IBW PAN

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Sustainable management of coastal lagoons. Cross-cut through Vistula Spit.

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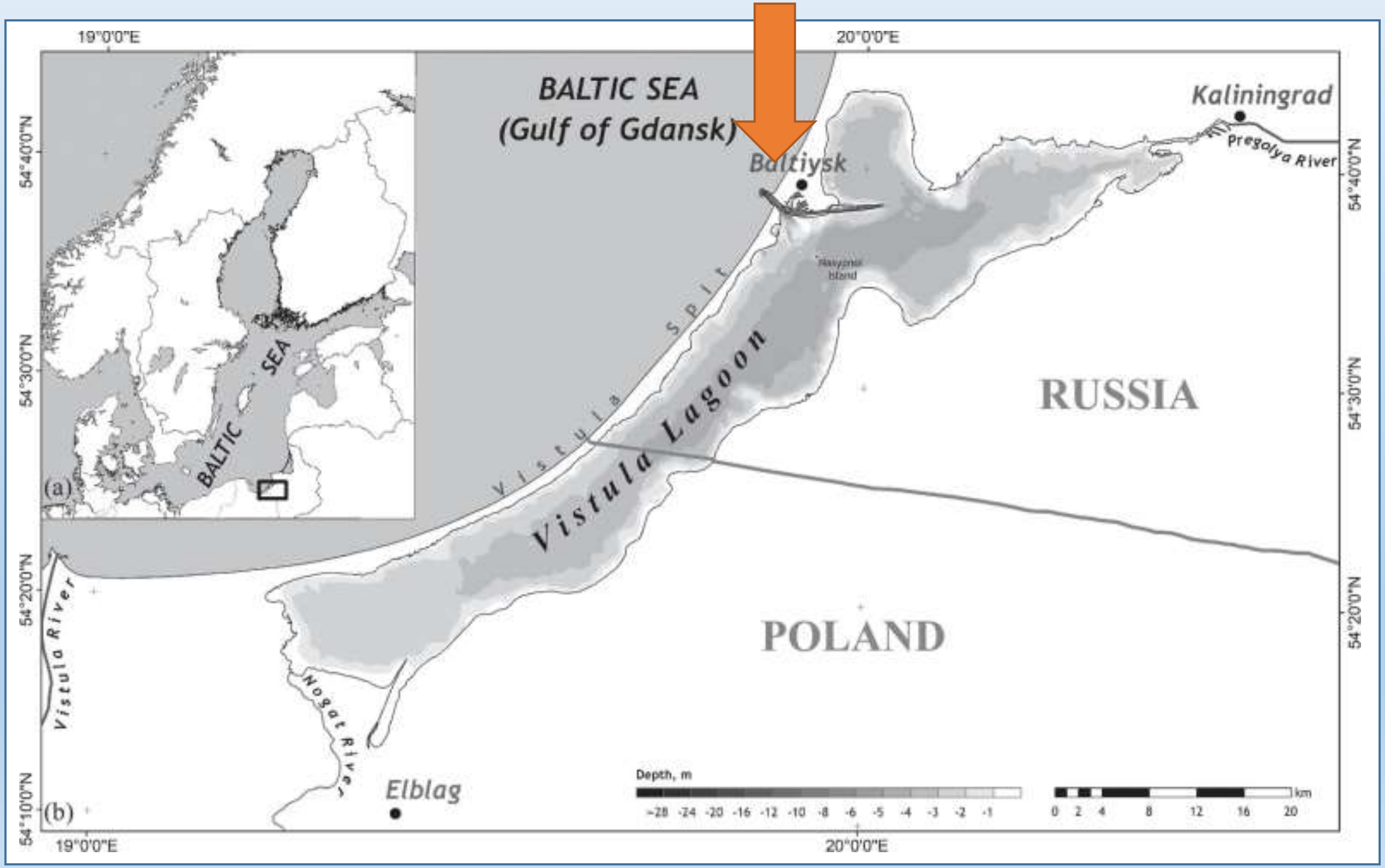
Presentation outline:

1. Study area – Vistula Lagoon
2. Difficult relations with Russia: limited access to Polish part of the Lagoon
3. Selection of passage site: hydro-, litho- and morphodynamic investigations
4. Artificial island for sediment storage: impacts on lagoon wave and current fields
5. Biodiversity restoration – artificial island as compensation for lost habitats occupied by a large hydraulic project
6. Lessons learned

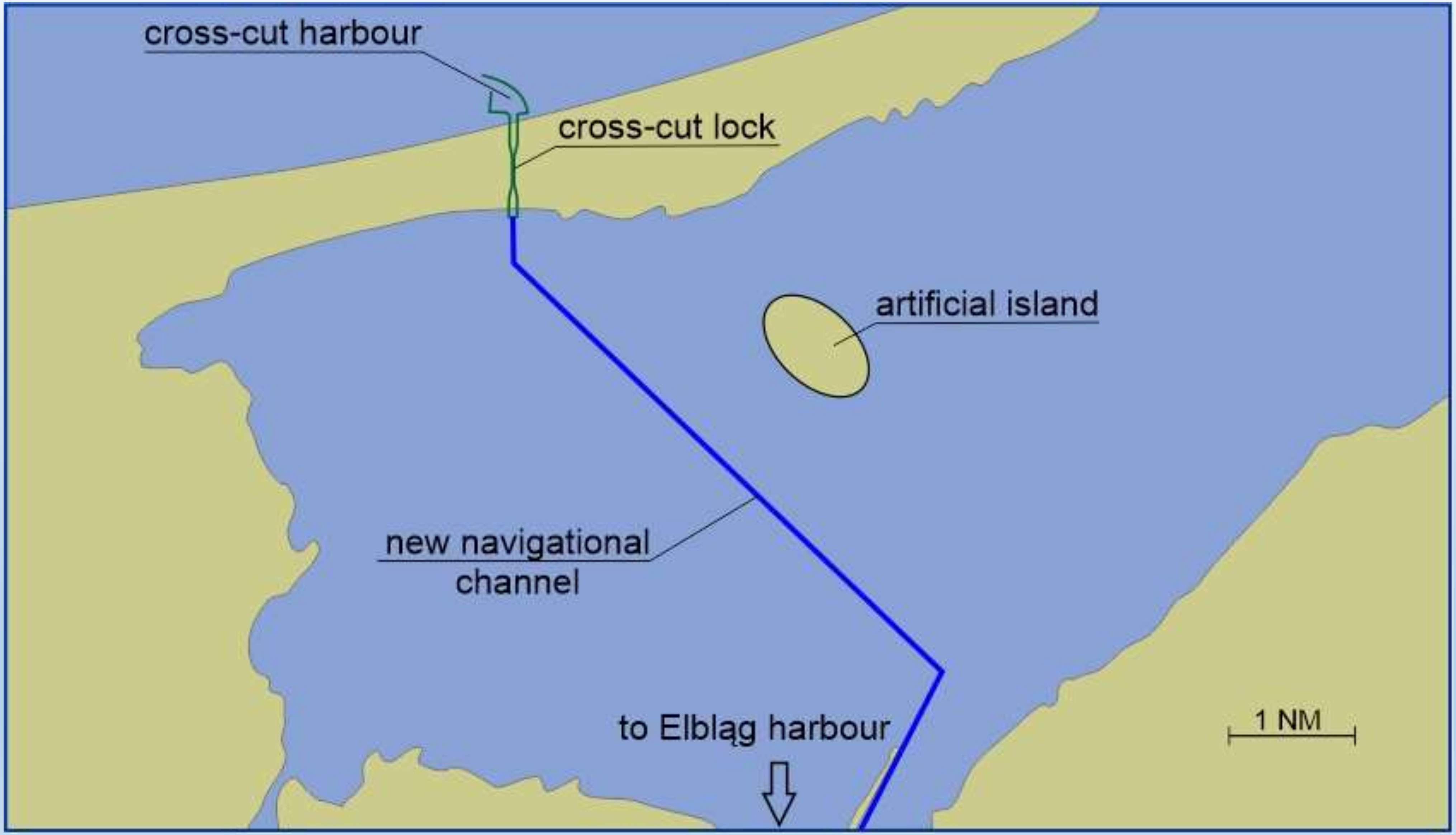
1. Study area – Vistula Lagoon, Baltic Sea, Polish/Russian water body

