EUREF Activities

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Reference Frame Sub Commission 1.3a for Europe of the International Association of Geodesy (IAG)

EUREF

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- The **IAG Sub-commission EUREF** is responsible for the maintenance of the European Terrestrial Reference System (**ETRS89**).
- EUREF is composed of representatives from **European IAG member countries**; annual symposium (plenary) and the Governing Board (GB)
- Links to about **130 European organizations**, agencies, universities from more than 30 countries – related to geo-referencing, positioning, and navigation
- The **GB** is composed of members elected by the plenary, members in charge of special tasks and ex-officio members. Governance of EUREF activities and policy.
- Provides all of its products and services on the “best effort” basis and **free of charge** to the public
- **EUREF is both a user and a provider of GNSS**

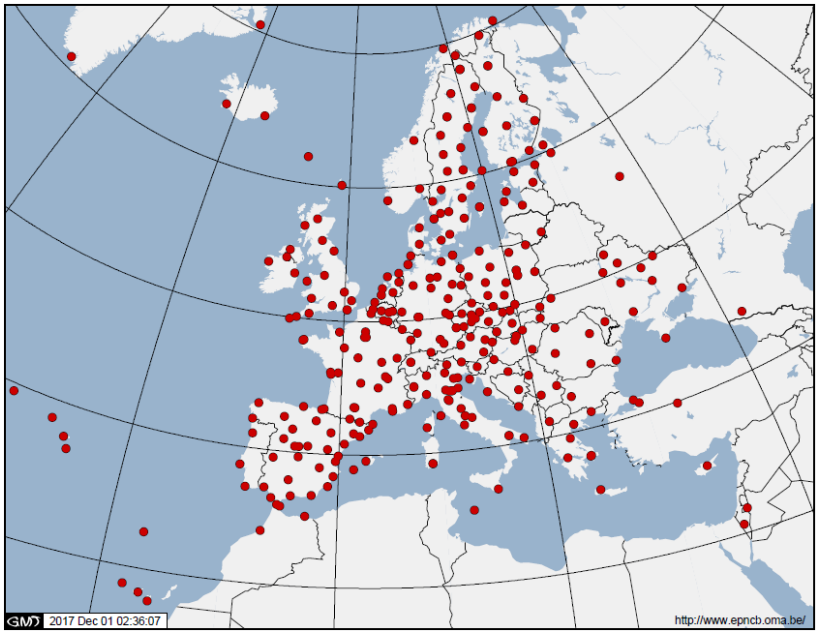
EUREF symposium 2017

May 17-19, Wroclaw, Poland

- ~100 participants; new resolutions and new Terms of References
- Peer-rewiewed proceedings to be appear in Geodesy and Cartography
- Tutorial lectures ”Real-Time Infrastructure and Applications in Europe”
- Next EUREF symposium May 30 – June 1, 2018, Amsterdam, Netherlands

EPN Data, Products, Activities (C. Bruyninx)

- Observation, navigation and meteorological data files (hourly, daily and high-rate 15-minute)
- Real-time observation data
- ITRS/ETRS89 station positions and velocities
- Tropospheric zenith path delays
- Real-time satellite orbit/clock corrections
- **Data reprocessing:** Reprocessing historic data to improve station time series, antenna corrections, satellite orbit information,…
- **Multi-GNSS:** New GNSS are available. More stations are able to observe all GNSS satellites. EPS is adopting new systems.
- **RINEX3 format:** Adoption of RINEX3 format for GNSS data submission, archiving and analysis.



