Adaption of typhoon risk modeling to climate changes

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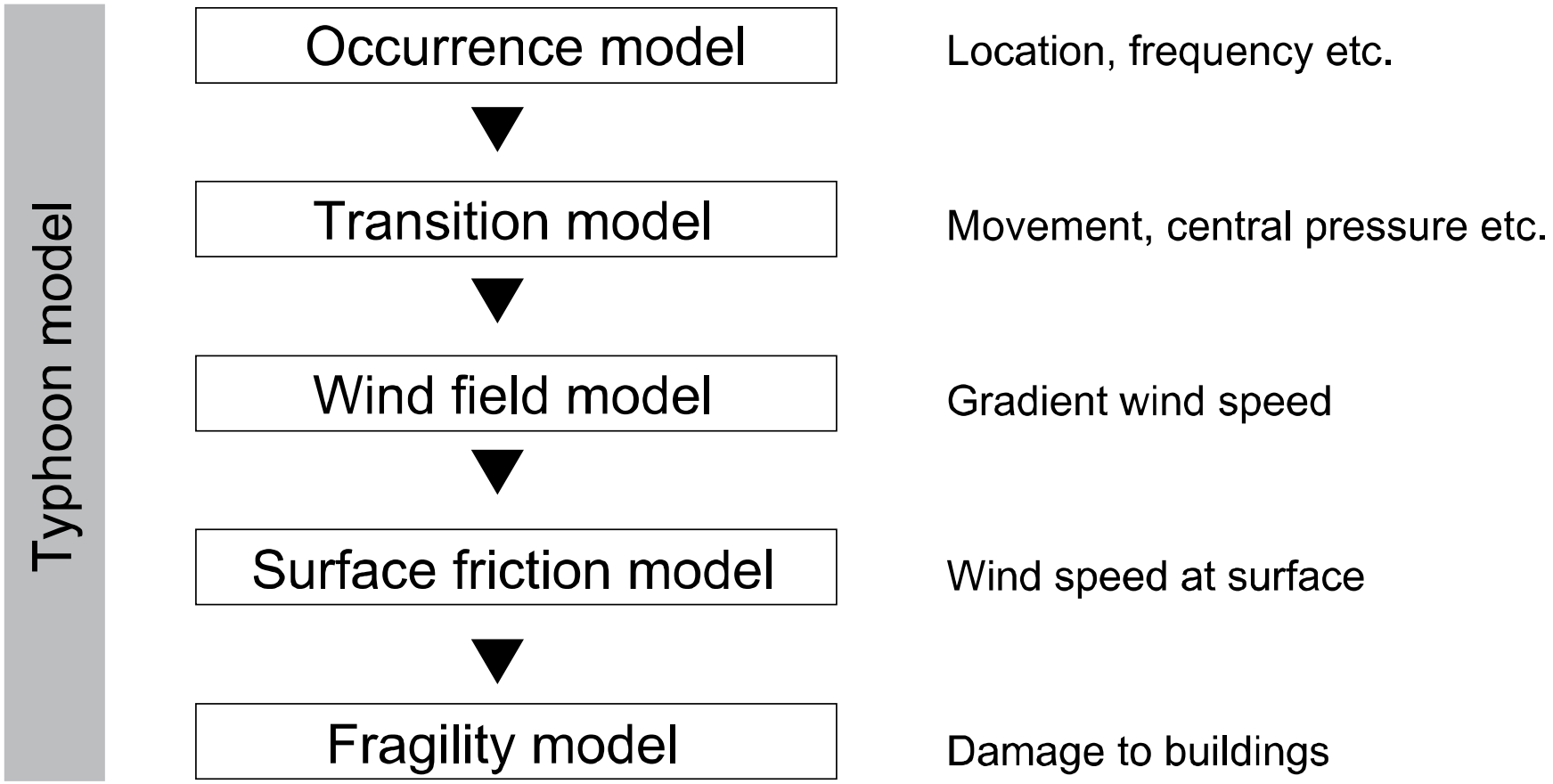
Overview

