Tropospheric Delay and Loss correction by Water Vapor Radiometer

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Thanks for our observations

VLBI observation of the M81 core with the CVN in X-band and the Pseudo-Closure Analysis

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CVN observation was published (2015.12)
KaVA data are being analyzed.

VLBI observations of a flared optical quasar CGRABS J0809+5341

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Published in the last week!
## Wet delay correction Tools

<table>
<thead>
<tr>
<th>Method</th>
<th>Time Scale</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS</td>
<td>300 seconds</td>
<td>Available all around the world (328 stations are registered.) Limited to the zenith direction Delay only</td>
</tr>
<tr>
<td>Ray Trace</td>
<td>3 hours</td>
<td>Available all around the world (241 stations are registered.) Omnidirectional Delay (and absorption)</td>
</tr>
<tr>
<td>Water Vapor Radiometer</td>
<td>10 seconds</td>
<td>No VLBI/WVR stations in Japan Omnidirectional Delay and Absorption Phase compensation</td>
</tr>
</tbody>
</table>
GPS EPL in Shanghai

A 70-mm change of excess path was observed on May 31, 2016.
Azimuth Dependence by Ray Trace

A 10-mm azimuth dependence was observed at 20-degree elevation.

North of Shanghai

May 31, 2016
Shanghai
(Shao1520
Archived by
Petrov)
Azimuth Dependence at El≈20deg

The 10mm change is disregarded in geodetic measurement by VLBI in which the zenith delay is corrected by GPS zenith delay.
Sub mm phase tracking by WVR

A WVR is possible to trace changes of excess path delay with an accuracy better than 1 mm.

Tahmoush and Rogers_2000
WVR in SHAO
GPS, Ray-trace and WVR delay

May 31, 2016

Tianma, Shanghai

Excess Path length (mm)

Time in CST (hour)

Cloudy

Rain
EPL measured on differential Tb

\[ EPL(\text{mm}) = 7.94 \times \Delta T_b(K) \]
A new receiver on Tianma 65m

We can clearly see the water vapor resonance on a signal received by new receiver.

By Li Bing
Absorption Correction

• SecZ method is introduced to VERA
  – At a start and an end of an observation
  – Note on the difference between KVN and VERA.

• Tsys*
  – At every scans
  – A hot load is the reference.
Troubles in Hot Load Calibration?

KaVA open-use observation on M81 (Kawaguchi, Jiang and Shen)

Email from Jiang Wu at 10:43 on September 21, 2016
Tsys* calculation by WX data for ISG

Ishigaki Tsys data on 2015/080 in LOG and CALC

Shambayati model_2008
Is humidity of ISG OK?

2015056.WS.ISG (KaVA Open-Use for YuZhu Cui)
Concluding Remarks

• SHAO WVR works well only at a fine weather, no cloud and no rain.

• A water vapor spectrometer shall be an important radiometer in future.
  – Phase compensation (VERA/KVN/CVN compatibility)
  – Absorption correction (no secZ)

• Ground weather data is useful to recover troubles on hot load calibration.
  – VERA humidity data reliable?