centimeters. The interannual part of this variability is now believed to be crucial during the onset phase of an El Nino event. The core of the problem is thus to determine whether or not accurate sea level observations can be useful to estimate the salinity variability when the temperature counterpart can be deduced from in-situ measurements. This will be illustrated by considering an independent source of information to evaluate the level of accuracy. By combining temperature observations from the TAO/TRITON array and an estimate of the salinity variability from an indirect approach, dynamic height anomalies are at first used as a basis to validate the measurements of the Jason-1 mission at the scale of the equatorial Pacific Ocean (8N-8S; 137E-80W). Preliminary comparisons show a good agreement in terms of variability with a RMS difference of about 3-4 cm. It is shown moreover that these interim Jason-1 observations present a similar performance compared to the TOPEX/Poseidon products or even better. This gives us confidence to separate the respective contribution of the thermal and salinity fields in the sea level anomalies. By using in situ measurements from a few sites that are instrumented with several salinometers at depth, we expect to study the relationships between the salinity variability such as salinity barrier layer and sea surface salinity and its signature in sea surface height.

OS51C-12 1135h

OSCAR (Ocean Surface Currents Analysis - Real time): An Operational Resource for Various Maritime Applications and El Niño Monitoring in the Tropical Pacific Using Jason-1 Data

Gary S E Lagerloef[1] (206-726-0501; lager@esr.org)

Gary T Mitchum[2] (727-553-3941; mitchum@marine.usf.edu)

Fabrice Bonjean[1] (206-726-0501; bonjean@esr.org)

Robert Cheney[3] (301-713-2857; Robert.Cheney@noaa.gov)

[1]Earth and Space Research, 1910 Fairview Av E Suite 102, Seattle, WA 98102, United States

[2]Department of Marine Science University of South Florida, 140 Seventh Ave. So., St. Petersburg, FL 33701, United States

[3]Laboratory for Satellite Altimetry, NOAA, E/RA31, SSMC3, Room 3620 1315 East-West Highway, Silver Spring, MD 20910-3282, United States

OSCAR is a pilot processing system and data center delivering tropical Pacific Ocean surface velocity fields via the Internet. Surface currents are computed from satellite altimeter and vector wind data using methods developed during the Topex/Poseidon altimeter research mission. OSCAR is a transition to operational oceanographic applications using Jason-1 altimeter data. The various uses include large scale climate diagnostics and prediction, fisheries management and recruitment, monitoring debris drift, larvae drift, oil spills, fronts and eddies, plus opportunities for search and rescue, naval and maritime operations. OSCAR provides velocity maps updated on a weekly basis at 1 degree resolution. This is made possible by (1) the rapid availability of Jason-1 Interim Geophysical Data Records (IGDRs) within 2-3 days delay from the time of satellite measurement, and (2) the fact that Jason-1 IGDR data approach the accuracy of scientific Topex/Poseidon and Jason-1 altimeter Geophysical Data Records (GDRs) which are generally delayed one to two months.

These velocity fields have been particularly useful in monitoring the recent evolution of ENSO conditions. The ten-year Topex/Poseidon record indicates that eastward equatorial surface velocity anomalies lead the Niño SST anomalies by about three months. Monthly maps have been produced for the NOAA/NCEP Climate Diagnostics Bulletin (CDB) using Topex/Poseidon IGDRs from January 2001 through June 2002, and Jason-1 IGDR data thereafter. Eastward current anomalies associated with the recent SST warming have been prevalent much of the time from early summer 2001 to the present. An assessment of the tropical Pacific surface circulation anomalies through November 2002 will be presented using the most recent Jason-1 measurements.

OS51C-13 1150h

Jason-1 Science Data Distribution

Nicolas Picot[1] (33-61-283-253; Nicolas.Picot@cnes.fr)

Kelley Case[2] (818-354-5870; Kelley.E.Case@jpl.nasa.gov)

[1]CNES, 18, avenue Edouard Belin, Toulouse 31401, France

[2]JPL/Caltech, 4800 Oak Grove Dr., Pasadena, CA 91109, United States

The Jason-1 altimetric satellite, launched December 2001, continues the work of the highly successful, on-going, TOPEX/POSEIDON satellite in mapping the global sea surface topography. These data will extend the high accuracy sea surface height data set, which is used by oceanographers, climatologists and other scientific and commercial users.

The CNES AVISO, the French multi-satellite databank dedicated to space oceanography, and the NASA Physical Oceanography Distributed Active Archive Center will distribute these data to the science community.

