Subject: Scholes cabin 5 (P): A perfect day at Atka Bay

7 February 2010 1802 UTM -70.6691, -8.8552

Dear Stirling,

A lovely sunny day, cold with a light breeze. We started off nose-in to bay ice, and did a CTD. Then the captain announced that he would let everyone off onto the ice, and we rushed to finish our analyses - but the bay ice was too thin and unstable. So we cruised north, and to our surprise found the polyna open all the way to the ice shelf near where we load cargo, and we had our excursion there instead. We were hoisted off on a 'people carrier' - a device rather like one of those 'witches hat' roundabouts in old-fashioned children's playgrounds. Four people at a time stand on a ring, clinging to a cargo-net tent. They are lifted by the big crane, swung high over the sea, and deposited gently on the ice. (Coming back was not nearly as much fun - we climbed a ladder onto the prow). On the ice we played soccer and cricket and walked to see a penguin colony. Our feet on Antarctica, at last!

Actually, that is not what I meant by 'a perfect day'. I have been waiting for a 24 hour period near the ice shelf to do a 'budget closure experiment'. That is a good way to check if all our techniques agree. If we are in a consistent water body (which we should be, since we are almost stationary at the moment) and the weather is stable, then we can assume that the ecosystem is close to 'steady state'. If we have uninterrupted records of pCO2, O2:Ar and the photosynthetic and ocean parameters for that period, then everything should add up and agree. Actually, contrary to the general belief, ecosystems are seldom in balance. There is usually a theoretical balance point, but the system is always bit out of kilter, and as fast as it tries to get back into equilibrium, the balance point shifts somewhere else. But today is about as close as we are going to get.

The process of photosynthesis liberates a fixed number of atoms of oxygen for every molecule of CO2 it takes up and for every photon of light it capture. Therefore, as the pCO2 goes down, the O2:Ar in the water should go up in a balanced way. The amount that they both change should agree with calculations of the photosynthetic rate based on the light intensity and the photosynthetic parameters. It is a bit more complicated than that, because we also have to account for fluxes into and out of the system - between the seawater and atmosphere, and sideways into and out of the water column we are measuring. That is where that 'perfect day' comes in. Because the Atka bay is relatively shallow, our CTD this morning went nearly all the way to the bottom - so, no way out there. Since the wind was light and steady, we can calculate the exchange flux between the atmosphere and ocean from the difference between the PCO2 of the water (nearly constant at 325 ppm) and the atmosphere (385 ppm). Finally we assume that in

the sideways direction the inward flows are equal to the outward flows, because it is similar ice shelf water all around.

This is a tough test to pass! There are so many places where we could make an error. With just one measurement you would be in blissful ignorance. With two types of measurements, t would be hard to know which one was wrong if they disagreed. With three, we tend to go with the majority. But it is really important to try to balance the books, if for no other reason than to find out how mistaken we are. Sometimes we learn more from our errors that from our successes.

Love,

Dad