Coastal modelling of Liepaja port-lake system

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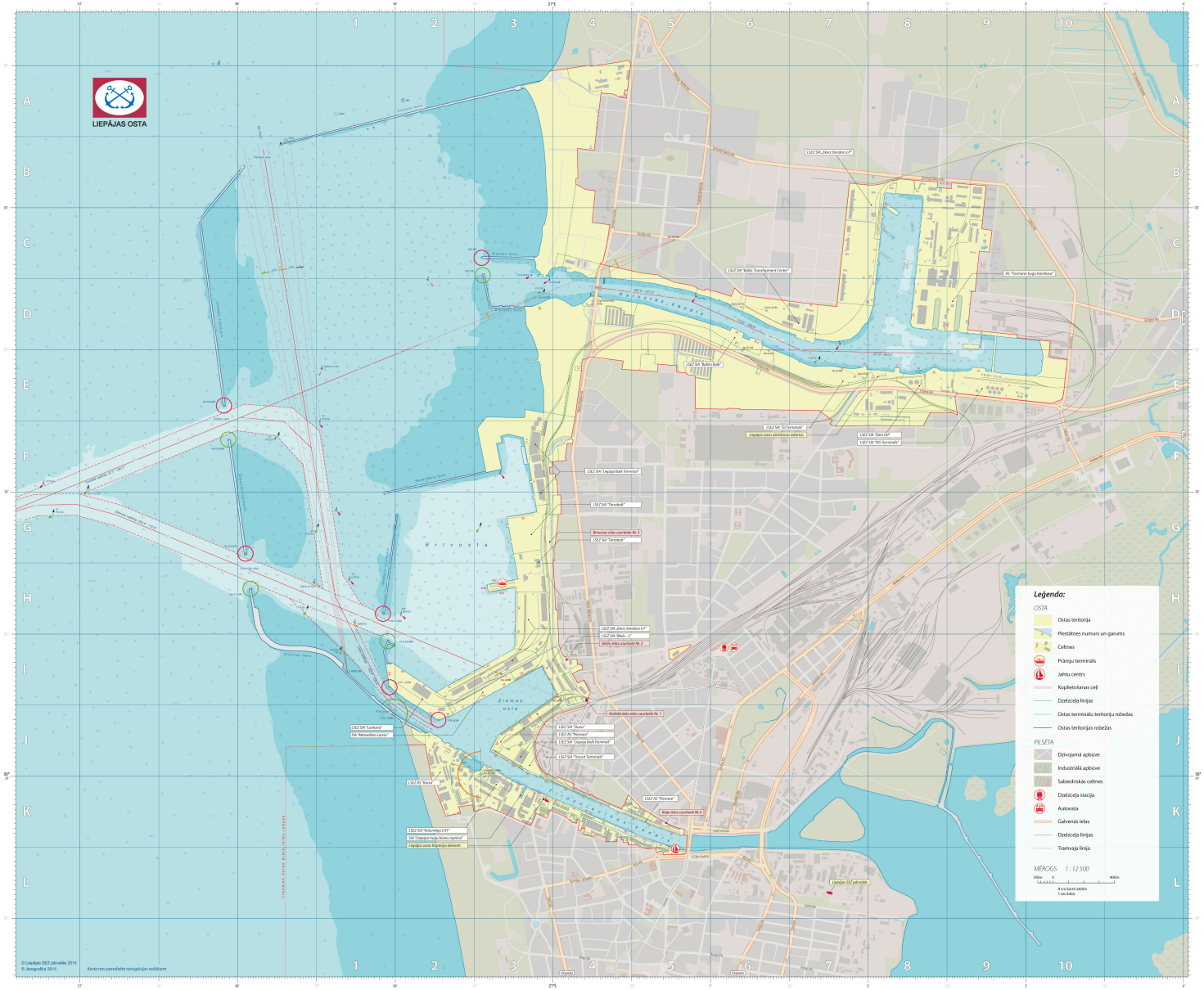
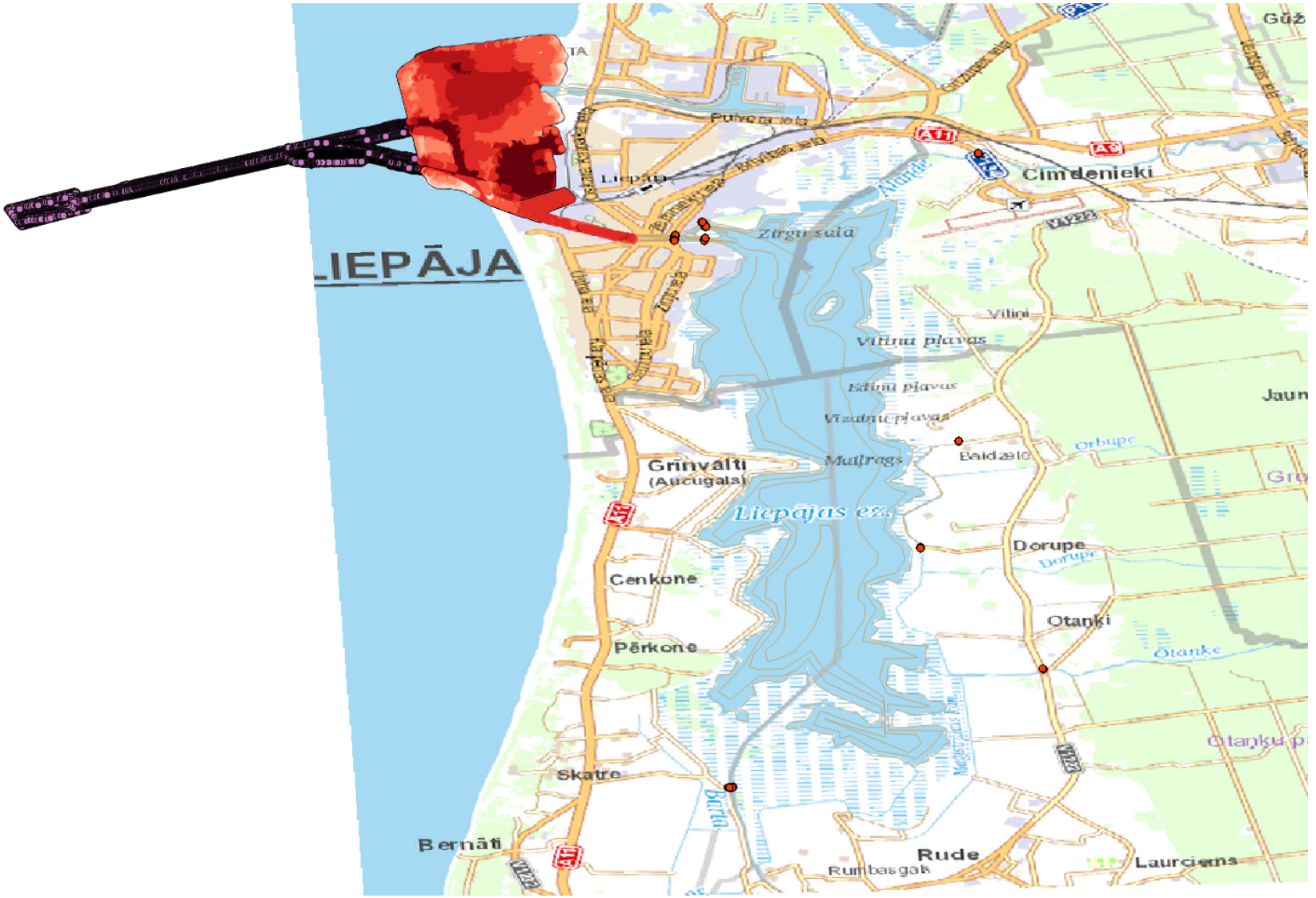
Sea bathimetry at port



