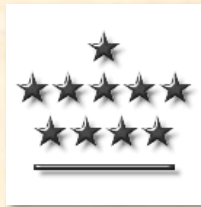# R_A versus R_i: a tell-tale comparison

Frédéric Clette

SIDC – WDS "Sunspot Index"
*Royal Observatory of Belgium*

R_A: the closest equivalent to R_i

- Most solar activity indices or irradiances include a chromospheric or coronal component:
    - Different underlying physical and emission processes
    - Non-linear relations
    - Time delays

➡️ ***Too different to provide a full validation***

- Multiple equivalences in the American sunspot number:
    - Visual sunspot count (Wolf formula)
    - Network of multiple stations (amateur-size instruments)
    - Statistical processing
    - *NB: Few common stations with the SIDC network (<~ 15%)*

- But different processing method:
    - True "floating" network average (K coefficients relative to network average)
    - **No pilot station**

R$_A$- R$_i$ differences over 6 decades (daily values)

- Dispersion: 10 to 5% rms outside cycle minima
- Main deviations:
  - Early period 1945 – 1970 (up to 35%): flaws in the processing method
  - Large "glitch" in August 1998: transition to a new corrected processing ?
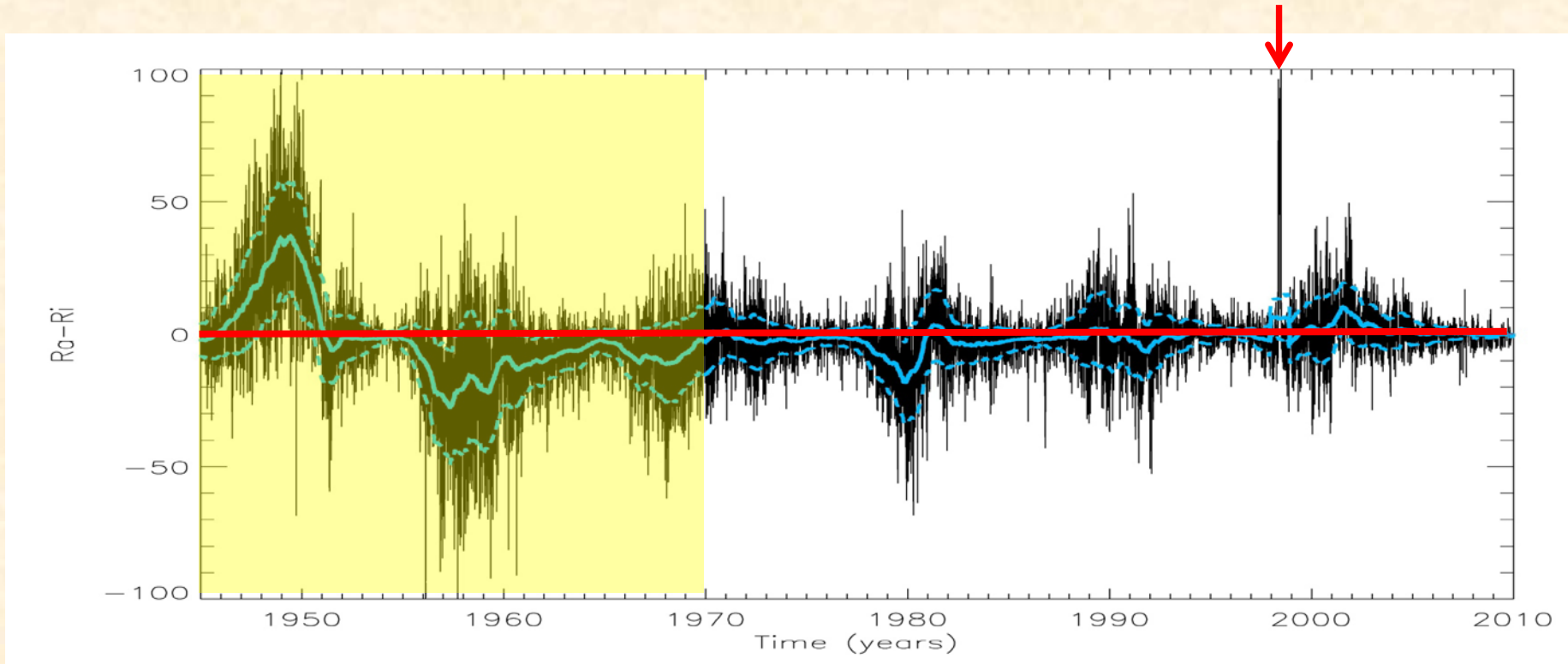
An essential step: the processing method

- Focus on the observations (subjectivity, etc.) and the network

- **Critical aspects in the American number R_A (AAVSO)**:
  - No reference station, manual processing, additional observer rating factor

- Flaws in the processing method: found after 50 years

- Original data lost before 1992 ⟹ No backward correction possible

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The Golden rules

1. **Archival of all raw input data**

2. **Detailed documentation of the processing method and definitions and of the observing technique**

