TU WIEN VieVS

Vienna VLBI and Satellite Software

Scheduling Geodetic VLBI using VieVS

Matthias Schartner[a]

[a]TU Wien, Department of Geodesy and Geoinformation

What is a schedule?

A schedule is basically the observing plan of a session.
It determines which station should observe which source at which time.

- What do we need?
  - parameters which describe the antenna and recording hardware
  - parameters which describe the sources
  - parameters which describe the setup of the experiment

  → all information are saved in the so called sked-CATALOG files
- What else?
  - scheduling logic
  - rules
  - models...

Geodetic VLBI Scheduling — Definitions

scan: a time period during which multiple stations observe the same source simultaneously

observation: a single baseline during a scan. $n_{obs} = \frac{n_{sta} \cdot (n_{sta}-1)}{2}$ ($n_{sta} = 5 \rightarrow n_{obs} = 10$)

subnet: a subset of all available stations that observe one source simultaneously

Example:

6 stations: $\underbrace{4 \text{ stations}}_{\text{subnet 1}}$ scan source 1, $\underbrace{2 \text{ stations}}_{\text{subnet 2}}$ scan source 2

Geodetic VLBI Scheduling

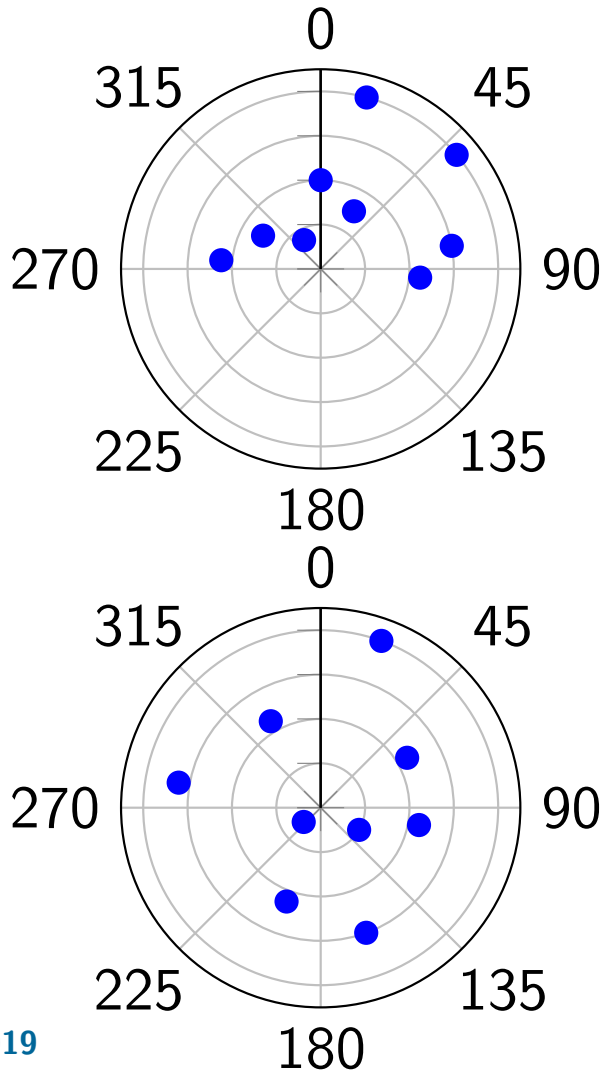
Catalogues

Catalogues store necessary information about antennas, sources and observing modes

- sources
  - source.cat
  - flux.cat
- antennas
  - antenna.cat
  - positon.cat
  - equip.cat
  - mask.cat
- observing modes
  - modes.cat
  - freq.cat
  - rx.cat
  - ...

Strategies

- maximize number of observations
  - redundancy
- maximiye sky coverage
  - troposphere is biggest error source
  - troposphere can be better estimated, if you have observations in every direction
  - $\rightarrow$ you are optimizing distribution of observed sources over each station (sky coverage)
  - one or two sources simultaneously



