minutes or more also improve accuracy; combining 1 hour occupations with precise orbital data yields a vertical error of <3 cm for all stations within 20-30 km of the fixed reference. In both case studies, gravity measurements tracked known mass changes in the reservoir. In the southern Salt Lake valley study, mass changes measured along the line of gravity stations qualitatively tracked water well level changes, but very complicated local hydrology precluded more detailed quantitative comparisons. At the Geysers, the station grid shows coherent spatial signals, with gravity changes that are within measurement error of theoretical predictions.

URL: http://thermal.gg.utah.edu/~gettings

G21C-0284 0830h POSTER

Sea Level, Tectonics, Environmental Monitoring and Altimeter Calibration in Eastern Mediterranean

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The Eastern Mediterranean area is one of great interest for its intense tectonic activity as well as for its regional oceanography. Recent observations convincingly demonstrated the importance of the area for regional meteorological and climatologic changes. Monitoring tide-gauge locations with continuous GPS on the other hand removes the uncertainties introduced by local tectonics that contaminate the observed sea level variations. Such a global tide-gauge network with long historical records is already used to calibrate satellite altimeters (e.g. on TOPEX/POSEIDON, GFO, JASON-1, ENVISAT, etc.), at present, a common IOC-GLOSS-IGS effort –TIGA. Crete hosts two of the oldest tide-gauges in the regional network, at Souda Bay and Heraklion. We recently completed the instrumentation of a third, state-of-the-art mean sea level (MSL) monitoring facility in southwestern Crete, on the isle of Gavdos, the southernmost European parcel of land. Our project (GAVDOS) further expands the regional tide gauge network to the south, and contributes to TIGA and MedGLOSS. The presentation will focus on the altimeter calibration aspect of the facility, in particular, its application to the JASON-1 mission. Another component of the "GAVDOS" project is the repeated occupation of the older tide-gauges at Souda Bay and Heraklion, and their tie to the new facility. We will present results from positioning of these sites and some of the available tidal records. The Gavdos facility is situated under a ground-track crossing point of the original T/P and present JASON-1 orbits, allowing two calibration observations per cycle. It is an ideal site if the tectonic motions are monitored precisely and continuously. The facility hosts in addition to two tide gauges, multiple GPS receivers, a DORIS beacon for positioning and orbit control, a transponder for direct calibration, and is visited periodically by water vapor radiometers and solar spectrometers, GPS-laden buoys, and airborne surveys with gravimeters and laser profiling lidars. The French transportable laser ranging system (FTLRS) completed recently a co-location campaign at Chania, Crete, for improved orbit control over the site, and to ensure the best possible and most reliable results.

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

G21C-0285 0830h POSTER

Results of TOPEX/Poseidon-Jason Calibration and Recent Changes in Global Mean Sea Level

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The Jason-1 radar altimetry mission was designed to resolve changes in global mean sea level variation to provide for studies of interannual sea level change. We have completed a calibration of the Jason-1 measurements as part of an effort to continue the 10-year time series of sea level change measurements compiled by the TOPEX/ POSEIDON (T/P) mission. We have completed detailed comparisons of the T/P and Jason-1 sea level measurements, including each of the measurement corrections using the latest instrument and geophysical corrections, including precise orbits and seastate bias models. We present the results of cross-satellite and independent tide gauge calibrations. In late 2002 global mean sea level (GMSL) as measured by Jason-1 and TOPEX/POSEIDON satellite altimetry surged by 15 mm over a period of a few weeks. This anomaly is on the order of the longer surge seen during the strong El Niño event of 1998. Interannual and low-frequency signals in sea level variability can have significant effects on the recovery of secular trends in short records. *Nerem et al.* [1999] estimated that one would need at least 10 years of continuous altimeter coverage to resolve a 2 mm yr^{-1} secular trend with an accuracy of 0.5 mm yr^{-1} in the presence of ENSO variability. Similarly, *Chambers et al.* [2002] have observed that long-term GMSL from tide gauges is significantly affected by El Niño/Southern Oscillation (ENSO) climate cycles, although the size of the Southern Oscillation Index (SOI) does not predict the magnitude of change in GMSL. Sea level anomalies associated with El Niño events are mostly attributable to steric changes in the ocean. However, thermal affects mask eustatic changes due to the addition of water to the ocean, such as surges in glacier melt [*Dyurgerov*, 2002]. We use results from satellite altimetry, Expendable Bathythermograph, and the Estimating the Circulation and Climate of the Ocean (ECCO) model to investigate the spatial extent and depth distribution of the contributions to GMSL.

