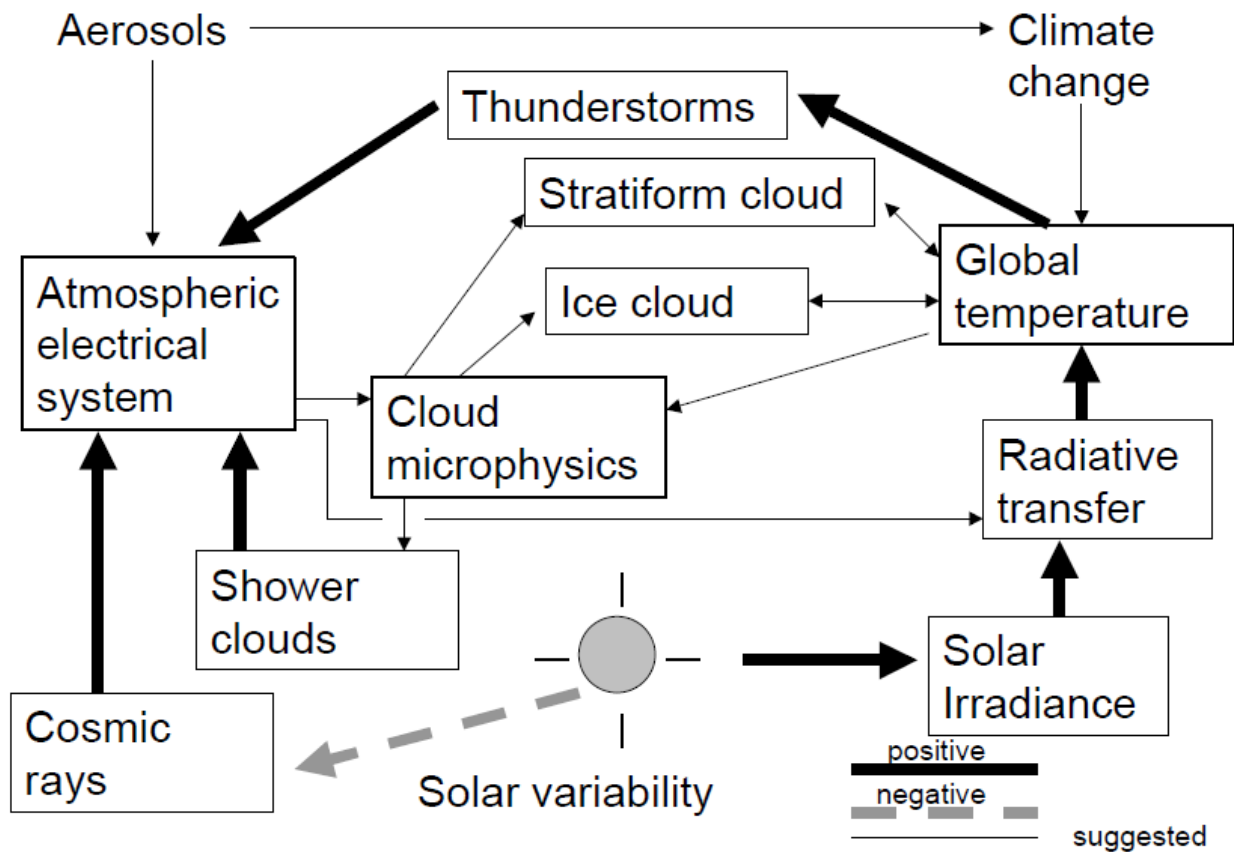


The lightning activity over Poland during different solar activity as seen from the ground and space

