

Report of the Troposphere Coordinator: Operational Product



Rosa Pacione

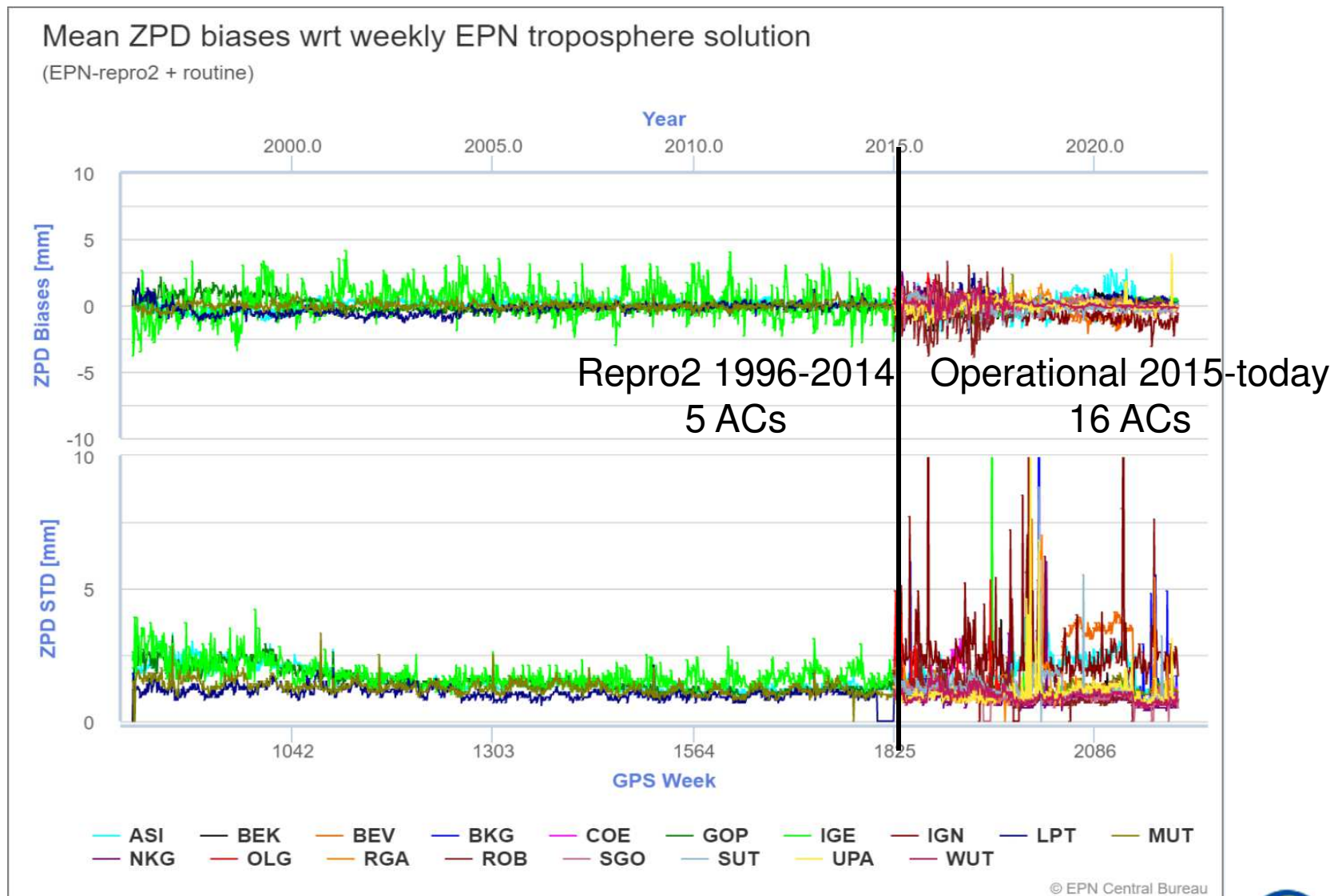
Troposphere Coordinator



e-GEOS, ASI/CGS-Matera, Italy

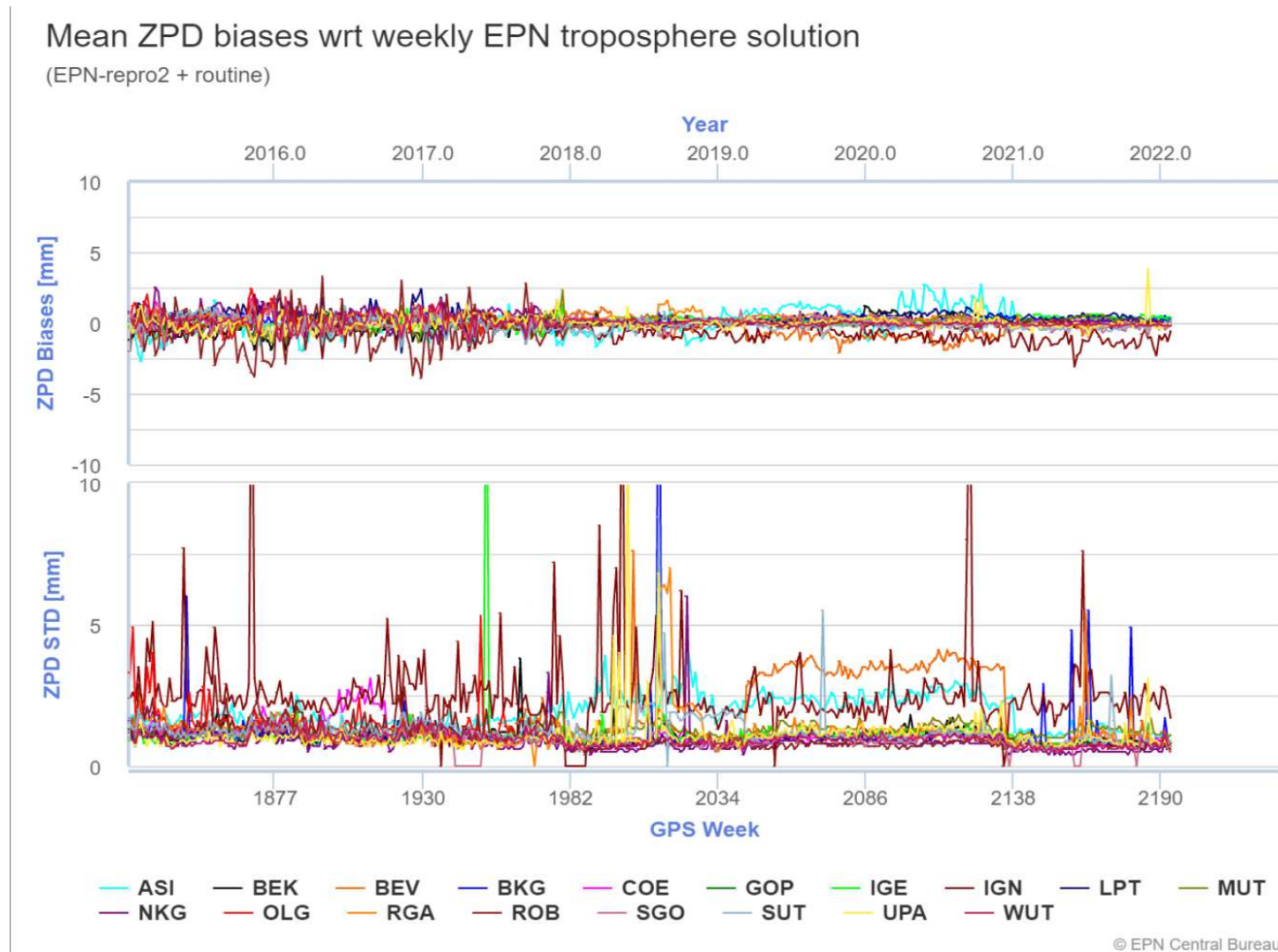
EPN-Repro2 & Operational

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



