THE ASSOCIATION OF ALBEDO AND OLR RADIATION WITH VARIATIONS OF PRECIPITATION – IMPLICATIONS FOR AGW

William M. Gray and Barry Schwartz
Colorado State University, Fort Collins, Colorado

1. INTRODUCTION

Global warming scenarios from CO_2 increases are envisioned to bring about rainfall enhancement and resulting upper troposphere temperature and water vapor increases. The initial warming resulting from the blockage of infrared (IR or OLR) radiation due to CO_2's increases has been programmed in climate models to develop yet additional rainfall, temperature, and water vapor increases. This causes an additional blockage of IR energy to space which is substantially larger than the original CO_2 blockage of IR by itself. This additional longwave IR blockage of energy to space (a positive feedback mechanism) is simulated in the models to be twice or more as strong as the original IR blockage from CO_2 alone. We question the reality of this positive feedback mechanism. This study is directed towards determining the reality of such large positive feedback processes. This is a crucial question for determining the likely amount of global warming that will result from the anticipated doubling of CO_2 by the end of the 21st century.

We have analyzed a wide variety of albedo and IR differences which are associated with rainfall variations on many different space and time scales. Our goal is to determine the extent to which we are able to accept or reject the reality of the Global Climate Model (GCM) simulations. The following analysis indicates that the GCM simulation of the influence of a doubling of CO_2 give far too much global warming. We anticipate that a doubling of CO_2 will act in a way to cause the global hydrologic cycle to increase in strength by approximately 3-4 percent. Our analysis indicates that there will be very little global temperature increase (~0.3^{o}C) for a doubling of CO_2, certainly not the 2-5^{o}C projected by the GCMs.

2. DATA ANALYSIS

We have analyzed 21 years (1984-2004) of ISCCP (International Satellite Cloud Climatology Project) outgoing solar (albedo) and IR (OLR) on various distance (from local to global) and time scales (from daily to decadal). We have investigated how radiation measurements change with variations in precipitation as determined from NCEP-NCAR reanalysis data on a wide variety of space and time scales (Figure 1). We have stratified our radiation and rainfall data into three latitudinal sections and six longitudinal areas (Figure 2). We analyzed IR and albedo changes which were related to reanalysis-determined rainfall variations by month (January to December) and by yearly periods for the tropics (30^{o}N-30^{o}S; 0-360^o) and for the globe, defined as 70^{o}N-70^{o}S; 0-360^o for this study.

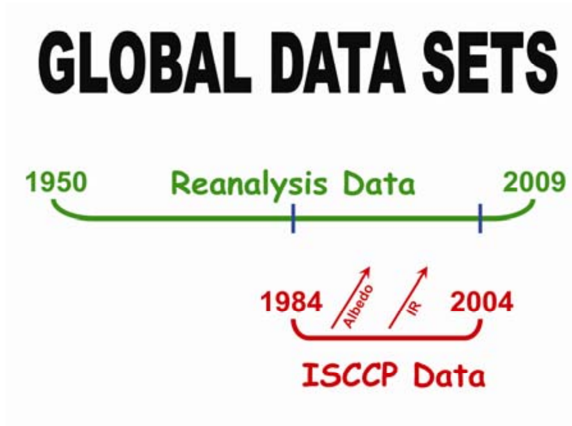

Figure 1. Data sets used along with the data periods used for analysis. Both reanalysis and ISCCP observations were analyzed.

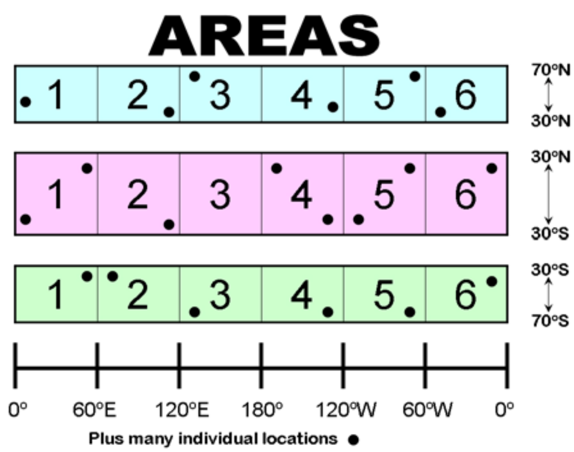

Figure 2. Areas for which individual radiation calculations were made. Dots represent individual grid points for which simultaneous daily-monthly rainfall and radiation measurements were made.

For each month and region we have categorized our 21 years of ISCCP radiation data into the 10 highest average monthly rainfall values and subtracted the 10 lowest average monthly rainfall values. We analyzed IR and albedo differences between these 10 highest versus 10 lowest precipitation months. These monthly rainfall differences were typically between 4-7 percent of the total rainfall. For the 10 highest minus 10 lowest yearly rainfall differences within the tropics (30^oN-30^oS; 0-360^o) and for most of the globe (70^oN-70^oS; 0-360^o), rainfall differences varied between 2-3 percent.

A second rainfall stratification involved comparing the rainfall and associated IR and albedo differences for variations in rainfall for the years of 1995-2004 versus the years of 1984-1994. The latter 10 years had approximately two percent more tropical and global rainfall than the earlier period. The individual monthly differences for the earlier and latter period were in the range of 3-4 percent of the mean rainfall values.

The third rainfall stratification involved daily mean rainfall and its association with IR and albedo at many individual stations. We also analyzed 3-hourly radiation information associated with daily average rainfall differences. Our individual 3-hour albedo analysis showed that albedos can be as high as 800-1000 Wm^{-2} over heavy rain and cloud regions near mid-day.

3. FINDINGS

a) The albedo occurring over the top of strong precipitation and high cloud regions typically increases at a greater rate than does the usual decrease of IR within these same rain and cloud areas. Heavy rain and cloud areas are local places of strong enhanced net radiation to space (Figure 3 – left diagram). In almost all organized rain and cloud areas we find that albedo to space goes up in both magnitude (Wm^{-2}) and in percentage more than the expected simultaneous magnitude and percentage reduction of IR flux to space.

