Inleiding tot de zuurstofcyclus

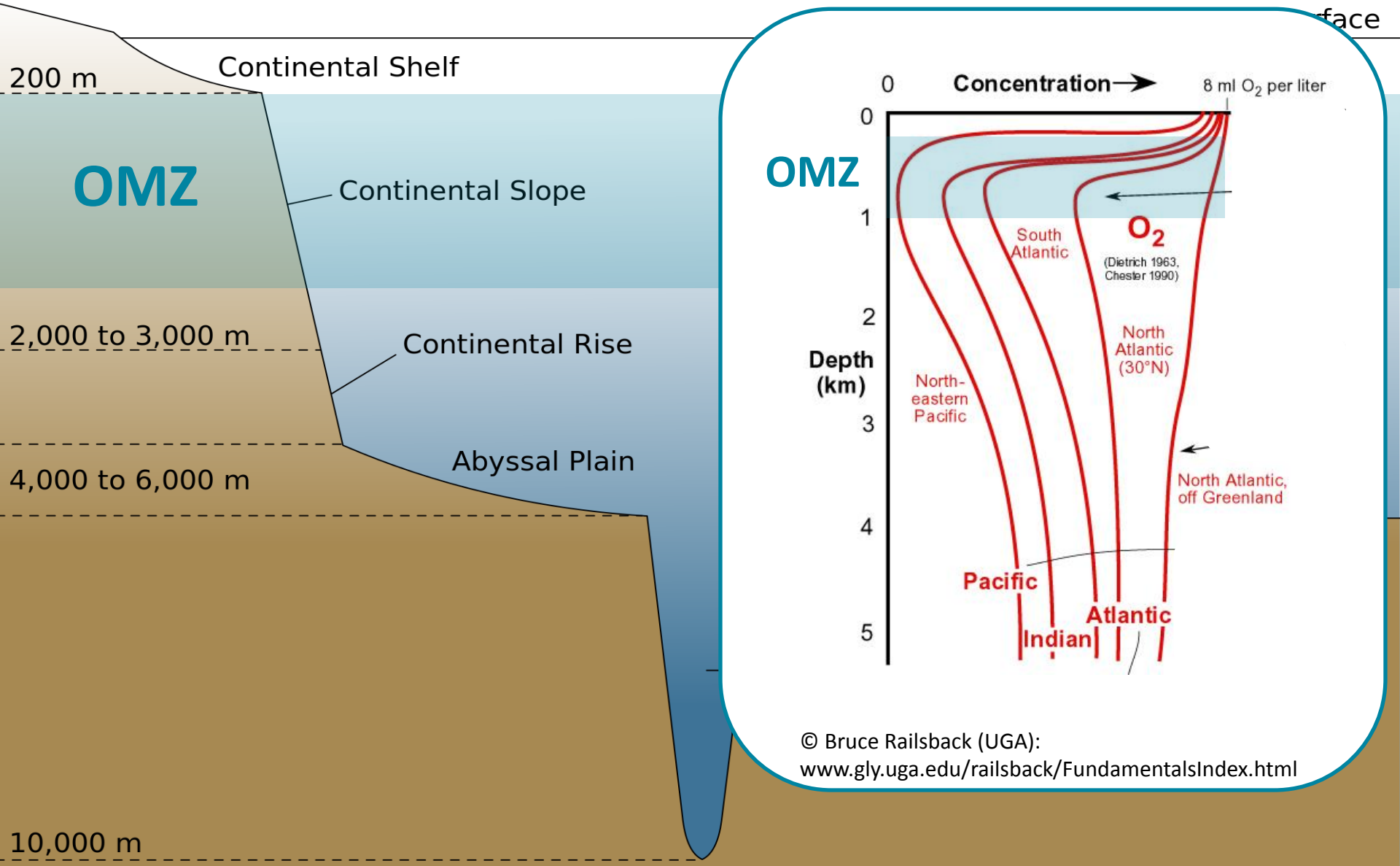
Mieke Sterken (VLIZ)

Inhoud

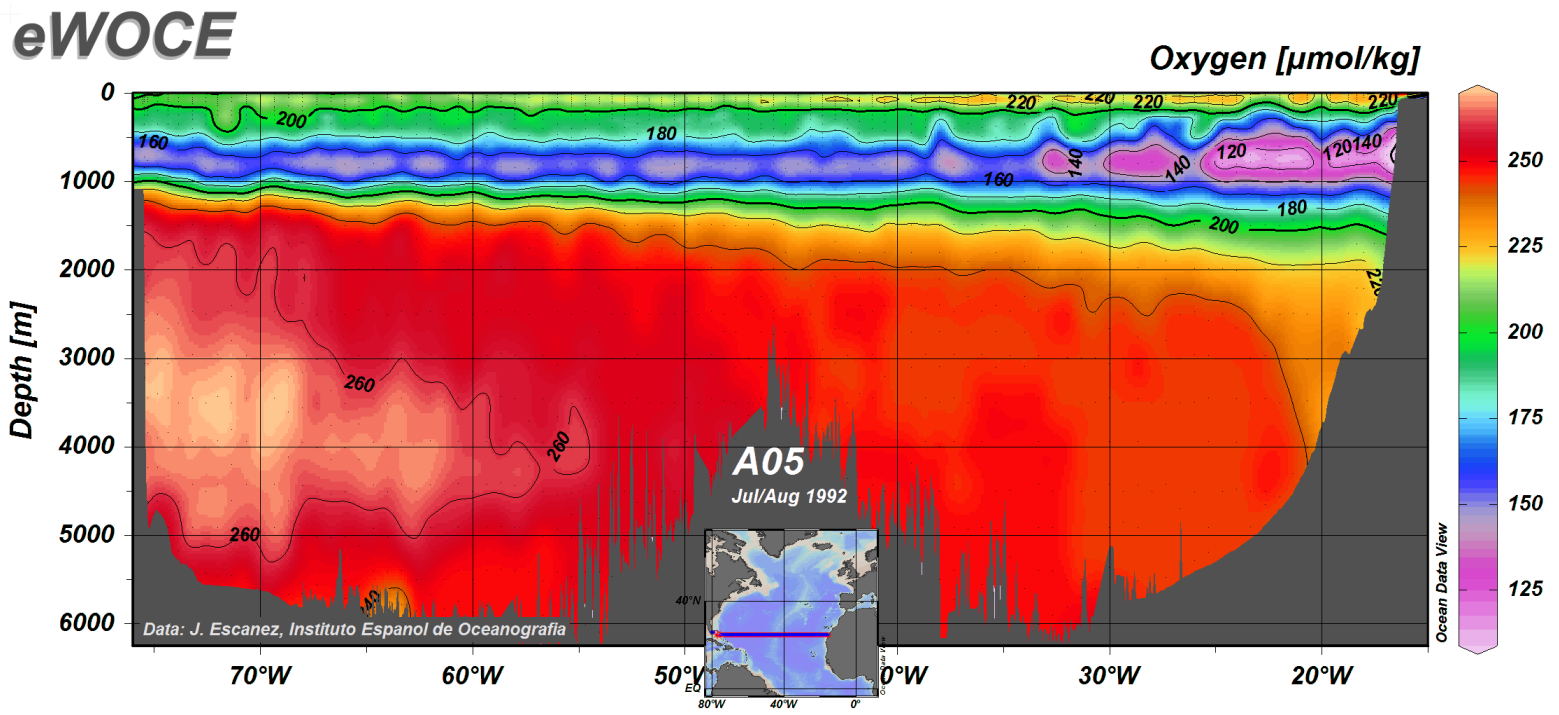
- Waarneming: zuurstofprofiel in de oceaan
- Verklaringen:
    - Abiotisch: gaswisseling & mixing
    - Abiotisch: temperatuur & druk
    - Biotisch: oorsprong
    - Biotisch: verbruik
- Evolutie:
    - Oorsprong
    - En nu?

