

Analysis of EOP and Scale from the Simultaneous CONT17 Networks

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Overview



- CONT 2-week Campaigns
- What makes CONT17 unique?
- What can we learn from independent simultaneous networks?
=> Precision & Network biases
- Comparisons of PM and LOD with GNSS
- Scale comparisons
- Conclusions

CONT Campaigns



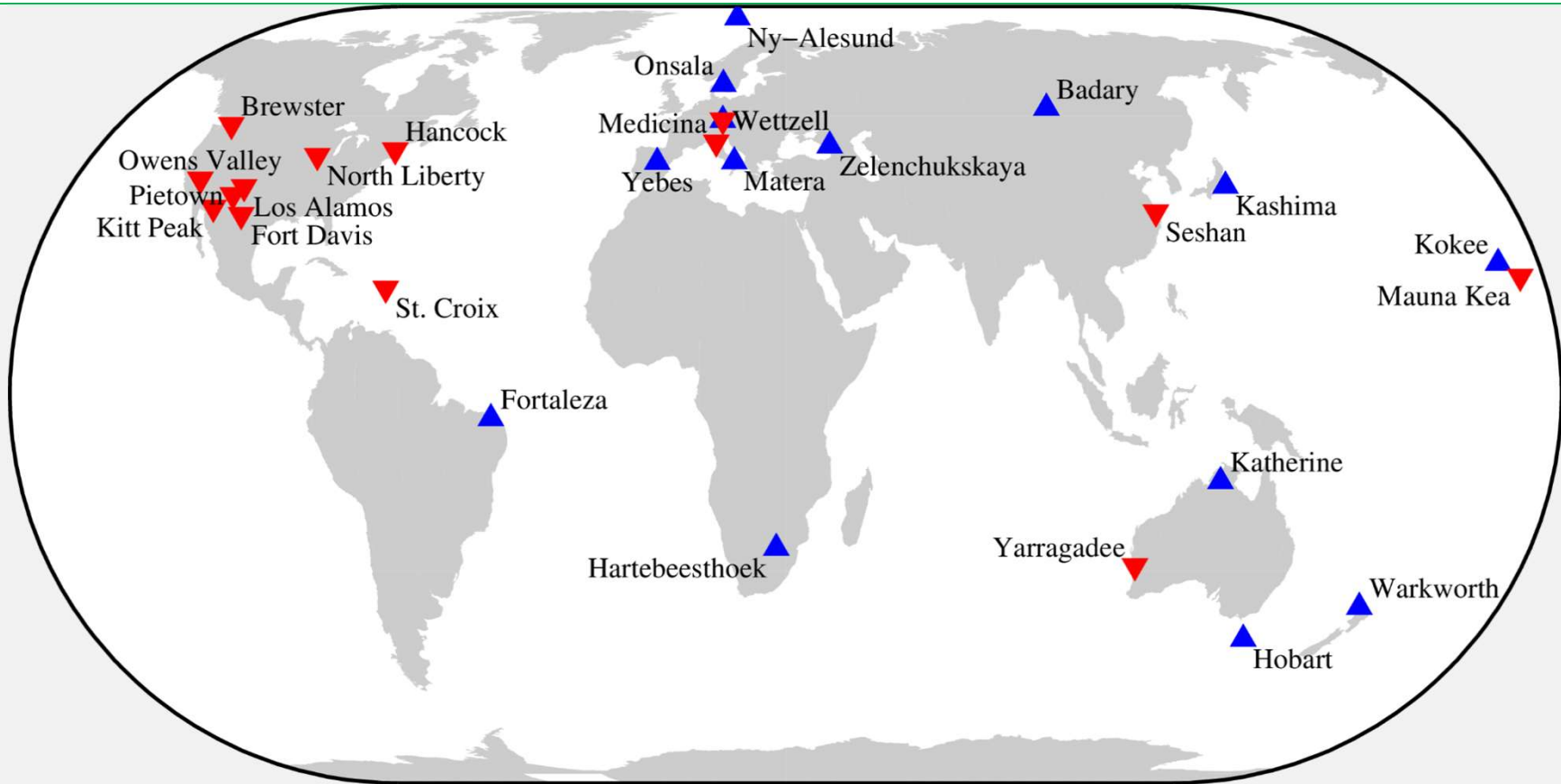
- Demonstrate state of the art every 3 years
 - Network stations are tested much more than for operational observing to help ensure better campaign performance
 - Allows us to calibrate and validate the VLBI technique
- Continuous data has value
 - Look at geophysical signals in the data
 - Compare with other techniques (GNSS) which are continuous.
- Allows probe of intrinsic precision of VLBI
 - Data over 2 weeks not as sensitive to long term or seasonal effects
 - Determine intrinsic precision/accuracy of UT1, which is uniquely measured by VLBI

CONT Campaigns



Campaign	Network size	Period	Span
CONT02	8	Oct 2002	15 days
CONT05	8	Sep 2005	15 days
CONT08	11	Aug 2008	15 days
CONT11	13	Sep 2011	15 days
CONT14	17	Sep 2014	15 days
CONT17 Legacy 1	14	Nov-Dec 2017	15 days
CONT17 Legacy 2	14	Nov-Dec 2017	15 days
CONT17 VGOS	6	Dec 2017	5 days