G21D MCC: Level 1 Tuesday 0830h

Deformation Processes Posters

Presiding: **J T Freymueller,** University of Alaska, Fairbanks**; M Battaglia,** University of California, Berkeley

G21D-0286 0830h POSTER

Continental Dynamics Between India and Antarctica by Global Network Solution Using Maitri, Indian GPS Station at Antarctica

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The GPS-Geodesy program initiated in 1995 by establishing a Permanent IGS GPS Tracking station at NGRI has resulted in the estimation of Indian plate motion to be 37 $\pm$2.0 mmy^{-1} towards NNE direction. To understand the tectonic activity and crustal deformation in the south of Indian peninsula, the driving mechanisms and the response of the Indian Ocean Lithosphere and holistically compound the Indian Plate kinematics, NGRI has extended the GPS-Geodesy programme by establishing a permanent GPS station at Maitri, at Antarctica in 1997 in Schirmacher oasis between SANAE and SYOWA. The data from the IGS stations in the islands surrounding Indian plate is included in the global network solution. Very long baselines from Kerguelen, as it is relatively a stable site, to Maitri and other IGS Stations in different plates Casey, Davis, Seychelles, Coco, Hartebeesthoek, Yaragadee, and Tidbinbilla have been estimated. The GPS derived velocity vectors of these sites throw a significant insight into the plausible causes of northward movement of Indian plate. These results also elucidate the strain accumulation processes in the Indian Ocean and the effects of these forces on the Indian Plate.

G21D-0287 0830h POSTER

Observation of Sea-floor Deformation in Tokai-Nankai Region, Japan

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We have developed an observation system for observing sea-floor crustal deformation. The observation system is composed of 1) acoustic measurement between a ship transducer and sea-floor transponders, and 2) kinematic GPS positioning of the observation vessel. A sea-floor positioning test has revealed that our system can obtain the horizontal location of a sea-floor station within 5-6 cm (95-% confidence interval) [Tadokoro et al., 2001].
We installed transponder networks at Tokai region (Suguga trough), and Nankai trough, Japan, with water depths of 1000-2200 m. The transponders are set in a 13-inchs glass sphere, and equipped batteries for five-years-measurement. Large subduction earthquakes are expected to occur in these regions during early this century. It is necessary to monitor spatial distribution of coupling regions and their temporal changes for predicting these earthquakes and disaster prevention. The sea-floor transponder network is expected to be a useful tool to accomplish them. Each network is composed of two to four transponder arrays. We plan to monitor sea-floor deformation in the regions five years.
The GPS positioning causes the major error in our whole system. An experiment on kinematic GPS positioning with several base lines and a moving antenna shows that larger base lines, especially for those about 50 km or longer, causes larger GPS positioning error [Sato et al., 2001].
Temporal and spatial variations of sound speed structure in seawater is also a possibility of error source. We repeatedly measured sound speeds in regions of about 4 square-miles by using CTD profilers. The results are as follows:) The long-term (seasonal and annual) change in sound speed is up to 15 m/s (1 %) in a portion shallower than about 600 m.) The short-term (within several hours to one day) change is 3-5 m/s at several layers.
We also performed CTD profiler measurements with two vessels so that we could detect correct lateral variations of sound speed. The distances between the two vessels are 2, 1, 0.6, 0.3, and 0.15 miles. The two vessels were located on lines parallel and perpendicular to the orientation of ship drift.
We also performed CTD profiler measurements with two vessels so that we could detect correct lateral variations of sound speed. The distances between the two vessels are 2, 1, 0.6, 0.3, and 0.15 miles. The two vessels were located on lines parallel and perpendicular to the orientation of ship drift.

