SPACE DEBRIS SYMPOSIUM (A6)
Mitigation and Standards (4)

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SATELLITE REENTRY PREDICTIONS FOR THE ITALIAN CIVIL PROTECTION AUTHORITIES

Abstract

In just five months, from September 2011 to January 2012, three campaigns of reentry predictions were carried out in support of the Italian civil protection authorities. The satellites involved were UARS, ROSAT and Fobos-Grunt, which received widespread attention for the marginal risk on the ground associated with their uncontrolled reentry.

From the technical point of view, the three reentry campaigns offered the occasion to compare some semi-empirical thermospheric density models under varying solar and geomagnetic activity conditions, dealing with spacecraft characterized by quite different configurations, shapes, masses and attitude control. However, what made the experience substantially different from usual reentry test campaigns was the strict interaction with the civil protection community and the public. In fact, in order to provide understandable and unambiguous information useful for civil protection planning and applications, the nominal reentry time predictions were of no use, while a particular care was devoted to the definition of appropriate reentry uncertainty windows.

The attention of the civil protection authorities was focused, of course, on the Italian territory, so the relevant question for any planning was the following: given a certain uncertainty window, where and when a fragment might have crossed the national airspace and hit the ground? In order to meet this demand, during the last three days of satellite residual lifetime, reentries where simulated over Italy to obtain quite accurate ground tracks, debris swaths and air space crossing time windows associated with the critical passes over the national territory still included in the current uncertainty window. This information was updated, if needed, but remained relatively stable and accurate until the reentry, not much affected by the actual trajectory evolution due to the varying air drag. In other words, it was easy to understand for people not familiar with orbital dynamics, unambiguous and remarkably stable, all qualities that made it very useful for civil protection applications.

This paper presents the work done, the information issued to the Italian authorities, the results obtained and the lesson learned during the three above mentioned campaigns. They might be of some help and offer useful insights on reentry predictions for civil protection applications if really dangerous space objects were to decay without control from orbit in the future.