# Implementation of the hydrological module chain in RODOS system

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NATIONAL CENTRE FOR NUCLEAR RESEARCH
ŚWIERK

# RODOS

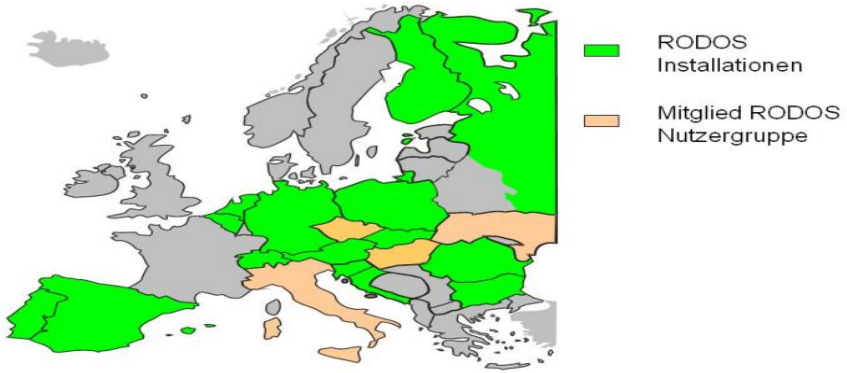
## Real-time On-line Decision Support System

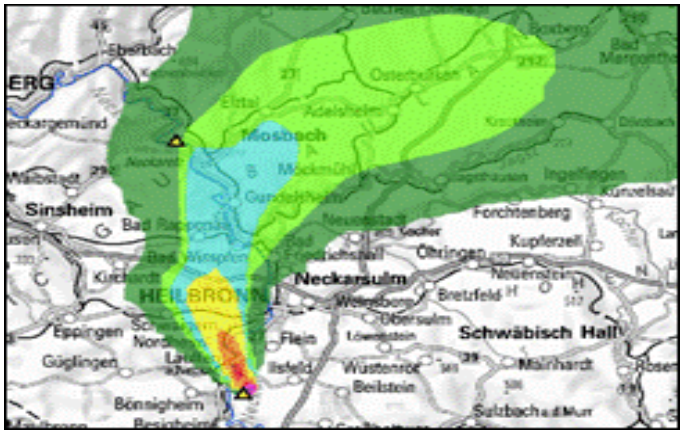
**Koordynator: Karlsruher Institut für Technologie (KIT)**

Institut für Kern- und Energietechnik

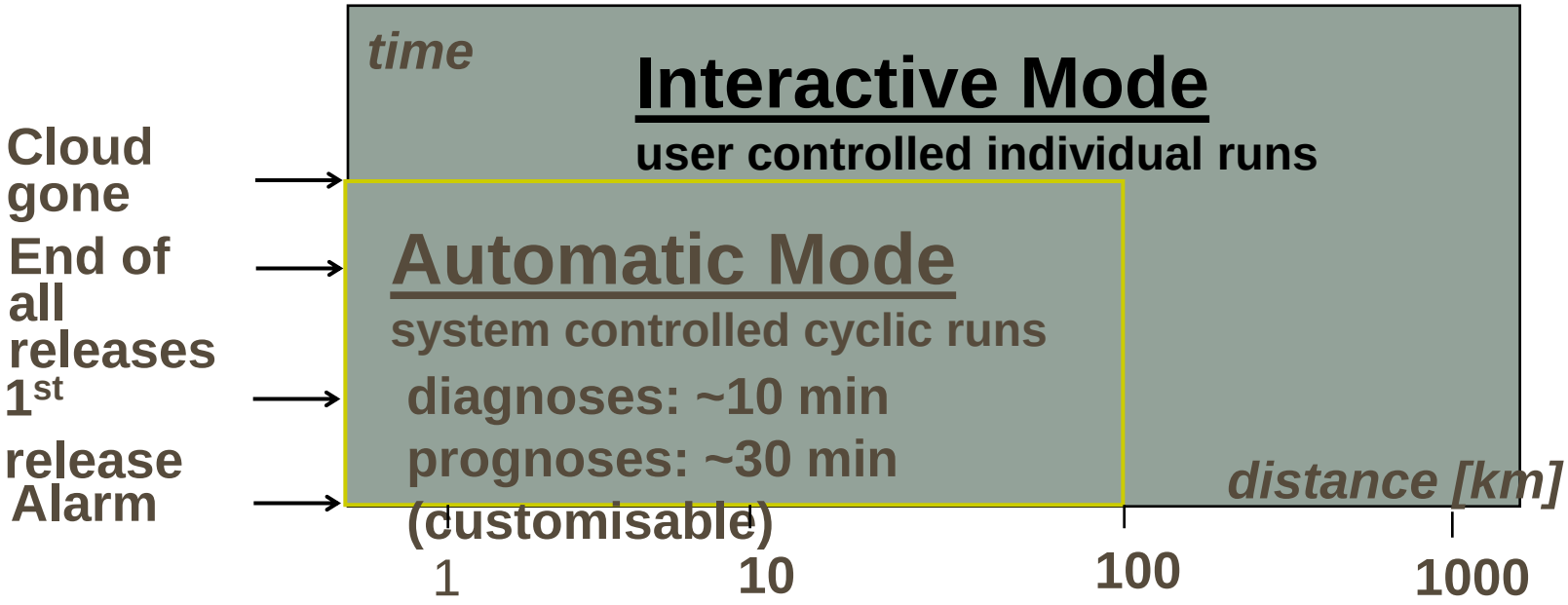
**In the presentation some materials prepared by:**