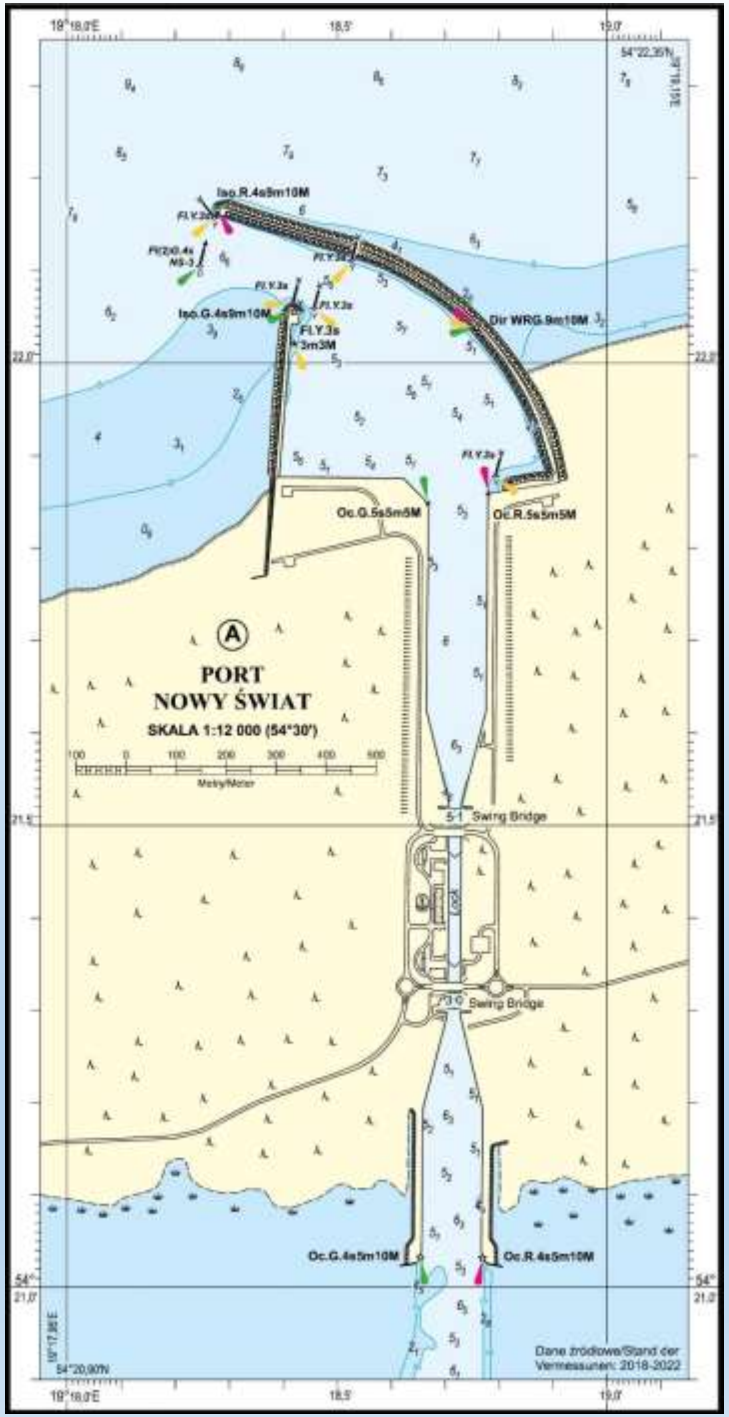
2. Difficult relations with Russia: limited access to Polish part of the Lagoon

