

Parallel sunspot counts with SDO/HMI

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4th SSN Workshop, Locarno, May 2014

Why compare? Initial considerations

- Does adding magnetic information to intensitygrams have any effect on sunspot counts?
- How much does group splitting affect the counts?

Assumptions

- Using the same observer for both counts will decrease differences in observer counting practices and bias to a minimum

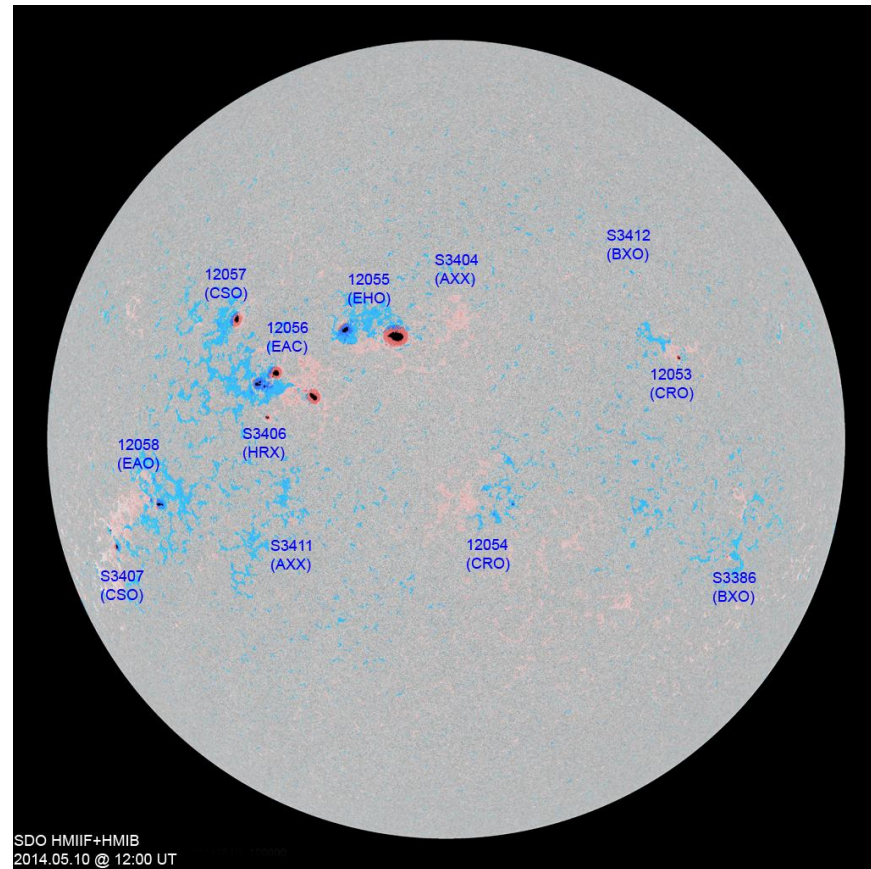
Expected results

- No major differences between the counts
- When the counts are different, group splitting will account for most of the differences

