



VIENNA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF GEODESY  
AND GEOINFORMATION

7<sup>th</sup> VieVS User Workshop 2016, Sept. 14-15, Vienna, Austria

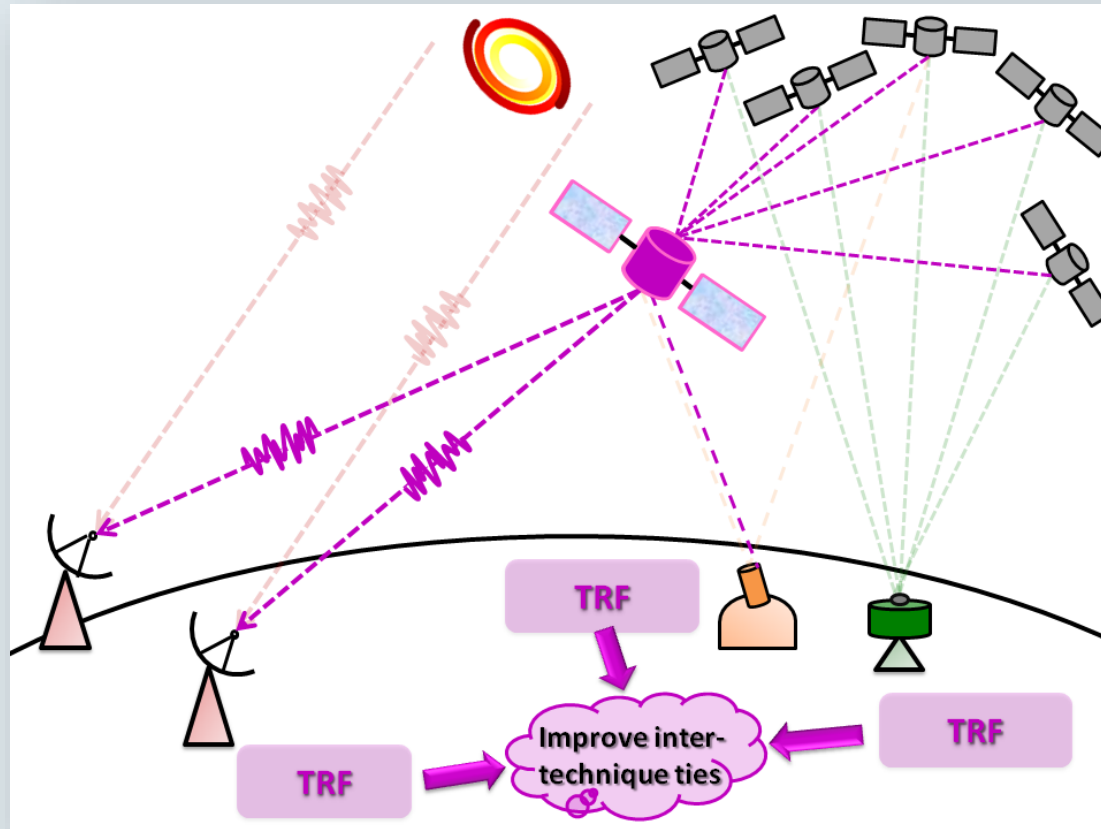
# Scheduling of VLBI observations to satellites with VieVS

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# VLBI satellite observations

