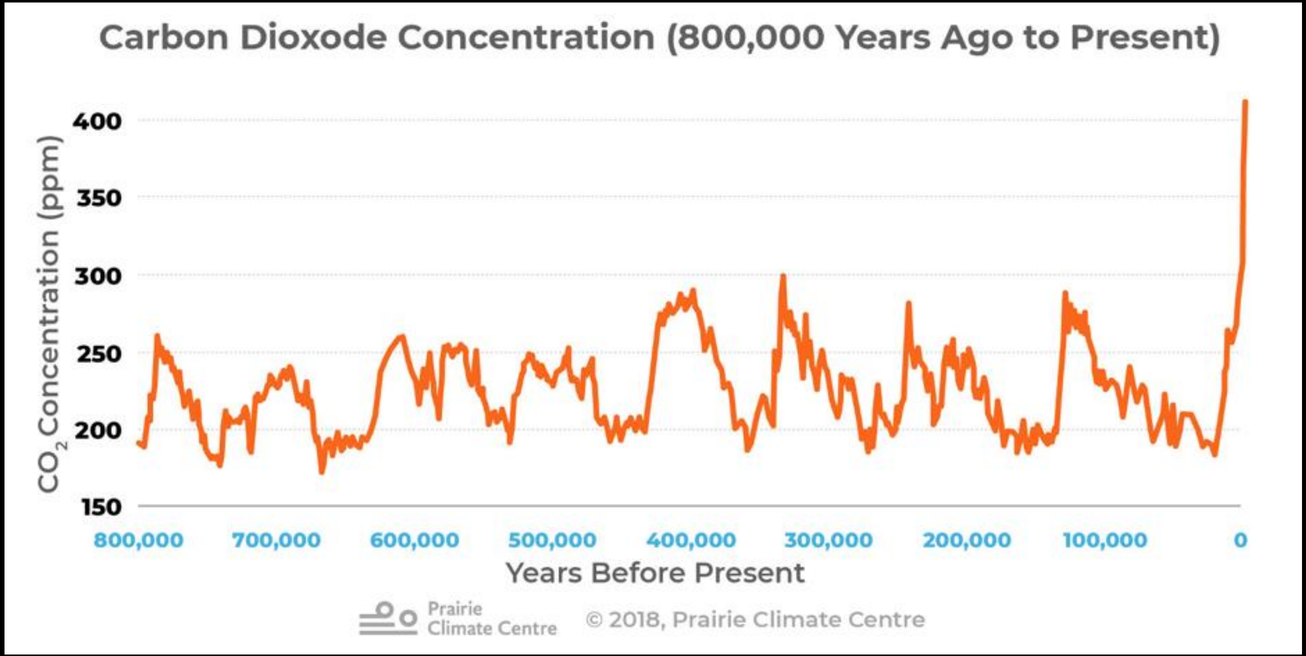
The future of our oceans

- Dr. Jan-Lukas Menzel Barraqueta -
European Ecological Consulting SL

NAMIBIA SCIENCE WEEK
08.11.2023

https://www.youtube.com/watch?v=0Z8g-smE2sk

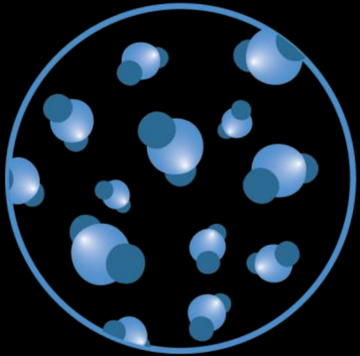


RATES OF CHANGE……

……NEVER SEEN BEFORE

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

CO_2 concentration



Highest in at least 2 million years

Sea level rise

Fastest rythm in at least 3.000 years

Artic sea ice

Lowest level in at least 1.000 years

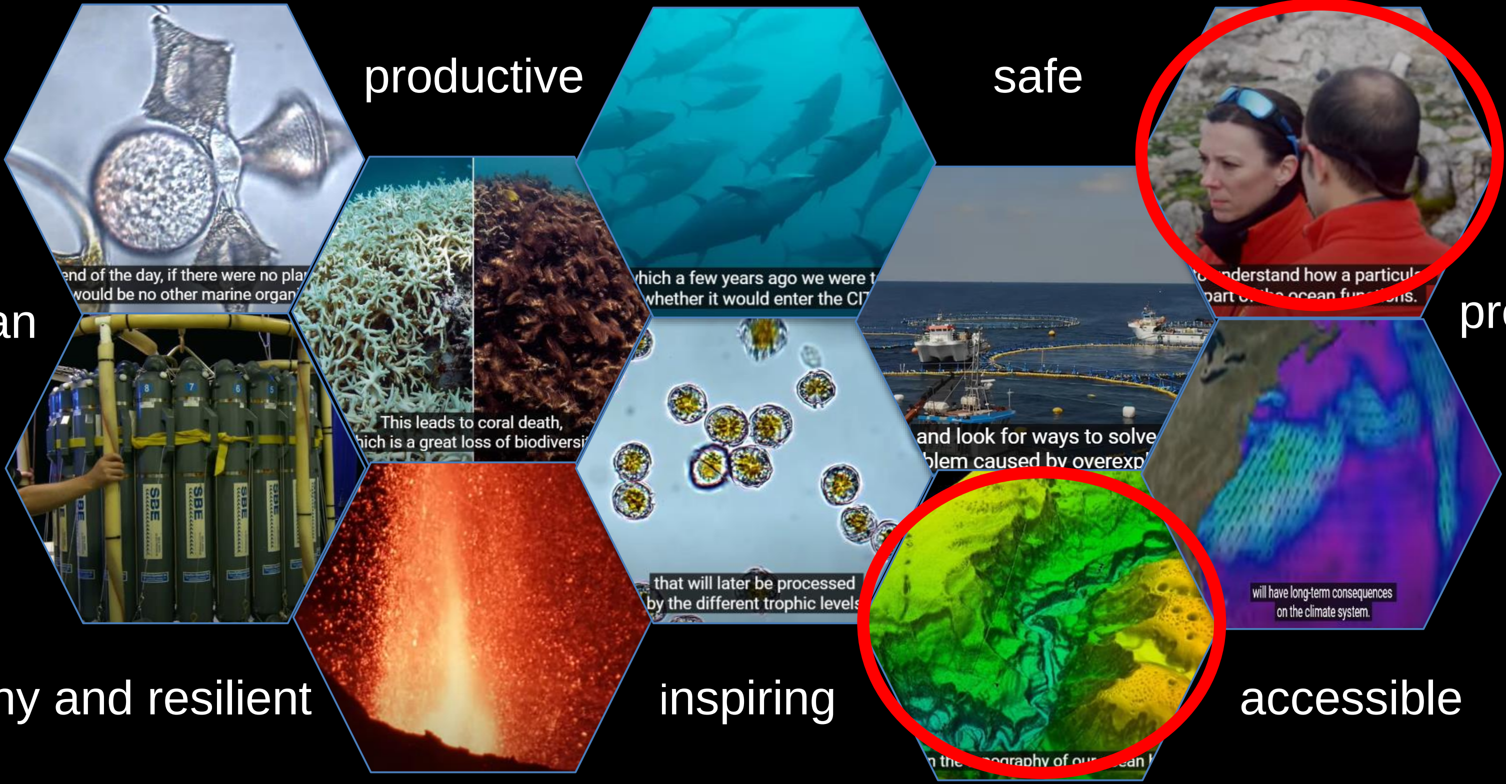
Glacier retreat

Unprecedented in at least 2.000 years

TEMPERATURE INCREASE

IN ALL SYSTEMS

"The science we need for the ocean we want"



