Critical Analysis of Earth's Energy Budgets and a new Earth Energy Budget

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Critical Analysis of Earth's Energy Budgets and a new Earth Energy Budget

Brendan Godwin
10th May 2023

Abstract

These Earth Energy Budgets (EEBs) came to prominence in 1997 when Kiehl and Trenberth produced their EEB known commonly as KT97. They have regularly come under attack. Primarily they show the Earth emitting 300% more radiation than it receives from the Sun. This energy is being generated out of nothing and violates the 1st Law of Thermodynamics. They also show the Sun shining on the dark side of the Earth, something that just doesn't happen.

All the radiation data in these EEBs, with the exception of Long Wave Down LWD and Long Wave Up LWU infrared IR radiation at the surface, have been divided by 4. This shows the Sun shining equally on all 4 quadrants of the Earth. This has the effect of having the Earth emitting 300% more radiation than it receives from the Sun. This 300% extra radiation is supposedly being generated out of nothing by a greenhouse effect GHE in the atmosphere. It seems apparent that this divide by 4 system is being used as a means of justifying the GHE theory.

IR radiation is 100 times less energetic than visible radiation. That means the 322 W/m^2 of IR LWD is the equivalent of 3.22 W/m^2 of visible or Short Wave Down SWD radiation from the Sun.

Since it appears these EEBs are being used to calibrate climate models, it has become necessary to review these EEBs and that in turn led to it becoming necessary to generate a new Earth Energy Budget to bring some realism back into them.

This paper produces a new Earth Energy budget based on measured data. The Earth receives 1,361 W/m^2 of Short Wave Down SWD solar radiation at the top of atmosphere TOA and 1,361 W/m^2 of Short Wave Up SWU and LWU arrive back at the TOA. 589 W/m^2 of solar radiation is absorbed in the surface and 589 W/m^2 of LWU, latent heat and thermals is emitted by the surface. There is no mystery radiation being generated in the atmosphere and the budget is in balance.

Introduction

There are a number of these Earth's Energy Budgets. They all show in the order of 161W/m^2 of incoming solar radiation in the visible spectrum or SWD being absorbed by the Earth's surface and 398W/m^2 of longwave IR radiation being radiated from the Earth's surface.

Stephens et al 2012.[i]

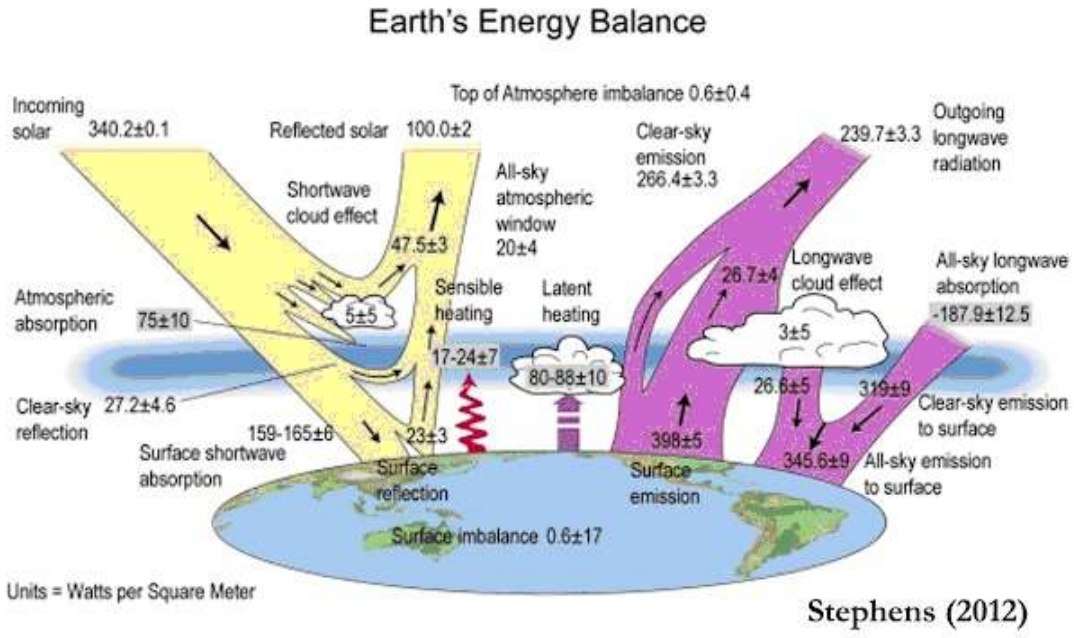


Figure 1

NASA's Energy Balance.[ii]

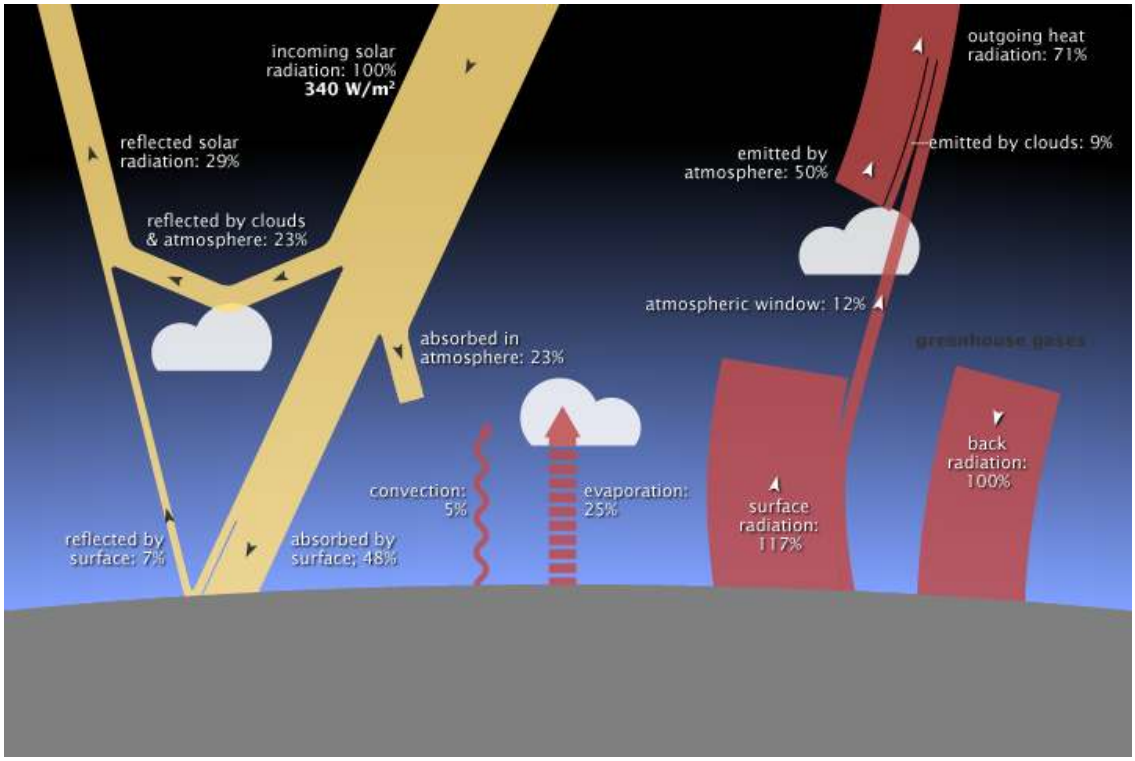


Figure 2

Kiehl and Trenberth 2009.[iii]

Kiehl and Trenberth's first energy budget was KT 97 shown below. Their 2009 budget is shown and discussed further on.

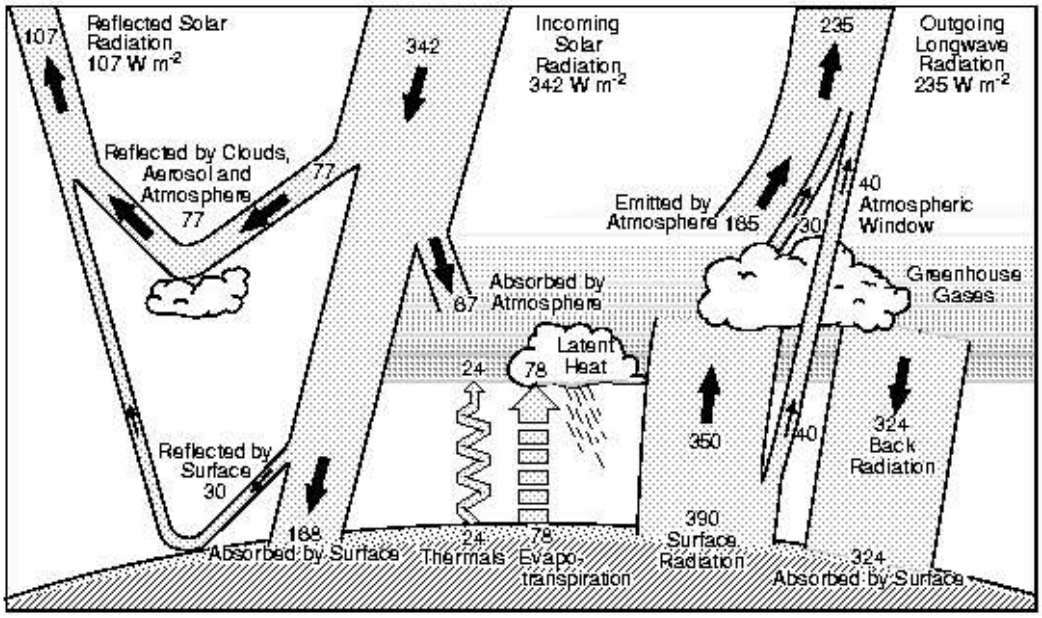


Figure 3. KT97

Wild et al 2013

Probably the paper that at least tries to explain their reasoning the most is *Wild et al 2013*.[iv]

