

## ***Interactive comment on “The dynamic chamber method: trace gas exchange fluxes (NO, NO<sub>2</sub>, O<sub>3</sub>) between plants and the atmosphere in the laboratory and in the field” by C. Breuninger et al.***

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Received and published: 30 December 2011

We appreciate the positive evaluation of our manuscript. We thank the editor for his comments. Our replies and indications of changes to be made to a revised manuscript are listed below.

Comment 1 p5190ff.: In Eqs. (4.x) and following, overbars (average values) for some quantities in the chemistry terms are introduced. This is done without sufficient explanation. It remains questionable whether e.g. the use of averaged O<sub>3</sub> and NO concentrations for the regression analysis of NO<sub>2</sub> (Eq. 4.1 ff.) does not lead to sys-

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tematic errors. This procedure assumes that - while NO<sub>2</sub> ambient concentrations vary over a large range - the concentrations of NO and O<sub>3</sub> either remain nearly constant or vary uncorrelated to NO<sub>2</sub>. However, in field conditions it is often observed that the concentration time series (diurnal or synoptic cycles) of NO, NO<sub>2</sub>, and O<sub>3</sub> are strongly correlated (or anticorrelated) to each other. Therefore the authors should consider and discuss this issue thoroughly.

Reply The meaning of overbars is now explaining at the corresponding place, where these quantities are introduced. For the rest of the Editor's comment we like to refer to two short paragraphs which have been shifted and added, respectively: (1) after Eq. (4.3) page 5191, line 1 (former on page 5192, line 6-13): "The quantities  $n_1$ ,  $n_2$ ,  $n_3$  and  $b_1$ ,  $b_2$ ,  $b_3$  cannot be determined (graphically or numerically) from single pairs of  $m_{a,i}$  and  $m_{s,i}$ , but from a (statistically sufficient) set of measured  $m_{a,i}$  and  $m_{s,i}$  (i.e. data sets classified for defined conditions of irradiation, temperature, humidity, concentrations, respectively). Therefore,  $n_1$ ,  $n_2$ ,  $n_3$  and  $b_1$ ,  $b_2$ ,  $b_3$  represent mean values for these data sets. Consequently, the quantities  $Q$ ,  $A_{leaf}$ ,  $j(\text{NO}_2)$ ,  $k$ ,  $m_{s,\text{NO}_2}$ ,  $m_{s,\text{NO}}$ , and  $m_{s,\text{O}_3}$  in Eqs. (5.1) (5.3), (6.1) (6.3), and (7.1) (7.3) must be averaged over the same (time) period (the same data set) of  $m_{a,i}$  and  $m_{s,i}$  measurements from which the quantities  $n_i$  and  $b_i$  were derived." (2) after Eq. (7.3) page 5192, line 5: "It has to be stated, that the use of averaged concentrations (quantities with overbars) for regression analysis (Eq. (4.1) ff) may eventually result in systematic errors for the derived quantities of compensation point concentrations and deposition velocities, particularly, if these concentrations will vary over a large range. This can basically not be ruled out. Moreover, concentration of NO, NO<sub>2</sub>, and O<sub>3</sub> may be more or less correlated, particularly during field conditions. The way we have considered these and other correlations is the application of the General Gaussian Error Propagation where those concentrations are considered explicitly (see Sect. 3.4.7). Errors (e.g. temporal variability) of averaged quantities are propagated to the final error of compensation point concentrations and deposition velocities."

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Comment 2 p5221, line 1-2 (and Figs. 13b, 14b): It is not clear to the reader, how the regression lines of  $F_{ex}$  vs.  $m_s$  in Figs. 13b and 14b have been calculated. The text refers to Eq. (5.1) while the figure captions refer to Eq. (8.1.1). Both of these equations contain the parameters  $b_1$  and  $n_1$  that are defined as linear regression parameters for  $m_s$  vs.  $m_a$ , which is a bit confusing.

