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IVS General Meeting

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Session 1

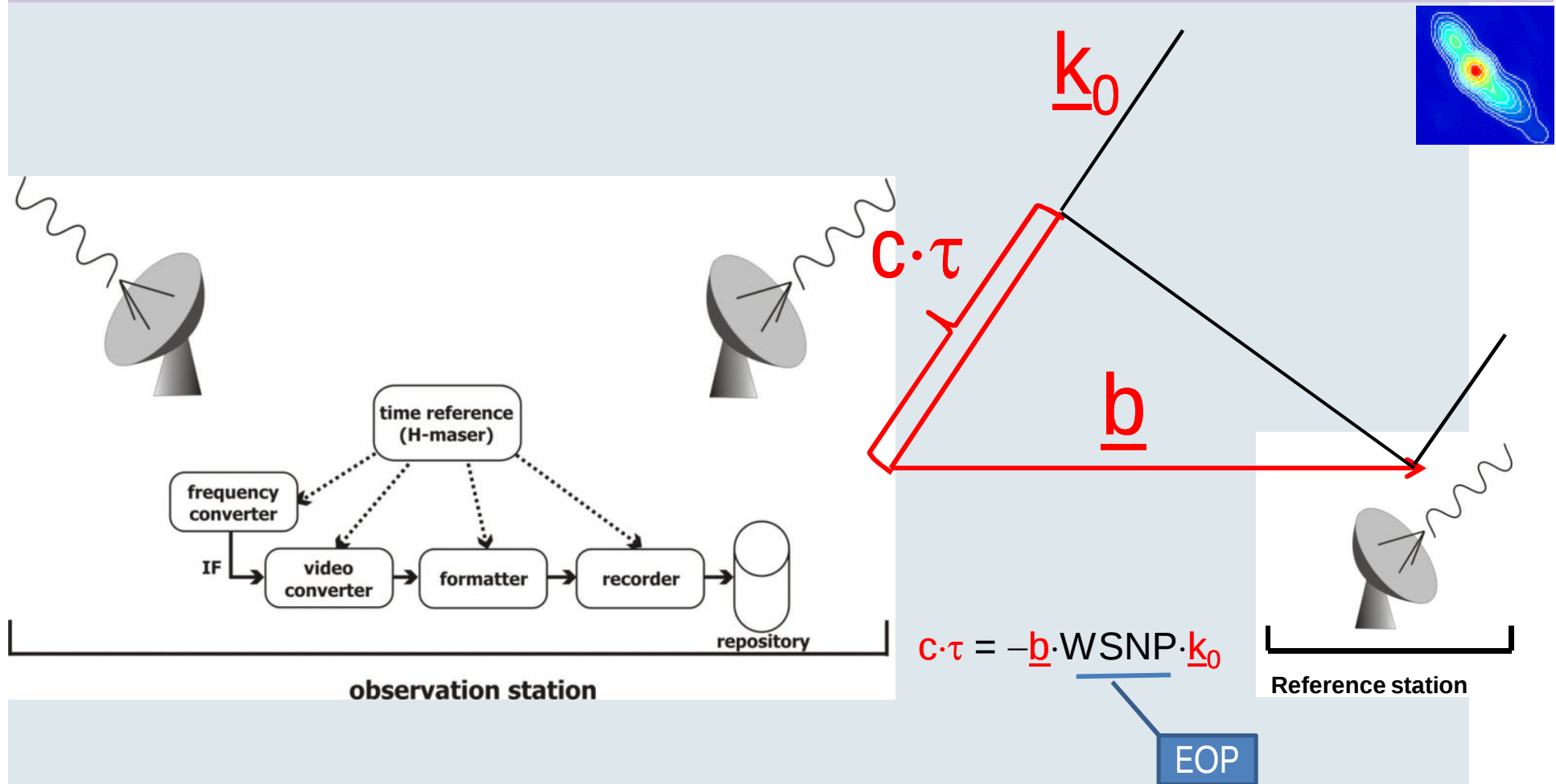
New observing strategies with twin telescopes for geodetic VLBI

