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Direct in situ Measurements of Current Density Variations in the Ionosphere by Using the Current Density Probe Rogowski Coil Onboard Sych M Satellite

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We present the results of the first direct in situ measurements of current density variations to ion and electron whistler waves in the low latitude ionosphere onboard the Ukrainian Sych 1M satellite, in the frame of Variant experiment. These results were based on the measurements from the Rogowski coil sensor developed at LPCE (Orléans, France). This instrument consists of a toroidal coil with a high permeability core and is dedicated to measurements of the variations of the current component perpendicular to the torus. A more detailed description of the principle of measurement and instrument operation can be found in [1, 2]. The scientific objective of the experiment was to study current density variations in the different regions of the upper ionosphere. Due to a technical failure of the third stage of the launcher, only a limited amount of short duration measurements could occasionally be performed in different regions of the ionosphere. In addition to this, the electromagnetic cleanliness of the satellite was far from perfect, causing the data to be very noisy. Special care had to be taken to de-noise the data of all instruments using multi-scale techniques before any interpretation could be carried out. We were eventually able to find simultaneous occurrences of whistlers in the electric and magnetic field data and in current density data, in a frequency band ranging from several tens of Hz up to approximately 1 kHz.

The upper limit was given by the cutoff frequency of the preamplifier (400 Hz) and the lower limit by the high noise level in the ELF frequency band. The comparison of electromagnetic and current density data associated with the whistlers provides proof of the concepts and techniques used and validates the use of the Rogowski coil for current density variations measurements.

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