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Solar Evolution and Extrema

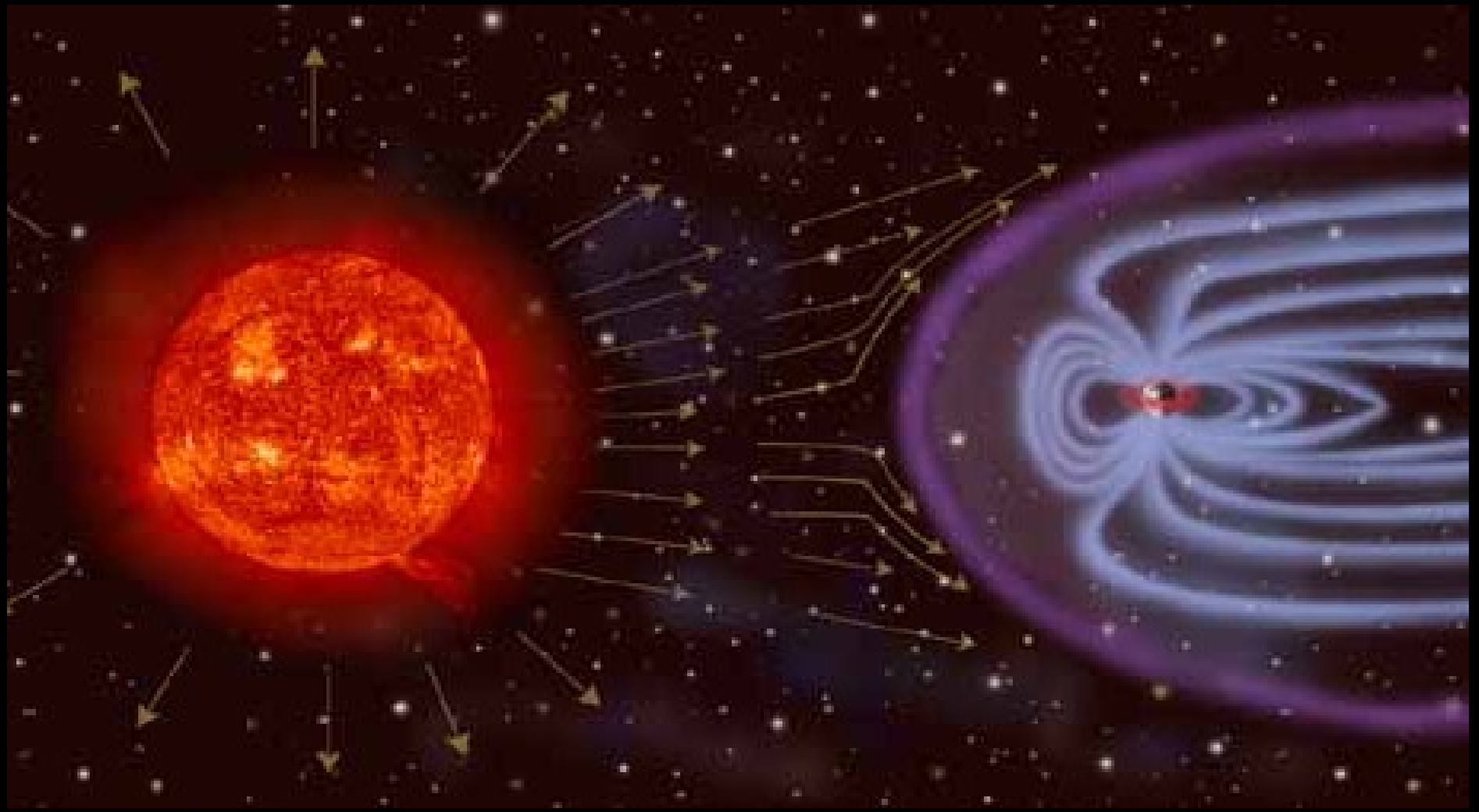
Dibyendu Nandi

Center of Excellence in Space Sciences India

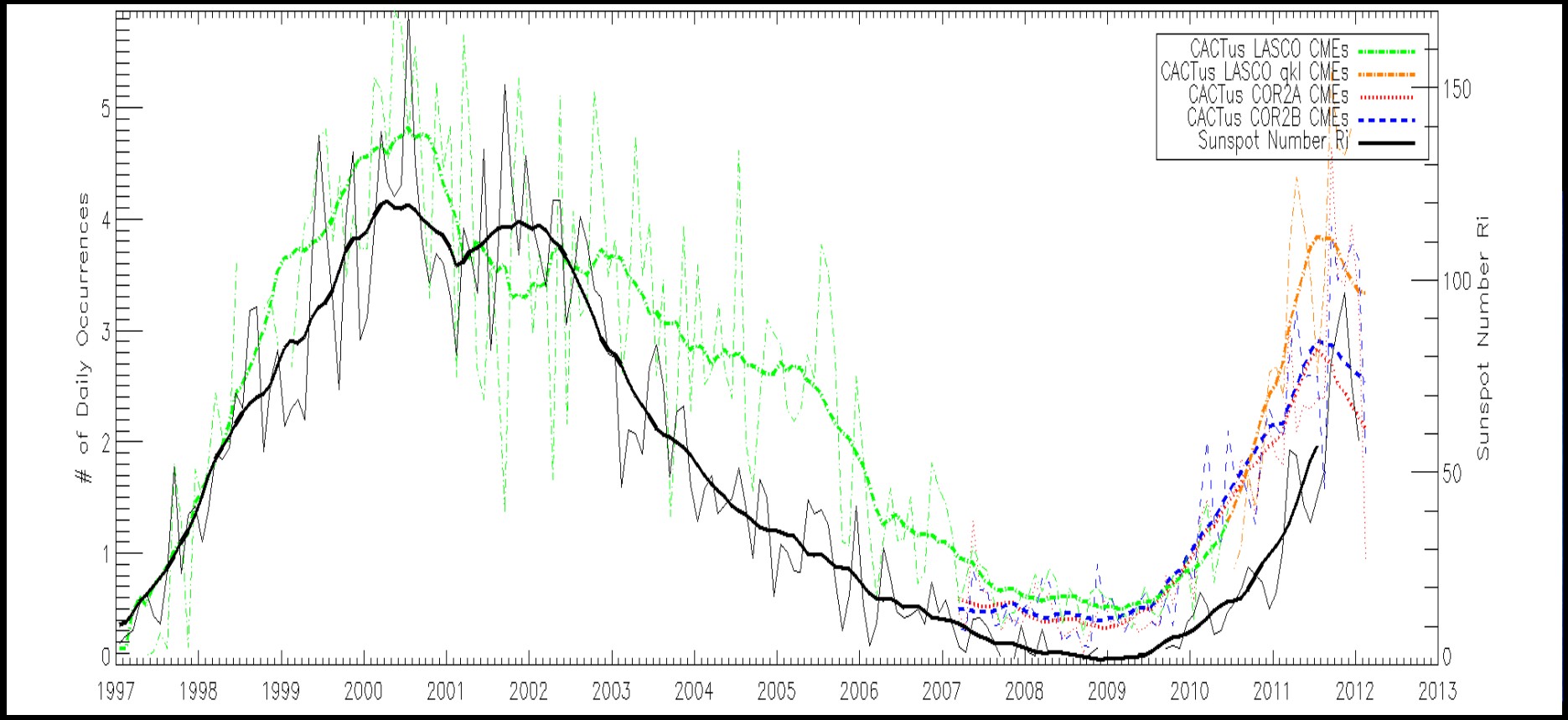
Indian Institute of Science Education and Research

Kolkata

The Sun varies and this variation modulates the electromagnetic and particulate environment of the Heliosphere on diverse time-scales