productive

safe

clean

predictable

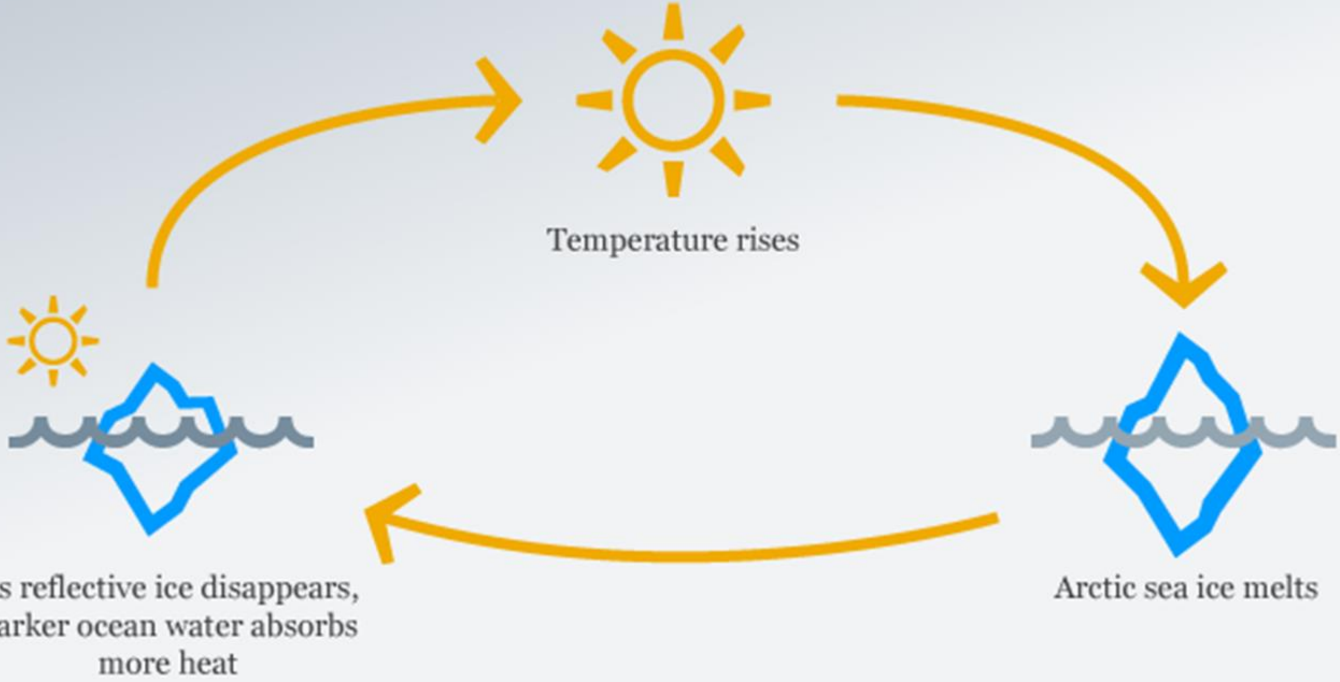
healthy and resilient

inspiring

accessible

OCEAN´S

Melting of Arctic sea ice feedback loop



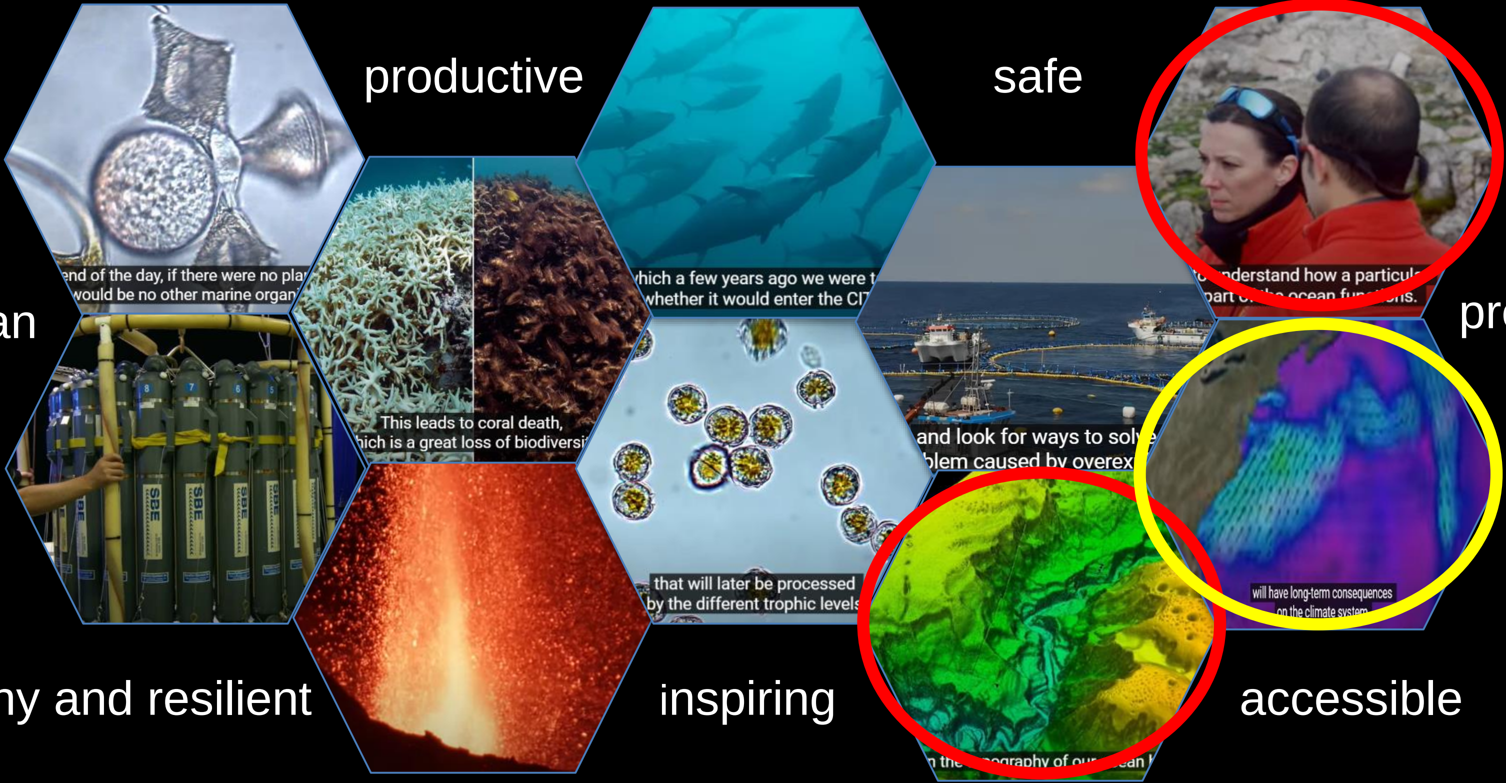
Source: National Academies of Sciences, Engineering, and Medicine

Hard core small science

One area

Extrapolation

"The science we need for the ocean we want"



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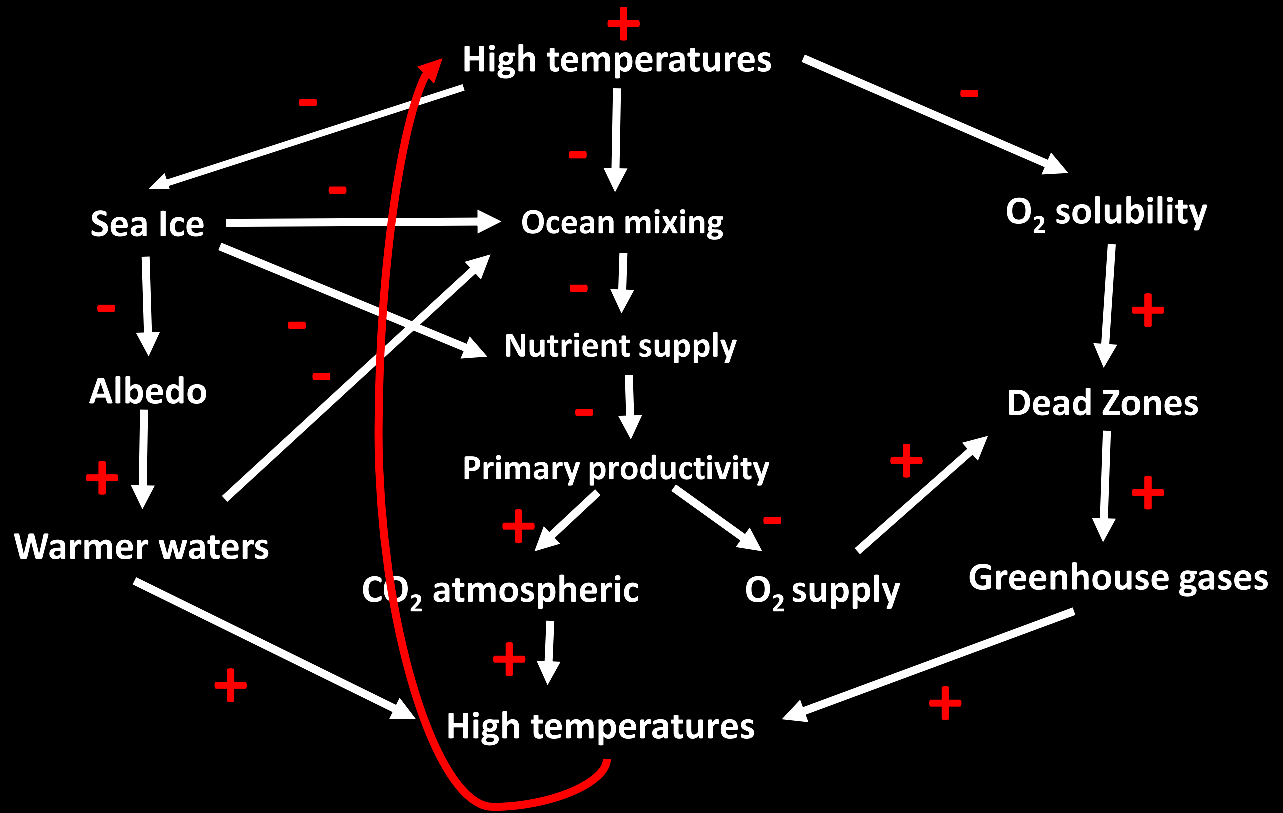
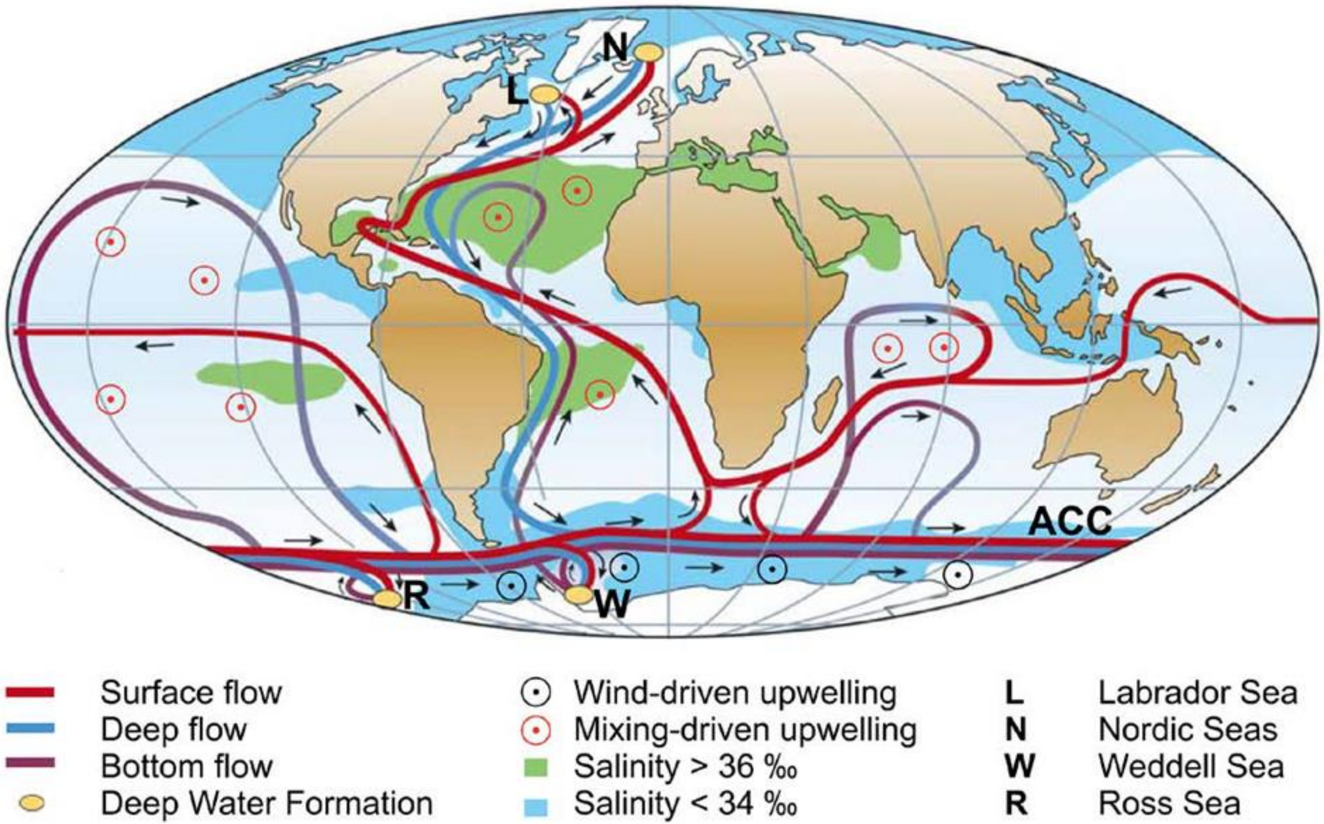

+
High temperatures
-
-
-
Sea Ice
Ocean mixing
O$_2$ solubility
-
-
+
-
Nutrient supply
Albedo
-
-
Dead Zones
+
Primary productivity
+
+
-
+
Warmer waters
CO$_2$ atmospheric
O$_2$ supply
Greenhouse gases
+
+
+
High temperatures


N
L
ACC
R
W
Surface flow
Deep flow
Bottom flow
Deep Water Formation
Wind-driven upwelling
Mixing-driven upwelling
Salinity > 36 ‰
Salinity < 34 ‰
L Labrador Sea
N Nordic Seas
W Weddell Sea
R Ross Sea

Past 50 years oxygen depleted waters have expanded fourfold

→ **Up to 40% loss of oxygen in some areas**

Deoxygenation can accelerate global warming
(Marine production of greenhouse gases under low oxygen conditions)

Letter | Published: 16 February 2017

Decline in global oceanic oxygen content during the past five decades

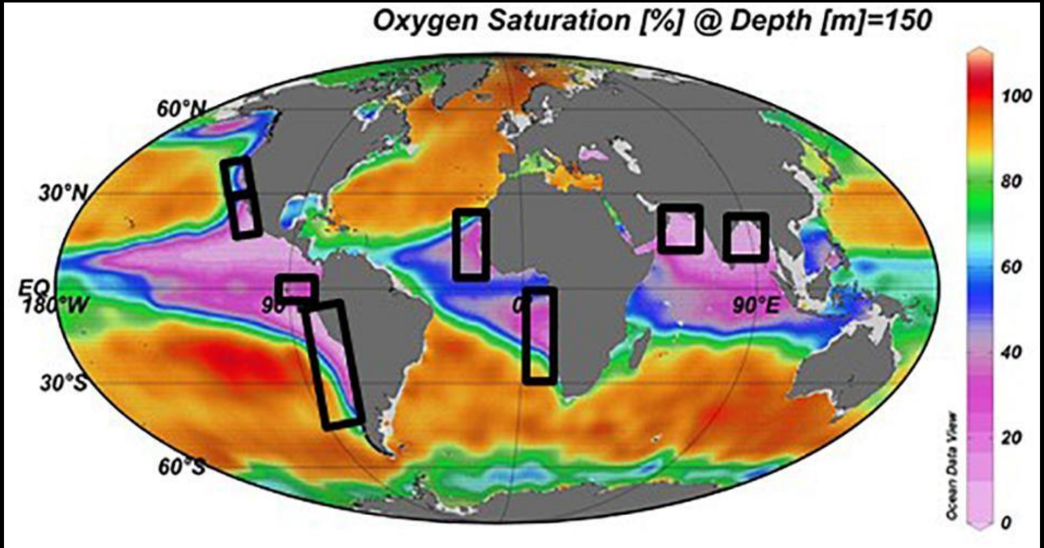
Sunke Schmidtko, Lothar Stramma & Martin Visbeck

