TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

VIE_SIM

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VieVS User Workshop

7 – 9 September, 2010

Vienna

Why simulations?

- generate artificial delay observables – useful to test
  - new scheduling strategies
  - different station network geometries
  - antenna specifications
  - ...

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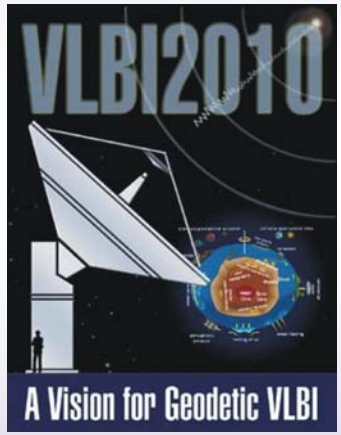

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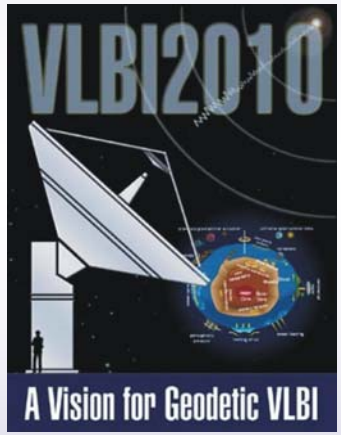

- generate zero input NGS files – useful to test the impact of different models in the analysis

What is simulated?

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

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zwd - troposphere zenith wet delay

provided by a turbulence simulator

based on the approach by Nilsson et al. (2007)
accounts for spatial and temporal correlations

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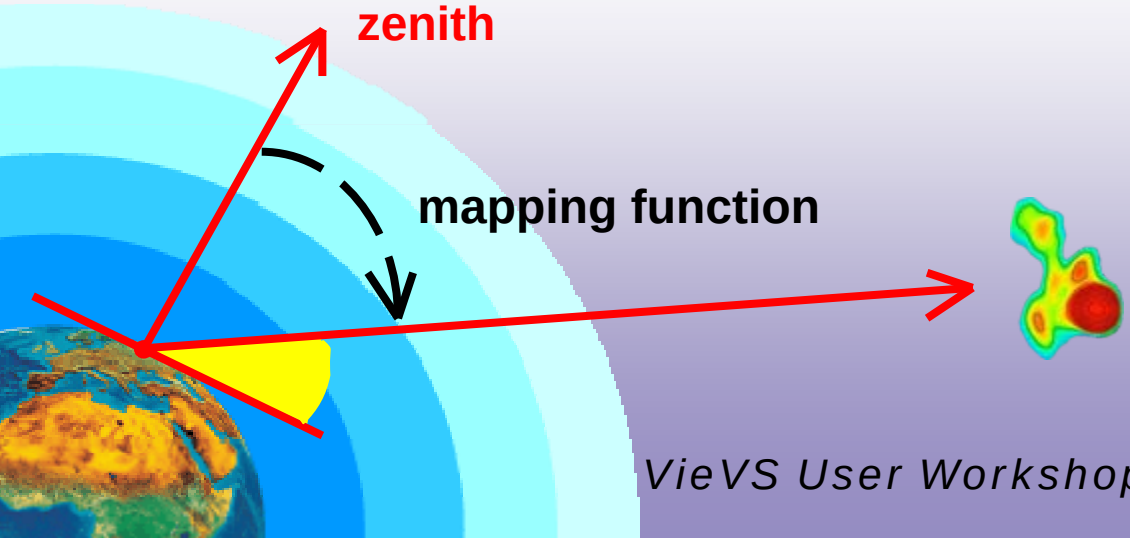
mf(el) - mapping function (elevation)



you should use the same mf for the creation of the simulated files and for the processing of the simulated data – unless you want to study mf errors

What is simulated?

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

clk - station clock

simulated as sum of a random walk and an integrated random walk process

according to Herring et al. 1990

What is simulated?

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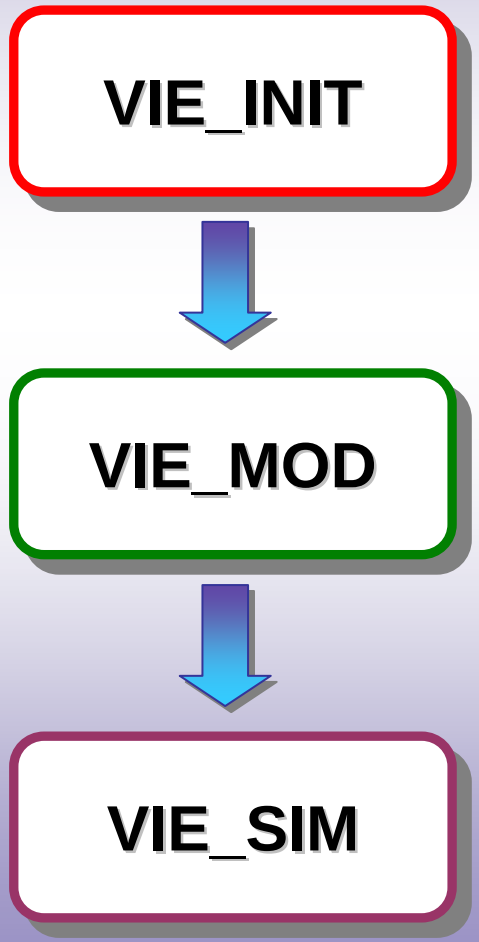
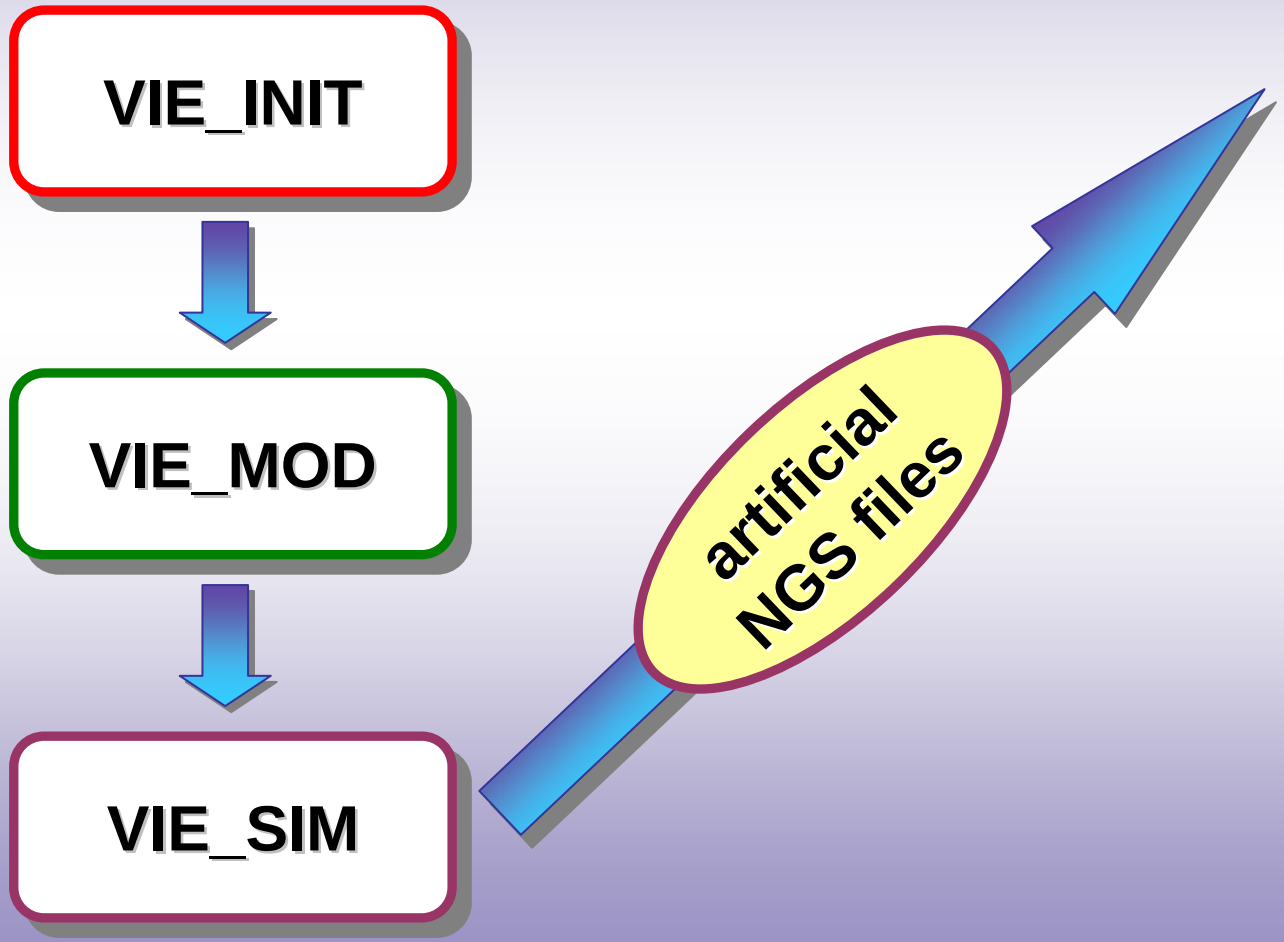
$$o\text{-}c = (zwd_2 \cdot mf(el_2) + clk_2) - (zwd_1 \cdot mf(el_1) + clk_1) + wn_{bsl}$$

wn_{bsl} - white noise per baseline

VieVS and VIE_SIM



VieVS and VIE_SIM



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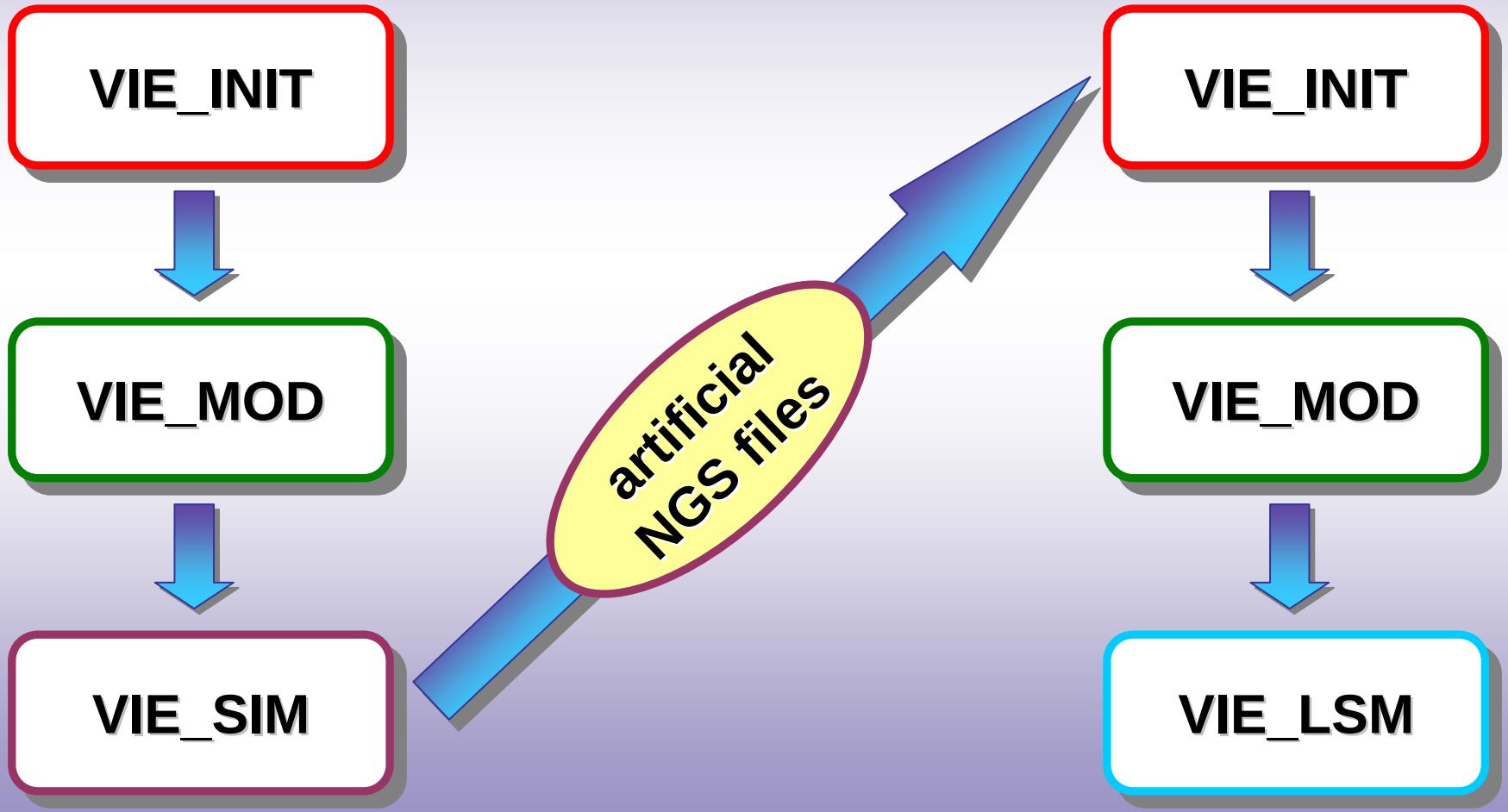
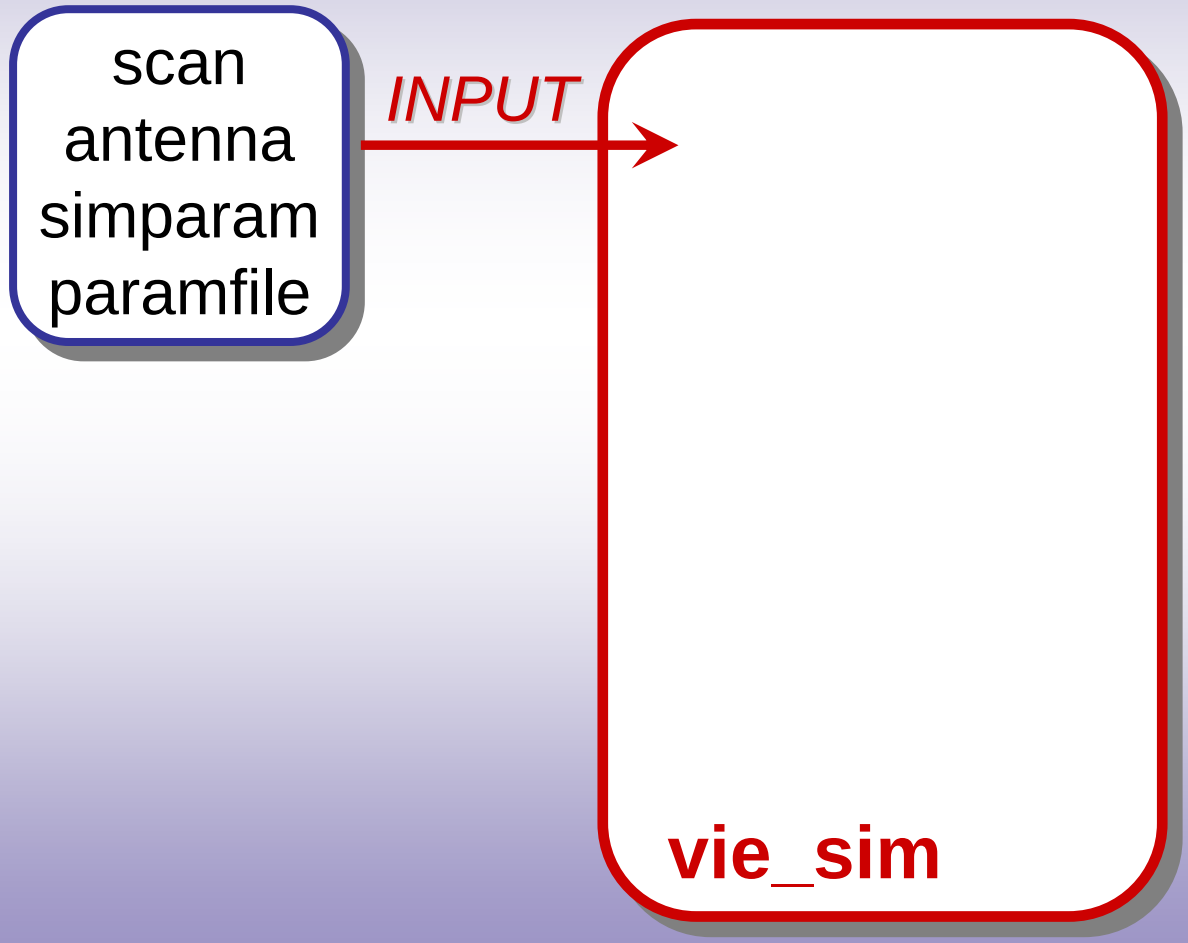