Operational Tropo Products

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Operational Tropo Products

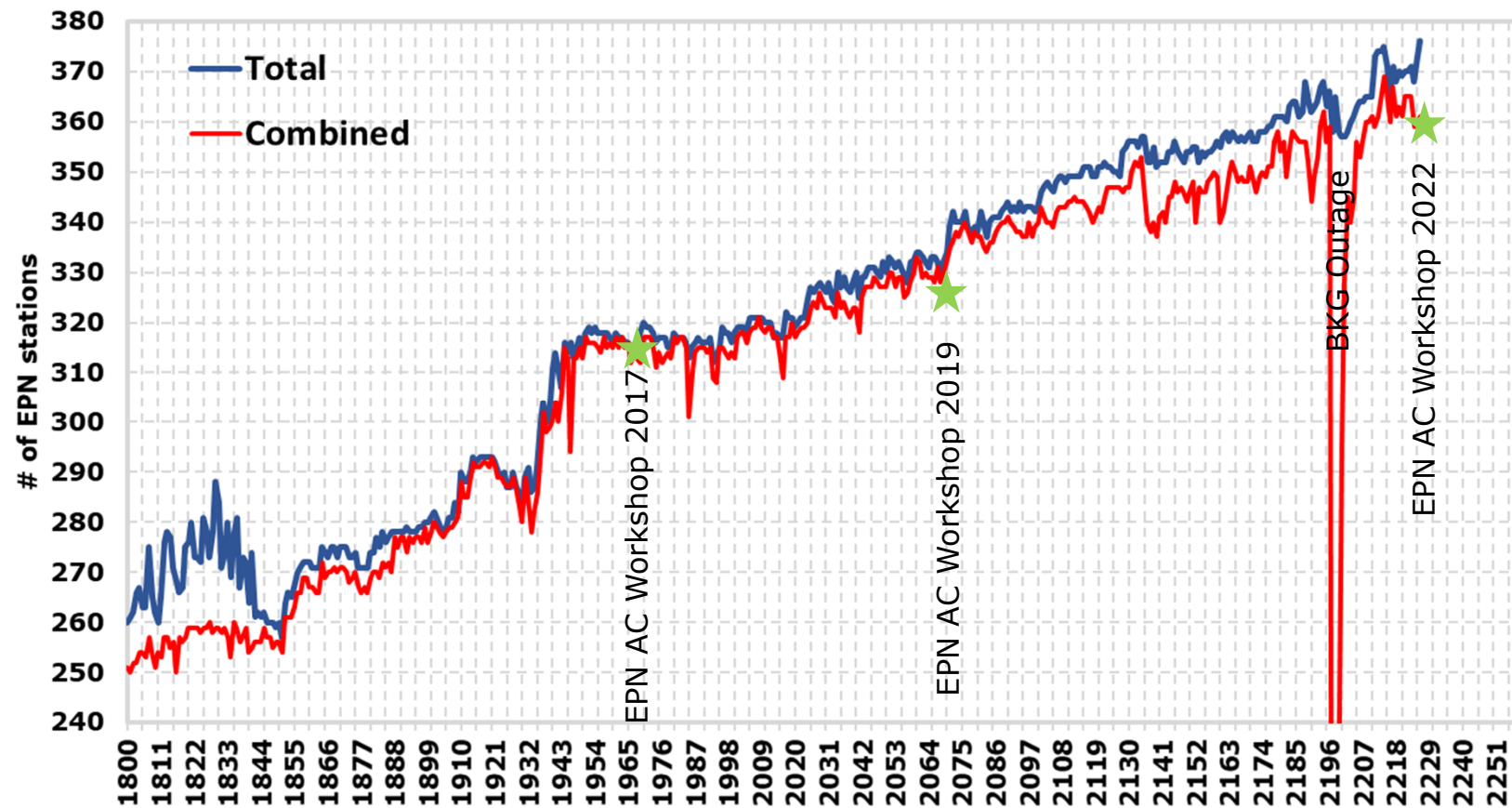
Main changes since the EPN AC Workshop 2019 in Warsaw:

- GPS week 2139: ASI started using GipsyX for the generation of final and rapid products;
- GPS week 2139: IWV added in the EPN combined product;
- GPS week 2196: BKG outage: EPN combined product available at BEV;
- GPS week 2196: BKG outage, ACs started uploading solutions to BEV. For the time being IGN, MUT, SGO solutions not available at BEV;
- GPS week 2212: Manual inclusion of RGA solution due to a cyber attack.

