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Editorial-The 8th International Workshop on Modeling the Ocean (IWMO 2016) in Bologna, Italy, June 7-10, 2016

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EDITORIAL

Editorial—the 8th International Workshop on Modeling the Ocean (IWMO 2016) in Bologna, Italy, June 7–10, 2016

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The 8th International Workshop on Modeling the Ocean (IWMO 2016) was held on June 7–10, 2016, at one of the oldest universities in Europe—the University of Bologna in Italy (founded 1088 A.D.). The workshop returned to Europe for the second time (the other European IWMO was held in Norway in 2013; Berntsen et al. 2014). Since the establishment of the IWMO in 2009 (Oey et al. 2010a, b), meetings were held four times in Asia, two times in Europe, two times in North America, one time in Australia, and for the 10th anniversary of IWMO, the 2018's meeting will be held in South America (Brazil) for the first time.

The 2016 IWMO meeting celebrated the 20-year anniversary since the first Princeton Ocean Model (POM) users' group meeting held in June 1996 at Princeton. The early POM users' group meetings led to the establishment of the IWMO in 2009. The IWMO expands to include different models and a very wide range of topics involving the ocean and its coupled interaction with other aspects of the earth's environment, as can be seen from this and previous IWMO meeting agendas and related publications. The 20th anniversary event was noted by presentations on the history of ocean modeling over these two decades and an award given by The Historical Oceanography Society to Professor Emeritus George Mellor for his pioneering contribution to turbulence modeling (Mellor and Yamada 1974, 1982), coastal ocean modeling (Blumberg and Mellor 1983), and the development of POM (Blumberg and Mellor 1987), which led the way for many other community ocean models that exist today.

About 80 scientists attended the IWMO 2016 meeting, which included nine keynote distinguished speakers, ~65 oral presentations, and ~25 posters. Continuing with the IWMO tradition, students and postdocs participated in the Outstanding Young Scientist Award competition. The meeting covered a wide range of topics in ocean modeling, analysis, and processes, and this special issue of Ocean Dynamics represents a collection of 18 peer reviewed papers from participants of IWMO-2016. The papers went through rigorous reviews as regular papers in Ocean Dynamics, with the help of reviewers from IWMO members as well as external experts. The studies in this issue utilized a wide range of hydrodynamic numerical models such as ECOM, FVCOM, NEMO, POM, and ROMS, as well as several wave prediction models such as WAM, SWAN, and WaveWatchIII. Geographically, the studies covered the major oceans (the Atlantic, Indian, and Pacific Oceans) as well as semi-enclosed seas (e.g., the Mediterranean and Baltic Seas). The papers can be generally divided into four categories: (1.) Model development, analysis, and data assimilation (Byun and Hart 2017; Cipollone et al. 2017, Jordi et al. 2017; Liu et al. 2017; Wei et al. 2017); (2.) Coastal modeling and process studies (Bie et al. 2017; Ezer 2017; Ezer and Atkinson 2017; Liao et al. 2017; Lu et al. 2017, Trotta et al. 2017); (3.) Surface wave modeling (Clementi et al. 2017; Cieślikiewicz et al. 2017; Gic-Grusza and Dudkowska 2017;

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Guo and Sheng 2017; Sun et al. 2017); (4.) Biogeochemical-physical coupled models (Mussap et al. 2017, Luo et al. 2017). Below are short summaries (alphabetically ordered) of the 18 studies included in this special topical collection.

Bie et al. (2017) used POM for long-term (1979–2010) simulations of the southwest coast of the Indian Ocean. The model results were evaluated against various observations including SST, altimeter data, and tide gauge data, demonstrating the modeling challenges imposed by the small-scale topographic features and meso-scale eddies of the region. Model simulations of the impact of cyclone landfalls in Mozambique using different forcing show an improved storm surge prediction when tides and atmospheric pressure are included, with a significant contribution from the inverted barometer effect.

Byun and Hart (2017) proposed a new interpolation method to provide tidal boundary conditions for regional coastal ocean models. The study shows that standard interpolation of tidal velocities can introduce errors in tidal ellipses and demonstrates how the new method works for simulations of the M2 tide along the Korean coast using ROMS.

Cieślikiewicz et al. (2017) used the wave model SWAN and a POM-based hydrodynamic model to study wind-wave-induced currents in the Gulf of Gdańsk. Hindcast models of the Baltic Sea provide boundary conditions for the local high-resolution models. The results show that during strong northerly storms, the bottom currents are dominated by wave-induced velocities while direct wind-induced currents are smaller.

Cipollone et al. (2017) compared three global ocean products: global reanalysis (C-GLORES), observed global data set (ARMOR3D), and a free running "eddy-permitting" global ocean model (NEMO). The goal was to evaluate data assimilation schemes and see how well these systems can represent mesoscale variability in the ocean. The results demonstrate that the data assimilation can improve the variability in the ocean model and project surface information into deep layers of the ocean.

