第4次作业

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Homework 4

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# Question 1

If the top 100 m of ocean warms by 5°C during a 3-month summer period, what is the average rate of net energy flow into the ocean during this period in units of W m−2? If the atmosphere warms by 20°C during the same period, what is the average rate of net energy flow into the atmosphere? ([Hartmann, 2016, p. 129](#_ENREF_1))

## Solution

If the top 100 m of ocean warms by 5°C during a 3-month summer period, the average rate of net energy flow into the ocean during this period is

If the atmosphere warms by 20°C during the same period, the average rate of net energy flow into the atmosphere is

# Question 2

The blackbody emission from the surface can be linearized about some reference temperature *T*0.. And the sensible cooling of the surface can be written as . Calculate and compare the rates at which longwave emission and sensible heat flux vary with surface temperature, *T*s. In other words, if the surface temperature rises by 1°C, by how much will the longwave and sensible cooling increase? Assume that *T*0 = 288 K, *T*a is fixed, *ρ* = 1.2 kg m−3, *c*p = 1004 J kg−1 K−1, *C*D = 2 × 10−3, and *U* = 5 m s−1. ([Hartmann, 2016, p. 129](#_ENREF_1))

## Solution

We have

and

So, if the surface temperature rises by 1°C, the longwave and sensible cooling will increase by

and

respectively.

References

Hartmann, D. L. (2016). Chapter 4 - The Energy Balance of the Surface. In D. L. Hartmann (Ed.), *Global Physical Climatology (Second Edition)* (pp. 95-130). Elsevier. <https://doi.org/10.1016/B978-0-12-328531-7.00004-9>