

A Calibration of POES Hemispheric Power Index and its Strong Linear Relation to the *IHV* Geomagnetic Activity Index

Leif Svalgaard, ETK

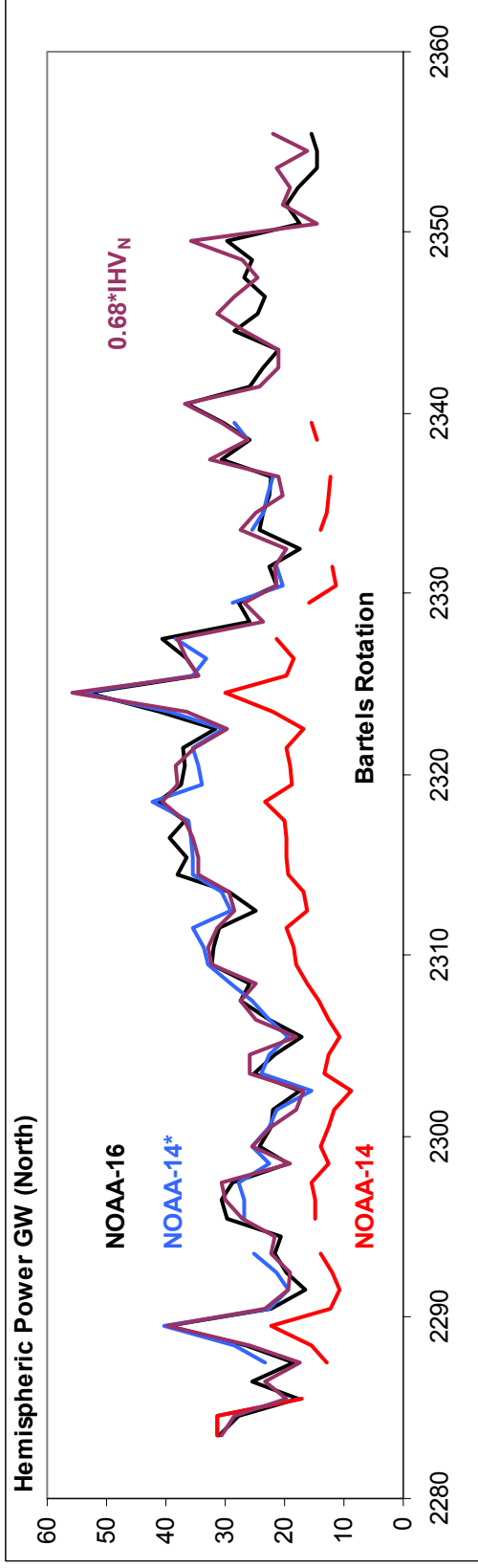
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A newly-defined geomagnetic activity index, the Inter-Hourly Variability Index (*IHV*), has been found to have a very high correlation ($R=0.93$ for monthly means) with the NOAA/POES Hemispheric Power Index (*Hp*) that provides an estimated power in gigawatts deposited in the polar regions by energetic particles during transits over the poles by the NOAA POES satellites. The relationship is strong enough to allow us to intercalibrate the many POES satellites. Each satellite (n) has its own scale factor, $F(n)$, between *Hp* and *IHV* from various instrumental causes. Because *IHV* has a very stable long-term calibration (being derived from dozens of ground-based observatories) we can use *IHV* to provide a stable calibration for *Hp* as well. We calculate for each POES satellite the ratio between F for the satellite and F for a suitably chosen reference satellite. The ratio between these two F -