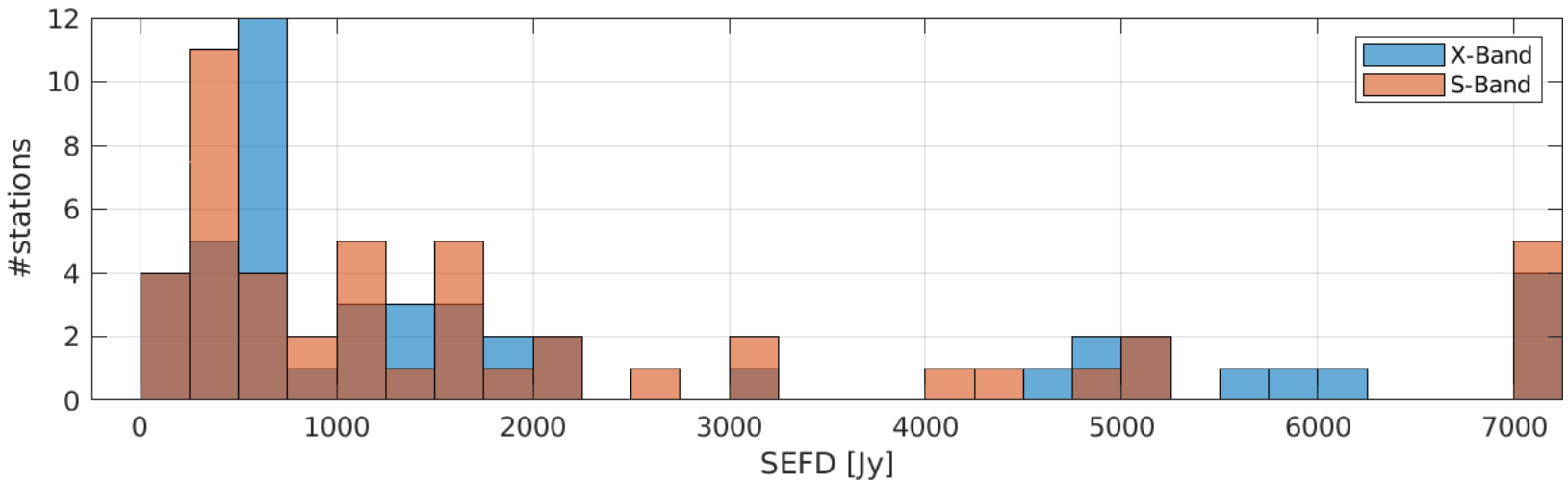
General

- different visibilities at different antenna
- different antenna slew time
- $\rightarrow$ every antenna could start/stop at different times
- scan start is the same $\rightarrow$ stations are idling before or after scan
- sometimes stations are not participating in the next scan
- every baseline (2 stations) has different scan length:

$$T = \left(\frac{SNR}{\eta F}\right)^2 \cdot \left(\frac{SEFD_1 \cdot SEFD_2}{rec}\right) + corsynch$$

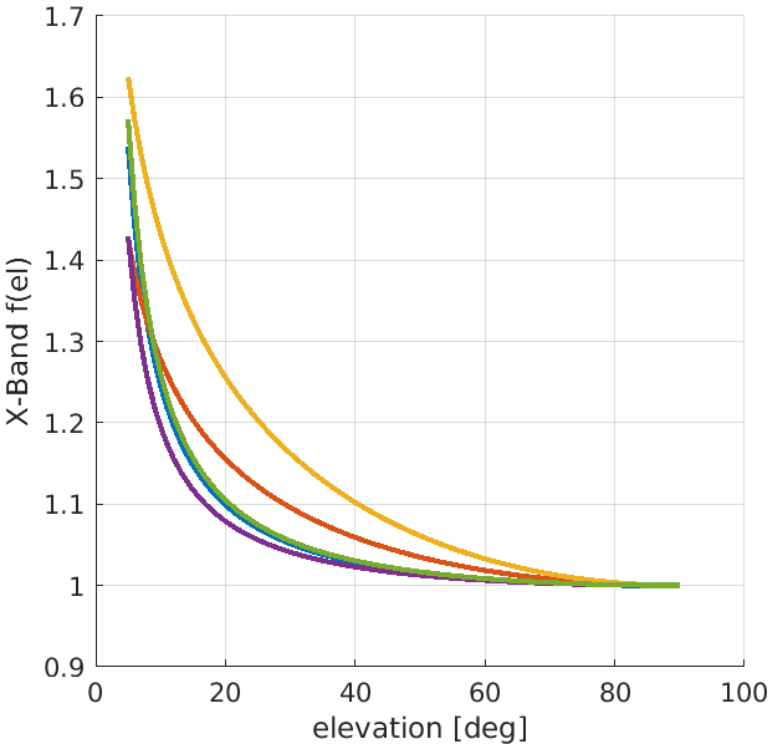
Station sensitivity

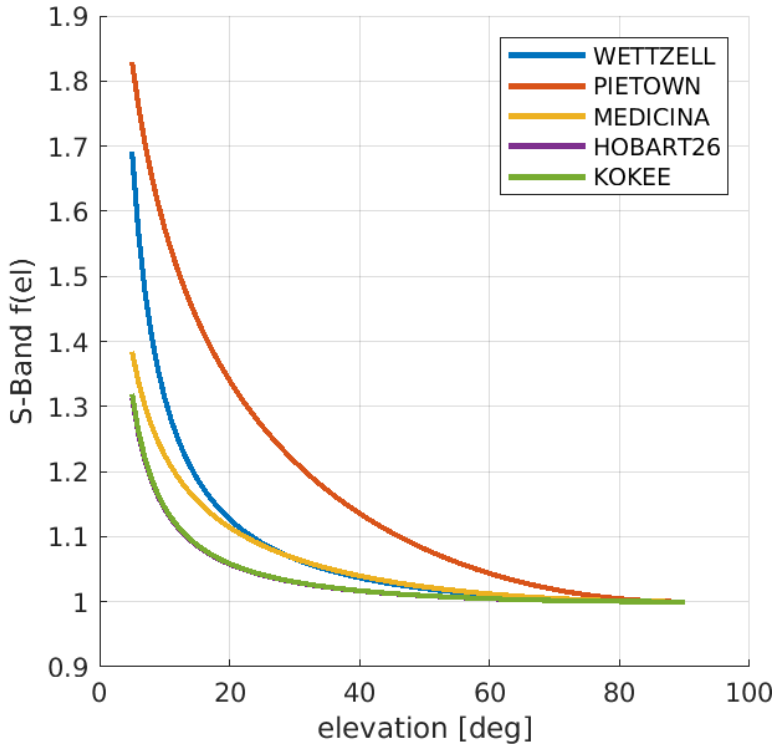
$$T = \left(\frac{SNR}{\eta F}\right)^2 \cdot \left(\frac{\mathbf{SEFD_1 \cdot SEFD_2}}{rec}\right) + corsynch$$



