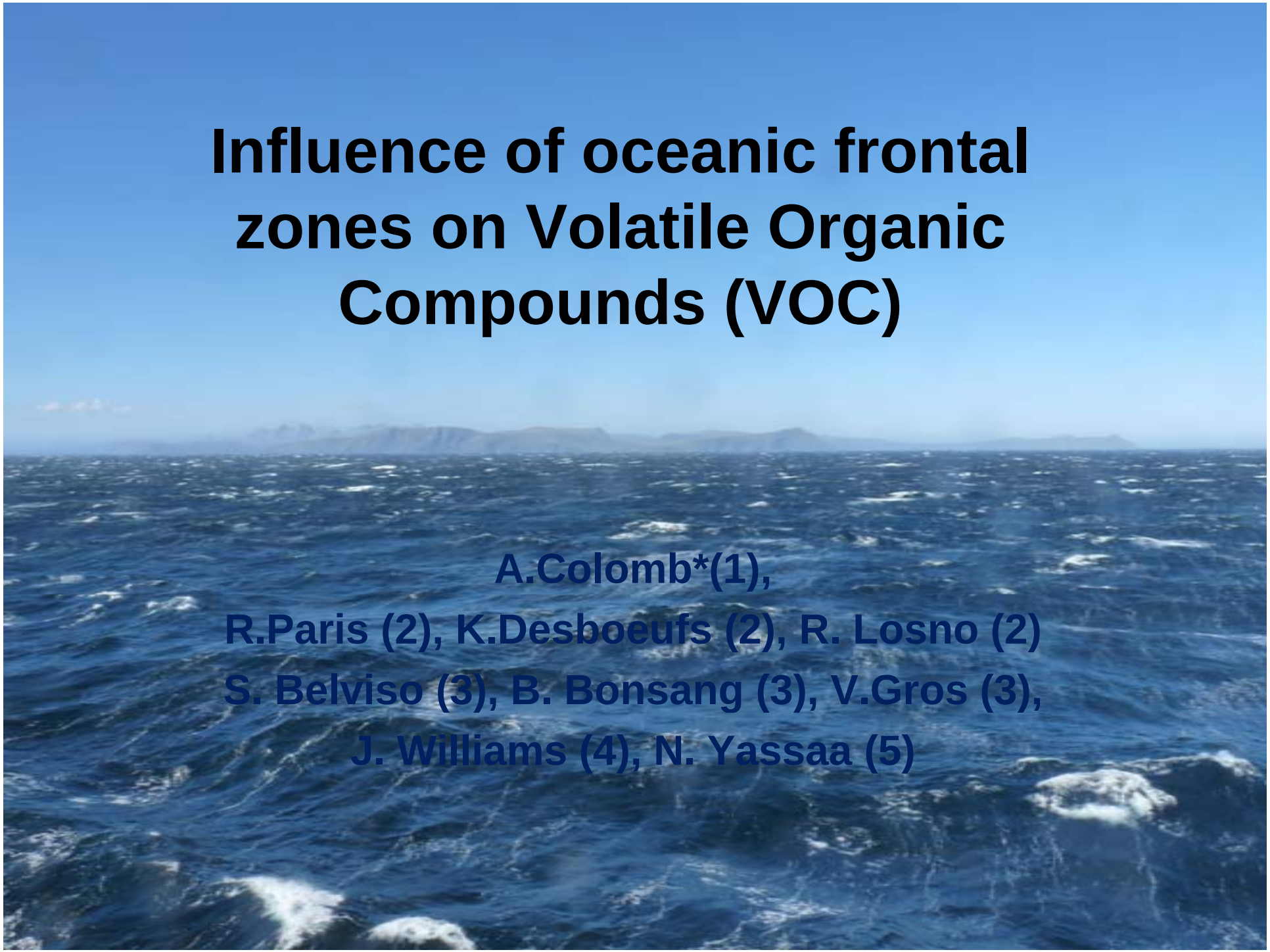


Influence of oceanic frontal zones on Volatile Organic Compounds (VOC)

A.Colomb*(1),
R.Paris (2), K.Desboeufs (2), R. Losno (2)
S. Belviso (3), B. Bonsang (3), V.Gros (3),
J. Williams (4), N. Yassaa (5)

MOTIVATION

•Air-ocean interface →surprisingly poorly characterized in terms of organic trace gases

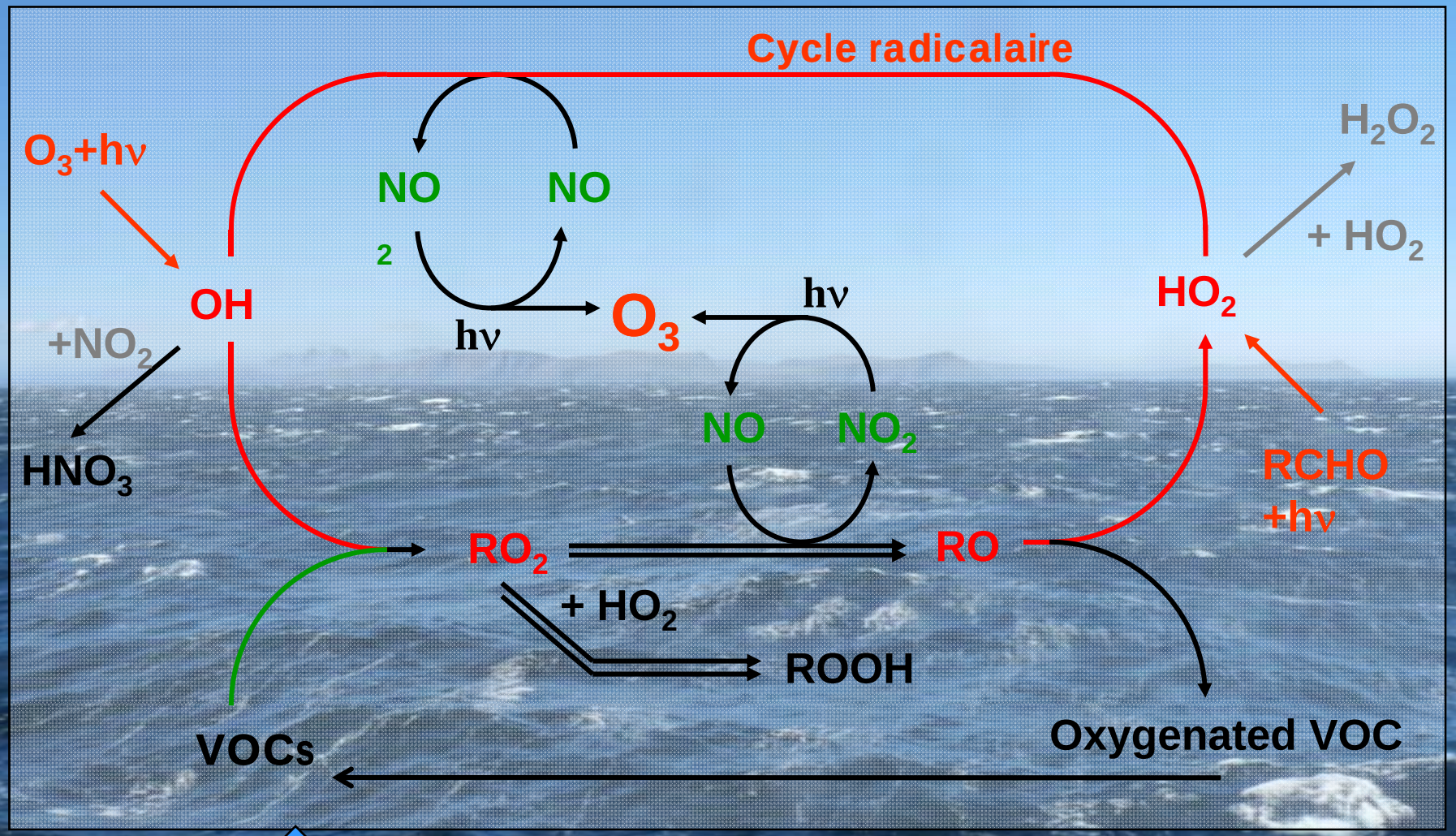
• Important roles in the Earth's atmosphere, impacting on ozone chemistry and aerosol formation, thereby influencing the Earth's overall oxidation capacity and radiative budget.

•Ocean surface may be a highly variable source or sink for many compounds depending on the latitude, temperature, wind speed and biological composition of the surface water.

-1/ Marine emission of VOCs / Phytoplanctons species
→ Laboratory experiments, Mesocosms experiments, Ship campaign

-2/ Influence of frontal zones on organic traces in the atmosphere

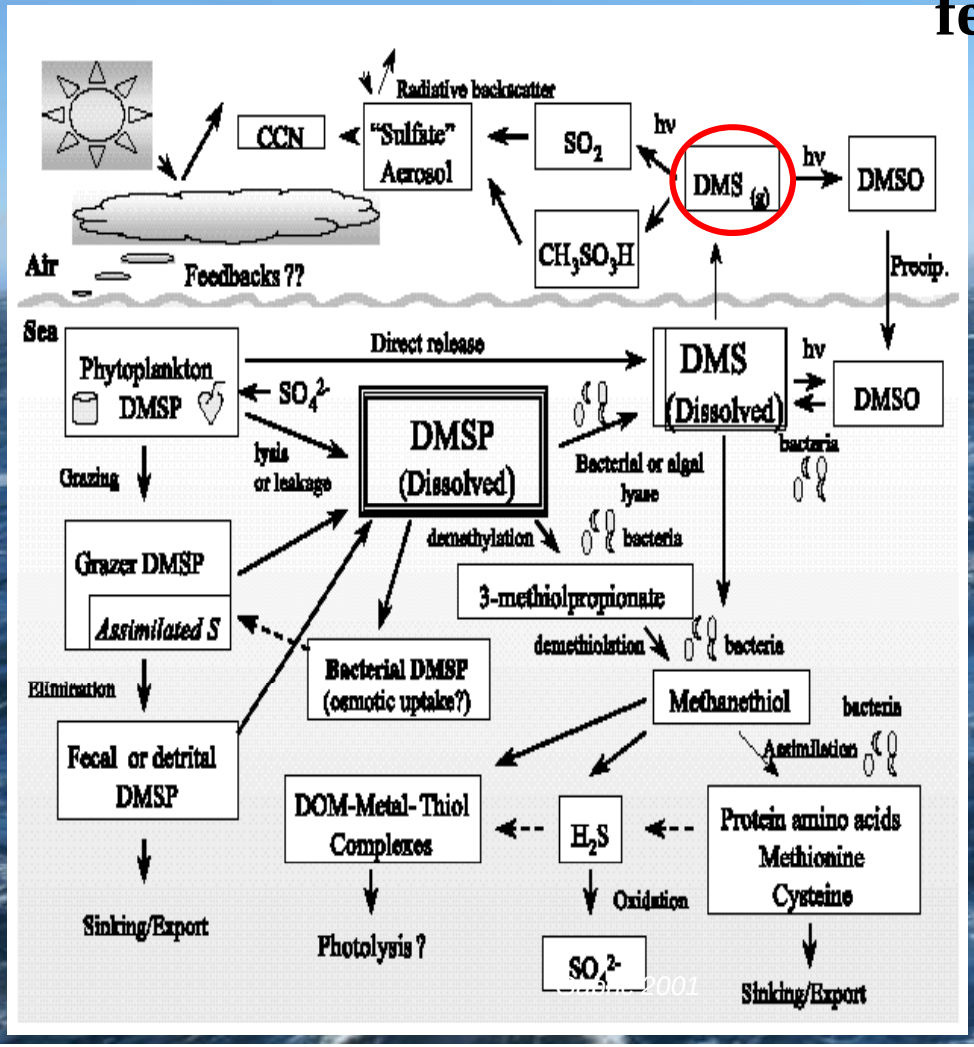
VOC impact


Cycle radicalaire
O_3+hν
OH
+NO_2
HNO_3
NO
NO
2
hν
O_3
hν
NO
NO_2
HO_2
H_2O_2
+ HO_2
RCHO
+hν
RO_2
RO
+ HO_2
ROOH
VOCs
Oxygenated VOC

