

Mapping of Coastal Cliff Erosion in Denmark

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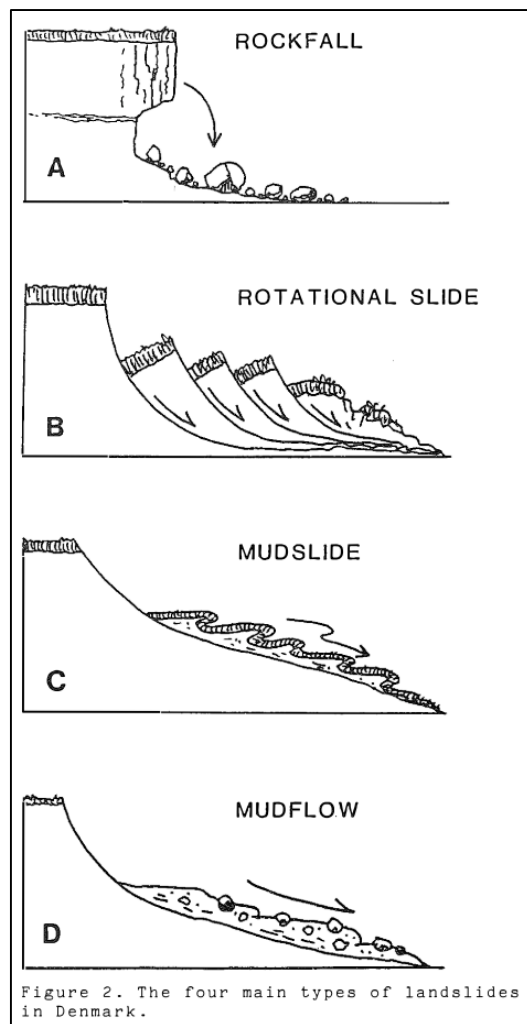


Geological Survey of **
Denmark and Greenland

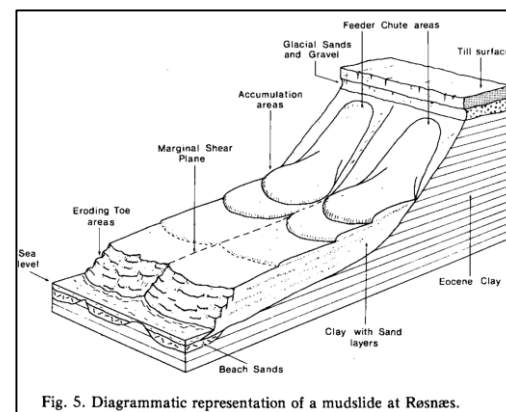
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Background



Pedersen et al. (1989)

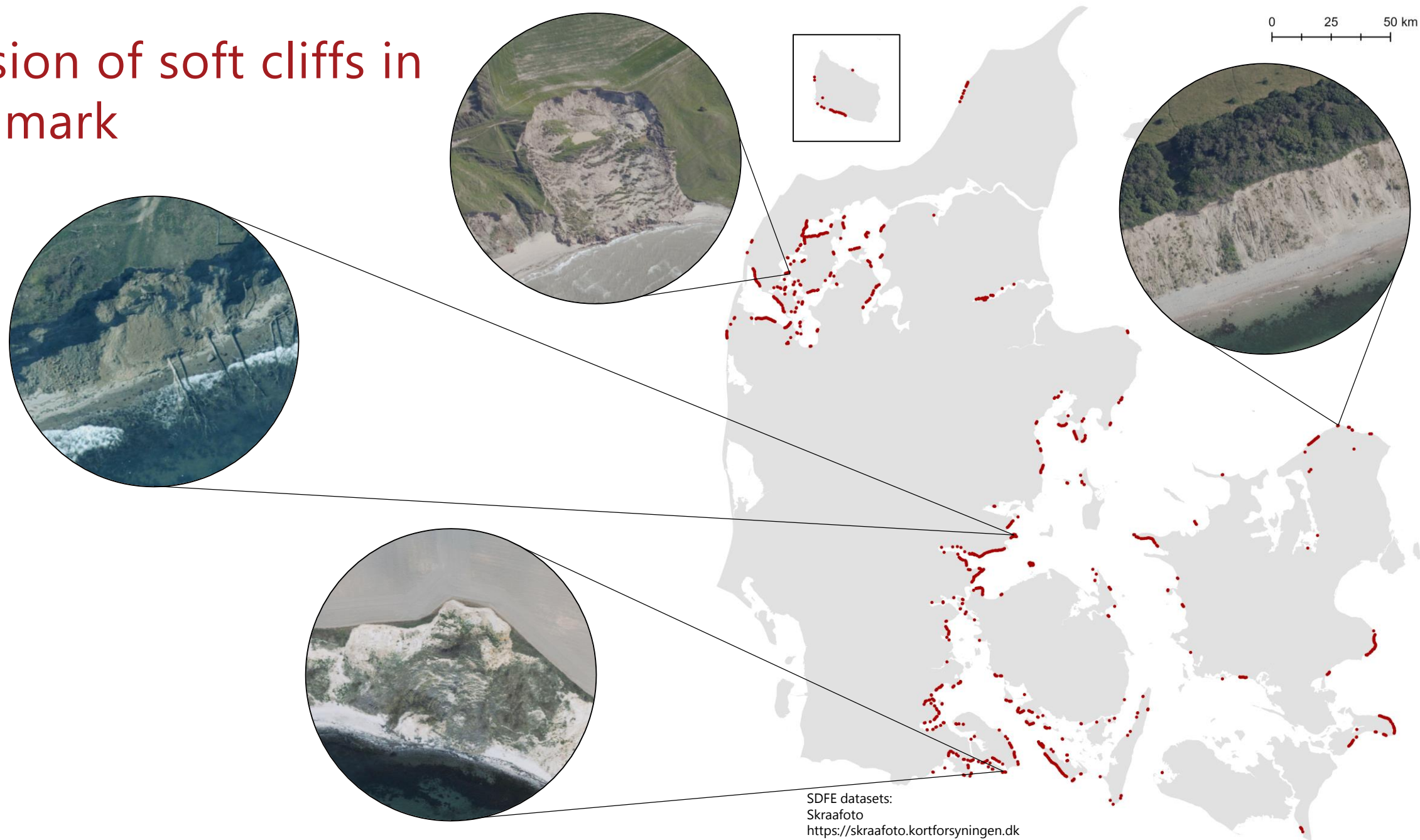


Prior (1977)

