Services of the International Association of Geodesy and IGS -

Global Geodetic Observing System

Links & References

Ruth E. Neilan

Director, IGS Central Bureau; Vice-Chair, GGOS

www.igs.org

www.ggos.org

FIG Rome 2012, Reference Frames in Practice

May 5









Outline

- Some cool historic images Satellite Geodesy
- IAG, IGS and Global Geodetic Observing System (GGOS) context
- IGS
 - Organization
 - Products
 - Web surfing and resources
 - Prime Focus:
 - IGS M-GEX Multi-GNSS Global Experiment
 - IGS Real–Time Project
 - IGS and ICG Activities
 - 10 years AFREF, example of challenges for regional references
- GGOS & other initiatives
- MEGA Meta-data Exchange for Geodetic Applications –



Nic Donnelly



Positioning, geodesy, surveying, astronomic observations



Peter Apian's Geographia, circa 1533

Navigation & Timing



Harrison I, First marine chronometer, ~1700

19,000 Satellites in Earth Orbit





All GNSS Artist view - GPS World



IAG, GGOS & IGS

- The International Association of Geodesy (IAG) represents the geosciences associated with the **geometric & gravimetric** aspects of the dynamic Earth.
- IAG is part of International Union of Geodesy and Geophysics (IUGG) & International Council for Science (ICSU). IAG is the oldest of the international scientific associations... 150 years old in 2012, celebration 2013 (Potsdam)
- IAG's Global Geodetic Observing System (GGOS) integrates all IAG Services... to coordinate geodetic measurements, analysis and product generation to support science and society.
- The IGS coordinates GNSS tracking, data analysis and product generation to support GGOS and other users
- Key to the IGS approach: sharing investments and operational costs by pooling the resources of many (> 200) organisations in over 100 countries to maintain an independent ground tracking network and generate high accuracy products ... voluntary federation, reliability through redundancy, data & products openly available to all users.



IGS contributes the GNSS global contribution to the International Terrestrial Reference Frame (ITRF) where all regional reference frames are connected



Space Geodesy Today – Observations, Combination and Integration



- Ensure the **consistency** and improve the **accuracy** of the resulting geodetic products
- **Complementary use** of the individual techniques to strengthen the solutions
- Benefits from observing instruments co-located at the same site/satellite
- Distinguish genuine geodetic/geophysical signals from techniquespecific systematic biases
- Crucial to get a more detailed view and understanding of the complexity of the "System Earth" and its geophysical processes.

International GNSS Service - IGS





Perspective on Our World of Multi-GNSS

GPS, GLONASS, Compass, Galileo, SBAS - "more better"



Early lessons with GPS show that in-depth GPS/GNSS studies in any region require a global infrastructure - this is the perspective that drove the development of an international federation - IGS. (Seeded from CASA-Uno'88 & IAG CSTG)

Driven by understanding our planet

- Science is 'continent-blind'
- GNSS applications for top-end science & technology in regional areas, must have a global construct, network, a global reference frame
- Improving Earth observing with GNSS can provide early warning for natural disasters and mitigate their effects:
 - Tsunamis, sea level rise, earthquakes, volcanoes
 - Weather, Space weather, climate change,...
 - Real-time responses

IGS Mission

"The International GNSS Service provides the highest-quality GNSS data, products, and services in support of the Earth observations and research, positioning, navigation and timing, the terrestrial reference frame, Earth rotation, and other applications that benefit society."*

IGS is a key component of the Global Geodetic Observing System – GGOS

*From IGS Strategic Plan 2008-2012





International GNSS Service (IGS)

- Potential of GPS for Geodesy, Surveying and Geodynamics was recognized in the late 1980's.
- Start of IGS Test Campaign in June 1992, Official IAG Service since 1994.
- Renamed "International GNSS Service" in March 2005: GPS + GLONASS
- Products:
 - Precise Orbits
 - Clock corrections & timescale
 - Station positions and velocities –>ITRF
 - Troposphere parameters
 - Ionosphere maps
 - Earth orientation
- GPS and GLONASS tracking & products.
- New Multi- GNSS Global Experiment ...



IGS









Associate Analysis Center (AAC)



International GNSS Service Formerly the International GPS Service

The IGS is a voluntary federation of more than 200 worldwide agencies in more than 100 countries that pool resources and permanent GPS station data to generate precise GPS products with open data policy.

