CHARACTERIZATION OF AEROSOL OPTICAL PROPERTIES AND SOLAR FLUX FOR LBA-ECO

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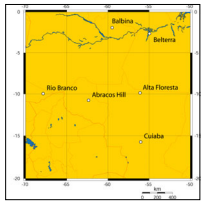
LBA-Related Publications:

Schafer, J. S.; Holben, B. N.; Eck, T. F.; Yamasoe, M. A.; Artaxo, P.
Atmospheric effects on insolation in the Brazilian Amazon: Observed modification of solar radiation by clouds and smoke and derived single scattering albedo of fire aerosols
10.1029/2001JD000428
11 September 2002

Schafer, J. S.; Eck, T. F.; Holben, B. N.; Artaxo, P.; Yamasoe, M. A.; Procopio, A. S.
Observed reductions of total solar irradiance by biomass-burning aerosols in the Brazilian Amazon and Zambian Savanna
10.1029/2001GL014309
05 September 2002



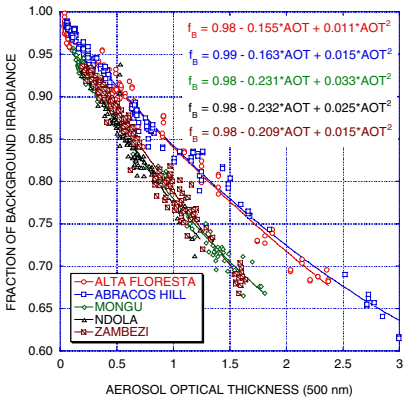
We propose to continue monitoring aerosol optical properties, water vapor, and surface irradiance within our existing network. Our network currently includes seven established sites, with six located in the Amazon basin, that have provided regular measurements at some locations since the early phase of the LBA project dating back to January 1999. Further observations will enhance the multi-year dataset already acquired, and allow for a comprehensive study of inter-annual variability of aerosol optical properties (biomass-burning and background aerosols) both seasonally and spatially.
We plan to continue our studies of the attenuation of broadband irradiance by biomass burning aerosols across the region. These studies have produced two LBA related journals papers to date. Further, at least two funded LBA investigators are producing surface irradiance products from satellite data, and will benefit from our flux measurements for validation of their products and our AOD data will be useful for smoke attenuation analyses.

Relevant Science Questions:

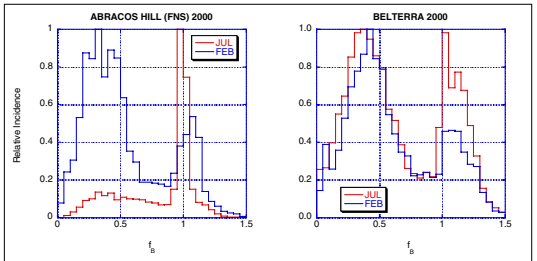
TG-Q2 - What is the (climatically driven) seasonal and inter-annual variability of trace gas and aerosol fluxes between the atmosphere and different land use and land cover types?
Our multi-year (extending back to 1992 for some sites) aerosol monitoring record is applicable to this, given the association between trace gases such as ozone and CO_2 and biomass burning aerosol transport

TG-Q3 - Are losses and gains of carbon from Amazônian ecosystems in forms other than carbon dioxide (e.g. carbon monoxide, methane, volatile organic carbon, organic aerosol) of sufficient magnitude to influence ecosystem carbon balance?
We can possibly contribute to other investigators analyses of TG-Q3 issues in that the AERONET data can provide some estimates of aerosol mass, and smoke is almost entirely carbon (organic and black carbon).

SAMPLE RESULTS FROM PRIOR LBA ANALYSES



CIMEL sunphotometers and collocated pyranometers were employed at two southern Amazonian sites in order to quantify instantaneous reductions of total irradiance due to high aerosol optical thickness (AOT) smoke events (relative to values modeled for background aerosol conditions). Results from the Brazilian sites are presented for 1999 and for comparison, a similar analysis is displayed for data from three south-central African sites during the burning season of 2000

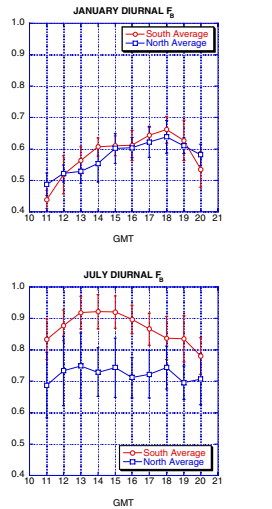


Regional differences in seasonality of received broadband flux are evident (characterized her as histograms of the fraction of background irradiance received).