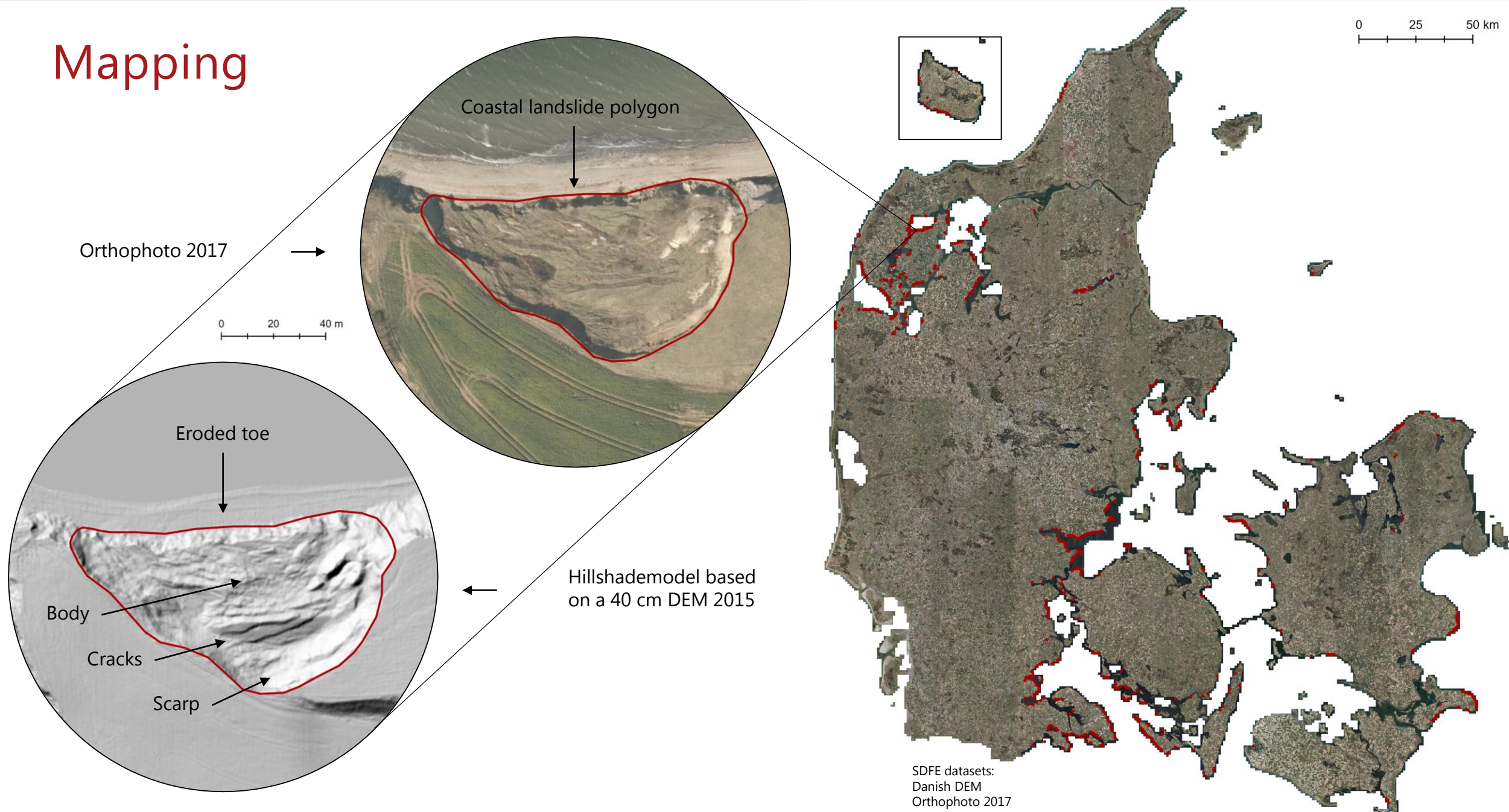
→ **First comprehensive study of Coastal Cliff Erosion in Denmark**



