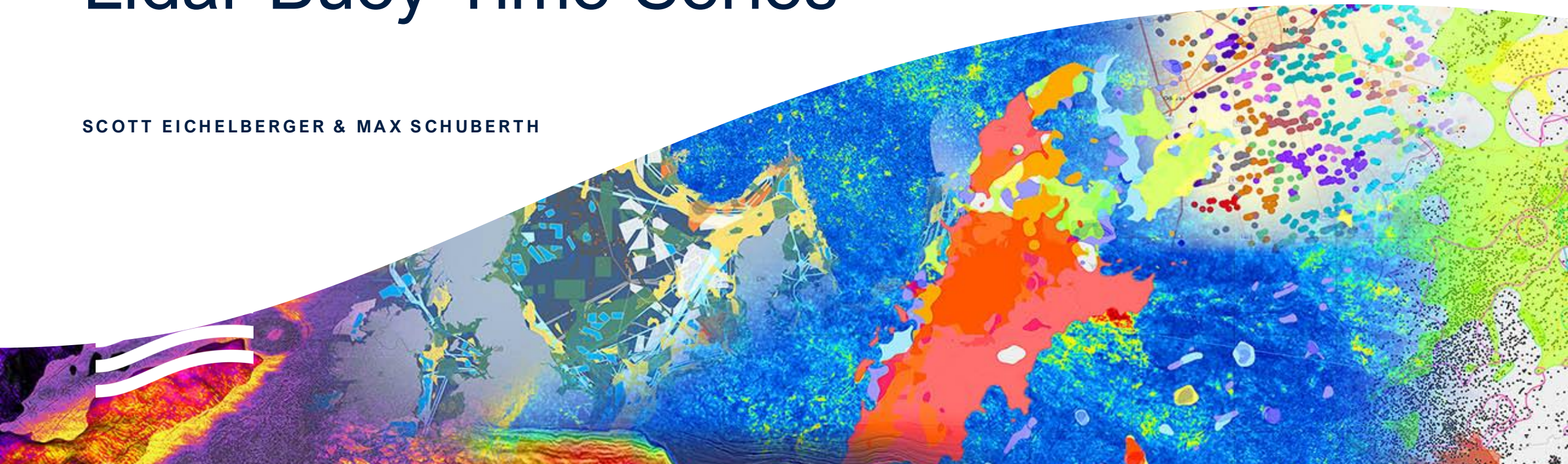
Hidden Uncertainties in Floating Lidar Buoy Time Series

SCOTT EICHELBERGER & MAX SCHUBERTH



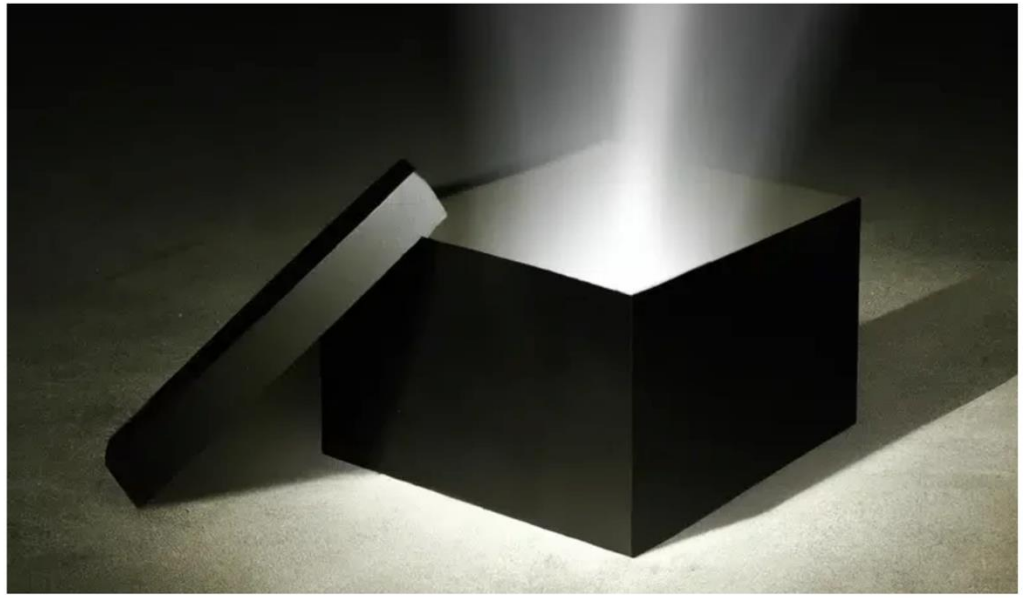
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Motivation – Opening the Black Box



