

MeteoSAT Rapid Response Web Service (MS2RWS)

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EO based Real Time alert system

This solution can help the local observatories and the User/First responder communities to have a real time information on the beginning of new eruption only based on Low GSD (4x5 sqKm) and High frequency (1 image every 5 minutes) Remote Sensing data.

This module is based on the use of specific channel mounted with minor changes on all the geostationary satellite enabling a world wide monitoring service

The obtained results demonstrated its applicability on different volcanic context in terms of volcanic dimension and eruptive style

• SCIENTIFIC RATIONALE

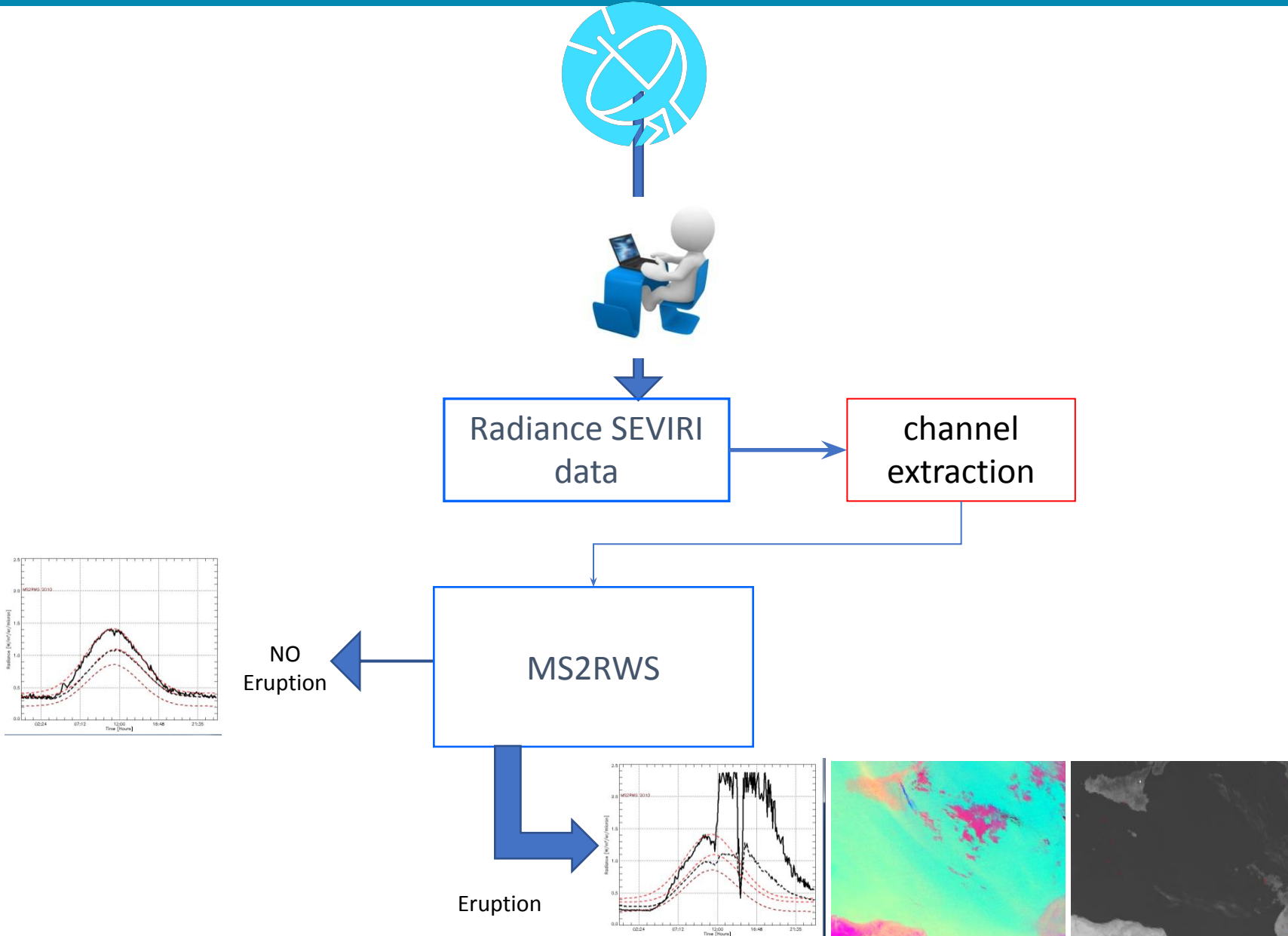
- Infrared remotely sensed data can be used to evaluate the surface thermal state of active volcanoes. Because the spectral radiance emitted by hot spots reaches its maximum in the region of Mid InfraRed (MIR), the early detection of an impending eruption is realized by exploiting the SEVIRI 3.9 μm channel . Despite its spatial resolution ($3 \times 3 \text{ km}^2$ at sub satellite point), Dozier et al. demonstrates that the presence of a high temperature source, even affecting only a small portion of one large pixel, causes a dramatic increase of the emitted MIR radiance.
- A procedure named MS2RWS (MeteoSat to Rapid Response Web Service), has been developed to exploit the capability to detect the beginning and duration of an eruption. The algorithm is an improvement of the procedure presented in Musacchio et al. [2011, 2012], mainly based on a “difference of differences” method applied to the SEVIRI 3.9 μm measurements