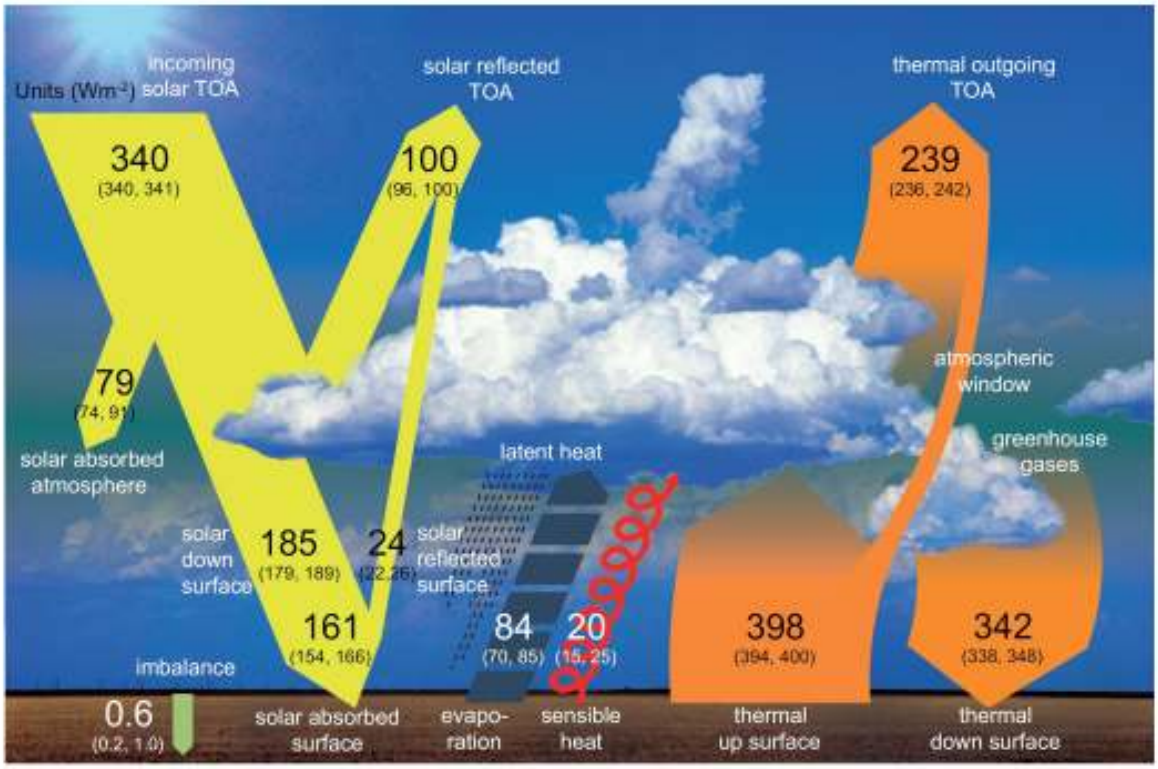


Figure 2.11: | Global mean energy budget under present-day climate conditions. Numbers state magnitudes of the individual energy fluxes in W m⁻², adjusted within their uncertainty ranges to close the energy budgets. Numbers in parentheses attached to the energy fluxes cover the range of values in line with observational constraints. (Adapted from Wild et al., 2013.)

Figure 4

All of these are obviously wrong in that they violate the laws of physics and in particularly the 1st Law of Thermodynamics in that they invent energy out of nothing. The Earth absorbs 161 W/m^2 and emits 502W/m^2 (including latent heat and thermals). The Earth is emitting 312% more energy than it received from the Sun.

A number of writers have already written critical analysis of these energy budgets.

Terigi Ciccone does a very good analysis of NASA's energy budget.[v]

> EARTH's ENERGY BUDGET. There are three fundamental components shown in the Earth's Energy Budget (EEB.)
>
> First, the information provided inside the two light blue ovals is actual measurements taken by accurate and sophisticated instruments and are the only verifiable data on this entire diagram.

there are NO VERIFIABLE NUMBERS IN THIS RED COLLECTIVE.[1] All other numbers in the red collective are estimates, guesses, and wishful thinking.

His reference shows the fallacy of the Stefan-Boltzmann Constant in calculating 398.2W/m^2 of outgoing terrestrial radiation.

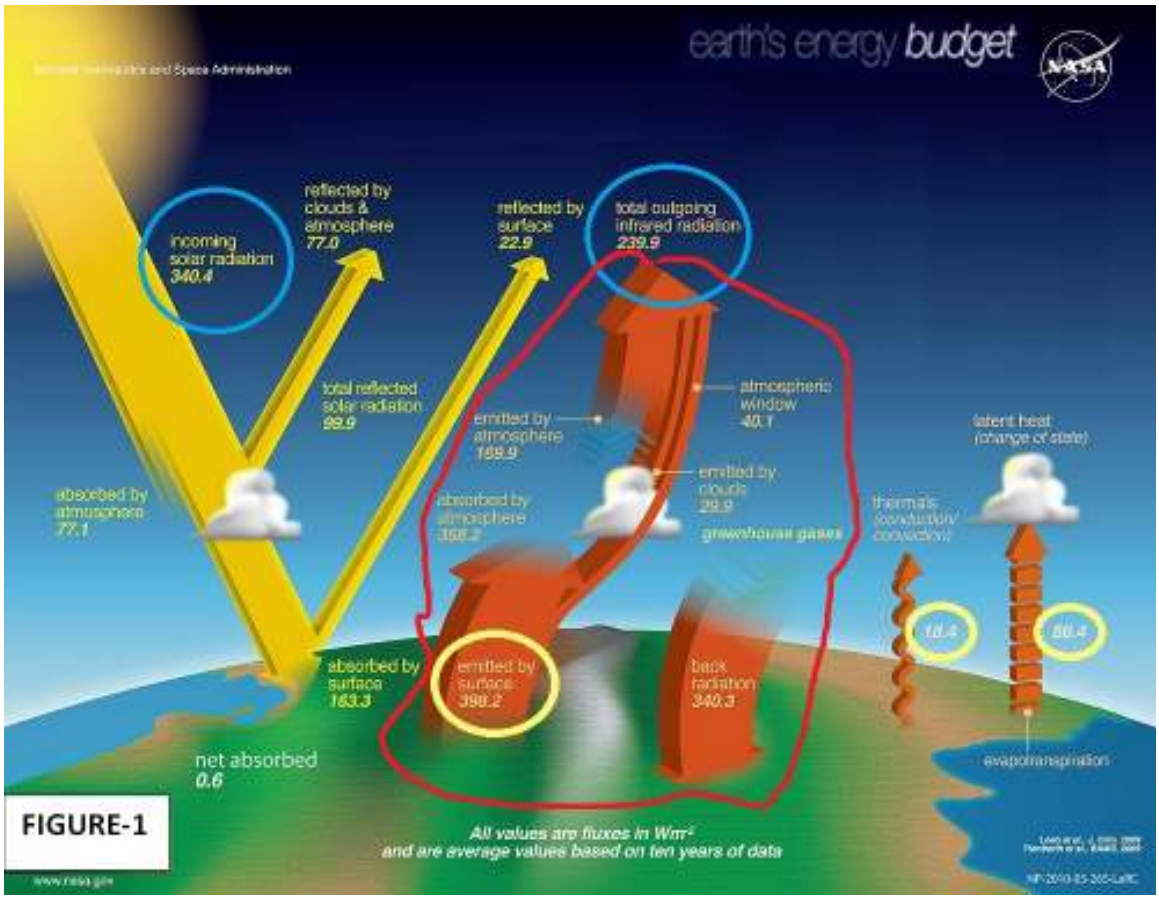


FIGURE-1

CO_2 is too diluted to warm the atmosphere. In Figure-6,[2] we see a sample of the atmosphere, an array of 10,000 air molecules, of which one is CO_2. Alarmists tell us that at 400 ppm, this one CO_2 molecule will heat up the other 2,499 molecules by an alarming amount! That is the equivalent of

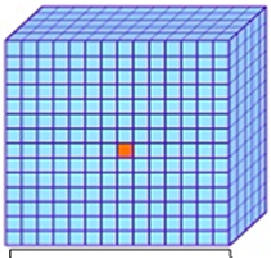


Figure-6

[1] Quote: "At the assumed average temperature of the earth (15°C, 59°F), it's 398.2 W/m^2. Source http://nov79.com/gbwm/sbc.html, The Stefan-Boltzmann Constant is in Error. It shows about 40 times too much radiation at normal temperatures. **(NASA Charts)"**

[2] ***The Stefan-Boltzmann Constant is in Error***
http://nov79.com/gbwm/emit.html , See article Heat Trapping.

saying ONE CUP OF HOT COFFEE HEATS THE OTHER 2,499 CUPS OF COFFEE TO AN ALARMING AMOUNT, REALLY?

