The Problem with TSI

The problem with Total Solar Irradiance [TSI] is two fold:

Firstly: Scientists aren't Climatologists.

Secondly: Climatologists aren't Scientists.

Let me explain.

Scientists have been using satellites since 1979 to measure Total Solar Irradiance.

The current generation of measurements come from the state-of-the-art satellite mission called the Solar Radiation and Climate Experiment [SORCE]:

> The Solar Radiation and Climate Experiment (SORCE) is a NASA-sponsored satellite mission that provides **state-of-the-art measurements of** incoming X-ray, ultraviolet, visible, near-infrared, and **total solar radiation**.
> ...
> SORCE measures the Sun's output with the use of state-of-the-art radiometers, spectrometers, photodiodes, detectors, and bolometers engineered into instruments mounted on a satellite observatory.
>
> The SORCE satellite orbits around the Earth accumulating solar data.
>
> http://en.wikipedia.org/wiki/SORCE

The SORCE mission web site also clearly states that the scientists think they are providing "precise measurements of total solar irradiance":

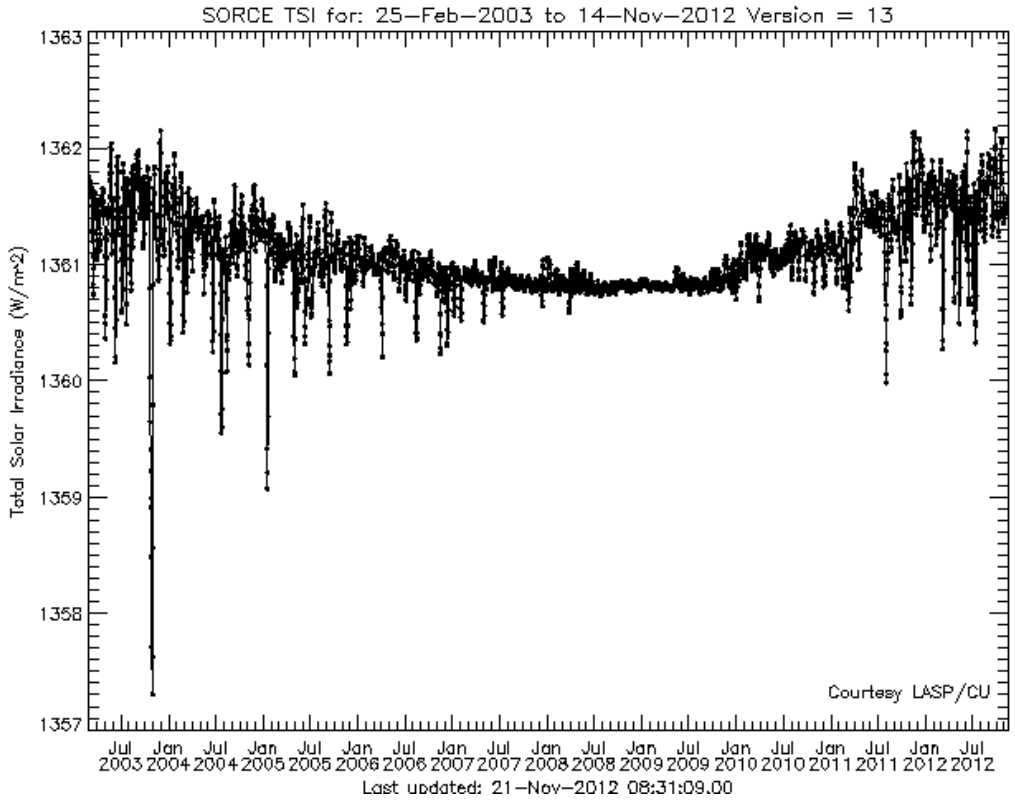
> The SORCE spacecraft was launched on January 25, 2003 on a Pegasus XL launch vehicle to provide NASA's Earth Science Enterprise (ESE) with precise measurements of solar radiation. It launched into a 645 km, 40 degree orbit and is operated by the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado (CU) in Boulder, Colorado, USA.
>
> It will continue the **precise measurements of total solar irradiance** (TSI) that began with the ERB instrument in 1979 and has continued to the present with the ACRIM series of measurements.
>
> SORCE will also provide the measurements of the solar spectral irradiance from 1nm to 2000nm, accounting for 95% of the spectral contribution to TSI.
>
> http://lasp.colorado.edu/sorce/index.htm

Everything seems perfectly straightforward.

