



Update on International GNSS Service (IGS) Multi-GNSS Activities and Plans

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The International GNSS Service (IGS)

- Operations since 20 years
- Internationally distributed voluntary organization of more than 200 institutions.
- Originally a pure GPS service.
- CfP for International GLONASS Experiment (IGEX) in 1998. Resulted in GLONASS Pilot Project. 2003 GLONASS fully incorporated into IGS.
- 2005 renamed into International GNSS Service.
- Operating today a global tracking network of more than 350 active stations, among them 140 GPS/GLONASS stations.



Experience of the IGS

- GNSS data analysis, determination of highest quality orbits, clock corrections and site coordinates.
- IGS contribution is pivotal for realizing and making accessible of the ITRF as metrological basis for monitoring of processes in the Earth system.
- Definition of international standards, e.g., concerning formats (RINEX, ANTEX, SINEX, ...), site guidelines, ...
- Involved in definition of real time formats and protocols with RTCM.
- Monitoring of differential code biases (GPS and GLONASS) as part of clock and ionosphere parameter determination and ambiguity resolution.
- Determination of IGS Time Scale.



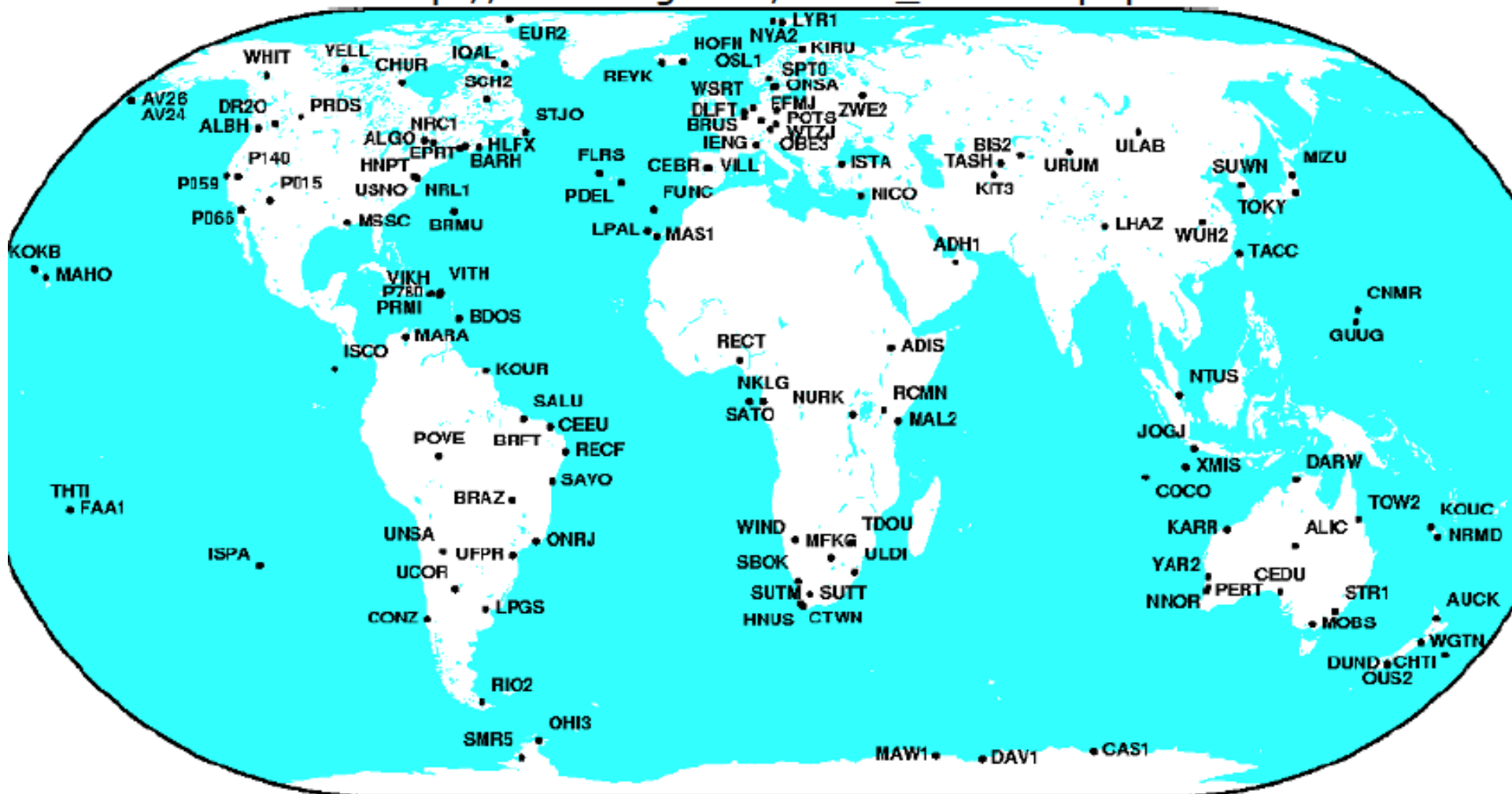
Current Developments

- New orbit and clock combination software ACC 2.0:
 - Multi-GNSS capable, interchangeable
 - Orbits and clocks in common well defined reference frame (ITRF)
- Provision of uncalibrated phase delays for ambiguity resolution.
- Launch of Real-time Service this year, GPS-only but goal is Multi-GNSS.
- Transition to Multi-GNSS capable format RINEX 3.0x.
- Multi-GNSS Experiment.



Real-Time Network

http://www.rtigs.net/nrcan_monitor.php



<http://igs.org>

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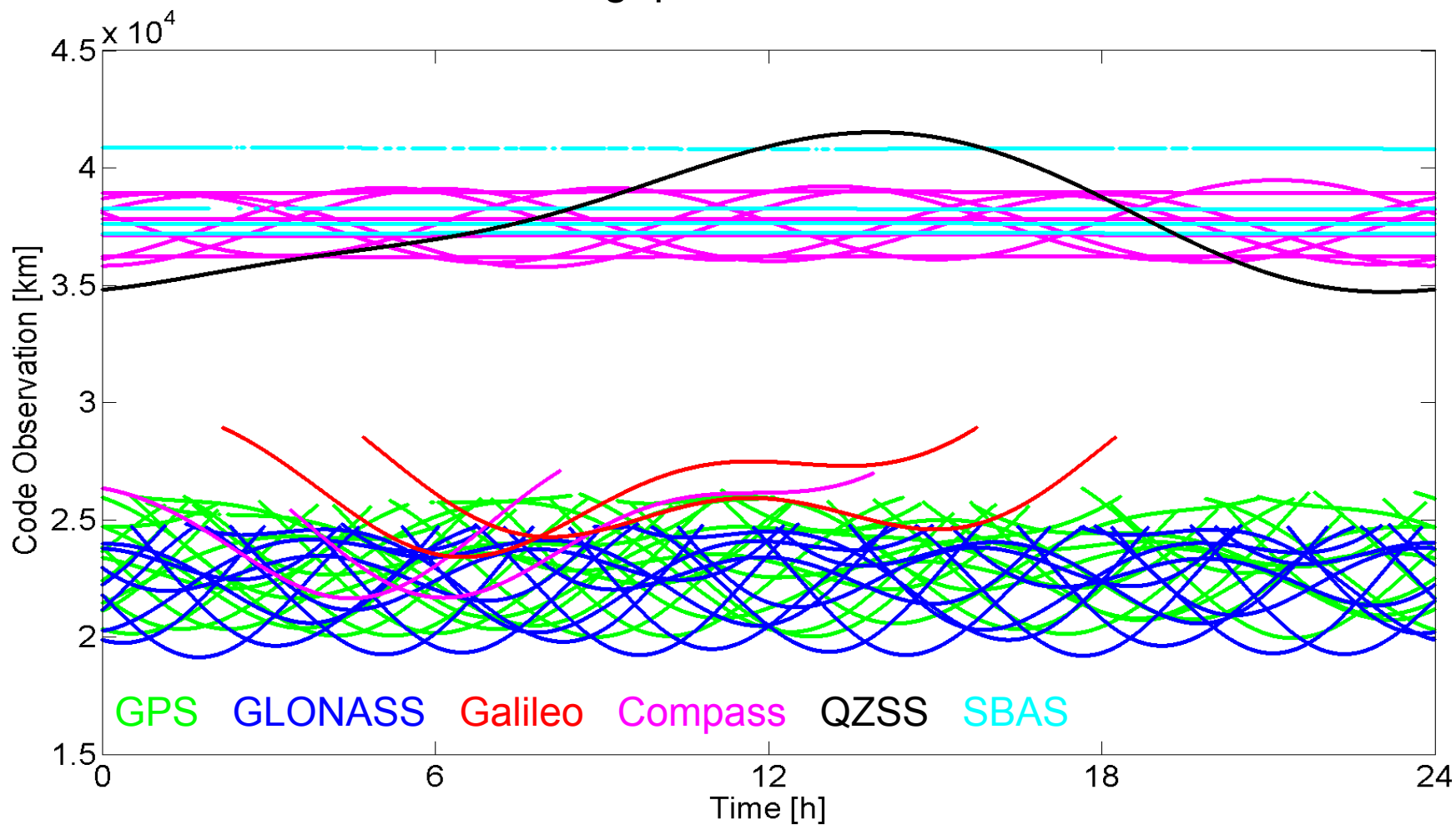
Multi-GNSS Experiment (M-GEX)