**Wolfgang Raskob, Claudia Landman, Dmytro Trybushnyi have been used**

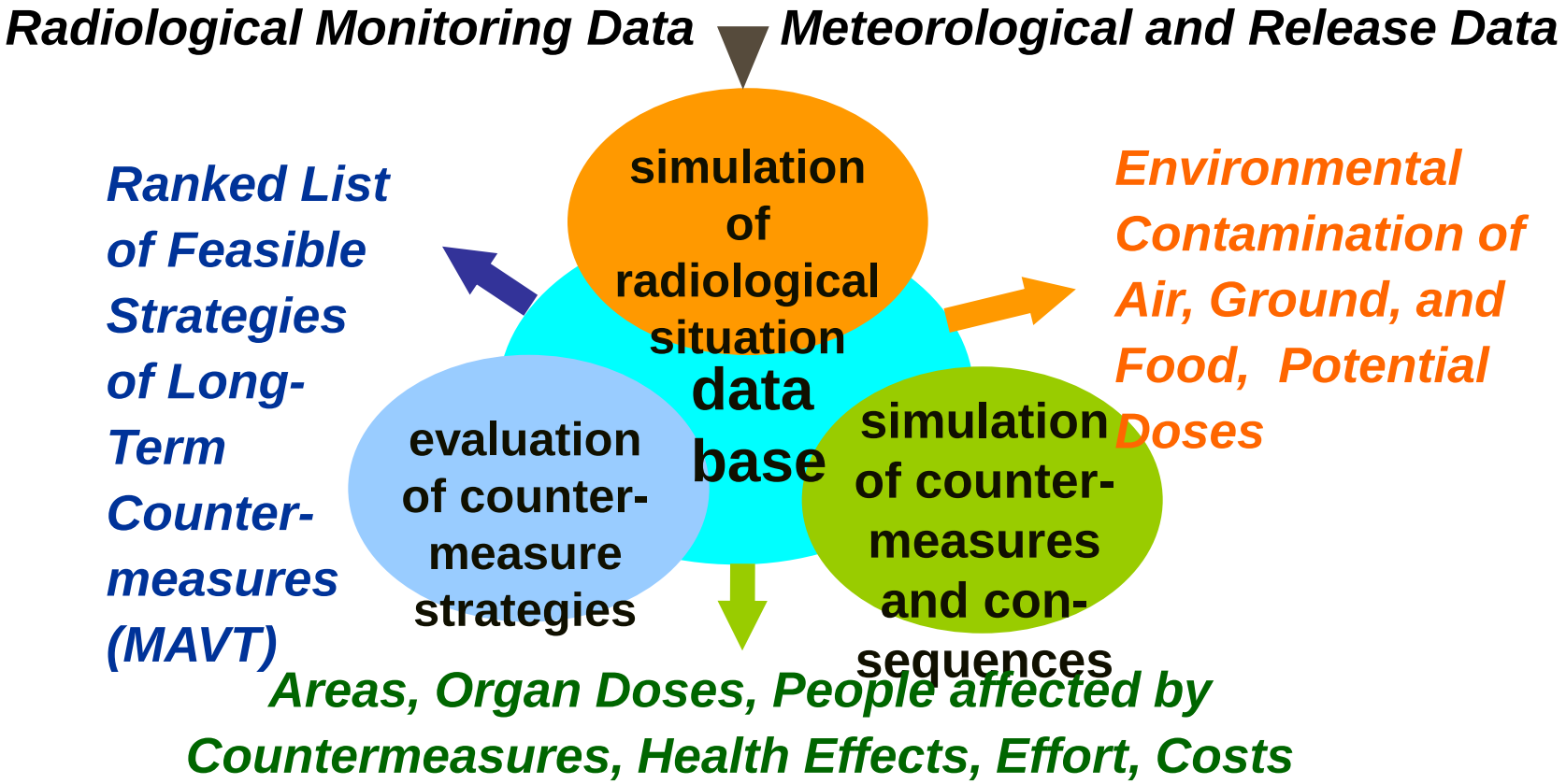


# Operation of RODOS in different time and distance ranges

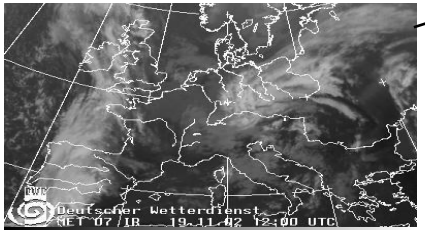


# JRodos: Tasks, input data, output



# Level 1: Acquisition, processing and presentation of radiological and meteorological measurements and prognostic data

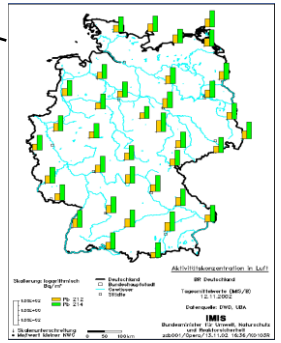
**RODOS system**




**meteorological forecasts; far range dispersion calculations results**


**European NPP DB; source term DB; measured meteorological and source term data**

**local monitoring data; airborne gamma spectrometric measurements**

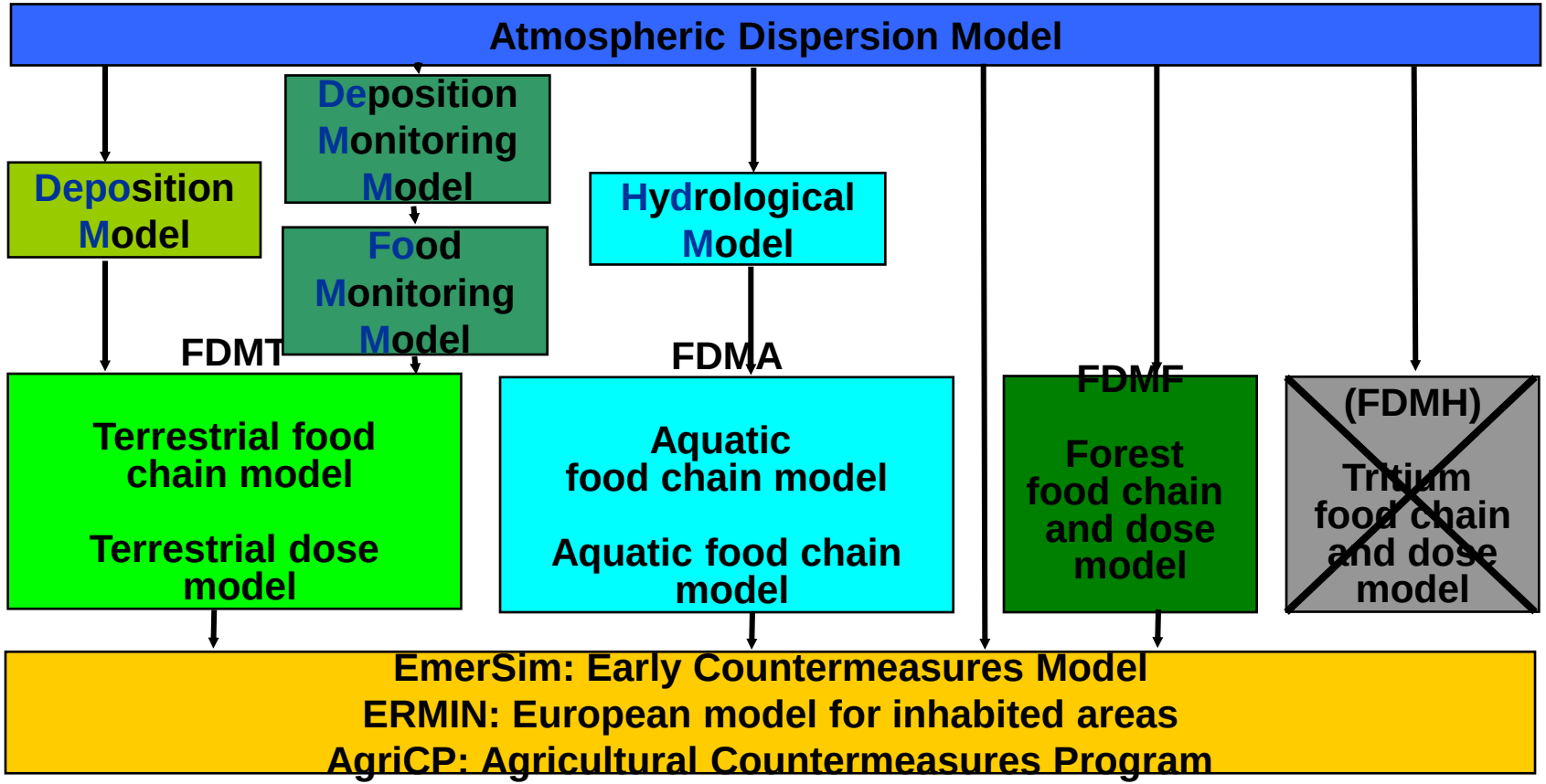


**national monitoring data**

# Adaptation of data bases to national or regional conditions

- **Numerical weather prediction data for near and far range atmospheric dispersion models**
- **Real time data (meteorological and release)**
- **Site and plant data; inventories, source terms**
- **Geo referenced data for model calculations (elevation, population, production, land use, radio-ecological regions)**
- **Data bases for JRodos hydrological model chain**

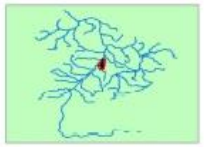
## (Level 2) Up-to-date simulation of radiological situation:
## Radioecological and dose models in JRodos



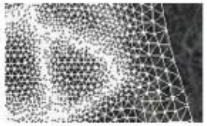
# Hydrological model chain HDM

Radionuclide wash-off from watersheds (RETRACE)

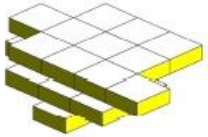
(1D) River flow, sediments and radionuclide transport (RIVTOX)



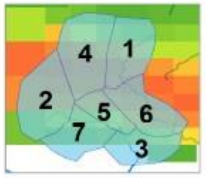
(2D) Reservoirs, floodplains and coastal areas (COASTOX)



(Box) marine environment (POSEIDON)



Aquatic food chains (FDMA)




(3D) Deep river reservoirs, lakes (THREETOX)

