

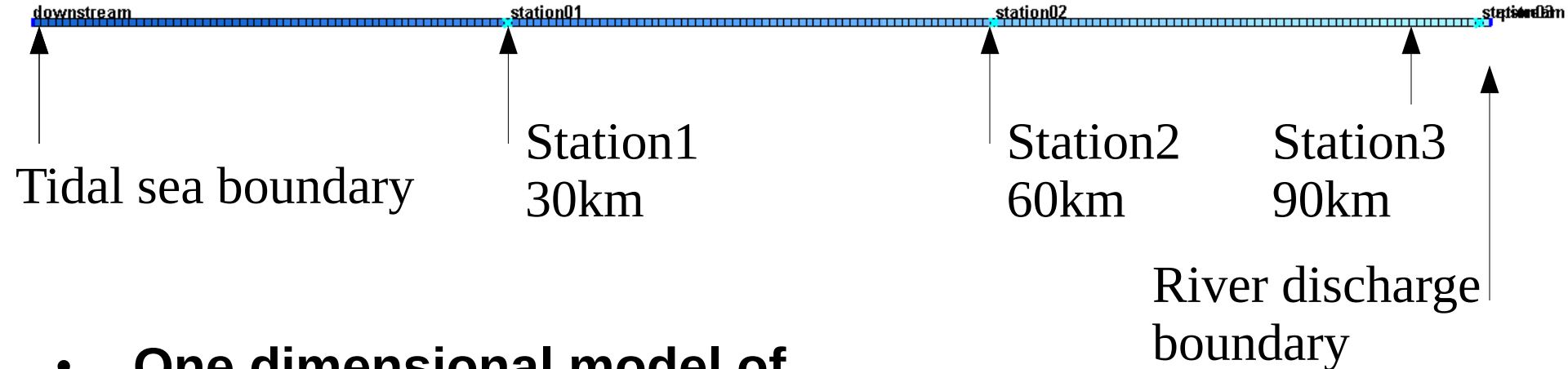
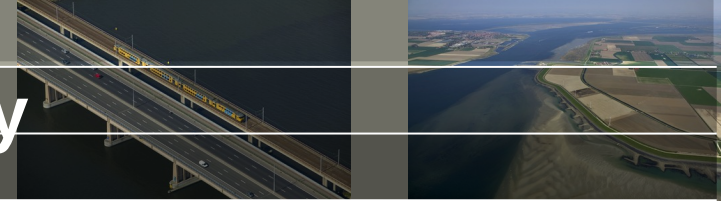


[www.openda.org](http://www.openda.org)

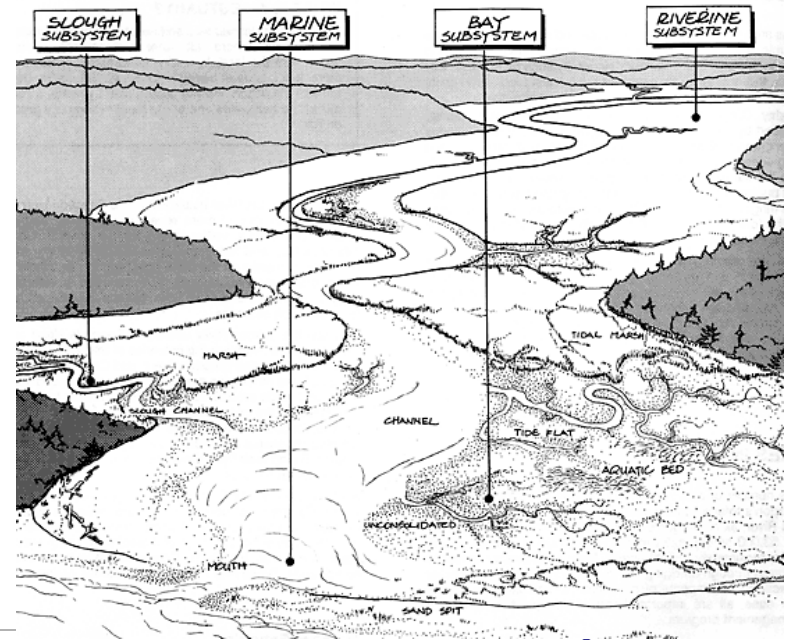
# Calibration of an estuary with Delft3D-FM

**Martin Verlaan, Nils van Velzen,  
Werner Kramer, Alja Vrieling, ...  
Deltares, TU Delft, VORtech**

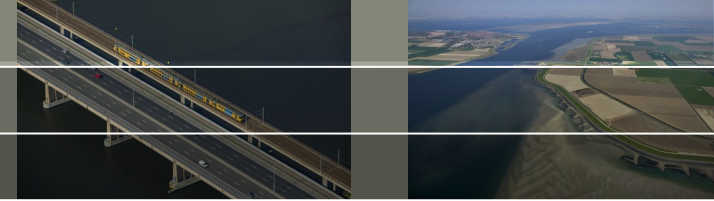
# Simplified model of an estuary



- One dimensional model of 100km length
- Tidal boundary (left) M2 (12h25min) and S2 (12h)
- Constant slope depth
- River inflow  $500\text{m}^3/\text{s}$
- 3 Observation locations
- Observations are not real but generated with 'truth' model.

