Conceptual Model - Causes of Haze in Wolf Island Wilderness Area

Regional sulfate and sulfate transported from the eastern United States are the major causes of haze in the Wolf Island Wilderness Area. Organics from biomass burning in the southeastern U.S., especially in the state of Georgia also contributes significantly to regional haze in the Wolf Island Wilderness Area.

As shown in Figure 1, Wolf Island Wilderness Area is located on a barrier island on Georgia's Atlantic coast. The wilderness is approximately 37 miles south of Savannah, Georgia. The wilderness consists of all 5,126 acres of the Wolf Island National Wildlife Refuge. The wilderness area consists of islands, saltwater marshes, and scrub-shrub areas. The nearest IMPROVE site is located in Okefenokee (OKEF1) at a distance of approximately 62 miles (100 km). The nearest highway is highway 99, about 5 miles to the west. Interstate 95 is 7 miles to the west. Based on all the valid aerosol measurements during 2000-2004 in OKEF1, the average $PM_{2.5}$ mass concentration is 9.3 μg/m^3. The average total light extinction coefficient (B_{ext}) is 88.6 Mm^{-1} (Visual Range ~ 55 Km; Deciview ~ 21). The average contributions of the major aerosol components to Okefenokee haze are particulate sulfate 56.4%, nitrate 5.4%, organic matter (OMC) 16.8%, elemental carbon (light absorbing carbon, LAC) 4.3%, fine soil 0.8%, sea salt 0.7%, and coarse mass (CM) 3.2%.

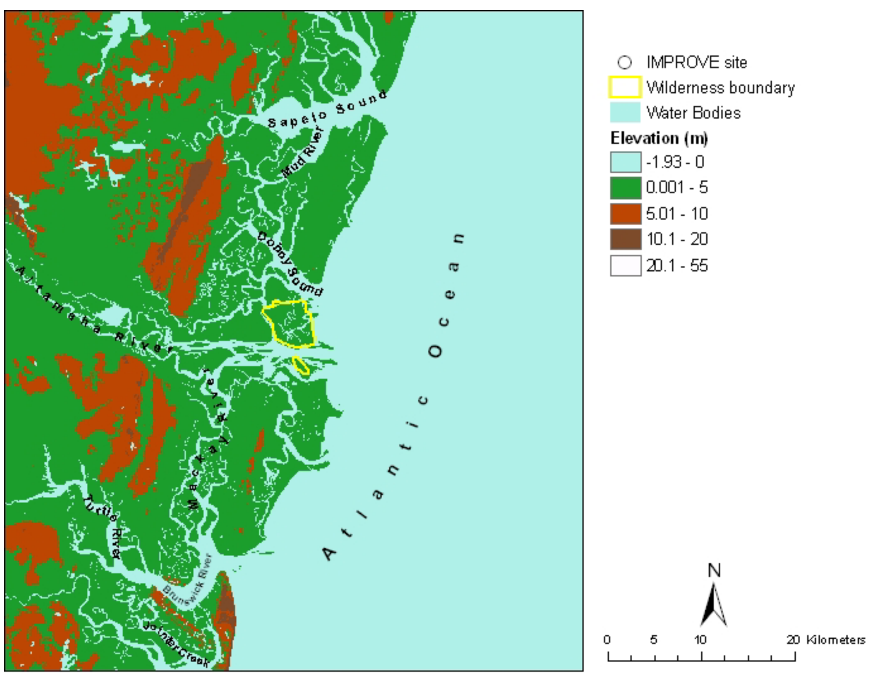

Figure 1. Terrain and land features surrounding the Wolf Island Wilderness Area

Sulfate is the largest aerosol contributor to light extinction during the 20% worst days, with a contribution of ~ 65%. OMC contributes about 19% to light extinction during the 20% worst visibility days. Figure 2 shows that the highest occurrence of the 20% worst days happened in May, July, and October, in which over 30% of the sampling days are 20% haziest days at Okefenokee. As shown in Figure 3, on the 20% worst visibility days, sulfate is the largest aerosol contributor to haze throughout the year. Figure 4 indicates that during the 20% best days, air usually comes from south of the site; while during the 20% worst haze days, air usually comes from north of the site.

