Preliminary Conceptual Model - Causes of Haze in Caney Creek Wilderness Area (CACR1)

Sulfate transported from the eastern United States in the summer is the major cause of haze in the Caney wilderness area in Arkansas. Sulfate in average contributes ~ 70% to regional haze during the 20% worst haze days observed at the site CACR1 based on two and a half years of IMPROVE data available from 2000 – 2002.

Caney Creek Wilderness occupies 14,344 acres in the Ouachita Mountains of western Arkansas, a region of east-west oriented mountain ranges. The IMPROVE site representing Caney Creek Wilderness Area is CACR1, located at an elevation of 690 m (2,263 ft) on an exposed part of Eagle Mountain, 3 km (2 mi) northwest of northwestern Wilderness boundary. As shown in Figure 2, the average $PM_{2.5}$ mass concentration measured at CACR1 during July 2000 to December 2002 is 9.8 $\mu g/m^3$. The average total light extinction coefficient (B_{ext}) is 78.8 Mm^{-1} (Visual Range ~ 50 Km; Deciview ~ 20.6). The average contributions of the major aerosol components to Caney Creek haze are particulate sulfate 53.1%, nitrate 11.6%, organic matter (OMC) 13.2%, elemental carbon (light absorbing carbon, LAC) 4.0%, fine soil 1.2% and coarse mass (CM) 4.2%.

