and may operate shared-use scientific instrumentation and equipment on a per-cruise basis. The newest addition to the WHOI fleet, R/V ATLANTIS, was built in 1997 and configured to serve as the tender for the submergence assets of the NDSF. The R/V ATLANTIS has a dynamic positioning system for precise navigation, abundant laboratory space for scientific needs and a fully equipped machine shop. The ALVIN submersible can operate at any depth from the surface to 4,500 meters at speeds of 0-3.4 km/h (0-2.0 knots), and can remain submerged for up to 10 hours during normal operations. The sub normally carries two observers and various internal and/or external instrumentation and tools. It is capable of maneuvering within areas of rugged bottom topography. It can hover at neutral buoyancy in mid-water and/or resting on the bottom to perform scientific and engineering tasks, including still and video photography. It uses its manipulators and storage basket to deploy various scientific tools and to collect samples. It can provide a limited amount of electric and hydraulic power plus data logging capabilities for instruments and equipment not normally part of the submersible. The ALVIN Group is dedicated to the productive execution of submersible scientific programs and is available to provide assistance to the user for program design and execution. The remotely operated vehicles (ROVs) operated by the NDSF include the JASON-MEDEA system, the ARGO II camera sled and the high-frequency deep-towed DSL-120A side-looking sonar. Over the past ten years, research using these vehicles has provided major contributions to the understanding of deep-sea geological, chemical and biological processes in the world oceans. They have contributed to successful deployment of ocean floor observatory monitors and various sensors which seek to understand the biological, geological and geotechnical properties of young crust and provide an ability to make routine time series measurements. These systems are currently undergoing upgrades and new capabilities will provide the scientific community with a 6500m capability and increased power, manipulation, control and sensors in each vehicle. Members of WHOI Marine Operations are available for pre-cruise planning and assistance in innovative uses of the assets at sea. The NDSF is sensitive to the requirements for multi-disciplinary submergence research and strives to provide continuing excellence in support of biological, chemical, geological, and physical oceanography.

**OS42P-10 1605h**

### Scheduling and Planning Processes for the National Deep Submergence Facility

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The adaptability of the National Deep Submergence Facility (NDSF) to a wide variety of science needs is its strength, but this complexity can also confuse and intimidate new users. The NDSF maintains strong science liaison services and provides potential users with assistance throughout the process of cruise planning, proposal preparation, and execution of field programs. Procedures for gaining access to these vehicles are not difficult and potential users are assisted both directly by the NDSF personnel and also through a user group of scientists dedicated to providing the benefit of their experience. A successful mechanism for obtaining feedback between users and operator has been established through the Deep Submergence Science Committee (a UNOLS oversight committee) and the science community. Programs are selected for funding on a competitive basis through various federal funding agencies by standard agency review processes. Costs of the facility assets vary considerably depending on the assets chosen and advice regarding optimal use of the vehicles is discussed in detail with potential users. DSV ALVIN and its support ship R/V ATLANTIS are owned by the U.S. Navy. ATLANTIS is operated under charter agreement with the Office of Naval Research. Operation of the NDSF remotely operated vehicle (ROV) assets can be arranged in a fly-away mode on appropriate vessels within the UNOLS fleet or on commercial vessels or foreign research vessels provided they are suitably equipped. Scheduling of the R/V ATLANTIS is arranged through UNOLS, as is the use of the ROVs on UNOLS ships. Coordination between funding agencies and the UNOLS scheduling process strives to provide the users with the optimal scheduling of the assets in a given year.

**OS42P-11 1620h**

### Deep-sea Biological Research: NOAA and NSF

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The presentation will outline NOAA and NSF programs available for the support of deep sea biological research. A wide diversity of projects are currently supported through programs such as NOAA's National Undersea Research Program and the new Ocean Exploration Program, as well as the NSFs Division of Ocean Sciences and its RIDGE2000 program. These routinely use deep submergence facilities available to the research community. A number of organizations and scientists have considerable experience with these programs and may be useful resources to the broader community in providing advice and perspectives on problems of particular importance in undersea research. The individual National Undersea Research Centers, DESSC the Deep Submergence Science Committee of UNOLS, and the operators of the National Deep Submergence Facility at Woods Hole, are well equipped to advise on issues such as scheduling, assessing the usefulness of manned vs. unmanned vehicles, the most appropriate and available technologies to undertake proposed research projects, and the need for patience.

