

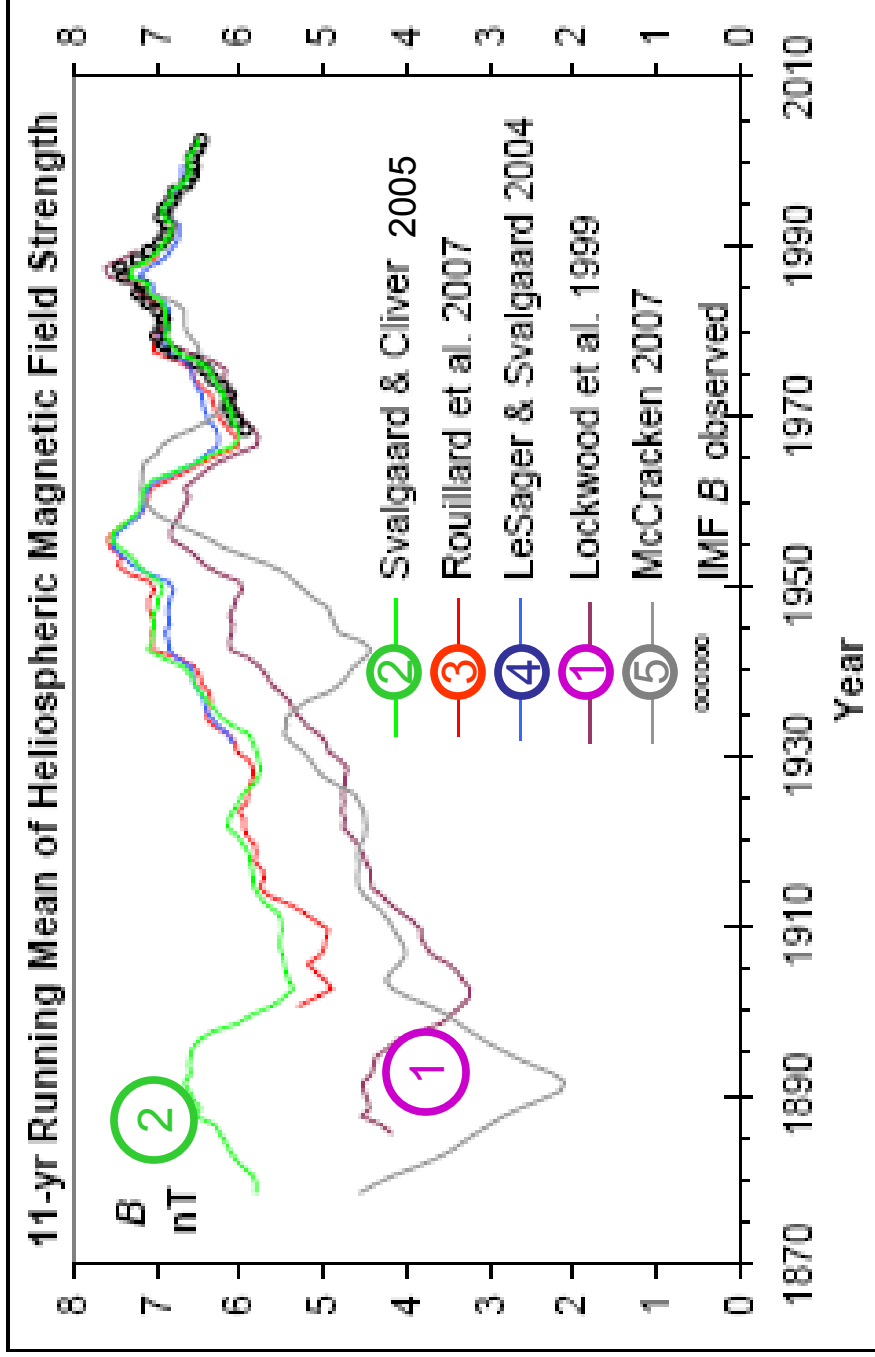
~130 Years of Solar Wind Data: The Floor and More