Station sensitivity

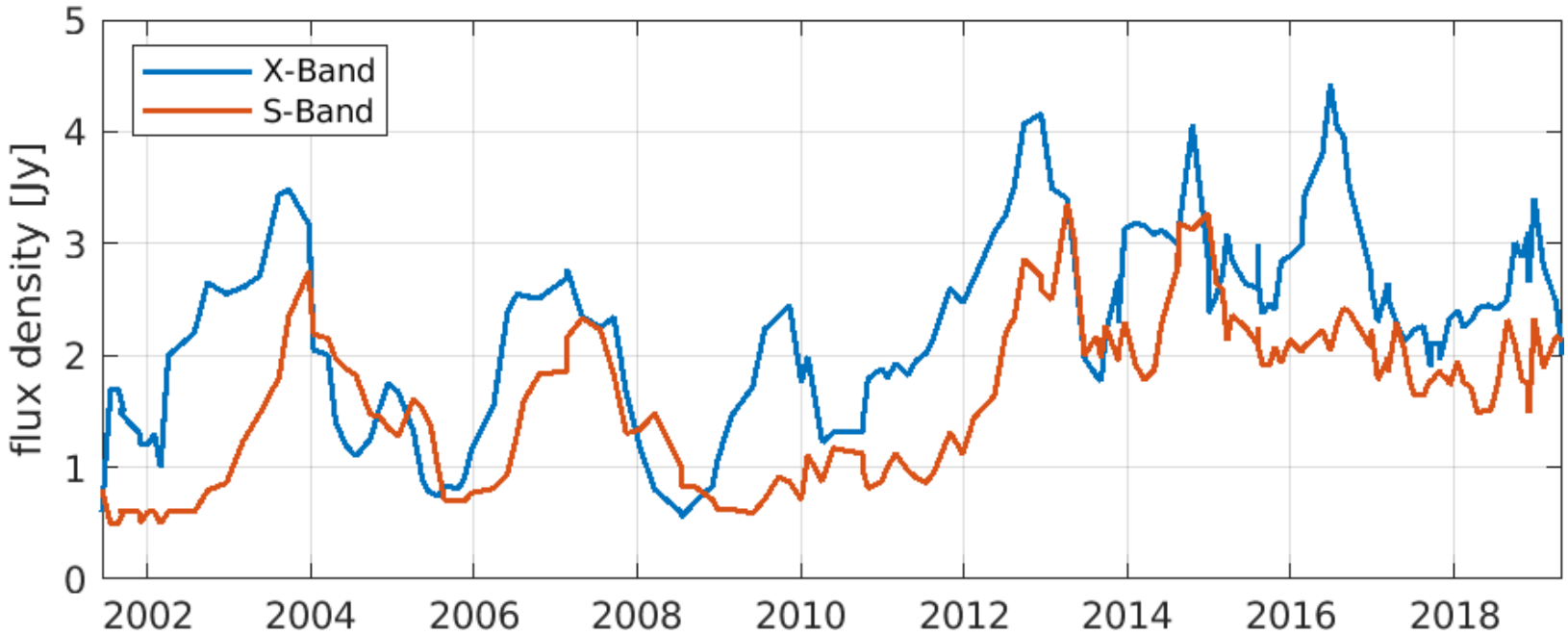
$$T = \left(\frac{SNR}{\eta F}\right)^2 \cdot \left(\frac{\mathbf{SEFD_1 \cdot SEFD_2}}{rec}\right) + corsynch$$





