MISREPRESENTATIONS OF CLIMATE SCIENCE

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Science is described as the systematic study of the structure and behaviour of the physical and natural world and is based on observation and experiment. That is, any hypothesis must be derived from sound observations and reproduceable experiments.

The UN’s Intergovernmental Panel on Climate Change (IPCC) uses global and annual average temperature as an index for describing climate change. However, this index is misleading because it hides and does not account for the regional and seasonal differences in the rates of warming that have been observed. The human-caused global warming hypothesis, to be valid, must also explain these regional and seasonal variations.

EARTH’S CHANGING CLIMATE

Since 1979, based on conventional and satellite observations, observations have been systematically analysed as the basis for global weather forecasting. The analyses are stored in a database (NCEP/NCAR R1) maintained by the US National Center for Environmental Prediction (NCEP). A satellite derived database of atmospheric temperature is held by the University of Alabama, Huntsville (UAH).

The near surface (2 metre) temperature trends for various latitudinal bands, obtained from the NCEP database, are shown in Table I. These data show significant differences in the rate of warming for different regions of Earth. Clearly, the polar regions are warming faster than any other regions. In contrast, across the Southern Ocean there is almost no warming trend.

In addition, there are significant seasonal differences in the rates of warming over the polar regions, as shown in Table II. Over both the Arctic and the Antarctic the rates of warming are much greater during the winter months than those of the summer months.

The observations show that the index of global and annual rate of Earth’s warming of 1.7oC per century does not capture the differing regional and seasonal characteristics. Any explanation for the recent warming must be able to explain why these regional and seasonal differences occur.

THE ROLE OF CARBON DIOXIDE

Carbon dioxide is described as a well-mixed greenhouse gas in the atmosphere and its concentration is measured in parts per million (ppm). Carbon dioxide is constantly flowing between the atmosphere, the biosphere and the oceans. The annual average concentration has little regional variation but there is a marked seasonal cycle with the range of the cycle being a maximum over the Arctic.

Carbon dioxide is taken from the atmosphere, primarily by way of two processes: by photosynthesis to growing terrestrial plants, and by absorption into the colder oceans. Carbon dioxide enters the atmosphere by way of decaying terrestrial plant material, from outgassing from warmer oceans, and through emissions associated with the industrial and lifestyle activities of humans. Because of the large natural flows, the average residence time in the atmosphere of a carbon dioxide molecule is only about four years.

The emissions generated by human activities have grown to about ten percent of the natural flows. Despite the seasonal atmospheric carbon dioxide concentration peaking over the Arctic, far from human settlement, it is claimed that the rising atmospheric concentration is caused by human activity.

Regardless of the origins, carbon dioxide concentration is increasing in the atmosphere. As summarised by IPCC, the increasing concentration of carbon dioxide reduces longwave radiation emissions to space, thus upsetting Earth’s long-term radiation balance. The slight reduction in flow of radiation energy to space, called ‘radiation forcing’, is claimed to be a source of heat that warms the Earth’s atmosphere.

CLIMATE MODELLING

The IPCC recognises climate forcing as ‘a modelling concept’ that constitutes a simple but important means of estimating the relative surface temperature impacts due to different natural and anthropogenic radiative causes.

A fundamental flaw in this modelling concept is an assumption that, prior to industrialisation, Earth was in radiation balance.

Firstly, nowhere on Earth is there radiation balance: over the tropics absorption of solar radiation exceeds emission of longwave radiation to space; over middle and high latitudes emission of longwave radiation to space exceeds absorption of solar radiation. Earth is only in near radiation balance because heat is transported by winds and ocean currents from the tropics to middle and high latitudes.

Secondly, the latitude focus for absorption of solar radiation varies with seasons. There is a need for the ocean and atmosphere transport to vary with the seasonal shift. Consequently, as shown in Figure 1, the seasonally changing solar radiation causes Earth’s global average near surface (2 metre) air temperature to oscillate with an annual range of about 3oC.

Rather than being in balance, as claimed by the IPCC, the net radiation exchange with space oscillates about a balance point. The reason for the oscillation is the differing fractions of landmass in each of the hemispheres. The Northern Hemisphere has a higher proportion of land while the Southern Hemisphere has much more ocean surface than land surface.

