





# Release of a new Sunspot Number Practical and logistical issues

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### Outline

- New standards
- Versioning system
- Scientific supervision
- Maintenance of a Group Number series
- Archival of original data
- Communicating the new results (E. Cliver)

### New Standards: the 0.6 Wolfer factor

- Past choice: applying the 0.6 factor to all post-Wolf observations.
- Original justifications ?
  - Wolfer's respect for his boss R.Wolf
  - Balance in favor of the largest part of the series (> 140 years, before 1893)
  - Reluctance to (manually) multiply by 1/0.6 all R<sub>z</sub> values for 2 centuries

#### • Do we get rid of the 0.6 factor?

- Yes, because of obvious drawbacks:
  - Nowadays, R<sub>i</sub> values « abnormally » lower than all modern counts
  - Confusion, repeated requests, even mistrust

#### No, because of problems and risks:

- Confusion in the user community (well beyond solar physics)
- Uncontrolled impact on models and operational applications (space weather predictions: spaceflight, pipeline infrastructure, power grid)
  - Hardcoded SN import as solar activity input
  - Large number of users, wide range of domains: impossible to identify the possible «victims».

#### Overall consensus: 0.6 factor must be dropped

### New standards: Global reference scale

 The last 60 years include a ~20% excess due to the Zürich sunspot weighting.

 Do we keep the current scale or do we step back to the preweighting scale ?

- Yes, keeping the current scale because:
  - Avoids disturbance and confusion for users: recent SN-based proxies don't need to be changed.
  - NB: the above reason becomes pointless if the 0.6 factor is dropped.
- No, stepping back because:
  - The weighting deviates from the original standard definition of the Sunspot Number used for all numbers before 1947 (85% of entire sunspot record).
  - All sunspot observers contributing to the past and present sunspot network use the standard Wolf count.
- Overall consensus: reducing all values after 1947

### New standards: the 0-11 quantization

- Do we get rid of the jump from 0 to 11?
- Original justification:
  - Mimics the Zürich SN: Wolf number from a single station
  - NB: some discretization also up to SN=30
- Yes because:
  - Large artificial jump for low values
  - Poisson statistics valid for higher values is altered for low activity
  - Non-linear relation with other solar indices in the low range
  - Was not always applied by Zürich anyway
- No because different statistics a low SN:
  - Not applicable to past SNs: Zürich period 1893-1980 and any past period when a multi-station average is not possible.

#### Conclusion:

- In favor of eliminating the jump
- However, a study must be done about the impact (can be done using the new SN recalculation software at SILSO

### New standards: modifications to the method

- K coefficients = biased estimator
  - Indications of a bias?
  - Problem: k coefficients have been used for all past values since Wolf
- Continuous daily production of SN (no more monthly processing) :
  - Possible with new software and database
  - Values in near-real time (NB: currently, EISN: Estimated SN)
  - Problems:
    - Determination of k coefficients requires a time averaging and implies a (constant) time lag.
    - Published values can change at random times up to 12 months after the date: confusion for users, non-matching versions used in different analyses
- Must be compatible with two constraints:
  - Applicable both to the present SN and to the historical values
  - Applicable to current data (no data available for all days after the last elapsed day)
- Conclusion:
  - WDC-SILSO will work on a new version of the software allowing a continuous daily calculation, as new data are assimilated (an extended cross-validation phase will be required with classical monthly calculation)
  - WDC-WILSO will work on the calculation of rotational means (Carrington rotation) next to the current monthly means

### New Standards: a new symbol « S »

- Why a new symbol ?:
  - Currently, multiple symbols: R<sub>i</sub>, R<sub>z</sub>
  - R for « relative »:
    - Relative only in the sense of a synthetic index (no physical unit)
    - R does not evoke anything about the underlying solar nature of the index
  - Need to mark the transition to a fully revised index (+ 0.6 factor ?)

#### • Do we adopt a new symbol for the SN ?

- A new unique symbol: Possible options:
  - Base letter « S »: evokes directly « Sun », « sunspot »
  - One (subscript) index: avoids confusion with other S symbols (e.g. enthropy)
  - Possible index options:
    - « T »: for total (allows N and S for hemispheric indices)
    - « R »: for relative (keeping the original Wolf's idea)
    - « i »: for international (equivalent to the current R<sub>i</sub>)
    - « 1 ... 2 ... 3», version number
- Consensus on S symbol but not clear agreement on the subscript index
- The use of a new name « Wolf number » was suggested, but this raised objections (confusion between individual observation and global index, « sunspot number » much more widely used)

