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

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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

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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

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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/

OS52A-0190 1330h POSTER

Radar Altimeter Absolute Calibration Using GPS Buoy and Tide Gauges

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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.

OS52A-0191 1330h POSTER

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

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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 missions relative to one another in order to integrate the measurements

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into a comprehensive data set. In previous studies, a relative bias has been estimated between Geosat and TOPEX using data from the WOCE tide gauge network. However, the true accuracy of the method is unclear given the large time gap and no other external verification. During the TOPEX/Poseidon-Jason Calibration/Validation Mission, 210 days of data are available to test the relative bias computed from tide gauges with a more accurate calculation computed from direct Jason-TOPEX SSH residuals. This provides a unique opportunity to validate the technique and assess its accuracy. Here, we discuss the technique of relative bias calculation with tide gauges, and examine the results when applied to Jason and TOPEX. Results suggest an accuracy of a few millimeters. Also, results are presented for the relative bias calculation between TOPEX Side A and TOPEX Side B. The Side A/Side B tests include the application of different sea state bias models and their effects on bias determination. A comprehensive investigation is presented concerning the effects of altimeter data gaps and overlaps on these relative bias estimates. Additionally, data from the new TOPEX Tandem Mission are examined in order to quantify the effect of mean sea surface (MSS) error on relative bias estimation. During the Tandem Mission, TOPEX will be flying along a new groundtrack which has not been included in current MSS models.

OS52A-0192 1330h POSTER

Sea level differences between Topex/Poseidon altimetry and tide gauges: observed trends and vertical land motions

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Nine year-long (1993-2001) sea level difference time series have been constructed by comparing sea level recorded by tide gauges and Topex/Poseidon altimetry. Although the primary goal of such an analysis is to define a sub network of good quality tide gauges for calibration of satellite altimetry systems, in particular Jason-1. The difference time series displaying large positive or negative trends may give evidence of vertical land motion at the tide gauge site. We have analyzed 98 tide gauge records from the UHSLC. Among them, 42 sites mainly located on open ocean islands, give very good agreement (better than 2 mm/year) with Topex/Poseidon-derived sea level trends. 22 other sites, mainly located along the continental coastlines of the Pacific Ocean, present sea level trends differing by more than 5 mm/year with Topex/Poseidon. Many of these sites are located in active tectonic areas (either in the vicinity of subduction zones or in active volcanic areas), where vertical land motions (either transient or long-term) are expected. For example, this is the case at Kushimoto, Ofunato, Kushiro (Japan), Kodiak Island and Yakutat (Alaska), La Libertad, Callao, Caldera (western south America), and Rabaul (western Pacific). When possible, we compare these observed trends in sea level differences with GPS and/or DORIS observations.

OS52A-0193 1330h POSTER

GPS Survey of the salar de Uyuni, Bolivia, for Satellite Altimeter Calibration

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The salar de Uyuni, a 100km x 100km salt flat in the Andean Altiplano of southern Bolivia, is the largest dry lake on Earth. The size, high albedo and remarkable flatness of the salar make it an ideal reference surface for satellite-based altimeters - in particular, the Geoscience Laser Altimeter System (GLAS) to be flown on the Ice, Cloud and Land Elevation Satellite (ICESat) - especially with regard to range measurements and waveform analysis of return signals. A simple reference surface such as the salar can be mapped by ground-based surveying, although the sheer size of the area requires adaptations to standard survey techniques.

We describe a survey of the salar de Uyuni carried out with car-mounted kinematic GPS over a seven-day period in September 2002. We divided the salar surface into a number of survey grids that were driven in multiple directions to yield redundant measurements and corresponding error statistics at grid crossover points. Adjacent grids were overlapped so we could also determine errors between grids and over multi-day time periods. In addition, we set up five fixed GPS sites on the salar to serve as local survey control in post-processing. These fixed sites will be used to map ionospheric effects and interpolate them to the roving GPS receivers. If successful, this will allow reprocessing of GPS solutions using L1 data only, with a corresponding reduction in noise compared to solutions using the standard ionosphere-free LC combination.

We present our surveyed topography of the eastern half of the salar de Uyuni, comparing it to previously-published elevation measurements and to the best geoid model available for the region. We show the close relationship between the topography of the salar and the shape of the geoid, a result we had expected since the salar is flooded each austral summer to an almost uniform depth. We also demonstrate knowledge of the surface height of the salar to within the measurement error specified for the GLAS instrument.