Aerosol Production

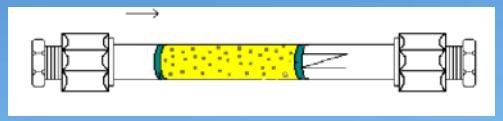
Aerosols may have a negative

feedback on the global warming

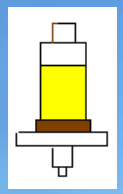


Experimental Strategy

SAMPLING



Solid Adsorbent



Chemical Reagent

ANALYSES

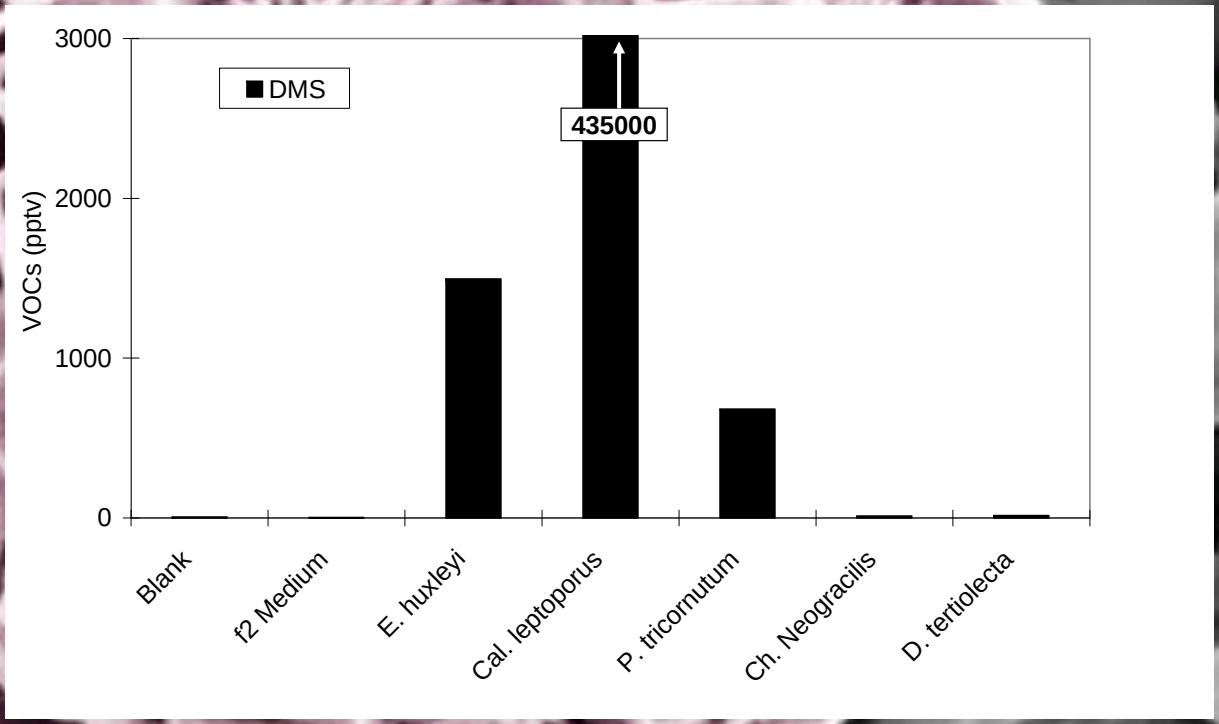
(GC/MS)

(HPLC)

AND/ OR on-line GC-FID/GC-MS/PTR-MS

Labs Experiments

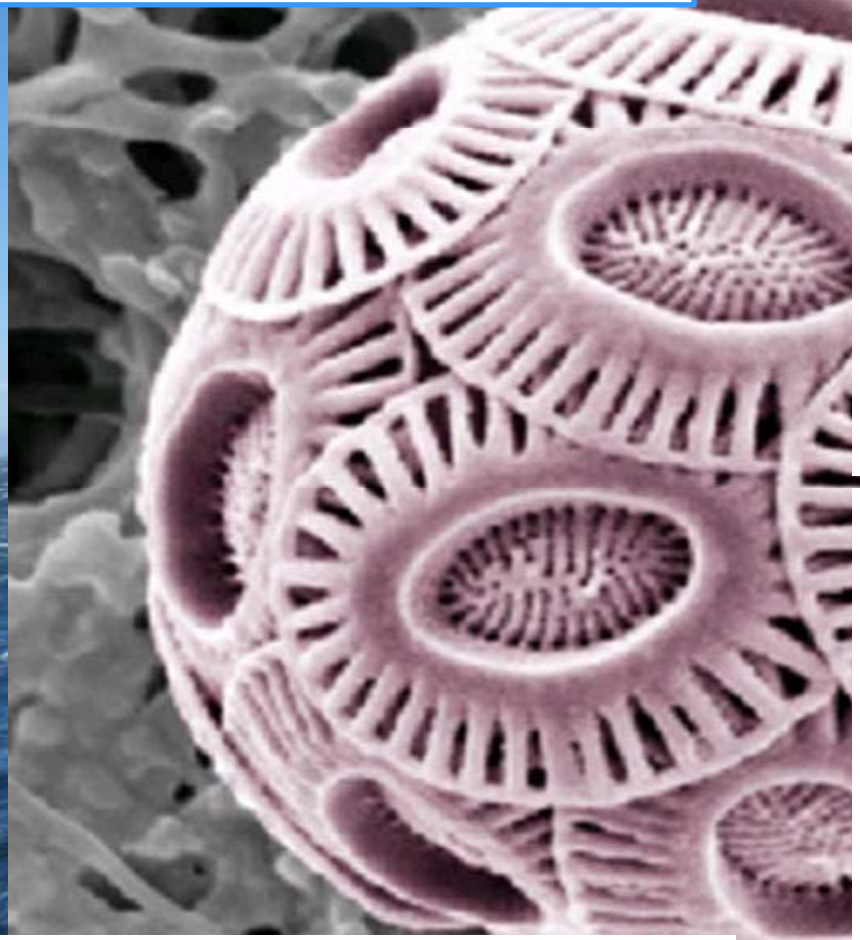
2 coccolithophorids : *C. leptoporus* and *E. huxleyi*
2 diatoms : *Ch. neogracilis* and *P. tricornutum*
1 chlorophyte *: Dunaliella tertiolecta*

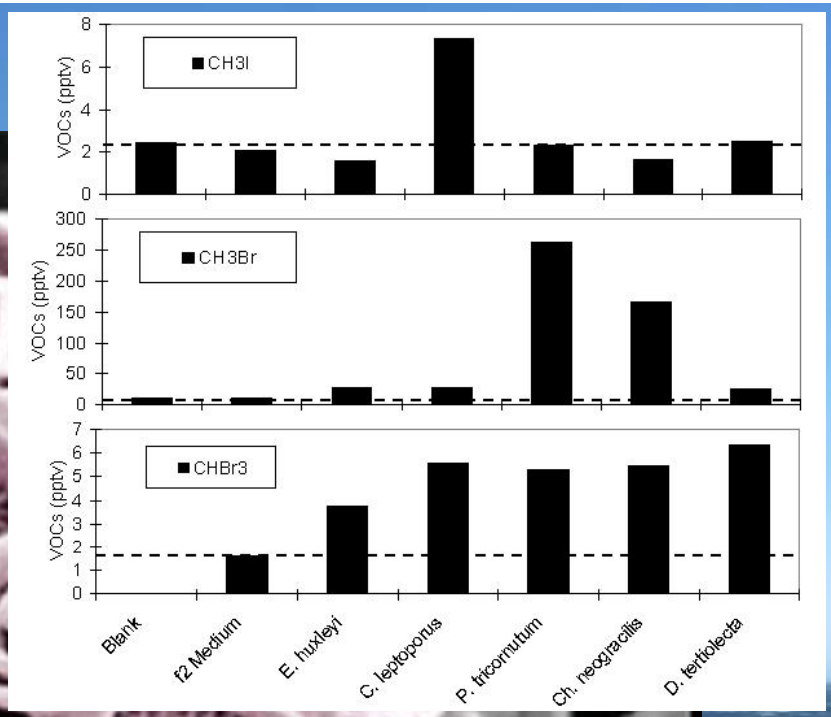


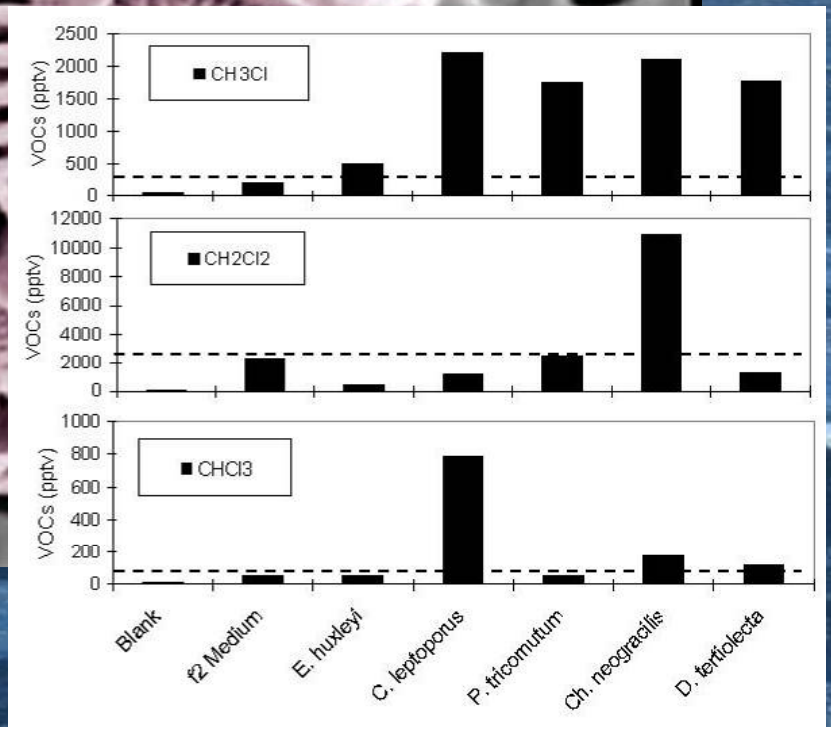
2 microns

DMS Emission → coccolithorids

Labs Experiments







Each algae emits different kind of VOCs…

Labs Experiments

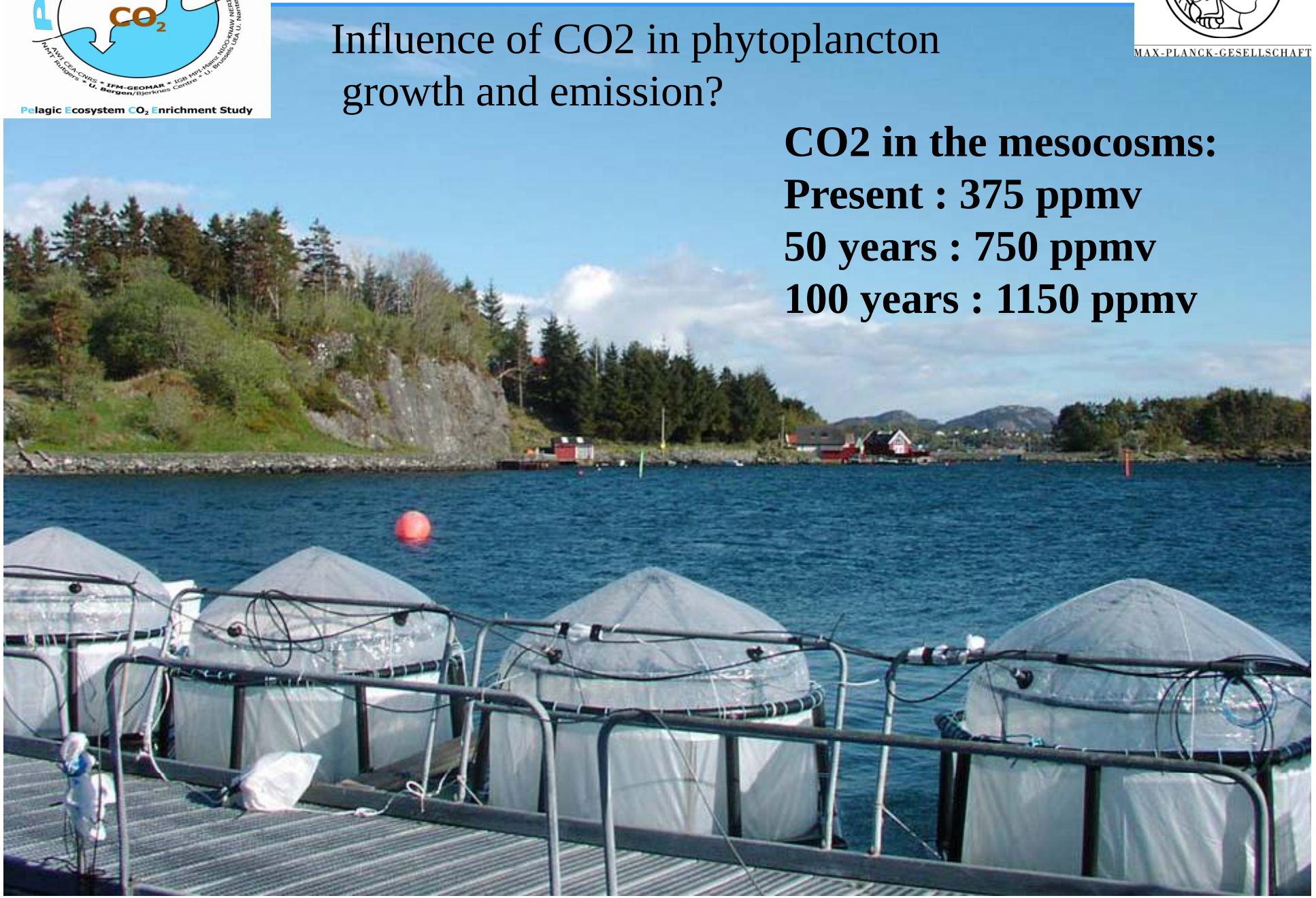
	Emiliania huxleyi	*Calcidiscus leptoporus*	*Phaeodactylum tricornutum*	*Chaetoceros neogracilis*	*Dunaliella tertiolecta*
Chlorophyl a (µg l^{-1})	87	87	683	134	432
VOCs (pmol l^{-1}/Chl_a)					
Isoprene	11.45	5.40	2.85	28.48	2.85
DMS	55.09	16074.35	3.18	0.22	0.10
CH3Cl	0.0255	0.1744	0.0022	0.0697	0.0055
CH2Cl2	-	0.0000	0.0006	1.0023	-
CHCl3	0.0002	0.1229	0.0000	0.0088	0.0004
CH3Br	0.0020	0.0019	0.0004	0.0072	0.0001
CHBr3	0.0020	0.0038	0.0001	0.0016	0.0002
CH3I	-	0.0005	-	-	-
Trichloroethene	0.3792	0.0287	0.0016	0.0262	0.0005
C2H5Cl	0.0040	0.1131	0.0004	0.0811	0.0020
1.1 dichloroethane	0.0880	0.0497	0.0005	0.0399	0.0004
1.2 dichloroethane	0.0302	0.0179	0.0002	0.0007	0.0004