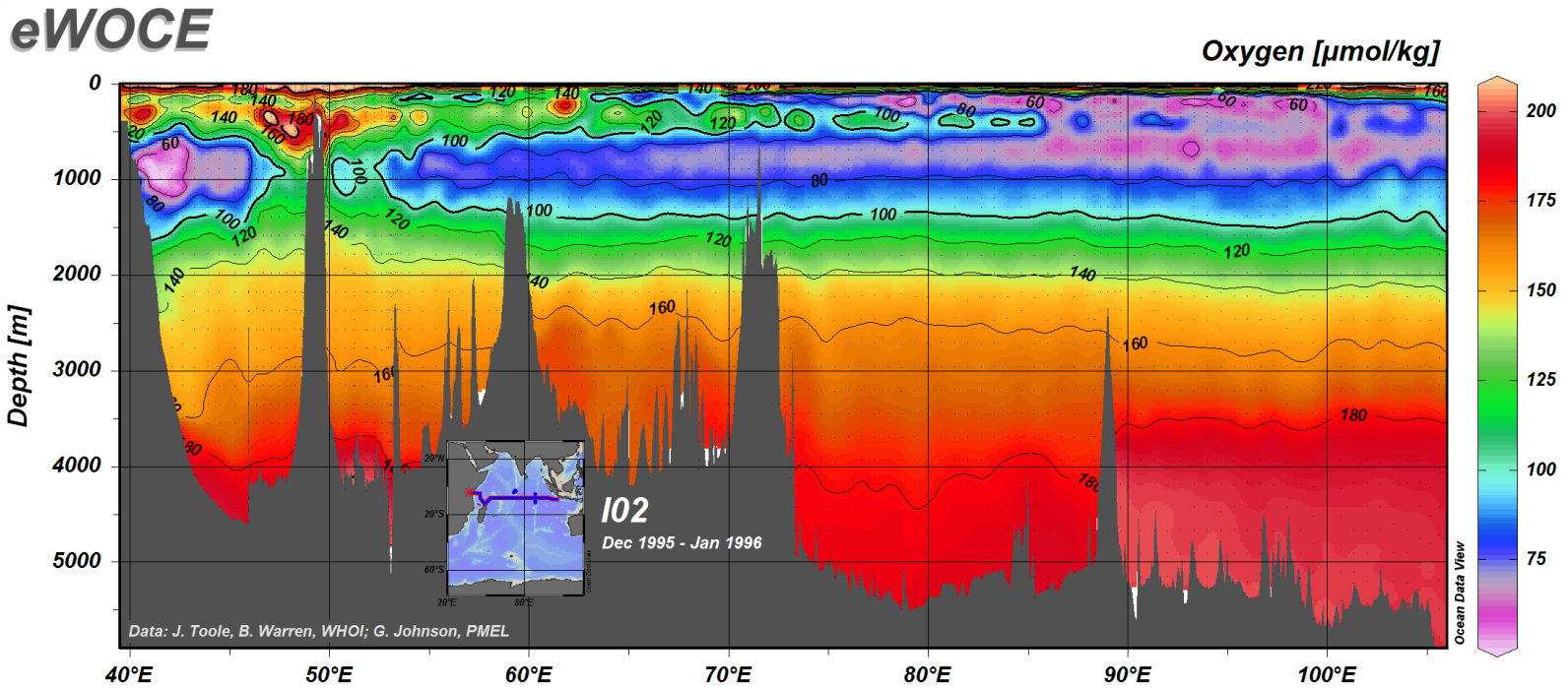
VLIZ

Waarneming: zuurstofprofiel



© Bruce Railsback (UGA):
www.gly.uga.edu/railsback/FundamentalsIndex.html

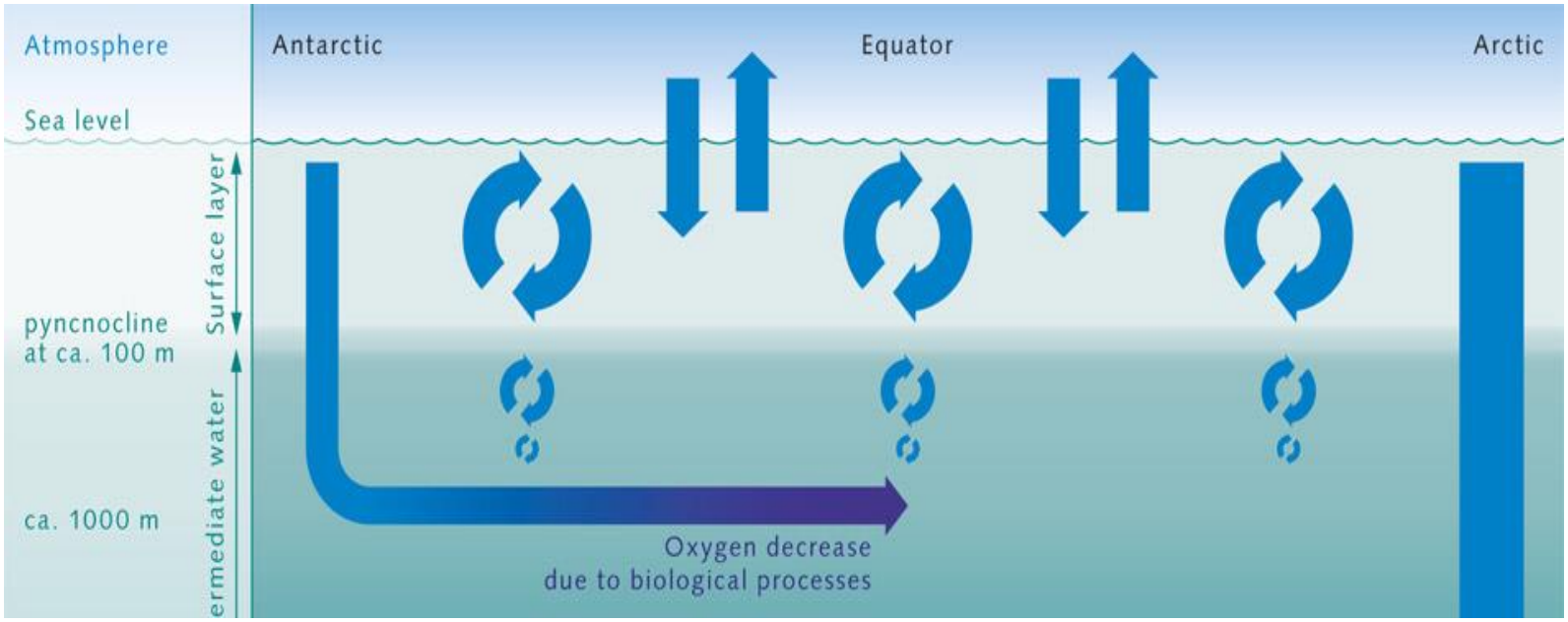

eWOCE
Oxygen [µmol/kg]
Depth [m]
A05
Jul/Aug 1992
Data: J. Escanez, Instituto Espanol de Oceanografia
Ocean Data View


eWOCE
Oxygen [µmol/kg]
Depth [m]
I02
Dec 1995 - Jan 1996
Data: J. Toole, B. Warren, WHOI; G. Johnson, PMEL
Ocean Data View

Verklaringen:

Abiotisch

- Gaswisseling & mixing



- Uitwisseling van gassen aan het oceaan-oppervlak
- Goede mixing, tot aan de pycnocline (c. 100 m diep): drukverschil

*(*Bron: http://worldoceanreview.com/en/wor-1/ocean-chemistry/oxygen *)*

Verklaringen:

Abiotisch

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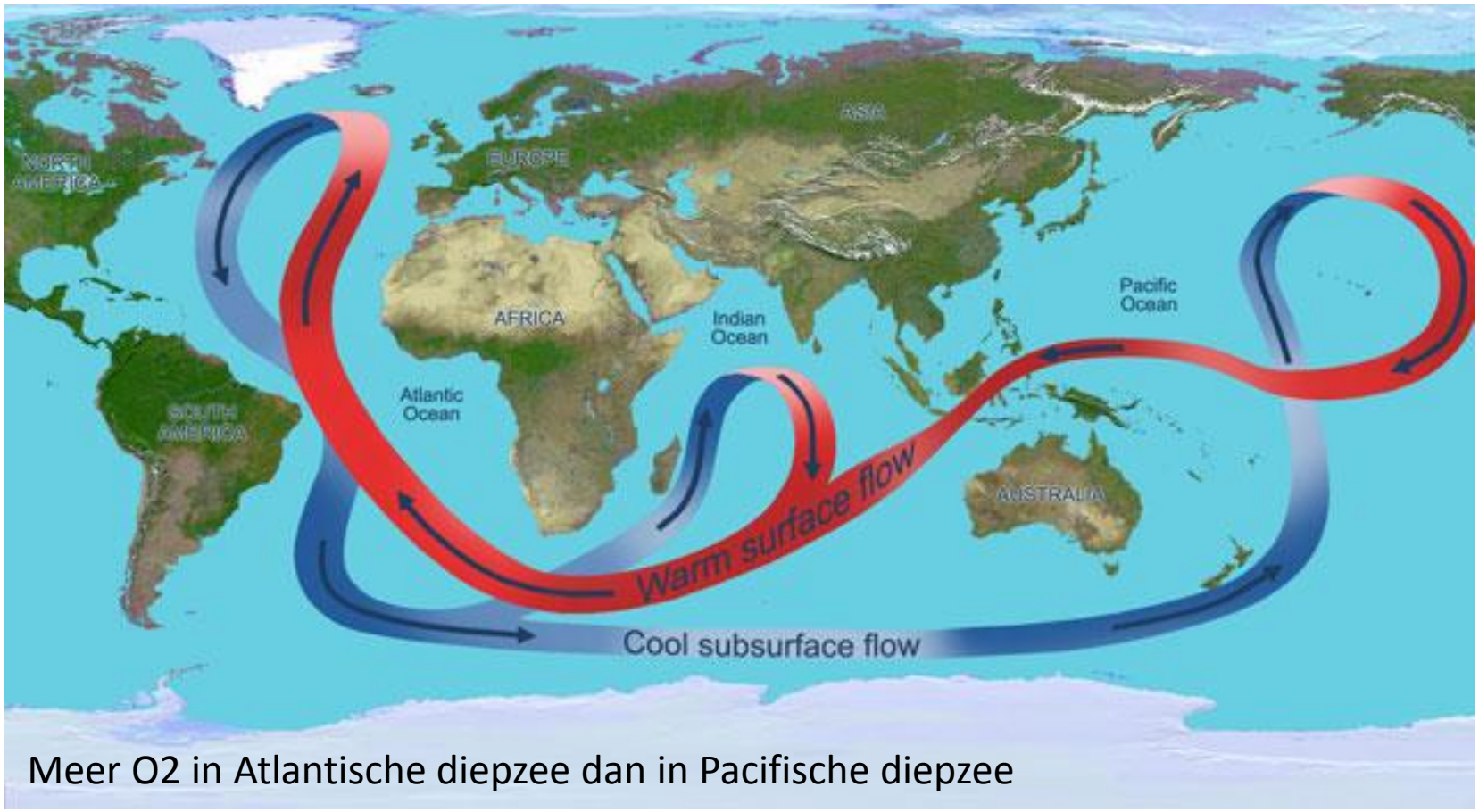


