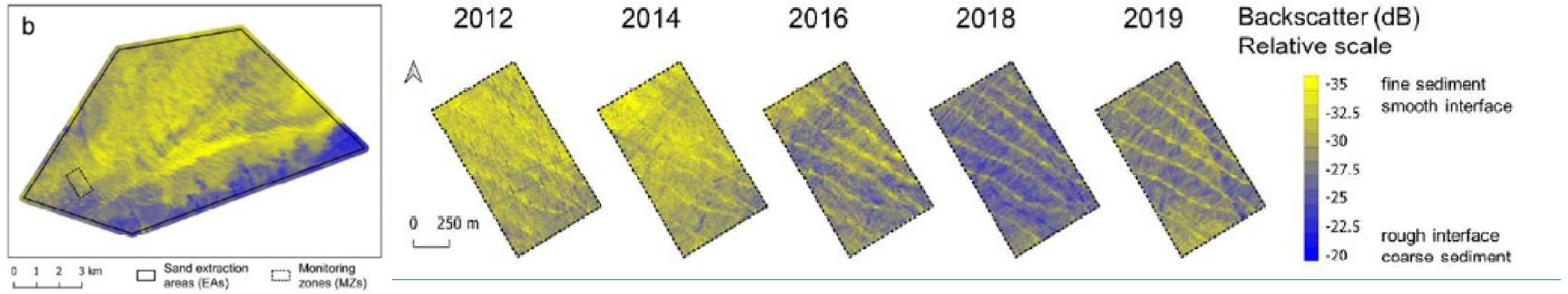
Most drastic impact of sand extraction when a high and continuous extraction coincides with a varying nature in local geological layers and sediment types



Wyns et al. (2021). Near-field changes in the seabed and associated microbenthic communities due to marine aggregate extraction on tidal sandbanks: A spatially explicit bio-physical approach considering geological context and extraction regimes. https://doi.org/10.1016/j.csr.2021.104546

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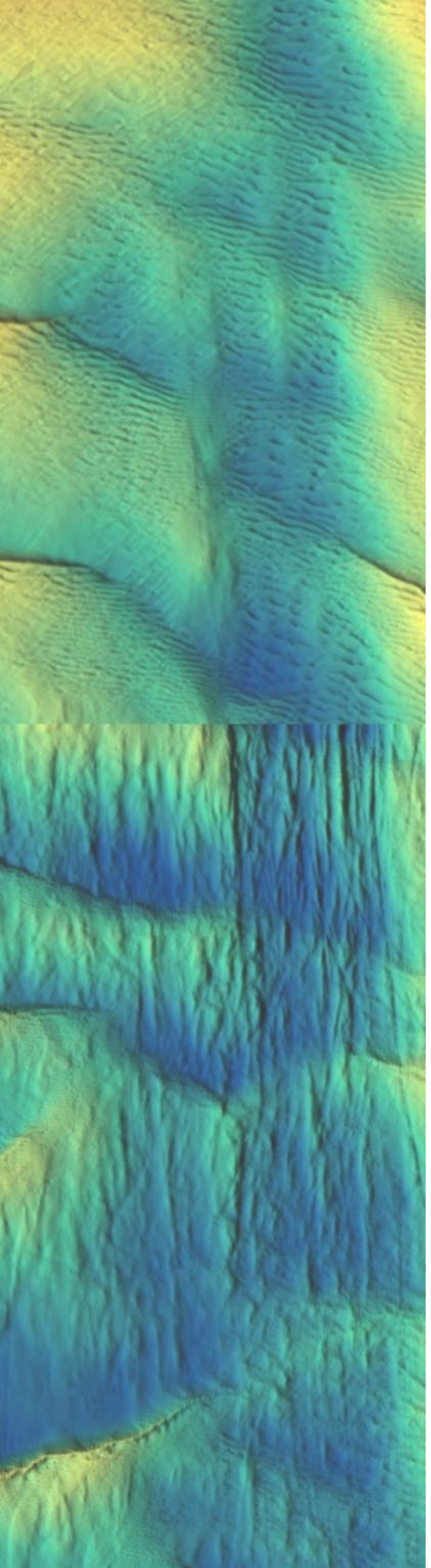
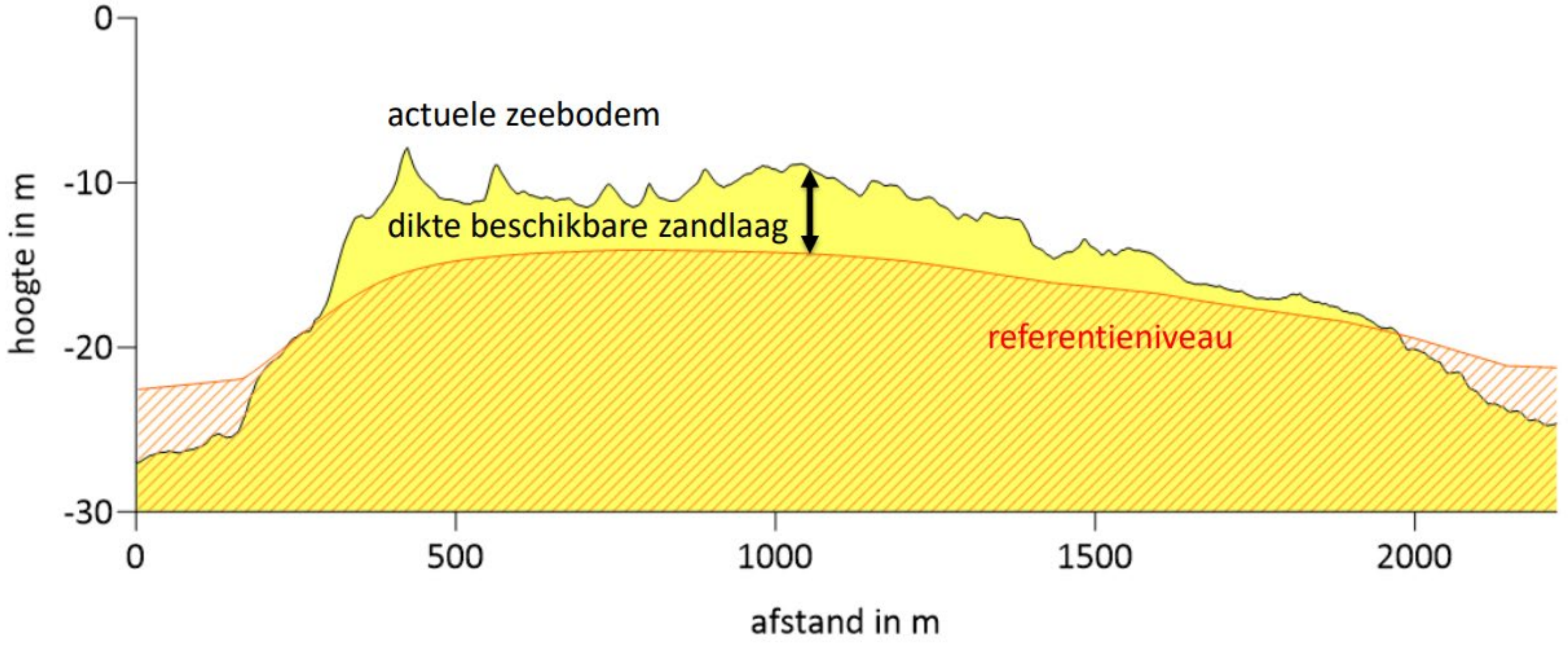
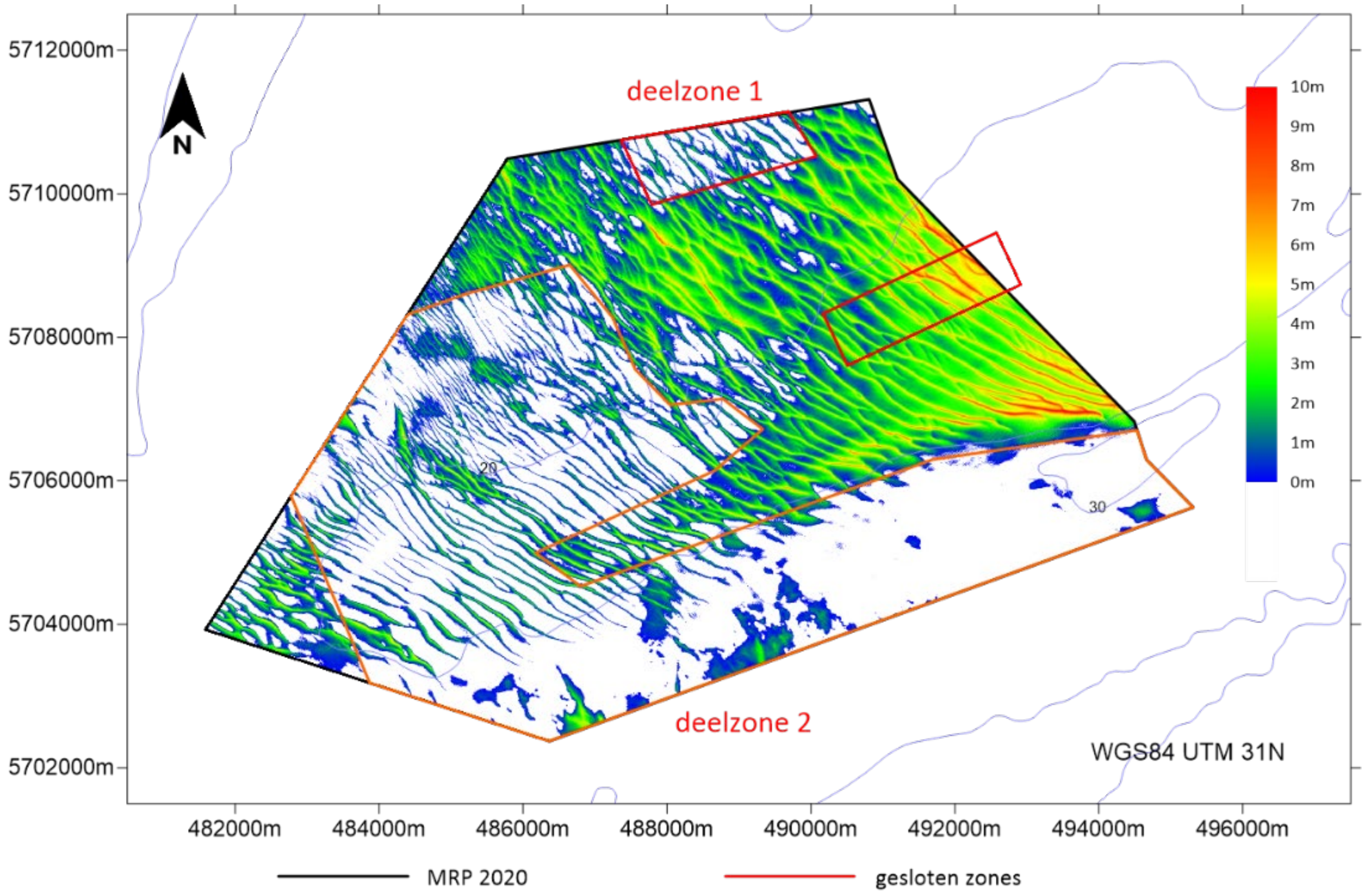


Implementation of maximum extraction limit or reference surface for each extraction area based on resource thickness, preserving sand bank structure and sediment characteristic criteria





➡ More frequent closure of subzones in extraction areas

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Recovery dynamics after intensive sand extraction

