

# Work within the COST Action ELECTRONET on the coupling of the atmospheric electric circuit to earthquakes, lightning and the sun-earth environment

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eLECTRONET



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**Добро јутро**  
**ΚΑΛΗΜΕΡΑ**  
**GOOD MORNING**



**e**LECTRON**ET**



# I am glad to be here in this very sad anniversary

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https://www.tandfonline.com/doi/abs/10.1080/09593332308618341

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Original Articles

## Transport of Toxic Organic Aerosol Pollutants from Yugoslavia to Greece during the Operation "Allied Force"

S. Rapsomanikis, C. Zerefos, D. Melas & N. Tsangas  
Pages 1119-1125 | Published online: 11 May 2010

Download citation <https://doi.org/10.1080/09593332308618341>

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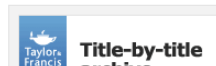
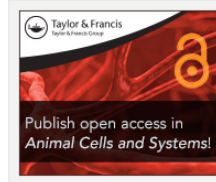
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## Abstract

Between March 24 and June 10, 1999 a large number of chemicals were ejected into the atmosphere because of air strikes on chemical industries and oil storage facilities in former Yugoslavia. Chemicals released into the atmosphere under suitable meteorological conditions can be transported across borders to large distances. The releases may have contained not only conventional air pollutants but also semi-volatile organic compounds (SOCs) which include dioxins, furans, PCBs and PAHs, all known to be hazardous to health. A measuring programme was initiated at Democritus University of Thrace, Greece to monitor the chemical characteristics of atmospheric aerosol during February, March and April 1999. Particulate matter (aerosol) was collected on filters and was analysed using high-resolution gas chromatography coupled to high-resolution mass spectrometry for their content in SOCs. In the present work we show evidence of two events with three to twenty fold increased SOCs in the atmosphere of Northern Greece which were associated with air masses transported from the conflict area, following the destruction of chemical plants and oil storage facilities.

Keywords: Dioxins, furans, PCBs, PAHs, SOCs, Kosovo war

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It is fairly well understood that transboundary pollution of long-lived gases and aerosols is common and can be detected over larger areas, or even across continents. The cases of acid rain from Central Europe and the U.K. reaching Scandinavia (TARASSON, 1998), Sahara dust transport across the Atlantic (TALBOT et al., 1986), and South African bio-mass burning gases and aerosols reaching Australia (FISCHMAN et al., 1996), are well documented in the literature.

## 1 Background

During the 77-day period of air-strikes, a large number of industrial and military facilities was destroyed (VUKMIROVIC, 1999). Despite the large publicity, targeting information is incomplete and quite often contradictory. However, Table 1 was compiled by cross-checking, whenever possible, the available information about destruction of targets that were notable and of importance as to their effects on the environment.

## The War in Kosovo

## State-of-the-Art

**Table 1:** Targets of importance as to their effects in the environment (listed by city). The dates correspond to Local Daylight Saving Time

<b>ALEKSINAC:</b> Industrial zone (28/5)
<b>BACKI PETROVAC:</b> "GELAREVO FARM" oil refinery (15/4, 7/6), "PODUNAVLJE" agricultural and industrial complex (21/4), Industrial zone (21/4)
<b>BARIC:</b> "Prva Iskra" chemical industry (17/4, 19/4, 10/5, 20/5)
<b>BELGRADE:</b> "Sloboda" household appliances factory (4/4), "Beopetrol" storage depots (4/4), "Jugopetrol" storage facilities (16/5, 18/5), "1 JULI" agricultural complex (2/5), Petrol station (1/6), Power supply system (7/5, 31/5), "21 Maj" farm equipment factory (26/5), 2 distribution stations (27/5)
<b>BOGUTOVAC:</b> "Beopetrol" oil product depot (4/4, 8/4, 1/5, 12/5, 25/5), Power house (8/4)
<b>BOR:</b> "Jugopetrol" fuel storage facilities (15/5, 17/5, 21/5, 26/5, 27/5), Mining-Smelting complex (22/5, 26/5), Industrial zone (17/5)
<b>CACAK:</b> "Sloboda" household appliances factory (28/3, 30/3, 4/4, 6/4, 13/4, 27/5), "Cer" factory (10/5, 11/5, 15/5, 18/5), Machinery unit (10/5), "Naftagas" facilities (11/5), "1 October" clothes factory (11/5), Industrial zone (15/5, 17/5), "Jugopetrol" facilities (23/5)
<b>CUKARICA</b> (suburb of Belgrade): "Jugopetrol" storage facilities (18/5, 20/5, 22/5)
<b>CUPRIJA:</b> "Dobricevo" agricultural complex (2/6)
<b>DEVET JUGOVICA :</b> "Beopetrol" fuel storage facilities (6/4)
<b>GNJILANE:</b> "Mladost" agricultural-industrial complex (26/3), Battery factory (10/4, 2/5), Industrial zone (29/5)
<b>KOSTOLAC:</b> "Drmno" thermoelectric power plant (23/5)
<b>KOVILOVO:</b> Petrol station (15/5)
<b>KRAGUJEVAC:</b> "Crvena Zastava" car factory (9/4, 12/4, 15/4)
<b>KRUSEVAC:</b> "14 October" mining equipment and machinery factory (12/4, 15/4), Municipal heating plant (12/4), "Trajal korporacija" factory (14/5)
<b>KURSUMLIJA:</b> "Kapaonic" wood processing works (19/4), "Metalac" production plant (20/4), "Elektrodistribucija" company (20/4)
<b>KRALJEVO:</b> "Beopetrol" fuel storage facilities (24/4, 11/5)
<b>LIPLJAN:</b> "Radioton" factory (6/5)
<b>LIPOVICA:</b> "PLASTIKA" plastics factory (25/3), Fuel storage (26/3 caused a great fire in Lipovica forest)
<b>LUCANI:</b> "Milan Blagojavic" chemical plant (5/4), Chemical industry (water & sewage pipes) (6/4, 8/4)
<b>NIS:</b> "DIN" tobacco factory (5/4, 19/4, 30/5), "ELECTRONSKA INDUSTRIJA" (5/4), "ELECTROTEHNA" warehouse (5/4, 7/4), "Fidelinka" pasta factory (7/4), "Iastrebar" pump factory (7/4), "Iagodinska pivara" warehouse (15/4), Metal processing industry (24/4), "ELECTRO MANG" industry (24/4)

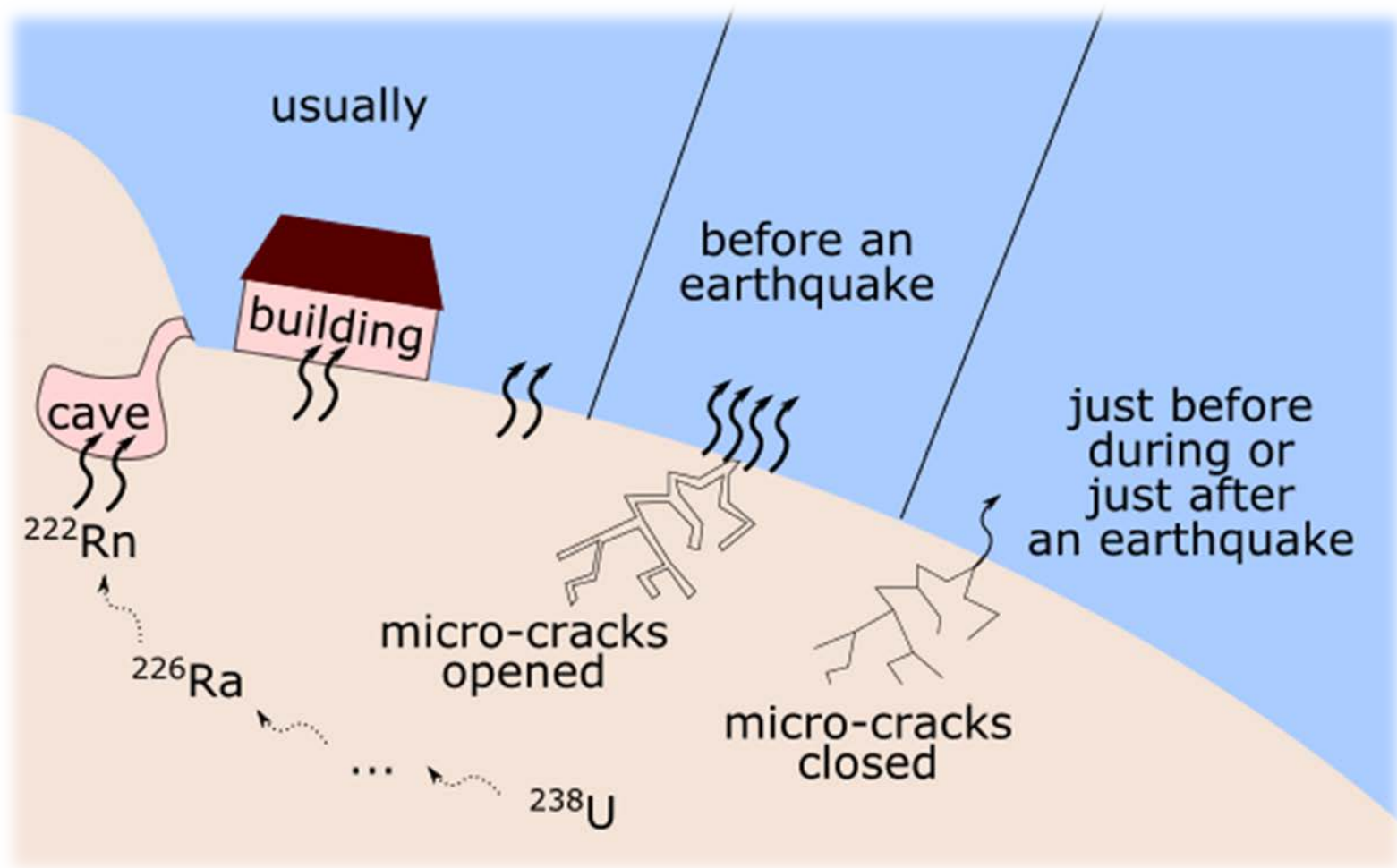
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vol sampler  
used in  
Kragujevac  
and bombed  
petrol  
refinery  
Pancevo***



- **A. Coupling of the atmospheric electric circuit to earthquakes, lightning and the sun-earth environment**
- **B. The problem of concept and data integration within the Sun-Earth environment**



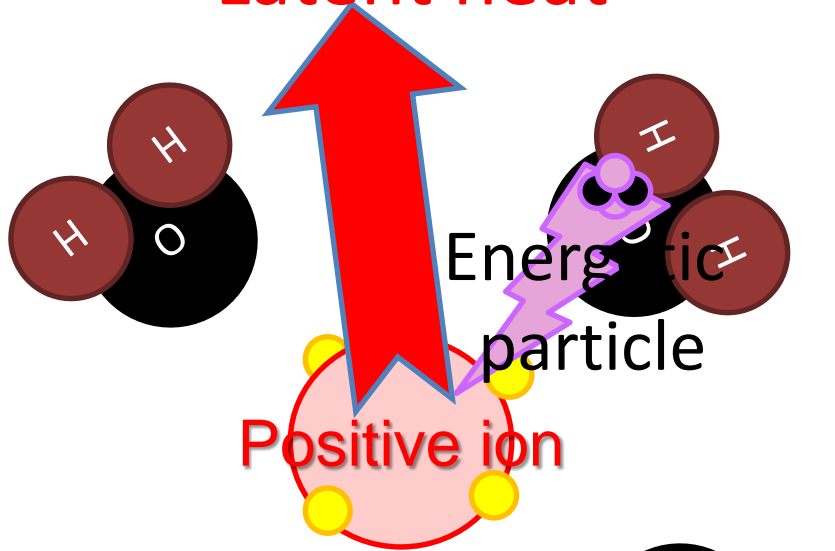
# $^{222}\text{Rn}$ and earthquakes



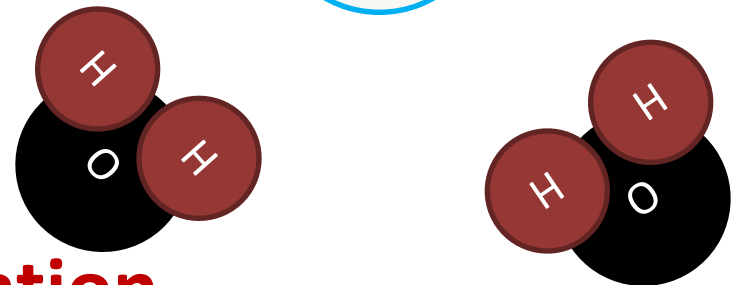
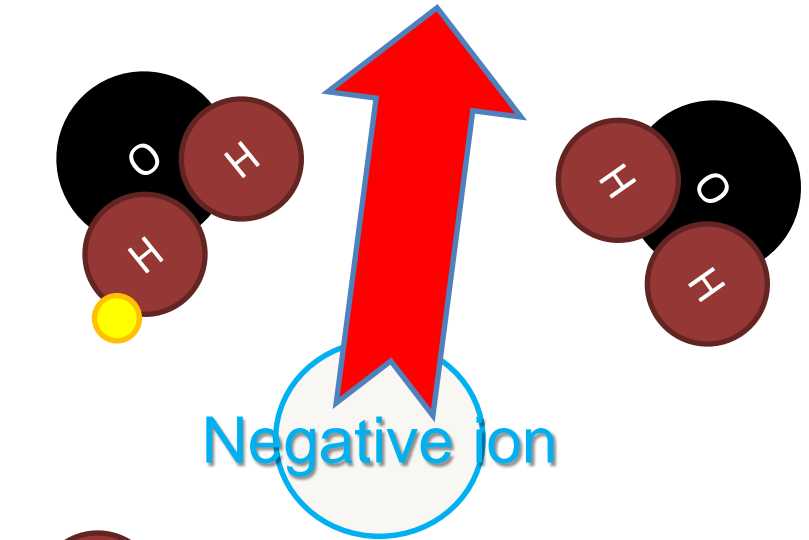


