Objective 1 To determine the role of upwelling on the supply, loss and air sea exchange of trace and biogenic gases

Nitrous oxide (1)

Upwellings are important sites for emission of N_2O, accounting for a significant proportion of total marine emissions
Elevated N2O in upwelled surface waters is assumed to result entirely from ventilation of sub-surface sub-oxic waters.
Additional sources :-

a) N2O production by nitrification (stimulated by elevated production) in the upwelling filament
b) Vertical diffusion of N2O into the surface filament as it is advected offshore

have not been considered in previous non-Lagrangian studies.

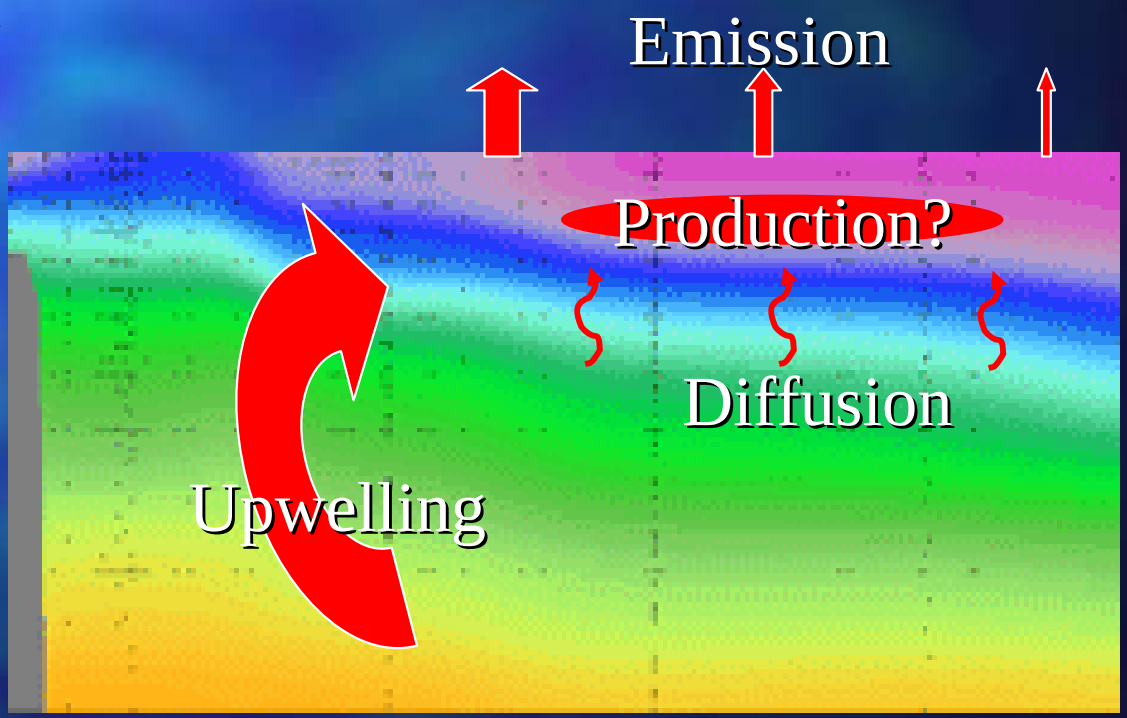
1. Aim:- N2 budget in Lagrangian patch to discriminate between upwelling, diffusion and *in situ* production

Measurements: - vertical profiles of N2O and 15N-N_2O; N2O production and nitrification rate measurement;
15N-N_2O production from ^{15}N-NH_4

Requirements:-
CTD water samples; deck incubations

Concurrent measurements
Nutrients, Nitrification (Darren)
Temp, salinity

For Post-voyage budget & analysis require:-
Microstructure Kz
Upwelling velocity
Dilution/entrainment estimates



Nitrous oxide (2)

2. Aim:- derive robust regional air-sea N2O fluxes for an upwelling system

Measurements: -
Underway surface N2O mapping in and outside filament, and atmospheric N2O

