The ocean model covers North Pacific Ocean from 16S to 60N with 1/4 degree horizontal resolution. The model is restarted daily from previous nowcast fields. Once the model is restarted, it continuously assimilates the temperature/salinity fields constructed from altimeter sea surface height anomaly data and MCSSTs, and is forced by the Navy Operational Global Atmospheric Prediction System (NOGAPS) surface forcing to generate a nowcast. Forecasts up to 72 hours are made with available NOGAPS forecasts.

The data assimilation scheme is incremental adjustment with a vertical weighing function based on the oceanic variability scales.

The data assimilating North Pacific Ocean nowcast/forecast model has been experimentally in real time at NRL since July 1, 1999. The assimilation of satellite data shows a strong improvement in retaining the ocean energetics, particularly in the Kuroshio extension region. The comparison with TAO array temperature profiles shows model with data assimilation are better then persistence and the analysis.

URL: http://www7320.nrlssc.navy.mil/npacnfs_www/

G21A MC: 131 Tuesday 0830h

Crustal Deformation: New Results I

(joint with S, T, V, DI)

Presiding: **J T Freymueller,** University of Alaska, Fairbanks**; A Tikku,** Lamont-Doherty Earth Observatory of Columbia University

G21A-01 0830h INVITED

Monitoring the Earth's Gravity Field Using the GGP Network

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Continuous high precision gravity measurements are the basis of the Global Geodynamics Project (See Crossley et al., 1999, Network of superconducting gravimeters benefits a number of disciplines, Trans. Am. Geophys. U., 80, 121-126). We now have 4 years of recording, since July 1, 1997 and the project will end in 2003. So far about 17 stations have contributed to the database that is maintained at the International Center for Earth Tides in Brussels. The data is used for a number of projects, some local, some global. For example, at each station, tidal analysis yields information on ocean tidal loading and the correlation between atmospheric pressure, local hydrology and gravity. When combined with data from absolute gravimeter measurements, regularly taken at many of the stations, some long term tectonic signatures are beginning to emerge.

Data from various parts of the GGP network are also combined for other projects. Most of the Japanese stations contribute data to the Ocean Hemisphere Project that combines seismic and tectonic measurements in the Western Pacific region. In Europe a project is underway to use the GGP stations to provide ground truth for satellite gravity missions, such as GRACE, that are searching for large scale hydrology and other signals. Finally all of the GGP stations contribute data to the detemination of Earth rotation parameters such as the polar motion and Free Core Nutation. The latest results from these and other projects will be presented.

G21A-02 0845h

Constraints on the Mid-Continent Deformation Gravity Gradient Determined from Co-located GPS and Absolute Gravity Observations

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The deformation gravity gradient (DGG) is the ratio of the time rate of change of surface gravity to vertical crustal velocity. Different processes generate different theoretical predictions of the DGG. Consequently, observational constraints on the DGG are necessary to link crustal uplift observations to satellite-derived observations of the time rate of change of the Earth's gravitational field, which will be generated by upcoming satellite missions such as GRACE. Larson and van Dam (2000) have compared secular gravity trends from 4 sites in interior North America to crustal uplift rates obtained from global point-positioning analyses of GPS observations, and found they agree, assuming a nominal DGG value appropriate to postglacial rebound of -0.15 μGal/mm (Wahr et al., 1995). Here we revisit and extend their analysis in order to determine the observational constraints on the DGG in mid-continent North America. We use recently published gravity rates derived from significantly more absolute gravity observations and a different GPS analysis scheme. Lambert et al. (2001) have published secular gravity rates for 7 sites in mid-continent North America, using all available absolute gravity observations and allowing for instrumental offsets. The sites, chosen to sample postglacial rebound, lie on a transect from Churchill, Manitoba, located on Hudson Bay, to North Liberty, Iowa. Four of these sites (Churchill, Flin Flon, Lac du Bonnet, and North Liberty) also feature a nearby GPS station. The GPS observations were analyzed using double differencing with Bernese 4.2, yielding 5 year time series for vertical position. The daily repeatabilities of 5 to 9 mm compare well to the weekly repeatabilities of 7-8 mm reported by Larson and van Dam (2000). A comparison of the vertical rates derived from these time series to the secular solid-surface gravity trends finds a DGG of -0.14 ± 0.06 μGal/mm. This value is in good agreement with model predictions for postglacial rebound, which range from -0.135 to -0.17 μGal/mm using the ICE-3G postglacial rebound model and a nominal viscosity structure. More sites with co-located absolute gravity and GPS are needed to reduce the relatively large uncertainty of the derived DGG.

