MODULLES

MOdelling of marine **DU**nes : **L**ocal and **L**arge-scale **E**volution**S** in an OWF context

Webinar

October 17th, 2024

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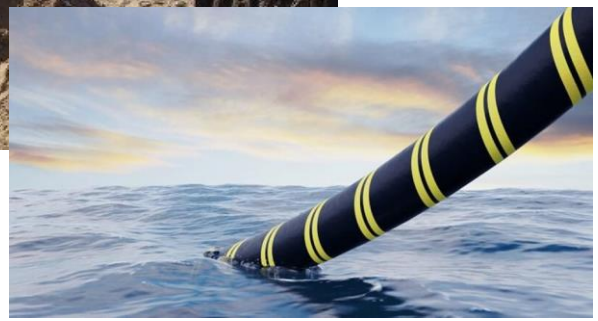
Agenda

Webinar : 14h – 15h30

14h – 14h05	**Introduction** *(Nicolas Michelet)*
14h05 – 14h20	**WP #2 - Small-scale modelling** *(Alban Gilletta)*
14h20 – 14h35	**WP #3 - Large-scale modelling** *(Nicolas Michelet)*
14h35 – 14h50	**WP #6 - Exploring the dune resilience** *(Nolwenn Quillien)*
14h50 – 15h00	**Results transfer to the ORE sector** *(Stéphane Rochwerger & Jean Chavet)*
15h00 – 15h30	**Q&A session**

Project context

What would be the cable installation work impact on marine dunes migration ?



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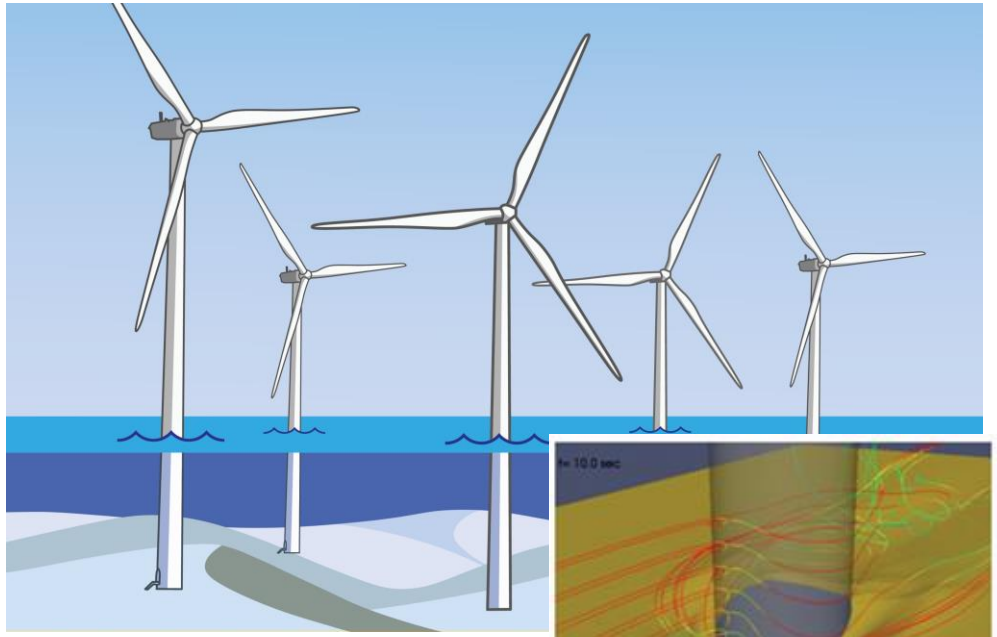

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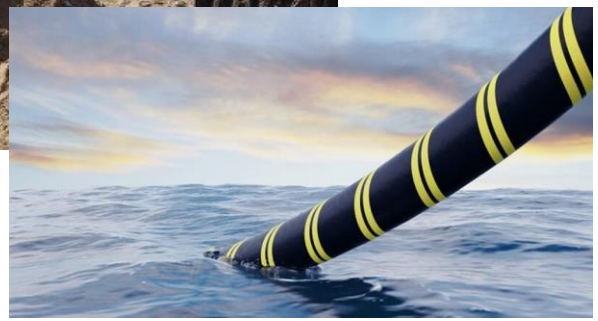

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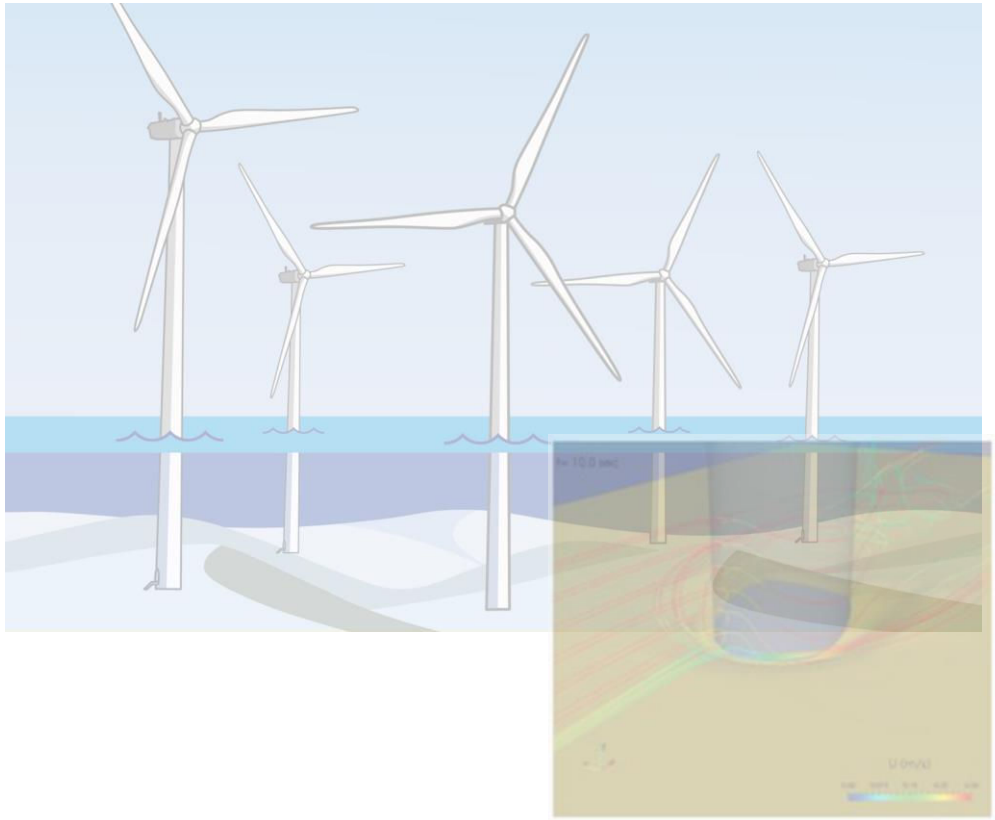

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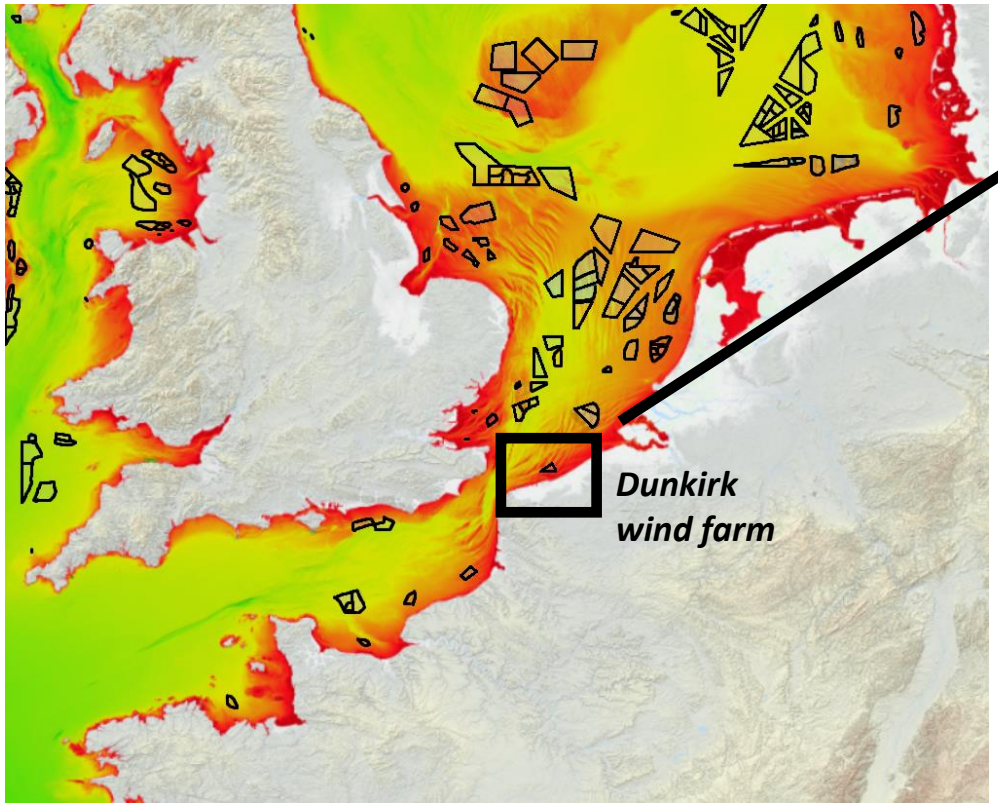
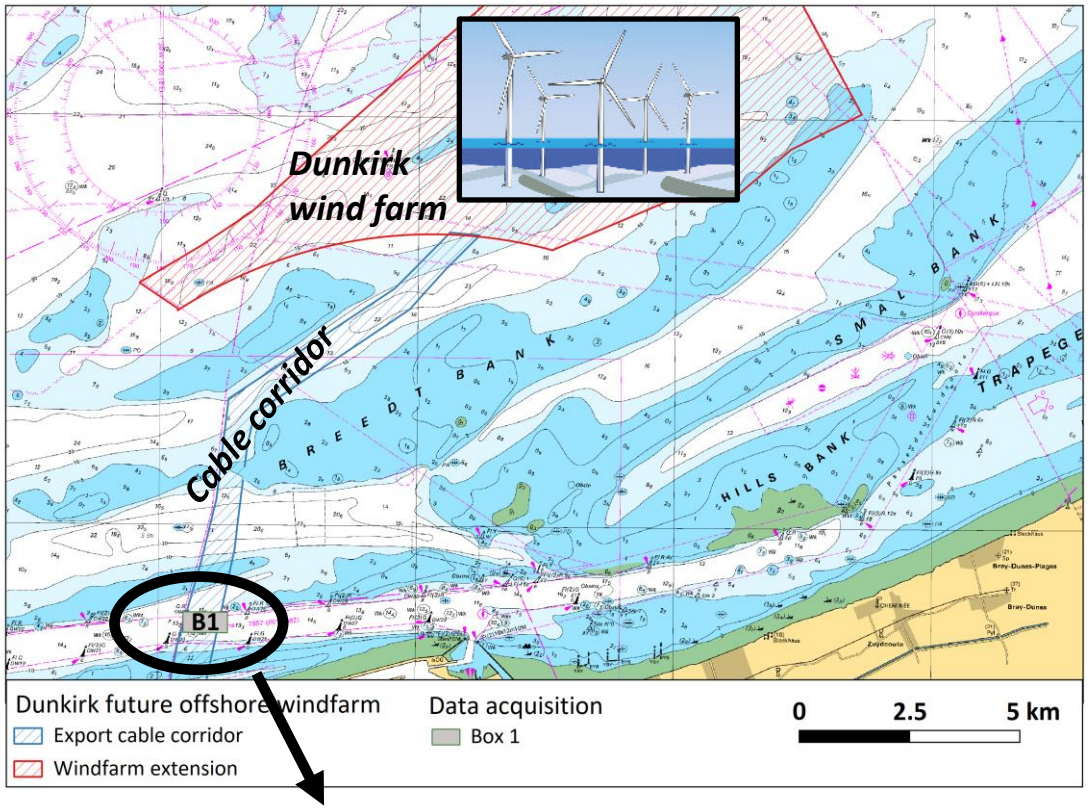
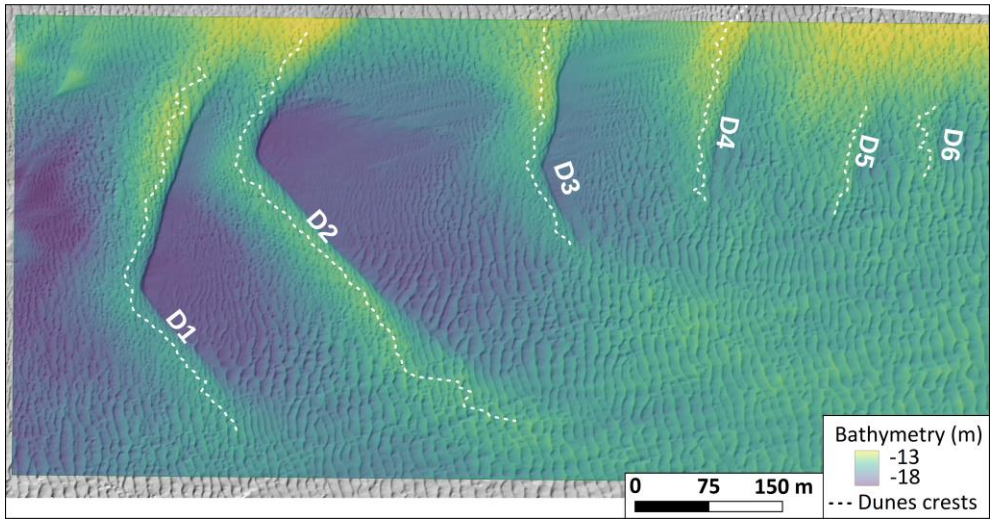


