Expert opinion on the greenhouse gas theories and the observed infrared absorption properties of the Earth's atmosphere

(Excerpt)

5. I have been asked to provide expert opinions on two different issues which are largely related to the basic physics and the observational evidences of the hypothetical CO_2 greenhouse effect based anthropogenic global warming (AGW). A short introduction, definitions and problems are given in sections **5a** and **5b**. My expert opinion respecting the theoretical and observational issues above are given in section **6.** The summary of the evidences and facts on which my expert opinion rests are discussed in greater details in section **7**.

5a. Do greenhouse gas theories contradict energy balance equations?

5a-1. This problem is related to the theoretical foundation of the planetary greenhouse gas (GHG) greenhouse effect (GE). The planetary GE is an observed global radiative phenomenon. In climate science GE is defined as the difference between the surface radiative temperature t_S and the planetary shortwave effective absorption temperature t_A: $\Delta t_A = t_S - t_A$ K, where $t_A = (F_A/\sigma)^{1/4}$, F_A is the effective available absorbed solar radiation (ASR), and $\sigma = 5.6699833\times10^{-8}$ Wm^{-2}K^{-4} is the Stefan-Boltzmann (SB) constant. Unless specified otherwise, all physical constants were taken from the National Institute of Standards and Technology (NIST), *Mohr, et al.* (2006)[R2−1],[D1−1]. The thermodynamic ground surface temperature is $t_G = t_S/\varepsilon_b^{1/4}$ where ε_b is the longwave (LW) surface (lower boundary) flux emissivity. Perfectly black surfaces will have $\varepsilon_b \equiv 1$, $t_G = t_S$, and $S_U = \sigma t_S^4 = S_G = \sigma t_G^4$, where $S_G = \sigma t_G^4$ is the upward blackbody radiation from the ground surface. GE may also be expressed by the all-sky greenhouse factor

(GF) which is the difference of the respective flux densities (computed via the SB law): $G_A = \sigma t_S^4 - \sigma t_A^4 = S_U - F_A$. The ASR depends on the long term mean of the local solar constant F_0, and the Bond albedo α_B : $F_A = F_0(1-\alpha_B)/4$, and $\alpha_B = F_R / F_E$. Here $F_E = F_0 / 4$ is the global mean available shortwave flux density over a unit area at the top of the atmosphere (TOA), F_R is the reflected part of F_E, and obviously, $t_A = ((1-\alpha_B)F_0/(4\sigma))^{1/4}$. Similarly to t_A one may define the $t_E = (F_E/(4\sigma))^{1/4}$ effective planetary temperature, and the $t_R = (F_R/(4\sigma))^{1/4}$ effective reflection temperature of the planet. In astrophysics GE is defined via the total SW energy interacting with the planet: $G_E = \sigma t_S^4 - \sigma t_E^4$, and $\Delta t_E = t_S - t_E$. t_A and G_A are constrained by the energy conservation principle : $t_A = (t_E^4 - t_R^4)^{1/4}$, and $G_A = G_E + F_R$.

5a-2. To determine the GE one needs to know the global mean surface temperature, the solar constant, the Bond albedo and the outgoing longwave radiation (OLR) at the TOA for all-sky condition. The conventional textbook data of these quantities are: $t_S = t_G = 288$ K, $F_0 = 1368$ Wm^{-2}, $\alpha_B = 0.3$, and $OLR^A = 239$ Wm^{-2}, *Schmidt*, 2010**[R2−13]**. Slightly different numbers giving the same Δt_A may be found in *Lacis et al.* 2010**[R2−9]**. Based on these numerical data the greenhouse temperature rise and the corresponding flux density difference are: $\Delta t_A = t_S - (F_A/\sigma)^{1/4} = 33$ K, and $G_A = S_U - OLR^A = 151$ Wm^{-2}. The often used normalized (dimensionless) greenhouse factor is $g_A = (S_U - F_A)/S_U = 0.387$.

5a-3. Without internal planetary heat sources (entering into the system at the lower boundary) isolated planets in steady state radiative equilibrium (RE) obey the conservation principle of radiant energy. The long term global mean absorbed part of F_E should satisfy the $OLR^A = F_A$ equation. In the example above the planetary RE condition is closely satisfied, the imbalance (rounded to the nearest integer) is zero: $OLR^A - F_A = 0$ Wm^{-2}. In **Fig. F1-1** the spectral aspects of the greenhouse effect are presented. Notice that in the wavenumber domain the areas under each curve are proportional with the spectrally integrated flux densities. The GHG GE hypothesis assumes that the balance requirement is in the form of $OLR^A(\overline{\tau}_A, S_U) = F_0(1-\alpha_B)/4 = F_A(F_0, \alpha_B)$ where $\overline{\tau}_A$ is the IR flux optical depth of an air column. This physical quantity can only be accessed by extremely complex radiative transfer (RT) computations. Keeping the right side at a constant F_A (meaning that F_0, and α_B are constants), then the increased GHG content must be compensated by the LW absorption and emission processes of the surface-atmosphere system. For example in a global average clear atmosphere CO_2 doubling will increase $\overline{\tau}_A$ by about 0.0242 , *Miskolczi and Mlynczak*, 2004**[R1-10]**, pp. 242 , Table 6. In *Miskolczi*, 2007**[R1-14]** it was shown with sufficient mathematical rigor that the clear-sky OLR and the surface upward radiation in radiative equilibrium are related by the $OLR = S_U f(\overline{\tau}_A)$ equation, where $f(\overline{\tau}_A) = 2(1+\overline{\tau}_A+\exp(-\overline{\tau}_A))^{-1}$ is the transfer function (see **Fig. F1-5)**. Locally, in the stochastic dissipative climate system the radiative equilibrium is not a constraint, $\overline{\tau}_A$, and S_U can take any value. However, on global scale the radiative equilibrium is a strict constraint and the $OLR^A(\overline{\tau}_A, S_U) = F_A$ assumption violates the energy conservation principle. That is, the reduced OLR (due to increased $\overline{\tau}_A$) cannot be restored without adding thermal or radiative energy to the system. The correct relationship must have the form of $OLR^A(\overline{\tau}_A, S_U, \beta, S_U^C) = F_A(F_0, \alpha_B)$, where β is the cloud cover, $S_U^C = S_U^C(h^C)$ is the upward flux density from the cloud top, and h^C is the average or equilibrium cloud top altitude. Evidently α_B will also depend on the cloud cover and cloud altitude: $\alpha_B = \alpha_B(\beta, h^C)$. The details of the derivation of the equilibrium cloud cover are presented in **[R1-17]**, and in **Figs. F1-14**, **F1-15**, and **F1-16**. Note that ignoring the $OLR^A(\overline{\tau}_A, S_U, \beta, S_U^C) = F_A(F_0, \alpha_B)$ strict energy balance requirement discussion on the GE and the related global climate change does not have much merit.

5a-4. Without any theoretical or experimental proofs Δt_A and G_A are simply attributed to the absorption and re-emission of the surface upward radiation by the infrared (IR) active atmospheric gases. So far no structured GHG GE theories exist which are capable to predict a-priori the observed equilibrium Δt_A and G_A. Since the definition completely ignores the radiative effect of the cloud cover the missing GHG GE theory is not surprising. The real world OLR^A must be the weighted sum of the clear-sky and cloudy sky OLRs: $OLR^A = (1-\beta)\,OLR + \beta\,OLR^C$. Here OLR and OLR^C are the clear-sky and cloudy sky components of the OLR, and β is the cloud fraction. In a two level radiating system (surface and cloud top) the Δt_A or G_A alone can never be directly associated with the GHG content of the atmosphere.

5a-5. In 1896 Svante Arrhenius put forward the question: ***"Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere?"***, and he tried to quantify the effect of the CO_2 and associate it with the ice-ages in the planetary climate history, *Arrhenius*, 1896[R2–2] pp. 1. The CO_2 greenhouse effect hypothesis in its simplest form states that increasing CO_2 content of the atmosphere will increase the absorbed upwelling LW radiation from the surface, will reduce the outgoing LW radiation, and will increase the downward LW radiation received by the surface. As a result, the surface will warm up until the top of the atmosphere radiative balance is restored, *Pierrehumbert*, 2010[R2–3] pp. 349-350; *Lindzen*, 2007[R2–4] pp. 940, Fig 3; *Nurse and Cicerone*, 2014[R2–5] pp. 2; *Smith*, 2008[R2–6] pp. 8. Of course this is not a greenhouse theory but an unproven hypothesis which poses deliberate constraint on the atmospheric response to increased greenhouse gas content. The key information which are badly missing here is the expected response of the global mean flux optical depth and the long time RE state of the atmosphere.

5a-6. Climate modelers generally assume a hypothetical positive feedback process which amplifies the initial warming: higher surface and atmospheric temperatures will increase the water vapor content of the atmosphere, and the increased water vapor absorption will further increase the warming effect. This unphysical assumption stems from the Schwarzschild solution of the RE situation in stellar atmospheres, *Schwarzschild*, 1906[R2–7] pp. 28, Eq. 11. Since the magnitude and quantitative constraint of this effect is unknown climate models are stabilized with different kinds of ad-hoc H_2O feedback parameterizations.

5a-7. The unresolved theoretical problems of the origin and mechanism of the atmospheric GE will be discussed in detail in paragraph 7. It will be shown that the GE effect is a global scale RE process with a definite equilibrium state of the global mean radiative climate parameters. Related to the GE the most important radiative transfer parameter is the global mean flux optical thickness.

5b. Is the proposed greenhouse effect due to anthropogenic carbon dioxide emissions supported by observed atmospheric thermal and humidity structures and global scale simulations of the infrared absorption properties of the Earth's atmosphere?

In short, analysis of the foregoing shows that the proposed greenhouse effect is impossible.

5b-1. This problem is related to the empirical validation of the hypothetical CO_2 greenhouse effect based AGW. The practical approach to this validation effort is to collect long term geographically diverse global radiosonde data sets containing information about the state of the surface and the atmosphere, and perform high quality radiative transfer computations to obtain the true long time global average radiative structure of the system. Once the reliable global mean flux density components of the system are known then the simple task is to compare the global mean observed greenhouse effect to the predicted one by the GE hypothesis (outlined in paragraphs **5a-4** and **5a-5**).

5b-2. The first obvious requirement to conduct such studies are the availability of global scale primary radiosonde observations. Readily available sources of the vertical temperature, water vapor and ozone structures are the world climate data centers and the national meteorological data archives. In our validation efforts we frequently used the following radiosonde data sets: *NOAA-S*[D1−2] (one full year of high resolution soundings from the former NOAA testing facility in Sterling VA), *TIGR2*[D1−5], *TIGR2000*[D1−4], and *NOAA-R1*[D1−3]. All of these data sets were used in our computations and are attached to this report as supplemental data files. In **Fig. F1−2** comparisons of the thermal and water vapor structures of the global mean TIGR2 and the *USST76*[R2−8] atmospheres are presented. Compared to the USST76 atmosphere the significant differences in the vertical temperature and H_2O structures are obvious. Notice that the USST76 tropospheric lapse rate is much higher, the isothermal stratosphere does not exist, and the H_2O column amount is about half of the global average. Unfortunately global climatological data sets are also subject to deliberate data manipulations therefore extreme care is needed to identify a suitable archive.

5b-3. The second obvious requirement is an adequate high quality radiative transfer (RT) software. It must be quite obvious that the accuracy of a research RT code should not be restricted by speed requirements, vertical resolution or absorption band structures common in radiative transfer modules in climate models. Our choice was the High-resolution Atmospheric Radiative Transfer Code (HARTCODE) which was explicitly developed for extreme numerical accuracy, *Miskolczi*, 1989[R1−2], *Rizzi et al.*, 2002[R1−8]. A short sensitivity summary is presented in *Miskolczi*, 2010[R1−15] pp. 257, Table 3. Comparisons of different RT codes − involving HARTCODE − and their validations may also be found in *Kratz et al.*, 2005[R1−11] or in *Saunders et al.*, 2007[R1−13].

5b-4. Further unique features of HARTCODE are the strict preservation of the monochromatic Beer-Lambert law, the Helmholtz reciprocity principle, and the spherical refractive computation of the directional transmittances through every optical path segments. The spectroscopic details of the infrared flux transmittance and optical depth computations are presented in *Miskolczi*, 2011[R1−16] pp. 6, *Miskolczi*, 2014[R1−17] pp. 36. In **Fig. F1−3** the Helmholtz reciprocity principle is demonstrated for vertical and horizontal viewing geometries.

5b-5. The average planetary climate − as a set of scalar climate parameters − assumes an extensive global average cloud cover with a characteristic global average cloud altitude. The global average cloud cover breaks up the IR planetary radiation field into three major regions. The three regions and the definitions of the flux density components of interest are displayed in **Fig. F1−4**. From computational point of view − for obtaining accurate flux density components at the external and internal boundaries of the planet − a spherical refractive line-by-line (LBL) flux code should operate over three spherical shell sectors with sufficient vertical, angular and wavenumber resolution and for about thousand atmospheric structures from global radiosonde locations. Such complexity of computations is far beyond the capability of any publicly available LBL code and any climate radiative transfer module built into general circulation models (GCMs).

5b-6. In **Fig. F1−4** the transmitted, absorbed, upward and downward emitted, and lower boundary fluxes in the three regions are: S_T, A_A, E_U, E_D, and S_U (clear-sky, red shading), S_T^C, A_A^C, E_U^C, E_D^C, and S_U^C (above cloud, blue shading), S_T^{Cu}, A_A^{Cu}, and E_U^{Cu}, and S_U (below cloud upward, green area), S_T^{Cd}, A_A^{Cd}, E_D^{Cd}, and S_D^C (below cloud downward, green area). The downward upper boundary fluxes at the clear and above cloud regions are zero. The reference altitude is at $z_0 = 0.0$ km, the TOA altitude is at $z_{top} = 70.0$ km and the altitude of the top of the equilibrium global average cloud cover is at $h^C = 1.916$ km.

5b-7. Surface fluxes may be referenced to the TOA by applying a spherical correction sc : $sc \approx R_E^2 / (R_E + z_{top})^2 = 0.97838$ where $R_E = 6371000$ m is the volumetric radius of the Earth. Due to refraction (and the related vertical layering) the accurate computation of sc is far more complex and results in an $sc = 0.978918$ (0.0547 % larger) value, which corresponds to an effective altitude of $z_{top}^e = 68.236$ km.

5b-8. In cloud free areas the ground surface (having a global average thermodynamic temperature t_G) and the semi-transparent atmosphere above (with an average GHG and thermal structure) can directly and freely cool to space. The same is true above an average planetary cloud cover, but with different lower boundary condition. The combined lower boundaries of these two regions constitute the active planetary surface (APS) of the Earth. In the third region (below the cloud cover) the IR radiation cannot escape to space and cannot contribute directly to the planetary RE. Among the flux density components, the $OLR = S_T + E_U$, $OLR^C = S_T^C + E_U^C$, $OLR^{Cu} = S_T^{Cu} + E_U^{Cu}$, and the $OLR^{Cd} = S_T^{Cd} + E_D^{Cd}$ relationships must hold, where OLR is the clear sky OLR, OLR^C is the cloudy sky OLR, OLR^{Cu} and OLR^{Cd} are the upward and downward LW radiation below the cloud layer, respectively.

A comparison of some TIGR2 flux density components with the most recent − but deeply flawed − Trenberth-Loeb-NASA global energy budget is presented in **Fig. F1-23**. According to the long term steady state requirement there cannot be any accumulating direct radiant energy in any of the three regions, however, unlimited transfers of radiant energy to-and-from the global latent heat reservoirs are permitted (as it happens in the real environment through the phase boundaries).

5b-9. The most important conclusion of our computations is the solid empirical proof of the existence of the assumed steady state planetary RE. The key planetary IR fluxes from the active planetary surface are: $OLR^A = (1-\beta)(S_T + E_U) + \beta(S_T^C + E_U^C) = 238.94$ Wm^{-2}, and $S_U^A = S_U\,(1-\beta) + S_U^C\beta = 341.98$ Wm^{-2}. The astrophysical textbook value of the effective planetary surface (skin) temperature is $t_G = (16\pi\sigma d_E^2 / L_0^T)^{-1/4} = 278.683$ K which is in perfect agreement with the mean all-sky surface air temperature from radiosonde observations: $t_S = (S_U^A/\sigma)^{1/4} = 278.68$ K. Here $L_0^T = (2/5)\pi^{4/3}\sigma^{-1/3} d_E^{8/3} r_0^{-2/3}$ is our theoretical solar luminosity, d_E is the semi-major axis of the Earth's orbit , and r_0 is the solar radius (both are in meters).

5b-10. From the observed fluxes the Bond albedo and the cloud cover may also be easily deduced (see in **[R1−17]** pp. 33, and pp. 44) : $\beta = (S_U^A/sc - S_U)/(S_U^C - S_U) = 0.6615$, and $\alpha_B = 1 - OLR^A/S_U^A = 0.3013$. From about thirteen years (1976-1989) of radiosonde observations the indirectly derived solar constant is $F_0^{obs} = 4S_U^A = 4OLR^A/(1-\alpha_B) = 1367.93$ Wm^{-2}. Later we shall see that F_0^{obs} is also in perfect agreement with the F_0^T theoretical solar constant of $F_0^T = 1367.9514$ Wm^{-2}.

