GSM – Grand Solar Minimum. You really should do the Research!

CSS-29a

Climate Model TSI-AMO-CO_2 Solar Forecast

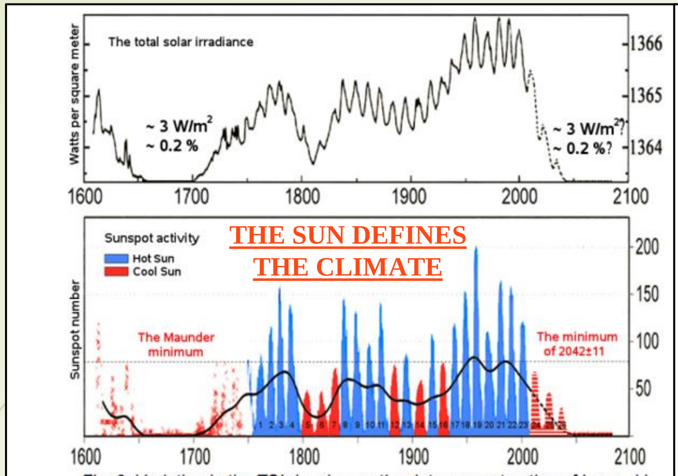
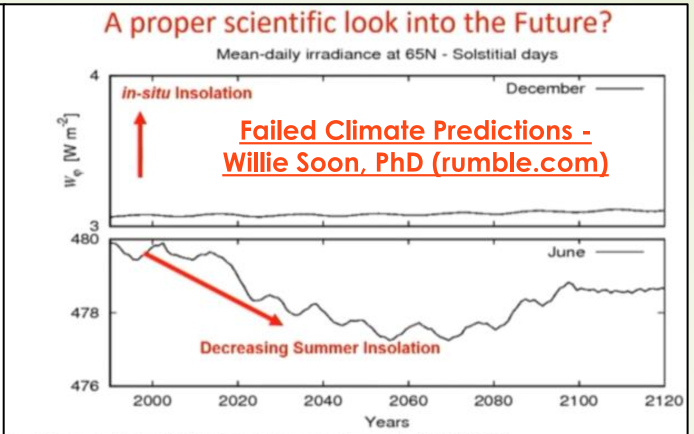
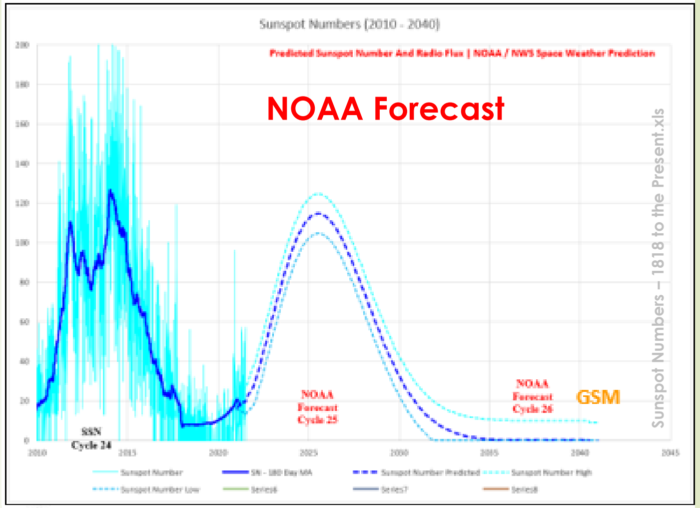
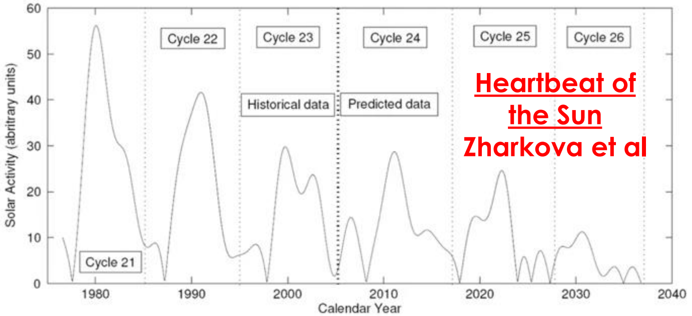


Fig. 3. Variation in the TSI drawing on the data reconstruction of Lean, J.L (2000) and Wang Y. - M., Lean J.L., Sheeley N.R. (2005) up to 1978, sunspot activity of the Sun from 1611, and changes forecast by us after 2008 (dotted lines).



1. Cionco and Soon (2017) Earth-Science Reviews, vol. 166, 206-222;
2. Cionco, et al. (2018) New Astronomy, vol. 58, 96-106
3. Cionco, Soon et al. (2020a) Advances in Space Research, vol. 66, 720-742
4. Cionco, Soon et al. (2020b) Advances in Space Research, vol. 66, 1992-2000
5. Cionco et al. (2021) Earth and Space Science, vol. 8, e2021EA001805

