

# **Analysis of EOP and Scale from the Simultaneous CONT17 Networks**

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**EVGA Meeting  
Las Palmas, Canary Islands, Spain  
March , 2019**

- 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

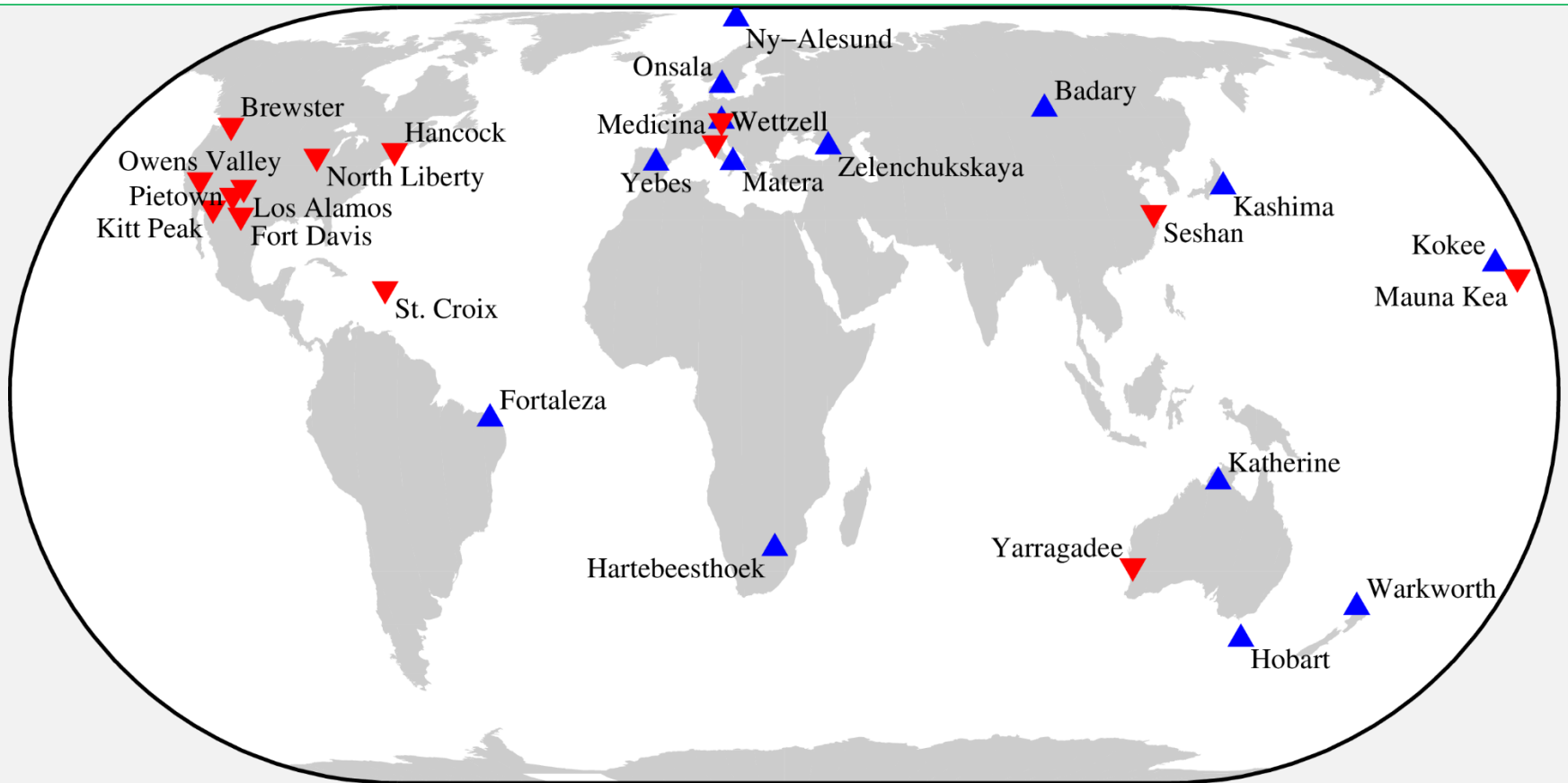
- Demonstrate state of the art every 3 years
  - Network stations are tested much more than for operational observing to help ensure better campaign performance
  - Allows us to calibrate and validate the VLBI technique
- Continuous data has value
  - Look at geophysical signals in the data
  - Compare 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

