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Stochastic Weather Generator for Extreme waves

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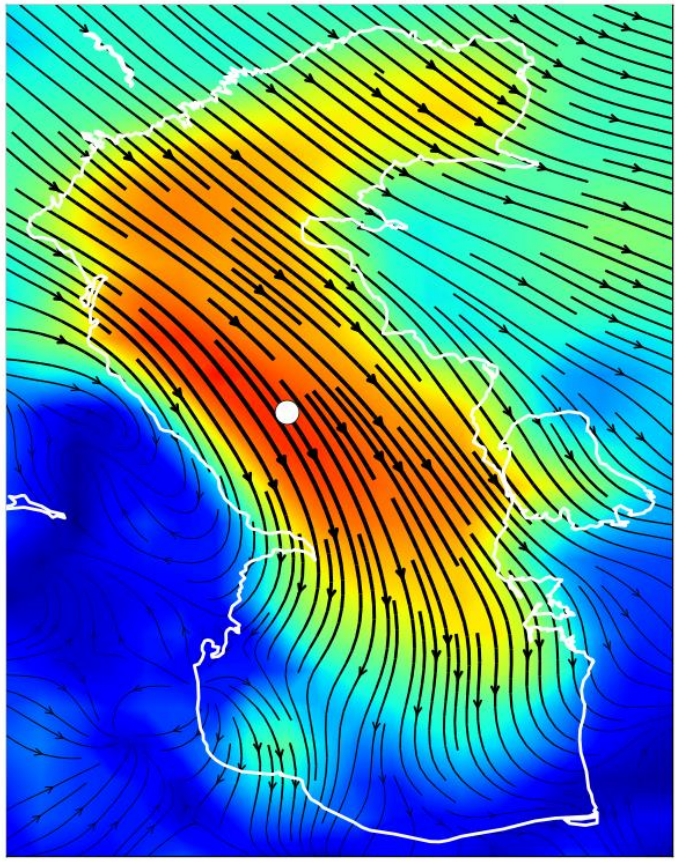
Spatio-Temporal Weather Generator

General idea:

To produce synthetic time series of weather data of unlimited length based on the statistical characteristics of weather data



Motivations:

- Energy demand – cold spells
- Damage induced by extreme events (Insurance Industry)
- Fraction of Attributable Risk (FAR) analysis

In this talk:

- Extreme waves for the Caspian Sea
- Based on stochastic winds

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Caspian Sea description

- *1000 km long x 600 km wide in the largest*
- *Deep water reaching 1000 m*

- *Spectral wave model SWAN*
- *Forced by CFSR 1 data (12hrs / 0.5º)*
- *1979 -> 2011 (32 years)*
- *8km grid (90 x 154 nodes)*

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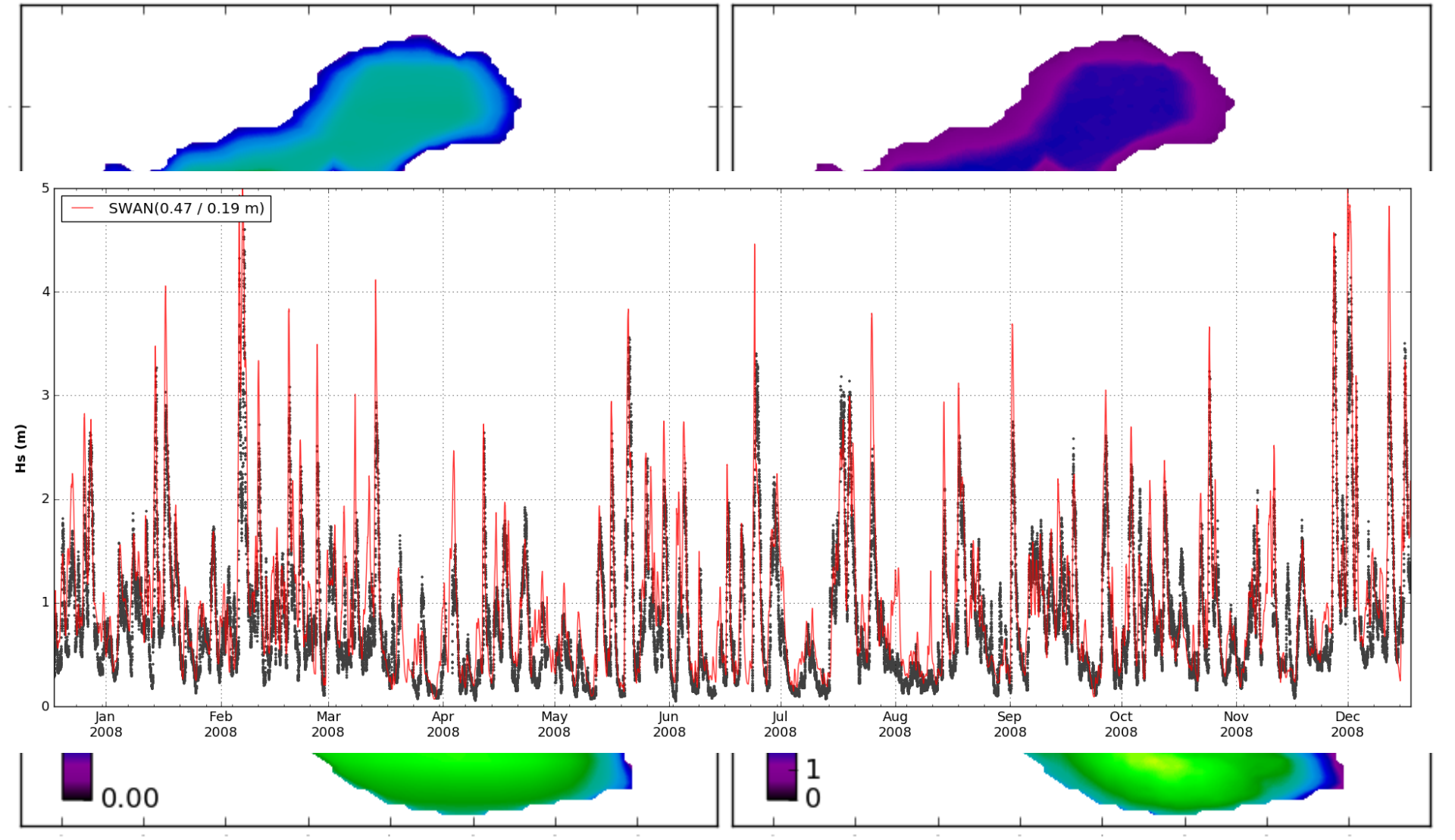
Caspian Sea wave climate