G21D-0288 0830h POSTER

The Adriatic region: an independent microplate within the Africa-Eurasia collision zone

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We use Global Positioning System measurements at 30 sites to study crustal motion in the Adriatic region (central Mediterranean), alternately viewed as a promontory of North Africa or as a microplate within the Africa-Eurasia plate boundary.

We employ publicly available GPS observations made stations of the European Reference Permanent Network (EUREF) and the Italian Space Agency (ASI) continuous GPS networks to estimate deformation in the Adriatic region. We analyze the data using the GAMIT/GLOBK software. To improve the realization of a stable reference frame for the velocity solution, additional sites from the International GPS Service (IGS) and EUREF networks are included through the publicly available global regional loosely constrained solutions performed by the Scripps Orbit and Permanent Array Center (SOPAC). All together, our solution includes data spanning 4 years from 106 stations, including 44 in the Mediterranean area. We incorporate 23 additional sites from McCluski et al. [2000] to resolve the deformation in the Eastern Mediterranean and Caucasus.

Preliminary motions (1999-2002), relative to stable Eurasia, show a north-westward motion (N 24±5 W) at 5±1 mm/yr for stations located on the northern edge of the African plate. Sites in Corsica and northwestern Italy show no significant deformation, while the stations close to the Adriatic sea are characterized by a north-eastward motion (N 24±5 E) at 5±1 mm/yr. Stations located on the eastern edge of the Adriatic Sea move in the same direction (N 21±8 E) at a somewhat slower rate (3±1 mm/yr). The northward displacement (N 3±8 E at 3±1 mm/yr) of sites in the southern Italian peninsula may reflect a transition zone between the African plate and the Adriatic region.

To test the competing tectonic models proposed, we develop a block model of regional deformation that accounts for plate angular velocities and strain accumulation on plate boundary faults. The results suggest that an independent microplate model provides a better explanation for most of the deformation observed the Mediterranean area. In particular, this model correctly

reproduces the NE motion of the Adriatic region, the motion of the Anatolian and Aegean plates in the eastern Mediterranean, and the NW motion of the African plate.

G21D-0289 0830h POSTER

Distribution of Displacement Across Canyonlands Grabens Using GPS and InSAR

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The Needles District of Canyonlands National Park in southeastern Utah is a unique geologic region in which active extensional salt tectonics can be observed. The Needles District of the Canyonlands consists of an approximately 500-meter-thick sedimentary section that is underlain by the Paradox evaporites. This entire package is situated on the western flank of the Monument Uplift. As the adjacent Colorado River incised down into the Paradox salt substrate, the upper sedimentary sequence became unbuttressed and consequently begain to extend toward the Colorado River along the 4° northwest dip of the Monument Uplift's western flank. Prior to our study, knowledge of Canyonlands deformation rates was limited to long term geologic averages between 2 mm/yr and 2 cm/yr that assumed spatial and temporal uniformity. Our research utilizes two geodetic techniques, Global Positioning System (GPS) and Interferometric Synthetic Aperture Radar (InSAR), to observe a clearer picture of current deformation rates across the entire study area. Rates from these two techniques are independently determined, thereby allowing a means of comparison and error estimation. Utilizing 14 European Remote Sensing (ERS) Synthetic Aperture Radar (SAR) images encompassing a 7-year period of observation (1992-1999), 10 successful interferograms with short baselines (< 100 m) from both ascending and descending orbital trajectories have been produced. The decomposition of these interferograms, in conjunction with campaign GPS data, indicates relative regional subsidence of up to 3 mm/yr within the graben system, predominantly east of Cataract Canyon. The interferograms additionally show spatially varied rates of horizontal deformation, with a maximum rate of deformation (6 mm/yr) near the eastern margin of the faulted region. GPS observations corroborate InSAR decomposition results. Observations of deformation along several profiles support prior modeling efforts that suggest basal salt flow regulates overburden deformation.

