
GGOS Bureau for Standards and Conventions

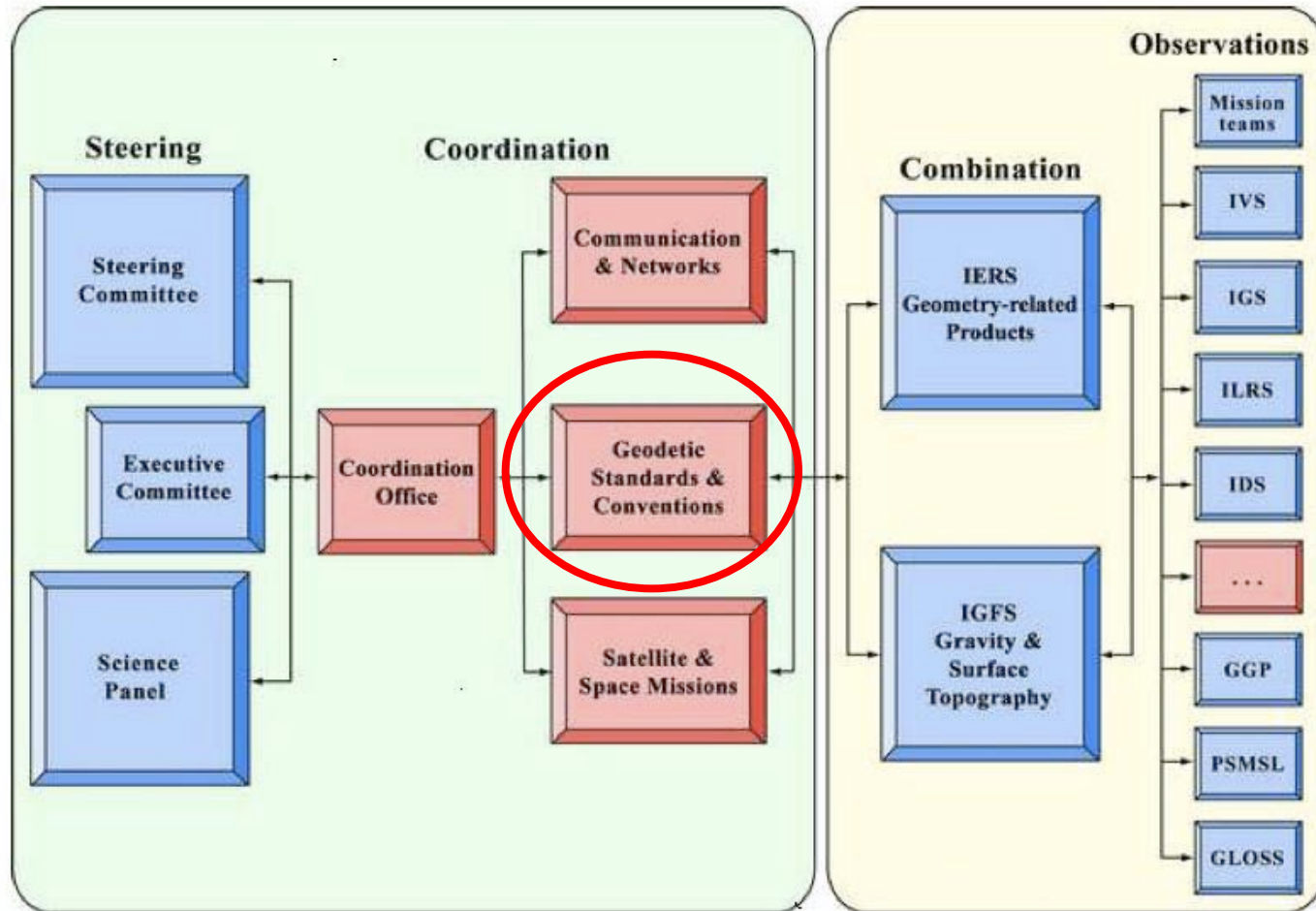
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GGOS Structure



