ANOMALIE PRESISMICHE NEI SEGNALI RADIO VLF-LF IN OCCASIONE DEL TERREMOTO D'ABRUZZO

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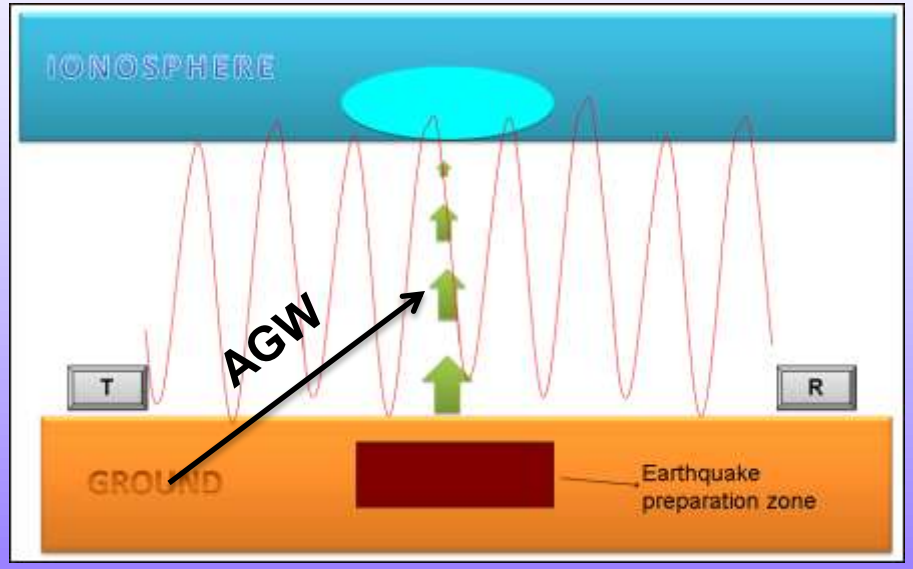
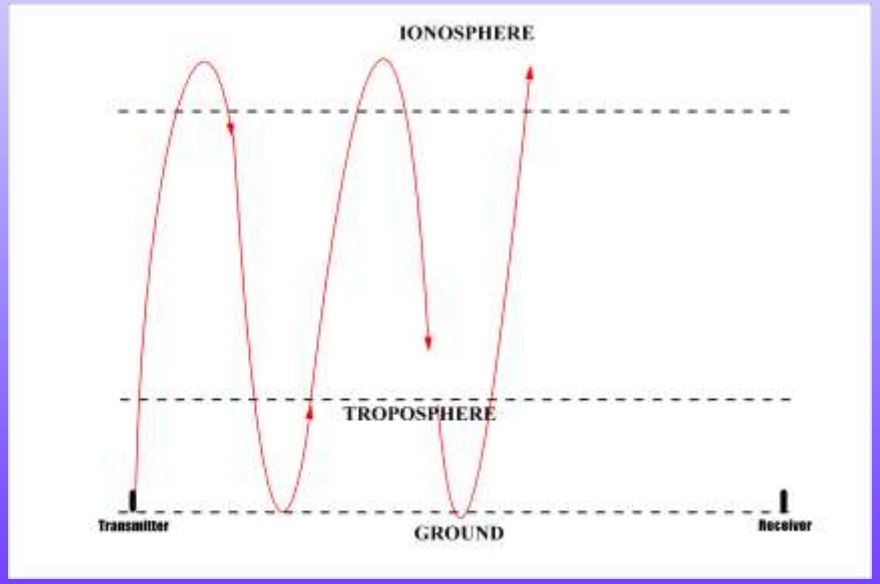
2) Dipartimento di Ingegneria meccanica, Università di Roma Tor Vergata

SEGNALI RADIO VLF



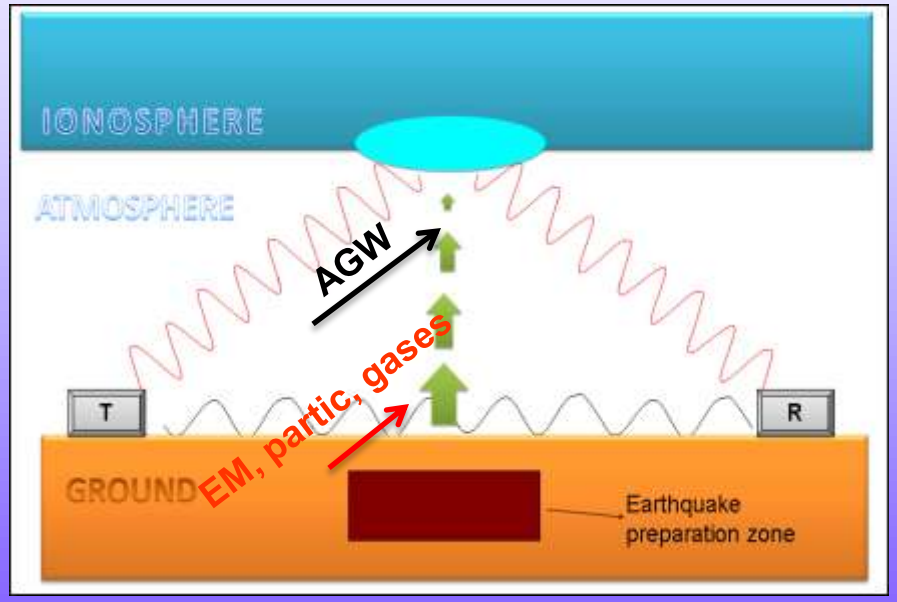
SEGNALI CON FREQUENZA 15-60 kHz USATI PER IL SEGNALE ORARIO, PER RADIO NAVIGAZIONE E PER SCOPI MILITARI.

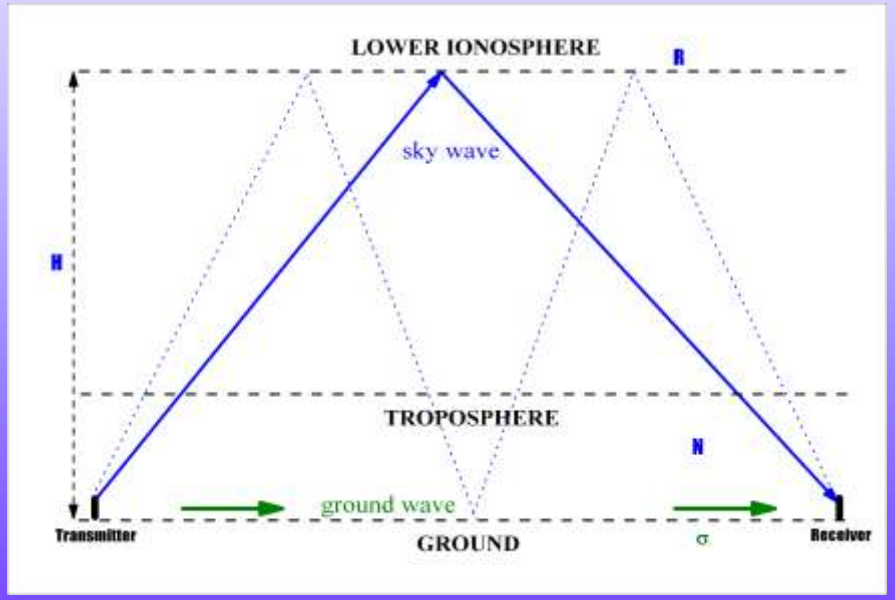


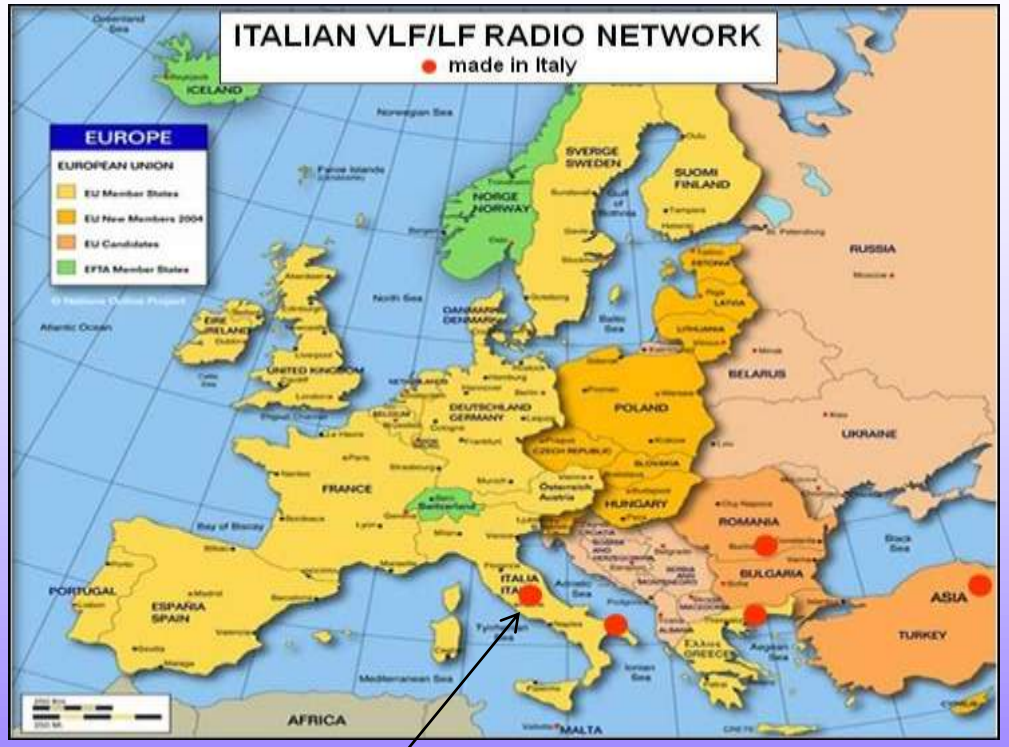
Rete in funzione in questa versione dal Novembre 2008, ma il ricevitore italiano è operativo dal 2001.

SEGNALI RADIO LF

SEGNALI CON FREQUENZA150-300 kHz TUTTORA UTILIZZATI DA ALCUNE STAZIONI DI RADIODIFFUSIONE.

