An Electrical Theory of Stratosphere Temperature Distribution

Introduction

The thesis of this note is that not only is the greenhouse effect invalid, it is also proving itself obstructive to potentially useful science. One wonders how many Martian landers have been lost because the greenhouse model of the atmosphere was inadequate to predict the true pressure and density profiles. It is obstructive to gaining a grasp of the long standing mystery of the temperature of the Sun's corona, and why gravitational compression causes protostars to ignite.

These are merely some scientific objections, the economic and political fallout have been covered in detail elsewhere.

The greenhouse effect really needs to take its place alongside the four humours, phlogiston theory, miasma theory, the geocentric universe, canals on Mars, and all the other failed theories, which at the time held the consensus, in the dustbin of history, and quietly forgotten.

The author's background in aeronautics led to an initial confusion with the nomenclature used by climate scientists. The air in the region of the atmosphere above 25km is too thin for even the fastest aircraft to operate, so to a typical aerodynamicist, the 'stratosphere' is taken as the region above the troposphere, what in climate science is called the 'tropopause'. The 'tropopause' is taken as the boundary between the troposphere and the stratosphere. This confusion of terms indicates a lack of consultation of climate science with people who need to understand the atmosphere in order to design aircraft to fly in it.

Above 25km, the atmosphere is a fairly hard vacuum, and this is often referred to as the height where 'space' begins.

We shall use the climate science nomenclature in this note.

In this note we consider the temperature distribution in the upper stratosphere between 25 and 47 km, where the temperature gradient is positive. Current wisdom believes this to be caused by heating resulting from the decomposition of ozone. We examine that assertion, and deduce that it must be incorrect, for the same reason the greenhouse effect is invalid – it requires spontaneous generation of energy, arising from a fundamental confusion of power with energy.

An alternative theory is proposed, which is expected to find application to the upper atmospheres of the worlds in the Solar System, and also to explaining the long standing mystery of the high temperature of the Sun's corona.