Data flow in VIE_SIM



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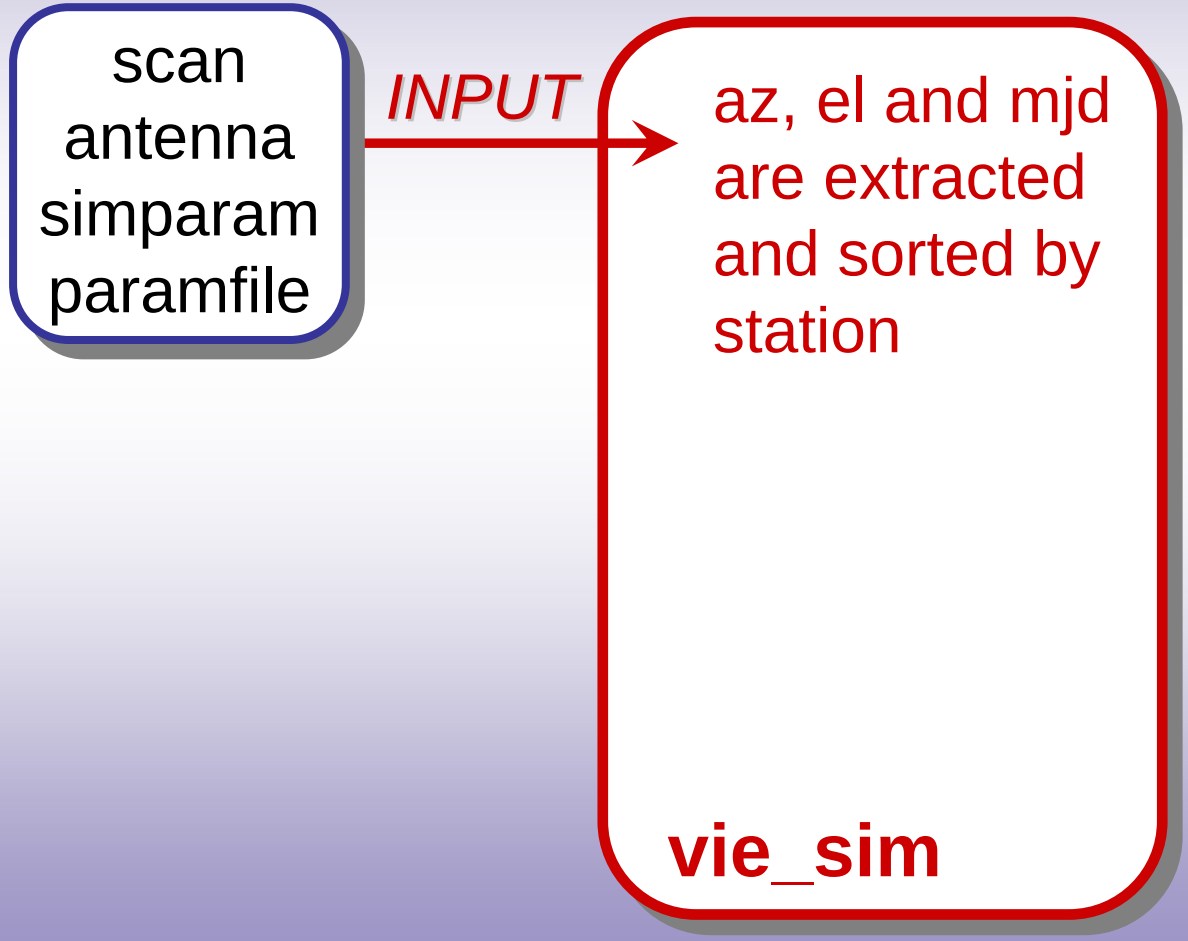

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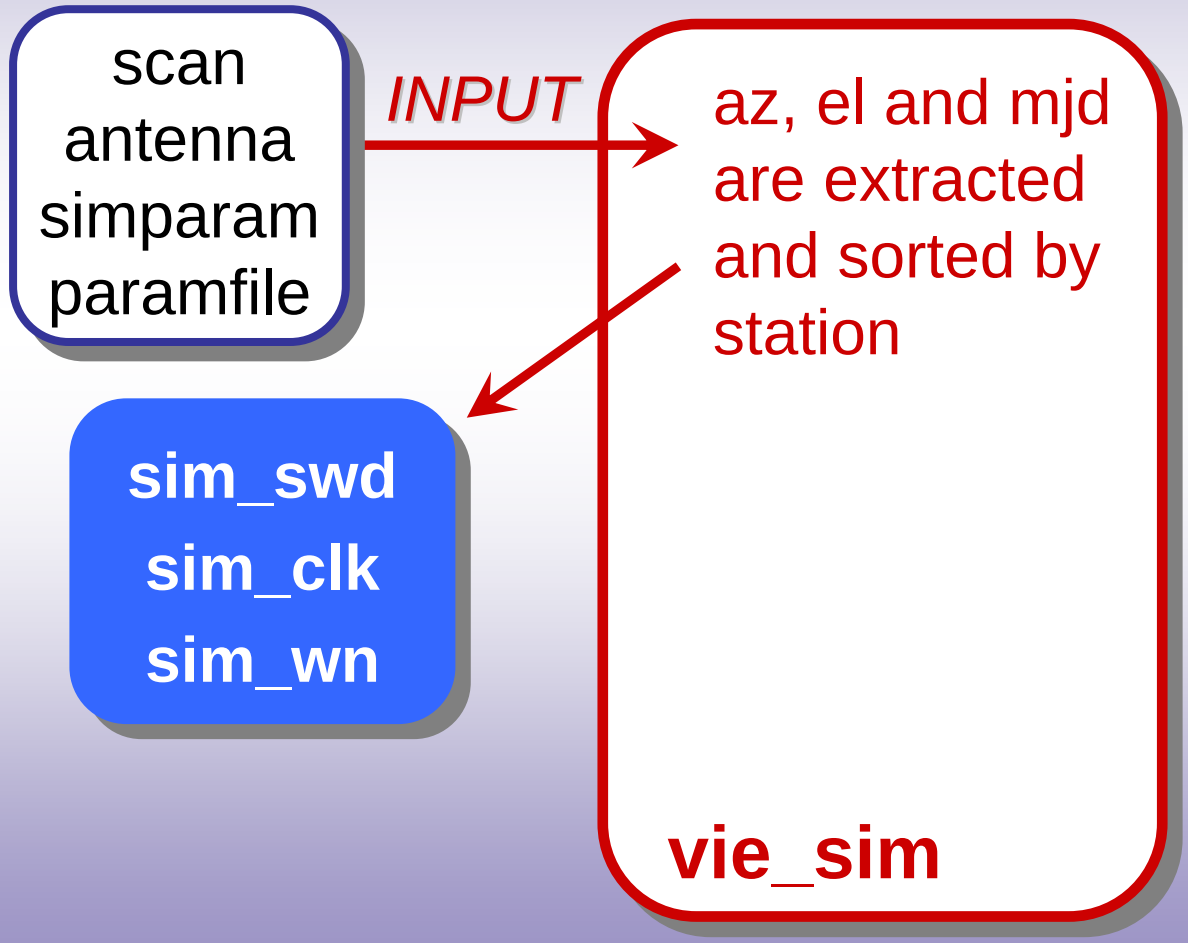

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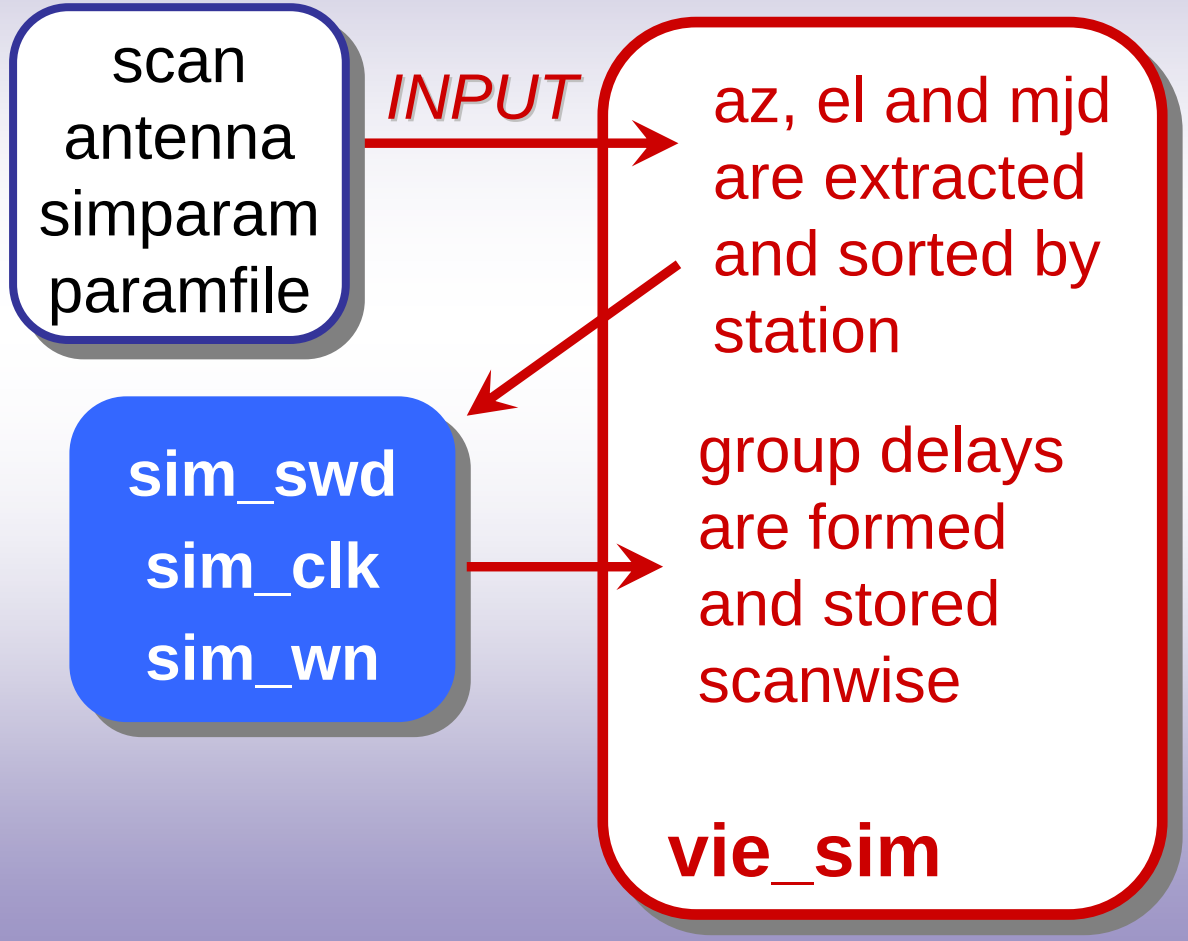