1/DMS
2/Isoprene
3/CH3Cl

Mesoscosms Experiments

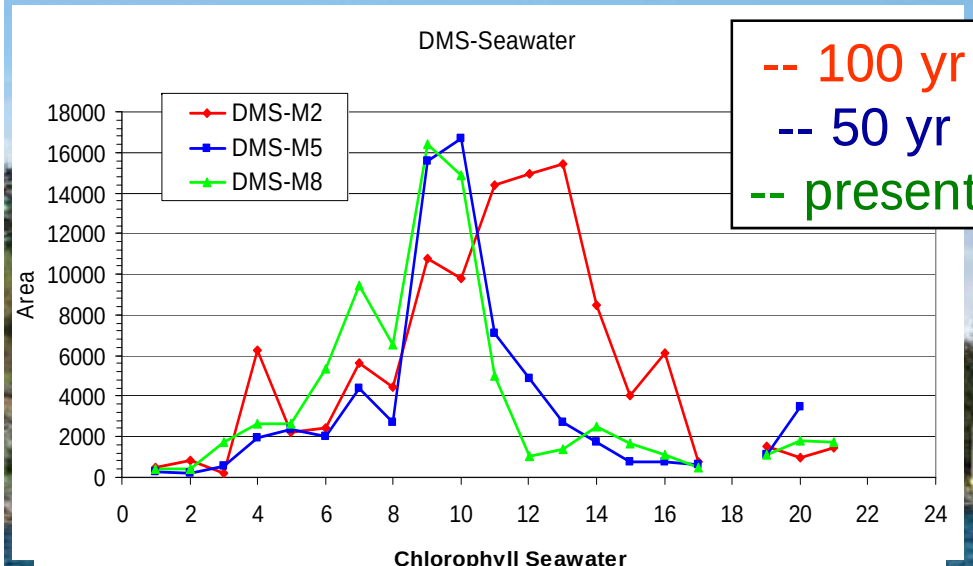
Influence of CO2 in phytoplancton growth and emission?

CO2 in the mesocosms:
Present : 375 ppmv
50 years : 750 ppmv
100 years : 1150 ppmv

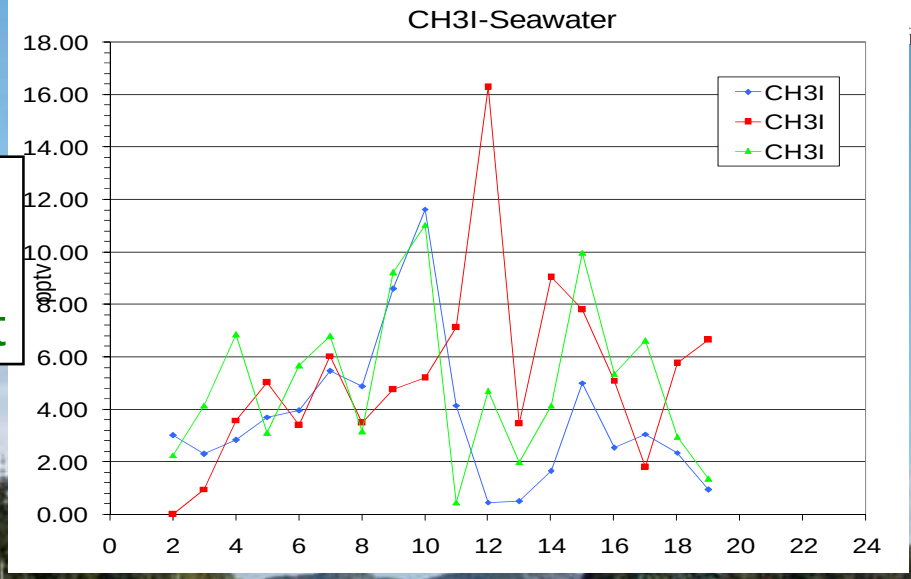


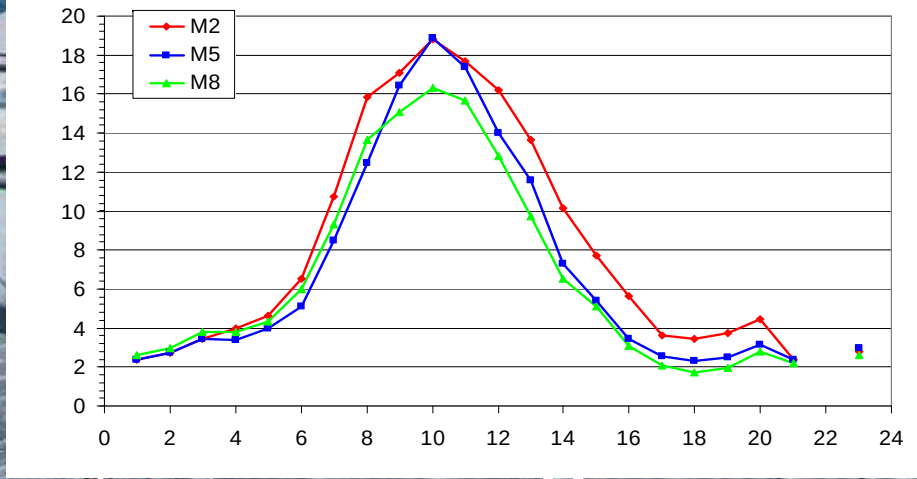
Pelagic Ecosystem CO_2 Enrichment Study

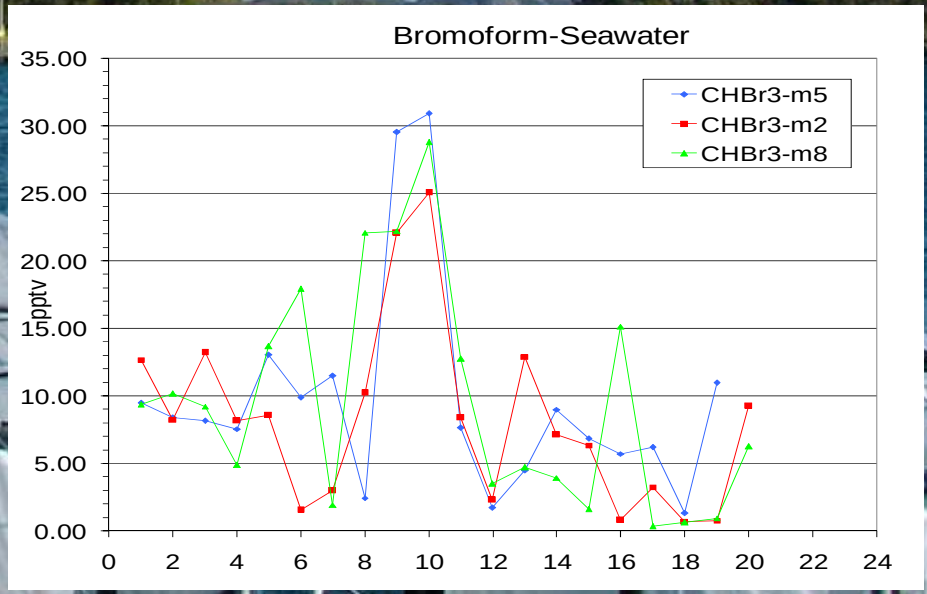
Present : 375 ppmv
50 years : 750 ppmv
100 years : 1150 ppmv



-- 100 yr
-- 50 yr
-- present

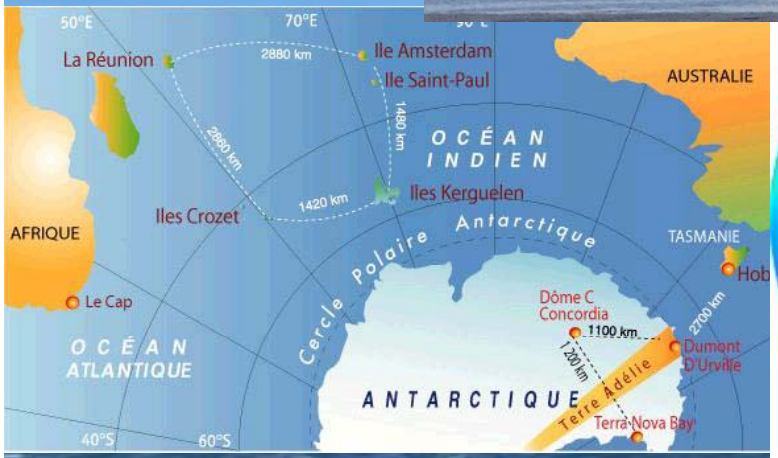






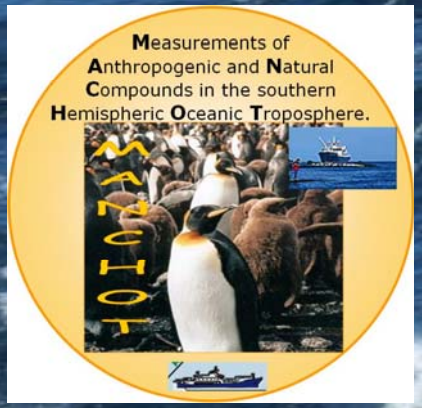
Experiences en Mesocosm

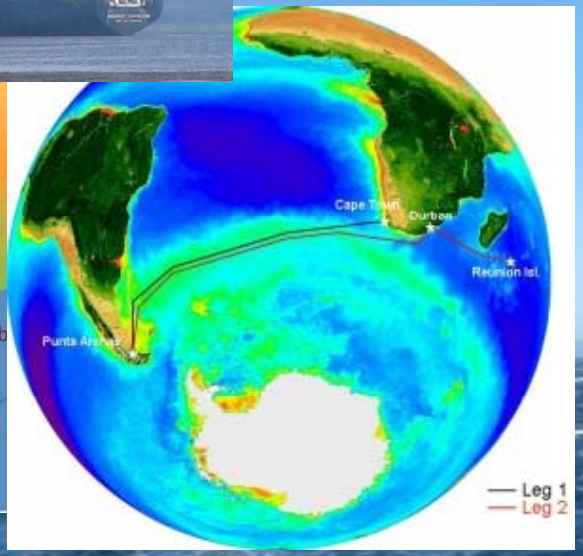
Ship campaigns



MANCHOT project

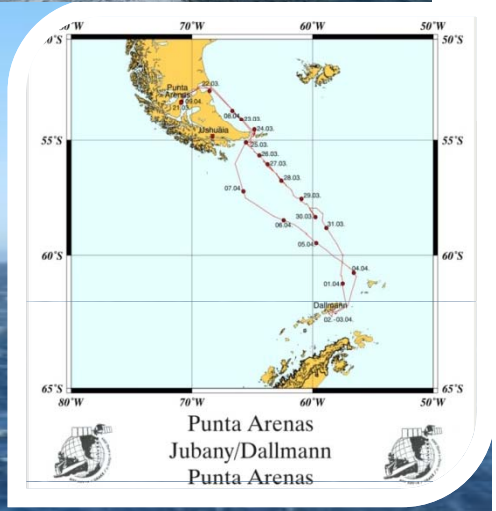
(decembre 2004)





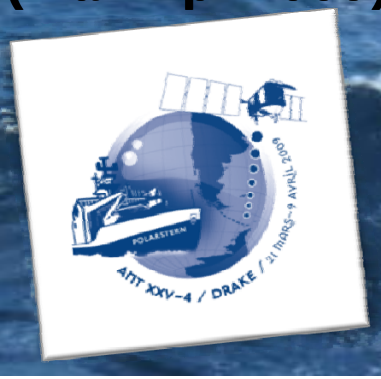
OOMPH project

(jan. Feb 2007)

