

URL: <http://www.physics.utoronto.ca/~edwards/>OS31A CC: 524 C Wednesday
0830h

Coastal Region Dynamics III

Presiding: W Alex, Naval Research
Laboratory, Stennis Space Center; **K
Lamb**, University of Waterloo

OS31A-01 0830h INVITED

**The evolution of nonlinear internal
waves in Massachusetts Bay:
observations and model results.**Alberto D Scotti (ascotti@unc.edu)Department of Marine Sciences, Venable Hall 17-3 CB
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Nonlinear internal waves are a common feature in many coastal areas. In Massachusetts Bay, trains of high-frequency and short-wavelength internal waves are generated by the semi-diurnal barotropic tide flowing over Stellwagen Bank, and propagate shoreward. In this talk, we present observational and modeling results that have been accumulated over the past 6 years. We will consider in particular the strongly nonlinear interaction with the bottom that occurs when the waves propagate along the incline leading to the shallow (25 m) area just off the coast south of Boston. Contrary to what was previously thought, only part of the baroclinic energy is dissipated locally. The remaining energy propagates in the shallow area to the west of the incline, creating highly nonlinear and very steep waves of elevation that we were able to observe in great detail. The evidence accumulated so far suggest that these waves depart strongly from the hydrostatic equilibrium. The consequences for modeling will be discussed.

OS31A-02 0850h

**On the resonant generation of breaking,
mode-2 solitary-like waves**Marek Stastna¹ (416 946 3019;
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The weakly nonlinear theory of the resonant generation of internal solitary waves by temporally varying background currents over small amplitude topography (i.e. as recently discussed by Wang and Redekopp, *Dyn. Atm. Oceans*, vol. 33, pg. 263) shows no preference for mode-1 waves over higher mode waves. In this talk we discuss numerical modeling efforts we have undertaken to resonantly generate mode-2 solitary-like waves. After briefly reviewing the reasons why mode-2 waves cannot, in general, be truly solitary we show examples of mode-2 wave generation for a stratification typical of the coastal ocean. We demonstrate that for certain physically reasonable situations the energy lost to a mode-1 tail is of secondary importance, when compared to the changes in the wave shape due to the existence of a highly active core. We discuss diagnostics based on weakly nonlinear theory that can be employed to diagnose whether a given situation (stratification and background current) can reasonably be expected to yield resonantly generated mode-2 solitary-like waves.

OS31A-03 0905h

**Circulation Variability on the
Newfoundland and Scotian Slopes**John W Loder¹ (1-902-426-3146;
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Moored measurements and hydrographic surveys are used to describe the structure and recent variability of currents and hydrographic properties along the Newfoundland and Scotian Slopes. Measurements from June 2002 to July 2003 at two sites in Flemish Pass show a seasonal variation in the upper-slope branch of

the Labrador Current, with greatest transport in winter. Measurements from June 2000 to May 2003 at three sites across the Scotian Slope on the Halifax line show seasonal and interannual variations, including a disruption of the equatorward Labrador Current Extension by an intrusion of Warm Slope Water associated with a Gulf Stream meander. The current structure and transports are compared with historical observations and numerical model estimates.

OS31A-04 0920h

**Ageostrophic Fluctuations in the
Cozumel Channel.**Jose Ochoa¹ ((1-52-646) 174-0500;
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The Caribbean Current flows easterly and turns mostly north as it impinges the Yucatan coast, producing a persistent northerly flow along the coast that passes between the Yucatan Peninsula and the Cozumel Island; through the Cozumel Channel. The near surface subinertial flow of the Cozumel Channel, which is 18 km wide, 50 km long and 400 m deep, and its relationship with pressure measurements at both sides of the channel, was recently examined by Chávez *et al.* (2003) showing the existence of periods lasting over one month with large ageostrophic fluctuations. Five years later, the flow velocity was measured again for a year, but at four locations around Cozumel Island, two of them 8.6 km apart in the middle of the channel, thus allowing estimations of the along the channel velocity gradients. The new measurements reveal that, as suggested by Chávez *et al.* (2003), the advective nonlinearity or curvature of the current explains most of the lack in geostrophy for subinertial motions. The curvature is, at times, large enough that the geostrophic flow is in the opposite direction than the actual flow; i.e. a larger than unity Rossby number. Intensity indexes, in pressure difference as well as in velocity, that favor suprainertial variations show consistently that the periods of ageostrophic fluctuations are much richer in high frequency fluctuations than the periods of nearly geostrophic behavior. The intensity index is smaller on the eastern side of Cozumel Island remaining correlated with the other. The speculation is that small eddies or meanders ride, at times, on the Caribbean Current and produce: the ageostrophic fluctuations observed within the channel, and the intensification of high frequency fluctuations all around the island.

