DGFI part of project PN 5
Status report

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## Work packages and schedule

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*DGFi Forschungsgruppe FOR1503, 19/20 Sept 2013, Berlin*
WP5420: VLBI time series

- Implementation of new models into the new DGFI software DOGS-RI should be finished in about 1-2 months
- Current IVS operational analyses using OCCAM are based on several outdated models
- Long-term solutions including radio source coordinates needed for PN 5
- Extensive (“manual”) reprocessing needed, as available DGFI time series only include source coordinates back to November 2012
- Student helper could be engaged for the reprocessing effort

Problems: software not available yet, time-consuming reprocessing necessary
WP5430: SLR time series (1)

- DOGS-OC able to follow all standards as agreed upon in January 2013
- Nearly automated reprocessing possible at any time
- Weekly 10-satellite solutions available since 2000
- Multi-satellite solutions allow better decorrelation of estimated parameters than standard LAGEOS1/2 solutions

Problems: —
WP5430: SLR time series (2)

Satellite altitude [km]

- 19135: ETALON 2
- 19105: ETALON 1
- 5850: LAGEOS 1
- 5625: LAGEOS 2
- 1485: AJISAI
- 1450: LARES
- 927: BEACON-C (non-spherical)
- 832: WESTPAC
- 815: BLITS
- 815: STARLETTE
- 815: STELLA
- 691: LARETS

Time:
- 1975
- 1985
- 1995
- 2000.0 until 2013.5
- 2015

09.04.2013: Collision with space debris

Computation period:
2000.0 until 2013.5

Not included yet:
- BEACON-C (non-spherical)
WP5440: GNSS time series

- CODE contribution to second IGS reprocessing campaign (estimated by Peter Steigenberger, IAPG) available soon
- Time span: 1994-2013
- Total number of stations: 378
- Standard SINEX files contain geocenter coordinates and satellite antenna phase center offsets, but no nutation or troposphere parameters
- Deviations from FOR1503 standards (among others): ocean pole tide loading not applied for coordinates, non-tidal atmospheric loading not applied, Lense-Thirring and geodesic precession not applied, version 2 of Vienna loading corrections (including bug?)

Problems: slight deviations from the FOR1503 standards
WP5300: Refined combination strategies

WP5320: Non-linear station motions

WP5330: Epoch combinations
Significance of (semi-)annual station motions

Derived from differences between epoch and multi-year reference frames (combined GPS, SLR and VLBI solutions; 1994-2006; 335 stations with 528 sets of positions)
Strategies to deal with non-linear station motions

• **Modeling**
  – improved modeling of global geophysical fluids (atmosphere, oceans, hydrology, etc.) that are responsible for the station motions
  – WP5100 (BKG)

• **Parameterization**
  – set up parameters like annual and semi-annual sine functions for the station coordinates (besides linear station velocities)
  – WP5320 (DGFI)

• **Sampling**
  – estimation of epoch reference frames instead of multi-year reference frames
  – WP5330 (DGFI)
WP5320 Non-linear station motions (1)

- Implementation of periodic signals into the DGFI combination software DOGS-CS:
  - user-defined wavelength
  - amplitudes of sine and cosine wave to be solved for
- Amplitudes of periodic signals in the coordinate time series are set up together with station velocities

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3 velocity components 6 amplitudes wave-length [a] a priori values

- Implementation of periodic signals into a separate Helmert transformation program
Identification of stations with clear annual signal, e.g.: IGS site TSKB (Tsukuba, Japan) with an amplitude of 9 mm (derived from final time series) in the up component.

Attempt to estimate the amplitude directly with DOGS-CS.

Problems: estimated amplitudes too small; how to define the datum, when setting up periodic signals for all stations?
Epoch reference frames (ERF) w.r.t. different sampling rates available
cf. IAG 2013 presentation by Bloßfeld M. et al.: „Epoch reference frames as short-term realizations of the ITRS“
Differences between ERF and LRF (1)

Yakutsk (Russia): annual signals not able to cover short-term effects from previous slide
Differences between ERF and LRF (2)

Sofia (Bulgaria): strong signal in the up component; trends probably due to deficiencies in the velocity estimates of the LRF
Hofn (Iceland): different amplitudes for consecutive intervals, but good phase agreement.
Summary

- SLR and GNSS time series available soon
- Big effort necessary to generate long-term VLBI solution including source coordinates
- Sine and cosine waves for station coordinates implemented into DOGS-CS, but estimated amplitudes still too small
- Strategy for the computation of epoch reference frames developed
- Epoch reference frames allow the monitoring of non-linear and non-periodic station motions such as post-seismic deformations
- Epoch reference frame solutions are a perfect basis for comparisons with solutions derived with other approaches