

Subject: Scholes cabin 5: The ice

18 December 2009 04:45 UTM 57.5935 S 2.6897

Dear Stirling,

We saw our first iceberg about an hour ago, a big craggy one several kilometres to the port, looking blue and evil in the early morning fog. The big ones show up clearly on the radar, so they are easy to avoid. The water is also full of small ones, called 'growlers' that only stick up about a meter above the waves. We have a lookout on the bridge at all times to steer us through them. Obviously us Antarctic newbies are excited, but the captain has mixed feelings. It is his job to steer us safely through the thick barrier of pack ice that guards the continent. We expected to see 'bergs' a day ago already, and the fact that we did not means that the ice is still quite solid.

You will see from our coordinates that we are now east of 0 degrees. Normally the Agulhas aims for a crack, called a *polyna*, that opens up close to the Greenwich line. Every day we receive satellite images of the ice, prepared by the University of Bremen from radar data that can see through clouds. There is no crack on 0 degrees yet, but there is a broad *polyna* to our east, so we are heading for that. The actual bay where we plan to unload the stores for SANAE IV is still choked with ice too thick for the Agulhas to break through. We can only push through ice up to about 300 mm thick.

The sea surface temperature is -0.6 C, which is below the freezing point of pure water - but the sea is salty, which lowers its freezing point. Remember the experiments Charlie showed you with supercooled water? In winter the sea does get cold enough to freeze (actually, the sea ice is fresh water, because the salt gets excluded by the freezing process), and a skirt of 'pack ice' extends nearly all the way to Bouvet Island, about 55 S. In summer it retreats but never completely goes away. The ice barrier gets torn apart by winds and the powerful circumpolar currents, causing big gaps to open up between the ice and the land, allowing ships to sail through.

The pack ice (which is sea ice) is different from the ice shelf, which is attached to the Antarctica landmass, although it is usually floating. The ice shelf results from snowfall, not frozen seawater. It is like an ice cliff towering above the ship, so it must be hundreds of meters deep below water level. Ice shelves are important because of climate change and sea level rise. Since they are floating, or only just grounded, they are quite unstable, and big chunks can break away. That is one of the main sources of icebergs - the other is glaciers that end in the sea. A huge piece of the Ross Ice Shelf - nearly the size of Gauteng province - broke off a decade ago, and a bit of that is currently blocking the entrance to our normal unloading spot, after drifting halfway round Antarctica.

Pieces of ice shelf breaking free does not cause the sea level to rise (they are already floating, after all), but may act as the cork coming out of the bottle, allowing dammed-up ice on the continent itself to flow down to the sea. If all the ice in Antarctica were to melt, the oceans would rise by 150 m!

Antarctica has been ice free in summer in the distant past (hundreds of millions of years ago, in the time of dinosaurs). The amount of ice at the poles is a powerful feedback mechanism on the Earth's climate. Snow and ice are bright, and reflect the sun's energy back into space. Seawater and rocks, on the other hand, are dark and absorb sunlight. So if the Earth cools a bit, more ice forms, and that causes the Earth to cool some more.

The opposite is true if the earth warms a bit. The ice caps act as amplifiers of the change. This is called a positive feedback loop. The polar ice feedback may be one of the main ones responsible for the flip-flopping of the Earth between ice ages and warmer periods over the last four million years.

Agulhas used to unload onto the ice shelf closest to SANAE IV, but still more than a hundred kilometres away from the base. To get the heavy cargo off there they had to use bulldozers to cut a steep ramp into the ice down to the level where the ship cranes could reach. That was really dangerous - the ice shelf is always shedding icebergs, and working with a heavy bulldozer on an icy ramp right next to a cliff above the sea is risky. So this time we plan to unload onto thinner bay ice (only a few metres thick, but still strong enough to support a caterpillar tractor) at the old German base of *Neumayer II*, at a place called *Akta bukta*. A *bukta* is a bay.

We have also been seeing whales - I am not sure what species - southern fulmars and snowy petrels.

Love,

Dad