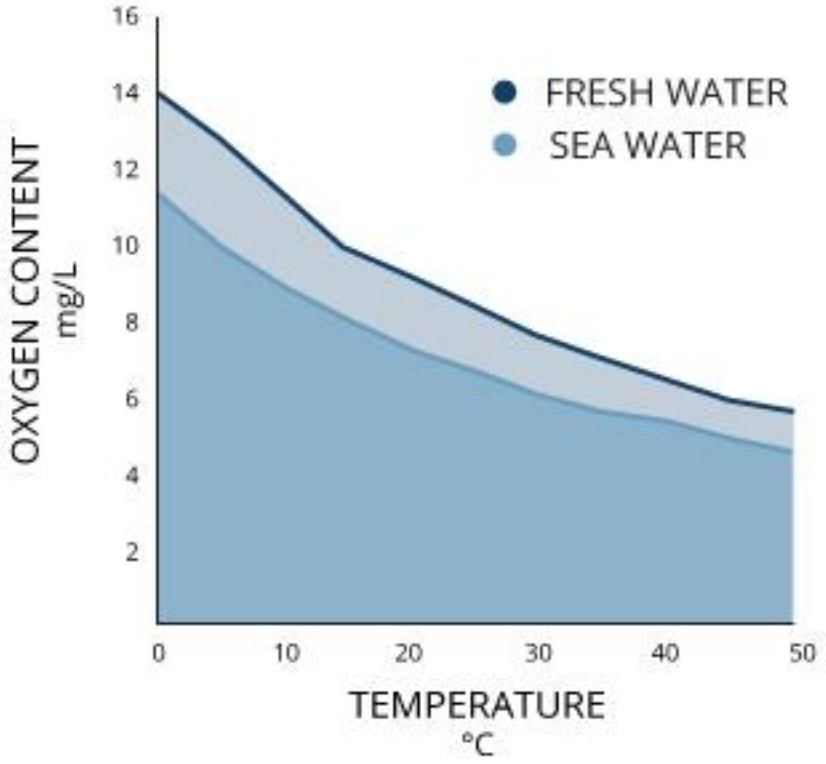
Meer O2 in Atlantische diepzee dan in Pacifische diepzee

(Figuur: © NASA)

Verklaringen:

Abiotisch

- Gaswisseling & mixing
- Temperatuur & druk



Diepzee:

- kouder => meer opgeloste O2
- hogere hydrostatische druk
  => meer opgeloste O2

Verklaringen:

Abiotisch

- Gaswisseling & mixing
- Temperatuur

Biotisch

- Oorsprong

Zonlicht

Fotische zone

Sea Surface

200 m

Continental Shelf

Continental Slo

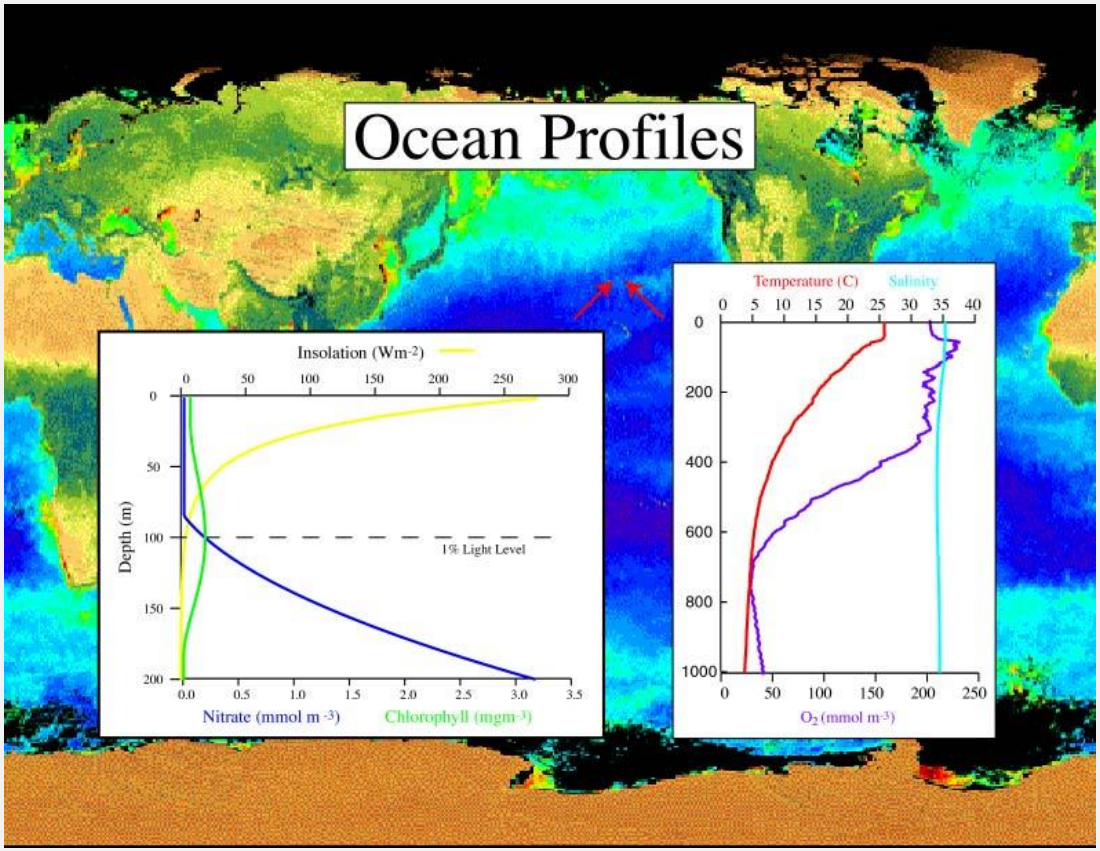
2,000 to 3,000 m

Continenta

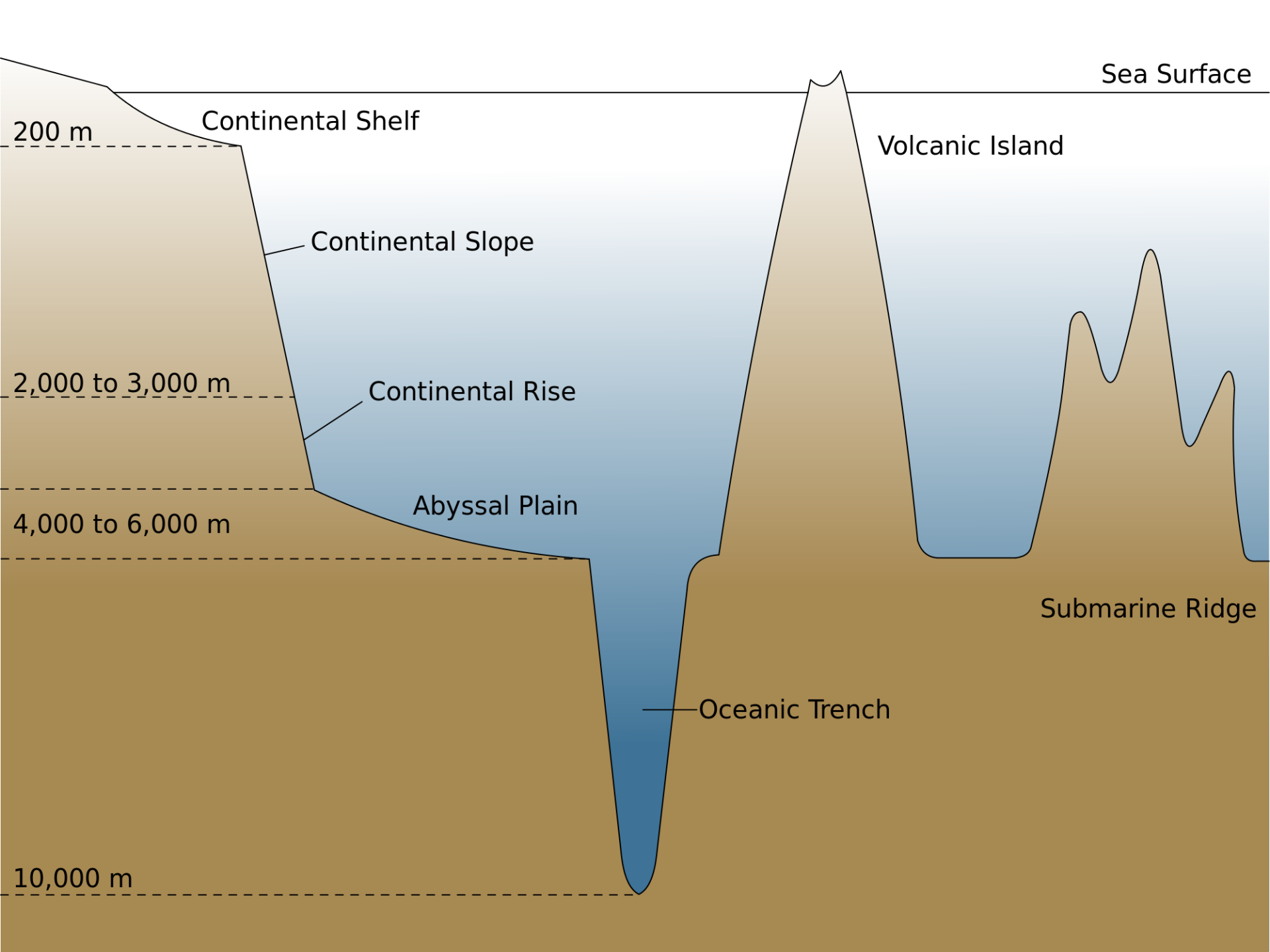
Abyssa

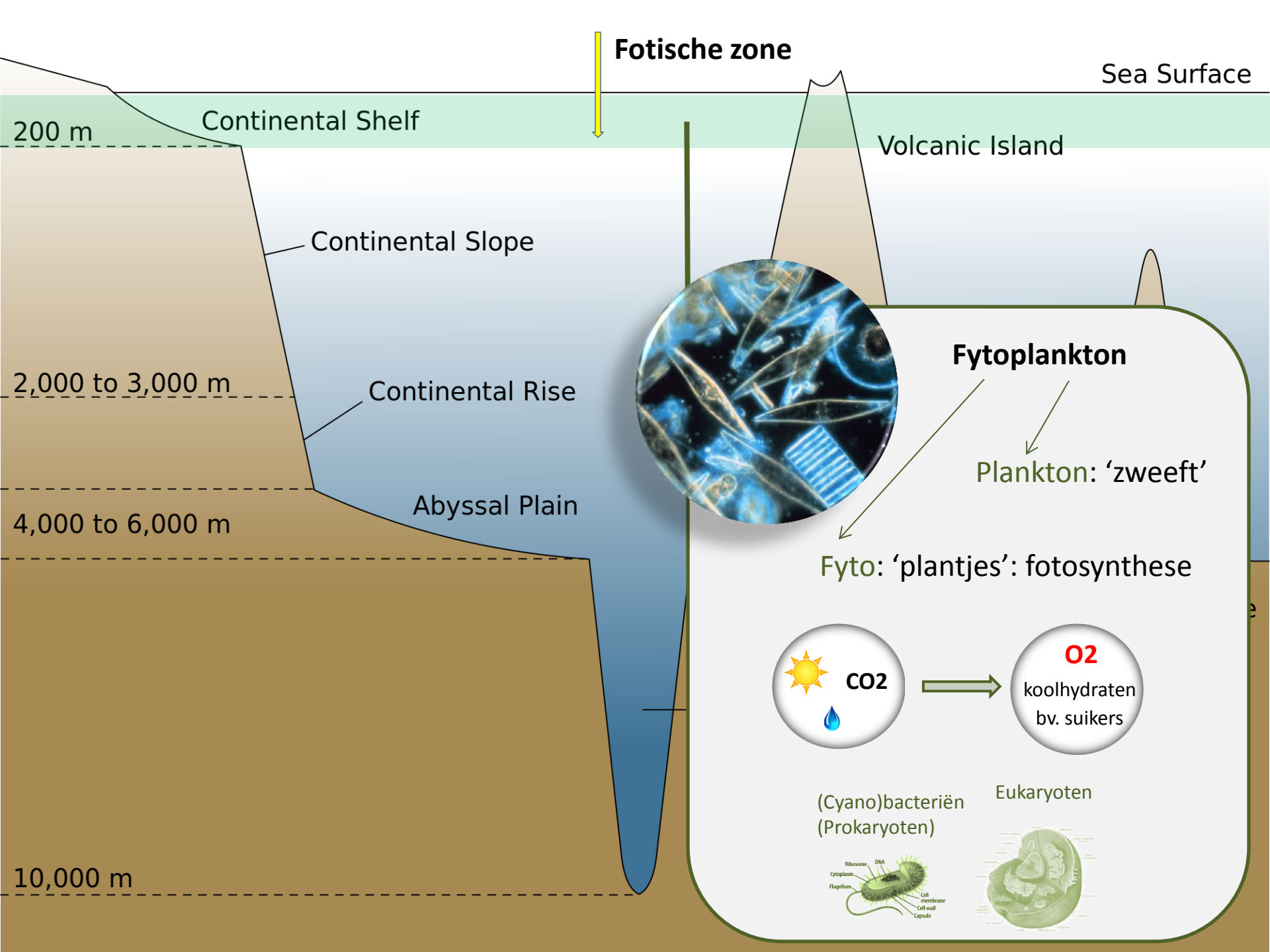
4,000 to 6,000 m

10,000 m



Figuur: SeaWiFS Project, NASA/Goddard Space Flight Center & ORBIMAGE


Sea Surface
Continental Shelf
200 m
Volcanic Island
Continental Slope
2,000 to 3,000 m
Continental Rise
Abyssal Plain
4,000 to 6,000 m
Submarine Ridge
Oceanic Trench
10,000 m


