Main field: Earth Sciences & Environment

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"Aerosol-Meteorology Interactions during TRAnsboundary pollution cases"

In the context of climate change, transboundary air pollution increasingly affects air quality and aerosol–meteorology interactions at regional and even global scales. Emissions from these sources are not accounted for in traditional numerical weather prediction (NWP) models, although there is an influence of aerosols on the atmosphere. To study aerosol–meteorology interactions and various feedbacks in the atmosphere integrated modeling can been applied. Several studies have recently investigated the regional effects of wildfires, dust storms, and land cover changes on meteorology in Ukraine [1,2]. These findings demonstrated the critical importance of accounting for complex atmospheric feedbacks, which had not been identified. At the same time, two major challenges were revealed. First, the impacts of large-scale transboundary cases remain uncertain. Second, verification of modeling results is difficult to carry out due to absence of suitable aerosol observations in Ukraine and outdated state of the national air quality monitoring network.

The project aims to investigate cases of transboundary aerosol pollution, which represent one of the most impactful hazards, leading to changes in atmospheric processes through direct and indirect aerosol effects, decline in regional scale air quality, and significant impacts on human health, the environment and ecosystems. The plan is to apply seamless/ online-integrated modelling approach, in particular to use the Enviro-HIRLAM (Environment–HIgh Resolution Limited Area Model) modelling system [3] for modelling complex interactions as well as spatiotemporal distribution of different aerosol species and their depositions – key variables that determine exposure. Verification against advanced observations at the Station for Measuring Ecosystem-Atmosphere Relationship (SMEAR, located in Hyytiälä, Finland) will provide a solid foundation for improving the accuracy of such estimates and for assessing model sensitivity.

The project is divided into three main parts. The first part involves modeling activities using the Enviro-HIRLAM model for selected cases of transboundary pollution. The second part focuses on model output verification using observations obtained at the Hyytiälä SMEAR-II station. The third part consists of modelling results post-processing, their visualization, analysis and interpretation as well as reporting (report and presentation on hybrid seminar) and preparing manuscript for a peer-reviewed science journal.

References

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