

Validation/Reconstruction of the Sunspot Number Record, 1841-2007

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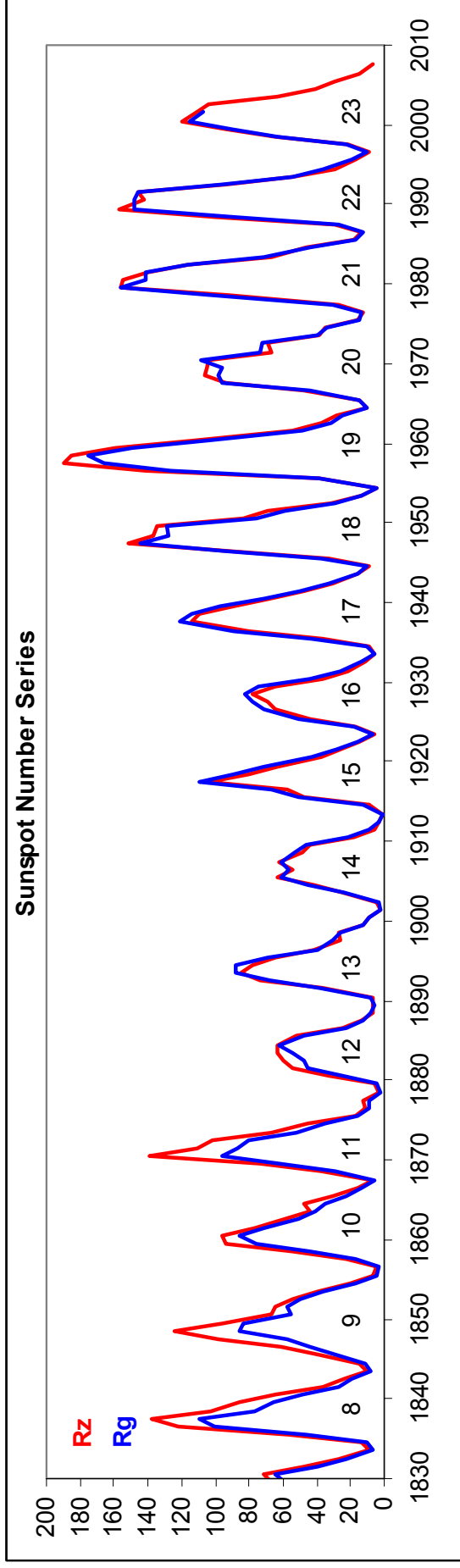
Sunspot Number (SSN) Applications

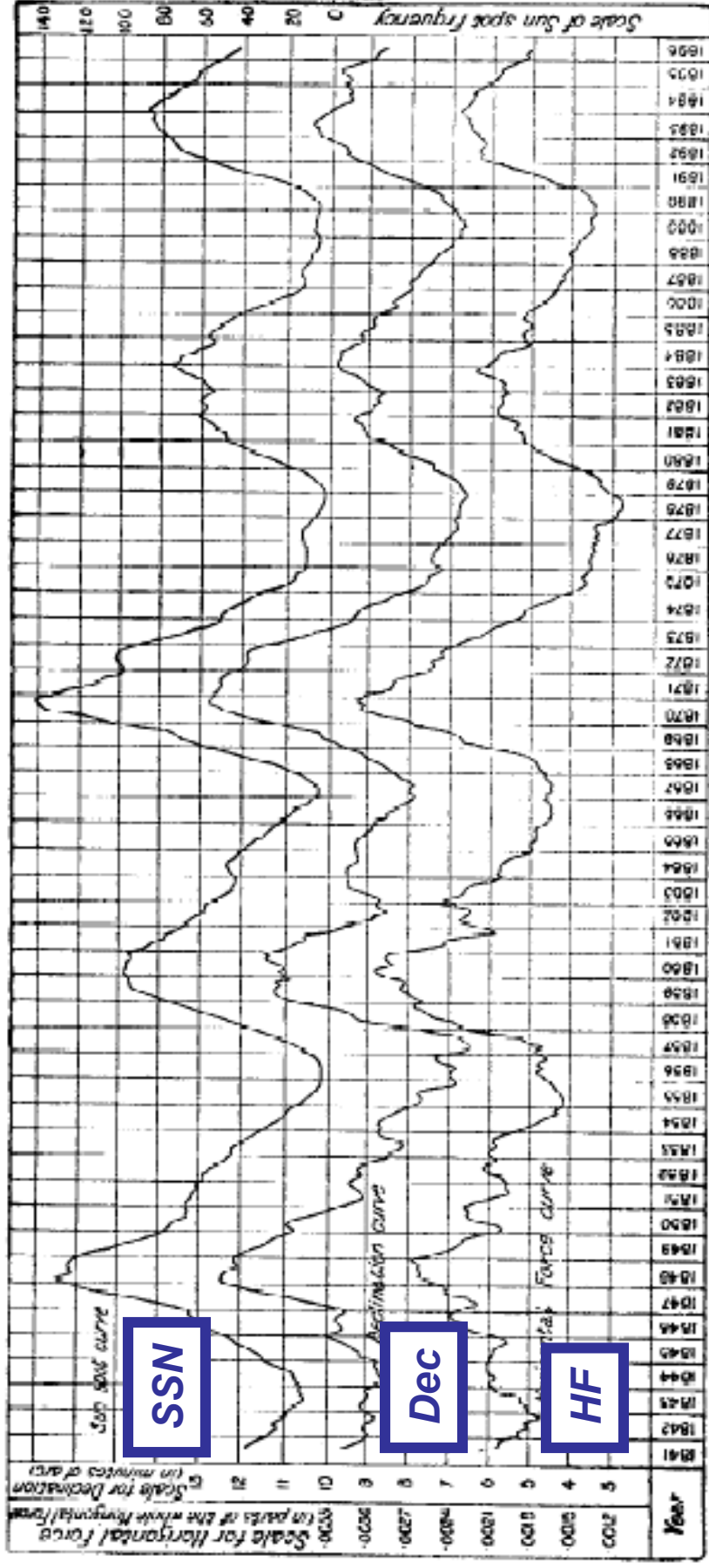
- Solar Dynamo
- Space Weather/Climate
- Cosmic Ray Modulation
- Climate Change

