A photograph showing a group of people, including a woman in a blue headscarf, standing in front of a large satellite dish antenna. The scene is outdoors, and the antenna is the central focus. The image has a slightly grainy, low-resolution quality.

**Valerio Tramutoli**  
University of Basilicata

**Tecniche satellitari robuste per il  
monitoraggio dei rischi naturali e  
ambientali.**

# Research activities mainly on

- ✗ Characterization and Development of new satellite sensors
- ✗ Development of new satellite data analysis algorithms

for

Meteorology, Climatology, Atmospheric studies

&

Natural, Environmental, Technological Risks  
Monitoring and Prevention

# Development of new satellite data analysis algorithms



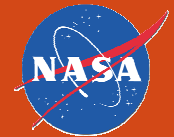
Main projects leaded or participated by DIFA (responsible V. Tramutoli)

## INTERNATIONAL PROJECTS

- EO-1 CAL/VAL (NRA-99-0ES-01)
- GMOSS Network of Excellence (Global Monitoring for Security and Stability)
- GRIDCC (GRID enabled remote instrumentation with distributed Control and Computation)
- G-MOSAIC (GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises)

## FUNDING AGENCY OR PROGRAM

NASA



EC-FP6/GMES-ESA



EC-FP6/IST





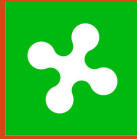

EC-FP7/GMES-ESA



# Development of new satellite data analysis algorithms



Main projects leaded or participated by DIFA (responsible V. Tramutoli)

<i>INTERNATIONAL/ REGIONAL PROJECTS</i>	<i>TARGET REGIONS</i>	<i>FUNDING AGENCY OR PROGRAM</i>
<p>→ <b>MUDVOLCANOES</b> (Monitoring short term fluctuations in mud volcanoes methane emissions)</p>	<p>→ <b>SOUTH CAUCASUS</b> (Azerbaijan)</p>	<p><b>NATO</b> Science for Peace </p>
<p>→ <b>STREGEOS</b> (Stress related geohazards in South Caucasus)</p>	<p>→ <b>SOUTH CAUCASUS</b> (Armenia, Azerbaijan, Georgia)</p>	<p><b>EC-FP6/INTAS</b> </p>
<p>→ <b>AVVISA</b> (Forest Fires Detection by Satellite)</p>	<p>→ <b>Lombardia Region</b> (Italy)</p>	<p><b>Lombardia Region</b> Civil Protection Office </p>
<p>→ <b>AVVISTA</b> (Fire Hotbed Detection by Satellite)</p>	<p>→ <b>Palermo Province</b> (Sicily-Italy)</p>	<p><b>Palermo Province</b> Civil Protection Office </p>



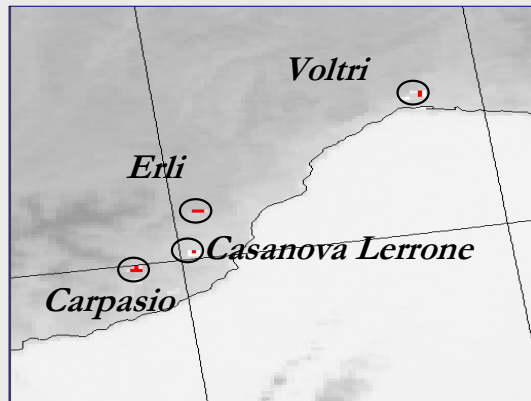


# Development of new satellite data analysis algorithms

## Robust Satellite Techniques (RST, Tramutoli, 1998, 2005, 2007)

### Forest fires

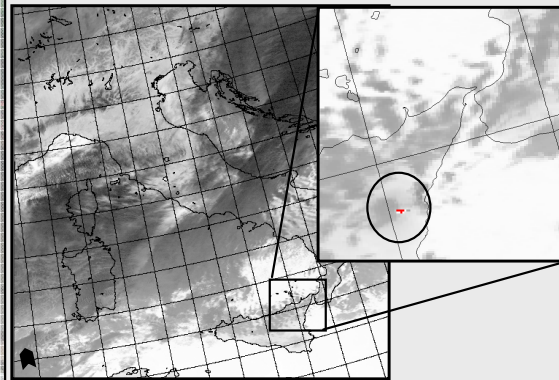
e.g. Fires in Italy, February 2005



fires

### Volcanic eruptions

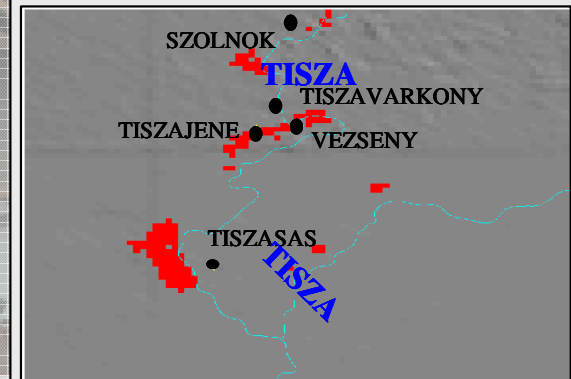
e.g. 2004-2005 Etna eruption (Italy)



Hot spot

### Floods

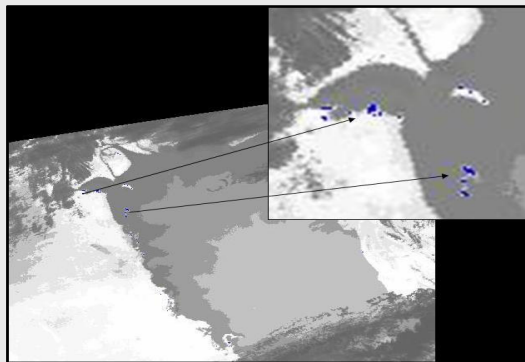
e.g. Ungary flood, April 2002



Flooded areas

### Sea pollution

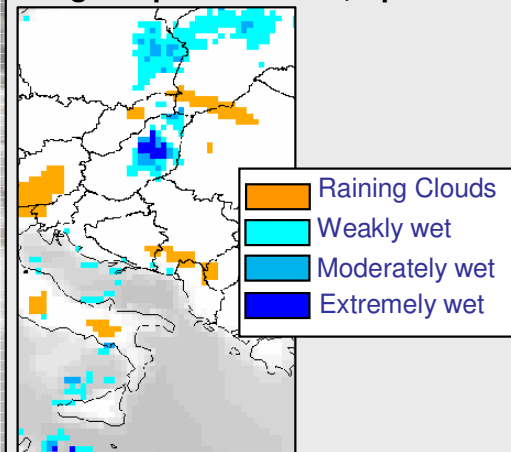
e.g. Oil spill in the Persic Gulf, January 1991



Oil spill

### Soil wetness

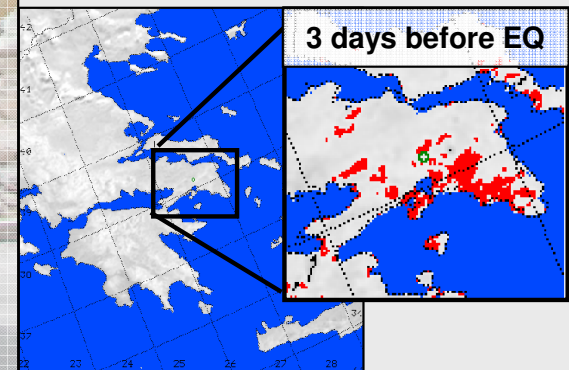
e.g. Carpathian Basin, April 2000



Raining Clouds  
Weakly wet  
Moderately wet  
Extremely wet

### Earthquakes

e.g. 7 September 1999 Athens Earthquake



Thermal anomalies




### *Natural and Environmental hazards*

- **Forest fires detection** and risk assessment
- **Volcanic eruption** detection, monitoring and prediction
- **Oil spill** detection and monitoring
- **Flood risk**
- **Seismic areas** monitoring
- **Desertification** process monitoring
- Etc....

### *Civil security*

- **Pipeline** blasts
- **Bonfires** in refugee camps
- **Oil spill** due to pipeline sabotage
- **Terrorist attack** first warning
- Etc....

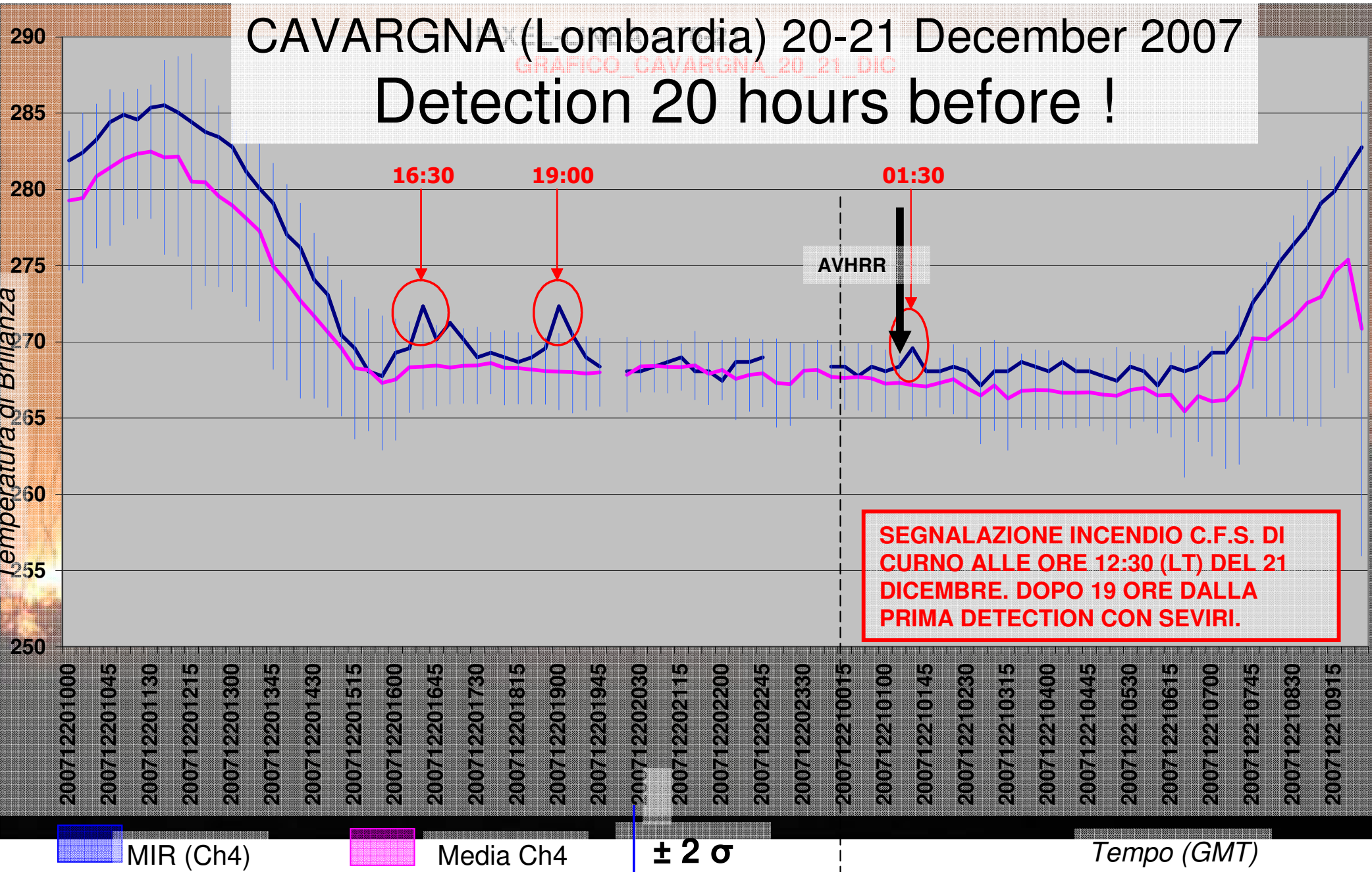


- 
- Within 15 minutes
  - Smallest than 100sm  
(goal 30sm)