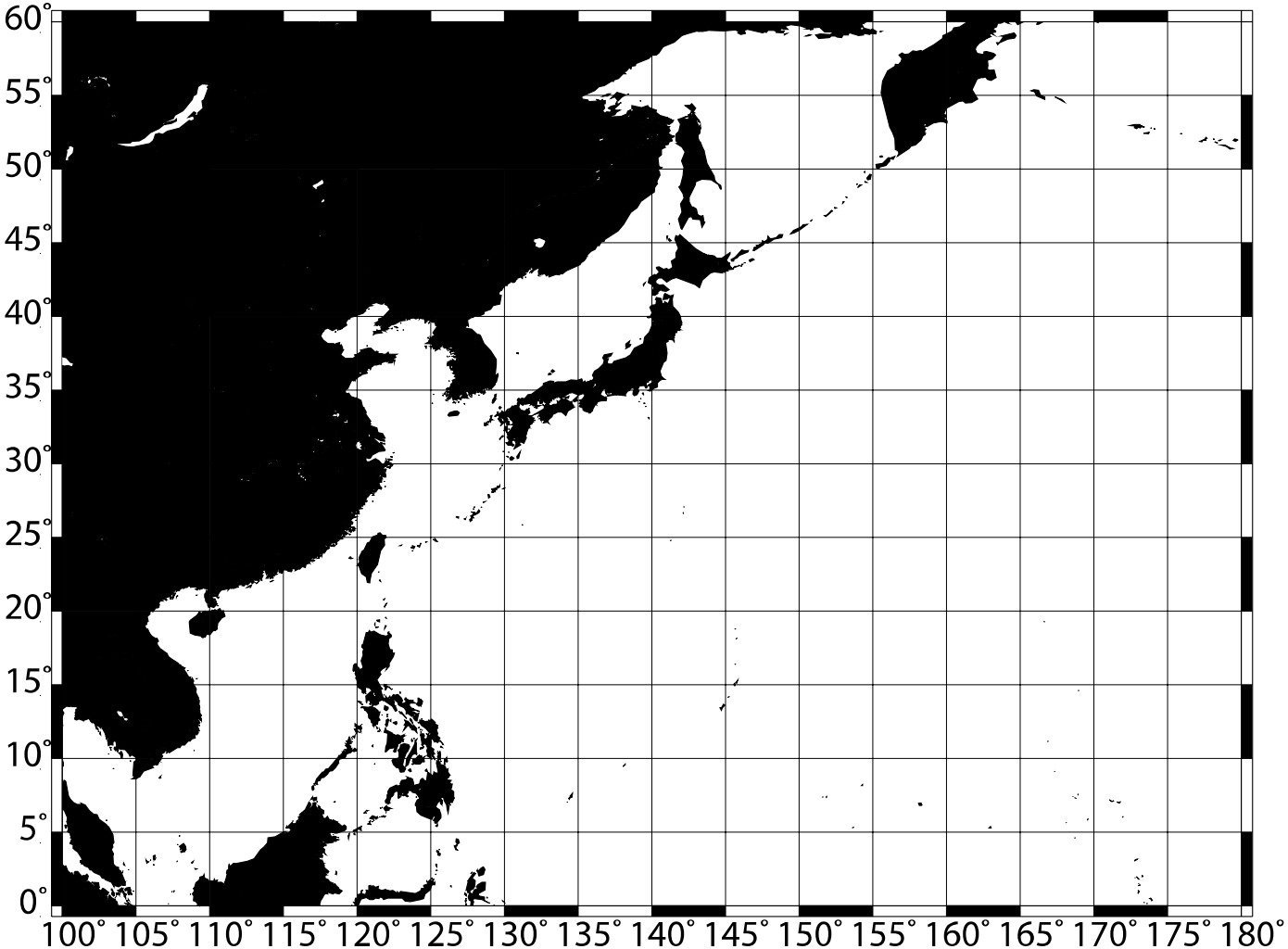
- Introduction of the typhoon model utilized in the present study and its adaptation to possible climate changes.
- Influence of sea surface temperature (SST) change on the intensities of extreme wind speeds induced by typhoons.
- Consequences of the increased intensities of the extreme wind speeds to the performance of structures in terms of failure probability.
- An investigation on how the policies in regard to structural design may be adapted to the climate changes to maintain the structural reliability.

