Efficient quantification of the impact of demand and weather uncertainty in energy system models

AP Hilbers [1], DJ Brayshaw [2], A Gandy [1]

1: Department of Mathematics, Imperial College London
2: Department of Meteorology, University of Reading

Climate forecasting for energy workshop

Uncertainty on time series inputs leads to *demand and weather uncertainty* on model outputs

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INPUTS

Demand & weather data at different locations on the grid

- Demand levels
- Wind speeds
- Solar irradiances

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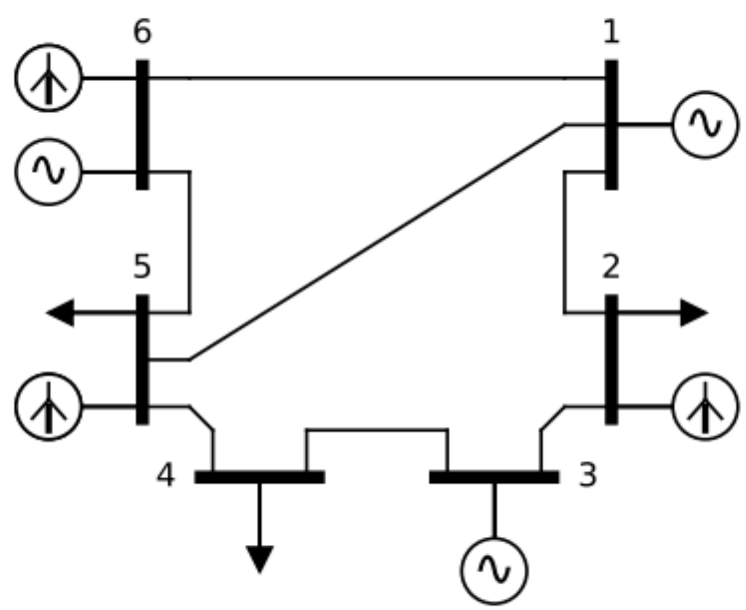

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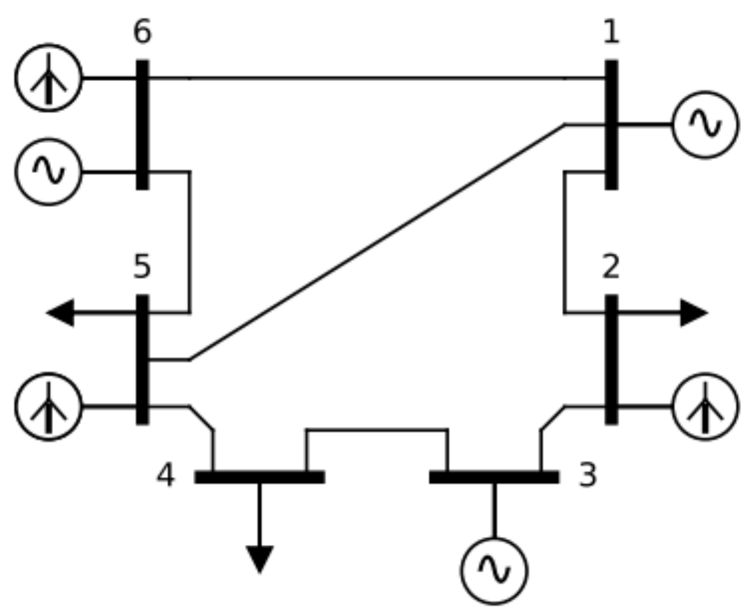

