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Aerosol radiative forcing over liquid water clouds based on A-Train synergies and active/passive polarized observations

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Strong radiative forcing is induced by absorbing aerosol overlying low level clouds, as it leads to a local change of the earth albedo due to the radiative interactions of the aerosol and clouds layers and to an extremely important but local warming effect in the aerosol layer (Frazer and Kaufman, 1980). There are few regions where this impact may be significant at regional scale. It is the case of biomass burning particles transported over the Atlantic West of central Africa above bright stratocumulus clouds.

Although the general physical process of this interaction is well understood in terms of direct forcing, it is largely uncertain because of the lack of accurate global scale observations of the aerosol optical parameters above the clouds [Yu et al. 2006], but also because of the need to account for time and space variations of the aerosols and cloud properties in the analysis. Only limited regional in-situ measurements [Keil and Haywood 2003] and satellite data analysis [Chand et al. 2009] have been performed. Moreover, the retrieval of cloud properties is biased by the presence of aerosol above the clouds.

The new developments combining polarized active (CALIPSO [Hu et al. 2007]) and passive (PARASOL [Waquet et al. 2009]) observations offer the opportunity to retrieve the properties of aerosol above the clouds with an accuracy difficult to achieve by a standard inversion of the lidar data or an analysis of the unpolarized radiance. Those polarized products used in combination of the recently developed CALIPSO/CloudSat synergies [Josset et al. 2010] offer a guidance to better estimate the potential bias in liquid water cloud properties retrieval in standard passive retrievals.

We will describe those new developments and show on a few case studies how those new A-Train products based on polarization can be used as input in a radiative model (example of the Matrix Operator MOdel - MOMO [Fell and Fischer 2000] - will be considered here, and further detailed in the presentation by Doppler et al., this conference) to estimate the radiative forcing of biomass burning along with the associated vertical repartition of the shortwave flux and modification of the heating rate. We will also show an illustration of the expected modifications of this radiative forcing coming from a first order estimate of the cloud diurnal cycle as observed by the geostationary observations of METEOSAT.

We will finally finish with a few perspectives related to the amount of work that still has to be done to precisely address this complex and largely unexplored problem.