GGSP: Realisation of the Galileo Terrestrial Reference Frame

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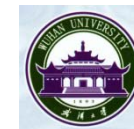*Gerd Gendt, Markus Rothacher*
GeoForschungsZentrum Potsdam

GGSP Prototype Team

- **Introduction: Status of Galileo**

- **Status of the Galileo Geodetic Service Provider (GGSP) Prototype**

- **Derivation of the Galileo Terrestrial Reference Frame (GTRF)**

  - ◆ **GTRF realization**

  - ◆ **GTRF maintenance**

  - ◆ **Results**

- **Recommendations for the Galileo Reference Service Provider (GRSP)**

- **Financing of Galileo secured by EU finance minister decision, but**

- **Implementation delayed by several years → In-Orbit-Validation (IOV) phase n.e.t. end of 2009 → Full Operational Capacity (FOC) n.e.t. 2012**

- **Third bidder consortium for the Galileo Space Segment (beside EADS and OHB)? Bidding to start this summer**

- **Two experimental satellites started**
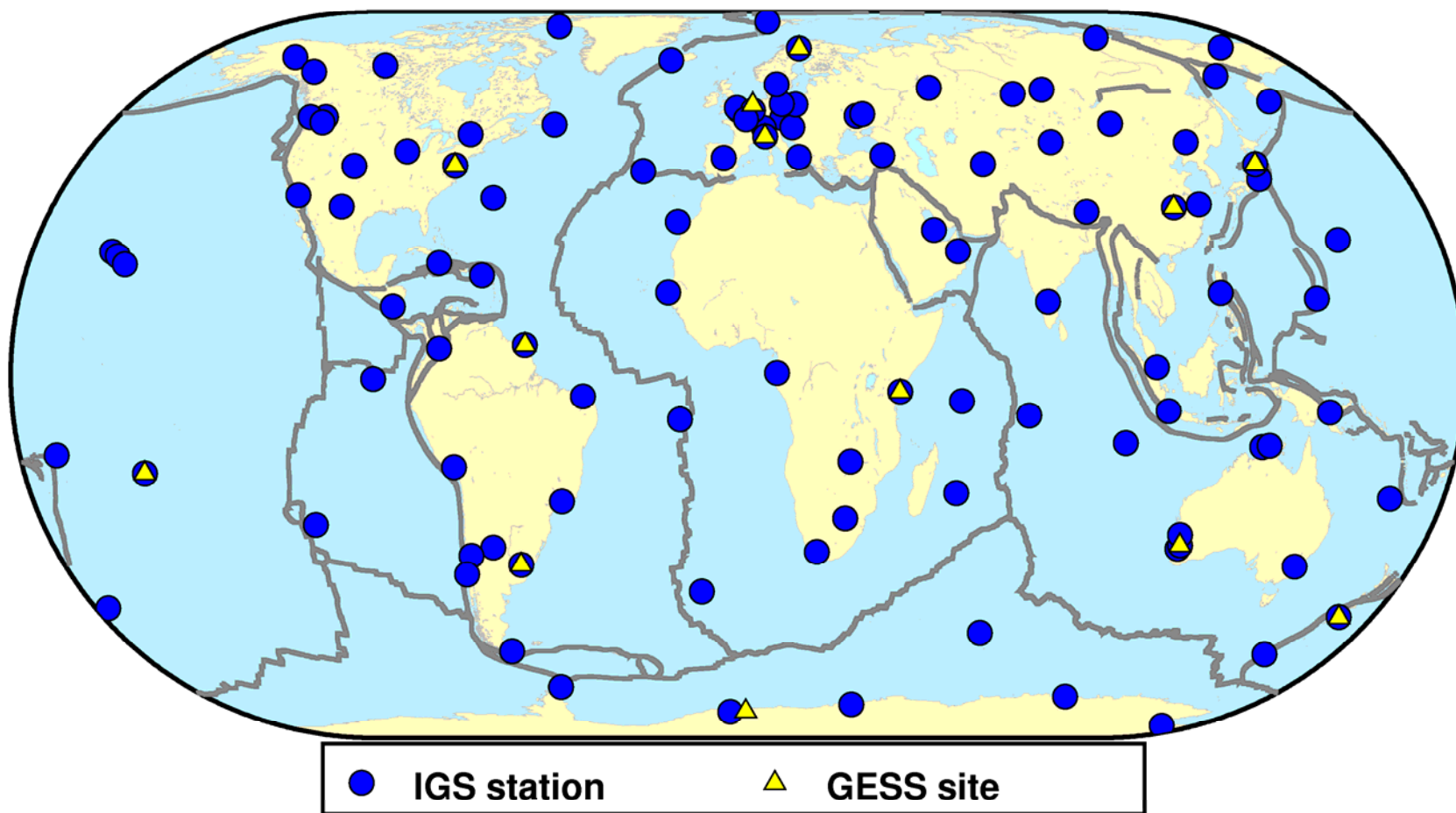
- **GIOVE-A started Dec 2005 with two years**
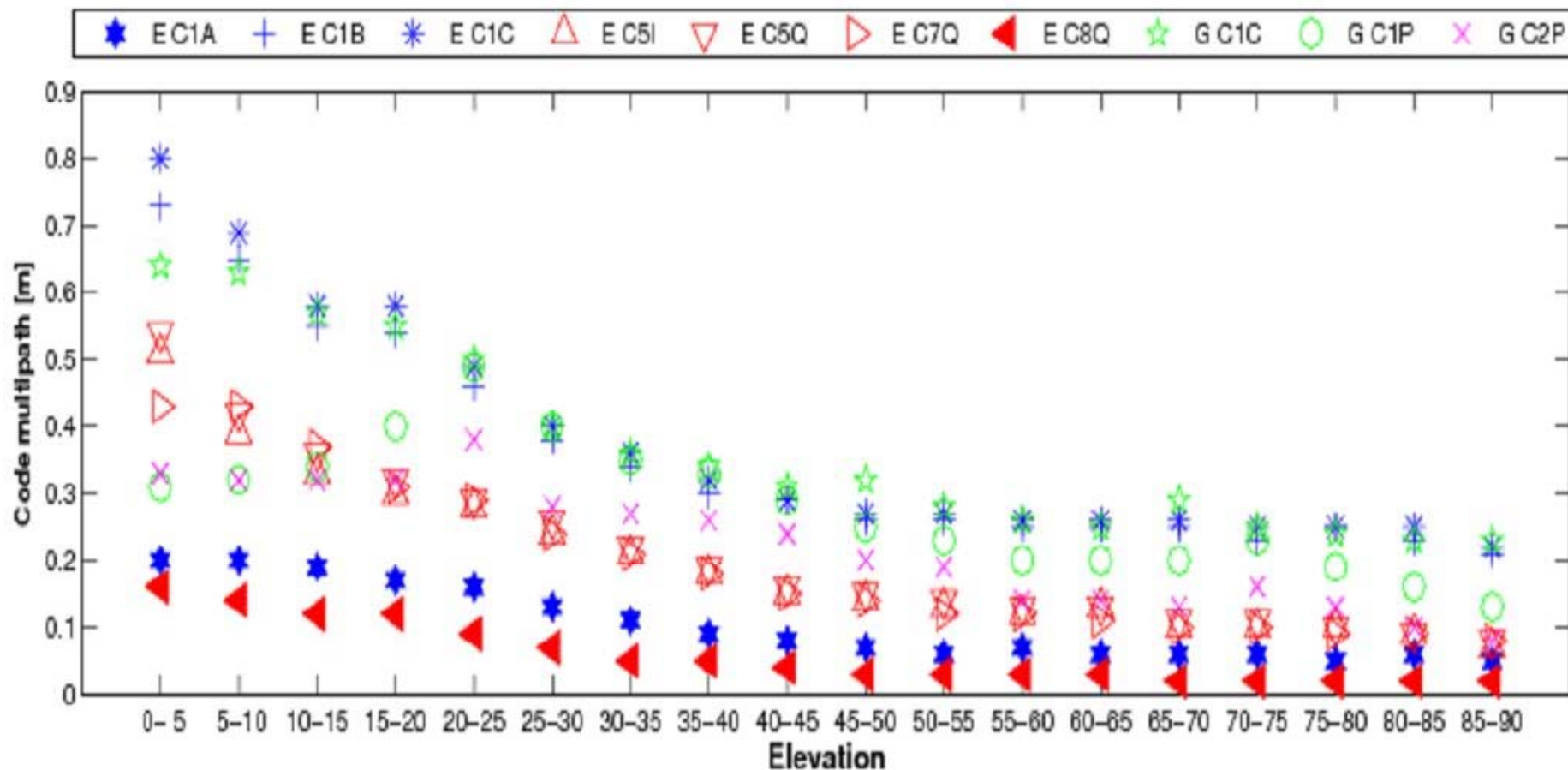
- **Several results of GIOVE-A published** (T. Springer, 2008)
- **Promising first results of GIOVE-B**