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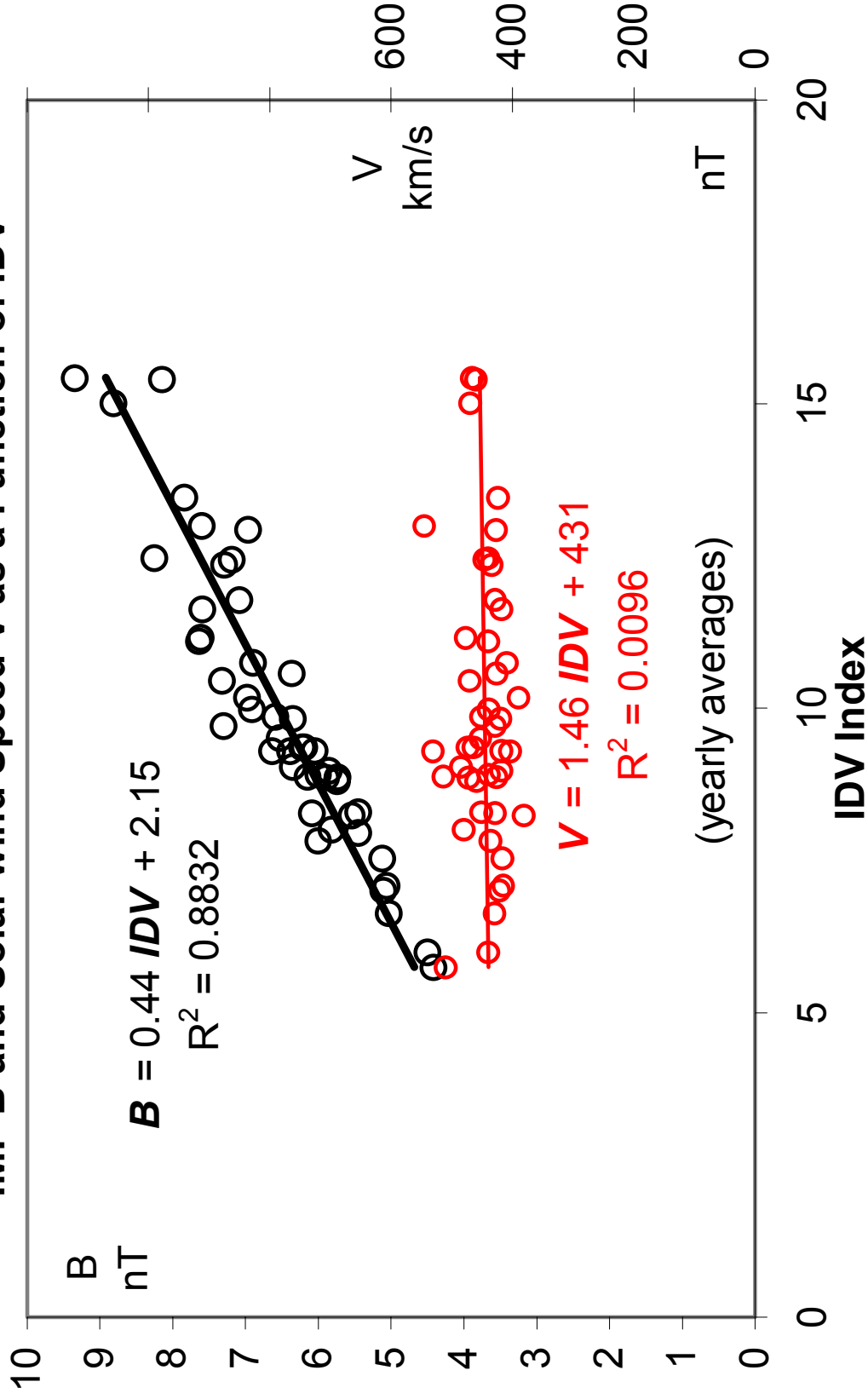
Outline

- **Long-term solar wind reconstruction:
Emerging consensus**
- **Floor in the IMF: Then & Now**
- **Secular variation of solar wind speed**
- **Entering a Gleissberg Minimum?**



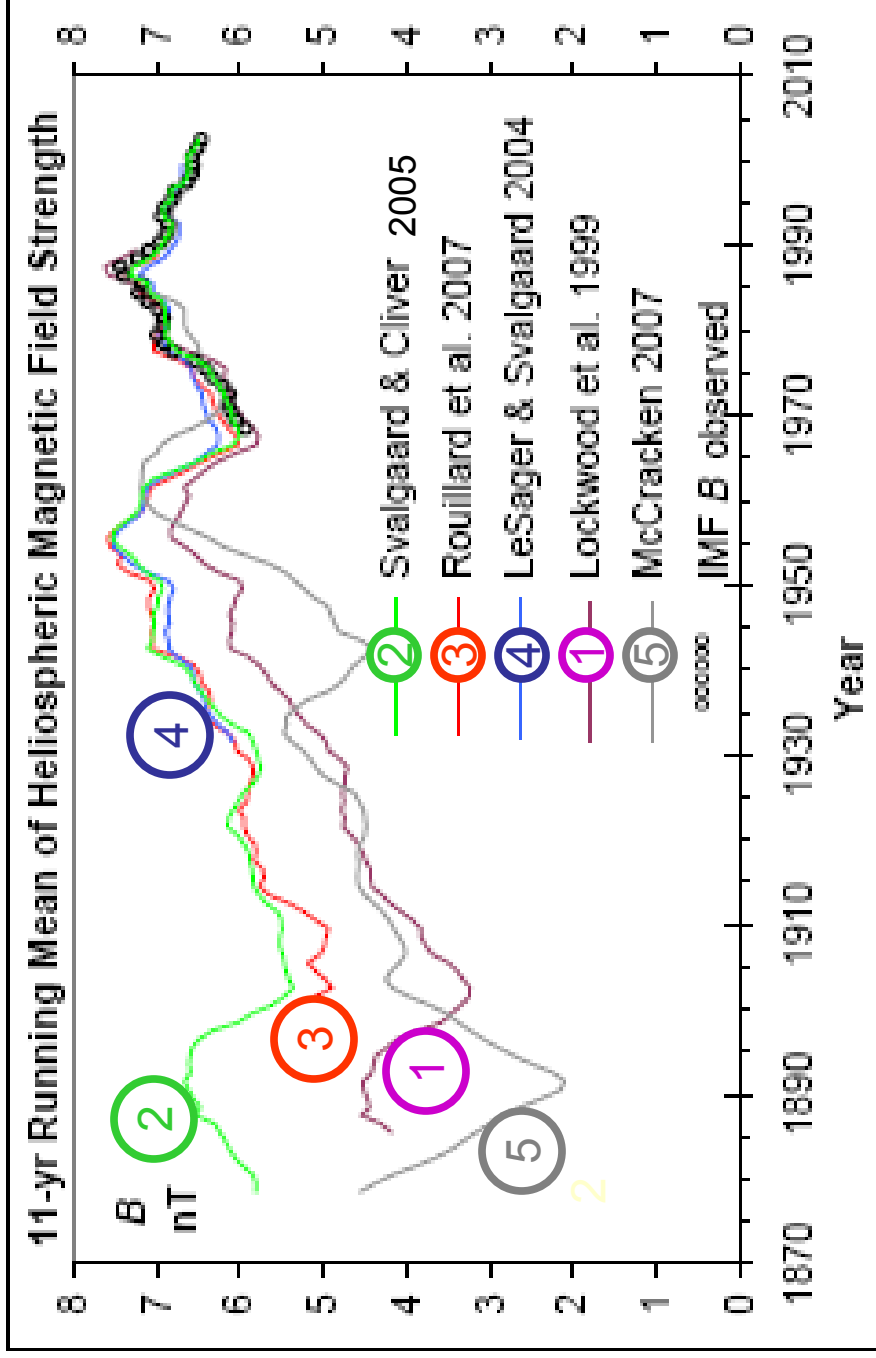
Long-term Solar Wind Magnetic Field Reconstruction:
Emerging Consensus

