

Impact of climate change on storm surges and waves on the Belgian Continental Shelf

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Overview

- Storm-surge and wave models
- Model forcings
- Definition of extreme events
- Analysis of wind fields
- Impact of climate change on storm surges
- Impact of climate change on wave heights
- Conclusions and perspectives

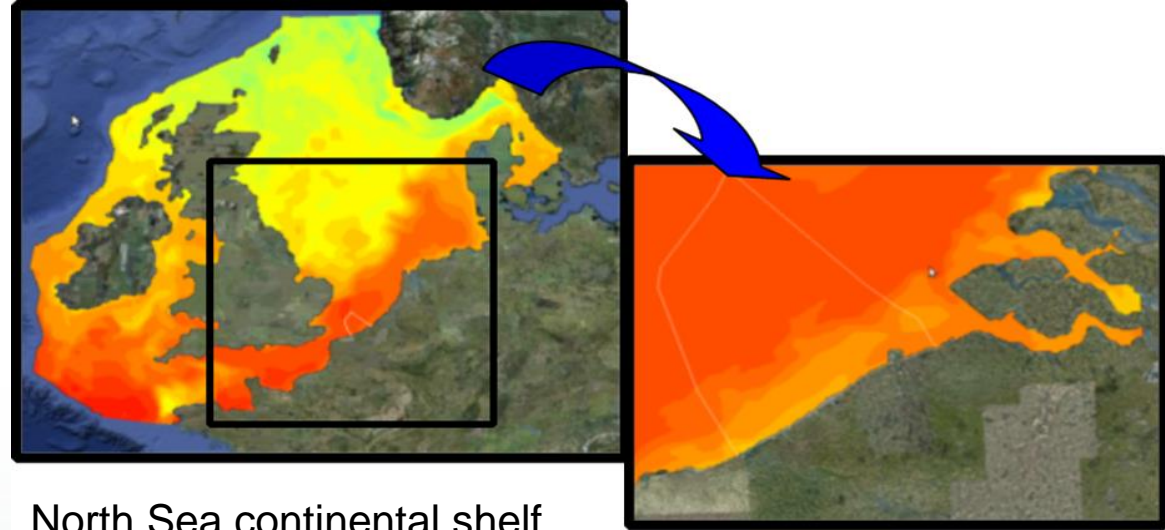
Storm-surge and wave models

Estimation of SSH and impact on **storm surges** from simulations with the COHERENS model:

- 2D simulations
- Belgian continental shelf

COHERENS output:

- Water elevations
- (Maximum currents)



North Sea continental shelf
~ 5km

Belgian continental shelf

Estimation of impact on **waves** from simulations with the WAM model

WAM output:

- Wave heights

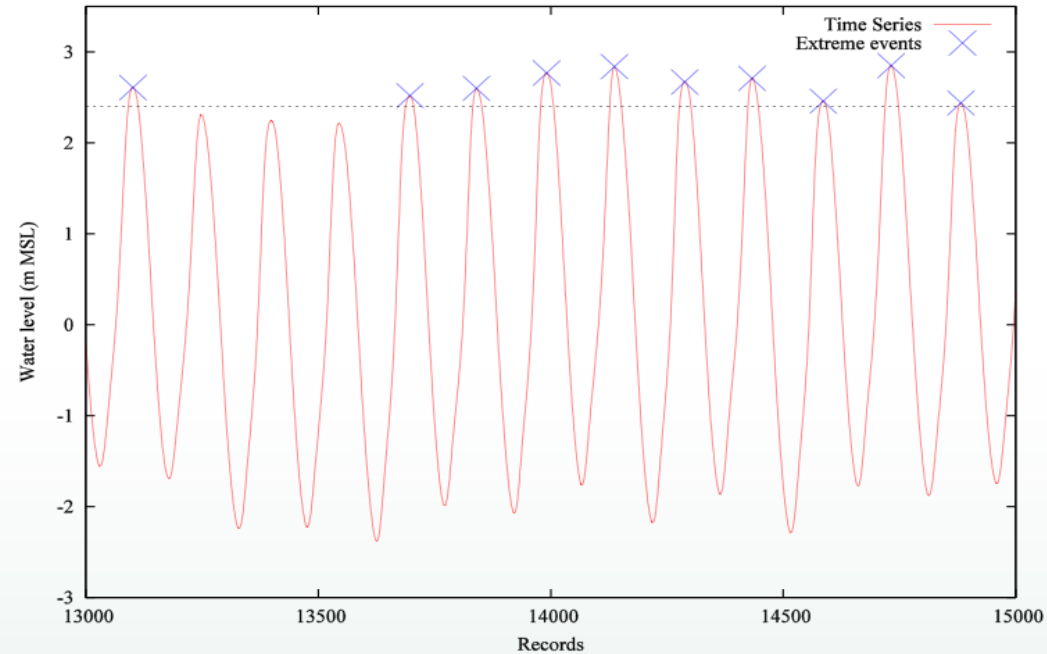
Model forcings

- Three runs:
 - **Historical (1976-2005) – forced by CNRM-CM5**
 - Evaluation (1980-2010) – forced by reanalysis ERA-Interim
 - **RCP85 (2069-2099) – forced by CNRM-CM5**