Jing Sun

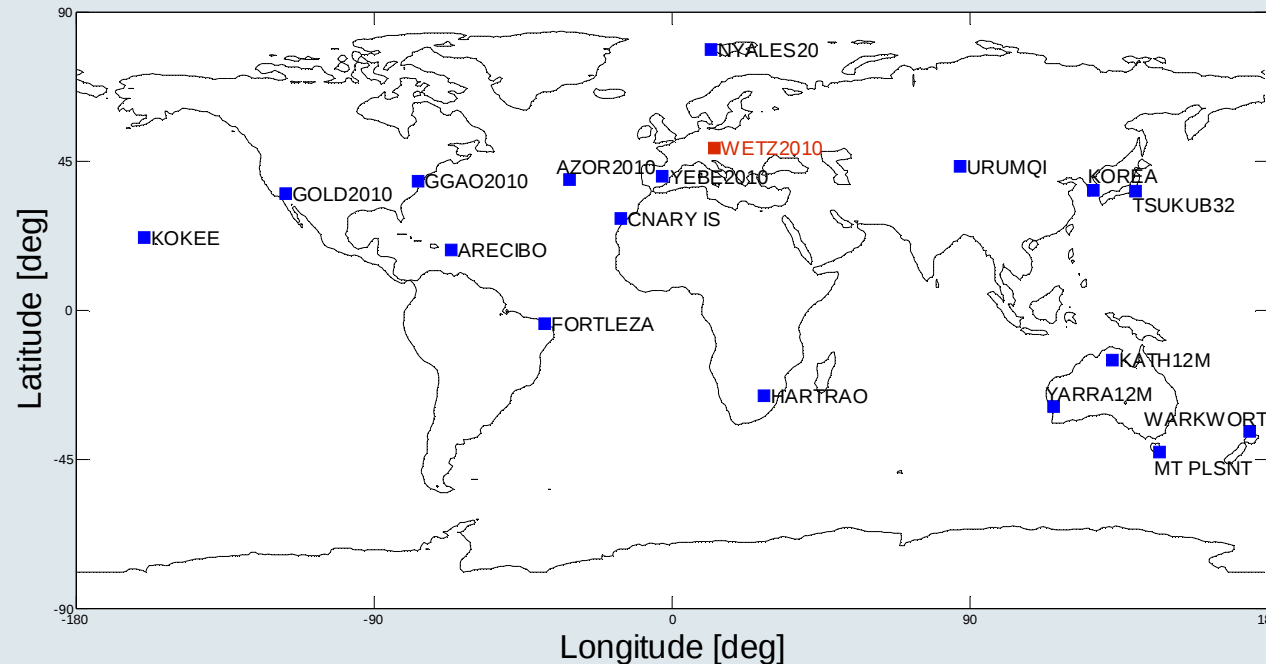
Tobias Nilsson, Johannes Böhm, Harald
Schuh

Advantages

- (1) Same troposphere above the twin telescopes
- (2) Same h-maser clock connecting them



Simulation parameters

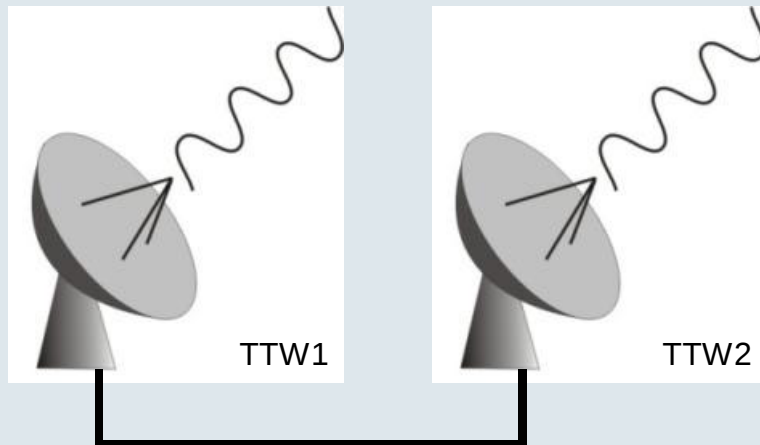


- interim network of **18 stations** with fast slewing antennas (az: **12 deg/s**, el: **6 deg/s**)
- twin telescopes at **WETZ2010** station
- source-based scheduling algorithm (**4 sources** observed simultaneously, **X/S Band**)
- $C_n = 1.0 \cdot 10^{-7} \text{ m}^{-1/3}$, $H = 2000 \text{ m}$, $v = 8.0 \text{ m/s}$ towards east, clock error is **1e-14 @ 50 min**, white noise of **4 ps** per baseline

Observing strategies(1)

(1) Same source observations

The twin telescopes point simultaneously to the same radio source.



- ✓ increase the sensitivity
- ✓ counteract the troposphere effect for calibration

$$SEFD = \frac{2 * k * T_{sys}}{A_{eff} * \eta}$$

SEFD	Antenna sensitivity
k	Boltzmann's constant
T_{sys}	System temperature
A_{eff}	Effective collecting area of the antenna
η	VLBI processing factor (0.5 - 1.0)

