

Subject: Scholes cabin 5 (p): Hey sunshine!

31 December 2010 0400 UTM -64.1912, -5.0404

Dear Stirling,

At about midday today, I noticed that the O₂:Ar ratio began to climb steeply, and the pCO₂ in the water to fall. What was going on? Then I glanced outside - sunshine! After nearly a week of heavily overcast weather, it was wonderful to see sparkling waves again.

The biology in the ocean began to respond very quickly, a reminder that with all this focus on nutrient limitation, we should not forget that photosynthesis requires light too! That is really obvious at my Skukuza tower - the carbon balance goes from being a net flux from the atmosphere into the land during the day, to a flux out of the land back to the atmosphere during the night, as regularly and predictably as breathing in and breathing out. One loses sight of that a little down here in the realm of the midnight sun - I had not seen any clear daily rhythm in the data at all, up to this point. The buffering effect of the ocean probably also helps to obscure the pattern - it takes a while for the CO₂ taken up and the O₂ produced by photosynthesis to diffuse through the mixed layer, which tends to smear out the cycle a little.

At these latitudes (we are approaching the Antarctic Circle once again), the cycle that matters the most is the annual rather than the daily one. For half the year, the lack of sunlight must be a severe constraint on phytoplankton productivity here. The photosynthetically-active radiation drops off exponentially with depth into the water as well. As a result, the radiation levels these phytoplankton are happily living at would be way too low for my savanna trees. That is one of the reasons the phytoplankton have lots of 'secondary pigments' to help capture the blue wavelengths that penetrate best into the ocean, whereas my tree leaves are full of anthocyanin, whose job it is to protect them from sunburn!

By the time we did the 2100 CTD, the water was noticeably green. But what was interesting was the depth profile of chlorophyll fluorescence. Usually the maximum occurs at around 50 m depth, just a little above the thermocline. This evening, the readings were high, but only in the top 15 m. All the action was at the surface. It might be that the surface phytoplankton were quickest off the mark, and had not been tumbled down into the depths by the wind-and-wave driven turbulence yet, but it might also be the migration to the surface of the phytoplankton. They are like tiny submarines, with adjustable buoyancy provided by droplets of oil (actually, our sinking and rising drifting buoy works the same way), and can move to the light zone that suits them best. The results of the HPLC and scanning electron microscope analyses will help answer that question, but we won't know for several months yet.

It wasn't only the phytoplankton that was happy. We were able to go out onto deck for the first time in days, and catch a few rays of sunshine. It is amazing how that raises everyone's spirits. We had become a little worn down by the relentless routine of two CTDs and ten surface sample and UCTD stations per day. Sunshine produces vitamin D in the skin, and it combines with cholesterol to form a critical neurotransmitter that is responsible for keeping us happy. Smiles broke out all round.

Love,

Dad