

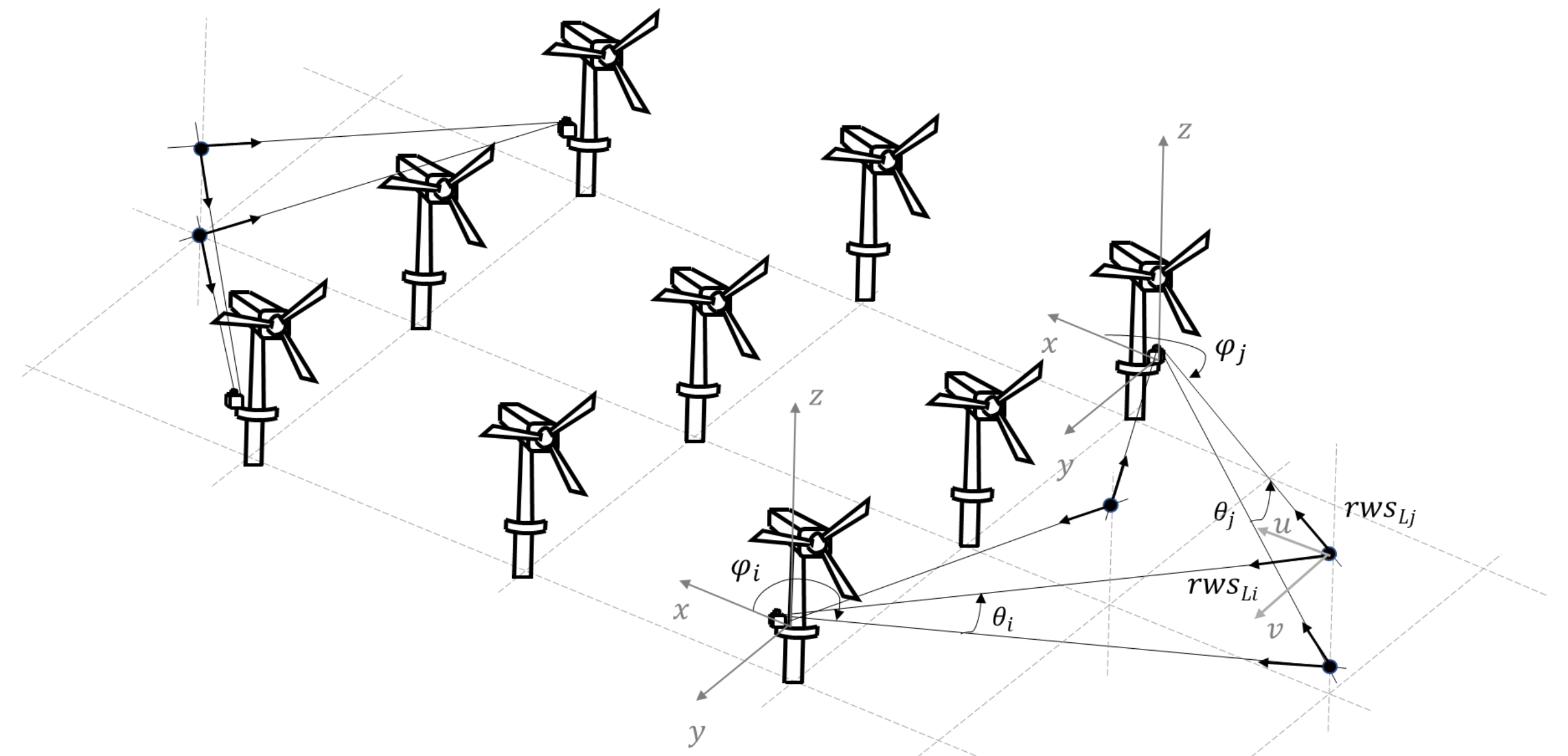
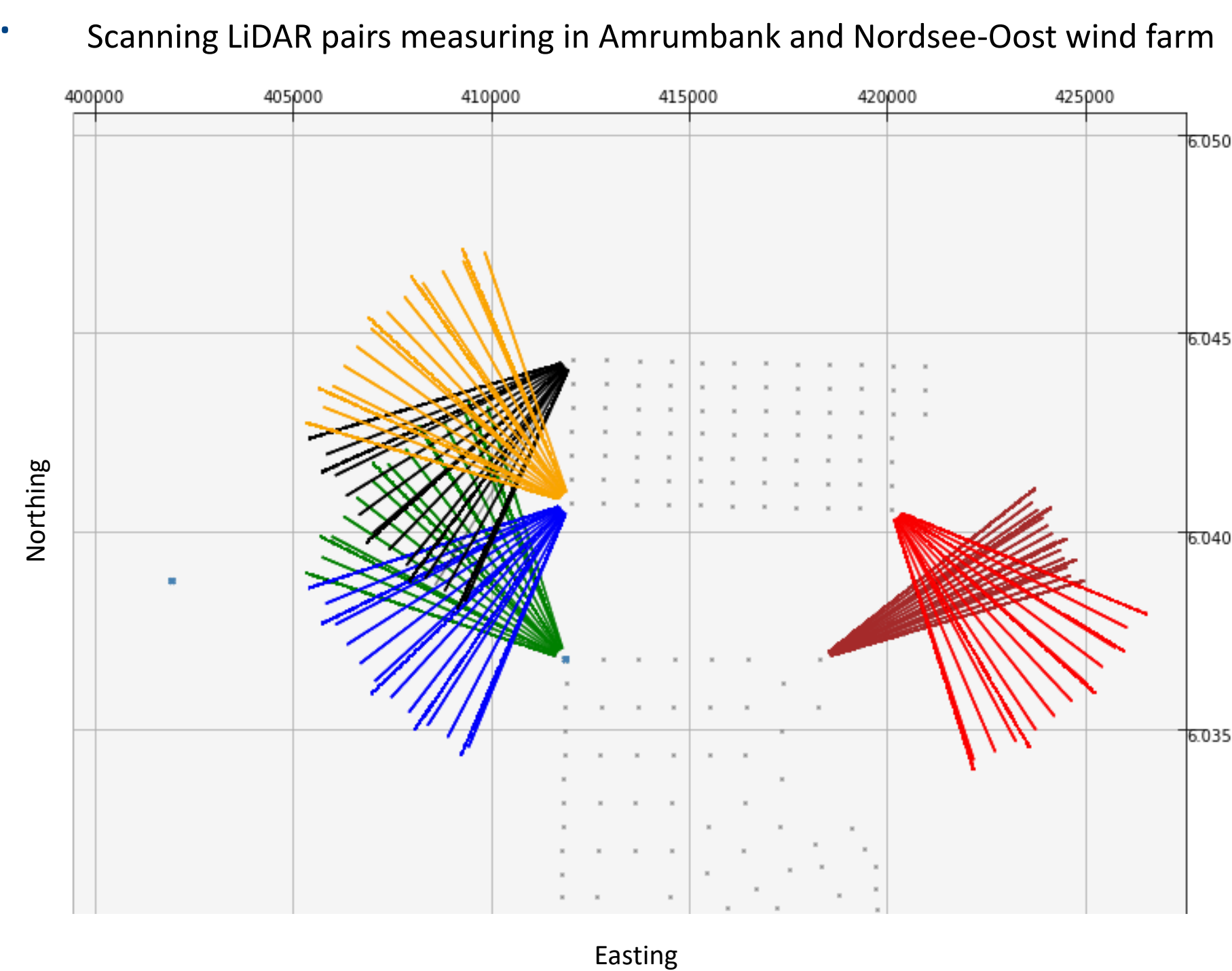
OWA GloBE: The management, processing and evaluation of a large dataset for the identification and quantification of Global Blockage Effects