EPN Tracking Network

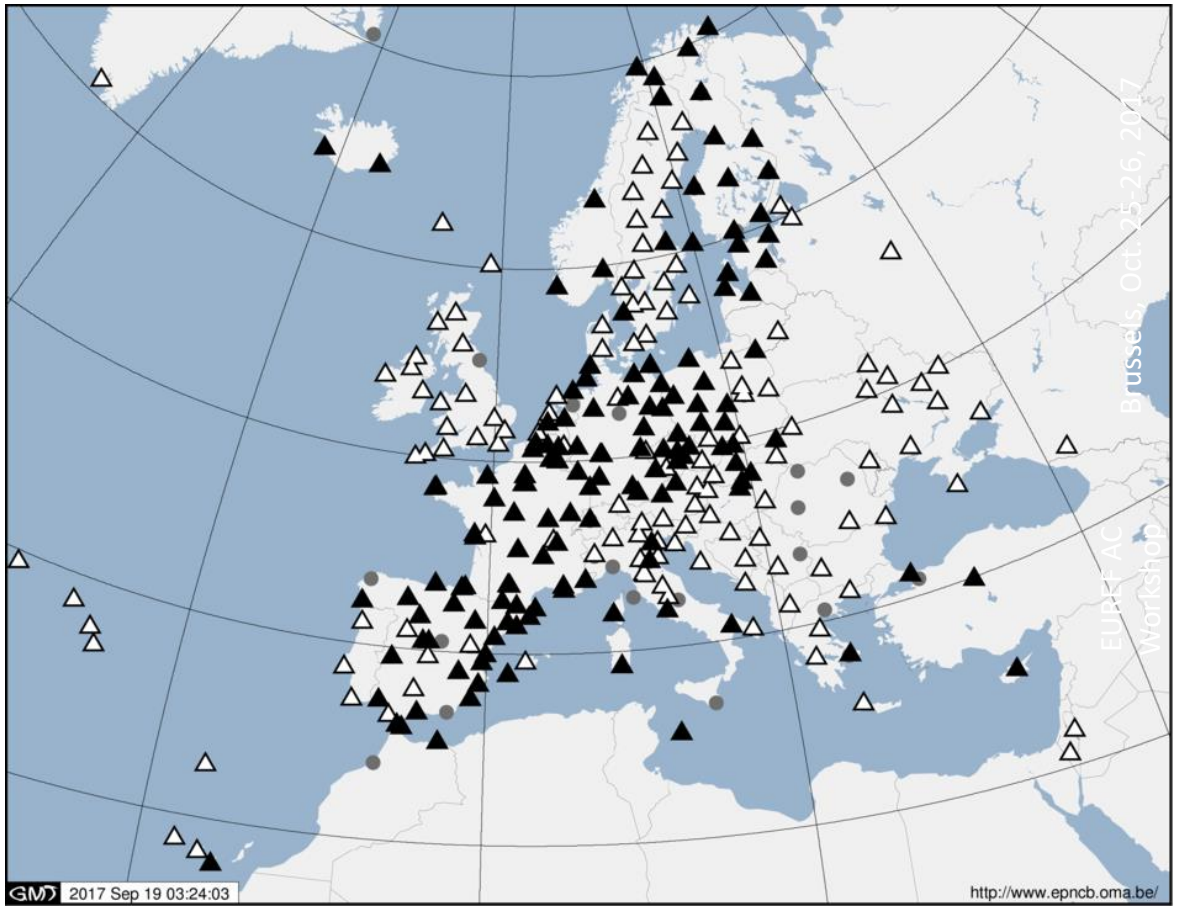
321 stations in the EPN

GPS-only : gray circles --> 32 stations (10%)

GPS+GLO: white and black triangles --> 290 stations (90%)

GPS+GLO+GAL (RNX3): black triangles --> 145 stations (45%)

Exceptionally well ?
In IGS, 43% of the stations indicate GAL tracking in site log



