

Meeting the Challenge: How can the International GNSS Service (IGS) Contribute to the Global Geodetic Observing System (GGOS)?

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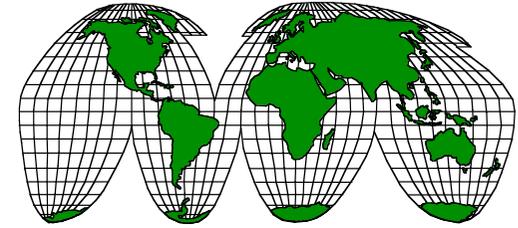
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IGS Workshop
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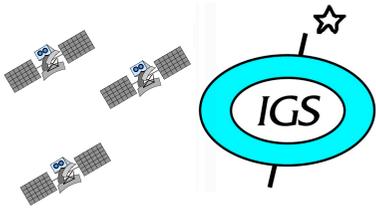




Overview



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- Quick look at IGS today
 - IGS and GGOS
 - Contributions and Benefits
 - Challenges - Implementation and Coordination
 - Organization
 - Summary
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- Some Acronym definitions:
 - GEO: Group on Earth Observations
 - GEOSS: Global Earth Observing System of Systems
 - IGOS-P: Integrated Global Observing Strategy - Partnership
 - ICG: International Committee on GNSS (UN Office of Outer Space Affairs)



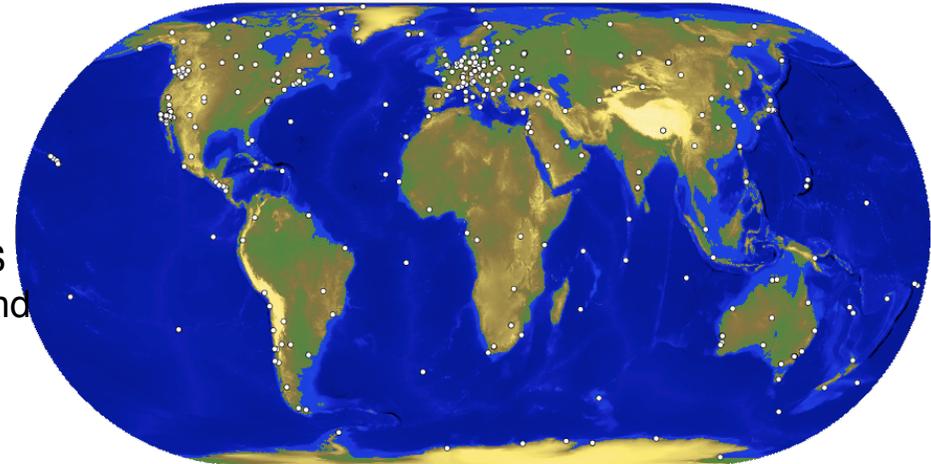
International GNSS Service

Formerly the International GPS Service

GNSS: Global Navigation Satellite System

The IGS is a voluntary federation of more than 200 worldwide agencies that pool resources and permanent GNSS station data to generate precise GNSS products.

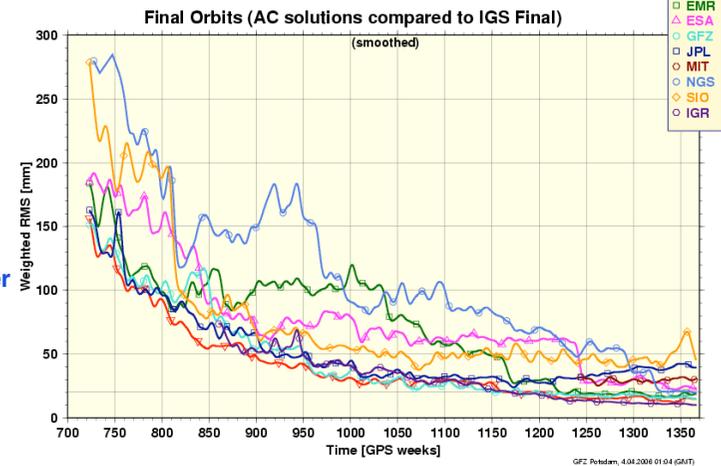
Over 380 permanent, geodetic GNSS stations operated by more than 100 worldwide agencies comprise the IGS network. Currently the IGS supports two GNSS: GPS and the Russian GLONASS.



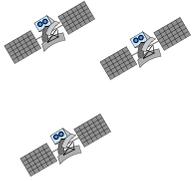
IGS products are formed by combining independent results from each of several Analysis Centers. Improvements in signals and computations have brought the centers' consistency in the Final GPS satellite orbit calculation to ~ 2cm.