- **Galileo Geodetic Service Provider Prototype started in July 2005 as project of the 6th FP of the EU**

- **Prolongation until May 2009**

- **Main tasks:**

  - **Realization of a GTRF aligned to the ITRF**

  - **Inclusion of GSS when installed**

  - **Entity between GCS and services and users**

  - **Software extension for Galileo:**

    Bernese, NAPEOS and EPOS "Galileo ready"

- **Initial realization in November 2007**

- **About 100 IGS sites and 13 GESS**

- **Campaign-wise analysis (4 weeks each three months)**

- **RINEX 3.0 as standard data format within GGSP for GPS+Galileo data**

- **Software tests and validation**

IGS station   GESS site

Ground network for GIOVE satellites

RINEX 3.0

Screenshot of WordPad window titled "gmiz1290.08o - WordPad" showing a RINEX 3.0 observation file:

```
|      3.00           O                M             RINEX VERSION / TYPE
S2R                   ROOT             20080508 011406 UTC PGM / RUN BY / DATE
                                                    MARKER NAME
NONE                                                MARKER TYPE
DSF GSTBV2            ESA                            OBSERVER / AGENCY
                     GETR                           REC # / TYPE / VERS
                                                    ANT # / TYPE
  -3857260.0500   3108700.2100   4003931.6530       APPROX POSITION XYZ
        0.0000         0.0000         0.0000         ANTENNA: DELTA H/E/N
    2008     05     08     00     00    00.000       TIME OF FIRST OBS
    2008     05     08     23     59    59.000       TIME OF LAST OBS
G    10 C1C L1C D1C S1C C1P S1P C2P L2P D2P S2P      SYS / # / OBS TYPES
E    20 C1A L1A D1A S1A C1C L1C D1C S1C C7I L7I D7I S7I C7Q  SYS / # / OBS TYPES
        L7Q D7Q S7Q C8Q L8Q D8Q S8Q                 SYS / # / OBS TYPES
