Assessment of geodetic products from 24h VGOS session using ITRF2020

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Motivation

- The VGOS 24h sessions have been running for several years now and are maturing as a source of geodetic products.
- A combined reference system realization that includes them has now become available in the form of ITRF2020.
  - Previous solutions include the estimation of the station coordinates by aligning the observing network to the ITRF2014 => (Mikschi et al., 2021)

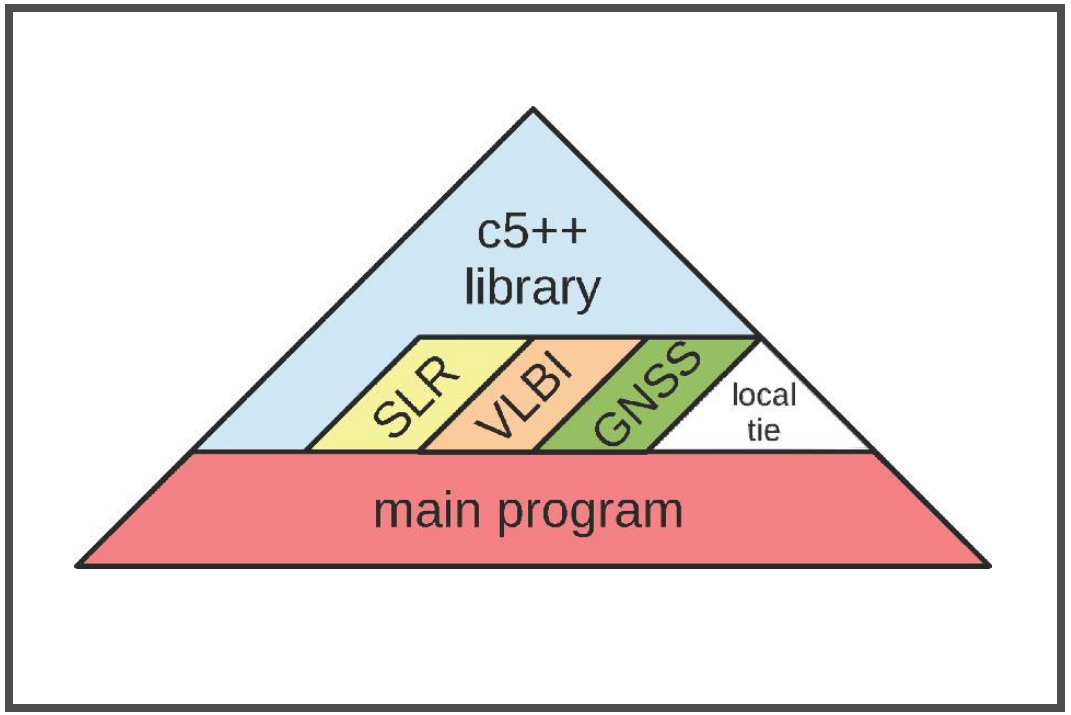
Motivation

- The c04-20 series, the new EOP series that is aligned to the ITRF2020 reference frame, is accessible for evaluation.
- The VGOS 24h sessions are an interesting testbed for gauging the performance of several parameters with respect to the goals set by GGOS.