JRodos

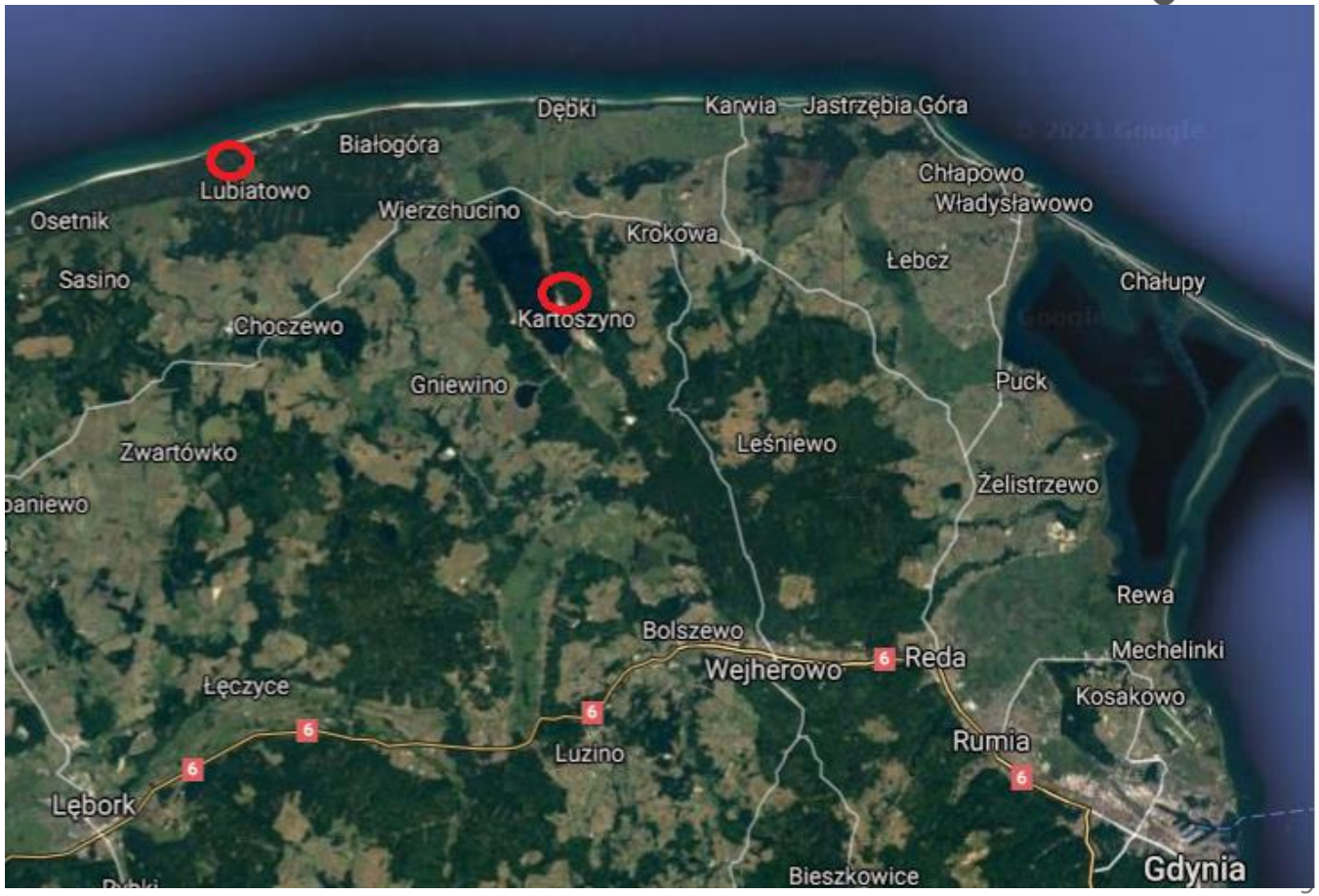
Atmospheric Dispersion and Deposition

Data Base

Hydrological Model Chain

# Considered localizations

- Two considered localizations:
  - Lubiatowo-Kopalino
  - Żarnowiec

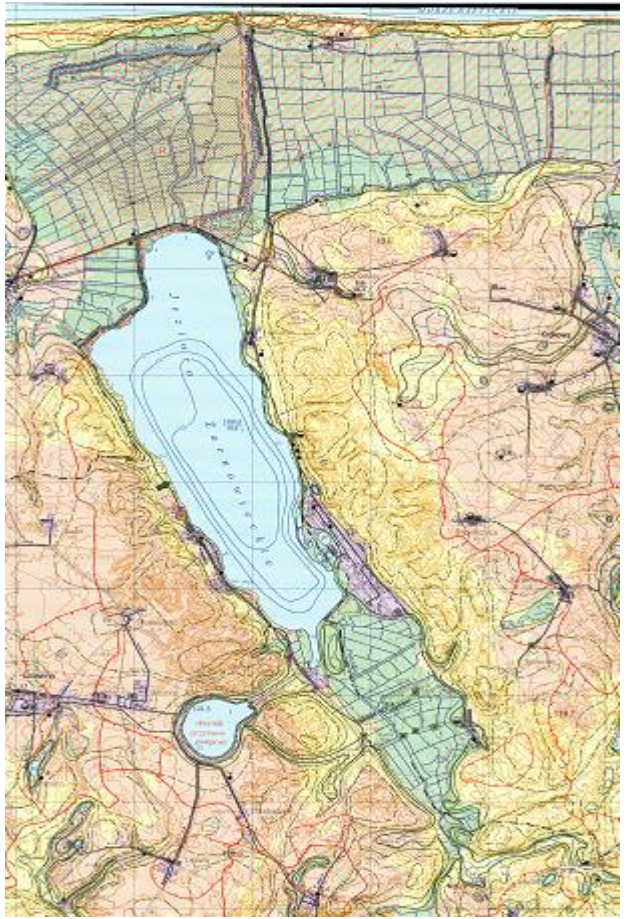


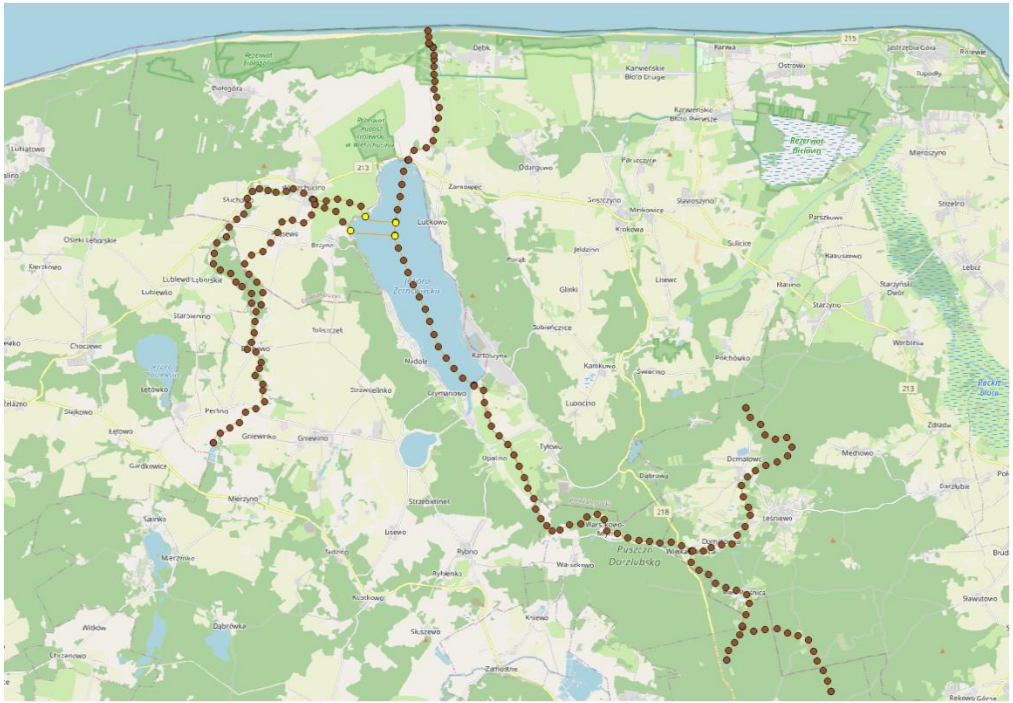
# Implementation of hydrological module chain

Main developers: R. Bezhenar, S. Kivva, O.Pylypenko with support of M. Zheleznyak

- The main water inland pathway:
  - Two main tributaries to Zarnowiecki Lake: Piasnica river and Bychowska Struga
  - Zarnowiecki Lake
  - Outflow from Zarnowiecki Lake to the sea: Piasnica river
- Coastal region
- Customization of the output software interfaces of the HDM models to present the results of HDM modelling
  - RETRACE_ R: the distributed watershed model
  - RIVTOX: 1-D model of radionuclide transport in the river
  - COASTOX: 2-D model for radionuclide transfer for big lakes and coastal regions.
  - FDMA – Foodchain Dose Model Aquatic: simulating contamination of freshwater biota and doses via freshwater aquatic pathways.
  - POSEIDON – compartment model for radioactivity transfer in marine environment

# Implementation of hydrological module chain



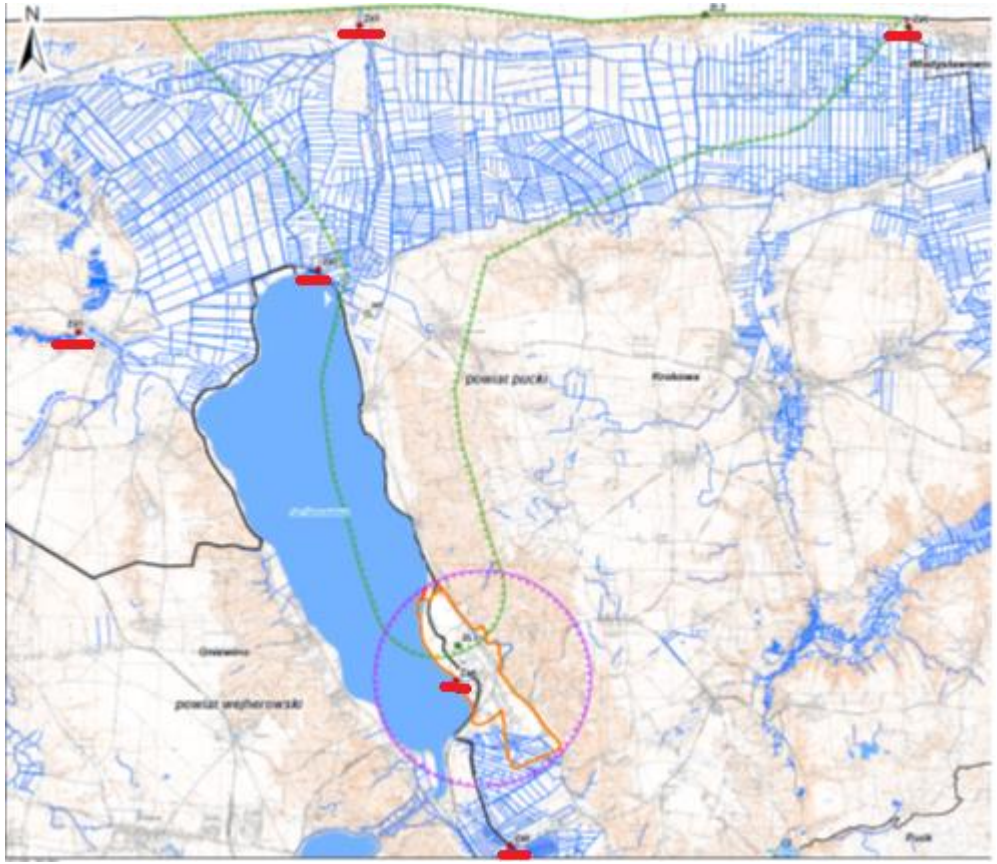


# Implementation of hydrological module chain

*Implementation of RETRACE-RIVTOX*

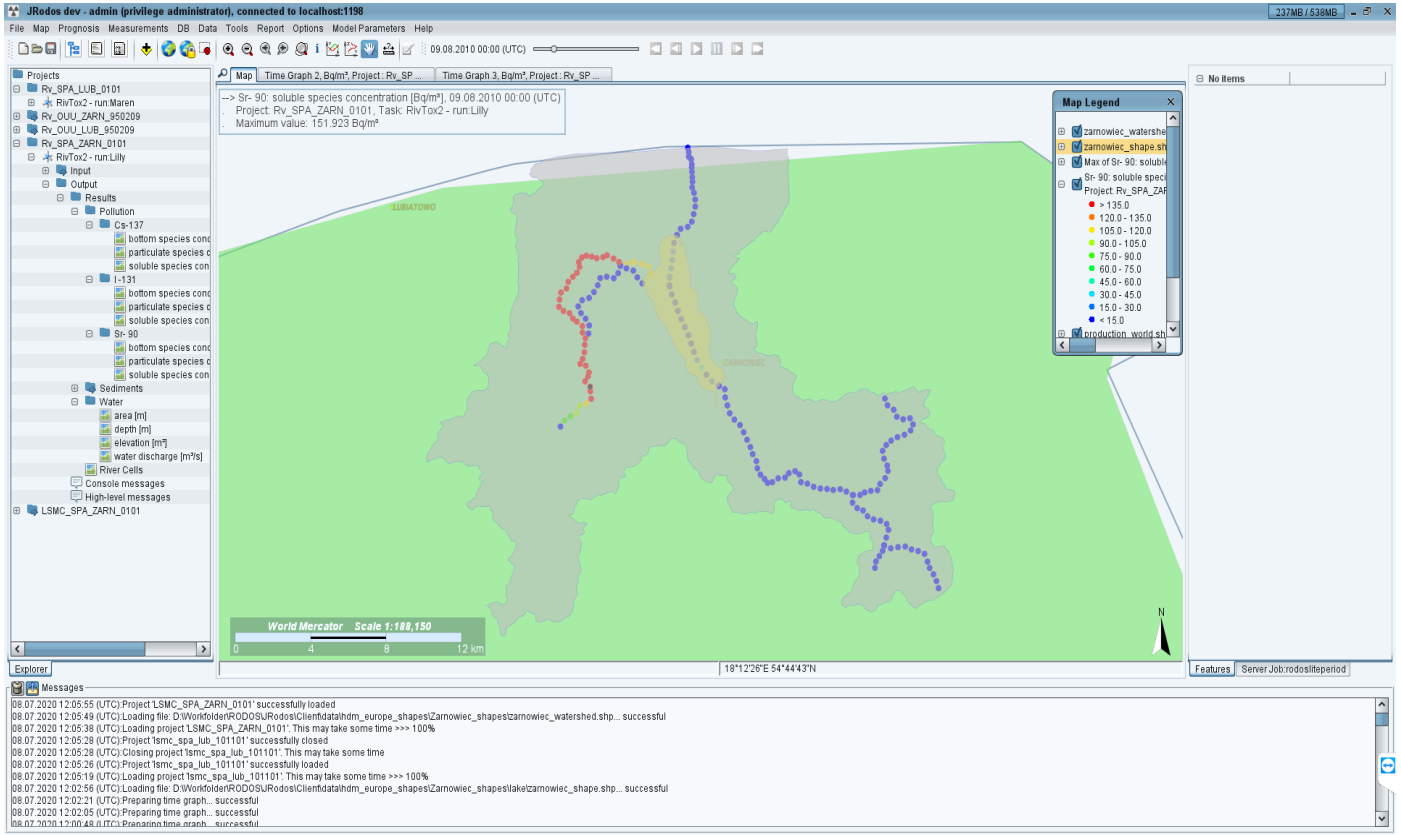
- Information about river network geometry: mesh representing the river network constructed by breaking down the modeled rivers into discrete points, links and nodes. In addition, a shapefile detailing the geometry of the river also constructed.
- Data on river cross-section determined and assigned to every point of the modeling domain.
- Boundary and initial conditions prepared in RIVTOX-specific format.
- The results of hydrological modeling of RETRACE have been compared with observation data presenting a good fit.
- Deposition from RODOS ADM provides input data for RIVTOX

# Implementation of hydrological module chain




Measurement
Points (water level,flow)