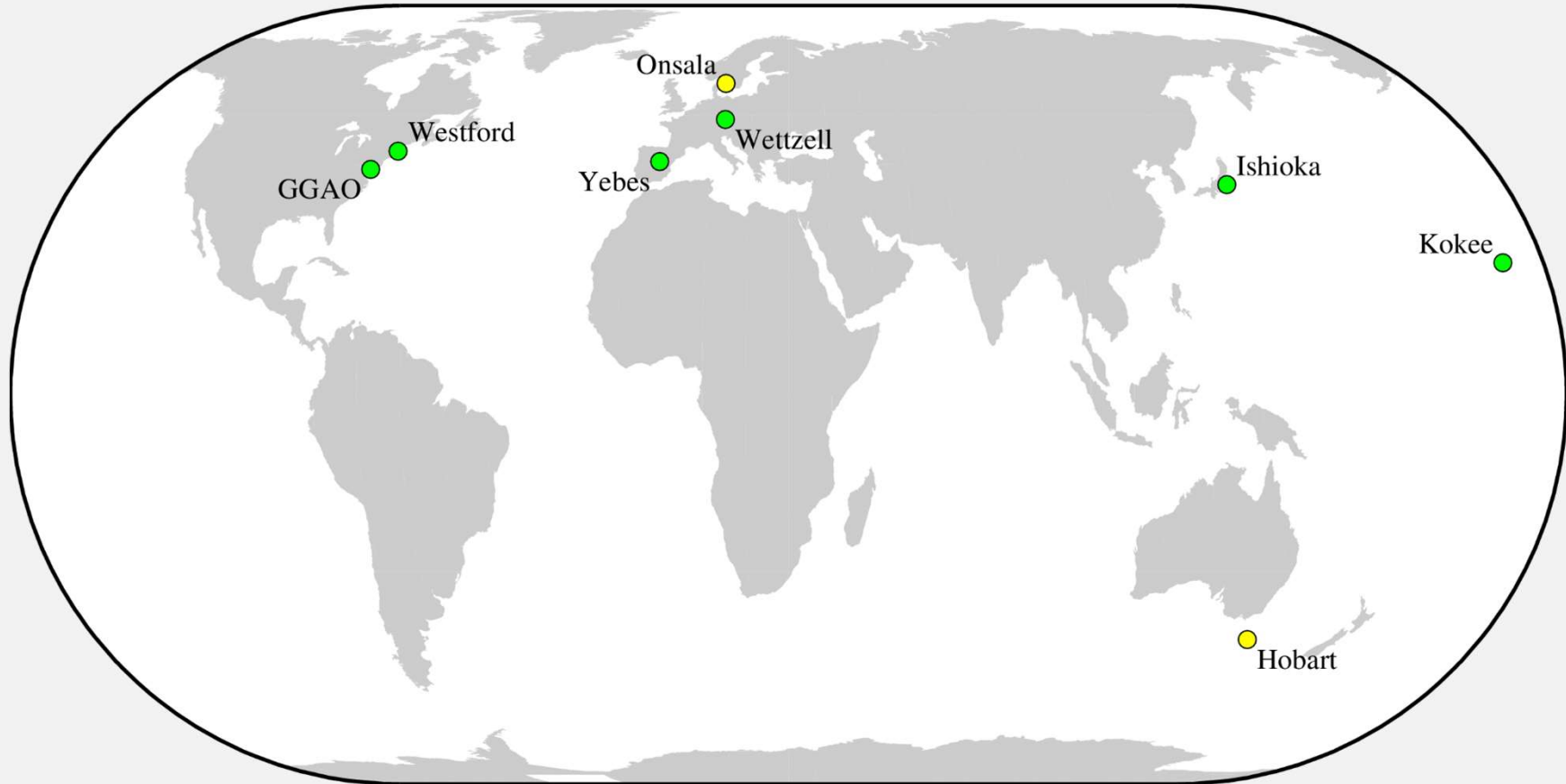
CONT17 Networks



Legacy-1: Legacy S/X network of fourteen IVS network stations

Legacy-2: Legacy S/X network of ten VLBA stations plus four IVS network stations

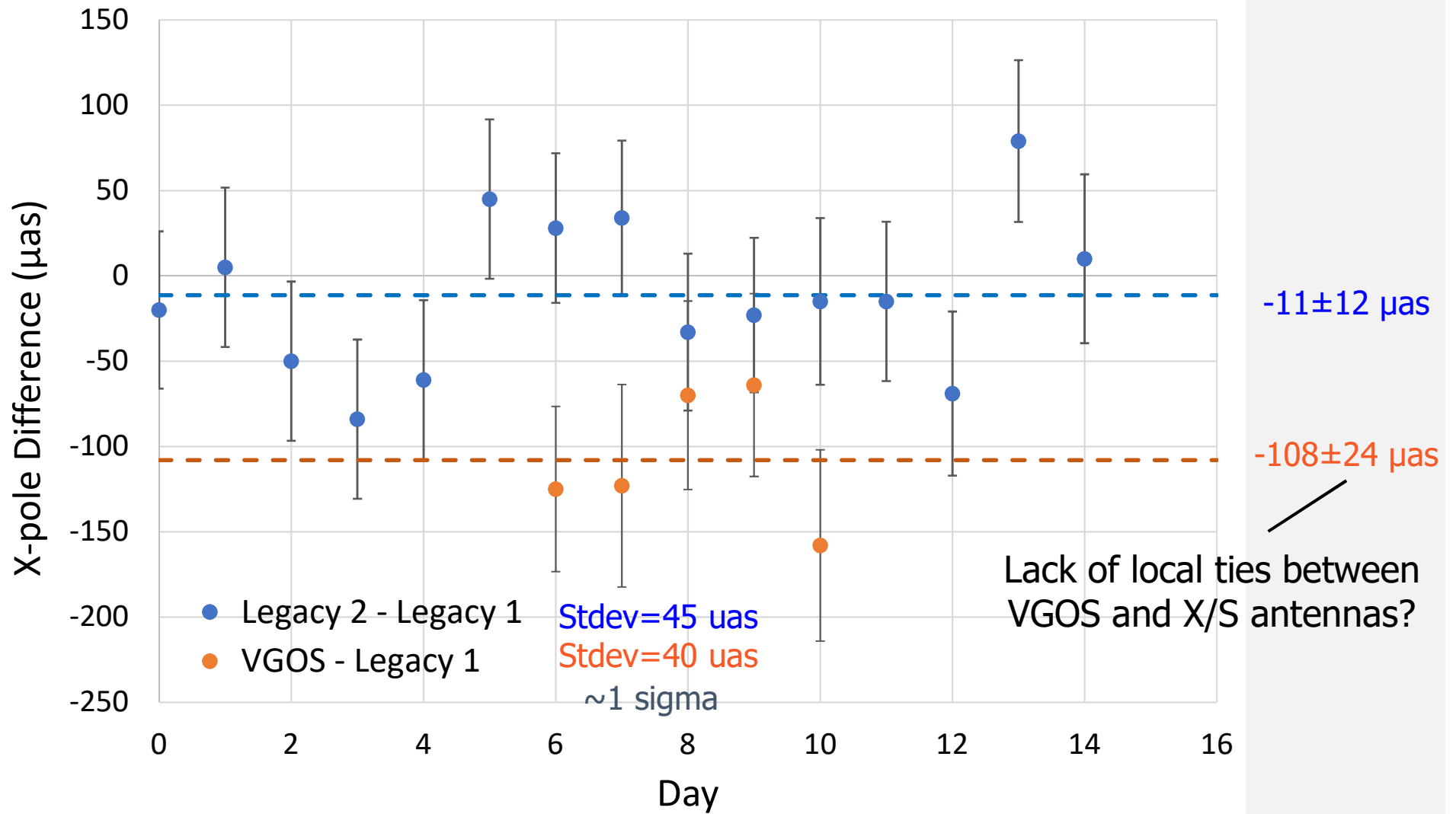
