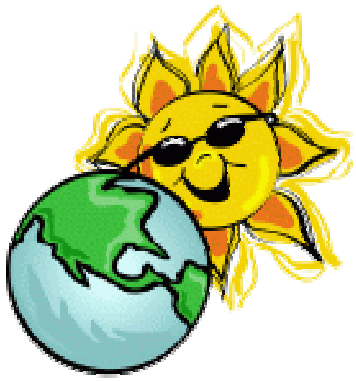


Fifth Workshop

Solar Influences on the Magnetosphere, Ionosphere and Atmosphere

Nessebar, Bulgaria, 3-7 June 2013

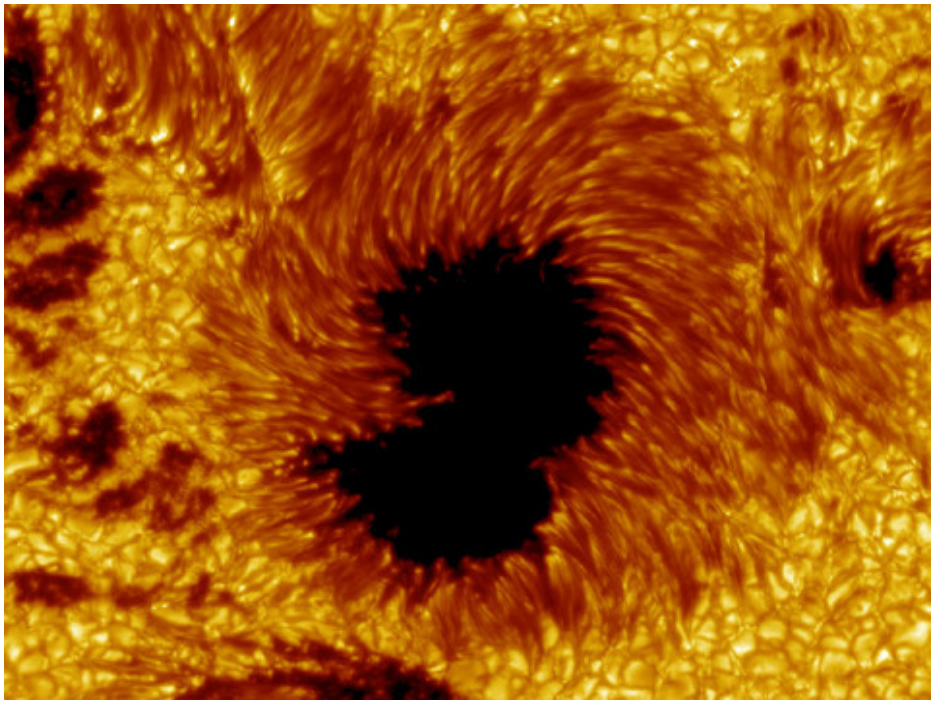
Solar magnetic fields, sunspots and coronal mass ejections during the last sunspot minimum

Yana Asenovska, Simeon Asenovski, Katya Georgieva, Boian Kirov

Space Research and Technology Institute,
Bulgarian Academy of Sciences

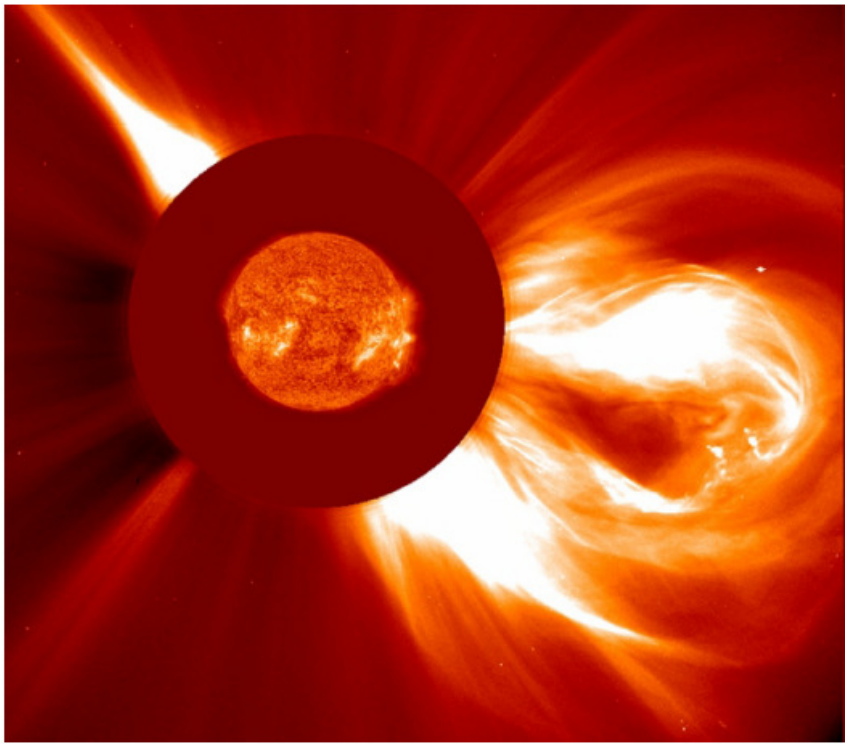
Sunspots

- Dark areas on the solar surface
- Manifestation of the solar toroidal magnetic field
- Number, area and brightness of sunspots reflect the intensity of the solar magnetic fields



