Title: Remote sensing of above cloud aerosols

Abstract:
The direct and indirect radiative effects of aerosols suspended in the atmosphere above clouds (ACA) are a highly uncertain component of both regional and global climate. Much of this uncertainty is observational in nature – most orbital remote sensing algorithms were not designed to simultaneously retrieve aerosol and cloud optical properties in the same vertical column. Thus the climate modeling community has limited data to inform model development efforts, which encapsulate the current understanding of climate. Furthermore, field measurements have identified regions with consistent ACA, and regional simulations show that the radiative forcing may be significant. For this reason, there has been a recent push to develop the ability to determine ACA distribution, optical properties and cloud interactions, while also providing a means to validate models. Several algorithms have been created that utilize existing instruments for these purposes. However, the observational data sources, algorithm characteristics, geophysical assumptions and retrieved products from these methods are highly variable. This chapter is a review of these techniques, their uncertainties, and the associated validation efforts. We will also discuss the future of ACA remote sensing, both with regards to new instruments and the potential for new algorithms.