OS32S HC: 316 C Wednesday 1330h

Transport and Transformation of Biogeochemically Important Materials in Coastal Waters III

Presiding: **B J Eadie,** NOAA - Great Lakes Environmental Research Laboratory**; S A Green,** Michigan Technological University

OS32S-01 1330h

Winter Storms and Benthic-Pelagic Coupling : Spatial and Temporal Patterns of Resting Egg Production, Dispersal, and Survival

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Studies of planktonic communities traditionally emphasize seasonal population growth, describing how the balance of births and deaths alters species abundance and maintains community composition. A longer timescale process involves the production of resting eggs, the formation of viable "egg banks", and the purging of these reservoirs during winter storms. Here we document production, dispersal, and resuspension patterns for *Daphnia* resting eggs in Lake Michigan. We utilize a direct monitoring technique (sequential sediment traps) and contrast resuspension of resting eggs during winters of major storms with years when the weather was more moderate. The spatial formation of viable "egg bank" sites is not widespread, but constrained to regions of rapid sedimentation. Rapid burial probably minimizes consumer losses as eggs pass through the bioturbation zone. Recently, resting "egg banks" have proven valuable as a way of testing historic evolutionary and ecosystem hypotheses. We present evidence for a dramatic increase in resting egg production and sexual activity in planktonic organisms associated with anthropogenic activity over the past 200 years.

OS32S-02 1345h

Fronts and Plumes as Organizers of Spatial Distribution of Nutrients and Plankton in Lake Michigan

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Rapid cooling and heating of water along lake margins can result in winter (cold water inshore) and spring (warm water inshore) fronts that allow spatial organization of nutrients and plankton. This organization is disrupted by storms that re-suspend bottom sediments, creating a sediment plume in shallow areas of the lake and increasing cross margin transport of water, sediment and sediment associated nutrients, biota and resting stages. We examined spatial organization of nutrients and plankton in the presence and absence of plumes for winter and spring fronts during 1998-2000 by conducting ship-board surveys of nutrients and plankton along transects normal to the shore in the southern basin of Lake Michigan before and after storms. The potential for fronts and plumes to organize structure of nutrients and plankton is strongly dependent on location in the lake because inflow of nutrients from rivers, current patterns, and variations in cross-margin transport. Fronts and river input of nutrients on the eastern shore tend to increase nutrient and plankton concentrations there. The plume, which is intense in this region, may also inject nutrients that further benefit the plankton.

OS32S-03 1400h

Numerical Modeling of Bioluminescence in the Coastal Ocean.

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The objective of this study is to determine if a short-term forecast (2-3 days) of the bioluminescence potential is possible with the modeling of bioluminescence intensity by tracers.

Bioluminescence potential (BL) predictability experiments (predictions of intensity, depth and distance offshore of the BL maximum) were conducted by using tracers dynamics with velocities and diffusivities from the fine-resolution model of the Monterey Bay Area (ICON model, developed in "An Innovative Coastal-Ocean Observing Network (ICON)" project sponsored by the National Oceanographic Partnership Program) and from a finer-resolution submodel of the ICON model (frsICON, around the upwelling front at the north of the Monterey Bay).

For tracer initialization, observations are assimilated into the tracer model while velocities and diffusivities are taken from the hydrodynamic model and kept unchanged during initialization. This dynamic initialization procedure provides the initial tracer distribution that is balanced with the velocity and diffusivities fields from the hydrodynamic model. After that, three days of prognostic calculations were conducted.

Two cross-shore surveys of bioluminescence data conducted at two locations(north of the Bay and inside the Bay) were used in four numerical experiments designed to estimate the limits of bioluminescence predictions by tracers. These cross-shore sections extend around 25km offshore, they are around 30m deep, and on average they are approximately 35km apart from each other.