Coronal mass ejections

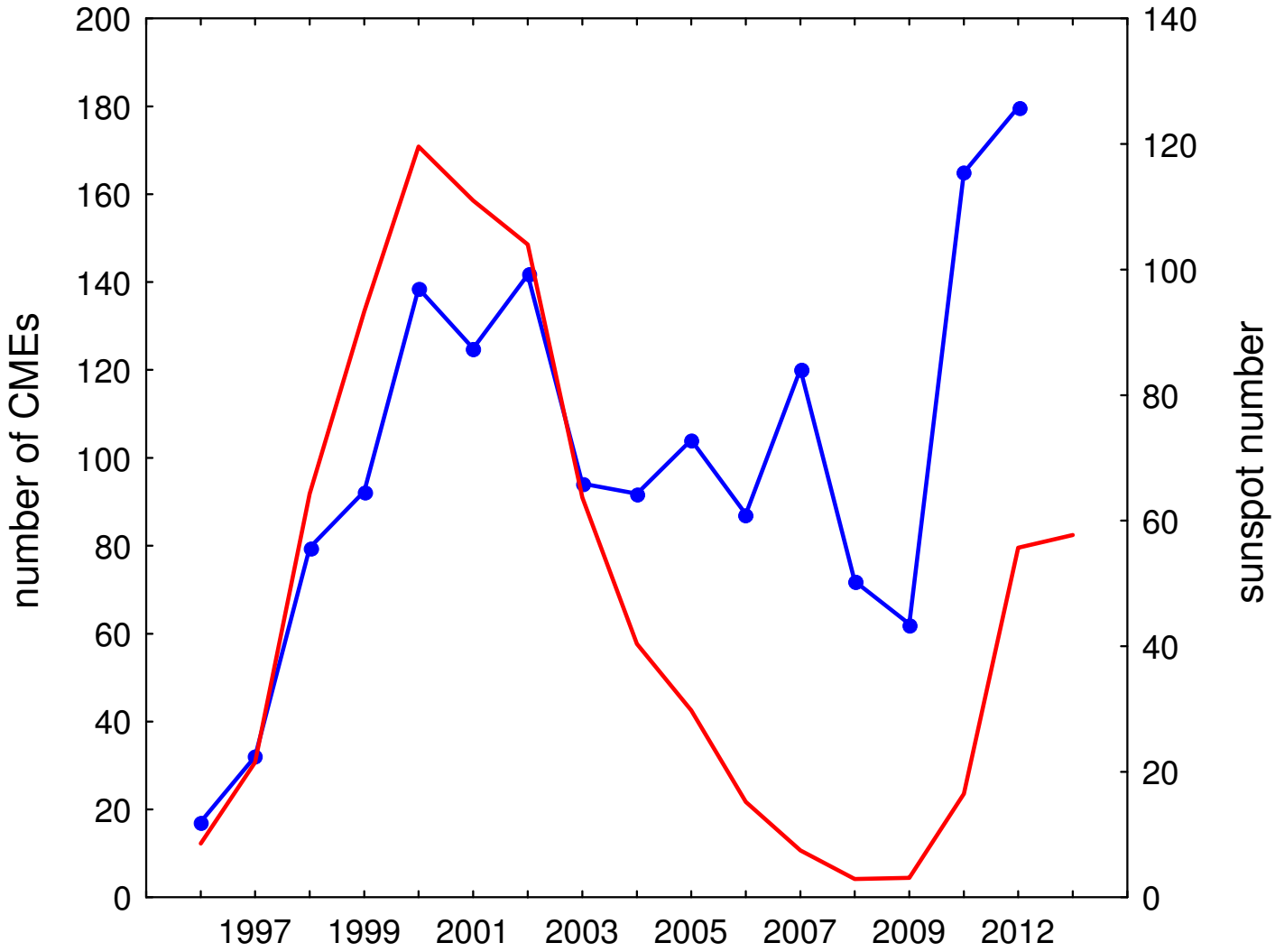
- Manifestation of the solar toroidal field
- Concentration of coronal material moving away from the Sun, but the lower part of the structure always stays attached to the Sun
- Prominence, cavity and flux rope (shock sheet for high speed CMEs)