• OBSERVATIONAL INFRASTRUCTURE

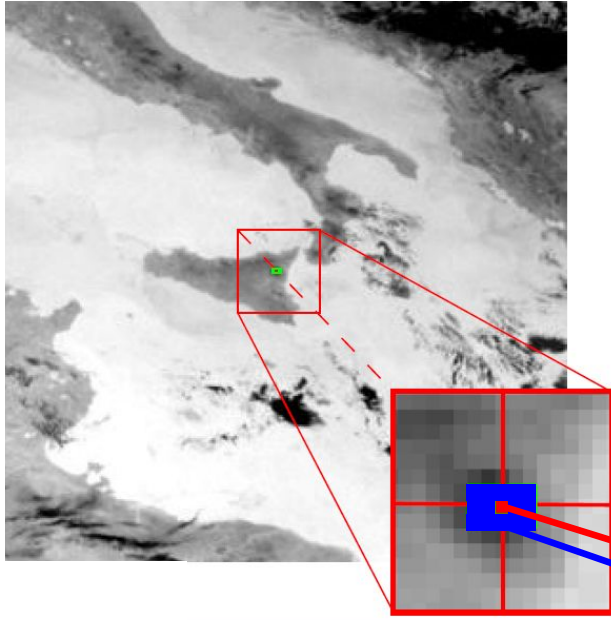
EO data	Band centers (μm)	Spatial Resolution (m)	Resolution time
SEVIRI (GOES, HIMAWARI)	3.9	4x5 km	1 image every 5 minutes