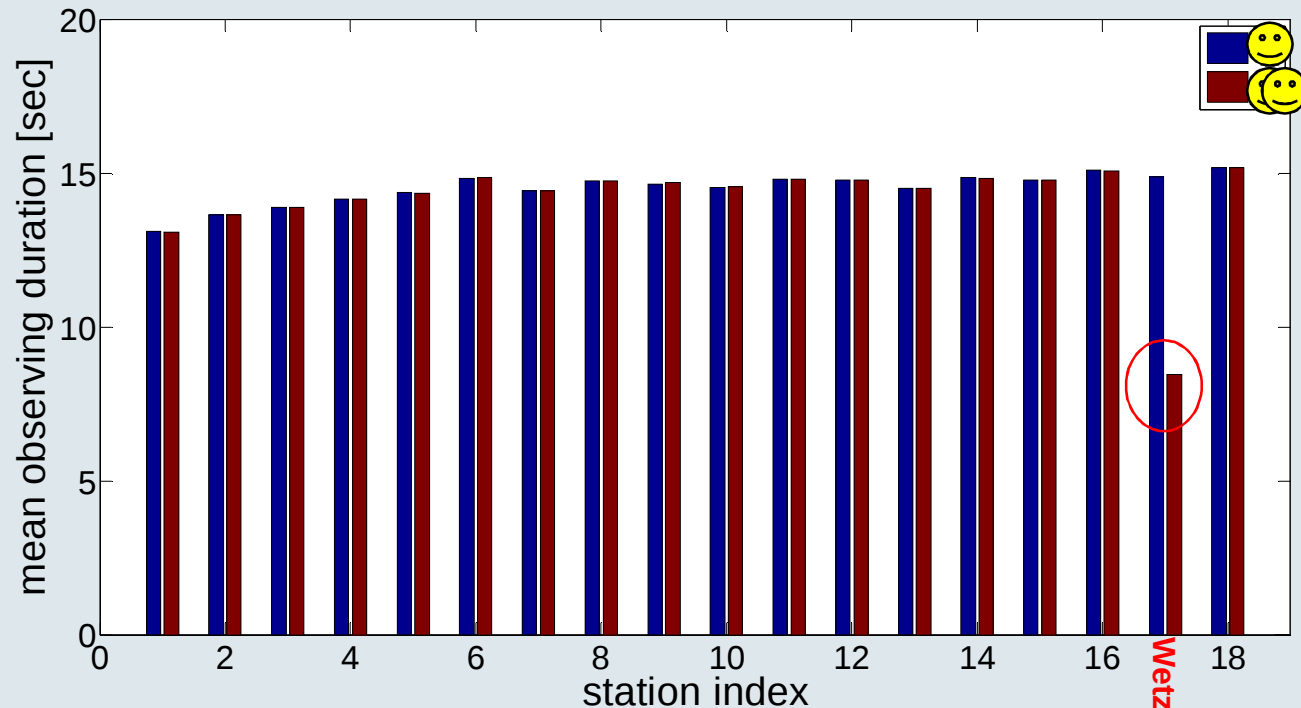
$$\text{duration} = \left(\frac{\text{SNR} * 1.75}{F} \right)^2 * \left(\frac{\text{SEFD}_1 + \text{SEFD}_2}{\text{rate} * \# \text{channels}} \right)$$

One observation:

$$c \cdot \tau = -\underline{b} \cdot \text{WSNP} \cdot \underline{k}_0 + [\text{wzd}_{12} * \text{mfw}_{12} + \text{clk}_{12}] - [\text{wzd}_r * \text{mfw}_r + \text{clk}_r] + \text{wn}_{\text{bl12r}}$$

Observing strategies(1)

(1) Same source observations



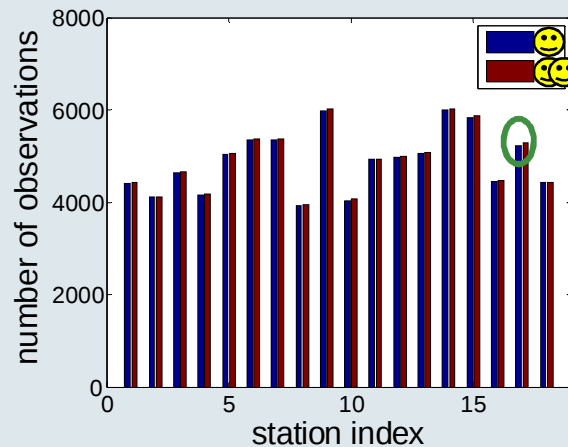
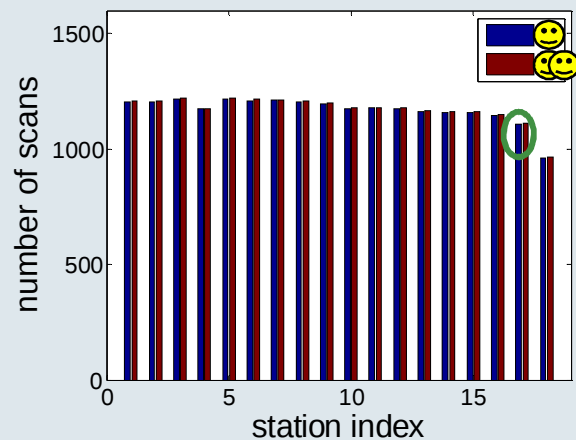
Latitude

