

Is there an impact of tropospheric ozone on the climate change mitigation potential of forests in Trentino (Northern Italy)?

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Abstract Tropospheric ozone has a dual role in climate change. On the one hand, its positive radiative forcing of 0.25-0.65 W/m² makes ozone the third most important greenhouse gas, after CO₂ and CH₄ (IPCC, 1997). On the other hand, ozone has been estimated to affect forest health and growth and therefore to reduce their potential C sink (e.g. Wittig et al., 2009). Failure in accounting for ozone effects on C sequestration has been estimated to increase the cost of climate change mitigation (Felzer et al., 2005). It is therefore important to have reliable information on distribution and effects of ozone, especially for mountain forests, which are considered particularly sensitive to climate change and exposed to high ozone levels. In 2007, a five-year meso-scale (6,200 km²) study was undertaken in Trentino, North Italy, where forests are estimated to stock 31x10⁶ t C in their above-ground biomass (Tonolli and Salvagni, 2007). We (i) measured ozone concentration at 15-20 forest sites according to a systematic grid, (ii) modeled ozone exposure and associated risk for vegetation and (iii) investigated the effects on vegetation by means of field studies and statistical modeling (Gottardini et al., 2012). Results showed that ca. 76-95% of the forest area experienced an ozone concentration that exceeds the EU and UN/ECE risk thresholds, with a potential reduction of growth and therefore C sequestration. However, although specific symptoms related to ozone exposure have been identified on sensitive vegetation, measured effects on growth and health of forests were much less obvious. Despite the high exposure levels recorded, ozone was never a significant predictor of basal area increment and defoliation. Rather, frequency of tree damage and N-related variables were the most important predictors. An ad-hoc investigation based on long-term monitoring data confirmed the scarce relationship existing between ozone exposure and flux and tree defoliation and growth. A complex picture emerged, with potential high risk and early indicators of effect, but apparent limited impact of ozone on growth and therefore on C sequestration and climate mitigation potential in Trentino. There is a clear need to reconcile this picture into a consistent, meaningful frame.

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