OS52A-0194 1330h POSTER

New Estimates of Tide Gauge Vertical Velocities Based on Nearby GPS Sites

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Land motion rates in the vicinity of tide gauges play a significant role in determining global sea level. A global set of GPS sites with three to nine years of data, low repeatabilities, and position within 10 km of a tide gauge were chosen to study the vertical motion at the tide gauges. Using the JPL GIPSY-OASIS software, precise point positioning was performed to determine the position of each site for the duration of each time series. The non-fiducial point positioning method allowed for a consistent analysis of a large number of stations while linking all of the solutions to the ITRF2000 reference frame. In addition to geodetic height, a number of other metrics were examined including formal error, number of pseudorange observables, number of good phase residuals, percentage of observations at low elevation, and mean total zenith tropospheric delay. The majority of the data that was used had formal errors less than 2 cm and at least 1000 pseudorange observables for each day analyzed. Breaks were inserted at the points of large offsets in the metrics and the site rate was estimated again. The rate of each site was computed by de-trending the position time series, computing the dominant periodicities, and then computing the rate again while taking into account the computed periods. Using this technique, the formal error as well as the repeatability of each new rate estimate was capable of being reduced as compared to the estimates of rate in which biases such as these were not estimated. A list of the new estimated trends at 26 sites as well as a thorough analysis of the associated errors will be shown in greater detail.

OS52A-0195 1330h POSTER

Absolute Sea-level Monitoring and Altimeter Calibration Facility at Gavdos, Crete, Greece

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We introduce the recently instrumented mean sea level (MSL) monitoring facility on western Crete and the isle of Gavdos. We will focus on the altimeter calibration aspect of the facility, in particular, its application to the JASON mission. The Eastern Mediterranean area is one of great interest for its intense tectonic activity as well as for its regional oceanography. Recent observations have convincingly demonstrated the importance of that area for the regional meteorological and climatologic changes. Tide-gauge monitoring with continuous GPS has gained importance lately since tectonics contaminate the inferred sea level variations, and a global network of tide-gauges with long historical records can be used as satellite altimeter calibration sites (e.g. TOPEX/POSEIDON, GFO, JASON-1, ENVISAT, etc.). This is at present a common IOC-GLOSS-IGS effort, already underway (TIGA), and our facility is part of it. Crete hosts two of the oldest tide-gauges in the regional network and our project will further expand it to the south with a new site on the isle of Gavdos, the southernmost European parcel of land. One component of our GAVDOS project is the repeated occupation of two already in existence tide-gauge sites at Souda Bay and Heraklion, and their tie to the new facility. We show here initial results from positioning of these sites and some of the available tidal records. Gavdos is situated under a ground-track crossing point of the original T/P and present JASON-1 orbits. It is an ideal calibration site if the tectonic motions are monitored precisely and continuously. The facility hosts in addition to the tide gauges: GPS and DORIS beacons for positioning, transponders for direct calibration, water vapor radiometers and solar spectrometers, GPS-loaded buoys, airborne surveys with gravimeters and laser profiling lidars, transportable laser ranging systems, etc., to ensure the best possible and most reliable results.

URL: http://www.gavdos.tuc.gr

OS52A-0196 1330h POSTER

Evaluation of GPS-based orbits for the Jason-1 Mission with Application to Near Real-Time Sea Surface Heights

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The Jason-1 BlackJack is a state-of-the-art GPS receiver capable of tracking up to 12 GPS spacecraft on both GPS frequencies (L1 and L2) using advanced codeless tracking techniques. Preliminary tests of the orbits computed using the BlackJack data in a reduced dynamic strategy suggest the RMS radial accuracies are better than 2 cm, and provide reason for optimism that the 1-cm goal can be reached. We describe the precise orbit determination (POD) process and results from various tests that support the accuracy assessments.

We also describe recent advances in near real-time (NRT) POD for the Jason-1 mission. New results suggest that GPS-based orbits computed within 3-5 hours of recording the last element of tracking data have RMS radial accuracies of 2-3 cm. These orbits are used to demonstrate the capability to derive high-accuracy NRT sea-surface heights from the Jason-1 mission. Such sea-surface height products could prove valuable to specialized users in the oceanographic community who rely on real-time monitoring of the global oceans.