### **Versioning system**

- A future version-tracking will be necessary:
  - Some corrections not yet fully determined or still debated
  - Recovery of new historical data (early SN)
  - Optimization of the statistical methods (mainly recent SN)
- Implementation:
  - Version number: Single number N? N.n ? Date or year? Current = 0 or 1 ?
  - For each version:
    - README file: description of modifications relative to previous version
      - Affected time interval, correction factor, offset, etc.
      - Type of correction, rationale (diagnostic of inhomogeneity)
      - Other?
    - Ancillary data:
      - Numerical values used for the correction (if function of time)
      - Base original data
      - Reference to a scientific paper
      - Other?
- Distribution:
  - SILSO Web site :
    - Main data page: always latest version
    - Archive of past versions: series + README + ancillary data
  - + full mirroring at NGDC ? Or only latest version ?
- Overall consensus on the versioning system and documentation
- Version number = year of release (used in archive but not as index to the S symbol)

### **Scientific supervision**

- Need for an approval scheme for future updates of the SSN:
  - Approval of corrections introduced by WDC-SILSO
  - Suggestions of new corrections to WDC-SILSO
  - Suggestion of new products: data presentation, quality control

#### Advisory Committee:

- 5 to 10 members, « light » organisation
- Specialists in long-term indices, scientific users of the SN series
- Sessions: mostly by e-mail, occasional direct meetings

#### Endorsement by scientific Unions:

- Role: Nomination of Committee members, report approval
- ICSU-WDS: overall coordination of World Data Center
- IAU:
  - Originally, main parent Union (founding of the SIDC Brussels)
  - WG on « Solar synoptic observations »
- URSI, IUGG
- Others?
- **IAU resolution:** official endorsement of a new version of the SN
- Overall agreement on an IAU-endorsed Advisory Committee
- The necessary steps will be taken, first contacting the IAU authorities.
- This will be implemented in the framework of the IAU Working Group on « Solar synsoptic Observations » created recently (A. Pevtsov)

### **Maintenance of a Group Number series**

- Justification:
  - Original H&S series stops in 1998 (never extended)
  - Early period (< 1750) does not allow to derive reliable sunspot counts</li>
  - Evidence for a different underlying information about solar activity in the SN and GN (Dudok de Wit, Tlatov & Nagovitsyn, Friedli)
- Problem: continued co-existence of two parallel "sunspot" series:
  - Risk of confusion: which one is the right one or best one?
  - Version updates may not be synchronized with SN series
- How do we implement ?
  - Parallel production with Ri, starting in 1981, using the same method as SN
  - Before 1981, revised H&S series:
    - Cross-calibration over 1981-1998
  - Group counts without a 12.08 factor? (values clearly different from SN)
  - Documenting the SN-GN distinction:
    - README file: describing the differences between SN-GN and the (known) reasons of the time variations of the SN/GN ratio
    - Bibliography: relevant papers on the subject
  - Probably released by early 2015

### **Archival of original data**

- Need to make the original data at the base of the SN determination available in a central repository.
- Two kinds of data:
  - 1. Tables of counts (compiled files) and publications directly related to the SN production:
    - E.g. successive versions of Wolf's SN numbers, key texts describing methods and changes
  - WDC SILSO, ROB, Brussels
    - 2. Digitized copies of original reports, written/printed tables, sunspot drawings
    - HASO, Univ. De Extremadura, Merida (http://haso.unex.es/)
- Call to the SN workshop contributors: we need
  - Data sets assembled for your analyses
  - Base numbers used for published plots

### **Communicating the new results**

#### Institutional Web sites:

- SILSO Web site
- Other sites?
  - ICSU-WDS (https://www.icsu-wds.org/)
  - NOAA/NGDC (http://www.ngdc.noaa.gov/)
  - ESA SW portal (http://www.esa-spaceweather.net/)
- Publications: special journal issue cf. E.Cliver
  - How to reach communities outside solar physics?
    - Magazines: EOS, Space Weather Journal, Nature Climate Change, ...

#### Press release ?

- National Level
- International level (through which agency?)

#### General outreach:

- Generic & amateur astronomy (Web sites, mailing lists):
  - Sky & Telescope, astrosurf
- Other channels:
  - Wikipedia page
  - Tweeter, social networks

#### • When ?

### For keeping track of future progresses



WDC – SILSO Sunspot Index and Long-term Solar Observations

### New dedicated Sunspot Number Web site: http://sidc.be/silso



## SSN Workshop wiki *(incl. all PDF presentations)* http://ssnworkshop.wikia.com/wiki/Home