Bioluminescence potential predictability experiments show that assimilation of limited available BL observations into the tracer equations allow, with good accuracy, to reconstruct and predict (over a 72- hour period, and over 25-35km distances) the depth, distance offshore and intensity of the BL maximum. The assimilation of BL data from only one cross-shore survey located inside of the Bay gave a good reconstruction of depth and distance offshore of the BL maximum observed during a cross-shore survey outside the Bay. However, the assimilation of only data from this outside cross-shore survey cannot reconstruct the observed bioluminescence structure inside the Bay.

The results of these numerical experiments will be discussed and presented.

URL: http://coam.usm.edu/ICON

OS32S-04 1415h

Coastal Bioluminescent Marine Snow

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In order to determine if bioluminescent organisms were differentially concentrated within marine snow relative to ambient water, individual aggregates were photographed in situ and collected by hand using SCUBA from a shallow coastal fjord in East Sound, Washington, USA. Mechanically stimulated bioluminescence (BL) was measured with an integrating sphere and photomultiplier system. BL on marine snow and in the ambient water varied significantly over short time scales (111 days) and vertical spatial scales (15 m resolution). These are among the first measurements of BL on marine snow, and are the first quantitative estimates of BL marine snow over the water column in a coastal environment. BL was enriched up to 180 times within aggregates over that contained in an equal volume of surrounding seawater. However, the contribution of BL associated with marine snow to total BL in the water column was < 1 % due to the relatively low volume occupied by marine snow overall in the water column. Even though BL marine snow is relatively rare per volume water, these aggregates represent concentrated sources of potential light that produce BL many times brighter than individual dinoflagellates when disturbed by grazers. Previous studies have shown that marine snow concentrations are frequently higher around the thermocline and at density discontinuities. Although our studies show that aggregate BL is influenced by depth, the brightest aggregate BL was not consistently at the thermocline. Aggregate mass was found to be a significant predictor of aggregate BL for detritus-based marine snow. The most abundant source of BL in the aggregates was the heterotrophic dinoflagellate, *Protoperidinium leonis*. Concentrations of BL dinoflagellates, *Protoperidinium spp.* and *Noctiluca scintillans*, were significantly correlated with aggregate BL as a function of depth, date, and type of marine snow. Because planktonic bioluminescent emissions have been shown to deter feeding on individual BL dinoflagellates, BL-enriched marine snow may play an important role in coastal carbon cycling and food web structure.

URL: http://www.lifesci.ucsb.edu/~biolum

OS32S-05 1430h

The Rapid Genesis and Evolution of an Estuarine Plume in Coastal Waters

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Estuarine and riverine plumes are a principal mechanism by which terregiounsly derived anthrophogenic, biogenic and geogenic material are transport to coastal waters and subsequently transformed. Additionally, plumes have a profound impact on the dispersion and recruitment of a variety of life among other life cycle processes. Understand the physical nature of these discharge events thus has important implications for understand species population dynamics, coastal eutrophication, and earth system science as whole. It is by which, one means, the land is linked to the sea.

In this presentation, the genesis and rapid evolution of an estuarine plume is examined and some implications of these short-term events on continental shelf plankton communities are discussed. Specifically, the genesis and rapid evolution of a Chesapeake Bay plume event observed in sea surface temperature (SST) imagery during a two-day period in early June 1998 is examined.

The onset and rapidity of this event was brought about by rapid water level adjustments within the lower portion of the Bay generated by the relaxation and reversal of northward wind stress. This adjustment provided sufficient head for plume generation and enabled relatively warm estuarine water to advance southward as a gravity along the Virginia-North Carolina coast at an initial speed of about 1.5 m s-1, slowing after 30 hours to roughly 0.5 m s-1. The length of the intrusion extended for more than 80 km downstream from the Bay mouth and occupied a region out to 12 km from the shore before detaching and dissipating over the mid shelf region after the onset of an offshore wind stress. The entire process was complete within 40 hours after plume inception.