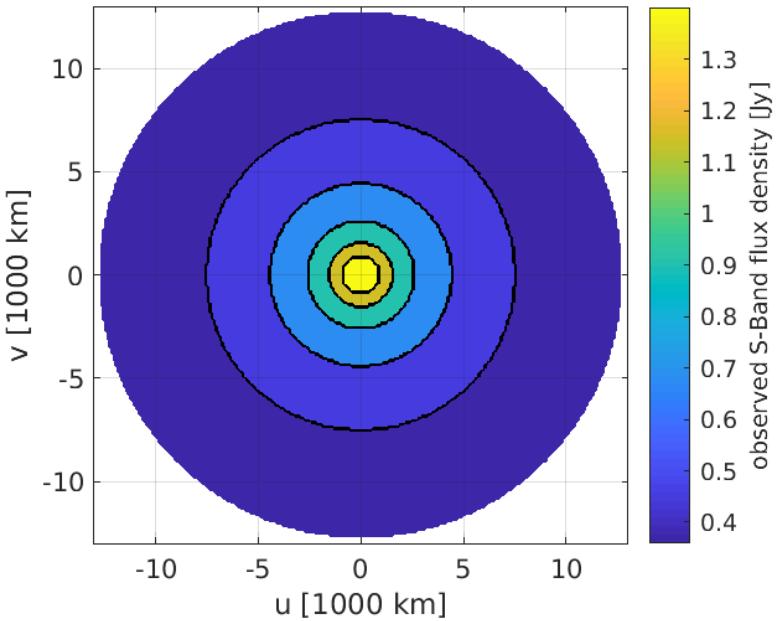
Source brightness Example: 0059+581

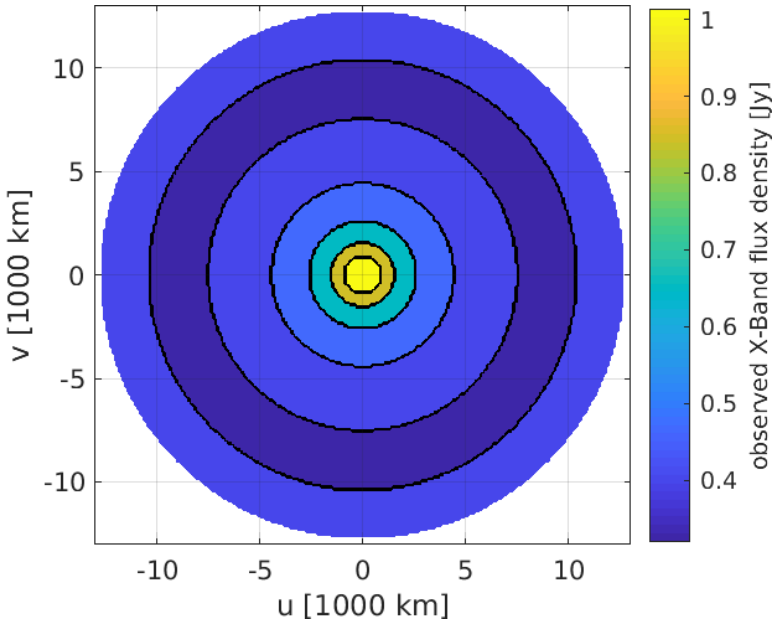
$$T = \left(\frac{SNR}{\eta \mathbf{F}}\right)^2 \cdot \left(\frac{SEFD_1 \cdot SEFD_2}{rec}\right) + corsynch$$



Source brightness Example: 3C274

$$T = \left(\frac{SNR}{\eta \mathbf{F}}\right)^2 \cdot \left(\frac{SEFD_1 \cdot SEFD_2}{rec}\right) + corsynch$$

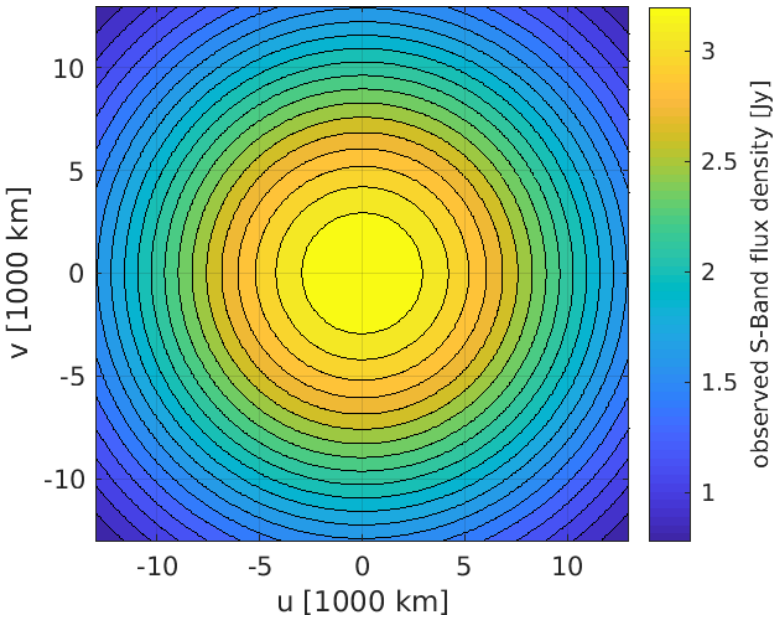


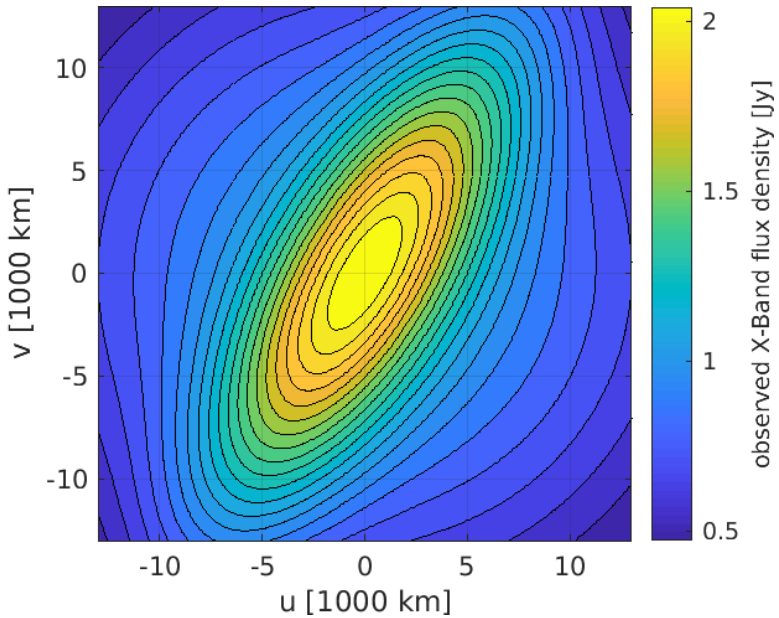


Source brightness

Example: 0458-020

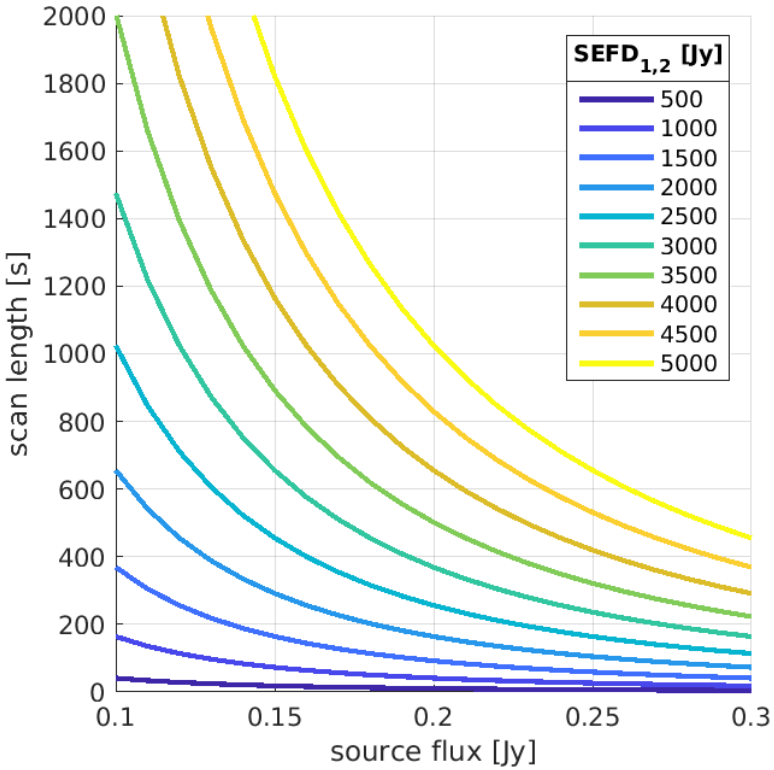
$$T = \left(\frac{SNR}{\eta \mathbf{F}}\right)^2 \cdot \left(\frac{SEFD_1 \cdot SEFD_2}{rec}\right) + corsynch$$