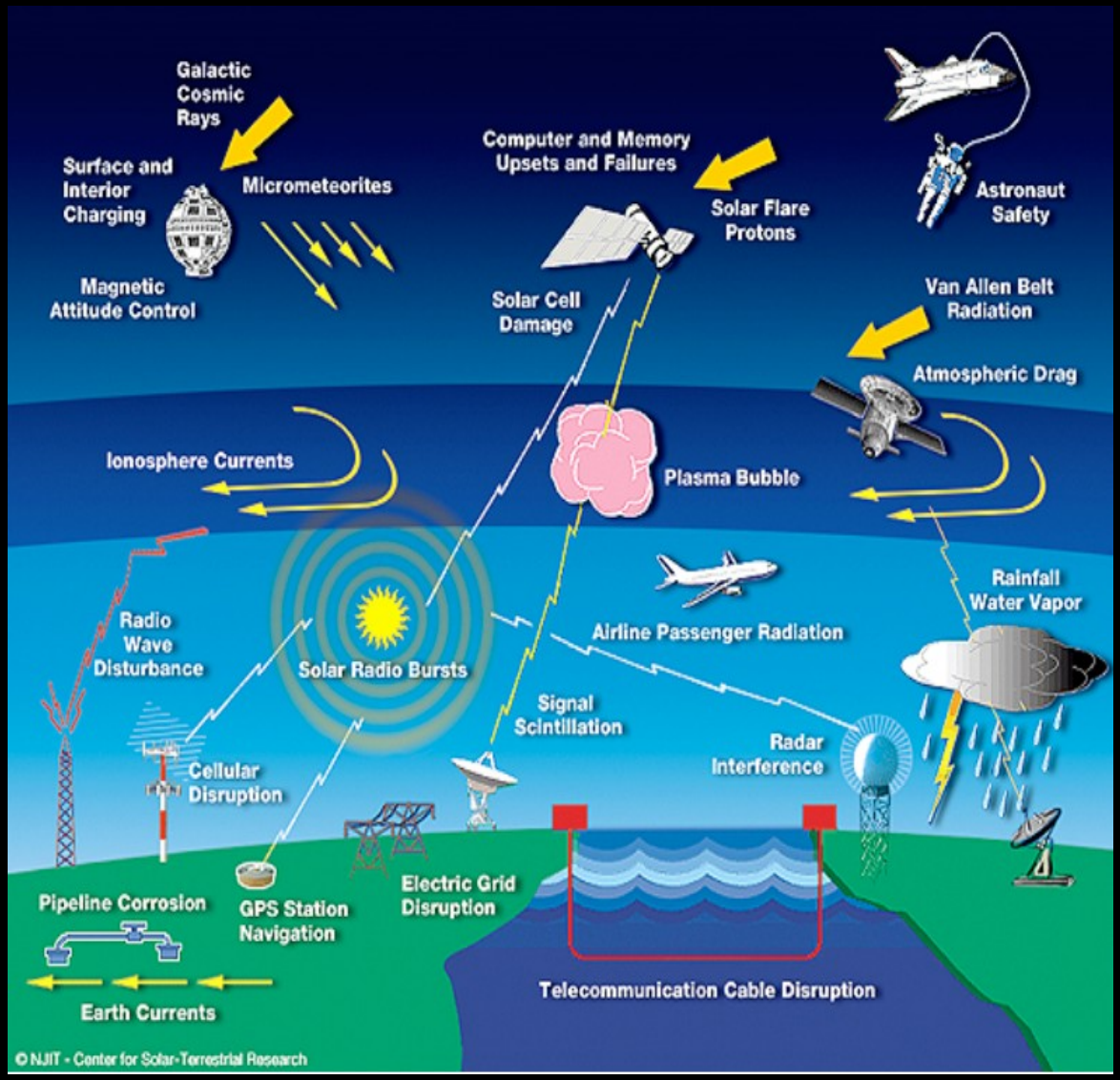


Sunspots are the Seats of Solar Storms



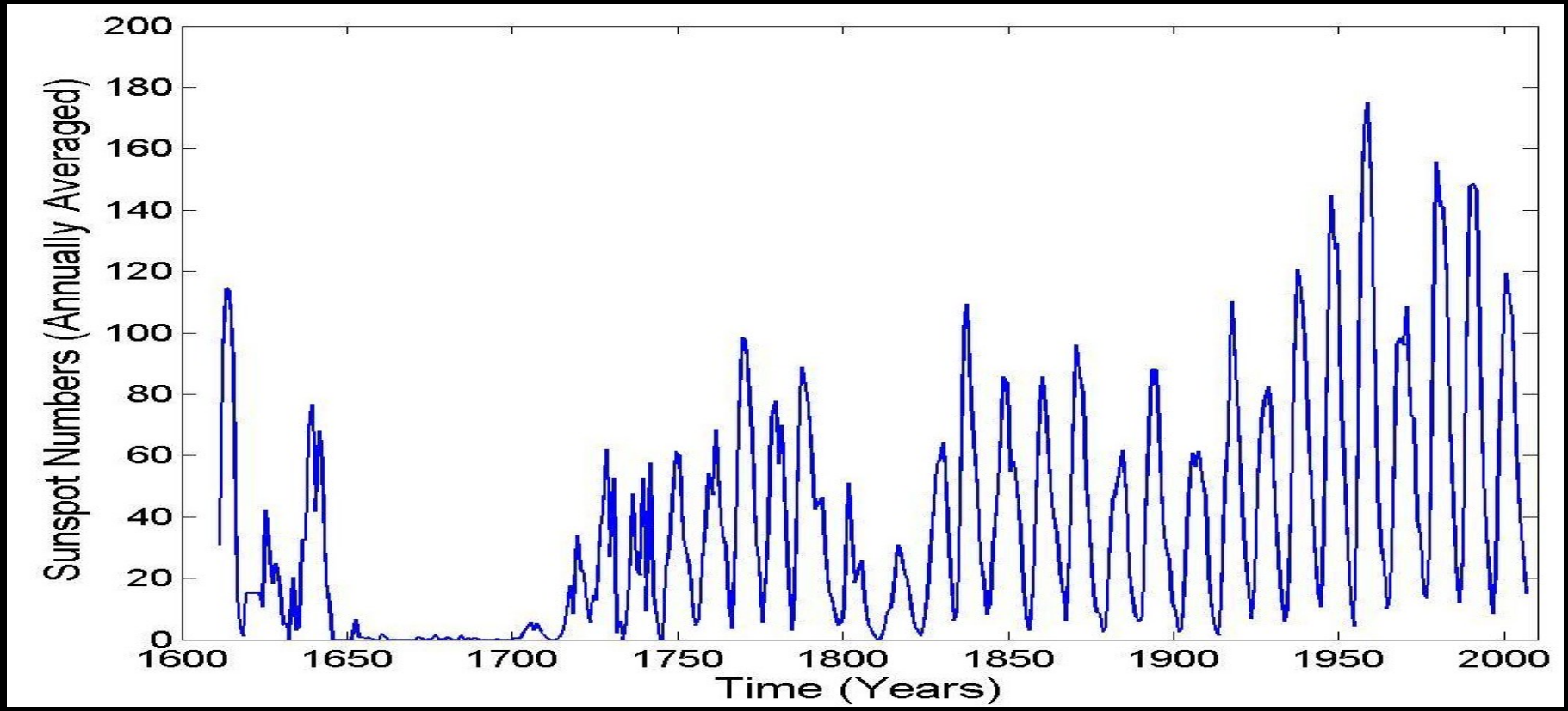
- Solar flares and coronal mass ejections (CMEs) – biggest explosions in the solar system – eject magnetized plasma and charged particles ($m \sim 10^{12}$ Kg, $v \sim 500$-2000 km/s, $E \sim 10^{24}$ Joules)
- Rate of solar storm occurrence correlated with sunspot cycle