OS32S-06 1445h

Sources and Cycling of Dissolved and Particulate Organic Carbon in the Mississippi River Plume and Adjacent Coastal Waters of the Northern Gulf of Mexico

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The Mississippi River Plume and adjacent coastal waters in the northern Gulf of Mexico are very dynamic regions for carbon cycling. As the largest river in the

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North America, the Mississippi River drains 41% of the continental United States and carries large amounts of terrestrial organic matter to the Gulf of Mexico. The sources and transformation of organic matter in the Mississippi River plume, however, are not well understood due to the intense mixing and complex nature of the region. As part of an investigation of colored dissolved organic matter (CDOM), we measured stable carbon isotopic (δ^{13}C) compositions for over 60 dissolved organic carbon (DOC) and 60 particulate organic carbon (POC) samples collected from the surface water in the Mississippi River Plume and adjacent coastal waters in the northern Gulf of Mexico during two cruises in 2000 and 2001. In addition, C/N ratios were also determined for over 150 POC samples. These δ^{13}C and C/N results combined with over 200 DOC measurements from the area provide a comprehensive assessment of the sources and transformation of terrigenous organic matter in the Mississippi River plume. Our results indicate that a general mixing of terrestrial and marine organic matter occurred in the region but large variations in δ^{13}C and C/N ratios were observed along the salinity gradient. We will attempt to use high-resolution CDOM fluorescence, chlorophyll fluorescence, and optical backscatter data from a towed undulating vehicle (the ECOShuttle) to identify the local removal and production processes that appear to play an important role for organic carbon cycling in the region.

OS32S-07 1520h

Transport of Organic Fe Complexing Ligands in the Mississippi River Plume

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Recent research has shown that some coastal systems can be Fe limited due to low inputs from either riverine or benthic sources. However, not all coastal systems exhibit these characteristics. Some are shallow systems with tight benthic to water column coupling while others may be heavily influenced by a large river. Even with river influence, previous research has indicated that large fraction of the Fe is removed in the estuarine mixing zone. In the past 5 years much attention has focused on the role of organic Fe complexing ligands for controlling Fe solubility and phytoplankton uptake in the open ocean. Very few coastal or estuarine measurements of Fe speciation have been published. In order to evaluate the processes that control the concentration and conditional stability constants of these organic Fe complexing ligands in a river dominated coastal system, samples were collected during 2 cruises to the Mississippi river plume in 2000. Samples were stored frozen and later analyzed using a competitive ligand (2-(2-Thiazolylazo)-p-cresol (TAC)) equilibration cathodic stripping voltammetry technique. Results show that Fe is greater than 99.9% organically complexed everywhere in the plume. Ligand concentrations are high in the brown water (over 50 nM), decrease in the green water and remain relatively constant very far offshore (approximately 20 nM). There is no systematic change in the conditional stability constant with log K ranging from 10.6 to 12.3. Our results indicate that this system is not likely to be Fe limited even far from the river source due to a high concentration of organic Fe complexing ligands.

OS32S-08 1535h

Microbial Ammonium Recycling and Grazing Rates Along a Salinity Gradient in the Mississippi River Plume