Jan Błęcki, Rafał Iwański, Roman Wronowski, Paweł Jujecko

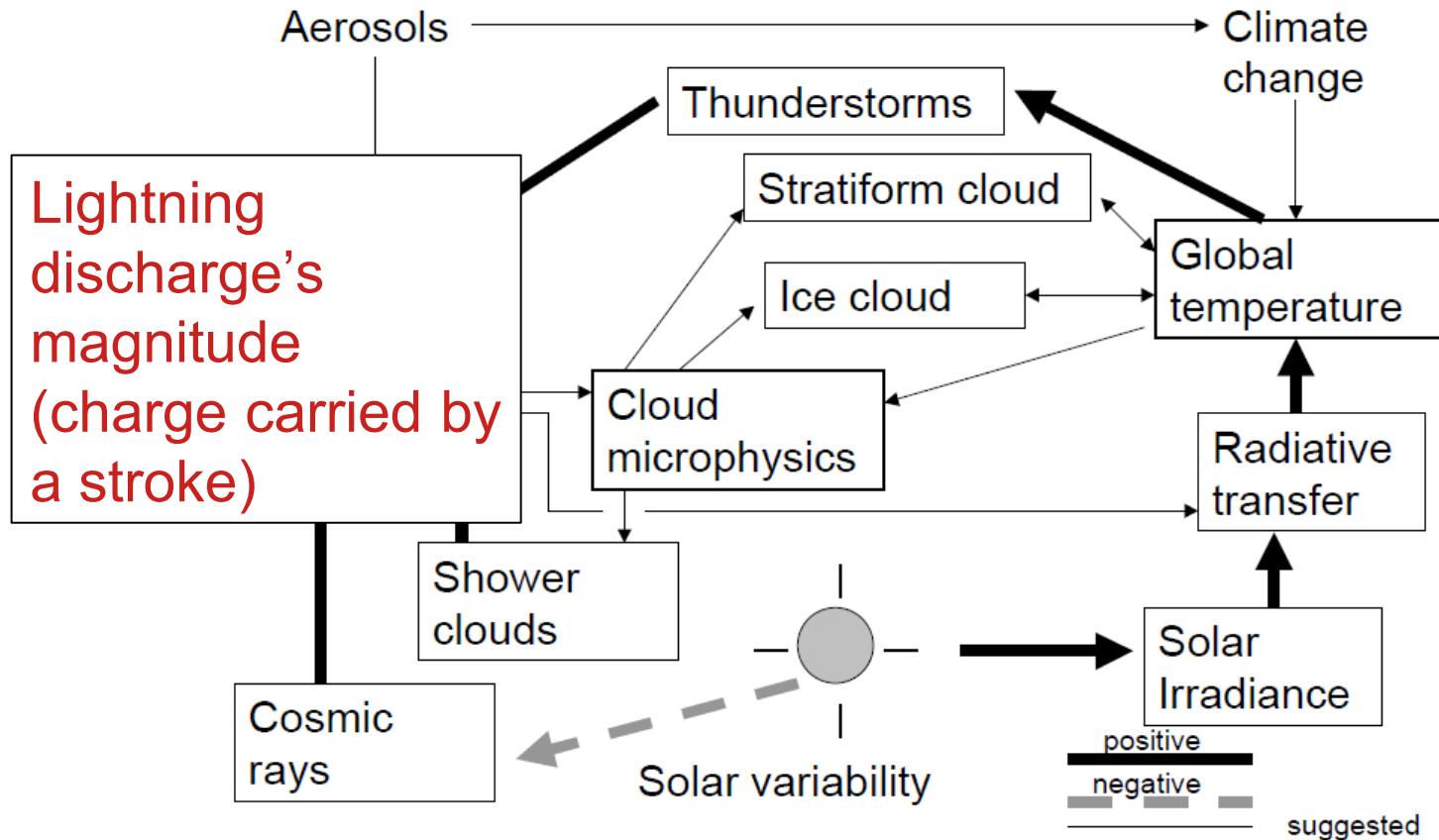
¹ Space Research Centre PAS, Warsaw, Poland

