

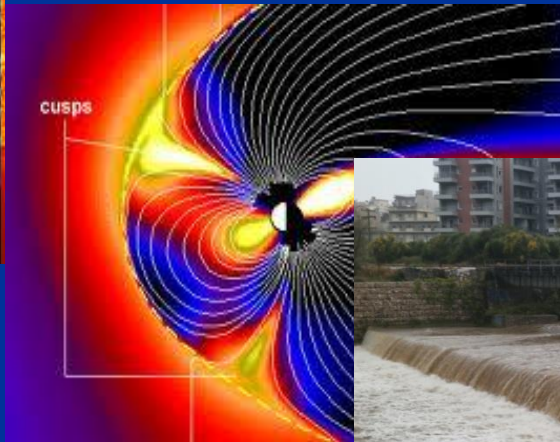
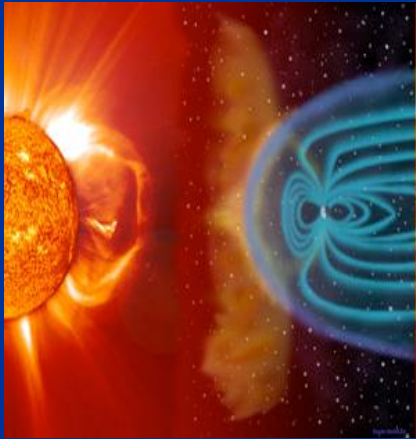
Correlation between Extreme Space - Atmospheric variations

March 2012 superstorm

Anagnostopoulos G.

Contribution by:

K. Kourtidis, N. Hatzigeorgiu, N. Kastelis, D. Efthymiadis)



A. SCIENTIFIC BACKGROUND

1. Current research

- **Sun-Magnetosphere- Climate relationships (S.M.CL-r) research is a topic of increasing interest in the last 20 years.**
- *Review by Grey et al. (2010) : ~350 references (1995-2010)*
- **Investigations *on Solar* influences to Earth reveal new important information**



3. Most important S.M.Clr results concern 11 year Solar Cycle correlations up to now* ...

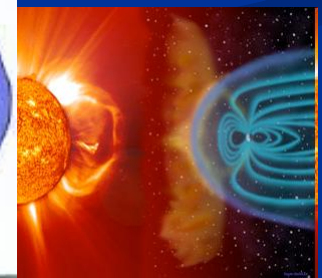
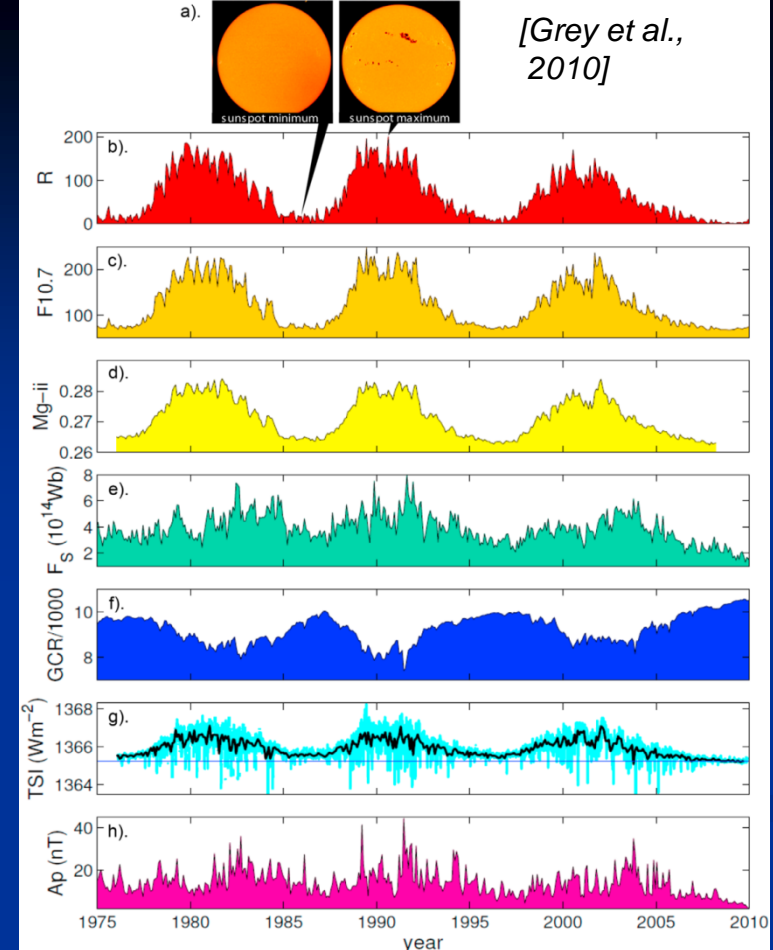
- ✓ solar irradiance
- ✓ open solar B-field flux
- ✓ Geomagnetic Activity
- ✓ cloudy (cosmic ray)
- ✓ as well as
- ✓ Stratospheric changes
- ✓ Sea S. Temperature (~4 years delay)
- ✓ Polar temperatures & winds

[Grey et al., 2010 & references therein]

- ✓ Quasi- biennial oscillation (QBO)

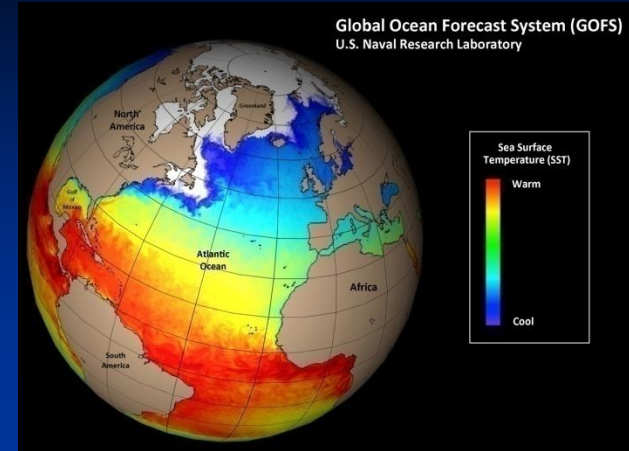
[Labitzke, 1987; Labitzke and van Loon, 1988;
Labitzke et al., 2006].

- ✓ *brief review



2. S.M.CL-r research: social applications

■ **Separate natural – anthropogenic influences.**



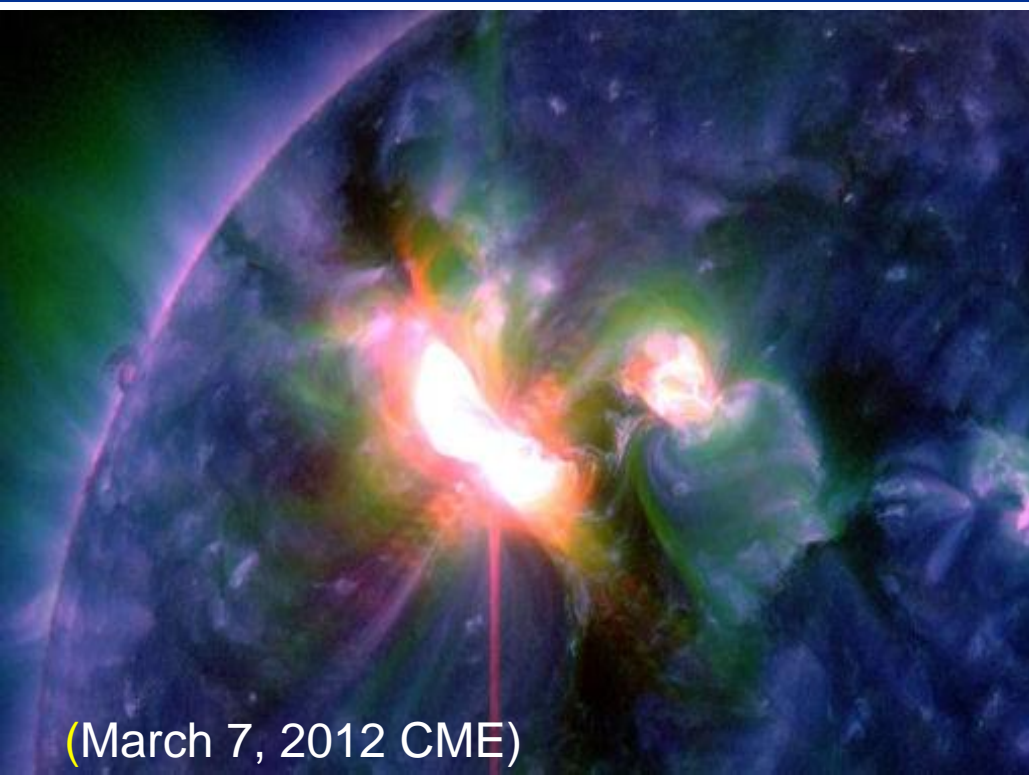
■ **Improve Climate changes - predictions**



■ **Understand / predict
Extreme weather events:
protect People' health / life**



The results of this presentation have been gained because of...



