

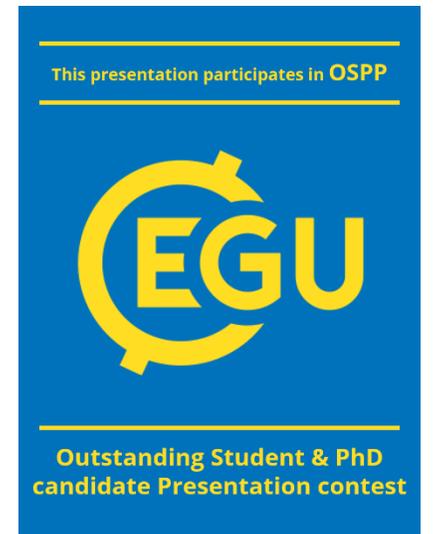
# Precision of Galileo satellite orbits obtained from simulated VLBI observations

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# Overview

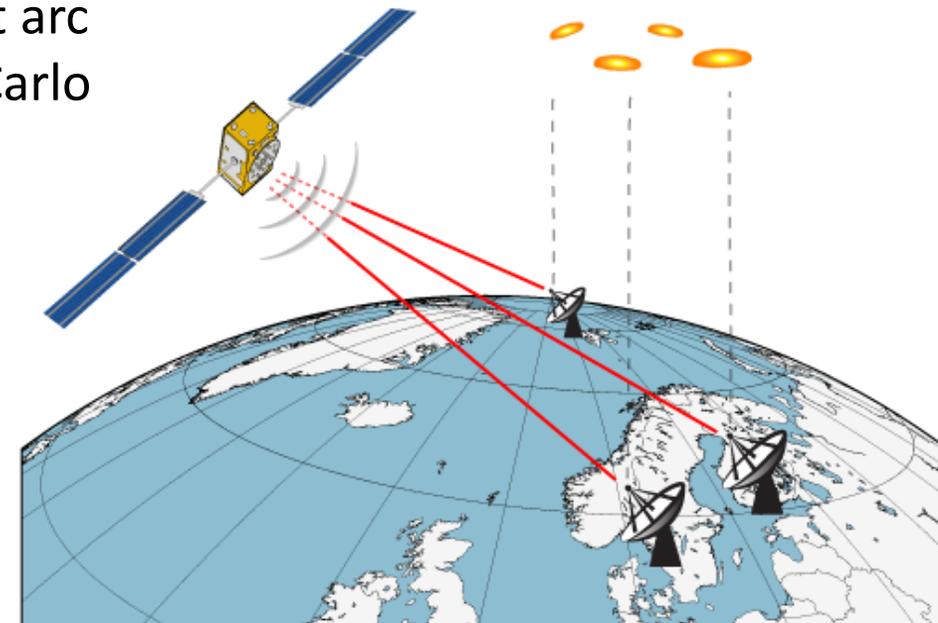
Comparing evaluation of satellite observations for estimating orbit arcs by analysis ...

## ... beforehand

Dilution of Precision (DOP)  
factors as indicator for sensitivity  
of satellite observations