CONT17 Networks



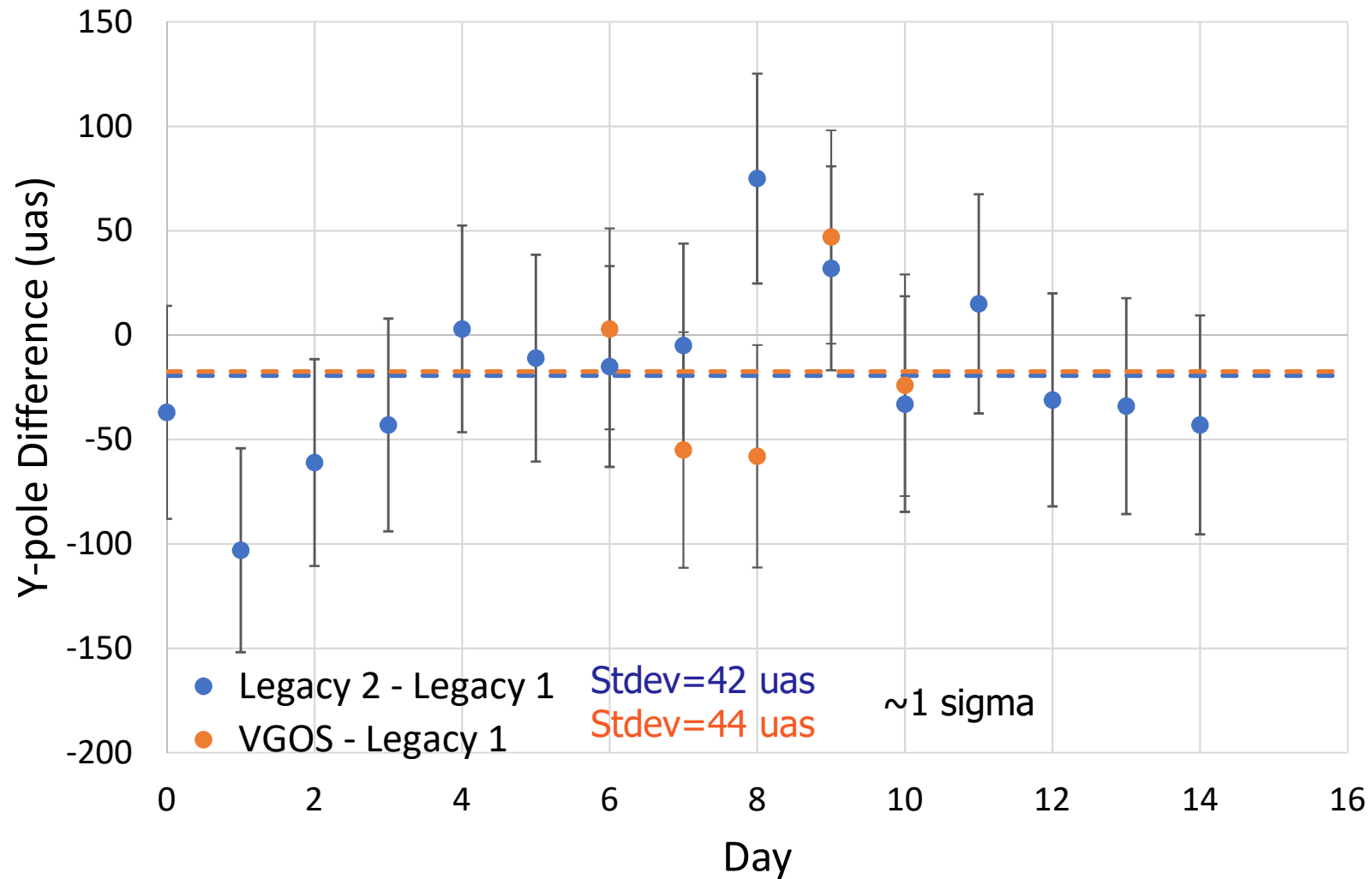
VGOS Demo: VGOS broadband network of six VGOS stations

VGOS Demo: Hobart no broadband yet; Onsala was tag-along due to test session results not stable enough yet

