On a possible explanation of Livingston-Penn effect

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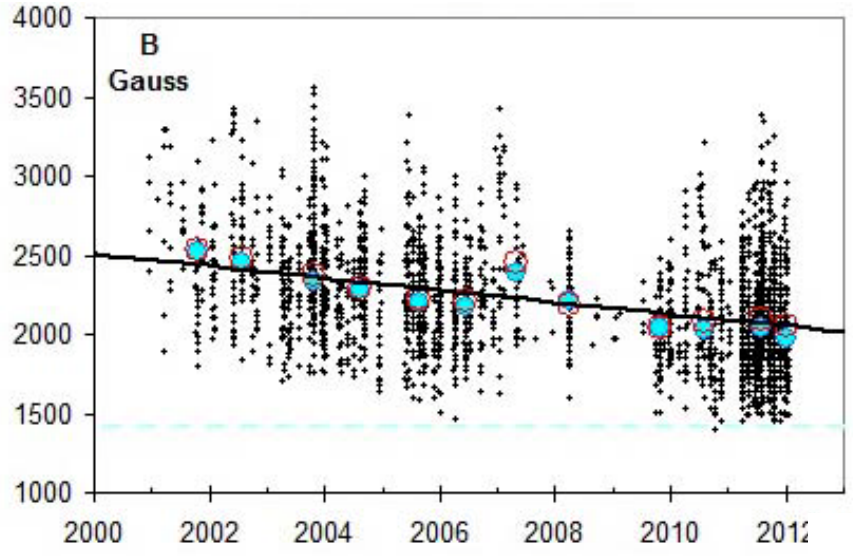
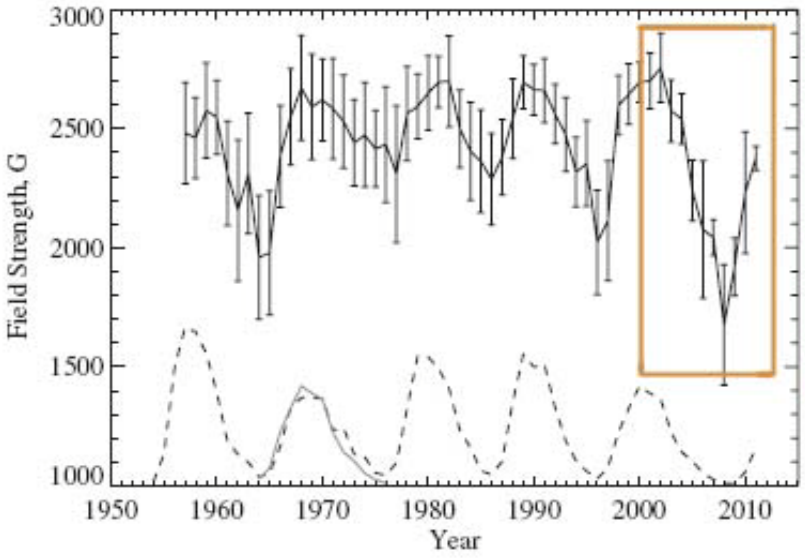
Long-term variations of magnetic field strength in sunspots



Livingston&Penn effect: **gradual decrease** over 2000-2012

Compiled synoptic data sets (1957-2012) from 7 observatories of the former USSR (*Pevtsov etal – ApJL , 742, 2011*): **cyclic variations**



