

Energy-Balance and Layer Models

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Solutions:

- Chapter 2–3 Homework Solutions

Homework

Homework Exercises:

- *Forecast*, Ch. 2, Exercises 1, 2, 4, 5, & 7
- *Forecast*, Ch. 3, Exercises 2 & 3.

Notes on Homework:

There is a typo in the book. In Ch. 2, Ex. 2, in the part about corn oil. A dietary Calorie is 4200 Joules, not 4.2 Joules.

To solve layer models, remember these principles:

1. Start at the boundary to space and set $I_{\text{out}} = I_{\text{in}}$
2. Use the value of I_{out} to calculate the temperature of the top layer of the atmosphere
3. Calculate the heat emitted from the top layer of the atmosphere going up and down.
4. List all the sources of heat absorbed by and emitted by the top layer. When shortwave light goes through a transparent atmosphere (for example, the shortwave sunlight going through the atmosphere to the ground in the one-layer model), you don't count that as emitted or absorbed, but you do count all the light that gets emitted or absorbed. After step 3, you will typically know all of these but one. Use the principle of energy balance (total heat out = total heat in) to calculate the unknown heat flow.
5. Calculate the temperature of the next layer down and use that to calculate all of the heat flows out of that layer. (this is like steps 2 and 3, but for the next layer down)
6. Repeat these steps one layer at a time until you get to the ground.

For Ch. 3, exercise 3, the big difference to the one-layer model in the book is that the shortwave sunlight is absorbed by the atmosphere and doesn't reach the ground.