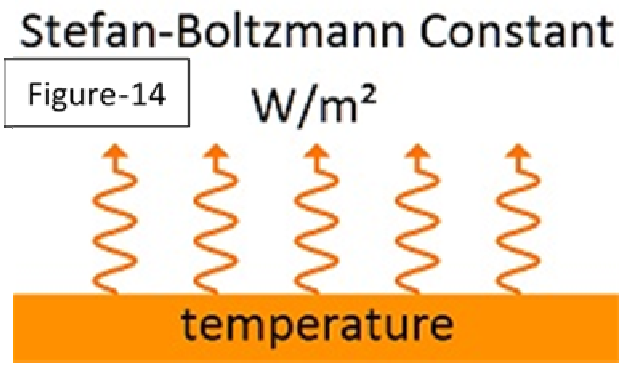
. . . there are no accurate and repeated measurements to show that the earth's surface radiates to the atmosphere 398.2 W. That is more than double the heat the surface receives from the sun;

But the Energy Budget also shows a heat source called the "Greenhouse effect of 340.3" W reinjected from the atmosphere to the surface shown inside the dark red collective in Figure-1.

- The greenhouse effect is not scientifically explainable in terms of physics, mathematics, or thermodynamics.
- The term and concept of "Radiative Forcing" or "greenhouse effect" do not exist in any physics, chemistry, or thermodynamics studies. Instead, these terms appear uniquely used and aligned only in the alleged and self-defining field of "climate change." This is not science, but science deception.
- What role does gravity have in warming the atmosphere? Is it an addition to the greenhouse effect, an alternate to the greenhouse effect, or a combination?[3]

why the Earth Energy Budget MUST BE RADICALLY REVISED OR DISCARDED ALTOGETHER.

these CO_2/GHG molecules radiate away photons in femtoseconds.[4]



9. The Stefan-Boltzmann Constant (S-BC) is wrong and wrong by a lot.[5] Figure-14 shows us the concept of the S-BC, which, according to the

[3] Theories have been put forth that show that gravity can induce atmopspheric warming using the simple Ideal gas law, see article. Josef Loschmidt's Gravito-Thermal Effect.pdf. Using data from NASA of the temperatures and atmospheric conditions of some planets and moons Nikolov and Zeller have advanced a similar gravitational warming theory, see https://www.semanticscholar.org/paper/New-Insights-on-the-Physical-Nature-of-the-Effect-Nikolov-Zeller/bddadcd85b73526f261abc74dab952913881837f

[4] A femto second is 1-quadrillionth of a second, about 1/1,000,000,000,000,000th of a second,

[5] http://nov79.com/gbwm/sbc.html

NASA earth energy budget, shows is about 40 times too much radiation at ambient temperatures. For example, the S-BC says that matter emits 459 watts/m2 of infrared radiation at a room temperature of 27°C. That is like saying that A SMALL KITCHEN TABLE IS EMITTING AS MUCH ENERGY AS FIVE 100-WATT LIGHT BULBS. It tells us that a BLOCK OF ICE RADIATES 315 W/M². That equals three 100- Watt light bulbs per cubic meter of ice, and the Earth's Surface radiates 398.2 W. Nothing like this is happening in the real world. As Richard P. Feynman stated, "*It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with the experiment, it's wrong*."

The same S-BC tells us that the earth's surface, as seen in the Figure-1 earth energy budget, is emitting 398.2 W/m2[6]. Please recall that in Figure-1, there are only two verified measurements numbers, the 340.4 W TSI arriving from the Sun to Earth and the 239.9 W exiting the earth. All the other numbers are estimates, best guesses, or speculative conjectures.

This figure of 340.3W/m^2 from Terigi Ciccone's Figure 1[vi] of downward thermal IR radiation needs a much closer scrutiny.

There's a bit more to take away from *Wild et al 2013*. He uses the stupid and meaningless term "sensible heat". This has been replaced by it's proper name, thermals or convection.

It should be noted here that Terigi Ciccone referred to all the numbers in his red collective as estimates and guesses. Wild et al did use measurements for InfraRed IR up from the surface and IR down to the surface. There are many measuring sites around the world that measure this data. However, whilst they had all the measurements, they did not use the LWU measurements. Instead used modeled estimates. They used both models and measurements for LWD.

The following are some quotations from *Wild et al 2013*.

4.2.2 Thermal radiation
The thermal radiation is of central importance in the discussion of climate change, as it is most directly influenced by changes in the concentration of

[6] QUOTE "Also, there are no square meters in the atmosphere, but climatologists needed square meters to convert 3.7 W/m² into 1°C by reversing the Stefan-Boltzmann constant. Reversing the Stefan-Boltzmann constant is not valid, because it applies to radiation emitted from an opaque surface, not from a three dimensional and transparent atmosphere. It means climatologists started at the desired endpoint of 1°C and contrived a method of getting there." Source http://nov79.com/gbwm/rte.html , Radiative Transfer Equations. The underlying science for greenhouse gases was contrived through fake math.

radiatively active gases in the atmosphere. In the CMIP5 GCMs, the net thermal budgets at the surface and in the atmosphere show larger discrepancies than at the TOA,

The surface thermal budget consists of the downward and upward flux components. From a modeling point of view, the upward flux can be determined straightforward using the surface temperature and the Stefan–Boltzman law, and is therefore affected with less uncertainty. Modeling of the downward thermal flux is more challenging, as it depends on the complex vertical structure of the physical properties of the atmosphere. It is also the flux that most immediately responds to alterations in the concentration of radiatively-active gases in the atmosphere and therefore can be seen as an indicator of the atmospheric greenhouse effect as experienced at the surface.

Downward thermal radiation measurements have historically been performed at far fewer sites than downward solar radiation measurements, since it requires a more sophisticated measurement technology (Ohmura et al. 1998). . . . **Here we use the latest status of the BSRN archive as available in June 2012 to allow the inclusion of an unprecedented wealth of observations of downward thermal radiation**.

5.2
With respect to the solar fluxes at Earth's surface, we inferred in this study a global mean value near 185Wm^2 for the downward solar radiation, which fits best to the direct surface observations (Sect. 4.2.1).

[**Note**: There is a heavy focus on models and model biases. Most of the discussion is on models.

This figure of 185Wm^2 is averaged from the GEBA and BSRN measurements averaged using models. Taken from Figure 10. Observations are determined as the sum of diffuse and direct radiation measurements which are both short wave in the visible spectrum.]

185W/m^2 is the global average solar radiation received and absorbed by the Earth's surface in the visible spectrum. 30% albedo or 100W/m^2 is based on the average global cloud cover. It can happen that at one particular site there is 0/8 cloud cover. This site will receive 285W/m^2 of solar radiation. That is balanced against, e.g., South Pole station that receives 0W/m^2 for 6 months of the year, plus other sites that might have 8/8 cloud cover.