## OS42Q HC: 319 B Thursday 1330h

## Stratified Coastal and Estuarine Circulation V

***Presiding:*** **C N Flagg,** Environmental Sciences Department, Brookhaven National Laboratory**; G Pawlak,** Department of Ocean and Resources Engineering University of Hawaii

**OS42Q-01 1330h**

### Laboratory Studies of T-S Driven Flows with Partial Mixing: Stommel Transitions, Multiple Equilibrium and Oscillations

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Laboratory experiments show behavior of a basin subjected to thermal and salinity buoyancy fluxes with limited mixing. Two distinct modes of flow have been observed in previous experiments*. The "S-mode" has significant salt stratification and relatively uniform temperatures. Using T as a measure of the temperature buoyancy flux, the "T-mode" develops for greater T. It possesses more rapid speeds and smaller salinity variation and even lower temperature than the S-mode. In box-model theory, hysteresis and discrete jumps (Stommel transitions) are found for the two flow modes as T' is gradually increased. Experiments show a much more limited range of hysteresis but the Stommel transitions are clearly visible. In recent experiments designed to investigate a new box-model theory**, the hysteresis and Stommel transitions are not detected. For small T' oscillations are found and for larger T' the T-mode is found. A simple new theory for oscillations is presented. Some results may apply to polar seas. The halocline present in Arctic and Antarctic regions clearly corresponds to the layers seen in the S-mode. Parameters needed for transition to either an oscillation or to a T-mode are discussed. *J. A. Whitehead, M. L. E. Timmermans, W. Gregory Lawson, S. N. Bulgakov, A. M. Zatarain, J. F. A. Medina & J. Salzig , Laboratory Studies of Thermally and/or Salinity-Driven Flows with Partial Mixing: Part 1 Stommel Transitions and Multiple Flow States, JGR, (In Press).

** Whitehead, 2000 Stratified Convection with Multiple States. Ocean Modelling, 2, 109-121 (2000).

**OS42Q-02 1345h**

### Reversing Circulation Patterns in a Tropical Estuary

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Four shipboard surveys were carried out during the spring and neap tides of the dry and wet seasons in a tropical estuary of Central America in order to determine a) whether circulation patterns persisted with season, and b) whether the intraseasonal patterns changed from spring to neap tides. Water velocity profiles were measured along four transects in the Gulf of Fonseca, which communicates with the Pacific Ocean and fulfills the definition of an estuary. Water density profiles were obtained at the end of each transect repetition and also in the deepest part of each transect. During the dry season the Gulf of Fonseca showed a circulation pattern consistent with that of an inverse estuary. Net outflow of saltier gulf waters appeared near the bottom in the deepest part of the gulf and throughout the water column over the right (looking seaward), whereas net inflow from the adjacent Pacific Ocean developed near the surface and over the left. This circulation pattern was likely a consequence of large evaporation rates and coastal forcing. In contrast, during the wet season the gulf exhibited a typical estuarine circulation owing to increased precipitation and river discharge rates. The contrasting circulation patterns of both seasons were better developed during neap tides than during spring tides. The transverse dynamics of the system seemed to be more ageostrophic during spring tides than during neap tides as evidenced by more robust transverse flows. Therefore, advection and friction should have been more relevant to the transverse dynamics during spring tides than during neap tides.

URL: http://www.ccpo.odu.edu/~arnoldo/fonseca/fonseca.htm

**OS42Q-03 1400h INVITED**

### Buoyancy Forced Exchange Flow Over a Sill

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We consider the flow in a semi-enclosed basin, subjected to a destabilizing surface buoyancy flux and separated from a large adjoining reservoir by a sill. Convective mixing in the basin produces a lateral density gradient between the basin and reservoir, which drives an exchange flow over the sill.