Method and data

1. Count sunspots from Magigrams.

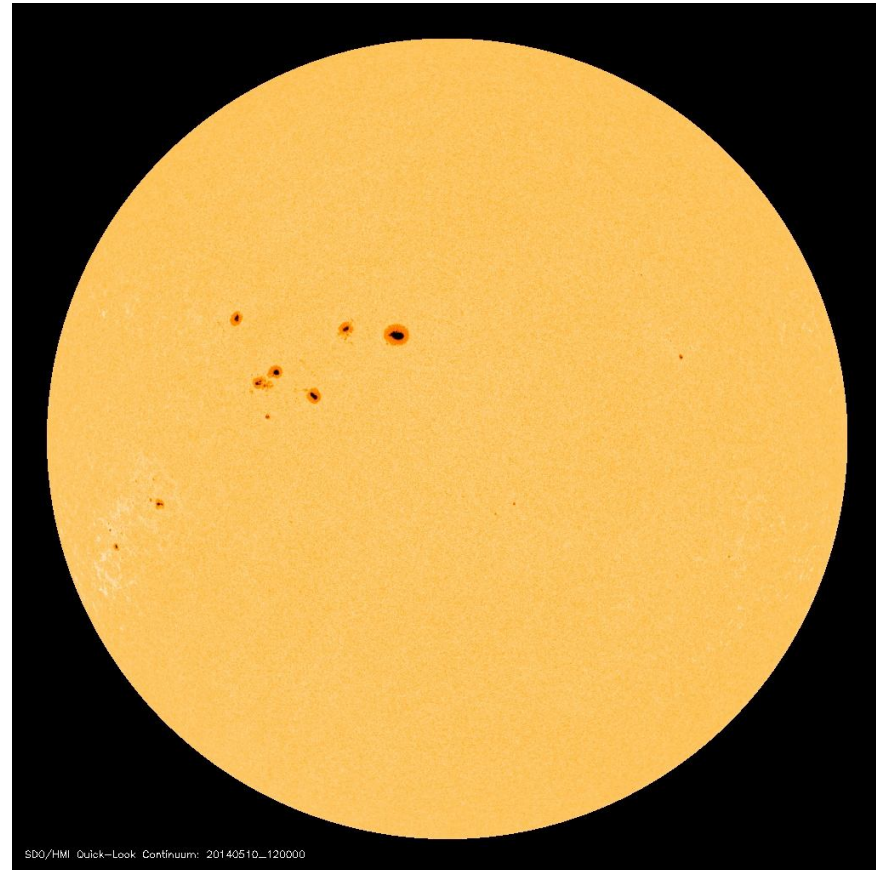
- Based on SDO HMIIF/HMIB 4K resolution composite (magneto intensitygram -> Magigram)
- Counted at 1K resolution
- Published daily at STAR (<http://solen.info/solar>) using the last image set of the previous day
- From Oct.1 2013 added a count at 12 UT
- Data interval: 2012.1 - 2014.4



Method and data

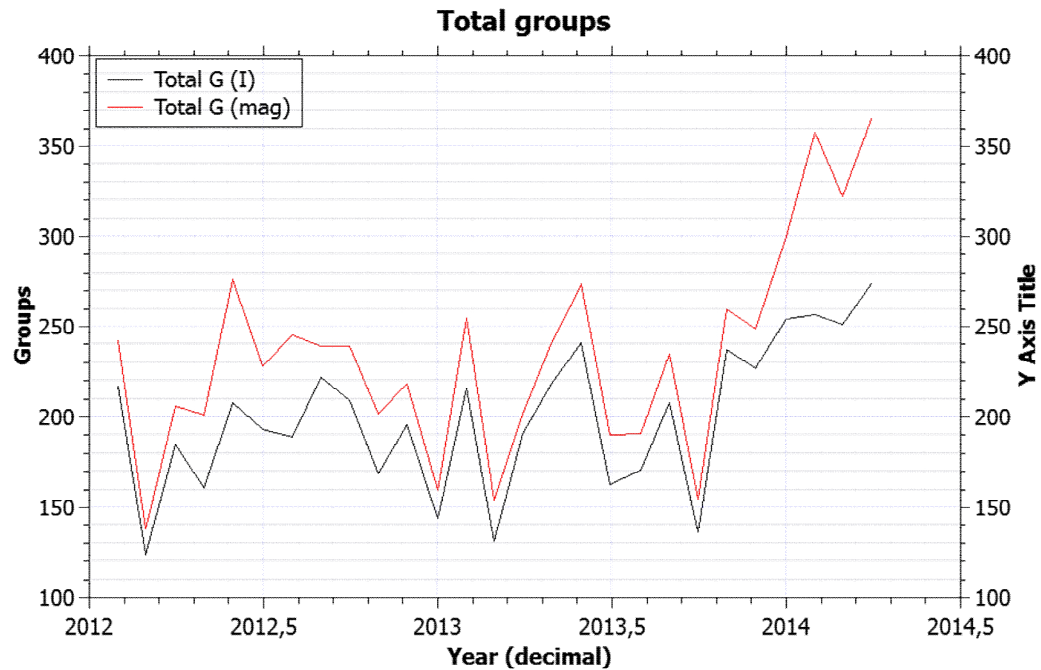
2. Count sunspots from flattened intensitygrams.