Typhoon model



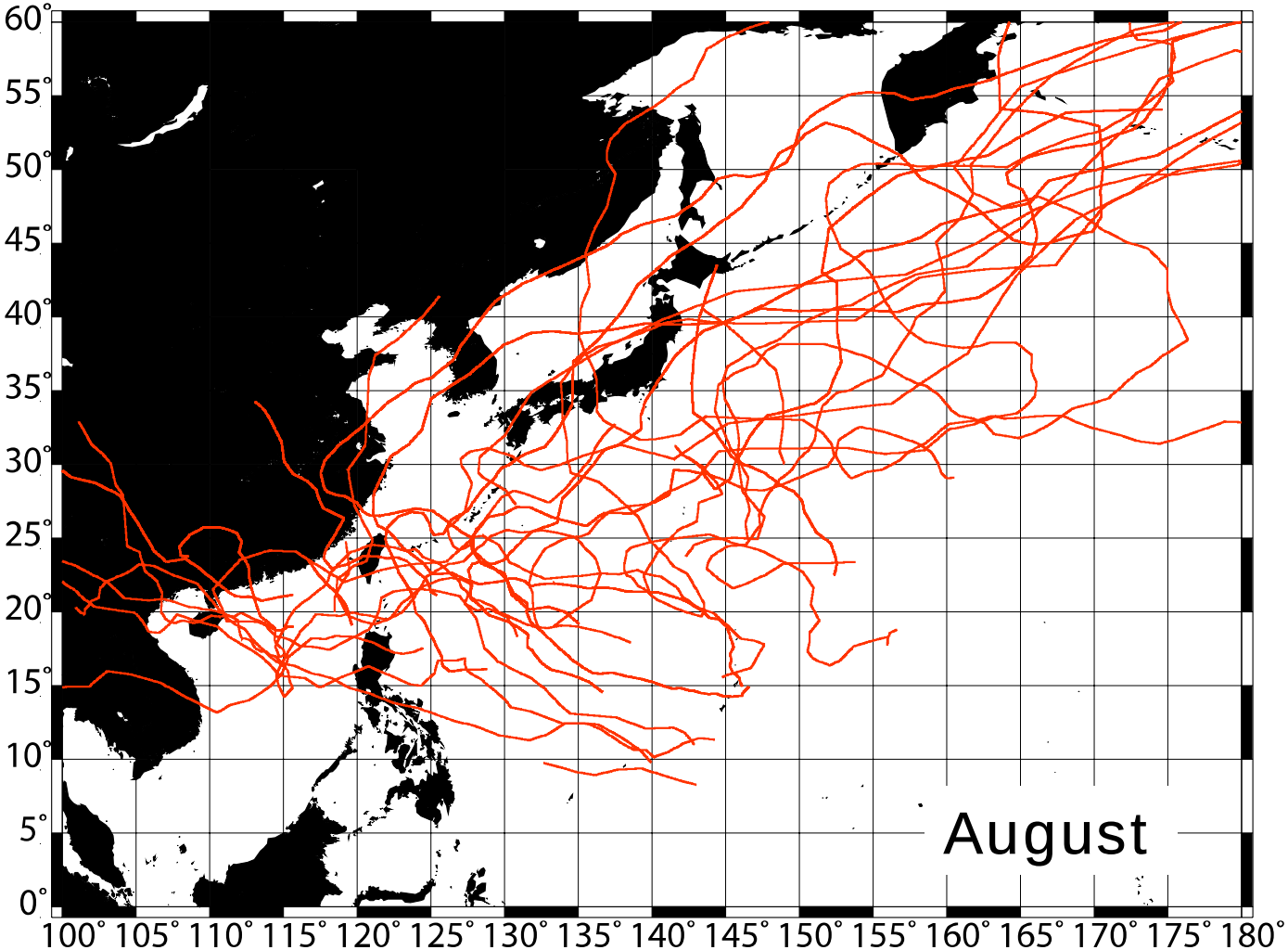
Transition model

Map of the northwest Pacific

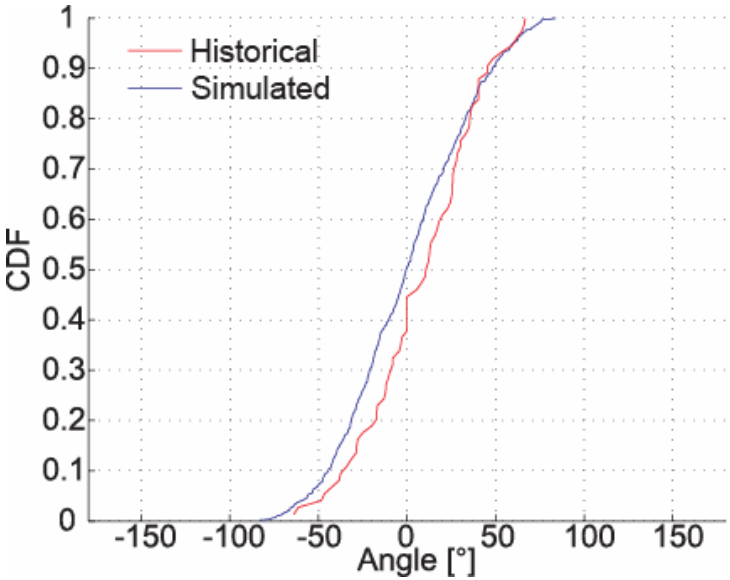


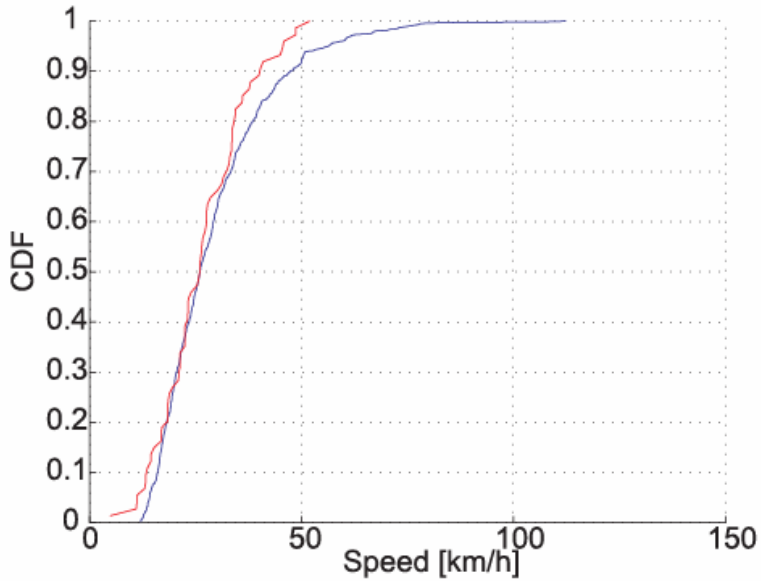
Transition model

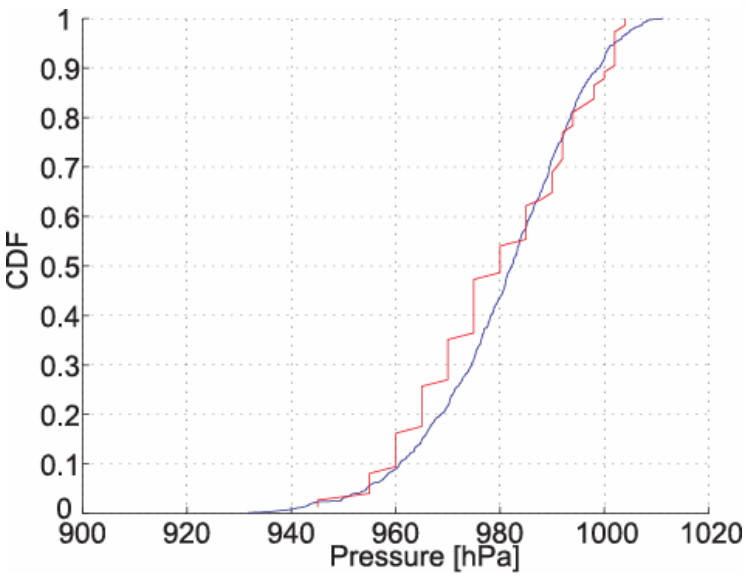
Map of the northwest Pacific with 30 typhoon tracks



