



Climate Change

C3S\_422 Lot2 Deltares – Baltic Sea case study

## Sea level change in future: mapping Danish municipality needs for climate information

**Jian Su**, Kristine S. Madsen, Jens Murawski, Jacob W. Nielsen

*Danish Meteorological Institute*

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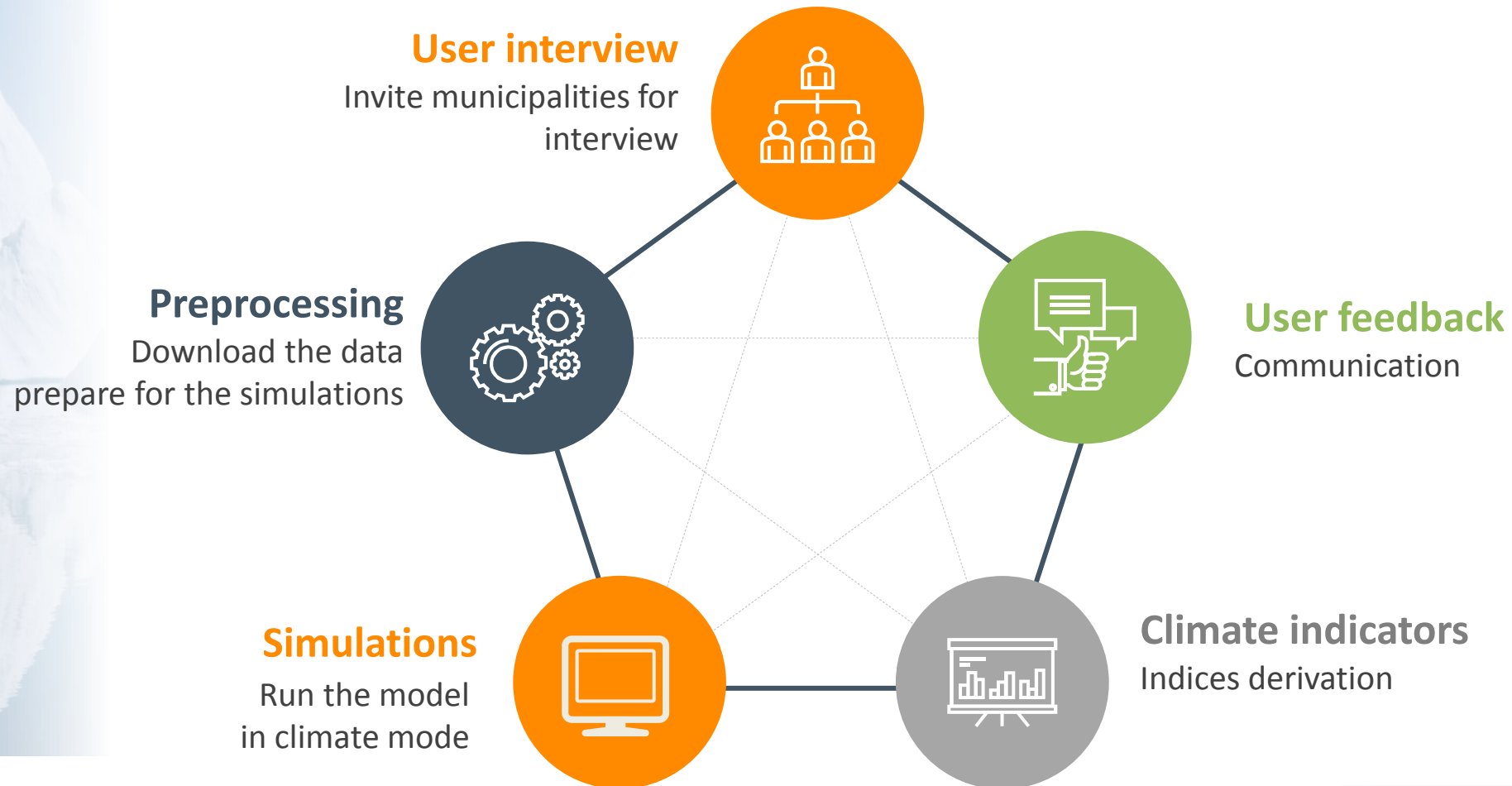