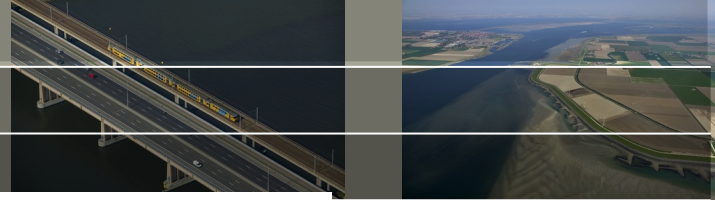


# Questions part 1

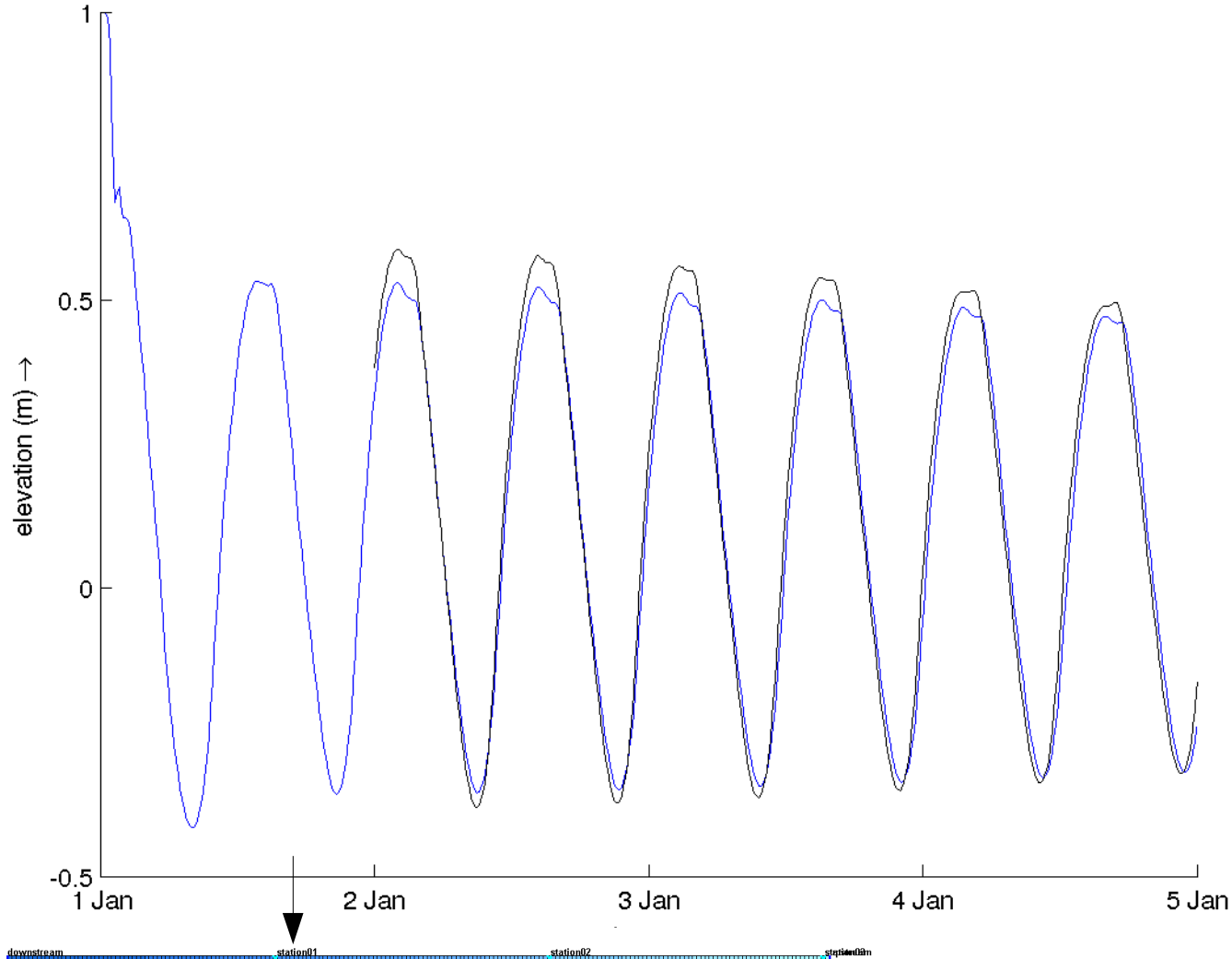


- Download estuary\_dflow.zip from <http://www.openda.org/course> and unpack
- Delft3D-FM plugin for OpenDA is standard from OpenDA v2.2
- Run the simulation with OpenDA, using the main OpenDA file `oda_run_gui.bat` ->and open `Simulation.oda` → start run
- Prepare some time-series plots with quickplot
  - Start matlab in direcory `src/tools_lgpl/matlab/quickplot/progrsrc` and run `d3d_qp` or start quickplot from your Delft3D release.
  - the observations are available as noos files in folder `stochObserver`. Use add to plot and change the color.
  - Model output can be found in `stochModel/work0/DFM_output_estuary`
- What are the most likely causes of differences between observations and model?

