A Case Study on Computation of ETRS89 coordinates of non EPN Permanent GPS stations

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Objective: create a 'product'

- Product specifications according to Torres and Koesters (T&K,2004)
  - Components of the product (Public A):
    - Coordinates: ETRS89, Class A
    - Data: as for EPN stations, free access
    - Station: site, equipment and purpose comply with EPN specs
  - The quality evaluation is paramatrized by the variables [coords, data, site, equipment, purpose]
  - Less stringent for Public B or Private C stations

Review of Certification procedures, as proposed by T&K

- NMA: application
- EPNCB:
  - analysis of prerequirements
  - Accept/reject
- Station manager: data submission to LDC
- LAC: data analysis
- EPNCB: reports on data accessibility, quality, station performance, accuracy; proposal for accept/reject
- TWG: decision on acceptance
- EPNCB: Registration as densification station

Case Study

- 'Botton to Top' approach, according to Habrich
- Assume check list status:
  - NMA ☺ done
  - EPNCB ☺ done
  - Station Manager ☺ done
  - LAC ☜ I address this
  - EPNCB, TWG, EPNCB: waiting

  Need to demonstrate:
  - Data analysis of non EPN + EPN stations
  - ETRS89 coordinates with class A for all

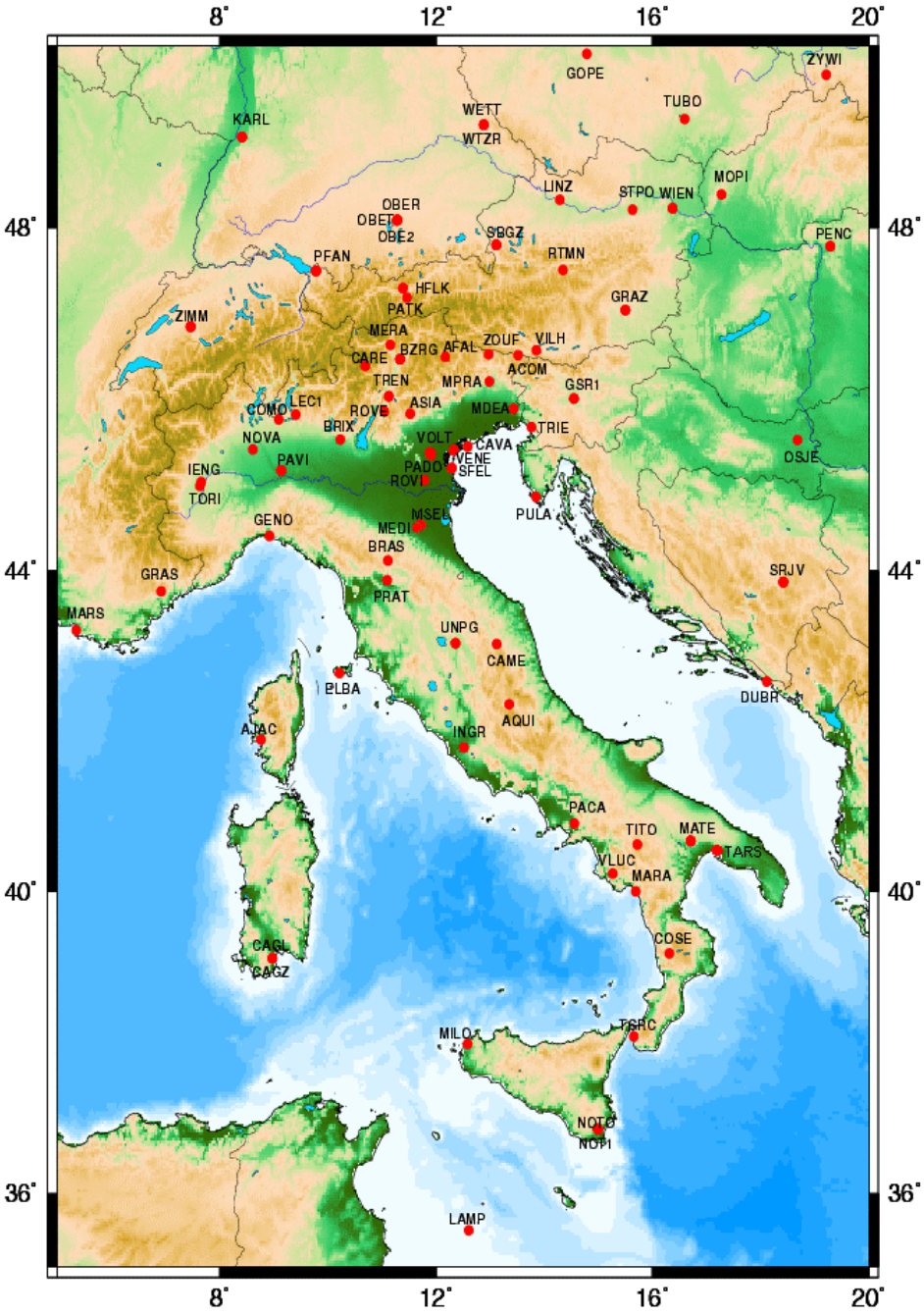
Metadata

- EUR13047.SNX + EUR1304E.CRD: from BKG
- UPA13047.SNX: from LAC
  - 40 stations total, in Italy and Austria
  - seven days continuous, 30 sec, 5 deg min elev
  - EPN overlap: AQUI, VENE, BZRG, LAMP, CAME, COMO, ELBA, GENO, IENG, MATE, MEDI, PADO, TARS, UNPG, ZOUF (15)
  - SBGZ and HFLK included
  - Austrian (WIEN, PATK, STPO) and other Italian permanent stations
  - Data Centers: Graz, GEODAF, SOPAC, Padova, BKG (for EPN)