# The main driver for the observed energy release in atmosphere

Latent heat

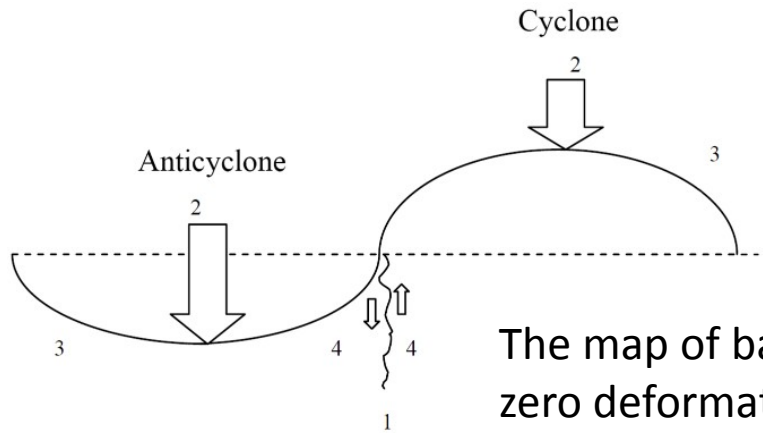
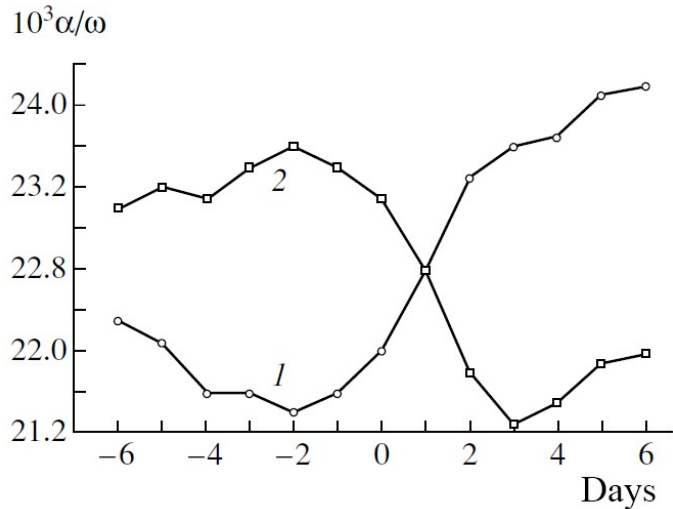


Latent heat



**Ion's hydration**

# Barometric strain



The map of barometric strain on 11 of March 2011. Green line – zero deformation between the negative (red) and positive (blue) strain. Blue X – epicenter of Tohoku earthquake

# For an area 1km X1km weather barometric strain

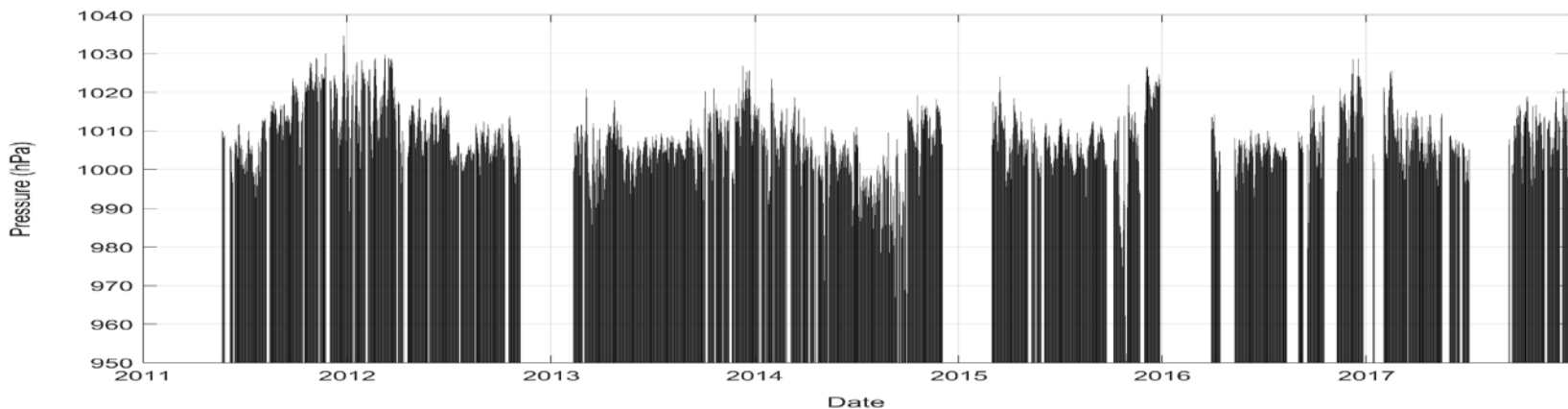
- $P_{\text{atm}}$  Low 980- High 1020 mbar
- $\Rightarrow$  980 gr-1020 gr /cm<sup>2</sup>
- $\Rightarrow$  9.8 Mtn-10.2 Mtn /km<sup>2</sup>
- $\Rightarrow$   $\leq 0.4$  Mtn difference of L and H pressure systems, equals to weight of 40 cm water

## PRESSURE

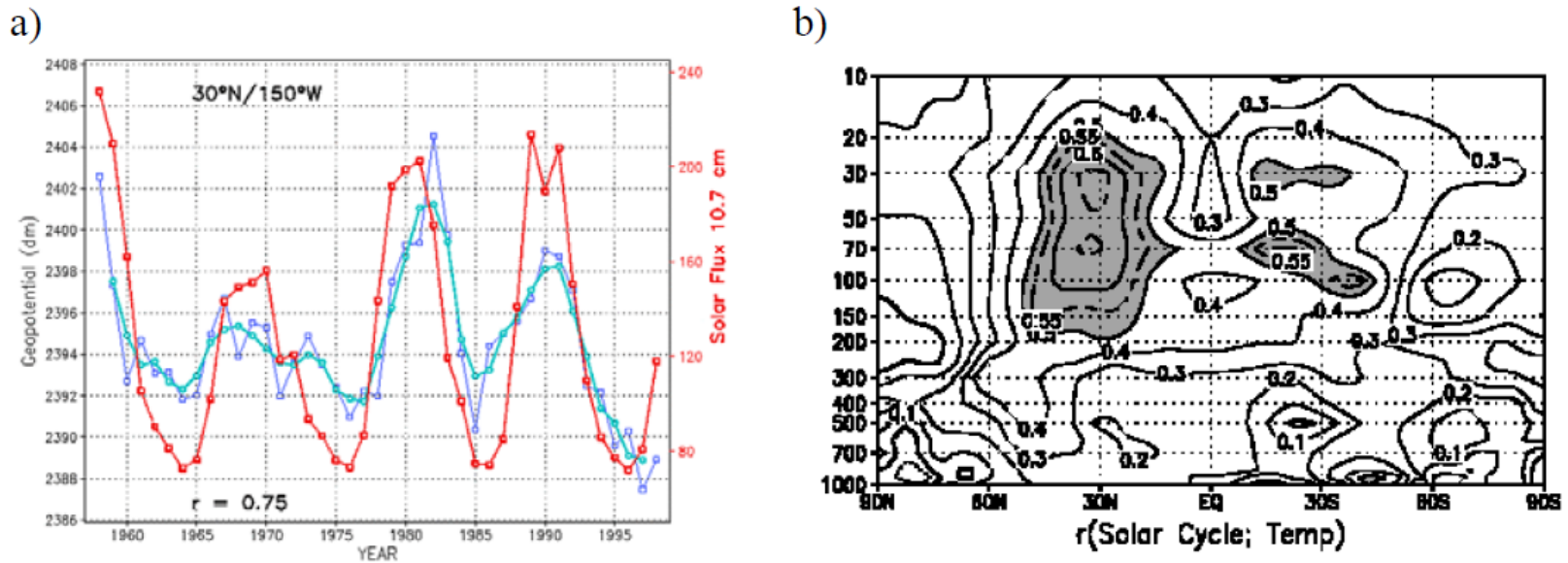
- 2 mbar diurnal
- 10-40 mbar L-H passages, 5-10 d
- 10-20 mbar yearly

## RAIN

- Average yearly rain @ 40°N around 80 cm, most of it in winter



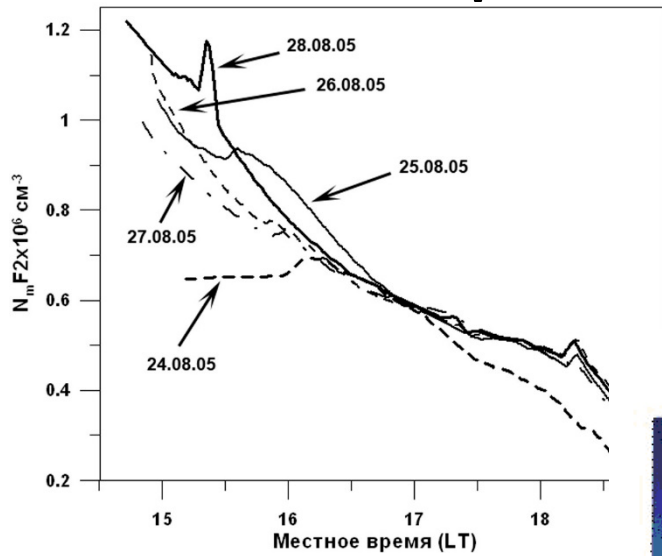
# 30 hPa geopot. height (a measure of mean T below 24 km, stratosphere)



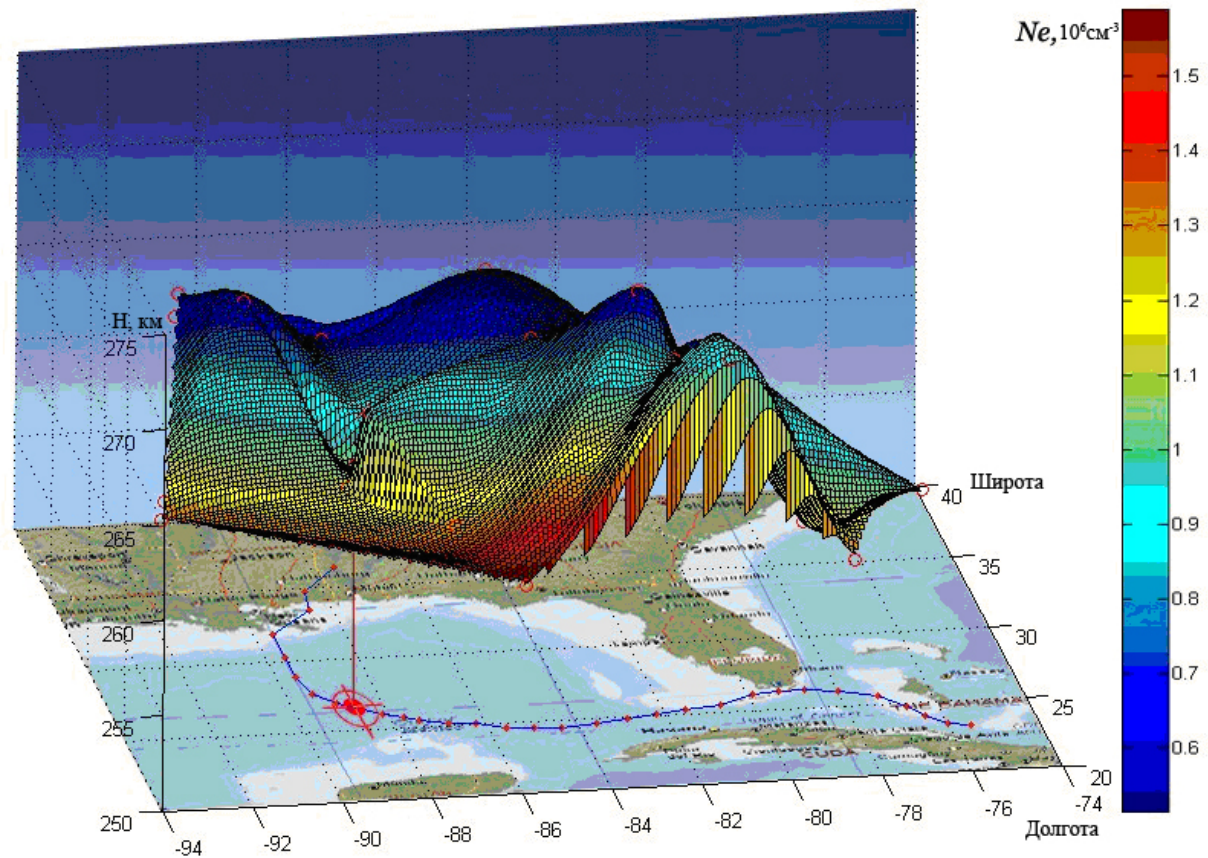
**Figure 6:** a) Geopotential heights at 30 hPa (blue curve) at 30N, 150W versus 10.7cm solar flux (red curve). b) Correlation between zonally averaged annual mean detrended temperatures and 10.7cm solar flux, shaded regions are for correlations  $>0.5$  (adapted from *Labitzke and Matthes (2003)*).