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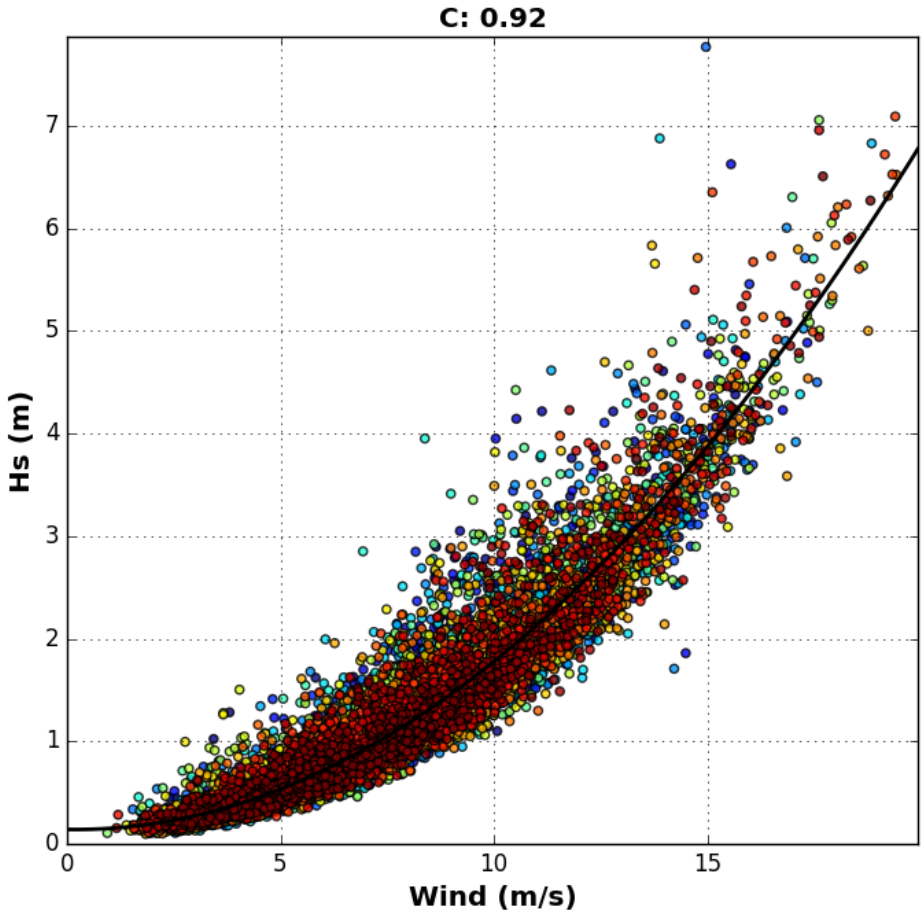
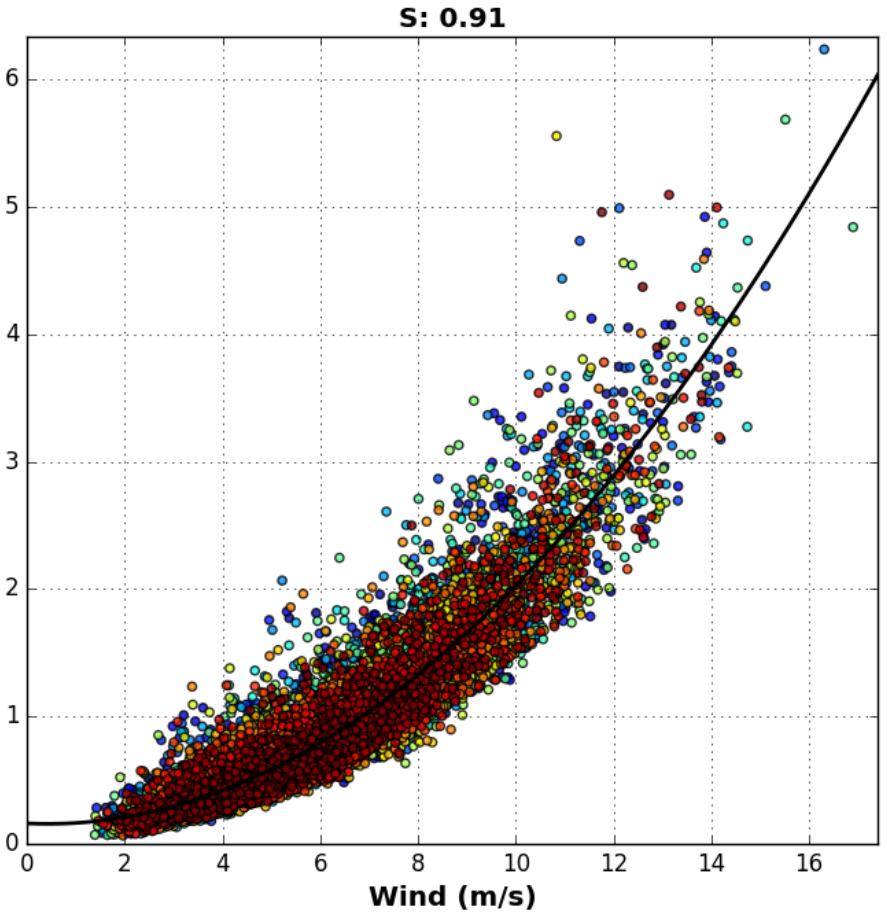
Relation Wind / Waves

- Highly correlated (swell-free)