Two SSN Series

R_{INT} : 1700 - 2007 (SIDC/ROB)

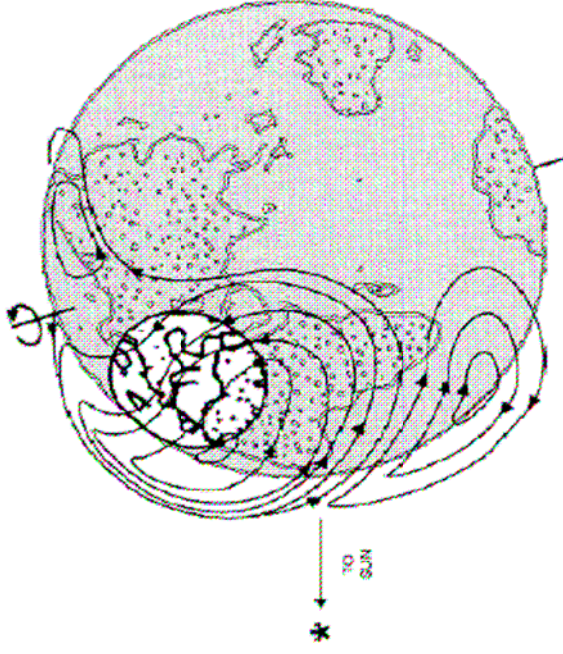
R_G : 1610 - 1995 (Hoyt & Schatten, 1998)



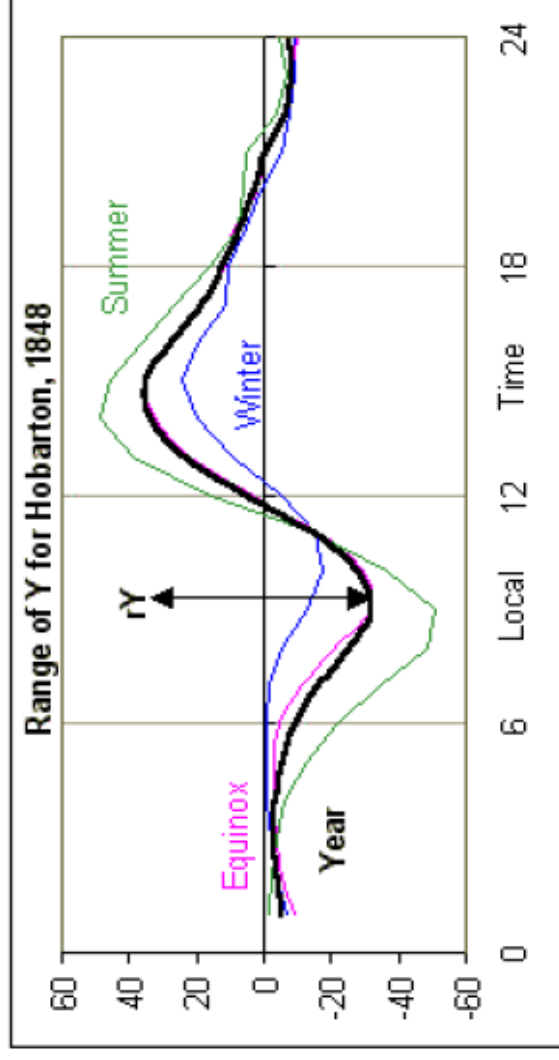


Ellis (1898)

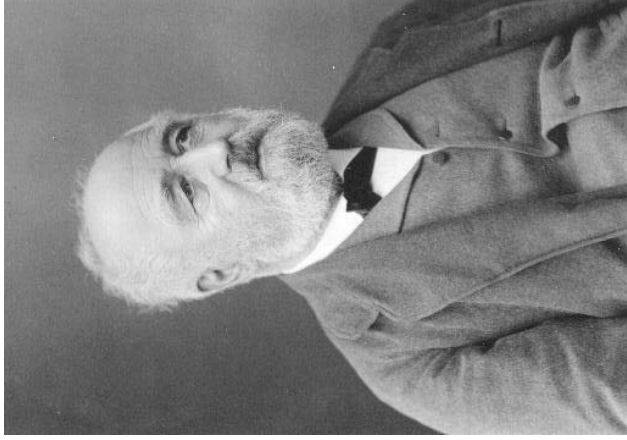
SSN correlated with daily range of geomagnetic elements