Many satellite missions, Earth science missions, multidisciplinary applications, National Mapping Agencies and Universities rely upon the openly-available IGS products, such as ephemerides and coordinate time series.



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.

Graph courtesy Analysis Coordinator J. Ray, NOAA, NGS



2011 May 17 16:46:43

Over 400 permanent tracking stations operated by more than 100 worldwide agencies comprise the IGS network. Currently the IGS supports two GNSS: GPS and the Russian GLONASS. IGS plans to include Galileo, Compass and QZSS once available.

GPS Applications in IGS Projects & Working Groups

IGS Reference Frame Timing and Precise Clocks Ionosphere WG Antenna Calibration WG Bias and Calibration WG Troposphere WG Sea Level - TIGA Project Real-Time WG & Project Data Center WG GNSS WG Orbit Modeling WG

http://igs.org

IGS Tracking Network

• Over 380 active global tracking stations









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IGS Multi-GNSS Network: GLONASS + GPS







The Global Picture: Global Velocity Field





The International <u>GNSS</u> Service (IGS), formerly the International GPS Service, is a voluntary federation of more than 200 worldwide agencies that pool resources and permanent GPS & GLONASS station data to generate precise GPS & GLONASS products. The IGS is committed to providing the highest quality data and products as the standard for Global Navigation Satellite Systems (GNSS) in support of Earth science research, multidisciplinary applications, and education. Currently the IGS includes two GNSS, GPS and the Russian GLONASS, and intends to incorporate future GNSS. You can think of the IGS as the highest-precision international civilian GPS community.

Whenever your use of IGS data or products results in a publication, please include a <u>citation</u>.

| What's new: Updated: October, | General GPS/GNSS questions? |
|--|-----------------------------|
| 2011. | Please visit resource links |
| 2012 IGS Workshop | |
| PPP-RTK & Open Standards | |
| Symposium and Workshop | |
| IGS M-GEX - Call for | |
| Participation - New Information | |
| IGS M-GEX Response Form | |
| | |
| IGS-CB NTRIP Caster | |
| IGS Workshop on GNSS | |
| Biases 2012 | |
| JAXA M-GEX - Call for | |
| Participation | |
| IGS08 Realization adopted | |
| IGS 2010 Workshop Summary | |
| Recommendataions | |
| IGS 2010 Workshop | |
| Presentation Videos | |
| IGS Strategic Implementation | |
| <u>Pian - 2011</u> | |



This web site is part of the IGS Central Bureau Information System (CBIS), providing both IGS member organizations and the public with information about the IGS organization, the IGS network of stations, and IGS data & data products (such as precise ephemerides).

igs.org





| | Summary by Month | | | | | | | | | |
|----------|--|--------|--------|--------|----------------|-----------|--------|---------|---------|---------|
| Month | Daily Avg | | | | Monthly Totals | | | | | |
| Month | Hits | Files | Pages | Visits | Sites | KBytes | Visits | Pages | Files | Hits |
| Apr 2012 | 257492 | 172163 | 190571 | 1825 | 17214 | 113793325 | 52932 | 5526566 | 4992728 | 7467284 |
| Mar 2012 | 261723 | 174279 | 196276 | 1753 | 17507 | 118827708 | 54353 | 6084566 | 5402677 | 8113413 |
| Feb 2012 | 259072 | 171722 | 193972 | 1607 | 16538 | 109033941 | 46616 | 5625200 | 4979939 | 7513099 |
| Jan 2012 | 269834 | 181148 | 200705 | 1855 | 18274 | 115455078 | 57517 | 6221870 | 5615589 | 8364867 |
| Dec 2011 | 262350 | 178046 | 197881 | 1581 | 4114 | 26600403 | 11073 | 1385168 | 1246326 | 1836450 |
| Totals | Totals 483710455 222491 24843370 22237259 33295113 | | | | | | | | | |



- Precise positions (5 mm) for 400 worldwide reference stations
- S All products mutually consistent in the IGS realization of the International Terrestrial Reference Frame
- Continuous development of *new applications* and products in Working Groups and Pilot Projects

