

Research Highlight

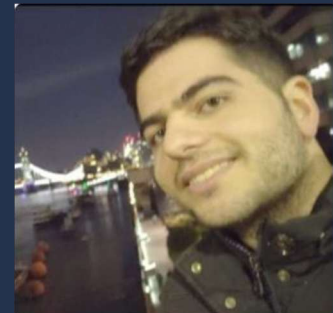
'Global impact of anthropogenic NH_3 emissions on upper tropospheric aerosol formation'

Summary

Atmospheric ammonia can double the number of atmospheric particles over high emission regions and lead to the potential for increased cloud formation, a study finds. Anthropogenic ammonia emissions, which primarily stem from agricultural activities such as fertilizer application, are projected to double by 2100. While much is known about ammonia's effects on surface air quality, less is known about how much reaches the upper atmosphere and its effects there. Christos Xenofontos and colleagues modeled the effect of anthropogenic ammonia emissions on particle formation in the upper troposphere and lower stratosphere. The authors compared two global simulations of atmospheric chemistry, one with anthropogenic ammonia emissions included and a baseline with no human-caused emissions. The model shows that convection carries ammonia above the surface layer, strongly enhancing aerosol formation and growth, resulting in changes in aerosol composition and abundance over high emission regions. These aerosol particles increase cloud condensation nuclei by 2.5 times compared to baseline. Aerosol optical depth increased by 80% which affects the absorption of light by particles in the atmosphere and potentially climate. According to the authors, ammonia is projected to reach the upper troposphere in high enough concentrations that its effects should be included in climate models and projections.

Authors' bios

Christos Xenofontos is a PhD student at the Environmental Predictions Department of the Cyprus Institute's Climate and Atmosphere Research Center (CARE-C). His research focuses on modelling new particle formation in the upper troposphere. He holds a Marie Skłodowska Curie Actions (MSCA) Fellowship.



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Impact

Ammonia (NH_3) emissions from human activities can significantly influence aerosol processes in the upper troposphere and lower stratosphere (UTLS). Using an Earth system model, this study shows that anthropogenic NH_3 strongly enhances new particle formation and growth,

leading to substantial changes in UTLS aerosol composition and abundance. These changes can enhance cloud condensation nuclei concentrations by a factor of 2.5 in the upper troposphere over high-emission regions. In addition, aerosol optical depth can increase by up to 80%, potentially affecting climate. The findings underscore the need to account for UTLS NH₃-driven aerosol processes in Earth system models to improve predictions of atmospheric composition and cloud effects in climate scenarios.

Reference

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