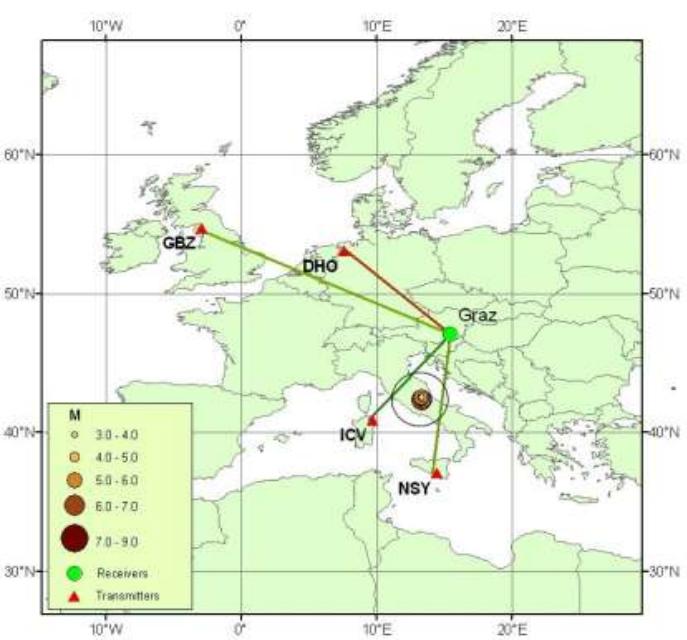




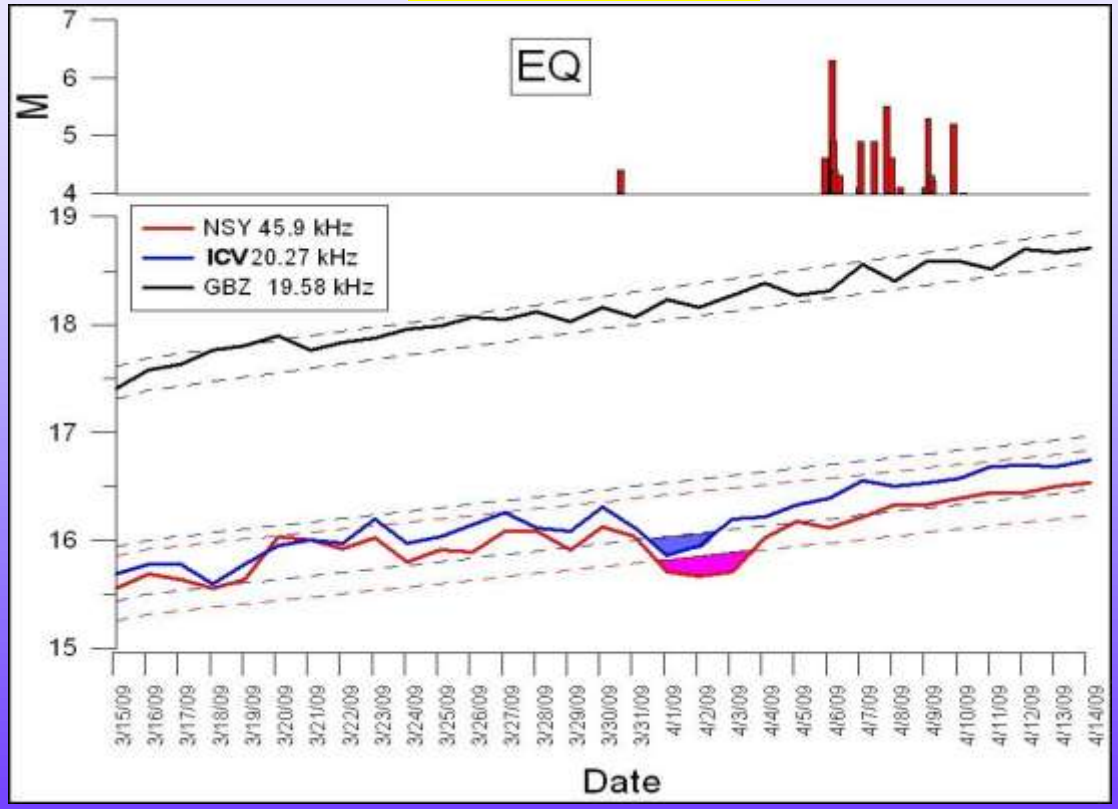


Rete messa in funzione nel Marzo-Aprile 2009.
Il ricevitore in Italia centrale (grotta Amare) ha sostituito un vecchio strumento installato nel 1992.