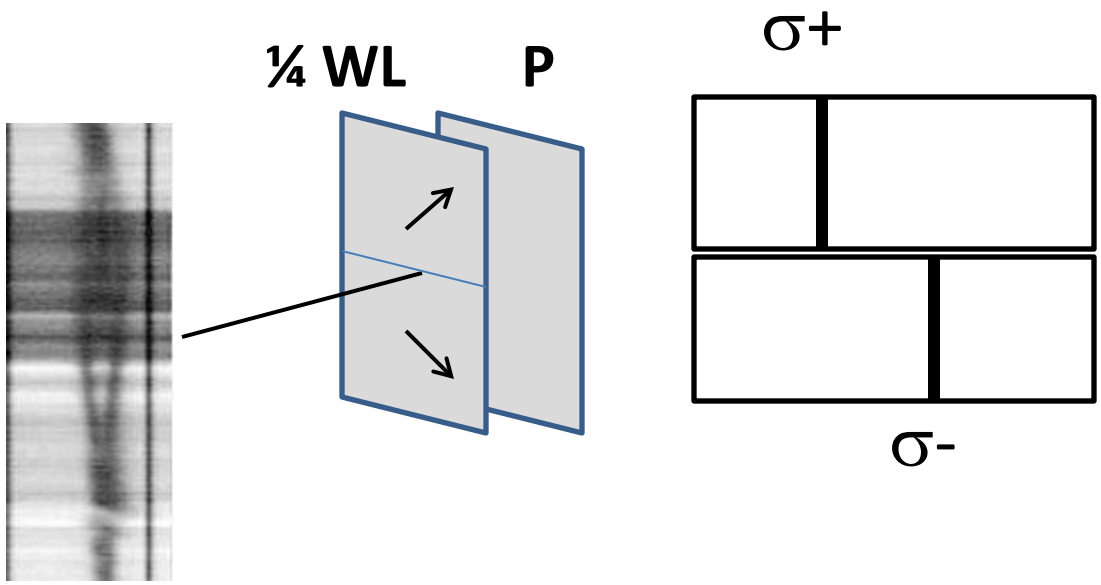
Observatories of the former USSR

Crimean observatory (CRAO): continuation of USSR sunspot MF strength obs. program in 1998-2012

