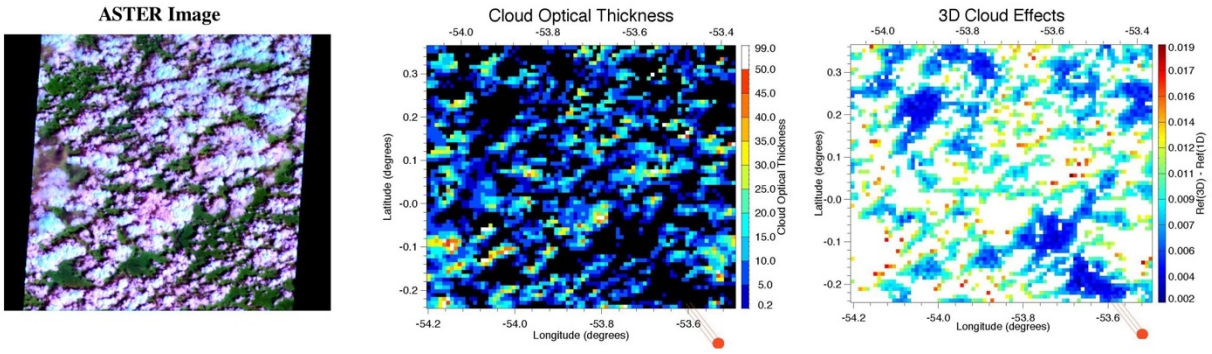
Three-dimensional (3D) radiative effects of clouds in biomass burning Amazon Basin



Often the Earth's atmosphere is assumed to be horizontally uniform for simplicity. However this assumption is often not valid, particularly in a cumulus cloud field such as the one in the left panel. In that case, the full 3D radiative transfer process has to be considered. The left panel is a high-resolution ASTER image of a cumulus cloud field over the biomass burning region in Brazil. The 60km by 60km image is centered on the equator at 53.78 degrees West and was taken on January 25, 2003 with solar zenith angle of 32 degrees and solar azimuth angle of 129 degrees. The incident solar beam is schematically indicated in the middle and right panels. The middle panel is a collocated MODIS image of cloud optical thickness showing considerable non-uniformity. (Clear pixels are masked as black). The size of the image is 80km by 60km with a resolution of 1km. The cloud cover is 53 percent. The right panel shows the difference between a 3D radiation field and its 1D counterpart in the clear region with aerosol optical thickness of 0.1 and non-reflecting surface. (Cloud pixels are masked as white). It is evident that over non-reflecting surfaces, clouds enhance clear region reflectance almost everywhere. This may result in overestimation of aerosol optical depth in the vicinity of clouds. This biomass burning Amazon Basin cumulus cloud scene was selected as a new case for the Phase III of I3RC to evaluate the performance of various 3D radiative transfer codes. In addition to ASTER and MODIS, Multi-angle Imaging Spectro-Radiometer (MISR) measurements of the scene are also available and will be used for the retrieval of cloud and surface properties. Click here for more information about the I3RC project, and to read a recently accepted BAMS paper by Cahalan et al. (2005). These images show the complexity of a typical cumulus cloud field. As we continue to improve our understanding of the climate system, we expect to encounter more complex phenomena where 3D radiative transfer becomes crucially important.

Guoyong Wen and Alexander Marshak