ATMOSPHERIC OXYGEN AND CO2 FLASK CONCENTRATION MEASUREMENTS FROM GROUND AND AIRCRAFT SITES IN EUROPE

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ABSTRACT

Measurements of concurrent changes in both the atmospheric O_2 and CO_2 mixing ratios have been proven to be useful independent information for the partitioning of anthropogenic CO_2 into its different sinks [e.g. *Keeling et al.*, 1996]. This information is used along with the "classical" partitioning models that make use of CO_2 concentration and (radioactive as well as stable) isotopic composition information [e.g. *Keeling et al.,* 1995]. Global carbon budget reconstruction needs long time series observations of global means. Downscaling to a more regional assessment introduces a closer relation to possible annual and regional variations in prescribed oxidative ratios of biospheric and combustion processes. With the goal of improving the knowledge on the temporal and local variability of the O_2/ CO_2 signal, we present the results of the analysis on an extended data set from the remote station of Lutjewad (The Netherlands) and compare them with the findings of different other sampling stations in Europe, starting from 2001 till present.

INTRODUCTION

Flask samples have been periodically taken at the remote station of Lutjewad (The Netherlands), located at 6º 21' E, 53º 24' N, 1 m a.s.l., on the Wadden-sea dike in a perfectly flat surrounding in the very north of the Netherlands. Basic installations at the station could be started in late 2000, and successively more sampling and measurement instruments could be installed there.

The 60 meters high metal framework tower supports air intakes and (meteorological) instrument platforms at 7 m, 40 m and 60 m height. In particular, seasonal and regional variations will be shown, as measured by O_2/N_2 "isotopic ratio" mass spectrometry (IRMS), with respect to gas chromatography (GC) measurements of the CO_2 mole fraction in the air. The daily variability will be represented by means of samples taken in diurnal cycles and compared to that sampled in Hegyhatsal (Hungary) and Fyodorovskoje (Western Russia). Samples have also been taken onboard aircraft above the stations Schauinsland (Germany) and Hegyhatsal (Hungary), and above three stations (Fyodorovskoye, Syktyvkar, Ubs Nur) in Russia, at heights up to 3000 m, in order to reconstruct the continental background and maritime influences over these areas. First results are shown and specific problems are discussed. Additional concentration measurements of CO and CH_4 as well as stable isotopes of CO_2 are also given.

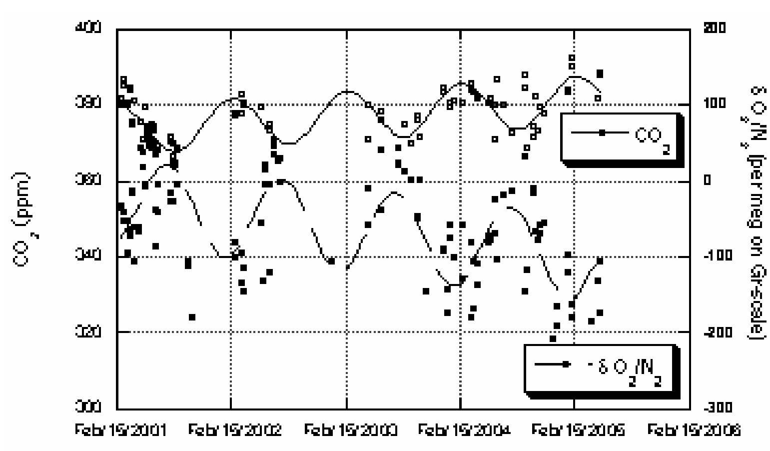

Fig. 1: The Oxygen and CO_2 concentration data of the Lutjewad station at 60 m.

PRELIMINARY RESULTS AND DISCUSSION

The Oxygen and CO_2 concentration record at Lutjewad starts in February 2001 and is shown in Fig. 1. At Lutjewad the CO_2 has a minimum in August, and increases towards the maximum in the middle of February. Oxygen mirrors this behavior slightly anticipating CO_2 maxima and minima. On the local Groningen O_2-scale the mean value of $\delta O_2/N_2$ is -56 per meg, with an annual amplitude of 56 per meg. Trend analysis shows an oxygen decrease of 19±3 per meg per year (w.r.t. Groningen reference 2534) and a CO_2 increase of 1.96±0.33 ppm per year. Figure 2 shows the seasonal covariance of oxygen with the CO_2 concentration of the record. All data are detrended to February 2001, applying a CO_2 increase rate of 1.96ppm/year and an O_2 decrease rate of 19 per meg/year. The slope of the linear fit, is -1.09 ± 0.06 mol per mol, reflecting the influence of the land biota on the seasonal cycles.