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- Hourly generation levels of different technologies
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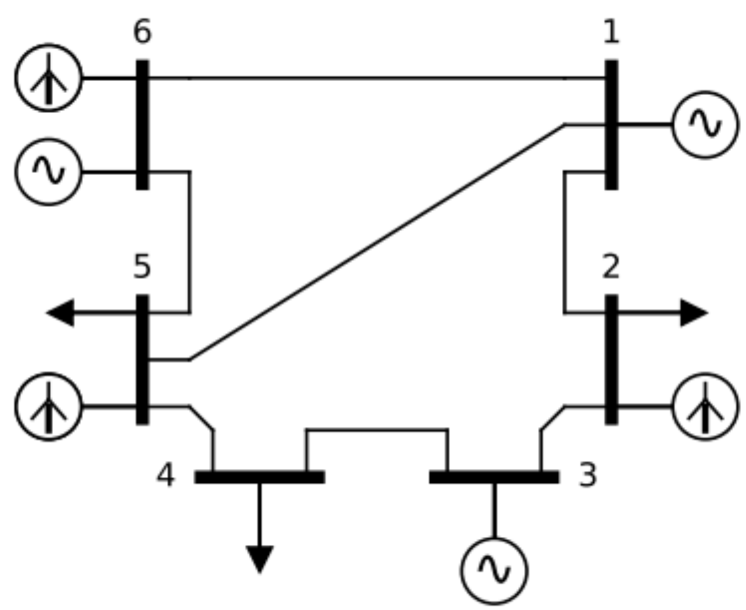

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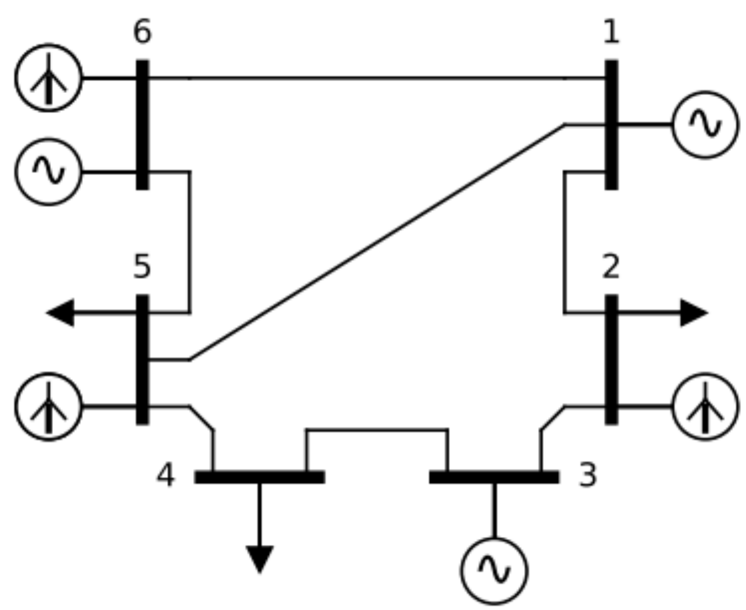

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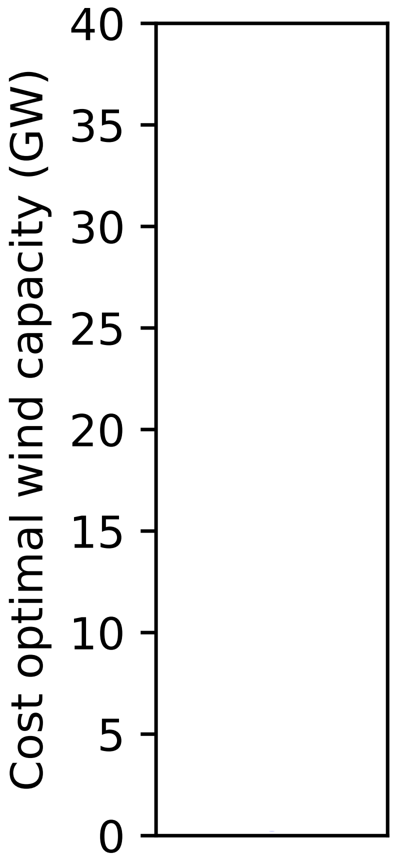