😊 : One telescope at WETZ2010

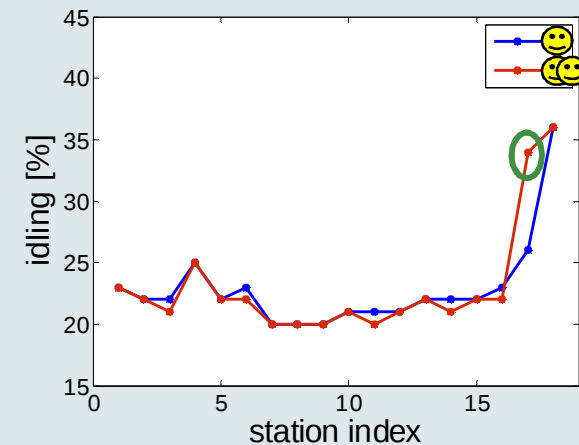
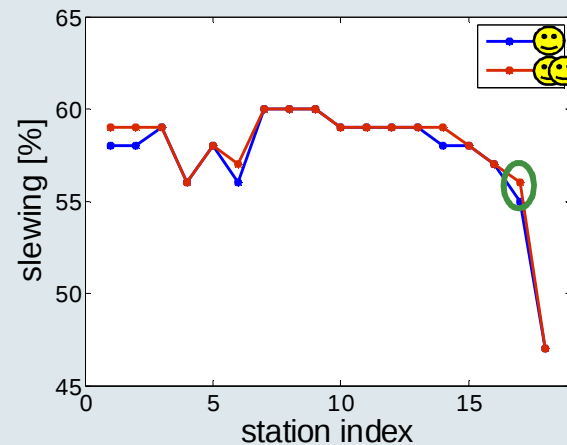
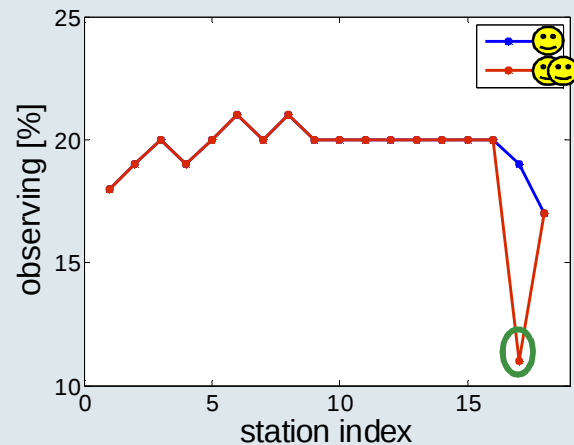
😊😊 : Twin telescopes at WETZ2010

Observing strategies(1)

(1) Same source observations



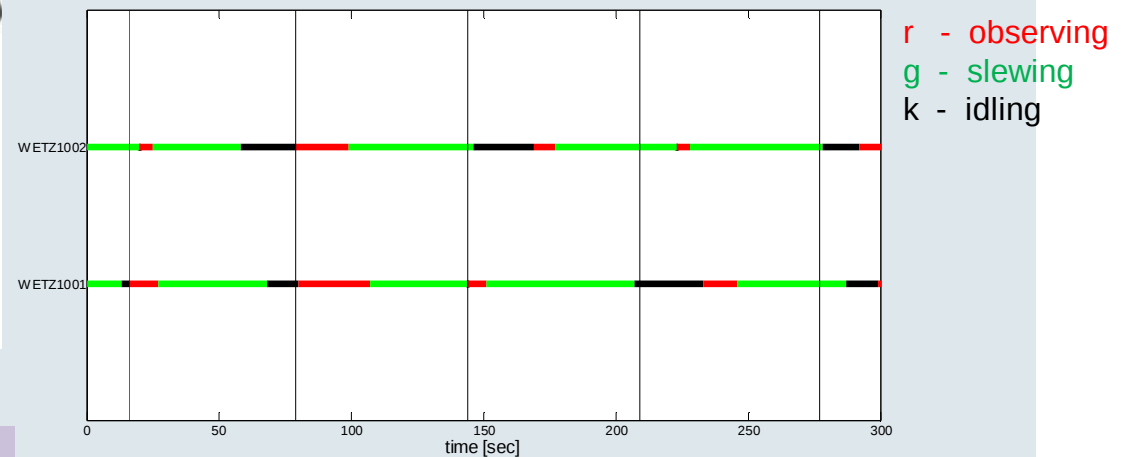
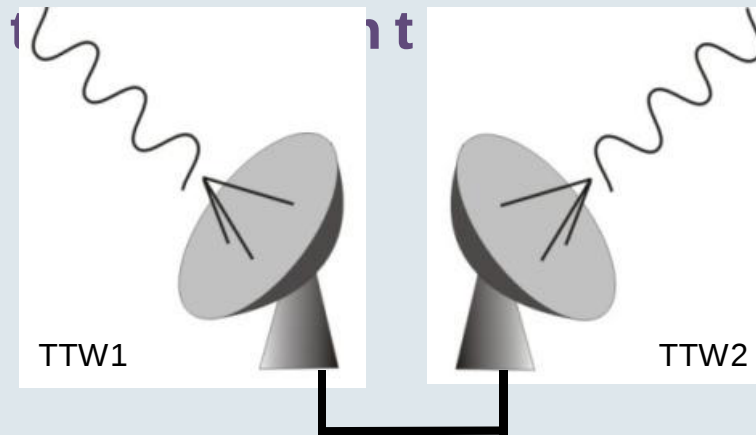
- Similar number of obs
- Less observing
- More idling (Waiting for other stations to start the scan)



Observing strategies(2)