Bathymetry of the North Seas planned and in operation Offshore Wind Farms (OWF) and power cables (data from ©EMODNET)

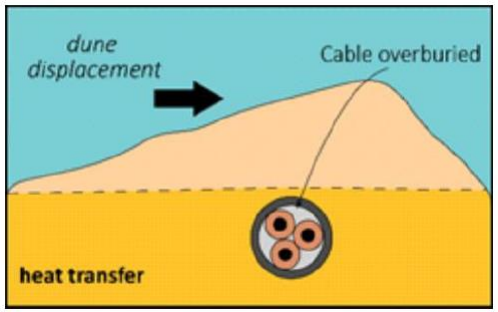


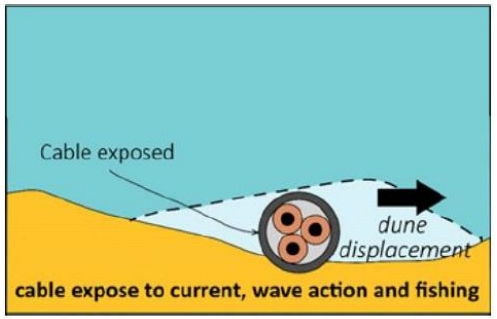


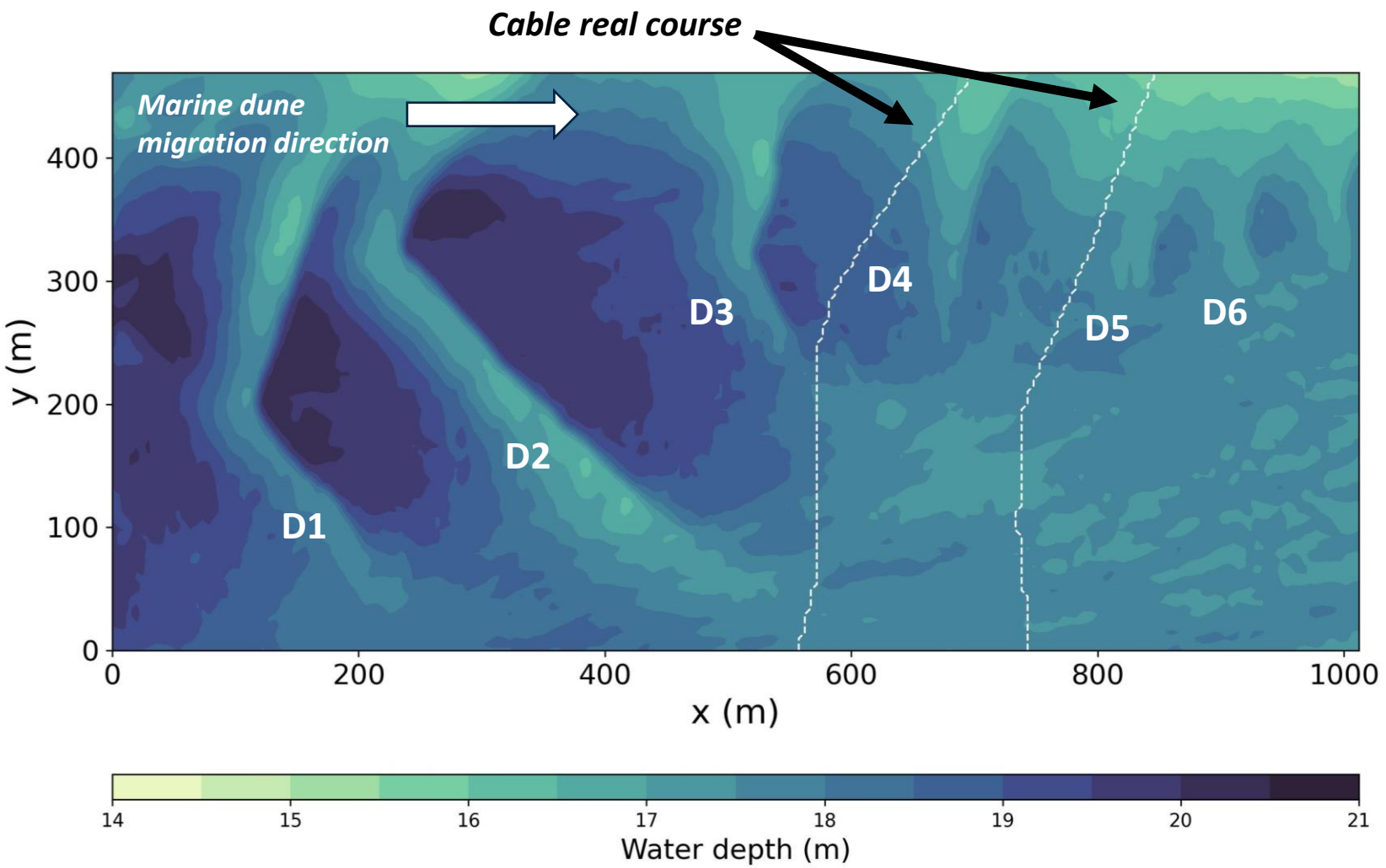
Study context

- Installation of two export cables
  - Crossing the path of marine dunes

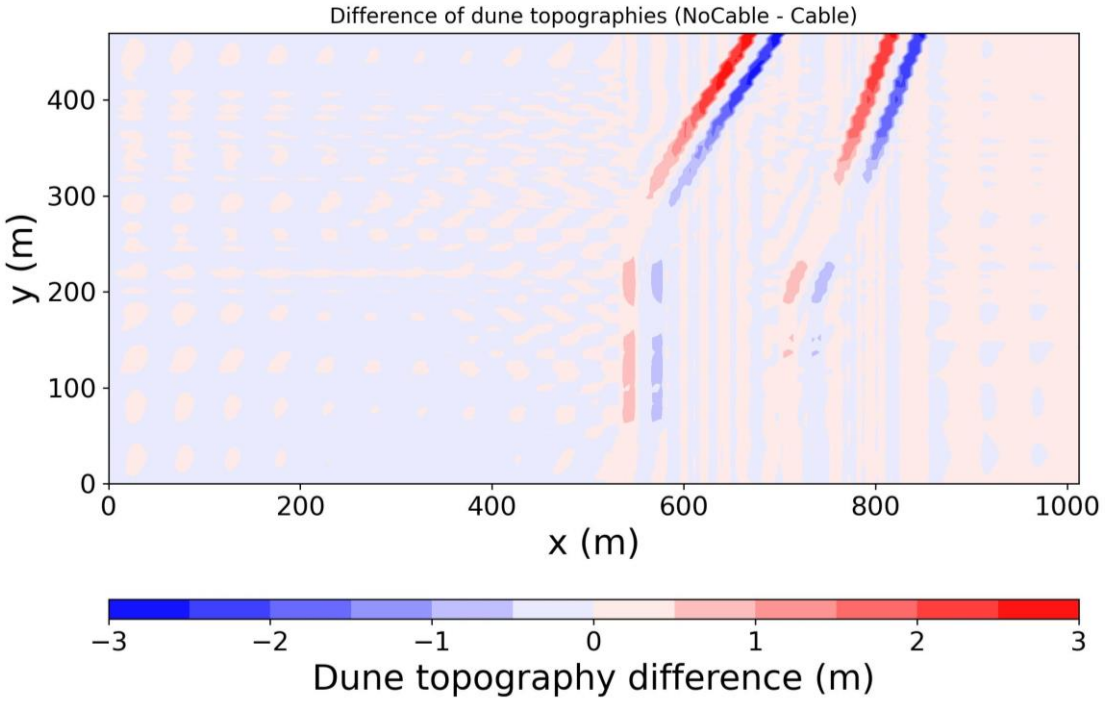
- **What impact induce the cable installations works on marine dunes migration ?**

