Surprises in energy yield assessment

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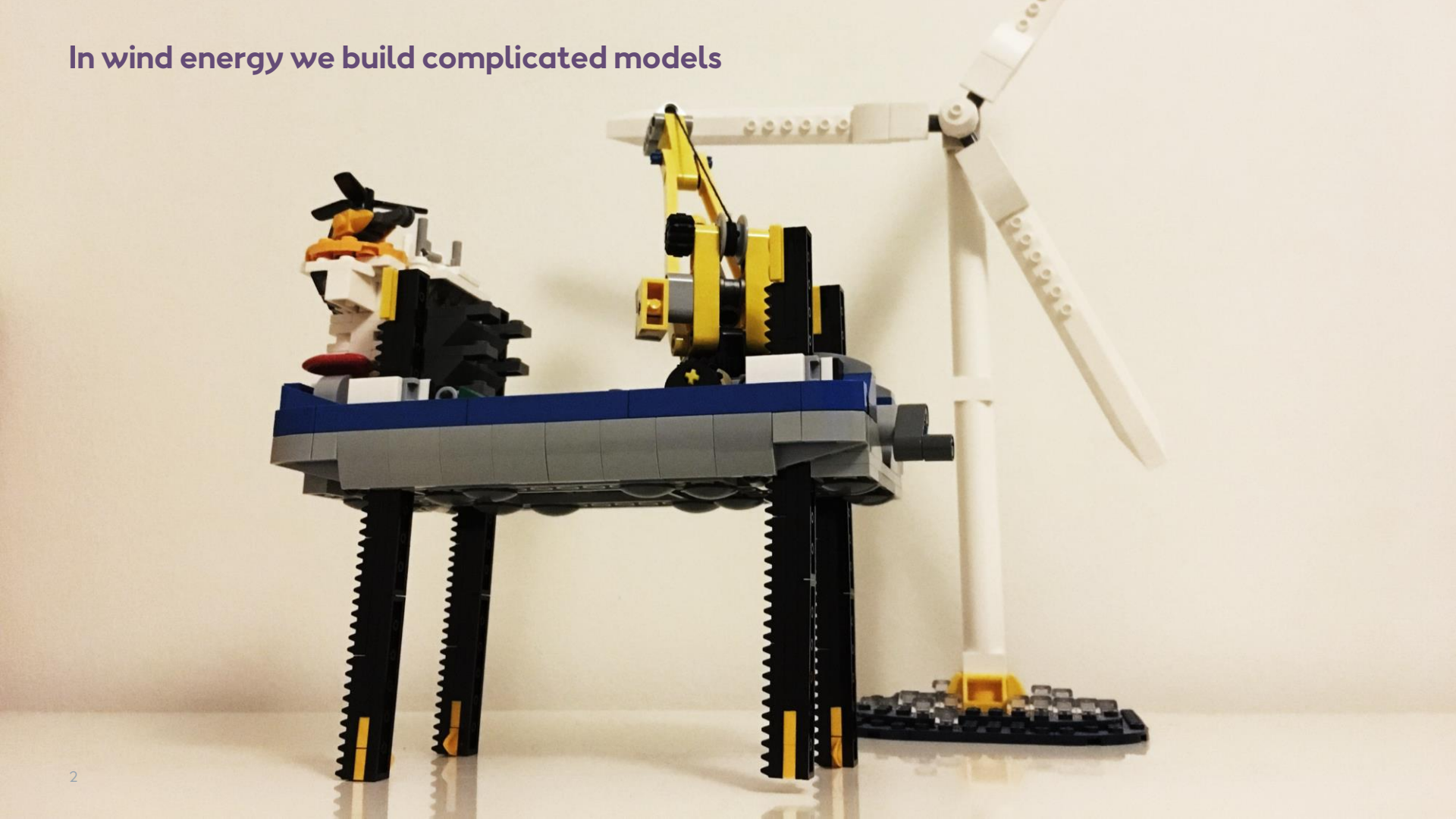
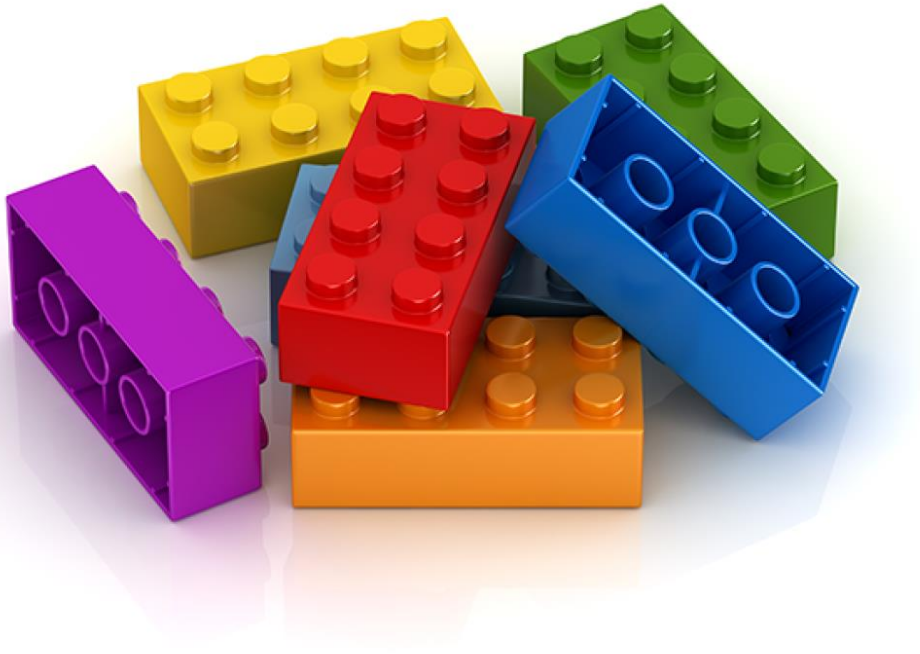
Wind Energy Denmark, October 30 2018