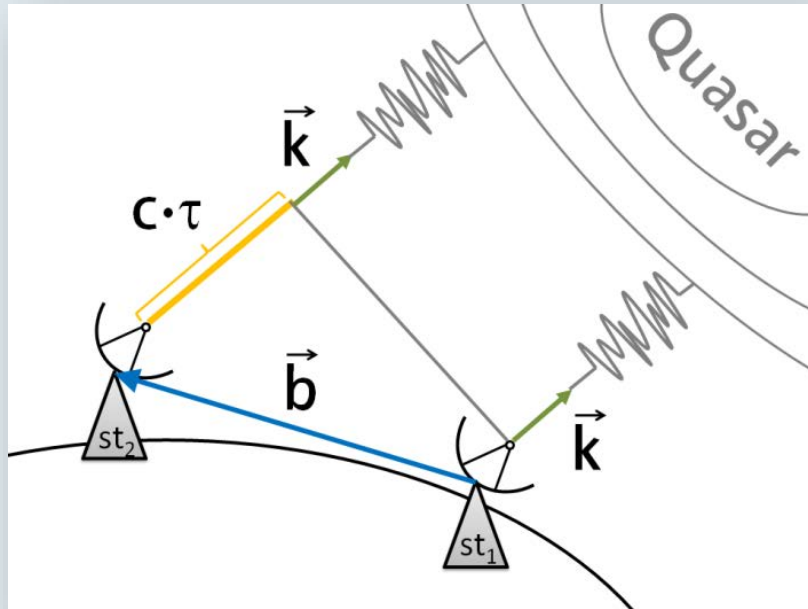
- Motivation
  - Establish inter-technique ties in space
  - Improved future ITRF realizations



„Co-Location in space“ (Plank L, 2014)

# Framework conditions

## Standard VLBI

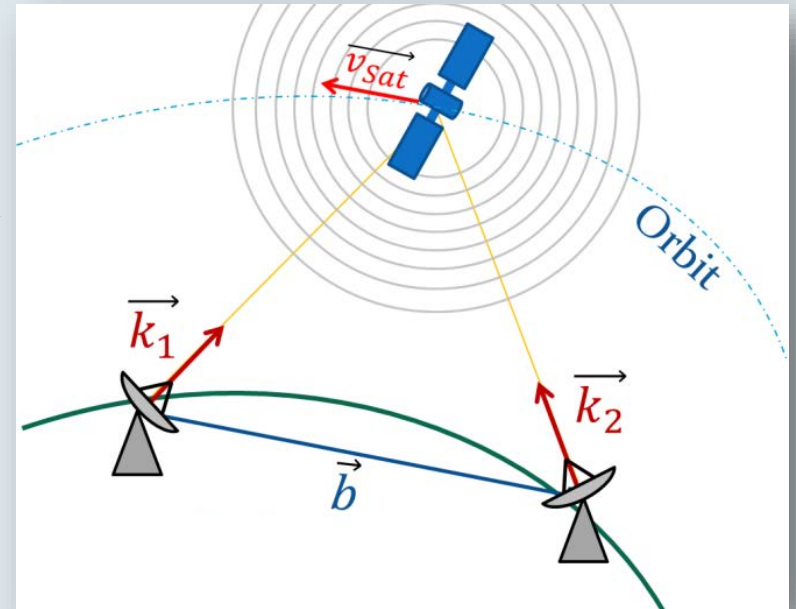


### Natural radio sources (quasars)

- At an infinite distance
- Parallel view directions  $\vec{k}$
- Fixed points in the sky
- S/X-band



## Satellite observations



### Artificial signal sources

- In the Earth's near field
- Different view directions ( $\vec{k}_1 \neq \vec{k}_2$ )
- Moving fast
- e.g. L-band for GNSS

- Suitable observation plans („**Schedules**“) are required
  - Defining the time sequence of a VLBI experiment
  - Generated by dedicated VLBI scheduling software
    - SKED (*Gipson J, 2012*)
    - VIE\_SCHED (*Sun J, 2014*)

→ **Problem:** Available scheduling programs for geodetic VLBI did not support satellites as radio sources routinely.

→ **Idea:** Development of a **satellite scheduling module** for the Vienna VLBI Software (VieVS; *Böhm et al., 2012*).