   In the adjacent subsidence areas of little or no cloudiness and rain there is typically a reduction of albedo that is one to two times greater than the enhancement of IR to space (right side of Figure 3). In scattered and broken cloud areas of little or no significant rain there is typically a close balance between the enhancement of IR to space and the reduction of albedo (Figure 3 – center).

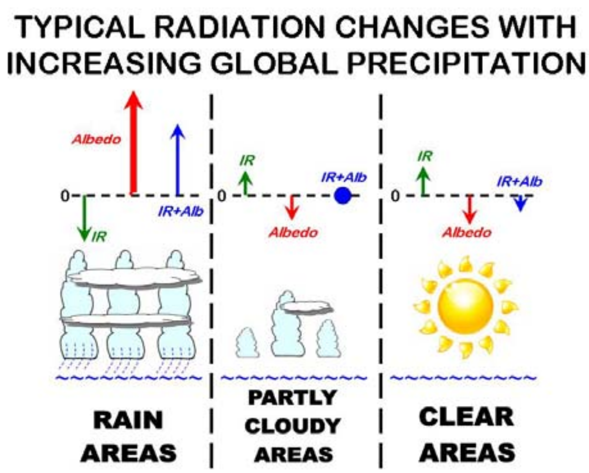

Figure 3. Typical variations of IR, albedo and (IR + albedo) associated with rainy, partly cloudy, and clear areas, respectively.

b) IR and albedo usually change in opposite directions. They have a high negative correlation. There are places and times however, where IR and albedo change together to either enhance or to suppress outward radiation flux.

c) The typical enhancement of rainfall and updraft motion in the cumulus and cumulonimbus clouds within heavy raining meso-scale disturbance areas acts to increase the return flow subsidence in the surrounding broader clear and partly cloudy regions (Figure 4). Global rainfall increases typically cause an overall reduction of specific humidity (q) and relative humidity (RH) in the upper and middle tropospheric levels of the broader scale surrounding subsidence regions. This leads to a net enhancement of IR to space, both over the tropics and the globe. Albedo is typically decreased as much or more than IR is increased in the broadscale clear and partly cloudy areas. But over the rainy and cloudy areas, the albedo is greatly enhanced. The albedo enhancement over the cloud-rain areas tends to increase the net (IR + albedo) energy to space more than the weak suppression of (IR + albedo) in the clear and partly cloudy areas.

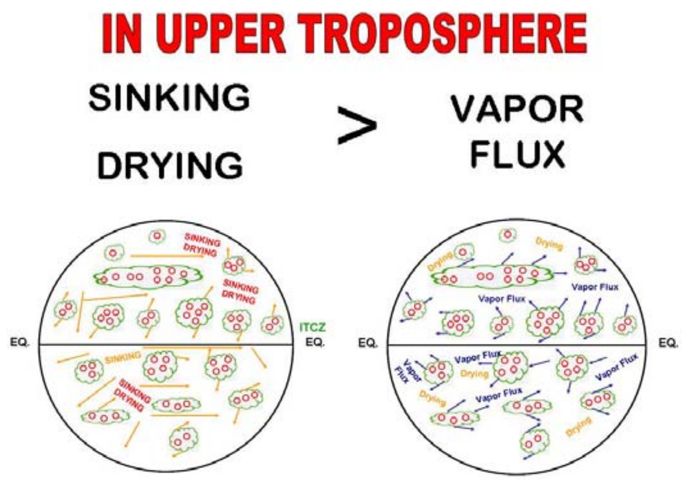

Figure 4. Idealized portrayal of global deep cumulus rain areas. The left diagram illustrates the sinking mass coming from the deep rain clouds which acts to dry and slightly warm the upper and middle troposphere. The right diagram shows water vapor being advected from the same rain areas. Observations indicate that, in general, the sinking-drying in the middle and upper troposphere is greater than the vapor replacement by advection and evaporation.

d) We observe that upper level RH and moisture content (q) at 300 mb (~10 km) and 400 mb (~8 km – not shown) are typically reduced for increasing amounts of net tropical rainfall. This is a direct consequence of the slightly greater return flow mass subsidence coming from the smaller areas of strong and concentrated updrafts of the deep cumulonimbus (Cb) rainclouds. This lowering of upper-level water vapor over the broad subsidence areas slightly increases the optical depth (τ) and slightly lowers the radiation emission level to a warmer layer where more IR energy is able to be radiated to space (Figure 5).

Figure 5. Two contrasting views of the effects of deep cumulus convection. The top diagram emphasizes the extra cloud albedo and extra return mass flow subsidence associated with extra IR energy being emitted to space. By contrast, the bottom diagram interprets the outflow from the deep cumulus as moistening the upper levels and blocking additional IR to space due to little change in albedo. The bottom diagram is not realistic.

Table 1 (top) portrays the monthly average variations of IR, albedo, and (IR + albedo) differences associated with the 10 highest minus 10 lowest monthly rainfall differences for each of six tropical longitudinal sections. Note that the sum of the six areas shows that with enhanced rainfall there are small reductions of 300 mb specific and relative humidity. Similar differences were observed at 400 mb (not shown). We observe that tropospheric temperatures at 250, 300 and 400 mb increase only slightly with precipitation increases of 2-4 percent.