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## W o r k f l o w

# End-to-end user interaction approach



02

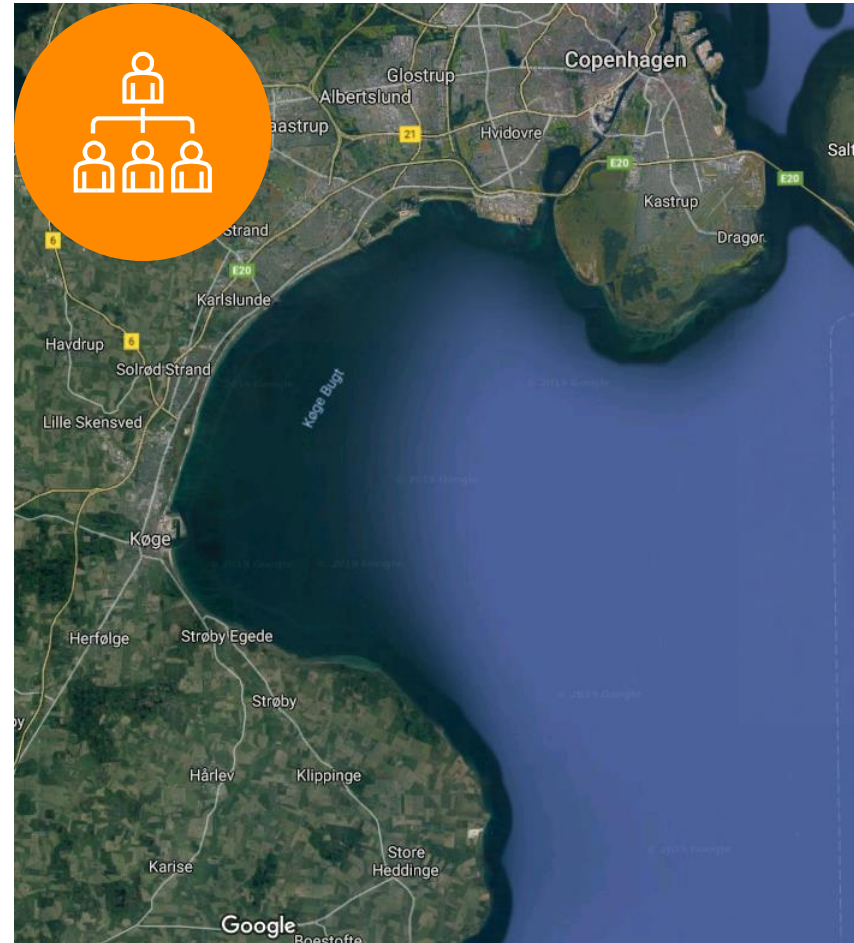


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## Motivation

# Why this study (Why Køge Bay)?

- **Climate change** will affect the coastline of the Baltic Sea.
- In Denmark, a large part of the responsibility for **climate adaptation** lies with the **local municipalities**.
- 10 areas have been selected as flood prone according **to the EU flood directive**. This study focuses on one of the selected areas, Køge Bay.



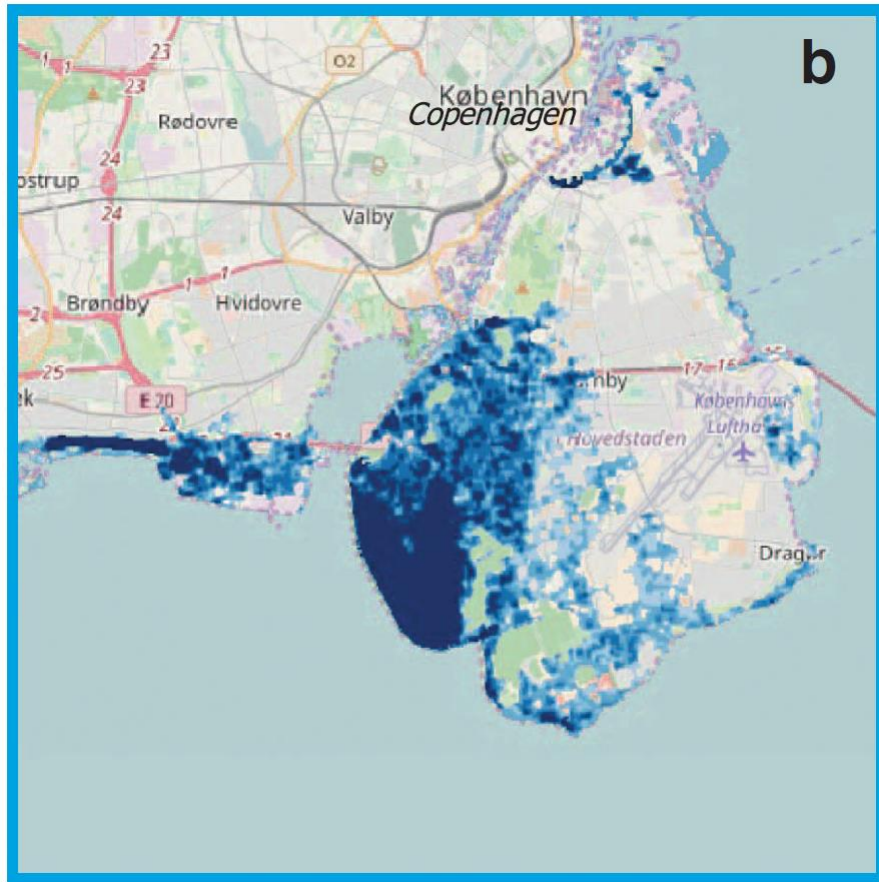


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## Problems

# Inundation depth (m) associated with 2m flood



03



DMI  
Vejr, klima og hav

(Prahl, et. al, *Scientific Data*, 2018)





