Extreme response statistics

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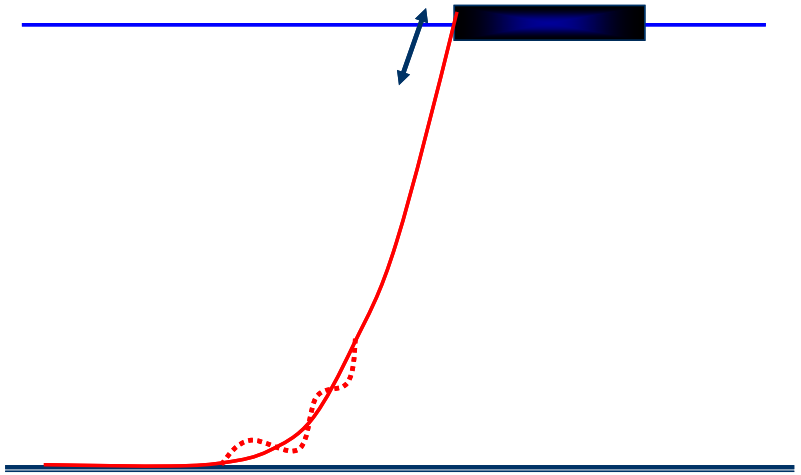
MARINTEK
Norsk Marinteknisk Forskningsinstitutt
SINTEF

