Development of advanced hyperangular polarimetric cloud retrievals for current and future NASA missions

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The hyperangular polarimetric observations obtained by the HARP2 instrument of the NASA PACE observatory offers a unique and complicated information source for cloud remote sensing. Typically, cloud remote sensing problems have avoided optimal- estimation based approaches because expensive in-line radiative transfer calls would have made the approaches infeasible. In this method, we take advantage of the fact that the polarimetric cloud remote sensing problem is approximately single scattering (with minor higher-order scattering contributions), making it possible to approximate radiative transfer from precalculated bulk-scattering phase functions.

In this work, we will present our preliminary efforts toward the development of an optimal estimation-based framework for polarimetric retrieval for low-level liquid clouds. This framework leaves more opportunities to expand the retrieval paradigm and handle additional aspects of the retrieval problem as compared to existing polarimetric cloud retrieval approaches. For example, current polarimetric liquid cloud retrievals neglect multispectral and total reflectance observations that can more fully inform the retrieval solution as well as constrain cloud vertical profile. We will outline the methodology of this new approach and introduce new urfique retrieval products, including bin-resolved droplet size distribution (at cloud top) and a cloud vertical profile dependent.