Transition model

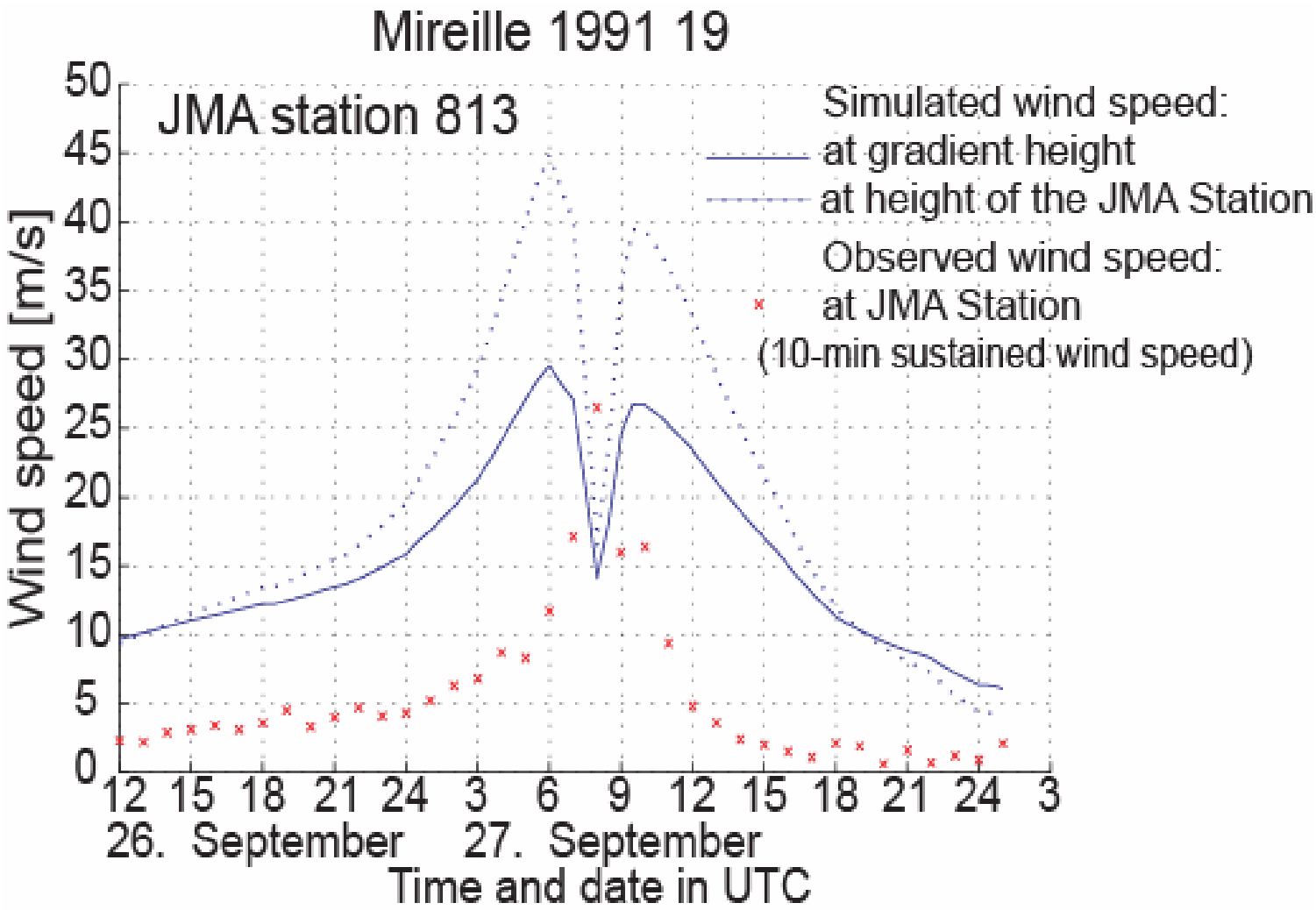






Comparison of historical and simulated data. August; latitude = 32°; longitude = 120°-160°

Wind field and surface friction model

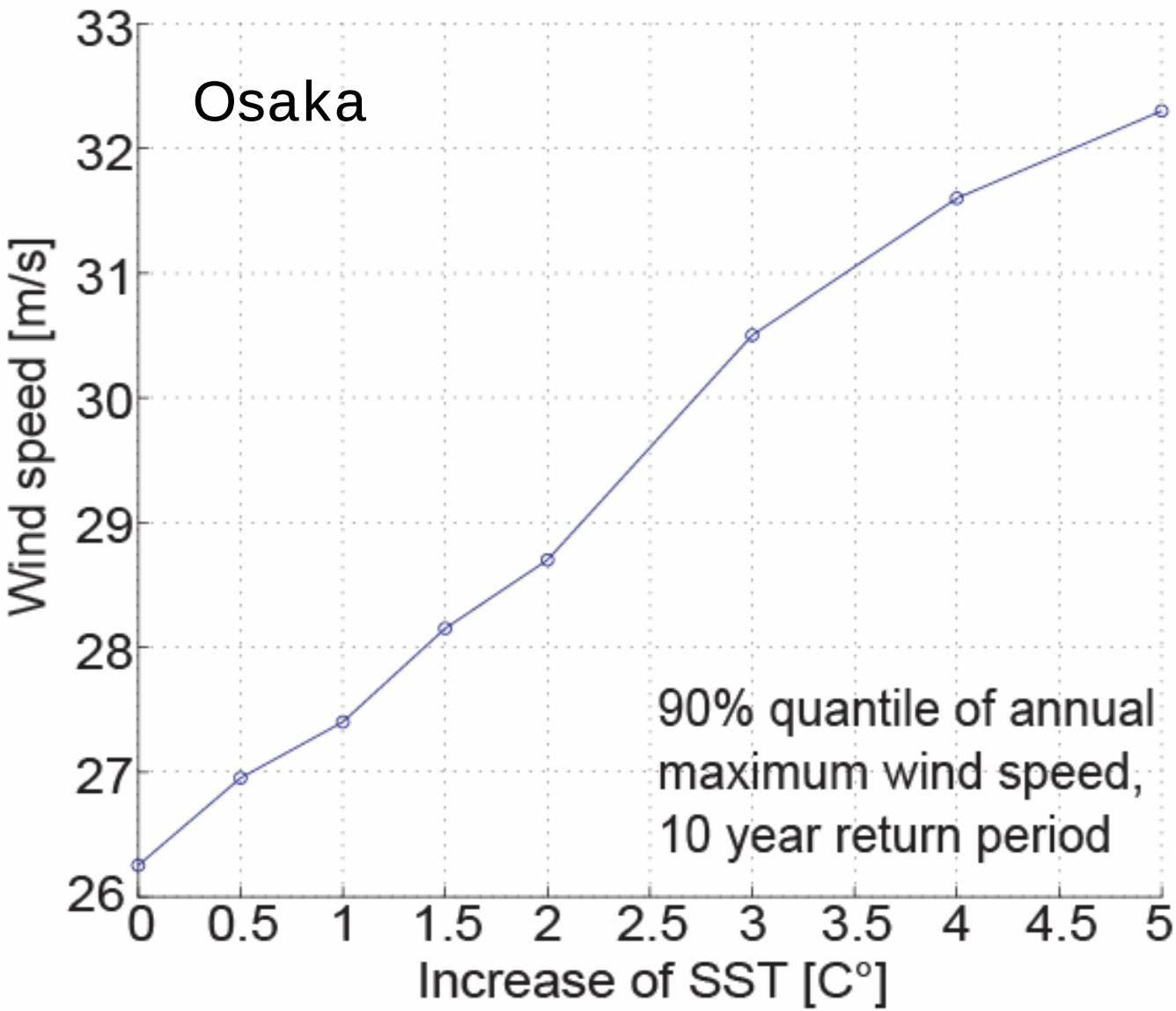


Adapting typhoon model to climate changes

Change of the central pressure of typhoons at each time step is modeled as a function of SST.

