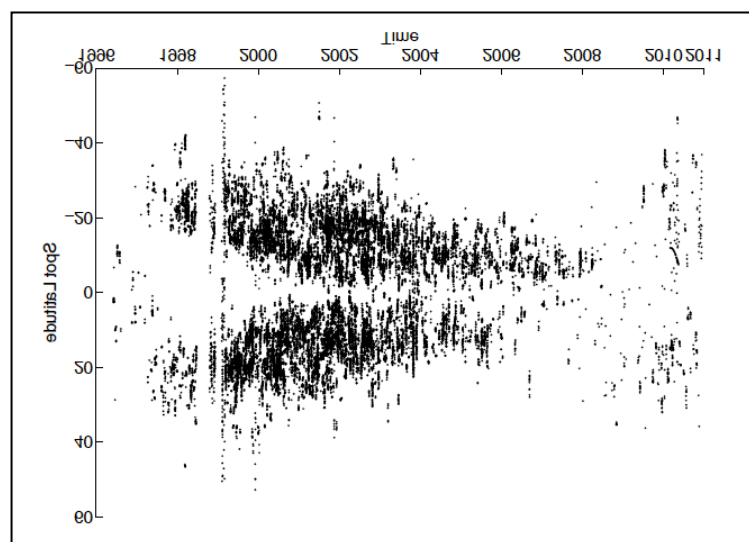# *Workshop Summary/Discussion*

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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

- Publically, 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
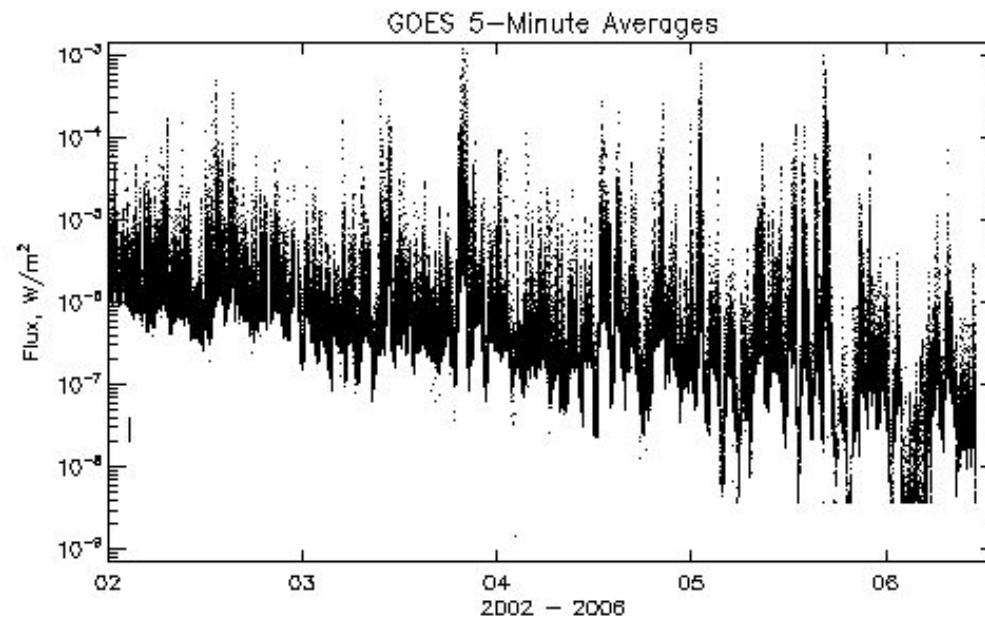
Livingston-Penn effect