Access on the Russian side



3. Selection of passage site: hydro-, litho- and morphodynamic investigations

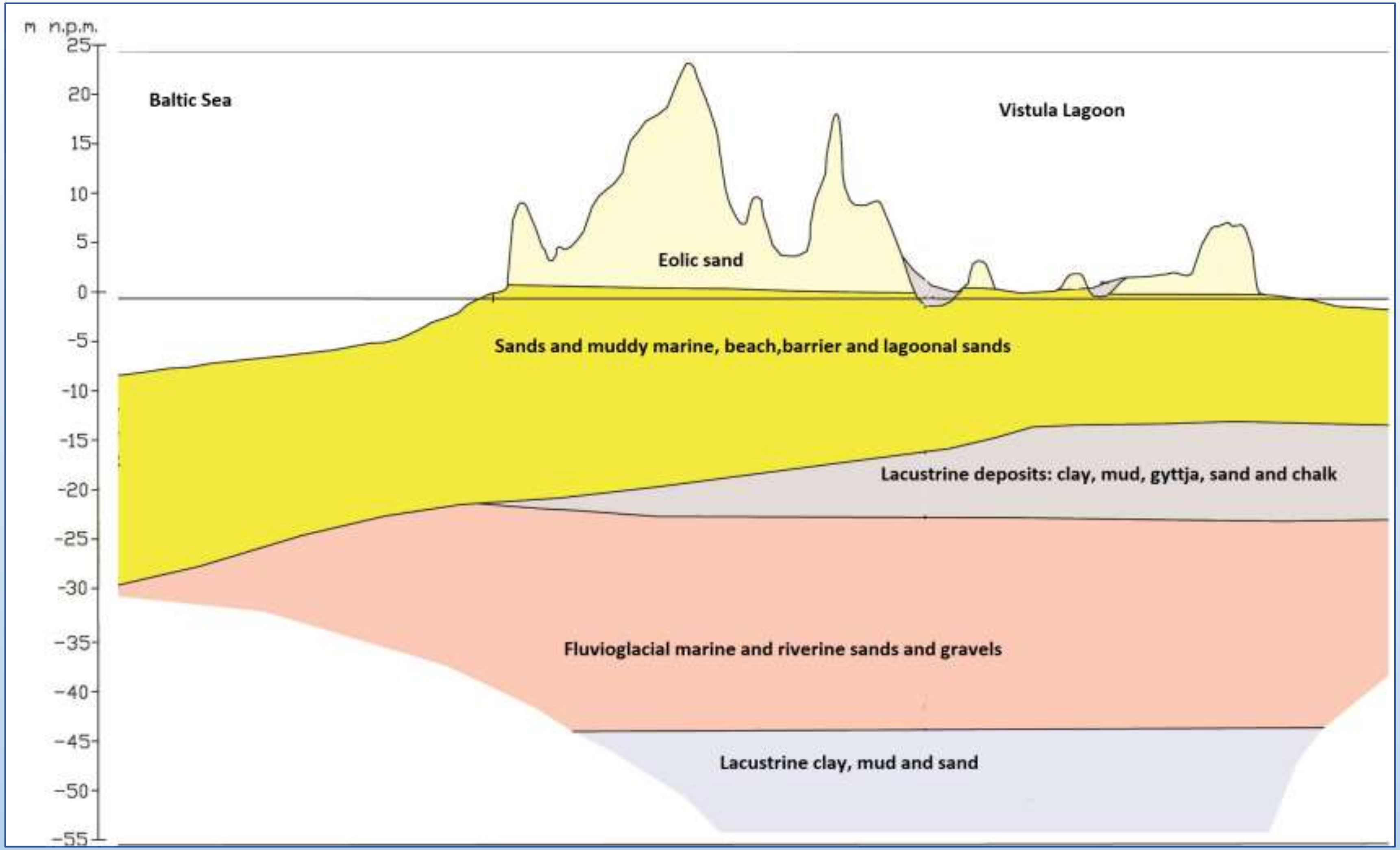




PORT
NOWY ŚWIAT
SKALA 1:12 000 (54°30')
Metry/Meter
Iso.R.4s9m10M
Iso.G.4s9m10M
Fl.Y.3s
3m3M
Dir WRG.9m10M
Oc.G.5s5m5M
Oc.R.5s5m5M
Swing Bridge
Lock
Oc.G.4s5m10M
Oc.R.4s5m10M
Dane źródłowe/Stand der
Vermessunen: 2018-2022
18,5'
19,0'
22,0'
21,5'
21,0'
54°22,35'N
54°20,90'N

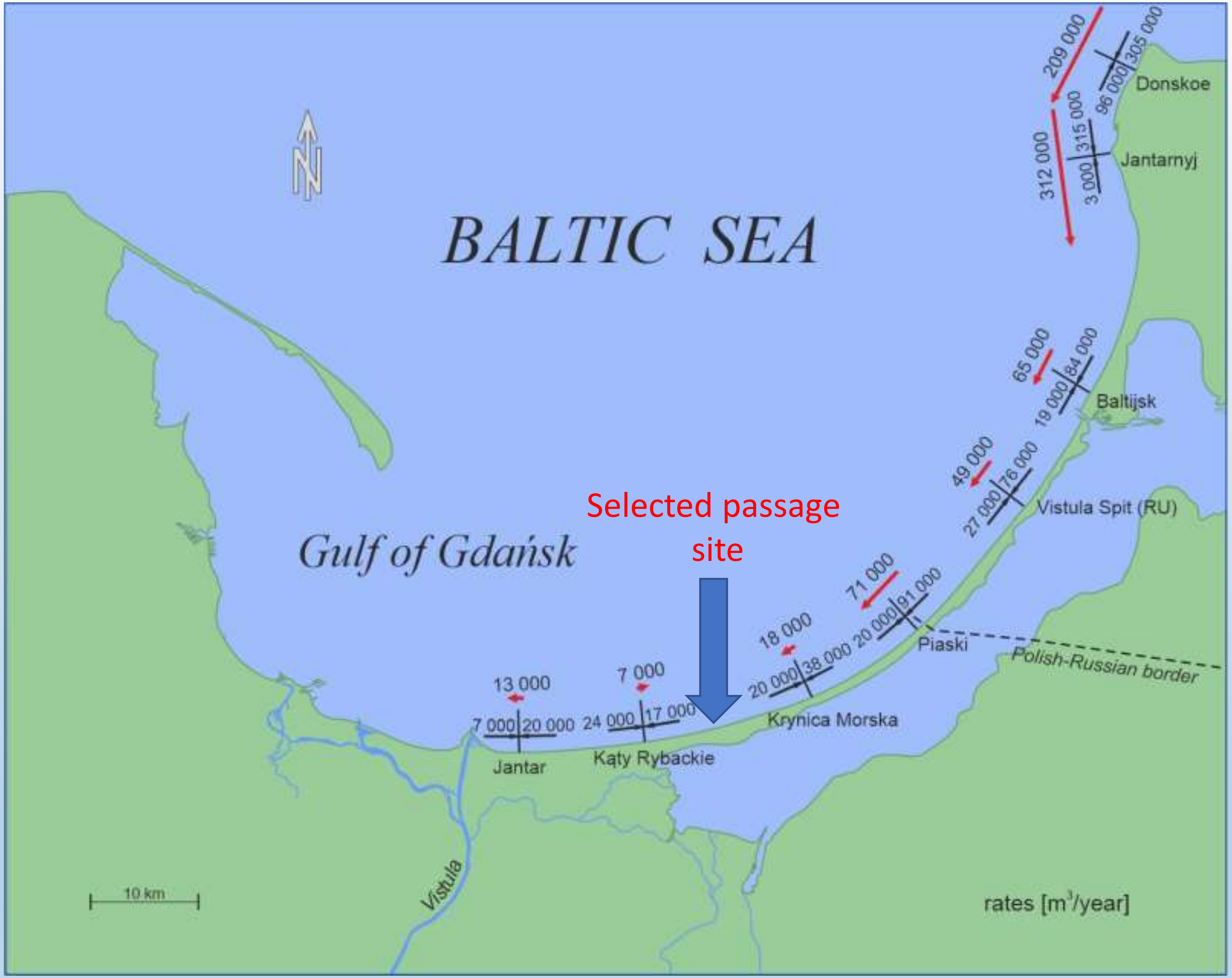

Cross-cut site in 2017 – wide beach and firm dunes indicating sand saturation,

Photos. Grzegorz Różyński 17-05-2017



Geological cross-section through the Lagoon barrier (the Spit) - sand saturation is evident

Morphodynamic conclusion:
perfect passage site on the Spit should be located where sediment transport is lowest.

