The effects of Aerosols and Solar activity on the Global Electric Circuit in a changing Climate

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Introduction

- The global electric circuit (GEC) links the electric field and current flowing in the lower atmosphere, ionosphere and magnetosphere
- GEC forms a giant spherical condenser which is charged by the thunderstorms to a potential of several hundred thousand volts
- GEC drives vertical current through the atmosphere's columnar resistance.

Aims and Progress

- Research the connection between
  - Solar activity,
  - Aerosol loading
  - Lightning activity (GEC)
- Coastal, boreal forest and urban area first in Finland and then globally.

Data

- Lightning data - **FMI**
- Total sunspot number - **SILSO, Royal Observatory of Belgium**
- Solar wind speed, Proton density and Flux **- OMNI2 data**
- Cosmic ray – **Oulu neutron monitor (NM)**

Acknowledgements

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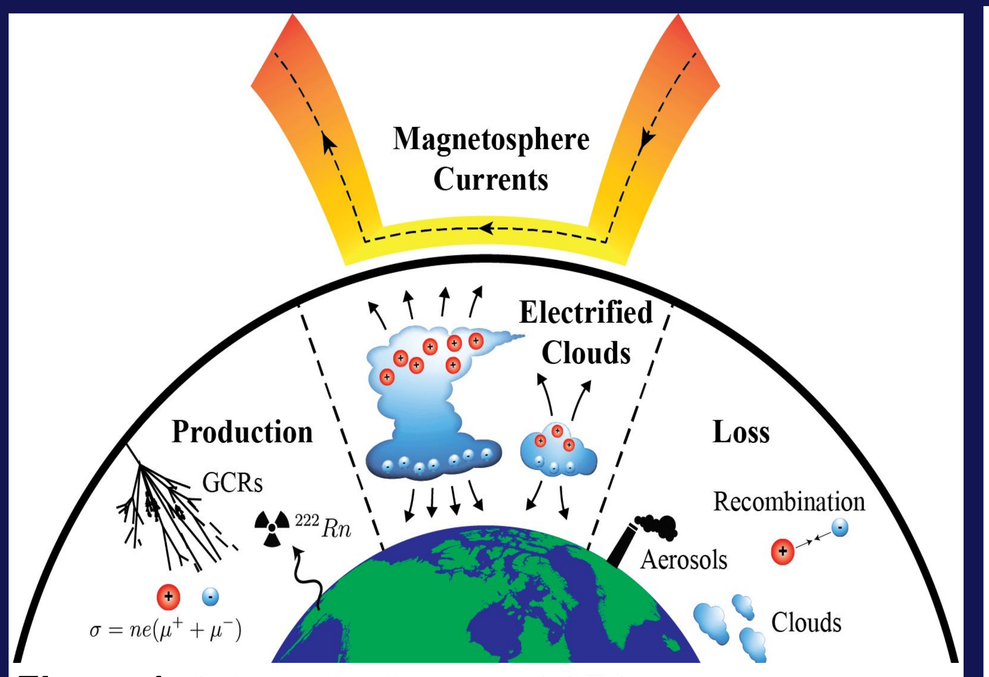

Figure 1. Schematic diagram of GEC.(Credit: A. Dean and G. Lucas)