5b-11. From large scale simulations (involving the TIGR2, TIGR2000, NOAA-R1 and NOAA-S radiosonde archives) we gained enough confidence to conclude that the Earth's long time global mean flux optical thickness $\overline{\tau}_A$ is equal to a theoretically predictable universal constant τ^T : $\overline{\tau}_A = \tau^T = 1.86756$. This τ^T is the solution of a transcendental equation which combines the RE requirement and the conservation principle of the flux optical depth. In **Fig. F1−5** the fundamental radiative transfer functions and the normalized upward atmospheric emissions for about thousand weather balloon observations are displayed. The theoretical τ^T may be computed from the $f(\tau_A)=V(\tau_A)$ equation (red dot), or from the $g(\tau_A)=2A(\tau_A)/5$ equation (light blue dot). The theoretical equilibrium optical depth is the natural constraint on the equilibrium mass of the condensing GHG (water vapor) in the atmosphere .

5b-12. The constancy of the IR flux optical depth is maintained in each and every randomly selected subsets of different length from a 61 year long NOAA-R1 time series, **[D1-2]**. In **Fig. F1−6** the increase of the atmospheric carbon dioxide in the studied NOAA-R1 time series are apparently coupled with the decrease of the atmospheric water vapor column amount. Here the CO_2 and H_2O normalized column amounts are plotted for the 1948-2008 time interval. The constancy of the flux optical depth is demonstrated also in **Fig. F1−7**. Detailed numerical data of the regression analysis of the key variables − altitude, temperature, H_2O, CO_2, and flux optical depth − are given in **Fig. F1−8**, *European Geosciences Union (EGU)*, 2011[R1−16] pp. 18. According to **Figs. F1−5**, **F1−6**, and **F1−7** the long term global mean OLR and S_U cannot change independently. Based on the NOAA-R1 soundings and simulations **Fig. F1−20** shows the no-feedback response and the true observed changes of the OLR in the 200-1500 cm^{-1} spectral range. More details are presented in **Fig. F1−21** where the no-feedback responses of some other GHGs are also displayed. There is no such thing that the OLR remains constant and the surface warms up due to some incorrect GHG GE hypothesis, or because of the outcomes of CO_2 doubling experiments conducted with never validated GCMs. The Intergovernmental Panel on Climate Change (IPCC) ignores the fact that the clear-sky OLR is governed by the unpredictable stochastic nature of the upper tropospheric humidity field (and the global cloudiness) which cannot be modeled by any (deterministic) global climate model. In Fig. **F1−22** a short video demonstrates the changes in the upper tropospheric humidity field. Evidently, to find the solution of the global mean radiation climate (or the GHG GE) is not an appropriate task for GCMs.

6. *My opinion respecting the issues referred to above*

6a. In climate science the arbitrary definition of the GE is not suitable to associate the heat absorption properties of the atmosphere with the amount of GHGs present in the atmosphere. The reason is the two level radiative structure of the atmosphere and the unlimited supply of the water vapor in its three phases.

The stochastic nature of the humidity field makes the tracking of the phase changes of the H_2O impossible therefore the quantitative knowledge on the changes of the optical depth (that is related to the phase transitions of the H_2O) is unknown. The classic GH effect hypothesis is not a theory and it is unable to establish the required quantitative relationship between the GHG content of the atmosphere and the planetary surface temperature. Further on, it violates a long line of well established first principles of theoretical physics.

In the last decade fundamental structural equations were developed for describing and understanding the global average radiation field and the RE state of the Earth-atmosphere system. The large number of new physical relationships − and new universal constants of radiation physics − converging to form a coherent picture of the planetary IR radiative processes which ultimately establishes the radiative budget of the Earth-atmosphere system.

Compared to surface and satellite flux density observations the rigorous numerical testing of the new equations were not producing any contradictory results. The new equations and constants were presented in a series of published papers, open conference presentations, and in NASA science team meetings. So far neither the equations nor the numerical results were openly conquered by radiative transfer experts or challenged by the wider climate science community.

It is apparent that the key climate parameters of the planet can be deduced theoretically from purely astronomical considerations and some plausible assumptions on the material composition of the planetary surface and the structure of the atmosphere. The theoretically constant equilibrium flux absorption coefficient of the Earth's atmosphere negates the existence of the Arrhenius type greenhouse gas greenhouse effect. If there are no changes in the greenhouse effect then there is no climate sensitivity to manmade increase of the atmospheric CO_2 . The excess optical depth from increased CO_2 will condense into water droplets and will eventually rains out from the atmosphere.

Science is not a talk-show, all arguments and critiques against the new view of the greenhouse effect must be quantitative. If this situation remains for long, then the system of new equations will be upgraded to the only greenhouse theory which explains the observed facts and obeys the fundamental principles of physics.

6b. Evaluating the global average flux density components from ground truth observations it is evident that the Earth-atmosphere system is in RE with a theoretical solar constant. All empirical global mean flux density components satisfy the theoretical expectations. The greenhouse effect predicted by the Arrhenius greenhouse theory is inconsistent with the existence of this RE. Hence, the CO_2 greenhouse effect as used in the current global warming hypothesis is impossible.

In this report all my arguments focused on the theoretical and observational issues of the greenhouse effect and not on the question whether the global surface temperature is changing or not. As long as the greenhouse effect terminology of the climatologists refers only to the steady state temperature difference between t_S and t_A I have no objection. The $\Delta t_A \approx 28$ K, and the related $G_A \approx 128$ Wm^{-2} clear sky temperature and flux density differences are real, they can be measured, computed and theoretically predicted. However, these numbers are constants, they cannot violate the planetary radiative equilibrium and energy conservation principles. Any perturbations to the flux optical depth by non condensing GHGs will force the hydrological cycle to restore the theoretical equilibrium optical depth.

My overall conclusion is that the Arrhenius type greenhouse effect is an incorrect hypothesis and the CO_2 greenhouse effect based global warming hypothesis is also an artifact without any theoretical or empirical footing.

7. The reasons for my opinion

7-1. All planets in our solar system are isolated celestial objects orbiting around the Sun. Isolated objects can only exchange energy with other objects and the surrounding environment by means of radiation. The exchange of radiant energy happens through the active planetary surface. By definition the active planetary surface is the sum of the (solid or liquid) surface areas which contributes to the exchange of radiant energy with the Sun and the surrounding (space) environment. The APS may receive inward radiation from the full 4π solid angle, and also emits and reflects (or scatters) radiation into the full 4π solid angle. Planets with condensing GHG atmospheres usually have complex multi-layer adaptive APS which controls the planetary RE. Further on, we shall use the concept of a 'passive' planet. By definition a passive planet has negligible internal source of thermal energy propagating through the APS and the atmosphere above and contribute to the top of the atmosphere net radiation.

7-2. On a properly chosen time scale a passive planet is said to be in steady state RE if the total available (or intercepted) solar SW radiation is equal to the total LW radiation leaving the APS, and the ASR is equal to the OLR leaving at the top of the atmosphere. Such a planet will obey the energy and momentum conservation principles of the radiation field in its simplest form where all planetary LW flux density components are scaled with the solar constant. These are the top level constraints imposed on the radiation field of the Sun-planet system, and actually assures, that a passive planet cannot change the local solar constant. Obviously such a planet is an abstraction, but it is not an unrealistic one. It is quite reasonable to assume that after the formation and during the billions of years of planetary evolution planets have ample time to reach the steady state RE. On the other hand, any power dissipation in the system which is unrelated to the incoming solar radiation will just add an extra (small) energy term to the OLR and move the planetary flux emissivity a little above unity.

7-3. It should be recognized that the Sun is a very complex object and the solar constant has its own natural fluctuations. Depending on the state of the Sun F_0 may vary (on different time scales) between $F_0^{min} = 1359.7$ and $F_0^{max} = 1376.2$ Wm^{-2} introducing 1.2% (quasi-periodic) changes in the short term averages, *A. Berk et al.* 2008[R2–24]. From F_0^{min} and F_0^{max} the arithmetic average is F_0^{av} = 1367.95 Wm^{-2}. It is not very wise to declare an official solar constant and continuously upgrade it according to the relatively short term satellite or ground based observations. Even NASA warns that their data in the *NASA Fact Sheets*, 2012[R2–12] are approximations and they are not appropriate for scientific use. The data are usually given in three or four significant digits and they cannot be consistent with the known physical laws of nature where the key astronomical information and the most fundamental constants of the theoretical physics are given with 10-50 ppm relative accuracy.

7-4. Sun is the source of the observable radiative and not directly observable entropy flux densities and their specific intensity, radiance or brightness counterparts. We have found that the theoretical solar luminosity, solar surface emission and the solar constant may be derived from the next theoretical equation: $F(d)=(\pi/\sigma)^{1/3} d_E^{8/3} r_0^{-2/3} d^{-2}/10$ where $F(d)$ is the flux density in Wm^{-2}, and d is the distance from the center of the Sun in meters. In this universal function d may vary from inside the Sun to anywhere in the solar system. The theoretical solar luminosity, solar surface emission, solar constant and the available SW flux density may easily be computed from $F(d)$: $L_0^T = 4\pi^{4/3}\sigma^{-1/3} d_E^{8/3} r_0^{-2/3}/10$, $E_0^T = (\pi/\sigma)^{1/3}(d_E/r_0)^{8/3}/10$, $F_0^T = (\pi/\sigma)^{1/3}(d_E/r_0)^{2/3}/10$, and $F_E^T = F_0^T/4$. The theoretical solar constant and the available SW radiation are: $F_0^T = 1367.95145$ Wm^{-2}and $F_E^T = 341.98785$ Wm^{-2}. The very important point here is the fact that the $F(d)$ theoretical function depends only on geometrical factors (the solar radius and the semi-major axis of the orbit of the Earth) and of course, independent of any short term or long term satellite or ground based radiation measurements. Consequently, debate on the theoretical F_0^T solar constant should be restricted to the debate on the accuracy of r_0, and d_E. Of course, the barycenter of the solar system and the steady state center of the Sun (as a fixed geometrical point) does not exist. Sun is not a fixed perfect sphere but a rotating and pulsating gas globe which is subject to gravitational perturbations from other members of the solar system. This physical reality reflected in the singularity of the $F(d)$ function at $d \equiv 0$ where $F(0)=\infty$. The reference solar constant F_0^T is mathematically consistent with the radiation laws and the known accuracies of the Planck and Boltzmann constants (from NIST). It is also consistent with the most accurate values of r_0 , and d_e, and with the spectral solar constant of *Chance and Kurucz*, 2010[R2−10]. The existence of the theoretical solar constant does not support the idea of introducing a kind of new standard solar constant (and the backward correction of previous standards) based on purely the newest satellite observations. The accuracy of flux density or radiance measurements will never conquer the accuracy of the measurements of distance, linear size or time.

7-5. The extreme stability of the climate over millions of years is obviously based on the existence of the F_0^T theoretical solar constant. In **Fig. F1−9** F_0^T is compared to the observed F_0^{obs} (quoted under paragraph **5b-10**), and the newest satellite observations from *Kopp and Lean*, 2010[R2−11]. The $F_0^T = F_0^{obs}$ equality means that the planet is in strict radiative equilibrium with the theoretical solar constant.

7-6. Recently there is a serious problem with the use of the classic definition of the GE given in **5a-1.** The ambiguity arises from the fact that some scientists recognized that the classic GHG greenhouse effect cannot be discussed without the presence of the global cloud cover and started to use the greenhouse effect terminology in a generalized way, including the cloud effect, see **[R2−13]** and **[R2−9]**. This confusion should be avoided, CO_2 is a greenhouse gas and not a solid or liquid substance. If there is no cloud cover present in an air column one has to talk about the clear-sky greenhouse effect, and in fact that is what we are interested in. Based on our global mean atmosphere the global mean clear sky GHG Δt and G_F are: $\Delta t = 30.4$ K, and $G = 141.6$ Wm^{-2}. To quantify the cloud effect first the role of the cloud cover in the climate system must be specified, as we did in *Miskolczi*, 2014[R1−17]. There is another serious problem with the classic definition, namely the use of the ground surface thermodynamic temperature and assume a perfectly black surface. In reality the ground surface is not black, and what we need to put into the SB law is the true t_S radiative temperature. Radiosonde observations show that $t_S = 286.06$ K and the physically meaningful GHG Δt and G at the ground are: $\Delta t = 27.9$ K, and $G = 127.9$ Wm^{-2}. In **Fig. F1−10** the vertical contribution to the clear-sky G factor is demonstrated. Here the different computations of the G factor gives consistent results. However, G_R from

Raval and Ramanathan, 1989[R2−14] or *Ramanathan and Inamdar*, 2006[R2−15] shows large discrepancy (about 20 W m^{-2} overestimate). The cause is the incorrect mathematical representation of GF, see for example Eqs. 1-2 in **[R2−14]** (NATURE, VOL 342, pp 759).

7-7. Climate change will be regarded as deviations from the long term average state due to possible internal (natural random) fluctuations or external perturbations of the total energy input to the system. Internal fluctuations are due to the chaotic nature of the dissipative dynamic climate system and they do not alter the long term radiative balance. Regarding the large variety of time scales of the possible internal fluctuations and external perturbations that may occur one has to be careful with selecting the length of a characteristic averaging time interval for establishing the RE. Planets with large amount of latent heat storage in geological reservoirs may moderate the internal and external fluctuations by phase pinning (Maxwell rule). In the Earth's atmosphere the water vapor is the only condensing GHG, therefore the triple point (we call it phase temperature) of the H_2O at $t_P = 273.16$ K has a unique role in the climate system. Although the relationship between the thermal history of the Earth and the composition of the atmosphere on evolutionary time scale is an interesting subject, the manmade CO_2 greenhouse problem is only relevant to the last century.

7-8. Theoretically steady state RE of non-condensing GHG atmosphere of a passive planet cannot exist, since the ground surface of such planet would cool down freely to the astronomical limiting temperature dependent partly on the local solar constant and Bond albedo, and partly on the outward diffusion of thermal energy from the planetary interior. In the special case of Earth the astronomical limiting temperature is practically equal to the temperature of the triple point of H_2O. In other word, at some (sufficiently low) temperature any gas will become a condensing GHG, therefore, without the presence of condensing GHGs in the system there is no atmosphere at all. Note that in gas phase the spectral gas absorption is restricted to certain spectral ranges characteristic of the molecular structure of a particular GHG. An atmosphere with condensing GHGs might have several internal boundaries (cloud layers) at different altitudes which instantly disrupt the propagation of the electromagnetic radiation, consequently, the global mean cloud cover is the major factor in establishing and maintaining the planetary radiative balance.

7-9. The above concept is fully consistent with observations of atmospheres of comets and planets in the solar system. A comet starts to build up atmosphere when getting closer to the Sun and the surface materials start to evaporate. On the reverse trajectory when getting farther from the Sun the atmosphere condenses back to the surface and disappears. In the thin Martian carbon dioxide atmosphere there is no extensive cloud layer and the planetary RE is maintained by the diurnal changes of the mass of the GHG atmosphere and the heat (released or received) at the lower boundary by the phase changes of the CO_2. In the hot and thick atmosphere of the Venus the complex, fully closed multi-layer cloud structure completely de-couples the radiation field of the ground surface from the OLR. Below the closed cloud layers the IR radiation field is a type of cavity radiation in RE. The planetary RE is maintained solely by the radiation from the cloud top and the atmosphere above.

7-10. On the Earth the planetary RE situation is far more complex. Since the phase changes of the H_2O may happen at any time and anywhere in the system the Earth has an extremely variable cloud, surface ice and snow cover. The combined surfaces where the water vapor is in direct contact with liquid water, snow, and ice will be termed as the phase boundary. Through this hypothetical complex surface the total amount of water vapor in the atmosphere will change by the release or buildup of the latent heat by evaporation, condensation or sublimation. In steady state the net condensation and evaporation associated with rain droplets (within the atmosphere) must be zero and the mass balance of the atmosphere is maintained by the evaporation or sublimation from the ground surface and precipitation or deposition to the ground surface. These processes will result in decrease or increase of the flux optical thickness which is coupled with the mass exchange trough the lower boundary. The total mass (or the potential energy) of the atmosphere and the flux optical thickness is controlled by the virial theorem, **[R1−17]** pp. 45 . The mass conservation in the hydrological cycle expresses indirectly the conservation of the flux optical thickness. The observed and theoretically predicted constant flux optical thickness (in **[R1−15]** pp. 260) is a plain proof of the climate control by the water cycle. In other words, increasing or decreasing the energy input to the system will result in the release or store of the required amount of radiant or thermal energy through the phase boundary to assure the radiative equilibrium while keeping the temperature of the phase boundary unchanged.

7-11. The water vapor feedback problem was already mentioned in **5a-6**. From the NOAA-S **[D1−2]** archive 689 high quality all-sky radiosonde observations were processed to show the relationship between the local mean layer temperature and water vapor column density. During 1992-1993 from the high resolution (6 second) data 654130 individual layer mean temperature and water vapor column density pairs were collected. In **Fig. F1−11** the primary measured relative humidity and the computed H_2O column density profiles are plotted showing no significant correlation. In **Fig. F1−12** the linear correlation coefficient between the temperature and natural logarithms of the column density is 0.99, which − considering the relevant quantitative theoretical relationships − is not a surprise. In view of the known analytical dependence of the ambient temperature on the water vapor content of an individual air parcel the whole hypothesis seems to be a nonsense. It must be clear that locally the temperature and water vapor content of the air parcels are alternative variables and they are not connected by some ad-hoc positive or negative feedback parameter. According to thermodynamics phase transitions are controlled by the changes in the molar free energy and entropy.