# Algorithms

## Timely detection of forest fires

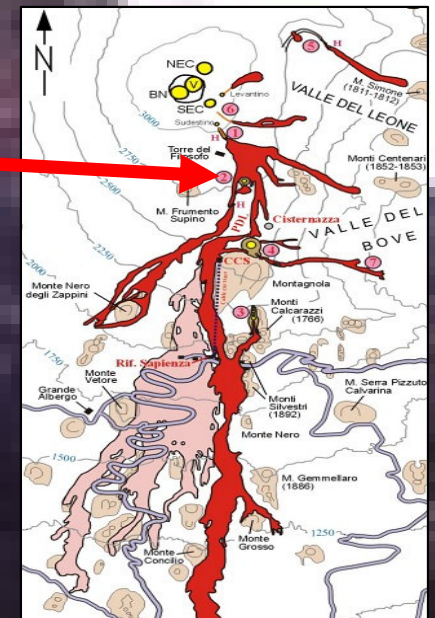
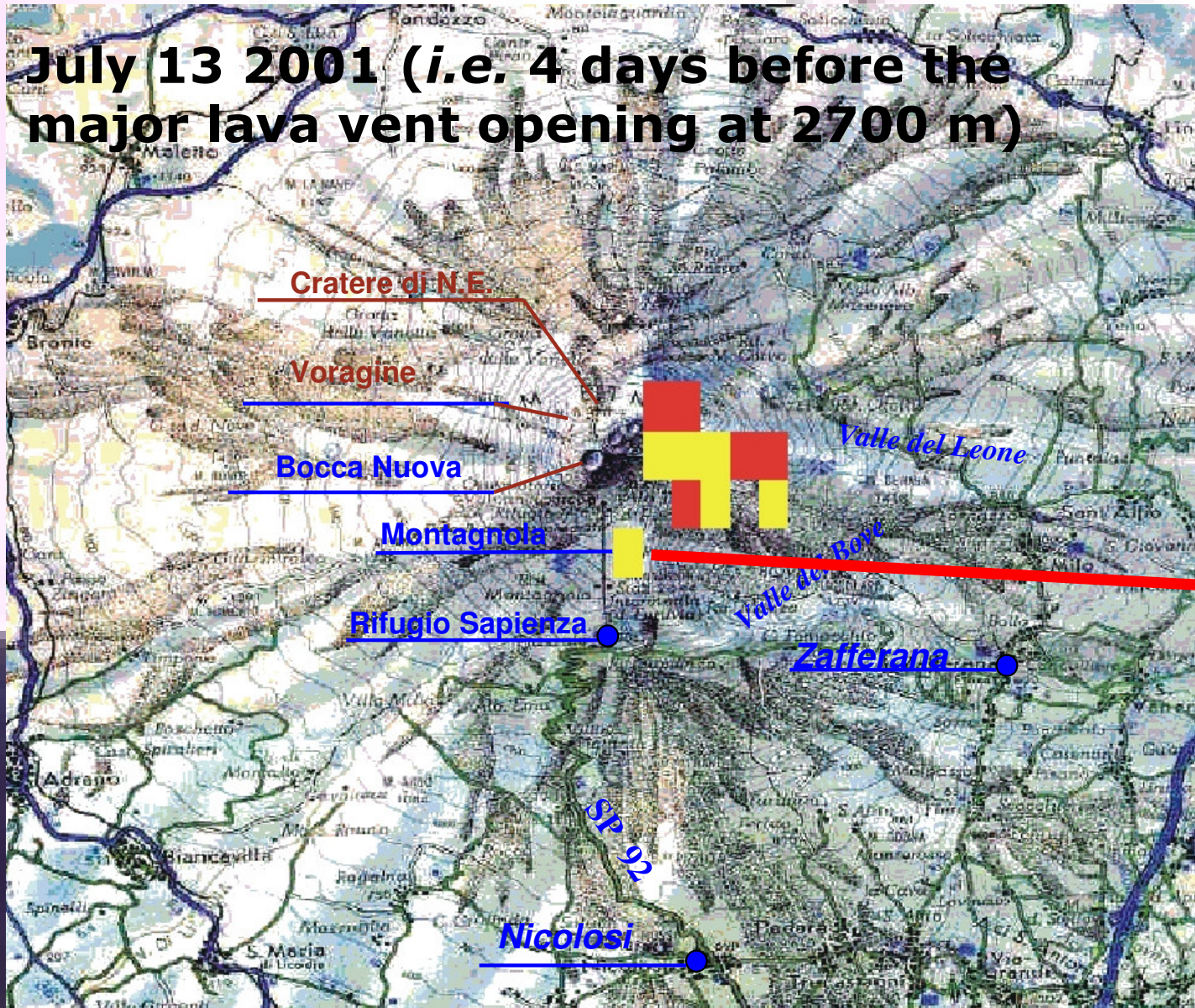
CAVARGNA (Lombardia) 20-21 December 2007  
 Detection 20 hours before !





# Algorithms Monitoring volcanoes

**July 13 2001 (i.e. 4 days before the major lava vent opening at 2700 m)**

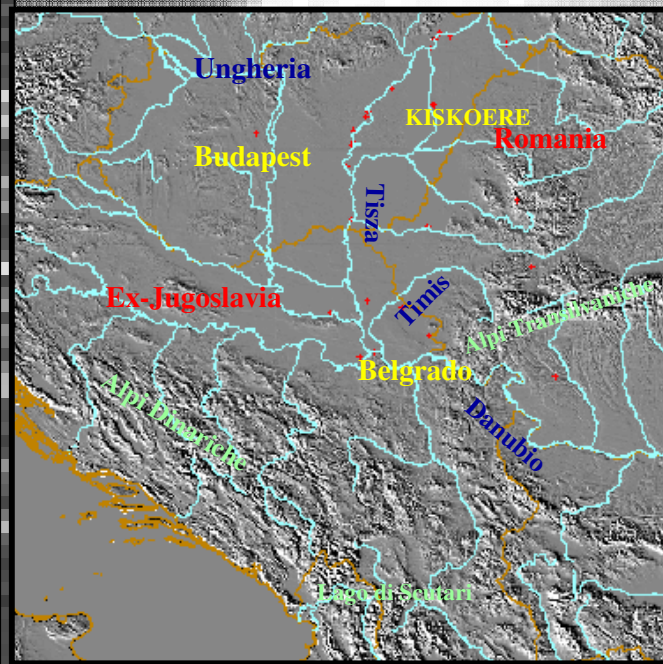


**July-August 2001  
lava flows reports**

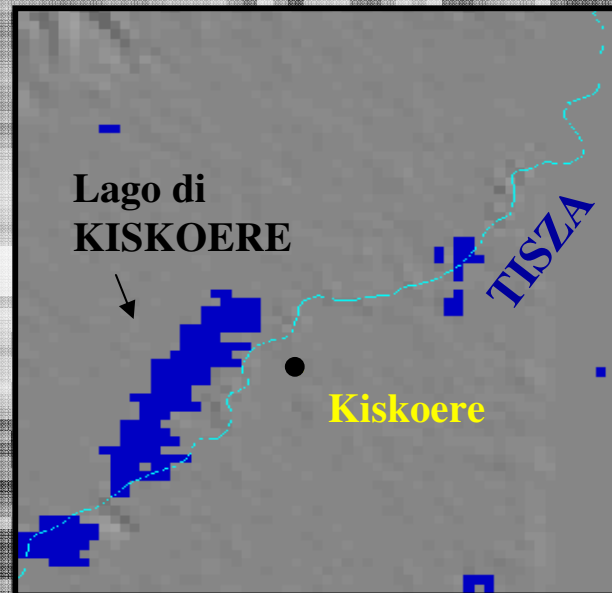


# Algorithms Monitoring floods

## Central Europe April 2000

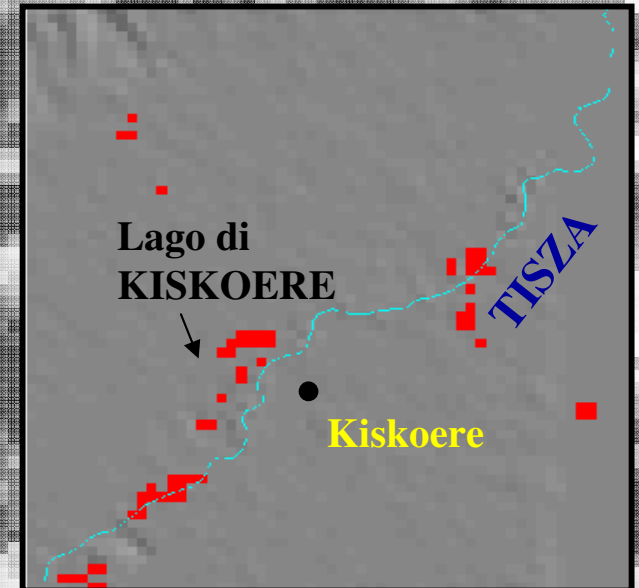


09/04/00 ore 14



water bodies by  
XIAO & CHEN (1987)  
method

09/04/00 ore 14



$\otimes$   $z-1 \leq -1$  (only  
flood affected  
areas are  
detected by  
applying RST  
approach)