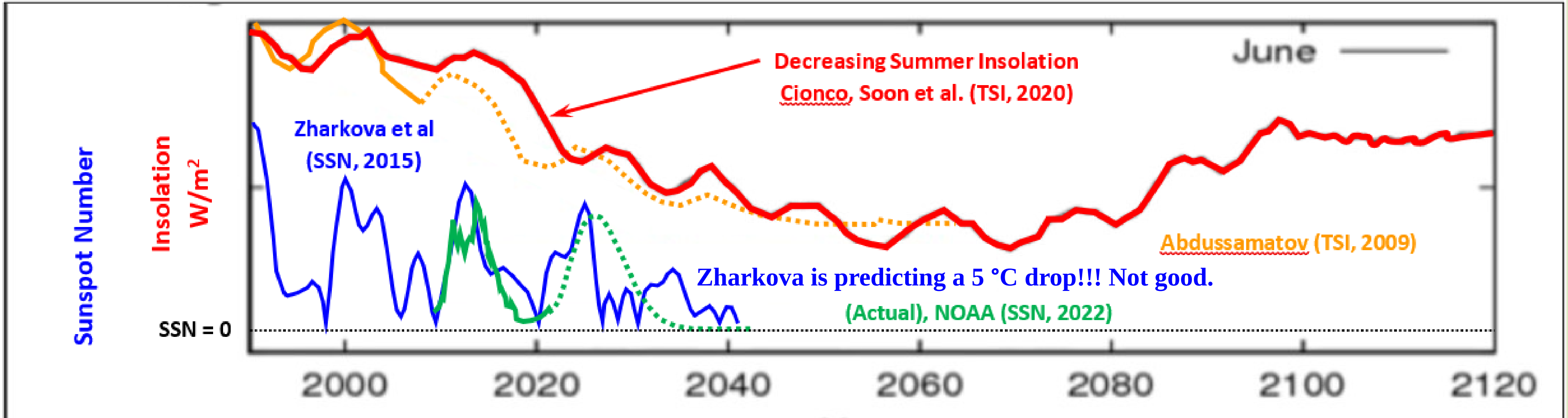




This post is an expansion of my "simple" climate model (introduced in my CSS-16 – Central England Temperature – Model post). No forecasting was done in my previous posts. This post takes a stab at forecasting. As before, I will focus on just the Total Solar Irradiance (TSI, as a proxy), the Atlantic Multi-decadal Oscillation (AMO) and CO_2. The AMO follows a well established sinusoidal pattern and the CO_2 forecast is following a well established 2nd order polynomial equation. The solar forecast does not fit any easily modelled equation. So, I have consolidated four different forecasts (Abdussamatov, Cionco/Soon, NOAA and Zharkova) to approximate the change in TSI. Those forecasts are shown here (two are TSI, two are Sunspot Numbers). I also changed things up a little by applying a CO_2 climate sensitivity to the CO_2 forecast rather than just a straight percentage. All the forecasts show the TSI declining steadily, reaching a bottom sometime in the late 2030s to 2050s. The new Modern Grand Solar Minimum (GSM) is generally forecasted to last a few decades (potentially as deep as the Maunder Minimum but not quite as long). I went with a relatively short option (a couple of decades). As shown in the TSI forecasts, the GSM could extend out further.

Model Solar Forecasts

As in previous posts, there are many other parameters that could be included (Pacific Decadal Oscillation (PDO), El Niño Southern Oscillation (ENSO), volcanic eruptions, etc.). These other parameters do not lend themselves to easily established equations. Also, the TSI is just a proxy that could have deviations.



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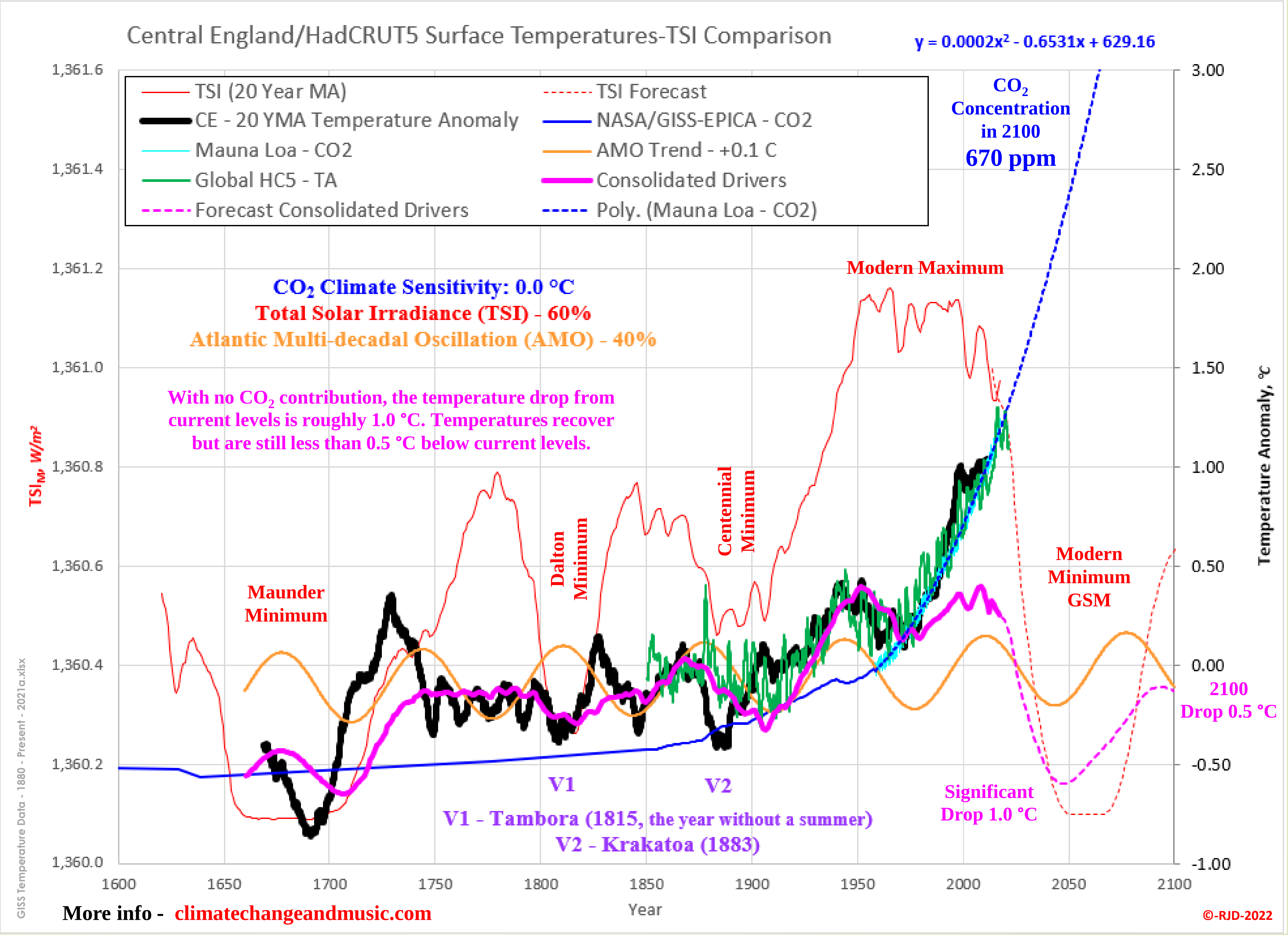
CSS-29b

