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First Identification and Quantification of Detached Tip Vortices Behind a WEC Using Fixed Wing UAS

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Quantifying blade tip vortices helps to understand the process of vortices detaching from the wind converter blade and their development in the wake until finally dissipating in the far wake, contributing to overall turbulence. This is especially interesting for set-ups of numerical simulations when setting the spatial resolution of the simulation grid.
The MASC-3 (Multi-purpose Airborne Sensor Carrier Mark 3) UAS (Unmanned Aircraft System) by the University of Tübingen measured atmospheric and meteorological quantities during the HeliOW campaign in July 2018 data behind a wind energy converter (WEC) (Enercon E-112) north of Wilhelmshaven, Germany, at the Jade Wind Park. Aside turbulence distribution, air temperature, humidity and the three wind components u, v, w in front of the WEC and in the wake were measured. By evaluation of the wind components, detached blade tip vortices were identified in the time series. The presented data were captured under a dominating marine stratification about 2 \unit{km} from the North Sea coast line with northern wind direction. The measured vortices are compared to the analytical Burnham-Hallock model for two vortices spinning in opposite direction. The model has its origin in aviation, where it describes two aircraft wake vortices. It will be shown that the BH model can be used to describe wake vortices behind a WEC. An evaluation method is presented to measure detached tip vortices with a fixed wing UAS. Also an improvement for the model in WEC wake use will be proposed.