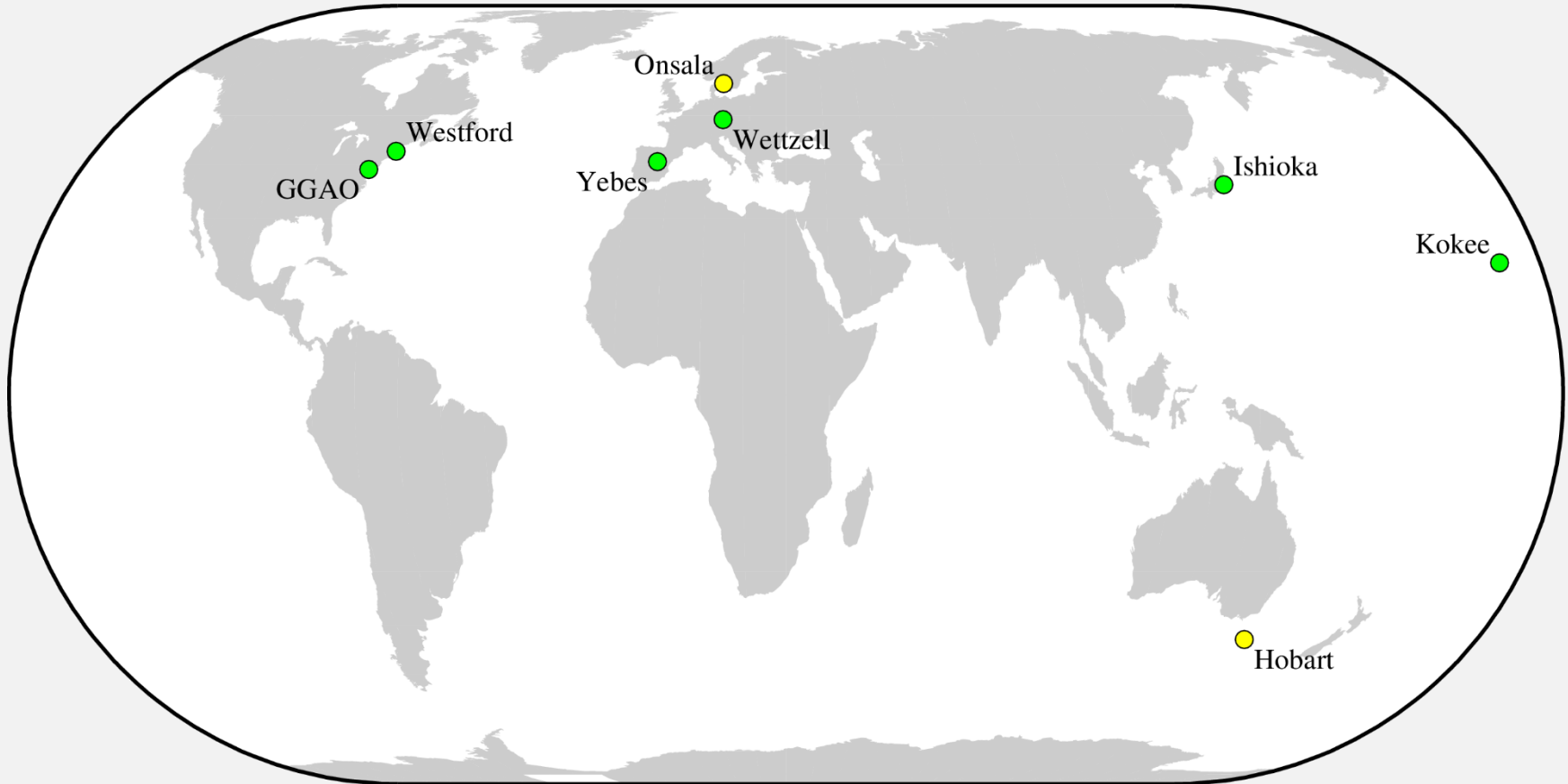
# CONT17 Networks



**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

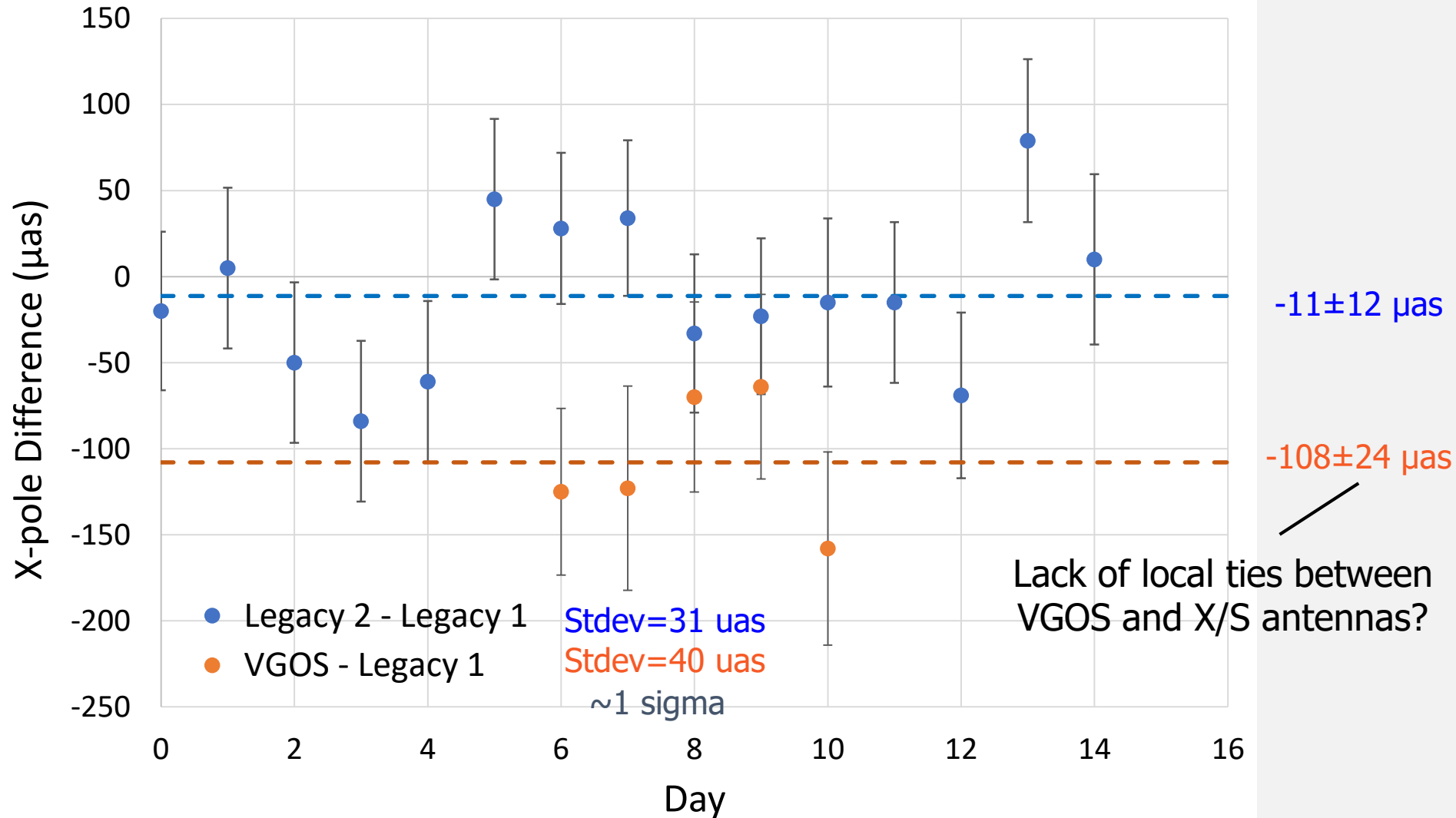
# CONT17 Networks



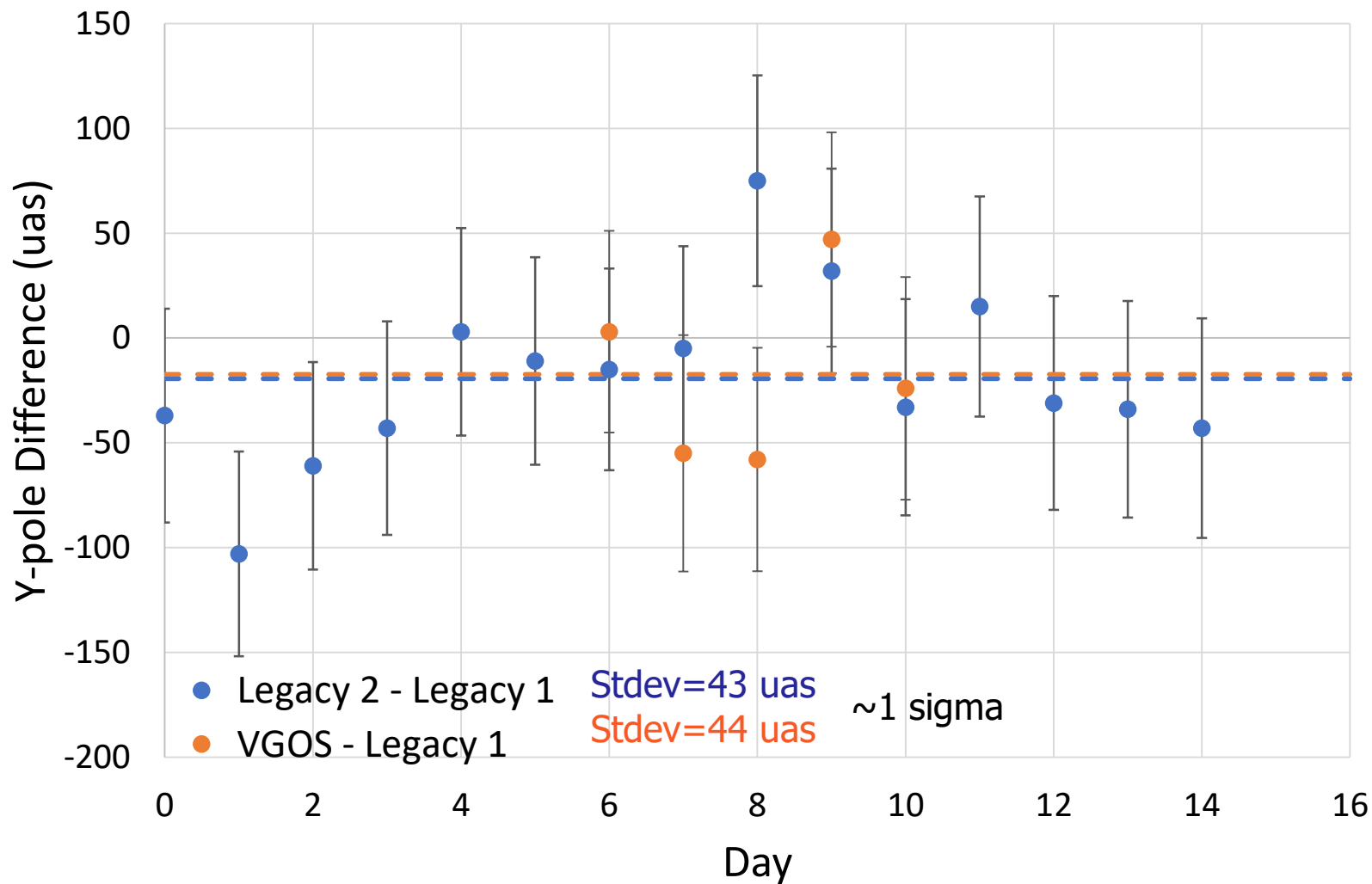
**VGOS Demo:** VGOS broadband network of