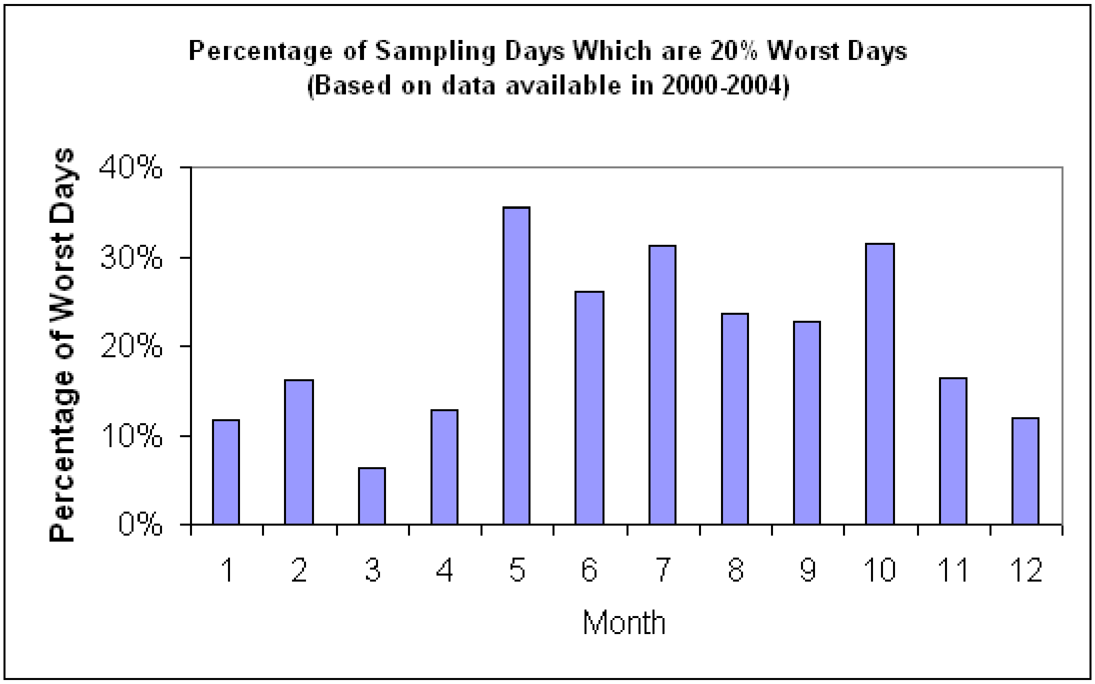

Figure 2. Percentage of sampling days that are 20% worst days in each month

Based on the PMF receptor modeling, six source factors are identified for OKEF1. Figure 5 illustrates the contribution of each PMF resolved source factor to $PM_{2.5}$ mass at the site. Sulfate-rich secondary aerosol is the biggest contributor to $PM_{2.5}$ mass, with a contribution of ~49%, followed by biomass burning emissions (34%). Difference maps of the PMF factor score weighted and un-weighted residence times (Figure 6) suggest that secondary sulfate mainly transports from the southeastern U.S., while biomass smoke is mostly from Georgia, South Carolina, and the border of North Carolina and Tennessee.

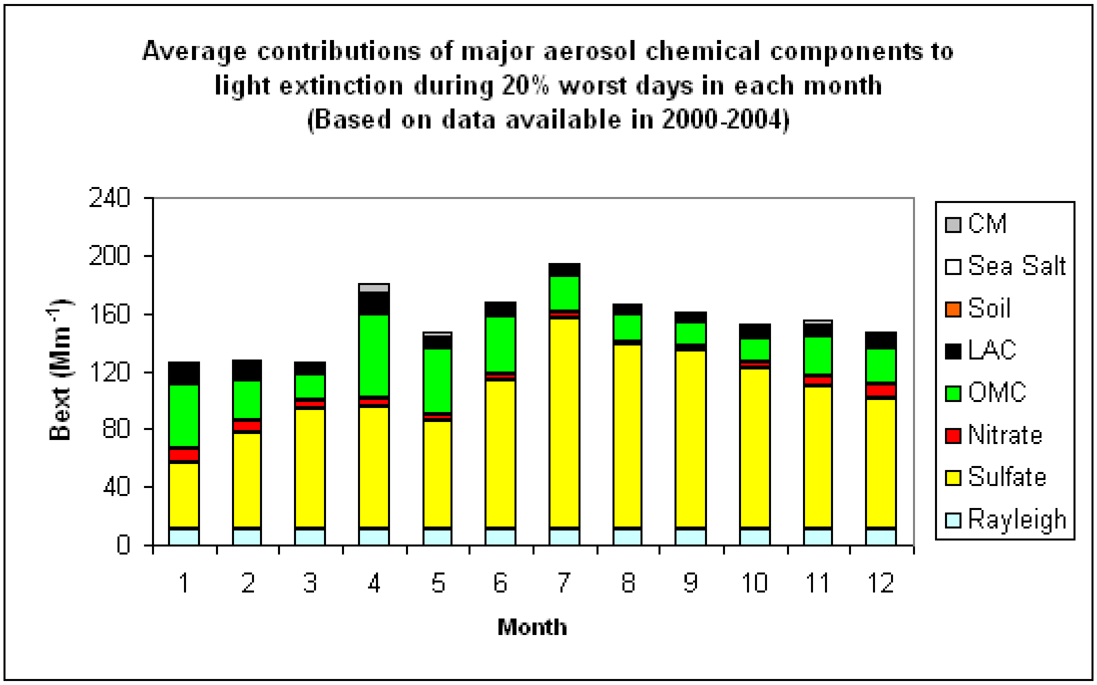

Figure 3. Average contributions of major aerosol chemical components to light extinction during 20% worst days in each month

