GEO EUROPEAN PROJECTS' WORKSHOP-7

Barcelona
15-16 April 2013

GEO GROUP ON EARTH OBSERVATIONS

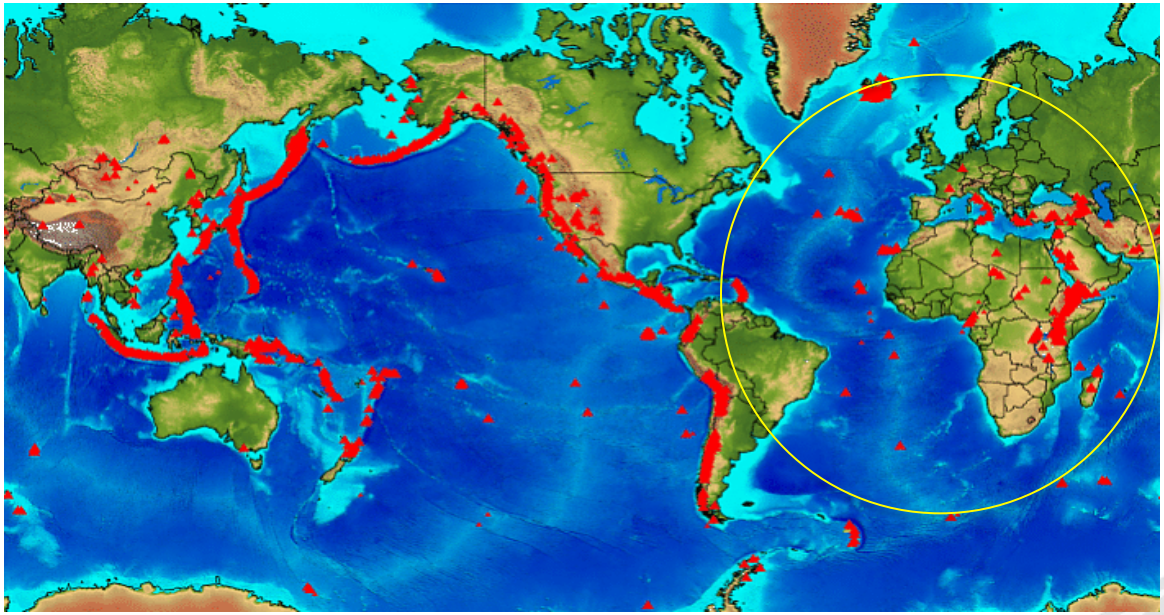
Spaceborne, Real-time, Multi-parameter Synoptical Monitoring of Erupting Volcanoes at Continental Scale: Concepts and Demonstration

Fabrizio Ferrucci (IPG Paris)

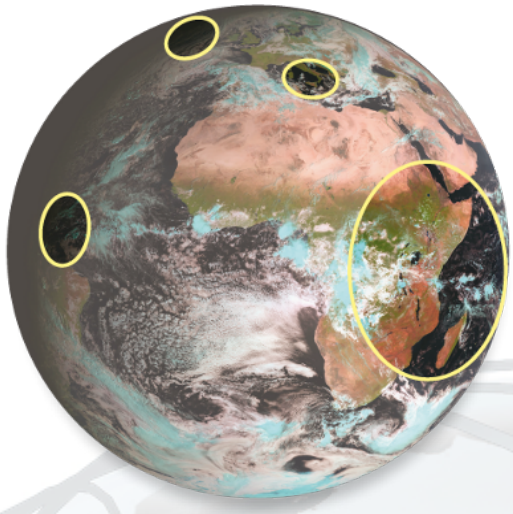
GeoViQua GRUMETS UAB CREAF MIRAMON

on ground

~ 1,500 volcanoes erupted in the last 12,000 yr (Holocene)
~ 700 volcanoes erupted at least once in historical times
> 600 have no permanent monitoring or no monitoring at all



From: Global Volcanism Program http://volcano.si.edu/world/find_regions.cfm



The current EVOSS playground

in the atmosphere

ICAO (International Civil Aviation Organization) Volcanic Ash Contingency Plan :

