

Sun shunned

The *Fifth Assessment Report* of the UN's climate panel wrongly rejects the Sun as a cause of climate changes

"Maunder's principal contribution was to emphasize the varying level of solar activity over the centuries since the advent of the telescope, with particular attention to the scarcity of sunspots from about 1645 to 1715, beginning only 35 years after the start of telescopic observations. Maunder's point was conveniently ignored, or even denied, because no one knew what it meant. Fortunately, Jack Eddy took up the historical investigation about 30 years ago and turned up enough old records that the reality of the "Maunder Minimum" was established beyond any reasonable doubt. Subsequent historical research has unearthed detailed systematic records of sunspot numbers which show how peculiar the behavior of the Sun was during that time. Then with modern data on the atmospheric production rate of carbon 14 by cosmic rays, Eddy went on to show that such prolonged periods of solar inactivity have occurred ten times in the last 7000 years. So we may anticipate that there will be yet another Maunder Minima in the future."

— E. N. Parker, University of Chicago (2003)¹

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The many, many thousands of pages of the *Assessment Reports* of the UN's climate panel, the IPCC, are the expression of the beliefs of a small circle of scientists and interested lobbyists who, against all evidence, have convinced themselves that humans are having a dramatic effect on the Earth's climate. The IPCC itself describes its role as "to assess...the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation."³ In short, before they began to compile their reports, the IPCC took "human-induced climate change" as their belief; perhaps adding the term "risk of" as a weak attempt to suggest impartiality.

The "Principles" under which the IPCC operates include the following: "In taking decisions, and approving, adopting and accepting reports, the Panel, its Working

¹ p. xii of Soon and Yaskell (2003).

² Any opinions expressed by Willie Soon in this chapter are strictly his own.

³ From p. 1 of *Principles Governing IPCC Work* (available at <https://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles.pdf>).

Groups and any Task Forces shall use all best endeavours to reach consensus.”⁴
The IPCC’s objective of consensus is plainly anti-scientific.

In 11th-century Iraq, Alhazen, justly celebrated in the *ummah wahida* of Islam as one of the founders of the scientific method, wrote that the seeker after truth does not place his faith in any mere consensus, however widespread or venerable. Instead, using his hard-won scientific knowledge, he takes care to verify what he has learned of it. “The road to the truth,” said Alhazen, “is long and hard: but that is the road we must follow.”

In my field, the physics of the Sun, the IPCC asserts against all evidence that the Sun has little influence on climate change. This represents neither a consensus nor an authoritative review of the subject. My own summary of the latest science and evidence on the Sun’s influence on the climate comes to quite opposite conclusions (Soon and Lüning 2013).

Of the 38 co-authors and 3 review editors of the IPCC’s solar sub-chapter (chapter 8 by Myhre *et al.* 2013), only one is an expert on solar physics. Perhaps not surprisingly, then, the subchapter is shot through with critical errors and serious misrepresentations. These include:

- Misleading discussion of the Sun’s radiative forcing;
 - The IPCC authors’ formulation of the Sun and climate relation in terms of the idealized radiative forcing and feedback scenario missed a great opportunity to highlight the *primary* importance of the non-linear dynamics for the evolution of the Earth’s orbit around the Sun which produces unique and non-repeatable changes in the seasonal distribution of incoming sunlight.
- Concealment of problems in determining absolute total solar irradiance;
 - The IPCC authors failed to alert readers to the fact that great uncertainty in measuring the level and variation in total solar irradiation still exist, to the extent that estimates from several measurements differ by as much as 5 to 10 Wm⁻². The uncertainty is

⁴ From p. 2 of *Principles Governing IPCC Work*.

so great that we cannot have confidence in any climatic signals from rising atmospheric CO₂.