TROPICS (30°N-30°S; 0-360°)

Monthly (High – Low) Precipitation Values

Δ Rain (3.9%) *(10 High) - (10 Low)* Avg. of each of 12 months	0 0-360	1 0-60E	2 60-120E	3 120E-180	4 180-120W	5 120-60W	6 60W-0
300 mb Temp. (°C)	0.02	0.13	0.27	0.23	(0.34)	(0.21)	0.02
Specific Humidity (q)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Relative Humidity (RH)	(1.66)	(1.34)	(2.33)	(1.73)	(0.41)	(1.20)	(2.69)

Δ Rain (2.0%) *(95-04) - (84-94)* Avg. of each of 12 months	0 0-360	1 0-60E	2 60-120E	3 120E-180	4 180-120W	5 120-60W	6 60W-0
300 mb Temp. (°C)	0.16	0.26	0.24	0.11	(0.05)	0.13	0.25
Specific Humidity (q)	(0.03)	(0.02)	(0.03)	(0.05)	(0.04)	(0.02)	(0.04)
Relative Humidity (RH)	(3.92)	(2.84)	(3.53)	(4.84)	(3.83)	(3.24)	(5.23)

Table 1. Changes in 300 mb temperature, specific humidity (q), and relative humidity (RH) by area between two rainfall difference data sets for the tropics. Rain differences average 3.9 percent for the 10 highest minus 10 lowest monthly differences and 1.9 percent for the (95-04)-(84-94) data set differences. Negative values are in red. All 300 mb moisture parameters showed decreases with enhanced rainfall.

The NCEP reanalysis data shows that there has been a steady decrease in upper tropospheric RH over the last 40 years (Figure 6). ISCCP data for the tropics show a small decrease in precipitable water (PW) since the mid 1980s (Figure 7). We do not find that net tropospheric water vapor content is necessarily related to rainfall rate. Increases in tropical and/or global rainfall typically lead to decreases in upper tropospheric water vapor content. This is in contrast with the general assumption of most climate scientists who believe that as global rainfall increases that tropospheric water vapor content will have to rise. This thinking fails to take into account the nature of the small-scale cumulus convective units. With the proper convective cloud model it is quite plausible that upper tropospheric moisture undergoes a decrease as tropical and/or global rainfall rates go upward. A long observational paper is presently being prepared to more fully document our many observations of the association of changes of rainfall with albedo and IR.

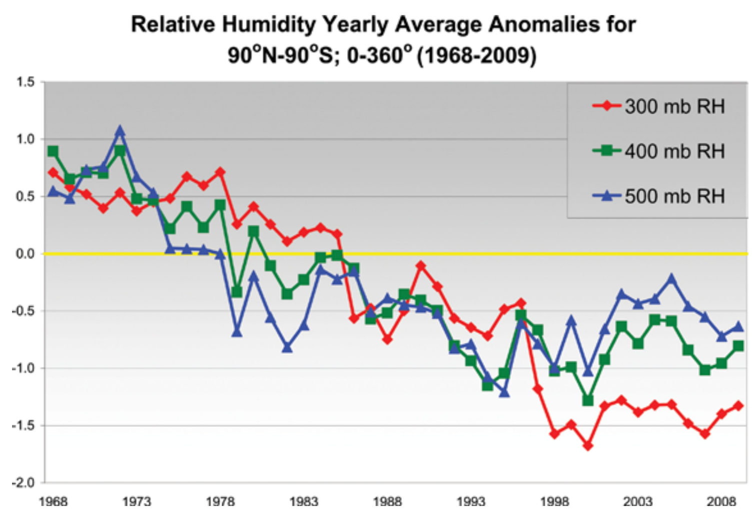

Figure 6. Annual standard deviations (SD) of global upper and middle tropospheric relative humidity (RH) trends over the period from 1968-2009 from the NCAR reanalysis data. Note the downward trend.

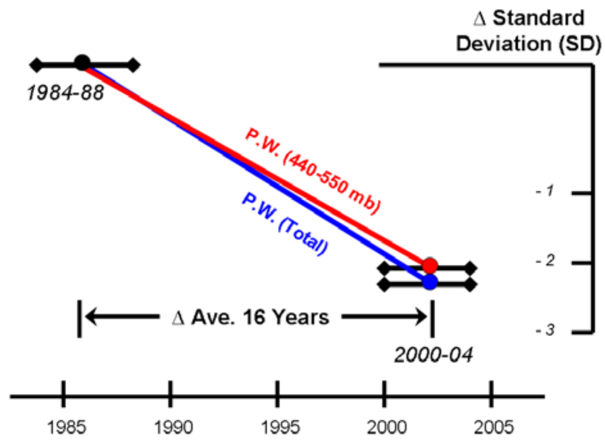

Figure 7. Trends in multi-year precipitable water for the global tropics as measured by ISCCP data.

4. IMPLICATIONS OF THESE OBSERVATIONS

The above measurements are at odds with the GCM simulations of precipitation increase associated with rising CO_2 amounts. Most GCMs show large upper tropospheric tropical temperature and water vapor increases to be associated with increased rates of precipitation. We do not observe such upper tropospheric temperature and moisture gains with rainfall enhancement. The GCM simulations assume that CO_2's blockage of IR stimulates an enhancement of extra rainfall which causes yet larger increases in upper level temperature-moisture and consequently causes stronger reductions in IR energy to space. These assumptions require the models to impose an increase in water vapor (to keep RH constant) as upper level temperature gains occur. We do not observe such upper-level temperature and moisture rises. We do not find that upper tropospheric temperature and RH are necessarily related to each other as the GCMs typically assume. We also do not find that upper and lower tropospheric water vapor amounts are strongly correlated with one another as the GCMs do.

It is possible for the troposphere to gain energy from increases in CO_2 and to simultaneously enhance its radiation to space to largely balance out all or most of the CO_2 energy gains. Such a compensation will allow CO_2 to increase with very little or no gain in tropospheric temperature. Such energy compensation can occur by CO_2 increases causing a lowering of the radiation emission level to a warmer temperature and thereby increasing the outward IR (σT^4) flux to space. The energy compensation can also occur by assuming that the CO_2-induced extra cloudiness-rainfall causes a compensating rise in albedo. Or, the CO_2-induced blockage could be compensated for (as the GCMs have chosen to do) by having upper tropospheric temperature rise by amounts of 3-4^{o}C or more. Our observations suggest that such an upper-level warming and consequent moistening process due to rising levels of CO_2 does not occur.