G21A-03 0900h INVITED

Absolute Gravity Changes In Alaska

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Visco-elastic deformation models such as that of Soldati et al. [1999] predict time varying gravity signals associated with post-seismic deformation following the 1964 Prince William Sound earthquake (Mw=9.2). The rates of change are a function of the upper mantle viscosity. Aseismic creep is also a candidate mechanism for the deformation. The models differ in the spatial distribution of gravity changes; visco-elastic signals span a much larger region.

Previous absolute gravity measurements have been made in Fairbanks, Alaska and Palmer, Alaska, during 1990-1991. Estimated uncertainties are in the 3-5 uGal range Visco-elastic gravity changes for Palmer are predicted to range from zero to tens of uGal, depending on the model viscosity and thickness parameters. New absolute gravity measurements at these sites are scheduled for September 2001, with 2 uGal estimated uncertainty. We hope to present initial results of the new measurements, with discussion of their implications for model testing. Different time series and instruments will be merged, and necessary corrections will be discussed

G21A-04 0915h INVITED

Temporal Gravity Observations in Volcanic Areas : Contribution and Limitation of Field Relative Gravimetry

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Relative gravimetry has been successfully used in the last decades to evidence temporal gravity changes related with ground deformation or mass flux in volcanic areas. Recent instrumental developments in relative gravity data acquisition combined with performances of GPS surveying have significantly improved the sensitivity and the efficiency of the measurement of the gravity field on land. Classical analogical land gravity meters are now advantageously replaced by new generations of microprocessor based instruments allowing automatic measurements digitally recorded along with other useful information. Such improvements offer new potentialities for the study of internal processes through precise surveying or differential continuous recordings. In the meantime, due to intrinsic properties of relative instruments, rigorous and constraining protocols for data acquisition and processing are required to minimize the effects of instrumental drift and possible calibration changes that should be carefully controlled. The combination of relative and absolute gravity measurements then appears as a promising way to study the mass flux associated with the volcanic activity especially in strong topography or island areas. Current potentialities and limitations of relative instruments are discussed here from results of laboratory experiments and field surveys in volcanic areas performed by IRD and IPGP.

G21A-05 0935h

The Interpretation of Gravity Changes and Crustal Deformation in Active Volcanic Areas

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Combined geodesy and gravity measurements allow us to infer the density of intrusive bodies, and better constrain deformation sources. Estimates of the parameters (volume, mass, density) of the intrusion in volcanic areas are usually computed matching gravity and uplift data to an isotropic point source in a homogeneous half-space. We investigate three factors that can help in obtaining a more realistic picture of the intrusive body:

(1) A layered Earth model, with one or more elastic layers.

(2) Coupling between elastic and gravitational effects. Deformation changes the gravitational field in two ways: dilatational strains change the local density, and displacements perturb any density contrasts, especially at the free surface.

(3) Non-spherical source geometries.

Our results show that:

(1) For an elastic model appropriate to Long Valley caldera, we find no major differences between modeling the intrusion using a point source in a homogeneous or layered medium. For the layered medium we find (a) a slightly deeper source (9.4 vs 8.8 km) and larger mass (0.500 vs 0.447 M.U.) for the numerical model; (b) the same volume (0.155 km^3) for both models; (c) the density of the intrusive body increases of about 10% for the numerical model (from 2900 to 3200 kg/m^3).