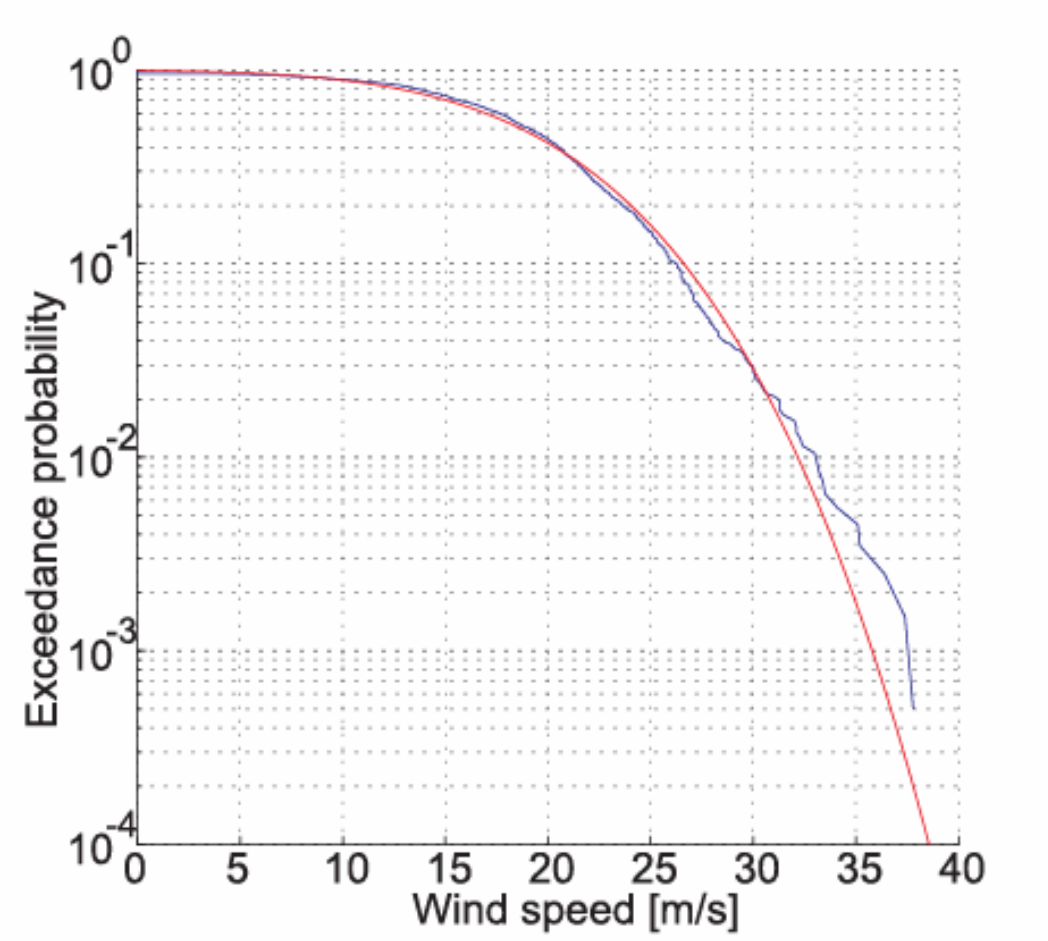
The effect of climate changes on the intensities of typhoons is considered in terms of SST increase.

Increased extreme wind speeds



Annual maximum wind speed

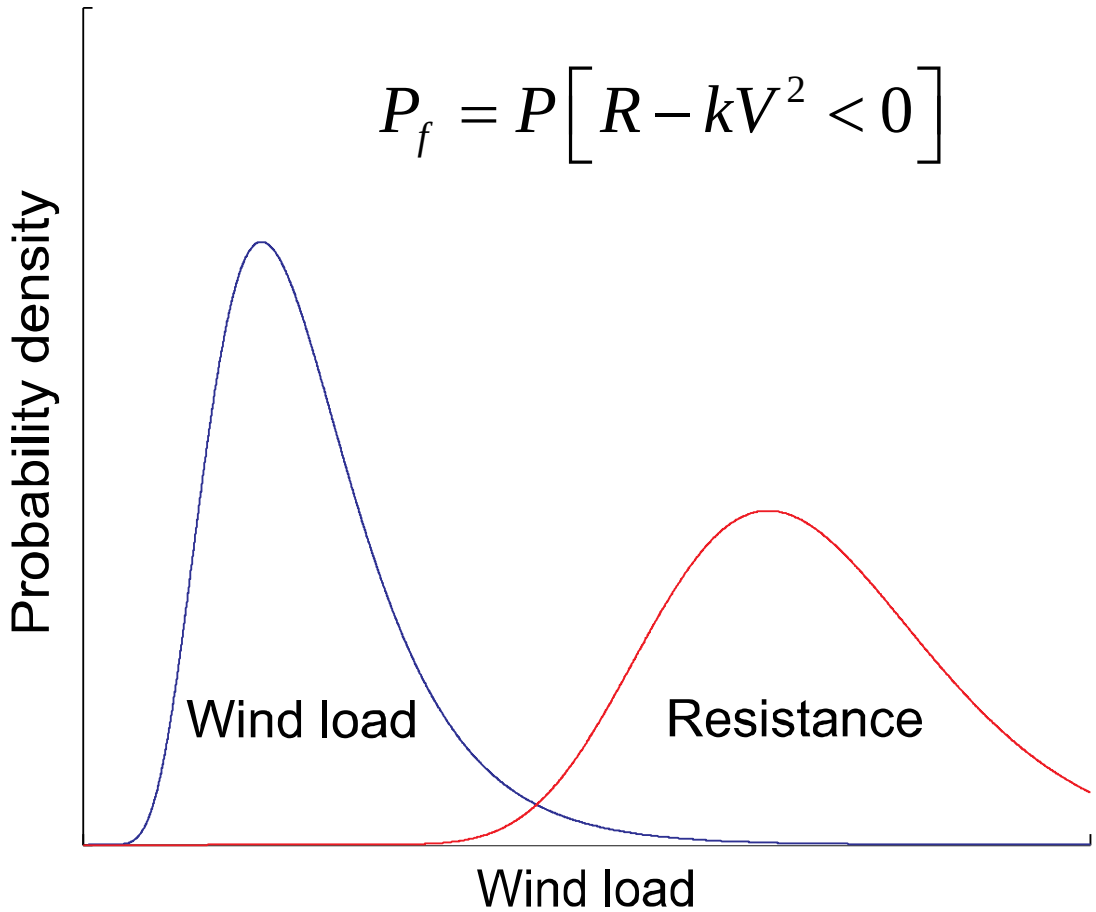
Fitting annual maximum wind speeds to a shifted Weibull distribution



