OS52C-0246 1330h POSTER

Equatorial to Mid-Latitude Connections in Eastern Boundary Currents

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Over twenty years ago, Enfield and Allen (1980, J. Phys. Oceaogr., 10, 557-578) used tide-gauge sea level height data to show the connection between the equator and the mid-latitude coastal ocean in the eastern Pacific. Careful selection of tide gauges and quality control of the data allowed both seasonal and interannual time scales to be examined over a period of 24 years. Today, 10 years of TOPEX/POSEIDON altimeter data allow us to re-examine the seasonal and non-seasonal connections between the equator and higher latitudes in the eastern boundary currents (EBC's) along the coasts of the Pacific and Atlantic Oceans. We present the seasonal progressions in both basins and hemispheres, showing the low-to-high latitude development of the seasonal cycle and also the offshore propagation of annual Rossby waves. This brings out several general tendencies: 1) The signals are stronger in the Northern Hemisphere basins, due to the fact that the ITCZ is located north of the equator in both basins; 2) The signals are stronger in the NE Pacific than in any of the other basins; and 3) There is an annual signal of high sea surface height that propagates down both Southern Hemisphere EBC's in austral spring (September-November) as the SW trade winds weaken along the equator and the equatorial cold tongue collapses. This last feature is somewhat like an annual "El Nio" effect and acts to suppress the onset of wind driven upwelling in the Peru-Chile and Benguela Current Systems.

OS52C-0247 1330h POSTER

Sea-Surface Topography and Precise Geodesy From Aircraft: Applications to Coastal Oceanography

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Highly dynamic coastal ocean processes occur at temporal and spatial scales that cannot be captured by present or planned satellite altimeters. Space-borne gravity missions such as CHAMP, GRACE and GOCE also provide time-varying gravity and a geoidal msl reference surface at resolution that is too coarse for many coastal applications. The Naval Research Laboratory and the Naval Oceanographic Office have been testing airborne measurement techniques, gravity and altimetry, to determine sea-surface height and height anomaly at the short scales required for littoral regions. We have developed a precise local gravimetric geoid over a test region in the northern Gulf of Mexico from historical gravity data and recent airborne gravity surveys. The local geoid provides a msl reference surface with a resolution of about 10-15 km. A series of altimetry reflights over the region with time scales of 1 day to 1 year reveal a highly dynamic environment with coherent and rapidly varying sea-surface height anomalies. Although wind-driven topography may also be a factor, airborne expendable bathy-thermograph (AXBT) data collected at the same time show apparent correlation with wave-like temperature anomalies propagating up the continental slope of the Desoto Canyon. The observed variability may be responsible for some part of the long-term average topography calculated by differencing the gravimetric geoid with a satellite altimetry msl reference.

OS52D MCC: Hall D Friday 1330h

Ocean Eddies, Mixing, and Turbulence Posters

Presiding: **P A Rona,** Rutgers University; **D M Fratantoni,** Woods Hole Oceanographic Institution

OS52D-0248 1330h POSTER

The Reddy Maker

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For years I have been looking for an explanation for eddy formation in the absence of both classicial instability and a detachment from a corner. I have been interested in such a process because some eddies are formed without any of the above two processes being present. The "Reddy maker" represents such a new mechanism. Specifically, we propose a new process for the formation of high-amplitude anticyclonic eddies (lenses) from outflows emptying into the ocean at mid-depth. The essence of the new mechanism is that, in order for an inviscid outflow to exist as a continuous (uninterrupted) current, the condition $g'S/f > \alpha(g'H)^{1/2}$ [where g' is the "reduced gravity", S the bottom slope, f the Coriolis parameter, α a coefficient of order unity whose value depends on the potential vorticity and H is the maximum thickness] must hold. When this condition is not met, the outflow can only exist as a chain of propagating eddies.

An outflow advances primarily along the isobaths but usually slowly descends toward the bottom of the ocean due to frictional effects. Most of the time, this descent is accompanied by a reduction in the bottom slope and by entrainment, both of which bring the outflow closer and closer to the above critical condition. It is, therefore, argued that most outflows ultimately reach the critical point and break into chains of propagating eddies (unless they are first destroyed by diffusion and mixing). This is not the usual instability process associated with the breakdown of a steady solution, because, in this case, a steady solution cannot exist.