(2) Coupling between elastic and gravitational effects (or self-gravitation) are second order over the distance scales normally associated with volcano deformation. We find no significant differences in any of the source parameters.

(3) Choosing the right source model to invert geodetic and gravity data is the critical step in the geological interpretation of the data. If the source does not possess a spherical symmetry, the standard approach of using a point source to invert uplift and gravity data will lead to biased estimates of the source parameters. In the case of Long Valley caldera, the inflation source (a vertical prolate ellipsoid) is located 5.9 km beneath the resurgent dome with an aspect ratio equal to 0.475, a volume change from 1982 to 1999 of 0.136 km^3 and a density of around 1700 kg/m^3. A spherical source overestimates the source depth by 2.9 km (33% increase), the volume change by 0.019 km^3 (14% increase) and the density by about 1200 kg/m^3 (40% increase).

G21A-06 1010h

Assessing the Time-Predictable Earthquake Recurrence Model at Parkfield, CA Using Geodetic Data

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The elapsed time since the 1966 M6 earthquake at Parkfield, CA has significantly exceeded the expected interevent time according to the time-predictable recurrence model. This model, used in many seismic hazard predictions, states that the time until the next earthquake is the stress drop of the most recent event divided by the stressing rate on the fault. In practice, the recurrence time is often predicted from the ratio of the slip in the most recent event to the interseismic slip-deficit rate (the rate that slip on the seismogenic part of the fault lags the long-term slip-rate).

Geodetic data indicate that strain has accumulated on the fault since 1966, yet the M6 earthquake predicted for 1988 has not yet occurred. Here we test whether the time-predictable model is consistent with the Parkfield geodetic data. Parkfield should be an ideal place to apply this model because of its long history of ∼M6 earthquakes (most recently in 1966), the striking similarity among these events, the availability of geodetic data spanning a time comparable to previous interevent times, and the simple fault geometry.

We used trilateration data spanning the 1966 event, and the trilateration and GPS data collected since that event, in extremal inversions for rigorous bounds on the coseismic moment and interseismic moment deficit rates. We in turn used these values to estimate the range of interevent times predicted by the model that are consistent with the data. With a transition depth of 14 km and a deep slip-rate of 33 mm/yr, the maximum interevent time (95% confidence) based on the time-predictable model is 18 years. If further work confirms this result, it calls into question the validity of the time-predictable recurrence model.

These results improve on our previous work in terms of statistical methodology. Moreover, we will incorporate into our estimates of maximum interevent time the uncertainty in transition depth and deep slip-rate, both of which are integral in defining the moment deficit rate.

G21A-07 1025h

Is Present Day Continental Deformation Nearly Plate-Like? If so, Why?

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Some indicators of deformation (seismicity, late Cenozoic faulting, regional topographic relief) suggest broad deformation zones. However, space geodetic mappings of current movements and Holocene fault distributions often show straining focussed in very narrow zones. Conventional wisdom has it that continental deformation is spread over broad regions while straining of oceanic lithosphere occurs in narrow zones. Here I present evidence, largely from recent GPS surveys, suggesting present day continental deformation is actually occurring in a largely plate-like manner through the relative motions of a small number of micro-plates within each deforming zone, sometimes perturbed by isolated zones of deformation driven by local lithospheric density gradients. How can this be so? I speculate that this behavior is caused by the inherent lateral heterogeneity of continental lithosphere and by frictional and ductile weakening and strengthening mechanisms that promote focussed deformation that migrates with time.

Qualitative indications of active deformation can sometimes be misleading. In many active regions erosion and tectonism are in balance and very low rates of slip on inclined faults can generate significant steady-state topography. However, in currently inactive regions, erosion rates are very low, much less than rates of vertical movement in even moderately active deforming zones. Therefore landscape relief provides evidence for current activity but preserves it over long periods, millions to tens of millions of years (Ma) (e.g. Alps, Rocky Mountains). Secondly, background seismicity is a qualitative measure of tectonic activity and only the largest earthquakes contribute significantly to representative long term deformation rates, so the spatial distribution of all smaller events can be misleading. Finally, many mappings of active faults encompass features up to several Ma old that are not necessarily representative of current activity.