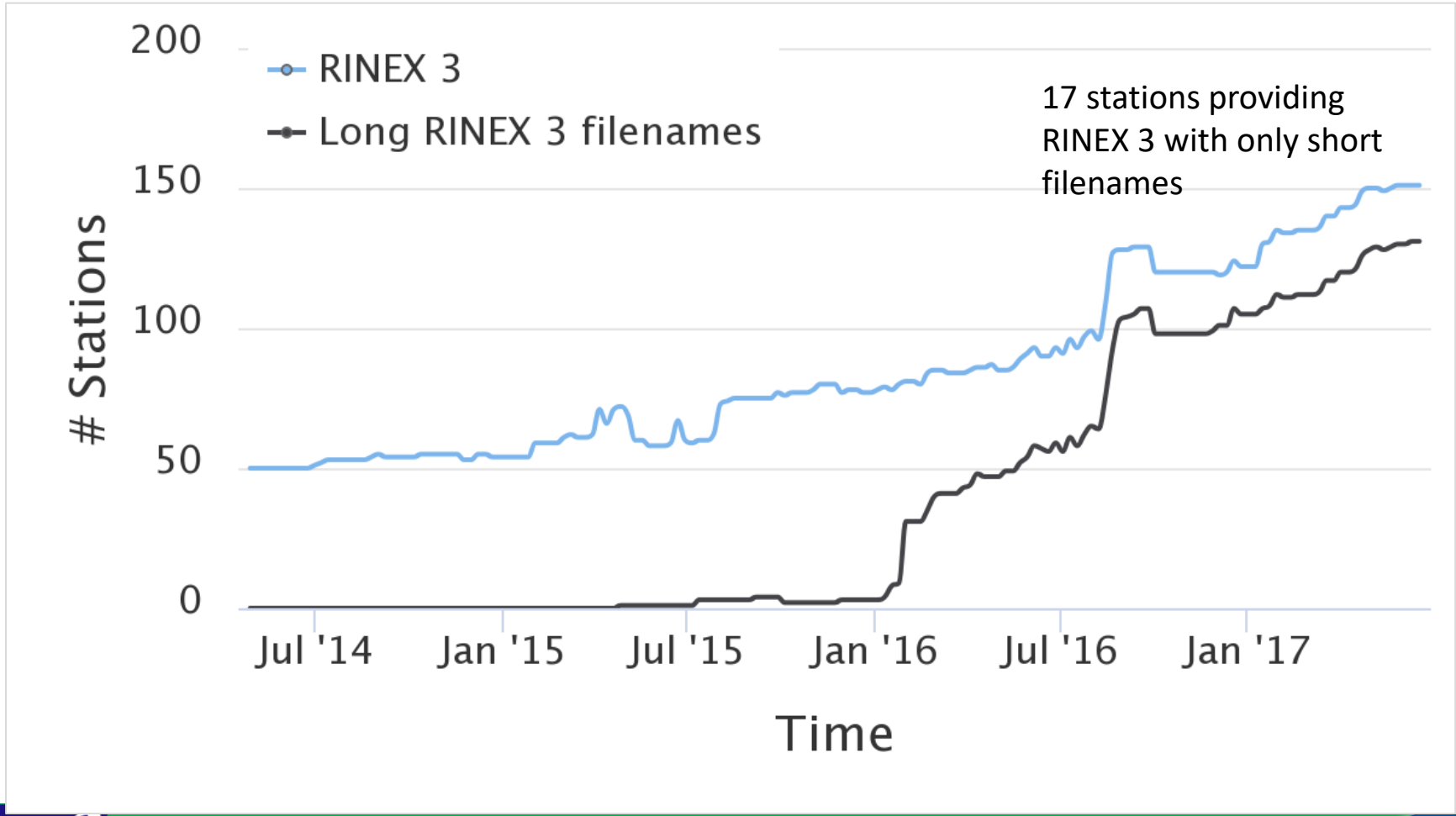
RECEIVER TYPE	CARRIER PHASE SIGNALS				
	E1	E5a	E6	E5b	E5a+b
TPS NET-G5	L1B	L5I	L6B	L7I	L8Q
JAVAD TRE_3 DELTA	L1X	L5X		L7X	L8X
JAVAD TRE_G3TH DELTA	L1X	L5X			
LEICA GR10	L1C	L5Q		L7Q	L8Q
LEICA GR25	L1C	L5Q		L7Q	L8Q
LEICA GR25	L1C	L5Q		L7Q	
LEICA GR25 (KURE, TOR2)	L1C				L8Q
LEICA GR30	L1C	L5Q		L7Q	L8Q
LEICA GR50	L1C	L5Q		L7Q	L8Q
LEICA GRX1200+GNSS	L1X	L5X	L6A	L7X	L8Q
LEICA GRX1200+GNSS	L1C	L5Q		L7Q	L8Q
LEICA GRX1200+GNSS	L1X	L5X		L7X	L8Q
SEPT POLARX4	L1C	L5Q		L7Q	L8Q
SEPT POLARX4TR	L1C	L5Q		L7Q	L8Q
TRIMBLE NETR9	L1X	L5X		L7X	L8X
TRIMBLE SPS855	L1X	L5X		L7X	L8X