# Initial performance

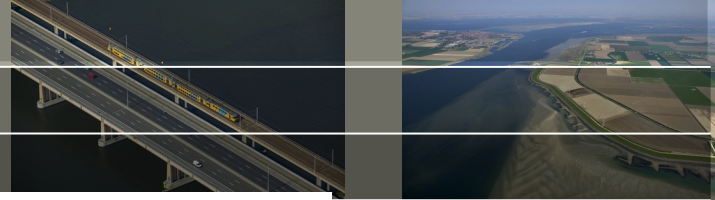


station01

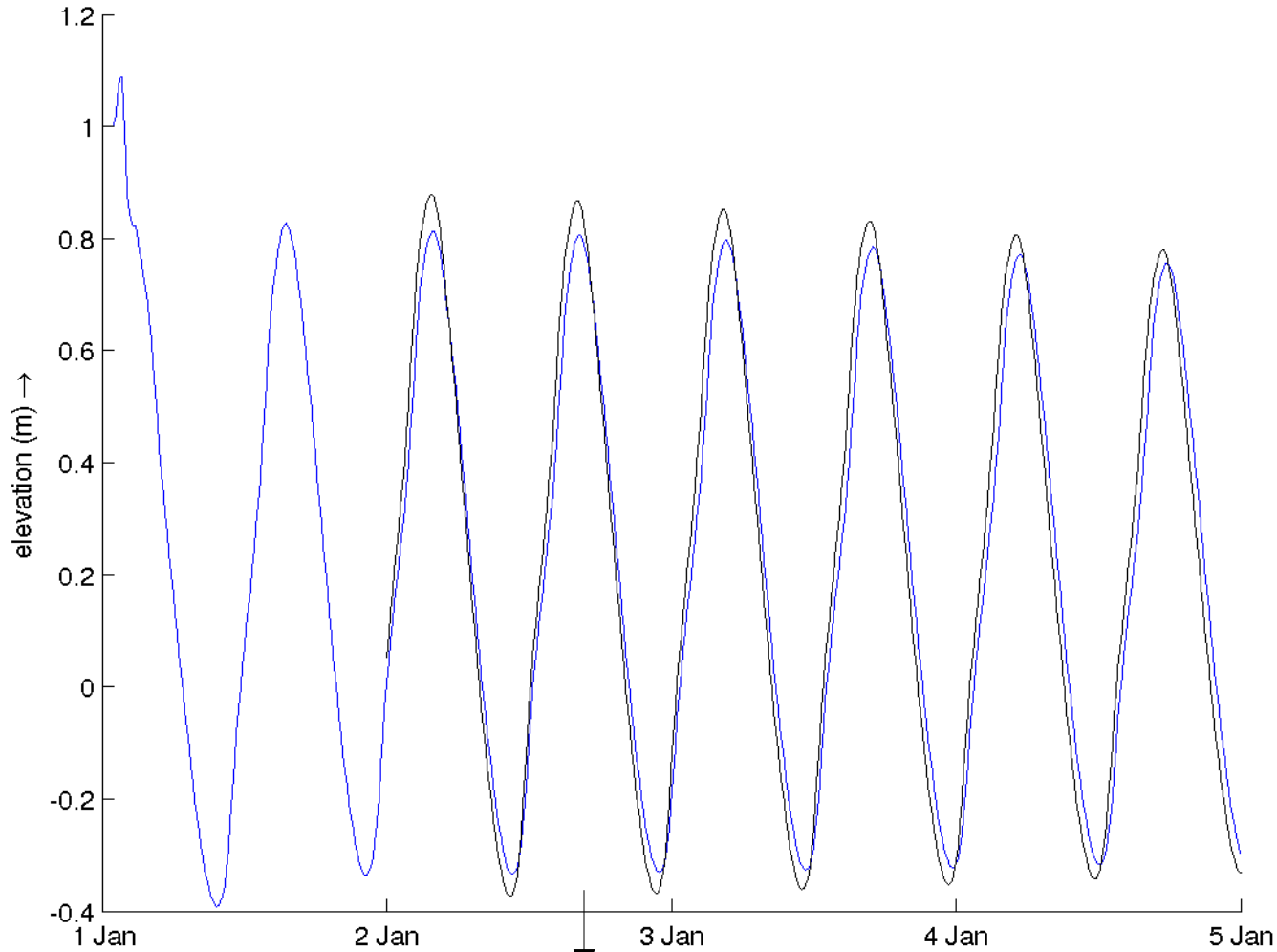


RMSE=4.3cm

# Initial performance



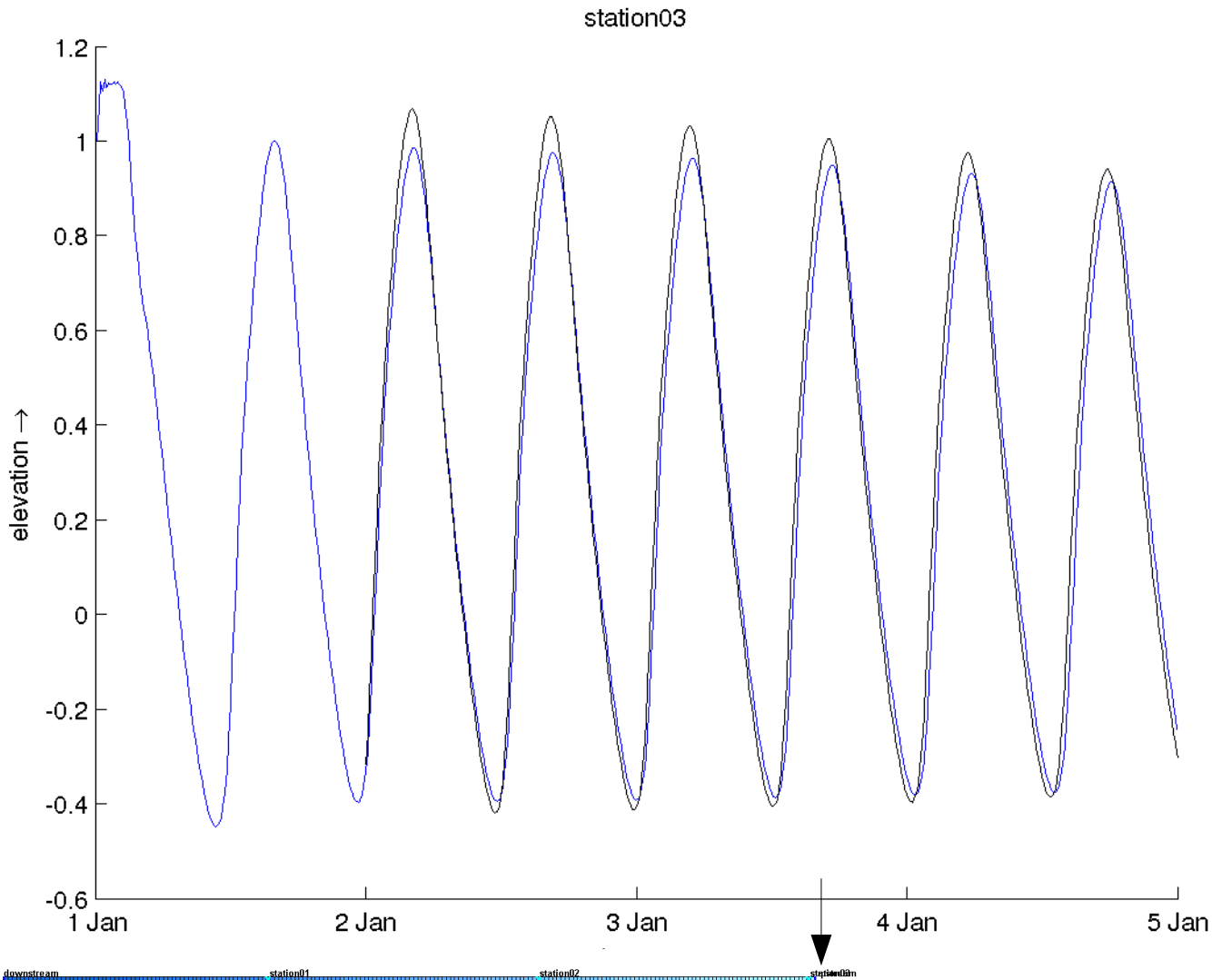
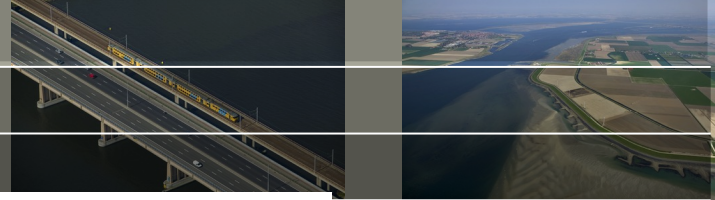
station02



RMSE=7.4cm

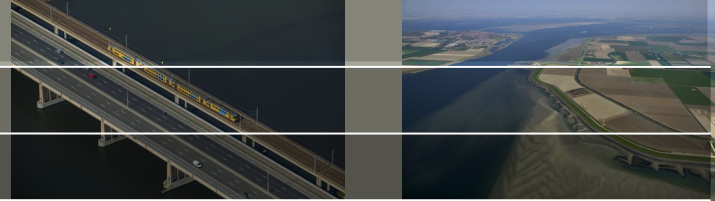
downstream station01 station02 station03

