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The PIRATA observations are analysed to diagnose the climatic variability in the tropical Atlantic from 1997 until present. Calendar daily climatologies for each meteorological parameters, and for each level of oceanic temperature and salinity, are computed and updated from the daily data available in real-time on the PIRATA NOAA/PMEL Web site <http://www.pmel.noaa.gov/pirata/>. Simple and standardized daily anomalies are deduced by retrieving the daily observations from these climatologies. The computations are made either for each one of the 10 sites of the PIRATA present array, or for 2-D analyses along the two meridional and the equatorial lines. Proxies of climatic indexes of the meridional and equatorial modes are proposed using the PIRATA data at selected stations. The largest climatic episodes during the study period are discussed and placed in the context of other regional and global analyses. This product is continuously updated and placed on the PIRATA Web maintained at FUNCEME (Brazil) <http://www.funecme.br/>. It complements the information already available on the other PIRATA Web sites.

OS34A-02 1545h

30-70 day Oscillations in the Tropical Atlantic

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The strongest mode of decadal climate variability in the tropical Atlantic is the so-called interhemispheric or "dipole" mode. Here we present evidence of intraseasonal (30 - 70 day) oscillations in the northern and southern tropical Atlantic trade wind systems, which may contribute to the timing and intensity of the interhemispheric decadal fluctuations. Intraseasonal oscillations in near-surface winds reach 5 m s^{-1} and force changes in sea surface temperature (SST) of up to 0.25°C through their effect on latent heat loss and oceanic circulation. Oscillations of the northern tropical Atlantic trade winds are part of a larger spatial pattern that resembles the North Atlantic Oscillation. Furthermore, the northern tropical Atlantic intraseasonal oscillations are significantly correlated with the Madden-Julian oscillation (MJO) in the tropical Indo-Pacific Ocean when the MJO leads by 20 - 25 days. Possible links between the Indo-Pacific and Atlantic, as well as the potential role of the tropical Atlantic intraseasonal oscillations in the evolution of decadal tropical Atlantic SST anomalies, will be discussed.

OS34A-03 1600h

Analysis of the remotely sensed winds : Sensitivity of ORCA model to the scatterometer wind forcing

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Numerical Weather Prediction and analysis outputs are usually used to investigate oceanic and climatic processes and to run ocean models in a forced mode. This oceanic forcing function might be validated and improved, particularly for wind stress and turbulent heat fluxes, directly by the use of scatterometer high-resolution surface wind data. Indeed, enhanced global turbulent flux fields are constructed from ERS and SeaWiFS on board QuikScat with a spatial resolution of 0.5° in longitude and latitude, and a temporal resolution of 12-hour, daily, weekly, and monthly. The quality of the remotely sensed fluxes is investigated through comparisons with data from buoys operated by the Pilot Research moored array in the Tropical Atlantic (PIRATA) project. The correlation coefficients exceed 0.85, the biases are less than 0.5 m/s and the root-mean-square (rms) are less than 1.7 m/s . For wind direction the difference standard deviation is less than 20° . For latent heat flux estimates, the bias is quit small and not significant, while the rms difference, and the correlation coefficient are about 22 W/m^2 and 0.79, respectively. The PIRATA buoy data are then used to assess the quality of flux properties (spatial and temporal patterns) estimated from satellite as well as from NWP analyses (ECMWF) and re-analysis (ERA40) for the time period 1996 - 2003. For instance,

the wind large-scale characteristics from satellite and models compare well. However, significant discrepancies are found in the tropical areas, and especially between satellite and ECMWF analysis.

OS34A-04 1615h

Tropical Instability Waves and the warming of the Atlantic cold tongue : Analysis of the ATLAS and ADCP PIRATA moorings data from 0n, 23W

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Temperature, salinity, and recent velocity records from the PIRATA moorings at 0n, 23oW collected during 2002, as well as accompanying satellite SST and winds are used to examine the Tropical Instability Waves (TIW) and their role in the mixed layer heat balance of the central equatorial Atlantic. The TIW appear as periodic 20-30 day fluctuations in currents which intensify beginning in June in phase with the strengthening of the southeasterly trade winds and the seasonal appearance of the equatorial cold tongue. Zonal velocity fluctuations are largest in July-August, while meridional velocity fluctuations are largest in August-September. The meridional component of velocity is also distinguished from the zonal component in that fluctuations of the meridional component extend coherently in the vertical to at least 120 m while zonal fluctuations are coherent within the mixed layer only. Our estimate of horizontal eddy heat advection in the mixed layer averaged June-September is 100 W m^{-2} with meridional advection dominating and peaking in late boreal summer. Averaged over the whole summer the contribution of the TIW events to the warming of the mixed layer is of 0.5°C , which corresponds to a modest value of the eddy heat advection of 15 W m^{-2} . Since this value is very much less than the estimates of the summer mean eddy horizontal heat advection of $50 - 100 \text{ W m}^{-2}$ this indicates that horizontal and vertical eddy heat advection balance in part.