(2) Multidirectional observations

The antennas are observing separately in different directions



- ✓ get more observations
- ✓ strengthen the geometry

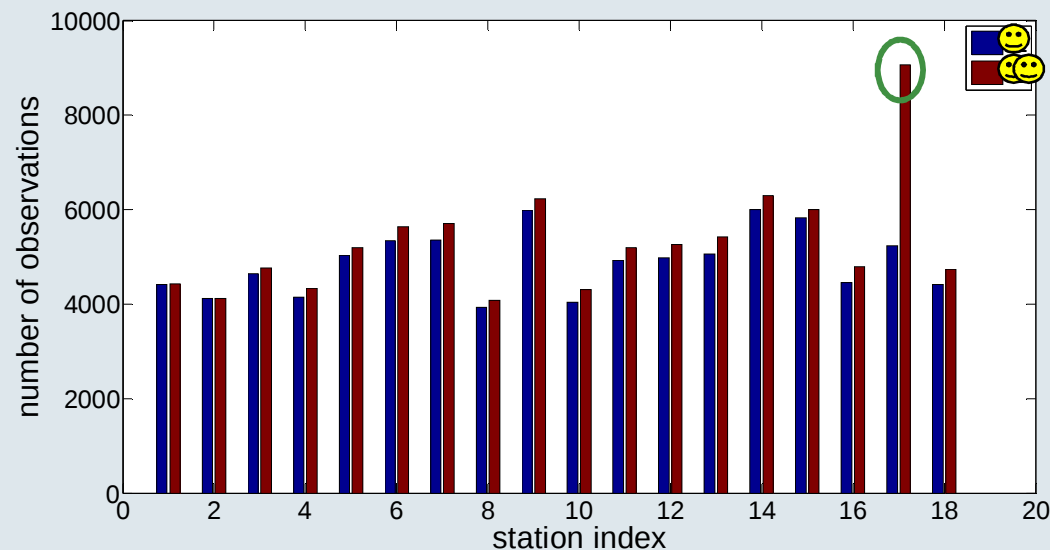
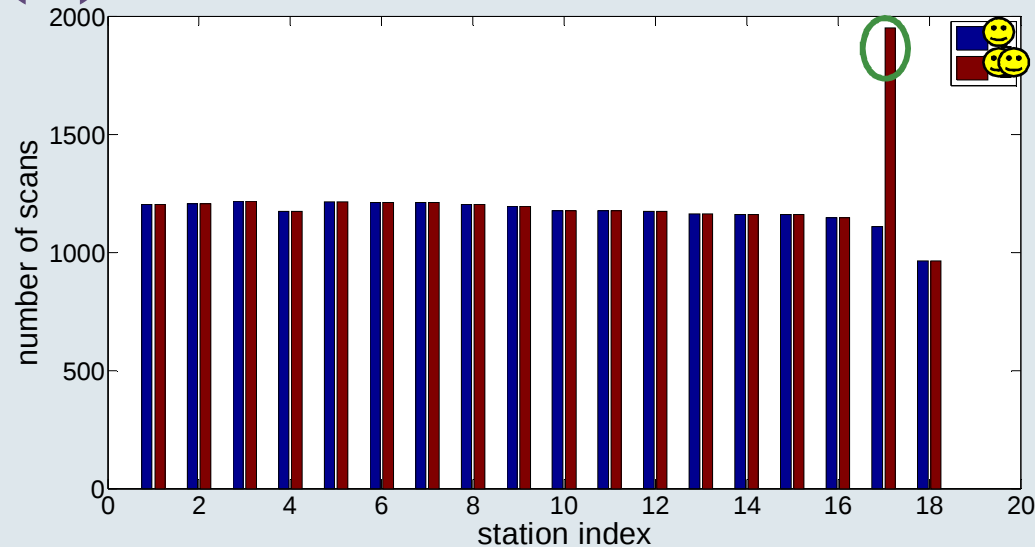
Two observations:

$$c \cdot \tau_1 = -\underline{b} \cdot \text{WSNP} \cdot \underline{k}_0 + [\underline{wzd}_{12} * \underline{mfw}_1 + \underline{clk}_{12}] - [\underline{wzd}_{ra} * \underline{mfw}_{ra} + \underline{clk}_{ra}] + \underline{wn}_{bl1ra}$$

$$c \cdot \tau_2 = -\underline{b} \cdot \text{WSNP} \cdot \underline{k}_0 + [\underline{wzd}_{12} * \underline{mfw}_2 + \underline{clk}_{12}] - [\underline{wzd}_{rb} * \underline{mfw}_{rb} + \underline{clk}_{rb}] + \underline{wn}_{bl2rb}$$

Observing strategies(2)

