Offshore Wind Extrapolation to Wind Turbine Heights Using AI/ML Random Forest Algorithm

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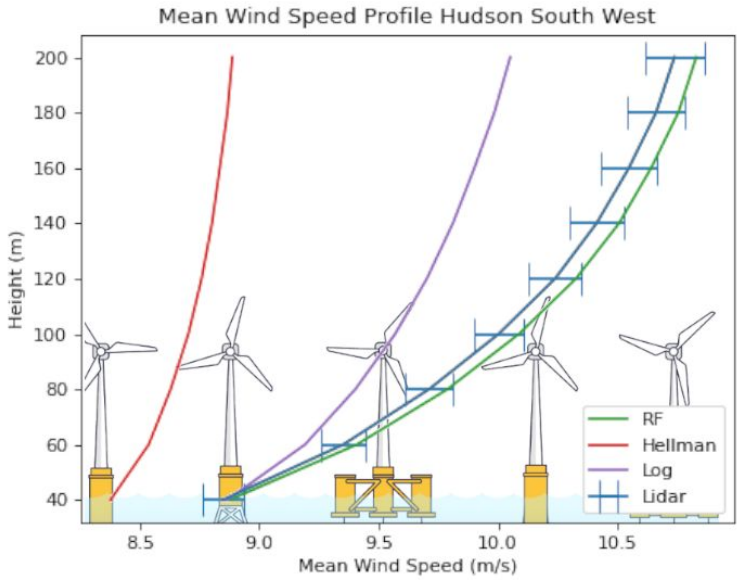
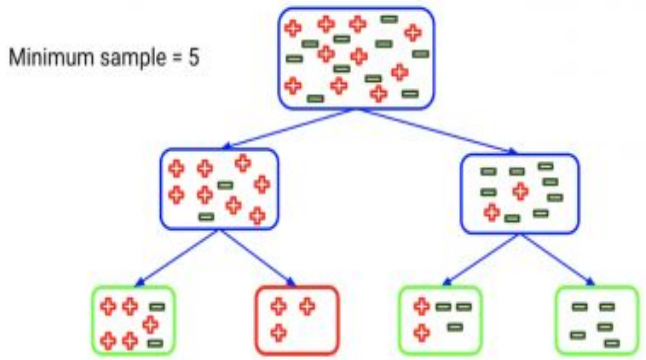




