

# Global statistical analysis of MISR aerosol data: A massive data product from NASA's Terra satellite

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## **Abstract**

In climate models, aerosol forcing is the major source of uncertainty in climate forcing, over the industrial period. To reduce this uncertainty, instruments on satellites have been put in place to collect global data. However, missing and noisy observations impose considerable difficulties for scientists researching global aerosol distribution, aerosol transportation, and comparisons between satellite observations and global-climate-model outputs. In this paper, we propose a Spatial Mixed Effects (SME) statistical model to predict the missing values, denoise the observed values, and quantify the spatial-prediction uncertainties. The computations associated with the SME model are linear scalable to the number of data points, which makes it feasible to process massive global satellite data. We apply our proposed methodology, which we call Fixed Rank Kriging (FRK), to the level-3 Aerosol Optical Depth dataset collected by NASA's Multi-angle Imaging SpectroRadiometer (MISR) instrument flying on the Terra satellite. Overall, our results were superior to those from nonstatistical methods and, importantly, FRK has an uncertainty measure associated with it.