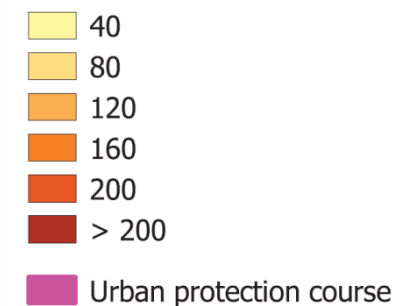
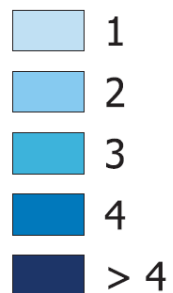
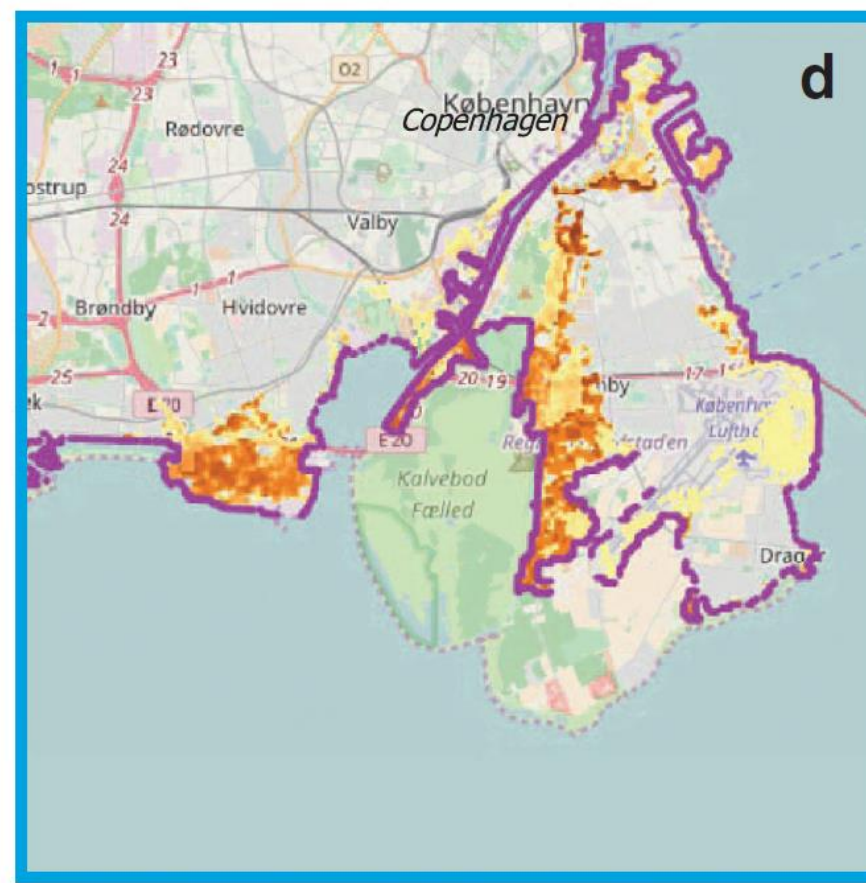
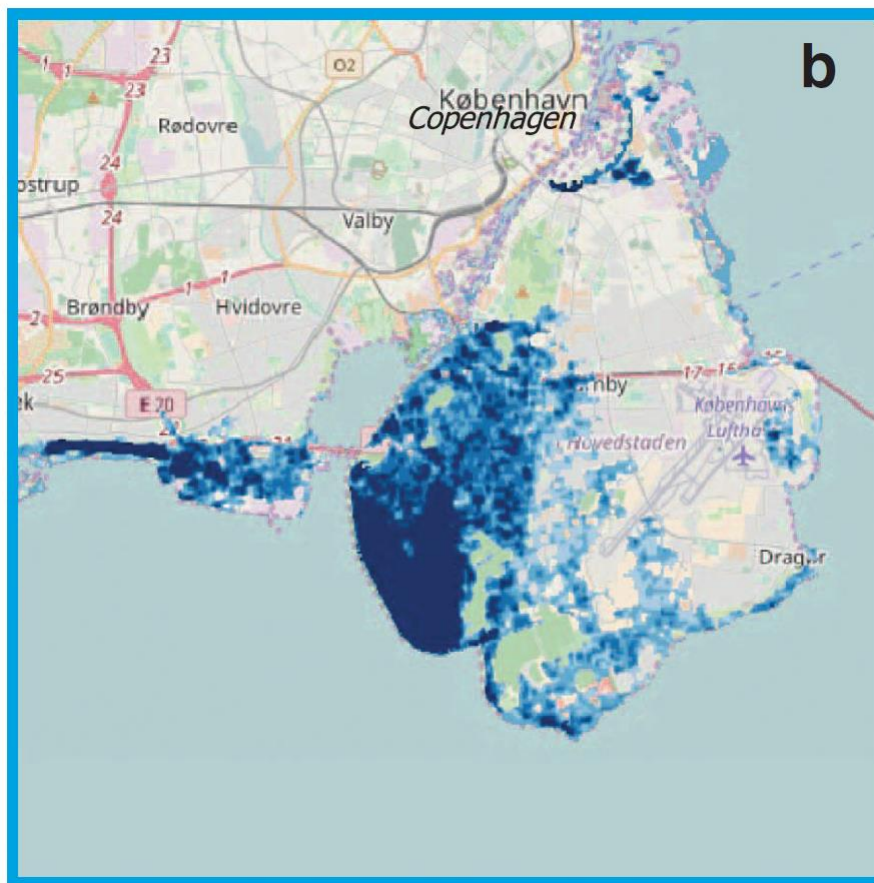


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## Problems

# Damage cost (€/m<sup>2</sup>) associated with 2m flood



DMI  
Vejr, klima og hav

(Prahl, et. al, *Scientific Data*, 2018)





