# ICARTT Studies of Biomass Burning

## Impact on US Air Quality

Over the last several decades, the annual average Arctic surface temperature has increased at almost twice the rate of the global change in surface temperature. Increased surface temperatures lead to the weather conditions necessary to sustain extreme fire events, resulting in increased fire frequency, severity, and duration over North America (Figure 1). During the 2004 summer, the largest Alaskan wild fire event on record occurred in late June-July and consumed 2.72 million hectares of boreal forest. Measurements obtained during ICARTT show that increased aerosol loading resulting from these fires severely impacted US air quality.

**Fig 1** Area Burned in North America 1950-2005

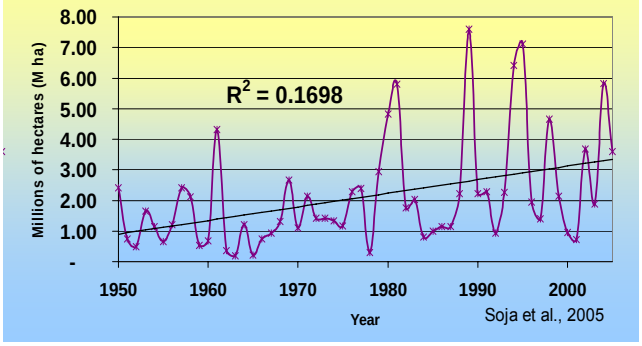
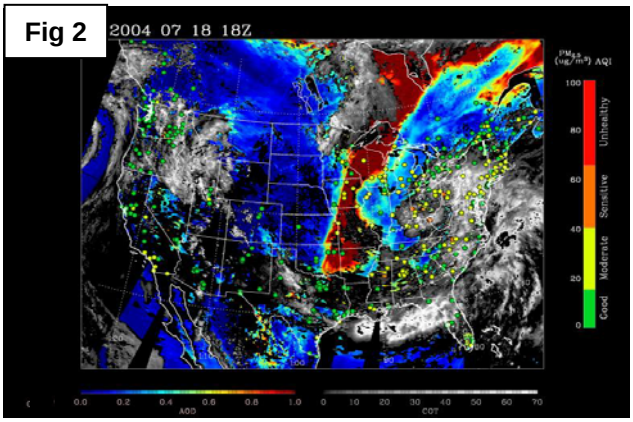



**Fig 2**




## What did we do during ICARTT?

Satellite, remote and in-situ airborne, and ground measurements collected during ICARTT provided a unique opportunity to quantify the impacts of the Alaskan fires on US air quality. By combining aerosol measurements from these different platforms, 3-dimensional view of aerosol loading due to the wild fires was obtained.

## What did we learn?

Satellite data from the MODIS instrument on July 18, 2005 showed high aerosol loading in the atmosphere extending from Hudson's Bay to Northern Texas (Figure 2). The aerosols where associated with long range transport of smoke from the Alaskan wildfires. This aerosol plume advected south-eastward behind the cold front (evident in the MODIS cloud optical thickness) over the following 3-4 days. NASA's DC8 LIDAR aerosol scattering measurements on July 20 showed the high aerosols seen by MODIS over the southeastern US were at several layers in the lower troposphere (Figure 3).

**ICARTT Data Provides an Integrated Picture of Aerosol Loading** **Fig 3**

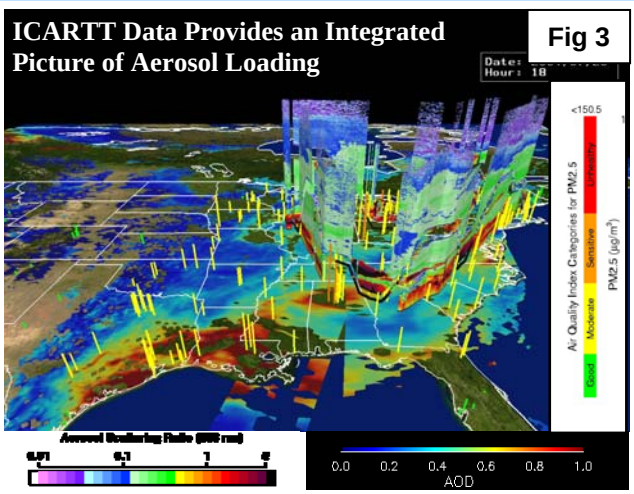
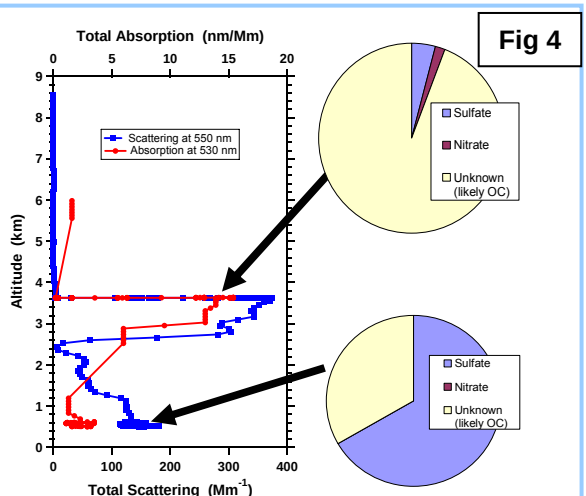
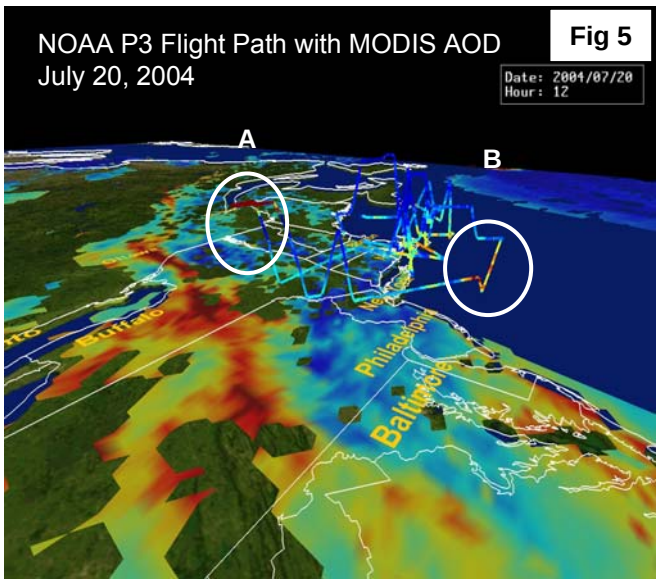
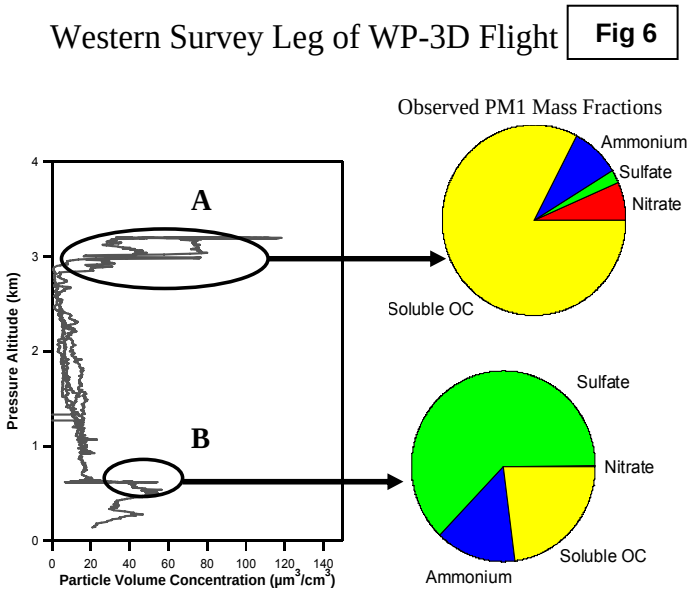