# Ionospheric irregularity over Katrina



Bondur et al., 2008a



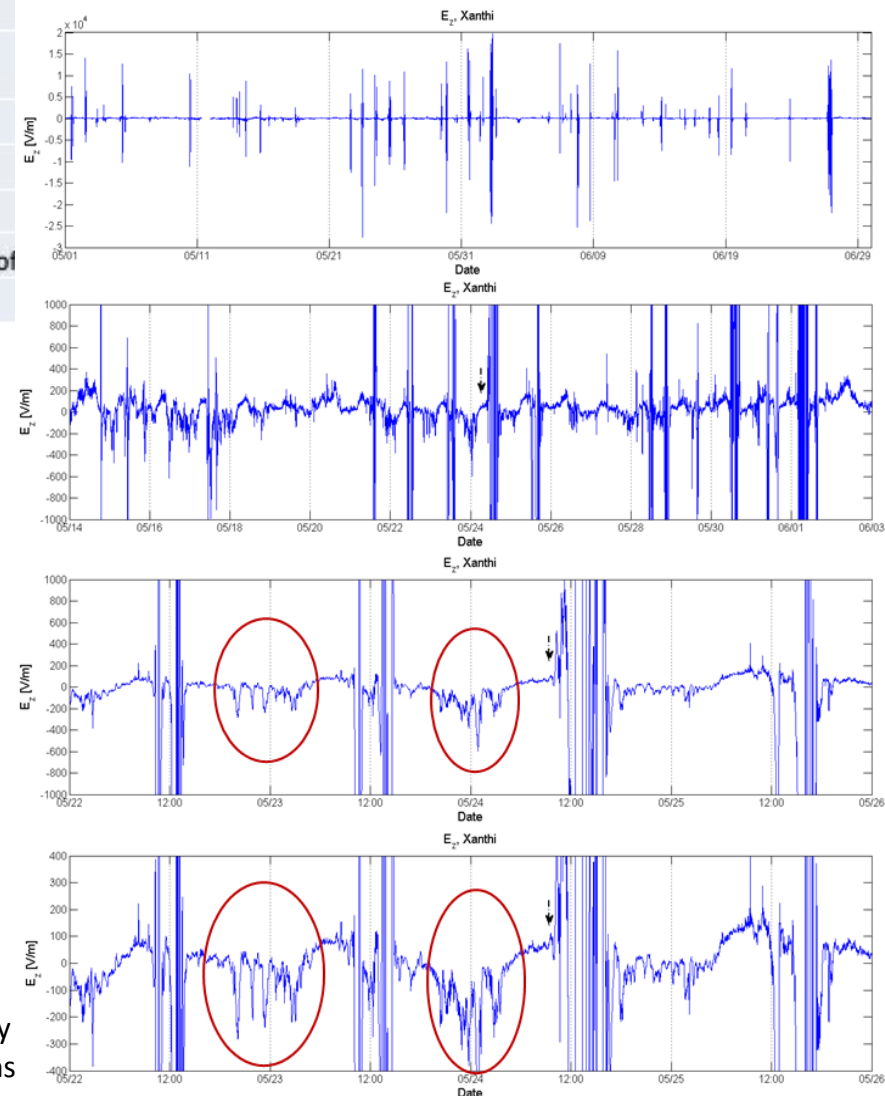
# Results – EQ8, GREECE



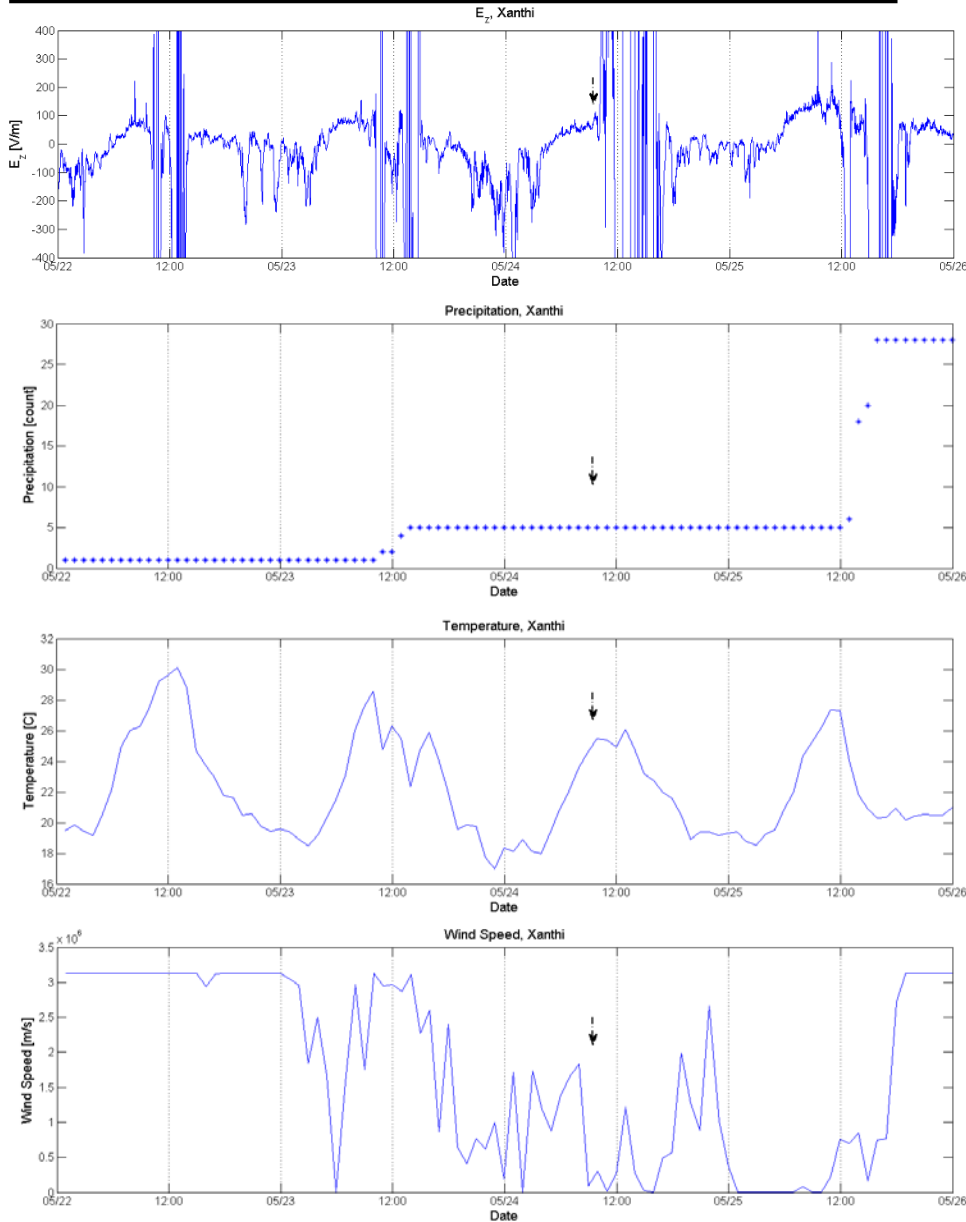
EQ No	EQ8
DATE	24-May-14
TIME (UTC)	9:25:02
Magnitude (R)	6.9
Preparation area (km)	927
Depth (km)	6.43
Latitude (°)	40.29
Longitude (°)	25.39
Place	22km SSW of
Country	GREECE

## Potential Gradient data

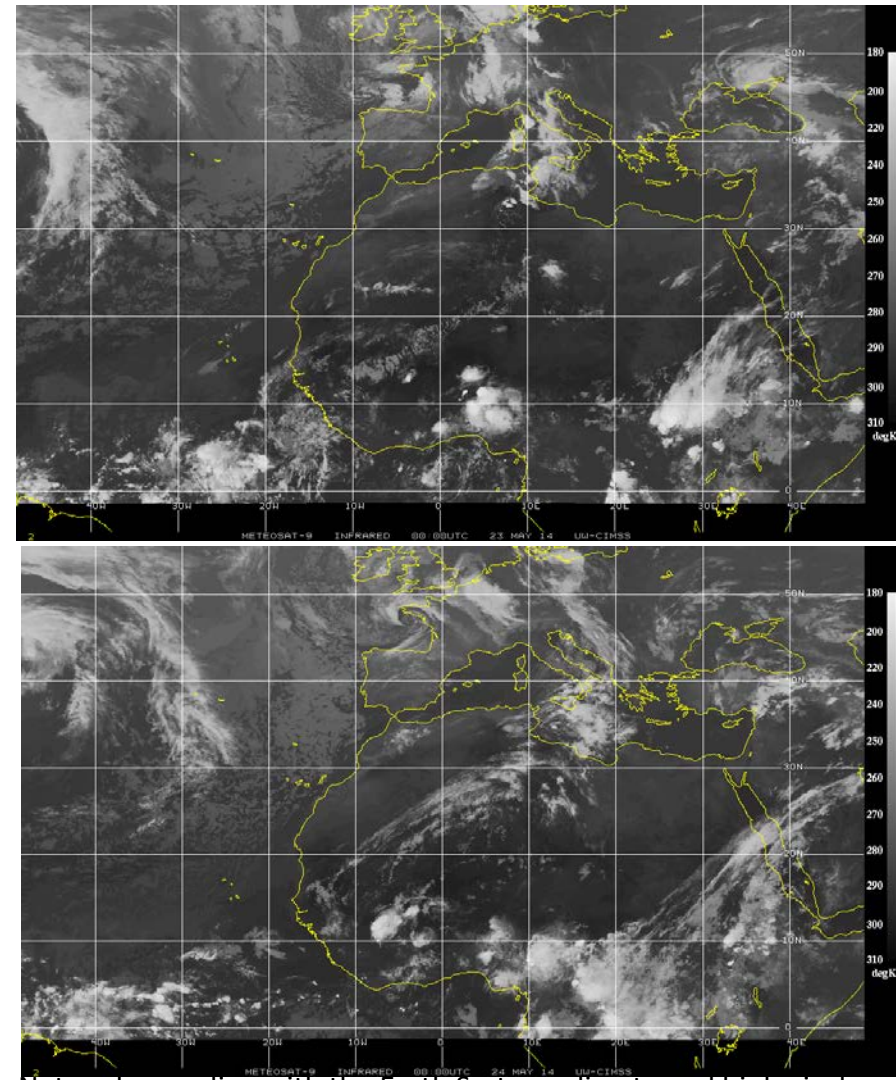
- Multiple bay-like reductions of the PG was detected a couple of hours and ~ 1,5 day before the EQ
- Similar to anomalies reported by Mikhailov et al. 2004.
- Depth: 300 – 400 V/m
- Duration: 1-1.5 hours



# Results – EQ8, GREECE



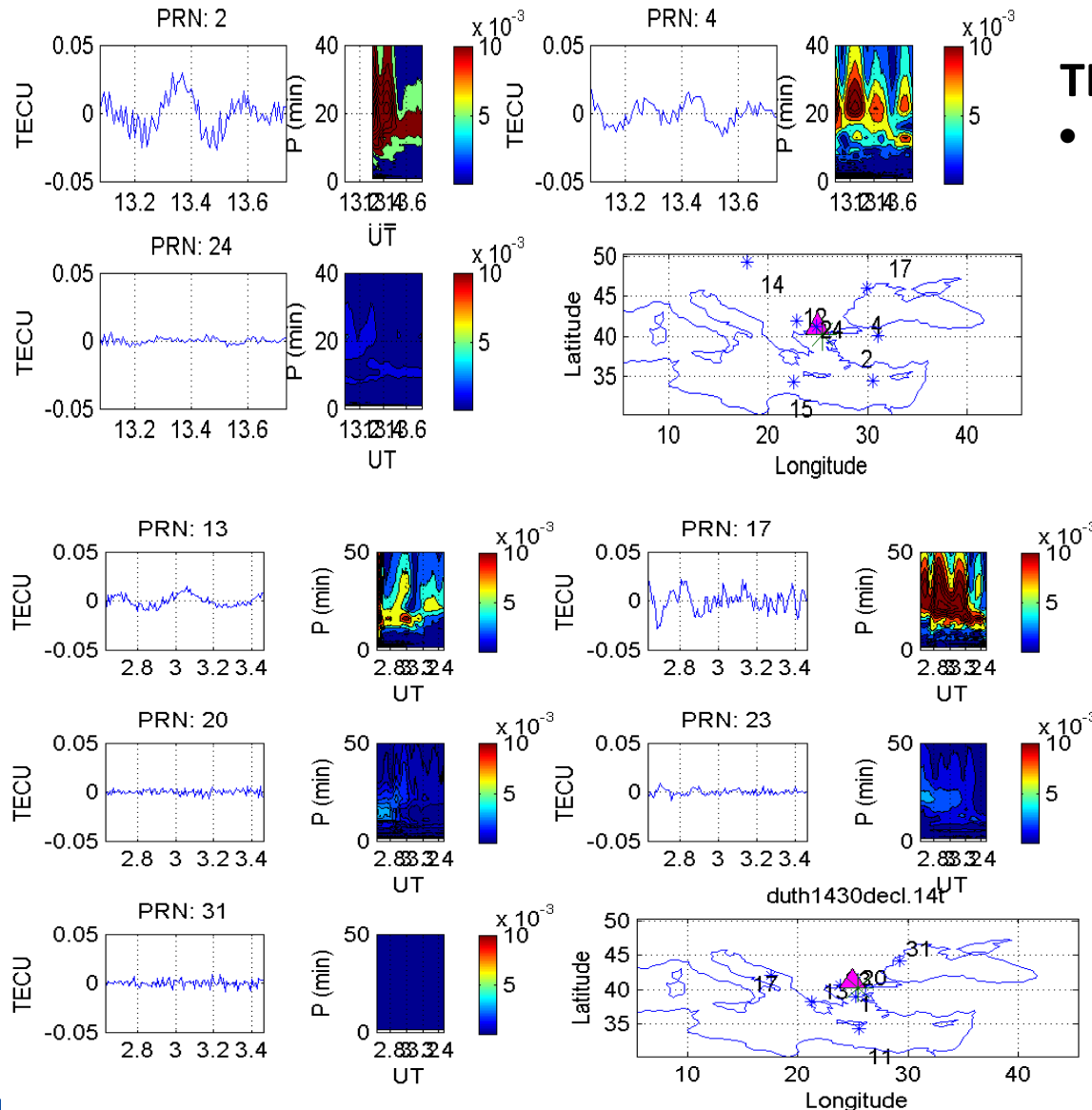
## Meteorological data



Network: coupling with the Earth System, climate and biological systems (ELECTRONET) Cost Action 15211



# Results – EQ8, GREECE



## TEC spectral analysis

- Wave oscillations with periods T=20 min of the TEC was also detected two and one day prior to the EQ:
  - 13-14 UT two days prior to the EQ
  - 2.8-3.4 UT one day prior to the EQ