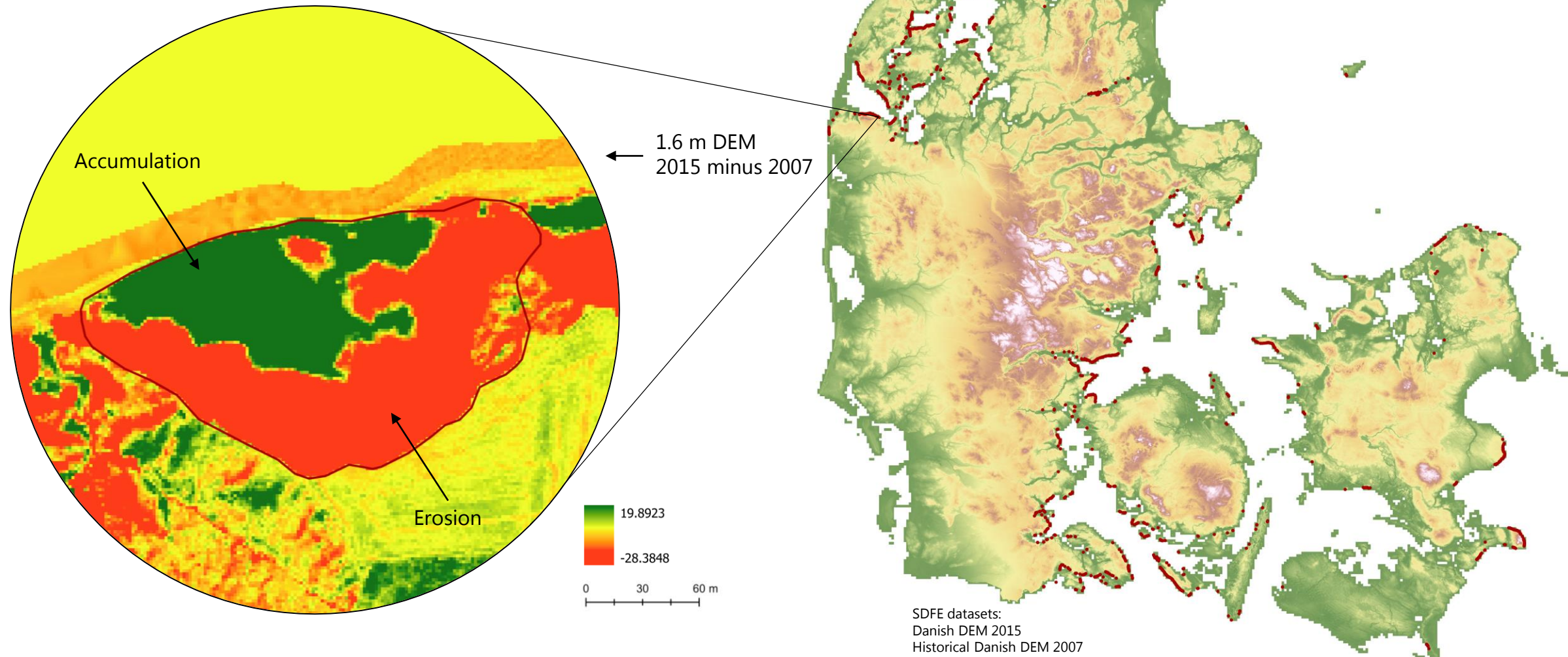
Erosion of soft cliffs in Denmark



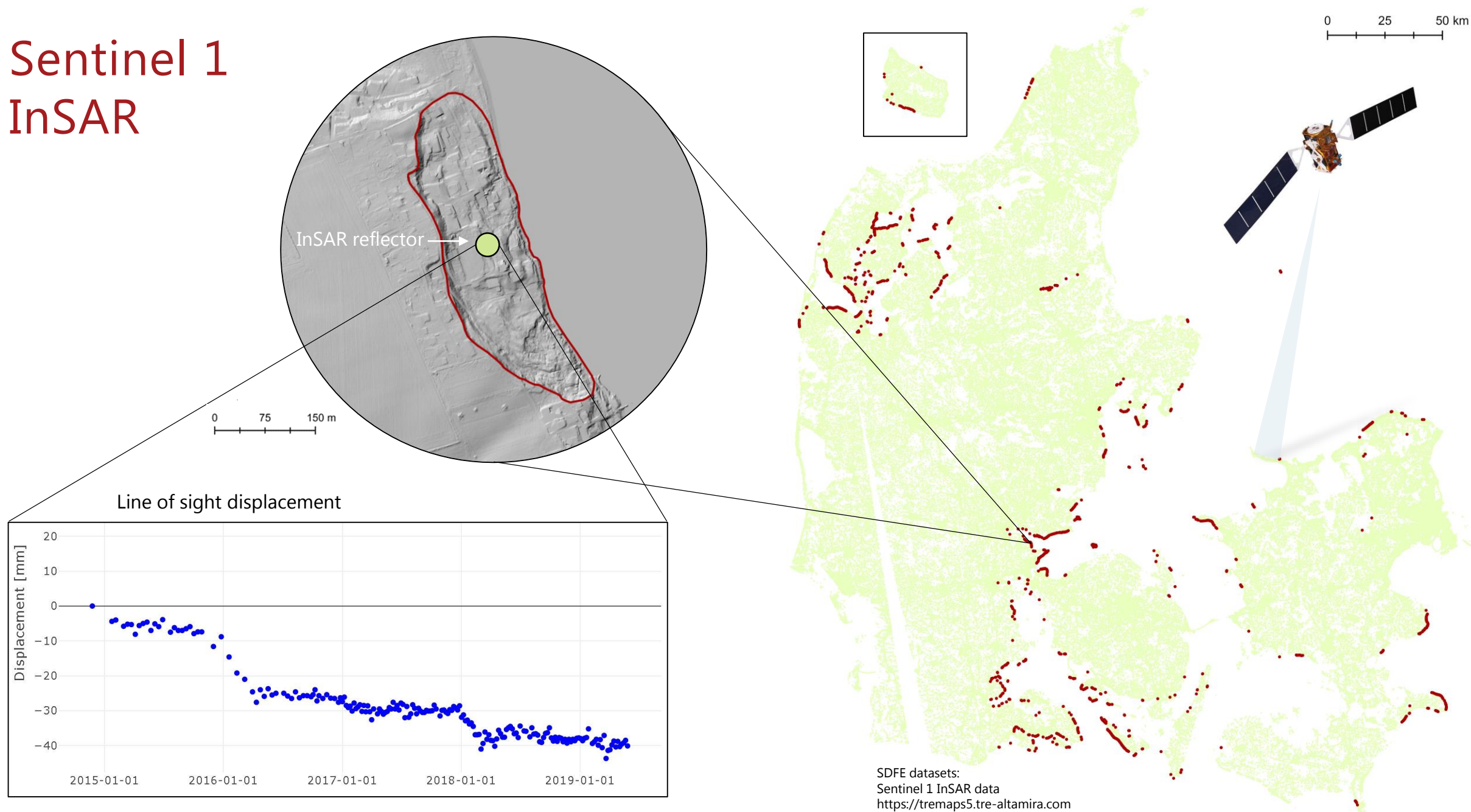
Mapping



Digital Elevation Model of Difference (DOD)