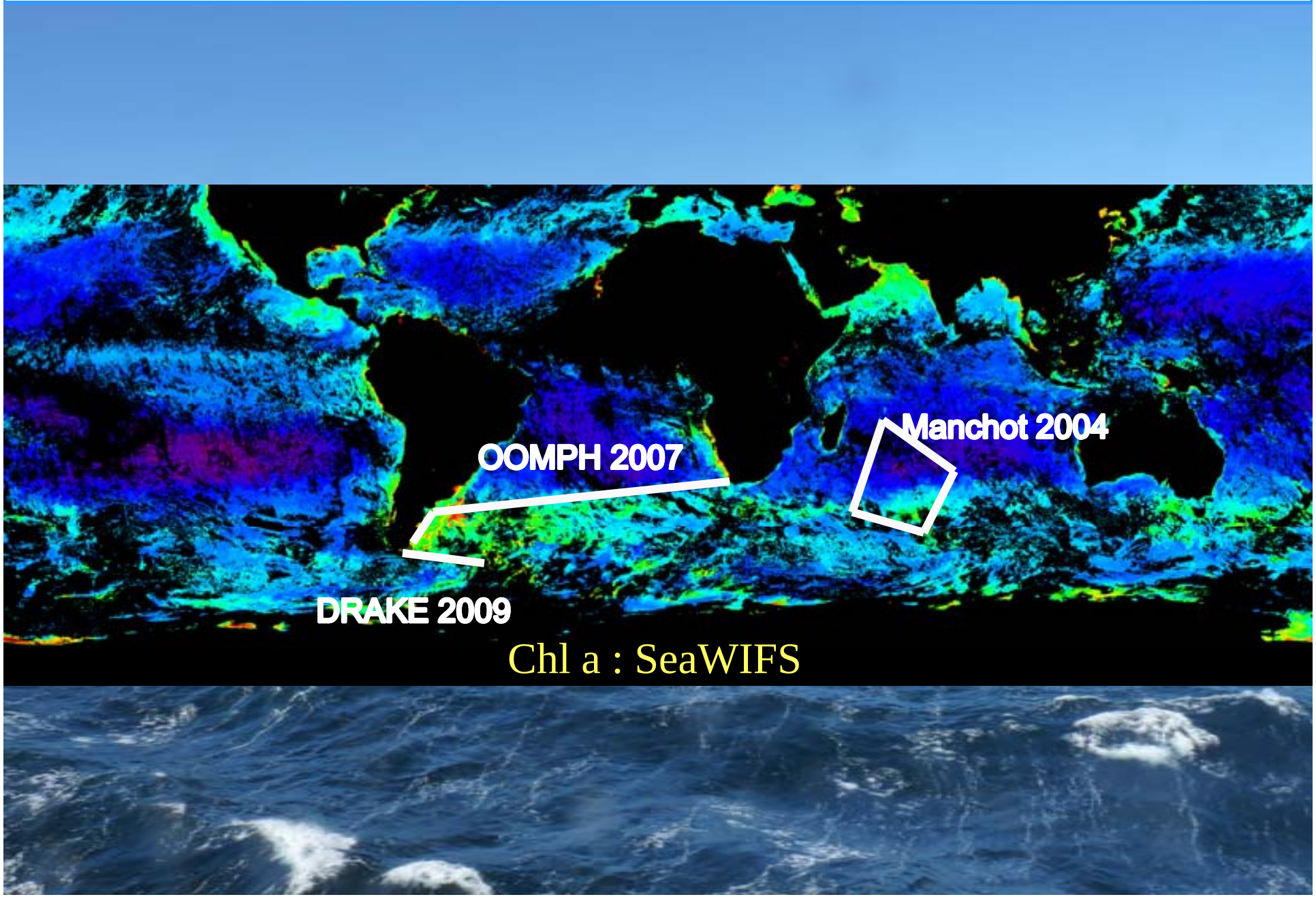


DRAKE project

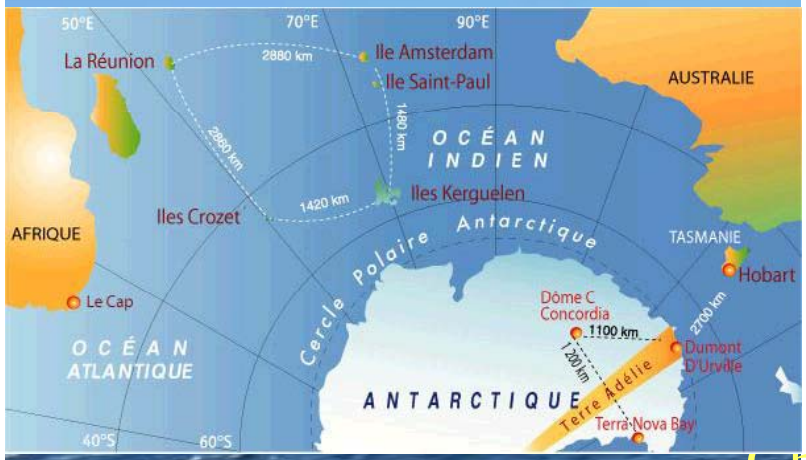
(mar. Apr 2009)

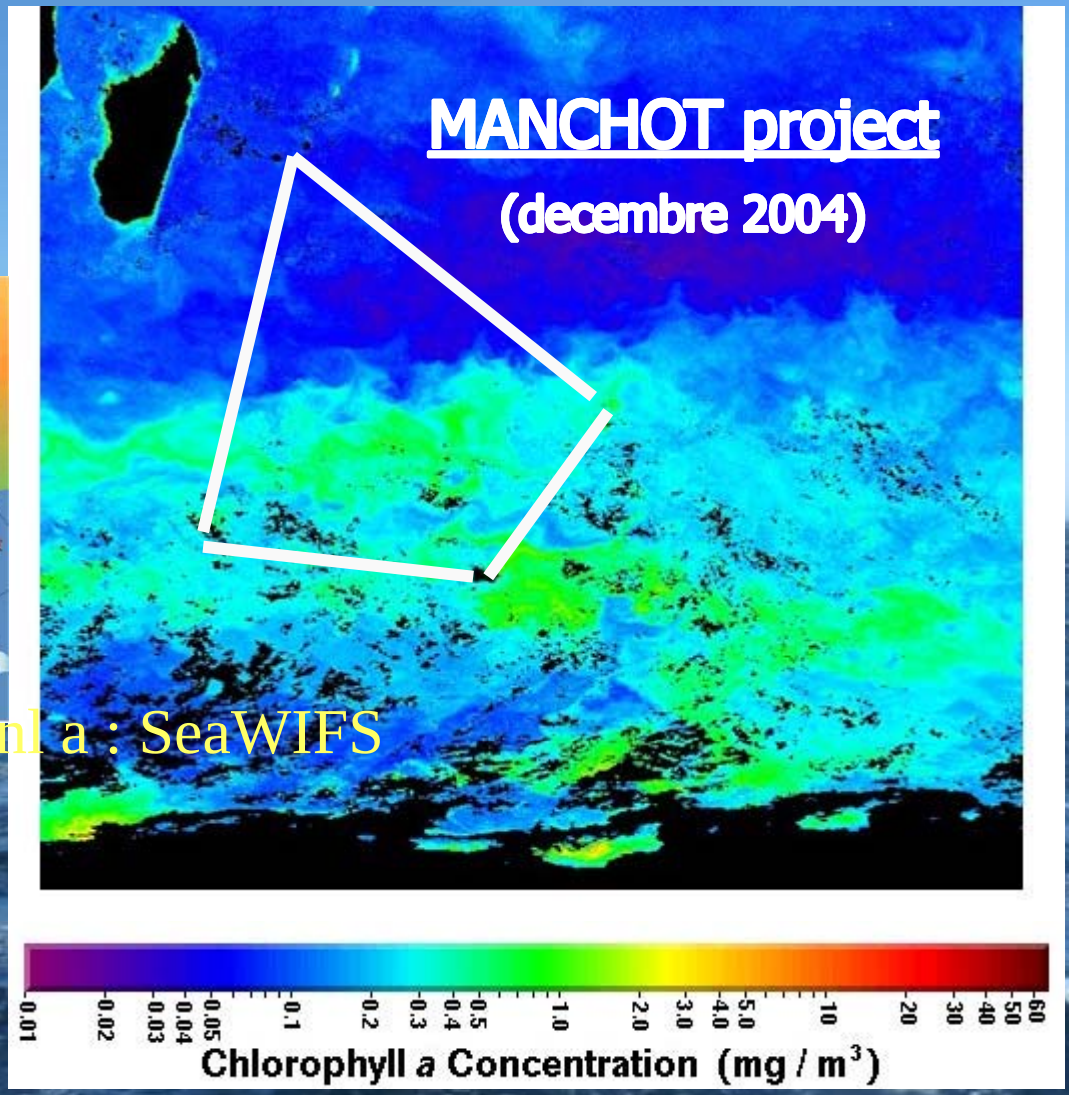


Ship campaigns



Ship campaigns



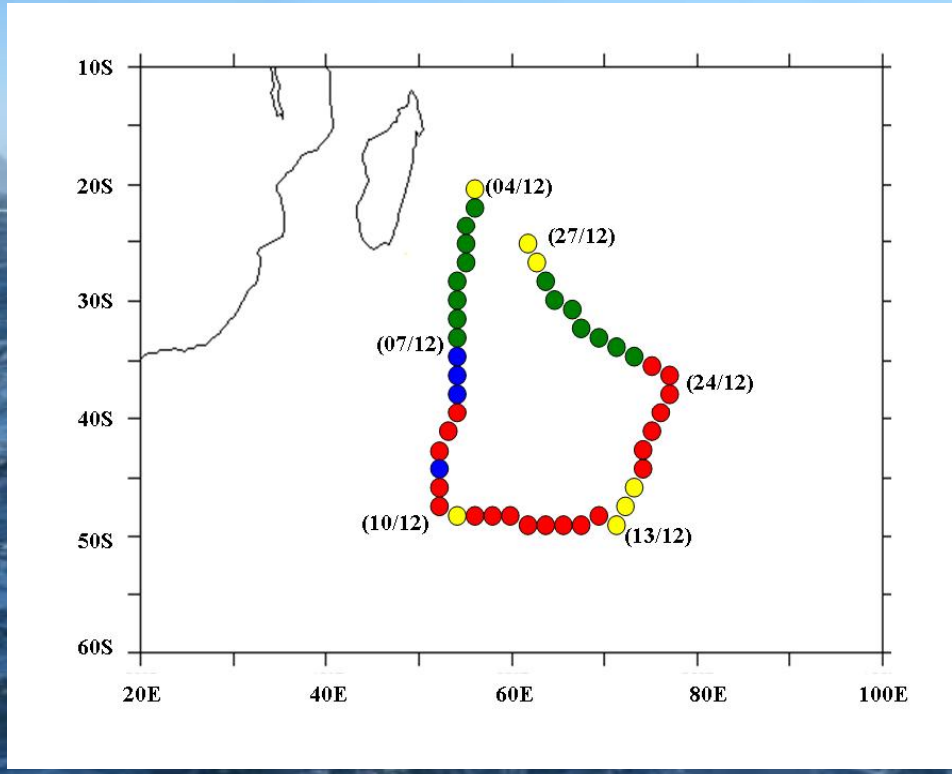


Chl a : SeaWIFS

PHYSAT group

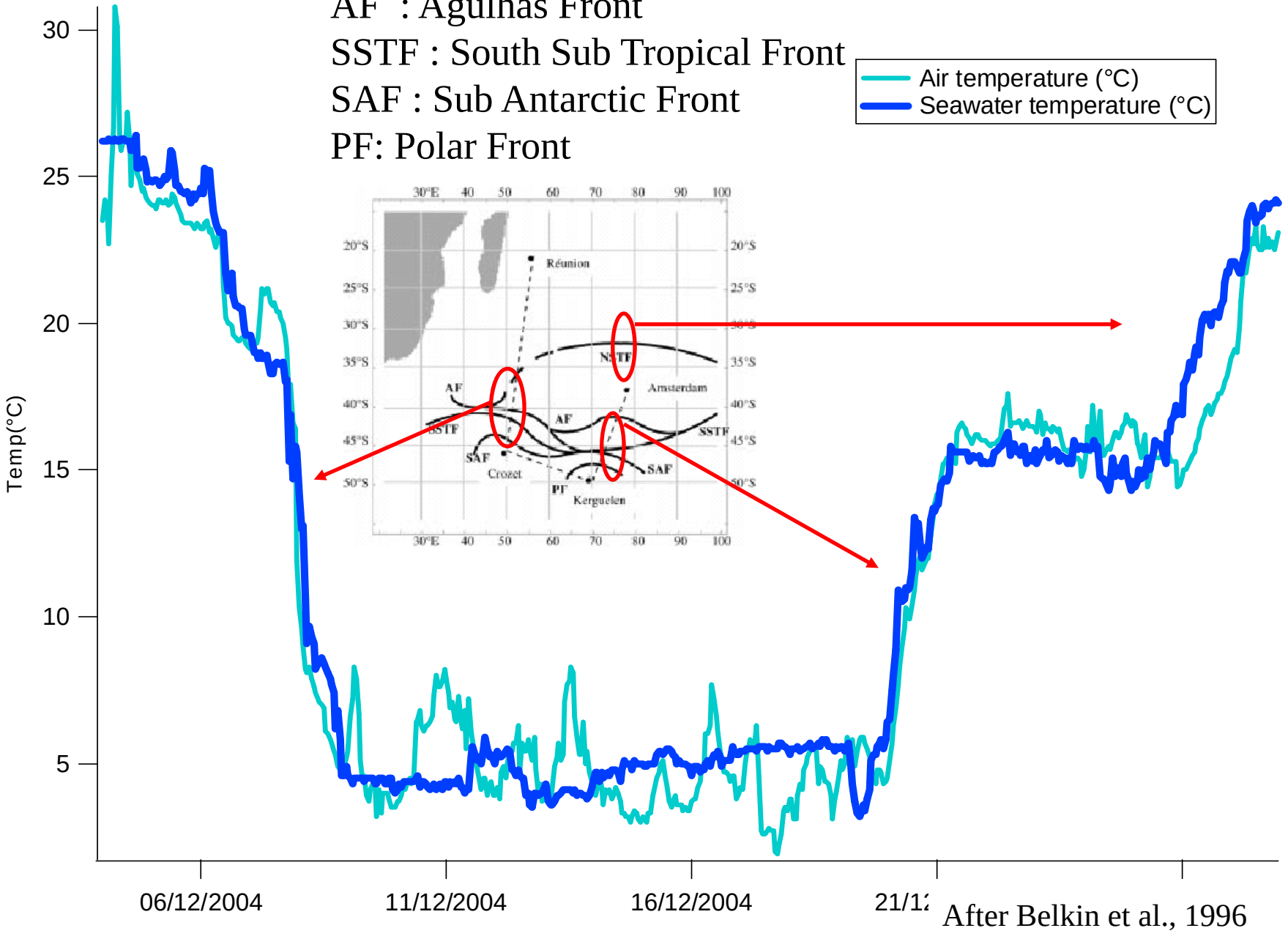
Algorithm developed to detect the major dominant phytoplankton groups from anomalies in the signal measured by ocean colour satellites. This new method, named PHYSAT, allows the detection of some dominant phytoplankton groups in surface waters. The PHYSAT approach is based on the identification of specific signatures in the waterleaving radiance measurements spectra (nLw) from ocean colour sensor measurements. It has been described in detail in Alvain et al.[27]