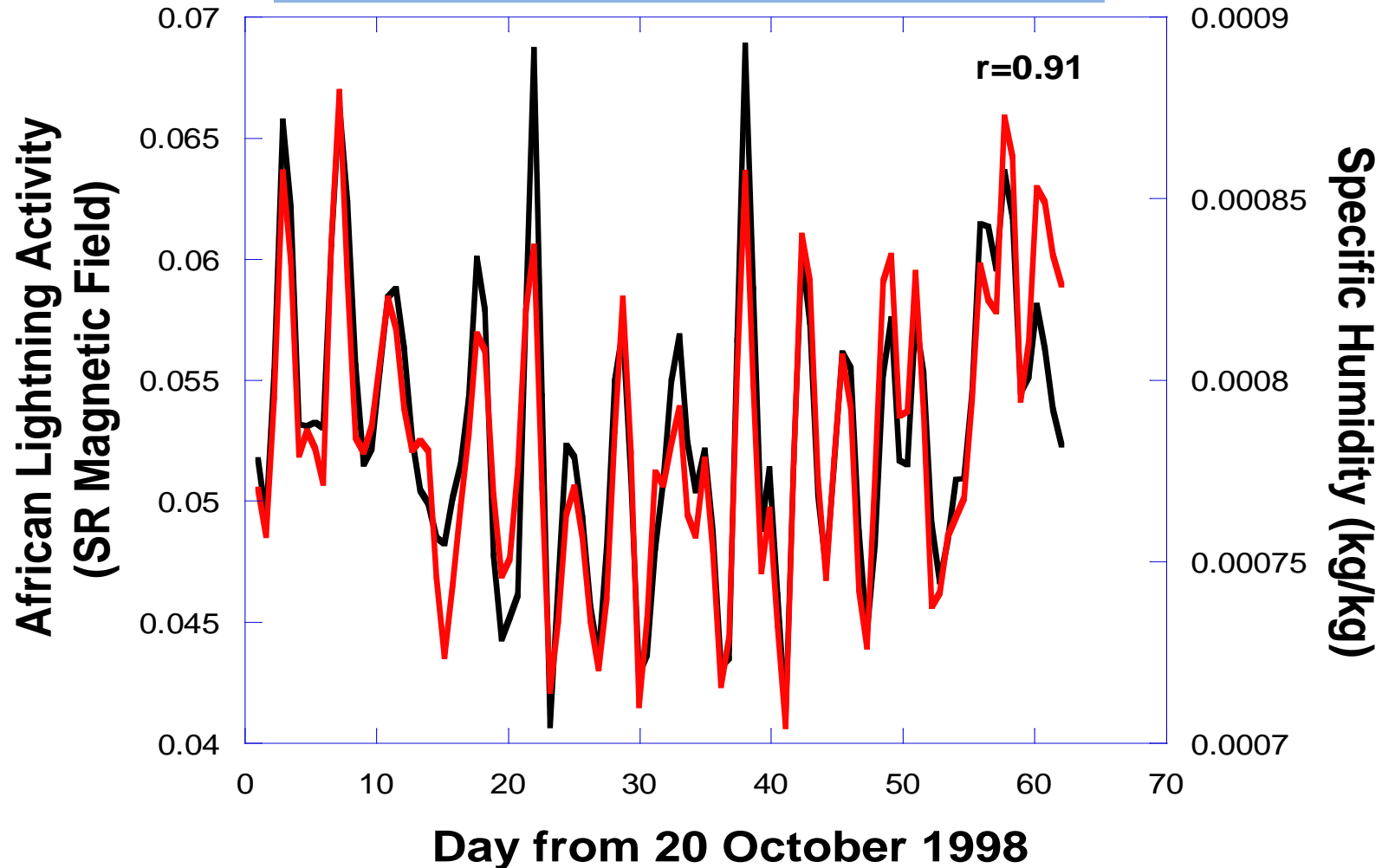




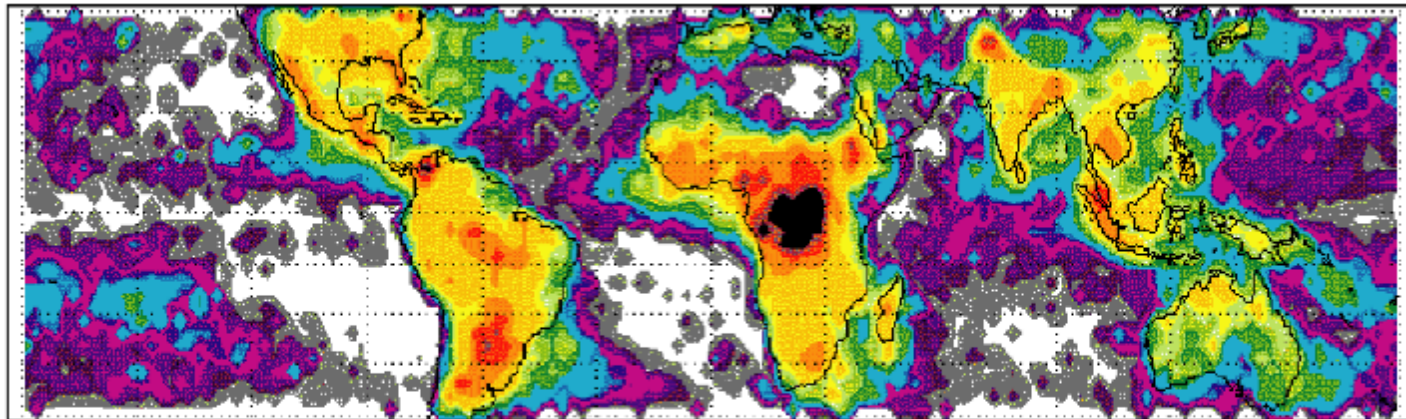
# Lightning

# Lightning Activity vs. Specific Humidity (300mb) +24hours

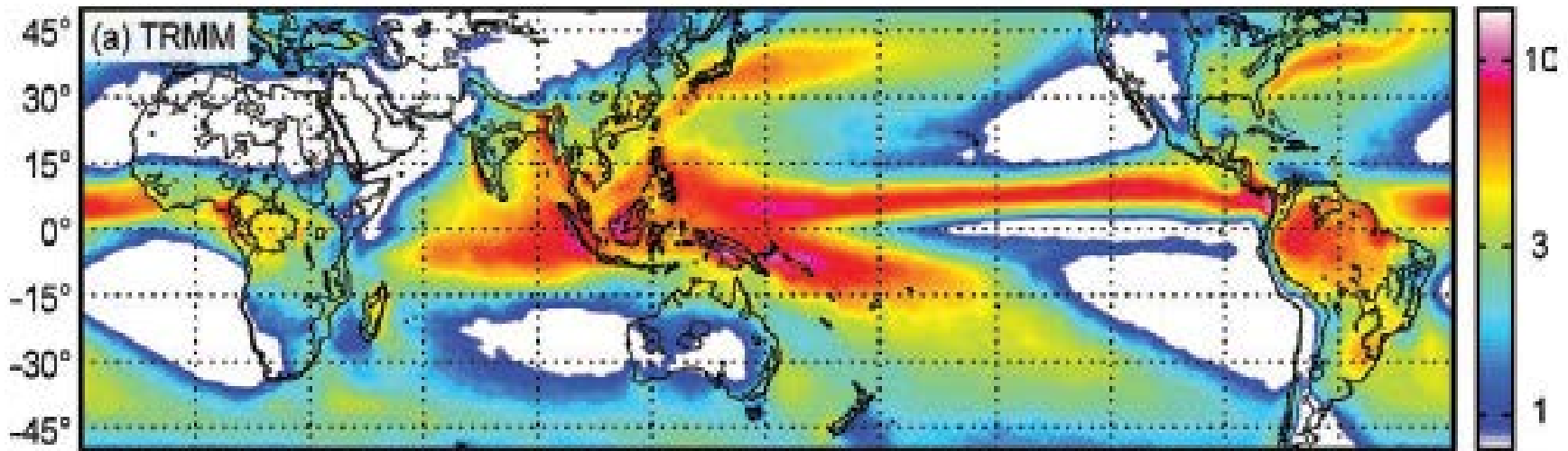
26% SR change => 0.1 g/kg change



# Flash date (E. Williams) and rainfall rate mm/yr (Virts et al. 2013)

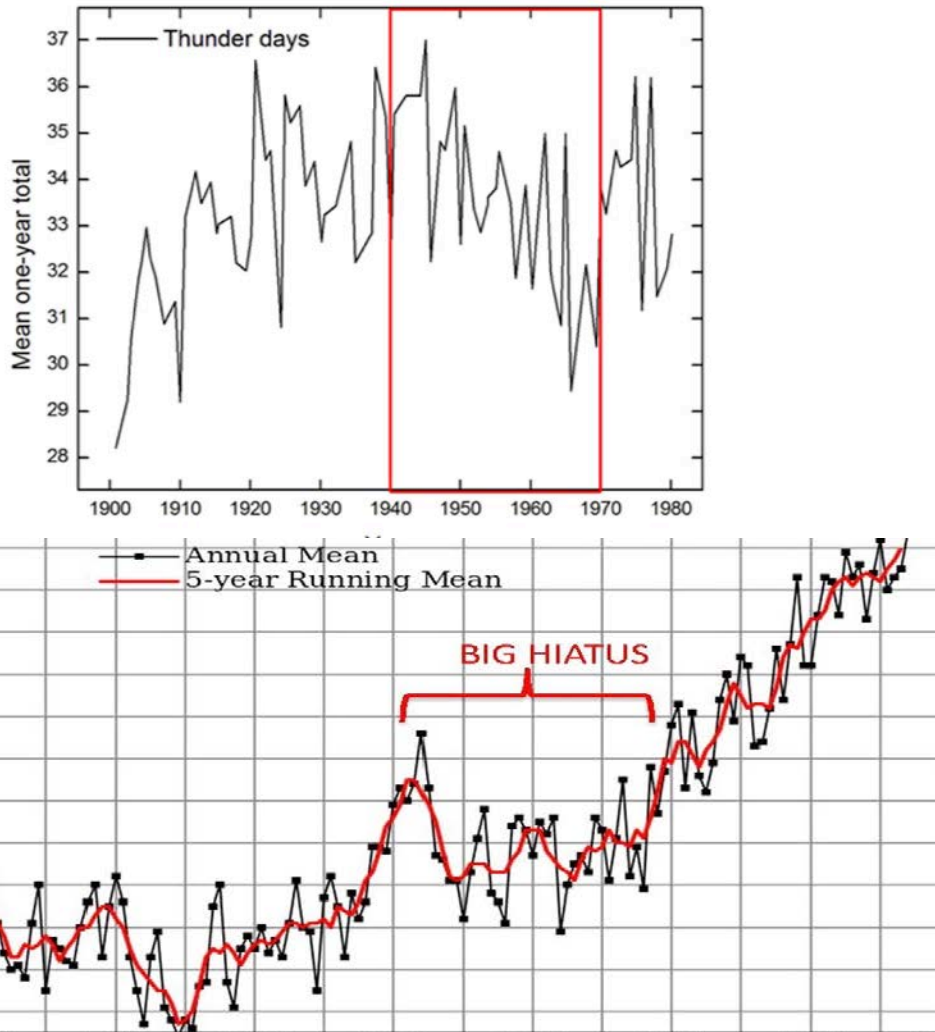


Flash Rate Density (flashes/km<sup>2</sup>/yr)



# Thunder days (Changnon, 1985) vs global T

Yearly counts of thunder days in North America





## Below some **paper+pencil estimates** of the time it takes for the global circuit to recycle the charges

- Earth surface charge =  $2.5 \times 10^5$  C.
- Lightning strike current =  $2 \times 10^4$  A . Duration = 1 ms.
- $1 \text{ A} = 1 \text{ C/s} = 1 \text{ mC} / \text{ms}$  -> **each lightning brings down  $2 \times 10^4$  mC = 20 C.**
- To bring down to Earth from the atmosphere charge equal to the Earth surface charge of  $2.5 \times 10^5$  C, it would take  $2.5 \times 10^5 \text{ C} / 20 \text{ C} = 12,500$  lightning strikes.
- With 50 lightning strikes occurring globally per second, in  $12,500 / 50 = 250$  s = **approx. 4 min a charge equal to the Earth surface charge is brought down to Earth** (and since the Earth surface charge does not has a trend in the short-term, equal charge has to go from the Earth surface to the atmosphere in the same time).

Q:

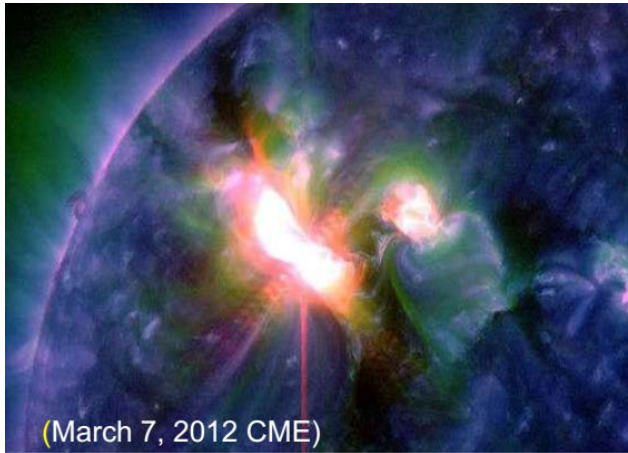
- If lightning rate has increased in the 20<sup>th</sup> century but PG remained constant,
- 1. where are the extra charges for lightning generated? -> in the troposphere
- 2. for charge conservation, extra CG+ and CG- charges have to be equal
- Why is the Earth's surface negatively charged?

# B. The problem of concept and data integration within the Sun-Earth environment



ΔΗΜΟΚΡΙΤΕΙΟ  
ΠΑΝΕΠΙΣΤΗΜΙΟ  
ΘΡΑΚΗΣ

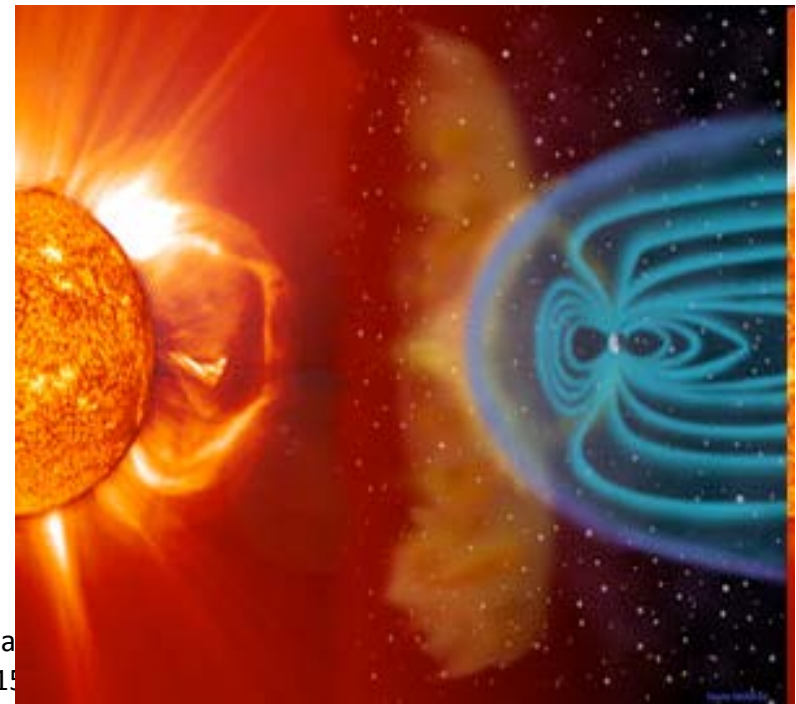
## Can earthquake generators interact with geomagnetic storms? The March 7 2012 CME



(March 7, 2012 CME)



COST is supported by the EU Framework Programme Horizon 2020



Action Title: "Atmospheric Electricity Network: coupling with the Earth's magnetic field"  
Cost Action 15111

# Vladimir Vernadsky

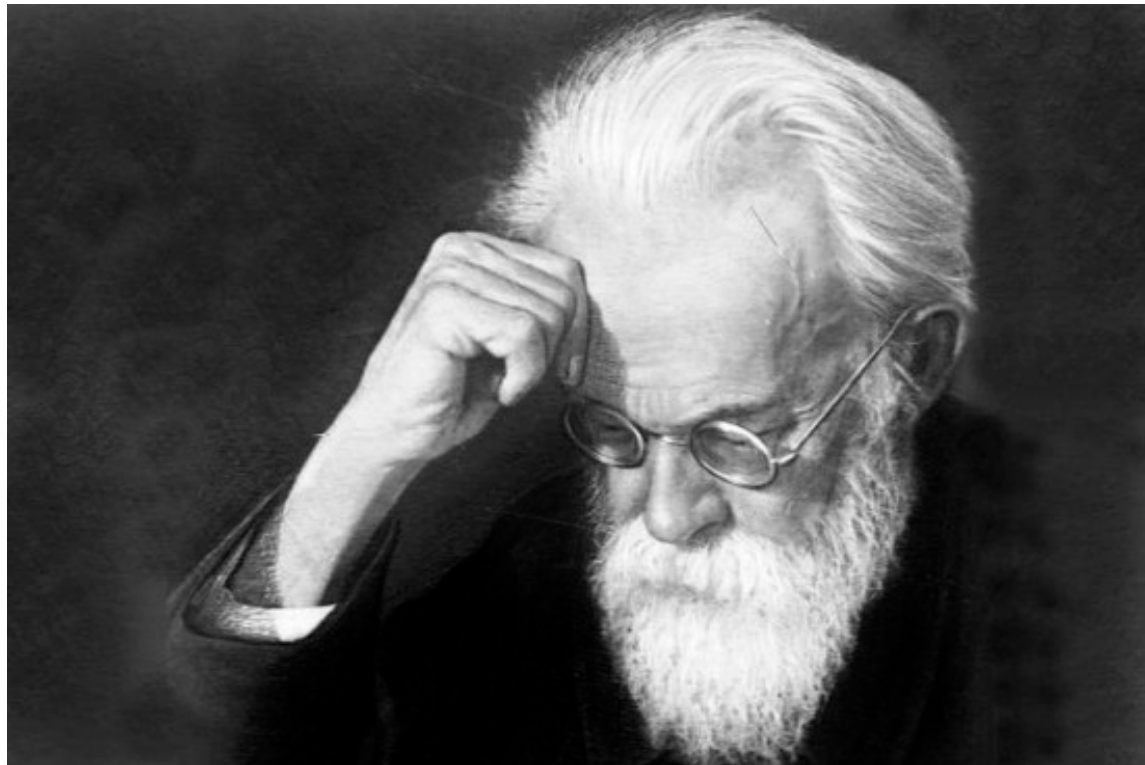
## 1863-1945

1912 – Lecture at the Russian Imperial Academy of Sciences “On the gaseous breath of the Earth”