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Uptake and regeneration rates of ammonium and grazing rates on phytoplankton and bacteria were studied along a salinity gradient (0.2-34.4$^{o}/_{oo}$) in the Mississippi River plume in May 2000. NH_4^+ uptake and regeneration rates were derived from surface water samples amended with 4 μM $^{15}NH_4^+$ and incubated for 24 hrs in a temperature-controlled ship deck incubator. Concentrations of $^{14}NH_4^+$ and atom% ^{15}N were measured by HPLC on subsamples at the beginning and end of incubations. Similar experiments were conducted on a second set of samples fractionated by 2 μm Nuclepore filters to reveal the role of bacteria in NH_4^+ regeneration. Grazing rates on heterotrophic bacteria and phytoplankton were estimated by serial dilution experiments incubated for 24 hrs in the deck incubator. Cell abundance of bacteria and phytoplankton were assessed by flow cytometry. Heterotrophic nanoflagellates (HNF) were counted by epifluorescence microscopy after DAPI staining. Ammonium concentrations were highest at 8-14$^{o}/_{oo}$. Chlorophyll concentrations and abundances of phototrophic eukaryotes and *Synechococcus* peaked around 10$^{o}/_{oo}$, whereas bacteria abundance decreased with increasing salinity. HNF occurred at ca. 2500 cell ml^{-1} at stations with salinities up to 23$^{o}/_{oo}$and ca. 1300 cells ml^{-1} at high-salinity stations. Ammonium regeneration was highest (0.12 μmol N l^{-1} h^{-1}) at 28.2$^{o}/_{oo}$, and NH_4^+ uptake (0.36 μmol N l^{-1} h^{-1}) at 14.7$^{o}/_{oo}$. Ammonium uptake was low in the <2 μm fraction at low and mid-salinity stations, pointing towards the occurrence of larger phytoplankton. Uptake rates were low and similar between total and fractionated samples at oligotrophic high salinity stations characterized by *Prochlorococcus* dominance. NH_4^+ regeneration rates were similar in both fractions or higher in the <2 μm fraction at 5 out of 9 stations, suggesting an important role of bacteria in river plume NH_4^+ recycling. Grazing pressure on *Prochlorococcus* was 0.8-1.5 d^{-1}. Grazing pressure on *Synechococcus* and phototrophic eukaryotes varied among stations without regional trend (0.1-2.8 d^{-1}). Bacteria were grazed at lower rates (0.2-0.5 d^{-1}) than phytoplankton, a factor which may have contributed to their important role in NH_4^+ regeneration.

OS32S-09 1550h

Stable Isotopic Indicators for the Biogeochemical Cycling of Organic Matter in a Temperate North Pacific Estuary, Oregon, USA

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The distributions of del 13C and del 15N in suspended particles were examined monthly for two years at ten stations along a 60 km transect in the euphotic zone (0.5m) of the Yaquina River and Estuary, Oregon. Organic material in estuaries is a mixture of land-derived and oceanic carbon and nitrogen. In addition, in situ biological processes both produce and consume organic components. The stable isotopes of carbon and nitrogen reflect the isotopic composition of their sources, and thus provide a means of identifying those sources. In the Yaquina estuary both del 13C and del 15N in planktonic material increased from the freshwater terrestrial region of the river downstream to the Pacific Ocean. Isotopic carbon increased from -27.7 1.4 to -22.1 1.5 per mil del 13C between the freshwater terrestrial region of the river to the Pacific Ocean. Particulate nitrogen increased from 2.6 1.0 per mil in the freshwater region to 7.2 1.4 per mil del 15N at the ocean. Relative to salinity, the isotopic increases were non-linear, indicating that processes in addition to simple mixing of the two end members were occurring. Isotopic data suggest that river outflow provided a source of nutrients in the freshwater portion of the estuary, whereas heterotrophic remineralization and nutrient recycling were important in the tidal regions of the estuary.

OS32S-10 1605h

Nitrogen and carbon isotopic composition of dissolved organic matter in marine environments