GGOS, 2008

GGOS Bureau for Standards and Conventions (BSC)

- The BSC has been established in 2009 and is operated by DGFI and IAPG, TU München
- Director: D. Angermann (successor of U. Hugentobler since April 2011)
- Secretary (deputy director): T. Gruber
- BSC-Team:
 - Geometry, TRF: U. Hugentobler, P. Steigenberger
 - Earth Orientation, CRF: M. Gerstl, R. Heinkelmann
 - Gravity: J. Bouman
 - Vertical reference systems: L. Sanchez
- Associated: J. Ihde (BKG)
J. Kusche (Uni Bonn)
- Representation of all IAG Services needs to be established



Motivation and tasks of the BSC

- For the generation of highly accurate GGOS products **consistency** among the data sets from the different space geodetic observation techniques is of **crucial importance**.
- The analysis of the precise geodetic observations shall be based on the definition of **common standards** and a **unique representation and parameterization** of the relevant quantities.
- Major tasks of the BSC are
 - to **keep track of the strict observance** of adopted geodetic standards and conventions in the generation of geometric and gravimetric products issued by the IAG Services,
 - to **review, examine and evaluate** all standards, constants, resolutions and conventions adopted by IAG,
 - to **identify gaps, inconsistencies and deficiencies** in standards and conventions and to initiate steps to close them,
 - to **propagate** geodetic standards and conventions to the wider scientific community and promote their use.

Terrestrial reference frame, modeling issues ...

Conventional modeling of station positions (IERS Conventions):

- The general model connects the **instantaneous position $x(t)$** of a point at epoch t , and a **regularized position $X_R(t)$**

$$X(t) = X_R(t) + \sum \Delta X_i(t)$$

- The current ITRF model is **linear**, i.e., a position at a reference epoch t_0 and a constant velocity (V). The regularized station position (X_R) at an epoch t is expressed as:

$$X_R(t) = X_0 + V(t - t_0)$$

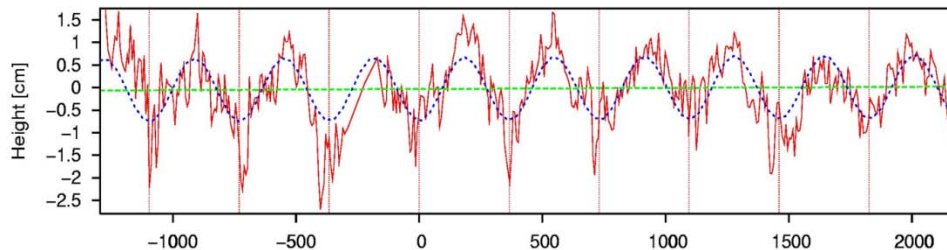
The terms $\sum \Delta X_i(t)$ and their impact on TRF and other GGOS products are discussed in the following

Correction models $\sum \Delta X_i(t)$ for data reduction

- Conventional models (IERS Conventions 2010)
 - Solid Earth Tides
 - Pole Tide
 - Tidal Loading
 - ocean tidal loading (FES2004, EOT08a, ...)
 - atmospheric S1/S2
- Technique-specific correction models (IAG Services)
 - propagation corrections
 - antenna effects
 - ...
- Non-conventional displacements of reference markers
 - non-tidal loading (atmospheric pressure and hydrological)
 - post-seismic displacements
 - other secular, episodic or seasonal variations

