Logistics Planning Outline for the 2010/2011 NBP/ODEN 2-boat Operation

In an attempt to coordinate the science between the ODEN and the NBP for next year's 2-boat operation, the information below will be compiled and passed out during the planning meeting in November.

Principal Investigator: Melissa Chierici
Project leader onboard NBP/ODEN (if other than P.I.):
Project title: Processes driving the CO2 system in sea ice and water in the climatically sensitive Amundsen and Ross seas.
Participants onboard (tentative): Total: 4 persons Name and function: PI: Melissa Chierici: scientist, responsible for water column and underway systems, sampling and CO2 system measurements. Data quality and scientific interpretation. Co-I: Agneta Fransson, scientist, responsible for sea ice work. Sea ice sampling and CO2 system measurements. Fluxchambers pCO2. Data evaluation and interpretation. Two more not identified yet

Please give a brief cruise synopsis. Include the following: research objectives and proposed cruise track.

The aim for the proposed project is to investigate the carbon dioxide (CO_2) system, the sea-ice-air CO_2 fluxes and the fate of the atmospheric CO_2 in the water column and sea ice in areas of varying ice conditions in the Amundsen and Ross Seas in the Southern Ocean. The project takes advantage of the reported decreased sea ice cover in the Amundsen Sea and the observed growth in the Ross Sea to investigate the effect on the carbon system to assess the consequences of a changing environment. The project will use ship-based measurements on the CO_2 system and ancillary parameters (chlorophyll a sensor, oxygen sensor) to provide new insights on the interannual variability of the biogeochemical processes driving the CO_2 system.
We will use measurements on total alkalinity and pH to calculate the full oceanic carbonate system. Measurements will be performed in the sea ice, water column (in sea ice area). CO2 fluxes will be measured at the ice-air interface using flux chambers. Data will also be used to investigate the calcium carbonate saturation state in the two areas thus increase understanding of the role of sea ice in the fate of oceanic CO2 and contribute to study of ocean acidification.

Data from this study and previously collected CO_2 data from OSO06, 07/08 and 08/09 will be used to calculate the CO_2 sea-ice-air fluxes and in models to quantify the strength of the processes affecting the CO_2, and the vertical transport of carbon in a sensitive area of a changing Southern Ocean. Moreover, ongoing research from previous OSO expeditions regarding the possibility of using satellite data to evaluate surface CO_2 algorithms, and facilitate future monitoring of oceanic partial pressure of CO_2 (pCO_2) and remotely sensed sea-air CO_2 fluxes in addition to ship based *in-situ* observations. Annually repeated studies in these contrasting areas are comparable to investigate climatically driven conditions and provide an excellent opportunity to obtain information about the feedbacks and how a change in environmental conditions affects the sea-air CO_2 flux.

Major components:

- Sea-ice-air CO2 flux measurements using flux chambers on the sea ice
- Process studies in sea ice by measurements on CO2 system in sea ice cores and brine (sackholes) and under ice water.
- Water column sampling from CTD-Rosette in previous investigated areas (ice condition allowing)
- Continuous underway measurements of CO2 system in air and water (~8 m depth)

- Incubation experiments investigating effects of climate change by simulation of increased temperature (warming) and CO2 (ocean acidification).

- Study of calciumcarbonate shells of pteropods (species sensitive for ocean acidification) by collection of pteropods using plankton net. Samples will be stored in fridge and analysed post-cruise.

Preferred cruise track is depending on both sea ice stations and water column interests. Amundsen Sea is highest priority. For sea ice the main goal is to sample different types of ice (see red squared area in Figure 1); e.g. first year ice, multiyear ice, landfast ice (see red circle, Figure 1). More important to find places with secure sea ice with little snow on top. Preferable to have longer sea ice stations. That means that for sea ice the cruise track is flexible while for the water column research onboard the Oden it is preferable to investigate the troughs that has been previously visited and investigated during OSO 07/08 and 08/09 (Figure 2). Water column stations will be agreed with physical oceanography team onboard IB Oden and also depend on sea ice conditions allowing CTD-water sampling work.

Figure 1

Sea ice studies and approximative sampling areas for OSO10/11 and 11/12: Main focus is the Amundsen Sea area

Note! Exemplified through the OSO08/09 ice conditions. Blue dots stations from OSO08/09

