ENERGETIKAI KÉNYSZEREK

AZ ÜVEGHÁZHATÁS KIALAKULÁSÁBAN

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2001 – 2005 NASA Langley Research Center

Senior Principal Scientist

Far-Infrared Properties of the Earth Radiation Budget
A Proposal Submitted to NRA 03-OES-02
Submitted April 15 2003

Martin G. Mlynczak, **Bill Collins**, **Dave Kratz**, **Ping Yang**, **Christopher J. Mertens**, **Ferenc Mislkolczi**, **Robert G. Ellingson**, **Bill Smith, Sr**., **Bryan Baum**,**Paul Stackhouse**, **Larry Gordley**

8.1 Science Team Member Responsibilities

- Mlynczak, **Miskolczi**, Mertens,and Smith : **CERES and AIRS window radiance verification**
- Kratz, Mertens, **Miskolczi**, Gordley : **Far-IR flux derivations**
- Ellingson, Mertens : **Radiative cooling rates**
- **Miskolczi**, Kratz, and Mlynczak : **Spectral Greenhouse Effect**
- Yang, Baum, and Stackhouse : **Far-IR Cirrus Properties**
- Collins, Mertens, Kratz, **Miskolczi** : **Climate Model Comparisons**
- All : **Error Analysis**

http:/science.larc.nasa.gov/ceres/STM/2005-11_miskolczi_airs.pdf

RS & NAS Feb. 27th 2014

Climate Change
Evidence & Causes

An overview from the Royal Society and the US National Academy of Sciences

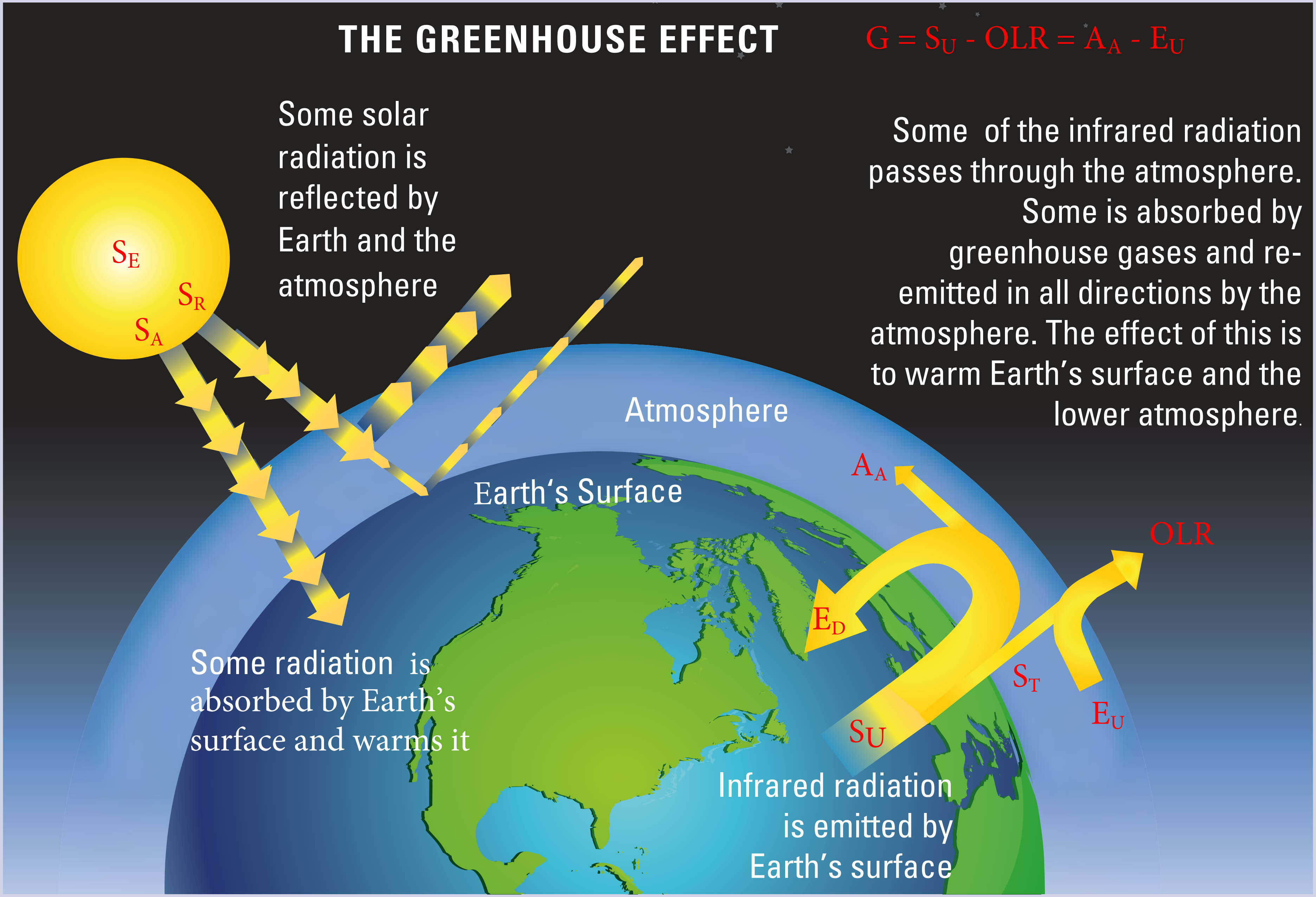
NATIONAL ACADEMY OF SCIENCES

THE ROYAL SOCIETY

Greenhouse gases affect Earth's energy balance and climate

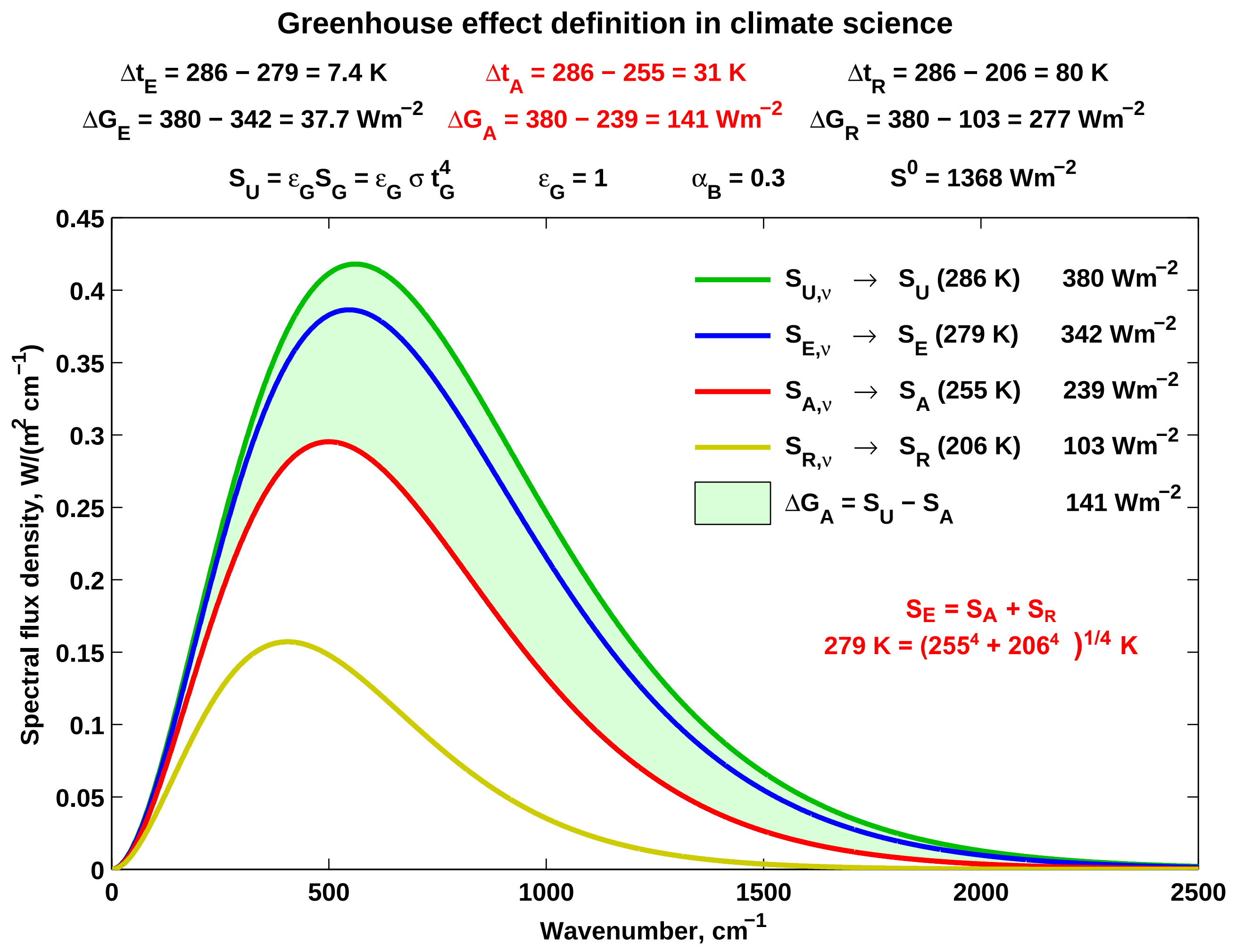
Greenhouse gases in the atmosphere, including water vapour, carbon dioxide, methane, and nitrous oxide, absorb heat energy and emit it in all directions (including downwards), keeping Earth's surface and lower atmosphere warm. Adding more greenhouse gases to the atmosphere enhances the effect, making Earth's surface and lower atmosphere even warmer.

An overview from the Royal Society and the US National Academy of Sciences



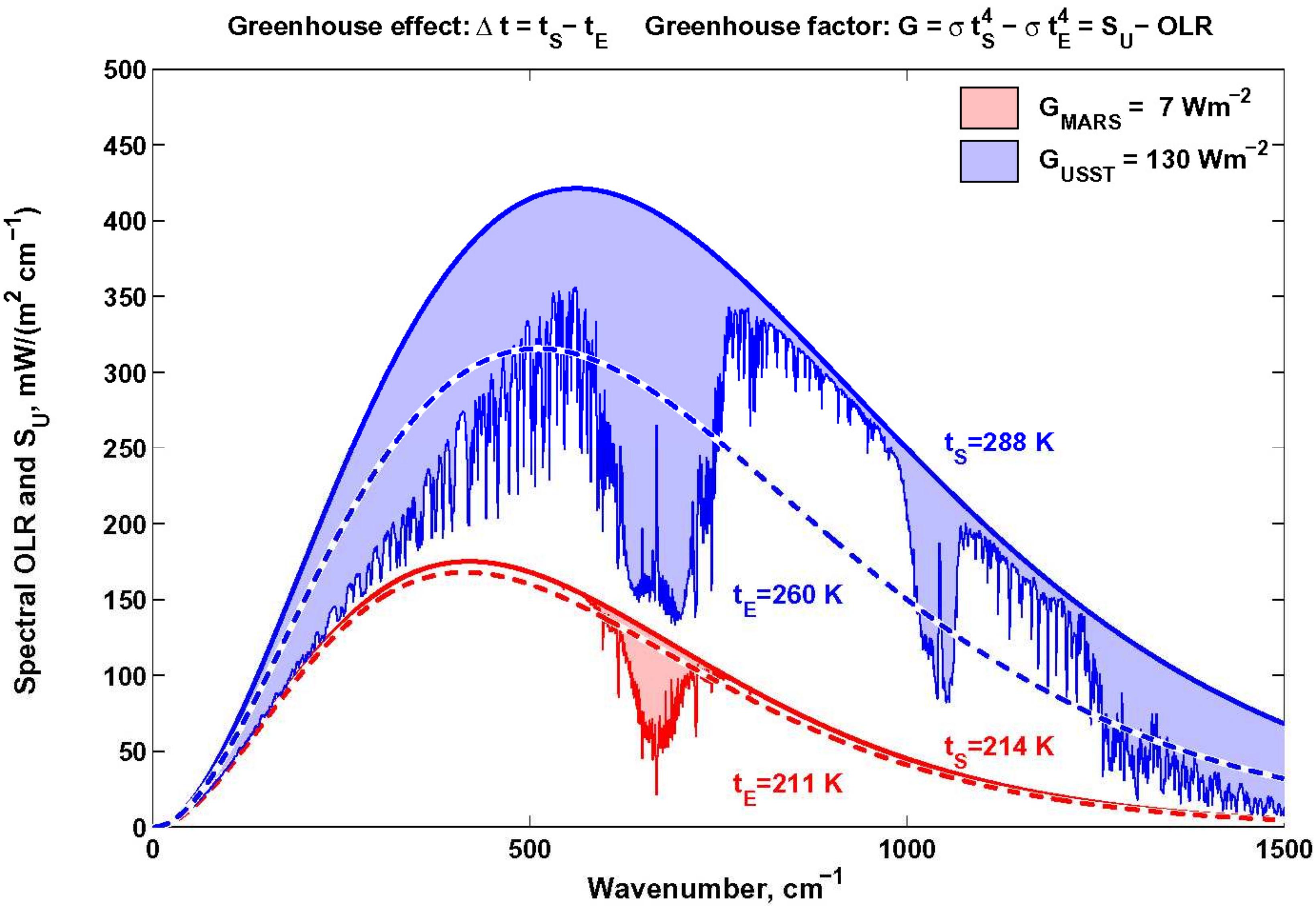
RS - SIR PAUL NURSE President

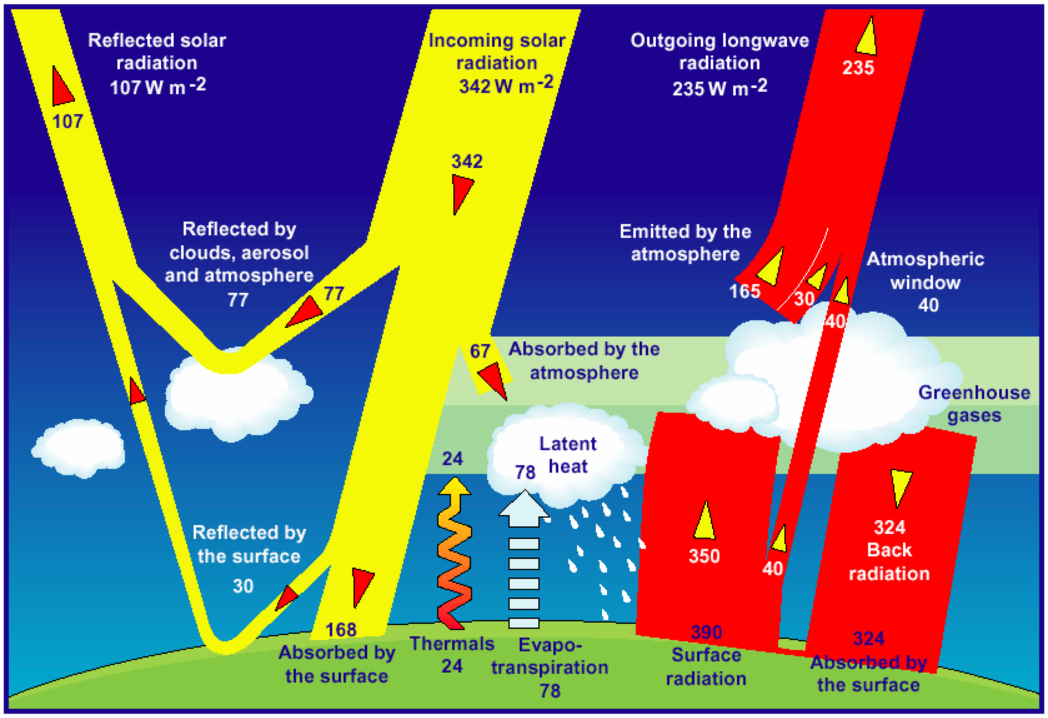
NAS - Dr. RALPH J. CICERONE President



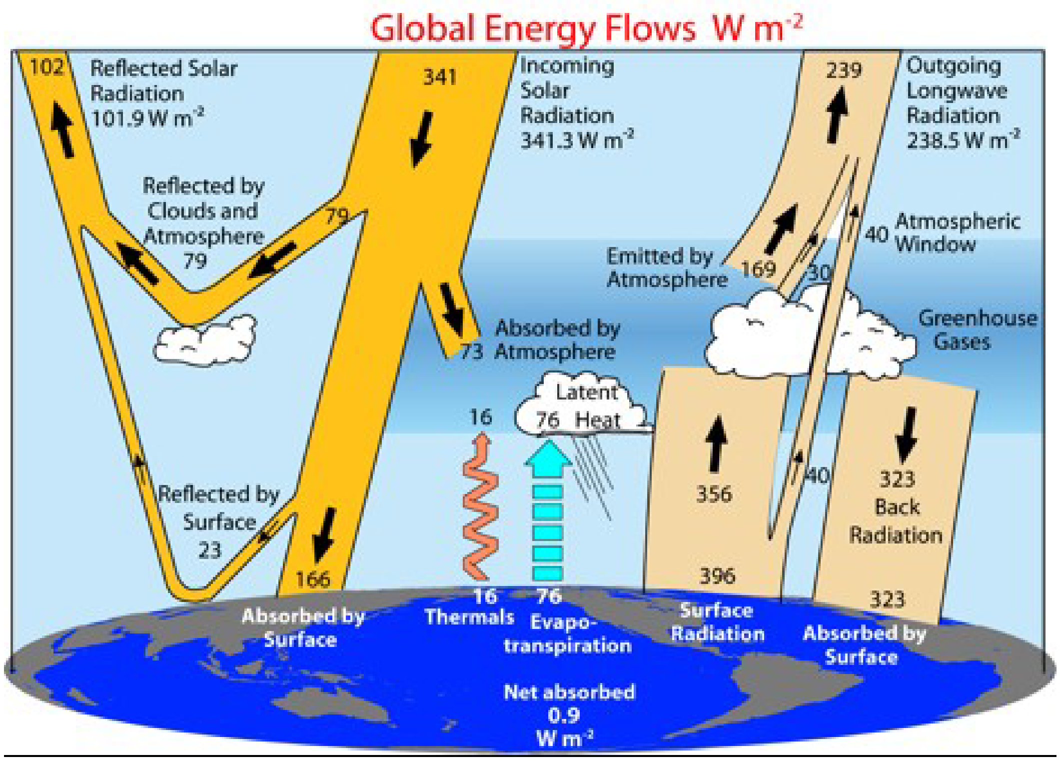
Greenhouse effect definition in climate science
Δt_E = 286 − 279 = 7.4 K
Δt_A = 286 − 255 = 31 K
Δt_R = 286 − 206 = 80 K
ΔG_E = 380 − 342 = 37.7 Wm^−2
ΔG_A = 380 − 239 = 141 Wm^−2
ΔG_R = 380 − 103 = 277 Wm^−2
S_U = ε_G S_G = ε_G σ t_G^4
ε_G = 1
α_B = 0.3
S^0 = 1368 Wm^−2
S_U,ν → S_U (286 K) 380 Wm^−2
S_E,ν → S_E (279 K) 342 Wm^−2
S_A,ν → S_A (255 K) 239 Wm^−2
S_R,ν → S_R (206 K) 103 Wm^−2
ΔG_A = S_U − S_A 141 Wm^−2
S_E = S_A + S_R
279 K = (255^4 + 206^4)^1/4 K
Spectral flux density, W/(m^2 cm^−1)
Wavenumber, cm^−1
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0
500
1000
1500
2000
2500