We present the following Jason-1 products and distribution methods that will be made available: near-real-time operational sensor data record (OSDR), interim geophysical data record (IGDR), geophysical data record (GDR) and higher level products, such as sea surface height anomaly products and quick-look browse images.

OS51D MCC: 104 Friday 0830h

Quantitative Developments in Coastal Oceanography I

Presiding: **K Brink,** Woods Hole Oceanographic Institution**; E Thornton,** Naval Postgraduate School**; J Barth,** Oregon State University

OS51D-01 0830h INVITED

On the process of upwelling: Progress from Sverdrup to Allen

Robert L Smith[1] (541.737.2926; rsmith@coas.oregonstate.edu)

Adriana Huyer[1] (541.737.2108; ahuyer@coas.oregonstate.edu)

[1]Oregon State University, College of Oceanic Atmospheric Sciences, Corvallis, OR 97331-5503, United States

Sverdrup (1938), in a paper entitled "On the process of upwelling", described observations made during three cruises off southern California in the spring of 1937 and noted that "it does not seem feasible to make the described conditions the subject of a mathematical analysis". Sverdrup expressed the hope that "in the future it will be possible to undertake special series of observations during periods of upwelling in order to obtain better knowledge of the phenomenon and to answer many questions which now must be left open". It would be more than thirty years before "special series of observations" were made to study coastal upwelling. Some thirty years ago the first session on "Upwelling and coastal oceanography" was scheduled at an AGU meeting: progress in understanding upwelling had finally picked up where Sverdrup had left off and it continues today with GLOBEC and CoOP studies. It is not hyperbole to say that for more than 30 years John Allen has been "instrumental" in our progress in understanding the processes of coastal upwelling in both the mathematical analysis of ideas and the quantitative analyses of observations. We nostalgically recount some steps in the development of our understanding of coastal upwelling: from coastal jets through coastal trapped waves to the coastal transition zone.

OS51D-02 0850h INVITED

Progress in Upwelling Research: Ecosystem Modeling From CUEA to GLOBEC

Richard T. Barber[1] (252-504-7578; rbarber@duke.edu)

Richard C. Dugdale[2] (415-338-3518; rdugdale@sfsu.edu)

[1]Duke University Nicholas School of the Environment and Earth Sciences, 135 Duke Marine Lab Road, Beaufort, NC 28516-0721, United States

[2]San Francisco State University Romberg Tiburon Center, PO Box 855, Tiburon, CA 94920, United States

Ecosystem modeling of coastal upwelling systems began with a pulse of small but intense effort in the late 1960s, just when John Allens oceanographic career was taking shape. This presentation tracks the remarkable parallel evolution of the physical modeling and food web modeling of coastal upwelling. The Coastal Upwelling Ecosystems Analysis (CUEA) project provided Allen, a physical oceanography purist, with an early and sometimes uncomfortable association with many biologists and fisheries scientists. As the decades unfolded, Allen was more exposed to both biologists and biology in the interdisciplinary milieu that characterizes oceanography at Oregon State University. This exposure helps explain Allens role in the Global Ecosystem Dynamics (GLOBEC) project. Both guarding the flame and encouraging others to be warmed by it, he maintains the rigor of the core physics while enabling other disciplines to use the physical model. We recount some of the intellectual advances that have characterized the parallel and sometimes convergent evolution of physical and biological upwelling modeling.

OS51D-03 0910h INVITED

Coastal Meteorology and Wind-Forced Coastal Ocean Currents

R M Samelson (541 737-4752; rsamelson@coas.oregonstate.edu)

COAS, Oregon State University, 104 Oc Adm Bldg, Corvallis, OR 97331-5503, United States

The work of John S. Allen and others has established that coastal winds are a primary forcing agent for coastal ocean currents. In the last several decades, considerable progress has been made in the observation and analysis of coastal wind fields. For many years, information on coastal winds was limited to point measurements from coastal stations and moored buoys, supplemented by ship and aircraft observations, and products derived from large-scale atmospheric pressure analyses. The limitations of these characterizations for estimating wind stress over the U.S. west-coast shelf have been dramatically illustrated by thorough comparisons of the various estimates, and by the results of focused observational programs in the coastal zone. Recently, wind stress fields measured by satellite scatterometers and derived from mesoscale atmospheric models have become available. The availability of these fields offers exciting new opportunities, and is leading to new advances in understanding, but important challenges and uncertainties remain. These uncertainties have implications for the future of coastal ocean modeling.