The foundation of the International GNSS' Service (IGS) is a global network of over 400 permanent, continuously operating, geodetic-quality GPS and GLONASS tracking sites. The station data are archived at IGS Global Data Centers and four Regional Data Centers. Analysis Centers regularly process the data and contribute products to the Analysis Center coordinator, who produces the official IGS combined products. The Central Bureau is responsible for day-to-day management of the IGS following policies set by the IGS International Governing Board.



| The IGS classic product s | set — satellite orbits, clocks, Earth rota- |
|---------------------------|--|
| tion parameters, and stat | tion positions — is augmented by newer |
| products born from IGS \ | Working Groups and Pilot Projects: |
| Troposphere | • GLONASS classic products |
| • Ionosphere | Sea Level and Tide Gauges (TIGA) |
| • Real-time | • GNSS/WG |

Precise Timing and clock products

The IGS reference frame coordinator determines tracking site coordinates and velocities in the International Terrestrial Reference Frame (ITRF), and organizes the IGS contribution to ITRF.

*Global Navigation Satellite System

Central Bureau Information System CDDIS Global Data Center IGN Global Data Center SIO Global Data Center KASI Global Data Center bttp://igs.org bttp://cddis.gsfc.nasa.gov bttp://igs.ensg.ign.fr bttp://sopac.ussd.edu bttp://gdc.kasi.re.kr

IGS Central Bureau Jet Propulsion Laboratory MS 238-540 Pasadena, CA 91109 USA Telephone: (818) 354-2077 Fax: (818) 354-8545



| GPS SATELLITE EPHE Satellite & Station | MERIDES/ I CLOCKS | ACCURACY | LATENCY | UPDATES | SAMPLE Interval |
|---|------------------------------|---------------------|-----------|----------|-------------------------|
| Broadcast Orbits Sat. clocks | | ~100 cm ~5 ns | real time | | daily |
| Ultra-Rapid (predicted half) | Orbits Sat. clocks | ~5 cm ~3 ns | real time | 4x daily | <u>15 min</u> 15 min |
| Ultra-Rapid (observed half) | Orbits Sat. clocks | <3 cm ~0.15 ns | 3 hours | 4x daily | <u>15 min</u> 15 min |
| Rapid | Orbits Sat. & Stn. clocks | <2.5 cm 75 ps | 17 hours | daily | <u>15 min</u> 5 min |
| Final | Orbits Sat. & Stn. clocks | <2.5 cm <75 ps | ~12 days | weekly | 15 min 5 min |
| Real Time Combination | Orbits Sat. clocks | ~10 cm <0.3 ns | 25 sec | 10 sec | 10 sec |
| Real Time AC Streams | Orbits Sat. clocks | ~10 cm ~0.3-2 ns | 8-20 sec | 5-10 sec | 5-10 sec |

Note 1: IGS accuracy limits, except for predicted orbits, based on comparisons with independent laser ranging results. The precision is better. Note 2: The accuracy of all clocks is expressed relative to the IGS timescale, which is linearly aligned to GPS time in one-day segments. Note 3: Real Time products are provided on an experimental basis. See http://www.rtigs.net/index.php and http://igs.bkg.hund.de/ntrip/orbits. Note 4: The methods used by some RT Andrysis Genter sensult in bigs to cho biases for individual satellites. Clock standard deviation, which is the more important metric for Precise Point Positioning, is typically of the order of 0.1 ns.

| GLONASS SATELLITE | EPHEMERIDES | | | | |
|-------------------------------------|--|--------------------------------------|------------|-------------|---|
| Final | | 5 cm | 12-18 days | weekly | 15 min |
| GEOCENTRIC COOR TRACKING STATION | DINATES OF IGS S (>130 SITES) | | | | |
| Final Positions | Horizontal Vertical | 3 mm 6 mm | 12 days | weekly | weekly |
| Final Velocities | Horizontal Vertical | 2 mm/yr 3 mm/yr | 12 days | weekly | weekly |
| EARTH ROTATION P | ARAMETERS | | | | |
| Ultra-Rapid (predicted half) | Polar Motion Polar Motion Rate Length-of-day | 0.2 mas 0.3 mas/day 0.05 ms | real time | 4x daily | 4x daily |
| Ultra-Rapid (observed half) | Polar Motion Polar Motion Rate Length-of-day | 0.05 mas 0.25 mas/day 0.01 ms | 3 hours | twice daily | twice daily (00 & 12 UTC) |
| Rapid | Polar Motion Polar Motion Rate Length-of-day | <0.04 mas <0.2 mas/day 0.01 ms | 17 hours | daily | daily (12 UTC) |
| Final | Polar Motion Polar Motion Rate Length-of-day | 0.03 mas <0.15 mas/day 0.01 ms | ~13 days | weekly | daily (12 UTC) |
| Note: The IGS uses VLE | I results from IERS Bulletin A to | calibrate for long-term LOD b | iases. | | |
| ATMOSPHERIC PARA | METERS | | | | |
| Final tropospheric | zenith path delay | 4 mm | <4 weeks | daily | 5 min |
| Ionospheric TEC | grid | 2-8 TECU | ~11 days | weekly | 2 hours; 5 deg (lon) x 2.5 deg (lat) |