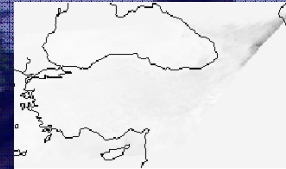
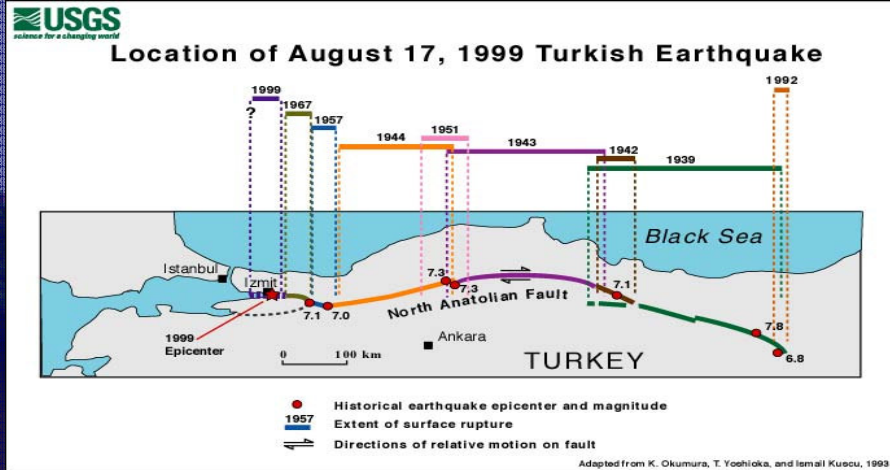


# Algorithms

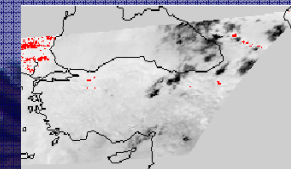
## Monitoring seismic areas

17<sup>th</sup> August 1999 Izmit ( $M_s=7.4$ )

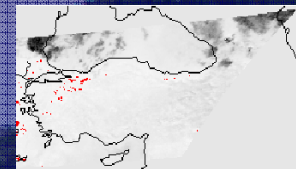
METEOSAT - TIR



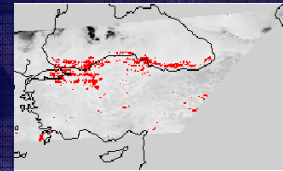
6 August 1999



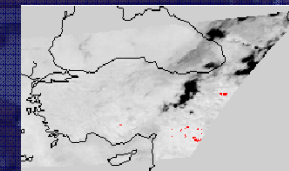
11 August 1999



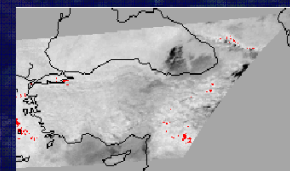
12 August 1999



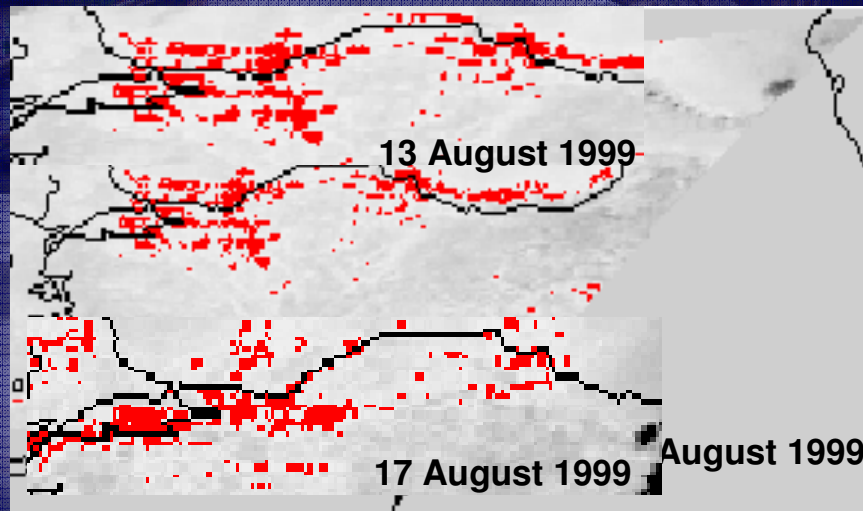
13 August 1999



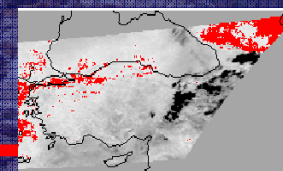
15 August 1999



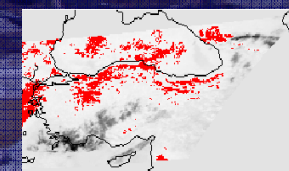
16 August 1999



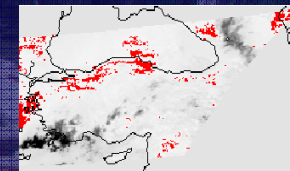
■ Pixels with ALICE index > 2



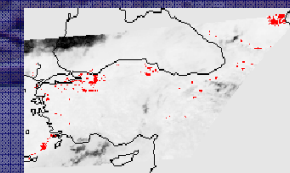
17 August 1999  
(Izmit earthquake)



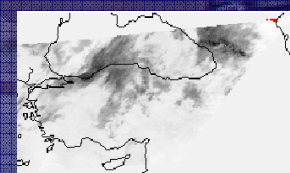
19 August 1999



20 August 1999



21 August 1999



23 August 1999



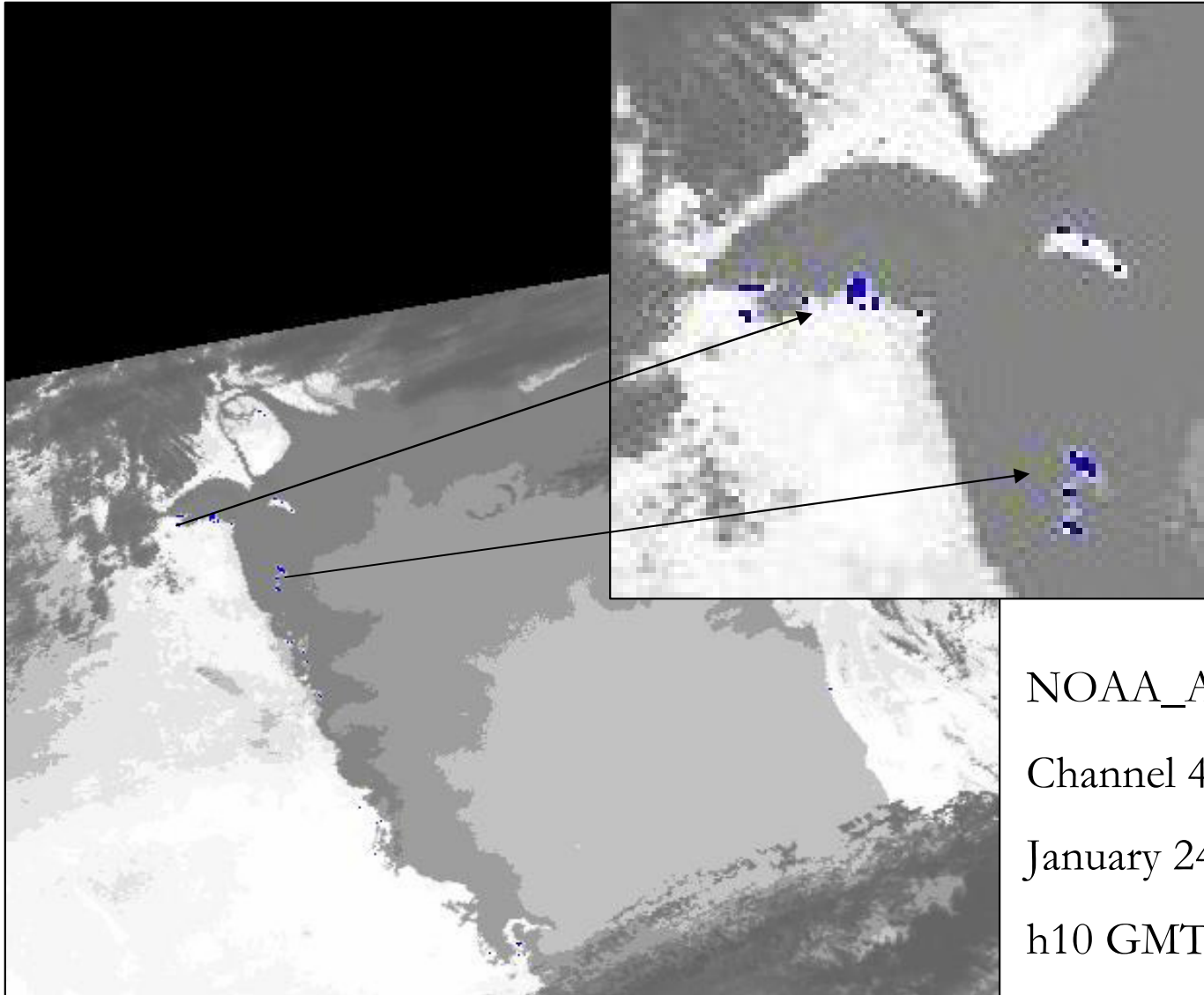
# Algorithms

## Monitoring oil discharges and seapages



# Algorithms

## Invasion of Kuwait (January 1994)



Oil spill

NOAA\_AVHRR

Channel 4 (10.5-11.3  $\mu\text{m}$ )

January 24, 1991

h10 GMT

# Algorithms

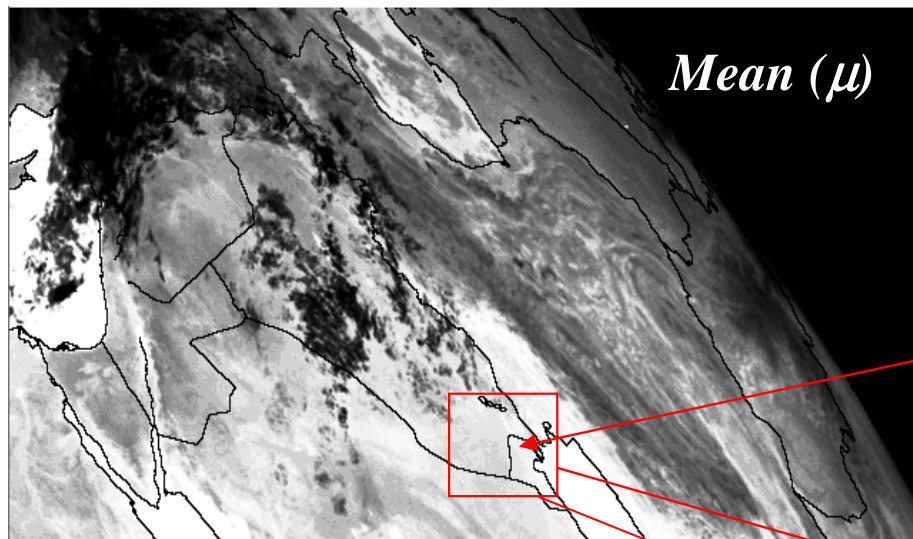
## Real-time monitoring of Infrastructures