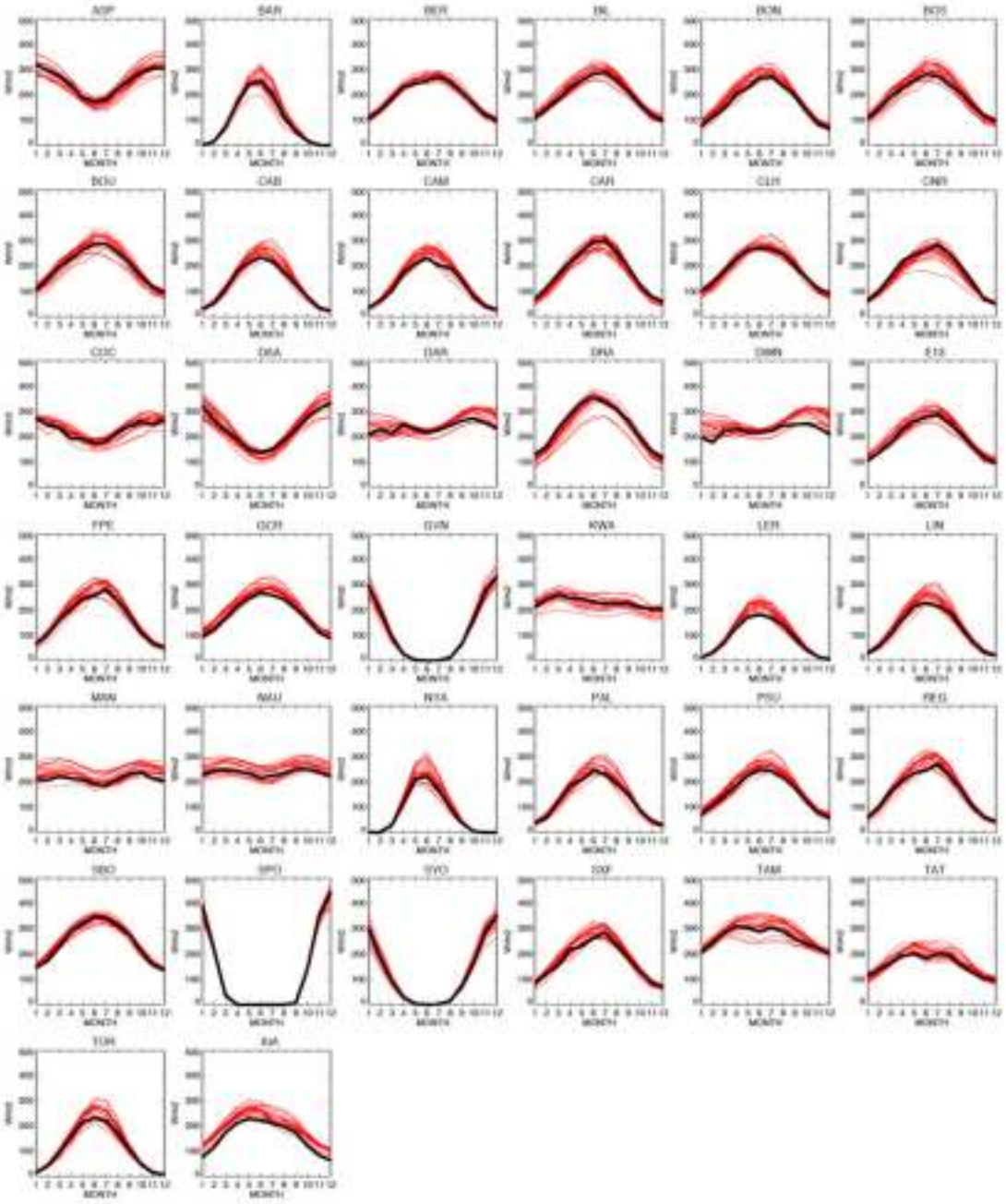


Fig. 10 Mean annual cycles of downward solar radiation at Earth's surface as observed at 38 BSRN sites (*thick black lines*) and calculated by 22 CMIP5 models (*thin red lines*). Observations determined as sum of diffuse and direct radiation measurements. For explanation of abbreviated station names and station coordinates see Table 1. Units Wm^{-2}

Figure 5

5.4

For the global mean downward thermal radiation, the **best estimate** of $342 Wm^2$ derived in Sect. 4.2.2 is used in Fig. 1. . . . . were not directly determined, but derived as residual terms in the surface energy balance equation. . . . Since these residuals were estimated on a global mean basis, they cannot be directly evaluated against surface observations.

> Independently, Ohmura (2012) estimated the global mean downward thermal radiation from BSRN observations at 345 Wm^{-2} . . . the models show a tendency to underestimate the downward thermal radiation
>
> The upward thermal flux from the surface can be more straightforward determined than the downward flux discussed above and is less controversial, as it essentially requires the knowledge on the distribution of surface temperature and the Stefan–Boltzman law. . . . The multimodel mean and median upward thermal radiation calculated by these climate models are both close to 397 Wm^{-2}

It becomes obvious why all the lead up discussion focuses heavily on models and model biases. They have used this in an attempt to justify their global mean downward thermal radiation.

> 5.5 Surface net radiation
> From the best estimates for the thermal exchanges in Fig. 1 (397 Wm^2 up, 342 Wm^2 down) a net surface thermal cooling of -55 Wm^2 can be inferred.
>
> 5.6 Non-radiative surface energy fluxes the sensible heat [*thermals/convection*] flux is the one that is perhaps least constrained by observations. . . . we therefore have to rely largely on modeling studies.
>
> for the latent heat flux there are observations that have the potential to be used as constraints on a global basis. The latent heat flux is the energy equivalent of the surface evaporation, which on a global mean basis must equal precipitation. . . . Global mean precipitation according to the Global Precipitation Climatology Project (GPCP, Huffman et al. 2009) is estimated at 2.6 mm/day, corresponding to a latent heat flux equivalent of 76 Wm^2 . . . GPCP value is much more underestimated and put their best estimate at 88(± 10) Wm^2

Britannica confirms 1,000mm/year average which equals 2.74mm/day.[vii]

Wild et al 2013 use 185 Wm^{-2} for the downward solar radiation. This figure was derived from measurements and models. They use data from the Global Energy Balance Archive (GEBA, *Gilgen et al. 1998*; *Ohmura et al. 1989*) and the database of the **Baseline Surface Radiation Network (BSRN**, *Ohmura et al. 1998*). Primarily BSRN. They provide no measurements for the 24W/m^2 reflected from the surface. This is described as a ‘best estimate” and is derived from CMIP5 models.

EEB IPCC Global Mean

It should be noted here that the data for short wave up and down are averaged to a global mean and are not measurements. They are based on the solar constant which is a measurement. The following is a reference that is no longer on the Internet. It was probably Wiki which has since been updated.

> **Solar constant**
> The "solar constant" is the total solar irradiance at top of atmosphere, where the Earth directly faces the Sun, when the Earth is one AU from the Sun. Estimates of its value, from about forty years of satellite measurements, are in the range of 1360 to 1373 W/m²[2][3], with recent estimates toward the lower end of that range. Just how "constant" the Solar Constant really is is disputed[1][2]. (The average irradiance over the entire Earth is 1/4 of that, so if the solar constant is taken as 1365±5 W/m² then average irradiance is 341.25±1.25 W/m², because the surface area of a sphere is 4× the area of a circle of same radius.)

The 340 W/m² of solar radiation reaching the Earth's TOA is not a simple divide by 4. It has been determined from *Loeb et al 2009*[viii]. They take actual measurements and convert them to a "best estimate". They have taken an approximate 1361W/m^2 raw data measurement. That is put through a constrainment algorithm, a divide by 4.0034 to convert it to a global average, then put through a model. The divide by 4.0034 implies that the 4 quadrants of the Earth are not equal.

Wild et al 2013 have 340W/m^2 of short wave SW solar radiation hitting the Earth and 339W/m^2 of long wave LW infrared radiation going back to space. They make no allowance for the 79W/m^2 that disappeared into a black hole in the atmosphere and never came out. For a balance they need the Earth emitting the same as it receives. They have balanced the SW budget only.

> 4.1 TOA radiation budgets
> According to the CERES EBAF satellite data product (Loeb et al. 2009), the global mean reflected shortwave TOA flux for the period 2001–2010 amounts to 100 Wm^{-2}, with a stated uncertainty in absolute calibration alone of ~2 % (2-sigma), corresponding to 2 Wm^{-2}. The EBAF data set adjusts the solar and thermal TOA fluxes within their range of uncertainty to be consistent with independent estimates of the global heating rate based upon in situ ocean observations (Loeb et al. 2012; Loeb et al. 2009). The 100 Wm^2 adjusted in this way are at the upper end of this uncertainty range which spans from 96 to 100 Wm^{-2} (Loeb et al. 2009). . . . The close

agreement of the GCMs with the satellite estimate from CERES EBAF is not surprising, since the cloud schemes of the GCMs are usually tuned to match the satellite reference values on a global mean basis.

5.2 Surface solar fluxes

An estimate of the reflected solar radiation at Earth's surface is obtained in Fig. 1 considering in addition to the downward solar radiation the surface albedo. Assuming a global mean surface albedo of 0.13, from the best estimate of 185 Wm^{-2} solar energy incident at the Earth's surface, 24 Wm^{-2} are reflected. The value of 0.13 corresponds to the multimodel mean albedo of the CMIP5 models used here.

5.3 Atmospheric solar absorption

Combining our best estimates of TOA and surface absorbed solar radiation in Fig. 1, 240 and 161 Wm^{-2}, respectively, leaves an amount of 79 Wm^{-2} as a residual for the absorption of solar radiation in the atmosphere. This amount coincides with the independent estimate given by Kim and Ramanathan (2008), who integrated global data sets for aerosols, cloud physical properties, and radiation fluxes with a Monte Carlo Aerosol-Cloud-Radiation (MACR) model to determine an atmospheric solar absorption of 79 Wm^{-2}.

Kiehl and Trenberth's Earth Energy Budget

Kiehl and Trenberth 2009 produced another Earth Energy Budget.[ix] This was an update on KT97 the original *Kiehl & Trenberth 1997* Earth Energy Budget.[x]