six VGOS stations

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

# X-pole Differences



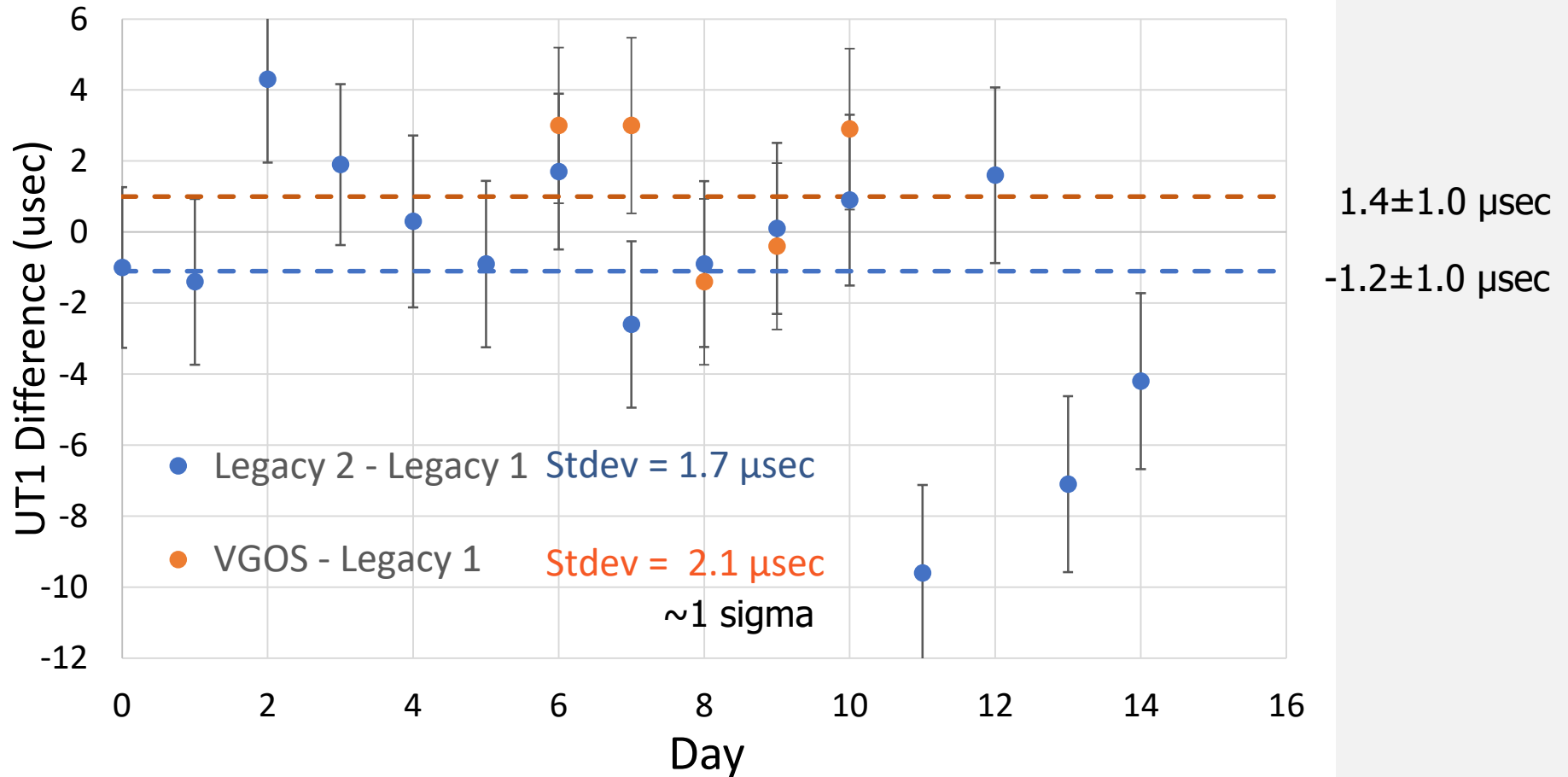
# Y-pole Differences



-17±23  $\mu$ s  
-19±13  $\mu$ s



# UT1 Differences



Correlator Station Offsets (Ed Himwich):