Studiedag Zand
18 October 2024

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Lucia LopezLopez
Koen Degrendele
Marc Roche
Florian Barette

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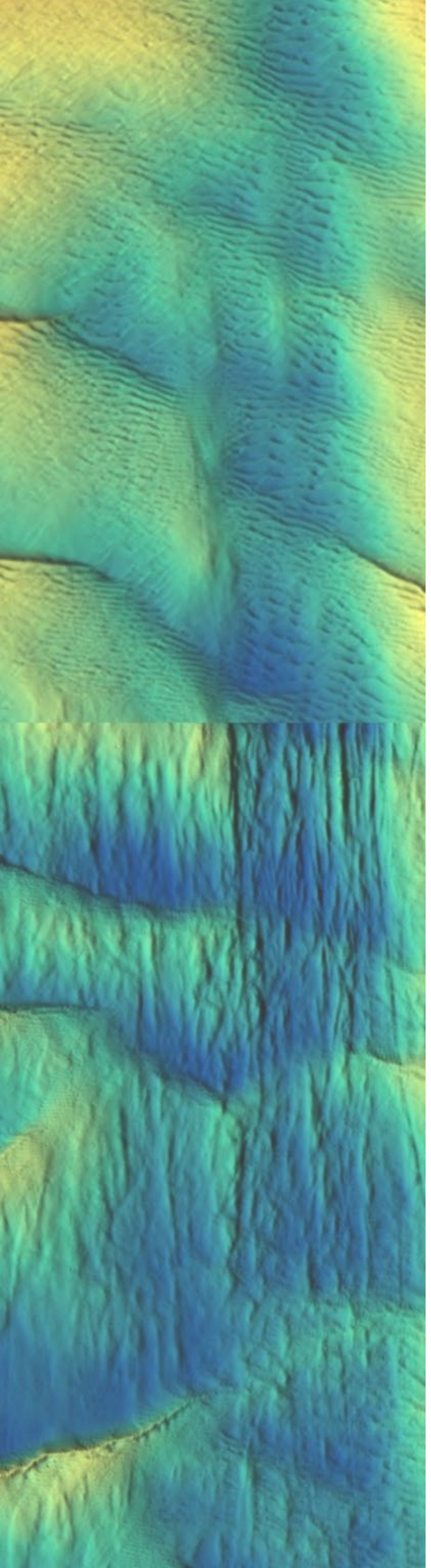
economie
FPS Economy, S.M.E.s, Self-employed and Energy

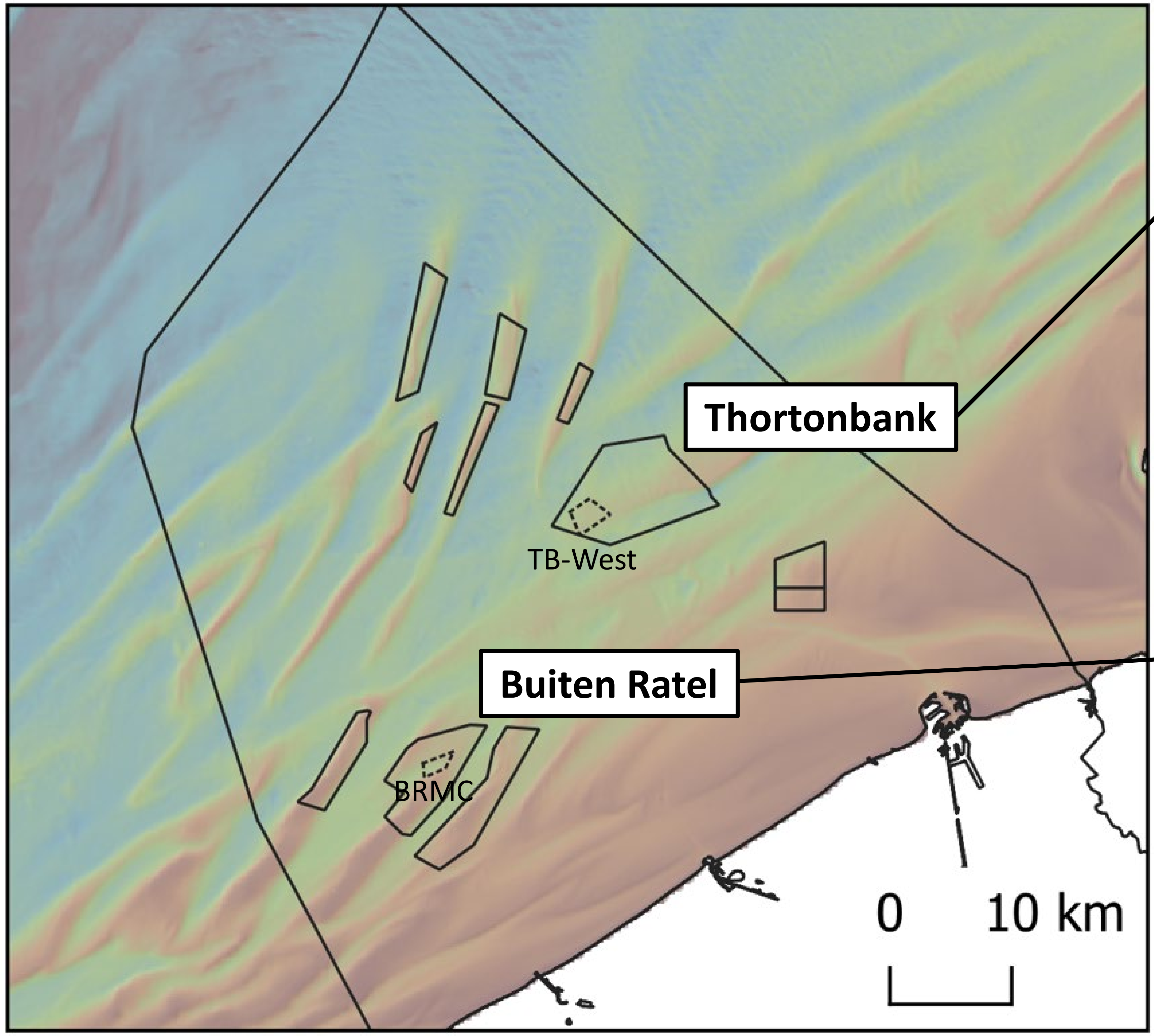
In preparation: Lopez Lopez L., Barette F., Degrendele K., Francken F., Roche M, Terseleer N., Vandeneynde D., Van Lancker V., De Backer A. Evolution of macrobenthos and morpho-sedimentary dynamics in areas closed for aggregate extraction.

Why?

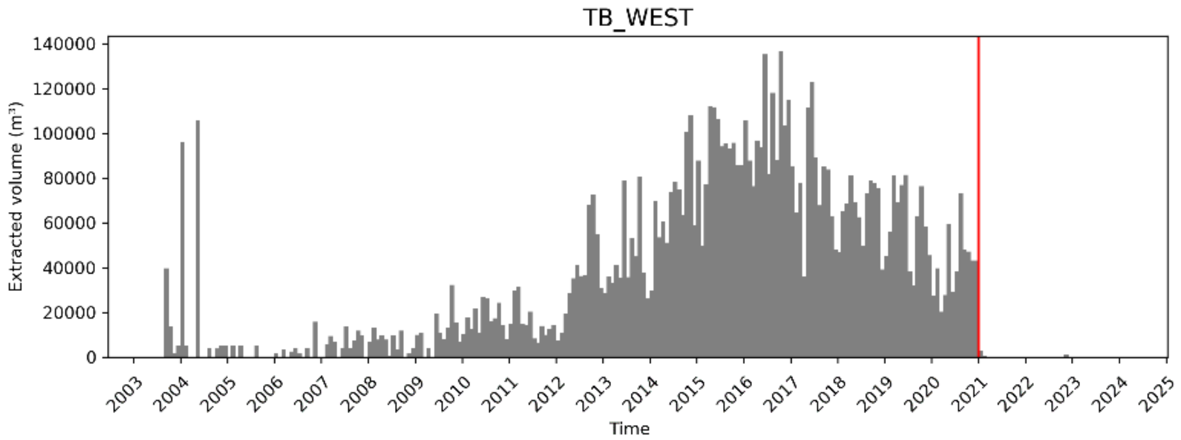
- Insights are important to evaluate whether an impact is reversible and whether the marine ecosystem can recover to pre-dredged or reference conditions
- Definition of recovery:
  - Physical recovery = sediment composition and seabed morphology is similar to either pre-dredge conditions or local reference sites and dredge tracks and furrows are no longer detectable by imaging techniques (Boyd et al. 2004)
  - Biological recovery = establishment of a community that is virtually indistinguishable from surrounding, non-impacted reference sites (Cooper et al 2005)
- MSFD policy driver - disturbance versus loss
- Provide insights in potential active restoration processes

Study areas and extraction history

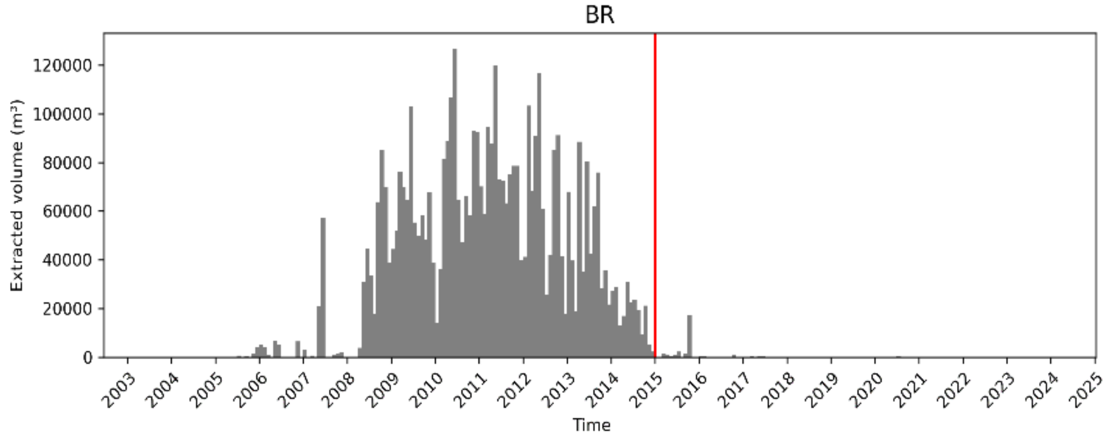




Extraction hotspot since 2015
TB_West subzone closed in 2021



Extraction hotspot from 2008 – 2014
BRMC closed since 2015



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Sampling methodology

MBES derived bathymetry and calibrated backscatter

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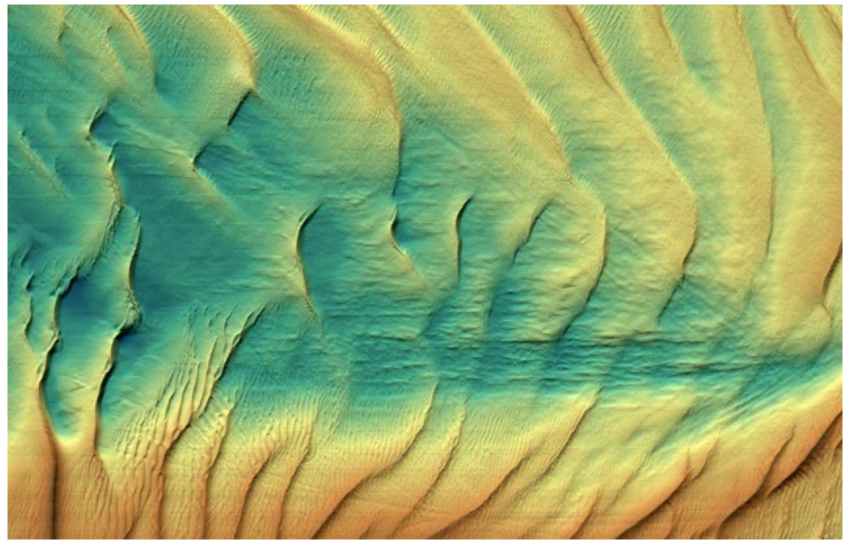
FPS Economy, S.M.E.s, Self-employed and Energy