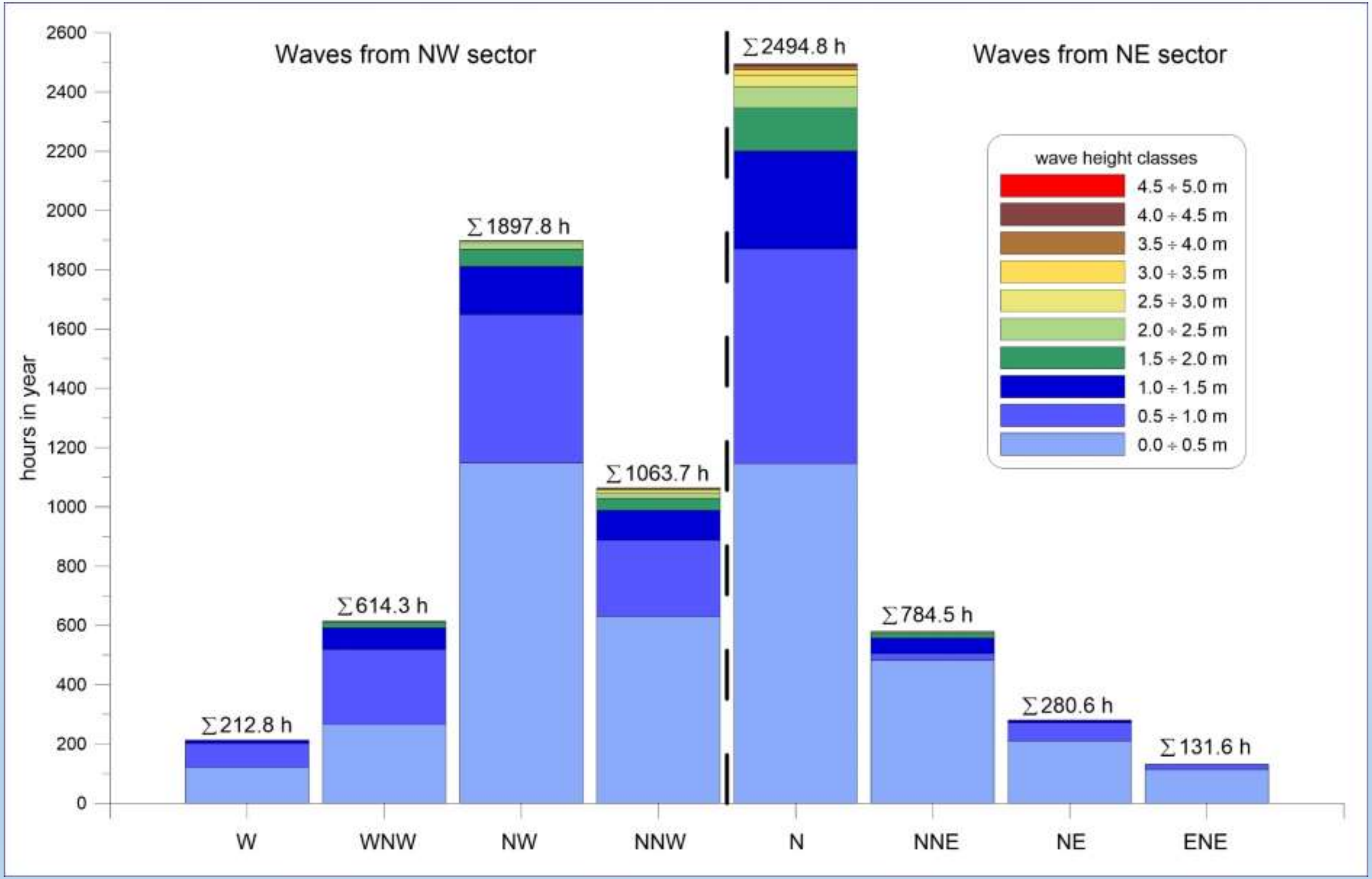


Required input:

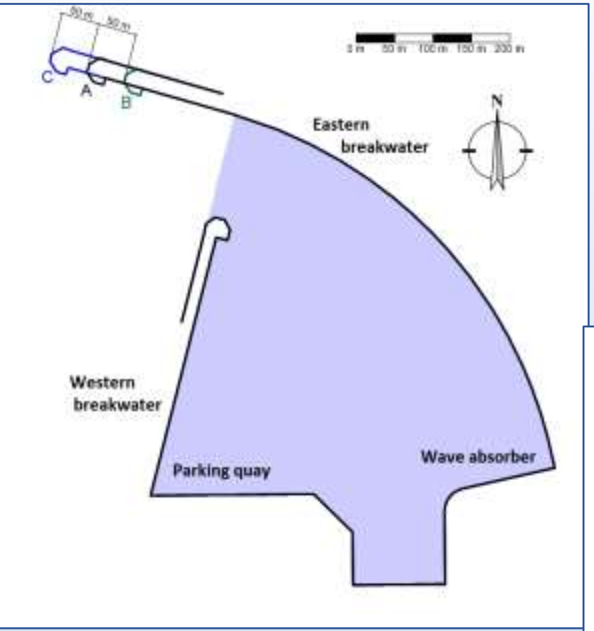
- wave climate,
- nearshore and offshore bathymetry,
- beach granulometry.

UNIBEST model and van Rijn formula for sediment transport was used.