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High molecular weight (HMW) dissolved organic matter (DOM) was isolated using cross-flow ultrafiltration from seawater across a salinity gradient in the Chesapeake Bay/Middle Atlantic Bight (MAB) and Galveston Bay/Gulf of Mexico regions. Nitrogen and carbon isotope ratios (δ^{15}N and δ^{13}C) were measured on the isolated HMW DOM samples (defined as size fraction between 1-200 nm), which made up about 50-60% of the total DOM in the estuarine regions and decreased to about 35% of the DOM at the MAB and Gulf of Mexico stations. Measured δ^{15}N values varied from 4.8 to 8.1 while δ^{13}C values ranged from -26.5$^{o}/_{oo}$ to -21.1$^{o}/_{oo}$ in the Chesapeake Bay/MAB area. In the Galveston Bay/Gulf of Mexico region, δ^{15}N values changed from 3.2$^{o}/_{oo}$ to 9.5$^{o}/_{oo}$ and δ^{13}C values were between -26.1$^{o}/_{oo}$ and -20.9$^{o}/_{oo}$. Similar distribution patterns of δ^{13}C and δ^{15}N were observed in both study areas, with values of δ^{13}C increasing consistently with increasing salinity. This clearly demonstrates a shift of HMW organic carbon sources from largely terrestrial inputs in the upper estuarine areas to marine dominated organic carbon sources in lower estuarine and coastal regions. However, the distribution pattern of δ^{15}N is more complicated with δ^{15}N values first increasing with salinity in estuarine regions then decreasing towards the seawater endmember. The distribution pattern of δ^{15}N suggests a more dynamic N cycling and that, in addition to organic matter sources, biogeochemical and isotopic fractionation processes are important factors governing marine HMW DOM δ^{15}N values. Vertical profiles of HMW DOM δ^{13}C in both the MAB and the Gulf of Mexico generally decrease from surface water to deep waters whereas the opposite was found for δ^{15}N. HMW DOM components with heavier δ^{13}C and lighterδ^{15}N seem to be preferentially degraded during their transport from surface to deep waters, similar to findings previously observed for oceanic POM. The overall isotopic fractionation and enrichment processes are distinct for carbon and nitrogen during production, transformation, and degradation pathways of HMW DOM in the ocean. While carbon isotopic signatures can be used as an indicator of HMW DOM sources, nitrogen isotopic composition, on the other hand, appears to be related to both source functions and subsequent recycling in marine environments. Comparisons of δ^{15}N with previously published Δ^{14}C values for the same samples are in agreement with these conclusions about the ^{15}N pathways.

OS32S-11 1620h

Molecular Characteristics and Bioavailability of Riverine Dissolved Organic Matter (DOM)

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The bulk chemical characteristics as well as specific molecular traits of different DOM sampled along the river continuum were investigated on a seasonal base in the highly pristine and oligotrophic River Tagliamento, Italy. DOM size- and chemical fractionation (ultrafiltration and C18 solid phase extraction) revealed that up to 80

OS32S-12 1635h

Dissolved Organic Matter (DOM) of the Rivers Ob and Yenisei: Seasonal Aspects and Transformation Processes During Estuarine Mixing in the Kara Sea, Russia

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Two important factors that influence biogeochemical fluxes of organic matter in the Arctic Ocean are the extended shelf areas and the large amount of freshwater discharged by Arctic Rivers. Riverine DOM plays a

crucial role in the estuarine carbon budget and is subject to changing physical, chemical and biological parameters in the estuary. Among the rivers entering the Arctic Ocean Ob and Yenisei alone account for about one third of the total annual riverine discharge. While data on water discharge are relatively robust this is not true for estimates on annual DOM transport to the Kara Sea, mainly due to insufficient temporal resolution of dissolved organic carbon (DOC) data during the spring-flood and winter periods. Based on DOC data from 4 cruises in the Kara Sea we estimate the annual DOC transport of Ob and Yenisei to be 7.5-9.6 TgC. Conservative distribution of both DOC and dissolved organic nitrogen (DON) along the salinity gradient indicate the predominantly refractory character of this riverine DOM. This observation is consistent with laboratory experiments which showed only minor losses due to flocculation processes and bacterial decomposition as well as low in situ respiration measurements. The distribution of optical and chemical properties of DOM in the Kara Sea underlines its conservative behavior, but also supplies clues about the potential importance of brine rejection and photooxidation for DOM in the Eurasian shelf. The role of heterotrophic bacteria for DOM cycling in the Kara Sea is currently under investigation and will allow to estimate the importance of biological versus physical factors for DOM processing in the Kara Sea.

