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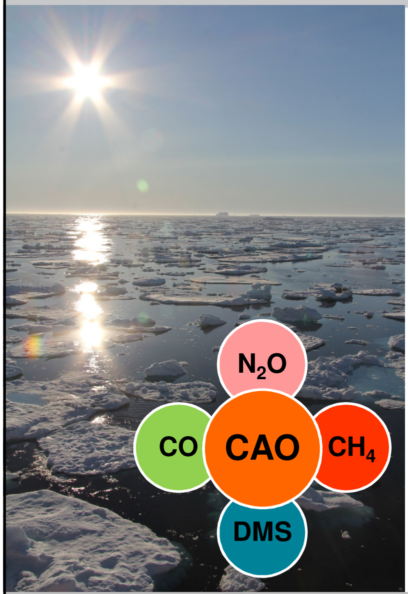

Pathways and emissions of climate-relevant trace gases in a changing Arctic Ocean – PETRA

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Warming, Acidification, Decreasing Sea-Ice

Combined impact may prove additive, synergistic or antagonistic

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Rationale

	T° C	OA	Light	Most vulnerable processes in the Arctic Ocean
N_2O	X	X		Nitrification
CH_4	X	X		Aerobic CH_4 oxidation, non-conventional CH_4 production via DMSP
DMS	X	X	X	(Multiple)
CO	X		X	photochemical production from POM and CDOM

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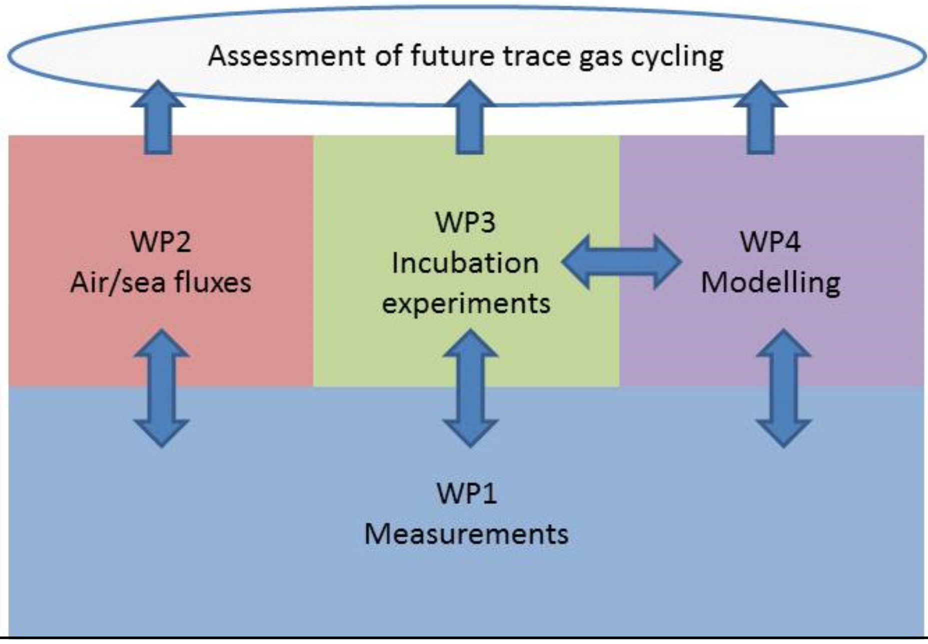
Objectives



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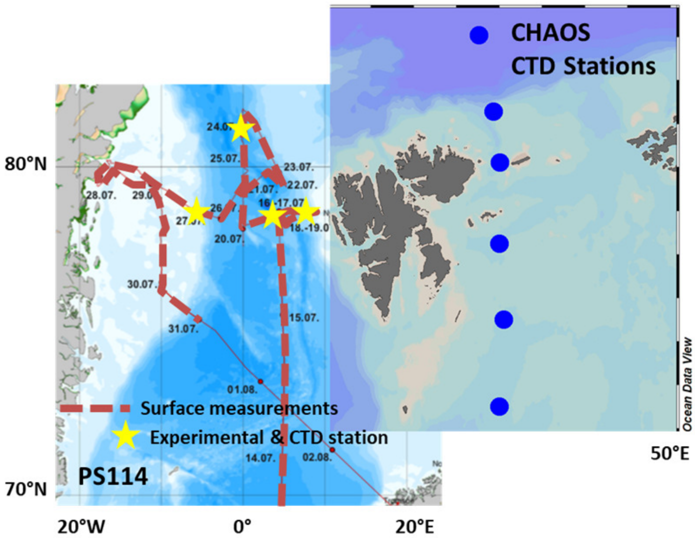
Fieldwork



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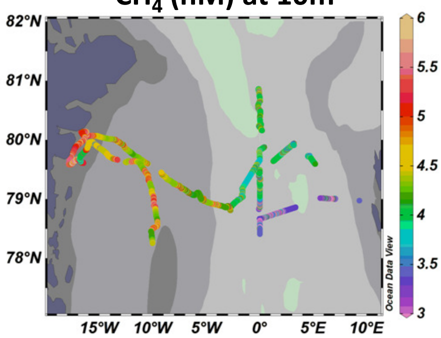
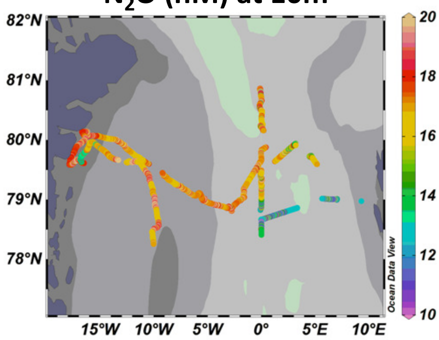
WP1 - Measurements

