ASME® OMAE 2021
International Conference on Ocean, Offshore & Arctic Engineering

A 2nd benchmarking exercise on estimating extreme environmental conditions

EC Benchmark 2

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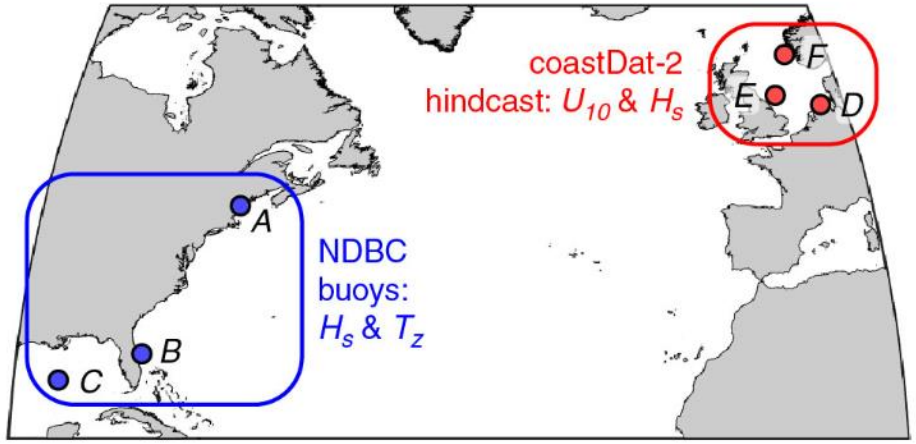
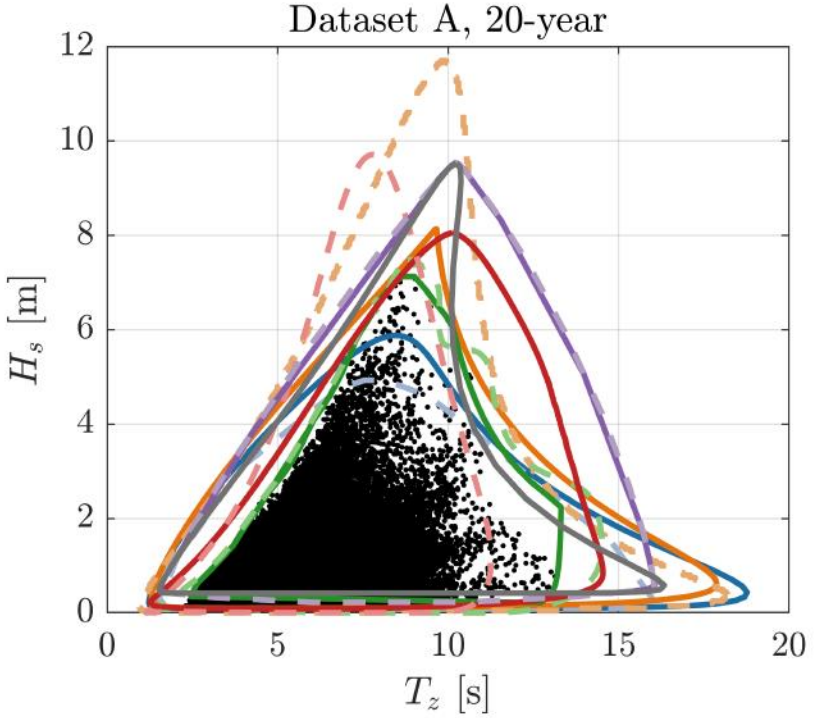
Background: EC Benchmark 1

- Announced at OMAE 2019[1]
- Comparison of method for calculating environmental contours, using common datasets
- Entries from 9 teams from 15 organisations and 8 countries
- Results presented at OMAE 2020 and in special issue of Ocean Engineering[2,3]
- Large variation between contours from different groups
- Main differences due to
  - Statistical model
  - Contour method
  - Serial correlation