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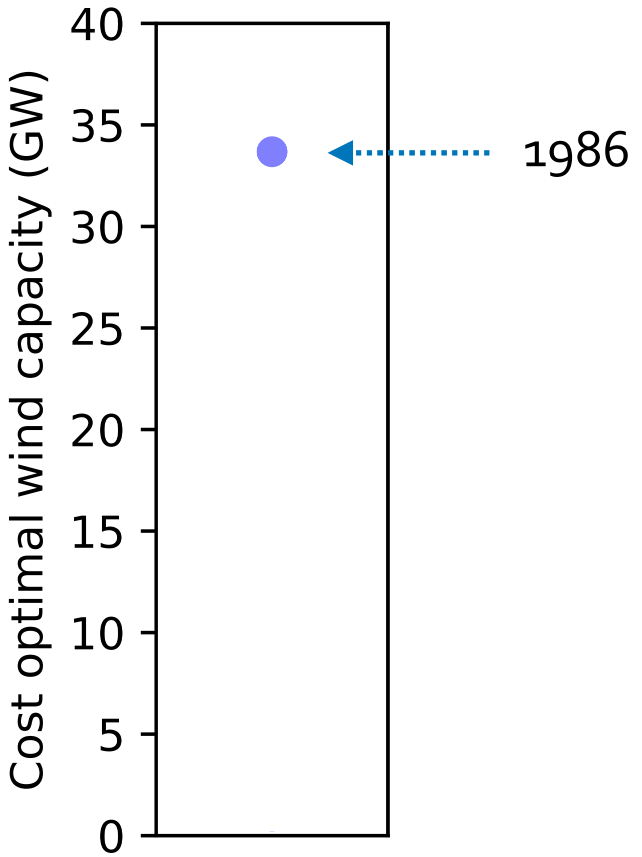

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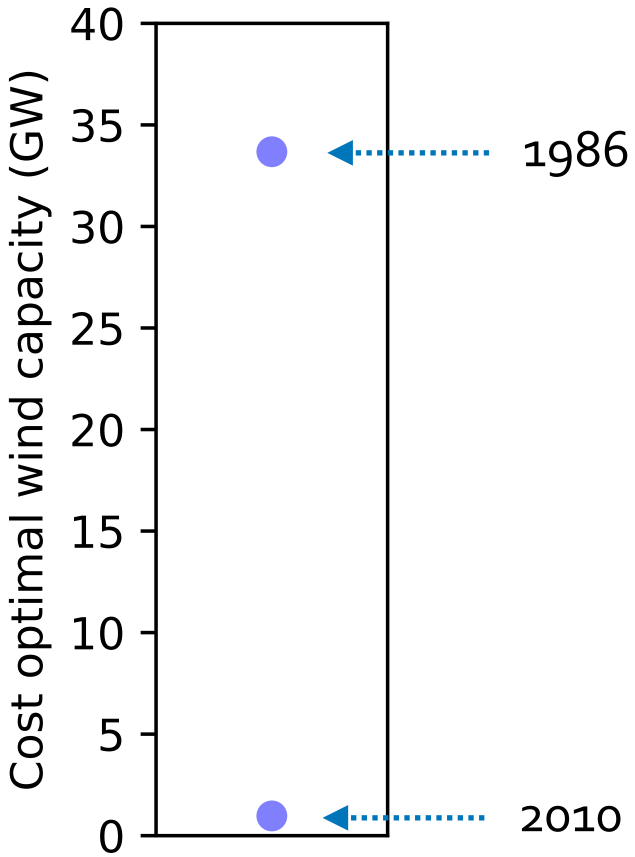

