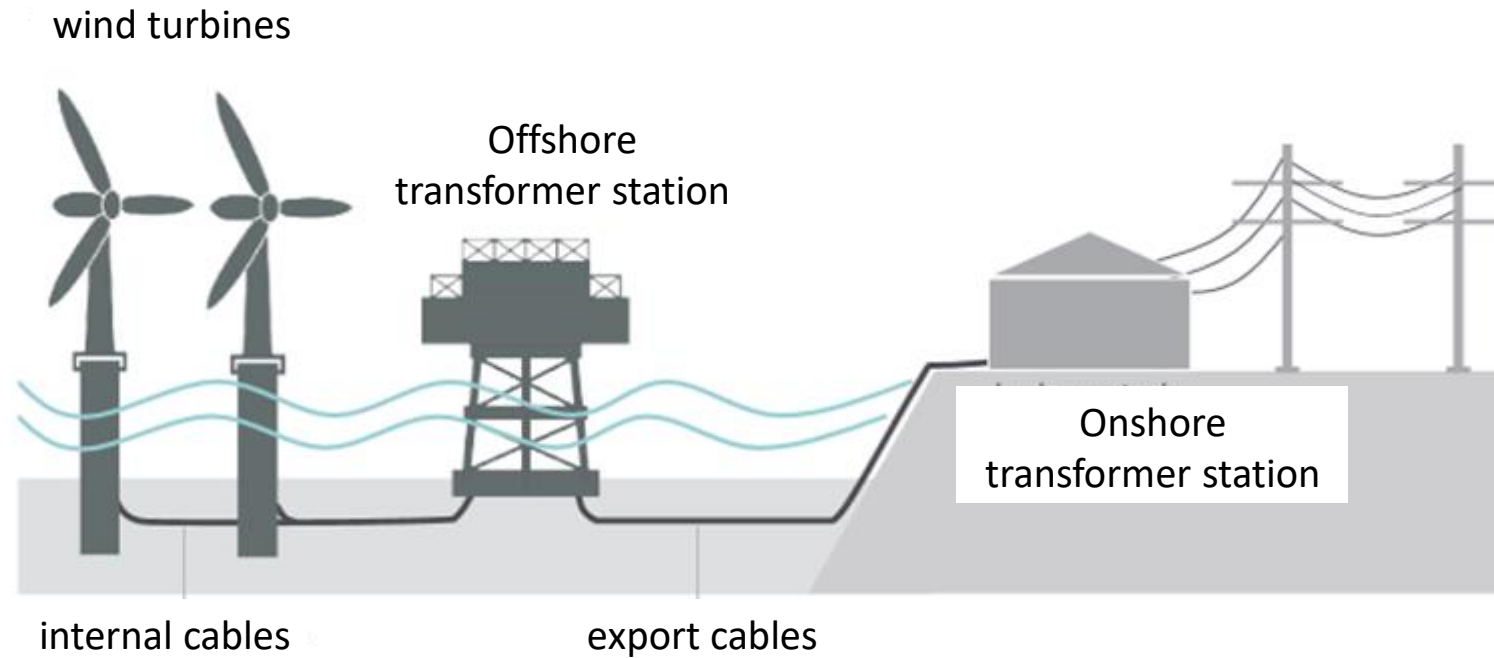


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# THE SPREADING OF SUSPENDED MATTER FORMED DURING CONSTRUCTION WORKS OF OFFSHORE WIND FARMS