Steel Catenary Riser from FPSO

Study performed at CeSOS and MARINTEK with Callas and Philippe Mainçon

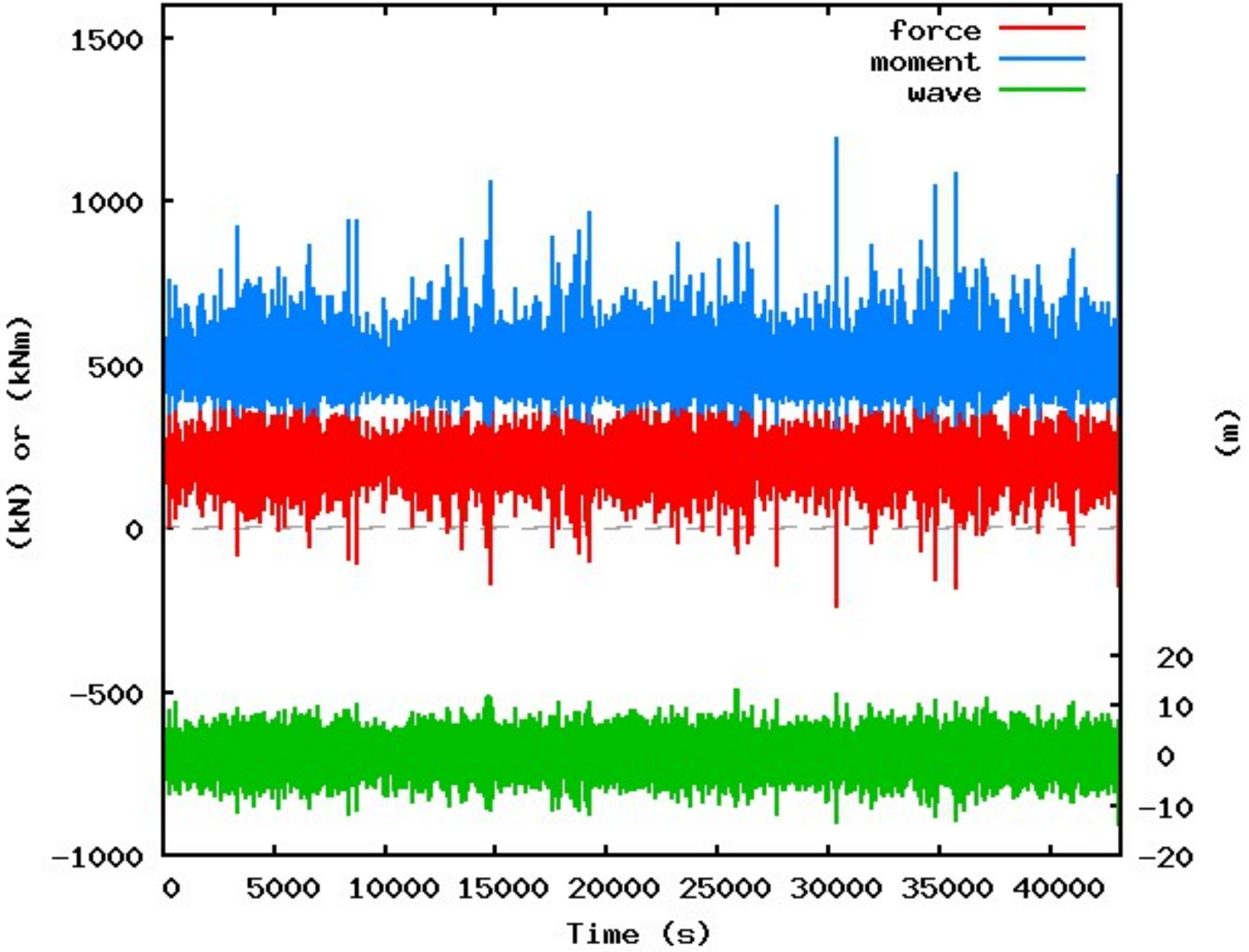


- Large heave motions cause large response near the seafloor
- Seeking the 20 year bending moment near the seafloor with 1 % probability of exceedance

Long-term extreme statistics