Climate Model TSI-AMO-CO_2 CO_2 Sensitivity – 0.0 °C

The three parameter forecasts (TSI (red), AMO (orange) and CO_2 (blue)) are shown here. This first plot assumes that the CO_2 contribution is zero. The Catastrophic Anthropogenic Global Warming (CAGW) alarmists can relax. This is just being used as a baseline. CO_2 has been included in the upcoming slides. The magenta curve represents the modelled temperature and is compared to the Central England Temperature (CET, black) and the HadCRUT5 surface temperature (green).

Model TSI-AMO-CO_2 ECS = 0.0 °C

There are certainly some deviations, but the "simple" model does a better job of modelling historical temperatures than CO_2 alone. The two most significant deviations occurred in the early 1700s (which would have only minor CO_2 influence) and more recently post-1975 (which could include significant CO_2 warming). More discussion to follow.



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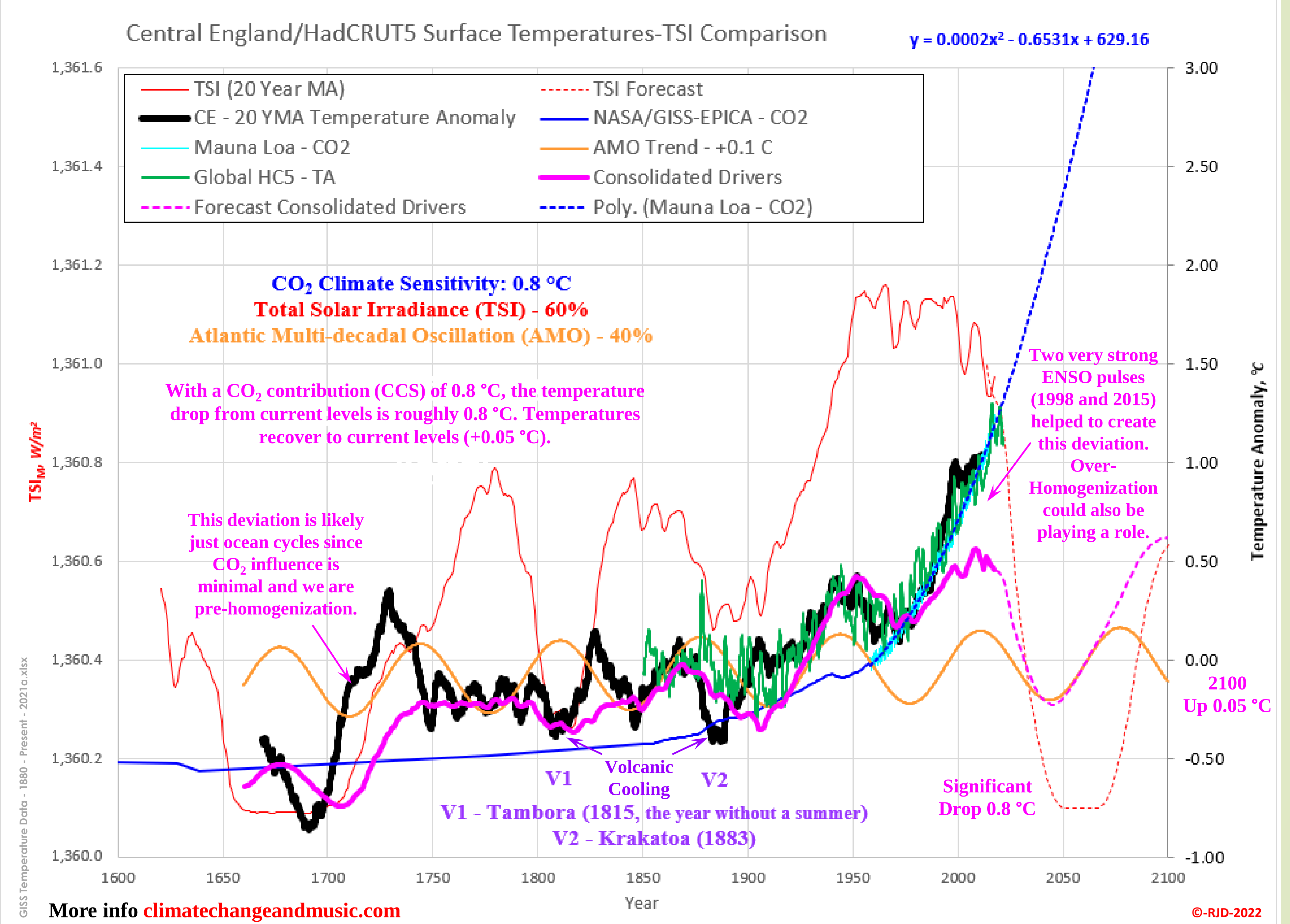
CSS-29c