Fotische zone
Sea Surface
Continental Shelf
200 m
Volcanic Island
Continental Slope
2,000 to 3,000 m
Continental Rise
Abyssal Plain
4,000 to 6,000 m
10,000 m
Fytoplankton
Plankton: ‘zweeft’
Fyto: ‘plantjes’: fotosynthese
CO2
O2
koolhydraten
bv. suikers
(Cyano)bacteriën
(Prokaryoten)
Eukaryoten
Ribosome
DNA
Cytoplasm
Flagellum
Cell membrane
Cell wall
Capsule

Fotische zone

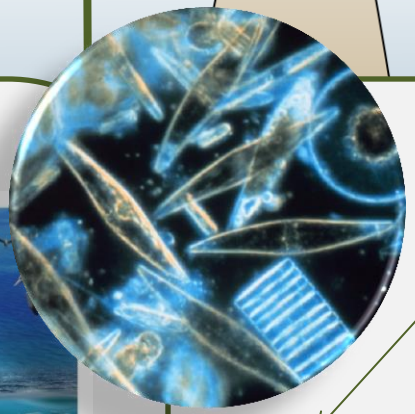
Sea Surface

200 m

Continental Shelf

Volcanic Island

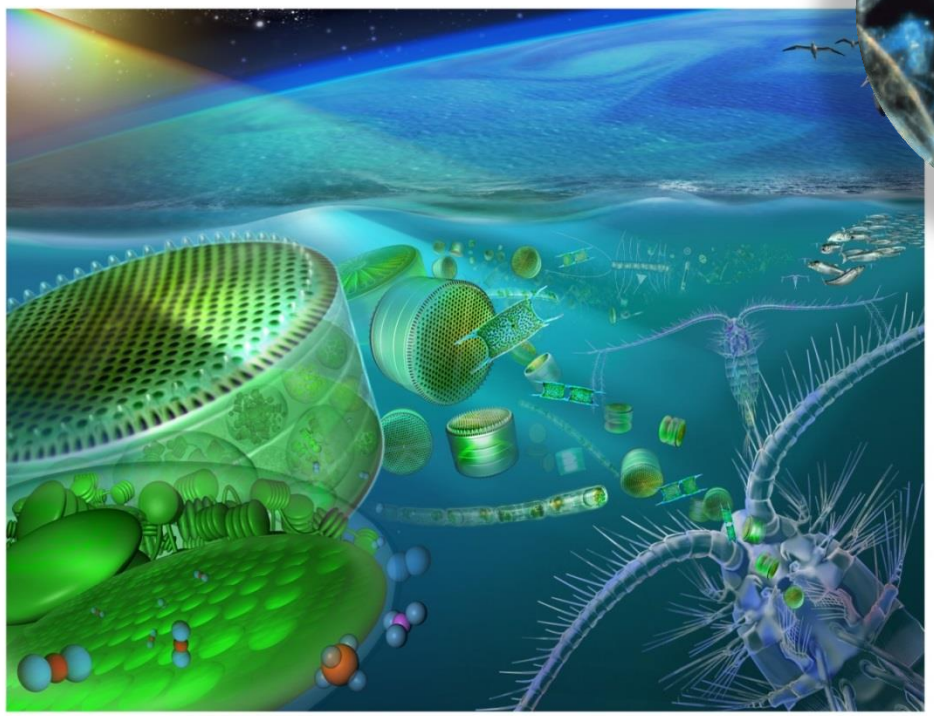
Continental Slope



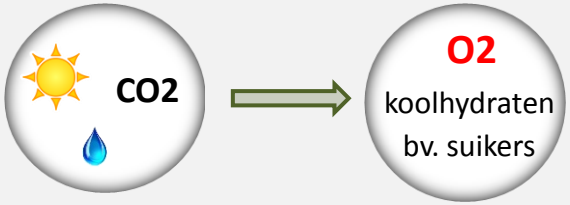
Fytoplankton

Plankton: ‘zweeft’

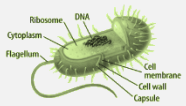
Fyto: ‘plantjes’: fotosynthese



Figuur: © G.Gorick – CLAMER / VLIZ
(http://www.vliz.be/projects/clamer/outreach/booklet.html)



(Cyano)bacteriën
(Prokaryoten)



Eukaryoten

Fotische zone

Sea Surface

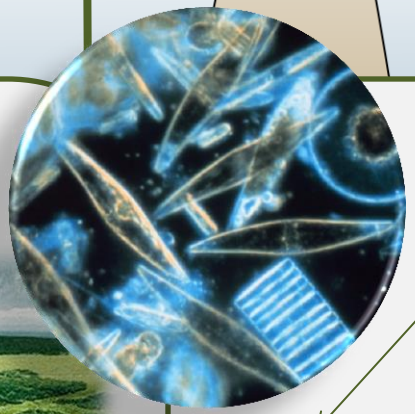
200 m

Continental Shelf

Volcanic Island

Continental Slope

1 L: 100,000-100 M algen



Fytoplankton

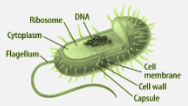
Plankton: ‘zweeft’

Fyto: ‘plantjes’: fotosynthese

CO2 → **O2** koolhydraten bv. suikers

c. 50% van de O2-productie

(Cyano)bacteriën (Prokaryoten)