OS31A-05 0935h

**A Laterally-Averaged Nonhydrostatic
Ocean Model**Daniel Bourgault¹ (danielb@physics.mun.ca)Dan Kelley² (dan.kelley@dal.ca)¹Department of Physics and Physical Oceanography,
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Laterally-averaged dynamical equations are often used in numerical models of narrow coastal regions such as fjords and estuaries. Such models are preferable to 2D formulations, because they can handle variable-width effects such as flow acceleration at coastal constrictions. They also have a considerable speed advantage over 3D models. However, most laterally-averaged models share a significant weakness – they rely on the hydrostatic approximation. This is problematic for application in coastal areas where nonhydrostatic effects, such as mixing by sill-generated internal waves, are important. To fill this gap in applicability, we developed a nonhydrostatic laterally-averaged model. Its iterative scheme for the nonhydrostatic terms makes it comparable in speed to conventional hydrostatic models for flows that are approximately hydrostatic. This gives the model a wide range of applicability. We illustrate the model strengths and weaknesses in the context of laboratory experiments and field measurements of the tidal flow over Knight Inlet sill.

URL: <http://www.physics.mun.ca/~danielb>

OS31A-06 0950h

**Modeling Of The Langmuir Circulation
And Breaking Waves Effects On The
Oil Spreading and Dispersion In
Surface Layer**Efim Pelinovsky¹ (enpeli@hydro.appl.sci-nnov.ru);
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The problem of the modeling of the oil slick and surfactant spreading in the field of the unsteady and inhomogeneous currents and breaking waves is discussed. Some analytical solutions of the advective-diffusion equation for slick are obtained. Results show that the variation of the concentration field is the nonlinear function of the current velocity. To simulate oil spreading, transport by currents and wind, entrainment, breakup and dispersion the new 3D Lagrangian model was developed. It describes oil spreading and advection, entrainment of oil in the water by breaking waves and resurfacing entrained droplets. The turbulent diffusion processes are modeled by use Lagrangian stochastic simulation technique based on the random walk method for Gaussian "spilletts". The statistical model of the breakup was proposed to reproduce observed log normal distribution of oil droplet sizes. The model was linked with 3D hydrodynamics model that includes Stokes drift. The used turbulence model Kantha and Clayson (2003) describes turbulent kinetic energy injected near the surface by breaking waves and the kinetic energy input from Langmuir circulations. The detailed results of simulations of turbulence, droplet spectra and concentration in the wave enhanced layer for stormy conditions by linked models are presented.

OS32A CC: 524 C Wednesday
1030h

General Ocean Sciences I

Presiding: K Lamb, University of
Waterloo; **T Qu**, IPRC/SOEST,
University of Hawaii

OS32A-01 1030h

On the reliability of ENSOYoumin Tang¹ (212-998-3249; ytang@cims.nyu.edu)Richard Kleeman¹ (kleeman@cims.nyu.edu)Andrew Moore² (andy@bondi.colorado.edu)¹Courant Institute of Mathematical sciences, 251
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In this study, ensemble predictions were constructed using two realistic ENSO prediction models and using stochastic optimals. By applying a recently developed theoretical framework, we have explored several important issues relating to ENSO predictability including the reliability measures of ENSO dynamical predictions; and the dominant precursor that control reliability. It was found that prediction utility (R), defined by relative entropy, is a useful measure for the reliability of ENSO dynamical predictions, such that the larger the value of R , the more reliable a prediction. The prediction utility R consists of two components, a dispersion component (DC) associated with the ensemble spread, and a signal component (SC) determined by the predictive mean signals. Our results show that the prediction utility R is dominated by SC . Using a linear stochastic dynamical system, we further examined SC and found it to be intrinsically related to the leading eigenmode amplitude of the initial conditions. This finding was validated by actual model prediction results, and is also consistent with other recent work. The relationship between R and SC has particular practical significance for ENSO predictability studies, since it provides an inexpensive and robust method for exploring forecast uncertainties without the need for costly ensemble runs.