In contrast, late Quaternary and Holocene fault slip rates, detailed analysis of active landscape features, and space geodetic measures of movement rates provide quantitative measures that may be more reliable guides to present-day activity. This evidence is just now emerging in many regions of the world. I use these observations to show that present day straining is concentrated in zones that are narrow (a few 10s to a few 100s of km wide) relative to the dimensions of the intervening, largely inactive blocks (100s to 1000s of km). Recent results from the western US, Greece, Turkey and New Zealand support this view.

Such kinematic behavior may be due to lateral variations in rheology and internal stresses that are intrinsic properties of continental lithosphere. Differences in thermal history, rock type, and tectonism generate lateral variations in lithospheric strength. Tectonic and magmatic activity create lateral density gradients within the continental lithosphere that perturb local stresses and can drive deformation. Deformation, once localized, will continue until local stress heterogeneities are relieved by density redistribution that accompanies deformation. In addition, frictional lock up of faults or ductile strengthening mechanisms can lead to deactivation and migration of deforming zones. Finally, changes in the forces driving and resisting motions of bounding plates, ultimately of thermal origin, lead to stress perturbations that can change the distribution and rates of continental deformation.

G21A-08 1045h

Edge-Driven Block Rotations Interpreted From New GPS Results: Papua New Guinea

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An ongoing discussion in plate tectonics involves whether microplate motions are driven by plate edge forces or by flow at the base of the lithosphere. We present results from a GPS network of 40 sites spanning much of the mainland of Papua New Guinea (PNG). Most of the sites are concentrated in the region of the active Finisterre arc-continent collision and have been observed on multiple campaigns from 1993-2001. Significant portions of the Ramu-Markham fault are locked, which has implications for seismic hazard assessment in the Markham Valley region. Additionally, we find that out-of-sequence thrusting is important in emplacement of the Finisterre arc terrane onto the PNG mainland. Site velocities derived from these GPS data have helped to delineate the major tectonic blocks in the region. We model site velocities by simultaneously dealing with rigid block rotation and elastic strain. We find that the mainland of PNG consists of four distinct tectonic plates: the Australian, South Bismarck and Woodlark plates (in agreement with previous studies), and a previously unrecognized New Guinea Highlands plate. The relative rotation poles for at least two of these plate pairs plot on their respective boundaries, indicating that microplate motion in PNG may be dominantly edge-driven, as predicted for this region by Schouten and Benes (1993).

G21A-09 1100h

Bookshelf Tectonics Observed by InSAR: Coseismic Deformation and Triggered Back-Slip in the South Iceland Seismic Zone from June 2000 earthquakes

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We present InSAR observations of deformation due to two MS = 6.6 earthquakes that occurred in the South Iceland Seismic Zone (SISZ) on June 17 and 21, 2000. The SISZ is a transform zone connecting the western and eastern volcanic zones in Iceland. The SISZ consists of many parallel right-lateral N-S striking faults that accommodate an overall left-lateral E-W shearing associated with plate spreading, in a " bookshelf tectonics" fashion. The June 2000 earthquakes happened on two of the parallel N-S striking faults.

We have analyzed a series of 21 interferograms of an area in South Iceland. Coseismic deformation originating from the two faults located approximately 20 km apart is observed in the interferogram series. We observe up to 15 cm of range change due to right-lateral strike-slip on these N-S striking faults, although the fault displacement is mainly perpendicular to the satellite look direction. Modeling of the fault geometry and slip distribution was carried out assuming finite dislocations buried in an elastic half-space. Both forward modeling in a trial-and-error scheme and two step inversion have been conducted. In the two step inversion we first solve for non-linear model parameters (the fault geometry) using simulated annealing and then estimate the fault slip distribution with linear least squares. With both dislocation-modeling methods we find a best-fitting model that agrees well with aftershock locations and moment magnitudes estimated by U.S. Geological Survey (from seismograms). The fault slip distribution of both events was slightly asymmetric on near vertical faults that extend to approximately 10 km depth and are 15-16 km long. The trial-and-error models have a maximum slip of about 2 meters over a 3-km-wide area near the center of the faults. Maximum slip found by the inversion depends on the assumed smoothness of the fault slip. The models can explain majority of the observed signals.