URL: http://www.doronnof.net/features.htmlvideo

OS52D-0249 1330h POSTER

North Brazil Current Ring Collisions With the Lesser Antilles

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The earth's largest ocean rings are spawned near 8°N in the western tropical Atlantic from the equator-crossing North Brazil Current (NBC). NBC rings, which can exceed 450 km in diameter and 2000 m in vertical extent, translate northwestward parallel to the South American coastline until they collide with the Lesser Antilles in the southeastern Caribbean Sea. The rings entrain filaments of nutrient- and sediment-rich Amazon and Orinoco River discharge, impact the distribution of icthyoplankton, and pose a physical threat to expanding offshore oil and gas exploration. The six rings generated annually are also responsible for up to one-third of the equatorial-to-subtropical mass and heat transport associated with the Atlantic meridional overturning circulation, a fundamental component of the earth climate system. Recent RAFOS float and surface drifter trajectories illustrate the translation and structural evolution of several NBC rings and enable the determination of the downstream fate of South Atlantic water trapped within the ring core. These results indicate that NBC rings do not enter the Caribbean Sea intact as simulated by numerical ocean models but are instead sheared apart through topographic interaction along the eastern flank of the Lesser Antilles.

URL: http://science.whoi.edu/users/dfratantoni

OS52D-0250 1330h POSTER

Influence of Multiple Islands and Their 3-D Geometry on the Bifurcation of Eddies

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A recent study investigated the interaction of a self-propagating barotropic cyclonic eddy with a right vertical cylinder and determined the conditions for an eddy to bifurcate into two eddies. In the present study we performed two series of idealized laboratory experiments. The first series investigated the importance of the geometry of the obstacle, in particular its height, the slope of the side walls and the geometry of the horizontal cross sectional area. As in the previous study, after a self-propagating cyclonic eddy came in contact with the obstacle, fluid peeled off the outer edge of the vortex and a so called "streamer" went around the cylinder with a counterclockwise velocity. Under the right conditions, this fluid formed a new cyclonic vortex in the wake of the cylinder, causing bifurcation of the original vortex into two vortices. The present results suggest that bifurcation occurs only when the obstacle height is more than 0.85% of the eddy height and that fairly steep sloping walls do not influence the bifurcation mechanism. In addition, an elliptical horizontal cross section of the obstacle brought into light that an important parameter for the bifurcation to occur is the length the "streamer" has to travel around the obstacle and not the dimension of the obstacle in the direction orthogonal to the flow. The second series of experiments investigated the importance of two obstacles to the bifurcation of the self-propagating cyclonic eddy. Multiple eddies were generated by the interaction of a single cyclonic eddy with two right vertical cylinders. The exact number of eddies depends on the ratio of the obstacle separation to the eddy size and the geometry of the encounter. Furthermore, we observed the formation of an eddy of opposite sign, anticyclonic, at the downstream side of the gap between the two obstacles. This last observation in the laboratory is in agreement with recent observations of North Brazil Current Rings, suggesting that these very idealized laboratory experiments may bring some insights to the fate of mesoscale vortices in the Ocean.

OS52D-0251 1330h POSTER

Gravitational potential energy sinks/sources in the oceans

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Gravitational Potential Energy (GPE) is lost during convective adjustment. Using climatological datasets, the annual mean GPE loss due to convective adjustment in the world oceans is estimated as 0.11TW. GPE conversion from the mean state to eddies is also estimated, using the commonly accepted Gent-McWilliams scheme. Our estimate is that about 1.7TW is converted from mean state into eddy GPE.

The known sources of GPE are: wind stress work on the geostrophic current (1.3TW, but it is unclear how much of this energy can be converted into GPE) and tidal dissipation rate in the deep ocean (0.9TW, corresponding to 0.18TW after conversion through mixing), near-inertial gravity waves (0.7TW, corresponding to 0.14TW after conversion through mixing), and gravitational GPE generated by geothermal heating (0.05TW).

This indicates a large imbalance in the GPE balance in the oceans. It is speculated that there might be large source of GPE that has not been counted in the current estimates. For the current climate setting, a large amount of heat is lost in the North Atlantic. As a result, the mixed layer penetrates deep and the amount of GPE loss due to convective adjustment is large. In addition, conversion through the baroclinic instability is relatively strong in the North Atlantic. In order to maintain the balance of heat and GPE, northward transport of heat and GPE is required.