Climate Model TSI-AMO-CO_2 CO_2 Sensitivity – 0.8 °C

The CO_2 Climate Sensitivity (CCS) is nowhere near settled in science in the broader climate community. So, I will present a few alternatives. The starting point (CCS=0.8 °C) is in line with the University of Chicago's MODTRAN model and with Wijngaarden and Happer's 2021 paper, "The Relative Potency of Greenhouse Molecules". In my opinion, this is the closest to reality when all factors (Urban Heat Island Effect (UHIE), TSI, historical data, etc.) are taken into account. The TSI and AMO are weighted 60/40% in this scenario, respectively. The spread on the post-1970 deviation has narrowed a little but is still very visible. The significant deviations may have many explanations (as outlined on the plot). The drop here takes us down to Dalton Minimum levels versus the Maunder Minimum levels on the previous CCS=0.0 °C slide. Cold (and dangerous (the real threat)) in either case.

Model TSI-AMO-CO_2 ECS = 0.8 °C



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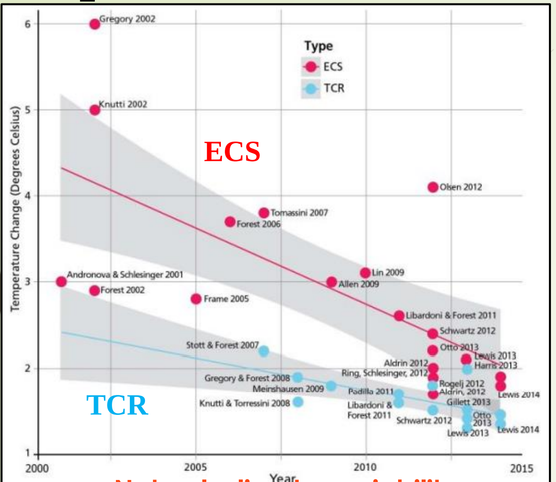
CSS-29d