X-pole Differences

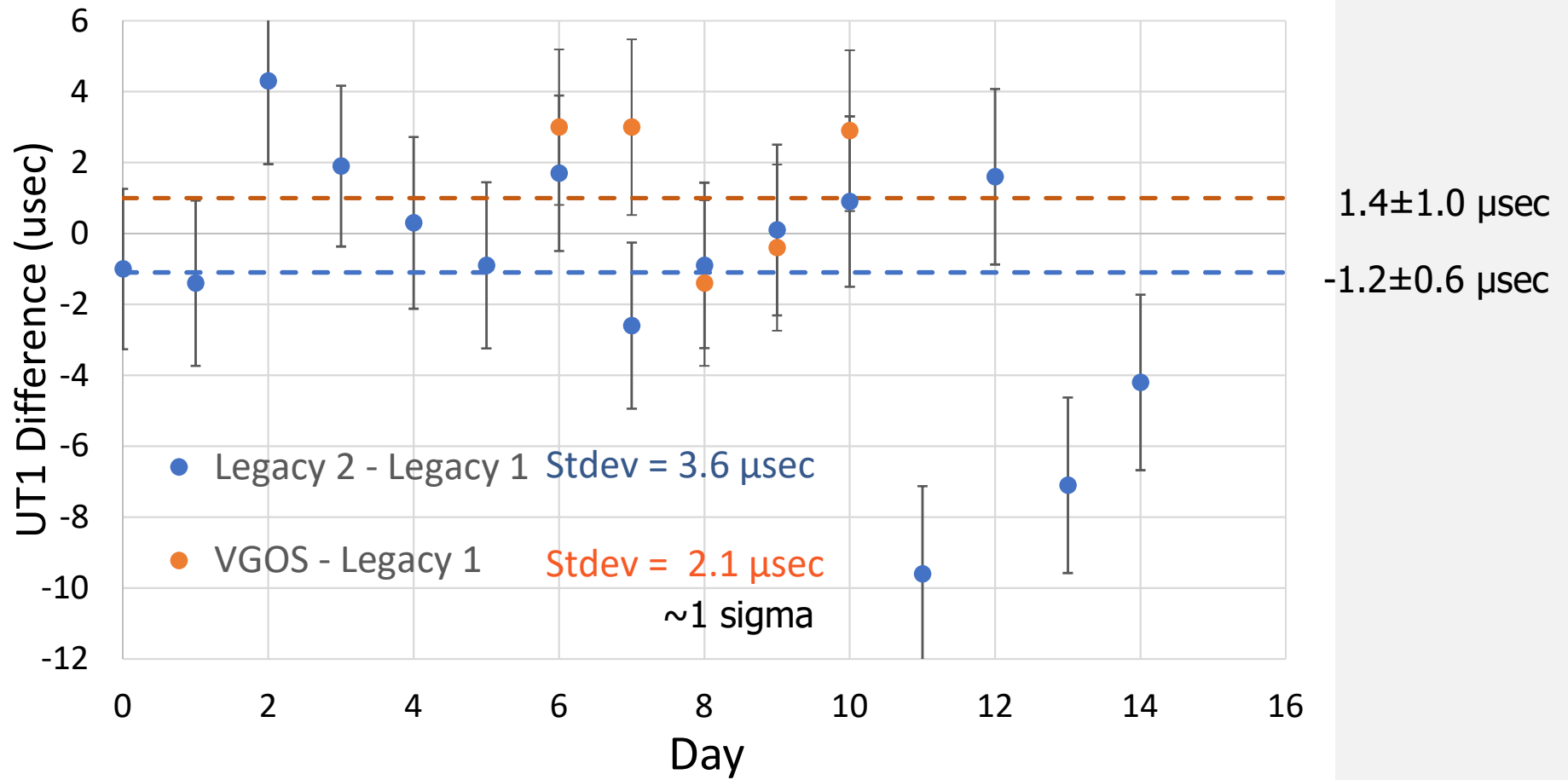


Y-pole Differences



-17±13 μas
-19±23 μas

UT1 Differences



Correlator Station Offsets (Ed Himwich):
VGOS – Legacy1 = $1.0 \pm 0.10 \mu\text{sec}$
VLBA- Legacy1 = $-1.15 \pm 0.10 \mu\text{sec}$



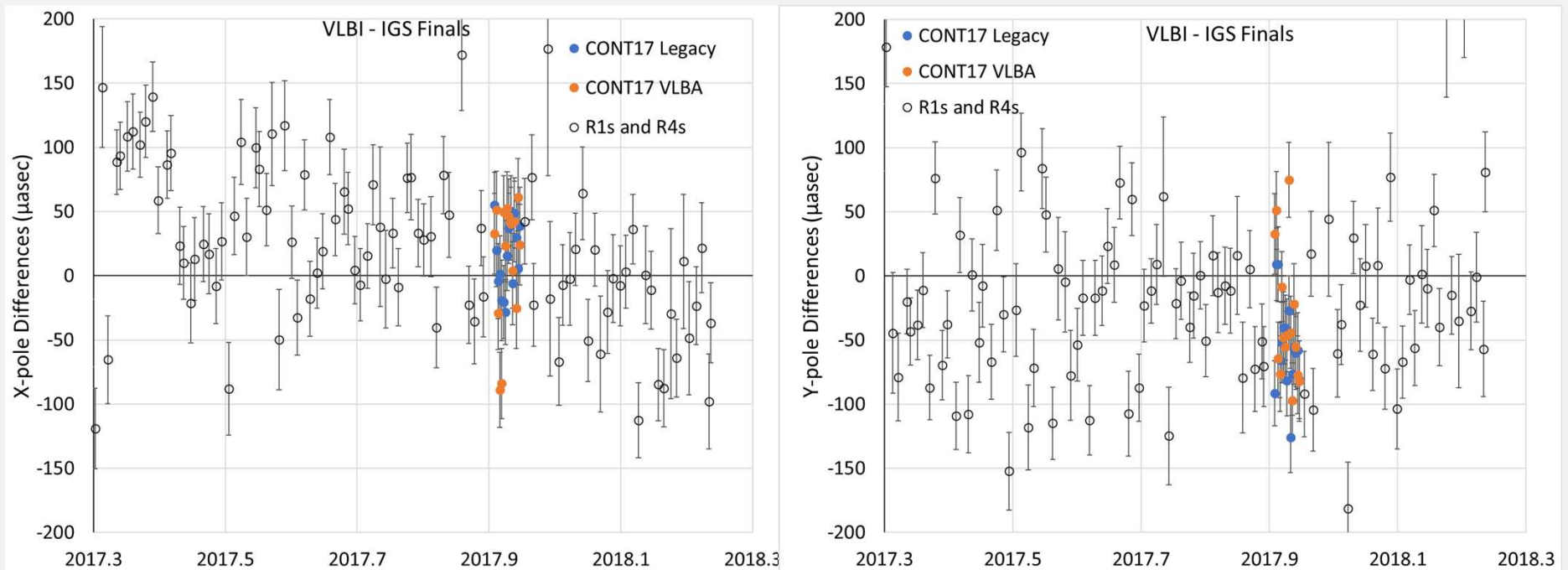
Based on recent history but not applied for CONT17

