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Atmospheric research at the Bialystok super site

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Atmospheric research around the 300 meters tall Bialystok tower, Poland (53.23N, 23.03E; 183m a.s.l.) has started in 2003 with regular aircraft profiling. In situ measurements of temperature, relative humidity, ambient pressure and CO_2 mixing are obtained, as well as mixing ratios of CO_2, CH_4, CO, H_2, N_2O and SF_6 from laboratory analysis of flasks that are sampled at altitudes of 100, 300, 500, 1000, 1500, 2000, and 2500 metres above ground level. Since August 2008, in situ CO_2measurements have been upgraded, from which better agreements have been achieved between in situ CO_2 and the flasks. During each flight, two profiles are taken with a spatial separation of 20 kilometres. Analysis of the corresponding spatial variability of the columns is presented.

A low maintenance system for semi-continuous measurement of CO_2, O_2/N_2, CH_4, CO, N_2O and SF_6 from five tower levels (up to 300 m) and the associated flask programme (CO_2, O_2/N_2, CH_4, CO, N_2O, SF_6, Ar/N_2, H_2 and ^{13}C and ^{18}O isotopes in CO_2) were added in July 2005. Near real-time CO_2 data are provided in the frame of the IMECC project. The time series of the in situ measurements and their variability patterns will be presented.

In October 2007, the station was equipped with a ceilometer that works like a small LIDAR system and has been designed to detect cloud base height. The data provides cloud statistics for the station which is important for sun-dependent measurements (e.g. FTIR). A long term goal is to also retrieve information on the planetary boundary layer from analysis of the backscatter signals.

In the frame of two EU projects (Geomon, IMECC), an automated FTIR system was set up and is operational since March 2009, which qualifies Bialystok also as a TCCON site. FTIR measurements, calibrated against the global in situ surface network, permit to link satellite CO_2 observations (e.g. the GOSAT programme) to the global surface network. First time series of FTIR CO_2 and CH_4 data will be presented.

Footprint analysis using the STILT model shows that the measurements made at the 300 m level are regionally representative, with dominant wind directions advecting air travelled across central Europe to the station. The much larger footprints for the total column measurements of the FTIR were calculated using the TM3 model.

The current equipment set makes Bialystok one of the most important sites for greenhouse gas in situ measurements in Europe. It is also one of only four sites worldwide where co-located FTIR solar absorption (total column measurement) and vertically resolved measurements on tall towers are performed.