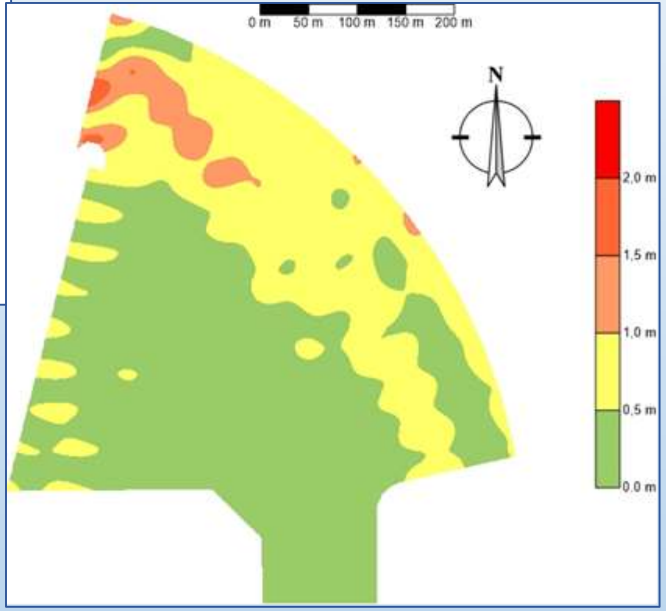
The passage site is where minimum resultant annual sediment transport rate was calculated



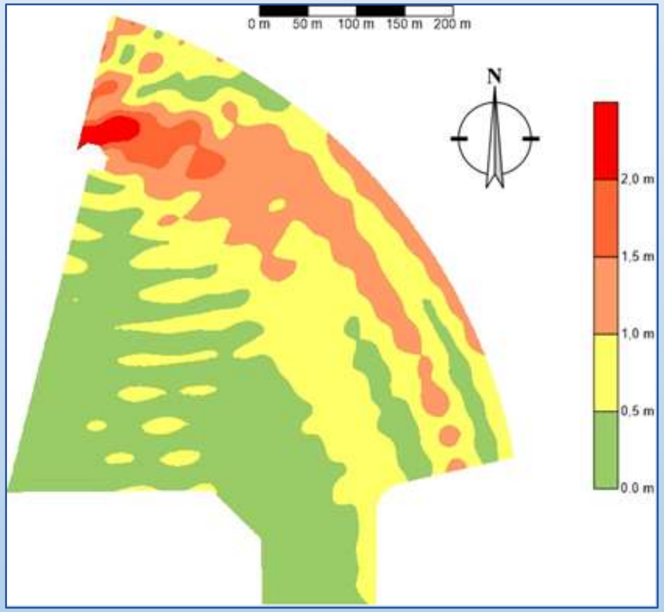
Significant wave height distribution for a statistical year near the passage site



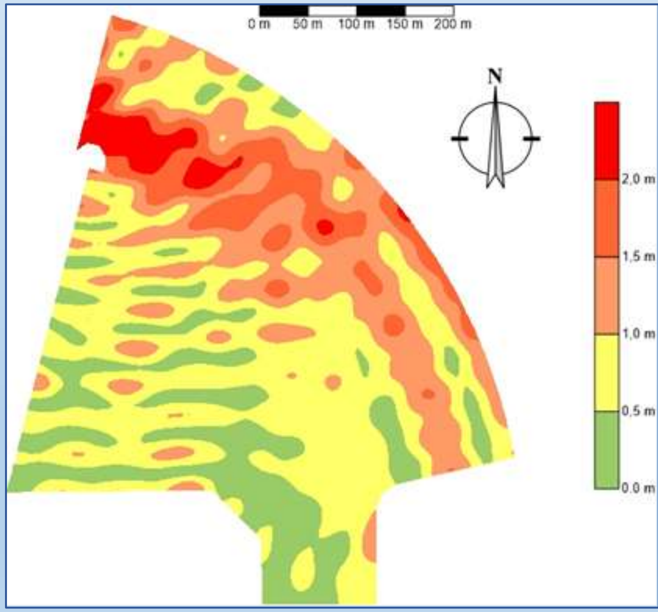
3 variants of outer harbor (length of eastern breakwater)