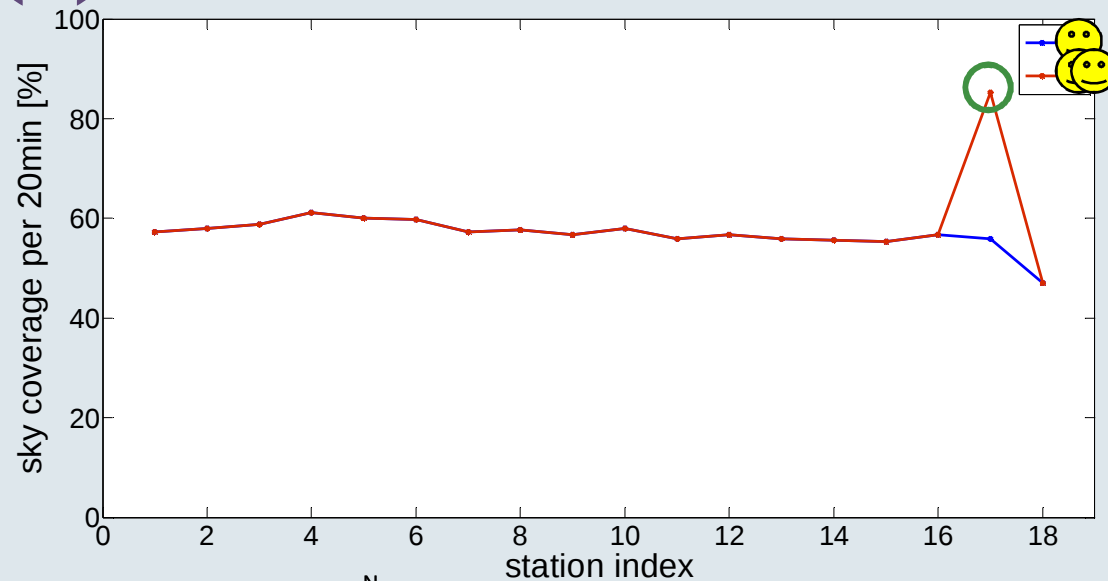
(2) Multidirectional observations



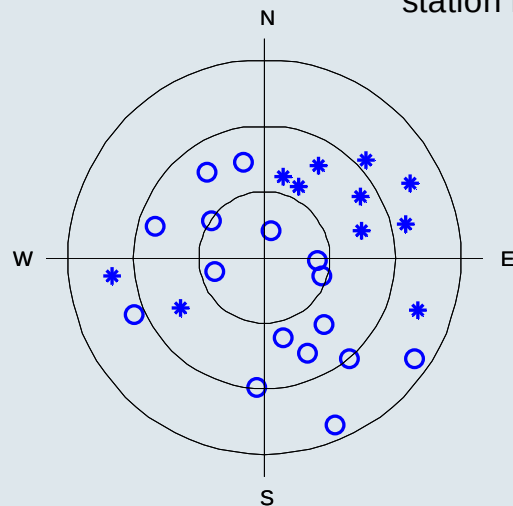
– Double observations at WETZ2010 station

Observing strategies(2)

(2) Multidirectional observations



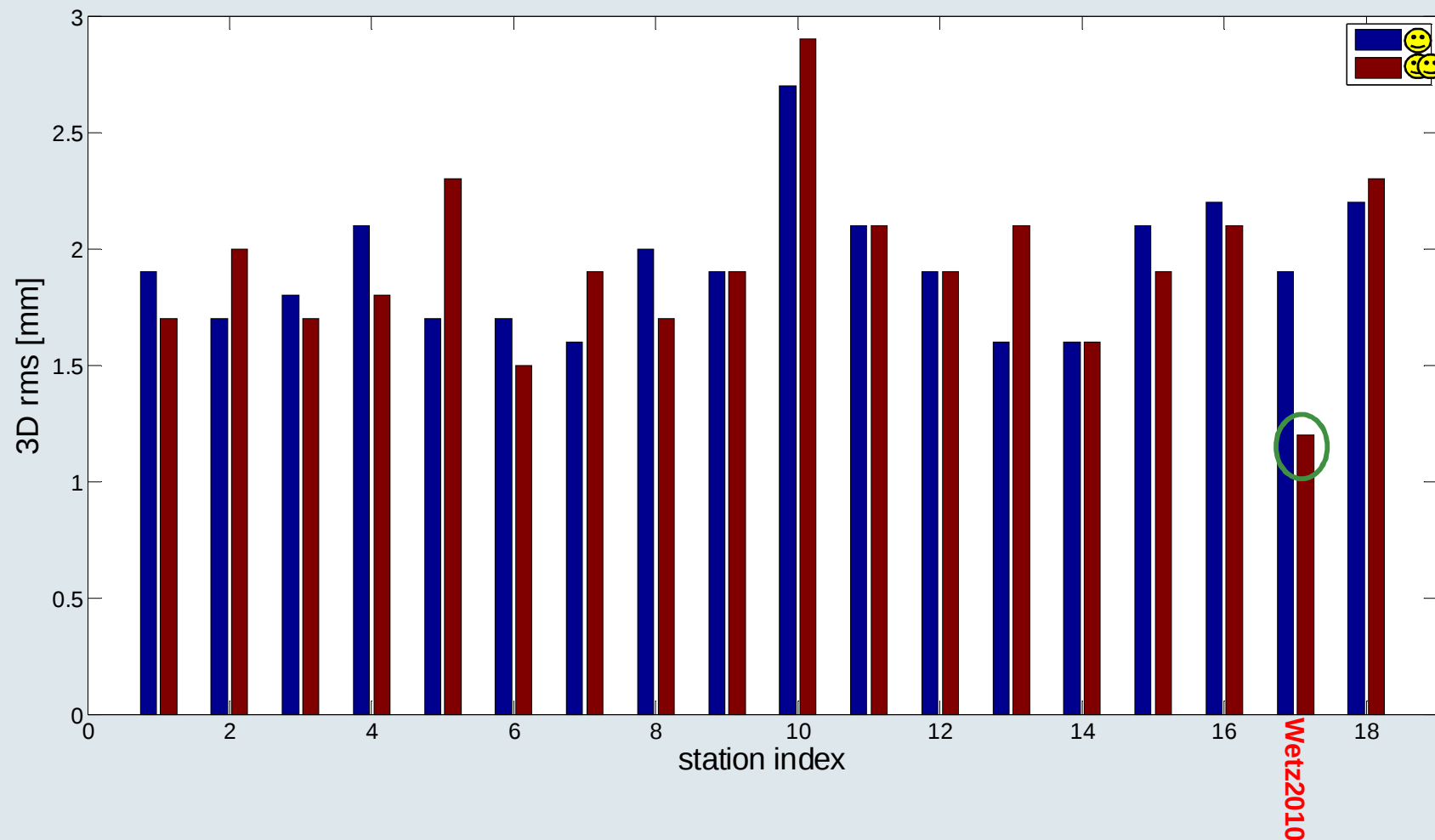
– Better sky coverage at
WETZ2010 station