# Accidents/sabotages to pipelines in Iraq (18 October 2005)

## False alarms elimination by RST



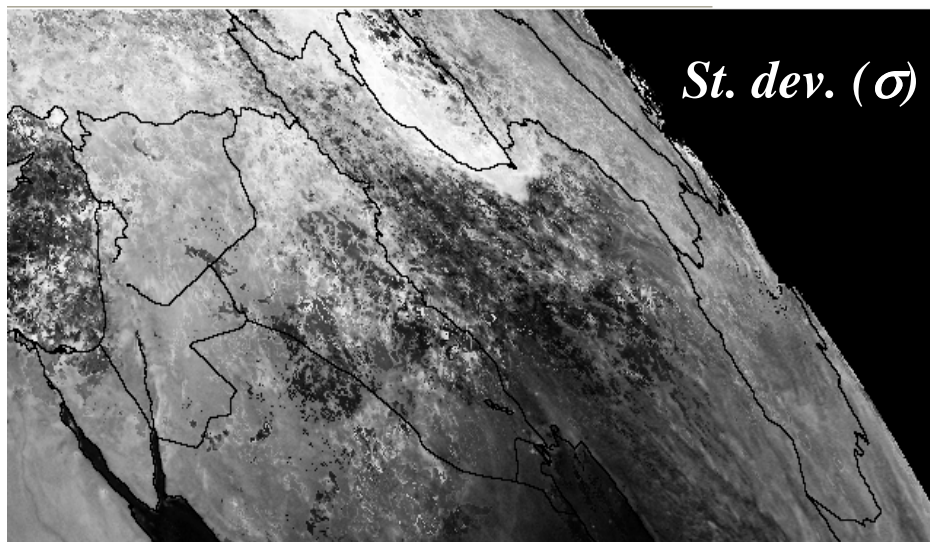
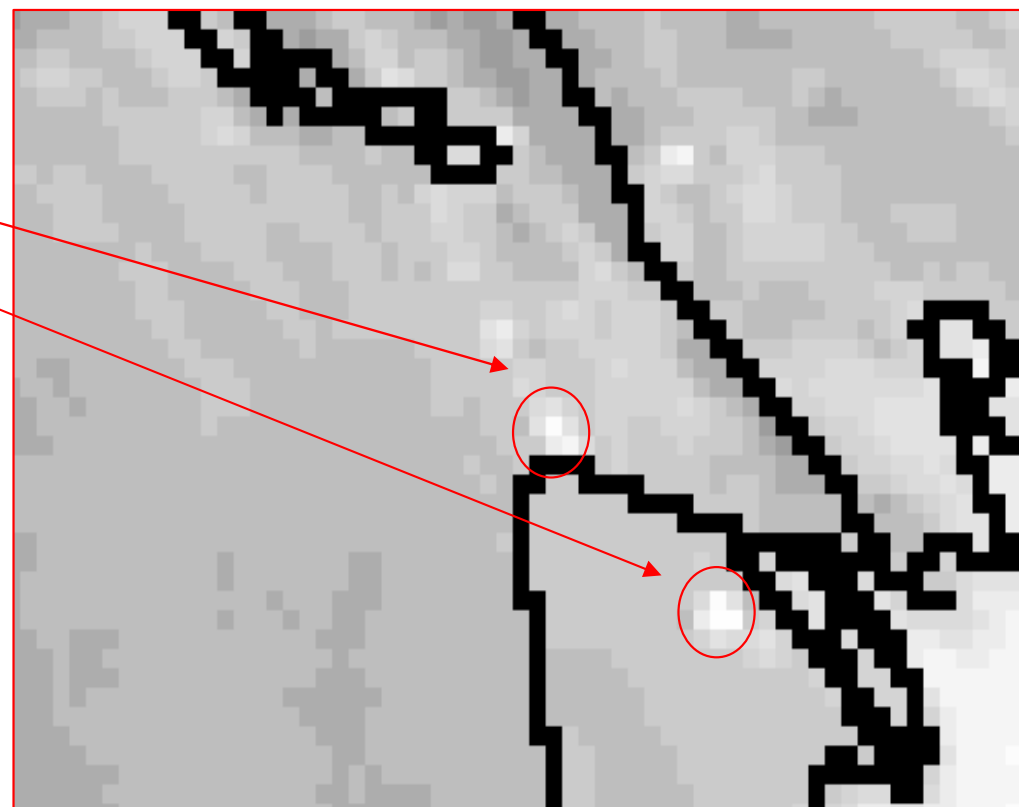
### Reference fields

Month: October

Time-slot: 23:00 GMT

SEVIRI Channel: 3.9  $\mu\text{m}$

*Permanent heat sources (e.g. refineries or power plants)*



# Accidents/sabotages to pipelines in Iraq (18 October 2005)

## False alarms elimination by RST



nts)

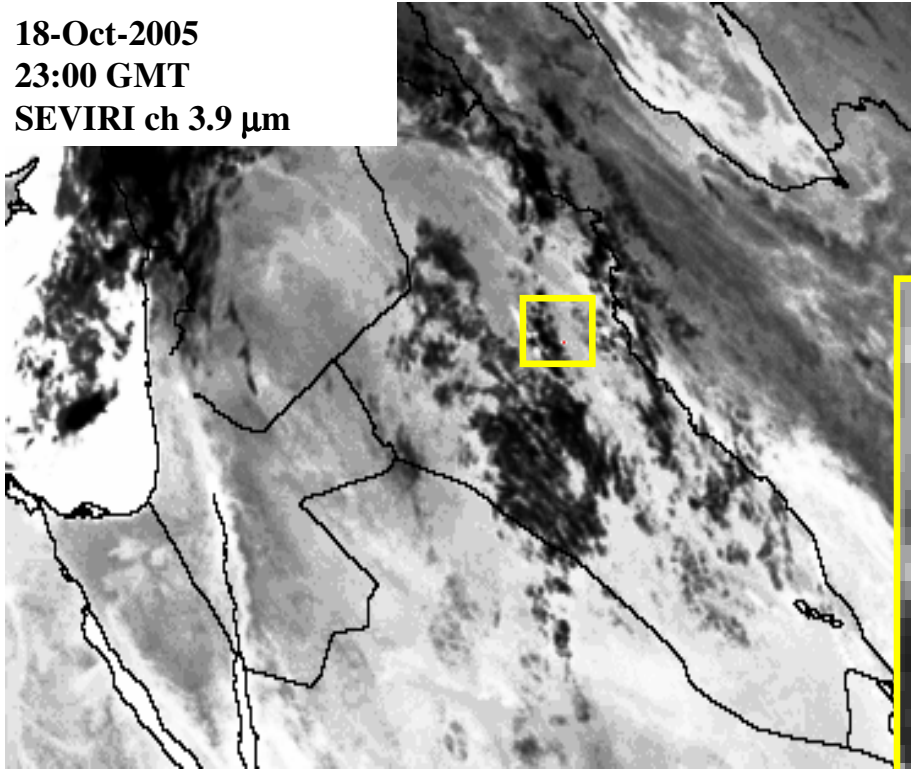




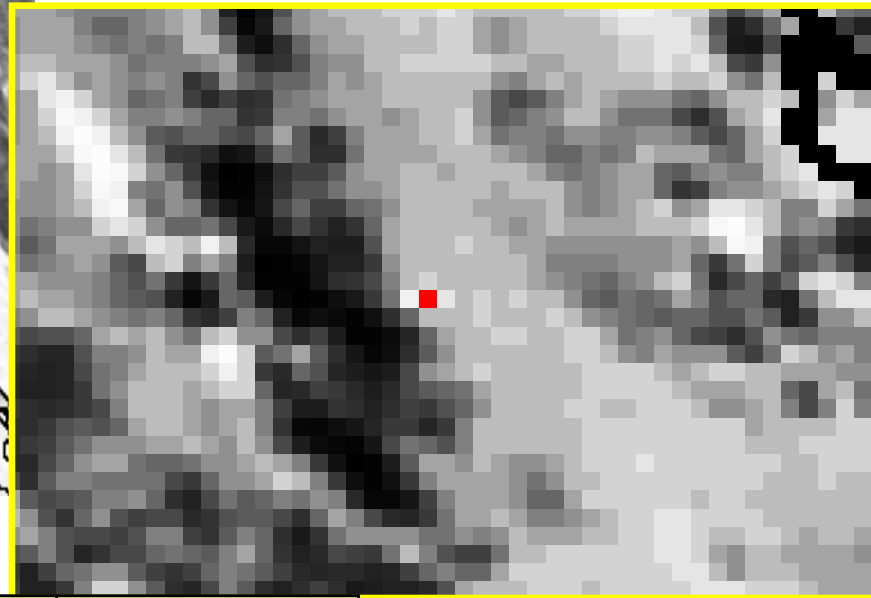
# Accidents/sabotages to pipelines in Iraq (18 October 2005)

