South American perspective of the International Charter 'Space and Major Disasters'

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The International Charter 'Space and Major Disasters' is the first space-based operational initiative to provide fast and assured access to satellite data and services during emergencies caused by natural or technological disasters. The Charter concept was introduced at the last global space conference UNISPACE III in 1999, and now space agencies around the world make this concept a reality. ESA, CNES, BNSC/DMC for Europe, CSA for Canada, NOAA/USGS for U.S.A, ISRO for India, CONAE for Argentina and JAXA for Japan ensure the current participation in the Charter operations by supporting its functions and tasking their satellite resources for data and information delivery. The Charter is completing its 6th year of operations. It has already earned itself worldwide recognition as an effective mechanism of applying space technologies to disaster management at the local, national, and regional levels. The uniqueness of the Charter lies in a single point of contact and a coordinated approach to space supported disaster relief offered by the Charter members. Data acquisitions from multiple sensors, both passive and active, aboard the participating satellites are carried out with high planning priorities, and information products are delivered with short turnaround through pre-identified Authorized Users (AU), which are the national civil protection agencies and organization with similar mandates, to those dealing with the aftermath of disasters in the field. The overall process is managed by a specialist, called the Project Manager (PM), well versed in satellite remote sensing and data analysis, who is nominated from among the member space agencies and their associated staff.

As a further step in the evolving Charter operations, the PM function is being expanded to directly involve in disaster management the authorities of the affected country, which may not be a Charter member state, and a proposal to this effect is presently implemented for South America. This paper introduces the implementation of the proposal and the benefits it brings to both the Charter and the South American region, which has seen repeated Charter activations for floods, landslides, ocean storms, and volcanic eruptions. The latter disaster type is of particular interest to the region and is used as an example to illustrate the operational system functions and satellite data derived products that were generated for the Etna eruption in July 2001, Nyiragono in January 2002, Stromboli in April 2003, Montserrat in July 2003, Galeras in August

2004, and Comoros in December 2005.

The first Charter activation over a volcanic event took place on July 26, 2001, at the behest of the Italian Civil Protection to monitor the Etna eruption. Optical images from SPOT and LANDSAT and SAR images from ERS-2 and RADARSAT-1 were processed for volcanic plume, thermal mapping, and differential interferometry to detect ground deformation. As in many other cases of the Charter coverage, routine monitoring of active volcanoes is believed to provide the critical benchmarks for assessing the effects of a disaster occurrence.

Next, the Charter was activated on January 21, 2002, by the Belgian Civil Protection, when the Nyiragongo volcano in the Democratic Republic of Congo erupted and threatened the city of Goma. Four Charter satellites, namely SPOT-2, SPOT-4, ERS-2 and RADARSAT-1, were tasked, but only RADARSAT-1 data were used for lava flow mapping because of the unacceptable levels of cloud cover in the optical imagery and some Doppler effects in the ERS data. Nonetheless, the optical and the ERS tandem mission data were used for image rectifications and for preparing the base maps. Experience has shown that even raw radar images could be used for lava flow delineation because of the sensitivity of radar brightness to the state of lava solidification and moisture.

In the case of the Stromboli volcanic eruption, the request for change detection maps was received from the Italian Civil Protection by the Charter on-duty staff on April 9, 2003. The request was acted upon immediately and congruent archive and new SPOT-2, -4 and -5, RADARSAT-1, and ERS-2 datasets were acquired. The ASAR image data from the then newly launched European ENVISAT satellite were also obtained. The change detection maps prepared with the orthorectified SPOT and RADARSAT-1 colour composites revealed the breach of the old crater wall and the lava flows on the northern slopes. All the new lava strips could be accurately traced on the post-eruptive Fine mode RADARSAT-1 image products.

The Charter was activated on July 18, 2003, on the request of the U.K. Department for International Development. The object of the Charter intervention was to produce for the end users in the Montserrat Volcano Observatory (MVO) and the Environmental Systems Science Centre of the University of Reading a new elevation model (DEM) to describe the changed topography of the volcano system following a series of eruptions in July 2003. A RADARSAT-1 multi-date colour-coded composite of the 1997 eruptive event was used to show the significant changes in radar image tone that can be induced by these accumulations. Consequently, for the purpose of this Charter activation the DEM was generated by radargrammetric (radar stereo) technique and Standard mode RADARSAT-1 images were used. The end users found the DEM re-

sults beneficial in enabling to calculate the volume of volcanic collapse as a result of the eruption. Moreover, additional mapping products, consisting of orthorectified radar imagery acquired soon after the eruption, provided the users with some indications of the changing crater structure.

On August 11, 2004, the Galeras volcano erupted in a column of ash and gas. The Charter was activated by the Argentinean AU to assist the national geological staff with the monitoring of this eruption. The event was managed by means of four RADARSAT-1 images acquired on both ascending and descending orbits in Standard 1, 2 and 6 beam modes. One of these was an archive image of May 1999 and the others were newly acquired images postdating the disaster. The images were co-registered using the August 27 acquisition. The 1999 RADARSAT-1 archive image and the Landsat TM mosaic of 1985/95 were used as reference for image interpretation and change detection. By stacking the 1999 RADARSAT-1 image with the newly acquired images, surface changes due to ash deposits could be highlighted. The RADARSAT-1 images also highlighted the fact that the volcanic activity led to the formation of many fissures in the main crater and on the active cone. Layover and foreshortening did hamper image co-registration, however, the radar image analysis helped in accentuating the topographic contrasts around the crater area, and along with the Landsat mosaic, landscape visualization for use by the local authorities was made possible.

The Charter was activated on the December 1, 2005, by the UN Office for Outer Space Affairs (OOSA) acting as the Charter Co-operating Body on the request of UNOCHA, UNDP (Resident Coordinator) and the French Red Cross following the eruption of Karthala volcano in the Comoros. Mount Karthala sent out clouds of ash and flying sparks, leaving the capital Moroni and other villages on the main island of Grande Comore covered in grey dust. There were concerns regarding the availability of drinking water in the areas exposed to smoke and ash. Earlier the Comorian government had also requested for assistance in the absence of means to monitor the disaster by air and because of ground inaccessibility. Five Charter satellites were tasked, namely IRS, NOAA, RADARSAT-1, SPOT-4 and SPOT-5. Change detection products were generated to create damage assessment maps from the before and the after event RADARSAT-1 and SPOT images.

In addition to these products on slides, some 3-D animated models of the disaster sites prepared with satellite data are also displayed in the paper presentation.