# Initial performance



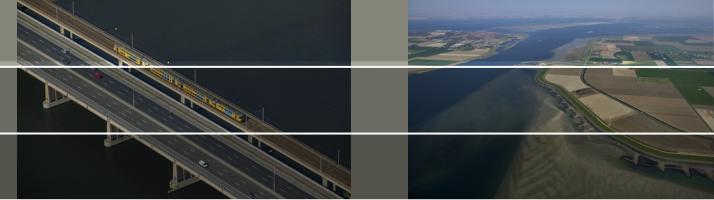
RMSE=7.4cm

# Questions part 2



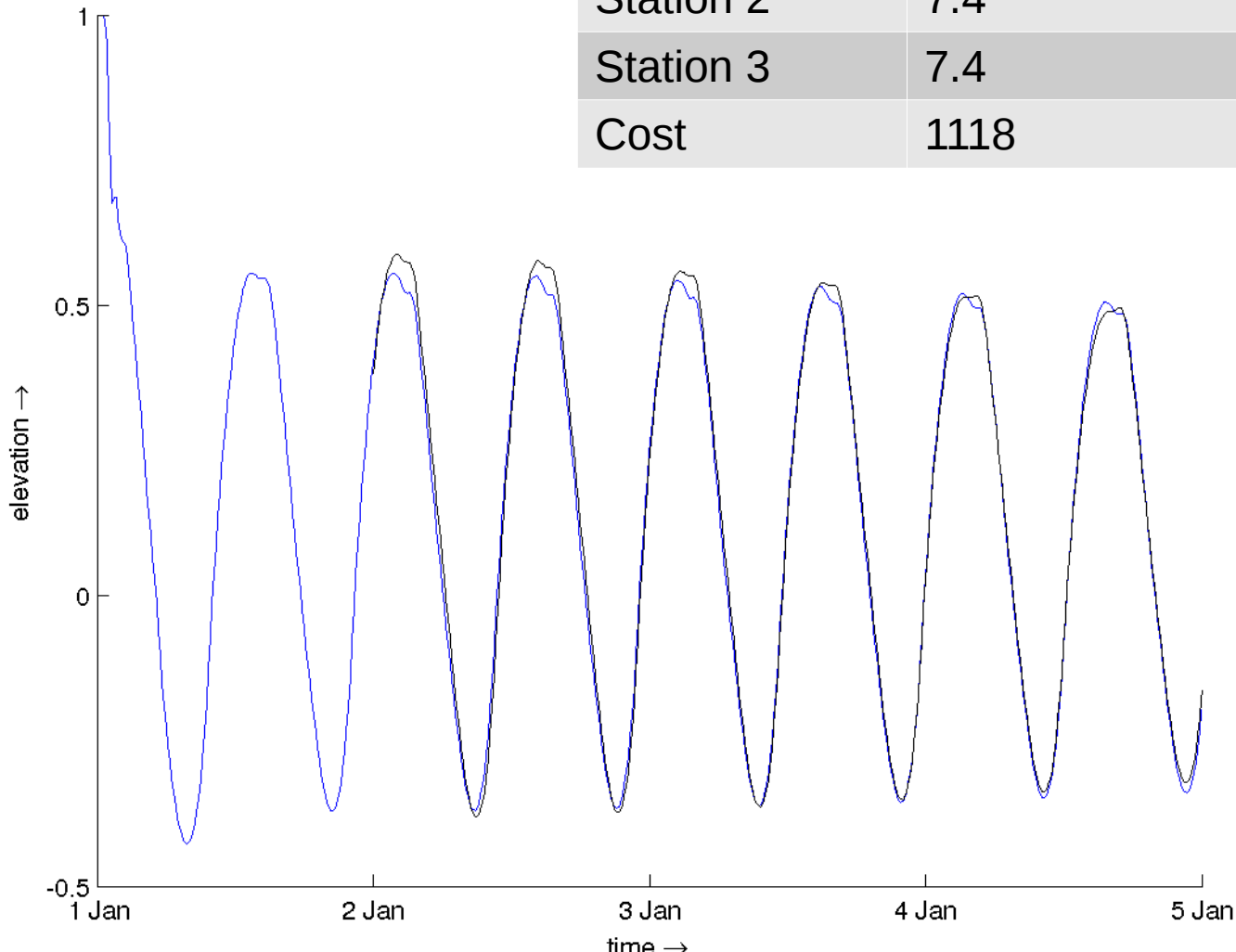
- Run the calibration for change to the M2 tidal constituent for the western boundary (experiment M2)
  - Start OpenDA with `oda_run_gui.bat` → `Dud.oda`
  - Look at the output in the control tab and output tab
  - Note the output in the result files `results_dud.csv` and `results_dud.m`
  - The output of each of the runs can be found in `work/work<number>`. For historical reasons the real runs start in `work2` for DUD.
  - Plot the time-series with `quickplot`.
- Is this what you expected?

# Calibration M2



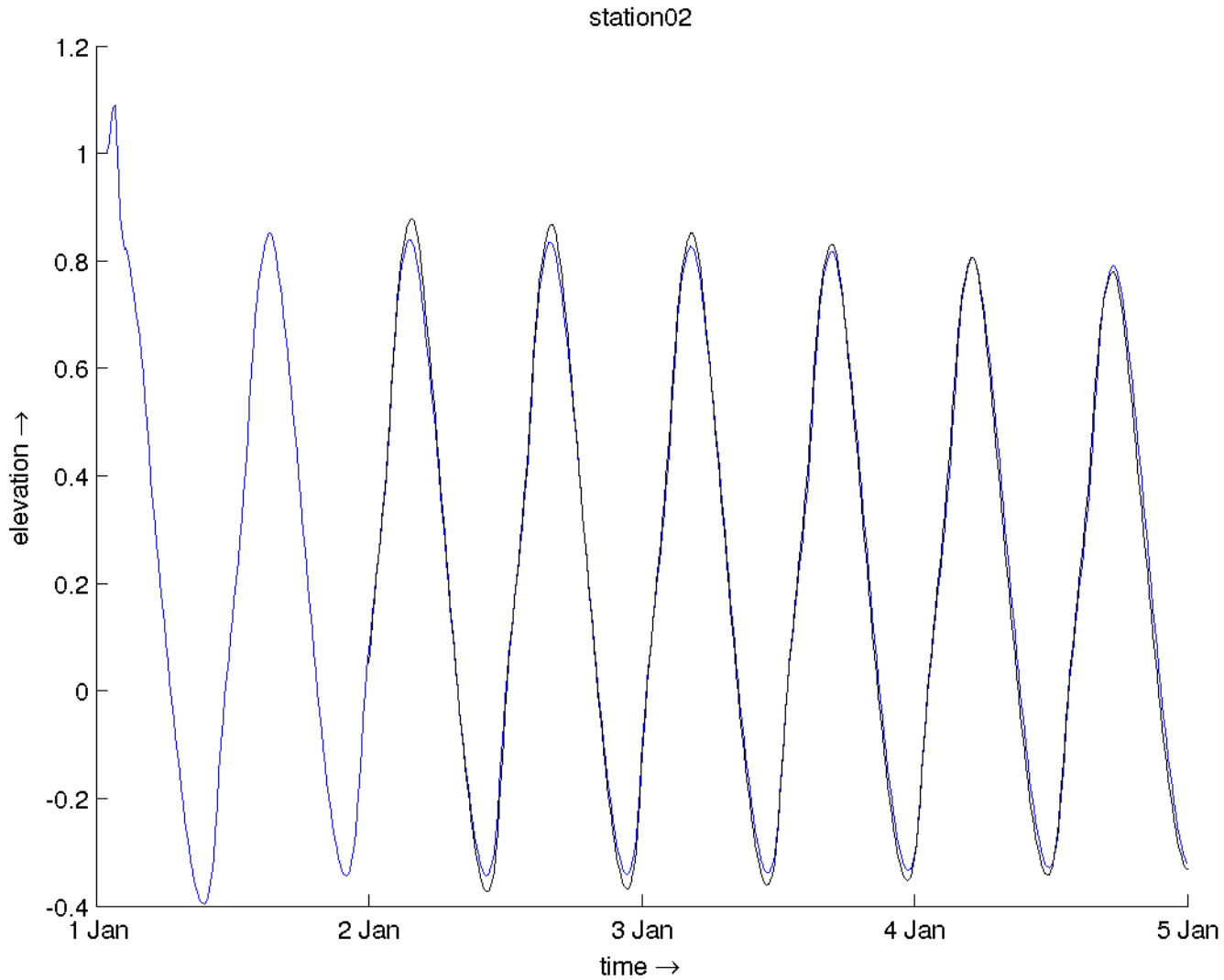
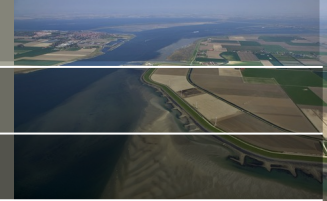
## Station 1