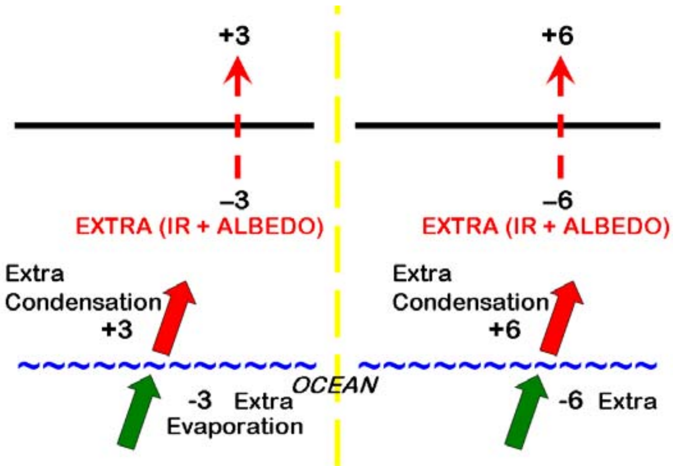

Figure 8. Portrayal of how extra energy gain by the troposphere through enhanced surface evaporation of 3 or 6 Wm^{-2} cannot be accumulated by the troposphere but must be converted to radiant energy and fluxed to space.

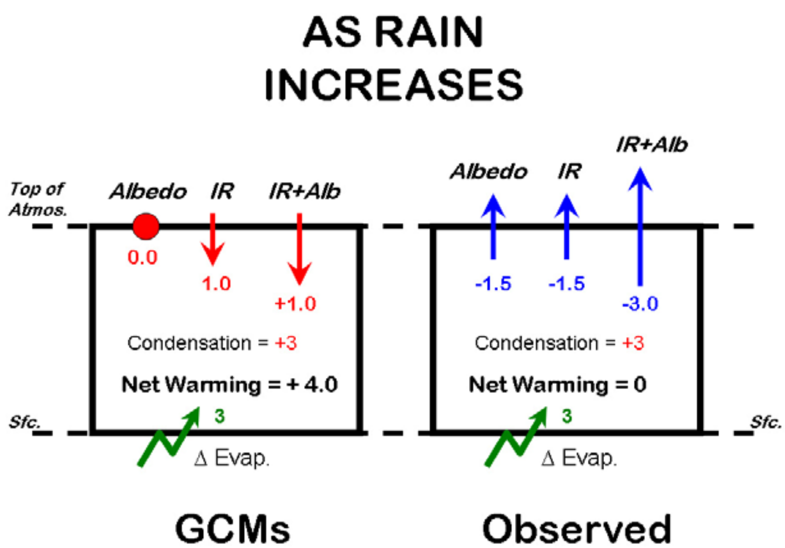

Figure 9. Contrasting versions of the influence of the enhancement of tropospheric temperature by the GCMs due to extra surface evaporation-tropospheric condensation (left side) versus this study's interpretation (right side). Our observations imply there must be an atmospheric energy balance because the atmosphere cannot store energy. Any increased evaporation-condensation must lead to a similar magnitude of enhanced radiation energy to space.

Troposphere Does Not Store Energy.

It is necessary that any enhanced or reduced flux of outward radiation energy to space from the upper atmosphere be matched by a similar enhanced upward or reduced flux of energy (radiation, evaporation, and sensible heat) from the surface. The troposphere cannot store energy. The primary question of compensation for increased CO_2

blockage of IR energy to space is how it will produce the required equal compensating upward energy response from both the surface and at upper levels. Excess net upward surface to air energy flux must pass through the atmosphere and escape as radiation energy to space (Figures 8 and 9). A decreased net global surface to air upward energy flux must initially be compensated by a net decrease in radiation energy flux to space. But this situation cannot last long. Decreased upward surface to air energy flux will lead to an increase in surface energy and a consequent increase in evaporation and sensible heat transfer to the atmosphere. The initial surface warming will be largely cancelled. But the increased rate of the hydrologic cycle will continue to occur. This is how we view the changes resulting for CO_2 increases – mainly through enhancement of the hydrologic cycle through greater rainfall but with very little change in global temperature.

We find that there is not a positive temperature and water vapor feedback as the modelers have assumed. In fact we see an opposite influence. As rainfall increases, upper-level water vapor contents are weakly reduced and temperatures only increase slightly.

The GCMs have assumed that as CO_2 increases it will cause a progressive increase in blockage of IR energy to space and, in addition, a further blockage of IR energy to space will occur from the assumed simultaneous temperature-vapor increase in the upper atmosphere. Any temperature rise at constant RH requires that water vapor also rise. The modelers have made the crucial, but faulty, assumption that <u>as temperature rises from increased CO_2 that it will do so in a way that keeps RH constant</u>. This requires that CO_2 increases that produce temperature increases must also cause water vapor increases and further blockage of IR to space. This leads to yet higher temperature and higher water vapor contents and greater blockage of energy to space.

Our observations do not agree with these GCM scenarios. Our observations indicate that upper-level moisture actually goes down as precipitation rates increase. Upper tropospheric temperature in the tropics and around the globe increase very little for increased rates of precipitation of 2-4 percent. Precipitation rate increases of 2-4 percent are similar to those assumed by GCMs for a doubling of CO_2.