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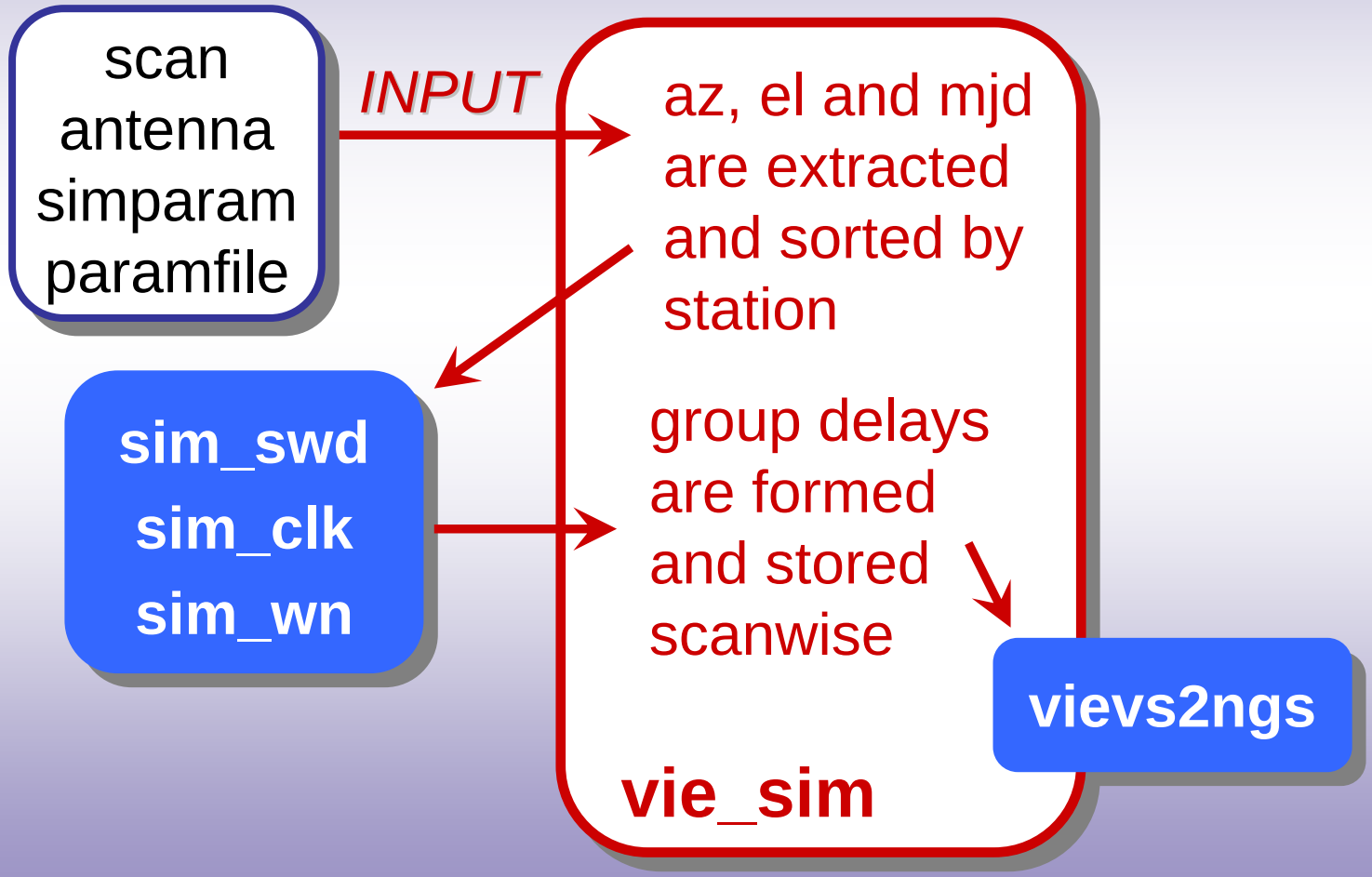
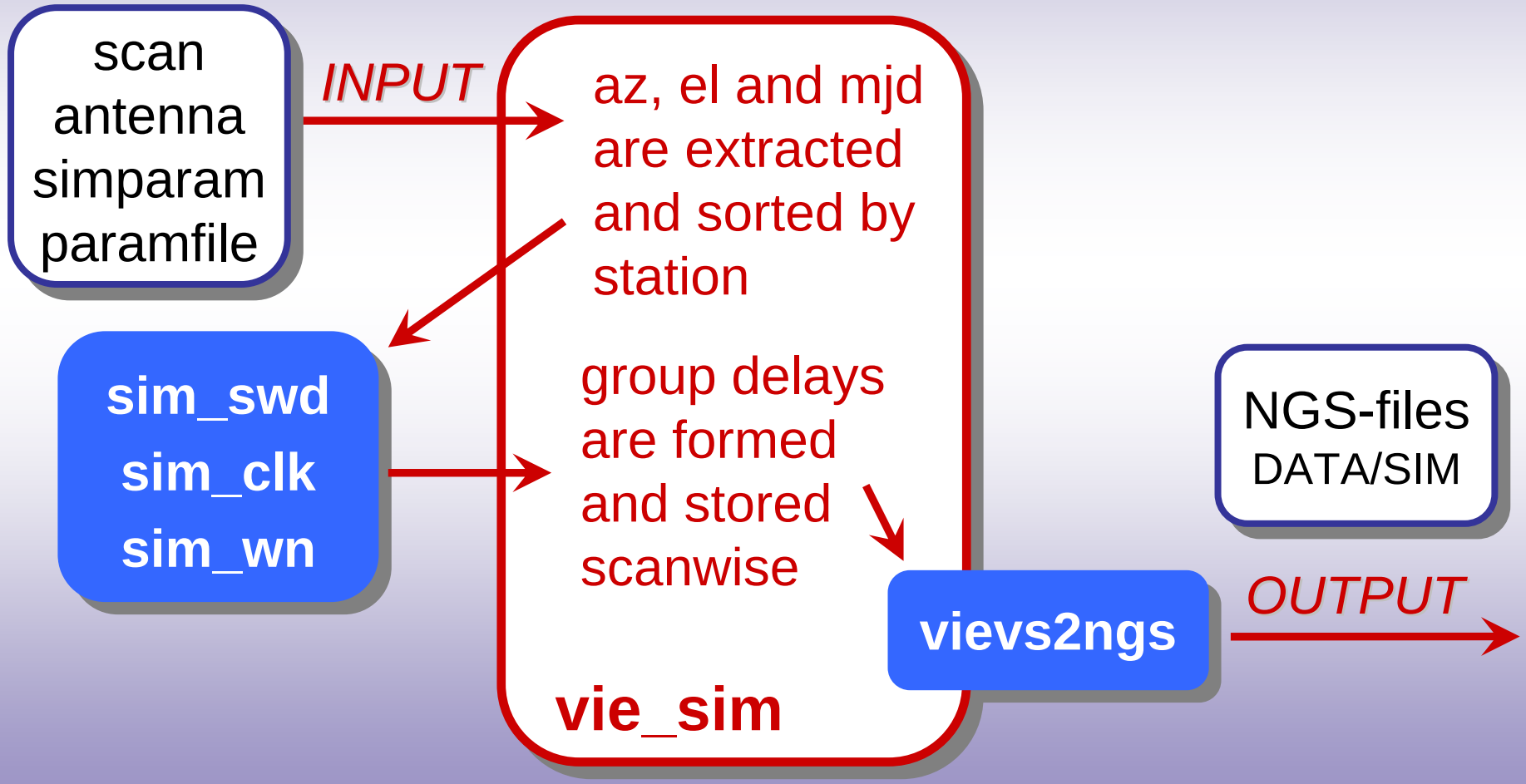


Data flow in VIE_SIM



The output of VIE_SIM

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- we simulate the (o-c) vector and write the (o-c) + c to the observed value in the NGS-files
- ionosphere correction and cable cal need to be taken into account
- interface for exchange of simulated data

Before running VIE_SIM

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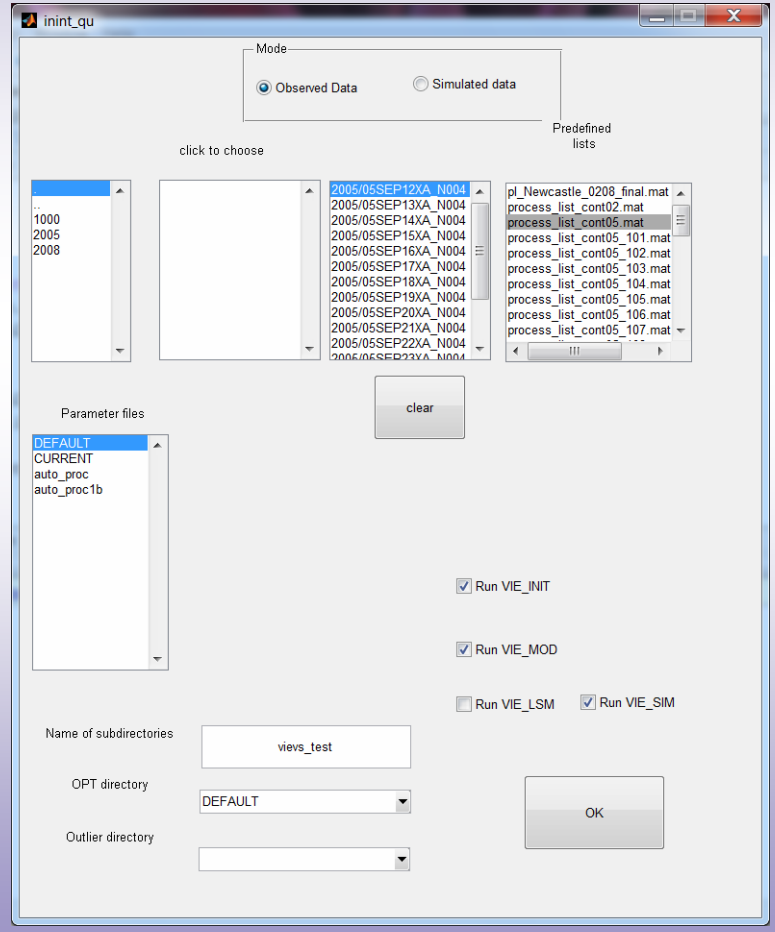
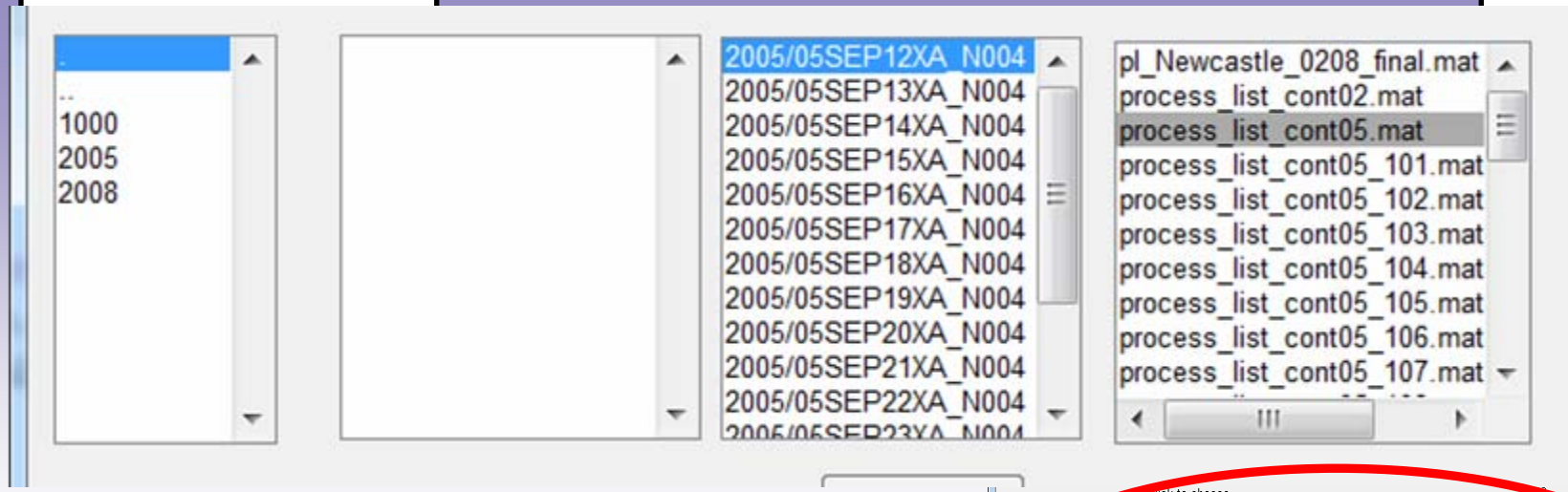
- Do not use any outlier files!
- make sure to set the quality code limit in the 2nd GUI to >9 (it is important that all observations are used for the simulation)
- After the simulation you can process the simulated data with any options you like!