Nature **542**, 335–339(2017) | Cite this article

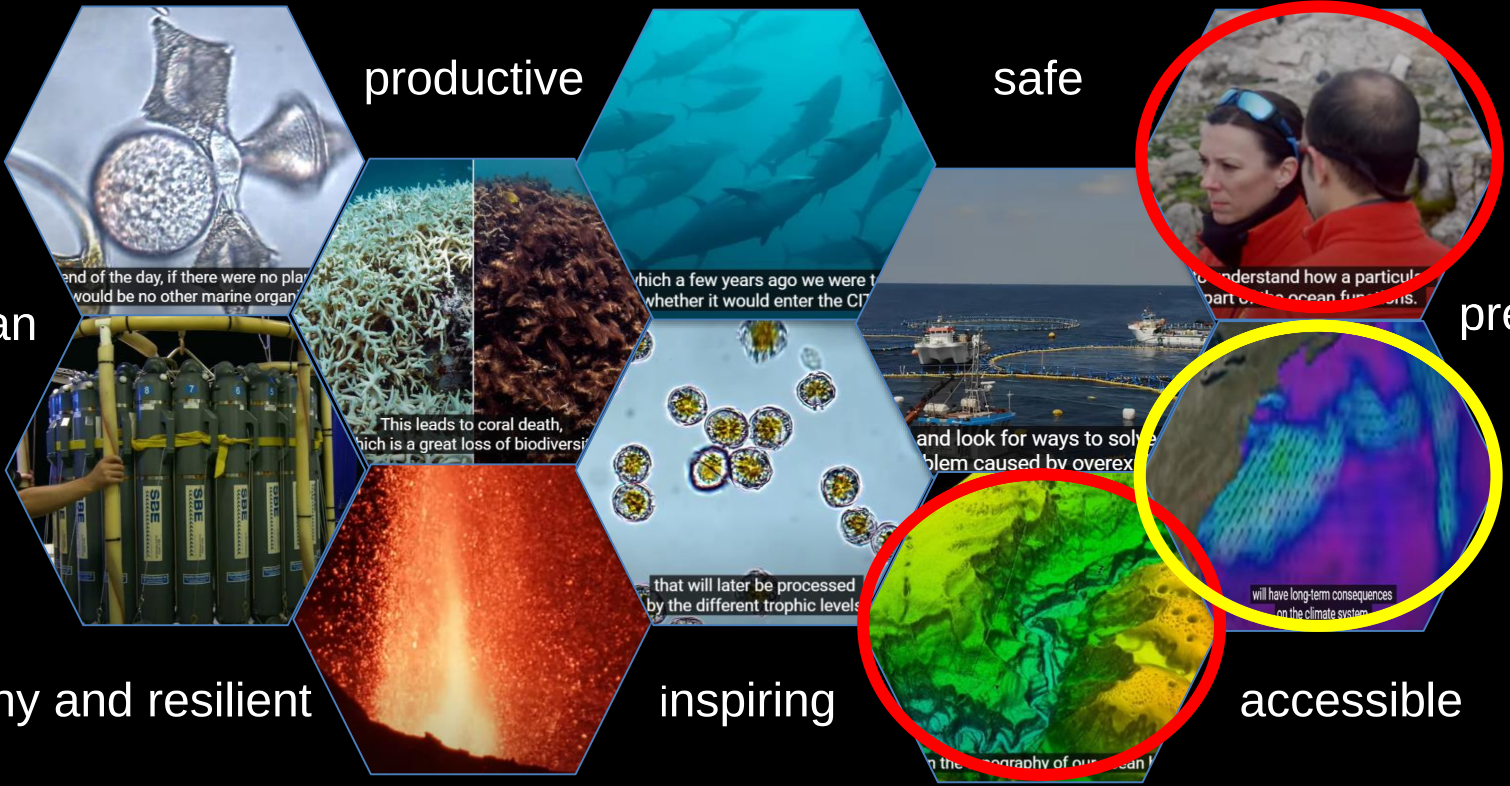
Expanding Oxygen-Minimum Zones in the Tropical Oceans

Lothar Stramma[1,*], Gregory C. Johnson[2], Janet Sprintall[3], Volker Mohrholz[4]
+ See all authors and affiliations

Science 02 May 2008:
Vol. 320, Issue 5876, pp. 655-658
DOI: 10.1126/science.1153847



"The science we need for the ocean we want"



productive

safe

clean

predictable

healthy and resilient

inspiring

accessible

OCEAN´S

ALUMINUM

Dust
Dust
Dust

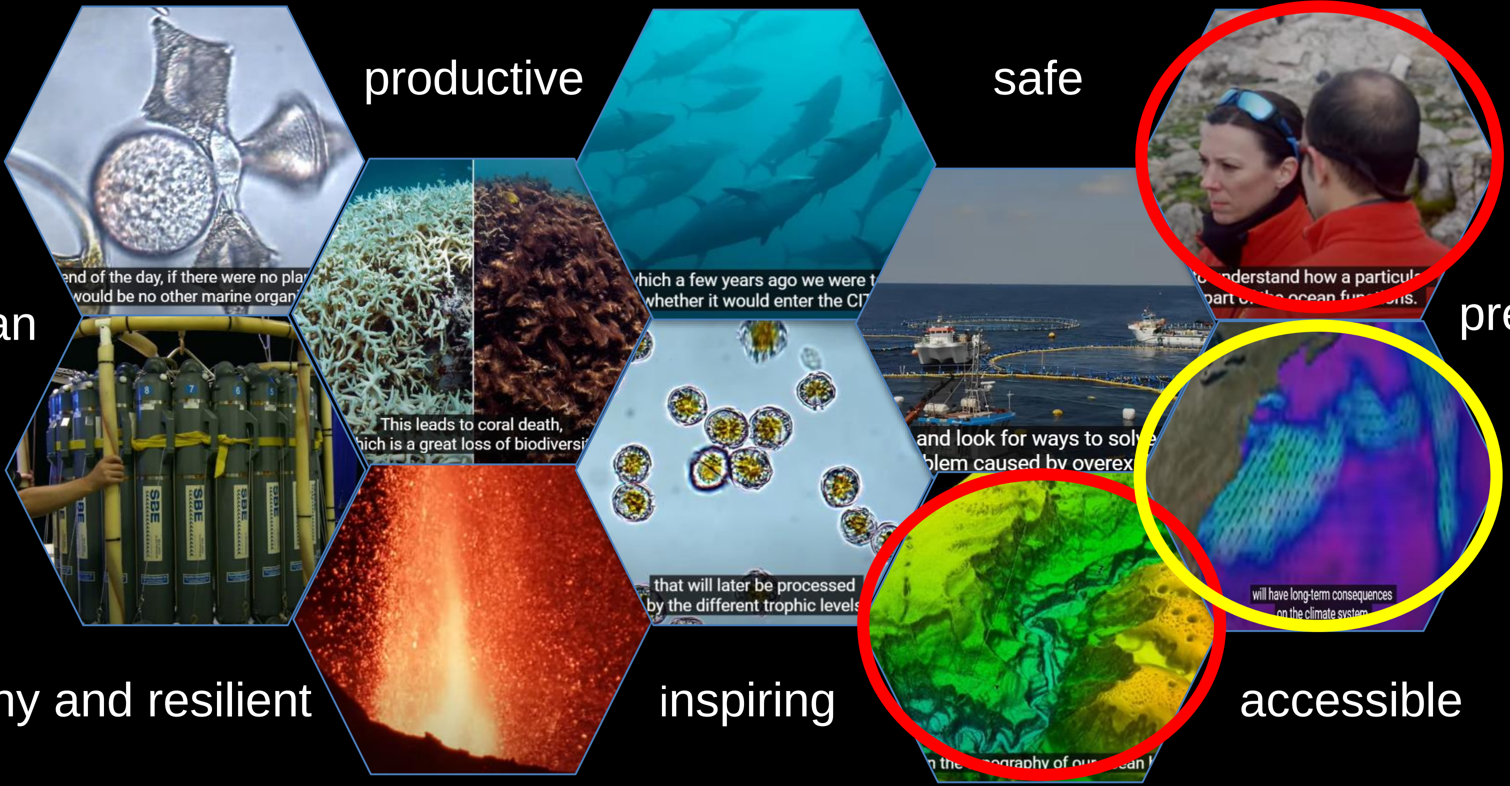
"The science we need for the ocean we want"