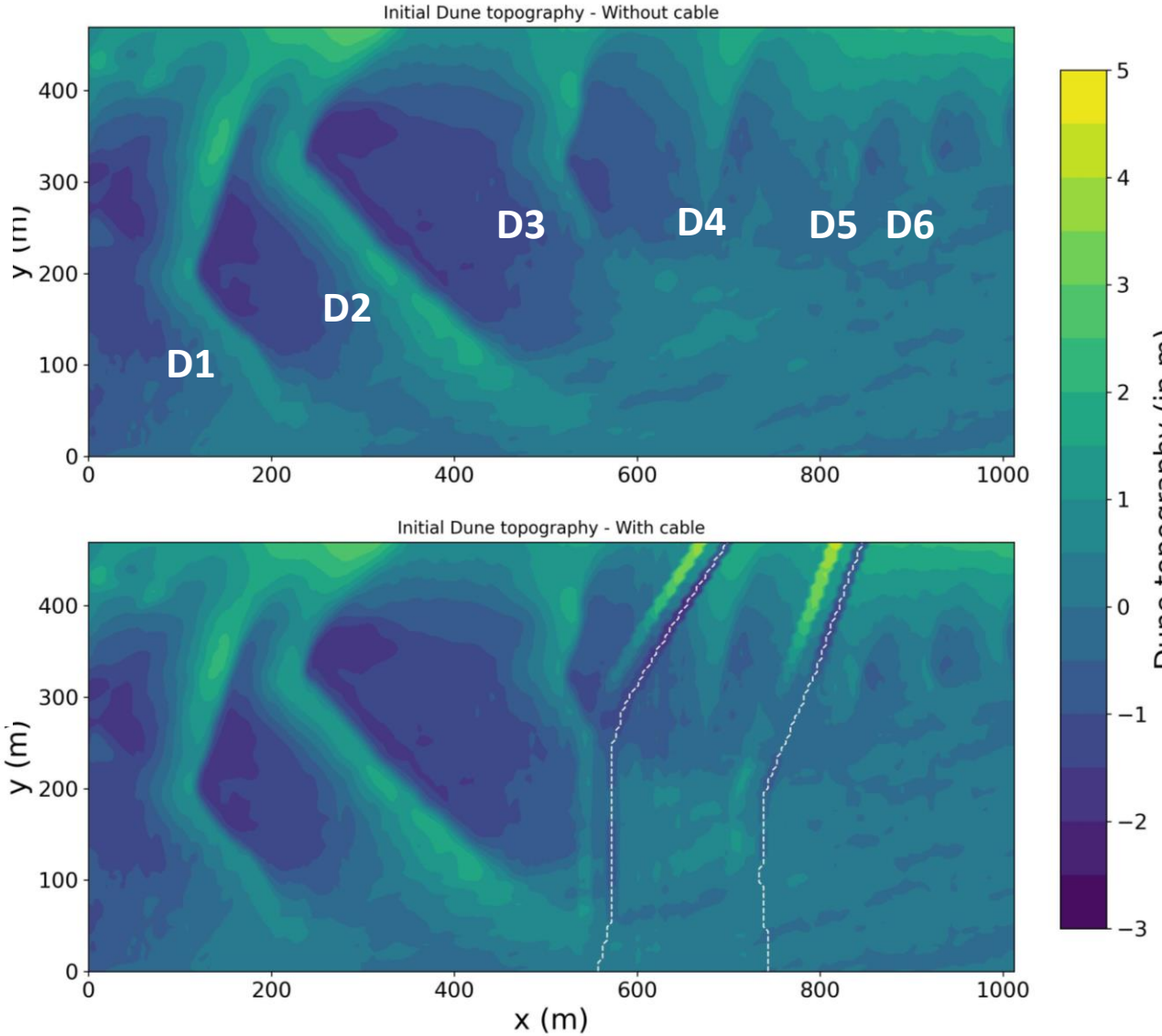






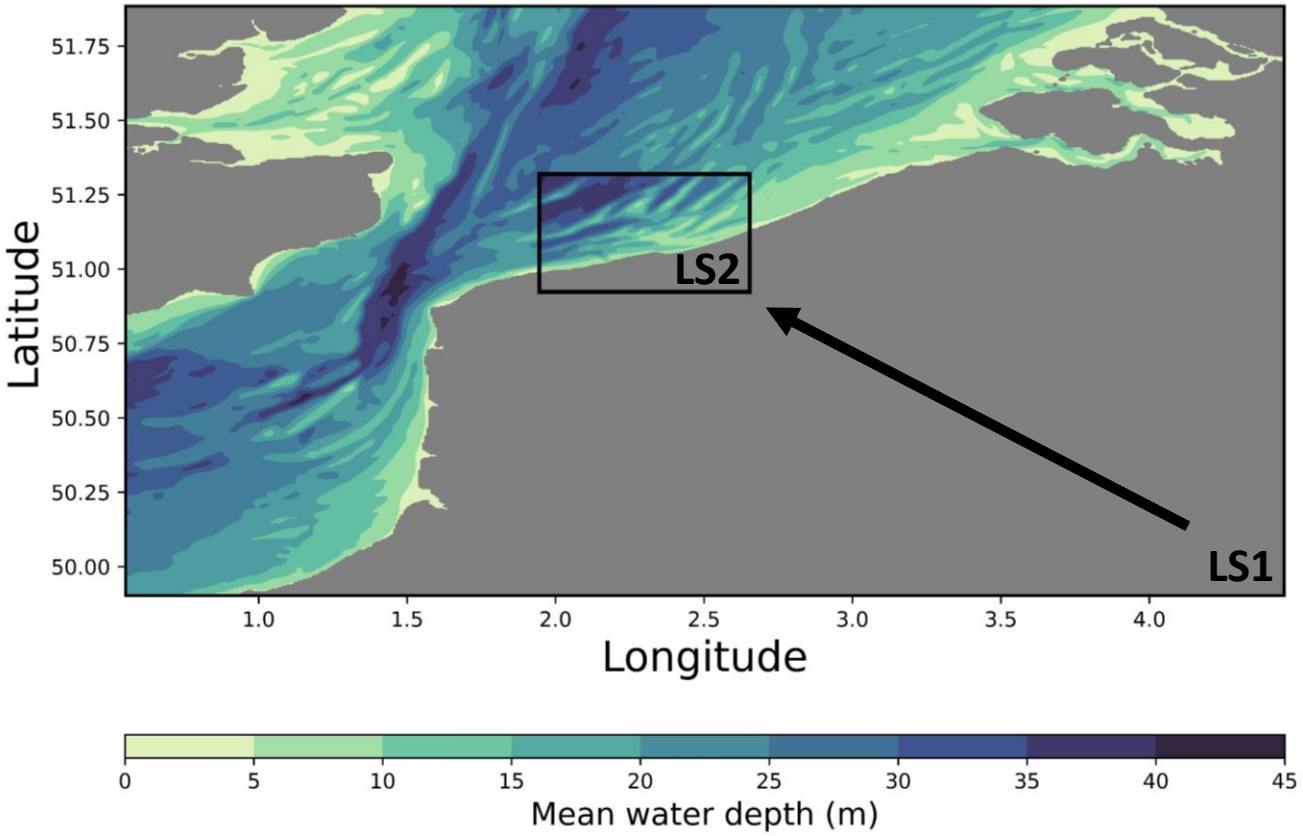
Dredging of the bathymetry





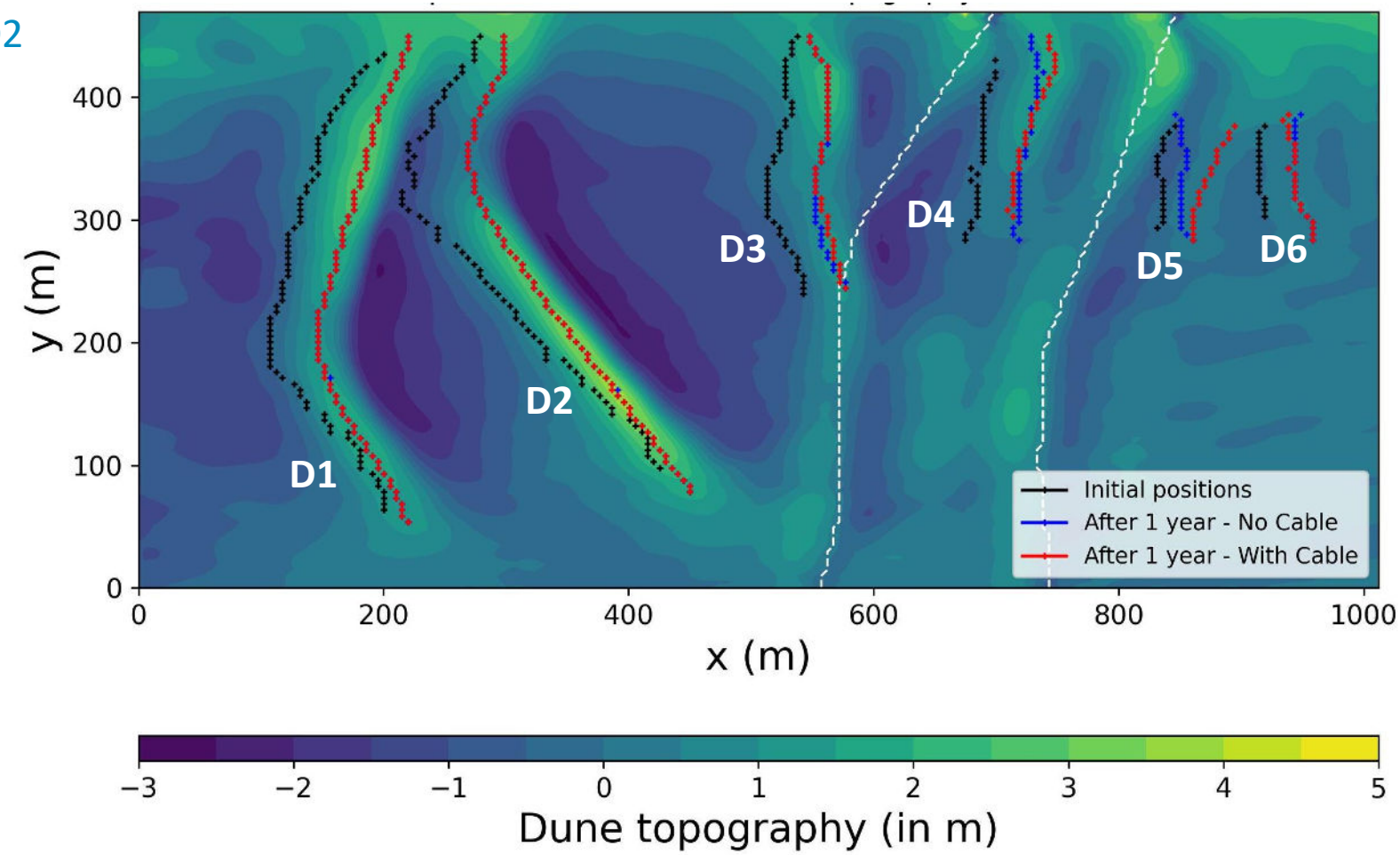
Numerical modelling – Model description

- **CROCO** – hydrodynamic model set on three scale
  - LS1 – Account for wind and tidal forcing
  - LS2 – Account for wind and tidal forcing
- **WaveWatch 3** set on three scale
  - Global run
  - NORGAS run
  - LS2 – boundaries coming from NORGAS
- **USGS** sediment module
- Hydrodynamic and morphodynamic validation performed but not shown here