A series of numerical experiments was conducted to quantify the energetics of the flow within the basin, that is, the amount of kinetic and potential energy stored within the basin and the rate at which these quantities are transported to and from the reservoir via the exchange flow over the sill. The numerical experiments were formulated to mimic and extend previous laboratory studies with the objective of developing scaling laws for the energy transfers in terms of the externally imposed flow parameters.

Volume and boundary integrated energetics were computed for both steady and time-varying regimes. In the steady-state limit, the rate of energy flux through the surface is balanced by dissipation within the basin and advection of potential energy over the sill and into the reservoir. The analyses focus primarily on this latter quantity because it is closely related to the outflow density and volume transport in two-layered exchange flows.

A second set of experiments was conducted to quantify the transient energetics in response to a sudden change in the surface forcing. These results, combined with a linear impulse-response analysis, were used to derive a general expression describing the advection of potential energy across the sill for periodically forced flows. The analytical predictions are shown to compare favorably with directly simulated flows and to be reasonably consistent with limited field observations of the seasonal variability through the Strait of Bab al Mandab.

THU

### OS42Q-04 1415h

## Frontal Controls on the Cross-sill Exchange of a Broad Fjord

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As part of a collaborative European project entitled Oceanographic Applications to Eutrophication in Regions of Restricted Exchange (OAERRE), we are examining the controls of horizontal and vertical exchange in multiple fjordic systems, including the Clyde Sea located on the southwest coast of Scotland. The Clyde Sea is a wide ($\sim$ 20 km) and deep (up to 200 m) fjord, separated from the North Channel of the Irish Sea by a broad sill of depths reaching 40 to 50 m. Along the sill boundary, a strong density front separates the stratified Clyde Sea basin from the tidally mixed North Channel. This front is thought to exert considerable control on the basin flushing. Using a week-long time series of moored and shipboard observations of current and hydrography concentrated on the sill, we observe considerable spatial variability in both the tidal and subtidal flows. Tidal currents, ranging between 10 and 30 cm/s, are directed across-sill at the northern and southern flanks while directed along the sill bathymetry in the central portion. Subtidal currents exhibit more complex time varying lateral and depth-dependent structures. During the period of observations, across-sill subtidal currents are largely directed out of the estuary over the central portion of the sill, but exhibit a developing two-layer circulation over the northern and southern reaches. Alongsill currents are generally weak on either flank, whereas a depth-dependent alongsill current structure emerges over the center of the sill. We propose the variability observed in the sill's subtidal current structure and cross-sill exchange depends in part on the relative position of the density front. Wind forcing is considered.

### OS42Q-05 1430h

## Observations of a Seasonal jet-like Circulation at the Central North Sea Cold Pool Margin

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In summer thermal stratification dominates the structure of much of the European continental shelf seas, isolating pools of cold dense bottom water below the thermocline. Adjacent to these areas are regions where tidal energy dissipation is sufficient to maintain mixing of the water column against the input of surface buoyancy through solar heating. The boundary between the areas represents a transitionary region of strong horizontal density gradients forming both surface and bottom fronts. An increasing body of evidence demonstrates that it is the bottom density fronts that are dynamically significant. Such fronts are persistent and remain geographically fixed because of the stabilising influence of associated bottom slopes and tidally generated bottom friction.

In the central North Sea a series of cruises using a combination of observational techniques (high resolution towed undulating CTDs using Scanfish, conventional CTDs, ship board ADCP and satellite tracked drifting buoys) has produced a detailed and consistent description of the circulation dynamics of the region. Bottom fronts extend continuously along the 40 m contour from the Firth of Forth to the eastern end of the Dogger Bank and then on to the edges of the Skaggerak. Present from May to November, they represent the dominant transport pathway within the region, with intense ($>$ 20 cm/s) and narrow ($<$ 20 km) jet-like flows.