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Methodology

Concatenate variables

Monthly means

Decompose in
and high (daily

Periodically extended EOF simulation of monthly means

Generation of daily
monthly mean

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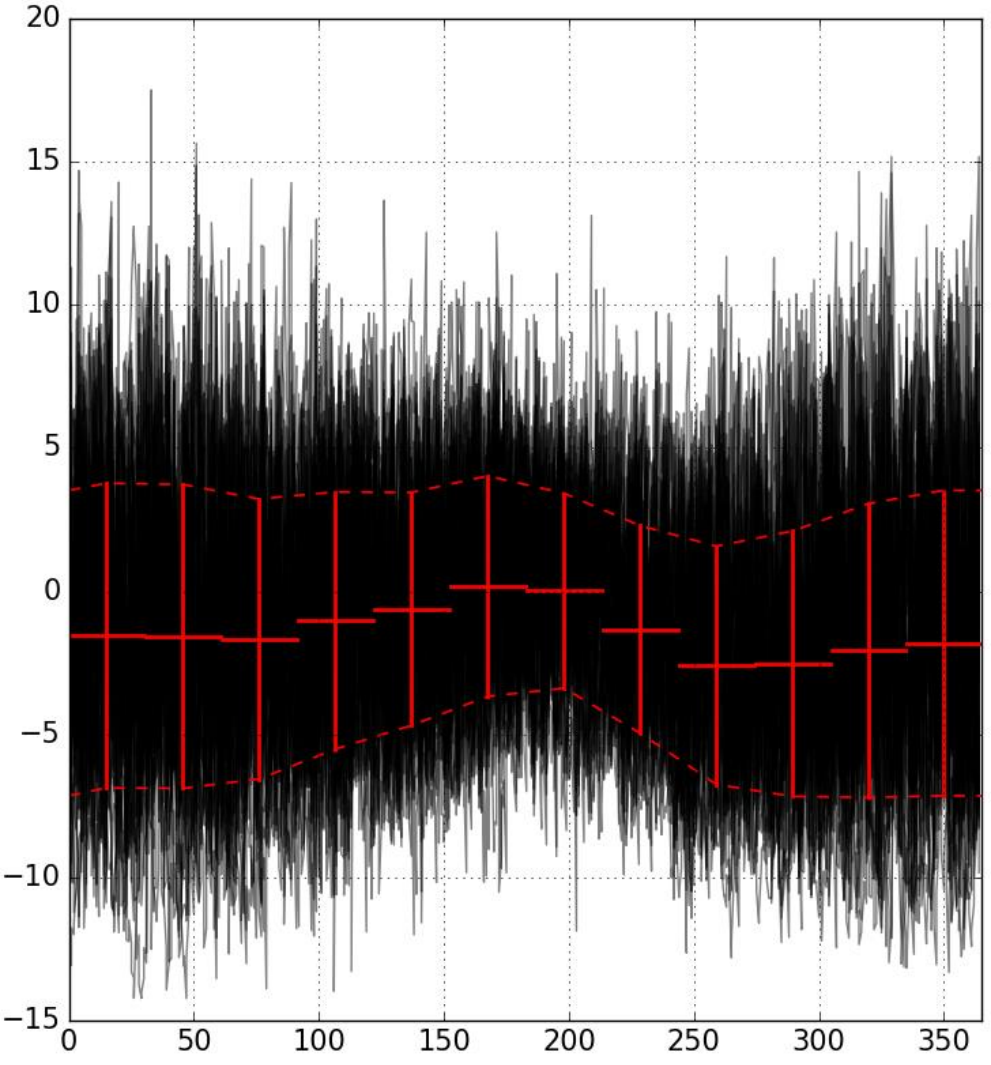

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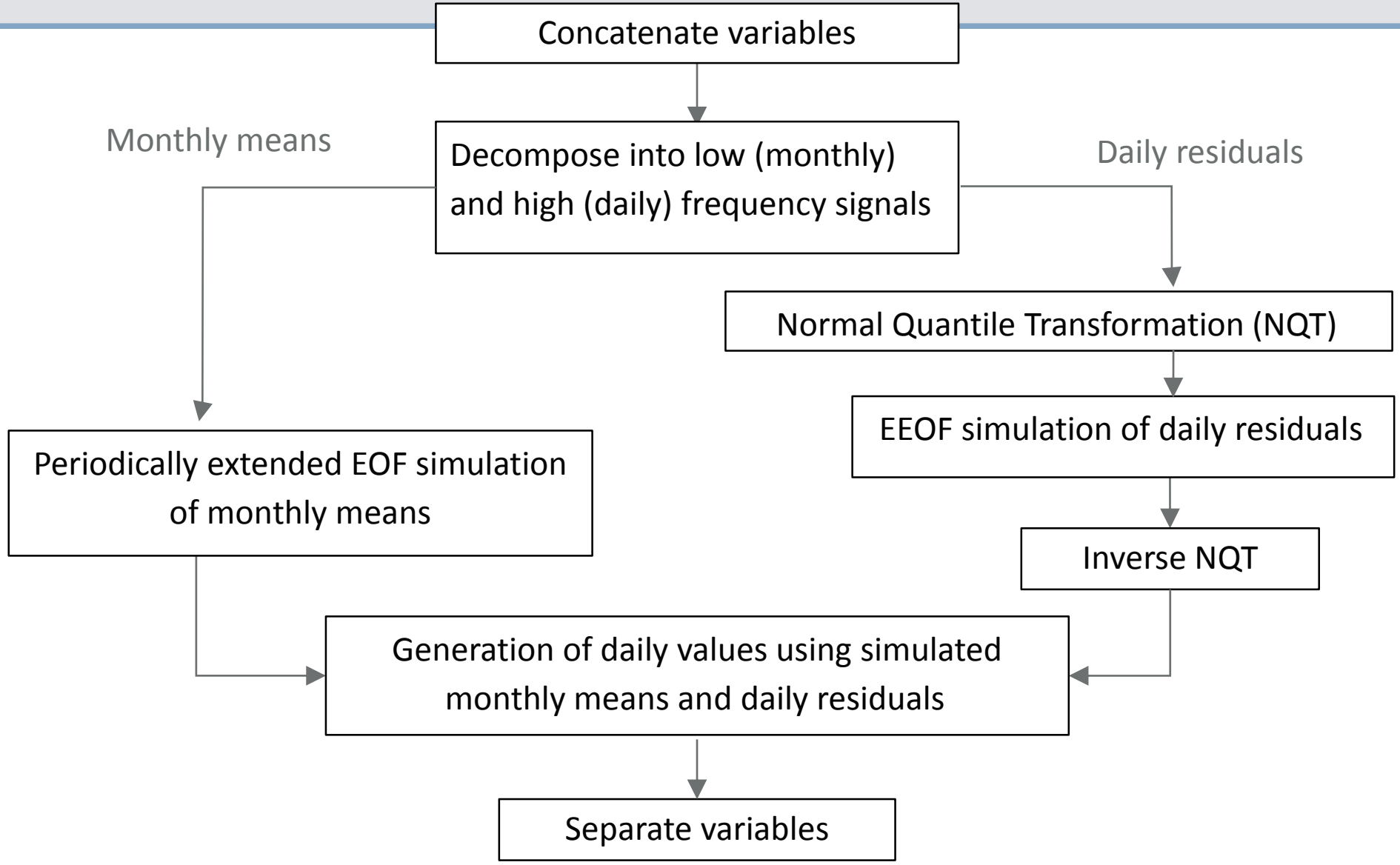
Methodology