# Implementation of hydrological module chain

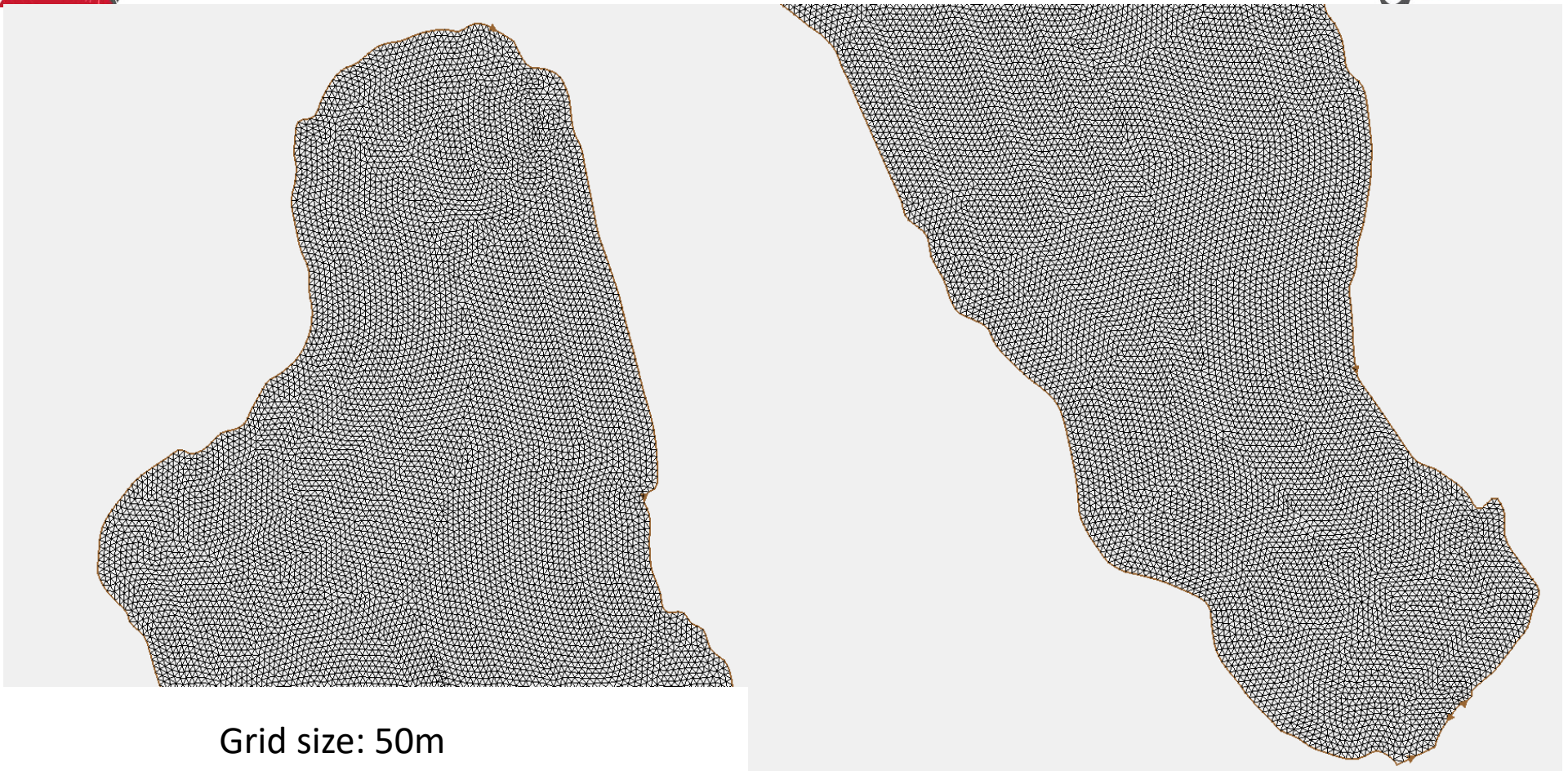


# Implementation of hydrological module chain

*Implementation of COASTOX*

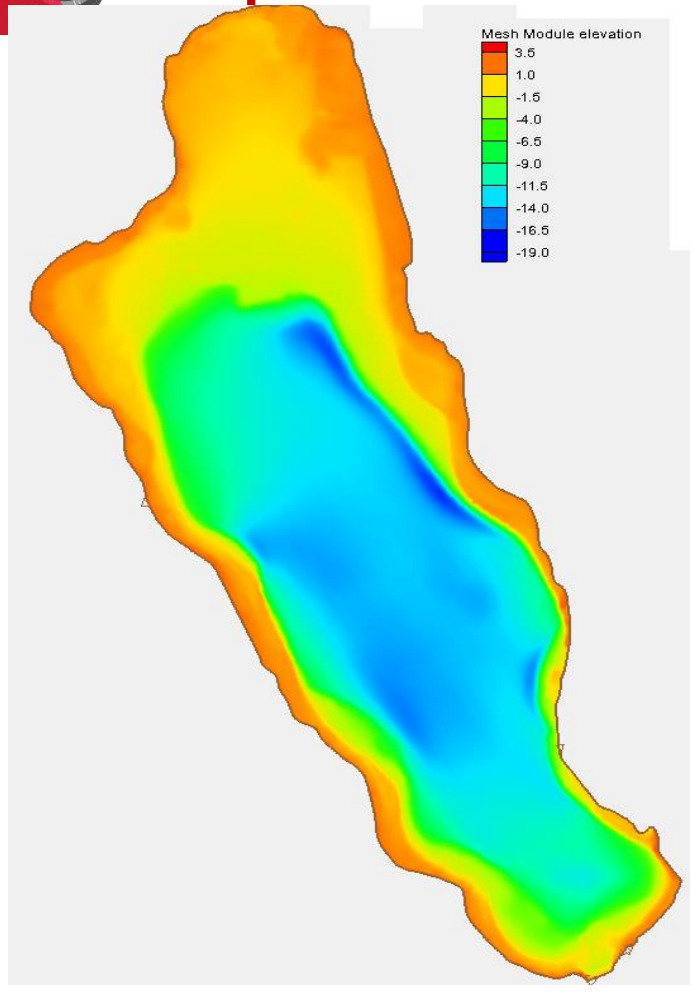
- Bathymetry  data and mesh preparation (~39000 mesh points)
- Inflow and outflow data adapted from monitoring
- Determination of flow along the lake
- Comparison with observation data shows a good fit
- Deposition from RODOS ADM provides input data