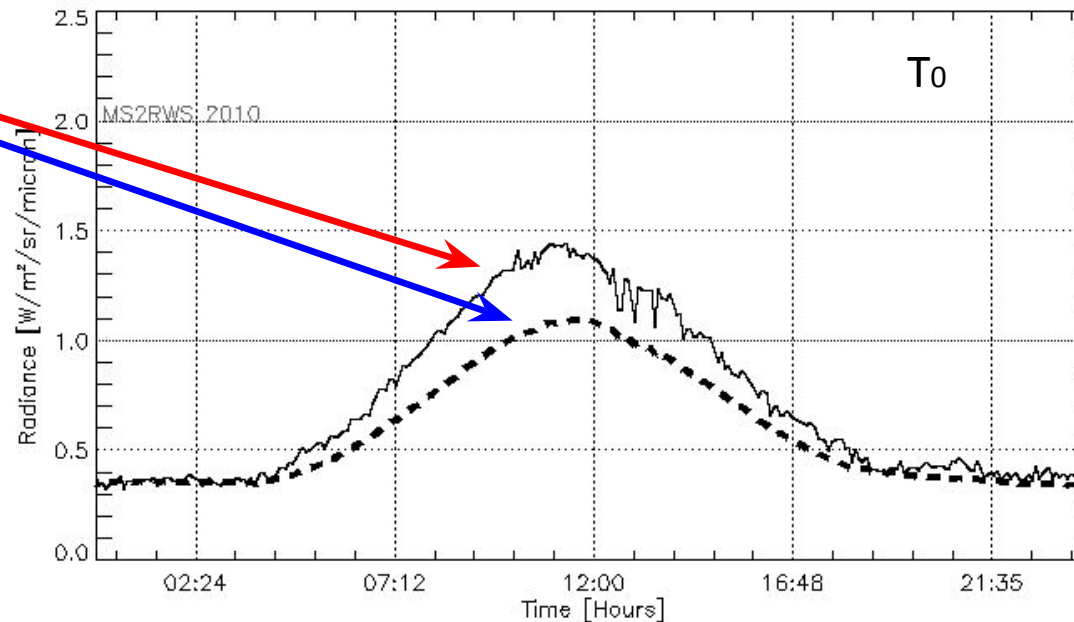
• INFRASTRUCTURE FOR DATA PROCESSING



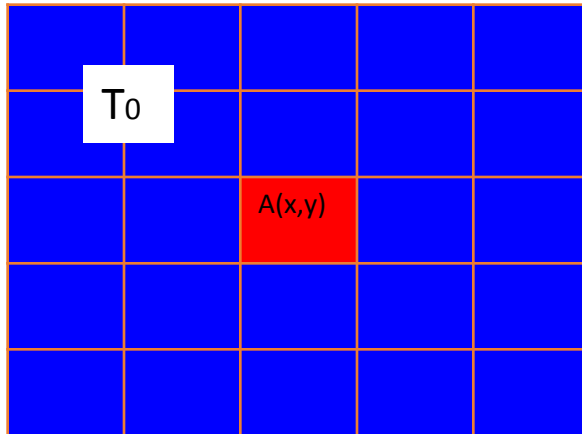
• METHODOLOGY



- The MS2RWS, every 5 (or 15 minutes), captures the radiance value of the pixel centered over Mt Etna and the mean radiance values



- Methodology [for 4th channel

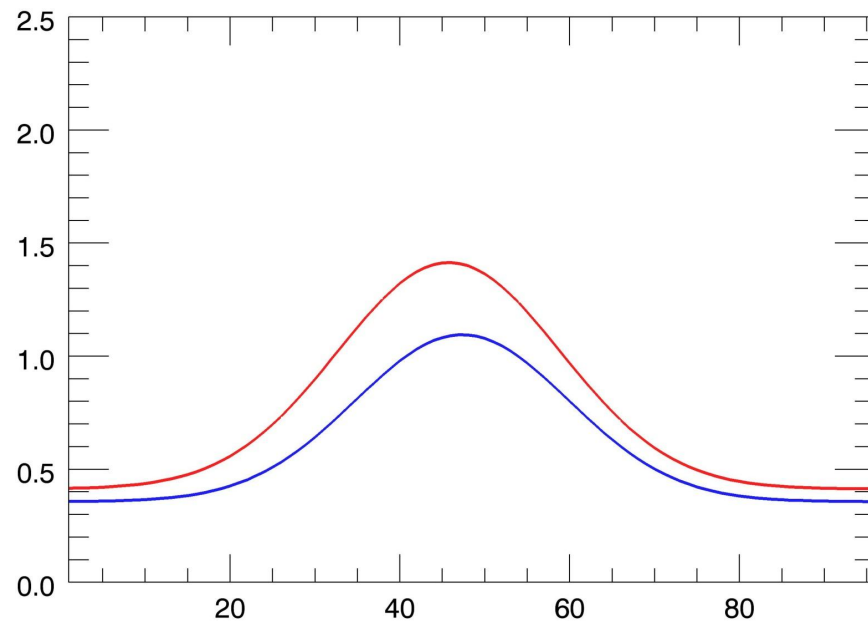


Upper limit = $\max_{T_i \in T} A_{T_i}(\bar{x}, \bar{y})$ where $T = \{T_0, T_1, \dots, T_m\}$

