Bias Correction of Operational Storm Surge Model Using Neural Networks

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EGU22

Improve predictions?

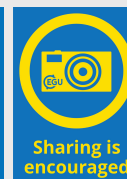Water Level = Tidal Component + Meteorological Component

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Improve predictions?

Water Level = Tidal Component + Meteorological Component

Numerical model

$$\epsilon = SSH_{model} - (SSH_{observed} - tide)$$

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Improve predictions?

Water Level = Tidal Component + Meteorological Component

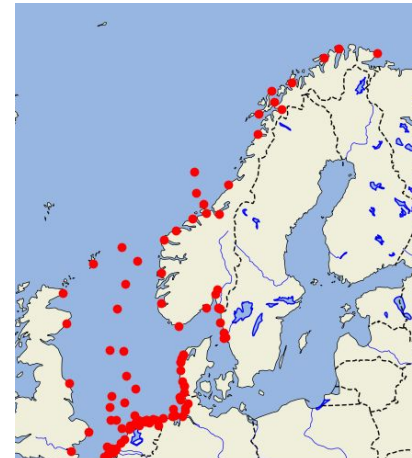Numerical model

$$\epsilon = SSH_{model} - (SSH_{observed} - tide)$$

ML

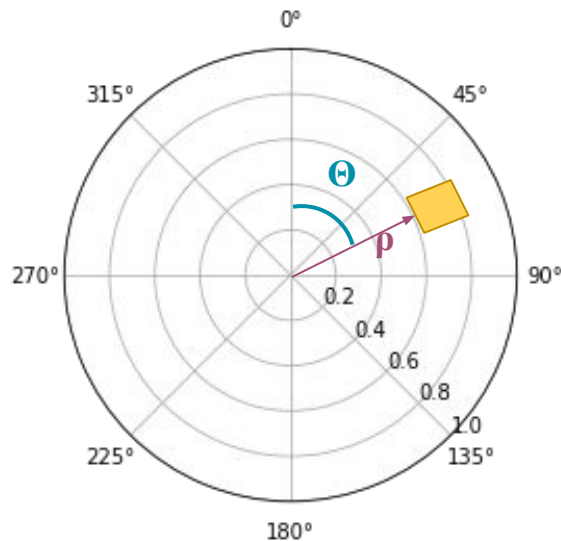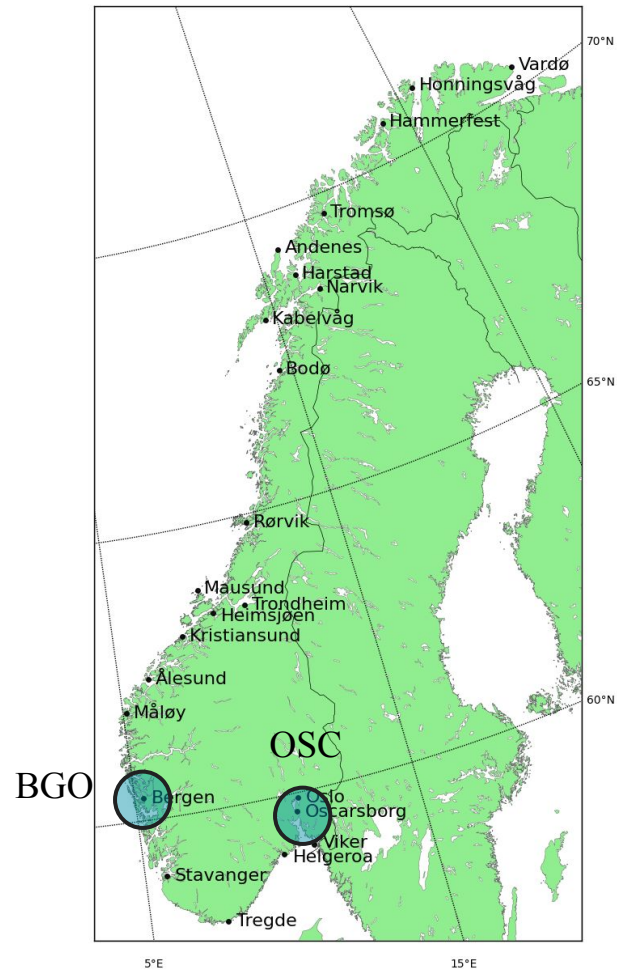ML quantifies the bias in the numerical model and is in agreement with the meteorologists' intuition.