IGS is a key component contributing to the ITRF and enabling its densification. IGS fosters unique application projects and working groups.

- IGS Projects & Working Groups**
- IGS Reference Frame
- Precise Time & Frequency Transfer
- GLONASS Pilot Service Project
- Low Earth Orbiters Project
- Ionosphere WG
- Atmosphere WG
- Sea Level - TIGA Project
- Real-Time WG
- Data Center WG
- GNSS WG

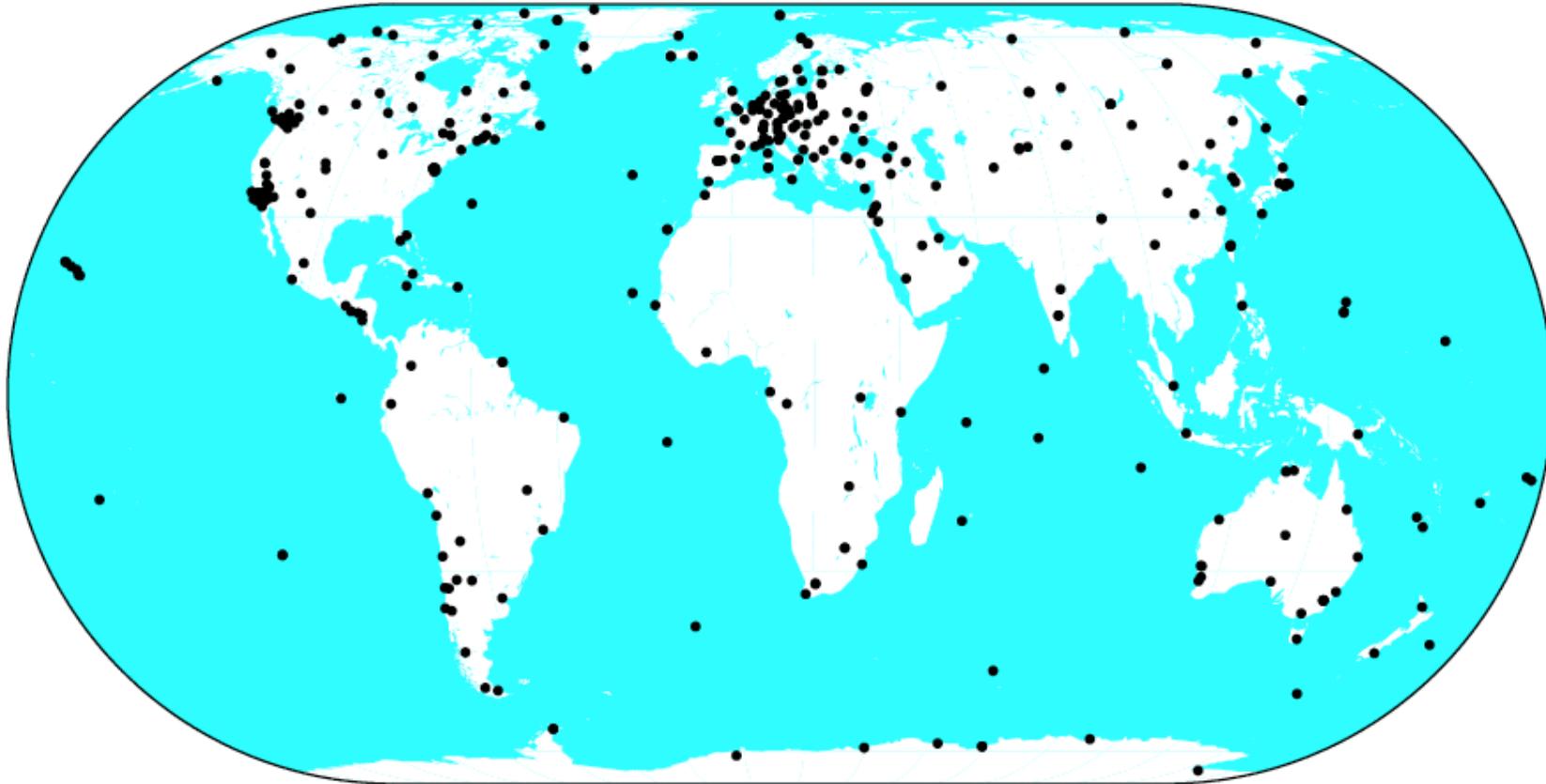


Graph courtesy Analysis Coordinator
G. Gendt, GFZ Potsdam



IGS Tracking Network 2006

GPS + GLONASS



IGS 2005 Jun 16 17:25:53

<http://igscb.jpl.nasa.gov/network/netindex.html>



15 Years later.....



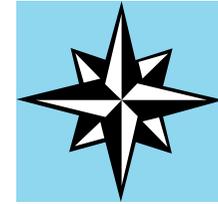
From GIG'91:

