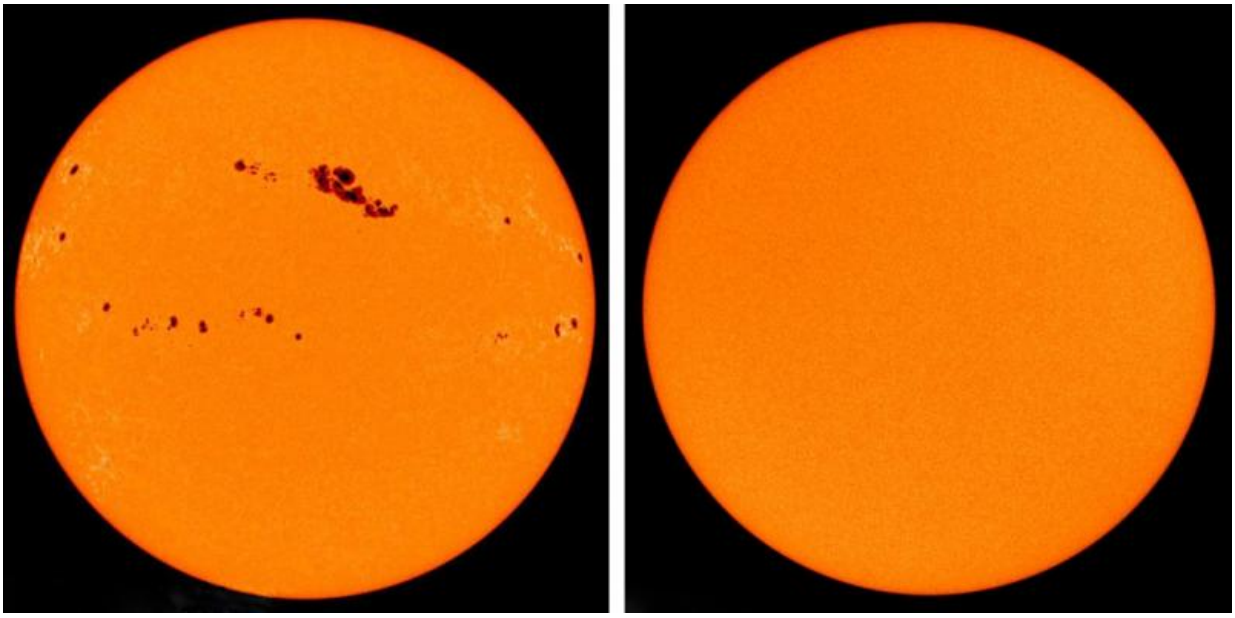
The sun has no influence on the current global temperature increase, study says

August 24 2017, by Helmut Hornung



Solar cycle: Solar irradiance is not constant. The brightness of our sun varies over an approx. eleven-year period, in which the number of sunspots also varies. The image on the left is from 2001 (solar maximum), the one on the right from 2009 (solar minimum). Credit: NASA/ESA/SOHO

It's becoming warmer on Earth. Temperatures during the period spanning 2001 to 2010, for example, were around 0.2 degrees Celsius higher than the previous decade. No serious scientist doubts that humans play a decisive role here. Nevertheless, other factors also influence the global climate, for example the geometry of Earth's orbit and volcanic

eruptions. But what role does the sun play?