productive

safe

clean

predictable

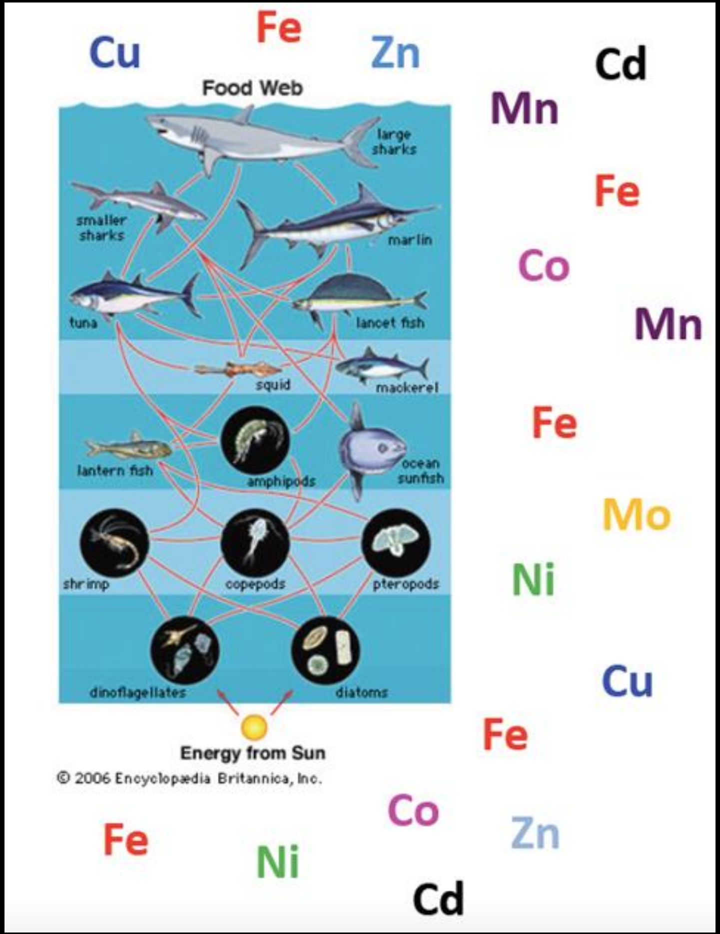


healthy and resilient

inspiring

accessible

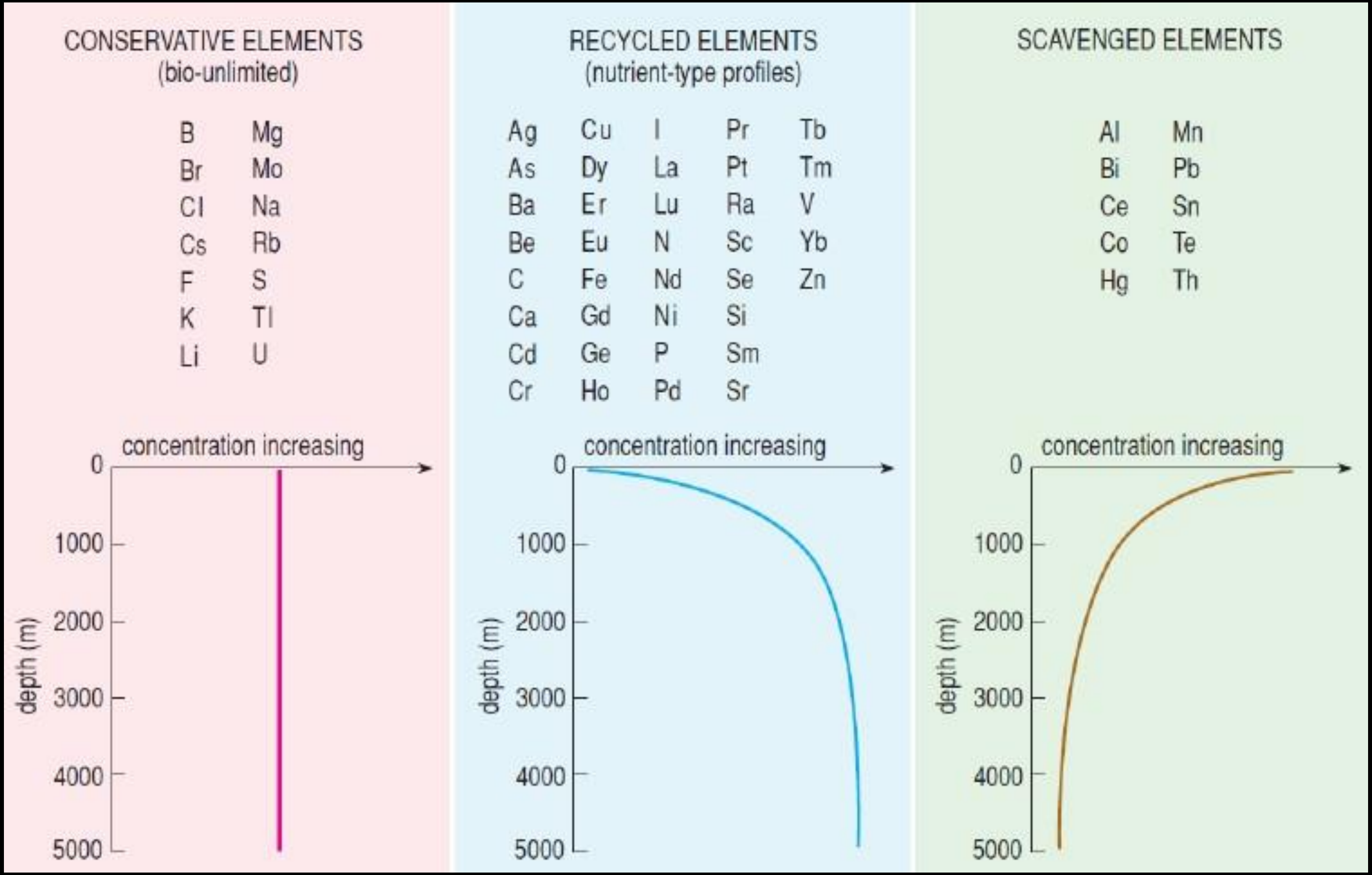
OCEAN´S



Nutrients(micro)

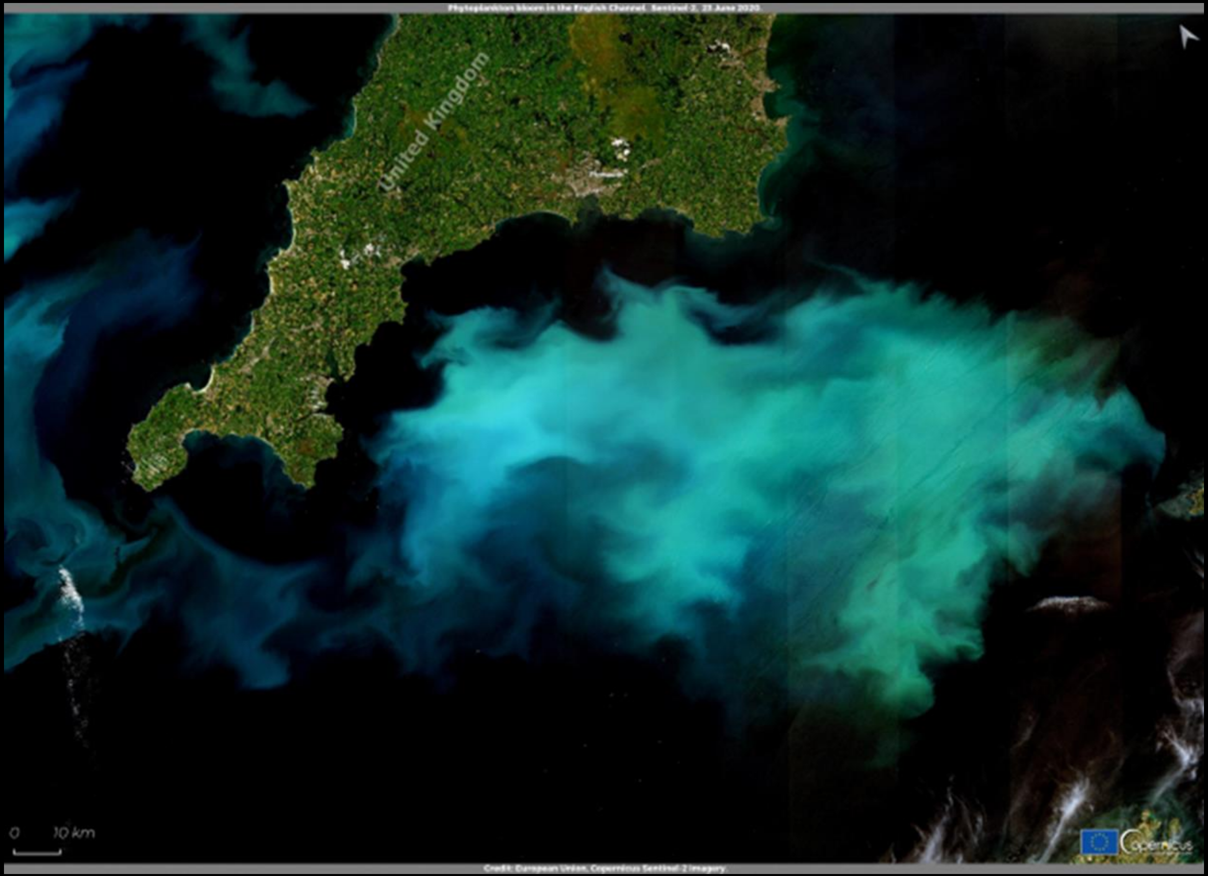
Pollution indicators

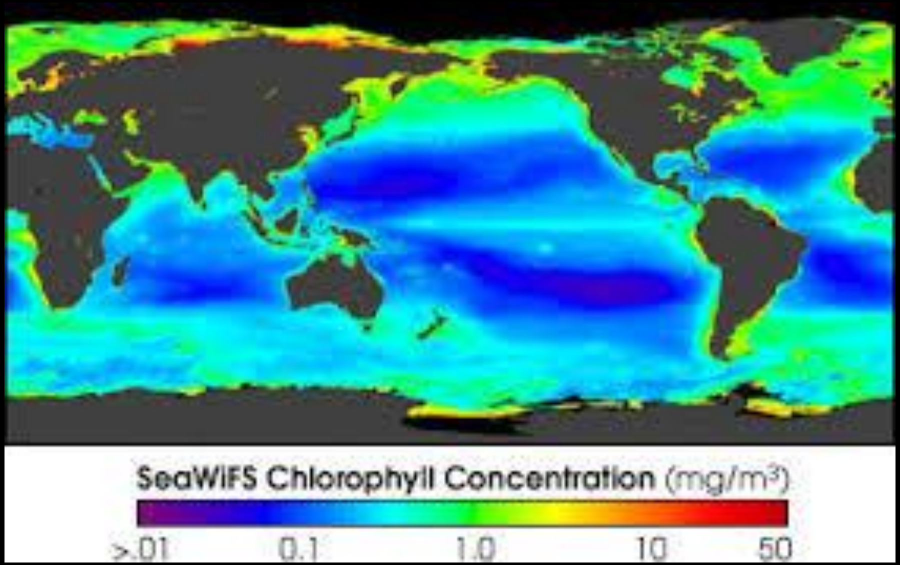
Tracers of processes



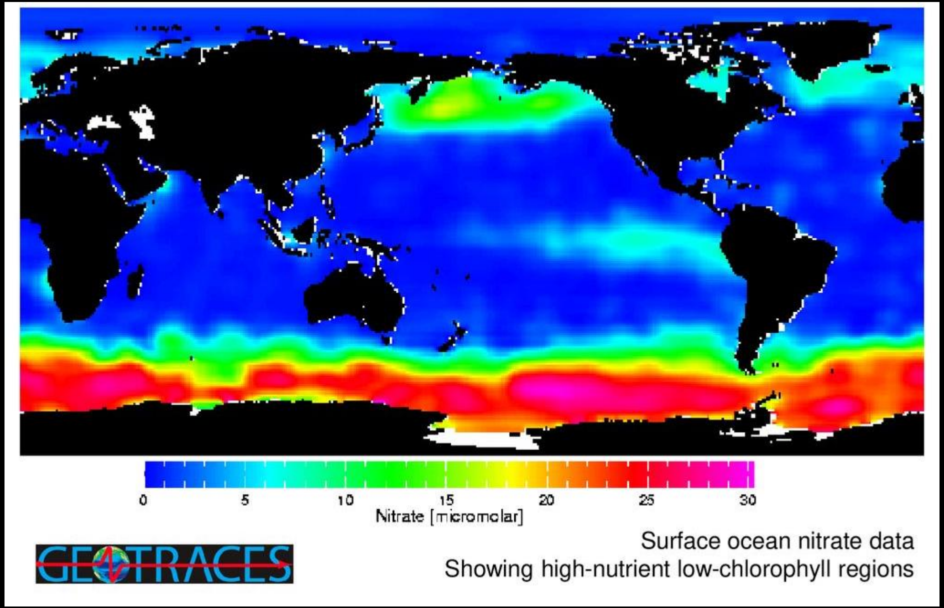
Chemical oceanography 4th, Millero

¿What is this?