Bathimetry of Baltic proper from EMODnet,
but Latvian data are bad there.
Depth increased by few meters for better agreement with port bathimetry and coastline at Liepaja

Port and lake bathimetry

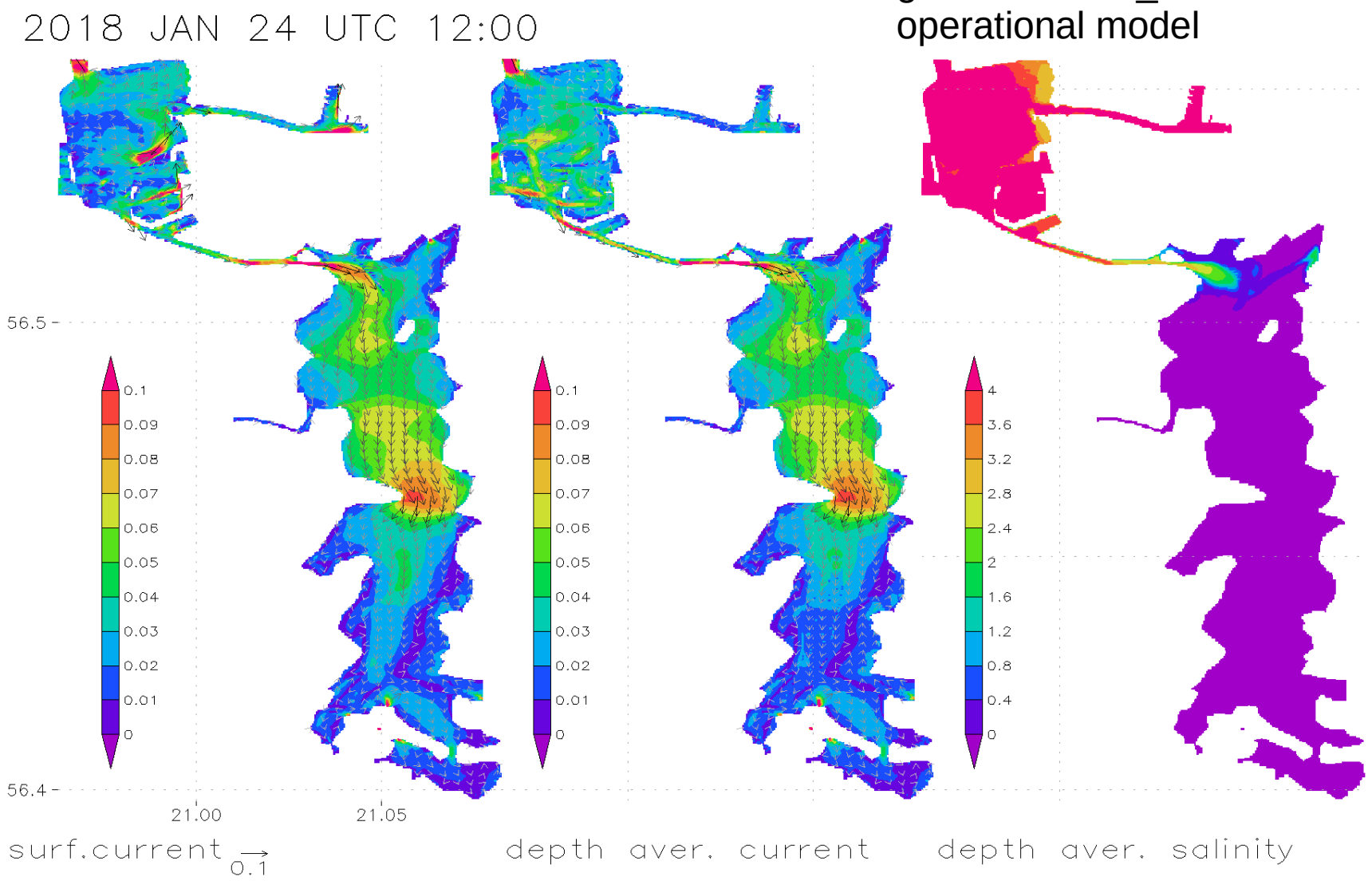


Lake bathimetry rather approximate from available countourlines

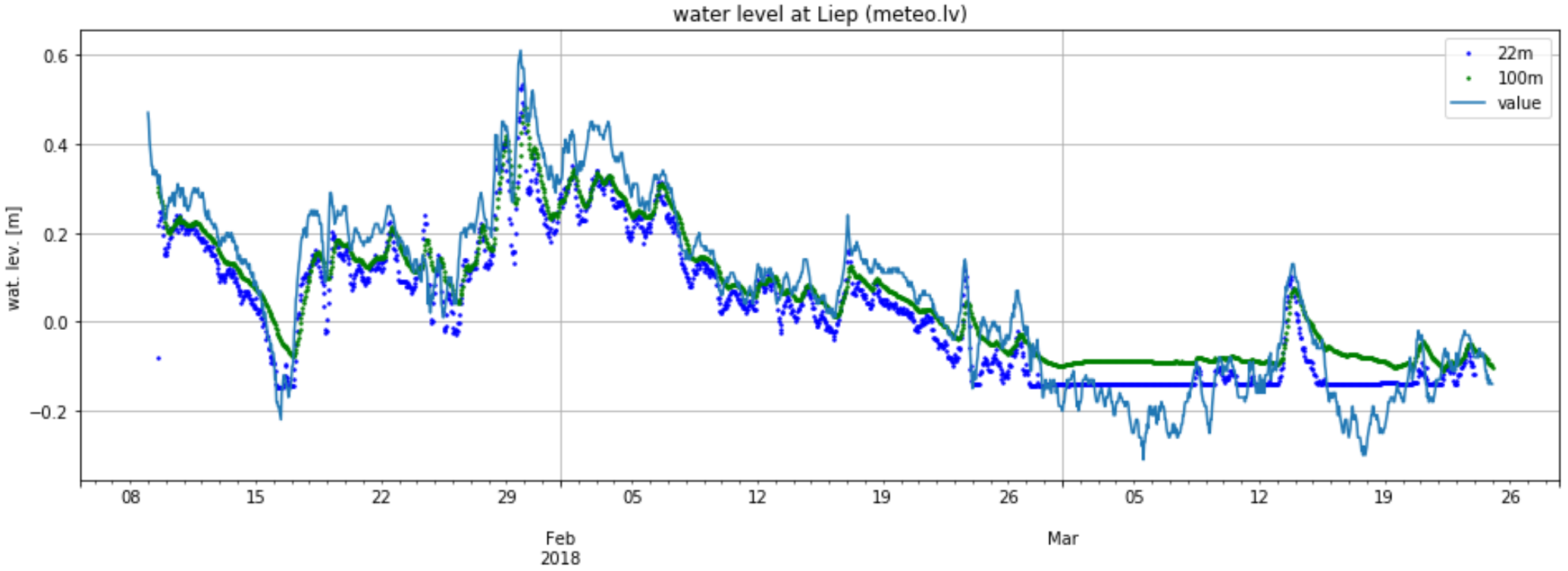
Non-nested HBM setup

Resolution 22 m

Water level, temperature, salinity at gates from LU_HBM Baltic sea operational model