OS51D-04 0930h INVITED

Offshore Ekman Transport and Ekman Pumping off Peru During the 1997-1998 El Nino

David Halpern (818-434-3762; david.halpern@jpl.nasa.gov)

Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109, United States

Satellite ocean vector wind measurements are used to describe onshore-offshore Ekman transport and Ekman pumping/suction (i.e., downward/upward velocity) in the coastal ocean at 15S off Peru, where upwelling is the dominant physical process. Normal and El Nino conditions are defined for May 1992 - April 1997 and May 1997 - May 1998, respectively. During normal conditions, both Ekman suction and offshore Ekman transport produced upwelling. During the El Nino, the May-August speed of Ekman pumping was nearly 4 times larger than the normal speed of Ekman suction and offshore Ekman transport nearly doubled. The strong Ekman pumping may be the source for the deepened coastal thermocline during El Nino, although the evidence is not conclusive because of the absence of in situ observations.

OS

OS51D-05 0950h INVITED

The Baroclinic Instability of Time Dependent Zonal Flow.

Joseph Pedlosky (508-289-2534; jpedlosky@whoi.edu)

Woods Hole Oceanographic Institution, Woods Hole Oceanographic Institution Physical Oceanography Dept., MS21, Woods Hole, MA 02543, United States

The baroclinic instability of a zonal current on the beta plane is studied in the context of the two-layer model on the beta plane when the shear of the basic current is a periodic function of time. The basic shear is contained in a zonal channel and is independent of the meridional direction. The instability properties are studied in the neighborhood of the classical, steady shear, threshold for marginal stability. It is shown that the linear problem shares common features with the behavior of the well-known Mathieu equation. That is, the oscillatory nature of the shear tends to stabilize an otherwise unstable current while; on the contrary, the oscillation is able to destabilize a current whose time-averaged shear is stable. Indeed, this parametric instability can destabilize a flow that at every instant possesses a shear that is sub-critical with respect to the standard stability threshold. This is a new source of growing disturbances. The nonlinear problem is studied in the same near neighborhood of the marginal curve. When the time averaged flow is unstable the presence of the oscillation in the shear produces both periodic finite amplitude motions and aperiodic behavior. Generally speaking, the aperiodic

behavior appears when the amplitude of the oscillating shear exceeds a critical value depending on frequency and dissipation. When the time averaged flow is stable, i.e. sub-critical, the presence of finite amplitude aperiodic motion occurs when the amplitude of the oscillating part of the shear is large enough to lift the flow into the unstable domain for at least part of the cycle of oscillation. A particularly interesting phenomenon occurs when the time averaged flow is stable and the oscillating part is too small to ever render the flow unstable according to the standard criteria. Nevertheless, in this regime parametric instability occurs for ranges of frequency that expand as the amplitude of the oscillating shear increases. The amplitude of the resulting unstable wave is a function of frequency and the magnitude of the oscillating shear. For some ranges of shear amplitude and oscillation frequency there exist multiple solutions. It is suggested that the nature of the response of the finite amplitude behavior of the baroclinic waves in the presence of the oscillating mean flow may be indicative of the role of seasonal variability in shaping eddy activity in both the atmosphere and the ocean.

OS51D-06 1010h INVITED

Separation of an Advectively Trapped Buoyancy Current at a Bathymetric Bend

David C Chapman (508-289-2792; dchapman@whoi.edu)

Woods Hole Oceanographic Institution, MS21, Woods Hole, MA 02543, United States

The coastal current system along the east coast of North America, from the Labrador Shelf to Cape Hatteras, must negotiate complex bathymetry with numerous sharp bends and large cross-shelf channels. The behavior of these shelf currents is studied here using an advectively trapped buoyancy current (ATBC) model, in which a coastal buoyancy current on a sloping bottom forms a surface-to-bottom density front that becomes trapped along an isobath by offshore advection of buoyancy in the bottom boundary layer. Alongfront flow is concentrated in a nearly geostrophic surface-intensified frontal jet. Trapping occurs where the cross-shelf bottom velocity vanishes on the shoreward side of the front, thus terminating offshore buoyancy advection and causing the bottom boundary layer to detach and flow upward along frontal isopycnals.

