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Incorporating the correlation between upstream inland, downstream coastal and surface boundary conditions into climate scenarios for flood impact analysis along the river Scheldt

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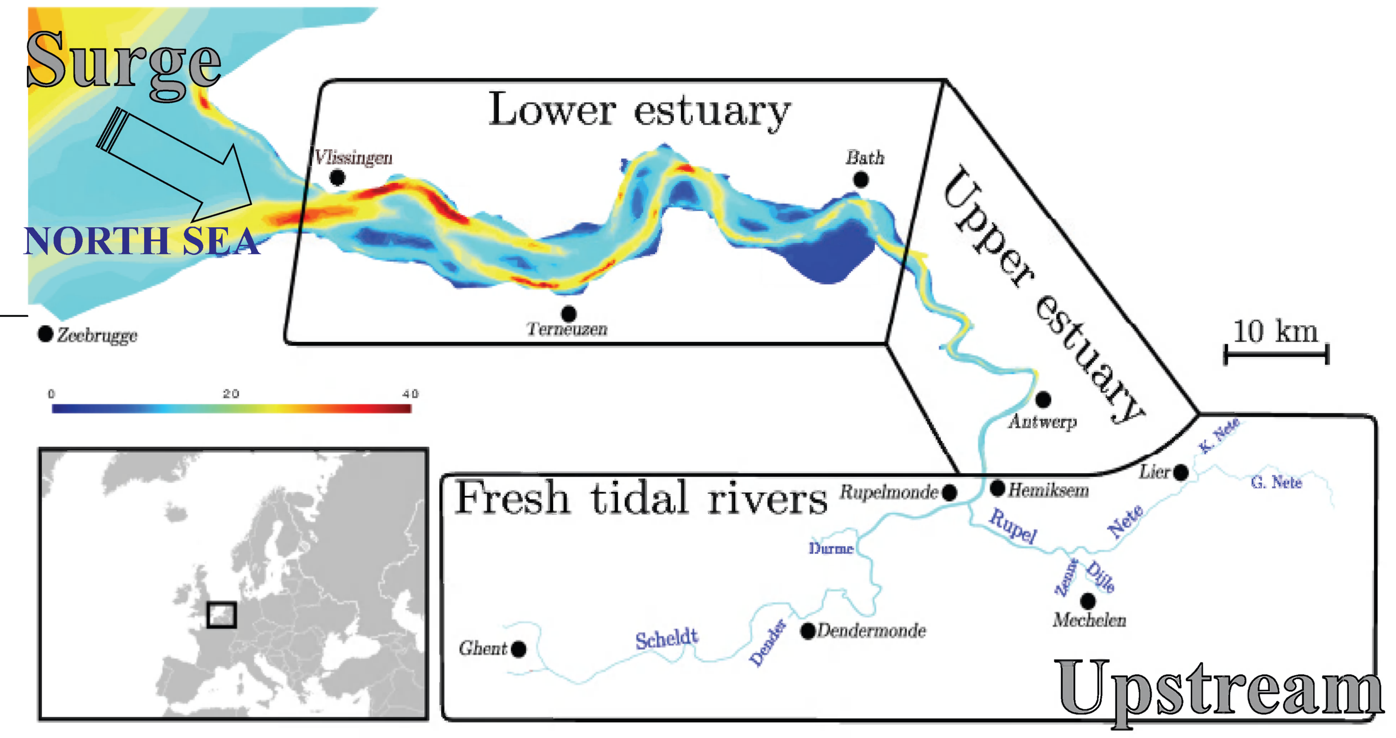
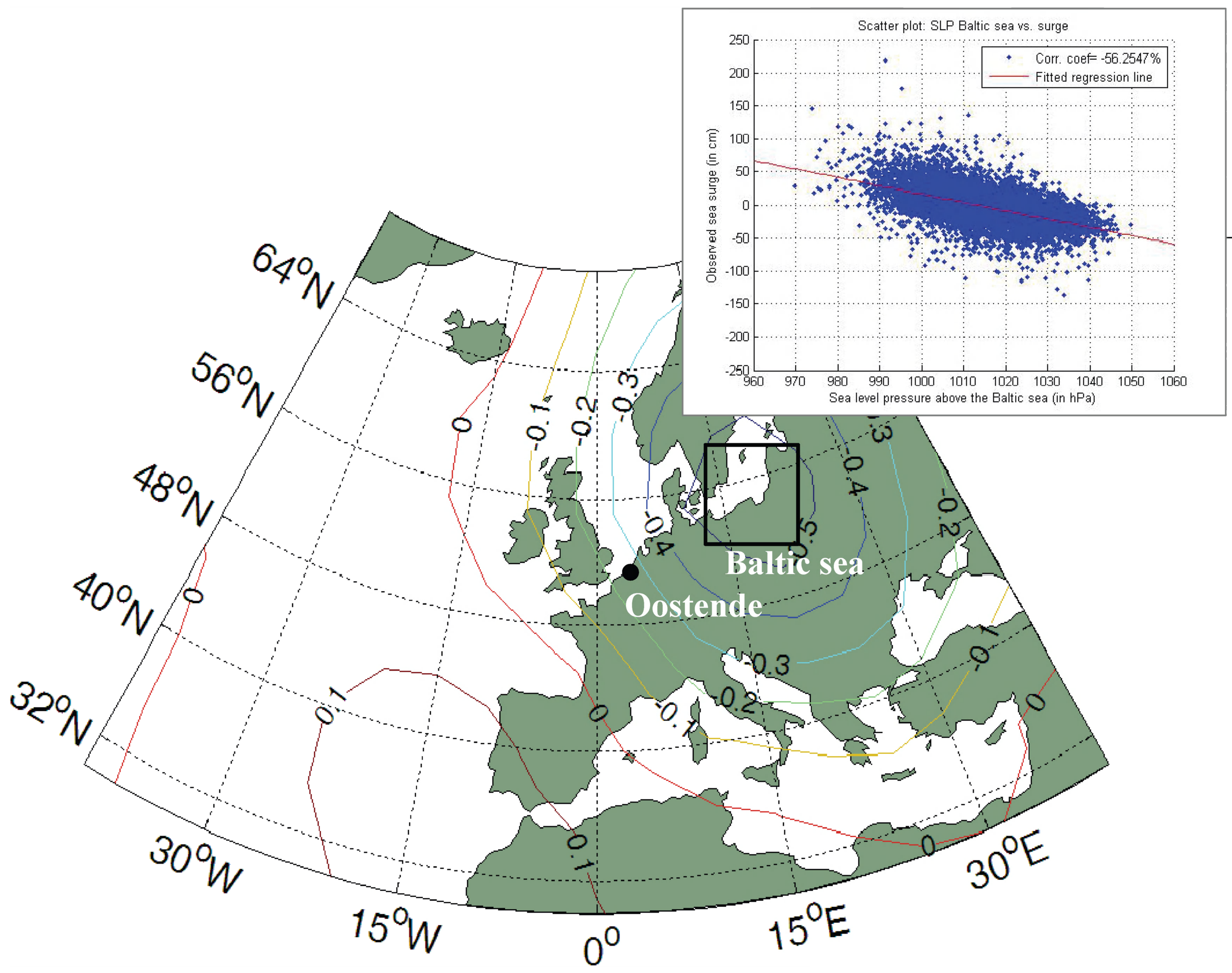
Motivation