OS52A-0197 1330h POSTER

JASON-1 PRECISE ORBIT DETERMINATION (POD) THROUGH THE COMBINATION AND COMPARISON OF GPS, SLR, DORIS AND ALTIMETER CROSSOVER DATA

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Jason-1, launched on December 7, 2001, is continuing the time series of centimeter level ocean topography observations as the follow-on to the highly successful TOPEX/POSEIDON (T/P) radar altimeter satellite. The precision orbit determination (POD) is a critical component to meeting the ocean topography goals of the mission. T/P has demonstrated that the time variation of ocean topography can be determined with an accuracy of a few centimeters, thanks to the availability of highly accurate orbits based primarily on

SLR+DORIS tracking. The Jason-1 mission is intended to continue measurement of the ocean surface with the same, if not better accuracy. Fortunately, Jason-1 POD can rely on four independent tracking data types available including near continuous tracking data from the dual frequency codeless BlackJack GPS receiver. Orbit solutions computed using individual and various combinations of GPS, SLR, DORIS and altimeter crossover data types have been determined from over 100 days of Jason-1 tracking data. The performance of the orbit solutions and tracking data has been evaluated. Orbit solution evaluation and comparison has provided insight into possible areas of refinement. Several aspects of the POD process are examined to obtain orbit improvements including measurement modeling, force modeling and solution strategy. The results of these analyses will be presented.

OS52A-0198 1330h POSTER

JASON-1: Initial Sea Surface Height Analysis

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ERS-2 and GFO satellite altimetry data are currently processed on a real time basis at the Naval Research Laboratory and the Naval Oceanographic Office. And once the TOPEX maneuver is complete we will work to return it to the processing stream. With the beginning of the Jason-1 osdrs and gdrs these data sets were added to the processing stream at NRL so that they could by analyzed in an analogous manner. The techniques used in the real time processing are presented. Extensive analysis is performed on the data, both during and post processing on a daily basis. This allows problems in the Jason data stream to be identified in a real time manner. These analyses demonstrate how much data is flagged as suspect in the processing, at what point it is flagged, and for what reason. Orbit solutions are the greatest source of error in real time altimeter products, and an orbit correction algorithm provides continuous analysis of orbit accuracy. Analysis of the final Jason data sea surface height anomaly is made through examination of crossover rms values, and collinear rms values in the case of Topex/Poseidon, both for each altimeter and between altimeters. The results of this processing are presented graphically on a daily basis on "The Real Time Ocean Environment" web site (www7300.nrlssc.navy.mil/altimetry).

OS52A-0199 1330h POSTER

Compatible Sea Surface Height Anomaly Records for TOPEX/Poseidon and Jason-1 Missions

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The Physical Oceanography Distributed Active Archive Center at JPL (JPL PO.DAAC) has developed two new products for sea level residual measurements. These are the sea surface height anomalies for TOPEX/Poseidon (TPSSHA) and for Jason-1 (J1SSHA). These residuals are calculated by editing the data from the PO.DAAC Merged GDR (MGDRB) for TOPEX/Poseidon and from the Jason-1 (I)GDR data series and are currently available through the JPL PO.DAAC web site, http://podaac.jpl.nasa.gov/.

To calculate the sea surface height anomaly, TPSSHA uses Jason-1 compatible tide, mean sea surface, electromagnetic bias, wet correction, and inverse barometer parameters.

Consequently, the entire data set for TOPEX/Poseidon, beginning in October, 1992, will be available with these Jason-1 compatible parameters to provide a long-standing data record.

In particular, the TPSSHA and J1SSHA will provide compatible measurements of the sea level residuals during the tandem TOPEX/Poseidon and Jason-1 missions, which began in mid September, 2002.

OS52A-0200 1330h POSTER

New Along-Track Mean Sea Surface Model for TOPEX and JASON Altimeter Data

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To investigate sea level variability and other important ocean phenomena measured by satellite altimetry, an accurate mean sea surface (MSS) is required. A previous investigation has shown that the MSS can be represented as a plane over small regions 2 km wide by 7 km along the satellite ground-track, and the parameters can be estimated directly from the sea surface height measurements. However, this model also may not represent the MSS as well in all areas, for example in places where the MSS changes significantly within the boundaries of the plane. In order to improve the accuracy of the along-track MSS model in these regions, a new surface with more degrees of freedom has been tested. The new surface allows for different along-track and cross-track gradients in different quadrants of the region. Because of this shape, it is designated the pyramid MSS model. Parameters of the model are calculated using TOPEX data from January 1993 to December 2000.

To quantify improvement when using the new pyramid MSS model compared to the plane model, the global and the local statistics of sea level anomalies are computed and compared, using observations from both the TOPEX and JASON altimeters. Comparisons are also made at several tide gauge sites. The results show significant improvement using the new pyramid MSS model.