    30.000                                           INTERVAL
                                                    END OF HEADER
> 2008 05 08 00 00  0.0000000  0 10
E01  24591291.897 7 -14715757.393 7      -2491.257 7       45.100 7  24591017.851 7 -11223464.902 7      -1908.872 7
44.500 7          .000 0          .000 0          .000 0          .000 0          .000 0          .000 0          .000 0
.000 0          .000 0          .000 0          .000 0          .000 0
G17  24311484.912 7   -509388.344 7      -3796.762 7       46.500 7  24311483.757 5        32.300 5  24311478.219 5
99551403.789 5      -2958.536 5       32.500 5
G10  21935824.173 8 -15028859.027 8       2084.254 8       49.000 8  21935822.722 6        36.500 6  21935817.093 6
89823526.265 6       1624.167 6       36.800 6
G25  23493545.251 7  -6275729.847 7        533.415 7       45.900 7  23493544.944 5        33.300 5  23493539.082 5
96202140.518 5        415.591 5       33.300 5
G13  21509518.068 8 -19521125.682 8      -2111.863 8       51.500 8  21509517.107 6        36.800 6  21509508.675 6
88077863.610 6      -1645.601 6       37.300 6
G02  20340090.343 8 -27762074.008 8       1419.905 8       51.000 8  20340089.055 6        39.300 6  20340079.876 6
83289253.063 6       1106.511 6       40.500 6
G23  24473770.764 7  -4346840.640 7      -3407.089 7       42.600 7  24473769.644 4        24.300 4  24473761.253 4
100215943.138 4      -2654.776 4       24.300 4
G04  20660982.557 8 -23368148.768 8      -1105.740 8       50.700 8  20660981.149 6        38.500 6  20660974.285 6
84603239.904 6       -861.491 6       39.500 6
G07  23671150.138 7  -2985615.869 7       1973.360 7       45.900 7  23671149.281 5        34.300 5  23671143.598 5
96929403.204 5       1537.803 5       34.300 5