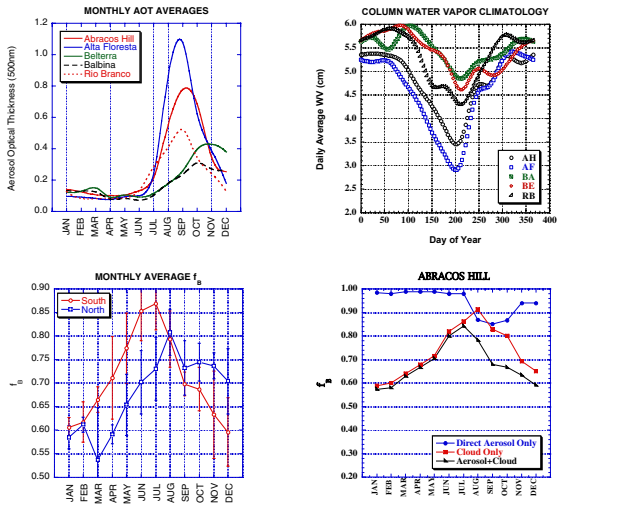
AOT	Fraction of Background		Shortfall (W/m2)	
(500nm)	Brazil avg.	Africa Avg.	Brazil avg.	Africa Avg.
0.5	0.91	0.87	81	121
1.0	0.84	0.78	145	210
2.0	0.72	0.63	254	353
3.0	0.63	-----	337	-----

In addition to our permanent installations, a number of additional CIMEL sunphotometer and flux sensors will be deployed in support of any intensive field campaigns planned for the next few years (as for SMOCC, Dry-to-Wet Season Field Campaign (August-November 2002)) with Brazilian and European collaborators. A micro-pulse lidar (providing details of vertical aerosol distribution), 4-5 additional CIMEL sun-sky radiometers, and a temporary network of 20-30 hand-held sunphotometers can be implemented as needed during select experiments.

Our previous studies have presented fractional reductions in expected flux due to smoke, and we now plan to also assess the radiative effects of clouds at all our network sites. MODIS cloud products (fractional coverage and optical thickness parameters) may be used with the observed local irradiance reductions to develop empirical algorithms for estimating cloud attenuation of surface flux. The large spatial aspect of MODIS data will allow us to scale our point source observations to a basin-wide quantification of cloud effect. The characterization of diurnal trends in cloud attenuation, which varies greatly with month, will provide time-of-day corrections that can be applied to MODIS observations. The accuracy of MODIS measurements, necessarily limited to a short duration, can thus be improved for application to non-overpass periods of the day.
Collection of additional aerosol properties data sets from our LBA network will enable us to study the regional aerosol optical properties in detail and to investigate seasonal trends. We plan to investigate possible differences in aerosol single scattering albedo and size distribution between sites in central Amazonia versus in the southern arc of deforestation, that may result due to differences in the severity of the dry season and thus differences in fuel moisture content. Additionally, seasonal trends in aerosol absorption at each site will be studied, which may result from differences in transport and aging of aerosols and in the fuel moisture as the dry season transitions to the wet season.



Observed diurnal trends of fraction of background total irradiance values (f_B) averaged by hour of day. Plots are based on data from the following sites and years:
JANUARY North- Balbina (2000), Belterra (2000,2001)
South- Alta Floresta (2000), (2000,2001), Rio Branco (2001)
JULY North- Balbina (2000,2001), Belterra (2000,2001)
South- Alta Floresta (1999,2001), (1999,2000), Cuiaba (2001)



A high-quality climatology of aerosol and water vapor properties for the Amazon Basin is gradually emerging. Using the average aerosol optical thickness for two sites during the period of study, and the observed relationship (Solar zenith: 30) for direct flux reduction by smoke (Schafer et al., 2002b), an estimate was made of monthly f_B values expected at these sites if aerosol were the sole attenuator. This f_B estimate is most applicable to August-October when the atmospheric aerosol is smoke-dominated.

With a crude assumption (ignoring cloud/aerosol interaction) that the cloud attenuation is the difference of the observed attenuation and the estimated smoke aerosol attenuation, a rough approximation of the reduction due to cloud is presented.