IMF B and Solar wind Speed V as a Function of IDV

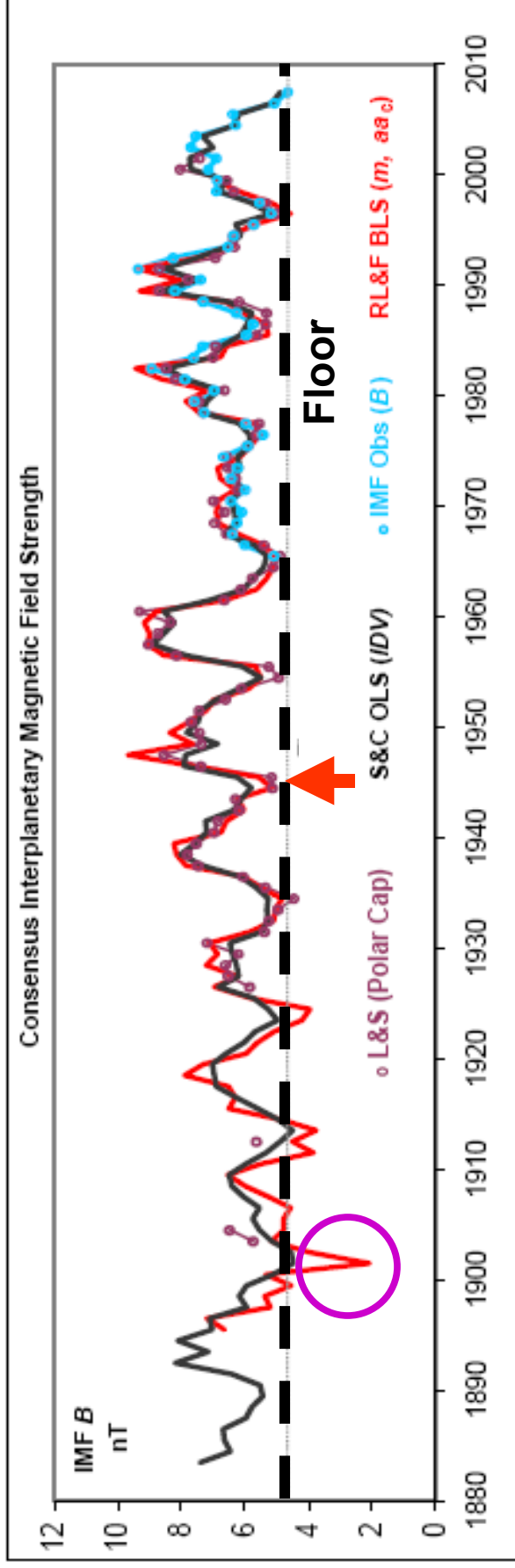


(Svalgaard & Cliver, JGR, 110(12), 2005)