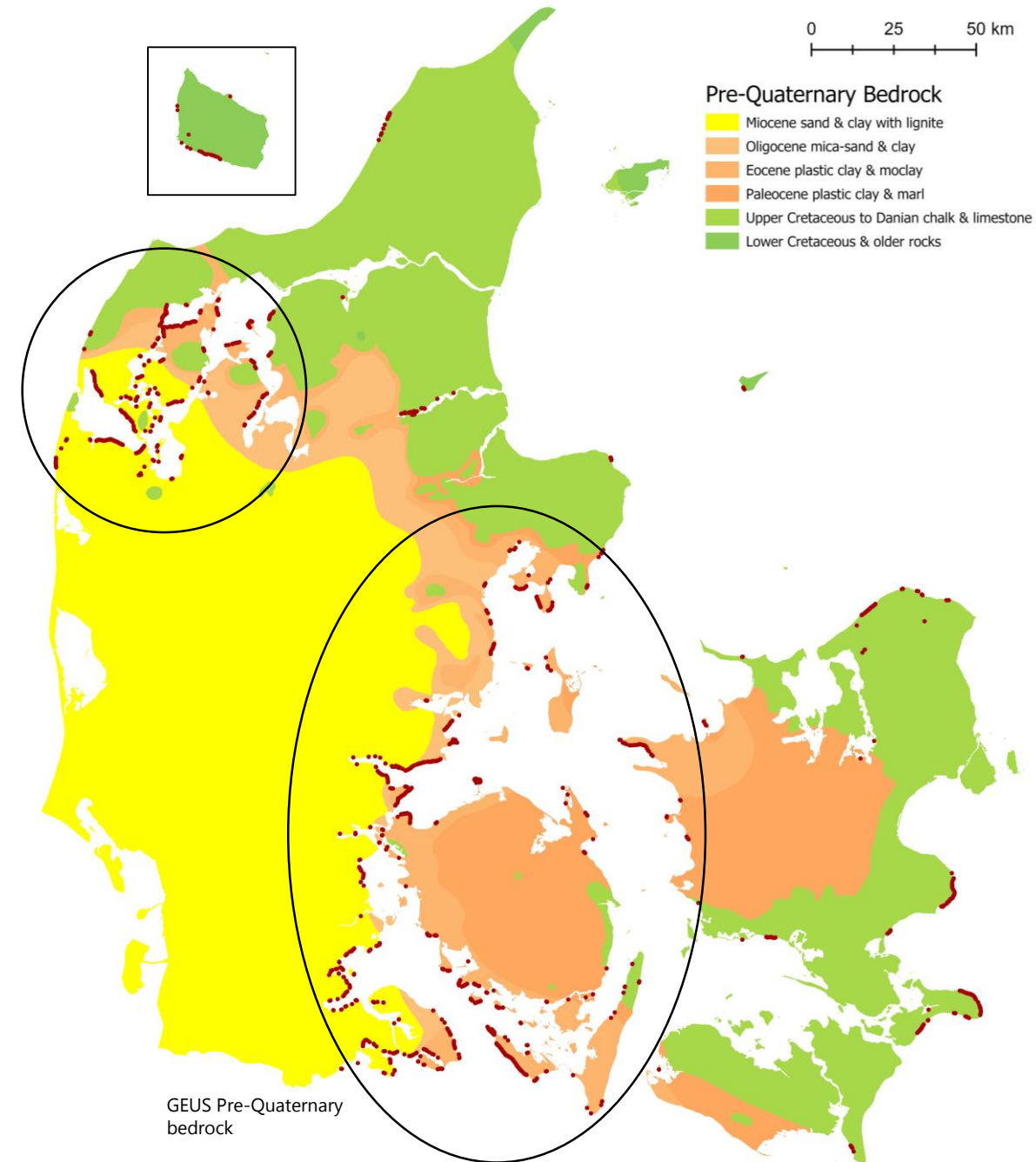


Sentinel 1 InSAR



First Results

- Investigation of cliffs along all Danish coasts
- **~2500 mapped coastal landslides**
- Erosion rates up to 20 m in 30 years (1.5 m/year)
- Sliding seems to be the predominant process
- Neogene & Paleogene clay may be a conditioning factor for cliff erosion
- Rockfall is sporadic and therefore not included in the database