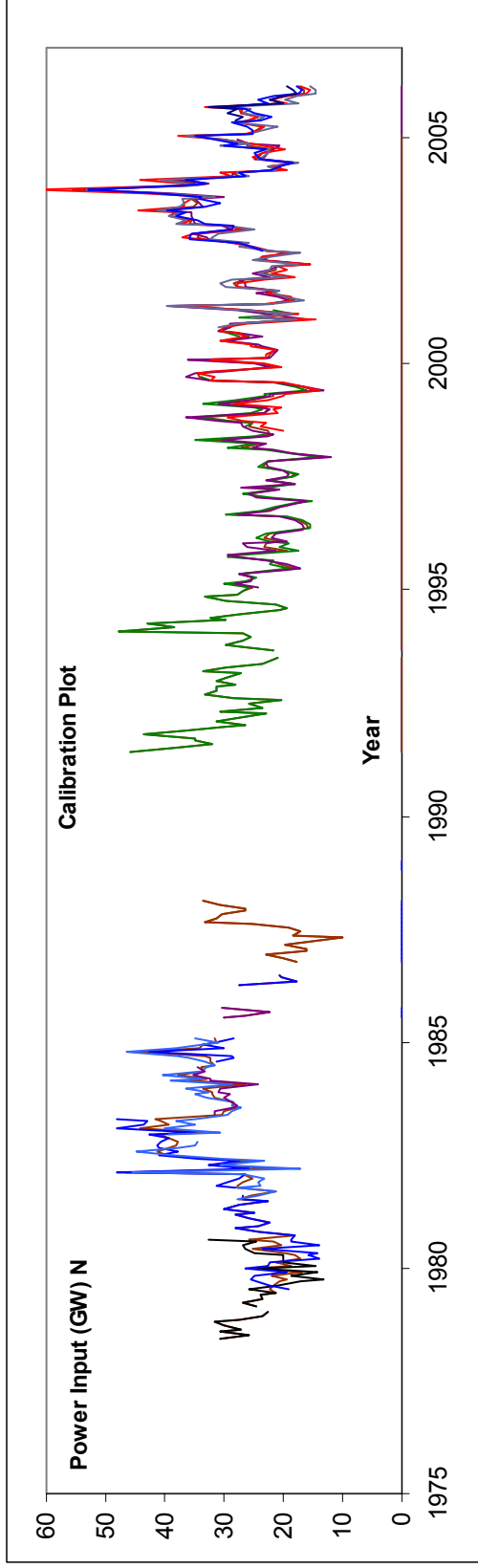
values is the calibration factor to reduce satellite n to the reference. If we use NOAA-16 as reference satellite, we find Hp (GW) = 0.68 IHV with correlation coefficient 0.93. This is for the Northern Hemisphere. A similar result holds for the Southern Hemisphere. This relationship holds back to the beginning of the Hp -series in 1978. We do not see any reason why it should not hold prior to that. Since IHV is available back to 1883, we have inferred Hp back to 1883 as well. IHV can be calculated in near real-time. The IHV index is also a good proxy ($R = 0.96$) for interplanetary parameters (magnetic field B nT and solar wind speed $V_o = V / (100 \text{ km/s})$): $B V_o^2 = 4.34$ ($IHV - 6.2$) for monthly means and $B V_o^2 = 4.60$ ($IHV - 8.7$) for yearly means. It follows that Hp is similarly controlled by $B V_o^2$ as confirmed by direct comparison.

We analyze the POES Hp data as given at the website <http://www.sec.noaa.gov/pmap>.

We show below the 27-day (Bartels) rotation averages of Hp measured by NOAA-16 and compared to IHV (scaled by 0.68). They match closely. For other satellites a similar good match is obtained (e.g. as shown for NOAA-14), but each satellite has a different scale factor to IHV . The ratios between these scale factors are the calibration factor to bring a satellite on the NOAA-16 scale.



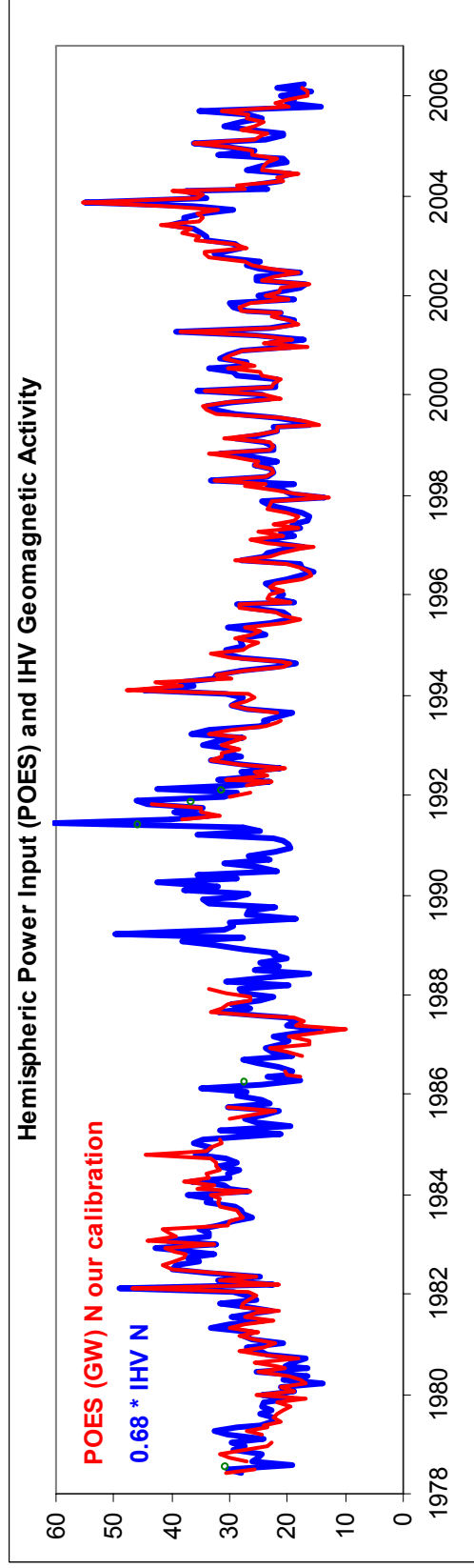
Here we show with different colors the result of normalizing all the satellites to NOAA-16:

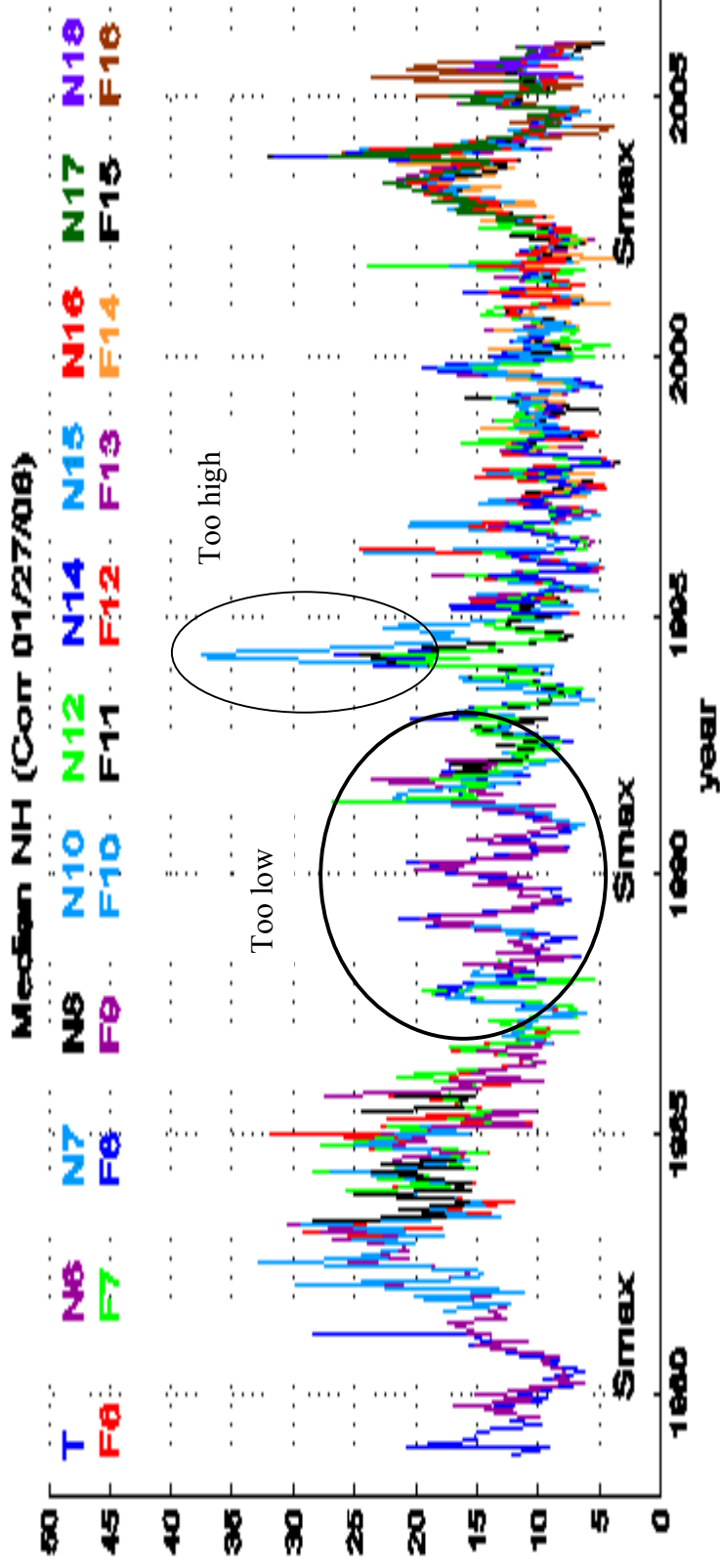


Northern Hemisphere	Scale
SAT	Factor
TIROS-6	1.456
NOAA-6	1.408
NOAA-7	1.292
NOAA-8	1.307
NOAA-10	1.706
NOAA-12	0.966
NOAA-14	1.336 < 1996.0
NOAA-14	0.766 1996.0-1998.5
NOAA-14	0.931 1998.5-2001.0
NOAA-14	1.786 > 2001.0
NOAA-15	0.853
NOAA-16	1.000
NOAA-17	0.955
NOAA-18	1.118

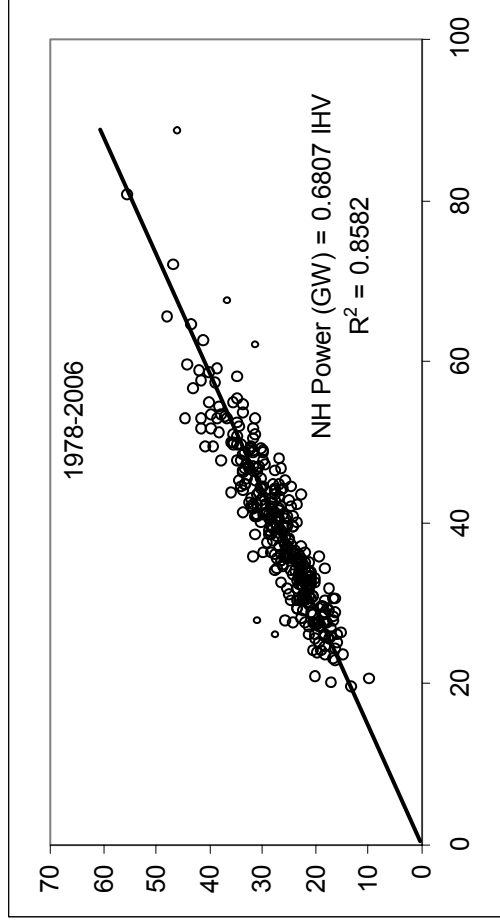
Scale factors to reduce a satellite to NOAA-16.
For NOAA-14 the calibration changes over time
as shown.

Using the intercalibrated satellite measurements we
construct a composite time series of *Hp* POES and
compare it with *IHV*:





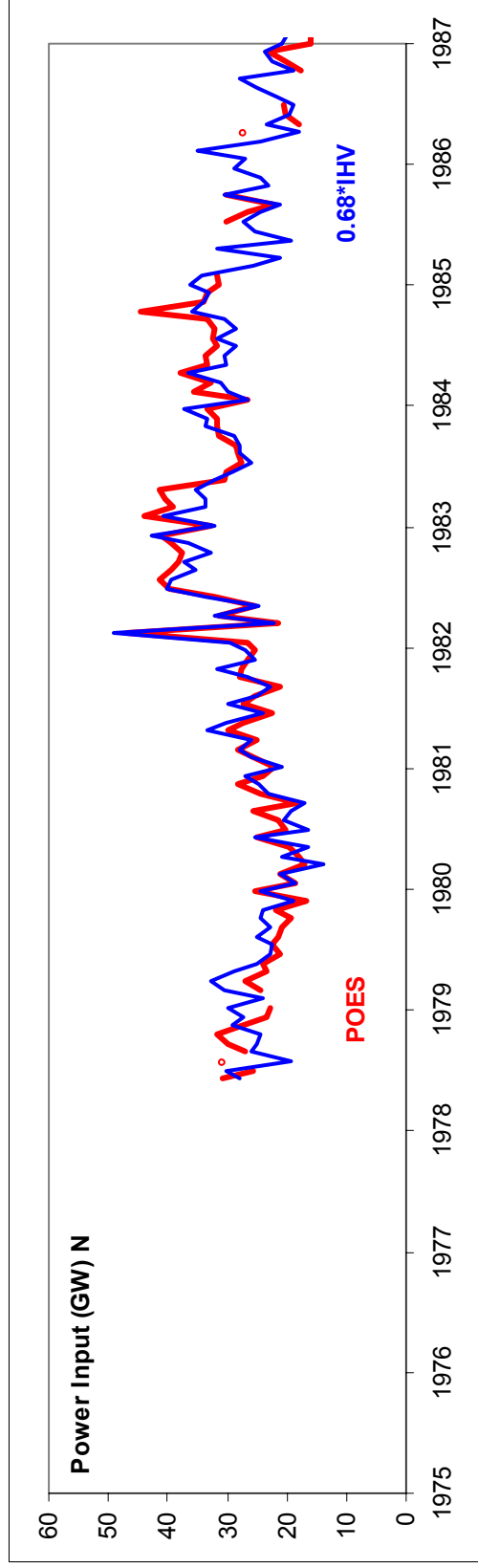
Shamelessly taken from Barbara Emery's upcoming paper on the POES calibration. There are significant differences apart from the general level being different by about a factor of two.

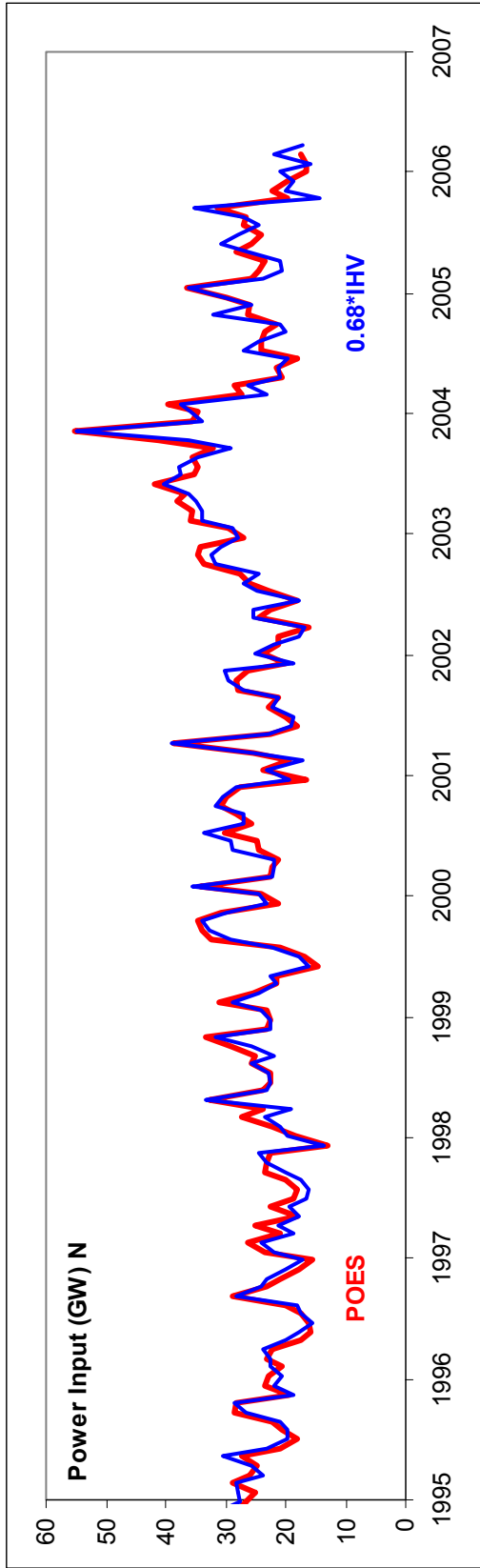
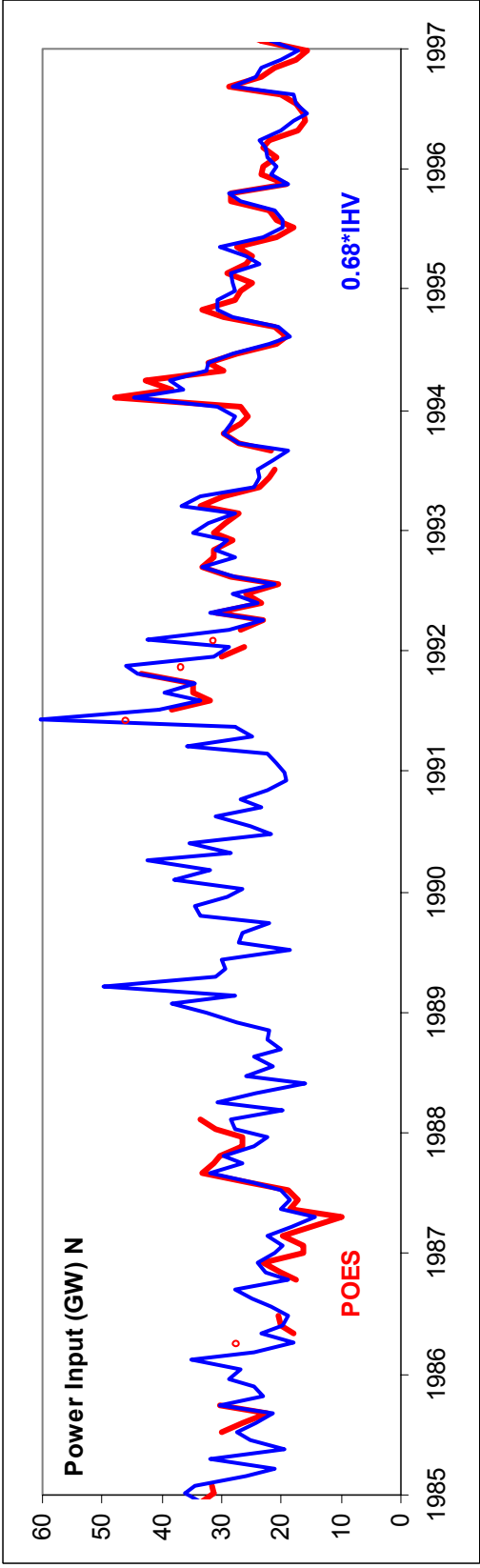


Correlation between rotation averages of POES *Hp* (N) and *IHV* for the Northern Hemisphere.

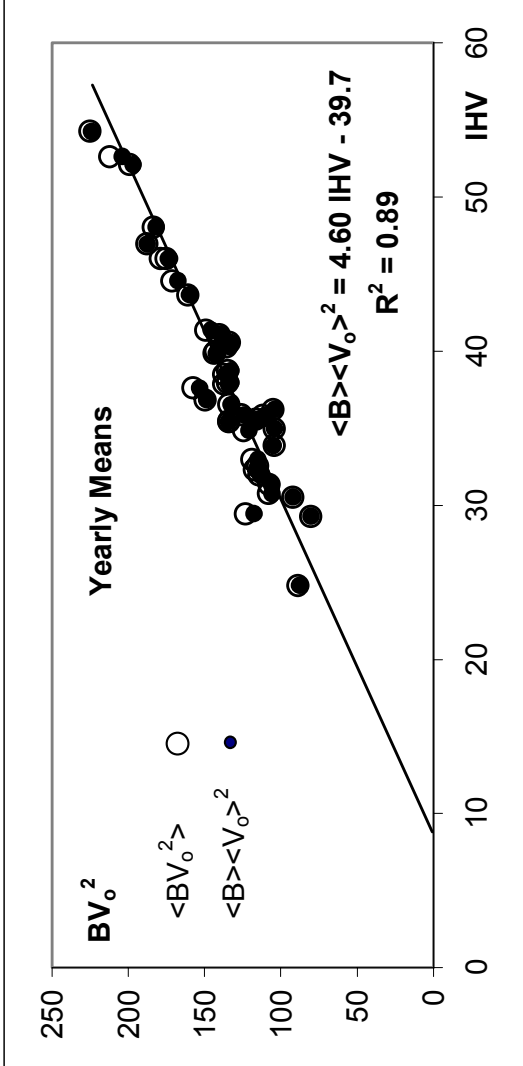
Very similar result for the Southern Hemisphere (no surprise as POES *Hp* is calibrated originally so that the South has the same mean as the North.

Detailed comparison between 27-day (Bartels) rotation averages of POES and *IHV* (both N):

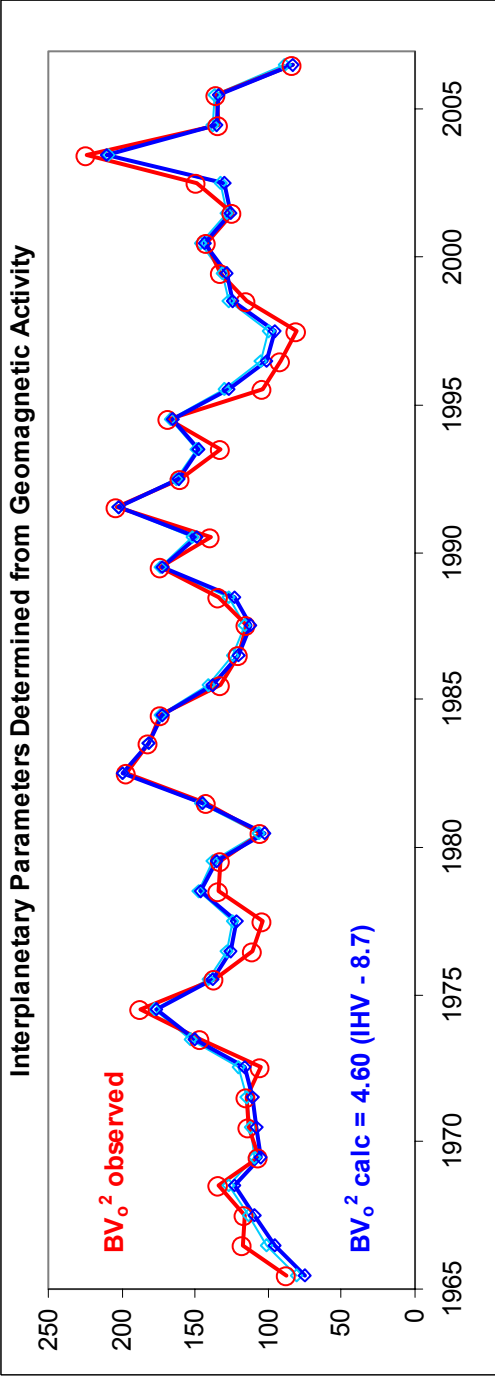


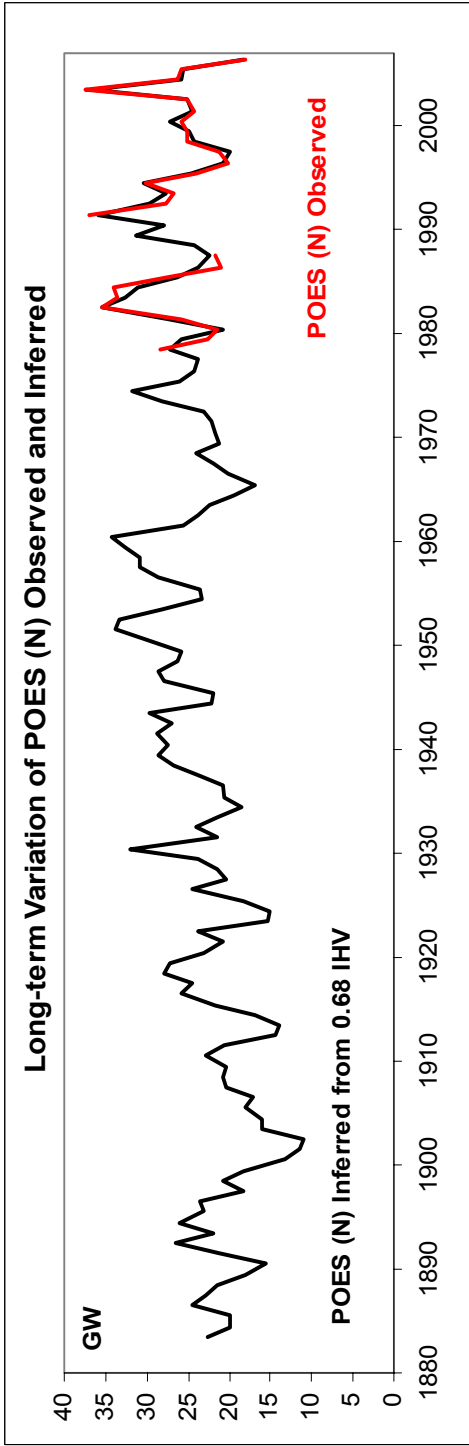


The correlation between yearly means of IHV and the product of IMF strength B (nT) and V square of solar wind speed V (actually $V_0 = V/100$ km/sec). It makes very little difference if BV_0^2 is calculated before averaging or from averages of B and V_0 .

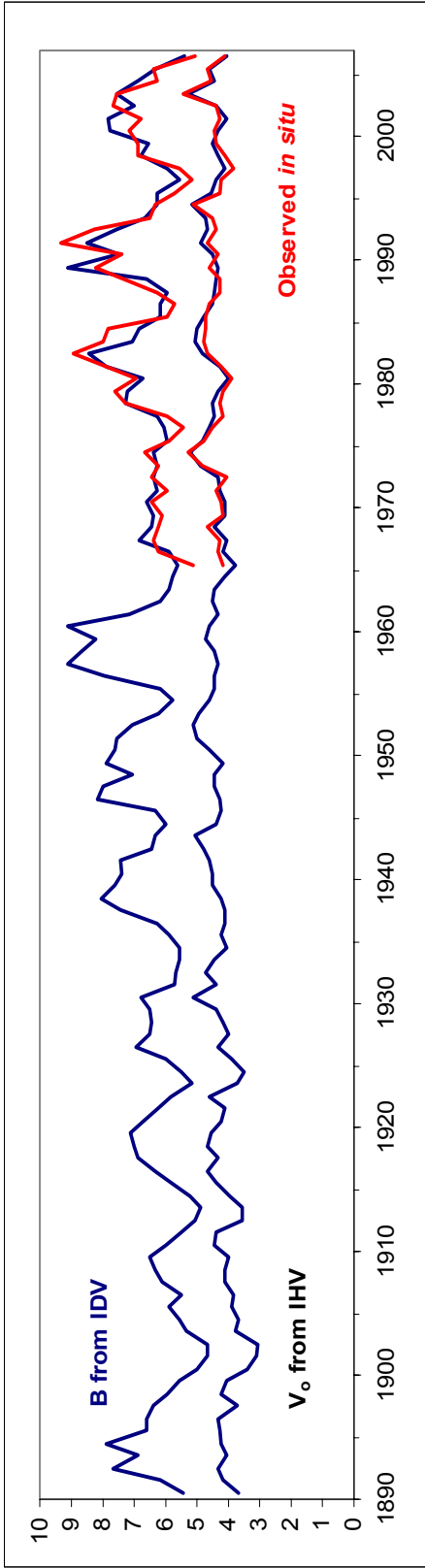


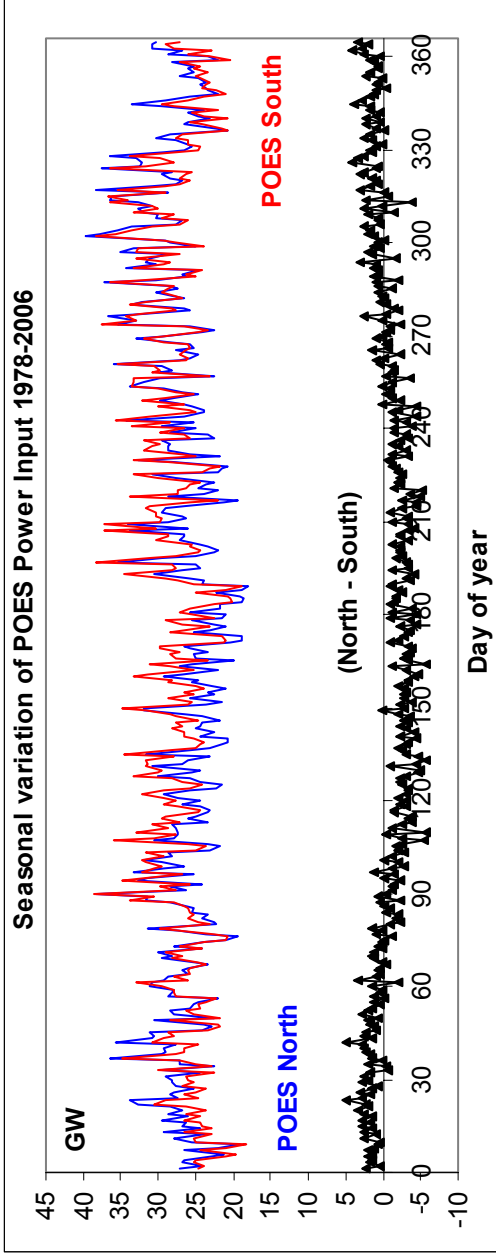
Time series graph of the above correlation. The IHV 22-year cycle is evident



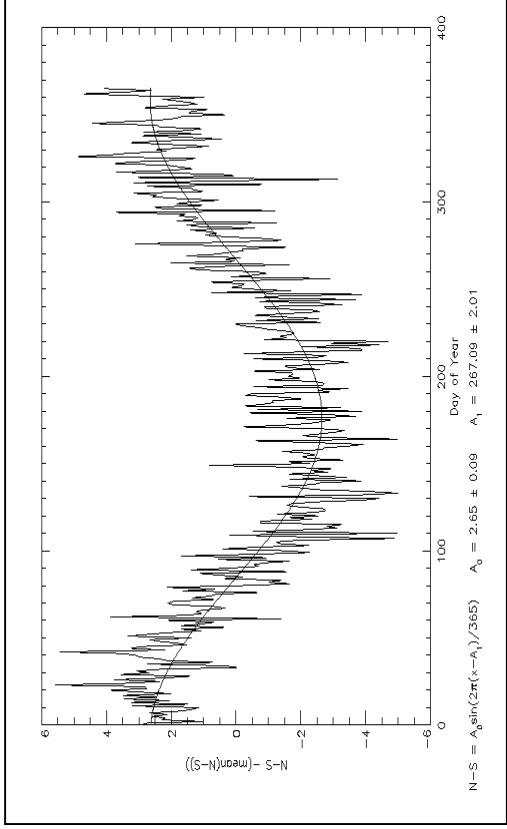


Since *IHV* is known back to 1883 we can reconstruct *POES Hp* back to then as well.
IHV gives BV_o^2 , but, actually, *B* and V_o are both known separately:





We confirm that there is a yearly variation of H_p , being larger in local *winter*. IHV also shows this curious fact.



The difference (North - South) of H_p POES (and of IHV) can be fitted to a sine wave that goes through zero within two days of the equinoxes. The cause of this ($\pm 10\%$) variation is unknown.