Galileo observables extracted from RINEX 3

Signal complexity is not reflected by RINEX 2 format

12 EPN stations provide Galileo obs. only in RINEX 2

Usage of RINEX 3 long filenames



Antenna Calibrations

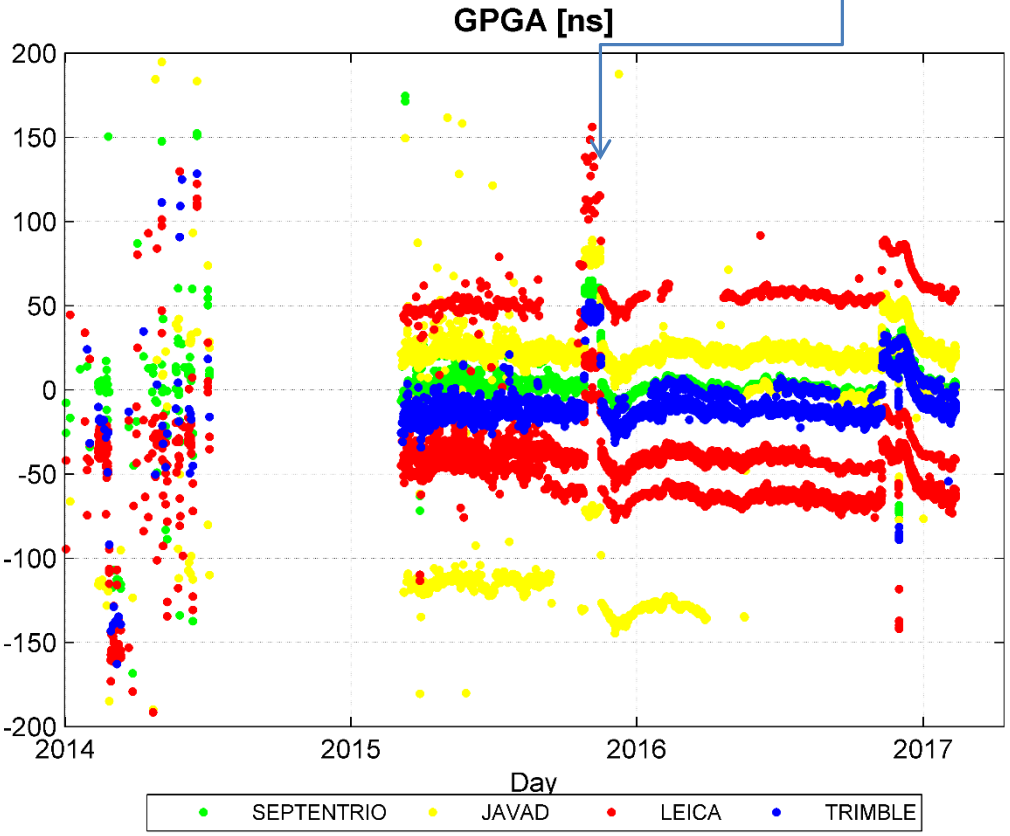
- 158 stations provide Galileo observations
- 11 of them have Galileo receiver antenna calibrations (all individual) ….
- Future issues on antenna calibrations because antennas are already installed on-site…