Opening the blackbox

Lidar type uncertainty



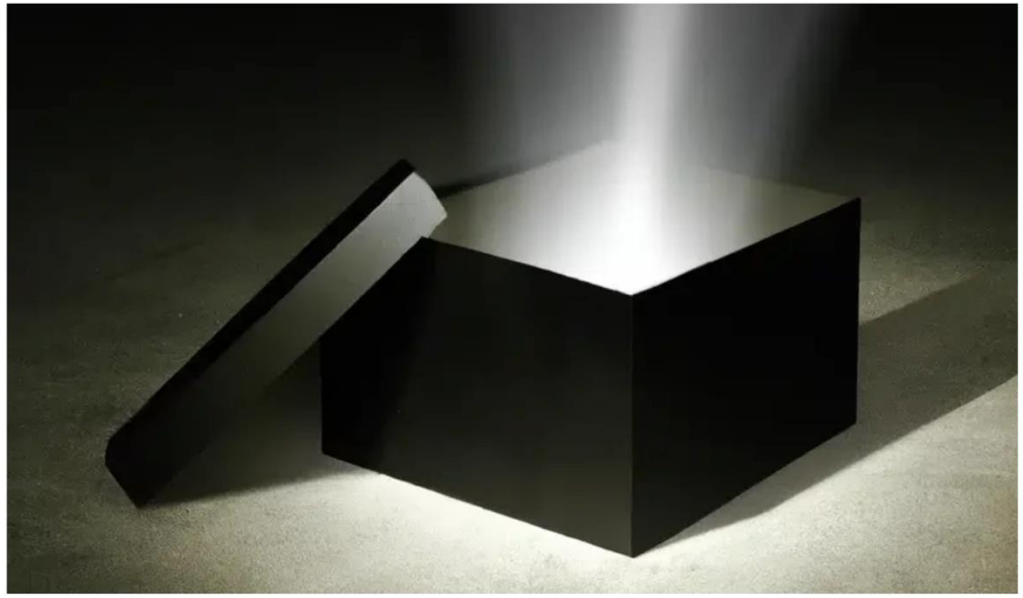
Rafael Tavares
Lead Measurement Engineer

"…It has become challenging to characterize the expected performance of a lidar type without detailed knowledge of factors such as firmware and hardware version, filtering configuration, data post-processing, configuration at calibration trials and more….

The complexity is further amplified in the floating lidar industry."

https://www.linkedin.com/pulse/lidar-type-uncertainty-rafael-tavares-frzaf/

Motivation – Opening the Black Box



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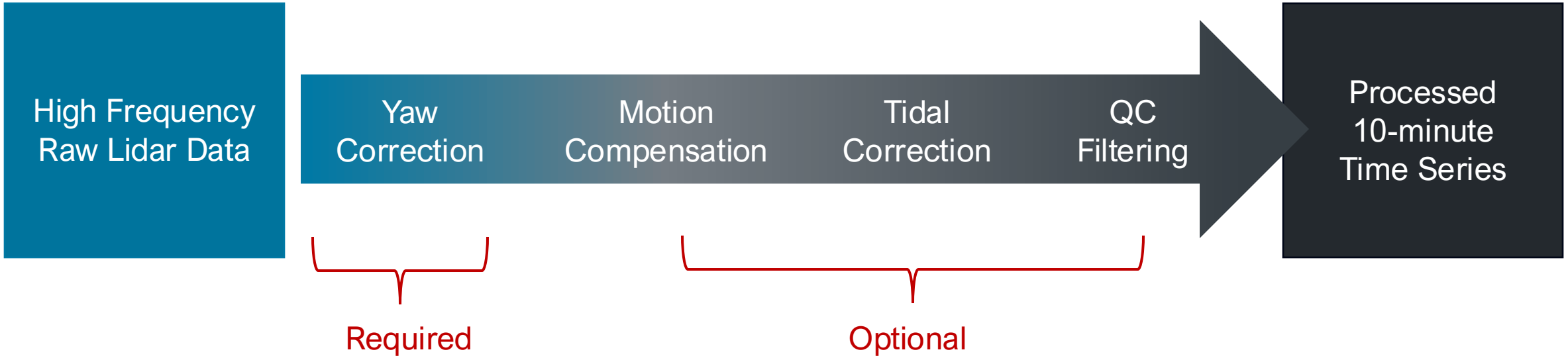
Rafael Tavares
Lead Measurement Engineer