VGOS - Legacy1 = 1.0  $\pm$  0.10  $\mu$ sec

VLBA - Legacy1 = -1.15  $\pm$  0.10  $\mu$ sec



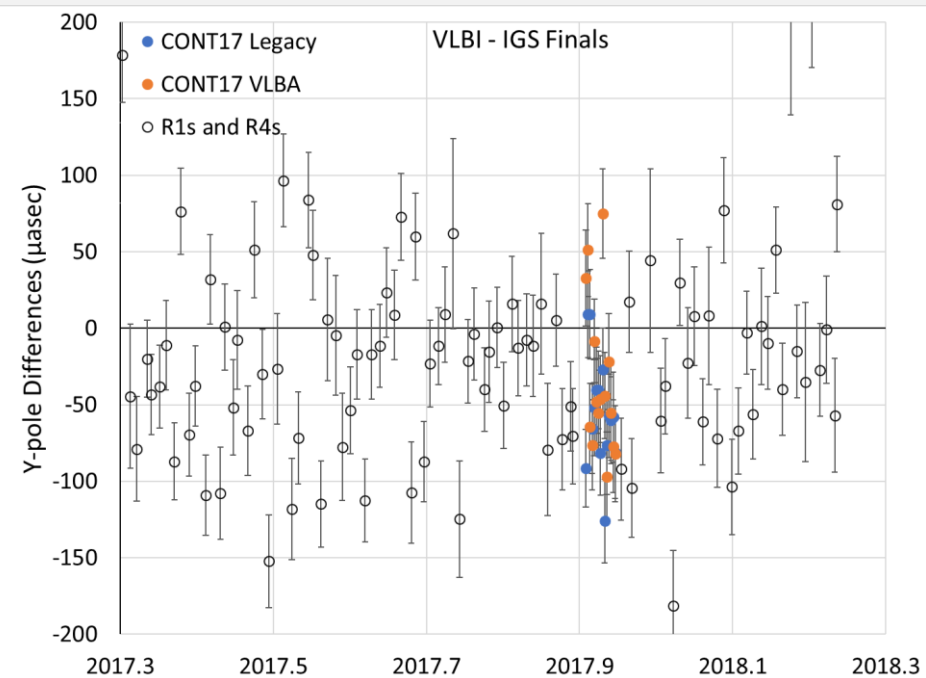
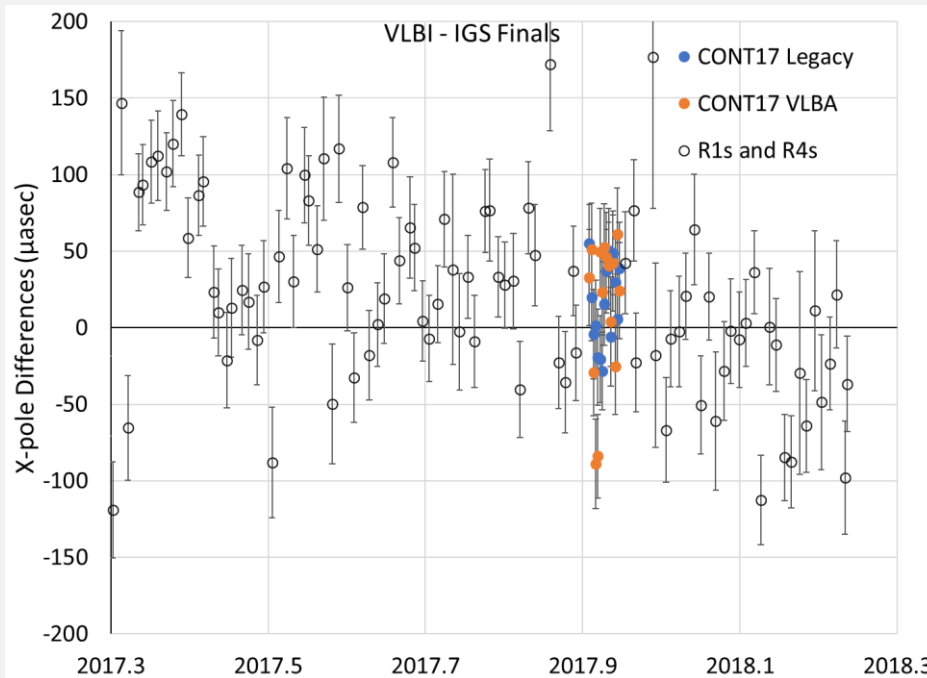
Based on recent history but not applied for CONT17

