A first systematic look at sunspot statistics from space

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As told to H. S. Hudson

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Background

- The SOHO/MDI observations provide a stable and systematic view of sunspots with 12.5 cm optic
 - 1024x1024 pixel CCD full-Sun readout
 - Ni I line (6768 Å) 5-point line profile at 94 mÅ resolution => pseudocontinuum images
 - Near-continuous observations commencing 1996, up through overlap with SDO/HMI
- Automated detection of spots with standard imageprocessing techniques: STARA, developed with L.
 Fletcher (Glasgow) and S. Marshall (Strathclyde) as a part of a PhD research program

STARA performance

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Sunspot numbers



Sunspot numbers

- Comparison with SSN on the basis of 3-month running mean (sic)
- STARA sunspot number a simple count, as opposed to the SSN algorithm
- Normalization to SIDC number in late phase
- Large discrepancy (SIDC > STARA) in early Cycle 23
- Different behavior across Gnevyshev gap
- Good agreement in late cycle

Sunspot Areas



• The umbra/total area varies systematically across the cycle; cf. TSI modeling

Umbral Magnetic Fields



Livingston-Penn Comparison



Conclusions

- The MDI data provide, through STARA, a homogeneous dataset of seeing-free sunspot measurements over half a Hale cycle
- The results show systematic and well-determined differences with the SIDC sunspot number
- Umbral fields appear to vary across the cycle, but the Livingston-Penn effect is not directly confirmable

For details, see Fraser's PhD thesis (Glasgow 2012), or arXiv:1108-4285

Editorial comments

- The STARA sunspot catalog may be the most precise record of sunspot occurrence in existence
- It will continue into the SDO era
- There will be multiple applications of this information
- There should be detailed investigations of the database, in conjunction with the MDI team, to improve it against the inevitable (but doubtless small) systematic errors

Albregtsen-Maltby photometry



Opinions

- The STARA magnetic fields are consistent with the Penn-Livingston effect
- The Albregtsen-Maltby photometry may be consistent with the Penn-Livingston effect
- The Penn-Livingston effect is probably cyclic and does not represent a drastic and novel change in the behavior of solar activity
- But we don't really know yet