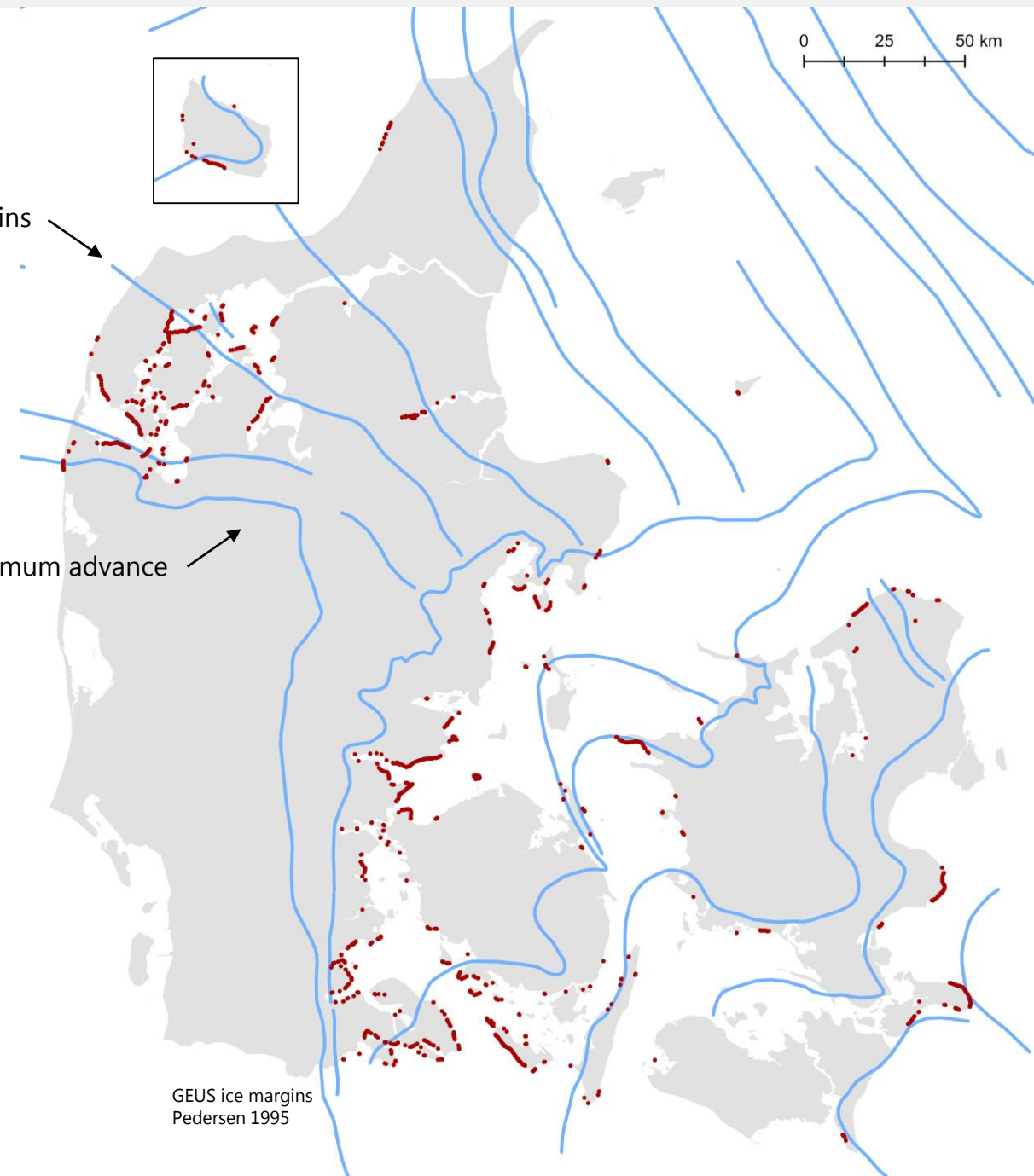
Last Glacial Period

- Coastal Cliff Erosion occurs predominantly in landscapes formed under the Fenno-Scandian ice sheet
- Coastal Cliff Erosion is part of the ongoing evolution of the postglacial landscape

