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Comparison of the mixing layer heights estimated by sodar and simple parametrization at Dome C, Antarctica

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On the Antarctic plateau, during the summer, the atmospheric boundary layer shows the typical mid-latitudes behaviour, which is a convective (although weak) layer during the warmer hours of the day followed by a stable layer during the “night”.

During the night the depth of the turbulent layer can range from an altitude of less than 10 meters up to several tens of meters. This range of investigation is too large to use the measurements of a meteorological tower, and at the same time too limited to use common acoustic or optical remote sensing systems, which have the first range gate starting in the best of cases from 20-30 meters.

At the French-Italian station of Concordia (Dome C, Antarctica) a high resolution surface-layer sodar was operated continuously during the summer 2011-2012. The instrument characteristics, i.e. its spatial and temporal resolution, allowed the monitoring of the mixing layer evolution with the adequate resolution during the entire diurnal cycle, allowing to collect a large data set during the all summer.

The conditions of ground homogeneity and lack of horizontal advection make of Dome C an ideal site for testing parametrizations of stable and unstable boundary layers.

In the stable cases, the mixing-layer height estimated using the sodar measurements was compared with the values obtained using the parametrizations proposed in literature for different atmospheric and stability conditions.

For the convective cases, a new diagnostic equation is proposed, based on a dimensional analysis that takes into account the time-averaged integral of the near-surface turbulent heat flux, the background static stability, and the buoyancy parameter. Despite the simplicity of the model it is in good agreement with the observations, and is able to reproduce the entire diurnal evolution with satisfactory accuracy.