# Comparison of VLBI-IGS PM

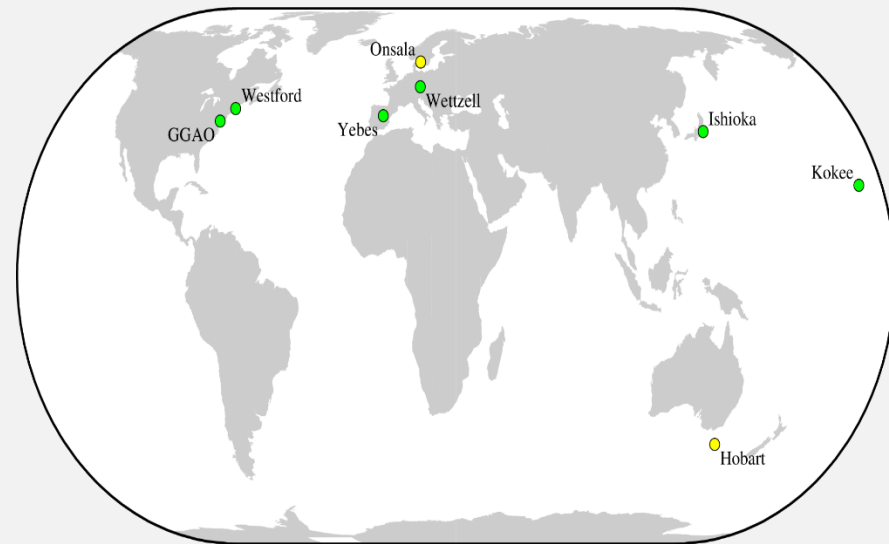
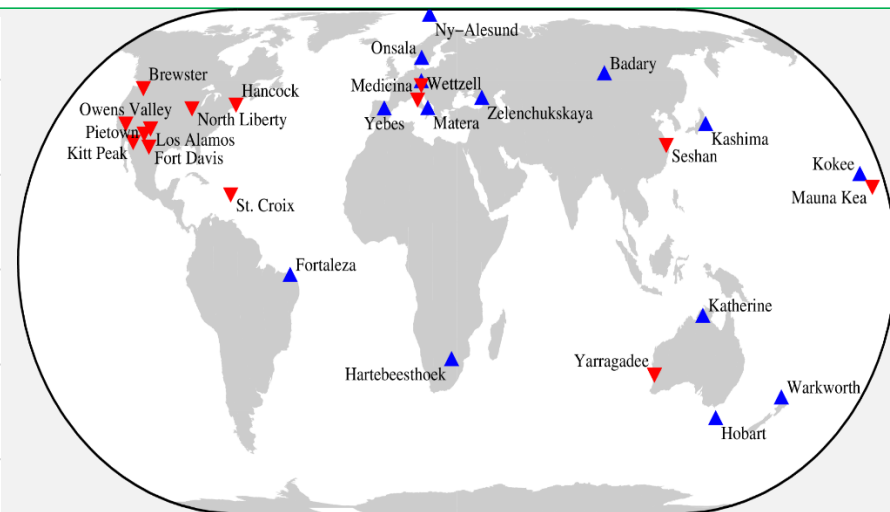
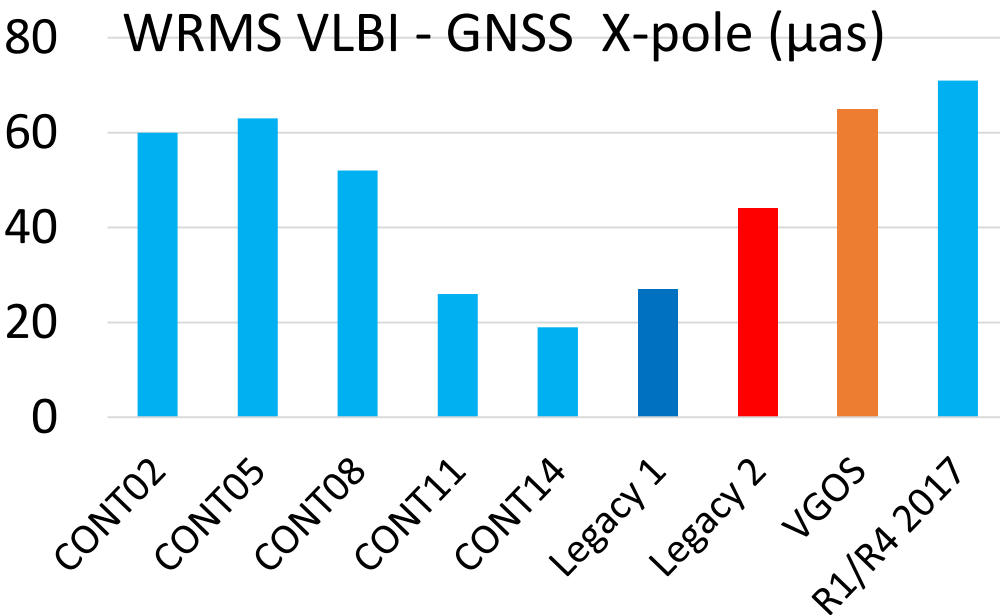


## Alternate measure of the precision of VLBI EOP?

⇒ Compare with independent GNSS measurements



# WRMS VLBI-IGS PM



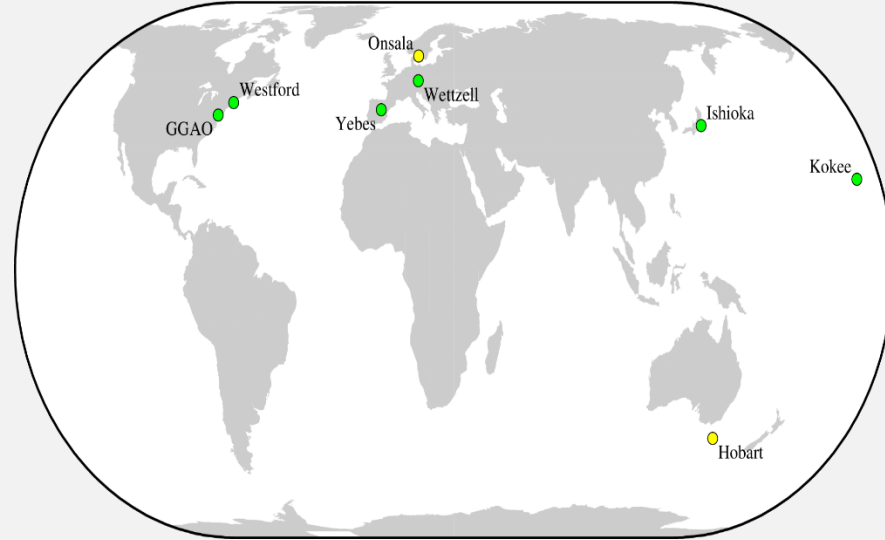
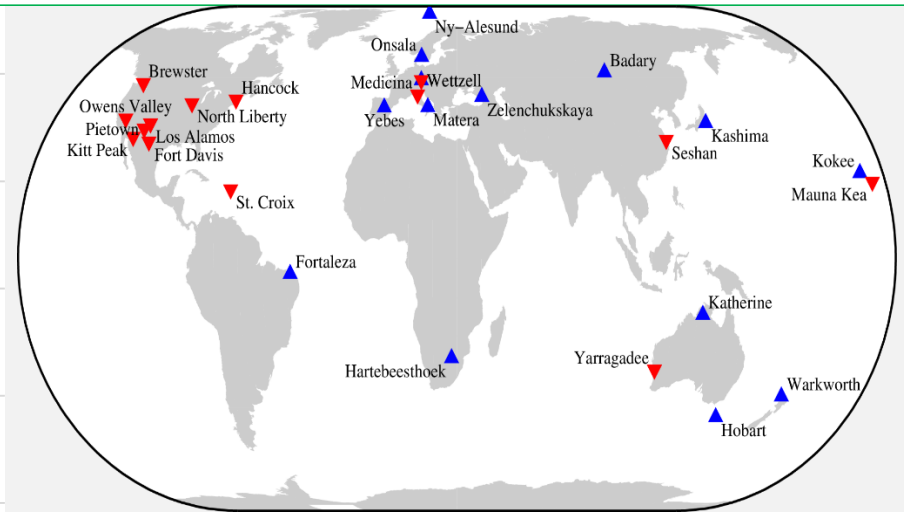
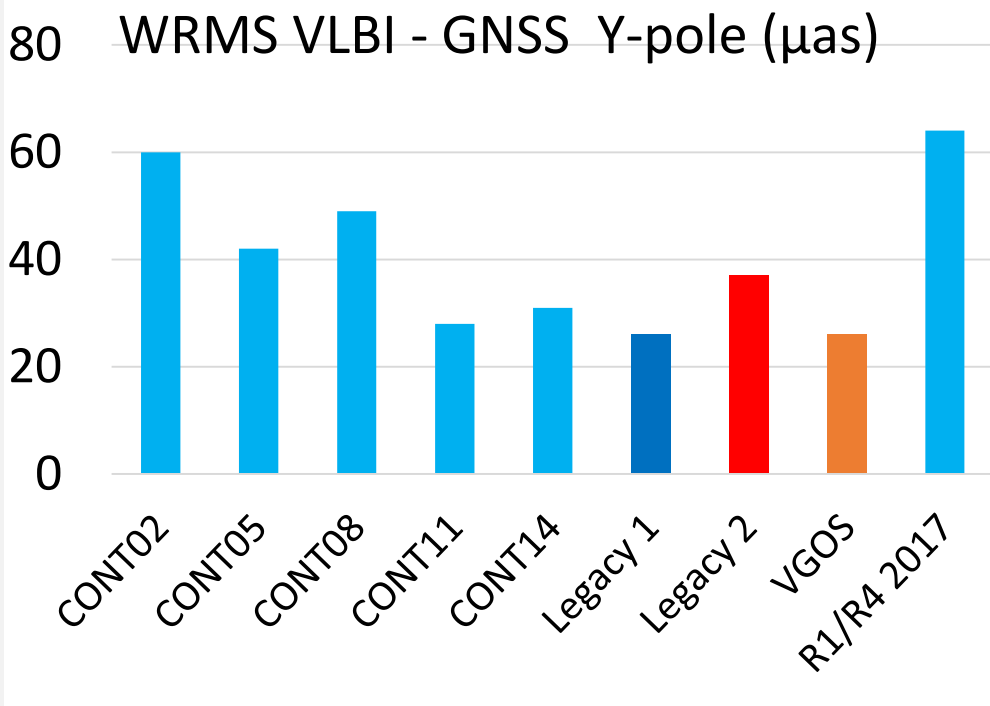
Legacy 1 comparable to CONT11.