Analysis Design/Tools

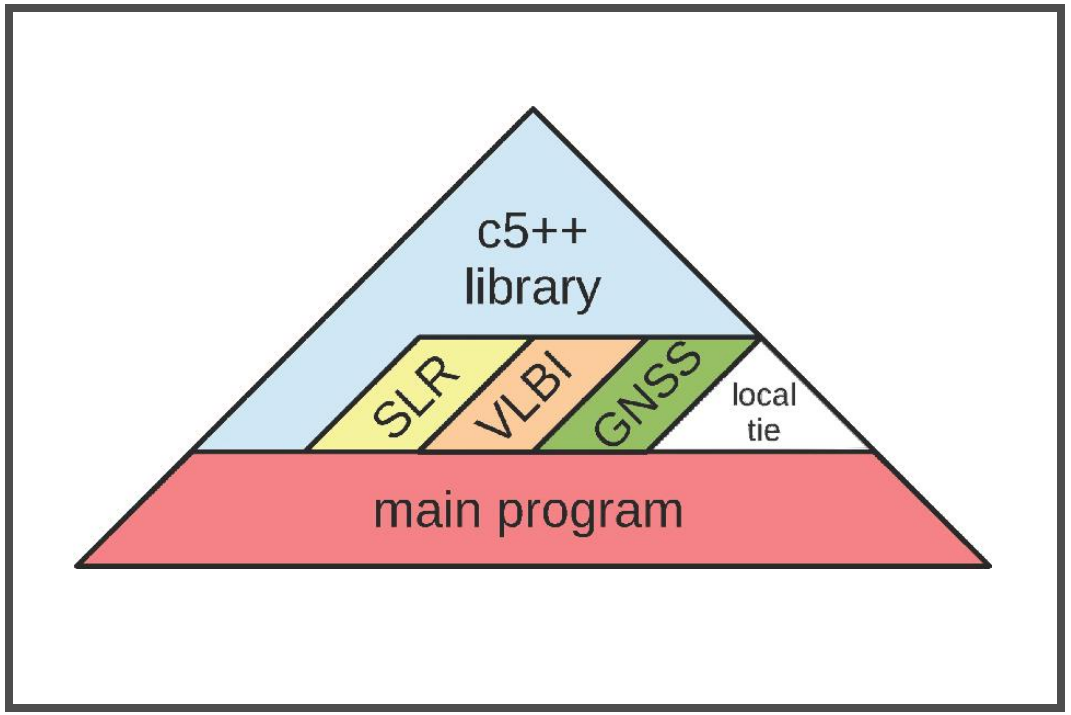
The c5++ data analysis package is used. Our group maintains a forked version we call c5lunar, with modified/added modules.

- Lunar VLBI
- Multi-GNSS
- Adaptive Square-root Kalman filtering



Analysis Design/Tools

We can develop/evaluate different concepts to our hearts desire, as we have access to the source code ✌
Examples include:
-> Evaluation of antenna deformation using material temperatures (see the presentation by R. Handirk tomorrow at 09:15)
-> Comparison of VGOS-R sessions with multi-GNSS (see the presentation by R. Haas tomorrow at 15:30)

