Arctic-Arc

WHAT DOES 'ICE DRIFT' MEAN ?

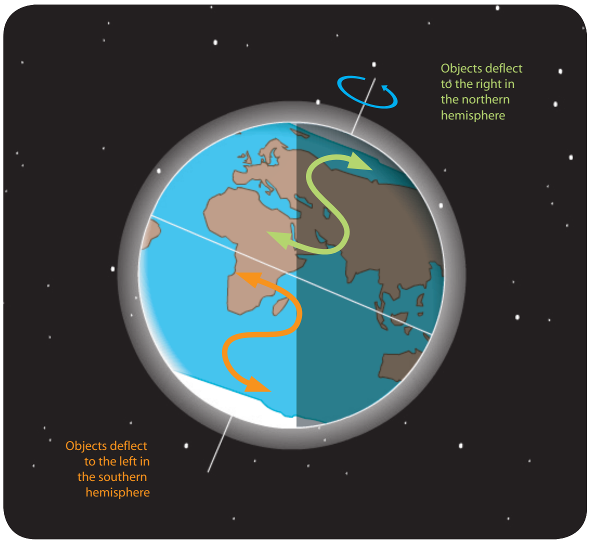
The sea ice that covers the Arctic Ocean does not stay in the same place, even in the middle of the ocean where there is ice at all times throughout the year. In fact, propelled by the combined action of the winds and currents, the ice can move up to speeds covering several kilometres a day! This movement is called "ice drift".

Reasons the ice movess

The main reason for sea ice to drift is the wind. In the Arctic, there is a permanent anticyclone. This anticyclone generates prevailing winds that control the three main "currents" of the drift ice in this region.
However, because the Earth rotates, the ice does not follow the exact direction of the wind: the direction in which the ice flows is diverted 20° to 40° to the right by the Coriolis Effect.

A few words on the Coriolis Effect

Don't believe everything you've heard concerning the Coriolis Effect. If you've heard that the water draining down your sink or toilet turns one way when you're in the northern hemisphere and the other way when you're in the southern hemisphere, don't believe it. The Coriolis Effect turns out to be important only at our Earth's scale, influencing our winds and cyclones, our ocean currents but, also, projectile, airplane and bird trajectories.
Gaspard Coriolis discovered at the beginning of the nineteenth century that any gravitational body moving across a rotating object undergoes a sideways pull, perpendicular to the speed of movement. This fictitious force from which originates the Coriolis Effect, draws the original movement to the right in the northern hemisphere and to left in the southern hemisphere. This effect is strongest between the equator and the two tropics while, closer to the poles, it becomes weaker and weaker.



The three main currents of the drift ice in the Arctic

- The first current of the Arctic ice drift, called the Beaufort Gyre, is a clockwise rotating movement in the Beaufort Sea. It takes between 3 and 5 years for a particle of ice to do a complete circuit.
- The second is called the Transpolar Drift and carries ice from the Siberian coast (Russia) to the east coast of Greenland via the North Pole. The ice takes 3 years to go from one point to the other and is then discharged into the Atlantic.
- The third current, less important than the first two and which only flows during the wintertime, carries ice from the east coast around the southern tip of Greenland, then up the west coast.

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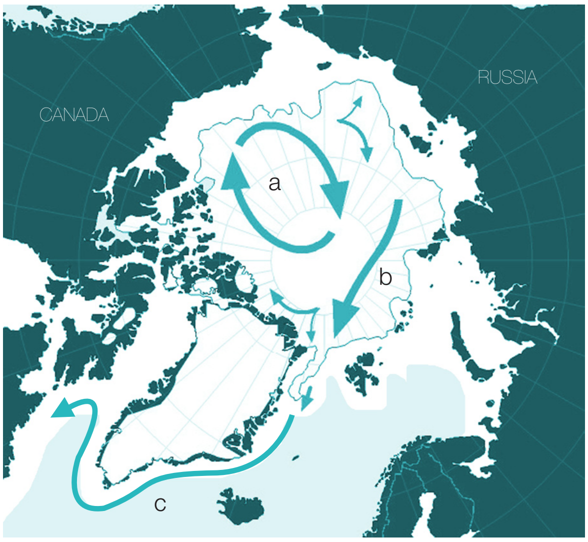
This one is called the Greenland Current.
« Les océans Arctique et Austral »,

a. Beaufort Gyre
b. Transpolar Drift
c. current around Greenland

SUMMER

WINTER



In 1895, the Norwegian Fridtjof Nansen completed the first "Arctic drift". He voluntarily allowed his ship, the Fram, to be caught in the sea ice north of Russia. The crew spent 3 long Arctic winters on their ship before it was finally released from the ice just north of Norway, thereby demonstrating the existence of the Transpolar Drift. winters on their ship before it was finally released from the ice just north of Norway, thereby demonstrating the existence of the Transpolar Drift.
Today's Arctic explorers are well aware of these ice drift currents. In fact, depending on the route they decide to take, the movement of the ice can actually help them to progress more quickly (as though they were on a conveyor belt). Of course, the ice drift can make their task much more difficult and explorers going in the "opposite direction" of the drift can find themselves going backwards several kilometres during the night while they are asleep.

How do we measure ice drift?

The most accurate way to measure an ice drift is to place a transmission beacon on the ice. The position of the beacon can be tracked very accurately by satellite. This method is also used to follow the course taken by ocean currents. However, while this technique may provide very accurate information, the information is by essence only used punctually because the number of beacons around is still rather low.
Although the data provided is less accurate, satellites allow, on the other hand, an overall perspective. In fact, some satellites enable you to even measure the thickness of the ice as well as distinguish the newer from the older ice. The overall ice movement can then be assessed by comparing images obtained over a number of consecutive days, as is the case on the map below. Satellite data and ground readings are therefore complementary to one another.