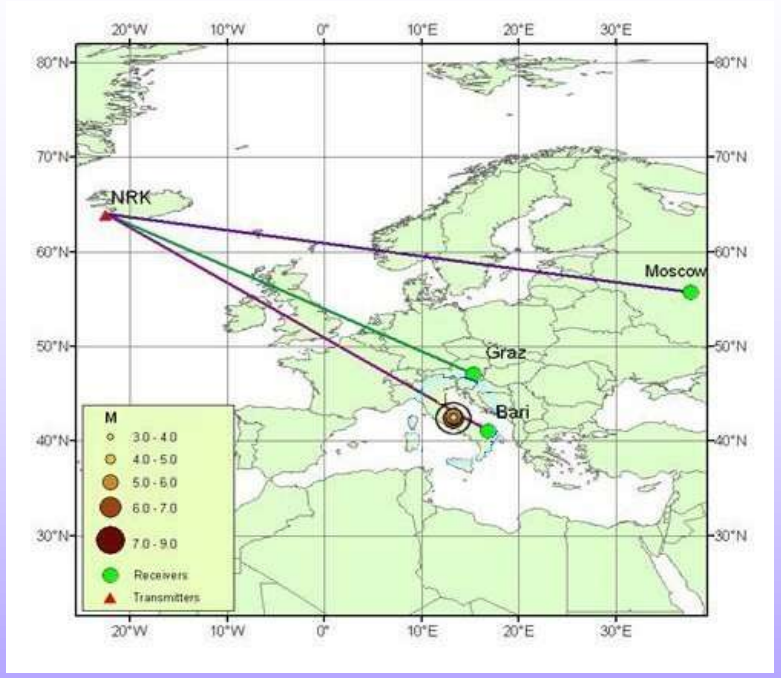
ANOMALIE VLF

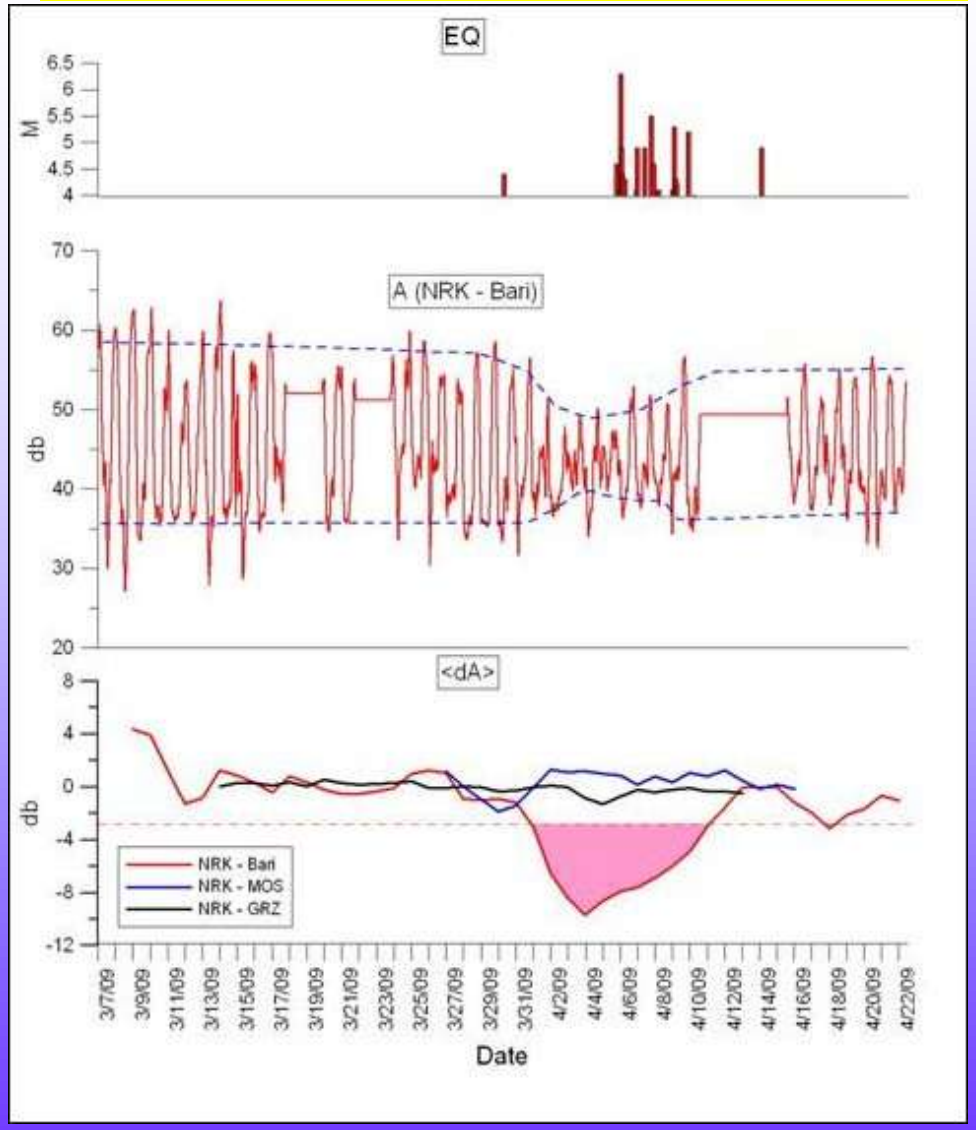


METODO TT

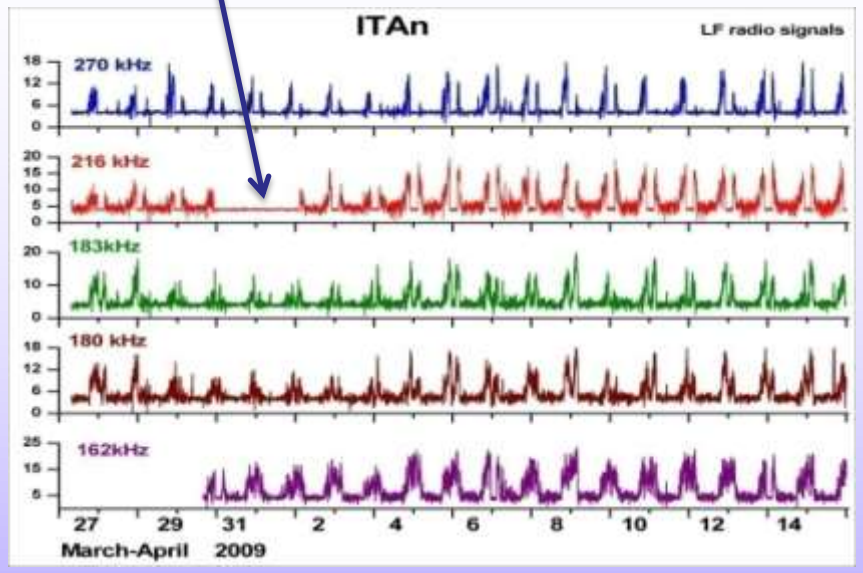


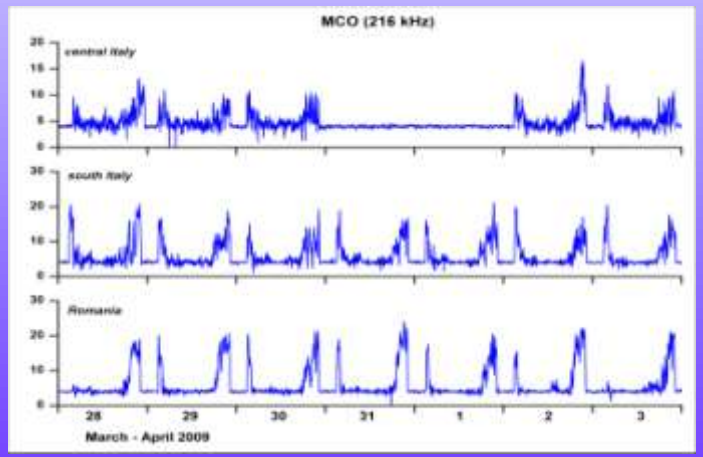
METODO DELL'AMPIEZZA NOTTURNA

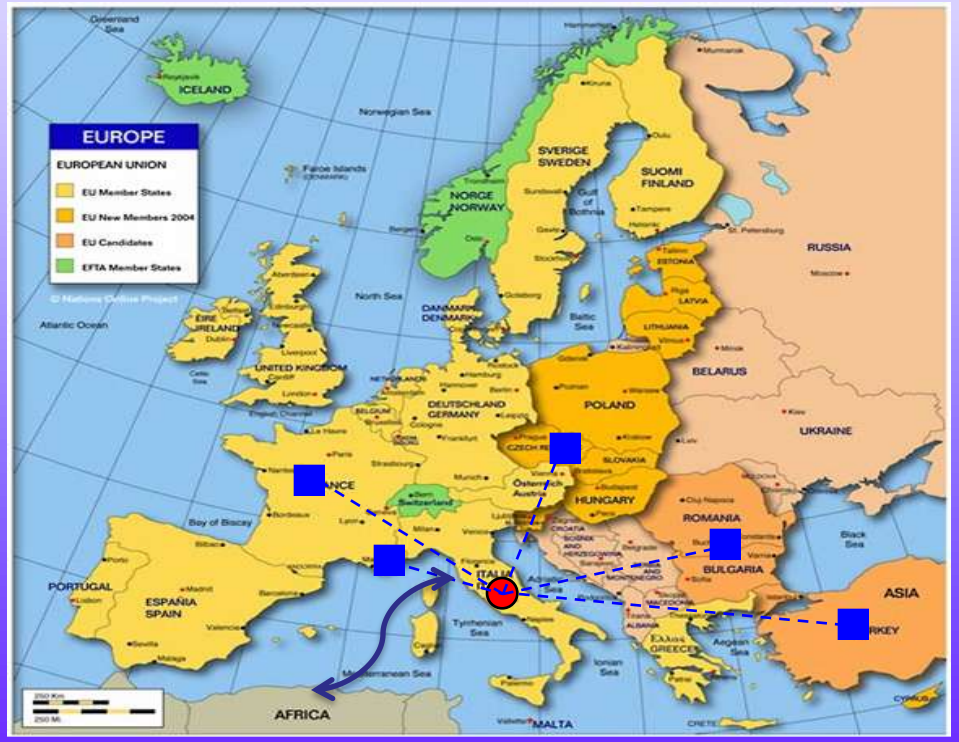


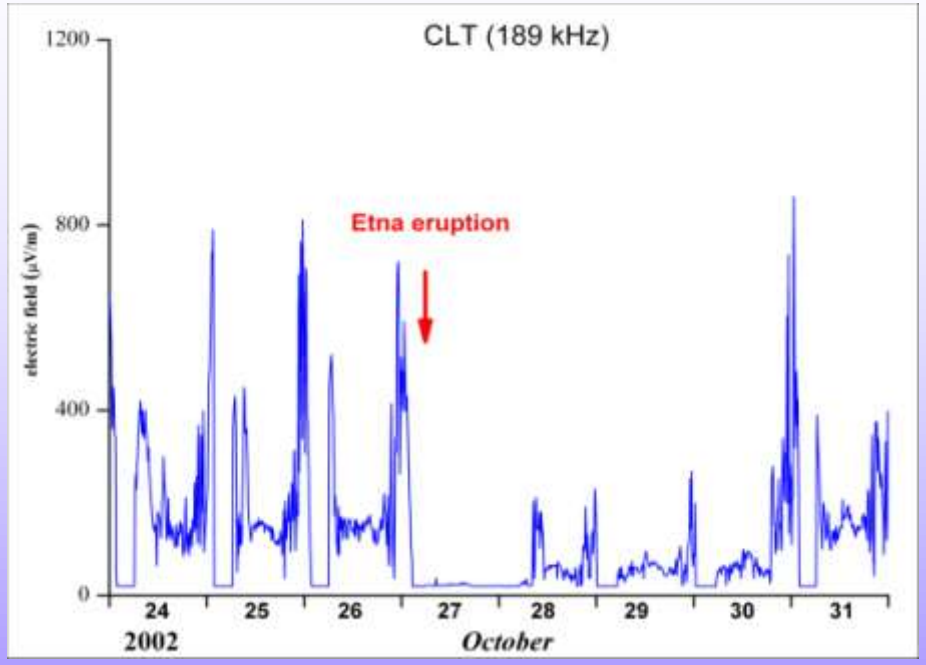


ANOMALIA LF


ITAn
LF radio signals
270 kHz
216 kHz
183kHz
180 kHz
162kHz
27 29 31 2 4 6 8 10 12 14
March-April 2009


MCO (216 kHz)
central Italy
south Italy
Romania
26 29 30 31 1 2 3
March - April 2009


EUROPE
EUROPEAN UNION
EU Member States
EU New Members 2004
EU Candidates
EFTA Member States
ICELAND
NORGE NORWAY
SVERIGE SWEDEN
SUOMI FINLAND
RUSSIA
BELARUS
UKRAINE
POLAND
DEUTSCHLAND GERMANY
UNITED KINGDOM
HUNGARY
ROMANIA
BULGARIA
PORTUGAL
ESPAÑA SPAIN
AFRICA
ASIA
MALTA


CLT (189 kHz)
1200
800
400
0
electric field (μV/m)
Etna eruption
24
25
26
27
28
29
30
31
2002
October


CZECH
REPUBLIC
CZE
270 kHz
FRANCE
ITALY
MCO
216 kHz
AS
189 kHz
CLT
100 km

Nat. Hazards Earth Syst. Sci., 10, 215–216, 2010
www.nat-hazards-earth-syst-sci.net/10/215/2010/

Natural Hazards and Earth System Sciences

Brief communication

"A pre seismic radio anomaly revealed in the area where the Abruzzo earthquake (M=6.3) occurred on 6 April 2009"

P. F. Biagi[1,2], L. Castellana[1], T. Maggipinto[1], D. Loiacono[1], L. Schiavulli[1], T. Ligonzo[1], M. Fiore[3], E. Suciu[4], and A. Ermini[5]

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Abstract. We report the information that in the days of the radio anomaly presented in the paper Biagi et al. (2009) an interruption of the broadcasting from the transmitter (RMC, France) happened. It remains unclear if the action resulted in a complete power off of the system, or in a reduction in the radiated power, and if this has affected France only, or every direction. Should a complete power off have occurred, the proposed pre-seismic defocusing is inexistent. Our doubts on this action are reported.

1 Facts and comment

In a recent paper in this journal (Biagi et al., 2009), we reported an anomaly in the intensity of the Radio Monte Carlo (RMC, f=216 kHz, Roumoules, France, referred to as MCO in the paper) signal in the period from 31 March to 1 April 2009. The anomaly was revealed by a receiver in operation at the Amare cave, that is located in the area affected by the recent L'Aquila (central Italy) earthquake (M=6.3). In the paper, we excluded the possibility that the anomaly was related to the transmitting station, because in the considered period the receivers in Bari (southern Italy) and in Bucharest (Romania) received normally the same signal (Fig. 6 in Biagi et al., 2009). We attributed the anomaly (drop) in the radio signal to a defocusing of the signal radiated by the RMC station and we proposed that this was evidence for a precursor of the L'Aquila earthquake.

Recently, we became aware of new information. Specifically, the DX Listening Digest 9-031 of 8 April 2009 (available at http://www.w4uvh.net/dxld9031.txt) reports that "*... RMC on 216 kHz from Roumoules, France, ... was off the air on 31 March and 1 April. ... on Wednesday morning at 03:00 UT RMC* [was] *back on the air*". A manager said, "*... it was a "test" from RMC to know if there are still people who listen to 216 kHz. ... As they received complaints, the frequency is still in use. If no complaints were received the transmitter was off for good...*". In addition, the Italian blog on radio information "radiolawendel.blogspot.com" reports that "*France may have arranged the power-off of the long-waves transmitter in Roumoules that RMC uses for covering the entire French territory...*" (http://radiolawendel.blogspot.com/2009/04/francia-rmc-il-tribunale-spegne-i-216.html, original text in Italian). To a written request of one of our colleague, the Radio Monte Carlo Office replied that in the two-days period between 31 March and 1 April 2009, the RMC transmitter in Roumoules was under maintenance.

In any case it remains unclear if the action resulted in a complete power off of the system, or in a reduction in the radiated power, and if this has affected France only, or every direction.

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(biagi@fisica.uniba.it)

SIMULAZIONE DI PREVISIONI SISMICHE

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2) Dipartimento di Ingegneria meccanica, Università di Roma Tor Vergata

PREVISIONE DI UN TERREMOTO

DEFINIRE IL TEMPO DI AVVENTO

ENTRO 10-15 GIORNI

DEFINIRE LA LOCALITA'

ENTRO UN CERCHIO DI DIAMETRO DELL'ORDINE DI QUALCHE DECINA DI KILOMETRI

DEFINIRE LA MAGNITUDO

CON UNA INCERTEZZA DELL'ORDINE DI 0.5

Dipartimento Interuniversitario di Fisica

CONFERENZA

PREVISIONE DEI TERREMOTI: STATO DELL'ARTE
I PRECURSORI RADIO E LE RETI DI MONITORAGGIO

Relatori

Prof. PIER FRANCESCO BIAGI
Università di Bari

Prof. MASASHI HAYAKAWA
University of Electro-Communications
Tokyo

Prof. OLEG MOLCHANOV
Institute of Physics of the Earth
Mosca

Martedì 23 Settembre 2008 ore 17.00
Sala Convegni F.C.R.P.
Viale della Repubblica 111

Seismologist's Prediction of Sichuan Quake Ignored

The same night of Sichuan's May 12 earthquake, Chinese scientist LI Shihui revealed on his blog that Chinese seismologist Geng Qingguo accurately predicted the quake and warned authorities about the disaster in late April. According to LI, Geng's report was ignored by Chinese authorities.