Wave height for p = 0.05 (20 years), NW approach, H_s = 3.3 m, T_p = 9.2 s

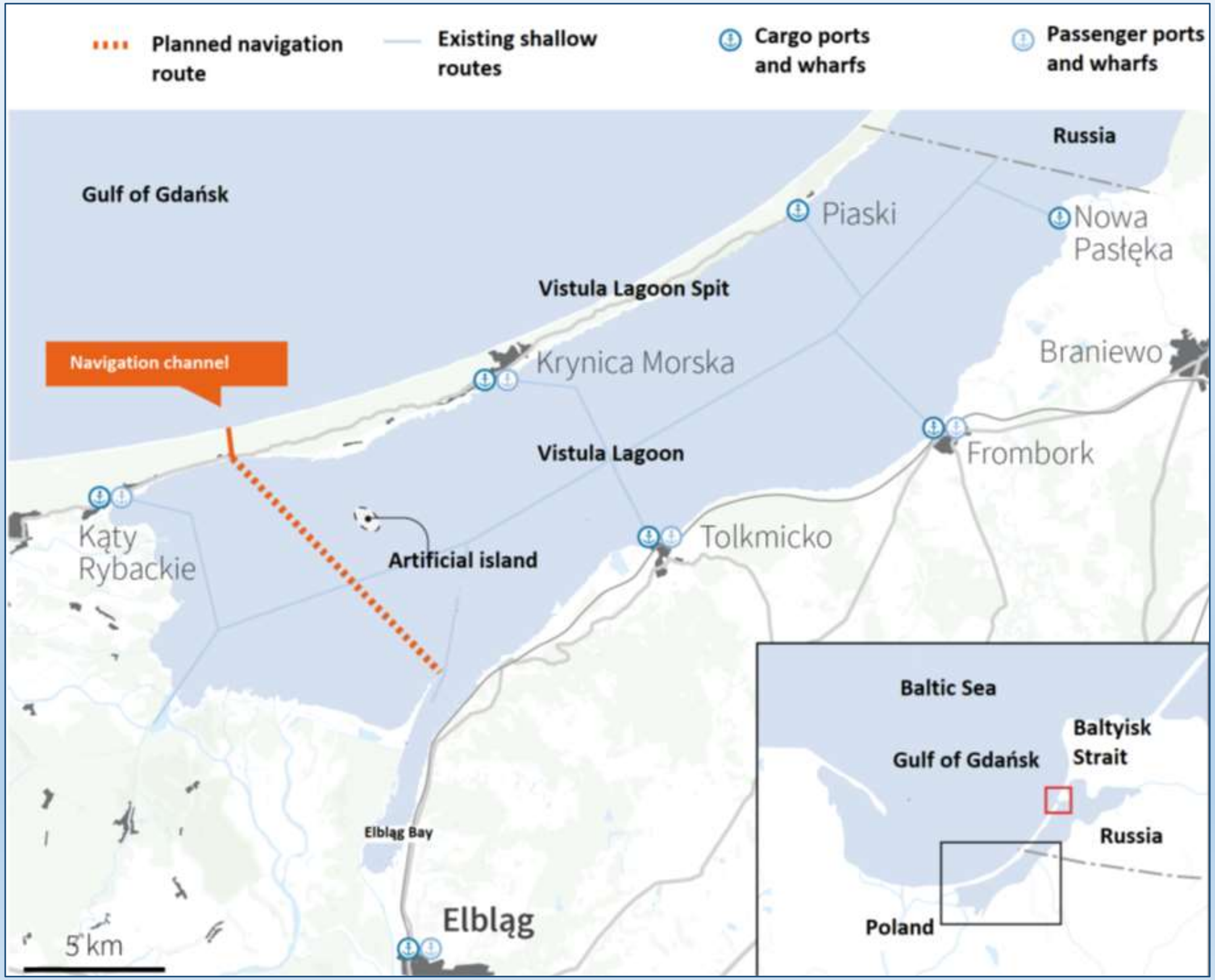


Wave height for p = 0.05 (20 years), WNW approach, H_s = 2.35 m, T_p = 7.8 s

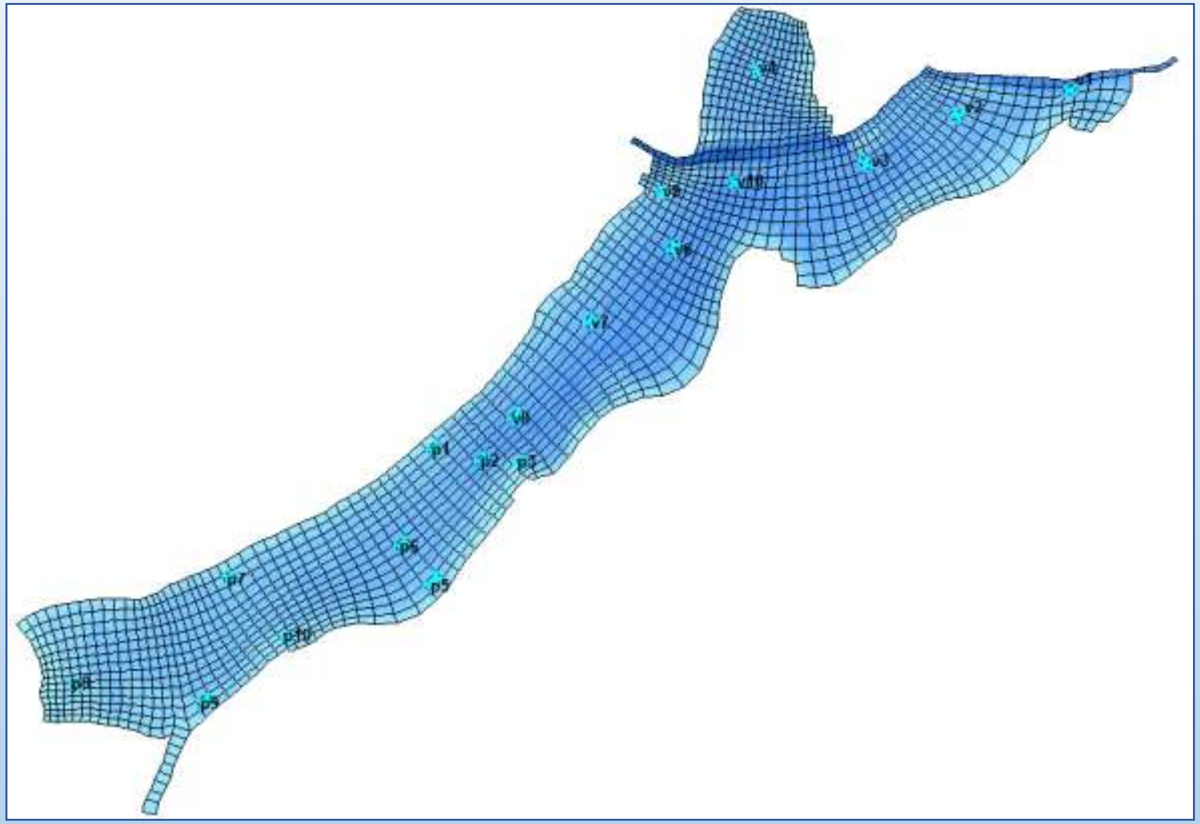


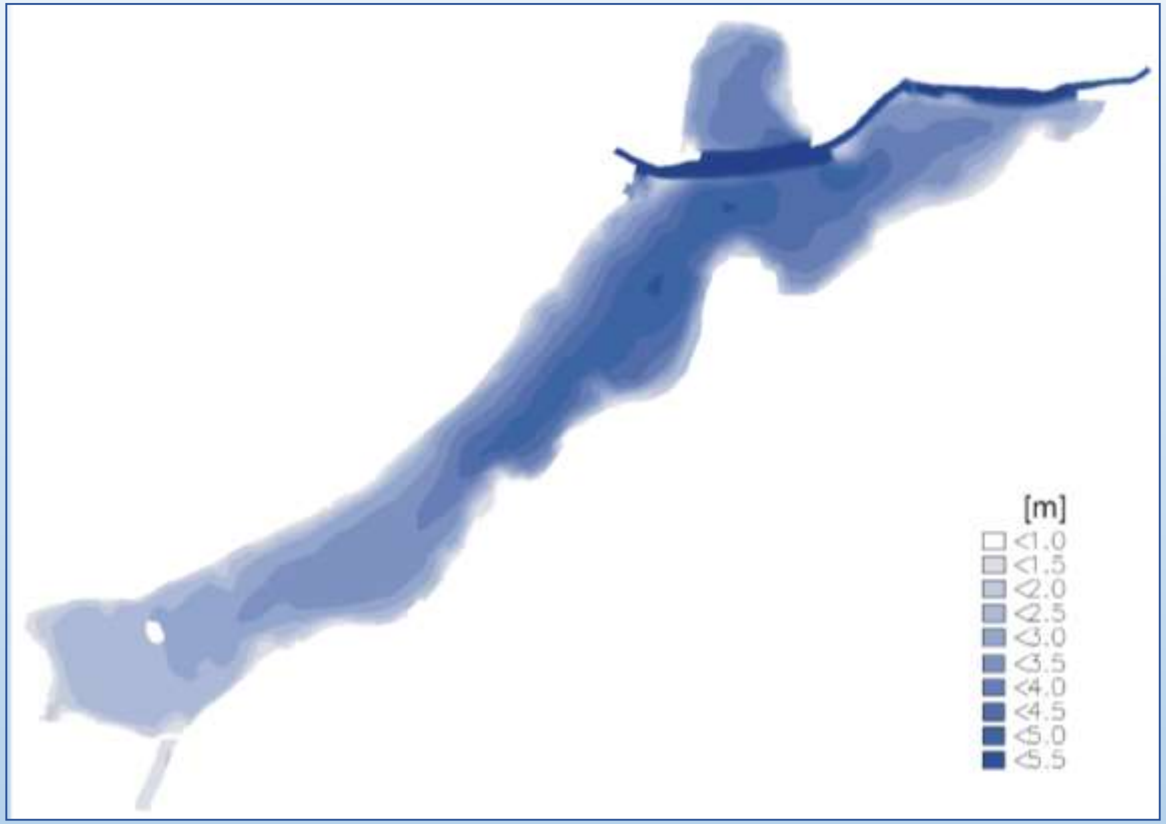
Wave height for p = 0.01 (100 years), WNW approach, H_s = 2.63 m, T_p = 8.4 s

