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Editorial

Special issue of *Dynamics of Atmospheres and Oceans* in honor of Prof. A.R. Robinson

Professor Allan R. Robinson was one of the founding fathers of geophysical fluid dynamics. His research interests and seminal contributions have encompassed the dynamics of rotating and stratified fluids, boundary-layer flows, thermocline dynamics, the dynamics and modeling of mesoscale ocean currents, and the influence of physical processes on ocean biology. He is recognized as one of the pioneers and leading experts in modern ocean prediction, and contributed significantly to the techniques for the assimilation of data into ocean forecasting models. In the late 1950s and 1960s, Prof. Robinson's research focused on fundamental geophysical fluid dynamics, including major contributions to thermocline theory, the wind-driven ocean circulation, coastally trapped waves, inertial currents and boundary layers. In the early 1970s, Prof. Robinson initiated investigations on realistic flow fields focusing in particular on mesoscale dynamics and forecasting, with contributions to western boundary currents, mesoscale eddies and baroclinic instabilities. He pioneered "ocean weather forecasting science" at the beginning of the 1980s, especially the development of conceptual models for the assimilation of both in situ and satellite data, specializing in the 1990s in the coupling between the deep sea and the coastal ocean. Focusing on mesoscale dynamics and coastal interactions, he also contributed to the development of new coupled physical-biological-acoustical and optical models, and he developed theories on the effects of oceanic motions on biological dynamics. Professor Robinson was also the Founding Editor of *Dynamics of Atmospheres and Oceans*.

This special issue is in honor of Professor Robinson. The contributions highlight his exceptional achievements over a wide range of oceanographic investigations, and include theoretical research on physical and interdisciplinary ocean dynamics and processes; fundamental ocean modeling and simulations including data assimilation; descriptive and quantitative dynamical studies in specific ocean regions, especially the New England shelf-slope region, Mediterranean Sea and California Current System; and finally, applied research relating to the management of coastal zones, rapid environmental assessment, and naval and maritime operations.

The first two manuscripts summarize some of Prof. Robinson's remarkable contributions to coastal ocean science and physical-biological ocean dynamics. Brink gives a lively and interesting account of the influence of Robinson's seminal paper on continental shelf waves and his subsequent contributions to programs in oceanic circulation dynamics of the coastal zone. Goodman then reviews the theory and novel approaches developed by Robinson on the dynamical interactions of nutrients, phytoplankton and zooplankton as they are advected by the ocean circulation.

The next three manuscripts focus on fundamental physical and biological ocean modeling and simulations. Gregorio et al. compare laboratory realizations, numerical simulations and theoretical investigations of buoyant, gravity-driven coastal plumes. The authors study the internal dynamics of

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developing plumes and quantify departures from geostrophic theory. Agreement between the steady inviscid geostrophic theory, and laboratory and numerical experiments is found to depend on two non-dimensional parameters which characterize, respectively, the steepness of the plume's isopycnal interface and the strength of horizontal viscous forces (the horizontal Ekman number). Liang considers the theory of entropy production due to uncertainty in geophysical fluids by splitting the entropy generation into a local component and a transfer from other components, and the barotropic instability of a zonal jet is used to exemplify the procedure. Anderson et al. address the issue of how oceanic mesoscale activity and the associated biological response change when the relative speed of air to water is taken into account in the surface forcing. They compare two model runs, one with surface stresses specified as only a function of wind speed and the other where the wind stresses are an interactive function of relative wind speed to ocean surface current, and find significant differences in the eddy statistics and biological response.

The next two manuscripts concentrate on ecosystem modeling and in particular the importance of the ocean mesoscale for the larvae dispersal. Fiechter et al. consider the effects of data assimilation of physical variables on a regional coupled circulation-ecosystem model in the Gulf of Alaska. They find that data assimilation improves the model's ability to reproduce the timing of mesoscale processes along the shelfbreak, which plays an important role in controlling the ecosystem processes. Lobel builds upon earlier collaborative work with Robinson by addressing how mesoscale eddy formation off the coast of the Big Island of Hawaii affects larval retention. Specifically, Lizardfish larvae are found to be capable of settling earlier during the times when these commonly observed eddies are present.

The next three manuscripts focus on descriptive and quantitative dynamical studies in ocean regions which were some of the favorites of Prof. Robinson, and for which he made outstanding contributions. Gangopadhyay et al. address the problem of initialization of an ocean model with application to the California Current System. They introduce the use of observational and statistically based analytical feature models for regional mesoscale phenomena to initialize dynamical nowcast/forecast models of this complicated eastern boundary current system. In contrast, Song et al. considered how upwelling cells in the California Current System are altered by the structure of wind stress forcing. Idealized winds are constructed that mimic the basic structures of wind stress and wind stress curl that occur in some commonly used wind products. The ROMS adjoint model with passive tracers was used to show how the source of upwelled water in each case can be tremendously different, which has implications for understanding how interannual changes in wind may alter the source of upwelled waters.

Ramp et al. studied the Monterey Bay surface atmosphere-ocean system with advanced high resolution measurements confirming and consolidating the strategy of rapid environmental assessment with adaptive sampling to enhance ocean predictive capabilities. Multiple nesting and data assimilation techniques are described, as well as multimodel outputs, demonstrating the importance of data initialization in the local models.

Brown studied the effects of winter variability on internal tides in the Gulf of Maine. The author utilizes ocean observations from a winter 1997-98 field program in the Wilkinson Basin in the western Gulf of Maine. In particular he studies the tidally-induced depth-dependent residual currents, finding: clockwise-rotating semidiurnal internal tides of about 5 cm/s below the mixed layer; clockwise-rotating inertial currents; and less energetic subtidal current variability.

Simoncelli et al. propose a new coastal rapid environmental assessment methodology for initializing ocean simulations in coastal regions by combining a nesting strategy and an optimal interpolation data assimilation scheme for coastal opportunity measurements, showing the value of near coastal data for the forecast quality. They demonstrate week-long forecast skill in the northern Adriatic Sea coastal region. Campanelli et al. discuss a large Po river flood event in 2001 that has affected the Northern Adriatic Sea oceanographic and biochemical conditions. Large flooding of the Po inhibits the dense water formation processes occurring in the successive winter and the nutrients discharged give rise to an important phytoplankton bloom in the spring of the same year.

The last three manuscripts involve research results linked to specific ocean applications, from small embayment dynamics to oil spill predictions and re-analyses for climate studies.

Using a model, Bellafiore et al. study marine processes in the complex Boka Kotorska Bay system in the southeastern Adriatic Sea Montenegro coastline, and find that the freshwater inputs into the Bay system can strongly influence the hydrographic properties of the water column and the circulation in the region. They characterize the Bay as an estuarine system, with a surface outflow to the sea and a bottom inflow to the Bay. Mariano et al describe a series of modeling activities for the 2010 Deepwater Horizon Oil Spill in the Gulf of Mexico, and results are presented that are in qualitative agreed with observations. Predictions were found to be improved when velocities from data-assimilative ocean models were used, and mean model estimates indicate that after three months, about 25% of the oil remained in the water column, with most of the oil being below 800 m. Finally, Masina et al describe an optimal interpolation-based data assimilation system used to produce global ocean reanalyses that were validated against a set of high quality in situ observations and independent data. The reanalyses exhibit a global warming trend in the upper ocean during the last five decades that is within the range of recent observation-based estimates. The authors also demonstrate that the climatological heat and salt transports are within the range of observational estimates and those derived from atmospheric reanalyses.

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