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Temporal variability of atmospheric CO_2 mixing ratios at Kasprowy Wierch, southern Poland

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Gradual increase of atmospheric CO_2concentration over the last 150 years, by far exceeding natural variations, has been unequivocally attributed to human activities. The anthropogenic impact on the global carbon cycle is mainly related to fossil fuel and biomass burning, land-use changes, as well as various industrial activities. Although the level of atmospheric CO_2 is increasing, its growth rate is varying with time, responding to changes in the magnitude of the CO_2fluxes entering and leaving the atmospheric carbon reservoir, to or from the land biosphere and the world oceans. These temporal changes have both anthropogenic and natural origin. Development of reliable carbon cycle models requires adequate observational data. They are delivered mostly by the existing global and regional monitoring networks (GLOBALVIEW, 2005).

The Kasprowy Wierch station is located in the south of Poland, within the High Tatra Mountains. The meteorological observatory which hosts the monitoring station is located on top of a mountain peak called Kasprowy Wierch (49^o14'N, 19^o59'E, 1989 m a.s.l., 300 m above the tree line). The climate of Kasprowy Wierch area is typical for a continental mountain location, with relatively large diurnal and seasonal variations of temperature, high precipitation rate, frequent changes of atmospheric pressure and strong winds. Regular observations of atmospheric CO_2mixing ratios at Kasprowy Wierch begun in 1994. Continuous measurements using GC technique were initiated in 1996.

The Kasprowy Wierch CO_2 record, when compared to marine CO_2 reference, reveals similarities but also remarkable differences. Although the mean growth rates of CO_2 concentration characterising both records are similar, the apparent year-to-year variability of this parameter is substantially higher for Kasprowy Wierch. The peak-to-

peak amplitudes of seasonal changes observed at Kasprowy Wierch are consistently higher than those characterizing the marine reference curve. The mean difference is equal around 5.2 ppm.

Apart from daily and seasonal changes, also synoptic scale variations of CO_2 mixing ratios are occasionally recorded at Kasprowy Wierch station. They are associated with variable CO_2 load of different air masses transported across the European continent. Depending on the history of the given air mass, these differences can be large enough to be recorded as distinct "events" in the concentration record. They have nothing in common with similar events due to local contamination. Distinction between these two classes of events is possible by retrospective analyses of regional atmospheric circulation with the aid of backward trajectory modeling or full-fledged, 3D transport models. Several examples of such synoptic-scale CO_2 events recorded at Kasprowy Wierch are presented and discussed. The backward trajectory modeling was done with the aid of HYSPLIT code (http:/www.arl.noaa.gov/ready/hysplit4). Synoptic-scale CO_2 concentration events occur from time to time at different stations across the European continent and if they can be synchronized and attributed to specific meteorological situations they may serve as valuable calibration/validation tool for regional CO_2 transport models.

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References:

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