Climate Model TSI-AMO-CO_2 CO_2 Sensitivity – 1.0 °C

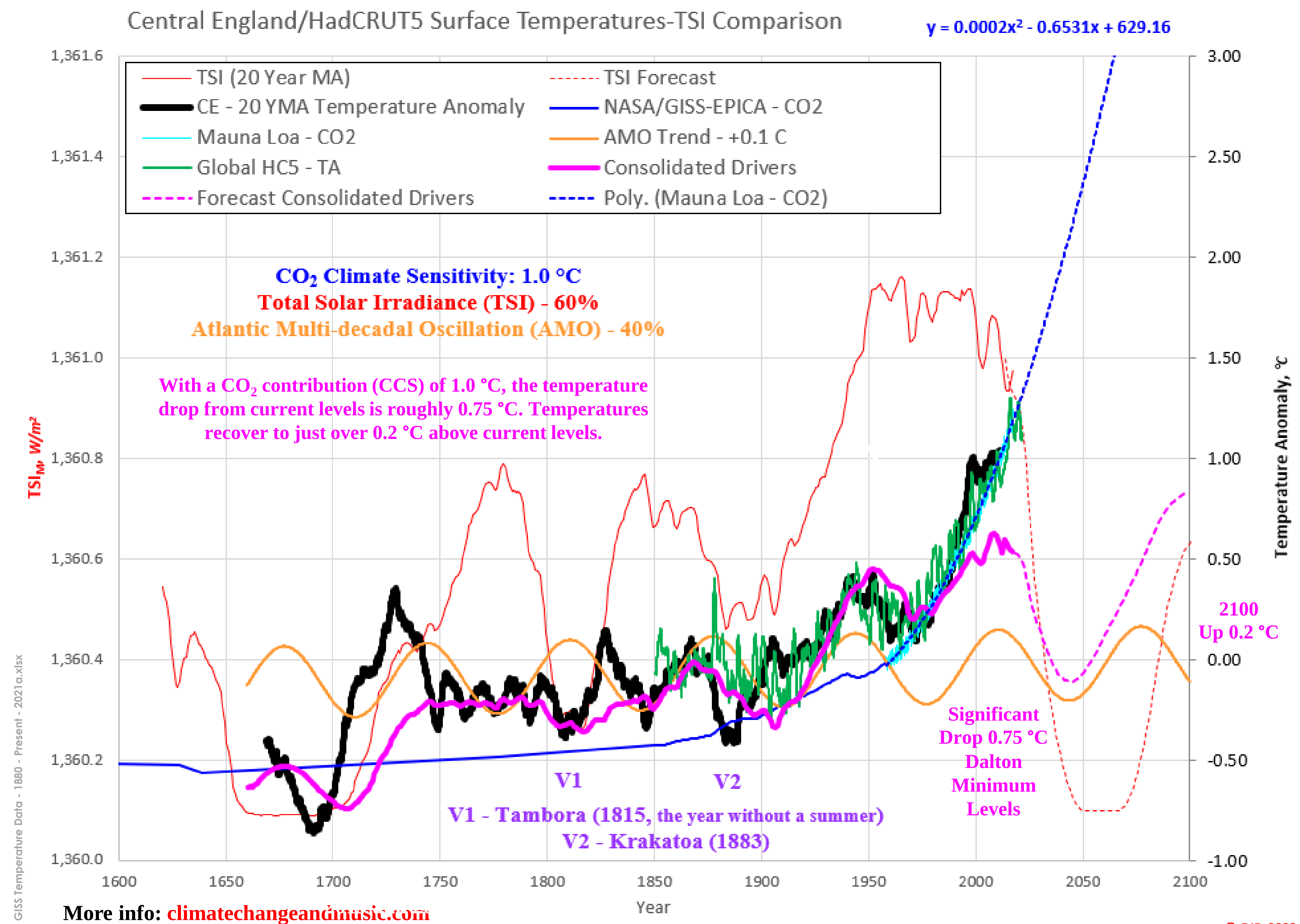


Natural_climate_variability

Figure 7. Compilation of published transient climate response (TCR) and equilibrium climate sensitivity (ECS) values to atmospheric CO2 doubling. (Adapted from Figure 1 in Refs. [20,27] where all references listed in the figure are reported: from link)

Model TSI-AMO-CO_2 ECS = 1.0 °C

A general consensus (for what it is worth) among climate scientists that can think past the simplistic, unscientific CO_2 narrative, puts the CCS around 1.0 °C. A similar result to a CCS = 0.8 °C. As shown above the trend for both ECS and TCR are down. These estimates are generally based on the assumption that the temperature change is due to CO_2. Any natural influence drops the CCS further.



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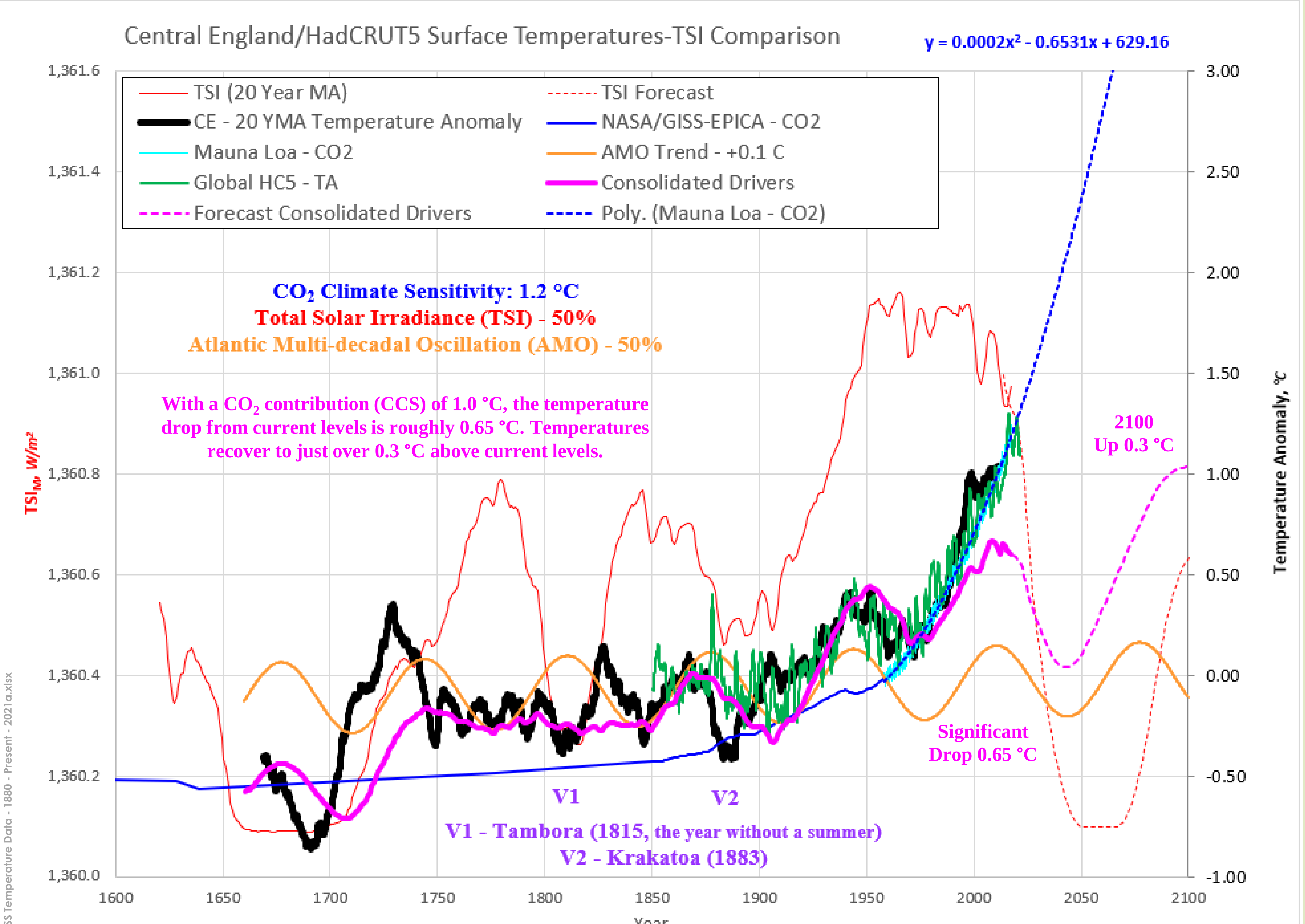
CSS-29e