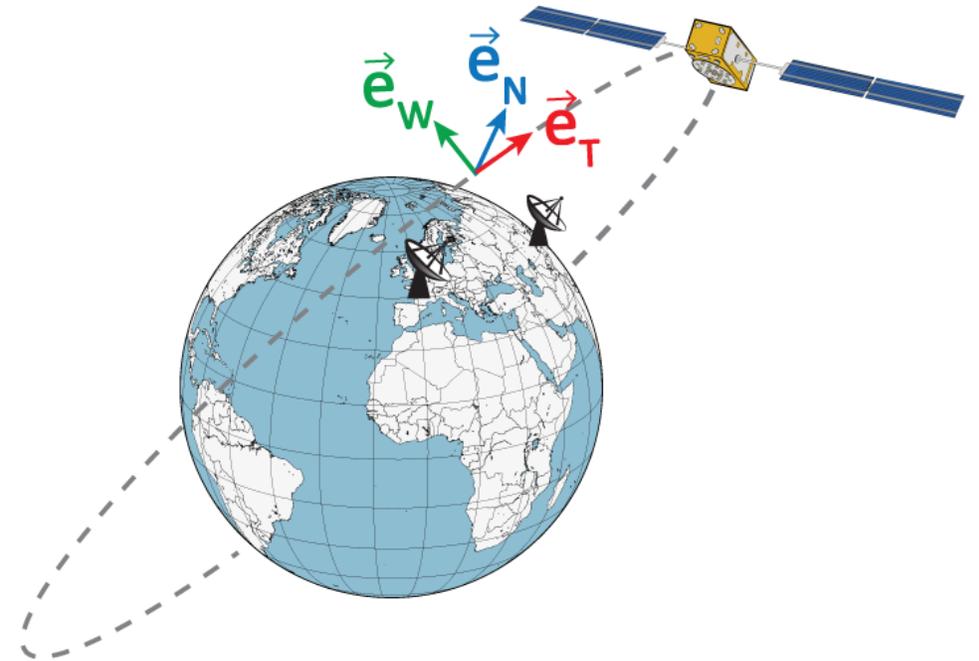
## ... of simulations

precision of estimated orbit arc  
assessed based on Monte Carlo  
simulations



# Evaluation of satellite observations

- indicator for sensitivity of satellite observations
- sensitivity towards satellite position in the NTW-frame such as
  - normal component (**NDOP**)
  - tangential component (**TDOP**)
  - cross-track component (**WDOP**)
- represent formal error in respective component per VLBI measurement error in  $[\text{cm}/\text{cm}]$
- the smaller the value the higher the sensitivity



# Precision of Galileo satellite orbits

schedules

creating schedules including quasar and satellite observations

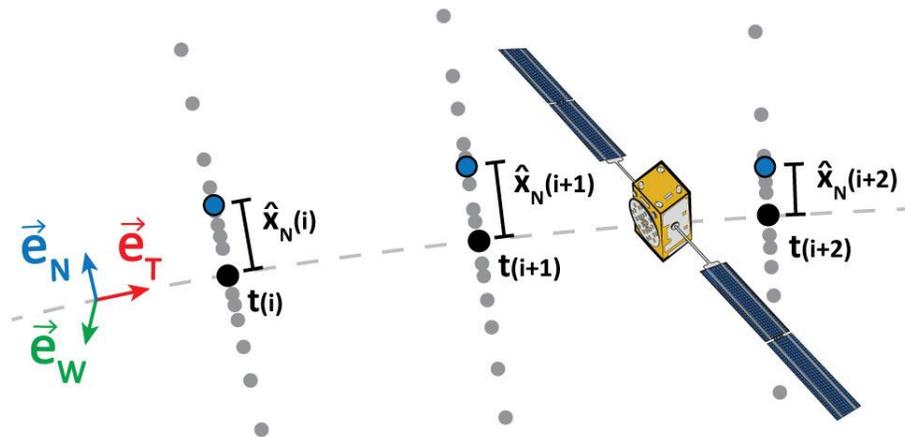


simulations

1000 simulations with 50 [ps] white noise for satellite scans

analysis

estimation of offset from a-priori orbit (sp3) for the individual components of satellite position as piecewise linear offsets