Grab sample derived sediment and macrobenthos

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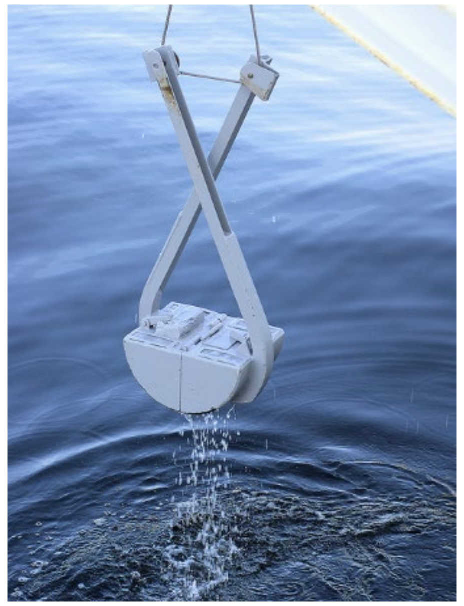

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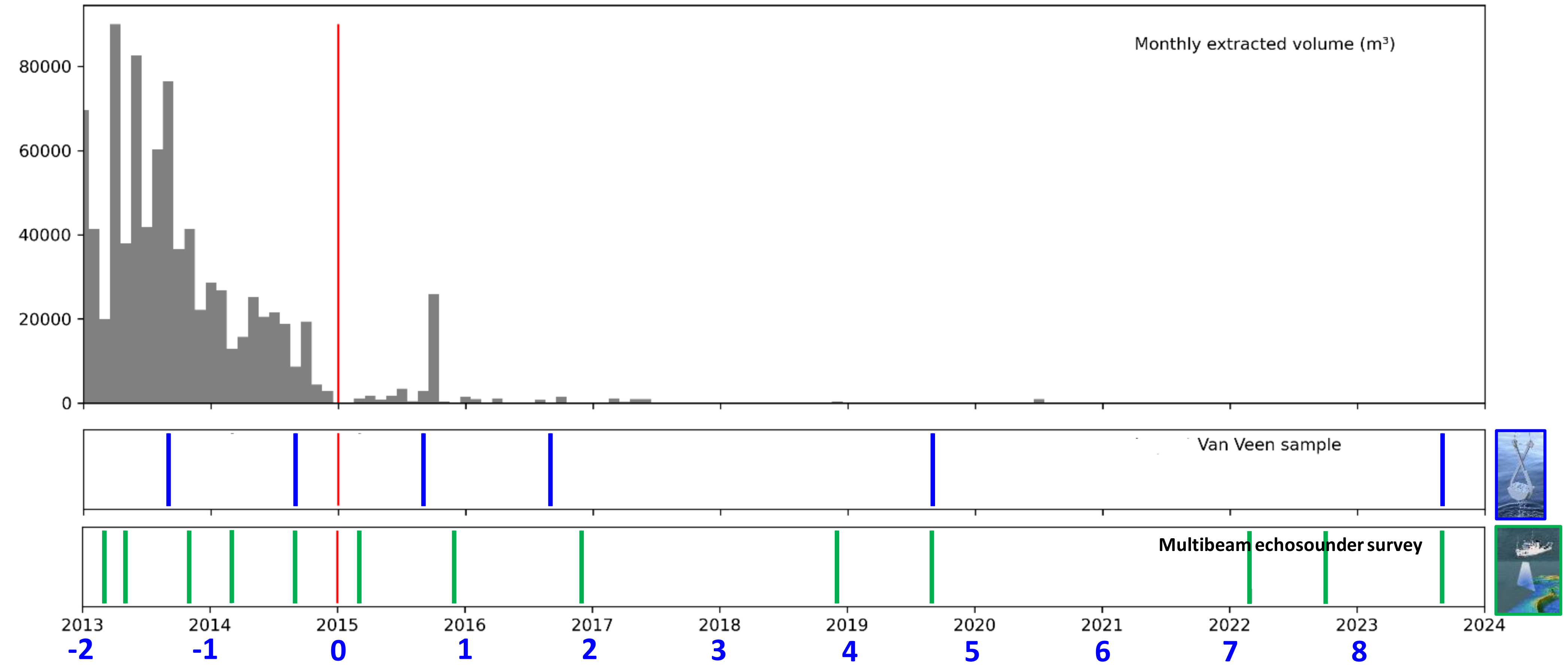
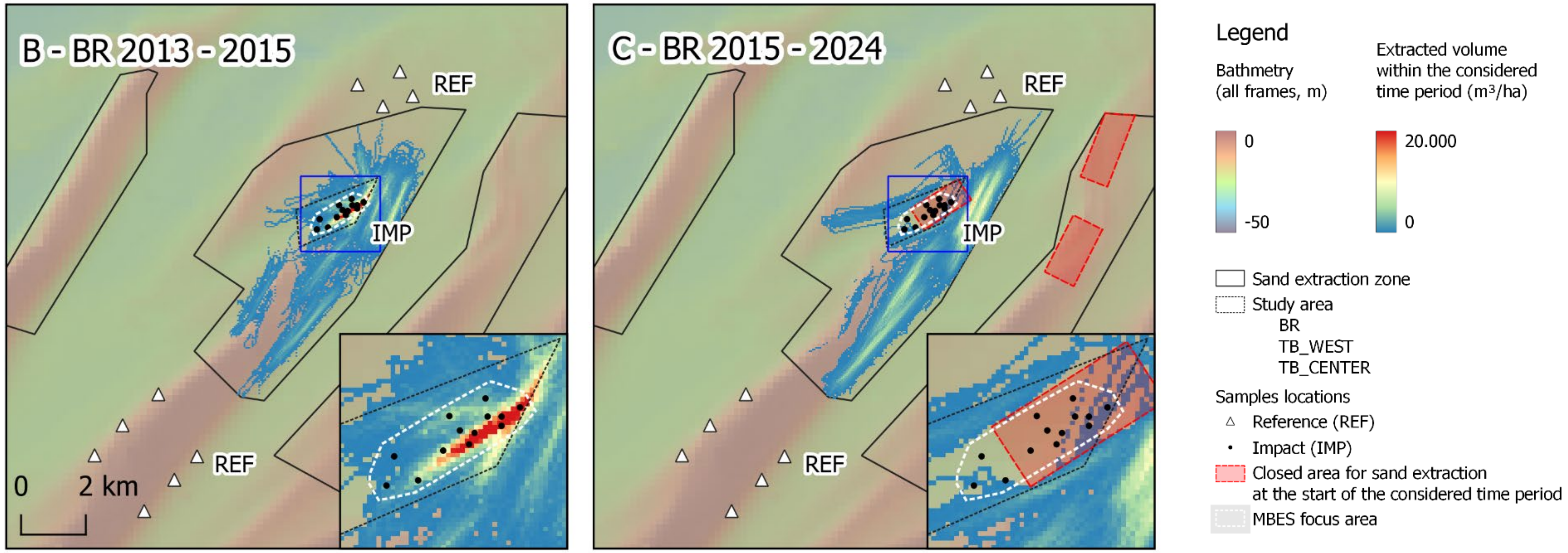
Buiten Ratel study design