Climate Model TSI-AMO-CO_2 CO_2 Sensitivity – 1.2 °C

This slide uses a CCS of 1.2 °C. This corresponds to the IPCC's best estimate before they factor in their positive water vapour feedback hypothesis that increases the potential ECS range from 1.8 to 5.6 °C. Not exactly settled science (even without considering their unsubstantiated hypothesis). The same story plays out here. The temperatures (already dropping since early 2016) will continue to drop further (0.65 °C in this case) before recovering to roughly 0.3 °C above current levels. Note that the TSI/AMO split has been adjusted to 50/50% for this scenario.

Model TSI-AMO-CO_2 ECS = 1.2 °C

The variations are almost limitless. As mentioned in the first slide, The solar forcing going into this GSM could be as high as 5 °C (according to Zharkova et al). I have used a more modest GSM forcing of roughly 1.5 °C. We do not want to see what happens if Zharkova et al are correct. A 1.0 °C drop will lead to crop failures and mass starvation (on top of the food crisis we are already facing)



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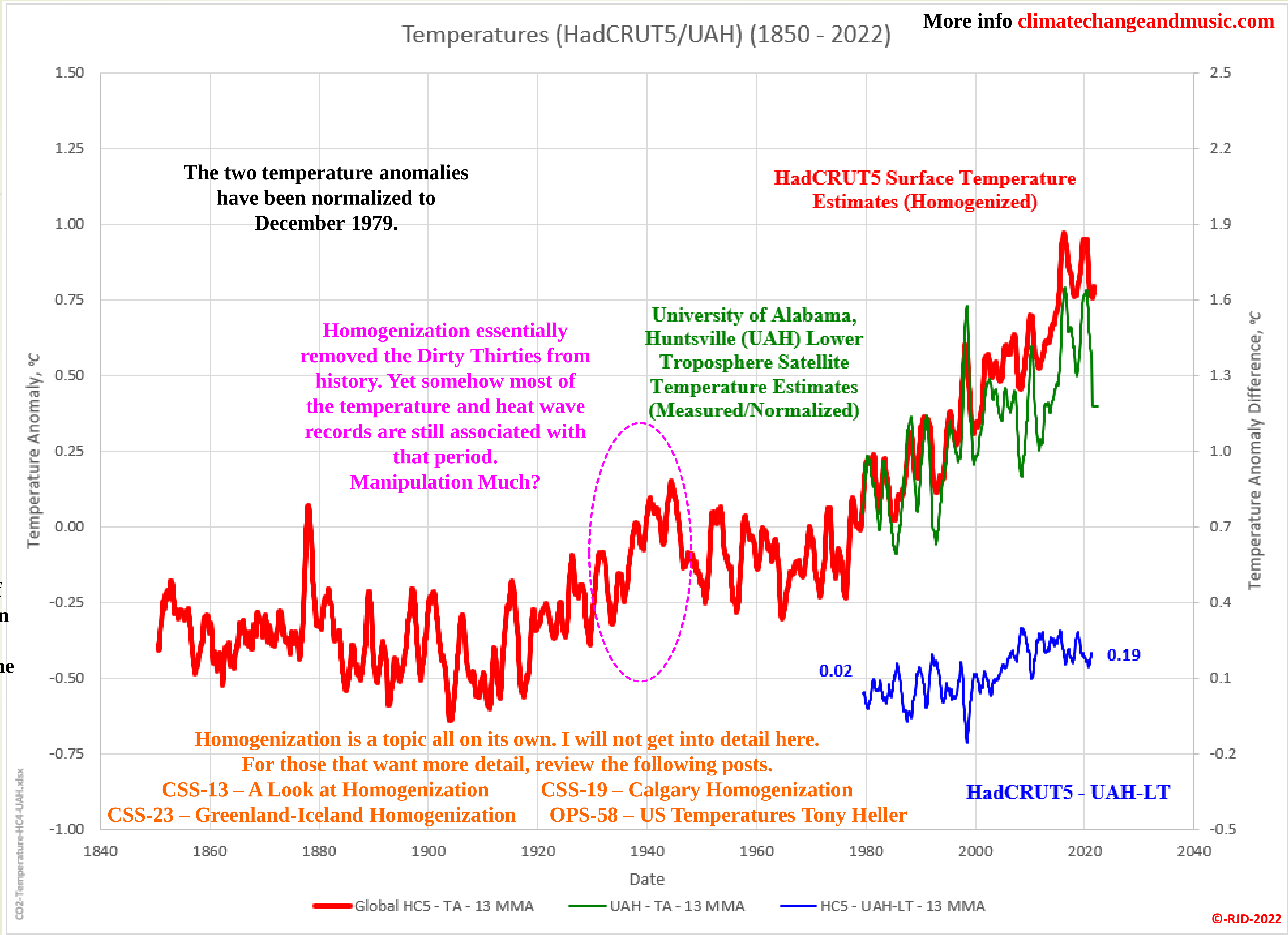
CSS-29f