Operational Tropo Combination

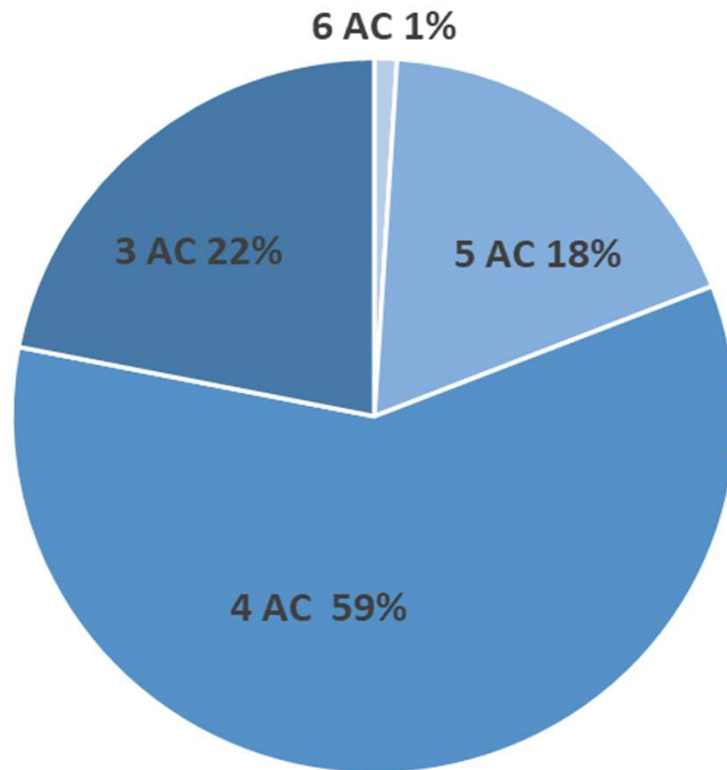
Total versus Combined Stations:

- EPN AC Workshop 2019: **328** combined stations
- EPN AC Workshop 2022: **343** combined stations



Operational – AC Redundancy

Each of the EPN AC processes a subnetwork of the EPN. The EPN stations are distributed among the ACs in such a way that each station is analyzed by at least three ACs. This ensures the reliability of the EPN products.



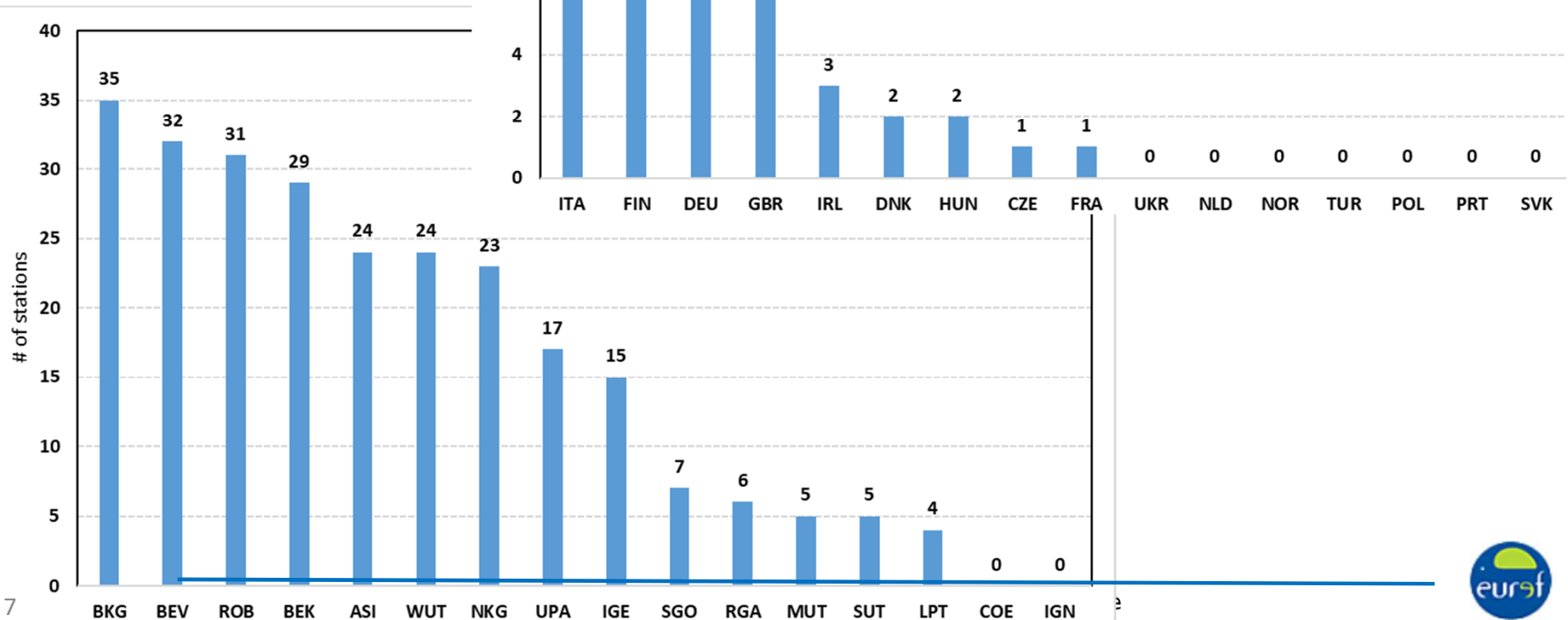
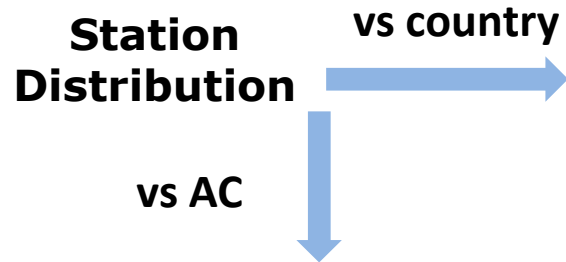
October 17, 2022: 393 EPN stations