The dynamics of an ATBC at a sharp bend in bathymetry and at a cross-shelf channel are investigated using a primitive-equation numerical model, focusing on the separation of the frontal jet from the topography. The response depends on the relative size of the buoyant inflow that creates the ATBC and a weak alongshelf background current that is typically imposed to ensure the downstream propagation of the buoyant inflow. With no background current, the ATBC separates at either the single bend or the channel, regardless of the strength of the buoyant inflow. With a background current, the ATBC follows the isobaths around the bend until the bottom velocity parallel to the front vanishes, after which the frontal jet separates and flows freely away from the topography, while the foot of the front remains attached near the trapping depth. The separation point is highly sensitive to the magnitude of the background current, with changes of a few cm/s having a major impact on the response. Unlike most geophysical flows, the separation process is basically linear and does not require large nonlinear inertial contributions to the momentum balances. The model suggests that substantial losses of buoyant Labrador shelf water are likely to occur at the southern tail of the Grand Banks, and that ambient/offshore currents probably control the penetration and cross-over of the shelfbreak front at the Northeast Channel.

OS51D-07 1050h

A Multi-System Investigation of Mixing, Circulation and Productivity at the New England Shelfbreak Front.

Robert W. Houghton[1] (1-845-365-8328; houghton@ldeo.columbia.edu); Burke Hales[2] (1-541-737-8121; bhales@oce.orst.edu); Dave Hebert[3] (1-401-874-6610; hebert@gso.uri.edu); John Marra[1] (1-845-365-8891; marra@ldeo.columbia.edu); Mark Prater[3] (1-401-874-6512; m.prater@gso.uri.edu); Robert D. Vaillancourt[1] (1-845-365-8549; vailanc@ldeo.columbia.edu); Laura Prieto[1] (1-845-365-8449; pgalvez@ldeo.columbia.edu); Leah Bandstra[2] (1-541-737-9269; lbandstr@coas.oregonstate.edu); Paul Covert[2] (1-541-737-3649; pcovert@coas.oregonstate.edu)

[1]Lamont-Doherty Earth Observatory of Columbia University, 61 Route 9W, Palisades, NY 10964, United States

[2]College of Oceanic and Atmospheric Sciences, Oregon State University, 104 Ocean Admin. Bldg., Corvallis, OR 97331, United States

[3]Graduate School of Oceanography, University of Rhode Island, South Ferry Road, Narragansett, RI 02882, United States

We have just concluded a field experiment to investigate the role of mixing and secondary circulation in maintaining productivity at the New England shelfbreak front. The experiment combined the technologies of a purposeful dye tracer, multiple isopycnal (COOL) floats to tag the horizontal motion of the dye and measure the diapycnal velocity (which is directly related to the divergence of density flux), and a pumping SeaSoar towed vehicle with an attached microstructure instrument resulting in an oceanographic dataset that optimized sampling resolution and spatial coverage at the meso-scale. Instrumentation mounted on the SeaSoar provided high resolution in-situ measurements of light backscattering, attenuation, chlorophyll fluorescence, temperature, salinity, pressure and PAR. In addition, the pump on the SeaSoar supplied a stream of seawater for a multitude of biological and chemical parameters in the ship's laboratory. These include analysis of discretely captured samples for chlorophyll a, particulate carbon and nitrogen, PvsE response and variable fluorescence using a Pulse Amplitude Modulated Fluorometer. The pumped seawater stream also enabled continuous shipboard measurement using instrumentation too large or sensitive to be placed on the SeaSoar body, such as variable fluoresence using a Fast Repetition Rate Fluorometer, light absorption of total and dissolved seawater components using twin WETLabs' AC9s, and autoanalyzers for water nutrient and carbon dioxide chemistry. The experiment consisted of three cruises with dye injection into the interior of the cold pool July 2001 and two dye injections into detaching bottom boundary layer water at the foot of the front June and August 2002.

Preliminary results reveal evidence of off shore transport of bottom shelf water at the shelfbreak. This transport is predominantly isopycnal although some diapycnal flow to lower densities is evident. They also reveal strong vertical and cross shelf gradients in nutrients, CO2 and phytoplankton biomass throughout the late spring to summer. The magnitude of the gradients and the location of the phytoplankton with respect to the nutrient gradient in particular, suggest a tight coupling between the vertical flux of nutrients to the euphotic zone and the growth and maintenance of the phytoplankton crop. Results from dye tracking, COOL float and microstructure analysis will reveal the mode and magnitude of delivery of deep, nutrient rich waters to the euphotic zone, and thus the degree to which the rate of biological processes are controlled by physical forcing.

OS51D-08 1105h INVITED

A New Perspective on Wind-Driven Coastal Upwelling, the Importance of Non-Linear Momentum Flux.