- 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
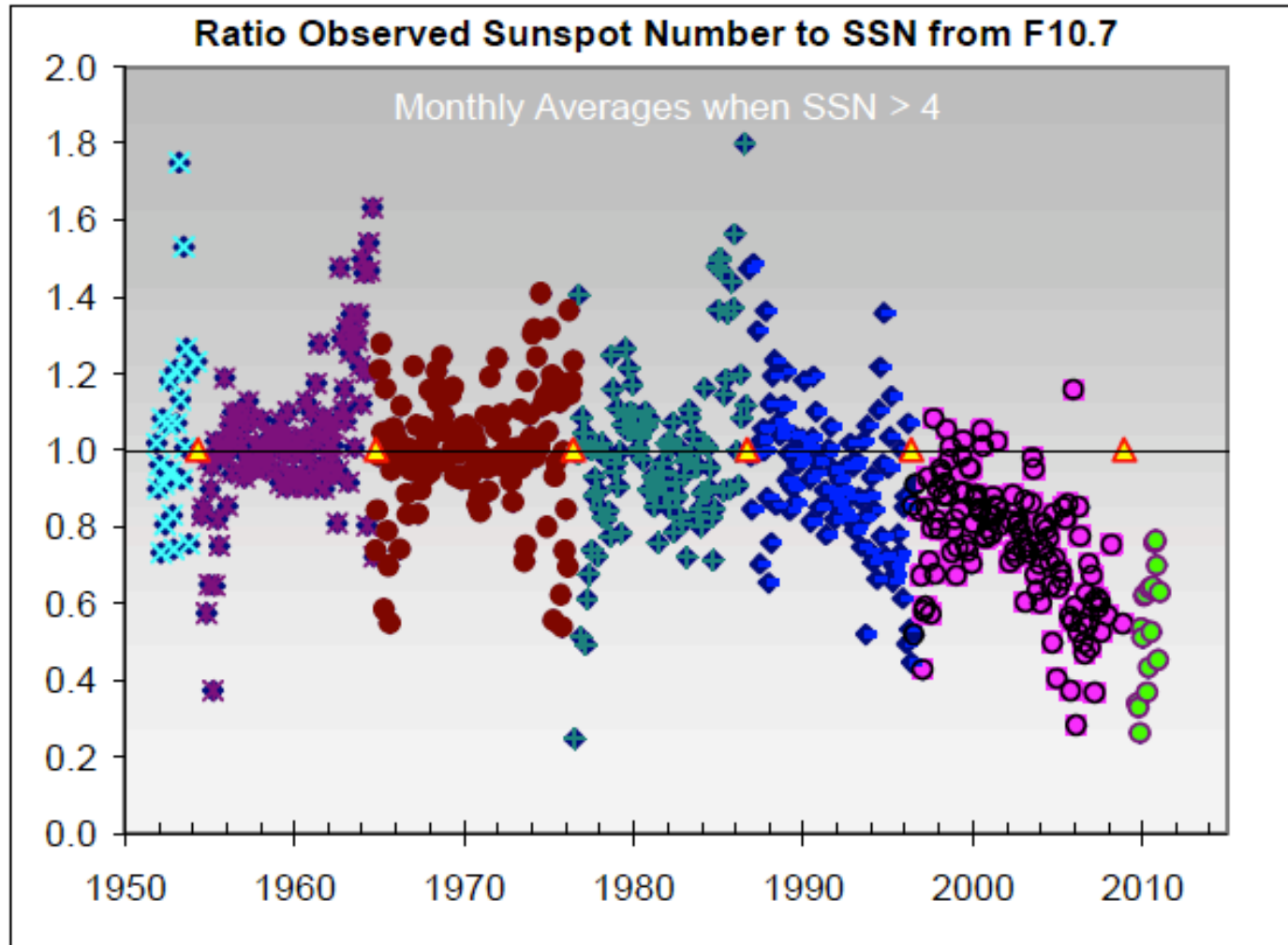
Livingston-Penn quandary