- Cherry-picking of the total solar irradiance dataset;⁵
 - The IPCC authors largely ignored at least two other datasets that can be shown to be of better quality.
- Outdated and biased selection of references;
 - The IPCC authors failed, for example, to cite potentially important sun-climate connection paper by Soon and Legates (2013) which provides disconfirming evidence against the role of atmospheric CO₂ for recent climate change.
- Insufficient understanding of the problems involved in reconstructing total solar irradiance by the method described in Steinhilber *et al.* (2009, 2012);
 - Steinhilber *et al.*'s method of reconstruction is of very poor, if not incorrect, quality but it is being promoted by IPCC authors to be the best results for historical values of total solar irradiance.
- Misplaced reliance on synthetic 11-year solar cycles;
 - There is no known measurements to suggest the existence of the 11-year-like solar cycles in the Sun irradiance variation for all historical time. Because the IPCC authors proposed that all paleoclimate modeling group to assume such a cycle in their climate models, their conclusion can create artificial results and misleading conclusions on decadal variations in the actual climate system.
- Ignorance of Fontenla *et al.* (2011), the best paper on physical modeling of Sun's irradiance at all wavelengths;
 - The IPCC authors neither cite Fontenla *et al.* (2011), nor do they include the important conclusion from Fontenla *et al.* (2011) that accurate knowledge and information on solar UV irradiance is important for a physical modeling of the relationship between the stratosphere and troposphere.
- Misrepresentation of solar magnetic field measurements by Livingston and Penn at the U.S. National Solar Observatory; and

⁵ PMOD: Physikalisch-Meteorologisches Observatorium Davos; ACRIM: Active Cavity Radiometer Irradiance Monitor; RMIB: Royal Meteorological Institute of Belgium. Please see Scafetta and Willson (2014) for a summary of available measurements of total solar irradiance.

- Livingston and Penn clearly suggest that their solar magnetic field observation may be extrapolated to yield a highly weakened Sun in the near future, but IPCC authors misrepresented the fact by suggesting only a minor effect.
- Erroneous and unqualified rejection of the study of Sun-like stars.
 - The IPCC authors incorrectly claimed that the study of sun-like stars is not important for any physical facts about our Sun. Their rejection is based on the illogical assumption that useful knowledge about the Sun cannot be obtained from observation of other stars.

The IPCC draws attention to the estimated inter-annual variability of the Sun's radiative forcing as being merely several twentieths of a Watt per square meter, but overlooks the 90 Wm^{-2} change that occurs in total solar irradiance from its maximum to its minimum distance from Earth. The relative importance of seasonal insolation on historical climate change can be readily demonstrated. During the warm Eemian interglacial period 130,000 to 110,000 years ago, the amplitude of the seasonal insolation was 2 to 3 times larger than today because the eccentricity of the Earth's orbit was 4% greater. Even if one wished to assume no difference in intrinsic, non-orbital component of solar irradiance between the Eemian warm period and the current or Holocene warm period, the importance of the relatively large seasonal insolation during the Eemian period in explaining the drastically warmer climate that then prevailed is consistent with many high quality paleoclimate records.

What cannot be ignored is the persistent and systematic failure of computer climate model simulations cited by the IPCC to represent and simulate the full dynamics of the seasonal evolution of climate. Cronin (2014) recently highlighted the fact that even the simple question of what average solar zenith angle to use in climate models is not resolved and that the incorrect representation of solar zenith angle can lead to a surplus of solar radiation of 7 to 20 Wm^{-2} in the global energy budget.

For the mid-Holocene Climate Optimum period of roughly 6000 years ago, for example, January (i.e., winter minimum) temperatures in China, based on study of paleo-vegetation and pollens, were known to be about 6 to 8°C warmer than

present. Jiang *et al.* (2012)⁶ recently showed that all 36 of the world’s best climate models in the Paleoclimate Modeling Intercomparison Project backward forecasted *cooler* winter temperatures for the mid-Holocene than present. In addition, for the mid-Holocene annual-mean temperatures in China, 35 out of 36 models incorrectly simulated a cooler climate than present (see Figure 2d and Table 3 in Jiang *et al.* 2012).