One coseismic interferogram indicates that post-seismic back-slip occurred on a part of the June 17 fault, sometime during the timespan of the interferogram from June 19 to July 24, 2000. This back-slip was most likely triggered by the June 21 earthquake, which forced the block between the two faults towards south. This suggested back-slip amounts to about 10 cm and is minor compared co-seismic slip that occurred on this fault plane on June 17. However, we suggest that such minor back-slip is sufficient to create fault slicken-sides. This is consistent with geological studies of fault slip (slicken-sides) at other eroded faults in the SISZ that have indicated that both right-lateral and left-lateral slip has occurred on some of the N-S faults in the zone.

G21A-10 1115h

Effective Transition Zone and Revised 3-D Dislocation Model of Interseismic Deformation for the Cascadia Subduction Zone

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The apparent success of the dislocation model in forward and inverse modeling of subduction zone interseismic deformation is largely due to the use of an Effective Transition Zone (ETZ) between the updip locked zone and the zone of full slip at depths. The ETZ of a subduction interface is philosophically comparable to the "effective elastic thickness" of a lithospheric plate. Interseismic deformation rates change with time due to viscoelastic stress relaxation, but the dislocation model takes a "snapshot" by attributing all deformation to fault motion. CAS3D-2, a new 3-D interseismic dislocation model for Cascadia, is based on the concept of ETZ. Horizontal deformation data, including strain rates and surface velocities from GPS measurements, provide primary geodetic constraints, but uplift rate data from tide gauges and leveling also provide important validations for the model.The effect of northward secular motion of the central and southern Cascadia forearc is subtracted to obtain the effective convergence between the subducting plate and the forearc. The locked zone, based on the results of previous thermal models constrained by heat flow observations, is located entirely offshore beneath the continental slope. In the ETZ, slip deficit rate is assumed to decrease exponentially with downdip distance. The exponential function resolves the problem of over-predicting coastal GPS velocities and under-predicting inland velocities by previous models that used a linear downdip transition. A wide ETZ partially accounts for the stress relaxation in the mantle wedge since the last great earthquake 300 years ago. The deformation pattern at a different time after a great earthquake would be different from what is observed at present at Cascadia and thus would require a different ETZ in a dislocation model.

G21A-11 1130h

GPS Velocity Field and Active Tectonics of the US Pacific Northwest

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GPS measurements from 1992 through 2001 are being used to estimate a velocity field for about 300 geodetic markers in Washington and Oregon. The campaign data set comprises over 4000 station occupations on 430 days between June, 1992, and August, 2001. In August, 2001, we occupied 200 sites in northern Oregon and throughout Washington. Site velocities are estimated in the ITRF97 frame and then rotated into the North American (NA) reference frame by minimizing the velocities of 19 NA sites estimated by our processing. The outstanding feature of the velocity field in the NA reference frame is a clockwise rotation of most

of western Oregon and parts of SW Washington about a nearby pole. Superimposed on this rotational signal is roughly E-directed uniaxial contraction arising from temporal stress increases across the Cascadia subduction thrust. We model the velocity field with a series of rotating blocks whose boundaries are subject to strain due to drag against adjacent blocks. We invert the GPS results to solve for poles of rotation, spatial distribution of coupling on the 3-dimensional subduction thrust fault, and sections of the block boundaries. Modeling results, that do not include the 2001 data, show that the GPS vectors are fit best when a NW Washington block also rotates clockwise relative to North America but more slowly than Oregon does. These results suggest that the rate of permanent shortening, the type that causes upper plate earthquakes, across the Puget Sound region is approximately 2.1 $\pm 1.2 mm/a$.