1926 – Wrote “Biosfera”

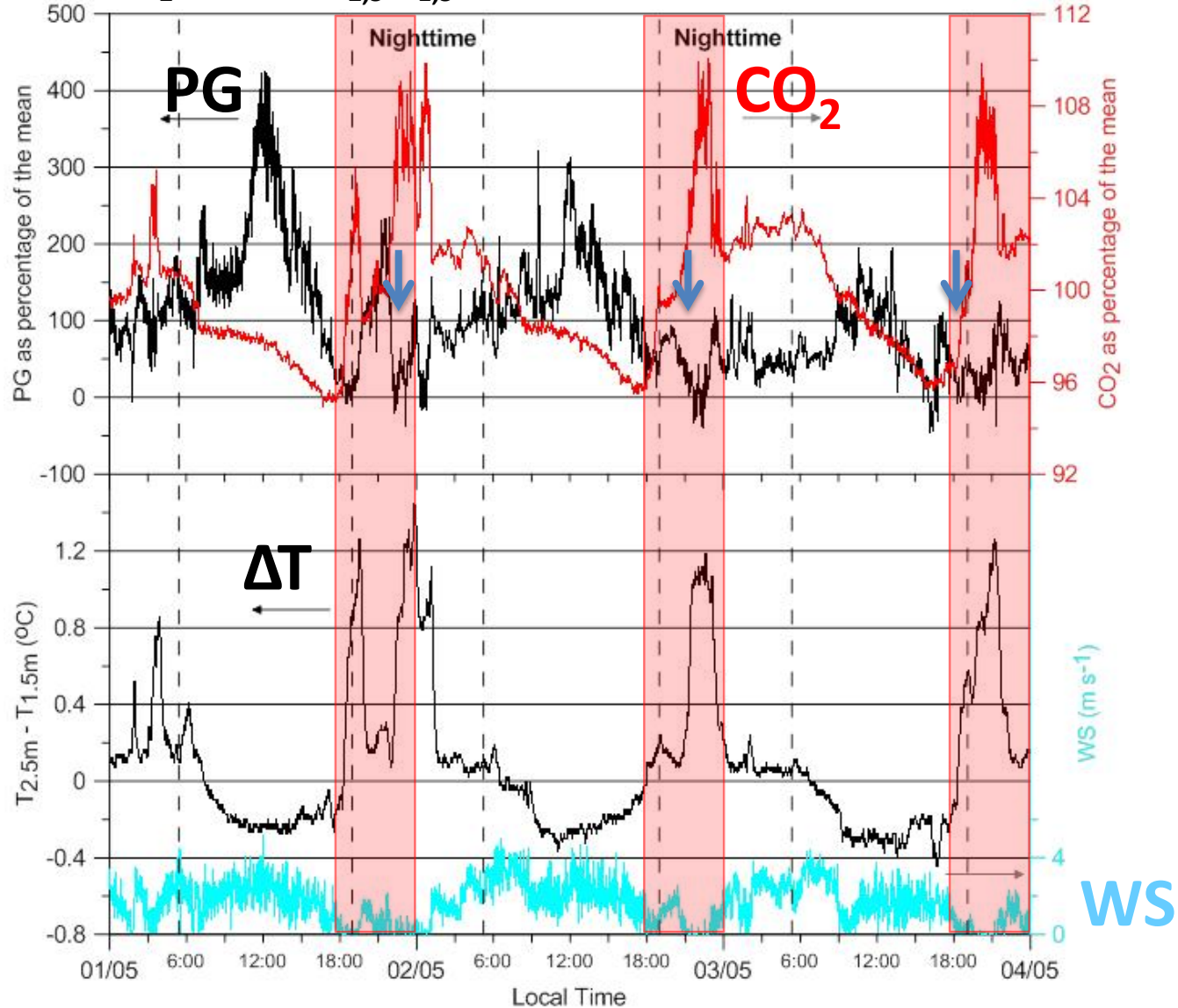
WWII – Wrote “Noösfera” (mindsphere): Man’s thought as a geological force (first *Anthropocene* concept)

Founders of the concept of Geospheres and their interaction



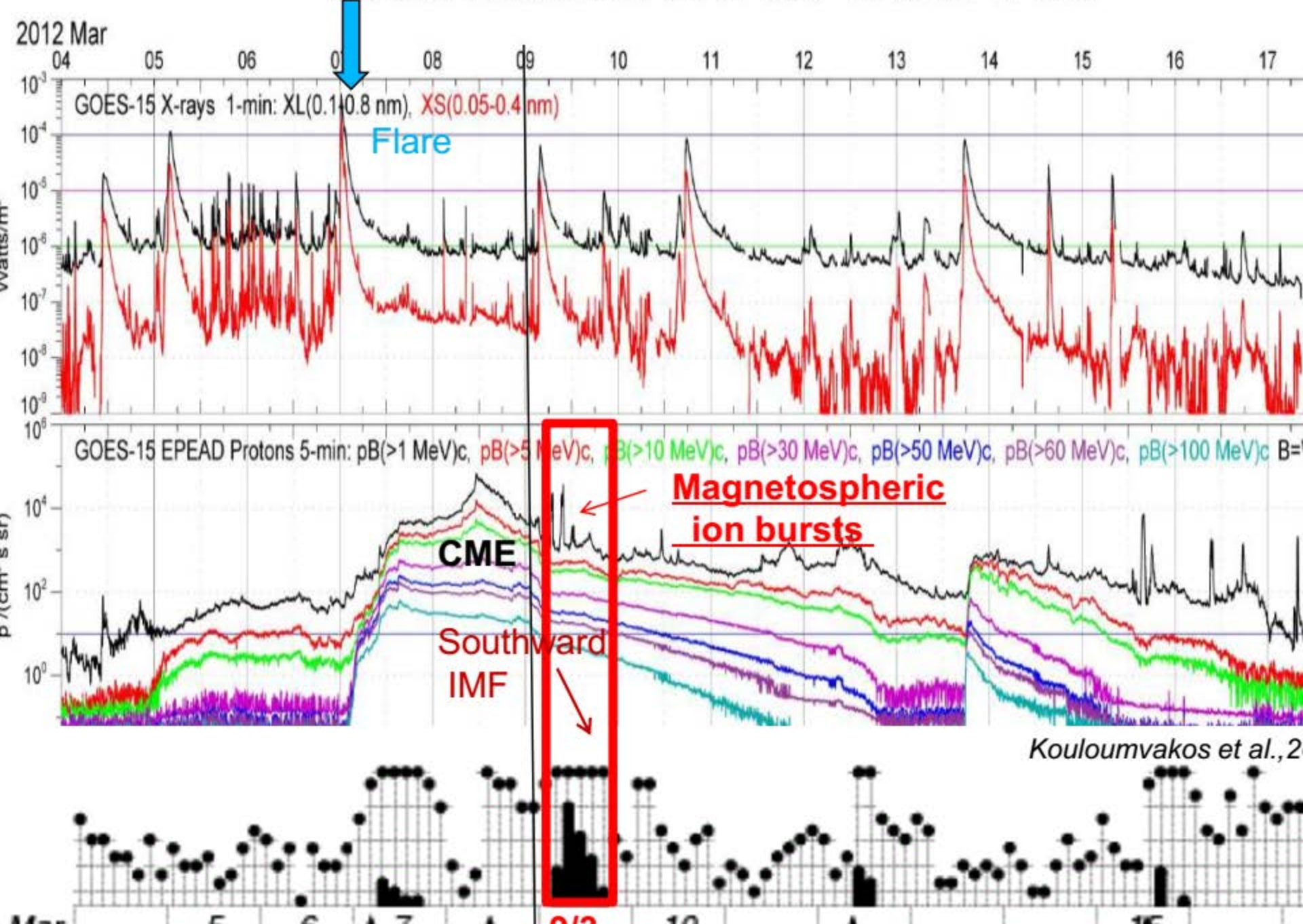


AW-PG, CO<sub>2</sub>, WS και T<sub>2,5</sub>-T<sub>1,5</sub> για το διάστημα 01 – 03/05/12



- Physical precursors of earthquakes – part of the system of geospheres interaction
- Physical precursors of earthquakes are continuation in atmosphere and ionosphere indicators of tectonic and seismic activity
- Generalized precursor – Synergetic composite from results of multiparameter monitoring:  
*Which parameters?*

# FOCUS: 9 / 3 Extreme Event: 2012-03-04 00h - 2012-03-17 24h



# DAY 8/03/2012



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ΘΡΑΚΗΣ

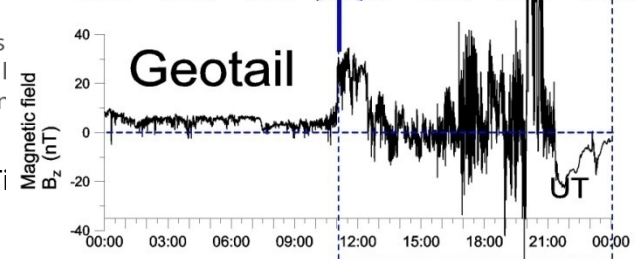
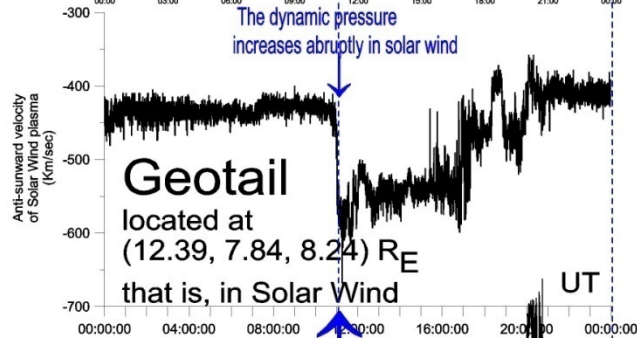
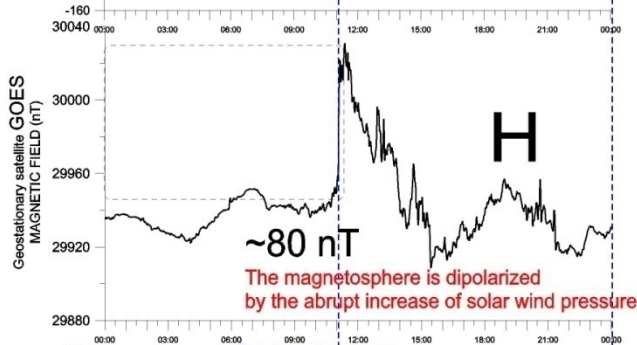
## SSC (Sudden Commencement Storm)

Geomagnetic storms, as observed by ground-based magnetometers, commonly begin with an increase in the strength of the geomagnetic field. These storms are called sudden commencement storms (SSC), and the enhancements are associated with sudden increases in

the dynamic pressure of the solar wind



**Disturbance storm time (Dst) index** gives information about the strength of the ring current



COST is the EU Horizon

Action T

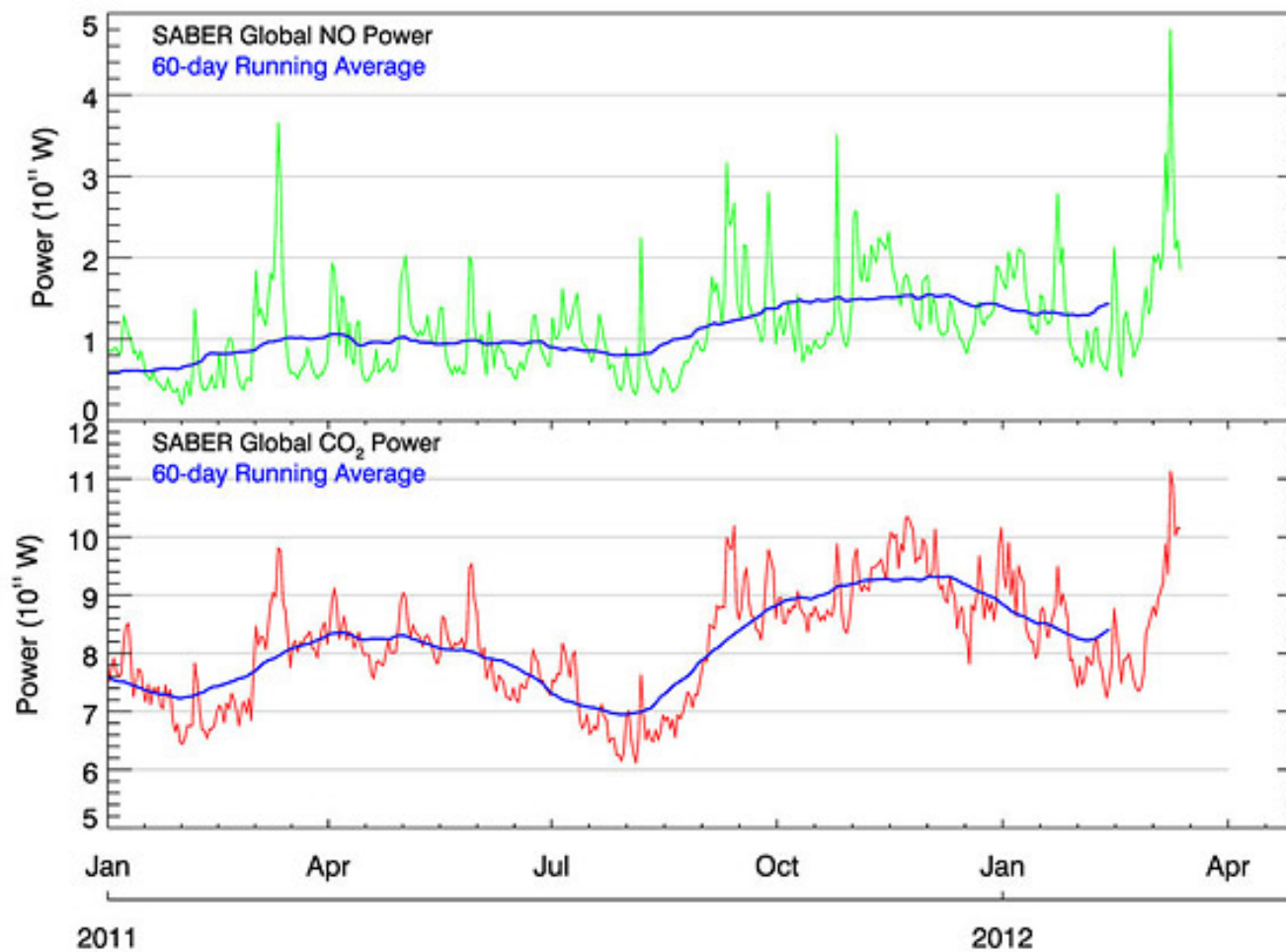
tem, climate and biological systems (ELECTRONET)







