

been assessed by deploying a short range sonar system just outside the surf zone. As a 10 kHz source was transmitting a series of acoustic pulses to spherical targets, both forward and backscatter acoustic signals were recorded. The main limiting effects of volume and boundary conditions on the performance of sonar systems in the near-shore are bubble scattering and absorption, wave induced focusing and reverberation and bottom reverberation. Monitoring forces in the inhomogeneous seafloor requires long-term and extensive accurate stress measurements. The interpretation of the stratigraphic record provides a geologic framework of reference. Seismic profiles of the area collected with a very high resolution sub-bottom chirp system reveal outstanding termination sets at the edges of the canyon, and a high variability in the thickness of the transgressive layer. [On-going work supported by ONR]

OS41A-08 0830h POSTER

Energy Balance in the Gulf of California

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The Gulf of California is a dynamically active marginal sea. It is only open boundary, connects to the Pacific Ocean and is the responsible for most of the dynamical forcing. The circulation and the hydrographic structure of the water near the surface in all the gulf presents important variations with annual and semi-annual periods as a consequence of the variability of the forcing agents. Among these forcings are the Pacific Ocean, the heat flux and the wind stress at the surface. From the preliminary analysis of a circulation model (ROMS) implemented for the Gulf of California, we found that one of the most important dynamical processes that controls the gulf large to medium scales are due to shear instability associated to the piling-up of water in the eastern side of the gulf by the wind and its subsequent realize of energy through barotropic instability (i.e. transfer of mean potential energy to kinetic energy) and the generation of large eddies. To investigate these dynamical processes we analysed the energy balance of the gulf using the results of the mesoscale ocean model. The climatology of some of the components of the energy equation had been evaluated and we discuss its implications.

OS41B CC: 524 C Thursday 0830h

Dynamics of Ocean Circulation I

Presiding: R B Scott, University of Texas Institute for Geophysics Jackson School of Geosciences; **B Nadiga**, Massachusetts Institute of Technology

OS41B-01 0830h INVITED

Internal Modes of Variability of the Midlatitude Ocean Circulation

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Recent studies, using methods of dynamical systems theory, have demonstrated the existence of large-scale low-frequency modes of internal variability of the ocean circulation. Of particular interest for decadal-to-interdecadal variability in the midlatitude ocean are the so-called gyre mode and the interdecadal mode. Both modes are able to destabilize the large-scale ocean circulation, but through entirely different physical mechanisms. In this presentation, the dynamical mechanisms of propagation and growth of these modes, their effect on the variability of the ocean circulation, and their potential role in climate variability will be described.

OS41B-02 0850h

An Idealized Modeling Study of the Gulf-Stream and Kuroshio Extension Systems

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A shallow-water model is used to study the dynamics of the mid-latitude wind-driven ocean circulation. A bifurcation analysis of the steady-state equilibrium solutions is presented. The analysis is in terms of several control parameters: some that control the wind-stress pattern and others that controls the dissipation parameterization. Of the parameters that control the wind-stress, one controls the tilt of the zero-curl line, another controls the relative intensity of the vorticity input in the subtropical and sub-polar gyres and a third controls the overall intensity of the wind-stress. We identify parameter ranges for which multiple equilibria with elongated and contracted western boundary current extensions exist. We also present time-dependent solutions with low frequency variability associated with transitions between the elongated and contracted modes of circulation. The modeled variability is conjectured to correspond to similar elongation-contraction patterns of variability observed in the Kuroshio and Gulf-Stream extension systems from satellite observations.