G21A-12 1145h

Plate kinematics of East Asia From GPS Observations

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The velocities of 16 stations extending from Svalbard Island in the north Atlantic to eastern Siberia define the Eurasian plate with a root-mean-square (rms) less than 1 mm/yr. Using these stations as a frame of reference, we have estimated velocities for 58 stations in east Asia from the Arctic to southern China and combined these with the results of other investigators to infer the first-order kinematics of East Asia. The boundary between the Eurasian and North American plates in eastern Siberia is marked by a zone of mild, < 2 mm/yr, compression across the Cherskiy Range but is unclear farther south. Our single permanent station in northern Chukotka (BILI) does not move relative to North America by more than 1 ± 1 mm/yr. Stations in Siberia at the northern margin of the Sea of Okhotsk, at Sakhalin Island, and at western Hokkaido move relative to North America by 2-5 mm/yr and may indicate the existence of microplates encompassing one or more of the Sea of Okhotsk, Bering Sea, and Arctic Ocean. Our estimates of the velocities of stations in southeastern Russia (VLAD), Korea, and China are sensitive at the level of 2-6 mm/yr to the realization of the Eurasian frame and render problematic the characterization of the motion of South China and a possible Amurian plate to the north.

G22A MC: Hall D Tuesday 1330h

Operational Altimetry: Data Sources, Systems, and Applications II *(joint with OS)*

Presiding: **G Jacobs,** NRL**; J Lillibridge,** NOAA

G22A-0202 1330h POSTER

Operational and Precise Orbit Determination for GEOSAT Follow-On Altimetry

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The GEOSAT Follow-On spacecraft (GFO-1), launched in early 1998, began continuous radar altimeter coverage of the oceans in 2000. After an extensive series of calibration campaigns in 1999 and 2000, the satellite was accepted by the U.S. Navy on November 29, 2000. GFO supplements the altimetry data from TOPEX/POSEIDON and ERS-2 (and their successors JASON-1 and ENVISAT), by providing a different synoptic sampling of the oceans with its 17-day ground track repeat cycle.

Altimeter crossover analysis suggests that GFO is capable of "cm-class" altimetry, with orbit error as the largest contributor to the sea surface height error budget. Satellite laser ranging (SLR), especially in combination with altimeter crossover data, offers the only means of precise orbit determination, due to the failure of the GPS tracking system on board GFO. SLR tracking is augmented by the operational Doppler tracking system. These data have been used to tune the gravity field and satellite macro-model (a 3-D representation of the spacecraft geometry and surface properties) used in the orbit determination software.

Near real-time medium precision orbits (MOEs) are generated at GSFC within 72 hours, with radial orbit errors of 10 cm or less. These preliminary orbits are suitable for mesoscale studies where short-arc orbit error removal doesn't severely impact the sea surface height signals. Beginning in August, 2001 GSFC began releasing Precision Orbit Ephemeris (POE) data for use in the NOAA GDR and NASA Pathfinder Project. The POE orbits are more accurate than the MOEs, with orbit errors of 5 cm or less. To characterize the errors, these orbits are evaluated using tracking data residual analysis, GFO crossover and collinear analyses, dual-satellite crossovers, and direct orbit comparisons. Geophysical validation of the final sea surface heights is performed by comparisons with in situ tide gauge data as well as height fields from contemporaneous altimetry missions.