² Satellite Remote Sensing Centre, IMWM-NRI, Cracow, Poland



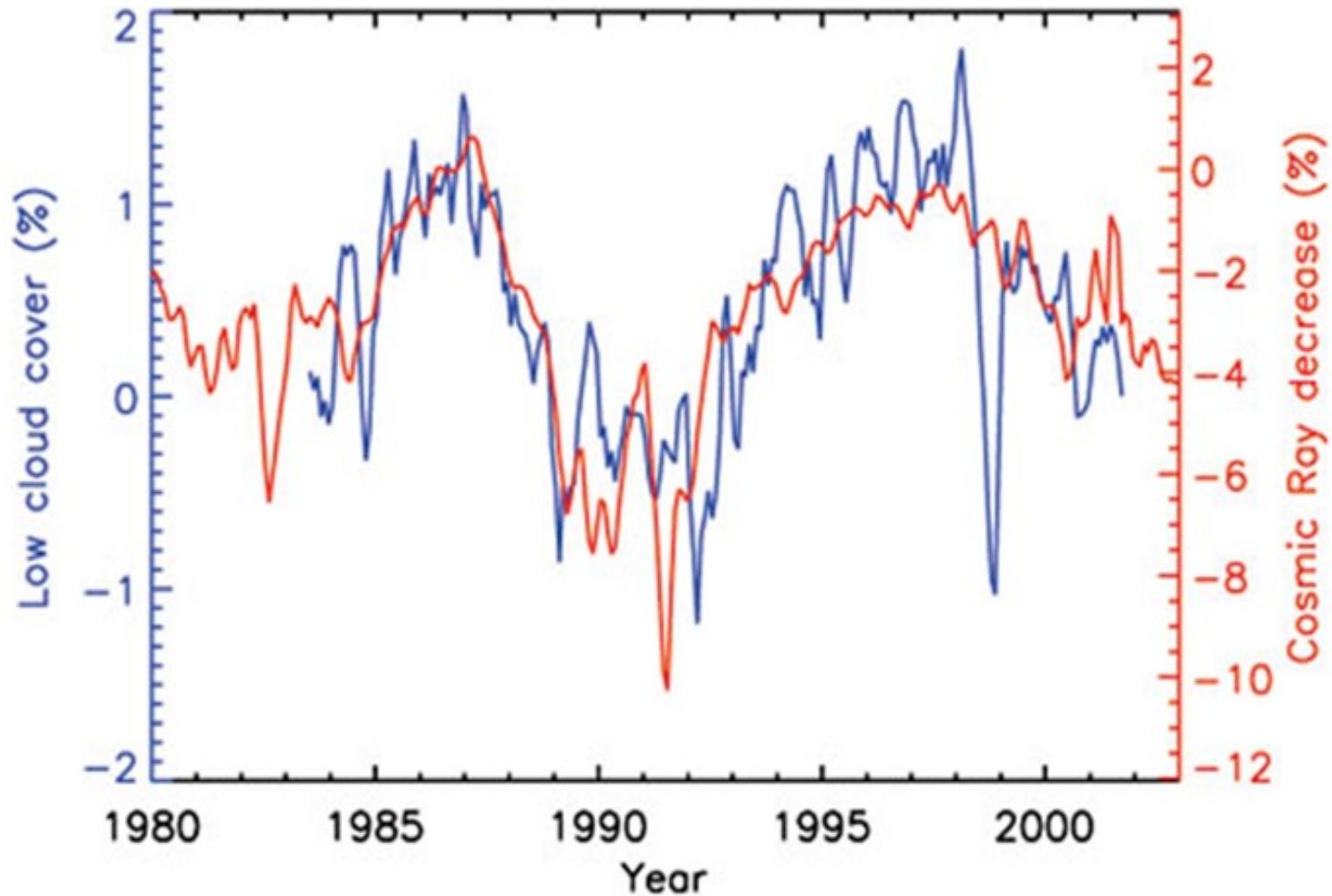
Harrison,2005

Our hypothesis



Harrison, 2005

Correlation of the cosmic rays flux measured by neutron monitor with the low cloud coverage obtained from satellite ISCCP (Marsh & Svensmark, 2003).



GCR-cloud mechanism

GCR → ionisation → higher aerosol nucleation → more cloud condensation nuclei (CCN) → more droplets, but smaller ones (less likely to fall down) → more clouds with higher water content

(Yu, 2002)

GCR-cloud mechanism

GCR → ionisation → higher aerosol nucleation → more cloud condensation nuclei (CCN) → more droplets, but smaller ones (less likely to fall down) → more clouds with higher water content

Confirmed by clouds measurements during Forbush decreases

(e.g. Svensmark et al. 2016)

GCR → Lightning discharges (LD)

- Forbush Decreases (low GCR)
decrease LD no. in
tropics/subtropics (Wu, 2019)
- GCR → no. of thunderstorms in the
US (Lethbridge 1981, Chronis 2009)
- No correlation between GCR and LD
no. (Siingh 2013,'14, Kudela 2017)

SATELLITE DEMETER

Launched on June 29, 2004 to a polar orbit and 98° inclination. Measured regions of $\pm 65^\circ$ (i.e. without the auroral regions). Finished its mission in December 2010. Initial height 715 km, decrease to 660 km in December 2005.