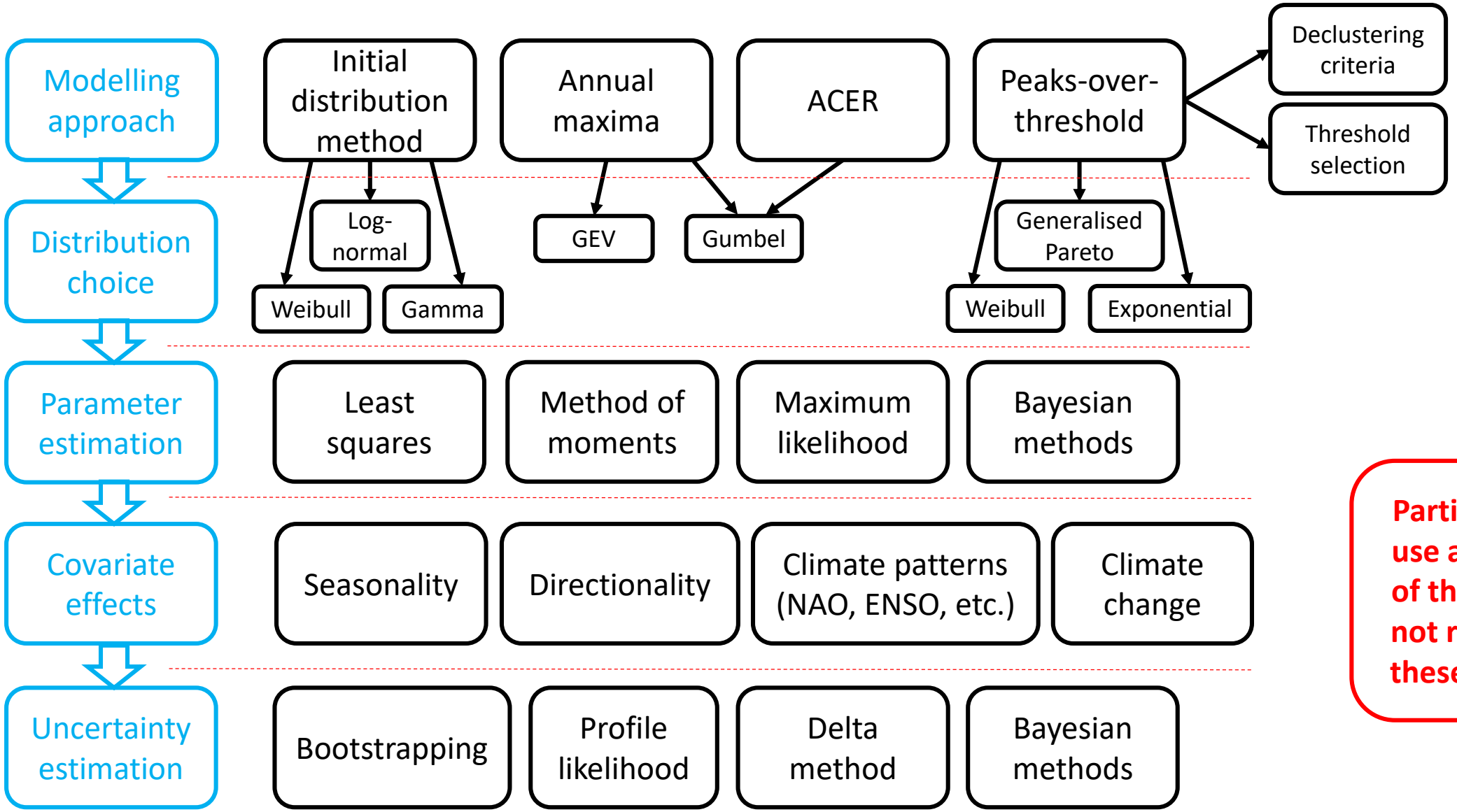


1. A.F. Haselsteiner et al., "A Benchmarking Exercise on Estimating Extreme Environmental Conditions: Methodology and Baseline Results," Proc. OMAE2019, Glasgow. DOI:10.1115/OMAE2019-96523.
2. A.F. Haselsteiner et al., "A benchmarking exercise for environmental contours," Submitted to Ocean Engineering, 2021.
3. G. de Hauteclocque et al., "Quantitative assessment of environmental contour approaches," Submitted to Ocean Engineering, 2021.

Motivation for EC Benchmark 2

- Further examine effects of statistical modelling choices
- Use ultra-long datasets from a global climate model (FIO-ESM) to provide quantitative assessment of methods
- Focus on univariate extremes to highlight effects of modelling choices

