Session 1
Space Geodynamics : Reviews, Project, Network and Reference Frame

01-01

Living on a Restless Earth

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ABSTRACT

Earthquakes, volcanic eruptions, severe storms, floods, droughts, and tsunamis are those not so welcome natural events that have plagued humanity for millennia. It is commonly believed that the Minoan civilization was destroyed by the one two punch of a cataclysmic volcanic explosion and the associated tsunami. We only have to look at the Kobe Earthquake, a moderate sized earthquake, that cost thousands of lives and rocked the global economic system to understand the value of improved forecasting and preparedness. Solid Earth scientists are making impressive gains in our measurement and understanding of Earth dynamics. A global geodetic network with millimeter accuracy supports the measurements of Interferometric Synthetic Aperture Radar (INSAR), Light Detection and Ranging (LIDAR) and geodetic GPS networks with the measurement of subtle centimeter and millimeter scale surface changes such as the subsidence of basins due to fluid withdrawal or the emplacement of magma deep within an awakening volcano. Lidar provides for the rapid evaluation of coastal erosion and the accurate measurement of flood plains, or the tracing of fault structure below forest canopies for the ultimate purpose of risk assessment. GRACE will measure time variations in gravity with sufficient accuracy to measure on a monthly basis centimeter level changes in ground water or the heating of the worlds oceans.

Our vision is to equip the next generation with the tools necessary to prepare for earthquakes and volcanic eruptions with the same certainty as we now prepare for severe storms. Geodetic imaging or timely synoptic measurement of crustal deformation will be one of these critical tools. The technology of choice is likely to be InSAR deployed in high to geosynchronous Earth orbit. Lidar based topographic mapping has been amply demonstrated by the Mars Global Surveyor whose topographic maps of the Red Planet leave us all in awe. We need similar spacebased lidar mapping here on Earth to better track the dynamics of our coastal zones and flood plains and to map the subtle signatures of fault zones over our land surfaces. Another target should be the viscoelastic relaxation waves that sense both the strength and structure of the crust as they slowly propagate outward from earthquake epicenters. Interacting viscoelastic waves may sufficiently change the stress regime within the crust to play a role in earthquake generation. Presently we can measure only the near field effects of these waves immediately following an earthquake.

The Solid Earth does not end at the ocean's edge. Satellite borne ocean altimeters provided us with the first accurate and complete map of ocean bathymetry. High resolution swath mapping altimeters could vastly expand our ability to look into the ocean basins to locate and better understand under sea thermal events such as thermal plume fields and volcanic eruptions. The GRACE mission will demonstrate the mapping of water storage over the Earth's surface through the measurement of time variable gravity. Future gravity missions will provide another two to three orders of magnitude in sensitivity utilizing laser based navigation or quantum gravity gradiometers to measure the warping of the earth's crust in ocean trenches, the building of the Andes, or the migration of magma into awakening volcanoes.

Space based geomagnetic measurements such as magnetolluric sounding will provide new views into the Earth, opening up possibilities of imaging the Hawaiian hot spot plume, examining stress related changes in the lithosphere and mantle, accurately measuring magnetohydrodynamic flow within the Earth's core, or verifying the differential rotation of the solid inner core.

01-02

Global Geophysical Fluids Center of IERS: A Progress Report

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ABSTRACT

The Global Geophysical Fluids Center (GGFC) and its seven Special Bureaus (SB, for Atmosphere, Oceans, Tides, Hydrology, Mantle, Core and Gravity/Geocenter) were establishes by the International Earth Rotation Service in 1998, to support global geodynamic research. Mass transports in the geophysical fluids of the Earth system will cause observable geodynamic effects on a broad time scale. These include (1) variations in the solid Earth's rotation (in length-of-day and polar motion/nutation) via the conservation of angular momentum and effected by torques at the fluid-solid Earth interface; (2) changes in the global gravitational field according to Newton's gravitational law; and (3) motion in the center of mass of the solid Earth relative to that of the whole Earth ("geocenter") via the conservation of linear momentum. These minute signals have become observable by space geodetic techniques, primarily VLBI, SLR, GPS, and DORIS, and new exciting data will be available by space gravity, altimetry, SAR, and magnetic missions. In this sense the precise space geodetic techniques have become effective means of remote sensing of global mass transports. The GGFC and its SBs have the responsibility of supporting, facilitating, and providing services to the worldwide research community in the related research areas. We compute, analyze, compare, archive, and disseminate the time series of the angular momenta and the related torques, gravitational coefficients, and geocenter shift for all geophysical fluids, based on global observational data, and/or products from state-of-the-art models some of which assimilate such data. The computed quantities, algorithm and data formats are standardized. This paper reviews our activities, reports the status, and looks forward into the future.