Requirements:-
Clean Underway surface supply

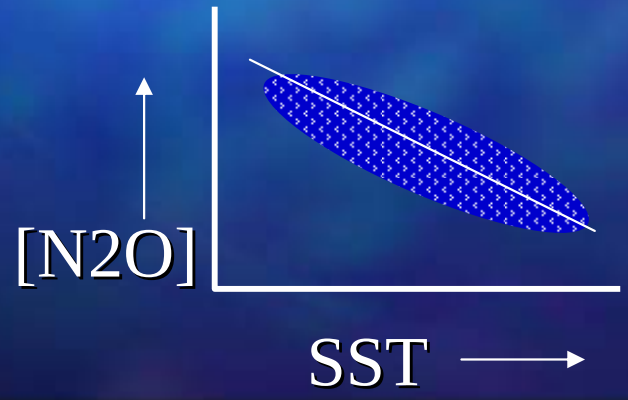
Concurrent measurements - Core (Temp, salinity)

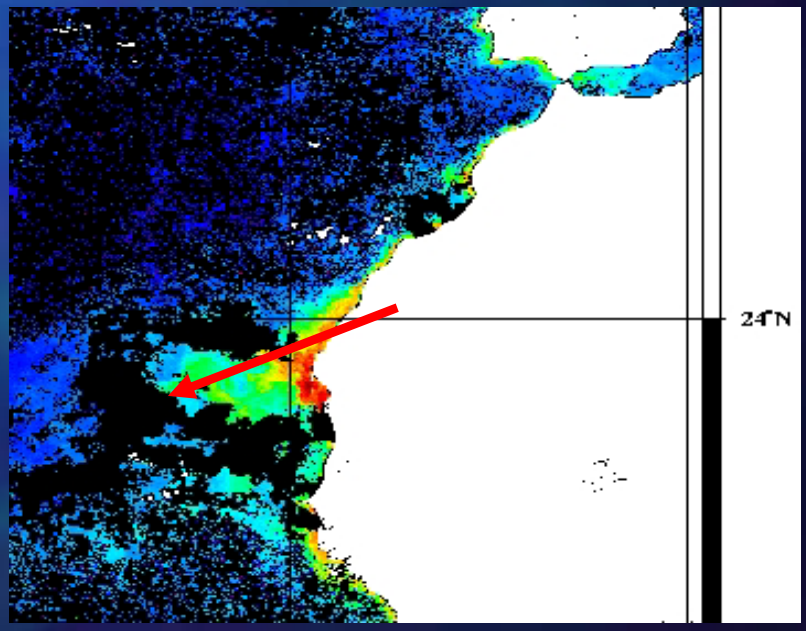
For post-voyage budget & analysis require :- Transfer velocity, Met data (windspeed, direction)

3. SST and N_2O correlate in upwelling regions, with relationships established in Arabian Sea and Californian systems

Aim:- derive N2O-SST relationship for region, and extrapolate to global upwelling emissions,
Examine other potential predictive proxies (chlorophyll, nutrients)

Measurements
& **Concurrent measurements**
As above
chlorophyll fluorescence
nutrients





Methane (1)

Upwellings are sites of high methane supersaturation and emission in SOME upwelling regions-

Vertical advection of intermediate waters is not the direct source of methane in these systems. Either lateral advection of shelf water of high methane content (originating from sediment), and/or *in situ* production in near-surface water associated with elevated biological productivity, or combination of both.

Note:- Initial German SOLAS measurements identified no sig. CH_4 supersaturation in this region; later voyage identified supersaturation reaching max of ~150% around 19^0N 17^oW.

1. Aim:- to examine spatial variability in biological methane production and consumption along the upwelling filament, and to establish why upwelling systems are variable methane sources

Measurements: - vertical profiles of CH_4 and 13C-CH_4; 13C-CH_4 methanotrophy rate measurements
Underway surface CH_4 measurements in and outside filament

Requirements:-
Rosette water samples volume
Deck incubations

Concurrent measurements
Nutrients, Chlorophyll, Zooplankton biomass, grazing?
POC, PON, Core (Temp, salinity)

Methane (2)

2. **Aim**:- derive robust regional air-sea CH4 fluxes for an upwelling system

Measurements: - Underway surface CH4 mapping in and outside filament and atmospheric CH4

Requirements:- Rosette water samples volume, Clean Underway surface supply

Concurrent measurements:- Core (Temp, salinity)