4. Artificial island for sediment storage: impacts on lagoon wave and current fields

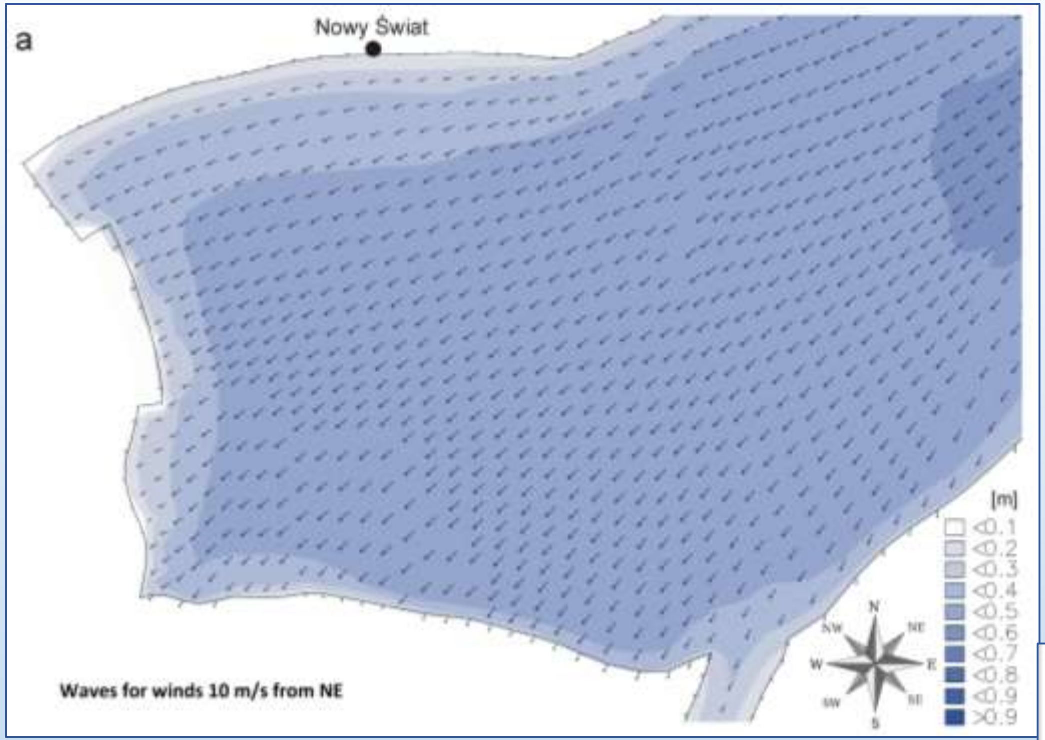


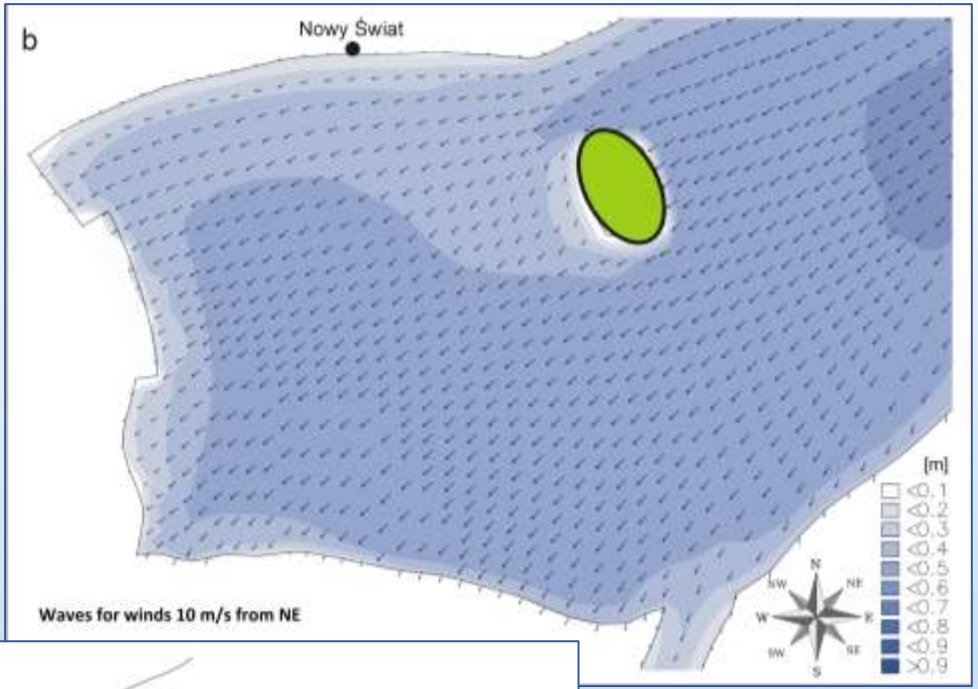
Impact of the Island on local waves and currents