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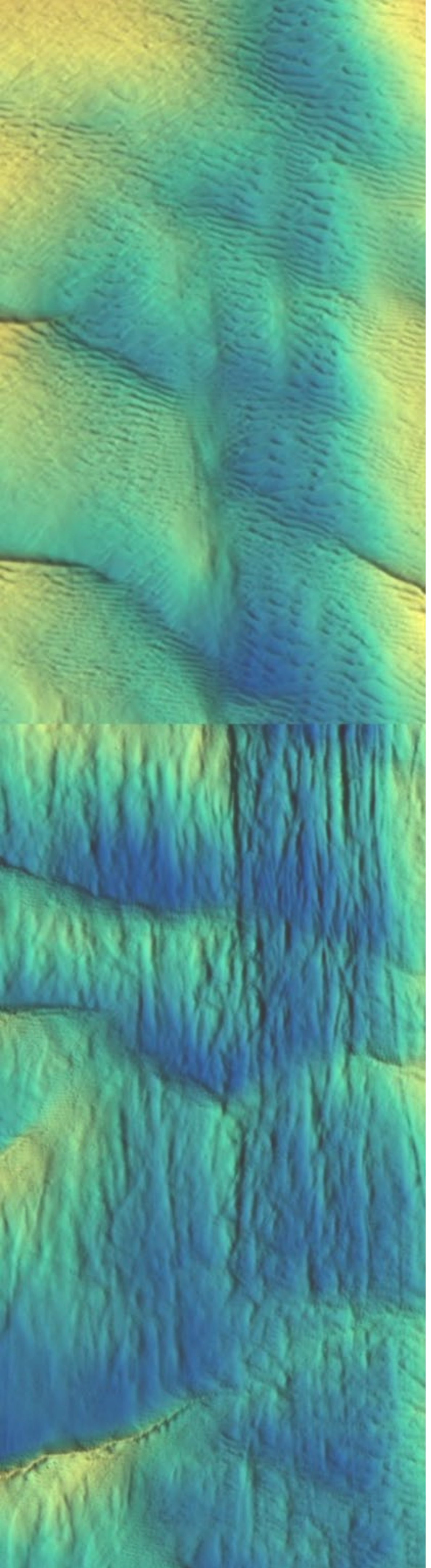
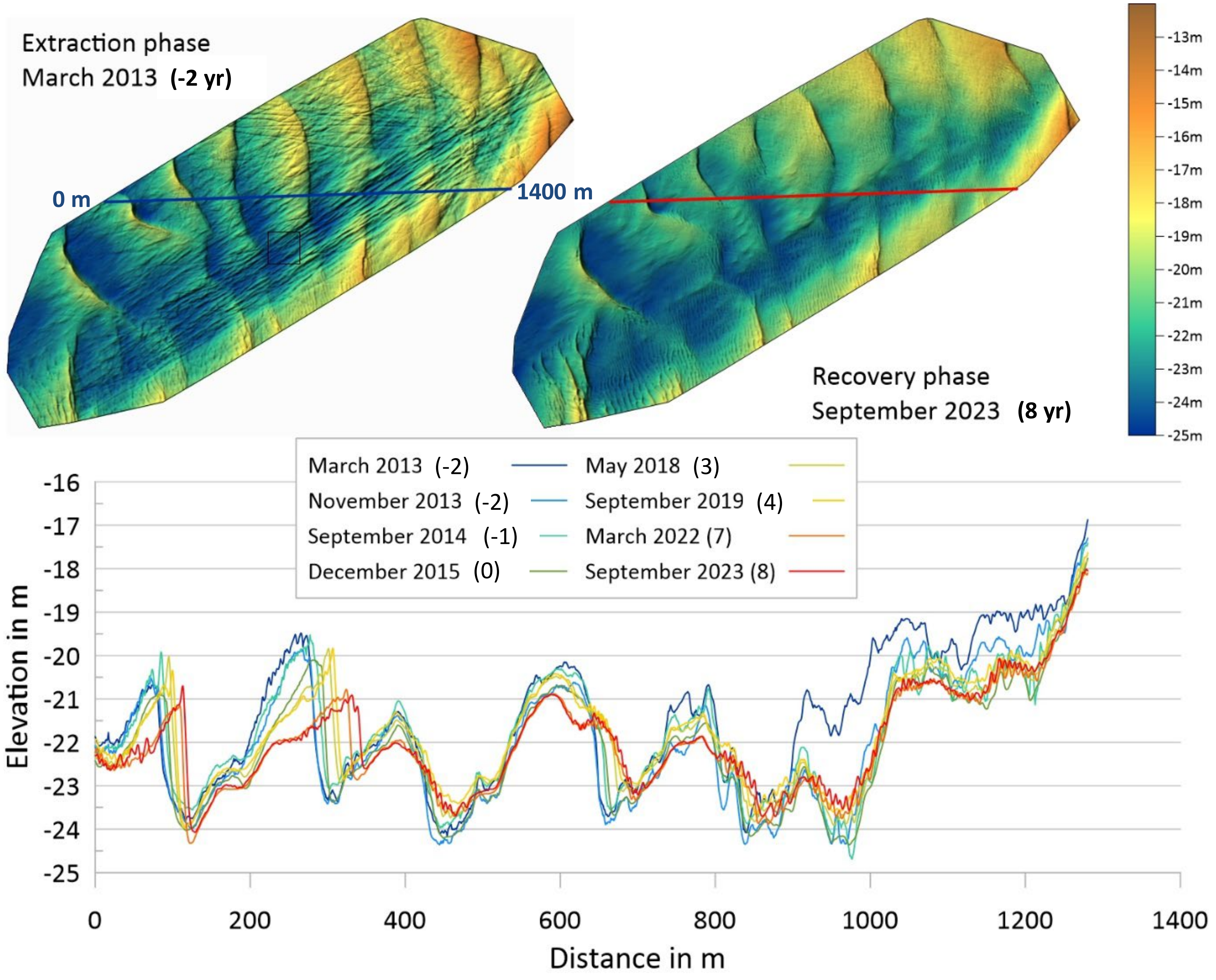
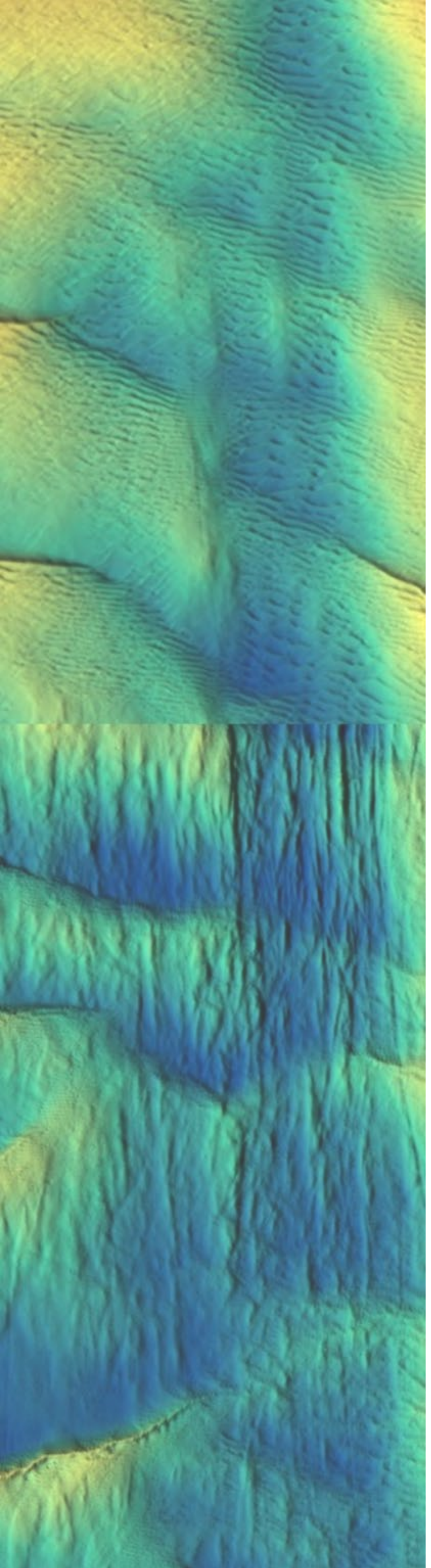


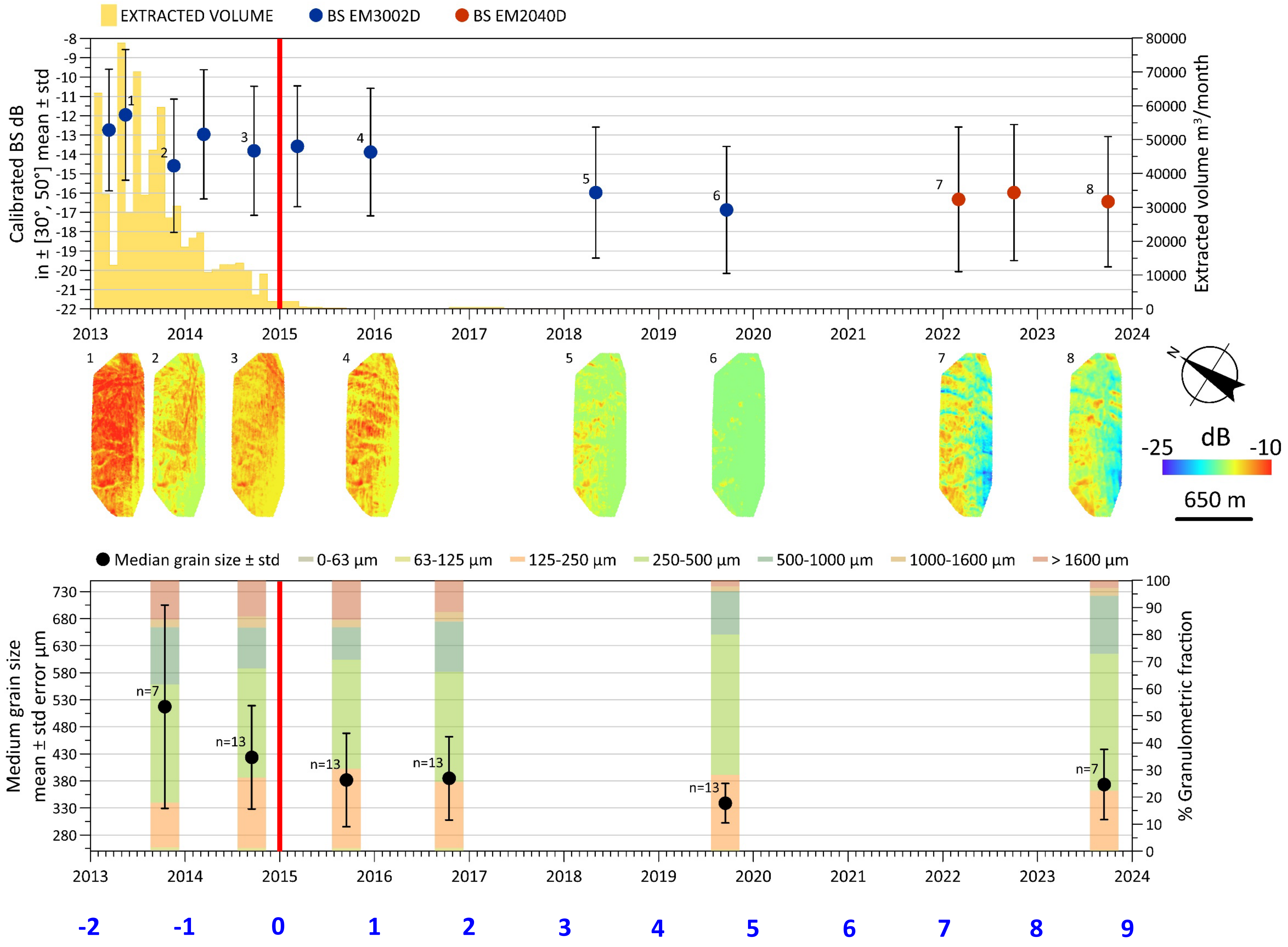
BR impact - Bathymetry & seabed morphology



- Bathymetry remains stable – no infill of depression created during dredging
- Dredge furrows gradually disappear
- Reappearance of small-scale morphology – sand ripples after 3 years
- No recovery of larger-scale morphology - sand waves.



BR impact – Backscatter



- After cessation of extraction, BS levels decrease upto 2020, stabilizing afterwards ~sediment fining and decrease in rugosity
- The BS level is closely correlated with the % sediment >1600µm.
- BS in years 7 and 8 reflects more natural small-scale morphology

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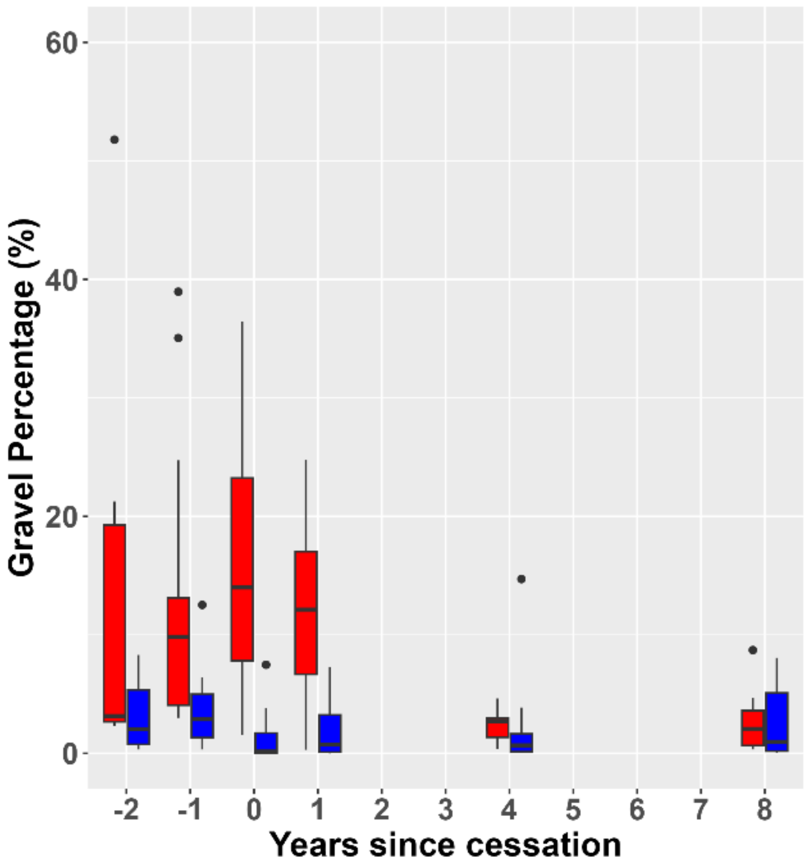
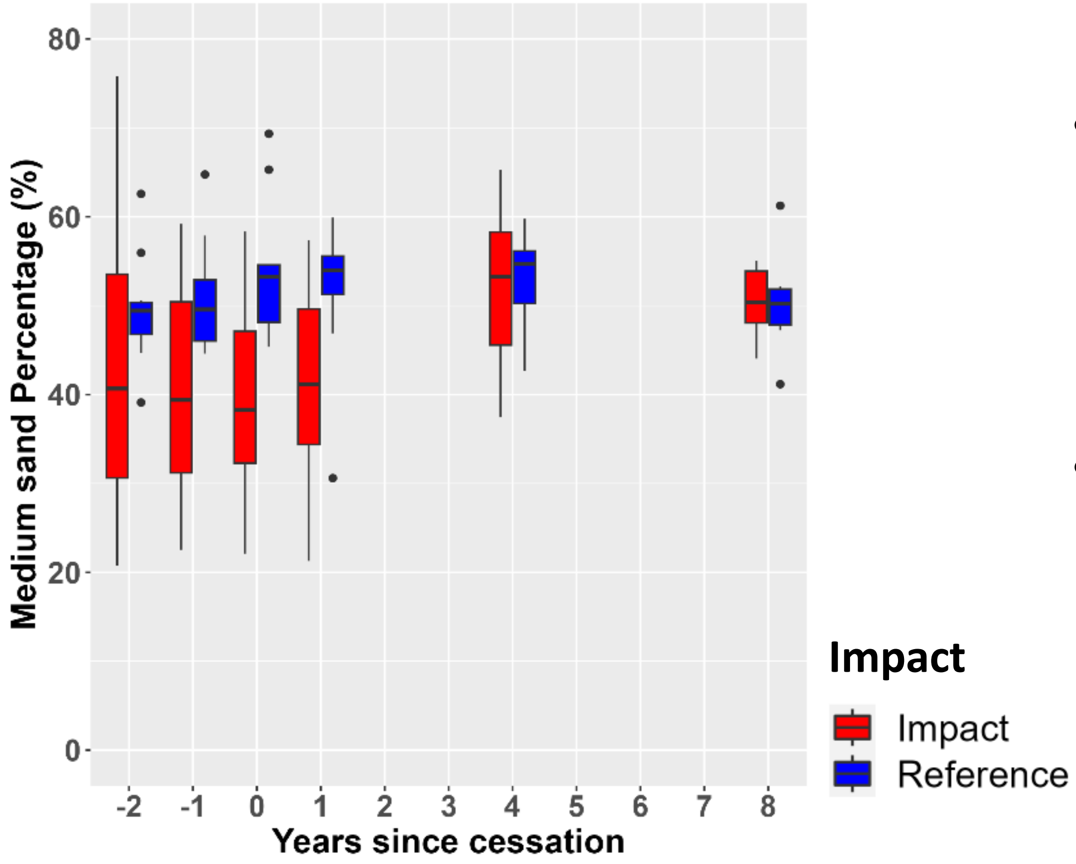
BR – Sediment evolution