Phytoplankton bloom in the English Channel. Sentinel-2, 23 June 2020.
United Kingdom
0 10 km
Copernicus
Credit: European Union, Copernicus Sentinel-2 imagery.



https://oceancolor.gsfc.nasa.gov/SeaWiFS/



Phytoplankton captures up to 40% of the atmospheric CO_2 and produces 50% of O_2

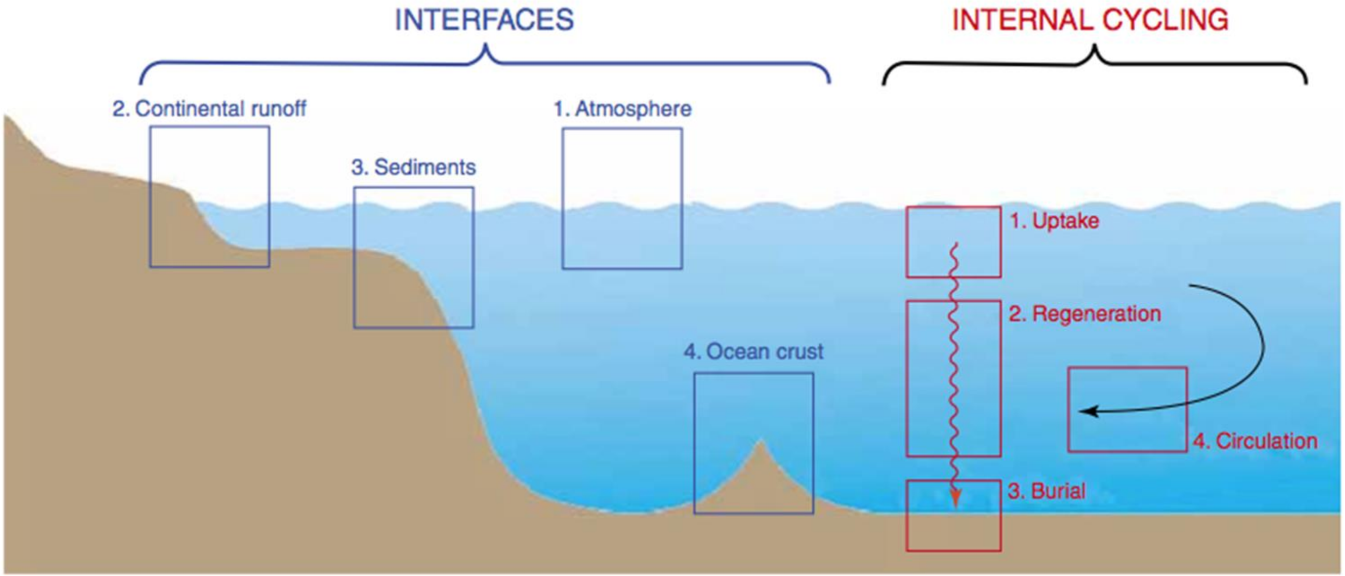


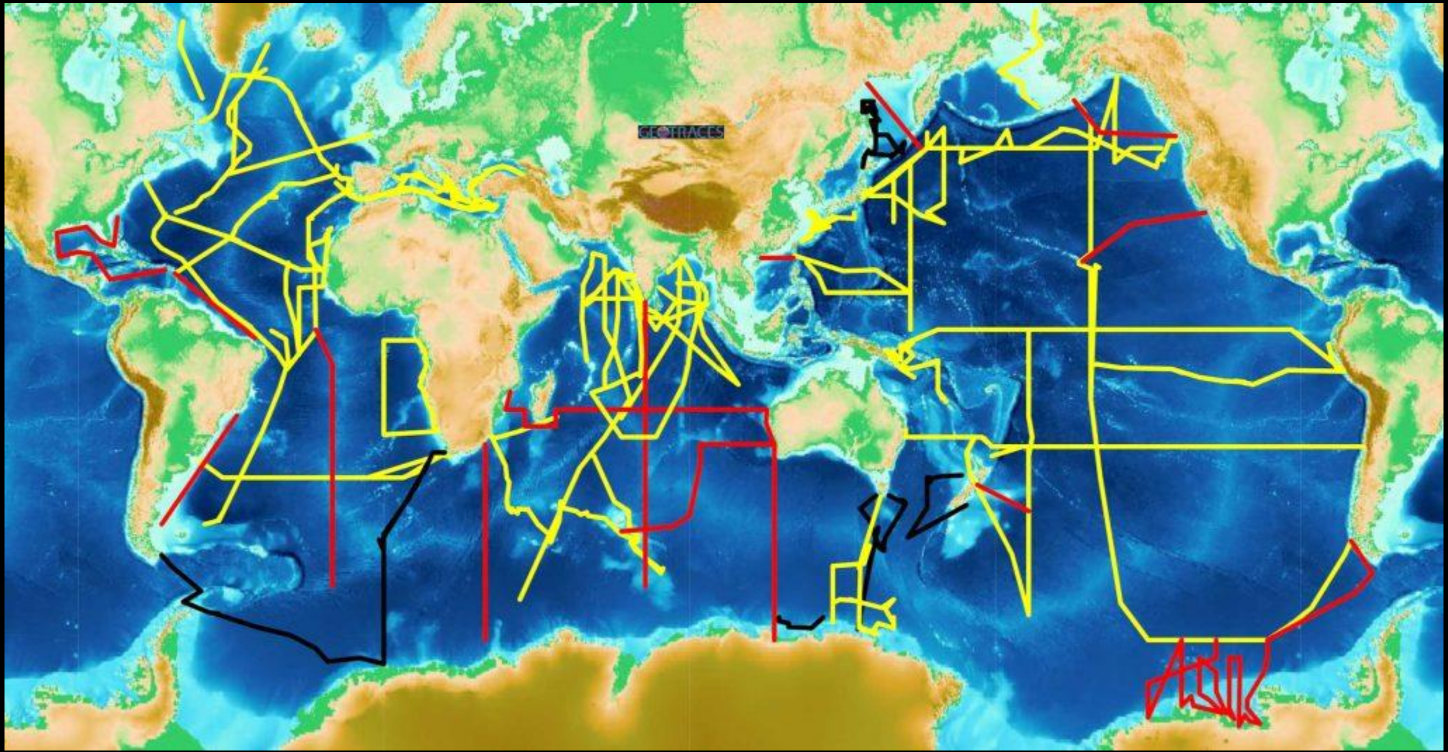
Figure 12. A schematic diagram illustrating the major influences on the distribution of TEIs in the ocean. Four major ocean interfaces (blue) and four major internal processes (red) are responsible for ocean TEI patterns. Within GEOTRACES, interface processes form the basis of Theme 1, while internal cycling processes are the basis of Theme 2.

GEOTRACES

SCOR

International Science Council

Scientific Committee on Oceanic Research



Interactive map

TRACER OF INPUTS

ALUMINUM

Dust

Rivers

Hydrothermal

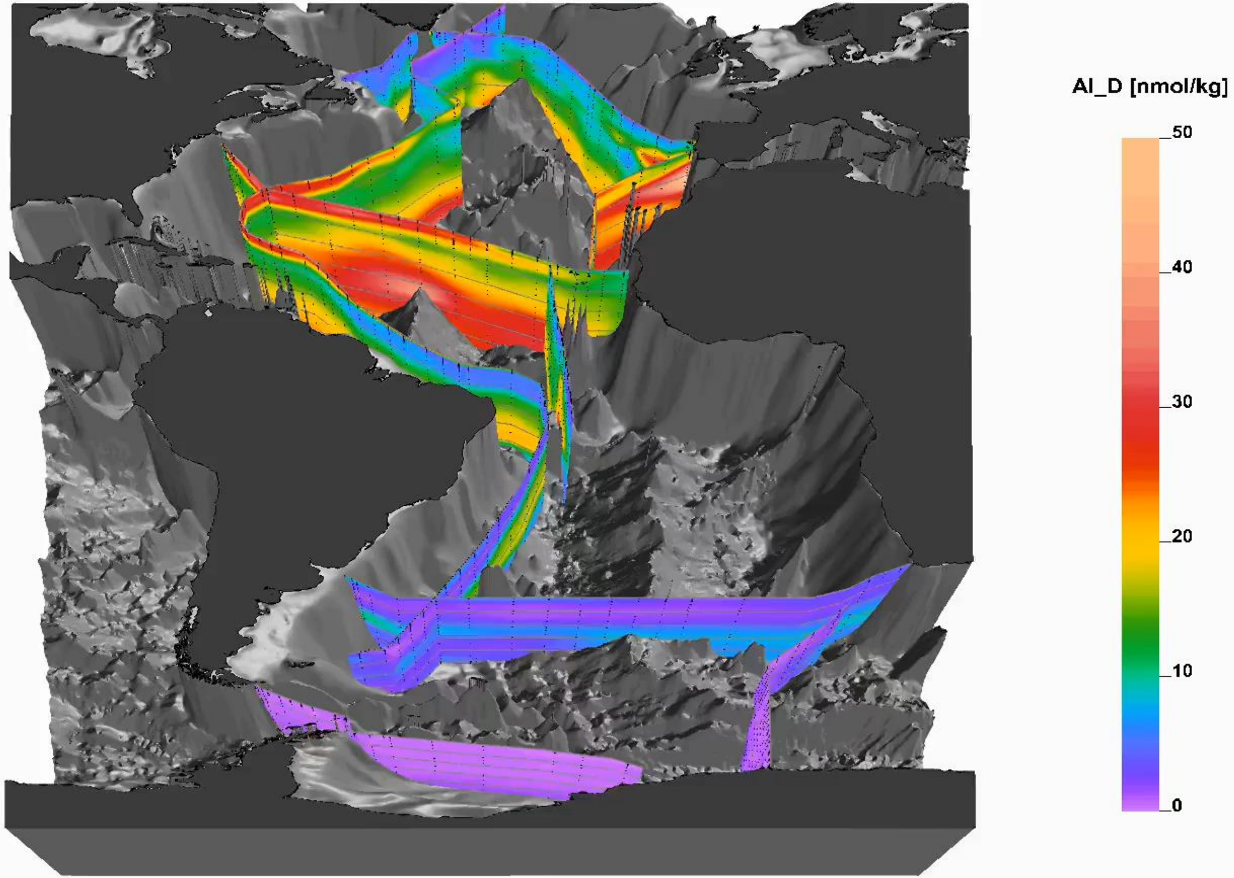
Volcanic

Hydrothermal

Dust

Volcanic

Rivers



eGEOTRACES

Data: Eric P Achterberg, Hein J de Baar, Mariko Hatta, Jessica K Klar, Christopher Measures, Jan-Lukas Menzel Barraqueta, Rob Middag, Christian Schlosser, Jingfeng Wu Graphics: Reiner Schlitzer

frontiers in Marine Science

DATA REPORT
published: 14 July 2020
doi: 10.3389/fmars.2020.00468

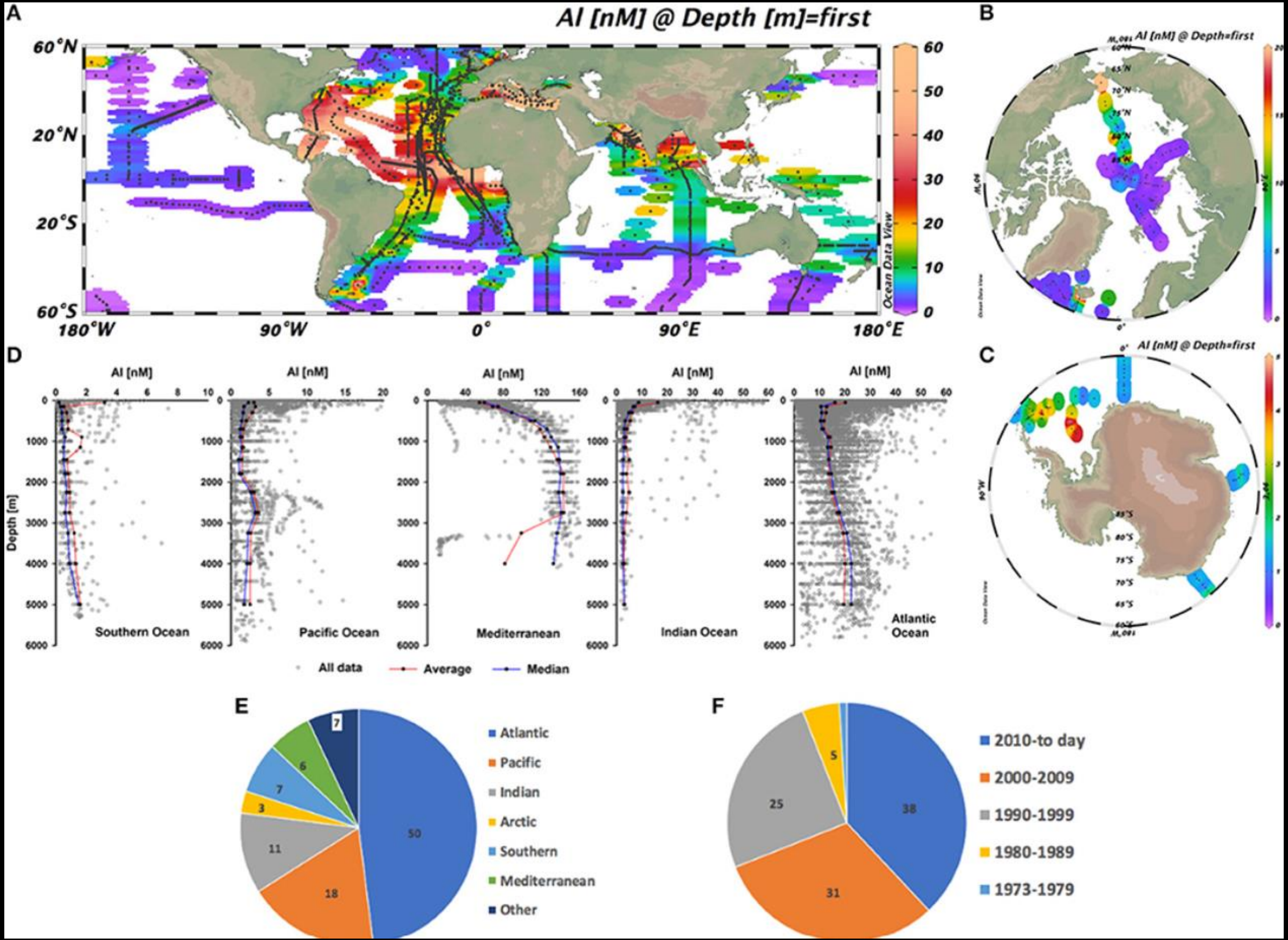
A First Global Oceanic Compilation of Observational Dissolved Aluminum Data With Regional Statistical Data Treatment