## False alarms elimination by RST

18-Oct-2005  
23:00 GMT  
SEVIRI ch 3.9  $\mu\text{m}$



October 18th 2005 pipeline blast due to a sabotage in Iraq

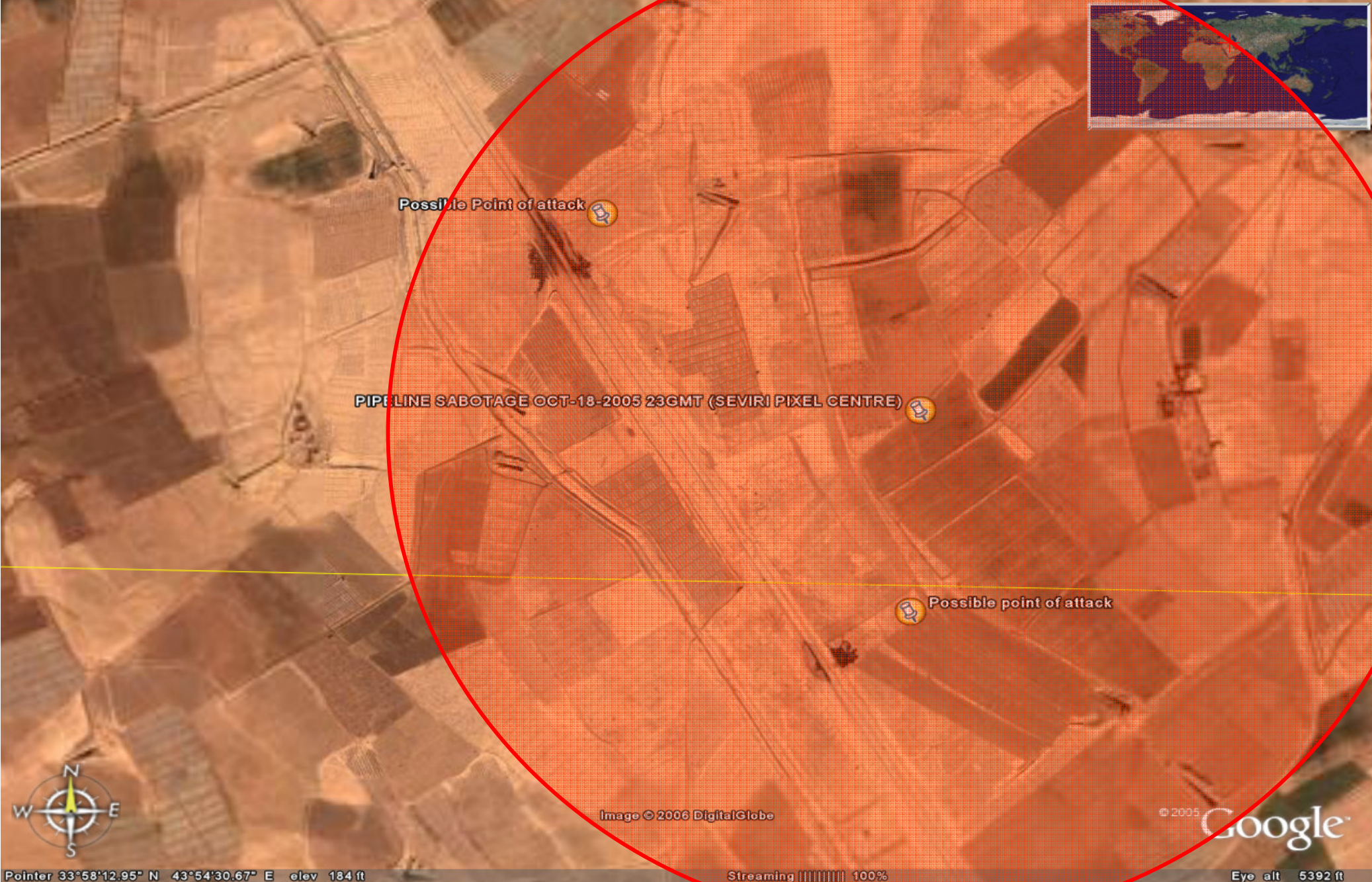


■ ALICE >1.5

Hot spot	Tb (K)	$\mu$ (K)	$\sigma$ (K)	ALICE (Tb - $\mu$ )/ $\sigma$
<b>Pipeline attack (detected)</b> (Lat 33.972 Long 43.91)	285.66	281.58	2.60	1.56
<b>Refinery</b> (Lat 30.215N Long 47.388)	291.31	290.80	1.36	0.37



# Algorithms (validation)





# Algorithms

Sabotages to pipelines in Iraq

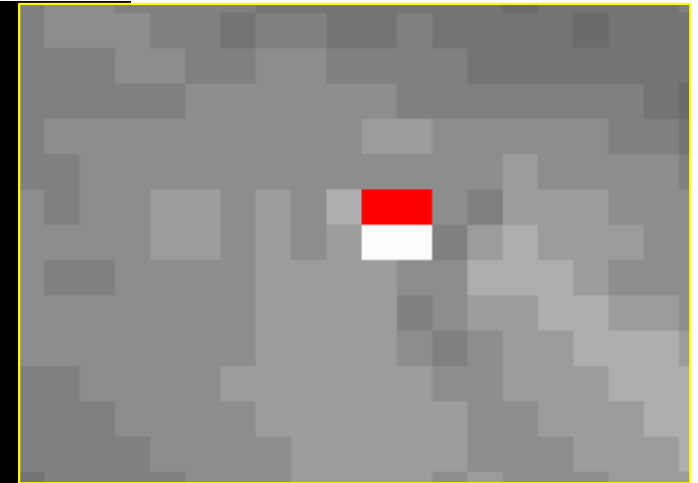
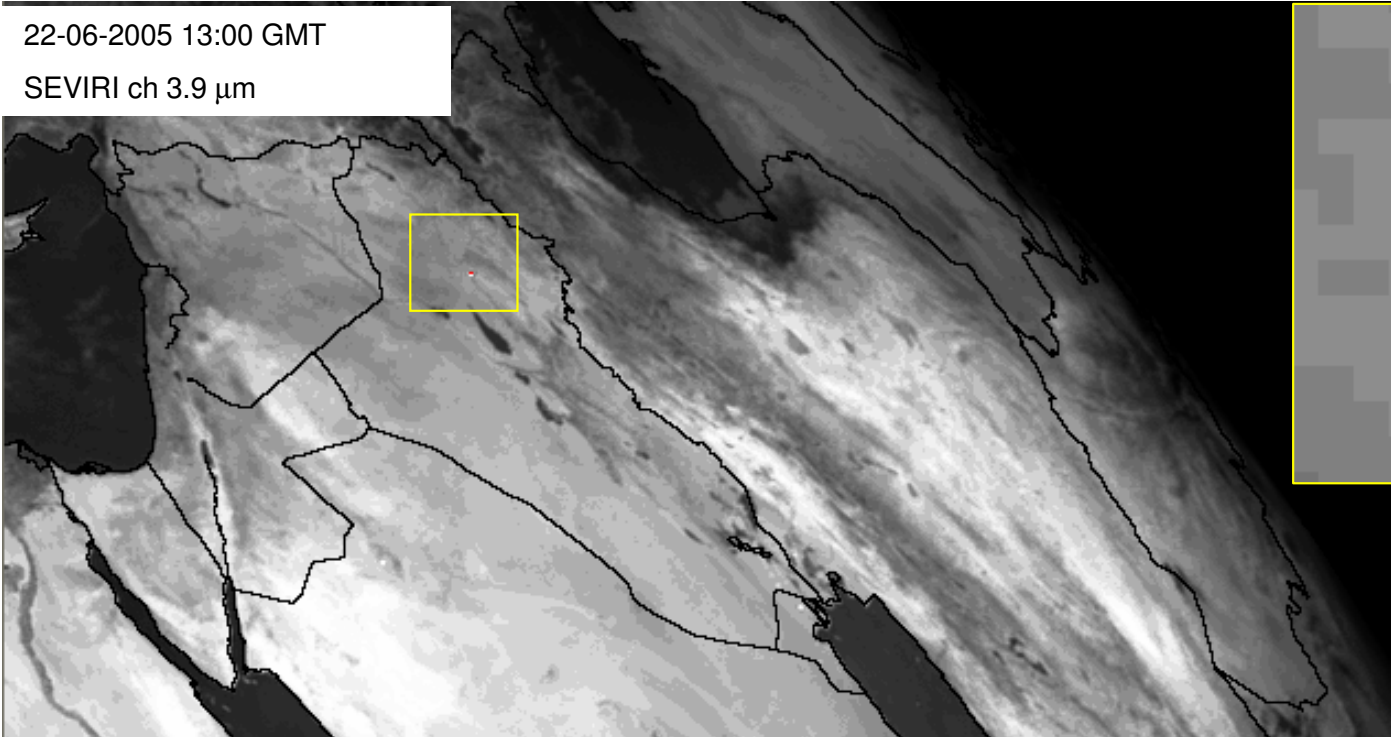
## Identification for sure of time of the events by RST

Detected by RST since 13:00 GMT of 22 June

(the day before the one indicated by the international press!)

22-06-2005 13:00 GMT

SEVIRI ch 3.9  $\mu\text{m}$



■  $\otimes_{\text{MIR}}(r,t) > 2$

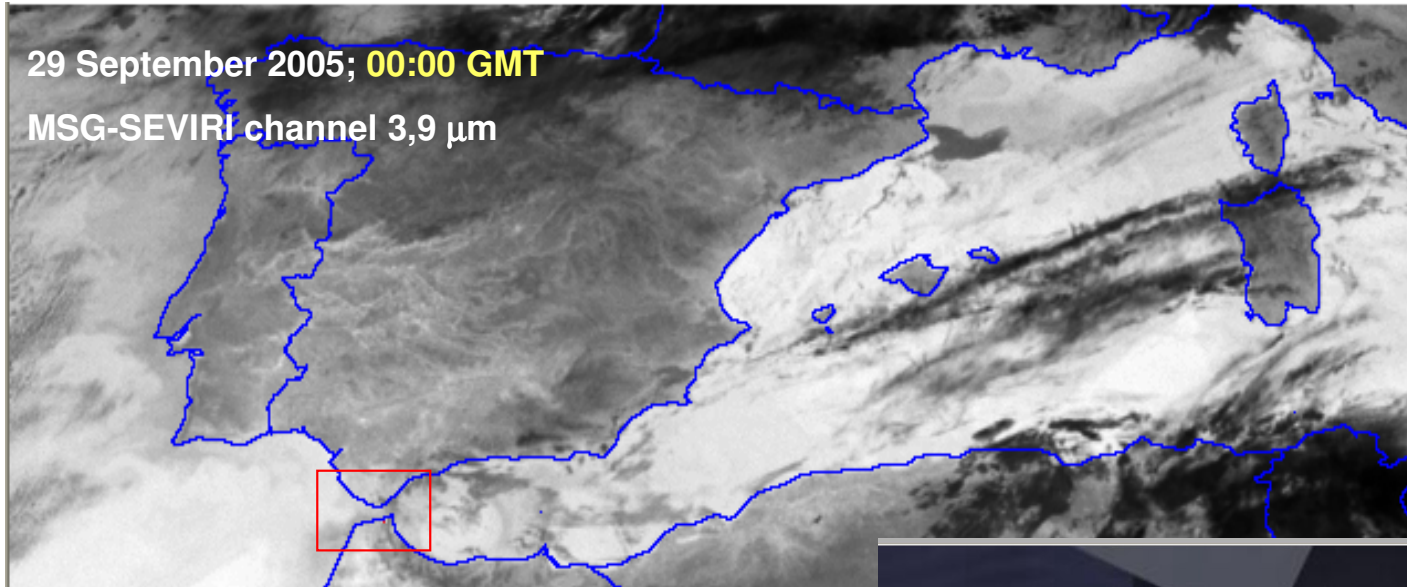


## Monitoring populations

(Immigrants on the move!)