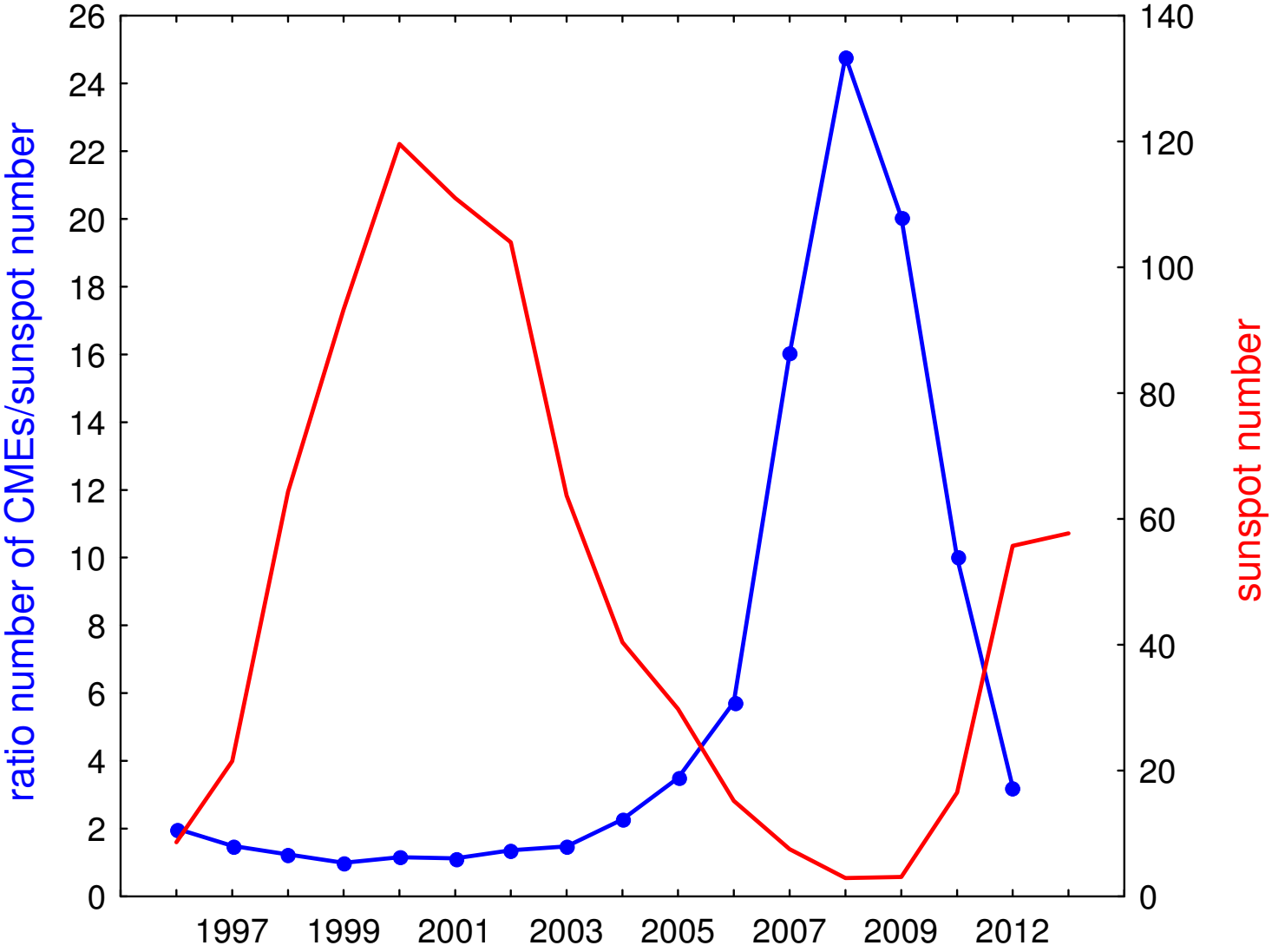
Coronal mass ejections

- Due to the large scale solar magnetic field and loss of equilibrium
- Generally CMEs originate from active regions or quiescent filaments (Forbes et al., 2006)
- High-speed CMEs are usually produced in active regions with sunspots (Falconer, et al., 2008; Gopalswamy et al., 2010). They tend to be wider, closer to the solar Equator, decelerate faster, carry more mass and energy (Du, 2012).
- Slow to moderate speed CMEs are linked more with large quiescent filament (prominence) eruptions outside active regions (Low, 2001)
- CME productivity increases with active region size measured by sunspot area (Canfield et al.,1999)