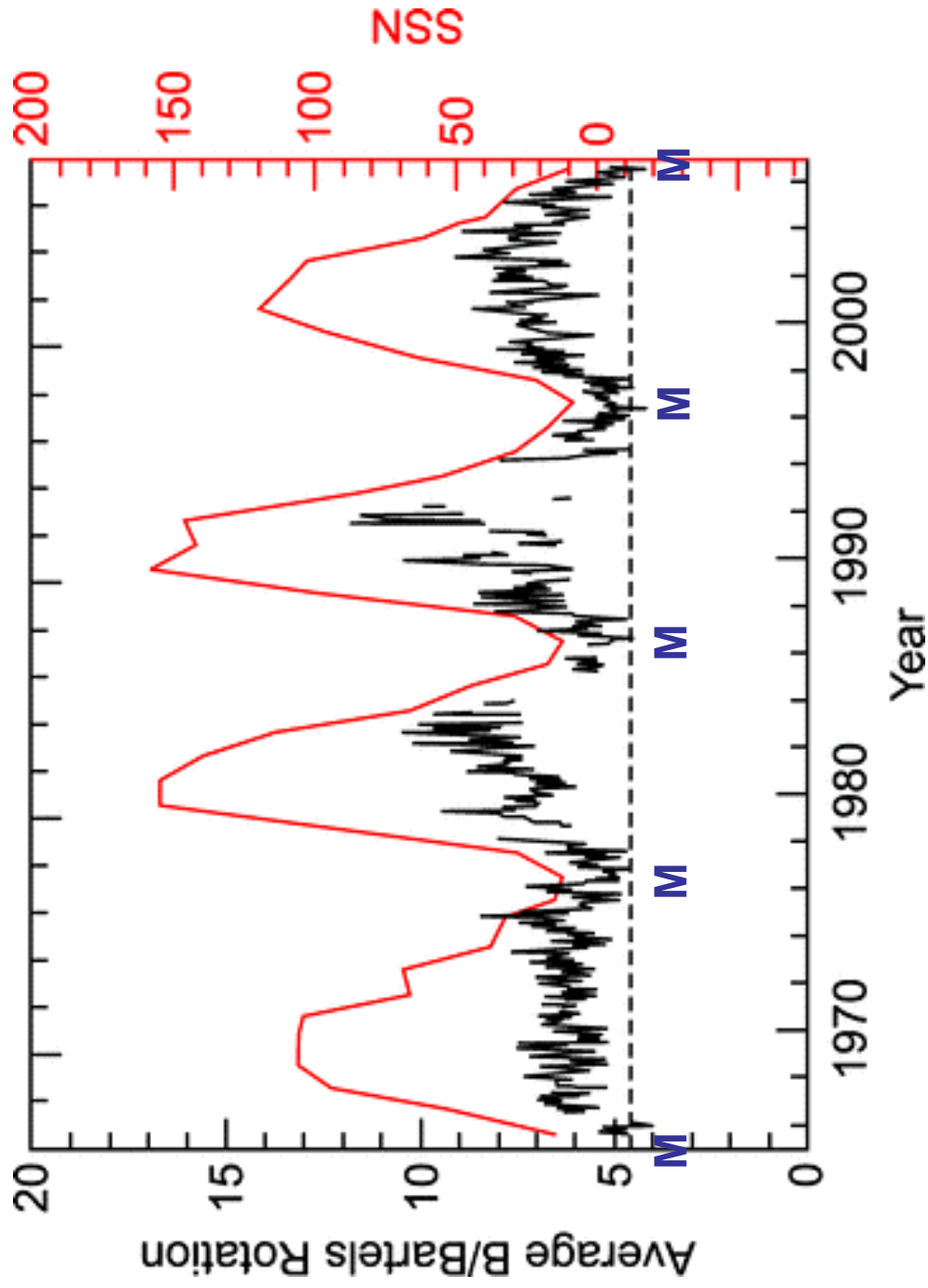
The IDV index has the useful property of being highly correlated with B and independent of V



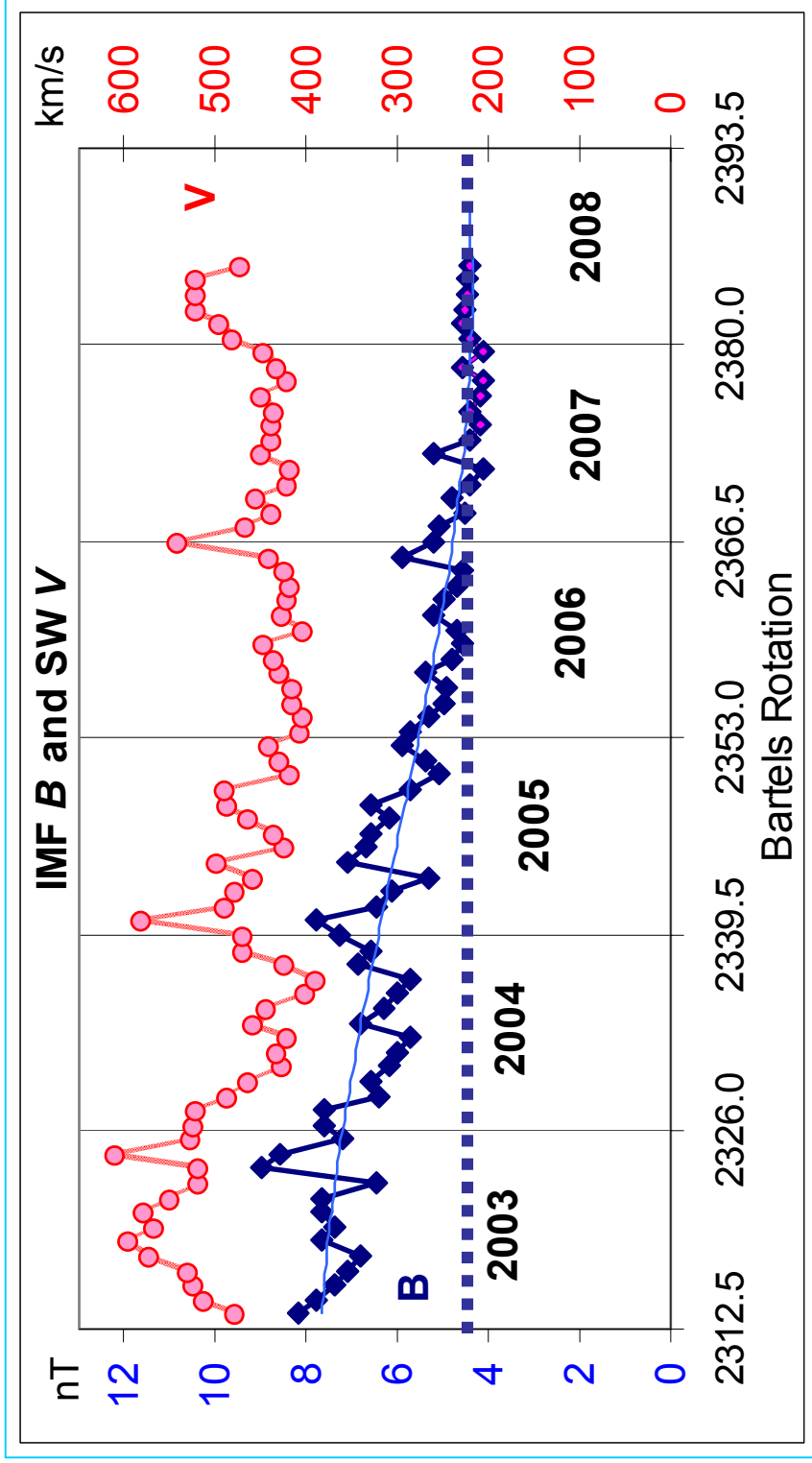
Long-term Solar Wind Magnetic Field Reconstruction:
Emerging Consensus (Exception: McCracken, 2007)