-**ALERTING PHASE** "The initial response commences when a volcanic eruption is expected…." Action: **a "Danger Area" is declared by NOTAM around the volcanic source**

-**REACTIVE PHASE** "The Reactive Phase commences at the outbreak of the volcanic eruption and release of volcanic ash …" Action: **a "Start of Eruption SIGMET" notice is released**

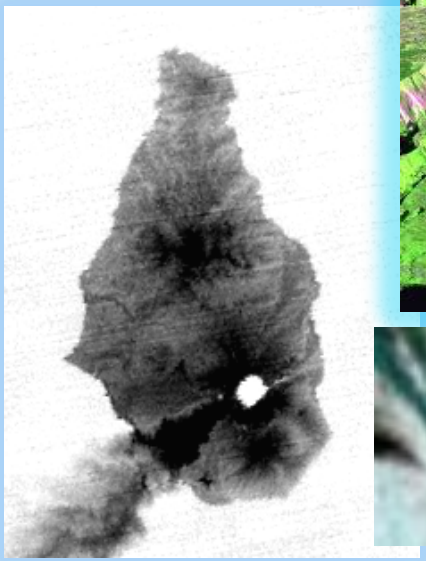
These concepts are the backbone of evoss

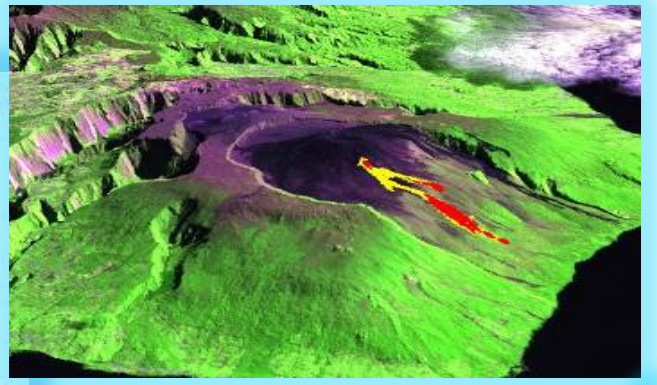
European Volcano Observatory Space Services

A worldwide, spaceborne monitoring service for real-time,
Volcano Crisis Management and support to Volcanic Ash avoidance

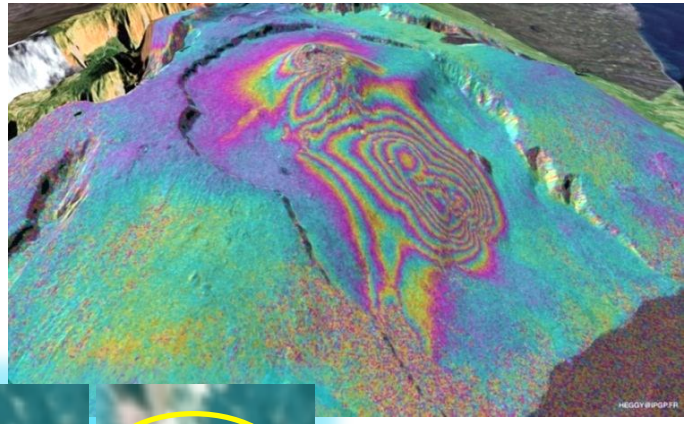
aeronomie.be booz&co. BGS 1835 KNMI IES IPGP INSTITUT DE PHYSIQUE DU GLOBE DE PARIS s[&]t dependable solutions TRE DLR OHB CGS ULB Università degli Studi di Roma CENTRO di RICERCA PROGETTO SAN MARCO "La Sapienza"

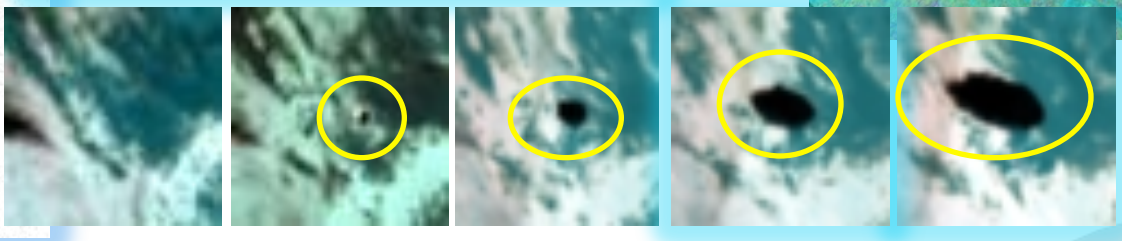
GeoViQua GRUMETS UAB CREAF AGAUR MIRAMON