Objectives

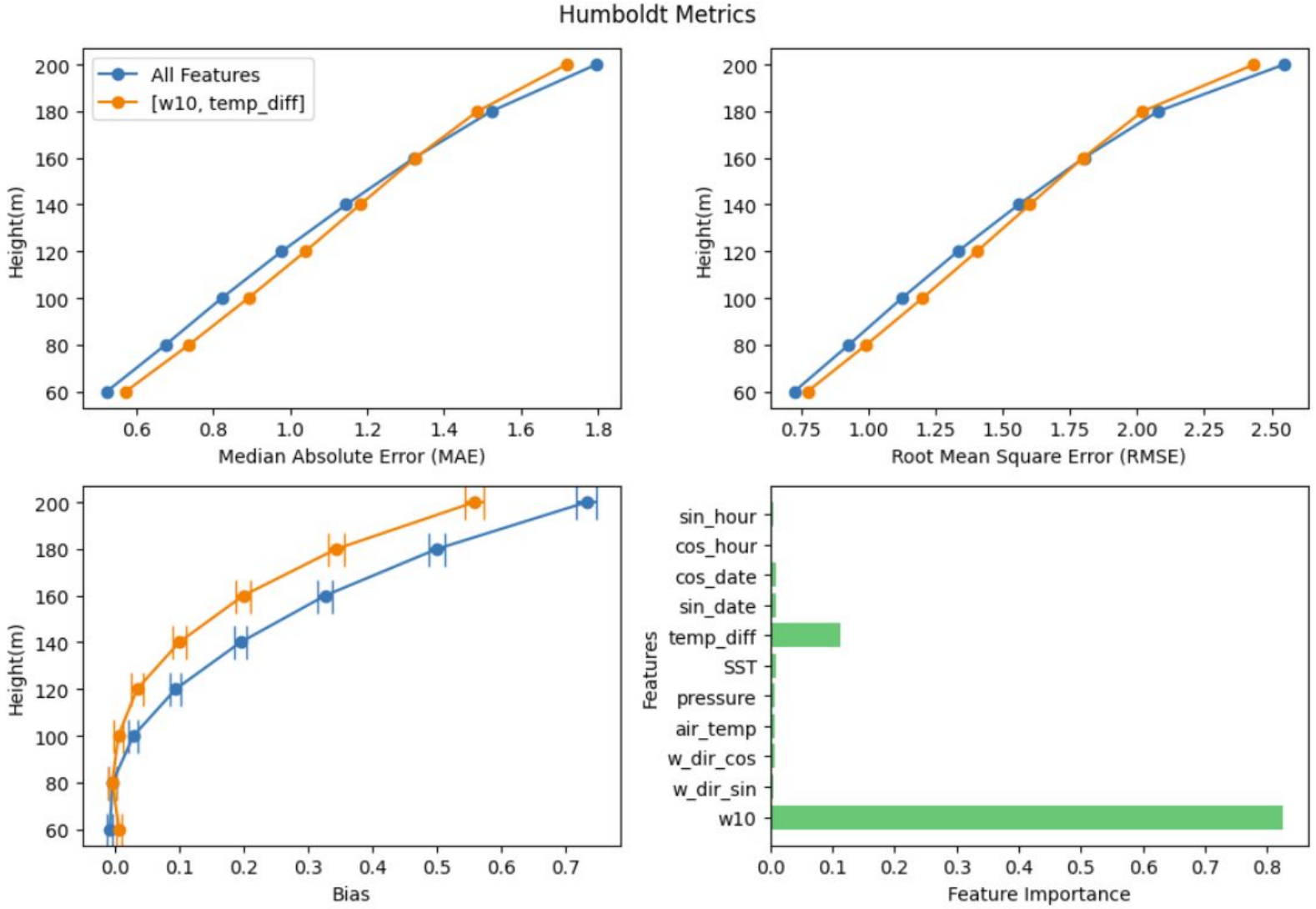
- Develop an extrapolation model based on machine learning to accurately predict ocean wind speeds at various heights, in view of application to the offshore wind industry.
- Understand what features are most important in estimating wind speeds at wind turbine hub height.
- Optimize the model through hyperparameter tuning.
- Test the developed model over the coastal USA on gridded 10m wind speeds from NOAA NCEI Blended sea wind product.

Feature Selection

- Median Absolute Error: median difference between the observations (true values) and model output (predictions). It provides an estimation of how well the model is able to predict the target value (accuracy) whilst being insensitive to outliers.