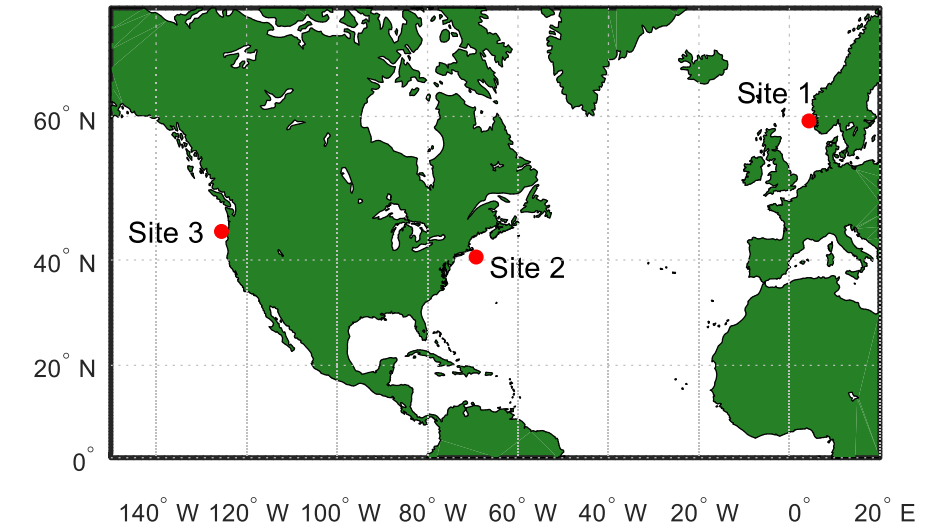
Examples of modelling options for univariate extremes



Participants can use any method of their choice – not restricted to these examples!

FIO-ESM 2.0 climate model datasets

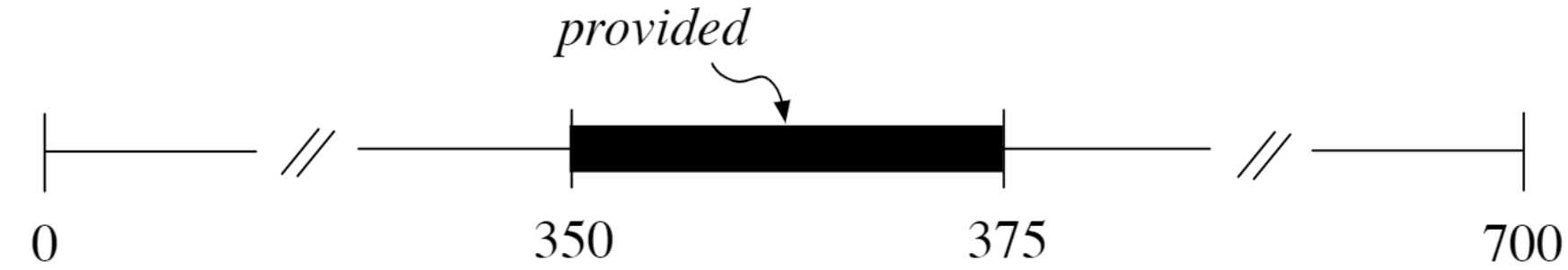
- Global wave model forced by climate model data[1,2]
  - Approx 1° × 1° grid
- Datasets contain:
  - Hs, Tp, Tz, mean wave direction
  - 3 hr time step
- Various runs:
  - 700-year quasi-steady state pre-industrial climate
  - 165-year historical run
  - 3 × 85-year future CMIP6 climate scenarios
  - 2 × 150-year CO_2 sensitivity experiments



- 3 locations used for EC Benchmark 2

1. Y. Bao et al. 2020, "FIO-ESM Version 2.0: Model Description and Evaluation". Journal of Geophysical Research: Oceans, 125(6), pp. 1–21.
2. Z. Song et al. 2020, "Centuries of monthly and 3-hourly global ocean wave data for past, present, and future climate research". Scientific Data, 7(1), pp. 1–11.

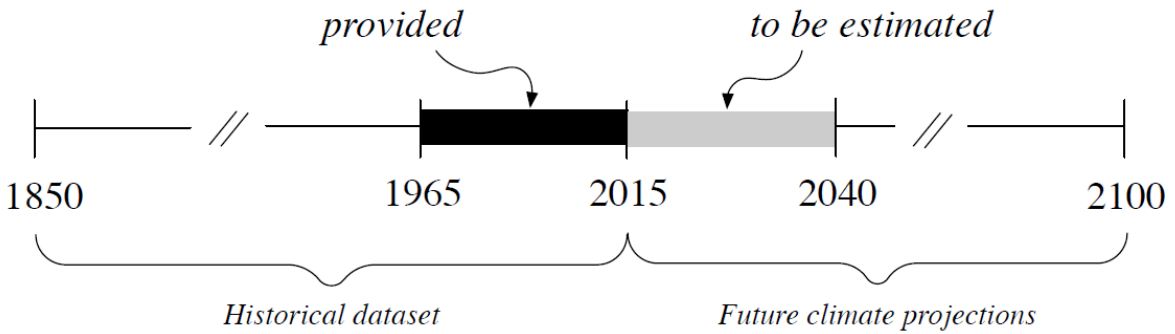
Exercise 1: Estimation of extremes in a steady state climate



Pre-industrial control dataset (years in steady-state period)

