The Solar Microwave Flux and the Sunspot Number

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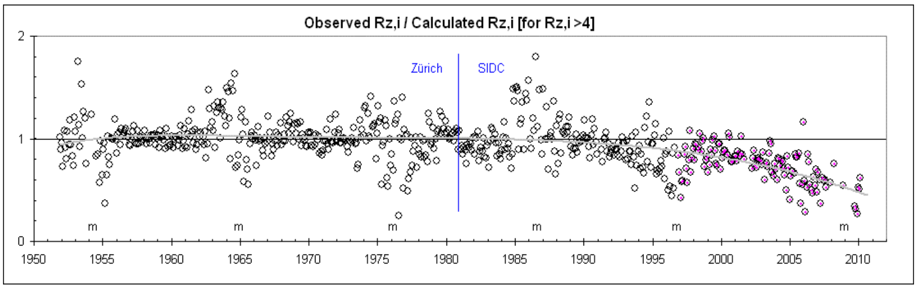
The time series of solar microwave flux traditionally is divided into a flare component, a slowly-varying component, and a base level. Since 1947 there have been routine radiometric measurements, and the non-flare F10.7 index (2.8 GHz) from Penticton has had broad usage. Systematic radiometry at other microwave frequencies (1.0, 2.0, 3.75, 9.4 GHz) have come from Toyokawa and Nobeyama since 1951; these and other programs continue to the present time, thus including the five most recent solar maxima. One can now ask how this measure of solar activity compares to other measures, in particular the sunspot number We correlate the sunspot number against the F10.7 flux for the interval 1951-1990, and obtain a purely formal polynomial fit [as the relationship is not quite linear]: The fit is good (R^2 = 0.977) up until ~1990.0 after which time the observed sunspot number falls progressively below the fitted number. To quantify the drift we divide the observed sunspot number by the fitted one. When the sunspot number is very low [near minimum, marked by *m*; worst case, zero] that quotient becomes very noisy or meaningless, so we plot only cases where the sunspot number was above 4:



It seems inescapable that the relation between the sunspot number and the microwave flux has changed significantly in recent years. Despite their differing nature and origins at different places in the Sun, these two indices are highly-correlated to the point where one can be used as a proxy for the other. However, during Solar Activity Cycle 23 we started to see a small but definite change in this relationship

The near constancy of the flux at minima since 1954 argues against a change of the physical conditions at the source locations, leaving the exciting possibility that Livingston & Penn may be correct that sunspots are becoming less visible leading to an undercount.