Geophysical Research Abstracts
Vol. 12, EGU2010-11872-4, 2010
EGU General Assembly 2010
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Growth response to a changing environment-Impacts of tropospheric ozone dose on photosynthesis of Norway spruce forests in Austria

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Tropospheric ozone is an important air pollutant, although plants have active defense strategies (e.g. antioxidants), the cumulative ozone dose may lead to chronic damages to plant tissues. Ozone enters into plants through stomata and reacts with other chemicals to create toxic compounds. This affects plant photosynthesis and may reduce CO2 fixation, and consequently growth. Open top cambers (OTC) are usually used to study the effects of elevated ozone levels on photosynthesis; whereas field studies with on site occurring ozone levels are rare. A recent modelling study on Norway spruce stands in Austria exhibited trends in model errors indicating that an increase in ozone dose leads to a reduction in volume increment.

This study aims to explore how different ozone doses affect photosynthesis under field conditions and may translate into growth response for 12 stands of Norway spruce, distributed along an ozone concentration gradient across Austria. A LI-6400xt photosynthesis system was utilized to collect physiological parameters including net photosynthesis, stomata conductance, internal CO2 concentration, transpiration, etc. Chlorophyll fluorescence data was collected by using a PEA chlorophyll fluorescence meter, and chlorophyll content was measured. Morphological characteristics and soil samples were also analyzed. Ozone dose to leaf tissue was calculated from external ozone concentration, the conductance of the stomata to ozone, the leaf area index and the time span of the day when ozone uptake takes place. Our results confirm that increasing cumulative ozone dose reduces maximum assimilation rate and carboxylation efficiency under field conditions. Our final goal is to quantify how far this ozone induced reduction in assimilation power ultimately translates into a growth reduction of Norway spruce in Austria.