

May 2009

Executive Summary

The Supersite initiative began with the "***Frascati declaration***" at the conclusion of the 3rd International Geohazards workshop of the Group of Earth Observation (GEO), held in November 2007 in Frascati, Italy. The recommendation is "*to stimulate an international effort to monitor and study selected reference sites by establishing open access to relevant datasets according to GEO principles to foster the collaboration between all various partners and end-users*". This recommendation is formalized as GEO task DI-09-010.

The particular objectives of this project are:

- 1). To provide ESA SAR data for the Supersites to the International geohazards community. Simplified access to SAR data for selected sites via the Internet will stimulate fundamental research and comparative studies and lead to new insights about earthquake and volcanic processes. In the first, initial stage of the Supersite program there are four earthquake sites (Tokyo, Vancouver/Seattle, Los Angeles and Istanbul) and three volcano sites (Mt. Etna, Vesuvius/Campi Flegreii and Hawaii).
- 2). To test ESA's new 'Virtual Archive' for centralized SAR data storage and distribution for geohazards applications. The demand on data in case of a severe earthquake or a severe volcanic eruption can be very high. ESA's "Virtual Archive" seems to be capable to fulfill the requirements of distributing very large data sets (multiple tens of GB) to a large user community (several hundred scientists) with minimum time delay (seconds). Preliminary tests show that download times of as fast as 3 seconds for one Envisat scene (150 MB) can be achieved .

Team composition

The PI of the project is Jose Achache, Director, GEO Secretariat (Group of Earth Observation). GEO is a voluntary partnership of governments and organizations involved in Earth Observations. As of March 2009, GEO's Members include 77 Governments and the European Commission. In addition, there are 56 intergovernmental, international, and regional participating organizations including the European Space Agency (ESA) and the Committee on Earth Observation Satellites (CEOS).

The Co-PI's are scientists participating in the International Geohazard Community. Initial Co-PI's include participants of the international Geohazard workshop held November 11-14 2008 in Naples, Italy (Use or Remote Sensing Technology for Monitoring Volcanoes and Seismogenic areas). Co-PIs will be named and added during the course of this project, initially at the discretion of ESA and eventually through a Mini Cat-1 process organized by the successor of the now defunct IGOS Geohazards Bureau. The Co-PIs include Prof. Falk Amelung, University of Miami, the Chair of the WinSAR consortium, an international consortium of Universities and research organizations using SAR for geohazards research. Co-PI Amelung

represents the Geohazard community in the Co-PI selection process.

Innovation

This project is innovative because it provides for the first time seamless access to full SAR data sets for the selected geohazards sites (referred to as Supersites). Although full datasets are in principle available, most research groups used only limited data sets with detrimental effects on the research enterprise (ancient data are archived in obsolete formats on tapes or CDs incompatible with modern computing environments). ESA's new "Virtual Archive" is a high-performing data archive and distributions system with download times of a few minutes for data sets of several 100 SAR images. This Virtual Archive relieves the user from the burden of data archiving and represents a quantum leap forward for the infrastructure of scientific research.

Contribution to Mission Objectives

This project contributes directly to Envisat's mission objective "to better understand solid Earth processes". Simplified access to SAR data for geohazards sites will stimulate comparative research and lead to a better understanding of earthquake and volcanic processes.

The new "Virtual Archive" will be a critical element to accomplish ESA's core mission of providing long-term, continuous Earth Observation data sets for scientific research. It can satisfy ESA's future requirement of daily distributing 10 TB data to the user community (Sentinel).

Detailed Description

The Supersite concept is to facilitate access to space and in-situ data for regional areas exposed to geological threats. The principal objective is to encourage basic research of earthquake, volcano and other hazardous geological processes to reduce the loss of life in geological disasters. The initiative begins in Phase 1 with 7 ad-hoc selected SuperSites, three of them for volcano research (Vesuvius/Phlegrean fields, Mt. Etna, Hawaii volcanoes) and four for earthquake research (Istanbul, Tokyo, Los Angeles). The Supersites meet at least one of the following criteria:

- populations are exposed to geological threats.
- an event is expected to occur in the near future.
- an appropriate place to stimulate basic research (earthquakes, volcanoes, landslides, relative sea-level rise).

The purpose of this proposal is to provide ESA's SAR data for the Supersites. The Phase 1 Supersites have been selected at the second workshop on the Use of Remote Sensing Techniques for the Monitoring of Volcanoes and Seismogenic areas (USERest) held in November 2008 in Naples, Italy. The objective of the Supersite selection was not only to stimulate basic research but also to jumpstart the initiative by user contributions. National geophysical and geological surveys such as Italy's Istituto Nazionale di Geofisica and Vulcanologia (INGV) and the U.S. Geological Survey (USGS) have already agreed to provide the corresponding ground based data (continuous GPS and seismic data). An initial list of voluntary contributors to the Supersite initiative is given in Appendix A. It is anticipated that the Japanese Space Exploration Agency (JAXA) and

the Canadian Space Agency (CSA) will join the program in the near future.

As a participating organization of GEO, ESA provides with its new "Virtual Archive" the infrastructure for the SAR aspects of the Supersite program. The "Virtual Archive" is a high-performance data portal linked to the EOLI-SA catalogue. Preliminary testing suggest download times of 10 seconds for one Envisat SAR image (150 MB) from a typical University computer and of as little as 3 seconds from a computers more closely connected to the Internet backbone.

