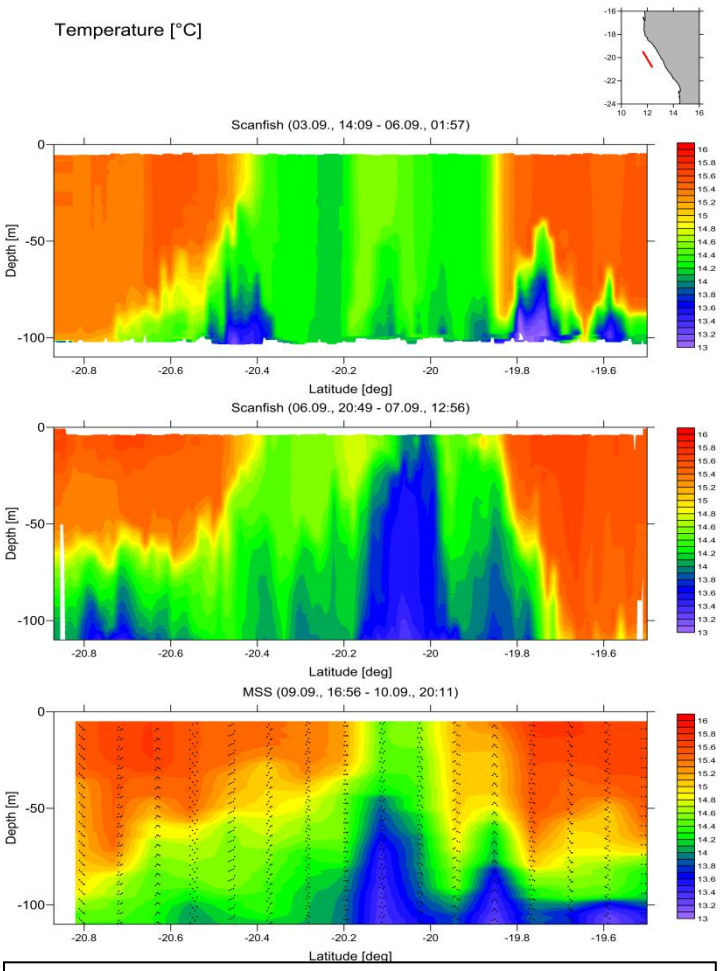
FS METEOR Cruise M 100/1
Second weekly report

Walvis Bay – Walvis Bay
1st September to 1st October 2013

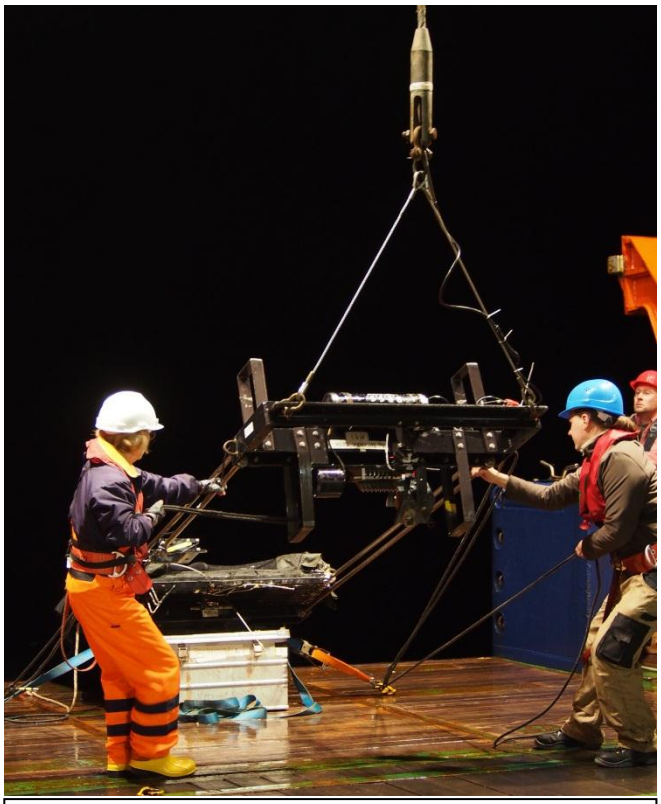
During the current time of year, upwelling filaments are characteristic structures of the Benguela-Current System. However, they may be covered under a thin warm surface layer hiding them from the sight of satellites or rain and clouds interfere with the recording. Nevertheless, with specially prepared images generated by DWD and IOW and combined with a long search – transect with our Scanfish, we succeeded to locate a suitable filament in the end. The Scanfish looks like a section from a glider's wing, being towed behind the ship undulating constantly between the surface and 120m depth. Temperature, salinity, oxygen and chlorophyll measured values are being constantly transmitted on board and deliver a structural image of cross sections through the filament (see fig.). At 30, 60 und 90 nautical miles distance from the coast, temperature data convey the distinct border of the cool filament towards the warm oceanic water masses to the South and North of the filament. In the third (lowest) panel the filament appears very narrow dissipating already within the warm ocean. With our full measuring power we surveyed along these sections: out-South, S-front, middle, N-front and out-North, taking water samples and running net-hauls all along. In parallel, we conducted experiments on respiration, production and growth of the organisms. We were lucky – including weather, to "bring home" all measurements of great variety and precision.



