



# VieVS

Vienna VLBI and Satellite Software

## How to simulate VLBI observations with VieVS

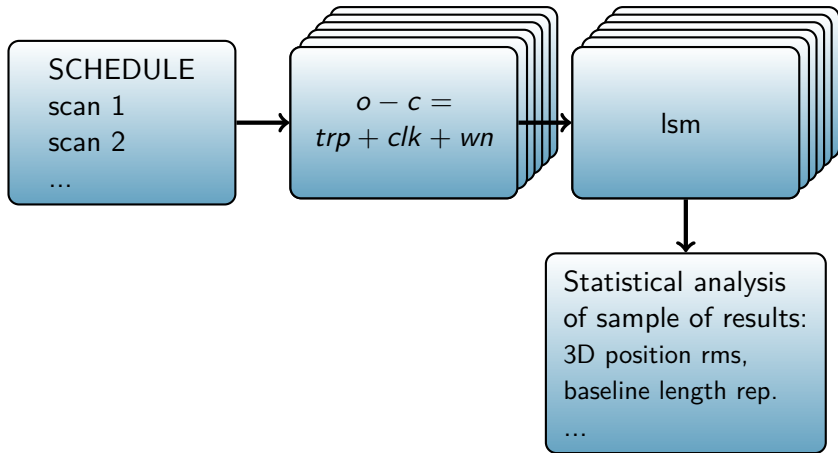
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## Why simulations?

- generate artificial delay observables - useful to test
  - new scheduling strategies
  - different station network geometries
  - antenna specifications
  - the influence of systematic effects, e.g. source structure
  - effect of different models

## Simulation procedure



## What is simulated?

$$o - c = \underbrace{(zwd_2 \cdot mf(el_2) + clk_2)}_{station2} - \underbrace{(zwd_1 \cdot mf(el_1) + clk_1)}_{station1} + wn_{bsl}$$

## What is simulated? troposphere zenith wet delay

$$o-c = \underbrace{\left( zwd_2 \cdot mf(el_2) + clk_2 \right)}_{station2} - \underbrace{\left( zwd_1 \cdot mf(el_1) + clk_1 \right)}_{station1} + wn_{bsl}$$

### *zwd* - troposphere zenith wet delay

- provided by a turbulence simulator
- simulated per station
  - based on the approach by Nilsson et al. (2007)
  - accounts for spatial and temporal correlation

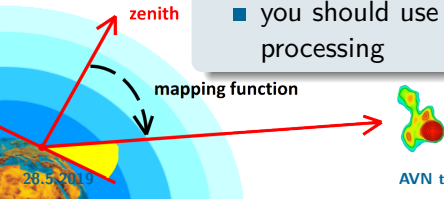


## What is simulated? mapping function

$$o-c = \underbrace{\left( zwd_2 \cdot mf(el_2) + clk_2 \right)}_{station2} - \underbrace{\left( zwd_1 \cdot mf(el_1) + clk_1 \right)}_{station1} + wn_{bsl}$$

### $mf(el)$ - mapping function (elevation)

- simulated per station
- you should use the same mf for creation and processing



## What is simulated? station clock

$$o-c = \underbrace{\left( zwd_2 \cdot mf(e_{l_2}) + \text{clk}_2 \right)}_{\text{station2}} - \underbrace{\left( zwd_1 \cdot mf(e_{l_1}) + \text{clk}_1 \right)}_{\text{station1}} + wn_{bsl}$$

### clk - station clock

- simulated as sum of a random walk and an integrated random walk process
- simulated per station
  - according to Herring et al. 1990



## What is simulated? white noise

$$o-c = \underbrace{(zwd_2 \cdot mf(e_2) + clk_2)}_{station2} - \underbrace{(zwd_1 \cdot mf(e_1) + clk_1)}_{station1} + wn_{bsl}$$

*wn* - white noise

- simulated per baseline



## Parameters

- tropospheric parameters
  - **Cn** refractive index structure constant
  - $H$  effective height of wet troposphere
  - $vn$ ,  $ve$  components of the wind vector
  - $wzd0$  a priori zenith wet delay
  - $dhseg$  correlation interval
  - $dh$  stepwidth for the numerical integration
- clock
  - **ASD** Allan Standard Deviation
  - @ at this amount of minutes minutes
- white noise
  - **wn** white noise for quasars
  - $wn_{sat}$  white noise for satellites

## Turbulence file

- holds individual parameters for each station
- stored in *VieVS/DATA/TURB*

# station	Cn	H	vn	ve	wzd0	dhseg	dh	ASD	@	wn	wn_sat
BADARY	1.37	2000	0.0	8.0	250	2	200	1e-14	50	32	50
TSUKUB32	3.45	2000	0.0	8.0	250	2	200	1e-14	50	32	50
KOKEE	1.39	2000	0.0	8.0	250	2	200	1e-14	50	32	50
NYALES20	0.65	2000	0.0	8.0	250	2	200	1e-14	50	32	50
HOBART12	1.60	2000	0.0	8.0	250	2	200	1e-14	50	32	50
FORTLEZA	2.46	2000	0.0	8.0	250	2	200	1e-14	50	32	50
YEBES40M	1.48	2000	0.0	8.0	250	2	200	1e-14	50	32	50
HARTRAO	1.34	2000	0.0	8.0	250	2	200	1e-14	50	32	50
TIGOCONC	2.08	2000	0.0	8.0	250	2	200	1e-14	50	32	50
WETTZELL	1.50	2000	0.0	8.0	250	2	200	1e-14	50	32	50
ZELENCHK	1.86	2000	0.0	8.0	250	2	200	1e-14	50	32	50
ONSALA60	2.19	2000	0.0	8.0	250	2	200	1e-14	50	32	50



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## Lecture VLBI Simulation

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