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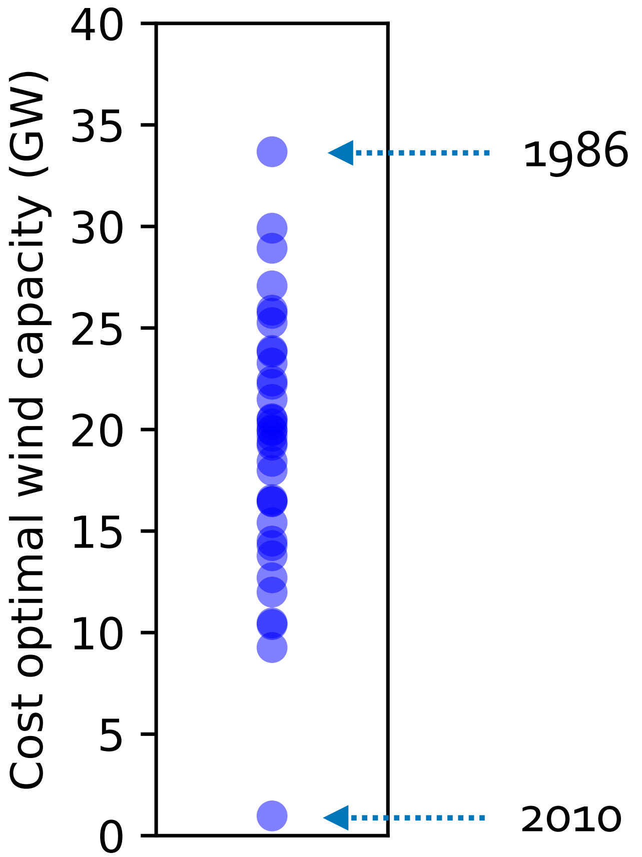
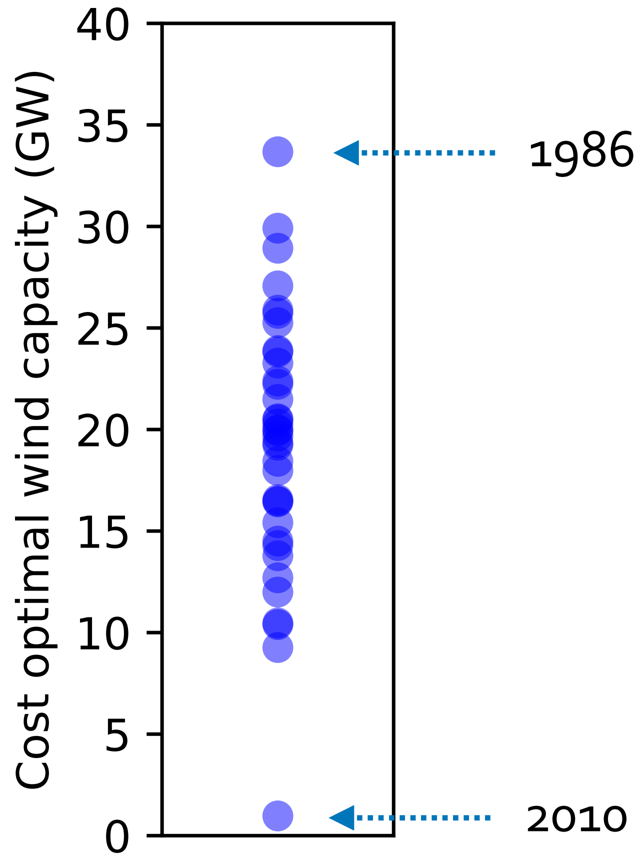


Natural climate variability can lead to large uncertainty on energy system model outputs

- Spread in model outputs across uncertain demand and weather can be large: risk in "picking wrong year"
- Other studies have shown similar results:
  Bloomfield et al (2016), Staffell & Pfenninger (2018) Collins et al (2018), Bothwell & Hobbs (2018), Kumler et al (2019), Bryce et al (2018), Amorim et al (2020).