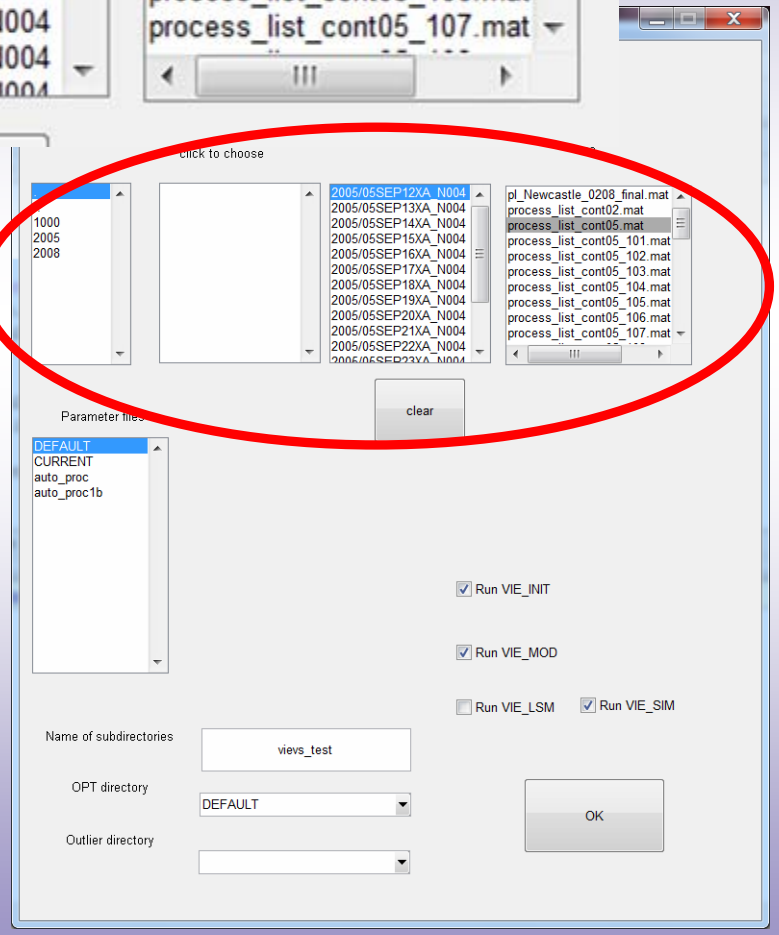
How to start the simulator

- start VieVS as usual





- in the first GUI choose the sessions for which you want to simulate



How to start the simulator

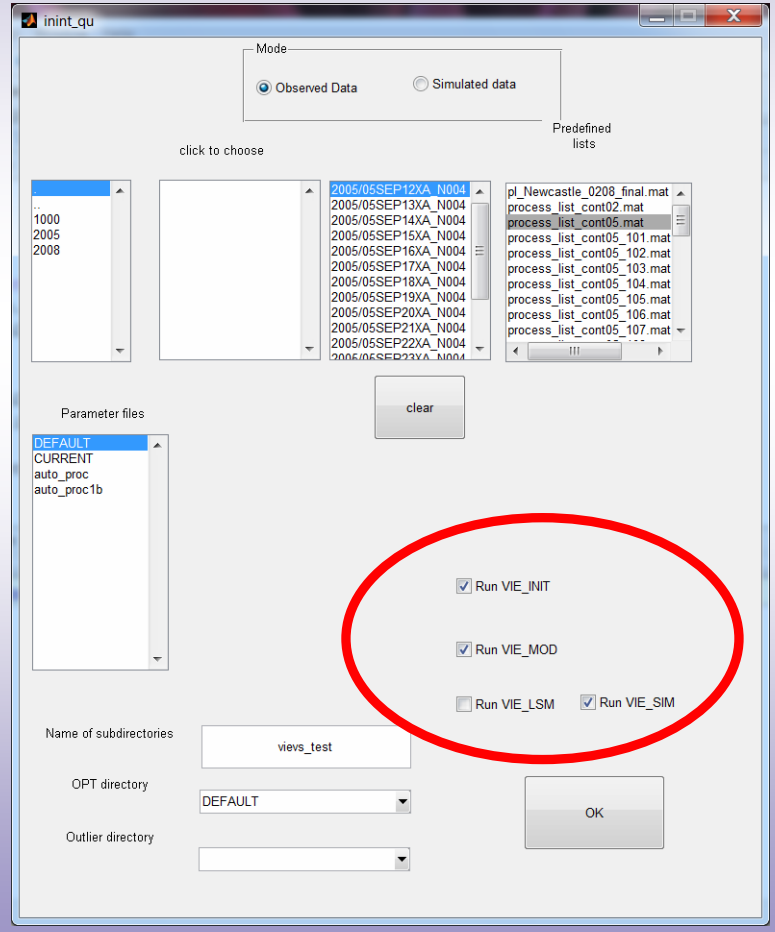
Run VIE_INIT

Run VIE_MOD

Run VIE_LSM

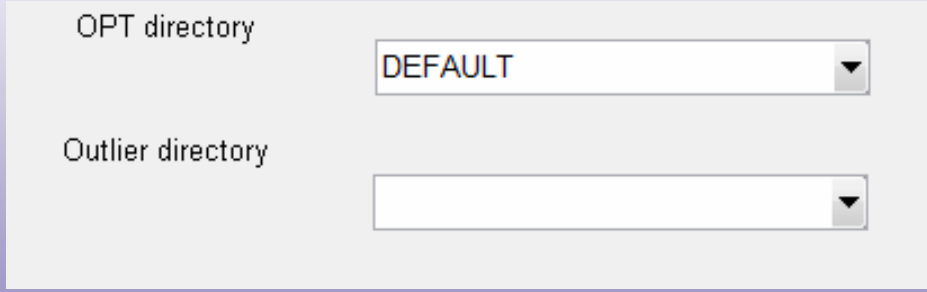
Run VIE_SIM

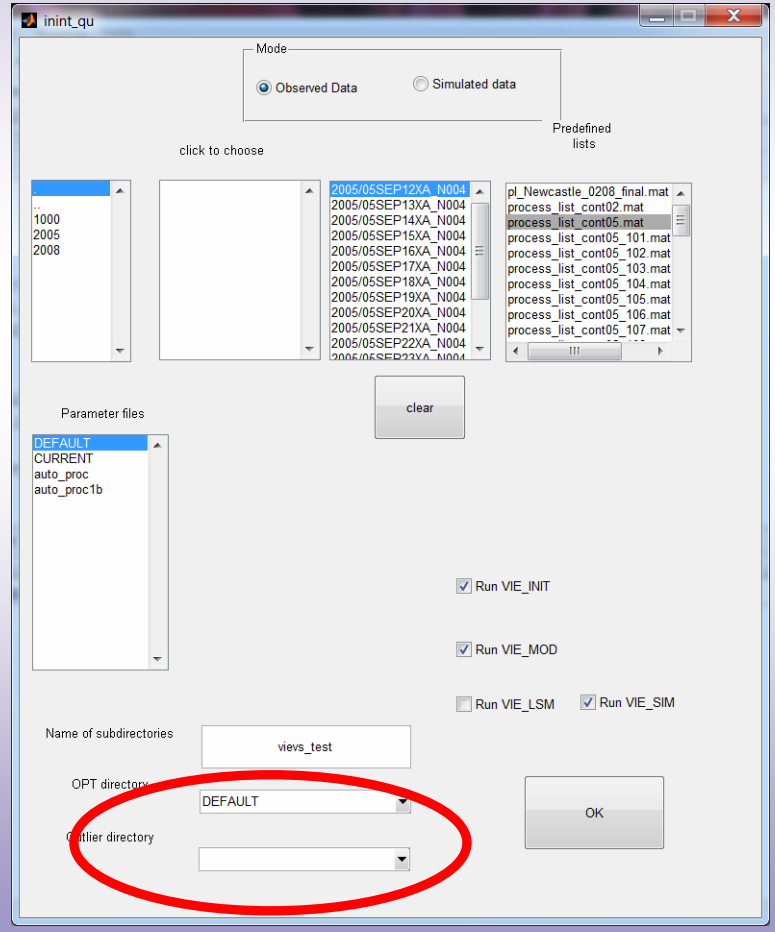
then choose to run VIE_SIM



How to start the simulator

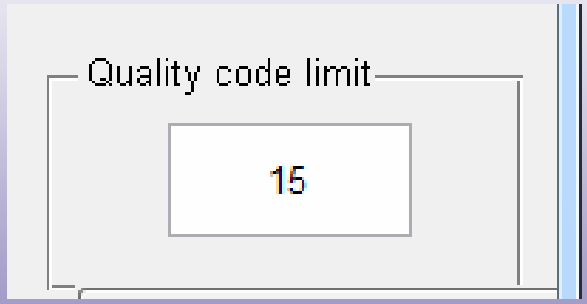
- do not use outlier files!
- if OPT files exist, rename them before starting the simulator

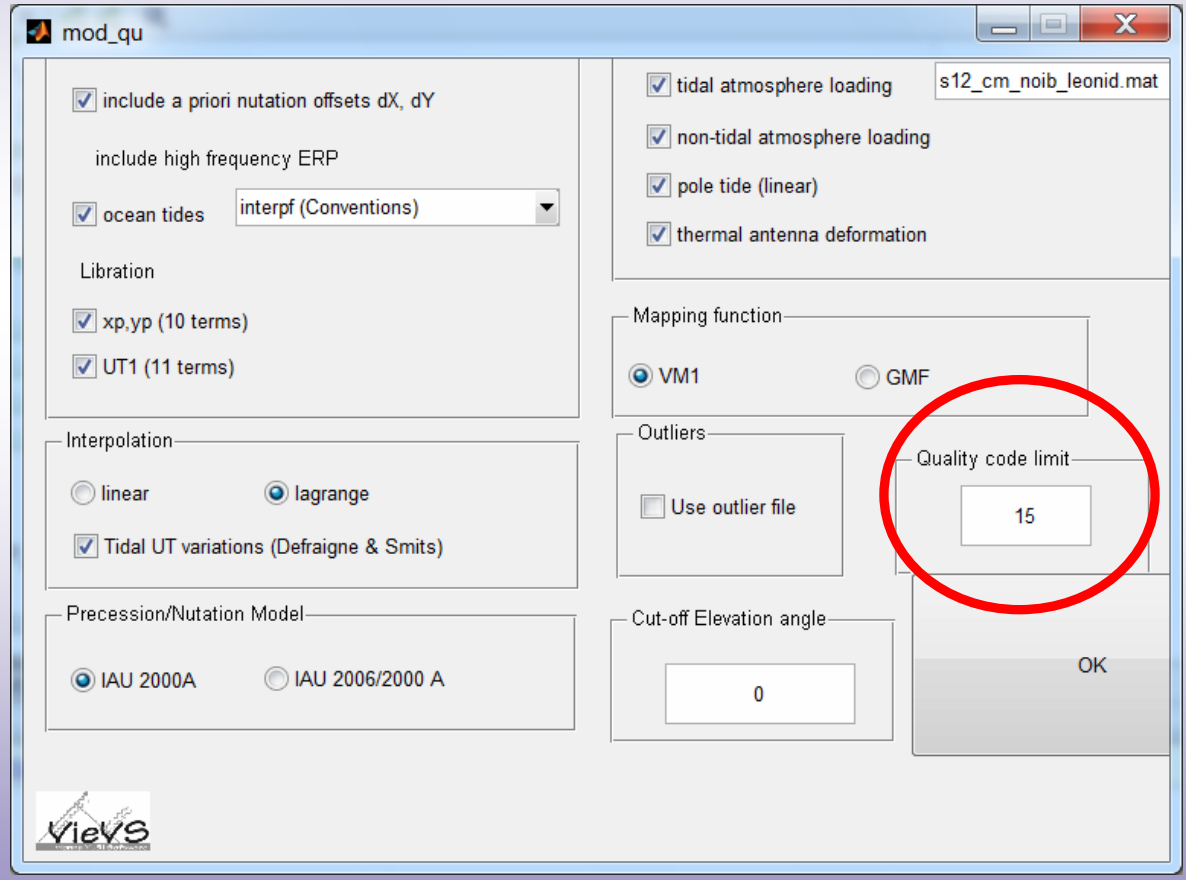




How to start the simulator

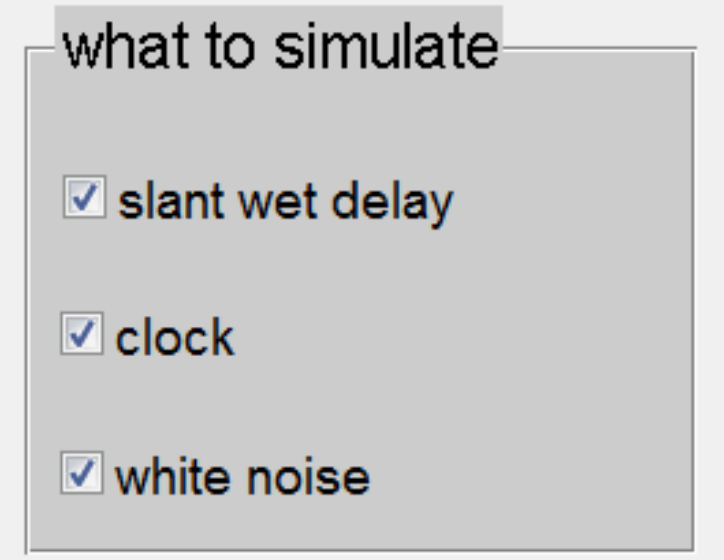
- set the quality code limit to a number > 9