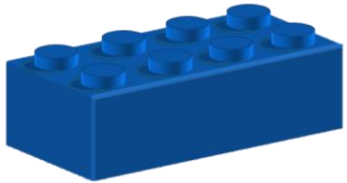
In wind energy we build complicated models



But sometimes we need to re-visit the building blocks

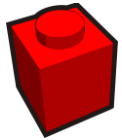


This presentation



Does bin size matter?

Which sector am I in?



What's your favourite season?

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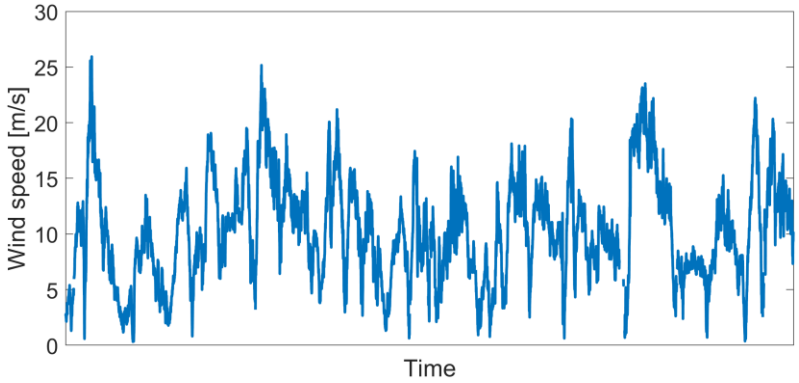
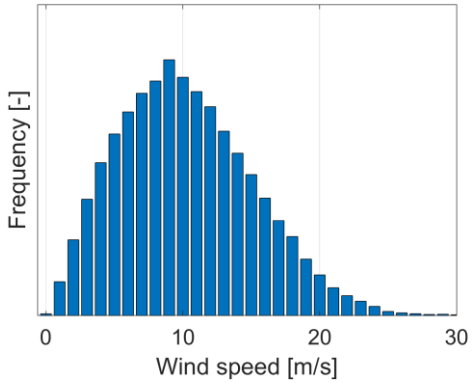
Binning the wind speed