Impact on crestlines positions

- No significant impact on dunes D1, D2 and D6
- Migration of D3
  - Increase of the movement on its southern crest
  - Fusion of the dune with the deposit
- Migration of D4
  - Reduction on its northern part
  - Increase on its southern part
  - Dune more aligned with the trench direction
- Strong increase of D5 movement



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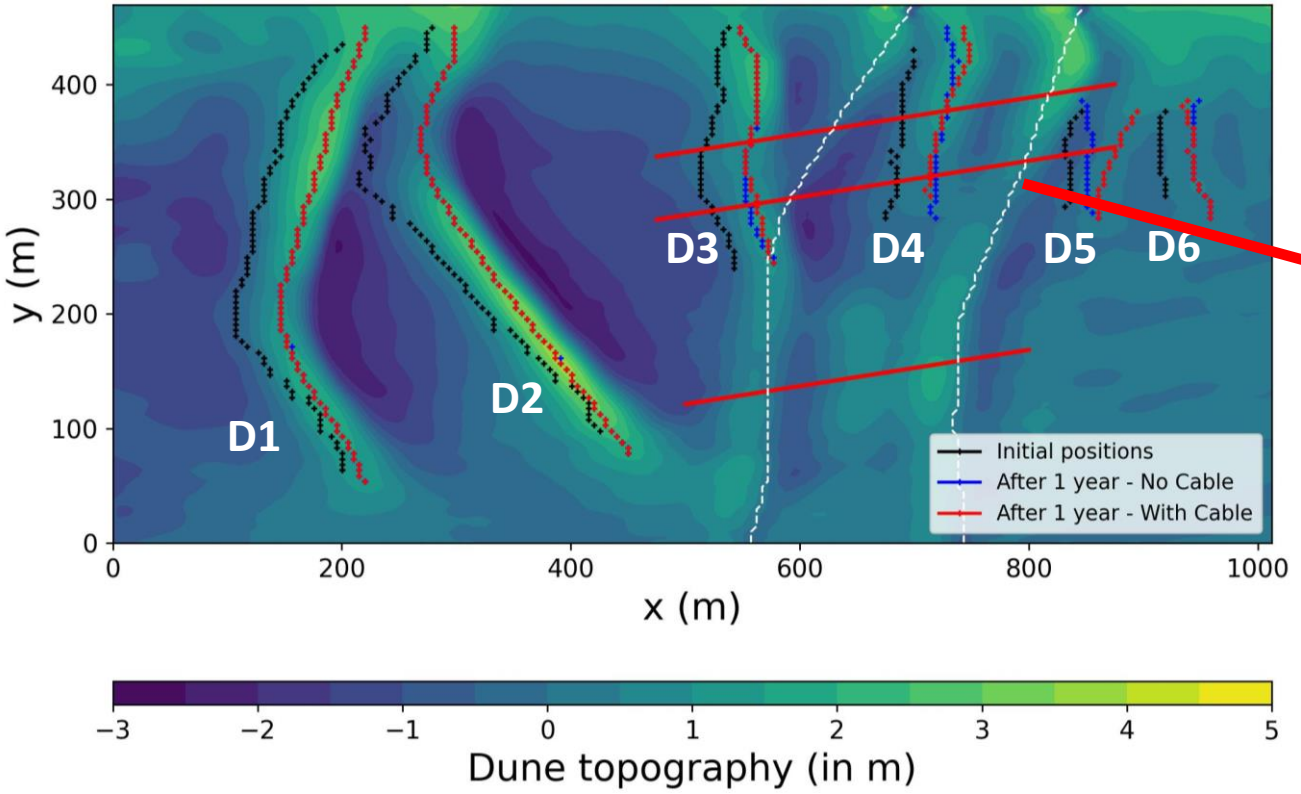
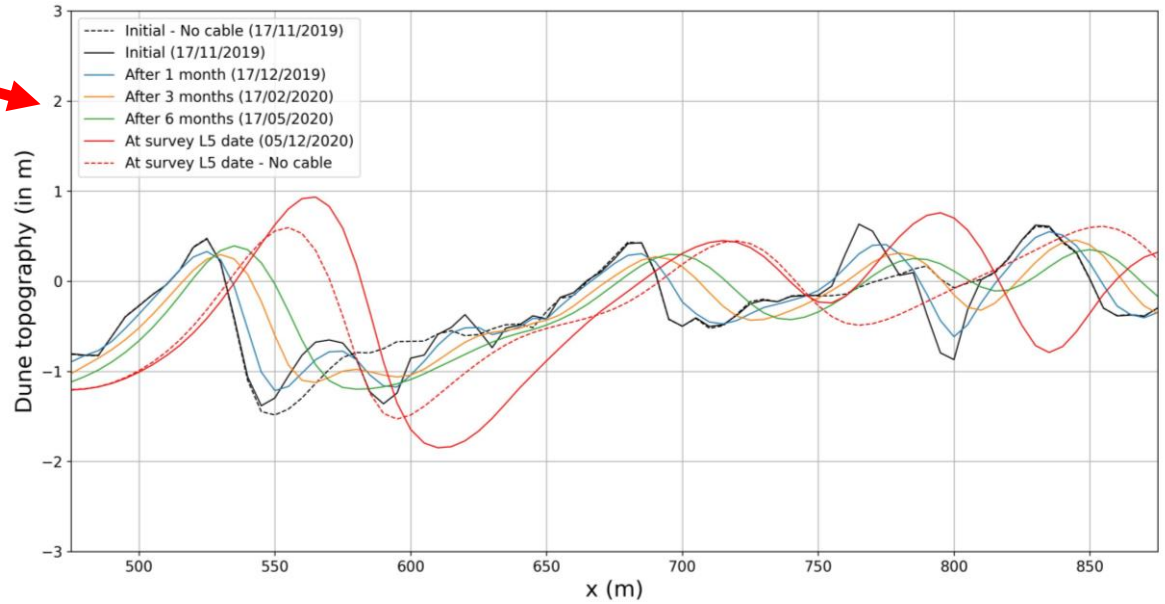
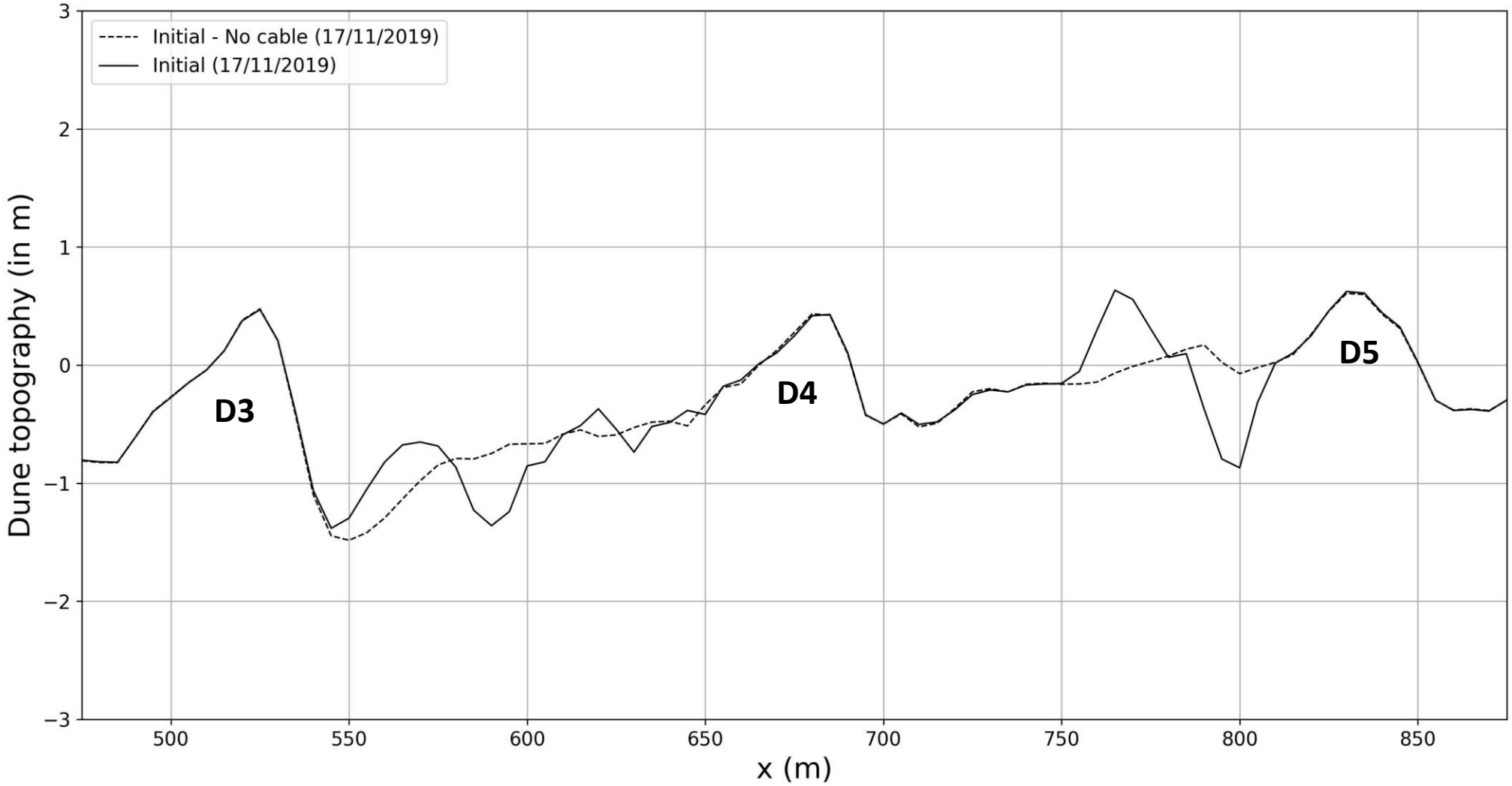