Space Weather Effects



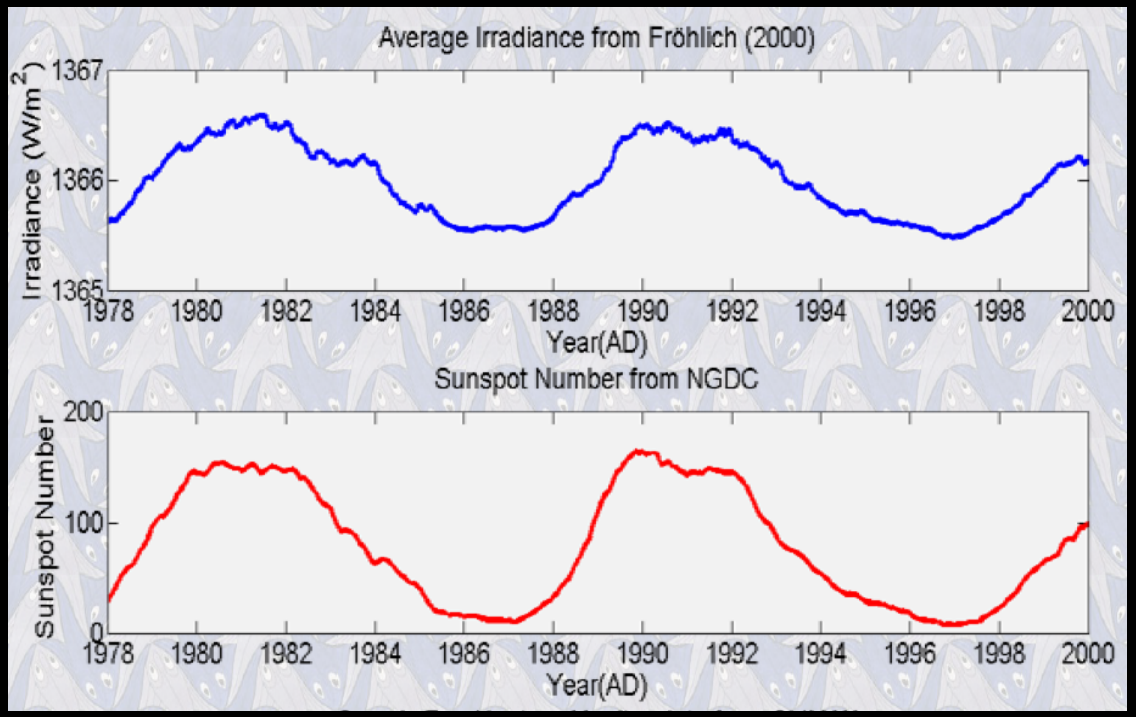
- Impact of space weather is broad on a technology-dependent society (See Schrijver's plenary talk on Tuesday, 8.30 AM, Library Hall)

The Cycle of Sunspots



The number of sunspots observed on the Sun varies cyclically;