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Methodology

Concatenate variables

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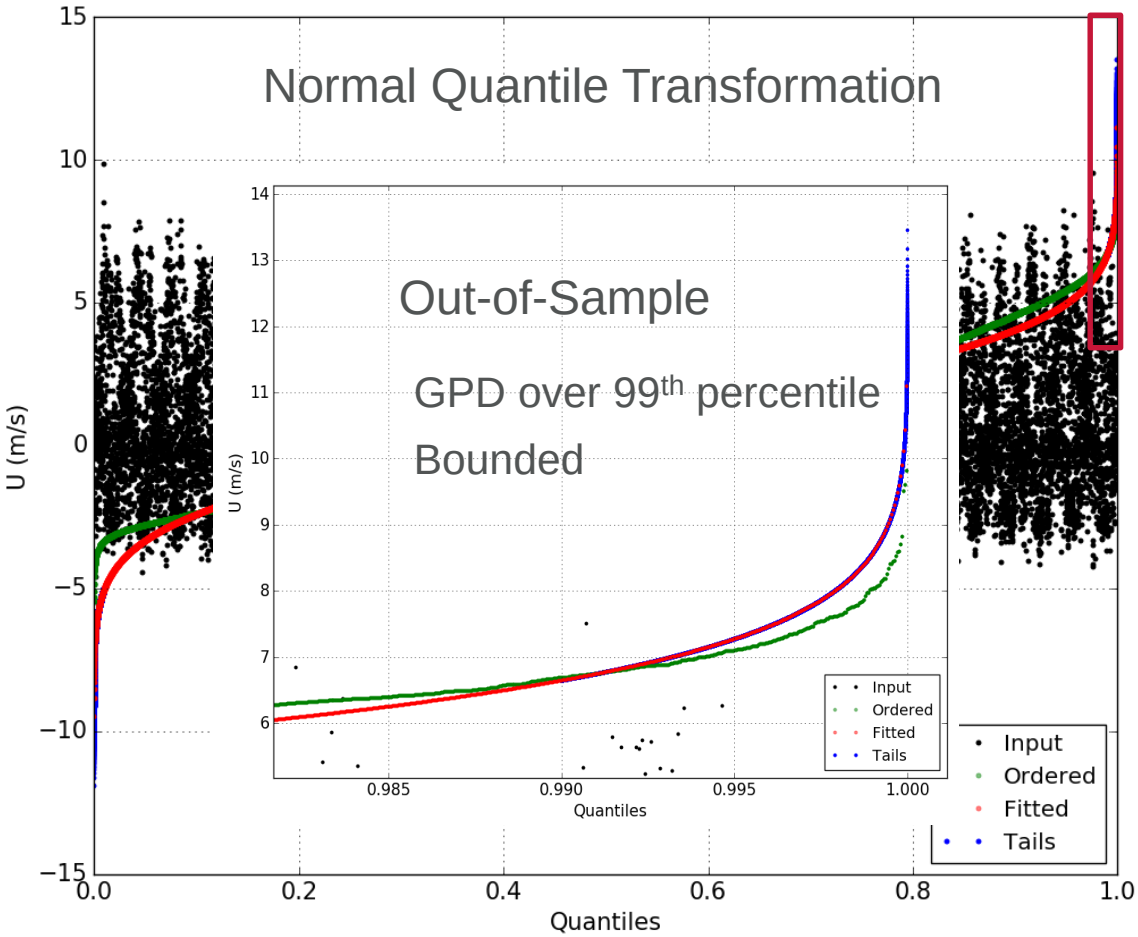
Daily residuals



nal Quantile Transformation (NQT)

EEOF simulation of daily residuals

Inverse NQT

simulated

siduals

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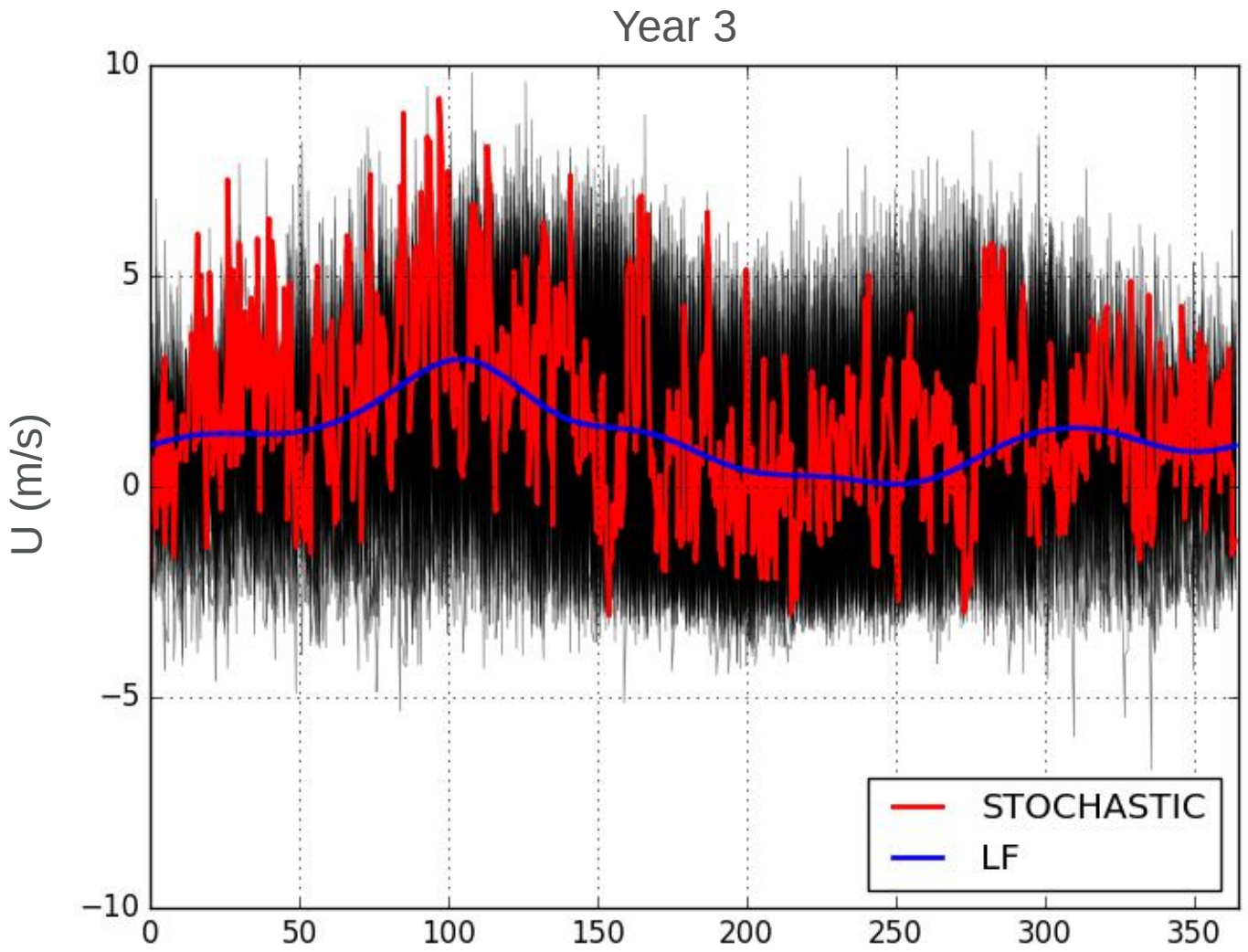
Methodology: built a stochastic year