Diatoms,
Haptophytes, Prochlorococcus
***Synechococcus-like cyanobacteria* SLC**



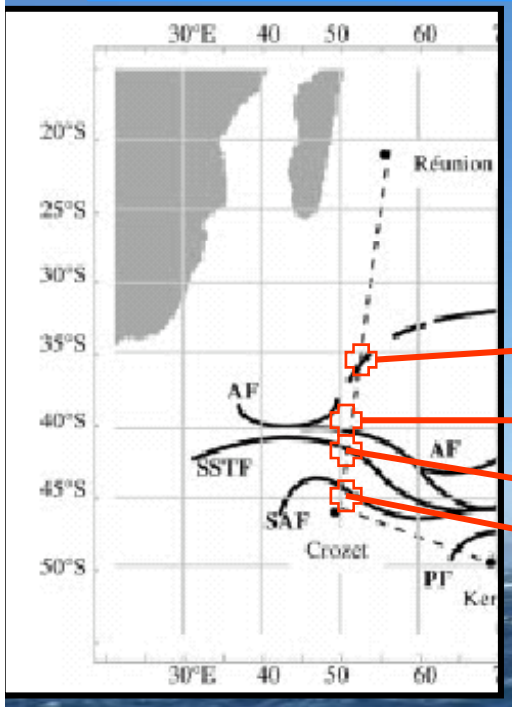
Frontal zones

AF : Agulhas Front
SSTF : South Sub Tropical Front
SAF : Sub Antarctic Front
PF: Polar Front

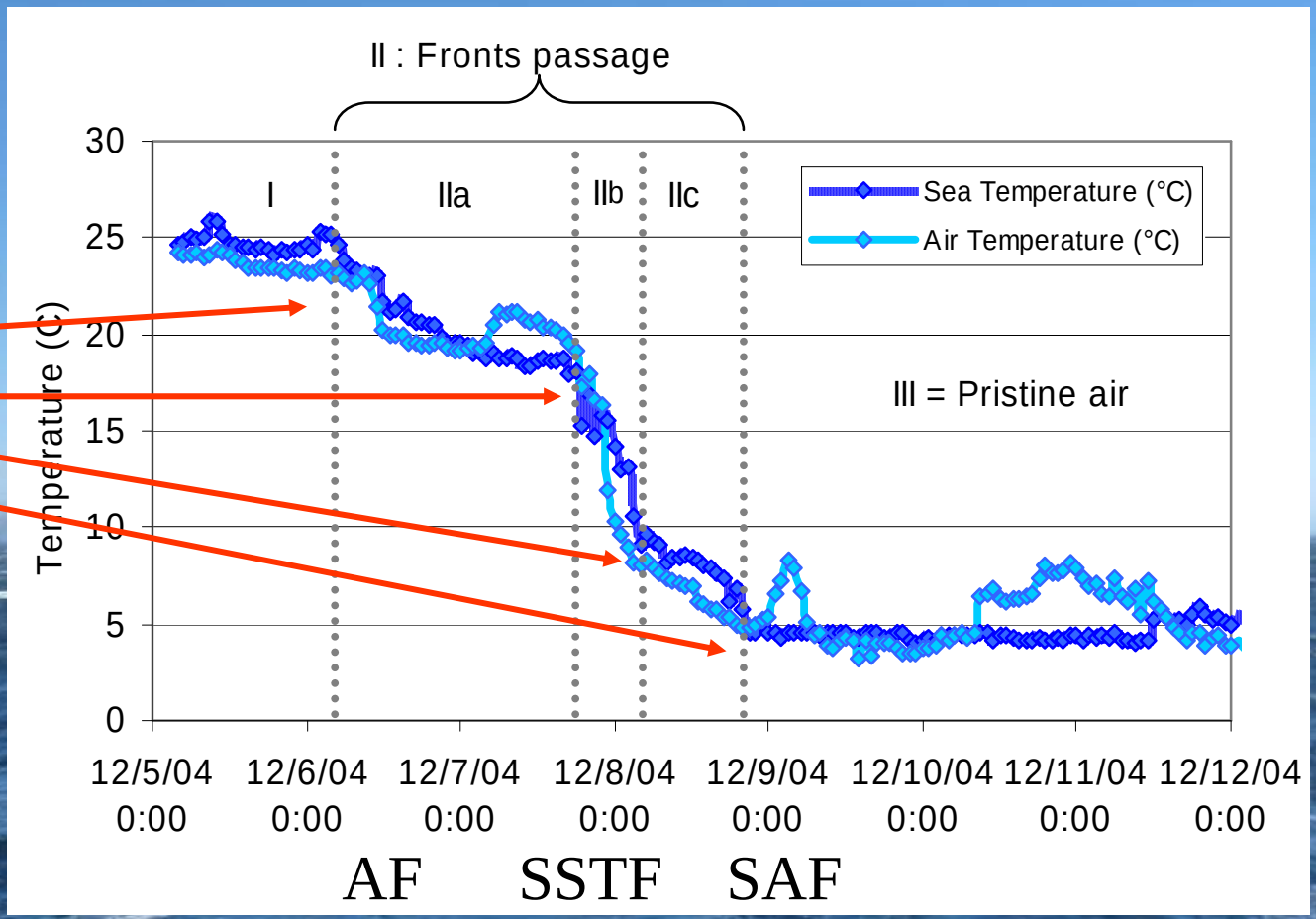


After Belkin et al., 1996

Réunion→ Kerguelen (4-12 Décembre 2004)



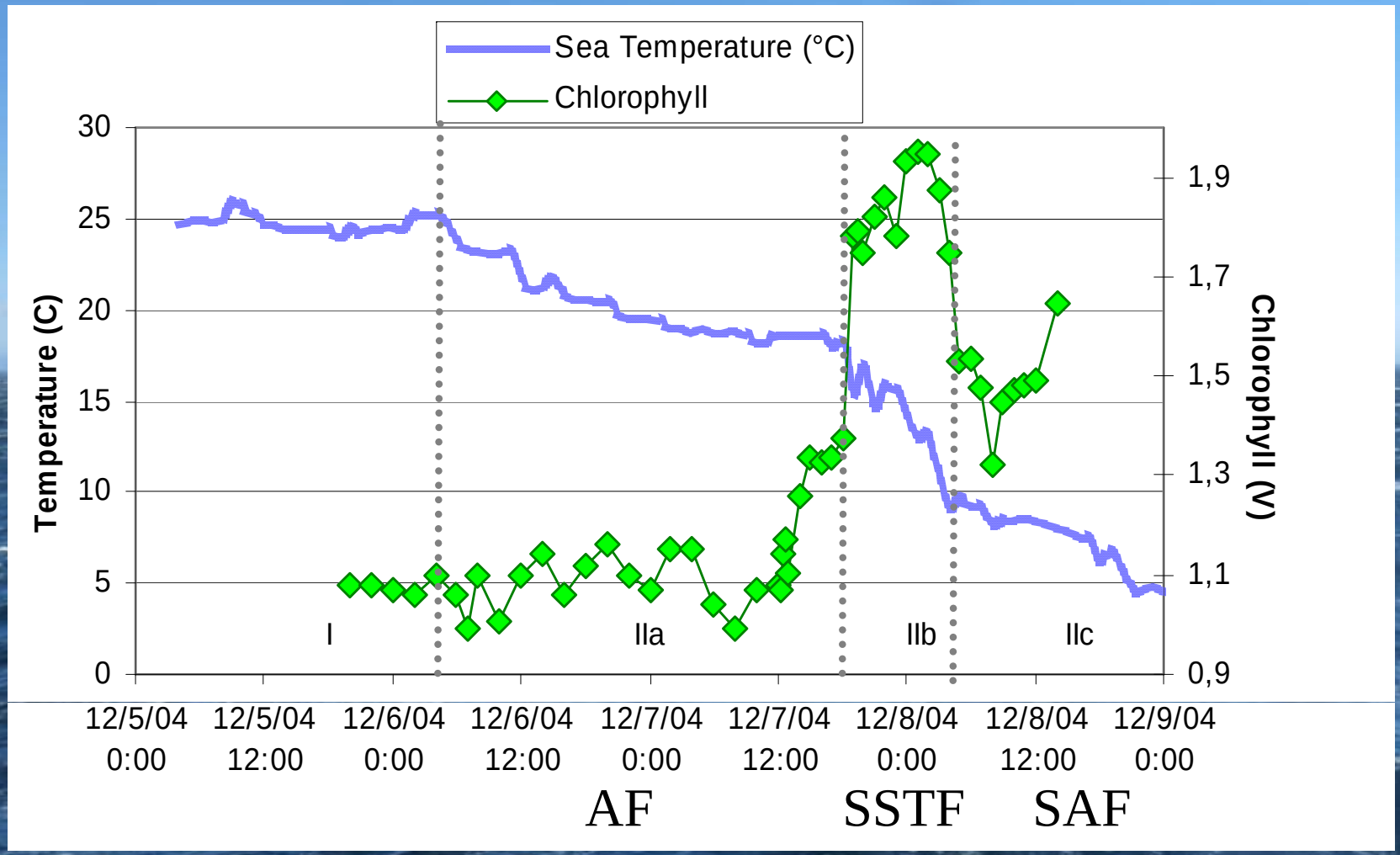
After Belkin et al., 1996



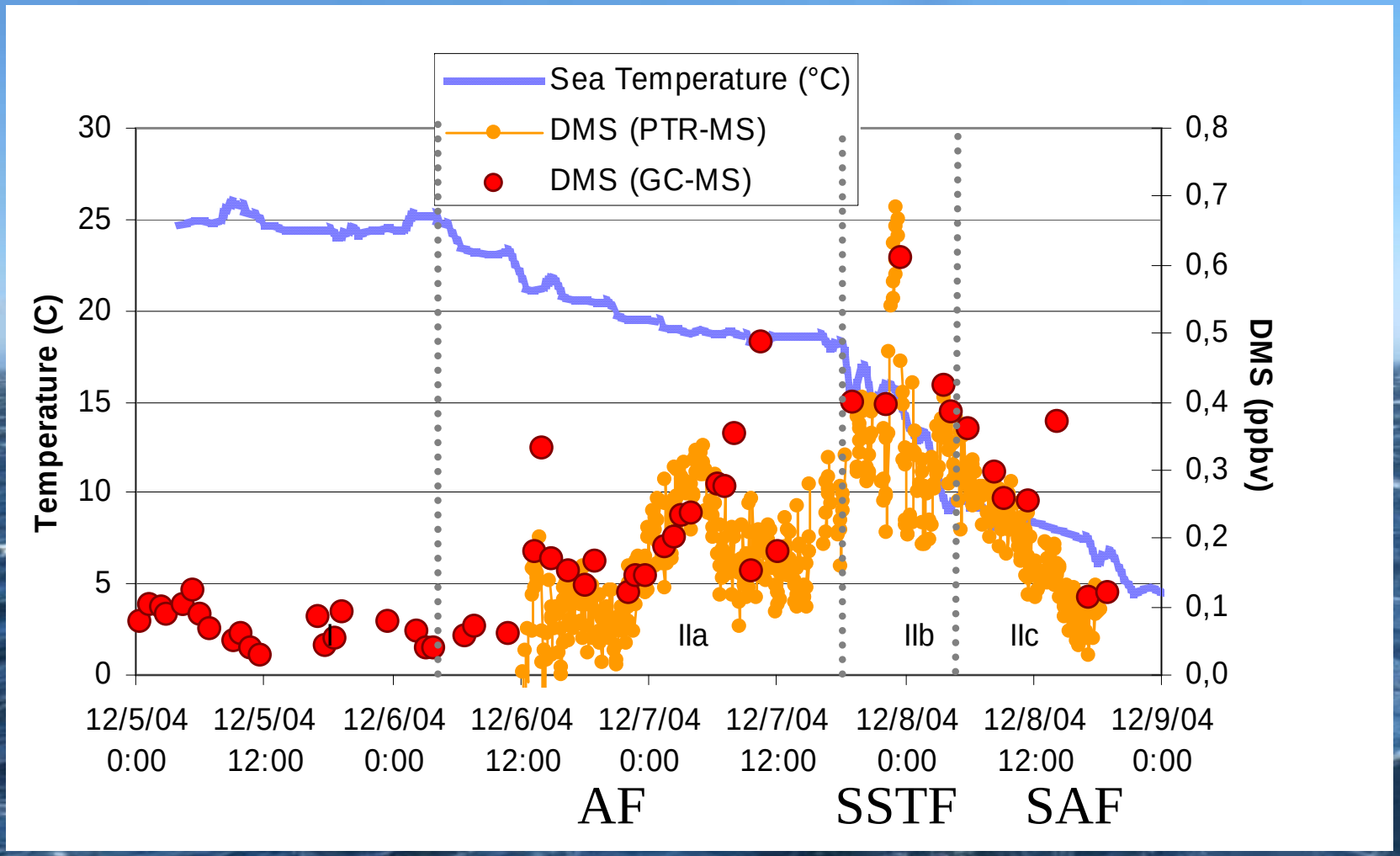
-4 Frontal Zones as described by Belkin et al.