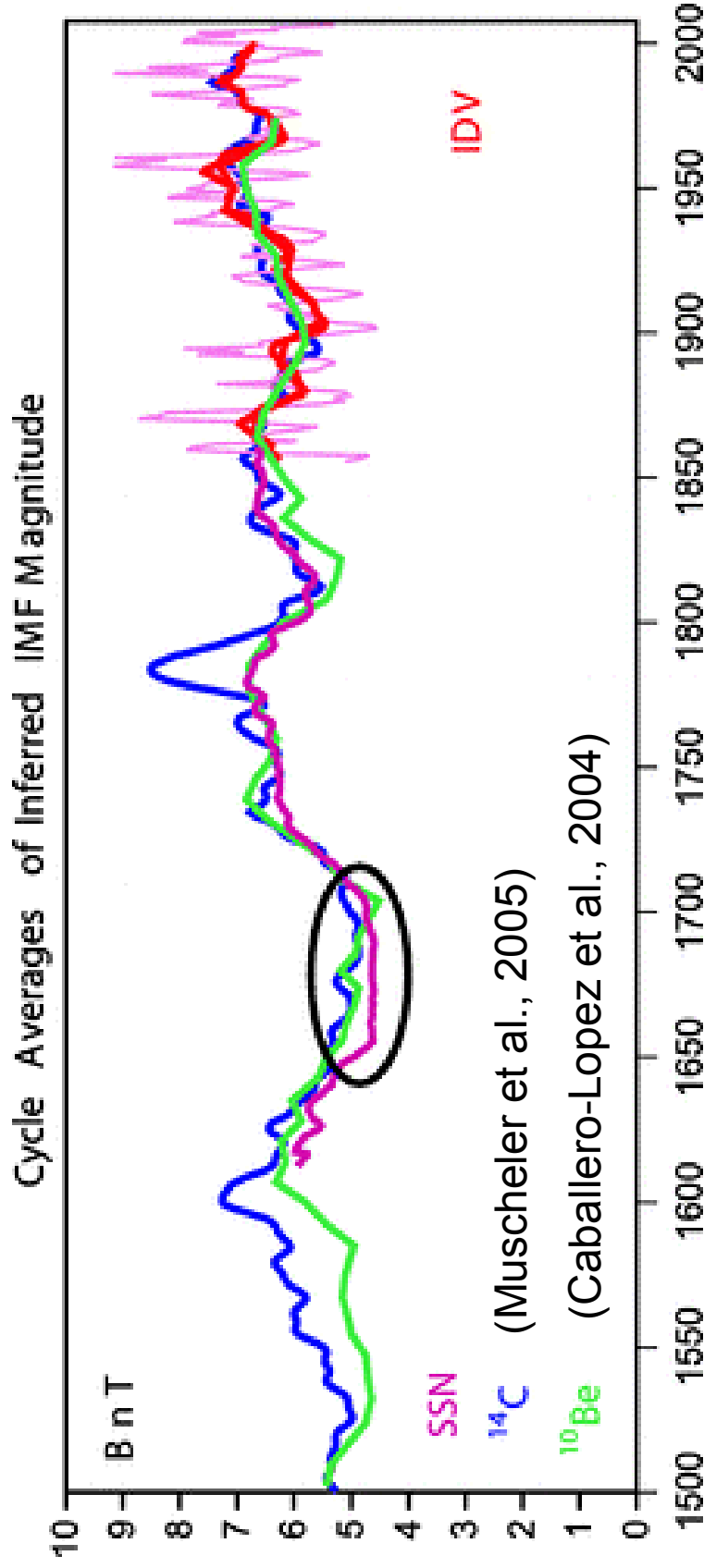
- Annual averages of B show evidence for a floor ~ 4.5 nT
- The sharp drop from 1945-1950 in the McCracken time series does not appear in geomagnetic data
- The low value in 1901 from RL&F is in error (APR, priv. comm.)