Because the radiation exchange with space is not in balance then the essential requirement of radiation forcing, as used in climate modelling, is invalid. Moreover, given the strong natural flows of heat within the climate system (oceans, atmosphere, and ice sheets) there is no reason to expect that, as carbon dioxide concentration increases, the small reduction in longwave energy to space will heat the atmosphere.

THE TROPICAL OCEAN HEAT BANK

The oceans have a thermal capacity that is much greater than the overlying atmosphere. Because of its lower density and specific heat, the thermal capacity of the atmosphere is equivalent to only about the top four metres of the deep oceans.

Over the tropical oceans, solar radiation passes through the atmosphere and is largely absorbed and heats the surface layer to a depth of several hundred metres. The tropical oceans, with their high thermal capacity, act as a heat bank for the climate system.

Some of the absorbed solar radiation is transported polewards by the ocean currents. The remainder flows to the atmosphere in the forms of net radiation emission, directly by conduction, and as latent energy associated with evaporation. Each of the processes involved in the flow of heat to the atmosphere is a function of ocean surface temperature. The warmer the ocean surface temperature then the greater the flow of heat to the atmosphere. However, the tropical ocean surface temperature varies with poleward transport of heat by the ocean currents: if the transport slows then the tropical ocean warms, while if the transport rate increases the temperature falls.

The equatorial lower troposphere air temperature, as measured by satellites, responds to changing ocean surface temperature, as shown in Figure 2. The correlation between the ocean and atmosphere temperatures for the period 1979 to 2023 is 0.80. It is the atmosphere temperature that responds to changes in ocean temperature because the correlation increases to 0.86 when the air temperature record is lagged by two months. It is heat and latent energy flowing from the ocean surface that regulate the temperature of the overlying atmosphere.

In addition to the large interannual variability of Figure 2, there was a warming trend of 0.7oC/century in the equatorial ocean. The warming trend in the lower atmosphere air temperature was of slightly larger magnitude (1.4oC/century) and the difference is explained by the physics of buoyant convection.

As the ocean surface temperature has warmed, so too there has been an increase in the rate of evaporation and flow of latent energy to the atmosphere. Consequently, there is an increase in heat available for transport to high latitudes by the winds. Poleward transport by the winds is a maximum during the winter months, and it is not surprising that the additional heat is observed as a stronger warming rate over polar regions during winter months, as noted in Tables I and II.

WHY HAVE THE TROPICAL OCEANS WARMED?

The recent 44 years of systematic conventional and satellite observations, together with established meteorological science, have been shown to link the slow warming of the tropical ocean surface layer to the regional and seasonal characteristics of polar warming. The outstanding question is, why have the tropical oceans warmed?

Solar radiation is the primary source of energy that warms the tropical ocean, and one possibility is that the intensity of solar radiation has increased. However, there is no evidence for such a change.

According to the IPCC, it is the increasing concentration of carbon dioxide that is the source of global warming. If this were to be the case, then it would be necessary for the additional carbon dioxide to significantly increase the emission of longwave radiation from the atmosphere to the surface. That is, the ocean would be warmed by an increase in the absorption of longwave radiation emitted downward by the greenhouse gases.

The absorption of longwave radiation at the surface can be calculated with validated radiation transfer models, such as the publicly available MODTRAN model. Table III shows the variation in absorption of longwave radiation at the surface as carbon dioxide concentration incrementally increases. The Table is constructed using the MODTRAN model for a tropical atmosphere and clear skies. The first line depicts the surface absorption (in watts per square metre – W/m2) for an atmosphere with only water vapour and carbon dioxide, the primary greenhouse gases. The second line is the incremental change as carbon dioxide concentration is increased.

The main point of Table III is that carbon dioxide makes a limited contribution to the absorption of longwave radiation at the surface. Water vapour is the primary greenhouse gas. Moreover, the increase in absorption of longwave radiation at the surface from additional carbon dioxide added during the 20th century is a miniscule 0.2 percent.