(March 7, 2012 CME)

Second Biggest Flare Of the Solar Cycle

(NASA SDO) http://www.nasa.gov/mission_pages/sdo/news/solar-activity.htm



Participating Universities and Research Centers

Aristotle University of Thessaloniki (AUTH)
National Observatory of Athens (NOA)
National and Kapodistrian University of Athens (NKUA)
Academy of Athens (AOA)
University of Ioannina (UOI)
Democritus University of Thrace (DUTH)



European Union
European Social Fund



OPERATIONAL PROGRAMME
EDUCATION AND LIFELONG LEARNING
investing in knowledge society

MINISTRY OF EDUCATION & RELIGIOUS AFFAIRS
MANAGING AUTHORITY

Co-financed by Greece and the European Union



programme for development
EUROPEAN SOCIAL FUND

(<http://proteus.space.noa.gr/~hnswrn>)

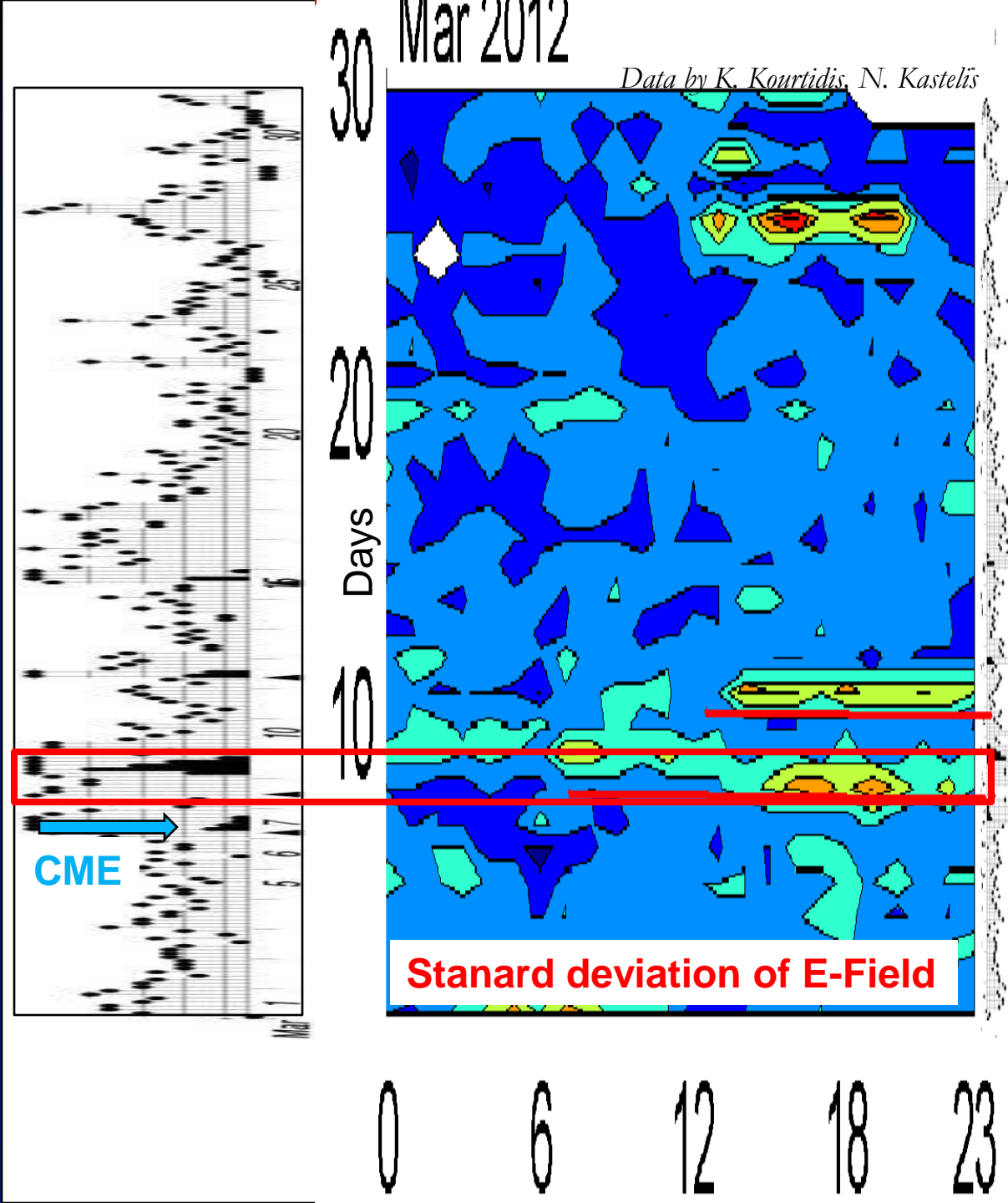
...and a collaboration
Dep. of Enviromental
Engineering
(Pr. K. Kourtidis)..

first correlation

- CME
- Magnetospheric activity
- Geoelectric field disturbances

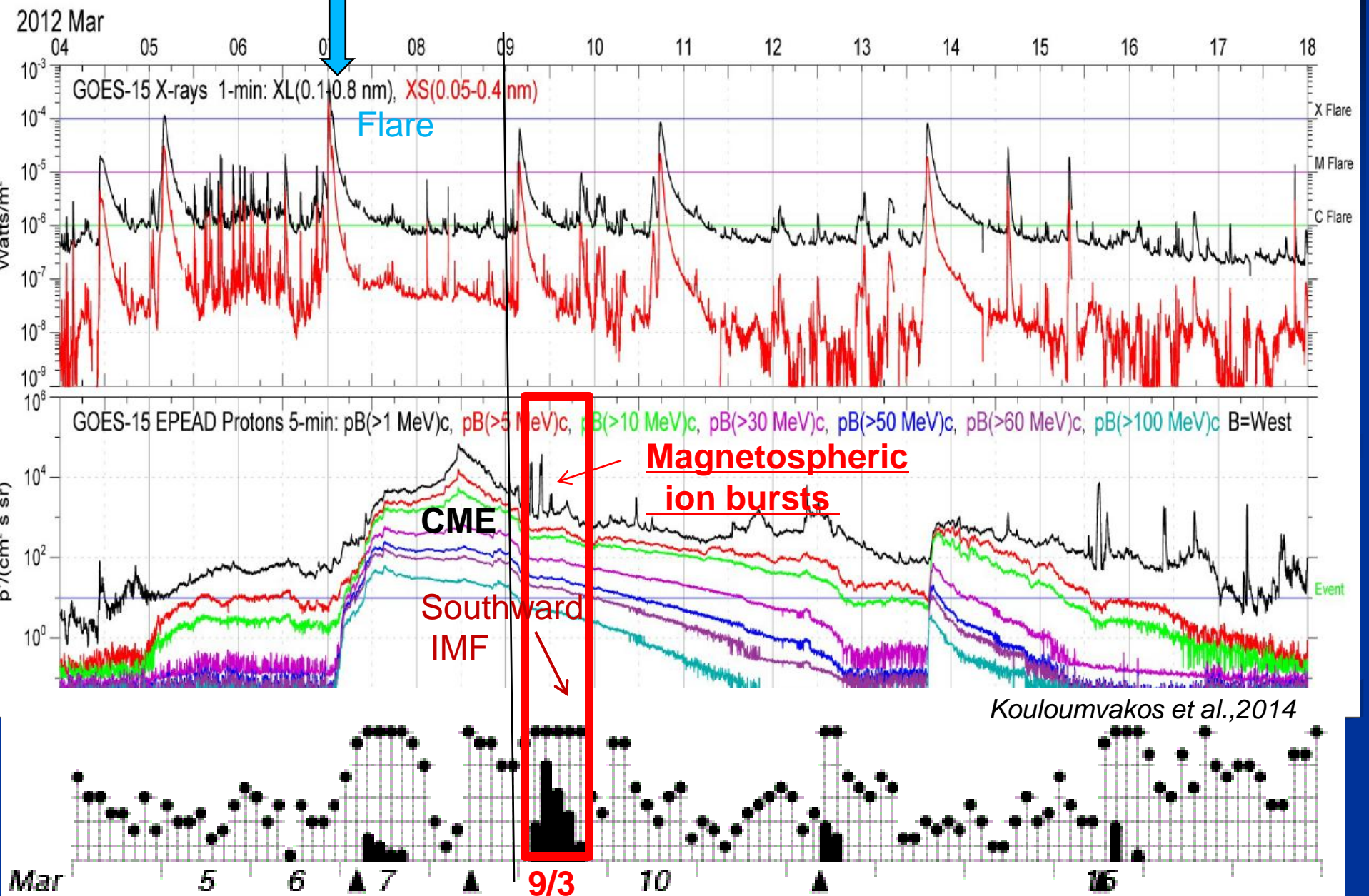
the days after the CME

(8-9.3.2012)