Jan-Lukas Menzel Barraqueta[1], Saumik Samanta[1], Eric P. Achterberg[2], Andrew R. Bowie[3,4], Peter Croot[5], Ryan Cloete[1], Tara De Jongh[1], Maria D. Gelado-Caballero[6], Jessica K. Klar[7], Rob Middag[8], Jean C. Loock[1], Tomas A. Remenyi[3,4], Bernhard Wenzel[1,2] and Alakendra N. Roychoudhury[1]*

[1] Department of Earth Sciences, Stellenbosch University, Stellenbosch, South Africa, [2] GEOMAR, Helmholtz Centre for Ocean Research Kiel, Kiel, Germany, [3] Antarctic Climate and Ecosystems—Cooperative Research Centre, University of Tasmania, Hobart, TAS, Australia, [4] Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, TAS, Australia, [5] iCRAG (Irish Centre for Research in Applied Geoscience), Earth and Ocean Sciences, School of Natural Sciences and the Ryan Institute, National University of Ireland Galway, Galway, Ireland, [6] Chemistry Department, University of las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain, [7] CEFREM, University of Perpignan Via Domitia, CNRS, IRD, Perpignan, France, [8] Department of Ocean Systems (OCS), NIOZ Royal Netherlands Institute for Sea Research, and Utrecht University, Texel, Netherlands

OPEN ACCESS

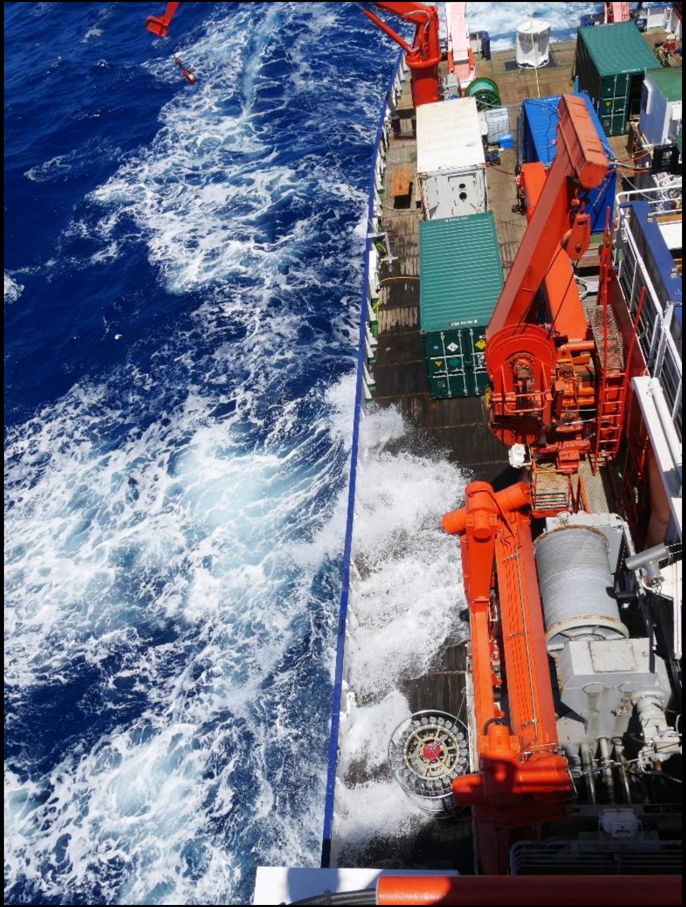
Edited by:
Antonio Tovar-Sanchez,
Consejo Superior de Investigaciones

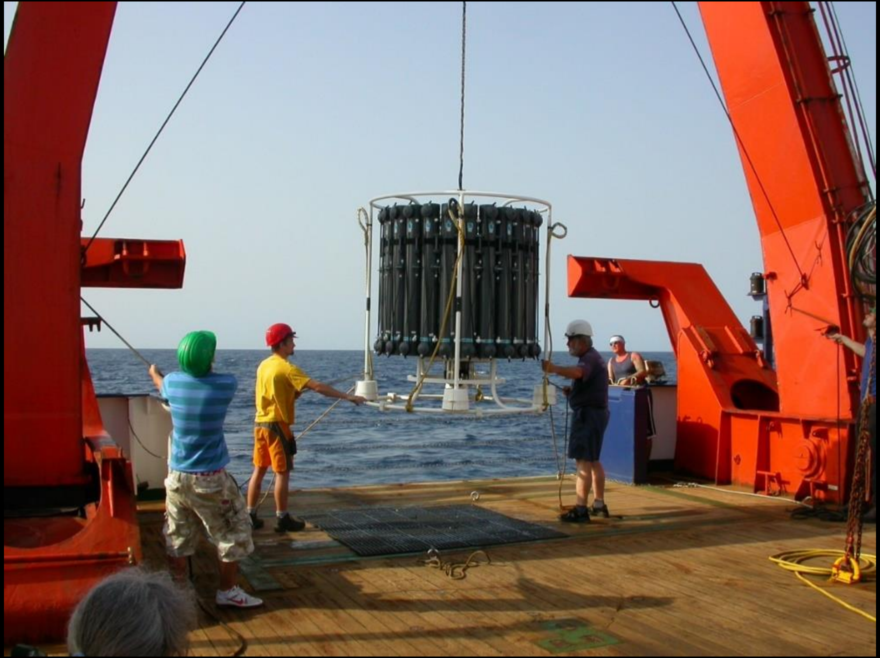


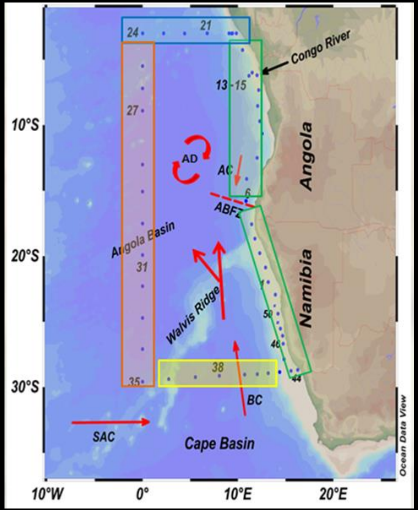
24.194 DATA POINTS

Maximum 674 nM
(Arabian Sea)
Minimum 0.05 nM
(Southern Ocean)

- determine in detail the distributions of trace elements and their isotopes (TEIs) in the water column of the SE Atlantic in order to constrain TEI supply and removal mechanisms





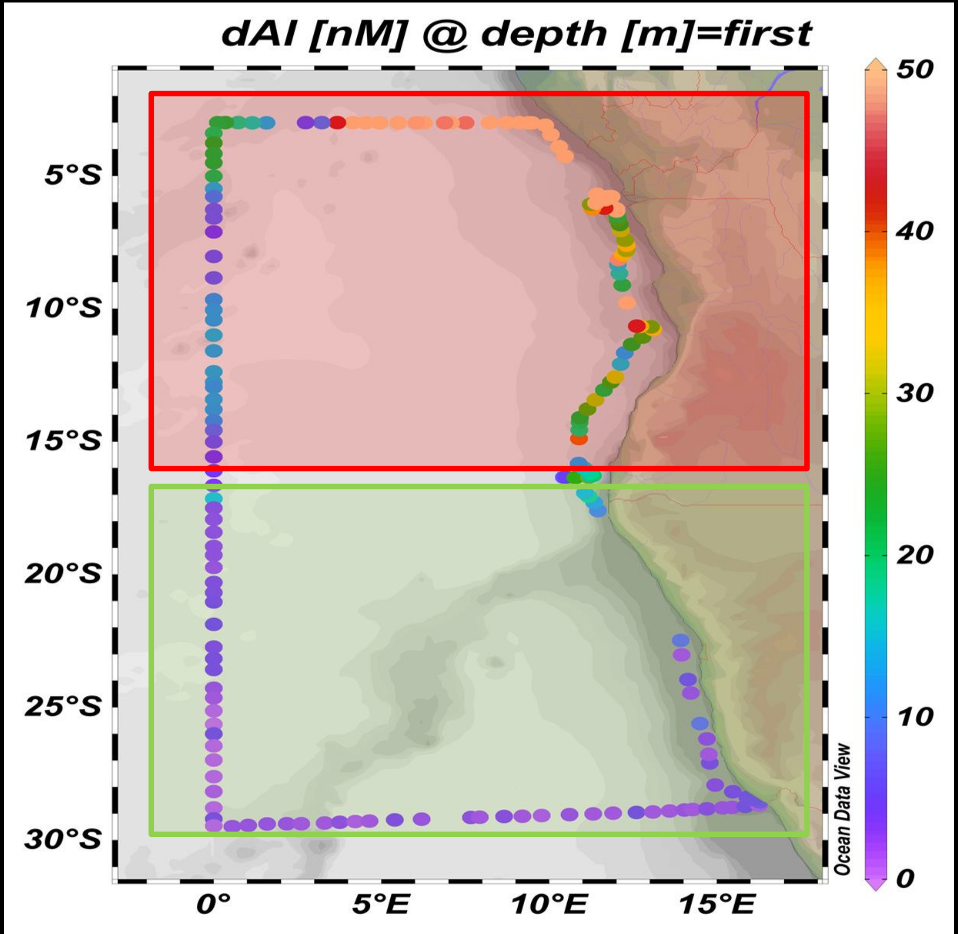


Northern part (red box) →High surface dAl

- Higher aerosol deposition
- Congo river plume
- Angola-Benguela Frontal Zone

Southern part (green box) → Low surface dAl

- Benguela & South Atlantic current
- Moderate aerosol deposition in coastal region
- Low aerosol deposition in open ocean sections



Menzel Barraqueta et al., unpublished

$$G = \frac{[\mathrm{Al}] \times \mathrm{MLD}}{\tau \times S \times D}, \qquad (1)$$

G is the total dust flux in g m^{-2} yr^{-1}

[Al] is the concentration of dAl (mol m^{-3}) in the surface mixed layer

MLD is the depth of the mixed layer in metres (m)

τ is the residence time in years (yr)

S is the fractional solubility of Al in dust (%)

D is the concentration of Al in dust (8.1 %, mol g^{-1}).

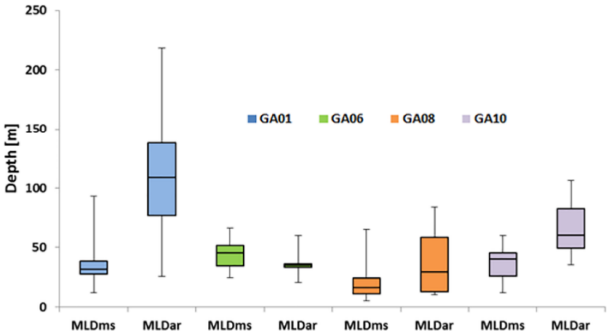


Figure 2. Box whisker plot for the MLD determined using in situ measurements (MLDms) and annual mixed-layer climatology (MLDar) (http://mixedlayer.ucsd.edu/, last access: September 2017) (Holte et al., 2017).