S_R Ionospheric Current System (Torta et al., 1997)



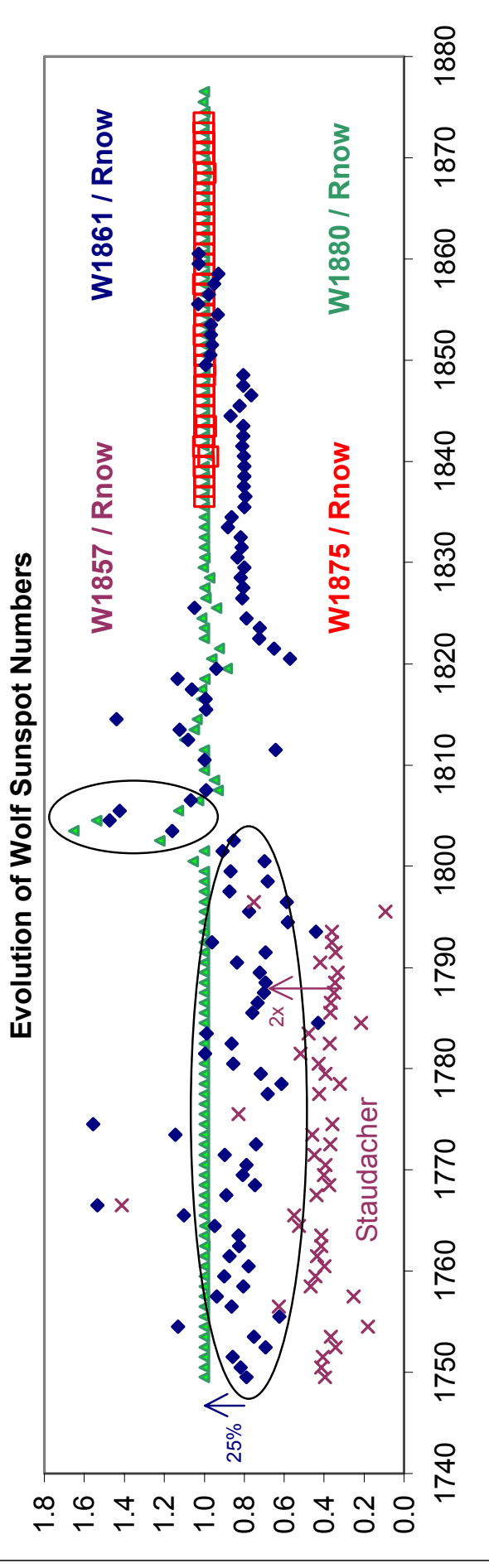
S_R at Hobart (1848)