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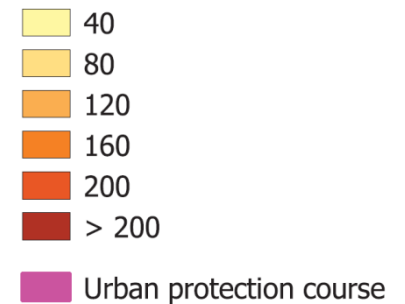
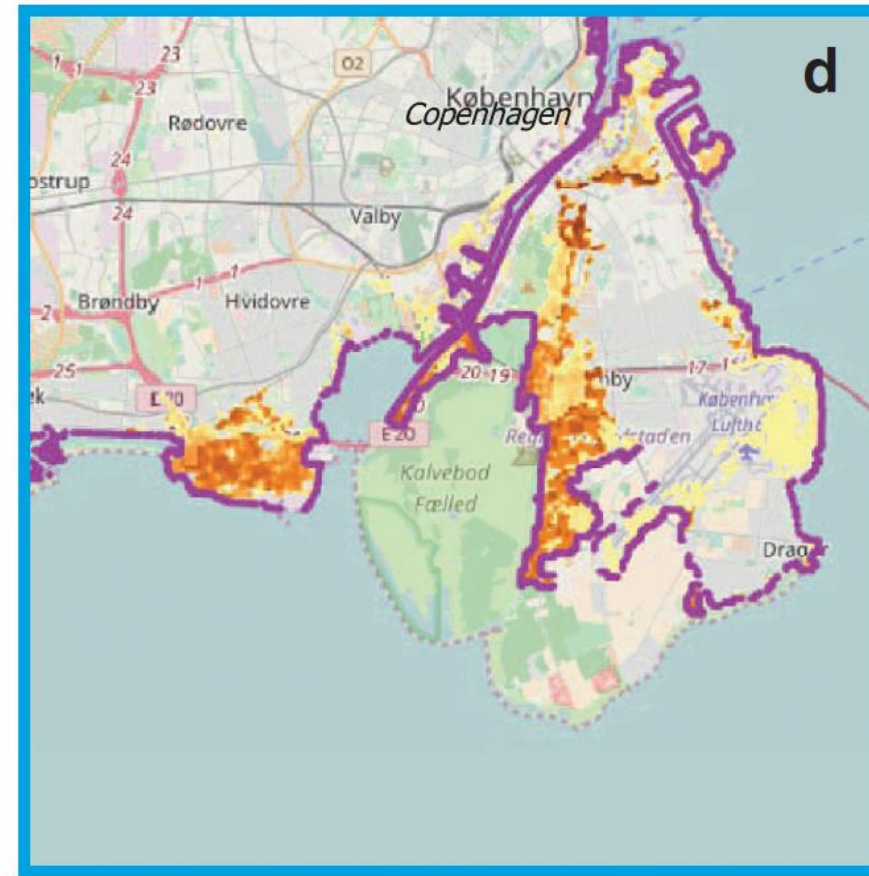


# Problems

## The solution – Dike 1.5m



Dragør



03



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## Problems

**Risk perception in Denmark related to storm surges:  
Is **LOW** amongst individuals and in the society as a whole. Why?**

- Events are **rare**
- Floods are often confined to **specific and local areas**, and in areas where floods regularly occur the number of persons and valuables is low
- No **deaths**
- No active communication about **former events**. We have no 1953 Holland, or, 1962 Germany floods to learn from
- Almost no planning measures. Still **a 'wait and see' attitude** (towards SLR and extremes) (cf. Fenger et al. 2008)

04



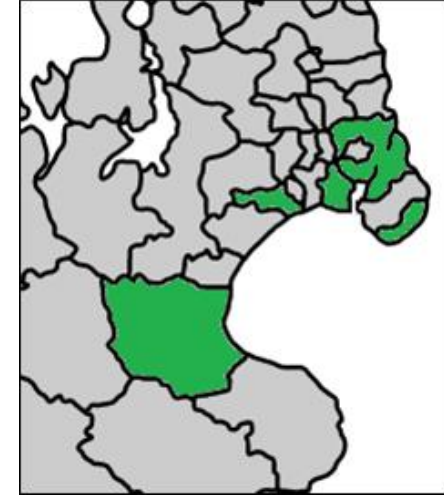
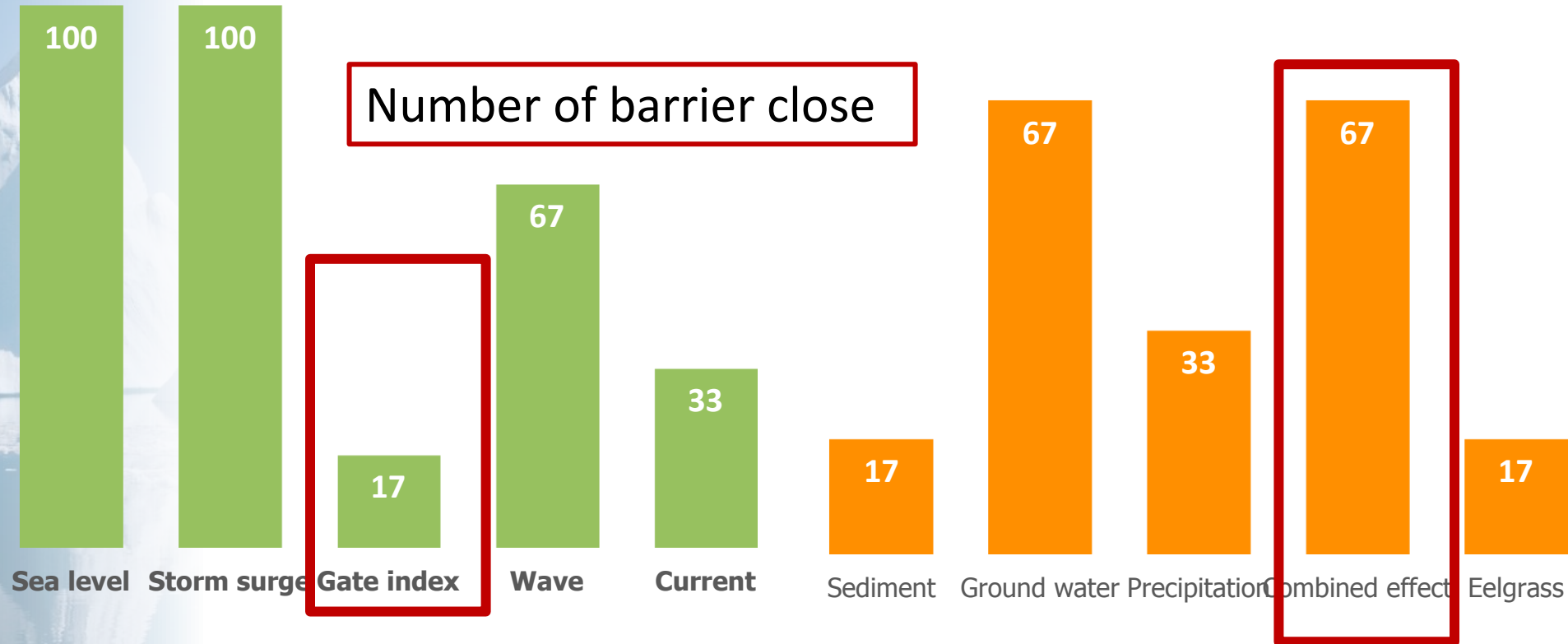