G22A-0203 1330h POSTER

Towards 1-cm Orbits

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TOPEX/POSEIDON (T/P) has demonstrated that using radar altimetry, the time variation of ocean topography can be determined with an accuracy of a few centimeters, and has also established the new capability for monitoring global sea level change with a precision of about 1 mm/year. This has become possible due to the high radial accuracy (2-3 cm) achieved for the T/P orbits, whereas in previous missions orbit error dominated the altimeter error budget. Jason, the T/P follow-on, will continue measurement of the ocean surface using radar altimetry with the same, if not better accuracy. Reaching the Jason centimeter accuracy goal would greatly benefit the knowledge of ocean circulation. For example this would reduce the present errors in estimates of time rates of change in oceanic heat flux divergence to values close to those anticipated for greenhouse gas increase, as well as obtain clearly submillimeter accuracy in determining global sea level rise, currently estimated to be 1-2 mm/year. What is required for achieving 1-cm radial orbit accuracy? Orbit accuracy depends on the fidelity of the force and measurement models, and quality of tracking data. Simulated SLR, GPS, and "perfect" tracking of the T/P and Jason satellites were studied using GEODYN, applying dynamic and reduced-dynamic strategies , current and anticipated error budgets, to evaluate error sensitivity and Precision Orbit Determination (POD) capability. Simulation studies indicate that achieving the 1-cm goal poses a major challenge, but is possible with sufficiently precise and dense tracking. Combination solutions such as GPS/SLR offer more promise than using GPS alone. Altimeter crossover data, although not evaluated in the simulations, also offer a very strong data type for POD. Possibly significant improvements to current T/P POD with the inclusion of altimeter crossover data are evaluated using actual data, and also presented.

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High Resolution SSH Anomaly Fields from Coincident T/P, ERS-2, and GFO Altimeter Observations

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It is recommended, both for mesoscale and large-scale [ocean circulation] studies, that multiple altimetric satellites be flown contemporaneously. (Koblinsky, et al., 1992). After many years of development this unique situation exists today. TOPEX/POSEIDON, ERS-2, and GFO missions at 10, 35, and 17-day repeat periods, respectively, are providing a dense spatial sampling of the global ocean. In order to accurately map the ocean mesoscale field from the combined missions, a homogeneous, inter-calibrated data set has been generated. This is achieved through the adjustment of GFO and ERS-2 altimetry into the more precise TOPEX/POSEIDON reference frame to minimize inter-mission biases and radial orbit errors. In this presentation we provide a time series of global high resolution sea surface height and surface geostrophic current anomaly fields from the blended multi-satellite data set. The height fields are validated against the WOCE global tide gauge network, and their eddy resolving capability is examined through inter-comparison with regional images provided by Sea Wifs and MODIS. The current fields are intercompared with surface drifter observations in regions where geostrophy dominates the flow to assess how well we can observe the eddy kinetic energy spectrum.

URL: http://nemo.gsfc.nasa.gov/ocean.html

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Towards a Global Operational Altimeter Service: RADS

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DEOS' anticipation of the need for global altimeter services started the Radar Altimeter Database System (RADS) project. Embedded in the Netherlands Earth Observation NETwork (NEONET), this project is supported by the Dutch government. After defining the database content, collecting altimeter and ancillary data from all available altimeter missions and combining them with the latest (correction) models, we have arrived at an (inter)nationally appreciated validated, calibrated and consistent altimeter data set, comprising over 15 years of valuable sea level, wave height and wind data. Whenever new data or knowledge arrives the database is updated. Major assets of RADS are the upgraded ERS orbits and the flexible data organization.

This paper presents an overview of the work involved in establishing RADS: the I/O, enhancements, screening, formatting, harmonization, and CAL/VAL. The aim is to improve the algorithms for converting satellite data to the final geophysical products. Global altimeter data from various satellites are intercompared or compared to external data, like tide gauges, wind speed measurements, etc. This has been used to establish the data's quality and to enhance algorithms for deriving the geophysical parameters. Also: ironing out inconsistencies in significant wave height, sea state, inverse barometer, wet troposphere corrections, orbits, biases, drifts, and time tagging. Access to the database at level 1 level is provided for by a web portal (`http://www.deos.tudelft.nl/altim/rads`). Here also status, higher level products, software, and literature can be obtained. Finally, examples are given of putting in RADS in research and education. We fully automated the Gulf Stream and El Niño web pages: Hovmuller diagrams and eddy kinetic energy plots are refreshed regularly. Furthermore, RADS has been successfully used at Delft Hydraulics in a data assimilation scheme for improving tides and storm surge predictions, showing the importance of near real-time observations, and at the Dutch Meteorological Office KNMI for ENSO studies.