OS34A-05 1630h

The impact of tropical instability waves on the equatorial mixed layer heat budget

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Several different OGCMs of the tropical Atlantic are used to study the effect of tropical instability waves (TIWs) on the equatorial mixed layer heat budget. We will report especially on two new and important results: Firstly, the often reported large meridional heat flux convergence of the TIWs is partly compensated by the associated vertical heat flux divergence. Secondly, the TIWs do not move heat from the tropical warm pool to the equatorial cold tongue but they take their heat from the atmosphere and do not cool the warm pool. This is consistent with the additional result that the TIWs are generated by barotropic and baroclinic instability.

OS34A-06 1645h

North-South Versus East-West Ocean Freshwater Balance Disruptions and Global Ocean Conveyor

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A disparity in redistribution of freshwater between the Atlantic and Pacific Oceans, both by the atmosphere and by the global ocean thermohaline circulation or "global ocean conveyor" itself, has long been recognized as a major cause of the observed asymmetry in SSS. However, it has not yet been examined whether this asymmetry accounts for the functioning of the global ocean conveyor, and whether the longitudinal, inter-basin freshwater balance is more or less important than the meridional, intra-basin freshwater balance. Recently, we have shown that even if SSS is zonally averaged and thus retains only schematic inter-basin contrasts, it can yield a reasonable global conveyor. In a subsequent series of sensitivity experiments, we have also shown that despite the southern (versus the northern) freshwater impacts are important control of THC dynamics, the inter-basin SSS contrasts may be even more important. Our results favor zonal versus meridional SSS contrasts as most critical for building up and maintaining the global THC. We have used an ocean circulation model in a series of sensitivity experiments with an idealized SSS that mimics either meridional, or zonal freshwater disparity, or both. Our experiments have revealed the Atlantic-Pacific SSS asymmetry being one of the most critical elements. Next to this major factor is the Southern Ocean freshwater balance, which, in our experiments of moderate freshwater discharges, has stronger impact on the overall THC functionality than the impacts in the North Atlantic. However, geologic record shows that the strongest freshwater balance disruptions occurred in the post-glacial North Atlantic. Yet we argue that it is the Atlantic-Pacific freshwater balance shift rather than local freshening is the main cause of the THC collapse following the North Atlantic meltwater events.

URL: <http://www.personal.psu.edu/bjh18>

OS41A CC: 220 C-E Thursday 0830h

Ocean Sciences Posters I

Presiding: T Qu, IPRC/SOEST, University of Hawaii; F J Maurrasse, Florida International University

OS41A-01 0830h POSTER

A Visual Basic Program to Generate Sediment Grain-Size Statistics and Extrapolate Particle Distributions

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Methods that describe and summarize grain-size distributions are important to geologists because of the large amount of information contained in textural data sets. Therefore, to facilitate reduction of sedimentologic data, we have written a computer program (GSSTAT) to generate grain-size statistics and extrapolate particle distributions. Our program is written in Microsoft Visual Basic 6.0, runs on Windows 95/98/ME/NT/2000/XP computers, provides a window to facilitate execution, and allows users to select options with mouse-click events or through interactive dialogue boxes. The program permits users to select output in either inclusive graphics or moment statistics, to extrapolate distributions to the colloidal-clay boundary by three methods, and to convert between frequency and cumulative frequency percentages. Detailed documentation is available within the program. Input files to the program must be comma-delimited ASCII text and have 20 fields that include: sample identifier, latitude, longitude, and the frequency or cumulative frequency percentages of the whole-phi fractions from 11 phi through -5 phi. Individual fields may be left blank, but the sum of the phi fractions must total 100% (+/- 0.2%). The program expects the first line of the input file to be a header showing attribute names; no embedded commas are allowed in any of the fields. Error messages warn the user of potential problems. The program generates an output file in the requested destination directory and allows the user to view results in a display window to determine the occurrence of errors. The output file has a header for its first line, but now

has 34 fields; the original descriptor fields plus percentages of gravel, sand, silt and clay, statistics, classification, verbal descriptions, frequency or cumulative frequency percentages of the whole-phi fractions from 13 phi through -5 phi, and a field for error messages. If the user has selected extrapolation, the two additional phi-fraction fields will be populated with data. The software with the necessary support files, installation instructions, and documentation is available free of charge from the USGS.