Climate Model TSI-AMO-CO_2 HadCRUT5 - UAH

This slide takes a quick look at the relationship between the HadCRUT5 Surface temperature data estimates and the University of Alabama, Huntsville (UAH) satellite Lower Troposphere (LT) temperature measurements. The Surface and Lower Troposphere temperatures can be different, but as shown their trends are diverging. Since 1979, HadCRUT5 temperatures have warmed up roughly 0.2 °C more than UAH LT temperatures. Is that difference due to the many levels of homogenization routinely conducted on the surface temperature estimates? Possibly. Homogenization occurs at the individual station level (with some questionable practices) and on a more global basis (HadCRUT5 recently replaced HadCRUT4 (CSS-25 – Incremental Homogenization)). Homogenization can have a significant impact on the data.

Model TSI-AMO-CO_2 HC5 - UAH



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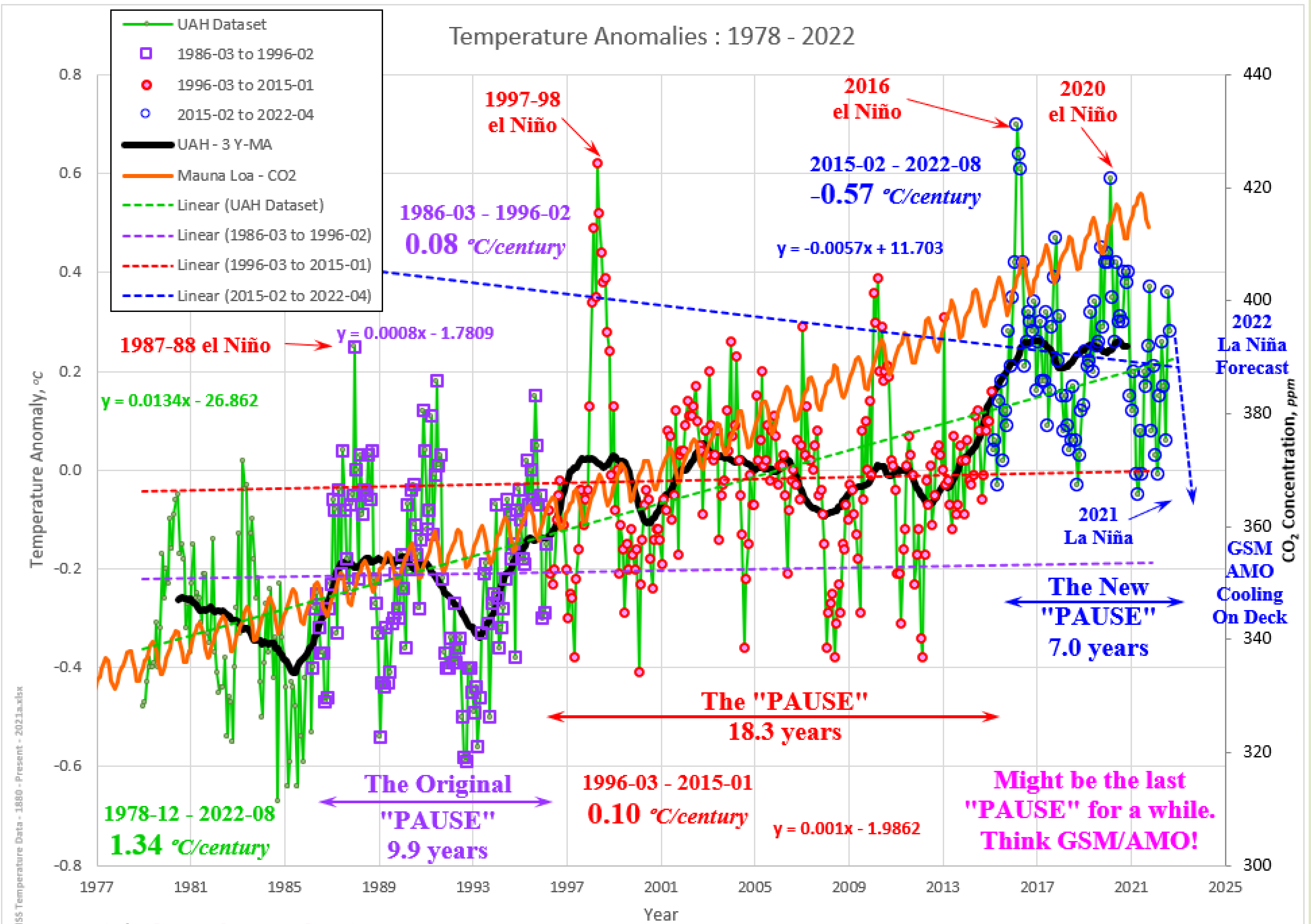
CSS-29g

Climate Model TSI-AMO-CO_2 UAH Pauses

The UAH detail is included to show the temperature response to step changes in ENSO. Significant El Niños (1987/88, 1997/98 and 2015/16) have been associated with long temperature pauses (9.9 years from March 1986 to February 1996, March 1996 to January 2015 (18.3 years) and the current pause (actually a shallow decline, for 7.0 years and counting). The ocean cycles are playing very significant roles in the UAH temperature data. ENSO dominates the monthly data, switching between El Niño and La Niña often.

