第2次作业

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摘要：第二章作业.

关键词：关键词1，关键词2

Homework 2

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**Abstract****:** Selected exercises for chapter 2.

**Keywords:** keyword 1, keyword 2

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# Question 1

“Calculate the emission temperature of Earth if the solar [luminosity](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/luminosity) is 30% less, as it is hypothesized to have been early in solar system history. Use today’s [albedo](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/albedo) and Earth-Sun distance.”([Hartmann, 2016, p. 48](#_ENREF_1))

## Solution

Using Eq. (2.10), the emission temperature of Earth

# Question 2

“Using the data in [Fig. 2.4](https://www.sciencedirect.com/science/article/pii/B9780123285317000025?via%3Dihub#f0025), estimate the blackbody temperature of Earth’s surface and the blackbody temperature of the atmosphere as viewed from Earth’s surface. How well do these temperatures agree with the temperatures derived from the model shown in [Fig. 2.3](https://www.sciencedirect.com/science/article/pii/B9780123285317000025?via%3Dihub#f0020)?” ([Hartmann, 2016, p. 48](#_ENREF_1))

## Solution

Applying the Stefan–Boltzmann law, the blackbody temperature of Earth’s surface is

and the blackbody temperature of the atmosphere as viewed from Earth’s surface is

In the model shown in [Fig. 2.3](https://www.sciencedirect.com/science/article/pii/B9780123285317000025?via%3Dihub#f0020), we obtained

from Eq. (2.13) and (2.14).

We see that but , i.e. compared to the observed global mean surface or atmosphere temperature (equivalent black body radiation temperature), the atmosphere temperature in the model shown in [Fig. 2.3](https://www.sciencedirect.com/science/article/pii/B9780123285317000025?via%3Dihub#f0020) is higher. However, the surface temperature in the model shown in [Fig. 2.3](https://www.sciencedirect.com/science/article/pii/B9780123285317000025?via%3Dihub#f0020) is lower than the observed temperature.

“This is because we have not taken into account the vertical transport of energy by [atmospheric motions](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/atmospheric-motion).” ([Hartmann, 2016, p. 33](#_ENREF_1))

References

Hartmann, D. L. (2016). Chapter 2 - The Global Energy Balance. In D. L. Hartmann (Ed.), *Global Physical Climatology (Second Edition)* (pp. 25-48). Elsevier. <https://doi.org/10.1016/B978-0-12-328531-7.00002-5>