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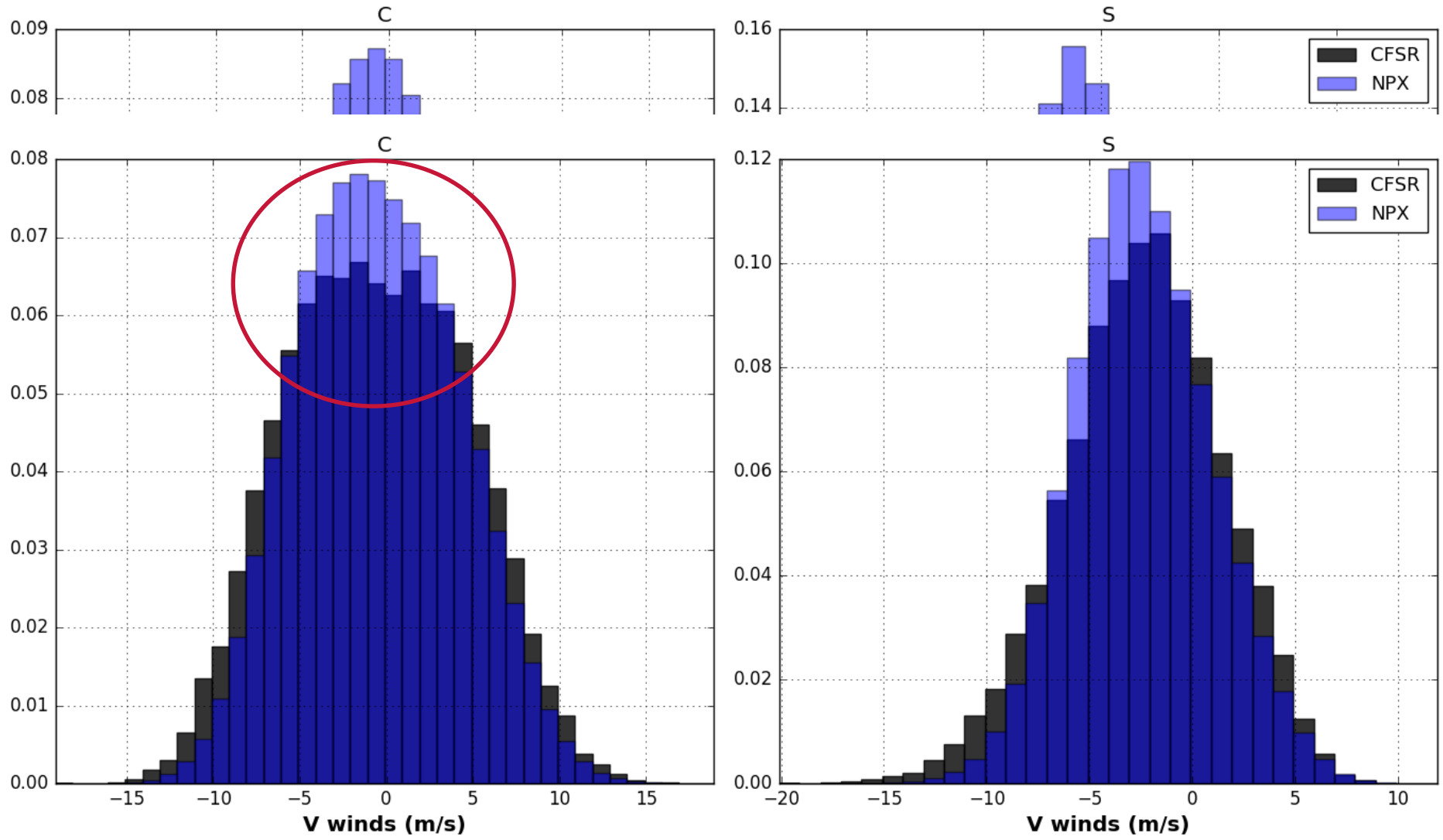
Stochastic model validation



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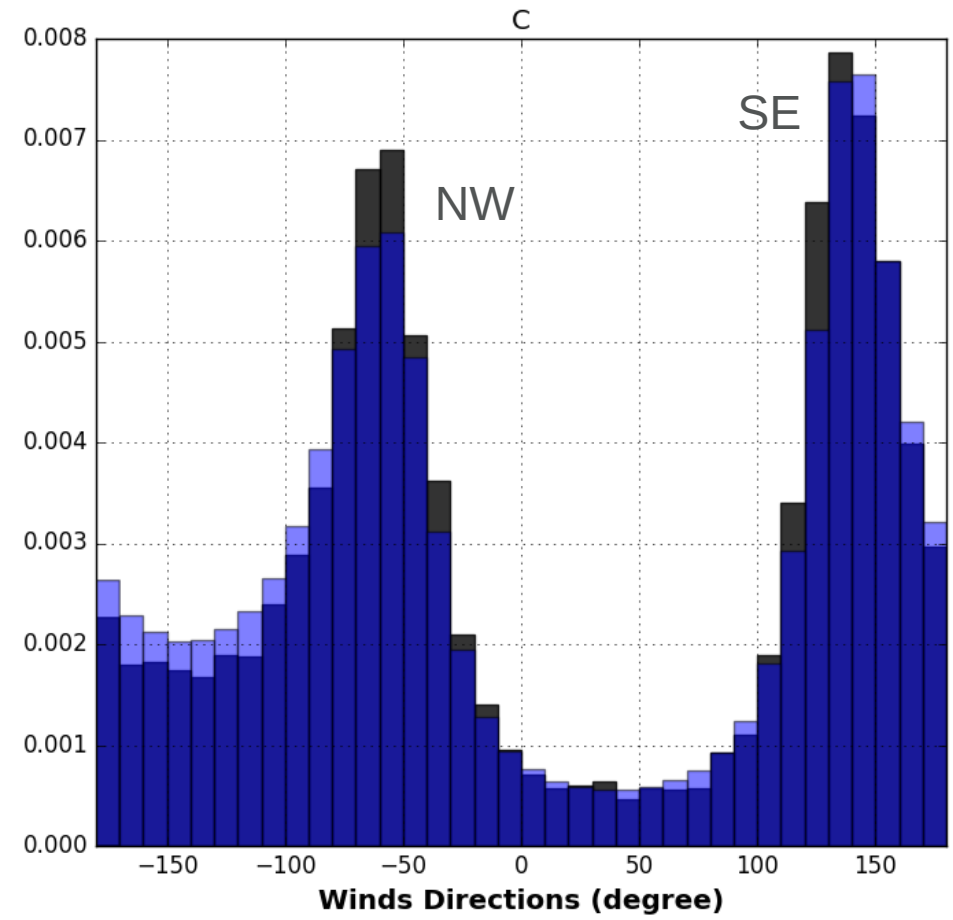
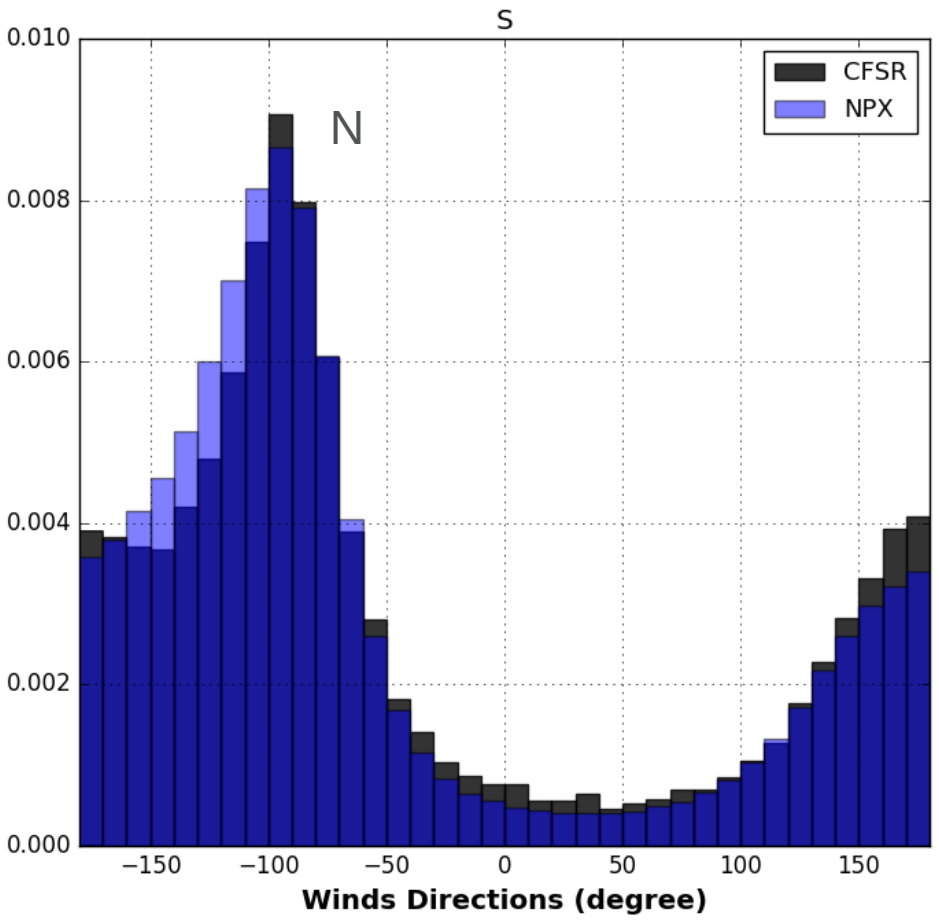
Stochastic model validation