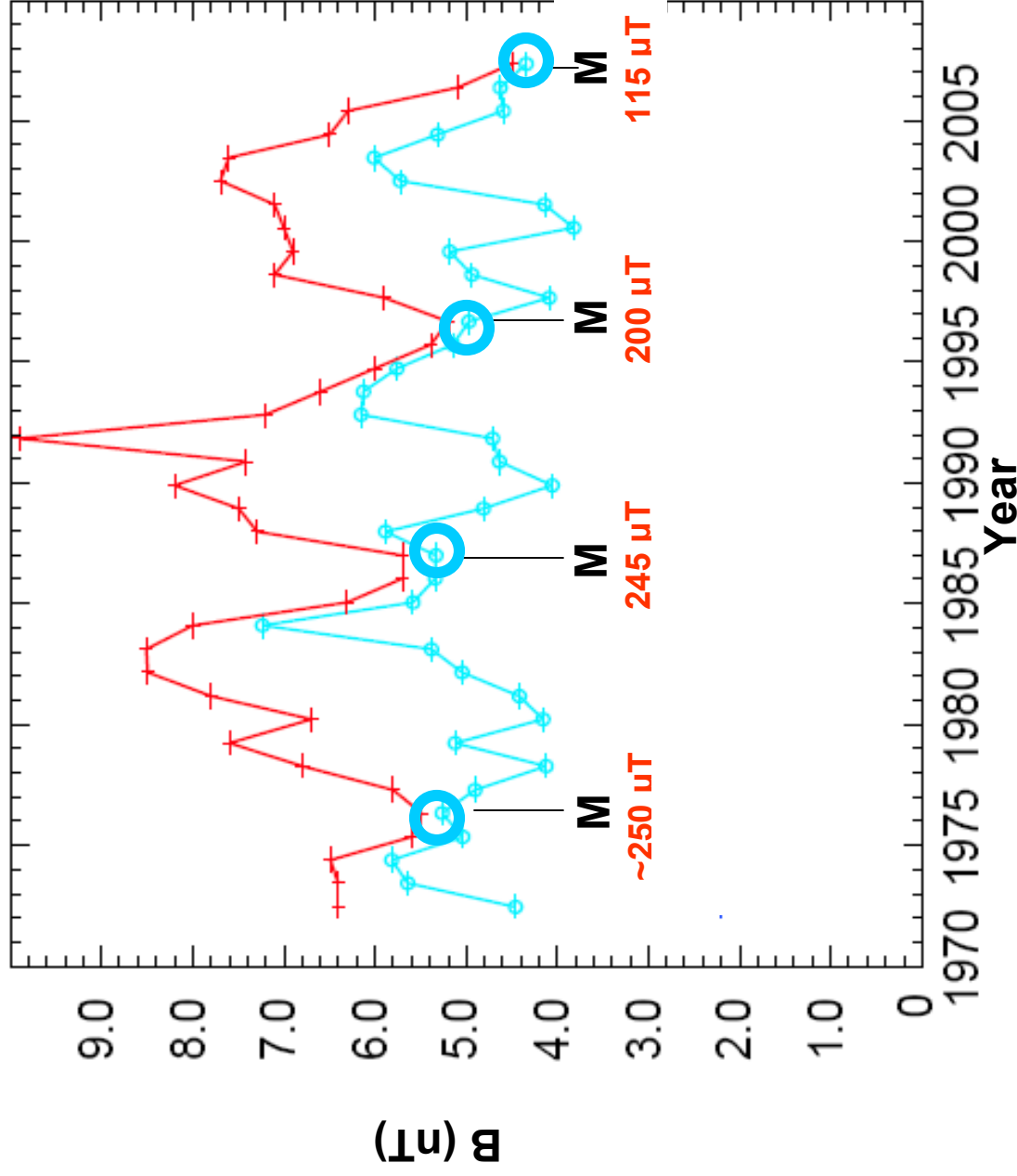
Floor in the Solar Wind Magnetic Field:
Direct Observations (27-Day Averages)