G21D-0290 0830h POSTER

Permanent GPS and crustal deformation in Greenland

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The National Survey and Cadastre - Denmark (KMS) is responsible for the geodetic definition of the reference network in Greenland. Permanent GPS plays an important role in the monitoring and maintenance of the geodetic network. Furthermore, KMS supports the international GPS infrastructure and research by supporting IGS.
In October 1998 KMS has established a permanent GPS station THU2 at Thule Airbase. Besides THU2 the old permanent station THU1 is also running. The Thule stations are important because they are two of the few northernmost stations in the IGS network. THU2 has been operating since March 1999, and it is now a high quality and high performance station contributing to the IGS Low-Earth Orbiters (LEO) network.
Besides the GPS stations in Thule, KMS is also running a permanent GPS station SCOB in Scoresbysund, which was established in August 1997, and in October 2001 a permanent station QAQ1 was established in Qaqortoq. This station is registered at IGS. Furthermore, University of Colorado operates the IGS station Kellyville near Kangerlussuaq and a station in Kulusuk. Using the BERNESE software, we have calculated daily baseline solutions between the GPS sites. The time series of the 3D crustal movements are analyzed due to post glacial rebound, plate tectonic and seasonal deformations (e.g. atmosphere loading). In addition, we have used the GIPSY OASIS II software to obtain similar time series. The results are compared with modeled estimates of the glacial rebound.

G21D-0291 0830h POSTER

Study of Co-Seismic Ground Deformation due to Two Earthquakes in India Using the Technique of SAR Interferometry

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The technique of SAR Interferometry has been used to study co-seismic ground deformation due to the Chamoli earthquake of 28th March 1999 and the Latur earthquake of 29th September 1993. For the Latur area, 11 ERS-1/2 SAR images were acquired and several pairs of co-seismic interferograms have been analyzed. The advantage here has been the relatively less rugged terrain while the fact that this is an agricultural land is the main hurdle in establishing the observed deformation signal as being due to the earthquake. At least two independent interferograms show possible deformation due the earthquake. For the Chamoli earthquake area, 10 ERS-1/2 SAR images were used to form co-seismic and topographic interferograms. One co-seismic interferogram has revealed possible deformation fringes due to the earthquake. The main hurdle for this area is the rugged mountainous terrain and possible strong atmospheric artifacts. ALthough the interferograms were noisy and only partial fringe patterns were obtained, an attempt has been made to use elastic dislocation modeling to obtain the best fit to the observed deformation. The results of these analyses and constraints on the earthquake parameters will be presented.

G21D-0292 0830h POSTER

A Study on Investigation of Crustal Deformation and Block Kinematics Along the Eastern Sector of the NAF by GPS Measurements

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This study constitutes part of an integrated project that have been carried out jointly by the Kandilli Observatory and Earthquake Research Institute (KOERI) and the TUBITAK-MAM to investigate crustal deformation and block kinematics by Global Positioning System (GPS) measurements in and around the eastern sector of the North Anatolian Fault (NAF) Zone. The integrated project is also include investigation of seismicity and earthquake potential. Additionally the Radon gas emissions will also be monitored on-line, near real-time along active fault zones in an attempt to predict earthquakes. The region is an ideal choice to carry out the above mentioned investigations, because due to the northward movement of the Arabian Plate, the Erzincan-Karliova region is squeezed, crushed, and expelled westward along the NAF and East Anatolian Fault Zones. The active fault pattern indicates that maximum crustal shortening and crustal deformation in Turkey takes place in this region. Despite this, the Yedisu segment of the NAF was identifed as a seismic gap and it has not been broken entirely since the 1784 earthquake. This region is the most tectonically active region in Turkey as far as the major earthquake occurences are concerned and it is capable of generating major earthquakes in every 3-4 years. It is quite obvious that following the 1992 Erzincan and 2003 Pulumur Earthquakes the Coulomb stress loading on the Yedisu segment of the NAF have been increased significantly and the region needs to be monitored vigilantly with the full armament of geophysical techniques such as seismic (network), geodetic (GPS, InSAR), and geochemical (Radon emissions) techniques. First period GPS measurements were performed at twelve GPS stations in the area. This study reports the evaluation of this GPS data.