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

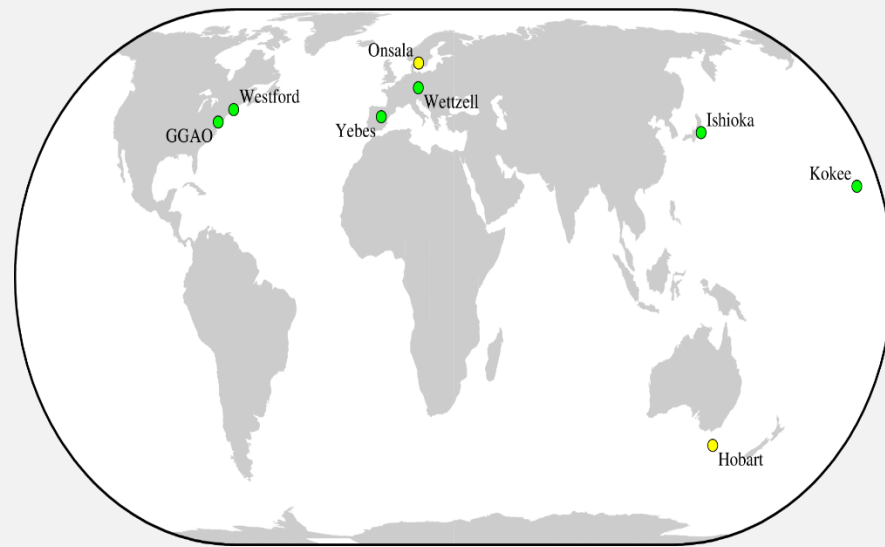
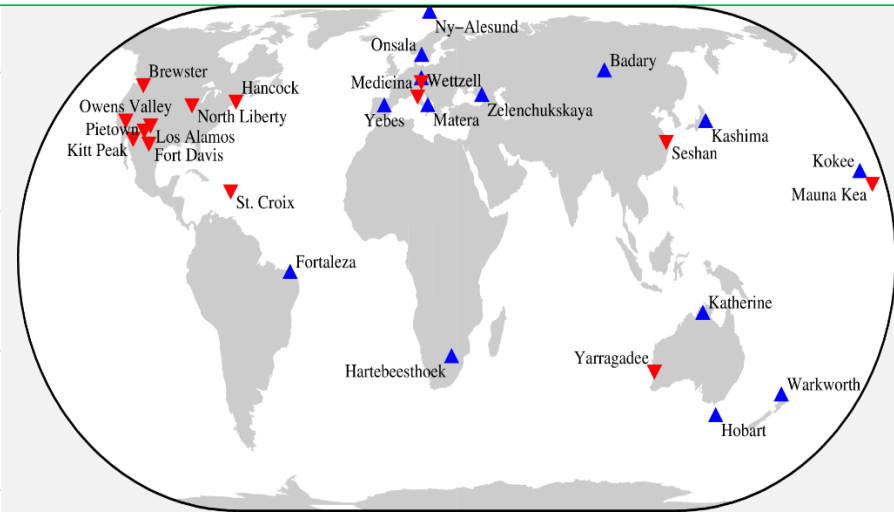
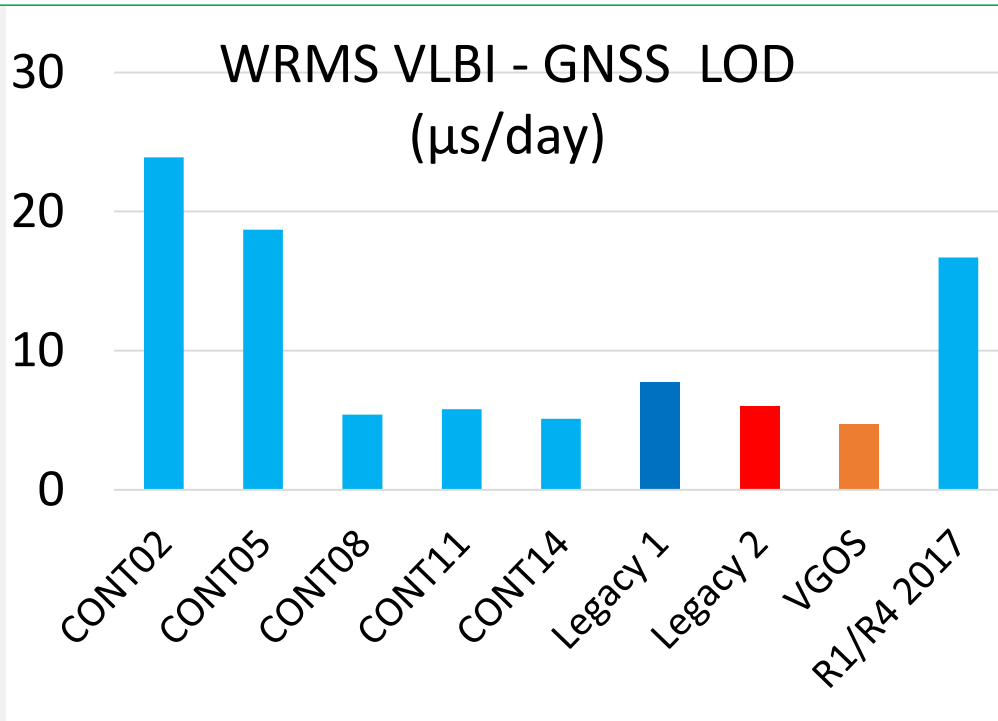