Floor in the Solar Wind Magnetic Field:
Recent Direct Observations



Floor in the Solar Wind Magnetic Field:
Cosmogenic Nuclei / long-term



+ SSW + HSS + CME

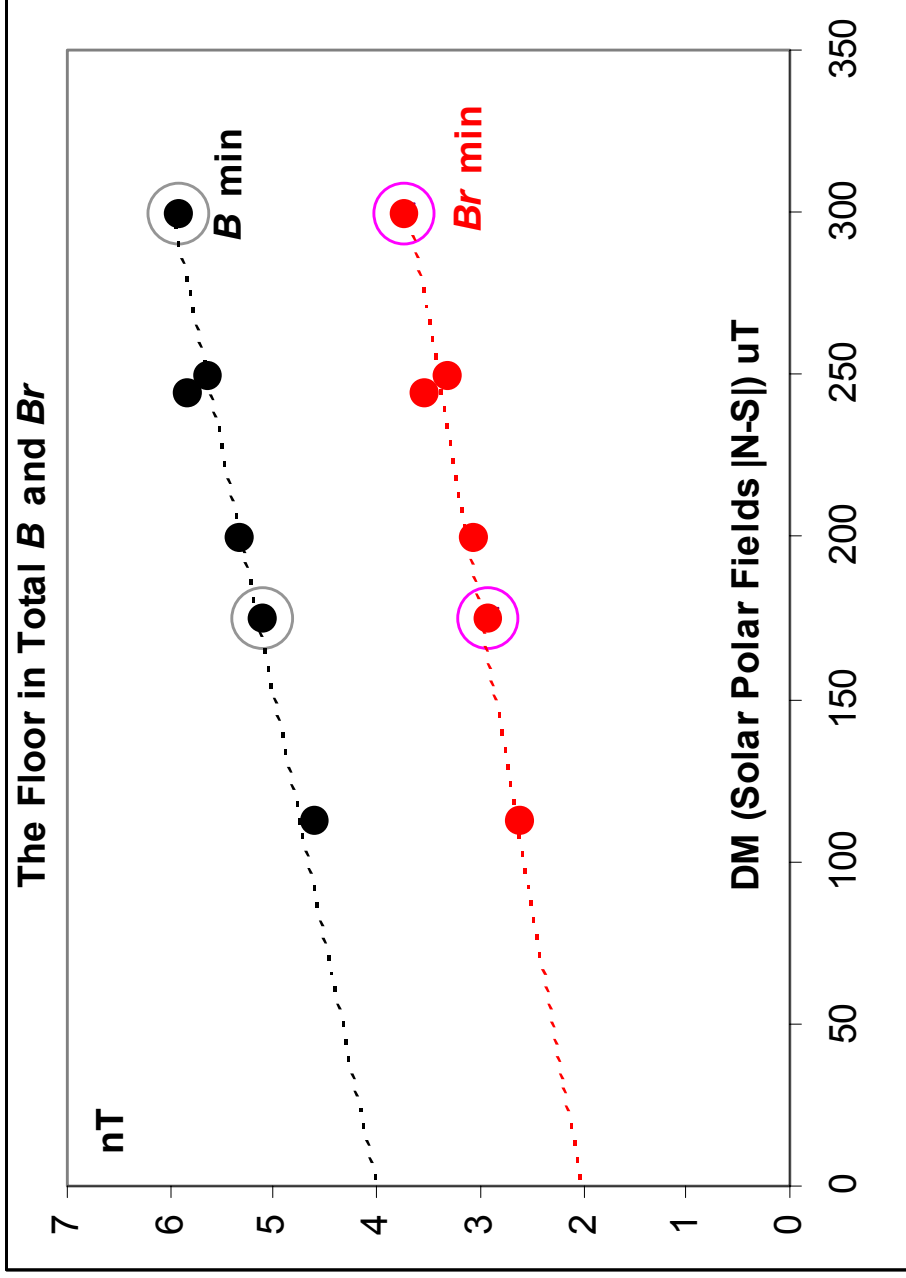
o SSW + HSS

(Fisk et al., 1999;
Owens & Crooker,
2006)