- SDO HMIIF 1K resolution
- Data interval: 2012.1 - 2014.3
- Lagging method 1 count by at least one month to eliminate memory effects



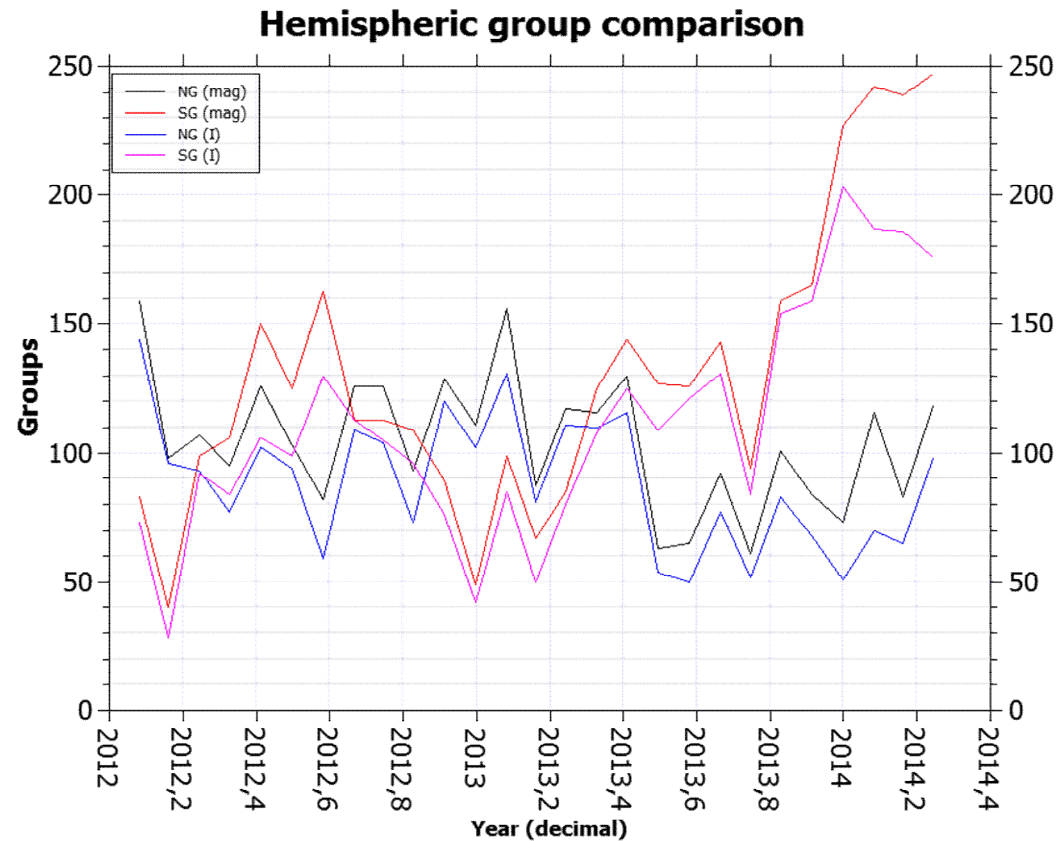
Results - groups

- More groups observed in magigrams, on average 17.7% more than for intensitygrams
- Increasing differences when the 90 day solar flux (1 AU) is at or above 150