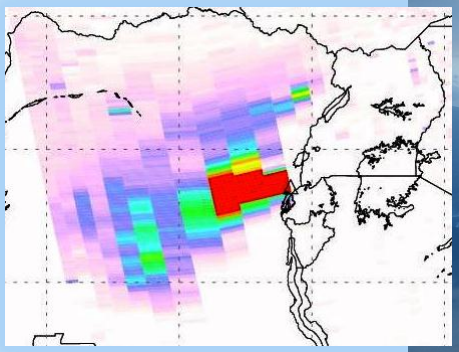


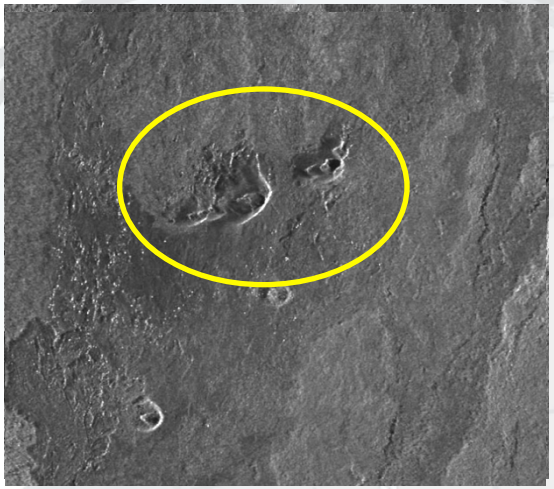
High-Temperature volcanic features





Volume change and pattern recognition





European Volcano Observatory Space Services

GMES-Space Grant Agreement no. 242535 (2010–2013)

evoss
European Volcano Observatory Space Services

Based on IR / UV satellite payloads SEVIRI, MODIS, IASI, OMI, GOME-2

- ✓ Real-time (15 minutes + twice daily), detection, location and quantitative evaluation of **Thermal Anomalies associated to Magma at surface** at any volcano in the current area of operation (***High-Temperature Anomaly Service***)
- ✓ Real time (15 minutes) detection, location, mapping and quantitative monitoring of **Volcanic Ash plumes** (***Volcanic Ash Service***), in co-operation with EUMETSAT
- ✓ Near-Realtime (> 3 times daily) detection, mapping and quantitative evaluation of **Anomalous SO_2 concentrations** at and around any volcano in the current area of operation (***SO_2 Service***)

Based on SAR satellite payloads COSMO-SkyMed and/or Radarsat, TerraSAR-X

- ✓ Delay-time **Volcanic Pattern change detection and Volume Change estimate** by spaceborne SAR observation (***Ground Deformation Service***)

GEPW-7
Barcelona 15-16 April 2013

42 Eruptions dealt with by EVOSS (2010-2013)

• **Nyamulagira (Congo) :**	Eruption	January 2 to 29, 2010
• **Soufriere Hills (Montserrat) :**	Pyroclastic flow on	February 11, 2010
• **Eyjafjallajökull (Iceland) :**	Eruption	March 20, 2010
• **Manda Hararo (Ethiopia) :**	Eruption	March 21, 2010
• **Piton de la Fournaise (Reunion) :**	Eruption	October 14, 2010
•	Eruption on:	December 9, 2010
• **Etna (Italy) :**	Eruptions on:	January 12, 2011
•	«	April 9, May 11, 2011
• **Grimsvötn (Iceland) :**	Eruption	May 24, 2011

Thermal – tests and operation

• **Nabro (Eritrea) :**	Eruption	**June 12 to July 17, 2011** (first tests)
• **Nyiragongo (Congo) :**	Lava lake - permanent	**since June 2011** (SEVIRI operation tests)
• **Erta Ale :**	Lava lake - permanent	**since June 2011** (MODIS operation tests
• **Etna (Italy) :**	Eruptions on:	**July 9–19–25–30, 2011**
	«	**August 5–12–20–29, 2011**