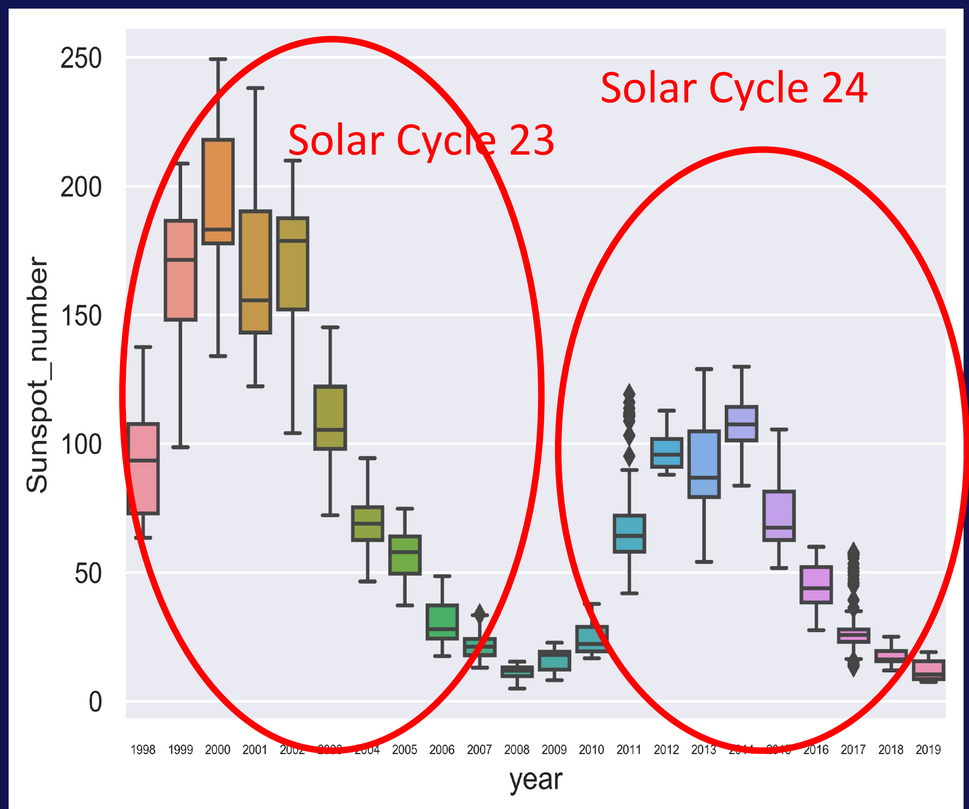

Figure 2. Solar Cycles 23 and 24 based on daily Sunspot Number 1998-2019

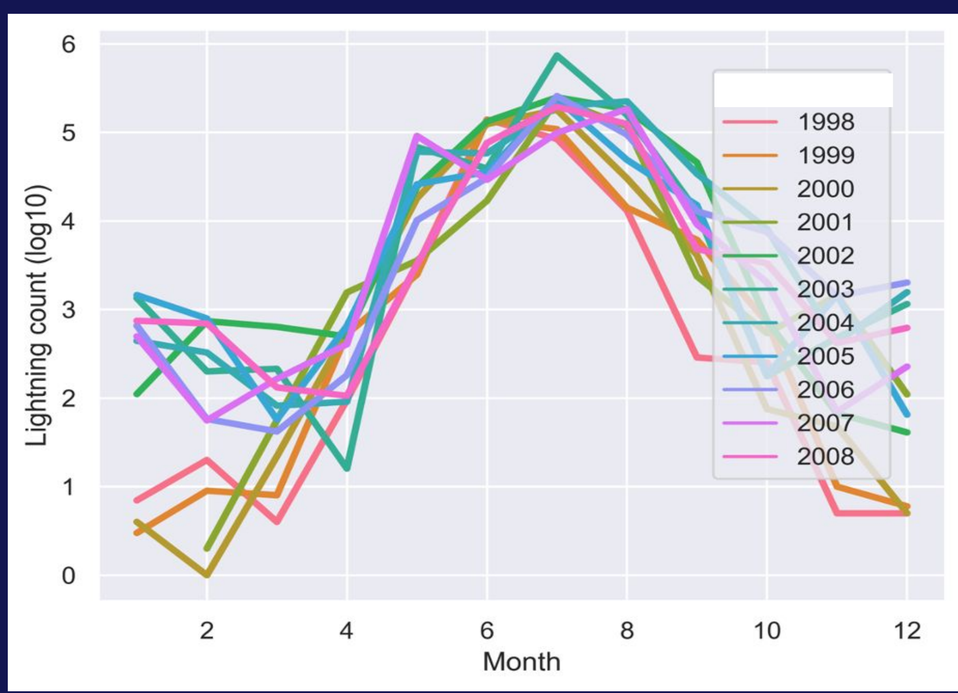

Figure 3. Annual trend of monthly Lightning Count (log10) for Solar Cycle 23. Most of the lightning occurs in the Summer, similarly for Solar Cycle 24.