"These layers of hardware, firmware and post-processing create a complex environment to assess the performance of systems…."

"The solution for this complex scenario is **transparency** and **standardization**."

https://www.linkedin.com/pulse/lidar-type-uncertainty-rafael-tavares-frzaf/

Floating Lidar Data Processing



Analysis Methodology

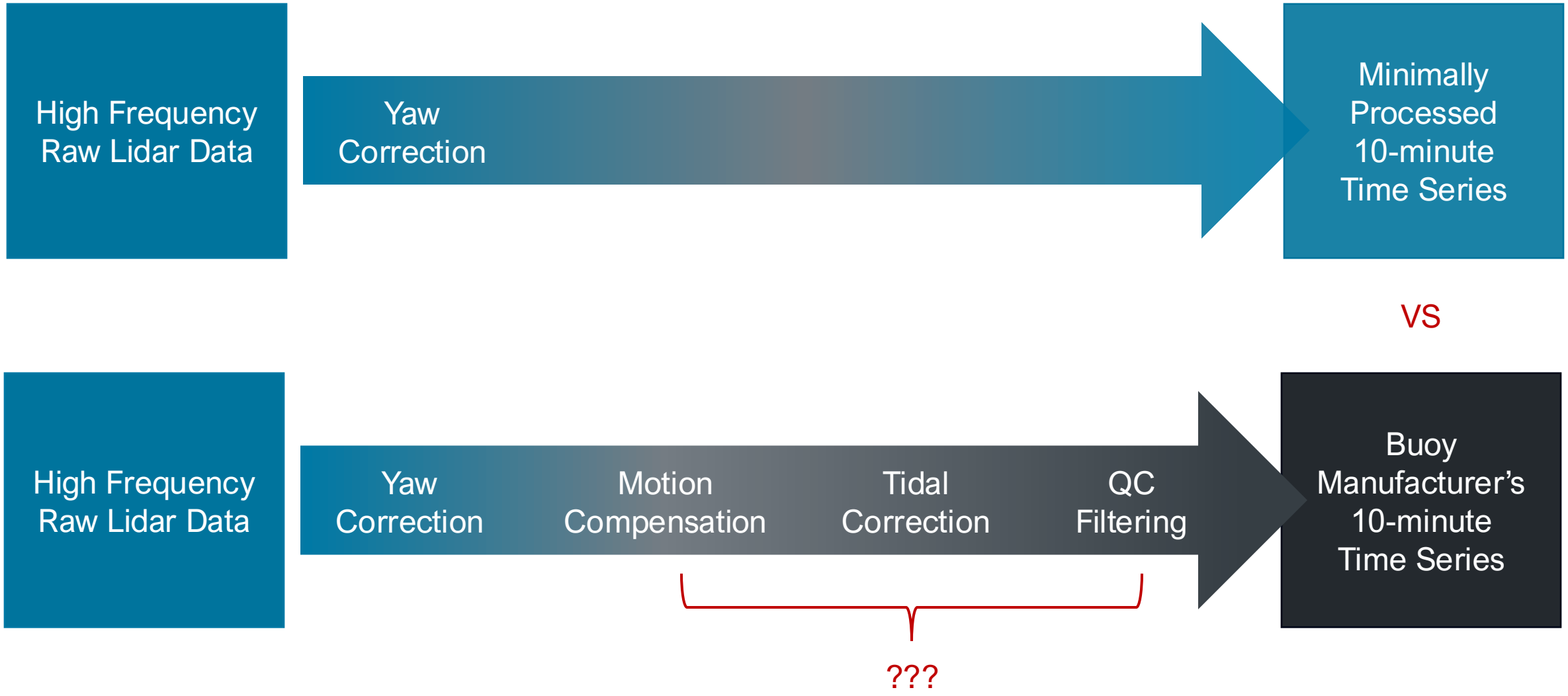
1. Develop a minimalist workflow to process the high-frequency lidar data files into a 10-minute average time series