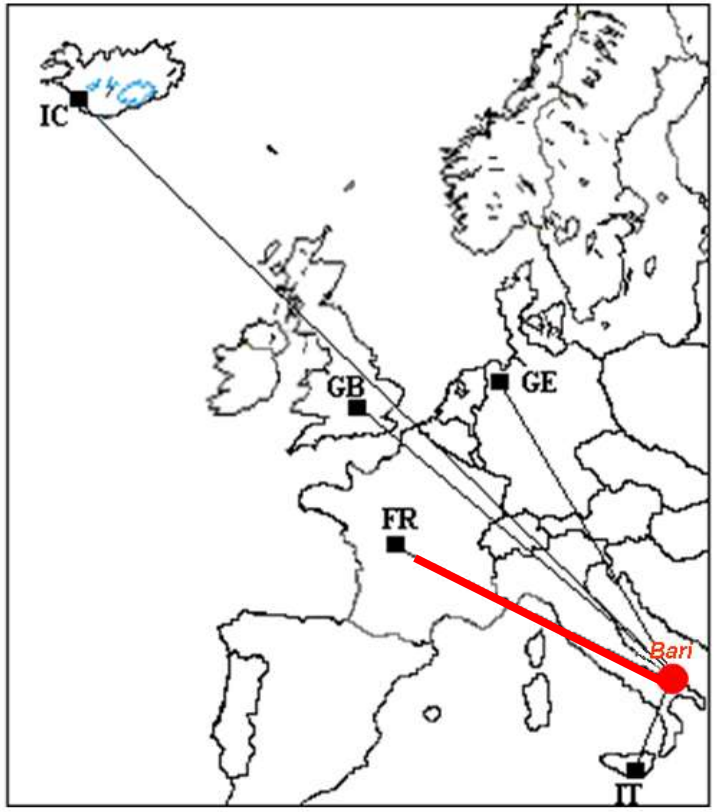
BBC

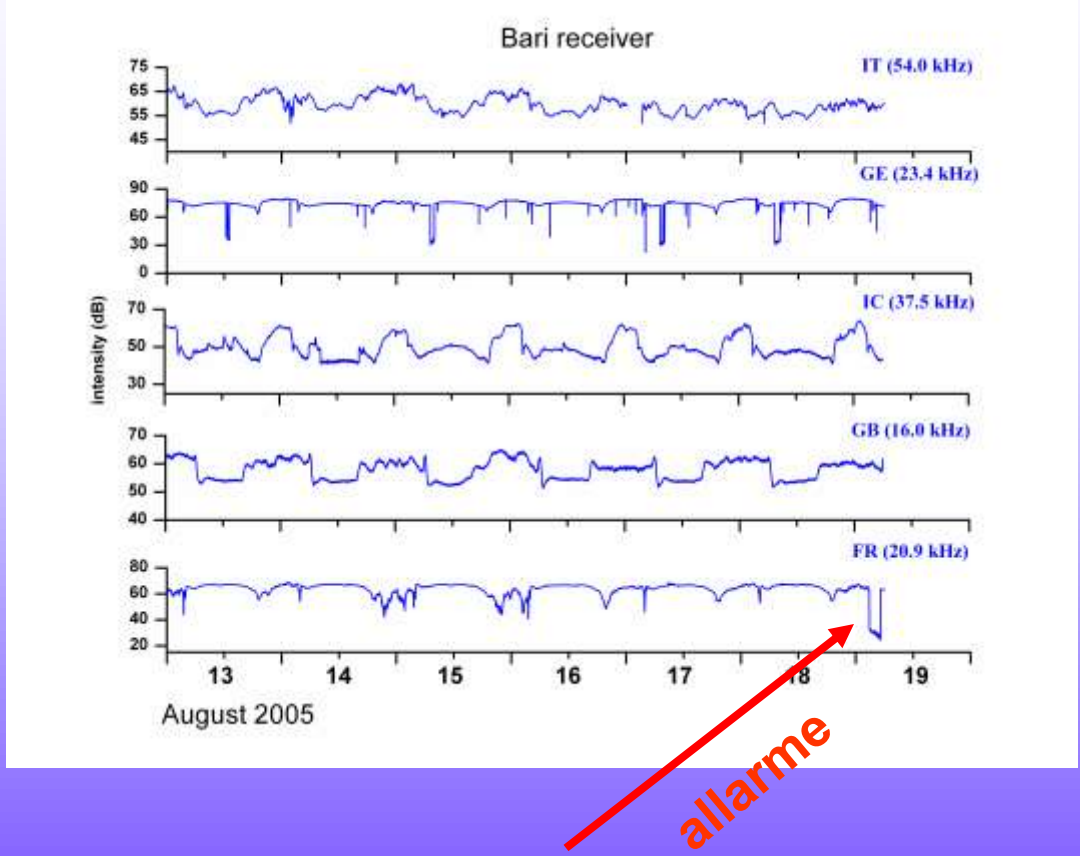
Plan for quake 'warning system'

Nasa scientists have said they could be on the verge of a breakthrough in their efforts to forecast earthquakes.
Researchers say they have found a close link between electrical disturbances on the edge of our atmosphere and impending quakes on the ground below. Just such a signal was spotted in the days leading up to the recent devastating event in China.

Many in the scientific community remain deeply sceptical about whether such signals are indeed indicators of an approaching earthquake.

SEGNALI RADIO VLF





Immaginiamo di essere nell'agosto 2005 e di esaminare i dati giorno per giorno.

In uno studio precedente erano state analizzate simili diminuzioni di intensità dei segnali radio VLF campionati a Bari durante 4 anni.

Nat. Hazards Earth Syst. Sci., 7, 423–430, 2005

Decrease in the electric intensity of VLF/LF radio signals and possible connections with the seismicity

P. F. Biagi, L. Castellana, T. Maggipinto, G. Maggipinto, A. Minafra, A. Ermini, V. Capozzi, G. Perna, M. Solovieva, A. Rozhnoi, O. A. Molchanov, and M. Hayakawa

SONO STATE INDIVIDUATE 8 DIMINUZIONI DI INTENSITA' DEL TIPO IN ESAME.

In 6 casi la connessione con la sismicità si è rivelata la spiegazione migliore e l'effetto principale è stato presismico.

In 1 caso è apparsa evidente una connessione con l'attività geomagnetica planetaria.

In 1 caso non è apparsa alcuna spiegazione convincente ma probabilmente la diminuzione era imputabile al trasmettitore.

Nel caso in esame l'attività geomagnetica (ottenibile on-line) si è rivelata normale. Allora, immaginandosi nell'agosto 2005, la probabilità che la diminuzione apparsa nel segnale radio FR potesse essere un precursore sismico sarebbe stata elevata.

Così poteva essere ragionevole provare a formulare una previsione procedendo passo passo.

PRIMO PASSO

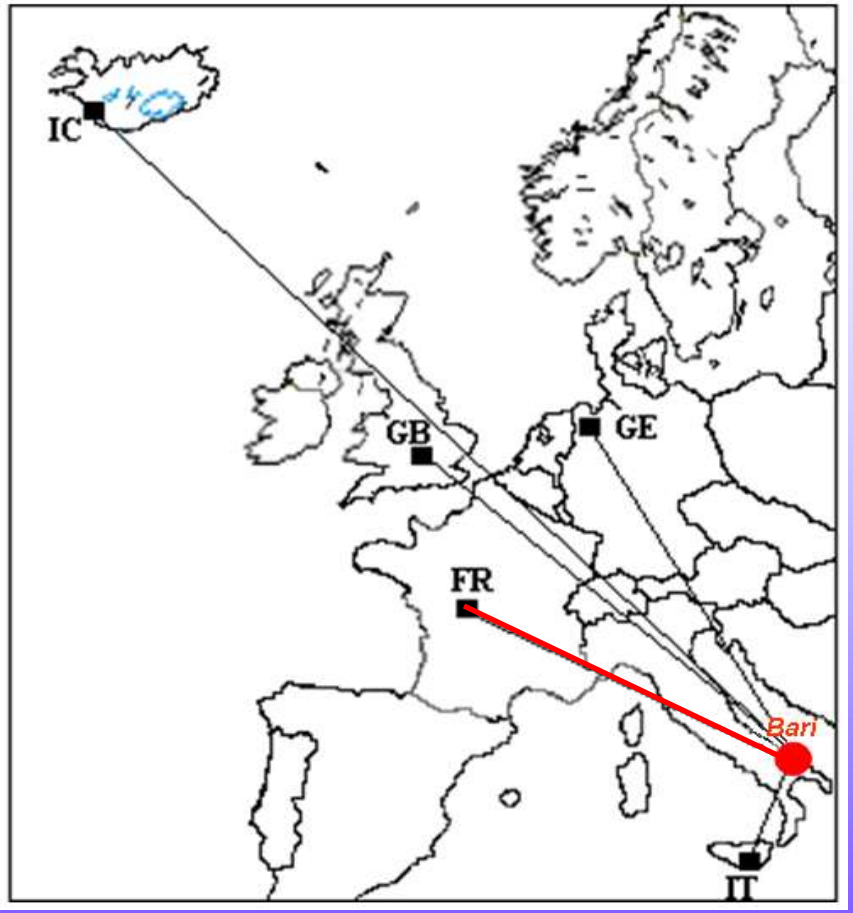
DEFINIRE IL TEMPO DI AVVENTO DEL TERREMOTO

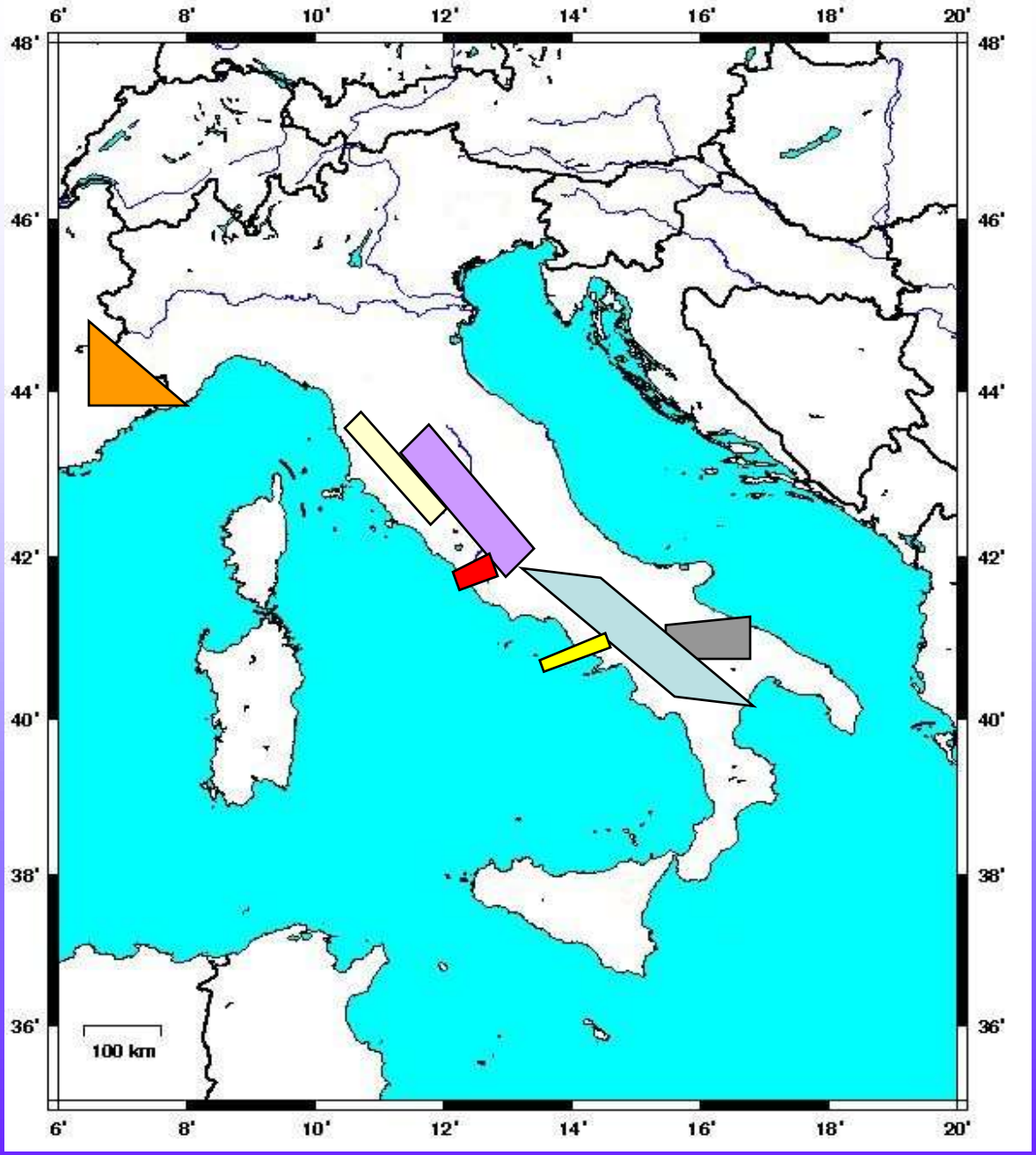
I risultati ottenuti da noi e da altri ricercatori (Molchanov, Hayakawa, Rozhnoi) negli ultimi 15 anni, hanno indicato un ritardo dell'avvento del terremoto, dopo l'inizio di anomalie nei segnali radio VLF-LF, variabile da 1 a 10 giorni.