"Finally, the resources available for acquisition of space geodetic systems and for their deployment, even with broad international participation, are increasingly becoming limited. Consequently, it behooves us to develop an overall rationale for the optimal use of these systems, taking into account their unique range of applications as well as their relative strengths and weaknesses, particularly in connection with Earth Rotation monitoring and terrestrial reference frame maintenance."

Melbourne, et. al., The first GPS IERS and Geodynamics Experiment - 1991, in "Permanent Satellite Tracking Networks for Geodesy and Geodynamics," IAG Symp. vol. 109, edited by G. L. Mader, pp. 65-80, Springer-Verlag, New York, 1993.



IGS & GGOS



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- Key Challenge - reference frame, *long-term observations, analysis and smooth, seamless incorporation of new technology*
 - GGOS/IAG - developing and strengthening links with Geoscience & Users
 - Collective voice for IAG's geodetic science, and broad geoscience community
 - Focus attention on consistency of data and products within IGS, other services
 - Support and stability of the IAG service's components
 - Developing compelling justifications for decision makers, need supporting voice of geo-scientific partners
 - Unfortunately, short term views persist in policies and programmatics
 - Resources: a *persistent* global issue, national entities affected
 - Sea-level, driving requirement and social issue for geohazards:
 - World Climate Research Program workshop on 'Understanding Sea-level Estimation and Variability', June 2006
 - Includes *dedicated geodetic* session - increasing dependence on geodesy si being realized



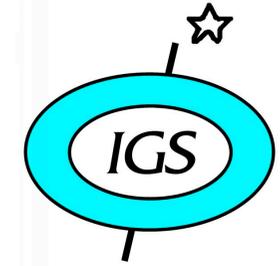
Directions



- Natural **densification** of the ITRF via GNSS - grows at exponential rate
 - GNSS enables users access to the ITRF, anytime, anywhere
- Multiple GNSS over the coming decade will be exciting and **challenging**, particularly for IGS and reference frame
 - **Consistency** of long-time series, minimizing discontinuities, 3-D precise reference including vertical, importance of gravity/geoid, real-time access,...
- IGS recognizes vital importance of Reference Frame issues
 - Continual improvement effort and keen attention to details
- IGS approach **influences GNSS providers**
 - Convergence of ITRF and GPS WGS84 over past decade
 - GPS and GLONASS --> IGS realization of ITRF and Contributions to IERS
 - Transformation of GLONASS PZ90 & GPS WGS84
 - EU IGS/IERS consortium developing the Galileo Geodetic Reference Frame (GGRF)
- IGS participating in International Committee on GNSS (ICG), established Dec '05 by United Nations Office of Outer Space Affairs (UN-OOSA)



What IGS Could Expect From GGOS



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- Some inputs/guidance in defining new directions and refining current ones
 - Improved cross-fertilisation and coordination with other IAG services and commissions
 - Increased coherence in the work of the individual services, from clearer (wider) goals
 - Better visibility of IGS (and other services' contributions) to the Earth Observation and Earth Science communities
 - Links to global political organisations (GEO, UN) could ease funding and resource problems for some IGS components
 - GGOS as our 'collective voice' should improve broader understanding of the critical role of geodesy for many purposes



What IGS Can Contribute to GGOS



- (Soon) a decade and a half of experience in routine daily operations generating high quality products relevant to GGOS
- (Soon) more than a decade of time series, reprocessed with the best models and methods available today
- Highly motivated and expert global community still striving to improve its raw and derived products
- Leadership initiative to bring GGOS/IAG services' analysis experts together
 - explore, discuss and plan integrated data, analyses and products
 - improve modeling, standards, conventions and consistency
- IGS standards and approach propagated at all user levels
 - E.g., GNSS is the easiest and most economical access to the terrestrial reference frame (ITRF)
- Promote GGOS through IGS' diverse and extensive community
 - IGS highly visible participation in the recently established ICG



IGS Contributions to GEOSS & IGOS-P via GGOS

- Huge ground network, providing the reference frame
- Continuous, long-term time series with high temporal resolution for deformation studies and Earth centre of mass
- Contribution to understanding sea level observations (TIGA)
- Ionosphere maps, global, near real-time, with high temporal resolution
- Contribution to high resolution, temporally varying gravity solutions (GRACE, GOCE)