CMEs number max in sunspot max and min in sunspot min

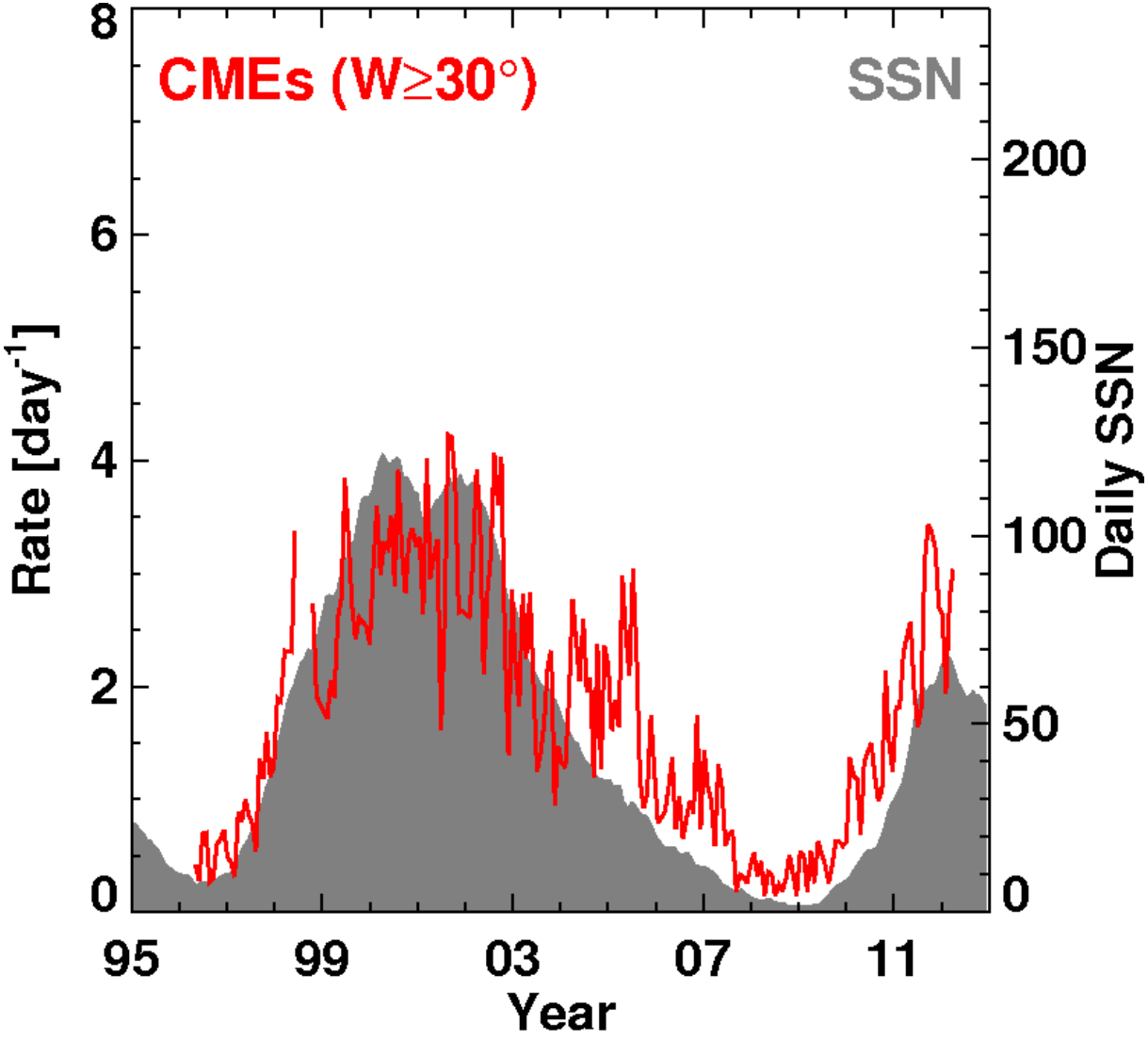


But the relation between the number of CMEs and number of sunspots is not linear

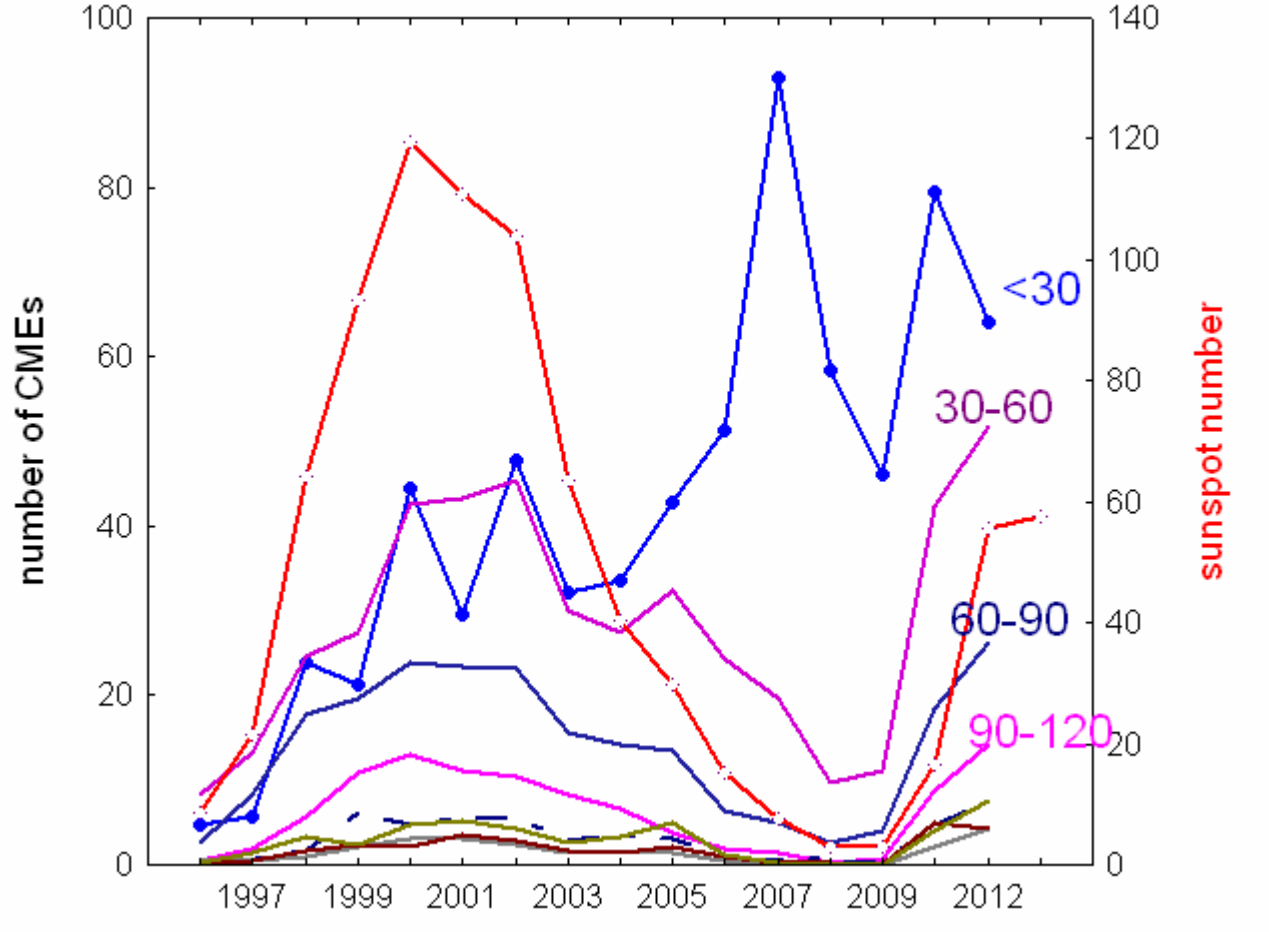


Possible reasons: instrumental?

Gopalswamy (private communication) - LASCO left as the only instrument operating on SOHO in the last 3 years ⇒ improved data cadence and detected fainter CMEs