- Pure marine boundary layer between Crozet et Kerguelen

Réunion→ Crozet (4-8 Décembre 2004)



Réunion→ Crozet (4-8 Décembre 2004)

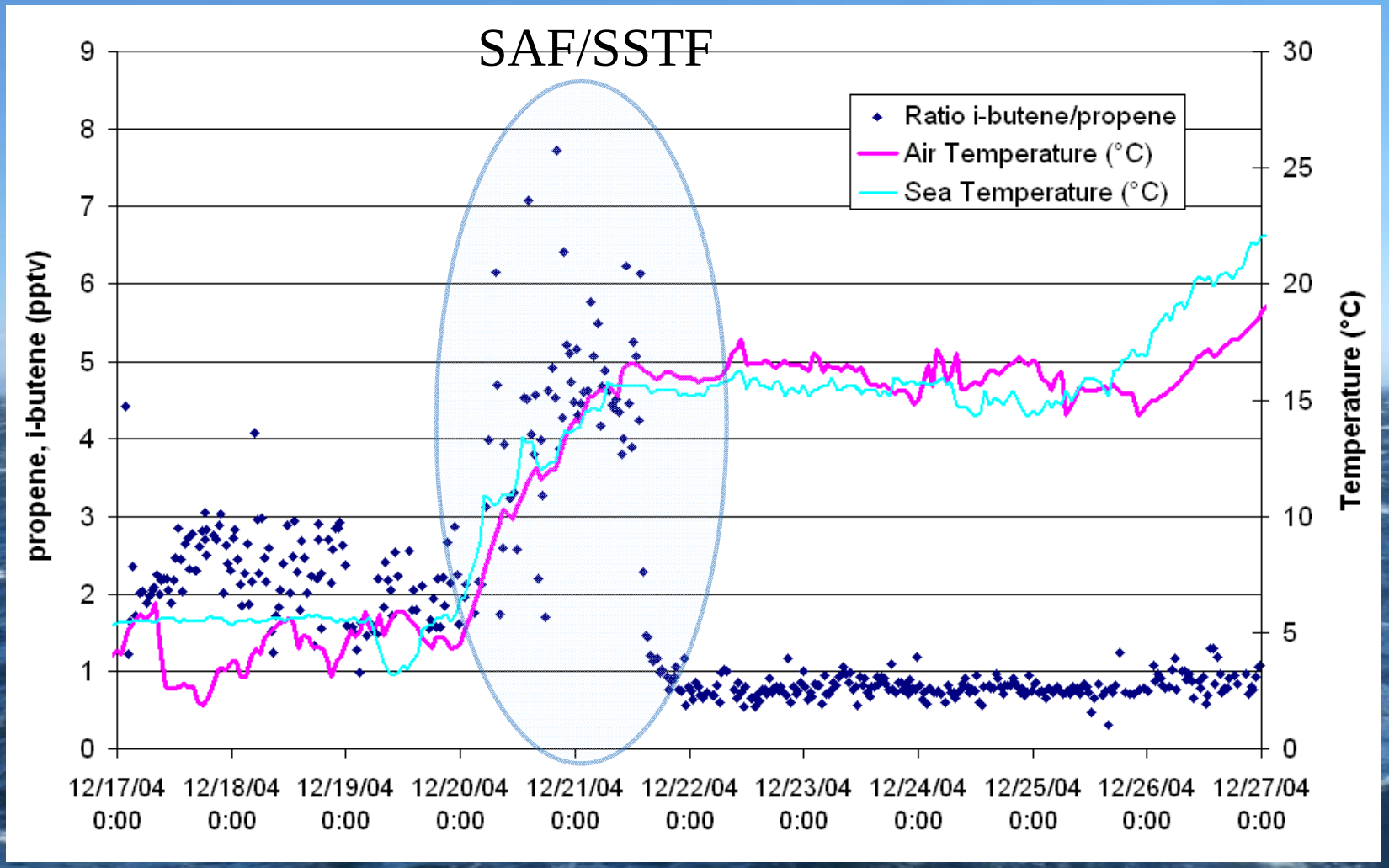


Fronts passage

	I	IIa	IIb	IIc	III
	North of front	*AF*	*SSTF*	*SAF*	South of front
CH3Br (pptv)	6.4 ± 2.3	**9.7 ± 3.0**	**10.7 ± 7.1**	**6.6 ± 1.2**	6.4 ± 1.6
CH2Br2 (pptv)	0.7 ± 0.3	**1.0 ± 0.3**	**1.2 ± 0.8**	**1.7 ± 0.9**	1.2 ± 0.5
CHBr3 (pptv)	3.0 ± 0.8	**2.4 ± 1.0**	**3.0 ± 1.0**	**2.4 ± 0.5**	0.5 ± 0.2
CH3I (pptv)	0.8 ± 0.6	**1.4 ± 1.2**	**1.6 ± 1.4**	0.5 ± 0.1	0.3 ± 0.1
DMS (pptv)	65.3 ± 26.6	**204.3 ± 108.1**	**452.6 ± 105.3**	**252.4 ± 103.8**	90.8 ± 45.6
T air (°C)	23.6±0.4	20.3±1.3	11.3±4.1	6.2±1.2	4.8±0.7
SST (°C)	24.8±0.5	20.0±1.9	13.3±2.5	7.5±1.6	5.2±0.3
Dominant species	**Prochlorococcus**	**Prochlorococcus Haptophytes**	**Diatoms**	**Diatoms and Haptophytes**	**Diatoms**

DMS + halogenes(bromide, iodide)

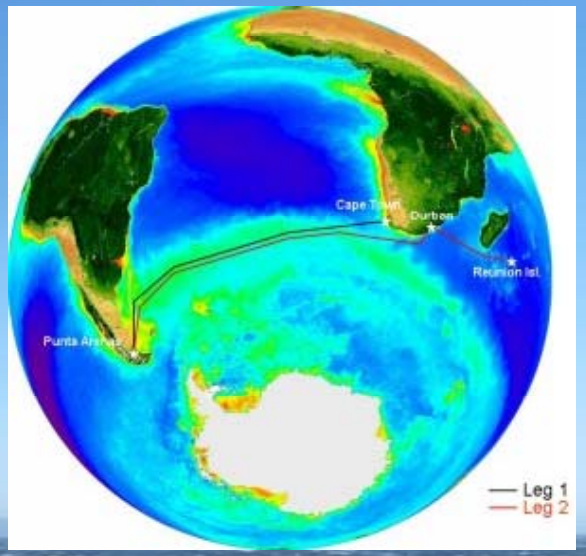
Kerguelen→ Réunion(Décembre 2004)

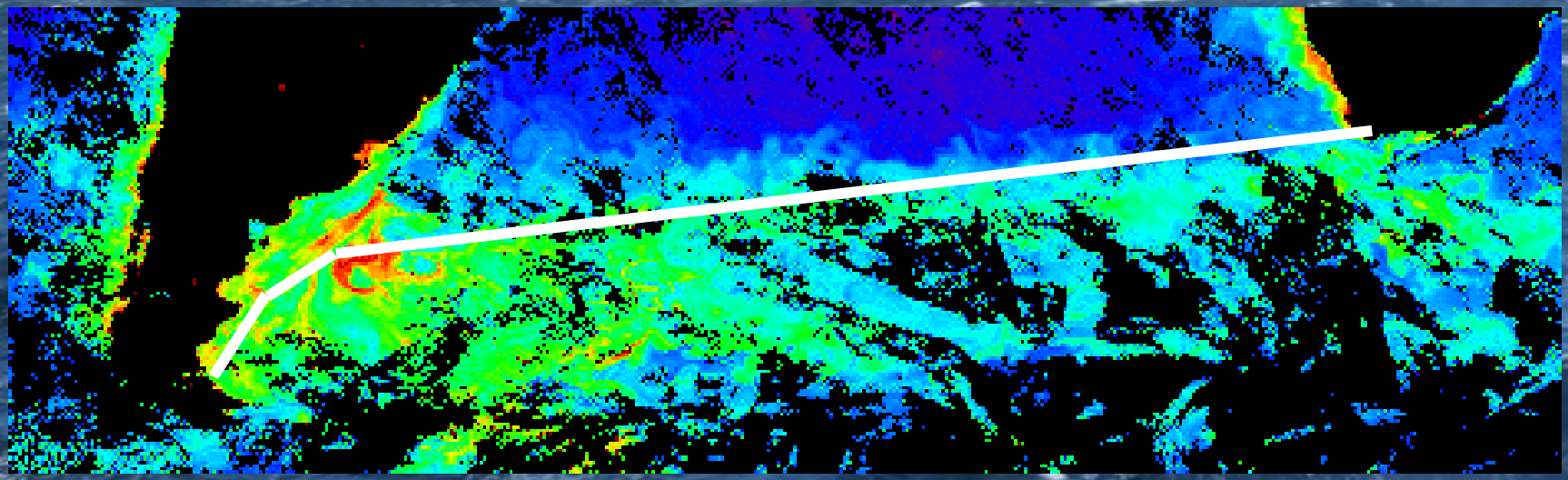


Ship campaigns

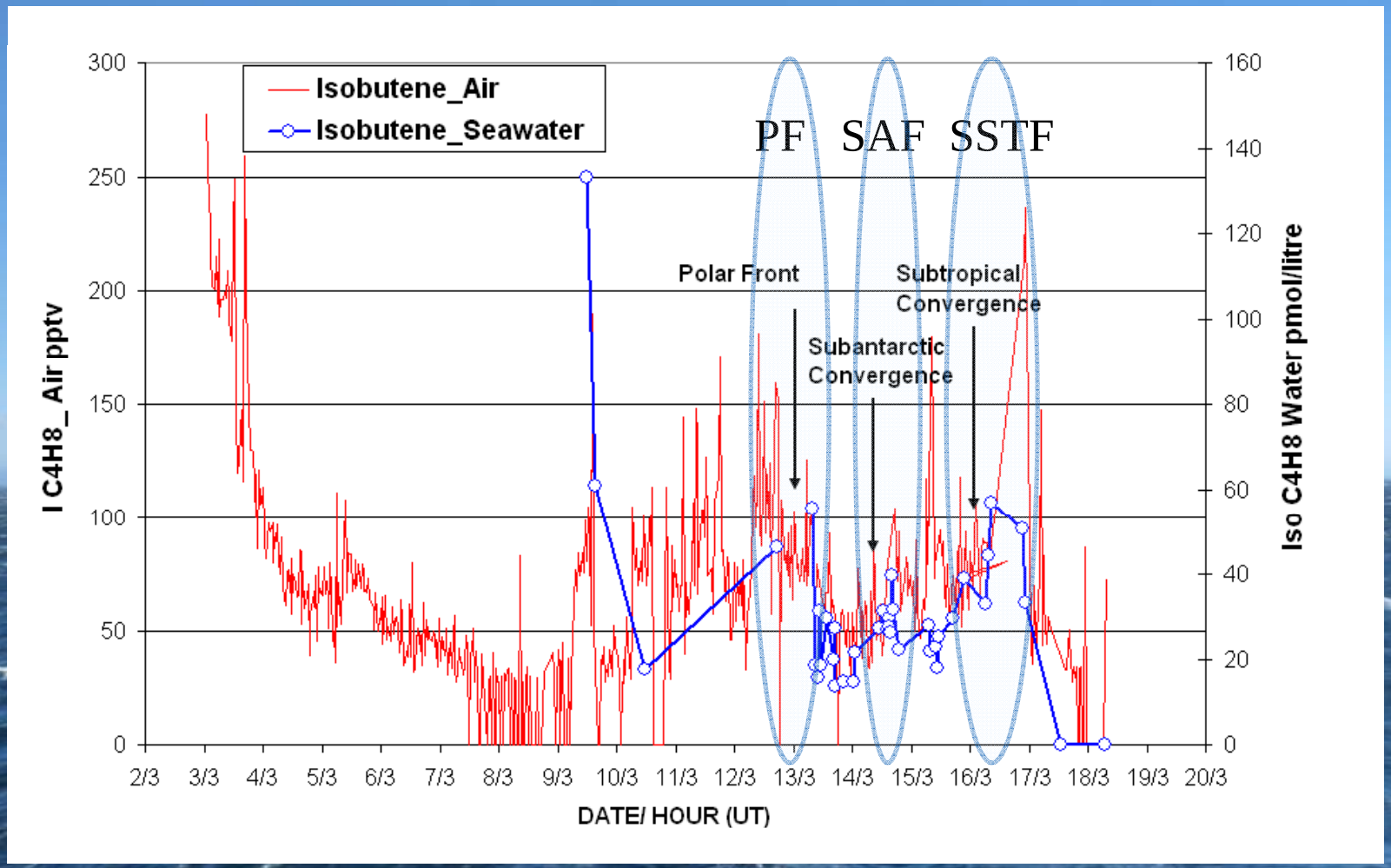
OOMPH project

(jan. Feb 2007)