Everyone is agreed: SORCE provides precise state-of-the-art measurements of TSI.

What could possibly go wrong?

The SORCE scientists very helpfully provide graphs of their mission data online:

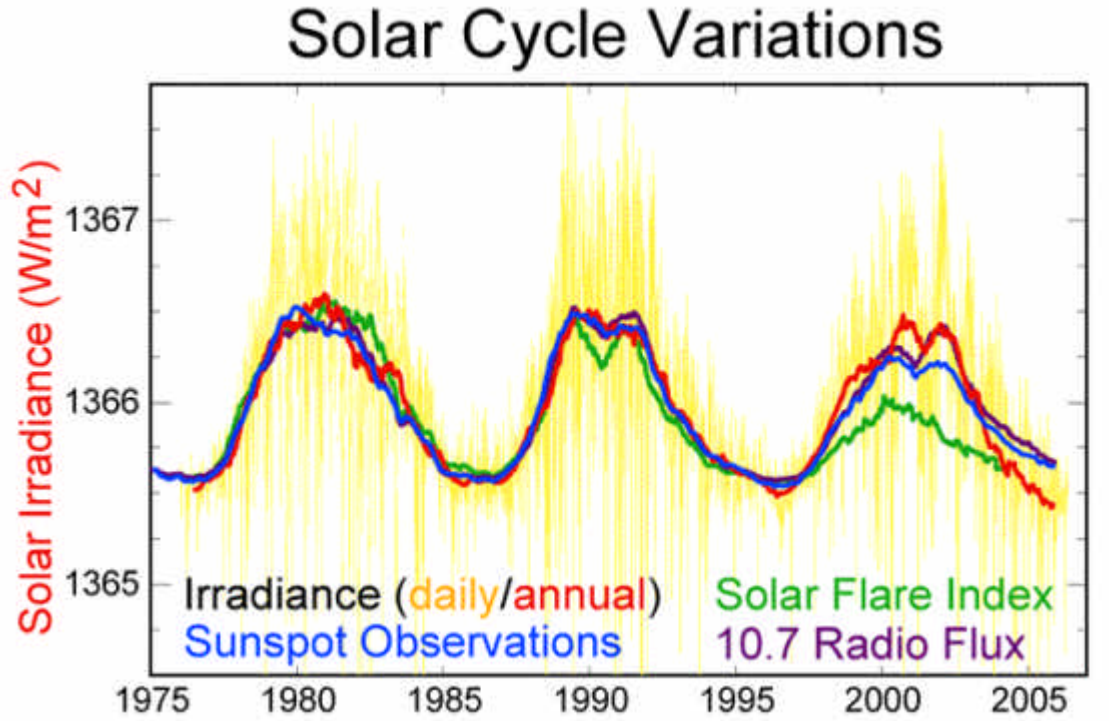


http://lasp.colorado.edu/sorce/total_solar_irradiance_plots/images/tim_level3_tsi_24hour_640x480.png
Daily Average Full SORCE Mission Plot

Everything looks good.

Even the Climatologists think the data is perfect.

Wikipedia thinks it's so perfect they include the data in their Global Warming article.