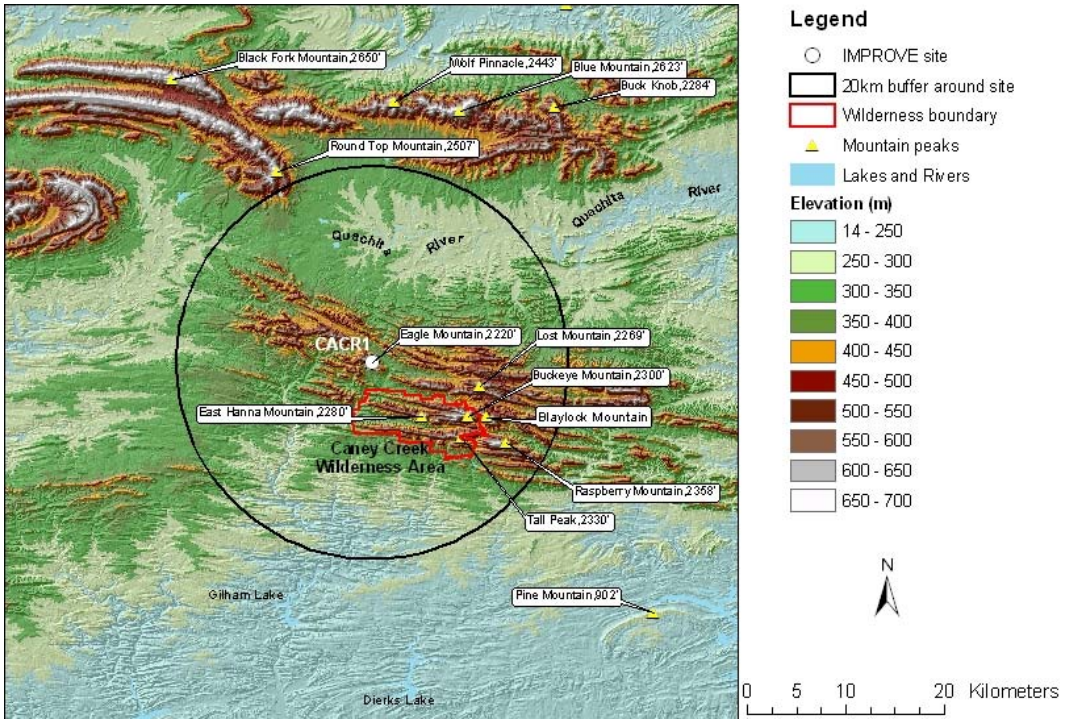

Figure 1. 20 Km terrain map

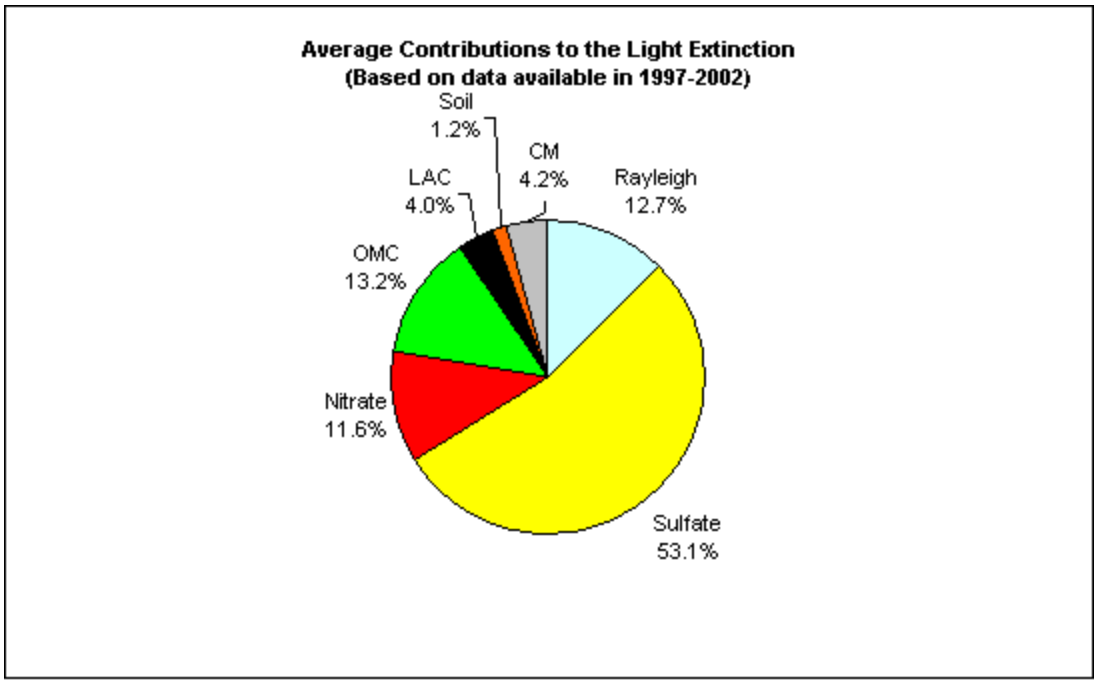

Figure 2. Average contributions of major aerosol chemical components to light extinction (based on data available from July 2000 to December 2002).

As Figure 3 and Figure 4 indicate, most of the 20% worst days happened in the extended summer season from May to September, and sulfate is the dominant aerosol component that contributes to the light extinction. Occasionally, nitrate may dominate aerosol light extinction and result in 20% worst days during the winter.

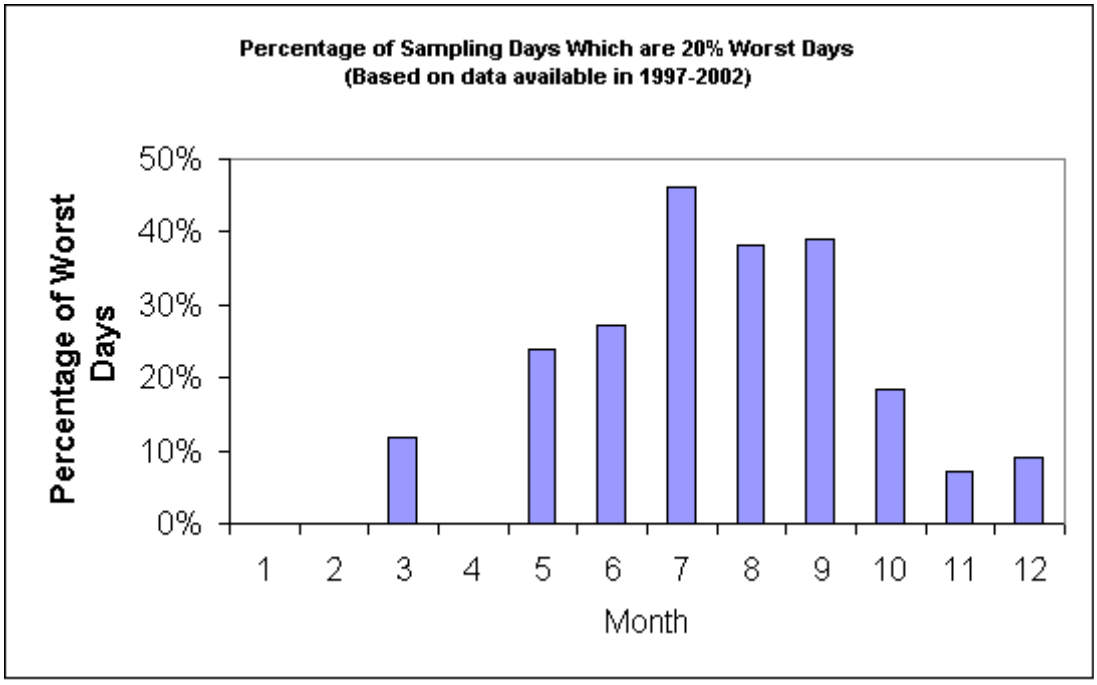

Figure 3. Percentage of sampling days that are 20% worst days in each month (based on data available from July 2000 to December 2002).