3. **Tracking of processing changes**

4. **Change only when it is essential (e.g. discovery of a flaw)**

5. **Long overlap periods:**
   old and new indices computed in parallel (min. one solar cycle)

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R_i/R_A ratio over 6 decades (monthly averages)
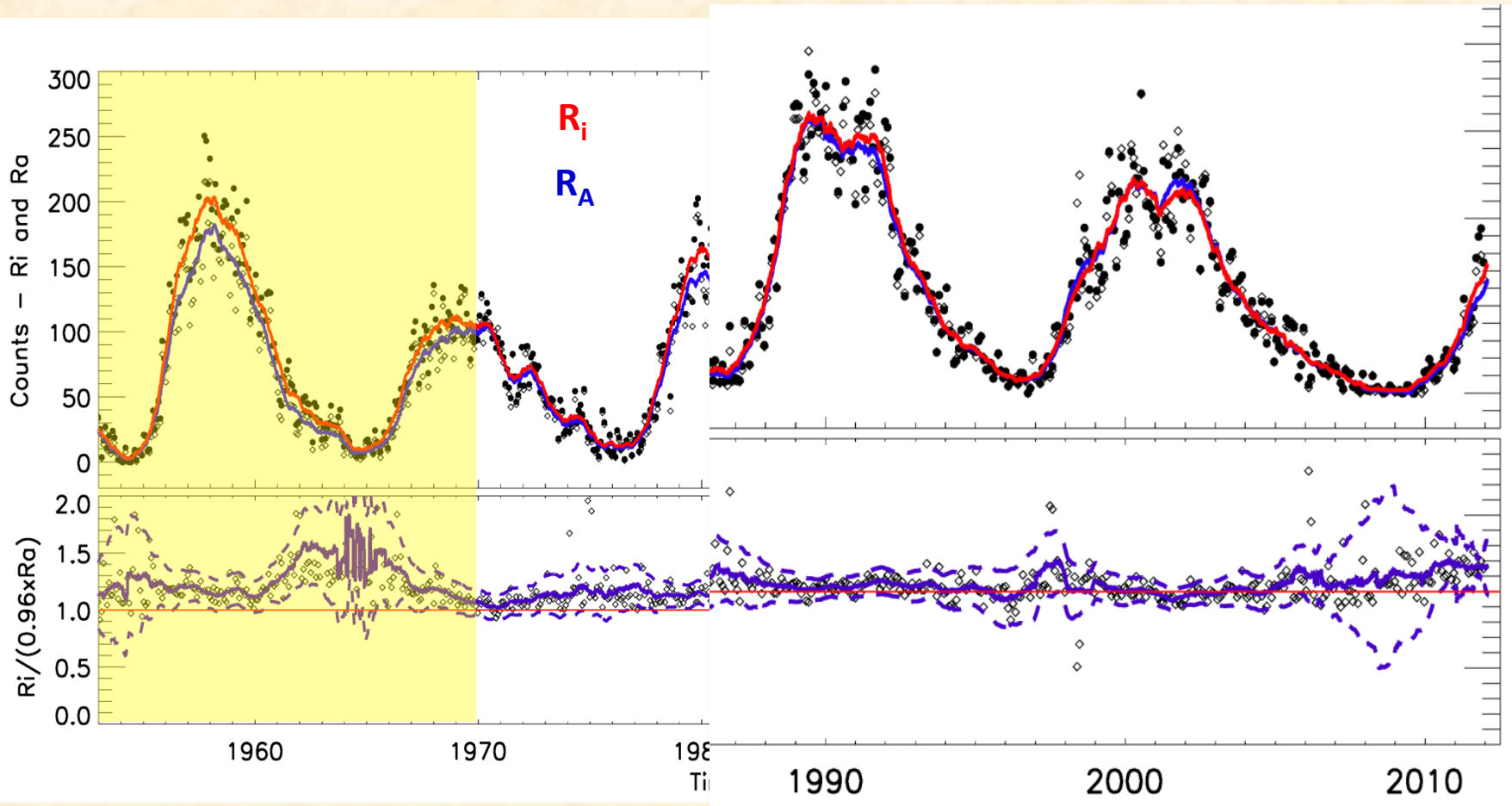
- Average ratio R_i/R_A close to 1: $R_i/R_A = 0.96$ over cycles 22 & 23
- **No significant deviation over the entire declining phase of cycle 23.**

Conclusion

- Two largely equivalent and independent series
- The 70-year long comparison shows:
  - A tight match, in particular over the last 30 years
  - **The absence of any significant long-term trend**
  - **No deviation during cycle 23** (declining phase, after 2000)
- The future: importance of continuing the R_A series
  - R_A is gaining value as the length of the series increases
  - Increases the mutual robustness of the R_i and R_A indices by providing an independent reference.
- New exchanges of know-how since 2010:
  - Comparison of methods and practices (no cross-contamination!)
  - Exchanges of data management tools (data import, database, quality control) for modernizing the production of the index.