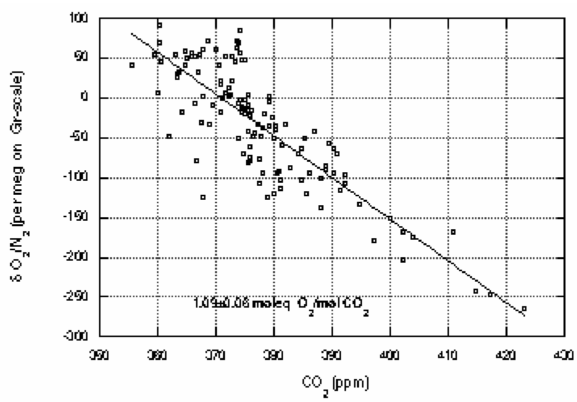

Fig.2: Seasonal covariance of oxygen and CO_2 concentrations sampled on Lutjewad mast station at 60 m.

Diurnal cycles sampled at Lutjewad are extremely heterogeneous, according to the different sources of the air masses that reach this station. They might be coming from agricultural as well as urban areas when from the south or originate on the sea when coming from the north and producing very negative O_2 / CO_2 ratios. Figure 3 gives an example of the O_2-CO_2 covariance in some diurnal cycles sampled in the years 2000, 2001 and 2002, that can be compared with other examples obtained from pure biogenic events sampled at Hegyhatsal (Hungary).

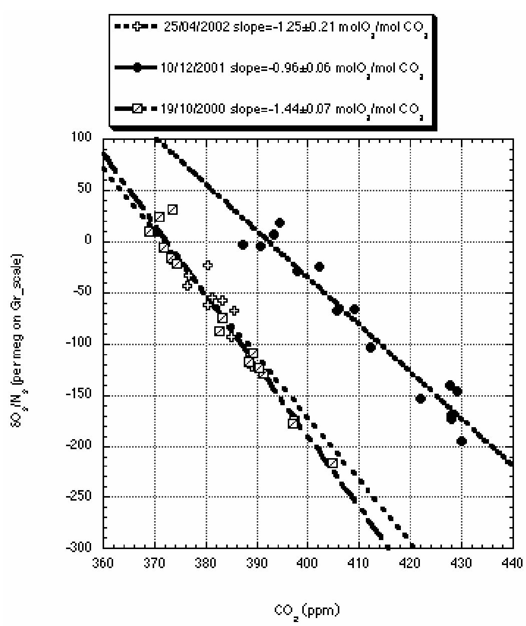

Fig.3: Diurnal covariance of oxygen and CO_2 concentrations sampled on Lutjewad mast station at 60 m.

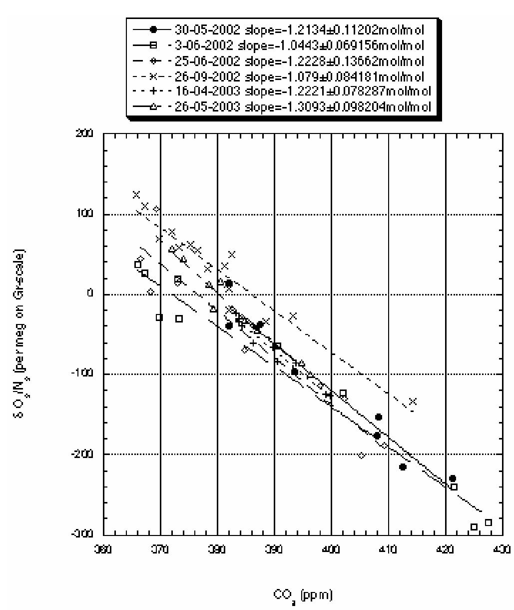

Fig.4: Diurnal covariance of oxygen and CO_2 concentrations sampled at Hegyatsal.

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