



# **Climate Change, Air Pollution and Global Challenges: Chapter 5. Air Pollution Risks to Northern European Forests in a Changing Climate (Developments in Environmental Science)**

*Juha-Pekka Tuovinen, Hannele Hakola, Per Erik Karlsson, David Simpson*

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The air pollution load to northern European forests is changing as a result of emission reductions. Climate change modifies this load, either directly via atmospheric processes or indirectly by affecting emission patterns. We estimate the risk of harmful effects due to tropospheric ozone and nitrogen deposition in present and future conditions. Our modelling results show that critical levels are exceeded in northern Europe for both ozone and nitrogen. Emission reductions will reduce the vegetation stress, but climate change is likely to have an opposite effect. While tropospheric ozone is reduced, its phytotoxic dose increases due to atmospheric warming. The amplified warming in the Arctic may significantly enhance shipping emissions. The effect of these increases extends to the boreal region. In addition, we review recent literature on the interactions between climate change and air quality, and discuss the assessment of pollution risks and carbon stocks and related synergies in emission control.

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