QuantitativeThermal and SO2 - online

• **Etna (Italy) :**	Eruptions on:	**September 8–19–29, Oct. 8-23, 2011**
• **Nyamulagira (Congo) :**	Eruption	**November 6, 2011 to March 15, 2012**
• **Etna (Italy) :**	Eruptions on:	**November 15, 2011**
	«	**January 3, 2012**
+ *Quantitative Ash Retrieval - online*	«	**February 6, 2012**

• **Etna (Italy) :**	Eruptions on:	**March 4-18 , 2012**
	«	**April 1-12-24, 2012**
	«	**February 2-19-20-21-22-28, 2013**
	«	**March 4, 16-17; April 3, 11-12, 2013**
• **Stromboli (Italy):**	Eruption	**July 6, 2012 and January 19, 2013**
• **Soufriere Hills (Montserrat) :**	Unrest	**from August 6, 2012**

FROM THE VIRTUAL VOLCANO OBSERVATORY

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European Volcano Observatory Space Services

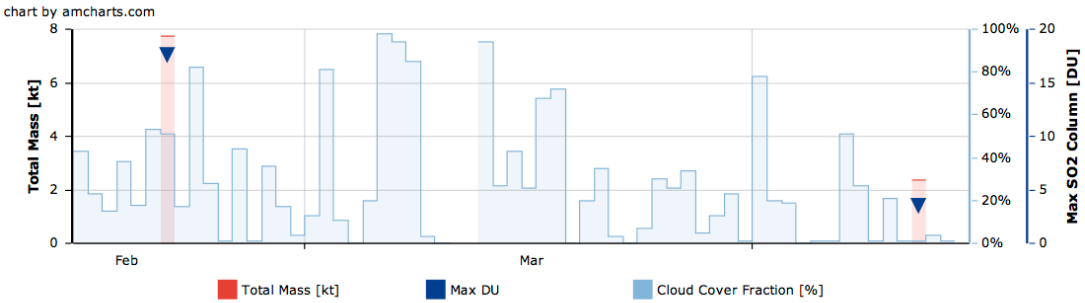
Catalogue Search | Virtual Map | Multitemporal Analysis | Anomaly Notification

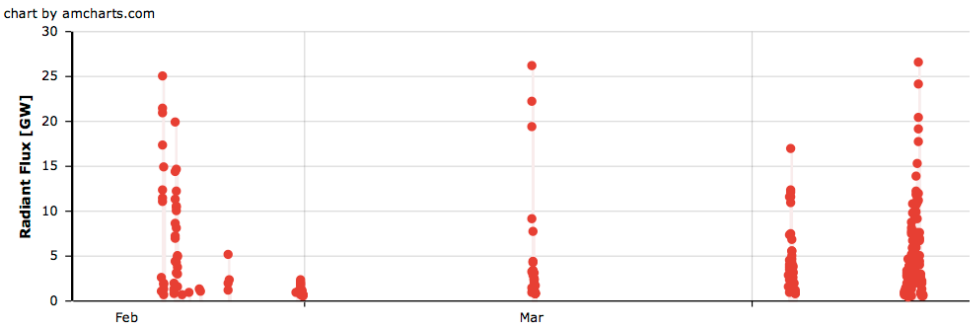
Select an area of interest: Etna
Select chart type: Radiant Flux and SO2 from GOME-2
Select a named time period: Last two months
From:
Till:

< Generate >

Etna (Italy)

SO_2 Total Mass @15km (GOME-2) vs High Refresh Rate Hot Spot Radiant Flux (SEVIRI)





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Catalogue Search | Virtual Map | Multitemporal Analysis | Anomaly Notification

Select an area of interest: Etna
Select chart type: Radiant Flux and SO2 from GOME-2
Select a named time period: User defined time period
From: 2013-04-11
Till: 2013-04-13

