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Application of ceilometers to retrieve planetary boundary layer height near tall-tower sites

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Tall tower measurement sites can provide continuous records of various climate-relevant atmospheric gases like CO_2, CH_4, CO, N_2O, or SF_6 at different altitude levels. With the help of inverse transport models, the results can be used to determine sources and sinks of important greenhouse gases. Several tall tower sites with heights around 300 m have been established in Poland, Germany and France.

Depending on the height of the tower and meteorological conditions, the different levels are influenced by air masses on a local to synoptic scale. A critical parameter for the analysis of the data is the planetary boundary layer height (PBL). If the top of the tower is still inside the PBL the measurements at the top level would be mostly influenced by local to regional sources and sinks. If the top is already in the free troposphere the measurements would be influenced by long-range transport. However, the PBL height cannot be derived from the tower measurements alone.

Within the preparations for the Integrated Carbon Observing System (ICOS), several methods for determining PBL height near tall tower sites have been evaluated. During a campaign in France in October 2008, lidar systems, radio sondes as well as two different commercial ceilometers (Vaisala CL31 and Jenoptik CHM15k) were run side-by-side. One goal of the campaign was to find out if and how ceilometers could be used to retrieve PBL height operationally and if they should become part of future ICOS network sites.