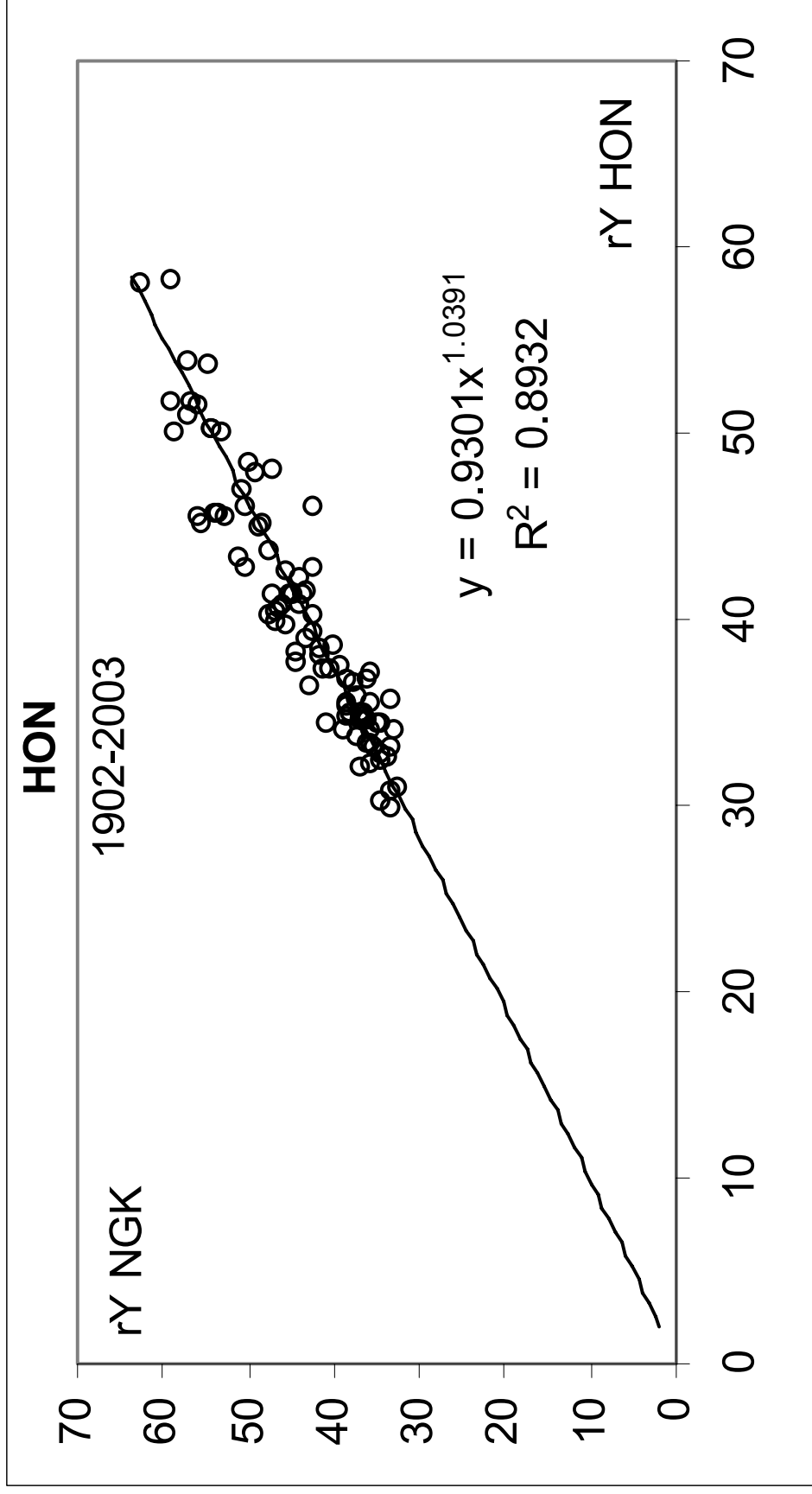
Rudolf Wolf

Wolf (1875) used the SSN-daily range relationship to adjust the SSN for years before 1848