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Abstract

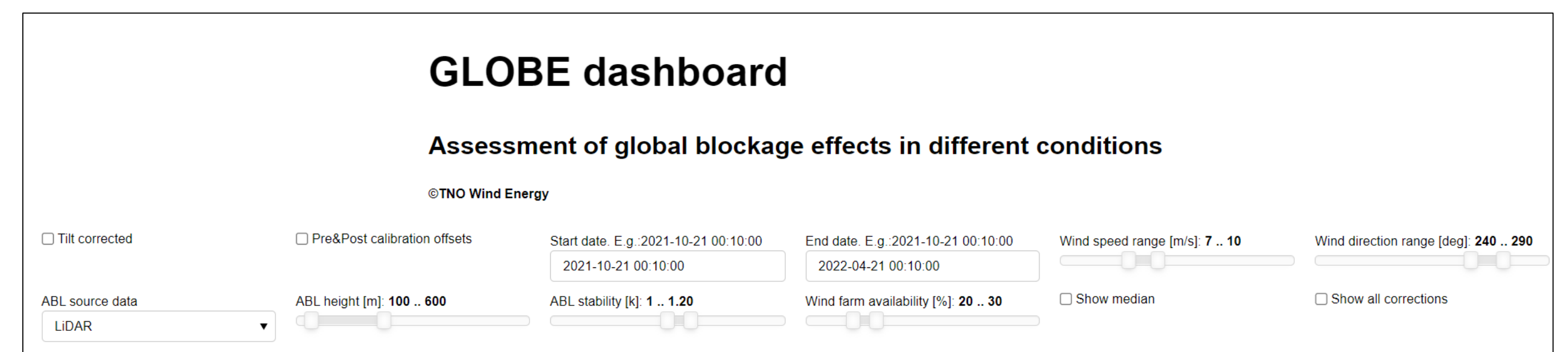
The GLOBE project represents one of the most extensive offshore measurement campaigns ever conducted in the wind energy industry, aiming to reduce the commercial uncertainty around the modelling of Global Blockage Effects (GBE), launched under the Carbon Trust's Offshore Wind Accelerator and led by RWE. The campaign took place at the Heligoland wind farm cluster in the German Bight. The campaign made use of 6 WindCube 400s devices measuring in a step-stare pattern up to 7km with drone calibration (picture is below. In blue and green, LiDAR 1 and 2, in black and yellow, LiDAR 5 and 6, in red and brown, LiDAR 4 and 7), a refurbished met mast equipped with profiling and high frequency measurement devices (cup and sonic anemometers), amongst others. The raw product of the campaign comprises terabytes of data from various different sources, and its analysis required the usage of data engineering, data science and statistics techniques. The work here presented culminates in an analysis of the magnitude of GBE depending on different atmospheric conditions and presents the various creative technical solutions found to address the challenge of processing a highly complex data set and relevant to any organisation wishing to engage in such an effort.