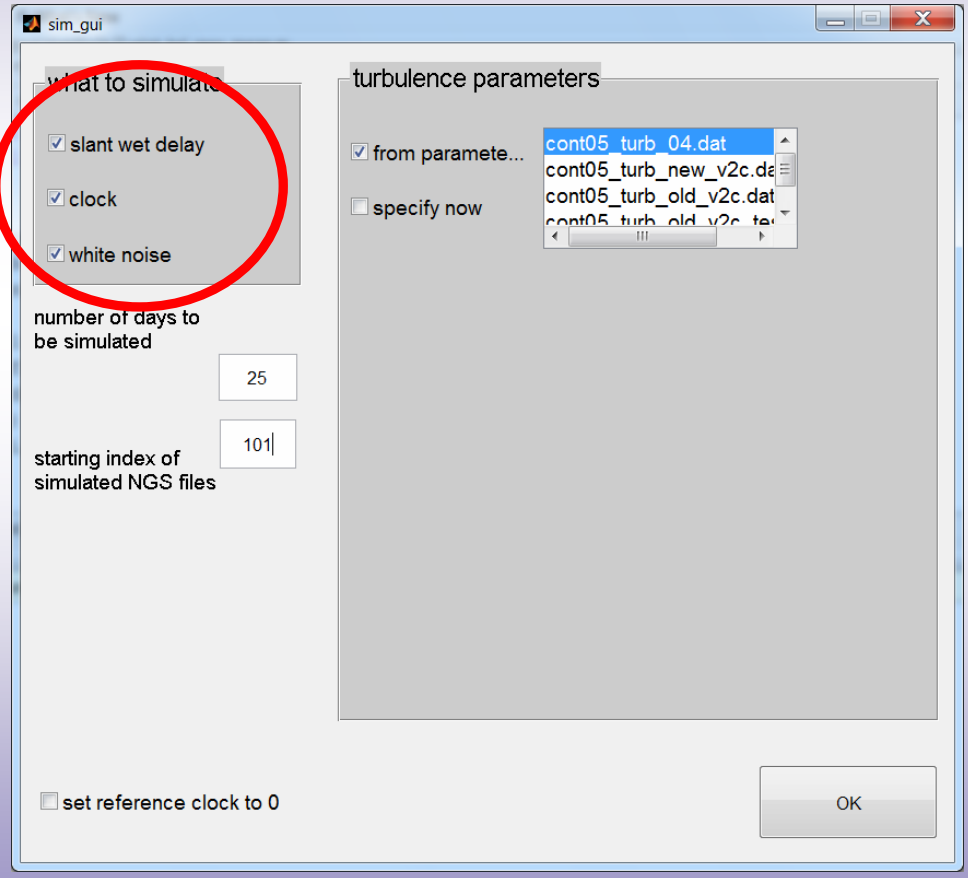




The simulator GUI

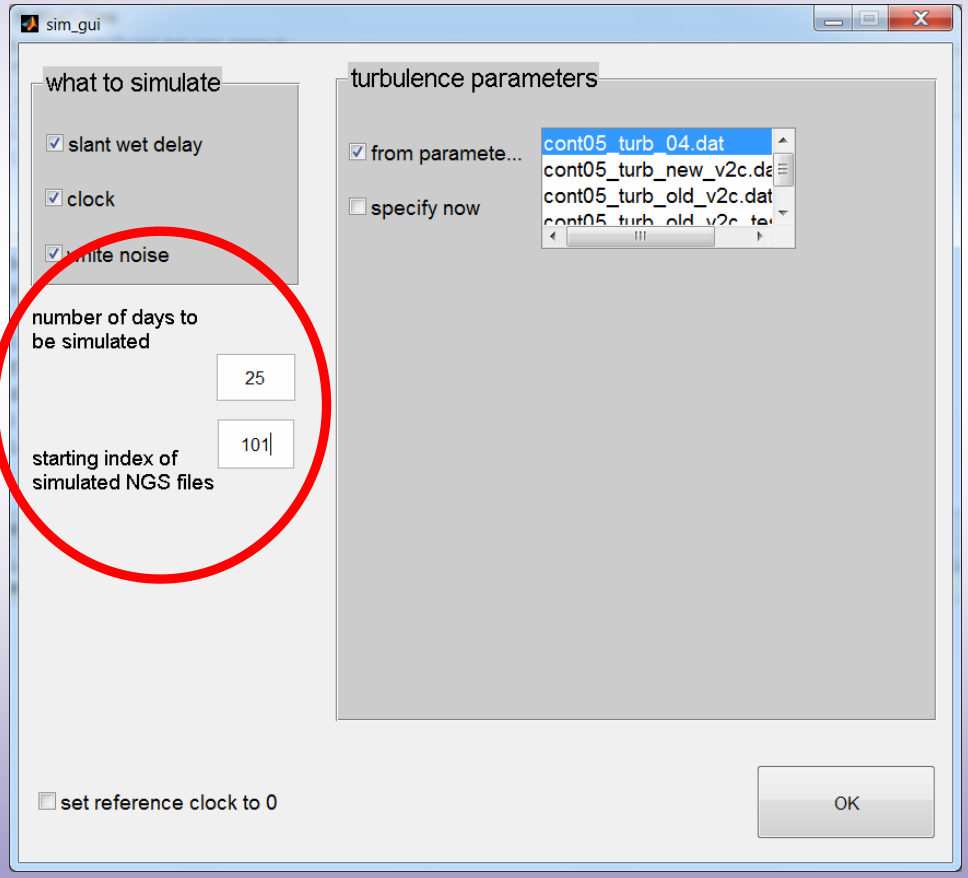
- choose the parameters to be simulated

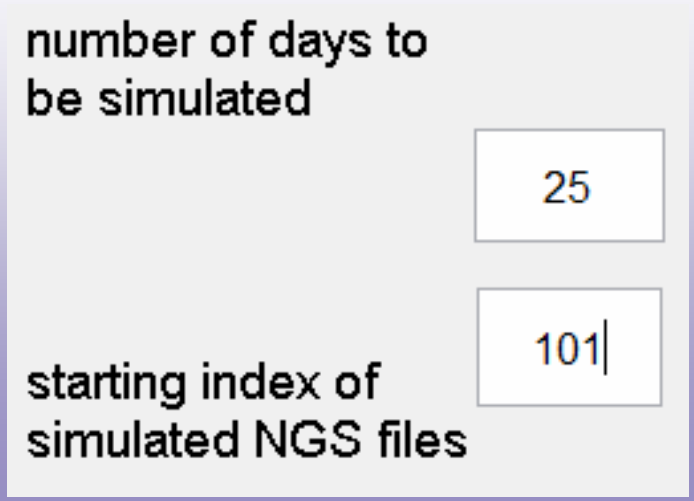




The simulator GUI

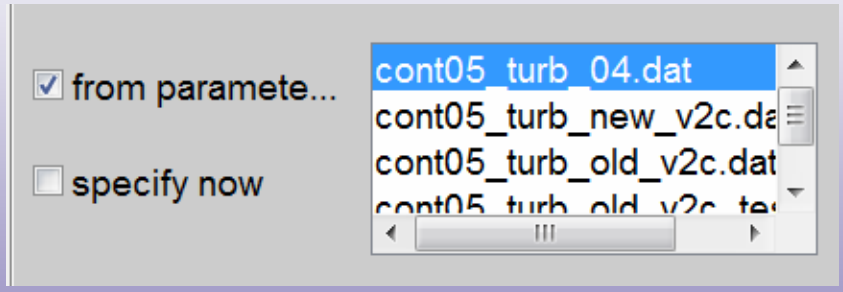
- enter the number of days and a starting point for the running number of the NGS files

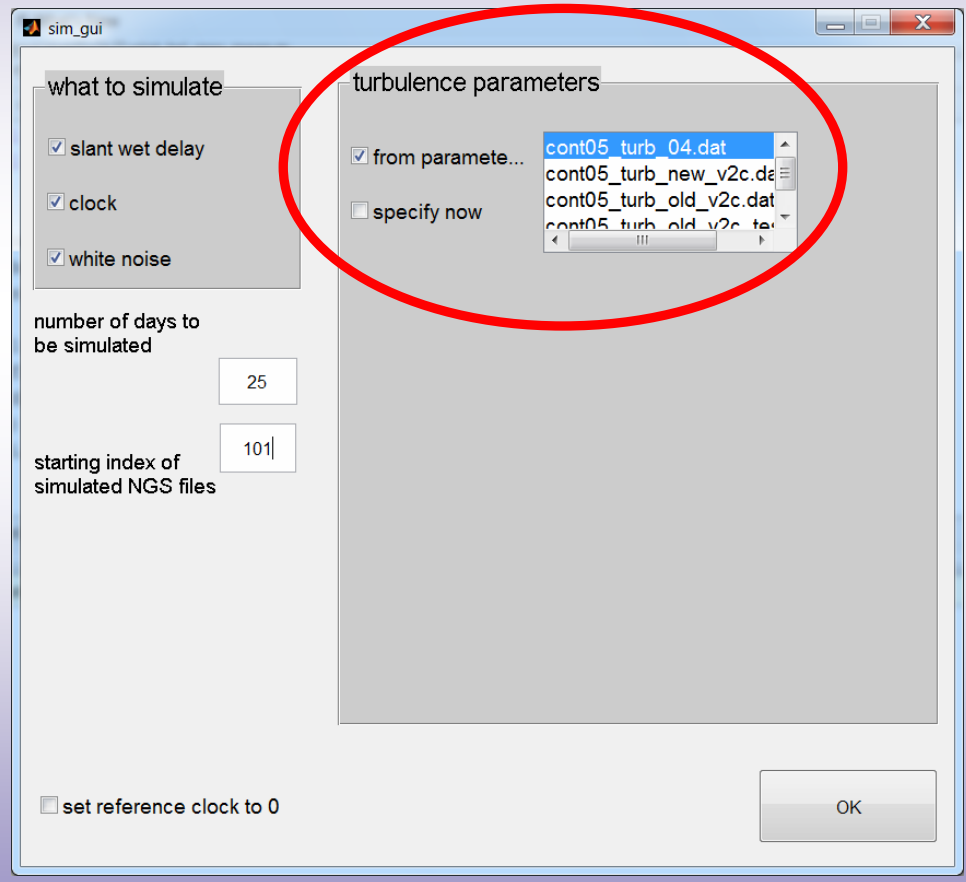




The simulator GUI

- choose a file containing the simulation parameters (can be station specific) …





Simulation parameter file

# station name	Cn	H	vn	ve	wzd0	dhseg	dh	ASD	@	wn
GILCREEK	0.80	3114	-2.72	-12.24	250	2	200	1e-14	50	30
KOKEE	1.78	2804	7.95	8.71	250	2	200	1e-14	50	30
SVETLOE	1.55	3114	11.12	-1.30	250	2	200	1e-14	50	30
WETTZELL	1.80	2518	7.25	-7.47	250	2	200	1e-14	50	30
WESTFORD	3.67	2804	6.01	-10.45	250	2	200	1e-14	50	30
NYALES20	0.95	3114	3.02	1.97	250	2	200	1e-14	50	30
TSUKUB32	2.30	2804	10.60	-0.30	250	2	200	1e-14	50	30
HARTRAO	1.47	3207	7.60	-5.56	250	2	200	1e-14	50	30
TIGOCONC	1.52	3207	8.93	-2.94	250	2	200	1e-14	50	30
ONSALA60	2.09	3114	2.57	12.49	250	2	200	1e-14	50	30
ALGOPARK	3.37	2518	-2.32	9.91	250	2	200	1e-14	50	30

station names (8 characters)

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turbulence parameters

Cn	refractive index structure constant	[$10^{-7} m^{-1/3}$]
H	effective height of wet troposphere	[m]
vn, ve	components of the wind vector	[m/s]

Simulation parameter file

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GILCREEK	0.80	3114	-2.72	-12.24	250	2	200	1e-14	50	30
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a priori zenith wet delay [mm]

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correlation interval [h] and stepwidth [m] for the numerical integration

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clock Allan Standard Deviation (ASD)

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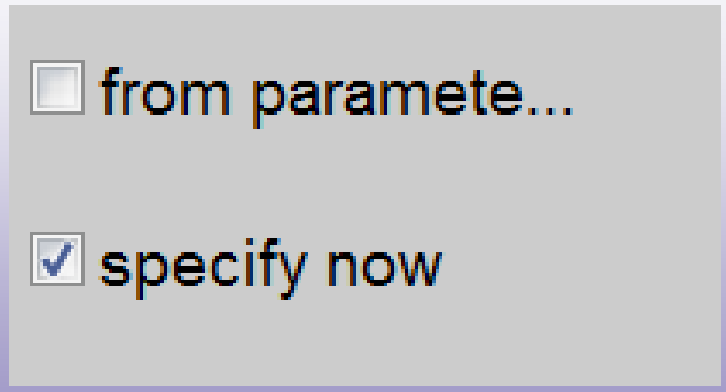
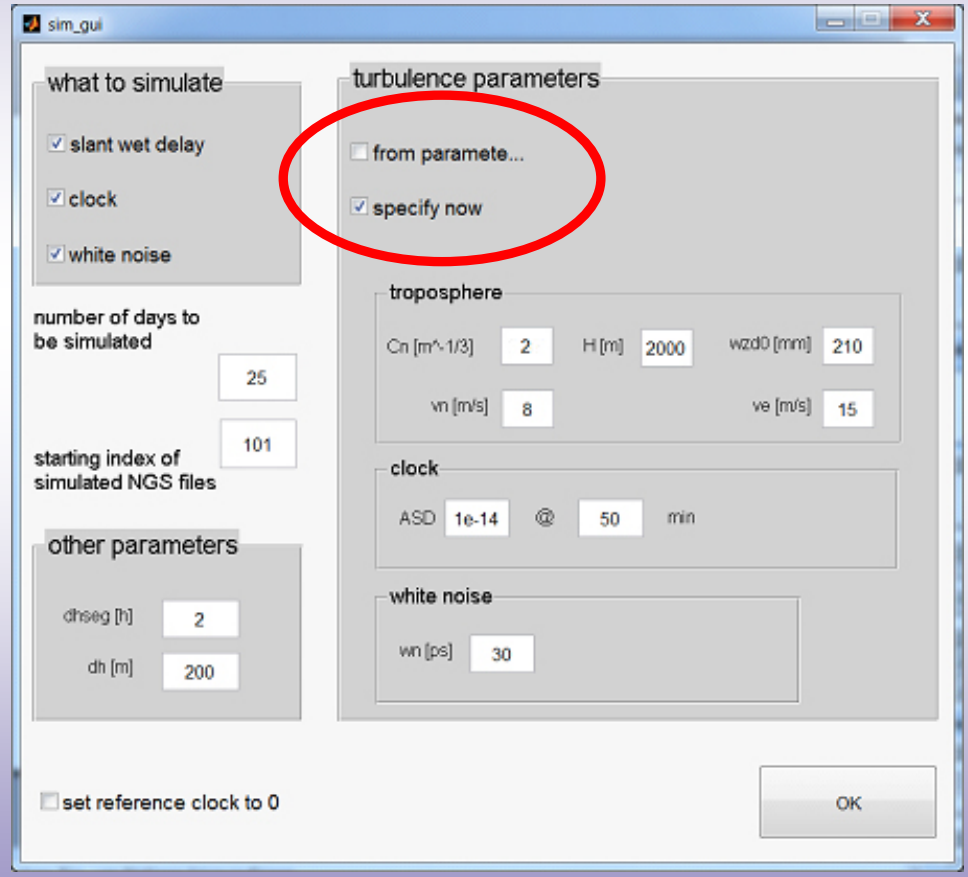
white noise [ps]