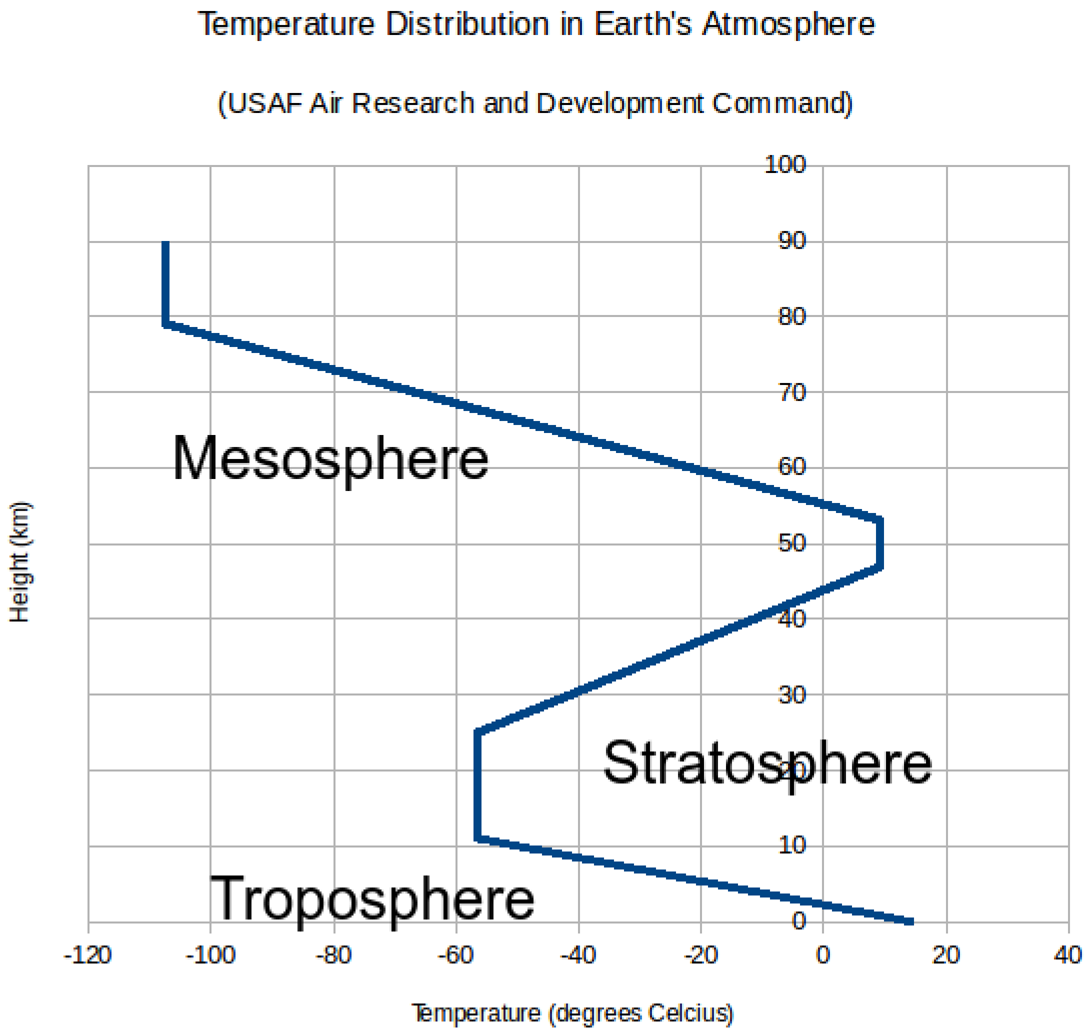
Initial Analysis

Since the temperature gradient is positive, we know that the atmosphere is stable under bouyancy forces, so we begin by assuming the gas remains in stratified layers which do not mix. It is difficult to see how CFCs, which allegedly will destroy the ozone layer, can reach this level, particularly as they are considerably denser than the atmospheric gases.

Indeed, the whole CFC hoax was based on the premise that ozone acts as a barrier to UV. That is incorrect. UV from the Sun converts oxygen to ozone, so we expect the ozone distribution over the globe to correspond to the irradiance, being least, if not actually non-existent, at the poles.

Ozone then decomposes back to oxygen, releasing the energy as heat. In effect, the ozone decomposition acts as a heat source between 25km and 47km in the ICAN standard atmosphere.

Our initial model of this region of the atmosphere is dominated by radiative heat transfer in which there is a heat source present.



We have shown elsewhere that the variation of irradiance with height is related to the temperature gradient via:

$$\frac{dq}{dz} = -\left(\frac{4\sigma\varepsilon}{(2-\varepsilon)}\right) T^3 \frac{dT}{dz}$$

where q is the irradiance, z the height, σ is the Stefan-Bolzmann constant, ε the emissivity and T the absolute temperature.

Empirical measurements indicate that the temerature gradient is substantially constant in this region. We shall denote it α.

We assume that the emissivity is proportional to the density which varies with height according to the polytropic relationship:

$$\rho=\rho_0\left(\frac{T}{T_0}\right)^{(n-1)}$$

where ρ is density and n is the polytropic index given by:

$$n=-\left(\frac{g}{\alpha R}\right)$$

where g is the gravitational acceleration and R the gas constant for the atmospheric gas. The subscript zero denotes the start of the region.

In order to render the equation readily tractable, it will be assumed that the emissivity is small compared with unity. So the equation reduces to:

$$\frac{dq}{dz}=-2\sigma\varepsilon_0\alpha T_0^3\left(\frac{T}{T_0}\right)^{(n+2)}$$

The temperature is calculated from the gradient:

$$T=T_0+\alpha z$$

The equation may now be integrated with respect to z:

$$q(z)=2\frac{\sigma\varepsilon_0 T_0^4}{(n+3)}\left(\frac{T}{T_0}\right)^{(n+3)}+c$$

where c is a constant.

Note that:

$$q_u=2\sigma\varepsilon_0 T_0^4$$

is the upwelling radiation from the tropopause layer below 25km.

This yields the value of the constant:

$$c=2\sigma\varepsilon_0 T_0^4\left(\frac{n+2}{n+3}\right)$$

From the ICAN standard atmosphere: T=282.5 K, T_0=216.5, α=3 K/km, so n=-11.4.

$q_u=250\varepsilon_0$

$c=1.12q_u$

$q(25)=q_u$

$q(47)=1.1q_u$

But this must be nonsense! The result indicates that at 47 km altitude the outwards radiative flux is ten per cent greater than its input value. But the input value is itself equal to the solar irradiance. Somehow the layer is generating an additional 10% irradiance from nothing!

An Electric Theory

We have fallen into the same trap as the protagonists of the greenhouse effect, and spuriously generated actual heat just from the emissivity of the gas. This arises because we incorrectly assume a direct relationship between power and temperature.

