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| **EARTH AND SPACE SCIENCE**  **431** *PRINCIPLES OF GLACIOLOGY*  **505** *THE CRYOSPHERE* | **Autumn 2018**  4 Credits, SLN 14855  4 Credits, SLN 14871 |
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| **Homework Week 9 – Sea Ice** | |

This exercise addresses questions associated with the annual cycle of growth and decay for multiyear sea ice in the Arctic.

Ice mass-balance buoys have been deployed in sea ice at various locations throughout the Arctic since 1993. These buoys are autonomous measuring stations that record the height of the ice surface both above and below a reference level (the top ice surface is typically assigned the position of 0 cm on the measuring stick), temperature profiles of the ice, surface air temperature, and atmospheric pressure. A datalogger records the data and the buoy transmits it *via* ARGOS satellite. The buoys drift with the ice and collect data for as long as their batteries function, or until they melt out and sink, sometimes a couple of months, sometimes a couple of years.

Ice mass-balance buoy data can be found at <http://imb-crrel-dartmouth.org/results/>. The questions below refer to sea ice temperature and mass-balance records for buoy 2006C. This buoy was especially long-lived, recording ice mass balance for 3 years!

Use the graphical displays provided (page 3) and data at the website to answer the following:

1. [2 points] What are the initial date, location, ice type, ice thickness, and ice and air temperatures for buoy 2006C at the time of its installation?
2. [2 points] Describe the first two annual cycles (2006-2007 and 2007-2008) observed in terms of the approximate dates and thickness of: ice growth, surface ice melt, and bottom ice melt.
3. [2 points] Describe the amount and timing (accumulation and melt) of the snow cover on the ice.
4. [2 points] Estimate average ice growth rates over both growing seasons (cm/day).
5. [1 point] Compare these two ice growth rates. Suggest reasons for their difference.
6. [2 points] Estimate average ice surface ablation rates over both melt seasons (cm/day)
7. [1 point] What factors control surface ablation rates?
8. [2 points] Estimate average ice bottom ablation rates for both melt seasons (cm/day)
9. [1 point] What factors control the bottom ablation rates? The bottom ablation for 2007 appears to be extremely large; speculate what factors could be responsible.
10. [2 points] How would you estimate the total amount of heat required for ice bottom melt over the duration of a melt season (per square meter horizontal area)?
11. [4 points] Estimate this total heat for the bottom ice melt at buoy 2006C for the 2007 and 2008 melt seasons
12. [2 points] If you did not know the thermal conductivity for sea ice how could you estimate it from the buoy data?
13. [2 points] Estimate the thermal conductivityfor the ice at buoy 2006C. Does your estimate seem higher or lower than what you expected? What are the limitations of this estimate?