Example: The 2009 L'Aquila, Italy earthquake.

The magnitude M6.3 L'Aquila, Italy earthquake of April 6, 2009 illustrates the need for Supersites (in this case for a global earthquake Supersite in discussion for Phase 2) and highlights the benefits of ESA's new "Virtual Archive" data portal. The L'Aquila earthquake occurred the day prior to this writing and was the most disastrous and deadly earthquake in Italy for the past 30 years (~220 casualties). Rapid access to SAR data of the epicentral region is paramount because InSAR can provide an independent assessment of the size, location and type of the earthquake, and of the tectonic strain accumulation in the region. This information is critical to better assess the earthquake risk of the region, in particular the likelihood that this earthquake was only a precursor to a much larger earthquake.

ESA is using a prototype version of the new "Virtual Archive" to distribute the L'Aquila imagery to the user community. About 7 GB of pre-earthquake imagery is already available and was downloaded to a Miami computer in as little as 12 minutes. All new data (about 8 orbit/cycle) will be posted immediately after image acquisition to the Virtual Archive for convenient access by the community. The broad distribution of the SAR data will lead to multiple, independent studies of the earthquake and of the Abruzzo region, and ultimately will lead to a better understanding of the seismogenic processes and earthquake hazard in this region.

Schedule

April 2009. Start of project. Data download from ESA's "Virtual Archive" catalogue operational for Phase 1 Supersites described below.

November 2009. Formalization of Supersite project with the successor to IGOS Geohazard at the ALOS meeting in Hawaii. Depending on success of Phase 1 consider to broaden the scope of project to Phase 2 Supersites.

Data requirements

Phase 1: Selected Supersites: Vesuvius/Campi Flegreii, Italy; Etna, Italy; Hawaii, USA; Istanbul, Turkey; Los Angeles, USA; Tokyo, Japan; Vancouver/Seattle, Canada/USA .

Phase 2: Supersite Candidates Iceland Sakurajima, Miyake-Jiima, Galapagos volcanoes, Piton de la Fournaise, Yellowstone, Mt Cameroon, Nyiragongo, Canary Islands, Teheran, Gulf of Corinth, Earthquake Supersites (all Disaster Charter earthquakes)

To achieve the project objective of stimulating scientific research it is imperative that for all Supersites complete data sets are available (all

archived and new ascending and descending acquisitions). Scientists conducting Supersite research will rely on the Supersite program for complete SAR data sets.

Near-real time data requirement

The geohazard research community is expected to develop automated, deformation monitoring programs and products for the volcano supersites. NRT data will encourage the development of such processing chains. A broad variety of deformation products produced by various group will in turn lead to a acceptance of these data products by the volcano observatories. All geophysical monitoring methods went through a similar transition from experimental to a standard data product.

Appendix A -- Community contributions to Supersite initiative

Informal agreements at USEReST workshop, November 2008, Naples, Italy.

Dzurisin, USGS	Hawaii SAR data
Sansosti, IREA Naples	Etna and Vesuvius ERS/Envisat data
Unavco/WinSAR	Data repatriation and renaming services
Unavco	host SuperSite GPS data if necessary
Amelung, U Miami (CSTARS)	Galapagos SAR data
Jonsson, U Zurich (ETH)	Iceland SAR data
Sigmundsson, U Iceland, Reykjavik	Iceland SAR data
Dixon, U Miami	Iceland GPS data (raw data plus velocity field)
Fernandez, CSIC-U Madrid	SAR, GPS, gravity, crustal structure for Canary Islands
Fernandez, CSIC-U Madrid	Organize Supersite workshop in Canary islands
Ganas, National Observatory, Athens	GPS for Gulf of Corinth, Greece
Briole, ENS Paris	SAR and GPS data for Gulf of Corinth, Greece
Martini, INGV Napoli	ground-based data for Vesuvius/C.F.
Sansosti and Lanari, IREA Napoli	SBAS displacement time series
Tim Wright, U Leeds	Dragon Project data (~2000 scenes/year)
Eric Fielding, JPL	Atmospheric models for California, UAV SAR data
Frank Marzano, U Sapienza Roma	Atmospheric Models for Etna/Vesuvius-Campi Flegreii
Puglisi, INGV Napoli	GPS data from Etna (raw data + daily solutions)
Puglisi, INGV Napoli	Organize Supersite workshop at Mt Etna.
Borgstrom, INGV Napoli	Lnks to WoVo data for SuperSites
Amelung, U Miami	Geodetic modelling software (geodmod)
Calais, U Purdue	East African Rift GPS (Campaign and continuous)
Walter, Motagh, GFZ Potsdam	SAR data for Turkey, Teheran
Walter, GFZ Potsdam	Link to EU FP7 project "Next generation seismic and
multihazard in-situ observatories"	
Pritchard, U Cornell	South America Subduction zone SAR data
Unavco/WinSAR	multi-satellite SAR data for Western North America
Salvi, INGV Rome	Italy SAR data (about 70 % of existing ESA archive)
NASA/NSF	funding for Unavco/WinSAR