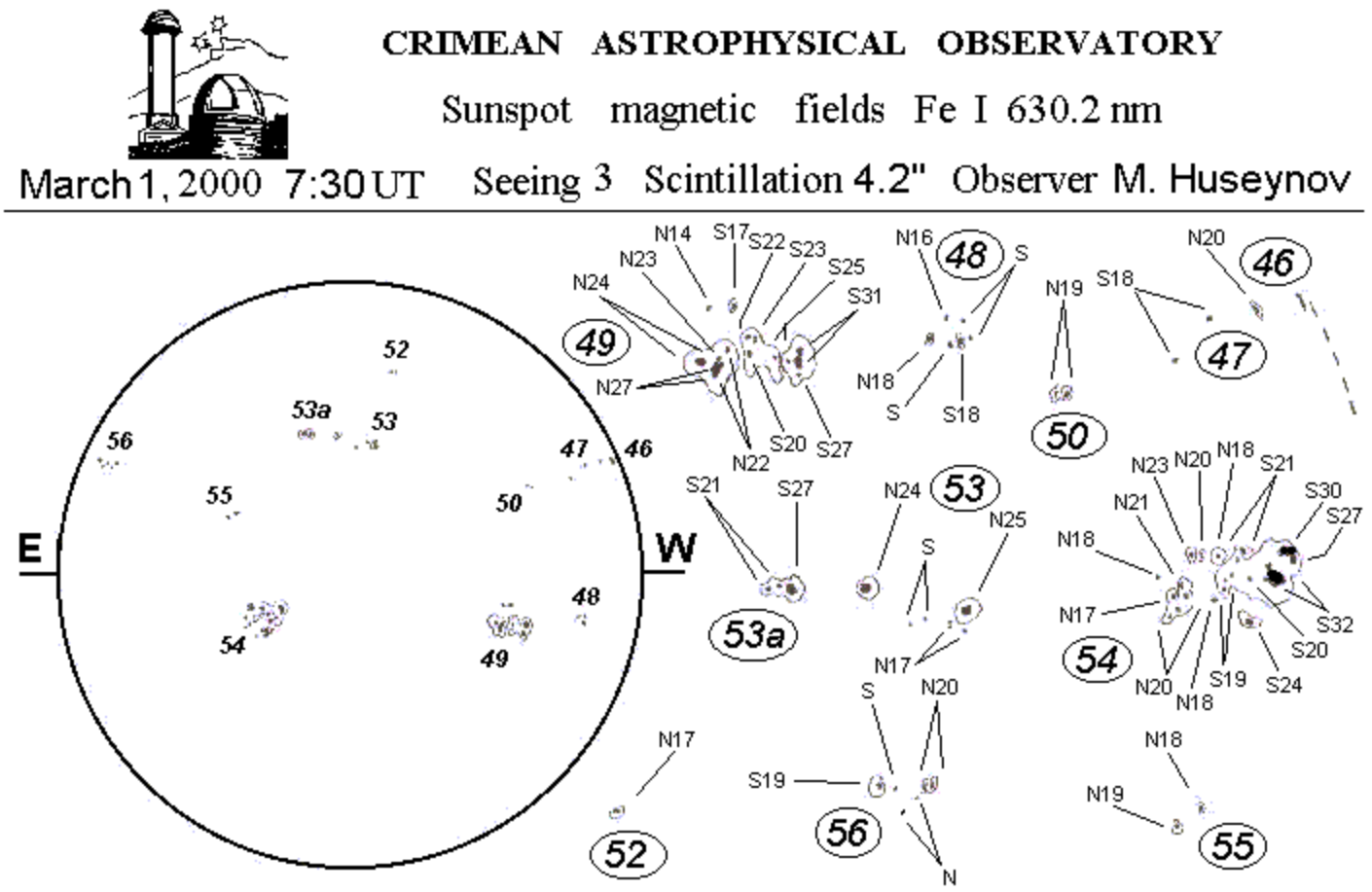
http://swc.crao.crimea.ua

CRAO: “classical” observational method:

-Combination of ¼ wavelength plate and polarizer
-Measurement uncertainty – 100G
-Sunspots and large pores (polarity and field strength), small pores – polarity only
-Maximal coverage of visible sunspots