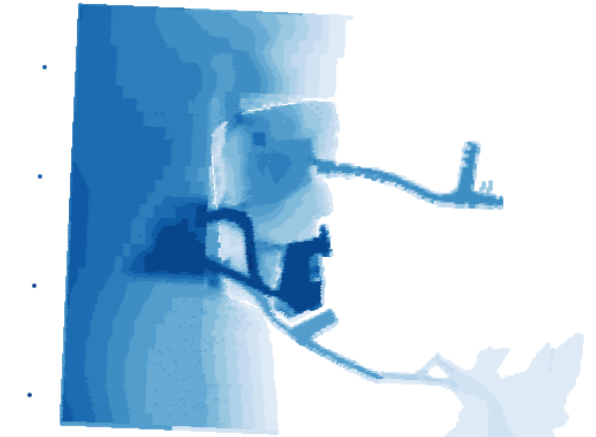
Ice jam in the channel

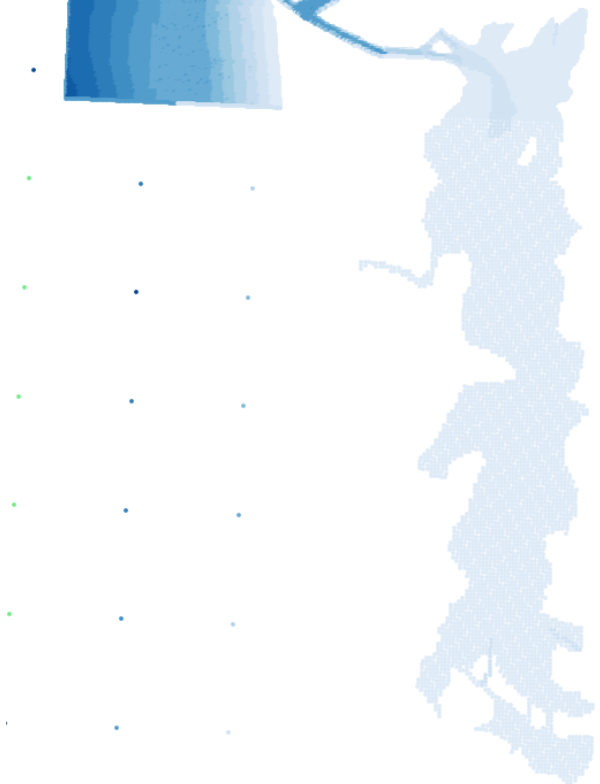


Nested HBM setup

1 nm resolution Baltic proper

30 m resolution port and channels





60 m resolution lake

Boundary data from LU_HBM, DMI.
Weather forcing: DMI HIRLAM

Observations

Automatic, hourly: water level, run-off, temperature

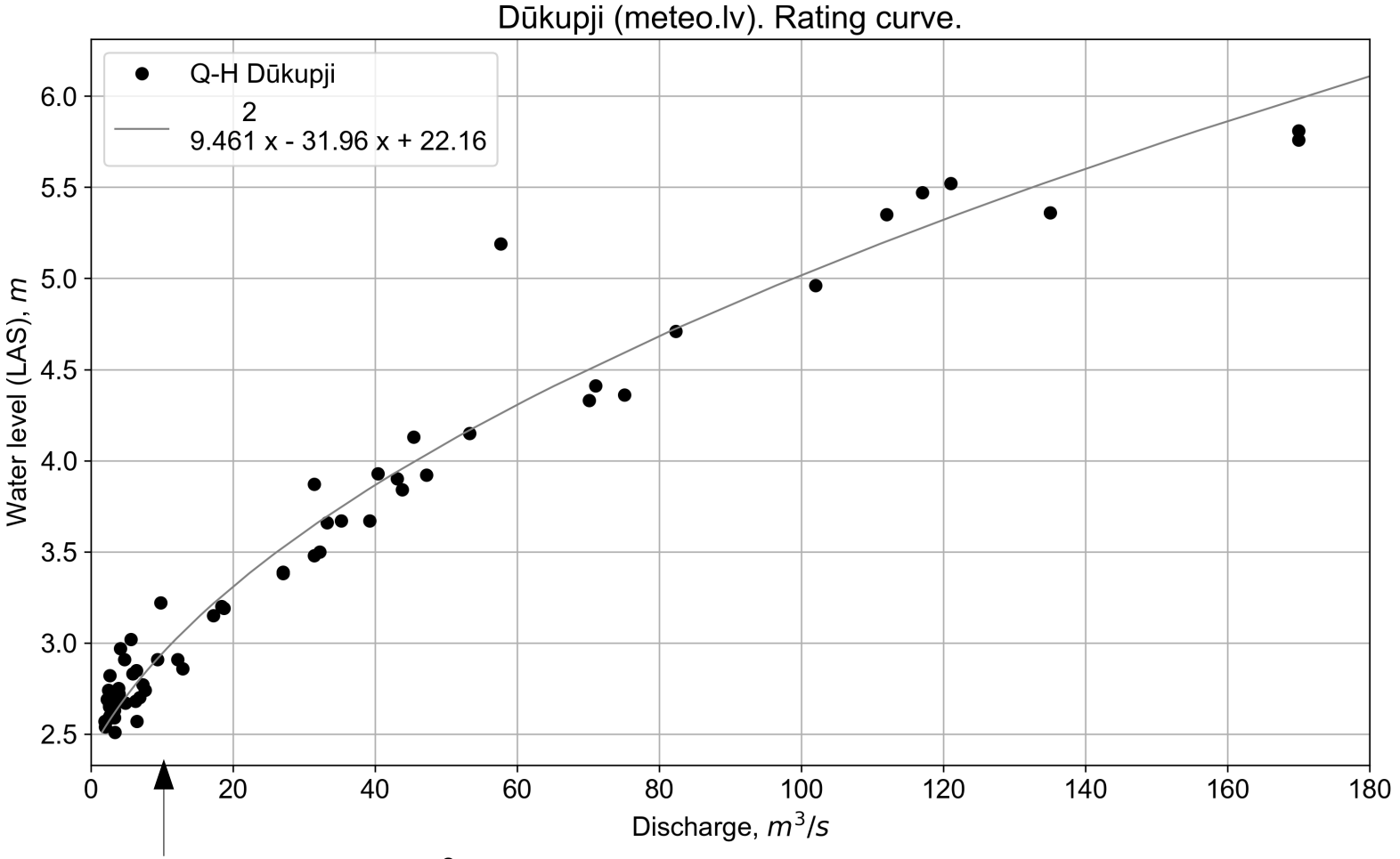
Manual, daily: sea surface temperature, salinity