Clementi et al. (2017) described a coupled ocean modeling system using NEMO as the hydrodynamic model and WaveWatchIII as the wave model. Experiments in the Mediterranean Sea evaluate the system by comparing the modeling results with observations and exploring the impact of the coupling. The results show that including ocean hydrodynamics in the system can improve the wave spectrum, but the impact of waves on the hydrodynamic model is relatively small.

Ezer (2017) used the generalized version of POM to study how the interaction between the Gulf Stream and bottom topography is affecting the generation of spatial and temporal variations of sea level along the US East Coast. Comparisons of realistic simulations with experiments using an idealized smooth topography demonstrate the importance of resolving coastal features such as Cape Hatteras and dynamic processes such as coastal trapped waves in ocean models. The study has implications for projection of spatial variations in sea level rise in coarse resolution climate models.

Ezer and Atkinson (2017) used empirical mode decomposition (EMD) to analyze the relation between variations in the Florida Current (FC) and variations in coastal sea level (SL). They show that the FC-SL correlation can be used to predict anomalously high water and coastal flooding along the US East Coast when a weakening in the FC is detected by the cable measurements. The study demonstrates how Hurricane Joaquin (2015) remotely influenced SL far away from the storm through its impact on the Gulf Stream.

Gic-Grusza and Dudkowska (2017) demonstrated new approaches to study sediment transport in the Gulf of Gdańsk during extreme storm conditions. The SWAN model is used to obtain waves and an analytical model is used to derive wave-induced currents and bottom stress. The results show that sediment dynamics are sensitive to bathymetry changes and not limited to shallow regions alone.

Guo and Sheng (2017) used a nested wave model WaveWatchIII to study the impact of future climate change on the wave field over the eastern Canadian shelf. The results show that while time-mean significant wave heights are expected to increase in the near future and then level off, the 5% largest waves are expected to increase dramatically into the far future. Future waves may also have significant spatial variations in their response to climate change.

Jordi et al. (2017) tested a new parallel domain decomposition that uses mathematical optimization to improve the workload distribution of parallel computing while maintaining the same solutions as traditional domain decomposition; such optimization may be important for coastal ocean models with complex coastlines. The increased efficiency of the algorithm was demonstrated with the sECOM parallel code for the Hudson River and the New York/New Jersey coasts.

Liao et al. (2017) used a nested regional model (ROMS) to study the forcing, dynamics, and propagation of coastal-trapped waves (CTW) in the Taiwan Strait. The propagation of CTW along the coast can impact local fisheries, since the southward propagation of anomalously cold water can kill tropical fish. There are also implications from this study on the seasonal monsoon-driven transports in the region.

Liu et al. (2017) tested a new grid generation method for coastal ocean models that automatically optimizes curvilinear-orthogonal grids to fit complex coastlines. The accuracy of the method was tested on two different coasts and with coastal trapped Kelvin waves. Because of trade-offs between orthogonality and grid alignment relative to the coastal, the new method may work for some coasts better than others, depending on the multiscale fractal nature of the coastline.

Lu et al. (2017) used a one-dimensional version of ROMS to study how to add the impact of vertical velocity in such models. Three types of upwelling processes were considered using various observations and the results were compared with a station data from the South China Sea. The best results were obtained when all three types of upwelling processes were included.

Luo et al. (2017) used a coupled physical-biological model based on FVCOM to study phytoplankton blooms in Lake Michigan. Sensitivity experiments showed the importance of riverine nutrient inflow to the phytoplankton growth pattern in the lake. The model was able to capture two bloom periods in 1998 that were detected by remote sensing.

Mussap et al. (2017) used a one-dimensional version of POM coupled with biogeochemical flux model (BFM-POM1D) to study the impact of climate change warming and anthropogenic changes such as river nutrient loading in the Gulf of Trieste (northern Adriatic Sea). Ensemble simulations provided uncertainties for different parameters and different scenarios. The study could help coastal management response to climate change-related pressures on ecosystems.

Sun et al. (2017) tested an ensemble adjustment Kalman filter (EAKF) in a global surface wave model to examine the performance relative to standard ensemble Kalman filter (EnKF), which is a more computationally expensive. Different sampling methods were tested, using satellite observations assimilated into the wave model. The results demonstrated an efficient dynamic sampling method as a good alternative to EnKF.

Trotta et al. (2017) used a very high-resolution multiple nesting model based on NEMO to study sub-mesoscale dynamics in the Gulf of Taranto (Ionian Sea, in the eastern Mediterranean Sea). The formation of sub-mesoscale eddies was found to be through small-scale baroclinic instability associated with a large-scale anticyclonic gyre. Observations showed the existence of sub-mesoscale eddies resembling the simulated eddies.

Wei et al. (2017) tested three algorithms that can simulate the air-sea interaction under storms and provide sea surface temperature to typhoon prediction models. The results showed great improvement in the simulation of storm intensity when the ocean cooling feedback is included. One method based on machine learning (ML) technique was found to be especially effective in representing nonlinear coupled interactions and producing realistic ocean cooling under a storm.

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