○ : WETZ2010 - 1
* : WETZ2010 - 2

Observing strategies(2)

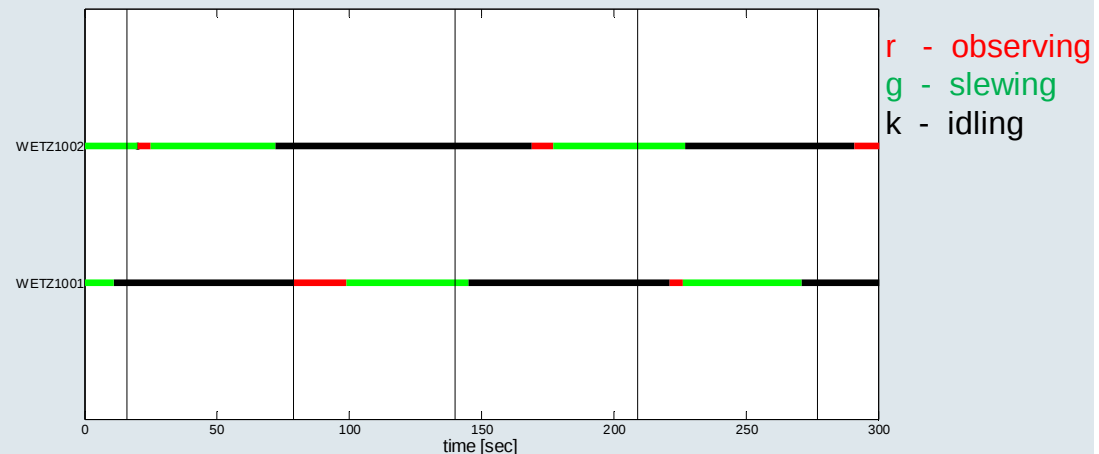
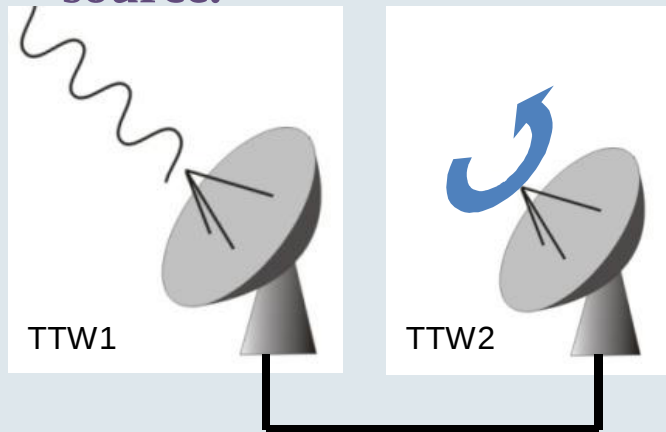
(2) Multidirectional observations



Observing strategies(3)

(3) Continuous observations

While one antenna is observing the other antenna is moving to the next radio source.



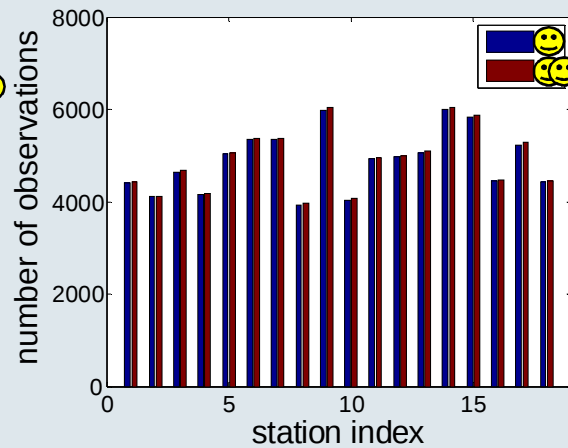
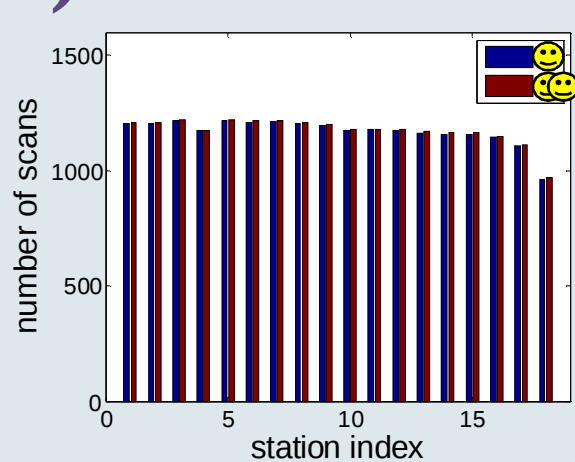
✓ continuous observations, without any temporal gaps