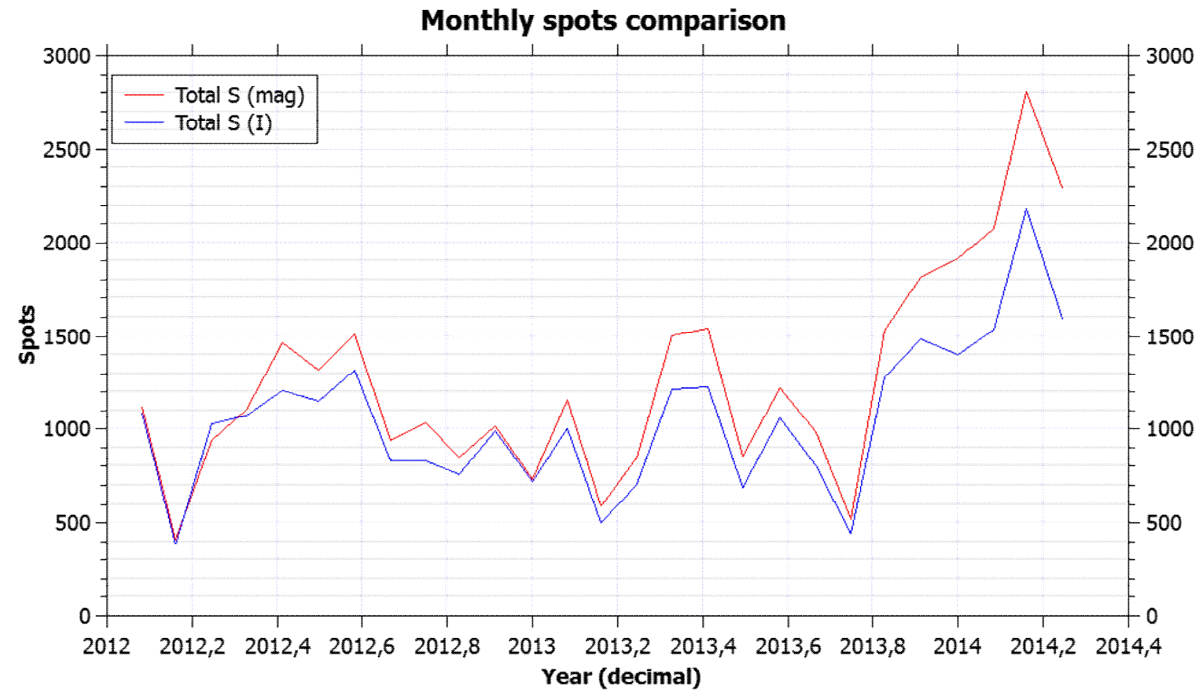
Results – groups by hemisphere

- Northern hemisphere groups on a slowly decreasing trend with similar development for both magigrams and intensitygrams
- Quick increase in southern hemisphere groups from October 2013.