## Monitoring populations

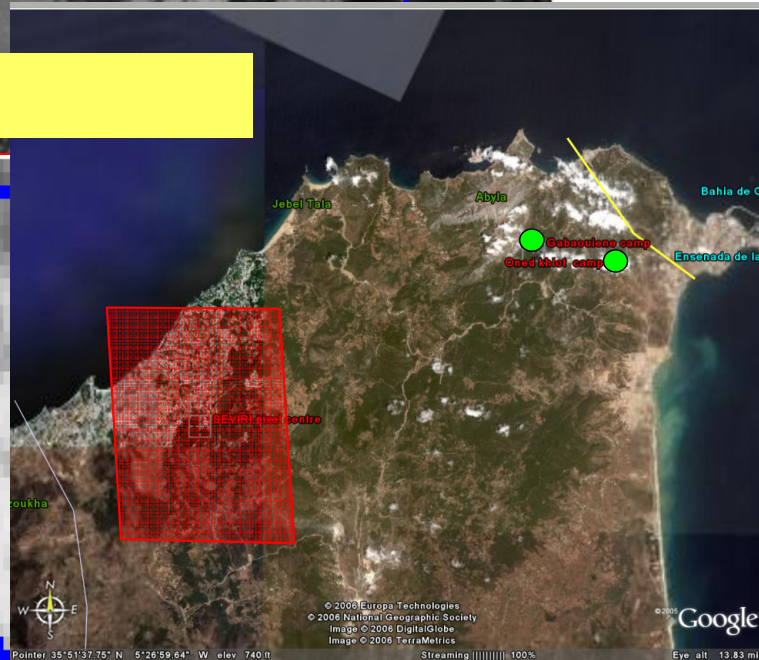
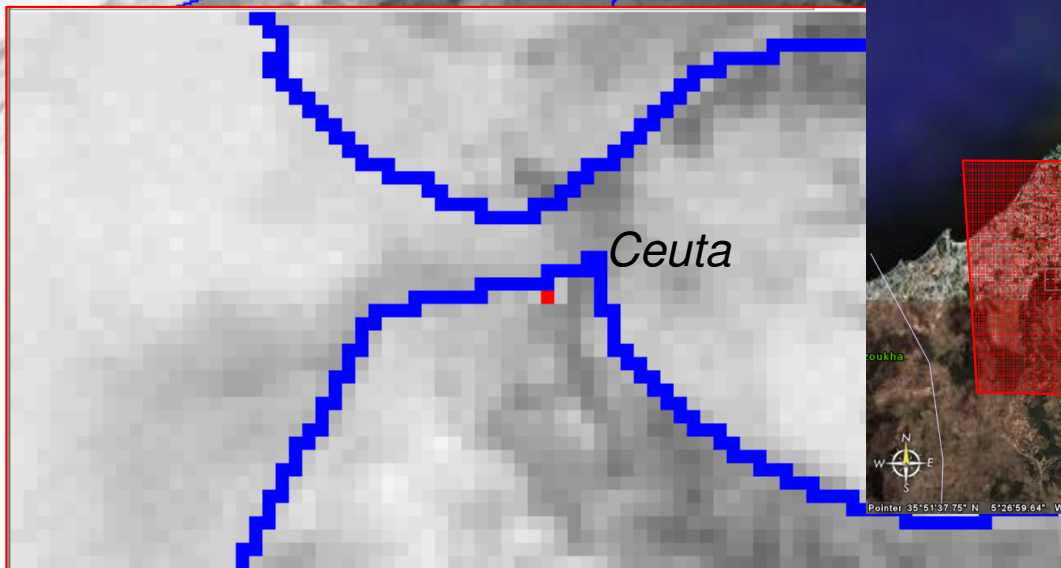


**Ceuta, September 29, 2005**

[...At three o'clock in the morning a group of twenty Congolese and some Costamarfileños crossed the two fences that separates Morocco from Ceuta. With them there have been other immigrants from different origins...]

<http://thistuesday.org>

**(3 hour before fences crossing)**



SEVIRI hot spot Campi rifugiati noti



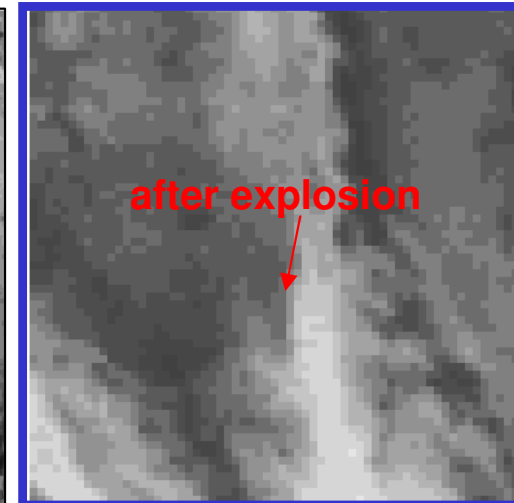
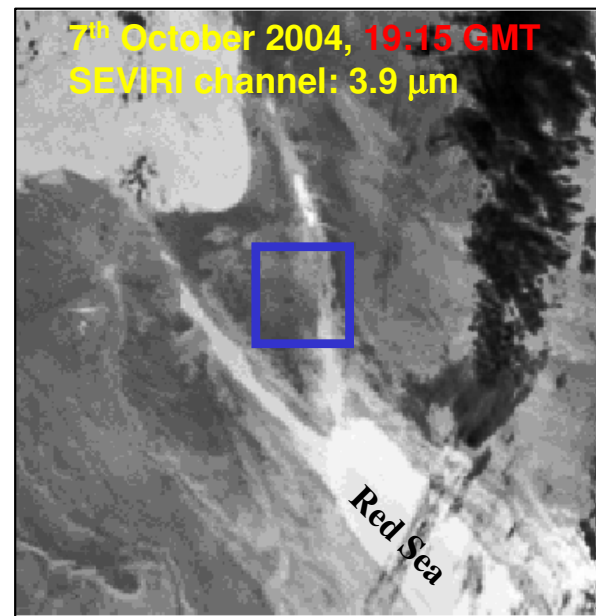
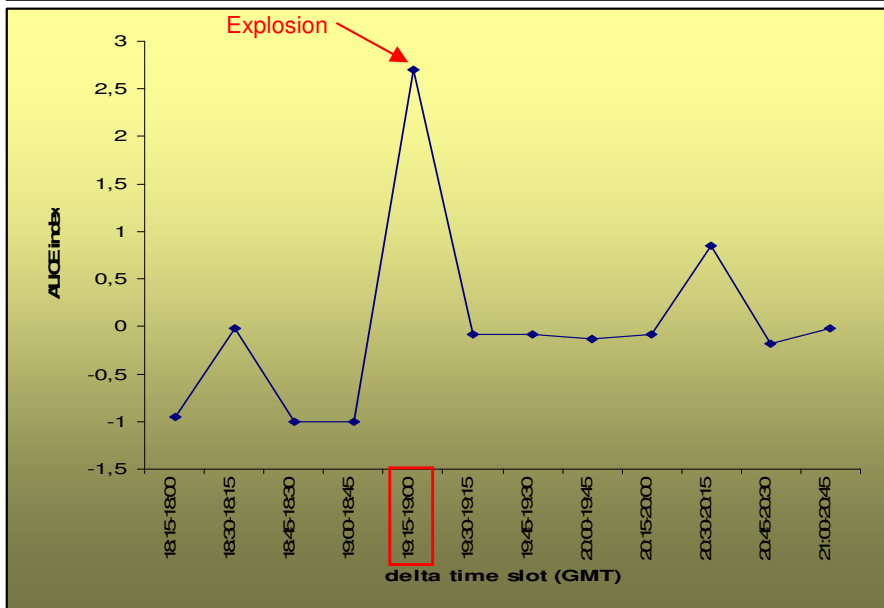
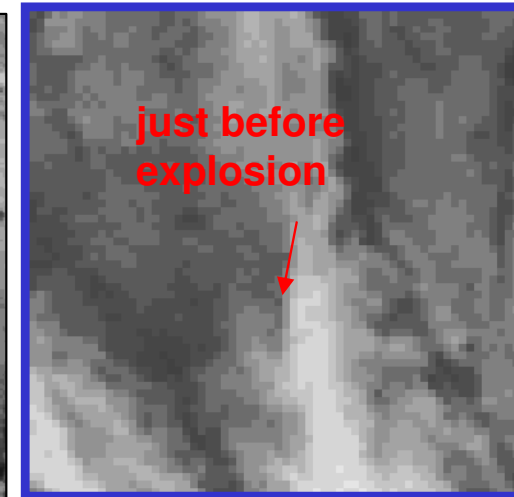
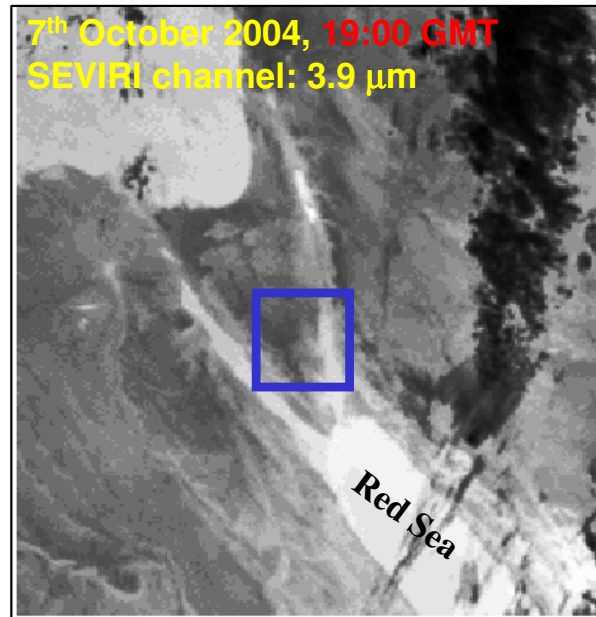
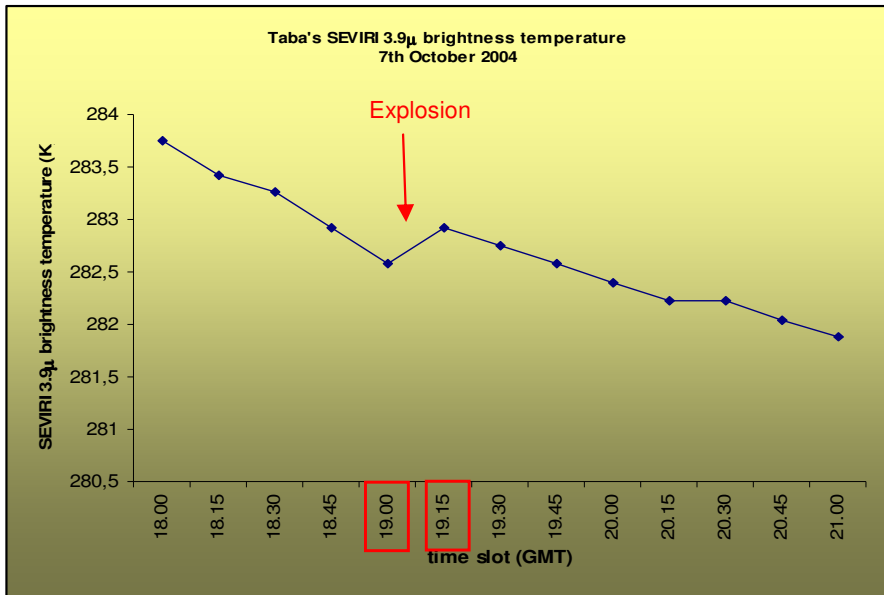
## Other security issues



