New Predictions for the Global Atmospheric Environment by 2030

An international group of scientists recently evaluated the likely changes in the global atmospheric environment between 2000 and 2030. The results suggest that current international legislation on air pollutant emissions is not enough to reduce the current associated problems related to increased ozone concentration and ecosystem damage due to elevated nitrogen deposition.

Air pollution is both a local and a trans-boundary problem caused by the emission of certain pollutants which either alone, or through chemical reaction, lead to negative environmental and health impacts. Ozone (O$_3$) is formed through the reaction of volatile organic compounds (VOCs), such as methane, and nitrogen oxides (NOx) in the presence of sunlight. O$_3$ is toxic to humans, animals, and plants and is an important greenhouse gas that contributes to global warming. On the other hand, enhanced emissions of sulphur dioxide (SO$_2$), NOx, and ammonia (NH$_3$) lead to increased long-range transport and deposition of nitrogen, which, in turn, affects the nutrient content of the soil (eutrophication) and favours acidification of ecosystems and loss of biodiversity. Large parts of the world are currently exposed to high concentrations of ozone and high deposition of nitrogen on ecosystems.

A recent study, carried out under the EU-funded research network ACCENT$^1$, has evaluated the effects of changing emissions and climate on ozone concentration, the balance between incoming and outgoing solar radiation, and the effects of nitrogen deposition on ecosystems by the year 2030. To this end, scientists used atmospheric chemistry models and three different emission scenarios. The first scenario, called the Current Legislation Scenario (CLE), developed by the International Institute for Applied System Applications (IIASA), reflects the implementation of current air quality legislation around the world. A second scenario, called the Maximum technically Feasible Reduction (MFR) scenario, represents a more optimistic case in which all currently feasible technologies are applied to achieve maximum emissions reduction. The third scenario, the Intergovernmental Panel on Climate Change SRES-A2 scenario, which is a more pessimistic case regarding emissions control, has been used as a contrast to the previous scenarios.

The main findings of the study are:

- By 2030, it is estimated that the global surface ozone will have increased globally by approximately 5% and 15% for the CLE and SRES-A2 scenarios respectively. Only the optimistic MFR scenario would reduce surface ozone concentrations by 8%.
- Climate change is expected to reduce surface ozone by approximately 3% with larger decreases over sea than over land. Nevertheless, some regions, such as the eastern United States, are expected to experience increases.
- Tropospheric ozone concentrations will increase by 5.2% and 13.2% for the CLE and SRES-A2 scenarios respectively, and will decrease by 4.3% under the MRF scenario. Consequently, the earth’s surface temperatures are expected to be warmer under the CLE and SRES-A2 scenarios and to cool down under the MRF scenario.
- At present, 10.1% of the global natural terrestrial ecosystems are exposed to nitrogen deposition above a critical load of 1 g N m$^{-2}$ yr$^{-1}$, above which changes in sensitive ecosystems may occur. By 2030, the portion of global natural terrestrial ecosystems exposed to nitrogen deposition above this limit will have increased under all three scenarios, to 16% (CLE), 11% (MFR), and 25% (SRES-A2) respectively.

The present study suggests that, by 2030, the current international legislation on air pollutant emissions may not be able to mitigate and reduce the current problems related to ozone concentration and eutrophication of ecosystems though nitrogen deposition. According to the results, only the introduction and enforcement of stringent abatement technologies to reduce NOx, CO, volatile organic compounds (VOC) and methane could prevent future problems in this area.

$^1$ACCENT project: Atmospheric Composition Change European Network of Excellence (http://www.accent-network.org/), supported by the European Commission 6$^{th}$ Framework Programme Thematic Priority for Sustainable Development, Global Change and Ecosystems (SustDev).


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Theme(s): Air pollution

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To cite this article/service: "Science for Environment policy": European Commission DG Environment News Alert Service