



## **Characteristics and background level detection of atmospheric CO<sub>2</sub> at GAW Global Station Zugspitze-Schneefernerhaus based on 35 years of continuous observations**

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35 years (1981-2015) continuous measurements of atmospheric carbon dioxide (CO<sub>2</sub>) at Zugspitze mountain station about 90 km south of Munich, Germany are investigated in this study. For the first 21 years (1981-2001) observation was conducted at Zugspitze summit (ZUG, 2962 m a.s.l.), while CO<sub>2</sub> measurement was performed at Zugspitze Schneefernerhaus Environment Research Station (ZSF, 2671 m a.s.l.) since 2002. The mean annual growth rate is  $1.58 \pm 1.25$  ppm per year during the first 21 years from 1981 to 2001 at ZUG, and  $2.07 \pm 1.12$  ppm per year for the last 15 years from 2002 to 2015 at ZSF. The average seasonal peak-to-peak amplitude increases slightly from  $11.60 \pm 2.62$  ppm (ZUG, 1981-2001) to  $12.61 \pm 1.90$  ppm (ZSF, 2002-2015). Regarding CO<sub>2</sub> weekly cycle, clear differences are found during weekends between ZUG and ZSF, while weekdays perform similar. As a high altitude observatory situated remotely from urban areas, CO<sub>2</sub> concentration at both ZUG and ZSF can still be influenced and contaminated by local/regional anthropogenic and biogenic sources and sinks. In order to remove the external influences and extract the real “background” level of CO<sub>2</sub> from measured data sets, a novel and efficient data selection method based on diurnal variation is performed. Performance of data selection is intensively discussed and compared with synoptical data as well as simultaneous radon measurement. Besides, nine months of parallel atmospheric CO<sub>2</sub> measurements at the Zugspitze ridge right above ZSF (2825 m a.s.l.) are also included for a short-term comparison with measured CO<sub>2</sub> at ZSF for the same period.

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