$$rD = a + b R_2$$

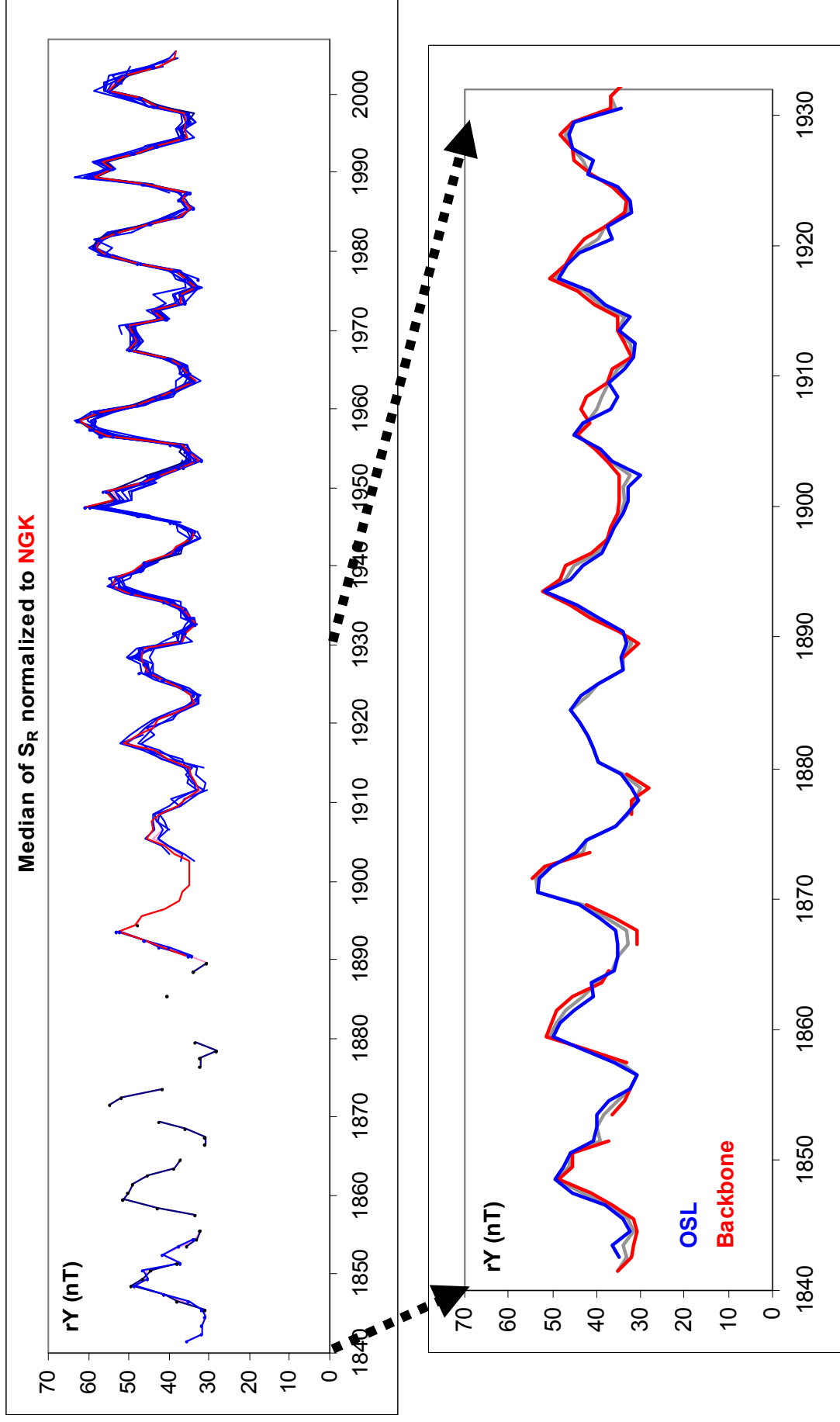


Step 1



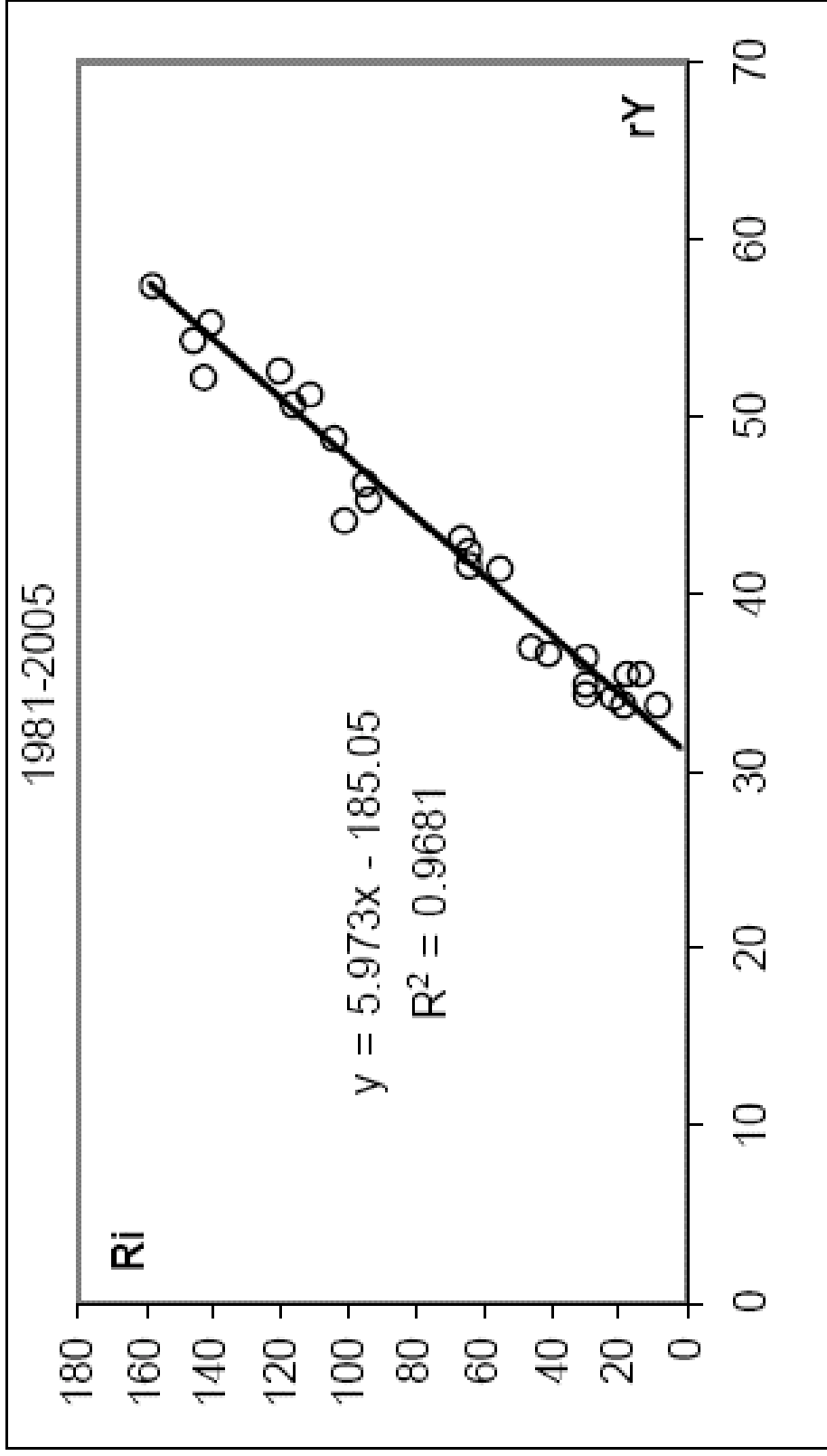
Show that over extended periods of time (decades, centuries) constant, stable relationships exist between rY at stations such as Niemegek and Honolulu that are widely separated in longitude and latitude.