OS41A-02 0830h POSTER

Ra-228, Ra-226 and Ra-228/Ra-226 Activity Ratio in the Northern South China Sea

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We report for the first time the surface water distributions of Ra-228 and Ra-226 in the northern South China Sea (SCS) and vertical profiles in the central deep basin of the SCS. Being a marginal sea, the SCS displays activities of both nuclides much higher than the open oceans. The surface water Ra-228 varies between 22 and 33 dpm/100L with higher values at stations adjacent to the landmass. The surface water Ra-226 varies from 10 to 15 dpm/100L with a distribution pattern similar to that of Ra-228. The Ra-228/Ra-226 activity ratio is fairly constant at about 2 or slightly higher. Ra-228 decreases rapidly from a surface maximum of about 22 dpm/100L to about 12 dpm/100L at and below 300m depth in the deep central basin. The deep water values are much higher than those of the open oceans. Ra-226, on the other hand, shows a surface activity of 14 dpm/100L, decreases to 10 dpm/100L at 200m, and then increases monotonically with depth to about 35 dpm/100L at and below 3000m. This distribution pattern is similar to that observed in the western North Pacific but the activity is higher by about 5 dpm/100L for the entire water column. The resulting Ra-228/Ra-226 is greater than one above 250m and becomes less than one below this depth with the ratio decreasing to about 0.35 in the deep water below 3000m. This ratio remains much greater than that in the open oceans, implying a strong Ra-228 input relative to Ra-226 into the SCS deep water.

OS41A-03 0830h POSTER

Ra-226 and Pb-210/Ra-226 Activity Ratio in the Northern South China Sea

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The surface water distributions and vertical profiles of Ra-226 in the northern South China Sea (SCS) have been measured. Surface water Ra-226 varies between 10 and 16 dpm/100 kg with higher values at stations adjacent to the landmass. Each Ra-226 profile shows an increase from the surface toward the bottom. Above 1000m depth Ra-226 is systematically about 5 dpm/100kg higher in the northern South China Sea than in the western North Pacific. This difference may be attributed to a strong Ra-226 source from the shelf and slope area of the SCS. Below this depth Ra-226 displays large variation within some of the profiles with lower limits being comparable to the activities of the western North Pacific but higher limits being systematically about 5 dpm/100kg higher. These high Ra-226 activities may reflect effects of the longer isolation time for the deep water in the SCS basin and strong Ra input from the underlying sediments. The Pb-210/Ra-226 activity ratio ranges between 1.4 and 2.7 in the surface water with higher activity ratio at the station closer to the Luzon Strait. The Pb-210 in excess over Ra-226 in the surface water due to atmospheric input may penetrate to a depth of about 200 to 500m. Below this depth, Pb-210/Ra-226 activity ratio ranges between 0.5 and 0.7 because Pb-210 is scavenged by settling particulates. Box model calculations within a mixed layer of 50m in the area yield a mean residence time of about 1 yr for Pb-210 if an atmospheric Pb-210 flux of 1 dpm/cm²/y is adopted. The activity ratio of about 0.5 to 0.7 in the deep water corresponds to a Pb-210 mean residence time of about 30 to 70 yrs with respect to particulate scavenging.

OS41A-04 0830h POSTER

Uranium and Thorium Distributions in the Sediments Collected From the Western South Okinawa Trough and the Northern South China Sea

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Uranium and thorium radionuclides were measured on three cores each collected from the western South Okinawa Trough (SOT) and northern South China Sea (SCS) in order to examine the variations of these radionuclides and their activity ratios in the sediments and to understand the geochemistry of these nuclides in these two marginal sea areas. Three box cores were taken from the basin of the northern SCS, and three gravity cores were collected from western SOT. The U-238 and U-234 activities in these cores show no significant vertical nor regional variations with activities ranging between 1.3 and 2 dpm/g and the U-234/U-238 activity ratio of about 1.1, quite close to the value of seawater (1.14). However, the activities of thorium isotopes are quite different between these two regions. In the northern SCS, Th-232 has a mean activity of about 2 dpm/g, and Th-228, the granddaughter of Th-232, has a similar mean value. Th-230 has activities generally ranging from 2 to 6 dpm/g. The Th-230/Th-232 activity ratio falls generally between 1 and 3. Th-232 and Th-228 in the western SOT show higher activities (3 dpm/g) than those (2 dpm/g) in the northern SCS. Th-230 in the northern SCS, on the other hand, ranges from about 2 to 6 dpm/g while that in the western SOT is about 2 to 2.5 dpm/g. Thus the Th-230/Th-232 activity ratio, similar to Th-230, is much higher in the northern SCS than in the western SOT. Since U-238 and U-234 are quite comparable between the two regions, this unusually high Th-230 in excess over U-234 in the northern SCS warrants further investigation.

