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Effects of a sea breeze discontinuity on air quality in an industrial coastal environment of the North Sea

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The effects of interaction between the sea breeze and synoptic wind on air pollutants have been studied in an industrial coastal environment of the North Sea. These effects have been investigated, during one day, using ground-based remote sensing systems and surface station data alongside with mesoscale modelling outputs. During a campaign in the North of France, continuous lidar measurements documented the structure and the evolution of the lower troposphere. The combination of lidar, sodar and surface station observations showed that the atmospheric boundary layer is well stratified during the night, with a stable double layer structure which slows the growing process of the mixing layer, in the morning and before the sea-breeze onset.

During the day, we observed discontinuity in meteorological measurements due to the sea-breeze occurrences. We have found that these sudden changes were well correlated with high concentrations of sulphur dioxide at ground level (up to 400 μg/m^3). The first sea breeze puff generates a change of the structure of the lower troposphere with a coupling between the residual layer and the convective boundary layer. The discontinuity of the sea-breeze gravity current is well observed by lidar signals and sodar echo.

The analysis revealed that the impacts of the sea-breeze discontinuity have significant implications on the local and the regional pollution above industrialized areas. This phenomenon triggers important changes on the local and regional air quality, more particularly in urban and industrial coastal localities.