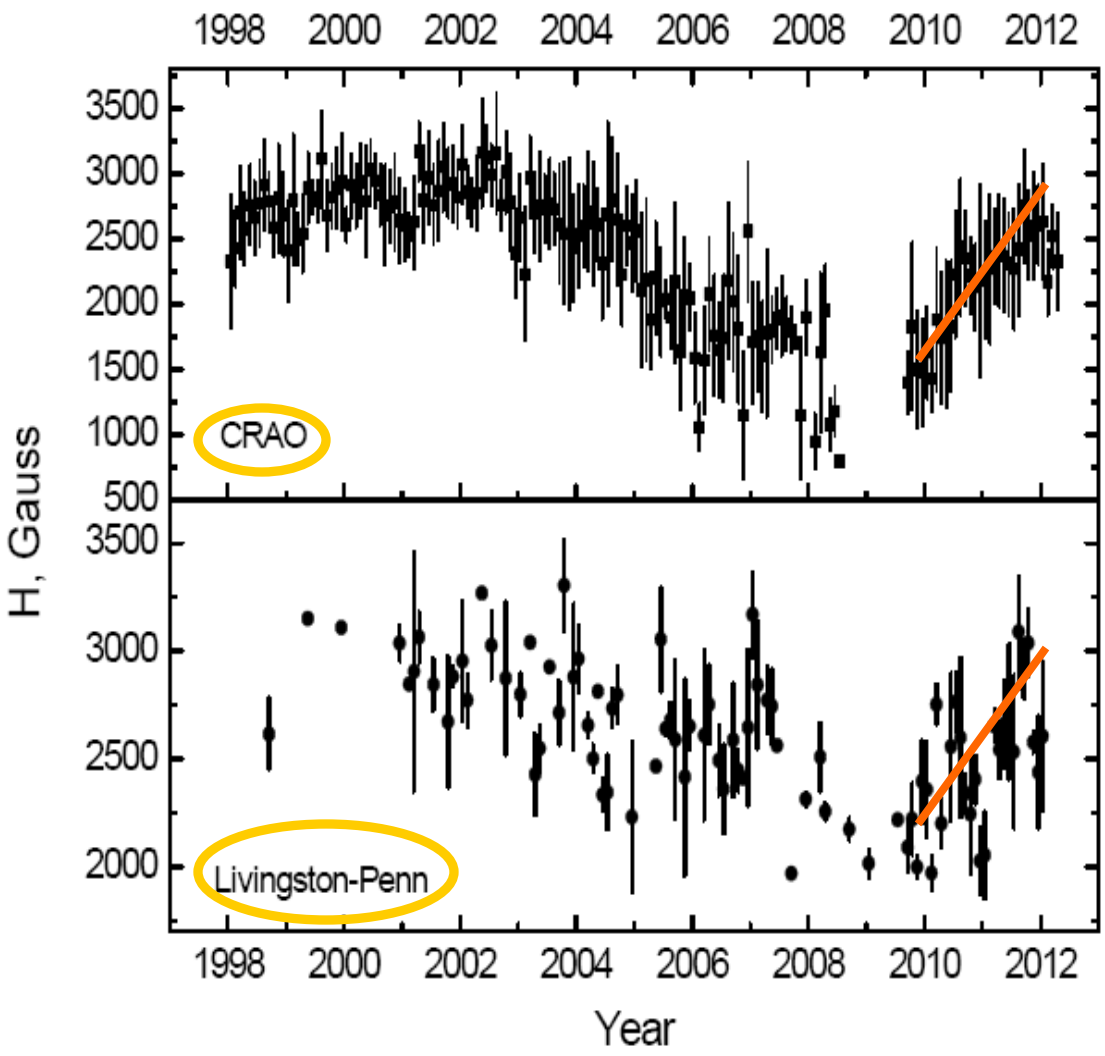


Example of Daily Observations

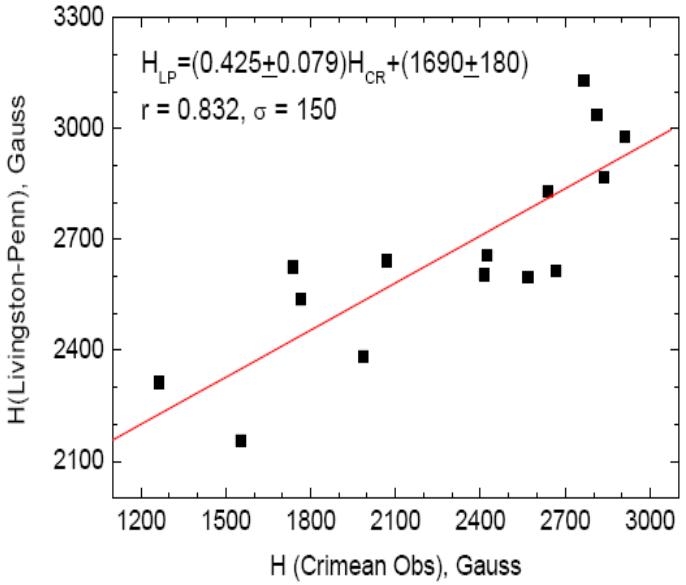


11N = 1100 Gauss (N polarity)

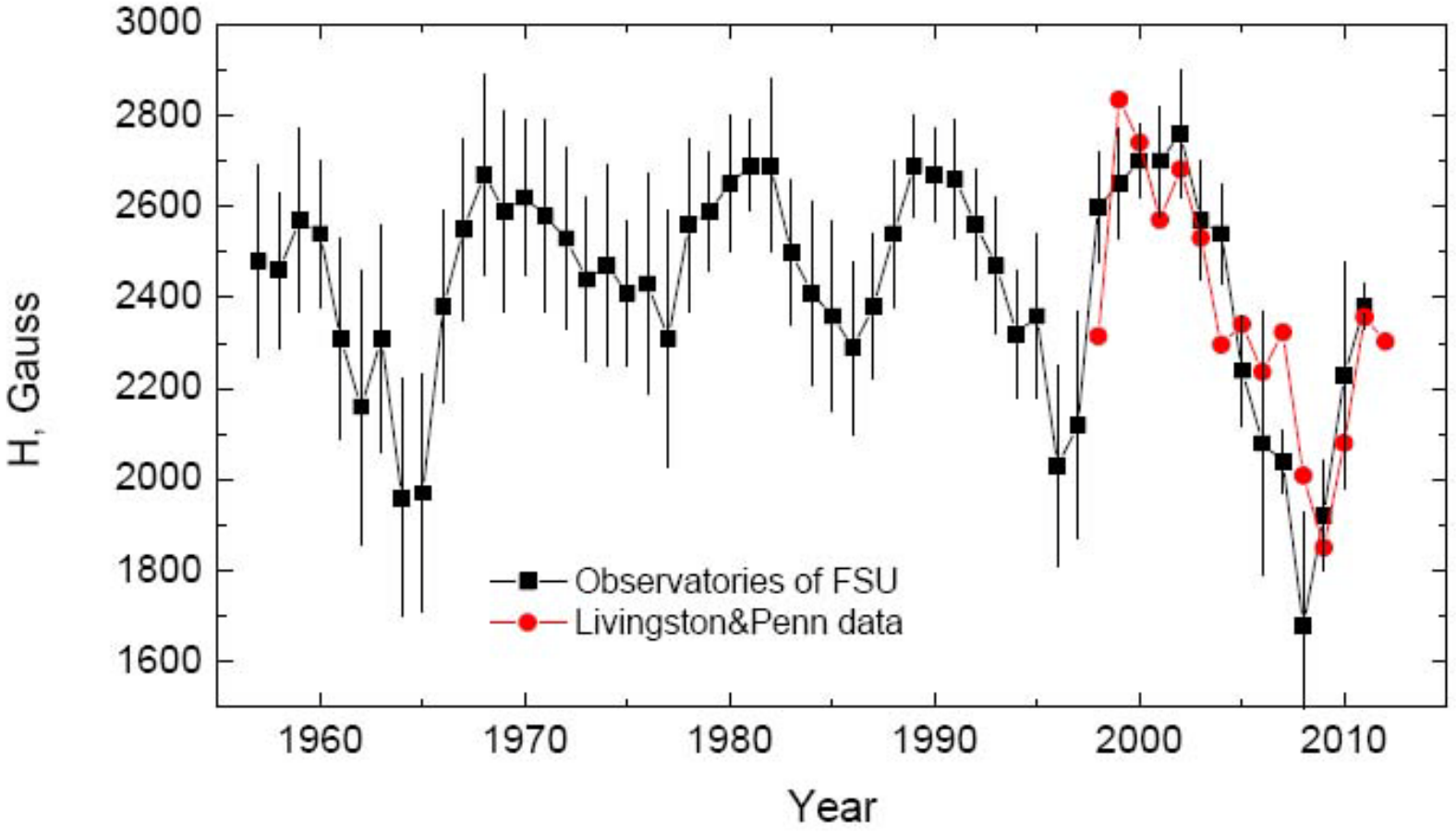
Monthly means of daily **strongest** sunspot magnetic field strengths