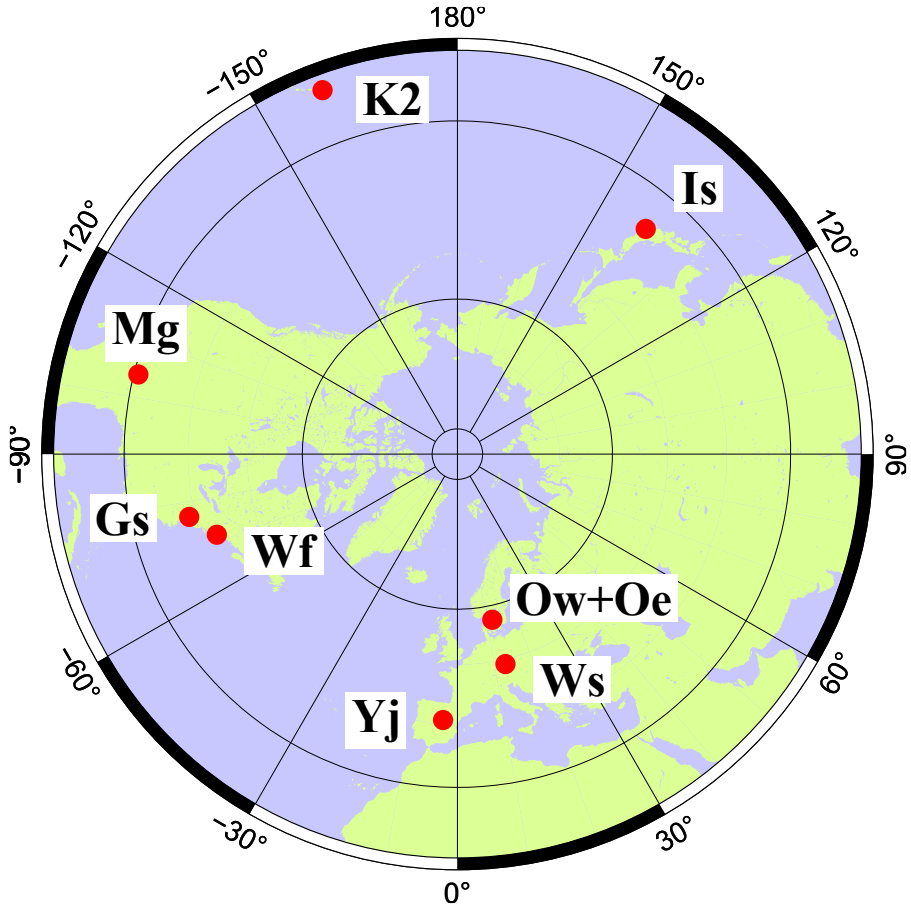


Analysis Design/Network

A total of 9 stations.
Possibility of full deployment since the beginning of 2020.

Actual makeup of sessions:

- 4% with up to 4 stations.
- 76% between 5 and 7 stations.
- 20% between 8 and 9 stations.

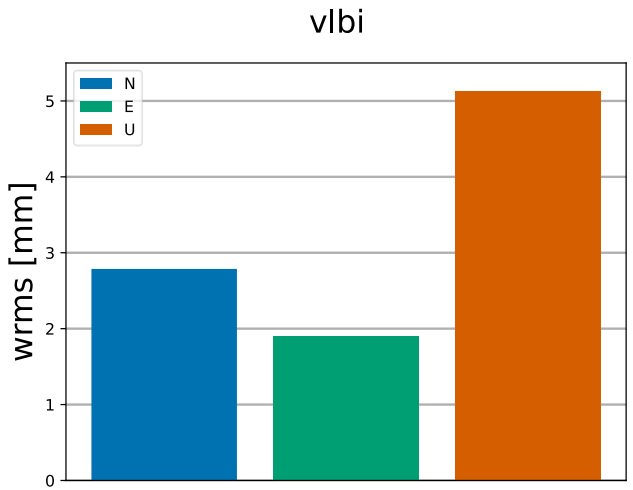


Analysis Design/Setup

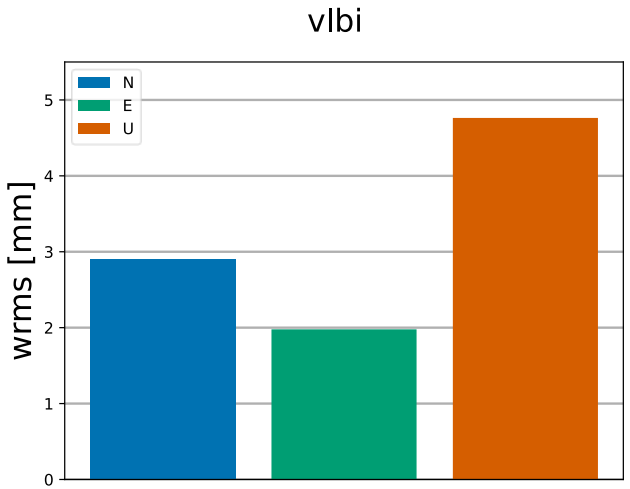
We used 24h VGOS sessions from 2019-2021 to evaluate station position repeatabilities and earth orientation parameter estimates (EOP).

- For different time resolutions of the tropospheric parameters.
- Clock estimation to 1h intervals.
- Cubic-splines interpolation with 5-day arc for providing a priori EOP.
- Fixing radio sources to ICRF3.
- We haven't incorporated the seasonal models yet in the ITRF2020 utilization.