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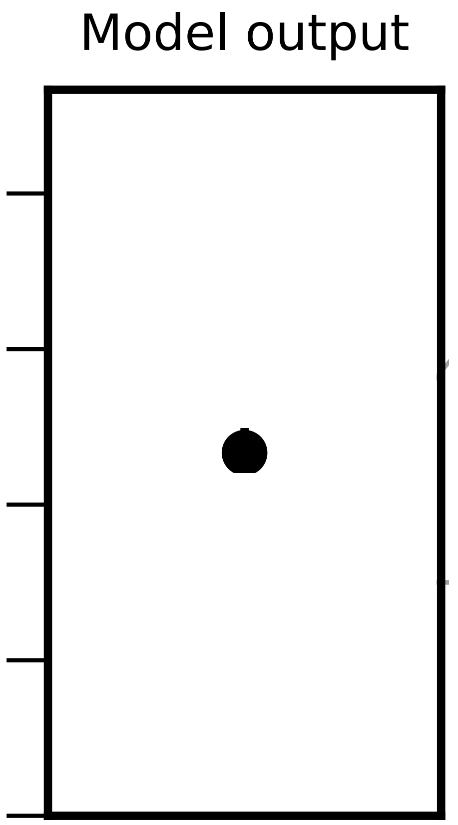

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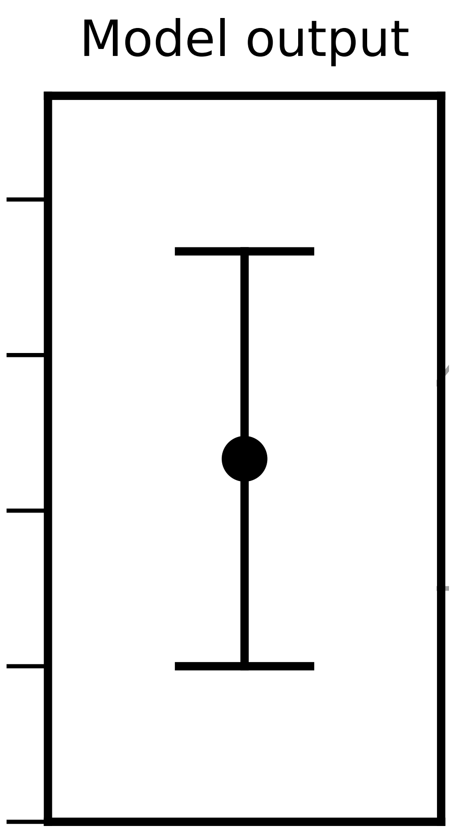

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Traditional Monte Carlo methods are inefficient in data and computation

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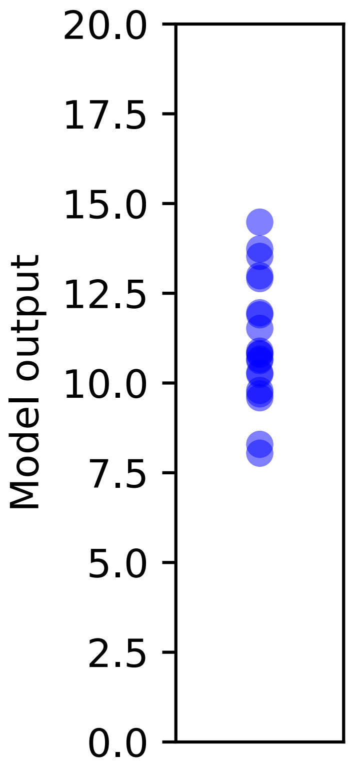

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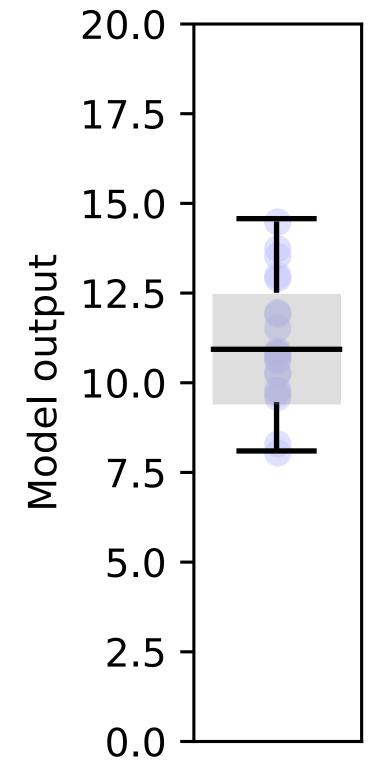