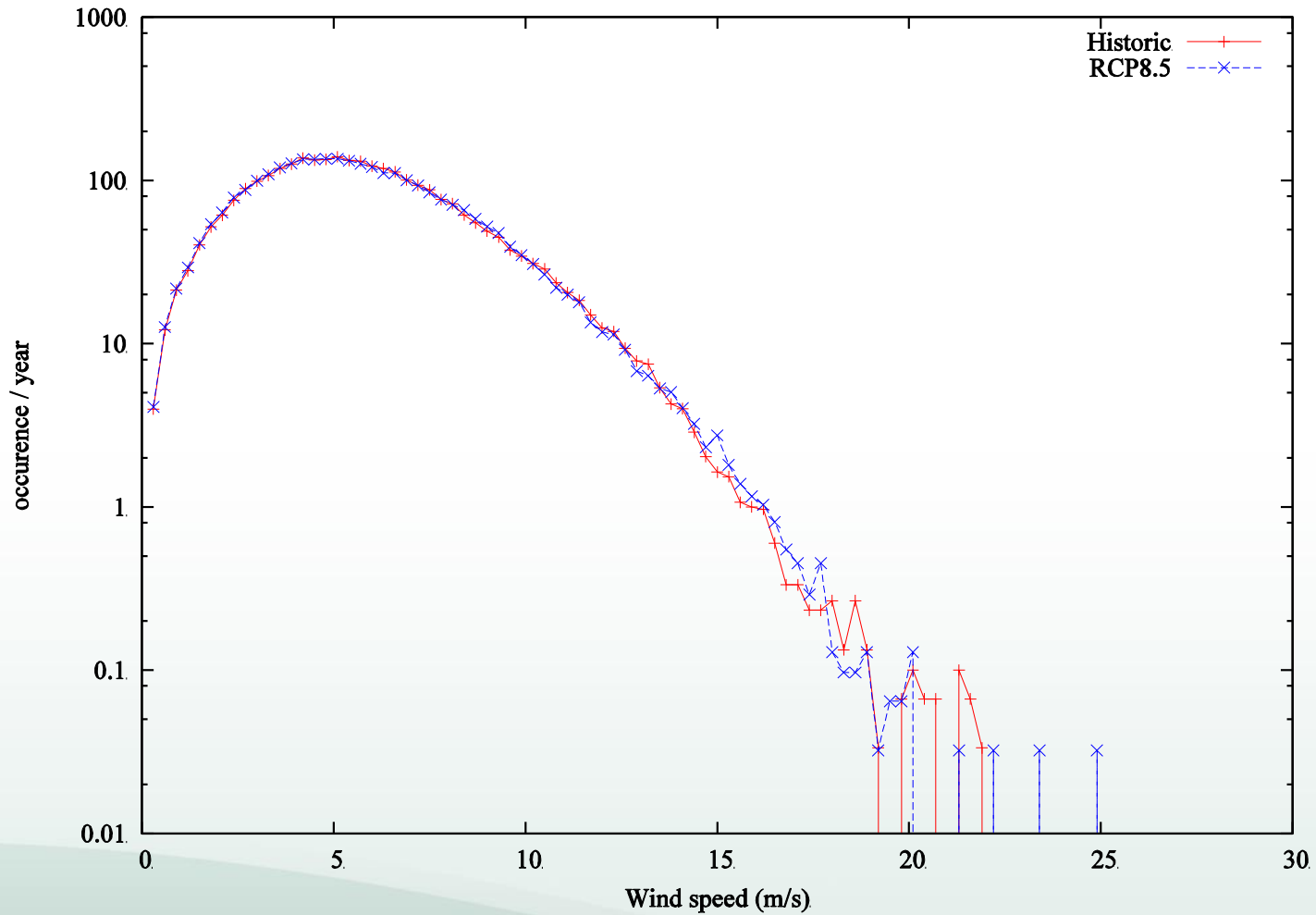
- COHERENS/WAM forcings:
 - Atmospheric pressure (only COHERENS)
 - Two components of wind

Definition of extreme events

- Kamphuis [2010] method for time series analysis
 - Definition of a threshold
 - For each period for which the threshold is exceeded, the maximum value during that period characterizes the extreme event
 - Distribution of extreme events parametrised by Weibull distribution