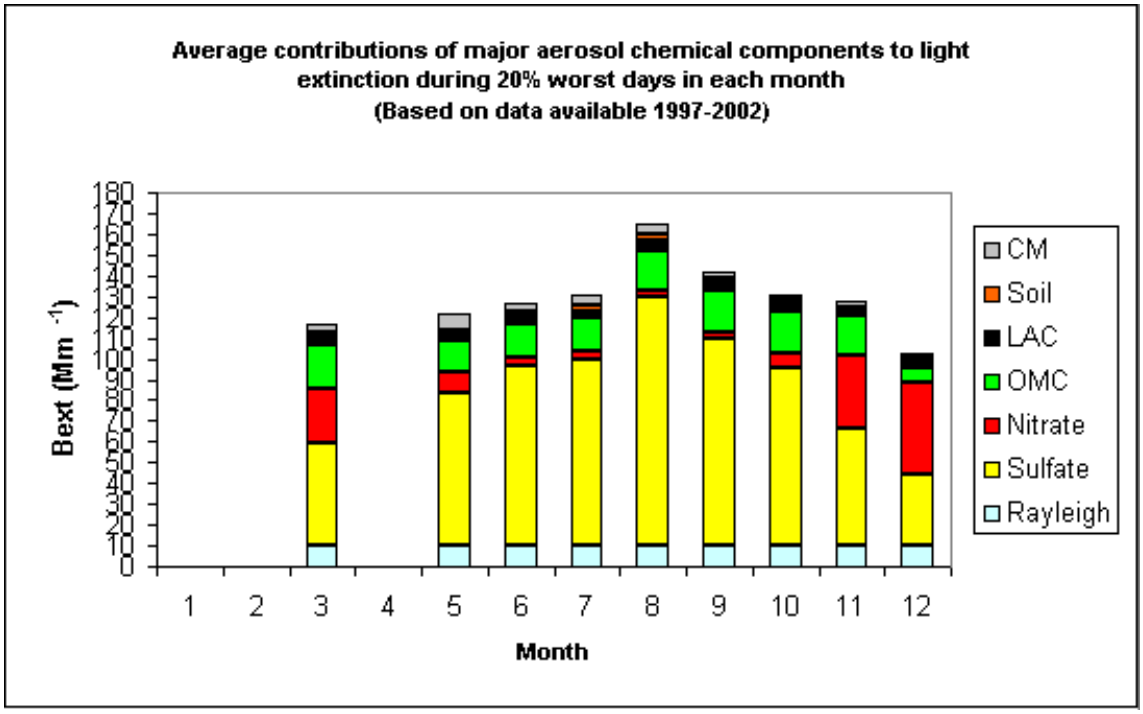

Figure 4. Average contributions of major aerosol chemical components to light extinction during 20% worst days in each month (based on data available from July 2000 to December 2002).

Residence maps as shown in Figure 5 suggest air generally transported from north to north west or south of the site during the winter. In the summer, air flows from the eastern United States are dominant. Figure 6 and Figure 7 (better to have a national SO_2 emission map) indicate that the eastern US is the major source region of the sulfate at the Caney Creek Wilderness Area.

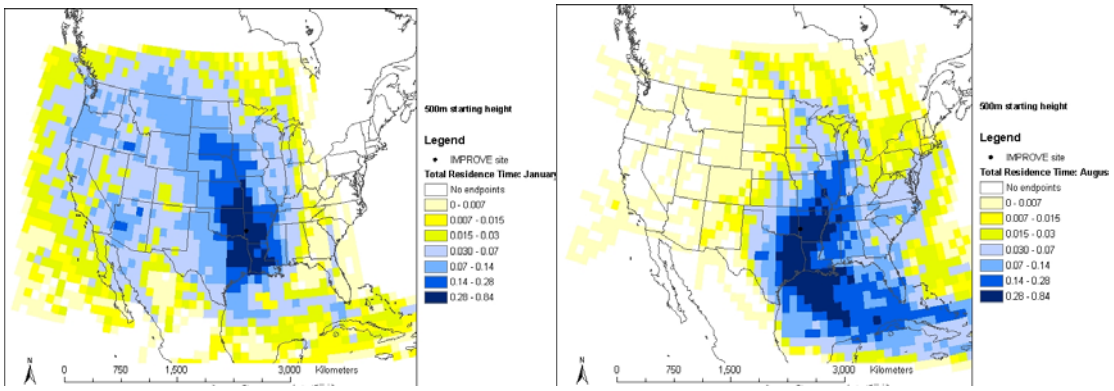

Figure 5. Normalized residence time in January (left) and August (right) (based on data from 2000-2002)

