EPN Reprocessing

An Update on the EPN Reprocessing Project: Current Achievement and Status

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The Project: Initiative/Action

Since the beginning of the EPN in 1996 different

- Reference frames,
 - Correction models,
 - Processing strategies and
 - Software versions were applied.

Consequently:

Causing discrepancies

Estimated coordinates are not consistent over the past 15 years! Time series reflect inconsistencies

Problem realized by many groups and culminated in the global reprocessing campaign of the IGS (compl. 2010).

The EPN initiative aims likewise at the improvement of

Consistent coordinates and velocities (time series) for the EPN, The reference frame realization (ETRS) and its by-products (e.g. troposphere) EUREF Symposium 2011 – Moldavia - Chişinău

Project Development

| Date | Items |
|---------------|--|
| October 2008 | Local Analysis Centre (LAC)-Workshop in Frankfurt initiated a plan for the EPN working group on "reprocessing". |
| February 2009 | Charter for the working group on reprocessing has been developed and has been accepted by the EUREF Technical Working Group (TWG). |
| June 2009 | First schedule for the reprocessing has been developed. |
| May 2010 | Pilot Processing initiated. |
| November 2010 | Pilot Processing has been completed. <i>Benchmark test</i> established and <u>Start up for <i>EPN-Repro1</i> (LAC-Workshop).</u> |

Pilot Processing

The pilot phase was thought as an initial step in order to:

- Setup facilities (computers, data, software)
- Re-distribute sites within the group of participating partners
- Test of different analysis strategies
- Recommendations for a common analysis strategy and products to be used
- The year 2006 has been selected due to the switch in reference frames (ITRF2000=>ITRF2005; GPSW: 1400).
- The pilot phase serves as a "proof of concept".
- Result: Reprocessed products were clearly improved.



Contributions within in Pilot Processing

| LAC BERNESE | GAMIT | GIPSY | Products Used | |
|-------------|-------|-------|------------------|--|
| ASI - | - | as0 | JPL repro. | |
| BEK be0 | - | - | PDR05 | |
| DEO - | - | de0 | JPL repro. | |
| GOP go0 | - | - | IGS repro1 | |
| IGE ig0 | - | - | IGS repro1 | |
| IGN in0 | - | - | IGS repro1? | |
| LPT lp0 | - | - | CODE regular | |
| MUT mu0 | mu_ | - | IGS repro1/ "" | |
| NKG nk0 | - | - | IGS repro1 | |
| OLG ol0 | - | - | IGS repro1 | |
| ROB ro0 | - | - | CODE reprocessed | |
| SGO sg0 | - | - | IGS final | |
| SUT su0 | - | - | IGS repro1 | |
| UPA up0 | - | - | PDR05 | |
| WUT wu0 | - | - | IGS repro1 | |

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Software: Pilot Processing (EPN-Repro1)

| Software | BERNESE 5.0 | GAMIT 10.35 | GIPSY 5.0 |
|----------------------------|----------------|-------------|-----------------------|
| GPS | Fix | Fix | PPP-Float/ Net Fix |
| GLONASS | Float | - | - |
| Global Mapping Function | - | Yes | Yes |
| Vienna Mapping Function | - | Yes | Yes |
| 2nd Order Ionosphere | - | Yes | Yes |
| Atmospheric Loading | - | - | - |



Resolutions LAC Workshop (2010)

- Present results of EPN-Repro1 campaign at the EUREF symposium (2011).
 - Do not postpone the reprocessing of the EPN (again)!
- Any IGS Repro1 products can be used.
- Antenna PCV-corrections are based on EPN_05.atx.
- Use the available software and their integrated models (e.g. troposphere).
 - GAMIT 10.35 or 10.40
 - ► GIPSY/OASIS 5.0 or 6.0
 - Bernese 5.0

Test and compare the different results of the LACs in a **benchmark test**!



Benchmark Test



- Select a network of 30 sites.
- Identify a set of identical data (GPSWEEK 1381).
- Apply the same PCV model.
- Any reprocessed product is permitted.
- Use the available software to your best knowledge.

Best case: The results are identical!