-1 0 1 4 8

IMP



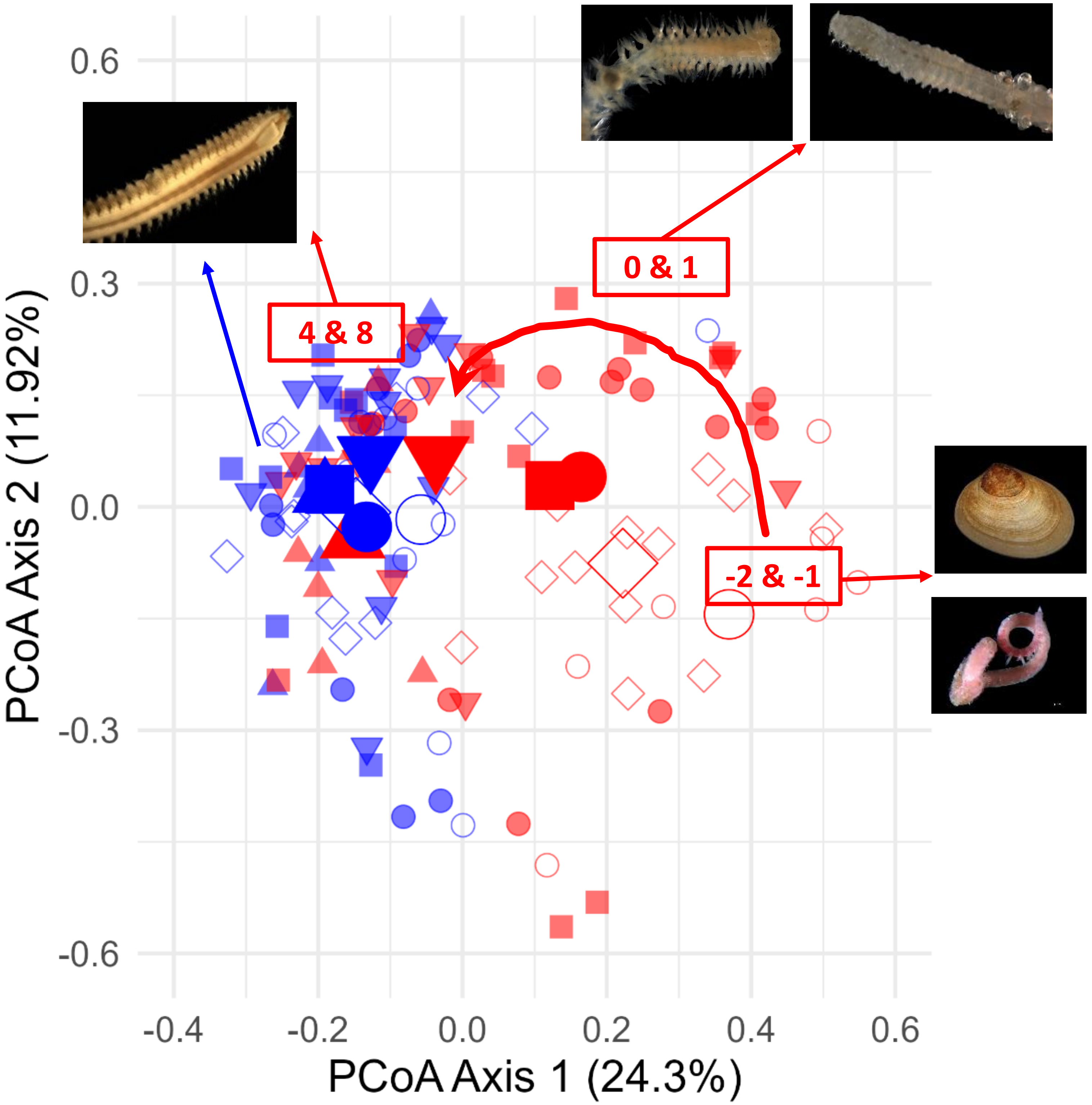


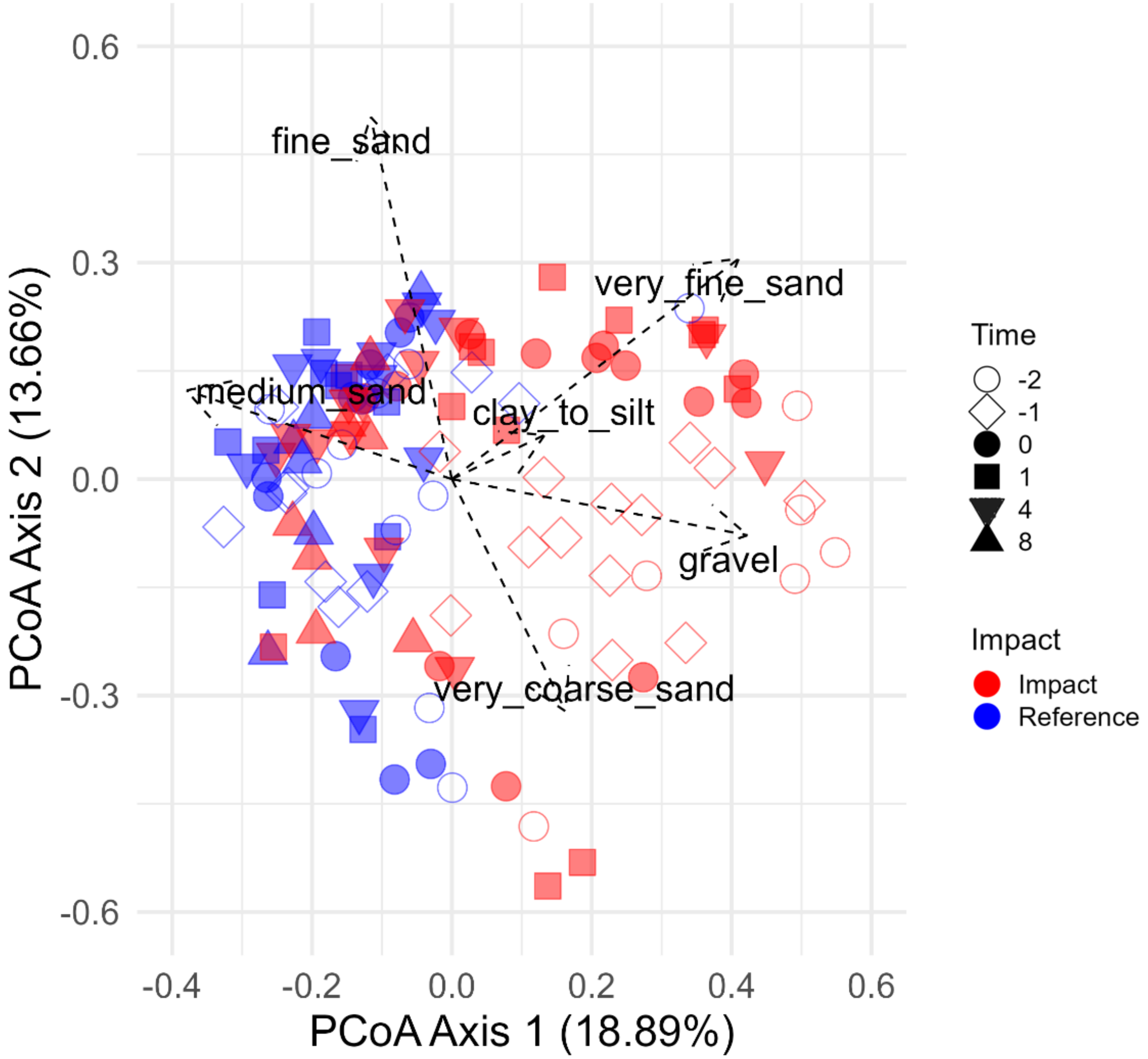
- In impact area, relative decrease in >1600µm and increase in 250-500 µm fraction
- Sediment of reference locations stable over time

REF

-1 0 1 4 8

BR– Benthic community





- Colonisationof opportunisitic species immediately after extraction
- Gradual recovery of benthic community to reference conditions after 4 to 8 years