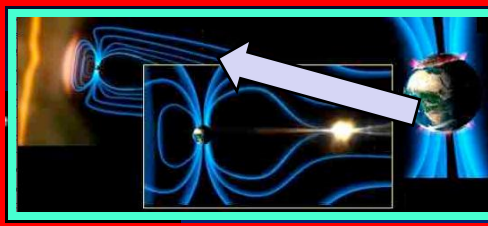


B. CASE STUDY: MARCH 2012 EXTREME EVENTS / GREECE

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



Magnetospheric e- injection / precipitation in Ionosphere

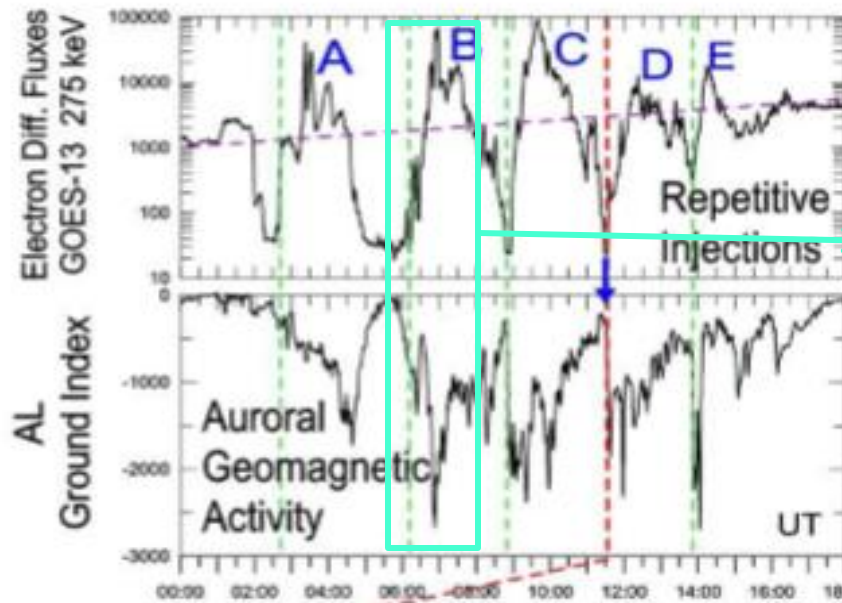


Polar-Orbiting and Geostationary Satellites

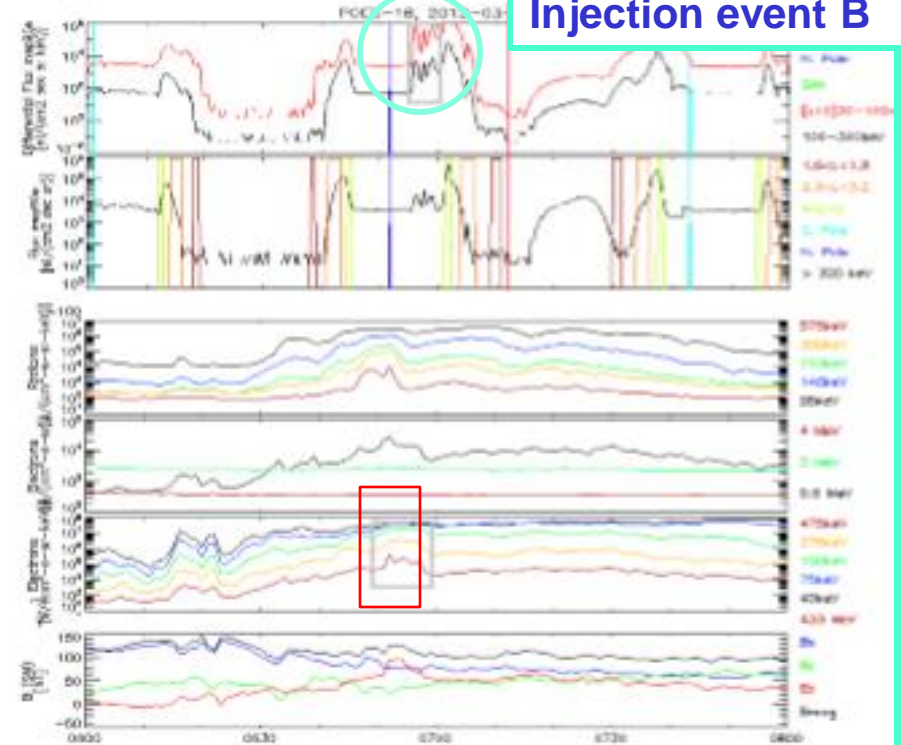


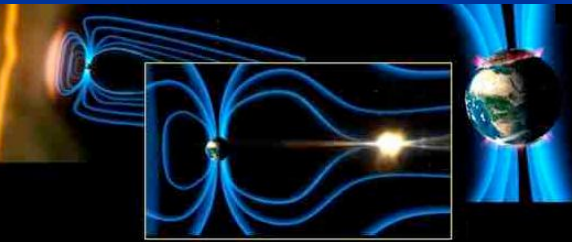
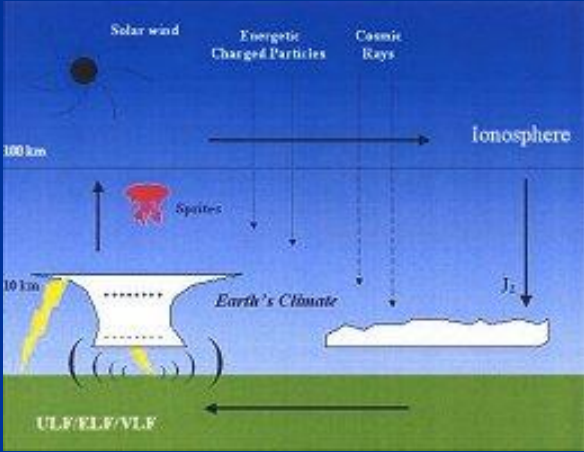
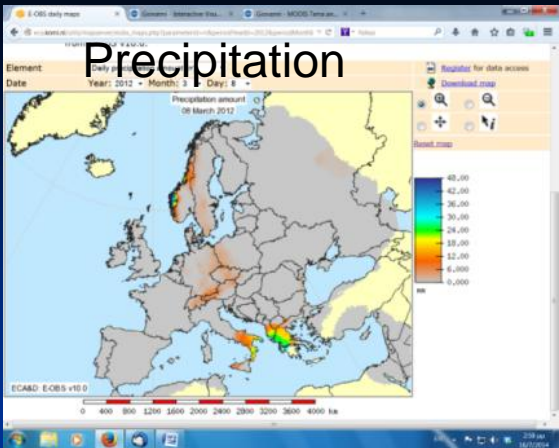
9.3.2012

Data processing by D. Sarafopoulos

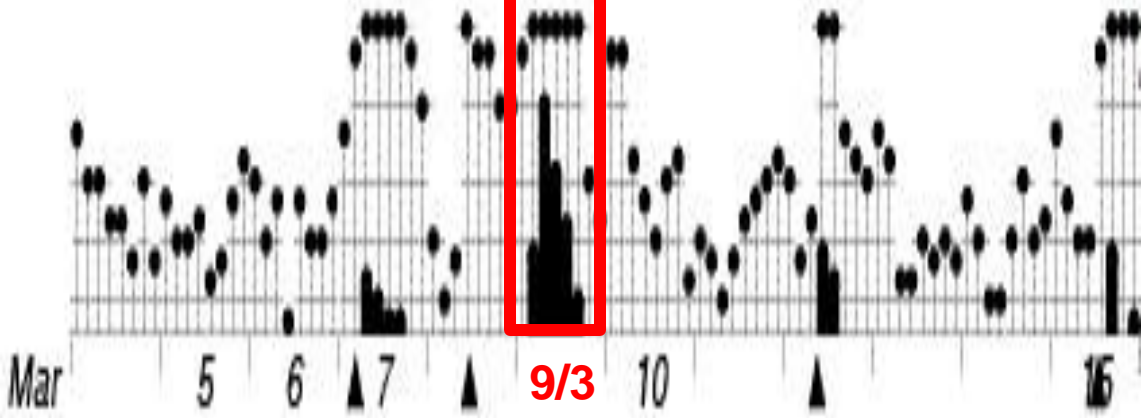
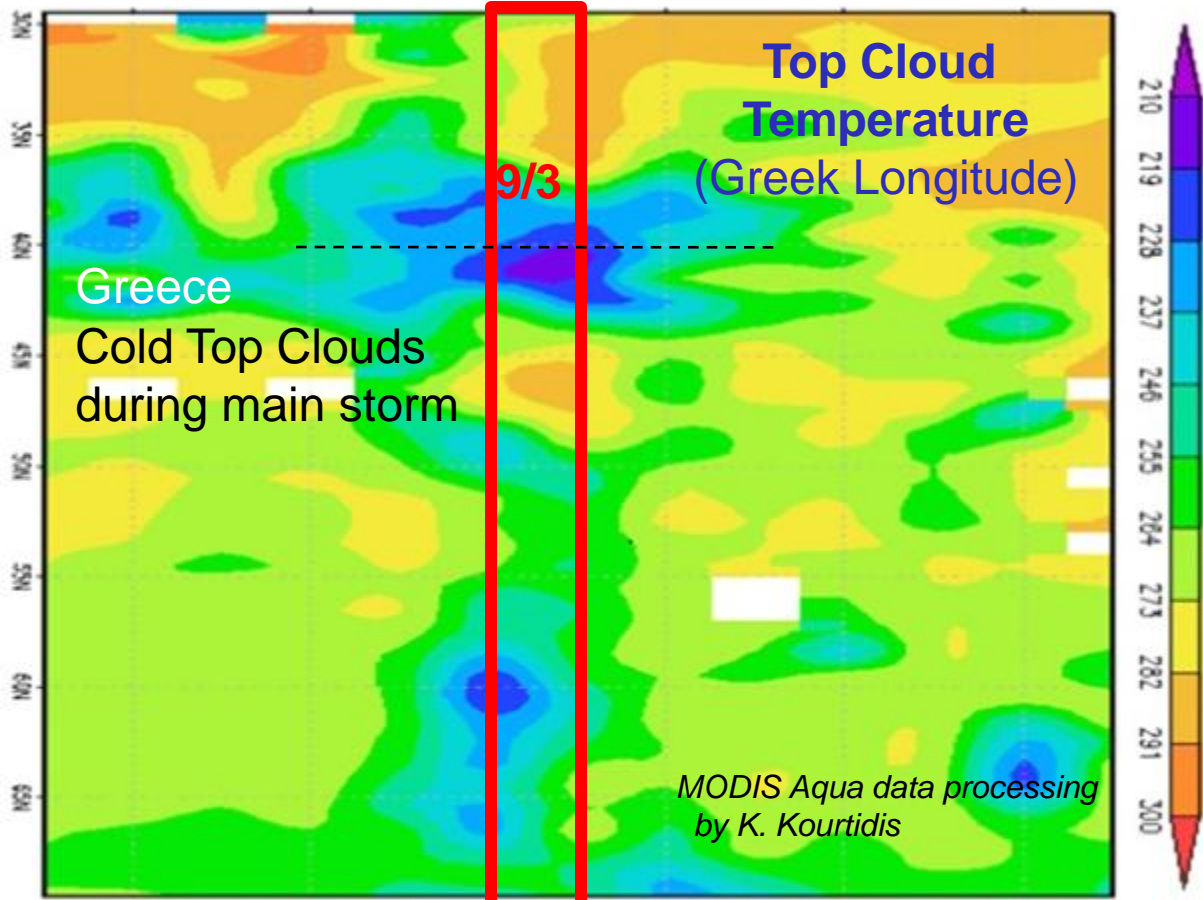