precision of adjusted arc in terms of repeatability

# Scenario: GSAT0206

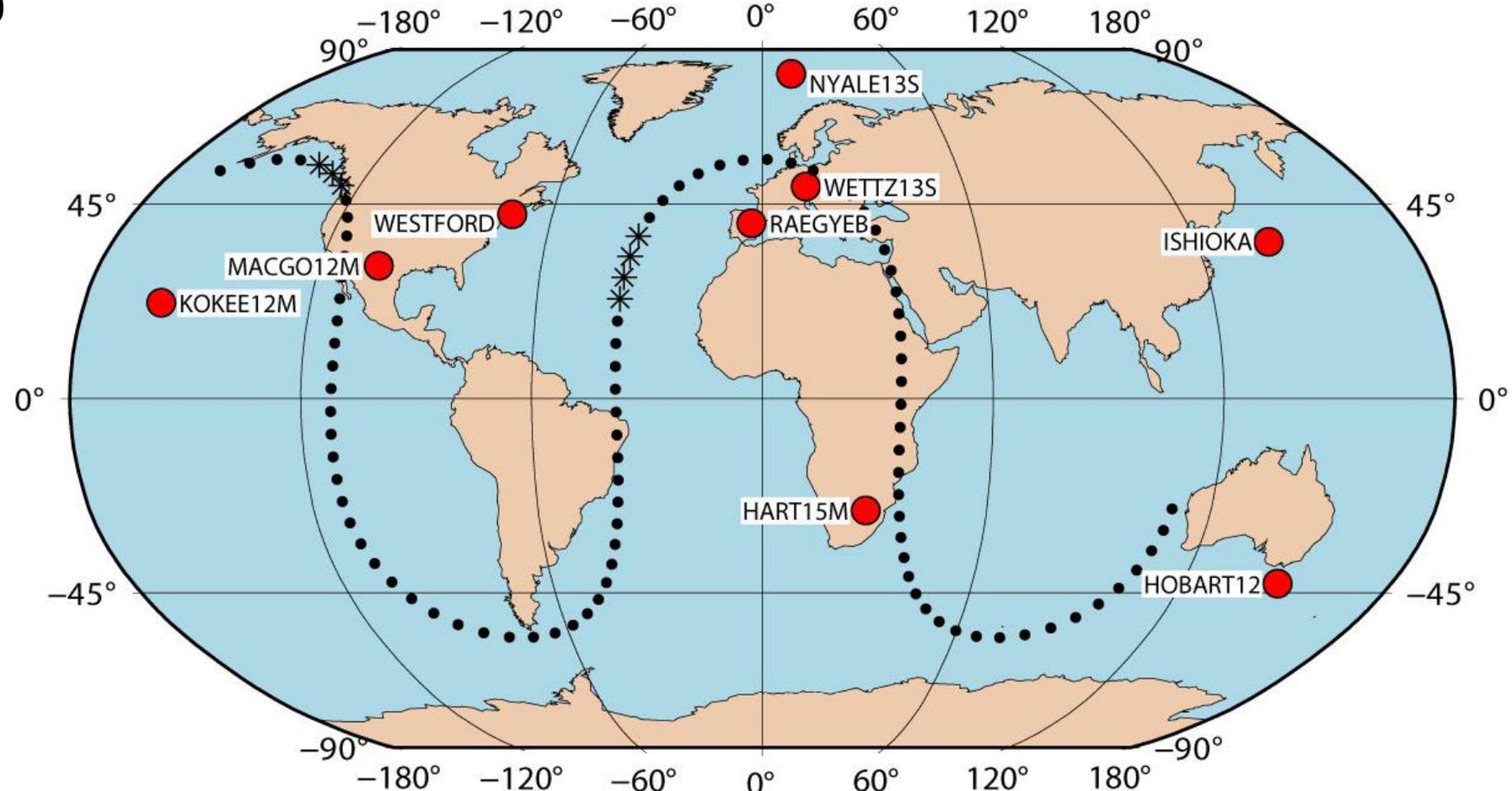
- 06.02.2022 00:00 – 00:00
- 9 station network