# Scheme of an offshore wind farm and typical connection infrastructure



Source: The Crown Estate; E.ON; DONG Energy; 4C offshore; prasa; McKinsey

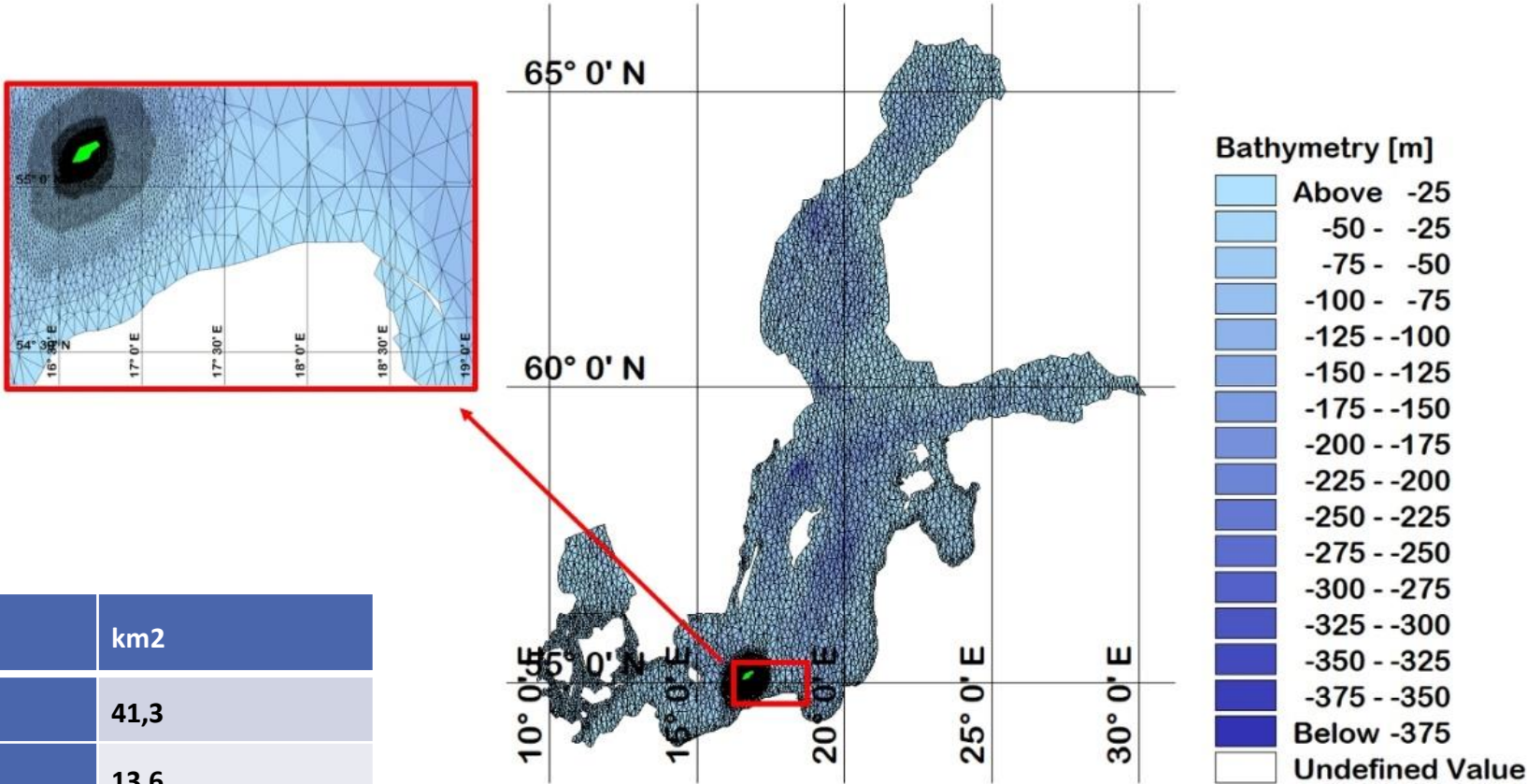
# Study area

The analyzed investment is located in the central part of the South Baltic Sea, at the foot of the northern slopes of the Słupsk Bank, about 55 km from the shoreline opposite the Ustka commune.

Geologically the sea bed in the wind mill area consists of layers gravel-stone bottom with sandy ribbons

Technical parameters	km2
Area of the offshore wind farm	41,3
Area of the buffer zone	13,6
Area occupied by the wind farm	27,7