- This workflow only applies a yaw correction to the wind direction data
- Wind speed and direction data are simply aggregated into a 10-minute average without any additional processing or filtering

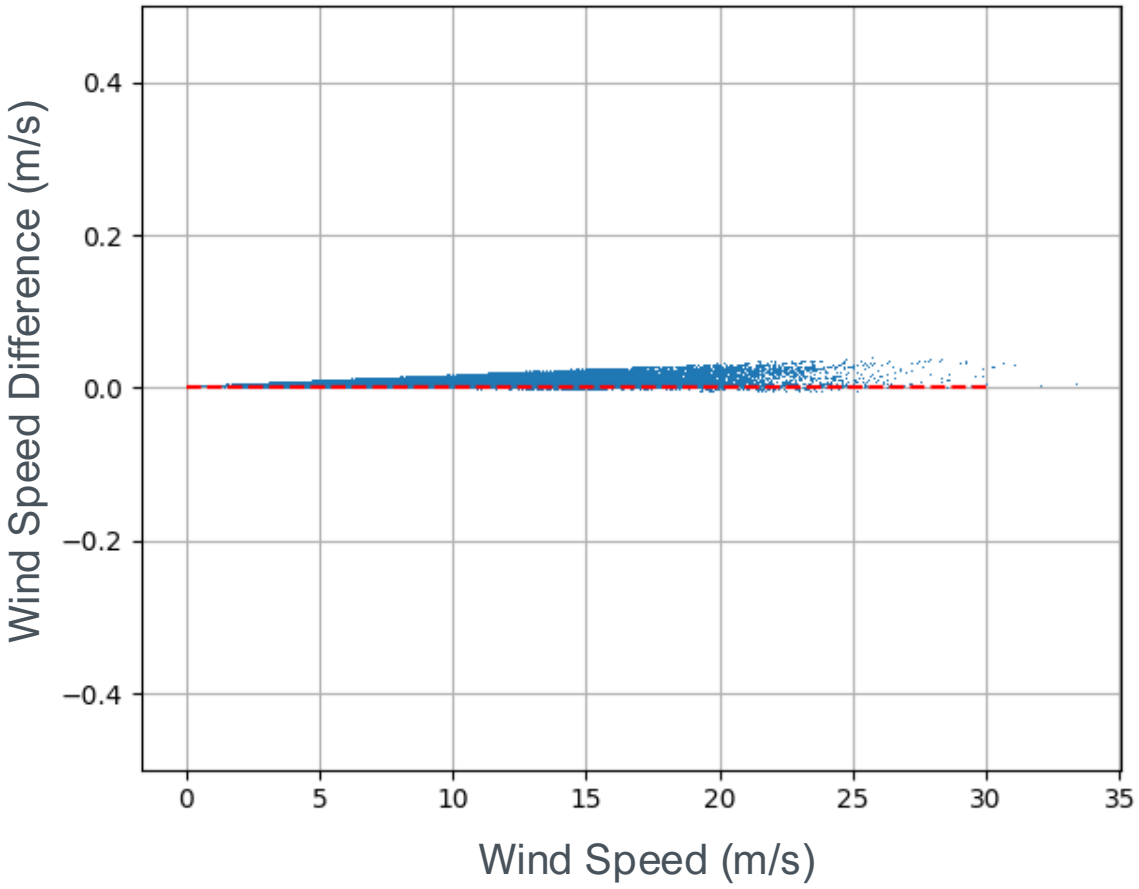
2. Compare our minimally processed time series against the 10-minute time series from the buoy manufacturer (the black box)