6 AC	5 AC	4 AC	3 AC
1%	18%	59%	22%
6	71	230	86

<http://www.epncb.oma.be/productsservices/analysiscentres/dataprocessingdistribution.php>

Operational – AC Redundancy

- 86 stations are analyzed by 3 ACs



Operational – Check the metadata

To be consistent with the site coordinate combination, stations excluded from the site coordinated combination due to incorrect antenna phase center offset are automatically rejected from the tropo combination (see section 4. INCONSISTENCY IN AC SINEX FILES in eurxxx7.sum file).

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·4· ·INCONSISTENCIES·IN·AC·SINEX·FILES¶
·=====¶
¶
·The·phase·center·offsets·reported·in·AC·SINEX·files·are·checked¶
·for·consistency·against·the·antenna·calibration·file·used·by·EPN¶
·(ftp://ftp.epncb.oma.be/pub/station/general/epn_14.atx)·¶
¶
·Stations·excluded·due·to·incorrect·antenna·phase·center·offsets:¶
¶
·Day·Sol·Site·Source·L1·PCO·(m)·L2·PCO·(m)·¶
·North·East·Up·North·East·Up·¶
·-----¶
·0·MUT·DELF·SINEX:·-·.0000·-·.0004·0.1274·-·.0001·0.0003·0.1411¶
·ANTEX:·-·.0002·-·.0010·0.1288·-·.0006·-·.0006·0.1423¶
·0·MUT·PPSH·SINEX:·0.0007·0.0001·0.1246·0.0005·-·.0001·0.1314¶
·ANTEX:·0.0001·-·.0000·0.1257·-·.0006·-·.0006·0.1337¶
·0·MUT·WUTH·SINEX:·-·.0000·-·.0004·0.1274·-·.0001·0.0003·0.1411¶
·ANTEX:·0.0008·0.0002·0.1275·0.0001·-·.0006·0.1414¶
·0·SGO·ZZON·SINEX:·0.0007·0.0001·0.1246·0.0004·-·.0001·0.1314¶
·ANTEX:·0.0003·-·.0002·0.1266·-·.0007·-·.0001·0.1356¶