Name	First guess	M2 calib.
Station 1	4.3 cm	2.2
Station 2	7.4	2.5
Station 3	7.4	2.6
Cost	1118	154

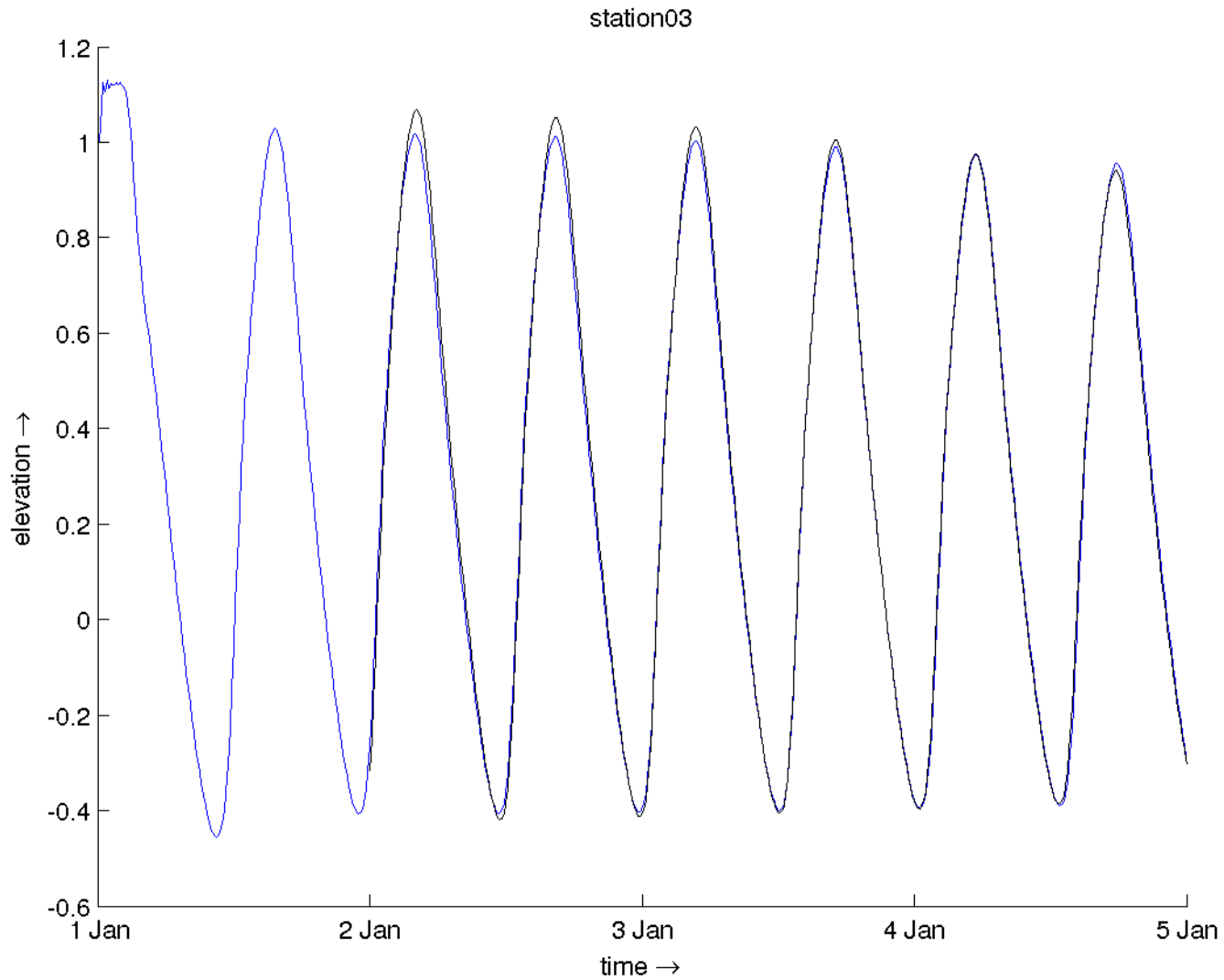
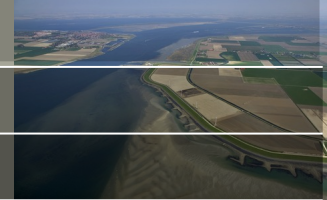




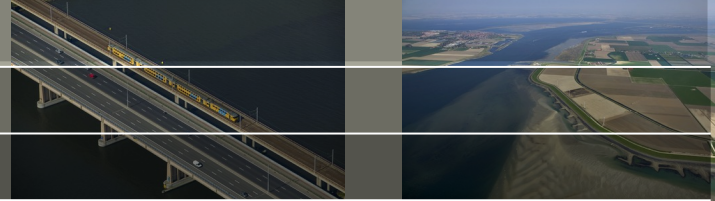
# M2 output Station 2



# M2 output Station 3



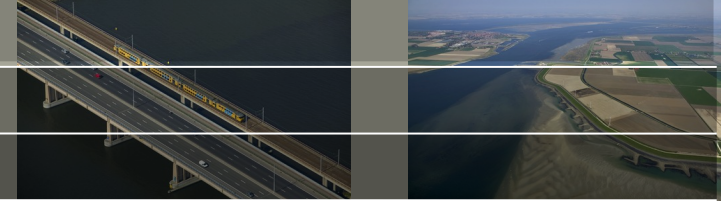
# Questions part 3



**Although the accuracy is much improved. We still see small phase differences. Let us try to add a calibration of the bathymetry to the optimization.**