There has been increased concern of the potential climate change threats that may negatively impact coastal populations. Increased flooding and erosion may occur because of high sea levels from the North Sea or from high peak flows from the upstream catchments or the combination of the two. Hence, it is instructive to investigate the correlations between upstream and downstream conditions. The Scheldt Estuary in Belgium was selected as a study site.



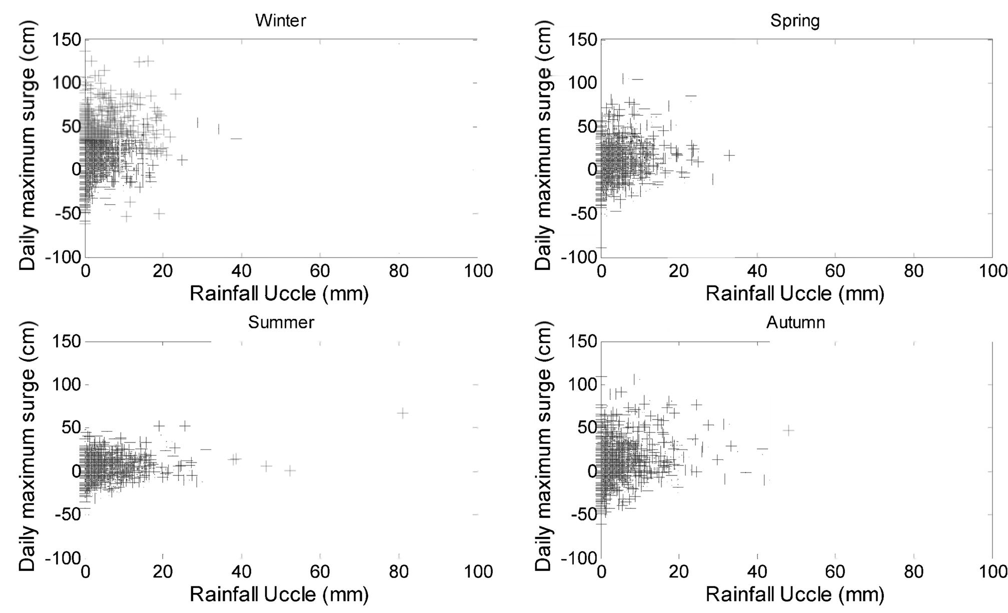


Historical correlation for SLP vs Surge

A strong negative correlation (-0.5 and more) was found for the Baltic sea region and the sea surges at Oostende (all winters from 1925 till 2000). Hence, a statistical regression relation was developed to relate the SLP at the Baltic sea with the surges at the Belgian coast.

On the Extremal dependency

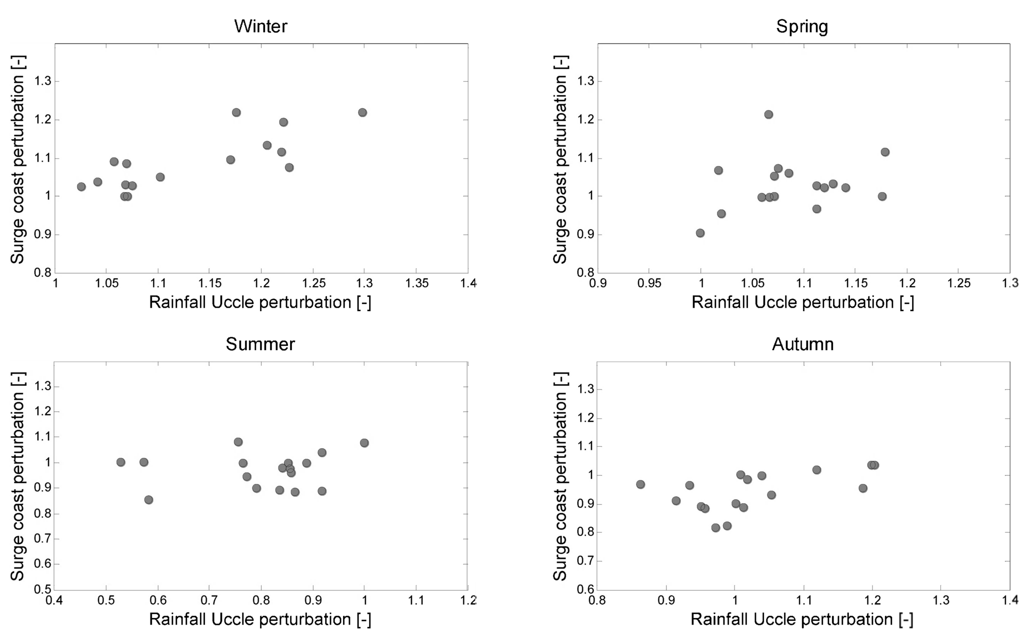
Extremal dependence is about establishing whether extremes from two variables are likely to occur simultaneously e.g. rainfall extremes upstream (Uccle) and surge extremes downstream (Oostende).



