PMOD TSI: SOHO keyhole effect, and possible degradation over time

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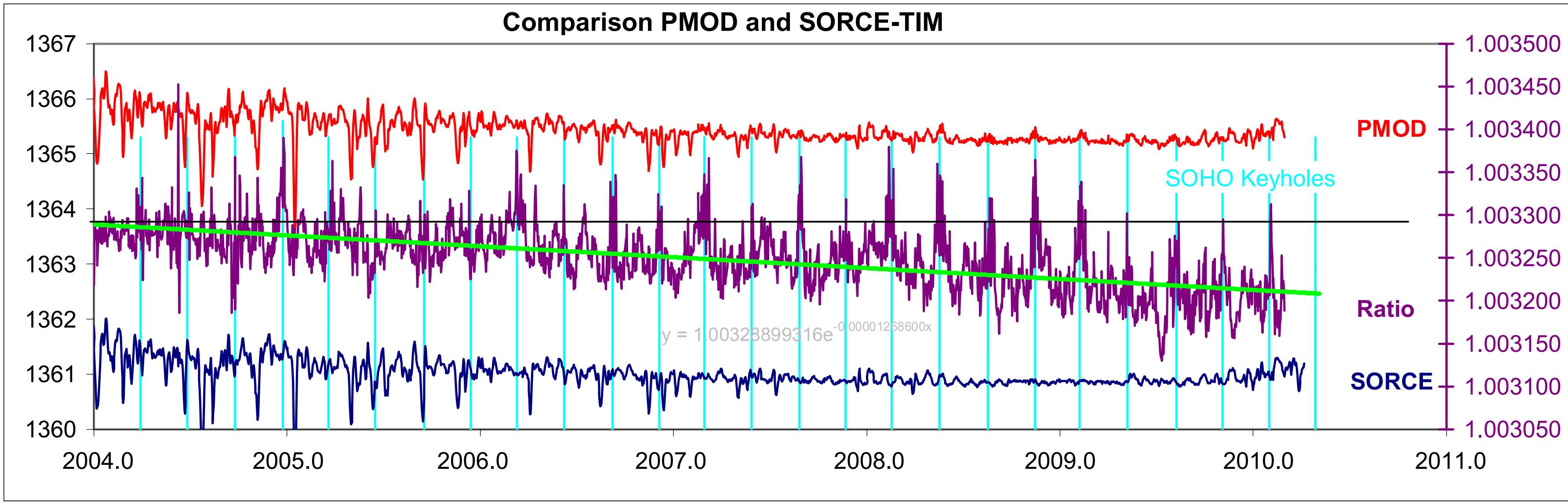
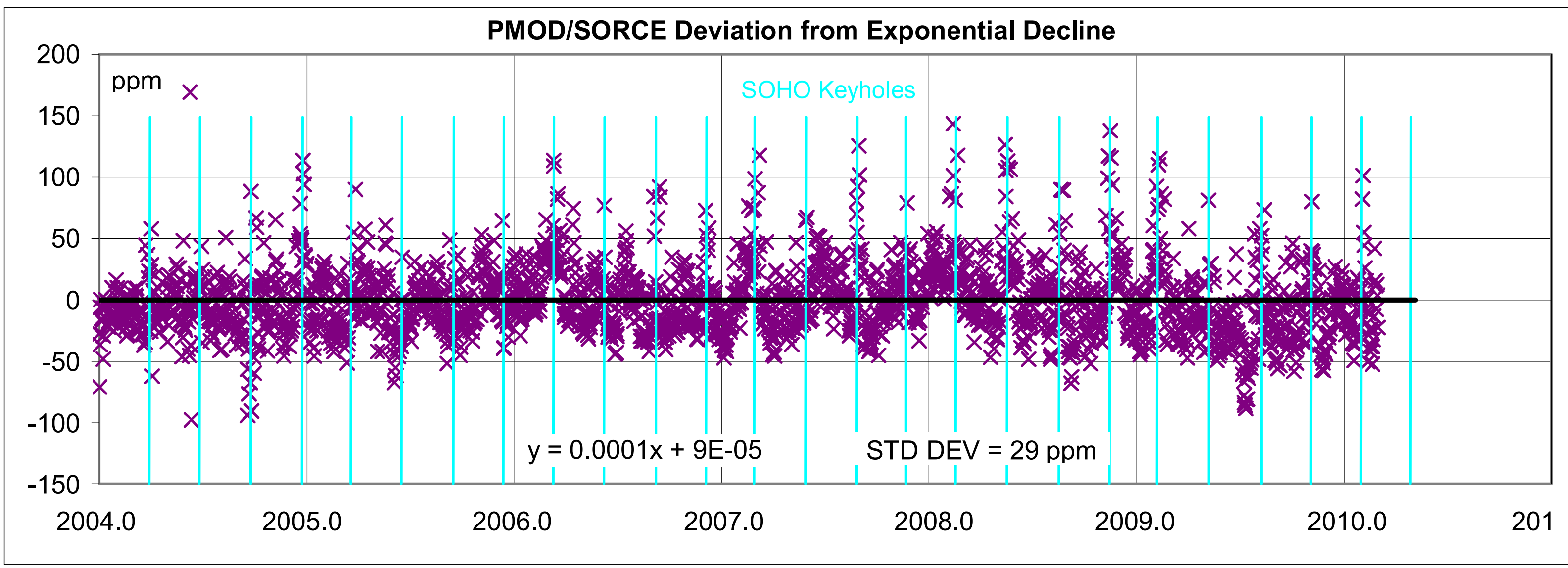
In an ideal world the ratio [or difference] between PMOD TSI and SORCE TIM TSI should be constant. This is not the case. The ratio PMOD/SORCE is slowly decreasing exponentially:



In addition, PMOD shows upwards ‘spikes’ on the order of 100 ppm at times when SOHO is in a keyhole indicating that some systematic errors are not corrected for or even identified.

The exponential decline could be instrument degradation [unless SORCE TIM has an unlikely ‘anti-degradation’, or the data reduction suffers from overcompensation of degradation].

The keyhole effect is especially clear when the data is plotted as single day values. Every keyhole has its associated spike without fail:



What’s a ‘keyhole’?

The term "keyhole", in antenna terminology, stems from a characteristic feature of aerial navigation maps showing the coverage of e.g. a radar antenna: A circular area near the antenna is shaded due to too-short range. In addition, any obstructions (hilltops, buildings) near the antenna will cause wedges to be shaded due to lack of coverage. Taken together, the appearance of the shaded area is often that of a keyhole. The term has since been generalized to refer to any area not covered by an antenna.

Sometime in 2003 the azimuth drive of the high gain antenna got stuck. The operations people were able to move to to a position which was ok for most of the halo orbit (+/-30 degree seen from Earth). But at the extremes it is not sufficient and we need bigger antennas from Deep Space network which helps, but these are not always available. So some data are lost, but not for GOLF, VIRGO and some of MDI which are stored in the on board memory during communication gaps with a new procedure giving high priority to these data producing data gaps for other experiments. As the antenna is locked at one azimuthal angle, SOHO is turned around its solar axis by 180 deg for the East or West legs of the orbit, respectively. So in this context the keyhole is when low emission in the antenna pattern close to extremes of the halo orbit are encountered.

Possible Degradation PMOD vs. SORCE

2010.25 since 2004.00 -0.080 W/m^2 Total

2010.25 since 1996.75 -0.172 W/m^2 Total

Which is about what is claimed that this minimum is smaller than the previous minimum

Perhaps it is premature to assert that there has been a secular decrease change in TSI over the past cycle …Or more conservatorily: “Sadly, this probably does mean we don't have good knowledge of how this current minimum relates to the prior one” [Greg Kopp].

