第 1 次作业

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摘 要：摘要.
关键词：关键词 1，关键词 2

Homework 1

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Abstract: Abstract.
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1 Question 1

"If you are standing atop Mount Everest at 8848 m, about what fraction of mass of the atmosphere is below you? (Use eq. (1.6).)"(Hartmann, 2016, p. 23)

1.1 Solution

About

$$1-\mathrm{e}^{-\frac{z}{H}} \approx 1-\mathrm{e}^{-\frac{8848}{7600}} \approx 68.8\%$$

of mass of the atmosphere is below me, according to eq. (1.6) (Hartmann, 2016, p. 10).

2 Question 2

"Compute the difference of saturation vapor pressure between 0°C and 30°C. Compare the results you get with eqs (1.10) and (1.11)."(Hartmann, 2016, p. 23)

2.1 Solution

Using eq. (1.10) (Hartmann, 2016, p. 12), the difference of saturation vapor pressure between 0°C and 30°C is

$$\frac{\Delta e_{\mathrm{s}}}{e_{\mathrm{s}}} := \frac{e_{\mathrm{s2}}-e_{\mathrm{s1}}}{e_{\mathrm{s1}}} \approx \frac{L}{R_{\mathrm{v}}T}\frac{\Delta T}{T} \approx \frac{2.26\times 10^6}{462\times 273}\times\frac{30}{273} = 196.9\%,$$

while this value becomes

$$\frac{\Delta e_{\mathrm{s}}}{e_{\mathrm{s}}} \approx \exp\left(\frac{L}{R_{\mathrm{v}}}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)\right)-1 = \exp\left(\frac{2.26\times 10^6}{462}\left(\frac{1}{273}-\frac{1}{303}\right)\right)-1 = 489.5\%$$

using eq. (1.11) (Hartmann, 2016, p. 13).

As can be seen from the calculations above, eq. (1.10) underestimates the difference, because the second derivative of saturated vapor pressure with temperature is positive (Hartmann, 2016, p. 13, Fig.1.9).

References

Hartmann, D. L. (2016). Chapter 1 - Introduction to the Climate System. In D. L. Hartmann (Ed.), *Global Physical Climatology (Second Edition)* (pp. 1-23). Elsevier. https://doi.org/10.1016/B978-0-12-328531-7.00001-3