The simulator GUI

… or directly enter the values – these will then be applied to all stations

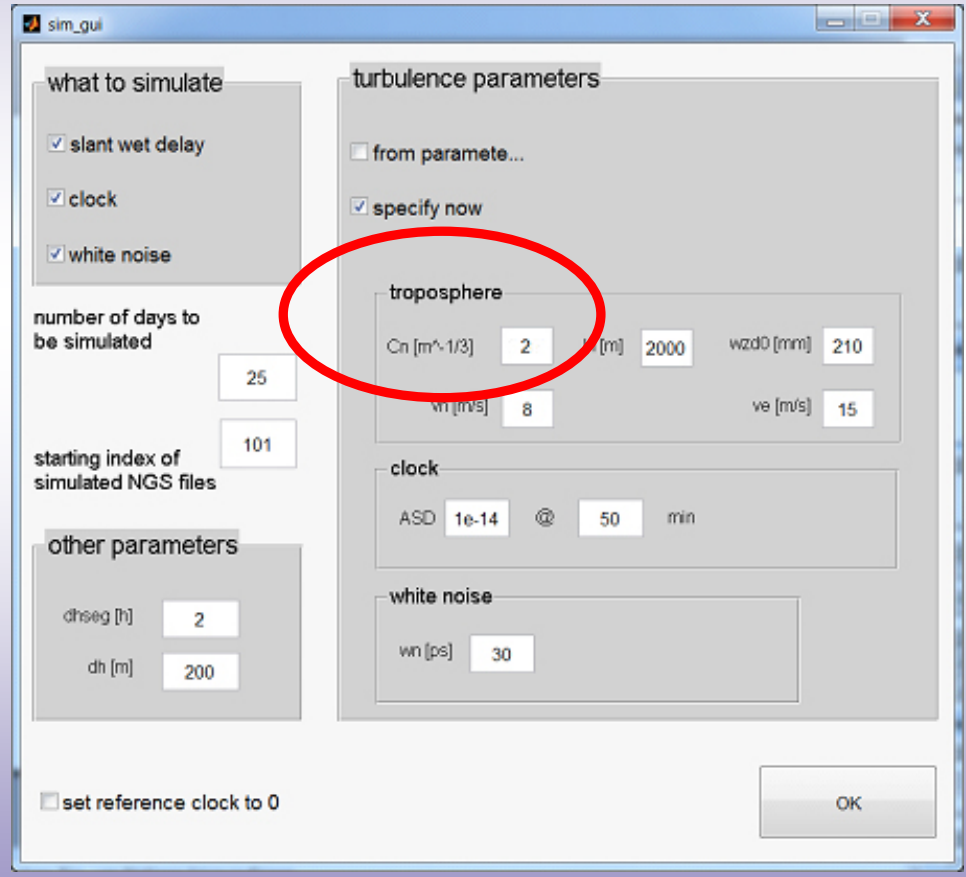




The simulator GUI

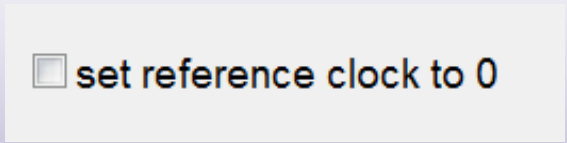
- wrong units! has to be entered in

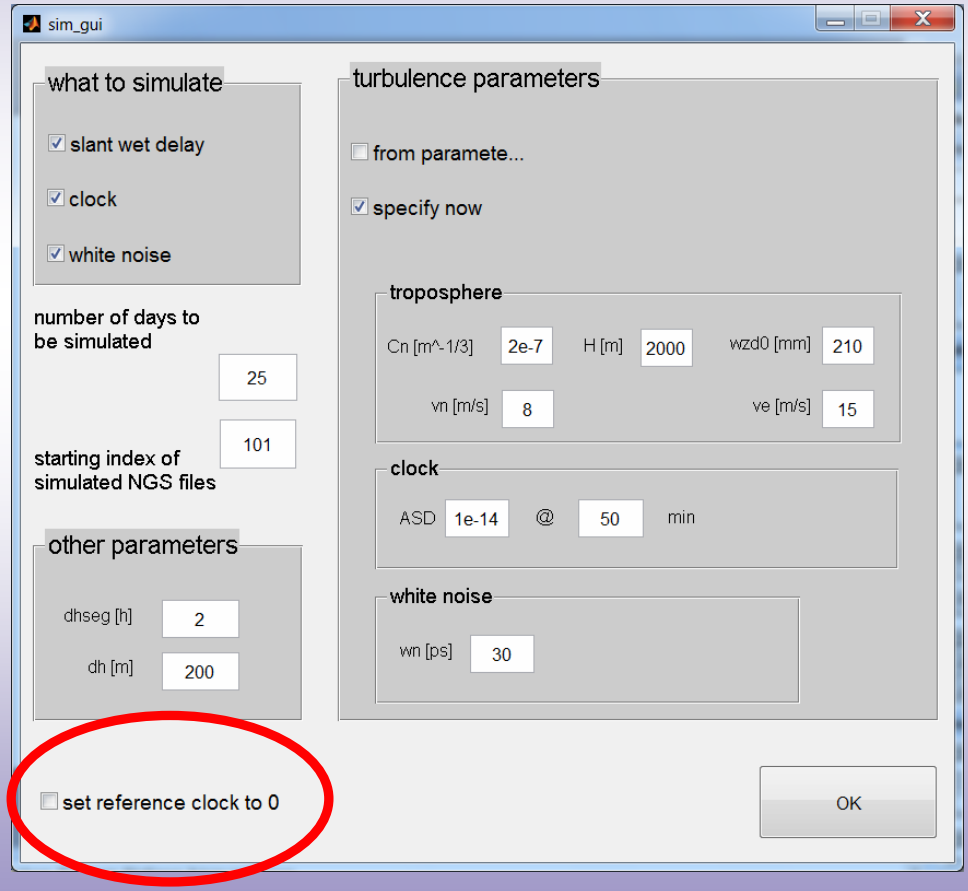
  1e-7 m $^{-1/3}$



The simulator GUI

- additional option: set reference clock to zero





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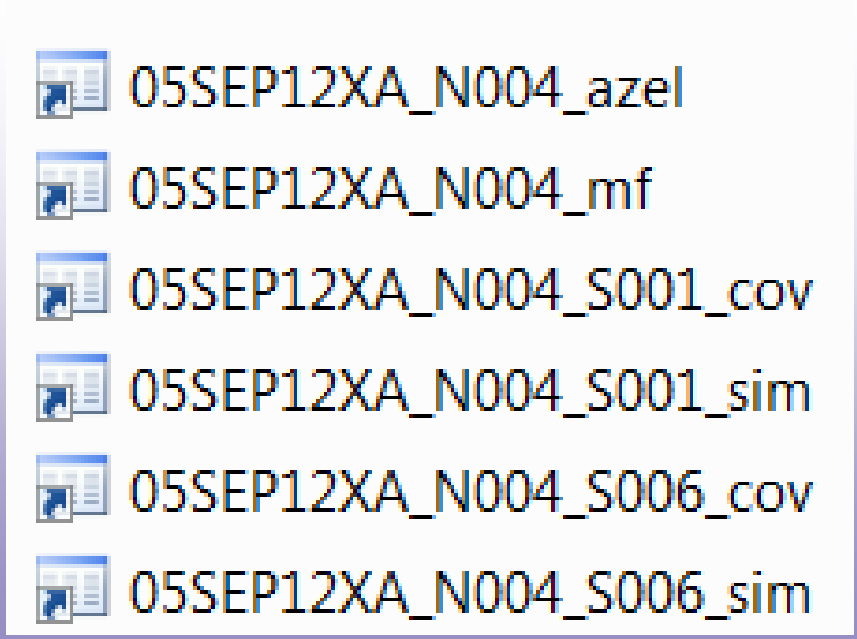

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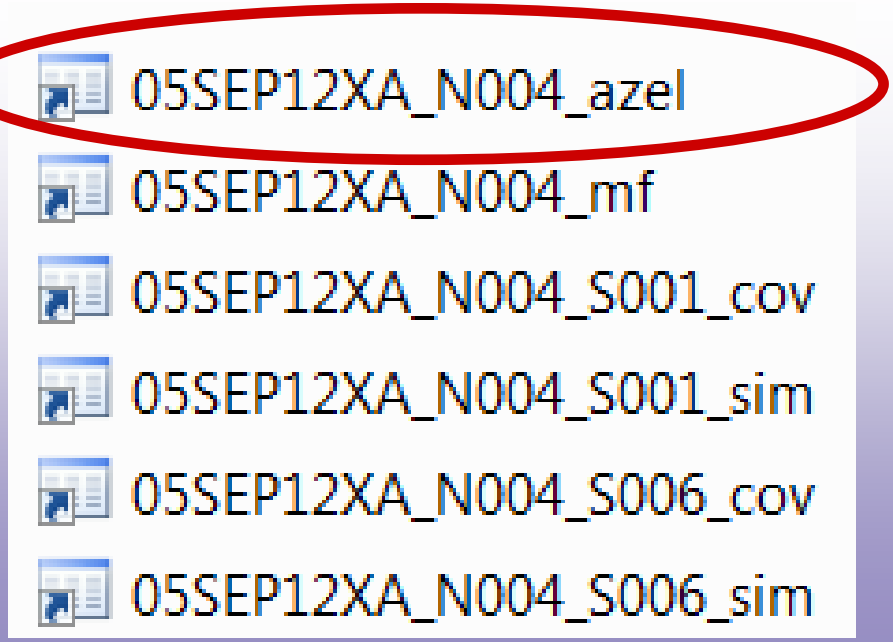

a MATLAB structure array that contains az, el, and MJD sorted by station

stored only once for each session

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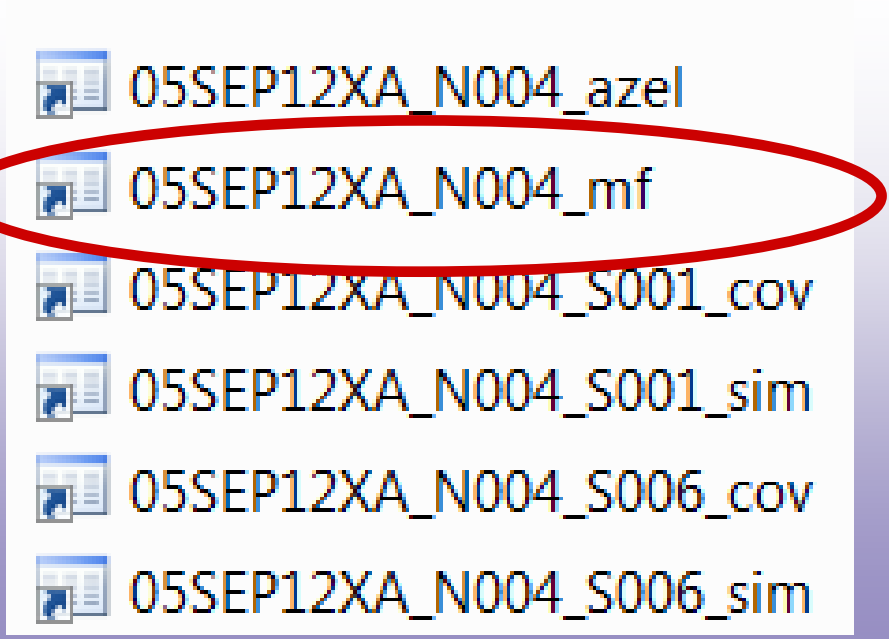
  VieVS / DATA / SIM / year
- in DATA / LEVEL4 / your_dir you find

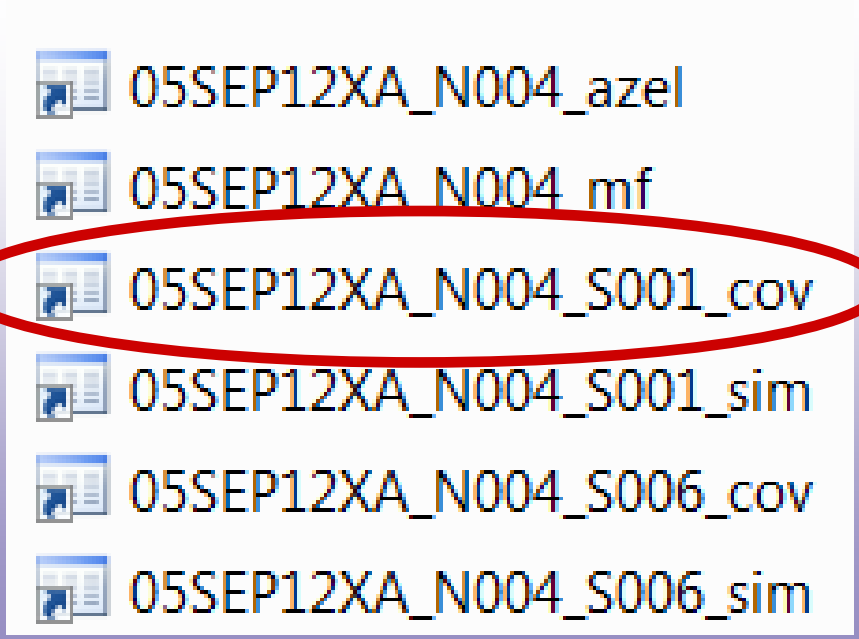


a MATLAB structure array that contains the mapping function sorted by station

stored only once for each session

Where the data are stored

- simulated NGS files are stored to VieVS / DATA / SIM / year
- in DATA / LEVEL4 / your_dir you find



a MATLAB structure array that contains the simulated correlation matrices for each station

