LITE and Airborne Lidar Observations of Biomass Burning Plumes

E. V. Browell, W. B. Grant, and S. Ismail
Atmospheric Sciences Division, NASA Langley Research Center, MS 401A,
Hampton, VA 23681, USA

Large-scale distributions of plumes from biomass burning regions in South America and Africa were observed from space by the LITE (Lidar In-space Technology Experiment) system during the STS-64 Shuttle mission in September 1994. Simultaneous aerosol backscatter measurements at 1064, 532, and 355 nm were made by LITE on many orbits over South America, Africa, and the tropical south Atlantic Ocean during the 11-day mission to study the distribution and long-range transport of biomass burning plumes and the impact of these plumes on the chemistry of the troposphere in the southern hemisphere.

Plumes from extensive fires in South America and Africa were observed by LITE near their source and in outflow regions over the southern Atlantic and over the Pacific west of Peru. Advection of the plumes was observed primarily below 5 km, and long-range transport of these plumes over large regions of the tropical southern Atlantic was also observed. The spatial distribution and optical characteristics of the biomass burning plumes are discussed in this paper, and these observations are related to atmospheric dynamics and source characteristics. The LITE results are also compared to airborne lidar measurements of biomass burning plumes made over this same region during the NASA Global Tropospheric Experiment (GTE) conducted in September-October 1992 over Brazil, southern Africa, and the tropical south Atlantic.

References:

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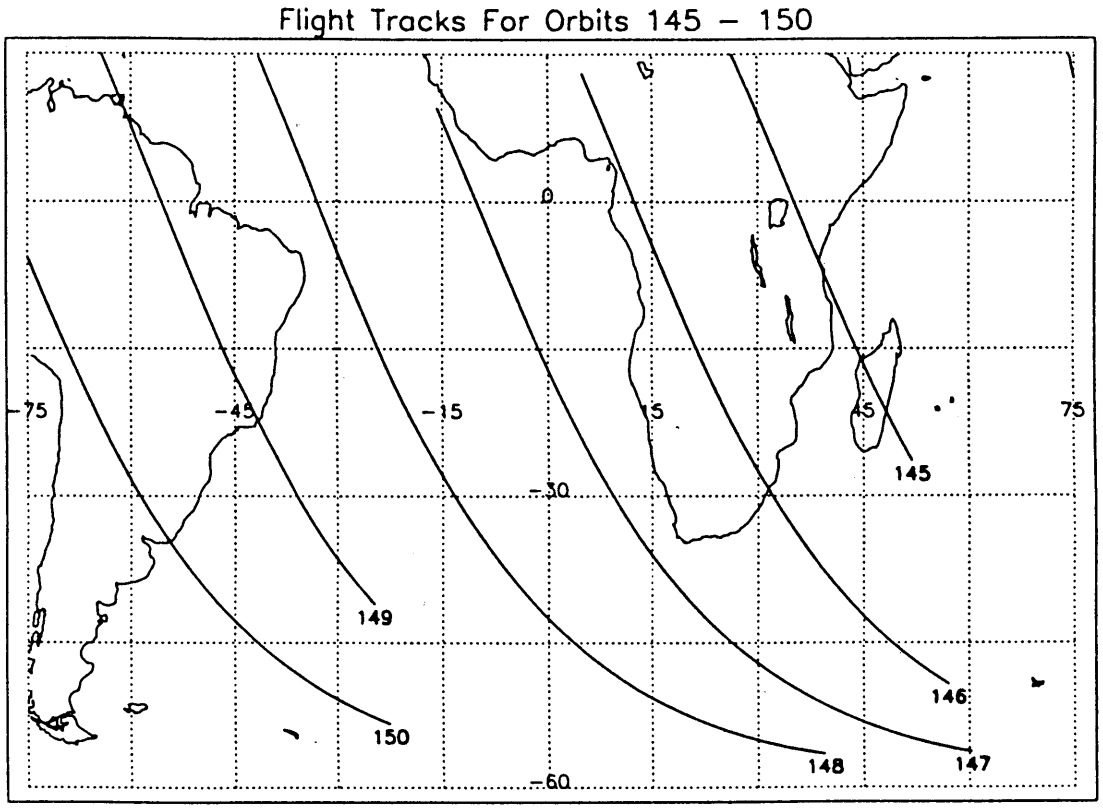

Figure 1. Six sequential LITE orbits covering biomass burning region from Africa to South America.