entro 10 giorni al massimo

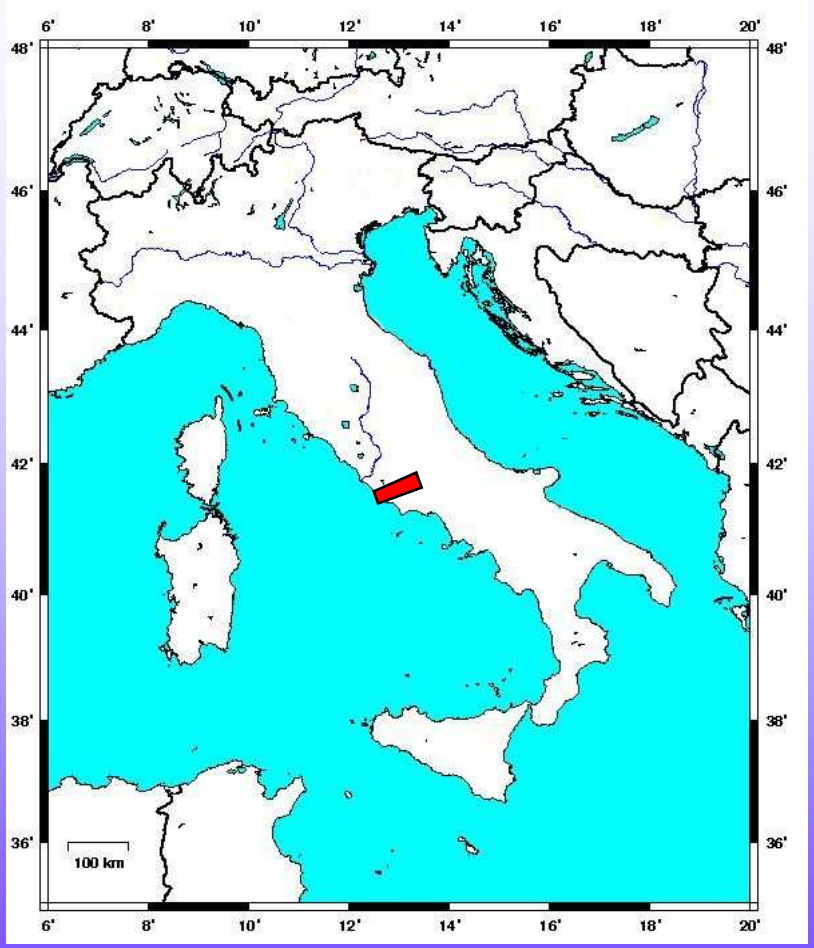
SECONDO PASSO

DEFINIRE LA LOCALITA' DEL TERREMOTO


IC
GB
GE
FR
Bari
IT


6'
8'
10'
12'
14'
16'
18'
20'
48'
46'
44'
42'
40'
38'
36'
100 km

Negli stessi giorni, una ulteriore informazione si sarebbe potuta acquisire e cioè una anomala emissione di gas Rn rivelata da una stazione INGV per la studio della radioattività ambientale situata nella zona di Anzio (Roma).

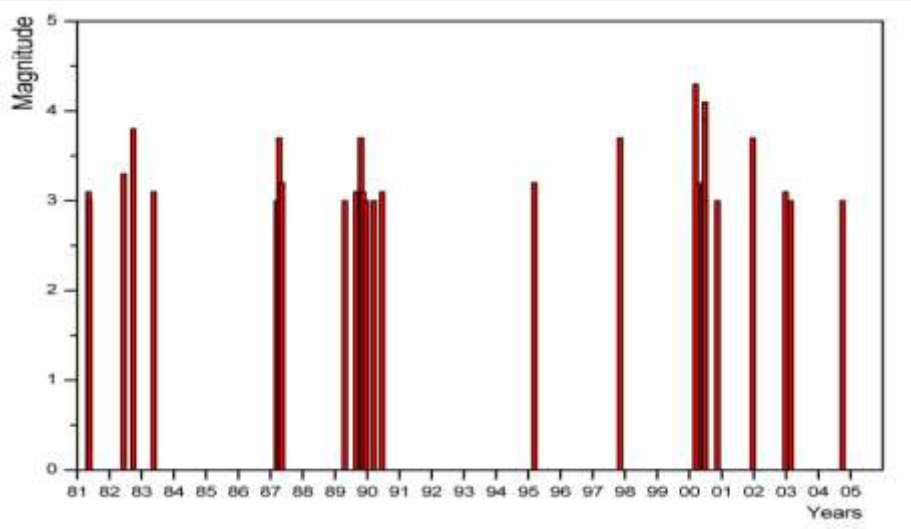


Così, fra le varie zone sismogenetiche indicate, poteva essere ragionevole scegliere questa.

TERZO PASSO

INDICARE LA MAGNITUDO DEL TERREMOTO

L'ANALISI DELLA SISMICITA' NELL'AREA NEGLI ULTIMI 25 ANNI HA RIVELATO UNA MODERATA ATTIVITA' CON UN MASSIMO VALORE DI M DI 4.3.



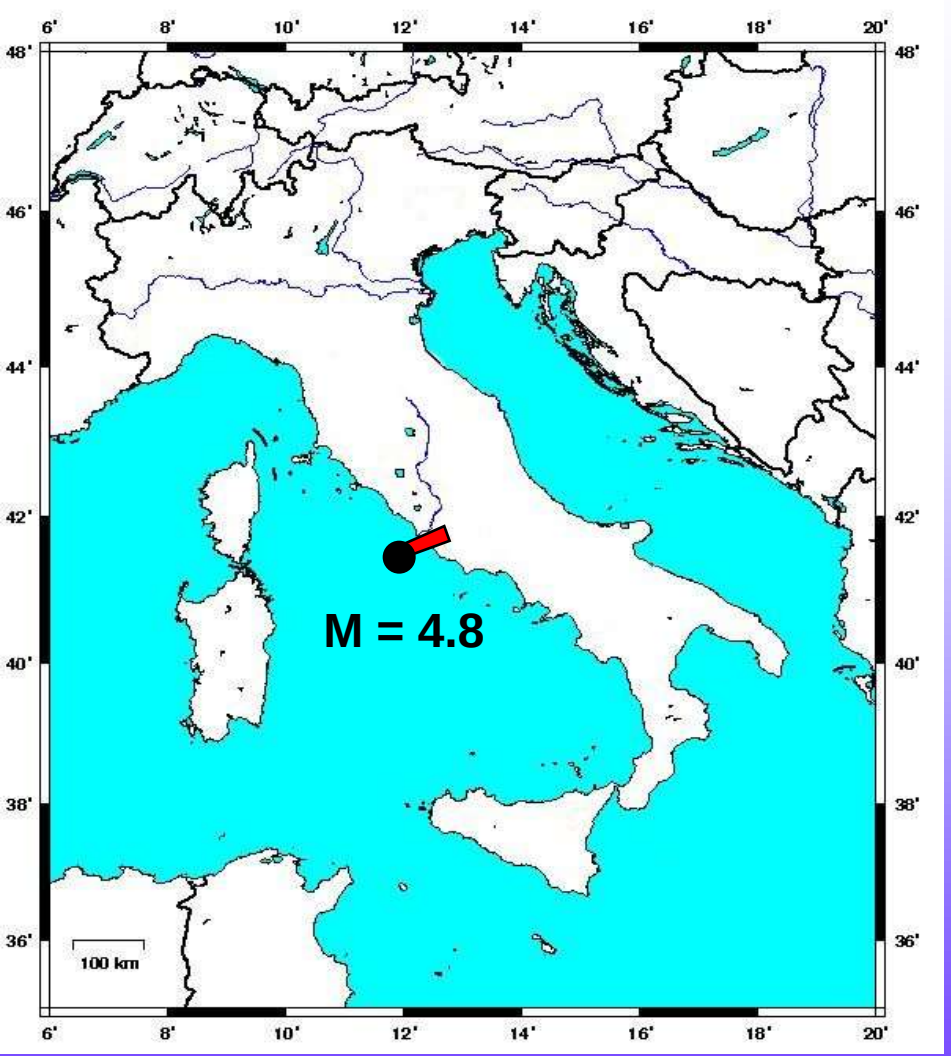
L'ANALISI DELLA SISMICITA' DAL 1950 AL 1980 HA EVIDENZIATO UNA CRISI SISMICA CON MASSIMA M PARI A 5.0.
D'ALTRA PARTE ANOMALIE NEI SEGNALI RADIO SONO STATE EVIDENZIATE DA UNA M MINIMA DI 4.5.