**Fig 4**



NASA DC8 in-situ measurements of aerosol optical properties (Figure 4) on the ascending flight over Alabama on July 20, 2004 show enhanced absorption and scattering (consistent with carbonaceous aerosols) at 3km while aerosols in the boundary layer show only enhanced scattering (consistent with sulfate aerosols). DC8 in-situ aerosol composition measurements, combined with in-situ fine aerosol volume measurements, confirmed that the boundary layer aerosol was primarily sulfate. However, since the DC8 does not measure carbonaceous aerosol mass, the 3km aerosol layer composition was predominately of unknown composition.



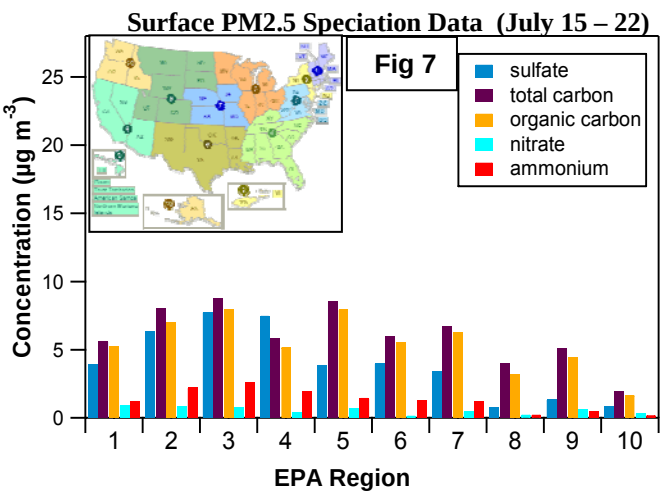




The NOAA P3B conducted a western survey flight leg during its flight on July 20, 2004 (Figure 5). During this western flight leg the P3 sampled the northern portion of the elevated plume to the south-east of Buffalo, NY (A) and sampled elevated particle volume concentrations over the Atlantic south of New York City (B). Speciated aerosol mass measurements onboard the P3 establish that the elevated plume (A) is composed of carbonaceous aerosols while the boundary layer plume (B) is predominately sulfate aerosol (Figure 6). Speciated aerosol mass measurements from the EPA surface network during the Alaskan wild fire event (July 15-22) showed significant increases in carbonaceous aerosol mass in the Eastern US (regions 1-5) associated with the Alaskan plume event (Figure 7).

## What does it mean?

Measurements taken during ICARTT showed that additional aerosol due to long-range transport and entrainment of the Alaskan wild fire plume, combined with a regional sulfate event, led to fine aerosol levels that were unhealthy for sensitive groups (40.5-65.4 μg/m3) over the Eastern US during late July 2004.

"Unhealthy for sensitive groups" means members of sensitive groups may experience health effects, but the general public is usually not at a major risk. Fine particles in smoke at these levels can aggravate chronic heart and lung diseases - and even are linked to premature deaths in people with these conditions. Understanding the impact of wildfires on fine aerosol levels over the US is an important public health issue that ICARTT helped address.

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*The multi-agency ICARTT <http://www.al.noaa.gov/ICARTT/> was formed to study the sources, sinks, chemical transformations and transport of ozone, aerosols and their precursors to and over the North Atlantic Ocean. ICARTT Fact Sheets are designed to present important new science results and findings of high societal relevance to technical non-experts in the community and have been reviewed by an internal committee of peers.*