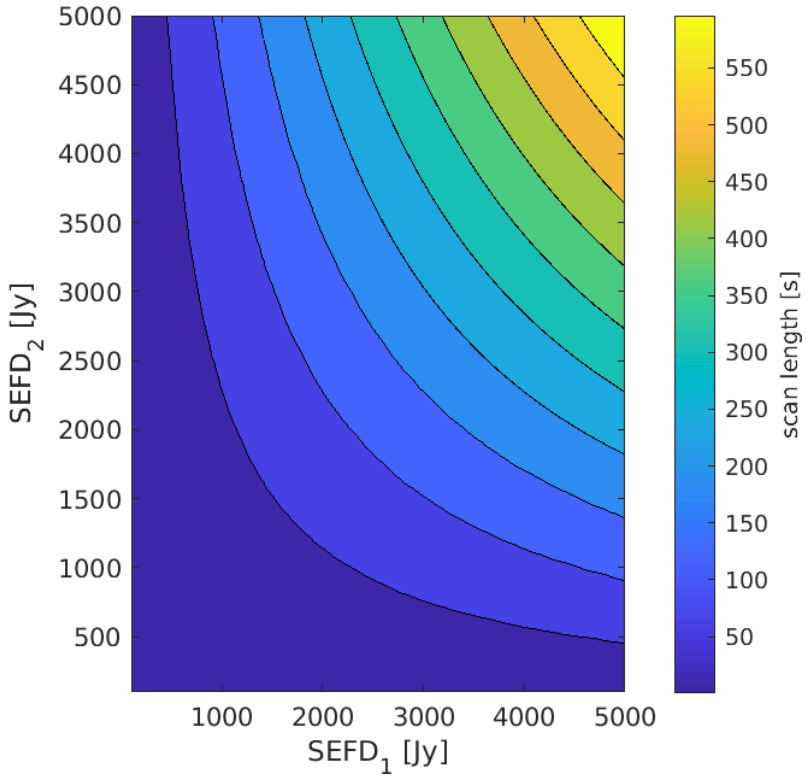




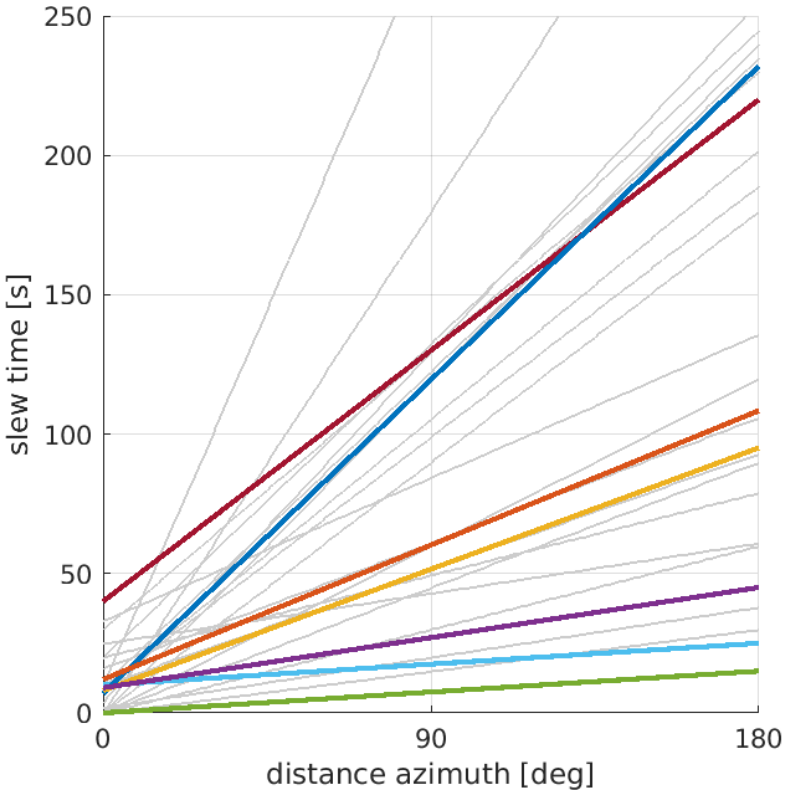
Scan length

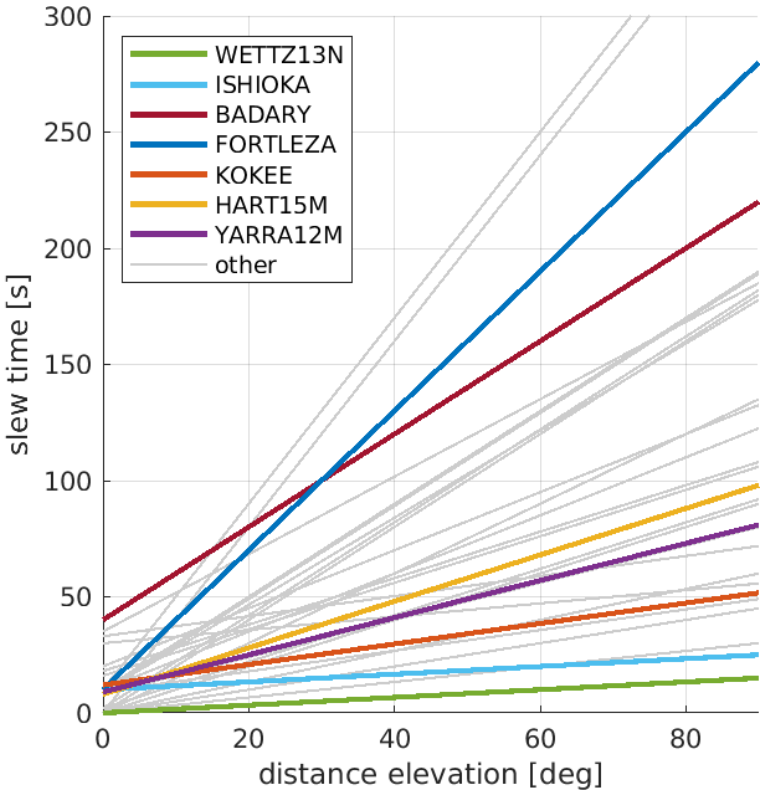
$$\mathbf{T} = \left(\frac{SNR}{\eta F}\right)^2 \cdot \left(\frac{SEFD_1 \cdot SEFD_2}{rec}\right) + corsynch$$





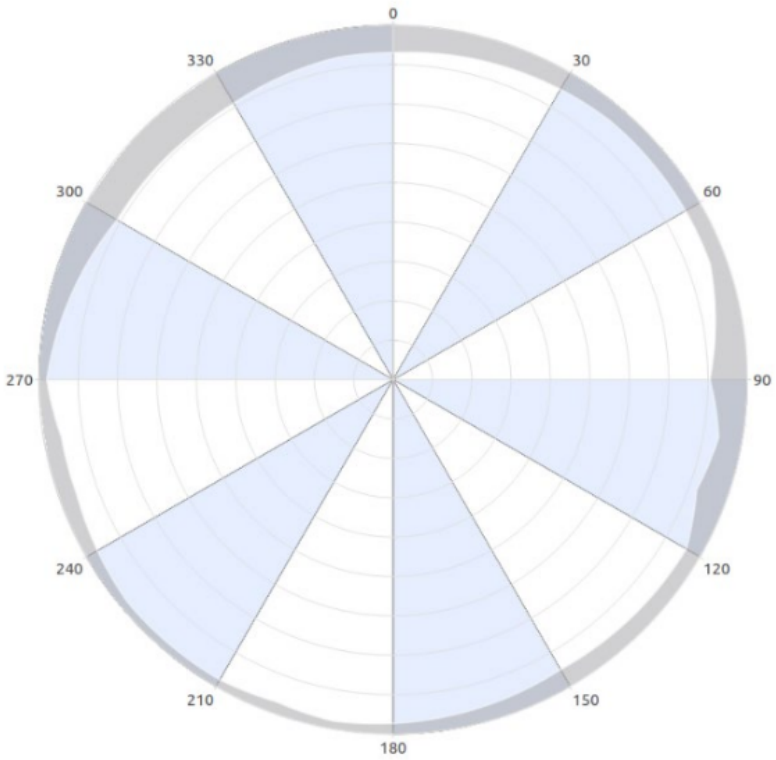
Slew time

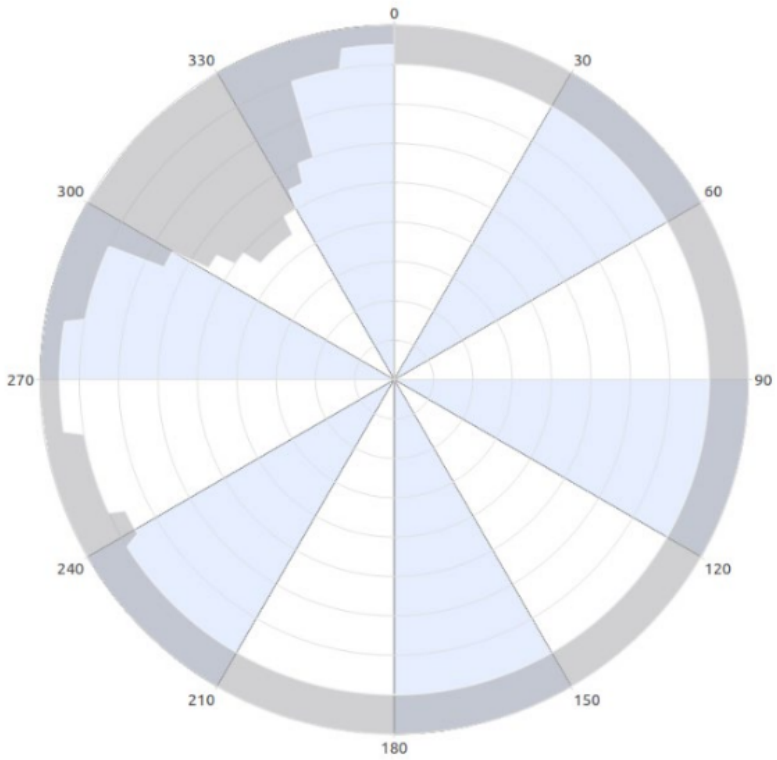

250
200
150
100
50
0
slew time [s]
0
90
180
distance azimuth [deg]