$A \in M(n, n)$, $n = 5$

Lower limit =

$\max_{T_k \in T} \left\{ \frac{[\sum_{i,j=1}^n A_{T_k}(i,j)] - A_{T_k}(\bar{x}, \bar{y})}{n^2 - 1} \right\}$



T_0

T_1

T_2

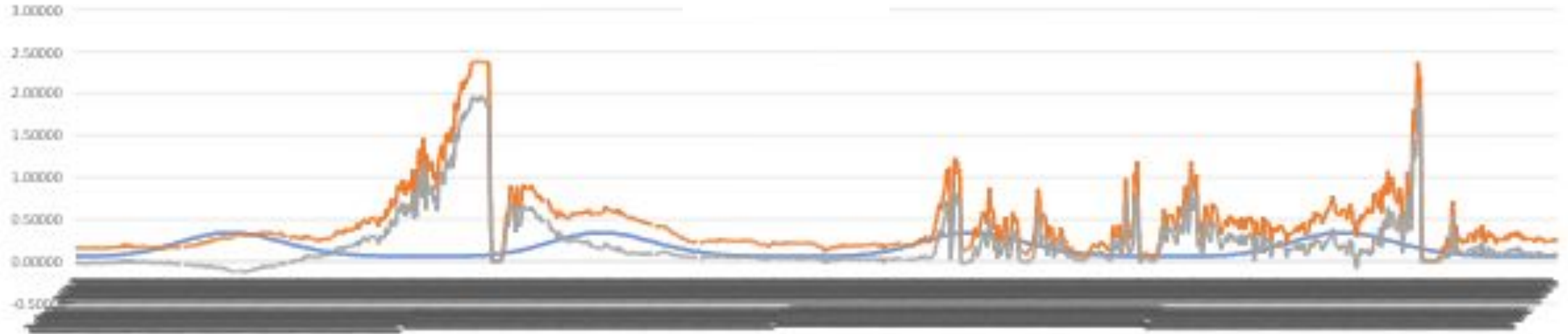
T_3

T_4

T_m
Where m are days

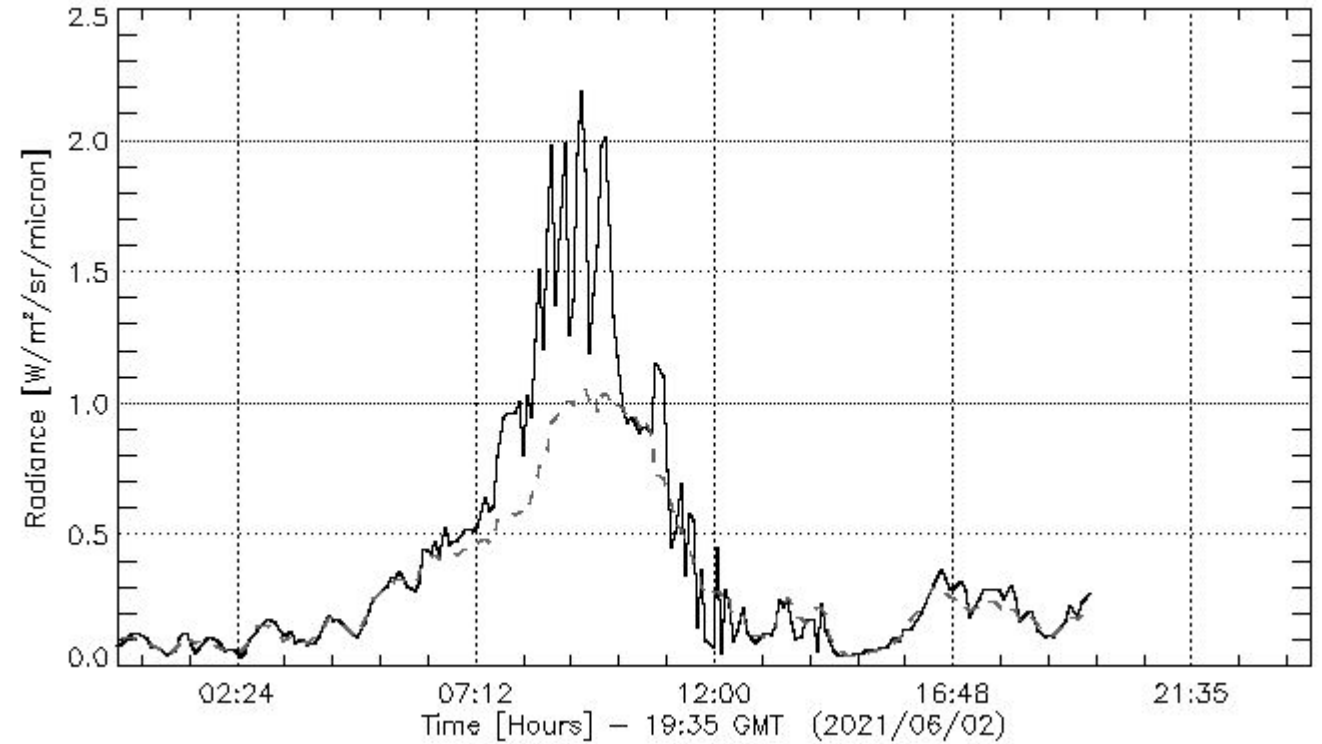
time

- December 2015 Eruption



• PRODUCTS AVAILABLE

Service output	Real Time monitoring for Hot spot detection (from SEVIRI)
Output format	Index (on/off; 0/1).
Temporal resolution	Frequency update: 288 time per day.
Output Spatial resolution	SEVIRI- MSG : 4x5 km
Spatial coverage	Nominally the whole hemisphere lighted by the Geostationary satellite
Resources and processing constraints (SW needs)	IDL and ENVI SW



• CURRENT DISTRIBUTION OF PRODUCTS

Method for products distributions: <http://160.97.1.28/rapidresp/>



OFF SHORE South El Hierro surface thermal analysis

The following graphics show the brightness temperature from MSG-SEVIRI data measured on South El Hierro.

Each graphic includes the values derived from 5 transects. Transects S1 and S2 are composed by 7 pixels, S7 by 6 pixels, transects S4, S5 and S7 by 5 pixels and S3 by 4 pixels.



Risposta inviata in data 27/06/2012 10:34.
Messaggio con priorità Bassa.
Interruzioni di riga in eccesso rimosse dal messaggio.

Da: Pascual Santamaría, Gregorio [gpascual@procivil.mir.es]
A: massimo musacchio
Cc: Alicia Felpeto Rielo (afelpeto@fomento.es); Alguadil Alguadil
Oggetto: RE: hierro 2012