PLANETARY GREENHOUSE EFFECT LINKED TO ATMOSPHERIC IR ABSORPTION

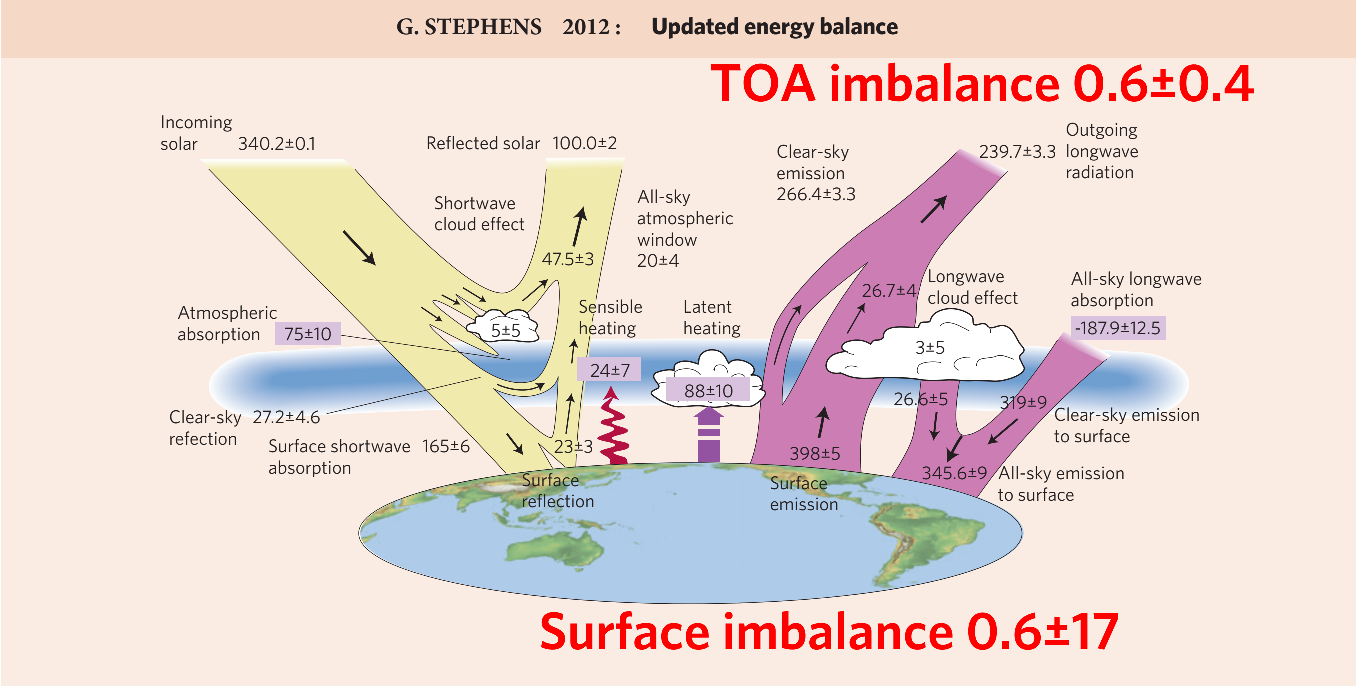



Reflected solar radiation 107 W m-2
107
Incoming solar radiation 342 W m-2
342
Outgoing longwave radiation 235 W m-2
235
Reflected by clouds, aerosol and atmosphere 77
77
Emitted by the atmosphere
165
30
Atmospheric window 40
40
67 Absorbed by the atmosphere
Greenhouse gases
Latent heat
78
24
Reflected by the surface 30
350
40
324 Back radiation
168 Absorbed by the surface
Thermals 24
Evapo-transpiration 78
390 Surface radiation
324 Absorbed by the surface

KT97

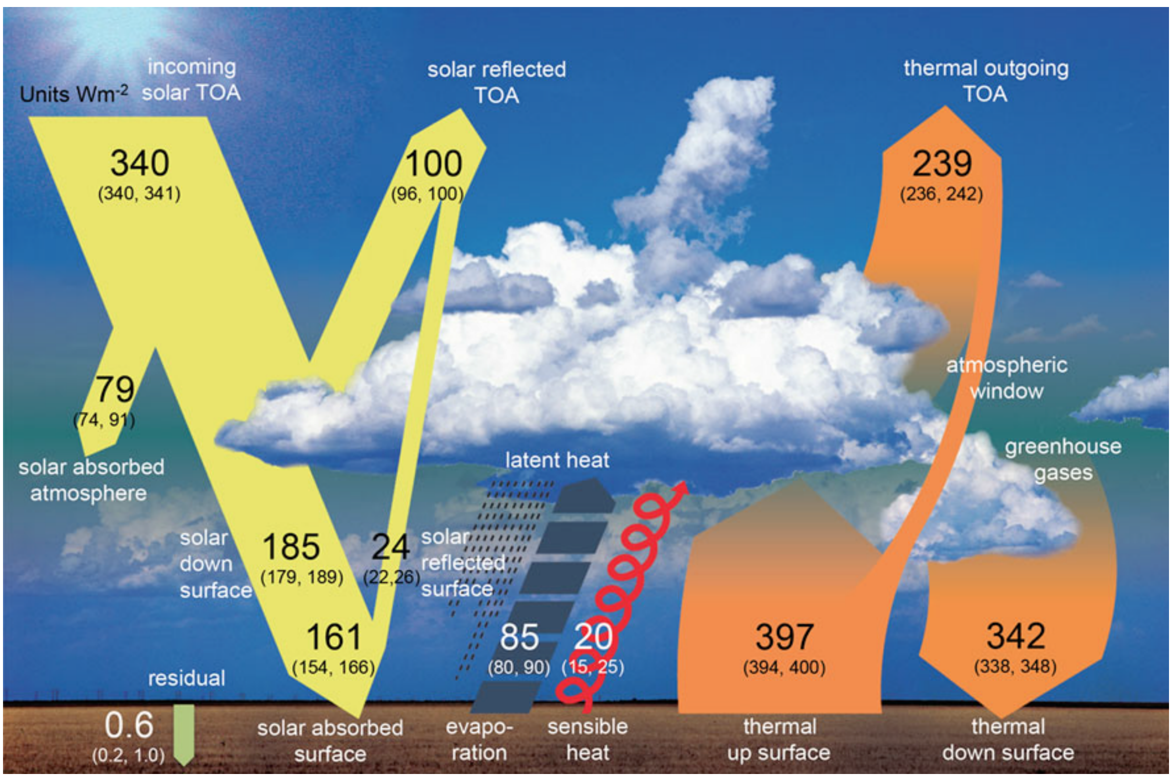

Global Energy Flows W m-2
102
Reflected Solar Radiation 101.9 W m-2
341
Incoming Solar Radiation 341.3 W m-2
239
Outgoing Longwave Radiation 238.5 W m-2
Reflected by Clouds and Atmosphere 79
79
Emitted by Atmosphere 169
30
40 Atmospheric Window
73 Absorbed by Atmosphere
Greenhouse Gases
Latent 76 Heat
16
Reflected by Surface 23
356
40
323 Back Radiation
166
396
323
Absorbed by Surface
16 Thermals
76 Evapo-transpiration
Surface Radiation
Absorbed by Surface
Net absorbed 0.9 W m-2

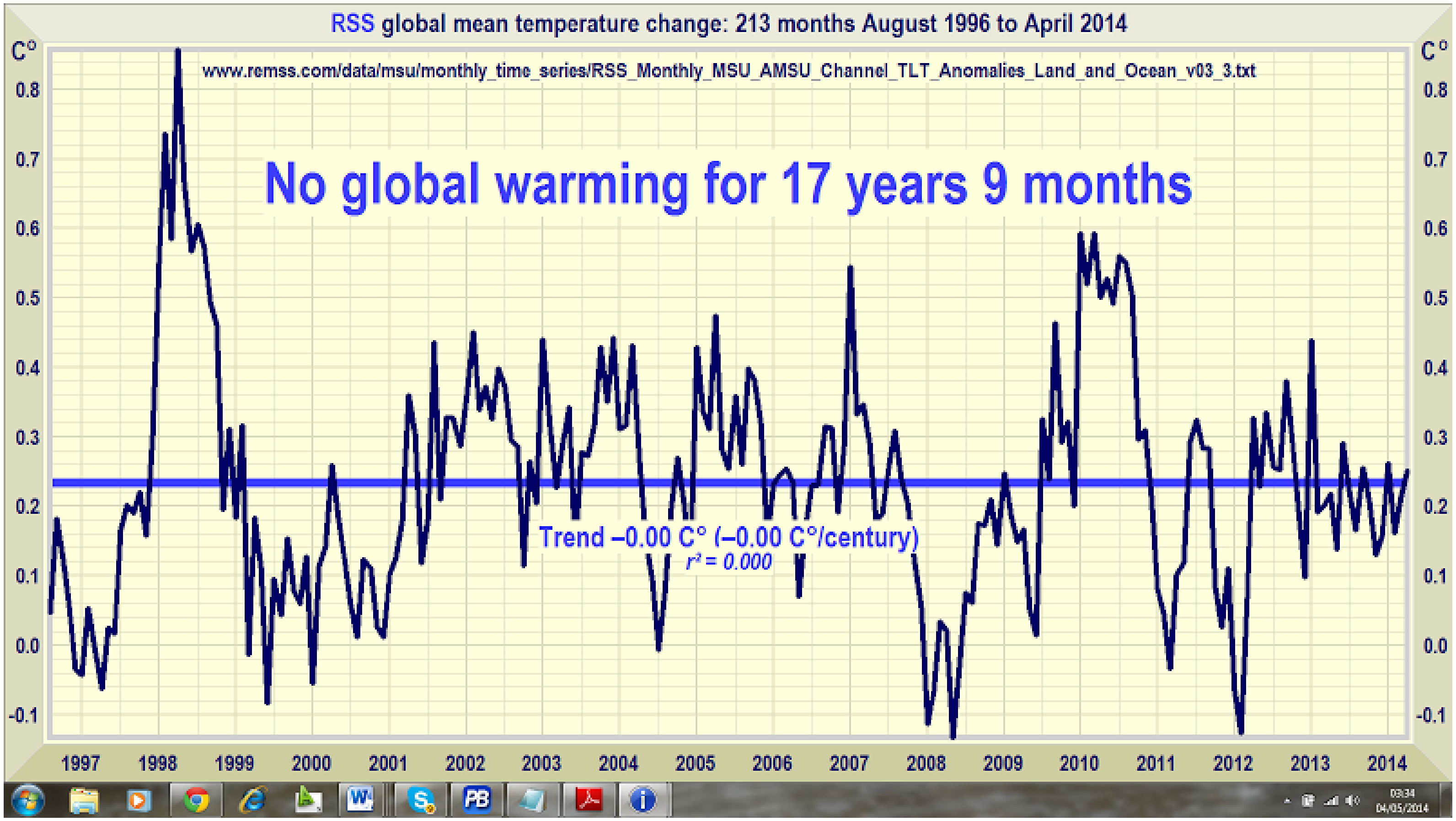
KT08



Martin Wild • Doris Folini • Christoph Schar •Norman Loeb • Ellsworth G. Dutton • Gert Konig-Langlo

Clim Dyn (2013) 40:3107–3134 DOI 10.1007/s00382-012-1569-8





S z ü n e t e l a k l í m a v á l t o z á s ÖSSZEFÜGGÉS : Kétségtelen az emberi tevékenység következménye

Mika János : **KLÍMAVÁLTOZÁS 13, 2014. ÁPRILIS 25., PÉNTEK**

" A melegedés megtorpanását minden bizonnyal a déli félteke óceánjainak váratlanul fel-erősödött hőelnyelő képessége okozza...."

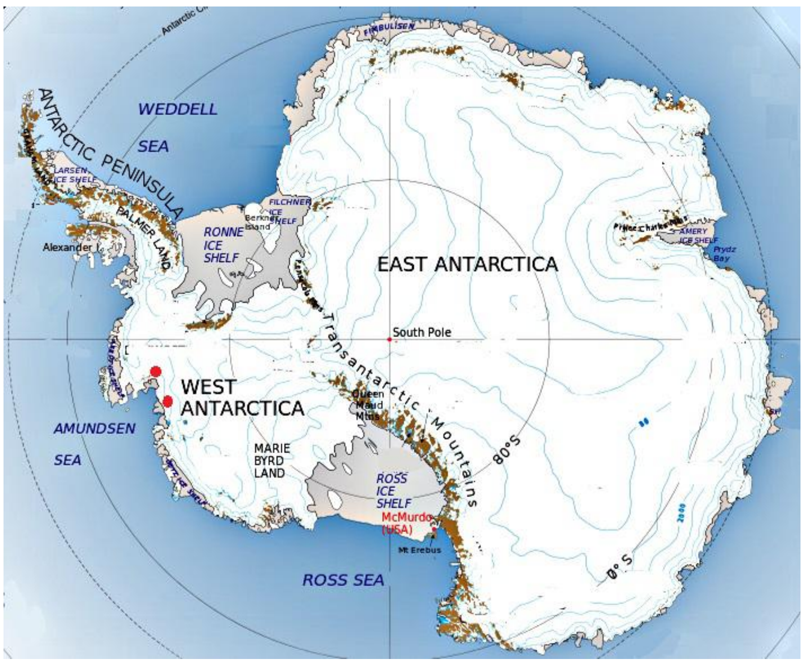
" Az éghajlati modellek nem tudják szimulálni a tapasztalt stagnálást. "

" Amíg tehát az óceáni cirkuláció számítását a kutatók fel nem javítják annyira a klímamodellekben, hogy megjelenjen bennük a hőmérséklet megtorpanása, addig azt sem leszünk képesek előre jelezni, hogy mikortól folyatódik a felmelegedés, és hogy ugyanolyan ütemű lesz-e, mint korábban. "

A New York Times headline reads : *"Scientists Warn of Rising Oceans From Polar Melt"* and goes on to say : *" **A large section of the West Antarctica ice sheet has begun falling apart** and its continued melting now appears to be unstoppable, two groups of scientists reported on Monday. If the findings hold up, they suggest that the melting could destabilize neighboring parts of the ice sheet and **a rise in sea level of 10 feet or more may be unavoidable in coming centuries**"*

The governor of California is now suggesting moving LAX and San Francisco airports.

Antarctica. (NASA image)

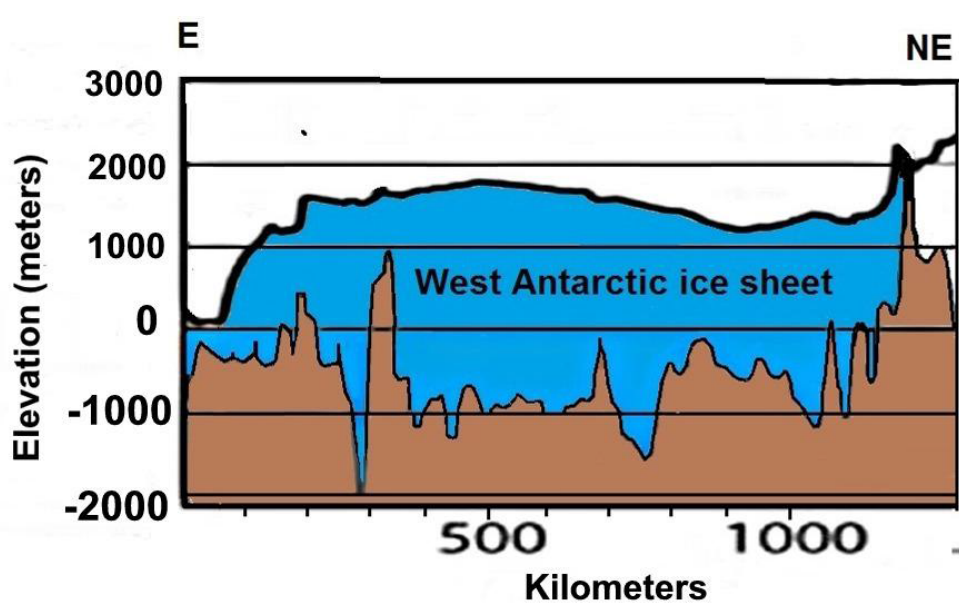


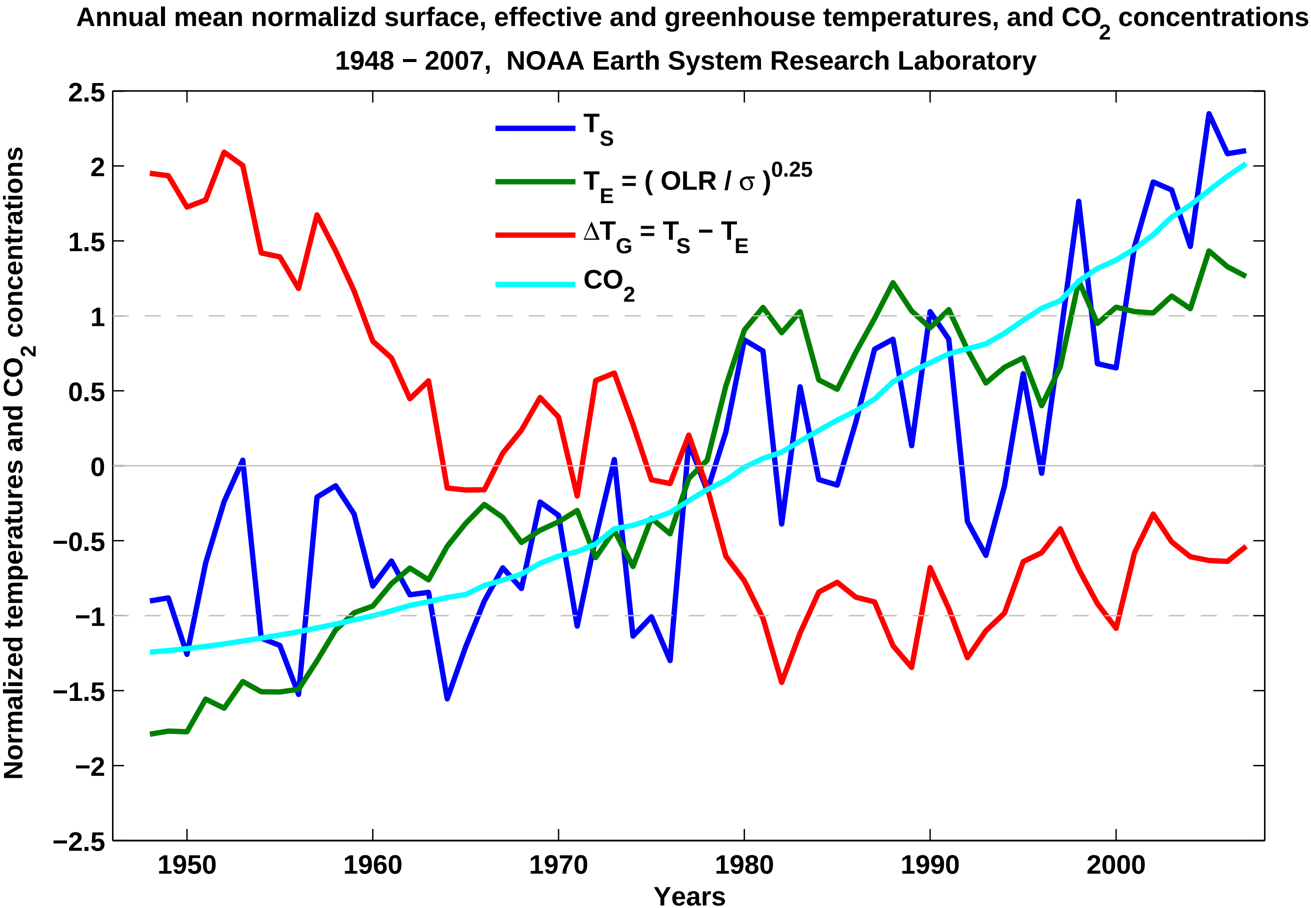
The East Antarctic ice sheet makes up more than 90% of Antarctic ice and has been growing.