# Implementation of hydrological module chain

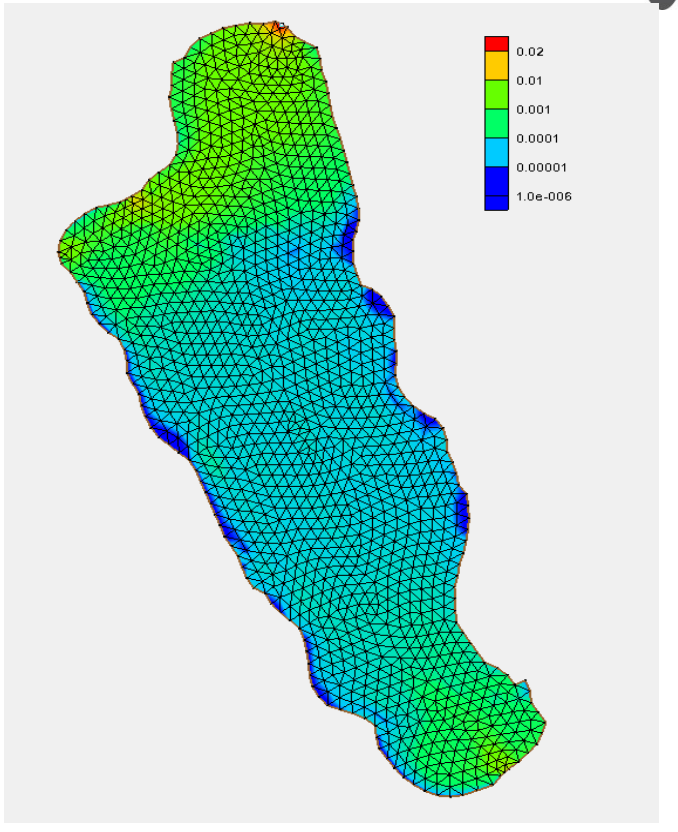


Grid size: 50m

# Implementation of hydrological module chain

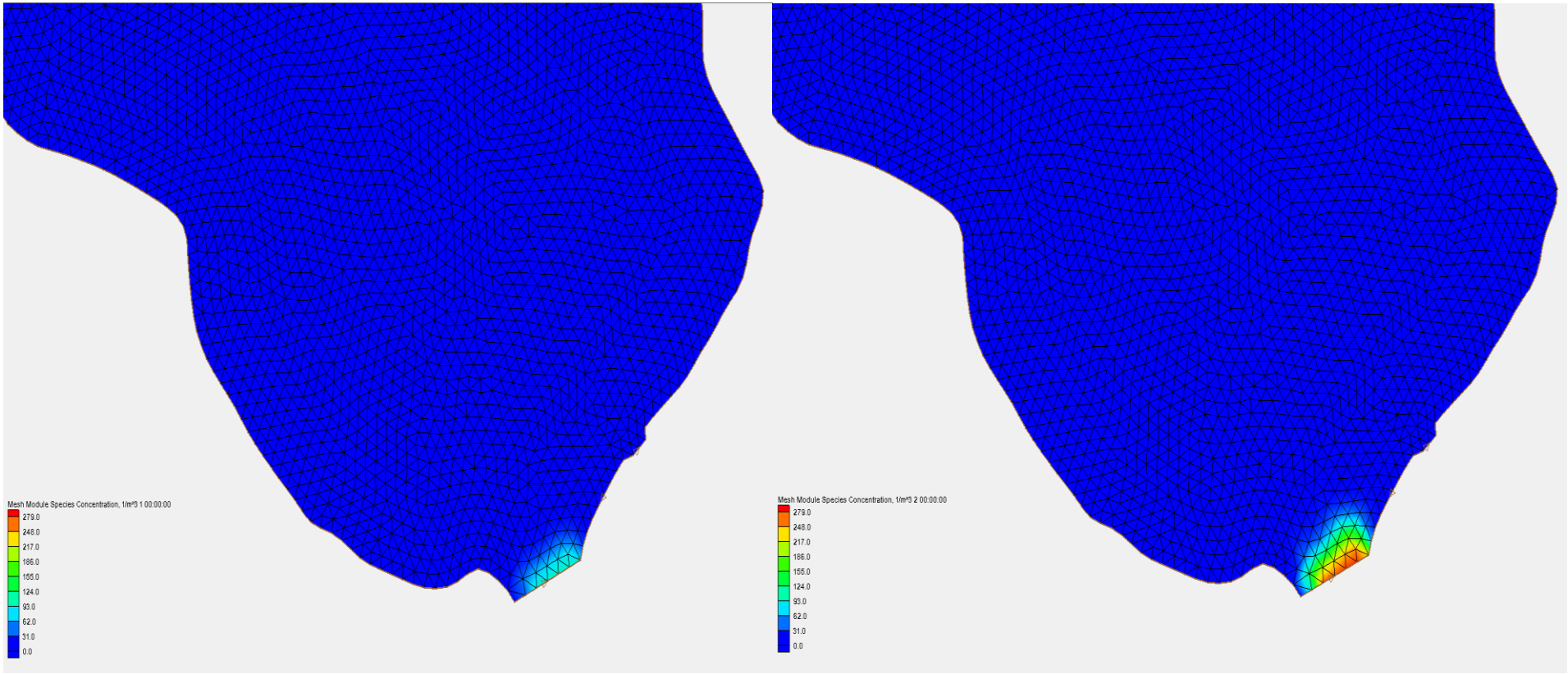



Bathymetry




Flow velocity

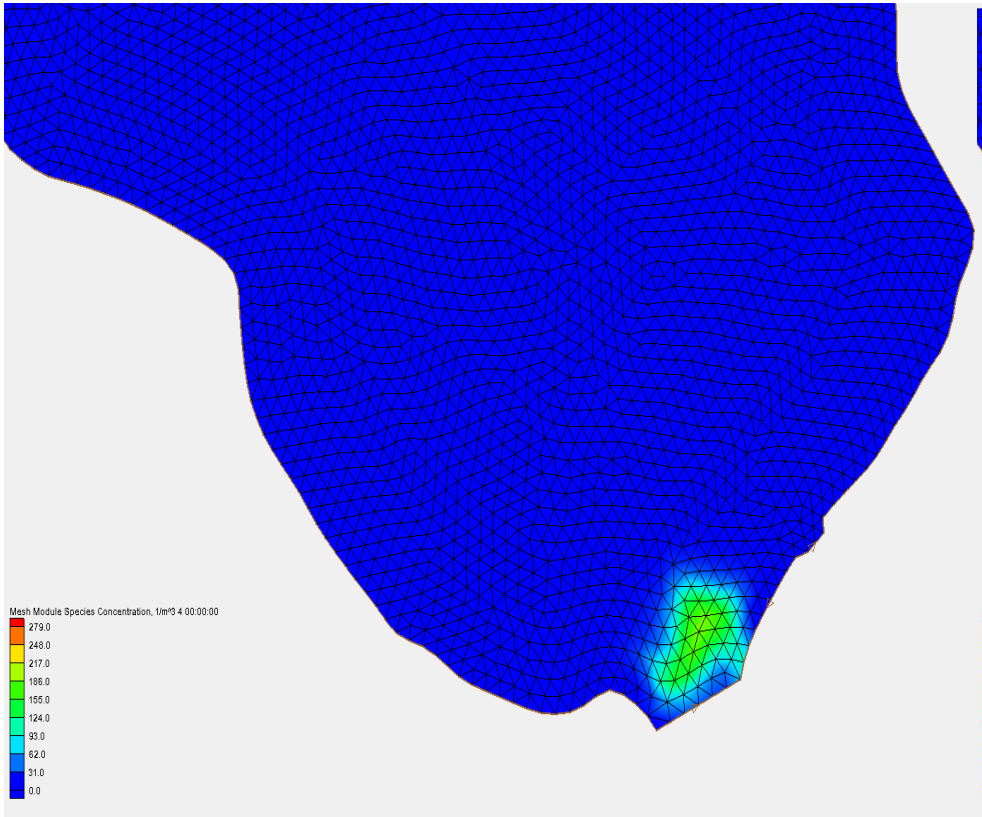
# Implementation of hydrological module chain



