Analysis of EOP and Scale from the Simultaneous CONT17 Networks

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

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

-11±12 µas
-108±24 µas

Lack of local ties between VGOS and X/S antennas?
Y-pole Differences

-17±23 µas
-19±13 µas
UT1 Differences

Correlator Station Offsets (Ed Himwich):

VGOS – Legacy1 = 1.0±0.10 µsec
VLBA- Legacy1 = -1.15±0.10 µsec

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
**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
Legacy 1 and VGOS comparable to CONT11.
Legacy 2 hurt by limited N/S coverage
All are much better than R1/R4s.
All CONT networks have generally comparable wrms agreement with GNSS as CONT11.

All much better than operational R1/R4s.
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

- CONT17 Legacy Network
- VLBA17 Network
- VGOS Network

Baseline Length (1000 km) vs. Baseline Length Repeatability (mm)

- 1 ppb
- 0.9 ppb
- 0.5 ppb
- 0.4 ppb
Conclusions (EOP)

- UT1 biases between the three networks are ~ 1.1-1.4 µs ~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 µas and 17 µas
  => Problem results from the lack of local ties between VGOS and X/S antennas
- Wrms differences ~ same as for Legacy differences
- Wrms agreement of legacy network PM with GNSS ~30-40 µas
- Twice as good as operational R1/R4 VLBI sessions
Conclusions (TRF)

- **Baseline length wrms scatter**
  - ~ 0.4 ppb VGOS network
  - ~ 0.5-0.9 ppb Legacy 2 VLBA network
  - ~ 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