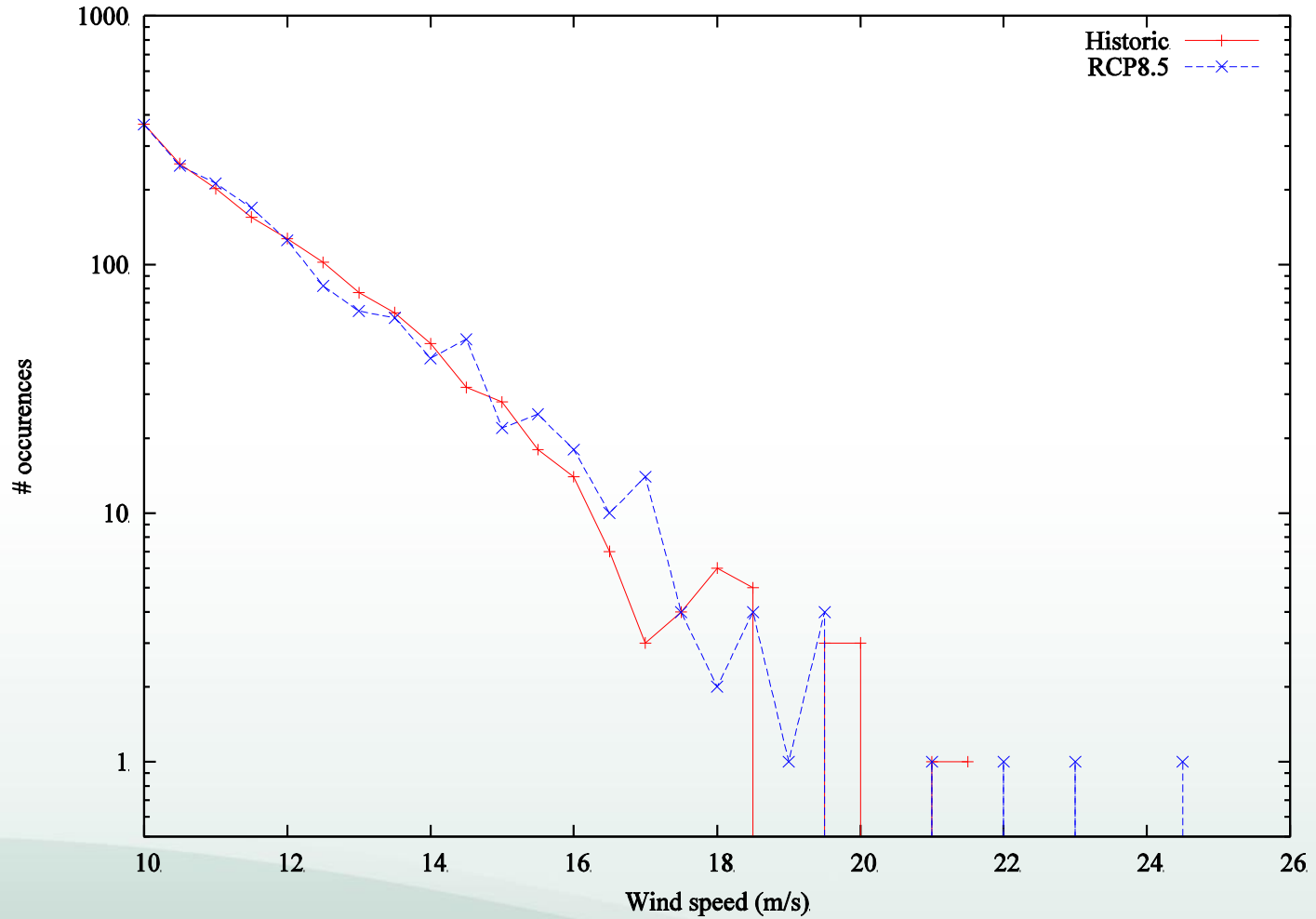


Wind analysis



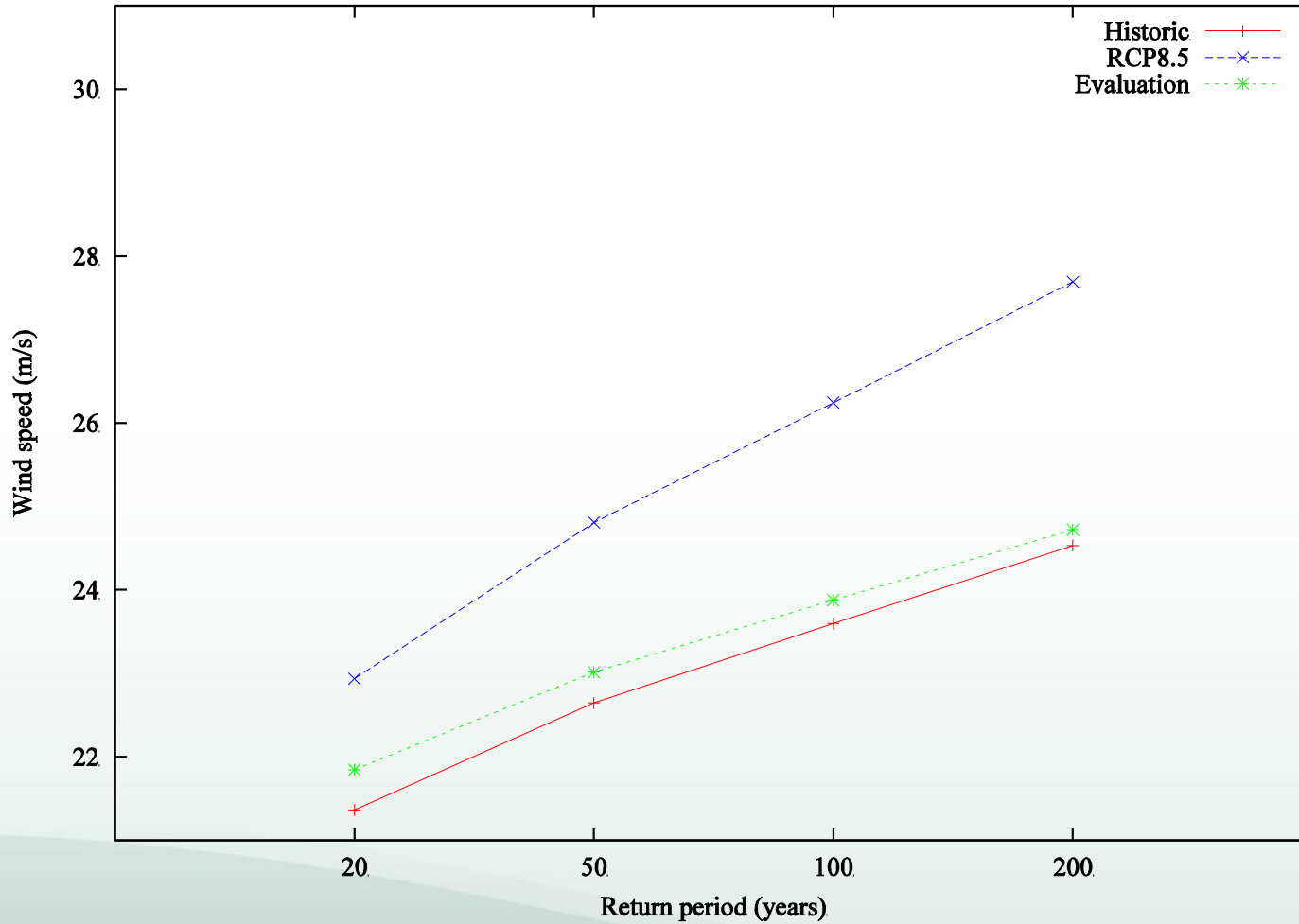
Distribution of wind speed at Ostend (logarithmic scale)

