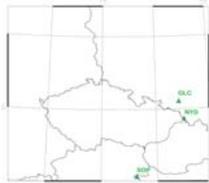


Optical observations of sprites supported by OST images



Anna Odzimek⁽¹⁾, Monika Pajek⁽²⁾, József Bór⁽³⁾, Piotr Struzik⁽²⁾, Petr Novak⁽⁴⁾
 Magdalena Mielniczek⁽⁵⁾ and Martin Popek⁽⁶⁾

- (1) Department of Atmospheric Physics, Institute of Geophysics PAS, Warsaw, Poland (aodzimek@igf.edu.pl)
- (2) Satellite Remote Sensing Centre, Institute of Meteorology and Water Management-National Research Institute (IMWM-PIB), Krakow, Poland
- (3) Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences HAS, Sopron, Hungary
- (4) Radar Department, Czech Hydrometeorological Institute (CHMI), Prague, Czech Republic
- (5) Gliwice, Poland (6) Nydek, Czech Republic

Optical observations of red sprites

- ❖ Transient Luminous Events (TLEs) are lightning discharges above thunderclouds. Red sprites are the most commonly observed TLE species, each lasting from a few to several tens of milliseconds, usually preceded by one or more positive cloud-to-ground (+CG) lightning flashes.
- ❖ TLEs are observed optically using low-light CCD cameras. Such observations are run from:
 - GLC - Gliwice, Poland (18.65 E, 50.28 N)
 - SOP - Sopron, Hungary (16.58 E, 46.68 N)
 - NYD - Nydek, Czech Republic (18.77 E, 49.67 N)
- ❖ Often in practice, near-real-time data available from lightning detection networks are used in order to direct cameras towards promising lightning activity.
- ❖ In large thunderstorm systems such as Mesoscale Convective Systems lightning activity may be spread and occur over different part of the system, making decision for camera direction ambiguous, especially if the angle of view is small, and also when there are more than one thunderstorms.

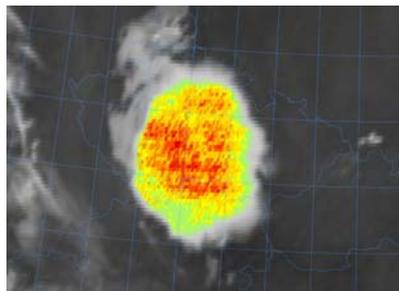
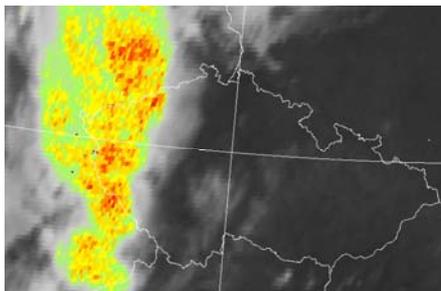
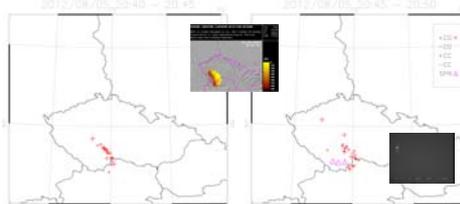
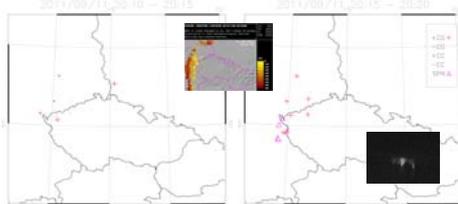
The satellite Overshooting Tops product (OST)

- ❖ Overshooting Tops (OST) are difference images based on satellite infrared imagery. An output image is the difference of brightness temperatures between two infrared spectral channels: WV (water vapour) 6,2 um and 10,8 um. This indicates thundercloud's overshooting top.
- OST : difference between WV 6,2 um and 10,8 um channels**
- ❖ Overshooting tops are indicative of powerful updrafts connected with severe weather. It is a dome-like protrusion that extends above the Cumulonimbus anvil, into the stratosphere. Overshooting tops locate the updraft near the top of the storm. So in the OST images it is clearly seen where the convective parts of the thunderstorm are, but also, in case of some large systems, if and where its stratiform part exists, above which the sprites may occur.
- ❖ Such OST images have been used to support TLE observations as a better indicator of where in the thunderstorm the sprite activity may occur. All delivered images have been prepared in the Satellite Remote Sensing Centre, IMWM-PIB, from current Meteosat imagery.

Case studies of sprite locations in relation to lightning and OST images details

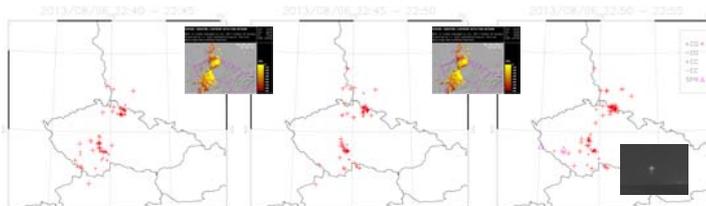
2011/09/11 20:10-20:20

2012/08/05 20:40-20:50

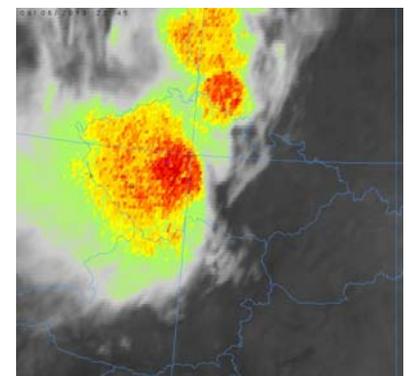


Plots of lightning activity, sprite locations (see legend) and corresponding OST images. Visualisation of lightning strokes other than +CG has been suppressed. In OST the locations of triangulated elements of sprites have been marked by dots (and letters).

2013/08/06 22:40-22:55



- ❖ We have selected three examples of case studies of the location of sprites in relation to lightning activity and the thunderstorm features in OST images.
- ❖ Location of sprites have been obtained by triangulation of at least two simultaneous observations.
- ❖ Lightning strokes detected by the CELDN system have been displayed in 5-min intervals preceding the sprite occurrence and when the sprite occurred.
- ❖ Lightning data from the CELDN system at 10-minute intervals, which are available for public at the CHMI web pages have also been shown, to compare to the selected data.



Conclusions

- ❖ Sprites often appear in less convective parts of thunderstorm system as also seen from the examples studied.
- ❖ OST images provide the convective structure of the thunderstorm therefore providing information on where sprites can occur whereas lightning activity can appear over other region of the thunderstorm.
- ❖ OST images are useful in observations of sprites.
- ❖ Combining information from lightning detection and OST can improve the efficiency of sprite observations.

The OST products were processed at IMWM-PIB from METEOSAT imagery under the EUMETSAT licence No. IMGW/LIC/MSG/10/06. Lightning strokes detected by CELDN system have been provided by CHMI.