

SIO 115 Homework 5 (due Friday 17 February): Sea-ice

Please write your answers on a separate sheet with your name clearly written at the top. You will be graded on your writing style as well as the content of your answer. Please write neatly.

1 a) In this photograph taken in Antarctica there are three distinct types of ice. (i) What are they? [3]

(ii) State briefly each ice type is formed. [3]

(b) One of these types of ice is typically measured by “concentration”.

(i) Which one is it? [1]

(ii) What is the approximate concentration of that ice type in this photograph? [1]



2 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]

3 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].

4 a) Go to http://nsidc.org/cgi-bin/bist/bist.pl?config=seaice_extent_trends and create two graphs showing the Arctic sea ice extent trend for August and September. Insert these graphs in your homework solutions, and discuss the main long-term trend. [2]

(b) By how much did the extent of September sea-ice decline between 1979 and 2012? [1]

(c) By how much has this change in sea-ice extent 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? [1]