7-12. The usual way to support the idea of the classic greenhouse effect is to present planetary energy budget schemes where the global radiative flux density components as well as the sensible and latent heat fluxes in the system are estimated either from direct measurements or from radiative transfer computations. The most well known is the *Kiehl and Trenberth*, 1997[R2−16] (KT97) energy budget. In **[R1−17]**, based on 13 years of radiosonde observations, it was first shown with high degree of accuracy that the Earth-atmosphere system is in the state of radiative equilibrium. The radiative imbalances at the upper and lower boundaries of the atmosphere that appear in recent radiative budget cartoons of (*Trenberth et al.*, 2009[R2−17], *Stephens et al.*, 2012[R2−18], *Wild et al.*, 2012[R2−19], or *NASA*, 2010[R2−20]) do not exist. The radiative equilibrium stems from energy conservation and energy minimum principles and it is the natural state of the Earth-atmosphere system. So far none of the published planetary energy budgets give any bearing to the origin and physics of the atmospheric greenhouse effect and unfortunately, almost all of them suffer from serious errors in the methodology and evaluation. Some of them are listed below.

7-13. Quantitative discussion of the greenhouse effect should be based on the strict, detailed, clear, and physically meaningful definition of the phenomenon. For example, in **[R2−13]** and **[R2−9]** we see published totally misleading quantitative results about how the share of the present-day global GE is distributed between GHGs and the cloud cover: 50 % from H_2O, 20 % from CO_2, 25 % from clouds, and 5 % contribution from minor GHGs. In common understanding these data means that the CO_2 absorption in the 15μm band is half of the absorption of the H_2O in the whole IR, which is sheer nonsense. Due to the heavily overlapping nature of the terrestrial spectral radiation field it is mathematically impossible to decompose the flux optical depth into the contributions of the individual molecular species, see **[R1−14]**, Appendix A. The LBL computational technique was developed to remove the uncertainties due to the spectral overlaps of the absorption coefficients of different GHGs. Clouds (or any kind of solid or liquid particles in the atmosphere) radiate continuous IR spectra and have nothing to do with the IR spectral absorption of the greenhouse gases. The cloud forcing approach to the greenhouse problem does not help to clarify and quantify the planetary radiative budget. **Fig. F1−4** (or Fig. 28 in **[R1-17]**) shows that the global average atmosphere is in radiative equilibrium $F_E = S^A$, and $OLR^A = F_A$. From the confirmed $G^A = S_U^A - OLR^A = F_R$ and $S_U^A = F_E$ equalities follow the conservation of radiant energy, radiative equilibrium, and they give solid empirical support to the theoretically introduced equivalent blackbody temperature. Because of the two layer structure of the global average atmosphere the ground surface referenced GE cannot contain any dependences on the albedo, cloud cover, radiative temperature, LW absorption, or flux optical thickness, rendering the GE to observations of t_G, and OLR^A, and leaving the greenhouse problem entirely to the mercy of the GCMs and their unphysical assumptions and countless ad-hoc tuning parameters.

7-14. No quantitative constraints on the shortwave system albedo, cloud cover and cloud altitude are established. These are key climate parameters, and some kind of theoretical expectation must be referenced or developed. The steady state planetary radiative balance is abandoned in favor of a hypothetical greenhouse warming. In science the quantitative estimate of 0.6 ± 17 Wm^{-2} missing heat **[R2−18]**, means that climatologists have no idea why and how the hidden (thermal and radiant) energy is distributed among the different latent heat reservoirs.

7-15. In the budgets the global mean thermal and GHG structure of the atmosphere is not specified. Generally the LW fluxes relevant only to the USST76 are used as the global average. The most recent NASA **[R2−20]** budget adopted the flux density components from the KT97 radiative budget which is obviously wrong. Transmitted flux densities from the surface (40 Wm^{-2}) in KT97 were computed for the USST76 atmosphere and its 390 Wm^{-2} surface upward flux. In the NASA picture in **Fig. F1-23** the corresponding fluxes are 40.1 and 398.2 Wm^{-2} which is nonsense. About ~10 Wm^{-2} increase in surface upward flux and practically unchanged surface transmitted flux density deserves some explanations.

7-16. The most serious problem with the cartoons are the ignorance of a long line of well-known fundamental concepts and principles of theoretical physics. Some of them are: energy and momentum conservation principles of the radiation field, Wien's law, virial theorem, energy minimum principle, Maxwell rule, Kirchhoff law, Helmholtz reciprocity principle, Vogt-Russel theorem, LeChatelier-Brown principle. One has to observe that the complexity of the climate system is not a free ticket for violating the first principles of physics.

7-17. We have discovered that vital climatological data sets were deliberately manipulated. The verification of the planetary energy budget and radiative balance require high quality primary information from global scale radiosonde observations. If the radiosonde observations are wrong then no one will trust in the satellite retrievals of the temperature, humidity or ozone structures. Satellite products depend on the calibration and tuning (of the instruments and retrieval algorithms) based on the ground truth information, see *Miskolczi*, 2005[R1−12]. The common mistake of the climatologists is to assume that the satellite information is correct, no matter what. This is not true, satellite information cannot ever be more accurate than the ground truth. It should be kept in mind that most of the vital flux density components cannot theoretically be measured by any instruments. For example the so called windows radiation is not a good representation of the S_T surface transmitted flux density. Scientist must also be aware that government research institutions may deliberately manipulate their databases to reflect their wild imagination on how the GE works. A good example is the NOAA-R1 archive which was used in our trend analysis study in **[R1−15]**. This global archive shows consistently that between 1948 and 2008 the flux optical depths from the profiles are equal to the theoretical τ^T of 1.867 (see **Fig. F1−7**). However, the true equilibrium optical depths is $\tau^e = 1.937$ and it is far off from τ^T which is an indication that none of the annual mean profiles are close to the radiative equilibrium. The $\tau^e - \tau^T = 0.06$ optical depth difference corresponds to about 250 % increase in CO_2 concentration. This is of course impossible, the Earth cannot be out of radiative balance (by about 4 $\mathrm{W\,m^{-2}}$ at the TOA) for 61 years. Such situation can only happen by altering the thermal structure (especially the close to surface temperature field). Much more serious the problem with the USST76 atmosphere and the KT97 budget, where due to the irrealistic temperature and humidity structure the imbalance in the OLR at the TOA is 29.38 $\mathrm{Wm^{-2}}$. The NOAA-R1 archive may be used for trend analysis, but − because it violates the energy conservation principle − it is useless for global energy budget research. Another examples are the TIGR2 and *TIGR2000*[D1−4] archives. A closer look at the TIGR2000 revealed that more than half (915 out of 1761) profiles are coincidental and they are included in both archives. The humidity and ozone structures in those coincidental profiles were poorly modified in an obvious way that the original thermal structures were preserved. The authors of the database should have known that the H_2O, O_3, and the thermal structures in the real atmospheres are highly correlated, which property is widely used in water vapor and ozone statistical retrievals from satellite spectral measurements.

7-18. In **Fig. F1−13** we present one sample (out of the 915 manipulated profiles) where the increased H_2O and ozone content resulted in increased flux optical depth (to a value corresponding to a CO_2 doubling). The upper left plot shows the unchanged temperature profile, the right plot shows the manipulated H_2O profile. The overall effect of cheating with the radiosonde data is summarized in the lower plot. Here the routine comparisons of 42 vital physical parameters that required by correct radiative budget computations are plotted. Two parameters, the normalized equilibrium extropy ($exw_{m,G} = f_m/(1-4T_{A,m})$) and the global surface radiative imbalance ($sn_G = (\varepsilon_b S_U/\sigma)^{1/4} - (A_A - E_D) - \sigma^{-1/3}$) are out of the acceptable ranges of 3σ. As a result of the data manipulation the TIGR2000 archive now contains 915 unrealistic atmospheric structures (mostly with increased upper tropospheric humidity) which makes the database useless for both remote sensing and radiative budget applications. Creating fake radiosonde observations to support the belief in CO_2 GE based global warming is not a scientific approach. The upper tropospheric humidity problem (if there is any) will not be resolved by artificial increase of the humidity data in the raw radiosonde observations. Unfortunately, there are evidences of extended data manipulations in other climate data sets which renders the whole climate science to a hiding game, and largely reduces the chances to obtain scientifically sound answers to the role of the GHGs in the global warming.

7-19. To establish the radiative equilibrium at the ground surface the spherical emissivity (or the anisotropy) of the inhomogeneous IR radiation field of the atmosphere has to be considered. The anisotropy of the downward LW radiation is the $\varepsilon_A = E_D / E_D^i$ ratio, where E_D is the radiation from the real atmosphere, and E_D^i is the radiation from an isotropic atmosphere of temperature t_S (t_S is the ground surface radiative temperature). Because of the $E_D^i \equiv S_U(1-\exp(-\overline{\tau}_A))$ mathematical identity, the equilibrium ground surface temperature is $t_G = (S_U/(\sigma\,\varepsilon_A))^{1/4}$. From the GAT profile $\varepsilon_A = E_D / E_D^i$=0.96515341, and the ground surface temperature is $t_G = 288.61$ K. These results are fully consistent with the observed constant flux optical thickness: $\overline{\tau}_A = \ln[\,S_U^2 / (S_U^2 - \sigma t_G^4 E_D)\,] = 1.86912 \approx \tau^T = 1.86756$. The surface phase temperature t_p is $t_P = (\sigma^{-1/3} + \varepsilon_A^{1/4} t_G)/2 = 273.18$ K. Summarizing our quantitative results in **Figs. F1−17**, **F1−18**, **and F1−19** the spectral distributions of the most important flux density components are presented. Compared to the NASA fact sheets the spectrally integrated fluxes are accurate up to 4-5 significant digits.

7-20. Almost all attempt to publish the results presented in this report failed. Articles were routinely rejected for publication in the mainstream scientific journals − Science, Astrophysical Journal, Tellus, Journal of Quantitative Spectroscopy and Radiative Transfer, Journal of Geophysical Researches etc. − mostly without sending for review. Probably this is the reason why it is hard to find any critical comments on the quantitative results in the peer reviewed literature. However, the blogosphere is flooded with academically illiterate comments from self-declared experts. As an example the ridiculous comments of *A. Lacis*, 2015[R2−21] (moderated by J. Curry at her Climate Etc. blog) on the *Miskolczi*, 2014[R1−17] paper is attached. The whole comment is just an ad hominem attack probably motivated by the lack of his knowledge of basic radiative transfer concepts. In **[R2−21]** J. Curry − without reading and understanding the paper − concluded that ***" The only potentially interesting point is whether the clear sky atmospheric optical depth has remained the same in the face of rising CO2, implying a decrease in water vapor. In any event, his analysis (theoretical and empirical) doesn't seem up to the task of sorting this out."*** It is a mystery why is she so sure without reading the article and trying to reproduce the numerical results. Not risking to make any quantitative statement J. Curry suggests the people to read the related critiques at the faceless Science of Doom blog, the Real Climate blog or at Roy Spencer's website. Science of Doom devotes number of posts and comments to discredit my quantitative results unfortunately only by his belief and not by his theoretical or computational skills. The same is true for the comments of G. Schmidt 2010[R2−22] at the Real Climate blog. His attitude is clearly reflected by the next quote from his blog where somebody asked him if it is possible for a physicist to explain Ferenc Miskolczi's theories and disprove them in a peer reviewed journal: " ***[Response: They are nonsense and so it is unlikely that anyone will take the time. See Roy Spencer's discussion for probably the best rebuttal yet. Further discussion on this is OT. - gavin]*** ". By all means this does not sound very scientific from a radiative transfer giant. Now let us look into the 'best' rebuttal. R. Spencer 2010[R2−23] wrote an 'executive summary' on my E&E [**R2− 15**] article where he simply ignored the important fact that in the whole article I dealt with clear sky condition. Since the clear and all sky fluxes are not directly (and quantitatively) comparable his numerical comparisons with the Kiehl-Trenberth radiative budget is totally meaningless. He is also confused in a series of radiative transfer details: unable to comprehend what anisotropy means and how to compute it (he called the spherical emissivity a 'fudge factor'), what is the flux density form of the Kirchhoff-Planck relationship, what is the Virial theorem and how to apply it, what is the directional and flux optical depth. To clarify some of his mistakes in his quantitative claims, in Fig. **F1−23** we compare basic all-sky global average TIGR2 IR fluxes with the ones in the NASA[R2−20] energy budget. Apparently − due to the fatal mistake of using the USST76 atmospheric model − not even one flux density component from NASA budget is close to the ones from TIGR2 GAT structure. And of course − as is shown by the true global average fluxes − the Kirchhoff's law is closely satisfied without applying any 'fudge factor' and the planet is in radiative equilibrium without any 'missing heat'.

7-21. If the blog comments above − without correct quantitative references to my well documented computational results − represent the matured opinion of the global warming community on the greenhouse science then certainly the open scientific discussion is impossible on this topic. One should remember that real science cannot ever be settled. Planetary climate science is not an exception, it will eventually make its progress with or without the consensus of the corrupt IPCC and some privileged climate scientists or ambitious politicians looking for more control over the people using false scientific reasoning . Hopefully, sooner or later the question of responsibility of the wasted millions of tax-payers money on fighting against a hypothetical catastrophic AGW will be raised.

Dr. F. M. Miskolczi
March 15, 2017

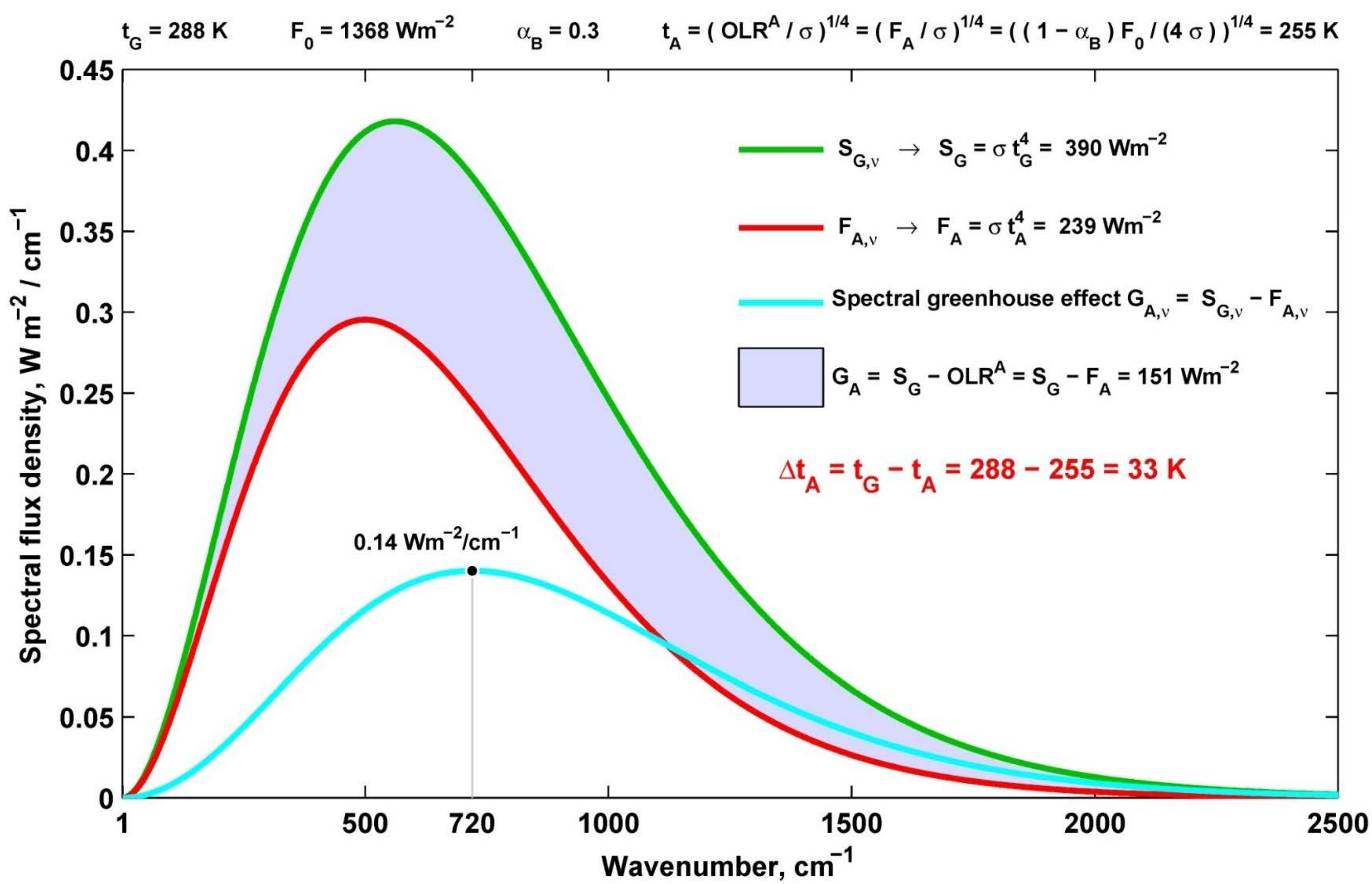

Fig. 1 Textbook definition of the atmospheric greenhouse effect. The greenhouse warming in steady state radiative equilibrium ($F_A = OLR^A$) is the $\Delta t_A = 33$ K difference between the surface thermodynamic temperature t_G and the planetary effective absorption temperature t_A. The greenhouse factor $G_A = 151$ Wm^{-2} is the difference in the respective flux densities (blue shaded area). In this view the planetary ground surface (lower boundary) is assumed to be perfectly black and t_G is equal to the surface radiative temperature t_S : $t_S = t_G = 288$ K, and $S_U = \sigma t_S^4 = \sigma t_G^4 = S_G = 390$ Wm^{-2} , where S_U is the surface upward infrared flux density.