Legacy 1 and VGOS comparable to CONT11.

Legacy 2 hurt by limited N/S coverage

All are much better than R1/R4s.

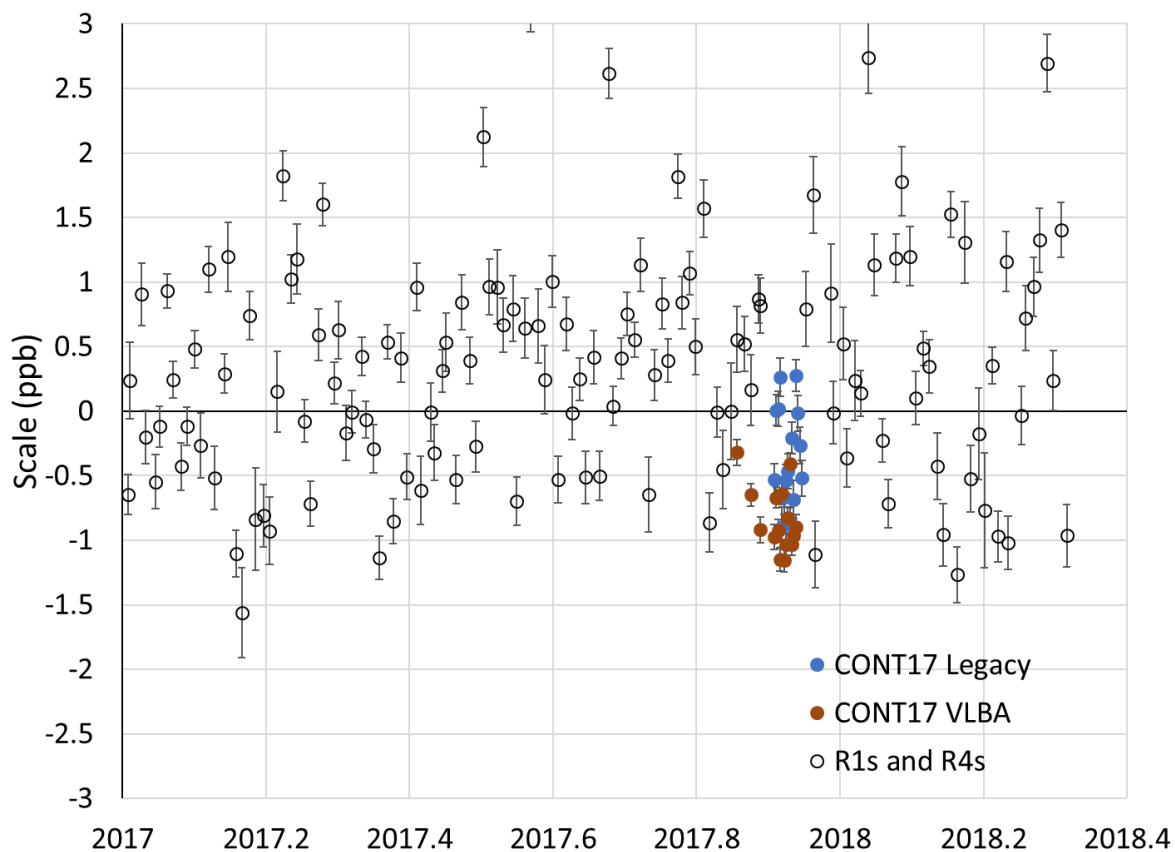
# WRMS VLBI-IGS PM



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

All much better than operational R1/R4s.