Wind analysis



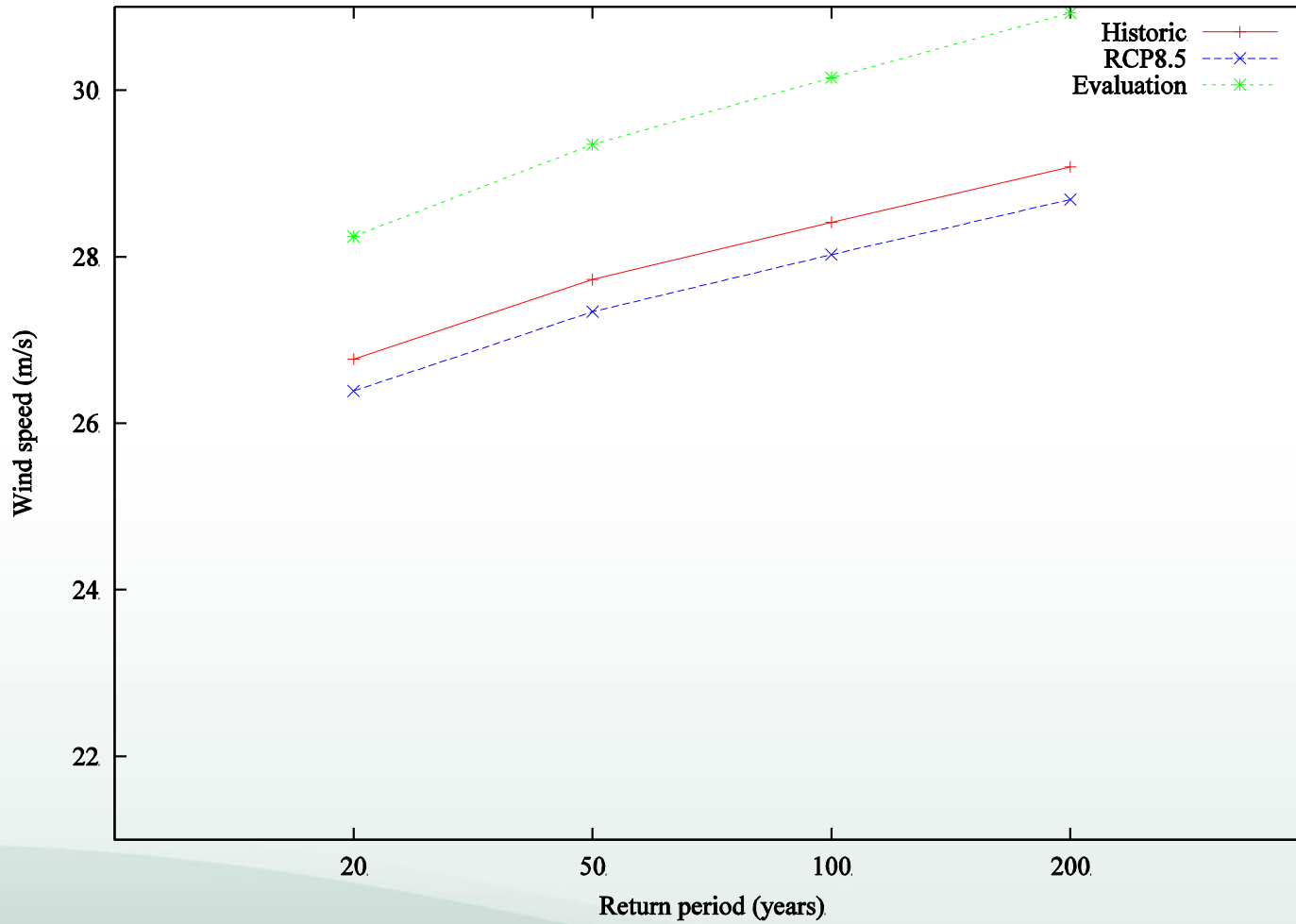
Distribution of maximum wind speed during extreme events at Ostend (logarithmic scale)