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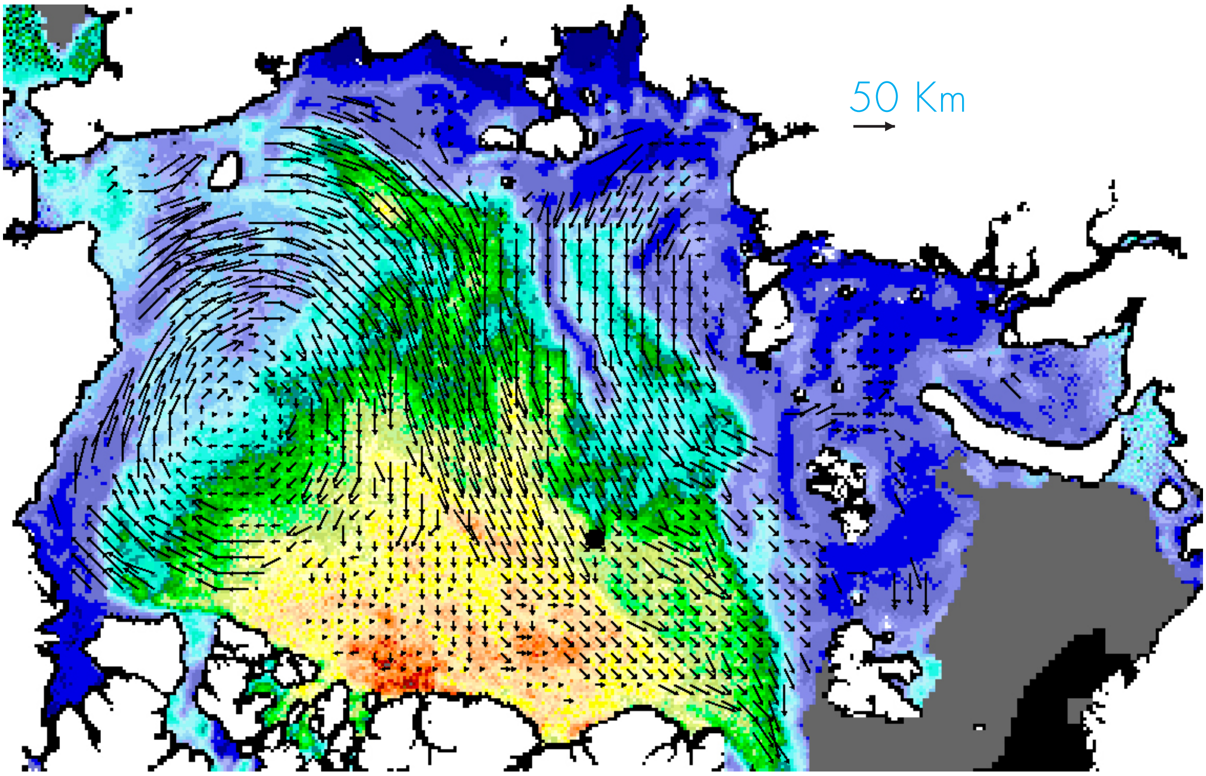
Picture of how sea ice drifts, taken over 3 days, from 30th April to 3rd May 2002.
This data was obtained from CERSAT, at the IFREMER marine research institute at Plouzané (France)



Arrows : indicate the direction and speed of the ice movement

Violet : new ice for that year

Blue to red : (and green and yellow): ice dating from previous years

Grey : eau libre

Black : areas for which there is no data.

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Proposed activity to be carried out in class

Equipment :

- a playing piece or board game pawn
- several sheets of paper
- a watch with stopwatch function

Preparation :

Stick the sheets of paper together to make one long strip of paper (using sticky tape, for example).

Place the strip of paper flat on one or two desks. Place the board game piece at one end of the paper, on the desk.

Activity :

The piece represents an explorer seeking to cross the Arctic Ocean. The teacher will make it move in the way described below. During this experiment, a pupil will be asked to pull on the strip of paper at an even rate so that it passes at a slow and constant speed under the explorer's feet. This represents ice drift. A second pupil will have the job of keeping an eye on the stopwatch, as indicated below.

Explain to the children that the explorer will be going "against the current" of the drift (represented by the strip of paper that will move at a slow and constant speed under his feet). However, the explorer will not be able to make regular, steady progress because he has to sleep from time to time. For the purpose of this exercise, we will say that he can walk for 4 seconds and then rest for 3 seconds. The rhythm at which the explorer progresses and rests is indicated by the pupil with the stopwatch and monitored by the teacher, who will then leave the game board piece stationary for 3 seconds on the "ice", which is moving backwards.

Before starting, each pupil can try and guess how much time the explorer will need to reach the other side of the ocean (represented by the other side of the desk).

Important: The strip of paper should move slowly and steadily so that it is not fully unrolled before the explorer reaches the other side of the desk.

As a second part of the exercise, conduct the experiment again, this time with the explorer going in the same direction as the ice drift. The time difference required to make the crossing is quite amazing.

Additional suggestion :

Find out more about the routes taken by expeditions that have crossed the Arctic Ocean on foot (for example Alain Hubert on the Arctic Arc expedition) and try to work out whether they went against the direction of the drift ice or in the same direction.
You will see that most explorers plan their expeditions such that the ice drift works with them, not against them.