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# Interview

## Interview results



Indices within this project

NOT covered

Climate Data Store (CDS)



DMI  
Vejr, klima og hav

(Madsen et al, *Frontiers in Earth Science*, 2019)







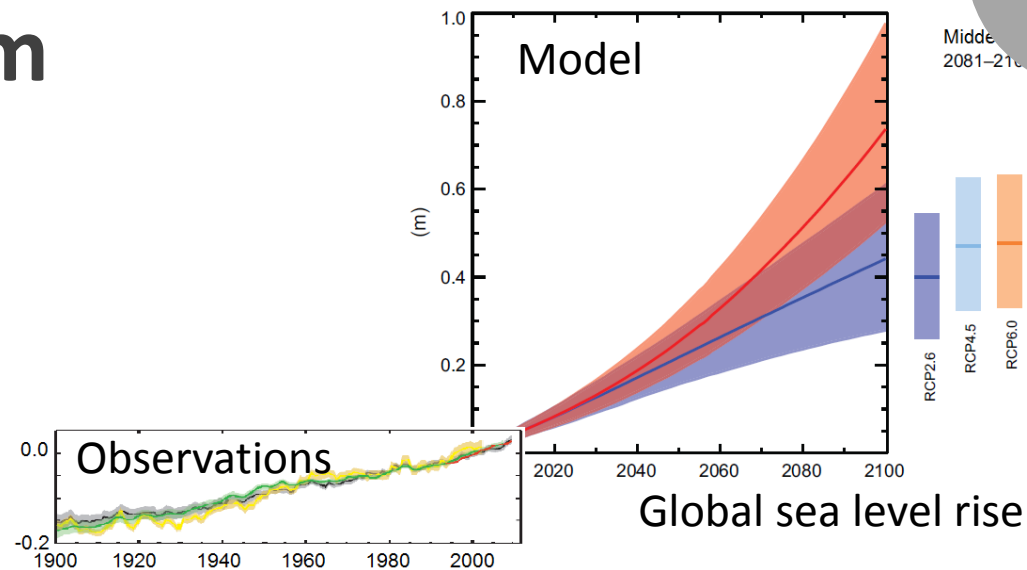
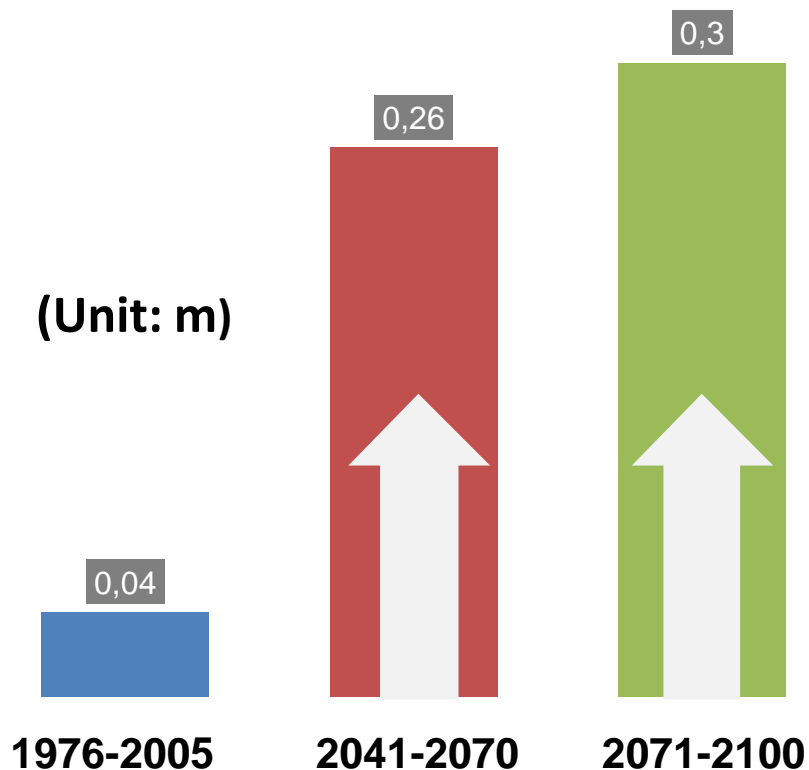
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# Sea level rise