Wind analysis



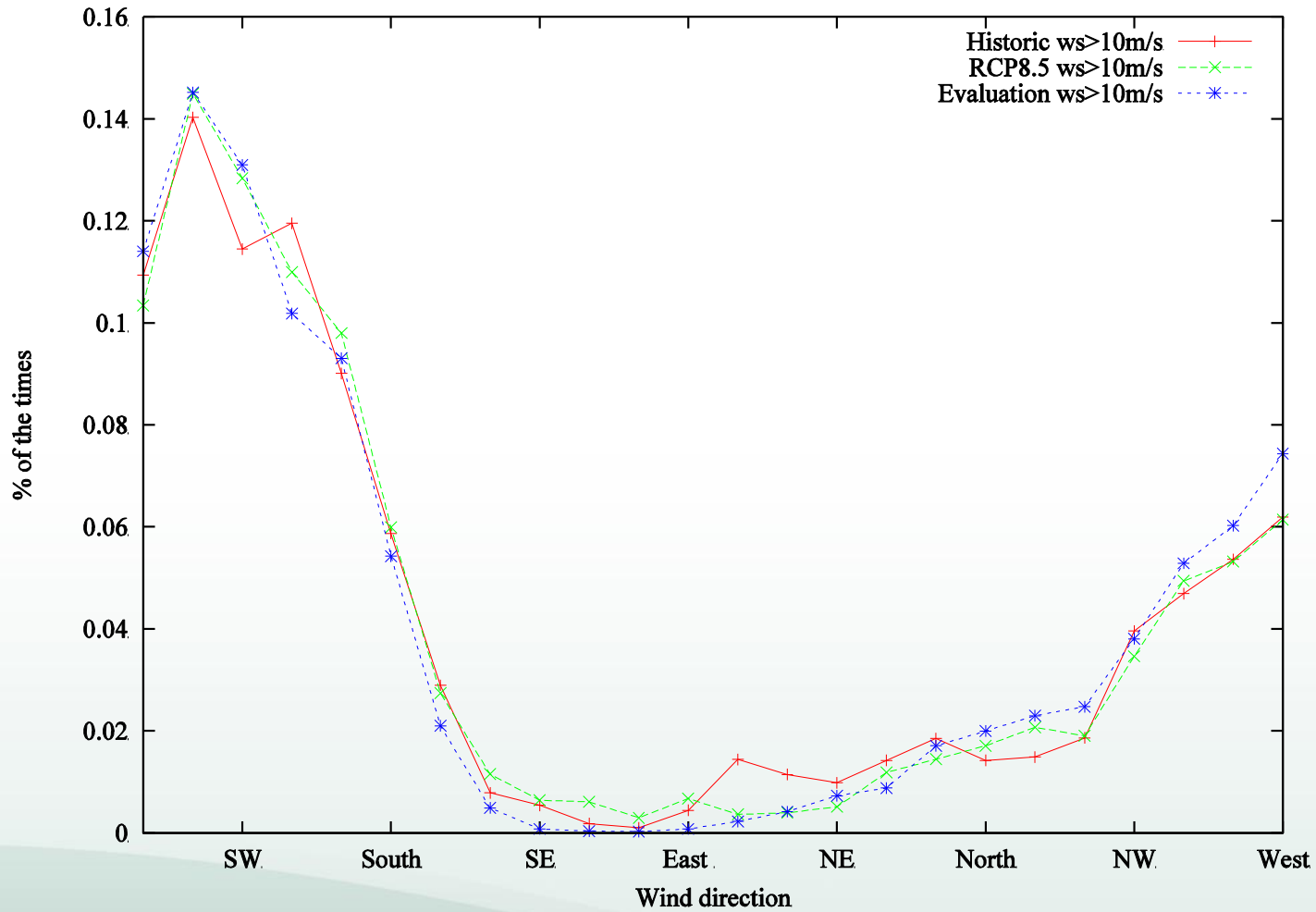
Maximum wind speed for a certain return period at Ostend

Wind analysis



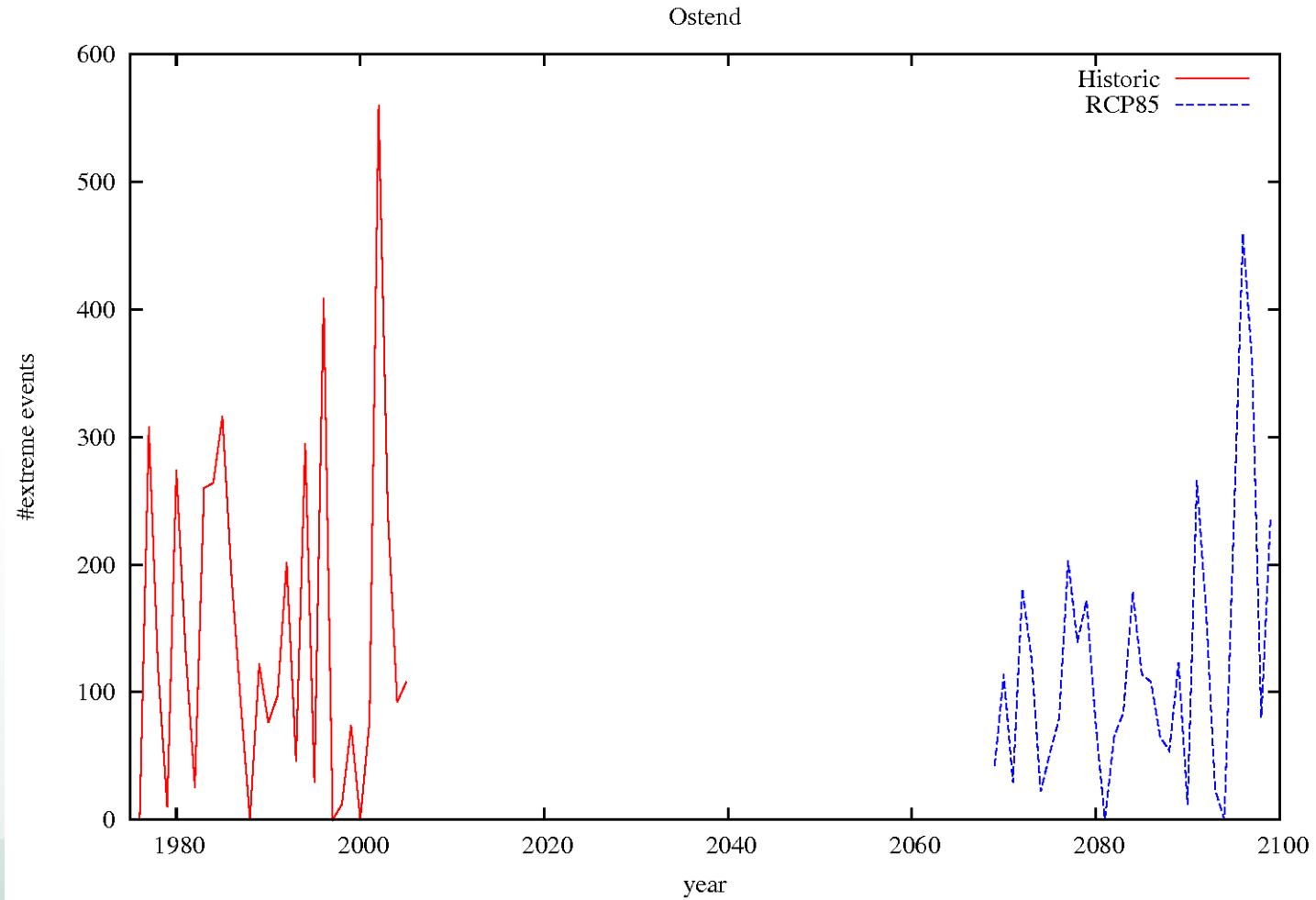
Maximum wind speed for a certain return period for Northern North Sea