OS52D-0252 1330h POSTER

Formation and Circulation of North Atlantic Subtropical Mode Water

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The formation, distribution, and circulation of North Atlantic Subtropical Mode Water (STMW) has been studied using observations collected by profiling floats. 71 profiling floats were deployed beginning in July, 1997 in the subtropical region of the North Atlantic as a part of the Atlantic Circulation and Climate Experiment (ACCE). The floats collect temperature and salinity profiles in the upper 1000 m at 10-day intervals and also allow velocity estimates to be made below the thermocline.

The formation of STMW was investigated using float observations of mixed layer depth and mixed layer temperature at the end of each winter, from 1998 to 2002. Extensive renewal of STMW was observed in 2001 winter, while only limited renewal occurred during the other winters. This variability in STMW renewal correlates well with the NAO index, which was negative only in 2001. The renewal generally occurred from the end of February to late March. Preferred locations of STMW renewal were observed in a western region near 70^oW, 35^oN and in an eastern region near 50^oW, 37^oN.

A temperature-based criterion was applied to detect the STMW and study its distribution, and the time-dependent volume of STMW was calculated to investigate its annual and interannual variability. The annual cycle indicated the maximum volume occurred in late March, with a gradual decrease throughout the rest of the calendar year. The interannual variability showed the minimum volume in 2000, when the NAO was at its positive peak.

URL: http://flux.ocean.washington.edu

OS52D-0253 1330h POSTER

The mixing of breaking internal waves

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Breaking internal waves play an important role in the vertical transport of oceanic energy, mass, and pollutants. Using laboratory experiments, we attempt to quantify the instabilities and mixing associated with the breaking of large amplitude internal waves. Our experiments focus on internal waves travelling on a thin density interface between two homogeneous layers.

We provide the results of laboratory experiments investigating the breaking of long, progressive internal waves away from boundaries. We quantify the flow using conductivity-temperature measurements, internal wave gages, and quantitative planar laser-induced fluorescence (PLIF) flow visualization. The results presented here focus on the quantitative flow visualization measurements and measurements of the overall mixing efficiency associated with a breaking internal wave.

Our results show that the long waves examined in the laboratory experiments break due to a strongly-modified shear instability. The instability takes the form of an organized row of Kelvin-Helmholtz billows originating in the high shear regions of the wave crests and troughs. Results are presented that compare the breaking wave amplitude to that predicted by the usually assumed Ri=1/4 stability limit.

Using a control volume approach, we quantify the mixing efficiency associated with a breaking internal wave. The work done by the wave in generating the turbulence is quantified using simple theory relating the incoming and outgoing measured wave energies. Mixing is measured by comparing potential energies of the control volume before and after the mixing event. We present results based on these calculations, and postulate possible trends relating the breaking internal wave mixing efficiencies to wave parameters.

OS52D-0254 1330h POSTER

Effect of tidal cycle on entrainment by the Grotto Vent plume, Main Endeavour Field, Juan de Fuca Ridge

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Our time series (24 hours; 26-27 July 2000) of acoustic images (15) of the initial 28 m rise of the coalesced buoyant plume discharging from black smokers at the top of the Grotto sulfide edifice exhibits an apparent relation between amount of bending in response to changing prevailing currents of the local mixed semi-diurnal tidal cycle and entrainment coefficient. We imaged the plume using a modified sonar system (Simrad SM 2000; 200 kHz) mounted on ROV Jason from a fixed position on the seafloor with a nearly horizontal slant range of about 20 m at a water depth of 2190 m. The acoustic imaging is based on Rayleigh backscattering from mineral particles suspended in the plume volume that are small (microns) relative to the wavelength of the acoustic pulse (centimeter), such that intensity of backscatter is proportional to particle load. We applied our visualization and quantification methods to reconstruct the buoyant plume from the gridded acoustic data set as a 3D volume object and to measure the parameters needed to calculate entrainment coefficient from the reconstructed plume.

The plume centerline constructed by joining the local center of mass of successive horizontal slices with height through the buoyant plume alternately bends between 0 and 30 degrees to the northeast and southwest in response to tidal forcing. The entrainment coefficient is defined by b=az+c, where b is the estimated characteristic radius of the plume, which is measured by 2D Gaussian fit on horizontal slices every 2 m from 4 m to 18 m above the vents; z is the height above vent; a is the entrainment coefficient; and c is a constant. The entrainment coefficient (a) generally increases (0.11+/-0.02 to 0.29+/-0.05) with increasing horizontal offset of the plume bend (d) from vertical (offset 0.5+/-1 m to 9.5+/-1 m at height 18 m). A linear regression between the plume bend (d) and the entrainment coefficient (a) produces a reasonable correlation coefficient (r=0.70). The coherence of the plume mass apparently decreases from greatest for vertical plumes to least for steeply bent plumes. The apparent relation between amount of plume bend, estimated entrainment coefficient, and observed plume coherence supports the importance of forced entrainment in mixing of bent plumes with the surrounding ocean and indicates the role of the tidal cycle in modulating the entrainment coefficient.