Steven J. Lentz[1] (slentz@whoi.edu)

David C Chapman[1] (dchapman@whoi.edu)

[1]Woods Hole Oceanographic Institution, MS 21, Woods Hole, MA 02543, United States

While significant progress has been made in understanding some aspects of the wind-driven response over continental shelves (e.g. the alongshelf flow), the processes controlling the structure and dynamics of the cross-shelf and vertical circulation remain poorly understood. For example, it remains unclear what determines whether the onshore return flow during coastal upwelling is in the bottom boundary layer or the interior. A new theory is proposed for two-dimensional upwelling that relates the structure of the wind-driven cross-shelf circulation and the associated dynamics to the stratification, bathymetry, and wind forcing. The theory predicts that the importance of the non-linear cross-shelf flux of momentum depends on the strength of the stratification, as measured by the Burger number $S = \alpha N/f$, where α is the bottom slope, N is the buoyancy frequency, and f is the Coriolis parameter. For weak stratification (small Burger number), the cross-shelf flux of momentum is small, the bottom stress balances the wind stress, and the onshore return flow is almost entirely in the bottom boundary layer. For strong stratification (Burger number of order one or greater), nonlinear cross-shelf advection of momentum is relatively large and balances the wind stress. Consequently, the bottom stress is small, and the onshore return flow is in the interior. These differences in the cross-shelf circulation clearly have important implications to the biological impact of coastal upwelling. Preliminary evaluations using both observations and numerical model results provide support for the proposed ideas.

OS51D-09 1120h

Tidal Currents on the Central Oregon Shelf: Models, Data, and Assimilation

Gary D. Egbert[1] (541-7372947; egbert@coas.oregonstate.edu)

Lana Erofeeva[1] (541-7373964; serofeev@coas.oregonstate.edu)

P. Michael Kosro[1] (541-7373079; kosro@coas.oregonstate.edu)

[1]COAS, Oregon State University, 104 Ocean Admin Bldg, Corvallis, OR 97331-5503, United States

Measurements of tidal currents on the central Oregon shelf are available from several sources, including recent high frequency (HF) coastal radar and Acoustic Doppler Profiler (ADP) deployments, and historical current moorings. In this paper we use a generalized inverse (GI) approach to compare these data to, and then assimilate them into, numerical models for the barotropic tides. Harmonic analysis of the data in short time windows using a modified admittance approach reveals that tidal currents on the Oregon shelf are highly variable in time, and can contain significant baroclinic components. Data from the winter months, when waters on the shelf are only weakly stratified, are found to be most nearly barotropic and thus most reasonable for assimilation into the shallow water equations model. The various data sources are used in several different combinations for assimilation and validation. Forcing the prior forward model with normal flow open boundary conditions obtained from a regional barotropic inverse model results in semi-diurnal barotropic currents that are consistent (within estimated error limits) with all available data. In contrast, diurnal currents on the shelf are very sensitive to details of the model configuration, and are significantly improved by data assimilation. Very similar solutions result from assimilation of either the HF radar or ADP data sets. The high sensitivity of the diurnal band currents can be understood dynamically in terms of trapped shelf waves. A short (85 km long) section of shelf off the central Oregon coast is wide enough to allow first-mode barotropic shelf waves at the sub-inertial diurnal frequencies. This results in locally resonant large amplitude diurnal tidal currents that are very sensitive to details in the local forcing, and hence quite variable in time.

OS51D-10 1135h INVITED

Field Observations of Shear Waves

R. T. Guza[1] (858-534-0585; rguza@ucsd.edu)

T. James Noyes[1] (858-534-9596; jnoyes@coast.ucsd.edu)

Steve Elgar[2] (508-289-3614; elgar@whoi.edu)

Thomas C. Herbers[3] (831-656-2917; herbers@oc.nps.navy.mil)

[1]Scripps Institution of Oceanography, UCSD-0209, La Jolla, Ca 92093-0209, United States

[2]Woods Hole Oceanographic Institution, MS #11, Woods Hole, Ma 02543, United States

[3]Department of Oceanography, Naval Postgraduate School, Monterrey, Ca 93943, United States

Meanders of the mean alongshore current in the surf zone called shear waves have alongshore propagating velocity fluctuations with periods of a few minutes and alongshore wavelengths of a few hundred meters. Shear wave velocity fluctuations observed within 250 m of the shoreline of a sandy, barred beach for 4 months were approximately horizontally isotropic, with root-mean-square values between 10–40% of the mean alongshore current V. Cross-shore variations of the time-averaged, shear wave momentum flux were consistent with shear wave energy generation in locations where V and the cross-shore shear of the mean alongshore current V_x were high. Farther from the shoreline where V and V_x were weaker, shear wave energy was both dissipated and transfered to the mean flow. In case examples where V is a narrow jet near the shoreline, the observed strong decay of shear wave energy levels seawards of the jet, and the cross- and alongshore structure of shear waves within the jet, were similar to predictions based on the linearly unstable modes of the observed V. Observed shear wave energy levels also were high with a strong, but broad (e.g. weakly sheared) V that is only marginally linearly unstable.

