Detecting Saharan Dust Events at Jungfraujoch

MSc or Semester Project

Motivation

Atmospheric aerosols have a huge influence on Earth’s climate and human health [1,2]. A big amount of the primary aerosol mass is due to mineral dust, e.g., coming from the Saharan region [3]. Several times a year dust-loaded airmass from the Sahara is transported to Switzerland. Major Saharan dust events can be recognized by the human eye, when the sky turns orange, others are only visible with special instruments. A place for such measurements within Switzerland is the High Altitude Research Station at Jungfraujoch in the Swiss Alps [4].

To better understand the effect of mineral dust in Switzerland, or on a more global view within in Europe, the first step is to identify Saharan dust events. Currently, dust events at Jungfraujoch are detected with an accuracy of 0.55 using the Single Scattering Albedo Ångström Exponent [3], that uses only a very small proportion of the available measurement data from Jungfraujoch and thus, there is room for potential improvement.

Data

The dataset at hand is a stationary time series with hourly resolution from the year 2020, 08.02. 14:00:00 to 25.11. 03:00:00. So, in total there are 6974 hours of data. All in all 325 optical and size distribution related features are present in the data set, like particle number concentrations, scattering coefficients, or number and volume size distribution.
In the given time period 26 dust events took place [5], which will be considered as ground truth.

**Goal**

As current detection methods only use a small fraction of the available data, the goal of the project is therefore to improve upon the state-of-the-art by leveraging machine learning methods (e.g., time-series modeling, regression and feature selection, low-rank approximations, etc.) for flagging out the occurrence of such events while exploiting all collected measurements. An improved detection would then help to better characterize such events and their implications on climate and human health.

**Deliverables**

The results should be presented in a short and clear documentation or a short paper, preferably written in Latex. The code should be well documented and give reproducible results, such as figures/plots and performance metrics. The description should be to the extent possible self-contained and in a language that is accessible to a fellow-student.

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**Literature**