01-03

Introduction of Crustal Movement Observation Network of China

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ABSTRACT

In this paper, the national major scientific project “Crustal movement observation network of China” is introduced. The network is consisted of fiducial network, basic network, regional network and a system for data transmission, process and analysis. In the network, GPS has been mainly equipped. Additionally, VLBI, SLR, precise gravity and precise leveling are applied. The preliminary application and further development of the network are presented.

01-04

The PCGIAP Regional Geodesy Campaigns

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ABSTRACT

The Permanent Committee for GIS Infrastrucutre in Asia and the Pacific (PCGIAP)operates under the banner UNESCO banner of the UN Regional Cartographic Conferences.It involves some 55 national Surveying and Mapping agencies with a major objective of building a regional GIS infracture for improved local and regional and decision making.

Underpinning the developemnt of a homogeneous GIS data set is the need for a compatible regional Geodetic framework. The PCGIAP Regional Geodesy Working Group has been established to undertake this task.

While its objective is application focused and not scientific driven, much of the data observed can be useful for scientific research purposes by APSG scientisst. In the longer term national geodetic networks applications will need to include tectonic plate motions results established by these scientific researchers as greater accuracy is required.

01-05

The International Laser Ranging Service and Its Impact on the APSG

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ABSTRACT

The International Laser Ranging Service (ILRS) was established in September 1998 to support programs in geodetic, geophysical, and lunar research activities and to provide the International Earth Rotation Service (IERS) with products important to the maintenance of an accurate International Terrestrial Reference Frame (ITRF). Now in operation for more than two and a half years, the ILRS develops (1) the standards and specifications necessary for product consistency and (2) the priorities and tracking strategies required to maximize network efficiency. The Service collects, merges, analyzes, archives and distributes satellite and lunar laser ranging data to satisfy a variety of scientific, engineering, and operational needs and encourages the application of new technologies to enhance the quality, quantity, and cost effectiveness of its data products. The ILRS works with (1) new satellite missions in the design and building of retroreflector targets to maximize data quality and quantity and (2) science programs to optimize scientific data yield. The ILRS currently includes about 40 SLR stations, routinely tracking more than 20 retroreflector-equipped satellites and the Moon in support of user needs.

The Governing Board, with broad representation from the international SLR and LLR community, provides overall guidance and defines service policies, while the Central Bureau oversees and coordinates the daily service activities, maintains scientific and technological data bases, and facilitates communications. In the Asia Pacific Region there are a number of operating SLR stations in China, Japan, Australia, and Russia. SLR stations in contiguous regions also provide data to APSG activities. Organizations in the APSG countries participate in ILRS permanent components including the Governing Board, Operations Centers, Data Centers, and Analysis and Associate Analysis Centers. They also take part in the active Working Groups in (1) Missions, (2) Networks and Engineering, (3) Data Formats and Procedures, (4) Analysis, and (5) Signal

Processing, which provide key operational and technical expertise to better exploit current capability and to challenge the ILRS participants to keep pace with evolving user needs.

Over its first two and a half years, the ILRS has focussed on improving its data products to better satisfy its customers, including the IERS, ITRF and the geophysical community. Some of the major gaps in geographic coverage have been filled. Some key voids still remain. New technologies are being implemented to enhance autonomous operations. Procedures for approving new missions for tracking have been implemented. Pilot projects are underway to compare results from different analysis groups and to develop a formal ILRS solution for the IERS. Data procedures have been streamlined and modernizing to speed quality assurance and data availability to the user. Engineering data bases have been established to improve network performance and data tractability. Work continues to reduce the remaining systematic ranging errors due to satellite signatures and refraction.

01-06

Status of Satellite Ranging in the Asia Pacific Region

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ABSTRACT

The performance and status of all satellite Laser ranging stations in the Asia pacific Region is presented.

01-07

Current Status and Future Plans for the Chinese Satellite Laser Ranging Network

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ABSTRACT

The Chinese SLR Network consists of 5 fixed stations located in Shanghai, Changchun, Beijing, Wuhan and Kunming respectively and 2 mobile systems. The single shot precision for Lageos for these stations is in the range of 12-30 mm. The improvements of the system performance for all stations are under way. The Chinese SLR Network participates in the national project "Crustal Movement Observation Network of China", and is actively supporting the global and regional projects, such as ILRS, IERS, WPLTN (Western Pacific Laser Tracking Network) and APSG (Asia-Pacific Space Geodynamics). The operation center and the data center for the Chinese SLR Network is located at Shanghai Observatory. The Lageos data analysis report for the global stations has been published every week at the web site of Shanghai Observatory since September 1999.