This research was supported by the Office of Naval Research and the National Ocean Partnership Program.

OS51D-11 1155h INVITED

Bragg Reflection of Ocean Waves from Sandbars

Steve Elgar[1] (elgar@whoi.edu)

Britt Raubenheimer[1] (britt@whoi.edu)

T. H.C. Herbers[2] (thherber@nps.navy.mil)

[1]Woods Hole Oceanographic Institution, WHOI MS11, Woods Hole, MA 02543, United States

[2]Naval Postgraduate School, Department of Oceanography, Monterey, CA 93943, United States

Resonant Bragg reflection of surface waves from a field of roughly shore-parallel sandbars was observed in Cape Cod Bay near Truro, MA during low energy wave conditions and during a storm. Although the Bragg resonance mechanism for wave reflection has been demonstrated convincingly in the laboratory, the corresponding impact of natural sandbars on ocean waves is not known. Multiple shore-parallel sandbars frequently are found in bays and gulfs, but observations of associated wave reflection have not been reported.

Here, we present the first observations of resonant Bragg reflection of ocean surface waves by a natural field of sandbars. The waves were reflected both from the bars and from the steep beach shoreward of the bars, causing complicated interference patterns of seaward and shoreward propagating waves. The observed cross-shore variations in the onshore- and offshore-directed energy fluxes are consistent with theory (Yu & Mei JFM 2000) for resonant Bragg reflection, including a 20% decay of the incident wave energy flux that is an order of magnitude greater than expected for wave-orbital velocity induced bottom friction.

When offshore wave heights were small (less than 0.25 m) there was no wave breaking across the sandbars, and the near-bottom velocities associated with the Bragg reflecting waves likely were too small to cause significant sediment transport. However, sediment mobilized during storms may be transported by velocity convergences and divergences associated with nodes and antinodes of the reflecting Bragg waves, possibly resulting in growth of the sandbars.

Funding was provided by the Mellon Foundation, ONR, and NSF.

OS52A MCC: Hall D Friday 1330h

Preliminary Results From the Jason-1 Mission II Posters *(joint with G)*

Presiding: **P VINCENT,** Centre National d'Etudes Spatiales**; B HAINES,** Jet Propulsion Laboratory

OS52A-0187 1330h POSTER

JASON1 mission : POSEIDON-2 Radar Altimeter Design and Results of in flight Performances

Guy CARAYON[1] (33 5 61 27 47 30; Guy.Carayon@cnes.fr)

Nathalie STEUNOU[1] (33 5 61 28 15 06)

Jean Luc COURRIERE[1] (33 5 61 28 15 06)

Patrick VINCENT[1] (33 5 61 27 44 69; Patrick.Vincent@cnes.fr)

Pierre THIBAULT[2] (33 5 61 39 37 64)

[1]Centre National d'Etudes Spatiales, 18 Avenue E. BELIN, TOULOUSE 31401, France

[2]Collecte Localisation Satellites, 10 Rue Hermes, Ramonville St Agne 31526, France

The Jason-1 mission, defined in cooperation between NASA and CNES, is the continuation of the present TOPEX/POSEIDON, whose major aim is to observe ocean circulation on a high coverage and long term basis with a level of accuracy yet unseen. Launched by NASA in december 2001, Jason-1 embarks the CNES Poseidon-2 radar altimeter together with other CNES and NASA instruments on the new French platform PROTEUS. Poseidon-2 inherits many characteristics from the experimental Poseidon-1 that has been successfully operating since mid 1992 onboard TOPEX. This new generation radar altimeter, provided in full redundancy, comprises high reliability components in order to achieve the 5 years expected lifetime. Ionospheric delay is removed through the introduction of an additional C-band measurement channel interlaced with Ku-band measurements. Each instrument exhibits a mass of 25 kg and a power consumption of 70 W. This paper presents the Poseidon 2 system architecture, technical features and the results of in-flight performance compared to the pre-launch performances (Pulse target, noises,).