M = 4.5 - 5.0

anomalia radio 19 agosto 2005 + Radon

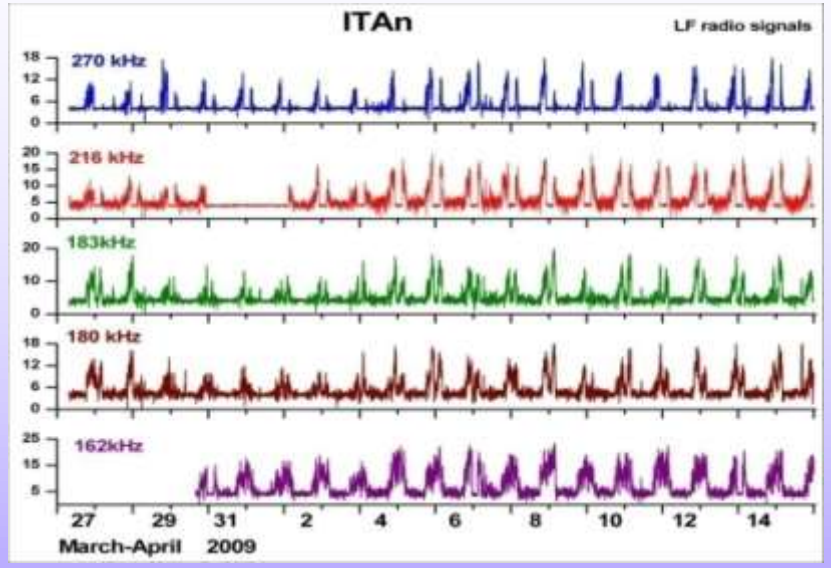
Previsione

a) entro 10 giorni
b) nella zona indicata
c) M=4.5-5.0



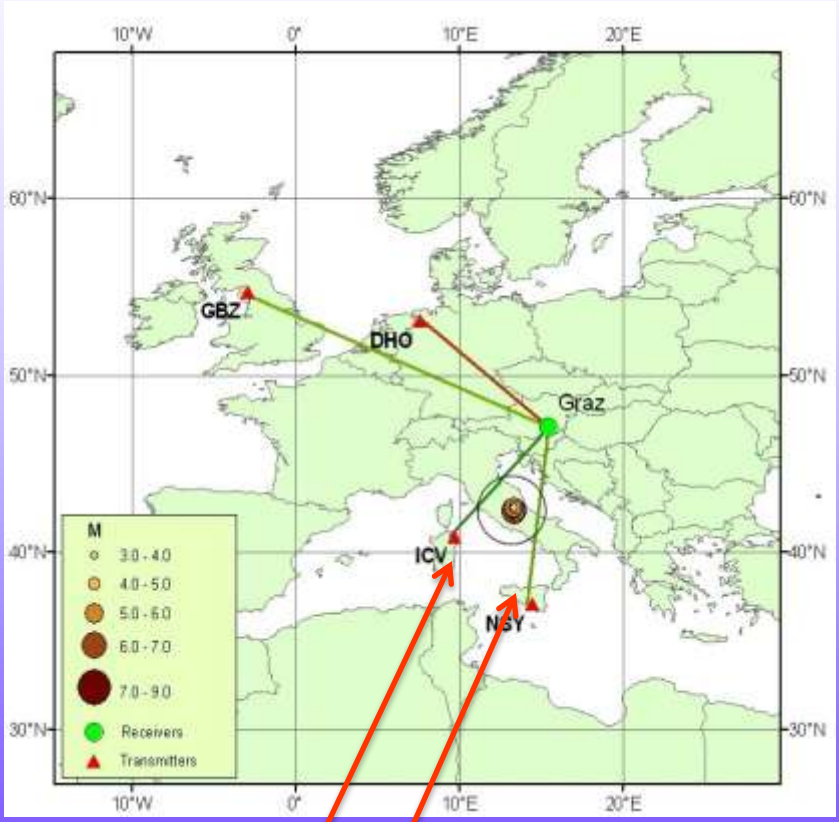
ore 12.00 del 22 agosto 2005

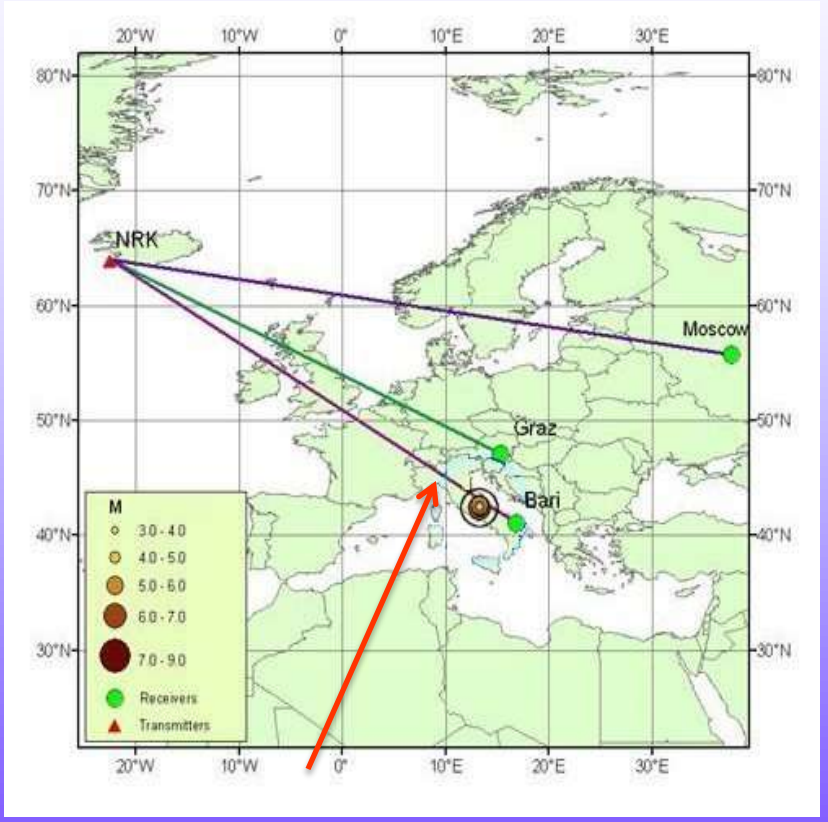
SEGNALE LF



anomalia iniziata il 31/03

SEGNALI VLF





anomalie iniziate il 31/03

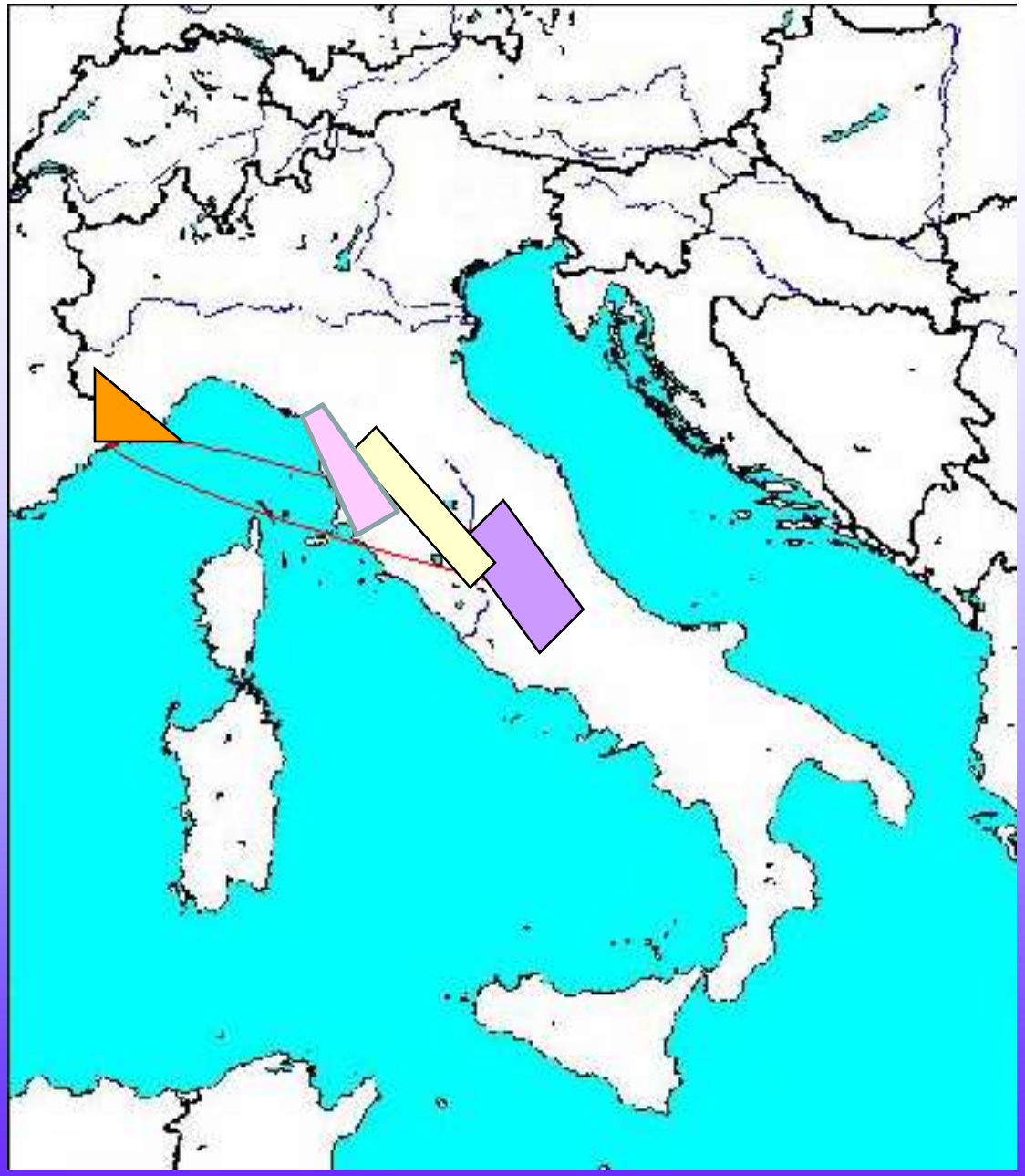
Primo passo

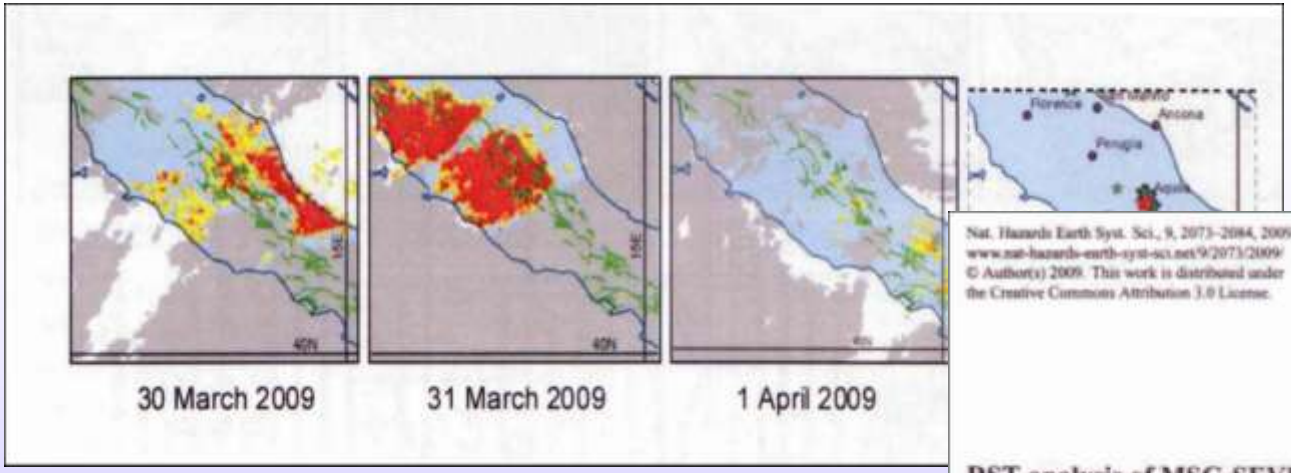
DEFINIRE IL TEMPO DI AVVENTO DEL TERREMOTO

entro 10 giorni al massimo

Secondo passo

DEFINIRE LA LOCALITA' DEL TERREMOTO





Nat. Hazards Earth Syst. Sci., 9, 2073–2084, 2009
www.nat-hazards-earth-syst-sci.net/9/2073/2009/