Evolution of the moved sediment – Middle transect



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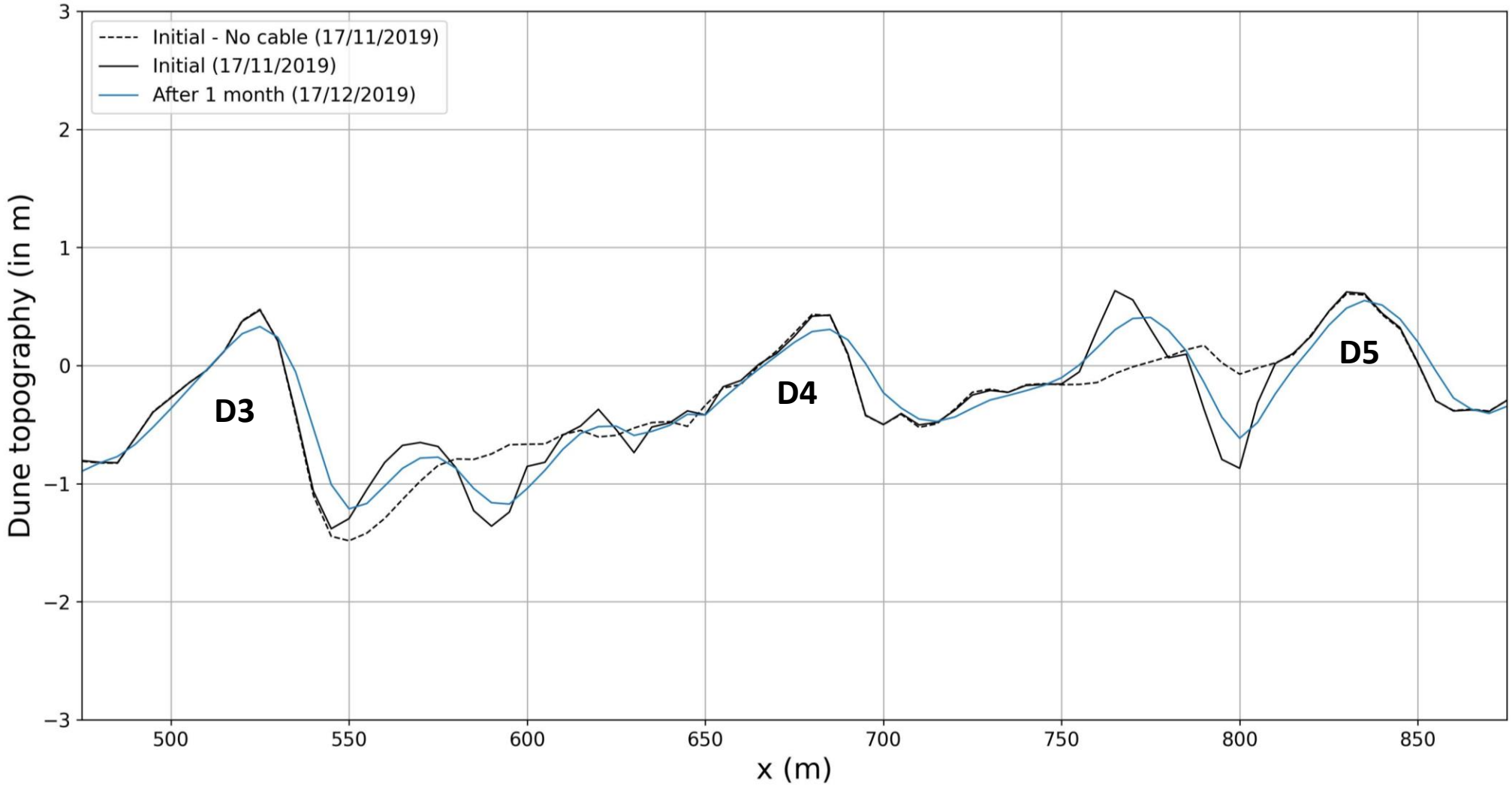

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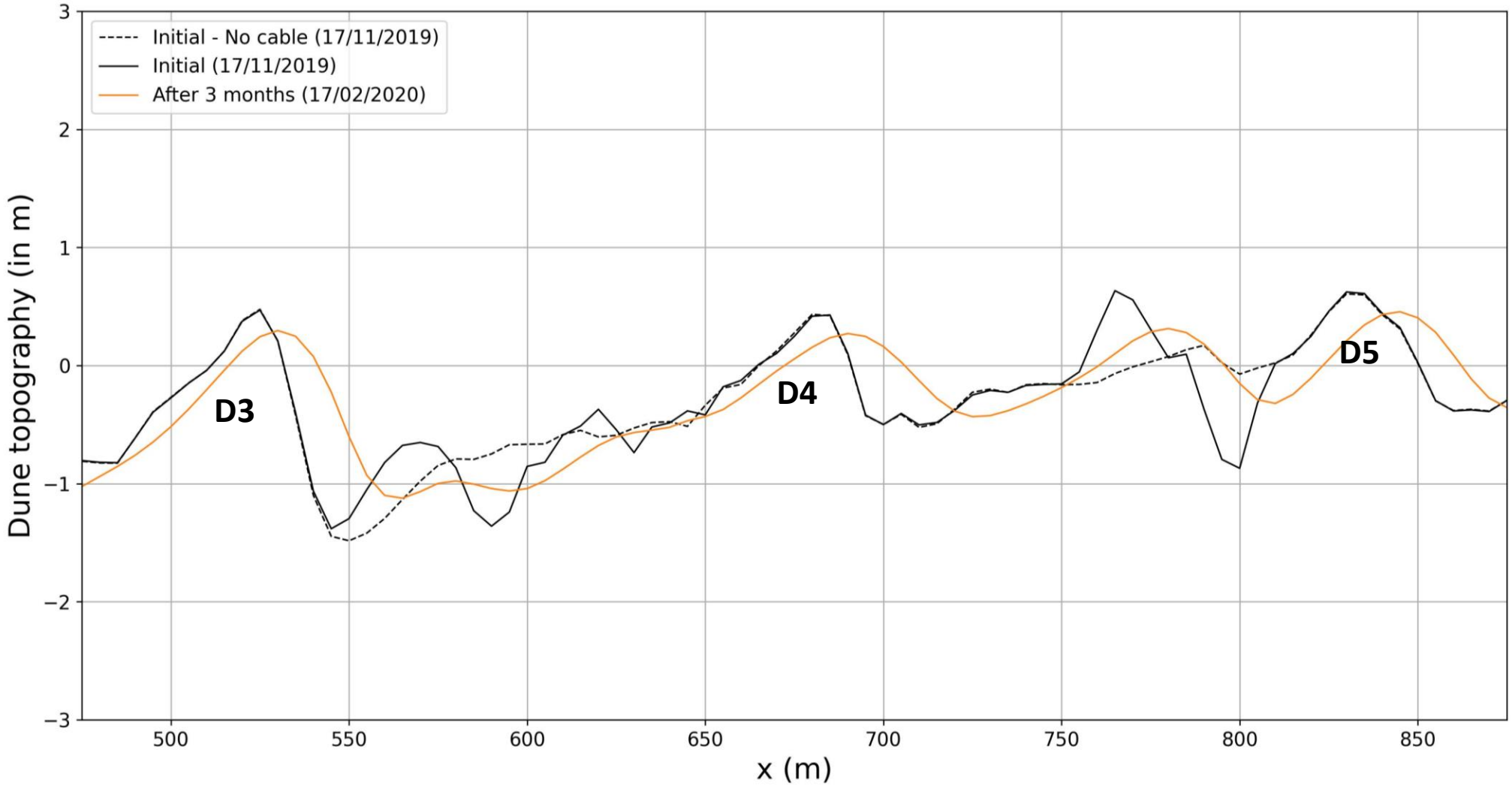

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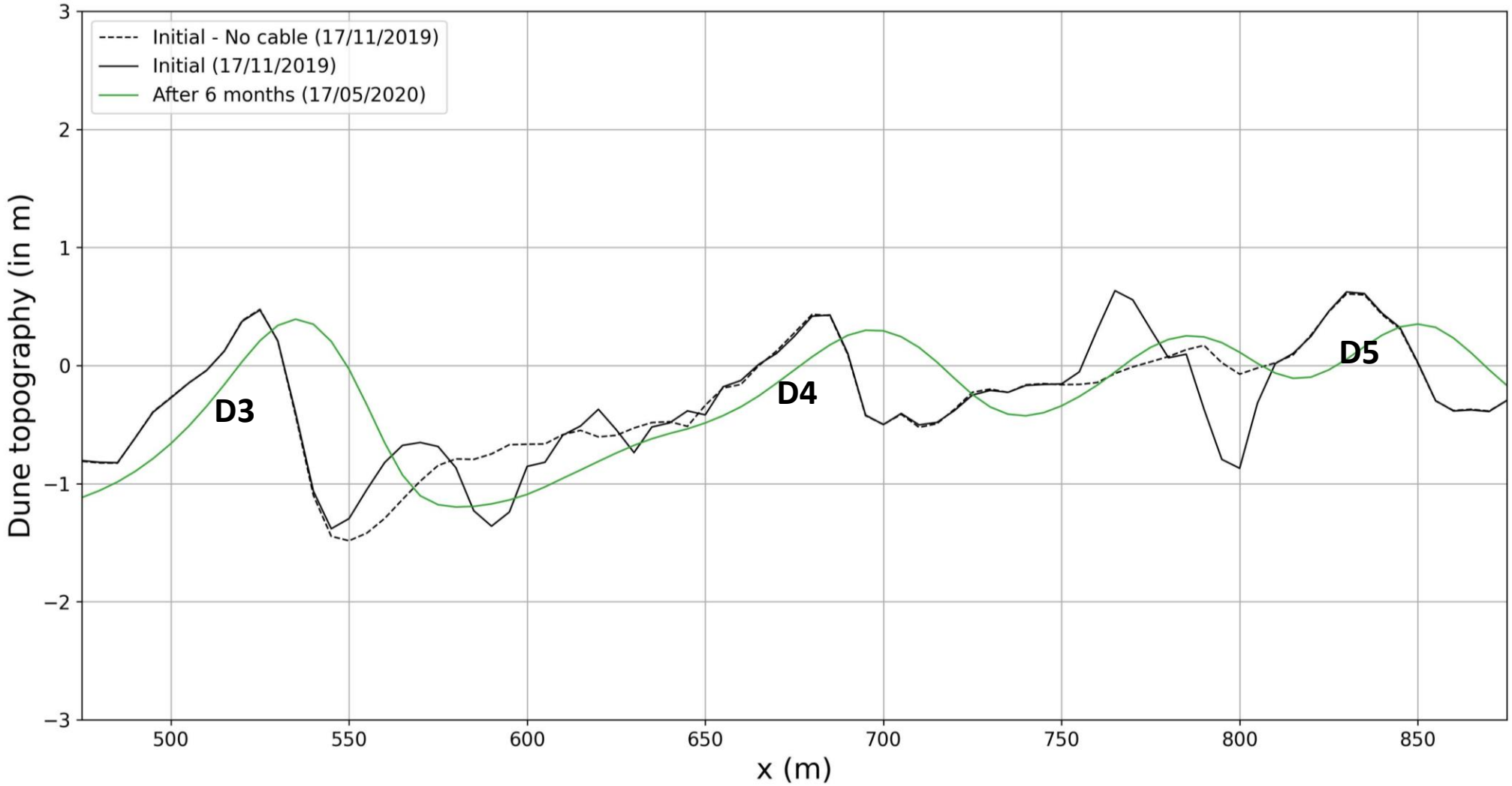