Injection event B





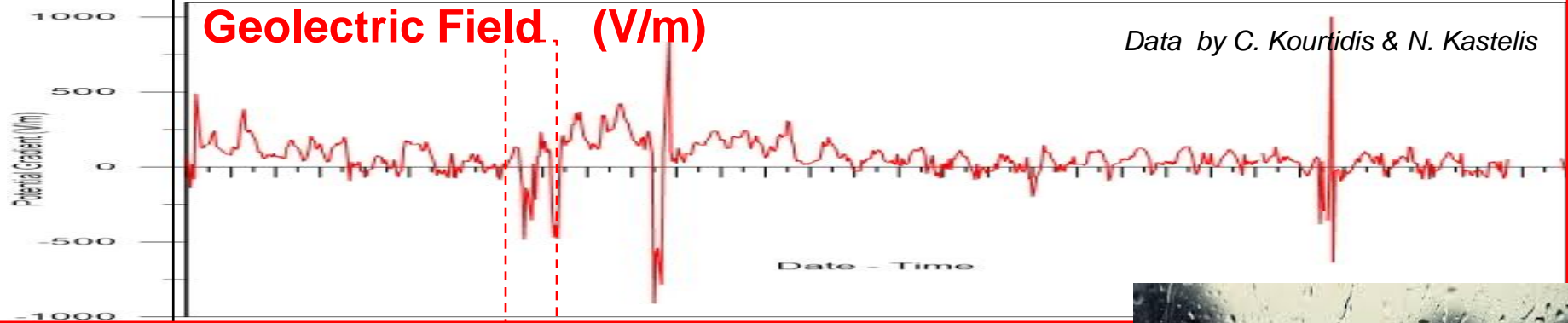
Latitude



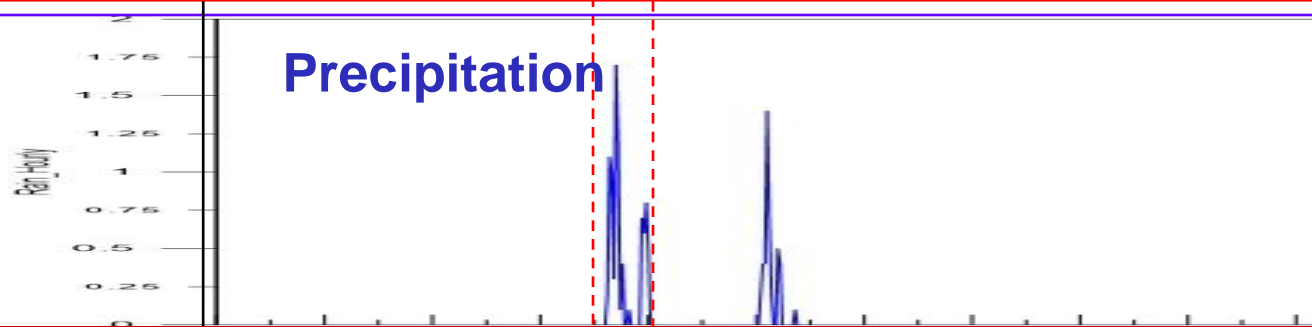
Correlation (d. 8-9): Geo-Electric field / Precipitation / magnetic storm / electrons

Geoelectric Field (V/m)

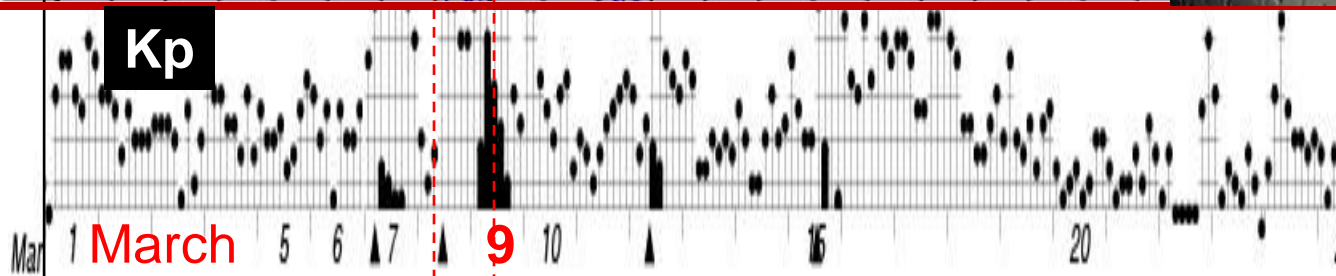
Data by C. Kourtidis & N. Kastelis



Precipitation



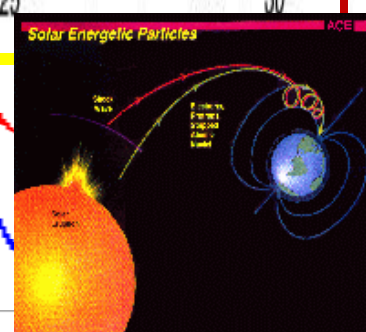
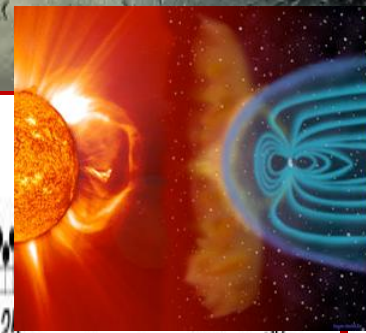
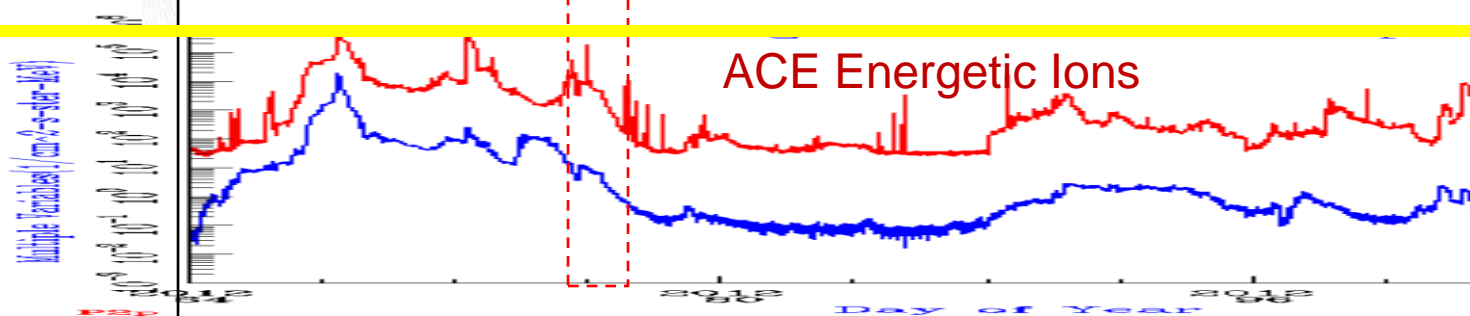
Kp



March

9

ACE Energetic Ions



Μάρτης... γδάρτης – Βροχές, κρύο και κακοκαιρία σε όλη τη χώρα



GREECE,
March 6-13, 2012
effects

Πέμπτη, 6 Μαρτίου, 2014 07:59 πμ

Απαγορευτικό απόπλου λόγω κακοκαιρίας. Σήμερα 13 Μαρτίου



Μπορεί να μη λη η Άνοιξη, ωστόσο, ο καιρός φαίνεται διατηρείται σε χειμωνιάτικα επίπεδα.