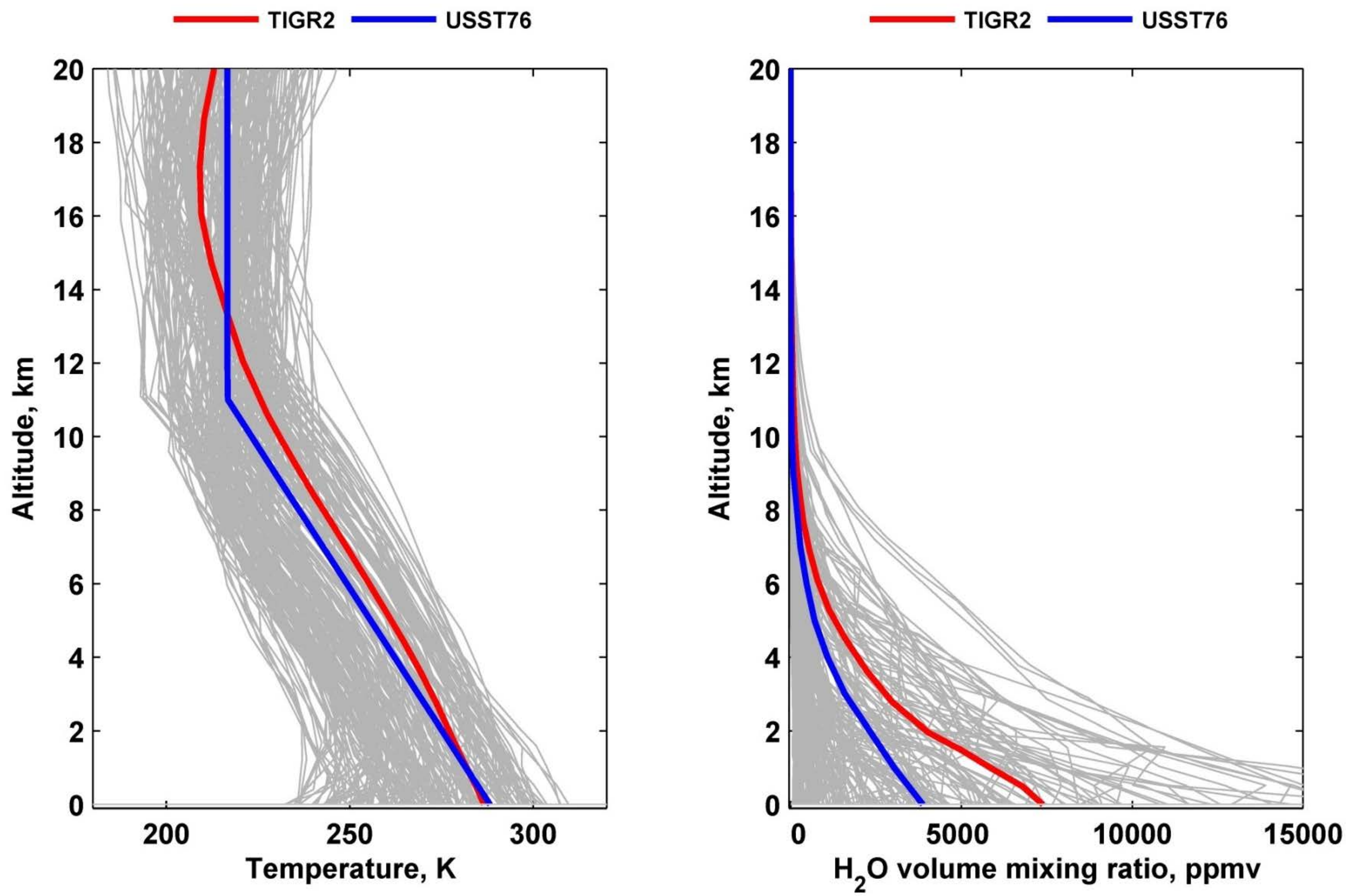

Fig. 2 Comparisons of the vertical thermal and humidity profiles of the global average *TIGR2* (GAT) [D1–5] and the *US Standard Atmosphere*, 1976 (USST76) [R2–8] atmospheres. Thin gray lines are the individual radiosonde data as it was observed by the TIGR2 global radiosonde archive. One has to notice the significant differences between the averages in both the thermal and humidity profiles (blue and red lines). Such differences adversely affect on the flux density simulations.

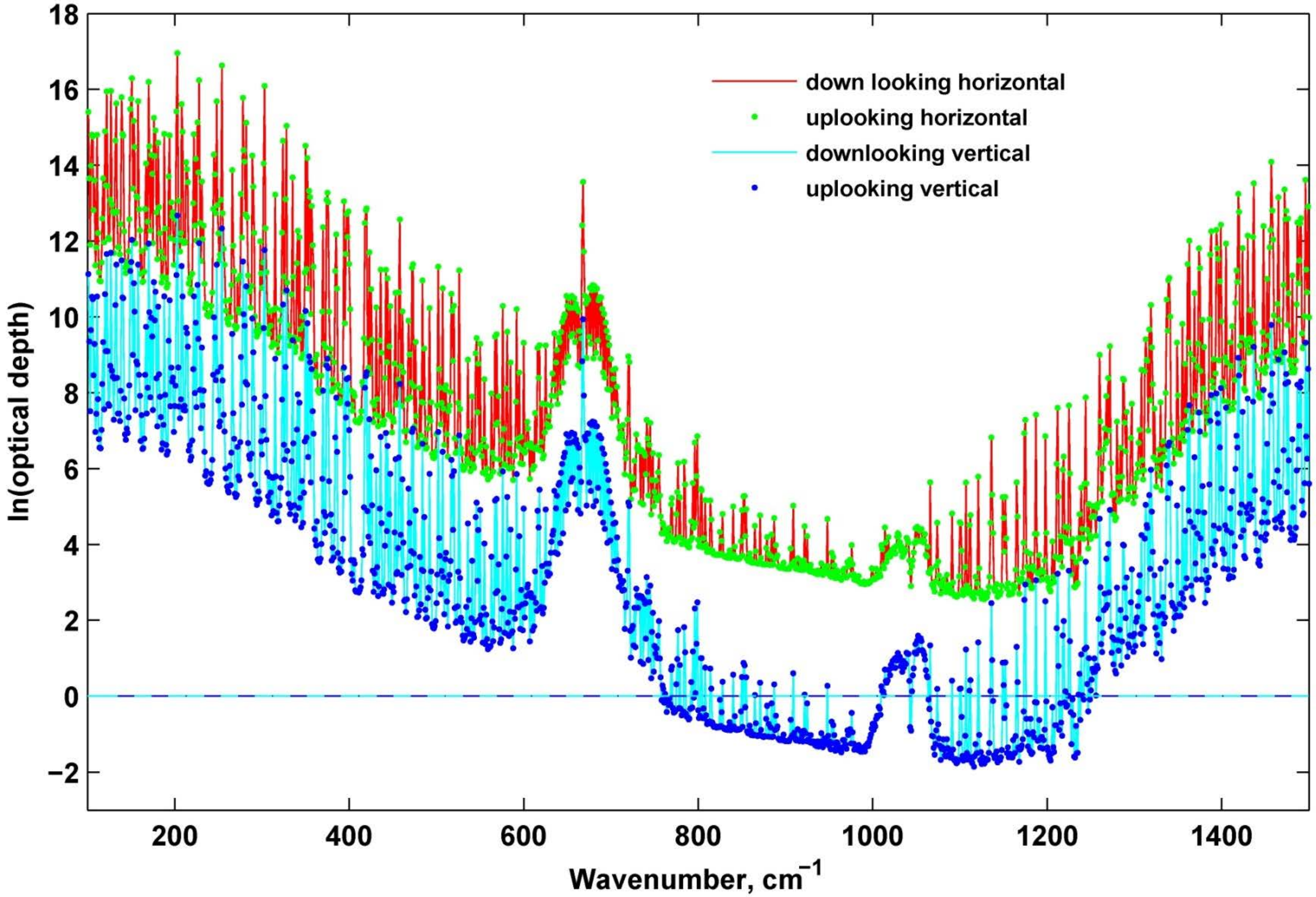

Fig. 3 Helmholtz reciprocity principle requires the equal line of sight optical depth (and path transmittance) for every slanted atmospheric optical paths. In this test vertical and horizontal viewing were considered. High resolution HARTCODE spectral optical depth computations perfectly reproduces the principle. Note that the Helmholtz principle is not valid for spherically integrated (hemispheric) flux optical depths.

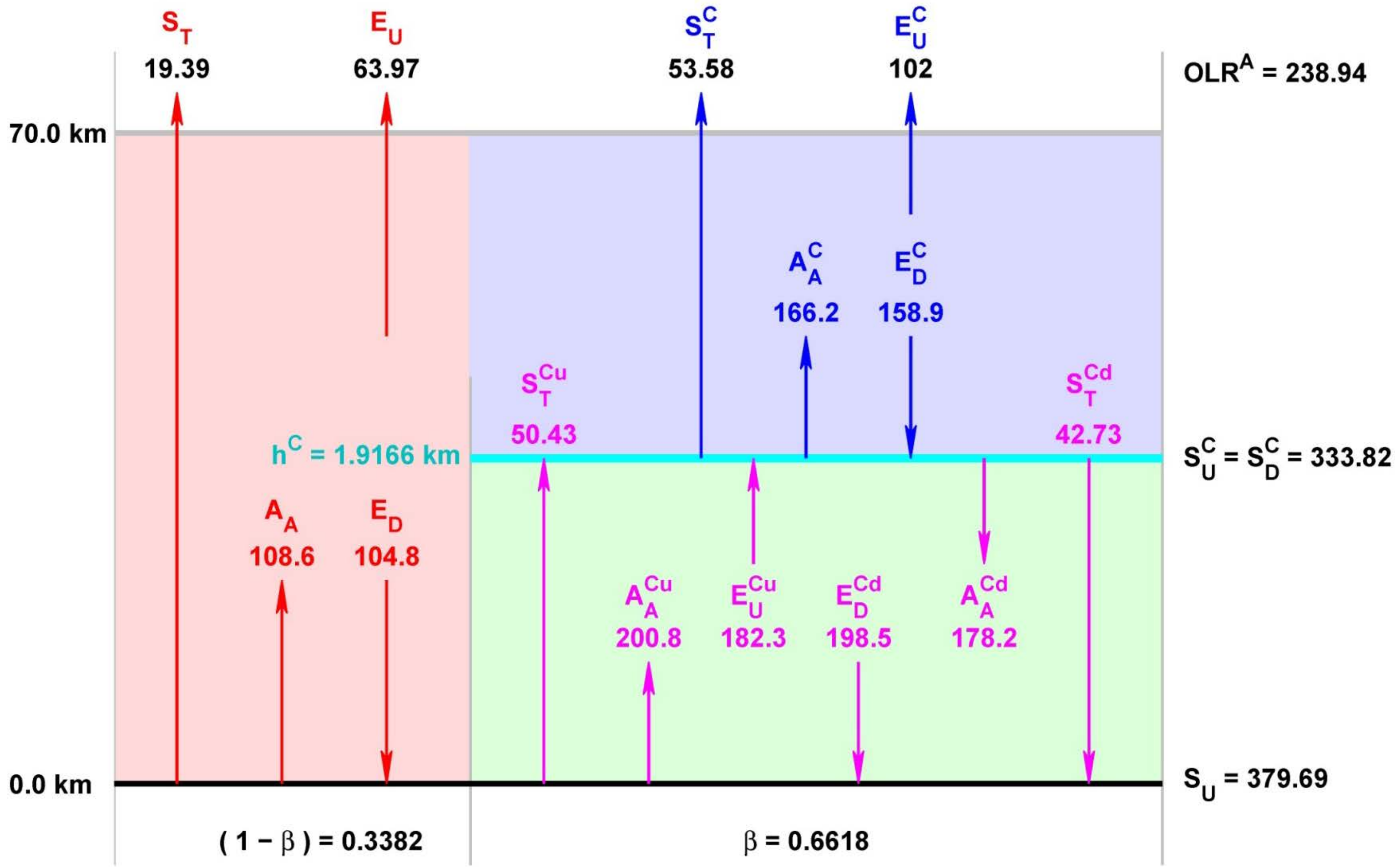

Fig. 4 All-sky IR radiative flux components (Wm^{-2}). The red, blue and green regions represent the sum of the clear, above cloud and below cloud portions (spherical shell sectors) of the atmosphere. This view is not a kind of simplified model, the flux density arrows are the real global mean fluxes of a spherical refractive atmosphere as it was derived from the TIGR2 global radiosonde archive. The numerical accuracy of the flux density components are five significant digits.

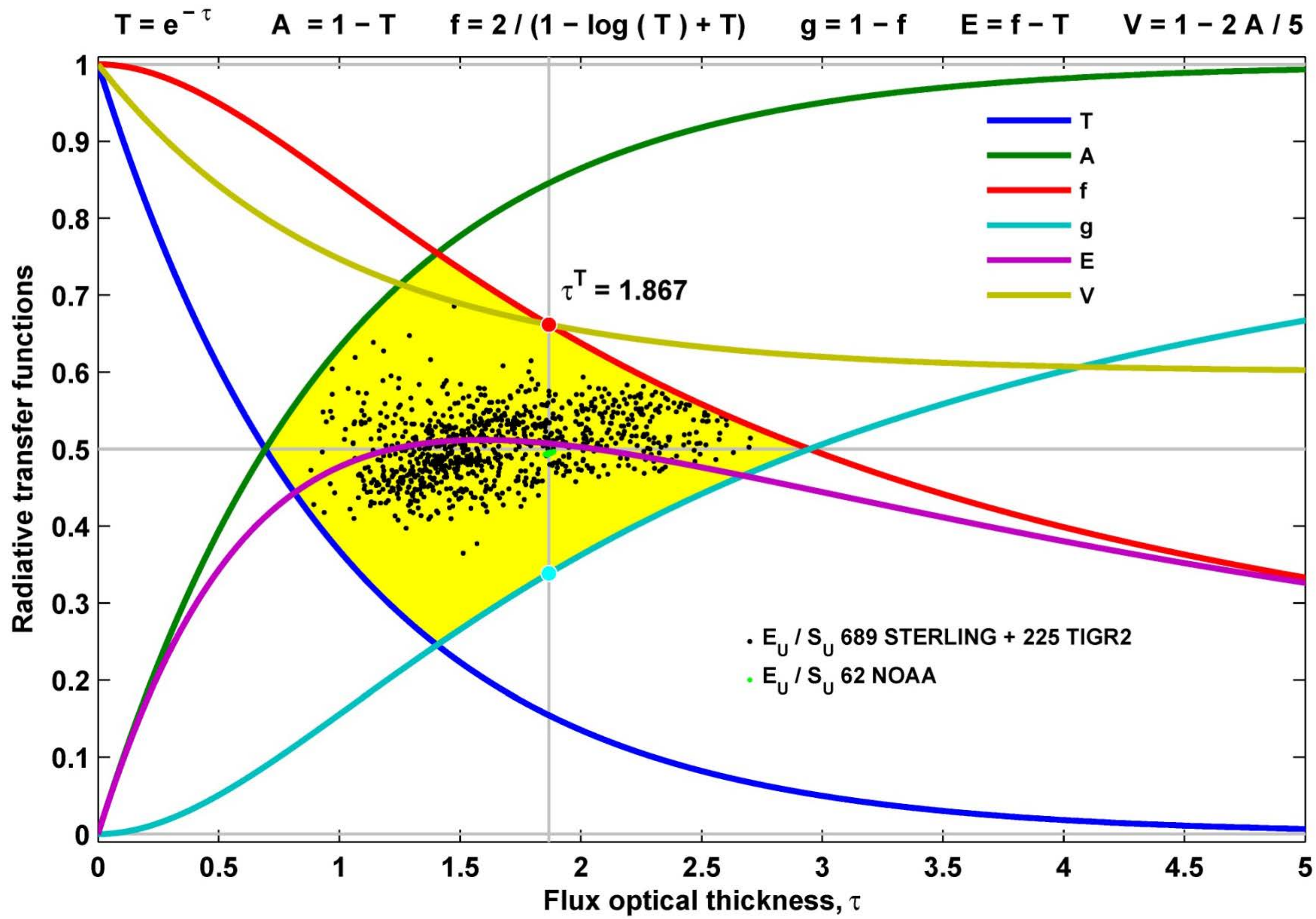

Fig. 5 Radiosonde observations show that the $E = E_U / S_U$ ratios and the optical depth τ_A are theoretically constrained by the radiative transfer functions. Here T, A, f, g, E, and V are the transmission, absorption, transfer, greenhouse, emission and virial functions respectively (see the exact definitions later). The average τ_A of the NOAA-R1 annual global means (green dots) and the global mean τ_A of the GAT atmosphere are equal to $\tau_A = 1.867$.