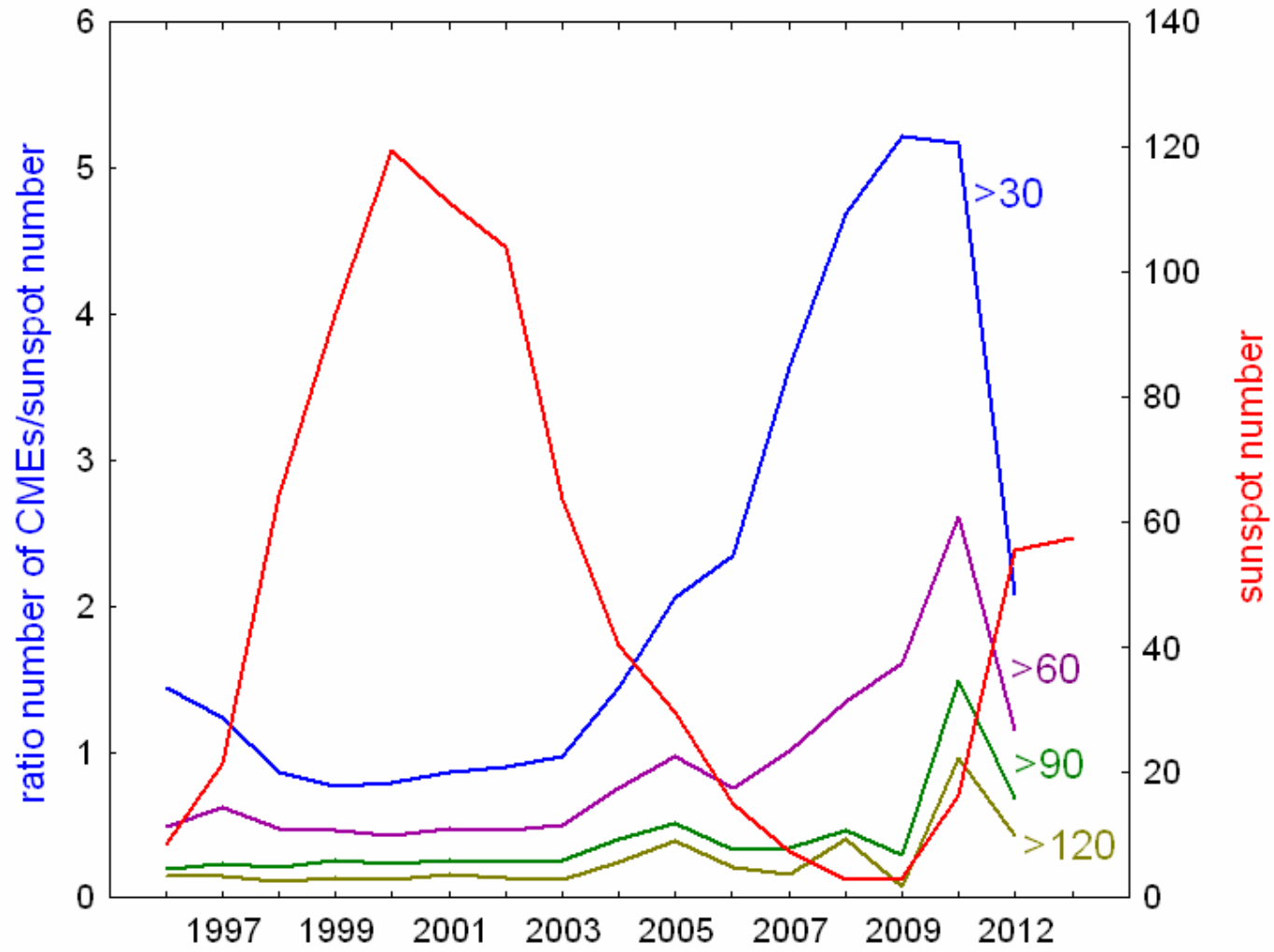


Indeed: max number of narrow/weak CMEs in sunspot min



But: even stronger CMEs have the same number in 2008 min as in 1996 with much smaller number of sunspots

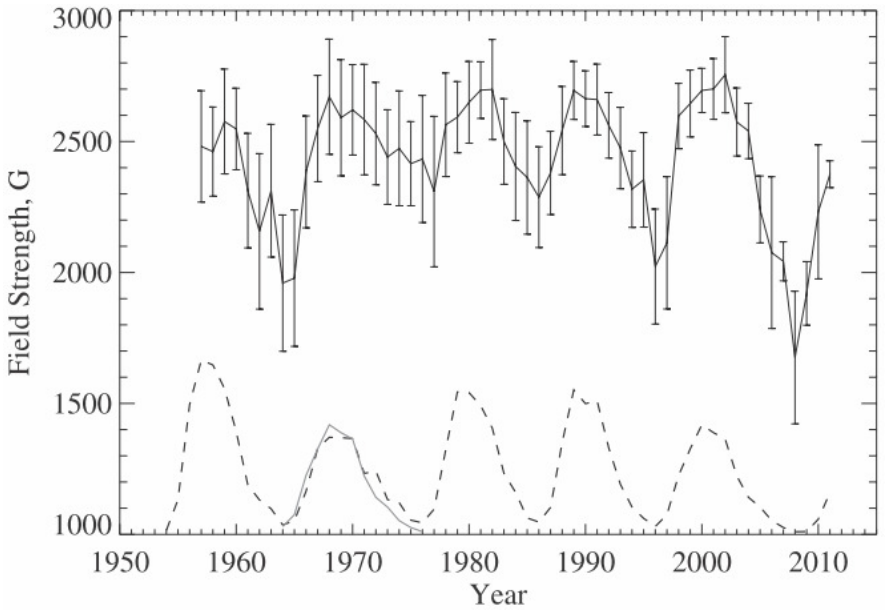
The ratio number of CMEs/sunspot number is biggest in sunspot min for all CMEs



What can be the reason?

