Geophysical Research Abstracts
Vol. 17, EGU2015-9844, 2015
EGU General Assembly 2015


# Detecting shallow mixing heights in two coastal locations with a scanning Doppler lidar

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Turbulent mixing is one of the most important processes in the lower troposphere for climate, weather and air quality. A key parameter describing turbulent mixing in atmosphere is mixing height, i.e. the height of the layer that is constantly in contact with the surface. Doppler lidar offers a way to observe the vertical wind velocity profile with a high enough time resolution to retrieve information on turbulent mixing. However, Doppler lidars cannot retrieve wind velocity measurements below an instrument-specific threshold, typically 100 – 200 metres. Here, we introduce a method for identifying mixing heights below the vertical minimum range of a scanning Doppler lidar.

The new method for detecting shallow mixing height is based on velocity variance in low elevation angle conical scanning, i.e. vertical azimuth display (VAD) scanning, which provides simultaneously the horizontal wind profile. This method is applied to measurements in two very different coastal environments: Limassol, Cyprus during summer; and Loviisa, Finland during winter. At Limassol the measurements were carried out from 22 August to 15 October 2013 at the Cyprus University of Technology campus, 600 metres NE from the Mediterranean Sea shoreline. At Loviisa, the measurement campaign took place from 10 December 2013 to 17 March 2014 on a 2000 m long, 500 m wide island in the Baltic Sea archipelago.

At both locations, the new method agrees well with mixing heights derived from turbulent kinetic energy dissipation rate profiles obtained from vertically-pointing Doppler lidar measurements. Furthermore, when the vertically pointing measurements indicated the mixing height to be below the Doppler lidar minimum range, the VADs indicated a shallow mixing height on 87 % of the time at Loviisa and on 58 % of the time at Limassol. At Limassol such low mixing heights occurred only during the night; at Loviisa very low mixing heights were also common during the day.