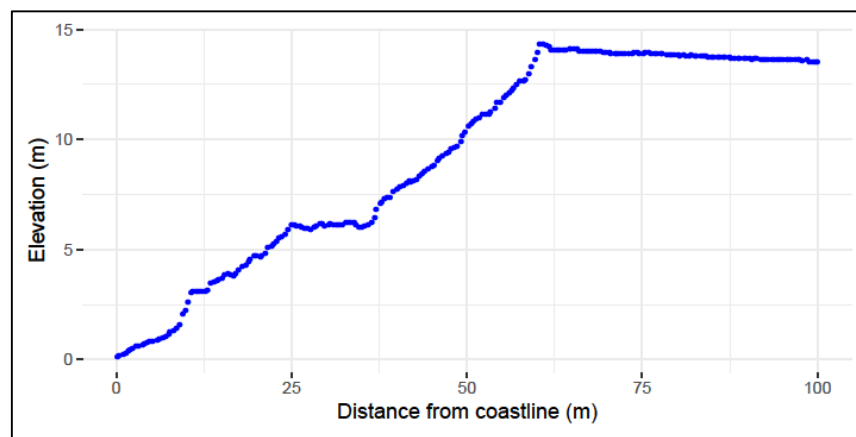
Weichsel ice margins

Maximum advance

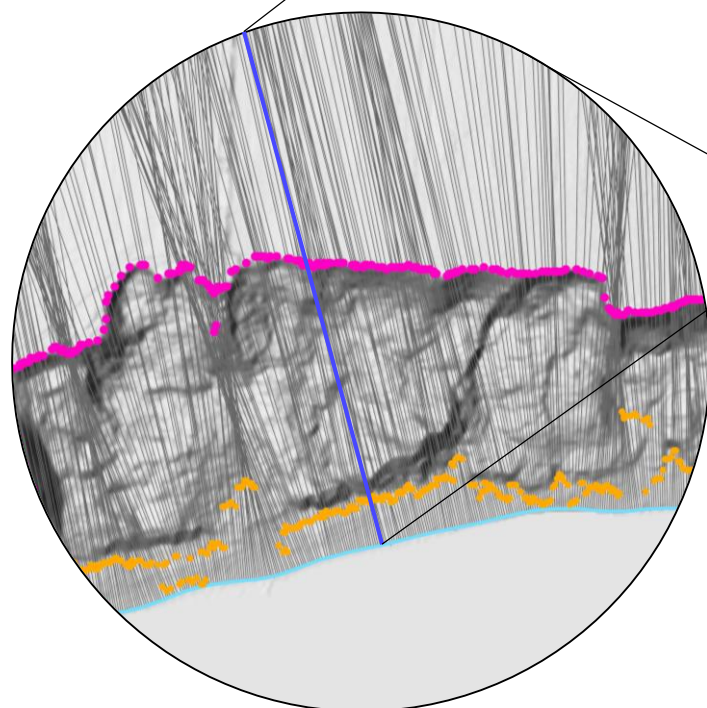
GEUS ice margins
Pedersen 1995



Cliff Metrics



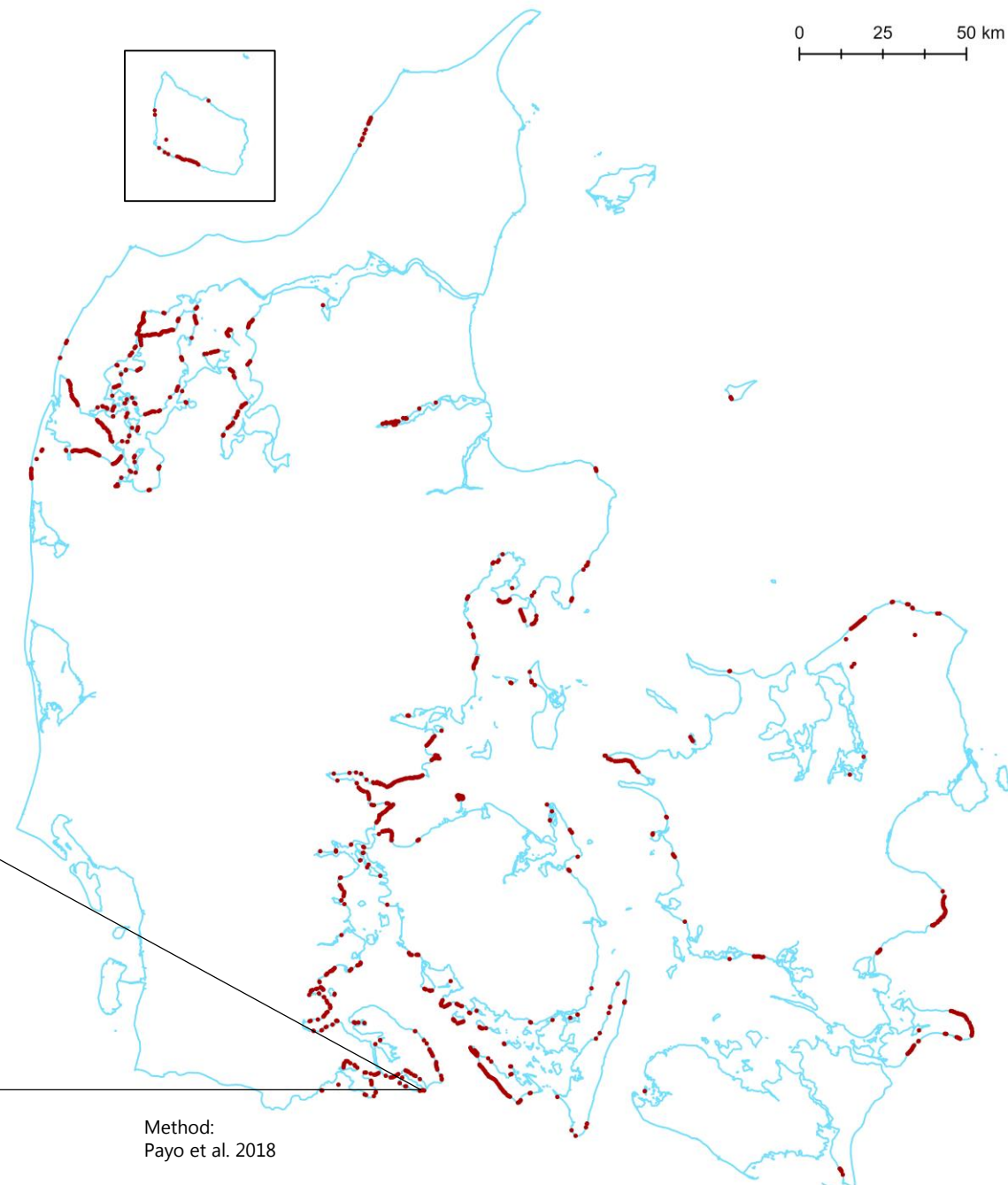
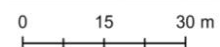
Automated delineation of cross-shore profile