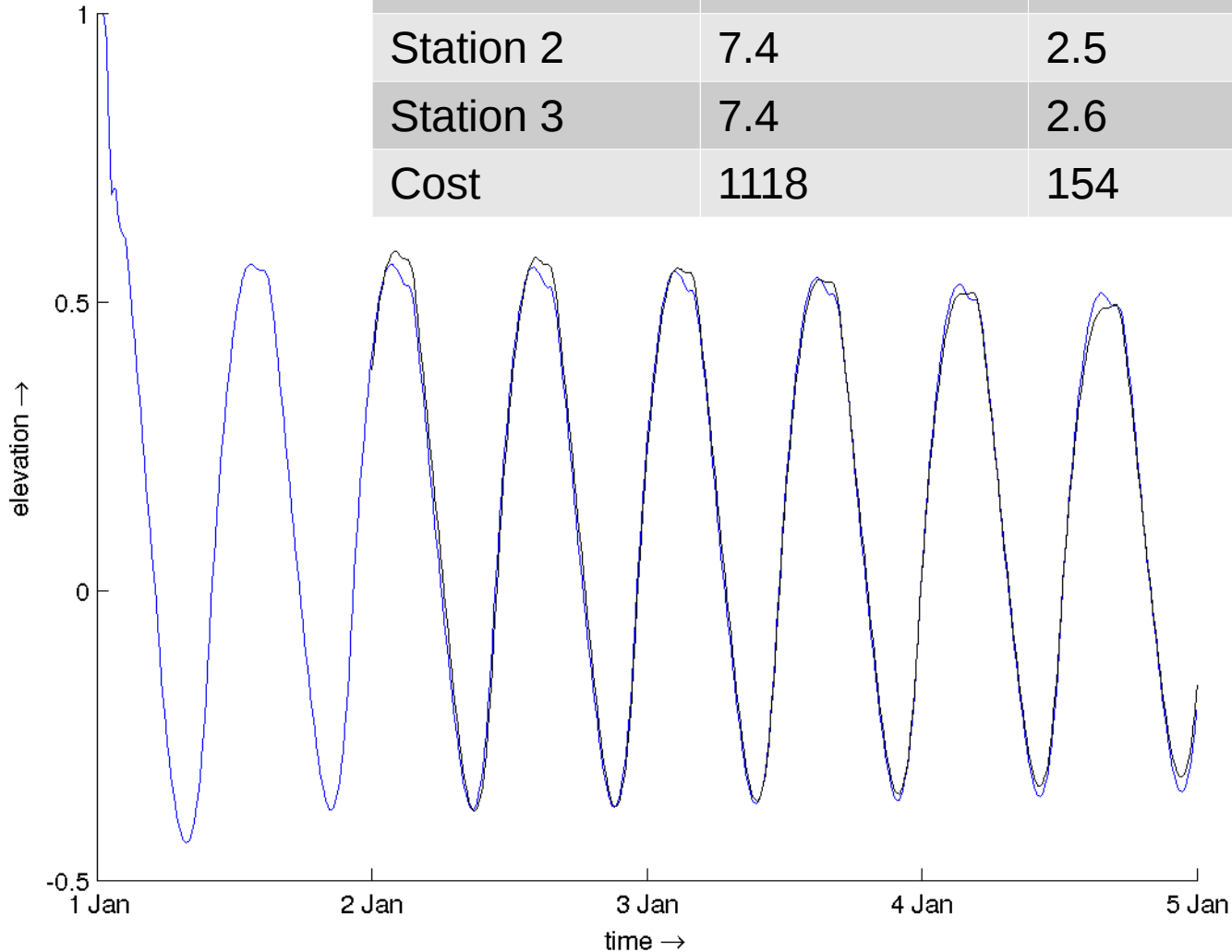
- Add the depth calibration to previous experiment (M2+DEP)
  - Uncomment DEPTH section in `stochModel/dflowfmStochModel.xml`
  - Run calibration again
  - Look at the output and plot the time-series.
  - Is this what you expected?

# Calibration Depth+M2

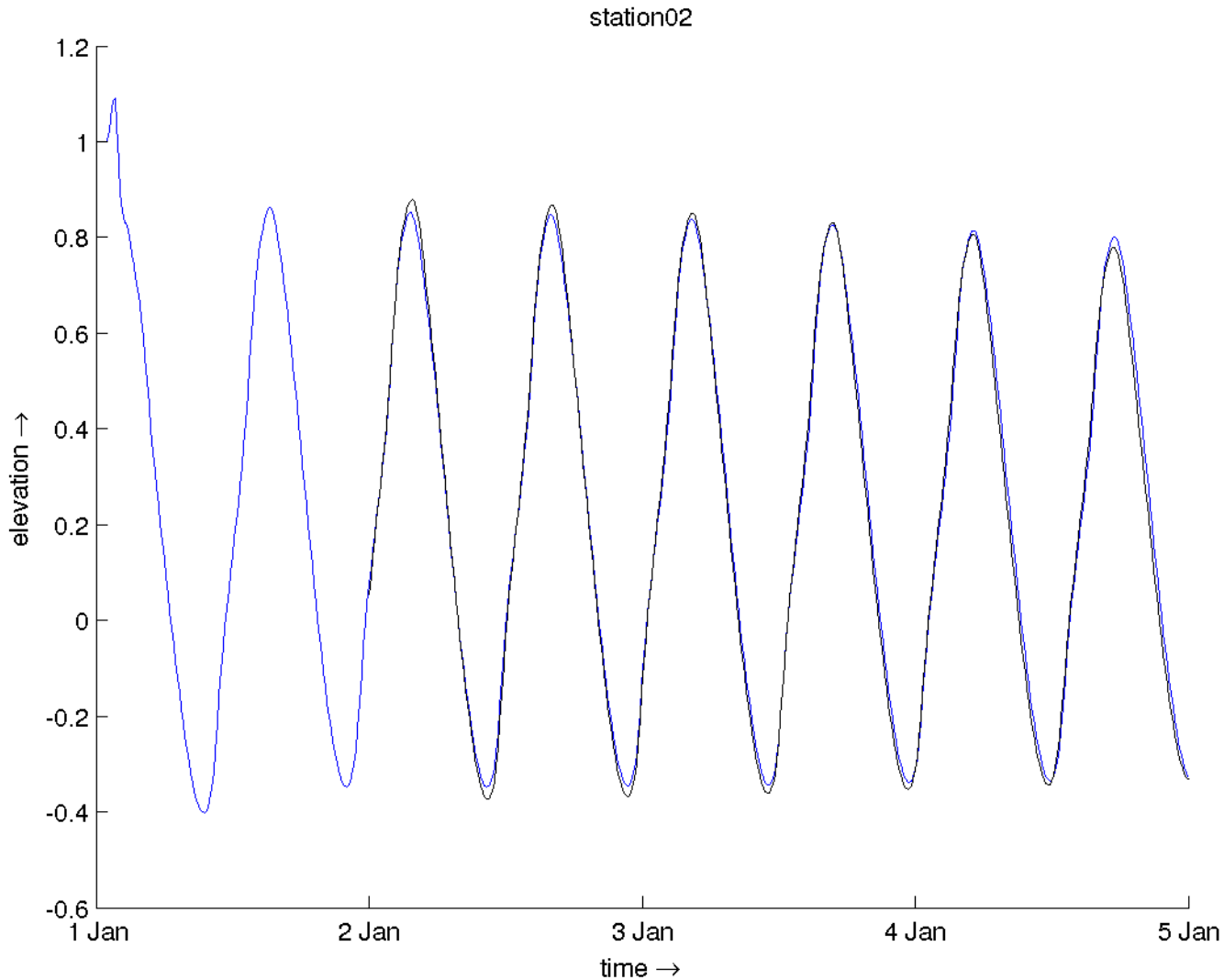
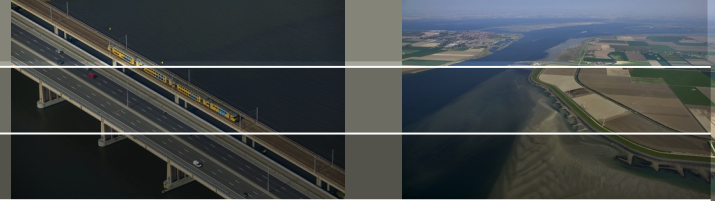