300
250
200
150
100
50
0
slew time [s]
0
20
40
60
80
distance elevation [deg]
WETTZ13N
ISHIOKA
BADARY
FORTLEZA
KOKEE
HART15M
YARRA12M
other

Horizon mask

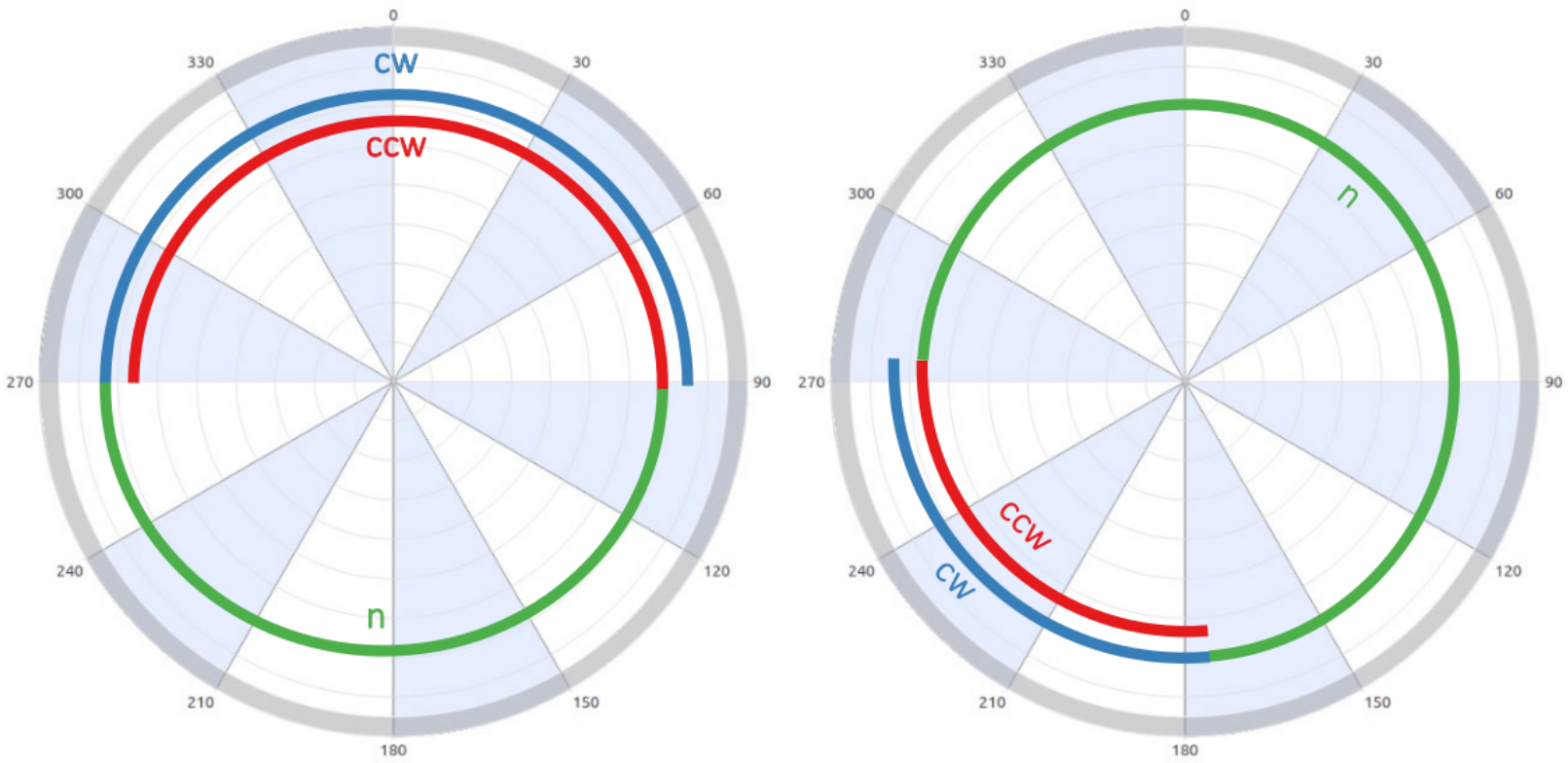
Example: HART15M and KOKEE12M



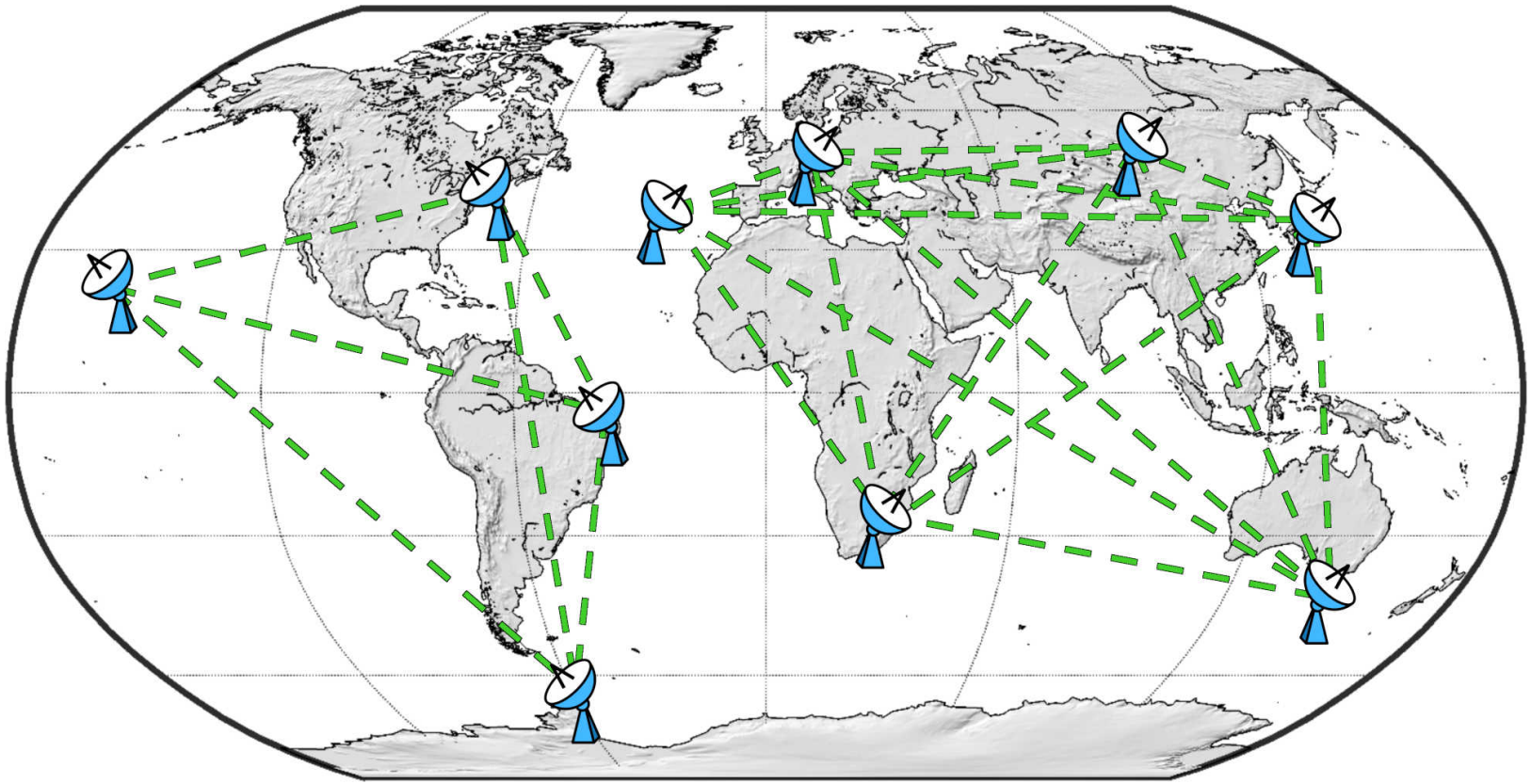


Cable wrap

Example: WETTZ13M and HART15M



Subnetting



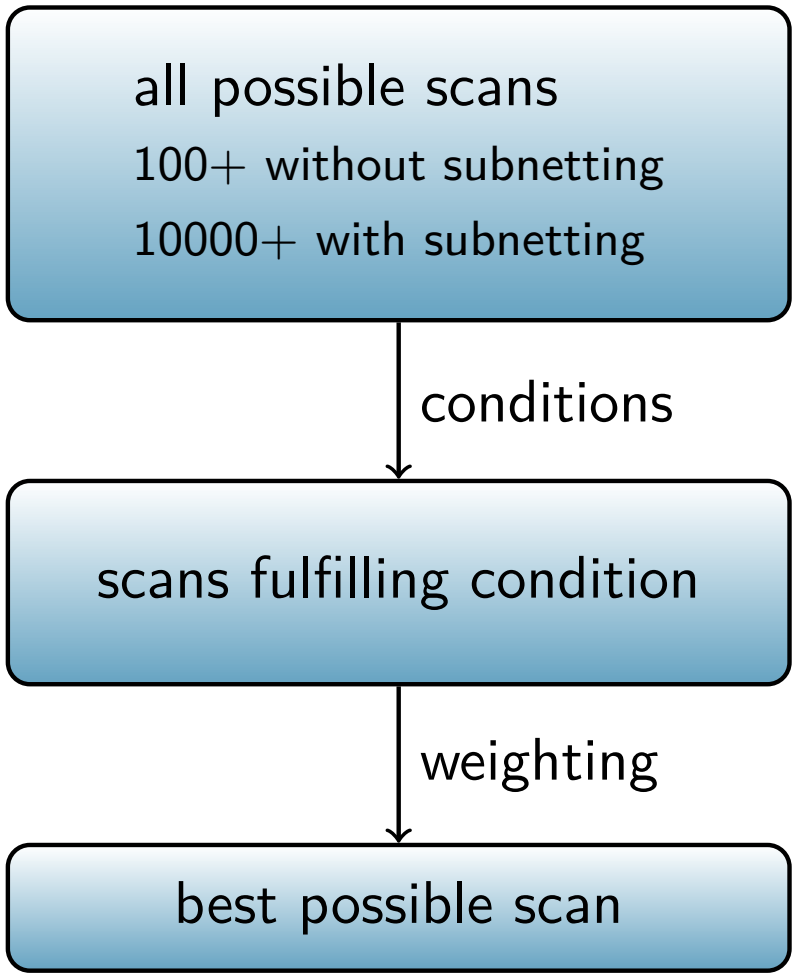
Scan selection? flowchart

Conditions:

- min sun distance
- cut-off elevation
- min source flux
- min source repeat
- max scan time
- max wait for slow antennas
- minimum station number...

Weight factors:

- sky coverage
- scan end time
- number of observations



TU WIEN VieVS

Vienna VLBI and Satellite Software

Lecture VLBI Scheduling

Matthias Schartner[a], matthias.schartner@geo.tuwien.ac.at

[a]TU Wien, Department of Geodesy and Geoinformation