

The Atmospherics of Climate Science

By Ross McLeod – 4 August 2012

Scope

The objective here is to compare the information presented by NASA in their [Planetary Fact Sheets](#) with calculations involving the Ideal Gas Law.

It is hereby acknowledged that there are problems with the Ideal Gas law versus real gases and mixtures.

An Ideal Gas obeys the Ideal Gas Law (General gas equation): $PV = nRT$

An Ideal Gas is modelled on the Kinetic Theory of Gases which has four basic postulates:

- Gases consist of small particles (molecules) which are in continuous random motion
- The volume of the molecules present is negligible compared to the total volume occupied by the gas
- Intermolecular forces are negligible
- Pressure is due to the gas molecules colliding with the walls of the container

Real Gases deviate from Ideal Gas Behaviour because:

- at low temperatures the gas molecules have less kinetic energy (move around less) so they do attract each other
- at high pressures the gas molecules are forced closer together so that the volume of the gas molecules becomes significant compared to the volume the gas occupies

The [Planetary Fact Sheets](#) and the relevant properties are summarised in the table below:-

Property	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Pressure (millibar)	92000 (Surface)	1014 (Surface)	6.9 – 9 Viking 1 Site	1000 (high in atmos.)			
Density (g/m ³)	65000 (Surface)	1217 (Surface)	20 (Surface)	160 (At 1 bar)	190 (At 1 bar)	420 (At 1 bar)	450 (At 1 bar)
Mean Molecular weight (g/mole)	43.45	28.97	43.34	2.22	2.07	2.64	2.53 – 2.69
Temperature (Kelvin)	737 K (Surface)	288 K (Surface)	210 K (Surface)	165 K (At 1 bar)	134 K (At 1 bar)	76 K (At 1 bar)	72 K (At 1 bar)
Diurnal temperature range – (K)	~ 0 K	283 – 293 K	184 – 242 K	?	?	?	?
Solar Irradiance W/m ²	2613.9	1367.6	589.2	50.50	14.90	3.71	1.51
Black Body Temperature	184.2 K	254.3 K	210.1 K	110.0 K	81.1 K	58.2 K	46.6 K

Detailed analysis

In this demonstration, we'll compare simple calculations based on the Ideal Gas Law and the information contained in the Planetary Fact Sheets. We'll also consider why NASA – a strong advocate for the “greenhouse effect” – makes no attempt to explain these properties in terms of the so-called “settled science”.

Venus

$$PV = nRT$$

$$92000 \text{ (mb)} \times 1000 \text{ (litre/ m}^3\text{)} = 65000 \text{ (g/ m}^3\text{)} / 43.45 \text{ (g/mole)} \times 0.082 \times T$$

$$T = 92000 / (0.082 \times 65000 / 43.45) = \sim 750 \text{ K}$$

Isn't it simply amazing that $PV = nRT$ and the average temperature coincide so well while the blackbody temperature misses by a wide margin!

Earth

$$PV = nRT$$

$$1014 \text{ (mb)} \times 1000 \text{ (litre/ m}^3\text{)} = 1217 \text{ (g/ m}^3\text{)} / 28.97 \text{ (g/mole)} \times 0.082 \times T$$

$$T = 1014 / (0.082 \times 1217 / 28.97) = \sim 294 \text{ K}$$

Isn't it simply amazing that $PV = nRT$ and the measured Diurnal temperature range and the average temperature coincide so well while the blackbody temperature misses by a wide margin!

Mars

$$PV = nRT$$

Because the Martian atmosphere is so slight we use 2 calculations – the minimum and maximum measured at the Viking Lander Site to demonstrate something significant.

$$6.9 \text{ (mb)} \times 1000 \text{ (litre/ m}^3\text{)} = 20 \text{ (g/ m}^3\text{)} / 43.34 \text{ (g/mole)} \times 0.082 \times T$$

$$T = 6.9 / (0.082 \times 20 / 43.34) = \sim 182 \text{ K; or,}$$

$$T = 9 / (0.082 \times 20 / 43.34) = \sim 238 \text{ K}$$

Isn't it simply amazing that $PV = nRT$ and the measured Diurnal temperature range and the average temperature coincide so well.