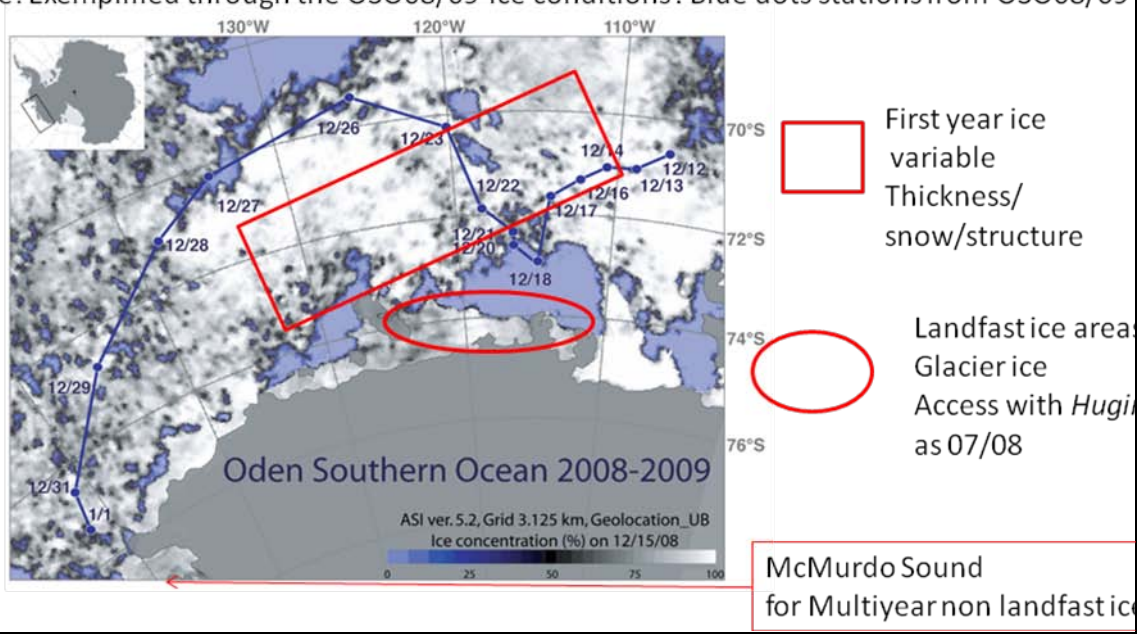
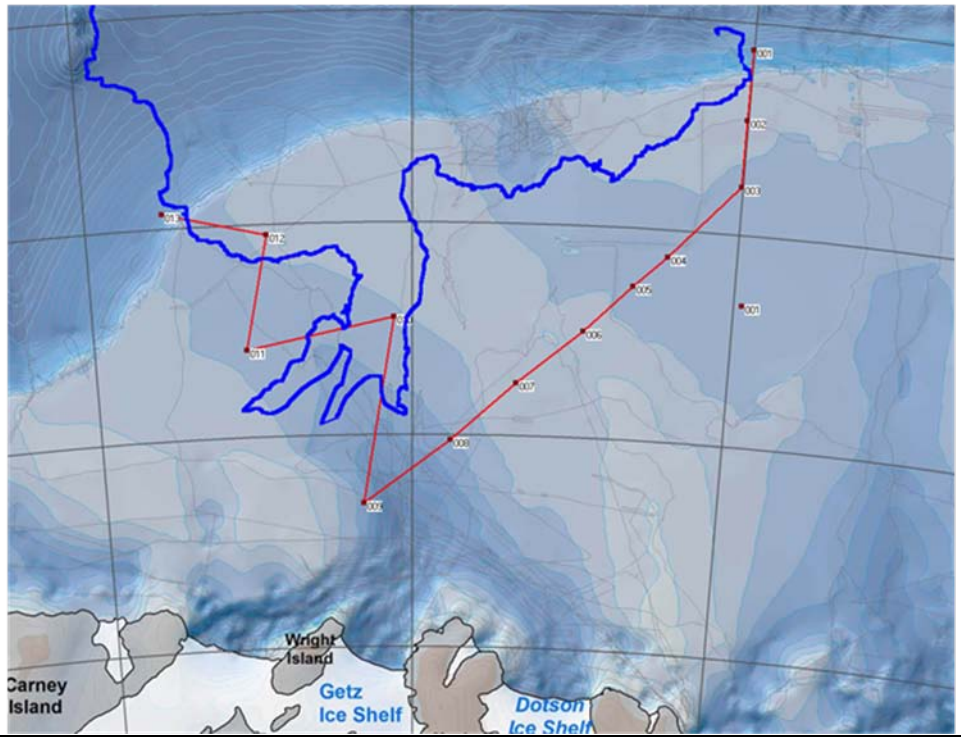


Figure 2

Water sampling areas. Preferably ice stations are combined with water column sampling of high priority for physical oceanography group onboard IB Oden. Ex. troughs and channels that were investigated on OSO07/08 and 08/09



Briefly describe sampling methods and major systems and equipment (collection method (i.e standard CTD, plankton nets, MOCness Nets, etc…)

Standard CTD with Niskin Rosette (at least 12 bottle), Ice coring Brine collection in sackholes Under ice water using a pump (self sustained) CO2 flux using chambers (preferably on ship electricity) Total alkalinity (potentiometric titration, we bring all equipment for that) Spectrophotometric pH Surface water in lab High frequency underway partial pressure of CO2 or pCO2 sensor Chlorophyll sensor (Minitracka II, Chelsea) Oxygen Optode (Aanderaa) for underway oxygen measurements Cool container for mesocosm experiments Air sampling underway