Interoperability of the GNSS's for positioning and timing (A. Caporali)

- All GNSSs can be used together to provide the end user with one PVT (Position Velocity and Time) solution at each epoch
- Requires a) intercalibration of the available GNSSs and b) that the receivers have no relative bias
- Studied GNSSs: GPS GLONASS Galileo BeiDou QZSS NAVIC SBAS/GAGAN
- Monitor daily 31 European GNSS sites with 5 different receivers (Javad, Leica, Septentrio, Topcon, Trimble)
- Questions to be addressed:
  - Alignment of the broadcast spatial reference frame of each GNSS to the common reference frame IGS14 of the SP3 precise ephemeris of CODE
  - Alignment of the broadcast temporal scale of each GNSS to the common reference time in the SP3 precise ephemeris of CODE
  - Do different receivers measure different offsets?

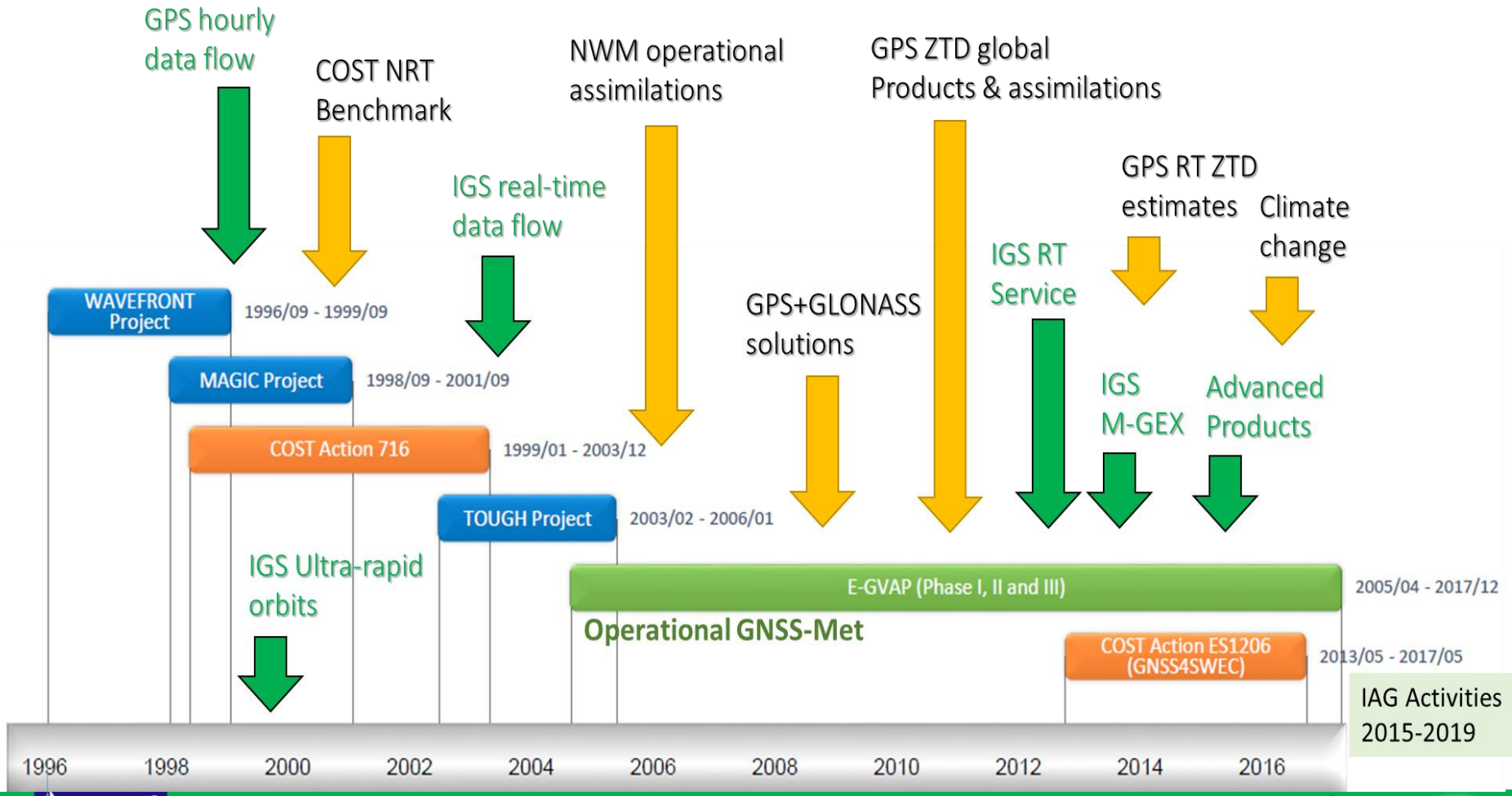
GPGA: Galileo to GPS Time Offset

- Very good performance in 2015
- **Offset ~50 ns between 26/10 and 16/11 2015**
- Receiver dependent biases are clearly visible



Similar findings also with other systems -> to be solved before seamless use of different receivers / different systems ; especially receiver dependent biases are visible

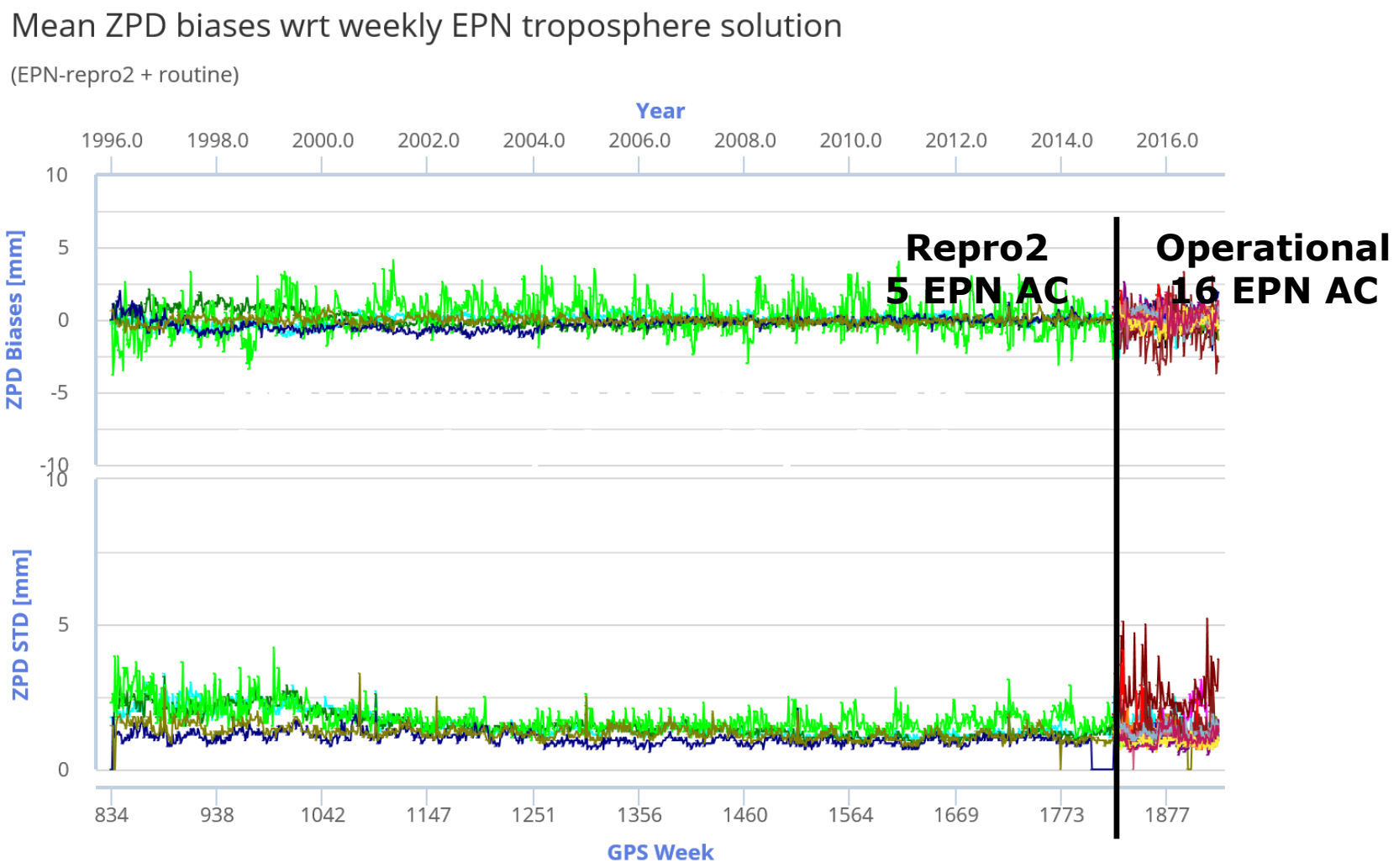
GNSS-Met research funded by EU Framework Programs (R. Pacione)



