Space and coordinated ground surveys of Transient Luminous Events

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After six years of preparation, FORMOSAT-2 (formerly the ROCSAT-2) satellite - the second satellite from Taiwan was successfully launched on 20 May 2004 from Vandenberg Air Force Base in California. FORMOSAT--2 carries two payloads onboard: the Remote Sensing Imager (RSI) to image the ground Earth, and the Imager of Sprites and Upper Atmospheric Lightning (ISUAL) to study the transient luminous phenomena. The ISUAL payload consists of an intensified CCD camera, a six-channel spectrophotometer and a red/blue band array photometer. With this set of instruments, ISUAL project seeks to determine the location and timing of upper atmospheric transient events above thunderstorms, to investigate their spatial, temporal and spectral properties, to obtain a global survey of upper atmospheric flashes, and to perform additional global surveys of auroras and airglows.

A typical ISUAL day of survey consists of 14 night orbits, but with the orbit over Taiwan setting aside for house keepings and calibrations. The available observation window for an orbit is around 25 minutes. For the first six months of operation, we devoted nearly 70 percent of time toward TLE survey. The detection rate of sprites and sprite halos was approximately two events per day. The detection rate of elves was surprising high with nearly seven events per day. Even more interestingly, more than 70% of elves were detected over oceanic regions. If one considers the cloud-to-ground lightning strokes rate over the land is ten times of that over oceans, the cause of this kind of land vs. ocean disparity certainly is truly intriguing.

In the first full year of observation, ISUAL has captured thousands of TLE events. In this talk, the global distributions of sprites, elves and jets will be presented. The correlation between TLEs and global lightning distributions will be examined. Comparisons of the occurrence rates for different types of TLEs between ground observation data and ISUAL data will also be presented. The newest findings from space-ground coordinated observation of TLEs will also be discussed. The NCKU team is supported in part by research grants from National Space program Office (94-NSPO(B)-ISUAL-FA09-01) and National Science Council (NSC93-2112-M-006-007, NSC93-2111-M-006-001) in Taiwan.

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