# Other security issues

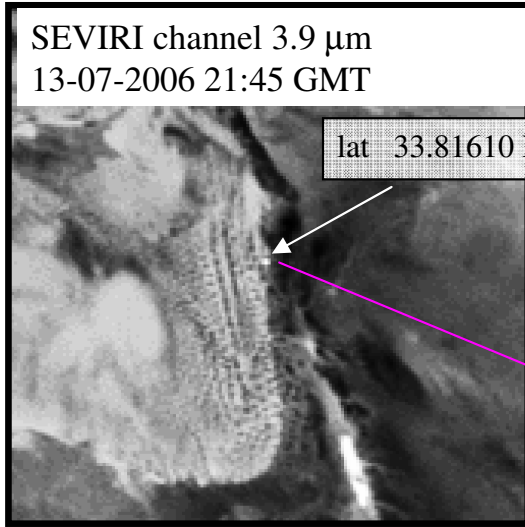
## Explosion at the Hotel Hilton

(Taba, Egypt, 7 October 2004)

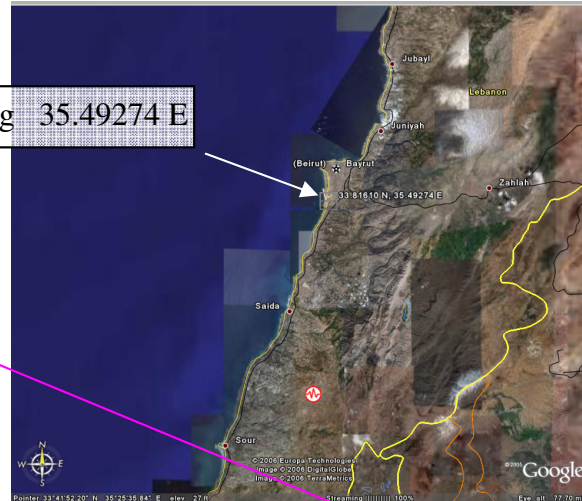


# Attack to the Lebanon International Airport

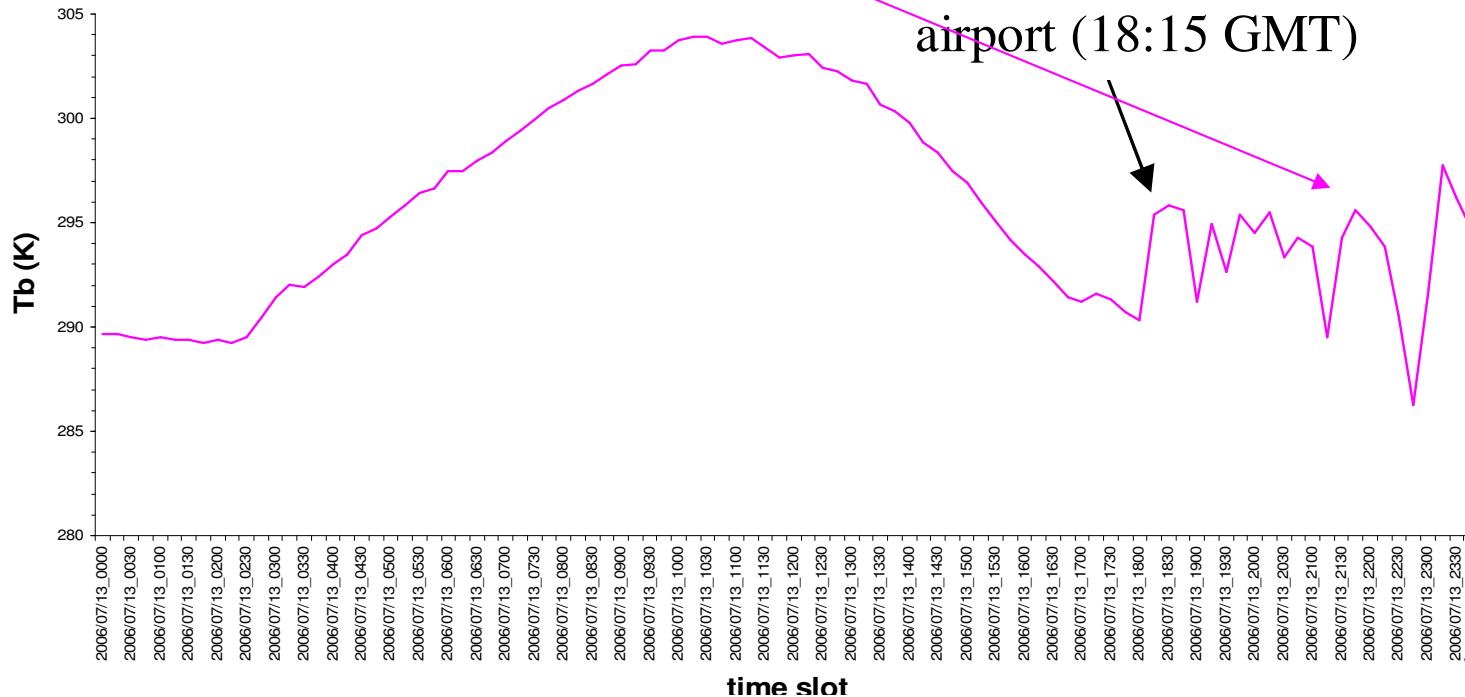
## Beirut 13-14 Luglio 2006



lat 33.81610 N, long 35.49274 E



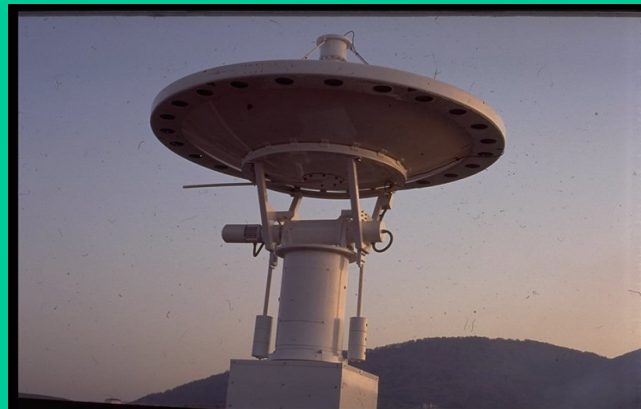
SEVIRI detection of attacks to Beirut airport (18:15 GMT)





# Receiving, Archiving & Processing Facilities for NOAA, EOS and MSG satellites

NOAA/EOS receiving system



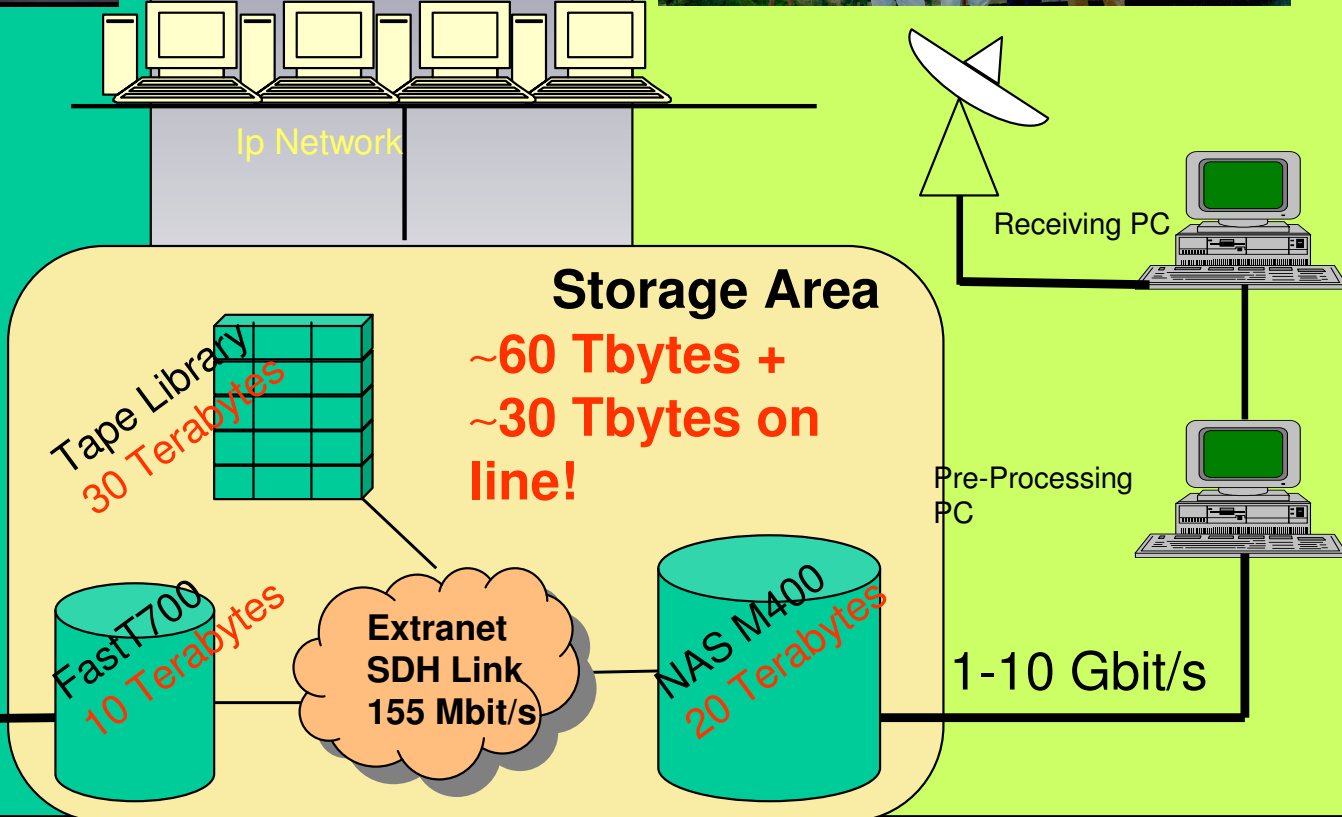
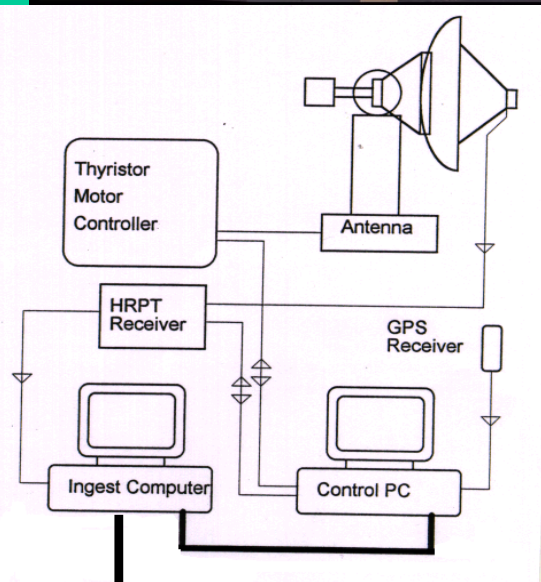
MSG receiving system



