**Title**

Clouds, Aerosols and Radiation: A Meteorology and Satellite Driven Analysis of Effective Radiative Forcing from Aerosol-Cloud Interactions

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**Abstract**

Uncertainty in the radiative forcing from anthropogenic activities since the Industrial Revolution is dominated by how clouds respond to aerosol. Climate projections are limited by this uncertainty. The cloud response to aerosol is influenced by the meteorological conditions of the atmosphere wherein the cloud is suspended. Understanding the covariation between meteorological state and cloud response to aerosol is a path forward to improve our understanding of aerosol effects on the climate. In this thesis we study aerosol-cloud interactions while controlling for meteorology using clustering techniques. This allows us to study the interactions per meteorological regime and gain deeper understanding of the effect of meteorology on aerosol-cloud interactions. Cloud-controlling factors are clustered using k-means clustering. Six meteorological clusters are found and satellite observations over ocean between -60 and 60 degrees latitude are used to study cloud response to changes in aerosol concentrations per cluster. The choice of clustering does not create significant variability in the sensitivity and the radiative forcing of the cloud albedo effect, but the sensitivity of cloud liquid water path and cloud fraction adjustments do show variability between clusters. This indicates that controlling for meteorology is specifically important for the adjustments to the cloud albedo effect. Our results show that the effective radiative forcing from aerosol-cloud interactions over our study domain since 1850 is -1.0 watts per square meter with a 90% confidence interval of [-1.6, -0.48] watts per square meter. There are variations in the forcing estimates depending on the number of clusters, but this signal is small compared to other sources of uncertainty. Our findings corroborate recent findings and present a novel method to control for meteorological covariation using cluster analysis.