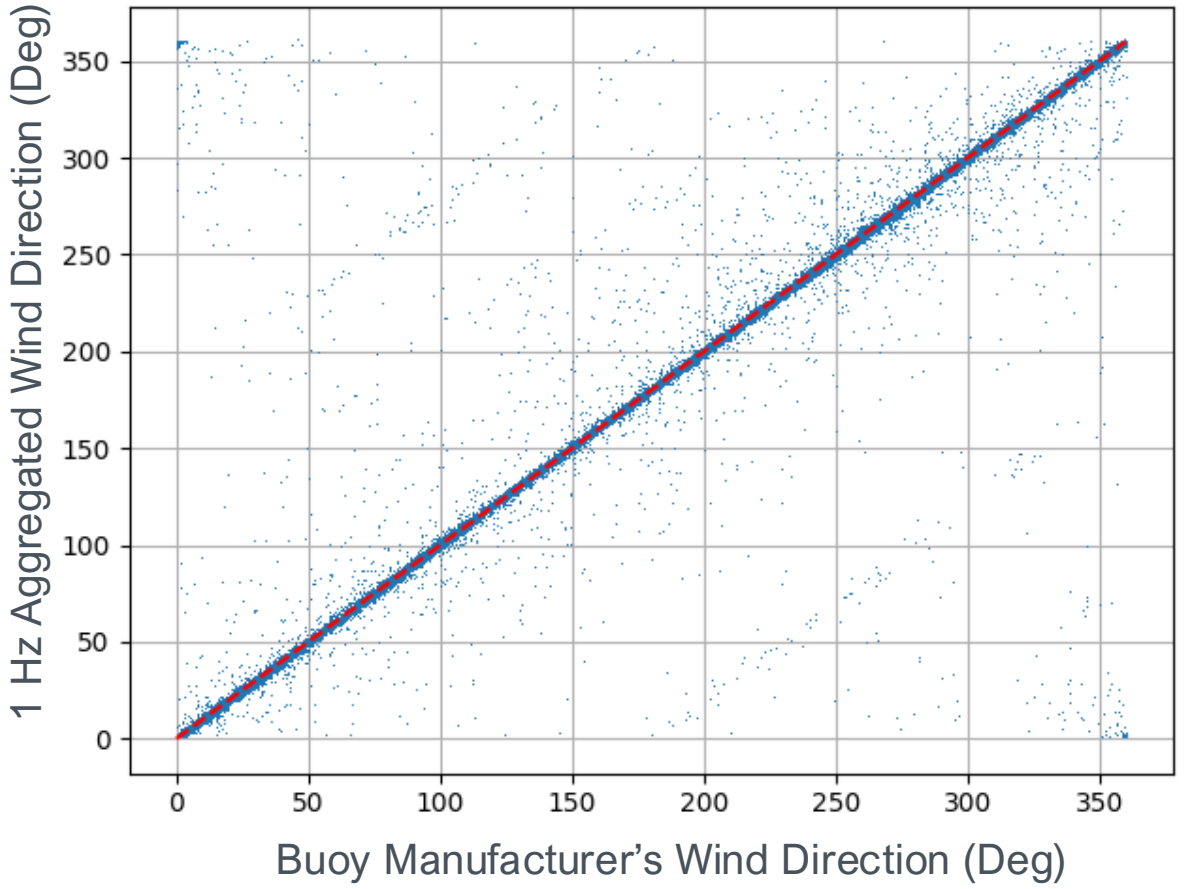
What do the high-frequency data show us that we can't see in the 10-minute data?