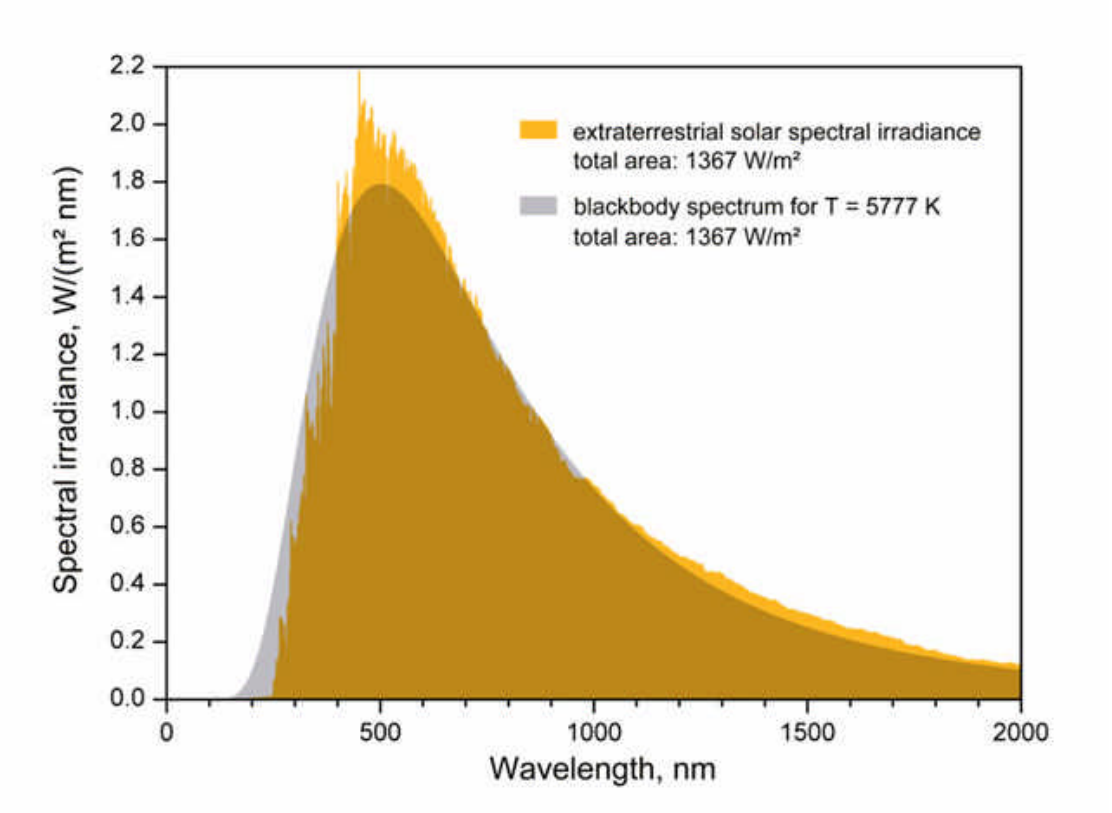
Satellite observations of Total Solar Irradiance from 1979–2006
http://en.wikipedia.org/wiki/Global_warming

However, there is a problem.

It's a problem for scientists.

It's a mortal blow to climatologists.

The first clue is provided by Wikipedia in their Sun article.
Very helpfully Wikipedia included a graph of Extraterrestrial Total Solar Irradiance.



The effective temperature, or black body temperature, of the Sun (5777 K) is the temperature a black body of the same size must have to yield the same total emissive power.
http://en.wikipedia.org/wiki/Sun

Let me elaborate.

The Sun's Photosphere has an effective temperature of 5,778 K.
Therefore, the Photosphere's Irradiance Spectrum should be equal to the Irradiance Spectrum of a Blackbody at 5,778 K.

Unfortunately, a funny thing happened to the TSI on its way to the SORCE satellite.

Between the Sun's Photosphere and the SORCE satellite:

> TSI **lost** a lot of high energy ultraviolet.
> TSI **gained** a lot of visible light.
> TSI **gained** a lot of low energy infrared.

Simply put:

> Something **absorbed** ultraviolet and then **emitted** visible and infrared.

This means:

> SORCE is **not** precisely measuring TSI.
> SORCE is precisely measuring **Transformed TSI.**

This all seems very strange on first inspection.

Climatologists will immediately wave their hands and say this is pure nonsense.

Scientists will look for an explanation.

But there is a very embarrassing explanation.

The explanation is very clearly stated.
The SORCE mission even appears to be proud of the fact:

> The **SORCE** spacecraft **was launched** on January 25, 2003 on a Pegasus XL launch vehicle to provide NASA's Earth Science Enterprise (ESE) with precise measurements of solar radiation. It launched **into a 645 km**, 40 degree **orbit** and is operated by the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado (CU) in Boulder, Colorado, USA.
>
> http://lasp.colorado.edu/sorce/index.htm

So what's wrong with a 645 kilometre orbit?

Everything if you are trying to precisely measure TSI.

Why?

Because the SORCE satellite isn't above the Earth's atmosphere!

SORCE is orbiting about **90,000 kilometres below** the top of the Earth's atmosphere.

