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First results from the 2009-2010 MU radar head echo observation programme for sporadic and shower meteors: the Orionids

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Csilla Szasz[1*], Johan Kero[1], Takuji Nakamura[1], David D. Meisel[2], Toshio Terasawa[3], Hideaki Miyamoto[4], Yasunori Fujiwara[5], Masayoshi Ueda[5], Koji Nishimura[1]
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[1]National Institute of Polar Research, [2]SUNY Geneseo, Geneseo, NY, USA, [3]University of Tokyo, Chiba, [4]University of Tokyo, Tokyo, [5]Nippon Meteor Society
[1]National Institute of Polar Research, [2]SUNY Geneseo, Geneseo, NY, USA, [3]University of Tokyo, Chiba, [4]University of Tokyo, Tokyo, [5]Nippon Meteor Society

The aim of this presentation is to demonstrate the capabilities of a new automated analysis scheme developed for meteor head echo observations by the interferometric Shigaraki Middle and Upper atmosphere (MU) radar in Japan (34.85 degrees N, 136.10 degrees E). Meteors, or colloquially shooting stars, are caused by particles from space that are heated up and shattered in the atmosphere. Meteor head echoes are radio waves scattered from the intense regions of plasma surrounding and co-moving with meteoroids during atmospheric flight.

Our analysis procedure computes meteoroid range, velocity and deceleration as functions of time with unprecedented accuracy and precision. This is crucial for estimations of meteoroid mass and orbital parameters, as well as investigations into meteoroid-atmosphere interaction processes. We collected an extensive set of data (>500 h) between June 2009 and December 2010. The data set contains both shower and sporadic meteor detections. Sporadic meteors are those that cannot be directly ascribed to a parent body. Sporadics are the most numerous among our observed particles, and the main contributors to the mass influx into the Earth atmosphere.

Here, we present initial results from data taken 2009 October 19-21. More than 600 of about 10 000 head echoes recorded during 33 hours were associated with the 1P/Halley dust of the Orionid meteor shower. The Orionid activity within the MU radar beam reached about 50 per hour during radiant culmination. The rate of sporadic meteors in the MU radar data, coming primarily from the direction of the Earth's apex, peaked at about 700 per hour during the same observations.

Head echoes of shower meteors are quite rare in modern high-power large-aperture (HPLA) radar data, primarily because sporadics outnumber shower meteors in the low-mass regime observable with these radar systems. The small collecting area of an HPLA radar system further limits successful observation of shower meteors. Analysis performed on a limited data set may, therefore, contain no or only a few shower meteors due simply to low statistical probability. In this work, we have estimated the MU radar collection area, calculated the flux of Orionid meteors, and show that the Orionid meteoroid stream activity could be accurately tracked with the MU radar when the radiant is at least 10 degrees above the local horizon.

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