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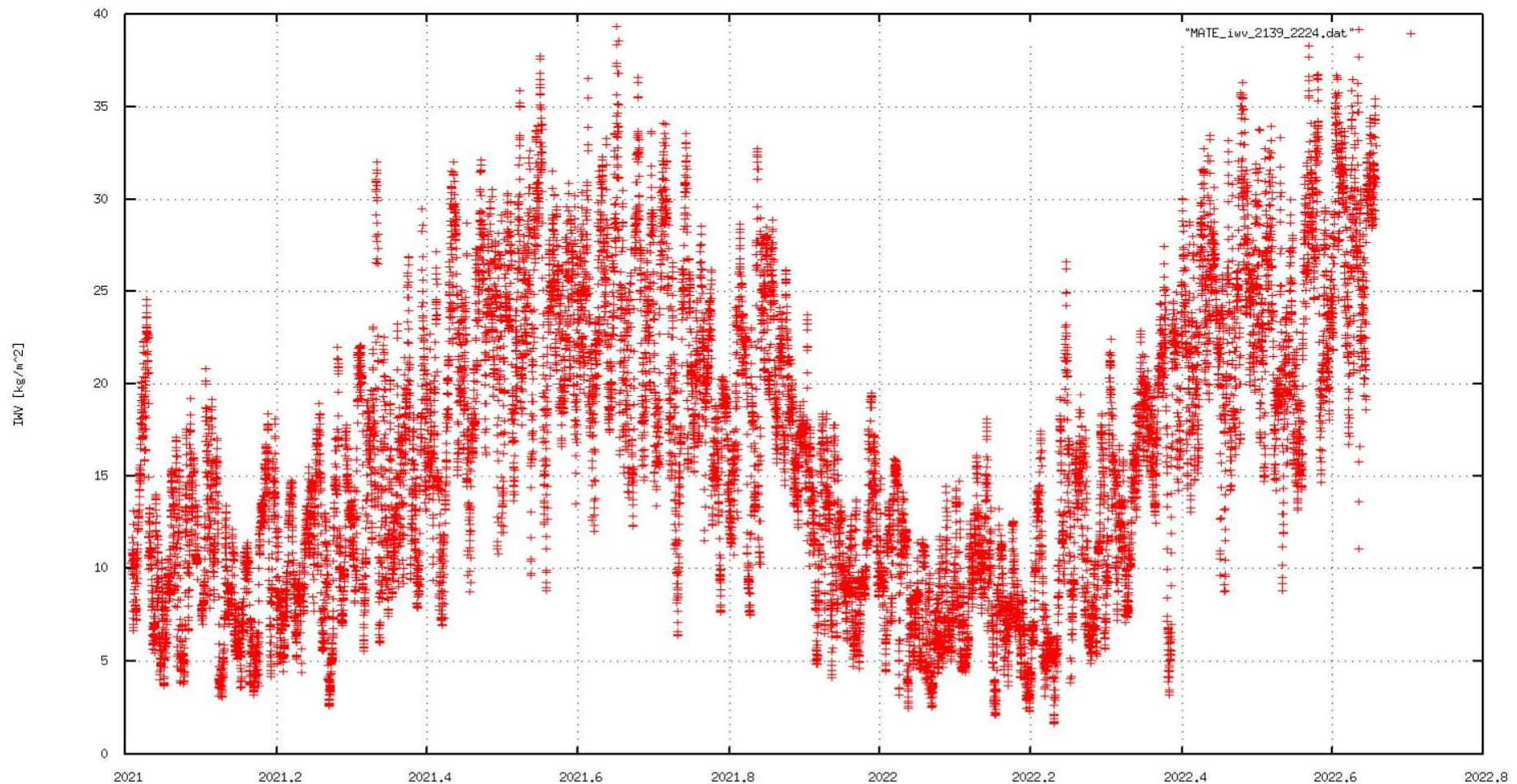
ZZON00HUN data are processed by the BEV, BKG and SGO ACs and included in the EPN since GPS week 2216 but due to metadata inconsistency it has been included in the tropo combination since GPS week 2223.

Operational - ZTD to IWV Conversion

- **Input:** EPN ZTD combined values
- **Auxiliary Data:** ECMWF operational products available at:
https://vmf.geo.tuwien.ac.at/trop_products/GRID/2.5x2/VMF1/STD_OP
Linear interpolation in time, bilinear interpolation in space
- **Output:** EPN ZTD and IWV in SINEX_TRO_v2.0 from GPS week 2139 (21JAN03)