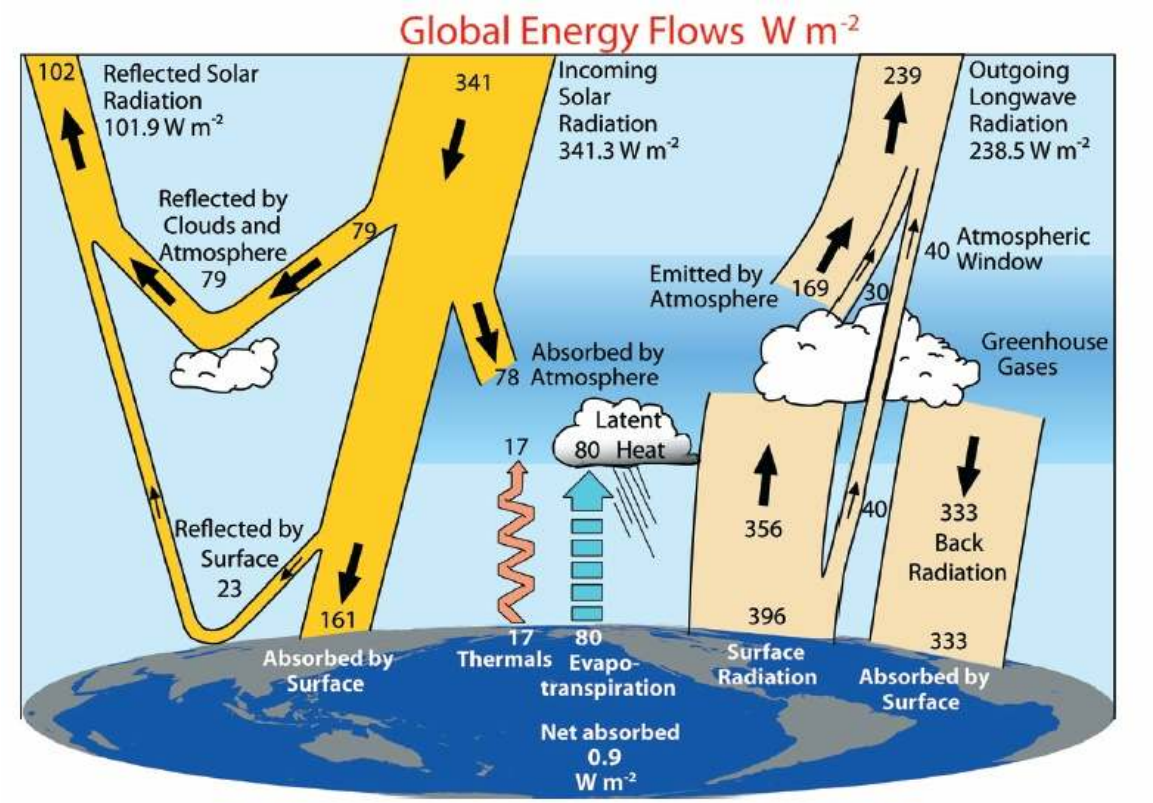


FIG. 1. The global annual mean Earth's energy budget for the Mar 2000 to May 2004 period (W m^{-2}). The broad arrows indicate the schematic flow of energy in proportion to their importance.

Figure 6

At the surface, the outgoing radiation was computed for blackbody emission at 15°C using the Stefan–Boltzmann law

$$R = \varepsilon\sigma T^4, \quad (1)$$

where the emissivity ε was set to 1.

At the TOA our values are determined from the CERES values as adjusted by *Fasullo and Trenberth (2008a)*. As noted in the "Datasets" section, the TOA energy imbalance can probably be most accurately determined from climate models

Global precipitation should equal global evaporation for a long-term average

Table 2b. Surface components of the annual mean energy budget for the globe, global land, and global ocean, except for atmospheric solar radiation absorbed (Solar absorb, left column), for the CERES period of Mar **2000 to** May **2004 (W m−2). Included are the solar absorbed at the surface (Solar down), reflected solar at the surface (Solar reflected), surface latent heat from evaporation (LH**

evaporation), sensible heat (SH), LW radiation up at the surface (Radiation up), LW downward radiation to the surface (Back radiation), net LW (Net LW), and net energy absorbed at the surface (NET down). HOAPS version 3 covers 80°S–80°N and is for 1988 to 2005. The values are from ISCCP-FD, NRA, JRA, and this paper. For the ocean, the ISCCP-FD is combined with HOAPS to provide a NET value.

Global	Solar absorbed	Net solar	Solar reflected	LH evaporation	SH	Radiation up	Back radiation	Net LW	NET down
ISCCP-FD	70.8	165.7	22.8	-	-	393.9	345.4	48.5	-
NRA	64.4	160.4	45.2	83.1	15.6	396.9	336.5	60.4	1.3
JRA	74.7	169.8	25.6	90.2	19.4	396.9	324.1	72.8	−12.6
This paper	78.2	161.2	23.1	80.0	17	396	333	63	0.9

There is widespread agreement among the other estimates that the global mean surface upward LW radiation is about 6Wm^{-2} higher than the values in KT97 owing to the rectification effects described in the "Spatial and temporal sampling" sidebar. We adopt a value of 396Wm^{-2}, which is within 2.1Wm^{-2} of all estimates but is dependent on the skin temperature and surface emissivity (*Zhang et al. 2006*) and can not be pinned down more accurately. To compute the land and ocean contributions, we use the ISCCP-FD ratios.

This leaves the downward and net LW radiation as the final quantities to be computed as a residual.

our revision estimates are 333 and 63 Wm^{-2} for the downward and net LW.

Kiehl & Trenberth 1997 estimated radiative forcing using models. They did not measure downwelling IR radiation, this was calculated with a radiative model. The radiative forcing for the individual gases was also estimated with the same model.

They used the Stefan–Boltzmann equation for blackbody emission at 15°C and an emissivity of 1. Emissivity of 1 is wrong and by a lot. Nasif Nahle calculates emissivity for CO_2 at 0.002[xi]

Their radiative forcing is wrong by a lot. Radiative forcing has never been measured in any experiment, it is always assumed. There has only ever been one scientific experiment where there was an attempt to measure the warming of the Earth from radiation coming from CO_2 molecules. That was *Wong & Minnett*

2018[xii]. They measured 0.0000000000°C of warming. If radiative warming is zero then radiative forcing can be nothing else but 0.0W/m^2.

Radiation Measurements

There are thousands of measuring stations around the world that measure radiation. The following have been used in this paper.

Baseline Surface Radiation Network - BSRN

The BSRN Archive is at the Alfred Wegener Institute (AWI) (http://www.bsrn.awi.de/). It is part of the World Radiation Monitoring Center (WRMC). BSRN measurements are taken using different instruments. They use a Pyranometer which measures all sky diffuse radiation in the visible spectrum. A Pyrheliometer which measures direct solar radiation. They also use a pyrgeometer for measuring downward thermal IR radiation. BSRN take radiation measurements from some 50 sites, 8 of these they also publish with the **Global Monitoring Laboratory GML** https://gml.noaa.gov/grad/surfrad/dataplot.html. GLM publish in a different format which has additional benefits.

BSRN add direct and diffuse radiation to give a global radiation figure. They don't measure net. Their published measurements are raw data, not globally averaged. They say they *use the latest status of the BSRN archive as available in June 2012 to allow the inclusion of an unprecedented wealth of observations of downward thermal radiation*. However from page 2130 of their paper *Ohmura et al 1998*:[xiii]

Ohmura et al published no BSRN measurements of downward thermal LW or SWD radiation data. The LWD data they used averaged 330 W/m^2 using 8 different models in Figure 8. Their downward shortwave irradiance SWD absorbed by the surface from Figure 7 averaged 170 W/m^2 from the same 8 models. This was a global average after dividing the total by 4.

The general citation for BSRN is:

Driemel, A., Augustine, J., Behrens, K., Colle, S., Cox, C., Cuevas-Agulló, E., Denn, F. M., Duprat, T., Fukuda, M., Grobe, H., Haeffelin, M., Hodges, G., Hyett, N., Ijima, O., Kallis, A., Knap, W., Kustov, V., Long, C. N., Longenecker, D., Lupi, A., Maturilli, M., Mimouni, M., Ntsangwane, L., Ogihara, H., Olano, X., Olefs, M., Omori, M., Passamani, L., Pereira, E. B., Schmithüsen, H., Schumacher, S., Sieger, R., Tamlyn, J., Vogt, R., Vuilleumier, L., Xia, X., Ohmura, A., and König-Langlo, G.: Baseline Surface Radiation Network (BSRN): structure and data description (1992–

2017), Earth Syst. Sci. Data, 10, 1491-1501, doi:10.5194/essd-10-1491-2018, 2018.

Antarctica

At Mawson in the Antarctic in 1974, the following instruments were installed. A Pyranometer, Pyrheliometer and a Pyrradiometer which measures net radiation being the difference between downward radiation in the visible spectrum and upward terrestrial IR radiation. The data was recorded on paper rolls. These were scaled as daily average measurements each month using a planimeter.



Figure 7 - Radiation trace


Figure 8 - Planimeter

This monitoring was only carried out for a short period of 3 years before being abandoned. These Mawson measurements from 1974 to 1977 are now available on the GEBA database. There are now four Antarctic sites that record radiation monitoring, SPO - South Pole Station, GVN – Neumayer - German station, DOM – DomeC - Italian and the Japanese station of SYO - Syowa. Their data is available on both GEBA and BSRN.

Global Energy Balance Archive - GEBA

https://geba.ethz.ch/

The Global Energy Balance Archive (GEBA) is a central database for the instrumentally measured energy fluxes at the Earth's surface, maintained by the Institute for Climate and Atmospheric Sciences at ETH Zurich. GEBA stores monthly means of the various energy balance components observed at worldwide distributed stations and currently contains 2,500 stations. Contact is Martin Wild.

"GEBA is co-funded by the Federal Office of Meteorology and Climatology MeteoSwiss within the framework of GCOS Switzerland."

National Data Buoy Center

The National Data Buoy Center or NDBC run by NOAA has 74 buoys, mostly in the Pacific Ocean with some in the North Indian Ocean. They measure short wave down data only. Their general ocean buoy search page is at:
https://tao.ndbc.noaa.gov/tao/data_download/

Clouds and the Earth's Radiant Energy System (CERES)

https://ceres.larc.nasa.gov/

Data availability from:
https://terra.nasa.gov/data/ceres-data
https://ceres.larc.nasa.gov/Data/

CERES is a satellite that measures upward radiation both shortwave and longwave. No raw data is available, all available data has been processed to a global average. There is no LW channel on CERES, LW daytime radiances are determined from the difference between the TOT [*filtered radiances in the SW (wavelengths . . . total (wavelengths between 0.3 and 200 mm*)] and SW channel radiances. *Loeb et al 2009*[xiv]. The principal contact at CERES is Dr Norman Loeb, the author of this paper.

Earth Radiation Budget Satellite (ERBS)

One of the National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites (NOAA-9 or NOAA-10). Measures shortwave and longwave up.