OS52A-0188 1330h POSTER

Jason Microwave Radiometer On Orbit Calibration, Validation and Performance

Christopher S. Ruf[1] (734-764-6561; cruf@umich.edu)

Shannon T. Brown[1] (734-647-3450; brownst@umich.edu)

Stephen J. Keihm[2] (818-354-3656; stephen.j.keihm@jpl.nasa.gov)

Amirit Kitiyakara[2] (818-354-0164; amarit.kitiyakara@jpl.nasa.gov)

[1]Department of Atmospheric, Oceanic Space Sciences, University of Michigan 2455 Hayward, Ann Arbor, MI 48109, United States

[2]Jet Propulsion Laboratory, California Institute of Technology 4800 Oak Grove Drive, Pasadena, CA 91109, United States

The Jason Microwave Radiometer (JMR) on the Jason-1 altimeter satellite measures radiometric brightness temperature (TB) at 18.7, 23.8, and 34.0 GHz in the nadir direction, from which is estimated the excess path delay (PD) through the atmosphere experienced by the Jason radar altimeter signal due to water vapor and suspended cloud liquid water. JMR is an improved follow-on to the TOPEX Microwave Radiometer (TMR) on the earlier TOPEX/Poseidon altimeter satellite. Early work calibrating JMR and validating its performance during the first six months of the mission will be presented.

Placement of Jason-1 into a virtually identical orbit with TOPEX/Poseidon, with approximately 70 s time displacement, has afforded unprecedented accuracy in the intercalibration of two satellite radiometers. The virtual elimination of spatial and temporal decorrelation errors between JMR and TMR TBs and PDs allows intercomparison fine tuning at a much more precise level, and with greatly reduced data averaging requirements, relative to the earlier TMR comparisons with other satellite instruments (SSM/I, ERS-1,2), island radiosondes, GPS, and ground-based water vapor radiometers.

Calibration of the JMR TBs has been evaluated at the low end of its on-orbit range by comparing the differences between vicarious cold reference TBs of it and adjacent TMR channels with those predicted by theory. At the high end of the TB range, comparisons are made with TMR TBs over suitable regions of the Sahara desert and Amazon rain forest. Characterization of JMR performance at intermediate TB levels is possible using a variety of statistical intercomparison techniques.

OS52A-0189 1330h POSTER

GPS-buoys for lifetime RA drift monitoring

Tilo Schoene[1] (+49-8153-1391; tschoene@gfz-potsdam.de)

Matthias Forberg[1] (forberg@gfz-potsdam.de)

Roman Galas[1] (galas@gfz-potsdam.de)

Christoph Reigber[1] (reigber@gfz-potsdam.de)

[1]GFZ Potsdam, Division 1: Kinematics and Dynamics of the Earth, Telegraphenberg, Potsdam, D 14473, Germany

With the launch of JASON-1 the successful mission TOPEX/Poseidon (T/P) is extended to a second decade. Various analyses have shown that any altimetry mission is subject to performance degradation resulting in an apparent sea level rise. Comparisons of RA with in situ measurements of the instantaneous sea level at Harvest Oil Platform have been used to monitor the absolute sea level measurements of T/P, but not for other missions. However, only a combination of e.g. ENVISAT and JASON-1 gives a sufficient coverage in time and space. For the past and current missions different strategies are used for the calibration and the drift monitoring, e.g. using crossovers or tide gauges as a height reference. The disadvantage of all calibration methods is, that no direct measurement beneath the sub-satellite tracks are available for all missions and, therefore, models have to be used to account for e.g. the sea surface slope or time varying signals. As shown for ERS and Topex/Poseidon, a GPS-equipped buoy, anchored beneath a sub-track, can be used as a height reference. Since GPS-derived coordinates are ITRF-referenced, an absolute calibration is possible. Until today only lightweight buoys were deployed. Therefore, no long-term sensor for the calibration and drift monitoring exists.

In May 2002 a ruggedized GPS-buoy was deployed by GFZ in the North Sea in the context of a large German sea level monitoring project. A triple intersect of ERS-2/ENVISAT with a Topex/Poseidon/Jason-1 and a GFO sub-track was chosen. This gives the unique possibility to monitor al active RA missions. The lifetime of the buoy is expected to be several years, therefore, a long-term calibration, drift monitoring and inter-calibration of different missions will be possible. In addition, the buoy is equipped with supplementary sensors, like a dynamic motion sensors and meteorological devices (e.g. wind speed, air pressure sensors), allowing a broader use for calibration, e.g. of wind speed or significant wave heights. All data is stored onboard and, additionally, is transferred ashore by a HF link. Three bottom-mounted tide gauge sensors supplement the calibration site, allowing also to account for the sea surface slope for off-track RA measurements. A wave tide recorder beneath the GPS buoy is used for comparisons of the SWH.