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**Mesosphere/Lower Thermosphere @70-100 km. Infrared radiation from NO, huge spike 8-10.3.** Credit: NASA/SABER/TIMED

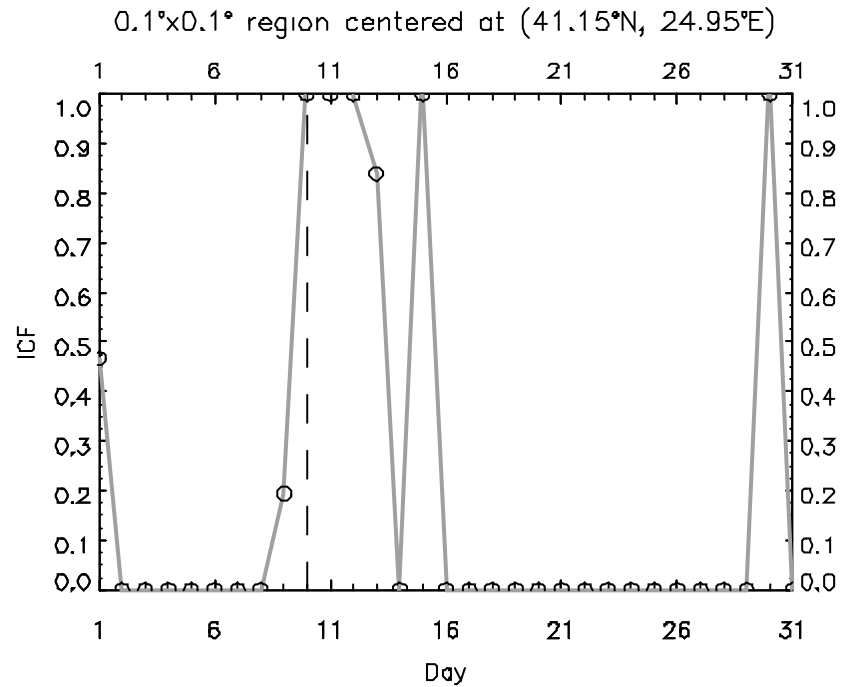


# Ice Cloud Fraction From MODIS/TERRA

Ice clouds form usually @8-10 km ASL

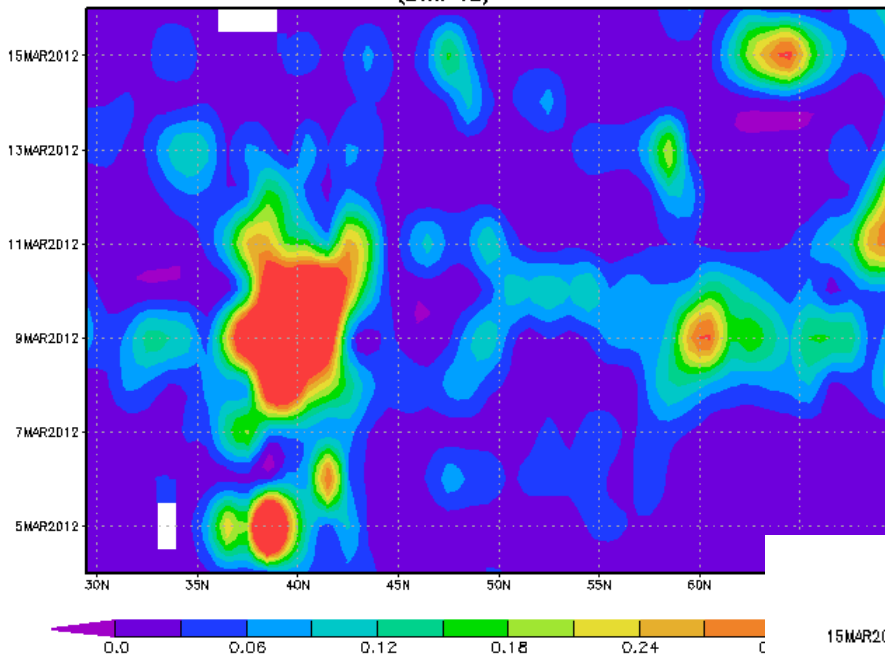


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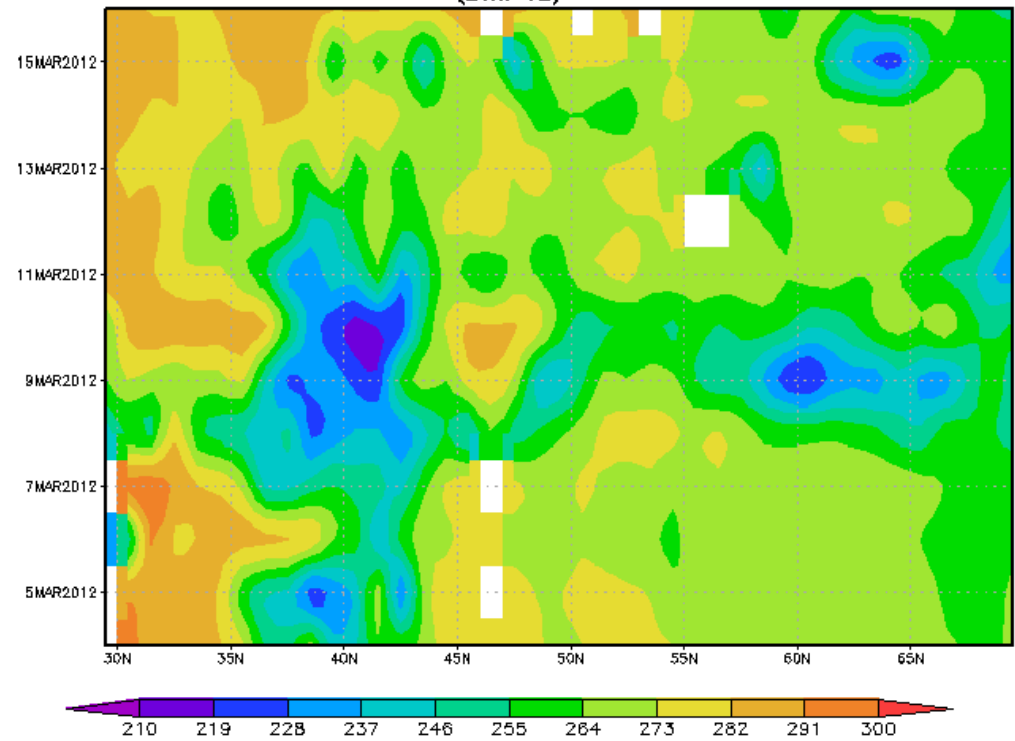
MYD08\_D3.051 Cirrus Reflectance (QA-w) [unitless]  
(Lon: 1E)



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ΘΡΑΚΗΣ

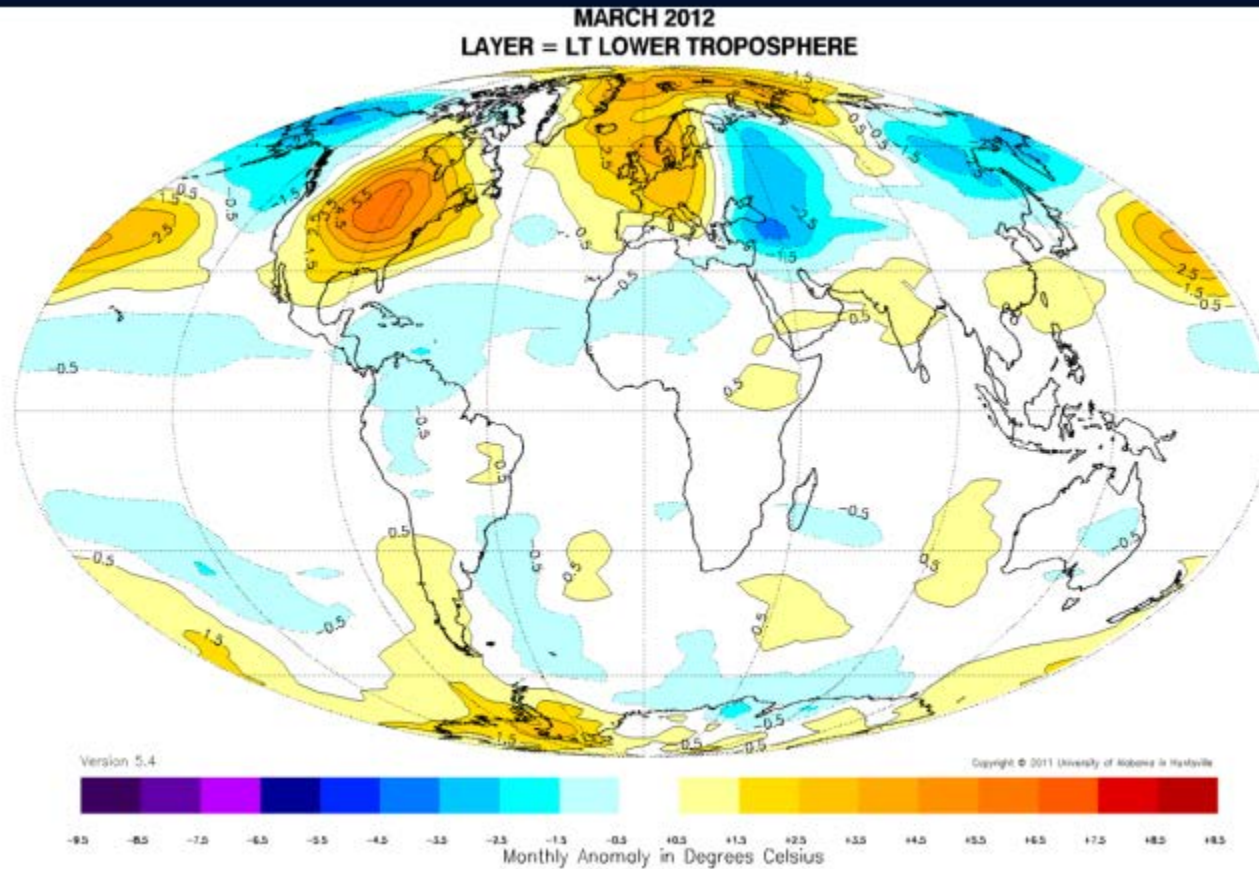


MYD08\_D3.051 Cloud Top Temperature (Day only) [Degree]  
(Lon: 1E)

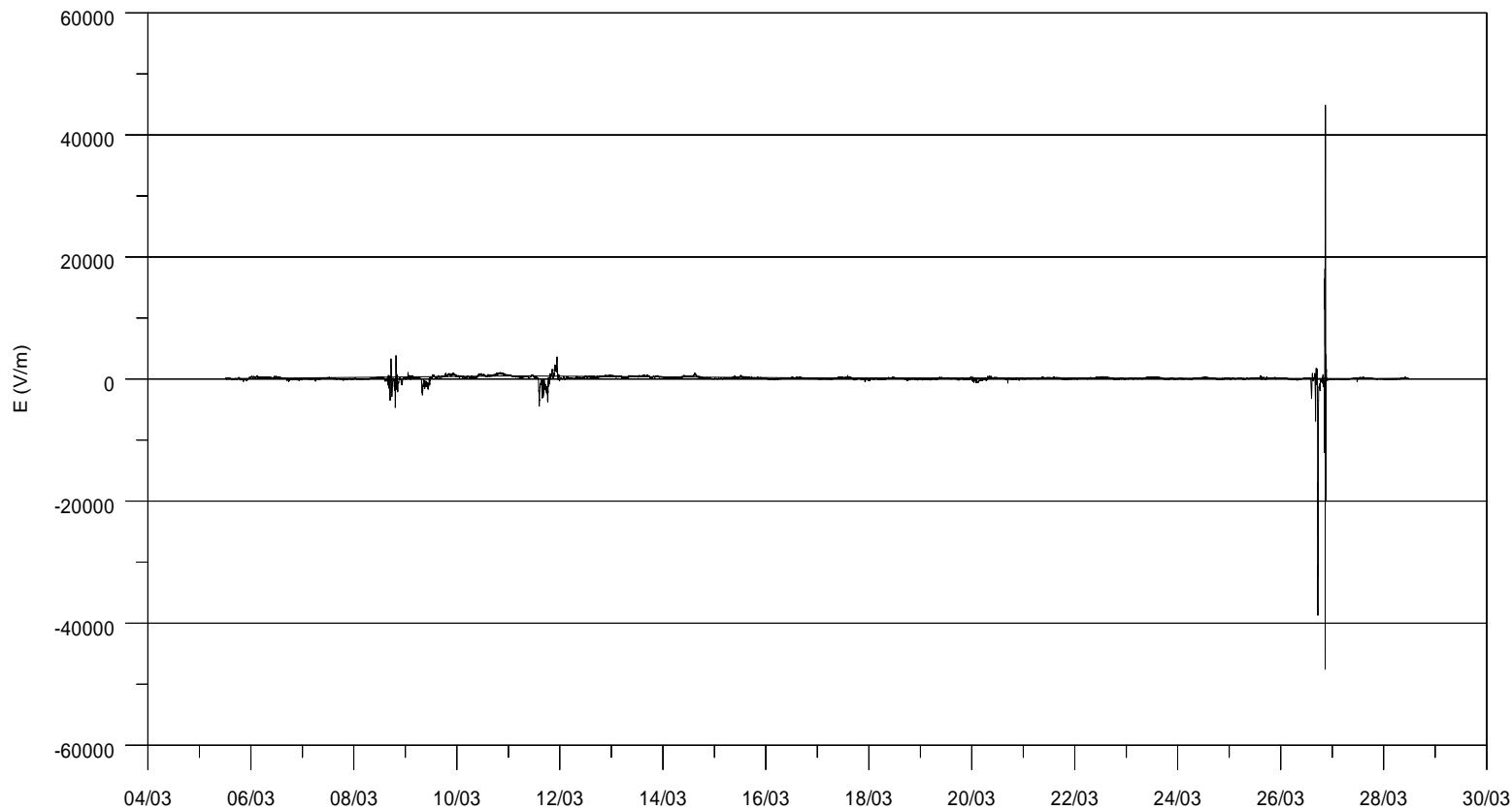


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Atmospheric vertical electric field @ ground level