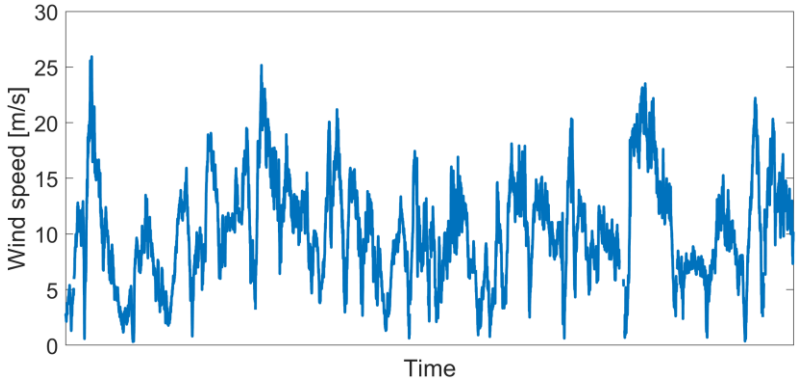


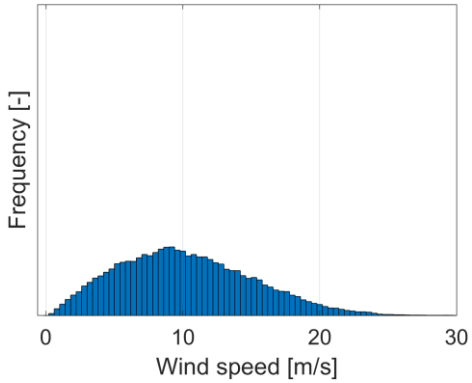


Why do we bin?

- Simplification
- Reduces fluctuations
- Sometimes an analytic distribution does not fit

Binning the wind speed





Does the AEP depend on the bin size?

