The role of subsidence in a weakly unstable marine boundary layer: a case study

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The diurnal evolution of a cloud free, marine boundary layer is studied by means of experimental measurements and numerical simulations. Experimental data belong to an investigation of the mixing height over inner Danish waters. The mixed-layer height measured over the sea is generally nearly constant, and does not exhibit the diurnal cycle characteristic of boundary layers over land. A case study, during summer, showing an anomalous development of the mixed layer under unstable and nearly neutral atmospheric conditions, is selected in the campaign. Subsidence is identified as the main physical mechanism causing the sudden decrease in the mixing layer height. This is quantified by comparing radiosounding profiles with data from numerical simulations of a mesoscale model, and a large-eddy simulation model. Subsidence not only affects the mixing layer height, but also the turbulent fluctuations within it. By analyzing wind and scalar spectra, the role of subsidence is further investigated and a more complete interpretation of the experimental results emerges.