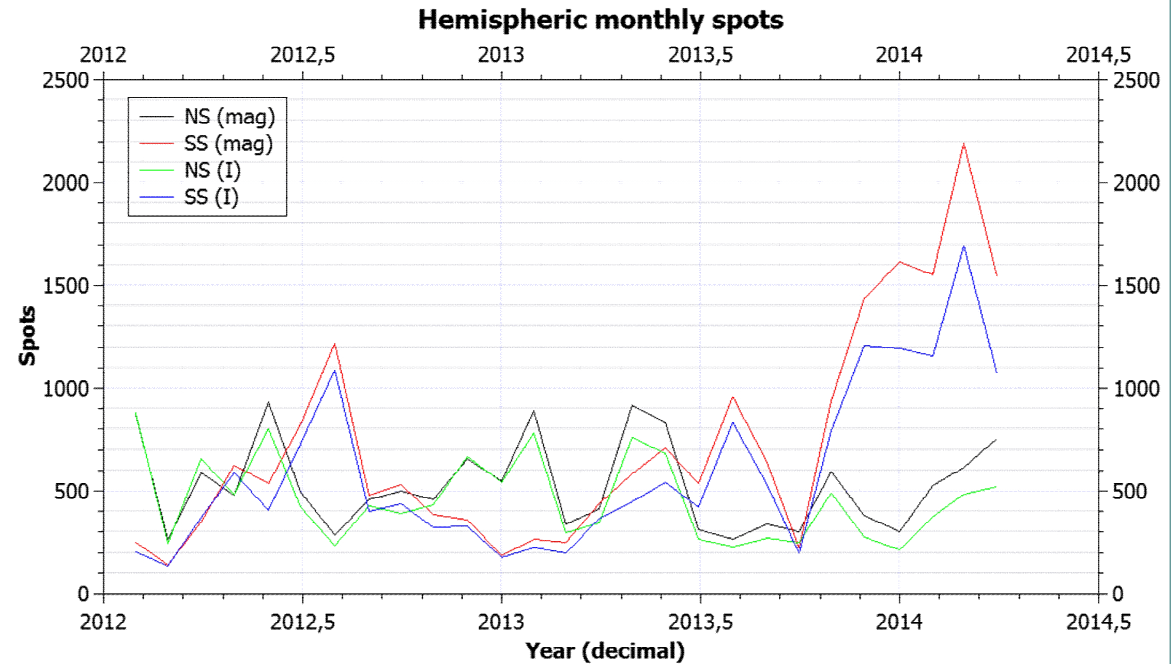
Results - spots

- Accumulated spots per month develops similarly for both counts, again with increasing differences from Oct.2013
- On average 19.7% more spots using magigrams



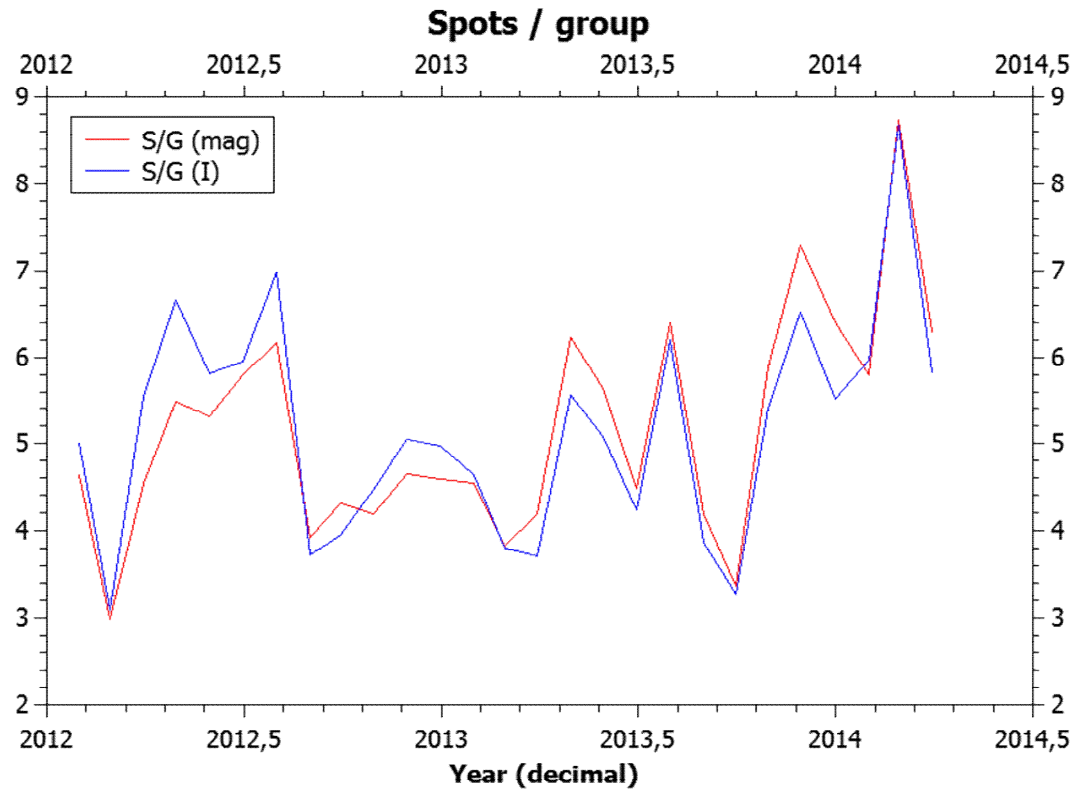
Results – spots by hemisphere

- Split by hemisphere the magigram count is similar or a little higher than for intensitygrams most months until Oct.2013
- 30% fewer spots for intensitygrams the last months