- 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?*
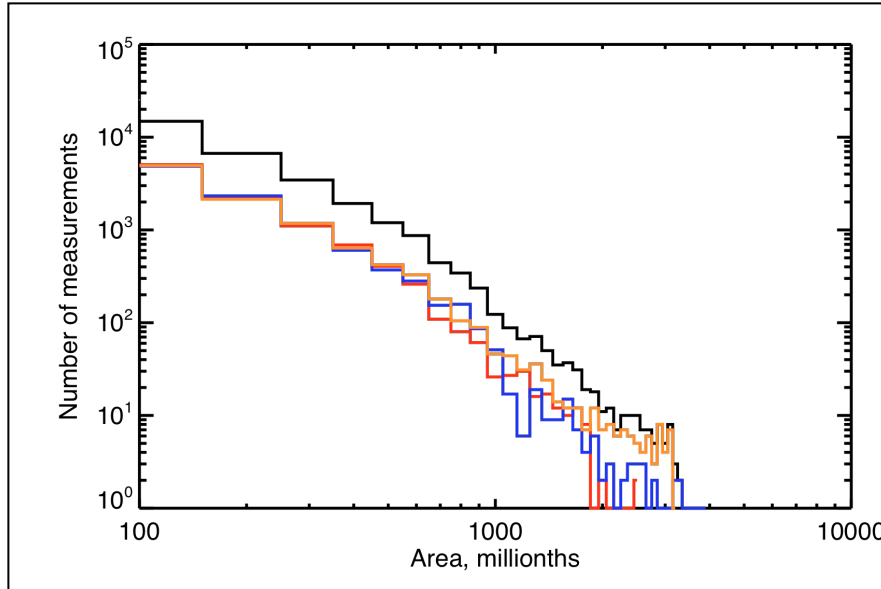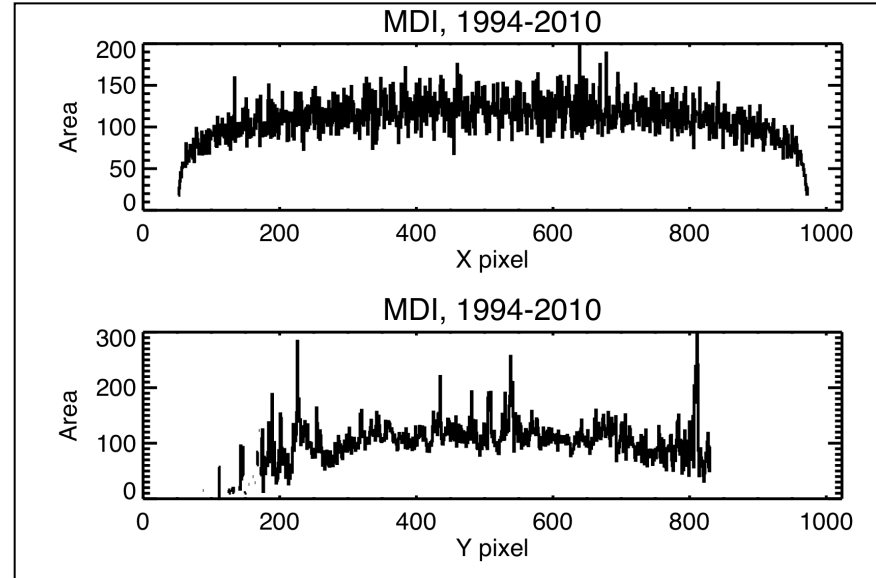
STARA performance
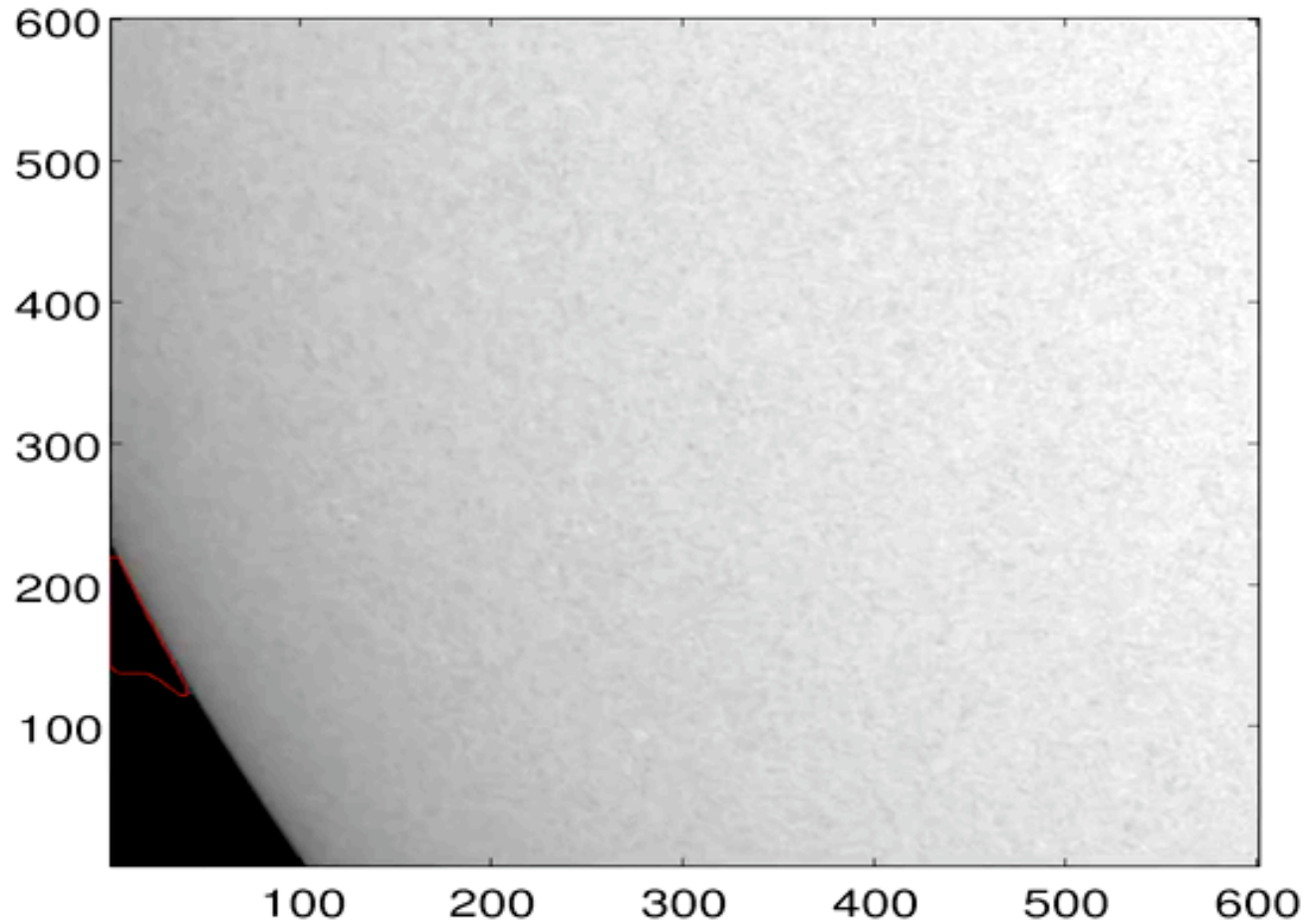
Note the completeness of the sample, down to a limiting area of about 15 MSH on MDI

STARA results

Areas histograms by thirds: red, blue, gold (after July 26, 2002)

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

5/27/12

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

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

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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