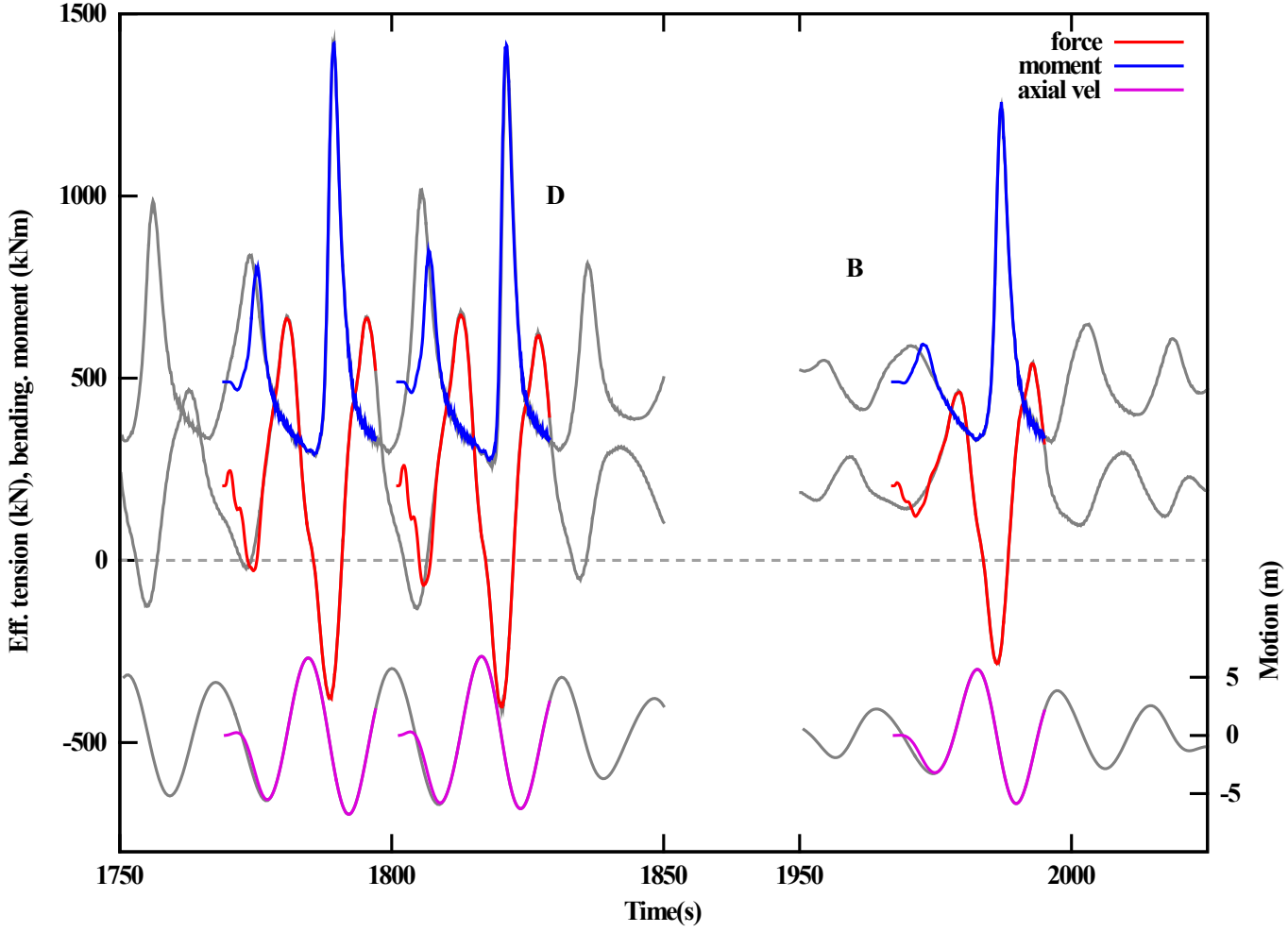
- Perform nonlinear simulations in ALL environmental conditions
  Simulations must be long enough to include contributions
- Accumulate results from all simulations using their relative probability
- Straightforward, but the extent of simulations is formidable