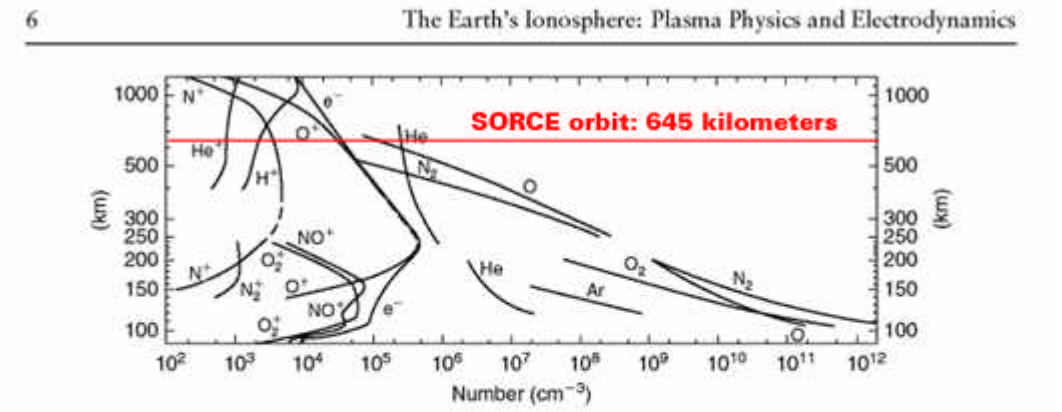


Figure 1.2 International Quiet Solar Year (IQSY) daytime atmospheric composition, based on mass spectrometer measurements above White Sands, New Mexico (32°N, 106°W). The helium distribution is from a nighttime measurement. Distributions above 250 km are from the *Elektron 11* satellite results of Istomin (1966) and *Explorer XVII* results of Reber and Nicolet (1965). [C. Y. Johnson, U.S. Naval Research Laboratory, Washington, D.C. Reprinted from Johnson (1969) by permission of the MIT Press, Cambridge, Massachusetts. Copyright 1969 by MIT.]

Still not convinced there is a problem?

Still think we can just disregard the atmosphere above 645 kilometres?

Think again!

There is a lot happening above 645 kilometres.

Let's start with Hydrogen doing something naughty in the geocorona.
Hydrogen emits X-Rays in the geocorona after colliding with Solar Wind ions:

> The geocoronal X-rays are caused by collisions of heavy ions of carbon, oxygen and neon in the solar wind with hydrogen atoms located tens of thousands of miles above the surface of Earth.
>
> During the collisions, the solar ions capture electrons from hydrogen atoms. The solar ions then kick out X-rays as the captured electrons drop to lower energy states.
> http://chandra.harvard.edu/photo/2003/moon/

Wikipedia tells us that Hydrogen emits ultraviolet light in the geocorona.

> The geocorona is the luminous part of the outermost region of the Earth's atmosphere, the exosphere. It is seen primarily via far-ultraviolet light (Lyman-alpha) from the Sun that is scattered from neutral hydrogen.
> http://en.wikipedia.org/wiki/Geocorona

The real story:
Hydrogen emits visible light and ultraviolet light when it collides with an electron.

> When an electron has an inelastic collision with Hydrogen the excess energy that has been transferred to the Hydrogen may be partially emitted as a visible sky-blue photon. The Hydrogen may then emit the remaining excess energy as a photon in the ultraviolet spectrum.
> [Refer to: http://www.unm.edu/~astro1/101lab/lab5/lab5_C.html]

How about Helium?
Helium+ is detected well above 645 km via its ultraviolet emissions at 30.4 nm.