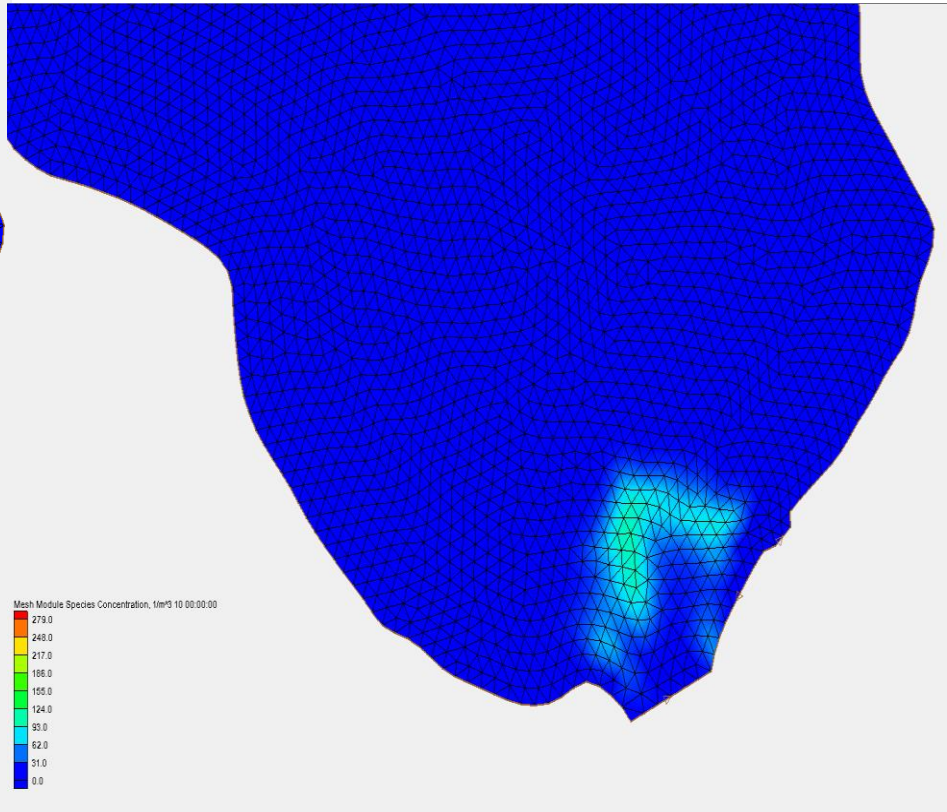

Day 1

Day 2

# Implementation of hydrological module chain

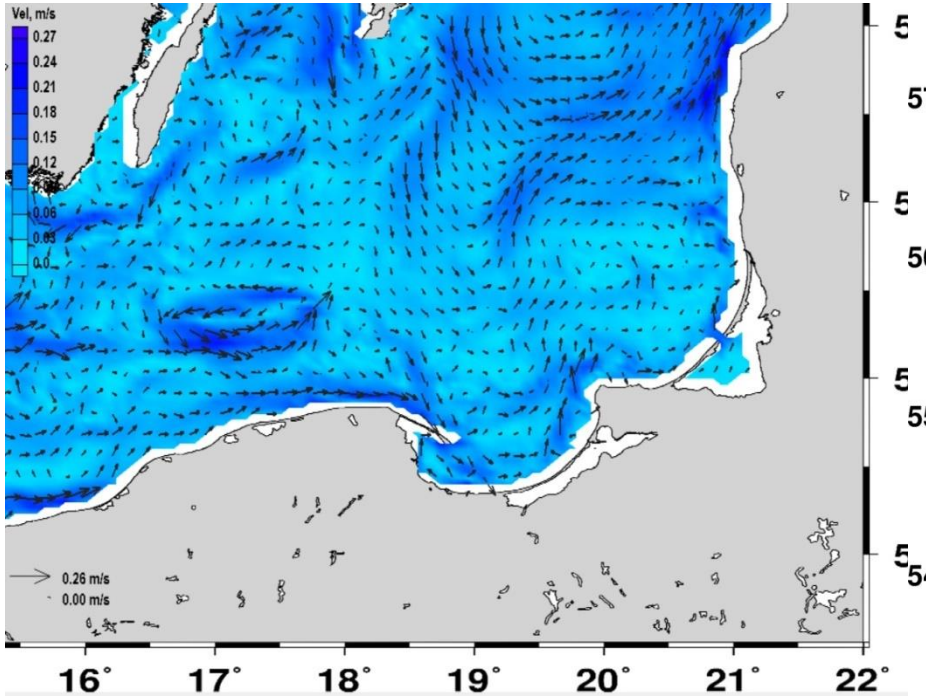



Day 5

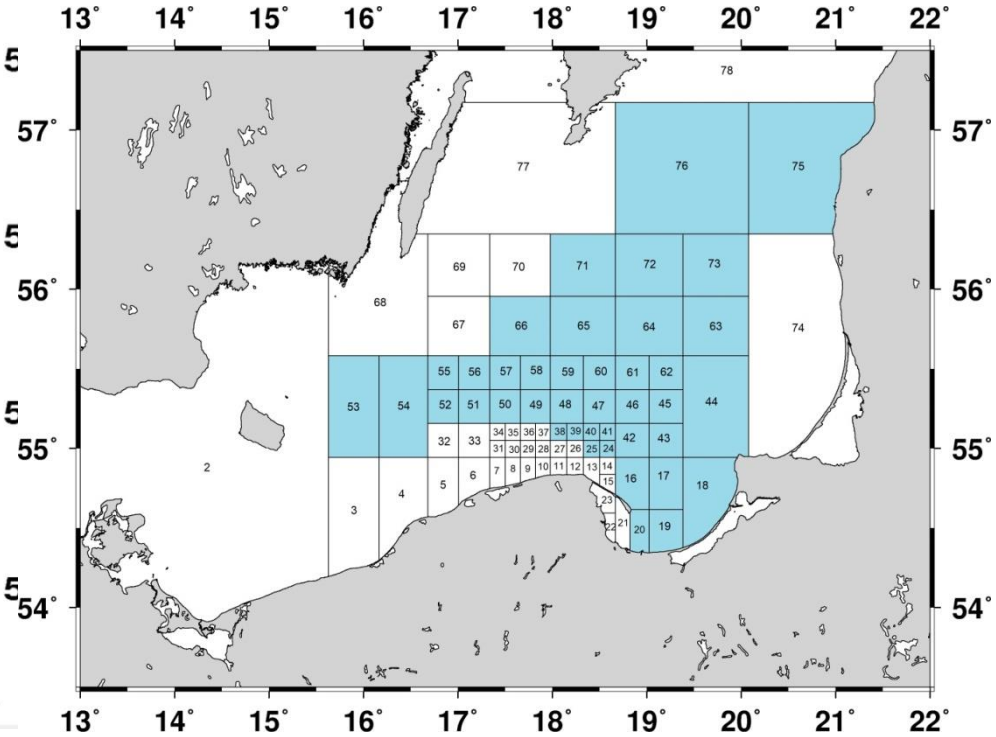



Day 10

# Implementation of hydrological module chain

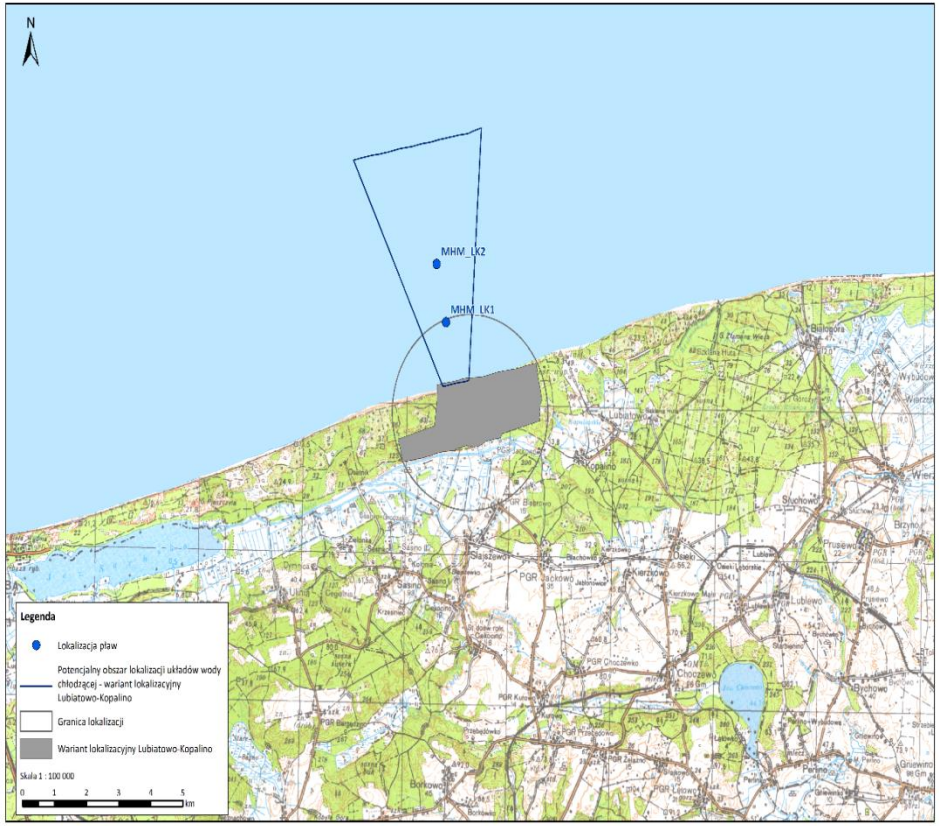


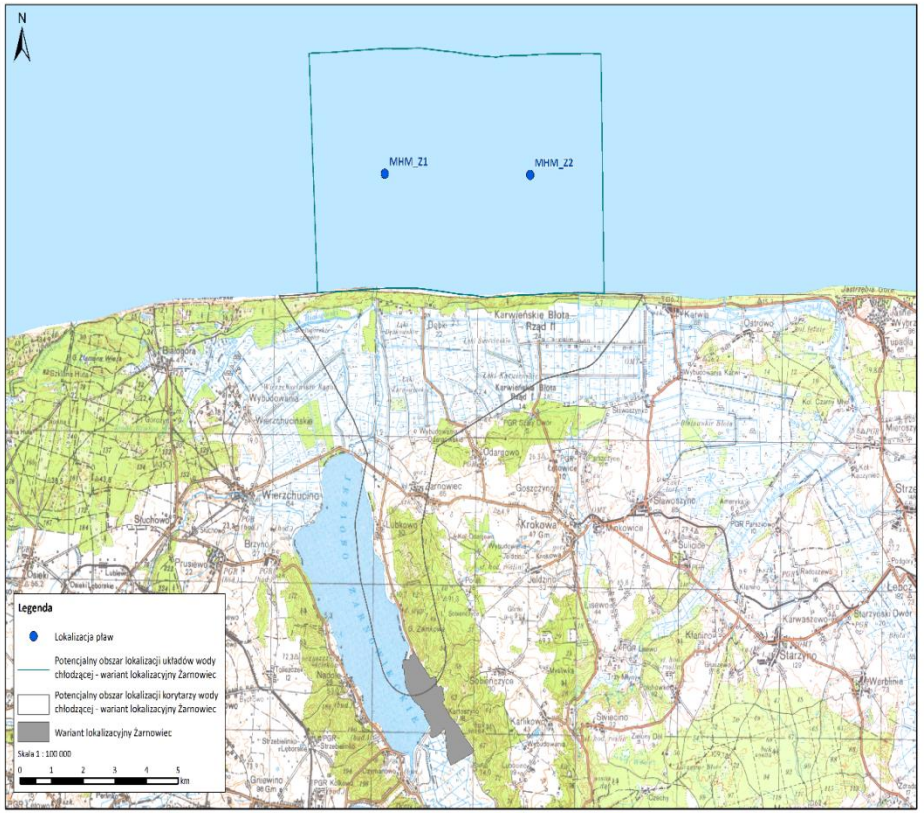

Application of NEMO-Nordic model for Baltic sea




Grid for Poseidon model

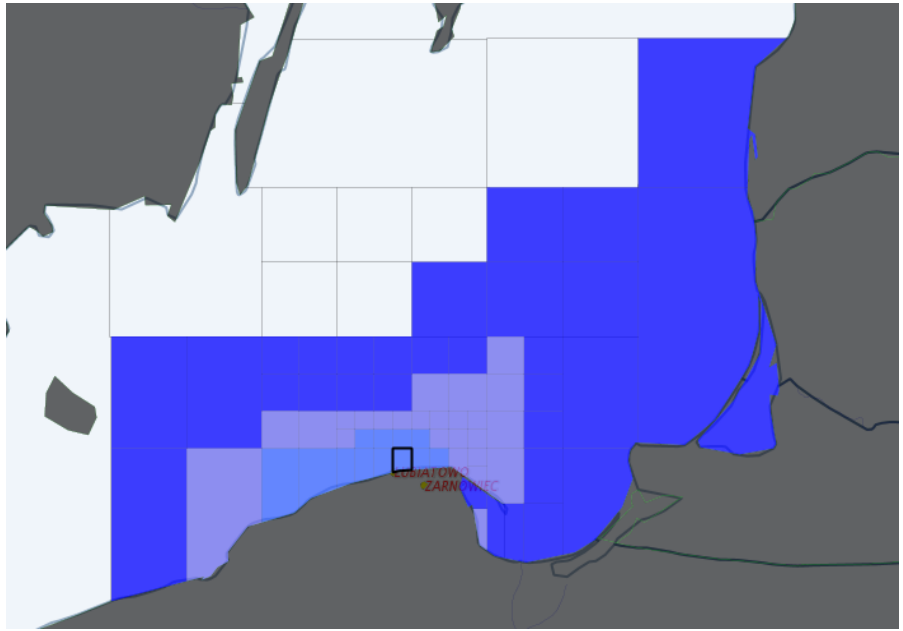
# Implementation of hydrological module chain



