1. INTRODUCTION

Each year, large amount of biomass burning aerosols is released to the atmosphere. These aerosols directly change the radiative energy budget by reflecting the incoming solar energy and by indirectly influencing the cloud properties. However, aerosols continue to be one of the largest sources of uncertainty in climate change studies (NRC, 1996) because the spatial distribution of aerosols, their chemical composition and microphysical properties are not well known. In this paper, the spatial distribution of biomass burning aerosols is estimated using GOES-8 imagery. Aerosol optical thickness is estimated for each smoke pixel and the mass of aerosol is calculated. The high temporal resolution of GOES-8 imager data is well suited for obtaining detailed quantitative estimates of biomass burning aerosols.

2. DATA SETS AND APPROACH

In this paper, we present results over Central America for 8 days in May 1998. Hourly data from the GOES 8 imager were used. The area of study is between 80-100W and 15 to 30S. The imager has channels with half-power response bandwidths of 0.52-0.74 µm (channel 1), 3.79-4.04 µm (channel 2), 6.47-7.06 µm (channel 3), 10.2-11.2 µm (channel 4), and 11.6-12.5 µm (channel 5). To simplify the retrievals and reduce the computational burden, the channel 1 data (effective spatial resolution of 0.57 x 1 km) were sampled every fourth pixel to match the lower resolution channels (resolution of 2.3 x 4.0 km). Channel 1 of the GOES imager was not designed for long-term accurate radiometry and thus has no onboard calibration. The other GOES channels have onboard calibration. The channel 1 reflectivity are adjusted for degradation following Bremer et al. (1998).

The first step is to remove cloud pixels from the GOES-8 imagery. To accomplish this, clear sky pixels are identified in channel 1 and channel 2 from the lowest radiances. The warmest temperatures in channel 3, 4, and 5 are used to obtain clear sky pixels. Cloud pixels are removed by using a combination of thresholds. The resulting image is a combination of smoke and clear sky pixels. The aerosol optical thickness is calculated for all cloud free pixels. To obtain aerosol optical thickness, aerosols are characterized as spheres with black carbon core and organic shell (Ross et al. 1998). The retrieved AOT values are then used to compute the total mass of aerosol released by biomass burning fires.

3. RESULTS AND DISCUSSION

Once AOT values are retrieved, the aerosol loading in the atmosphere can be calculated using the following formula:

\[ M = \Sigma (4/3) \rho S \tau_{\text{reff}} Q_{\text{ext}} \]

where \( M \) is the total mass of aerosol released, \( \rho \) is the mass density, \( S \) is the pixel area, \( \tau_{\text{reff}} \) is the effective radius. Figure 3 shows the mass of aerosol for each day in May 1998 for three time periods (1644, 1744, and 1944 GMT). \( P \) is assumed to be 1.23 g/cm-3, \( r_{\text{reff}} \) is 0.15 µm, and \( Q_{\text{ext}} \) is 2.

Figure 1 shows the mass of aerosol in M Ton for May 1998 for four different time periods (1644, 1744, 1844, and 2044 GMT). Peak values were around May 12, 1998. Note that data was not processed between May15-May20, 1998. Towards the end of the month, the mass of aerosols was around 0.2 Mton.

Our results indicate that smoke aerosols can be detected in an automated fashion from GOES-8 imager data. The retrieval of aerosol optical thickness compares well with ground-based measurements (Zhang and Christopher, 2000). The retrieved aerosol optical depth can be used to estimate the aerosol loading in the atmosphere.
Figure 1: Total mass of aerosol in MTon for May 1998 for four GMT times.

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