- Expectation: Differences have to be explained by
- •Different strategies, models
- Impact by the software and the operator

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Benchmark: Weekly Combination

| LAC | SW | RMS [mm] | X [mm] | Y [mm] | Z [mm] | X" [*1000] | Y" [*1000] | Z" [*1000] | Scale [ppb] |
|-----|----|-------------|-----------|-----------|-----------|---------------|---------------|---------------|----------------|
| 1 | GP | 2.6 | -2.1 | -9.8 | -8.6 | 0.2 | 0.2 | -0.1 | 1.2 |
| 2 | В | 0.6 | 2.8 | -2.0 | -2.3 | 0.0 | 0.1 | -0.1 | 0.0 |
| 3 | В | 0.8 | 1.3 | 5.4 | -2.4 | -0.1 | 0.1 | 0.1 | 0.0 |
| 4 | В | 0.4 | 0.4 | 3.0 | -0.5 | -0.1 | 0.0 | 0.1 | 0.0 |
| 5 | В | 0.4 | -0.6 | 3.5 | 0.7 | -0.1 | 0.0 | 0.1 | -0.1 |
| 6 | В | 0.4 | -1.4 | 2.3 | 1.0 | 0.0 | -0.1 | 0.1 | 0.0 |
| 7 | GA | 1.4 | -2.6 | 1.7 | -6.9 | 0.0 | 0.1 | 0.1 | 1.1 |
| 8 | В | 0.4 | 0.2 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 |
| 9 | В | 0.4 | -0.1 | 4.7 | -0.2 | -0.1 | 0.0 | 0.1 | -0.1 |
| 10 | В | 0.8 | -2.5 | -0.1 | 1.9 | 0.0 | -0.1 | 0.0 | 0.0 |
| 11 | В | 1.0 | -1.6 | -6.3 | 2.8 | 0.2 | -0.1 | -0.1 | 0.0 |
| 12 | В | 0.6 | 2.5 | -0.7 | -4.4 | 0.0 | 0.1 | -0.1 | 0.3 |
| 13 | В | 0.4 | -1.5 | 1.9 | 1.7 | 0.0 | -0.1 | 0.0 | -0.1 |

B: Bernese GA: GAMIT GP: GIPSY

Provided by Heinz Habrich (BKG)

Activities for EPN-Repro1

- Deadline for the submission of the reprocessed solutions was March 31, 2011.
 - Daily coordinates and ZTD (1996-2006)
 - Weekly coordinates (1996-2006)
- Contributions of 14 Local Analysis Centres
- Combination of weekly coordinates carried out by H.Habrich (BKG) with ADDNEQ2.
 - Similar problems as in the Benchmark test are visible.
 - => <u>Preliminary</u> Exclusion of the GIPSY solutions.
- Combinations of troposphere parameters by W.Söhne (BKG).
- Multiyear solution combined by A.Kenyeres (CATREF).



EPN-Repro1 – Troposphere

(W.Söhne/BKG)



EPN-Repro1

- The current solution has to be considered as preliminary!
- The integration of the GIPSY solutions needs further investigations
 - SINEX of GIPSY is not always clear.
 - Possible alternatives for the combination (approach, software) have to be considered.
- BERNESE agreement is good
- Improve Redundancy for GIPSY and GAMIT
- The differences in benchmark test need to be understood.
 - Fine tuning between the different LAC is necessary.

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The Future: EPN-Repro2

Future reprocessing activities of the IGS "**REPRO2**" will be initiated (2012?)

- ITRF2008/IGS08 reference frame
- Improved orbit modeling
- Implementation of new IERS conventions
- Higher order correction terms for the ionosphere
- Atmospheric loading effects might be included

Available reprocessed products in the ITRF08/IGS08 will initiate a new EPN-Repro2 campaign

CODE is expecting to finish their reprocessing activities (1994-2011) for the ITRF2008/IGS08 by the end of 2011



Conclusion

- <u>Preliminary</u> results for the EPN-Repro1 are computed
- Benchmark test need a more detailed analysis
- Software packages need to have the same models and standards (adopted to IGS standards)
- EPN-Repro1 shall be finished by autumn 2011
- LACs are prepared for EPN-Repro2 but waiting