http://acc.igs.org/



IGS Formats

Here is a collection of the formats currently used by the IGS. More details such as archive locations and file naming conventions are available via the <u>data center navigation</u> area.

| RINEX v. 2.10 | GPS and GLONASS observations, meteorological data, and navigation files |
|---|---|
| <u>RINEX v.</u> 2.11 | GPS and GLONASS observations, meteorological data, and navigation files |
| <u>RINEX v.</u> 2.12 | GPS and GLONASS observations, meteorological data, and navigation files - used for GNSS receivers reporting the C2 observable, currently considered experimental by IGS, data accepted on test basis only, contact CDDIS or other data centers. |
| <u>RINEX v.</u> <u>3.01</u> | GPS, GLONASS and Galileo observations, meteorological data, and navigation files - used for GNSS receivers reporting the C2 observable, currently considered experimental by IGS, data accepted on test basis only, contact CDDIS or other data centers. |
| SINEX | station position and velocity solutions |
| <u>Hatanaka</u> compact <u>RINEX</u> | GPS and GLONASS observations |
| <u>sp3</u> version c | GPS and GLONASS orbit solutions |
| <u>sp3</u> version a | GPS and GLONASS orbit solutions. <i>Discontinued January</i> 2006 |
| erp | Earth rotation parameter files (self-documented within) |
| clock RINEX 3.00 | station and satellite clock solutions |
| <u>clock</u> <u>RINEX</u> <u>3.02</u> | station and satellite clock solutions |
| IONEX | ionospheric TEC grid products |
| Tropo SINEX | Zenith path delay products |
| site log | History of site installation |
| | Antonno collibrationa |
| ANTEX | Antenna calibrations |

| HOME || ABOUT IGS || ORGANIZATION || FAQs || FTP ARCHIVES || WEBSITE INDEX |

Welcome!

Below is a listing of all the public mailing lists on igscb.jpl.nasa.gov. Click on a list name to get more information about the list, or to subscribe, unsubscribe, and change the preferences on your subscription. To visit the general information page for an unadvertised list, open a URL similar to this one, but with a '/' and the list name appended.

List administrators, you can visit the list admin overview page to find the management interface for your list.

If you are having trouble using the lists, please contact igscb@igscb.jpl.nasa.gov.

| Description |
|---------------------------------------|
| AFREF |
| GGOS |
| GEX (Inactive/Archive only) |
| GLOS Mail (Inactive/Archive only) |
| GS Analysis Centers |
| GS Antenna Working Group |
| GS Bias and Calibration Working Group |
| GS Data Center Working Group |
| GS Equipment Files |
| GS Infrastructure Committee |
| GS Multi-GNSS Experiment |
| GS Reference Frame Working Group |
| GS Real-Time Working Group |
| GS Station Operators |
| Fide Gauge Benchmark Monitoring |
| GS Troposphere |
| GS Central Bureau |
| GS LEO |
| GSMAIL |
| GS Analysis Report |
| GSStation |
| |







IGS – Multi-GNSS Global Experiment M-GEX

- Motivation
 - New and modernized systems and signals upcoming or available
 - Receivers have multi-GNSS capabilities
 - IGS must prepare for incorporation of new GNSS
- Goal
 - Experiment to operate an expanded network of new receivers capable of tracking new signals in addition to GPS & GLONASS
 - Support & coordinate with Multi-GNSS Asia (MGA) activities
- Tasks
 - Set-up tracking network of Multi-GNSS equipment
 - Make tracking data publicly available
 - Experiment with data flow and signals, qualify equipment, signals, ...
 - Upgrade IGS network to Multi-GNSS
 - Generate Multi-GNSS products