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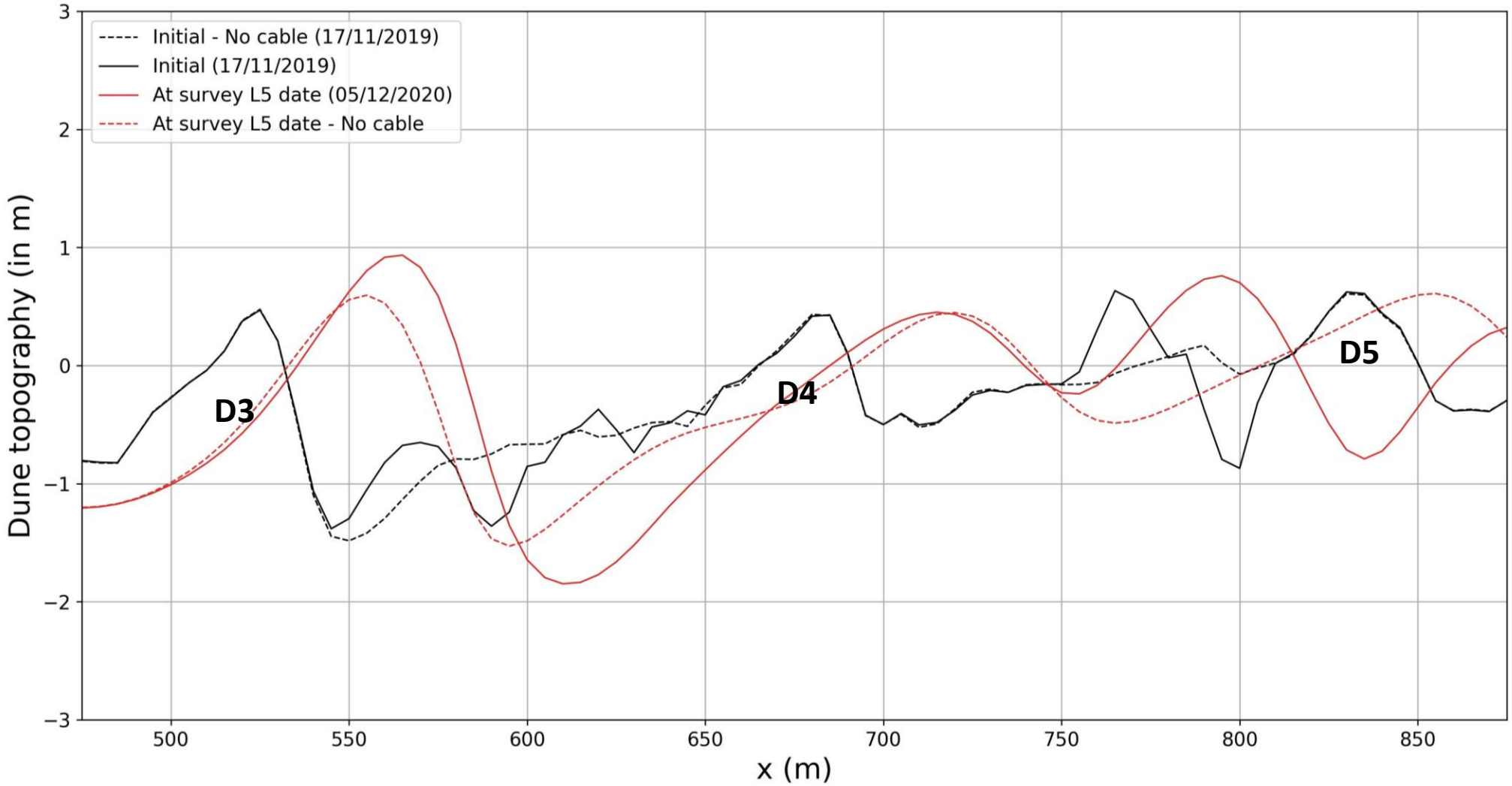

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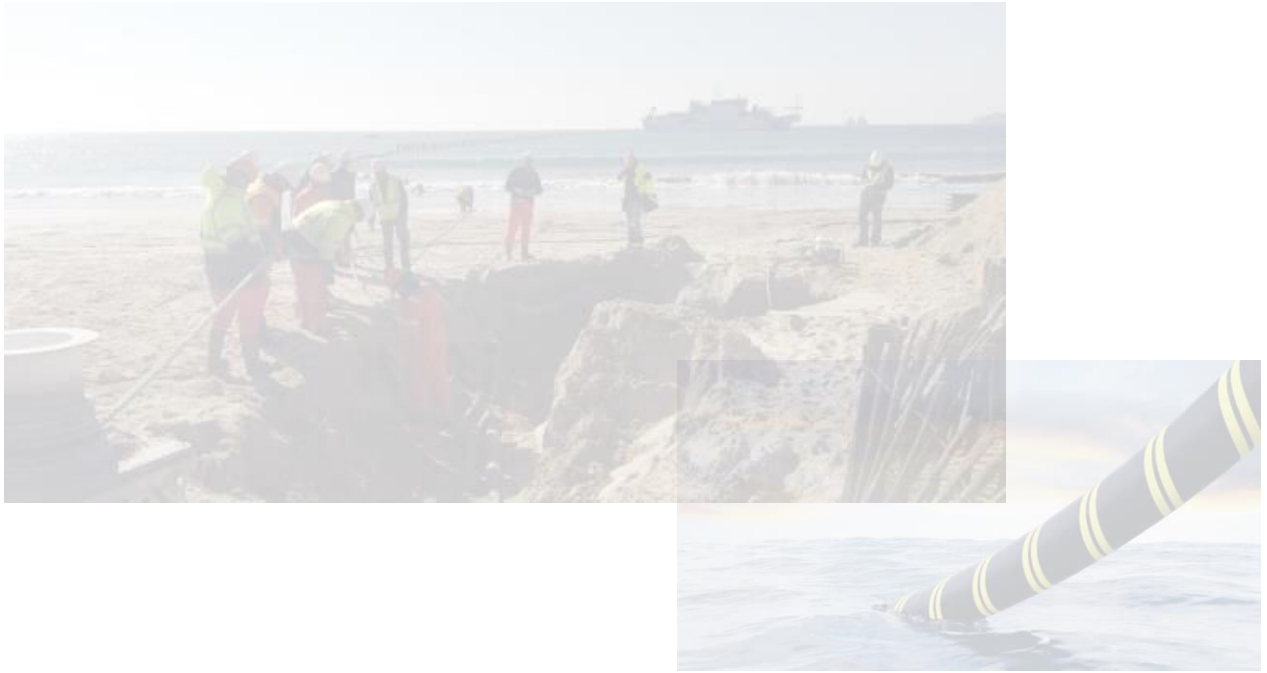

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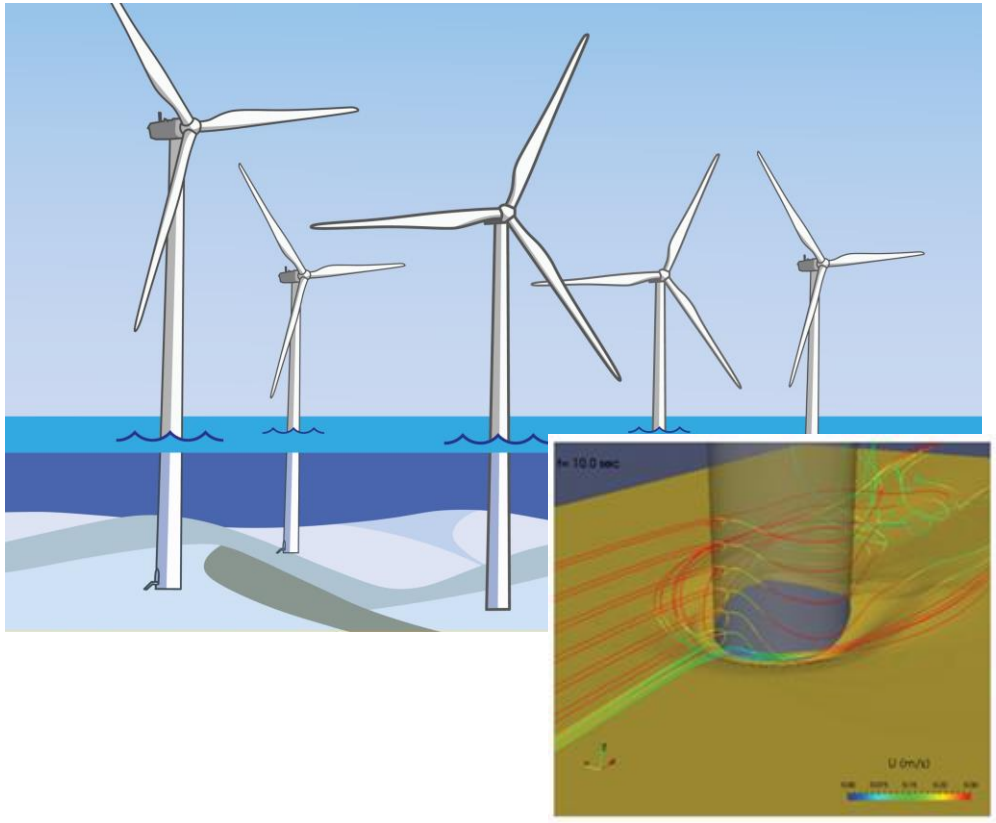
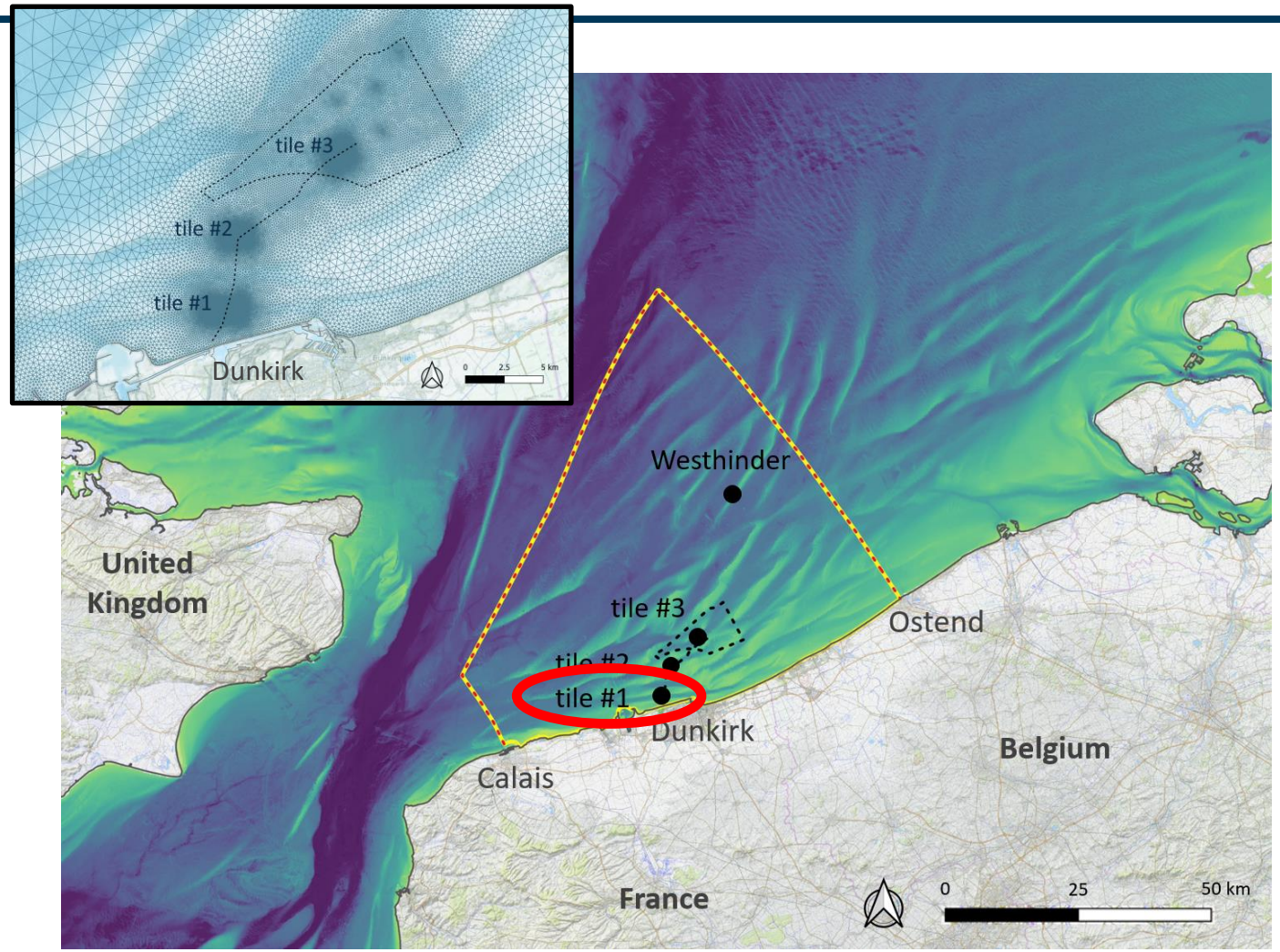