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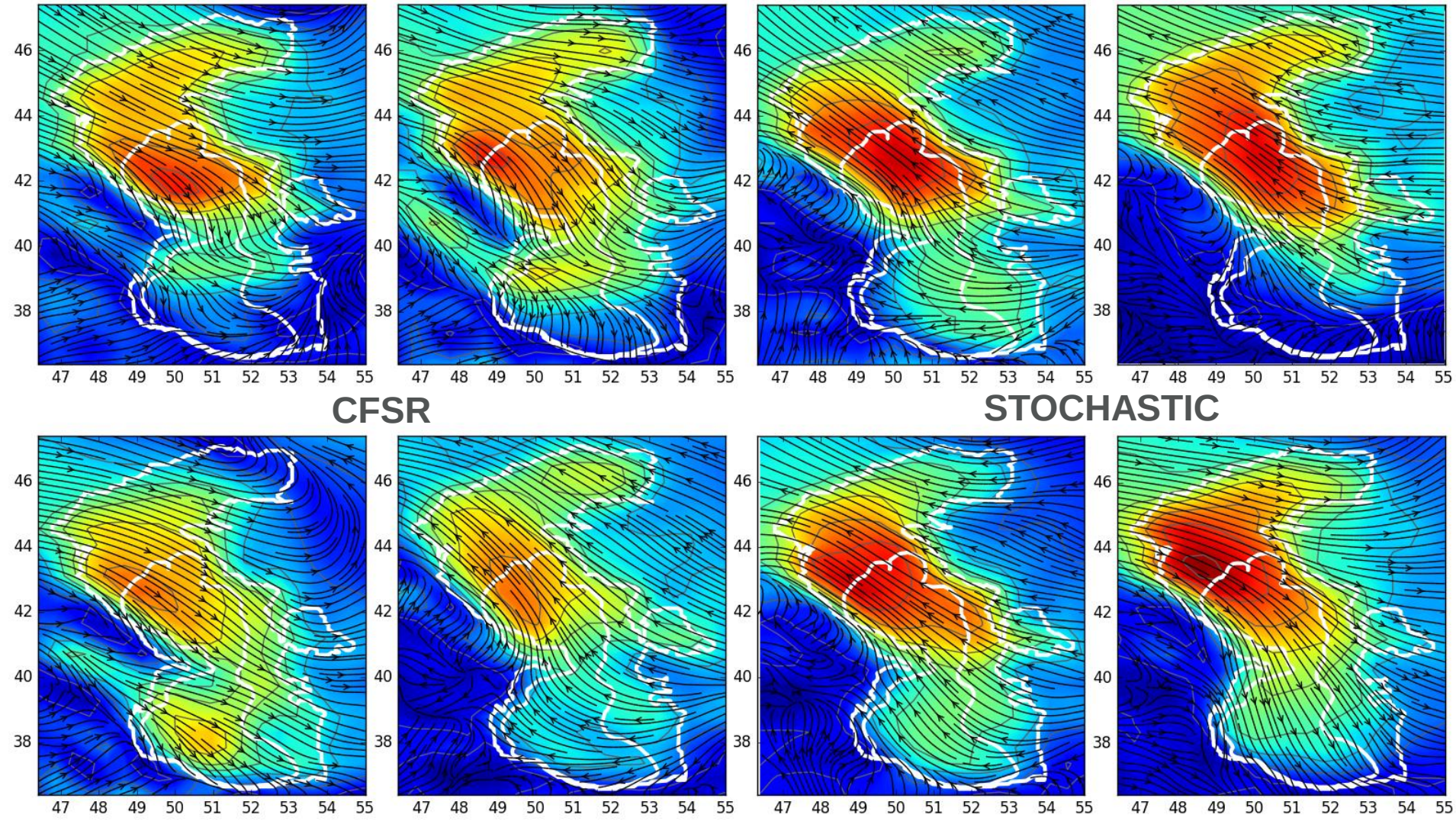
Some extreme events