OS52A-0201 1330h POSTER

Accuracy Assessment of Altimeter Derived Geostrophic Velocities

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Along track sea surface height anomaly gradients are proportional to cross track geostrophic velocity anomalies allowing satellite altimetry to provide much needed satellite observations of changes in the geostrophic component of surface ocean currents. Often, surface height gradients are computed from altimeter data archives that have been corrected to give the most accurate absolute sea level, a practice that may unnecessarily increase the error in the cross track velocity anomalies and thereby require excessive smoothing to mitigate noise. Because differentiation along track acts as a high-pass filter, many of the path length corrections applied to altimeter data for absolute height accuracy are unnecessary for the corresponding gradient calculations. We report on a study to investigate appropriate altimetric corrections and processing techniques for improving geostrophic velocity accuracy. Accuracy is assessed by comparing cross track current measurements from two moorings placed along the descending TOPEX/POSEIDON ground track number 52 in the Gulf of Mexico to the corresponding altimeter velocity estimates. The buoys are deployed and maintained by the Texas Automated Buoy System (TABS) under Interagency Contracts with Texas A&M University. The buoys telemeter observations in near real-time via satellite to the TABS station located at the Geochemical and Environmental Research Group (GERG) at Texas A&M. Buoy M is located in shelf waters of 57 m depth with a second, Buoy N, 38 km away on the shelf break at 105 m depth. Buoy N has been operational since the beginning of 2002 and has a current meter at 2m depth providing *in situ* measurements of surface velocities coincident with Jason and TOPEX/POSEIDON altimeter over flights. This allows one of the first detailed comparisons of shallow water near surface current meter time series to coincident altimetry.

OS52A-0202 1330h POSTER

Near-real-time Jason-1 Images

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The Jason-1 satellite mission provides sea surface height measurements in near-real-time (NRT). These operational data can be used for a variety of scientific and commercial applications, including marine meteorology, ship routing, and climate prediction.

The Physical Oceanography Distributed Active Archive Center (PO.DAAC), NASA's primary data center for archiving and distributing oceanographic data, is supporting the JASON-1 mission by capturing NRT data from Jason Ground System (JGS) and distributing the data to operational users. In addition, PO.DAAC will be processing the data to create value-added NRT browse images, which will be made available, along with their associated binary data, through the Near-Real-Time Image Distribution Server (NEREIDS).

Two NRT data products will be processed by JGS and captured by PO.DAAC: Operational Sensor Data Records (OSDRs) and Interim Geophysical Data Records (IGDRs). OSDRs have a latency of three hours from data collection and an orbit accuracy of 30 cm; IGDRs are available seventy-two hours after collection and have an accuracy of 2.5 cm. After capturing these data, PO.DAAC will automatically create significant wave height, wind speed, and water vapor content browse images from the OSDR data. Additional parameters will be provided from the IGDR data product, such as the sea surface height anomaly, among others. In this poster, we describe the functionality of NEREIDS and demonstrate the usefulness of operational altimetric data for scientific applications.

OS52A-0203 1330h POSTER

Real-time use of the Jason-1 sea surface height data in Japan Meteorological Agency

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Since January 2001, Japan Meteorological Agency has been operating an ocean assimilation system in which the TOPEX/POSEIDON sea surface height data is assimilated, and informing the ocean states using the outputs of the system. Jason-1 took over the TOPEX/POSEIDON orbit in August 2002. The assimilation system is operated with the Jason-1 data instead. We are planning to improve our ocean information by introducing real-time analysis and prediction in the present assimilation system, because of the real-time distribution of the Jason-1 IGDR. Prediction experiments indicate that the system has a capability of the prediction of Kuroshio meander occurred two months later, though the prediction tends to show an earlier occurrence of the meander than the real state. The prediction system will be improved by introducing a more accurate analysis for small-scale eddy as well as a tune-up of the model. The multi-altimeters data can represent small-scale eddy better than the single-altimeter data. The tandem mission of Jason-1 and TOPEX/POSEIDON will provide more accurate sea surface height fields with more homogenous error fields than Jason-1 or TOPEX/POSEIDON alone. The prediction experiments with the tandem mission data will be done in near future. Here we introduce the present assimilation system, the planning real-time analysis and prediction flow, and the prediction experiments for the Kuroshio meander.