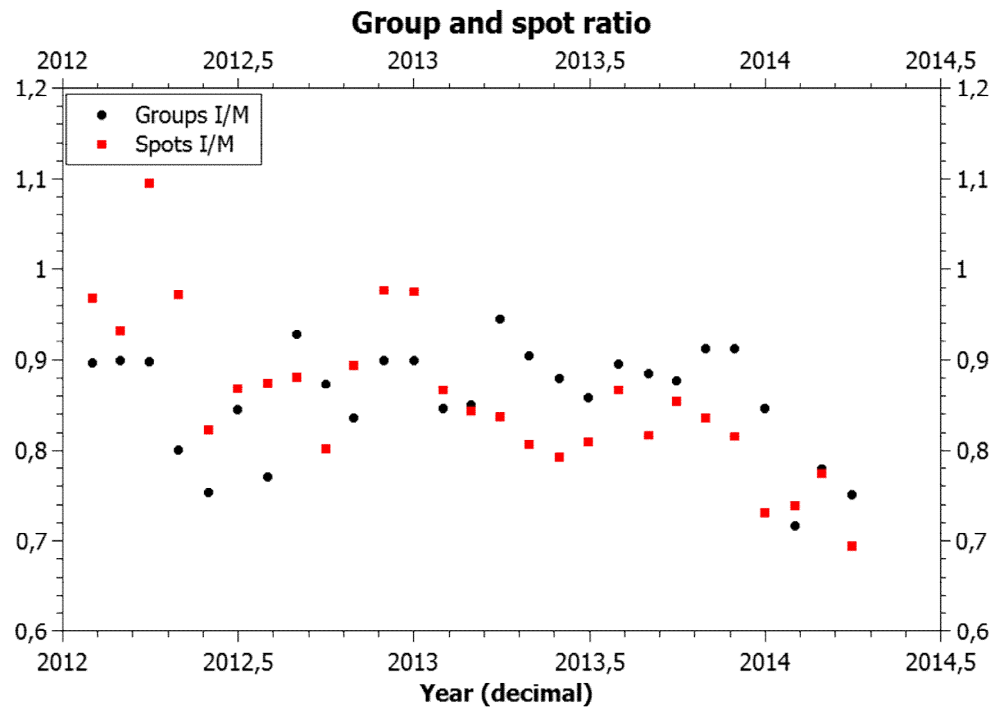
Results – spots / group ratios

- The spot / group ratio was mostly a little higher for the intensitygrams until Feb.2013, after then the magigrams have mostly been higher



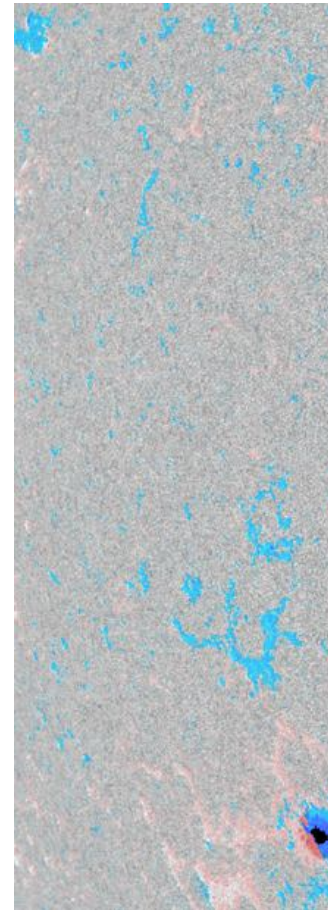
Results – monthly ratios

- No significant trend until December 2013, since then a larger difference between the counts
- Small spots make up a larger part of the magigram count with increasing solar flux

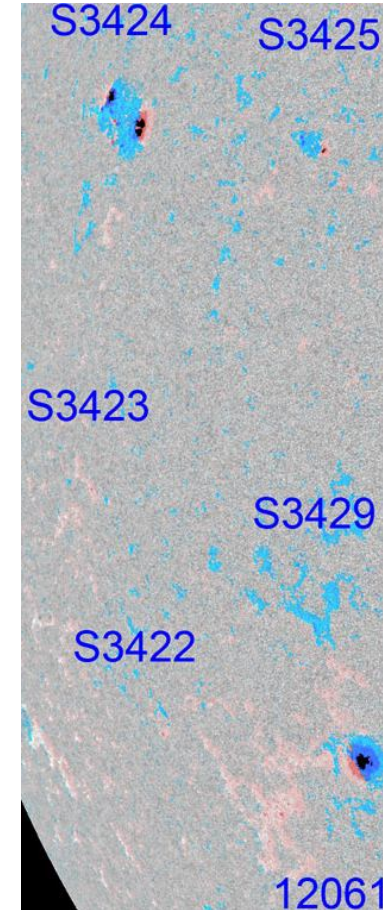


Why are there differences?