## Station 1

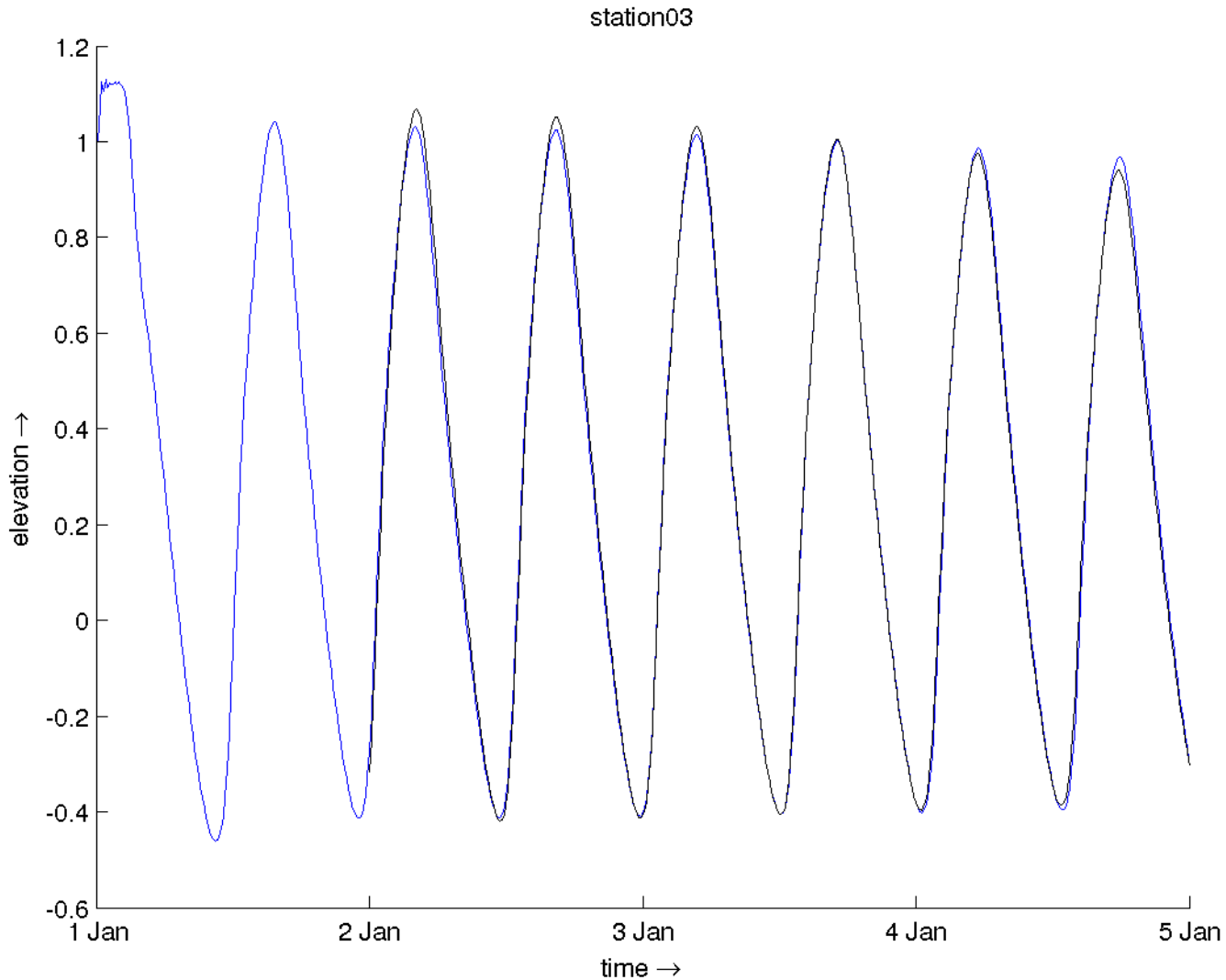
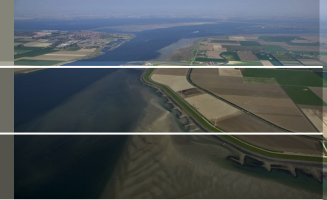
Name	First guess	M2 calib.	M2+DEP calib.
Station 1	4.3 cm	2.2	2.2
Station 2	7.4	2.5	2.5
Station 3	7.4	2.6	2.3
Cost	1118	154	143



