

## SIO 115 Homework 5 (due Friday 14 February): Sea-ice

You will be graded on your writing style as well as the content of your answer. The marks for each answer are in parentheses. For questions that ask you to draw sketches, you may hand-draw this and add it as an image/figure to the PDF you submit. When submitting homework, please stick to the naming convention

**SIO115\_Hw04\_Lastname\_Firstname.pdf**. Please email your answers to [parndt@ucsd.edu](mailto:parndt@ucsd.edu) with subject line **SIO115 Homework 4 Lastname Firstname** by the appropriate deadline.

**1 a)** What is the “albedo” of a material? [1]

**(b)** Give the typical albedos of sea-ice, fresh snow, ice and the open ocean. [2]

**(c)** Explain the “ice-albedo feedback”; is it a negative or positive feedback? Draw a sketch to show how this feedback works. [3]

**2 a)** What is the main type of remote sensing instrument used to measure the following parameters:

(i) sea-ice extent;

(ii) sea-ice thickness.

In each case, give two examples of such instruments that have been flown on satellites [6]

**(b)** Draw a schematic diagram of a cross-section through a typical sea-ice floe showing the following parameters:

- approx. diameter of floe
- approx. thickness of sea-ice
- ice freeboard
- ice draft
- ice free ocean surface

You do **not** need to show the snow/saline ice/congelation ice layers [5].

**3 a)** Go to [http://nsidc.org/cgi-bin/bist/bist.pl?config=seaice\\_extent\\_trends](http://nsidc.org/cgi-bin/bist/bist.pl?config=seaice_extent_trends) and create two graphs showing the Arctic sea ice extent trend for March and September. Insert these graphs in your homework solutions, and discuss the main long-term trends. [4]

**(b)** By how much did the sea ice extent decline in March & September between 1979 and 2019? [2]

**(c)** Estimate how much this change in sea-ice extent has affected Earth’s surface albedo. (Assume: (i) sea-ice albedo is 0.75; (ii) Earth is a sphere with radius of Earth is 6378 km; (iii) Earth is 70% ocean (including the Arctic Ocean) and 30% land with average albedo 0.2; (iv) that the albedo of everything else in the Earth system has remained unchanged). [4]

**(d)** In reality, what other parts of the Earth system do you need to consider in calculating how much sunlight is reflected back into space? [2]

**(e)** Why does changing sea-ice extent not significantly affect Earth’s energy balance in the winter? [2]