Working Groups

Ip Network

Storage Area



1-10 Gbit/s

1-10 Gbit/s

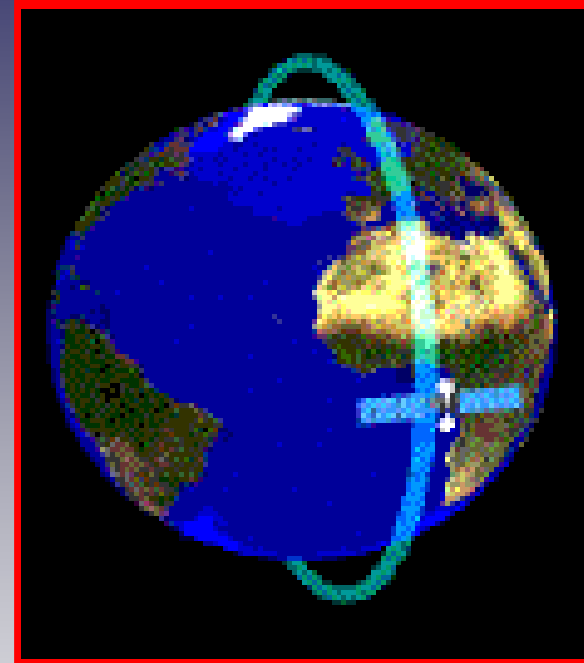
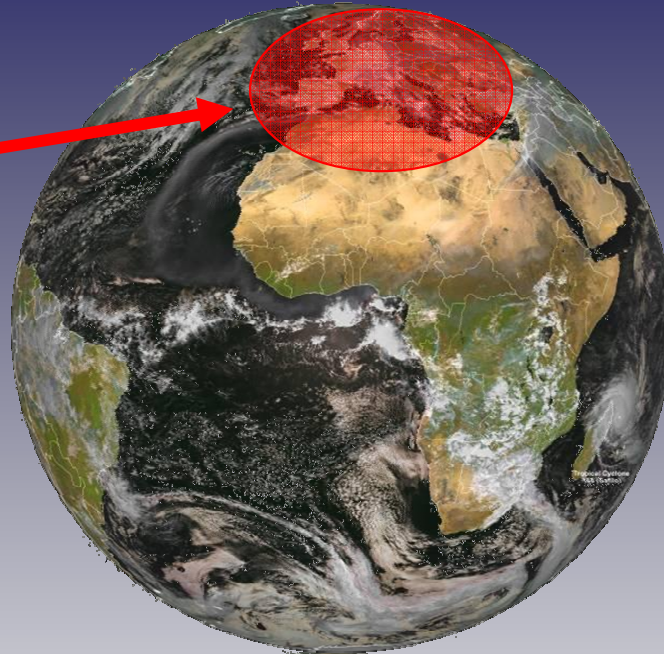


# Space-Time coverage

NOAA & EOS receiving station  
at IMAA

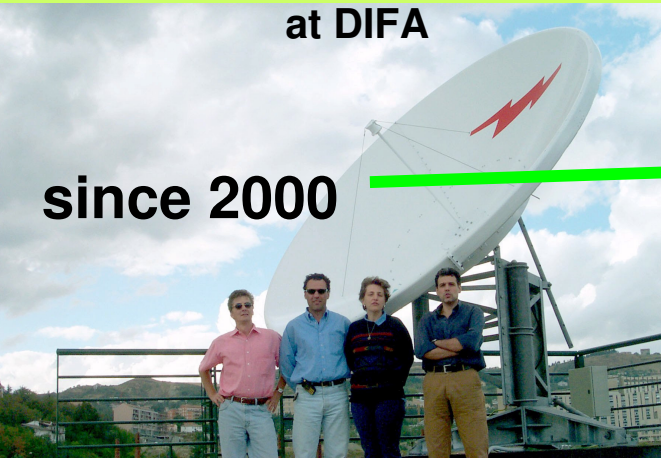


one image  
each 3-6 hours

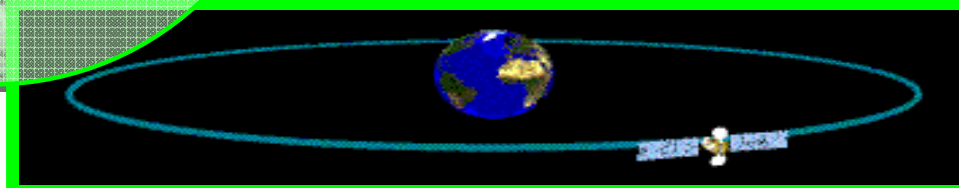
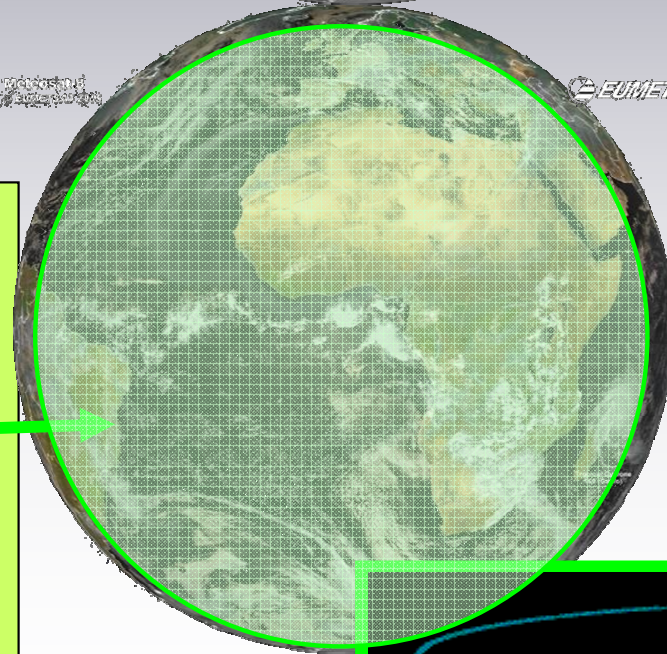


Meteosat & MSG receiving station  
at DIFA

since 2000



one image  
each 15 minutes





# Education on Spatial Technologies at the University of Basilicata



- 4 courses at University of Basilicata (Potenza & Matera campus)
- 2 PhD schools at DIFA
- more than 100 young specialists educated in the last 5 ys

The DIFA-IMAA Group on Advanced Satellite Techniques for Environmental Monitoring (GASTEM)

22.12.2008 05:36





# Education for public administrations



Course on Spatial Technologies on forest fires monitoring  
for Lombardia Region Civil Protection personnel and volunteers

Potenza-UNIBAS-March 2007





# Education on Spatial Technologies for foreign students/researchers

Organized in cooperation with:

- the Abdus Salam International Centre of Theoretical Physics (Trieste)
- IEEE (Geosciences and Remote Sensing)
- EC & GMOSS Network of Excellence



# Exporting knowledge and best practices



SCO initiative for the start-up of  
**South Caucasus Observatories and  
Tbilisi Satellite Station**

Georgian landscape





# Main published papers relevant to this topic

## Main publication on RAT-RST approach in International Journals and Books

1. V. Tramutoli: Robust AVHRR Techniques (RAT) for Environmental Monitoring: theory and applications. in *Earth Surface Remote Sensing II*, Giovanna Cecchi, Eugenio Zilioli, Editors, Proceedings of SPIE Vol. 3496, pp.101-113, 1998.
2. V. Cuomo, R. Lasaponara, V. Tramutoli: Evaluation of a new satellite-based method for forest fire detection *International Journal of Remote Sensing*, 22 (9), 1799-1826, 2001.
3. Pergola N, Tramutoli V., Scaffidi I., Lacava T., Marchese F.: Improving volcanic ash clouds detection by a robust satellite technique. *Remote Sensing of Environment* Vol. 90 (1), pp. 1-22, 2004.
4. Pergola N, Tramutoli V., Marchese F.: Automated detection of thermal features of active volcanoes by means of Infrared AVHRR records. *Remote Sensing of Environment* 93, 311-327, 2004.
5. Cuomo V., Filizzola C., Pergola N., Pietrapertosa C., Tramutoli V.: A self-sufficient approach for GERB cloudy radiance detection. *Atmospheric Research*, 72 (1-4), 39-56, 2004.
6. A. Bonfiglio, M. Macchiato, N. Pergola, C. Pietrapertosa, V. Tramutoli: AVHRR Automated detection of volcanic clouds. *International Journal of Remote Sensing*, 26(1), 9-27, 2005.
7. Tramutoli, V., Cuomo, V., Filizzola, C., Pergola, N., Pietrapertosa, C.: Assessing the potential of thermal infrared satellite surveys for monitoring seismically active areas. The case of Kocaeli (İzmit) earthquake, August 17th, 1999, *Remote Sensing of Environment*, 96 (3-4), 409-426, 2005.
8. Lacava, T., Cuomo, V., Di Leo, E. V., Pergola, N., Romano, F. and Tramutoli, V., Improving soil wetness variations monitoring from passive microwave satellite data: the case of April 2000 Hungary flood. *Remote Sensing of Environment*, 96/2, 135-148, 2005.
9. Genzano N., Aliano C., Filizzola C., Pergola N., Tramutoli V., A robust satellite technique for monitoring seismically active areas: the case of Bhuj - Gujarat earthquake. *Tectonophysics*, 431, 197-210, doi:10.1016/j.tecto.2006.04.024, 2006
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11. Tramutoli V., Jasani B., Pergola N., Filizzola C., Casciello D., Lacava T. (2008). "Early Warnings and Alerts" in Remote Sensing from Space - Supporting International Peace and Security, Jasani, B., Pesaresi, M., Schneiderbauer, S., Zeug, G., editors, GMOSS Book Vol.1, Elsevier, 2008, (in press).
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