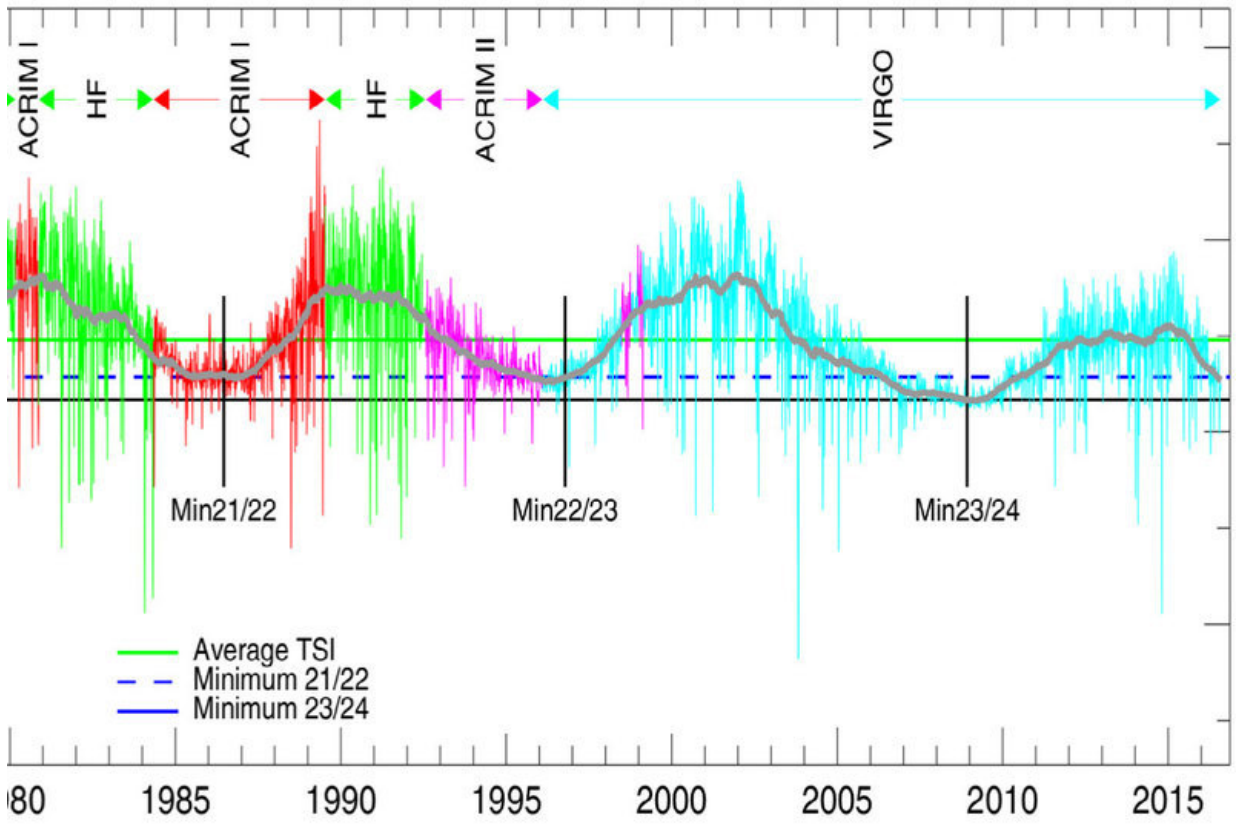
When the red, glowing orb of the sun sinks into the sea in the evening, it may provide peaceful and relaxed holiday moments. And even in the twilight we can still feel the cosy warmth delivered by the sun during the day. Yet, our star is anything but harmless. Not only does its UV radiation give some of our more careless contemporaries a serious sunburn. It is intrinsically extremely active, and parcels of hot plasma seethe constantly on the surface, injecting fountains of gas into space. Moreover, a wind of energetic particles constantly blows, occasionally freshening up to a storm, presenting a hazard to the sensitive electronics in satellites.

In addition to these routine phenomena, the radiant power of the sun is also subject to long-term fluctuations. These are caused by the solar magnetic field, the field lines of which are, as it were, "fused into" the electrically conductive gas. The strong turbulence rotates and twists the plasma tubes like rubber bands – which occasionally "snap" and then churn up the magnetic field.

These activities lead to phenomena such as dark spots or bright flares; the former are cooler regions, the latter regions with fibrous-looking bright spots and are hotter than their surroundings. The number of spots or flares is not always constant, but varies in an approximately eleven-year cycle. The total solar radiation intensity therefore also fluctuates in this period. These fluctuations average around 0.1 percent. However, the variations can also fluctuate – depending on wavelength, because the sun shines in numerous different bands of the spectrum. The ultraviolet radiation mentioned above, for example, which is particularly relevant with regard to the climate, varies by several tens of percents in the short wavelengths.

By way of its energy input, the sun can directly influence the climate of

our planet. However, the atmosphere only allows radiation to pass through in specific wavelengths, predominantly in visible light; the remainder is, in a manner of speaking, absorbed by molecules. Only part of the radiation therefore reaches Earth's surface and can heat it up. The irradiated surface, in turn, emits infra-red light, which is then held back by clouds or aerosols. This effect, without which the Earth would be around 32 degrees Celsius colder, warms the atmosphere. These processes resemble the conditions in a greenhouse.



Fluctuating solar radiation: This illustration shows variations within the eleven-year solar cycle as well as short-term variations caused by individual sunspot groups and solar flares. The average total brightness is represented by the grey curve. The different colours depict measurements with different instruments.