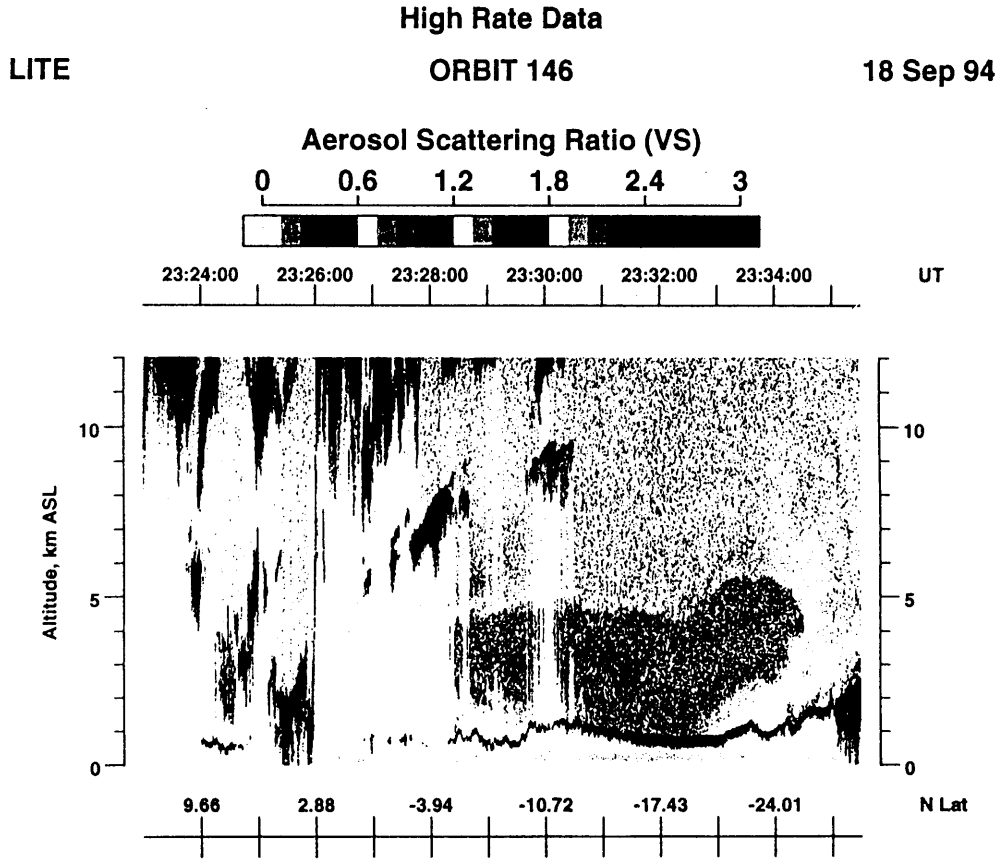

Figure 2. LITE cloud and aerosol data for orbit 146 across Africa. Biomass burning plume can be seen below 6 km and between about 5-26S. Aerosol scattering ratios in plume range from about 1.0 to 1.6.