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OS52A-0204 1330h POSTER

Near-real time temperature and salinity profiles in the Indian Ocean from JASON-1 altimetry

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The purpose of this work is to derive the near-real time profiles of temperature and salinity in the upper ocean and then estimate the heat and salt storage associated with the surface circulation in the Indian Ocean, using the combination of sea-level anomalies from TOPEX/Poseidon (T/P) and JASON-1 altimetry, and in-situ sea-level computed from climatological hydrographic data. This new technique is explained in Shi et al. (2002). The accuracies of the synthetic temperature and salinity, and heat and salt storage were evaluated using available hydrographic data. Further, the altimeter data derived sea surface salinity will also be used for validating the sea surface salinity estimated from satellite derived Outgoing Longwave Radiation (OLR). Murty et al. (2002) discussed the new method of estimating sea surface salinity using OLR, through a parameter the 'Effective Oceanic Layer'.

OS52A-0205 1330h POSTER

A Preliminary Comparison of Global Air-Sea Gas Transfer Velocity Fields Derived From the Jason-1 and TOPEX Altimeters

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The availability of collocated, near-coincident normalized radar backscatter data from the TOPEX and Jason-1 altimeters presents a unique opportunity to intercalibrate the two platforms and to compare derived fields of geophysical parameters. We recently reported on an altimeter algorithm [see URL] for estimating air-sea gas transfer velocities from the mean square slope of short wind waves (40-100 rad/m) and derived a six-year time-series of global monthly gas transfer velocity fields from the dual-frequency TOPEX altimeter. In this report, we update the time series to span the entire TOPEX mission to date (1993-2002) and compare the algorithm results from the first eight months of joint TOPEX/Jason-1 operations. Initial results suggest that the monthly gas transfer velocity maps generated from the two altimeters are very similar, although the Jason-1 product appears generally 'hotter'. Jason-1 transfer velocity fields show slightly higher global averages (∼ +2 cm hr bias) relative to TOPEX and significantly higher discrepancies (∼ 20 cm hr) at high latitudes (e.g. Southern Ocean). Comparison of along-track Ku- and C-band normalized backscatter suggests that the discrepancies are due to significant offsets between TOPEX and Jason-1 in both bands. Prospects for extending the time series to observe decadal trends and for improved spatial coverage with the repositioning of TOPEX will be discussed.

URL: http://remotesensing.whoi.edu/˜david/ktrans/ktrans.html

OS52A-0206 1330h POSTER

Interannual Volume Changes and Heat Transport Pathways in the Tropical Pacific

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Previous observational and numerical modeling studies have arrived at contradictory conclusions about mass and heat transport, particularly meridional transport, in the tropical Pacific during El Niño events. The present study uses TOPEX/Poseidon altimetric heights and a sigma-coordinate model to asses tropical Pacific volume changes during El Niño. We have previously presented results concerning the large-scale pattern of El Niño related volume redistribution, in which we showed that volume is indeed lost from the tropics during events, although this loss is smaller than the redistribution within the tropics. The volume redistribution was shown to be dominated by transports of heat. Recently, we have used Lagrangian techniques to examine the specific three dimensional pathways of heat transport through an El Niño event. The redistribution of heat, and therefore volume, occurs both along the equator and through interior pathways in both hemispheres. These interior pathways are anomalously strong and shallow during El Niño, bringing warm water into the eastern equatorial Pacific. Anomalous upwelling is an important factor in the cold anomalies in the western near-equatorial Pacific during El Niño. Similarly, anomalous downwelling leads to off-equatorial warm anomalies along the coasts of North and South America, and to anomalies near 20°S and 20°N.

OS52A-0207 1330h POSTER

The Satellite Altimetry Yellow Pages; A Guide for Users

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Satellite altimetry missions have reached a distinctive point of maturity and relevance in the scientific community. A directory of ocean altimetry data applications, the Satellite Altimetry Yellow Pages, is being developed as a directory to new and potential applications and data users. The Yellow Pages directory is designed to serve as a tool to clearly identify the operational and research applications of these highly effective ocean-observing systems, as well as the key players involved. The directory will serve as a professional guide for satellite altimetry users, both experienced and new.

This directory is designed to be a ready reference for defining satellite altimetry systems, exploiting them, validating and using the data, and will outline outreach activities associated with the projects. This database of altimetry applications will be the reference standard for the international satellite altimetry community; who is using the data, what they are doing with it, and how do you contact them.

