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# Non-reactive and reactive trace gas fluxes: Simultaneous measurements with ground based and vertically integrating methods

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The footprint area, i.e. the source region of a flux measured at a certain location, increases with increasing height above ground of the flux measurements. For non-reactive trace gases and horizontally homogeneous terrain (particularly with respect to deposition and emission processes), an increase in height should not alter the actual measured flux (constant flux layer assumption). For reactive trace gases, with chemical life times of about 30 s – 300 s, chemical production and loss processes within the measuring layer lead to vertical flux divergence. The magnitude of the flux divergence can be determined directly by comparing fluxes of reactive trace gases being affected by chemistry with fluxes of the same species being not altered by chemistry.

In August 2006, the field experiment LIBRETTO (LIndenBerg REacTive Trace gas prOfiles) was carried out in cooperation with the German Meteorological Service (DWD) at the field site of the Richard Aßmann Observatory in Lindenberg. At a 99 m mast, profiles of air temperature, relative humidity, wind speed and direction were measured. The mast is equipped with an elevator, where sensors for trace gases ($CO_2$, $H_2O$, $O_3$), air temperature and relative humidity have been installed. During the experiment, the elevator system was run continuously, providing scanned profiles of trace gas concentrations from 2 m to 99 m a.g.l. of the atmospheric boundary layer (ABL) approx. every 10 minutes. Between 0.15 m and 2.0 m, concentration differences of the trace gases $CO_2$, $H_2O$, $O_3$, NO and $NO_2$ were measured.

Applying the modified Bowen ration (MBR) method to the measured concentration differences and directly measured sensible heat flux (eddy covariance data from DWD) yields surface fluxes of the trace gases. Integral fluxes of $CO_2$, $O_3$ and sensible heat were computed simultaneously by applying the nocturnal boundary layer budget method to the scanned elevator profiles.

A direct comparison showed little deviations between the two methods for the passive $CO_2$ and sensible heat. This demonstrates the validity of the assumption of horizontal homogeneity. However, the fluxes of the reactive $O_3$ deviated significantly, with apparently higher deposition fluxes derived from the boundary layer budget method.

We will present simultaneously measured fluxes of $CO_2$, $O_3$ and sensible heat. Furthermore, we will discuss the reasons for the observed deviations between the two methods. Particularly the attempt will be made to explain these deviations with the measured quantities.