OS52D-0255 1330h POSTER

Cavity and flow studies of reproducible bubble entrainment events associated with rain.

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Rain contributes to the introduction of air into the sea by creating bubbles after impact. Some of these events, particularly from drops 0.8?1.2 mm in diameter, create bubbles reproducibly by a process called regular entrainment. To better understand the mechanics that creates the bubble, kinematic measurements of the cavities formed during regular entrainment events are examined from high-speed motion pictures and are compared with available computational methods. Experimental and numerical results agree with each other on the overall shape of the interface and the occurrence of bubble detachment. Measurements, however, show that the depth of the cavity stagnates before bubble entrapment in a manner that is unseen in the simulation. This stagnation appears to be caused by a counterbalance between surface tension and buoyancy at the bottom of the cavity and to result in the entrapment and eventual detachment of this portion to form the bubble.

OS52D-0256 1330h POSTER

Diurnal variations in rainfall, surface buoyancy flux, and surface salinity in the tropical Pacific and Atlantic Oceans

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The diurnal cycles of rainfall, surface buoyancy flux, and salinity are determined for the period 1997-2001 using measurements from ATLAS buoys of the TAO/TRITON and PIRATA moored buoy arrays in the tropical Pacific and Atlantic Oceans. Regional and seasonal differences in the diurnal cycle for ten separate areas covering different climatological regimes in each basin are presented.

Results indicate that there is a rainfall maximum between midnight and about 0800 LT, in agreement with previous studies of oceanic rainfall variability. An additional afternoon maximum is observed at several locations, the most prominent being in the northwest Pacific ITCZ, the South Pacific Convergence Zone (SPCZ), and central Pacific ITCZ. The afternoon peak in precipitation is mainly present during the season of maximum solar insolation, implying it results from surface forced convection. The surface buoyancy flux corresponding to the heat and fresh water fluxes measured at the buoys indicates negative (stable) values during the day, and a positive (unstable) values at night. Thus, fresh water flux contributes to stabilizing the water column in the afternoon. At night, however, positive surface buoyancy flux values indicate that surface cooling overwhelms any stabilization of the column due to fresh water flux, despite the nighttime precipitation maximum. Surface salinity generally exhibits a nighttime maximum, presumably governed by nighttime convectively driven turbulent mixing of higher salinity water from below the surface.

OS52D-0257 1330h INVITED POSTER

Temperature-Salinity Oscillations, Sudden Transitions, and Hysteresis in Laboratory Experiments and Layered Models

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Simplified box models of the cooling of a salt-stratified ocean have been constructed in the laboratory. A large isothermal basin of water has two layers with differing salinity. Beside this is a small basin connected to the large basin by horizontal tubes at the top, middle and bottom. Calculations indicate that there is a sudden transition and hysteresis between a shallow and a deep convection state if there is a relaxation temperature boundary condition and also if one tube has large flow resistance. Our laboratory studies to date do not clearly show hysteresis but have relatively sudden changes in properties for some parameters. The shallow state is frequently found as an oscillation, and the deep convection state is steady, although thermals produce small rapid fluctuations. Numerical models of the experiments produce qualitative agreement, but quantitative differences are large. In contrast, experiments

with a cavity at the bottom of a fresh water reservoir, subjected to steady heating from below and steady saltwater inflow has two distinct states, and exhibits a hysteresis range. Oscillations and transitions like those seen in these experiments may exist in natural bodies with a layer of fresh water cooled from above such as fjords, polar bays, or larger polar regions. The oscillation periods are much greater than either the fresh water or the thermal time scale, making the oscillation mechanism a candidate for climate oscillations. (Much of this work was done at the GFD summer program).

OS52D-0258 1330h POSTER

Simulation of the Stratified Turbulent Ekman Layer

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We investigate the role of density stratification on a turbulent Ekman layer induced by a wind on the ocean surface, using Large Eddy Simulations (LES). Analyses of the flow structure and statistics are presented, highlighting the effect of the stratification on modifying the depth of the Ekman layer.