The calculations of Table III underscore that carbon dioxide is not a driver of tropical ocean warming. This conclusion is supported by the observation that the concentration of carbon dioxide was only about 200 ppm during the last glacial period 20,000 years ago, when sea level was about 130 metres lower than today, and great ice sheets covered much of North America and Northwestern Europe. Over the next 10,000 years, as Earth recovered from the glacial climate, sea level rose to near the present level as the ice sheets melted. During the recovery the carbon dioxide increased by about 100ppm.

During the industrial period of the 20th century the carbon dioxide concentration increased by a further 100ppm, equal to the recovery from the glacial climate. The minimal changes in sea level and climate during the industrial period would not be detected without careful and systematic observations.

The likely explanation for recent warming of the tropical oceans is a reduction in poleward transport of heat by the oceans. Indeed, there is evidence that the Gulf Stream of the North Atlantic Ocean, a primary component of ocean heat transport, is slowing and has been slowing since the early 19th century. Winds and temperature contrasts drive the ocean currents, and it is expected that ocean currents will naturally fluctuate over a range of timescales to vary the climate.

CONCLUSION

The hypothesis and computer modelling that suggest human activities and the increase in atmospheric carbon dioxide are the cause of recent warming cannot be sustained.

There never was a balance between absorbed solar radiation and longwave radiation emitted to space. Earth’s radiation to space changes with the seasonally varying temperatures of the surface and atmosphere; this is according to well understood physics. The radiation forcing scheme that is the basis for including carbon dioxide in computer modelling leads to false outcomes.

The index of global and annual average temperature used by the IPCC is crude and hides the important regional and seasonal differences in the rate of warming as experienced over the recent 44 years. It is these regional and seasonal differences, together with well understood meteorological science, that point to slow variations of the ocean circulations being the cause of recent warming.

The recent warming is consistent with natural cyclical variations of the climate system. Attempts to halt the current warming by reducing atmospheric carbon dioxide concentrations will certainly fail. Government policies that are based on the alarming, but erroneous IPCC temperature projections are fraught.

**TABLE I. The near surface (2 metre) warming (oC/century) is not globally uniform but varies with latitude band.**

 *(Data from the NCEP database for the period 1979-2023)*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Latitude Band | 60N – 90N | 30N – 60N | 10N – 30N | 10S -10N | 30S -10S | 60S – 30S | 90S – 60S |
| Trend | 6.6 | 2.5 | 1.6 | 1.2 | 0.5 | 0.2 | 3.0 |

**TABLE II. The near surface (2 metre) warming (oC/century) over the Arctic (Lat.60N-90N) and Antarctic (Lat. 90S-60S) varies by season.**

*(Data from the NCEP database for the period 1979-2023)*

|  |  |
| --- | --- |
|  | SEASON |
| WINTER | SUMMER |
| ARCTIC | October – March8.1 | April - September4.2 |
| ANTARCTIC | April – September5.2 | October - March1.2 |

**TABLE 3. There is miniscule incremental increase in longwave radiation to warm the tropical oceans as carbon dioxide concentration increases.**

*(Calculations using the MODTRAN medium resolution radiation transfer model for the tropical atmosphere under clear sky conditions and with standard tropical temperature and water vapour profiles.)*

|  |  |
| --- | --- |
|  | Longwave radiation absorbed at the tropical surface (W/m2) from emission by water vapour and carbon dioxide |
| Carbon Dioxide Concentration (ppm) | 0 | 200 | 300 | 400 | 600 |
| Radiation absorption (W/m2) | 361.40 | 368.01 | 368.64 | 369.26 | 370.25 |
| Incremental Increase (W/m2) |  | 6.61 | 0.63 | 0.62 | 0.95 |

**Figure 1. Carbon dioxide concentration does not regulate Earth’s temperature because Global average near surface (2 metre) temperature has an annual cycle of about 3oC, significantly more than IPCC’s projected rise from a doubling of carbon dioxide concentration.**

*(Data from the NCEP database for the period 1979-2023)*

**Figure 2. Monthly temperature anomalies (oC) showing how the tropical lower atmosphere temperature responds to changing equatorial ocean surface temperature.**

*(Ocean data from the NCEP database; lower atmosphere satellite data from the University of Huntsville, Alabama)*

**Ocean Atmosphere**