## RCP 8.5 near-term $\uparrow 0.22\text{m}$

(Unit: m)



■ Historical  
■ RCP 8.5  
■ RCP 4.5

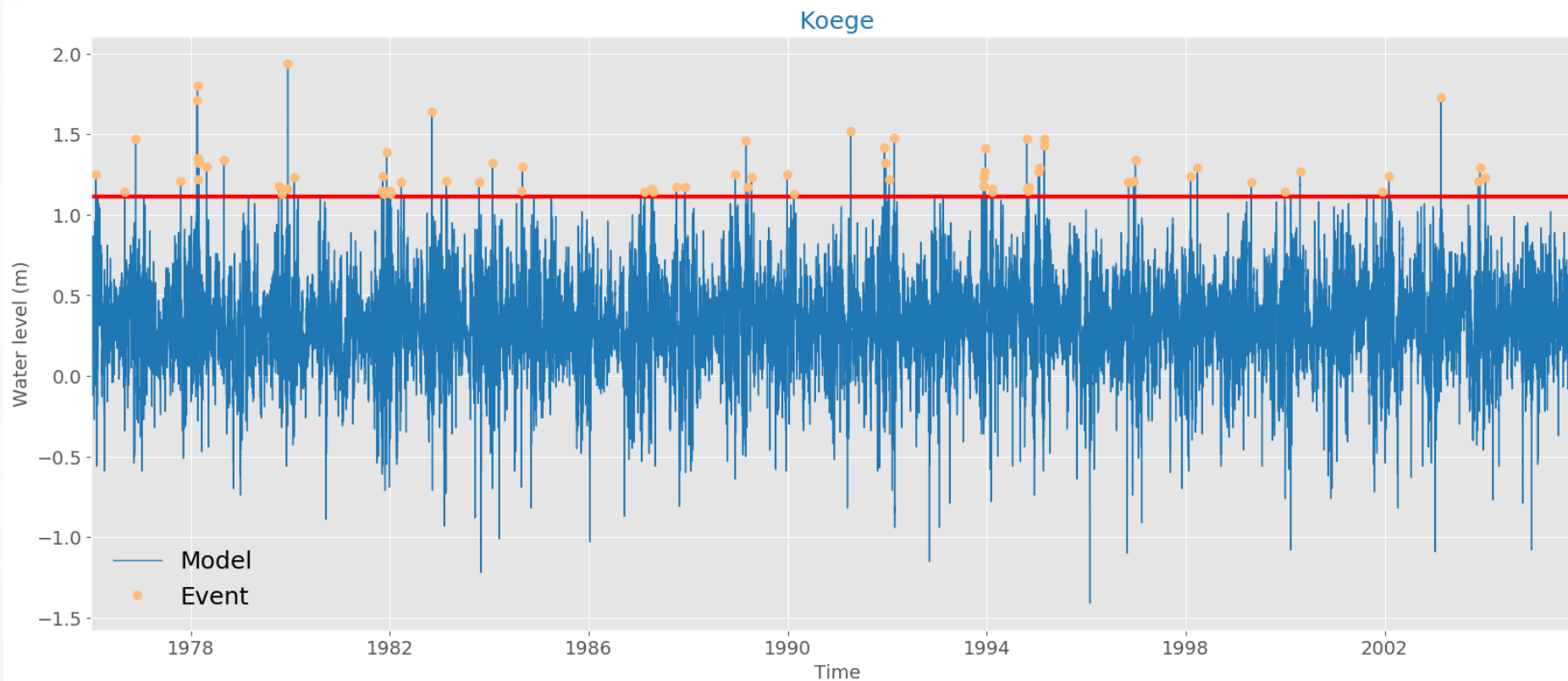


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# Gate index

## Peak over threshold



07



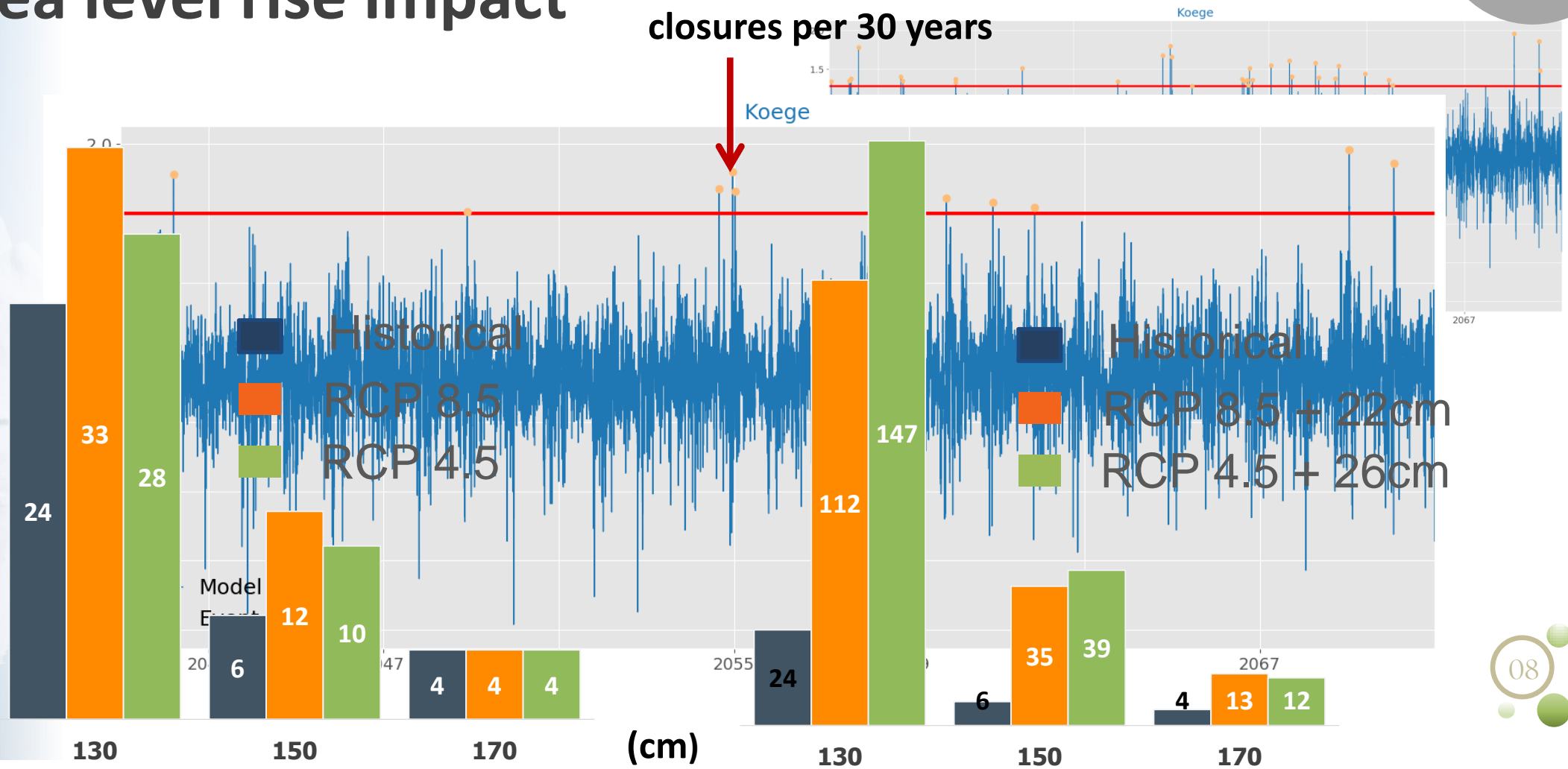
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Gate index

# Sea level rise impact

Unit: Number of  
closures per 30 years



WITHOUT sea level rise

Vejr, klima og hav

WITH sea level rise





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## Feedback



### Main interest

- very **high quality** storm surge warnings
- projections of possible present day and future **extreme sea level and wave heights** for the detailed coastline
- based on modelling of **past storm surges and future changes**
- taking observations and **historical records** into account.

There is a big wish for detailed information and for **authoritative scenarios**, which will help the collaboration between municipalities.



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P e r s p e c t i v e

# Compound effect: storm surge + precipitation



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DMI  
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(Source: Ramboll Studio)