Comparison of VLBI-IGS PM

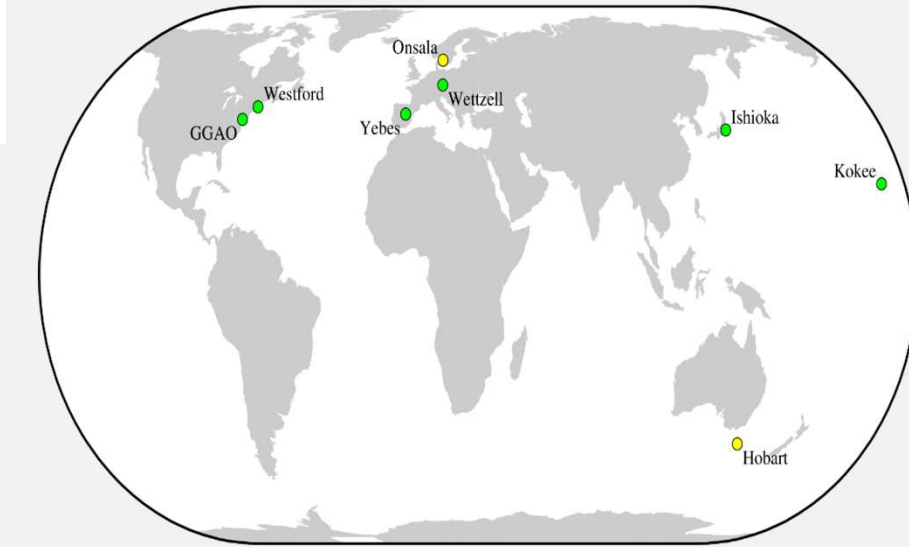
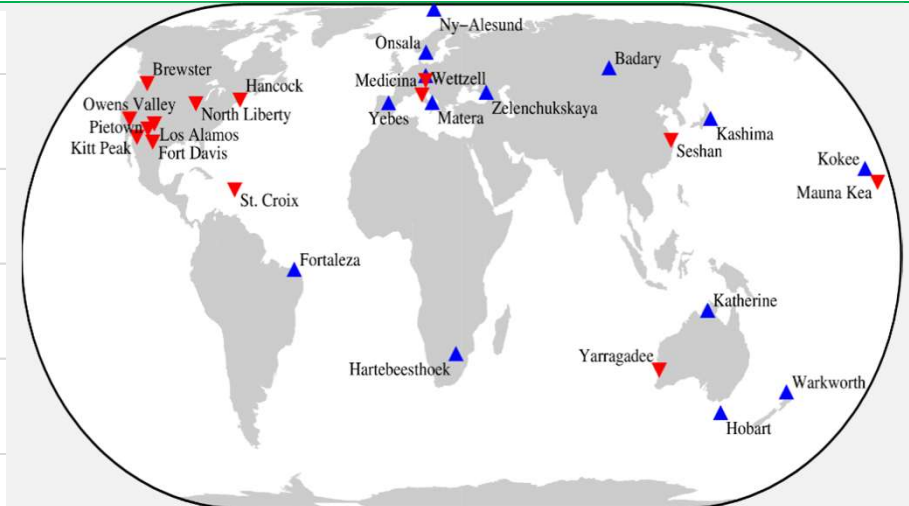
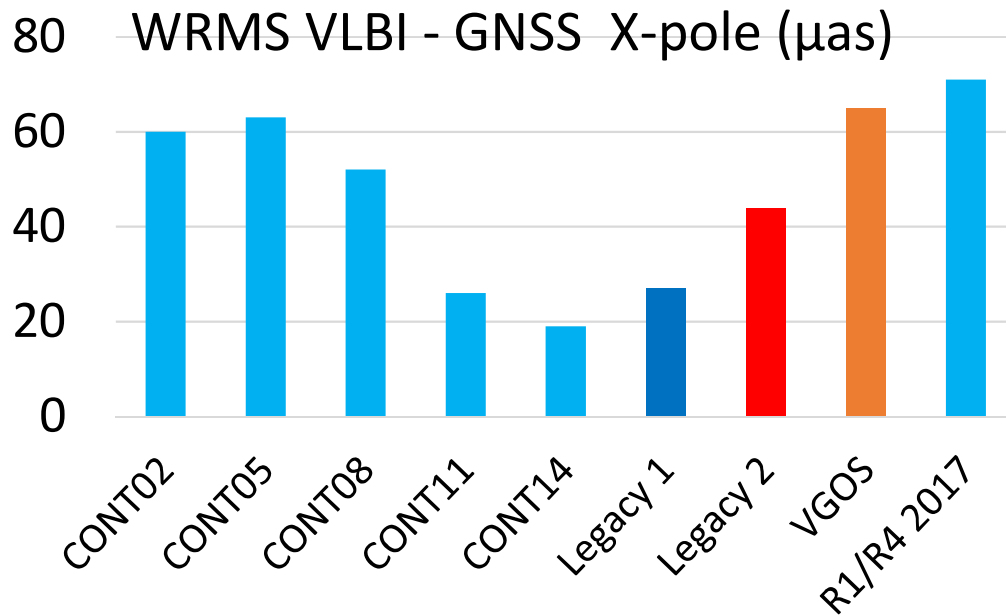


Alternate measure of the precision of VLBI EOP?

⇒ Compare with independent GNSS measurements

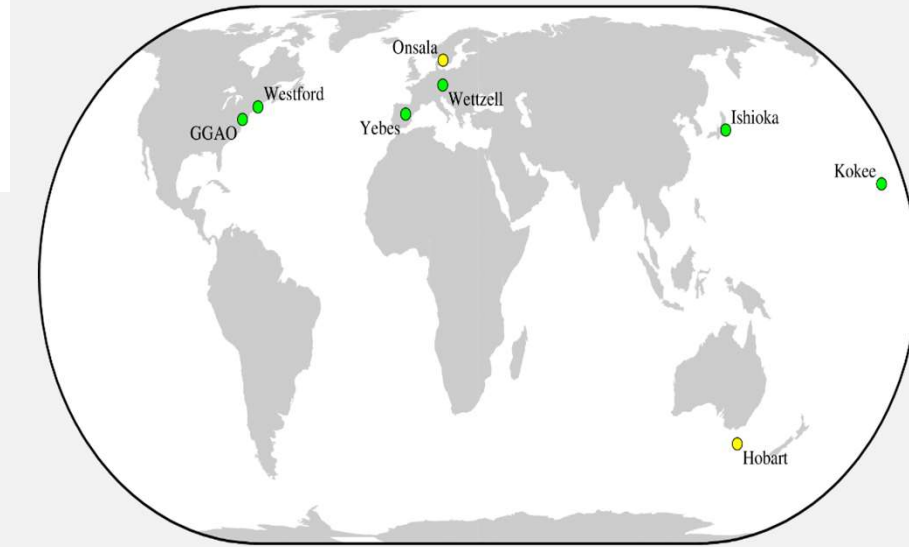
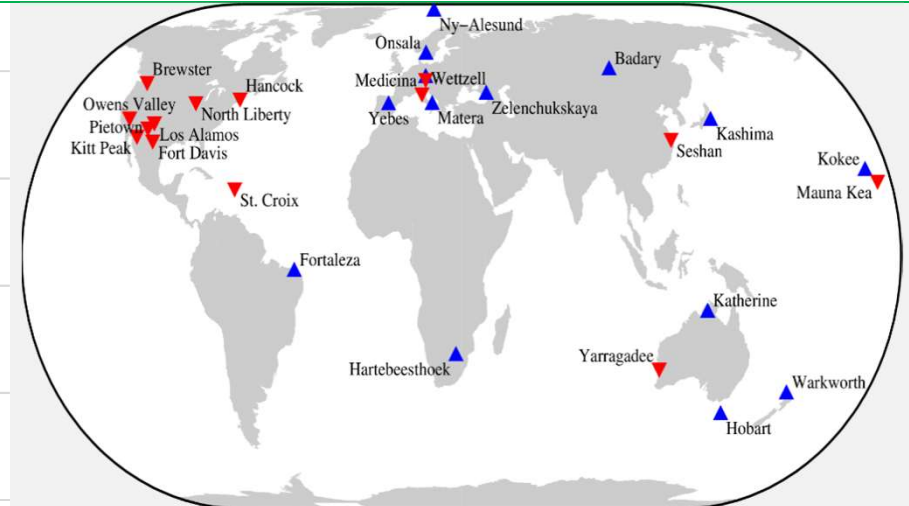
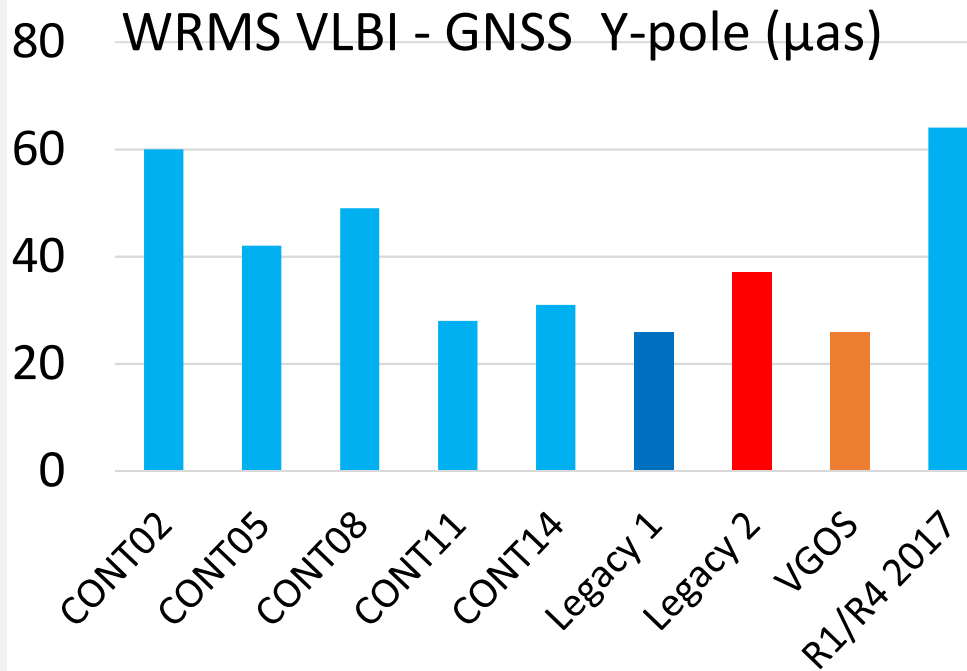