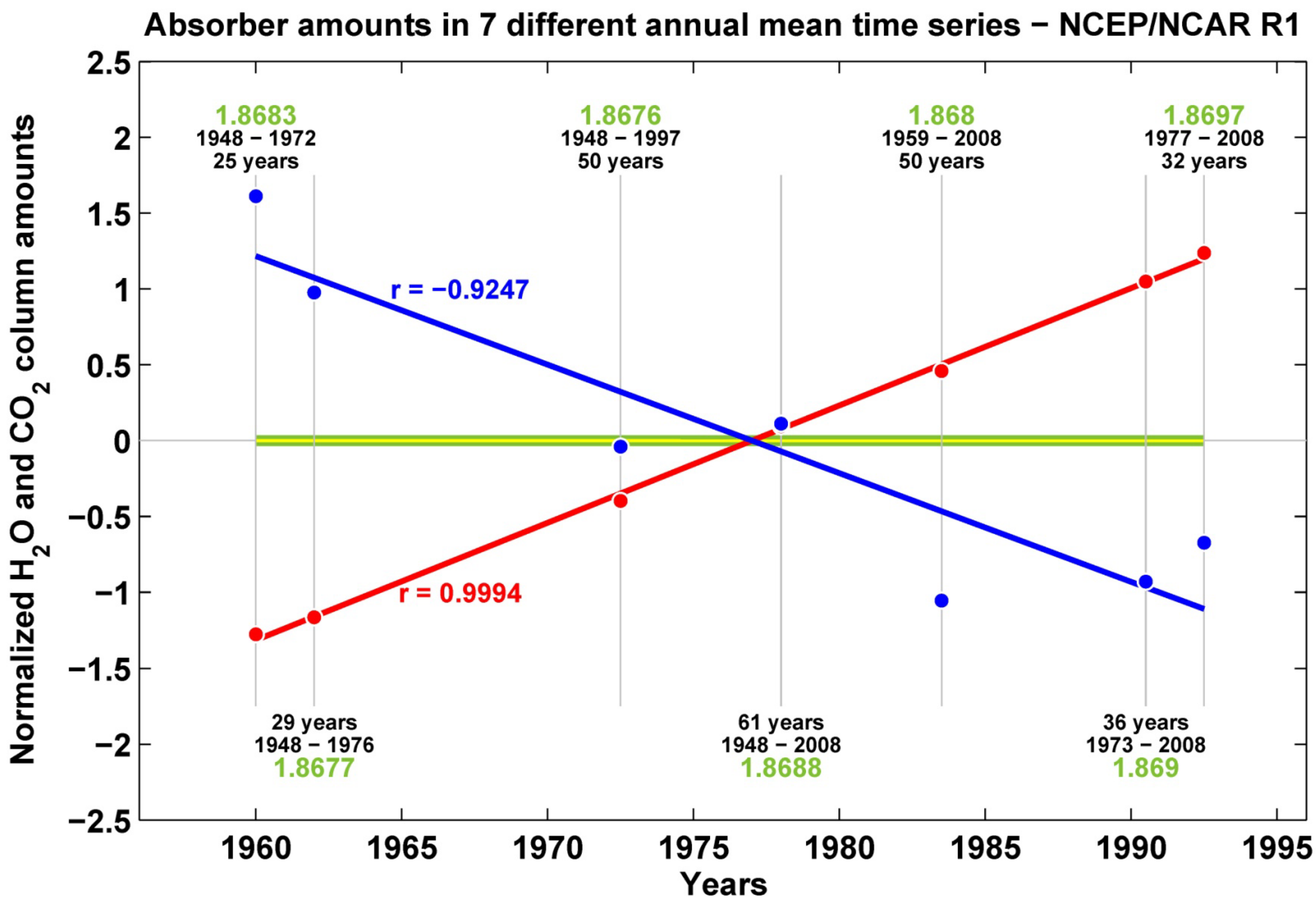

Fig. 6 Changes of H_2O and CO_2 (normalized) column amounts in 7 different time series. Data are from the NOAA-R1 (sometimes called NCEP/NCAR R1) radiosonde archive [**D1−3**]. The sign of the H_2O regression coefficient (in blue color) clearly an indication of the H_2O climate stabilizing role. The green and yellow trend lines (deviations from the sample mean and deviations from the $\tau^T = 1.867$ theoretical value) show no tendency.

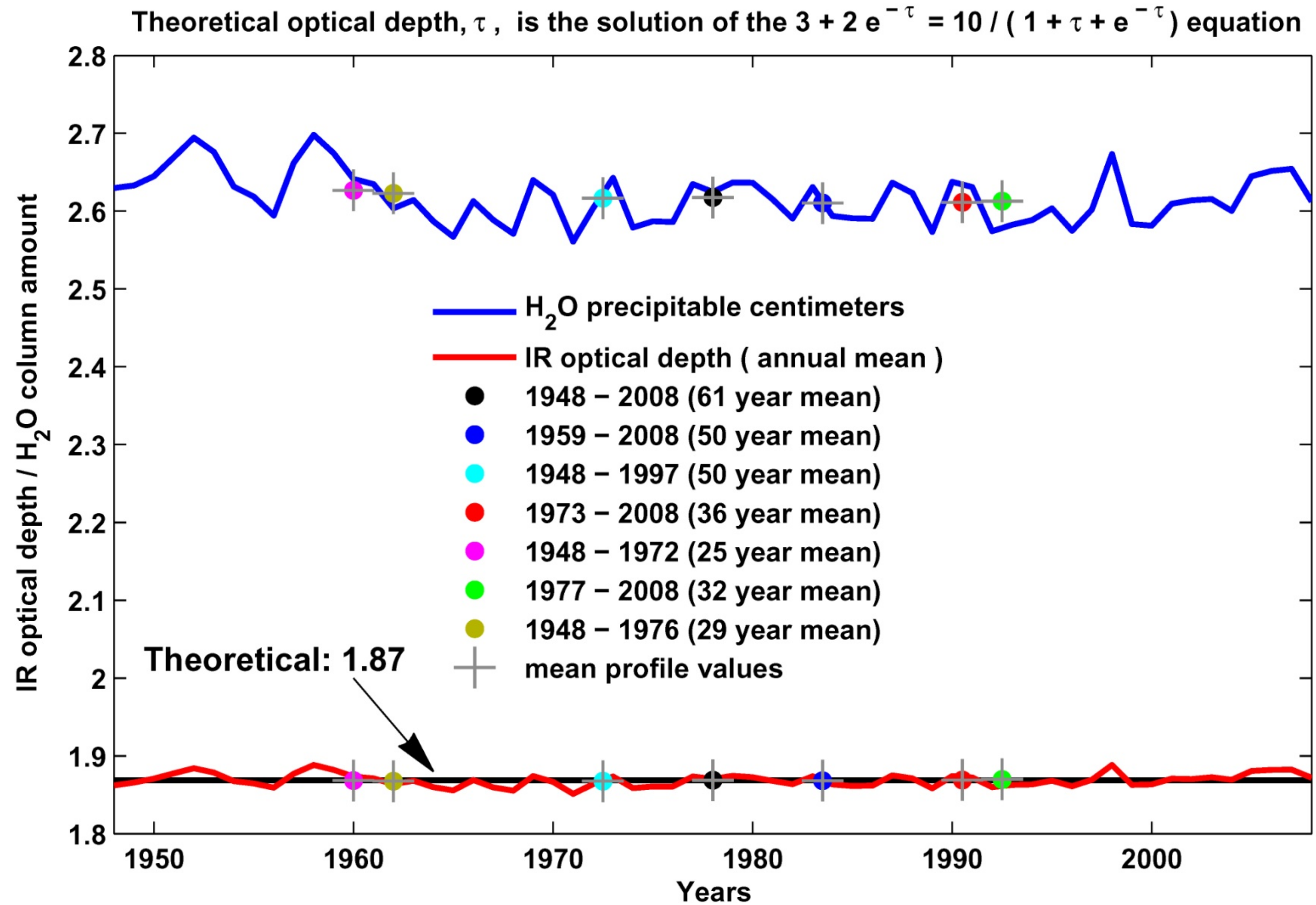

Fig. 7 The constancy of the annual mean flux optical depth in 7 time series of different length. Computations were based on the NOAA-R1 radiosonde archive **[D1−3]** . H_2O column amounts are in prcm. Notice that the random fluctuation in the IR optical depths (red line) correlate well with the H_2O column amounts (blue lines).

Time period	Centre	Years	Altitude	Temperature	H_2O	CO_2	Tau
1948−2008	1978	61	0.7931	0.8183	−0.2841	0.9839	0.06488
1959−2008	1983.5	50	0.8059	0.8349	0.04499	0.9937	0.2976
1948−1997	1972.5	50	0.6621	0.6625	−0.4843	0.9827	−0.2284
1973−2008	1990.5	36	0.6947	0.7987	0.1148	0.9974	0.3491
1948−1972	1960	25	−0.005748	0.1731	−0.5907	0.983	−0.4184
1977−2008	1992.5	32	0.58	0.7424	0.03992	0.9973	0.267
1948−1976	1962	29	0.001769	0.0584	−0.6048	0.9804	−0.4396

Fig. 8 Trend line correlation summary of the seven NOAA-R1 time series. The last five columns are linear regression coefficients for the top altitude of the air column, surface temperature, water vapor and carbon dioxide column amounts, and the flux optical depth. The IR flux optical depth has no correlation with time and the strong signal of increasing atmospheric CO_2 content in any time series is not present in the IR flux optical depth data **[D1−3,R1−5]** . Consequently, the atmospheric CO_2 increase cannot be the reason of global warming.

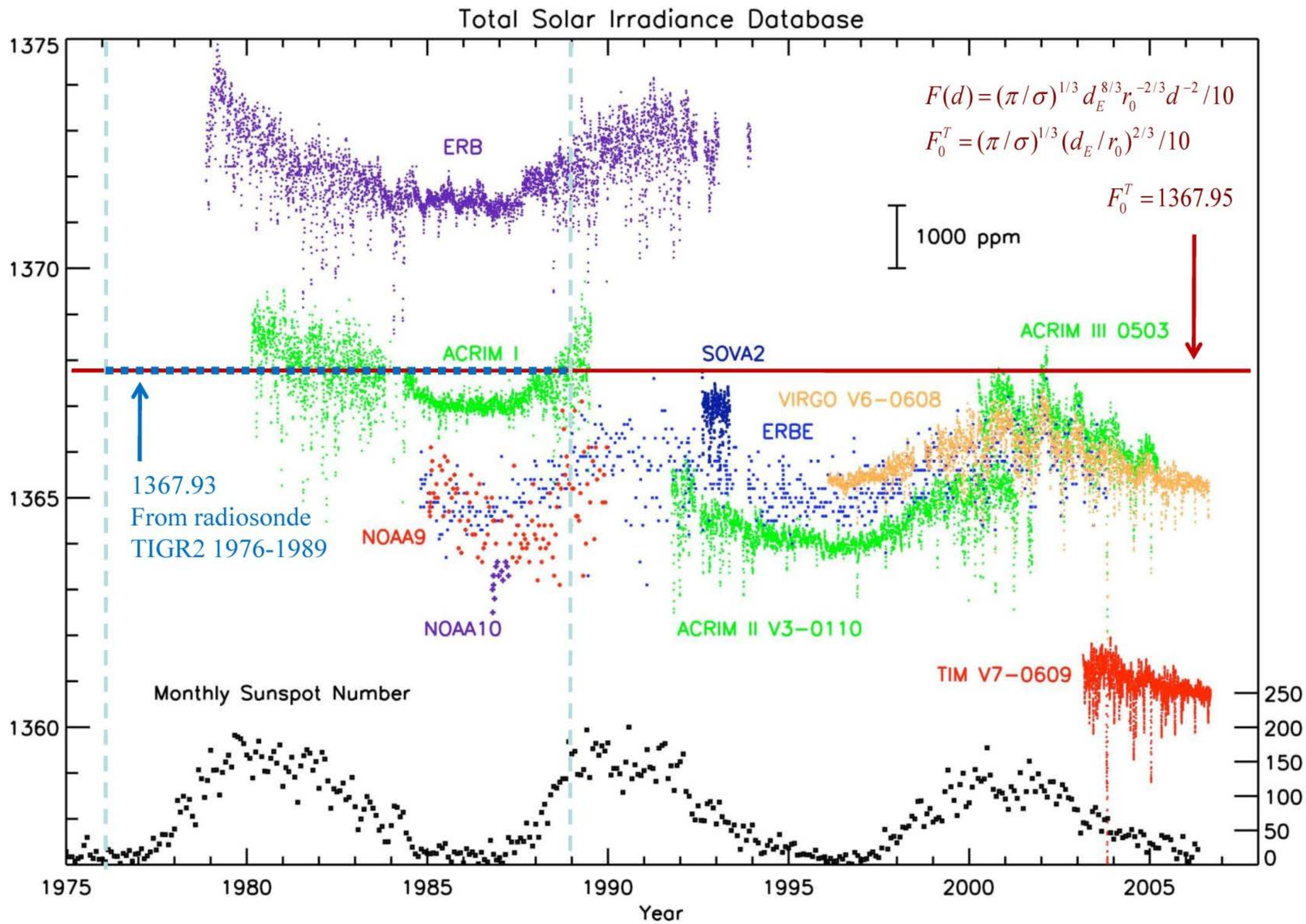

Fig. 9 Comparisons of the theoretical solar constant with direct satellite observations in **[R2−11]**, and with LW flux density simulations from the TIGR2 archive. The blue dotted line is at $F_0^{obs} = 4S_U^A$, and S_U^A is the all-sky global mean surface upward flux density from the active planetary surface. The $F_0^{obs} = F_0^T$ is the indication of strict planetary radiative equilibrium. (TSI and fluxes are in Wm^{-2}.)

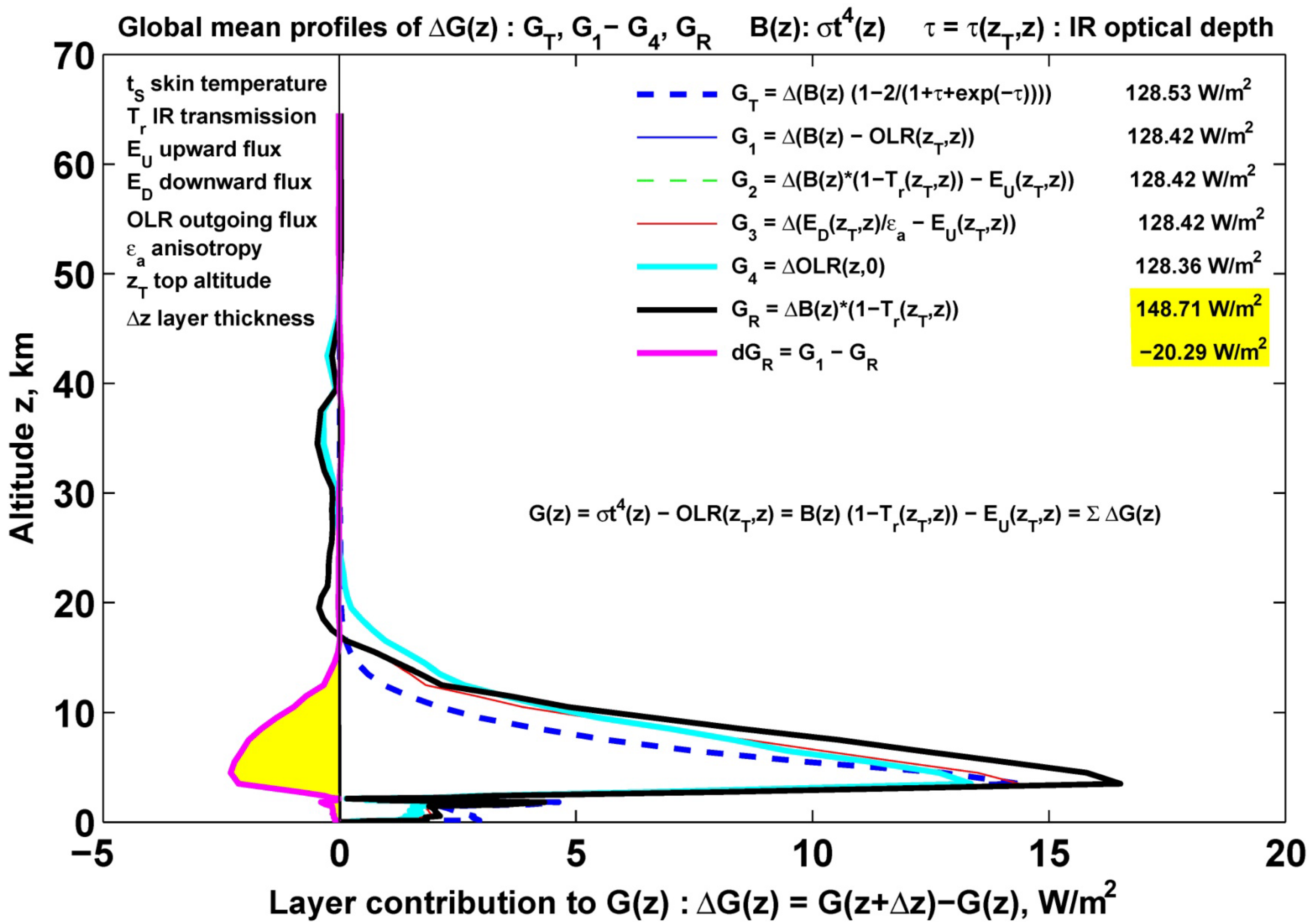

Fig. 10 Layer contributions to the greenhouse factor. Except G_R in *Raval and Ramanathan*, 1989[R2−14] different greenhouse factors are in good agreement. The mathematically incorrect representation of G_R gives about -20 Wm^{-2} cumulative error (overestimate) at the TOA.