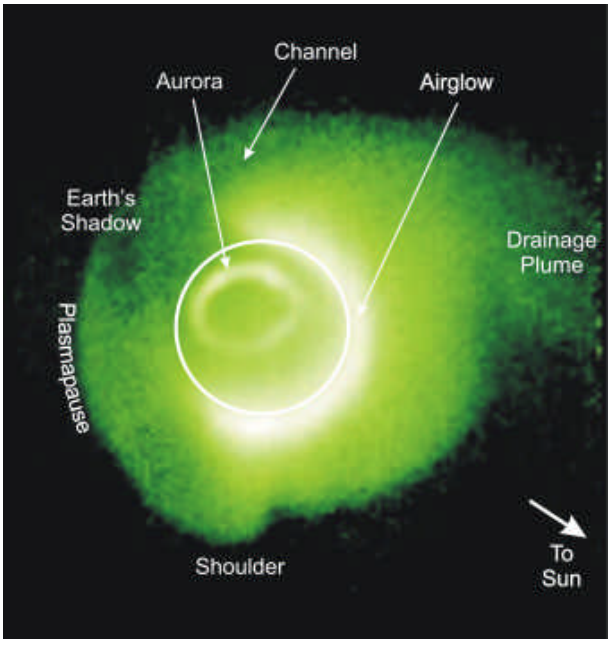
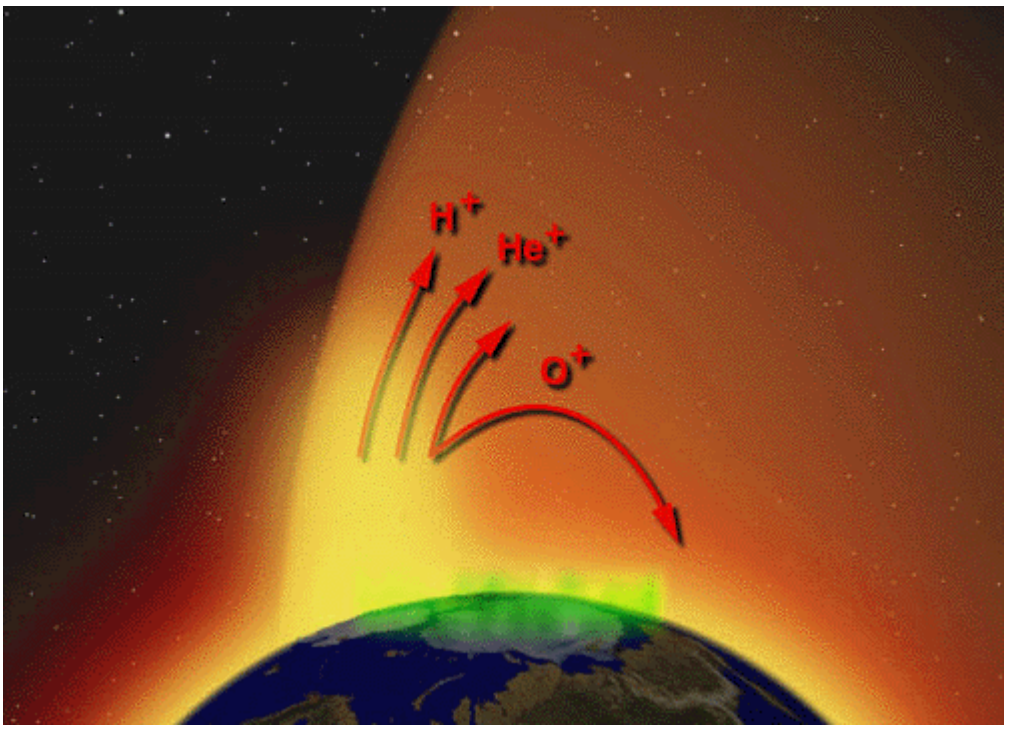


IMAGE Extreme Ultraviolet Imager
http://euv.lpl.arizona.edu/euv/

Let’s add some Oxygen into the mix.

Hydrogen+, Helium+ and Oxygen+ are transported well above 645 kilometres. These particles will emit ultraviolet and/or visible light when they have an inelastic collision with an electron or recombine with the electron to form a neutral particle. The neutral particle will then be ionised by solar radiation and restart the cycle. Alternatively, they might just absorb a lot of insolation and emit infrared radiation.



Another important aspect of the ionosphere-magnetosphere interaction is the outflow of plasma from the ionosphere into the magnetosphere.

This outflow is so substantial --10**26 ions per second during magnetically disturbed periods near solar maximum-- that the ionosphere could, in principle, fully populate the magnetosphere with plasma. (In fact, the magnetosphere contains a mixture of solar wind and ionospheric plasmas.)

The outflow of ions from the ionosphere takes a variety of forms:
the supersonic polar wind,
ion upwelling from the cleft ion fountain,
polar cap outflows, and
upward ion conics and beams from the auroral zone.

