Geophysical Research Abstracts, Vol. 9, 04191, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04191

Measurement and trend analysis of O_2, CO_2 and $\delta^{13}C$ of CO_2 from the High Alpine Research Station Jungfraujoch, Switzerland - a comparison with the observations from the remote site Puy de Dô

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Atmospheric O_2, CO_2 flask measurements from the high altitude research station Jungfraujoch, Switzerland, and from the observatory at Puy de Dôme, France, are presented. Additionally, the Jungfraujoch $\delta^{13}C$ record of CO_2 is discussed. The observations on flask samples collected at the Jungfraujoch station show, since 2003, an enhancement of the oxygen trend which amount to about 45 per meg/yr with a corresponding CO_2 increase of around 2.4 ppm/yr. This enhancement is also comparable with that observed at the Puy de Dôme station where oxygen, since 2003, has decreased with a rate of about 43 per meg/year whilst the CO_2 increase was of around 1.7 ppm/yr but exhibiting a higher variability.

The possibility of a long term drift in the PIUB O_2/N_2 scale is estimated to be less than 5 per meg/year. Such a long term drift of minor magnitude would not alter our conclusions but scale issues are presently investigated within international projects. These studies among different collaborations are important to minimize uncertainties of scale differences among different laboratories.

The apparent slopes calculated from correlation plots between detrended CO_2 and O_2/N_2 records and corresponding trends are significantly larger than the observed terrestrial exchange and fossil fuel emission slopes indicating a strong ocean influence.

The enhanced oxygen decrease rate cannot be explained by an influence of variable seasonality strengths nor by the values of carbon emissions given by [Marland, et al.,

2006] since it corresponds to only about -20 per meg/yr. A doubling of the emission rate would be needed to account for our observations, which is unrealistic even considering the accelerated CO_2 emission in Asia and India. Additionally, observations of the δ^{13}C record of CO_2which shows no variations in the trend support this view. It rather indicates a temporarily enhanced O_2 ocean uptake in contrast to the intuitively expected release of oxygen through a decreased oxygen solubility of the ocean due to global warming. A regional ocean cooling may be responsible for that, because of increased regional oxygen solubility and/or an increased ocean oxygen uptake due to an enhanced marine biological activity. Our observation is most probably a phenomenon of decadal variability of the ocean dynamics.

References:

Marland, G., et al. (2006), *Global, Regional, and National CO2 Emissions.* In Trends: A Compendium of Data on Global Change, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.