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Representativeness analysis of routine airborne CO_2 measurements for validating satellite measurements

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Tracer profiles measured by aircraft are the method of choice to link satellite measurements of atmospheric constituents to calibration scales used in ground based observing networks, which have provided the long-term backbone of atmospheric monitoring. Profiles can be collected in a routine way either using rental aircraft or from commercial airliners. In order to utilize these data for validation of remotely sensed column measurements, it is important to assess the spatial representativeness of the different profile locations.

High accuracy in situ CO_2 measurements have been made aboard rental aircraft over northeast Poland weekly since August 2008. Good agreements are found in the comparisons between the in situ CO_2 and the analysis results of flasks that are taken during the same flight. During each flight, two profiles are taken with a spatial separation of 20 kilometers. Analysis of the corresponding spatial variability of the columns is presented. Combination of flight profiles with a 300 meter tall tower with measurements at different levels enables us to calculate the column mean of CO_2between surface and 2.5 km altitude, the part of the atmosphere with the largest variability due to recent influence by surface fluxes.

Starting from 2011, IAGOS-ERI (Integration of routine Aircraft measurements into a Global Observing System – European Research Infrastructure) will provide continuous CO_2 and CH_4 measurements using instruments deployed aboard commercial airliners, with many profiles during take-off and landing over airports distributed all over the globe. Since these airports are usually colocated with larger populated areas and thus with emissions from fossil fuel combustion, the representativeness of tracer profiles need to be assessed. We analyzed CO measurements over Frankfurt airport from the MOZAIC using STILT (the Stochastic Time Inverted Lagrangian Transport model) combined with a high resolution CO emission map in central Europe. The analysis provides information on under which circumstances such profiles can be used for validation of remotely sensed column mixing ratios of CO_2 and CH_4.