These results highlight that it is crucial to consider the appropriate time scales and processes for management of the shelf seas. Ultimately, if models are to become reliable and believable management tools for biological and contaminant issues they must accurately represent temperature, salinity and flow fields. This can only be achieved by rigorous comparison with appropriate data and with the inclusion of the best possible forcing for models.

### OS42Q-06 1445h

## A Scaling Analysis for the Interaction between a Buoyant Coastal Current and the Continental Shelf: Experiments and Observations

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Buoyant plumes are a common occurrence in the worlds coastal oceans. Many of these buoyant outflows are influenced by rotation to the degree (low Rossby number) that they form coastal currents. Such currents flow along the shelf in the direction of Kelvin wave propagation, and have been observed to stretch hundreds of kilometers, while remaining only tens of kilometers in width. These flows are of considerable interest due to their resistance to mixing offshore, combined with their considerable ability to transport material (e.g. pollutants, biological material, etc.) away from a river or estuary mouth.

We present a parameter space that describes the interaction between a buoyant coastal current and the coastal bathymetry it encounters. Based upon three plume parameters, (Flow rate, Q; reduced gravity, g; and Coriolis parameter, f) and two topographic parameters (ambient ocean depth, H; and bottom slope, a) we scale the magnitude of bottom interaction between the buoyant coastal current and the topography, as well as the effects. Data is presented that supports the parameter space scaling. Measurements of downshelf and across-shelf evolution of experimental coastal currents are presented. Additionally, density cross-sections through a number of experimental plumes are shown. Experimental observations confirm that the dynamics of coastal current evolution can be predicted by the proposed parameter space. The proposed parameter space is also used to examine past field observations.

### OS42Q-07 1520h

## A Scaling for Tidal Estuary-Shelf Interaction Zones

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An estuary can amplify tides over the adjacent shelf. The objective is to characterize the intensity and extent of this estuarine influence. In pursuit of this goal, a tidal estuary-shelf interaction index ($T_i$) is defined as the ratio of the estuary-induced component of the tidal velocity amplitude over the ambient shelf amplitude. This non-dimensional index rates estuary influence relative to shelf influence. The characteristic ambient shelf velocity amplitude is constant; it can be taken from observations or shelf tidal theory. The estuary-induced component ($u_e$) is estimated as the mouth tidal volume flux divided by the cross-sectional area of the arc bounding a control volume of radius r. The dependence of $u_e$ on r causes $T_i$ to decay with increasing radial distance from the mouth. This decay in estuarine influence is due to radial spreading and increasing depth.

Interaction zone intensity is quantified by the value of $T_i$ at the mouth; where estuarine effects are largest. Extent is rated by defining an interaction radius. This radius is located where $T_i = 1$; it bounds the area over which estuarine influence is stronger than the shelf contribution.

Scaling results using the $u_e$ estimate and planar bathymetry compare well with the tidal flow field adjacent to the Delaware Bay. Tidal interaction zones for several other estuaries also are characterized. The interaction index $T_i$ and the interaction radius prove useful in classifying these estuaries and estimating their impact on tidal mixing levels.

### OS42Q-08 1535h INVITED

## Estuarine Circulation, Stratification and Mixing in a Variety of Flow Regimes

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Extensive variability-resolving observations of turbulent mixing and its "parent flow" have been made in various locales. Now what? Can we generalize some of the findings? This work in progress compares observations from the tidally stirred estuaries of the Fraser River, the Hudson River, San Francisco Bay, and from Liverpool Bay, a "region of fresh water influence." Some similarity and, more importantly, differences in the tidal and fortnightly variability of flow, stratification and mixing are discussed. The delicacy of the interplay between mixing, stratification and estuarine circulation, and its variations between different locales and regimes challenges our comprehension and our ability to model such flows.