Automatic, hourly: water level, temperature

Liepaja meteorological station

Automatic, hourly: water level, temperature. Occasionally: run-off

Barta hourly river discharge and temperature



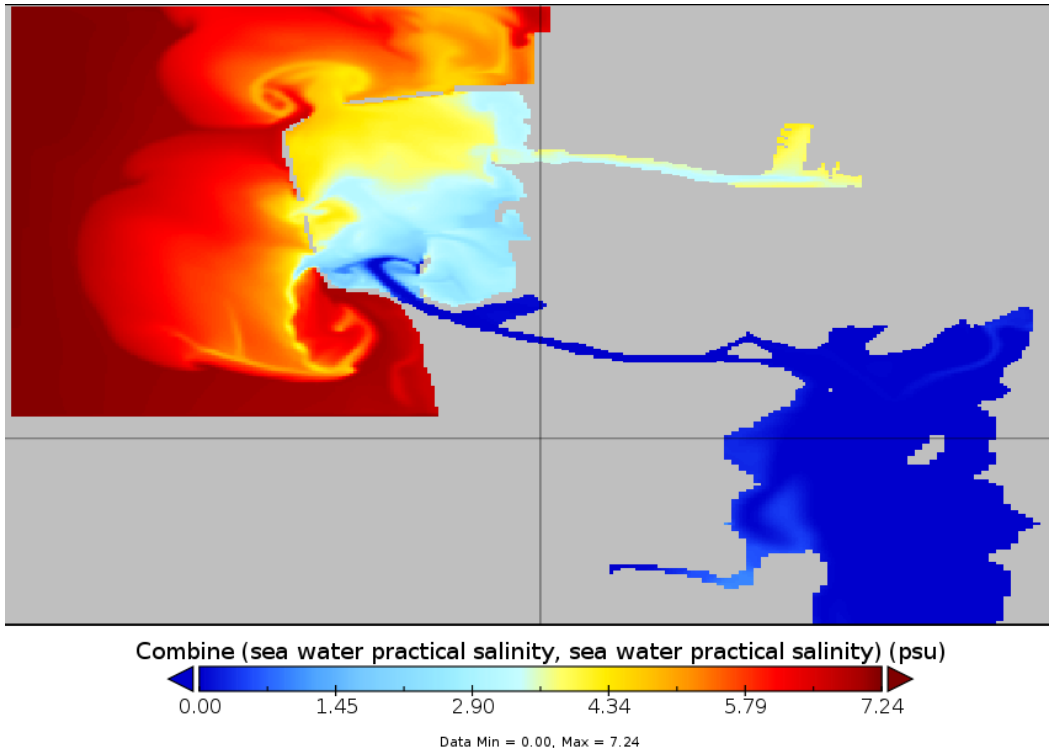
Yearly average ~12 m^3/s

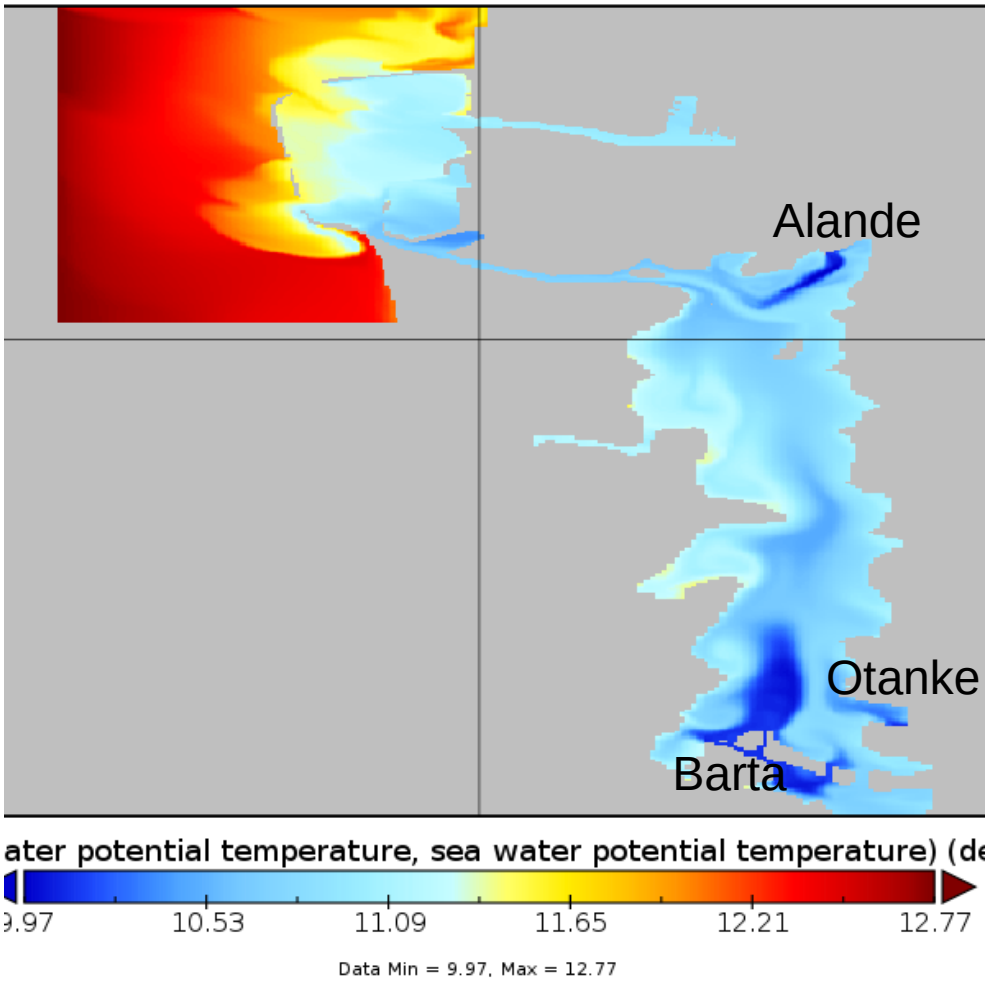
~ 20 km from Liepaja lake

From rating curve and water level in river, we get hourly river run-off.
Hourly data also for inlet temperature.