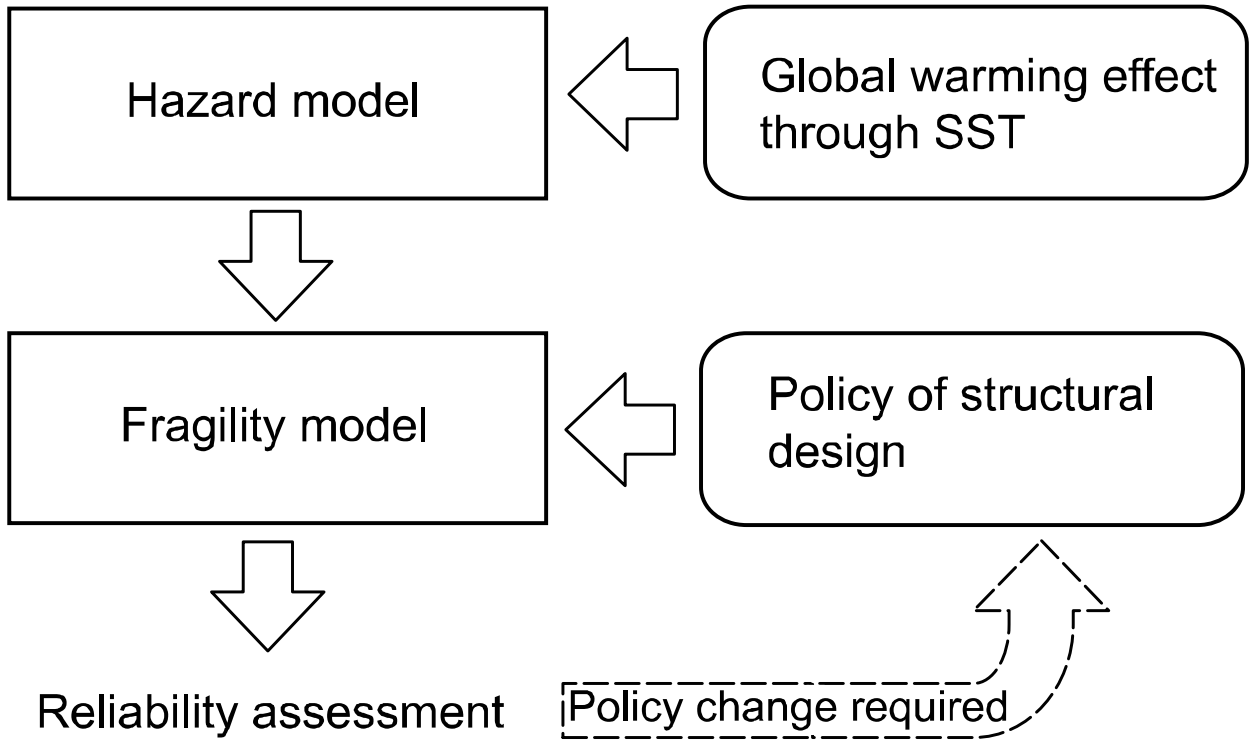
Probability of failure

Target probability of failure: $p_F \approx 10^{-5}\,[1/\,year]$

(JCSS Probabilistic Model Code)

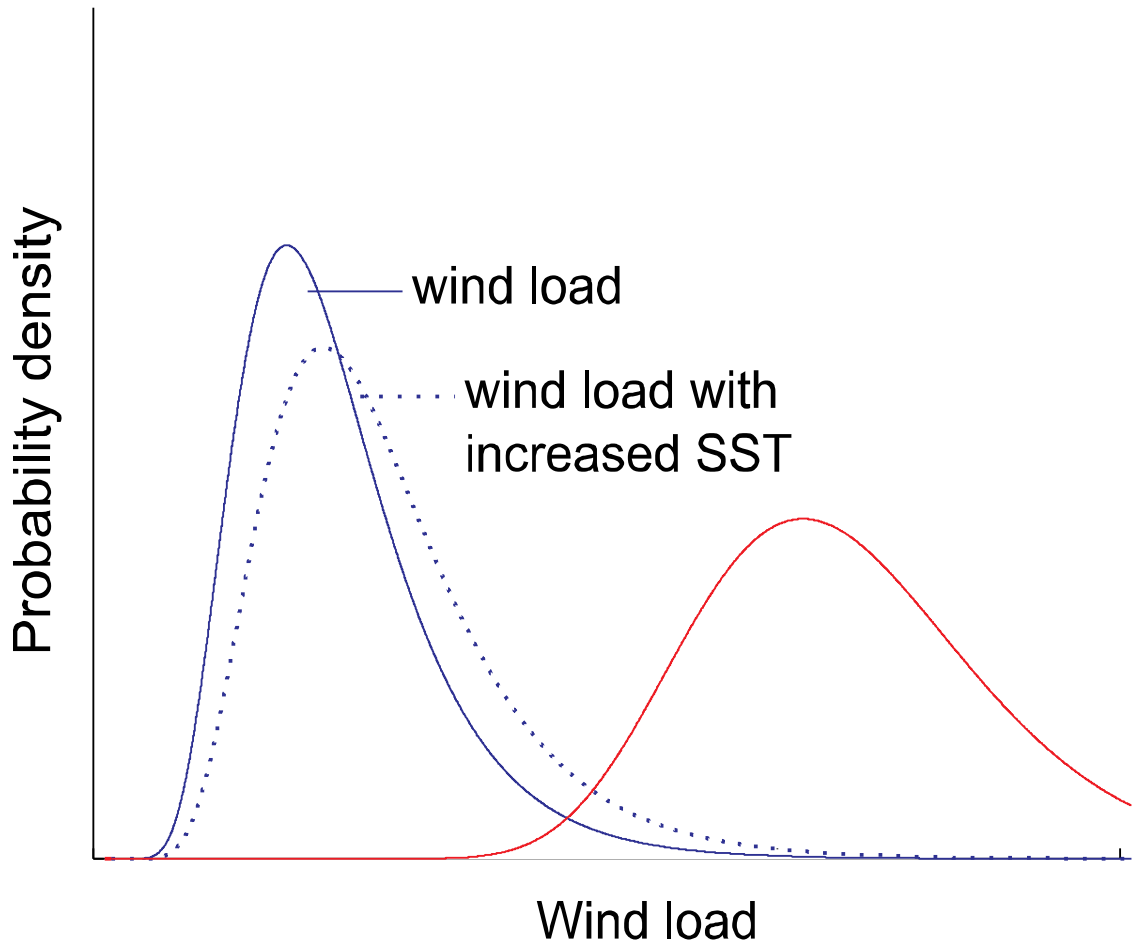


Adapting the structural design



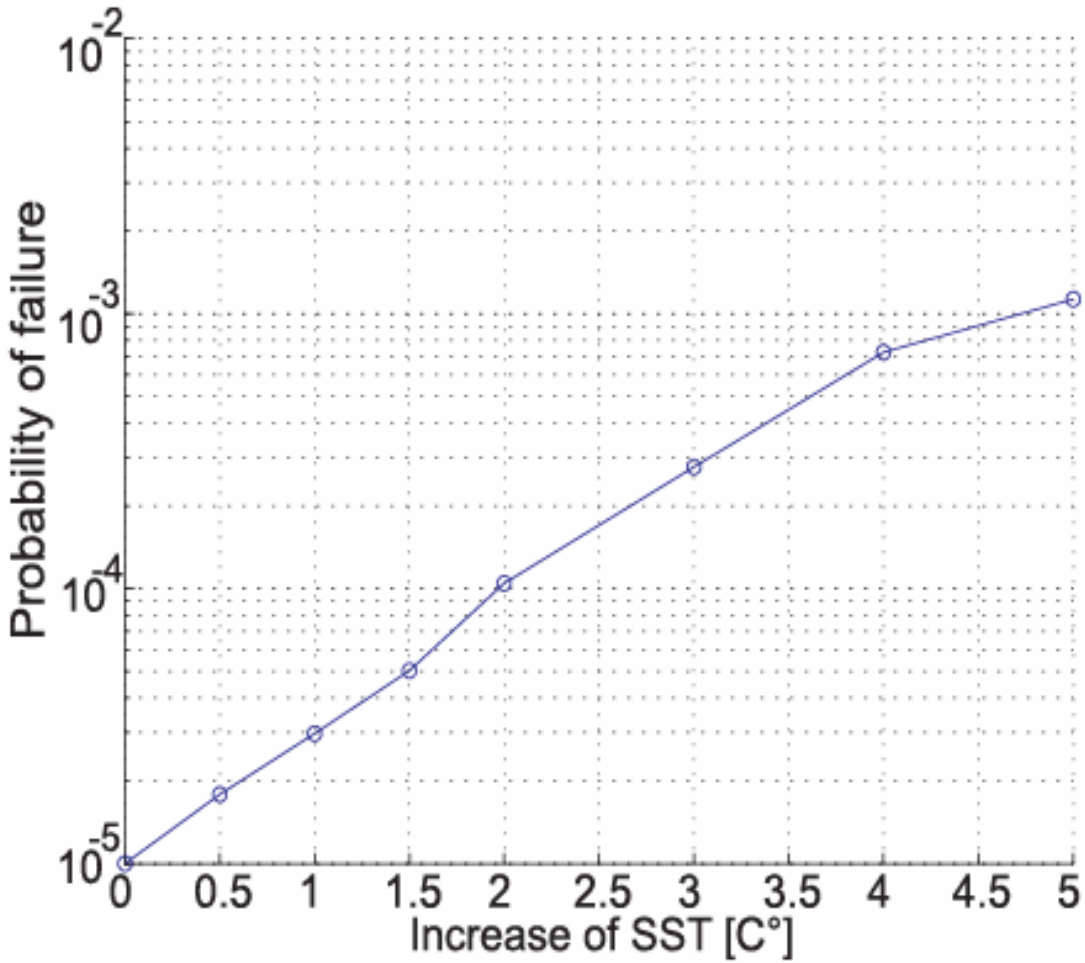
1. Increase of failure probability due to climate change
2. Adjusting the resistance to maintain failure probability

Increased probability of failure



Changes of the wind loads due to SST increases can lead to the increase of the probability of failure.