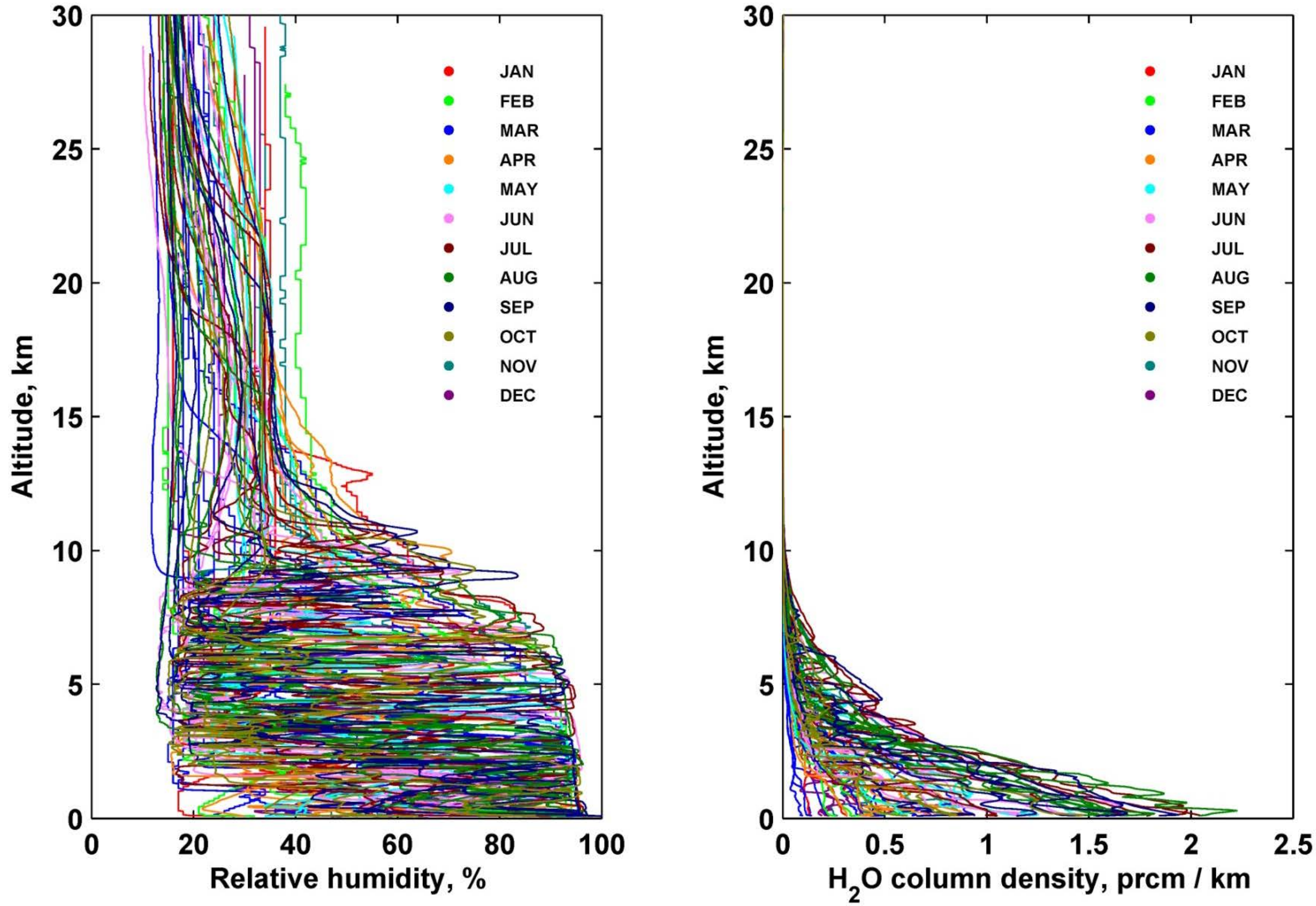

Fig. 11 High resolution radiosonde observations from NOAA Sterling, Virginia. The H_2O column density directly enters to the LBL computation of the layer flux transmittance and optical thickness. The left panel shows, that the tropospheric relative humidity is a true stochastic component of the climate system.

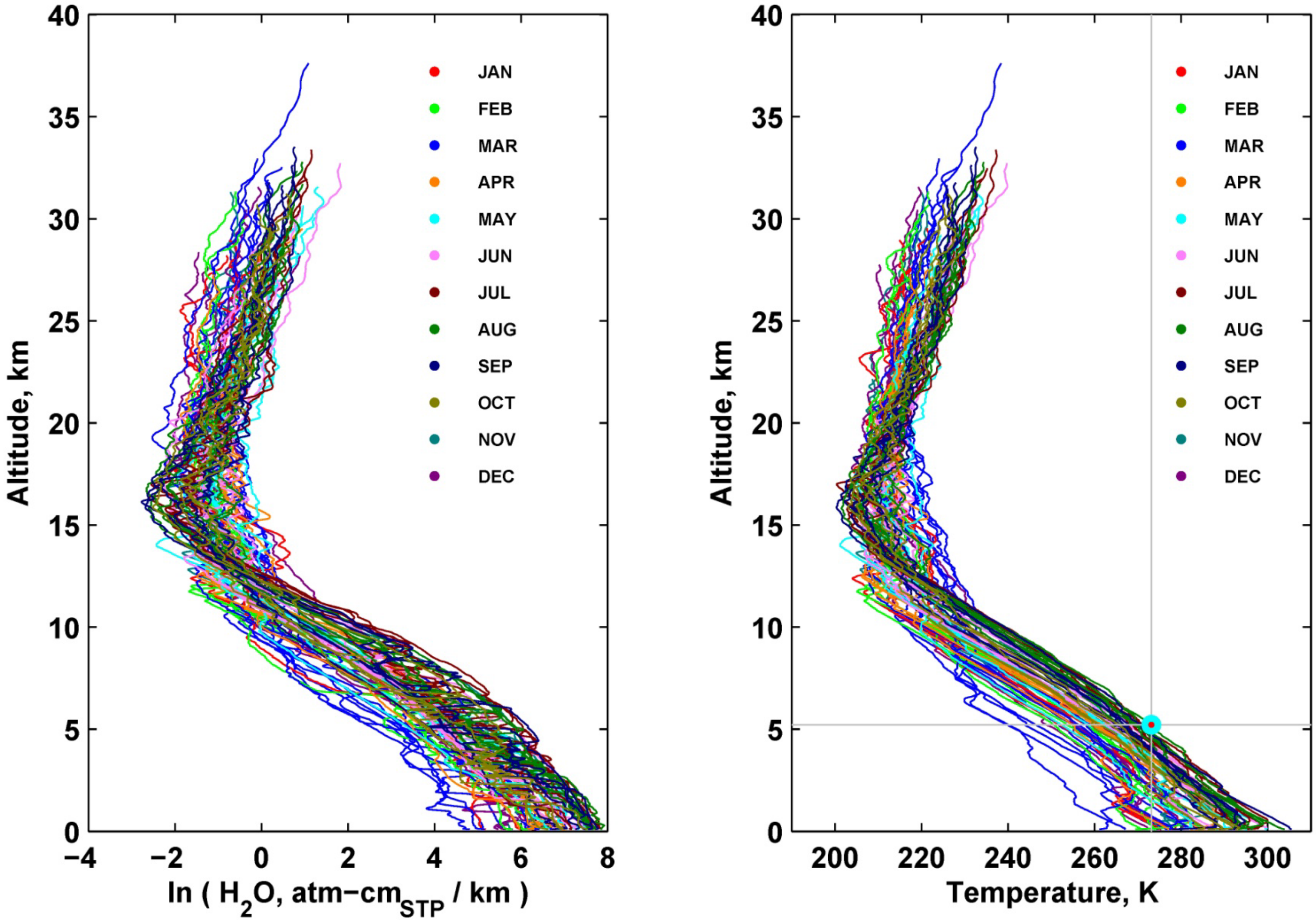

Fig. 12 High resolution radiosonde observations from NOAA Sterling, Virginia. The temperatures and H_2O column density are highly correlated, and they follow the relevant theoretical relationships. Many climatologists mistakenly call this relationship as positive feedback. The light blue dot around 5 km (in the right plot) is the observed maximum altitude of the H_2O condensation temperature at Sterling.

S/N	ts	h2o	o3	Su	Ed	OLR	St	Eu	tau
1621	266.6	0.5262	0.2546	286.7	200	213.8	78.48	135.3	1.295
2171	266.6	0.5274	0.3548	286.7	200.4	210.4	76.95	133.4	1.315
Δ	0	0.0012	0.1002	0.0004293	0.4968	−3.403	−1.535	−1.868	0.01976
Δ%	0	0.2281	39.36	0.0001498	0.2485	−1.592	−1.956	−1.381	1.525

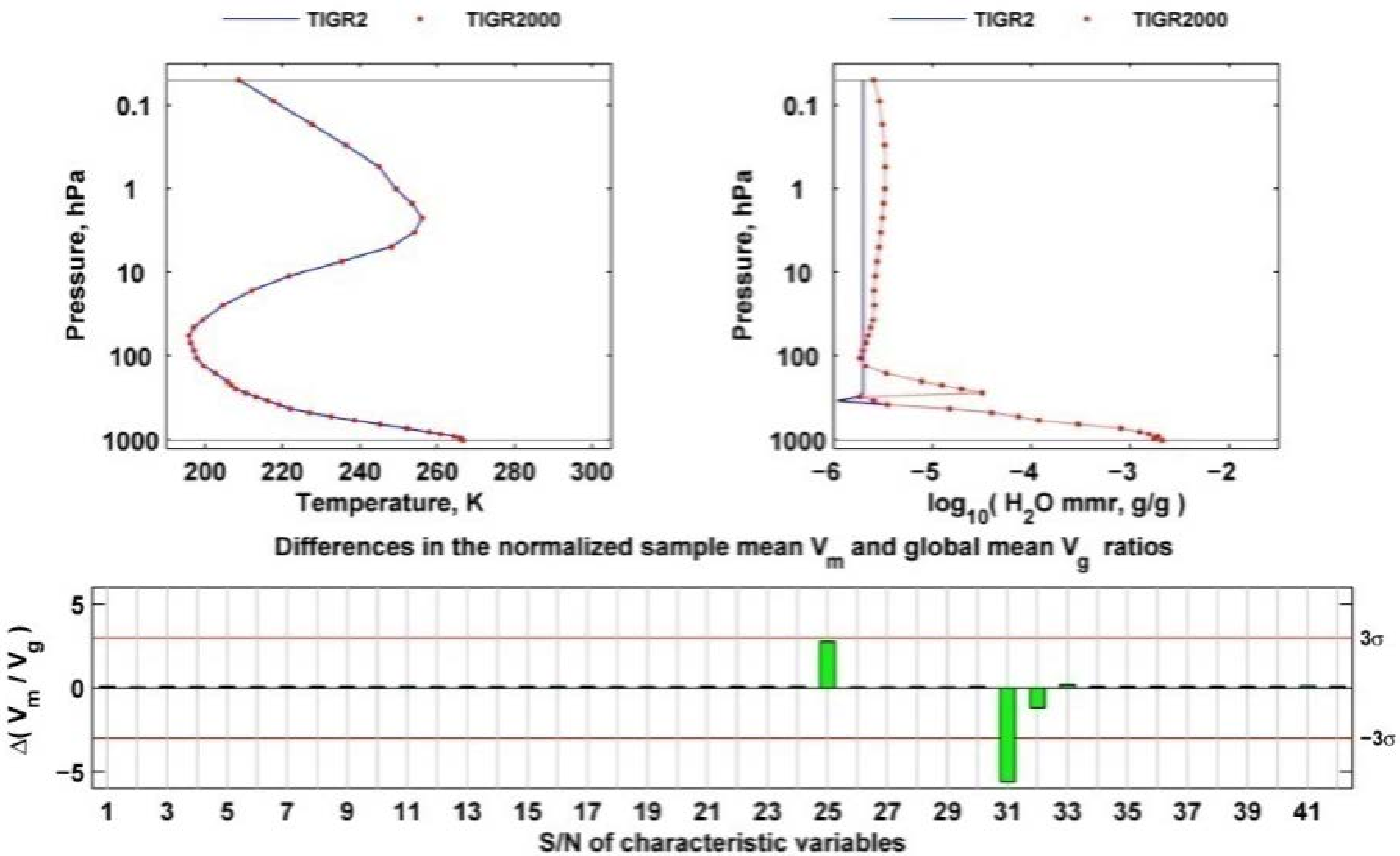

Fig. 13 Evidences of large scale data manipulation in radiosonde observations. Comparing the two versions of the TIGR database shows that in more than 50 % of the humidity profiles the upper tropospheric H_2O mass mixing ratio were increased. In this example the changes resulted in 3.4 Wm^{-2} decrease in OLR and significant increase in the flux optical depth. In the lower plot variables #25 sn_G and #31 $exw_{m,G}$ are outliers. See the text for the definitions of sn_G, $exw_{m,G}$.

Planetary radiative equilibrium cloud cover at h^C altitude

$$F_A = (1-\beta^A)\,OLR + \beta^A\,OLR^C$$

$$F_E = (1-\beta^E)\,S_U + \beta^E S_U^C$$

$$\beta^A(F_A, h^C) = (F_A - OLR)\,/\,(OLR^C(h^C) - OLR)$$

$$\beta^E(F_E, h^C) = (F_E - S_U)\,/\,(S_U^C(h^C) - S_U)$$

$$F_A = (1 - \alpha_B)F_E$$

$$\min\left(\|\,\beta^A(h^C,\alpha_B) - \beta^E(h^C,\alpha_B)\,\|^2\right)$$

Fig. 14 Radiative equilibrium cloud cover constraints. At the TOA LW fluxes from the APS must be equal to F_E, the all-sky outgoing LW radiation must be equal to F_A, and the cloud covers from the two constraints must be equal.

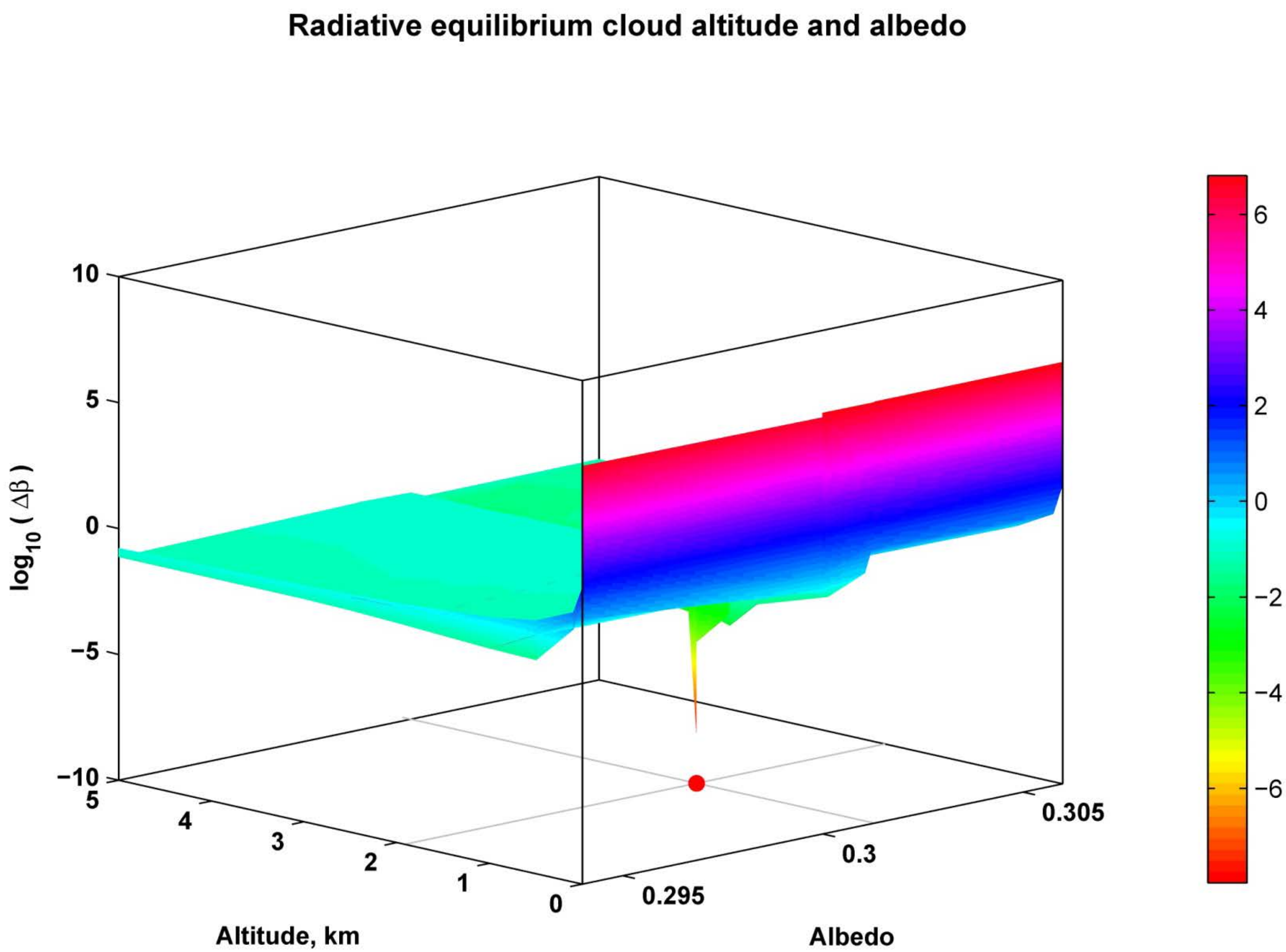

Fig. 15 The multi-parameter optimization algorithm. Sharp minimum found at $\alpha_B = 0.3013$ and $h^C = 1.9166$ km.