M-GEX

- More than 100 GNSS satellites will be available in the near future
- Not only more satellites, but also more and better signals, better clocks – *also Real-time stations*
- Heterogeneous system of satellite systems and heterogeneous user equipment interoperability, compatibility, interchangeability
- IGS is preparing for incorporation of new systems and signals into routine operations
- M-GEX Call for Participation Experiment from February through August 2012, continuing observations encouraged:
 - Seeking groups for tracking, archiving, analyzing of new signals
 - Interested groups can join at anytime



First results at IGS Workshop in Olsztyn, Poland, 23–27 July 2012

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IGS Associate Members Registration



Presented by IGS.org

IGS Real-Time Pilot Project

- Real-time product generation is part of IGS Strategic Plan
- Infrastructure
 - More than 120 active real-time stations
 - Close link to RTCM Joint WG established
 - <u>The Radio Technical Commission for Maritime Services</u> www.**rtcm**.org/
- Analysis
 - 6 real-time analysis centers
 - Real time clock combination
- Future
 - Include new systems and signals M-GEX
 - Real-time service To be announced soon

- Satellite clock corrections, orbits, ionosphere corrections
- Zero-difference Ambiguity resolution

IGS Real Time Network – March 2012

~160 Stations - soon to become openly available!

Real-Time Clock Product Table

| AC | Feb 6 2009 | | June | 8 2010 | June 15 2011 | | |
|--------|-------------------|------------------------|-------------------|------------------------|-------------------|------------------------|--|
| | Clock RMS (ns) | Clock Sigma (ns) | Clock RMS (ns) | Clock Sigma (ns) | Clock RMS (ns) | Clock Sigma (ns) | |
| Comb | 0.29 | 0.22 | 0.16 | 0.10 | 0.14 | 0.07 | |
| RTComb | - | - | 0.15 | 0.11 | 0.18 | 0.08 | |
| BKG | 6.72 | 2.97 | 0.20 | 0.12 | 0.30 | 0.07 | |
| CNES | - | - | - | - | 0.30 | 0.03 | |
| DLR | 0.38 | 0.10 | 0.20 | 0.12 | 0.25 | 0.12 | |
| ESOC | 0.42 | 0.38 | 0.21 | 0.12 | 0.17 | 0.12 | |
| GFZ | - | - | - | - | 0.33 | 0.06 | |
| NRC | 0.67 | 0.62 | 0.24 | 0.10 | 0.23 | 0.07 | |
| GMV | 1.67 | 1.66 | 0.28 | 0.14 | 0.34 | 0.10 | |
| TUW | - | - | 0.70 | 0.53 | 0.73 | 0.53 | |
| WUH | - | - | - | - | 0.57 | 0.07 | |

Real-Time Orbit Plot

IGS & International Committee on GNSS - Activities

- IGS & IAG & members of the GNSS Action Team since 2001; Associate Member of ICG since its establishment
- IGS and IAG and the International Federation of Surveyors (FIG) Cochairs the ICG Working Group on Reference frame, Timing and Applications, with Bureau of Weights and Measures (BIPM) and ITRF:
 - Task Forces established in 2008, ICG-3
 - Reference Frames Altamimi
 - Timing Arias
 - To facilitate GNSS providers experts to engage with the international community represented by IGS, IAG, FIG and others, with a goal of improved inter-operability, and common understanding of these fundamental elements of GNSS – Reference Frame and Timing
- IGS M-GEX endorsed by ICG at ICG-6 in Tokyo, Sept 2011

Global Geodetic Observing System

http://www.ggos.org/

Processes: Millions of Years & Fractions of Seconds

Catch the Earth!

GGOS is a program of the International Association of Geodesy (IAG):

- Ensures observations of the three fundamental geodetic observables and their variations: Earth's shape, gravity field and rotational motion
- Integrates different geodetic techniques, models, and approaches to ensure long-term, precise monitoring of observables in agreement with the Integrated Global Observing Strategy (IGOS)
- Is a recognized member of the Global Earth Observing System of Systems (GEOSS)
- Is a powerful tool consisting mainly of high quality IAG/IUGG/IAU services, standards, conventions and references, and of theoretical and observational innovations

Vision

Advancing our understanding of the dynamic Earth system by quantifying our planet's changes in space and time.