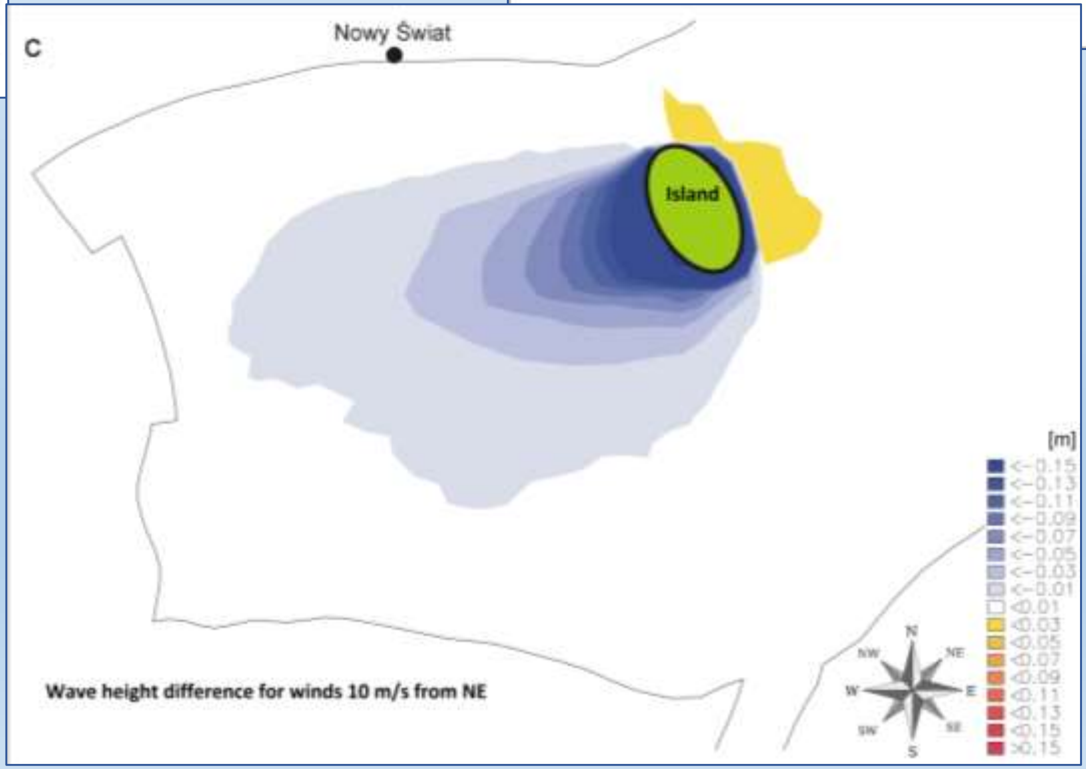




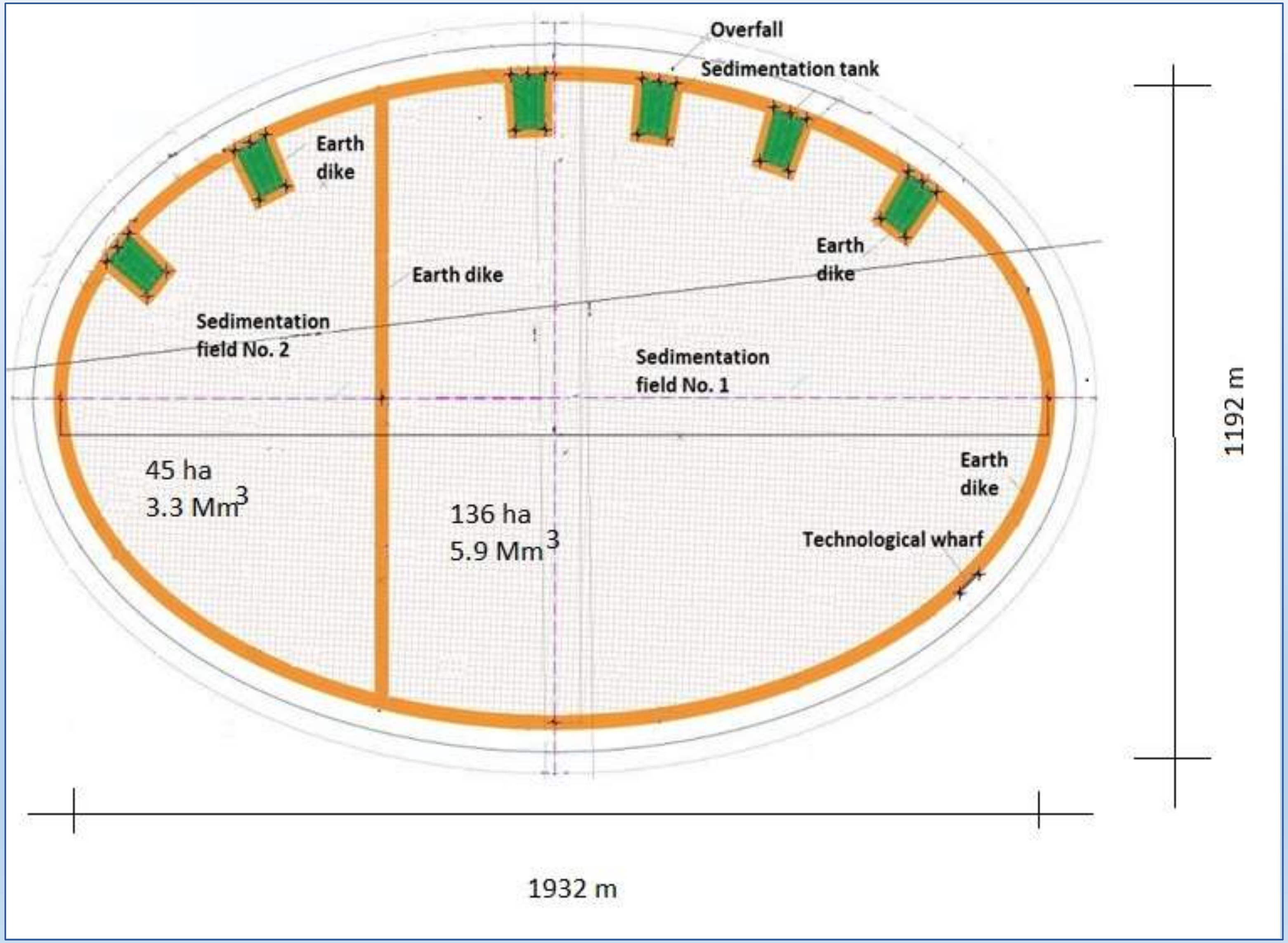
Local grid and bathymetry


a
Nowy Świat
[m]
<0.1
<0.2
<0.3
<0.4
<0.5
<0.6
<0.7
<0.8
<0.9
>0.9
N
NE
E
SE
S
SW
W
NW
Waves for winds 10 m/s from NE


b
Nowy Świat
[m]
<0.1
<0.2
<0.3
<0.4
<0.5
<0.6
<0.7
<0.8
<0.9
>0.9
N
NE
E
SE
S
SW
W
NW
Waves for winds 10 m/s from NE


c
Nowy Świat
Island
[m]
<-0.15
<-0.13
<-0.11
<-0.09
<-0.07
<-0.05
<-0.03
<-0.01
<0.01
<0.03
<0.05
<0.07
<0.09
<0.11
<0.13
<0.15
>0.15
N
NE
E
SE
S
SW
W
NW
Wave height difference for winds 10 m/s from NE

4. Biodiversity restoration – artificial island as compensation for lost habitats occupied by a large hydraulic project



Details of artificial Island: main field (136 ha) – restoration area, additional field (45 ha) – navigation channel maintenance

6. Lessons learned

- Local geology should be thoroughly inspected whether the site is sand saturated.
- Optimum passage location should coincide with minimum sediment transport (computed for a statistical year).
- Offshore and nearshore bathymetry, local wave climate and granulometric information necessary for morphodynamic analyses – data acquisition can be a challenge.
- Optimum configuration of breakwaters is a tedious process involving hydrodynamic, navigational and economic considerations.
- Lagoon hydrodynamic changes must be modeled in terms of wave height alterations, changes in current regimes, etc. Detailed modeling grid necessary.

Thank you,

Welcome to field trip!