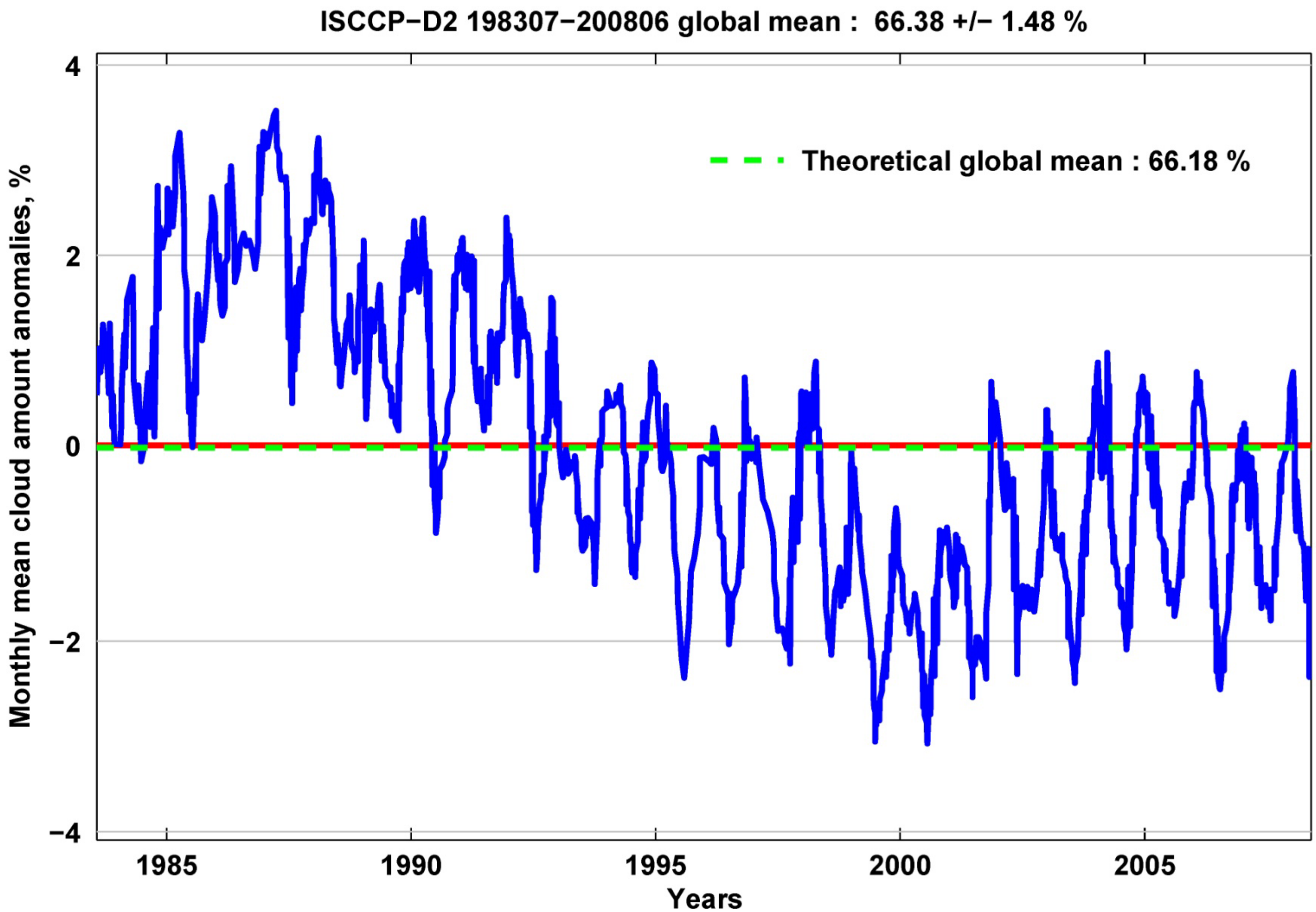

Fig. 16 The theoretical cloud cover (green dashed line) is compared with satellite observations in the 1983-2008 time interval (red line). The agreement is well within the uncertainty of the satellite observations. The theoretical equilibrium cloud cover is practically equal to the theoretical transfer function: $\beta = 2(1+\tau^T + \exp(-\tau^T))^{-1}$, where $\tau^T = 1.8676$ is the theoretical equilibrium flux optical depth.

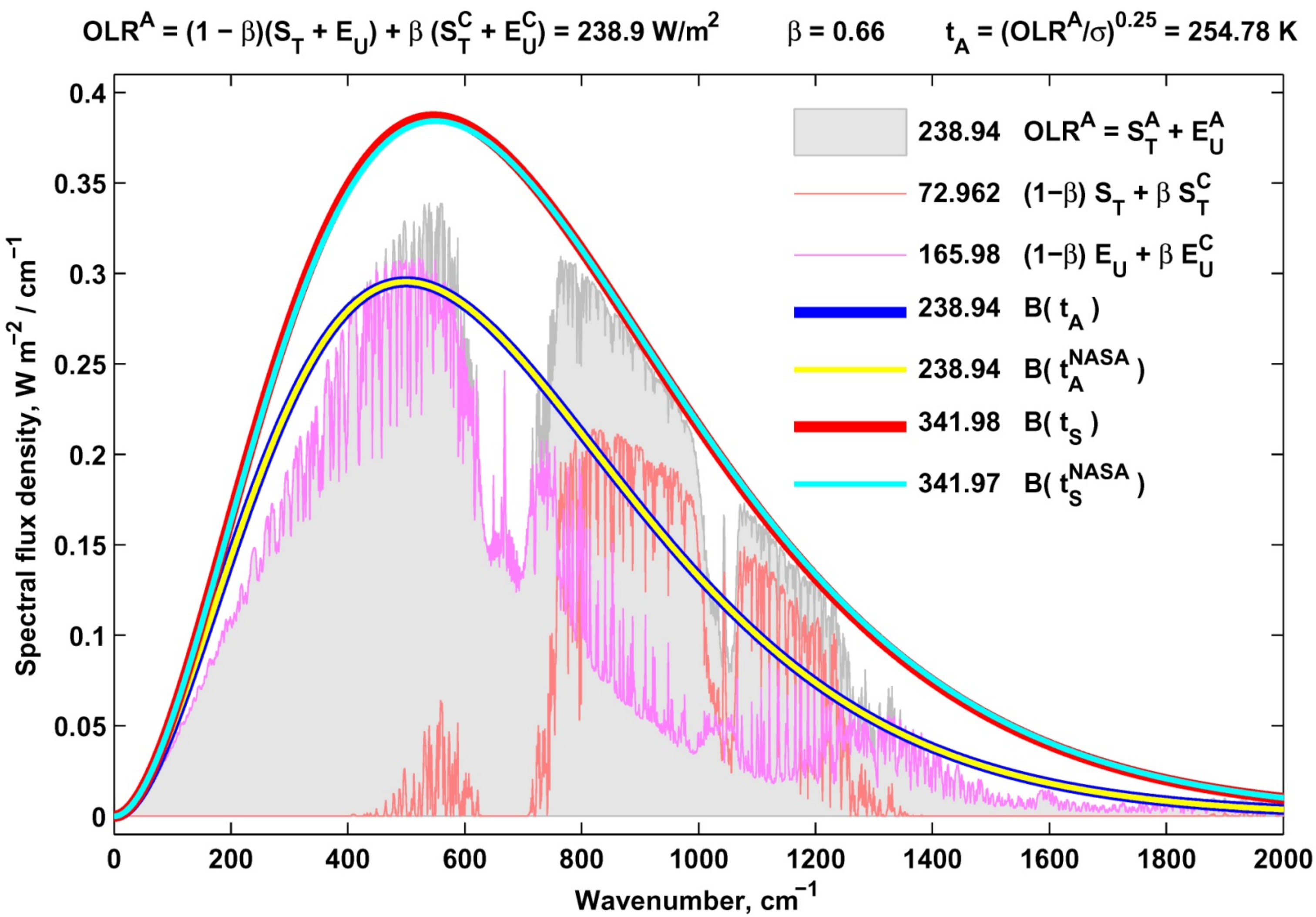

Fig. 17 Flux density spectra of the all-sky GAT atmosphere. The equivalent blackbody spectra $B(t_A)$, and $B(t_S)$ are equal to the equivalent spectra from $B(t_A^{NASA})$, and $B(t_S^{NASA})$. This is an indication that the GAT atmosphere is close to the real global average atmospheric structure.

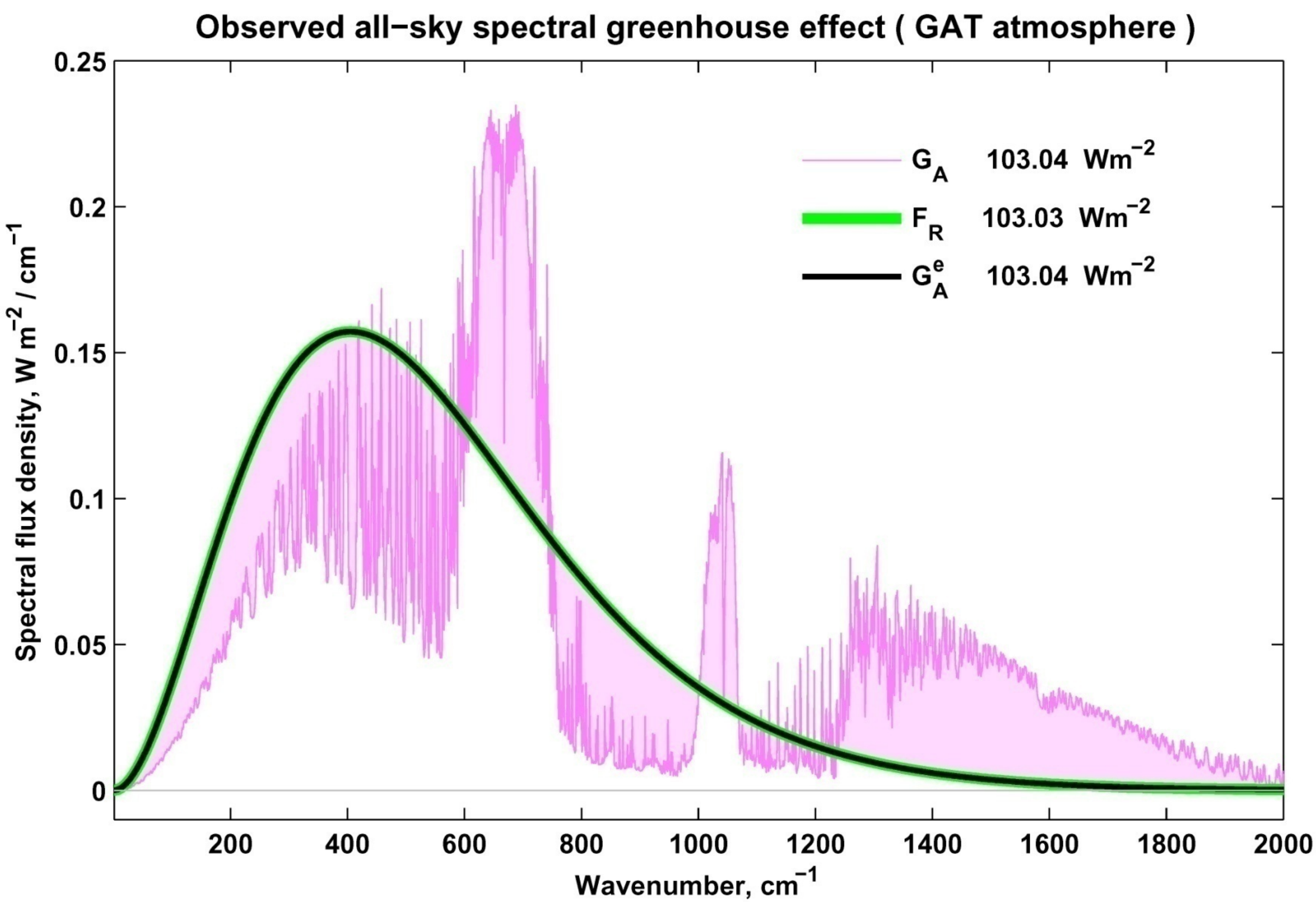

Fig. 18 Spectral all-sky greenhouse effect referenced to the APS. The integrated flux densities from the G_A^e and F_R curves agree reasonably well. While the surface referenced clear sky greenhouse effect ($\sigma t_G^4 - OLR^A = 154.5$ Wm^{-2}) has no clear physical meaning the APS referenced GF can easily be associated with the deposited momentum by the reflected radiation.

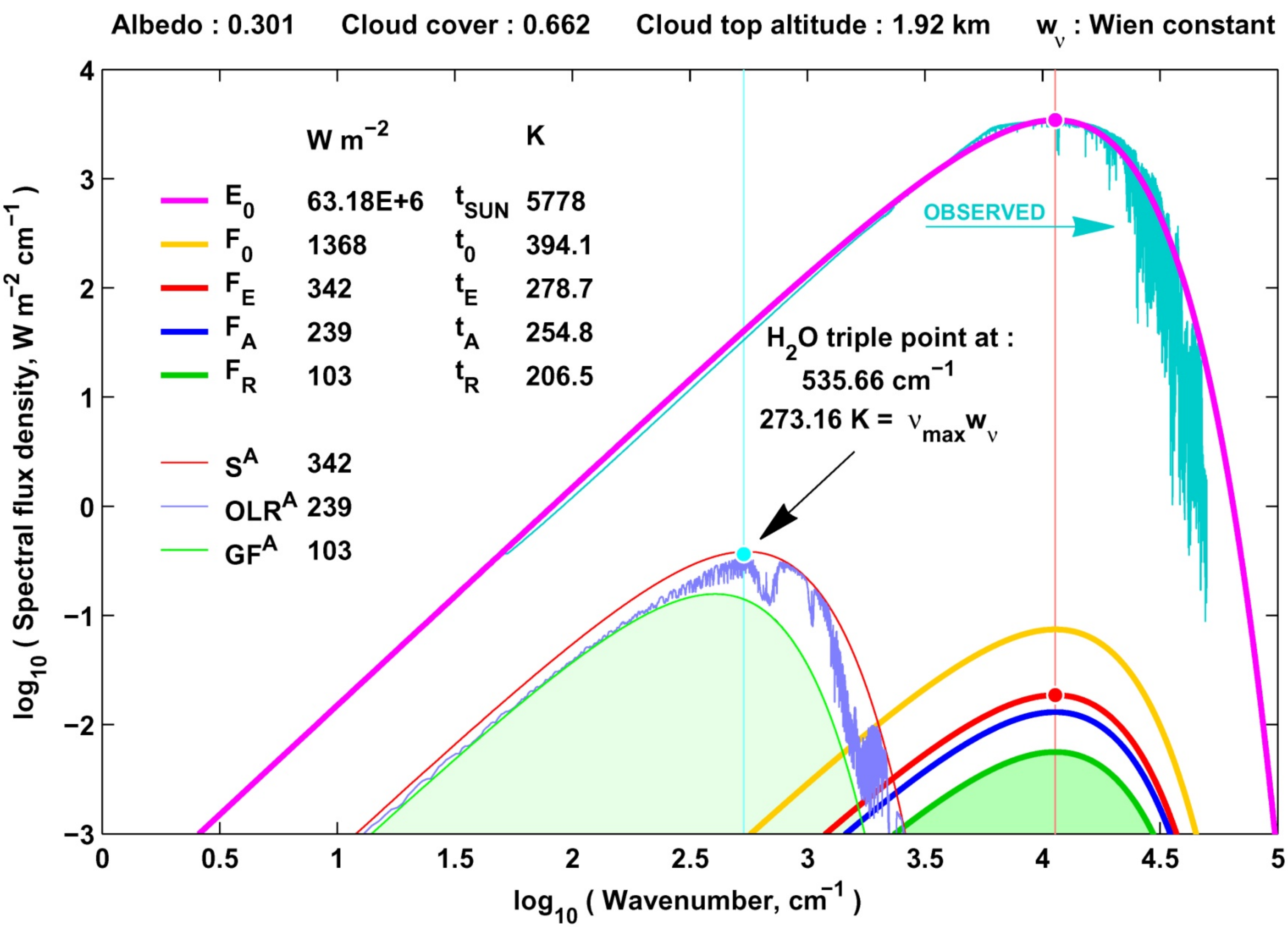

Fig. 19 Solar and terrestrial equilibrium blackbody spectra. The observed solar reference spectrum (dark cyan line) is from *Chance and Kurucz*, 2010[R2−10]. The light blue line is the observed TOA OLR^A from the TIGR2 radiosonde archive. The light cyan dot at the maximum of the OLR^A shows that the Earth has a special orbit where the Wien temperature is equal to the t_p phase temperature of the H_2O. Obviously OLR^A has the maximum entropy flux density.

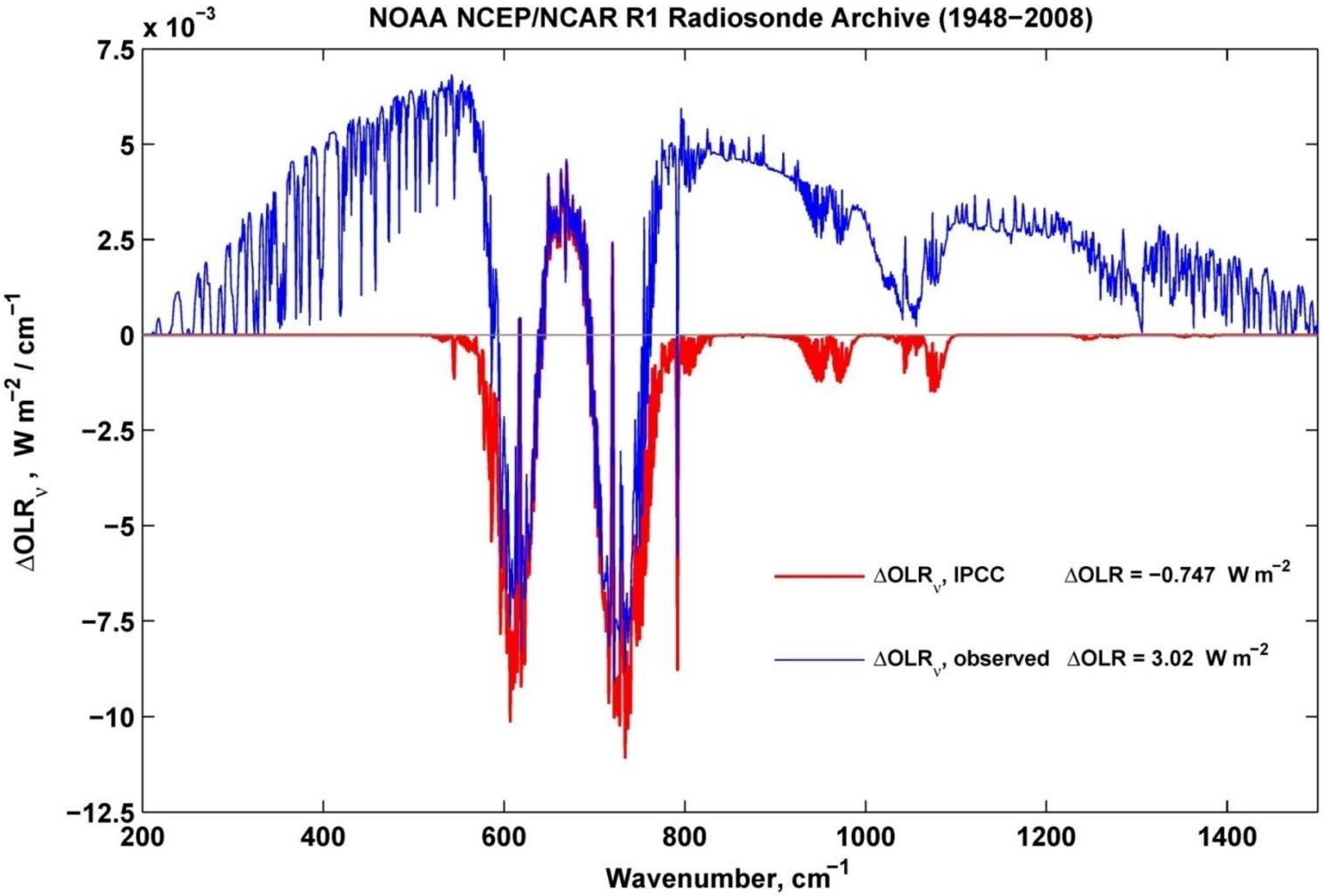

Fig. 20 Comparison of the observed and expected changes in the clear-sky spectral *OLR*. The IPCC type no-feedback response to 23.56 % increase in carbon dioxide is negative. The real atmosphere does not follow the GHG GE hypothesis of the IPCC, **[R1−17]** pp. 34 Fig. 1. The observed true change in the *OLR* is positive and the atmosphere does not resume the initial state. The fictitious no-feedback response is unrelated to climate change.

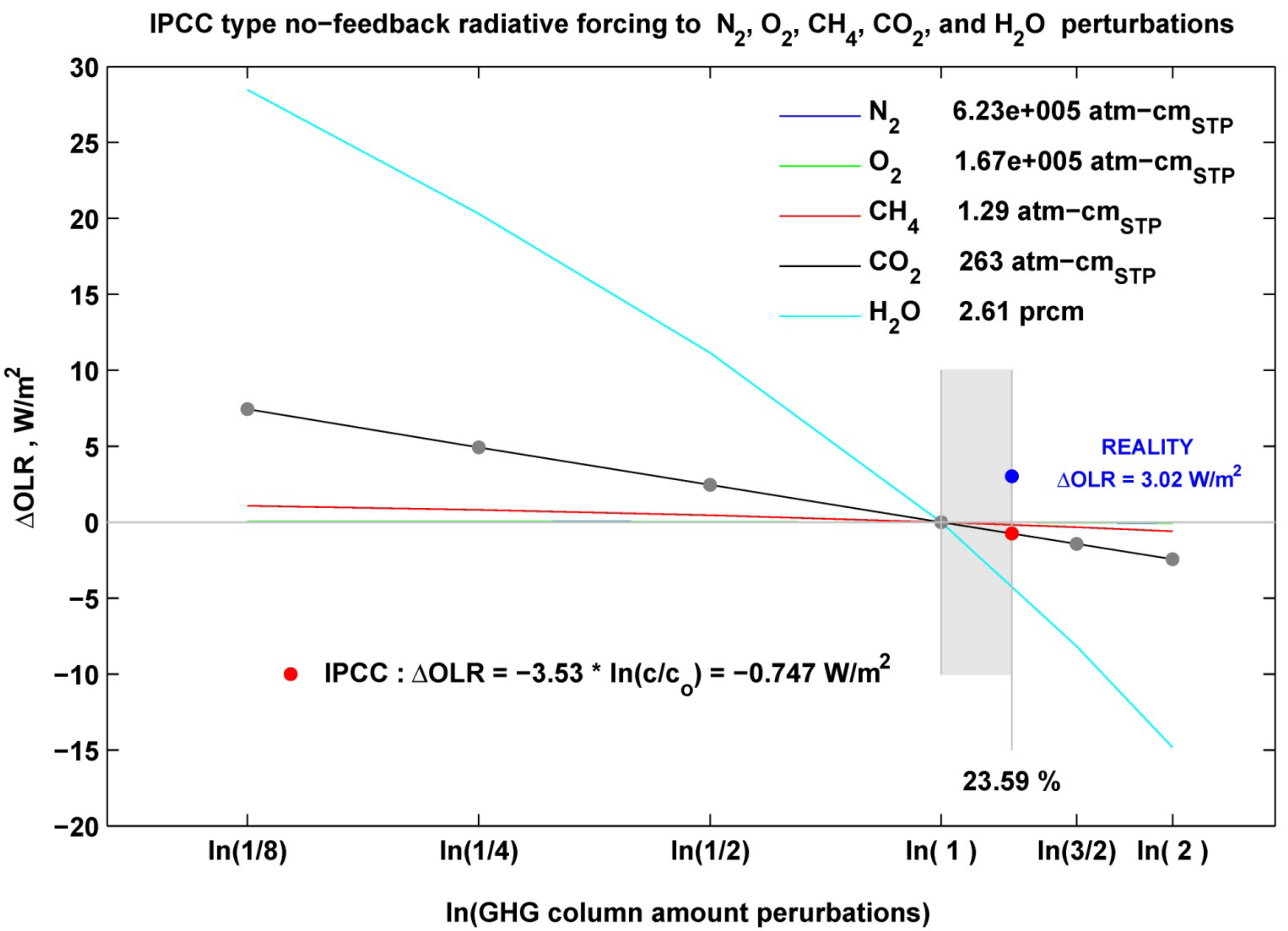

Fig. 21 HARTCODE GHG perturbatioon study shows that at the TOA the no-feedback response of increased atmospheric CO_2 is negative. The observed 23.6 % increase in CO_2 column amount causes -0.75 Wm^{-2} radiative imbalance (red dot) . In the same time period, based on the NOAA-R1 archive the real change is 3.02 Wm^{-2} (blue dot). The changes of OLR due to the pressure induced continuum absorption of N2 and O2 are negligible.

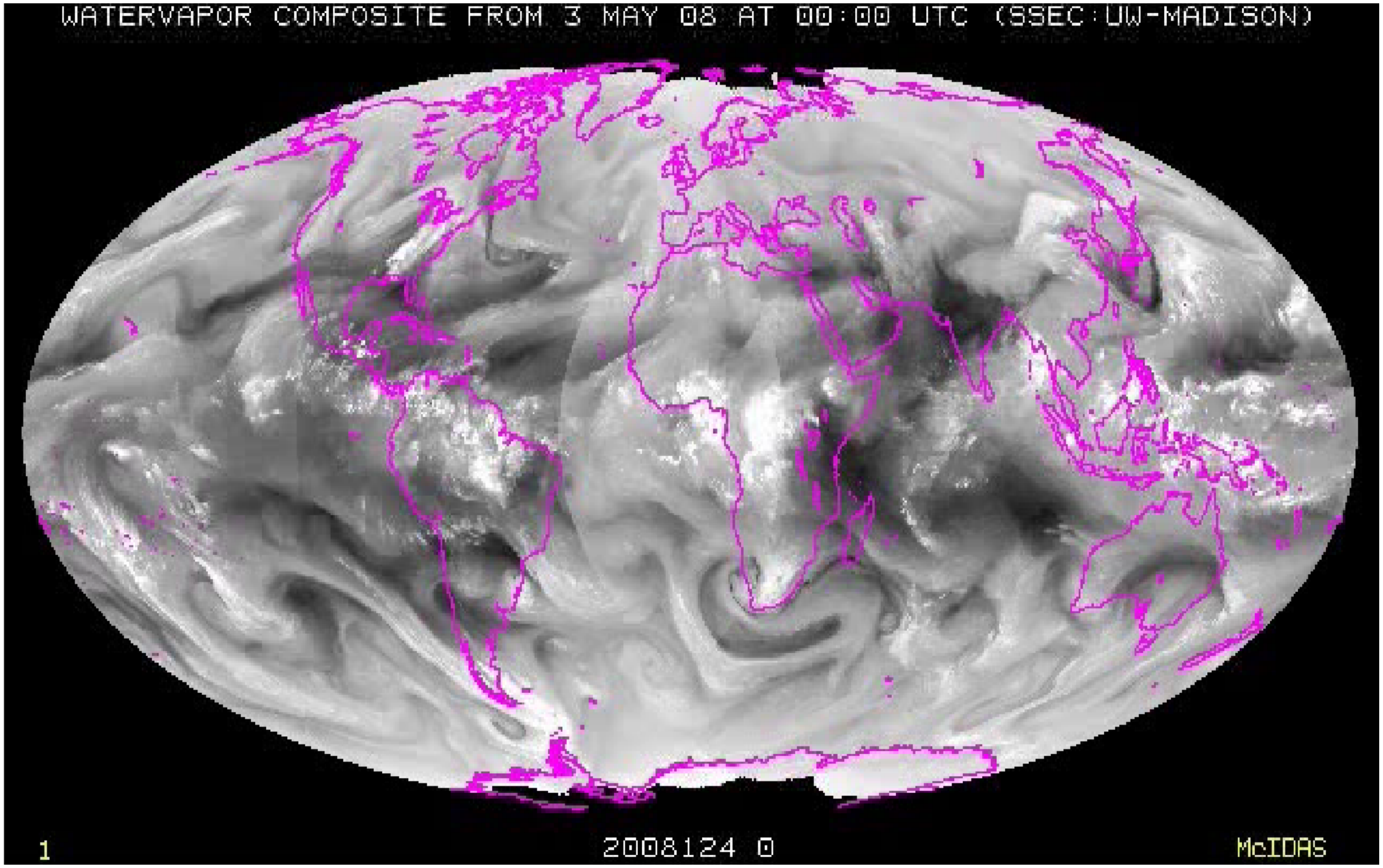

Fig. 22 Satellite view of the changes in the upper tropospheric humidity field**.** The global mean atmospheric IR emission to space is controlled by the chaotic changes of the humidity field. GCMs are unable to model the stochastic nature of the radiation climate, and the theoretical consraints governing the global mean radiation components are also not part of the GCMs. Click to activate the video.

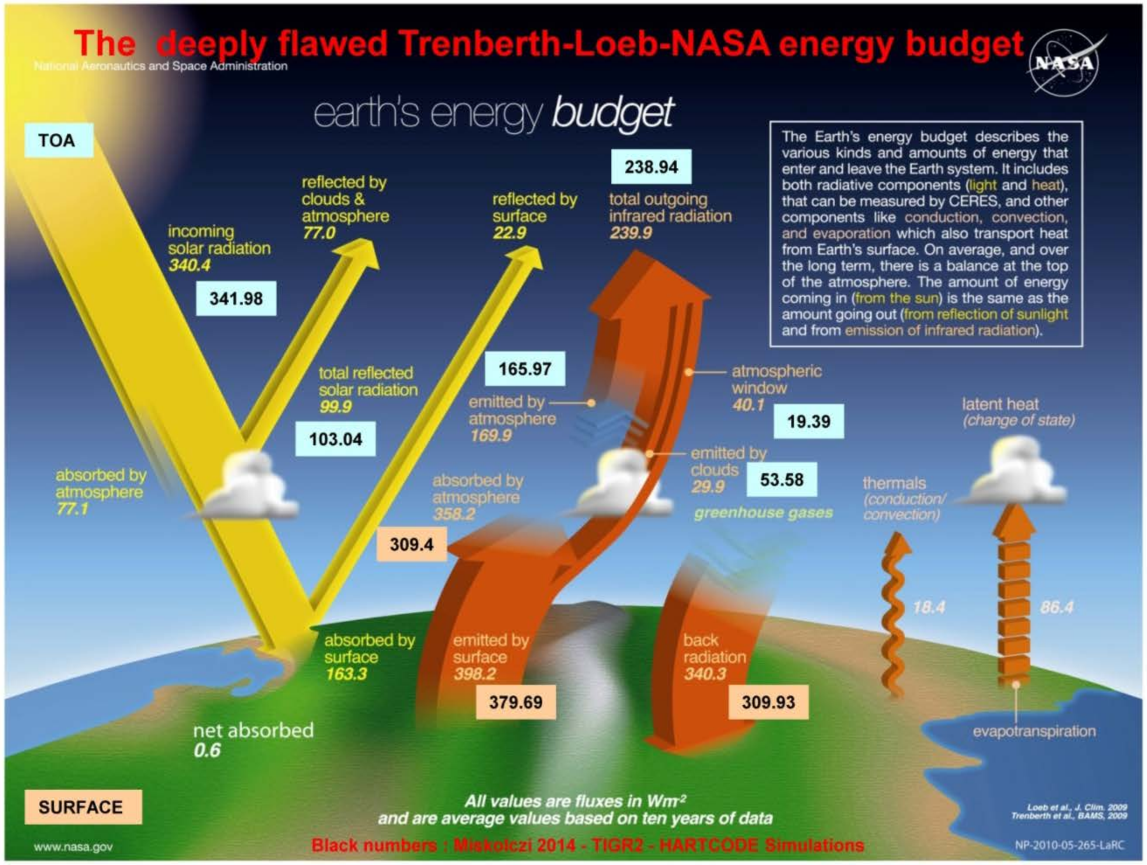

Fig. 23 All-sky energy budget of the Earth-atmosphere system (adopted from NASA**[R2-20])**. Because of the use of the USST76 Atmosphere the IR flux density components (light red numbers) are incorrect. The 0.6 Wm^{-2} fictitious missing heat (white number) is meaningless and violates energy conservation principles (Kirchhoff law). For reference the flux density terms from Fig. 4 are inserted into the original plot (black numbers). They were computed for the GAT atmosphere using HARTCODE. The blue and red squares are the top of the atmosphere and surface referenced components subsequently.