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REFERENCES

- Kirchhoff, V.W.J.H., Surface ozone measurements in Amazonia. *J. Geophys. Res.*, 93, 1469-1476, 1988.
- Kirchhoff, V.W.J.H., E.V. Browell, and G.L. Gregory, Ozone measurements in the troposphere of an Amazonian rain forest environment. *J. Geophys. Res.*, 93, 15850-15860, 1988.
- Kirchhoff, V.W.J.H., A.W. Setzer, and M.C. Pereira, Biomass burning in Amazonia, *Geophys. Res. Lett.*, 5, 469-472, 1989.
- Kirchhoff, V.W.J.H., and R.A. Rasmussen, Time variations of CO and O₃ concentrations in a region subject to biomass burning. *J. Geophys. Res.*, 95, 7521-7532, 1990.
- Kirchhoff, V.W.J.H., Y. Nakamura, E.V.A. Marinho and M.M. Mariano, "Excess ozone production in Amazonia from large scale burnings, *J. Atmosph. Terr. Phys.*, 54, 583-588, 1992.
- Kirchhoff, V.W.J.H., SCAR-B Brasil, Missão de Campo, relatório interno INPE, 76 pp, Julho, 1995.
- Kirchhoff, V.W.J.H., and P.C.Alvalá, Overview of an aircraft expedition into the Brazilian Cerrado for the observation of atmospheric trace gases, *J. Geophys. Res.*, accepted, 1996.
- McDougal, D., Smoke, Clouds and Radiation-Brazil (SCAR-B) Field Experiment, August 16 to September 14, 1995, Mission Plan, prepared by SCAR-B scientists and the SCAR-B Project Office, *NASA special publication*, 164 pp, July, 1995.

FIGURE CAPTIONS

Fig. 1.-Map of Brazil showing the main areas for aircraft sampling during SCAR-B.

Fig. 2.-Concentration of CO as a function of height, measured from aircraft platform at three different sites: Porto Nacional, Alta Floresta, and Cuiabá.

intensity-quantity of the smoldering fires in a given region. Fig. 2 shows maxima and minima of CO concentrations observed during SCAR-B. The maxima correspond to the SCAR-B mission period August-September; the minima correspond to a smaller special field campaign carried out in the wet season period of the cerrado, which is April. The first panel shows results for Porto Nacional, the second panel for Alta Floresta, and the third panel for Cuiabá. Note that the three panels are drawn at the same scale. These CO data clearly show the progression of more fire activity from Porto Nacional to Cuiabá, passing by Alta Floresta. The Porto Nacional result for CO confirms local observations of relatively clean air. The northern part of the cerrado had little activity

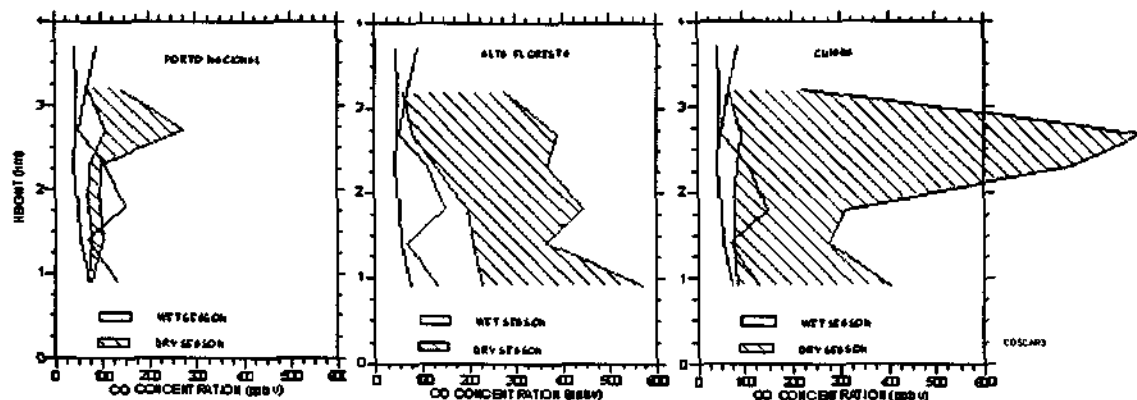


Fig. 2.-Concentration of CO as a function of height, measured from aircraft platform at three different sites:Porto Nacional, Alta Floresta, and Cuiabá.