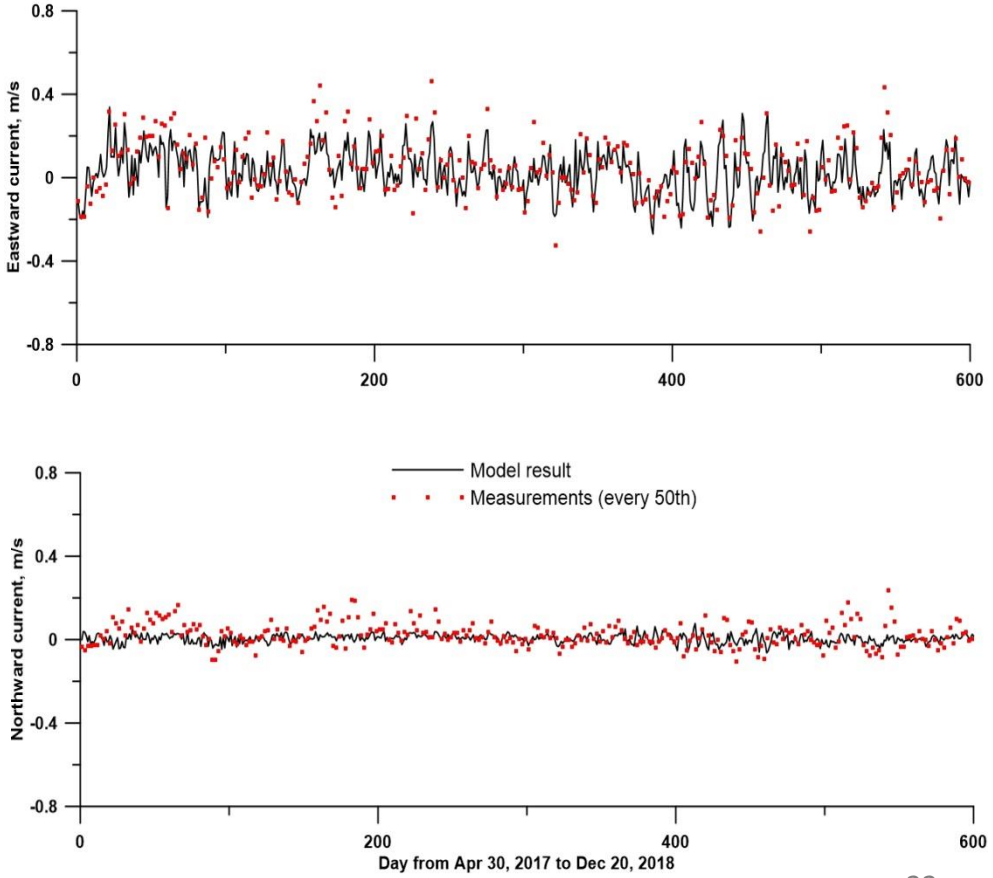




Monitoring from buoys on the sea

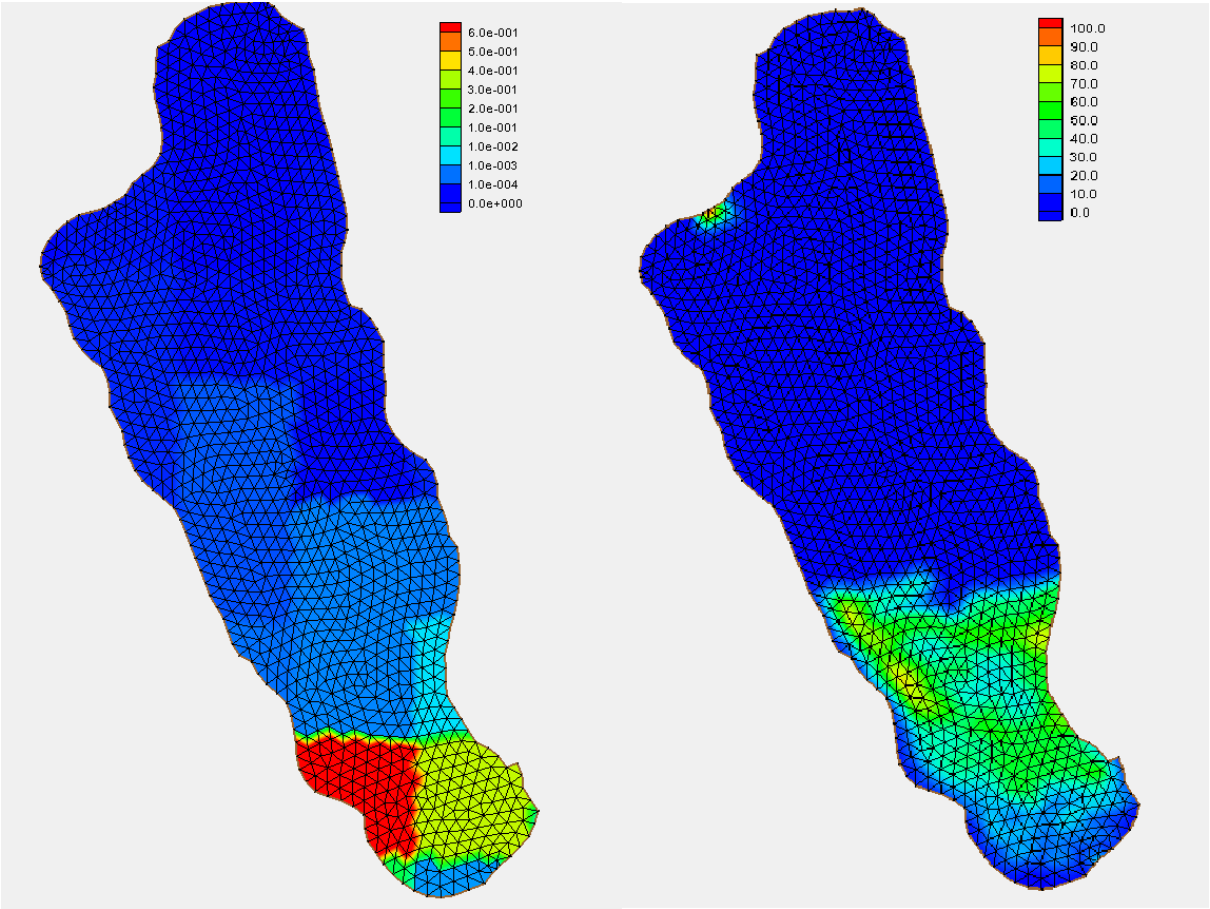
# Implementation of hydrological module chain



