6. SUMMARY AND CONCLUSION

6.1 RESUME

This thesis presents the results of an investigation of the relationship between certain environmental factors and the behaviour of atmospheric electrical polar conductivities. The study was carried out in the southern part of Kerala State and the adjoining region of Tamil Nadu. One of the important environmental factors in this region is the large deposit of the radioactive mineral monazite in the coastal sands. This was, therefore, a major factor that was studied. Other environmental factors included rainfall, temperature, wind, etc. While the electrical conductivities were measured using instruments developed for the purpose, meteorological data were mostly obtained from the India Meteorological Department.

For the investigation, a Gerdien condenser instrument was designed and developed for continuous monitoring of atmospheric electrical polar conductivities. Three such instruments were fabricated and installed at suitable sites at Chavara, Ambalapuzha and Kottarakara. Positive and negative polar conductivities were measured for four to five months at these sites. Subsequently, one of these instruments was operated at the campus of our institute and data from here for about three months are used, along with rainfall measured simultaneously using a self recording rain gauge, to demonstrate the effect of rainfall on conductivity.
An electric field mill was developed for measuring the vertical electric field. It was test run for about one month at Kottarakara. Some modifications were found necessary, which were taken up.

A Gerdien condenser aircraft payload was also developed for conducting aerial surveys of polar conductivities using a Pushpak aircraft of the Kerala Aviation Training Centre, Trivandrum. Three surveys were carried out, namely, Trivandrum to Alleppey along the coast, Trivandrum to Kanyakumari along the coast, and Trivandrum to Chavara via Kottarakara. The third survey also went over the sea for about 1 km. Before the airborne surveys were conducted, the payload was tested by mounting it on a jeep and driving it along the highways. The highlights of the results are given below.

6.2 HIGHLIGHTS OF RESULTS

The data from the measurements at ground level indicate the following:

(i) Polar conductivities have a similar behaviour in the region of study, as evidenced by the data from Kottarakara, Ambalapuzha and Trivandrum.

(ii) Conductivity values are six to seven times higher at a site like Chavara having a rich deposit of radioactive minerals, compared to areas without significant deposits of these minerals.

(iii) The diurnal variation pattern of polar conductivities is of the double oscillation type at all the sites, except during the
pre-monsoon period March to May at Chavara. Here the pattern is strongly influenced by wind during this period.

(iv) The monthly mean amplitude of diurnal variation at Chavara during the pre-monsoon months is dependent on the mean maximum temperature. This can be attributed to the influence of temperature on the exhalation and atmospheric transport of radon.

(v) The polar conductivities at Chavara show a sharp reduction after the onset of monsoon rainfall. The suppression of radon exhalation by rainfall must be the reason for this.

(vi) Pre-monsoon rainfall, which is isolated, causes a reduction in conductivity, which recovers slowly after the rain.

(vii) The vertical electric field at Kottarakara shows a double oscillation continental type behaviour that is more or less complementary to that of conductivity.

(viii) The morning maximum in conductivity occurs around 0400 hrs and the minimum around 0700 to 0800 hrs at all the sites in all the seasons. This is seen to be more or less true even for a station like Athens where time of sunrise changes considerably over the year. This variation has a strong similarity to the semi-diurnal variation of atmospheric pressure.

(ix) The aerial surveys have shown that the presence of natural radioactivity at the surface can be observed at 1000 to 2000 feet altitude, and possibly at higher altitudes also, by its influence on polar conductivities. This could be of use in preliminary surveys of radioactivity.
Surveys at ground level show that radioactivity from minerals in the soil and in rocks (in quarries) have a strong influence on atmospheric electrical conductivity.

In summary, the main findings of the study are:

(a) the diurnal variation pattern of conductivity at a site having a large deposit of radioactive minerals is strongly influenced by meteorological factors like wind, rainfall and temperature, and can be different in different seasons;

(b) rainfall causes a reduction in conductivity, and during periods of continuous rainfall, as in the monsoon season, the ratio of positive to negative polar conductivity becomes less than unity;

(c) atmospheric pressure may play an important role in determining the diurnal variation of conductivity;

(d) the presence of radioactive minerals at the surface can be detected from air-borne surveys of conductivity.

6.3 SUGGESTIONS FOR FURTHER STUDIES

The present study has made an attempt to understand some of the effects of environmental parameters like surface radioactivity, rainfall, atmospheric temperature, etc. on the behaviour of atmospheric electrical polar conductivities. While some interesting results have been obtained, the study also has brought to light some aspects of the behaviour of conductivities that need further investigation. Some of these aspects are discussed below.
An interesting observation made during the present study is that the morning maximum in conductivity is reached around 0400 hrs LT at almost all stations, rural and urban, and in all kinds of weather. Similarly, the morning minimum occurs between 0700 hrs and 0900 hrs. The usual explanation for the decrease in conductivity in the morning is based on sunrise and human activity, which seems to be unsatisfactory. There appears to be a relationship between the variation of conductivity and that of atmospheric pressure, their semi-diurnal components being almost exactly out of phase. The reason for the behaviour of conductivity in the early morning, therefore, has to be looked into more carefully. It would be useful to measure polar conductivities along with the small and large ion concentrations, the aerosol concentration, and meteorological parameters like pressure, temperature, humidity, etc.

Another point that needs to be looked into is the relationship between the amplitude of variation of conductivity and atmospheric temperature. The present study shows a dependence of the amplitude of variation of the monthly mean hourly values on the monthly mean maximum temperature. But a similar dependence of the daily amplitude of conductivity variation on the maximum temperature for the day is not seen. This is possibly due to the influence of other factors that may introduce random variations in the conductivity values. The explanation suggested here for the observed dependence is that of the influence of temperature on the exhalation and transport of radon. But an important influence on conductivity is that of aerosols. Explanations for conductivity variations at a site have mostly concentrated on the behaviour of aerosols. The effects of temperature and rainfall on
conductivity observed in the present study cannot be explained on this basis. It appears, therefore, that greater attention has to be given to the influence of meteorological parameters on radon exhalation and the consequences for atmospheric electricity.