ROCKET AND BALLOON STUDIES OF MIDDLE ATMOSPHERIC ELECTRODYNAMICS IN THE LOW LATITUDES

by

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PHYSICAL RESEARCH LABORATORY

AHMEDABAD 380 009

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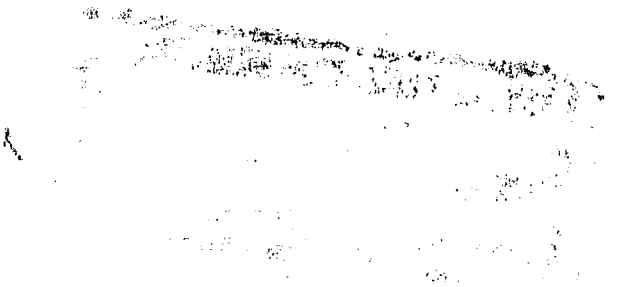
Dedicated to

My Parents...



C E R T I F I C A T E

I hereby declare that the work presented in this thesis is original and has not formed the basis for the award of any degree or diploma by any University or Institution.

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STATEMENT

The work presented in this thesis was carried out by the author at the Physical Research Laboratory, Ahmedabad under the guidance of Dr.S.P.Gupta and Prof.B.H.Subbaraya.

The studies presented in this thesis deal with various aspects of the electrodynamics of the middle atmosphere at low latitudes.

The author has been involved in the design and construction of instruments for measuring conductivity and electric field at stratospheric altitudes. These instruments were flown from the low latitude station Hyderabad (India) on balloon-borne platforms at a number of occasions in order to make in-situ measurements of atmospheric conductivity and vertical electric field in the stratosphere. The results of these measurements are presented and discussed in this thesis.

The first chapter forms the introduction to this thesis. Various concepts which are important for the study of middle atmospheric electrodynamics have been reviewed briefly in this chapter.

The second chapter deals with the physics of conductivity and electric field measurement. In this chapter, an attempt has been made by the author to discuss different

theoretical aspects of the measurement process.A simple model for the probe behaviour has been presented in this chapter and various possibilities encountered during realistic measurement situations are discussed in detail. The relaxation technique for conductivity measurement and the double probe technique for electric field measurement are described in this chapter(These techniques have been used by the author for conducting balloon-borne measurements). This chapter also contains a discussion on the author's investigations on the nature and extent of charging of the balloon-borne gondola during its ascent and float periods.

A discussion of the use of rocket-borne Langmuir probes for measuring ion and electron conductivity in the mesosphere is given in the second chapter. Using the electron and ion currents obtained from Langmuir probe measurements, the conductivities at these altitudes were derived. Ion conductivity for the mesosphere has been obtained using rocket-borne Langmuir probe data.This has been presented in chapter four.

Chapter three describes in detail the instruments constructed by the author for conducting in-situ measurements. This chapter also describes various support instruments that go with the payload during balloon flight. A discussion of the instrument testing procedure and the balloon launch procedure has been included in this chapter.

The results of measurement of polar conductivity and electric field in the stratosphere and mesosphere

constitute the contents of the fourth chapter of this thesis.

The fifth chapter of this thesis contains discussions of the results and the new findings obtained during the present work.

A comparison of the conductivity measurements done by the author has been made with measurements done elsewhere by other groups.The positive ion conductivity was observed to be higher than the negative ion conductivity by a factor of four and half.This aspect has been discussed in chapter five where a comparison has been made between theoretically expected ratio between the two polar conductivities with the observed ratio.

A comparison of stratospheric and mesospheric conductivities has also been done in this chapter. A discussion of the rocket body potential in the mesosphere as observed during several rocket flights is given. A suggestion has been made that the existence of such potentials might be indicating a presence of large vertical electric field in the mesosphere.

The effects of volcanic eruptions on conductivity has also been discussed in chapter five. The positive ion conductivity has been found to be affected much more drastically than the negative ion conductivity by volcanic activity.The implications of this observation are discussed.

The sixth chapter contains a summay of the important results. This chapter also contains suggestions for further work.

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CHAPTER III : INSTRUMENTATION AND DATA ANALYSIS