First results of the buoy performance will be presented.

URL: http://op.gfz-potsdam.de/seal/

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Radar Altimeter Absolute Calibration Using GPS Buoy and Tide Gauges

Stephane Calmant[1] (calmant@pinot.cst.cnes.fr)

Kai-chien Cheng[2] (cheng.168@osu.edu)

C.K. Shum[2] (ckshum@osu.edu)

Doug Martin[3] (dmmartin25@aol.com)

[1]Laboratoire d'Etudes en Geophysique et Oceanograhie Spatiales, Centre National d'Etudes Spatiales, 18 Ave., E. Belin, Toulouse, . 31400, France

[2]Laboratory for Space Geodesy and Remote Sensing Research, Department of Civil and Environmental Engineering and Geodetic Science, the Ohio State University, 2070 Neil Ave., Columbus, OH 43210, United States

[3]Highpointe Solutions, 93 Wildflower Road, NE, Rome, GA 30161, United States

The knowledge of instrumental biases of radar altimeter systems (TOPEX/POSEIDON, GFO, ERS-2, JASON, and ENVISAT) and their potential drifts is an inherent and stringent requirement to use altimeters for the monitoring of global sea level changes. In this study, we present early results of dedicated multi-altimeter calibration sites, for radar altimeter instrument calibration and monitoring, include JASON. Three sites will be described: (1) located at Marblehead, Ohio in Lake Erie adjacent to a NOAA water level gauge, (2) located at Vanuatu with two bottom pressure gauges (BPG) on the sea floor, S. Pacific, (3) near an offshore oil platform in Gulf of Mexico to be equipped with a NGWL gauge. The location of the each site was selected due to the proximity to the ground tracks or the crossover point of multiple altimeters such as Jason and others. The oil platform site is located within a few km to the triple crossover points, where the ground tracks of T/P (or Jason), ERS-2 (or ENVISAT), and GFO nearly intersect. The tide gauge for each calibration site is able to observe and collect the in situ water level height continuously in different temporal scale (e.g., every 6 min. in Marblehead and every 15 min in Vanuatu) with respect to different local vertical datums (e.g., IGLD 1985 in Marblehead). Due to the random ground track shift from the nominal track in each pass of the satellite, it is necessary to study the water surface gradients and apply that to in situ gauge measurements in each site. Thus, a GPS waverider buoy was deployed in Lake Erie in October 2001 for 6 one-hour sessions to measure lake level along the selected T/P track in order to support the along-track gradient for T/P and Jason. In addition, the information gathered from the GPS buoy was then used to convert in situ gauge measurements from IGLD 1985 to the geocentric datum, namely ITRF, to which the altimeter measurements refer. Consequently, the comparison between the in situ gauge data in Marblehead since 2000 to the T/P sea surface height (ssh) can be performed and altimeter bias and drift can be estimated. The early result of using Jason IGDR of cycle 8 and 9 will also be examined. The Vanuatu calibration site consists of 2 BPG's moored in open sea at Wusi (under a T/P and Jason track) and at Sabine Bank (at an ERS-2 and ENVISAT crossover). Both gauges provide sea level measurements since 2000. The resulting altimetric drift estimation of T/P, ERS-2, and Jason will be presented. The status of the Gulf of Mexico offshore platform site will be discussed.

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Determination of the Relative Bias Between JASON and TOPEX Using Tide Gauge Data

Shawn A Hayes[1] (1-512-471-6728; hayes@csr.utexas.edu)

Don P Chambers[1] (1-512-471-7483; chambers@csr.utexas.edu)

Timothy J Urban[1] (1-512-232-7519; urban@csr.utexas.edu)

Byron D Tapley[1] (1-512-571-5573; tapley@csr.utexas.edu)

[1]University of Texas at Austin Center for Space Research, Center for Space Research Campus Mail Code: R1000 University of Texas, Austin, TX 78712, United States

Low-frequency climate changes, such as the determination of global mean sea level, require time series on the order of decades or longer. However, no single altimeter satellite can ever hope to accumulate the necessary uninterrupted time series. Therefore, it becomes increasingly important to calibrate the measurements from various satellite altimeter missions relative to one another in order to integrate the measurements

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