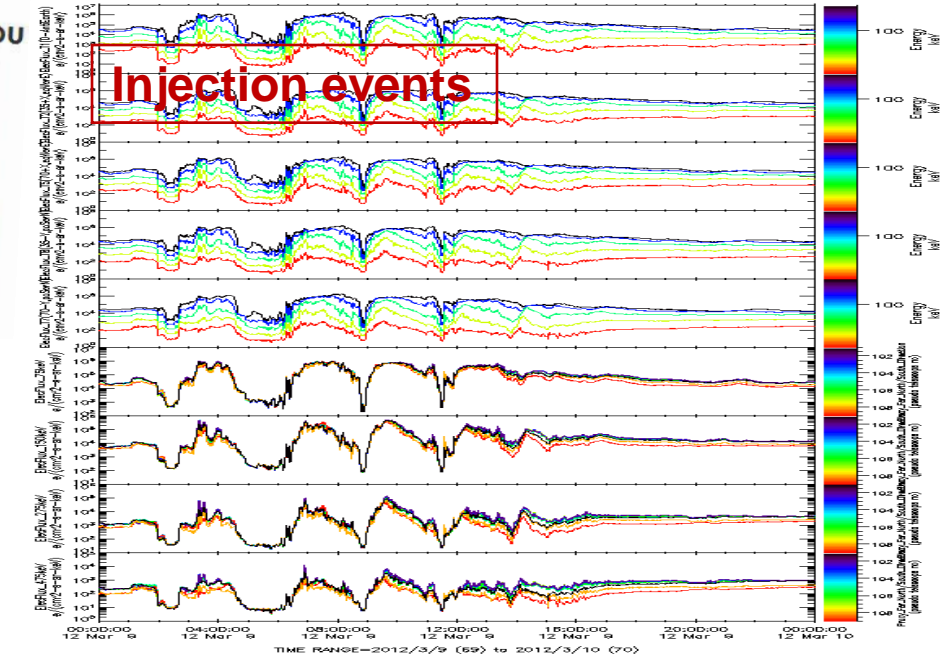
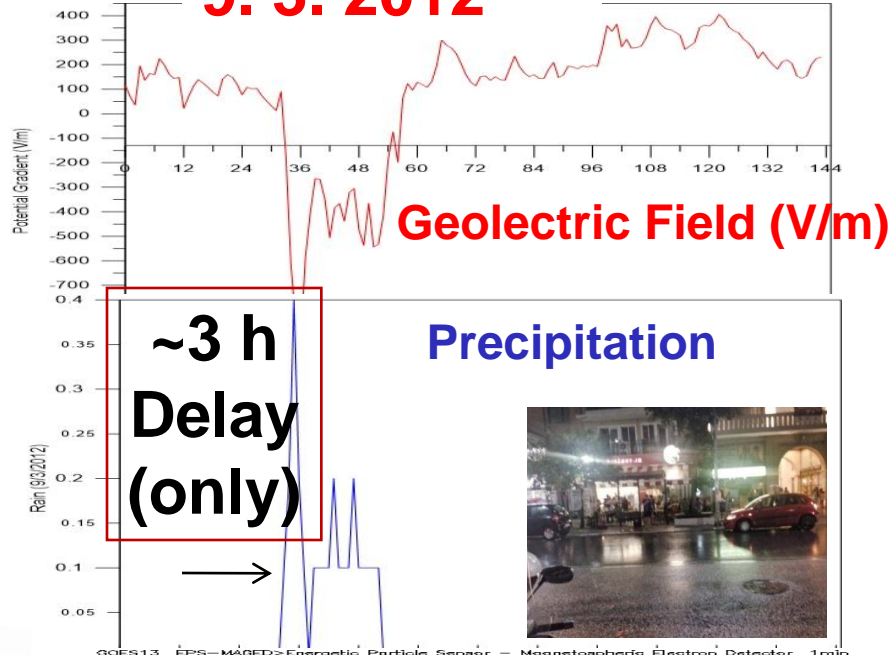


12/03/2012



Τοπικές βροχές και καταιγίδες θα σημειωθούν την Τρίτη 13 Μαρτίου σε ολόκληρη τη χώρα. Χιόνια θα πέσουν στα όρη και ημιορεινά. Οι άνεμοι θα πνέουν βόρειοι εντάσει 8 με 9 Μποφόρ. Θερμοκρασία θα κυμανθεί σε χαμηλά επίπεδα. Στην Απική θα σημειωθούν βροχοπτώσεις ενώ υπάρχει πιθανότητα να εκδηλωθούν καταιγίδες. Πρωί θα χιονίσει στα γύρω όρη. Τα φαινόμενα

9. 3. 2012



Please acknowledge data provider, NOAA-NGDC and SWPC at sem.goes@noaa.gov and CDAWeb when using these data. Generated by CDAWeb on Tue May 20 04:35:12 2014

C. Then...

[PDF] The Historic March 2012 Heat Wave: A Meteorological ...

www.crh.n

1 Mar 201

northwest



NEWS

News, features & press releases

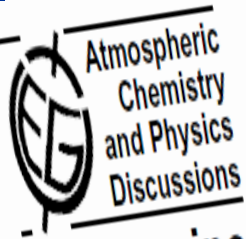
MISSIONS

Current, future

Historic March 2012 Heat Wave: A Meteorological Retrospective

Samantha Borth, Valparaiso University '12
Richard Castro, NWS Chicago
Kevin Birk, NWS Chicago

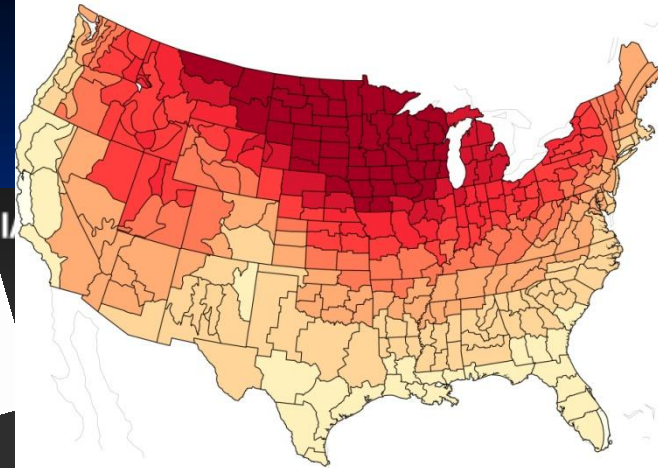
Media Resources



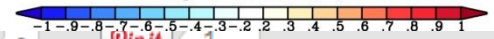
Will climate change increase ozone depletion from low-energy-electron precipitation?

J. G. Baumgaertner¹, P. Jöckel^{1,2}, M. Dameris², and P. J. Crutzen¹

March 2012 Temperature Departures
CMIP5 Ensemble Projection



Degrees Celsius (°C)



Text Size



Tweet

42



Μου αρέσει!

372

g+1

9

Print

NASA Measures Impact of Huge Solar Flare on Earth's Atmosphere

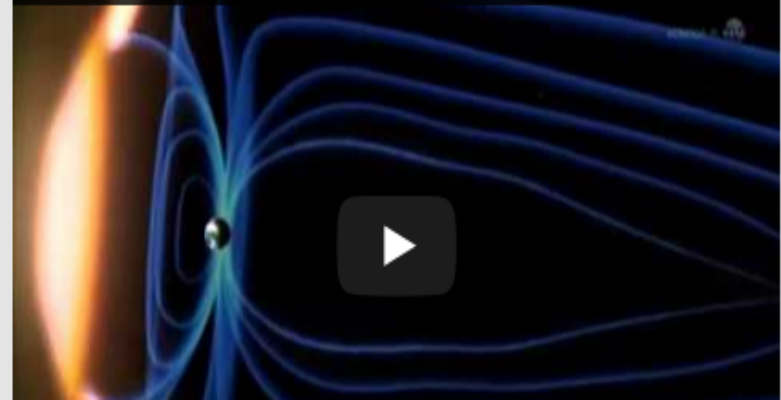
03.23.12

A key NASA instrument that can directly measure the impact of solar events on the Earth's upper atmosphere has weighed in on the huge flare that impacted Earth last week.

The flare was considered one of the largest solar events in years even though its impact on the power grid and communications was minimal due to the angle it hit Earth.

... direct interaction with the upper atmosphere was measured by NASA's SORBER (Sounding of the Atmosphere using Broadband Emission Radiometry) instrument orbiting on the TIMED (Thermosphere, Ionosphere, Mesosphere,

NASA Science - The Surprising Power of a Solar ...