### OS42Q-09 1550h

## Mixing Processes in an Estuarine Embayment: Beatrix Bay, New Zealand

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This presentation describes mixing and turbulence in a stratified estuarine embayment using parameters derived from measurements of temperature gradient microstructure. The field location was a flat-bottomed embayment, approximately 5 km in diameter, that was subject to reasonable stratification and weak velocity shear. Dissipation levels and turbulence length scales in the surface mixing layer, the pycnocline, the fluid interior and the benthic boundary-layer were measured and compared with expectations based on previous work in different systems. The observations highlight a number of points. (1) The lack of strong tidal flows means that buoyancy effects in estuarine embayments are more important than in the estuary-proper. (2) The combination of reduced tidal mixing and interacting thermo-haline stratification suggests the importance, in certain situations, of diffusive-convection. (3) Despite the shallow depths ($<$ 40 m) a number of hydrodynamic regimes exist adjacent to one another vertically, resulting in a highly variable distribution of turbulence properties.

### OS42Q-10 1605h

## Turbulent Characteristics of Tidal Flows in the Vicinity of the Chesapeake Bay Turbidity Maximum

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Data were collected near the turbidity maximum of the Chesapeake Bay for approximately twelve hours on sampling days in July and October 2001 using a 1200 kHz RDI ADCP (Acoustic Doppler Current Profiler) and a PME SCAMP (Self Contained Autonomous MicroProfiler). The ADCP was mounted to the vessel at the bow and the SCAMP was deployed off the stern. An anchor position in approximately 12 meters of water was held for the entire sampling period. The SCAMP was configured to operate in a free-rise mode and during the SCAMP casts the vessel was allowed to drift with the current in order to remain close to the SCAMP during data acquisition. ADCP measurements were collected continuously in beam coordinates at two-second intervals into 0.25 meter bins for the duration of each cast. The vessel was repositioned at the end of each cast and the maximum excursion of 200 meters occurred during maximum ebb tide. There were 58 SCAMP casts in July and 54 in October. ADCP data were taken for the duration of sampling on both sampling days.

ADCP measurements in beam coordinates and ADCP backscatter measurements are used in an attempt to infer turbulent properties of the flow including Reynolds stress and eddy viscosity. The fast response temperature sensors on the SCAMP are used to determine the dissipation of turbulent kinetic energy by Batchelor curve fitting. The independent turbulence values from both instruments are compared and gradient Richardson numbers are calculated from the ADCP velocity shear and the density measurements from the accurate temperature and conductivity sensors on the SCAMP.

### OS42Q-11 1620h

## Comparison of Turbulent Dissipation Rates in Different Flow Environments in Chesapeake Bay, USA

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Recent breakthroughs in the accessability of affordable, accurate velocity sensors with high temporal and small spatial resolution have made measurements from which turbulent properties of a flow can be calculated much more available. Even more recent has been the commercial availability of affordable temperature micro-structure profilers (MSP). From these instruments the dissipation rate of turbulent kinetic energy,$\epsilon$ ,can be estimated. $\epsilon$ is a property of particular importance, since it equals the amount of energy input at larger scales and also reveals important information about small scale properties such as shear and the Kolmogorov length scale. From 1998 to 2001 field studies were carried out in Chesapeake Bay deploying a 5 megahertz Acoustic Doppler Velocimeter (ADV) at three sites in three different flow environments: 1) a wave dominated surface boundary layer, 2) a shallow site where the measurement location was affected by both surface waves and the mean flow impinging on the bottom, and 3) a mean flow dominated site within the bottom boundary layer that was not affected by surface wind waves. In addition a temperature MSP and a 10 megahertz ADV on a profiling rig were used over a tidal cycle, concurrent with the deployed ADV measurements for site (3). Statistical differences in the nature of $\epsilon$ were observed in the three environments, due to the stochastic nature of wind waves versus the periodic nature of the predominately semi-diurnal tidal flows. $\epsilon$ values from the temperature MSP are compared to those calculated from the ADV data. Because the ADV data represent much longer temporal averages than those from the MSP these comparisons help reveal the intermittency of $\epsilon$.