ELF/VLF range for the electric field is from DC up to 20 kHz.



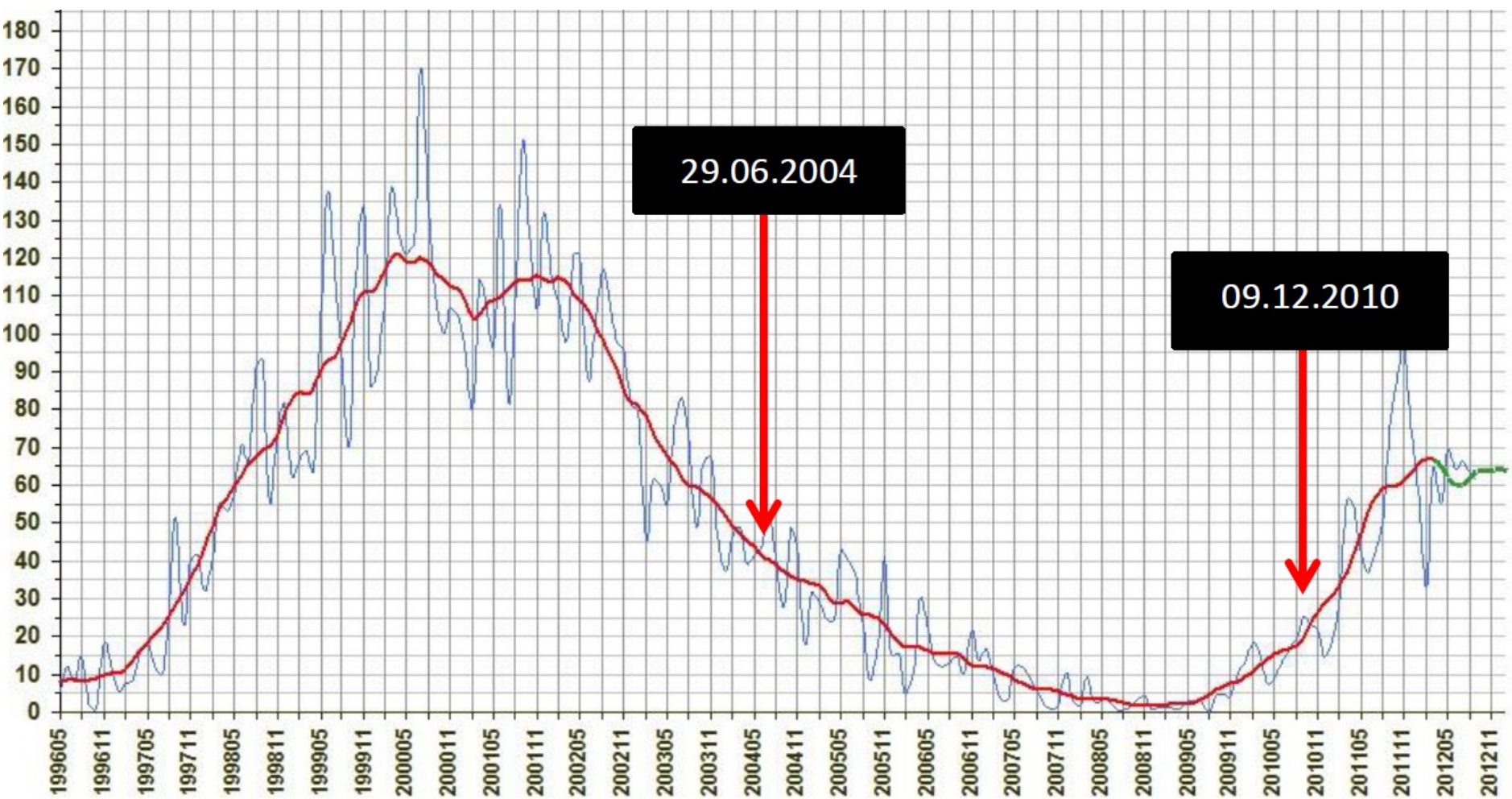
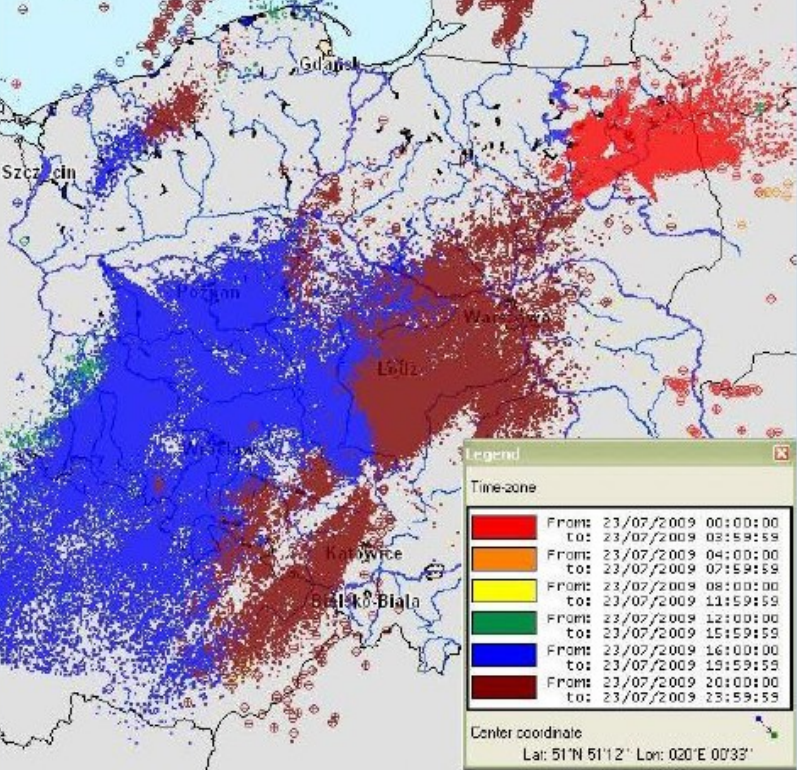