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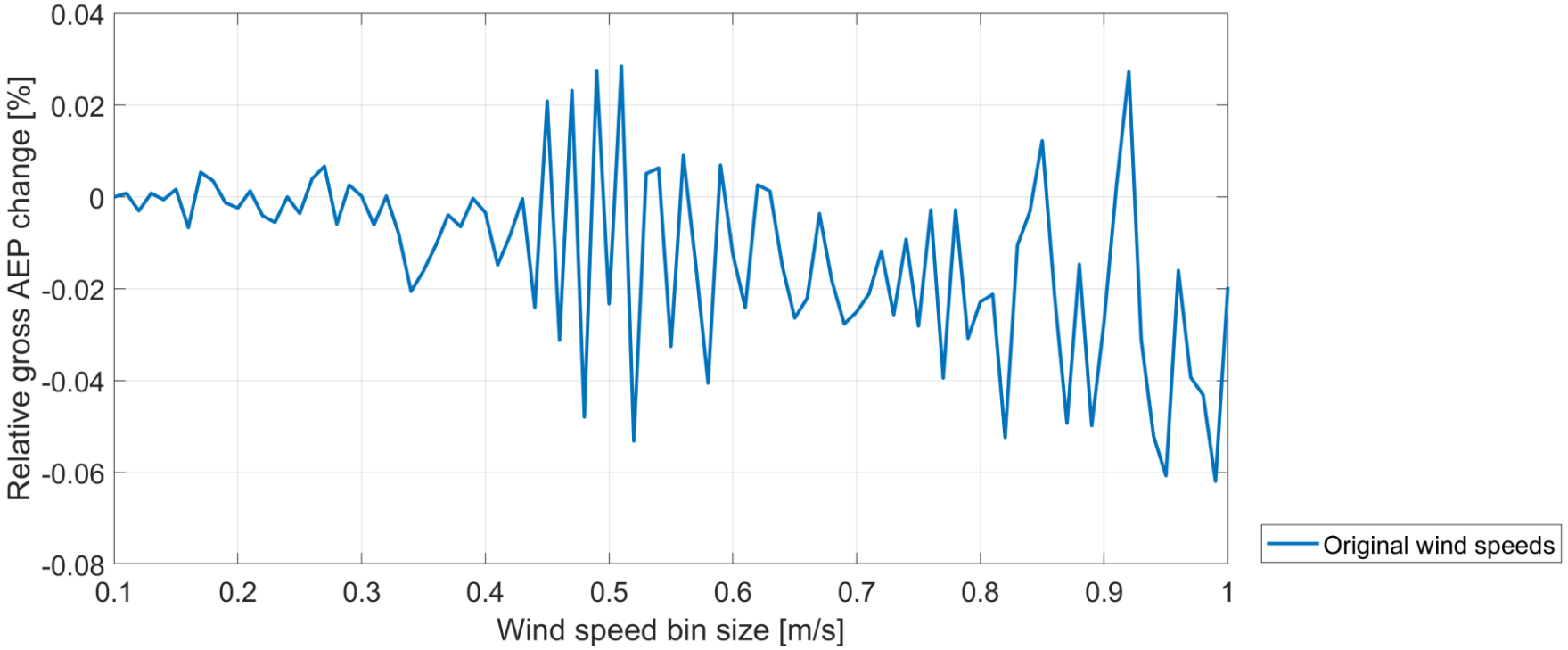