OS41B-03 0905h

Gravitational potential energy balance in a thermally driven model ocean

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Gravitational potential energy balance of the thermal circulation in a simple rectangular model basin is diagnosed from numerical experiments based on a mass conserving oceanic general circulation model. The vertical mixing rate is assumed a given constant. The model ocean is heated/cooled from the upper surface or bottom, with a linear or nonlinear equation of state. Although the circulation patterns obtained from these cases look rather similar, the energetics of the circulation may be quite different. For the cases of differential heating from the bottom and a nonlinear equation of state, the circulation is driven by mechanical energy generated by heating from the bottom. On the other hand, circulation for the other three cases is driven by external mechanical energy, which is implicitly provided by tidal dissipation and wind stress. The major balance of mechanical energy is between the source of energy due to vertical mixing and the sink of energy due to convection adjustment.

OS41B-04 0920h

A Model Study of Deep Current Interaction with the Gulf Stream

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A two-way coupled duo grid model is applied to the North Atlantic Ocean. Using 4th-order-accurate, non-staggered control volume z-level numerics, the modeled shelfslope and deep current system penetrate with sufficient intensity to Cape Hatteras to realistically affect Gulf Stream separation, mean path and variability that includes warm- and cold- core eddies that pinch off northern and southern Gulf Stream meanders. In model results and Yashayaev's new climatology, strong isopycnal flattening in the region between the shelf-slope and Gulf Stream core reflects thermohaline effects that are analogous to observed nonlinear baroclinic eddy dynamics in the rotating annulus experiments and atmosphere. Eddy activity and 18-deg mode water are discussed and compared with observations. The model runs one model year per 2 clock days on a 2 GHz P4 PC. This efficiency in addressing major observed dynamics, when coupled to Arctic Ocean with

ice dynamics and to a bottom-fit bottom boundary layer model and immersed boundary methodology, is critical to model-based climate risk assessment involving shelfslope methane hydrate gasification and ensuing strongly exothermic biogeochemical processes that may fuel major deep ocean warming and oxygen depletion and decreased Arctic Ocean ice cover. Strong positive feedbacks are possible and there is more than enough chemical energy stored in methane hydrates to melt all of the world ocean ice cover.

OS41B-05 0935h INVITED

Development of a finite element ocean model with a dynamically-adaptive unstructured mesh

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Unstructured, dynamically-adaptive meshing presents many potential advantages for modelling the ocean circulation. These include an ability to efficiently resolve smallscale flow structures as they evolve, improved representation of bathymetry/coastlines and the ability to test efficiently for numerical convergence for given model parameters and prescribed error tolerances. In this paper, we report on our progress towards developing a 3-dimensional, nonhydrostatic finite element ocean model with dynamically-adaptive meshing. One key issue is that standard finite elements fail to represent geostrophic and hydrostatic balance adequately - a strategy for circumventing this problem through a reformulation of the momentum equations will be discussed. Preliminary calculations will be presented for the wind-driven circulation in an idealised basin and simple buoyancy-driven flows.

URL: <http://julia.ese.ic.ac.uk/>

OS41B-06 0955h

New Equations for the Physical Properties of Geothermal Fluid near Vent Environments

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A set of workable fitted polynomial equations for calculating the physical properties: density, specific heat, adiabatic lapse rate and potential temperature of geothermal fluid (0 370 degree centigrade) in response to the temperature, pressure and salinity change, are attempted to be established in this study. The freshwater component of the equations are extracted from the recently released tabulated data of freshwater properties by Wagner and Prub (2002) which is recommended by the International Association for the Properties of Water and Steam (IAPWS). The salt water component of the equation, based on the near-linear relationship of density/specific heat with the salinity, is extracted from the classical lower temperature Equation of State of Seawater 1980's data sets. The freshwater and salt water components are combined to make the set of workable equation. The polynomial equations are calibrated with the existing experimental data and are also applied to the available geothermal fluid data released by the Ocean Drilling Project (ODP) office for back calculating the density and porosity. Though there are no reliable experimental data on the effect of salinity on density and specific heat in high temperature (>40 degree centigrade), the theoretical extension of the salt component are better in estimating the physical properties of the geothermal fluid than using only the freshwater equations or using only the regular seawater equation which limits its temperature to 0 and 40 degree centigrade.