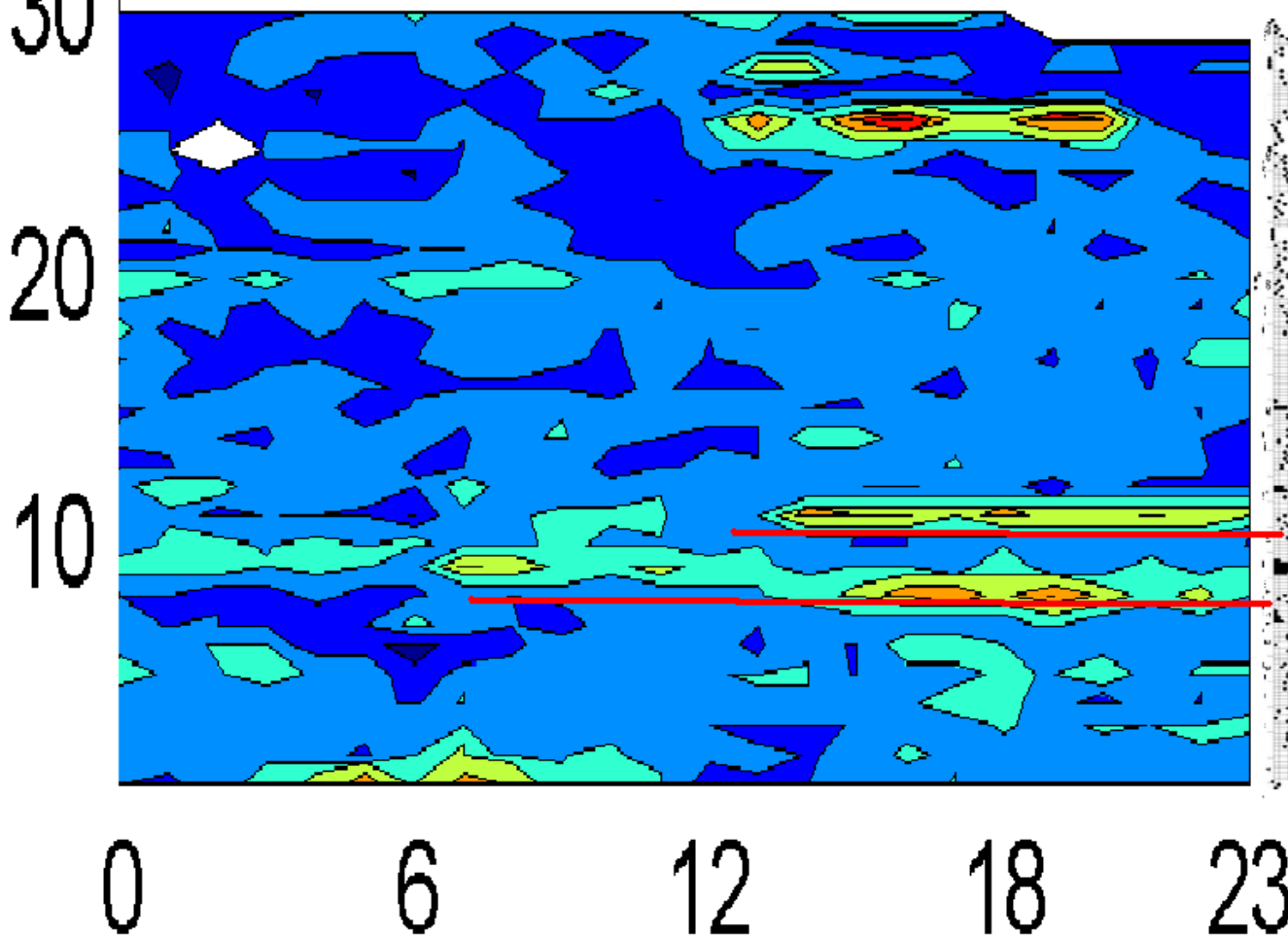


Mar 2012



ΜΟΚΡΤΕΙΟ  
ΕΠΙΣΤΗΜΙΟ  
ΘΡΑΚΗΣ

Day of  
March

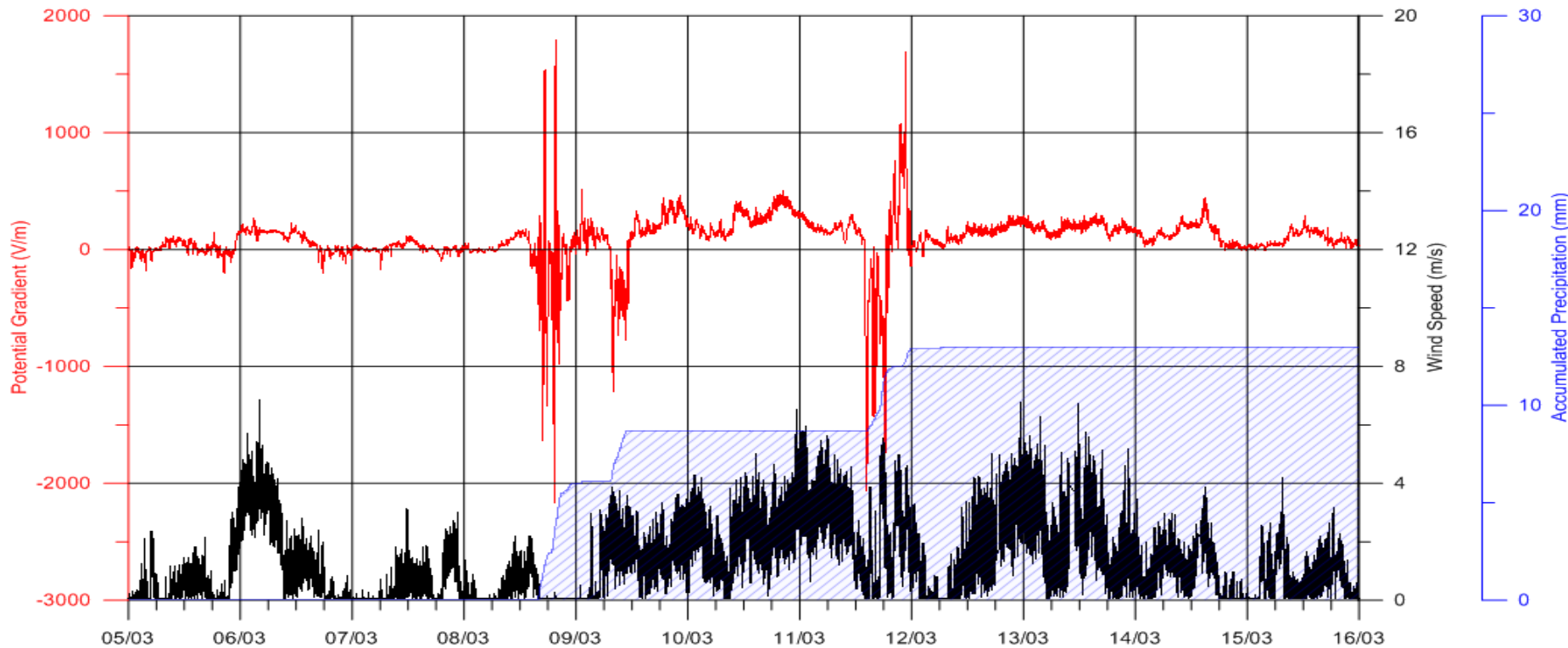


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Time (hrs)

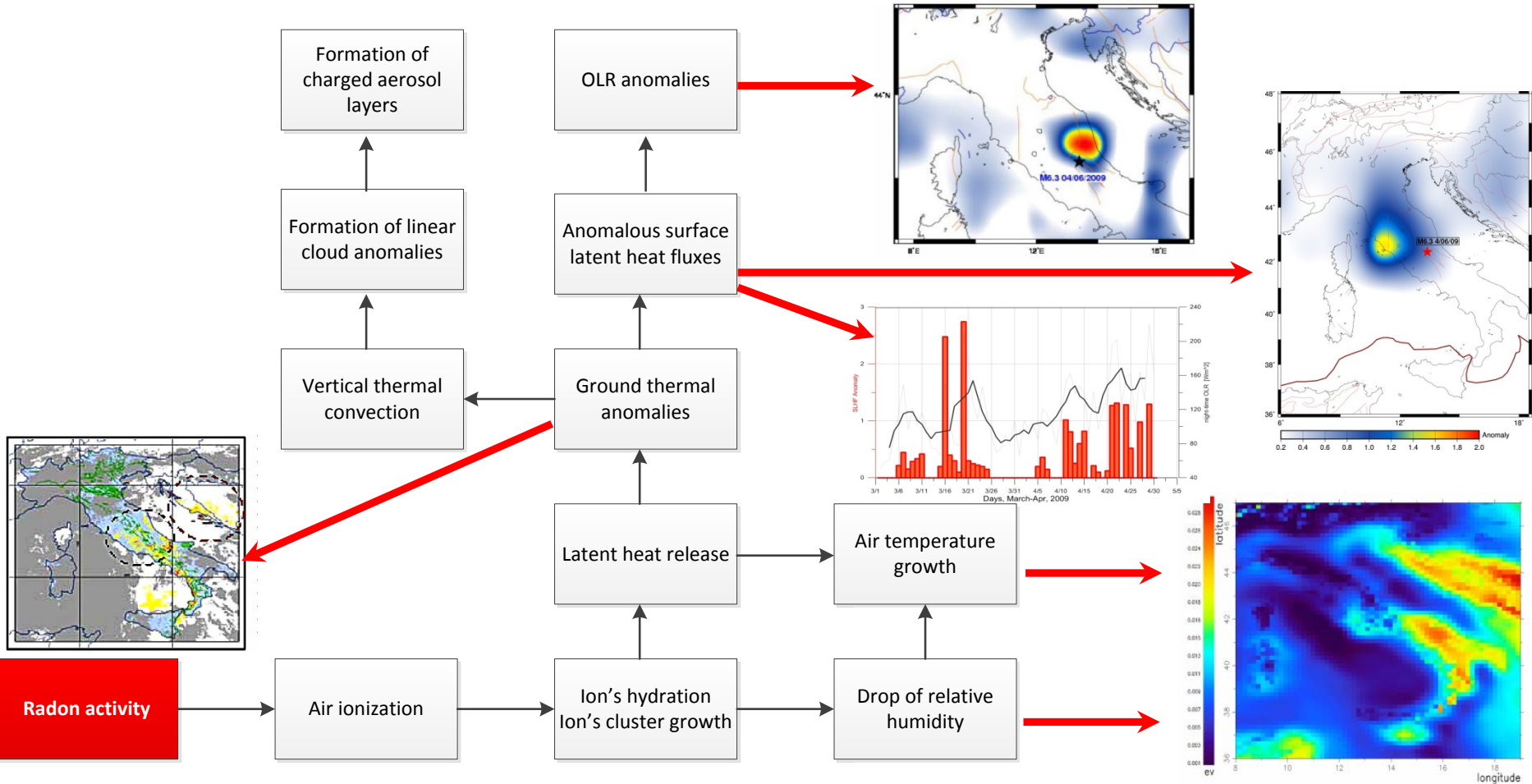
Color: Standard deviation of PG



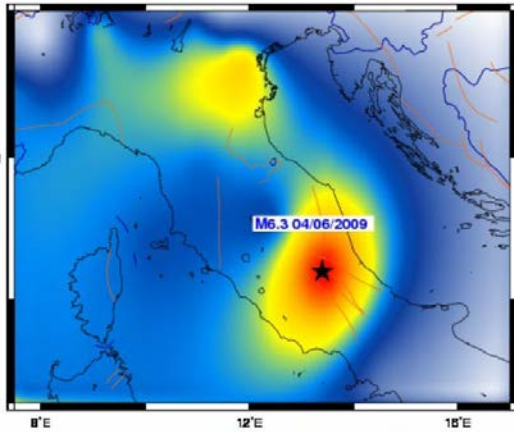


# Plasmachemistry-Thermal interface

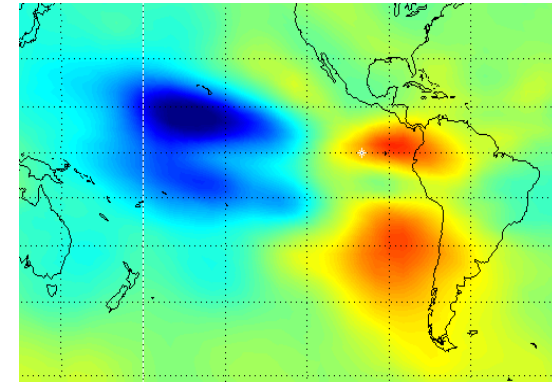
(S. Pulinets)



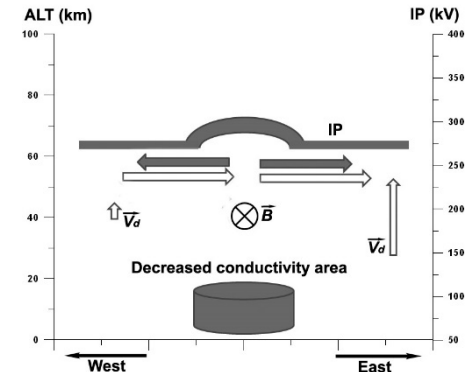
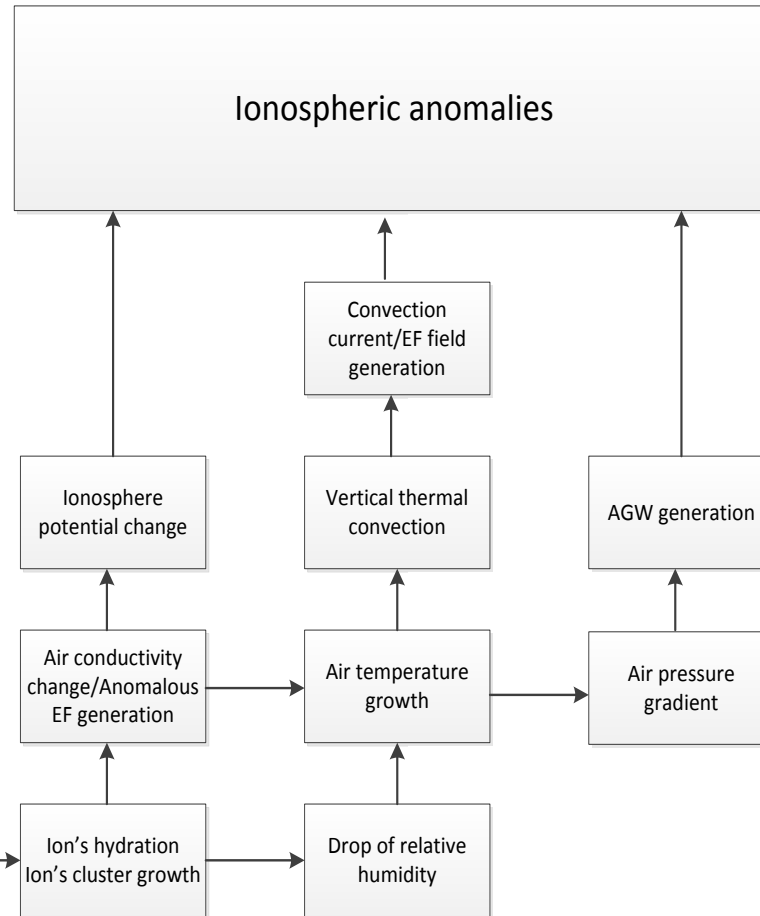
# Plasmachemistry-Electromagnetic interface