IPCC authors, and the computer models on which they rely, have also arbitrarily and incorrectly preferred the PMOD measurement of total solar irradiance (Fröhlich 2009) to two independent and arguably better results deduced by the RMIB (Mekaoui and deWitte 2008) and ACRIM (Scafetta and Willson 2014) groups. BenMoussa *et al.* (2013) recently raised the important question of accuracy in the calibration of satellite solar instruments, most of which are strongly affected by both in-orbit light and charged-particle radiation exposure and orbital decay. These authors concluded that the better quality control of the RMIB data were preferable to the rather subjective adjustments in the PMOD data—adjustments that were personally specified by Dr. C. Fröhlich, the Principal Investigator of the PMOD instrument. Scafetta and Willson (2014) provided detailed accounts on the PMOD data adjustment procedure and independently confirm the lower quality of the PMOD data.

Furthermore, IPCC authors have also failed to disclose or to explain that the measurement of total solar irradiance is confounded by our current inability to determine its absolute value.⁷ It is surely important to know whether the mean value is 1360, 1361 or 1365 Wm⁻² because without knowing how the mean climatic state is determined it would be impossible to confirm how the actual climate system is actually changing. The scientific importance of this indeterminacy⁸ is

⁶ This paper was not cited in the paleoclimate chapter (chapter 5) of the AR5 ‘s Working Group I report despite the fact that the lead author of the paper, Dr. Dabang Jiang is an expert reviewer for AR5 report.

⁷ For example, Meftah *et al.* (2014) reported that the SOVAP (Solar VARIability Picard) radiometer onboard *Picard* spacecraft measured the total solar irradiance for the summer of 2010 to be 1362.1 Wm⁻² with an uncertainty of ± 2.4 Wm⁻².

⁸ As another example of contemporary “pal-review” practices in science, a recent paper by Rind *et al.* (2014, p. 1119) has announced that simulations of Earth climate using two absolute values of TSI of 1367.0 and 1361.3 Wm⁻² only led to “understandable, repeatable, small” differences. These authors achieved their miraculous result by using a “compensation” approach that

also clear if one considers that, according to the IPCC's 2013 *Fifth Assessment Report*, the entire influence of humans on the climate⁹ since 1750 is a mere 2.3 Wm⁻².

Soon and Legates (2013), published before the IPCC's paper cut-off deadline, shows that a reconstructed history of solar irradiance can explain the changes in the Equator-to-Arctic surface temperature gradient from 1850-2012. Scientifically, this result is important for understanding climate dynamics because the Equator-to-Arctic temperature gradient has long been suspected as a key driver of the Earth's climate (Lindzen 1994). The IPCC, which purports to review all relevant scientific literature, makes no mention of this important result.

Likewise, the IPCC's promotion of the reconstructed history of total solar irradiance by Steinhilber *et al.* (2009, 2012) as the best possible result is disturbing. The Steinhilber reconstruction hinges on very weak statistical links (or lack thereof) between the radial magnetic field variable, B_r , and total solar irradiance published by Fröhlich,¹⁰ a co-author of Steinhilber in 2009. Strictly speaking, the relationship between these two variables shown in Fröhlich (2009)

involved tuning relative humidity threshold (from 82.7% to 83.1%) for forming clouds and global cloud cover (from 58.3% to 57.8%) at will. Such a convenient conclusion by Rind *et al.* (2014) is clearly contradicted by simulations of unforced variations in global temperature in Liang *et al.* (2013), using similar Goddard Institute for Space Studies climate models, that shows changes by as large as 1°C over 4000 years (see Fig. 1 in Liang *et al.* 2013). In order to fully arrest such artificial model tuning exercises, consider the idealized numerical experiments performed using other atmospheric general circulation models. In Barsugli *et al.* (2005), if a solar constant value of 1360 Wm⁻² is prescribed, an overheated global mean surface temperature of 38°C, instead of the observed 14 to 15°C, is produced. In order to examine how atmospheric deep moist convection interacting with large-scale flow on the equal global temperature footings, Kirtman and Schneider (2000) have to lower the baseline solar constant value of 1365 Wm⁻² to 990 Wm⁻²—a reduction by 375 Wm⁻²—in order to produce “an energetically consistent atmospheric general circulation”.