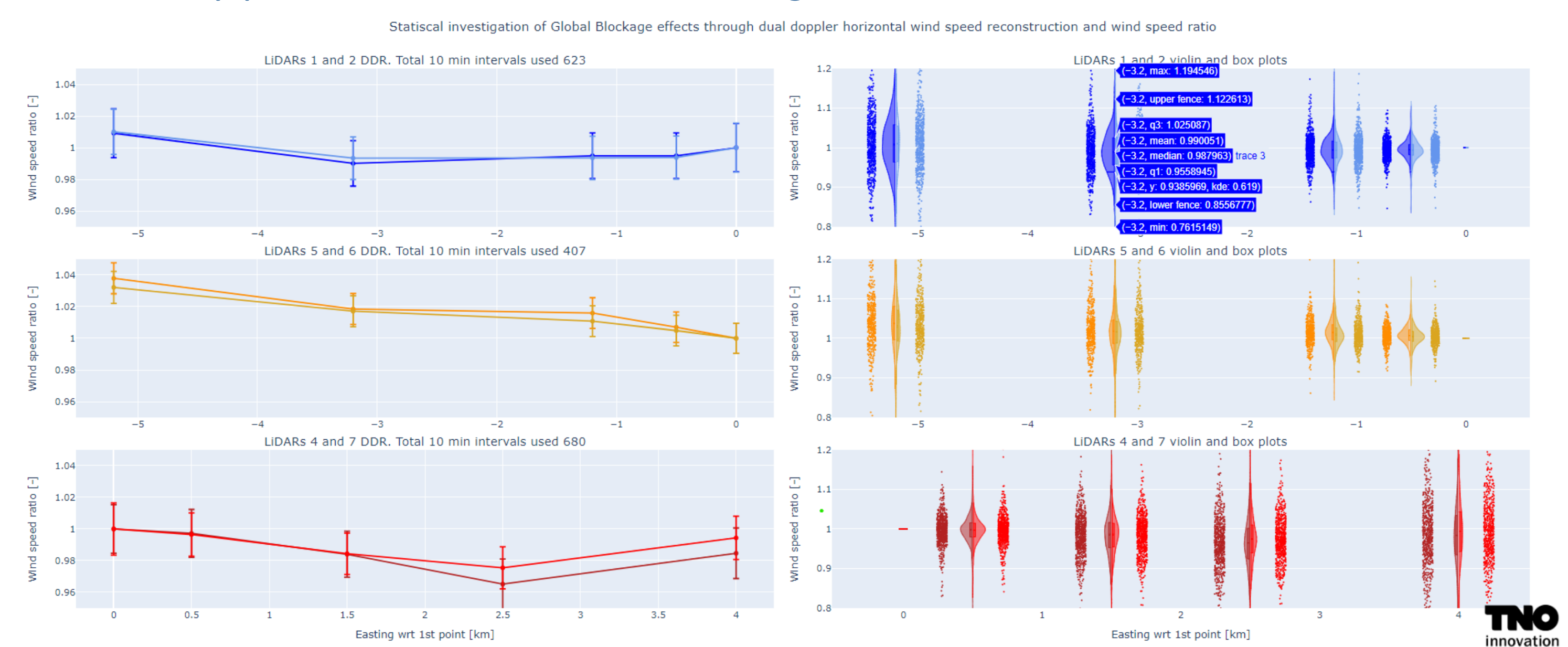
Furthermore, different types of corrections are applied to the data in order to account for (1) offsets in the radial wind speed measurements from pre and post campaign calibration exercises, (2) the tilting of the turbine, (3) offsets in the LiDAR and inclinometer sensors estimated by usage of a drone and (4) effects from other wind farm clusters (wakes).

Results: evaluating wind speed ratios

The final results are shown in an interactive dashboard so the user can evaluate the mean or median value of the WSR at each location upstream of the LiDAR pair. The main objective is to evaluate how the magnitude of GBE changes according to the external conditions, more specifically, wind speed and wind direction, Atmospheric Boundary Layer height and stability and wind farm availability. Various widgets are included in the dashboard, so that the user can assess the sensitivity of the results to both external conditions and corrections applied to the data. A figure of the available filtering criteria is shown below. The dashboard is coded resorting to the python *panel* library.



The final results are shown in a dedicated format. On the left, the mean or median statistics of the WSR at each relevant locations are shown. On the right side, the distribution of the underlying WSRs is shown. The underlying distribution is represented in violin plots, where the distribution of the WSR for the filtered conditions can be evaluated in great detail. In each row the results for a different pair are represented. Pair 12 is represented in the top row, followed by pairs 56 and 47. The below figure illustrated the final results.



Conclusions

The data retrieved in the GLOBE campaign culminates in a comprehensive data analysis process. This can only be successfully achieved with proper data management techniques that ensure a fast, reliable and automated analysis. Furthermore, the evaluation of GBE requires proper visualization tools so that results can be easily navigated, understood and a consensus on GBE built.

Acknowledgments

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