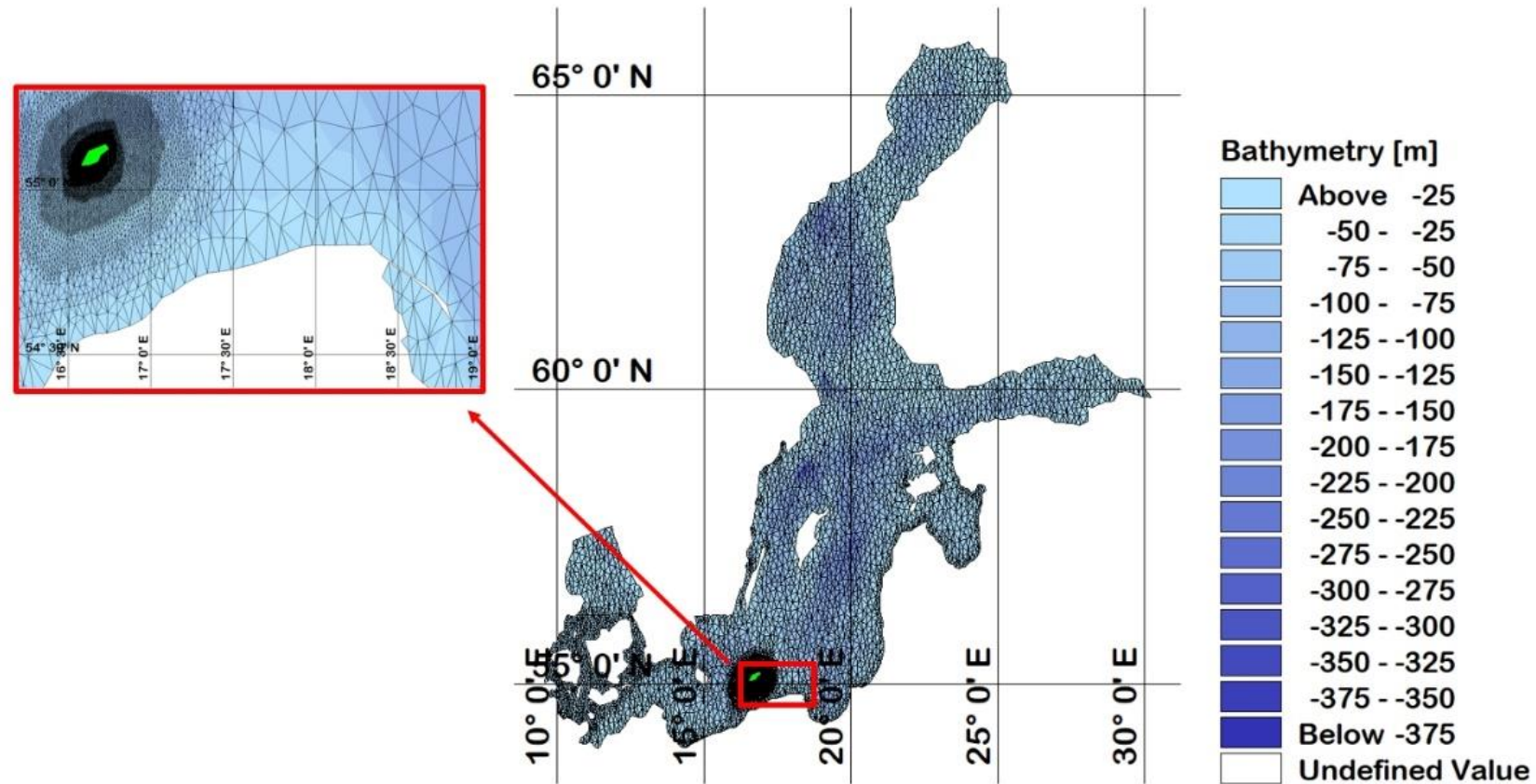
Location of the study area (green polygon), model domain and bathymetry



# Materials and methods

- model has been built based on MIKE, tools supplied by DHI and WRF,
- all the implemented models cover the entire Baltic Sea
- the Baltic bathymetry comes from NavSim,
- the MIKE model is based on flexible mesh, which allows high spatial resolution in the interesting area. The vertical resolution is the sigma coordinate system, a coordinate system used in computational models for oceanography, with 25 sigma layers.