Strong initial stable stratification is effective at inhibiting the growth of the Ekman layer during the first few inertial periods until the layer becomes more homogenized after which it grows at a rate proportional to the background stratification. Conversely, an unstable background stratification, for example possible under night time cooling conditions or surface evaporation, is quickly mixed by the Ekman layer and increases the overall depth of the shear layer.

It has been found that the tangential component of the Coriolis force, often neglected in geophysical applications, is significant at influencing the net properties of the Ekman layer, and can either increase or decrease the mixed layer depth depending on the wind direction and latitude. The time dependent problem of a variable wind stress is investigated and results are compared to turbulence measurements collected with an Autonomous Underwater Vehicle (AUV). The numerical method uses a pseudo-spectral Fourier technique for the horizontal plane, and a finite difference discretization in the vertical direction.

The dynamic LES model is used for the subgrid closure. The domain is periodic horizontally and extends to two Ekman depths vertically with an aspect ratio of 6x6x1 to permit development of the fastest growing linearly unstable modes.

OS52D-0259 1330h POSTER

Iterated Application of a Linear Inverse Temperature Model to Lake Michigan SSTs Generated by CH3D

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A methodology is presented describing the adjustment of a Lake Michigan hydrodynamic simulation through iterated application of a linear inverse temperature model. CH3D, a numerical model developed by the U.S. Army Corps of Engineers, is used to generate Lake Michigan surface temperatures for Mar 14, 2000. The simulation is initiated from Jan 1, 2000 under hourly windstress observations using a spatially uniform eddy diffusivity field. An inverse model is derived from the 2-d linear temperature diffusion equation which solves for eddy diffusivity given a surface temperature field. Observational SSTs are blended with model predicted temperatures and the inverse model is applied resulting in an adjustment to a spatially non-uniform eddy diffusivity field. The lake simulation is then re-initialized for the same time period with the refined diffusivity field. The process is repeated until the diffusivity field converges. The technique is tested using Great Lakes Forecasting System SST model output as a substitute for observational data, but the method is suitable for NOAA satellite SST data. This work was supported by the National Science Foundation.

OS52D-0260 1330h POSTER

Error Analysis and the Computation of Turbulent Fluctuations for 3D Volume Reconstructions of Acoustic Images of Black Smoker Plumes

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We present an error analysis and statistical description of 3D volume reconstructions and measurements based on our acoustic images of a high-temperature black smoker-type plume. Sources of error include (1) the intrinsic variance due to particle motion in the plume since the acoustic images are based on backscatter from small (5-100 μm) particles, (2) noise produced by the ROV Jason system on which the sonar was mounted, and (3) unwanted echos from the surrounding seafloor returning through the sonar sidelobes. Additional fluctuations in the particle concentration due to plume turbulence lead to time variations in the measured backscatter.

The data were collected in July 2000 by a SM2000 (330 MHz) sonar mounted on the ROV Jason. The sonar system was calibrated to record absolute backscatter pressure. The squared magnitude of backscattered pressure is converted to differential backscatter cross-section per unit volume (units 1/m), which is proportional to particulate concentration. Three-dimensional imaging data were obtained by a combination of time gating, digital beamforming, and mechanical scanning for resolution in range, azimuth, and elevation, respectively.

Several different processing steps were applied to the data to reduce the error: (a) averaging along the pings with a range window of 1 m reduced the standard error in a single ping due to intrinsic variance from 1 to 0.44, (b) narrow-band notch filtering reduced the effects of tonal noise, (c) bursts effected by occasional impulsive noise events were simply eliminated from further processing, (d) successive pings were subtracted in an effort to cancel out the effects of unwanted sidelobe returns. The resulting data were interpolated onto a uniform 3D grid with 0.5 m spacing.