The West Antarctic ice sheet accounts for only 8½ % of Antarctic ice and the Pine Island glacier (red dot) makes up only about 10% of that.

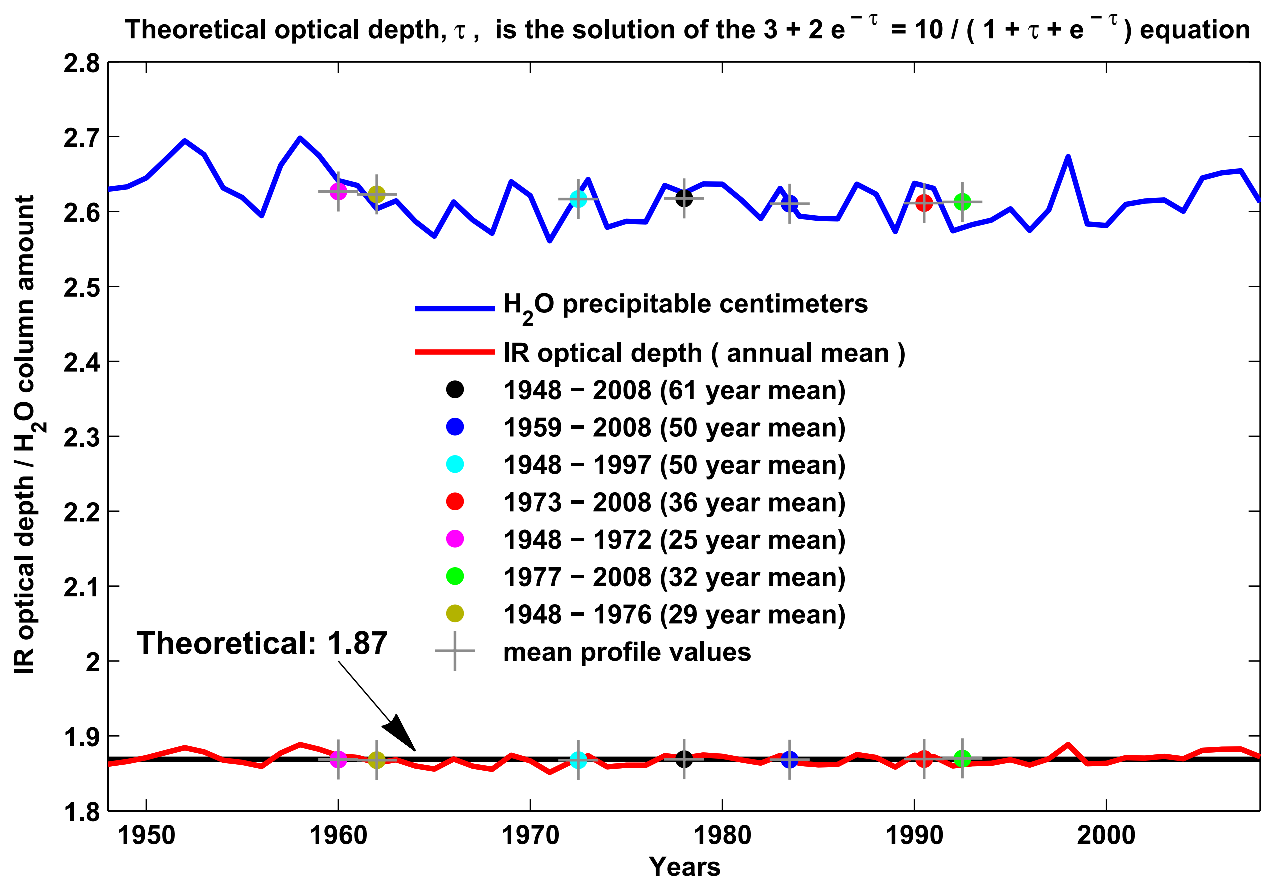
'UNSTOPPABLE COLLAPSE' OF THE WEST ANTARCTIC ICE SHEET IS NOT HAPPENING

Dr. Don J. Easterbrook, Western Washington University, Bellingham, WA





Annual mean normalizd surface, effective and greenhouse temperatures, and CO2 concentrations
1948 − 2007, NOAA Earth System Research Laboratory
T_S
T_E = (OLR / σ)^0.25
ΔT_G = T_S − T_E
CO2
Normalized temperatures and CO2 concentrations
Years
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
1950
1960
1970
1980
1990
2000

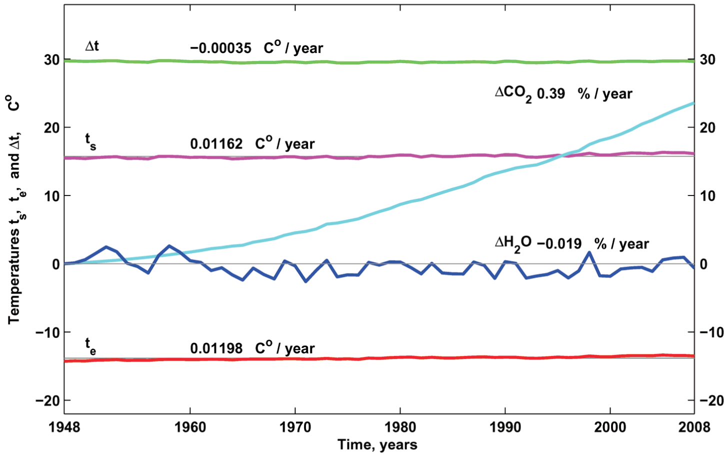


Theoretical optical depth, τ , is the solution of the 3 + 2 e^−τ = 10 / (1 + τ + e^−τ) equation
IR optical depth / H2O column amount
Years
H2O precipitable centimeters
IR optical depth (annual mean)
1948 − 2008 (61 year mean)
1959 − 2008 (50 year mean)
1948 − 1997 (50 year mean)
1973 − 2008 (36 year mean)
1948 − 1972 (25 year mean)
1977 − 2008 (32 year mean)
1948 − 1976 (29 year mean)
mean profile values
Theoretical: 1.87
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1950
1960
1970
1980
1990
2000

Observed greenhouse effect from the NOAA NCEP/NCAR R1 database (1948 − 2008)

The greenhouse effect, Δt, is the difference of the global average surface temperature, t_s, and the planetary effective temperature, t_e : $\Delta t = t_s - t_e$

ΔCO_2 and ΔH_2O relative column amounts are referenced to 1948



The greenhouse effect is effectively constant, with a negligible cooling trend since 1948 .
Surface temperature increase must be related to the increased absorption of solar radiation.

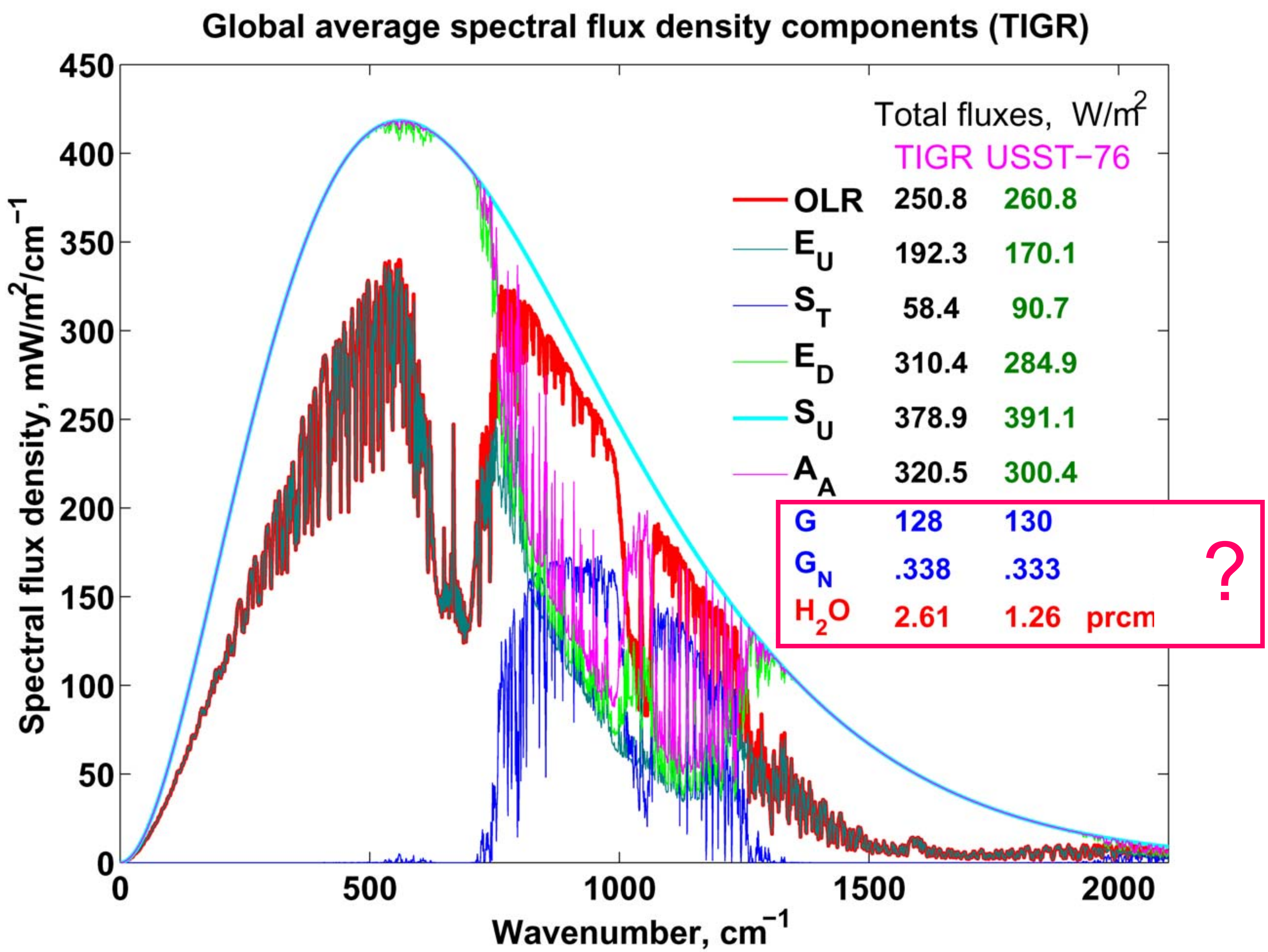
MAGYAR TUDOMÁNY : *Vélemény Miskolczi Ferenc: Értekezés az üvegházhatásról c. kéziratáról*

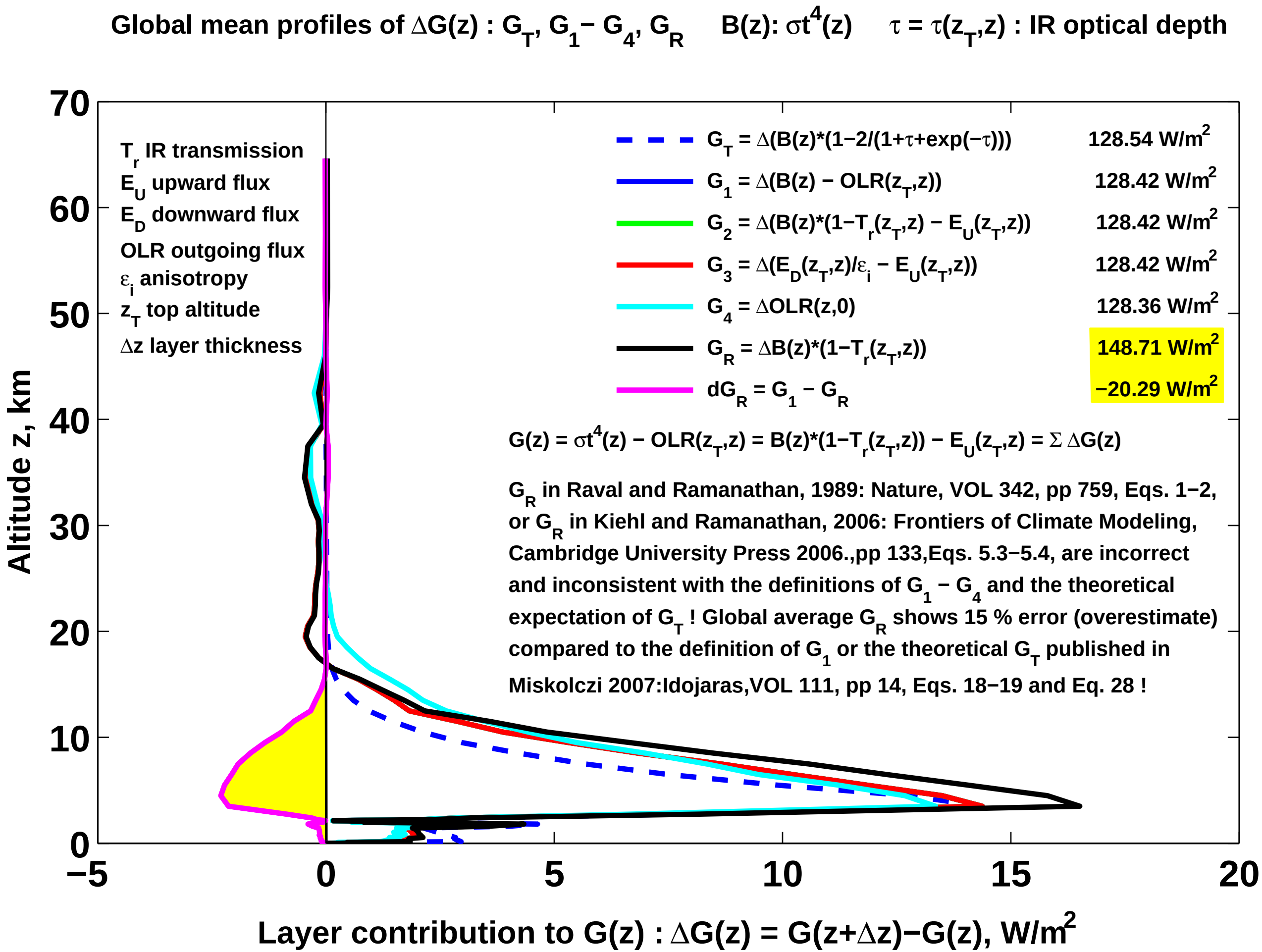
" Miskolczi Ferenc kéziratában bemutatott kiindulási feltevése szakmailag téves, elfogadhatatlan.Abból indul ugyanis ki, hogy a Föld-légkör rendszerbe beérkező és onnan távozó energia egyenlő....."

" Miskolczi a természeti folyamatokon tesz erőszakot akkor, amikor energia-egyensúlyt feltételez egy olyan rendszerben, amelyik gyakorlatilag soha nincs egyensúlyban...."
" Összefoglalva: megítélésem szerint a kézirat a súlyos szakmai tévedések, és az olvasókat félrevezető hivatkozási csúsztatás miatt nem alkalmas az MT-ben történő közlésre....."

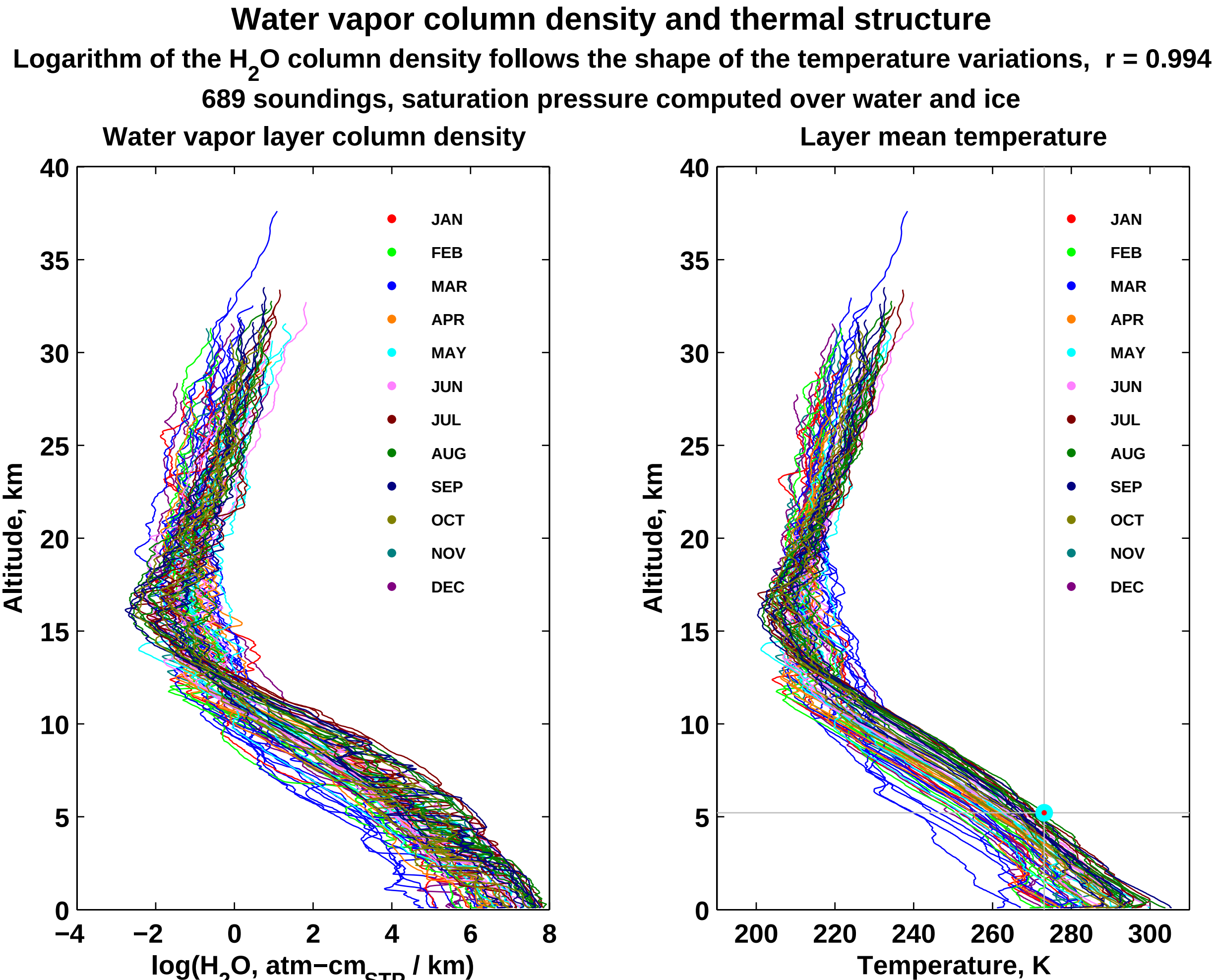
Budapest, 2013. 02.23.

