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A reduced-rank stationary Kalman filter is applied to a realistic model of the tropical Atlantic ocean. The goal is to estimate the sub-surface circulation and thermal structure for studies of the circulation pathways in the Atlantic subtropical and tropical gyres by assimilating Topex/Poseidon sea surface height (SSH) data.

The model is a reduced-gravity primitive equation of GCM of the upper ocean with a variable-depth mixed layer and a domain covering the Atlantic ocean between 30°N and 30°S. Wind stress and heat flux, calculated from wind speed and cloud cover provided by NCEP, are used to force the model at the surface. The assimilation scheme is an approximation to the extended Kalman filter in which the error covariances of the state estimates are only calculated in a reduced-dimension subspace spanned by a small number of empirical orthogonal functions (EOFs). Results from previous studies concerned with assimilating SSH in the tropical oceans suggest that the costly process of dynamically evolving the error covariances only results in minor improvements to the state estimates. Therefore, to obtain an assimilation procedure which only requires slightly more computational effort than a simple model integration, the asymptotically stationary error covariances are used.

Assimilation of simulated SSH data demonstrated the ability of the method to successfully constrain the circulation and sub-surface thermal structure. Assimilation of actual Topex/Poseidon altimetry data resulted in 23.6% reduction in the rms misfit with observed SSH relative to a pure model integration. Also, the agreement between the power spectra of the observed and model SSH is significantly improved by the assimilation. Evaluation of the impact on the subsurface fields is more difficult due to a lack of independent measurements. However, changes to the thermocline structure appear reasonable and the correlation between the observed SSH and the depth of the model thermocline are improved by the assimilation.

OS31M-10 1115h

Seasonal to Decadal Variability of the Tropical Atlantic Thermocline

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Recent studies aimed at understanding the low frequency variability of the tropical oceans have hypothesized that oceanic teleconnections between the subtropics and tropics could constitute the oceanic component of slow coupled ocean-atmosphere modes. Most of the attention has been focused on the Pacific Ocean because of the importance of the El Nino/Southern Oscillation. However, the interannual to decadal variability of the tropical Atlantic Ocean is a strong signal, and provides considerable motivation for studying the physics of subtropical-tropical connections within this basin. This study assesses the main kinematic characteristics of the thermocline branches of the subtropical-tropical cells (STC) in the Atlantic Ocean. A series of ocean model experiments are used to study the seasonal cycle of subduction, entrainment, and subsurface circulation. The subduction rate, timing, and duration are contrasted for the Northern and Southern Hemisphere. These quantities, poorly known for the Southern Hemisphere, are essential since they quantify the main source water of the upper equatorial thermocline. The subsurface pathways are characterized using conservative quantities as well as releases of simulated Lagrangrian floats. On longer time scales the role of momentum versus buoyancy forcing are considered on and off the equator in the context of oceanic teleconnections.

OS31M-11 1130h

The Path of Antarctic Intermediate Water Across the Equatorial Atlantic

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We used a slightly idealized configuration of a numerical ocean model to investigate how the Antarctic Intermediate Water (AAIW) crosses the equator in the Atlantic. We find that upon crossing the equator the Intermediate Western Boundary Current breaks up into eddies that have no signal in or above the thermocline. These eddies merge with the shallow retroflection eddy of the North Brazil Current (NBC)- North Equatorial Countercurrent retroflection at 7N to create NBC rings that reach well below 1000m depth. Futhermore we studied the intermediate depth flowfield along the equator. Based on available observations and our model results we reject the idea of strong zonal intermediate currents in the Atlantic. Instead we show that the notion of these intermediate currents is due to an undersampling of the strong annual and semiannual Rossby waves. The equatorial tracer distribution can be explained by Stokes drift and dispersion against the gradient of eddy kinetic energy.

OS31M-12 1145h

Observational Evidence for Flow between the Subtropical and Tropical Atlantic: the Atlantic Subtropical Cells