### OS42Q-12 1635h

## Mixing Levels and Mechanisms in the Main Basin of Puget Sound

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The dynamics of fjords are often simplified by assuming all of the mixing takes place over the sills and that the reaches, or basins, are relatively quiescent and simply advect water that obtains its properties at the sills. Microstructure measurements and current velocity data collected in the Main Basin of Puget Sound, Washington, however, show that it does not fit the "advecting reach" simplification of fjord dynamics. Although mixing levels in the Main Basin are two to three decades lower than observed and inferred levels over the Narrows and Admiralty Inlet sills, our measurements of diapycnal diffusivity, $K_\rho$, in the Main Basin are one to two decades greater than typical values found at the open-ocean thermocline. Additionally, the subthermocline stratification of the Main Basin is similar to the canonical stratification, $N_o$ (3 cycles/hour), of the open-ocean thermocline. This implies that significant diapycnal mixing of temperature and salinity gradients, and potentially oxygen and nutrient concentrations, is occurring in the Main Basin. We observed mixing events largely dominated by mid-depth density intrusions and low-mode internal tides. These observations suggest that there are at least several possible mechanisms for energy to propagate away from the dynamically active sills and result in higher than expected mixing levels in the fjord basins.

### OS42Q-13 1650h

## A Relationship Between Finestructure and Turbulent Flux on the Continental Shelf

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The possibility of a relationship between turbulent buoyancy flux and density gradient within a fluid of nonuniform density gradient has been hypothesized and investigated in the literature over the past three decades. Any such relationship would serve to either intensify, eliminate, or have no effect on the density gradient structure. We have field evidence from a continental shelf environment that a relationship which would intensify density finestructure can occur, at least under the conditions during our study.

Conductivity microstructure, water velocity, and stratification were measured during a tow-yo transect near the New England shelf/slope front in early August 1997. Estimates of $\chi$, the rate of dissipation of temperature variance, were computed from the conductivity data with vertical resolution of 0.3 m. Relationships between $\chi$ and shear, temperature gradient, buoyancy frequency ($N$) and gradient Richardson number ($Ri$) were explored in waters exhibiting variable density gradient, $N$ ranging from 5 to 40 cph. An average $\chi$ value was computed for data grouped into five classes of local mean temperature gradient ($d\bar{T}/dz$), and was proportional to $d\bar{T}/dz$ to the 0.7 power, which is consistent with diapycnal thermal eddy diffusivity $K$ being proportional to $(d\bar{T}/dz)^{-1.3}$ if one invokes the Osborn-Cox model. No correlation between $K$ and $Ri$ (computed at 4-meter vertical scale) was observed, so that systematic inhomogeneous large scale forcing was not responsible for a spurious correlation of $K$ and $d\bar{T}/dz$. Water mass salinity characteristics in the area make this $K$ to $d\bar{T}/dz$ relationship equivalent to the steep inverse relation $K = 10^{-10}N^{-3.3}$, with $N$ in radians/s and diffusivity in $m^2/s$. A different fit, $K = 2 \times 10^{-9}N^{-2.5}$, results if one questionable data ensemble is eliminated. These relationships are not expected to hold beyond the investigated range of $N$. These are not intended to be universal formulae, but are meant to describe the conditions we encountered. Possible causes and consequences of these relationships will be discussed, with one consequence being an interesting restriction of flux. An interpretation of the cause is that the lower-$N$ layers in this shelf area are more prone to instability of large-scale shear than the intervening interfaces, with the subsequent greater energy dissipation in the layers leading to higher buoyancy flux $KN^2$ in the layers than in the interfaces.