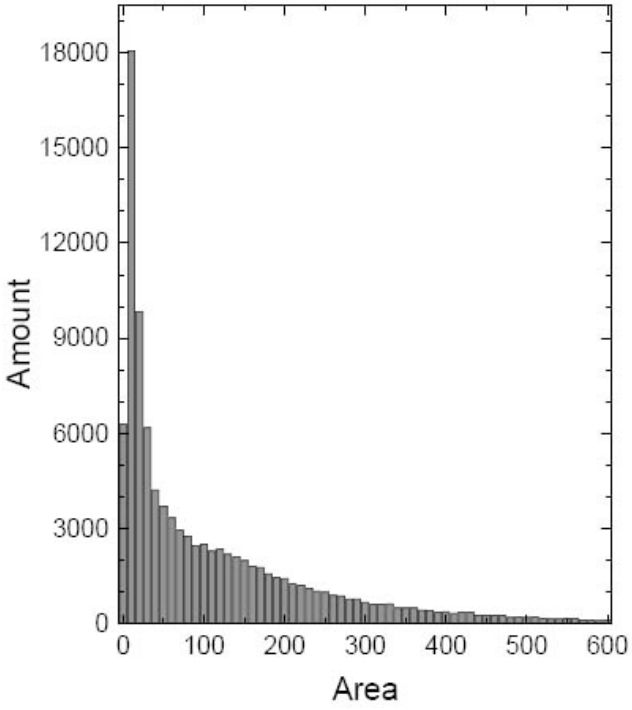
Correlation of yearly averages LP *vs* CRAO:

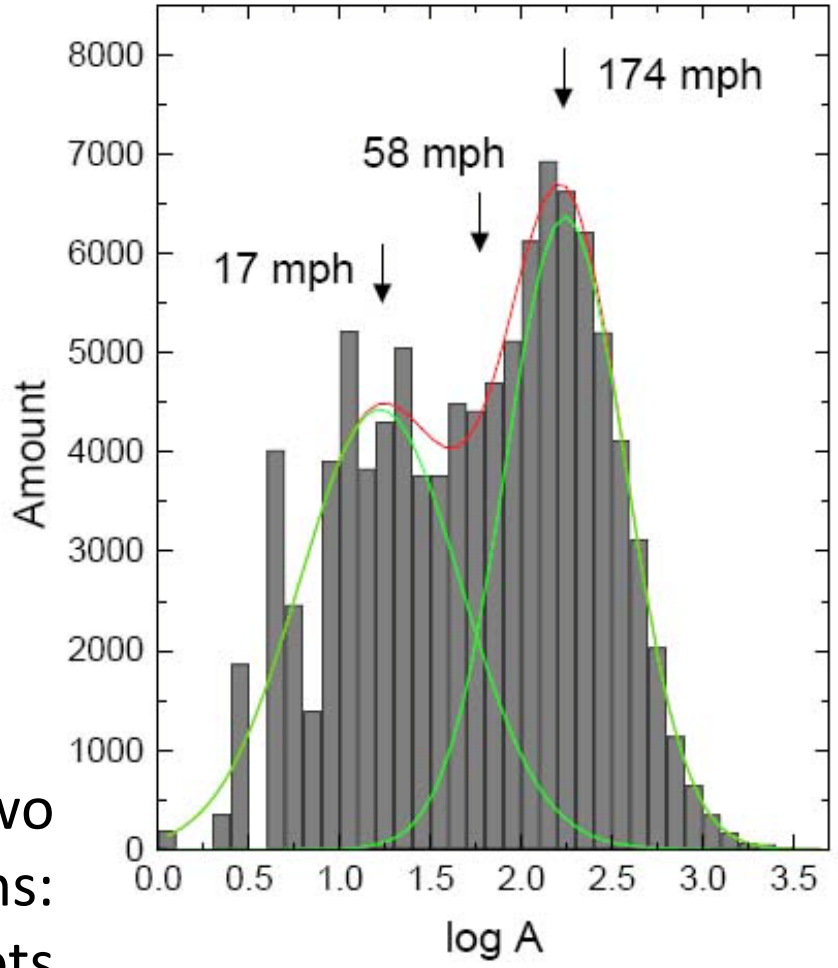


LP data (with a linear correction) among yearly values of the FSU observations (strongest MF)



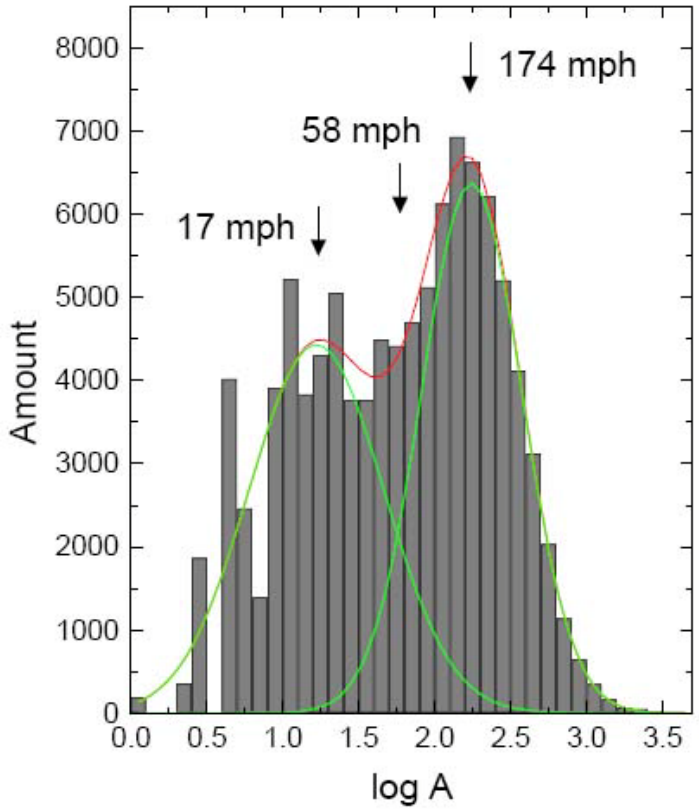
Populations of sunspots (main spots in groups), Kislovodsk synoptic data





Areas of sunspot: Two lognormal distributions: “small” and “large” spots

Four types of sunspots (combinations of two populations)



SS (only small spots), $A \leq 17$ mph

SL (small spots mainly+some large spots) $17 < A \leq 58$

LS (large spots mainly+some small spots) $58 < A \leq 174$

LL (large spots only) $A \geq 174$.