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An analysis of available hydrographic data in the Atlantic between 1950-2000 is carried out to determine the pathways of thermocline water from the shallow subtropical subduction regions to the tropics. The goal of this study is to describe and quantify these pathways using potential vorticity, salinity, and geostrophic and Ekman flow estimates, and to assess subtropical-tropical interaction in the thermocline and its interaction with the deep thermohaline overturning circulation in the Atlantic. In both hemispheres, the subducted Salinity Maximum Waters flow into the tropics in the pycnocline along both interior and western boundary pathways. The North Atlantic ventilating trajectories are confined to densities between about 23.4 to 26.0 σ_θ and only about 2 Sv of water reaches the tropics through the interior pathway, while the western boundary contributes about 3 Sv to the equatorward thermocline flow. The pathways skirt around the potential vorticity barrier and reach their westernmost location at about 10°N. In the South Atlantic, about 10 Sv of thermocline water reaches the equator through the interior (4 Sv) and western boundary (6 Sv) in the same range of densities as in the North Atlantic, but weighted toward a slightly higher mean density. The ventilation pathways are spread over a much wider interior window in the Southern than in the Northern Hemisphere, which at 6°S extends from 10°W to the western boundary. The equatorward convergent flows in the thermocline upwell into the surface layer and return to the subtropics through surface poleward divergence. As much as 70% of the tropical Atlantic upwelling into the surface layer is associated with these subtropical circulation cells, with the remainder contributed by the warm return flow of the deep thermohaline overturning circulation.

OS31N HC: 318 B Wednesday 0830h

Bentho-Pelagic Coupling at High Latitudes I

Presiding: **C Smith,** University of Hawaii at Manoa**; D DeMaster,** North Carolina State University

OS31N-01 0830h INVITED

Benthic-Pelagic Coupling in the Coastal Waters of Antarctica

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The coastal waters of Antarctic typically exhibit an intense but highly seasonal pulse of primary production. A four-year time-series of chlorophyll (size-fractionated at 20, 5, 2 and 0.2 microns) measured weekly, and feeding activity in 13 taxa of benthic suspension feeders measured twice-monthly by SCUBA divers, has provided new insights into benthic-pelagic coupling at high latitudes. The intensity and timing of the summer phytoplankton bloom varies between taxa (and hence size fractions), and is also highly variable between seasons. The timing of feeding activity in the benthos depends on the temporal pattern of availability of the particles selected, with taxa taking small cells having longer feeding periods than those taking larger cells (especially diatoms). Carnivorous taxa feed year-round, though feeding intensity decrease in winter. These data show that the seasonality of primary production exerts a major control on the biology of consumers, but that this seasonality becomes less intense at higher levels in the Antarctic food-web.

OS31N-02 0900h

FOODBANCS on the Antarctic Peninsula Shelf: The Benthic Food Bank Hypothesis and the Seasonal Deposition Pulse

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Primary production and biogenic particle flux on the Antarctic shelf exhibit extraordinary seasonal variability. This intense boom-and-bust production cycle may profoundly affect food availability and life-history strategies of shelf benthos. We hypothesize that much of the new production from the intense Antarctic summer bloom deposits rapidly onto the shelf floor where it degrades very slowly, providing a persistent "food bank" for detritivores. To test this hypothesis, we have conducted a seasonal study of the flux and fate of bloom phytodetritus at the West Antarctic Peninsula shelf floor, called **FOODBANCS** (**FOOD** for **B**enthos on the **A**ntarctic **C**ontinental **S**helf). Using sediment traps, core sampling, radiochemical profiles, and bottom photography, we evaluated temporal variability in the flux and inventory of bloom detritus on the west Antarctic Peninsula shelf, and benthic biological responses, in Nov 1999 (shortly pre-bloom), Mar 2000 (shortly post-bloom), Jun 2000 (end of the ice free period), Oct 2000 (end of winter-ice period) and Feb 2001 (shortly post bloom).

Sediment traps (moored 150 mab) indicate 5-fold seasonal and 10-fold interannual variability in the flux of POC and chloropigments to the seafloor during our study period. The intense seasonal pulse of phytodetritus can create a green carpet covering broad areas of the Peninsula shelf; seafloor surveys indicated a carpet in Feb 2001 covering at least 35,000 km^2. However, even with the phytodetrital carpet, seafloor inventories of chloropigments (and a variety of biomass parameters) were relatively constant at all sampling times, suggesting a persistent food bank for detritivores in Antarctic shelf sediments. This persistent food bank

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may influence the selection of life histories in Antarctic benthos.