Step 2



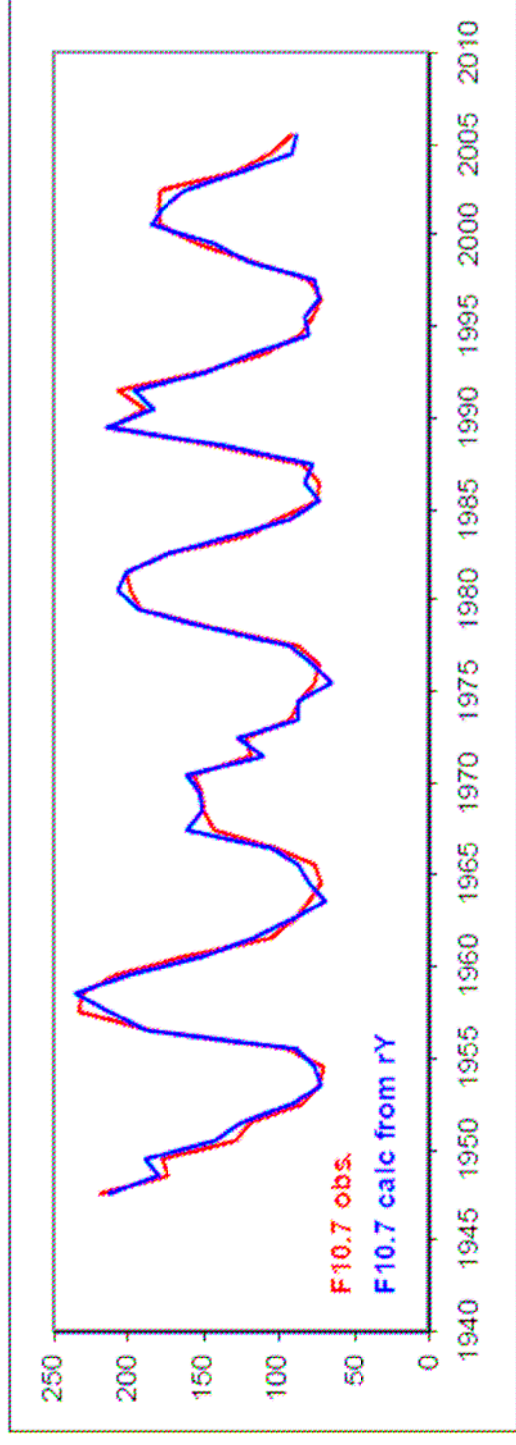
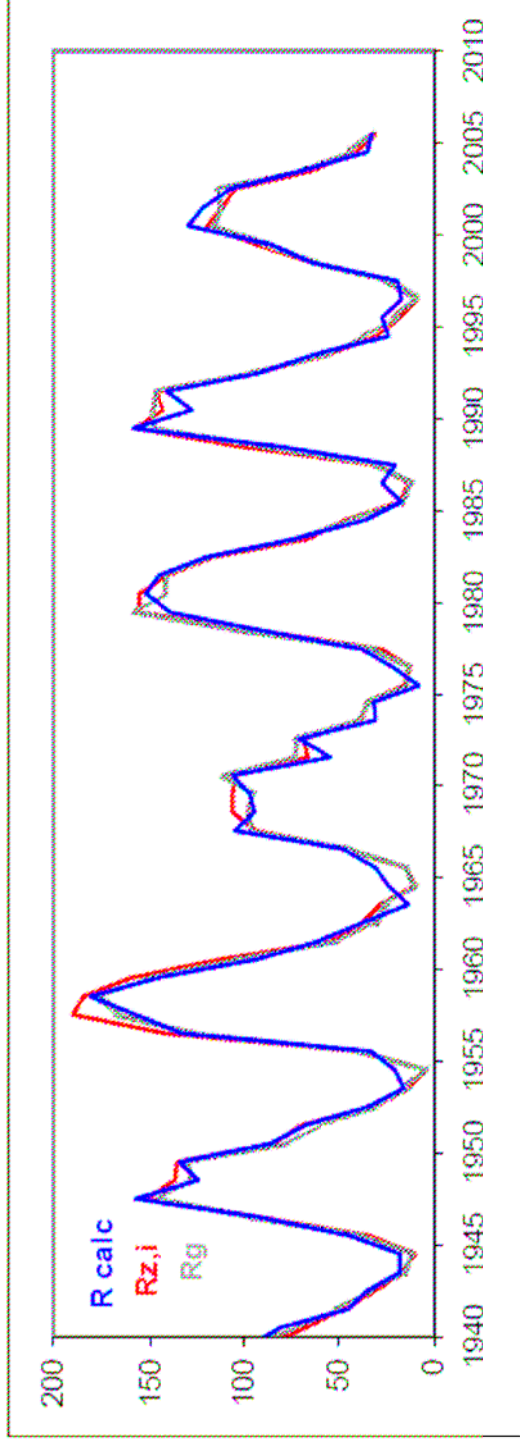
Link together observations of the regular variation observed at long-term stations (normalizing to Niemegek and using Oslo to bridge the gaps for early years) to obtain the variation of S_R since 1840