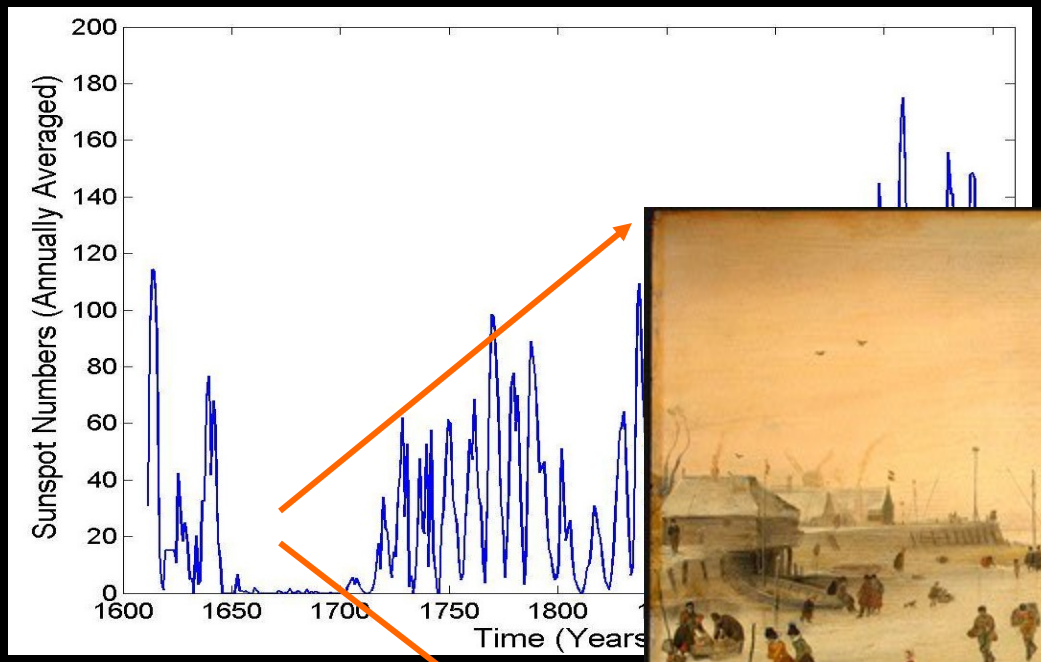
Solar Energy Output Varies with the Sunspot Cycle



- The TSI (total solar irradiance) is modulated by Sun's magnetic output

It is the primary natural energy input to the global climate system
— it is variable and not a constant!