<u>Mission</u>

We live on a dynamic planet in constant motion that requires long-term, continuous quantification of its changes in a truly stable frame of reference.

IAG Approved July 2011

Challenges for Planet Earth Monitoring

GGOS: Monitoring and Modelling the Earth's System

Reference frames: highest accuracy and long-term stability

Societal Benefits of Precision Geodetic Infrastructure

Ground-Based Component of GGOS

GGOS Mission

We live on a dynamic planet in constant motion requiring for its understanding long-term, continuous quantification of its changes in a truly stable frame of reference.

The mission of GGOS is:

to provide the observations needed to monitor, map and understand changes in the Earth's shape, rotation and mass distribution;

to provide the global frame of reference that is the fundamental backbone for measuring and consistently interpreting key global change processes and for many other scientific and societal applications;

to benefit science and society by providing the foundation upon which advances in Earth and planetary system science and pplications are built.

Future Core Ground-Based Infrastructure

- Core Network (~ 40 Stations):
- 2-3 VLBI telscopes for continuous observations
- SLR/LLR telescope for trackoing of all major satellites
- At least 3 GNSS antennas and receivers (controlled equipment changes)
- DORIS beacon of the most recent generation
- Ultra-stable oscillator for time and frequency keeping and transfer
- Terrestrial survey instruments for permanent/automated local tie monitoring
- Superconducting and absolute gravimeter (gravity missions, geocenter)
- Meteorological sensors (pressure, temperature, humidity)
- Seismometer for combination with deformation from space geodesy and GNSS seismology
- Additional sensors: water vapor radiometer, tiltmeters, gyroscopes, ground water sensors, ...
- General Characteristics: highly automated, 24-hour/365 days, latest
 technologies

GGOS Core Sites

Positive Developments:

•First really new infrastructure since about 15 years:

•IAG Services (e.g., VLBI2010, SLR, IGS M-GEX)

•Argumentation within GGOS

New GGOS Core Sites:

Wettzell: twin telescopes and new SLR

- Austrialia/New Zealand: 4 new core sites
- Wettzell, Germany: new twin and SLR telescopes
- Spain/Portugal: 4 new VLBI sites funded
- Norway, Finland, Sweden: proposals
- NASA: prototype site; proposal for 10 sites planned
 - Russia, China, Korea: several sites planned

rticipation σ Ω for a S **D** $(\mathbf{7})$

Google Search) The Web asi.it

GGOS Inter-Agency Committee (GIAC)

 Problem: long-term support and sustainability of the IAG Services and the global GGOS infrastructure

•Frankfurt Meeting, November 2-3, 2009 (D. Grünreich, R. Rummel): GGOS Intergovernmental Committee (GIC) with national governments/agencies to support GGOS

- → Frankfurt Declaration
- •GIAC Establishment, December 2010 at AGU •GIAC Elections April 2011:

Chair: John Labrecque (NASA)

Vice-chair: Gary Johnston (Geoscience Austrialia)

Secretariat: Bernd Richter (BKG)

GIAC Members

| Australian Government Geoscience Australia | Geoscience Australia AUSTRALIA | | Geodetic Institute NORWAY |
|---|--|---|---|
| Natural Resources Canada | Natural Resources Canada CANADA Chinoso Acadomy of | AUTHORITY | Korea Astronomy and Space Science Institute (KASI) REPUBLIC OF KOREA |
| SHAO | Sciences CHINA | | Institute of Applied Astronomy (IAA) RUSSIA |
| Set TIMEN AND SET OF LEVEL | Finnish Geodetic Institute FINLAND | National Research Foundation Hartebeesthoek Radio Astronomy Observatory | Hartebeesthoek Radio Astronomy Observatory SOUTH AFRICA |
| | Institut Géographique National | MINISTERIO DE FOMENTO BENATTURO GOGARECO MICIONAL | Instituto Geográfico Nacional (IGN) SPAIN |
| Federal Agency for Cartography_and.Geodesy | FRANCE Federal Agency for Cartography and | Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra | Federal Office of Topography swisstopo SWITZERLAND |
| ogenzia spoziale italiana | Geodesy GERMANY Italian Space Agency | NASA | National Aeronautics and Space Administration (NASA) |
| Land whenua Information New Zealand | ITALY National Geodesist Land Information New Zealand | | National Geodetic Service National Oceanic and Atmospheric Administration |
| | NEW ZEALAND | | |