Implementation of Poseidon model

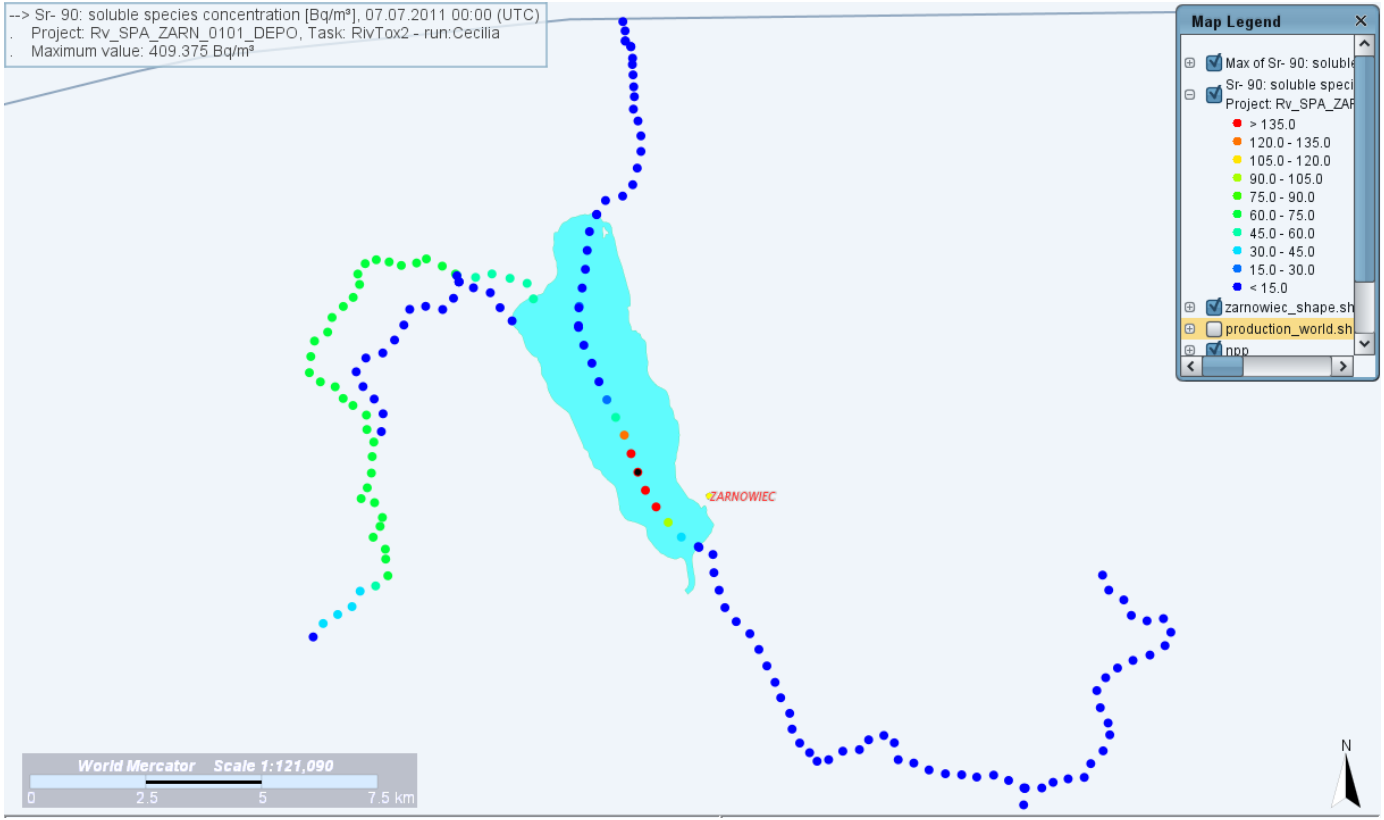


# Implementation of hydrological module chain



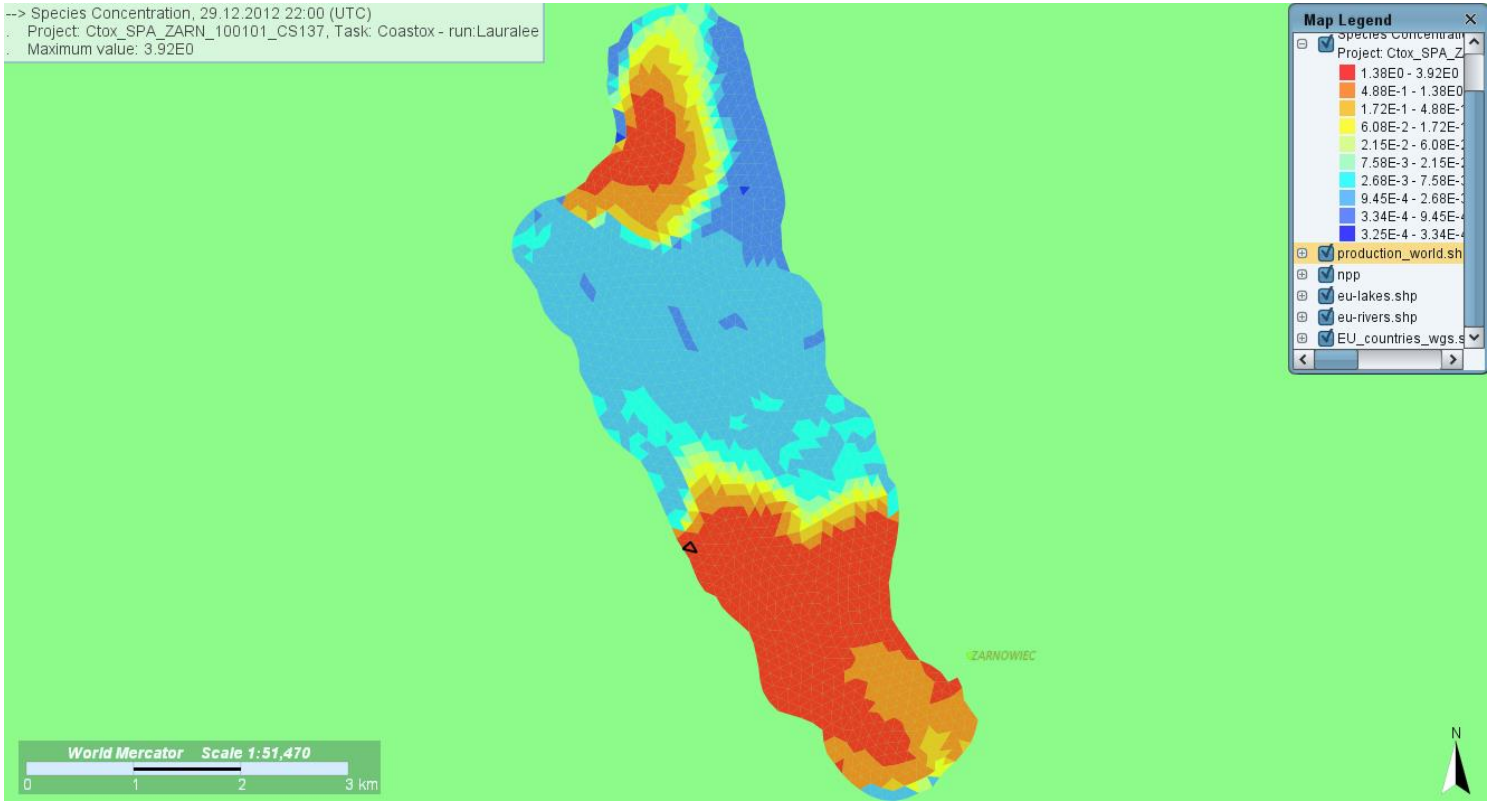

Deposition from atmospheric dispersion

# Example of calculations



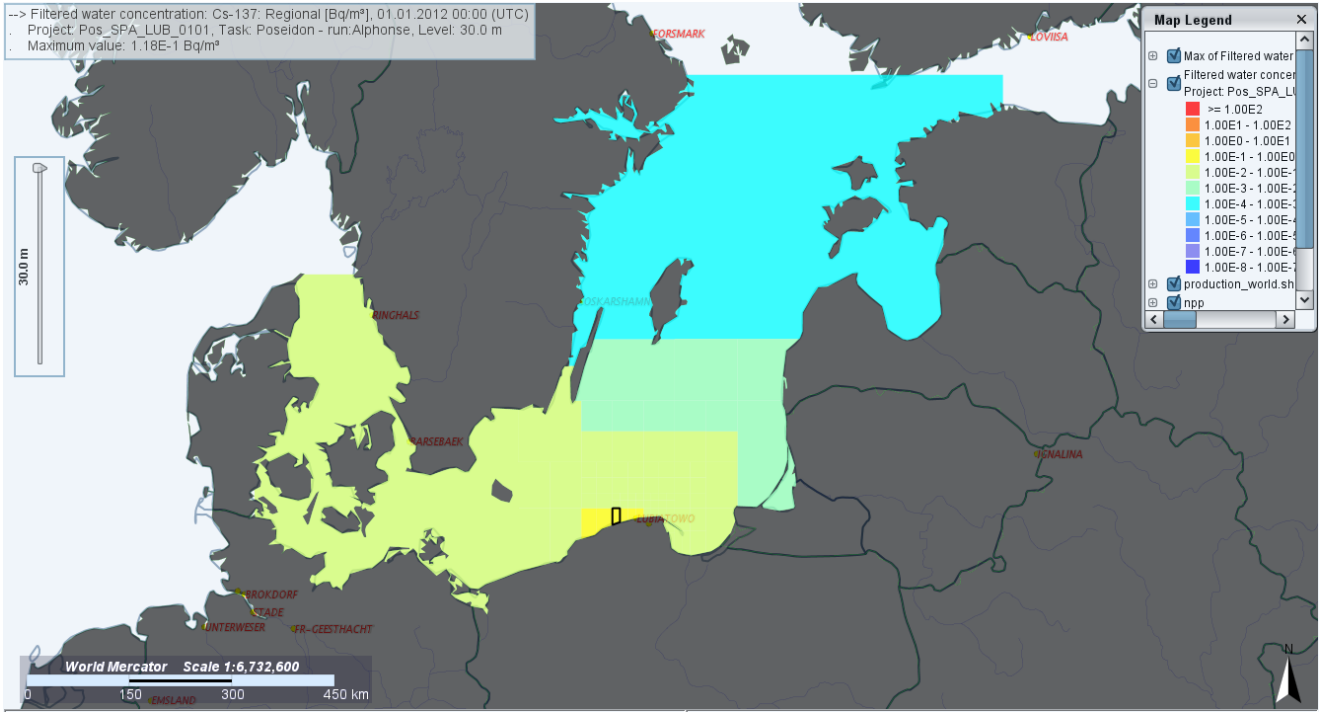

RIVTOX results

# Example of calculations



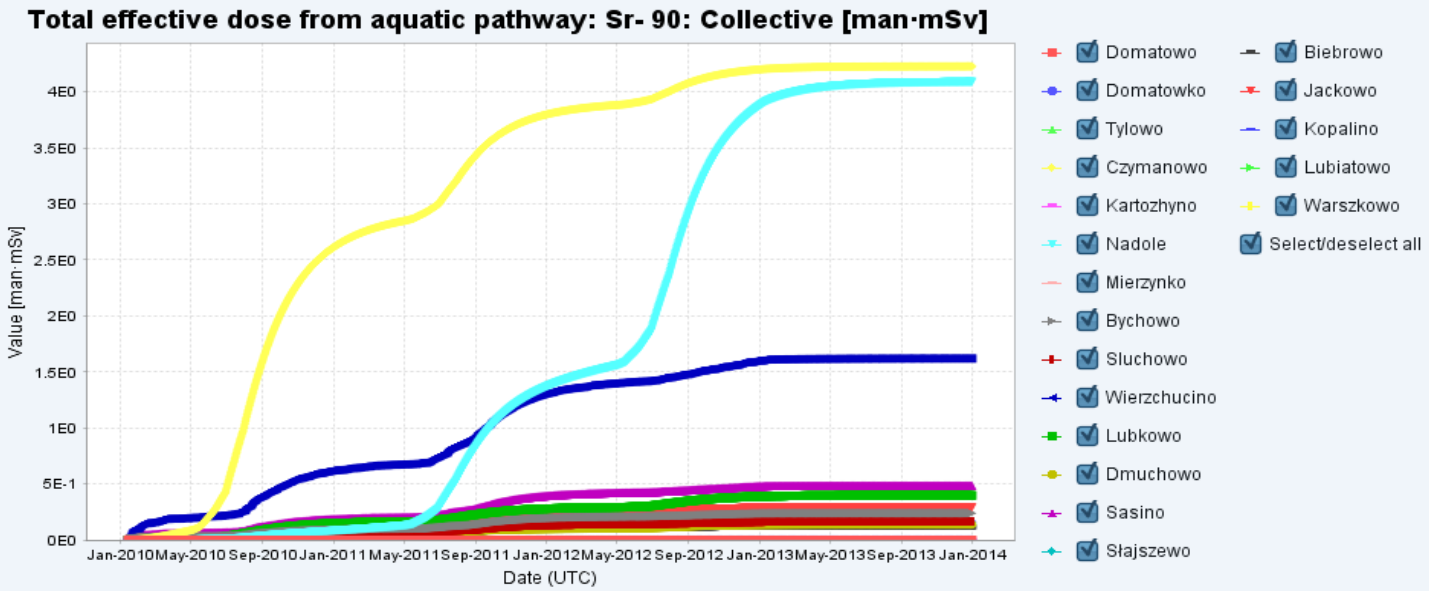

COASTOX results

# Example of calculations

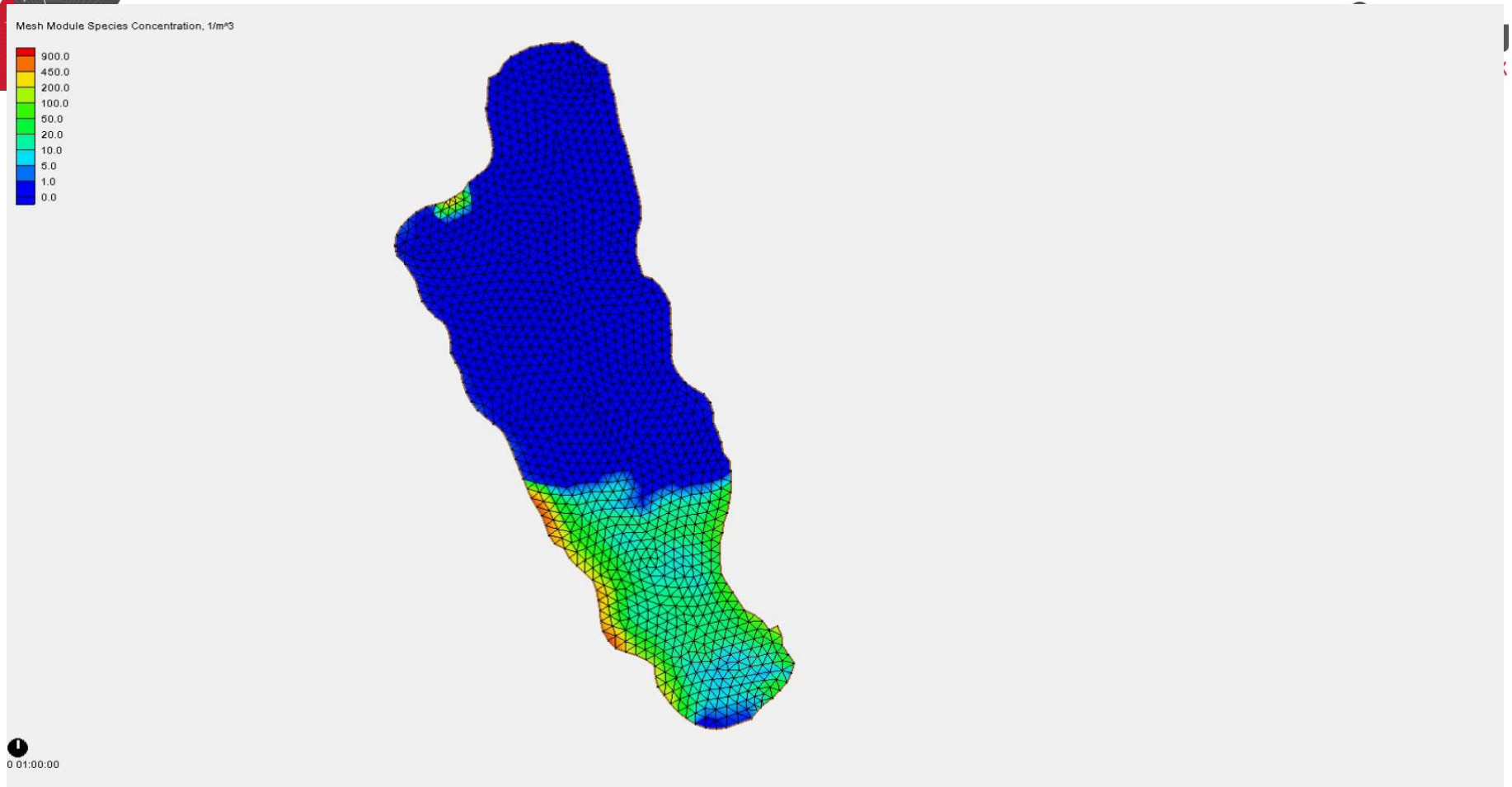



POSEIDON results

# Example of calculations




FDMA results




The effect of water pump station operation

# Conclusions

- Implementation of HDM consists of the following module chains:
  - LSMC->RETRACE->RIVTOX->FDMA (inland water pathway).
  - LSMC-> RETRACE-> RIVTOX ->POSEIDON (marine pathway with inland water pathway).
  - LSMC->COASTOX->RIVTOX->POSEIDON (marine pathway and inland water pathway with COASTOX module for accurate deposition on Żarnowieckie Lake treatment)
- POSEIDON model can be used directly for liquid releases into the sea (normal operation case)
- In general scenarios with liquid releases can be also simulated after some rearrangement of input data