G27  23500116.010 7  -5946121.403 7       1730.349 7       44.600 7  23500114.692 4        29.800 4  23500109.462 4
96229048.365 4       1348.408 4       29.800 4
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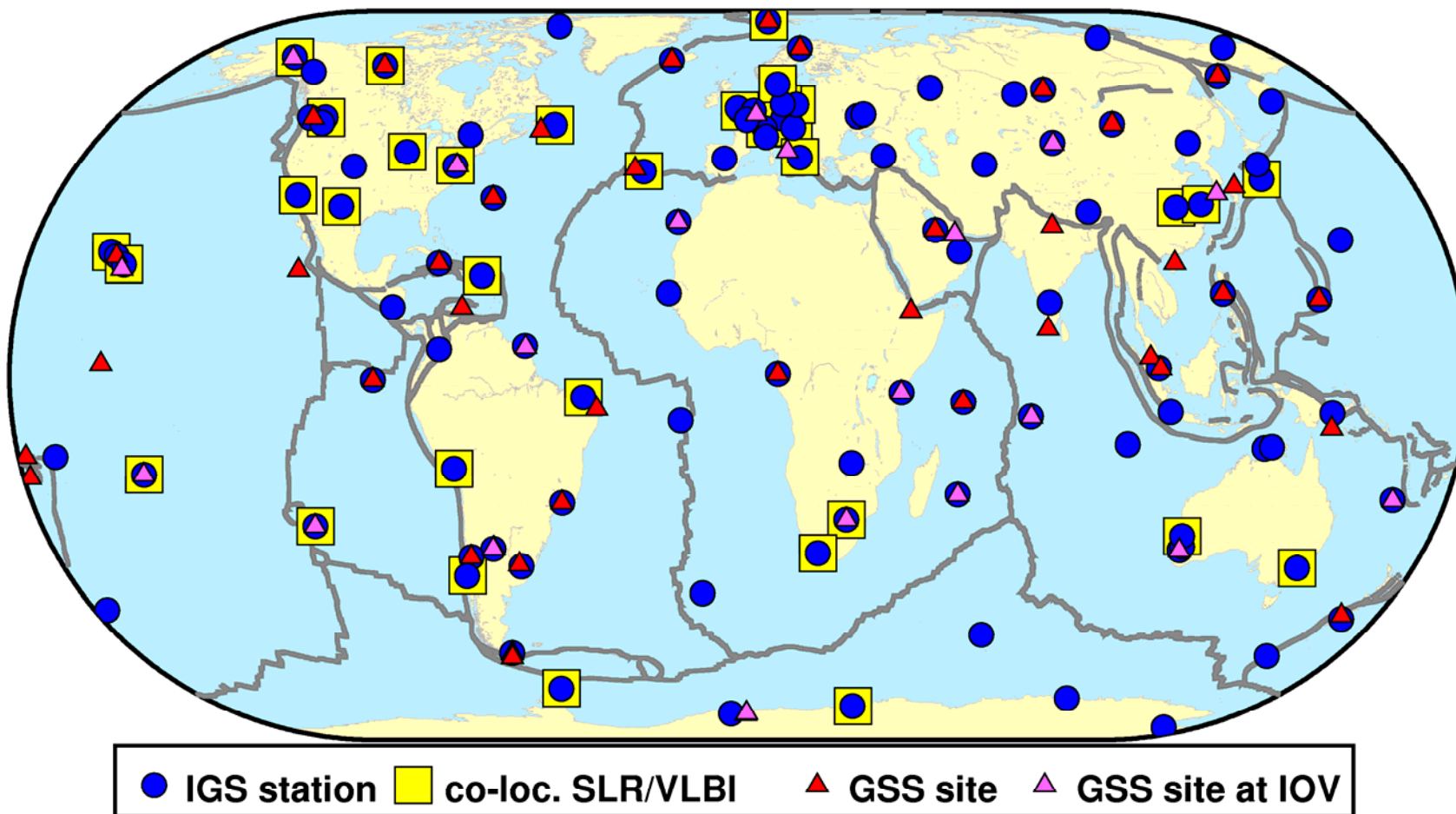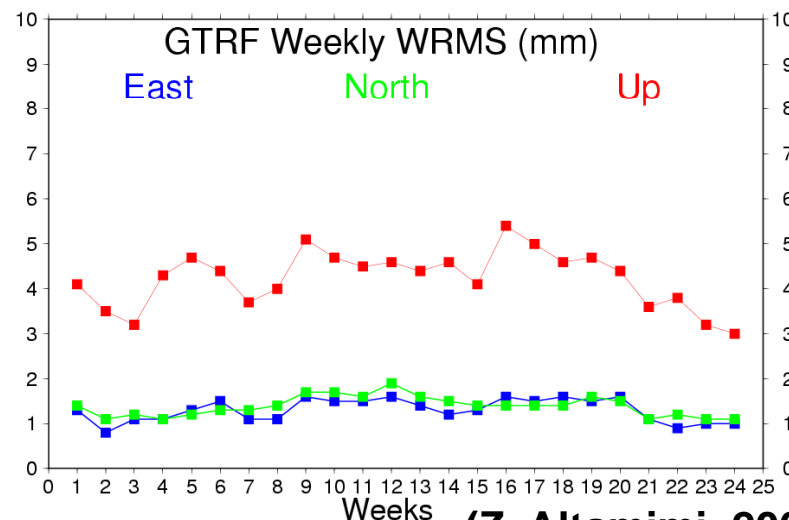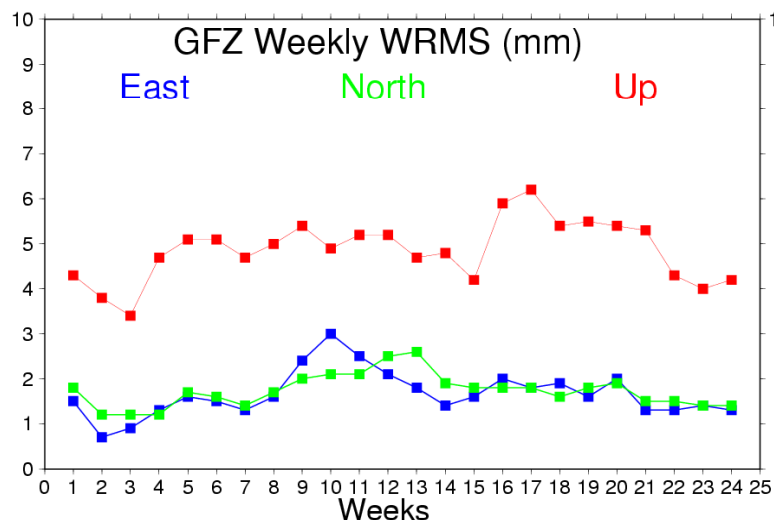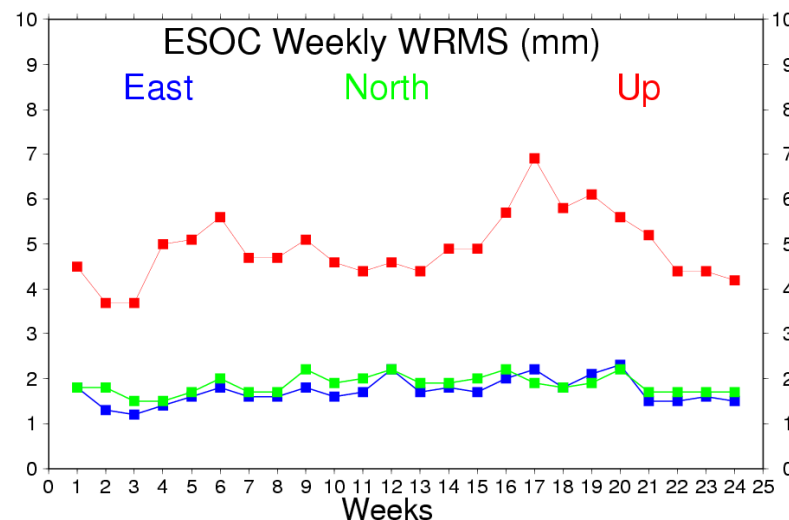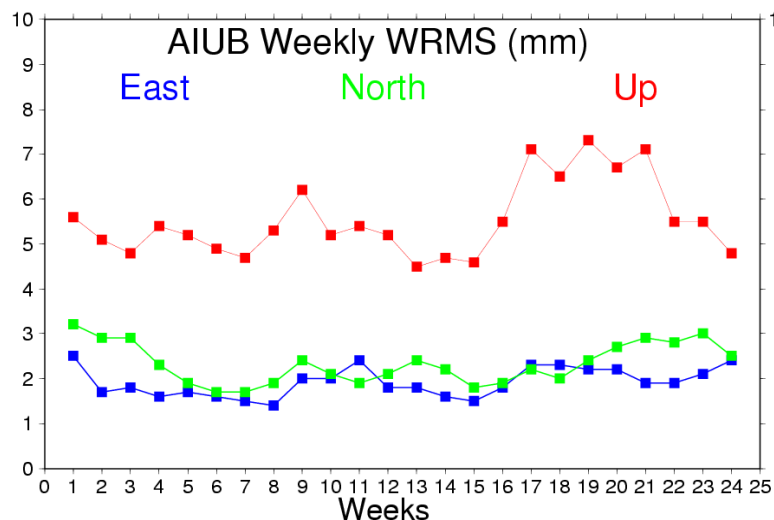
Drücken Sie F1, um die Hilfe aufzurufen.

- **Continuous operation to start in September 2008**

- **Weekly solutions validated with IGS Finals**

- **Semi-annual releases**
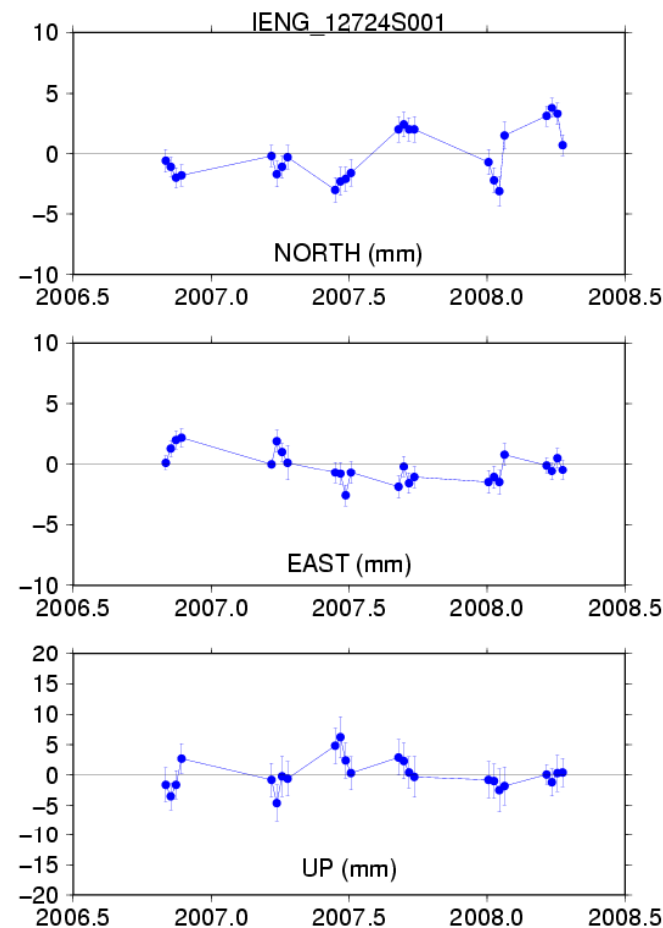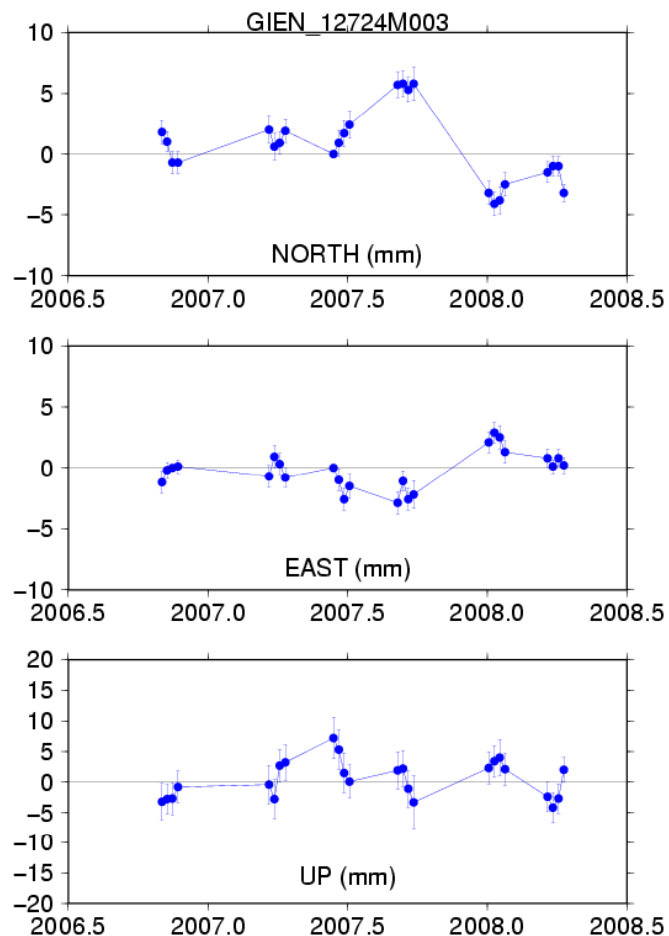
- **Combination aligned to ITRF2005**

IGS station   co-loc. SLR/VLBI   GSS site   GSS site at IOV

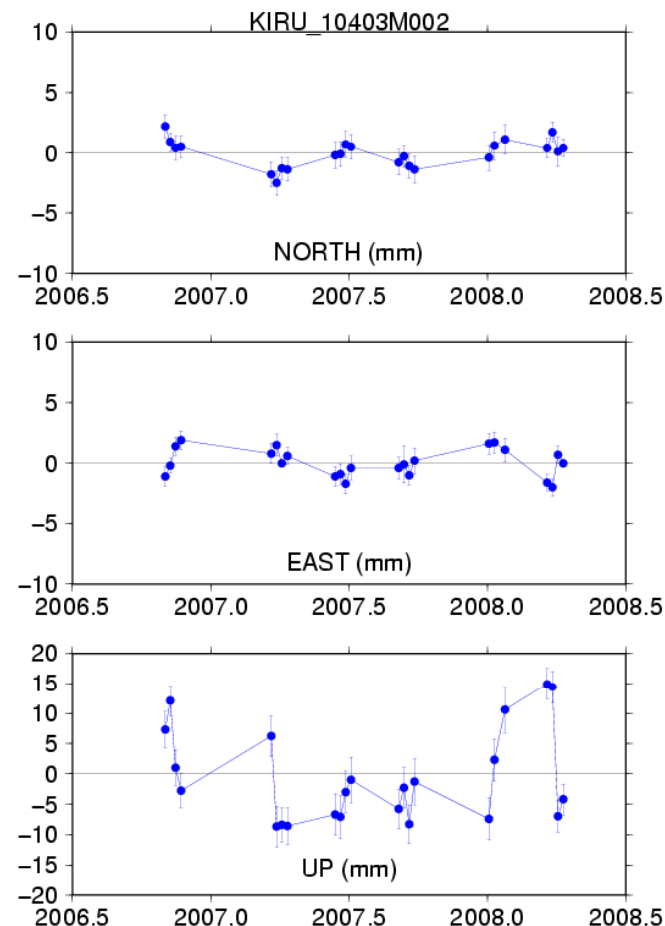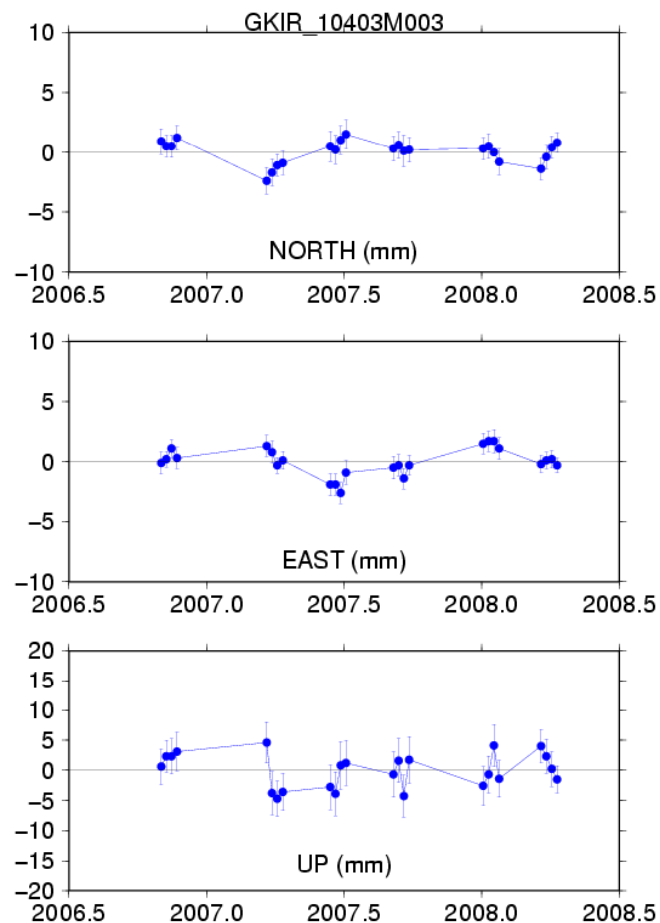**Repeatability w.r.t. the cumulative solution**

