

# Effect of ice and snow in the climate system

*In this worksheet, the components of the climate system (in this case: ice and snow) and their impacts on temperature are examined.*

In order to investigate the effect of ice and snow in the climate system, all components are switched ON in experiment A (left side) while in experiment B (right side), ice and snow are switched OFF with the remaining components switched ON. The difference between A and B can be seen in the difference map in the lower center. There, the global effect of ice and snow is given in the title and the map shows the regional impacts.

## Exercises:

(Advice: The figures and the articles listed below help to solve the exercises.)

### Global mean effect of ice and snow

1. Determine the global mean effect of ice and snow.
  - a. The temperature change in Northern winter (January) is: .....°C.
  - b. The temperature change in Northern summer (July) is: .....°C.
  
2. Do ice and snow have a cooling or a warming effect on climate? Explain, why (see figure 2):  
 .....  
 .....  
 .....

### Regional effects of ice and snow

Determine and compare the regional effects of ice and snow. Enter the temperature change of the particular region as an approximate value in the middle column, e.g. -2 °C to -3 °C. Describe the temperature change in words (e.g. slight/ strong cooling/ warming) in the right column and compare your observations with other regions (e.g. 1 and 2, 3 and 4, 5 and 6).

	Region	Temperature change in °C	Temperature change in words and comparison of the regions 1-2, 3-4, 5-6
<b>N-Winter (Set the MSCM to January!)</b>			
(1)	North America, North Asia		
(2)	North Atlantic, North Pacific		
(3)	Western North America, Europe		

(4)	Eastern North America and Asia as well as the adjacent part of the ocean		
<b>Set the MSCM according to the month listed in the column 'region'!</b>			
(5)	Antarctica in Southern hemisphere summer ( <b>January</b> )		
(6)	Arctic Ocean in Northern hemisphere summer ( <b>July</b> )		

### Explanations:

Find explanations for your observations on the effect of ice and snow on the temperature! The figures as well as the articles listed below will help you find the solutions. Explain...

- a. ... the difference between continents and oceans (row (1) and (2))!
- b. ... the difference between the global mean in January and July (exercise 1.1 and 1.2)!
- c. ... the effect on the Western parts of the continents in the Northern Hemisphere mid-latitudes as well as the Eastern parts of these continents and the adjacent oceans (row (3) and row (4))!
- d. ... the particular effect on the Arctic Ocean during Northern Hemisphere summer (row (6))!

## Useful figures



Figure 1: Source: NASA

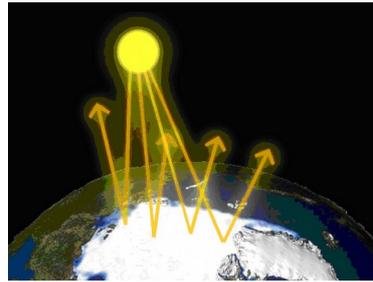


Figure 2: Source: Dirk Notz, MPI-M

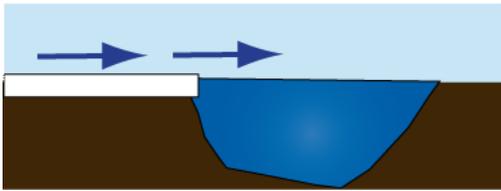


Figure 3: Source: Dieter Kasang

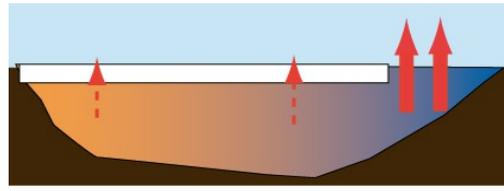


Figure 4: Source: Dieter Kasang

## Helpful articles to work on the exercises:

<a href="#"><u>Sea ice</u></a>	<a href="#"><u>Ice-albedo feedback</u></a>
<a href="#"><u>Cryosphere in the climate system</u></a>	