- Image comparison: Enhanced visibility (contrast) of small spots (spot area 1-7 microhemispheres)
- During the 12 hour span for the image example a total of 8 new ARs emerged on the complete visible disk. This was the second such rapid magnetic intensification event in May. The count increased by 6 groups. Another 24 hours later several of the initial groups had decayed to a spotless state.
- Group splitting / non-splitting is much easier to get right with magnetic polarity information.



2014.05.13 12:00 UT

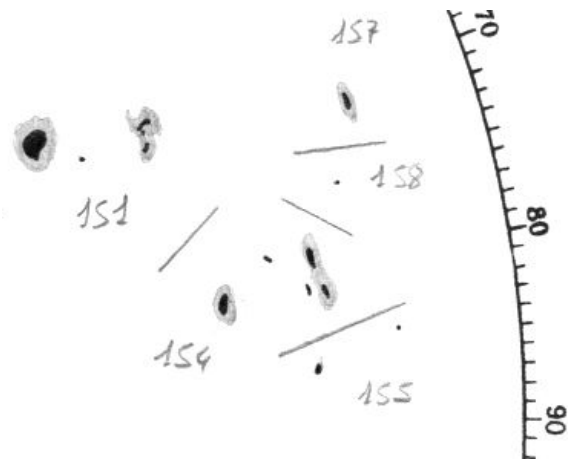


2014.05.13 23:45 UT

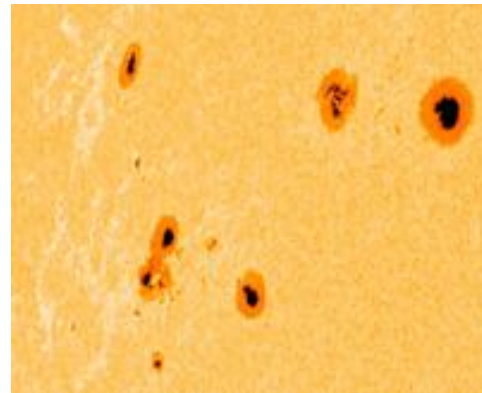
Conclusions

- HMIIF+HMIB composite enhances the visibility of small spots. An observer can be much more confident that a small spot is a spot and not noise with both visual and magnetic evidence.
- Magigrams extends observed lifetime of active regions. Facilitates lifetime tracking of active regions (observes small spots both at initial region formation and in decaying flux)
- Uniform counting of small spots whether located inside a larger region or by themselves. This results in more groups with only one or a few penumbra spots and a significantly higher number of groups than AAVSO and WDC-SILSO reports
- Incorrect splitting choices account for a larger part of the differences when there is complex clustering of groups. Enhanced visibility of small spots and a larger proportion of small spots compared to the total number of spots causes significant differences between the counts at solar max.

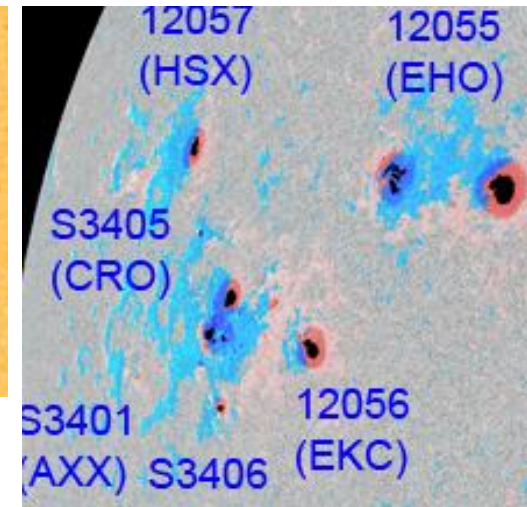
Addendum 1: Example comparison with Locarno



