POTENTIAL DISTRIBUTION AROUND SOUNDING ROCKETS IN MESOSPHERIC LAYERS WITH CHARGED AEROSOL PARTICLES

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It is shown that large potential variations can exist inside the wake of sounding rockets moving with supersonic velocity through the summertime mesopause region. The potential distribution is driven by charge separation induced by the shock wave of the rocket. The low conductivity conditions due to the attachment of free electrons to aerosol particles allow large electric fields, of the order of V/m, to be maintained. Large potential variations were observed within the wake of the two DROSPPS payloads while studying the electrical structure of the narrow layers of aerosol particles present in the summertime mesosphere. We have used a DSMC (Direct Simulation Monte Carlo) code to calculate the neutral flowfield around a 3 m long, 43 cm diameter cylinder resembling the DROPPS payload. The calculation is done for 85 km altitude that is where a deep reduction of the free electron density (bite-out) due to the electron attachment to aerosol particles has been observed by the DROPPS-1 payload. For the conditions studied, the light positive ions are embedded in the neutral flow and thus ions have the same compression factor as the neural gas. This is because the neutral drag force dominates over the electrostatic force for electric field on the order of 1 V/m. On the other hand, the heavy aerosol particles are only weakly affected by the shock and their distribution remains homogeneous. This assumption is valid for particles larger than 1 nm. The photometer data onboard the DROPPS-1 payload indicated aerosol particles up to 20 nm in size somewhat below the bite-out. Assuming that only light positive ions and heavy aerosol particles are present within the bite-out region, Poissons equation is solved for the potential distribution. The results show that the shock of the rocket has a positive few volts potential. The numerical results are in good qualitative as well as quantitative agreement with the DROPPS observations.

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2. H - Waves in Plasma

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4. C - Contributed Paper

5. No special instructions