← Cliff top

← Cliff toe

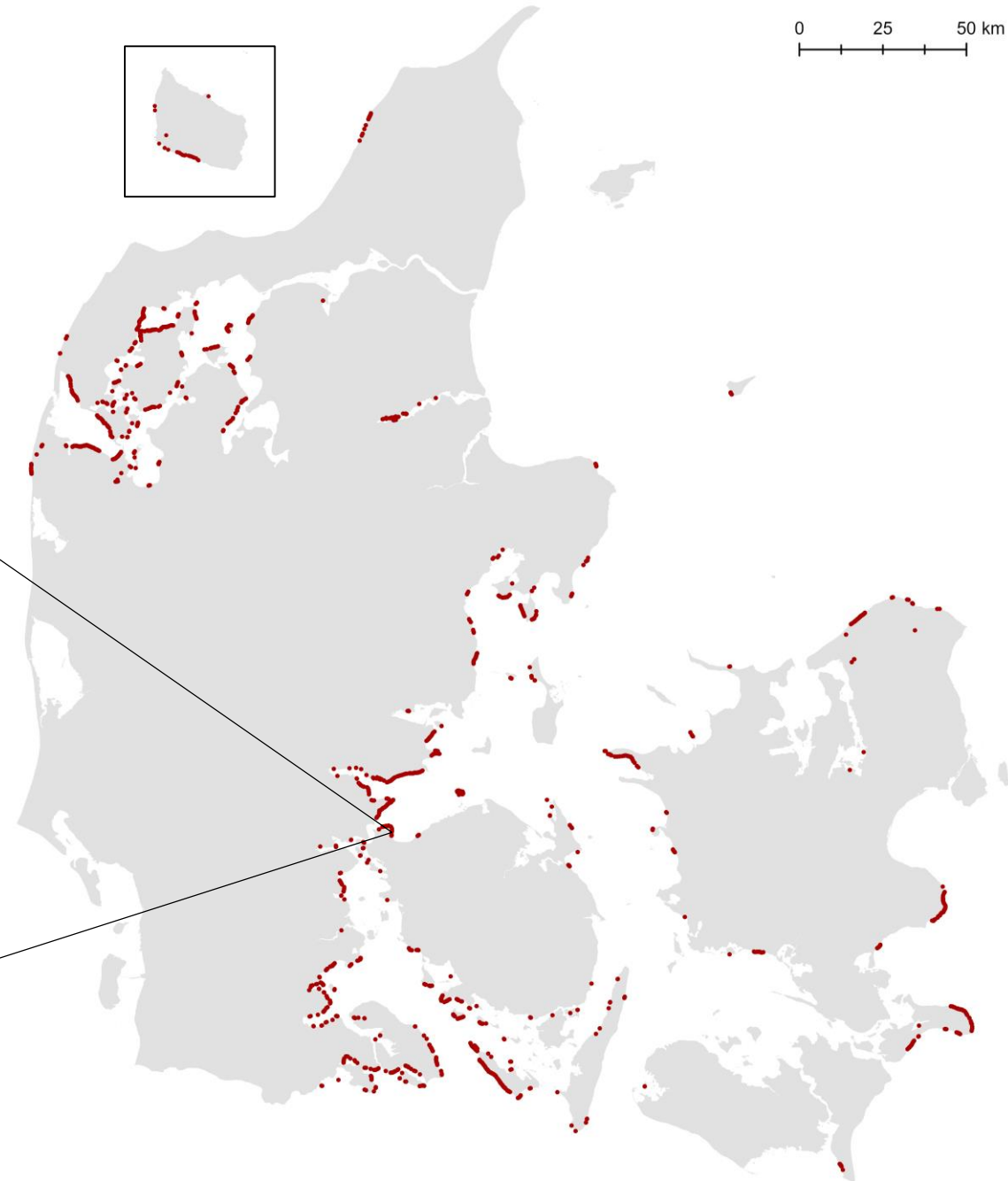
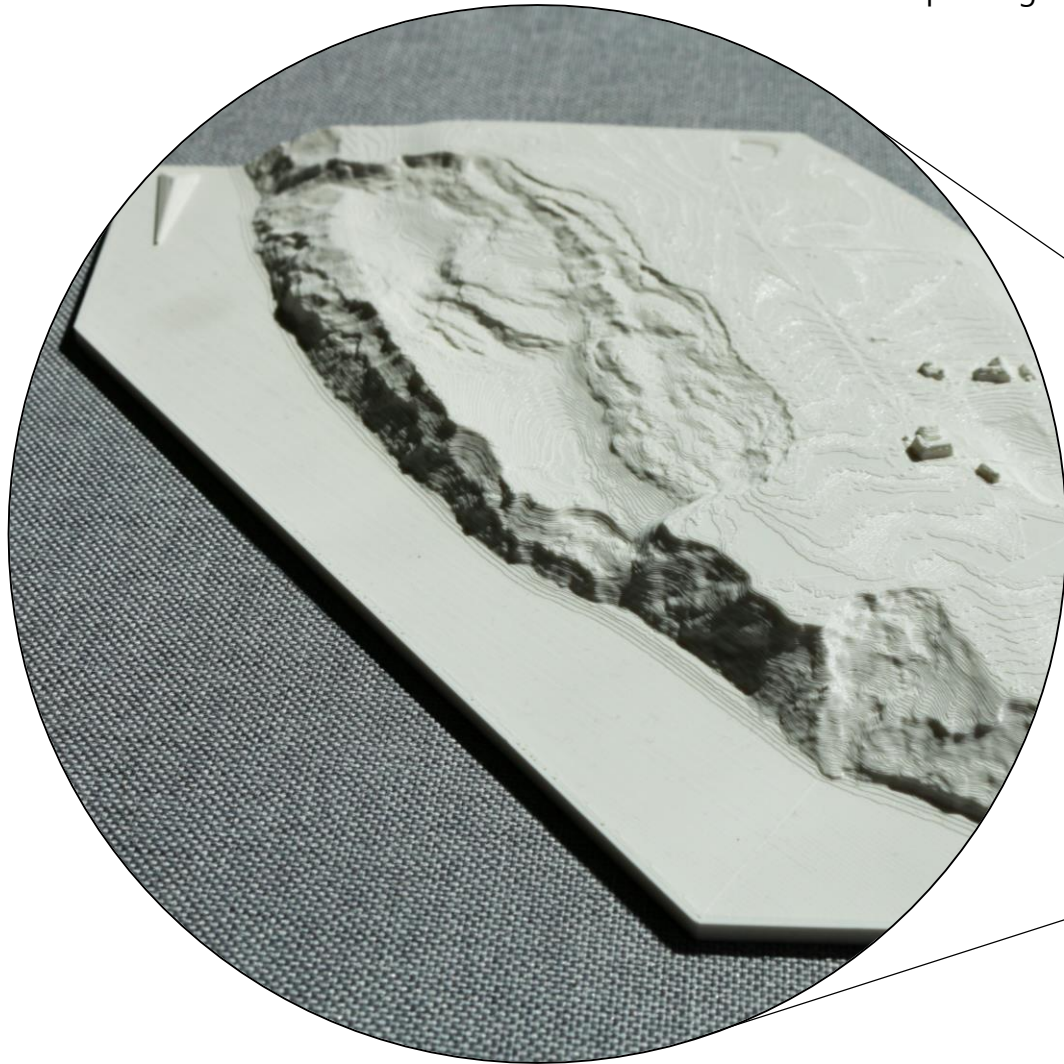
← Coastline