Only Mars has a blackbody temperature calculation close to the actual “average” atmospheric temperature.

Jupiter

$$PV = nRT$$

$$1000 \text{ (mb)} \times 1000 \text{ (litre/ m}^3\text{)} = 160 \text{ (g/ m}^3\text{)} / 2.22 \text{ (g/mole)} \times 0.082 \times T$$

$$T = 1000 / (0.082 \times 160 / 2.22) = \sim 169 \text{ K}$$

There is absolutely no “greenhouse effect” on Jupiter by any **rational** definition.

Isn't it simply amazing that $PV = nRT$ gives a very accurate estimate of the temperature at 1 bar pressure while the blackbody temperature misses by a wide margin!

Saturn

$$PV = nRT$$

$$1000 \text{ (mb)} \times 1000 \text{ (litre/ m}^3\text{)} = 190 \text{ (g/ m}^3\text{)} / 2.22 \text{ (g/mole)} \times 0.082 \times T$$

$$T = 1000 / (0.082 \times 190 / 2.07) = \sim 133 \text{ K}$$

There is absolutely no “greenhouse effect” on Saturn by any **rational** definition.

Isn't it simply amazing that $PV = nRT$ gives a very accurate estimate of the temperature at 1 bar pressure while the blackbody temperature misses by a wide margin!

Uranus

$$PV = nRT$$

$$1000 \text{ (mb)} \times 1000 \text{ (litre/ m}^3\text{)} = 420 \text{ (g/ m}^3\text{)} / 2.64 \text{ (g/mole)} \times 0.082 \times T$$

$$T = 1000 / (0.082 \times 420 / 2.64) = \sim 77 \text{ K}$$

There is absolutely no “greenhouse effect” on Uranus by any **rational** definition.

Isn't it simply amazing that $PV = nRT$ gives a very accurate estimate of the temperature at 1 bar pressure while the blackbody temperature misses by a wide margin!

Neptune

$$PV = nRT$$

$$1000 \text{ (mb)} \times 1000 \text{ (litre/ m}^3\text{)} = 450 \text{ (g/ m}^3\text{)} / 2.69 \text{ (g/mole)} \times 0.082 \times T$$

$$T = 1000 / (0.082 \times 450 / 2.69) = \sim 73 \text{ K}$$

There is absolutely no “greenhouse effect” on Saturn by any **rational** definition.

Isn't it simply amazing that $PV = nRT$ gives a very accurate estimate of the temperature at 1 bar pressure while the blackbody temperature misses by a wide margin!

Settled science vs scepticism

Prolonged exposure to climate “science”, as proclaimed by institutions we should be able to have faith in, has lead me to believe that the majority of the information dispensed by those proponents of climate “science” is simply not credible!

For example, the alleged font of all knowledge Climate – [SkepticalScience](#) – once lampooned anyone for claiming the Ideal Gas Laws could be used to explain their beloved “greenhouse effect” on Venus.

Here is that proposed claim for their beloved “greenhouse effect” on Venus:-

http://web.atmos.ucla.edu/~liougst/Lecture/Lecture_3.pdf

The claim is a permanent output of 16,728 Watts per square metre from a permanent input of 132 Watts per square metre.

This is presented as believable science whilst $PV = nRT$ is branded as nonsense?

So the question to ask then is: “Are NASA’s Planetary Fact Sheets little more than calculations using the Ideal Gas Equation?”

If so, as it certainly appears to be, is NASA acknowledging that this is a more satisfactory explanation for planetary temperatures than any “greenhouse effect” hypothesis?

By any legal definition this analysis and discussion appears to establish a “prima-facie” case.

Just where are the “greenhouse gas” calculations anyway?

Conclusion

Based on verified empirical observations we know that the outer “gas giant” planets receive insignificant solar irradiance whilst it is universally acknowledged that deep within their atmospheres the temperatures approach (exceed?) the surface temperature of the Sun.

How is this possible if $PV = nRT$ is slated as nonsense?

As the pressure of a gas increases, in a constant volume process, the temperature has to increase – real science says so.

Acknowledgements for Inspiration

- ✓ "[Rethinking the greenhouse effect](#)" by Alan Siddons
- ✓ "[Albert the engineer](#)" for his blog post on "[Real Science](#)" website.

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