OS31N-03 0915h

Benthic Responses to Seasonal Phytodetritus Deposition on the West Antarctic Peninsula Continental Shelf

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Phytodetritus is deposited annually on West Antarctic Peninsula (WAP) shelf sediments following the retreat of winter sea-ice. Bloom-derived organic material can be subducted into the sediments by activities of the benthos, where it may degrade slowly due to low temperatures. We conducted a seasonal study of the flux and fate of phytodetritus, and its impact on benthic community dynamics, at three stations in a transect crossing the WAP shelf (project FOODBANCS; see Smith et al., above). Fluorometric determination of chloropigments in sediments and sediment trap material indicated highly seasonal deposition; however, sediment inventories fo chloropigments remained relatively constant year-round, and sediment chloropigment concentrations varied little below the top centimeter. Microbial biomass appeared to follow a similar pattern at the two off-shore stations, with most seasonality limited to the top few centimeters. However, at the innermost shelf station, where OM deposition was considerably higher, microbial biomass did exhibit a seasonal response. Here, values in the top 5 cm increased following the bloom, with maximum values observed in Oct 2000. These data indicate the presence of a persistent sediment "food bank", which could support benthic detritivores year-round. Most macrofaunal higher-level taxa showed little seasonal variability in abundance. Only the surface-deposit-feeding ampharetid polychaetes exhibited strong evidence of a seasonal recruitment pulse. Thus, most macrofaunal detritivores may be exploiting a "food bank" within the sediments.

OS31N-04 0930h

Benthic Fluxes and Carbon Diagenesis in the Palmer Long Term Ecological Research Area

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Three stations near the Palmer LTER were sampled five times between November 1999 and March 2001 in an effort to determine the response of benthos to the seasonal delivery of phytodetritus. All three stations were in approximately 600m of water. Long-term sediment and organic carbon accumulation rates were 150 cm ky^{-1} and 0.47 moles C m^{-2} y^{-1} at the inshore station and were 30 cm ky^{-1} and 0.10 moles C m^{-2} y^{-1} at the two offshore stations. Results show that benthic responses in the area are less seasonal than pelagic production and particle export. Delivery of organic carbon as measured in a near-bottom sediment trap (150 mab) ranged from 0.5 - 1.2 mMoles C m^{-2} d^{-1} during three deployments between Nov. 1999 through Oct. 2000 and later peaked at 5.5 mMoles C m^{-2} d^{-1} for the time period between Oct. 2000 and Feb. 2001. In response, seabed respiration rates averaged 1.5 mMoles O_2 m^{-2} d^{-1} and were weakly seasonal at the innermost station and statistically similar during all seasons at the two offshore stations. Fluxes and porewater profiles of nutrients also varied little seasonally and suggest that remineralization in the upper four centimeters of the sediment column proceeds primarily via nitrate reduction.

OS31N-05 0945h

Seasonal and Annual Denitrification Rates in Antarctic Peninsula Shelf Sediments

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Porewater profiles of dissolved oxygen and nutrients, as well as dissolved nitrogen gas fluxes from shipboard chamber incubations were collected along the continental shelf of the Western Antarctic peninsula in the vicinity of the Palmer LTER site, in order to assess seasonal variation in benthic remineralization rates in a region with a highly pulsed influx of organic carbon. Three stations were occupied four times over the course of an annual cycle in March, June, and October of 2000 and in February 2001. Throughout the year, the inner-most station was generally more reducing than the outer two stations with shallower penetration depths for oxygen (8-15 mm) and nitrate (15-40 mm); porewater nitrate profiles decreased monotonically to zero. The outer stations had deeper oxygen penetration depths (12-35 mm) and occasionally exhibited sub-surface maxima in porewater nitrate. The penetration depths and calculated fluxes for oxygen and nitrate were fairly constant across all seasons suggesting there is little variability in the rates of benthic remineralization. This despite the pulsed organic carbon input, suggesting some time-integration of the benthic processes. Nitrogen gas fluxes were also relatively constant across all seasons (∼1.3 mmol N/m2/day) and were generally larger than would be predicted by the nitrate supplied denitrification rates. Our results suggest that as much as 80% of the denitrification in these sediments may be due to coupled nitrification-denitrification.