(Z. Altamimi, 2008)
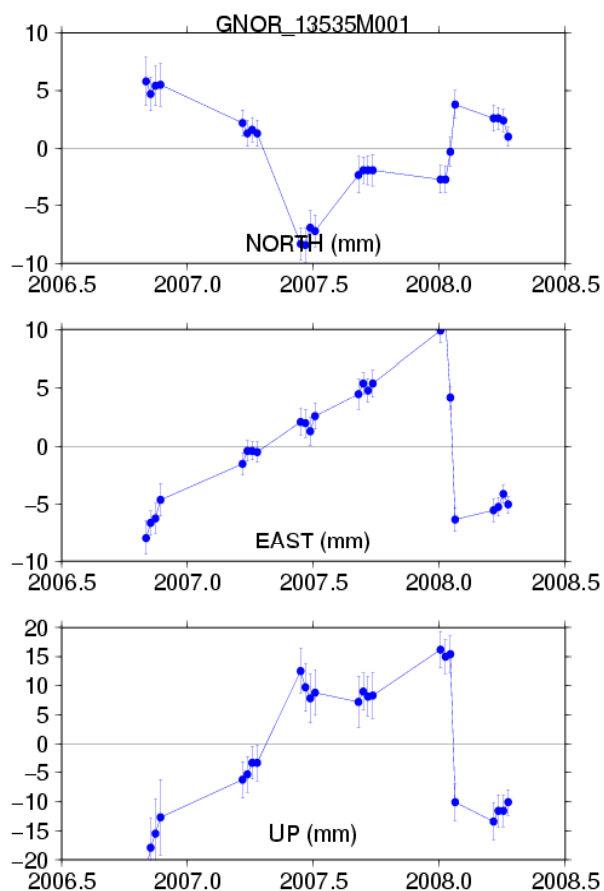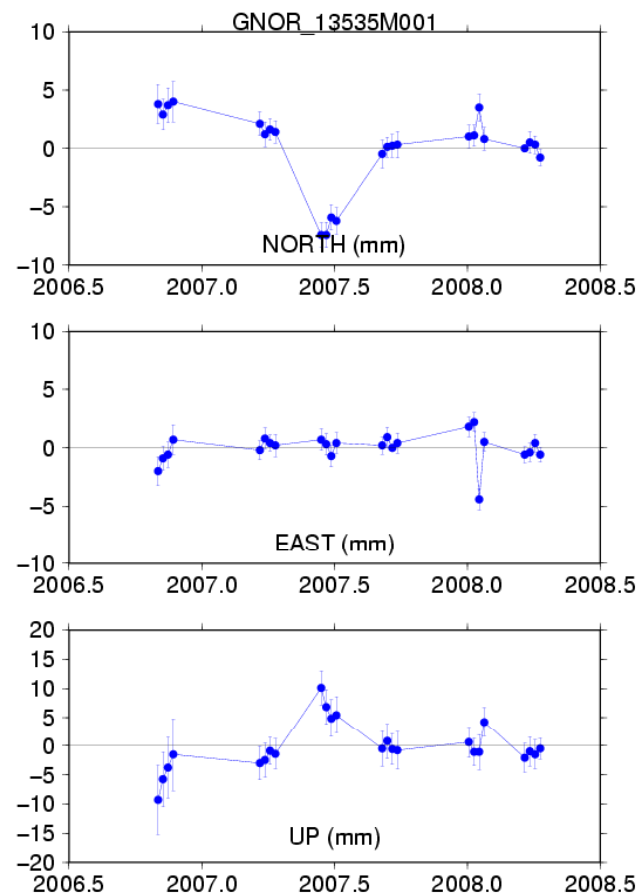
Torino, Italy

(Z. Altamimi, 2008)

Kiruna, Sweden

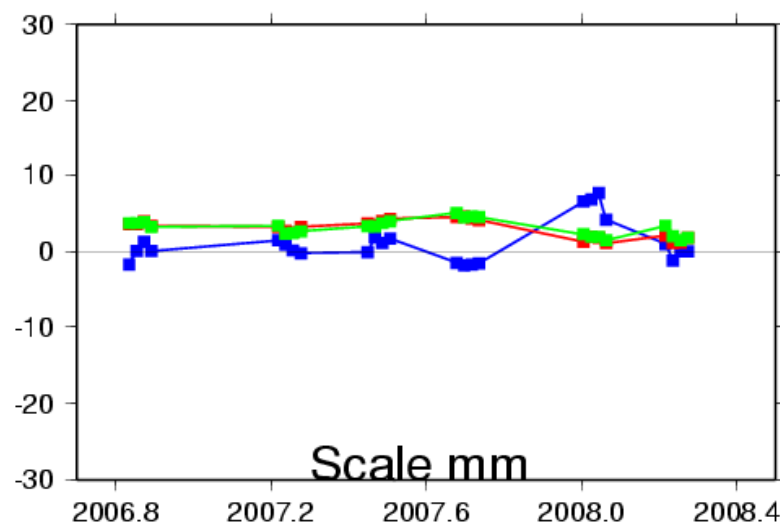(Z. Altamimi, 2008)

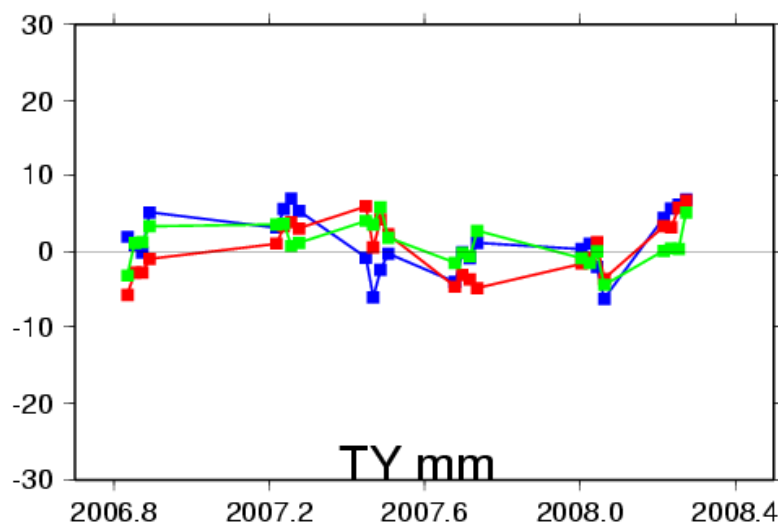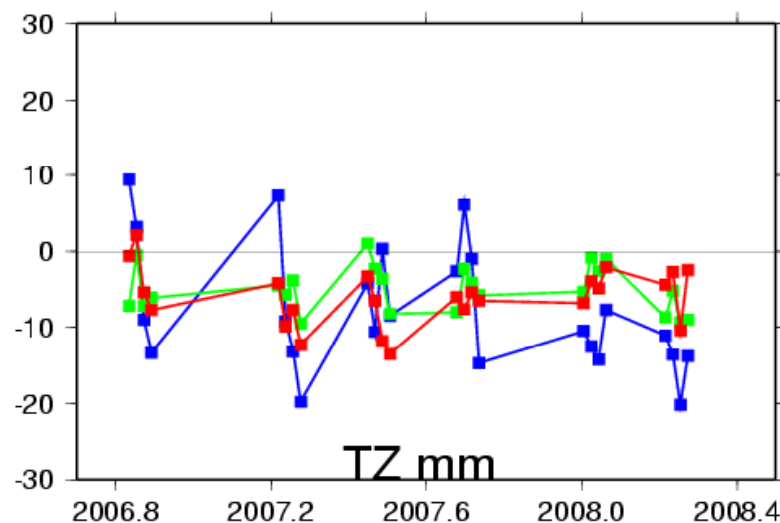**Nordwijk, The Netherlands (ESTEC test site)**

(Z. Altamimi, 2008)

(Z. Altamimi, 2008)

Orbits (PF solutions compared to GRF)

Clocks (PF solutions compared to GRF)
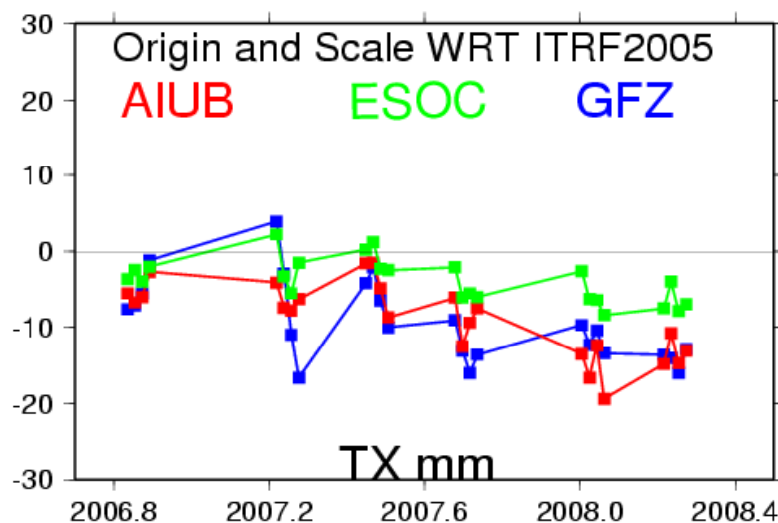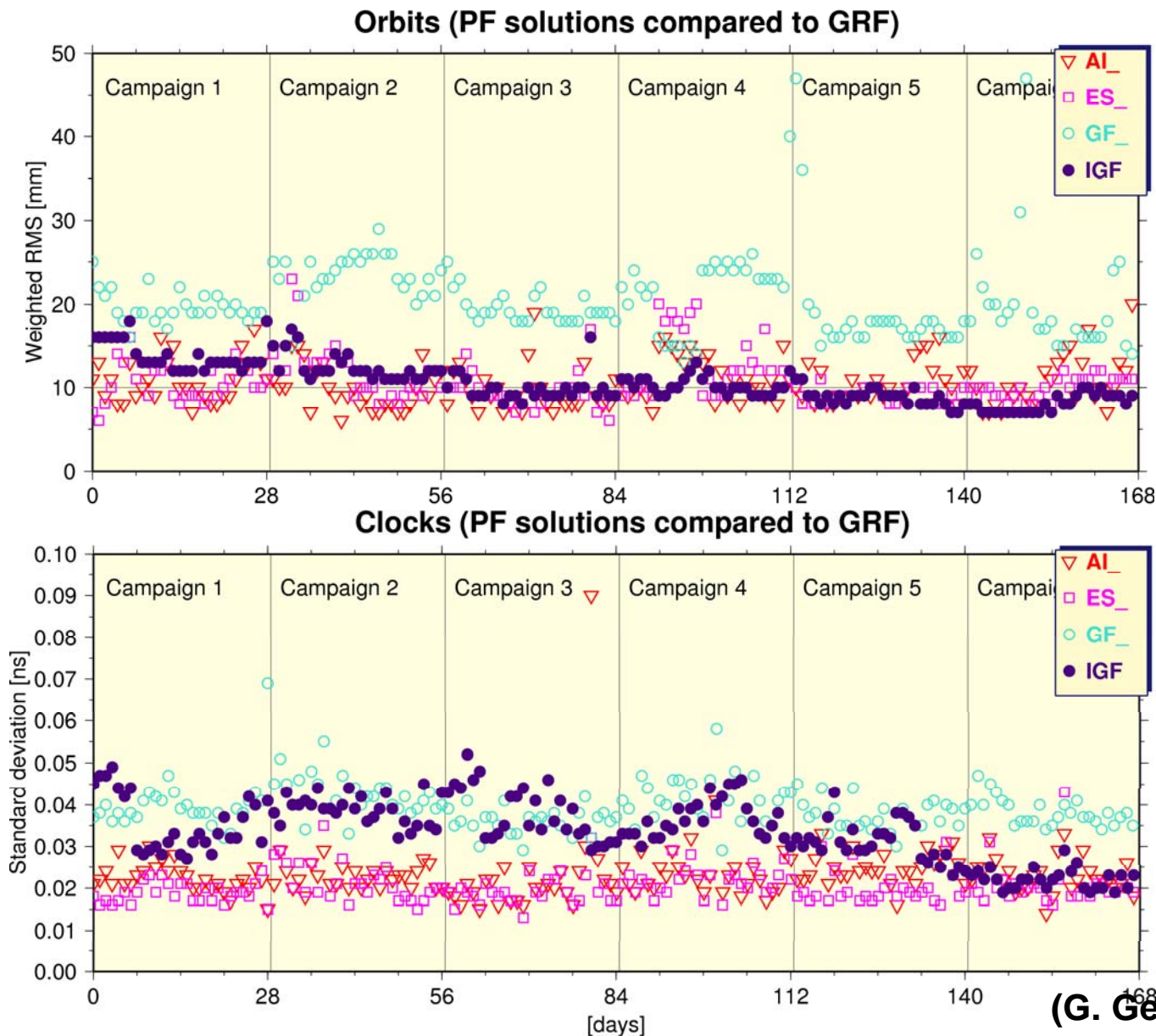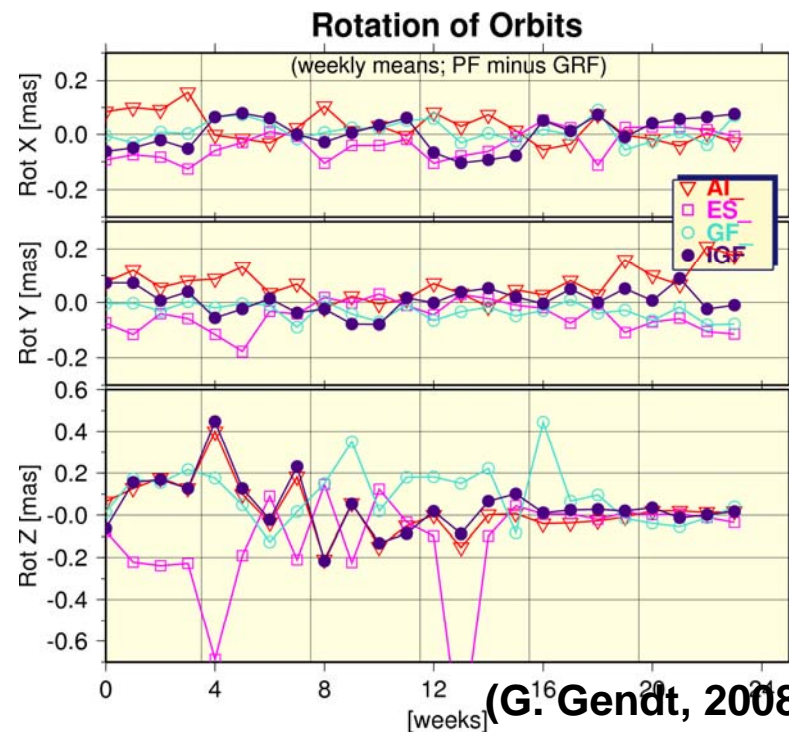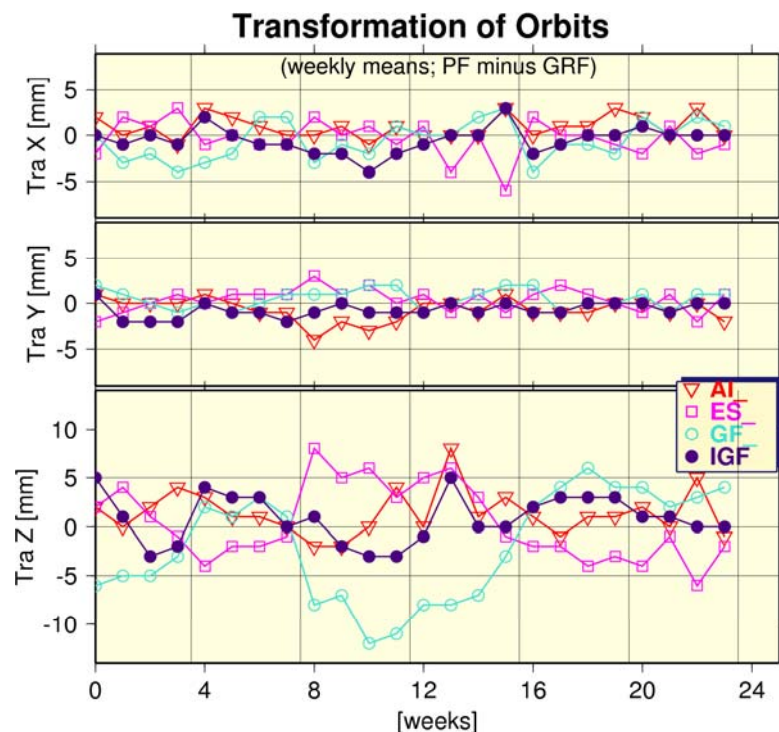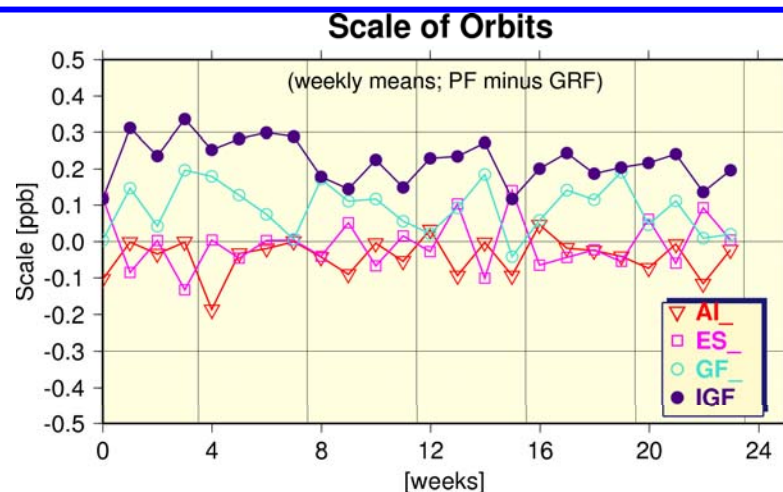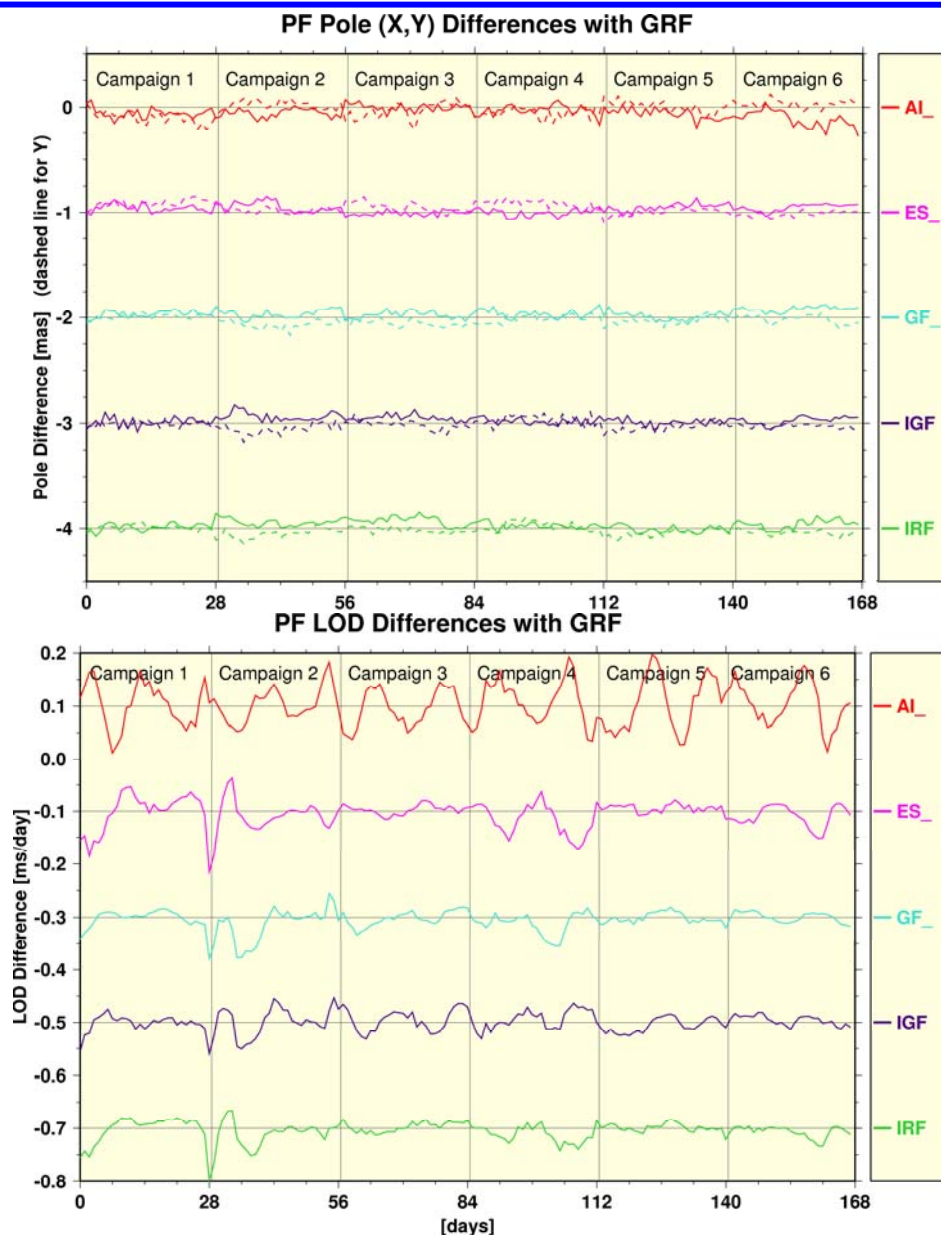
(G. Gendt, 2008)

(G. Gendt, 2008)

(G. Gendt, 2008)

I.e. phase between the end of GGSP prototype and IOV

- **Continuation of GESS monitoring**

- **Continuation of estimating versioned GTRF realization**