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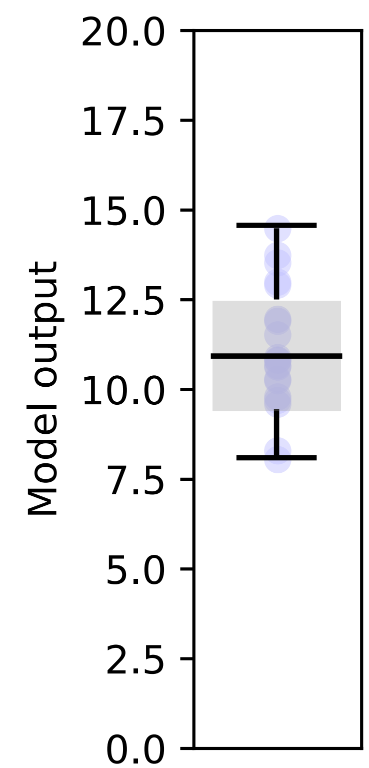

Inefficient in

- data: 100 years of demand and weather data
- computation: 100 1-year simulations

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Resample weeks from seasons

e.g. one week from winter, spring, summer, autumn

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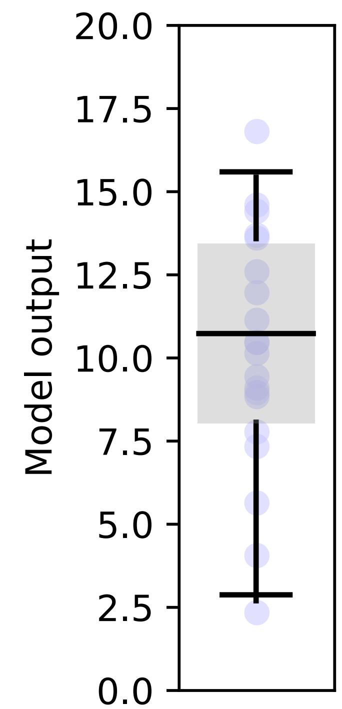

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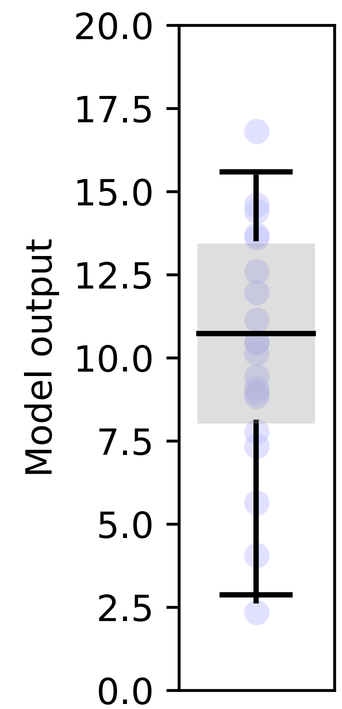

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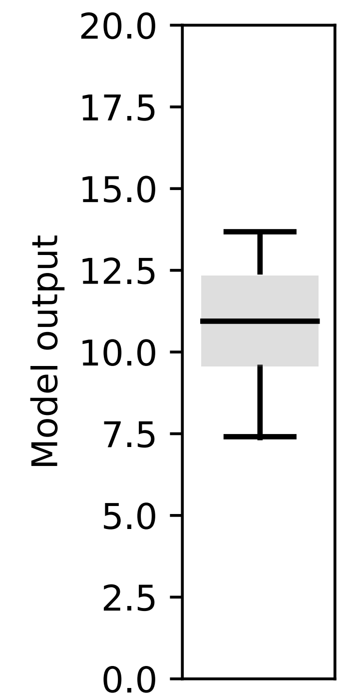