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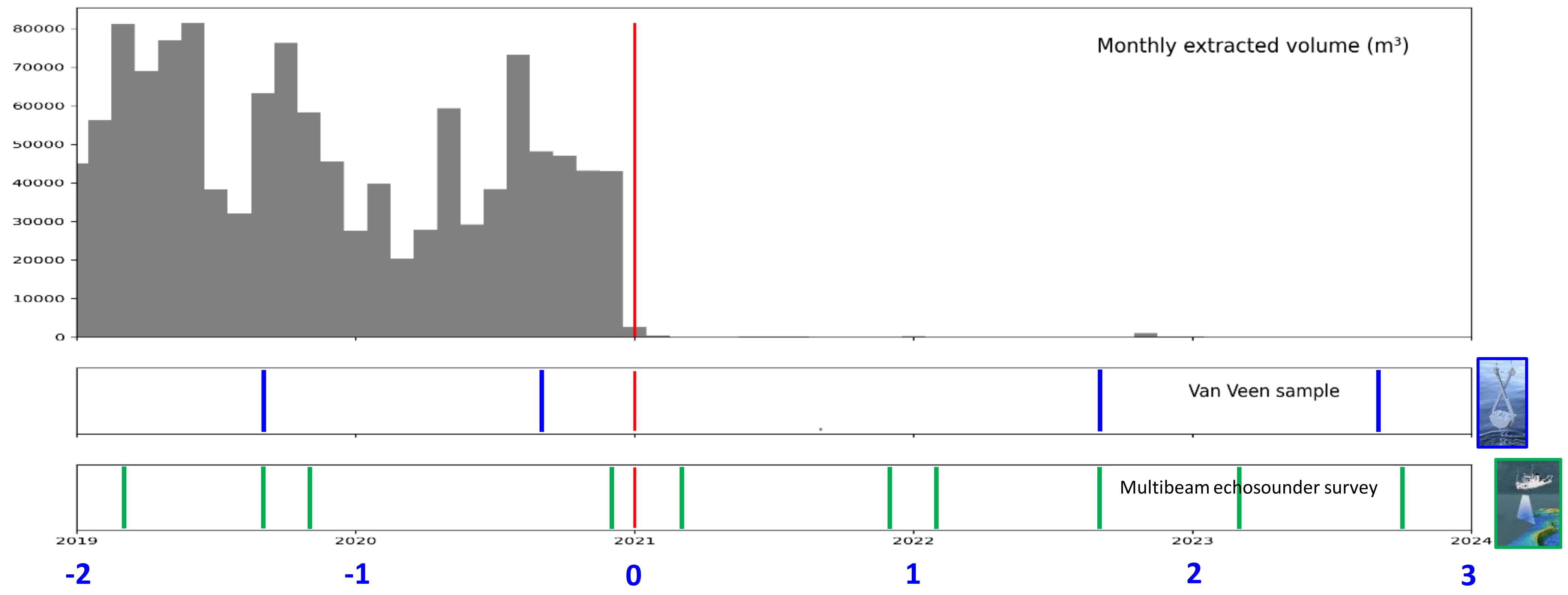
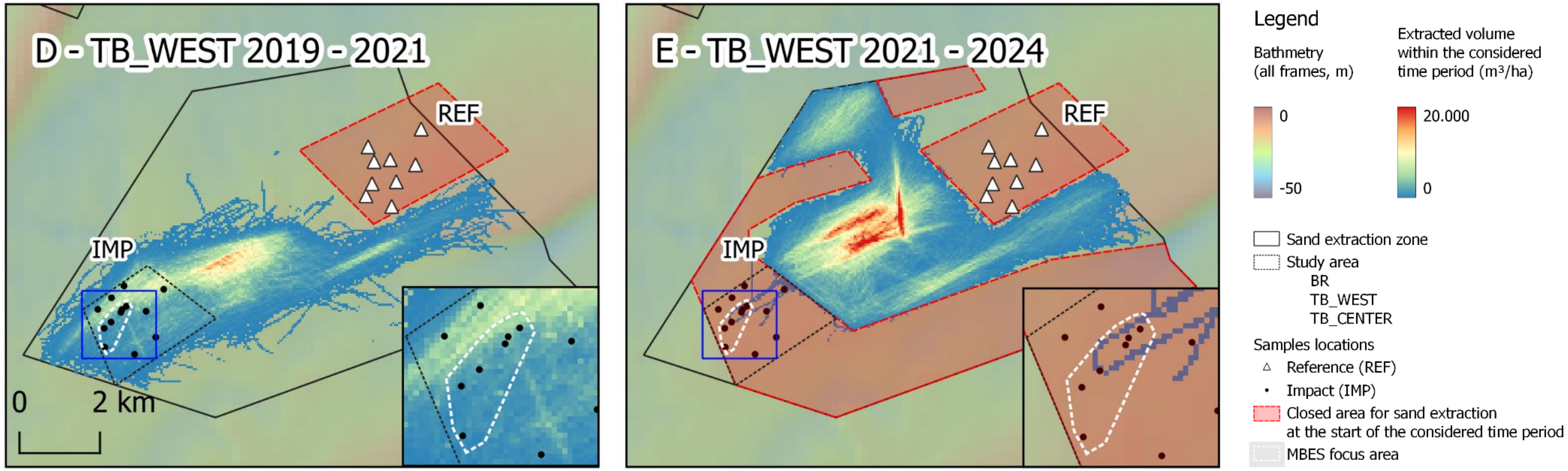
TB WEST study design





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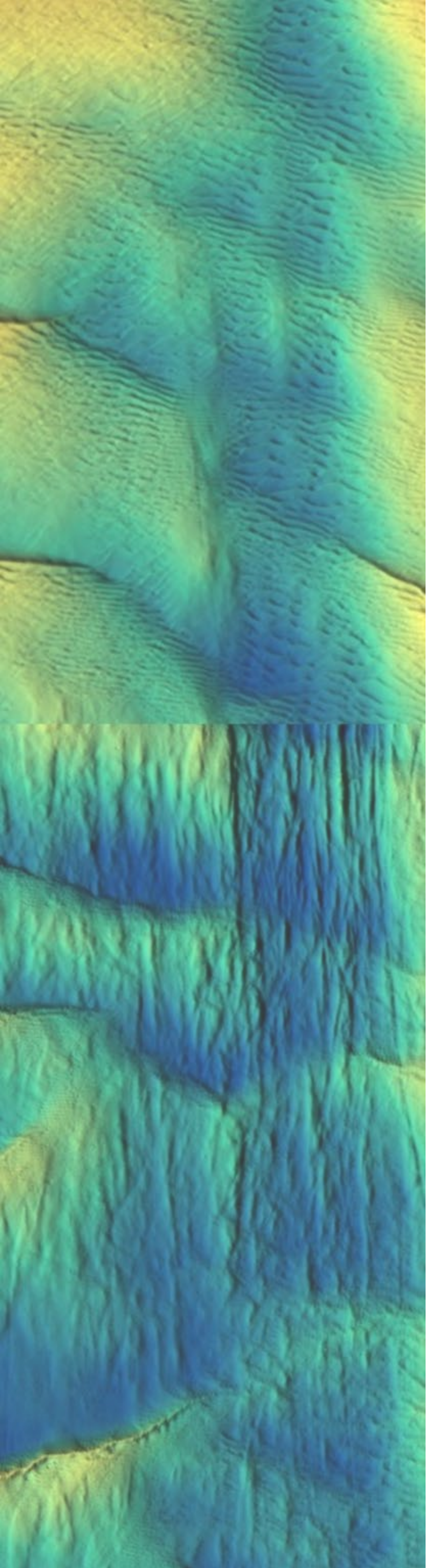
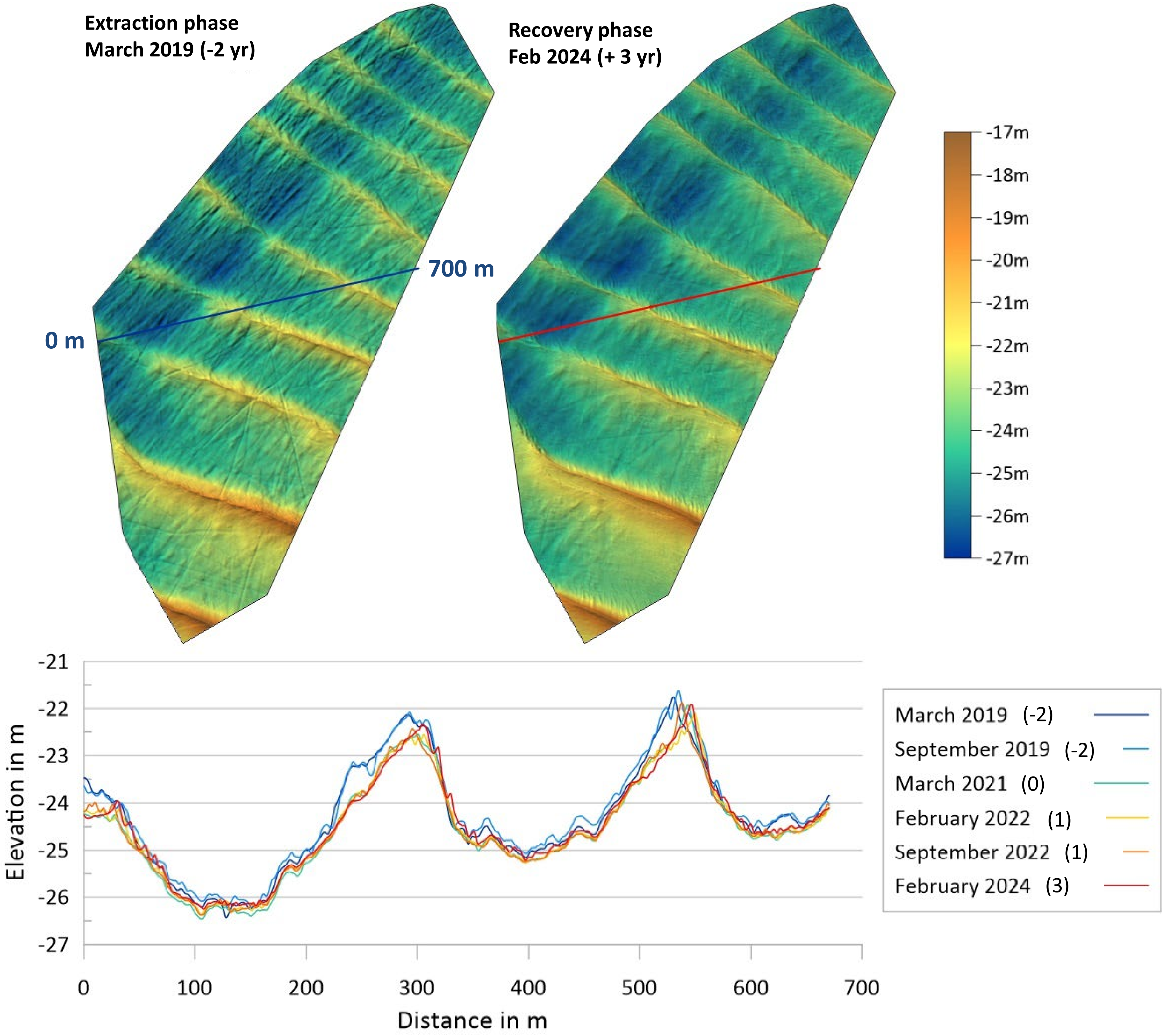
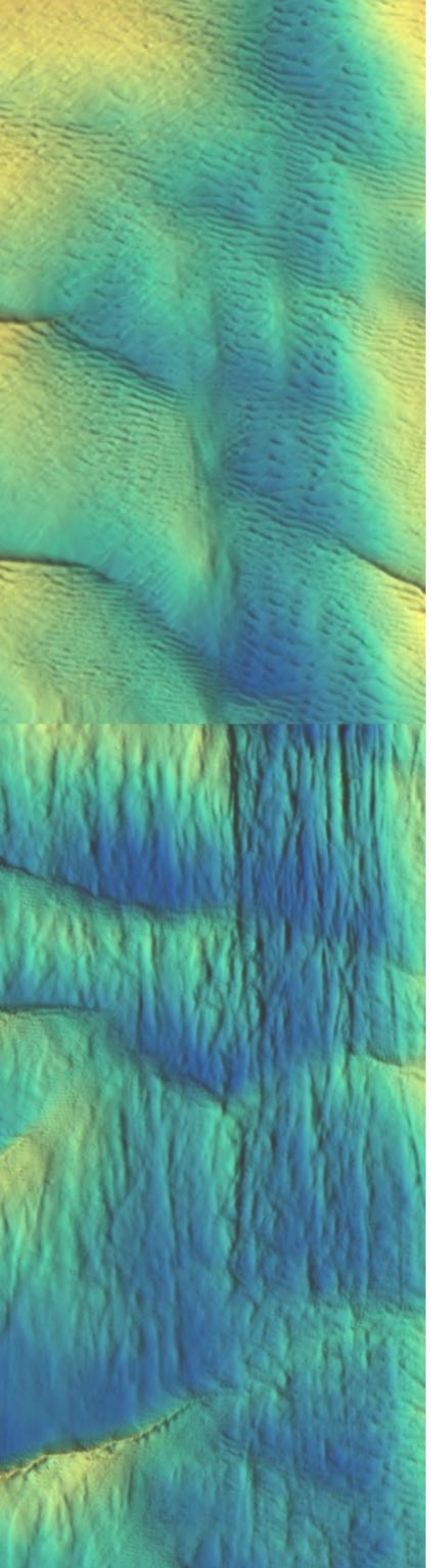