01-16

IGS and the APSG

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01-08

Decadal Plans for NASA's VLBI and SLR Programs

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ABSTRACT

NASA has been a world leader in the development of VLBI and SLR ever since the 1960's. In the 1970's through the 1990's NASA led VLBI and SLR programs made pioneering measurements that led to new understandings in plate tectonics, global geodesy and earth orientation parameters. Now in the first decade of the 21st Century, NASA, working with the global space geodesy community, has new plans and directions for these techniques which hopefully will lead to further successful support of earth science. This paper will elaborate on these plans and attempt to demonstrate their relationship to the APSG program.

01-09

New IAI CRL and the Research Activities Relating VLBI

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ABSTRCT

The organization and the fund system of our CRL changed overall this April 2001. The relation between CRL and the ministry of our government altered from thegovernmental institute to the Independent Administrative Institute (IAI). Former CRL's research funds strongly depended on the parent ministry, but new IAI CRL is fundamentally independent from the ministry. The characteristic of CRL research funds shifted from the government budgets to the grant from the government. CRL will move to the multi-funds research institute. We introduce the missions, goals, and major research field of new IAI CRL. We also show the research activities on the information technologies closelyrelating to VLBI and time transfer, such as realtime ATM-base VLBI, IP over VLBI, and the discussion of VLBI database system.

01-10

The IVS Two Years after Its Implementation

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ABSTRCT

The IVS has been implemented in February 1999. IVS is a service of the IAG, IAU and nowadays from FAGS. Its purpose is to coordinate internationally the VLBI components for geodetic and astrometric research and applications. This paper describes the responsibility of the IVS and its products. It informs on the activities, IVS has carried out since its inauguration to provide and improve the VLBI products such as Earth observation parameters, stations positions and velocities.

01-11

VLBI and the ITRF 2000

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ABSTRCT

VLBI is a significant contributor to the terrestrial reference frame and ITRF2000. The VLBI stations in the APSG regionconstitute a considerable portion of the global VLBI network coverage. The quality of the VLBI network will be assessed.The construction, scale and position/velocity origin ofITRF2000 will be discussed including collocations, comparisons between space geodetic techniques and densification of ITRF2000 in the APSG region.

01-12

Radio Astronomical Observatories Svetloe and Zelenchukskaya of the Quasar Project

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ABSTRACT

The current status of the Quasar Project will be presented. The parametres of radio telescopes, receivers and other hardware installed on the radio telescopes will be shown.

01-13

TIGO and Its Contribution to Reference Frames

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ABSTRCT

TIGO is a transportable integrated geodetic observatory. It consists of a VLBI-module for participating in geodetic VLBI observing programs, a SLR module for ranging to satellites equipped with retro reflectors, a basic module employing GPS and GLONASS receivers, a superconducting gravity meter,a time and frequency system, a seismometer and meteorological sensors. TIGO will be placed soon on the Southern Hemisphere and will fill a gap in the International Geodetic Space Network (IGSN). An arrangement has been established with the University of Concepcion/Chile for the operation of TIGO in Concepcion. This paper describes the technical lay out of TIGO, the status and results and the foreseen applications in Concepcion in order to contribute to reference frames.

01-14

On the Use of Fundamental Geodetic Network in Eastern Russia for the Regional Geodynamic Studies

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ABSTRCT

Now 20 permanent GPS sites of the IGS network are established in Russia and adjacent countries. Several of these sites are collocated with the seismological automatic stations of the IRIS network. In the frame of bilateral agreement between Russian Academy of Sciences and CNES/IGN permanent orbitographical DORIS beacons are in operations in Badary, Yuzhno-Sakhalinsk, Krasnoyarsk and one station in Uzbekistan - Kitab. The Russian SLR network, being a part of the global SLR networks, consists of the Mendeleevo, Komsomolsk/Amur, laser stations in Maydanak (Uzbekistan. The new SLR system are planning to be installed in the South Siberia (Altay), as well as several permanent GPS sites in the Eastern part of the country will operate from the next year. Two observatories of the geodetic VLBI network "QUASAR" at Svetloe (near S-Petersburg) and at Zelenchukskaya (North Caucasus) are expected to be in operation in the nearest future. All these stations will serve as a basement for the russian fiducial network and will provide its connection with the global ITRF system.

01-15

Korea GPS Networks

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ABSTRACT

The Primary interest of the KGN(Korea GPS Network) is to provide a service to support the geodetic and geophysical research activities through GPS data. The service develops the necessary specifications and standards in Korea. GPS data sets provide the wide range of applications and demands.

The KGN is based on 73 nationally distributed GPS sites (Figure 1) and ten agencies (Table 1). The KGN include various activities to focus on the crustal deformation, weather prediction, geodetic reference, cadastral mapping, Earth Gravity Model and earthquake monitoring listed in Table 2.

These GPS products are sufficient to support scientific studies in Korea. The Korea GPS Network itself (Figure 1) continued to expand in 1997 with the addition of six new agencies and stations. In a network consisting of 73 sites and ten agencies, new issues emerged from the national policy activities and international conferences shown in Table 3.