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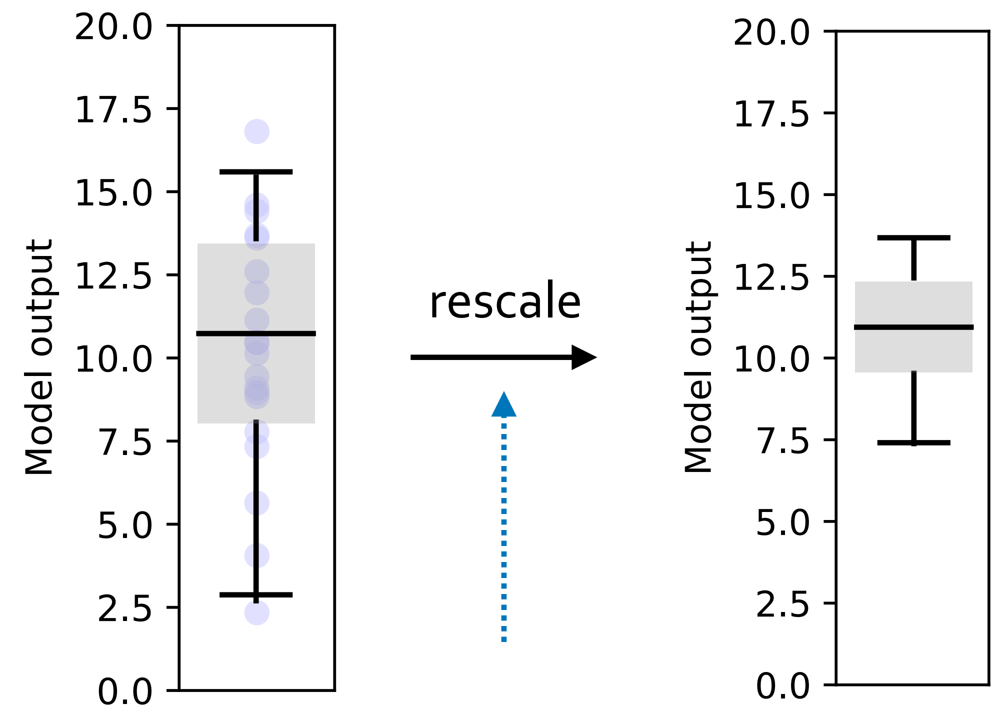

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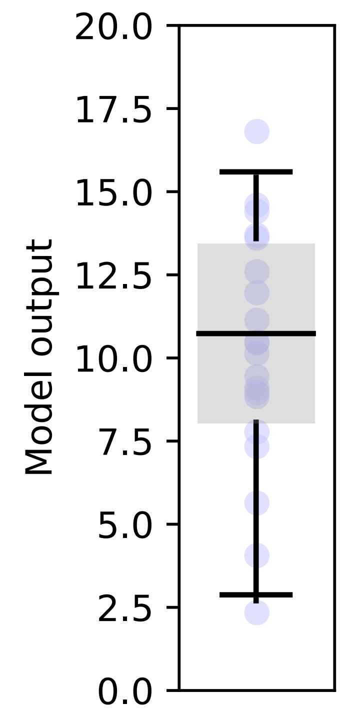

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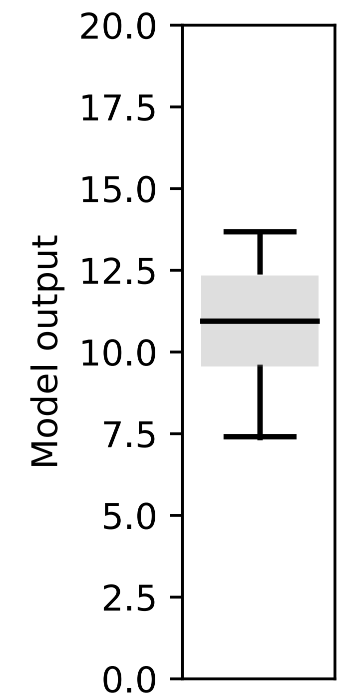

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- computation: 100 ~~1-year~~ **short** simulations

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- Details: AP Hilbers, DJ Brayshaw, A Gandy (2020). Efficient quantification of the impact of demand and weather uncertainty in power system models. *IEEE Transactions on Power Systems.*