Wind analysis



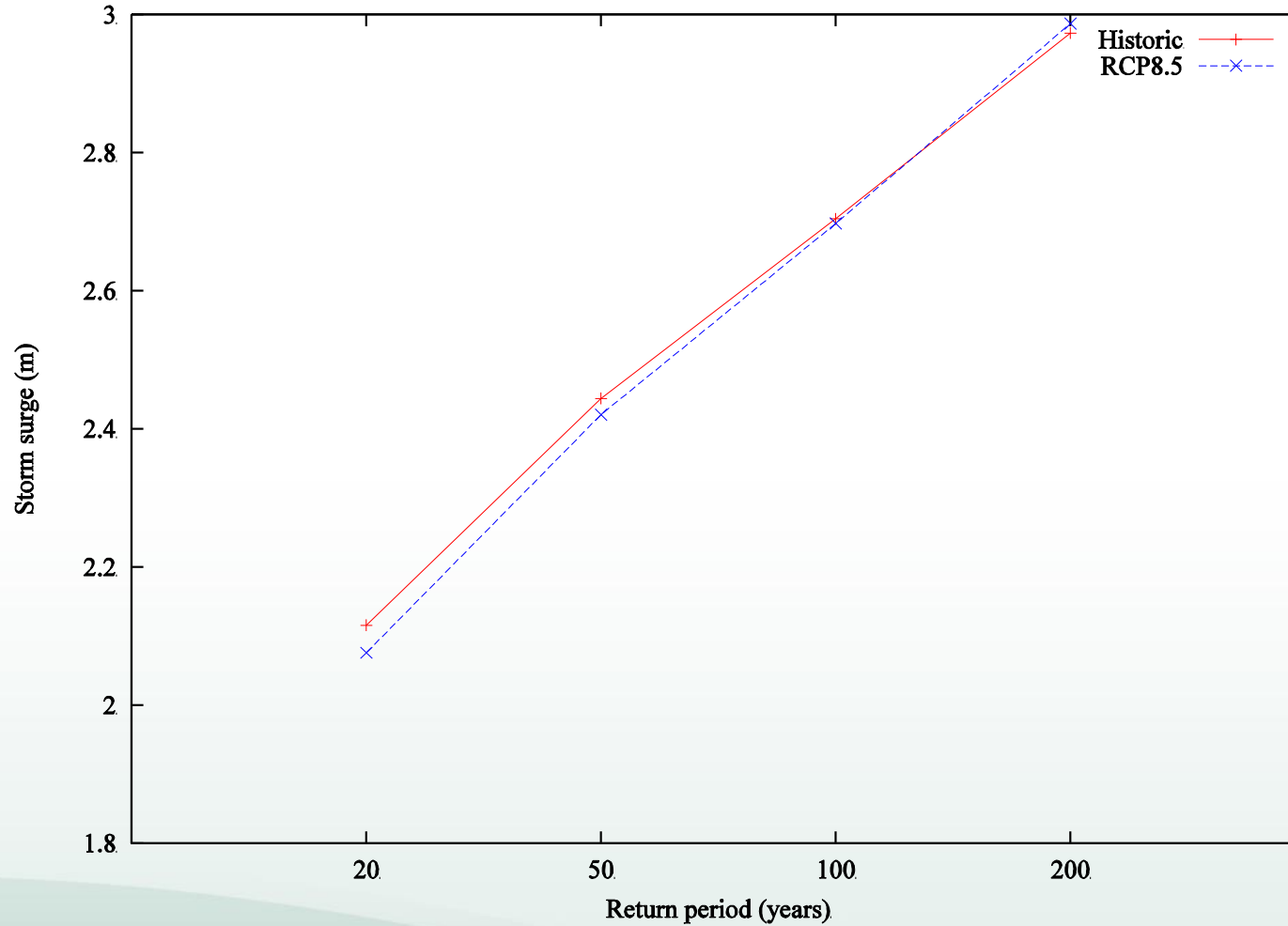
Wind direction (for winds higher than 10 m/s) at Ostend