Eukaryoten

Fotische zone

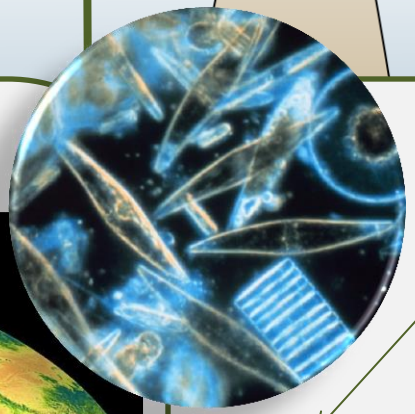
Sea Surface

200 m

Continental Shelf

Volcanic Island

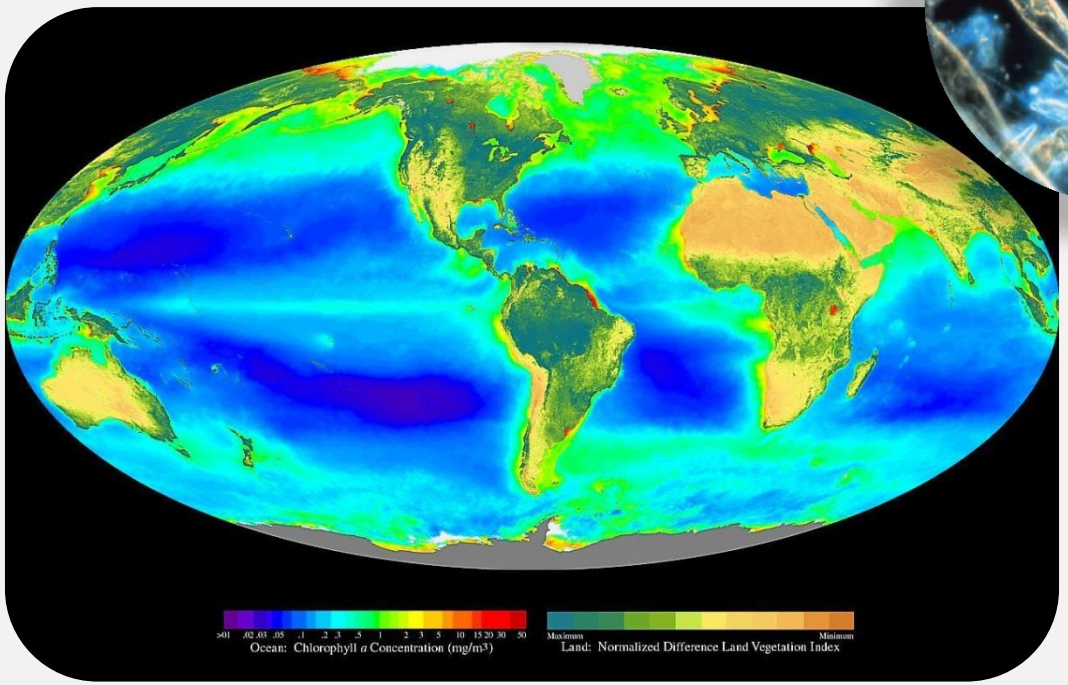
Continental Slope



Fytoplankton

Plankton: ‘zweeft’

Fyto: ‘plantjes’: fotosynthese

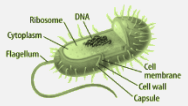


Estimates of autotrophic biomass (1997-2000)
Ocean: Chlorophyll-a concentration (mg/m3)

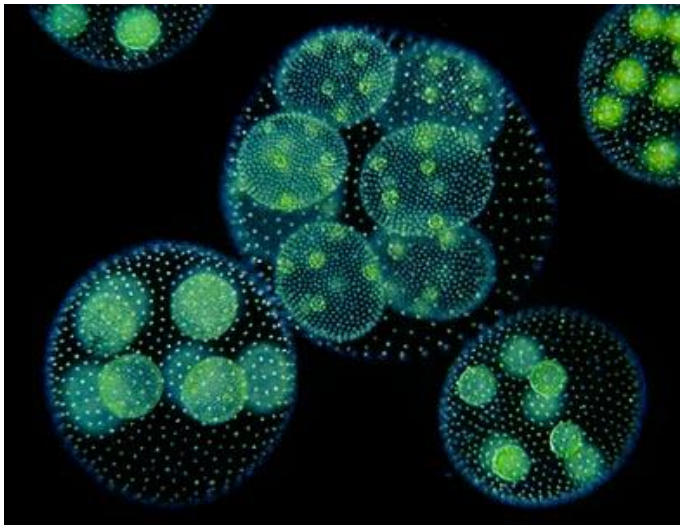
Figuur: © SeaWiFS

CO2 → **O2**
koolhydraten
bv. suikers

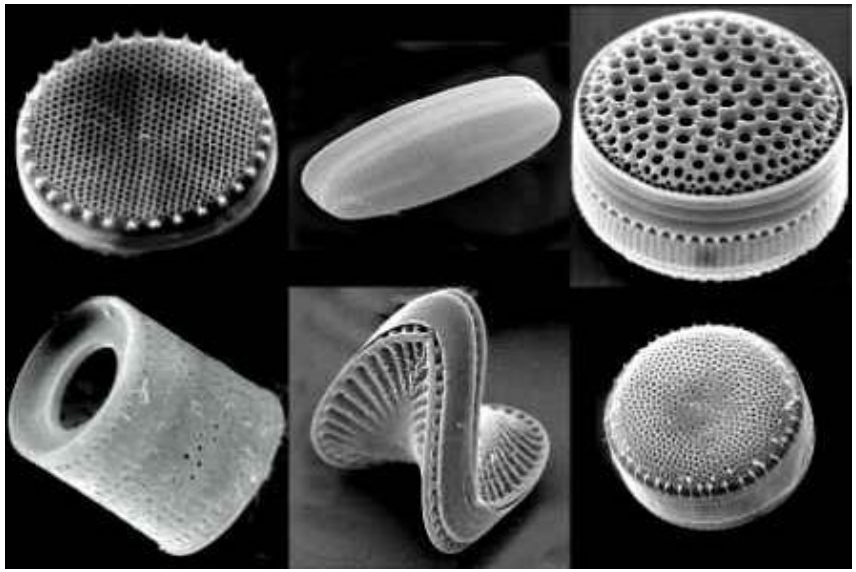
(Cyano)bacteriën
(Prokaryoten)