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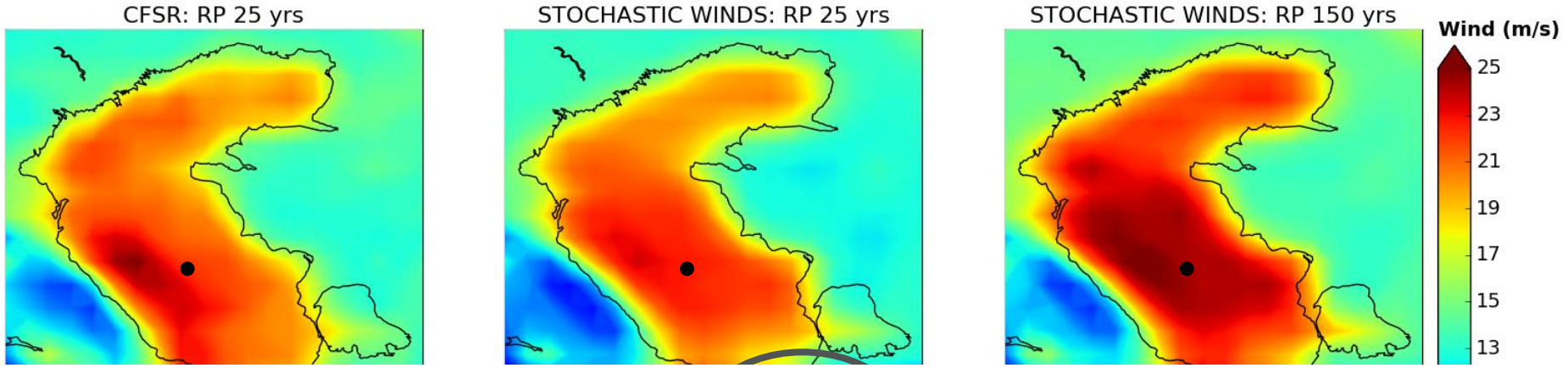
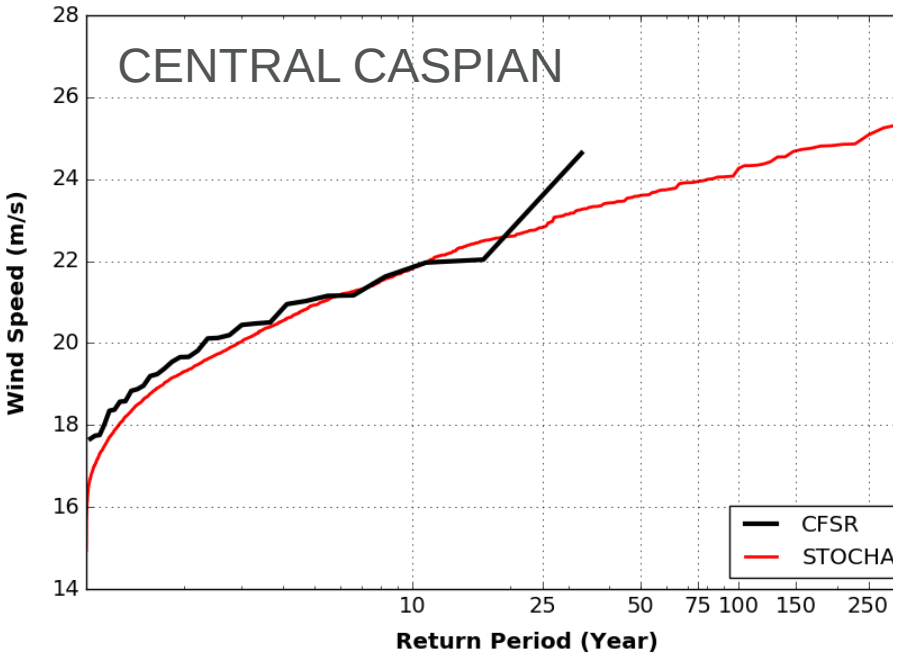
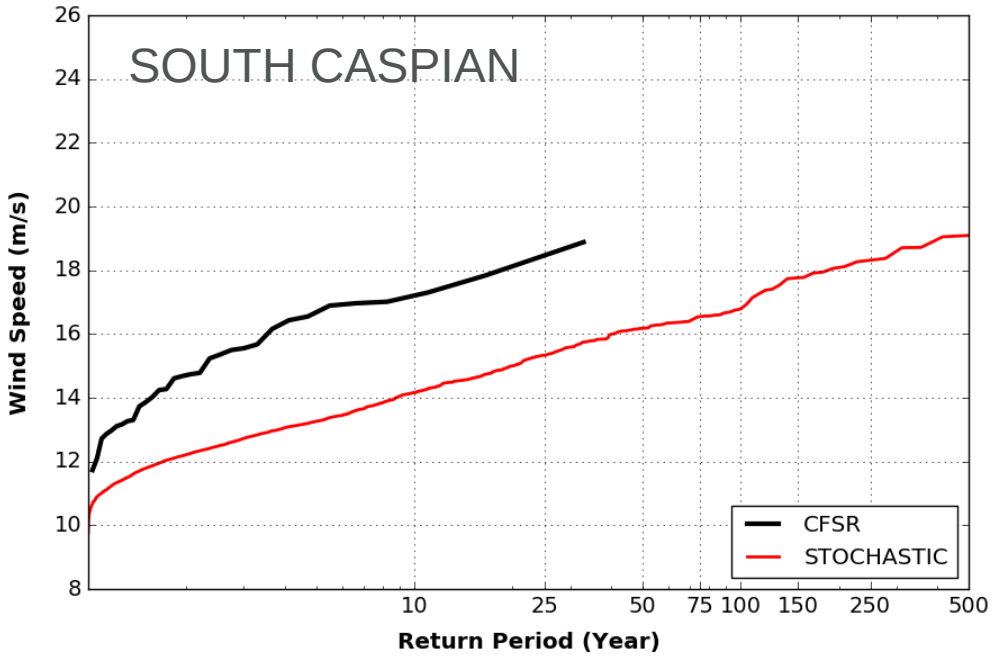
Wind RP curves & maps