# VieVS satellite scheduling module

**Station network**

**Satellites**

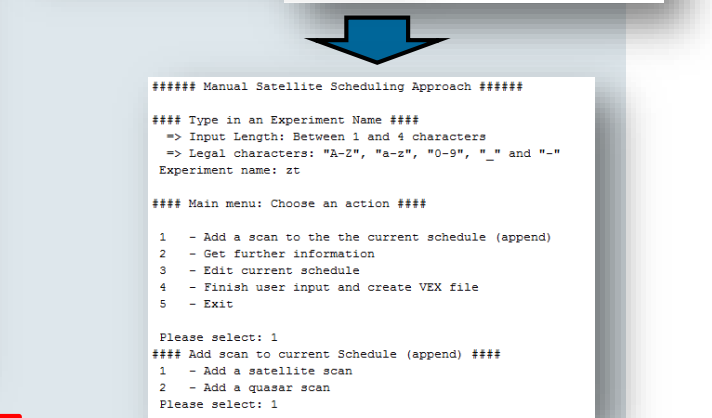
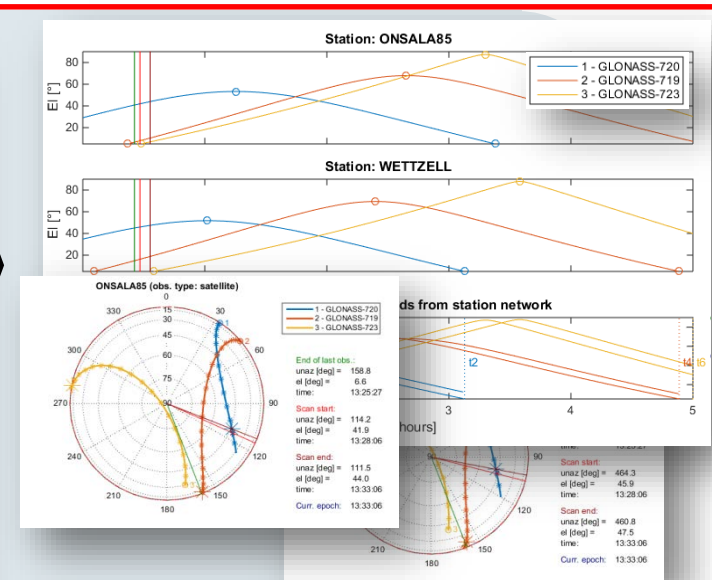
**Observation Time & parameter**

**Graphics & Visibility information**

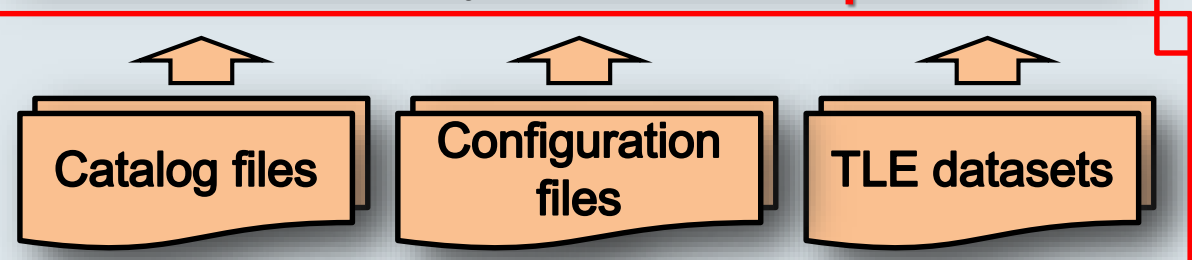
**User-interface**

**Input data**

The screenshot shows the Vienna VLBI Software 2.3 interface. The 'Station network' panel lists available stations like GBT\_VLBA and selected stations ONSALA85 and WETTZELL. The 'Satellites' panel shows a list of GLONASS satellites with selected ones GLONASS-719, 720, and 723. The 'Parameters' section includes 'Sundist' (4 deg), 'Cut-off el' (5 deg), and 'Source flux' (0.25 Jy). The 'Time options' section shows a start time of 13:00:00. The 'Strategy' section has 'Satellite observations' selected. The 'User-interface' section includes buttons for 'Load new catalogs', 'Load SCHED parameters', 'Save SCHED parameters', 'Save runp', and 'Save + Run'.