Distribution of temperatures of 3 Scanfish-cross sections through the filament document the sharp limits of North- and South borders of the filament: red = warm, green and blue = cold upwelled water. The depth of the filament corresponds to the maximal undulating range of the device.

Yesterday, during a first collective seminar we exchanged and discussed our data and observations as far as they were already available: many parts of the puzzle begin to fit together!

Apart from the shifts in temperature, salinity and oxygen, the transition from the central to frontal and outer filament structures was reflected in a decrease of CO_2 and a simultaneous increase of pH in the surface water. Increased primary production as indicated by a diatom bloom suggested enhanced CO_2 drawdown at the northern front and likely enhanced particle export to the deep.

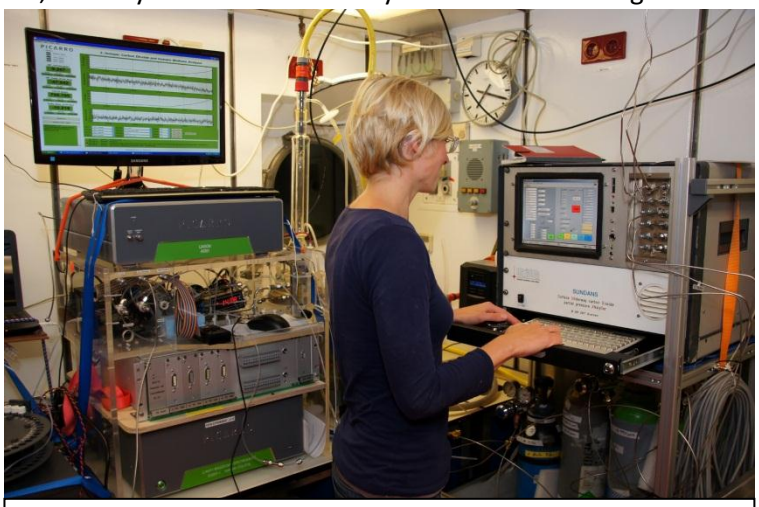


The krill-net MOCNESS comes on board: 9 single nets from different depth steps have still to be heaved to the deck

Further trace gas measurements besides methane (Dimethylsulfide, Carbondisulfide, Carbonylsulfide, Chlormethane, Bromemethane, Iodinemethane und Bromoform) have yet to be evaluated. However, methane indicated a significant impact of the filament-structures on the concentration and distribution of methane in the surface waters, where highest concentrations were found in the middle of the filament. This supports our hypothesis of filaments being responsible for transport of trace gases in upwelling areas thus strongly influencing their distribution. Decreasing CO_2 as observed in the frontal zone depends on high productivity of phytoplankton. Production was measured through incubations and respiration rates in comparison of water from outside – front – inside of the filament, indicating that fast growing phytoplankton consumed CO_2. The Upwelling Zones play a considerable role in budgets of the climatically relevant greenhouse gas – and we can now contribute data from the small scale but numerous filament structures.

High production of phytoplankton enhanced secondary production in turn: we found significant distributions of zooplankton and ichtyoplankton (fish larvae) from within to the outside of the filament. Distributions of nutrients – the basis of all production – has still to be measured in the home laboratory. However, net-data and physiological rates determined in krill were remarkable: These small but numerous crustaceans play a pivotal role in food webs and have to be considered rather as micro-nekton than as plankton, as they are able to actively follow favourable gradients. They were found within the filament obviously taking advantage of the enhanced trophic environment – the local krill-swarm even adjusted its amplitude of vertical migration to the depth of the filament.

Currently, we place all our bio-geochemical and biological observations into the oceanographic context – a characteristic approach of our project. As we find ourselves in the same boat, new ideas and concepts are being swapped continuously: we are enjoying a most exiting atmosphere!



Underway systems continuously measure salinity, temperature, oxygen, pH, CO_2 and CH_4 along the M100/1 cruise track and document the surface expression of a filament cross section

Cordially, Fritz Buchholz, Chief Scientist M100/1, 15 September 2013.