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Frequency and evolution of Low Level Jet events over the southern North Sea analysed from WRF simulations and LiDAR measurements

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Low Level Jets (LLJs) are usually defined as wind maxima in lower altitudes and can be frequently observed in the nocturnal atmospheric boundary layer over land where they have been extensively studied. However, LLJs are very often encountered in the marine atmospheric boundary layer as well where they are crucial for offshore wind energy as they tend to occur at much lower heights than over land and directly affect offshore wind turbines.

The frequency of LLJ events over the southern North Sea has been analysed by means of a 20-year WRF simulation with 2 km resolution which has been performed to generate a wind and stability atlas for the southern North Sea. The criteria given by Baas et al. (2009) have been applied to detect LLJ events in the WRF output. As a main result it has been found that LLJs occur quite often over sea but less frequently than over land. However, LLJs over sea occur more frequently in lower, wind energy relevant heights.

To confirm the model results, LiDAR measurements from the Offshore Boundary Layer Experiment at FINO 1 (OBLEX-F1), conducted by the Norwegian Centre for Offshore Wind Energy (NORCOWE) at the offshore research platform FINO1 between May 2015 and October 2016 have been analysed and filtered to detect LLJ events. During the campaign, LLJs were detected in 15 % of the time. They typically occur when the wind is coming from the land and most of them have a jet core height between 190 and 240 m.

Finally, results from a case study will be presented where one significant LLJ event has been studied by comparing WRF simulations with LiDAR and radiometer measurements from the OBLEX-F1 campaign. Whereas the jet speeds are underestimated by the model, the LLJ heights match quite well. The model results show that the LLJ is associated with a temperature maximum which is confirmed by radiometer measurements. The model results further allow studying the spatio-temporal evolution of the LLJ. It is found that at least in the selected case the LLJ initialises in the evening hours over land and then during the night moves towards the sea where it intensifies reaching a maximum in the morning hours.