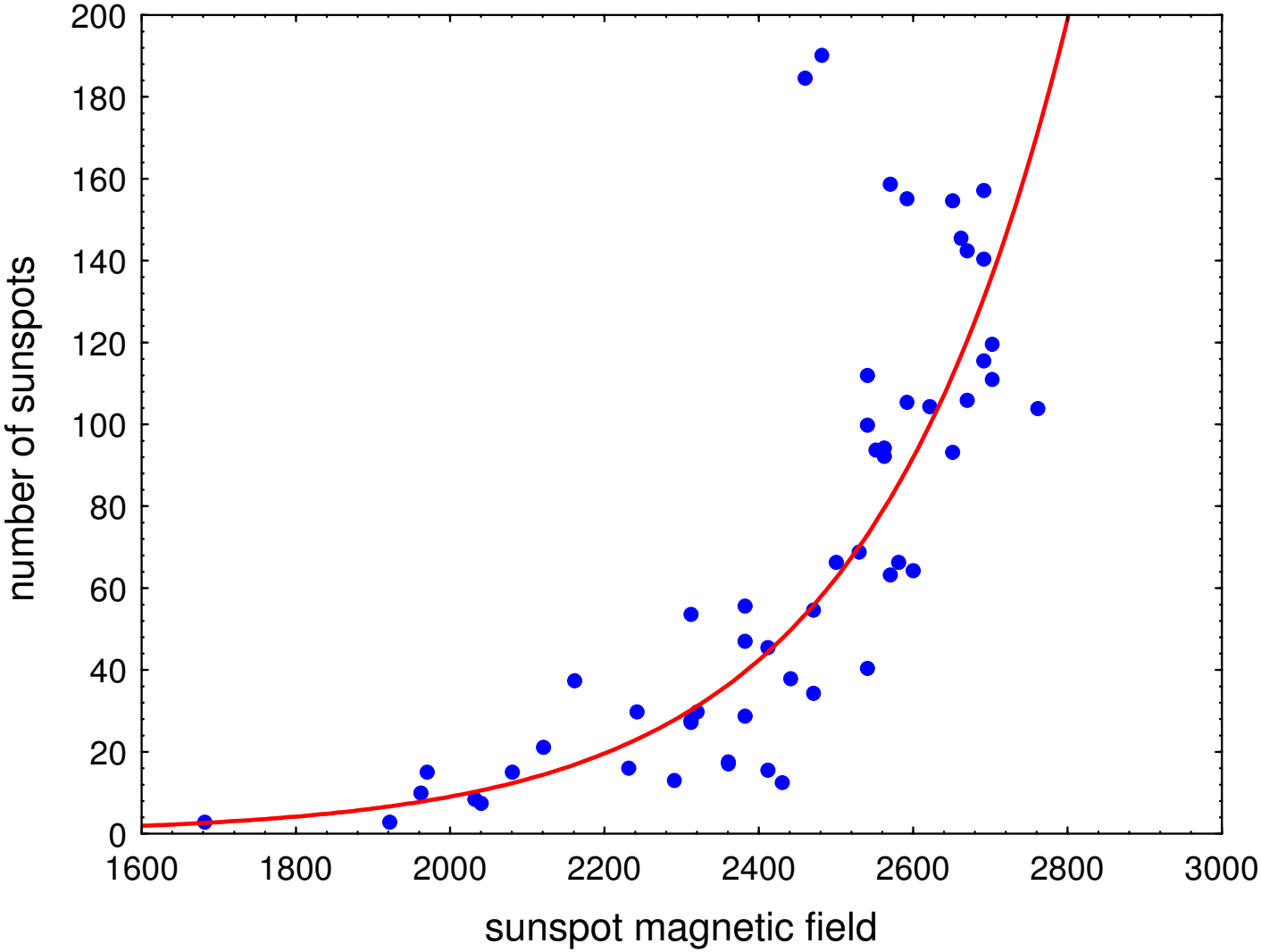
- CMEs are related to the solar toroidal magnetic field
- Sunspot field strength vary cyclically with the sunspot solar cycle

Pevtsov et al., 2012

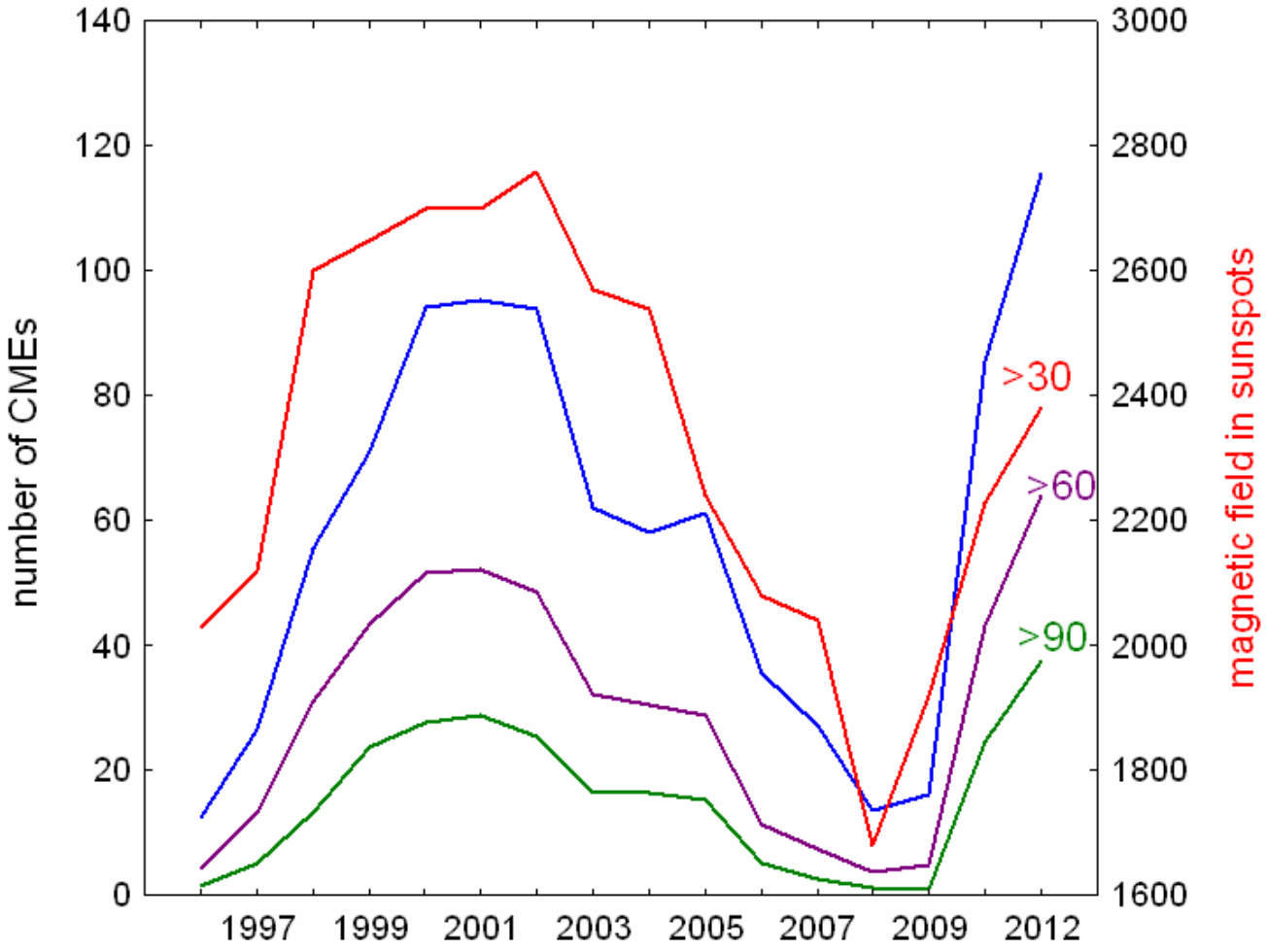


Can we regard the sunspot number as a good proxi for the solar toroidal magnetic field?