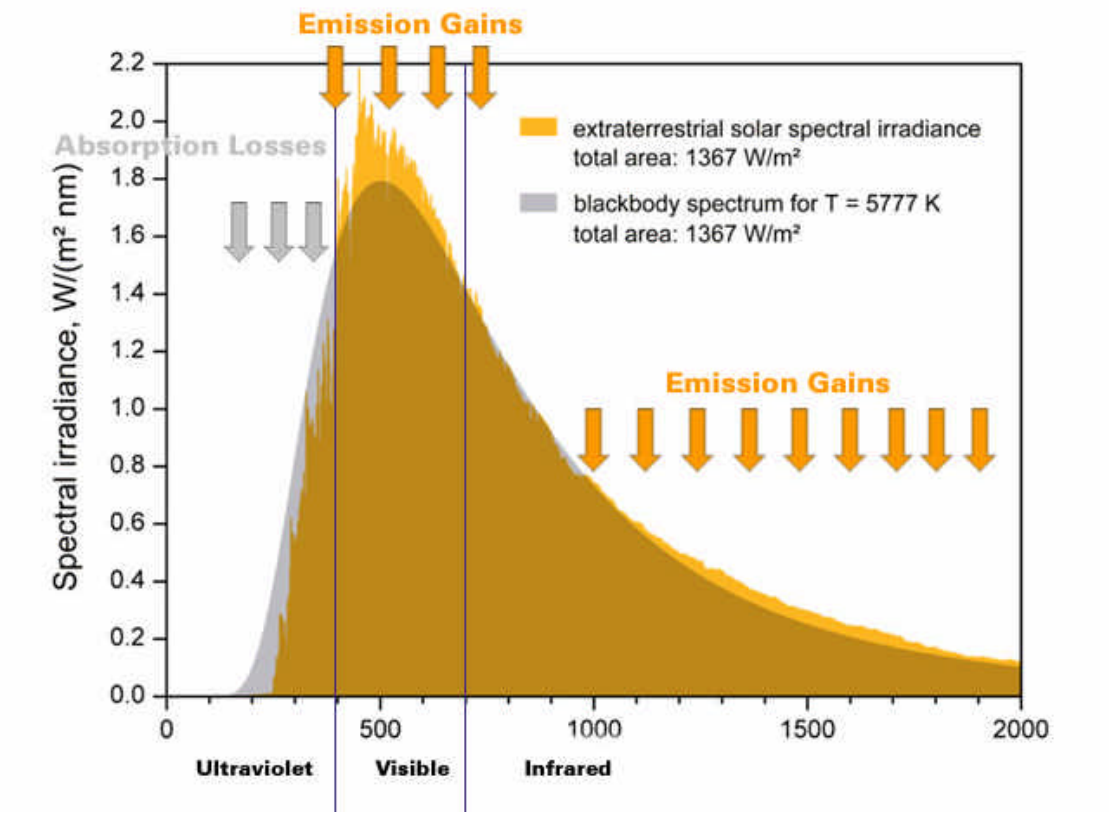
In addition to these high-latitude sources, strong O+ outflows from the mid-latitude ionosphere have been observed at times of intense geomagnetic activity. The strength and composition of the ionospheric plasma outflows vary with geomagnetic activity, season, solar cycle, local time, and altitude.

For example, the O+ component of the ionospheric outflow increases with increasing solar and geomagnetic activity, with a corresponding increase in the O+ density of the plasma sheet.

http://pluto.space.swri.edu/image/glossary/ionosphere3.html

The atmosphere above 645 kilometres is not densely populated.
But there is about 90,000 kilometres of it above the orbiting SORCE satellite.
Unfortunately we don't know all the details.
But we can see the net effect:

The atmosphere above 645 km absorbs high energy ultraviolet.
The atmosphere above 645 km emits a lot of visible light.
The atmosphere above 645 km emits infrared.



Lurking beneath this whole TSI fiasco is a dirty little secret.

It's a dirty little secret that climatologists definitely don't want you to know.

Simply put [without wanting to write a physics textbook]:

The atmosphere transforms energy.

Atmospheric particles absorb energy from:

The solar wind
Insolation [or moonlight or cosmic microwave background radiation...]
Other atmospheric particles – including ions and electrons

Atmospheric particles then have a number of options:

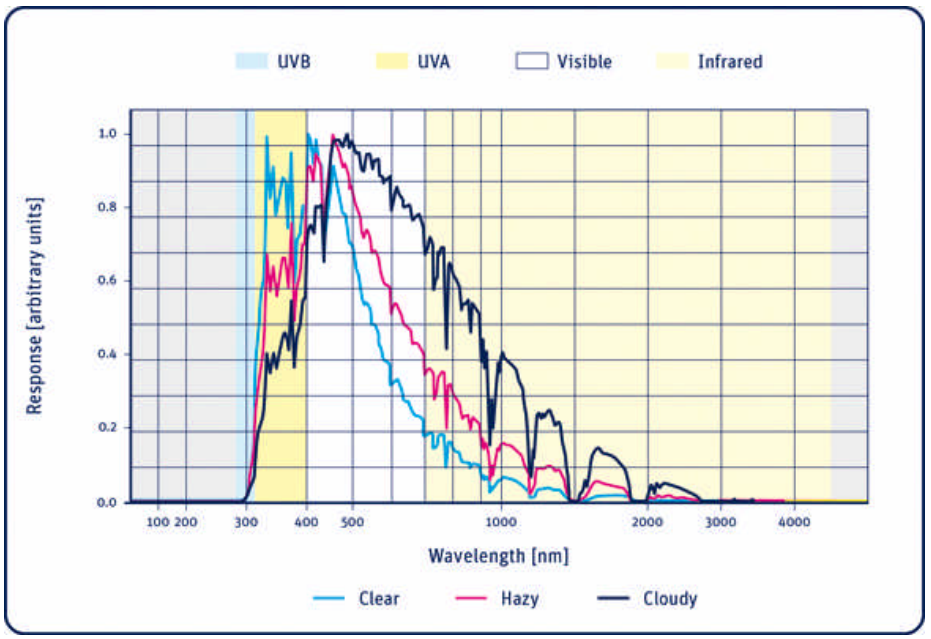
Emit a photon [or two]
Collide with another particle and transfer some energy [or not]
Ionize by emitting an electron [which contains excess energy]
Dissociate its molecular bonds e.g. O_2 + ultraviolet = $2O_1$
Recombine with another particle or electron

The atmospheric transformation of energy is clearly detectable at ground level.

Even climatologists could detect the transformations if they weren't so busy fudging the data and playing with their computer models.

All they have to do is compare two ground based irradiance spectrums:

> One measurement when the sky is clear.
> Another measurement when the sky is cloudy.



Spectral shift in irradiance with sky conditions. Credit: Kipp & Zonen
http://kippzonen-blog.nl/solar-energy/measuring-global-solar-irradiance/

When comparing the clear and cloudy spectrums it is evident:

> Clouds absorb UVB and emit visible light and infrared radiation.

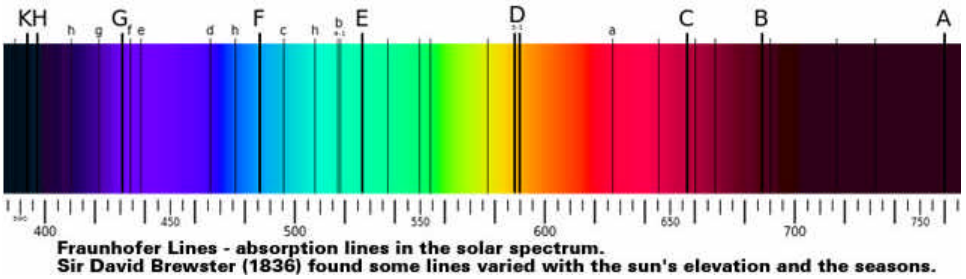
This is additional observational evidence that indicates:

> **The atmosphere transforms energy.**

This was observed by Sir David Brewster back in 1836:

> Sir David Brewster (1836) found that certain lines had strengths that varied with the sun's elevation and with the seasons. He correctly ascribed these 'atmospheric lines' as originating in the terrestrial atmosphere.
> http://laserstars.org/spectra/Fraunhofer.html

Unfortunately, these variable atmospheric absorption lines [in the solar spectrum] seem to have been written out the official scientific script.



Fraunhofer Lines - absorption lines in the solar spectrum.
Sir David Brewster (1836) found some lines varied with the sun's elevation and the seasons.

http://en.wikipedia.org/wiki/Fraunhofer_lines

Let's recap:

The atmosphere transforms energy.

Atmospheric transformations are not fully understood, identified or quantified.

SORCE is measuring Atmospherically Transformed TSI.

What does this mean?

Climatology's "Energy Budget" science is wrong.

Climatology's "Greenhouse Effect" science is wrong.

Climatology's "Global Warming" science is wrong.

Science needs to rediscover the work of Sir David Brewster.

Tim Cullen
Malaga
November 2012