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14. Abstract/Notes A summary of the research programs in optical aeronomy at this Institute is presented in this report. The facilities include: a laser radar for studies related to the mesospheric sodium layer and stratospheric aerosols; photometers and an interferometer for observations of the F-region (OI 6300Å and 7774Å), mesospheric (OH, O ₂ atm., NaD and OI 5577Å) and energetic particle excited (N ₂ ⁺ 3914Å and 4278Å and H _β 4861Å) nightglow emissions; and rocket-borne photometers for the equatorial upper atmospheric studies.			
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OPTICAL AERONOMY AT THE BRAZILIAN
INSTITUTE FOR SPACE RESEARCH

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ABSTRACT

A summary of the research programs in optical aeronomy at this Institute is presented in this report. The facilities include: a laser radar for studies related to the mesospheric sodium layer and stratospheric aerosols; photometers and an interferometer for observations of the F-region (OI 6300Å and 7774Å), mesospheric (OH, O₂ atm., NaD and OI 5577Å) and energetic particle excited (N₂⁺ 3914Å and 4278Å and H_β 4861Å) nightglow emissions; and rocket-borne photometers for the equatorial upper atmospheric studies.

1 - INTRODUCTION

The upper atmosphere research group at INPE has carried on a program of studies related to aeronomy and the physics of the solar-terrestrial environment during the last two decades. Most of the experimental work in this area is done using optical techniques. A laser radar (LIDAR) is in operation at São José dos Campos (23.2°S, 45.9°W) to study the mesospheric sodium layer and its dynamics, and also stratospheric aerosols. To observe various nightglow emissions in the equatorial and low-latitude regions, several photometers are operated on a routine basis at Cachoeira Paulista (22.7°S, 45.0°W) and Fortaleza (3.9°S, 38.4°W). An OI 6300Å Fabry-Perot interferometer is in operation at São José dos Campos to measure the thermospheric winds and temperatures. Recently, photometers for rocket-borne studies have been developed at this Institute. The first launch took place at Natal (5.8°S, 35.2°W) on December 11, 1985 to study the vertical profiles of the OI 5577Å and O₂ 7619Å nightglow emissions in the equatorial region. A summary of the research programs is presented below.

2 - LASER RADAR (LIDAR) STUDIES

Since 1969, INPE has been operating a laser radar at São José dos Campos. Initially, the transmitter was a ruby laser used for neutral atmosphere studies. In 1972, a dye laser tuned to the D₂ line of sodium (5890Å) was added to the LIDAR. Currently only the dye laser is operated. The dye laser data are used in two lines of research. The data which refer to the lower atmosphere (8-45 km) are used in studies of stratospheric aerosols. These aerosols originate in volcanic eruptions and, apart from their intrinsic interests, their study is important in correction of certain kinds of remote sensing data. The data from the mesosphere (75-105 km) are used in the study of the dynamics and photochemistry of the mesosphere by measuring the behavior of the free neutral sodium which is present in this region.

The characteristics of the LIDAR are given in Table 1. During the day, the receiver bandwidth must be greatly reduced in order to get an acceptable signal to noise ratio. This reduction unfortunately reduces the receiver efficiency so that the precision of the daytime data is much worse than that of the nighttime data.

A transportable laser radar is under construction. It is planned to use it in conjunction with rocket experiments to investigate the atmospheric sodium layer. When not being used in conjunction with rocket launches, it will be used to make simultaneous measurements with the São José dos Campos LIDAR. It is also planned to measure potassium in the mesosphere.

TABLE 1

LASER RADAR

<u>LOCATION:</u>	S.J. Campos (23.2°S, 45.9°W)		
<u>TRANSMITTER:</u>	Dye laser tuned to sodium D2 (589 nm)		
	Energy	30	Millijoules
	Bandwidth	12	Picometers
	Beamwidth	0.15	Milliradians
<u>RECEIVER:</u>	AREA	0.39 M ²	
		<u>NIGHT</u>	<u>DAY</u>
	Bandwidth	800 pM	30 pM
	Beamwidth	0.4 mR	0.2 mR
	Efficiency	2.4%	0.7%

3 - GROUND-BASED AIRGLOW STUDIES

Airglow observations at INPE started in 1970. Since that date, considerable progress has been made and numerous photometers and an interferometer have been designed and constructed at this Institute. At present, several photometers are operated on a routine basis at Cachoeira Paulista and Fortaleza. The emissions observed include measurements of the F-region (OI 6300Å and 7774Å) and mesospheric (OH (8-3), OH (9-4), O₂ atm. (0-1) 8645Å, NaD 5890Å and OI 5577). Both the O₂ and OH measurements are used to study rotational temperature in the mesopause region. A 15 cm OI 6300Å Fabry-Perot interferometer to measure the thermospheric winds and temperatures is in operation at São José dos Campos (about 100 km west from Cachoeira Paulista) and is expected to be moved to Cachoeira Paulista in due course. In a cooperative bilateral project with the University of Texas at Dallas a photometer is operated at Cachoeira Paulista to observe the N₂⁺ 3914Å and 4278Å and H_β 4861Å nightglow emissions excited due to energetic particle precipitation at low latitudes during magnetic disturbances. In another bilateral research project between the Boston University and INPE, a low light level airglow imaging system is in the process of installation at the Airglow Observatory at Cachoeira Paulista.

The present studies related to the equatorial and low-latitude regions include: morphology; F-region irregularities and dynamics; mesospheric photochemistry, dynamics and temperatures; thermospheric winds and temperatures; and effects of magnetic disturbances.

4 - ROCKET-BORNE AIRGLOW STUDIES

INPE has recently embarked on a program of rocket sounding of the upper atmosphere in conjunction with the Institute of Space Activities (IAE) of the Brazilian Air Force. The SONDA III rocket vehicle developed by IAE was used to launch two photometers at

Natal on December 11, 1985 to measure the OI 5577⁰Å and O₂ atm. (0-0) 7619⁰Å nightglow emission profiles. The next launch to measure the OI 6300⁰Å and 5577⁰Å F-region profiles is expected to take place in November 1986. Further experiments planned for 1987 and 1988 will include measurements of the O₂ singlet delta emission (in collaboration with the University of Saskatchewan, Canada) and a multiphotometer payload for lower thermosphere/upper mesosphere emissions.

It is expected that the existing facilities in optical aeronomy at this Institute will be important for several global studies proposed at the CEDAR Workshop (July 1986).

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