Step 3



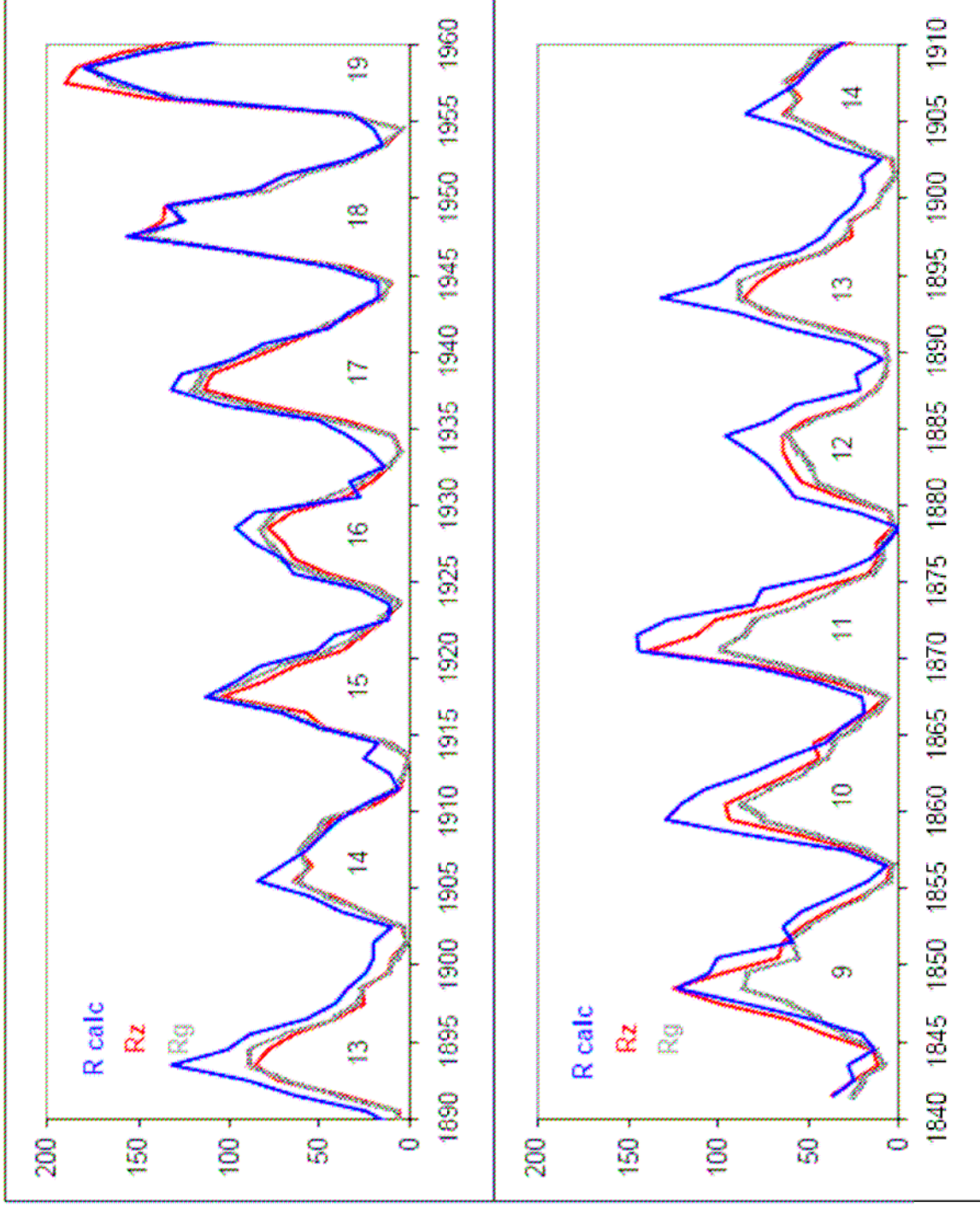
Relate average rY to R_{INT} (& $F_{10.7}$)

Step 3 (continued)



The daily range rY is highly correlated with R_{INT} & $F_{10.7}$ at all phases of the sunspot cycle

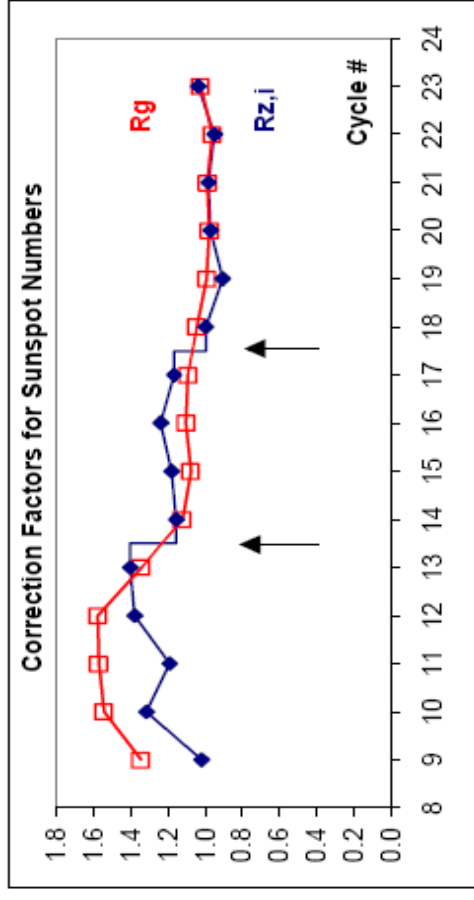
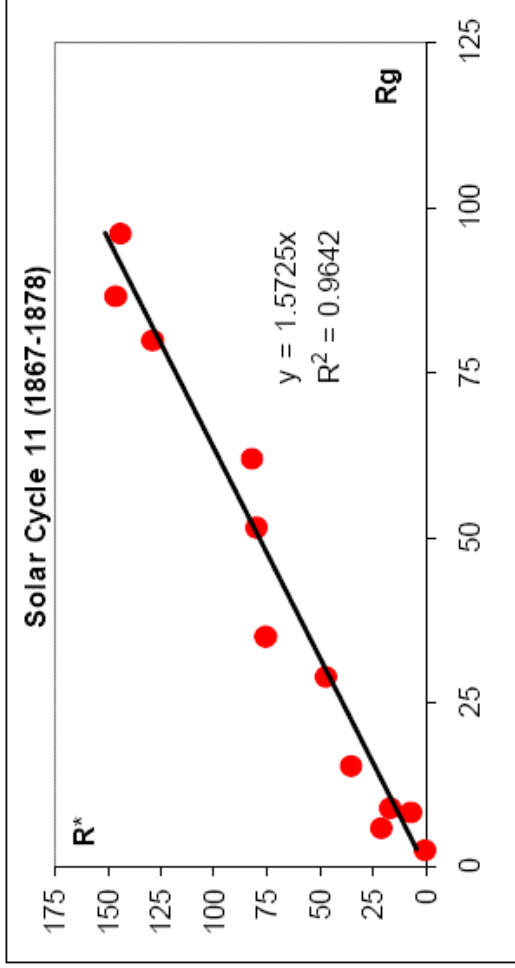
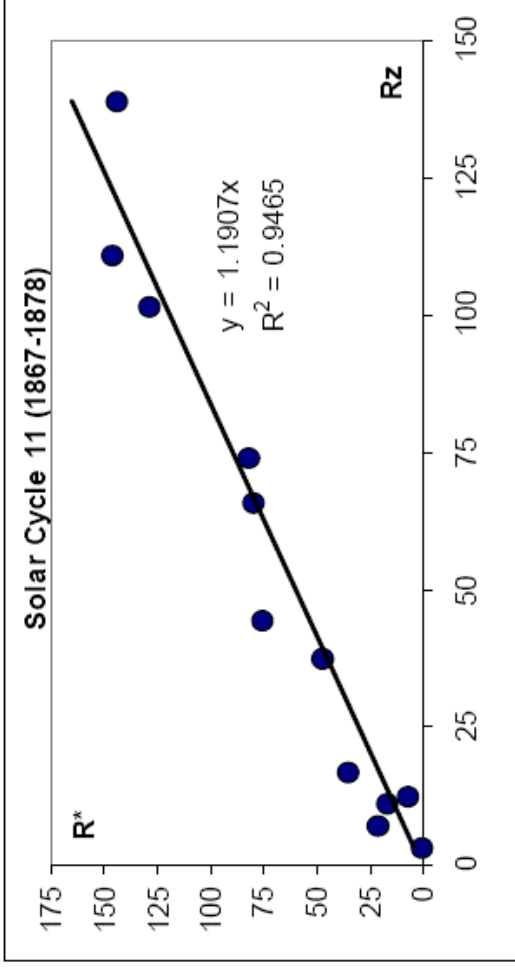
Step 4