5. THE NAS OR CHARNEY REPORT OF 1979 – BEGINNING SOURCE OF THE FAULTY AGW SCENARIOS

The basic error of the GCMs has been their general belief in the National Academy of Science (NAS) 1979 study – often referred to as <u>*The Charney Report*</u> - which hypothesized that a doubling of atmospheric CO_2 would bring about a general warming of the globe's mean temperature of between 1.5 – 4.5^{o}C (or an average of ~ 3.0^{o}C). These high warming values were based on the report's assumption that the RH of the atmosphere would remain quasi-constant as the globe's temperature increased. This assumption was made without any type of cumulus convective cloud model and was based solely on the Clausius-Clapeyron (CC) equation[1] and the assumption that the RH of the air will remain constant during any future CO_2-induced temperature changes. If RH remains constant as atmospheric temperature increases then water vapor content in the atmosphere must rise exponentially (Figures 10 and 11). The water vapor content of the atmosphere rises by about 50 percent if atmospheric temperature is increased by 5°C and RH remained constant. Upper tropospheric water vapor increases act to raise the atmosphere's radiation emission level to a higher and colder level. This reduces (decreases σT^4) the amount of outgoing IR energy which can escape to space.

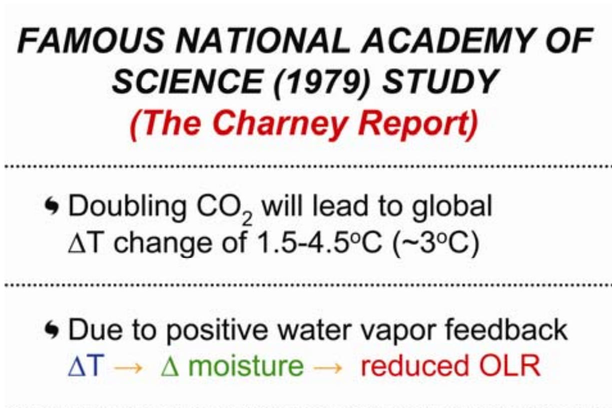

Figure 10. The influential NAS report of 1979 which deduced that any warming of the globe from increased CO_2 would occur with constant RH. This would assure an increase in atmospheric water vapor (q) with any temperature rise. This deduction was made without consideration for how the globe's hydrologic cycle functions.

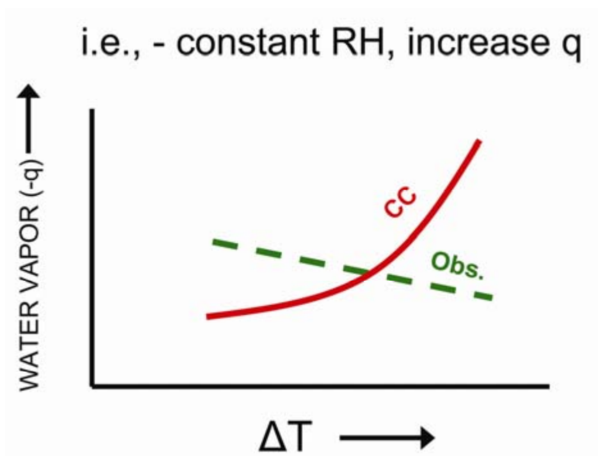

Figure 11. The relationship showing the increase of water vapor as temperature increases at constant RH based on the CC equation - red line. Our observations of upper and middle tropospheric water vapor show water vapor decreasing as temperature increases – green line.

[1] The CC equation specifies that as atmospheric air temperature rises, the ability of the air to hold water vapor goes up exponentially

Some of the climate modelers, such as the early NASA-GISS (Hansen 1988) model, have even gone further than the CC equation would specify for water vapor increasing with temperature. Hansen's early GISS model assumed that for increases of CO_2, that upper tropospheric RH would not just stay constant but actually increase. The upper tropospheric water vapor (q) which Hansen's assumed for a doubling of CO_2 in his early model led him to increase water vapor (Δq) in the upper troposphere by nearly 50 percent. This caused his model to specify a tropical upper tropospheric atmospheric warming for a doubling of CO_2 of as much as 7^{o}C (Figure 12 and Figure 13). No wonder Hansen got such high global warming estimates for a doubling of CO_2. It was these excessive warming values from grossly unrealistic model assumptions that he presented to a US Senate Committee during his famous hearing in June of 1988. It is a mystery that this gross technical flaw was not pointed out at that time.

Not only were Hansen's extreme and unrealistically high values of upper tropospheric moisture and temperature increases (for a doubling of CO_2) not challenged by his fellow modelers at the time, they were instead closely emulated by most of the other prominent GCMs of NOAA-GFDL (Figure 14), NCAR (Figure 15) and the UK Met Office (Figure 16). All of these early GCM simulations were designed to give unrealistically high amounts of upper tropospheric water vapor increases for doubling of CO_2 and, as a result, additional extra large blockage of IR energy to space with resulting large and unrealistic upper level temperature increases.

Our analysis does not show significant increases of upper tropospheric temperature and moisture with enhancement of tropical or global rainfall amounts of 2-4 percent that are similar to what would be expect to occur with a doubling of CO_2. This has also been discussed by Douglass *et al*. (2007) who show that tropical upper-tropospheric measurements and GCM results do not agree.

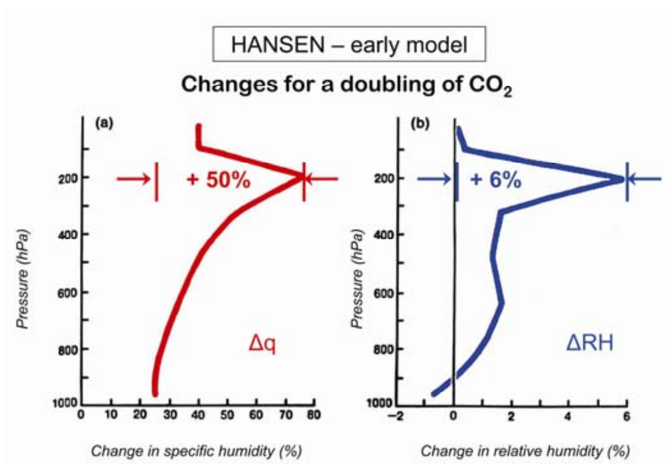

Figure 12. Early NASA model showing assumed increases in specific humidity (q) and RH for a doubling of CO_2. This model is very unrealistic. These results nevertheless, served as background for Hansen's famous 1988 report to Congress.