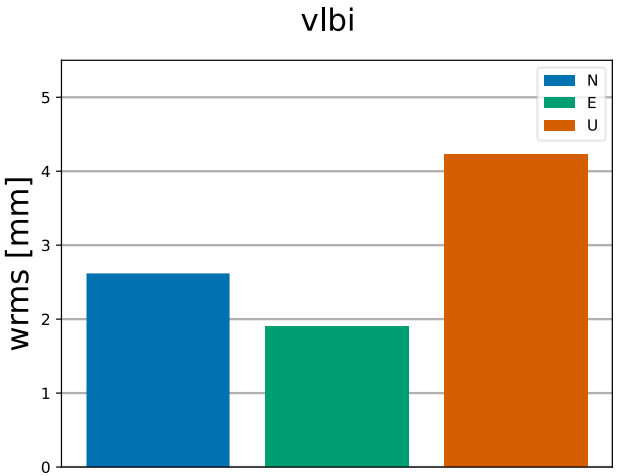
Results/Network



12h gradients – 1h zwd



15min gradients – 15min zwd

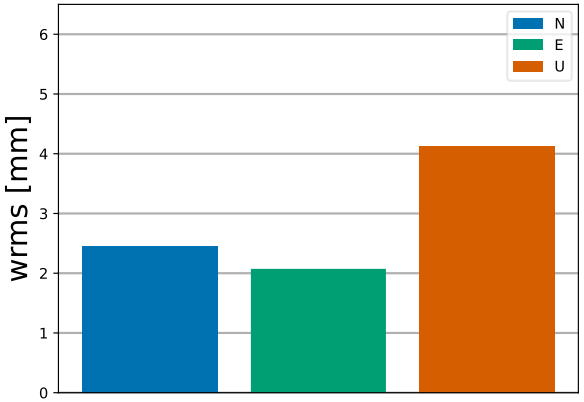


Denser tropospheric parameters

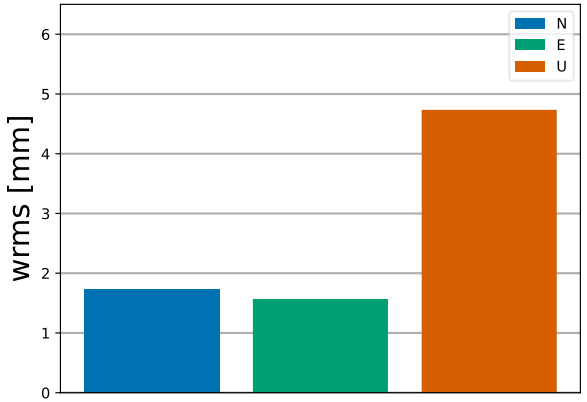
Kalman filtering

Results/Per Station

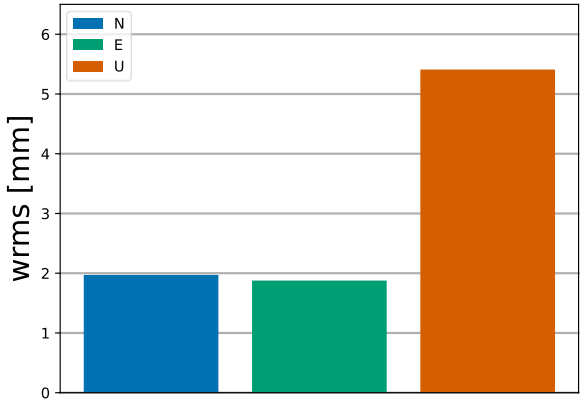
WESTFORD



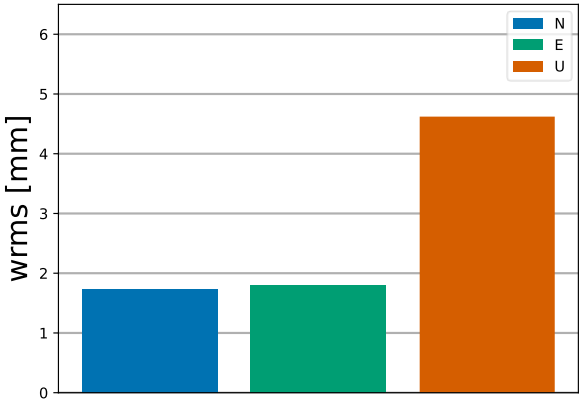
RAEGYEB



MACGO12M

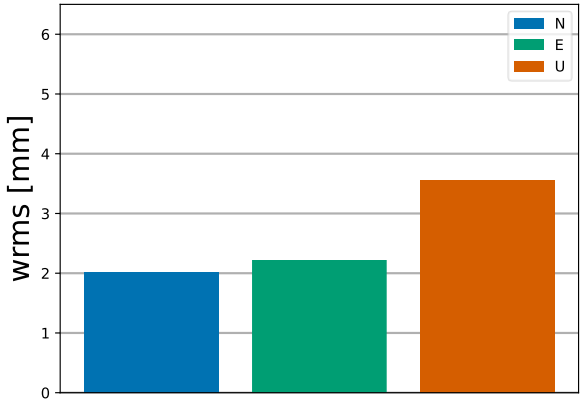