NASA's NIMBUS 11 Satellite

Measures shortwave and longwave up. Unlike CERES, NUMBUS 11 has an IR radiometer.[xv]

COADS

Global marine data observed during 1854-1979, primarily by ships-of-opportunity, Comprehensive Ocean-Atmosphere Data Set (COADS). 70 million unique reports contains 28 elements of weather, position, etc of air and sea surface temperatures, wind, pressure, humidity, and cloudiness, plus 11 derived variables. Ships don't measure radiation.
ICOADS
https://icoads.noaa.gov

Data in netCDF format .nc.

Atmospheric Window

Wild et al 2013 mentioned the atmospheric window but made no allowance. *Stephens et al 2012* allowed 20Wm^{-2} IR LWU for the window. NASA allow 40Wm^{-2}. *Kiehl and Trenberth 2009* allow for 40Wm^{-2}. No one explains where these values come from. They are all guesses. When one looks at the OLR spectrum, the window encompasses approximately 10% of the OLR spectrum.

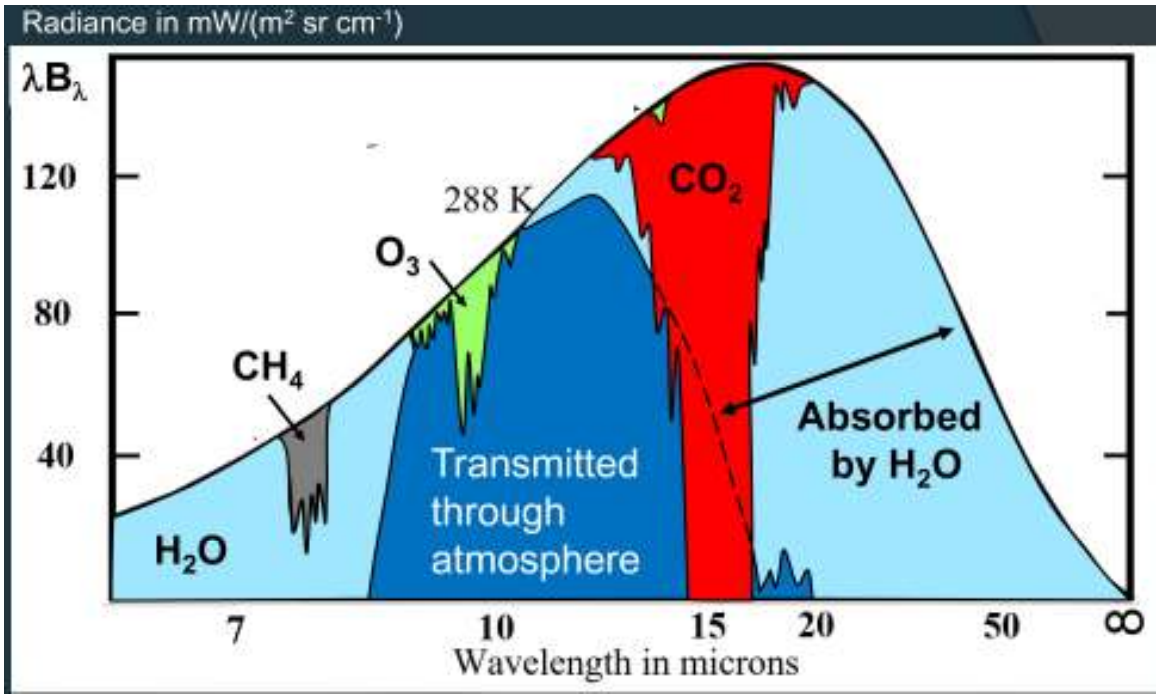


Figure 9

So if 240Wm^{-2} of IR LWU are being transmitted to space, approximately 24Wm^{-2} are being transmitted directly to space via the atmospheric window. None of this is being absorbed and emitted by radiatively active molecules in the atmosphere.

Evaporation

The latent heat flux is the energy equivalent of the surface evaporation, which on a global mean basis must equal precipitation. Global precipitation is 2.6 to 2.7 mm/day per location. This corresponds to a latent heat flux equivalent of 76Wm^{-2}. 76Wm^{-2} is almost half of the total solar radiation absorbed by the Earth's surface. This is a sizable amount and hence Wild et al's latent heat flux calculations are assumed correct. Wild et al felt their calculation was underestimated and allowed for 84Wm^{-2}.[xvi] Wild et al used CMIP5/IPCC AR5 models for their calculations.

After validating these calculations the results are similar. For this validation precipitation data was used from Our World in Data.[xvii] This gives global precipitation of 3.32mm/day. After converting the mass of 1 m^2 of precipitated water to Joules using the formula:

Q = mL

where:

- m [kg] – Mass of the body;
- L [kJ/kg] – Specific latent heat; and [L = 2264.7]
- Q [kJ] – Heat absorbed or released depending on the direction of the transition.

The following formula was then used:

$P_{(W)} = E_{(J)} / t_{(s)}$

Where: The power P in watts (W) is equal to the energy E in joules (J), divided by the time period t in seconds (s)

To convert Joules to W/m^2.

3.32mm/day equates to 89 W/m^2.

Thermals and Convection

Wild et al 2013 allow for 20W/m^2 in thermals & convection. All guessed from models. There are no measurements for thermals. There is a formula.[xviii]

order to obtain the turbulence statistical values to establish a wall function of the turbulent k–ε model. The averaging time of the statistical values was 5 min.

Before survey-1a, we confirmed a small horizontal distribution of surface temperature on the rooftop by infrared radiation images. Conductive heat sensors were painted the same colours at the two measuring sites in order to maintain the same solar reflectance and emissivity.

2.2. Method for estimating the CHTC

The CHTC was identified from a set of measurement data based on the following process.

A heat balance equation on a general surface can be expressed by Eq. (1). Then, the convective heat flux on a sunny day in a succession of sunny days can be drawn if the terms of the net radiation and conductive heat flux are measured, since the evaporation rate can be neglected.

$$R_{net} + CD + CV - l \cdot EV = 0, \quad (1)$$

where, CD is the conduction heat flux (W m^{-2}), CV the convection heat flux (W m^{-2}), EV the evaporation rate

The CHTC can be estimated by the following equation using the convective heat flux and the temperature difference between air and the surface.

$$h = CV/(T_{air} - T_{surf}), \quad (2)$$

where, h: convective heat transfer coefficient (CHTC) (W m^{-2} K^{-1}), T_{air}: air temperature [K], and T_{surf}: surface temperature [K].

In survey-1a, the net radiation was measured only at point 10. Then, the net radiation rates at the other measuring points were estimated based on Eq. (3).

$$LR = \varepsilon \cdot (F_{i,wall} \cdot LR_{wall} + F_{i,sky} \cdot LR_{sky} - \sigma T_{surf}^4), \quad (3)$$

where, $F_{i,j}$ is the configuration factor from the point i to faced j, LR_j the long wave radiation from the faced j (W m^{-2}), SR the net solar radiation (W m^{-2}), ε emissivity (assumed as $\varepsilon = 1.0$), σ the Stefan–Boltzman constant (W m^{-2} K^{-4}), subscript i the measuring point, subscript sky the sky, and subscript wall the wall around the measurement site.

The long wave radiation rates from the wall of the neighboring four-storey building and sky were identified from the

Conversion of thermals and latent heat to IR Electro Magnetic Radiation EMR

Allowing for the 20W/m^2 guess for thermals as being correct, we have 104W/m^2 leaving the surface as thermals and latent heat. This ultimately leaves the atmosphere to space as IR radiation. NASA, in their Climate and Earth's Energy Budget, do not explain how this happens. Thermals and latent heat are warmed air and evaporated water that rise and heat up the atmosphere above. Terigi Ciccone tries to explain under his section on ***How the atmosphere cooled?***[xix]

> When water vapor condenses in the atmosphere, most of its heat is lost in complex ways. First, some of this heat is radiated to space. . . . as these products fall towards the surface, the atmosphere loses some additional heat by conduction as they interact with the atmospheric gasses. And finally, when these condensed products reach the surface, they also cool the surface. . . . Dr. Richard Lindzen, MIT atmospheric physicist and lead author of the UN/IPCC AR3 report . . . tells us we do not know how the atmosphere cools. We do not understand atmospheric science, dynamics, and circulations. It is too complex
>
> Black body radiation is all infrared radiation given off by the earth and increases with temperature.

The laws of thermodynamics say that the thermal radiation is a result of the temperature of the atmosphere . . . the infrared radiation being emitted and transferred within the atmosphere is simply a result of the temperature, not the cause of the temperature, and to argue otherwise violates causality.[xx]

Ultimately this 104W/m^2 leaving the surface as thermals and latent heat is converted to IR EMR and radiated to space. Some of this conversion happens in clouds. All latent heat is converted to IR in clouds. Clouds form 67% of the Earth's surface. These are all formed from latent heat of evaporation of ocean moisture. Some thermals disappear up cumulonimbus clouds. Everything that has a temperature above absolute zero emits IR EMR. Clouds emit IR EMR from the water and ice in them. These emissions are independent of the absorption and emission of terrestrial IR radiation. Cloud IR emissions are where latent heat of evaporation is converted to radiation.

Radiation from a thermalized atmosphere

The atmosphere is thermalized from both above and below. Thermals from the surface warm the atmosphere from below. Incoming solar radiation warms the atmosphere from above. NASA Science explains.[xxi]

> *Incoming ultraviolet, visible, and a limited portion of infrared energy (together sometimes called "shortwave radiation") from the Sun drive the Earth's climate system. Some of this incoming radiation is reflected off clouds, some is absorbed by the atmosphere, and some passes through to the Earth's surface. Larger aerosol particles in the atmosphere interact with and absorb some of the radiation, causing the atmosphere to warm. The heat generated by this absorption is emitted as longwave infrared radiation, some of which radiates out into space*.

And.

> *All absorbed radiation is thermalized i.e. the absorbed energy is shared with surrounding molecules*.[xxii]

The stratosphere, the area of the atmosphere between the tropopause and the stratopause, warms with increasing height. This is as a result of incoming solar radiation in the UV spectrum being absorbed by ozone.[xxiii]

Oxygen also absorbs UV breaking it into two oxygen atoms. Ozone is destroyed by UV but as fast as it is destroyed it reforms by a separate chemical process.[xxiv]

> *Because the coordinate covalent bond in ozone is weaker than a traditional covalent bond, the bond is free to 'wiggle' about a bit. This means that the ozone can absorb a range of frequencies of photons*.[xxv]

Most UV is absorbed in the stratosphere.[xxvi]

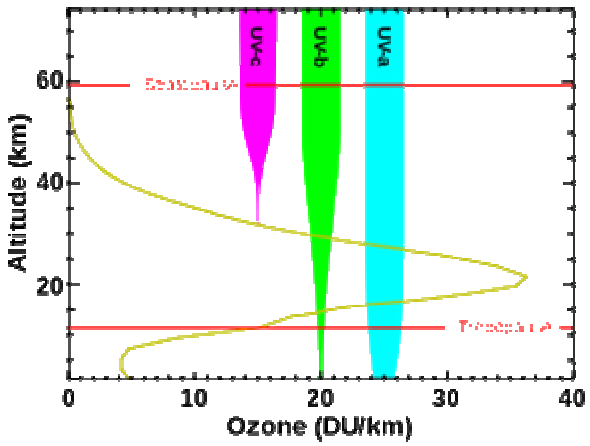


Figure 10

Solar Radiation TOA			Earth's Surface	
	%	W/m^2	%	W/m^2
UV	10%	136	4%	54
Visible	40%	544	43%	585
IR	50%	681	53%	722
Total	100%	1,361	100%	1,361 [xxvii]

When UV is absorbed by ozone and oxygen in the stratosphere it thermalizes the stratosphere.[xxviii] Some UV is re-emitted back to space. The thermalized stratosphere then emits IR. Some goes up and some down but because of the altitude, most IR emissions go to space.

Additionally, visible solar radiation is absorbed in the atmosphere which also thermalizes the atmosphere causing it to emit IR. Some of this absorbed radiation is re-emitted back to space. In the same way the surface absorbs visible solar radiation and re-emits IR, so too does the atmosphere.

A New Earth's Energy Budget

In light of all the aforementioned, these EEB diagrams require updating to make them closer to being realistic and not a fabrication. The Earth can't radiate more than it receives in solar radiation. That violates the laws of physics and thermodynamics. The Sun does not shine on the dark side of the Earth. It would appear that these Earth Energy Budgets are being used to calibrate climate models.[xxix] In order to justify the greenhouse effect producing radiation out of nothing in the atmosphere the proponents of these EEBs needed to divide the

incoming SW radiation by 4. In order to produce realism into these budgets, it has become necessary to produce a new Earth Energy Budget.

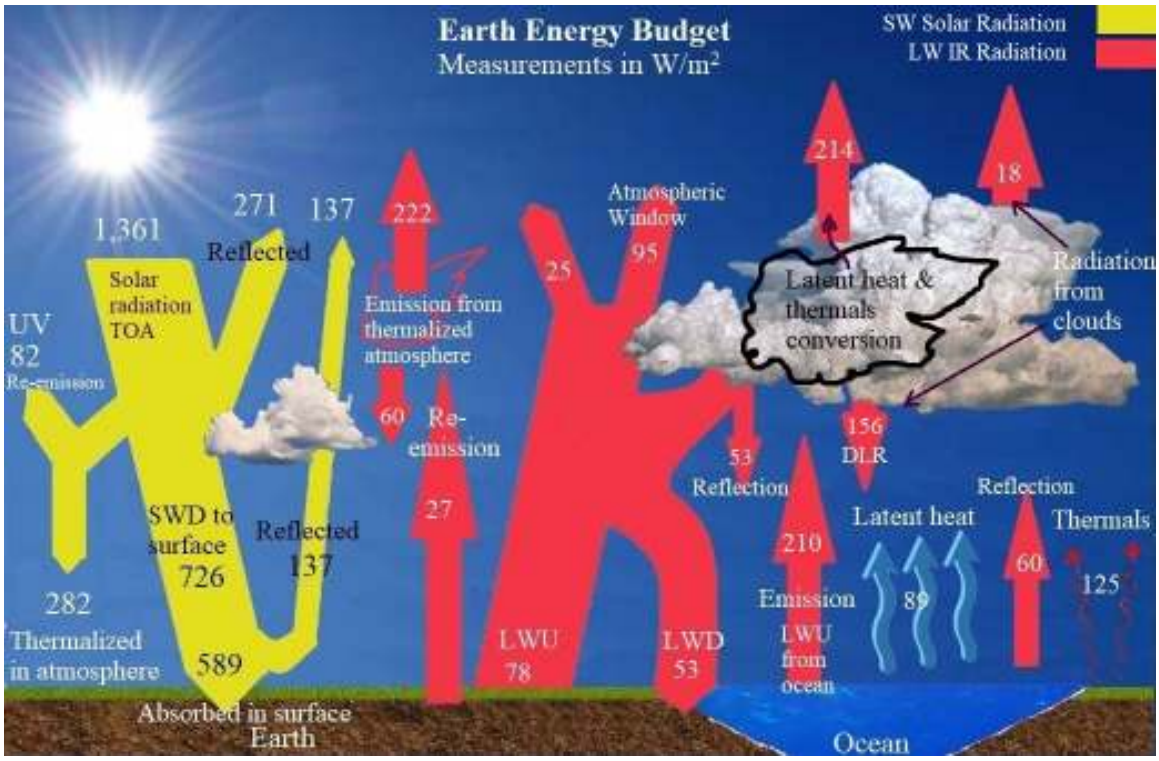


Figure 11 - Revised Earth's Energy Budget

The data for this budget has been taken from measurements in so far as measurements are available. Measurements have been taken from most of the measurement databases mentioned above. A solar constant of 1,361 W/m^2 is used which is the latest available data from Total Irradiance Monitor (TIM).[xxx] SWD, LWD and LWU measurements have all been averaged over time including day and night but not globally averaged.

There are very few measurements for LWU over the ocean. Only two were found. *Behr 1990*[xxxi] have one measurement which was an average for just one day. The Chesapeake platform had measurements which were affected by a shadow from the platform for half of each day.[xxxii] All of the papers describe the difficulties of measuring LWU over the oceans. The pyranometers for LWU measurements over ocean from ships and ocean buoys need gyro mounts to eliminate wave motion.

This paper has done what all these other papers have done and calculated LWU IR emissions over ocean using the Stefan-Boltzmann equation. It has to be mentioned that Terigi Ciccone has pointed out the SB equation is wrong[xxxiii]. The SB equation says that ice emits 315 W/m^2 of IR at 0°C. According to Terigi, that's the equivalent of 3 x 100W light bulbs. Theoretically the ice is melting at that rate.

South Pole station has ice radiating 139 W/m^2 of IR at -51°C both measured and that ice is not melting. Dome C in the Antarctic measured 147W/m^2 at -47°C, both measured, IR radiation from ice. These measurements accord with the SB equation.

Just on this Stefan-Boltzmann equation and LW measurements from the Earth. A 1 m^2 block of ice radiates between 140 W/m^2 to 315 W/m^2 of IR. If you put a hand near that block of ice you cannot feel any heat. You can feel the cold radiating from the ice. The ice is radiating IR at 0°C or below. It would probably be more appropriate to say the hand is radiating IR to the ice and in giving off that IR the hand cools. The hand is always giving off IR but appears to be forced to give off more IR when it is placed near a block of ice.

This 150 W/m^2 of IR that radiates from the ice is not the same as the 150W that radiates from a spot light. As Joseph Postma points out, *you're comparing W/m^2, with just W, when you compare to spot lights and bulbs. The W/m^2 of a bulb is actually in the millions, because the surface area of the filament is extremely small. The filament has to get to thousands of degrees to produce the 100W, and get so hot that it emits in the visible, not just the IR*[xxxiv]. The emitted intensity at the surface of a 100W bulb would be about 8800 W/m^2. But the intensity of the light one meter from that bulb would be about 8 W/m^2.[xxxv]

But there is more to it than that. Patrice Poyet points out: *Planck's equation stating that **more energy cannot be radiated by a radiation shifted to a longer wavelength (from SW to IR) as E=hv always stands**. . . . this energy is re-emitted in IR, with photons that are 100 times less energetic (IR) than those in the visible wavelengths (SW)* [xxxvi]. Nasif Nahle says that *the longer the wavelength is, the lower the energy density of that quantum/wave is*.[xxxvii] He then seems to say that radiation from a cooler body does not have the *energy required to excite an electron for it shifts from a lower quantum microstate to the next higher quantum microstate*. I.e. It gets absorbed but does not have the energy to change it's state. Radiation from a cold body can't warm a warmer body.