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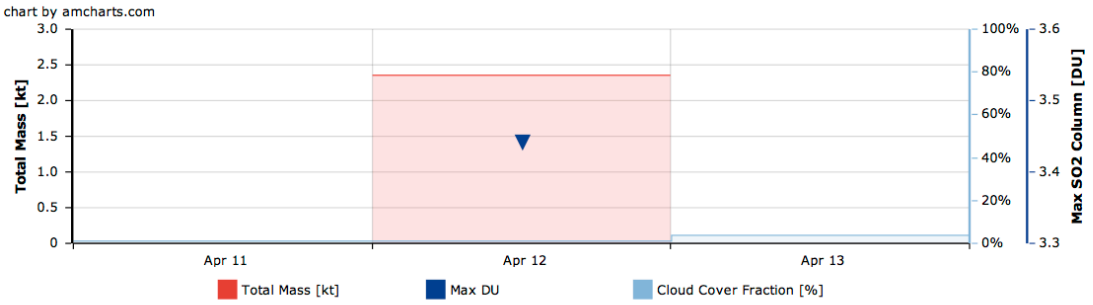
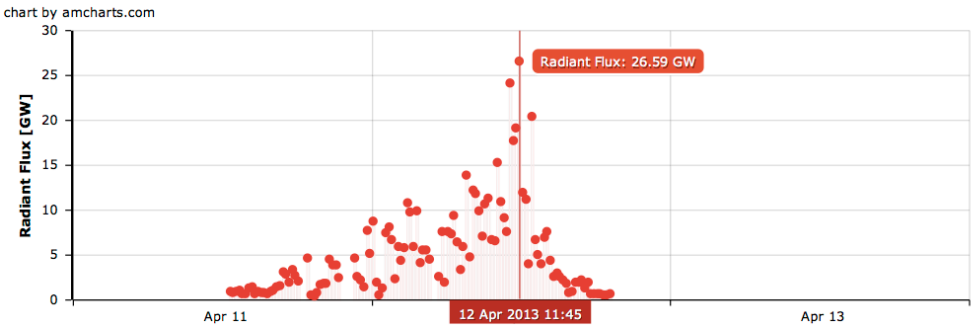
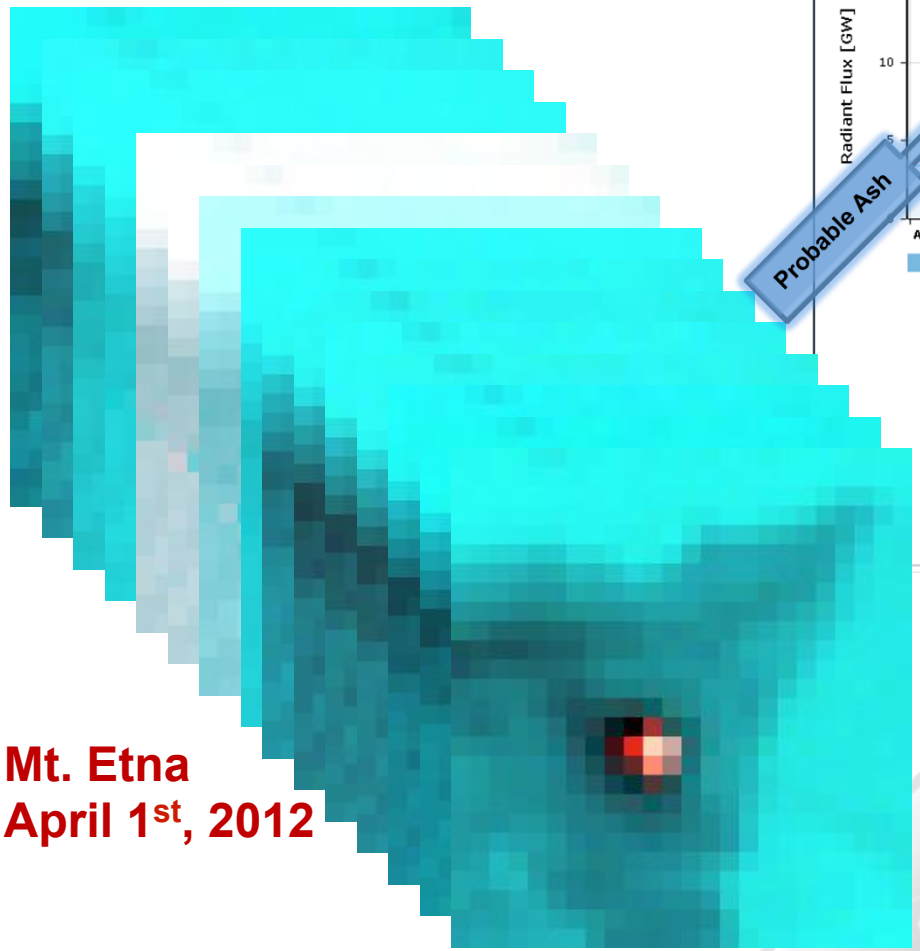
Etna (Italy)