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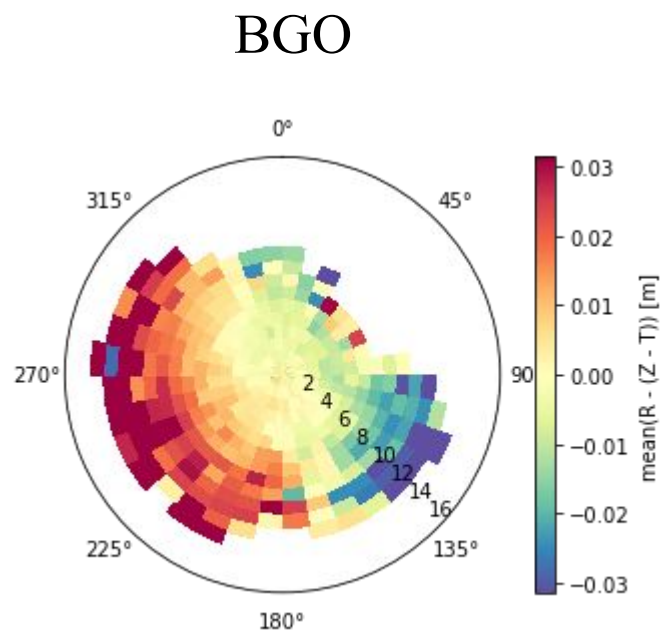Meteorological
Institute

Validation

Visualize the the dependence of the bias on wind direction and wind speed.

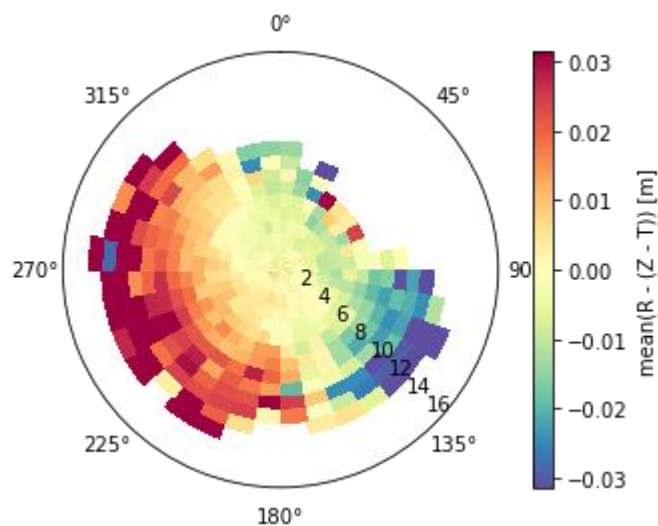Θ: **Wind direction** (from which it originates)
ρ: **Wind speed**

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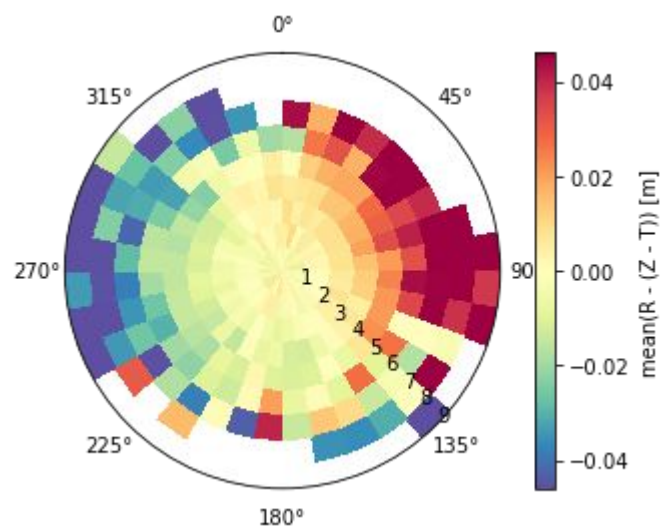Institute

Validation

BGO

Validation

Clear station dependent error pattern.

BGO

OSC

Bias Correction with NNs
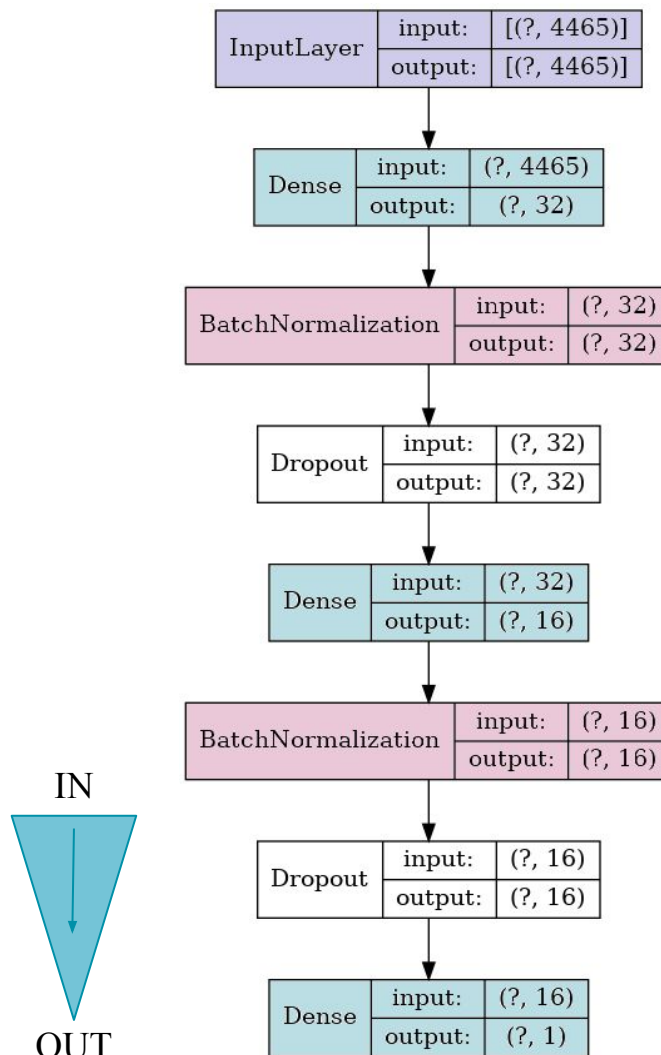
Predictors:

Wind

Pressure

Tide estimations

Past observations

Output from the numerical model

**Run one model for each location and lead time.**

1   2   3   hours

InputLayer	input:	[(?, 4465)]
	output:	[(?, 4465)]

Dense	input:	(?, 4465)
	output:	(?, 32)

BatchNormalization	input:	(?, 32)
	output:	(?, 32)

Dropout	input:	(?, 32)
	output:	(?, 32)

Dense	input:	(?, 32)
	output:	(?, 16)

BatchNormalization	input:	(?, 16)
	output:	(?, 16)

Dropout	input:	(?, 16)
	output:	(?, 16)

Dense	input:	(?, 16)
	output:	(?, 1)

IN

OUT

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Results

- ML corrects the bias in the numerical model.
- Lower RMSE for all lead times after correction.

OSC

t = 1 hr

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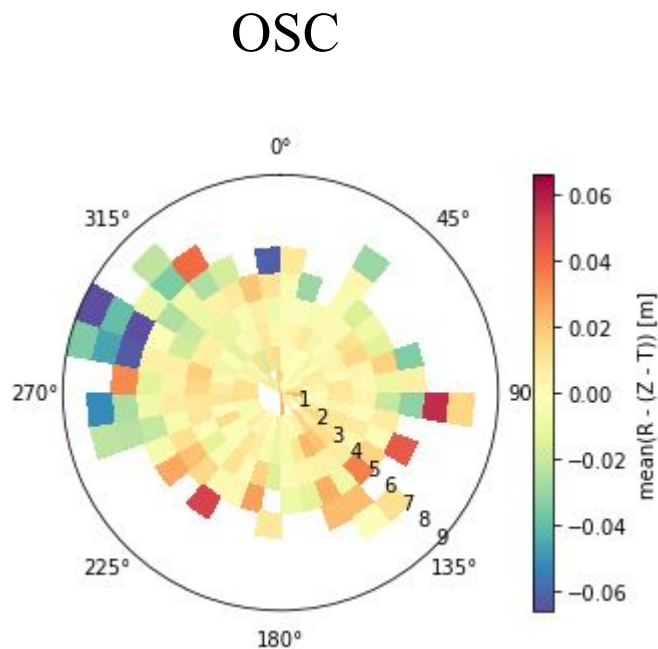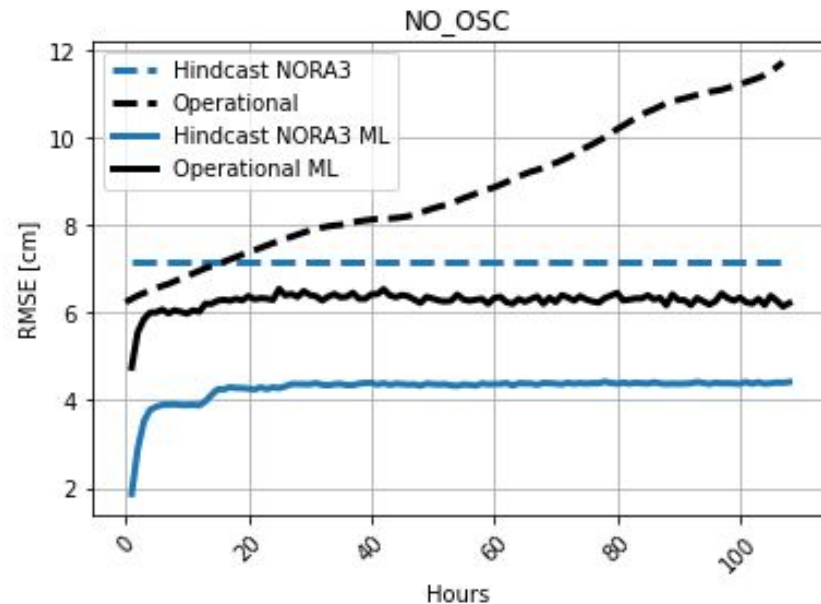
Conclusions

- Radial plots are useful tools that automate the validation process.

- Radial plots show agreement with the meteorologists' experience.

- We can reduce the bias in the numerical storm surge model with NNs.

- The method does not depend on the underlying numerical method.

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Thank you!

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