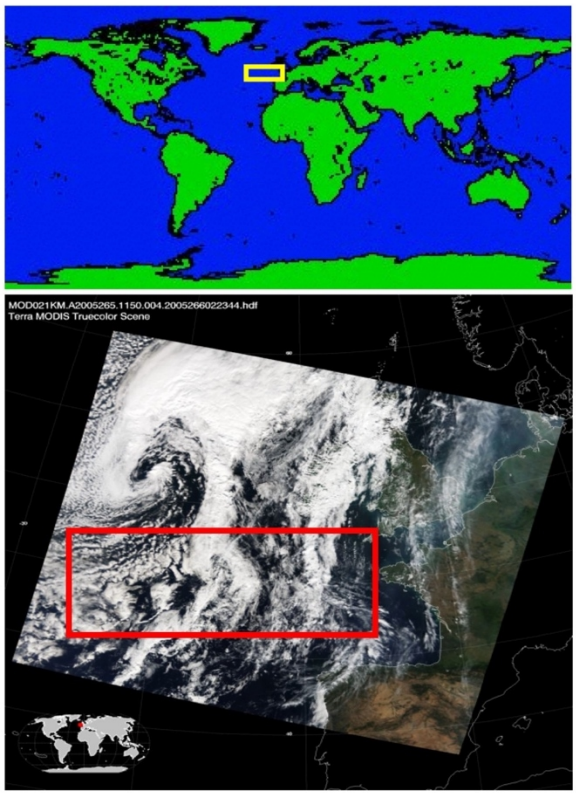
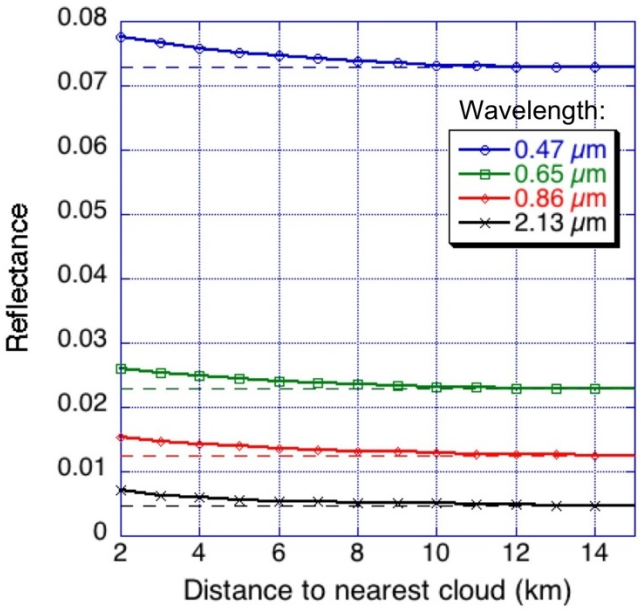
Enhanced Clear Sky Brightness in the Vicinity of Clouds





These images illustrate a study on the effect that atmospheric aerosols have on clouds and climate. NASA's Goddard Space Flight Center Climate and Radiation Branch scientists have studied various aspects of this effect, including the problem of accurately measuring aerosol properties near clouds. An important concern is whether current methods are accurate in attributing brightness variations near clouds to changes in the abundance and size of aerosol particles that reflect sunlight. Undoubtedly, an increase in brightness can indeed indicate optically thicker aerosol near clouds; for example, aerosols grow in the vicinity of clouds because of moist cloud environment. Detailed analysis similar to that presented in the publication Observations of Three-Dimensional Radiative Effects that Influence MODIS Cloud Optical Thickness Retrievals, however, reveals that other factors can also play an important role in enhanced brightness values near clouds. These factors include a blurring due to instrument imperfections, the presence of small undetected cloud puffs near cloud edges, and three-dimensional radiative interactions between cloudy and clear areas. Such three-dimensional effects occur when solar photons scattered from clouds can interact with air molecules, aerosol particles, and underlying surface that can reflect the photons back to satellite detectors. The top left panel of the image identifies an approximately 1000 km by 500 km size area of the Atlantic Ocean that has been used for an extensive statistical analysis of this problem. The bottom left panel illustrates a sample image of this area viewed by the MODIS instrument on board the Terra satellite. The right side panel shows results from the statistical analysis of hundreds of such images collected in September over a seven year long period from 2000 to 2006. The figure reveals that satellite images are indeed systematically brighter near clouds. (For reference, dashed lines indicate the average brightness far away from clouds.) Incorporating the additional factors mentioned above will improve the accuracy of space-based aerosol measurements and will help better understand the way aerosols (including human emissions) influence clouds and climate.

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