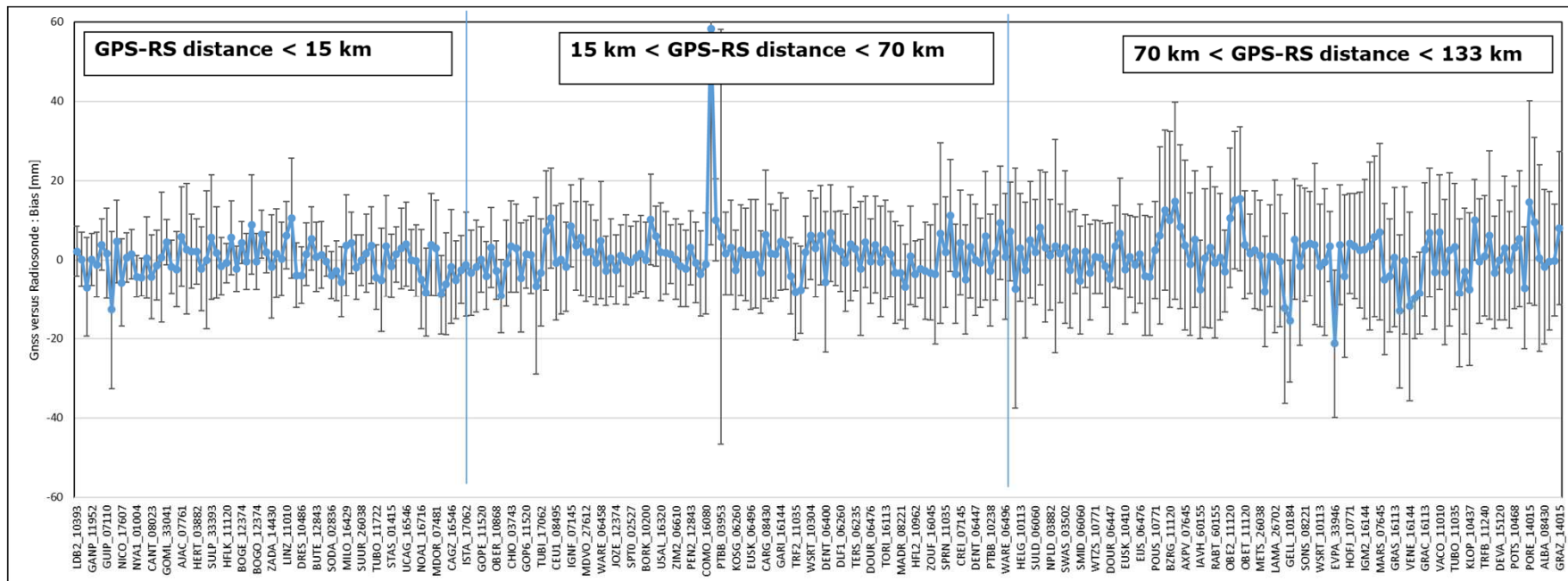
$$\begin{array}{lcl} \mathbf{ZTD = ZHD + ZWD} & \longrightarrow & \mathbf{ZHD = \frac{0.0022767 \cdot p}{1 - 0.00266 \cdot \cos 2\varphi - 0.00028 \cdot h}} \\ \downarrow & & \\ \mathbf{ZWD = ZTD - ZHD} & \longrightarrow & \mathbf{IWV = \frac{10^6}{R_v \left(k_2' + \frac{k_3}{T_m} \right)} ZWD} \\ \downarrow & & \mathbf{T_m = \frac{\int_H^\infty e/T \, dh}{\int_H^\infty e/T^2 \, dh}} \\ \mathbf{IWV = K(T_m) * ZWD} & & \end{array}$$

Operational – MATE00ITA IWV Time series



EPN multi-year tropo solution

- Last EPN multi-year tropospheric solution **T2195**: 1996-01/2022 (ref. euref mail #11054)



- Upcoming multi-year tropospheric solution for the period: 1996-08/2020

Forthcoming activities

- **Call for Daily Rapid Tropo -->** The troposphere combination is based on final products and it is available with a delay of 5-6 weeks w.r.t. the current date. To shorten this delay, a **daily rapid tropo combination** can be established based on daily rapid tropo estimates to be delivered by the ACs along with daily rapid site coordinates. Of course, the daily rapid tropo combination makes sense if an enough number of ACs is willing to deliver, on daily basis, tropo sinex along with the sinex in order to have the required redundancy mandatory for the tropo combination.
- Transition to **SINEX_TRO v2.0** format for the individual contributing solutions.

Summary

- Status of the EPN operational tropo product:
 - AC redundancy,
 - Check of the metadata.
- **IWV** added in EPN combined product.
- **Rapid daily tropo combination** can be set up if an enough number of ACs is willing to deliver rapid daily tropo estimates in addition to rapid daily site coordinates.
- Transition to **SINEX_TRO v2.0** format for the individual contributing solution to be planned.

Acknowledgment: the EPN ACs for providing the solutions used for the combination as well as the GNSS site owners for the collection and distribution of GNSS rinex data.
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