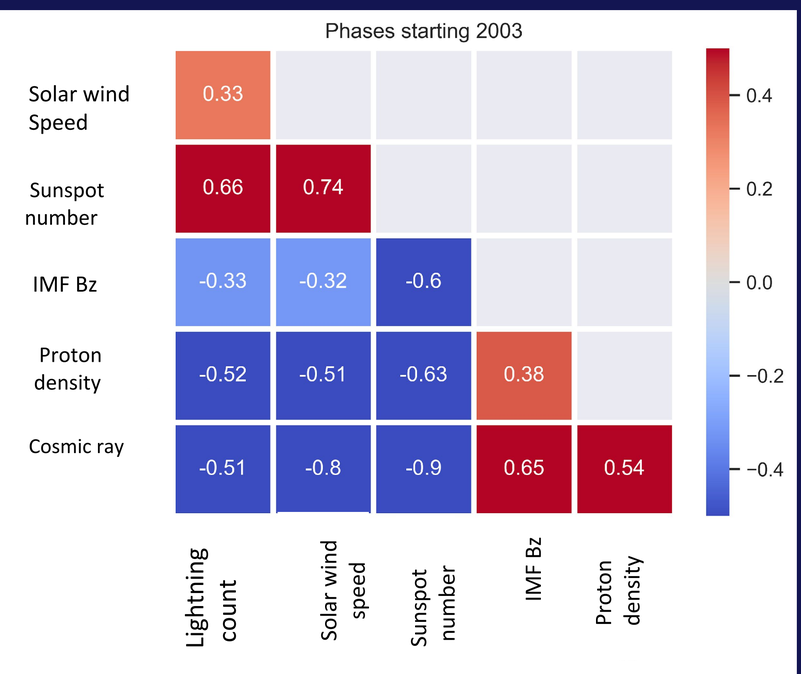

Figure 4. Linear correlation between variables by solar cycle phase, daily data, summers 2003-2008. Solar cycles vary differently from each other, with regards to lightning count.

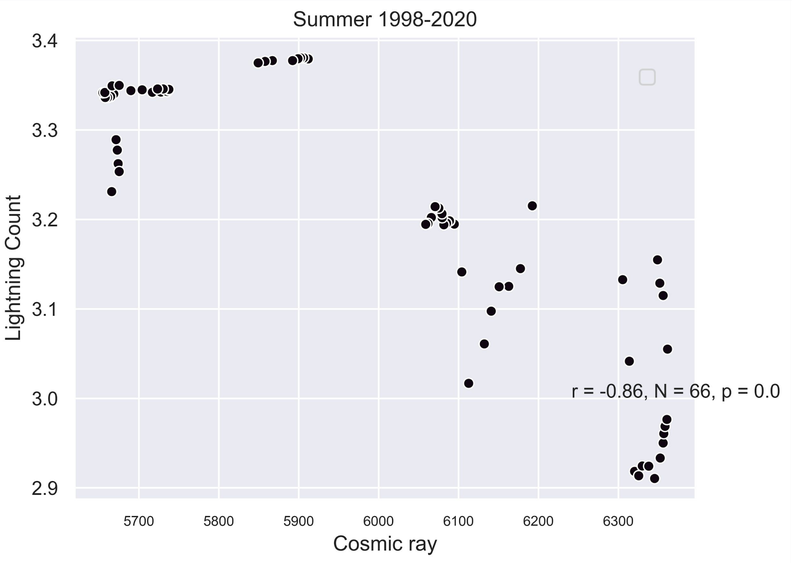

Figure 5. Daily Lightning Count (log10) vs Cosmic ray, Summers 1998-2019 - filtered by high number and energy proton flux (>10MeV). This suggests that when solar activity is high, the effect of cosmic rays is less on the ionization of the atmosphere

Conclusions

- The behaviour of lightning count vs solar variables(sunspot number, solar wind, proton density and proton flux) and cosmic ray, is different year by year
- The largest lightning count is seen in 2003 matching with the largest geomagnetic activity in high-latitudes.

References

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