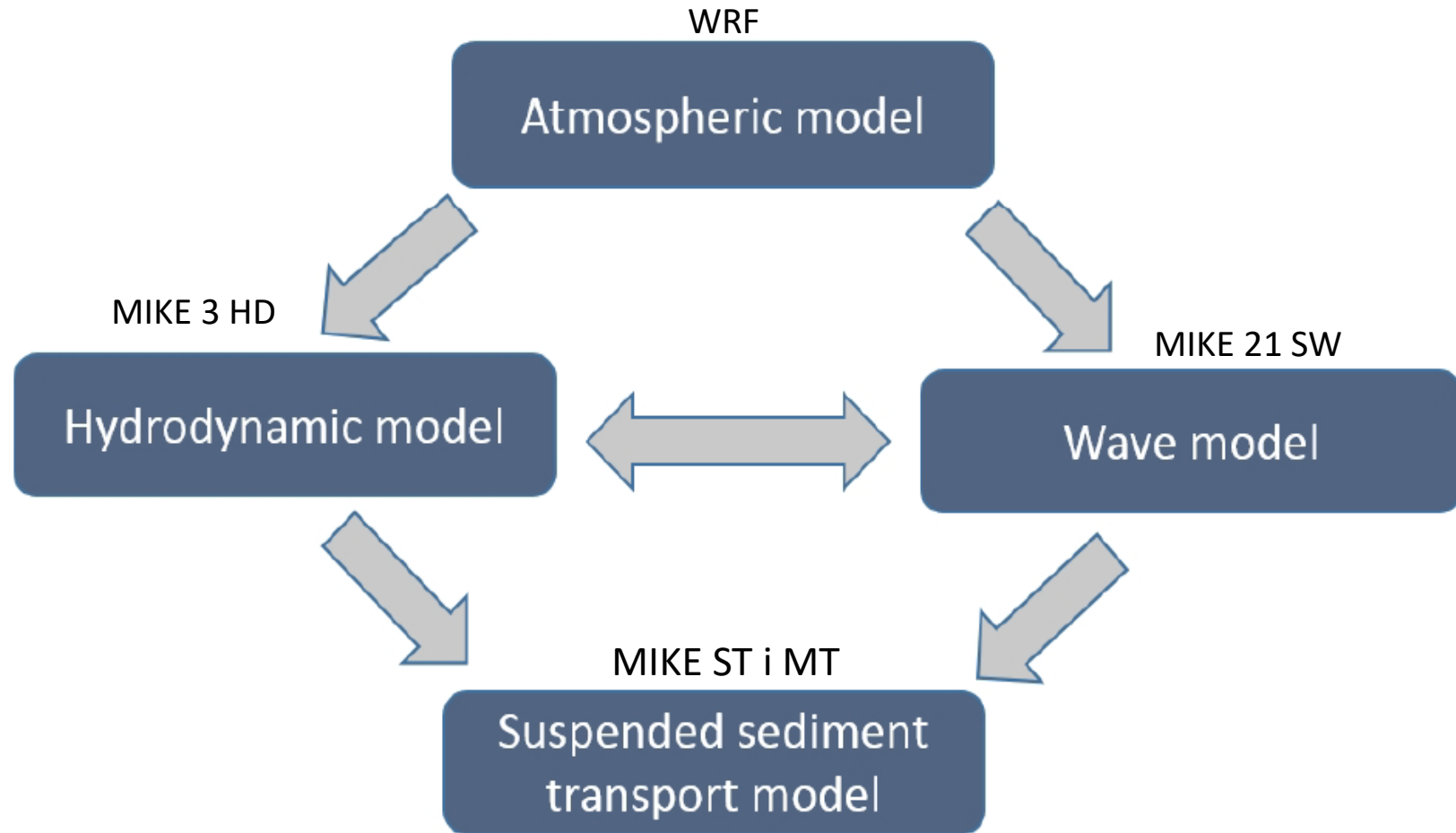
Location of the study area (green polygon), model domain and bathymetry



# Materials and methods:

- the main part of the couple model is the Hydrodynamic Model - Mike Flow Model for simulation of currents, water levels, salinity and water temperature,
- the hydrodynamic models require the atmospheric data provided by the forecasting model (WRF) and the other data provided by the Spectral Wave Model (SW),
- the MIKE 21/3 Coupled Model FM includes a dynamic coupling between the Mud Transport Module (MT) and the Sand Transport Module (ST).