EPN Routine Processing and Reprocessing

EPN ZTD Operational Processing

http://www.epncb.oma.be/_productsservices/sitezenithpathdelays/



Reprocessing Activities in the past 15 Years (C. Völksen)

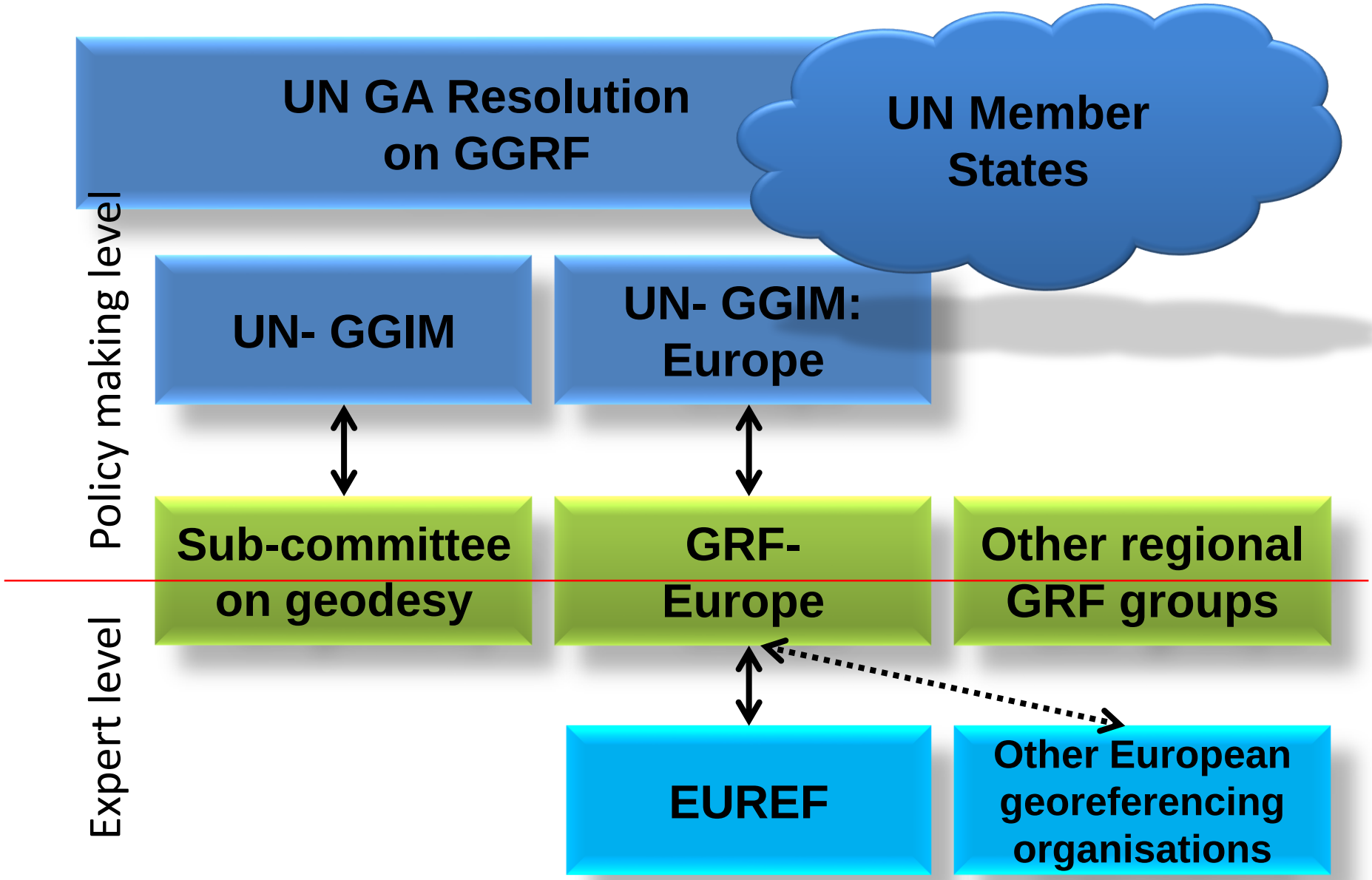
Year	Group
2002	University of California, R. Nikolaidis; (1991-2002)
2006	**Potsdam Dresden Group (PDR05), 1992-2005**
2007	BEK: subnetwork of the EPN (PDR05),1996 – 2005
2008	MUT/ROB: entire EPN-Network (PDR05),1996 - 2006
2008	IGS Repro1 (IGS05), 1994 – 2007 ➔ ITRF2008 ACs: CODE, EMR, ESA, GFZ, JPL, MIT, NGS, PDR, SIO
2009	EPN-Repro1 (IGS05), 1996 – 2007 (Jan.) (834-1408)
2013	IGS Repro2 (IGb08), 1994 – 2013 ➔ ITRF2014 ACs: CODE, EMR, ESA, GFZ, GRGS, JPL, MIT, NGS, SIO
2013	EPN-Repro2 (IGb08), 1996 – 2013 (834 – 1771)

During the period 1996 to 2017 different reference frames were realized, different standards and models applied, software changes and other things, which caused inconsistencies in the coordinate time series. -> need for reprocessing

EPN-Repro Products

- Available from BKG Server
  - http://igs.bkg.bund.de
  - ftp://igs.bkg.bund.de/EPNrepro1/benchmark/1381
  - ftp://igs.bkg.bund.de/EPNrepro1/products/wwww
  - ftp://igs.bkg.bund.de/EPNrepro2/products/wwww

- Products are used to derive updated coordinates and velocities for the entire EPN
- Used by the Troposphere Coordinator for the Evaluation of climate models


UN GA Resolution on GGRF
UN Member States
Policy making level
UN- GGIM
UN- GGIM: Europe
Sub-committee on geodesy
GRF- Europe
Other regional GRF groups
Expert level
EUREF
Other European georeferencing organisations

EUREF links

- EUREF web page: http://www.euref.eu/
- EUREF permanent Network EPN: http://www.epncb.oma.be

Thank you for your attention