OS32T HC: 317 B Wednesday 1330h

Southern Ocean Circulation

Presiding: **D Luther,** University of Hawaii at Manoa

OS32T-01 1330h

Comparison of Methods of Estimating Mean Synoptic Current Structure in "Stream Coordinates" Reference Frames: Impact on Structure, Transport and Dynamical Inferences With an Example From The Antarctic Circumpolar Current

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Stream coordinates techniques, that is, the methods of deriving the mean "synoptic" structures of narrow meandering ocean currents, have been in use for nearly two decades and have resulted in improvements in our understanding of the dynamics and transports of such currents. Stream coordinates have been applied to a wide range of currents, including the Gulf Stream, North Atlantic Current, Kuroshio, and Antarctic Circumpolar Current (ACC). Studies of these currents have involved different types of measurements, and have employed somewhat different assumptions to convert Eulerian measurements into a stream-coordinates reference frame. The key issues are how to determine, at any particular time, the location and direction of the core of the meandering jet relative to observations taken at fixed geographical locations. A recent experiment in the ACC's Sub-Antarctic Front (SAF) southwest of Tasmania, involving overlapping arrays of current meter moorings, inverted echo sounders, and horizontal electric field recorders, has provided an opportunity to test various stream coordinates methods to determine how well they achieve the goal of producing an accurate mean "synoptic" picture of the SAF current. It is found that, at least for the SAF southwest of Tasmania, the common assumption of a meandering "frozen field" baroclinic structure leads to the concealment of real baroclinic divergence and to an incorrect broadening of the current and temperature structures. The impact of the differing stream coordinate structures on dynamical inferences and transport estimates will be discussed.

OS32T-02 1345h

Synoptic Structure of the Sub-Antarctic Front Southwest of Tasmania: Temperature, Salinity and Absolute Velocity

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The mean "synoptic" structure of the northern, strongest, branch of the Antarctic Circumpolar Current southwest of Tasmania - the Sub-Antarctic Front (SAF) - is estimated by a stream-coordinates analysis of data from overlapping arrays of current meter moorings, inverted echo sounders, and horizontal electric field recorders deployed during the 1995-97 Sub-Antarctic Flux and Dynamics Experiment (www.soest.hawaii.edu/oceanography/dluther/SAFDE/index.html). An accurate stream coordinates reference frame is constructed without the usual suppositions about the behavior of the structure of the density or current fields (e.g. a frozen field assumption). The stream coordinates are derived from a daily objective mapping of the temperature field obtained from combining the IES travel time measurements with an empirical vertical mode structure constructed from the extensive hydrography acquired during WOCE (SR3 line). Full-water-column stream-coordinates sections of temperature, salinity and absolute velocity will be discussed and compared with prior observations of the SAF and other fronts. Separating the baroclinic and barotropic currents (using the Fofonoff bottom current definition of barotropic) reveals that (i) the SAF currents are divergent - both baroclinically and barotropically - in the cross-stream direction, and (ii) the cross-stream shear of the along-stream velocity is strongest on the cold side of the front. The barotropic contribution to the mean total transport is small. Dynamical inferences will be drawn from the stream coordinates sections.

OS32T-03 1400h

Interpreting Wind-Driven Variability of the Southern Ocean in a Stochastic Framework

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A stochastic model is derived from wind stress and bottom pressure gauge data to reexamine the response of the Antarctic Circumpolar Current (ACC) transport to wind stress forcing. A general method is used to estimate the drift and diffusion coefficients of a continuous stationary Markovian system. The response of the ACC to wind stress forcing can be described by a multivariate Ornstein-Uhlenbeck process. The stochastic model can serve as a null hypothesis for studies of wind driven ACC variability. Using this hypothesis, we show that a stochastic parameterization of the bottom drag can decrease the effective damping of the flow by means of a "noise-induced transition". The stochastic representation of the damping term indicates the fluctuations of the damping parameter and implies that the stochastic forcing is multiplicative. Multiplicative noise can substantially change the dynamical behavior of the underlying system; in this particular case the stochastic parameterization of the bottom drag results in an effective decrease of the damping. While observations suggest a phase lag between wind forcing and ACC transport, ocean models have not shown this effect, possibly because the effective damping is too large. Therefore, we suggest that this model deficit may have its origin in the traditional use of constant damping parameters.