ONSA13NE

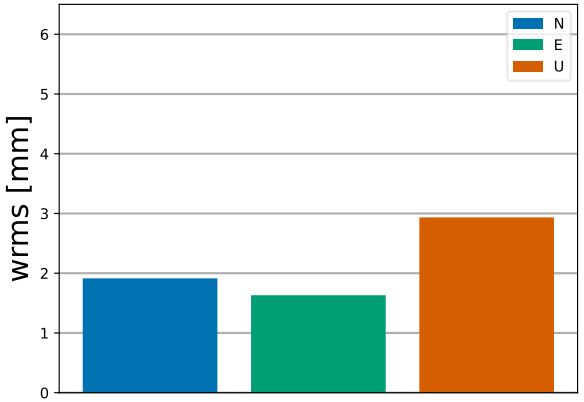


Results/Per Station

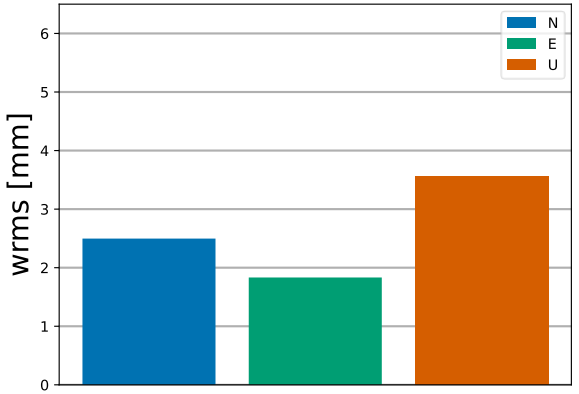
WETTZ13S



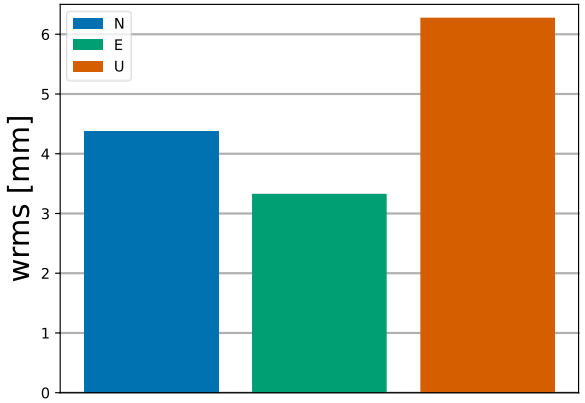
ONSA13SW



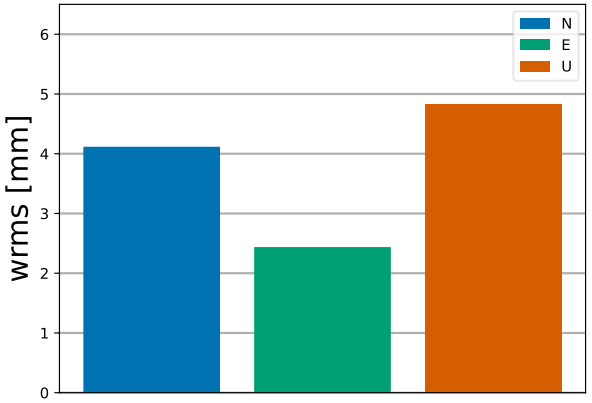
GGAO12M



KOKEE12M

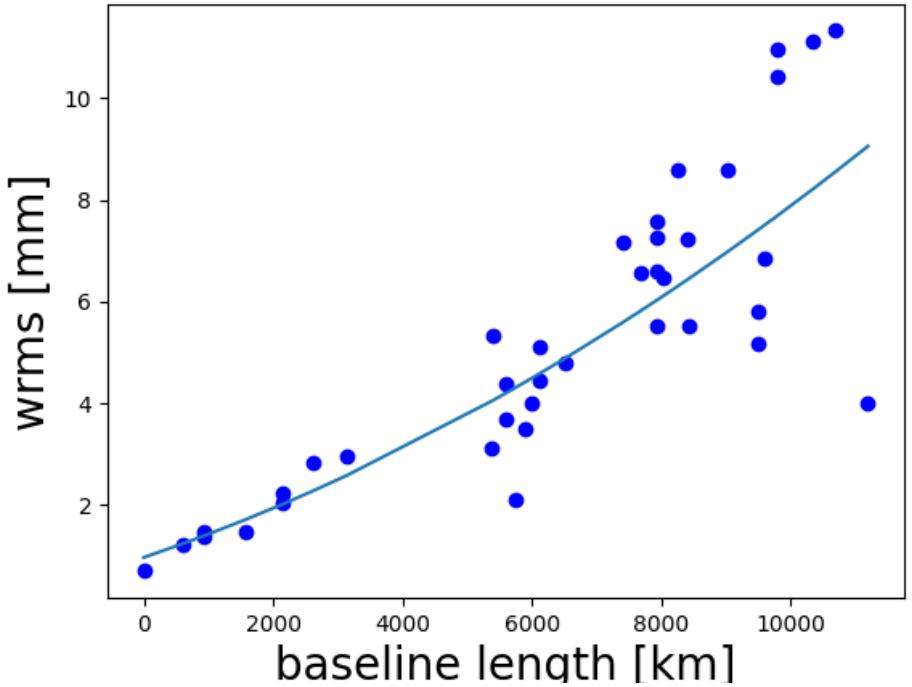


ISHIOKA



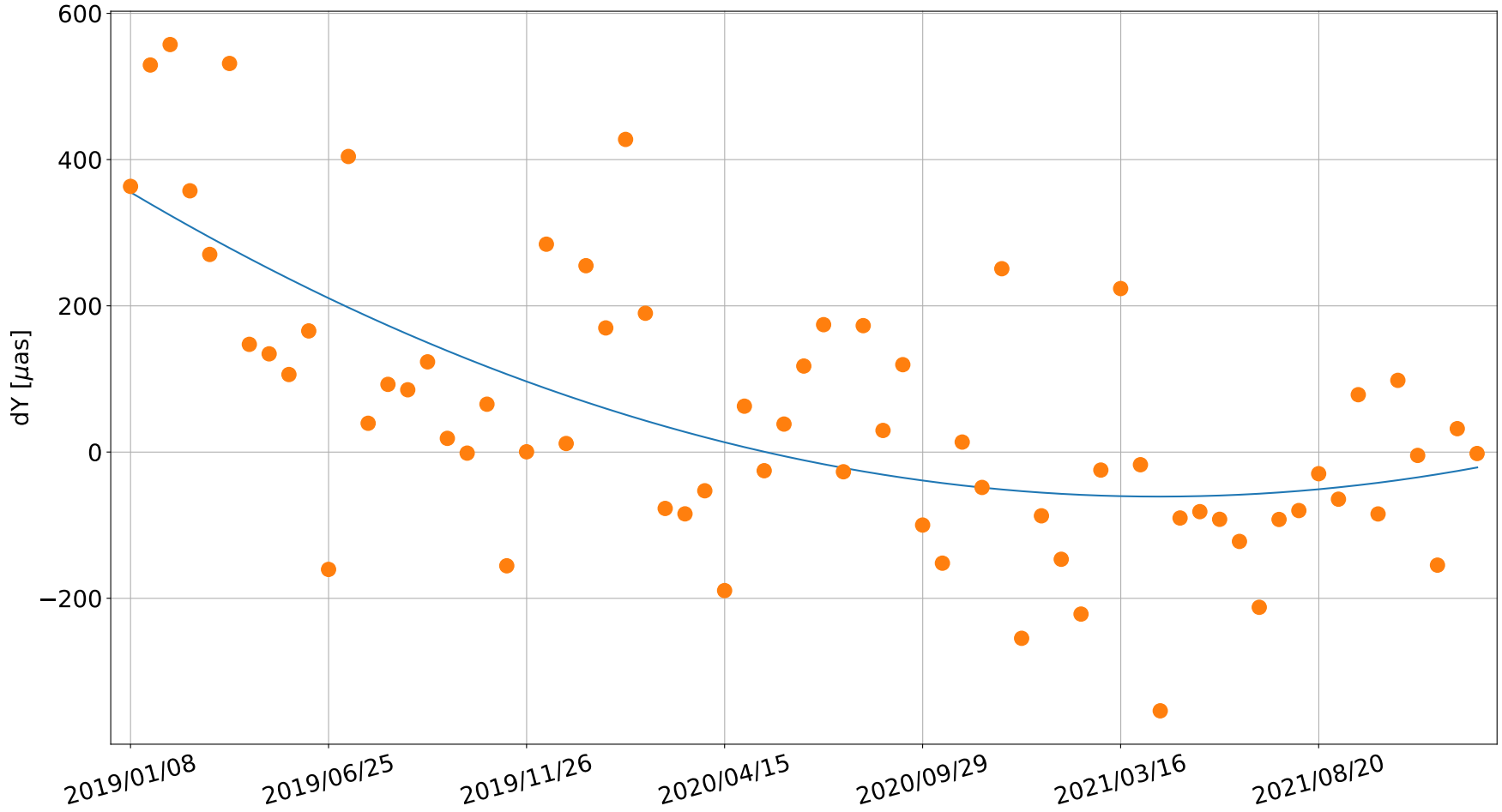
Results/Baseline Length repeatabilities

The baseline repeatability is about 4.5mm at 6000 km



Results/dY settling effect

The mean # of obs per session almost doubled after 2020, from 7000 to 12000.



Results/EOP repeatabilities (w.r.t. C04)

	EOP-c04-14	EOP-c04-20
	RMS	
UT1-UTC	11.6	13.5
x_p	302.9	286.6
y_p	317.6	272.8
dX	152.2	151.1
dY	173.9	189.3

All quantities are in µas, except for UT1-UTC which is in µs

UT1-UTC slightly improved w.r.t. state-of-the-art Legacy S/X.
Polar motion and celestial pole offsets at/or slightly worse than Legacy S/X.

Summary and Conclusions

- We were able to apply minimum constraints on the observation network as it is defined in ITRF2020.
- Station position repeatabilities and baseline length repeatabilities outperform the legacy S/X network.
- Troposphere can already be modelled more rigorously, especially on the gradient part.
- There is still road ahead to come closer to GGOS goals.

Thank you!