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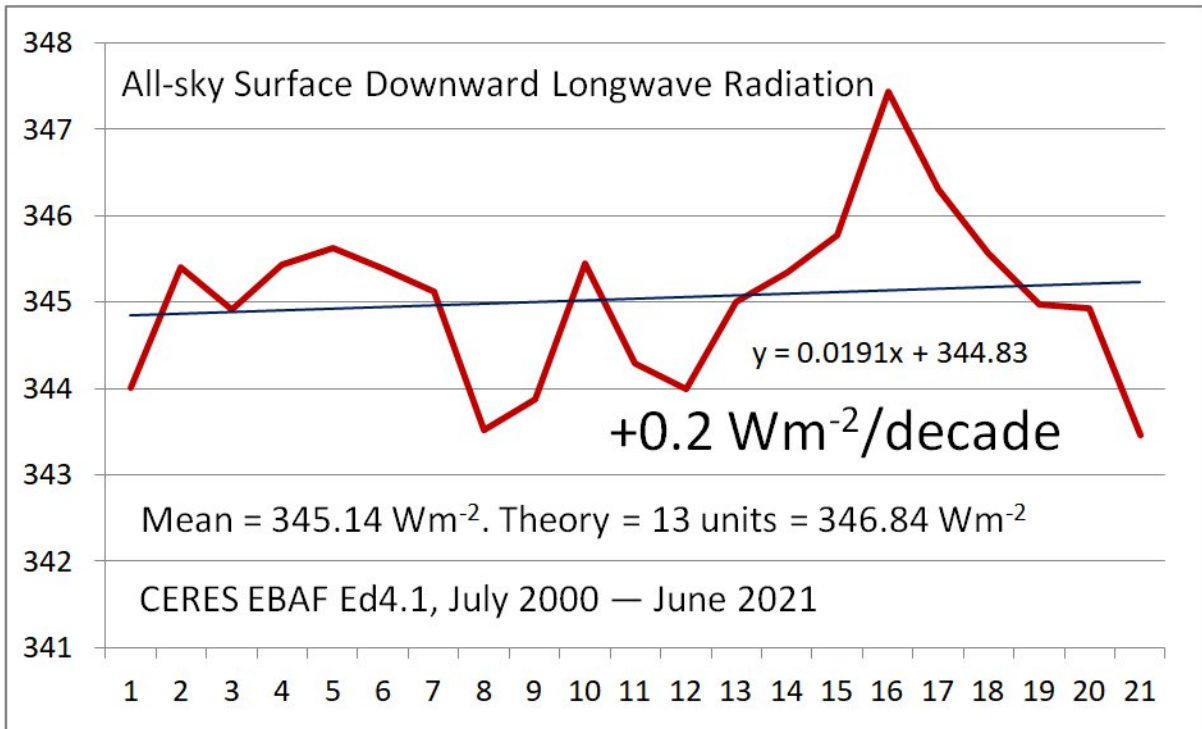


Earth energy flow system as the solution of four radiative transfer constraint equations