Credit: PMOD

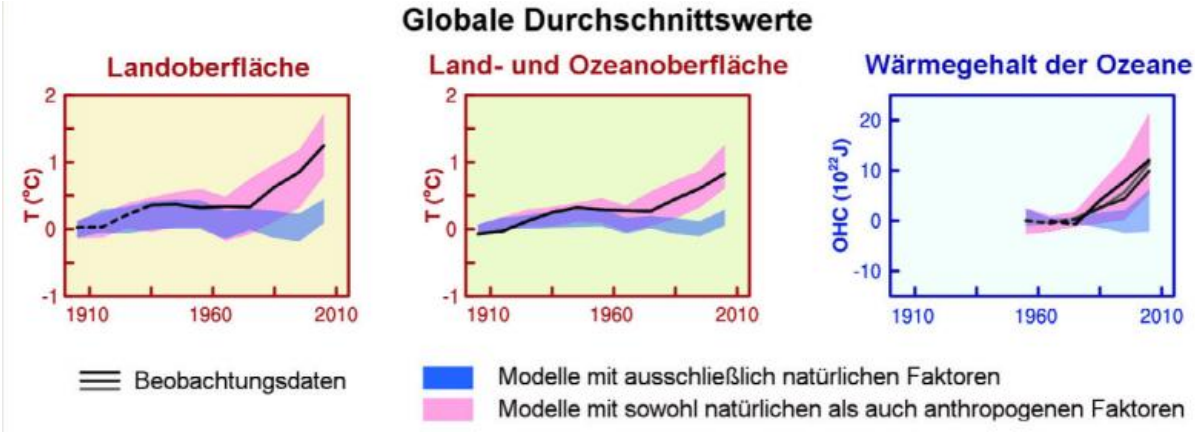
This is where the ultraviolet radiation plays its part. It is involved in a range of different chemical reactions – whereby UV is not just UV! For example, radiation at wavelengths less than 240 nanometres promotes the formation of ozone, longer wavelength UV, in contrast, destroys the same molecule. And together with the radiation at different wavelengths, different amounts of energy enter the troposphere, the lowest layer of the atmosphere, extending to around 15 kilometres above the ground.

The sun, however, not only emits radiation, but also a permanent flow of electrically charged particles, the aforementioned solar. If these particles penetrate the upper layers of Earth's atmosphere, they eject electrons from nitrogen or oxygen atoms, that is, they ionize them. This process influences atmospheric chemistry – whether, and if so, how this impacts the climate, is currently a matter of debate.

To investigate the influence of the sun on the climate, researchers look to the past. Here, they focus on the star's magnetic activity, from which the radiation intensity can be reconstructed. It is then apparent that the sun produces more intense radiation during active periods – apparent thanks to numerous spots and flares – than during its quiescent phases.

The sun had just such a break in activity during the second half of the 17th century, for example: between 1645 and 1715 its engine began to falter. During this period, referred to as the Maunder Minimum, Europe, North America and China recorded much colder winters. And even the summer was substantially cooler in some regions during this "Little Ice Age." Paintings were made at the time, showing ice skaters on the frozen Thames, for example.

When looking back at the past the scientists work with both old records of observational sunspot data (beginning in 1610) and using the C14 method, which can be particularly well applied to wood, as Carbon-14 input at the ground (trees) is not constant, but also changes with solar activity. This radioactive isotope is created when what are known as cosmic rays meet an air molecule in the upper layers of Earth's atmosphere.



Factoring in the human influence: Models can only reproduce the observational data if anthropogenic influences are included in the calculations. Credit: IPCC Report 5

The solar magnetic field extends throughout the entire solar system and partially screens off cosmic rays. If the magnetic field fluctuates, so does C14 production. In this manner, the deviation between tree ring age and C14 age represents a measure of magnetic activity and consequently for the radiant power of the sun.

So, how strongly does the sun currently influence the climate? What is known is that Earth has become warmer by around one degree Celsius

over the past 100 years. In the last 30 years alone, temperatures have increased at a rate not seen during the last 1000 years. It is another fact that the carbon dioxide concentration has increased by 30 percent since industrialization began in the mid-18th century.

During this entire period, the sun has been subject to periodic fluctuations in activity. And there has certainly been no increase in the brightness of the sun over the past 30 or 40 years, rather a slight decrease. This means that the sun cannot have contributed to global warming. In fact, the temperature increase noted in recent decades cannot be reproduced in models if only the influence of the sun or other natural sources are taken into account (for example volcanic eruptions). Only when anthropogenic, that is human-driven, factors are incorporated in the climate data, do they agree with the observational and measured data.

The researchers thus arrive at the conclusion that the increase in global temperatures since the 1970s cannot be explained by the sun. The observed temperature trend over the past three decades is linear – if it is a result of the increasing greenhouse gas concentration. In brief: the human influence on the climate is orders of magnitude greater than that of the sun.

On the other hand, the opinion of some scientists that the current decrease in solar activity will counteract global warming, does not stand up to a close examination, as global warming is a fact—and continues to advance. In contrast, it does appear possible that the sun influences the climate in the long term. The exact extent and precise mechanisms remain unclear, however.

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