CLEAR-SKY GREENHOUSE FACTORS





Global mean profiles of $\Delta G(z)$: G_T, $G_1 - G_4$, G_R B(z): $\sigma t^4(z)$ $\tau = \tau(z_T,z)$: IR optical depth
T_r IR transmission
E_U upward flux
E_D downward flux
OLR outgoing flux
ε_i anisotropy
z_T top altitude
Δz layer thickness
$G_T = \Delta(B(z)*(1-2/(1+\tau+\exp(-\tau)))$ 128.54 W/m^2
$G_1 = \Delta(B(z) - OLR(z_T,z))$ 128.42 W/m^2
$G_2 = \Delta(B(z)*(1-T_r(z_T,z) - E_U(z_T,z))$ 128.42 W/m^2
$G_3 = \Delta(E_D(z_T,z)/\varepsilon_i - E_U(z_T,z))$ 128.42 W/m^2
$G_4 = \Delta OLR(z,0)$ 128.36 W/m^2
$G_R = \Delta B(z)*(1-T_r(z_T,z))$ 148.71 W/m^2
$dG_R = G_1 - G_R$ −20.29 W/m^2
$G(z) = \sigma t^4(z) - OLR(z_T,z) = B(z)*(1-T_r(z_T,z)) - E_U(z_T,z) = \Sigma \Delta G(z)$
G_R in Raval and Ramanathan, 1989: Nature, VOL 342, pp 759, Eqs. 1−2,
or G_R in Kiehl and Ramanathan, 2006: Frontiers of Climate Modeling,
Cambridge University Press 2006.,pp 133,Eqs. 5.3−5.4, are incorrect
and inconsistent with the definitions of $G_1 - G_4$ and the theoretical
expectation of G_T ! Global average G_R shows 15 % error (overestimate)
compared to the definition of G_1 or the theoretical G_T published in
Miskolczi 2007:Idojaras,VOL 111, pp 14, Eqs. 18−19 and Eq. 28 !
Altitude z, km
70
60
50
40
30
20
10
0
−5
0
5
10
15
20
Layer contribution to G(z) : $\Delta G(z) = G(z+\Delta z) - G(z)$, W/m^2


Water vapor column density and thermal structure
Logarithm of the H2O column density follows the shape of the temperature variations, r = 0.994
689 soundings, saturation pressure computed over water and ice
Water vapor layer column density
Layer mean temperature
Altitude, km
log(H2O, atm−cmSTP / km)
Temperature, K
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
0
5
10
15
20
25
30
35
40
−4
−2
0
2
4
6
8
200
220
240
260
280
300

PHYSICS OF THE PLANETARY GREENHOUSE EFFECT

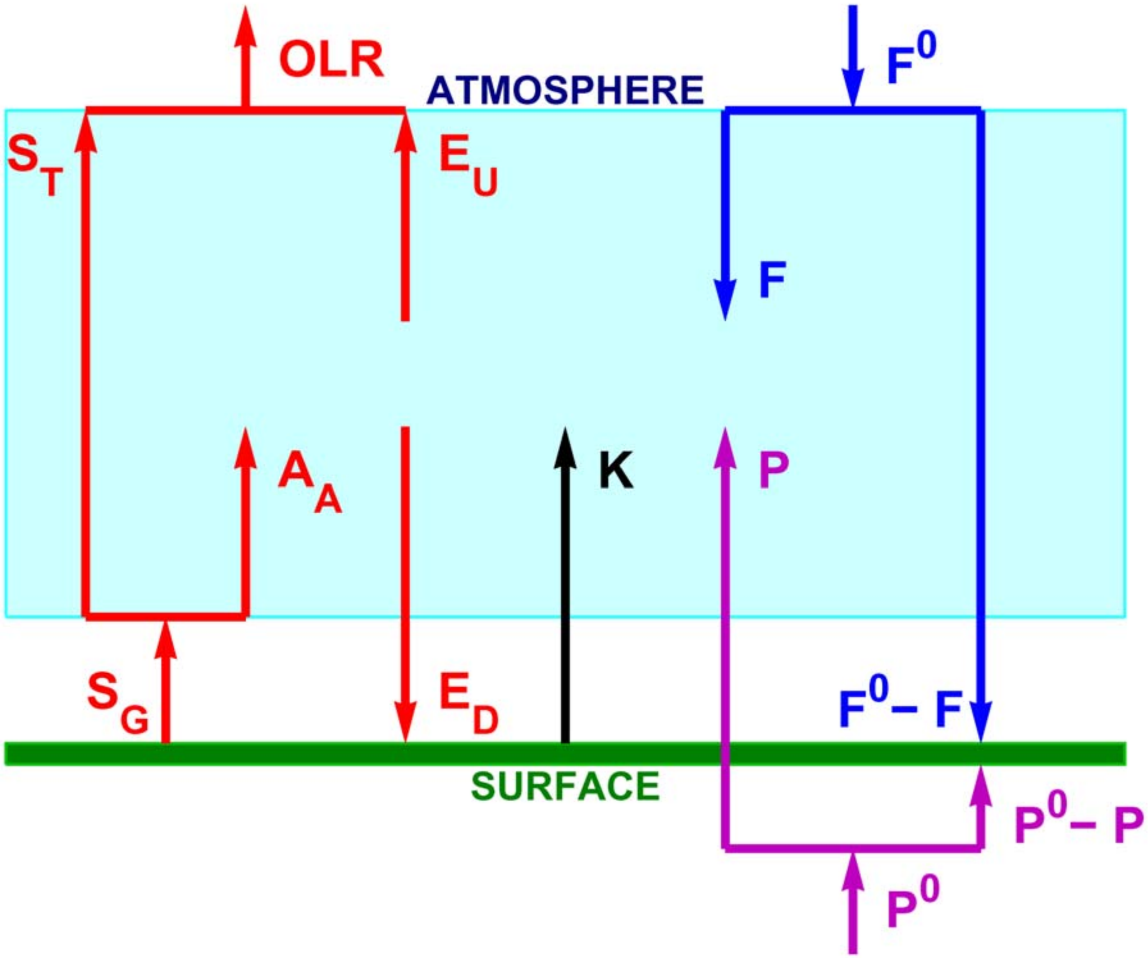
- Radiative transfer model of the Earth-atmosphere system
- Some facts - results of global scale LBL simulations
- Balance equations - Kirchhoff's law - virial theorem
- Transfer and greenhouse functions
- Effect of a partial cloud cover – characteristic altitude
- Global average profiles
- Planetary greenhouse effect in view of the new theory
- Conclusions

What is the official (IPCC, EPA, NASA, NOAA, NAS, etc.) greenhouse effect ?

Where is the integrity of climate science ?

What is the meaning of the consensus and peer review ?

RADIATIVE TRANSFER MODEL - $G = S_G - OLR = A_A - E_U$



Greenhouse effect:

$G = S_G - OLR$

$G_N = G / S_G$

All-sky measurements:

$S_G = 391\ Wm^{-2}$

$OLR = 235\ Wm^{-2}$

$G_N \sim 0.4$

QUESTIONS:

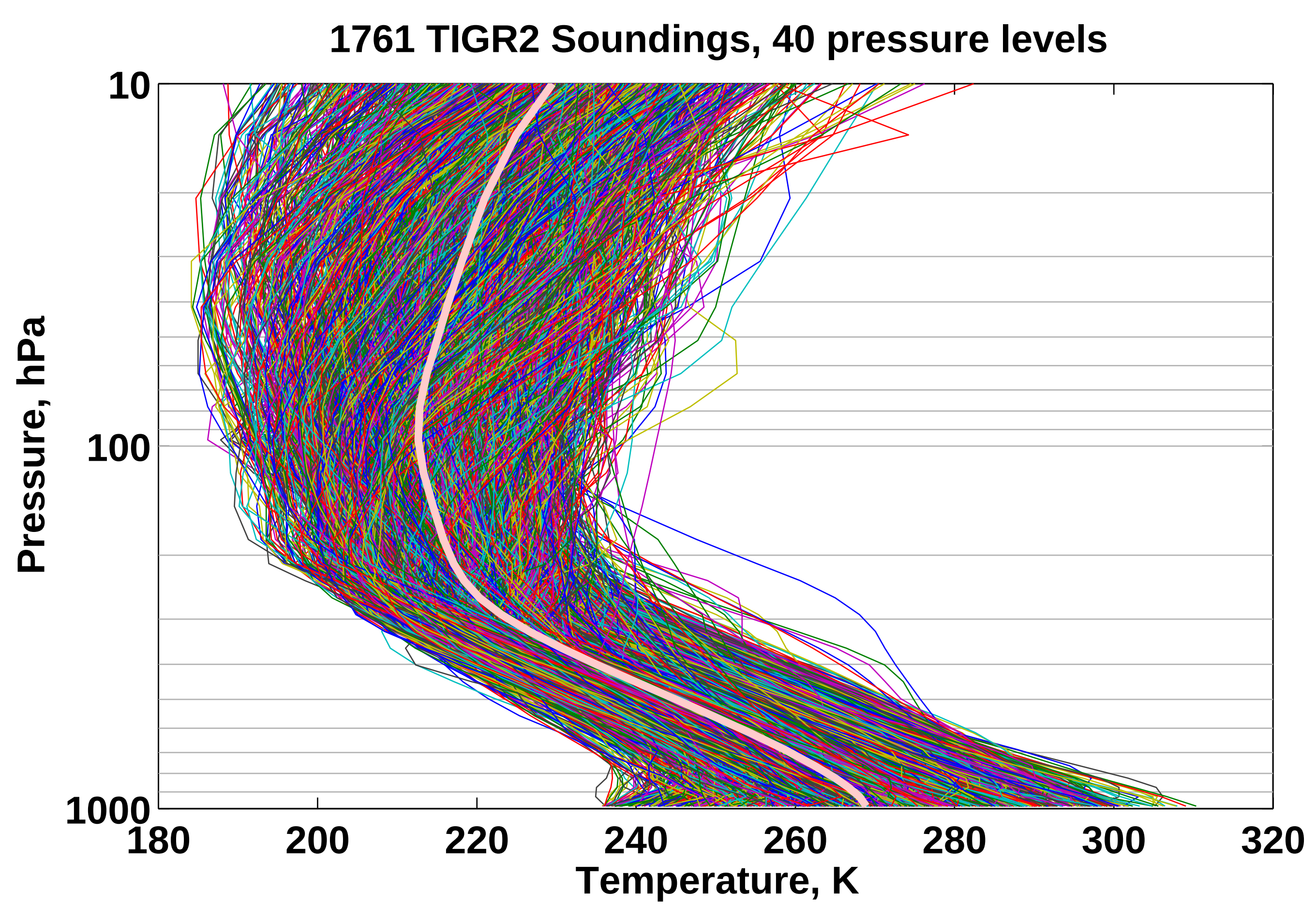
What can we learn from global scale simulations of IR fluxes ?

What are the theoretical relationships among the global average IR flux density terms ?

NET ATMOSPHERE: (1) $F + P + K + A_A - E_D - E_U = 0$

NET SURFACE : (2) $F^0 + P^0 + E_D - F - P - K - A_A - S_T = 0$

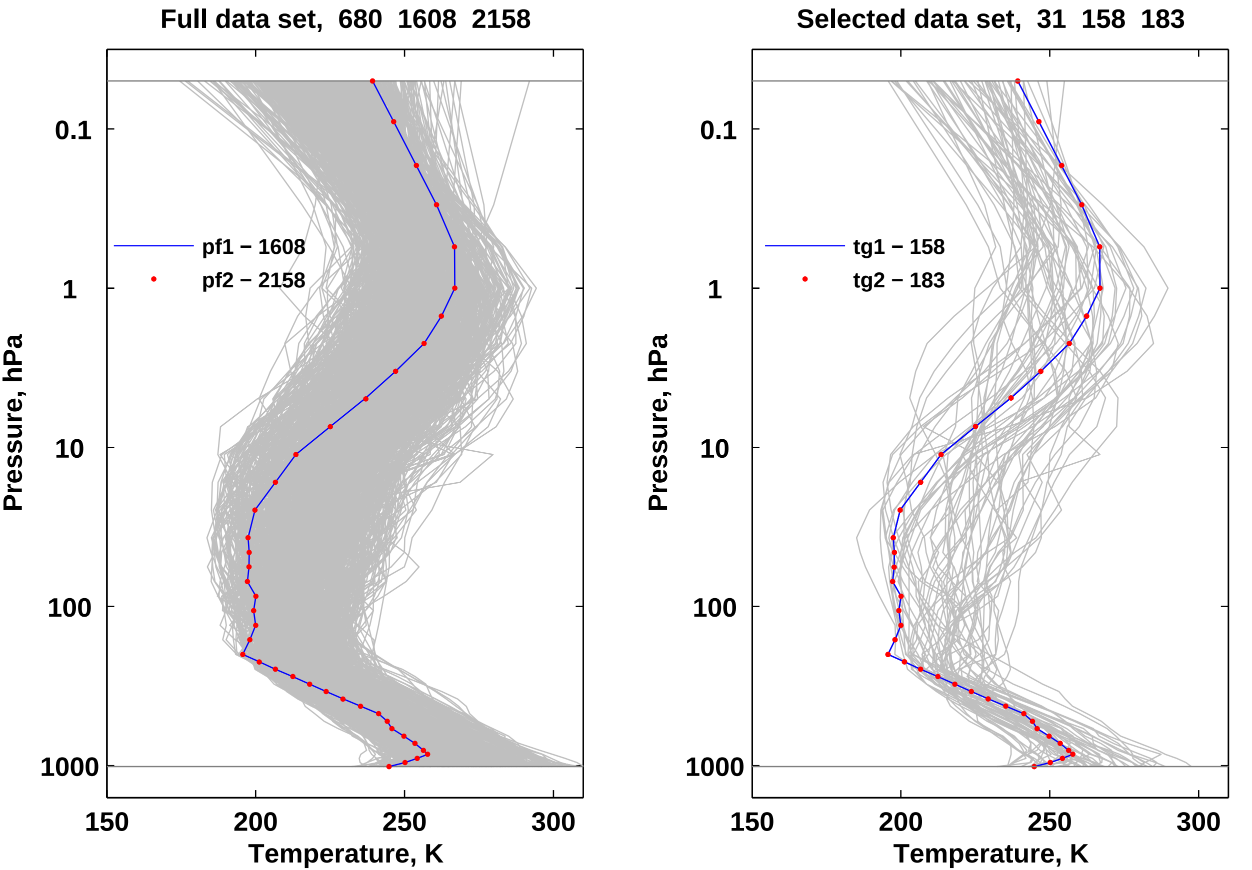
(3) $F^0 + P^0 = OLR$


1761 TIGR2 Soundings, 40 pressure levels
10
100
1000
Pressure, hPa
180
200
220
240
260
280
300
320
Temperature, K

Cross−referenced TIGR2 and TIGR2000 profiles

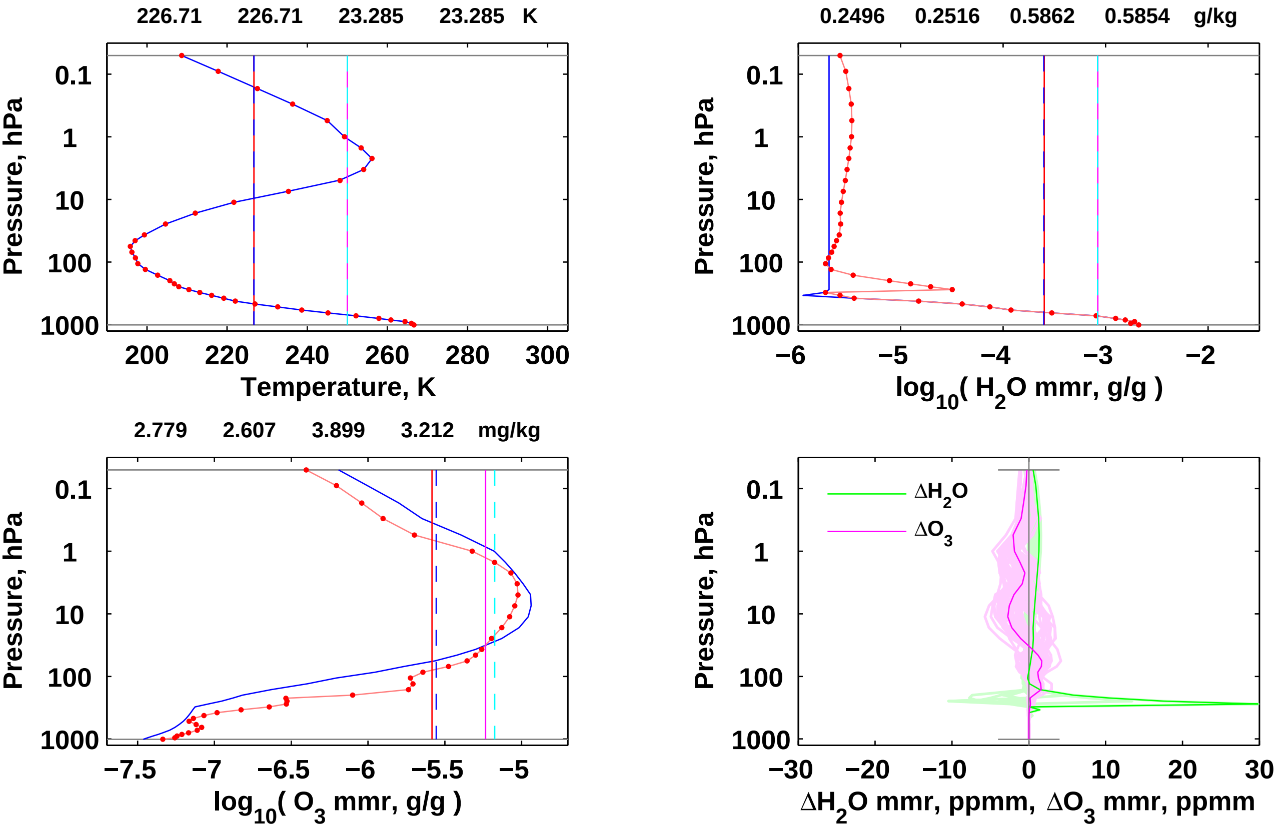
Profiles with exactly the same date, location and thermal structure are identical