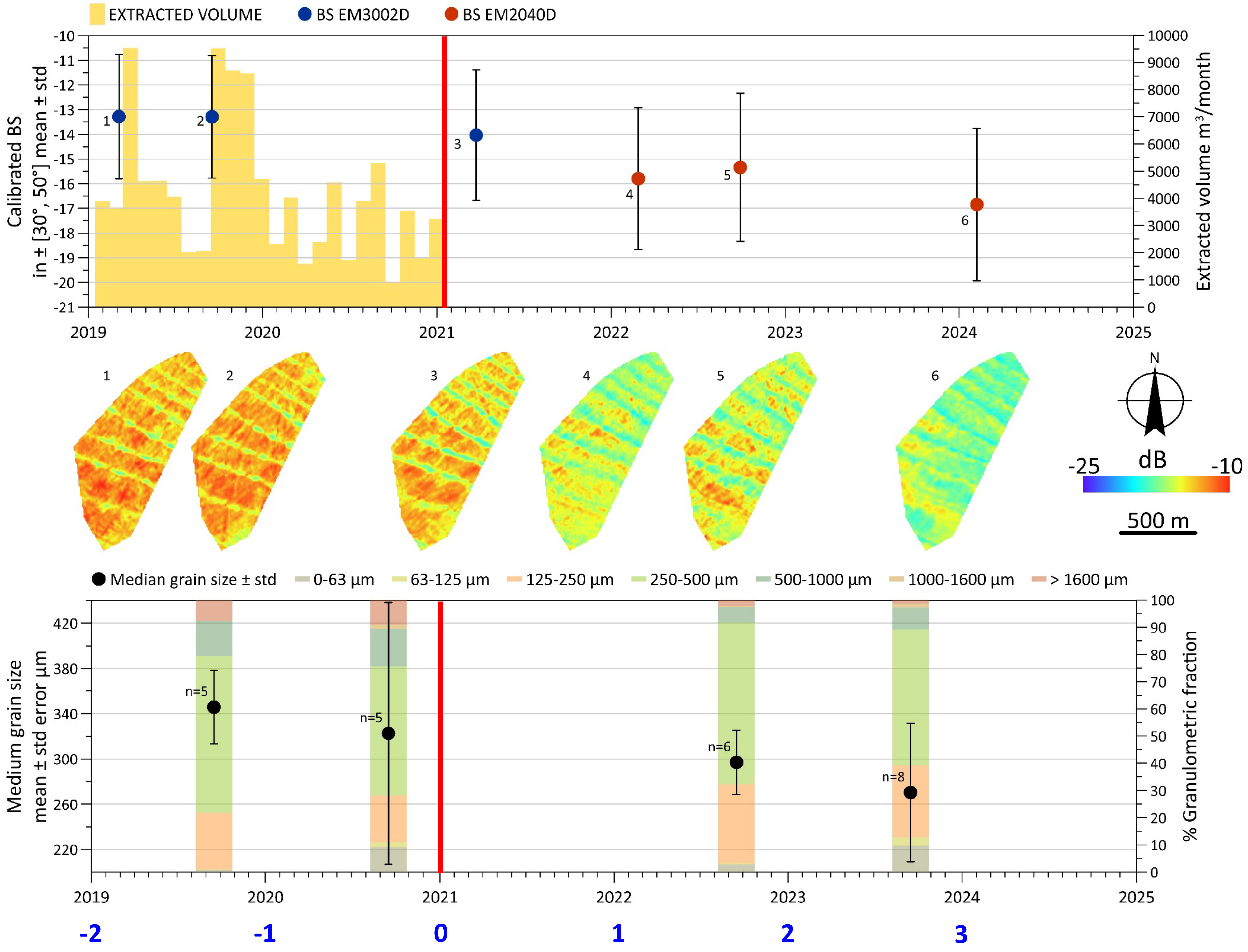
TB West – Bathymetry & seabed morphology



- Bathymetry stable after closure – no infilling of depression that was created during extraction
- Deep dredging furrows start to fill in immediately, and dredging marks are less apparent after 3 years
- No recovery yet of small- and large-scale morphology



TB WEST- Backscatter



- BS levels decreased from -13/-14 dB during extraction to -17 dB three years after, indicating fining of sediments.
- Correlates with a drop in fraction >1600µm and 500-1000 µm

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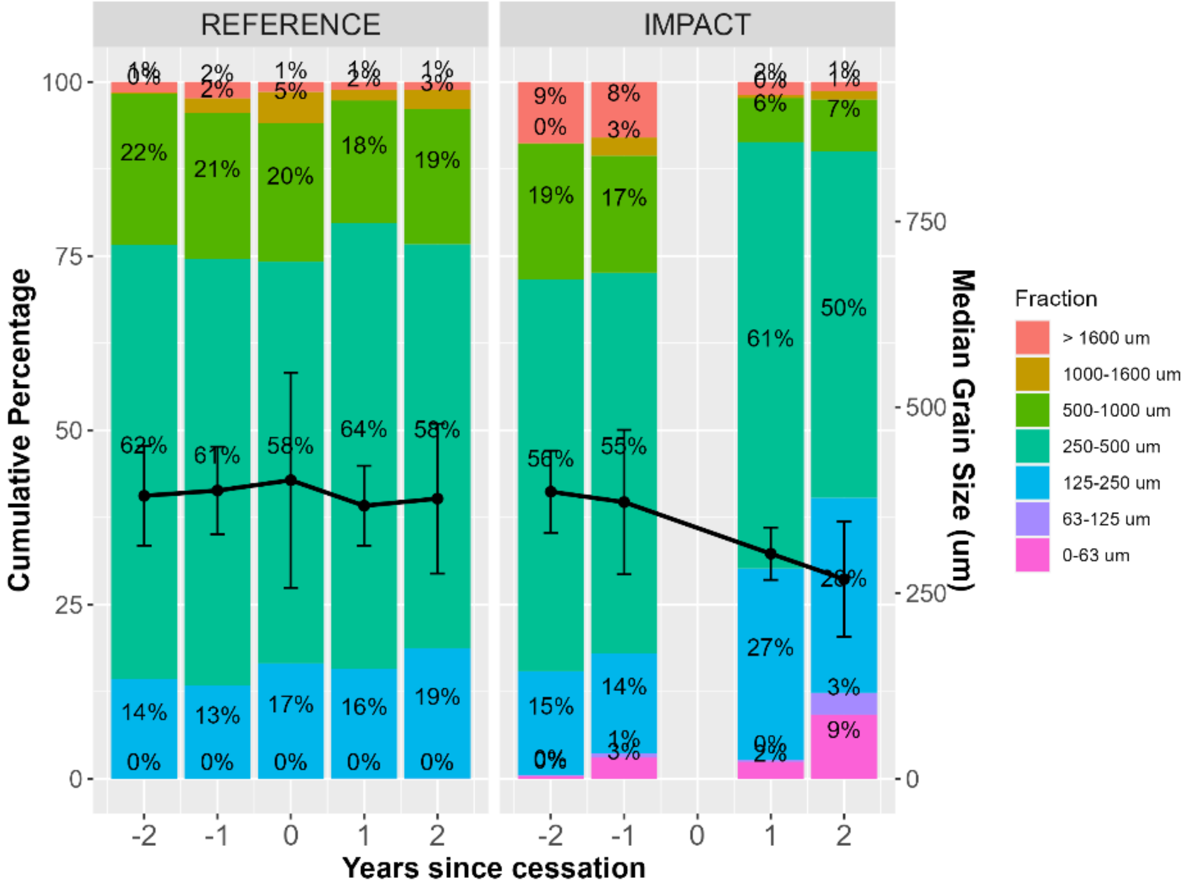
TB WEST - sediment

-2 -1 1 2

IMP



- In impact area, relative decrease in >1600µm and 500-1000 µm and increase in fine fractions (0-125 µm)
- Sediment of reference locations stable over time