Sampling methods and sites when ship in motion

Site/area/transect	Type of sampling to be performed, volume of H_2O collected
Underway measurements from surface water (seawater inlet) in lab Discrete sampling from sea water tap ~hourly	Continuous flow of 15 L/min (pCO2), chlorophyll sensor and oxygen sensor 2 L/minute Discrete samples for AT and pH 1 L/hour
Air samples	continuous

Sampling methods and sites from stationary ship

Sampling site	Type of sampling, weight/volume of samples and equipment, etc.	Time per station
Amundsen Sea	Water column from CTD-Rosette. We need ~1 L including rinsing of sample bottle and overfill.	depending on depth. Sampling takes 15-30 minutes
Amundsen and Ross seas (at few stations)	Plankton net tow for pteropods	1 hour

Sampling method and sites away from the ship, on ice

Sampling site	No. of persons	Type of sampling, weight/ volume of samples and equipment, etc.	Time per station
All types of sampling in first year ice and multiyear ice 8-10 ice stations	2	Ice coring, water and brine sampling, ice cores and minor equipment around 30kg, total volume 1L and 1-2 ice cores	3-8 hours
Landfast and glacier ice. 2 stations	2	Ice coring, brine and water sampling. Total Volume 1 L, 1-2 ice cores	3 hours
~ 4 ice stations	2	Ice coring (1-2 cores), under ice water and brine sampling total volume 5L, CO2 flux chambers	24 to 36 hours

Deployment/retrieval of equipment

Site	Type of equipment, weight/ volume, procedure, etc.	Time per station
4 stations (see above)	Flux chambers for continuous measurements of CO2	24

Which are the most prioritized sampling areas/methods?

Site/area	Method/type of sample	Other info
Amundsen Sea	Ice coring, brine, under ice water collection	Minimum 2 hours
Amundsen Sea	Flux chambers	24 hrs
Amundsen Sea	Water column CTD-Niskin	Ice covered areas
Underway	Continuous surface water and air	Along the cruise track

The following equipment needs to be installed onboard
(describe in detail, also needed connections to electricity, water, gas etc):

Total alkalinity titrator, need electricity 220 V
Spectrophotometer (220 V)
pCO2 instrument (sea water supply 12-15 L/min, as installed previously onboard) calibration gases (5 total)

Lab space	Wet lab	Dry lab	Other / specify
Meters of bench space	2	3	
Power needs (VA) 220/380 V	220V	220V	
Cold water (yes/no)	no	yes	
Hot water (yes/no)	no	yes	
Sewage (yes/no)	yes	yes	In wet lab need for water outlet (pCO2 instrument, has been arranged previously)
Compressed air (yes/no)	no	no	
Gas (yes/no)	yes		CO2 Calibration gases as previously installed port side)
Fume hood (yes/no)	no	Yes, occasionally	
Sea water intake (yes/no)	yes	yes	
Other (specify)			

Special lab areas needed:

Clean air room	
Other (specify)	

Storage of equipment and samples:

	Space needed (m^2/m^3)
Container	
Cold +2°C	0.3 m2
Freezer -20°C	0.2 m3
Freezer -80°C	0.1 m3

The following chemicals, gases or other hazardous substances will be used, including radioisotopes or other substances which may constitute a threat of contamination for sensitive analyses:

Substance	Weight/vol.	To be used for:
Hydrochloric acid (0.05 M)	4 L	Total alkalinity titration
m-cresol purple	2 g	spectrophotometric pH
Magnesium perchlorate	200 g	pCO2 instrument
ethanol	2 L	Cleaning and store pteropods
Sodium hydroxide 10 M solution	100 ml	pH system
CO2 gas 250 ppm	20L	pCO2 system
CO2 gas 350 ppm	20 L	pCO2 system
CO2 gas 450 ppm	20 L	pCO2 system
CO2 gas 550 ppm	20 L	pCO2 system
Synthetic air	50 L	pCO2 system

Hazardous waste:

Substance	Weight/vol.	Comments
m-cresol purple and seawater waste	40 L	

Disturbance to or sampling of organisms:

1. Species (scientific and English name)	Limacina helicina, pteropod
2. Handling/sampling method	Plankton net tow
3. Storage or handling onboard	Ethanol and in fridge
4. Possible risks to health or environment	No risks
5. Consideration required from the ship/other researchers	No considerations

Cargo to be taken onboard the ship:

Type, handling/storage	Weight (kg)	Volume (m3)
pH instrument with computers	30 kg	0.2
Total alkalinity instrument with computers	20 kg	0.2
Sample bottles	50 kg	0.2
Water baths	80 kg	0.1
Spare parts	100 kg	0.3
pCO2 system	100 kg	0.5
Sensors	20 kg	0.1
Plankton net + weight	20 kg	0.2

Cargo and samples to be taken off the ship:

Type, handling/storage	Weight (kg)	Volume (m3)
All equipment above		

Other support needed onboard Oden, or in preparation phase: