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Extending stratospheric mean age time series using AirCore

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Mean age of stratospheric air can be derived from observations of sufficiently long lived trace gases with approximately linear trends in the troposphere. Mean age can serve as a tracer to investigate stratospheric transport and long term changes in the strength of the overturning Brewer-Dobson circulation of the stratosphere. For this purpose, a low-cost method is required in order to allow for regular observations up to altitudes of about 30 km. Despite the desired low costs, high precision and accuracy are required in order to allow determination of mean age. We present balloon borne AirCore observations from two mid latitude sites: Timmins in Ontario/Canada and Lindenberg in Germany. During the Timmins campaign five Aircores sampled air in parallel from a large stratospheric balloon and where analysed for CO_2, CH4 and partly CO. We show that there is good agreement between the different AirCores (better than 0.1%) especially when vertical gradients are small. The measurements from Lindenberg were performed using small low-cost balloons and yielded very comparable results. We have used the observations to extend our long term data set of mean age observations at Northern Hemisphere mid latitudes. The time series now covers more than 40 years and shows a small, statistically not significant positive trend of 0.15 ± 0.18 years/decade. This trend is slightly smaller than the previous estimate of 0.24 ± 0.22 years/decade which was based on observations up to the year 2006. These observations are still in contrast to strong negative trends of mean age.