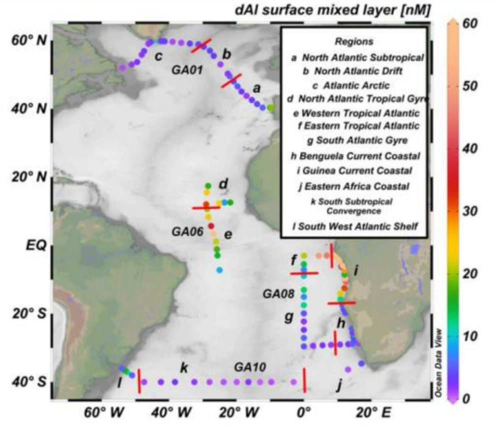
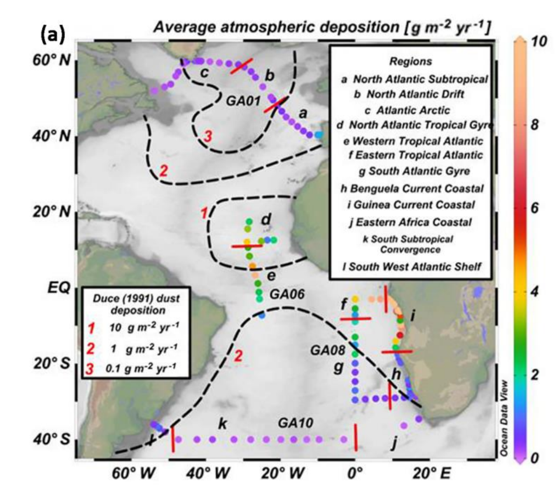
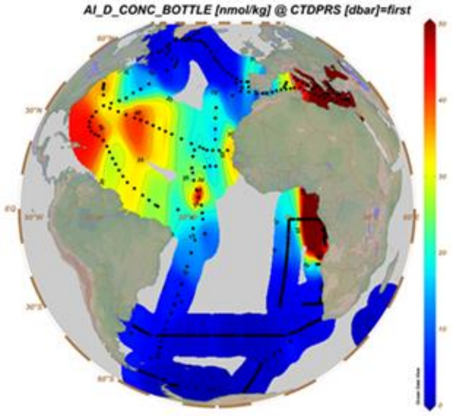


Figure 3. Surface mixed-layer dAl concentrations (nM) for the cruises used in this study (GA01, GA06, GA08, and GA10). Red lines divide the different biogeochemical provinces used in this study.





Biogeosciences, 16, 1525–1542, 2019
https://doi.org/10.5194/bg-16-1525-2019

Biogeosciences
Open Access
EGU

Atmospheric deposition fluxes over the Atlantic Ocean: a GEOTRACES case study

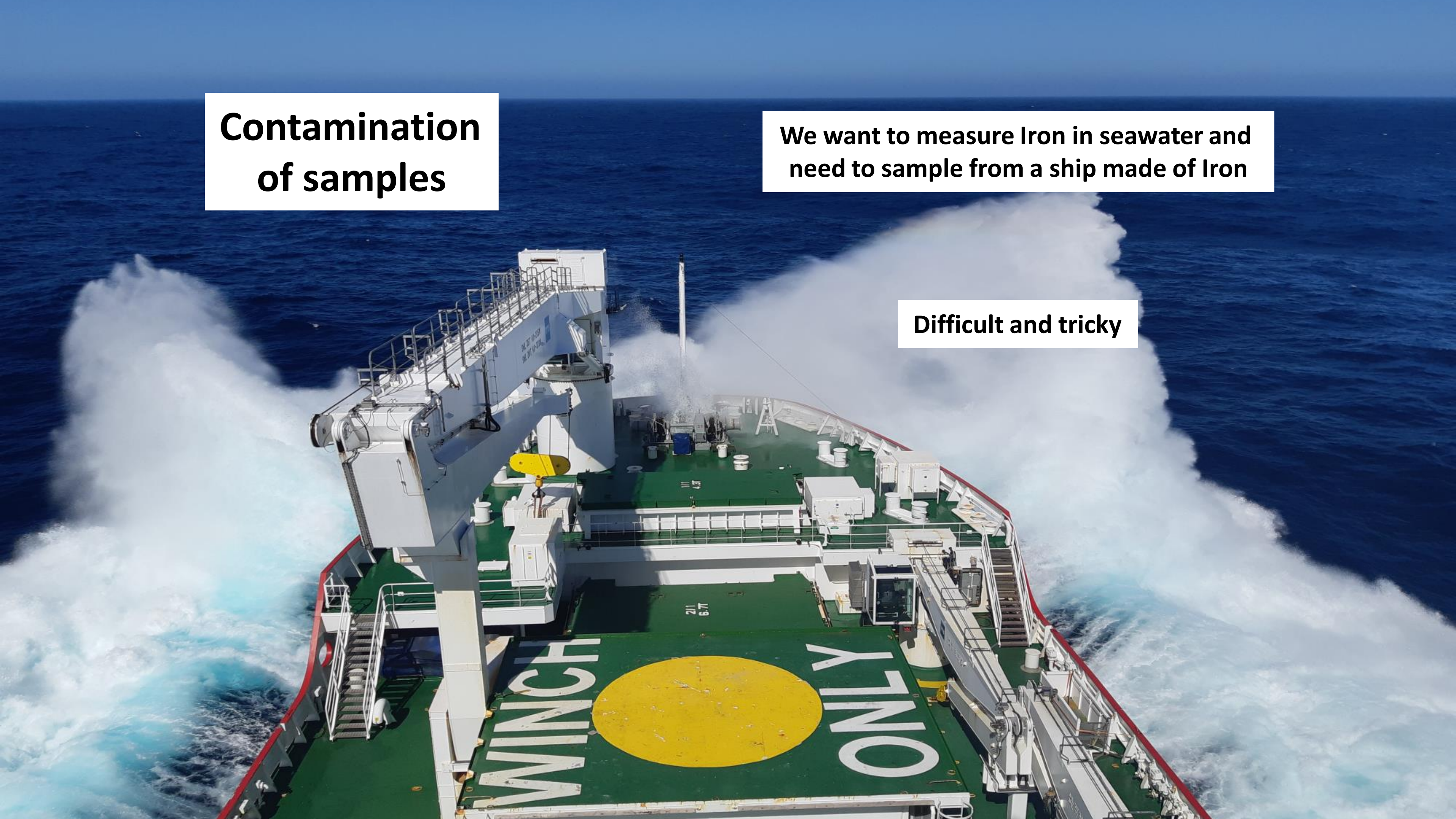
Jan-Lukas Menzel Barraqueta[1,2], Jessica K. Klar[3,4], Martha Gledhill[1], Christian Schlosser[1], Rachel Shelley[5,6,7], Hélène F. Planquette[6], Bernhard Wenzel[1], Geraldine Sarthou[6], and Eric P. Achterberg[1]

0,000000000001

Contamination of samples

We want to measure Iron in seawater and need to sample from a ship made of Iron

Difficult and tricky




2
36

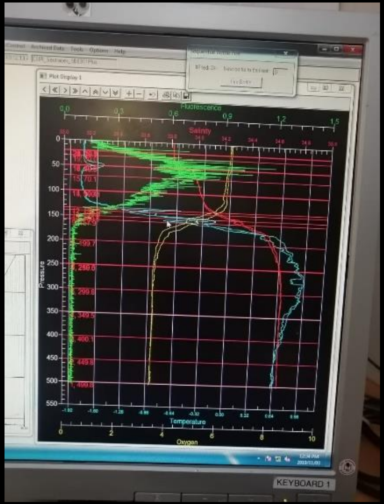
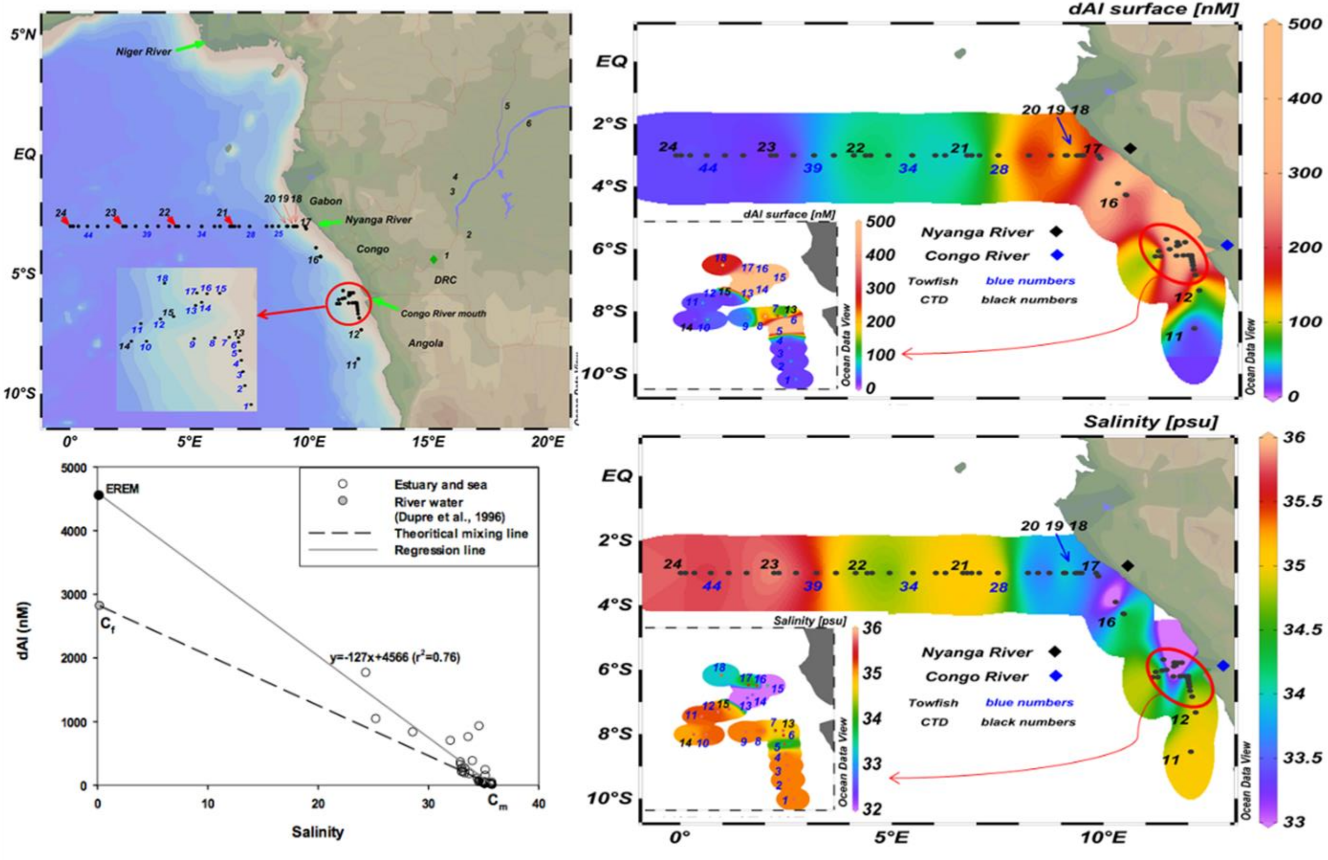
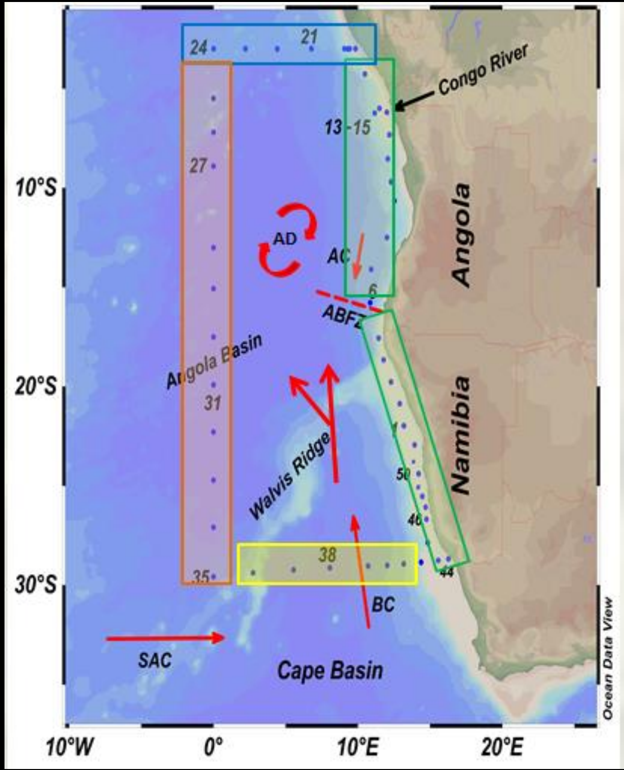
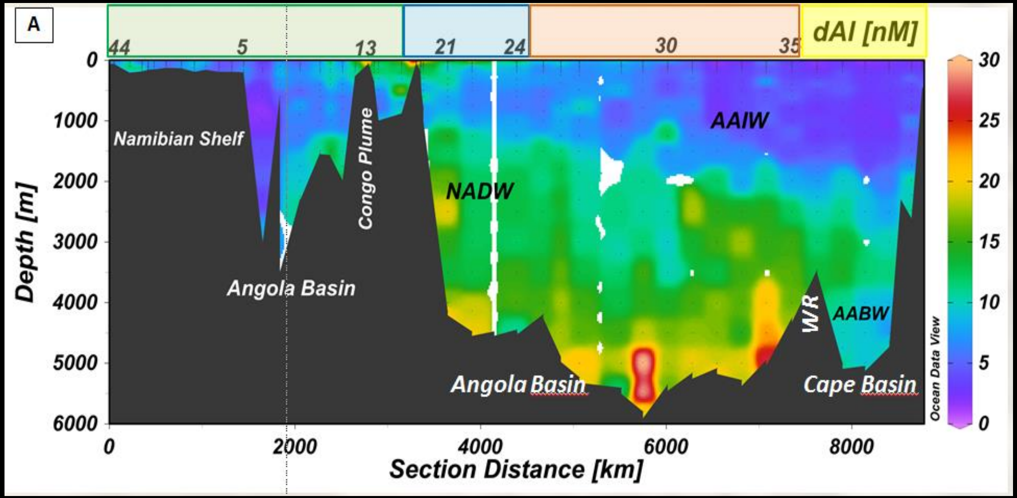