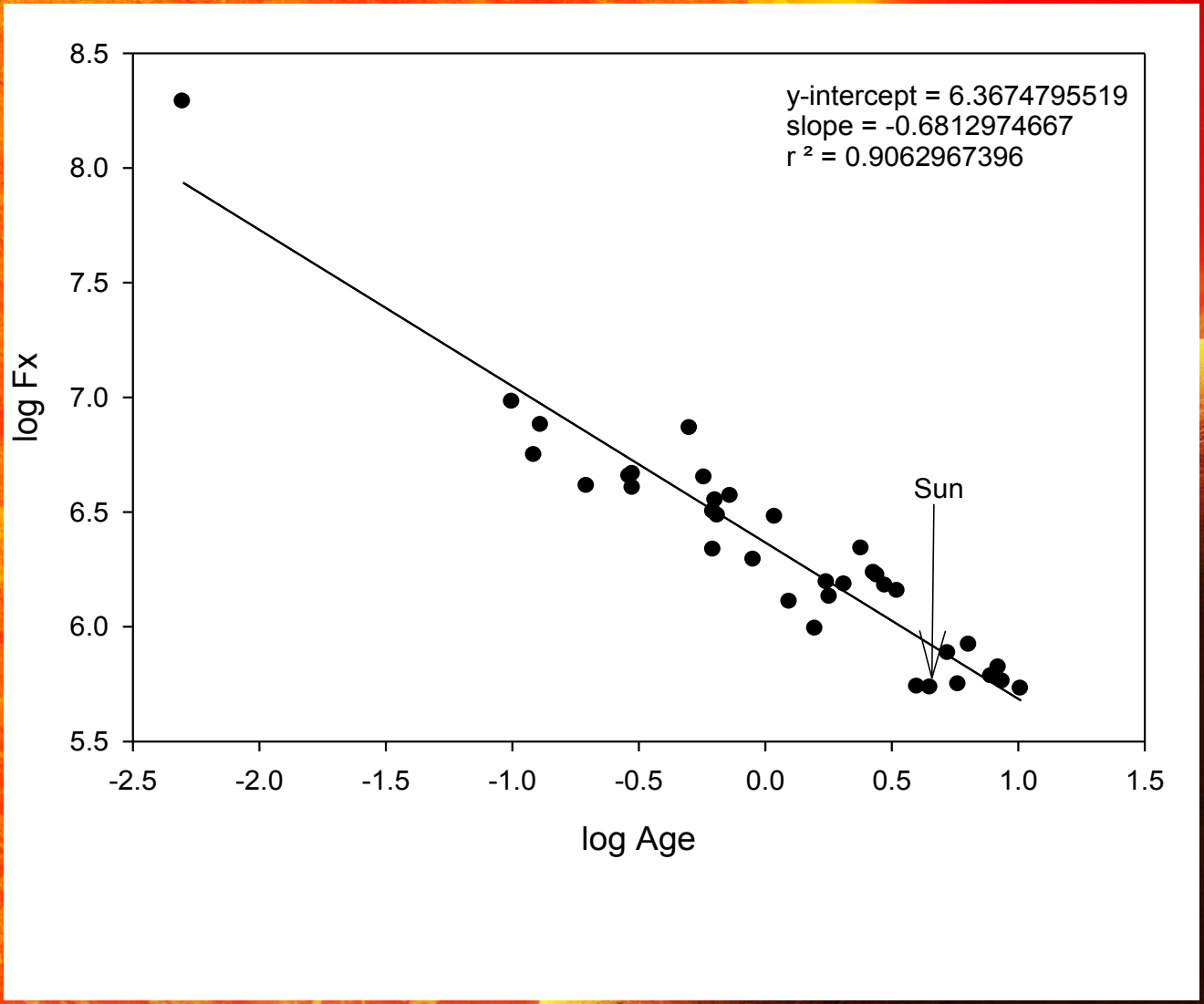
The Sun-Climate Link



"*A Scene in the Ice*", Hendrick Avercamp

- Maunder minimum, a period when solar activity almost stopped, coincides with the severest part of the Little Ice Age, during which the rivers Thames and the Seine froze over
- Is there a direct connection? What do long-term records say

The Sun evolves as a star and its consequent interaction with planets has important consequences for planetary atmospheres, climate and the evolution of life



Understanding solar activity and its impacts important both over short and long timescales; SEE will mainly concentrate on the latter

Magnetic Fields
Solar Storms
Solar Wind Conditions
Solar Radiation Spectrum
Energetic particles and Cosmic Rays

Solar Evolution and Extrema Project

Umbrella Organization: SCOSTEP

Duration: 2014-2018

Management (Co-Leaders)

Petrus C. Martens

Dibyendu Nandi

Vladimir N.Obridko

Broad Aims and Scope

- Sun's magnetic, radiative and particulate variability over lifetime
- Solar forcing of the heliospheric environment
- How do these changing conditions in space impact planets?
- How has Earth's climate and biosphere evolved in response?
- Understanding solar cycle predictability based on dynamo mecanism
- Origin of extreme solar activity (grand minima and maxima)
- Probability and intensity of extreme solar storms
- How will solar activity evolve in the future as Sun evolves as a star?

Topics and Tools

Theory and Modeling

- Stellar evolution
- MHD Dynamos
- Flare Physics
- Solar and stellar winds
- Solar and stellar magnetism (surface to corona)
- Stellar radiation and irradiance variability
- Sun-Planet Interactions
- Solar Forcing of Climate

Data Records and Constraints

- Sunspots (C14, Be10)
- Solar spectral irradiance
- Cosmic rays
- Earth response (Geomagnetic data, Paleoclimate data)
- Helioseismic data on solar plasma flows

SEE Highlights

182 Scientists 38 Countries

SEE membership is open. Based on interest, anyone can sign up. We intend to meet on the sidelines of major meetings and have dedicated workshops once in a while

Budget US$ 10K / year
Supplemented by national agencies (National WGs)

We intend to fund small pilot studies, support scientists to attend meetings in which SEE has a direct stake

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