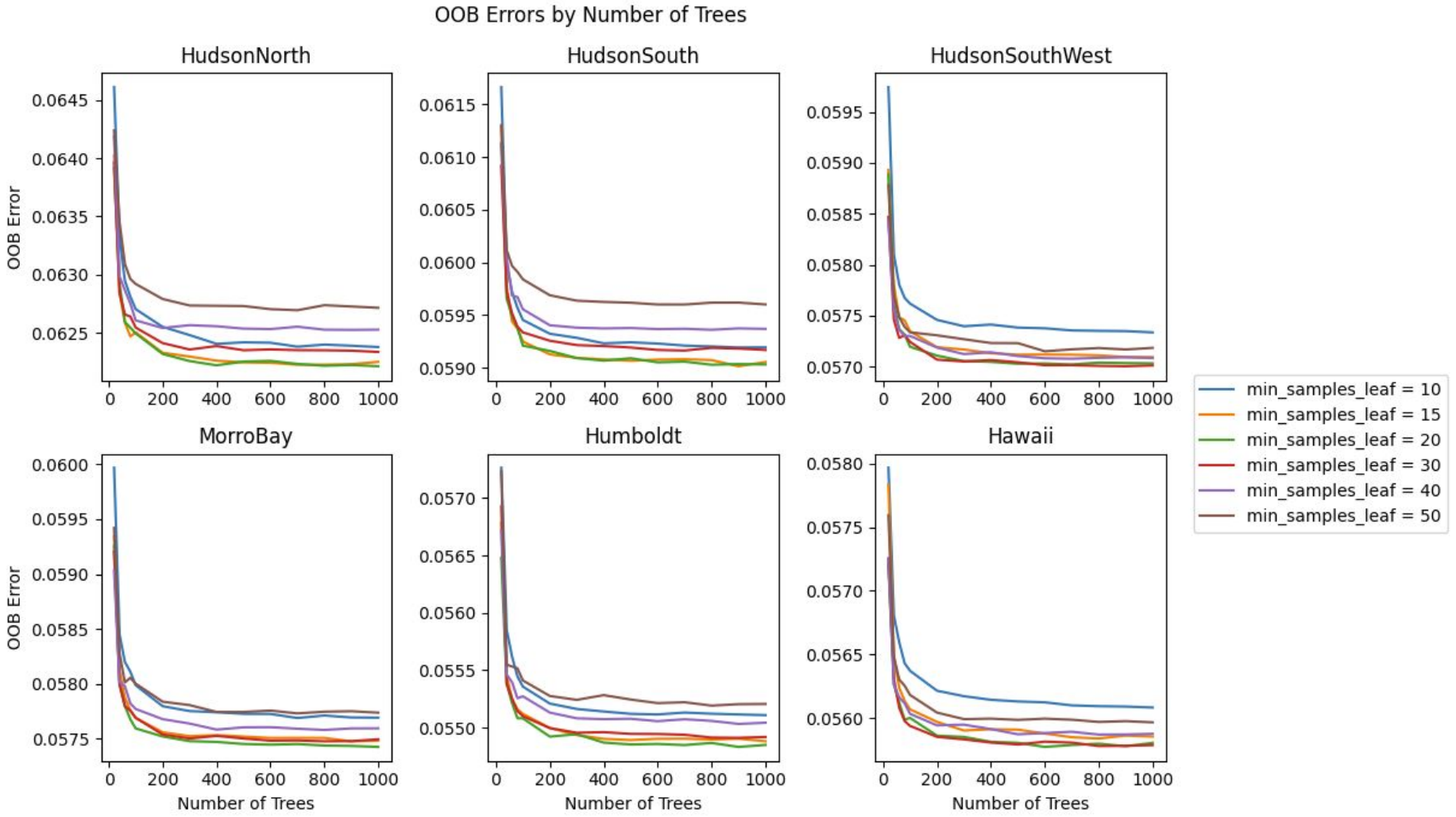
- Root Mean Square Error: mean difference and spread of the differences between the observations (true values) and model output (predictions). It provides an estimation of how well the model is able to predict the target value (accuracy) whilst being sensitive to outliers.

- Bias: the average difference between the model and observed values which may result from over/under prediction of the model if we consider observation as TRUE values



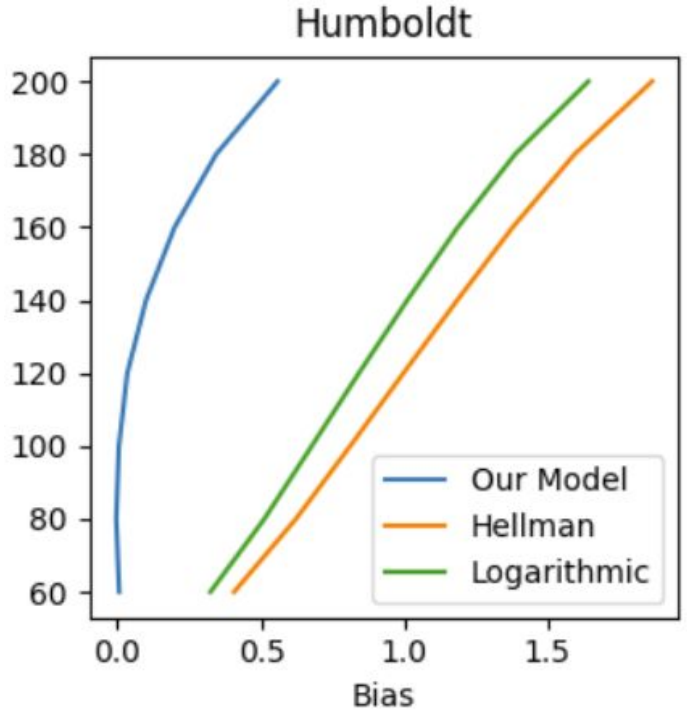
Hyperparameter Tuning

- number of trees: the number of simple models, or the number of decision trees, that are combined to create the final prediction
- min_samples_leaf: minimum number of samples required to be at a leaf node
- Out of Bag (OOB) error: a validation technique mainly used to measure the error or the performance of the models in every epoch (tree in the random forest) for reducing the total error of the models in the end



Conclusion and Next Steps

- Our model outperforms all conventional methods for predicting wind speeds at every height
- This model will be used to create offshore wind energy metrics developed from NOAA NCEI Blended sea wind product for the USA coastal region



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