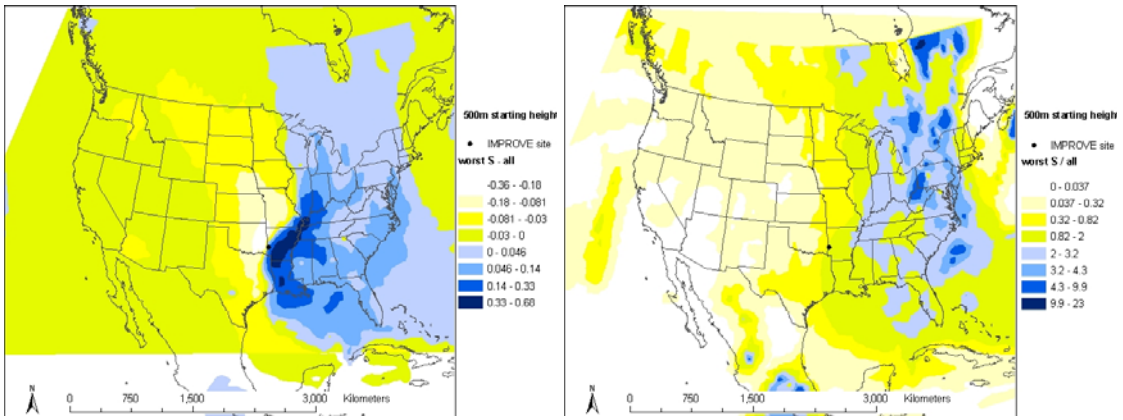

Figure 6. Difference (left) and ratio (right) of normalized residence time in 20% worst sulfate days and all days during 2000-2002 (possible important source regions are shown up as blue in the maps)

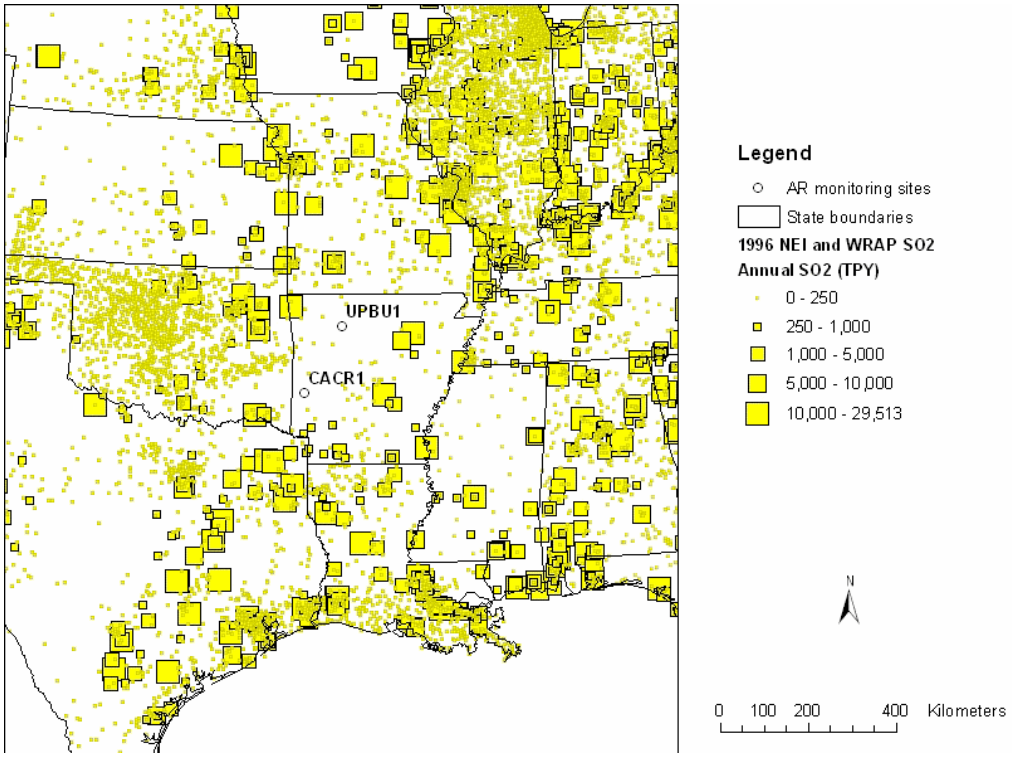

Figure 7. SO_2 sources based on 1996 NEI and WRAP database