R. J. Yokelson - Brazil campaign (2004)

2004 Field Measurements in Brazil -
The Tropical Forest and Fire Emissions Experiment (TROFFEE) -
TROFFEE Photo Galleries

* *Description* - We carried out multi-investigator airborne and ground-based campaigns that were coordinated with each other during the peak of the Brazilian biomass burning season in Aug-Sept 2004. The project name was TROFFEE (Tropical Forest and Fire Emissions Experiment). This project was aligned with the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA).

* *TROFFEE* ground-based campaign : Fuel consumption & fire ecology - A planned deforestation fire was carried out in northern Mato Grosso state by João Carvalho (Universidade Estadual Paulista) and Ernesto Alvarado (University of Washington). The time-resolved biomass combustion and total charcoal production were measured by this team. Other topics and investigators included:

- Propagation of smoldering combustion - J. Carvalho, Carlos Gurgel (Universidade de Brasilia), Fernando Costa (Instituto Nacional de Pesquisas Espaciais, INPE).
- Forest flammability and fire characteristics in forest adjacent to clearcuts - J. Carvalho.
- On-site meteorology and climatology - Ralf Gielow (INPE).
- Fire effects on groundwater chemistry - Maria Forti (INPE).
- Monitoring of recovery of burned areas with remote sensing - Mabiane (Doctoral Student in France), Niro Higuchi (Instituto Nacional de Pesquisas da Amazonia, INPA).
- Mercury emissions - Anne Fostier (Universidade Estadual de Campinas, UNICAMP).
- Regeneration of burned areas - J. Carvalho, Samuel Leite (Universidade do Estado de Mato Grosso, UNEMAT).

* *TROFFEE ground-based campaign: Fire emissions* - SCAR-B results suggested that most of the regional smoke in Brazil is produced by residual smoldering combustion (RSC) , which had never been explicitly sampled in Brazil because it is unlofted. We had shown in Africa that RSC had a large impact on fire-average emission factors (EF). We designed and built a mobile ground-based FTIR system to measure the RSC emissions from 5 Amazonian fires ranging from pasture fires to deforestation fires. This gives a good picture of regional RSC emissions to

integrate with the airborne studies of lofted emissions.

In particular, the RSC emissions were measured with the FTIR system on the planned fire described above. The lofted emissions from the same fire were sampled from the air. The CO and CO2 emissions were measured in real time over the course of the fire by a tower-based Fire Atmosphere Sampling System (FASS) loaned by the US Forest Service and deployed by Turibio Neto (INPE) and Emily Lincoln (USFS). The FASS has sensitivity to unlofted emissions that is intermediate between the ground and air platforms and provides a chemical map of the overall fire behavior at a point just above the center of the burn. Considering all the measurements, this may be the most studied fire in history.

The ground-based FTIR system was also used to get the first comprehensive characterization of the emissions from burning dung (at a pasture site). Dung is an important household fuel in south Asia and we found it produced huge NH3 emissions. To add to our database on biofuel emissions, started in Africa, we also measured emissions for a charcoal kiln and a cooking fire.

* *TROFFEE airborne campaign* - The airborne component utilized the INPE Bandeirante as a platform for 45 flight hours from August 25 to September 8 with the following major instruments onboard:

- Real-time ozone and mass-calibrated nephelometry and filter sampling - Paulo Artaxo (Universidade de São Paulo).
- PTR-MS - Thomas Karl and Alex Guenther (NCAR).
- Canister sampling followed by GC/FID ECD MS analysis - Don Blake (UC Irvine).
- Airborne FTIR - Bob Yokelson.

We sampled the initial emissions from 14 fires in 3 Brazilian states including the planned fire described above. This provided the most comprehensive field characterization of fire emissions to date and the first ever measurements of oxygenated volatile organic compounds (OVOC) from Brazilian fires or tropical deforestation fires. We also obtained the first field measurements of the initial emissions of HONO from biomass fires. HONO has important effects on OH in photochemical models of smoke plumes (J. Trentmann). We made long-range transect flights through at least 3 regional haze events (8/27 relatively clean, 9/5 medium smoky, 9/8 extremely smoky). This last event was featured on both the MODIS and MOPITT websites.

These 14 fires were sampled at approximately the same times as satellite overpasses and the fire locations are well-measured so we hope to test the satellite detection efficiency by hotspot or burned area mapping. During several days based in Manaus we obtained vertical profiles of trace

gases above an instrumented tower to study secondary organic aerosol production. We also measured the biogenic emissions over pristine forest and several different types of plantations to explore the effects of land-use change. This also gives data on clean air without biomass burning.