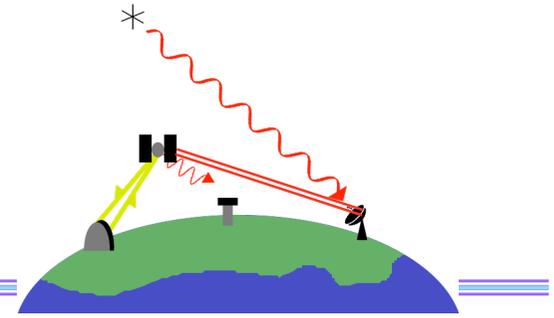
Critical Points Concerning GGOS Implementation

- Bringing the noble goals to people at the working level in the IAG Services: how will GGOS affect what they do?
- Making GGOS concrete: work plan for products, integration, identifying any gaps
- Strengthening the links to the gravity services, e.g. via LEOs
- Bringing in altimetry in a systematic way
- Bringing in remote sensing for geodetic surface change, Synthetic Aperture Radar (SAR)
- Some of the proposed requirements for data and products may be difficult to realise at the required accuracy
 - GGOS Science Plan should address this and set priorities



GGOS & IGS

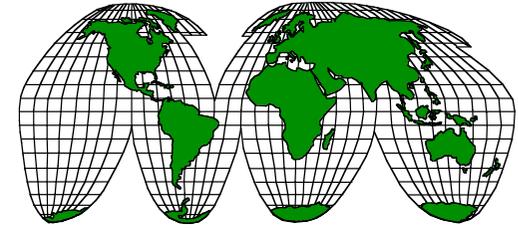
Coordinated Approach



- GGOS objective - supported by IGS:
 - Closely coordinated ***collocated, long-term, multi-technique, geodetic observations and analysis***
- Consider strategies toward future of multiple techniques that guide technical development over the coming decade
 - » ***Simultaneous integrated observations*** of multi-techniques
 - » SLR, VLBI capability to observe GNSSs should improve understanding: retro-reflectors on GNSS, VLBI capable to observe GNSSs as radio source per VLBI2010 report
 - » Could greatly improve inter-technique calibration/validation
 - » New approach to conventional ‘site ties’
- Applications requiring utmost accuracies of the reference frame need **order of magnitude improvement** - towards scale stability and 0.1 mm/yr geocenter



IGS and GGOS



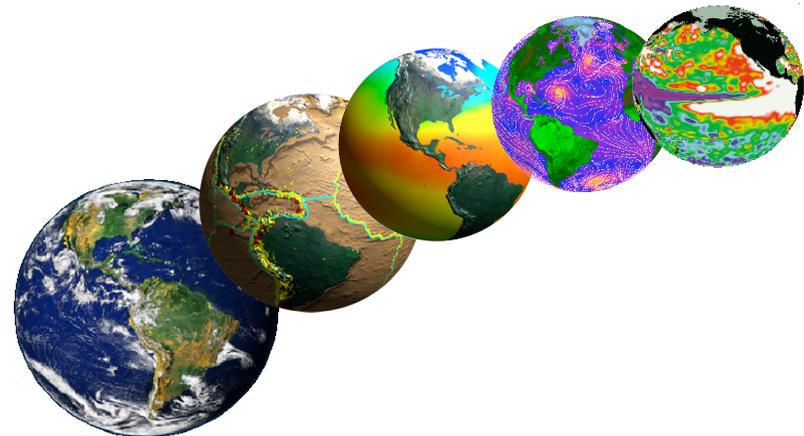
From an organizational point of view:

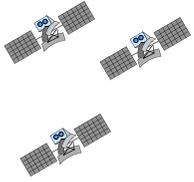
- The IGS is well-represented in the GGOS Steering Committee and Executive Committee
- IGS Governing Board is fully behind the GGOS effort
- Meetings of Chairs and of Directors of the Central Bureaus of some key services have taken place frequently since 2003
- GGOS needs to be firmly embedded in the IGS Strategic Plan



Summary

- IGS is poised to be fully engaged in GGOS
 - Mutual benefits identified
- This IGS Workshop and Governing Board Meeting Friday -
 - Initiates IGS Strategic Planning Process for 2008-2012, fully cognizant of GGOS
 - Continue to refine IGS contributions to GGOS
- IGS is committed to carefully incorporating and exploiting all GNSS bringing the benefits of GNSS technology evolution into GGOS





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