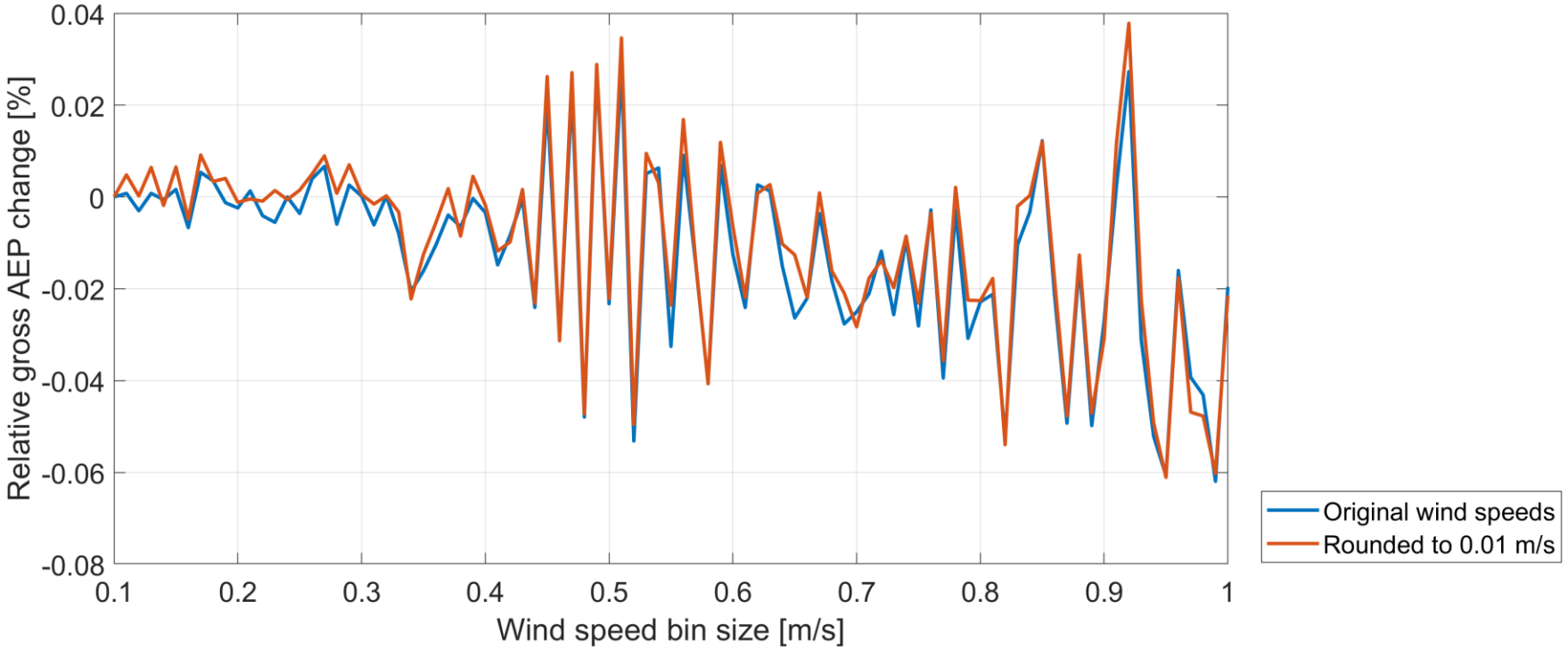
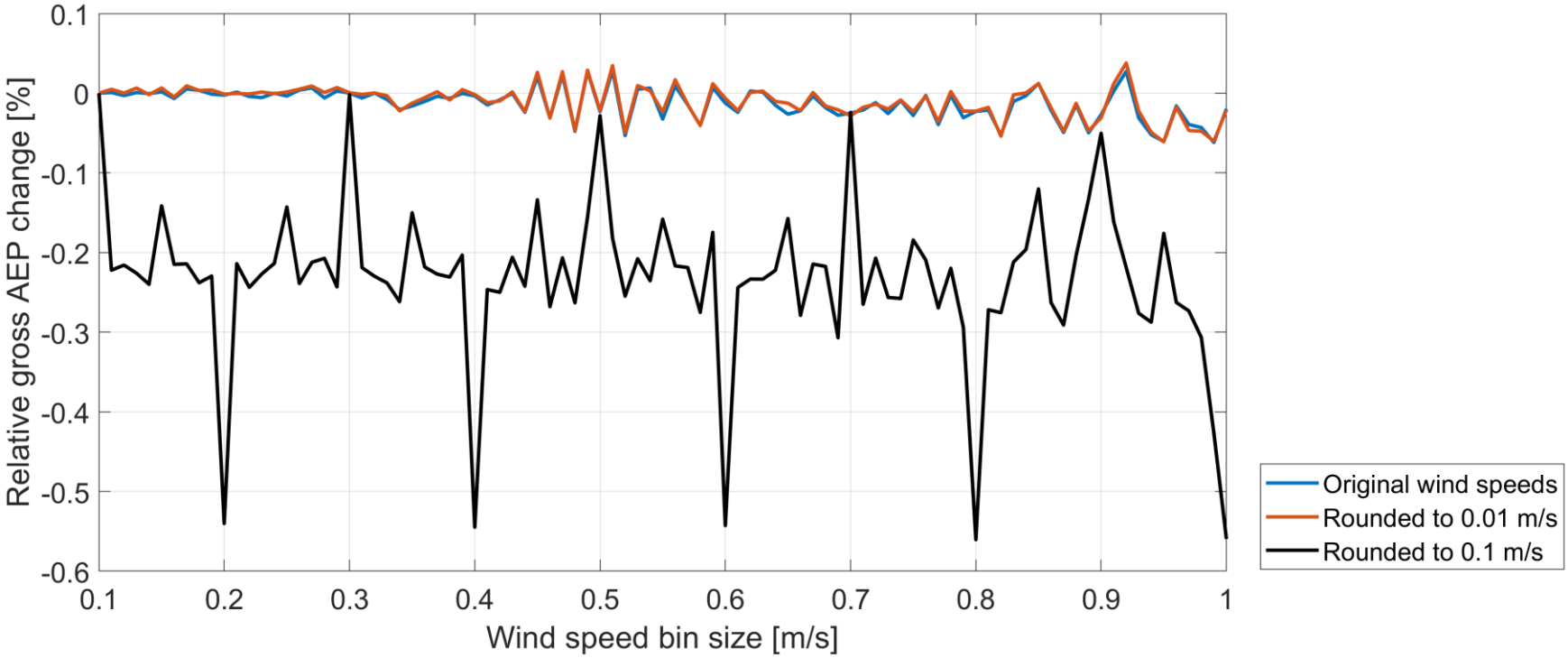
Effect of bin size on AEP?