during 1995, which was observed also in other trace gases. Alta Floresta, in the north of Mato Grosso, is a region at the limits between the cerrado, in the south, and the Pará rainforest to the north. It is a traditionally very active region, in which much biomass burning is observed each year. During SCAR-B there were occasions when the INPE aircraft could not take off, so much smoke was around the airport. Very dense layers of CO₂ and ozone were observed. The large CO concentration observed near Cuiabá is also not unexpected. Cuiabá, south of the Alta Floresta area, receives air masses from the north, which means contributions from the cerrado region, plus from the forest regions in the south of the Pará state. Cuiabá is also a traditional biomass burning region (Kirchhoff and Rasmussen, 1990; Kirchhoff et al., 1989).

CONCLUSIONS

The INPE portion of the SCAR-B mission was a successful field operation for which a large data base was obtained. Measurements were made at the surface, on an aircraft platform, and ozonesondes on balloons were launched from Cuiabá. From an initial overview of the trace gas observations, the CO results stand out showing large differences in concentrations among the three major sites. Cuiabá makes the largest contribution, with concentrations as large as 900 ppbv; Alta Floresta comes next, with as much as 600 ppbv. Less activity was observed near Porto Nacional, where maximum CO concentrations were below 150 ppbv, except at a layer near 2.8 km, where concentrations reached maxima of about 300 ppbv.

The INPE aircraft has been described in Kirchoff and Alvalá (1996). During SCAR-B it collected O₃ and CO₂ data, as well as UV-B radiation continuously; the remaining gases were obtained from grab sampling. The general sampling areas were concentrated near three cities of the cerrado area: Cuiabá, Porto Nacional, and Alta Floresta, as indicated in Fig. 1. The operation is summarized in Table 1 for ozone.

Table 1.-Aircraft Ozone Data Collected during the SCAR-B Field Mission: 15 vertical profiles and 7 long constant height flights.

DATE 1995	TIME (U.T.)	LOCATION	TYPE
09 AUG	13.2 - 15.2	CAMPO GRANDE (20.1 S, 54.5 W)	Constant height
10 AUG	14.3 - 15.5	CAMPO GRANDE (20.1 S, 54.5 W)	Profile
12 AUG	12.9 - 13.4	CAMPO GRANDE (20.1 S, 54.5 W)	Constant height
15 AUG	13.3 - 14.6	CUIABÁ (16 S, 56 W)	Profile
16 AUG	13.2 - 16.5	CUIABÁ (16 S, 56 W)	Constant height
17 AUG	14.1 - 15.2	CUIABÁ (16 S, 56 W)	Profile
18 AUG	13.6 - 15.7	CUIABÁ (16 S, 56 W)	2 Profiles
19 AUG	13.2 - 15.4	CUIABÁ (16 S, 56 W)	Constant height
21 AUG	18.2 - 19.8	ALTA FLORESTA(9.5 S, 56 W)	2 Profiles
22 AUG	14.4 - 15.8	ALTA FLORESTA(9.5 S, 56 W)	Profile
23 AUG	12.0 - 14.9	ALTA FLORESTA(9.5 S, 56 W)	Constant height
24 AUG	11.9 - 13.1	PORTO NACIONAL (12 S, 47 W)	Profile
25 AUG	16.6 - 18.2	PORTO NACIONAL (12 S, 47 W)	2 Profiles
26 AUG	15.9 - 17.6	PORTO NACIONAL (12 S, 47 W)	Constant height
27 AUG	17.5 - 19.0	ALTA FLORESTA(9.5 S, 56 W)	Profile
28 AUG	16.0 - 18.8	ALTA FLORESTA(9.5 S, 56 W)	2 Profiles
29 AUG	12.9 - 14.0	ALTA FLORESTA(9.5 S, 56 W)	Profile
30 AUG	11.9 - 14.1	CUIABÁ (16 S, 56 W)	Constant height