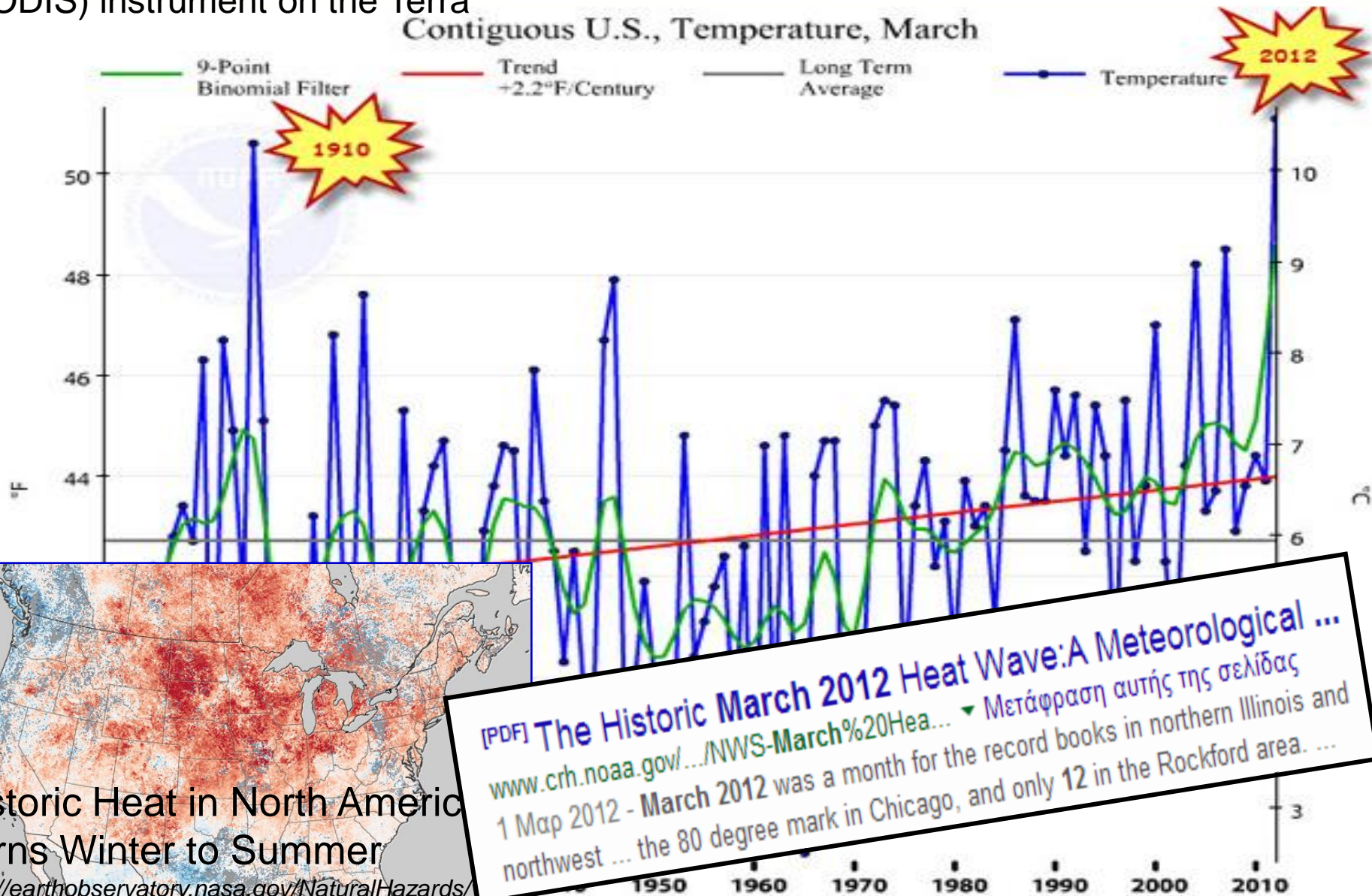


NOAA: March 2012 the Warmest on Record

by Chris Dolce, weather.com Meteorologist

(MODIS) instrument on the Terra

Contiguous U.S., Temperature, March



[PDF] The Historic March 2012 Heat Wave: A Meteorological ...
www.crh.noaa.gov/.../NWS-March%20Hea... ▼ Μετάφραση αυτής της σελίδας
1 Mar 2012 - March 2012 was a month for the record books in northern Illinois and northwest ... the 80 degree mark in Chicago, and only 12 in the Rockford area. ...

Historic Heat in North America
Turns Winter to Summer

<http://earthobservatory.nasa.gov/NaturalHazards/hp?id=77465>

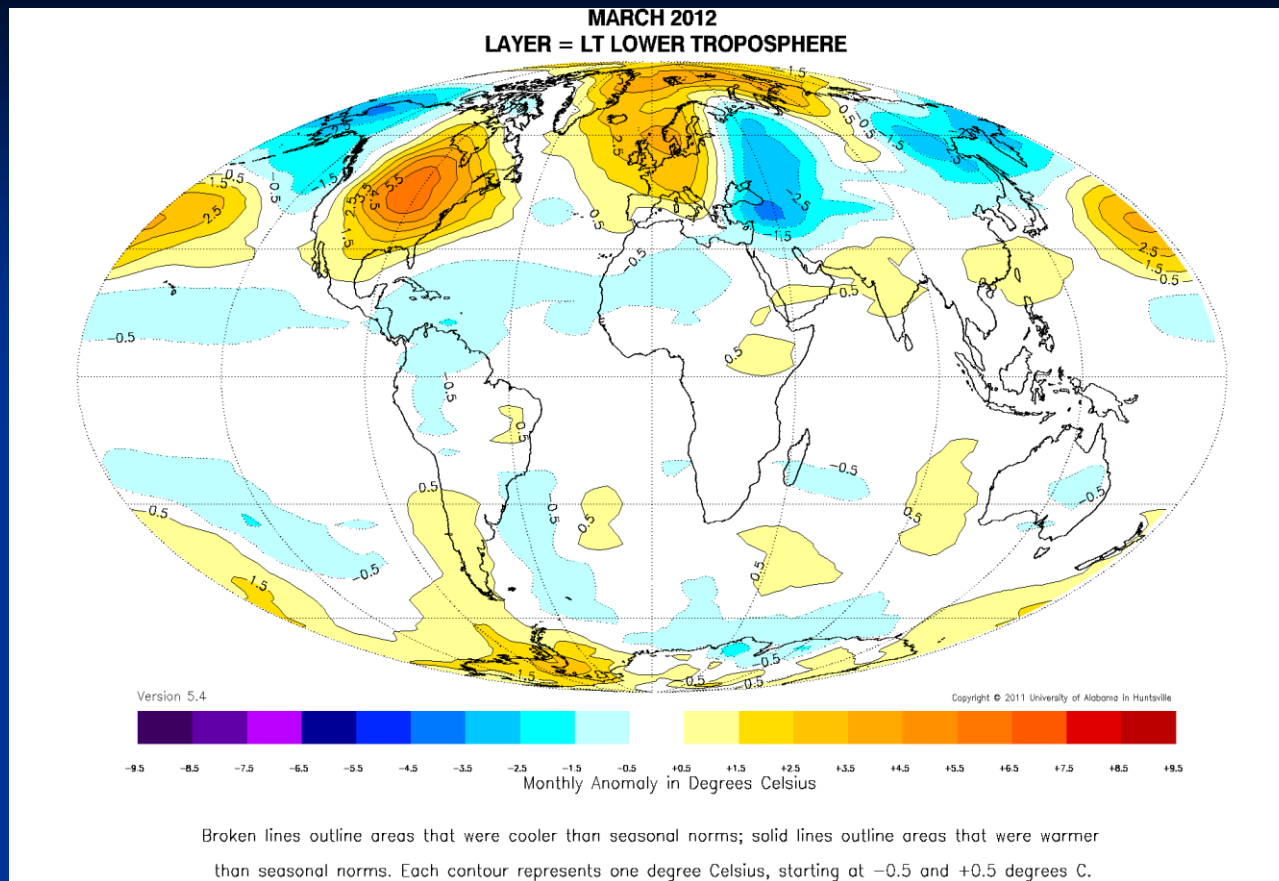
12-23 March

Was this extreme March 2012 U.S. heatwave event anticipated?

“A black swan most probably was observed in March 2012 (lest we forget 1910).... Our current estimate of the impact of GHG forcing is that it likely contributed on the order of 5% to 10% of the magnitude of the heat wave during 12-23 March... But there is always the randomness”.

The question: Randomness or a correlation between space & atmospheric extreme events?