The results show that the strongest dependence between rainfall extremes and surge extremes is during autumn (1981-2000)

SLP used to predict coastal surges

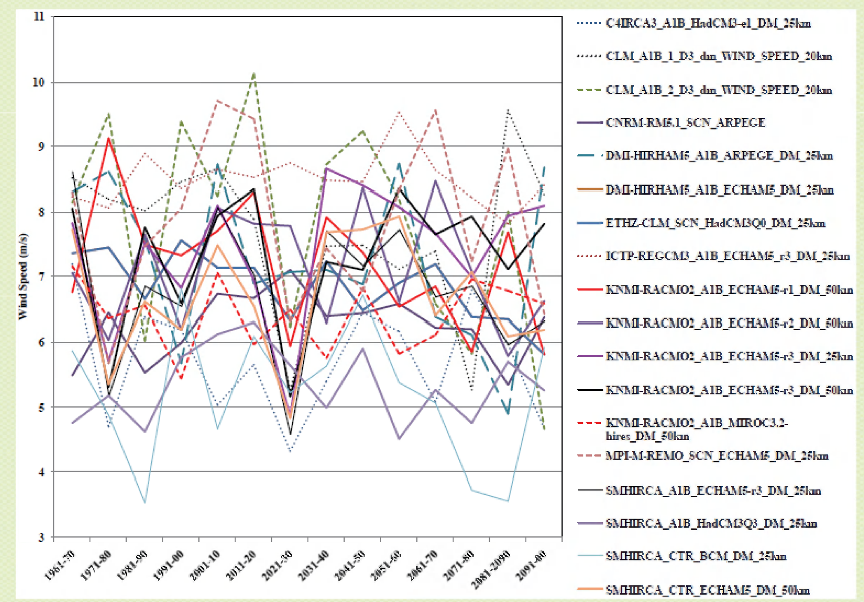
- CERA database (2 CLM runs)
- EU-FP5 PRUDENCE database (31 RCM runs)
- EU-FP6 ENSEMBLES database (18 RCM runs)



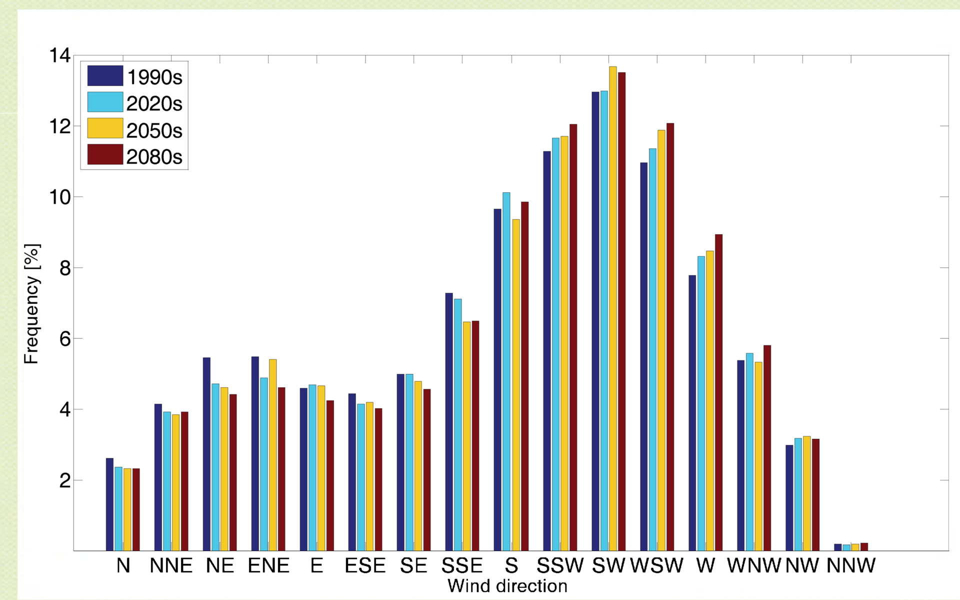
PRUDENCE RCM runs 2071-2100 vs. 1961-1990

Perturbation factor= future extremes/present extremes

Wind analysis Scheldt region [51N,52N;3E,4.5E]