Interpretation of Floor: Baseline Open Magnetic Flux

Svalgaard & Cliver, ApJ Lett. 661, L203, 2007

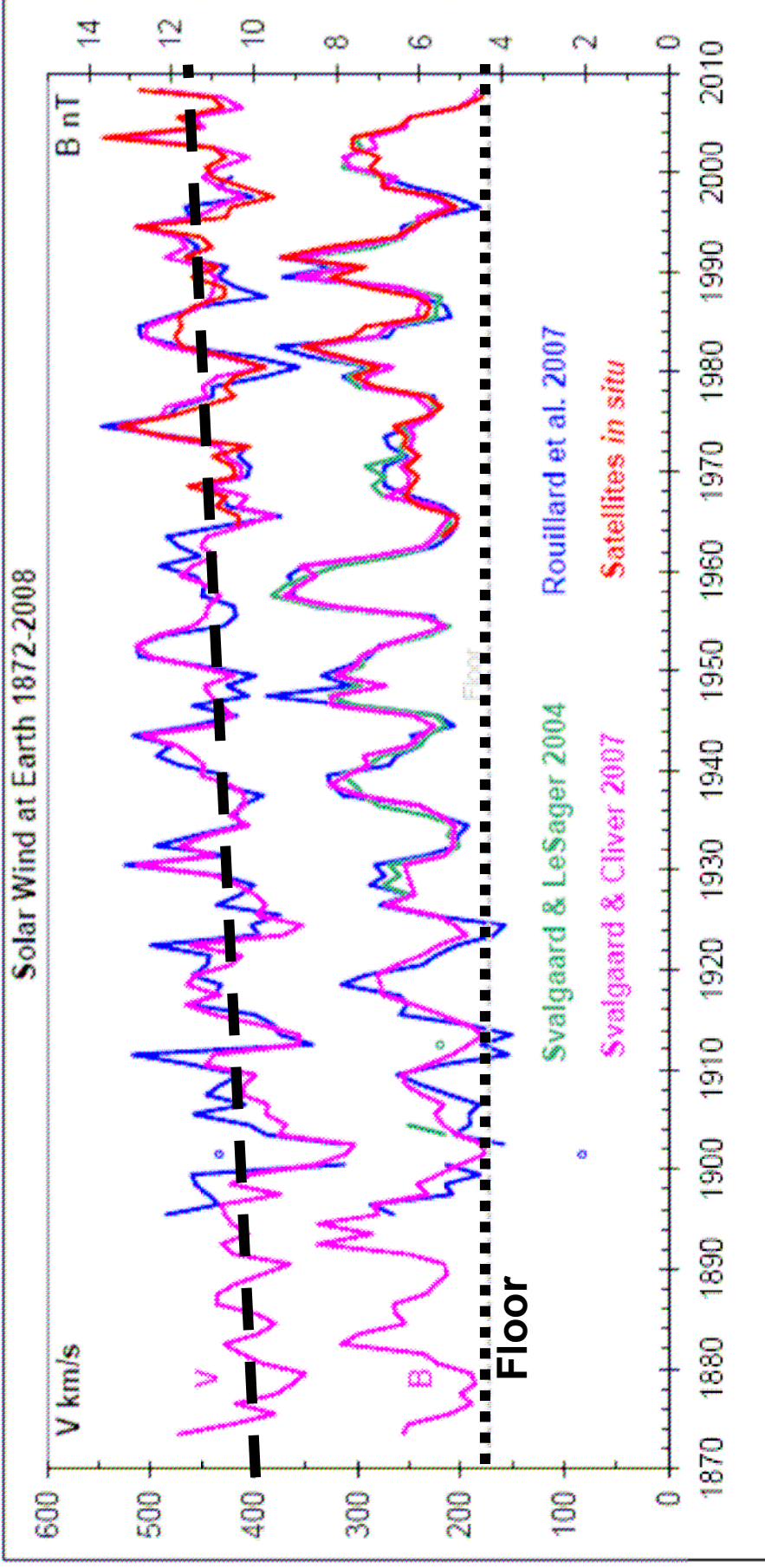
$$B(\text{nT}) = 0.27R^{1/2} + 4.6$$



For $SSN = 0$

Then: $B_{\text{Total}}(\text{ecliptic}) = 4.6 \text{ nT}$; $B_{\text{RADIAL}}(\text{all latitudes}) = 3.0 \text{ nT}$

Now: $B_{\text{Total}}(\text{ecliptic}) \sim 4 \text{ nT}$; $B_{\text{RADIAL}}(\text{all latitudes}) \sim 2 \text{ nT}$



(Rouillard et al., 2007; Svalgaard & Cliver, 2007)

~15% increase in solar wind speed during the last ~120 years

Plea for Help to Magnetospheric Physicists

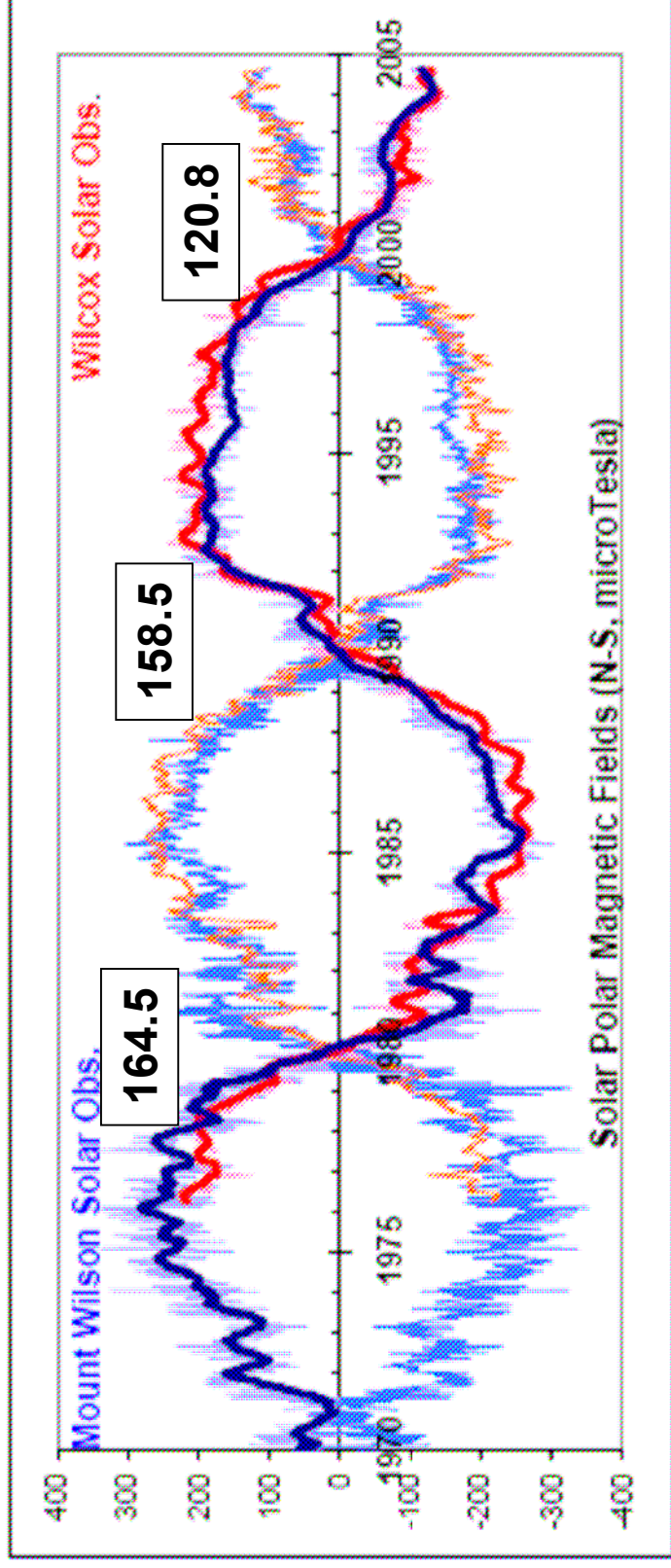
Open Question:

Effect of ~10% decrease of Earth's dipole since ~1850 on geomagnetic activity?

- Siscoe et al. (2002) → Decrease in activity (ISM model & Hill M/I coupling models)
- Glassmeier et al. (2004) → Weak/no effect (scaling relationships between magnetospheric parameters & M)

A Coming Gleissberg Minimum? Cycle 24 may be smallest in ~100 years

Test of Long-term Reconstructions,
Precursor Prediction Technique, Dynamo Models, ...



Conclusions

- Consensus long-term B & V / Validation of IDV
- Floor in IMF in ecliptic $B_{\text{tot}} \sim 4 \text{ nT}$ & $B_r \sim 2 \text{ nT}$ ($SSN = 0$)
- $\sim 15\%$ increase in solar wind V since 1872?