SO_2 Total Mass @15km (GOME-2) vs High Refresh Rate Hot Spot Radiant Flux (SEVIRI)

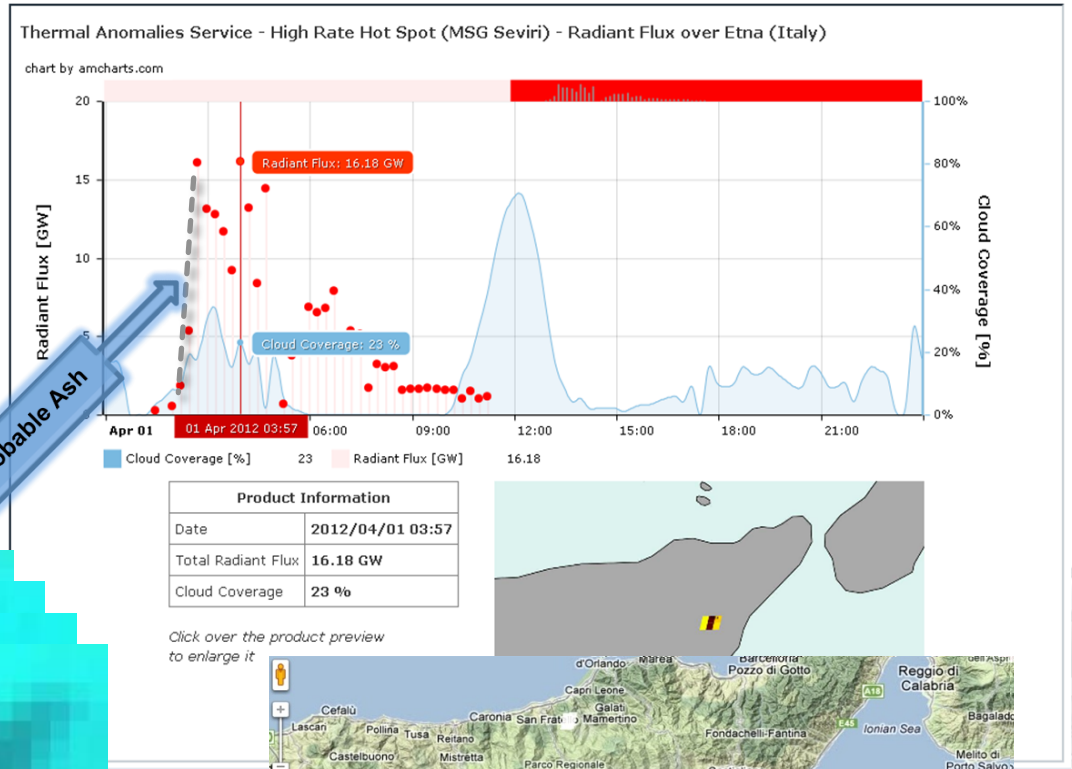




INTEGRATED EVOSS (SEVIRI) THERMAL-AND-ASH SERVICE

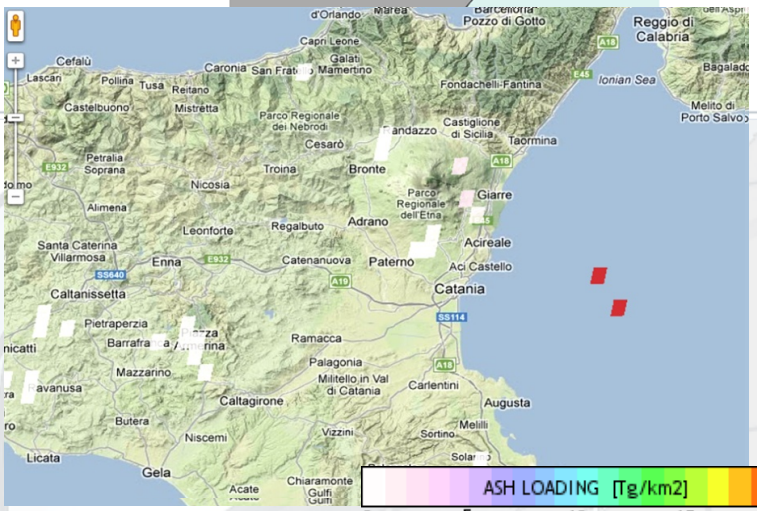


Mt. Etna
April 1st, 2012



Product Information	
Date	2012/04/01 03:57
Total Radiant Flux	16.18 GW
Cloud Coverage	23 %

Click over the product preview to enlarge it



FROM THE VIRTUAL VOLCANO OBSERVATORY

Catalogue Search | Virtual Map | Multitemporal Analysis | Anomaly Notification

