

A VOEvent model for Meteors and TLEs Optical Detections

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Abstract

Atmospheric transient events are subject of observation and investigation of a growing community. Professional as well as amateur observation networks are established in Europe and abroad to collect data important not only for the scientific investigation of some physics processes but also to assess their possible impacts on Earth's environment. We propose here an implementation of the Virtual Observatory Event standard to the domain of meteors and Transient Luminous Events (TLEs). A well establish standard for real-time alert on those domains will facilitate coordination between networks and make easier the extraction of critical information, and will come along with improved collaboration between the amateur community and agencies (e.g. the ESA Fireball Database, or the CNES Taranis mission).

1. Introduction

Atmospheric transient events are observed and analyzed for space weather forecasting or for scientific research in an increasingly systematic way. In particular meteor and Transient Luminous Events (TLEs) have often been subject of paired optical observation campaigns, as both benefit from continuous sky monitoring and similar hardware installations.

Data provided by professional and amateur observers need to be compared, merged and archived. A well defined standard describing observation metadata is then necessary in order to efficiently process those data and enable real-time updates

2. VOEvents for atmospheric surveillance

VOEvent¹ is a standardized protocol developed to report observations of astronomical events. It has been

¹<http://www.ivoa.net/documents/VOEventTransport/20170320/REC-VTP-2.0-20170320.html>

officially adopted by the International Virtual Observatory Alliance (IVOA) in 2006. The VOEvent system is already used by several large-scale projects as the Gamma-Ray Coordinate System (GCN) [1], the Large Synoptic Survey Telescope (LSST), the European Low Frequency Array (LOFAR), or the Solar Dynamic Observatory (SDO). In the framework of the Planetary Space Weather Service (PSWS) of the Europlanet-H2020 Research Infrastructure (EPN2020RI) project [2], we propose to use VOEvent for atmospheric observations like meteors and TLEs.

2.1. Meteors

Several camera networks already exist in Europe and around the world, aiming to detect and triangulate shooting, compute the trajectory of the possible meteorite and constrain the orbital properties of the meteoroid. Professional and amateur networks (see e.g. [6], [3], [4], [8]... ..fill references...) working together will allow Europe to be completely independent in obtaining awareness about Earth space environment and existing risks connected to Space Weather. ESA Space Situational Awareness program (ref?) would benefit from having a common and standard framework for sharing information on meteor and fireball detections.

Example of meteor VOEvent here:
<https://gist.github.com/cmarmo/de5c0d5332444385ac0d4afc9a5dd92e>

2.2. TLEs

Transient Luminous Events (TLEs) are large-scale optical events occurring in the upper-atmosphere from the top of thunderclouds up to the ionosphere. They are sometimes accompanied by terrestrial gamma-ray flashes (TGFs). TLEs may have important effects in local, regional, and global scales of the atmosphere, but many features of TLEs are not fully understood yet (e.g. [7]). TARANIS (Tool for the Analysis of RAdiations from lightNIngs and Sprites) is a CNES satellite project dedicated to the study of impulsive transfers of energy between the Earth atmosphere and the

space environment (citation?) The Taranis microsatellite will fly over thousands of TLEs and TGFs for at least two years. Its scientific instruments will be capable of detecting these events and recording their luminous and radiative signatures, as well as the electromagnetic perturbations they set off in Earth's upper atmosphere. Coupling TLEs observation to the already existent meteor detection networks, will allow the observation of TLEs over unprecedented space and time scales [5], strongly increasing the probability of joint detection and hence the scientific return of space missions such as TARANIS and ASIM (ESA).

Example of the VOEvent here:

3. Summary and Perspectives

- We propose an implementation of TLE and meteor VOEvent
- We have validated VOEvent structure and validated in the EPN2020 PSWS infrastructure

Todo

- Implementation in FreeTure
- Providing support for amateur and professional networks willing to adopt the VOEvent scheme
- ...

Acknowledgements

This work benefits from support of VESPA/Europlanet. The Europlanet 2020 Research Infrastructure is funded by the European Union under the Horizon 2020 research and innovation program, grant agreement N.654208. This work is supported by the French Space Agency (CNES) through the satellite mission TARANIS and a Chair of Excellence to S.C. from 10/2012 to 09/2017.

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