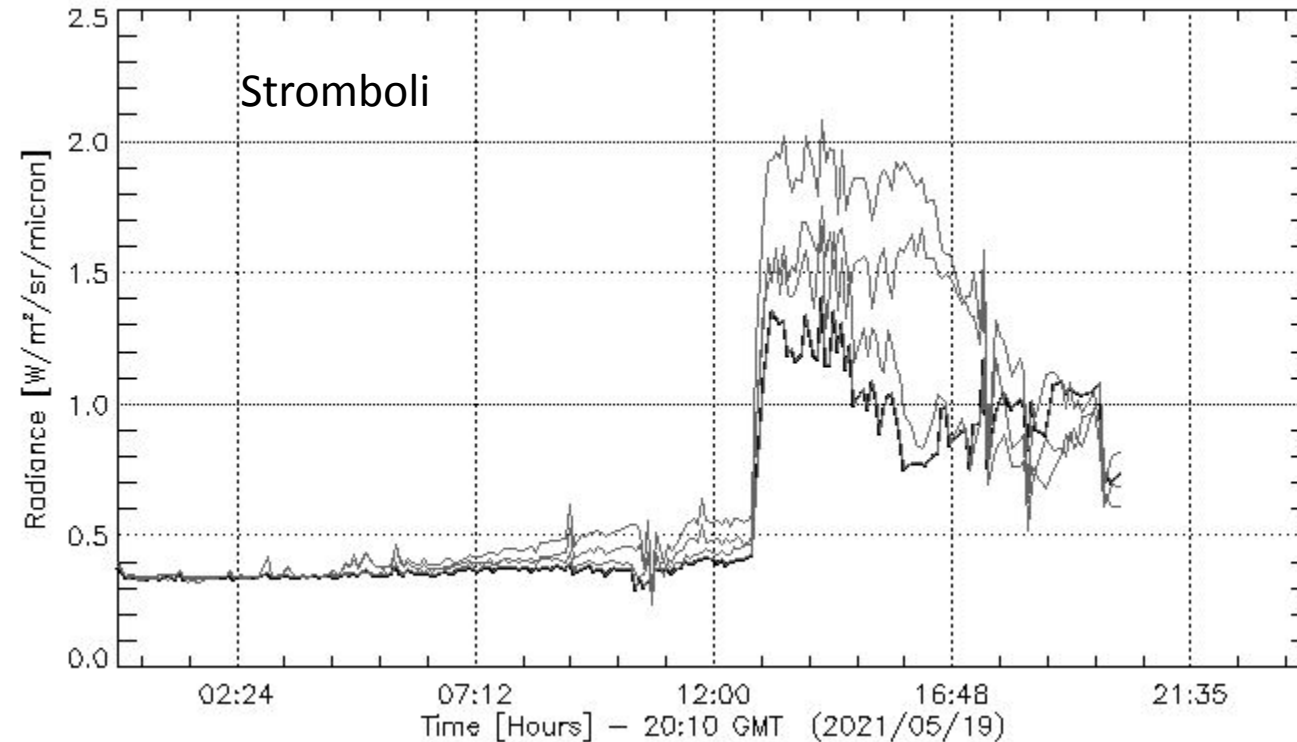
Dear Massimo,

After having consulted your offer among the information you can provide us will be very useful. For that reason, I would like to request your help more than last year. If we decide to change the coordinates of the area I will get in touch with you as soon as possible.

Thank you for your collaboration,

Best Regards,

Gregorio

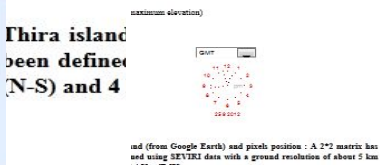


Height: 567 m A.S.L. (ma)

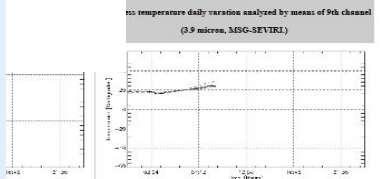
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Preliminary ASH detection analysis:
Brightness temperature difference (BTD) image obtained by using the MSG-SEVIRI channels 9 and 10 centered around 10.5 and 12 microns.
Negative BTD values (red pixels) may be indicative of a volcanic ash cloud presence.



• PROGRAMS/PROJECTS OF REFERENCE

Pianeta Dinamico **ATTEMPT**:

ATTEMPT will improve the procedure named MS2RWS (MeteoSat to Rapid Response Web Service) (Musacchio et al., 2011, 2012; Corradini et al., 2018), testing the results derived by using a narrower kernel, from 5x5 pixel to 3x3 pixel.



• TEAM & AFFILIATION

TEAM	AFFILIATION
Massimo Musacchio	INGV (Permanent staff)
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