Select an area of interest: Nyiragongo-Nyamuragira

Select chart type: Radiant Flux and SO2 from GOME-2

Select a named time period: User defined time period

From: 2011-11-04

Till: 2011-12-03

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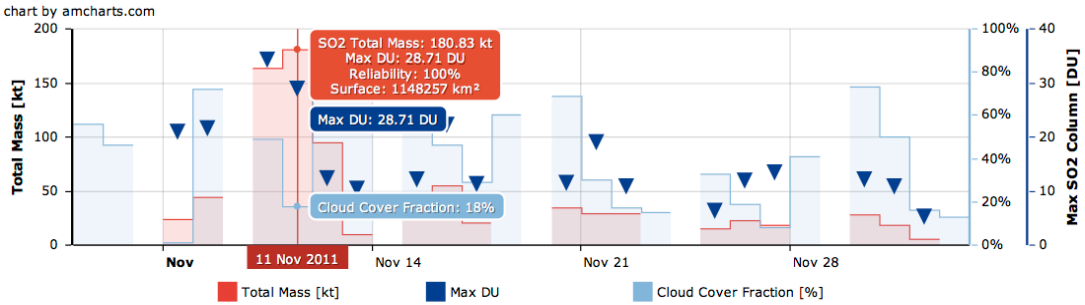
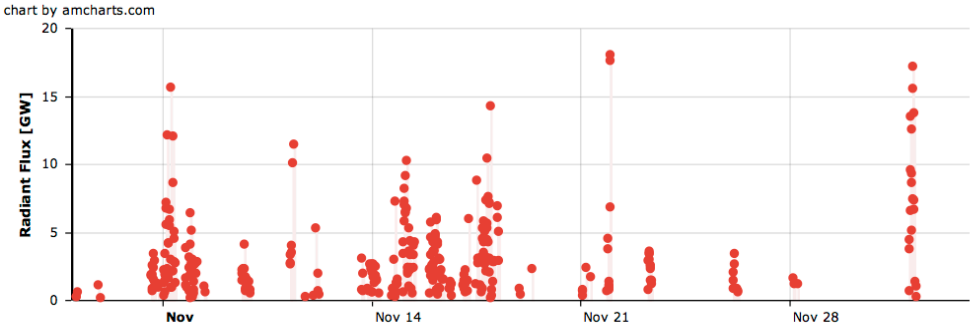
Nyiragongo - Nyamuragira (Congo)

SO_2 Total Mass @15km (GOME-2) vs High Refresh Rate Hot Spot Radiant Flux (SEVIRI)





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< Generate >

Nyiragongo - Nyamuragira (Congo)