Salinity, temperature

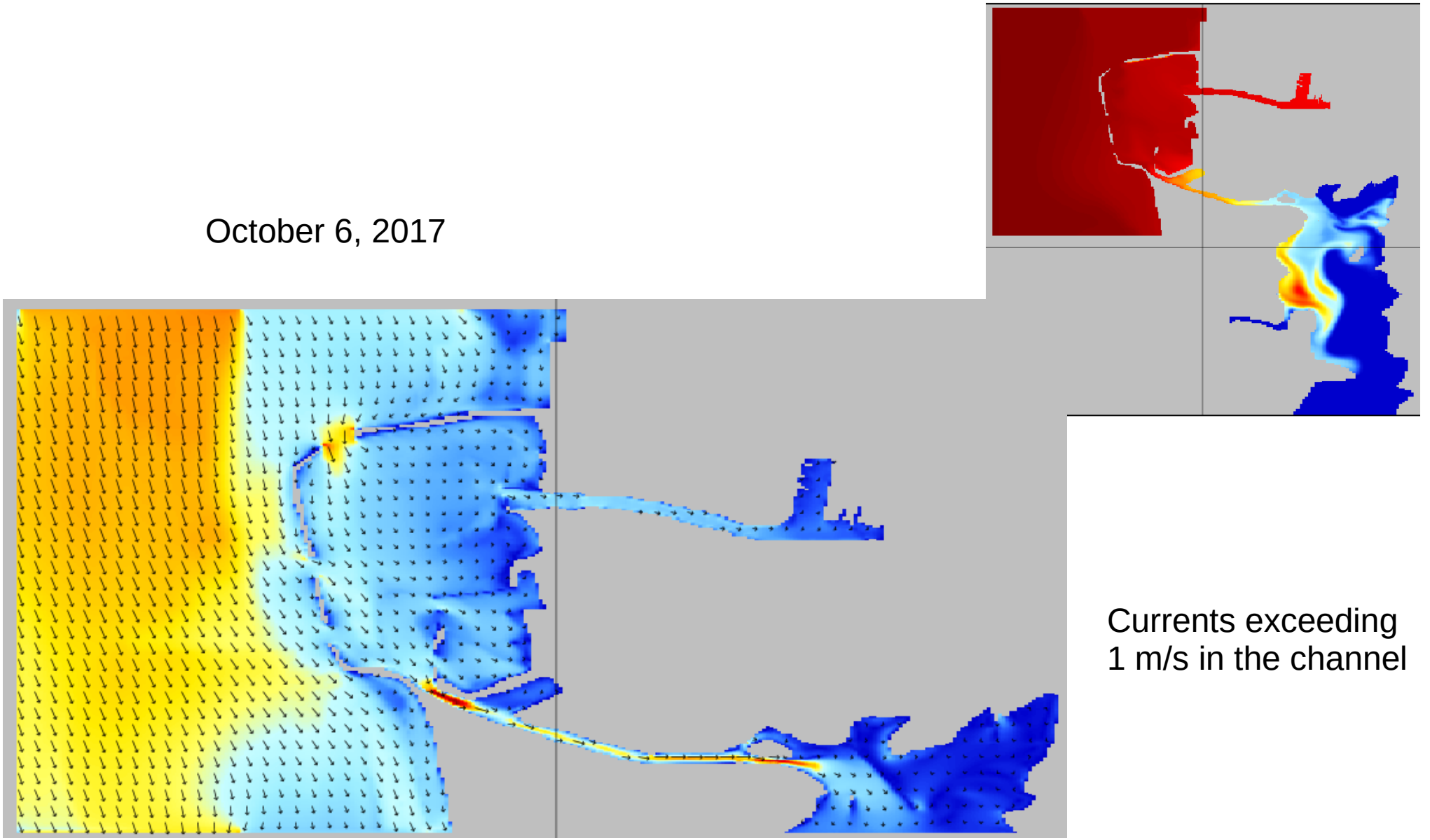
October 18, 2017





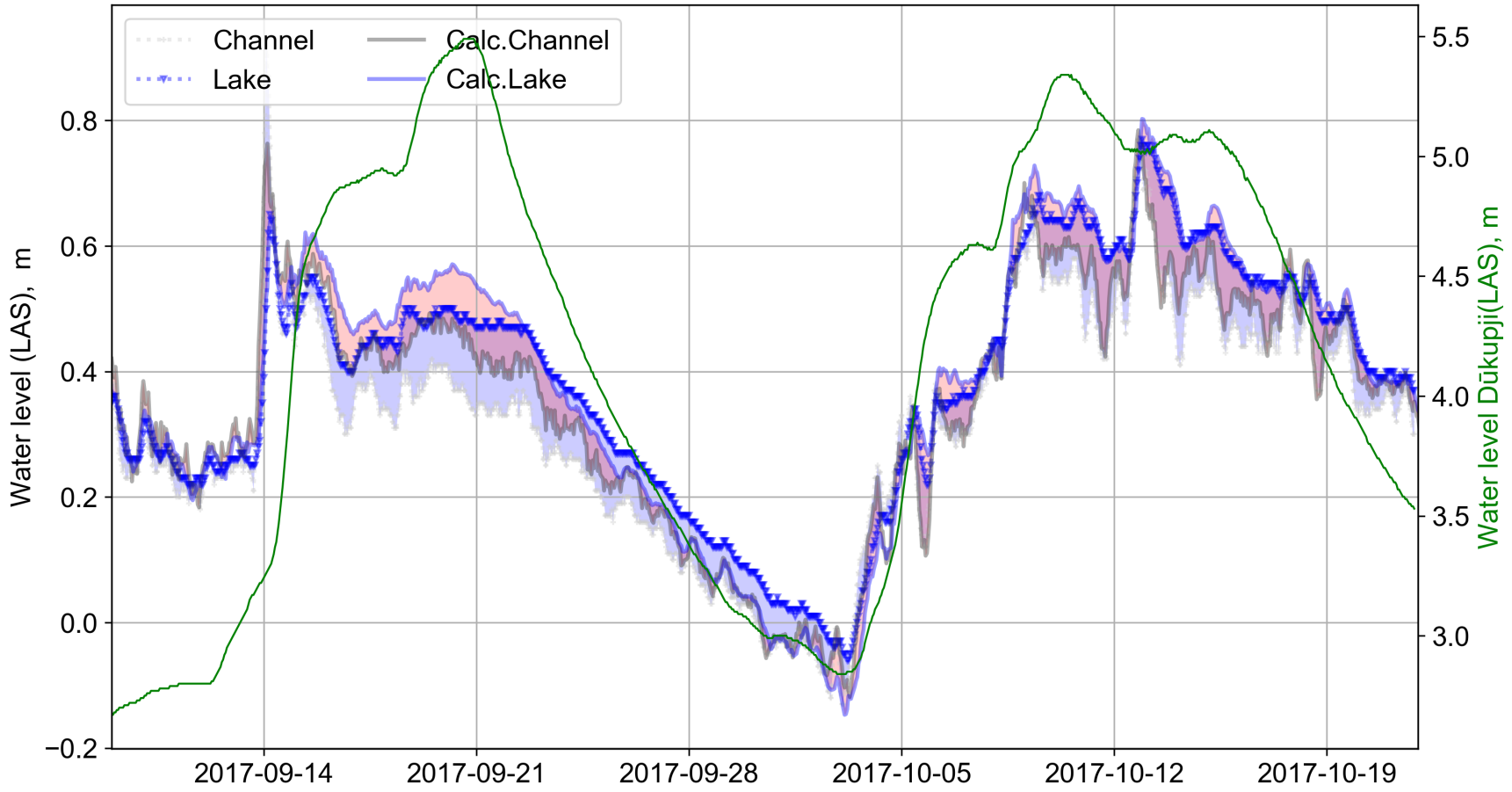
Inflow events

October 6, 2017



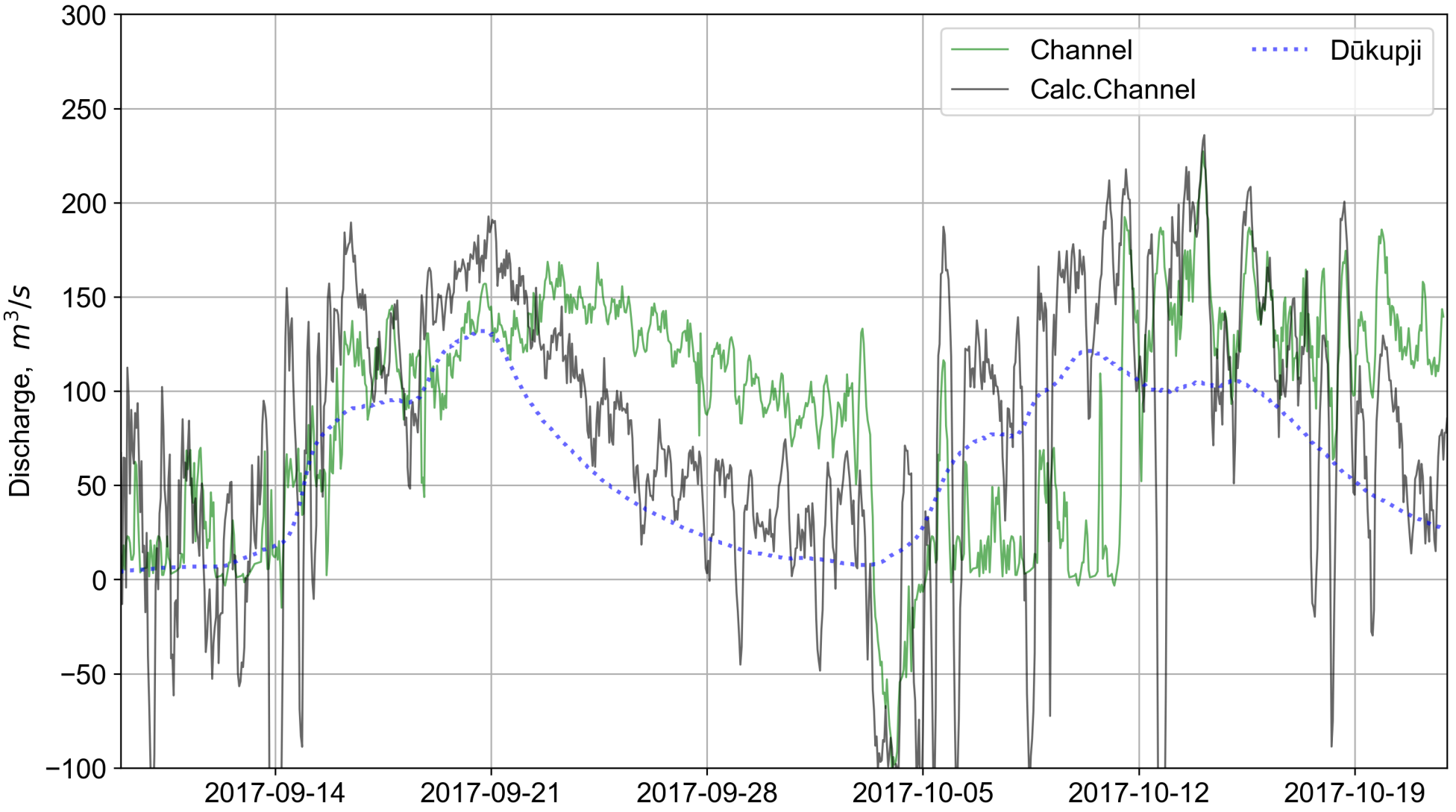
Currents exceeding
1 m/s in the channel

Water level at channel and lake

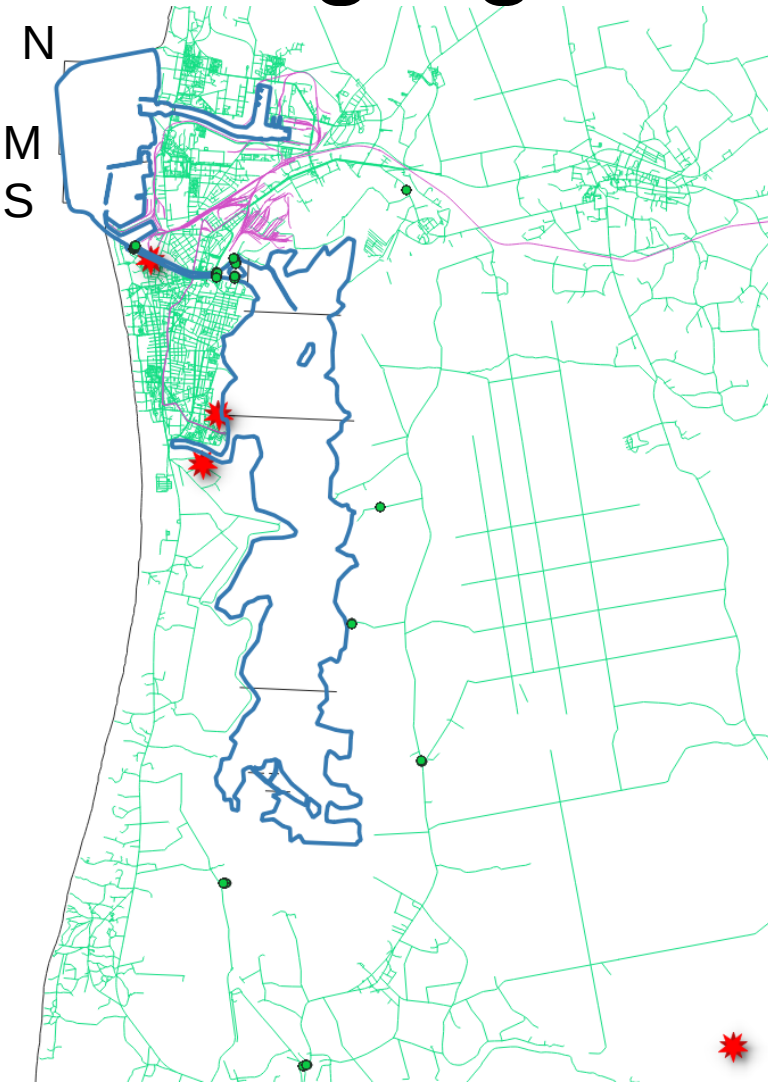