WRMS VLBI-IGS PM



Legacy 1 comparable to CONT11.
 Legacy 2 hurt by limited N/S coverage
 Both much better than R1/R4s
 VGOS hurt by lack of ties between VGOS and Legacy antennas

WRMS VLBI-IGS PM

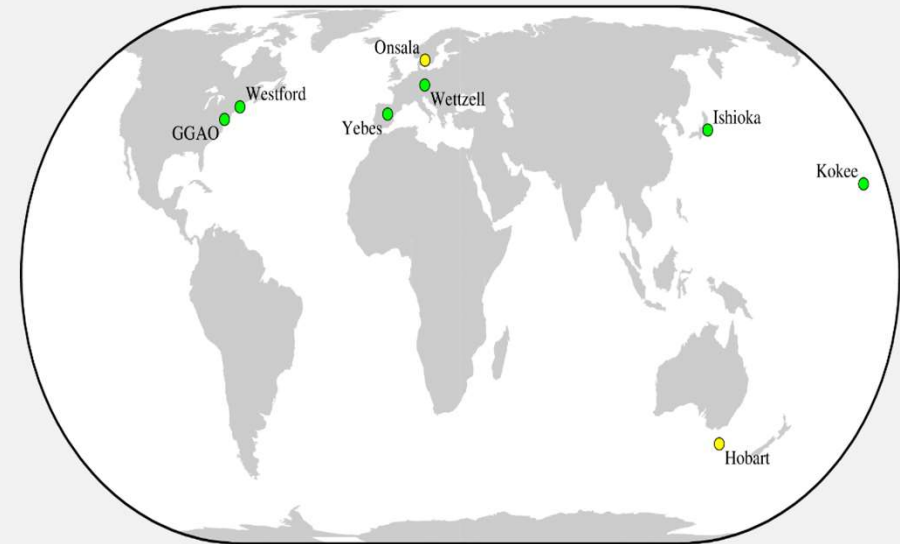
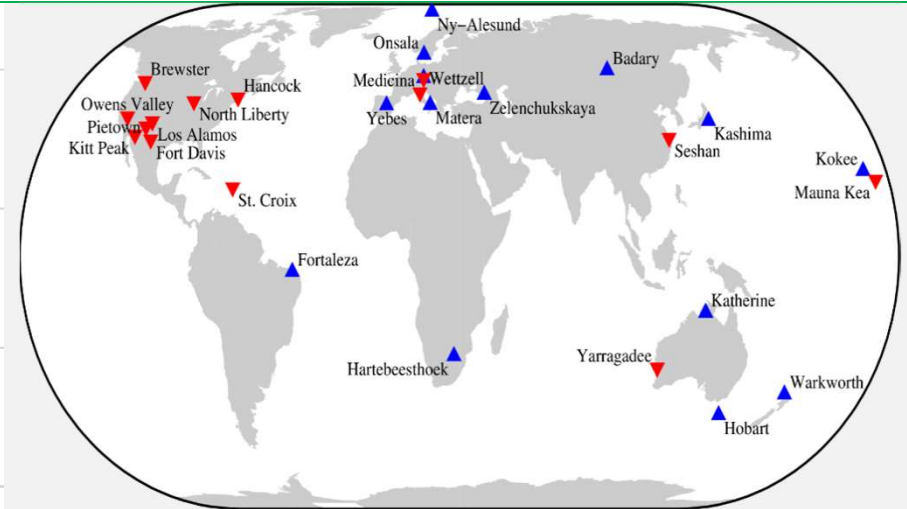
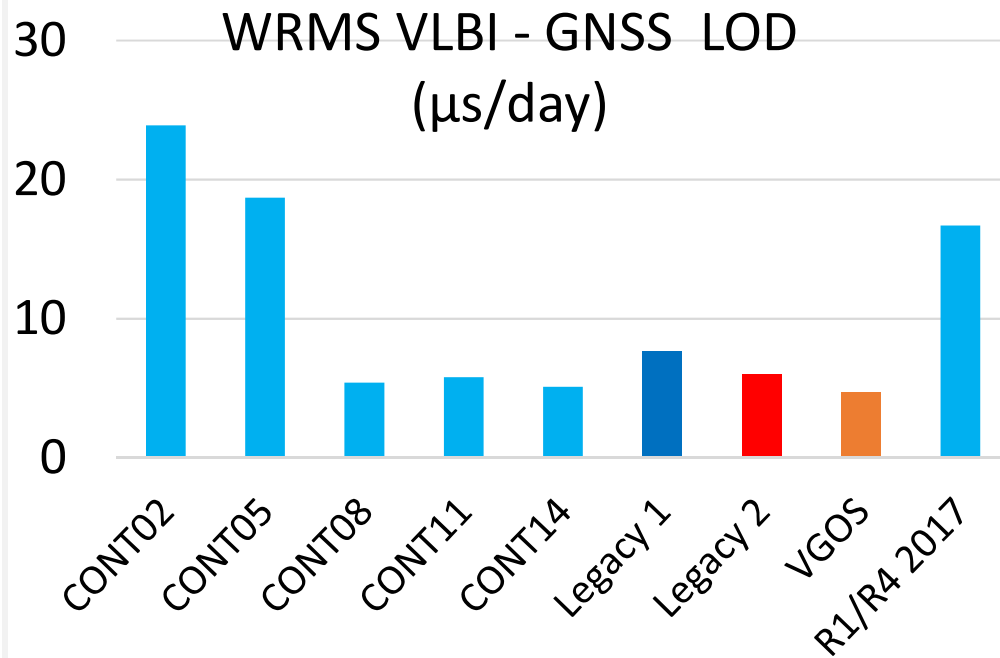


