A Standard Atmospheric Model with constant lapse rates for Titan

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Equations relating to this study

1. Lapse rate

$$a = \frac{\Delta T}{\Delta h} \qquad \text{Eq. 1}$$

2. Temperature at a desired altitude

$$T = T_1 + a(h - h_1) \qquad \text{Eq. 2}$$

Here, T_1 is a known temperature; h_1 is the altitude where T_1 is measured; h is the altitude in which temperature should be determined and a is the lapse rate.
For instance, if the lapse rate is -0.0006119 K/m and the temperature at 0m is 93.51K, then, temperature at an altitude of 10000m is given by

$$T = 93.51 + (-0.0006119)(10000 - 0)$$
$$T = 87.391K$$

3. Pressure at a desired altitude

$$\frac{P}{P_1} = \left(\frac{T}{T_1}\right)^{-g_0/aR} \qquad \text{Eq. 3}$$

Here, T_1 is a known temperature; P_1 is the altitude where T_1 is measured; T is the determined from Eq.2.; a is the lapse rate; R is the specific gas constant (= 295.8391 J/kg-K) and g_0 is the gravitation due to gravity (=1.375 m/s^2).

4. Density at a desired altitude

$$\frac{\rho}{\rho_1} = \left(\frac{T}{T_1}\right)^{-[g_0/aR+1]} \qquad \text{Eq. 4}$$

Here, T_1 is a known temperature; ρ_1 is the altitude where T_1 is measured; T is the determined from Eq.2. and a is the lapse rate.

Constants and values at ground level (0 m altitude)

1. Specific gas constant	$R = 295.8391$ J/kgK
2. Acceleration due to gravity	$g_0 = 1.375$ m/s^2
3. Temperature at ground level	$T_0 = 96.6004$ m/s^2
4. Pressure at ground level	$P_0 = 146645$ Pa
5. Density at ground level	$\rho_0 = 5.3446$ kg/m^3

Figures obtained from the Python code