stored for each simulation

Where the data are stored

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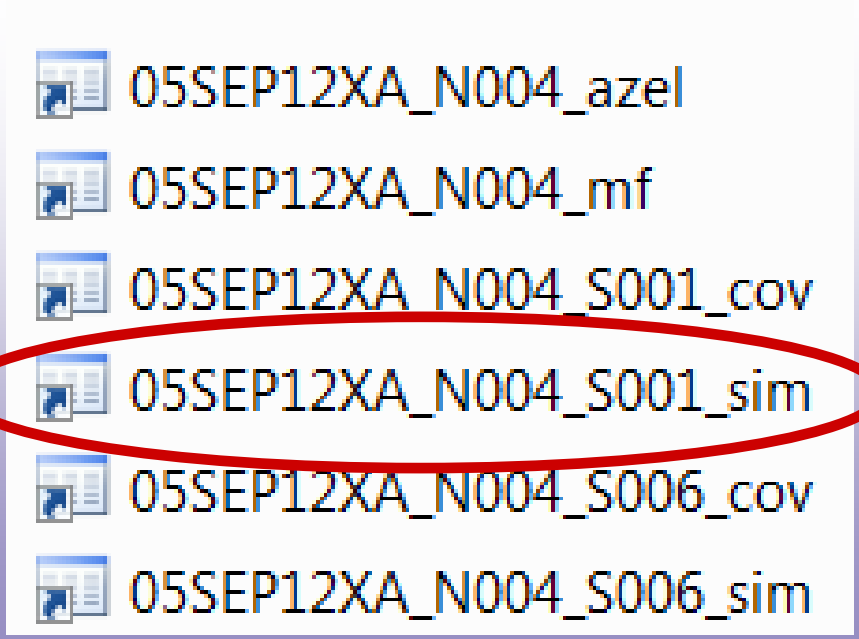
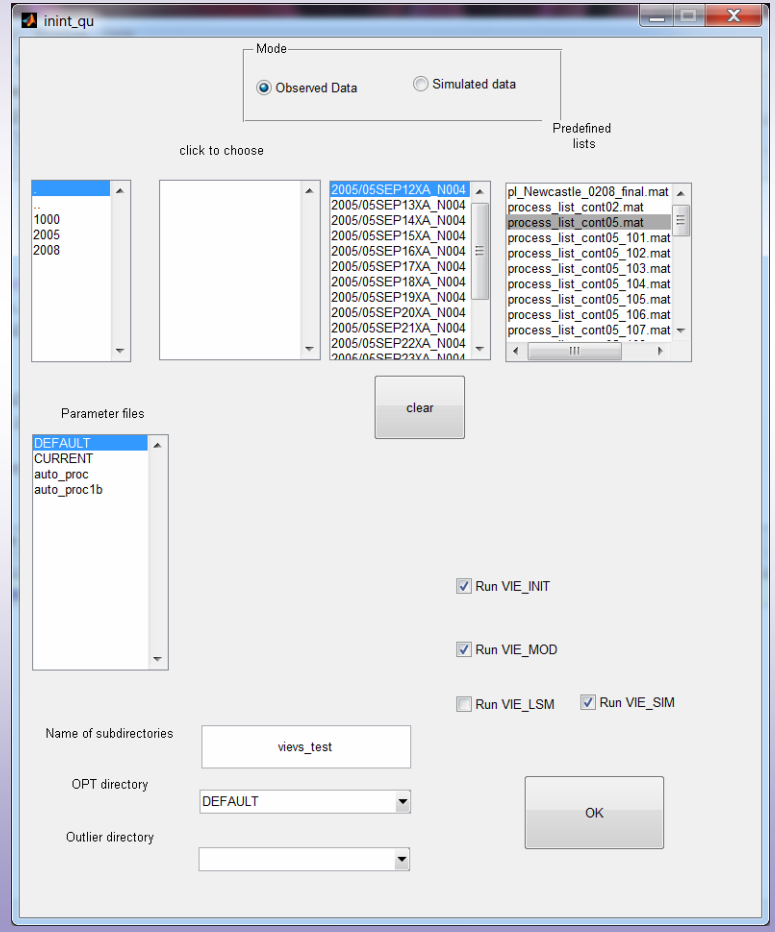


a MATLAB structure array that contains the simulated values of swd, clk, and wn for each station

stored for each simulation

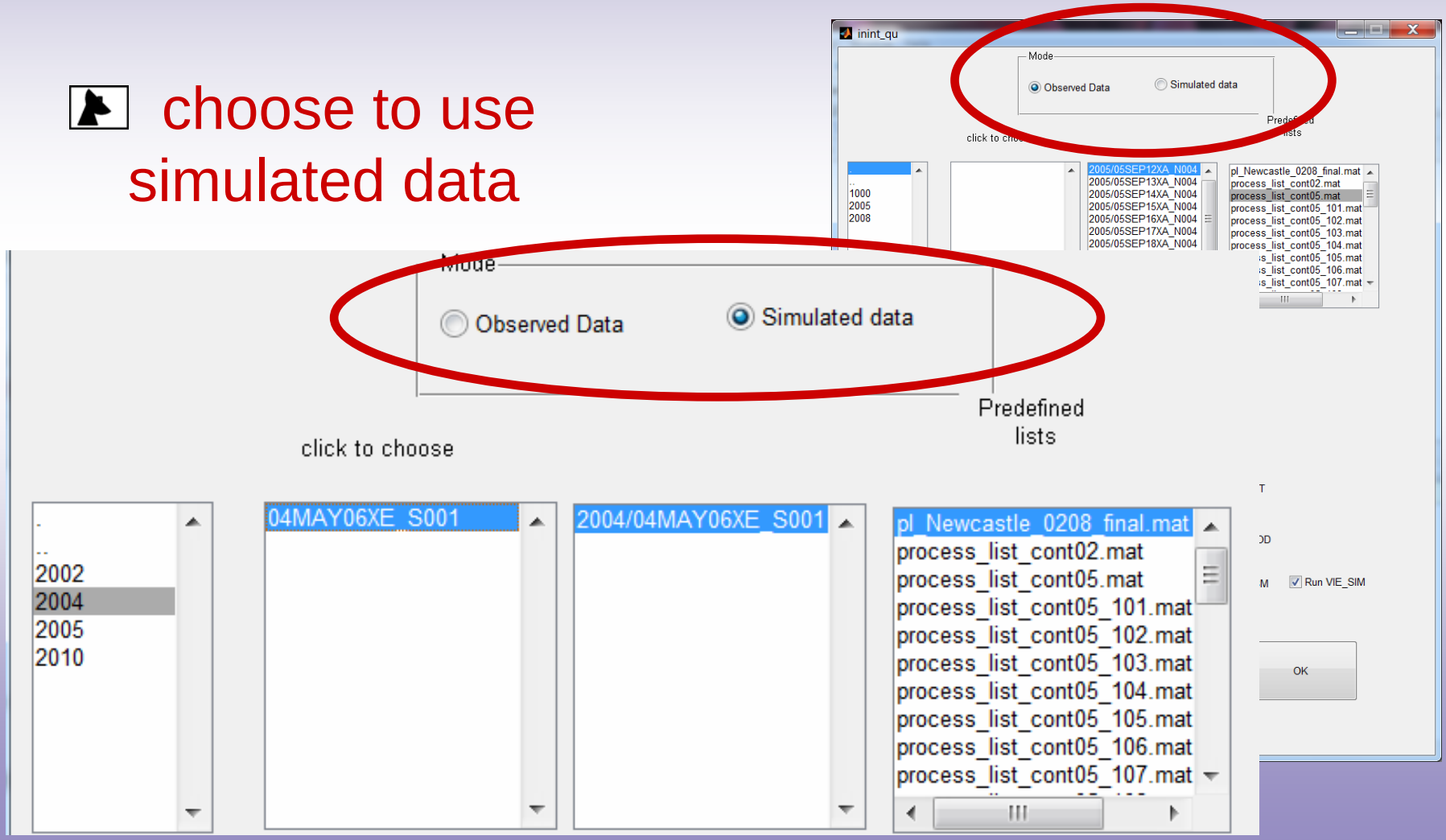
How to process simulated data

- start VieVS as usual



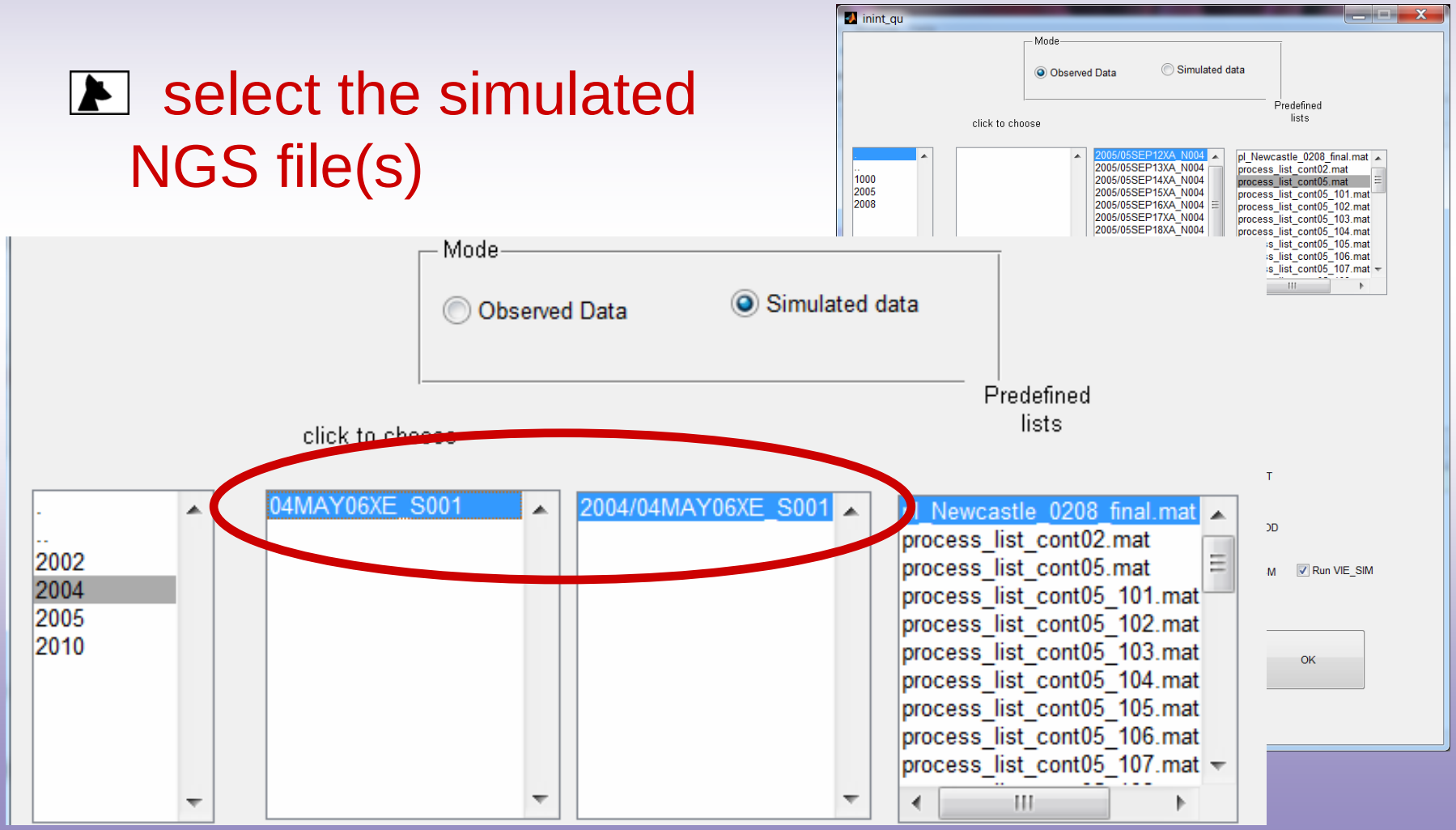
How to process simulated data

- choose to use simulated data



How to process simulated data

- select the simulated NGS file(s)