# OS42R HC: 316 C Thursday 1330h

## Transport and Transformation of Biogeochemically Important Materials in Coastal Waters V

*Presiding:* **J L Largier,** Scripps Institution of Oceanography**; J A Barth,** College of Oceanic and Atmospheric Science

### OS42R-01 1330h

## Field Study of Possible Cross-Shelf Transport Mechanisms for a Treated Wastewater Plume Discharged on the Continental Shelf off Huntington Beach, CA

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Preliminary results from an extensive field study that took place during May - Oct. 2001 on the San Pedro shelf off Huntington Beach in southern California will be presented. The Orange County Sanitation District brought together a multi-agency consortium in an effort to clarify the role played, if any, by their outfall in the 1999 - 2001 summer beach closures due to bacterial contamination. The sampling strategy was designed to address a hypothesis that the normally subsurface sewage plume, which is discharged 8 km offshore, is transported shoreward by internal waves during the stratified summer season, and then is introduced into the surfzone through an interaction with the ocean discharge from a nearby power plant. The study is also meant to address other surface, subsurface, and benthic mechanisms that could conceivably transport the treated wastewater to shore.

This talk will concentrate on the physical, chemical and microbiological data collected from moorings, bottom tripods, vertical profiling stations, tow-yos and beach samples. Five 48-h and one 24-h multi-ship surveys were conducted, measuring velocity, temperature, salinity, fluorescence, light transmission, nitrate, ammonium and bacteria from the surfzone to the shelf break. At 13 locations in depths from 10-200 m, surface and subsurface moorings and bottom tripods were deployed for a 4-month period starting in mid-June to collect temperature, salinity, velocity, light transmission, optical backscatter and sediment trap data. Additional moored velocity and temperature measurements were made over a shorter period of time in the very nearshore zone. Surf-zone temperature and bacteria were sampled once per day throughout the study period, and at hourly intervals during the cruise times. Additional time series data collected include meteorological variables, surface waves, and tidal heights.

### OS42R-02 1345h

## Long and Short Term Variability in Ocean Water Quality at Huntington Beach, California

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Ocean water quality at Huntington Beach varies over time scales that span at least seven orders of magnitude, from minutes to decades. Natural and anthropogenic factors apparently responsible for this variability include nearshore mixing phenomena, sunlight intensity, the phase of the moon, seasonal variations in rainfall, El Niño events, and changes in wastewater treatment and disposal practices. Ocean water quality at Huntington Beach has not significantly worsened since 1958, even as the surrounding area has undergone significant urbanization. The variability documented in this presentation calls into question national protocols for the monitoring and reporting of ocean water quality.

### OS42R-03 1400h

## Transport of Organochlorines Among Various Environmental Compartments in the Coastal Ocean off Southern California

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Dichlorodiphenyltrichloroethane and its metabolites (DDTs) and polychlorinated biphenyls (PCBs) were discharged into the coastal waters off southern California mainly via sewage outfalls. Notably, sediments on the Palos Verdes Shelf adjacent to the outfall system of the Joint Water Pollution Control Plant (JWPCP; operated by the County Sanitation District of Los Angeles County) are known to contain highly elevated levels of DDTs (relatively low level of PCBs also noticed). Since the discharge of DDTs and PCBs via sewage outfalls was banned in early and late 1970s, respectively, concentrations of DDTs and PCBs in wastewater effluents have continuously declined and become virtually non-detectable presently. However, DDTs and PCBs (especially DDTs) remain widely distributed in the Southern California Bight (SCB), even in areas far away from any known points of historical discharge. One hypothesis attributes the widespread distribution of DDTs and PCBs to resuspension and dispersal of these compounds from previously contaminated sediments to remote areas.

One way to determine whether DDTs and PCBs are transported away from contaminated areas is to examine the thermodynamics that dictates the redistribution of DDTs and PCBs. To accomplish this, we measured DDTs and PCBs in various interacting environmental compartments in three nearshore locations of the SCB with different levels of contamination. We found that DDTs and PCBs were widely distributed in the overlying water, sediment, polychaetes, and hornyhead turbot liver and muscle tissues. The Students t tests indicated that the measured partitioning coefficients between overlying water and other phases at a heavily contaminated location were significantly greater than what were predicted by the equilibrium partitioning

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