- **Starting of permanent processing in September 2008 until IOV**

- **Simulations concerning number and distribution of GSS**

- **Gradually substitution of IGS sites by GSS**

- **Upgrade of existing IGS+EPN stations to GPS + GLONASS + Galileo stations**

- **Inclusion of GSS into the IGS+EPN**

- **Extension of IGS+EPN products for Galileo**

- **Preparing standards, data bases etc. for Galileo**

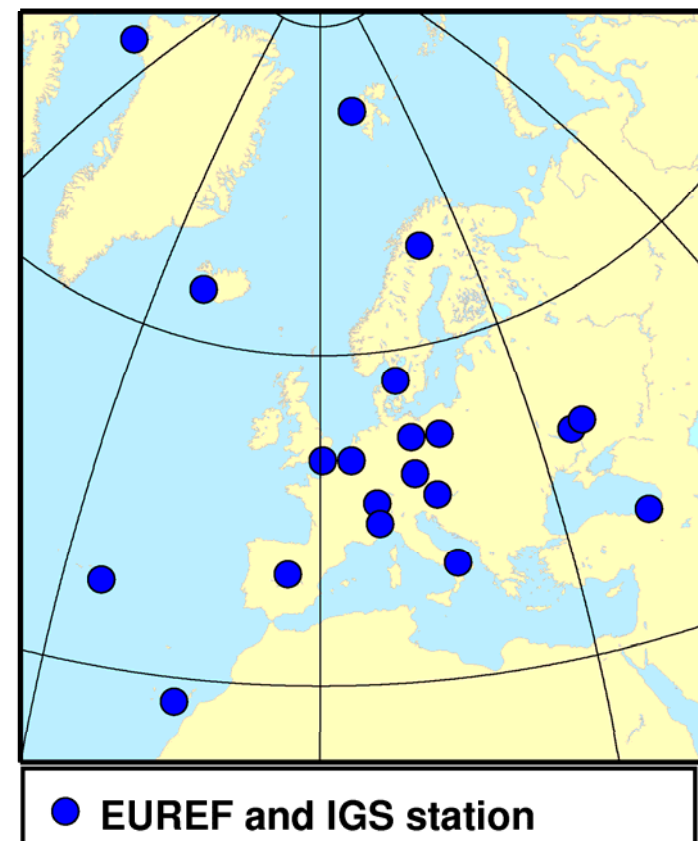- **Development of user-specific products to increase the acceptance of the GRSP**

- **Selection criteria of IGS/EPN stations**
  - ◆ **Co-location with VLBI/SLR**
  - ◆ **High-quality time reference**
  - ◆ **Proposed Galileo site**
- **21 EPN/IGS sites in GTRF**
  - ◆ **6 GPS+GLONASS**
  - ◆ **7 ECGN**
- **Encourage GRSP to announce the GSS as EPN stations**

● EUREF and IGS station

Thank you for your attention!

http://www.ggsp.eu