Effect of bin size on AEP?



Effect of bin size on AEP!



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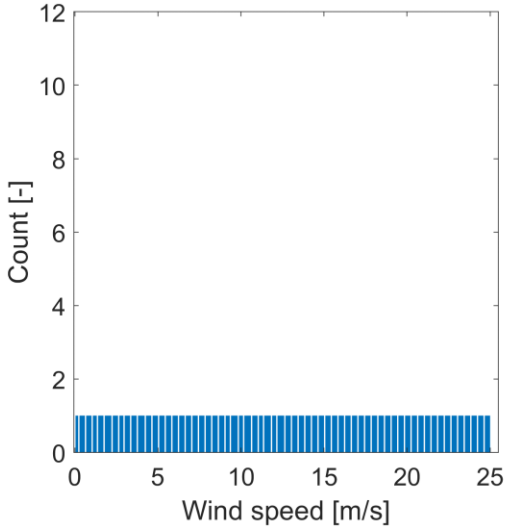
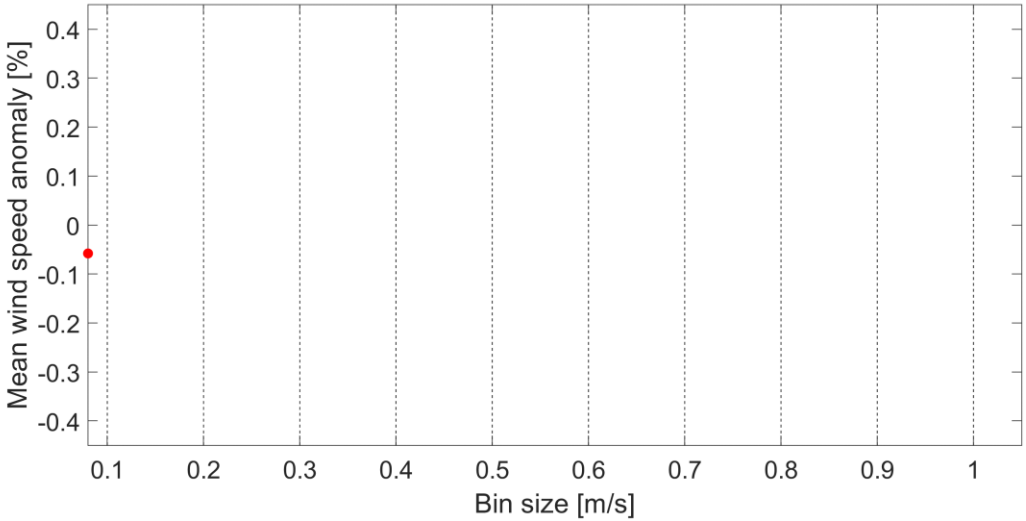
A simpler example