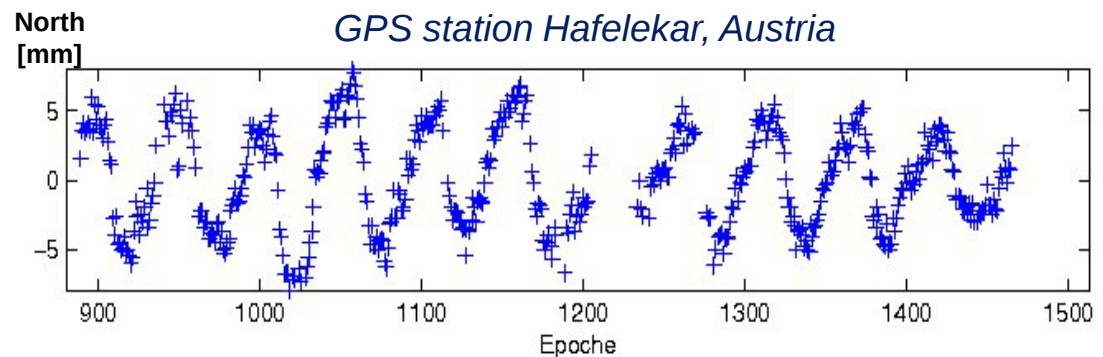
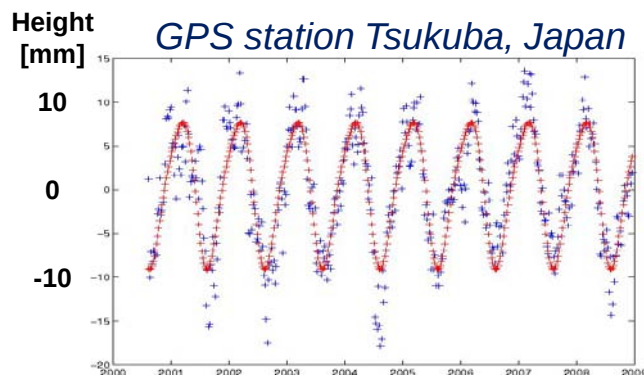
Discussion

- Consequences of the conventional approach
 - Non-tidal loading and other environmental effects are not considered
 - TRF results do not represent the “real” station motions



*Position time series for
GPS station Irkutsk, Siberia*

- The observed non-linear station motions can often rather well be explained by geophysical models (e.g., atmospheric pressure and/or hydrological loading), but many stations are also influenced by local effects



Non-tidal displacements in data reductions

- If atmospheric pressure and hydrological loading models are applied, seasonal position variations are reduced for many stations
- However, there are big challenges for an operational implementation, e.g.,:
 - Such models are less accurate than space geodetic observations
 - Discrepancies of several mm between different models do exist
 - It is difficult to account for local environmental effects
 - Models must be free of tidal effects and long-term biases
- Thus, at this time it is **not recommended** by the IERS conventions to include such modeling in operational solutions that support geodetic products
- Continued research efforts in these fields are strongly encouraged
- Models of non-tidal station displacements (including documentation) shall be made available to the user community through the GGFC

Requirements for TRF and other GGOS products

- A fundamental requirement is the definition of common standards and conventions and a consistent modeling and parameterization for the processing of the different space geodetic observations.
- These standards and conventions have to be applied by all analysis centers that are supporting IERS and GGOS products.
- The users of such products must exactly know, whereupon they refer to; i.e. the terms $\sum \Delta X_i(t)$ must be clearly and unambiguously defined.
- An appropriate handling of non-tidal station displacements is essential to satisfy the GGOS accuracy requirements.
- A high long-term stability is crucial for monitoring Global Change phenomena (e.g., sea level rise); thus model changes require a consistent reprocessing of the full observation time series.

Recommendations

- (1) The operational data analysis of the space geodetic observations that support GGOS products shall be based on common standards and conventions and a consistent modeling and parameterization.
- (2) A clear and unambiguous documentation of the GGOS products is essential and shall be made available to the user community. The BSC will provide recommendations/suggestions for such a documentation.
- (3) Further research efforts (e.g., regarding modeling of non-tidal displacements) are strongly encouraged. It is recommended that the GGFC should make available models of non-tidal station displacements, together with all necessary supporting information and implementation documentation.