G21D-0293 0830h POSTER

The Velocity Field in Europe and the Mediterranean from a Combination of Permanent GPS Network Results

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The accuracy achieved by permanent GPS networks now allows the detection of strain rate as small as 1 mm/yr over hundreds of kilometres, providing new constraints on how continental domains deform. In this study, we derive a new geodetic velocity field for Europe and the Mediterranean by rigorously combining (1) a selection of ITRF2000 sites, (2) a solution from a subset of sites of the European Permanent GPS Network (EUREF-EPN), (3) regional densification. The resulting velocity field describes horizontal crustal motion at approximately 130 sites in Europe with an accuracy of the order 1 mm/yr. We analyze time series to derive noise characteristics and thoroughly assess the uncertainties associated with velocities. This new velocity field is then compared and combined with published results based on campaign-mode measurements. The resulting combined velocity field provides an accurate picture of the deformation at the scale of Europe and the plate boundary zone between Europe and Africa in the Mediterranean. We discuss its tectonic implications.

G21D-0294 0830h POSTER

Deformation in the Jura Mountains (France) : First Results of Semi-Permanent GPS Network

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The western Alps and its foreland have a low to moderate seismotectonic activity, with several damaging historical earthquakes and palaeoearthquakes. The kinematics of the area is characterized by a radial extension in internal Alps and perpendicular compression in the forelands, consistently with a geodynamic model involving a counterclockwise rotation of Adriatic plate as well as the Africa-Eurasia collision. The Jura is the youngest external fold-and-thrust belt related to Alpine orogeny, with evidences of recent (Quaternary faulting) and current (seismicity, geodesy) activity. Previous geodetical studies, using triangulation and GPS data, give very high motions (3-4 mm per y) of Jura relative to stable Europe. Precise knowledge of deformation and slip rates are still unavailable to feed a reasonnable assessment of tectonic activity and seismic hazard. In 2000, we thus started the implementation of a semi-permanent GPS network, consisting in measuring 6 sites during around 10 days, twice a year. The sites were selected in order to represent the six main tectonic blocks separated by suspected active faults. One permanent site is located inside the semi-permanent network. The aim of the semi-permanent network is to enhance the regional permanent GPS network (the REGAL network), in order to infer a local crustal velocity field at lower cost. A first solution of position time series and linear station velocities has been performed using the GAMIT-GLOBK software. 19 REGAL stations and 27 IGS stations have been included in the solution. Formal uncertainties for the velocities in the ITRF 2000 reference frame are of 0.1 mm per y. The RMS of the transformation into

ITRF by constraining 5 IGS station velocities to their ITRF 2000 values is 0.5 mm per y. To get a measure of the real velocity precision, several analysis parameters will be tested, like the total time span of REGAL measurements, simulations of semi-permanent measurements at permanent stations or non-linear motion of the sites. The degree of convergence of the velocity results with adding observation epochs for the semi-permanent stations will be evaluated. Our first results indicate that the residual velocities, relative to the stable foreland, are less than 1 mm per y, and they are consistent with the velocity field calculated for the permanent stations in the western Alps (Nocquet and Calais, 2003, GJI), with a relative extension across the western Alps. Moreover, a differential displacement is recorded between the external and the internal Alps, which suggests that the Pennine Frontal Thrust is active, as previously shown by Nocquet and Calais (2003). Most of the semi-permanent points have a residual velocity towards the NW, consistent with the geological models that consider the same propagation of Jura folds and thrusts to the NW. Moreover, the preliminary calculation shows that differential velocities (0.5 mm per y) characterizes the points bordering the Vuache fault, one of the active faults of the Jura, indicating a pure left-lateral strike-slip motion on this fault, in agreement with the seismological and geological data.