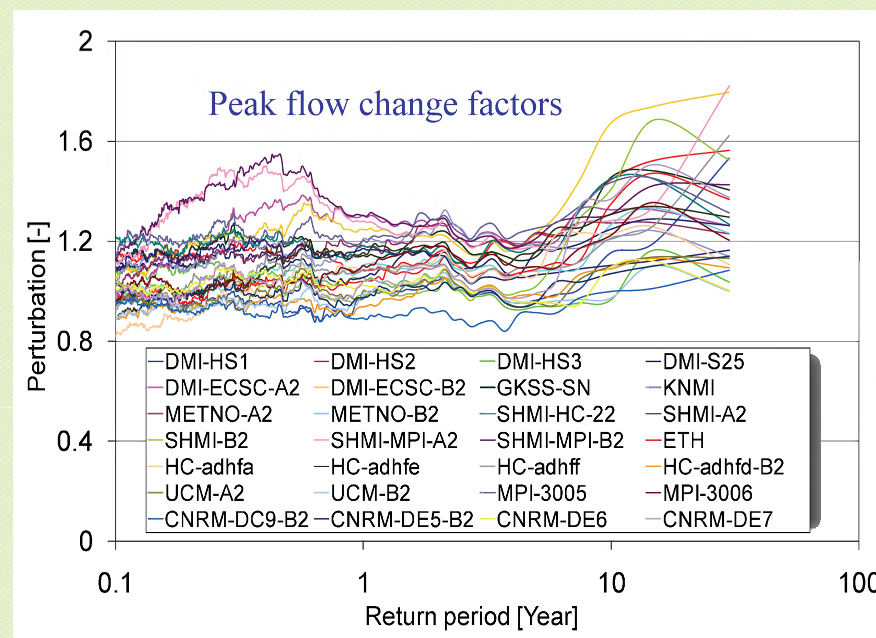


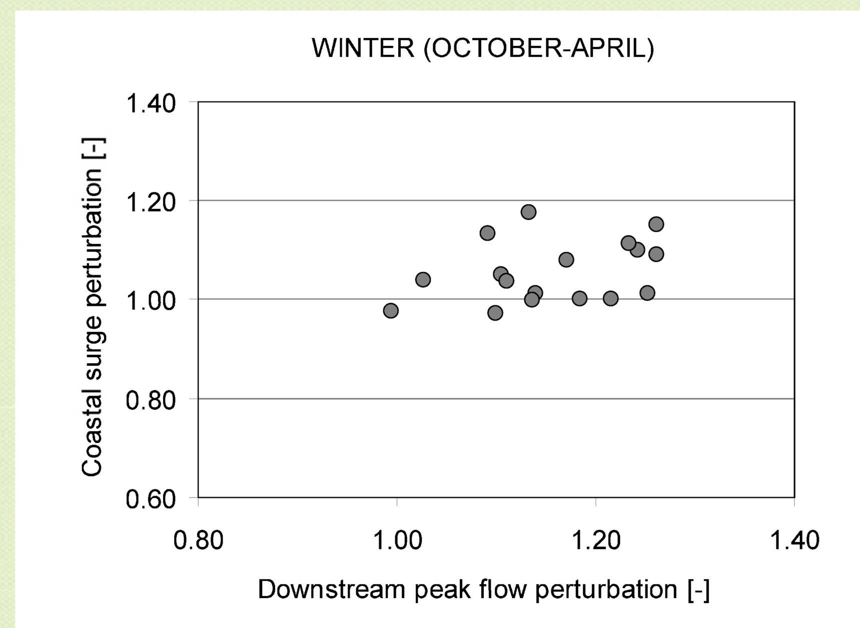
ENSEMBLES FP6(average >99 percentile)



CLM _1: 6 hourly wind speed

Hydrological impact and surge analysis (e.g. Molenbeek Erpe-Mere, Belgium)





PRUDENCE RCM runs 2071-2100 vs. 1961-1990

Main conclusions:

- Wind speed extremes(> 90th percentile) and directions do not vary significantly with historical data
- The high scenario for the 2080s vs 1961-1990: downstream peaks (↑25%) + upstream surges (↑15%) during winter
- The low scenario for the 2080s vs 1961-1990: downstream peaks (0%) + upstream surges (0%) during winter

Funding provided by:
European Union within FP7-THEME 6 - Environment, including climate.

THESEUS (Innovative technologies for safer European coasts in a changing climate)

COOPERATION

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