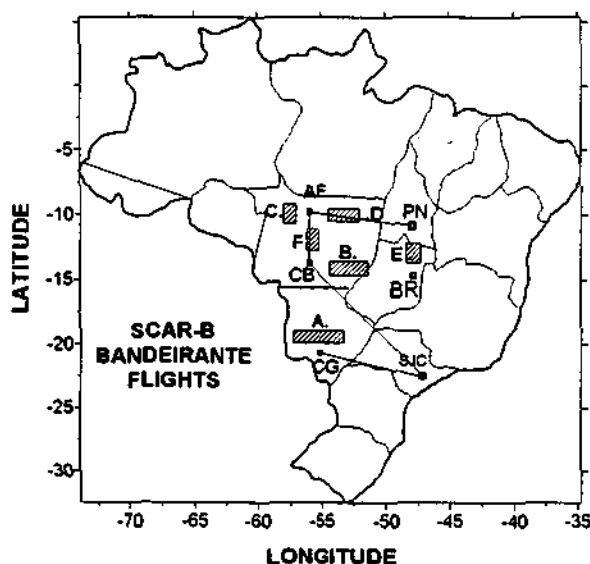


Fig. 1.- Map of Brazil showing the main areas for aircraft sampling during SCAR-B.

Carbon monoxide is produced directly from biomass burning, by incomplete combustion in the smoldering stage of the open field fire. It is a good indicator of the

COMPONENTS OF A BIOMASS BURNING EXPERIMENT IN CENTRAL BRAZIL: SCAR-B

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ABSTRACT

A large measurement campaign took place in central Brazil in August-September of 1995 to observe trace gases and aerosols produced in biomass burning events. The SCAR-B (Smoke, Clouds, and Radiation-Brazil) experiment was a collaboration between NASA and AEB/INPE. Measurements were made from the ground, and especially from different aircraft platforms. Important trace gases were measured, especially O₃, CO, CO₂, N₂O, and CH₄, plus UV-B radiation. The general conditions that prevailed in the meteorological conditions, air mass trajectories, burning intensity and distribution in Brasil are discussed. In addition to the standard network of radiosoundings, 30 additional sondes were launched from Porto Nacional (12° S, 47° W), and thirty ozonesondes were launched from Cuiabá (16° S, 56° W), between 15 August and 10 September.

INTRODUCTION

Four major areas of interest were identified for the Brazilian participation in SCAR-B: 1-Trace gases; especially O₃, CO, CO₂, N₂O, CH₄; and UV-B radiation. 2-Aerosols; measurement techniques used teflon and nuclepore filters, and an aethalometer. 3-Location of fire events, using AVHRR. 4-Meteorology, general meteorological conditions during the field experiment, and comparison with climatological means. This paper summarizes the trace gas measurements.

RESULTS

The SCAR-B mission (McDougal, 1995; Kirchhoff, 1995) was a very successful special field campaign in collaboration between the Space Agencies of the USA and Brazil. A large amount of trace gas data has been collected in the region of the Brazilian cerrado. The measurement techniques have been described, for example, by Kirchhoff (1988), Kirchhoff et al.(1988), and Kirchhoff et al.(1989). And with emphasis on biomass burning by Kirchhoff and Rasmussen (1990) and Kirchhoff et al. (1992). Some of the scientific topics of interest that were addressed are listed below:

- 1-Meteorological conditions during the field mission; Daily Meteosat images were collected and fire pixels from NOAA satellites.
- 2-Comparisons of trace gases concentrations during Wet and Dry seasons.
- 3-Horizontal distribution of trace gases near and distant from sources.
- 4-Atmospheric transparency and the correlation COx O₃.
- 5-Production of greenhouse gases CO₂, N₂O, CH₄.
- 6-Production of ozone in the higher troposphere using sondes.