Legacy 1 and VGOS comparable to CONT11.

Legacy 2 hurt by limited N/S coverage

All are much better than R1/R4s.

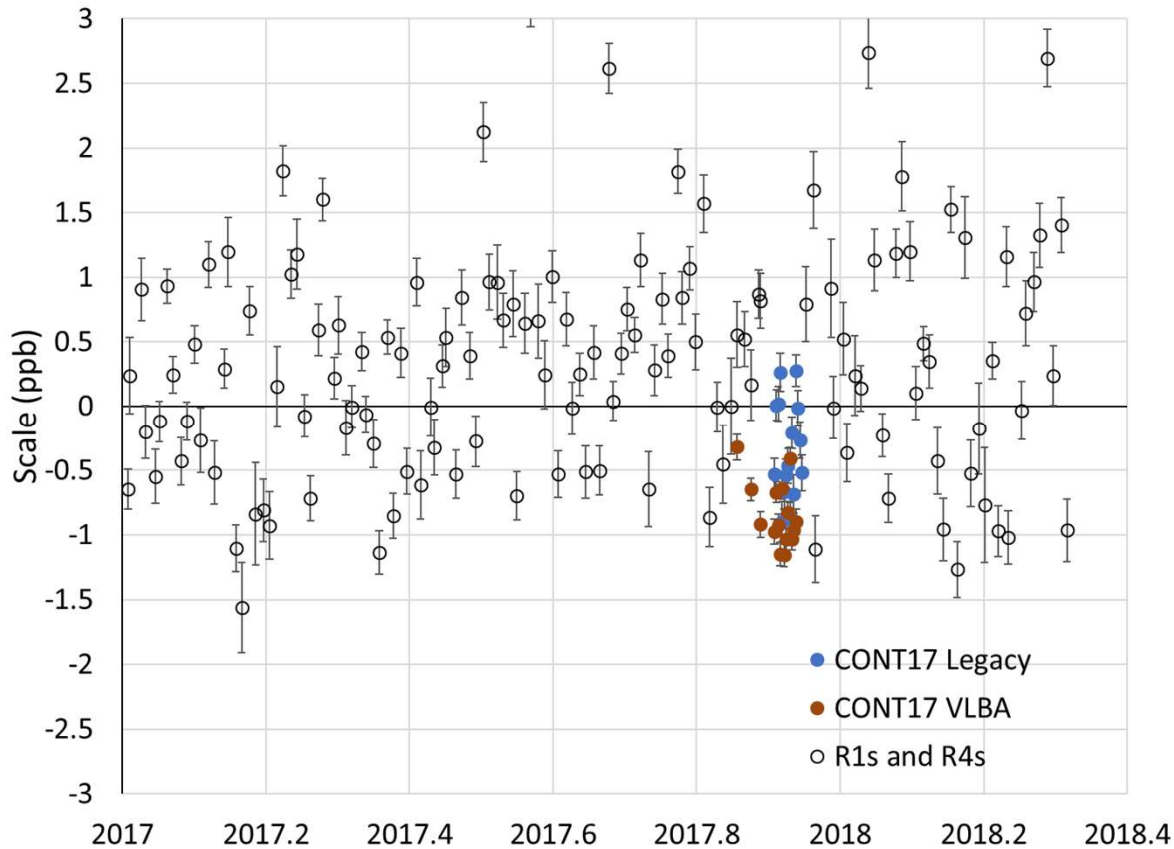
WRMS VLBI-IGS PM



All CONT networks have generally comparable wrms agreement with GNSS as CONT11.

All much better than operational R1/R4s.

VLBI Scale



	WRMS	
	ppb	mm
CONT02	0.44	2.7
CONT05	0.30	2.0
CONT08	0.24	1.5
CONT11	0.32	2.0
CONT14	0.26	1.7
Legacy 1	0.38	2.4
Legacy 2	0.25	1.6
R1/R4 2017	0.83	5.3

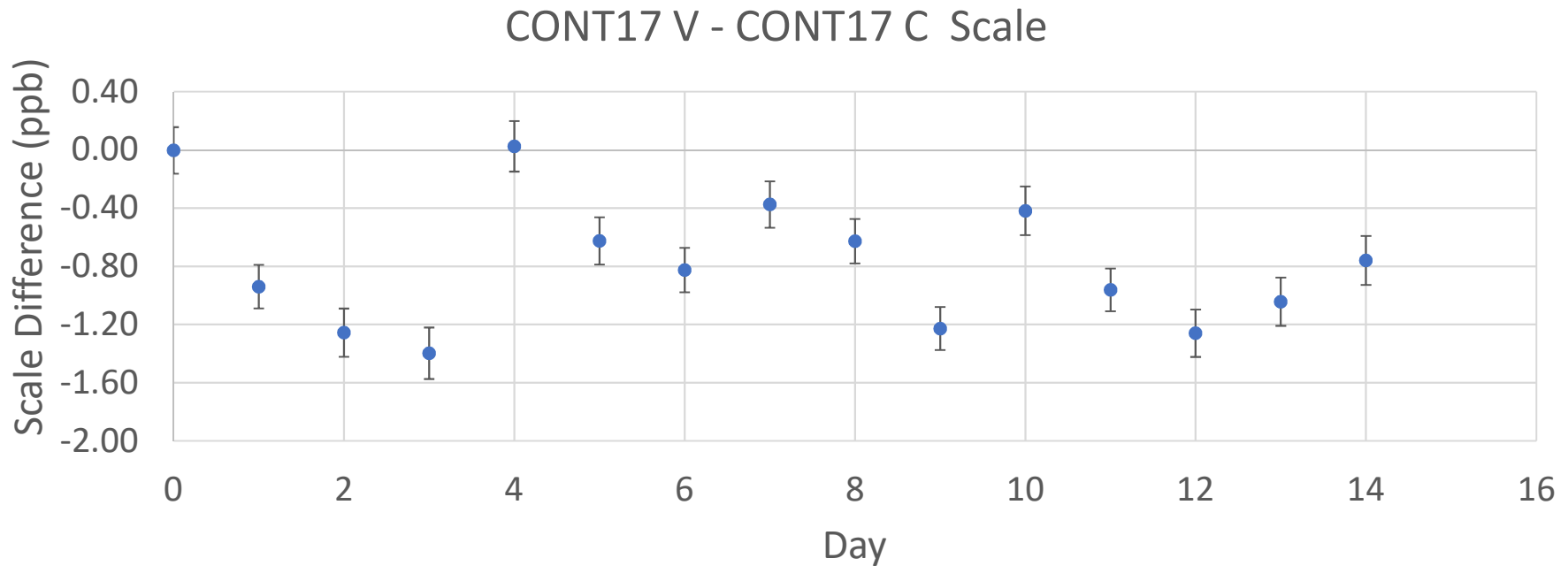
Scale precision = wrms repeatability (scale time series)