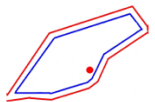
The Baltic Sea coupled model diagram



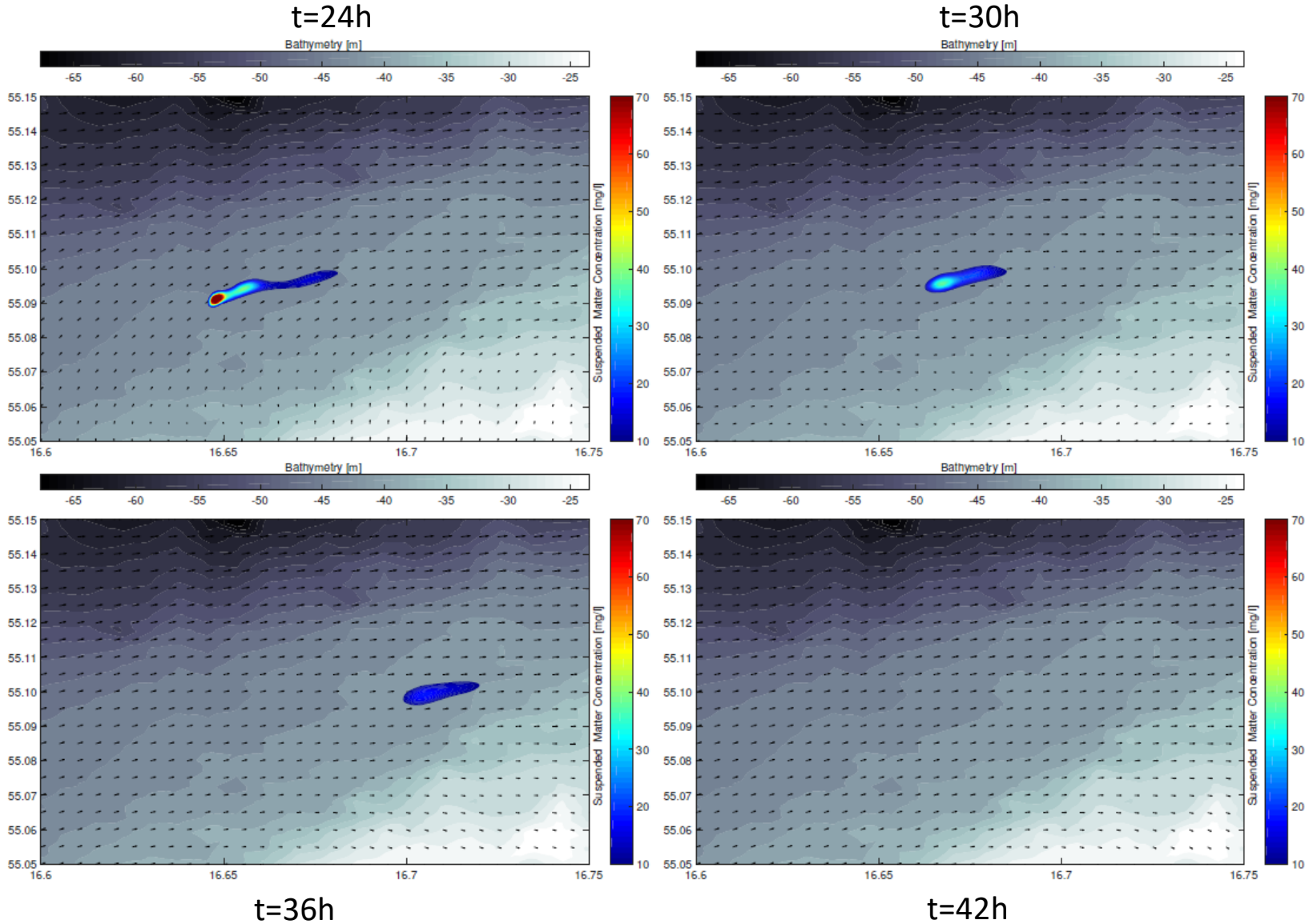
MIKE 21/3 Couple Model FM by DHI



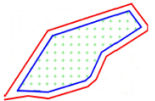
# Results:

Technical parameter	
Area of the offshore wind farm [km <sup>2</sup> ]	41.3
Area of the buffer zone [km <sup>2</sup> ]	13.6
Area occupied by the wind farm [km <sup>2</sup> ]	27.7
Method of dredging	Gripper dredging machine
Location of the discharged material	Water column
Spill% (fines only)	3
Dredging time [hours]	24
Dredging speed [kg/s]	300
dredger rate[kg/s]	9
FOR ONE WIND FARM	
The location of the wind farm with the buffer zone in the farm area	
Number of turbines [pcs.]	1
Distances between power plants [m]	not applicable
Highest power plant density [pcs/km <sup>2</sup> ]	not applicable

