

Oil smoke plumes as seen through MODIS and CALIPSO

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The main focus of this study is in the analysis and identification of a large number of petrochemical smoke plumes from data records spanning over a decade. The events presented in this study were focused on aerosol resulting from major industrial accidents involving offshore oil rigs, oil tank depots and onshore oil wells. The method is based on a synergistic approach of retrieving aerosol optical and microphysical properties using satellite remote sensing and sun photometer data. Data and instruments used in this study include the Moderate Resolution Imaging Spectroradiometer (MODIS), the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and Aerosol Robotic Network (AERONET) aerosol retrievals. This approach was constructed using existing retrieval algorithms and instruments with the intent, and further perspectives, for the development of new applications in the field of disaster management. The study also highlighted the inherent limitation of each individual algorithm, thus depicting the importance of further work on aerosol optical depth (AOD) retrievals from major oil smoke plumes. Results show a wide range of values in part due to the varying magnitude of each event in particular. Based on these results we believe that the AOD from the MODIS instruments show lower than expected values. The CALIPSO retrievals were heavily dependent on the type of lidar solutions showing a large degree of discrepancy between constrained and unconstrained retrievals. Unconstrained solutions were attributed to oil smoke plumes identified as part of a larger local aerosol layer. Conversely, lofted smoke was treated as opaque aerosol layers and the measured lidar solutions showed large values and uncertainty. The MODIS retrieval algorithms over land could not successfully retrieve aerosol properties for petrochemical smoke plumes, thus only the ocean algorithm was used for data analysis. When comparing to other studies that utilized ground-based retrievals, the Ångström exponent (AE) and effective radius (R_{eff}) values seem to be in good agreement. The measured lidar ratios (LR) and particulate depolarization ratios (PDR) seem to indicate higher values similar to values in the upper ranges of biomass burning smoke. Judging from the results we concluded that current satellite retrieval algorithms disagree on AOD ranges, for the most part, due to the extreme light absorbing nature of these types of aerosols. We conclude that further work, utilizing remote sensing ground based systems, is needed to properly assess aerosols properties stemming from oil smoke plumes. These results also show how important a synergic approach is for a complete understanding of such phenomena.