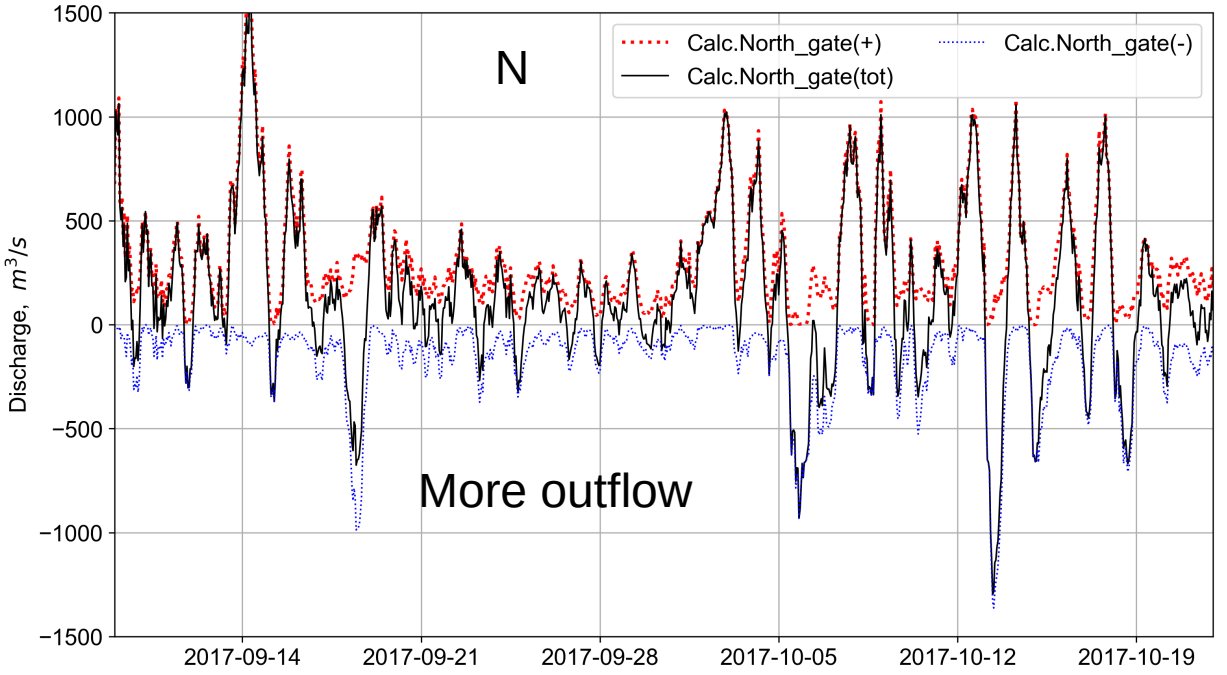
RMSE ~ 3 cm

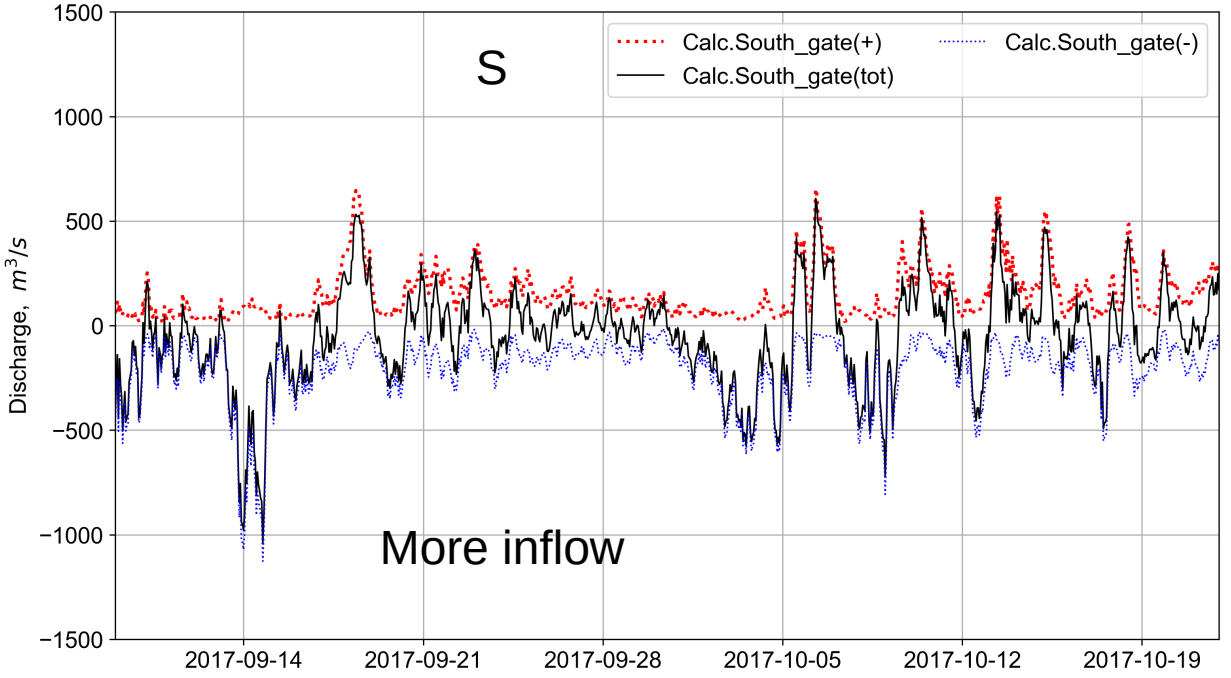
Run off though the channel



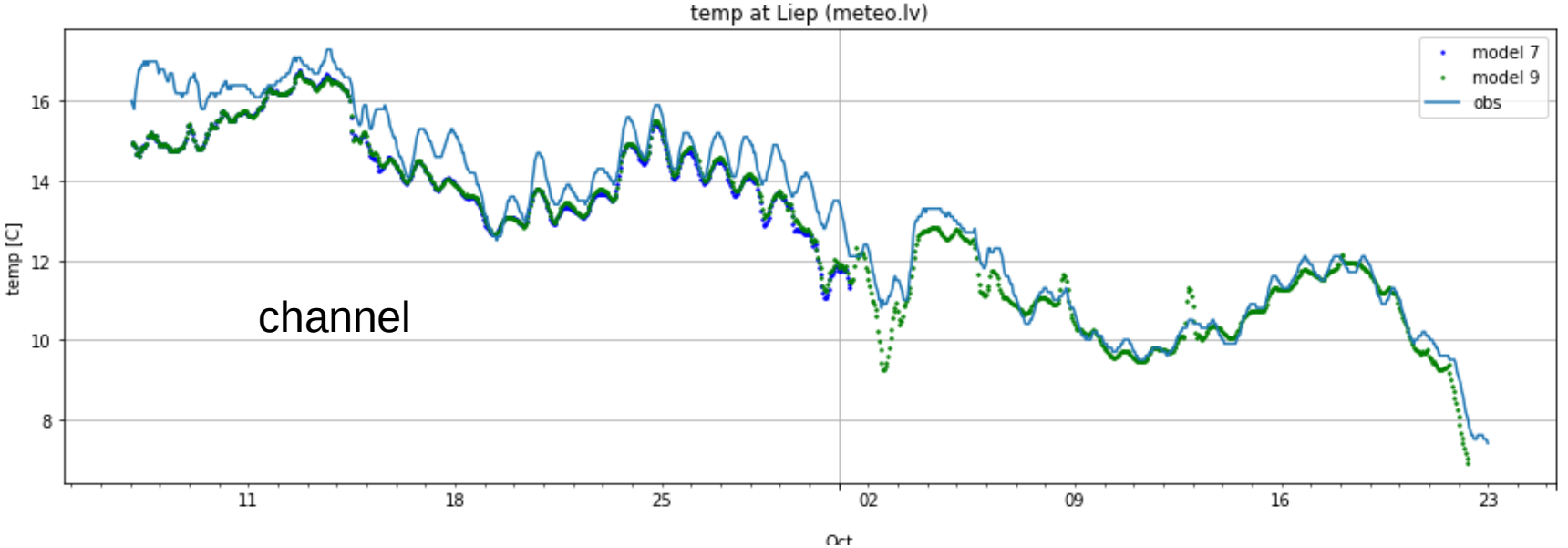
Run-offs through gates

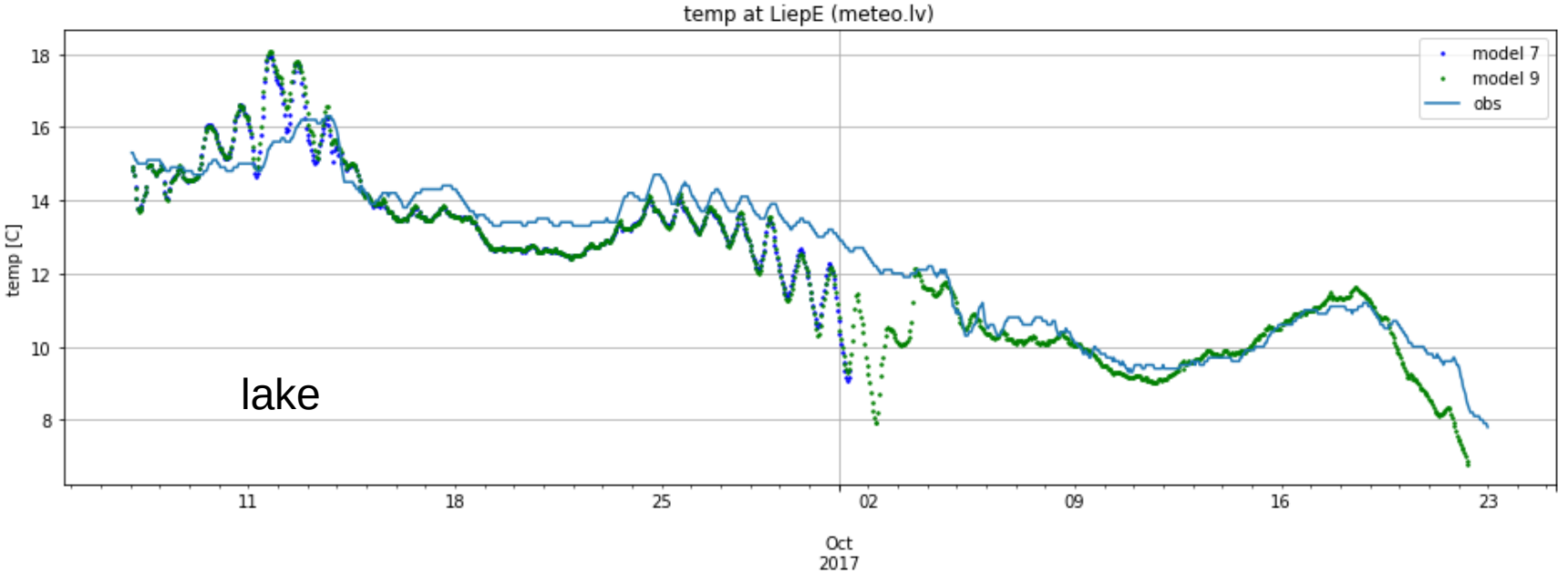






Temperature





Conclusions

- Nearly a week of simulation period is required to a reach stationary salinity distribution in port
- Inlet currents in the port are improved by using nested setup
- Hydrodynamic resistance of the channels can be fitted by adjusting its bottom friction factor
- Predominant inflows occurs through southern gate and outflow through northern gate according to predominant directions of wind and currents
- There is less agreement in stormy events, when waves and long-shore currents have to be accounted
- Wetlands have to be accounted in case of high water level in the lake
- Both model and observations show that there are Helmholtz oscillations (seiches) of water level in lake with roughly 10-12 hours $Period = 2 * \pi \sqrt{\frac{L_{ch} A_{lake}}{g A_{ch}}}$