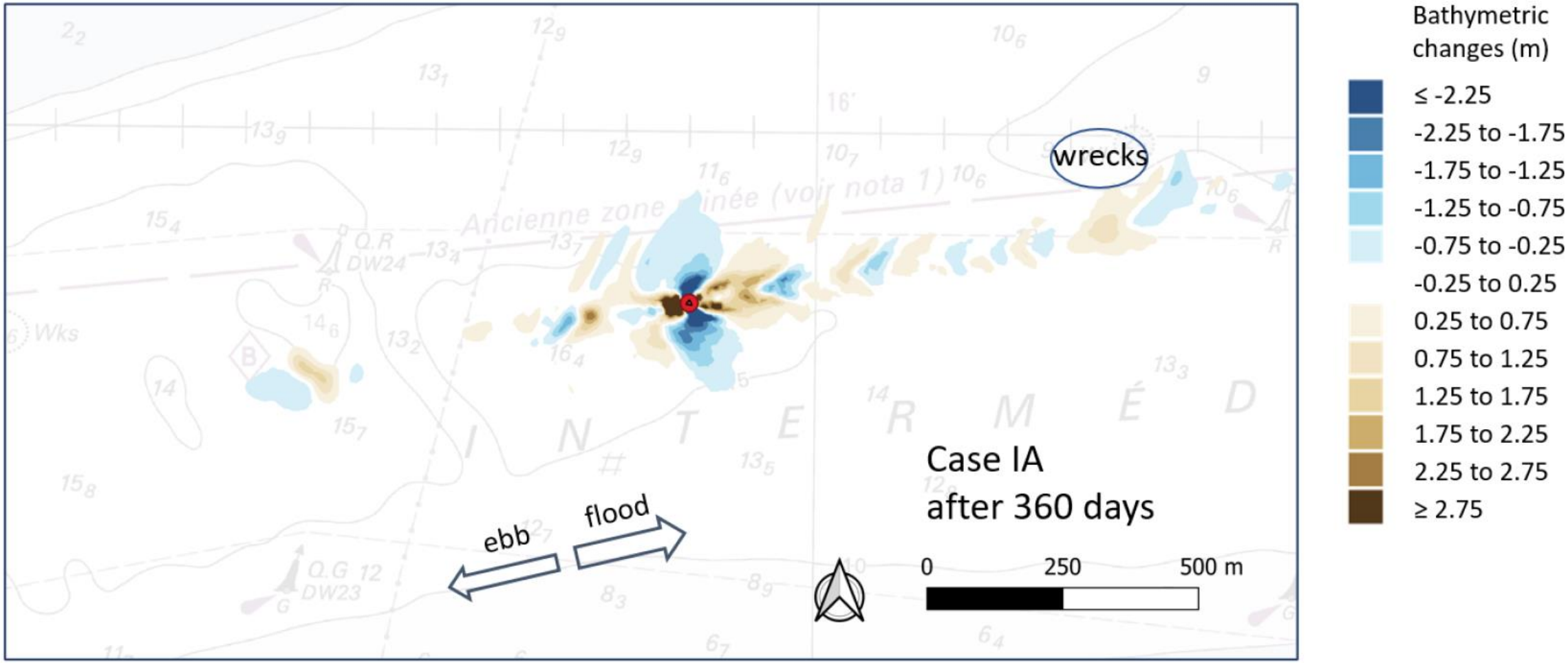
3D morphodynamic model offshore Dunkirk



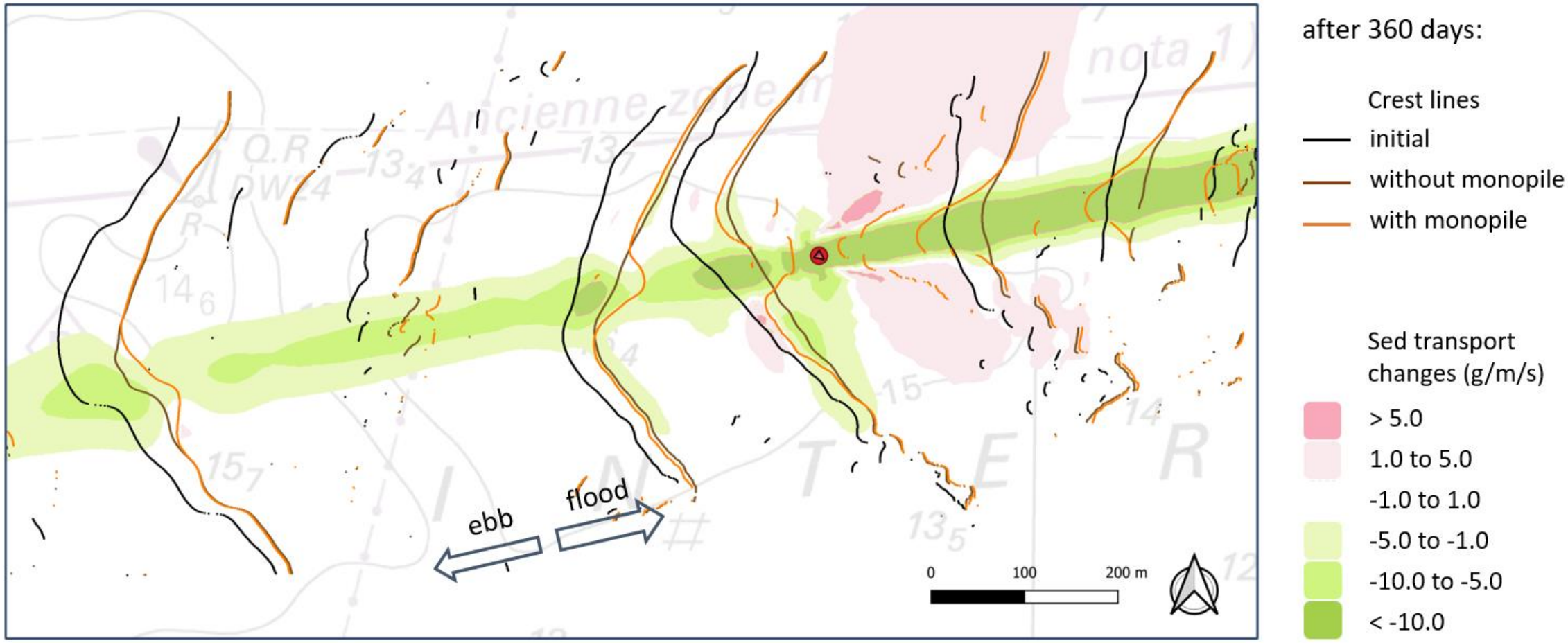
Physics		
Processes	Tides + wind & pressure -> 3D non-hydrostatic RANS model Turbulence -> horizontal: constant eddy viscosity vertical: mixing length (Tsanis) Bedload/total transport (SvR97) -> Exner equation	
Geometry		
Domain size	Representing ca. 55 km x 75 km	
Vertical spacing	5 irregularly spaced vertical levels	
Horizontal spacing	Min = 10 m	Max = 3000 m
Boundary conditions		
Bottom	Nikuradse roughness, $k_s = 2.5 \times d_{50}$ Infinite sediment layer One class of non-cohesive sediment (uniform distribution)	
Offshore	Tidal levels from FES2014 = 34 harmonic constituents Winds from AROME = hourly data at 1/40◦ resolution No sediment supply	
Time scales		
Physical duration	months to years	

