Subject: Scholes Cabin 5 (P): Eye in the sky

23 January 2010 0248 UTM 55.6526 S 34.5544 W

Dear Stirling,

We are looking for some really high-productivity water to take a sample in. There is always some near South Georgia, only it isn't always in the same place. In the ocean the ecosystems have an annoying habit of wandering around from day to day. Ecosystems move on land too, but very slowly, so I suppose it is just a matter of perspective.

We asked our colleagues in the Stellenbosch office to take a look at the satellite images and advise us. Several satellites have sensors that are specially tuned to look for chlorophyll, and can make very detailed maps of the chlorophyll concentration around the world. Unfortunately, chlorophyll absorption is greatest in the red and reflectance in the green. Both are in the visible spectrum, which is blocked by clouds. This part of the world is cloudy more often than not (we have hardly seen the sun for days) so the best our colleagues could do was take an average for this time of the year, and guide us to an area northwest of South Georgia.

Many of the satellites we use are in low earth polar orbit (around 700 km up). In other words they pass nearly over the north and south poles, rather than for instance going around the equator, like geostationary communications satellites do. This is a popular orbit because if you adjust the altitude just right, you go around the world in exactly the time it takes for the earth to have rotated to the same sun angle. So you are always looking at the ground at the same time of the day. This is called a sun-synchronous orbit, and helps in joining the images together into one big picture. If you then also make sure that the width of the image (called the swath) is big enough on either side of the orbit line, you get to see every bit of the world at least once a day (actually you pass overhead twice in a twenty-four hour period, but half of the orbit is in darkness, so you can’t see much). To reduce the cloud problem they usually build something called a composite image - which is a stitch-up of the best cloud free shots over a period of eight days or so. That is fine for looking at the land, which changes slowly over the seasons as the leaves green-up and then fall, but it is not much use when you are looking for a phytoplankton bloom in the ocean, which may last only a few days.

That is just one sort of satellite we use in ocean research. I have already talked about the satellite radar images we used to find our way through the pack-ice. Radar satellites are also useful for measuring the height of the waves, which is a good indicator of wind speed and storminess. That is called radar scatterometry. Radar altimeters are used to measure sea level rise very accurately. This email will get back to you via a satellite telephone link. We use similar satellites (actually 'constellations' of identical satellites) to

track the weather buoys and send the information they collect back to us. The location of the ship itself is logged by a global positioning system, which depends on another constellation of satellites. I could go on, but you get the point - satellites are really useful to us.

The measurements we take here on the ship are just one tiny dot at one instant. The satellites help us to see everywhere, all the time. Of course, there is some stuff they can't measure, which is why we need to be here in the first place. For instance, they can't see deep into the ocean, or measure pCO2, O2:Ar or nutrients directly, at least not yet.

Today we arrive at South Georgia. This marks halfway on our journey, distance-wise, although we are more than halfway in terms of time. We will get a few hours ashore, which we are all looking forward to. Mom says you are going to a rowing camp! I hope you have fun - just don't drink the water.

Love,

Dad