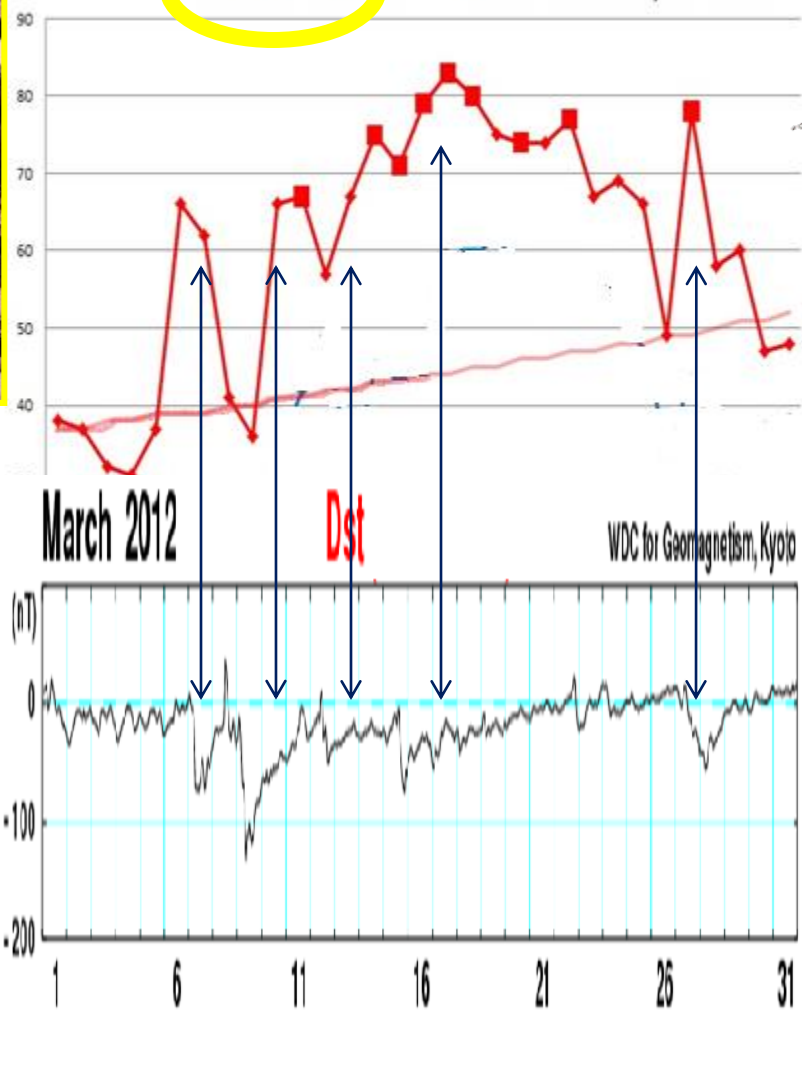
Temperature anomalies



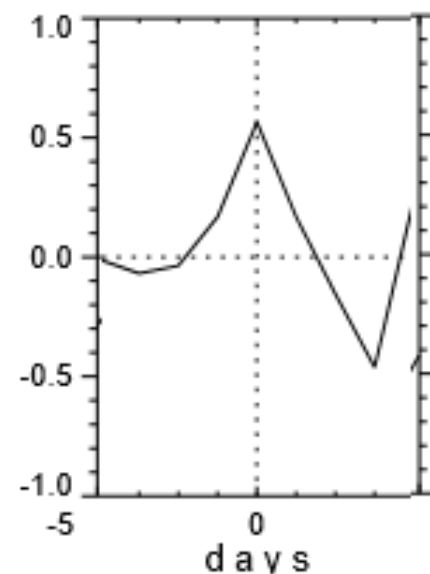
The March map of **temperature anomalies** shows that **warmer-than-average** temperatures occurred all over the globe: across the contiguous United States, Canada, Mexico, southern South America, the United Kingdom, Scandinavia, northern Russia, and parts of southeastern Asia.



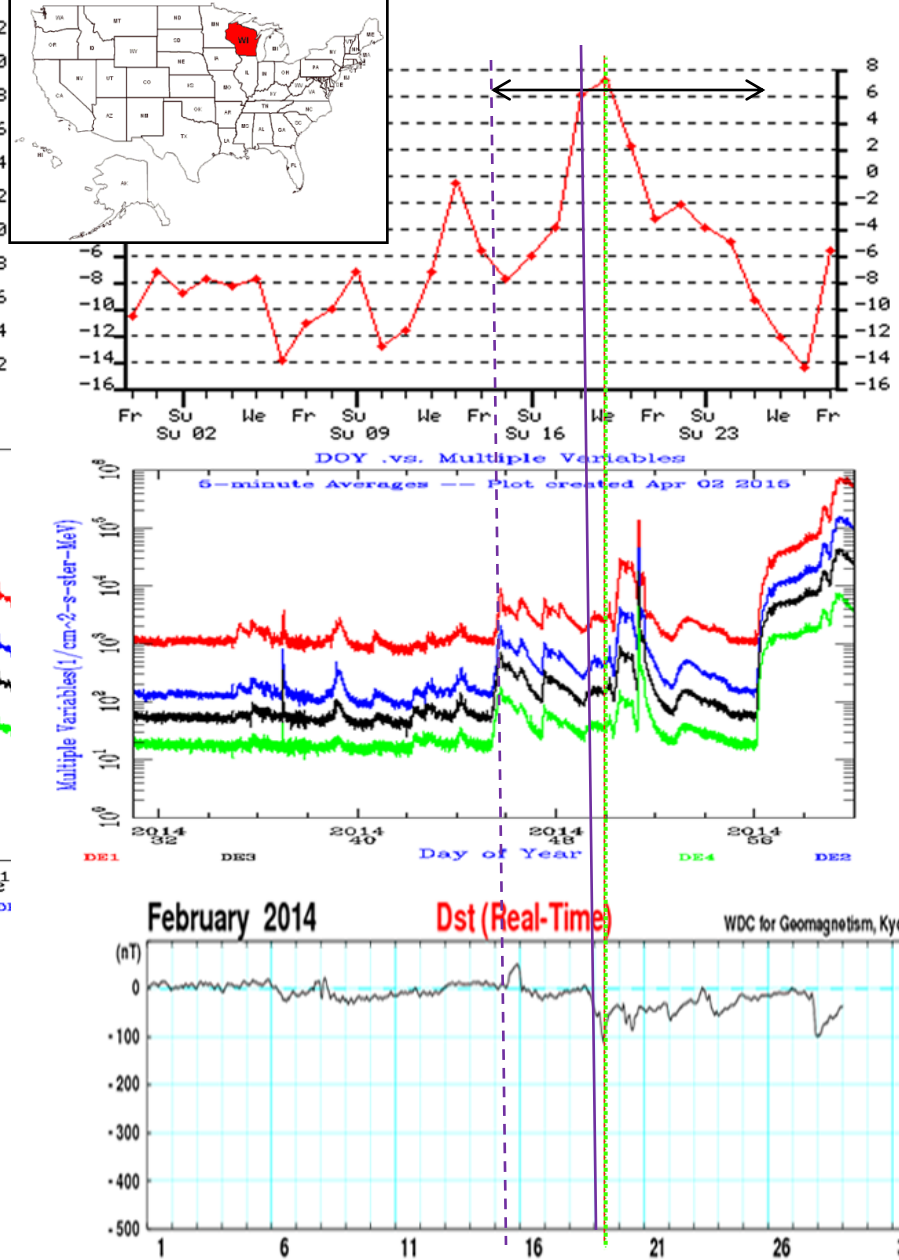
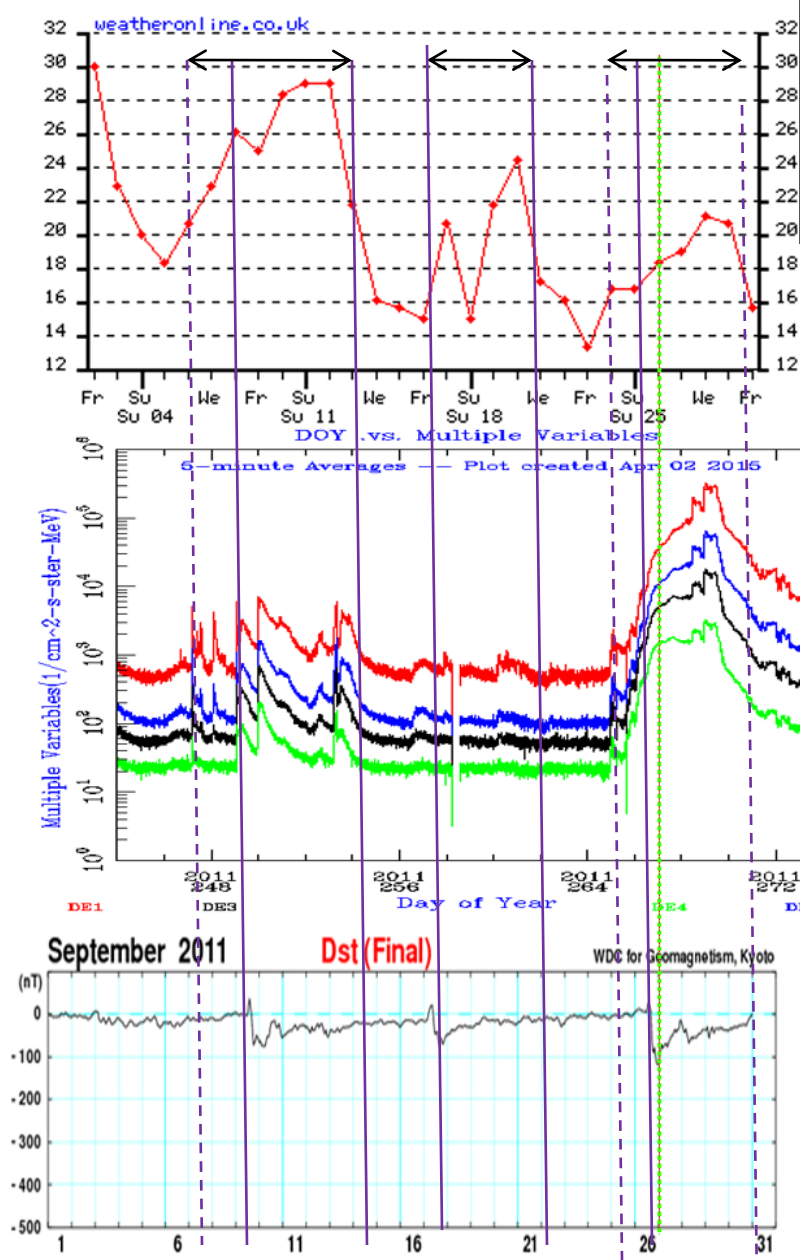
Record Warmth of March 2012 - La Crosse, Wisconsin