OS31N-06 1030h

Radiochemical Measurements From FOODBANCS: Examining Carbon Cycling and Bentho-Pelagic Coupling on the Antarctic Continental Shelf

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Time series measurements of naturally occurring Th-234 and C-14 were made at 3 Antarctic shelf sites (near Palmer Station) during the FOODBANCS project. Between November 1999 and March 2001, plankton, particle trap, sediment, and benthos samples were collected during 5 cruises that covered seasonal fluctuations in surface production and seafloor deposition. Th-234 data (24-day half life) from surface sediments and benthic faunal gut samples indicated that recent deposition (via water column production and/or resuspension) and active benthic feeding occurred during all seasons. Th-234 activities in benthic faunal gut samples were highest in the holothurian *Peniagone sp.* (∼160 dpm/g) followed by echiurans and the holothurians *Bathyplotes sp.* and *Scotoplanes globosa* (∼90-120). The lowest Th-234 activities were measured in various urchins (∼40 dpm/g) and the holothurian *Molpadia musculus* (<30 dpm/g). Particle trap Th-234 activities varied from 200-980 dpm/g. Seabed Th-234 mixing coefficients (reflecting particle transport during feeding and burrowing activities) varied from 1-35 cm^2/y with typical penetration depths for the tracer of 2-3 cm.

C-14 has been used as a tracer of benthic faunal particle selection, as a tracer of carbon source preference during digestion, and as a chronometer for establishing long-term sediment accumulation rates in the seabed. The ΔC-14 content of surface sediments varied from -200 to -300 per mil at the FOODBANCS stations, whereas the ΔC-14 values of body tissues from benthic epifauna ranged from -110 to -130 per mil. Based on the C-14 content of epifaunal gut sediment as well as surface sediment and body tissue C-14 values, approximately half of the 130 per mil C-14 enrichment (body C-14 vs. sediment C-14) comes from particle selection and the other half comes from preferential digestion of labile organic carbon. All 3 holothurians examined (*Bathyplotes sp., Scotoplanes globosa*, and *Molpadia musculus*) exhibited strong evidence for both particle selection and selective digestive processes. Radiocarbon sediment accumulation rates at the three shelf stations (water depths ∼600m) range from 30 cm/ky on the outer shelf to 150 cm/ky in a protected inner-shelf station.

OS31N-07 1045h

Bentho-Pelagic Coupling and Biogenic Silica Early Diagenesis: two case Studies in the Abyssal Northeast Atlantic and in an Antarctic Continental Shelf

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The effects of seasonality on the dissolution and preservation of biogenic silica in marine sediments have been studied in an abyssal plain in the northeast Atlantic (PAP site, EU-BENGAL program) and in a coastal site off the Antarctic peninsula (LTER site, NSF-FOODBANCS program). Low porewater asymptotic silicic acid (DSi, uM) and biogenic silica (BSi, weight %) concentrations characterize the PAP site (180-220 uM, 0.5 - 2.0 %, respectively) while higher concentrations were observed at the LTER site (600-700 uM, 10-15 %, respectively). Seasonality has been studied at the two sites owing to a series of seasonal cruises during which DSi and BSi concentrations have been monitored and BSi dissolution properties (apparent solubility, dissolution kinetics) have been studied by means of batch and flow-through experiments. Two different situations have been encountered during the two studies: at PAP, no phytodetritus has been observed but other studies have demonstrated the deposition of fresh material and its rapid consumption one month prior to the first cruise. At LTER, a 1-2 cm thick phytodetritus layer has been observed, but only during the last cruise of the program. DSi concentrations were affected by the seasonal deposition of biogenic particles, down to a depth of 10-15 cm, weakly at PAP and more strongly at LTER, leading to important seasonal variations in DSi benthic fluxes at the two sites. A strong seasonal signal showed up in the solid phase at the two sites, not in concentrations but rather, in the dissolution properties of the opal: following the deposition of fresh particles, significant increases in the apparent solubility, the dissolution kinetics (k) and the degree of non-linearity of k with departure from equilibrium (m) occurred at the two sites. The two sites differed remarkably in that these properties were affected over the 20 uppermost cm of the sediment column at PAP while only the core top seemed affected at LTER. This difference most probably reflected the bio-mixing of fresh diatoms by the benthic megafauna, which had time to occur at PAP but hadn't started by the time the last cruise took place at the LTER site. The benthic megafauna is able to transport rapidly at depth the fresh biogenic particles. The effects of this process, suggested to account for the observations reported herein in terms of BSi dissolution properties, remain to be tested in terms of BSi preservation using non-steady state diagenetic modelling.