⁹ It should be noted that we leave the original units for solar irradiance as it is here to be compared, albeit indirectly, with the so-called climatic forcing units of energy flux in the climate system without any conversion by assuming a certain value of planetary albedo and geometrical factors (see earlier discussion on the choice of solar zenith angle). The reason is that we wish to remind all scientists that the key physical processes and mechanisms leading to our observed cloud fields and planetary albedo are still not understood (see e.g., p. 180 in Hoyle 1996) and that resolving this one particular issue will certainly lead to a much improved state of our knowledge.

¹⁰ Dr. Fröhlich has since retired and Dr. Steinhilber has left academia, and so are no longer available to address concerns about the weaknesses of their studies. As a consequence, important errors may not be corrected or will have taken too long to be corrected if I remain silent and do not raise the issue.

was based on *at most only three data points*,¹¹ and this one stunning fact should be enough to shy any objective scientist away from attributing importance to the result. Yet the IPCC asserts that changes in the Sun's irradiance over the past 1000 to 10,000 years¹² must be small on the basis of Steinhilber's ill-evidenced but convenient result.

The IPCC cites Schmidt *et al.* (2011) as the best and most representative of the state of knowledge on reconstructing total solar irradiance, while condemning as flawed other recent studies of Sun-like stars (of which more later). Schmidt *et al.* propose that climate models should adopt their novel 1000-year solar irradiance reconstruction which features an artificially imposed 11-year cycle in total solar irradiance. The current state of knowledge does not support that approach; insufficient evidence exists either in direct measurements or in any reconstruction of total solar irradiance for the past climate.

Selective citation from the scientific literature by the IPCC is clearly evident and its impact is serious. The Sun's irradiance covers many wavelengths, primarily from infrared to visible light to ultraviolet. Solar ultraviolet radiation is known to be a very important influence on the amount of ozone in the stratosphere and it controls how much energy large-scale planetary waves can carry from the surface and from the climatically-active region of the atmosphere to achieve dynamic equilibrium. It is puzzling that the IPCC's *Fifth Assessment Report* never mentioned Fontenla *et al.* (2011),¹³ which is the best available scientific paper on the physical basis of, as opposed to the statistical or numerical modeling of, solar irradiance. Fontenla *et al.* account for many of the magnetic field structures and other features that are observed on the Sun and contribute to solar variability.

Furthermore, the IPCC has gravely misrepresented the work of two scientists from the U.S. National Solar Observatory. Livingston and Penn (2009) and Penn and

¹¹ A total of four points were shown in Figure 4c of Fröhlich (2009) but two of the points in the figure should not have been included: one is from an extrapolation back to 1976/1977 and another one is for the most recent minimum of sunspot Cycle 23/24 at around 2008 during the time of publication, before the solar activity minimum can actually be decided.

¹² The 9300-year reconstruction of total solar irradiance by Steinhilber *et al.* (2009, 2012) is featured on p. 390 of the report of Working Group I in the IPCC's *Fifth Assessment Report*.

¹³ Fontenla *et al.* (2014) have recently improved and updated their solar spectral irradiance in the far (122-200 nm) and extreme (10-121 nm) ultraviolet spectral regions.

Livingston (2011) concluded, on the basis of direct measurement of the trend in the magnetic fields of sunspots, that if current trends were to continue, large sunspots might soon altogether disappear from the face of the Sun. Instead, the IPCC in 2013 wrote that Livingston and Penn had suggested that only “half” of the sunspots might disappear. Specifically, the two solar physicists had written in their 2009 paper, “A simple linear extrapolation of those data suggested that sunspots might completely vanish by 2015.” Penn and Livingston further commented that “the predicted dearth in sunspot numbers, independent of the 11-year sunspot cycle, has proven accurate ... [t]he vigor of sunspots, in terms of magnetic strength and area, has indeed greatly diminished.”¹⁴ The scientific results and conclusion on the current and ongoing magnetic state of our Sun by Livingston and Penn are important simply because the variation of the Sun’s energy output is known to be important driver of Earth climate and that the flat-trending nature of the global temperature for the past 15-17 years has long been speculated to be connected to the recently weakened Sun’s magnetic behavior.

