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

E.W. Cliver
Space Vehicles Directorate
Air Force Research Laboratory
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
The IDV index has the useful property of being highly correlated with B and independent of V

(Svalgaard & Cliver, JGR, 110(12), 2005)
Long-term Solar Wind Magnetic Field Reconstruction: Emerging Consensus (Exception: McCracken, 2007)
- Annual averages of B show evidence for a floor \( \sim 4.5 \) 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

~4.4 nT
Floor in the Solar Wind Magnetic Field: Cosmogenic Nuclei / long-term

(Muscheler et al., 2005)
(Caballero-Lopez et al., 2004)
Interpretation of Floor: Baseline Open Magnetic Flux

(Fisk et al., 1999; Owens & Crooker, 2006)
For SSN = 0
Then: $B_{\text{Total (ecliptic)}} = 4.6 \, \text{nT}; \quad B_{\text{RADIAL (all latitudes)}} = 3.0 \, \text{nT}$
Now: $B_{\text{Total (ecliptic)}} \sim 4 \, \text{nT}; \quad B_{\text{RADIAL (all latitudes)}} \sim 2 \, \text{nT}$

\[ B(nT) = 0.27R^{\frac{1}{2}} + 4.6 \]
~15% increase in solar wind speed during the last ~120 years

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

(Svalgaard, Cliver, & Kamide, 2005)
Conclusions

- Consensus long-term B & V / Validation of IDV

- Floor in IMF in ecliptic Btot $\sim 4$ nT & Br $\sim 2$ nT (SSN = 0)

- $\sim 15\%$ increase in solar wind V since 1872?