OS31N-08 1100h INVITED

Interannual Variability of the Ross Sea Ecosystem: Climatic Forcing of Primary Production and Benthic/Pelagic

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Interannual variability in Southern Ocean polynyas is known to exist from physical oceanographic studies but its impact on primary production and pelagic and benthic ecosystems is relatively unstudied. During the ROAVERRS (Research on Ocean/Atmosphere Variability and Ecosystem Response in the Ross Sea) field program we examined interannual variability in the Ross Sea polynya via extensive sampling in the same region during the same mid-December through mid-January periods of both 1996/97 and 1997/98; and a third time one month earlier during 1998/99. The polynya opened earlier and more extensively during 1996/97 relative to 1997/98. The opening pattern during the third year was intermediate between 1996/97 and 1997/98. During the early summer of 1997/98, the Ross Sea region appears to have been cloudier and the sea ice more snow-covered than during the preceding and following years. There were significant differences between the years in accumulated particulate organic C and N but not in total chlorophyll a. Primary production and the removal of nutrient N, P, and total dissolved CO2 were significantly greater in 1996/97, when more Phaeocystis-associated chlorophyll was observed. Drawdown of Si was significantly higher the second year, in correspondence with pigment and cell count observations of higher diatom abundance. A leading candidate for external forcing of the physical variability associated with reduced productivity through mid-January during 1997/98 is the Southern Oscillation. The months leading up to our 1997/98 field season were characterized by the onset of a large ENSO event with atmospheric anomalies opposite those of the mild La Nina conditions of 1996. Large differences in the 500 mb height field in Amundsen/Bellingshausen Sea between the two years are consistent with Southern Oscillation (SO) anomalies from years past. Enhanced maritime influence over west Antarctica related to the 1997/98 SO excursion appears related to the observed variability in the physical and biological parameters in the Ross Sea polynya. Satellite-based ocean color estimates of primary production suggests that a high productivity event occurred in February, 1998, an apparently unusual feature in the main Ross Sea polynya. Nevertheless, export fluxes based on sediment trapping are lower during 1997/98 than during 1996/97, although not as low as our water column measurements in Dec/Jan suggest. Ultimately, the seafloor is the most reliable deep sediment flux indicator. Benthic respiration rate measurements in the polynya region show substantial interannual fluctuations consistent with the observed variability in net community production. In addition, year-to-year variability in algal community makeup (diatoms versus Phaeocystis) appears to have contributed to a settling flux or organic material with different C/P ratios, thus altering the relative nutrient ratios remineralized into the deep Ross Sea water column. This work suggests that ENSO events may significantly alter the C cycle and ecology of the Ross Sea and likely other coastal Southern Ocean polynyas.

OS31N-09 1130h INVITED

Bathymetric versus oceanographic control of benthic community patterns and processes in the SW Ross Sea, Antarctica

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The availability of organic carbon for consumption by sea floor communities under ice-covered seas is influenced by several factors, including rates of primary production in surface waters, sinking and lateral flux of POC, depth, bathymetric relief, and the near-bottom current field. ROAVERRS (Research on atmospheric variability, and ecosystem response in the Ross Sea) field programs in the SW Ross Sea during the austral spring / summer of 1996-97, 97-98, and 98-99 documented hydrography and primary production in surface waters, sinking particulate fluxes, sea floor community patterns and rates of benthic carbon uptake.

Distribution patterns and rates of carbon uptake by benthic biotic assemblages were compared to the pattern of primary production (indicated by total CO2 deficit) in surface waters and the expected lateral drift of sinking organic debris, as well as the influence of sea floor bathymetry. The abundance of biota with rapid turnover rates (ie. bacteria) was coupled closely to the spring/summer pattern of carbon dioxide drawdown in surface waters. Peaks in bacterial abundance occurred in sediments beneath and down-current from the Ross Sea polynya, which was considerably larger in 1996 than 1997. Patterns of abundance for macrofaunal and megafaunal communities were linked less strongly to interannual variation in carbon input and reflected longer term (multi-year - decadal) integration of carbon availability, though some benthic fauna appear to benefit from higher carbon fluxes via increased growth and reproduction. Benthic megafaunal assemblages were associated more closely with features of seafloor habitat (depth, current speed, seafloor slope) and sediment organics (% carbon, C/N, delta 13C), than with the pattern of polynya formation or primary productivity in the overlying water column. Standing stocks of deposit-feeding species were highest in deep basins in the SW where current speeds are low and organic debris is deposited on the sea floor. Filter-feeding fauna were abundant on shallow banks.

While the level of primary production in surface waters is paramount in determining organic carbon input to Ross Sea benthic communities, the spatial distribution of benthic megafaunal communities mimic more closely the pattern of bathymetry and sediment organic constituents of the seabed. Thus, while benthic megafaunal communities are undoubtedly dependent on primary production in the Ross Sea, "oceanographic control" of benthic communities is masked by the lateral advection and variable deposition of organic material at the seabed, resulting in strong "bathymetric control" over Ross Sea benthos.