Fluorescence
Salinity
Pressure
Temperature
Oxygen
KEYBOARD 1

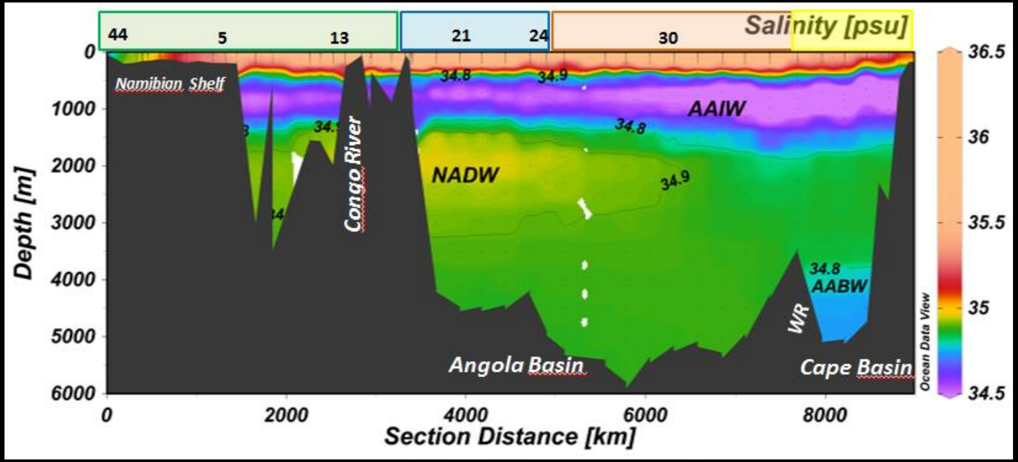
Figure 1. A) Map showing the location of CTD casts (numbers 11 to 24) and towed fish samples (blue numbers 1 to 46). Black numbers (1 to 6) show dAl sampling sites in the northern and southern tributaries draining in the Congo Basin (Dupre et al., 1996). Green diamond shows the location of the cities Brazzaville and Kinshasa. Thick green arrows show the position of the Congo, Nyanga, and Niger River mouths. DRC, Democratic Republic of Congo; B) Dissolved Al (dAl) for the Congo Plume; C) salinity for the Congo River Plume; D) Theoretical and observed linear relationship between salinity and dAl



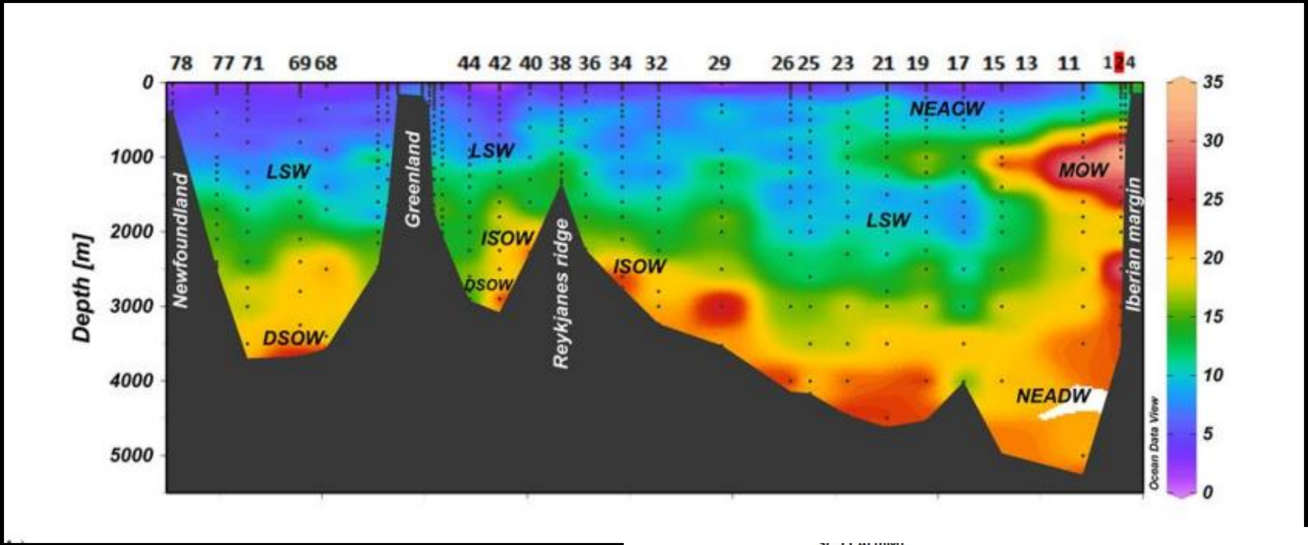
Menzel Barraqueta et al., unpublished







Menzel Barraqueta et al., unpublished



Biogeosciences Discuss., https://doi.org/10.5194/bg-2018-39
Manuscript under review for journal Biogeosciences
Discussion started: 23 January 2018

Biogeosciences Discussions
Open Access
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Aluminium in the North Atlantic Ocean and the Labrador Sea (GEOTRACES GA01 section): roles of continental inputs and biogenic particle removal

Jan-Lukas Menzel Barraqueta[1], Christian Schlosser[1], Hélène Planquette[2], Arthur Gourain[2,3], Marie Cheize[2], Julia Boutorh[2], Rachel Shelley[2,4,5], Leonardo Pereira Contreira[6], Martha Gledhill[1], Mark J. Hopwood[1], Pascale Lherminier[7], Geraldine Sarthou[2], Eric P. Achterberg[1]

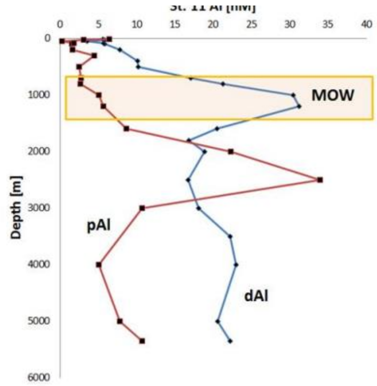

Figure S4: Profiles of dissolved and particulate Al [nM] at station 11. The orange box represents the approximate depth of the Mediterranean Overflow Water (MOW). The high particulate Al observed at ca. 2500 m depth is associated with inputs from the Iberian margin.

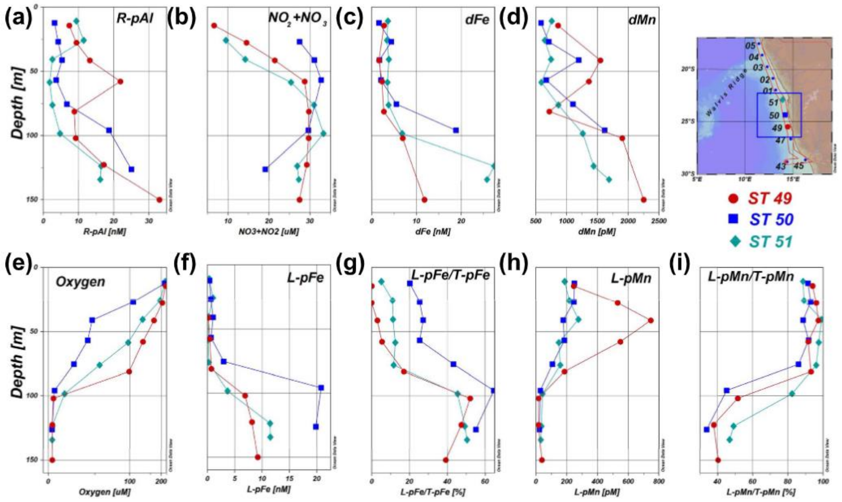

Figure 7. Water column profiles within the oxygen-depleted waters of the Lüderitz cell between stations 49–51 of (a) Refractory particulate aluminum (R-pAl); (b) Nitrate + Nitrite; (c) Dissolved Iron (dFe); (d) Dissolved Mn (dMn); (e) Dissolved Oxygen; (f) Labile particulate Fe (L-pFe); (g) Labile particulate Fe fraction (%); (h) Labile particulate Mn (L-pMn); (i) Labile particulate Mn fraction (%). Note the stretched scale for oxygen concentration.

Lowest oxygen concentrations (<4 µM) were recorded within the Lüderitz cell (ST 49–51; 23–25.5°S).

The oxygen minimum layer extended off the shelf and into the open ocean (3°S; ST 17–24) between ~200 and 500 m, with dissolved oxygen as low as 40.5 µM.

AGU ADVANCING EARTH AND SPACE SCIENCE

Global Biogeochemical Cycles

RESEARCH ARTICLE
10.1029/2022GB007453

Particulate Trace Metal Sources, Cycling, and Distributions on the Southwest African Shelf

Ali A. Al-Hashem[1,2], Aaron J. Beck[1], Stephan Krisch[1,3], Jan-Lukas Menzel Barraqueta[1,4], Tim Steffens[1], and Eric P. Achterberg[1,2]

Key Points:
- Different oxidation kinetics lead to decoupled Fe and Mn oxide redox

FINAL REMARKS

NO METALS NO FUN

NO METALS
NO PHYTOPLANKTON GROWTH
NO CO_2 DRAWDOWN