A uniform distribution of wind speeds

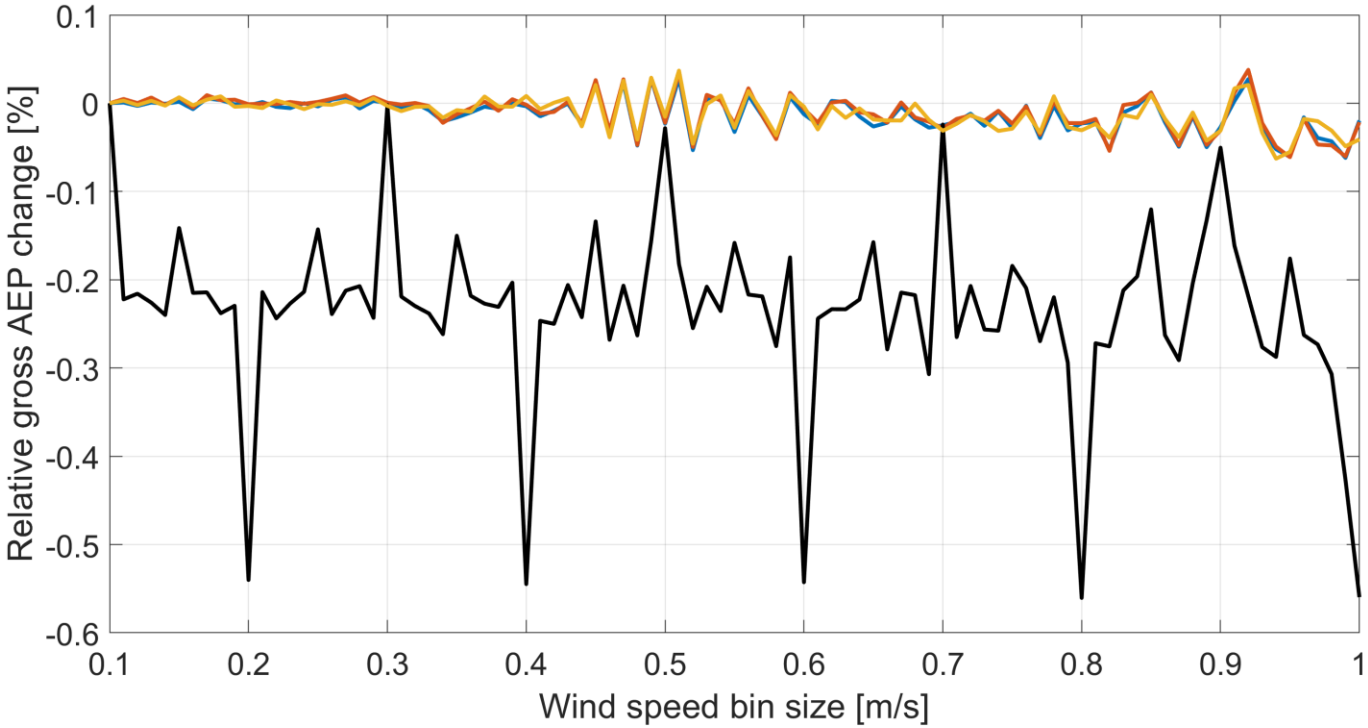
Resolution 0.1 m/s



Histogram of uniform distribution



Solution: add random noise to the data



Adding white noise with amplitude equal to the data resolution

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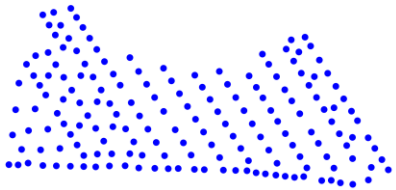
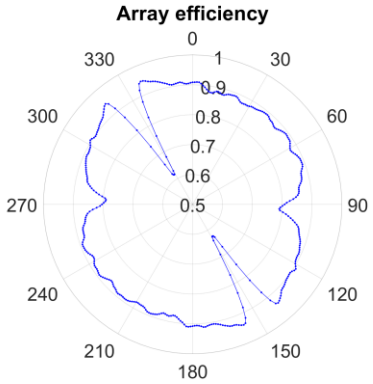
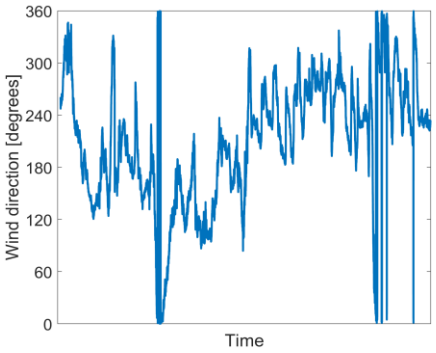
Binning in wind direction sectors

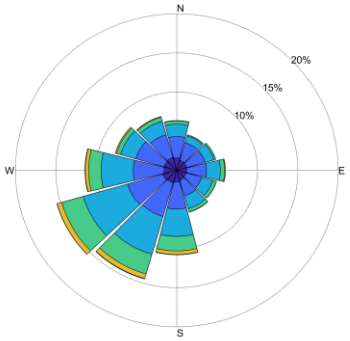
Wake model calculation





Binning wind direction in sectors





AEP =

production weighted by sector frequency

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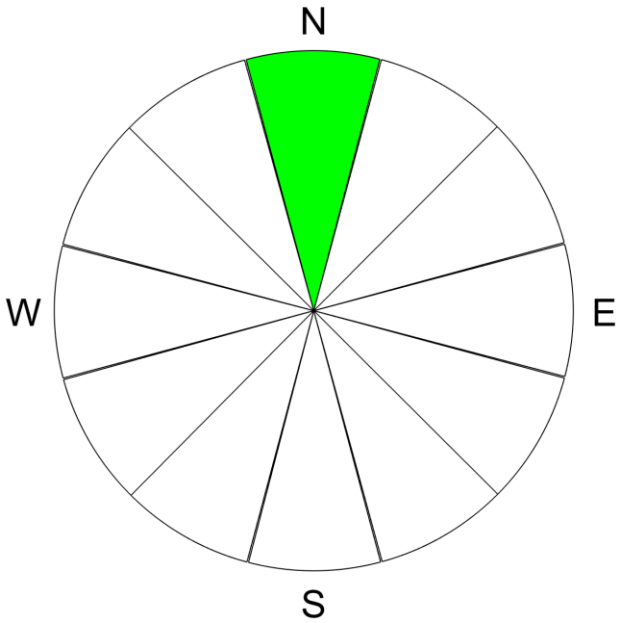
Definition of wind direction sectors



- Centre of the first sector is arbitrary
- Sector placements determine wind rose
- What happens to AEP as sector centres are displaced?