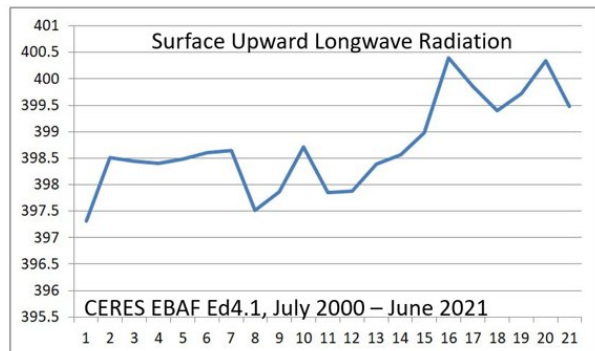
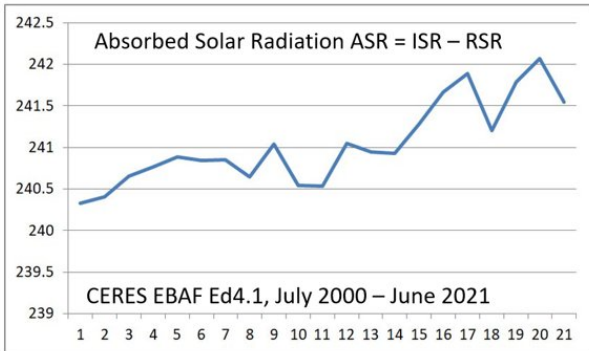
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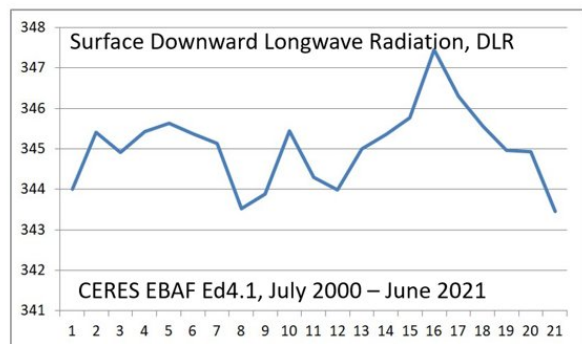
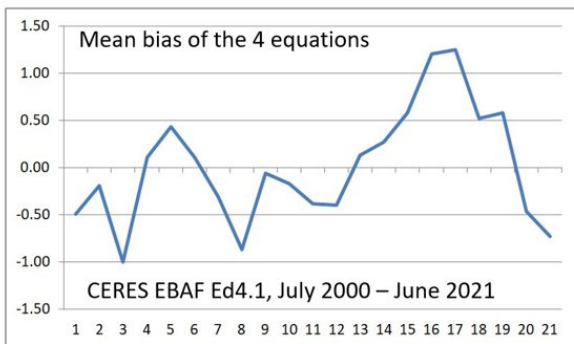
Global energy budget studies often state that “radiative energy exchanges between Sun, Earth and space are accurately quantified from satellite missions; much less is known about the magnitude of the energy flows within the climate system and at the Earth surface, which cannot be directly measured by satellites.” However, there are long-known theoretical tools to constrain surface energy flows to the top-of-atmosphere (TOA) fluxes by using Schwarzschild’s equation of radiation transfer. We control the validity of this equation in the annual global mean on two decades of CERES observations by creating four versions of it (clear-sky and all-sky, for the net and total radiation), and find them satisfied within less than $\pm 3 \text{ Wm}^{-2}$ for the individual equations, and with a difference of 0.005 Wm^{-2} only for the four equations together. The two net equations constrain the convective fluxes at the lower boundary and the hydrological cycle unequivocally to energy flows at the upper boundary (implementing a fundamental stability criterion); the other two represent specific conditions with a given optical depth, connecting total energy absorption at the surface to energy flows at TOA. Applying known definitions, these four equations can be solved, and the solution appears as a set of small integers related to a unit flux (example: surface downward longwave radiation = 13 units = 346.84 Wm^{-2} , see Figures). As a remarkable feature, the solution can be extended to further flux components not being involved in the original equations, including solar reflections at TOA both for all-sky and clear-sky, and a separation of the convective flux into its sensible and latent heat components in all-sky. This way, the complete annual global mean energy flow system can be presented as the function of TOA fluxes, without any reference to the atmospheric gaseous composition or lapse rate. — This theoretical description differs essentially from the picture given by the IPCC where Schwarzschild’s equations do not occur. Without these standard university textbook relationships (e.g., Houghton 1977, Eq. 2.13), the physical science basis is incomplete and misleading. This is a self-regulating system where feedbacks contradicting the stability criteria are not possible. If we change an atmospheric constituent (CO_2 , for example), energetic requirements will maintain the theoretical state by modifying other components (H_2O , temperature distribution, clouds, etc.). We propose an explanation based on a concept of Graeme Stephens: principles define the radiation processes that prescribe the properties of the atmosphere, rather than the opposite way. But as one and the same global mean state can be maintained through several seasonal, regional and local distributions and their changes are always possible at unknown magnitudes and time scales, emissions control is still necessary. — Comments on Trenberth (2022) global energy budget will also be presented.



Attribution



If the increase of absorbed solar radiation is anthropogenic, then global warming is from human influence.



Downward longwave absorption at the surface is not the cause of global warming.

Further readings:

Zagoni, M.: Sir John Houghton and radiation transfer, EGU General Assembly 2021, April 2021
<https://meetingorganizer.copernicus.org/EGU21/EGU21-1.html>

CERES 35th Science Team Meeting presentation (May 2021)
https://ceres.larc.nasa.gov/documents/STM/2021-05/34_Zagoni_CERES_STM35.pdf

CERES 36th Science Team Meeting presentation (October 2021)
https://ceres.larc.nasa.gov/documents/STM/2021-09/MP4files/26_MZagoni_presentation2.mp4

AMS2022 102nd Annual Meeting, Kevin Trenberth Symposium presentation (January 2022)
<https://ams.confex.com/ams/102ANNUAL/meetingapp.cgi/Paper/387827>