Full data sets (cr , pf1 , pf2) : 915 1761 2311,   selected data sets (crs , tg1 , tg2) : 60 225 250

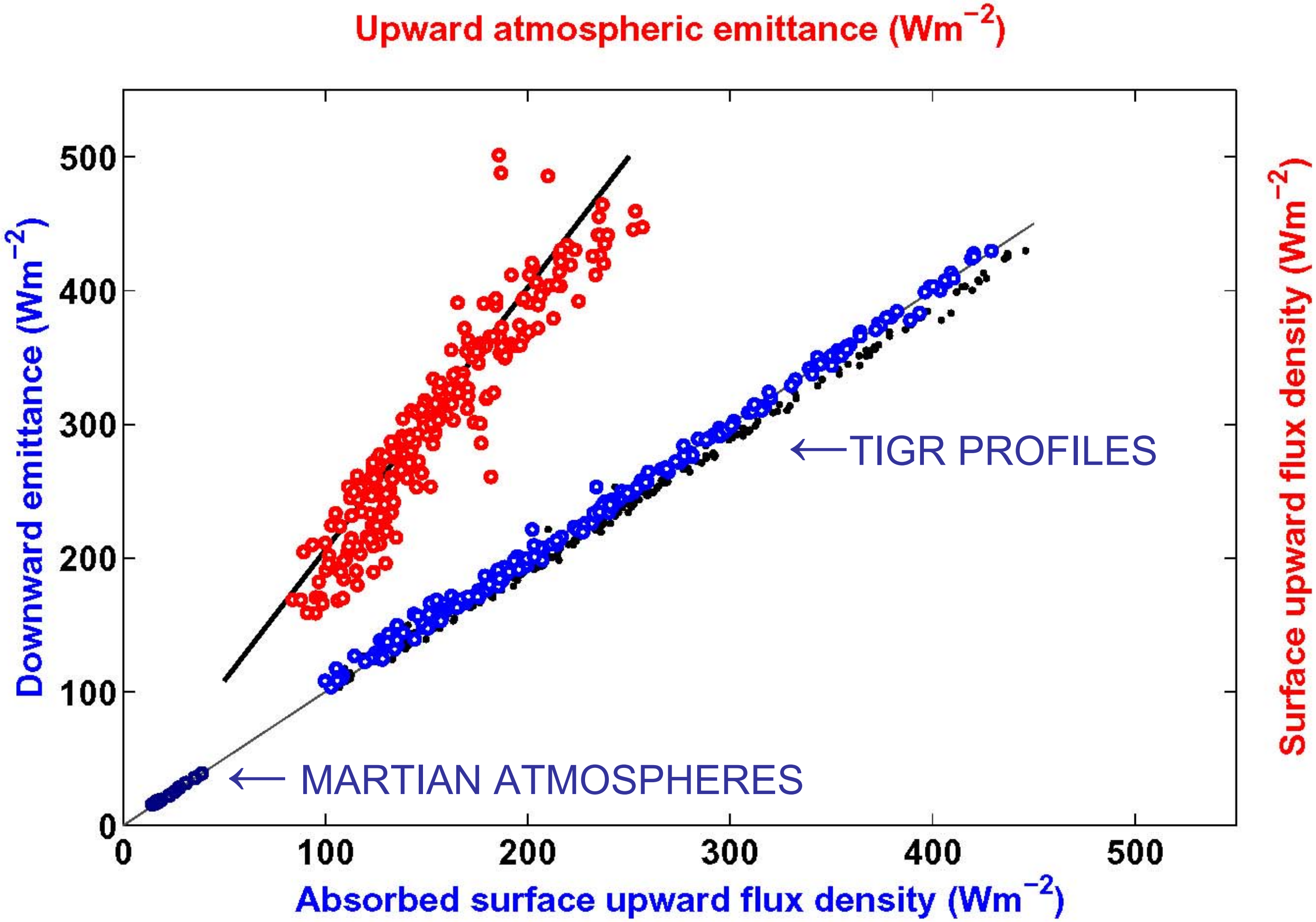


Cross−referenced profile # 60 TIGR2 # 1621 TIGR2000 # 2171

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	0.00043	0.4968	−3.403	−1.535	−1.868	0.01976
Δ%	0	0.2281	39.36	0.00015	0.2485	−1.592	−1.956	−1.381	1.525



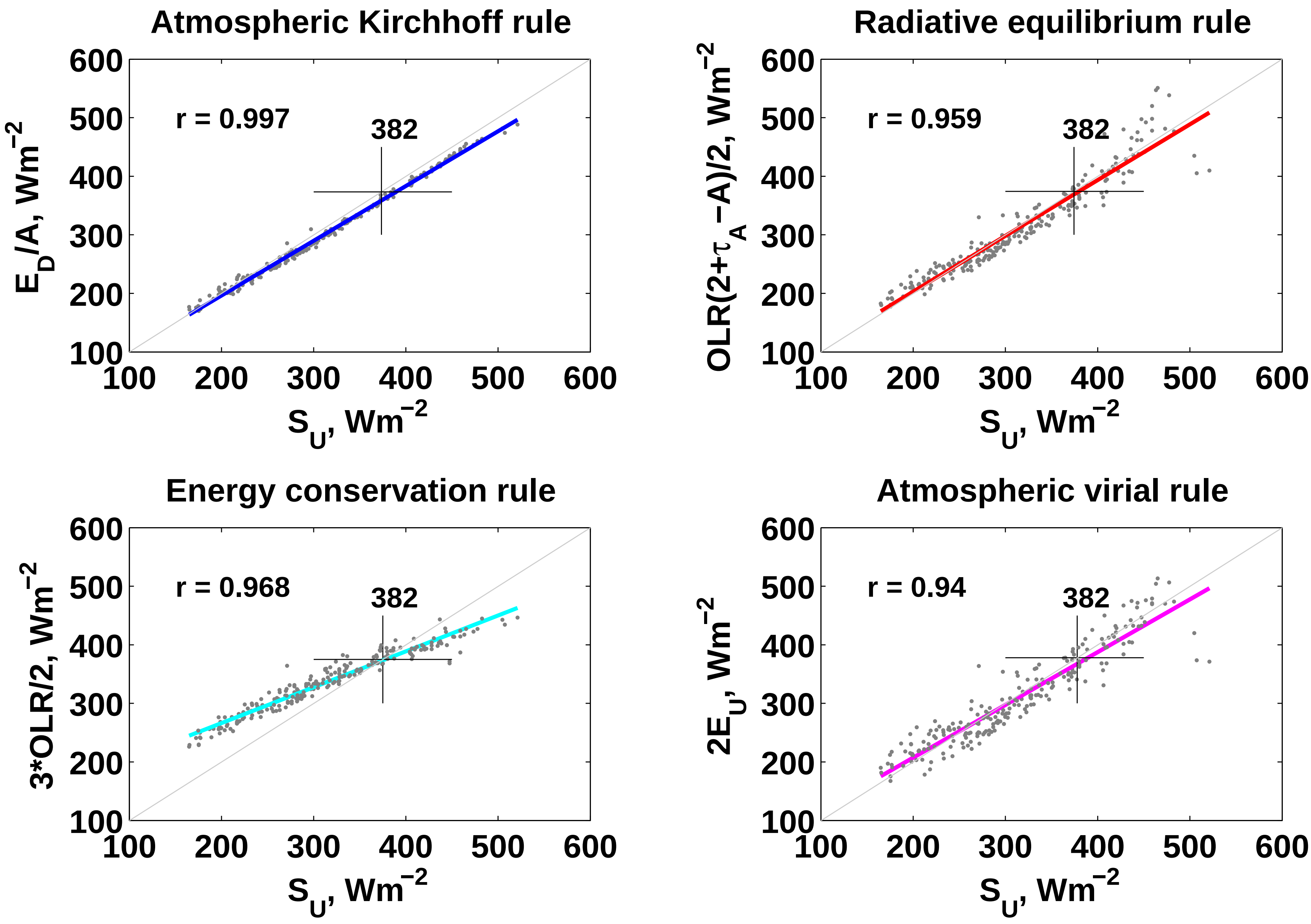
ABSORBED SURFACE RADIATION, A_A, DOWNWARD EMITTANCE, E_D, SURFACE UPWARD FLUX, S_U, AND UPWARD EMITTANCE, E_U



$E_D = A_A$ independent of the thermal structure and greenhouse gas content of the atmosphere (Kirchhoff law).

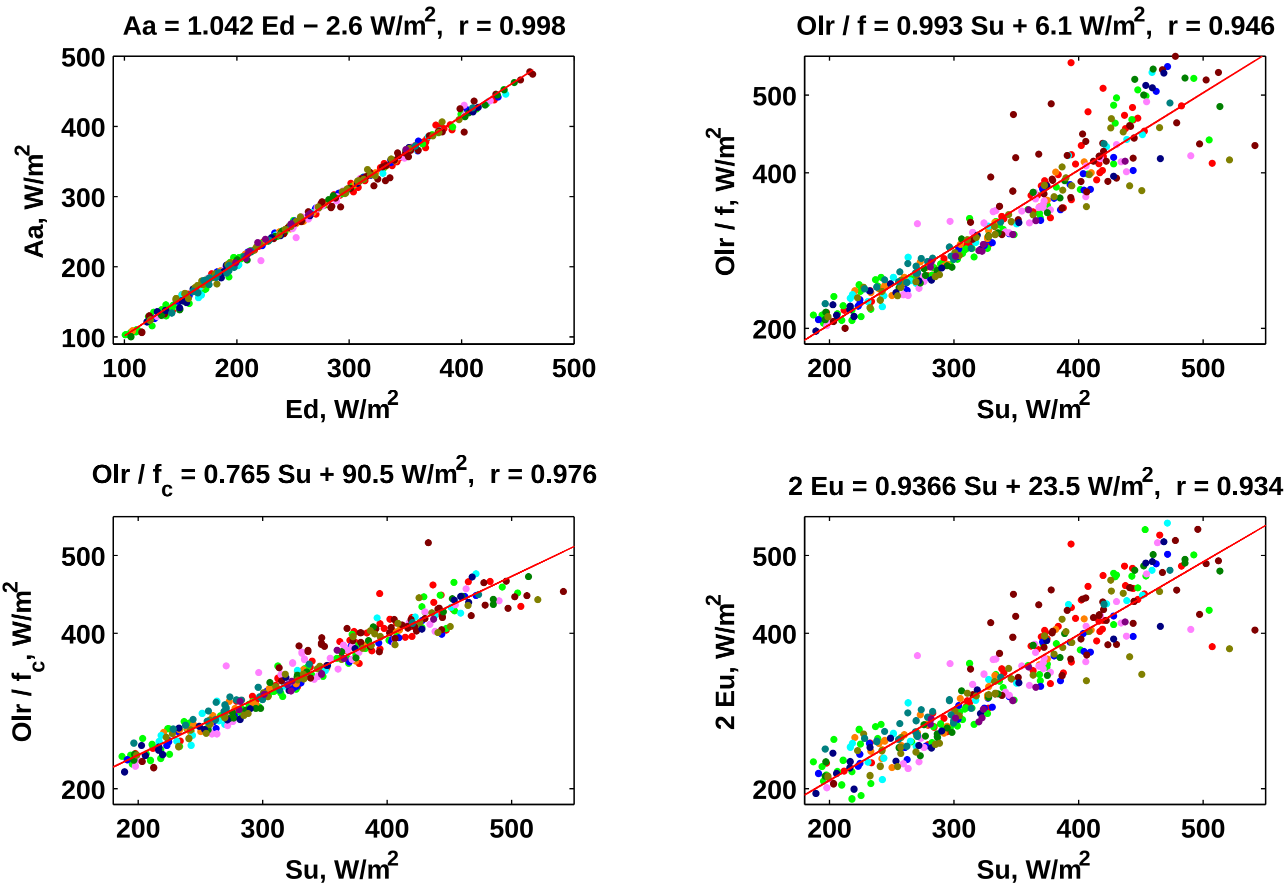
$S_U=2E_U$ Total gravitational potential energy is equal to two times of the internal kinetic energy (Virial theorem).

IR radiative structure of the atmosphere from TIGR2



Observed empirical facts, TIGR archives, 475 global soundings

Ed = Aa, Su = Olr / f, Su = Olr / f_c = Olr / (0.6 + 0.4 Ta), Su = 2 Eu



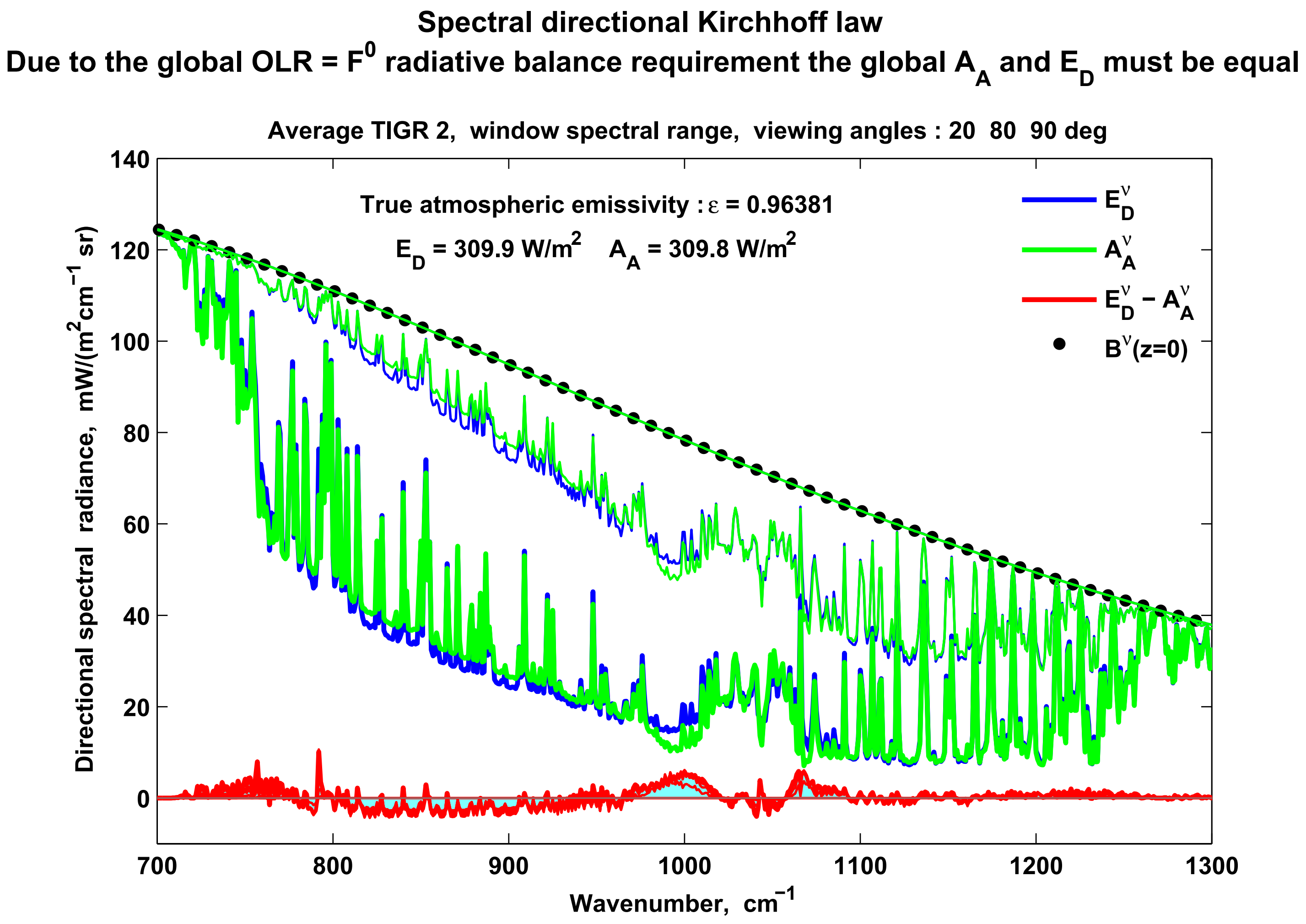
$$A_A = E_D \qquad S_U = 2E_U$$

$$S_U = \frac{3}{2}OLR \qquad S_U = \frac{OLR}{f}$$

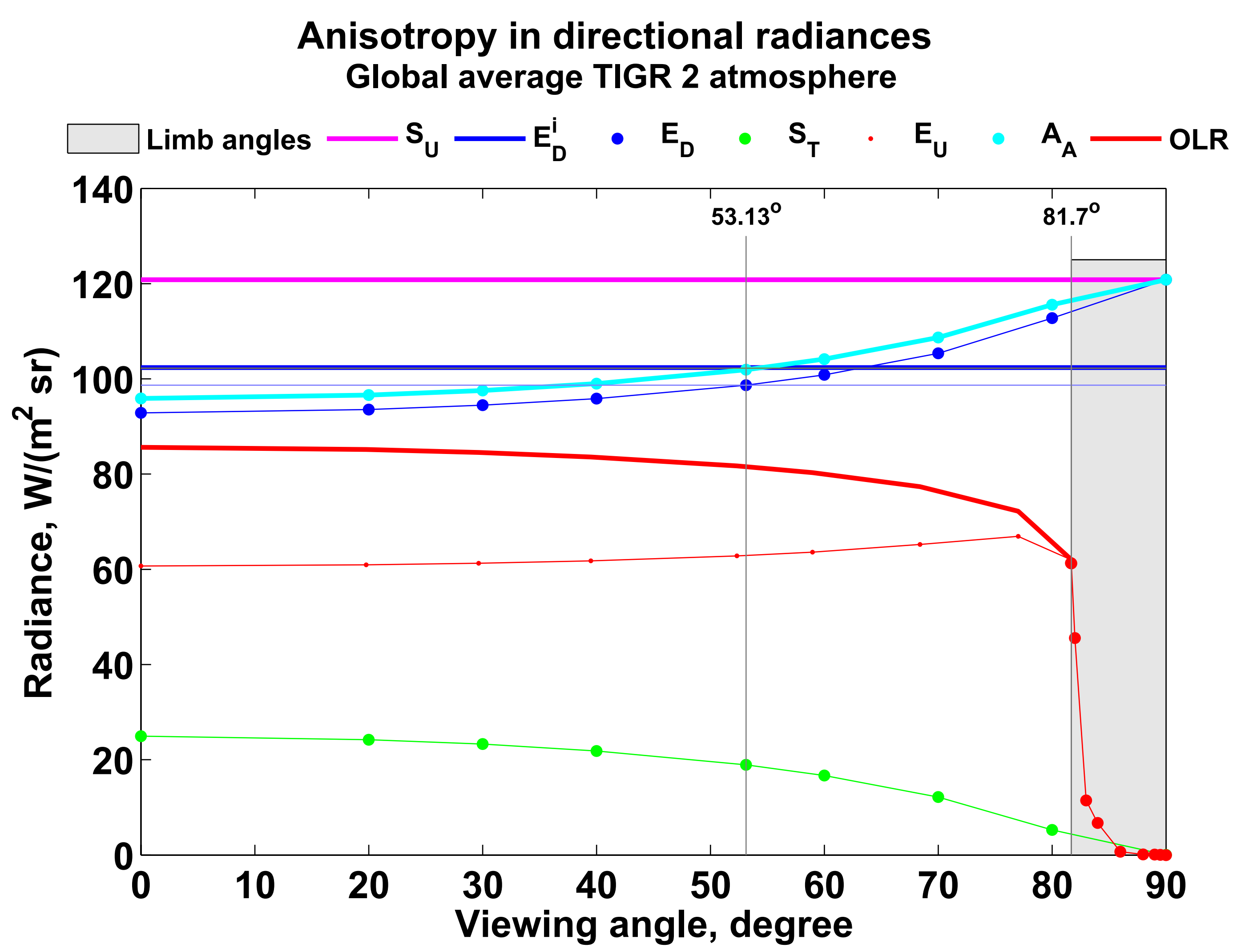
$$f = 2/(2 + \tau - A) \qquad OLR = E_U + S_T$$

$$A_A = S_U(1 - \exp(-\tau_A))$$

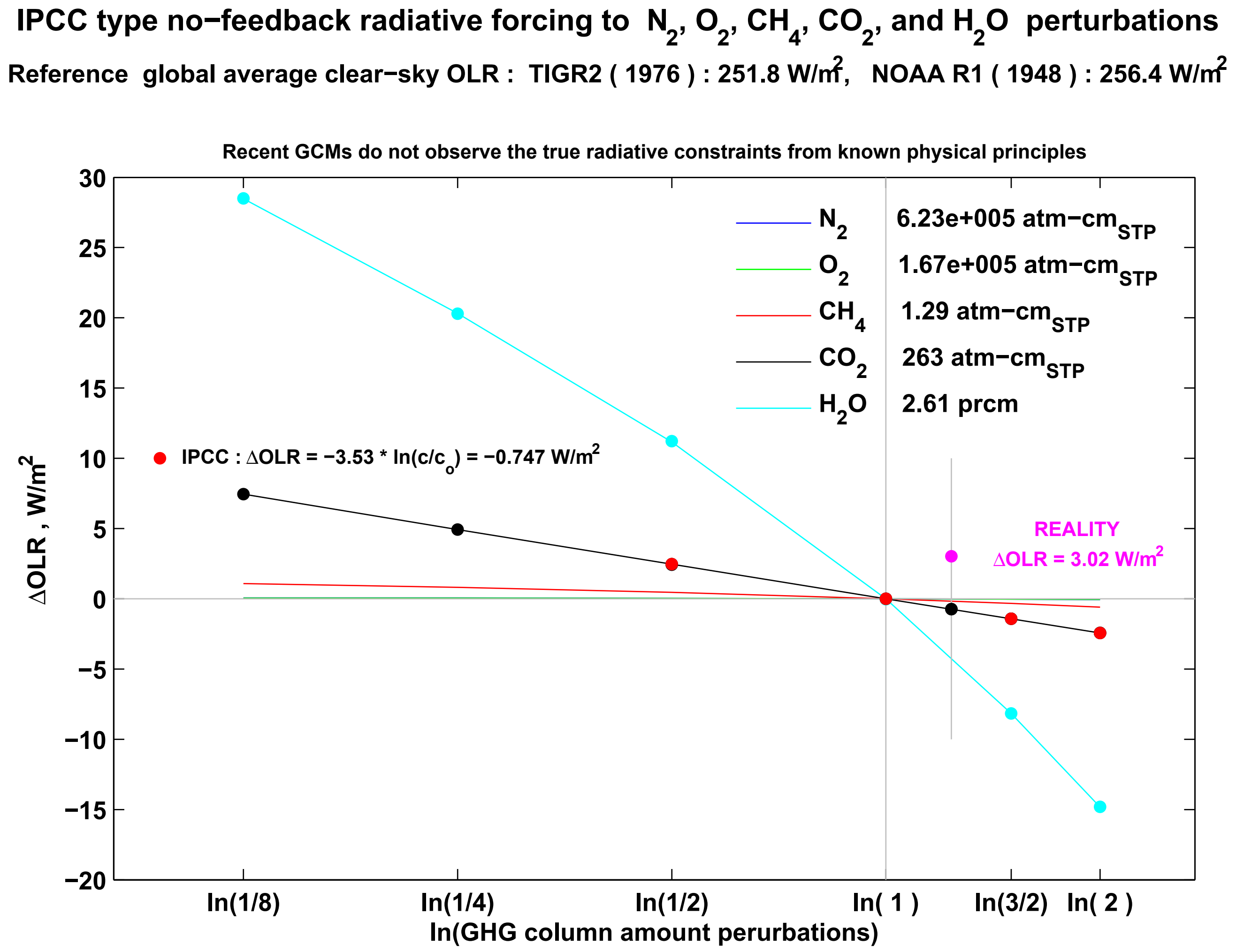
$$\tau_A = 1.867$$



Spectral directional Kirchhoff law
Due to the global OLR = F^0 radiative balance requirement the global A_A and E_D must be equal
Average TIGR 2, window spectral range, viewing angles : 20 80 90 deg
True atmospheric emissivity : ε = 0.96381
E_D = 309.9 W/m^2 A_A = 309.8 W/m^2
E_D^ν
A_A^ν
E_D^ν − A_A^ν
B^ν(z=0)
Directional spectral radiance, mW/(m^2cm^-1 sr)
Wavenumber, cm^-1
140
120
100
80
60
40
20
0
700
800
900
1000
1100
1200
1300

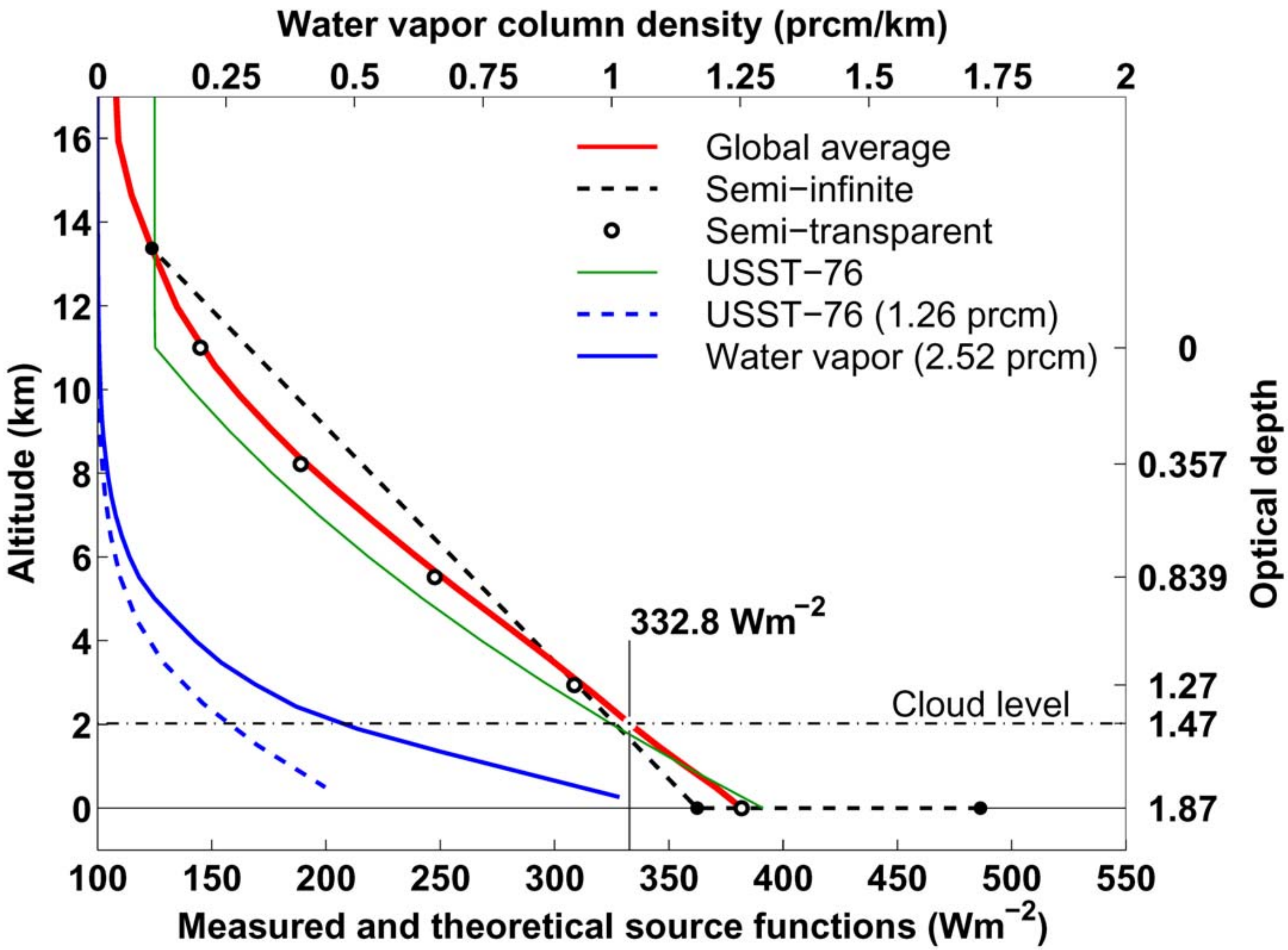


Anisotropy in directional radiances
Global average TIGR 2 atmosphere
Limb angles
S U
E i D
E D
S T
E U
A A
OLR
53.13°
81.7°
Radiance, W/(m2 sr)
Viewing angle, degree
0
20
40
60
80
100
120
140
0
10
20
30
40
50
60
70
80
90



IPCC type no−feedback radiative forcing to N_2, O_2, CH_4, CO_2, and H_2O perturbations
Reference global average clear−sky OLR : TIGR2 (1976) : 251.8 W/m^2, NOAA R1 (1948) : 256.4 W/m^2
Recent GCMs do not observe the true radiative constraints from known physical principles
N_2 6.23e+005 atm−cm$_{STP}$
O_2 1.67e+005 atm−cm$_{STP}$
CH_4 1.29 atm−cm$_{STP}$
CO_2 263 atm−cm$_{STP}$
H_2O 2.61 prcm
IPCC : ΔOLR = −3.53 * ln(c/c$_o$) = −0.747 W/m^2
REALITY
ΔOLR = 3.02 W/m^2
ΔOLR , W/m^2
30
25
20
15
10
5
0
−5
−10
−15
−20
ln(1/8)
ln(1/4)
ln(1/2)
ln(1)
ln(3/2)
ln(2)
ln(GHG column amount perurbations)

GLOBAL AVERAGE ATMOSPHERES

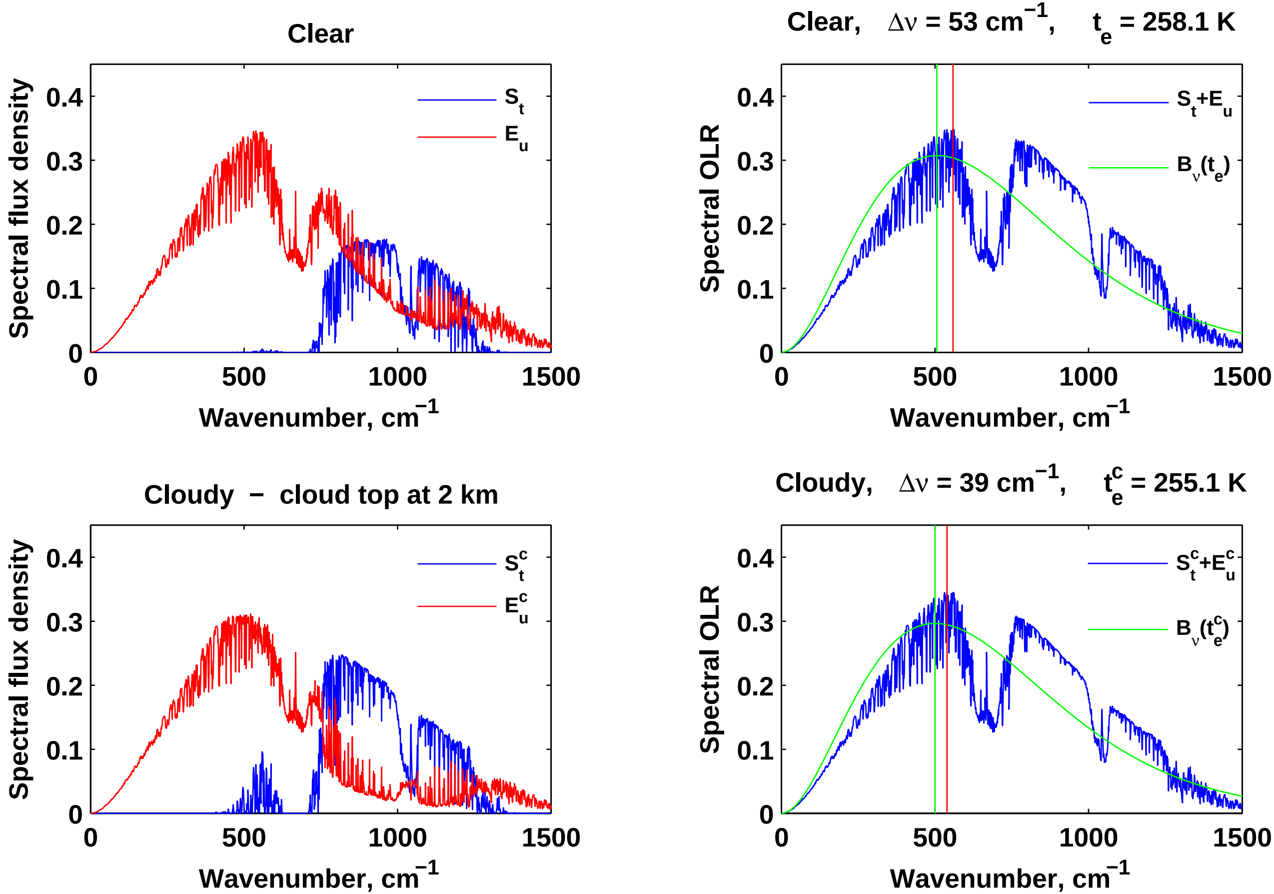


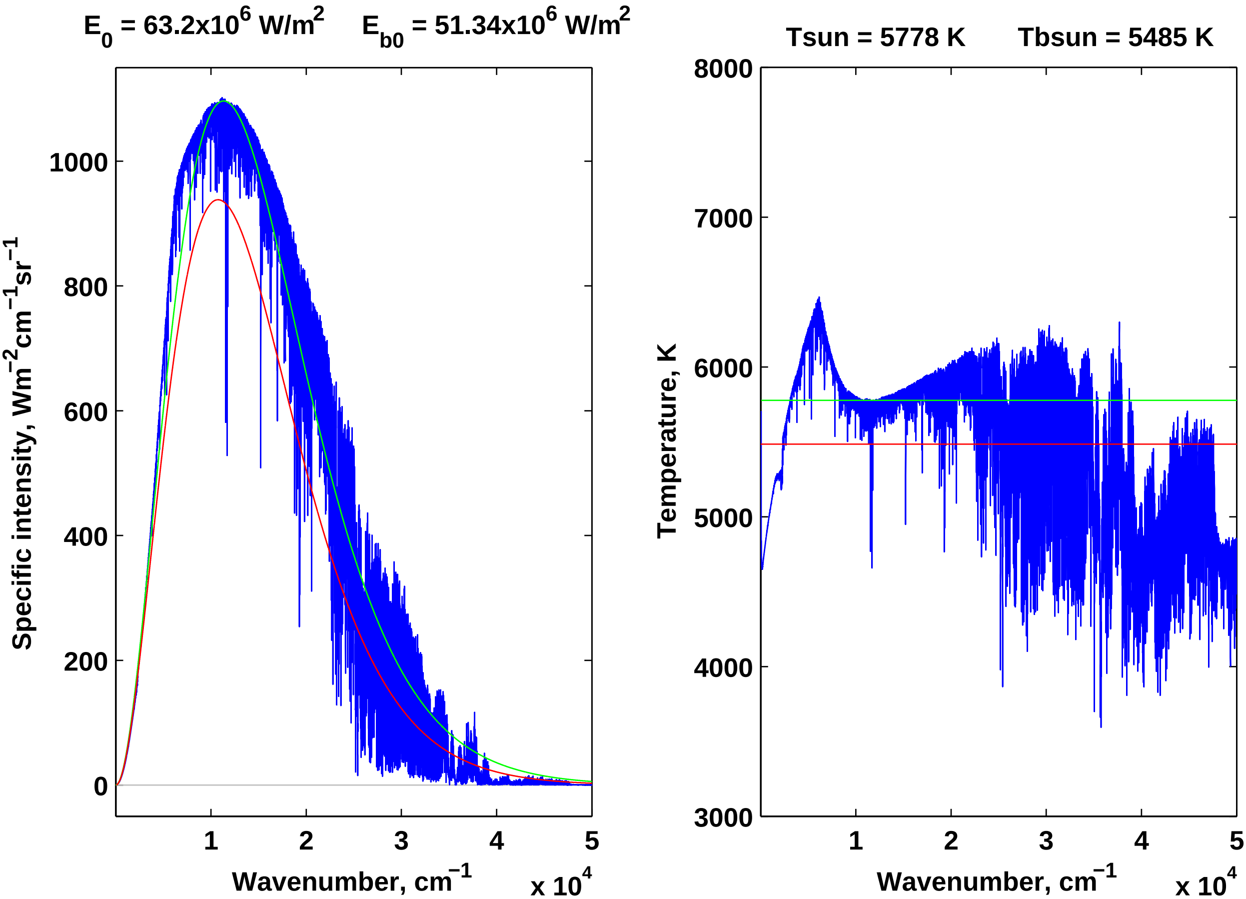
The USST-76 atmosphere is not adequate for global radiative budget studies.
(Not in radiative equilibrium, not in energy balance, H_2O amount is small)

Interpretation of the effective temperature

The global average spectral clear and cloudy OLR and the effective temperature violate the Wien displacement law

Spectral flux densities are in $W/m^2/cm^{-1}$

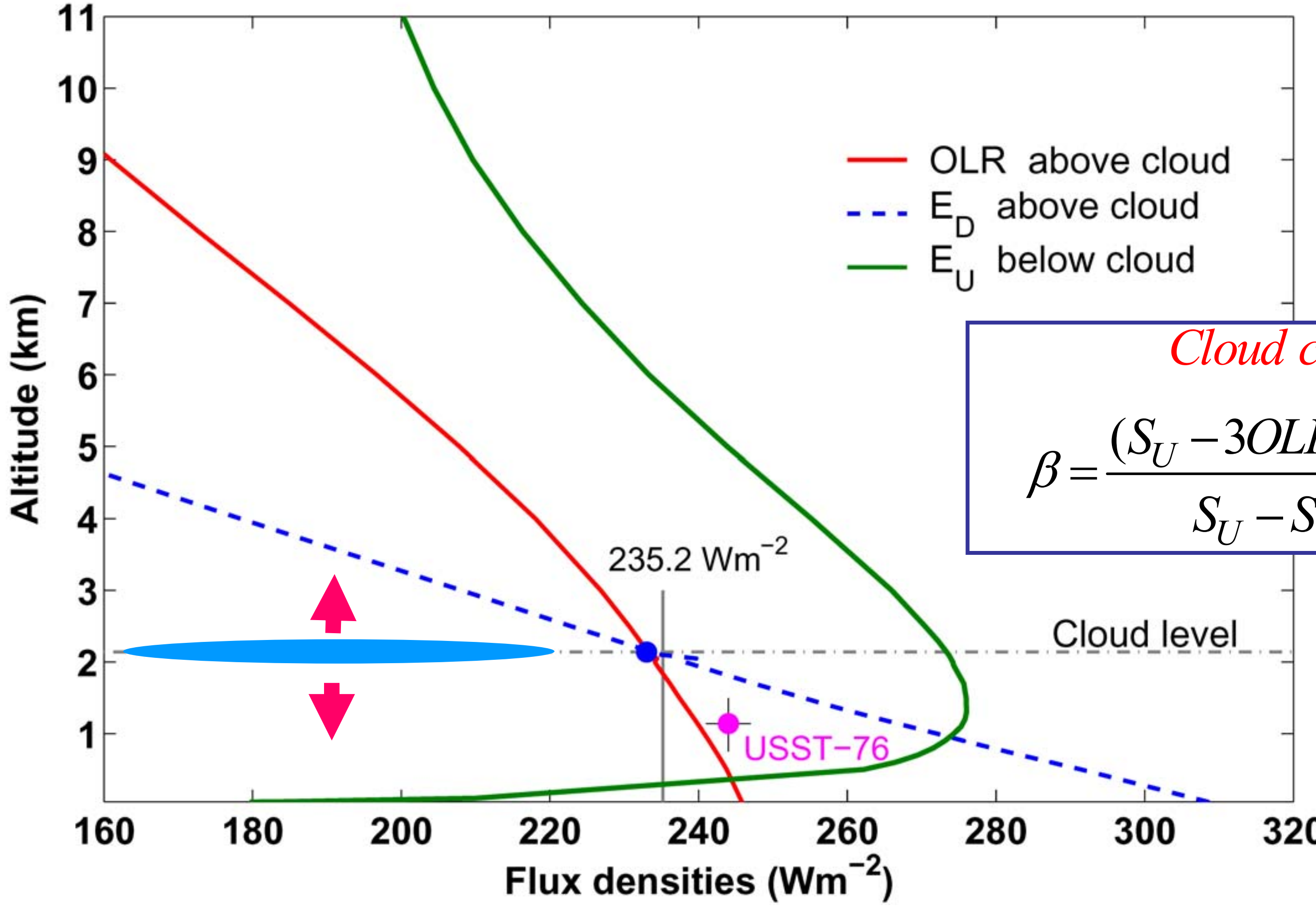




E0 = 63.2x10^6 W/m^2
Eb0 = 51.34x10^6 W/m^2
Specific intensity, Wm^-2cm^-1sr^-1
0
200
400
600
800
1000
1
2
3
4
5
Wavenumber, cm^-1
x 10^4
Tsun = 5778 K
Tbsun = 5485 K
Temperature, K
3000
4000
5000
6000
7000
8000
1
2
3
4
5
Wavenumber, cm^-1
x 10^4

SIMULATION OF VERTICAL CLOUDY FLUX DENSITY PROFILES

Global average atmosphere (TIGR)



Cloud cover

$$\beta = \frac{(S_U - 3OLR^A/2)}{S_U - S_U^C} \approx 0.6$$

The clear-sky OLR = 250 Wm^{-2} is too large. A partial cloud cover at some altitude may restore the correct global average.

(Kirchhoff: $E_D = A_A = OLR = F^0 + P^0 = OLR^A = 235$ Wm^{-2})

Planetary radiative equilibrium cloud cover at h^C altitude

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

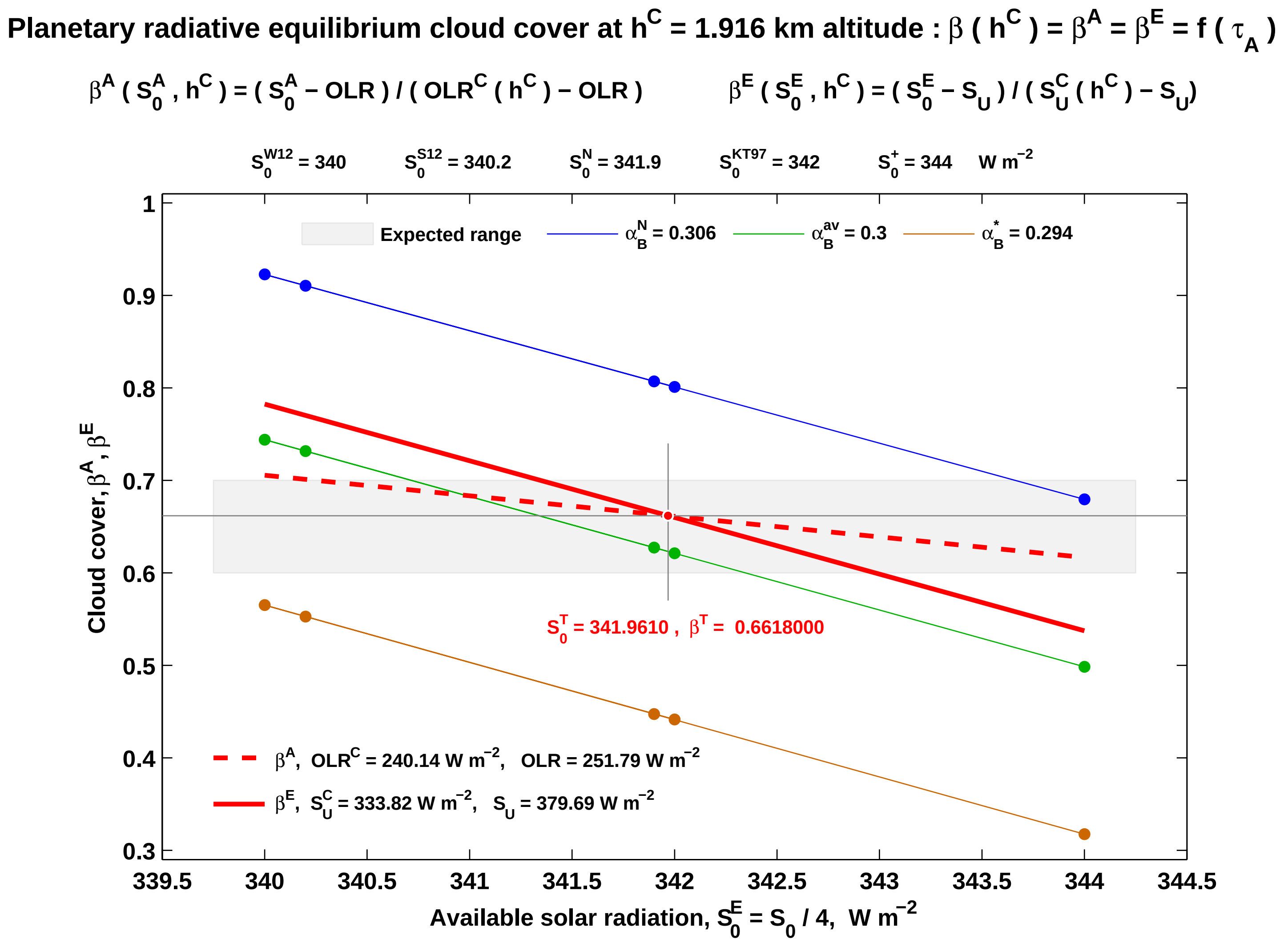
$$S_E = (1-\beta^E)\, S_U + \beta^E S_U^C$$

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

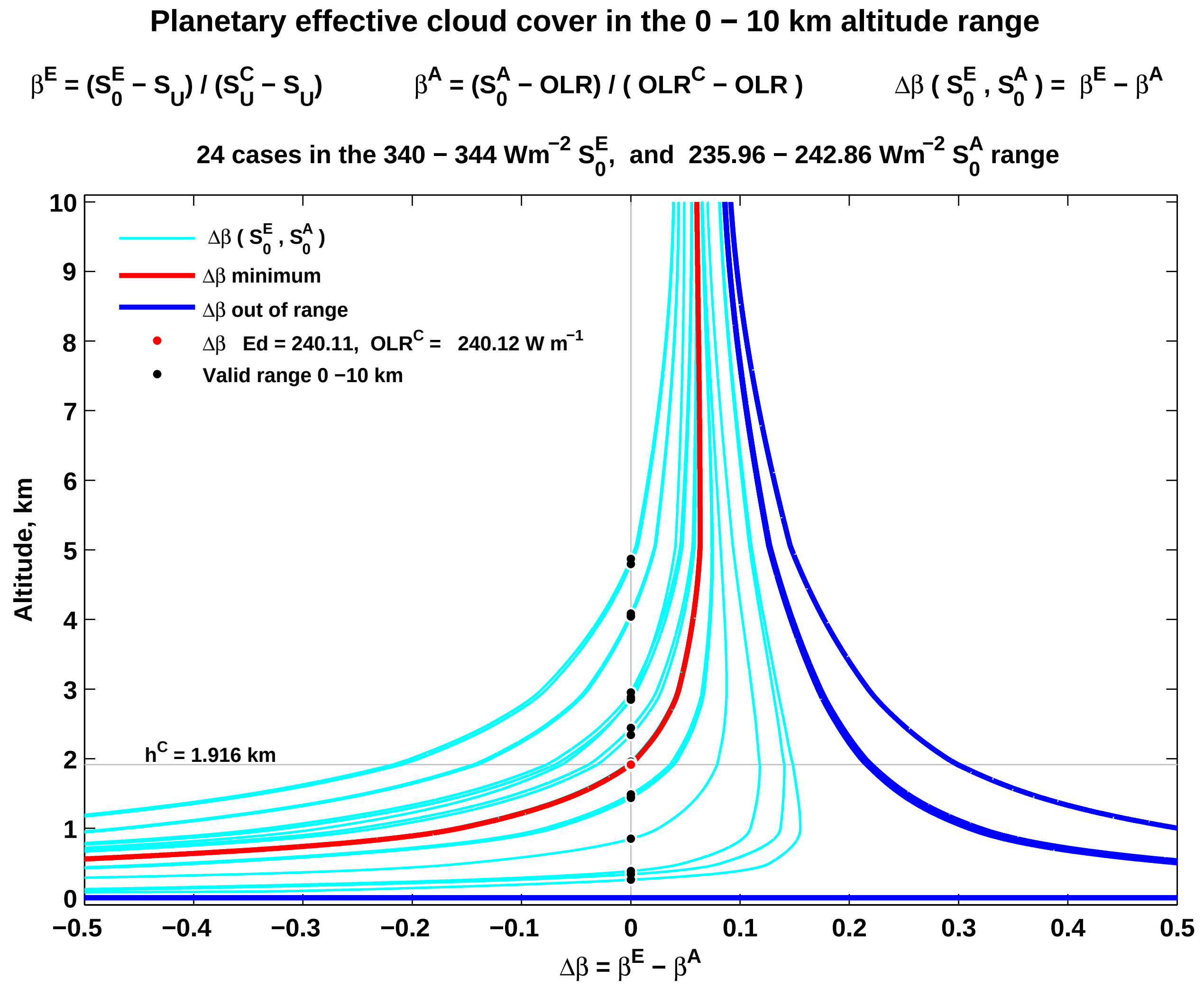
$$\beta^E(S_E, h^C) = (S_E - S_U) / (S_U^C(h^C) - S_U)$$

$$S_A = (1 - \alpha_B) S_E$$

$$\min\left(\| \beta_A(h^C, \alpha_B) - \beta_E(h^C, \alpha_B) \|^2 \right)$$

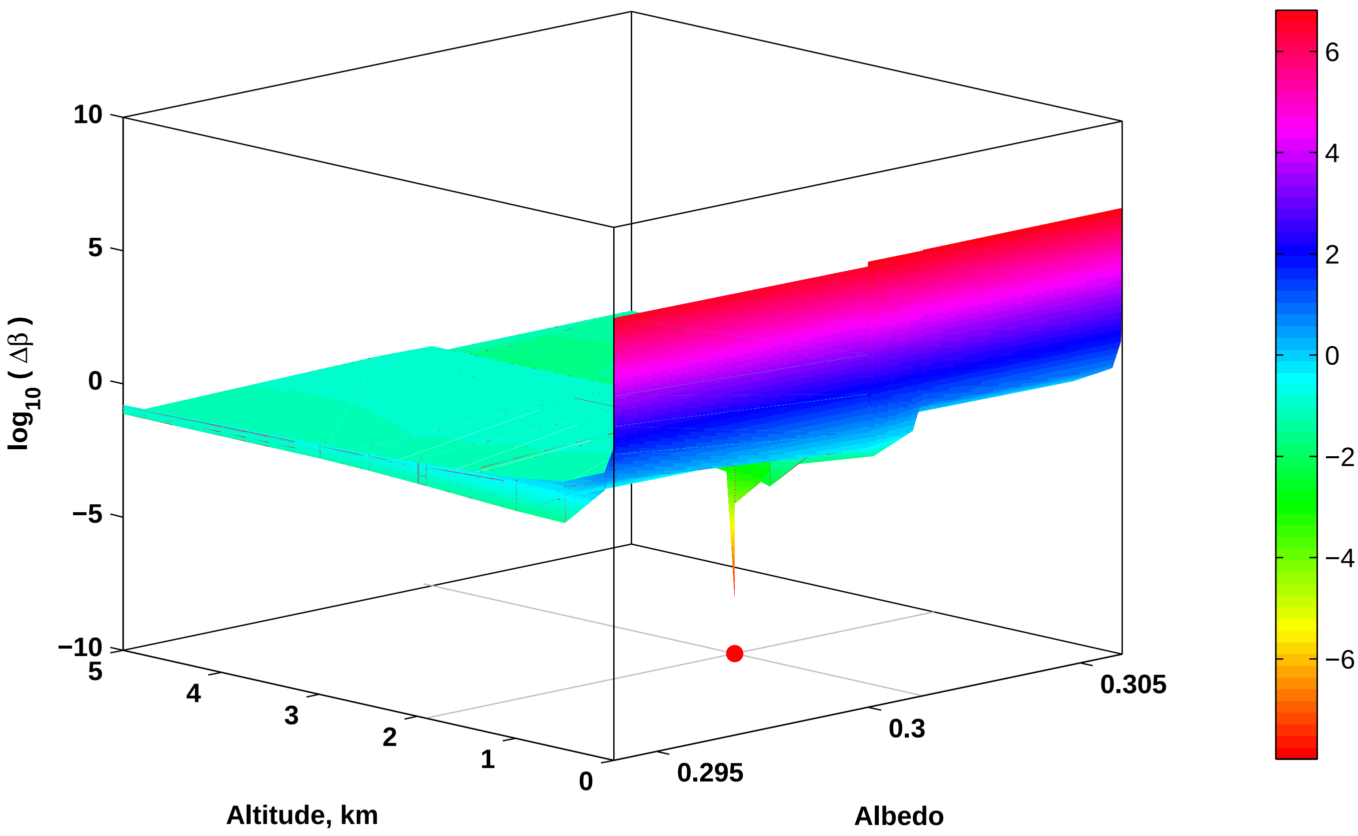


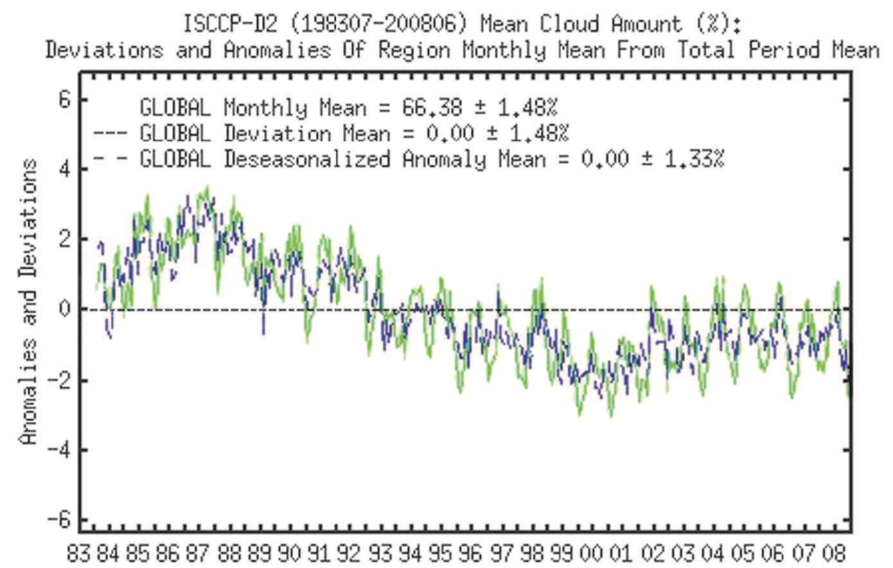
Planetary radiative equilibrium cloud cover at h^C = 1.916 km altitude : β (h^C) = β^A = β^E = f (τ_A)
β^A (S_0^A , h^C) = (S_0^A − OLR) / (OLR^C (h^C) − OLR)
β^E (S_0^E , h^C) = (S_0^E − S_U) / (S_U^C (h^C) − S_U)
S_0^W12 = 340
S_0^S12 = 340.2
S_0^N = 341.9
S_0^KT97 = 342
S_0^+ = 344
W m^−2
Expected range
α_B^N = 0.306
α_B^av = 0.3
α_B^* = 0.294
S_0^T = 341.9610 , β^T = 0.6618000
β^A, OLR^C = 240.14 W m^−2, OLR = 251.79 W m^−2
β^E, S_U^C = 333.82 W m^−2, S_U = 379.69 W m^−2
Cloud cover, β^A, β^E
Available solar radiation, S_0^E = S_0 / 4, W m^−2
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
339.5
340
340.5
341
341.5
342
342.5
343
343.5
344
344.5