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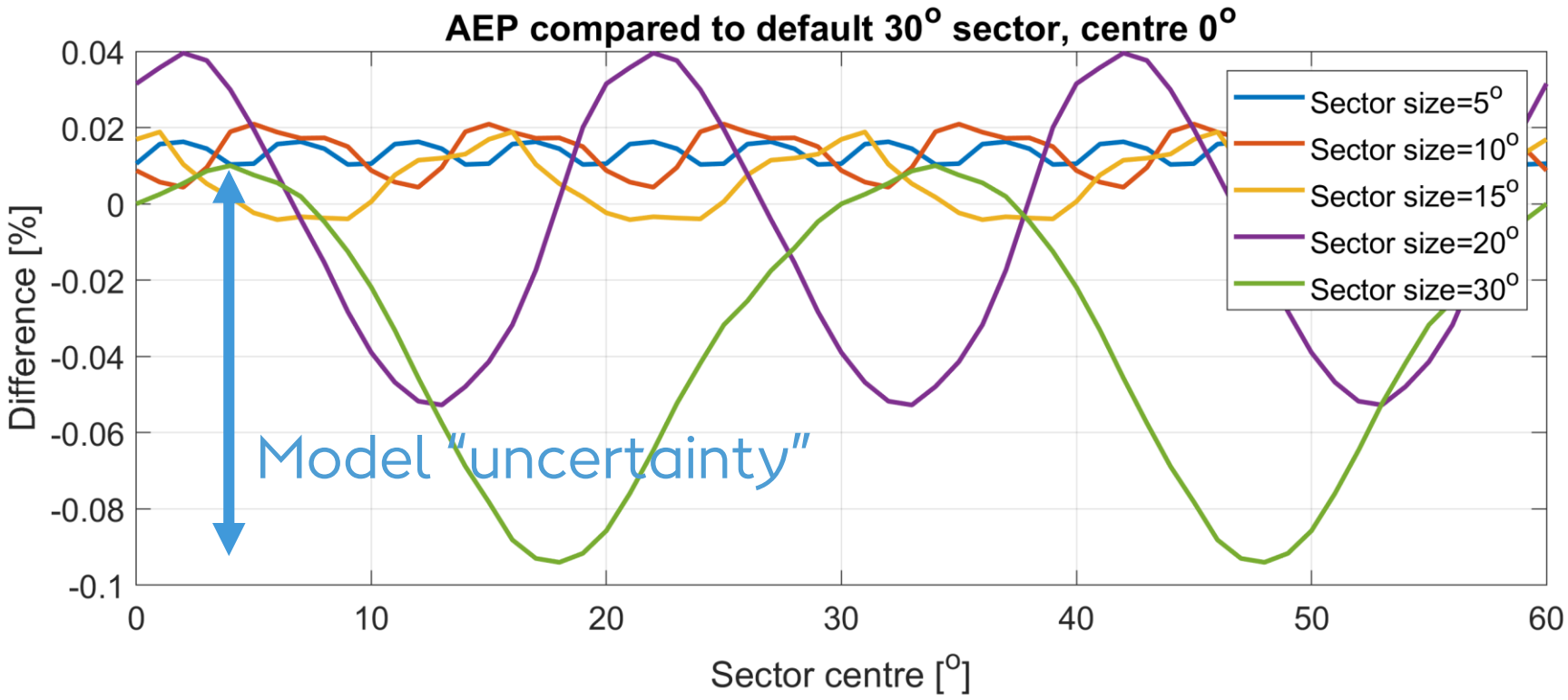
Effect of sector centre on AEP



0.1%~GWh/year~10^5 €/year

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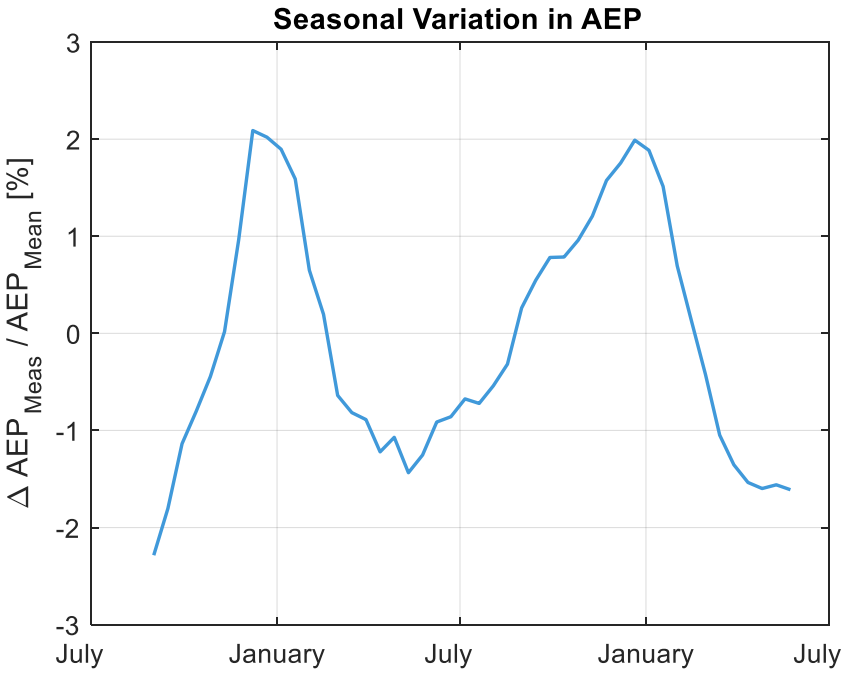
Seasonal variation of power curve

- Nacelle lidar campaign
- 18 months
- Make seasonal power curves
- Convert to AEP



Why?

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Consequences of seasonality

- Power curve warranty test results may depend on season
- Is this covered by the power curve uncertainty?
- Can we reduce energy yield uncertainty by using seasonal power curves?

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Conclusions

Sometimes a little disorder is good

Be mindful how you slice your pie

A summer power curve may depress you

Results may vary

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