Analysis Methodology



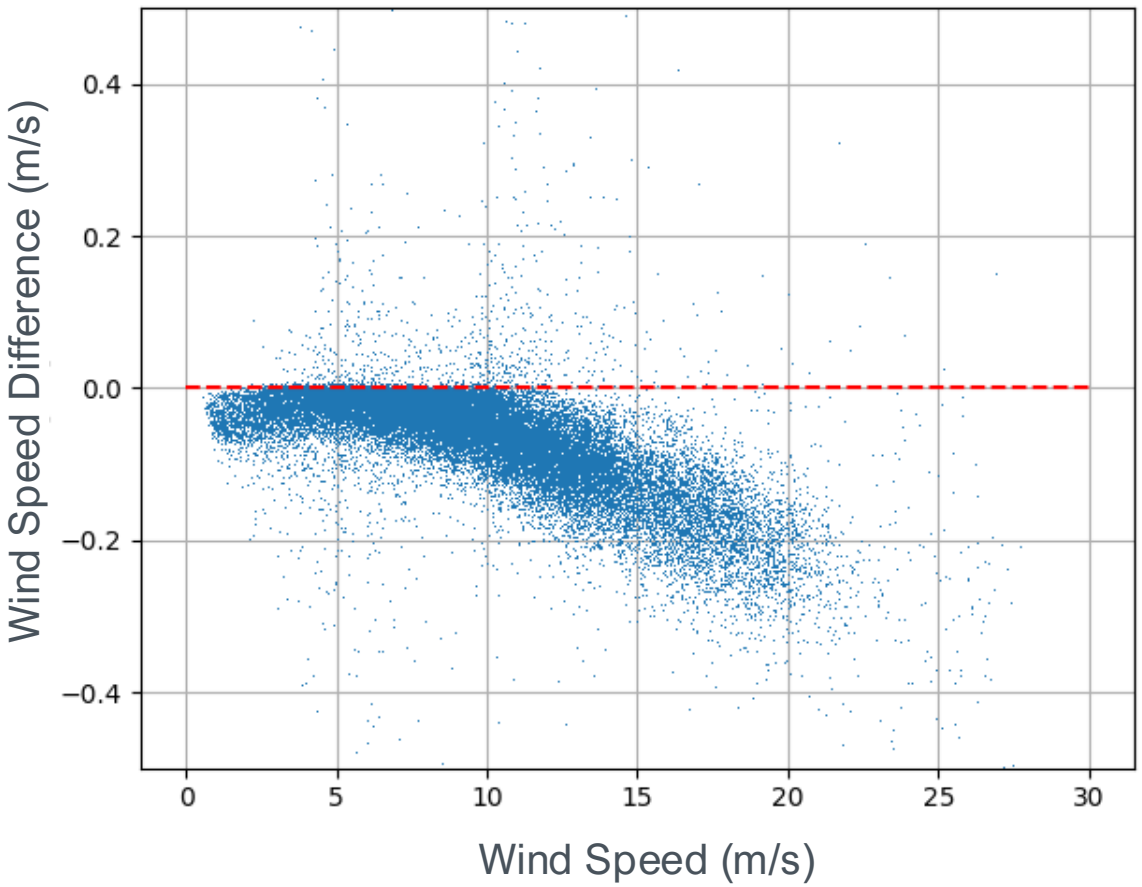
Results – Floating Lidar #1

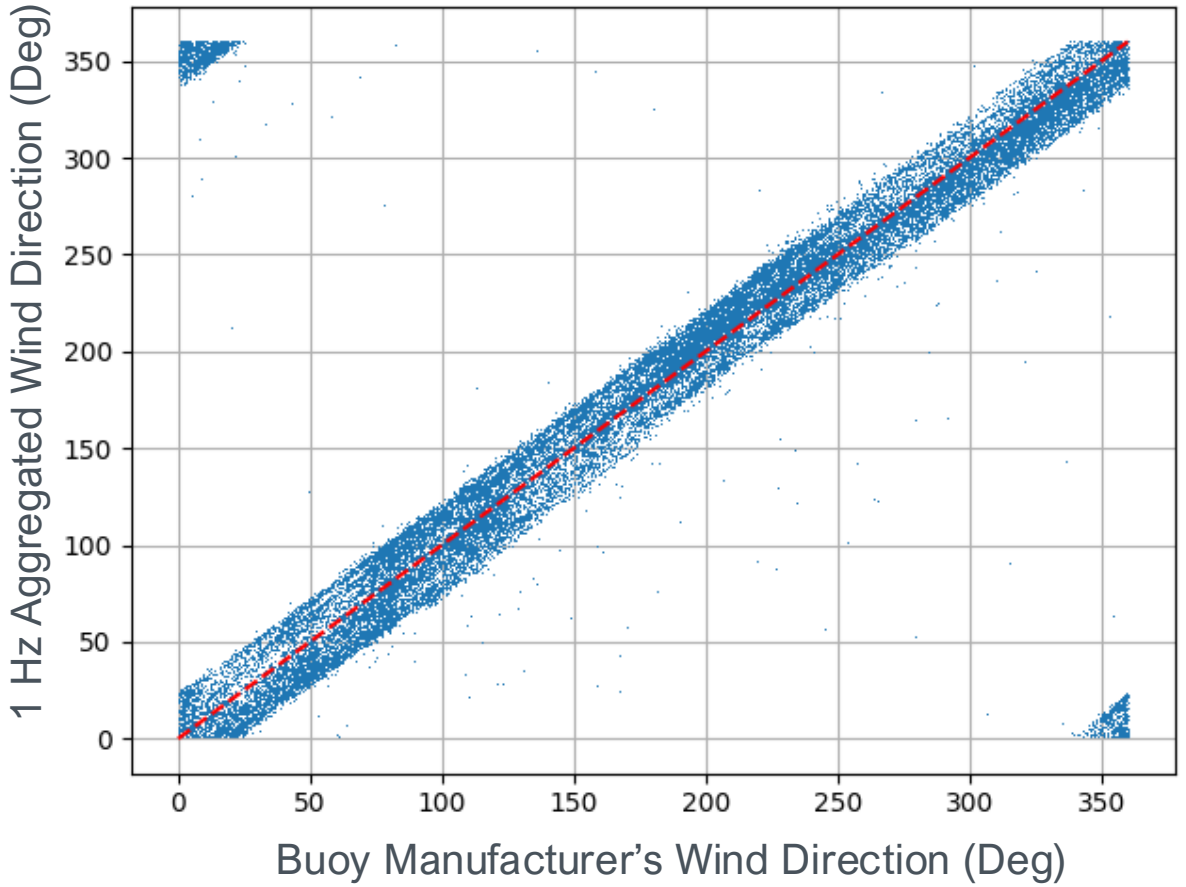




Good alignment, revealing manufacturer's data are also minimally processed

Results – Floating Lidar #2





Poor alignment, revealing manufacturer's data incorporate motion compensation and use a different compass for processing wind direction

Conclusions / Next Steps

- Some floating lidar data sets are minimally processed, while others are not
- Lidar processing strongly depends on supplementary measurements
- Our results should do not imply that one lidar data set is more accurate than the other, but simply that the level of processing is different