Model TSI-AMO-CO_2 UAH Pauses

From the early 1970s until the turn of the century, the AMO was contributing significantly to the temperature rise. The "PAUSE" is likely due to the AMO levelling off and the TSI declining slightly. Something was obviously overpowering any warming that CO_2 may have been providing. The AMO/GSM cooling is still coming!



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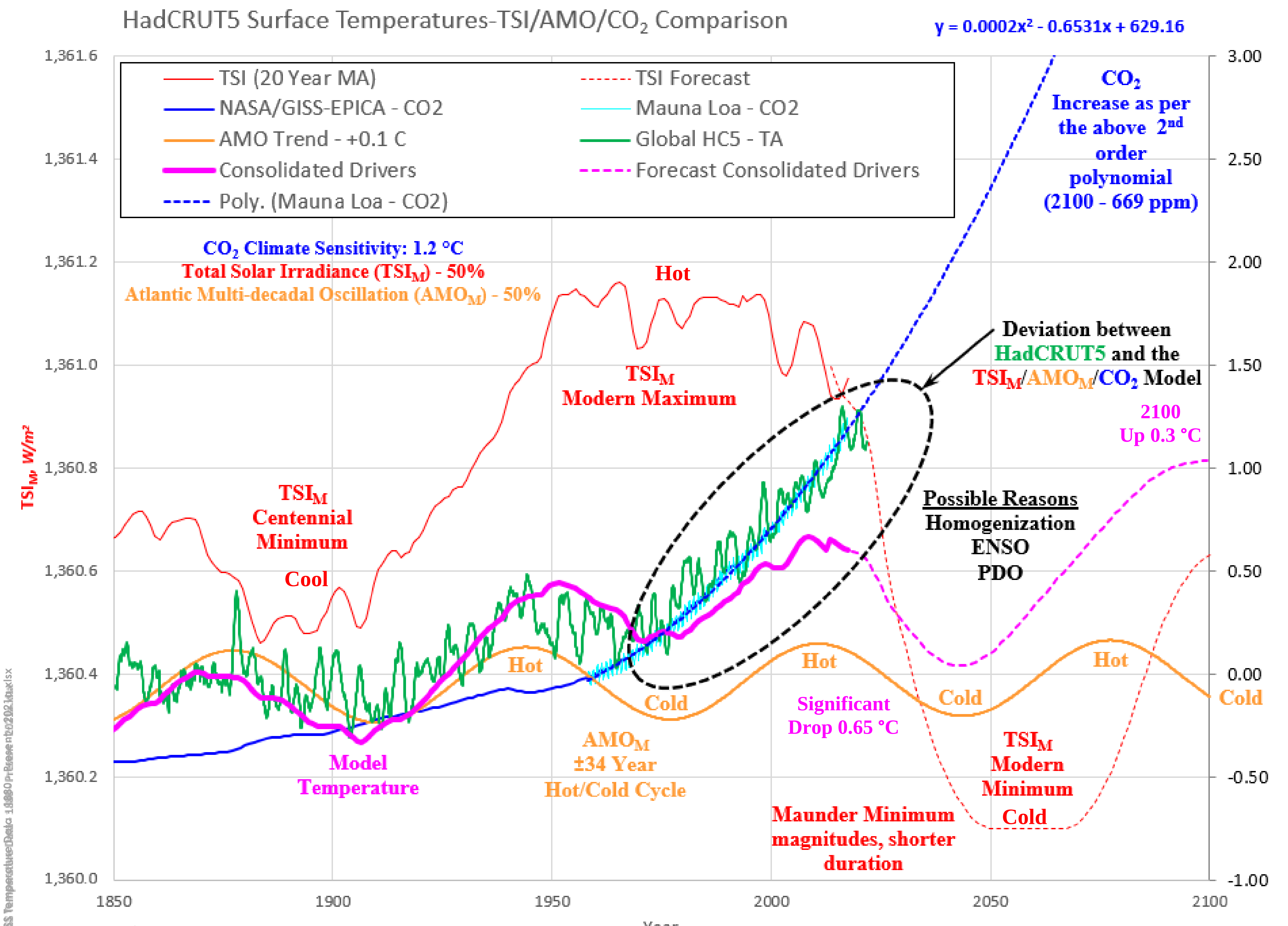
CSS-29h

Climate Model – HC5 TSI-AMO-CO_2 CO_2 Sensitivity – 1.2 °C

This slide focuses in on the HadCRUT5 surface temperature data set, sticking with the IPCC's 1.2 C. Again the model is not perfect, but the match is much closer than CO_2 on its own. Realistically, the current models (almost exclusively dependent calibrated to CO_2), cannot model the temperature fluctuations over the HadCRUT5 surface temperature data set, let alone the CET temperature data going back to 1659 (including the Maunder Minimum).

Model – HC5 TSI-AMO-CO_2 ECS = 1.2 °C

Some related discussion can be found in my CSS-27 – Is CO_2 Really the Primary Climate Driver post. The answer to that question is no. When all the relevant data is reviewed and incorporated, CO_2's warming influence is easily relegated to the minor trace gas contribution levels that anyone with common sense would expect. Rising CO_2 levels can contribute to warming but not dangerously, or in general, measurably on any time scale. CO_2 is not acting alone.



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