Punta Arenas → Captown

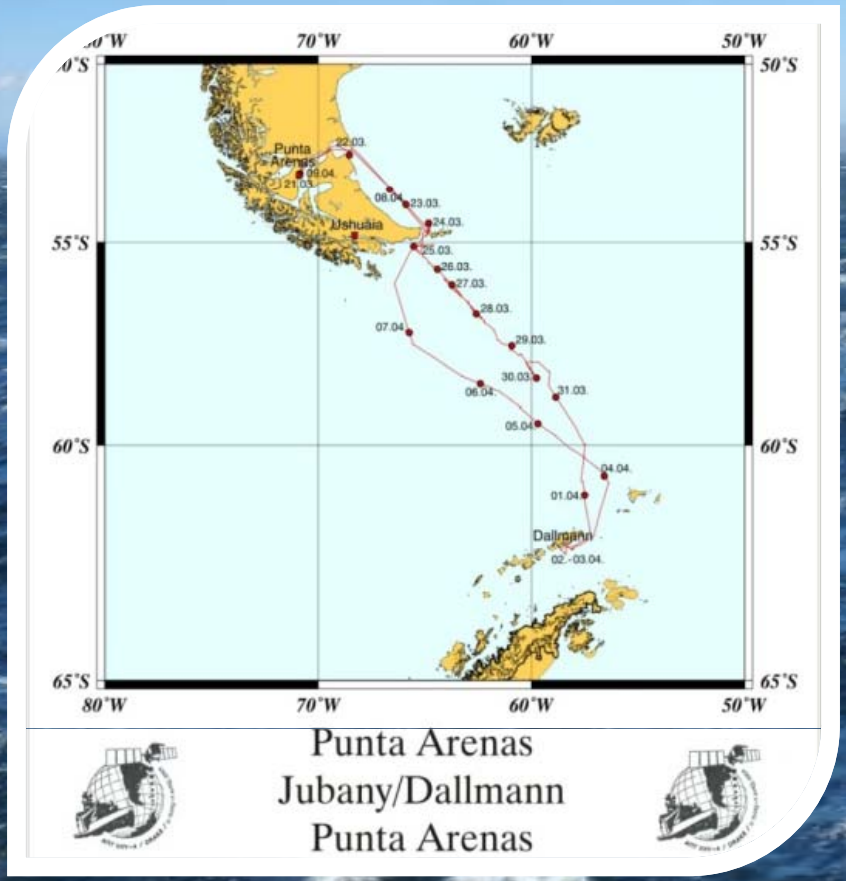


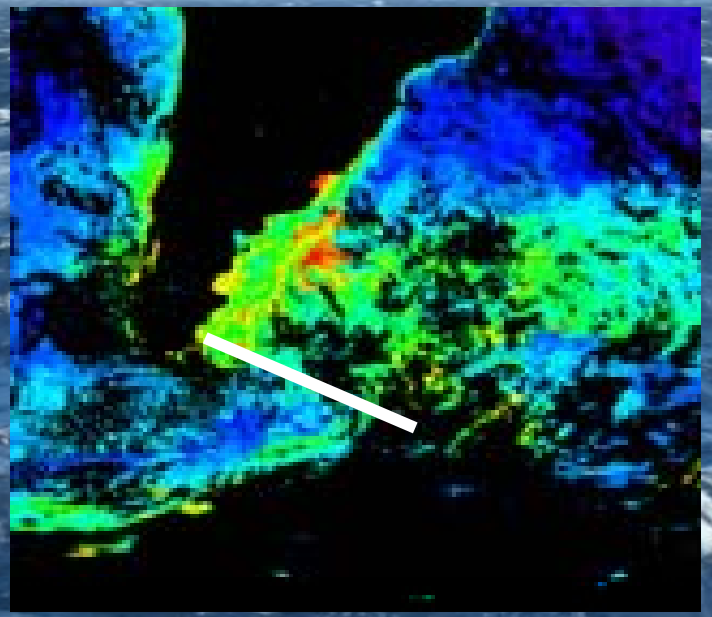
Large variations and an increase in NMHC concentrations in surface waters when crossing frontal systems (iso-butene)

Ship campaigns

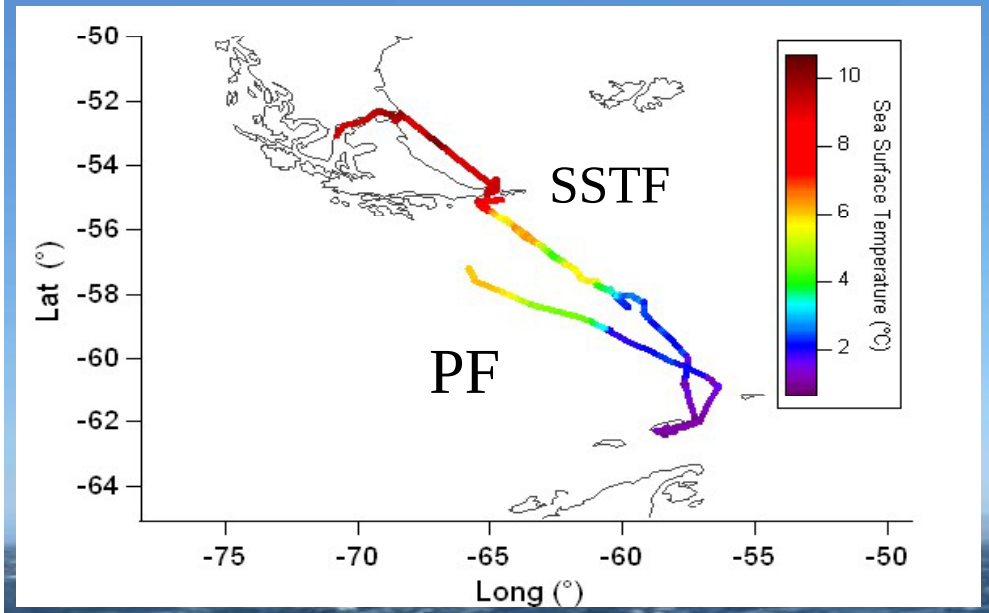
DRAKE project

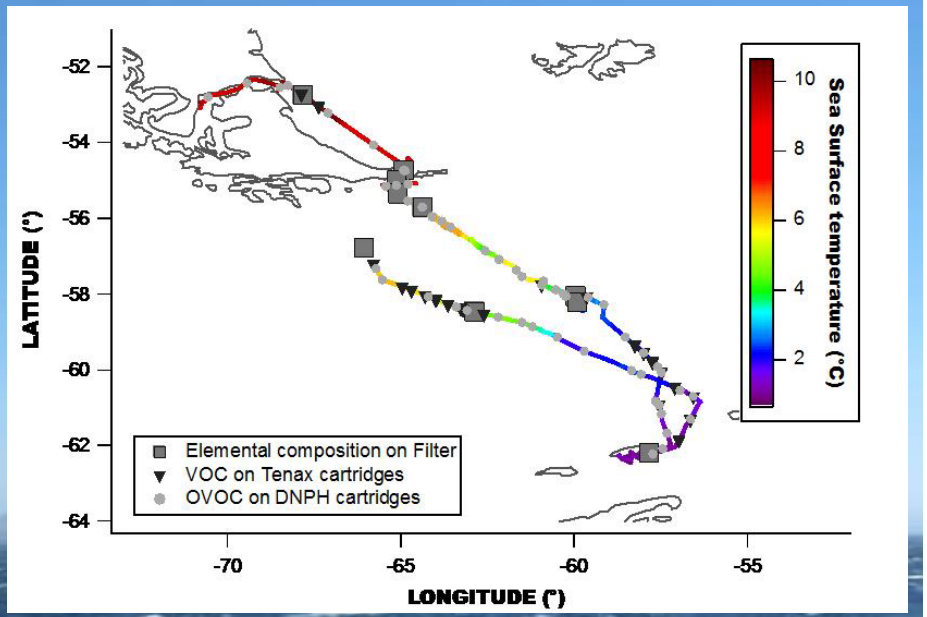
(Mar. Apr 2009)