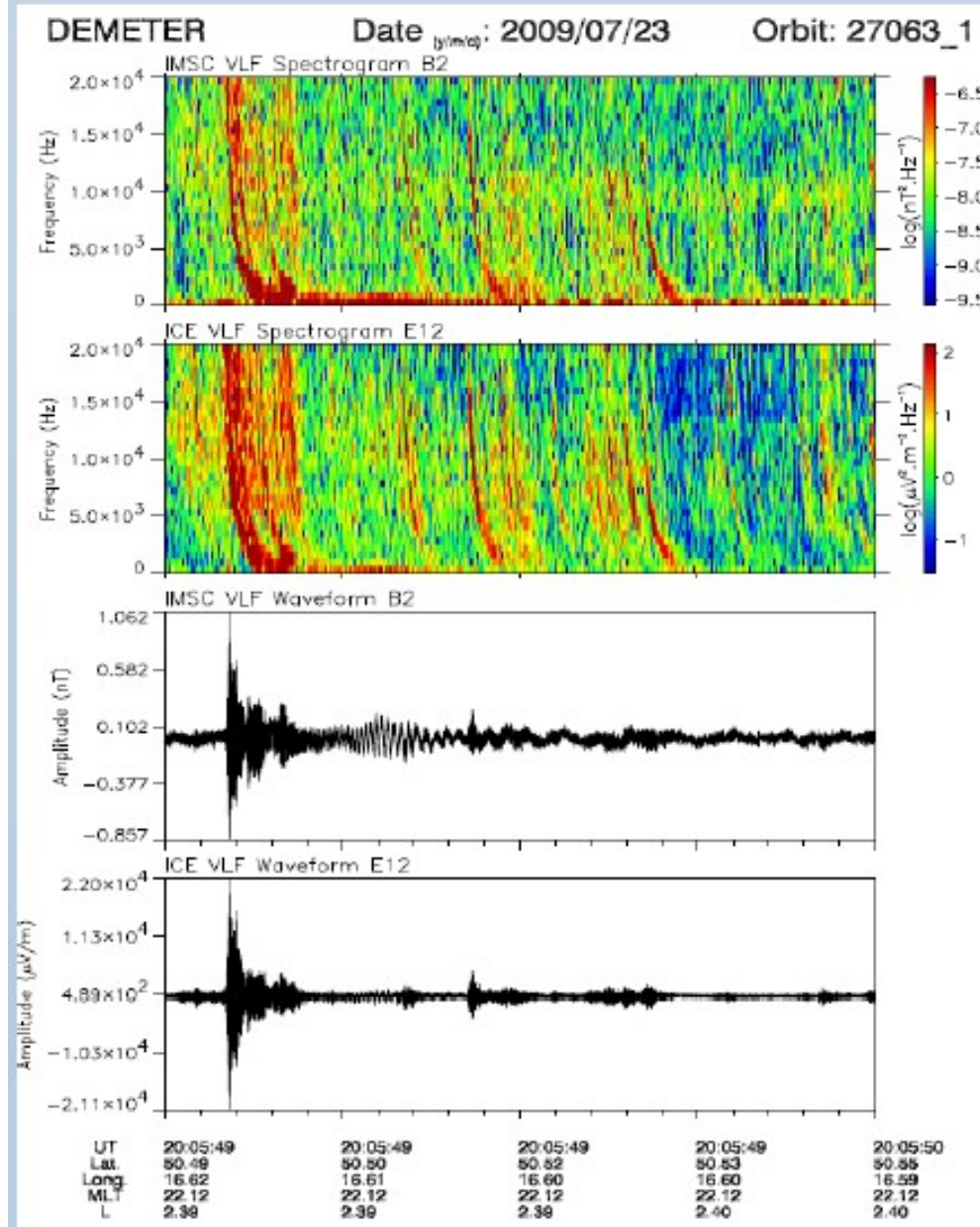
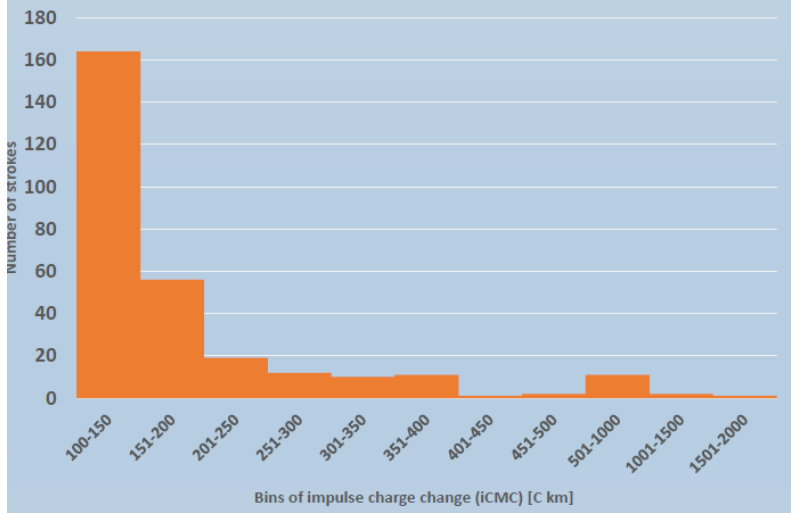