OS41A-05 0830h POSTER

Holocene facies analysis of the sedimentary record with anthropogenic impacts in the Ria de Vigo (NW Spain)

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The Ria de Vigo constitutes the southernmost ria of the Rias Bajas. The reconnaissance studies of this ria indicate a heterogeneous distribution of both terrigenous and carbonate sediments with a major axial deposit of cohesive sediments. These fine sediments are relatively rich in organic matter, particularly in the inner part of the ria. This is the result of a progressive change in hydrodynamic conditions along the ria. The outer parts are affected by severe storms in winter and by upwelling processes in summer, whilst the inner parts have an estuarine character throughout the year. The upwelling produces a marked increase in the biological productivity in the Ria and, consequently, these sediments have typically very high contents of organic matter. In recent years, increasing interest has been shown in the levels of heavy metals in sediments of the Galician Rias. Particularly, some of these studies showed a higher concentration of heavy metals in the muddest surficial sediments in the Ria de Vigo. However, and despite of the important human and industrial settlement in the Galician rias, knowledge about the evolution of historical contamination along the Holocene sedimentary record is scarce. In order to ascertain this evolution have been selected 8 gravity corer located along the axial part of the ria. This evaluation was focused on the muddy sediments of the axial part of the ria due to the dependence of metal levels on grain size, resulting from the association of metals with the finer particles, as it has been demonstrated by previous studies in the ria. On these sediments, the combination of geochemical, mineralogical and sedimentological data, facies interpretations (obtained from x-ray radiography), and their integration with high resolution seismic data (Uniboom and 3.5 Khz subbottom profiler) have allowed to establish the evolution of certain heavy metals (Zn, Cu and Pb) along the Holocene recent sedimentary record in the Ria de Vigo. Sediments in the outer ria are comprised by muddy sands showing a very slight enrichment in certain heavy metals in the upper sediments. Contrary to facies in the outer ria sediments,

facies in the inner ria comprises finer organic-rich sediments. These are related to the presence of biodeposits produced by mussel rafts and to a higher anthropogenic influence due to industrial activity. Both influences are notably reflected in the Cu, Zn and Pb vertical profiles, increasing markedly the levels of these metals in the uppermost 0.15 m of sediments. Diagenetic recycling may contribute to the enhancement of trace metal concentrations in the upper sediments of inner cores and also this is related to a higher content of organic carbon in these sediments. Results obtained in this ria constitutes a good reference to study other rias and coastal areas of the Iberian Atlantic margin. This work was funded by projects REN2003-02822 MAR, REN2003-03233 MAR, VEM2003-20093-C03-03 of the Spanish MCYT and PGDIT03RMA30101PR of the Galician Government (XUGA). Contribution N 302 XM2 group.

OS41A-06 0830h POSTER

The Spatial Variation of Biogenic Particles in the Northern South China Sea and its Implication

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Time-series sediment traps and current meters were deployed from 240 to 3520m depths at five sites along the NE-SW isobath of continental slope in the northern South China Sea(SCS) from 2000 to 2003 to measure the temporal and spatial variations of particle and biogenic material fluxes in order to decipher the particle and particulate carbon transport processes in this area. Mean mass fluxes were higher in the lower Kao-ping Canyon(KC) and the surface water of the SCS basin than those in the lower slope and the deep water of the basin, ranging from about 1000 mg/m²/d in the lower KC to 80 mg/m²/d on the lower slope, suggesting that the KC might be a conduit for transport of particles discharged from the Kao-ping River in southern Taiwan to the northern SCS. These particle fluxes increased with depth, indicating significant contribution of lateral transport to the lower slope. The mean POC and PIC contents decreased with depth in all sites, ranging from 11.1-2.21% for POC and 5.15-1.64% for PIC, reflecting the effects of dilution by lithogenic materials and of increasing decomposition with depth. The mean C/N ratios ranged from 8.36 to 10.4, generally increasing with depth, probably due to an increase of refractory POC relative to POM with depth. The biogenic material fluxes increased with depth on the lower slope, ranging from 4-30 mg/m²/d for POC and 4-16 mg/m²/d for PIC. Significant contributions to these fluxes on the lower slope might have been due to lateral transport. In the SCS basin, the particulate and biogenic material fluxes did not increase with depth, indicating negligible lateral effect.

OS41A-07 0830h POSTER

Building the Link Between Near-Shore Dynamics and the Stratigraphic Record

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In order to further investigate the transport mechanisms and the life cycle of sediments in continental margins, an experimental approach has been designed. It is outlined by the following three objectives: monitoring near-shore dynamics using acoustic tools, measuring seabed stress and load using sensors buried in the seafloor, interpreting off-shore stratigraphic record from seismic surveys. The overall objective is to describe the relationship between the water column hydrodynamics and the resulting geomorphologic response and to reconcile the time scales of storm events and geologic record. The area of study is located off of Scripps Institution of Oceanography, in coastal waters, between the two branches of the Rose canyon: La Jolla canyon and Scripps canyon. The feasibility of indirectly measuring the surface gravity wave field and the shallow currents, by distinguishing sound scattering of lagrangian tracers from other physical effects contributing to the backscatter signal, has

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.

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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/>

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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.