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On the roles of circulation and aerosols in the decline of mist and dense fog in Europe over the last 30 years

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Fog and mist are meteorological phenomena that have significant contributions to temperature variations. Understanding and predicting them is also crucial for transportation risk management. It has been shown that low visibility phenomena over Europe have been declining over the past three decades. The trends in mist and haze have been correlated to atmospheric aerosol trends. However, dense fog has not received yet such focus. The goal of this paper is to examine the roles of synoptic atmospheric circulation and aerosol content on the trends of dense fog.

We show that sulphur emission trends are spatially correlated with visibility trends, with a maximum correlation when visibility is between 1 km and 10 km. We find that atmospheric dynamics overall contributes up to 40% of the variability of the frequency of fog occurrences. This contribution is spatially variable and highly depends on the topography and the season, with higher values in the winter.

The observed long-term circulation changes do not contribute much to the trends in low visibility found in the data. This process is illustrated on three stations (De Bilt, Zürich Airport and Potsdam) for which a long-term visibility data and a thorough meteorological description are available. We conclude that to properly represent fog in future climate simulations, it is necessary to include realistic representations of aerosol emissions and chemistry, land surface properties and atmospheric dynamics.