Workshop Summary/Discussion

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MDI butterfly diagram, courtesy Fraser Watson (to 1/1/11)
Discussion points

- Meaning of workshop
- How to understand the Livingston-Penn results
- Encouragement to study the modern spots too
Meaning of workshop

- Publicly, the need to speak authoritatively about the SSN over historical times
  - Definition and calibration (yes, I like the compass needle)
  - Gratitude to SIDC (and AAVSO, and Sonne et al) for bringing the current SSN to perfection
- My personal $k$ factor ($k \sim 5$ at first try; 1.42 after a bit of practice)
Compass needle: Wolf’s great discovery?

- I endorse Leif’s scheme
- Compass deflections have a direct and physically understandable relationship with a strong correlate of SSN
- Wolf himself did it
- I suggest modeling with EVE data input and a quick check of flare effects with a better model
Livingston-Penn effect

• There’s no question that something is happening that we have not seen before
  – We should be proud of this, and exploit it
  – We should ignore wild-sounding claims about sunspots disappearing completely
• The data are weak, but the theory is weaker
Livingston-Penn graphic

Ratio Observed Sunspot Number to SSN from F10.7

Monthly Averages when SSN > 4

5/27/12
Livingston-Penn quandary

• We don’t really understand the physical origin of any of our best indices (SSN and F10.7), especially across wide dynamic ranges of activity
• It is even worse for less-well-understood items such as the MWO plage or Ca K indices (cf. IRIS improvements)

So, how do we relate any of this to something that theorists can understand? What observable could relate to a dynamo theory? Flux? $B$? Flares or (maybe better) CMEs?
Note the completeness of the sample, down to a limiting area of about 15 MSH on MDI
Areas histograms by thirds: red, blue, gold (after July 26, 2002)

Areas histograms by pixel coordinate: the wings of the butterfly?
Conclusions I

• The modern work on SSN has been wonderful, establishing its reproducibility and precision
• The older SSN records need rationalization
• This group needs to take charge of the perception of SSN:
  – Consensus
  – Public databases and ample publications
  – Propaganda that discredits any research not using the consensus SSN

5/27/12 Glasgow Astrochat 23-Feb-12
Conclusions II

• Phenomena associated with the Livingston-Penn observations are unmistakably novel and should motivate research into the physical origins of SSN and F10.7

• Automated reductions of observations from space spot data let us study complete samples with high precision (Yohkoh, MDI, HMI, balloons both new and old) – also ground-based instruments such as PSPT and SFO
Caveats

- Reject the Group Sunspot Number approach
- Abjure running means
- Establish consensus on early data under SIDC authority
- Endorse modeling of ionospheric effects, e.g. to include flares and microflares with new non-FISM spectra
- Eschew linear regression analysis