I.e. If you stand out in the 726 W/m^2 of solar radiation in the middle of the day you can feel it. Go outside in the night and stand in the 322 W/m^2 of IR you can't feel anything. That is because you are standing in radiation that is 100 times less energetic. You are standing in the equivalent of 3.22 W/m^2. IR energy from a 100W incandescent lamp is less than 1 micron wavelength and is 100 times more energetic than IR coming from a block of ice. There is a large difference between SW and LW radiation. They are not equal in terms of energy.

71% of the Earth's surface is ocean and 67% is covered by clouds. The oceans do not absorb IR[xxxviii] but the oceans emit IR. There is significant IR emission from

clouds both up and down. When there is cloud cover over the oceans, most LWD from clouds is reflected off the oceans and most LWU is reflected off the water and ice in clouds, whether over the ocean or not. There will be some absorption and emission by water vapor molecules in clouds as well.

In this new Earth's Energy Budget, LWD has been apportioned between radiation from clouds, reflection off clouds and the oceans, radiation from a thermalized atmosphere and radiation from radiatively active molecules in the atmosphere.

Although SWD has a global average of 726 W/m^2 arriving at the Earth's surface, noon time peaks average between 1,000 W/m^2 and 1,250 W/m^2. The peak SWD was a measurement taken from Mawson Antarctic in 1974 where the December average was 1,360 W/m^2. The Sun didn't set during December.

Albedo of Long Wave Down IR Radiation over the Ocean

Wong & Minnett 2018[xxxix] showed that IR radiation penetrates the ocean to a depth of just a few micrometres.[xl] That means that almost all Downwelling Longwave Radiation DLR or LWD will be reflected off the ocean surface. I.e. LWD has an albedo. There has never been any scientific experiment to measure this albedo. There are almost no measurements of LongWave Up LWU radiation from oceans.

There has only been two measurements of LWU radiation. One was *Behr 1990*[xli] in 1987. This was a 4 week cruise between 40S and 40N. Albedo was measured for Shortwave Down SWD radiation but not LWD. To measure LWD albedo, the instrument pointing down at the sea surface needs to have a screen to block all LWD and measure just the LWU from the ocean while with a separate instrument also measuring LWU without the screen at the same time and place. This has never been done.

Fung 1984[xlii] published Sea Surface Temperature - SST from *Alexander and Mobley 1976*[xliii]. The nearest comparable SST to *Behr 1990* was Atlantic Ocean Summer at 40N was 290K. This equates to 401W/m^2 LWU from the SB equation. *Behr 1990*'s one day measurement was 441 W/m^2 at 30°44'S with no SST taken.

The only other LWU and SST measurements we have are from Chesapeake Light Station. This is at 37N off the US coast in the Atlantic Ocean. Measurements were taken between 2000 and 2014 and averaged 442 W/m^2 with an average SST of 290K. This site has a unique feature in that the platform containing the instruments was in the Sun shadow during the morning affecting the shortwave radiation up and down. There was a clear difference between LWU measurements from AM to PM. This is shown in the COVE – CERES Ocean Validation Experiment[xliv].

Top of Atmosphere TOA radiation measurements from satellites

LWU to space has been taken from satellite measurements. The main data source for TOA measurements is CERES. The NASA contact to retrieve this data is Dr Norman Loeb. Data has to be ordered. He has published his data in his paper *Loeb et al 2009*.[xlv] All data for both SWU and LWU has been put through a global average calculation.

Incoming solar radiation is based on assuming a solar constant of 1365W/m^2

Outgoing SW and LW should also be 1365W/m^2

Outgoing LW is 234.4W/m^2

Albedo is 106.9W/m^2

No where in this paper are their outgoing measurements of 1365W/m^2

They have taken an approximate 1365W/m^2 raw data measurement. That is put through an algorithm, a divide by 4.0034 to convert it to a global average, then put through a model.

Worse, there is no LW channel on CERES, LW daytime radiances are determined by subtracting two different SW measurements.

It is difficult to call their end result a measurement and one cannot simply multiply by 4.0034 to get back to the raw measurement. Their end results are referred to as a "best estimate". They have taken raw data and converted that to a best estimate.

There are measurements taken from NIMBUS 11 that does have a LW channel. These were published in a 1968 paper by Ehrhurd Ruschke.[xlvi] Strangely even in 1968 Ruschke still published his data as a global average.

> *The reflected solar radiation and the outgoing long-wave radiation were measured in the spectral ranges from* ***0.2 to 4.0 microns*** *and from* ***5.0 to 30.0 microns*** *with a medium-resolution radiometer*.

Regarding Outgoing Longwave Radiation OLR. The satellite measured filtered radiation. The authors did not publish the filtered measurements taken by the Nimbus II satellite. They published the end results which were based on the unfiltered which was calculated from filtered measurements after computation.

Unfiltered was then used to calculate Outgoing Flux by a second formula. These formulae are in Appendix B on page 27.

This paper has taken the author's OLR Outgoing Flux calculation and used their Appendix B formulae to calculate back to obtain the measured filtered radiation. The formulae they used are:

$N(\theta) = [0.0439 + 5.4318 \times 10^{-3} \times N_f(\theta) + 1.0245 \times 10^{-5} \times N_f(\theta)^2 + \theta^3 \times (1.36 \times 10^{-8} - 7.9262 \times 10^{-10} \times N_f(\theta) + 1.1488 \times 10^{-11} \times N^f(\theta)^2)]$

$N(\theta)$ being unfiltered radiance and $N_f(\theta)$ filtered. θ is the angle of measurement. The result of this formula is unfiltered radiance which is then put through the following formula to give Outgoing Flux.

$E = 2.901 \times N(\theta)/ [1 + 1.933 \times 10^{-4} \times \theta - 4.247 \times 10^{-5} \times \theta^2 + 6.149 \times 10^{-7} \times \theta^3 - 7.807 \times 10^{-9} \times \theta^4]$

E being Outgoing Flux. The result is in cal cm^{-2} min^{-1}, then converted to W/m^2.

An Excel spreadsheet model was used and using a range of assumed filtered measurements and measurement angles the following results were derived.

Θ Deg	OLR $N_f(\theta)$		**Results**	cal cm^{-2} min^{-1}	Global Av OLR Flux	
90	950	W/m^2			201	W/m^2
90	960	W/m^2			201	W/m^2
90	1000	W/m^2			202	W/m^2
90	1360	W/m^2			210	W/m^2
45	960	W/m^2			112	W/m^2
135	960	W/m^2			-201	W/m^2
100	960	W/m^2			301	W/m^2
95	960	W/m^2			239	W/m^2
94	960	W/m^2			230	W/m^2
96	960	W/m^2			248	W/m^2
95.5	960	W/m^2			244	W/m^2
95.1	960	W/m^2		0.343807399944	240	W/m^2
92.83	871	W/m^2		0.312683	237	W/m^2

The end result is close to a divide by 4. The formulae are not explained but are an incredibly complicated divide by 4 formula. Filtered OLR at the TOA is approximately 871 W/m^2.

Another set of complicated formulae were used to determine SW reflected radiation. *Loeb et al 2009*'s divide by 4.0034 was used to remove the global average for SWU.

Summary

Dividing everything by 4 is not real measurements and violates the laws of thermodynamics. The Sun does not shine on the dark side of the Earth. This global average system has the Sun shining equally on all 4 quadrants meaning it is shining equally over the poles as over the Equator. None of these things are real. The budgets were not balanced with the Earth emitting more than it receives. It became necessary to build a new Earth Energy Budget.

In this new Earth Energy Budget, 1,361 W/m^2 of SWD hits the Earth TOA. 726 W/m^2 reaches the surface 589 W/m^2 is absorbed in the surface. 408 W/m^2 is reflected off clouds (271 W/m^2) and the surface (137 W/m^2). SWD minus reflections are 953 W/m^2. All emissions to space from the Earth, clouds and atmosphere total 953 W/m^2.

In total, 1,361 W/m^2 of SWD hits the Earth TOA and 1,361 W/m^2 of SWU and LWU arrive back at the TOA.

From measured data, 589 W/m^2 of SWD is absorbed in the surface. The surface emits or reflects 375 W/m^2 of LWU. Most of that is ocean emission. Oceanic LWU has been averaged at 378 W/m^2. There is now no energy being created out of nothing. 589 W/m^2 of SWD is being absorbed by the surface and 589 W/m^2 is being emitted by the surface as either IR, thermals or latent heat.

67% of the Earth is covered by clouds. Therefore 67% of LWD is radiation from clouds that emanate from latent heat of evaporation.

71% of the Earth's surface is ocean. The oceans only absorb LWD IR EMR to a depth of a few micrometres. A large percentage of LWD is reflected off the ocean back upwards towards space.

Since 71% of the Earth is ocean and 67% of the Earth is covered by clouds, a large percentage of LWD would then be a reflection of LWU off those clouds.

All IR radiating to and from the Earth's surface is 100 times less energetic than SWD from the Sun. That means that LWD of 322 W/m^2 is the equivalent of 3.22 W/m^2 of SW solar radiation in the visible spectrum.

This budget has been put together from measurements, not models based on assumptions, and is now balanced.

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