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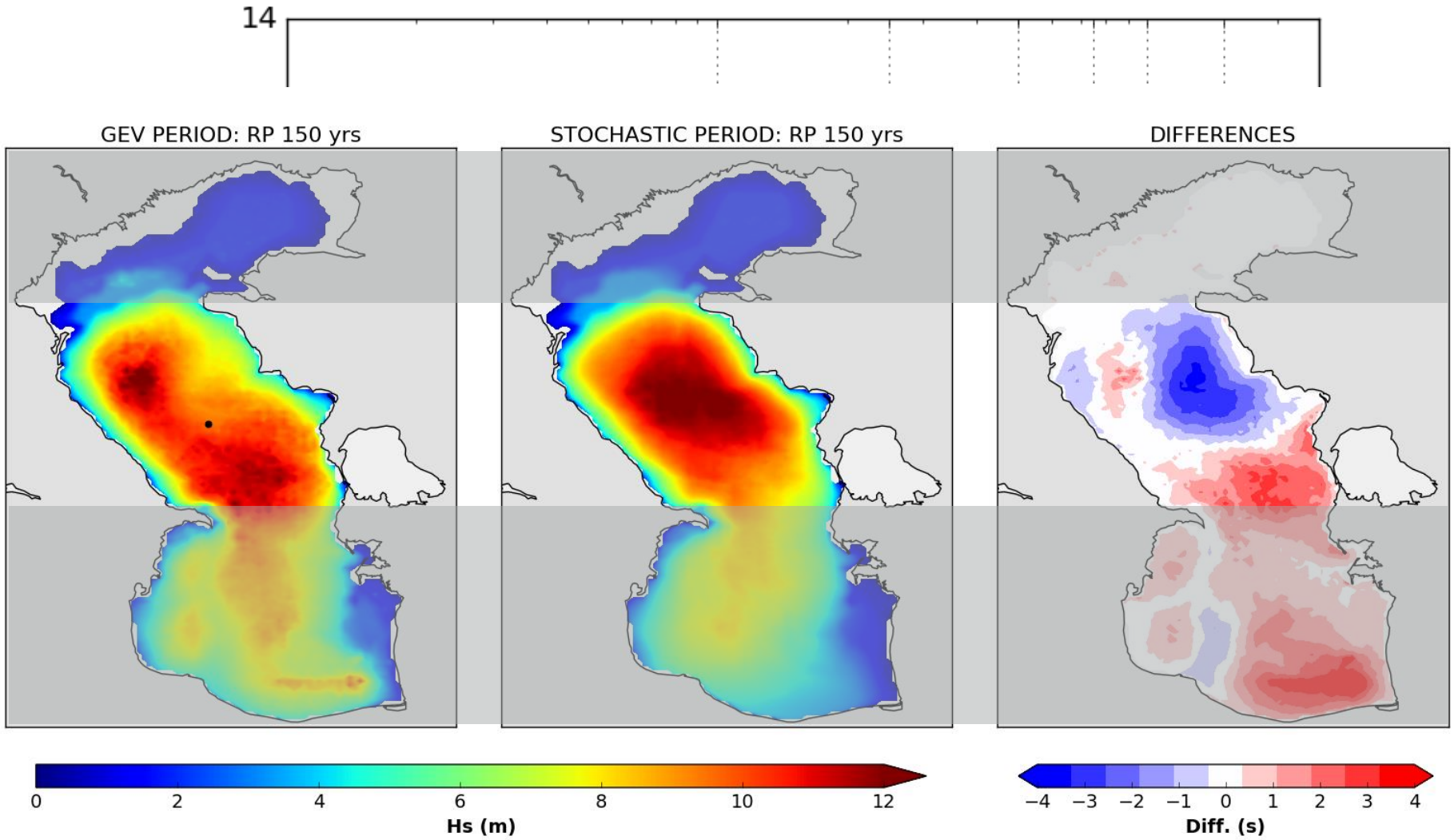
Wave Height RP curves & maps



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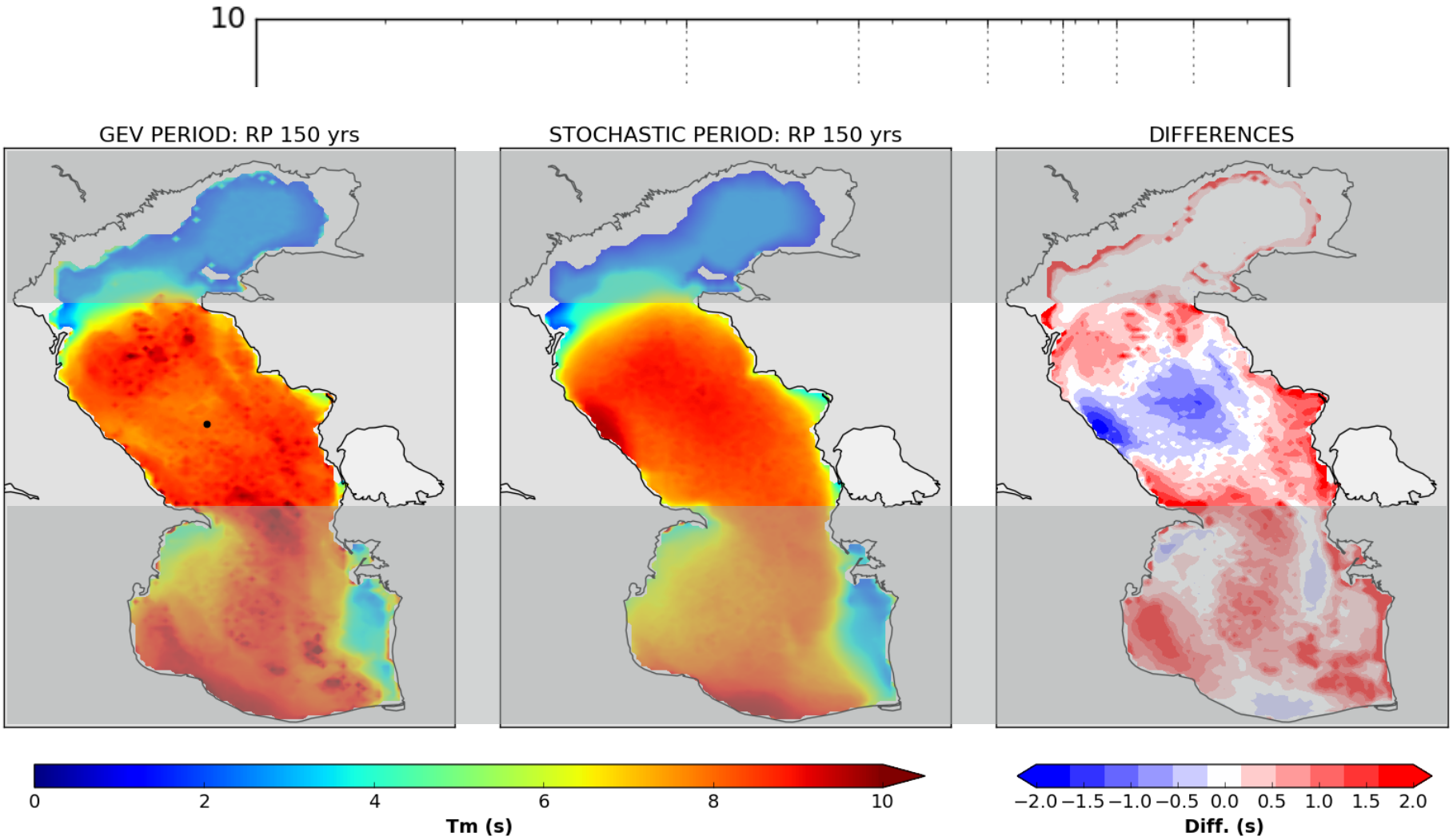
Wave Period RP curves & maps



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Conclusion and Perspectives

- *2500 years of stochastic winds*
- *Follows CFSR data with accurate distributions*
- *The spatial wind patterns are realistic*
- *Running a stochastic model for Hs and / or Tm for comparison*
- *Dig into differences between methods*