NOVEL METEOR SIMULATION AND OBSERVATION TECHNIQUES THAT EMERGED FROM BIG-SKY-EARTH COST ACTION

P. Butka[1], M. Gritsevich[2,3], D. Vinković[4,5], A. Cellino[6], M. Bertaina[7], S. Mönkölä[8], M. Moreno-Ibáñez[9], G. Nico[10], A. Nina[11], V. Srećković[11], S.T. Mitrović[12], [1]Technical University of Kosice, Department of Cybernetics and Artificial Intelligence, Slovakia (peter.butka@tuke.sk), [2]Department of Physics, University of Helsinki, Finland (maria.gritsevich@helsinki.fi), [3]Institute of Physics and Technology, Ural Federal University, Ekaterinburg, Russia, [4]Hipersfera d.o.o., Zagreb, Croatia, [6]Science and Society Synergy Institute, Cakovec, Croatia, [6]INAF - Torino astrophysical Observatory, Italy, [7]Physics Department, Torino University, Italy, [8]Department of Mathematical Information Technology, University of Jyväskylä, Finland, [9]Institute of Space Sciences (ICE, CSIC), Campus UAB, Carrer de Can Magrans, Barcelona, Spain, [10]Consiglio Nazionale delle Ricerche, Istituto per le Applicazioni del Calcolo (CNR-IAC), Bari, Italy, [11]Institute of Physics, University of Belgrade, Serbia, [12]University of Defense, Military Academy, Serbia.

Introduction: The cooperation of scientists in Big-Sky-Earth COST Action creates an emergent group of researchers with relation to meteor science. Big-Sky-Earth focuses on building a transdisciplinary network of researchers from area of astrophysics, geophysics, planetary science, and computer science, with the main ambition to support their collaboration in the new era of big data processing of data coming from new measurements and detection sites. Big-Sky-Earth offers an excellent platform for collaboration in order to develop novel approaches and techniques.

Selected cases: In this section we shortly describe selected cases of novel techniques related to observation and simulation of meteors, which emerged thanks to cooperation of researches in Big-Sky-Earth.

Detection of meteors from orbit and stratosphere. In the framework of the JEM-EUSO mission project and its precursors, including the Mini-Euso mission scheduled for launch in 2019, studies are being carried out in order to optimize the observation strategy [1] for the detection of bright meteors from ISS. The motion of the ISS can be exploited in some cases to reconstruct the 3-D trajectory of meteors. The activities also include attempts to put meteor detection cameras on the top of a new generation of rigid airships developed by Hipersphera (https://hipersfera.hr/). This would help in improving the observing conditions due to a higher altitude and changes in the observing location.

Detection of meteors in large sky surveys. A significant effort has been also put into detecting meteor streaks in images collected by large sky surveys. Modern sky surveys have large fields of view combined with a high resolution imaging, which turns them into a unique type of sensors for exploring meteor science, where the meteors heads are resolved (albeit defocused). Thanks to a large total observing time and sky coverage of such surveys, it is possible now to collect a significant number of meteors in their image databases. Big-Sky-Earth supported this research on SDSS images [2][3] and this initiative is also spread to the upcoming LSST (Large Synoptic Survey Telescope) survey.

Improved interpretation of meteor's parameters. To reliably interpret large amount of observational data generated by the fireball networks worldwide it is important to adequately account for the actual atmospheric conditions at the concurrent location and heights of a meteor. In [4] this problem is tackled by introducing atmospheric corrections into the model developed by Gritsevich [5]. Their approach can be inferred to produce better estimates of the meteor's characteristic parameters since it uses an improved representation of the atmospheric density. When applied to large data sets, the empirical atmosphere model can be employed to provide more reliable results. The method has already aided rapid recovery of the Annama meteorite based on observations by the Finnish Fireball Network.

Improved understanding of meteor radar reflections. Novel numerical methods are being used to test how the changes in the atmospheric conditions or shape or size of the meteor affect its radar reflections and to explain unexpected features in the measurements. The geometry of the meteor is presented as a rigid obstacle covered by non-magnetized plasma that is modeled as a Gaussian density distribution [6]. The computational model is based on partial differential equations of multiphysical wave equations and it is optimized for high performance.

Monitoring of the ELF/VLF/LF waves. New solutions are being implemented in tracking and analyzing event alerts that can be combined with alerts of meteor detection coming from the fireball networks. In particular, the dedicated instrument AWESOME (The Atmospheric Weather Electromagnetic System for Observation, Modeling, and Education receiver) can be used for the broadband ELF/VLF/LF waves monitoring. It consists of two magnetic antennas which collect broadband data set at the rate ∼32 GB per day.

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