- A minimal lidar processing workflow can be used to “audit” floating lidar time series data, allowing us to better understand the buoy manufacturer’s lidar processing and assess measurement uncertainty, even in cases without proper documentation

- Compile results for more floating lidar data sets from addition buoy manufacturers
- Further develop lidar processing workflow to quantify measurement uncertainty

Thank you

Scott Eichelberger & Max Schuberth

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Energy Starts With Us

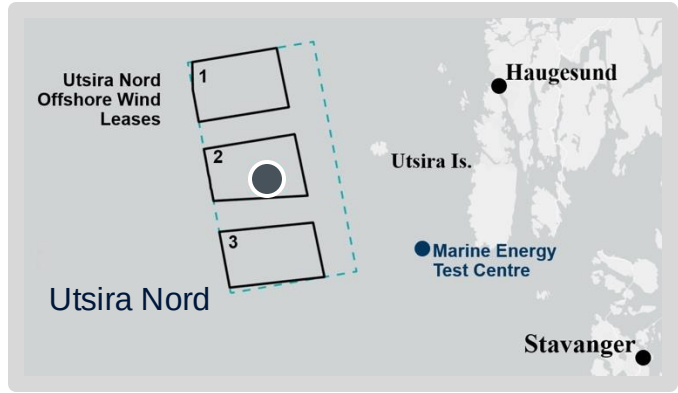
Current & Future Floating Lidar Buoy Deployments



Germany



Norway



East Coast U.S.