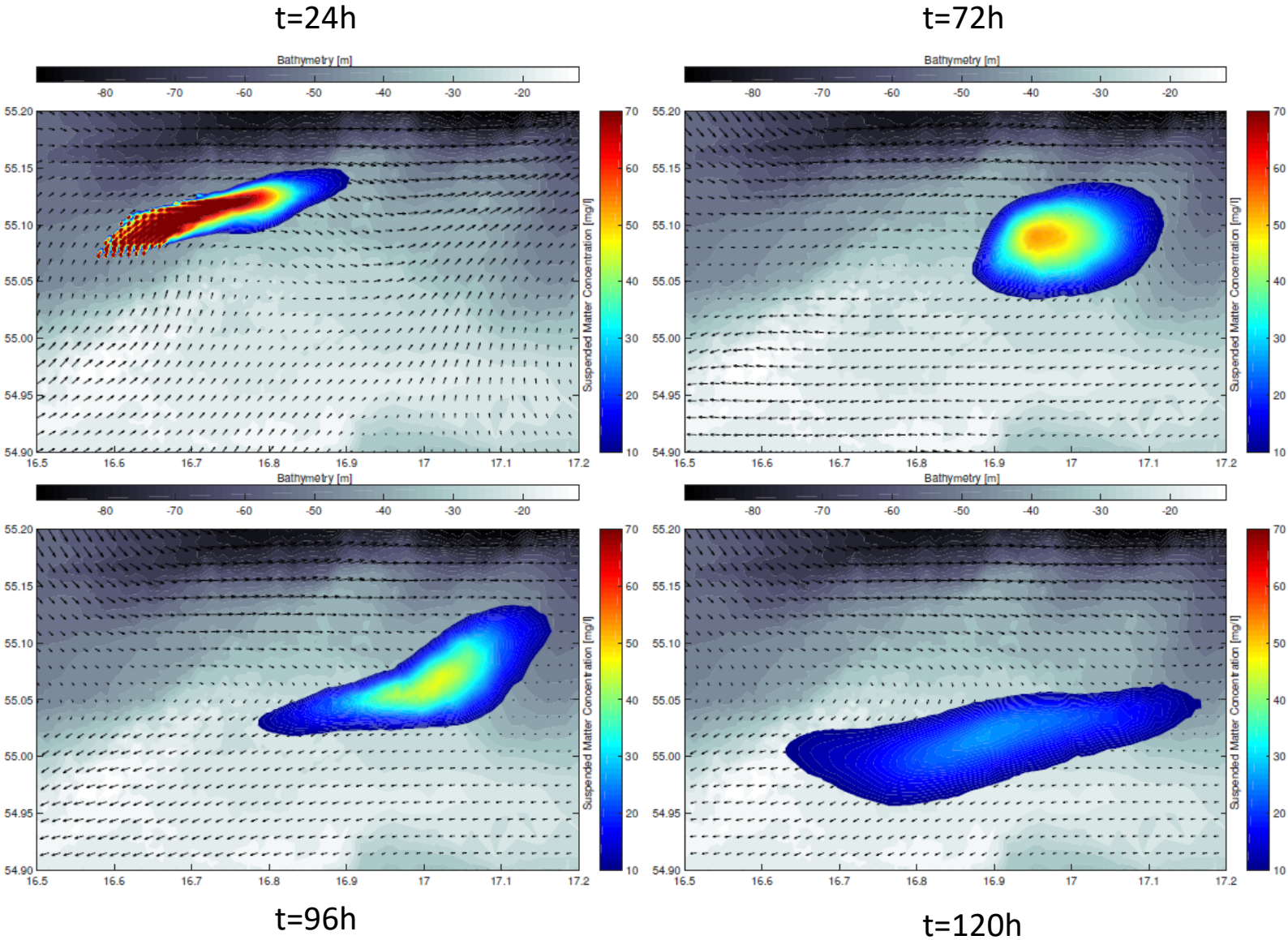
Suspended sediment concentration 24, 30, 36 and 42h after starting dredging work starting dredging work (for one wind farm)



# Results:

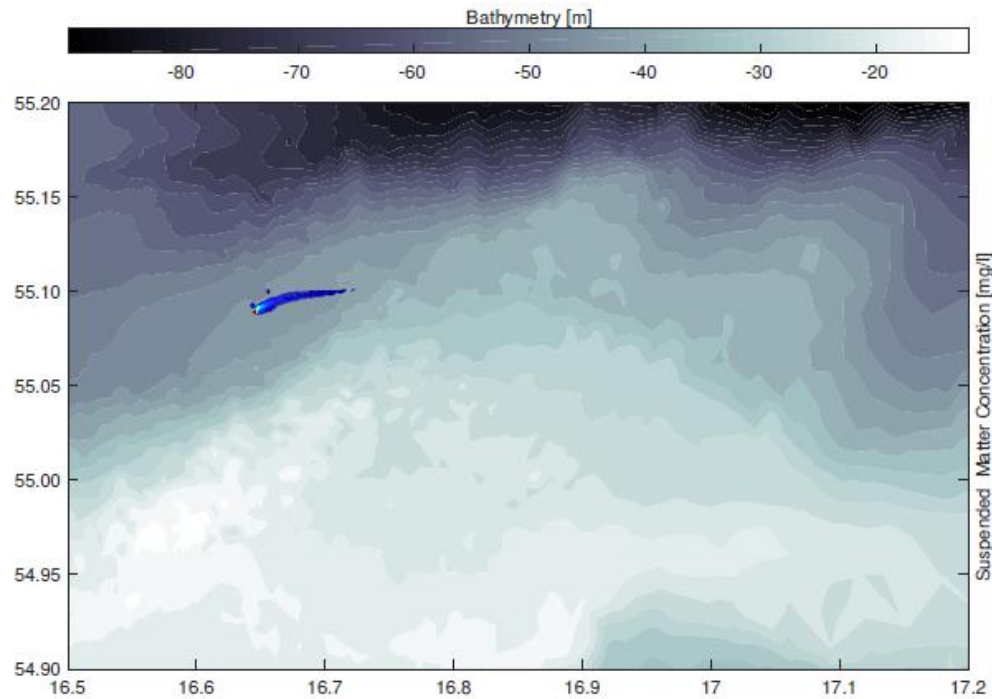
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dredger rate[kg/s]	9
CUMULATIVE CASE	
The location of the wind farm with the buffer zone in the farm area	
	
