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Studying the temporal and spatial evolution of turbulent mixing with a scanning Doppler lidar

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A key parameter describing turbulent mixing in atmosphere is mixing layer height (MLH), i.e. the height of the layer that is constantly in contact with the surface. Doppler lidars offer a way to observe the vertical wind velocity profile with a high enough time resolution to retrieve information on turbulent mixing and to identify the MLH above an instrument-specific threshold, typically 100 – 200 metres. Recently, we introduced a new method for identifying MLH below the vertical minimum range of a scanning Doppler lidar.

The new method for shallow MLH detection is based on velocity variance in low elevation angle conical scanning, i.e. vertical azimuth display (VAD) scanning. VAD scanning was chosen primarily because it provides simultaneously the horizontal wind profile. Applied to measurements at coastal locations, the new VAD-based MLH agrees well with MLH derived from turbulent kinetic energy dissipation rate profiles obtained from vertically-pointing Doppler lidar measurements. Therefore, a combination of VADs and vertically-pointing measurements enables covering the full range of MLH with a single instrument producing simultaneously the horizontal wind profile.

Here, based on several measurement campaigns carried out at the Hästholmen island in the Baltic Sea archipelago, we have extended this new MLH detection method to study the temporal and spatial evolution of the wind and turbulent mixing profiles in the vicinity of a small island.