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The effects of an absorbing smoke layer on MODIS marine boundary layer cloud optical property retrievals and radiative forcing

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Clouds, aerosols, and their interactions are widely considered to be key uncertainty components in our current understanding of the Earth's atmosphere and radiation budget. The work presented here is focused on the quasi-permanent marine boundary layer (MBL) clouds off the southern Atlantic coast of Africa and the effects on MODIS cloud optical property retrievals (MOD06) of an overlying absorbing smoke layer. During much of August and September, a persistent smoke layer resides over this region, produced from extensive biomass burning throughout the southern African savanna. The resulting absorption, which increases with decreasing wavelength, potentially introduces biases into the MODIS cloud optical property retrievals of the underlying MBL clouds. This effect is more pronounced in the cloud optical thickness retrievals, which over ocean are derived from the wavelength channel centered near 0.86 μm (effective particle size retrievals are derived from the longer-wavelength near-IR channels at 1.6, 2.1, and 3.7 μm). Here, the spatial distributions of the scalar statistics of both the cloud and aerosol layers are first determined from the CALIOP 5 km layer products. Next, the MOD06 look-up tables (LUTs) are adjusted by inserting an absorbing smoke layer of varying optical thickness over the cloud. Retrievals are subsequently performed for a subset of MODIS pixels collocated with the CALIOP ground track, using smoke optical thickness from the CALIOP 5km aerosol layer product to select the appropriate LUT. The resulting differences in cloud optical property retrievals due to the inclusion of the smoke layer in the LUTs will be examined. In addition, the direct radiative forcing of this smoke layer will be investigated.