  - Map on following slide

Non EPN stations (except HFLK) to be 'certified'

ACOM00000M000	FredNet
AFAL00000M000	FredNet
ASIA12714M001	Univ. Of Padova /CEGRN
BRAS00000M000	Univ. Of Bologna
CAVA00000M000B	Consorzio Venezia Nuova
HFLK11006S003B	AREF
INGR00000M000	Istituto Nazionale di Geofisica e Vulcan.
LEC112768M001	Polytech. Of Milano
MERA00000M000A	Studio Sacchin
MPRA12764M001	FredNet
NOVA00000M000	Polytech. Of Torino
PATK11029S001	AREF
ROVE00000M000	Technical Institute for Surveyors
ROVI12769M001	Univ. Of Padova /CEGRN
SFEL00000M000B	Consorzio Venezia Nuova
STPO00000M000	AREF
TRIE00000M000	FredNet
VOLT00000M000B	Consorzio Venezia Nuova
WIEN00000M000B	AREF



First step: EPN-like processing of weekly campaign

- 'Normal' processing of daily campaigns results in seven NEQ's
- Stack the 7 NEQs, constrain one station and generate UPA13047.SNX with ADDNEQ
- Before combining the local network with the EPN, we do an internal repeatibility check on daily solutions
  - weekly ADDNEQ run on daily NEQ's: verify day to day repeatibility <10 mm rms, with only one station (MATE) fixed
  - Note: ACOM and TRIE have 2 respectively 1 realizations

Second step: merge UPA into EUR

- ADDNEQ.1304 combination of EUR and UPA SINEX for wk 1304
  - Total of 177 stations
  - Helmert constraints:Tx, Ty, Tz (should result very small)
  - Overweight EUR relative to UPA SINEX
  - Use overlap stations to check consistency between the two SINEX's in ITRF00
    - Verify millimetric to sub mm discrepancy of UPA SNX relative to EPN overlap stations