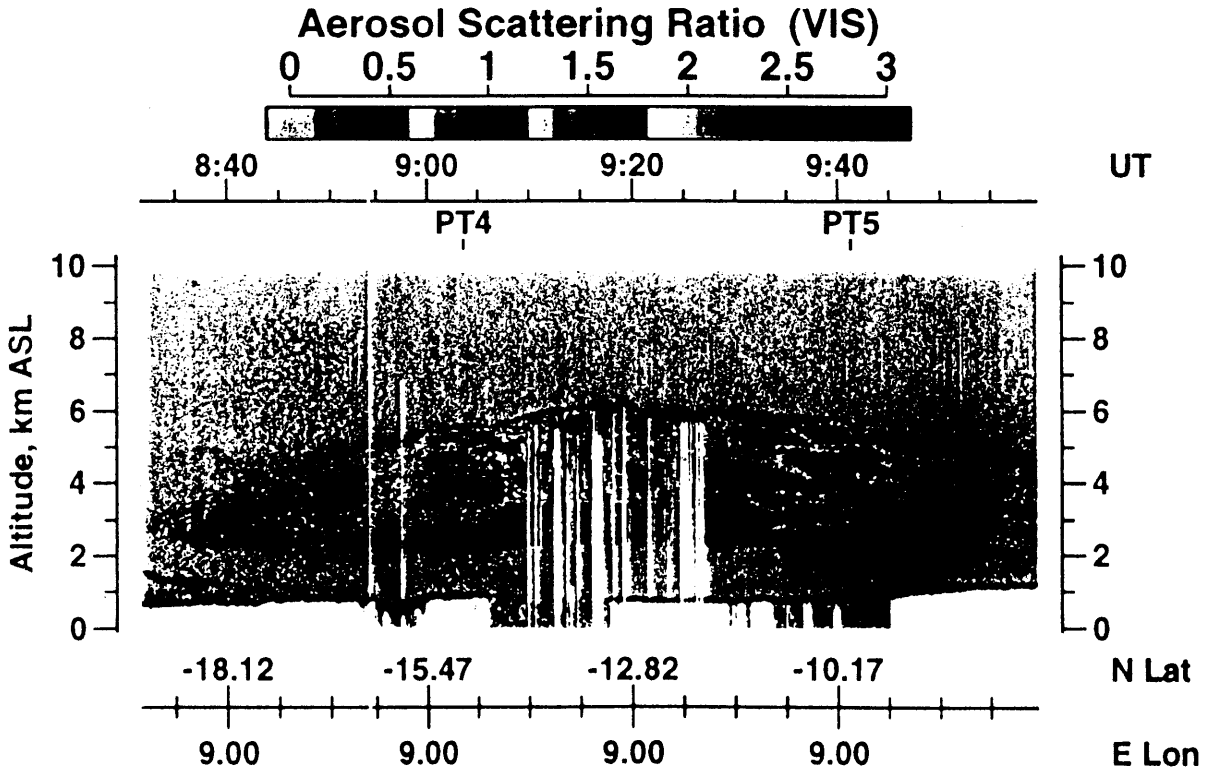

Figure 3. Airborne lidar measurements made during NASA GTE field experiment on 14 October 1992 off the west coast of Africa. The biomass burning plume has similar spatial and aerosol scattering ratio characteristics to the LITE data shown in Figure 2.

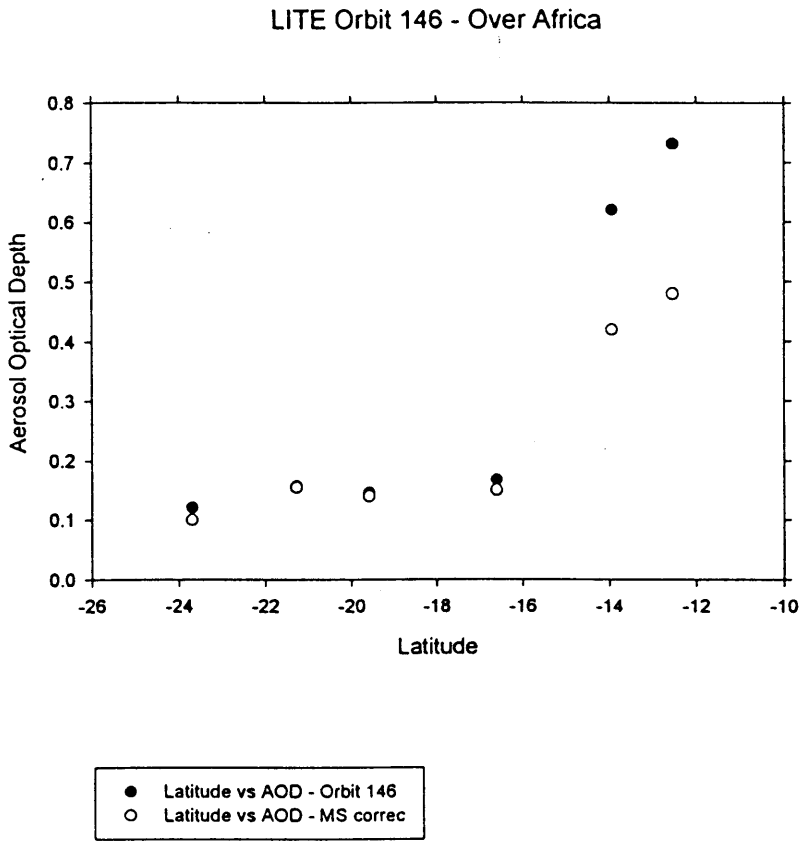

Figure 4. Optical depths calculated for locations along biomass burning plume shown in Figure 2. The uncorrected optical depths are given as solid circles, and the optical depths corrected for multiple scattering are shown as open circles.

Biomass Burn Aerosol Data

	Africa	South America
Number of passes	2	8-10
Altitude of top of aerosols	4-5 km	2-4 km
Latitude range	5-25S	3-32S
Diabatic lofting	Orbit 146	
Cloud capping	Orbit 145	Orbit 149
Daytime observation	Orbit 73	
Optical depths	light in north heavy in south	heavier to south

Figure 5. Summary of biomass burning plume observations over Africa and South America.

Values of α determined from LITE data:

Aerosol type	Approximate range of α
Clouds	-0.2 - 0.3
Saharan dust	0.3 - 0.7
Continental	0.8 - 1.2
Biomass burn	
tropics	1.1 - 1.7
boreal	1.7 - 2.0
Urban/industrial	1.7 - 2.7

Figure 6. Wavelength dependence of aerosol backscattering determined from combination of LITE measurements at 532 and 355 nm.