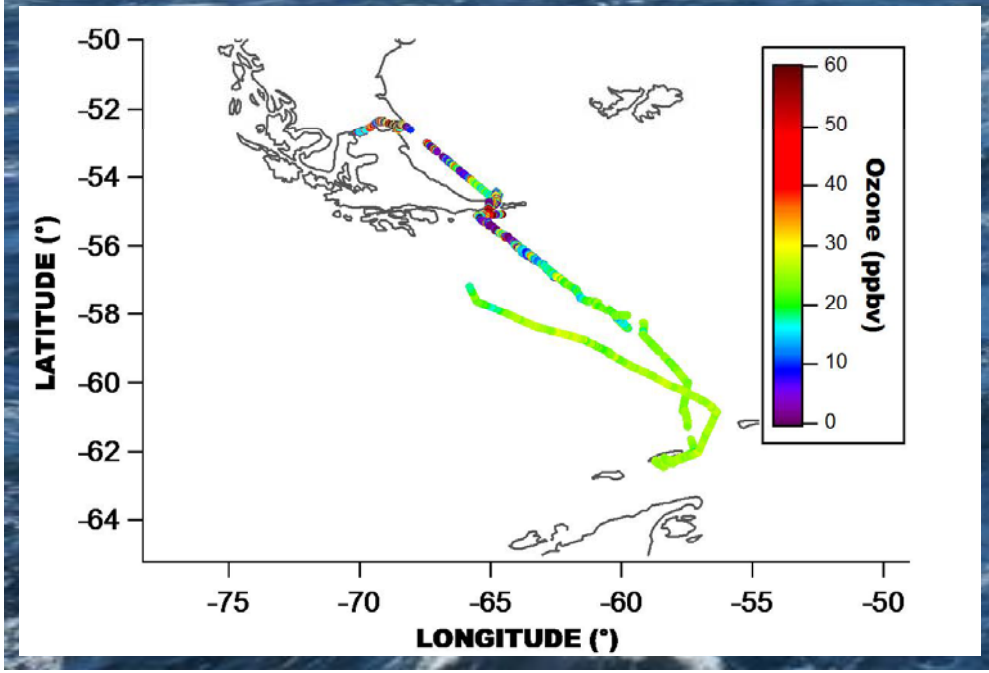


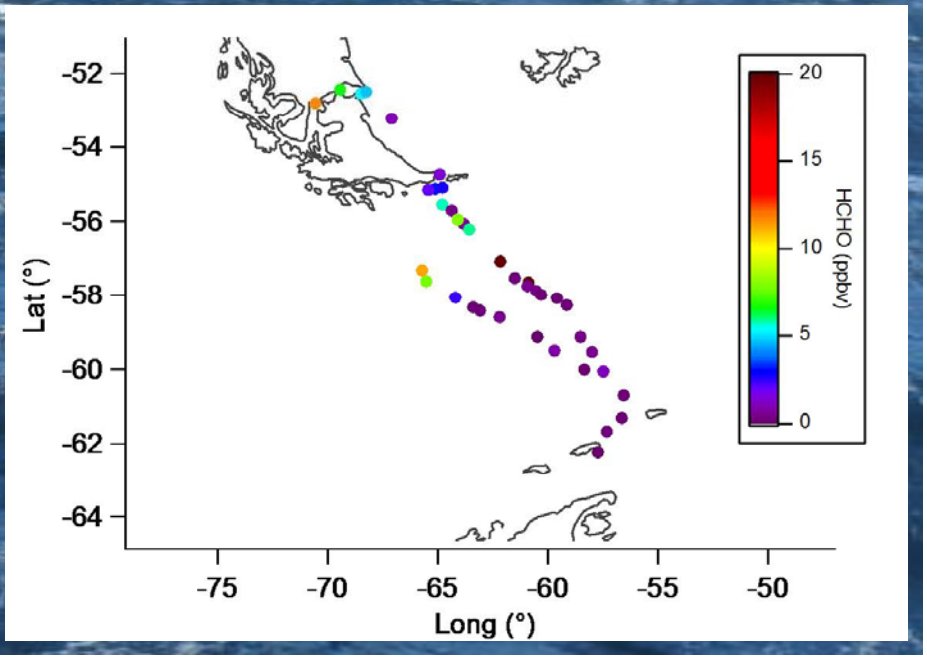


Ship campaigns

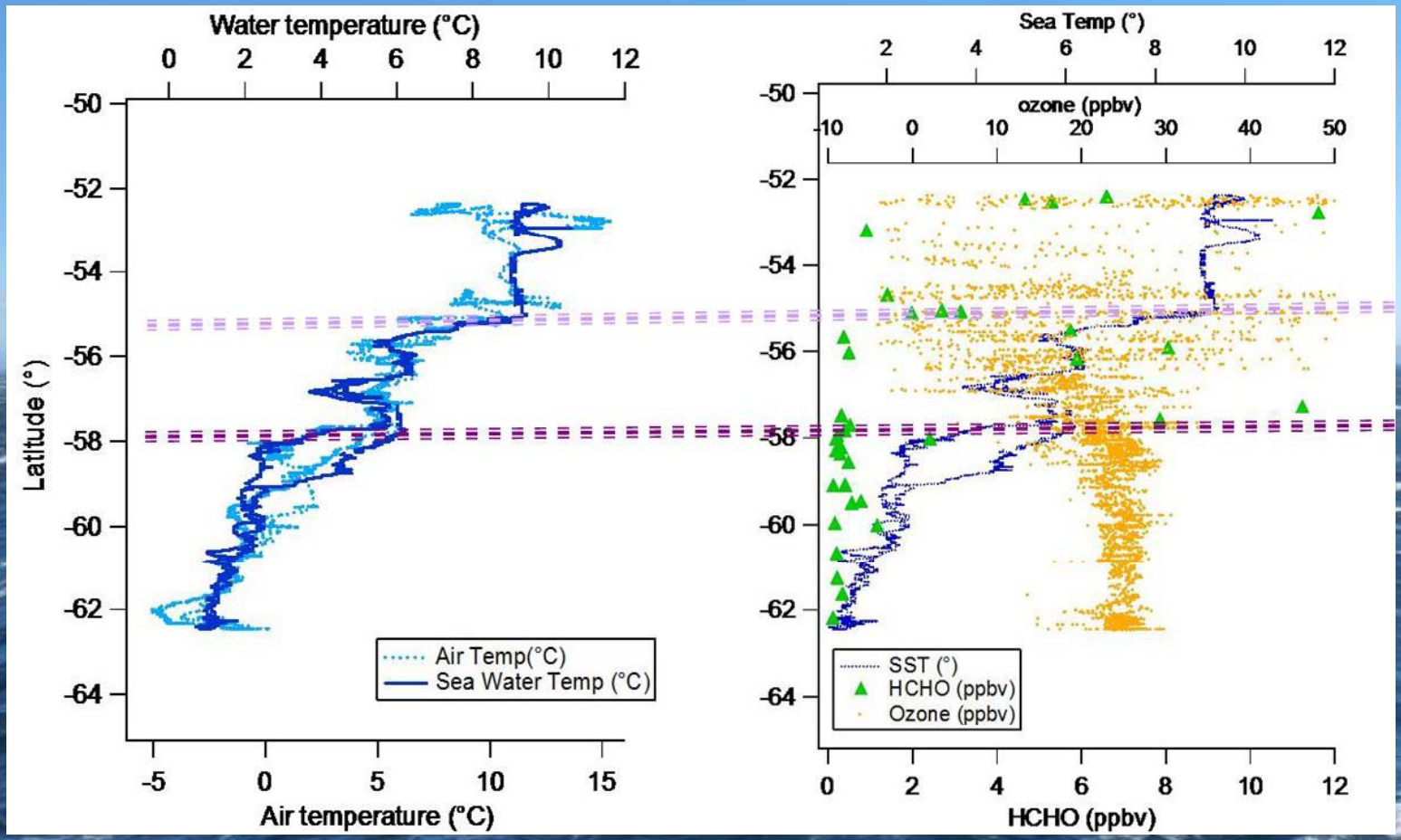






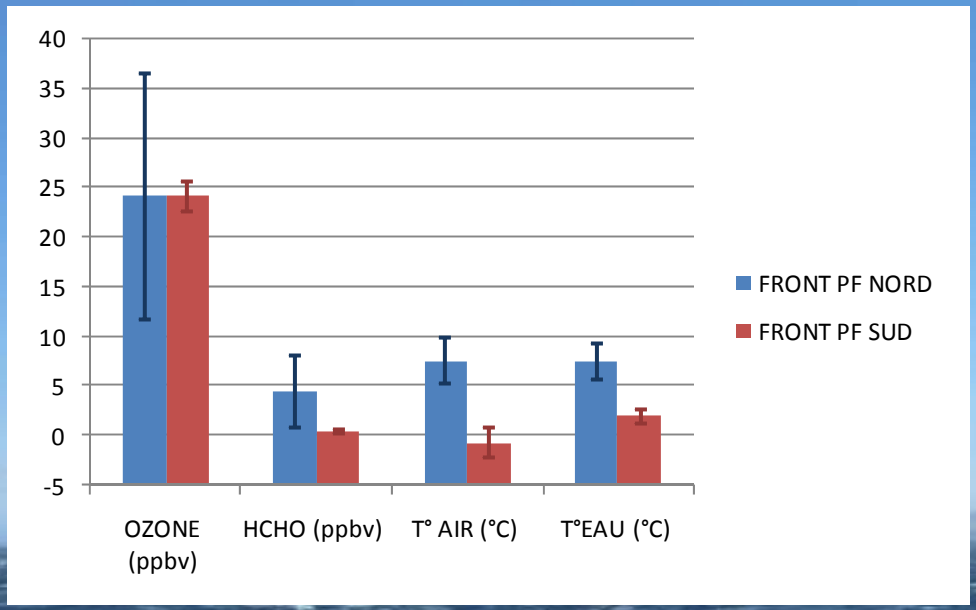


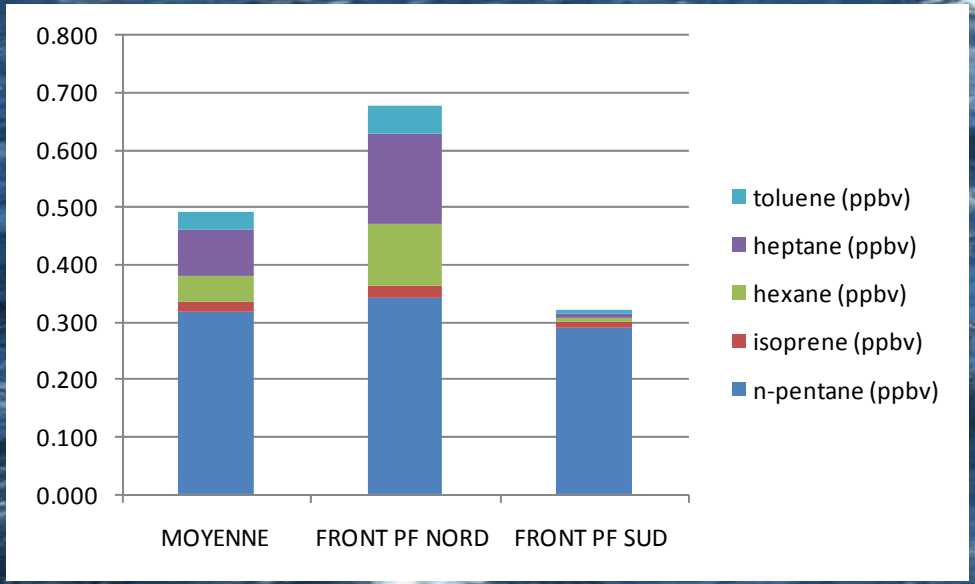
Punta Arenas → Antartica



SSTF

PF





Ozone : moyenne constante mais ecart type + grand → Nord : concentration + variable (sources /puits)

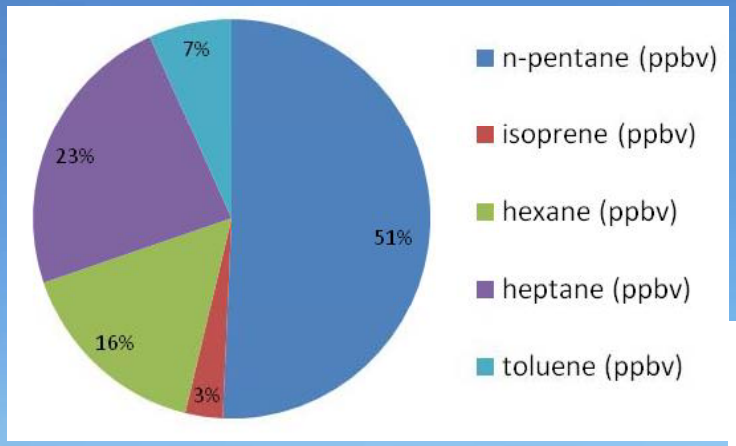
Ozone Sud: constant: background marine boundary layer !

Idem HCHO

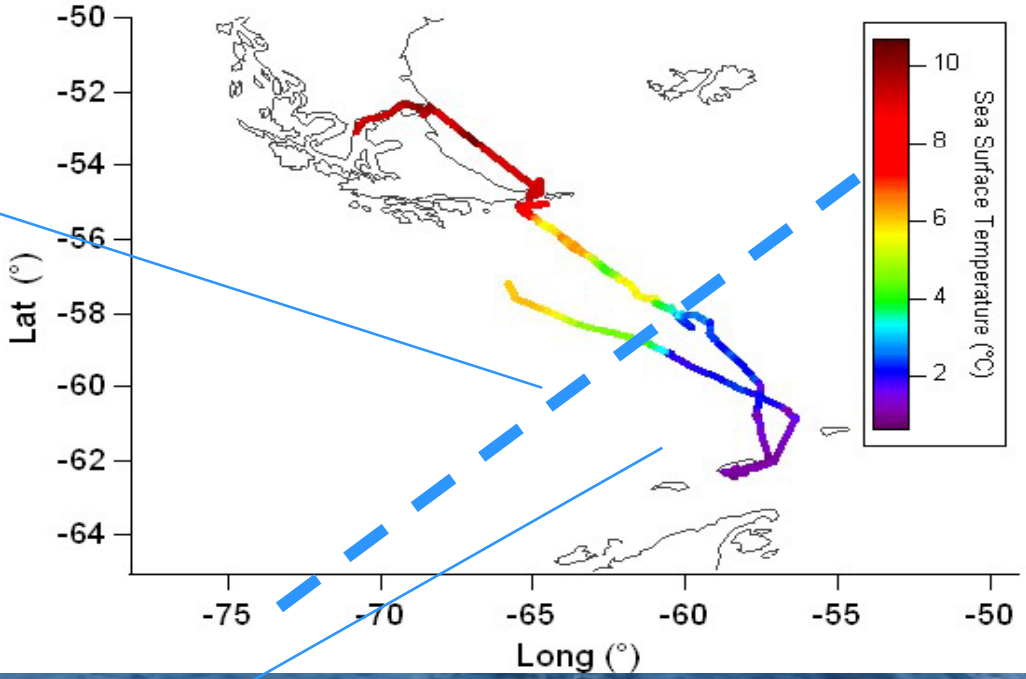
VOC :

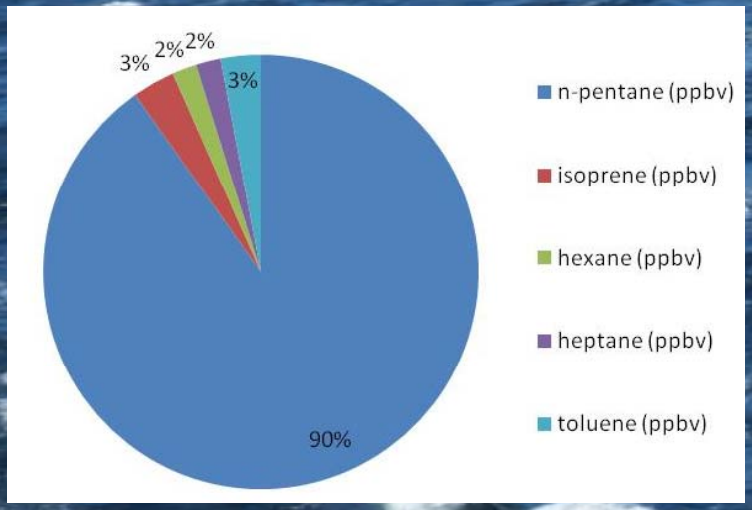
+ nord du front/sud : influence continentale

Au sud: espèces à longue durée de vie > (ie n-pentane)



North of PF





South of PF

Résultats des moyennes et des écarts moyens des concentrations d'ozone, de formaldéhyde et des températures de l'air, de l'eau et des COV.

	Mean *STD*	**North of PF** *STD North*	**South of PF** *STD South*
OZONE (ppbv)	**24.1 ±** *7*	**24.1 ±** *12.4*	**24.1 ±** *1.5*
HCHO (ppbv)	**2.8 ±** *2.8*	**4.5 ±** *3.6*	**0.4 ±** *0.2*
T° AIR (°C)	**3.6 ±** *7.5*	**7.5 ±** *2.3*	**-0.7 ±** *1.5*
T°EAU (°C)	**4.8 ±** *7.4*	**7.4 ±** *1.8*	**2 ±** *0.7*
n-pentane (ppbv)	**0.318 ±** *0.380*	**0.341 ±** *0.460*	**0.289 ±** *0.276*
isoprene (ppbv)	**0.015 ±** *0.007*	**0.020 ±** *0.200*	**0.010 ±** *0.100*
hexane (ppbv)	**0.044 ±** *0.105*	**0.108 ±** *0.169*	**0.006 ±** *0.004*
heptane (ppbv)	**0.082 ±** *0.176*	**0.158 ±** *0.246*	**0.006 ±** *0.002*
toluene (ppbv)	**0.031 ±** *0.087*	**0.046 ±** *0.112*	**0.010 ±** *0.006*

Thank YOU!!