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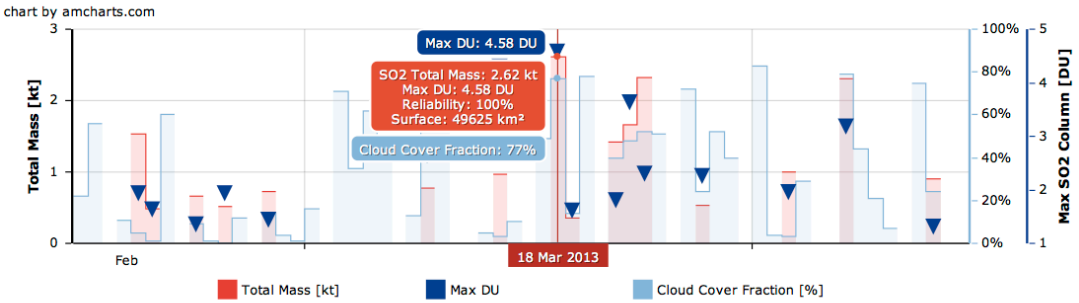
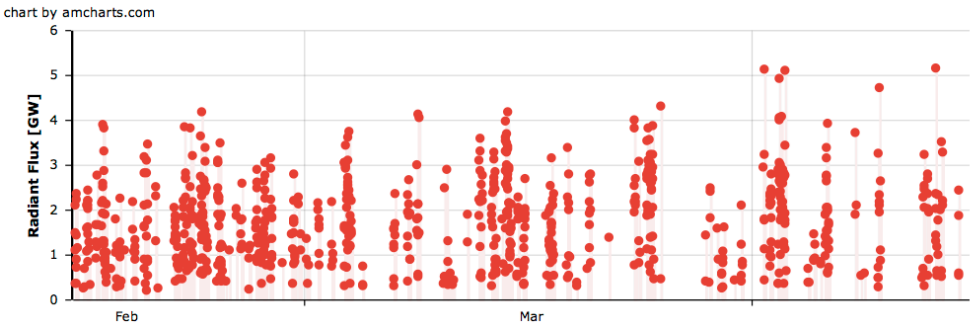


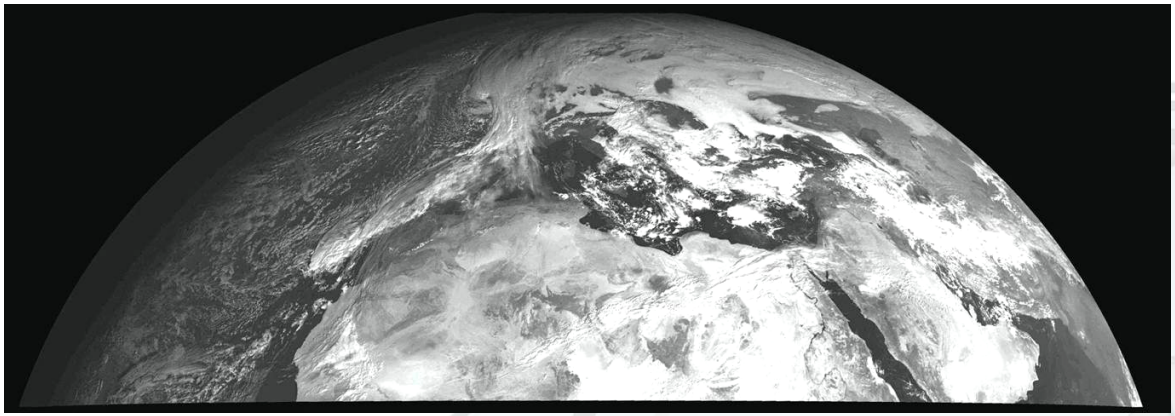


EVOSS STATUS AND TIMELINE

Research : Technical components **completed** in 2011 – Volcanological research continues on huge archives of thermal, gas, ash, ground deformation data

Success : **93%** (41 eruption detected and monitored automatically and in real-time vs. 44 occurred in the Region of Interest – *Note*: two of the three missing were underwater; the third, a minor intra-crater event at Mt.Etna)

Improvements : based on **new evidence** from research, or to exploit **new observation modes** (5-minute refresh by MSG's RSS on the northern half of the RoI, e.g.)



Demonstration : From October 2011, during 17 months + 4 extra months

EVOSS Web

EVOSS – the Virtual Volcano Observatory

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