Figure 2. 23rd-24th solar cycle. The red vertical arrows indicate the time interval of DEMETER operation.



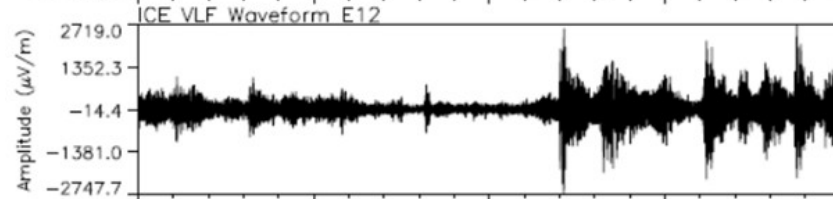
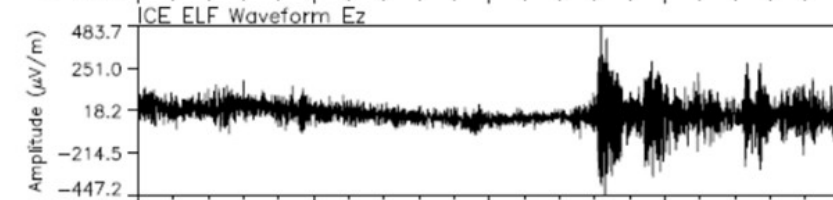
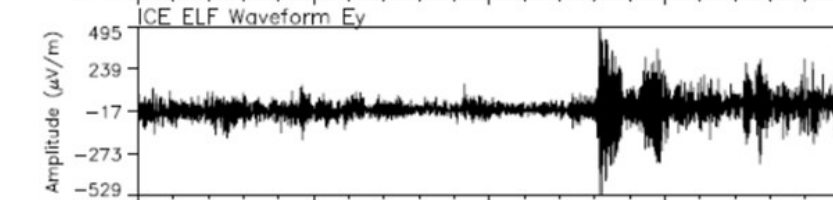
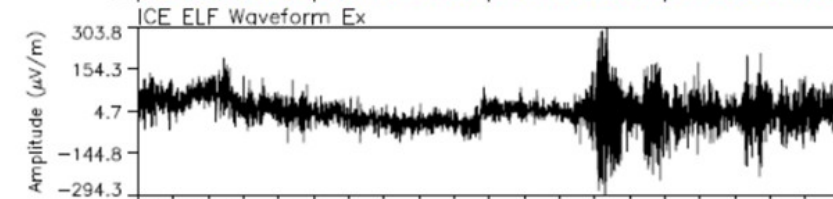
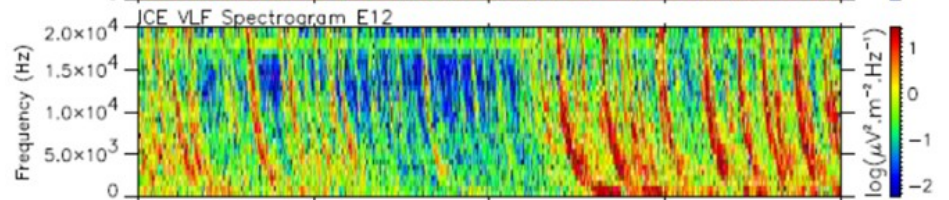
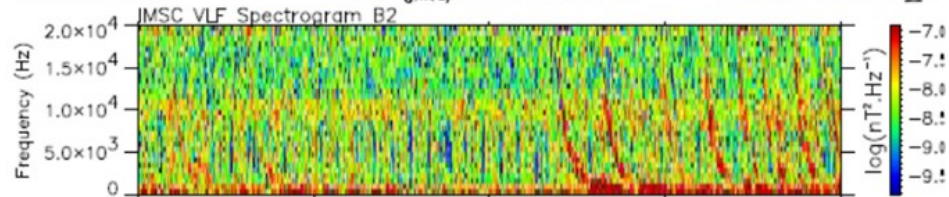
PERUN measurements. Sum of all discharges 23.07.2009.