- IGS prepares for the consistent incorporation of new GNSS into one single reference.
- Goal of M-GEX
 - Experiment to operate an expanded network of new receivers capable of tracking new signals in addition to GPS & GLONASS
 - Support JAXA Multi-GNSS proposal activities
- Tasks
 - Set-up tracking network of Multi-GNSS equipment
 - Make tracking data publicly available
 - Experiment with data flow and signals, qualify equipment, signals, ...
- Goal: Seamless transition to a multi-GNSS global tracking network and making available fully combined and consistent multi-GNSS products.



Multi-GNSS

Multi-GNSS Receiver Singapore, Trimble NetR9, LEIAR25.R3 LEIT





RINEX 3.0 Observation File

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3.00          OBSERVATION DATA      M (MIXED)          RINEX VERSION / TYPE
Bnx2Rnx          congo                20120309 082056 GMT PGM / RUN BY / DATE
Source NTRIP stream gnss.gsoc.dlr.de/GMSD1          COMMENT
GMSD1
M
Hauschild          DLR/GSOC          OBSERVER / AGENCY
5049K72188          TRIMBLE NETR9          4.43          REC # / TYPE / VERS
4938353448          TRM59800.00          SCIS          ANT # / TYPE
-3607665.0563  4147867.7288  3223716.9486          APPROX POSITION XYZ
          0.0000          0.0000          0.0000          ANTENNA: DELTA H/E/N
G  16 C1C L1C D1C S1C C2X L2X D2X S2X C2W L2W D2W S2W C5X SYS / # / OBS TYPES
    L5X D5X S5X          SYS / # / OBS TYPES
R  20 C1C L1C D1C S1C C2C L2C D2C S2C C1P L1P D1P S1P C2P SYS / # / OBS TYPES
    L2P D2P S2P C3X L3X D3X S3X          SYS / # / OBS TYPES
E  16 C1X L1X D1X S1X C5X L5X D5X S5X C7X L7X D7X S7X C8X SYS / # / OBS TYPES
    L8X D8X S8X          SYS / # / OBS TYPES
S   8 C1C L1C D1C S1C C5X L5X D5X S5X          SYS / # / OBS TYPES
C  12 C2I L2I D2I S2I C6I L6I D6I S6I C7I L7I D7I S7I          SYS / # / OBS TYPES
J  24 C1C L1C D1C S1C C1X L1X D1X S1X C1Z L1Z D1Z S1Z C2X SYS / # / OBS TYPES
    L2X D2X S2X C6X L6X D6X S6X C5X L5X D5X S5X          SYS / # / OBS TYPES