OS31N-10 1200h

Ice-Edge Blooms in the Barents Sea

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The generality of the importance of DMSP production and carbon excretion by Arctic phytoplankton through the growth season was tested in the Barents Sea in late winter (March 1998), spring (May 1988) and summer (July 1999). During these cruises we performed a reduced suite of measurements (particulate and dissolved DMSP concentration, chlorophyll *a* and primary production) in surface waters along a transect from Atlantic into Arctic waters, as well as 4 stations with vertical profiles.

The seasonal pattern in particulate and dissolved DMSP concentration is overshadowed by interannual variability when data from the same transect sampled in spring of 1993 and 1998 are compared, especially in open waters or with low ice coverage. Integrated particulate DMSP and chlorophyll *a* concentrations in the euphotic zone (0.1% of surface irradiance) were significantly higher (6-25 μmoles m^{-2} and 4-11 μg m^{-2}, respectively) in 1993 than in 1998 (2-10 μmoles m^{-2} and 1-4 μg m^{-2}, respectively). A similar factor of 2-5 is seen for dissolved DMSP. Within a seasonal cycle, particulate DMSP concentrations in open, surface waters are remarkably similar in late winter (0-16 nM), spring (2-10 nM) and summer (2-8 nM), except for a gigantic pulse of particulate DMSP (140 nM) under the ice in summer at 78° N, obviously much further north than the previous 2 cruises. Dissolved DMSP concentrations are clearly higher in spring than in late winter or summer.

Integrated primary production shows a large seasonal signal with highest values in spring, followed by summer and late winter, as expected. Extracellular carbon production was, on average, not present in late winter, and was 75% and 43% of particulate production in spring and summer, respectively. These results show high extracellular production during the growth season, with higher values in spring.

OS31O HC: 319 B Wednesday 0830h

Stratified Coastal and Estuarine Circulation II

Presiding: **R K Dewey,** University of Victoria**; D L Codiga,** University of Connecticut, Avery Point

OS31O-01 0830h

Across-Channel Tidal Velocity and Axis-Parallel Tidal Convergence in Straight, Weakly-Stratified Estuaries

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Understanding mixing and dispersion in tidal estuaries requires elucidation of across-channel tidal velocity and resulting frontogenesis. One of the simplest cases to consider in better understanding across-estuary tidal velocity is a straight and prismatic, weakly-stratified estuary channel with arbitrary across-channel variation in bathymetry. Analytical solutions are presented here for (i) density-driven, (ii) Coriolis-induced, and (iii) continuity-forced contributions to across-channel tidal velocity. Component (i): Since along-channel tidal velocity amplitude is generally larger over the central deep channel than over marginal shoals, the water column tends to be saltier (or fresher) over the central channel at the end of flood (or ebb). This results in an across-channel density-gradient that drives across-channel velocity and forms tidal fronts along the deep axis of the channel. Analytical solution shows density-driven across-channel tidal currents dominate in small fluvial estuaries (i.e., shallow, narrow channels with strong along-channel density gradients). Component (ii): The earth's rotation results in surface flow to the right of the along-channel tidal current (in the northern hemisphere) with return flow to the left along the bottom. Since the tide tends to turn earlier in the deeper central channel, tidal fronts form around slack water near channel-shoal breaks in topography. Analytical solution shows Coriolis-induced currents dominate in large estuaries (i.e., deep, wide, long channels). Component (iii): Because along-channel tidal velocity is greater over the deep channel than over adjacent shoals, along-channel gradients in depth-integrated velocity are also stronger along the deep channel. Continuity then requires an across-estuary depth-averaged tidal current. Analytical solution indicates continuity-induced across-channel tidal currents dominate in lagoons (i.e., shallow, wide systems with weak along-channel density gradients). Limitations to the above simplified analysis in real estuaries include channel curvature, along-channel bathymetric irregularities, strong stratification, lateral seiching, and time- and depth-dependent stratification and mixing.

OS31O-02 0845h

An Analytical Estuarine Circulation Model in an Arbitrary Bathymetry.

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A linear analytical solution for the local longitudinal velocity was developed to analyze the structure of velocity in an irregular bathymetry. The model was solved assuming a balance between the longitudinal pressure gradient and the vertical friction with a constant eddy viscosity coefficient. The solution is flexible in the sense that there is not restriction in the form of

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