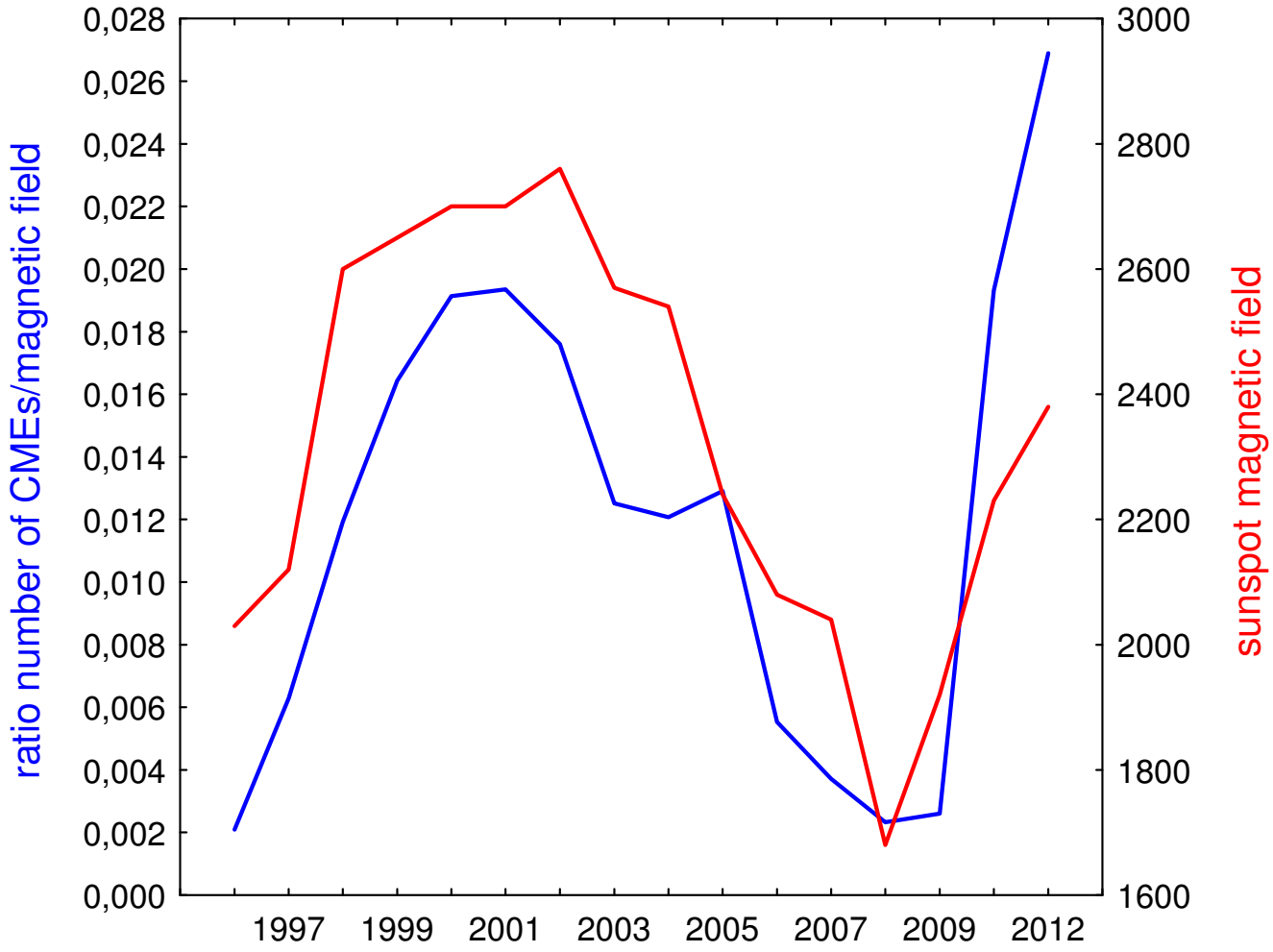
The relation between the sunspot number and magnetic field strength is not linear