The statistics of six successive 3D volumes were computed. Averaging the six volumes further reduced the standard error to 0.18. The total rms error, computed as the sample standard deviation divided by the square root of 6 (the number of volumes averaged into the mean), includes all sources of random error and falls in the range 0.1-0.4x10^{-4} 1/m. Intrinsic error (18% of mean) and rms error are both low compared to mean backscattering cross-section (core maximum is 1.1x10^{-4} 1/m) and similar to minimum values (core minimum is 0.3x10^{-4} 1/m). Total fluctuation in the plume structure during 20 minutes of recording (all volumes) falls in the range 0.1-3.0x10^{-4} 1/m, with the largest values in the plume core reflecting the high variability expected in a plume core. The rms fluctuations decay upwards along the plume axis at a similar rate as the mean backscattering cross-section, indicating that the dilution process is self-similar, as in buoyant plume models, even though particles are not true passive tracers. The effective plume width increases at the predicted rate of 0.1 m/m for a fully developed plume. Despite significant error levels, the turbulence structure of the plume is observed in the acoustic data and provides some constraints on the entrainment and dilution mechanisms.

URL: http://www.rci.rutgers.edu/~bemis/acoustic.htm

OS52D-0261 1330h POSTER

Turbulent Flow Over Submarine Canyon

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Results presented herein are part of an extensive research effort aimed at understanding to what extent laboratory experiments can be used as benchmarks for the development of numerical models (in the present context, models of coastal currents). Recent laboratory studies of laminar flows along model coastal regions have proven useful in the development and testing of associated numerical models. Recognizing, however, that the oceanic environment is by nature turbulent, it is important that these studies be extended to include turbulence. To initiate this line of inquiry, the present study introduced turbulence by mechanical means along the model ocean floor.

The experiments were conducted on the 14 m diameter turntable of the Laboratoire des Ecoulements Gophysiques et Industriels (LEGI) in Grenoble, France. The topography, which includes a vertical coastline, a horizontal shelf, a continental slope and a deep ocean, was placed in the center of a circular test cell. The systems considered were a continuous shelf, slope topography circumscribing the tank, and the same topography incised by a single generic canyon. The surfaces of the model (shelf, slope and canyon) in the experiments were either smooth or rough, with the latter being realized by 3 cm cubical elements placed along isobaths with a spacing of 12 cm. Experiments were conducted for either homogeneous or linearly stratified fluids that were initially in a state of solid body rotation. Relative motion is established by either modulating the tank rotation rate sinusoidally, to provide an along-isobath oscillatory background flow, or impulsively increasing (decreasing) the rotation rate, to provide an along-isobath downwelling (upwelling) favorable current.

The most remarkable difference between laminar and turbulent experiments is the presence of large scale eddies in all of the stratified impulsively forced upwelling/downwelling favorable flows for all topographic models (with/without canyon and smooth/rough boundary). Experiments with homogeneous fluids (barotropic) for both impulsively-started upwelling and downwelling favorable flows demonstrated that, for the parameters investigated, large-scale eddies (e.g., of the order of the width of the continental slope) were not in evidence; i.e., only small-scale disturbances (of the order of centimeters) were observed. These experiments demonstrate that, for the parameters investigated, the flows were barotropically stable. The amplitude of instabilities was larger for the case of downwelling favorable flows.

In a previous study, using laminar flows, we have identified three mechanisms that generate vorticity and hence eddies in the canyon. The present study examines the degree to which these three processes contribute to eddy formation in turbulent experiments.

OS52E MCC: 104 Friday 1330h

Nearshore Processes I *(joint with T)*

Presiding: **N Plant,** Naval Research Laboratory**; A Reniers,** Naval Postgraduate School

OS52E-01 1330h INVITED

Hydrodynamic and morphodynamic modelling of the surf zone

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Surf zones of sandy beaches are generally very dynamic systems showing complex behaviour over a range of time- and length scales. Modelling of this behaviour has evolved from two extremes of the spectrum: on the one hand, practical engineers who have to predict things on a timescale of months to years are trying to do this in an ever more detailed way, whereas research scientists (a.k.a. 'field guys') have typically tried to understand basic processes first. As long as predictive models are surf-zone averaged (as in many longshore transport predictors) or longshore-averaged (as in coastal profile models) many of the basic processes do not show up in the predictive models or are gathered in lump coefficients with a large scatter. This leads to a frustrating gap between the approaches, where it is often difficult to explain why large sums of money should be spent on either process research that does not improve predictions, or on development of models that do not represent many important processes.

This presentation will focus on the challenge of bringing the process research and the development of predictive models together, in such a way that increased knowledge, for instance on the behaviour of rip currents or sand ripples, actually makes a difference in morphological predictions on practically relevant timescales.

A very important step in meeting this challenge is to improve the efficiency of the process-based models that we can use both for integrating process knowledge and for making practical predictions. Some examples are: