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Using explainable artificial intelligence (xAi) to determine drivers of fog and low stratus clouds (FLS) occurrence and life cycle

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While clouds are a key component of the climate system, cloud processes and aerosol-cloud interactions are still poorly understood. This is also the case for fog and low stratus clouds, which are particularly affected by aerosol emissions at the surface and by land-atmosphere interactions.
In this study, Extreme gradient boosting (XGBoost) and xAI methods such as SHapley Additive exPlanations (SHAP) are applied to satellite-based FLS and aerosol data sets and reanalysis data to distill the effects of environmental conditions and aerosols on FLS occurrence and life cycle. The analysis is conducted over the Po valley (Italy), in winter and fall from 2006-2015.
The XGBoost model skillfully predicts FLS duration with an R^2>0.7. The sensitivity analysis identifies temperature and humidity as the most important predictors. A higher amount of aerosols seems to prolong FLS duration. This analysis showcases the potential of xAI to the analysis of nonlinear relationships in cloud systems.

Primary author: PAULI, Eva (Karlsruhe Institute of Technology)

Co-author: CERMAK, Jan (Karlsruhe Institute of Technology (KIT))

Presenter: PAULI, Eva (Karlsruhe Institute of Technology)

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