IGS & Regional Reference Frames

- IGS contributes the GNSS global contribution to the International Terrestrial Reference Frame (ITRF) since 1990's, providing the global grid to connect all regional reference frames and GNSS applications – alignment to the ITRF
 - All observations in a common, robust reference frame
 - Currently ITRF08
 - Next ITRF 2013, full reprocessing 1995 to date
- Supporting and cooperating with Unification of African Reference Frames (AFREF) since 1999 –
 - Africa has 50+ national reference frames and datums
 - Continental reference frame allows cross-border, international & intra-Africa development
 - Support development of transformations between GNSS and national datums
- Strong Liaison with International Federation of Surveyors (FIG) working with many National Mapping Agencies (NMA)

Map of the World with Country Flags

lgs.org Mail lists archived: afref@igscb.jpl.nasa.gov

| ⊌ ⊍ ⊍ | | | The AFREF February 2012 Archive by thread | | | | | |
|---|----------------------------|--------------------------|---|-----------------------|--------|----------|---------------|-----------------------|
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February 2012 Archives by thread

- Messages sorted by: [subject][author][date]
- More info on this list...

Starting: Thu Feb 2 22:34:52 PST 2012 Ending: Wed Feb 8 23:51:29 PST 2012 Messages: 9

- [AFREF-38] Which Countries in Africa are Actively Participating in the AFREF Agenda? Ivan Farayi Muzondo
 - [AFREF-39] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? stephen at ghana.com
 - [AFREF-41] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? Collins Fosu
 - [AFREF-42] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? Joel. VanCranenbroeck at leica-geosystems.com
- [AFREF-40] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? Nacho Romero
- [AFREF-43] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? olaide onabajo
 - [AFREF-45] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? stephen at ghana.com
- [AFREF-44] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? olaide onabajo
- [AFREF-46] Re: Which Countries in Africa are Actively Participating in the AFREF Agenda? olaide onabajo

Last message date: Wed Feb 8 23:51:29 PST 2012 Archived on: Wed Feb 8 23:51:53 PST 2012

- Messages sorted by: [subject][author][date]
- More info on this list...

This archive was generated by Pipermail 0.09 (Mailman edition).

Summary of Initiatives

- IAG developing strong links with FIG since 2003
- Active working within International Committee on GNSS (ICG) - IAG/IGS/FIG/IERS-ITRF/BIPM
 - lead working group on Reference Frames, Timing and Applications
- GGOS represents IAG in the Group on Earth Observations (GEO) and System of Systems (GEOSS)
- IAG Service represented on new International Council of Science – World Data System (ICSU-WDS)
 - WDS Scientific Committee http://www.icsu-wds.org/
- RTCM
- New Meta-data Exchange Format for Geodetic Applications (MEGA)
 - Nic Donnelly, LINZ up next

Extra Slides

Background

- There is no group looking broadly at geodetic metadata across the techniques: from terrestrial surveys to space geodesy
- Metadata frequently needs to be exchanged, but often there are not any accepted, open formats (for example, geodetic adjustment data)
- The standards which exist tend not to follow modern data exchange or format principles (for example, custom text formats)
- Individual organizations may have done work on standards, but discovery is difficult

Proposed solution

- Set up a joint FIG/IAG working group to cover
- Members representing the various techniques
- Mail list or online forum to discuss metadata issues
- Website to provide information about geodetic metadata standards

Objectives

- Develop a high level framework for geodetic metadata exchange standards
- Coordinate metadata standards development among geodetic disciplines
- Provide a forum for discussion of matters relating to metadata exchange
- Provide a centralized mechanism for discovery of metadata exchange initiatives in the geodetic community

Scope

- Metadata across all geodetic techniques
 - GNSS, VLBI, SLR, Terrestrial (angles and distances) etc
- As well as "data about data", includes consideration of data structures
- Include metadata relating to geodetic products (eg adjustments, orbits, site velocities)

Metadata and Data Exchange

Goals

The goals of GGOS are:

- 1. to be the primary source for all global geodetic information and expertise serving society and Earth system science;
- 2. to actively promote, sustain, improve and evolve the global geodetic infrastructure needed to meet Earth science and societal requirements;
- 3. to coordinate the international geodetic Services that are the main source of key parameters needed to realize a stable global frame of reference and to observe and study changes in the dynamic Earth system;
- 4. to communicate and advocate the benefits of GGOS to user communities, policy makers, funding organizations, and society.

to be the primary source for all global geodetic information and expertise serving society and Earth system science

- a. Identify the components and themes of GGOS needed to plan and meet evolving user requirements and to provide crucial data and information to the user.
- b. Define and implement internal and external interfaces needed for technical and organizational efficiency.
- c. Evaluate and review the current GGOS organization and structure.
- d. Develop mechanisms for regular review of GGOS quality and performance, including that of its data and products.
- e. Expand and broaden user communities by conducting impact studies and organizing joint workshops and symposia.
- f. Provide a unique point of access to the user community by creating and maintaining the GGOS portal.

to actively promote, sustain, improve & evolve the global geodetic infrastructure needed to meet Earth science & societal requirements

- a. Provide the scientific basis for the necessary global geodetic infrastructure, including establishing requirements for station distribution and data quality.
- b. Provide a forum for inter-Service communication and exchange of information about current activities, infrastructure performance and future plans.
- c. Identify major infrastructure deficiencies and propose remedies to the geodetic and user communities and appropriate entities including the GIAC.
- d. Support requests of stations, agencies and other organizations for resources.
- e. Advocate for the establishment of geodetic fundamental stations with potential sponsors.
- f. Advocate for relevant space-based components including operational chains of geodetic missions like gravity, altimetry, and SAR missions to provide spatial and temporal coverage of continuous and episodic changes in the dynamic Earth system.

to coordinate the international geodetic Services that are the main source of key parameters needed to realize a stable global frame of reference and to observe and study changes in the dynamic Earth system

- a. Improve the interaction and communication amongst GGOS, the IAG Services and Commissions by defining appropriate linkages, organizing inter-Service workshops and, when appropriate, holding joint or co-located GGOS EC and Service GB/DB meetings.
- b. Reform the GGOS governance structure in order to facilitate the execution of the Science Themes, manage the relationships between the IAG Executive, GGOS EC, the Services and the Commissions, fulfill GGOS's role in outreach, represent GGOS at forums such as GEO, and other activities as may be tasked.
- c. Identify data and product gaps, integrated products, additional Service and Commission components and, if necessary, new Services and Commissions that are needed to fully address the requirements of the GGOS Science Themes.

Tasks of Goal 3, (con't.)

to coordinate the international geodetic Services that are the main source of key parameters needed to realize a stable global frame of reference and to observe and study changes in the dynamic Earth system

- d. Establish and promote the use of reference frames, common standards and models, open data access, geodetic expertise and information, and even methodologies where appropriate, so as to ensure reliable, consistent and high-quality data and products for the geoscientific community.
- e. Promote combination analyses and integrated product generation across Services and Commissions, especially from co-located geodetic sites, in order to address the requirements of the GGOS Science Themes.
- f. Promote a culture of continuous quality improvement of the geodetic infrastructure, analysis center operations, effectiveness of the GGOS structural components, and of the generated GGOS data and products.

to communicate and advocate the benefits of GGOS to user communities, policy makers, funding organizations, and society

- a. Organize meetings about GGOS activities and participate in GEO meetings, user community events, conferences, workshops, symposia, etc.
- b. Identify GGOS requirements in terms of infrastructure and workforce and interact with funding authorities, national and international organizations and space agencies to advocate the importance of meeting these requirements.
- c. Promote the development and submittal to funding agencies of proposals that advance the goals of GGOS.
- d. Involve young scientists by means of GGOS scholarships and grants through national and international projects.
- e. Foster geodetic educational programs within universities, schools and research

Tasks of Goal 4 (con't)

to communicate and advocate the benefits of GGOS to user communities, policy makers, funding organizations, and society

- f. Strengthen outreach capabilities demonstrating GGOS benefits by means of case studies and success stories; realise a short GGOS movie to be presented and distributed for educational purposes.
- g. Review the respective roles of GGOS and the GIAC.
- h. Improve the recognition and visibility of GGOS within GEO, ICSU, COPUOS, CEOS, COSPAR and other organizations.