Correlation:
Dst (6–14 March) vs.
Temperature



**Correlation between
geomagnetic index Dst – Temperature**

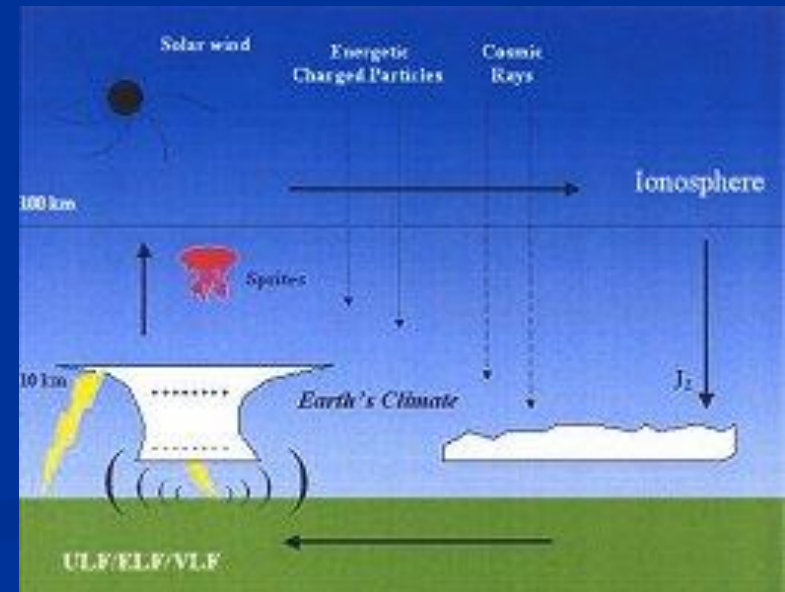


Several big (Dst<-100nt) storms between 1998 – 2015 show S.M.CL-relationship is NOT an unusual phenomenon!!!

D. GENERAL CONCLUSION-1

The great CME / superstorm of March 2012 was followed by
a FAST (few hours) response of
TROPOSPHERE to the MAGNETOSPHERE
(A sequence of physical events in GREECE)

*Probably suggests that radiation
belt electron precipitation
into the middle latitude atmosphere
may create an excess ionization
(during special S.M.Cl conditions)
via a non-linear process.*



GENERAL CONCLUSIONS -2

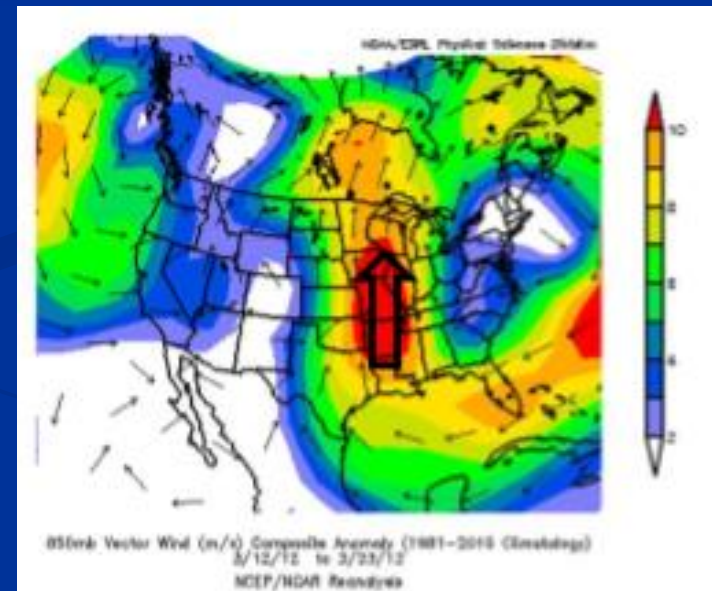
The great CME / superstorm of March 2012 in NE USA/Canada was followed by

Good correlation (day)

**Dst (geomagnetic activity)–Surface
Temperature in N.E. USA**

in the presence

- High Pressure
- Golf southward Stream
- (Positive NAO index)



The Historic March 2012 Heat Wave: A Meteorological Retrospective

Samantha Borth, Valparaiso University '12

Richard Castro, NWS Chicago

Kevin Birk, NWS Chicago

<http://www.crh.noaa.gov>

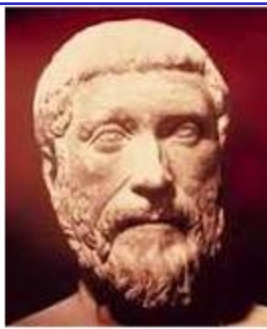
Figure 2.3 indicates the average 850 mb wind vector anomaly throughout the period of the heat wave. The arrow indicates the placement of the southerly low level jet.

CORRELATION OF SPACE – METEOROLOGICAL EVENTS

Already in ancient Greece, around 400 B.C., Meton observed sunspots (*Hoyt and Schatten, 1997*). After twenty years of solar studies he came to the conclusion that high solar activity, i.e. high number of sunspots, is associated with wet weather in Greece. Today the observations of Meton could have been associated with the changes of the North Atlantic Oscillation (NAO) (*Hurrell et al., 2003*).

Μέτων ο Αθηναίος

Ο Μέτωνας ήταν Έλληνας μαθηματικός, αστρονόμος, γεωμέτρης και μηχανικός ο οποίος έζησε στην Αθήνα τον 5ο π.Χ. αιώνα.



**Influence of Solar Activity
Cycles on Earth's Climate**



ESA ITT AO/1-4618/NL/AR

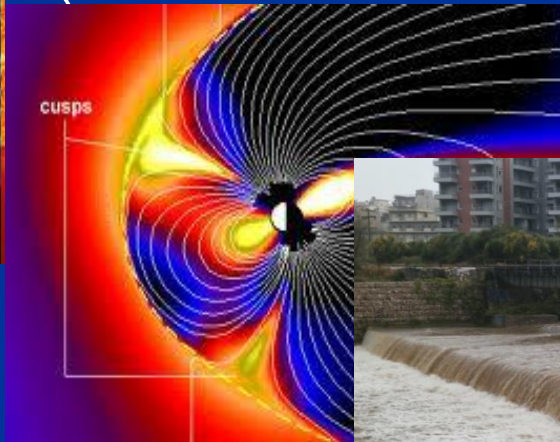
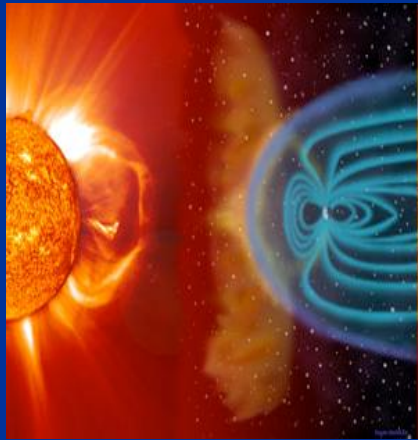
F. Beberg, H. Lundstedt, and P. Wintoft
Swedish Institute of Space Physics

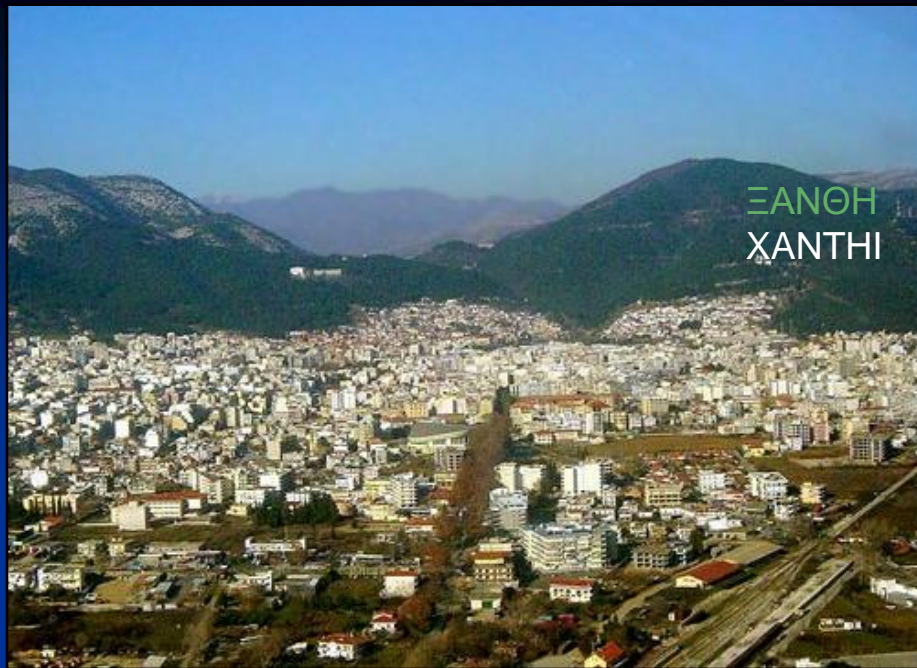
FINAL CONCLUSION:

Strong evidence of Correlation between
Big CME / superstorm /
Atmospheric variations

March 2012

(non-linear fast processe(s)?)





Thank you for your attention