PS114 – preliminary findings

CH_4 (nM) at 10m



N_2O (nM) at 10m



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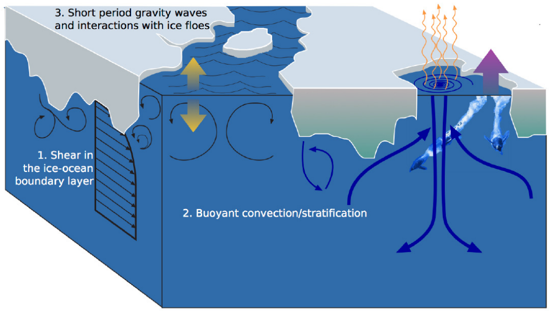
WP2 – Air-Sea fluxes

Computation of the air-sea gas exchange in ice-covered regions:

$$F = k_{eff}\,\Delta C = (1\text{-}f)\,k_{ice} + f\,k$$

A graphic illustration of the mechanisms that can lead to turbulence production and gas exchange in the ice–ocean boundary layer. (Fig. from Loose et al., 2014)



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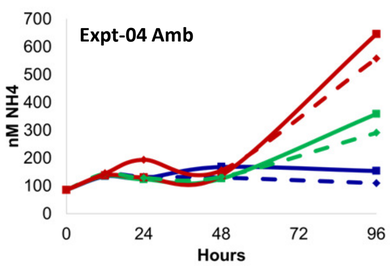
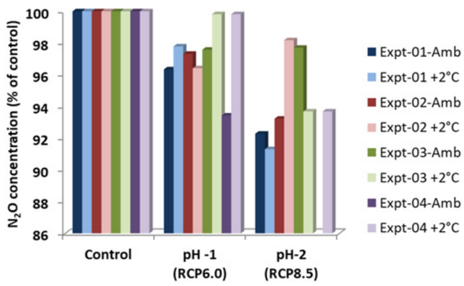
WP3 – Incubation experiments

PS114 – preliminary findings

Time series of $[NH_4^+]$ at ambient temperature



Summary of N_2O incubations at 48 hours



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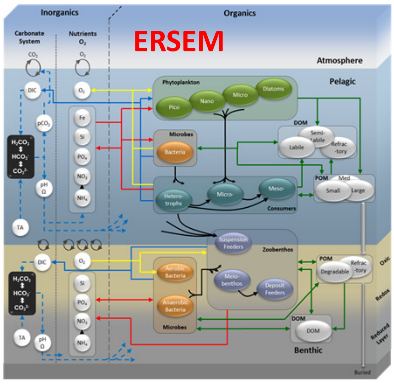
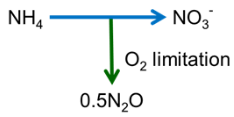
WP4 - Modelling

Mechanistic understanding from models

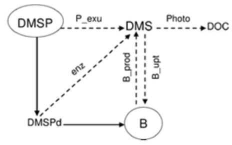


NH_4



Lessin et al., in prep

DMS



Polimene et al., Biogeochemistry, 2011

Models for CO and CH_4 are being developed

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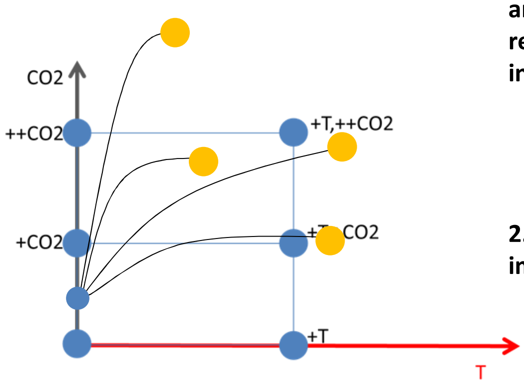
WP4 - Modelling

Mechanistic understanding from models



1. experimental data to define single and multiple stressor functional response and assess stressors interaction

2. model to explore the potential impact in the wider stressor space

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PETRA will deliver

High resolution spatial distribution of trace gases

- N_2O, CH_4, DMS, CO, CO_2

Improved air-sea fluxes in regions of sea-ice

- Shipboard and satellite measurements

Experimental evidence of CAO impact on trace gas fluxes

- Sensitivity of biogeochemical processes, nutrient chemistry and organism response

Mechanistic understanding of stressor impacts on trace gases

- Including interaction between stressors

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PETRA

- WP1: Arctic Ocean Trace gas distribution
- WP2: Air-Sea gas fluxes
- WP3: Stressor manipulation experiments
- WP4: Ecosystem modelling

$$F = k_{eff}\, \Delta C = (1\text{-}f)\, k_{ice} + f\, k$$

Parameter input: f, u, V_0, Q and profiles of T and S;
Matlab routines to calculate k_{eff} in the sea ice zone are available.

The effective gas transfer velocity (k_{eff}) vs. the fraction of open water (f). (Fig. from Loose et al., 2014)