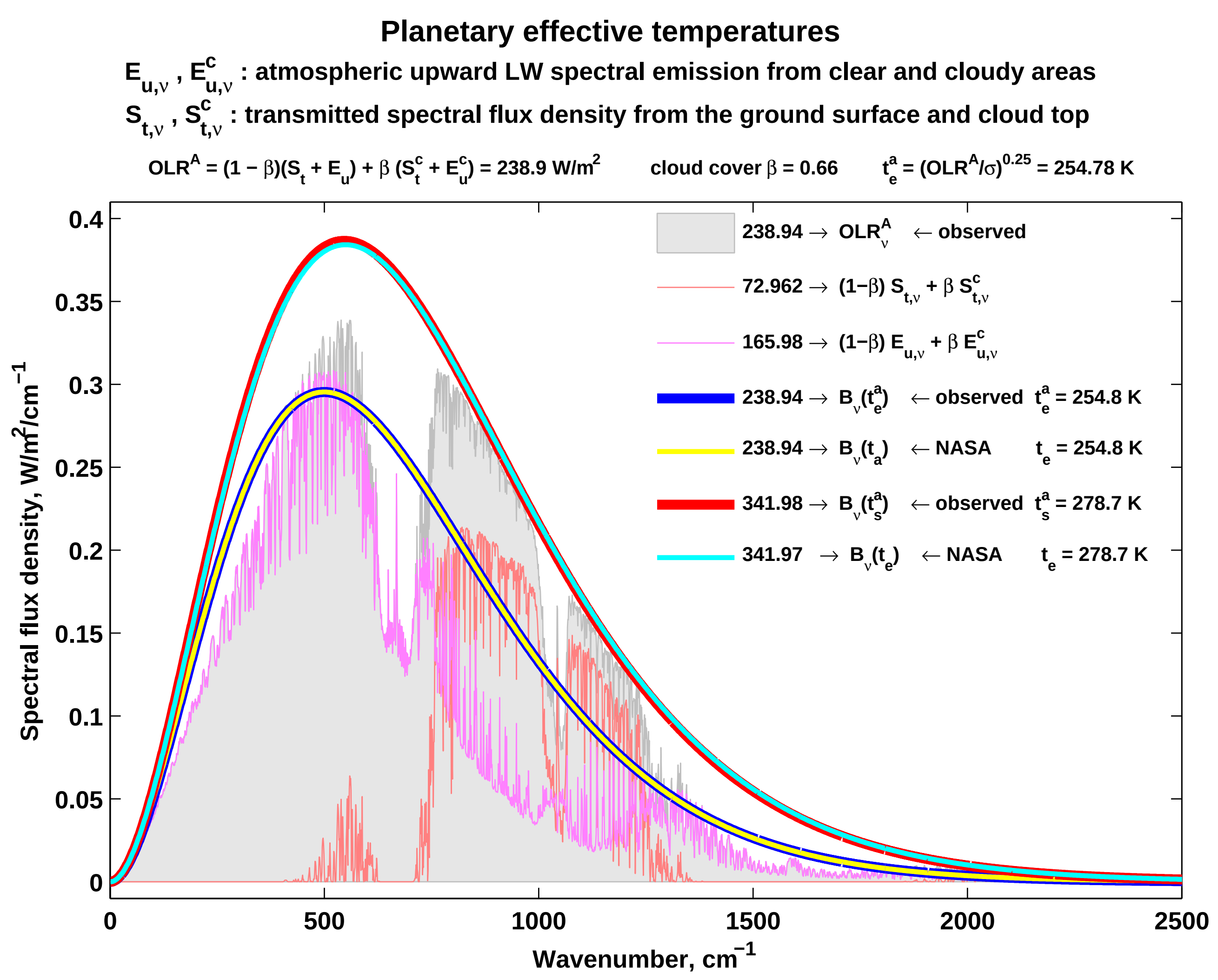


Planetary effective cloud cover in the 0 − 10 km altitude range
βE = (SE0 − SU) / (SCU − SU)
βA = (SA0 − OLR) / (OLRC − OLR)
Δβ (SE0 , SA0) = βE − βA
24 cases in the 340 − 344 Wm−2 SE0, and 235.96 − 242.86 Wm−2 SA0 range
Δβ (SE0 , SA0)
Δβ minimum
Δβ out of range
Δβ Ed = 240.11, OLRC = 240.12 W m−1
Valid range 0 −10 km
hC = 1.916 km
Altitude, km
Δβ = βE − βA

Radiative equilibrium cloud altitude and albedo




ISCCP-D2 (198307-200806) Mean Cloud Amount (%):
Deviations and Anomalies Of Region Monthly Mean From Total Period Mean
GLOBAL Monthly Mean = 66.38 ± 1.48%
--- GLOBAL Deviation Mean = 0.00 ± 1.48%
- - GLOBAL Deseasonalized Anomaly Mean = 0.00 ± 1.33%
Anomalies and Deviations
6
4
2
0
-2
-4
-6
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08

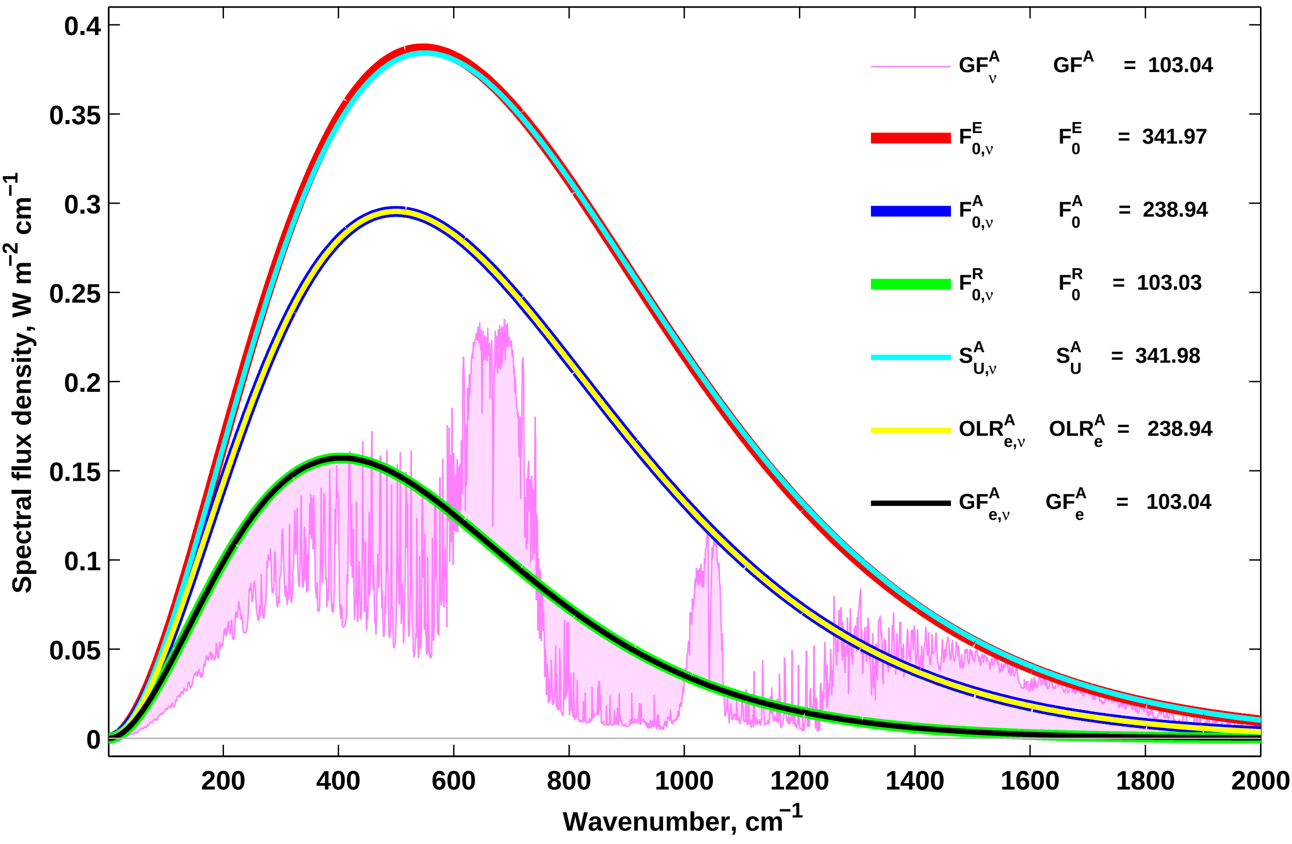


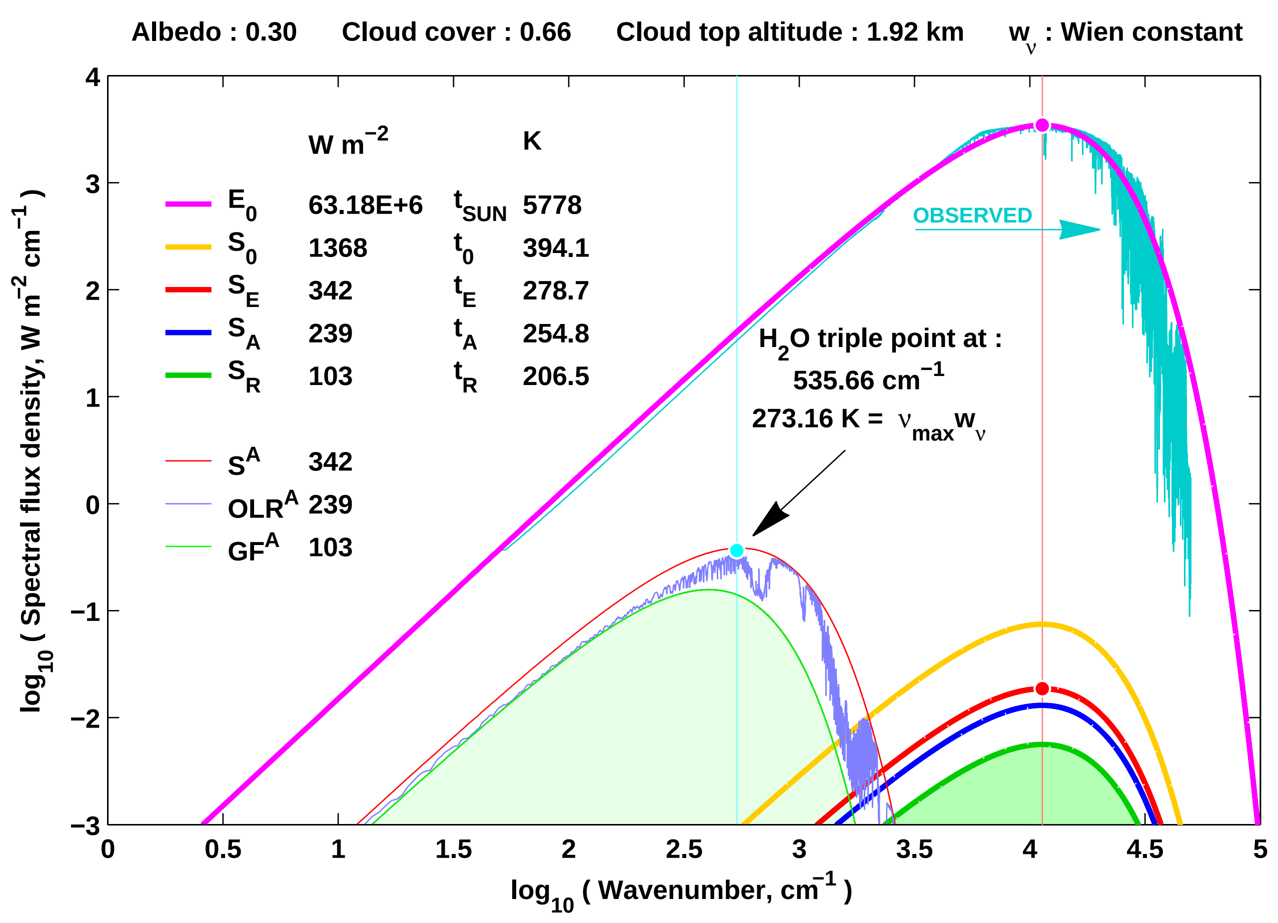
Planetary effective temperatures
$E_{u,\nu}$, $E^{c}_{u,\nu}$: atmospheric upward LW spectral emission from clear and cloudy areas
$S_{t,\nu}$, $S^{c}_{t,\nu}$: transmitted spectral flux density from the ground surface and cloud top
$OLR^A = (1 - \beta)(S_t + E_u) + \beta\,(S^c_t + E^c_u) = 238.9\ W/m^2$
cloud cover $\beta = 0.66$
$t^a_e = (OLR^A/\sigma)^{0.25} = 254.78$ K
238.94 → OLR^A_ν ← observed
72.962 → $(1-\beta)\ S_{t,\nu} + \beta\ S^c_{t,\nu}$
165.98 → $(1-\beta)\ E_{u,\nu} + \beta\ E^c_{u,\nu}$
238.94 → $B_\nu(t^a_e)$ ← observed $t^a_e = 254.8$ K
238.94 → $B_\nu(t_a)$ ← NASA $t_e = 254.8$ K
341.98 → $B_\nu(t^a_s)$ ← observed $t^a_s = 278.7$ K
341.97 → $B_\nu(t_e)$ ← NASA $t_e = 278.7$ K
Spectral flux density, $W/m^2/cm^{-1}$
Wavenumber, cm^{-1}
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0
500
1000
1500
2000
2500

Observed global mean spectral greenhouse factor, GF^A_ν

F^E_0, F^A_0, and F^R_0 : total effective, absorbed, and reflected SW radiation in W m^{-2}

S^A_U, OLR^A_e, and GF^A_e : total effective surface upwad, outgoing, and greenhouse LW flux densities in W m^{-2}

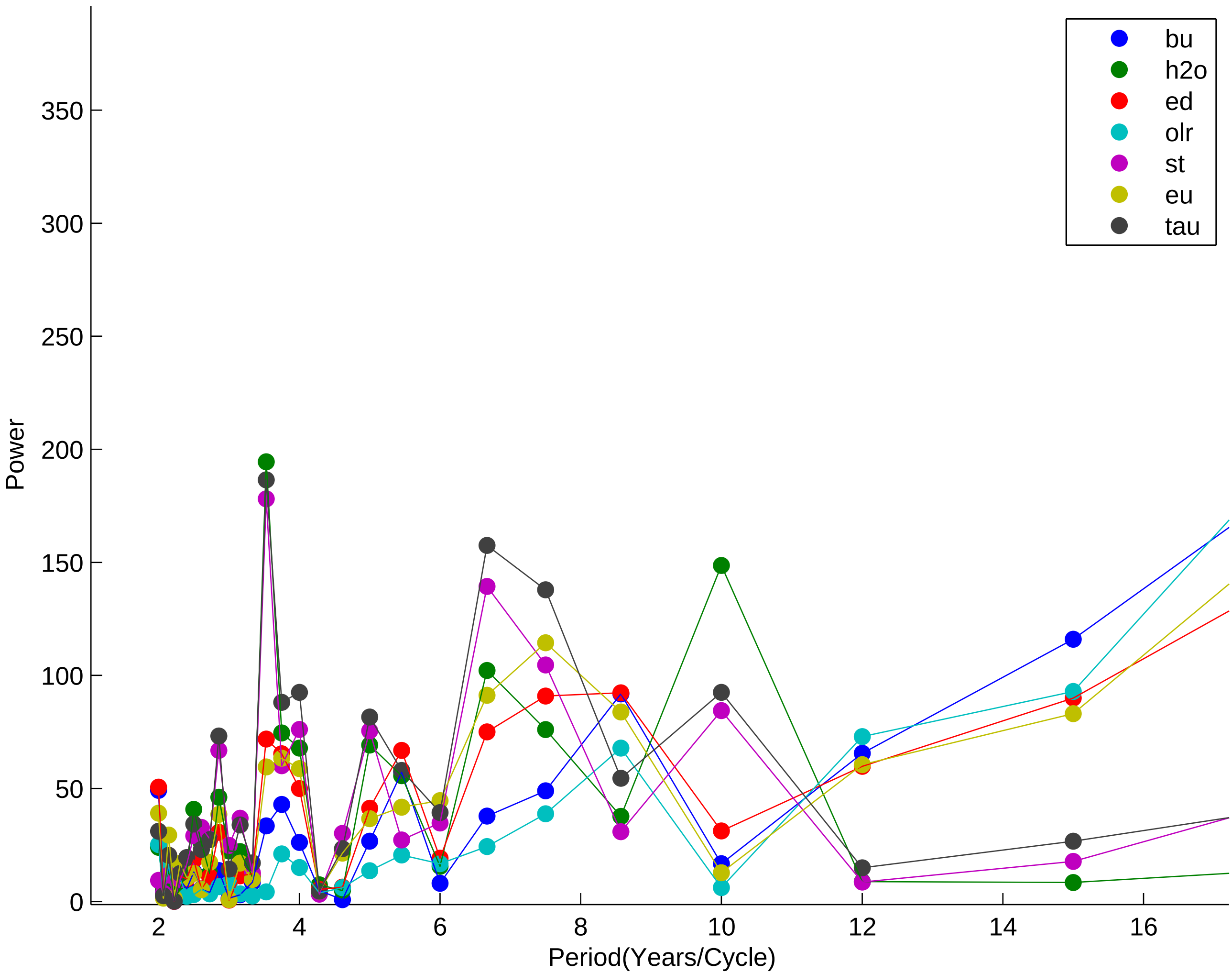




Albedo : 0.30
Cloud cover : 0.66
Cloud top altitude : 1.92 km
w_ν : Wien constant
W m^{-2}
K
E_0 63.18E+6 t_{SUN} 5778
S_0 1368 t_0 394.1
S_E 342 t_E 278.7
S_A 239 t_A 254.8
S_R 103 t_R 206.5
S^A 342
OLR^A 239
GF^A 103
OBSERVED
H_2O triple point at :
535.66 cm^{-1}
273.16 K = $\nu_{max} w_\nu$
$\log_{10}$ (Spectral flux density, W m^{-2} cm^{-1})
$\log_{10}$ (Wavenumber, cm^{-1})

wvmoll

WATERVAPOR COMPOSITE FROM 7 MAY 08 AT 09:00 UTC (SSEC:UW-MADISON)



bu
h2o
ed
olr
st
eu
tau
Power
Period(Years/Cycle)
0
50
100
150
200
250
300
350
2
4
6
8
10
12
14
16