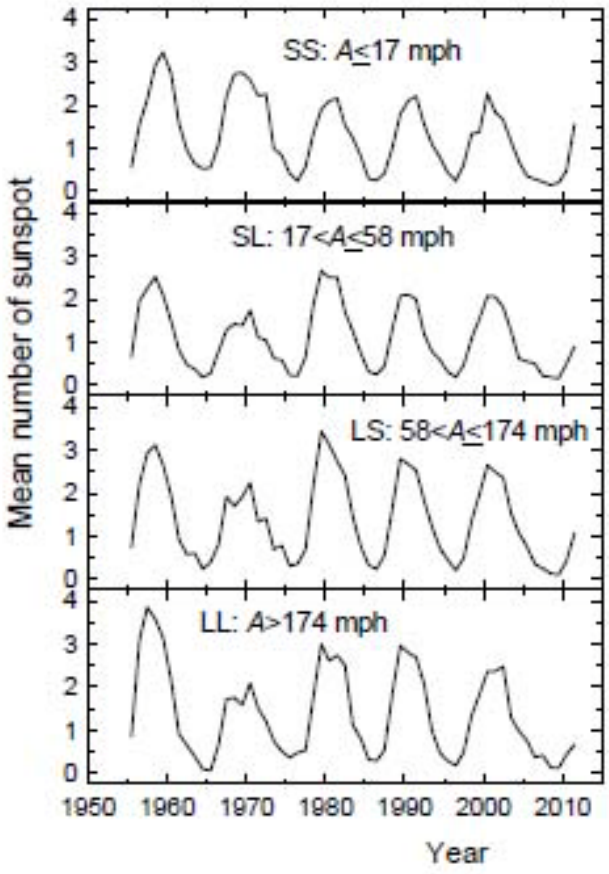
SS: H < 800-1000 Gauss

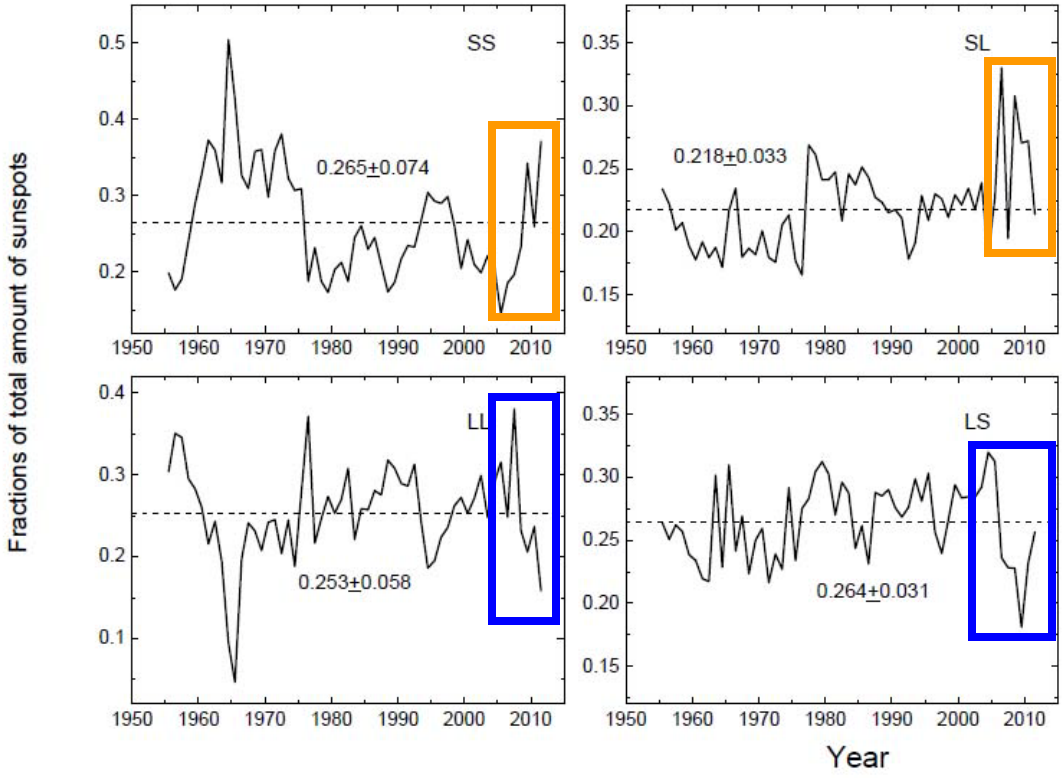
SL: H = 1000 ÷ 1700

LS: H = 1700 ÷ 2700

LL: H > 2700

Fractions of small and large sunspots





Small↗ Large↘

Fraction of small spots increase

Conclusions

- No **centennial decline** in strongest magnetic field strength in the last years is observed.
- An average measured value of sunspot MFs by Livingston-Penn effect may be regulated by a current relative composition of small and large sunspots.
- Combination of different data shows that magnetic field measurements exhibit **cyclic** variations only.
- The last conclusion can be verify by the long-term Mount-Wilson observations (from 1917)