# VLBI Scale



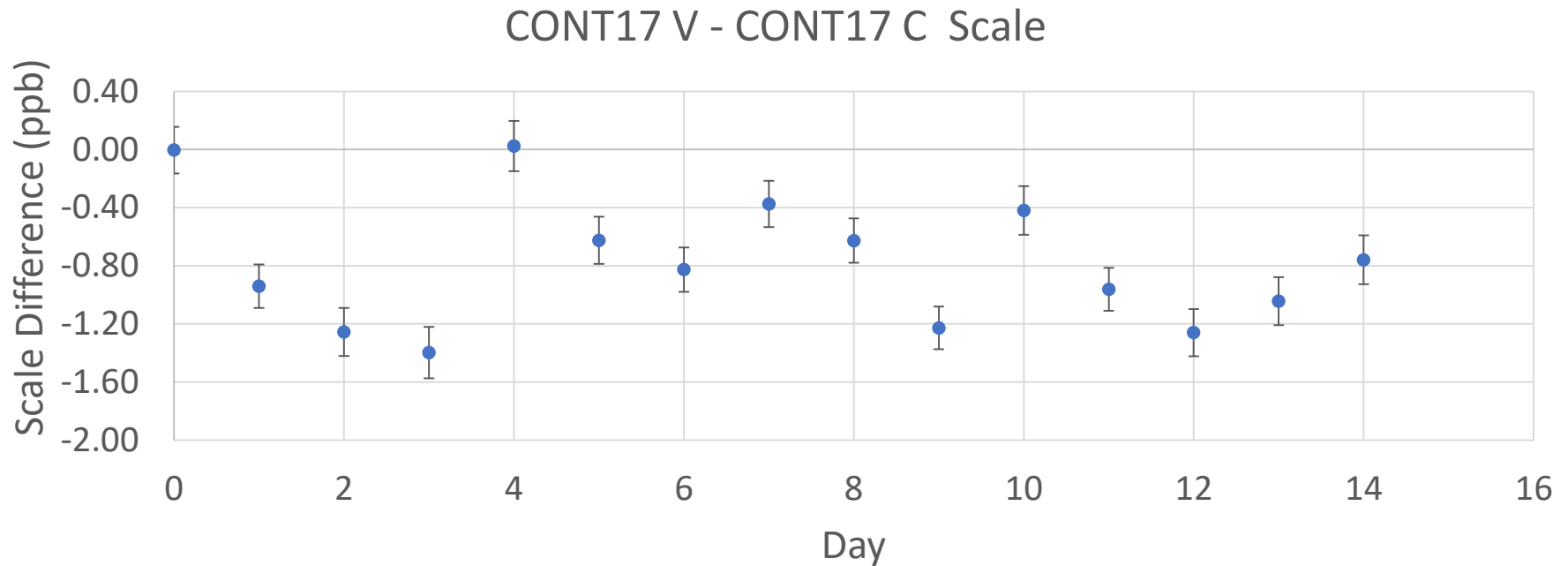
	WRMS	
	ppb	mm
CONT02	0.44	2.7
CONT05	0.30	2.0
CONT08	0.24	1.5
CONT11	0.32	2.0
CONT14	0.26	1.7
Legacy 1	0.38	2.4
Legacy 2	0.25	1.6
R1/R4 2017	0.83	5.3

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.



Avg. V-C difference = -0.78 ppb

Avg. sigma = 0.16 ppb

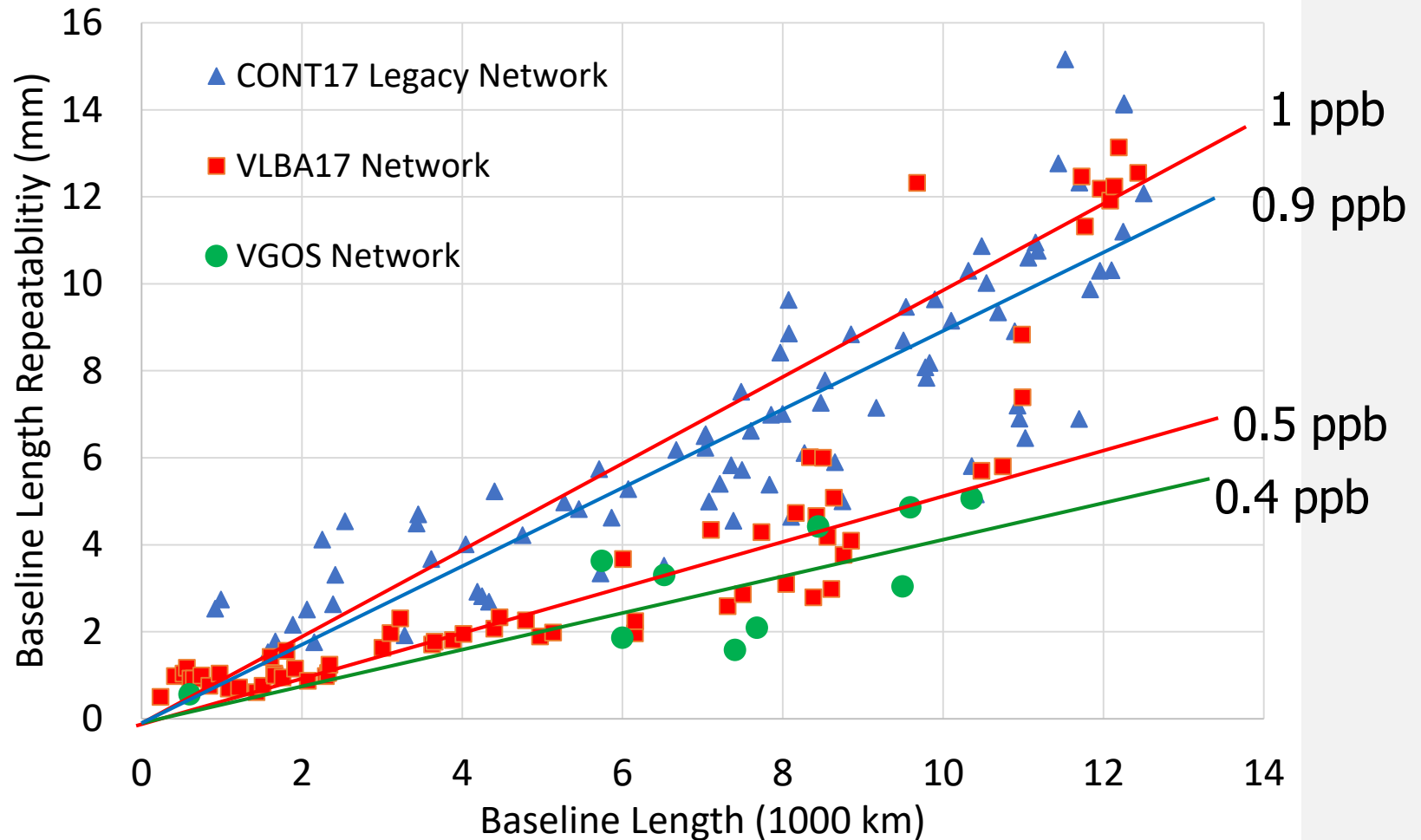
Stdev = 0.44 ppb

Stdev V = 0.25 ppb

Stdev C = 0.38 ppb

} Scale stability

# Baseline Length WRMS





# Conclusions (EOP)



- UT1 biases between the three networks are  $\sim 1.1-1.4 \mu\text{s} \sim 1 \text{ sigma}$
- Wrms differences  $\sim 1.5 \text{ sigma}$
  
- PMX and PMY biases and between Legacy networks are  $\sim 1 \text{ sigma}$
- Wrms differences also  $\sim 1 \text{ sigma}$
  
- 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
  - $\sim 0.4$  ppb VGOS network
  - $\sim 0.5$ - $0.9$  ppb Legacy 2 VLBA network
  - $\sim 0.9$  ppb Legacy 1 network
  - A larger VGOS network should increase station obs/hr and reduce the VGOS scatter
  
  - Wrms scatter of CONT17 legacy network scale series is in line with previous CONTs
  - Twice as good as R1s/R4s