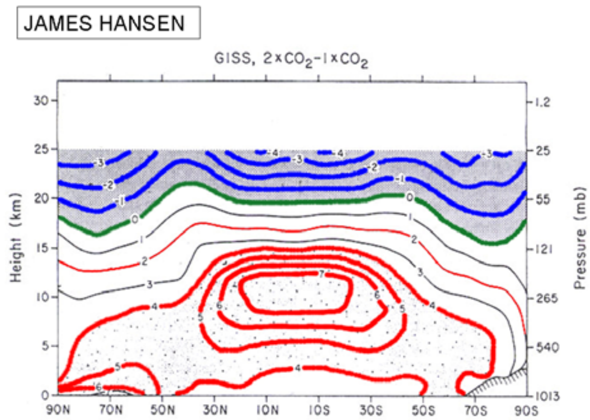

Figure 13. North-South vertical cross-section showing Hansen's early GCM's change in temperature (^oC) that would accompany a doubling of CO_2. There is no way an extra 3.7 Wm^{-2} blocking of IR could lead to such extreme upper tropospheric temperature increases.

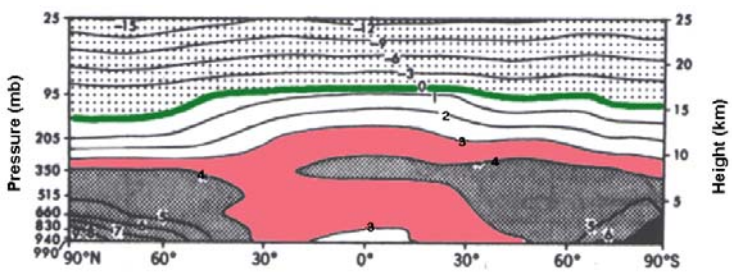

Figure 14. Same as Figure 13 but for NOAA-GFDL temperature predictions for a doubling of CO_2.

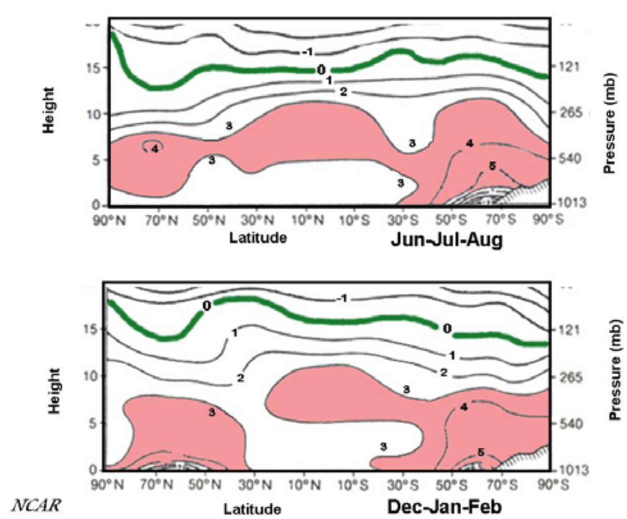

Figure 15. Same as Figure 13 but for NCAR GCM temperature predictions for a doubling of CO_2.

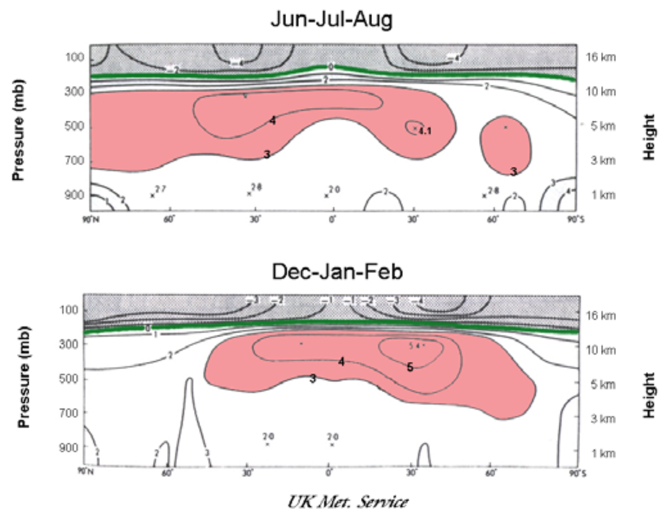

Figure 16. Same as Figure 13 but for the UK Met Office's temperature predictions for a doubling of CO_2.

6. CENTRAL FLAW OF THE GCMs

The cloud condensation schemes of the GCMs have been flawed from the start. Their condensation heating schemes cannot resolve the horizontally small convective elements. These grid sizes are too coarse to be able to deal with the large up-and-down recycling elements of the individual cumulus scale elements. The mass which goes upward in small concentrated regions (~3-5 km) of deep cumulus and Cb clouds must return to lower levels. Such up-and-down mass recycling cannot be resolved by the GCM grids.

The vertical gradient of water vapor holding capacity in the upper troposphere is especially large. Saturated air from the upper tropospheric outflow of Cb clouds which sinks to levels only 100 mb below it has its RH greatly reduced by values as much as 60 to over 90 percent (Table 2).

The upper tropospheric rainfall efficiency from Cb clouds is very high. These clouds, in the net, tend to reduce their broad scale surrounding upper-level RH. This allows for more IR energy loss to space. Likewise, there is a large enhancement of albedo energy off the top of the deep raining cumulus clouds and anvils.

The GCMs appear not to have been sensitive to implications of strong upper troposphere up-and-down mass compensation of deep raining clouds and their potential return flow subsidence drying. The modelers have viewed Cb convection as acting to moisten the upper troposphere (bottom diagram of Figure 5). This is a crucial flaw in their thinking. It allows them to accept the unrealistic view that upper-level moistening results from enhanced deep Cb convection. This is not supported by observations.