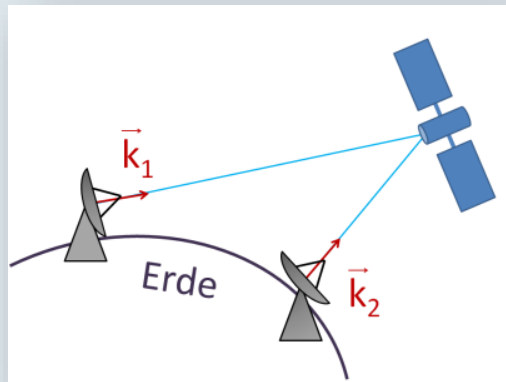
**Generation of VEX files**



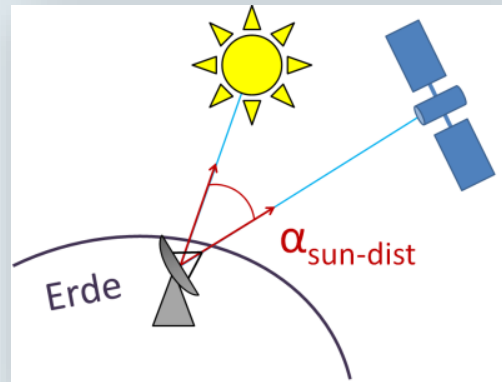
# Satellite observation conditions

- Conditions for the temporal availability of satellites as observation targets:

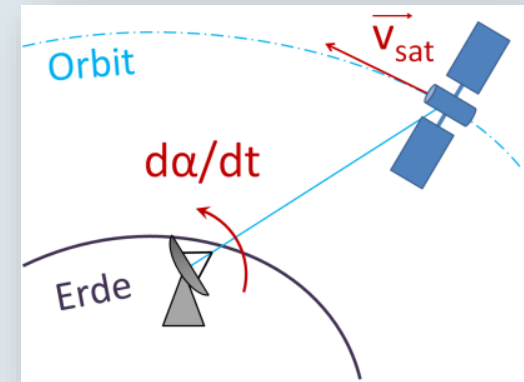
Common visibility?



Sun distance?



Antenna slew speeds?



- Tracking of the **cable wrap**
  - ➔ Calculation of slew times between scans
  - ➔ Check cable wrap limits

- **Combination of quasar- and satellite-scans** in one schedule

## 1. Manual mode

- Manual source selection
- Schedule is assembled scan by scan
- Automatic calculation of scan starts/end
- Good for short test sessions

## 2. Automatic mode (NEW!!)

- Station-based scheduling approach with sky coverage optimization at each site
- Good for longer sessions and the integration of satellite scans in a geodetic schedule

## Scenario:

- **Station network:** WETTZELL, ONSALA85
- **Date/time:** 2016-09-15, 20:00 – 22:00 UT
- **Scans:**
  - 1.) Quasar (calibrator)
  - 2.) GPS satellite (10 min track)
  - 3.) Quasar (calibrator)



# Questions?

## Contact:

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## References:

- Böhm J et al. (2012)**, The New Vienna VLBI Software, Proceedings of the 2009 IAG Symposium, Buenos Aires, Argentina, 31 August 2009 - 4 September 2009, Series: International Association of Geodesy Symposia, Vol. 136, Kenyon S, Pacino MC, and Marti U (eds.), ISBN 978-3-642-20337-4, pp. 1007-1012.
- Gipson J (2012)**, SKED – VLBI Scheduling Software, program manual, NASA Goddard Space Flight Center
- Hellerschmied et al. (2014)**, Observing satellites with VLBI radio telescopes – practical realization at Wettzell, 8th IVS General Meeting, Shanghai, March 2014.
- Plank L (2014)**, Precise station positions from VLBI observations to satellites: a simulation study, J Geod, 88: 659–673.
- Sun J et al. (2014)**, New VLBI2010 scheduling strategies and implications on the terrestrial reference frame, J Geod, 88: 449-461