DEMETER

Date (y/m/d): 2007/07/20

Orbit: 16280_1



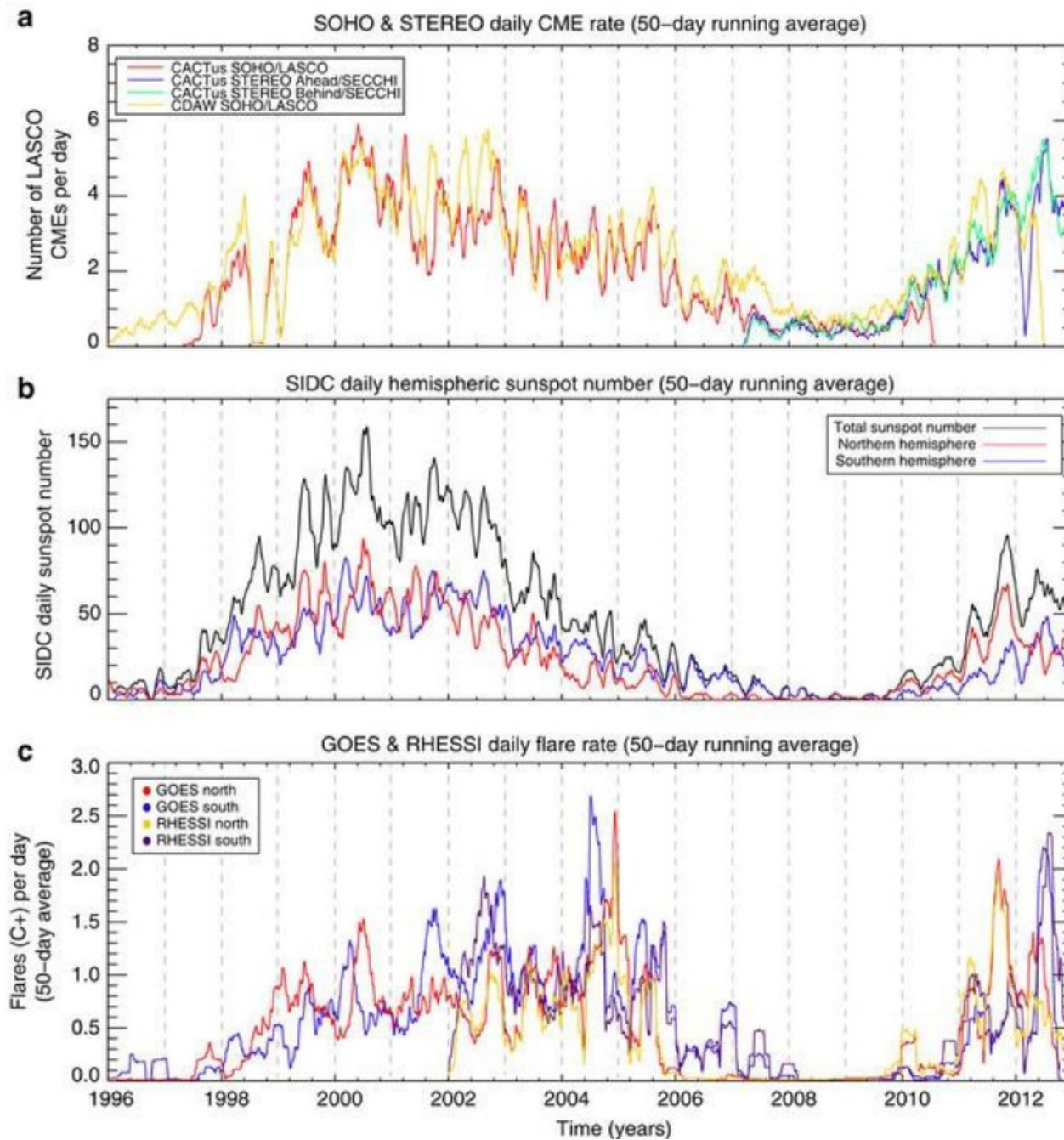
UT	20:10:34	20:10:34	20:10:34	20:10:34	20:10:35
Lat.	42.15	42.17	42.18	42.20	42.21
Long.	23.29	23.28	23.28	23.27	23.27
MLT	22.45	22.45	22.45	22.45	22.45
L	1.81	1.81	1.81	1.81	1.81

Summary

- Some of the most energetic lightnings of DEMETER observation occurred during the Solar minimum (Błęcki et al. 2022)
- No correlation between GCR and LD no.
- Assumption for further research
- GCR may influence magnitude of a lightning discharge
- Satellite data provide useful data for verifying this hypothesis



Thank you for your
attention



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Detection of Electro-Magnetic Emissions Transmitted from Earthquake Regions



Orbit: polar and circular
Altitude: 650km
ELF/VLF range for the electric field is from DC up to 20 kHz.
Ion density:
 $5 \cdot 10^2 - 5 \cdot 10^6 /\text{cm}^3$
Ion temperature:
1000 K - 5000 K
Electron density:
 $10^2 - 5 \cdot 10^6 \text{ cm}^{-3}$
Electron temperature:
500 K - 3000 K
Energetic electrons
30 keV - 10 MeV
Ion composition $\text{H}^+, \text{He}^+, \text{O}^+, \text{NO}^+$
There are two modes: a survey mode where spectra of one electric and magnetic component are onboard computed up to 20 kHz and a burst mode where waveforms of electric and magnetic field are recorded up to 20 kHz.