The Yellow Pages will serve as a working guide to define and track altimetry applications, identify key players in each user category, and facilitate communication between current and potential data users. It is also designed to serve as a model working method for close collaboration between scientists and commercial users to clarify distinct uses and to accurately describe and present the application of altimetry data.

The Yellow Pages directory will live on the AVISO web site, with a link from the NASA Ocean Surface Topography web site. A standardized format is in development that will provide a consistent layout for all entries, and aid information and content searches.

The focus of each Yellow Page summary will be distinct, with respect to the use of the data, to avoid redundancy with other summaries. Interesting and compelling graphics will be featured with each summary. Examples presented here include the Mercator ocean forecasting system, and marine mammal habitat studies.

URL: http://www.aviso.oceanobs.com/html/applications/welcome_uk.html

OS52A-0208 1330h POSTER

GEOSAT Follow-On Radar Altimeter Satellite Performance Studies

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Under a Navy Contract with Ball Aerospace and Technologies Corporation, the first GFO satellite was completed in 1997 and launched on 10 February 1998 on an Orbital Taurus launch vehicle. The satellite was operationally accepted on 29 November 2000. With an anticipated 8-year or more life, GFO (http://gfo.bmpcoe.org/Gfo) is a DoD satellite mission managed by the Space and Naval Warfare Systems Command's (SPAWAR's) Meteorological and Oceanographic (METOC) Systems Program Office (PMW 155) located in San Diego, California. The satellite is in the same Exact Repeat Orbit (ERO) as the original GEOSAT (800 km by 108 degrees inclination). All GFOs data products are available to the scientific community and are distributed by NOAAs Laboratory for Satellite Altimetry. The primary program objective was to develop an operational series of radar altimeter satellites to maintain continuous ocean observation for accurate global measurements of both mesoscale and basin-scale oceanography. Since its acceptance, Computer Sciences Corporation (CSC), under contract with the Navy, has provided a team known as the GFO Cal/Val and assisted by NASA and NOAA personnel has undertaken extensive and continuing calibration and validation activities on an exact repeat cycle basis. This paper will discuss the results of those Cal/Val efforts and present charts showing the performance history of the satellite, its sensors (both the Radar Altimeter and the Water Vapor Radiometer), and other relevant performance measures such as orbit accuracy.

URL: http://gfo.bmpcoe.org/Gfo

OS52A-0209 1330h POSTER

Low-Frequency Variability in the Kuroshio Extension System: Observations and Causes

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TOPEX/Poseidon altimeter data from the last decade are used to investigate large-scale circulation changes in the Kuroshio Extension and its neighboring recirculation gyre regions. Over the decade-long period from 1992, the large-scale changes of the Kuroshio Extension (KE) are characterized by the oscillation between an elongated state and a contracted state. In the elongated state, the KE has a larger eastward surface transport, a greater zonal penetration, and a more northerly zonal-mean path. The reverse is true when the KE is in the contracted state. Causes for this structural change in the downstream KE region (east of 158°E) are found to be due to the interior surface wind forcing accumulated along the long baroclinic Rossby wave characteristics from the east. In the upstream KE region, much of the observed low-frequency changes is found to be associated with the fluctuations of the southern recirculation gyre.

OS52B MCC: Hall D Friday 1330h

Integrating Marine Ecology and Ocean Carbon Cycle Dynamics: Data Synthesis, Numerical Modeling, and Data Assimilation Studies Posters

(joint with B, GC)

Presiding: **S Doney,** National Center for Atmospheric Research**; K Moore,** National Center for Atmospheric Research

OS52B-0210 1330h POSTER

Comparing Satellite and In-Situ Chlorophyll Measurements

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Obtaining accurate measurements of surface chlorophyll-a concentration in the world's oceans is critical for primary productivity and carbon cycle modeling. The satellite sensor, Sea-viewing Wide Field-of-view Sensor (SeaWiFS), has provided a continuous record of ocean chlorophyll measurements since September 1997. Statistical comparisons of in-situ versus SeaWiFS data were made to determine how well 9-km SeaWiFS observations match up with direct surface measurements. Results show that the agreement is fairly good (r-squared of 0.78), though SeaWiFS chlorophyll values are somewhat higher than their in-situ counterpart in 60% of the match-ups, particularly in low-chlorophyll areas. Yet while the global area-weighted mean is higher for SeaWiFS, regional differences among the major oceanic basins are evident. For example, the SeaWiFS values in the Antarctic are generally lower than the in-situ measurements. Comparisons were made using SeaWiFS mapped and binned data products and the results were similar.