CONT17 and VLBA17 similar to previous CONTS

Much better than R1/R4s

The larger and more global the network, the better the scale.

Scale



Avg. V-C difference = -0.78 ppb

Avg. sigma = 0.16 ppb

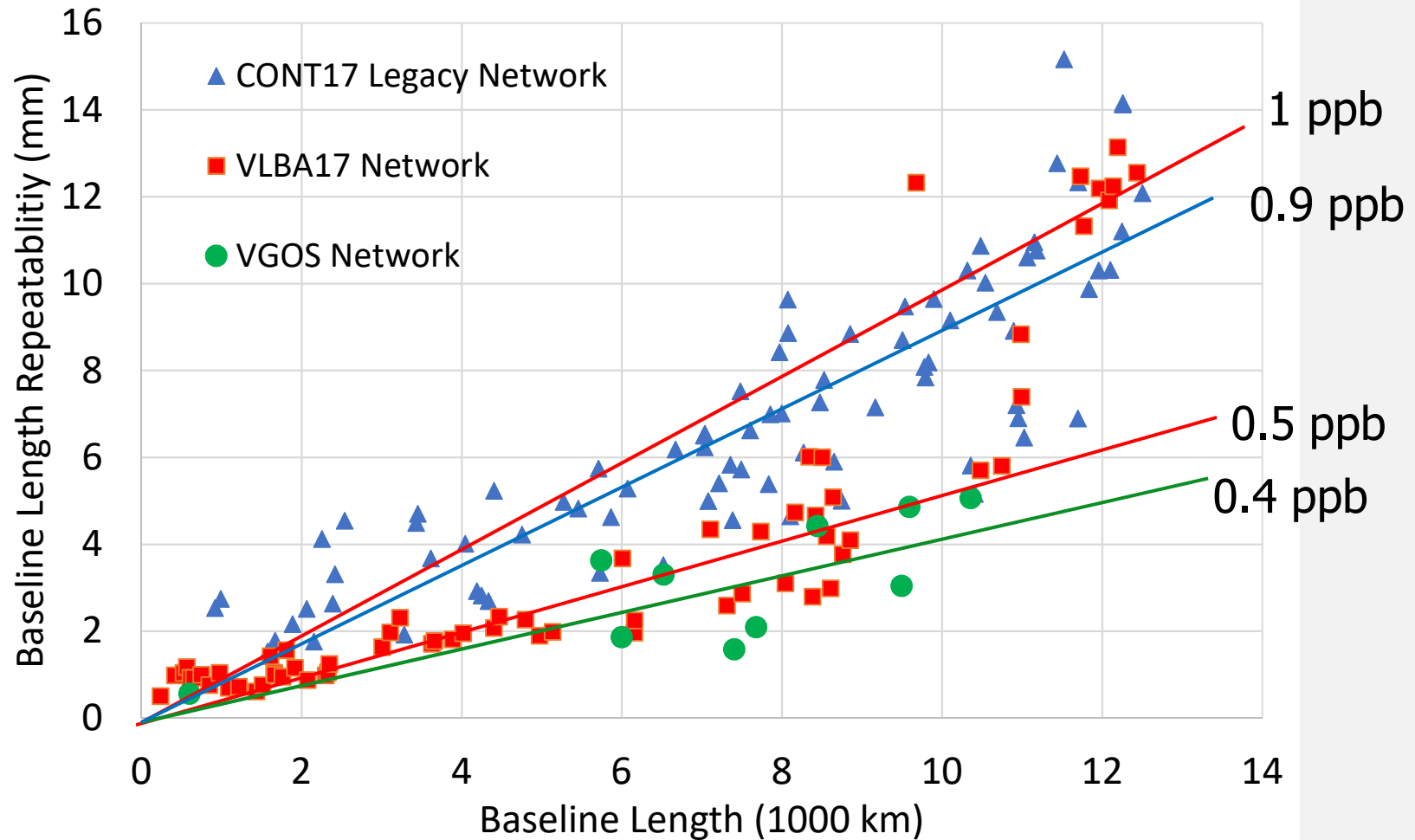
Stdev = 0.44 ppb

Stdev V = 0.25 ppb

Stdev C = 0.38 ppb

} Scale stability

Baseline Length WRMS



Conclusions (EOP)



- UT1 biases between the three networks are $\sim 1.1-1.4 \mu\text{s} \sim 1$ sigma
- Wrms differences ~ 1.5 sigma

- PMX and PMY biases and between Legacy networks are ~ 1 sigma
- Wrms differences also ~ 1 sigma

- PMX and PMY biases between VGOS and Legacy 1 = $108 \mu\text{as}$ and $17 \mu\text{as}$
=> Problem results from the lack of local ties between VGOS and X/S antennas
- Wrms differences \sim same as for Legacy differences

- Wrms agreement of legacy network PM with GNSS $\sim 30-40 \mu\text{as}$
- Twice as good as operational R1/R4 VLBI sessions

Conclusions (TRF)



- Baseline length wrms scatter
 - ~ 0.4 ppb VGOS network
 - ~ 0.5 ppb Legacy 2 VLBA network (~ 0.9 ppb on long baselines to only southern site Yaragadee)
 - ~ 0.9 ppb Legacy 1 network
 - A larger VGOS network should increase station obs/hr and reduce the VGOS scatter
- Scale series
 - Wrms scatter of CONT17 legacy network scale series is in line with previous CONTs
 - Twice as good as R1s/R4s