal inflow and outflow past an island in a channel (the so-called WAD “seamount” test). The runs are fully baroclinic with initial vertical stratification and in some runs the authors also added winds. In comparison with the model without WAD, large mixing tends to be produced near the coast where WAD processes dominate. This is similar to the findings of Xue and Du (summarized above) and suggests that WAD generates additional perturbations to the modeled stratified waters near the coast. Future work is necessary to understand this issue.

We wish to thank the National Science Council of Taiwan and the National Taiwan Normal University for co-sponsoring the IWMO. We are grateful to Dr. C.-T. Chen of NTNU for co-organizing the IWMO and for his help in making it a success. Last but not least, we thank all the reviewers—their dedication to scientific rigors makes this Collection a special treat to read.