

Polarimetric remote sensing of aerosols and clouds during MILAGRO

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During INTEX-B/MILAGRO an instrument called the Research Scanning Polarimeter (RSP) flew on the Jetstream 31 (J-31) together with the integrated suite of instruments described in the talk at this conference by Russell et al. The RSP makes accurate measurements of the radiance and polarization of reflected sunlight in nine spectral bands covering the range from 410 to 2250 nm with seven of the bands being in atmospheric windows. The instrument scans its field of view over an angular range of +/- 55 degrees and for MILAGRO the scan plane was oriented along the direction of flight of the J31. The spectral, angular and polarimetric information contained in the measurements made by the RSP allows the remote sensing retrieval of aerosol load, particle size, refractive index and shape (spherical/non-spherical) together with an estimate of the mixed layer depth of the aerosols. When clouds are present extremely accurate estimates of the mode and width of the particle size distribution near cloud top (50-100 m) can be made together with an estimate of the size mode deeper inside the cloud (200-500 m), optical depth, cloud top height, cloud base height and number concentration of droplets. The RSP is similar in terms of its spectral range, signal to noise ratio and accuracy to the Aerosol Polarimetry Sensor that is planned to fly on the NASA Glory mission in late 2008. The purpose of that mission is to improve the estimate of the direct and indirect effects of aerosols on the radiative forcing of climate and continuation of measurements of the total solar irradiance. The Glory mission will fly in the NASA A-train with the Orbiting Carbon Observatory in addition to the existing A-train missions. The objectives of RSP during MILAGRO were therefore:

- a) Evaluate aerosol and cloud retrieval algorithms for the NASA Glory mission Aerosol Polarimetry Sensor. Specifically:
 - i) Aerosol optical depth spectra (354-2138 nm, AATS-14; 340-1060, AERONET sites)
 - ii) Aerosol size distribution (AERONET retrievals, HIGEAR in situ measurements)
 - iii) Water vapor column estimates (AATS-14)
 - iv) Aerosol radiative impacts in clear sky (direct effect) and via clouds (indirect effect)
- b) Evaluate the aerosol retrievals from Aura, other A-Train and Terra satellite sensors in

order to determine potential synergies with Glory and issues related to retrievals for the complex mix of pollution, biomass burning and soil dust observed during MILAGRO.

c) Characterize surface spectral albedo and bidirectional polarized reflectance distribution function (BRDF) to help improve satellite retrievals.

d) Evaluate remote sensing methods (RSP + lidar, RSP+A-band spectrometer) for determining the aerosol radiative forcing profile against the measured spectral optical depth and radiative flux profile.

The J-31 made 13 flights out of Veracruz, Mexico, between 3 and 20 March 2006. In this paper we provide a survey of the RSP observations made during the flights, preliminary aerosol and cloud retrieval results and comparisons with other measurements. Future work will focus on the more complete validation of our retrieval algorithms and combining the RSP measurements with other observations as outlined in the objectives noted above.