OS32T-04 1415h

Mid-Depth Warming Trends in the Southern Ocean

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Temperatures measured in the Southern Ocean during the 1990s by Autonomous Lagrangian Circulation Explorer (ALACE) floats are consistently warmer than older hydrographic temperature measurements from the region. As part of the World Ocean Circulation Experiment, ALACE floats returned nearly 13,000 mean temperatures from depths between 700 and 1100 m, time averaged for 10 to 25 day intervals. Point by point comparisons of the ALACE temperatures with hydrographic profiles suggest a total warming of about 0.17 C between the 1950s and the 1980s. (Some of the floats also provided vertical profiles of temperature.) Warming is fastest near the Antarctic ice edge and within the core of the Antarctic Circumpolar Current, where the rate of mean temperature rise is nearly 1 C per century. This rate of increase is faster than the warming of the global ocean as a whole reported by Levitus and coauthors, and it is comparable in magnitude to ground level atmospheric temperature rises reported from islands within the Southern Ocean.

OS32T-05 1430h

A deep cyclonic gyre in the Australian-Antarctic Basin

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World Ocean Circulation Hydrographic Program sections I8S and I9S provide two quasi-meridional crossings of the South Australian Basin and the Australian-Antarctic Basin. Full water column conductivity and temperature profiles, a suite of nutrient measurements and two independent direct-velocity measurements (shipboard and lowered acoustic Doppler current profilers) are used to determine the pathways of Antarctic Bottom Water and Lower Circumpolar Deep Water from the Australian-Antarctic Basin into the South Australian Basin and to quantify the strength of the deep cyclonic gyre within the Australian-Antarctic Basin.

A western boundary current along the Kerguelen Plateau in the Australian-Antarctic Basin acts as the western limb of a deep cyclonic gyre and brings cold dense water north from the margins of Antarctica. Deep water sources for the western boundary current derive from the convergence of westward and eastward flow along the Antarctic continental slope, and a cyclonic recirculation within the Australian-Antarctic Basin. At the northern boundary of the Australian-Antarctic Basin, deep water within the western boundary current turns east, flows beneath, and merges with the Antarctic Circumpolar Current. This northern limb of the deep cyclonic gyre flows east along the southern flank of the Southeast Indian Ridge. Further downstream a saddle in the Southeast Indian Ridge, the Antarctic Discordance, allows a portion of the deep water to pass from the Australian-Antarctic Basin into the South Australian Basin. Rather than a simple bifurcation of the northern arm of the cyclonic gyre, the deep waters appear to take a meandering pathway to the Antarctic Discordance.

OS32T-06 1445h

Kinematics and Dynamics of Unstable Waves in the Antarctic Circumpolar Current

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Baroclinic and barotropic instabilities of the Antarctic Circumpolar Current (ACC) are evaluated based on linear stability analysis of ACC flow fields simulated by the Parallel Ocean Climate Model (POCM). Merdional transects of flow velocity are extracted at 4 degree longitude intervals from POCM for the area between 43S and 63S, a region which includes the Subantarctic and Polar fronts. Kinematic and dynamic properties of unstable modes are computed by applying quasigeostrophic linear stability analysis to a 3-layer representation of each y-z velocity transect. Properties of unstable modes are first evaluated as a function of location within the Southern Ocean for calculations which include the contribution of meridional topographic slopes to the vorticity equation. The effect of north-south sloping topography on unstable mode kinematics and dynamics is then evaluated by comparing (1) linear stability results computed by including the meridional topographic slope in the vorticity equation with (2) linear stability results computed by neglecting this term in the vorticity equation.

OS32T-07 1500h

Thermocline Depth and Exchange Fluxes Across Circumpolar Fronts

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