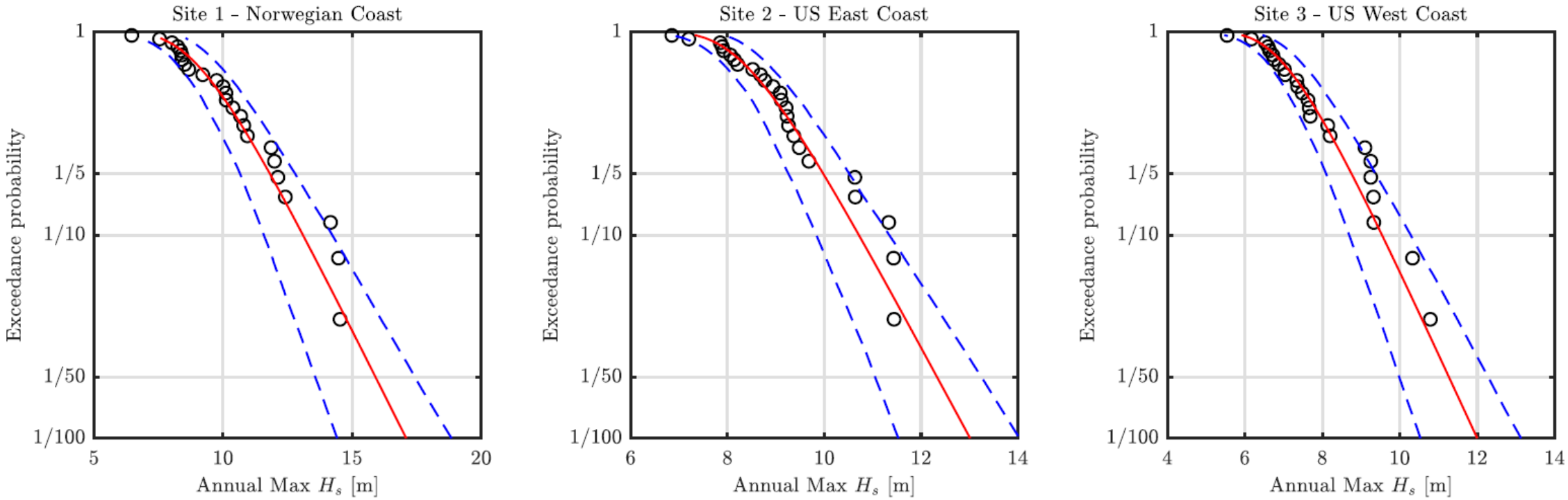
- Uses data from 700-year quasi-steady state pre-industrial control runs
- Participants provided with 25-year time series from central portion of dataset
- Task: Estimate return values of Hs at return periods of 5, 50, 500 years, plus 95% CI for estimates
- Participants **can use any method of their choice**
- Results will be compared to empirical estimates from 700-year dataset

Exercise 2: Estimation of extremes in a changing climate



- Intended to be representative of typical design problem:
  - Predict distribution of conditions over projected lifetime, based on historical data
- Participants provided with last 50 years of historical dataset
- Task:
  - Estimate the distribution of the maximum Hs over the subsequent 25-year period, $F_{25}(x)$
  - Provide estimates of quantiles of $F_{25}(x)$ and 95% CI at exceedance probabilities of $(1 - 1/N)^{1/25}$, for $N = 5, 50, 500$
- Participants:
  - **Can use any method of their choice**
  - Optional whether to estimate effects of climate change
- Results will be compared to empirical estimates from first 25 years of the 3 future climate runs

Baseline results – Exercise 1 (steady state)



- Annual maxima method
- Fitted with Gumbel distribution
- Parameters estimated using method of moments

- No covariate effects included
- Confidence bounds estimated using bootstrapping

Can you do better?!

Goals of EC Benchmark 2

- Examine differences in estimates of extremes resulting from the wide range of modelling choices
- Compare uncertainties when climate is either:
  - Steady state (exercise 1)
  - Changing (exercise 2)
- Prompt further development of the state of the art
- Promote discussion and collaboration between researchers

How to participate

- Indicate your interest by email: ecbenchmark@gmail.com
- GitHub repository holds:
  - Datasets
  - Baseline results (and code to reproduce them)
  - Up-to-date information
  - https://github.com/ec-benchmark-organizers/ec-benchmark-2
- Submit results by March 31st 2022
- Participants can present their own results at OMAE 2022
- All results will be presented at OMAE 2023

Thanks for your attention

Hi organisers,
I am considering participating
in EC Benchmark 2
Best, X. Treme

ecbenchmark@gmail.com

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