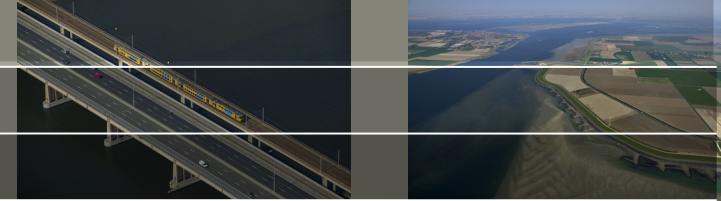
# M2+DEP output Station 2



# M2+DEP output Station 3



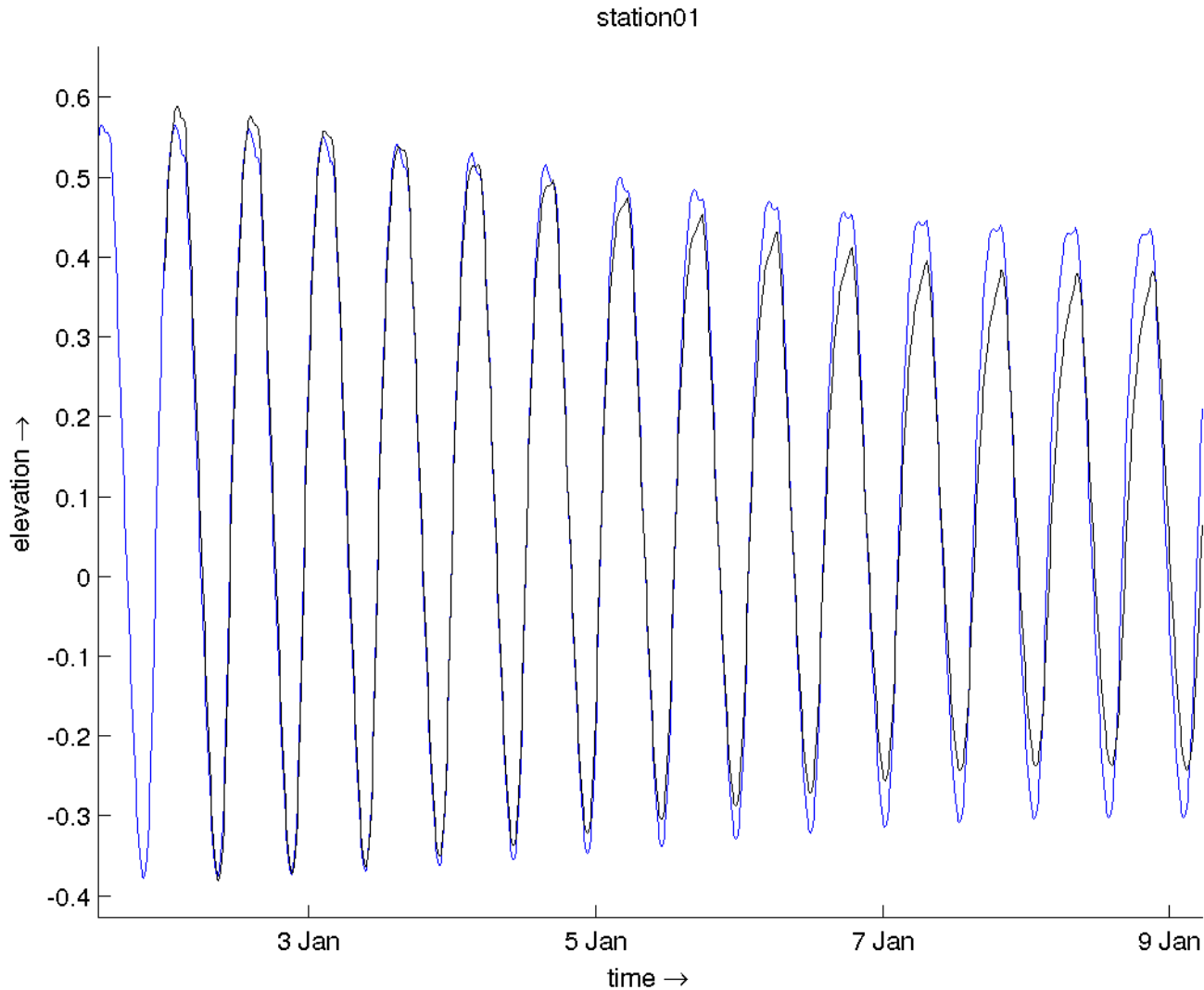
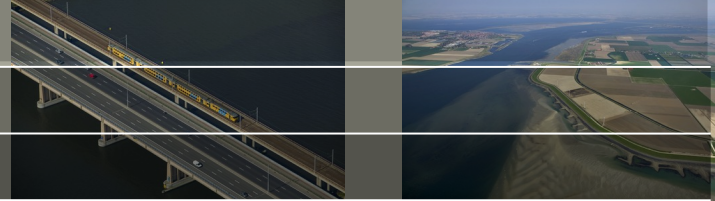
# Questions part 4



**The output looks nice. The cost-function is a bit lower still, but there is still a problem...**

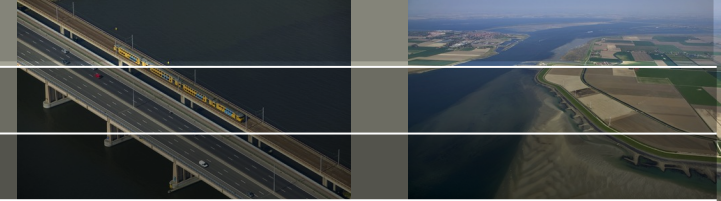
- Make a longer run with the final run of experiment M2+DEP
  - Modify `work/work<last_number>/estuary.mdu` and change the `TStop = 43200. [hours]` which is 30 days
  - Run Delft3D-MF for this case
  - Make time-series plots
  - What is wrong?
  - How does one fix this in the calibration?

# Long run for M2+DEP result





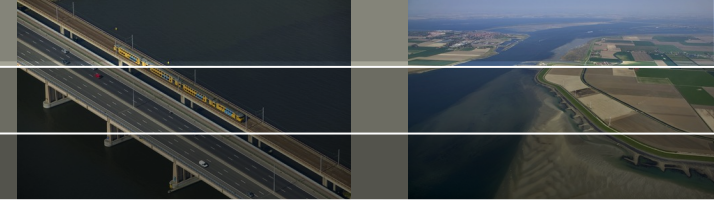
# Questions



**The error in S2 was attributed to M2. Let's make fix this with a longer simulation and adding S2 to the calibration**

- Add S2 to calibration and lengthen simulation experiment DEP+M2
  - Modify `stochModel/input_dflowfm/estuary.mdu` and change the `TStop = 43200. [hours]` which is 30 days
  - Lengthen the observations in `stochObserver/noosObservations.xml` to 31-1-1991 0:00h
  - Uncomment S2 section in `stochModel/dflowfmStochModel.xml`
  - Run calibration with OpenDA
- What would go wrong if we would use only 3 days of observations for calibration of S2 and M2?

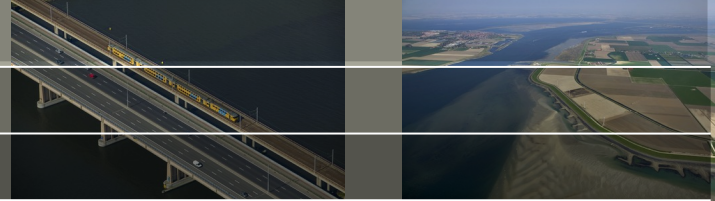
# Calibration DEP+M2+S2



Name	First guess	DEP+M2+S2
Station 1	4.5	1.6cm
Station 2	6.0	1.6
Station 3	6.9	0.6
Cost	8299.	450.

Parameter	Final value (change)	True values
M2.Amplitude	-0.5 cm	0.0 cm
M2.Phase	-1.9 degr	0.0 degr
S2.Amplitude	9.7 cm	10.0 cm
S2.Phase	-1.6 degr	0.0 degr
Depth	-0.8%	10%

# And much more



- Calibration of roughness
- Use calibration regions for depth or roughness.
- Proportional instead of additive modification of parameters
- Make subselections of observations
- Parallel computing
- Output formats and selection
- Try other algorithms
- Calibration of other models, such as sobek, swan or waqua
- ....