Work of PhD thesis : Noémie Durand

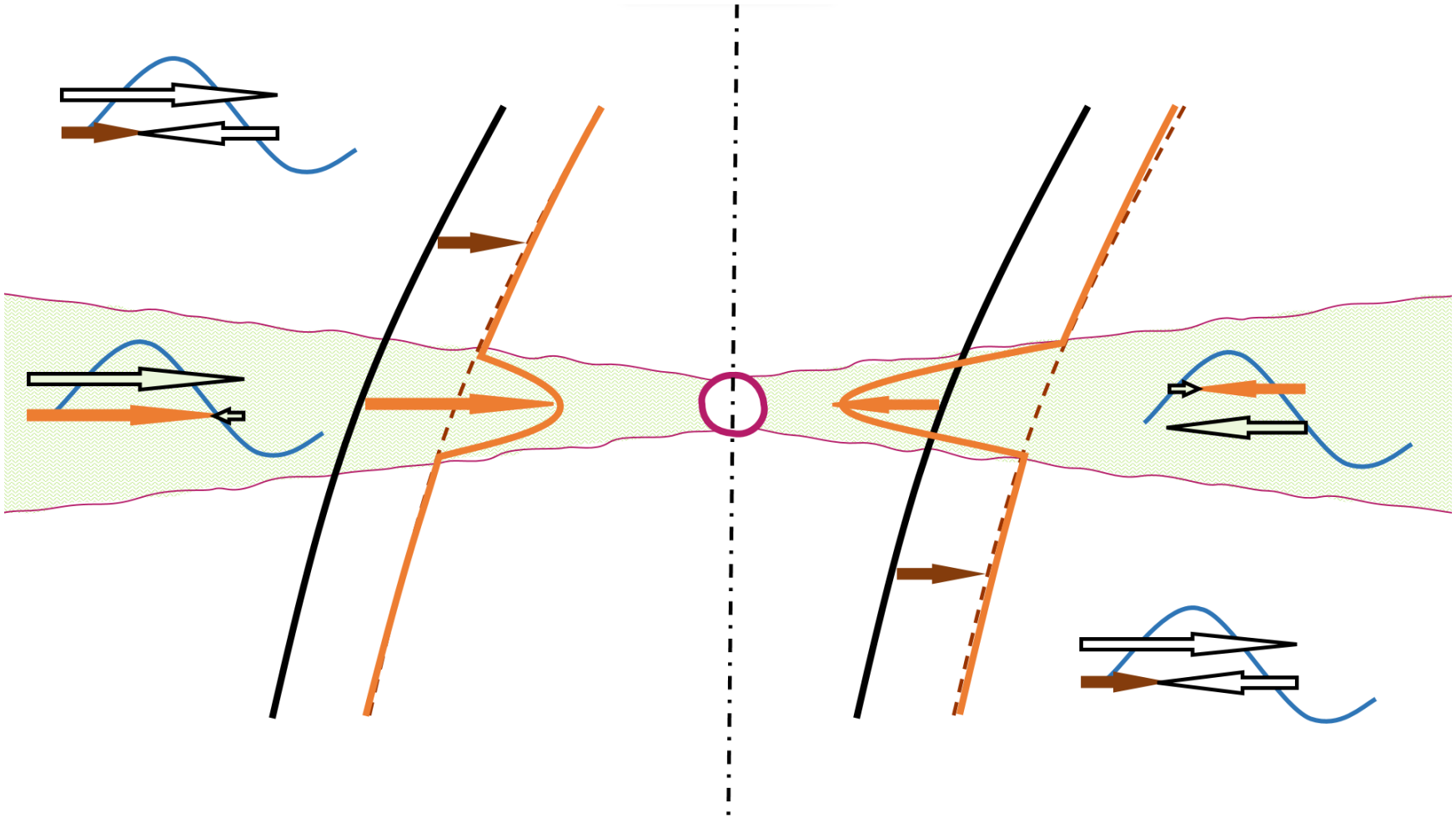
Interaction with a single monopile (1/2)



Interaction with a single monopile (2/2)



What happens when you introduce a monopile



Sediment transport rate for each phase of the tide

Hydrodynamic wake

Net transport rate outside wake

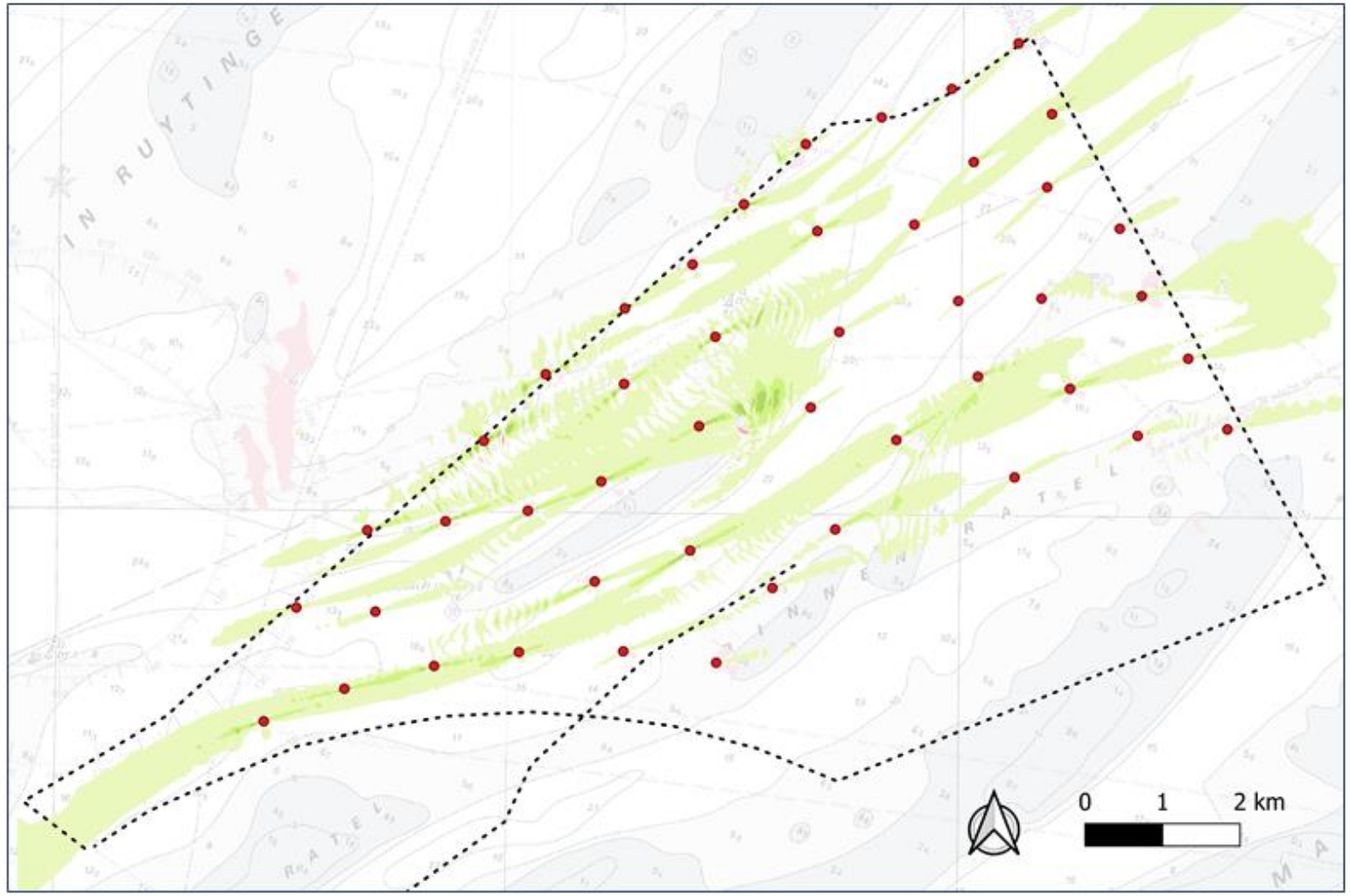
Net transport rate inside wake

Initial dune crest

Final dune crest in without monopile

Final dune crest with monopile

Interaction with an array of monopiles (1/2)

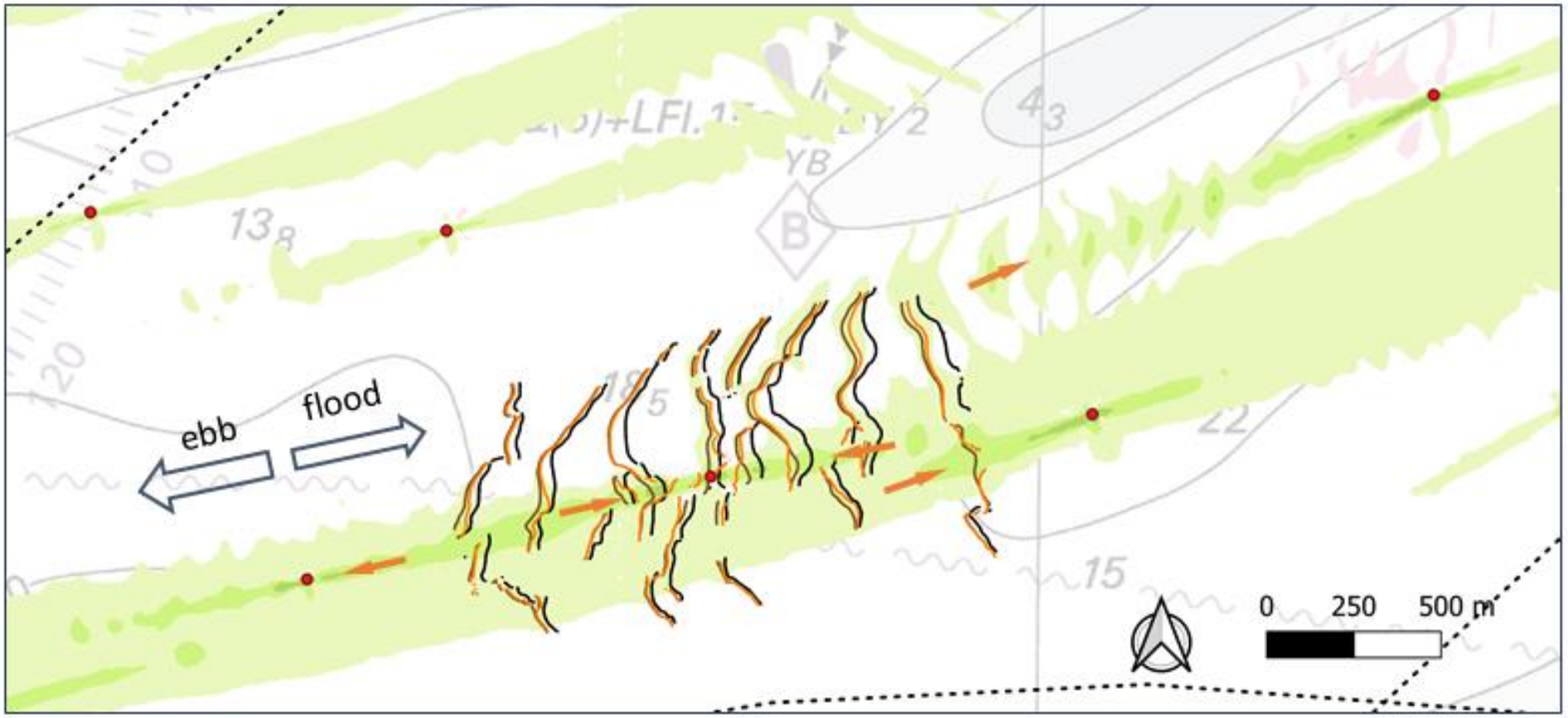


after 360 days:

Sed transport changes (g/m/s)

- > 10.0
- 2.0 to 10.0
- -2.0 to 2.0
- -10.0 to -2.0
- -20.0 to -10.0
- < -20.0

Interaction with an array of monopiles (2/2)



after 360 days:

Crest lines
initial
without monopile
with monopile

Sed transport changes (g/m/s)
> 10.0
2.0 to 10.0
-2.0 to 2.0
-10.0 to -2.0
-20.0 to -10.0
< -20.0

Thank you for your listening