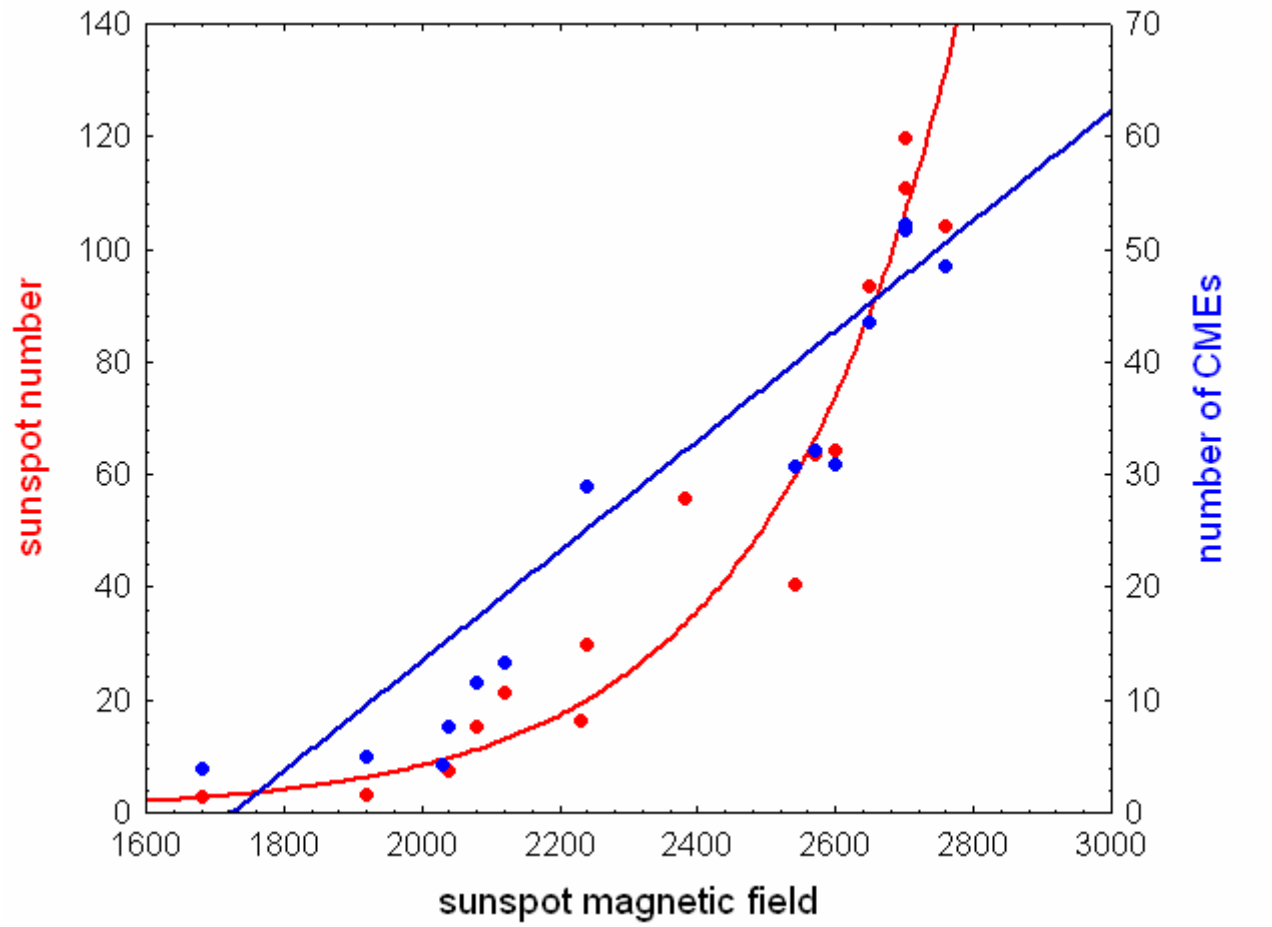
The number of CMEs follows the sunspot magnetic fields



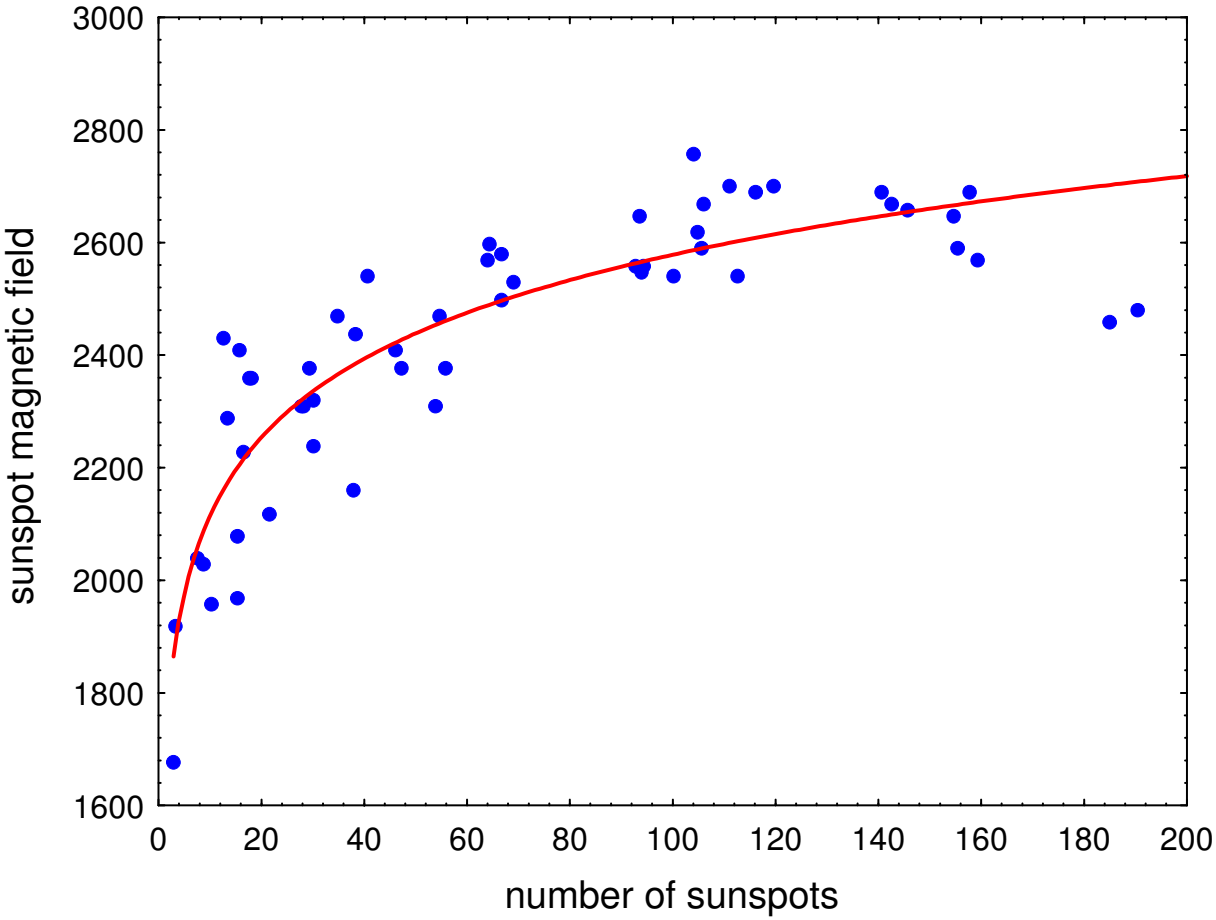
The ratio of the number of CMEs to the sunspot magnetic field also follows the sunspot magnetic field



The number of CMEs increases linearly, and the sunspot number increases exponentially with the sunspot magnetic field



The sunspot magnetic field seems to have an upper limit ~2800 G



Conclusion

- The number of sunspots is not a very good proxy for the solar toroidal magnetic field