Locarno May 8, 2014
5 groups in this relatively complex area



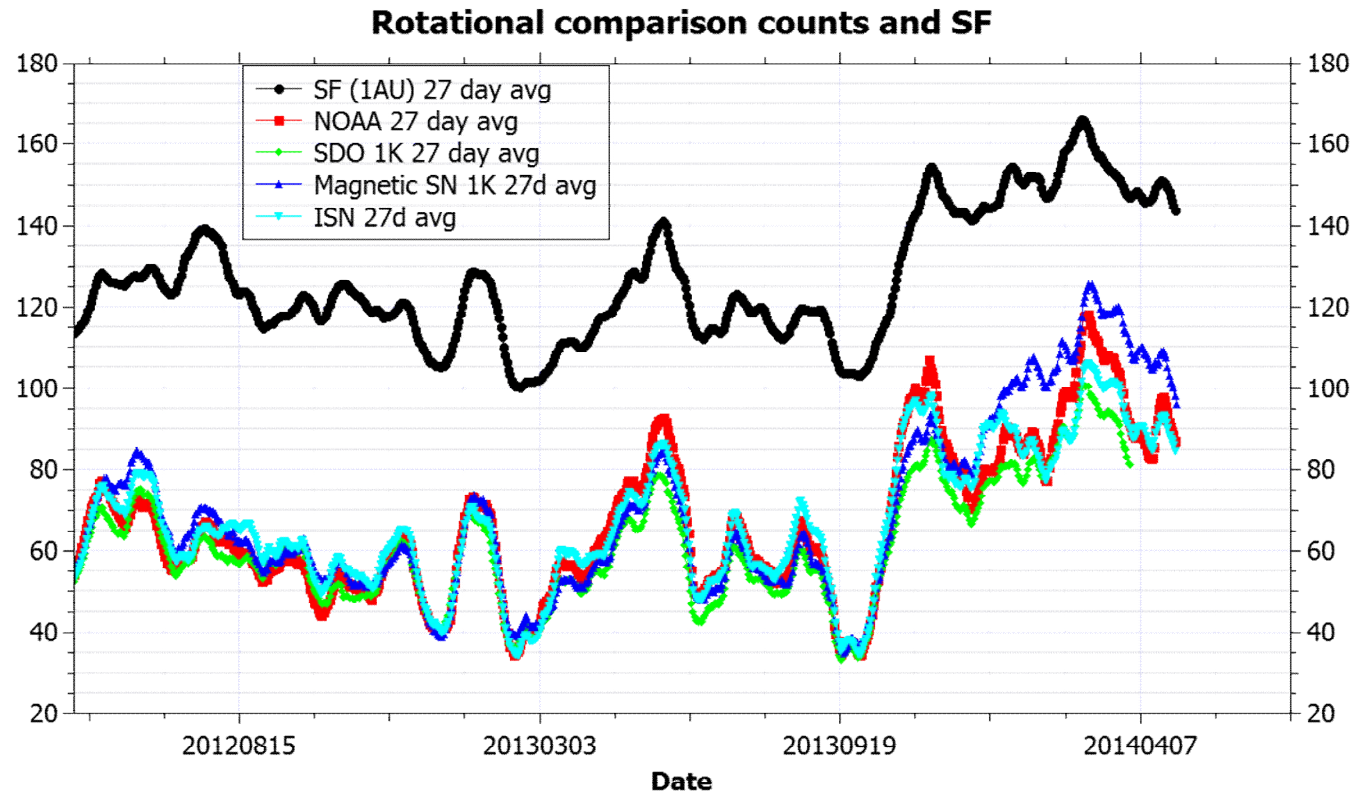
Impossible to tell if interpretation is correct using only SDO HMIIF image



The only problem with the Locarno interpretation is that group 155 is two groups (same polarity spots).

- Minor non-splitting problem, still better than several other observers. NOAA reported only 3 ARs in the same area later the same day, with 155/S3406 becoming AR 12059 2-3 days later when the spot was pushed into the southern hemisphere

Addendum 2: Does it matter which count we use?



- Low sampled counts can be compared to high sampled counts on timescales of one solar rotation or more. Taking this into account counts are surprisingly similar during periods of low to moderate activity and only diverge when SF > 140