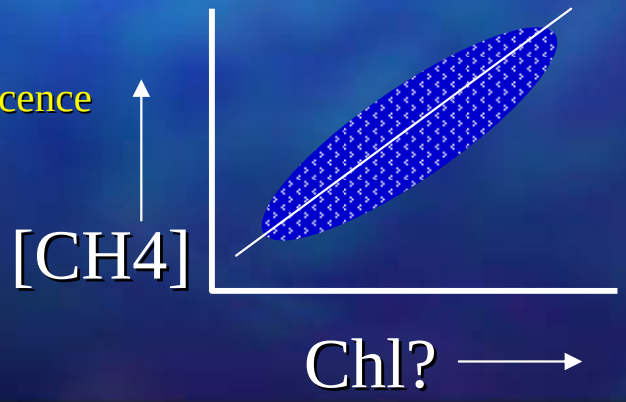
For post-voyage budget & analysis :-
Transfer velocity, Met data (windspeed, direction)

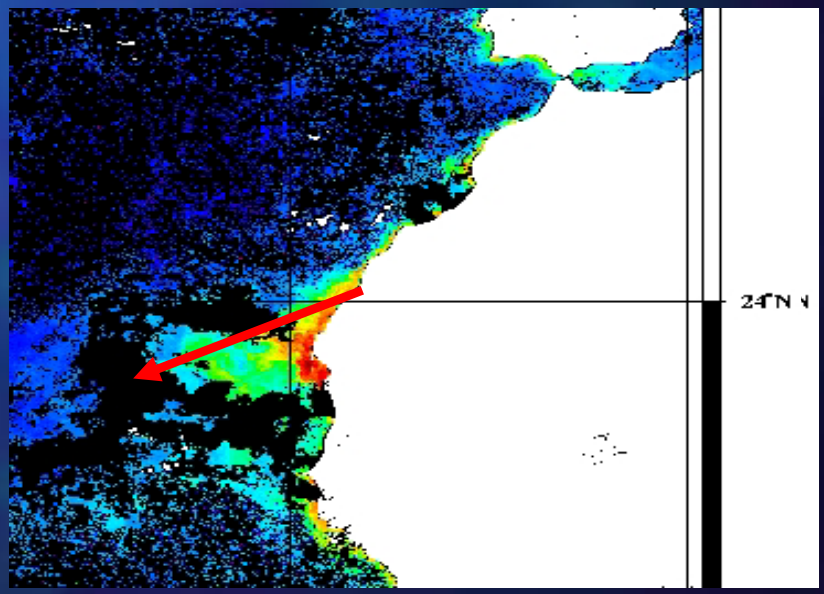
3. SST and CH4 correlate in SOME upwelling regions, CH4 correlates with chlorophyll in some regions

Aim:- examine predictive proxies (chlorophyll, SST, nutrients) for regional CH4 saturation & emission estimates

Measurements –
Rosette water samples volume
Underway surface CH4 mapping in and outside filament

Concurrent measurements
As above
underway chlorophyll fluorescence
nutrients





Carbon monoxide (1)

Upwelling systems are potential sources of CO, from photoproduction of CDOM. Photolabile CDOM arises directly from upwelling and indirectly from biological exudation

1. Aim:- derive robust regional air-sea CO fluxes for an upwelling system

Measurements: - Underway surface CO in and outside filament and atmospheric CO, surface mixed layer samples from rosette

Requirements:- Clean Underway surface supply, ~750ml from ~6-8 depths in upper 100m (including surface)

Concurrent measurements - Core (Temp, salinity), Incident light/PAR, incident UV?, CDOM absorbance, nutrients, chlorophyll fluorescence

For post-voyage budget & analysis requre :- Transfer velocity, Met data (windspeed, direction)

2. Aim:- Examine potential predictive proxies (chlorophyll, SST, nutrients) for regional CO saturation & emission estimates

Measurements – Underway surface CO in and outside filament and atmospheric CO

Concurrent measurements - as above

Carbon monoxide (2)

3. Aim :- Establish and compare CO photoproduction potential of deep water, and surface water inside and outside filament

Measurements -
Dark, light, screened and poisoned incubations, with subsequent CO concentration measurements

Requirements:-
Have deck incubator and silica tubes, but may be better to combine/coordinate with other Obj. 2 measurements
Incubation period minimum of ~6 hours (longer preferred) during daylight hours!

Concurrent measurements
CDOM absorbance, nutrients, deck irradiance/PAR/UV

4. Dissolved gas measurement using MIMS (underway & discrete)

O_2, N_2, Ar.....

O_2/Ar – respiration

N_2/Ar – denitrification (CTD samples in upwelling region)

O_2/Ar/N_2/SF_6 - gas exchange

MIMS arrives at early February 08 ; use on ICON dependent on set-up and freighting costs. Chances are that MIMS will not be available but if it is will drop CO measurements in 3.