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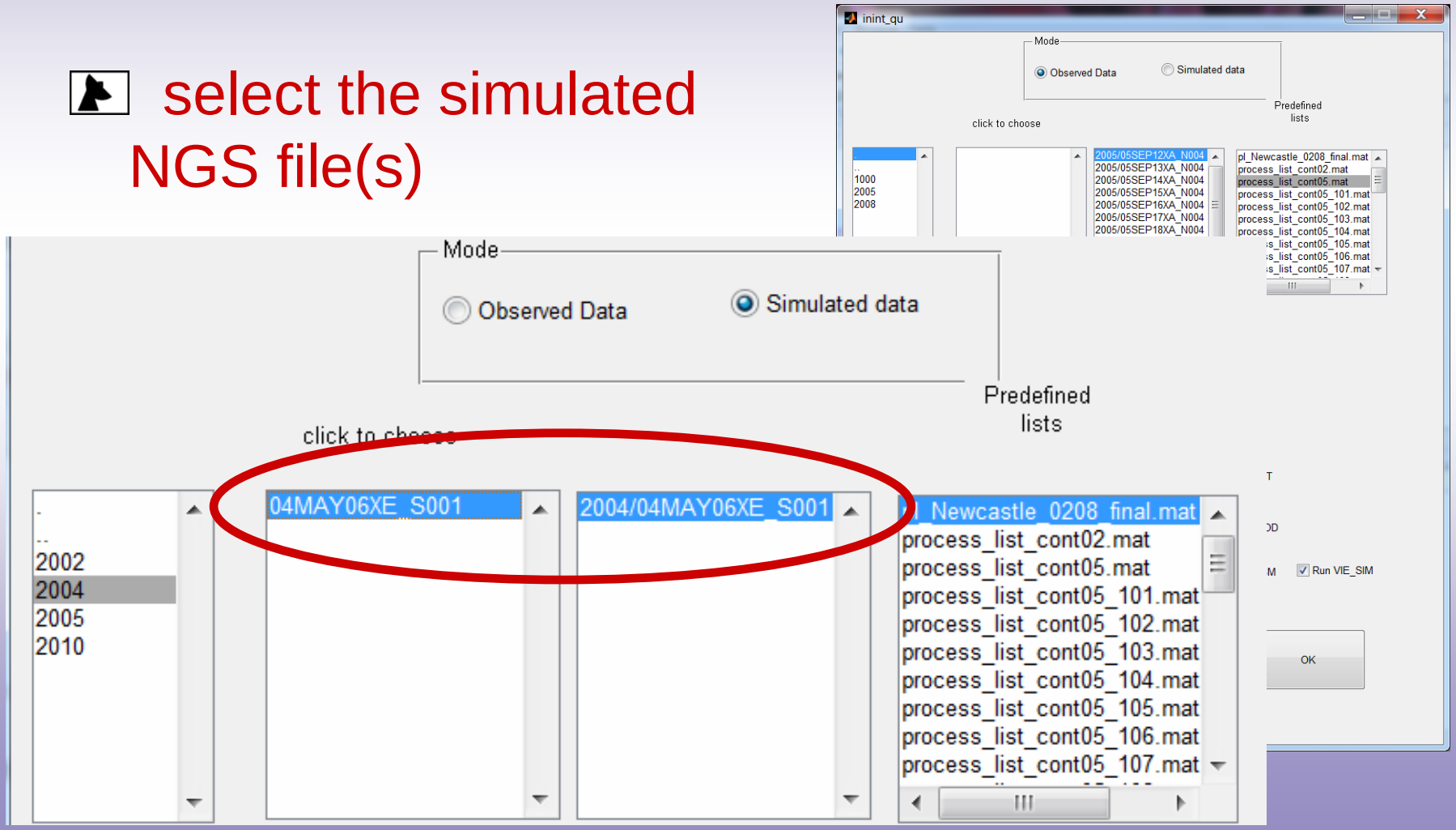
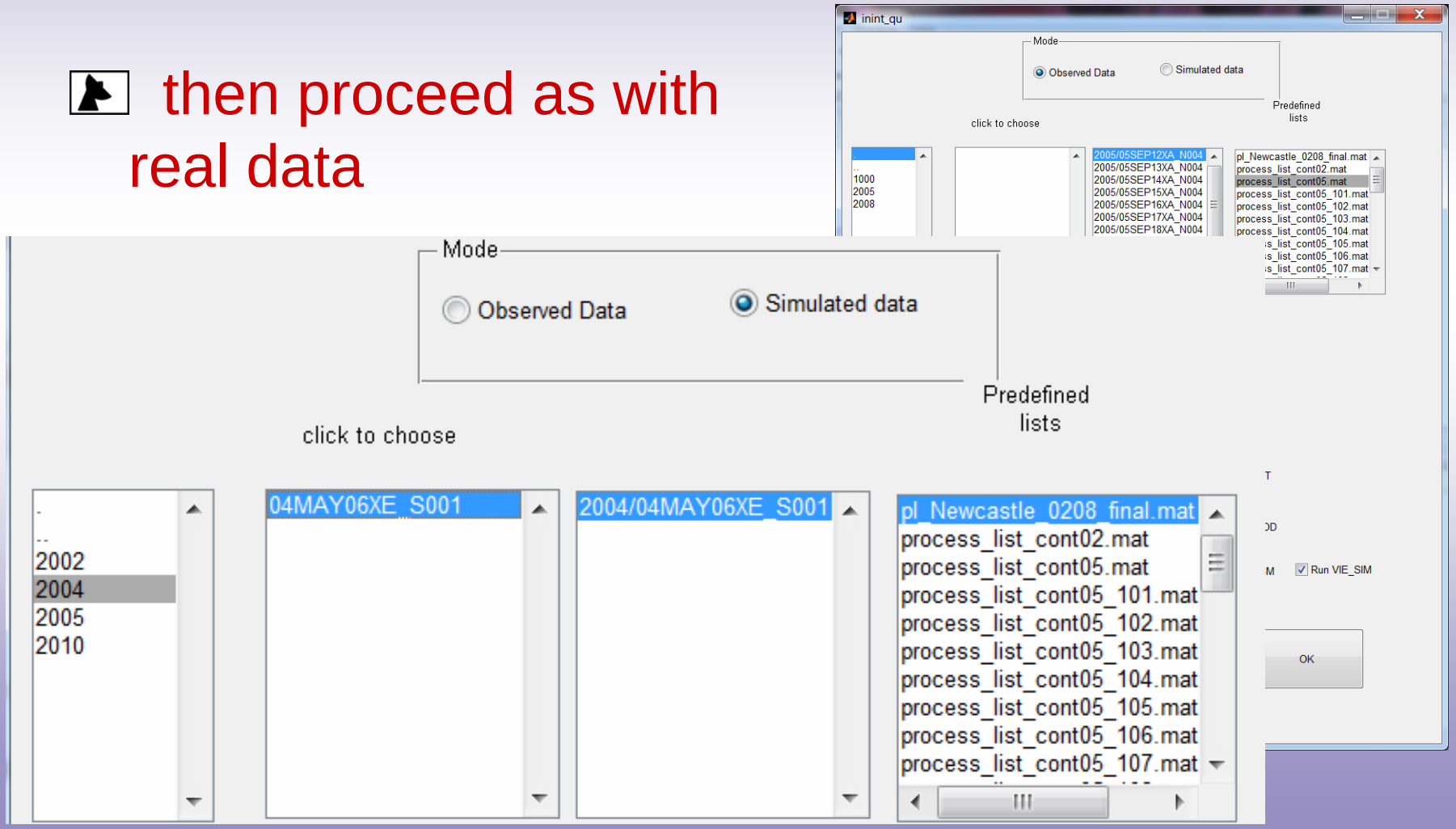


How to process simulated data

- then proceed as with real data



Validation of the simulator

- comparison of real and simulated data for the CONT05 experiment:

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- two sets of turbulence parameters (Nilsson and Haas, JGR, 2010)
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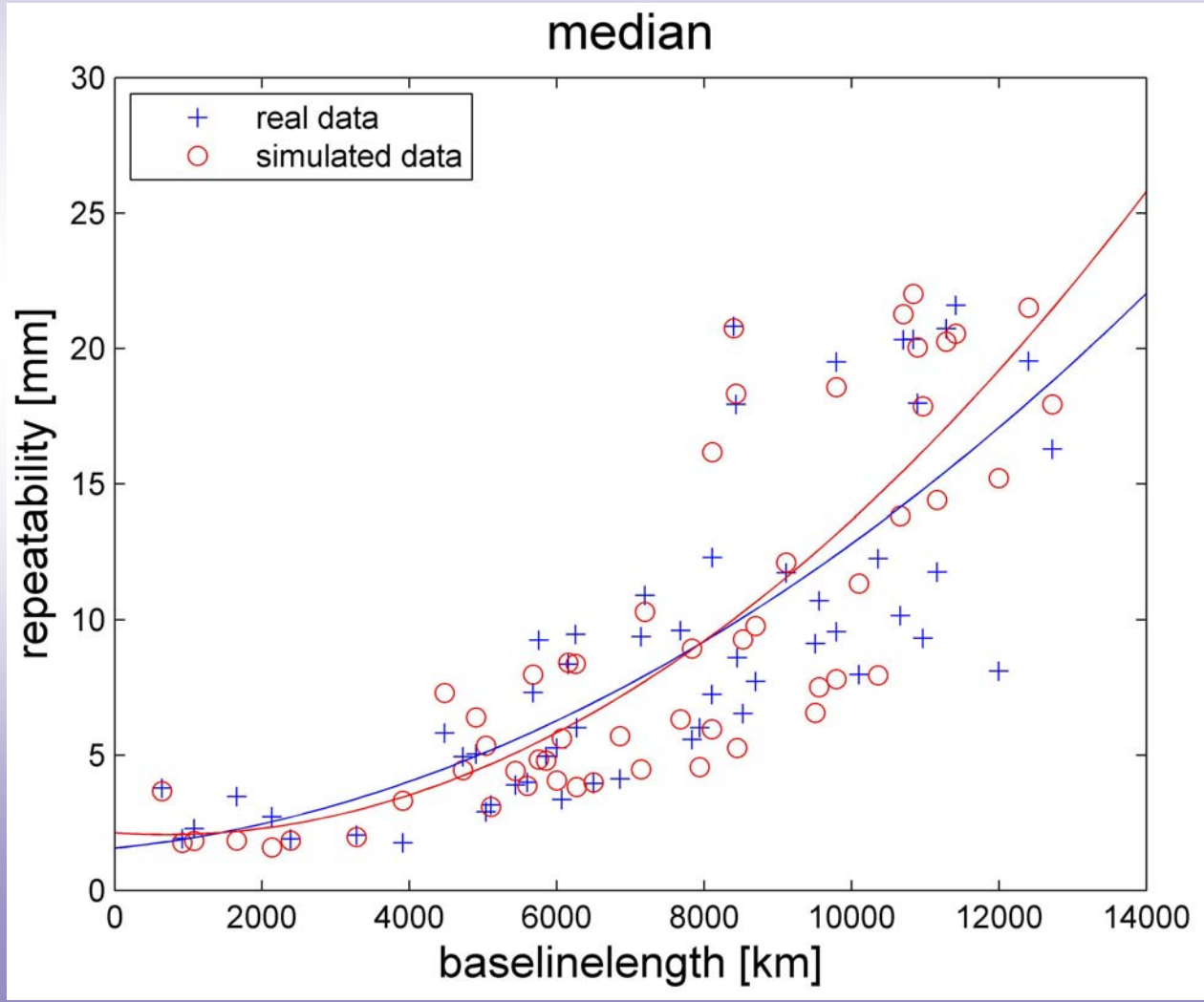
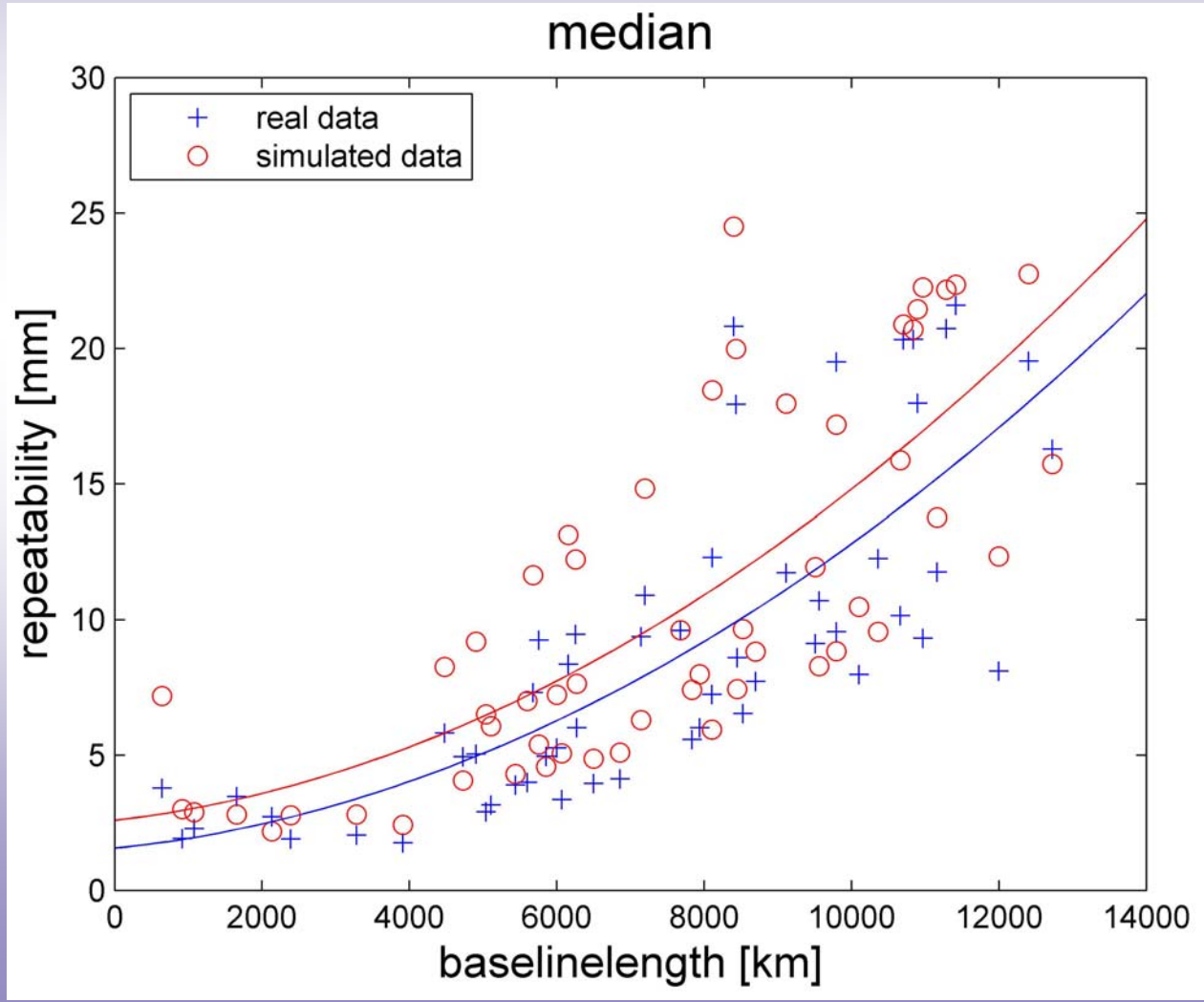
  - GPS derived
- ASD 1e-14 @ 50 min, wn set to the formal delay error reported for CONT05
- 25x15 days simulated -> median baseline lengths computed

Validation of the simulator

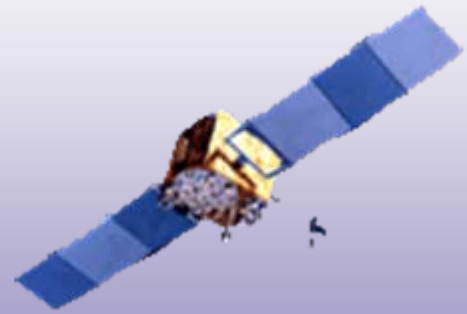


radio sonde derived turbulence parameters

Validation of the simulator

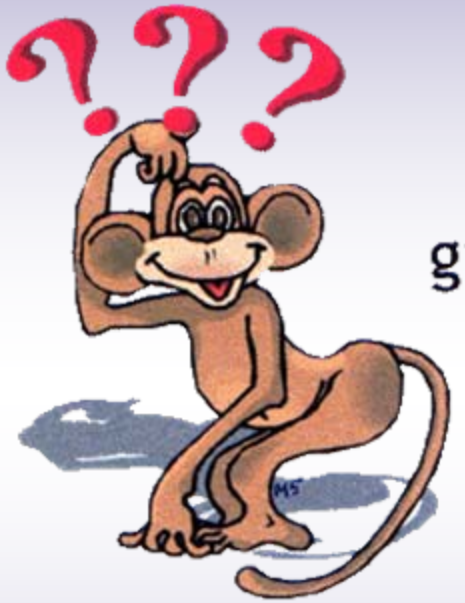


GPS derived turbulence parameters



PLEASE MIND THAT VIE_SIM IS STILL WORK IN PROGRESS!

IT MIGHT CRASH IN SOME CASES!



Questions
are
guaranteed in
life;
Answers
aren't.

problems? questions?
mail to **andrea.pany@tuwien.ac.at**