**ΔTEC anomaly  
L'Aquila 2009**



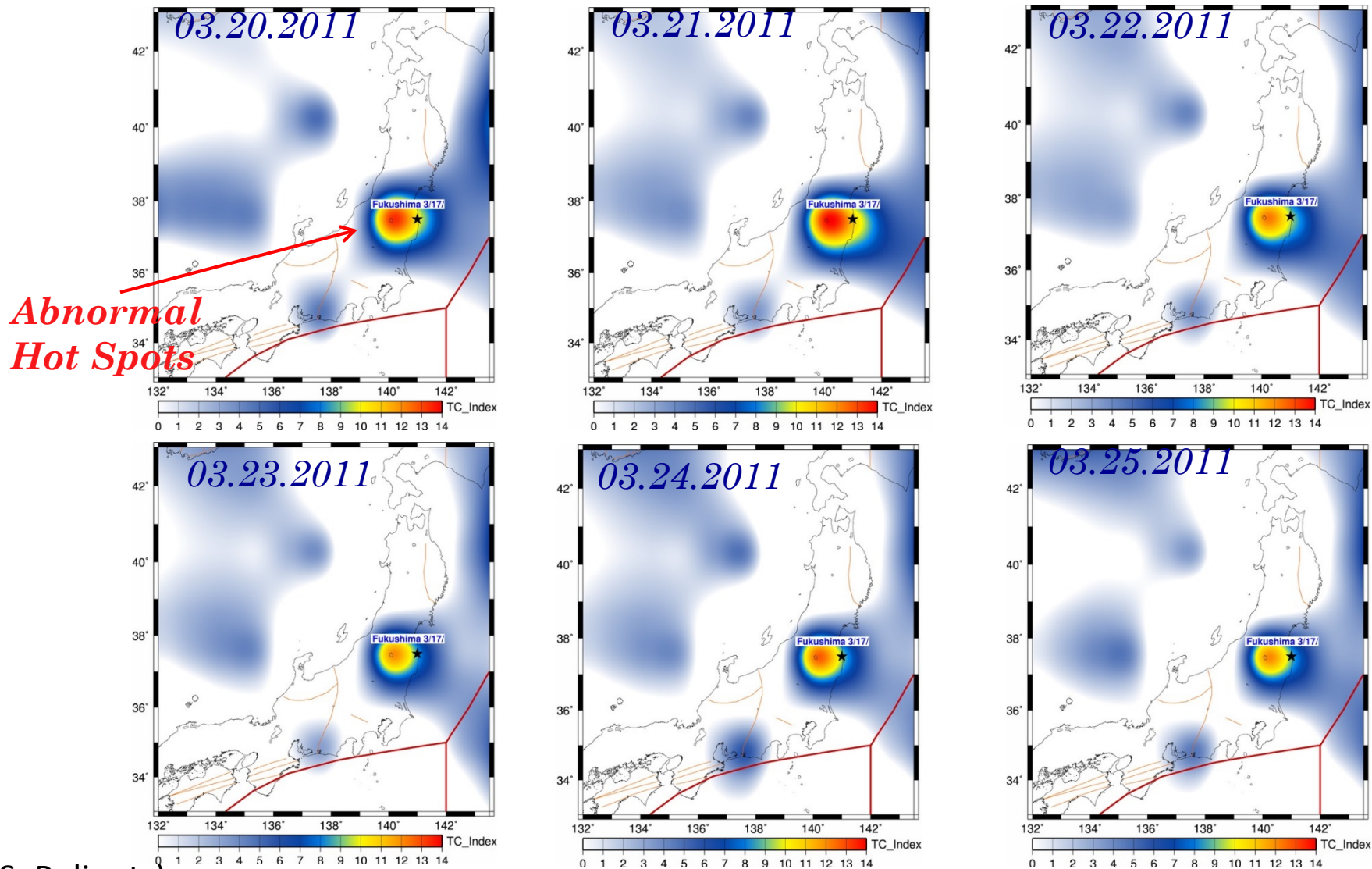
**ΔTEC GIM Central  
America EQ**



(S. Pulinetz)

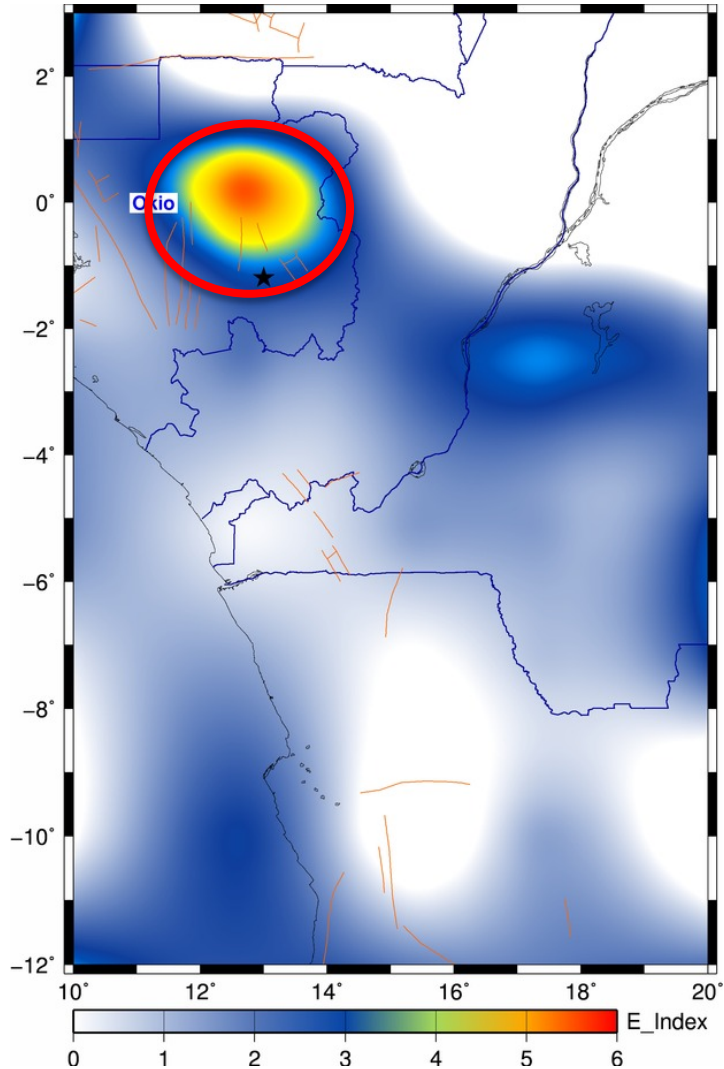
# LAIC model validation by technogenic radioactivity

## Day time OLR anomalous map for March 20- 25 , 2011 over Fukushima NPP, Japan



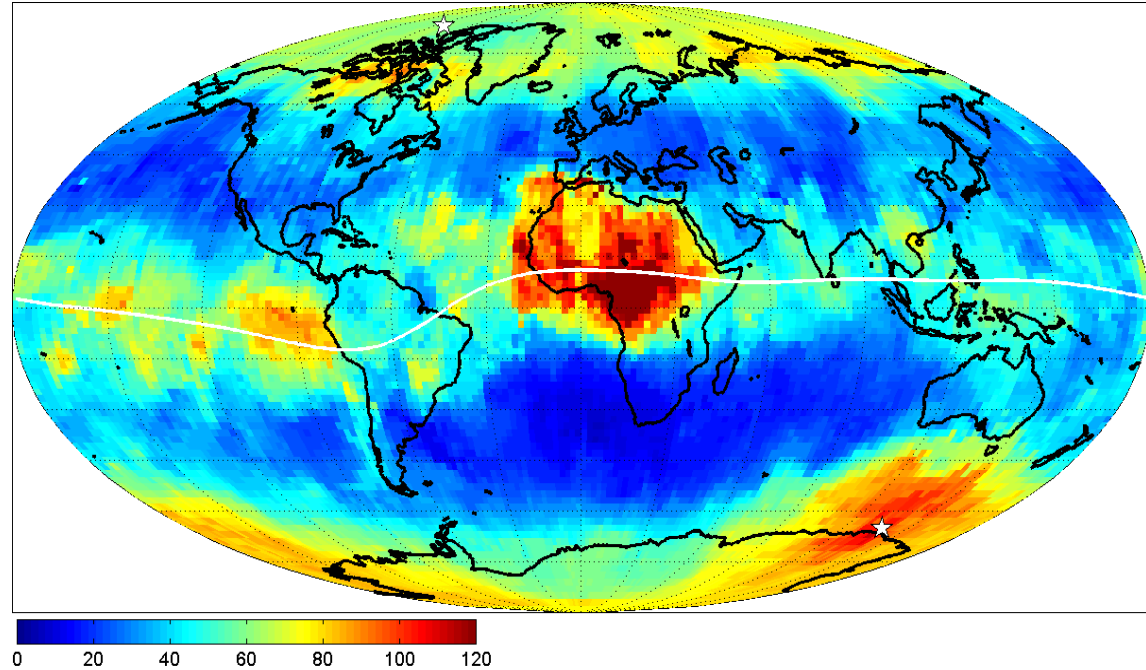


# Natural fossil nuclear reactor, Oklo, Gabon Africa



July 2004-2010

Strong effect of air ionization. Dry season.



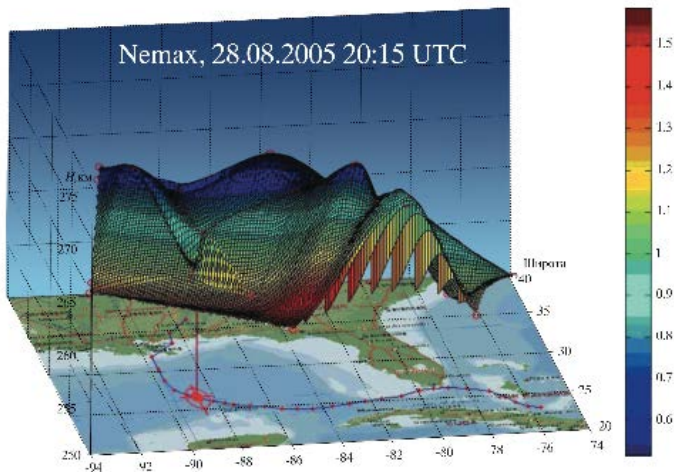
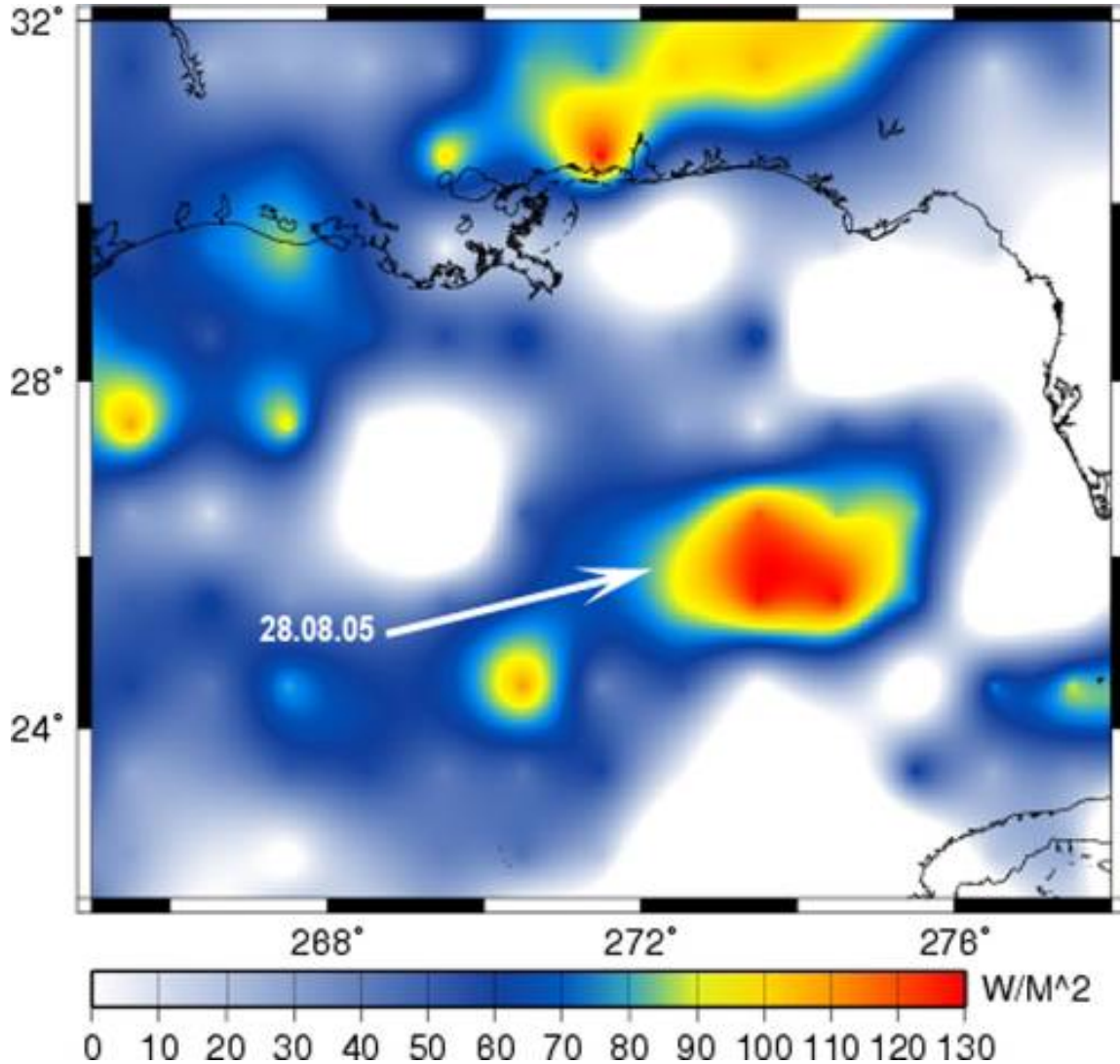
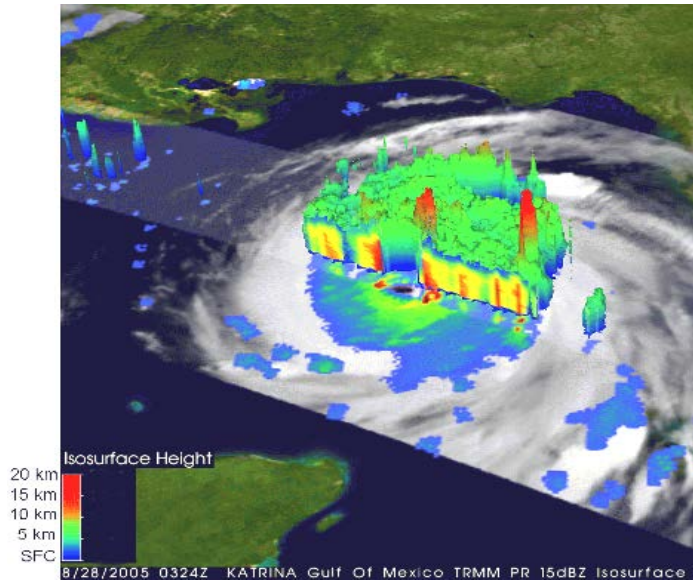
Tsybulya, 2004  
CHAMP satellite results

(S. Pulinets)



# Ionization by thunderstorm discharges (Hurricane Katrina)

(S. Pulinet's)



- More studies OR a different non-Cartesian approach are necessary to clarify the relationship between precursors, triggers and retarders?
- Which parameters to observe and how to integrate the observations?

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ΕΥΧΑΡΙΣΤΩ  
Хвала ти  
THANK YOU



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