Copernicus  
Europe's eyes on Earth

European  
Commission

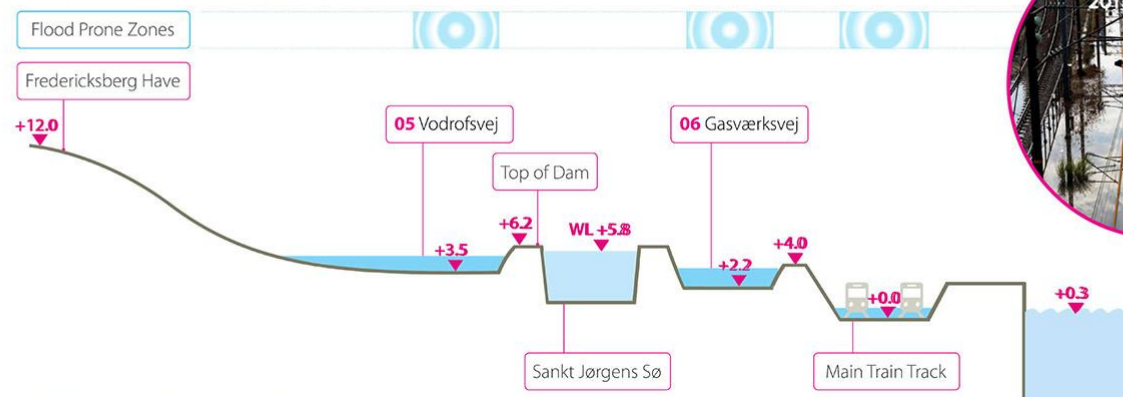


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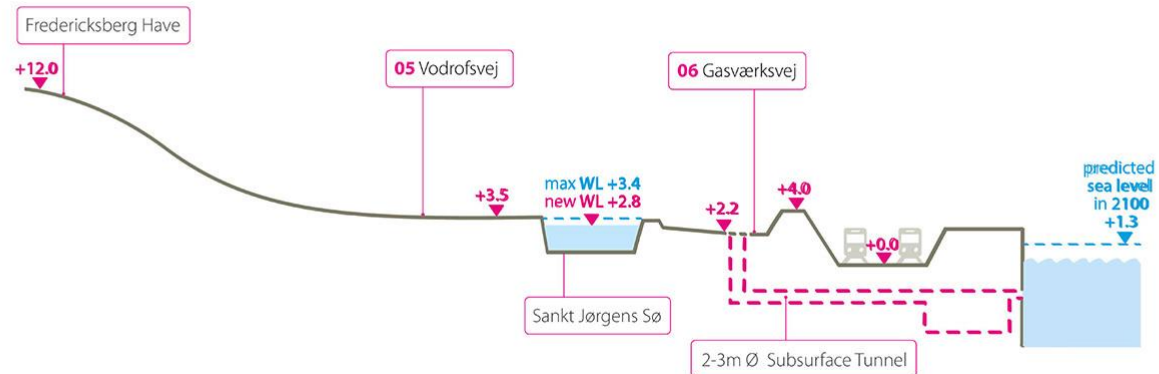


# Perspective

## BEFORE: Barriers



## AFTER: Connections



(Source: Ramboll Studio)



## Danish Climate Atlas

Climate information for the Danish Municipalities (and all other interested)

### Sea level

- Mean sea level changes
- Storm surges (20- and 50-year events and extreme)

### Precipitation

- Mean by season
- Long lasting winter rain and bursts

### Temperature

### Wind



DMI's driveway  
2. July 2011



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## Perspective



### Raising flood risk awareness

- Risk communication at all levels, where historic events play an active role e.g. by **projecting** their water levels/floods on today's society and into **the future**
- People must be **motivated and guided** to take own preventive measures
- A **more pro-active attitude** at governmental and municipality levels towards risk communication
- Sound **integrated planning strategies** based on economic analyses
- **Thinking ahead**

# Thank You

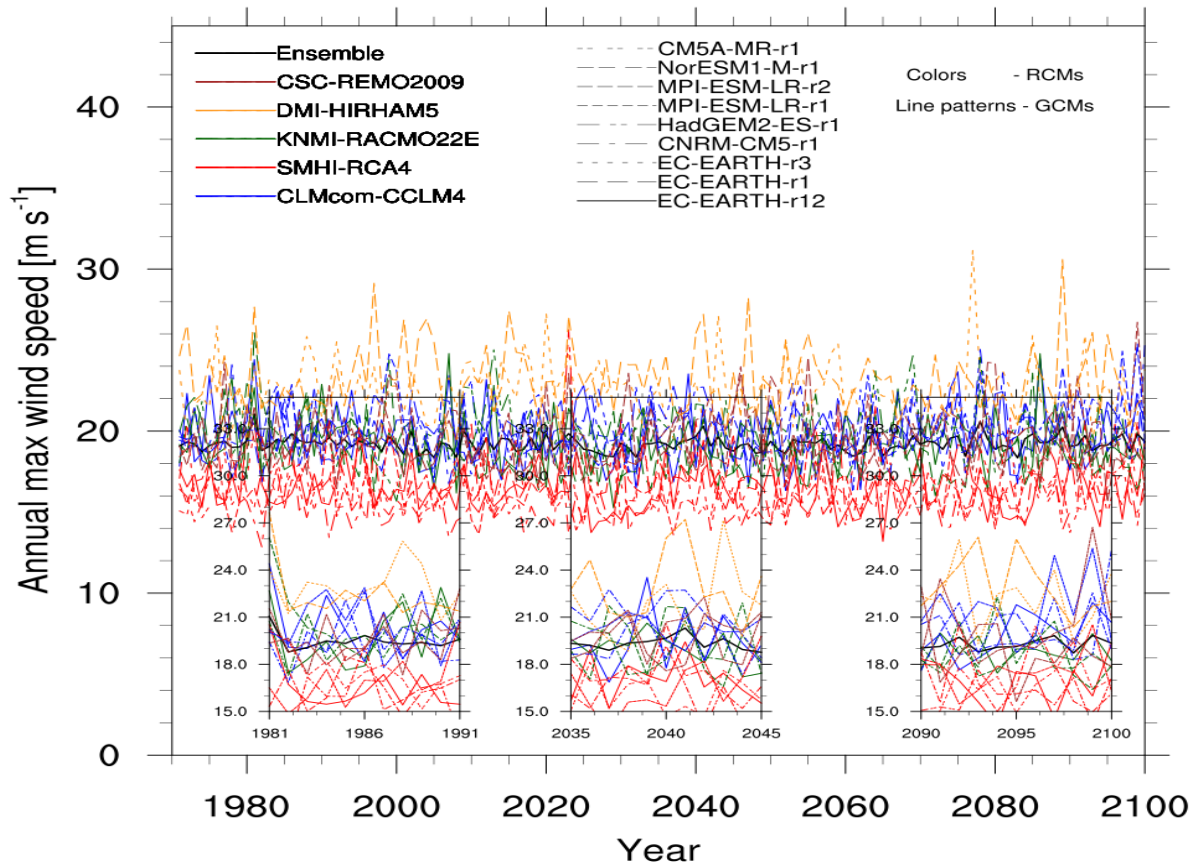
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# Perspective – Ensemble approach (CORDEX)

Time-series of annual max wind speed at Station Koege RCP8.5



Use of an ensemble of scenarios –  
illustration for max wind speed

The spread →

Uncertainty assessment →

Probability of the occurrence of  
certain events