Impact on storm surges



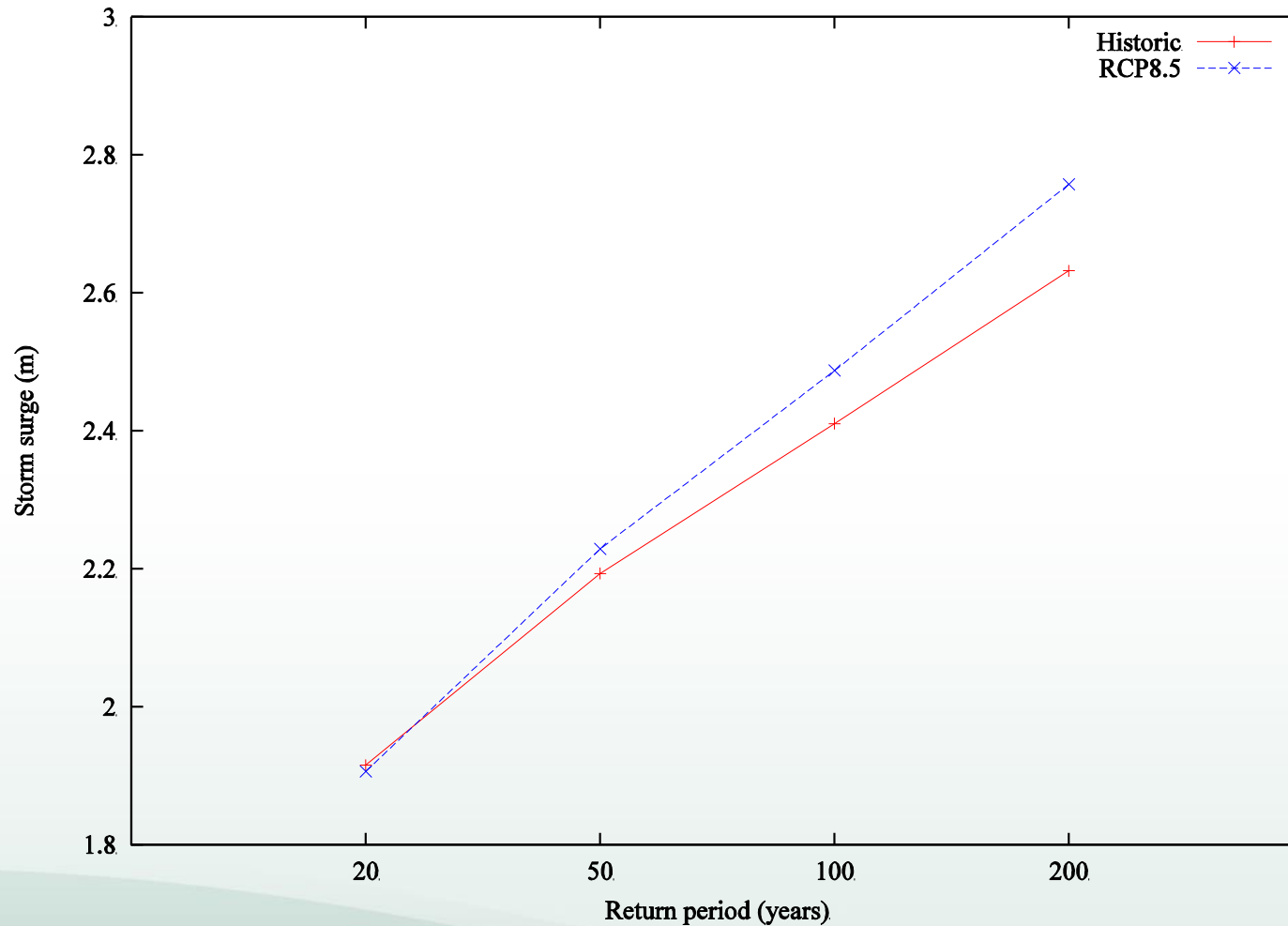
Number of extreme events for storm surges at Ostend

Impact on storm surges



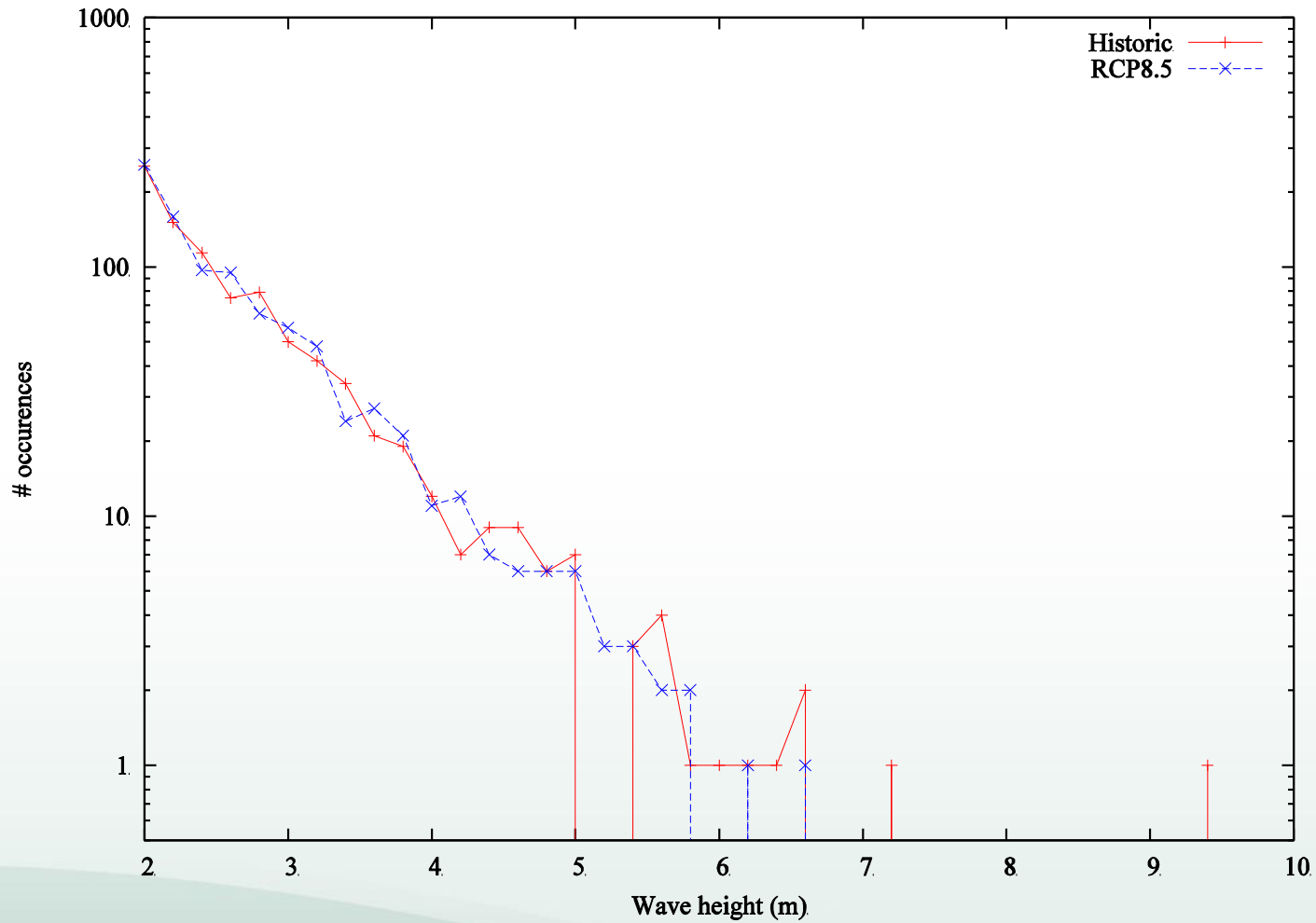
Maximum storm surge for a certain return period at Ostend