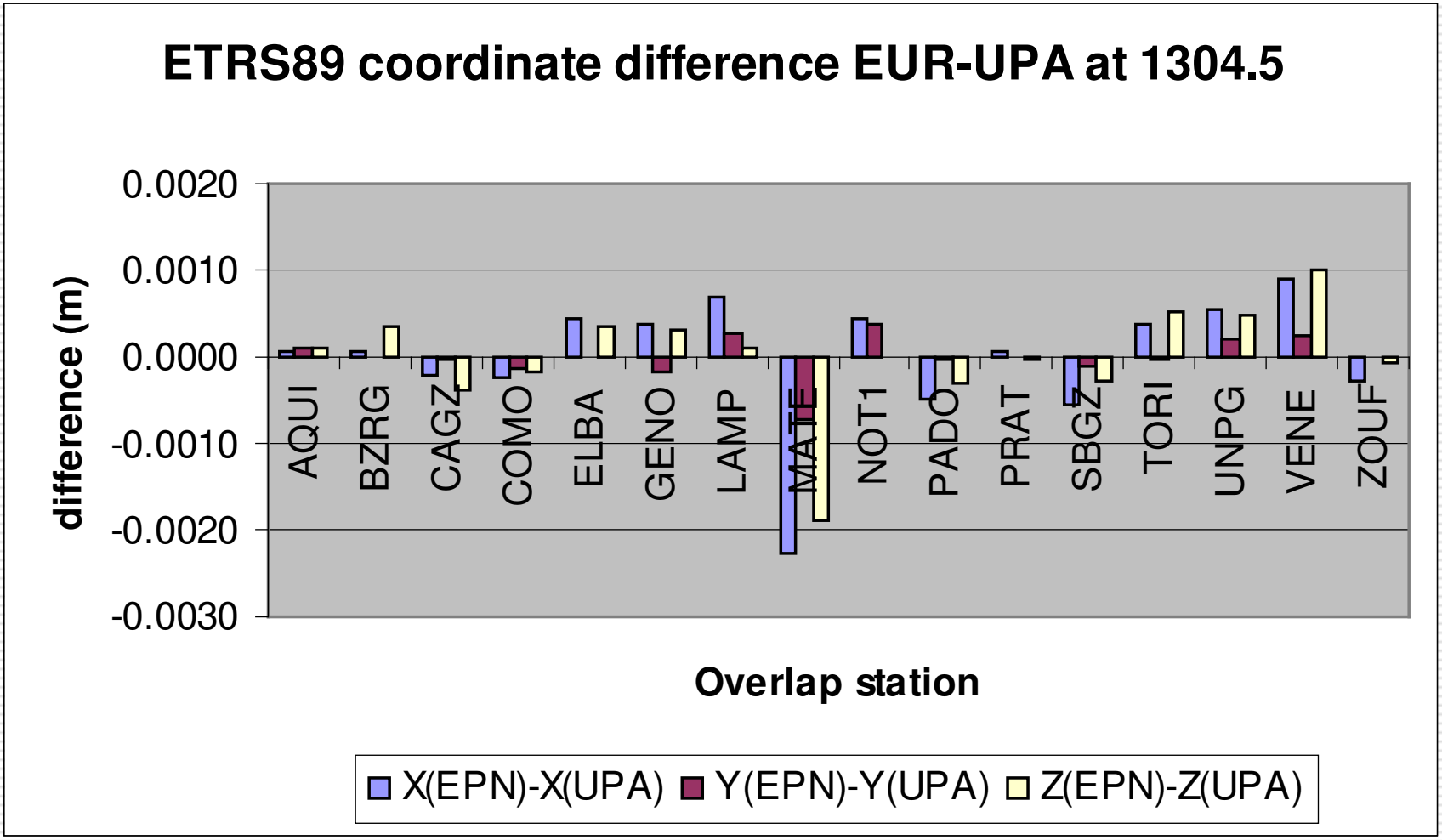
Final step

- Apply ETRS89 (Altamimi Boucher) transformation formula appropriate for ETRF2000, to obtain coordinates ETRS89 at computation epoch
- Compare resulting ETRS89 coordinates at epoch with EUR1304E.CRD, for common sites

Optional, but important (different campaigns will give different ETRS89 coords of same site because of different epochs):

- Map ETRS89 coordinates from epoch to 1989.0, for those stations for which ETRF2000 velocity is known
- Check agreement with coords in EUREF database (ftp://lareg.ensg.ign.fr/pub/euref/ETRF2000.SSC)
- Consider that some NMA consider ETRS89 coords at 89.0 only!

Result of the final check



That's it..!

X_ETRS89 (m)	Y_ETRS89 (m)	Z_ETRS89 (m)	Station	DOMES	YYYY	MM	DD
4273811.0533	1027226.4165	4608634.7682	ACOM	00000M000	2005	1	5
4298653.2975	927400.2740	4607414.1754	AFAL	00000M000	2005	1	5
4360032.9284	889071.7926	4555699.4546	ASIA	12714M001	2005	1	5
4500677.3756	884064.7680	4418473.1597	BRAS	00000M000	2005	1	5
4372204.8562	975914.7196	4524895.0766	CAVA	00000M000B	2005	1	5
4248505.3397	855575.5021	4667172.0736	HFLK	11006S003B	2005	1	5
4646739.5024	1031416.3613	4231463.7764	INGR	00000M000	2005	1	5
4390093.3364	727322.6338	4554436.1356	LEC1	12768M001	2005	1	5
4301951.1665	848418.3724	4616835.5548	MERA	00000M000A	2005	1	5
4306530.4860	993265.4813	4584380.2752	MPRA	12764M001	2005	1	5
4431899.3912	671366.9771	4522512.0289	NOVA	00000M000	2005	1	5
4255736.3155	862759.6805	4659191.2678	PATK	11029S001	2005	1	5
4364680.8554	851736.5953	4557204.6964	ROVE	00000M000	2005	1	5
4415779.8701	921117.4155	4494189.8150	ROVI	12769M001	2005	1	5
4396376.9774	957869.3404	4505424.6004	SFEL	00000M000B	2005	1	5
4101581.1179	1147722.7005	4732213.4287	STPO	00000M000	2005	1	5
4333582.0268	1061504.3450	4543010.4123	TRIE	00000M000	2005	1	5
4390693.4013	926138.2531	4517506.8042	VOLT	00000M000B	2005	1	5
4085097.7126	1200224.1632	4733306.7404	WIEN	00000M000B	2005	1	5

Summary of LAC checklist

- Process weekly campaign 'normally' (as for routine EPN work)
- Check day to day repeatibility with minimum internal constraints which are necessary to invert matrix (e.g. one station constrained)
- Combine local SNX (small weight) with corresponding EUR SNX (larger weight) to generate ITRF00 coords at epoch
- Verify offset in overlapping sites max 1-2 mm
- Transform ITRF00 coords into ETRS89 coords at campaign epoch
- Optionally map coords from epoch to 89.0

Additional monitoring (validation needs to be verified periodically!)

- Validation is epochwise: it should expire after some t.b.d. time
- Updating/validating procedures of validated stations need to be identified too
- The LAC should commit (under appropriate $ from NMA..) to:
  - Form time series of coords of non EPN stations by stacking combined (i.e. densified) SINEX's
  - Look for jumps, trends (see EPN SP on Time Series)
  - Estimate periodicities, power spectra, noise profile
  - Allan variance
  - Velocity