Finally, the IPCC asserts that studies comparing Sun-like stars to the Sun are flawed because the Sun has been proven to exhibit atypical variations in magnetic field and brightness. Yet the latest paper from the NASA’s *Kepler* mission¹⁵, Basri *et al.* (2013), asserts regarding an implication that the Sun exhibits a ‘normal’ level of magnetic activity as compared to the *Kepler* sample of Sun-like stars:

“We find no empirical evidence in the *Kepler* data for an excess of young active solar-type stars near us, nor is the Sun unusually photometrically quiet compared to its neighbors. That is perhaps not surprising, given similar results for Ca II (T. Henry *et al.* 1996). ... There have been previous suggestions that the Sun might be

¹⁴ The decaying umbral magnetic field strength tendency appears to still hold for data updated through February 2014 (private communication with Dr. Livingston on March 7, 2014).

¹⁵ The goal of *Kepler*’s mission is not only to study Sun-like stars but also to discover Earth-like planets. Petigura *et al.* (2013) recently quantified, based on statistics accumulated from the *Kepler*’s mission, that $11\pm 4\%$ of the Sun-like stars may harbor an Earth-sized planet receiving between one and four times the stellar irradiation intensity as that on Earth.

photometrically quieter than the bulk of similar stars...although they were tentative.”

Basri *et al.* (2013) in fact shows that the evidence from the study of Sun-like stars suggests a much larger amplitude of solar light output variations than that which has been estimated for our own Sun from various satellite projects to date.

In conclusion, the IPCC has been practicing “para-science”¹⁶ in that, while it affects the appearance of practicing science, it has violated long-held scientific norms and practices of fully and accurately representing the current state of scientific knowledge, and of proposing and testing alternative hypotheses in order to extend knowledge. Instead, the IPCC and its authors have acted out of prejudice in a manner that has misled both politicians and a largely unsuspecting public.

As a redress, I have spelled out here several of the IPCC’s numerous, specific and grievous errors in science. Each error has the effect of minimizing the role of the Sun and thereby supporting the IPCC’s unsupportable claim to be “95% confident” that most of the 0.7 °C global warming since 1950 was manmade. That assertion is made without evidence. The assertion is also self-serving, in that the IPCC depends on it for its own continued existence.

Contrary to reports of a “97% consensus”, Legates *et al.* (2014) demonstrated that only 0.5% of the abstracts of 11,944 scientific papers on climate-related topics published over the 21 years from 1991-2011 had explicitly stated an opinion that more than half of the global warming since 1950 had been caused by human emissions of CO₂ and other greenhouse gases. The overwhelming majority of scientists in climate and related fields, therefore, remain commendably open to the possibility that some other influence – such as the Sun – may be the true *primum mobile* of the Earth’s climate.

In manipulating its selection and representation of the scientific literature on the solar influence on global mean surface temperature, the IPCC has attempted to bolster the stance of a tiny minority of scientists and then to pretend, with 95%

¹⁶ The term "para-science" was used in Essex (2009) to allude to a kind of intellectual parasitism. It may be defined as going through the motions of science without actually doing science.

confidence, that this represents a “scientific consensus”. Such a consensus, even if it did exist, would be of no interest to science.

The central lesson to be learned from this episode in scientific history is that to create an organization financially and ideologically dependent upon coming to a single, aprioristic viewpoint, regardless of the objective truth, is to create a monster that ignores the truth. Regrettably, the cumulative effect of the IPCC’s conduct over the last 25 years has inflicted severe and long-term damage on the reputation of science and of scientists everywhere.

The Sun is the ultimate factor in causing change of terrestrial climate. At a small but measurable level, the Sun varies, just as most stars do. Centuries of observation and more recent research strongly suggest that our climate is modulated in important ways by the Sun’s variability. The basic physics of this connection is still poorly understood and stands at the frontier of research. But the body of needed raw data is now available, unlike even 20 years ago. Studying the response and inter-relation of other planets to the Sun’s variability will be extremely helpful in understanding our climate.

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