- Concentrate nonlinear simulations to sea states where there are significant contributions
- Can the simulations lengths be reduced?

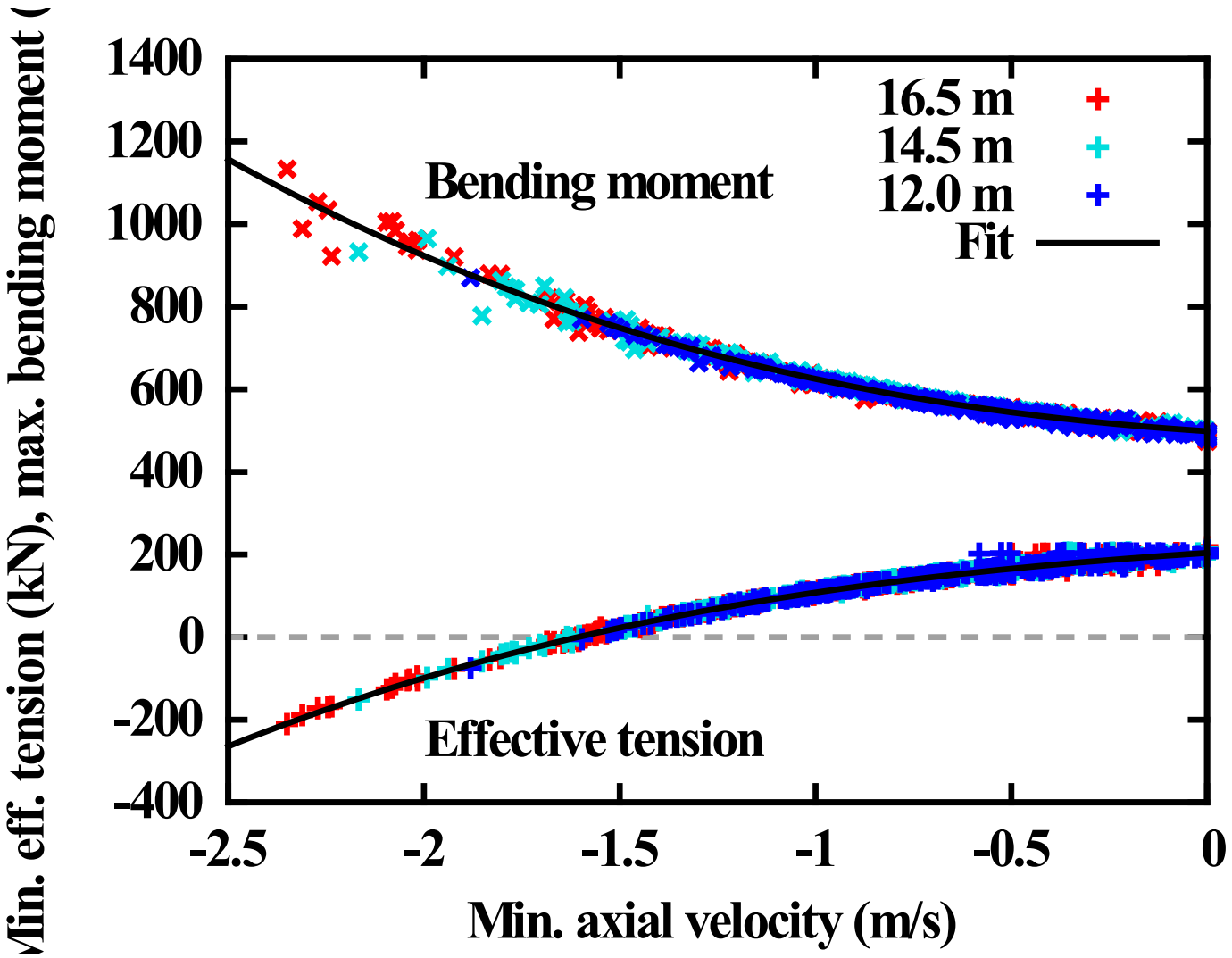

force
moment
wave
1500
1000
500
0
−500
−1000
(kN) or (kNm)
20
10
0
−10
−20
(m)
0
5000
10000
15000
20000
25000
30000
35000
40000
Time (s)

Simulation of selected intervals

1800 m water depth, 16.5 m sign wave height, 28 s intervals



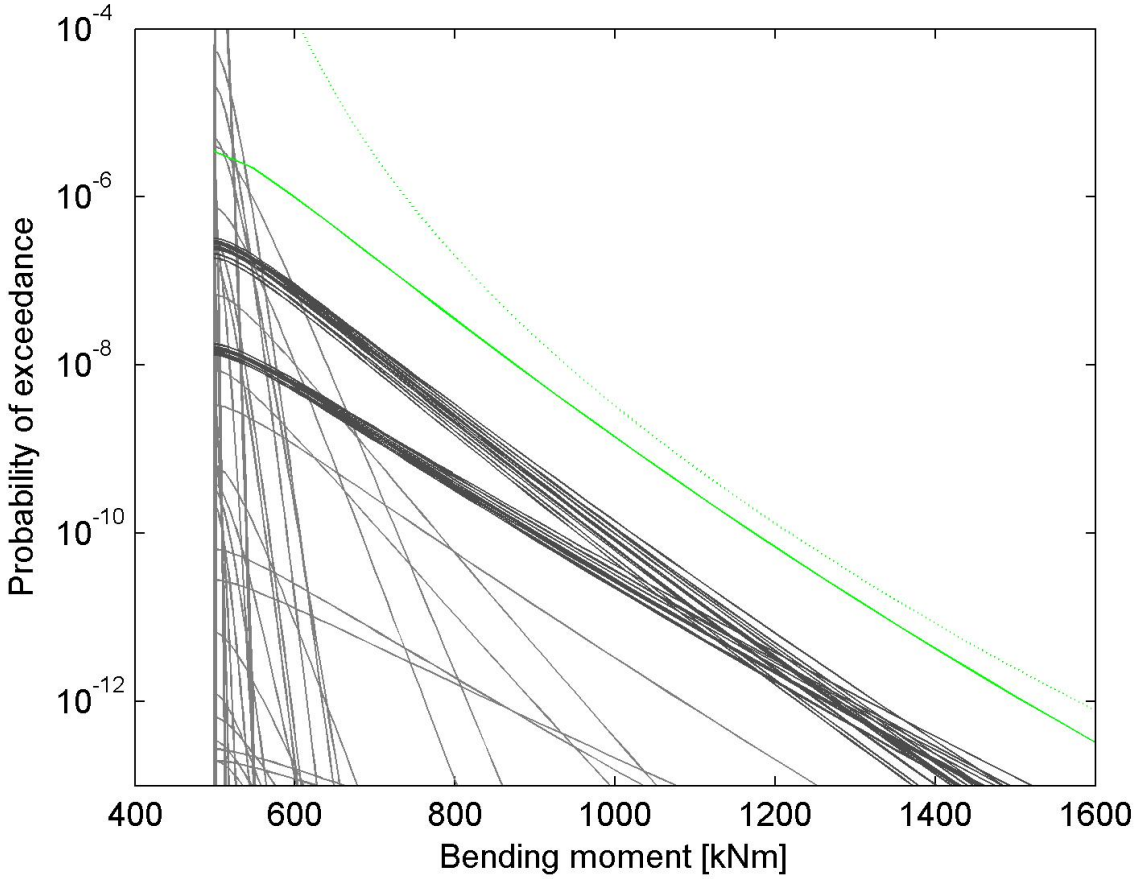
Corresponding maxima



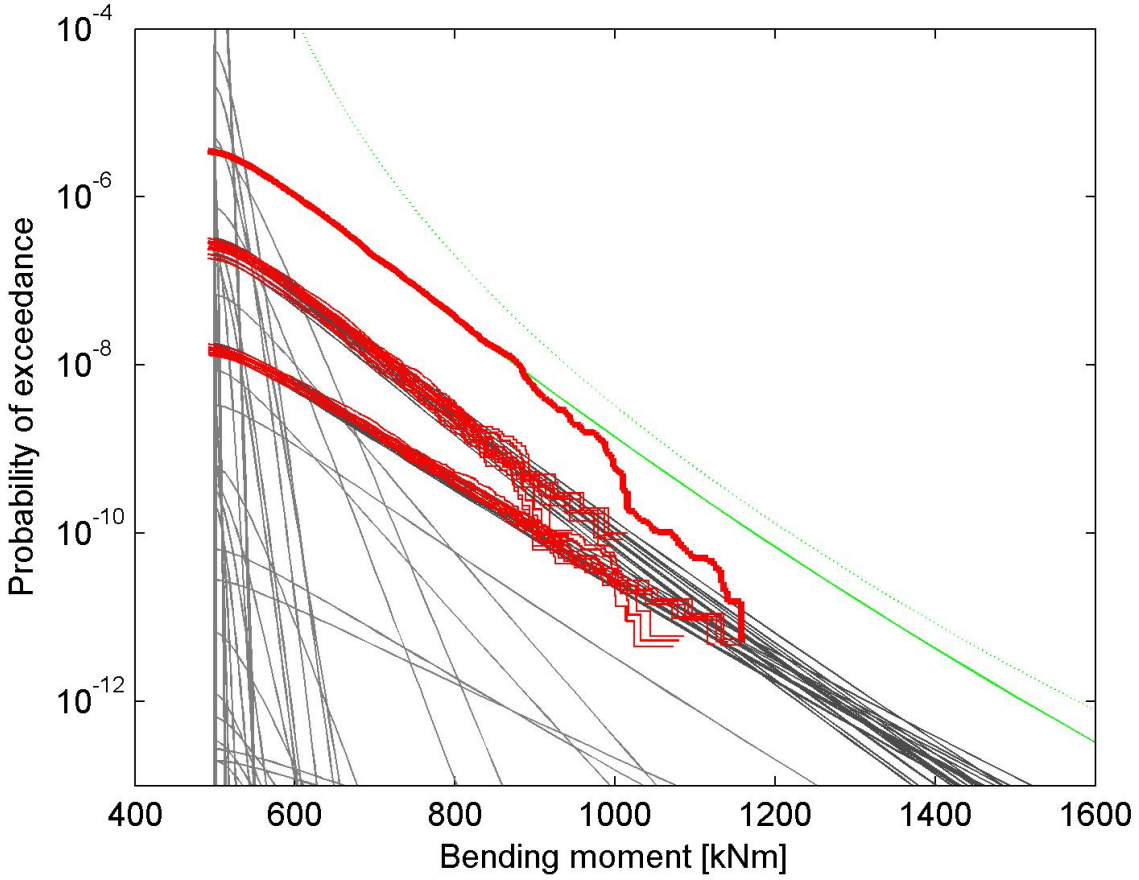
Our procedure

- Establish a nonlinear response predictor
- Predict the response in all 720 sea states and find the long-term extreme response
- Select sea states and intervals within sea states for simulations
- Combine the maxima samples from the simulations to the long-term distribution at the identified response level

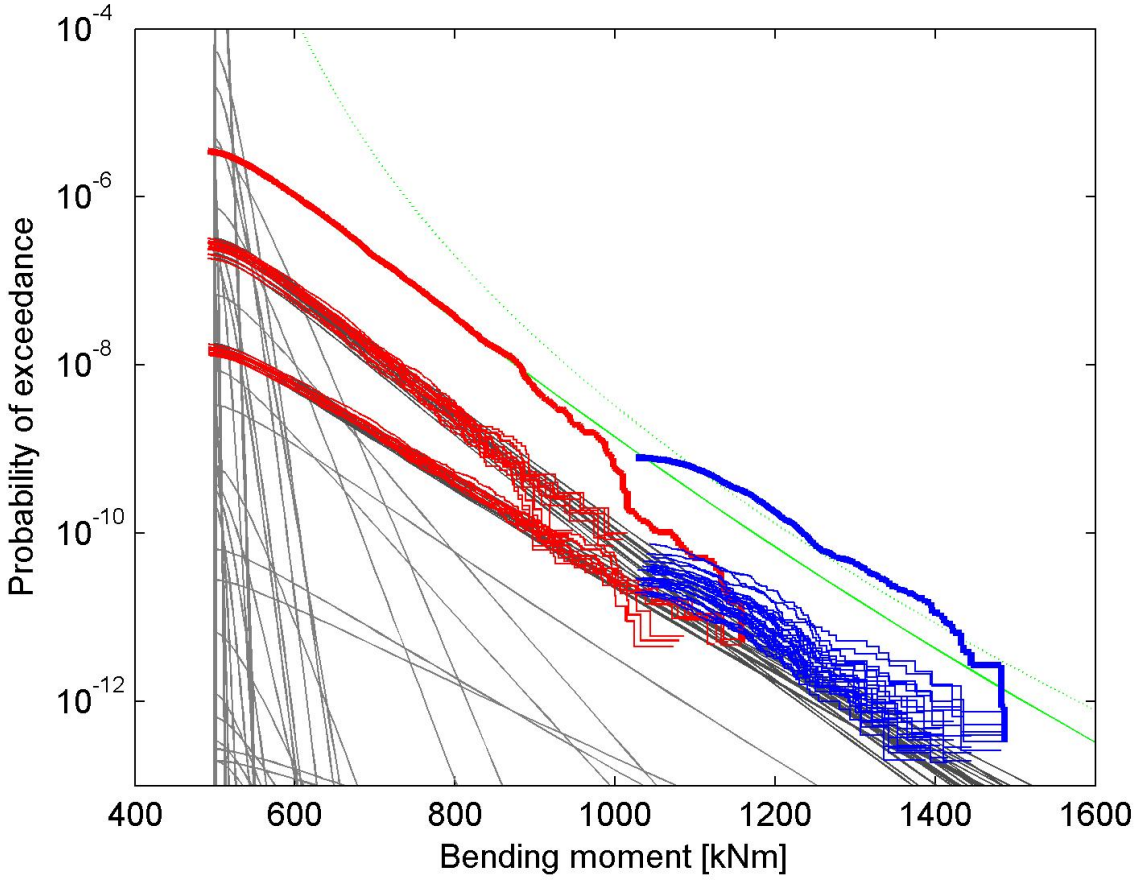
Predicted long-term response from the nonlinear predictor



Long-term response from simulations (23 * 60 hours)



and from selected intervals (23 * 100 intervals)



Conclusions

- Response predictors can be used to select relevant sea states
- And relevant intervals

- Simulating selected intervals reduces simulation lengths
- And avoids extrapolation

- The method may also be used for selecting experimental conditions

Thank you!