Natural Hazards and Earth System Sciences

RST analysis of MSG-SEVIRI TIR radiances at the time of the Abruzzo 6 April 2009 earthquake

N. Genzano[1], C. Aliano[1], R. Corrado[1], C. Filizzola[2], M. Lisi[1], G. Mazzeo[1], R. Paciello[2], N. Pergola[2,1], and V. Tramutoli[1,2]

[1]University of Basilicata, Department of Engineering and Physics of the Environment, Potenza, Italy
[2]National Research Council, Institute of Methodologies for Environmental Analysis (IMAA), Tito Scalo (PZ), Italy

Received: 31 October 2009 – Accepted: 10 November 2009 – Published: 11 December 2009

6 Conclusions

In this paper, the RST analysis has been applied for the first time to thermal image acquired by SEVIRI sensor on board MSG satellites, in order to verify the possible space-time relationships among TIR anomalies appearance and seismic events occurrence. The Abruzzo earthquake (6 April 2009, M_L ~5.8) has been considered as a test case for validation, while a relatively unperturbed period (no earthquakes with $M \geq 5$) was taken for confutation in the same months (March-April) of a different year (2008).

The validation/confutation approach puts in relief that thermal anomalies with RETIRA >4 (the highest relative intensity and S/N observed until now) appear in the central part of Italy five days before the main shock of Abruzzo earthquake (6 April 2009, M_L ~5.8). No similar anomalies have been observed in the absence of earthquakes in similar observation conditions in the period (March–April 2008) considered for confutation.

The possible relation between TIR anomalies appearance and medium-low magnitude earthquakes, already documented by previous work (e.g. Corrado et al., 2005) is confirmed, in fact TIR anomalies persistent in the space-time domain have been observed in Italy from few days to few weeks before seismic events of medium-low magnitude (Calabria, 8 April 2008, M_L ~4.0; Forlì, 5 April 2009, M_L ~4.6; Ibis, 19 April 2009, M_L ~3.9;) and in the Balkan region both before and after an earthquake of M_L =4.2 here occurred on 31 March 2009.

An original approach to identify and exclude TIR anomalies purely due to the effect (already described in Aliano et al., 2008a) of cloud cover and spatial distribution was proposed. Nevertheless the presence of clouds continue to limit the possibility to well investigate space-time persistence of TIR anomalies.

The use of passive MicroWave (MW) sensors could help to overcome such limitations. In fact, this kind of electromagnetic radiation, by penetrating (not raining) clouds, allows us to observe Earth's surface in any weather conditions. Even if passive MW sensors operate with a spatial resolution (10–50 km nadir view), which is much lower than the one (1–5 km) achievable by TIR sensors, such spatial resolution remains largely sufficient to monitor thermal anomalies we observed always at a wider scale around the epicentre zone.

Acknowledgements. The authors wish to thank the Aeronautica Militare Italiana for its support to have access to MSG-SEVIRI data used in this work.

Edited by: P. F. Biagi
Reviewed by: two anonymous referees

References

Aliano, C., Corrado, R., Filizzola, C., Pergola, N., and Tramutoli, V.: Robust Satellite Techniques (RST) For Seismically Active Areas Monitoring: The Case Of 21st May, 2003 Boumerdes/Thenia (Algeria) Earthquake, in: Proceedings of

AGU Fall Meeting 2009

ID# U23C-0046
Location: Poster Hall (Moscone South)
Time of Presentation: Dec 15 1:40 PM - 6:00 PM

Precursory Foreshock Signals before the Abruzzo, Italy, Mainshock (Mw 6.3) of 6 April 2009

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The seismicity before the L'Aquila, Italy, mainshock (Mw 6.4) of 6 April 2009 is analyzed with the purpose to detect precursory foreshock signals. The earthquake catalogue of INGV, Rome, is considered as data source and the analysis is performed in the earthquake area which is a circular area of radius 50 km centered at the mainshock epicenter. This area is large enough not only to cover the rupture zone, determined by the aftershock cloud, but also to allow for some error in the epicentral determinations. To secure homogeneity and low magnitude threshold, Mc, for data completeness, the catalogue segment covering the time interval from 01.01.2006 onwards is considered. The G-R diagram indicates that Mc =1.3 and analysis is performed for events of local magnitude ML ≥1.3. We detect in the earthquake area significant changes of the seismicity rate, r, based on the z-test (highest significance level, p; we set-up minimum at p = 0.95), and of the b-value based on the Utsu-test (highest significance level, P, approaches to 0; we set-up minimum at p = 0.05). The background seismicity terminated by the end of October 2008 when the seismicity rate, r, was found to accelerate significantly. Drastic increase of r was noted in the last 10 days before the mainshock when r increased by a factor of 24 with respect to the rate in the background seismicity. At the same time, the b-value dropped gradually from about 1.1 in the background seismicity to 0.67 in the last 10 days. Then, during the aftershock period it started to recover and by the end of June 2009 it reached around 1.0. The analysis was repeated with the algorithm FORMA (FORshock-Mainshock-Aftershock) specially designed to produce alert levels with time step of 1 day for changes in the states of seismicity on the basis of the concurrent significant variations of r and b. We set-up FORMA to produce four alert levels: green for p ≥ 0.9 and P ≥ 0.1, yellow for p ≥ 0.90 and 0.1 ≥P ≥ 0.05, blue for p ≥ 0.95 and 0.1 ≥P ≥ 0.05, red for p ≥ 0.95 and P ≤ 0.05. The algorithm detected a change in seismicity state at red alert level for 3 days by the end of October 2008. Then, during the foreshock period the alert level varied from yellow to blue and again to yellow but by the beginning of March 2009 the alert from yellow became blue for a few days and from 11 March it turned to red and remained red until the occurrence of the mainshock of 6 April 2009. Our results indicates that in areas of good earthquake monitoring, such the L' Aquila one, seismicity analysis in near real-time conditions may conclude with the detection of foreshock activity and the prediction of the mainshock.

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The preparatory phase of the April 6th 2009, Mw 6.3, L'Aquila earthquake: Seismological observations

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Few decades ago, the dilatancy-diffusion hypothesis held great promise as a physical basis for developing earthquakes prediction techniques, but the potential never become reality, as the result of too few observations consistent with the theory. One of the main problems has been the lack of detailed monitoring records of small earthquakes swarms spatio-temporally close to the incoming major earthquakes. In fact, the recognition of dilatancy-related effects requires the use of very dense network of three-component seismographs, which, in turn, implies the a-priori knowledge of major earthquakes location, i.e., actually a paradox. The deterministic prediction of earthquakes remains a long time, hard task to accomplish. Nevertheless, for seismologists, the understanding of the processes that preside over the earthquakes nucleation and the mechanics of faulting represents a big step toward the ability to predict earthquakes. Here we describe a set of seismological observations done on the foreshock sequence that preceded the April 6th 2009, Mw 6.3, L'Aquila earthquake. In this occasion, the dense configuration of the seismic network in the area gave us the unique opportunity for a detailed reconstruction of the preparatory phase of the main shock. We show that measurable precursory effects, as changes of the seismic waves velocity and of the anisotropic parameters in the crust, occurred before the main shock. From our observations we infer that fluids play a key role in the fault failure process, and, most significantly, that the elastic properties of the rock volume surrounding the main shock nucleation area undergo a dramatic change about a week before the main shock occurrence.

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The Study of Abnormal Variance of Temperature in Abruzzo, Italy M6.3 Earthquake on April 6, 2009

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How to identify the abnormal changes of temperature before earthquakes confronts us with such a critical question as: in which period the reference of background temperature should be chosen. In this paper, the celestial tide stress is used to tackle such problem because it has a triggering action on the activity of a fault for a forthcoming earthquake when the tectonic stress level has reached a critical stage. Also, the data of National Centers for Environmental Prediction is used to analysis the temperature before the earthquake. The method to select the related stage among the amount of periodic changes of the celestial tide stress is put forward and named as ATSCTF(Additive Tectonics Stress from Celestial Tide-generating Force) model. An algorithm is used to get the ATSCTF circles(Figure1). According to these circles and based on NCEP data, we take the temperature values of 1000 hPa(hundred Pa) on the sea surface on March 28 as the normal background (when the ATSCTF value is minimum), then subtract it from the values between March 28 and April 10 to get a time series of images showing the changing of temperature day by day(Figure.2). It can clearly show different stages about activities of Abruzzo's fault under tectonics stress and that before the shocking, abnormally temperature rising is exceptionally obvious. Based on ATSCTF model, it is possible to forewarn short-impending earthquakes.

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Predicting the unpEredictable; evidence of pre-seismic anticipatory behaviour in the common toad

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Keywords
common toad; earthquakes; seismicity; behaviour; reproduction; spawning; ionospheric perturbations; VLF sounding.

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Abstract

The widespread belief that animals can anticipate earthquakes (EQs) is poorly supported by evidence, most of which consists of anecdotal *post hoc* recollections and relates to a very short period immediately before such events. In this study, a population of reproductively active common toads *Bufo bufo* were monitored over a period of 29 days, before, during and after the EQ (on day 10) at L'Aquila, Italy, in April 2009. Although our study site is 74 km from L'Aquila, toads showed a dramatic change in behaviour 5 days before the EQ, abandoning spawning and not resuming normal behaviour until some days after the event. It is unclear what environmental stimuli the toads were responding to so far in advance of the EQ, but reduced toad activity coincides with pre-seismic perturbations in the ionosphere, detected by very low frequency (VLF) radio sounding. We compare the response of toads to the EQ with the reported responses to seismic activity of several other species.

Introduction

Research into the ability of animals to predict large seismic events such as earthquakes (EQs) has been hampered by the rarity and unpredictability of such events. EQs, unlike other natural hazards such as hurricanes and volcanoes, occur without any reliable preceding phenomena (Turcotte, 1990). This precludes the design of experiments to test hypotheses concerning unusual animal behaviour in relation to large seismic events, and most such observations were recollected once the EQ had already occurred (Rikitake, 1981). The inherent variability in the behaviour of animals, and the fact that much of the unusual behaviour seen in animals before EQs is also seen in other contexts, also confuses the overall picture (Buskirk, Frohlich & Latham, 1981). Most animals observed in previous reports have been domestic animals such as dogs, chickens, cows etc. as they are normally in close proximity to human settlements (Buskirk *et al.*, 1981). There have been fewer reports of wild animals in their natural habitat showing seismic predictive behaviour.