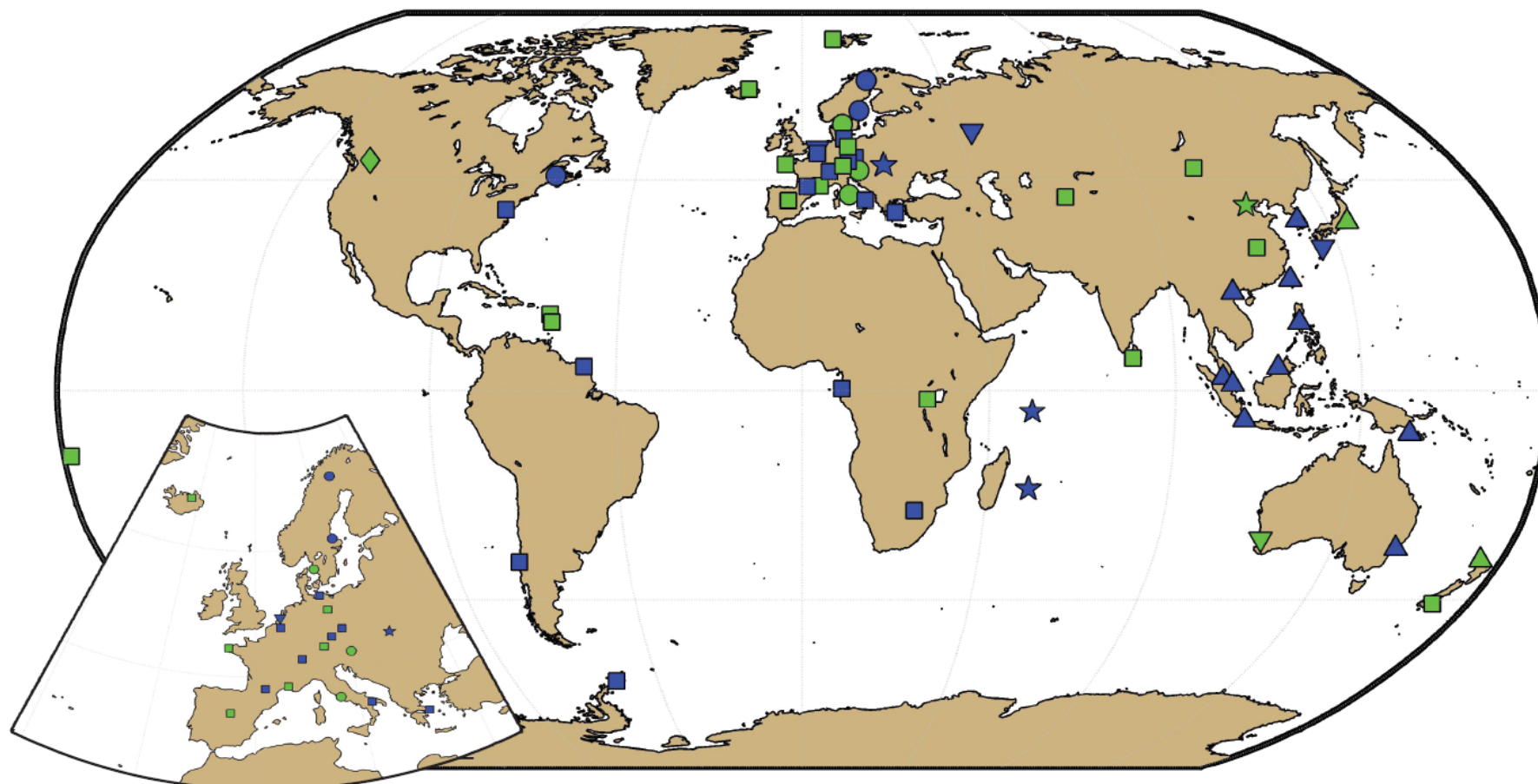
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...

many new observation types

new systems

M-GEX Network



- | | | | |
|---|-----------------------------|---|---|
| ★ | GPS/GLONASS | ● | GPS/GLONASS + GIOVE/Galileo + Compass/Beidou |
| ◆ | GPS/GLONASS + QZSS | ▼ | GPS/GLONASS + GIOVE/Galileo + Compass/Beidou + QZSS |
| ■ | GPS/GLONASS + GIOVE/Galileo | ▲ | GPS/GLONASS + GIOVE/Galileo + QZSS |
| | | ▲ | + SBAS |

<http://igs.org>

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IGS Working Groups and Working Groups



Working Groups
Data Center WG
Reference Frame WG
Tide Gauges WG
Space Vehicle Orbit Dynamics WG
Clock Product WG
Troposphere WG
Ionosphere WG
Antenna WG
Bias and Calibration WG
GNSS WG
RINEX WG
Real Time Pilot Project

How to convert IGS network to multi-GNSS?

Radiation pressure modelling for new satellites?

Clock products for new signals?

Incorporate new GNSS

New Systems and Signals

patterns for new frequencies

biases of new signals

new systems (M-GEX)

observation format (RINEX 3.0)

Real Time Products



M-GEX: Status, Results and Plans

- About 45 stations providing data, many also as real-time streams, soon about 55 stations.
- A number of formatting issues under investigation (file naming, satellite number assignments, ...). RINEX 3.0x working document.
- Understanding of equipment (performance of receivers and antennas), signals (biases and clocks), spacecraft behavior (attitude, antennas, radiation pressure).
- Results from data analysis is presented at the workshop:
 - Data availability and completeness
 - Zero baseline tests
 - Estimation of orbits and clocks (QZSS, Compass, Galileo IOV).
- Continuation of M-GEX, definition of short-term goals and dedicated experiments by the Working Group.



Conclusions

- Much experience in handling and processing of GNSS data is available in the IGS.
- IGS key projects are M-GEX and Real-Time Service.
- M-GEX continues with the goal to transition IGS to a true multi-GNSS service and to set the associated standards.
- We appreciate the high quality signals available in space and we want to make full use of them to the extent possible.
- The discussions and exchange in this forum are an opportunity.