Earlier Degradation Problem

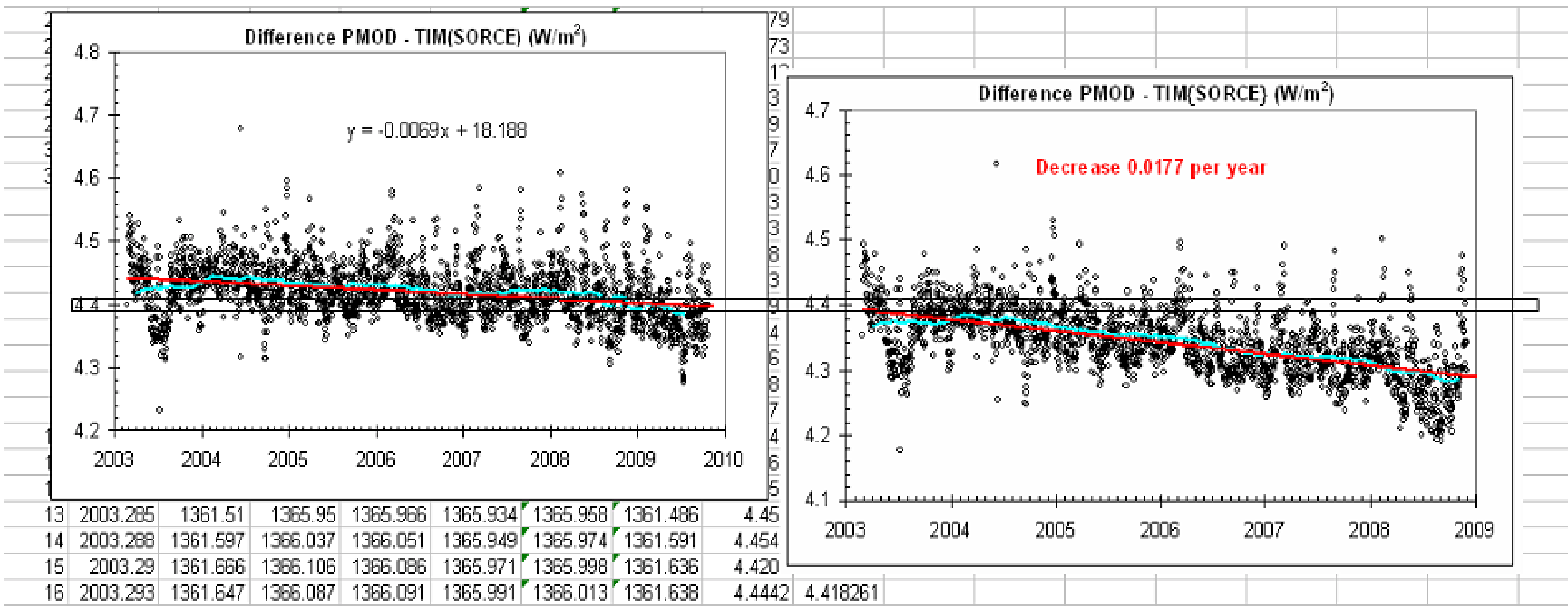


Figure to the right shows the TSI difference between PMOD [Fröhlich] and TIM on SORCE using the PMOD data file at the end of 2008, before I pointed out to Claus Fröhlich that the difference with SORCE was drifting by 0.18 W/m^2 per decade which in itself would explain most (0.21) of the 0.22 W/m^2 difference between the current minimum and the minimum in 1996, 12 years earlier. Claus went back over the calibration and found and corrected some of the problems. The new PMOD data file [left Figure] shows a much smaller drift [0.07 W/m^2 per decade], but still a drift, which seem to have reverted back to the larger value in 2009. I conclude that the claimed decline in TSI from last minimum to this minimum is probably not correct. One would expect a decline of 0.05 W/m^2 from the 1996 minimum because of a smaller residual sunspot number, but that is probably below the noise level.