Impact on storm surges



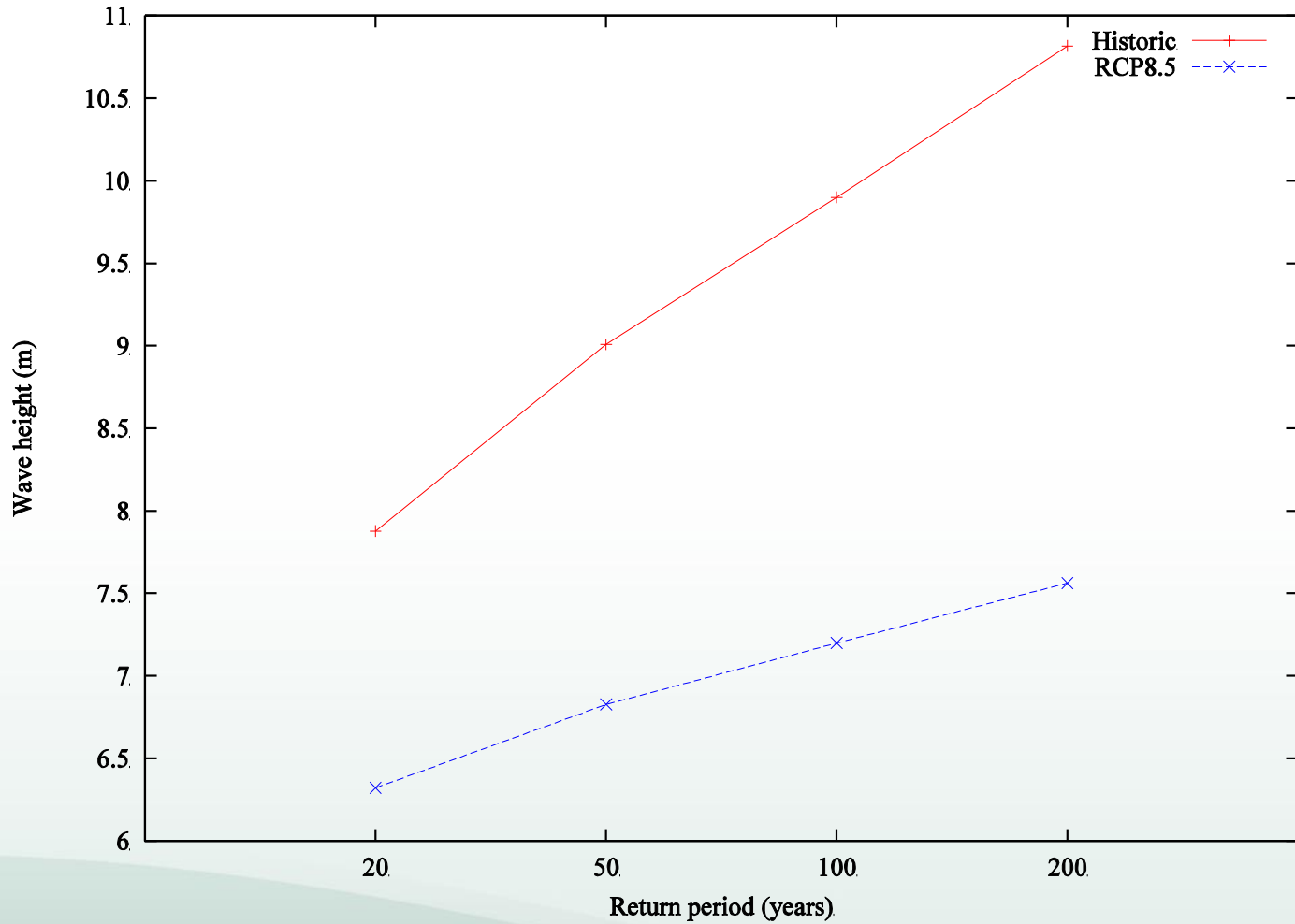
Maximum storm surge for a certain return period for Westhinder

Impact on significant wave height



Distribution of maximum values of significant wave height during extreme events at Westhinder (logarithmic scale)

Impact on significant wave height



Maximum significant wave height for a certain return period for Westhinder

Conclusions and perspectives

- Wind speed
 - Ostend
 - No large difference between historic and evaluation runs
 - RCP 8.5: moderate increase of wind speed
 - Northern North Sea station
 - Larger in evaluation run than in historic run
 - RCP 8.5: slightly smaller than historical run
- Differences in model forcing & spatial differences in climate

Conclusions and perspectives

- Storm surges:
 - Max. storm surges similar for historic and RCP8.5
 - Validation with historic climate necessary
 - Non-linear effects
 - Analysis at offshore locations needed

- Significant wave heights:
 - Decrease of max. significant wave height for RCP 8.5
 - Validation with historic climate necessary
 - Influence of changes in wind direction
 - Analysis at offshore locations needed

Conclusions and perspectives

- Some delays were encountered
- Work in progress
 - Further analysis of the results is needed and ongoing
 - Investigating the effect of outliers
 - Analysing the impact at offshore locations
 - Other periods 2010-2040 – 2040-2070
 - RCP 2.6 and RCP 4.5 scenarios
- Acknowledgements to ECMWF computing facilities for WAM simulations