Sinking 100 mb Pressure Levels	RH Percent Decrease	Resulting RH at base of sinking
125 mb to 225 mb	93	07
150 mb to 250 mb	90	10
175 mb to 275 mb	88	12
200 mb to 300 mb	86	14
225 mb to 325 mb	83	17
250 mb to 350 mb	77	23
275 mb to 375 mb	69	31
300 mb to 400 mb	63	37
325 mb to 425 mb	59	41
350 mb to 450 mb	56	44

Table 2. Amount of RH decrease by saturated air sinking 100 mb between various pressure levels (middle). The resulting lower-level humidity is given on the right.

7. COMPARISON OF THE ENERGY OF CO_2's DOUBLING WITH OTHER TROPOSPHERE ENERGY COMPONENTS

We have used the combination of ISCCP and NCEP-NCAR reanalysis data to construct an annual average of the global tropical (30°N-30°S; 0-360°) energy budget (Figure 17) for the years from 1984-2004. Note that the various surface and top of the atmosphere energy fluxes are very large. For the tropical surface, for instance, there are 637 Wm^{-2} of downward incoming solar and infrared (IR) energy. This downward energy flux is largely balanced by an upward surface energy flux of 615 Wm^{-2} which is due to surface upward fluxes from IR radiation, evaporation of surface liquid water, and surface to air sensible heat flux. Similar large energy fluxes are present at the top of the atmosphere and within the troposphere.

It has been estimated that a doubling of CO_2 (from the pre-industrial period) without any feedback influences would result in a blockage of IR to space of about 3.7 Wm^{-2}. The currently-measured value of CO_2 in the atmosphere is about 380 parts per million by volume (ppmv). If we take the background pre-industrial value of CO_2 to be 280 ppmv, then by theory we should currently be having (from CO_2 increases alone) about $(100/280)*3.7 = 1.3$ Wm^{-2} less IR energy being fluxed to space than was occurring in the mid-19th century. We are now about a third of the way to a doubling of CO_2 from the pre-industrial state.

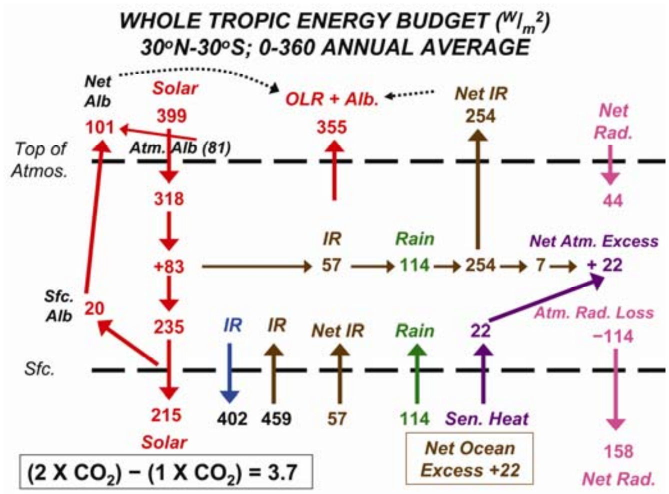

Figure 17. Vertical cross-section of the annual tropical energy budget in Wm^{-2} as determined from a combination of ISCCP and NCEP-NCAR Reanalysis data over the period from 1984-2004. The tropics receive an excess of about 44 Wm^{-2} radiation energy which is convected and exported as sensible heat to latitudes poleward of 30°. Estimates are that about half (22 Wm^{-2}) is transported by the atmosphere and the other half is transported by the oceans. Note how large these energy components are in relationship to a 3.7 Wm^{-2} resulting from a doubling of CO_2.

The 1.3 Wm^{-2} reduction in IR we have experienced since the mid-19th century is very small compared with the overall 399 Wm^{-2} of solar energy impinging on the top of the tropical atmosphere and the mostly compensating 356 Wm^{-2} of IR and albedo energy going back to space. It is impossible to isolate and attribute any changes in global climate parameters to such a relatively small CO_2-induced energy gain of 1.3 Wm^{-2}. How do we know that the earth system has not already compensated in its many other degrees of freedom to this small (1.3 Wm^{-2}) CO_2 energy influence? These CO_2-induced energy changes that have occurred up to now are largely in the noise level. Their specific influence is too small to ever be quantitatively specified. This is particularly the case when many of the globe's potential natural climate influences have yet to be well understood, and their influence quantitatively assessed.

8. DISAGREEMENT WITH IPCC-IV GCM MODELING RESULTS

Our data indicates that we should expect an enhancement of radiation to space with increased global rainfall. This is due to the increase in albedo over the rainy and cloudy regions and to the IR increases in the broad global subsidence and partly cloudy regions. We do not find a positive water vapor feedback as do the GCMs, but rather a weak negative water vapor feedback.

The IPCC-IV Report (Chapter 8, Figure 14) lists 19 GCM simulations of the equilibrium climate sensitivity (in ^{o}C) for the influence of a doubling of CO_2 (Figures 18 and 19).

Values range from 2.1°C to 4.4°C with the mean value being 3.2°C. Assuming no moisture change above the emission level (optical depth constant) and no albedo influence, then for a doubling of CO_2 it would be required that there be a temperature increase of 1.1°C. For a doubling of CO_2 to cause a net global warming of 3.2°C as the current GCMs suggest, it is necessary that these models have a required positive moisture and cloud feedback warming of about 2.1°C. This is equivalent to an extra enhanced radiation flux to space beyond a doubling of CO_2 by itself of ~7 Wm^{-2}. This is not realistic and indicates that the <u>new GCMs are making the same faulty assumptions as regards to the water vapor feedback that was made by the modelers of 15-20 years ago</u>.