REF

-2 -1 1 2

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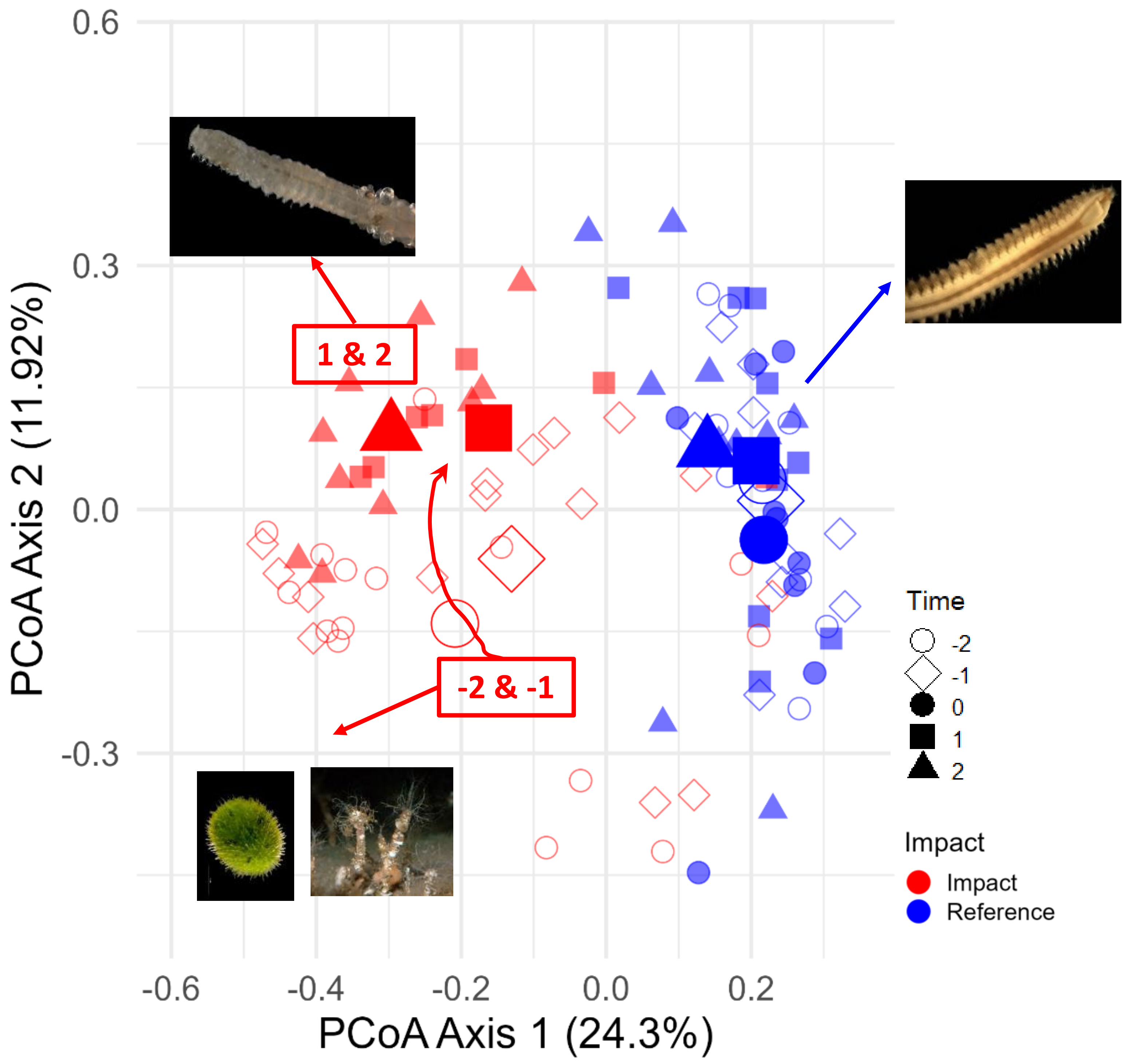
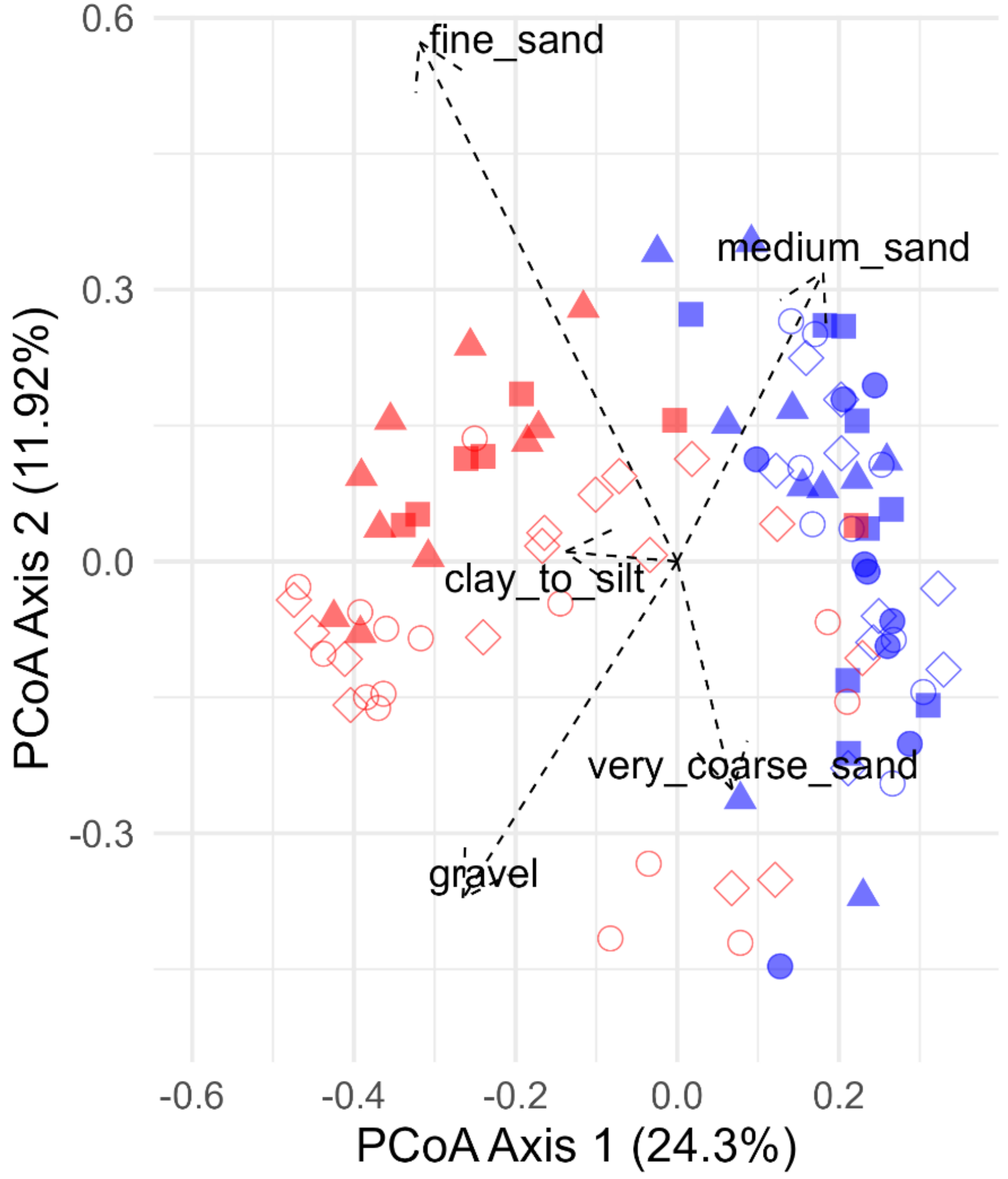
TB WEST





- Shift of community immediately after stop of extraction due to colonisation of opportunists
- No recovery of benthic community yet to reference conditions

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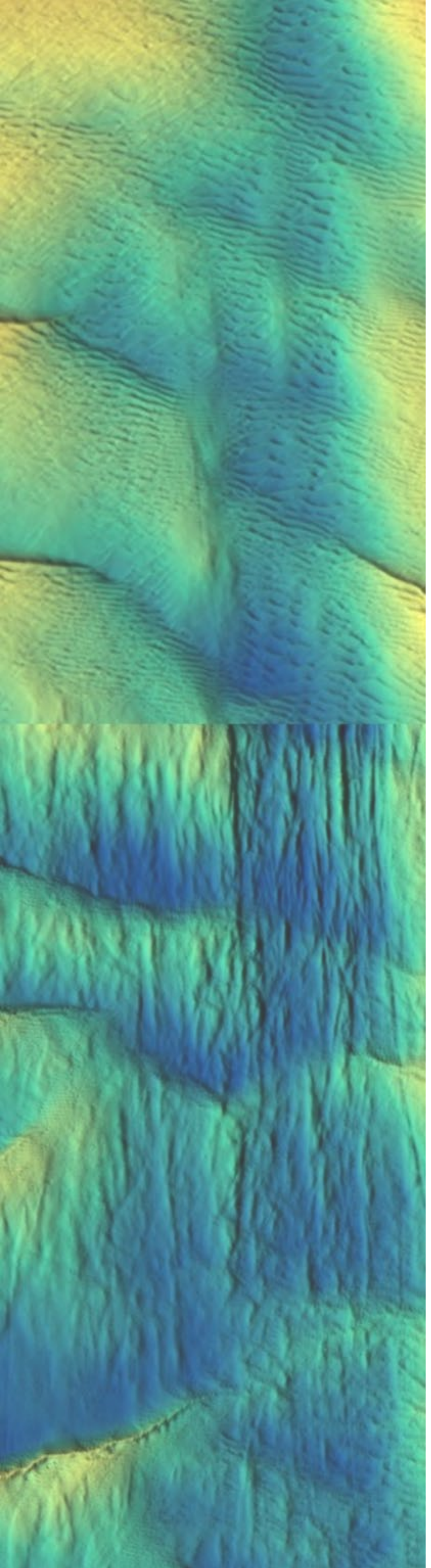
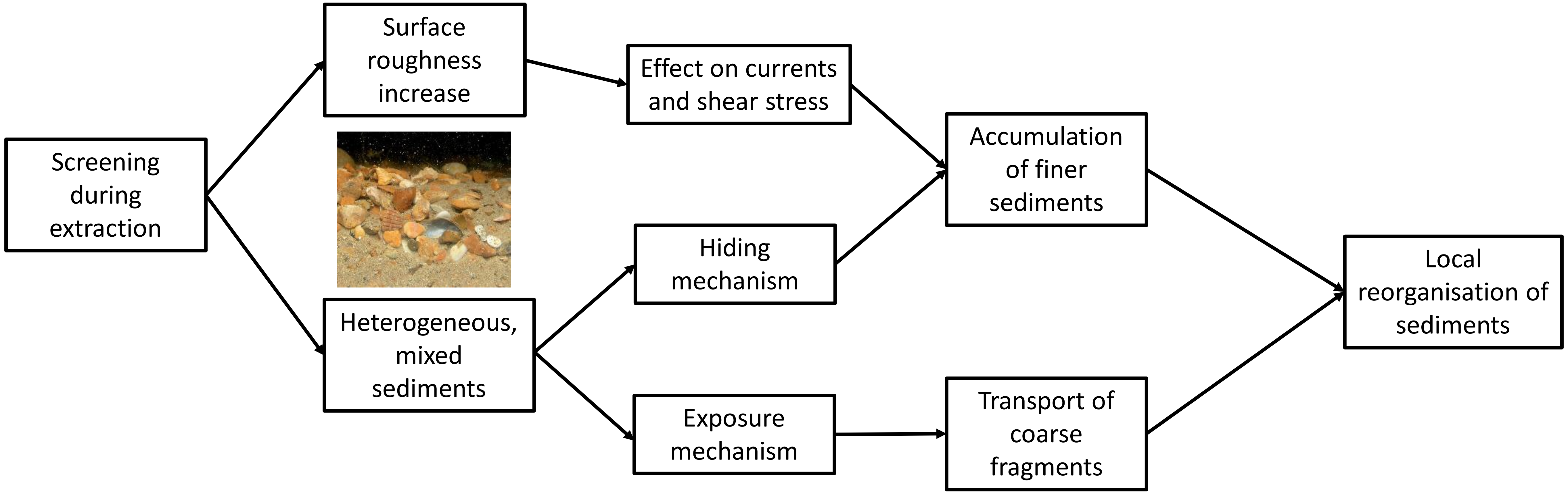
Conclusion

- Bathymetry does not recover after extraction ~ no infill of depressions
  - Confirms earlier results on Kwintebank
- Buiten Ratel has largely recovered after 4 to 8 years both physically and biologically:
  - Gradual changes in sediments (homogenisation and fining) resembling reference conditions likely the result of a local redistribution of sediments
  - Large-scale sand waves have not recovered (yet?), but small-scale sand ripples reappear indicating that natural dynamics are at play
  - Benthic community gradually shifted to reflect reference conditions i.e. *Nephtyscirrosa* community
- Thorntonbank did not (yet?) recover after 3 years, but first trends indicate similar processes as on BR:
  - Fining and homogenization of sediments driving the immediate shift in benthic community
  - Smoothing out of dredging furrows but for the moment no reappearance of small-scale morphology
  - Longer follow-up in time needed to see further evolution
  - Secondary impact of nearby extraction?



Hypothesis on seabed recovery process

- Results indicate that at both areas, a similar process regarding sediment reorganisation is at play
- Hide – exposure mechanism could aid recovery process:



- Local hydrodynamics and depth are probably key in the success of this process
- Further research e.g. in areas without screening or with different hydrodynamic conditions is needed to confirm or reject this hypothesis

THANK YOU!

Special thanks to: BELSPO and RBINS (OD Nature) for ship time on RV Belgica, crew of RV Belgica, VLIZ and DAB Vloot for ship time on RV Simon Stevin, crew of RV Simon Stevin, Hans Hillewaert for pictures, ILVO colleagues for analysing the samples, MSG RBINS for management of EMS data

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