ROBUST SATELLITE TECHNIQUES FOR THERMAL VOLCANIC ACTIVITY MONITORING, EARLY WARNING AND POSSIBLE PREDICTION OF NEW ERUPTIVE EVENTS

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1. INTRODUCTION

In the world there are more than 1500 active volcanoes, many of them are located in very remote areas where no ground based devices are generally available in operational way. Even in well monitored volcanic areas, traditional monitoring system are often inadequate to follow large scale and rapid space-time volcanic phenomena. Furthermore, is not uncommon that geophysical devices are destroyed by the same phenomena that should be monitored. Since volcanoes pose a serious threat for both local resident and infrastructures in the surrounding areas, as well as for the air traffic, reliable monitoring system are then required. Satellite remote sensing, thanks to several satellite platforms orbiting around Earth, providing data at anywhere with high observational frequency at generally low costs, may offer a valid contribute to volcano monitoring and surveillance [1]. Among the several satellite techniques for thermal volcanic activity monitoring up to now proposed, generally based on the use of single images and on detection algorithm at fixed thresholds applied everywhere in any observational condition, an innovative multitemporal approach, named RST (Robust Satellite Techniques), proposed some years ago, has shown high performances in detecting volcanic hotspots [1].This approach compares every thermal signal measured by satellite with its normal behaviour, determined processing homogeneous and historical satellite records in the space time domain. A local variation index named ALICE (*Absolutely LLocal Index of The Change of Environment*) is then computed at pixel level in order to identify possible volcanic hotspots [1],[2]. RST approach was successfully used to study volcanoes located in different geographic areas, such as Mount Etna (Italy), Merapi (Indonesia), Rabaul (Papua New Guinea), etc., thanks to its native exportability and easy implementation on different satellite platforms, offering a high reliability in different observational, environmental and atmospheric conditions [3]-[6]. More recently, an automatic and fully operational satellite monitoring system has been implemented at IMAA (*Institute of Methodologies for Environmental Analysis*) to monitor Italian volcanoes in real time, using both NOAA-AVHRR (National Oceanic and Atmospheric Administration -Advanced Very High Resolution Radiometer) and EOS-MODIS (Earth Observing System–Moderate Resolution Imaging Spectraradiometer) data, directly acquired by primary receiving systems [3]-[5].This automatic system is capable of generating, within a few minute after the sensing time, text alert files, which report the relative intensity and geographic location of detected hotspots, thermal anomalies maps, and *kml* files which provide

a quick visualization of the volcanic thermal anomalies on a common and standard platform, like Google Earth. Besides the detection and monitoring capabilities, the RST approach has even demonstrated a good sensitivity toward low intensity hotspots which may sometime announce impending eruptions. Low level hotspots were, in fact, identified by RST few days before the Mt.Etna eruption of 27 October 2002 [1], and recent studies have shown that possible thermal precursors were even detected before the Asamayama (Japan) eruption of 1 September 2004. In this paper, the RST performances in monitoring volcanoes will be further analyzed showing some recent results provided by the satellite monitoring system developed at IMAA. Moreover, the RST capability in identifying even possible thermal precursors of eruptive events will be further discussed, evaluating advantage expected by RST implementation on current geostationary satellites, like MSG-SEVIRI. Thanks to the best revisiting time today available (15 minutes), to a higher signal-to-noise ratio compared to polar satellites, SEVIRI should increase RST sensitivity towards low intensity hotspots, resulting suitable in promptly identifying abrupt changes in thermal signals, in presence of volcano unrest, for early warning purposes.

2. RESULTS

Starting from the middle of May 2008 a new volcanic eruption is occurring at Mount Etna (Italy), at time of writing. This eruption is continuously monitored by the automatic satellite system developed at IMAA processing both AVHRR and MODIS data. The RST products, generated within 6 minutes the sensing time, are available on line at web site *http://www.unibas.it/geospazioitalia/download.html*. This monitoring system is allowing us to follow the space-time evolution of the emitted lava flow at Mt.Etna, without generating false alarms. As previously described, RST approach offers a high potential towards low intensity hotspots. Low level thermal signals have been detected over Asamayama volcano (Japan), analyzing AVHRR and MODIS data, about one month before the strong eruption of 1 September 2004. This study is particularly interesting considering that Asamayama volcano had 21 years of quiescence, and for Mount Etna possible thermal precursors were observed just few days before a new volcanic eruption [1]. The implementation of RST approach on SEVIRI sensor shows like the strong and destructive volcanic eruption of Jebel Al Tair (a volcanic island located between Yemen and Eritrea) of 30 September 2007 was promptly detected by RST. This preliminarily results confirms that SEVIRI sensor may be successfully used for early warning purposes, within a reliable operational monitoring system RST based.

3. REFERENCES

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