## Obs. period A: 00:50 – 01:40

- ISHIOKA
- KOKEE12M
- MACGO12M
- NYALE13S
- WESTFORD

## Obs. period B: 12:10 – 13:00

- MACGO12M
- NYALE13S
- RAEGYEB
- WESTFORD
- WETTZ13S



# Scenario: GSAT0206

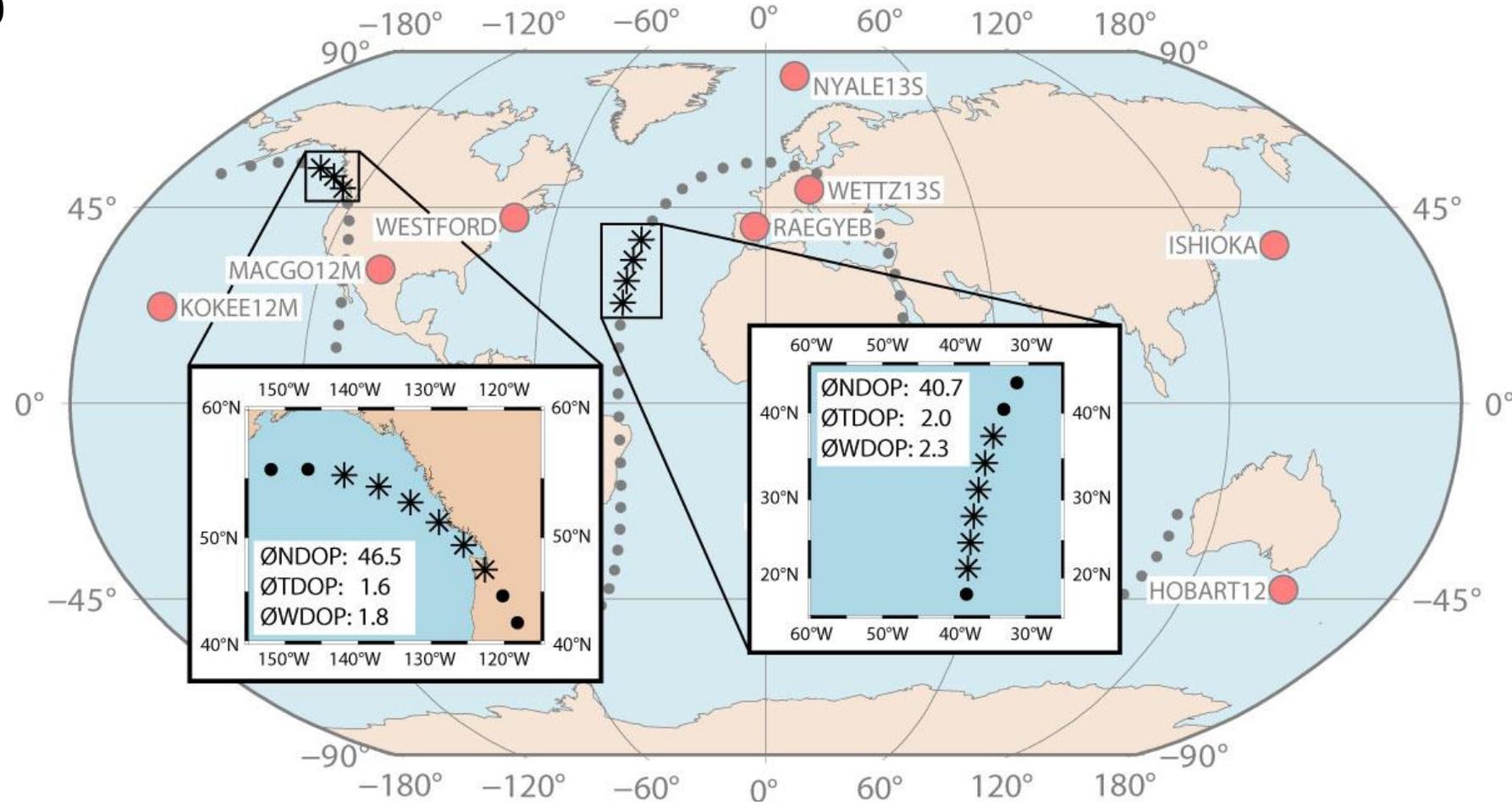
- 06.02.2022 00:00 – 00:00
- 9 station network

## Obs. period A: 00:50 – 01:40

- #stations: 5
- $\emptyset$ NDOP: 46.5
- $\emptyset$ TDOP: 1.6
- $\emptyset$ WDOP: 1.8

## Obs. period B: 12:10 – 13:00

- #stations: 5
- $\emptyset$ NDOP: 40.7
- $\emptyset$ TDOP: 2.0
- $\emptyset$ WDOP: 2.3



