

IN SITU OBSERVATIONS OF THE CHARGED PARTICLE ENVIRONMENT ASSOCIATED WITH PMSE AND NLC

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Through a combination of electrodynamic measurements made by sounding rocket payloads, we have observed both positively and negatively charged particles in regions of PMSE or NLC activity. These rocket flights included the NASA-sponsored MaCWAVE Program during July 2002 and the DROPPS Program during July 1999, both from the Andya Rocket Range, Norway. Our investigations were coordinated with the European MIDAS Campaign, which involved additional rocket flights and ground-based measurements by the ALOMAR Observatory and the EISCAT Radar Facility.

The instrument suite for each payload included Langmuir probes which observed deep depressions in the electron concentrations associated with PMSE/NLC regions. Simultaneous measurements of ram and wake Langmuir probes have shown that these bite outs are not an artifact of electron collection in a wake nor are they an artifact due to ram collision with charged positive particles. The bite outs were also observed when the applied collection voltage was adjusted to compensate for shifts in the spacecraft potential, thereby demonstrating that such bite outs are not the result of spacecraft charging.

In addition, high-time/altitude resolution measurements of charged particles were made with screened blunt probes. This flat-plate Langmuir probe configuration was used in the ram to identify the net polarity of charged particle regions. The blunt probes were configured in pairs; one had a fixed bias voltage of +2.5 volts and the other had a -2.5 volts bias voltage. The current signatures obtained during the flights are indicative of the existence of both positively and negatively charged particle regions. On some occasions both polarities were observed during the same flight. A direct correlation between the largest particle effects and the electron bite out regions was observed.

For the DROPPS payloads, a Gerdien condenser provided a third probe technique for investigating the vertical structure of ion constituents—both more mobile molecular species and low-mobility particulate species—in the vicinity of PMSE/NLC regions. A detailed, high-time resolution display of the Gerdien condenser currents showed a direct correlation of the positive-ion and charged-particle fine structure.

In all of the charged species data, sharp layers or edges in the concentration profiles were seen. Layer structures down to one-meter thickness, with random occurrences on the order of a few meters, suggest that these charge structures are related to the observation of PMSE events. In this paper we describe and interpret the data from a number of these sounding rocket flights.

1. (a)

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2. G - Ionospheric Radio and Propagation

3. (a)

4. I - Invited Paper, Program chair: Mihaly Horanyi

5. Special Session: Polar Mesospheric Summer Echoes and the Mesosphere