G21D-0295 0830h POSTER

Activities of the LEGOS/CLS Analysis Center Within the International DORIS Service

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LEGOS/GRGS and CLS have been involved in DORIS data processing since the launch of Spot-2 in 1990. They are in charge of the scientific analysis of DORIS data in the field of geodesy, geophysics and space oceanography. They decided to jointly participate as Analysis Center for the International DORIS Service (IDS) which has been officially started on July 1, 2003 as an IAG Service. The goal of this paper is to present the current activities of the Center realized with the GINS/DYNAMO software, as well as the recent evolutions brought to the processing. One of the most important is the contribution of the three new instruments launched during the last two years onboard Jason-1, Spot-5, and Envisat. We will present the contribution of the new satellites to the positioning performances. Recently, the first Grace Gravity Model has been released. We will present results obtained with this new gravity model.

G21D-0296 0830h POSTER

On-Line Operating 3-D Seafloor Positioning System (1)

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We propose a new observation system of on-line 3-D positioning which will be deployed on the sea-bottom of convergent type plate boundaries where large interplate seismic events occurred historically. The system has observation sites at assigned intervals along optical fiber cables. Using the several cables, crossing each other, we can construct a real-time operating network of triangular base lines. Each observing site on the cable will be equipped with two-kind high gain instruments i.e., the laser ranging and pressure gauge sensors, as well as additional apparatuses to remove the influence of temperature and salinity etc. on the data. Attenuation rate of visible rays in seawater is relatively smaller at bands of blue-color (wave length; $\sim$ 450nm) to yellowish green-color ($\sim$ 550nm). The attenuation rate of optical signals of blue to yellow-green color in highly transparent seawater is 0.1 $\sim$ 0.5 dB/m. If we can utilize the high power optical laser output of the blue to yellow-green band for the positioning, the signals can reach the target receiver station with highly sensitive detector located at the distance of 10**2 m or larger. Using additional data of thermal and salinity fields etc. for compensating refractive index of laser signal ray path in clean seawater, we may attain the resolution of laser ranging at an order of 1 mm for each triangular base line with the total length of 1 $\sim$ 2 km. The base line consists of several secondary positioning stations with the spacing of $\sim$ 10**2 m. To improve the data resolution, we apply signal processing such as low-pass filtering etc. As is important, we cannot decompose the change of the base line distance data into 3-D individual components. We need another kind data, such as pure vertical coordinate of the positioning sites to resolve the 3-D components. To measure the vertical coordinate of the seafloor stations, we utilize data from the high gain pressure sensor. In the case of crystallized quartz-based pressure sensor which are commonly used in several on-line sea-bottom seismic observation systems in Japan, the resolution of water depth change is $\sim$ 1 mm being sufficient to detect the arrival of larger tsunamis or similar phenomena. As a result of our previous observation based on the crystallized quartz-based pressure sensor, the maximum amplitude of pressure change due to tsunamis on the flat seafloor with the depth of 2 $\sim$ 3 km is approximately ten-times smaller than that at the tide gauge station at neighboring open shore. Generally, most of flat sea-bottom at plate boundary regions are covered with less consolidated sedimentary layer with variable thickness. During large shallow seismic events at regional distances, freely settled sea-bottom stations from the sea surface may suffer some additional or differential movement(s), especially in the horizontal directions, from deeper basal rock layer. To get observation data with high reliability even for long periods including some intermittent activity of shallow large earthquakes with the epicentral distances of several hundred km or less, we must carefully monitor the position not of instruments landed freely on sea-bottom surface but of those tightly fixed with the deeper basal rock. Thus, we have to install and fix observation sites of the network on deeply rooted boreholes or on tightly coupled tool with the basal rock layer, as many as possible. To raise the ratio of the number of observation items vs. the total system expense, we should add some other geophysical instruments such as gravity, broad-band seismic, or electro-magnetic sensors at selected stations.