# Repeatability

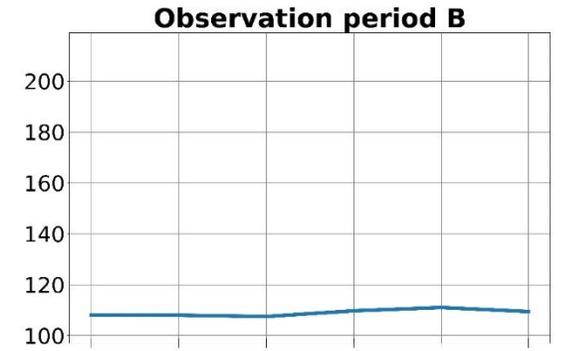
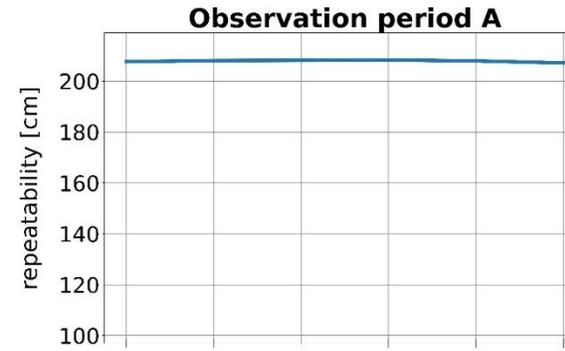
Obs. period A: **00:50 – 01:40**

- $\emptyset$ NDOP: 46.5
- $\emptyset$ TDOP: 1.6
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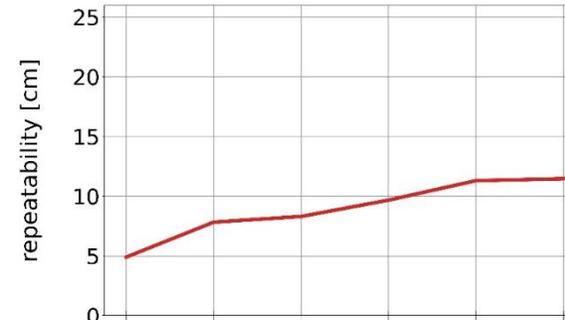
Obs. period B: **12:10 – 13:00**

- $\emptyset$ NDOP: 40.7
- $\emptyset$ TDOP: 2.0
- $\emptyset$ WDOP: 2.3

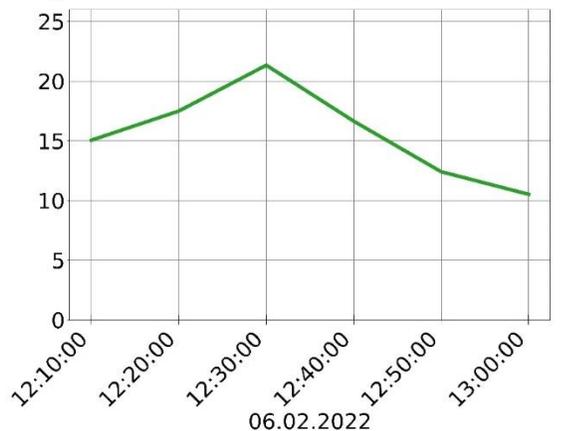
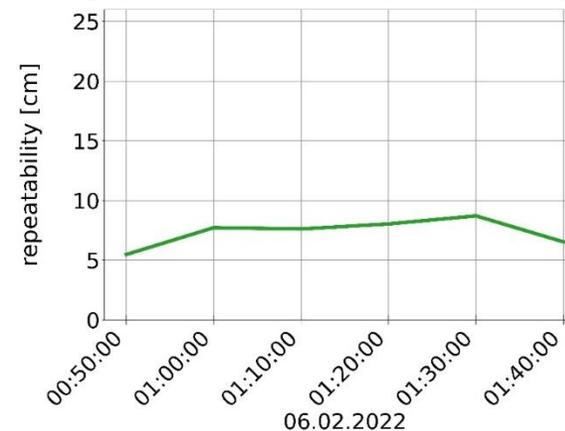
normal



tangential



cross - track



# Conclusion

- precision of the adjusted arc is dependent on observation geometry
- DOP factors and results of analysis based on Monte Carlo simulations concur
- DOP factors could be used as optimization criterion during the scheduling process
- observations rather insensitive to satellite normal component → constraints advisable

# References

- Wolf H. (2021): *Satellite Scheduling with VieSched++*, Master Thesis, Technical University of Vienna.
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- Klioner S. (1991): *General Relativistic Model of VLBI Observables*, Proceedings of the AGU Chapman Conference on Geodetic VLBI: Monitoring Global Change, Washington D.C., April 22-26. 1991.
- VieSched++: <https://github.com/TUW-VieVS/VieSchedpp/>