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A time series algorithm for simultaneous retrieval of atmospheric aerosol and surface reflectance from MODIS

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If given a consecutive set of images of the same region of the Earth obtained from space, an untrained human will easily solve many of the remote sensing problems, such as selecting clear-skies areas, identifying clouds, distinguishing between clear and hazy conditions, and so on. What, in contrast to our brain's work, is missing in our algorithms, armed with the modern science, that solving these problems becomes difficult and fraught with uncertainties?

One answer is that the contemporary concepts of aerosol and land remote sensing from whiskbroom (MODIS-like) sensors are pixel-based and disregard history of previous measurements. In this case, some important invariants of the atmosphere-surface system are overlooked. One example is a spatial structure (or texture) of the land surface at the landscape level, which generally changes at a very slow rate as compared to the frequency of spaceborne observations.

A new Multi-Angle Implementation of Atmospheric Correction (MAIAC) algorithm developed for MODIS will be described, which uses multi-temporal observations and an image-based rather than pixel-based processing. MAIAC retrieves aerosol optical thickness simultaneously with surface bidirectional reflectance and albedo at a spatial resolution of 1 km. The algorithm is generic and works over the dark vegetated surfaces as well as over bright deserts. An extensive validation shows a good agreement of retrievals with AERONET measurements.