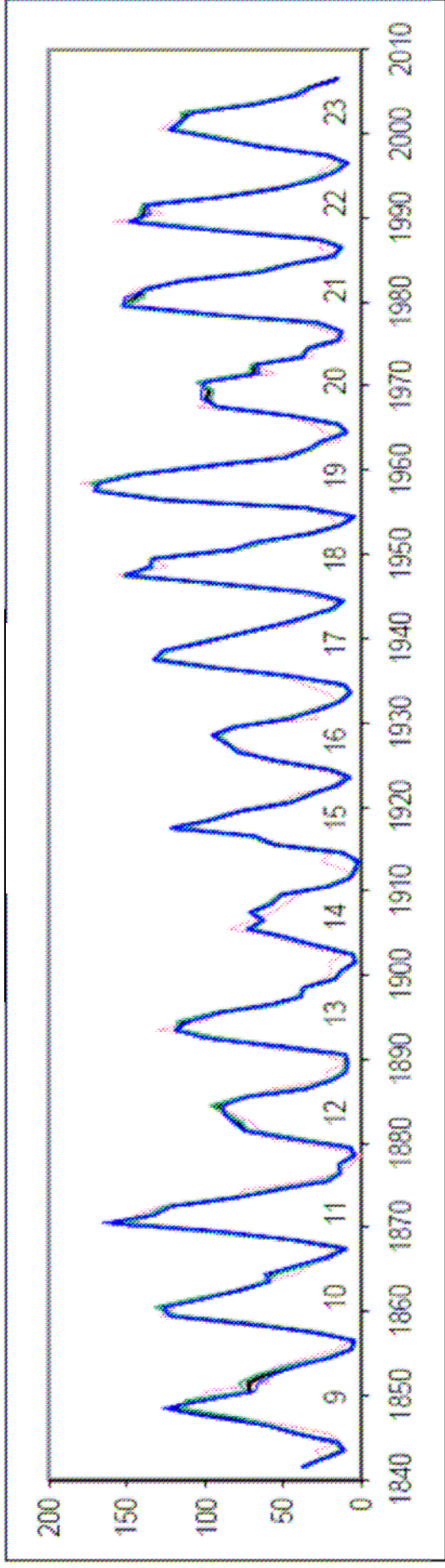
Use the R_{INT} vs. rY relationship to obtain a new SSN series back to 1840

Step 5

Cycle	Rg	Rz
9	1.347	1.020
10	1.545	1.317
11	1.572	1.191
12	1.580	1.379
13	1.343	1.403
14	1.121	1.156
15	1.075	1.180
16	1.103	1.238
17	1.093	1.166
18	1.046	0.996
19	0.991	0.905
20	0.978	0.970
21	0.986	0.982
22	0.961	0.948
23	1.026	1.036



Obtain correction factors for each cycle for the International and Group SSN series



Provisional SSN Series:
Cycles 10 & 11 comparable to 22 & 23

Work in Progress

- Strengthen 1840-present series
- Extend before 1840
- Determine causes of jumps in 1893 & 1945
- Determine effect of Earth's decreasing dipole (~10% since 1840)