Number of turbines [pcs.]	70
Distances between power plants [m]	625
Highest power plant density [pcs/km <sup>2</sup> ]	2.56

Possible change of suspended sediment concentration during 24h-120h for case working on more than one wind turbine (cumulative case)

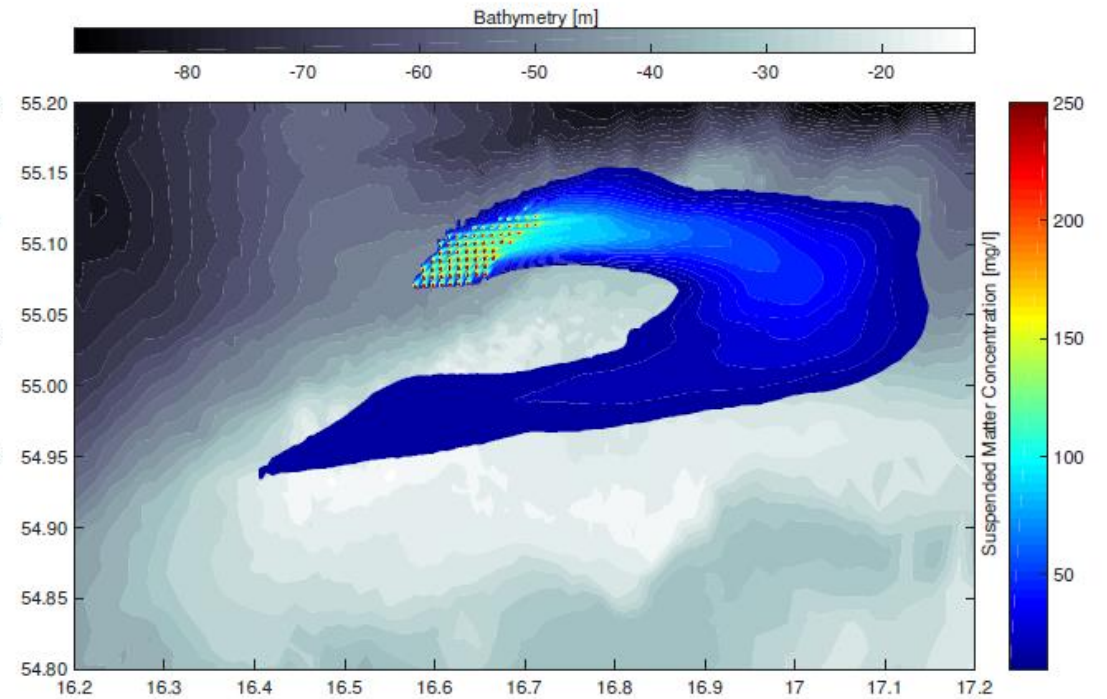


# Distribution of the maximum concentration of suspended sediment

FOR ONE WIND FARM



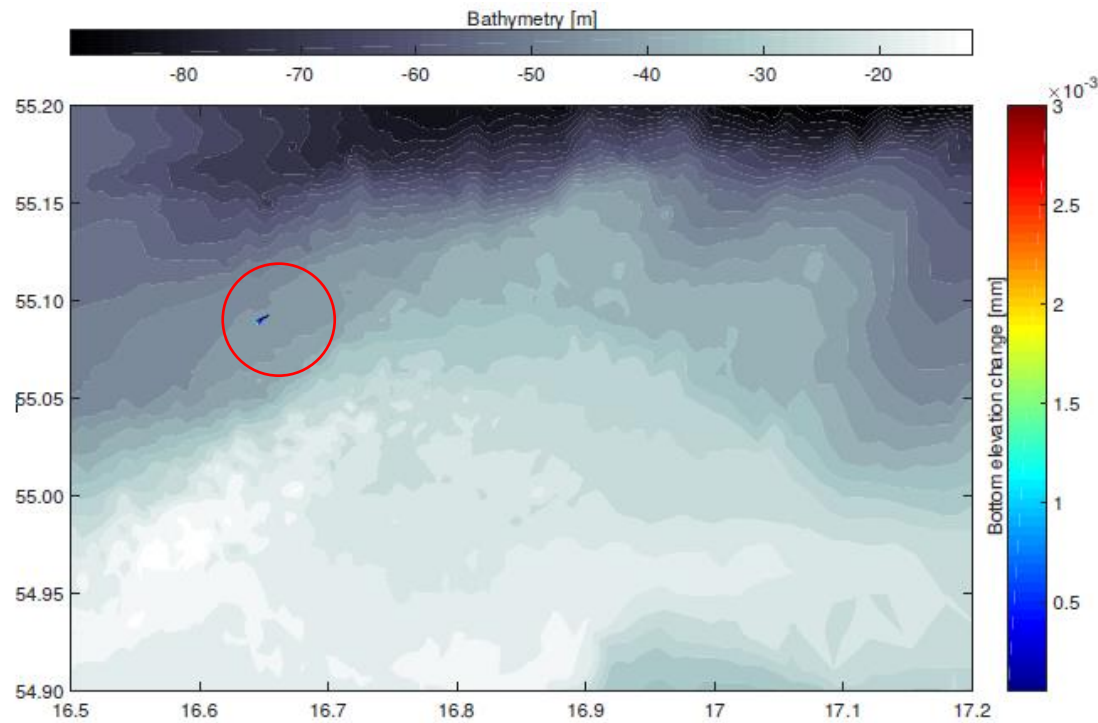
CUMULATIVE CASE



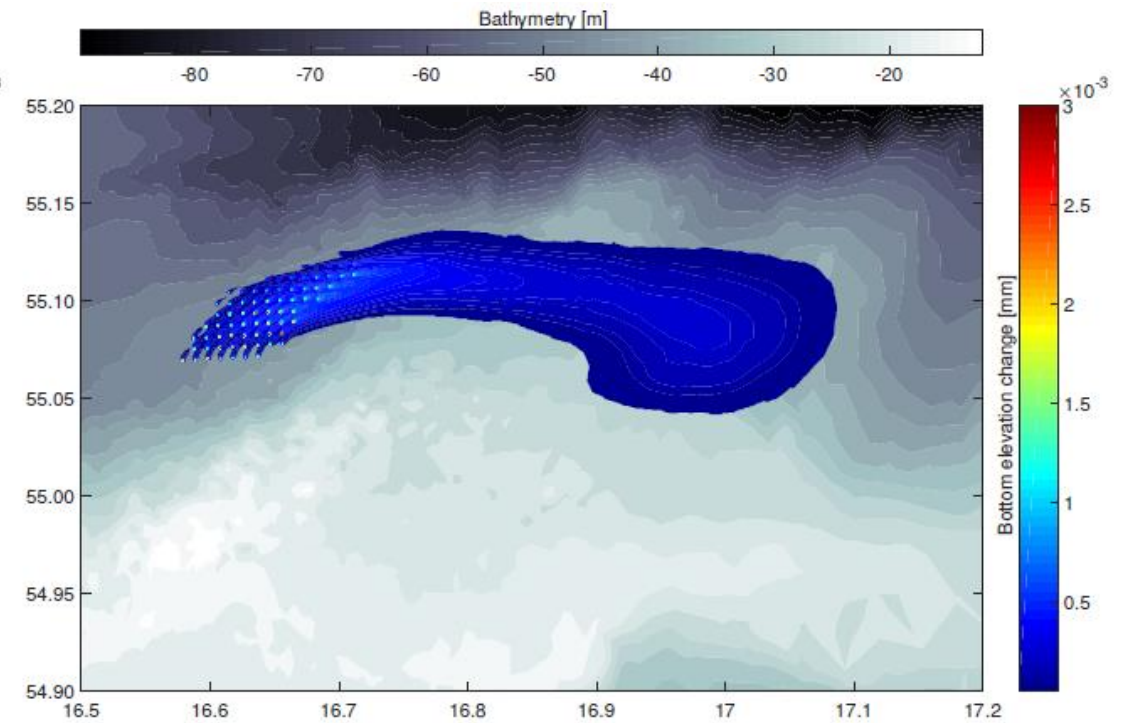


# Deposit of sediments during construction work

FOR ONE WIND FARM



CUMULATIVE CASE



# Final remarks:

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- Impact of dredging works on the spreading of suspended matter resulting from construction of the Offshore Wind will depend primarily on the type of foundation and on the scope of dredging and installation works carried out at the same time,
- Suspended sediment from dredging activities related to the construction of one turbine will remain at a level of more than 10 mg/l for maximum 42 hours,
- The range of the suspended sediment will not exceed 15 km.
- Bottom level change due to dredging is negligible, maximum values (less than 1 mm) will be at the locations of the dredging works and will decrease with the distance from the farm
- Cumulative impacts significantly increase the concentration of suspended sediment and the impact area. To avoid cumulative impacts, the works should not be carried out at distances closer than 2 km