If the upper level moisture values actually decreased as our analysis indicates (negative water vapor feedback), and the albedo increases over the cloudy and rainy areas as our measurements show, then there would be much less needed upper-level warming and moistening to balance a doubling of CO_2.

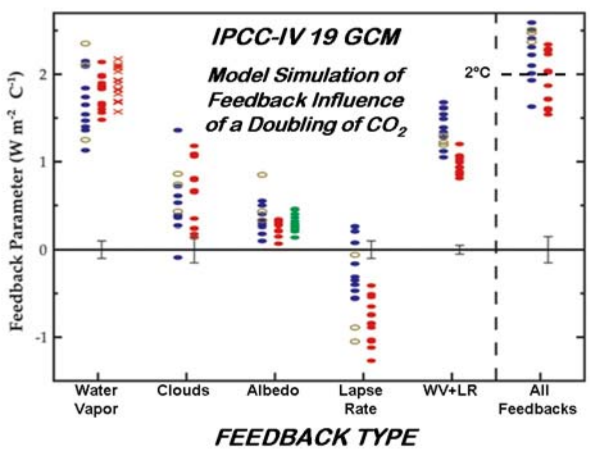

Figure 18. Scatter plot of the extra global feedback energy increases resulting from water vapor, albedo, cloud, and lapse-rate changes due to a doubling of CO_2 from 19 GCMs of the 2007 IPCC-IV report (Chapter 8, Figure 14). Most models give strong positive energy feedbacks.

Figure 19 compares our estimates of the global changes in five feedback influences resulting from a doubling of CO_2 (in red squares) vs. 19 models of the IPCC-IV (yellow circles). Except for the lapse-rate term, all our other estimated feedback influences (water vapor, cloud, albedo, water vapor+lapse rate) give much less positive energy feedback than do these recent GCM simulations. Combining all feedback terms, we obtain a net water vapor, cloud, albedo, and lapse-rate feedback of about minus 0.8°C for a doubling of CO_2 vs. the value of the average of the 19 IPCC-IV GCM runs of a positive 2.1°C for a doubling of CO_2. This is a feedback difference as large as 2.9°C. Figure 20 compares our projected estimate of the amount of global warming which will occur with a doubling of CO_2 (~0.3°C) compared to the average of the GCM estimates of ~3.2°C.

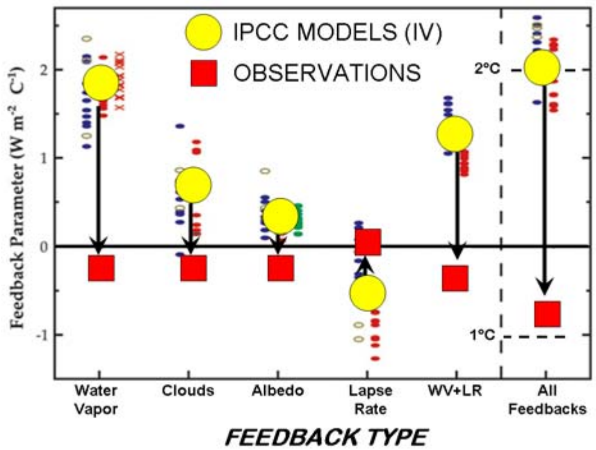

Figure 19. Comparison of the mean GCM feedback magnitudes (yellow circles) vs. what our observations imply as to the magnitude of the various feedback, processes (red squares). We envisage the expected 1.1°C warming from a doubling of CO_2 to cause a negative (not positive) feedback of about 0.8°C, not a positive feedback of 2.1°C as the GCMs indicate.

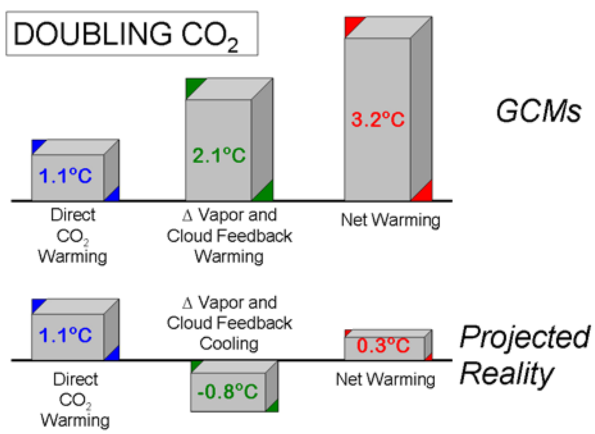

Figure 20. Contrast of what the GCMs give vs. what our observations indicate as to the likely global temperature changes which can be expected from a doubling of CO_2.

9. CONCLUSIONS

Observations of upper tropospheric water vapor over the last 3-4 decades from the NCEP/NCAR reanalysis data and ISCCP data show that upper tropospheric water vapor appears to undergo a small decrease while IR or outgoing longwave radiation (OLR) undergo a small increase. This is opposite to what has been expected from the GCMs. These models have erroneously exaggerated the magnitude of the water vapor feedback. They have also neglected the strong enhancement of albedo which occurs over the rain and cloud elements.

We should disregard what the GCMs have been saying about global warming from CO_2 doubling. We should not set mandatory quotas on replacement of fossil fuel energy with renewable energy (wind, solar, etc.) at this time. The honest and objective science to support such serious energy utilization changes is just not there.

10. REFERENCES

Douglass, D.H., Christy, J.R., Pearson, B.D. and Singer, S.F, 2007: A comparison of tropical temperature trends with model predictions. *Int. J. Climatol*., DOI: 10.1002/joc.1651. DOI: 10.1260/095830509787689277.

Schiffer, R.A., and Rossow, W.B., 1985: ISCCP (International Satellite Cloud Climatology Project) Global Radiance Data Set: A New Resource for Climate Research. *Bull. Amer. Meteor. Soc.*, **66**, 1498-1505.

Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller (eds.), 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 996 pp.