Much unusual behaviour shown by animals occurs shortly before an EQ, often coinciding with P-waves, which arrive a few seconds before the damaging S-waves that can be felt by humans (Buskirk *et al.*, 1981). This response to P-waves cannot be termed a predictive response, but rather an 'early warning system' (Kirschvink, 2000). Behaviour occurring several days or weeks in advance of the EQ is rarer. Fish, rodents, wolves and snakes reportedly exhibited strange behaviour up to 2 months before the Tangshan, China EQ (28/7/76, $M = 7.8$) and a month before the Haicheng, China event (4/2/75, $M = 7.3$), but most unusual behaviour occurred within a day or two of the event (Buskirk *et al.*, 1981). Out of 36 EQs occurring between 1923 and 1978 in Europe, Asia and the Americas, most unusual animal behaviour occurred near the epicentre within 1 or 2 days of the EQ and the species primarily reported were domestic. Fish, rodents and snakes were the only animals that showed unusual behaviour more than a week before the event, or at some distance (>50 km) from the epicentre (Buskirk *et al.*, 1981).

There are several possible mechanisms by which the prediction of seismic events by animals may occur. Animals may be able to detect seismic P-waves (which travel faster through the Earth's crust than the subsequent damaging S-waves), EQ lights (anomalous aerial luminosity) or ground tilt, all of which occur seconds to minutes before EQs (Kirschvink, 2000). Groundwater anomalies, increases in humidity and changes in electrical activity may also be detected (Kirschvink, 2000). Geomagnetic anomalies may also be a possible cause, particularly in animals that already have a well-developed magnetoreception system for circadian or navigational purposes (Kirschvink, 2000). Alternatively animals could be detecting raised radon gas levels; there have been many reports of radon anomalies in groundwater before EQs, although they do not occur in 100% of cases (Hauksson, 1981; Steinitz, Begin & Gazit-Yaari, 2003; Walia *et al.*, 2005).

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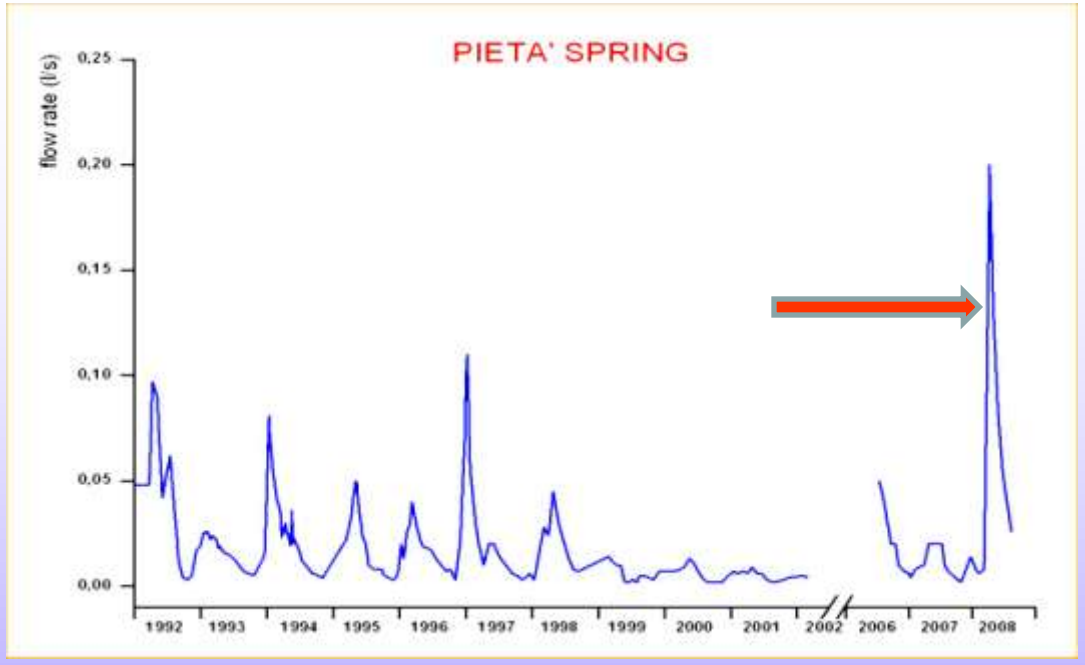
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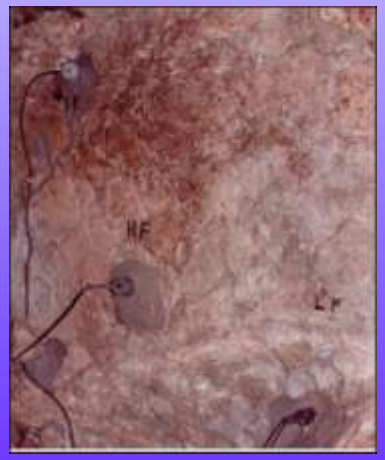
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AGU Fall Meeting 2009

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Search for precursory deformation anomalies preceding the 2009/04/06 L'Aquila earthquake.

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Two crossed 90-m long laser extensometers are operating in the Gran Sasso underground observatory (Central Italy) since several years. The instruments are characterized by very high sensitivity, wide frequency band (from DC up to hundreds of Hz), large dynamic range, and long-term stability (years).
Here we show results from the analysis of two-year-long strain preceding the 2009/04/06 L'Aquila earthquake, to search for clear anomalous strain signals and/or changes in the tidal admittance parameters.
No clear anomalous strain signal has been envisaged during the days before the earthquake. Also seasonal strain changes, mainly induced by seasonal charging and discharging of the aquifer, do not show clear anomalous features. We can not exclude the existence of very small strain anomalies, but they would be orders of magnitude smaller than predicted by the earthquake preparation zone model (Dobrovolsky et al., 1979).
Changes in the tidal admittance have also been indicated as possible earthquake precursors. Signal-to-noise ratio in the tidal band is particularly good in the case of the Gran Sasso extensometers. We have computed the ratio of the observed to the calculated (for a spherical elastic non-rotating Earth) complex amplitude of the M2 tidal component since January 2007. The strain records of both interferometers have been analysed using a 30-day-long moving window, shifted by 10 days. The results exclude any abnormal pre-earthquake behaviour larger than few-percent in amplitude and few degrees in phase.

Volumes and Issues Contents of Issue 2 Special Issue

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The 6 April 2009 earthquake at L'Aquila: a preliminary analysis of magnetic field measurements

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Abstract. Several investigations reported the possible identification of anomalous geomagnetic field signals prior to earthquake occurrence. In the ULF frequency range, candidates for precursory signatures have been proposed in the increase in the noise background and polarization parameter (i.e. the ratio between the amplitude/power of the vertical component and that one of the horizontal component), in the changing characteristics of the slope of the power spectrum and fractal dimension, in the possible occurrence of short duration pulses. We conducted, with conventional techniques of data processing, a preliminary analysis of the magnetic field observations performed at L'Aquila during three months preceding the 6 April 2009 earthquake, focusing attention on the possible occurrence of features similar to those identified in previous events. Within the limits of this analysis, we do not find compelling evidence for any of the features which have been proposed as earthquake precursors: indeed, most of aspects of our observations (which, in some cases, appear consistent with previous findings) might be interpreted in terms of the general magnetospheric conditions and/or of different sources.


Ancona
Arezzo
Perugia
Foligno
Spoleto
Terni
L'Aquila
Pescara
Chieti
Roma
Fiumicino
Latina
Caserta
50 km

Ultimo passo

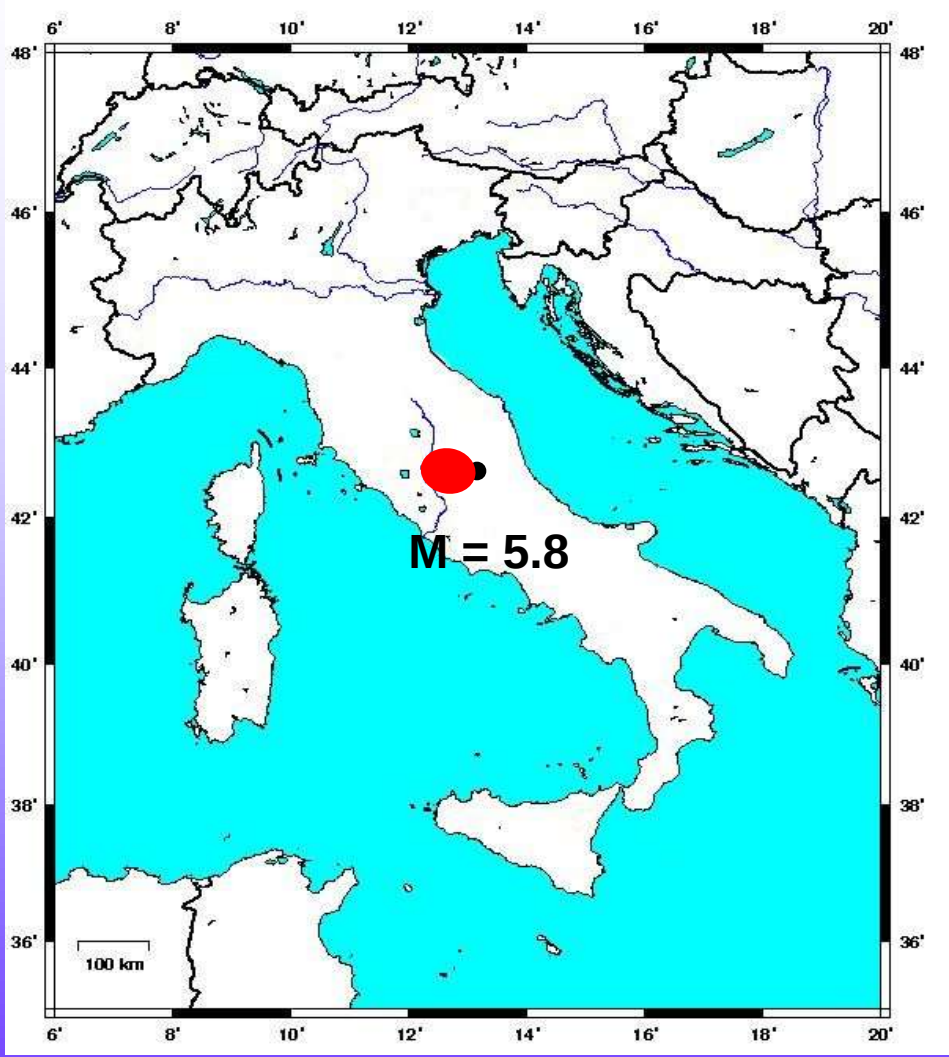
Indicare la magnitudo del terremoto

M=5.0-5.5

anomalie radio 31 marzo 2009+altre indicazioni

PREVISIONE

a) **entro 10 giorni**
b) **area indicata**
c) **M =5.0-5.5**



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