Method:
Payo et al. 2018

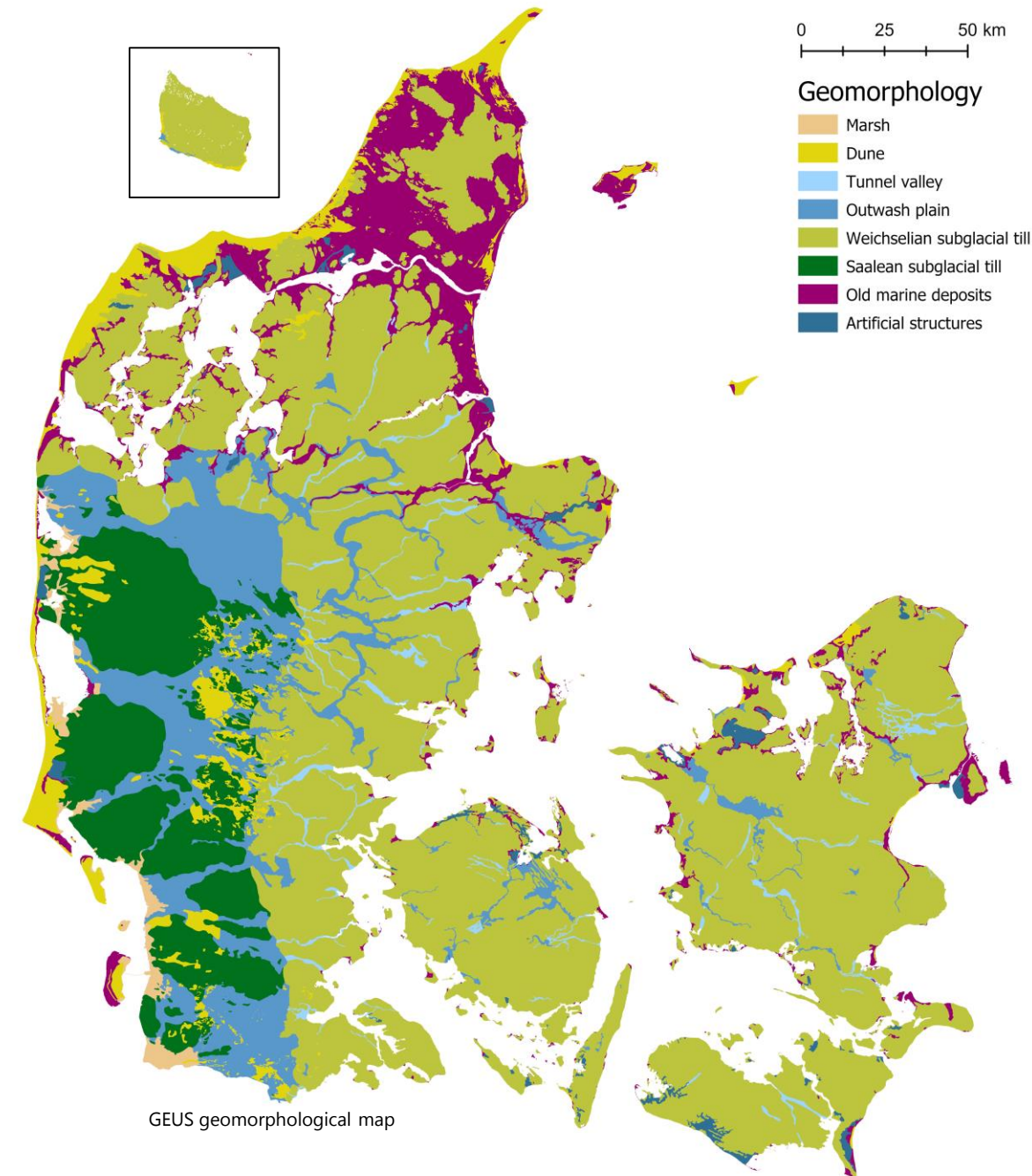
3D printing

Making cliff erosion
experientable with
3D printing



Next steps

- Descriptive and statistical analysis of coastal cliff erosion
- Detailed analysis of preconditioning and driving factors of slope failure on selected field sites
- Linking hydrological, meteorological and geological datasets to coastal cliff erosion on a national scale
- Development of a predictive model for coastal cliff erosion



Literature & Acknowledgments

Geological Survey of Denmark and Greenland (GEUS) Soil map of Denmark 1:200.000, LGP Ice Margins map, 3D printing

Payo, A., et al. (2018). "Development of an automatic delineation of cliff top and toe on very irregular platform coastlines (CliffMetrics v1.0)." *Geoscientific Model Development* 11(10): 4317-4337.

Prior, D. B. (1977). "Coastal Mudslide Morphology and Processes on Eocene Clays in Denmark." *Geografisk Tidsskrift-Danish Journal of Geography* 76(1): 14-33.

Schack Pedersen, S. A., et al. (1989). *Extent and economic significance of landslides in Denmark, Faroe Islands and Greenland. Landslides: Extent and Economic Significance*. Rotterdam, Brabb & Harrod.

The Danish Agency for Data Supply and Efficiency (SDFE) Danish DEM (2015), Danish historical DEM (2007), Orthophoto (2017), Skraafoto 2019, Sentinel 1 InSAR data 2015-2020



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