Increased probability of failure



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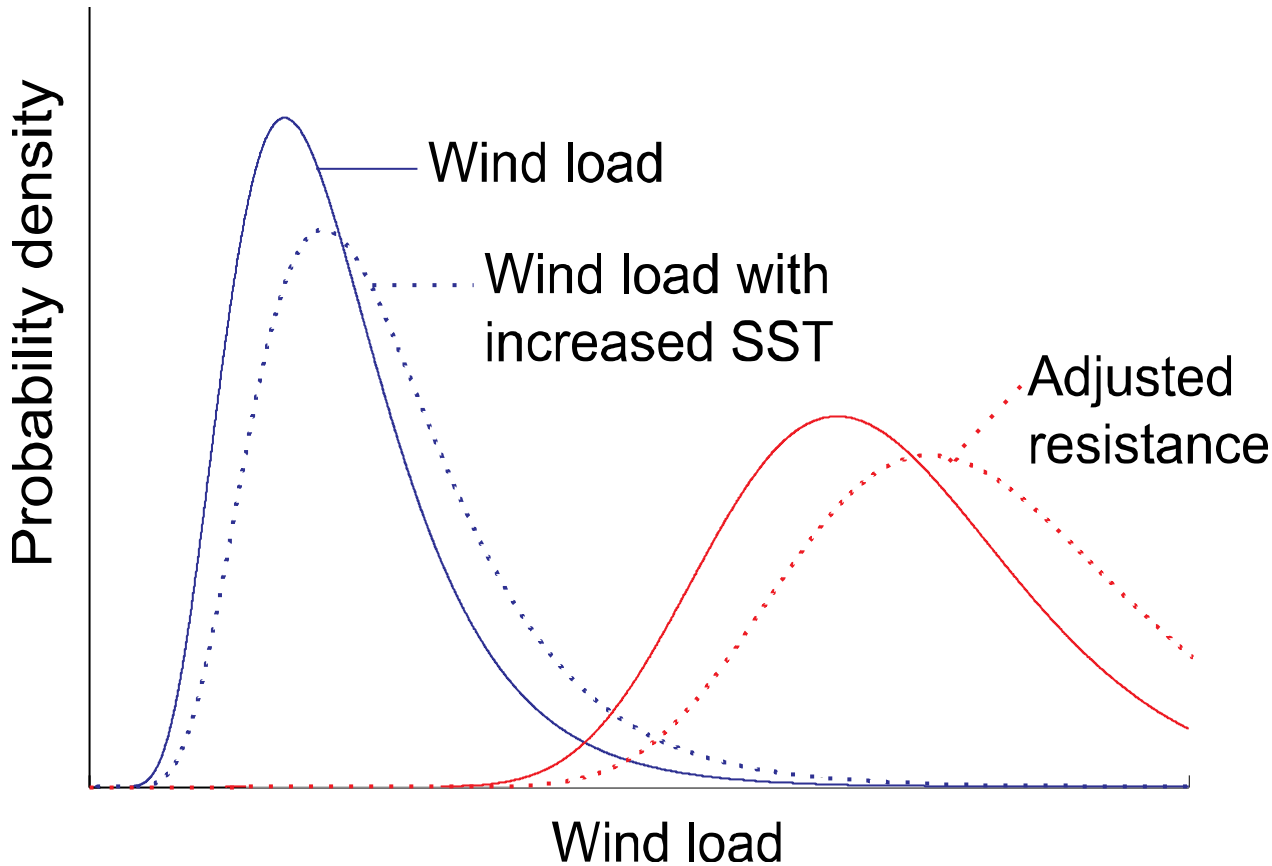
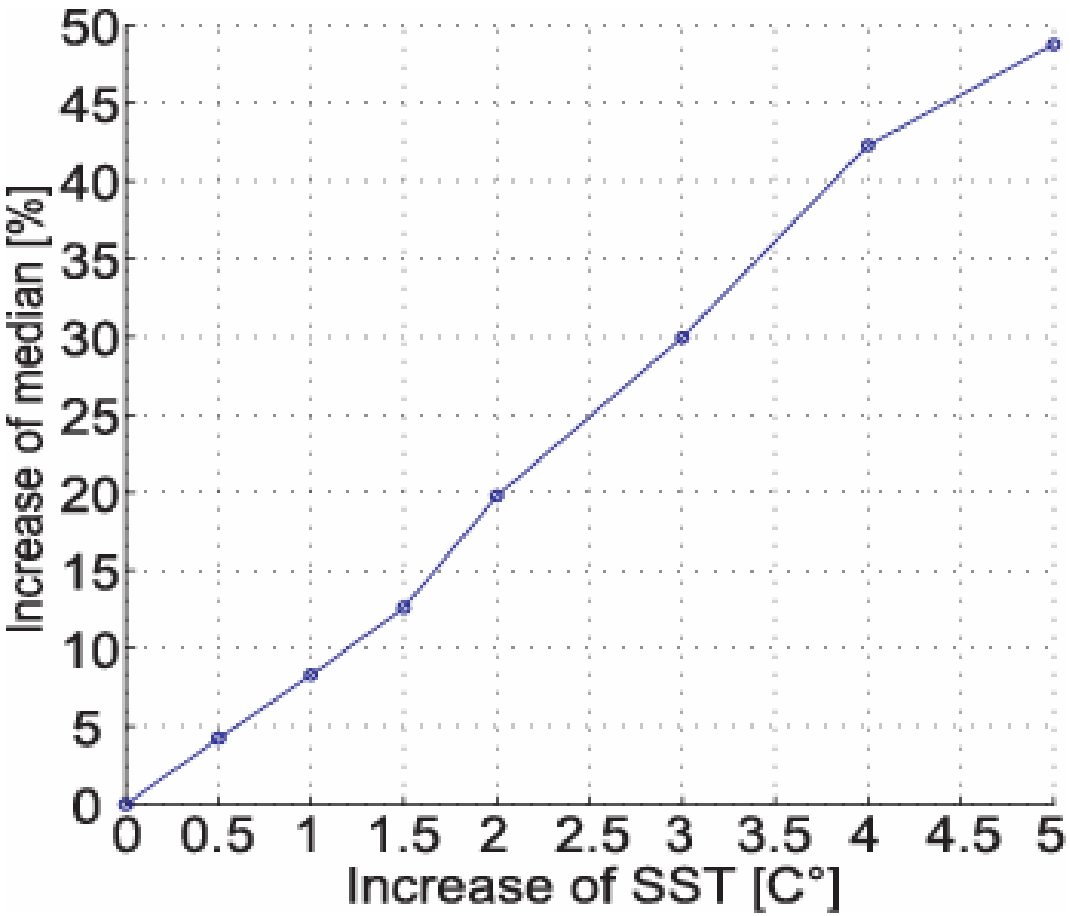


Policy change in regard to structural design may be required to maintain structural reliability.

Adapting the structural design



Conclusions

- Approach to adapt a typhoon model to climate changes is presented.
- Changes of the intensities of extreme wind speeds induced by typhoons due to SST increases are investigated.
- Significant increase of the probability of failure of structures may occur.
- Changes of the policies in regard to structural design may be required to maintain the present level of structural reliability.