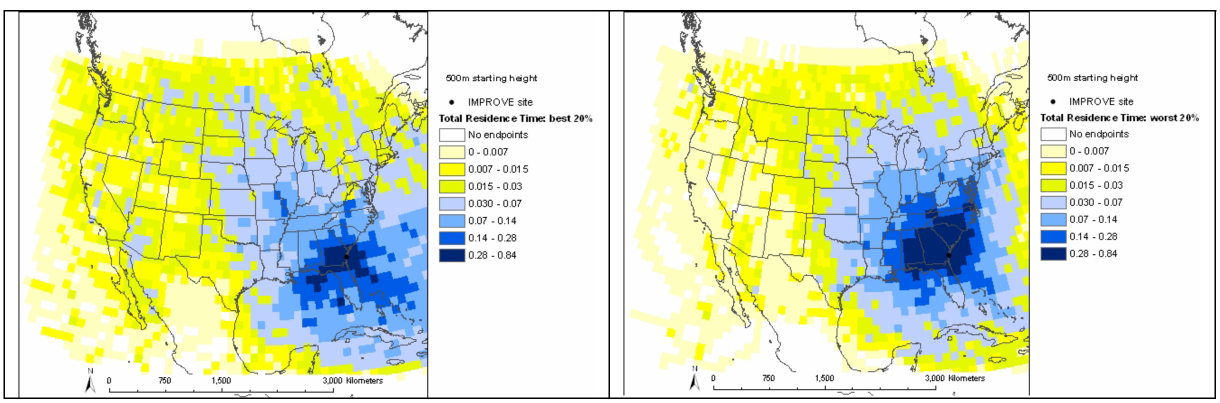

Figure 4. Normalized residence time for 20% best (left) and 20% worst (right) days (air mostly transported from the blue area under the given sampling days)

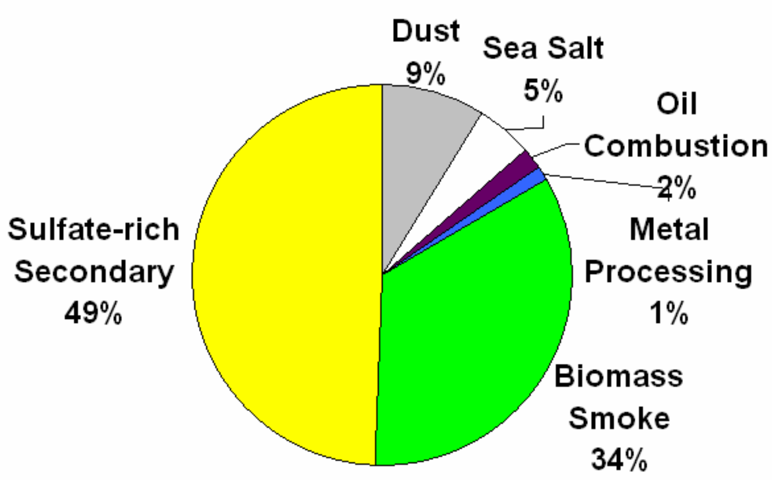

Figure 5. Average contributions of PMF resolved source factors to PM2.5 mass concentration.

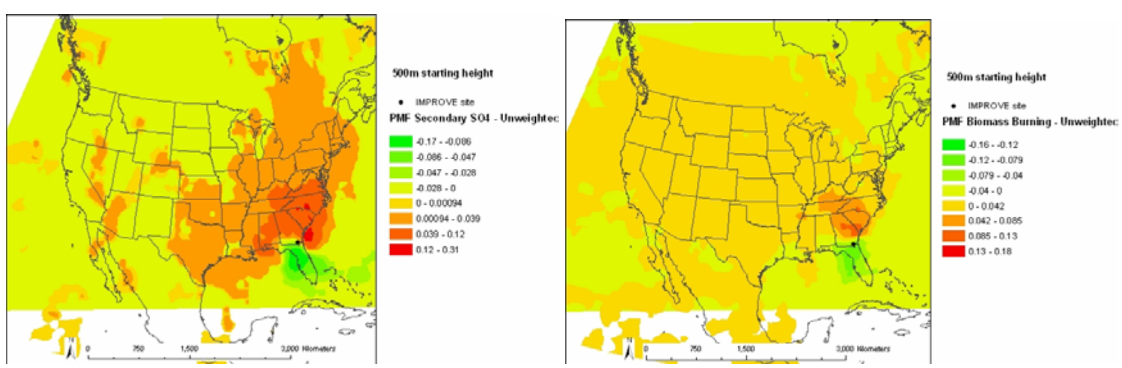

Figure 6. Difference maps of the PMF source factor (sulfate-rich secondary source factor on the left, biomass smoke source factor on the right) weighted and un-weighted residence times.