One observation:

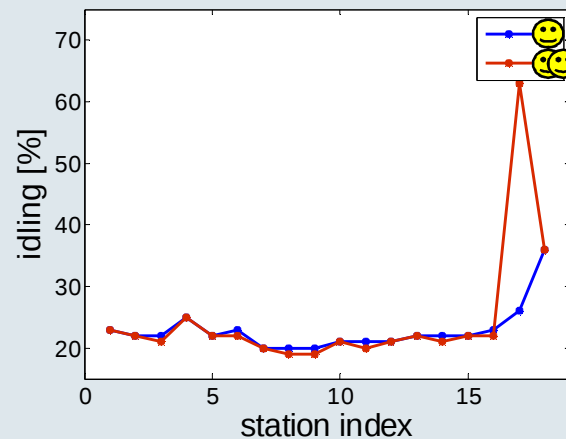
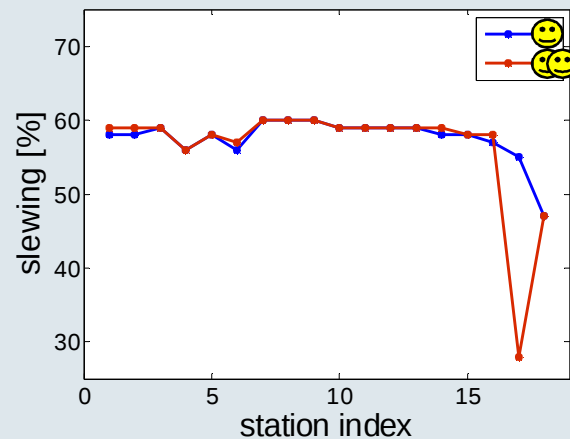
$$c \cdot \tau_1 = -\underline{b} \cdot \text{WSNP} \cdot \underline{k}_0 + [\text{wzd}_1 \cdot \text{mfw}_1 + \text{clk}_1] - [\text{wzd}_r \cdot \text{mfw}_r + \text{clk}_r] + \text{wn}_{\text{bl}1r}$$

Observing strategies(3)

(3) Continuous observations



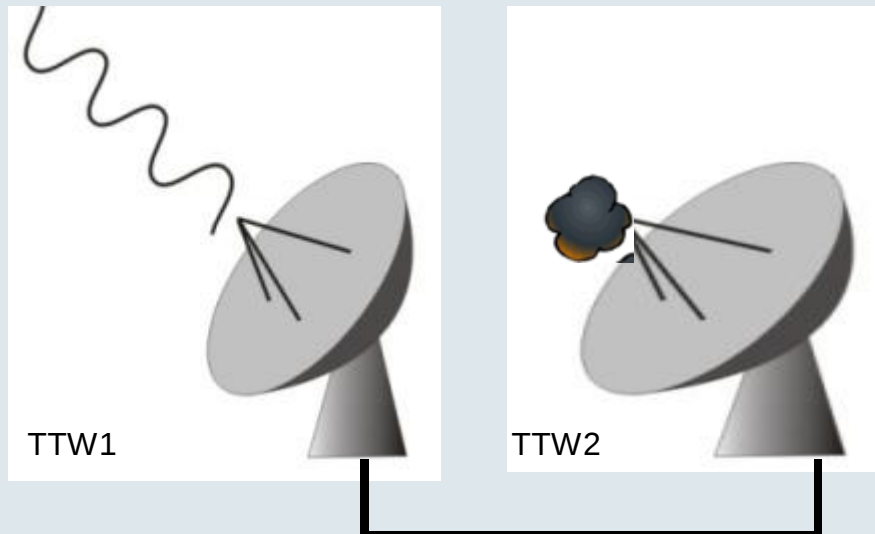
- Similar number of obs
- Less slewing
- More idling (Waiting for other stations to start the scan)



Observing strategies(4)

(4) Maintenance

While one antenna is not able to observe due to maintenance work, the other antenna can observe in a stand-alone mode and provide VLBI data at the site.



✓ full availability

Ongoing and planned work

- o More considerations will be included in scheduling:
 - (1) **More twin telescopes** in the network
 - (2) **Three telescopes** at one site
- o Implement **differential delay observables** to VieVS
- o ...

- **‘Multidirectional observations’** mode improve the sky coverage greatly (**53.4%**), then the station position repeatability is improved correspondingly (**22.2%**).
- For the **‘Same source observations’** mode and **‘Continuous observations’** mode, there is hardly any improvement except double differences will be used. In case of more twin telescopes, these two strategies will be more beneficial.

THE EN

Thank you for listening

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