Projections and uncertainties of sandy beach loss due to sea level rise at the European scale

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Problem

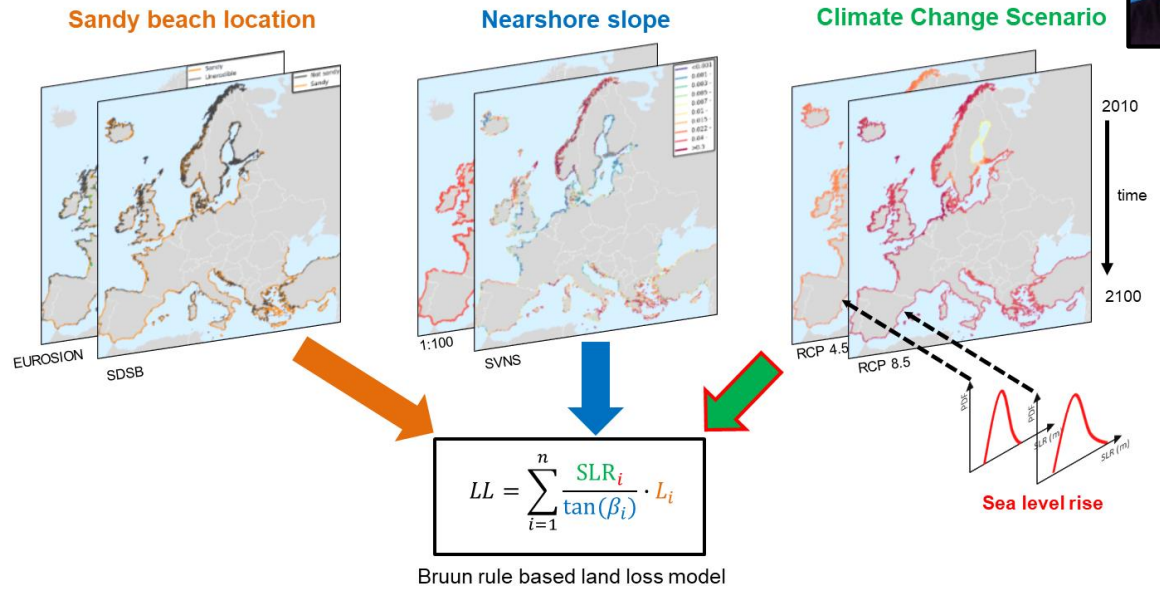
- Almost **41%** of European Union's population lives near the coast
- Big part of European coastline comprises **erodible sandy** stretches
- **Sea Level Rise** will cause **shoreline retreat**
- Need to identify **vulnerable coastal areas** to focus adaptation measures
- Quantify **uncertainties** in large scale assessments relative to **geophysical datasets** choices.

Methods

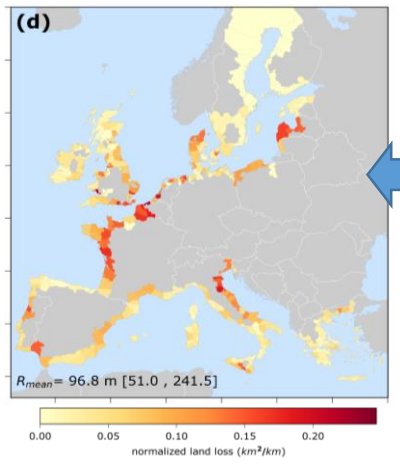
- **Bruun rule** erosion model using different available geophysical datasets
- **Probabilistic Sea Level Rise** regional projections[1]
- **Sandy beach location** from EUROSION[2] and SDSB[3]
- **Nearshore slopes** as constant (1:100) and from SVNS[4]
- Uncertainties quantification with a variance-based sensitivity analysis using **Sobol indices**

Results

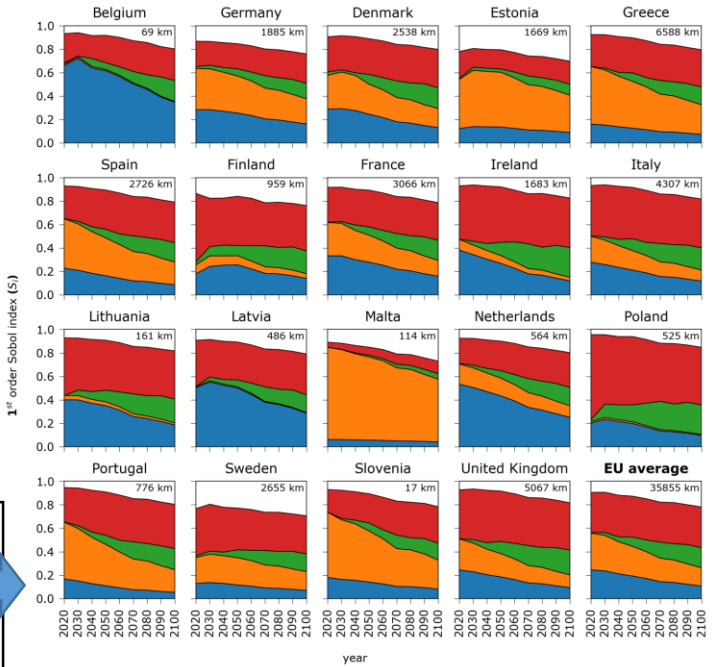
- European averaged median potential shoreline retreat of **97 m (54 m)** is projected under **RCP 8.5 (4.5)** by year **2100**, relative to the baseline year 2010
- This retreat would translate to **2,500 km² (1,400 km²)** of potential land loss
- Highly vulnerable regions are identified on the Italian Adriatic coast, the French Atlantic coast, Belgium, The Netherlands, Denmark, Lithuania and Latvia
- On average epistemic uncertainty (connected to data and methods) accounts for **45% (26%) by 2050 (2100)**



Bruun rule based land loss model



Normalized land loss (relative to coastal length) for NUTS3 regions at 2100 under RCP 8.5 for the SVNS and SDSB geophysical data combination



Temporal distribution of the relative contribution to the variance of the land loss of each EU country during the present century. Colors from bottom to top: nearshore slopes, sandy beach location, RCP, SLR, interactions

Deltares
Enabling Delta Life
EUCP
European Climate Prediction system
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References

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2) EUROSION. *Living with coastal erosion in Europe: Sediment and Space for Sustainability: PART I - Major findings and Policy Recommendations of the EUROSION project, European Commission* (2004).

3) Luijendijk, A. *et al.* The State of the World's Beaches. *Sci. Rep.* **8**, 6641 (2018).

4) Athanasiou, P. et al. Global distribution of nearshore slopes with implications for coastal retreat. Earth Syst. Sci. Data 11, 1515–1529 (2019).