We are left with the conundrum of why there is a positive temperature gradient between 25km and 47km. Also, how are we to explain the very high temperature at 47km, when a simple radiation balance would yield the 216.5K of the tropopause?

A positive temperature gradient implies a stratified atmosphere under bouyancy forces. A negative temperature gradient is needed to promote circulation.

We suggest that in the near vacuum environment exposed to intense ultraviolet and shorter wavelengths significant quantities of the gas are ionised.

At a given temperature, we expect the internal energy to be equally partitioned between the heavy ions and the much lighter electrons. The consequence would be that the electron velocity would, on average, be much greater than the ions. The apogee height reached by a particle depends only on its velocity, so it seems electrons would be thrown higher than ions and an electric field would be set up, directed outwards.

We now have a similar situation to the troposphere, only inverted. Rather than gas moving in a gravitational field we have charged particles circulating in an electric field.

In the troposphere we don't stand a chance of solving the governing equations of fluid flow, adding plasmas and electric fields into the mix raises the difficulty stakes by at least an order of magnitude. So we must be satisfied with a thermodynamic approach.

The work done in moving a particle of charge e a distance z in an electric field E is:

$$W = eEz$$

If the charge density is δ, then the charge in volume v is

$$e = v\delta$$

The enthalpy is:

$$H = m C_p T$$

where m is the mass of the volume of interest, or:

$$m = \rho v$$

where ρ is density.

The adiabatic equation is now:

$$T = T_0 + \frac{e}{m}\frac{Ez}{C_p}$$

where e/m is the charge to mass of the particle. We expect the gravitational field still to be present, so, from the First Law of Thermodynamics, we expect the temperature distribution to be given by:

$$T = T_0 + \left(\frac{eE}{m} - g\right)\frac{z}{C_p}$$

We implicitly assume any water exists as a perfect gas under these conditions, so an arid atmosphere value of lapse rate applies.

Using $g \sim 10 ms^{-2}$, we have:

$$\frac{eE}{m} \approx 13\, ms^{-2}$$

Since this region is where ozone is formed, it is reasonable to assume that the dominant species is oxygen. The charge is expected to be twice that of the electron, i.e. $2\times1.6\times10^{-19}$ coulombs, the mass is 16×1840 times the mass of an electron (9.1×10^{-31} kg) so the charge to mass is about 12×10^{6} coulombs per kg. The electric field strength would be 1.1×10^{-6} Vm^{-1}.

If the lapse rate is indeed a consequence of a weak electric field, it follows that the matter in the stratosphere is actually circulating, and not to be found in unmixing layers as in the tropopause.

Radiative Equation Revisited

We speculate that radiative heating is not the root cause of the stratosphere temperature gradient, but given that it exists, we may now use the radiative equation to determine the increase in IR radiation arising from the down conversion of UV energy via the ozone reaction.

The difference between this and our original analysis is in the boundary conditions. We begin our integration from the top of the stratosphere and calculate the increment in apparent radiative flux as we descend from 47km to 25km.

The numerical result is the same, but the interpretation is that the additional 10% of apparent irradiance is the contibution of the ozone reaction to the tropopause radiation balance.

Energy cannot be created spontaneously, so this energy is removed from the incoming short wave irradiance to the surface.

Some of this short wave is reflected by clouds and the Earth’s surface, reducing the IR emission from the surface, but the IR from the ozone reaction is not affected by the albedo.

The net result is an increase in the tropopause irradiance above what would have been the case without the ozone reaction (214K rather than 216.5K).

The 10% figure from the radiative equation is close to the value obtained by considering the proportion of solar irradiance which lies in the UV range (wavelengths shorter than 0.35 microns).

Conclusions

We do not believe that the heat (power) generated by the decomposition of ozone has any relevance to the temperature distribution in the stratosphere, and have proposed an alternative theory based on establishing an electric field from the separation of electrons and positive ions in the gravitational field.

What has been presented here is pure conjecture, but it is a conjecture which is worth investigating empirically, as it may assist in advancing understanding of planetary atmospheres substantially. Indeed it might even provide the basis for a credible theory for the high temperature of the Sun's corona.

Unfortunately, as long as we adhere to the arrant nonsense of the greenhouse effect, such investigations will not take place, at least in Western Universities. The scientific academies of Russia, China and India, which have never showed much in the way of allegiance to the climate change hysteria, can probably be trusted to take these ideas further. We wish them luck.