Reply The relationship between  $F_{ex,NO_2}$  and  $m_s,NO_2$  is determined by Eq. (5.1). The corresponding line is shown in Fig. 13b (Fig. 14b for  $O_3$ ). We corrected the references to the equations in the figure captions of figures 13b and 14b: (13b) "NO<sub>2</sub> exchange flux density ( $F_{ex,NO_2}$ ) vs. NO<sub>2</sub> concentration measured at the outlet of the dynamic plant chamber ( $m_s,NO_2$ ).  $F_{ex,NO_2}$  data were calculated according Eq. (1.1), their standard errors according to Eq.(11). Reddish diamonds stand for those  $F_{ex,NO_2}$  data, which have to be rejected for non-significance of  $\Delta m_{NO_2} = (m_a,NO_2 - m_s,NO_2)$ . Blue line (considering blue circle data) and pink line (considering blue circle and reddish diamond data) were calculated according to Eq. (5.1)."  
(14b) "O<sub>3</sub> exchange flux density ( $F_{ex,O_3}$ ) vs. O<sub>3</sub> concentration measured at the outlet of the dynamic plant chamber ( $m_s,O_3$ ).  $F_{ex,O_3}$  data were calculated according Eq. (1.3), their standard errors according to Eq. (11). Dark red line was calculated according to Eq. (5.3)."

Comment 3 p5221, line 17-21: This information about the experiments should be given earlier, either in the method or in the results section. Comment 4 p5221, line 5222: How should the photosynthesis and transpiration rates of "enclosed and comparable non-enclosed parts of the plant" be checked?

Reply to Comment 3 and 4 We added a short paragraph after page 5208, line 21 to describe the measurements: "We proved the photosynthetic capacity of the enclosed needles in comparison to control needles by measurements of in-situ CO<sub>2</sub> and H<sub>2</sub>O needle gas exchange in response to temperature, radiation using a portable gas exchange system (WALZ GFS3000, Walz, Effeltrich/Germany)."

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Additionally, we shifted the paragraph at the end of Sect. 3.3.6 (former on page 5221, line 18-21): "After field experiment we could not identify visual differences between enclosed and not enclosed plant material. Moreover, no differences in physiological performance were detectable. Furthermore, analyses of the composition of nutrients of needles were without findings. Detailed results of these analyses will be given in a consecutive publication."

Comment 5 p5225, line 4: The numbers seem to be not consistent. Shouldn't it read here "3.3 nmol/m<sup>3</sup> (0.075 ppb)"?

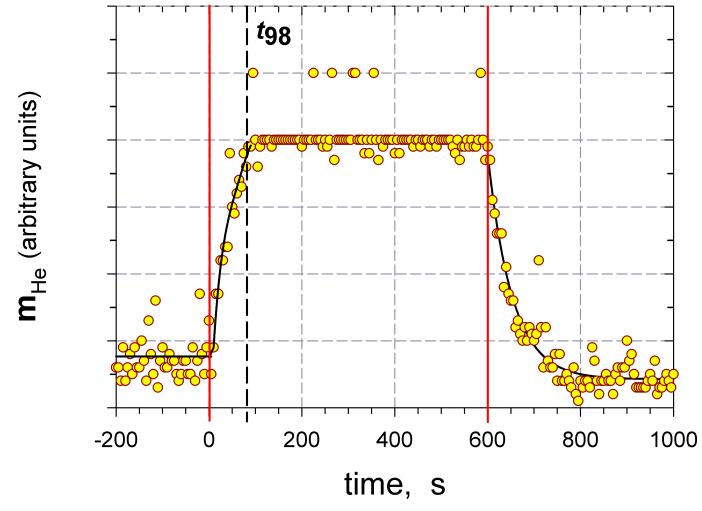
Reply That is true. We corrected it.

Comment 6 p.5268, Fig. 10: The black solid line in this figure is misleading. It starts to rise before time = 0 (start of He addition) and it also shows a wrong shape around  $t=0$ . The rising curve should rather show an exponential approaching to the higher Helium level.

Reply We agree and have made a new fit of the black solid line.

Language corrections p5216, line 25: replace "controlled" by "checked" or "quantified"  
p5217, line 4: change to "...have been determined..."  
p5226, line 25: I assume that "from each other" should be replaced here by "from zero".  
p5227, line 20: The use of the word "Furthermore" gives a misleading impression here. Not measuring all components of the triad was probably in direct connection to the use of zero/filtered air. I thus recommend to replace "Furthermore" by "This was related to the fact that ...".  
p5227, line 14: The term "not true" should not be used here, because the true value is not known! I recommend to modify the sentence to "...will be overestimated (see below) while they erroneously appear to be (highly) significant."  
p5234, line 14: Is the meaning here "more than 0.1 ppb"?

Reply Text will be corrected in the revised manuscript.



**Fig. 1.** Results of the response time test with helium.

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