G21D-0297 0830h POSTER

Examination on Repeatability of GPS/Acoustic Seafloor Positioning for the Reference Points deployed around Japan

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We have been developing a system for precise seafloor geodetic measurement with the GPS/Acoustic combination technique and deploying about fifteen seafloor reference points on the land-ward slope of the major trenches around Japan, such as Japan Trench and Nankai Trough. Each reference point has four sets of seafloor acoustic transponders placed in a square. The primary purpose of our observation is to detect and monitor the crustal deformation caused by the subduction of the oceanic plate near the plate boundary. At each point, we carry out a campaign observation with several days using a survey vessel of Japan Coast Guard and revisit it once or twice a year, though the weather condition often hinders sufficient data acquisition. The procedure of data analysis consists of following three different stages as a whole: (1) kinematic GPS analysis, (2) acoustic wave analysis to obtain round travel time between the transducer on board and seafloor transponder, (3) a combination of results from (1) and (2) to get the precise seafloor position. The analysis for (3) is performed by a linear inversion method based on the least squares estimation. Acoustic velocities are given from the CTD measurement as initial values and corrected in the process by using residuals of the travel time data. Using data from our reference points with comparatively many observation days, we examine repeatability of obtained seafloor positions. For this purpose, we divided data from one campaign epoch into independent subsets, each with one or two days, and compared the obtained coordinates. The best result shows a repeatability of several centimeters in the horizontal components for the averaged coordinates of four sets of stations.

G21D-0298 0830h POSTER

Repeated Observation of Sea-floor Crustal Deformation at Suruga and Nankai Trough in 2002 and 2003

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In order to monitor seafloor crustal deformation is one of the most important roles of global strain measurement because about 70 % of the Earth's surface is covered with seawater. Additionally, most part of the plate boundaries and seismogenic zones of interplate earthquakes are located under the sea. To achieve the monitoring of seafloor crustal deformation, we have developed a system with kinematic GPS positioning and acoustic ranging. We have repeatedly tested for the accuracy of our system in both Suruga Bay and Kumano Basin, central Japan in 2002 and 2003. The Suruga Bay is an appropriate site to test the seafloor observation system because it can be well-surrounded by coastal GPS reference stations with short baselines < 15km. In addition, a subduction plate boundary between the Philippine Sea and Eurasian plates lies in the Suruga bay, where a large earthquake has been anticipated to occur in a seismic gap. The Suruga Trough is thus worthy of monitoring the sea-floor crustal deformation. In the Suruga Trough, we installed two sets of three ocean-bottom units at depths about 800 m on both sides of the trough on October 29-30 and November 19-21, 2002, respectively. In the Kumano Basin, eastern Nankai Trough, we installed two arrays at about 2200 m depth on June 12 and July 14, 2003. We measured the slant ranges between the acoustic transducer on the observation vessel and those of the ocean-bottom units. Combining ship positions measured by GPS, vessel's attitudes, and acoustic travel-time data, we determine the precise locations of ocean-bottom units. Our system will make it possible to estimate very accurate seafloor position with acoustic ranging data. During the survey we also measured two CTD profiles at the same time over distances 0.1nm to 2 nm, to estimate lateral heterogeneity of the sea-water sound velocity. On the basis of such data, the observations enable us to estimate the strain accumulation at those plate boundaries. We report the evaluation about the locations of ocean-bottom units and these systematic errors in our whole observations. The present observation system will attain a centimeter-level resolution of sea-bottom position.

G21E MCC: 2010 Tuesday 1020h

Effect of Atmosphere and Ocean on Geodesy and Geodynamics: Observation and Modeling I *(joint with A, OS)*

Presiding: **D A Salstein,** Atmospheric and Environmental Research, Inc.**; T Johnson,** U.S. Naval Observatory

G21E-01 1025h

Global atmospheric datasets for excitations of Earth rotation and gravity

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Atmospheric reanalyses are routinely used in geodetic applications because of their general reliability and consistency. Those from the US National Centers for Environmental Prediction-National Center for Atmospheric Research span over 55 years, including the whole era during which satellite-based data were available for ingestion into data assimilation systems. From this reanalysis system, fields of winds and surface pressures are used to compute excitations for Earth rotation and polar motion and related values of the torques that transfer angular momentum between the atmosphere, ocean, and solid Earth. Additionally, the surface pressure field closely reflects the atmospheric mass distribution, important for studies of terrestrial gravity. The reanalyses of the European Centre for Medium Range Weather Forecasts, first over 15 years, and scheduled soon for 40+ years, provides an alternate, and higher resolution, set of such data. These supplement the operational series that provide the state-of-the-art results at any particular time. To investi-