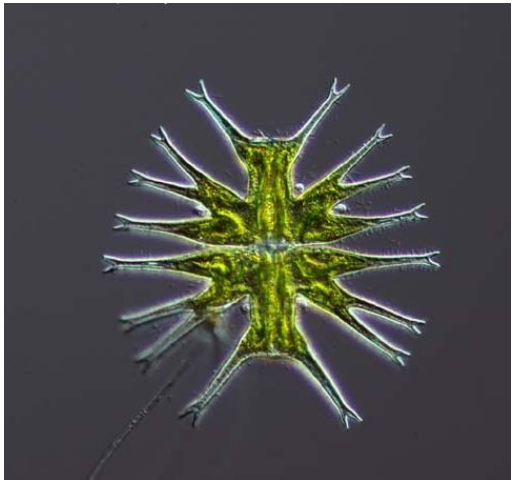
Eukaryoten



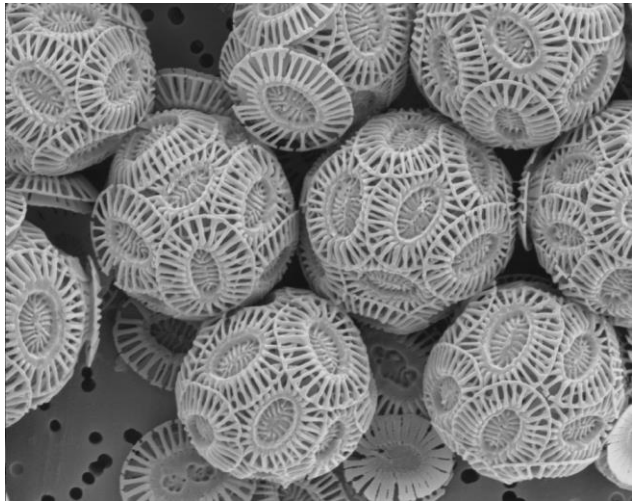
Volvox



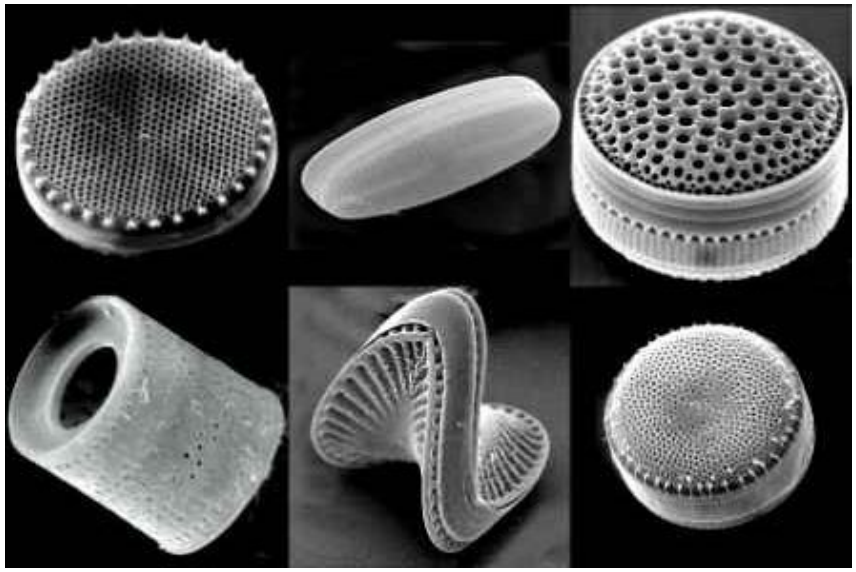
Diatomeeën
(kiezelwieren)



Micrasterias
(sierwier)



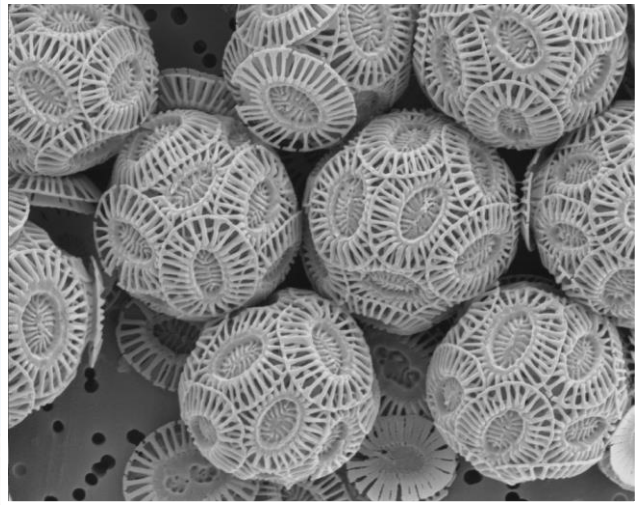
Coccolithen

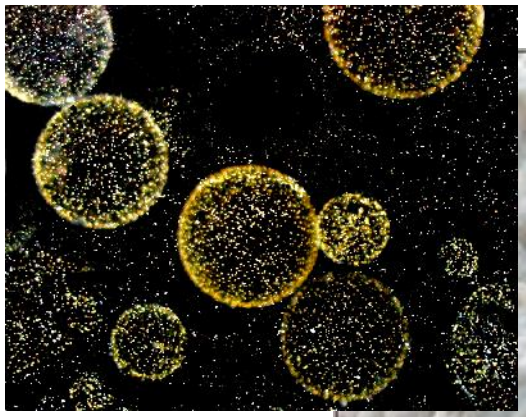


Diatomeeën
(kiezelwieren)

DIATOM FILTER

Coccolithen
(Emiliana huxlei)





Phaeocystis

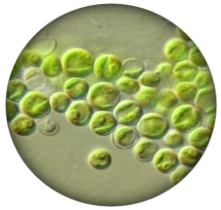
<u>schuimalg</u>

Noctiluca scintillans (**zeevonk** (dinoflagellaat))

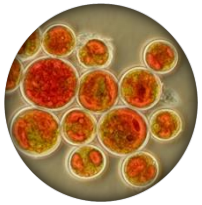
Voedingssuplementen

- *Spirulina*

- *Chlorella*

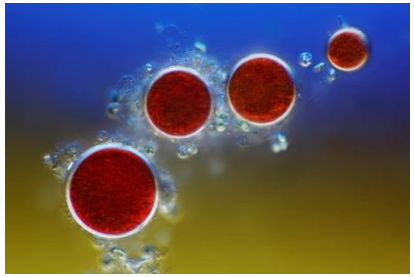


- *Haematococcus*



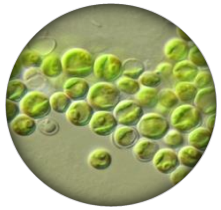
Rijk aan mineralen, kool-hydraten en anti-oxidanten

Haematococcus bevat het rode **pigment** 'Astaxanthine' dat een sterk anti-oxidant is.



- *Spirulina*

- *Chlorella*



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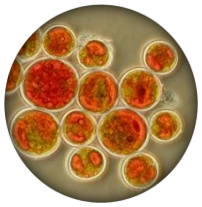
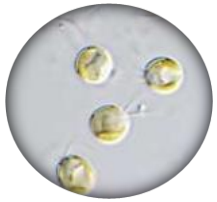


- *Isochrysis*

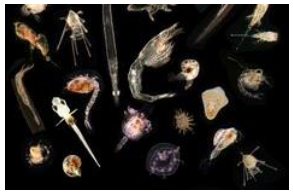


- *Nannochloropsis*

Voedingssuplementen

Rijk aan mineralen, kool-hydraten en anti-oxidanten

Voedsel voor zooplankton (kleine waterdiertjes)
→ op hun beurt voedsel
voor **vis** & **jonge dieren**



Biodiesel

Verklaringen:

Abiotisch

- Gaswisseling & mixing
- Temperatuur

Biotisch

- Oorsprong

Verklaringen:

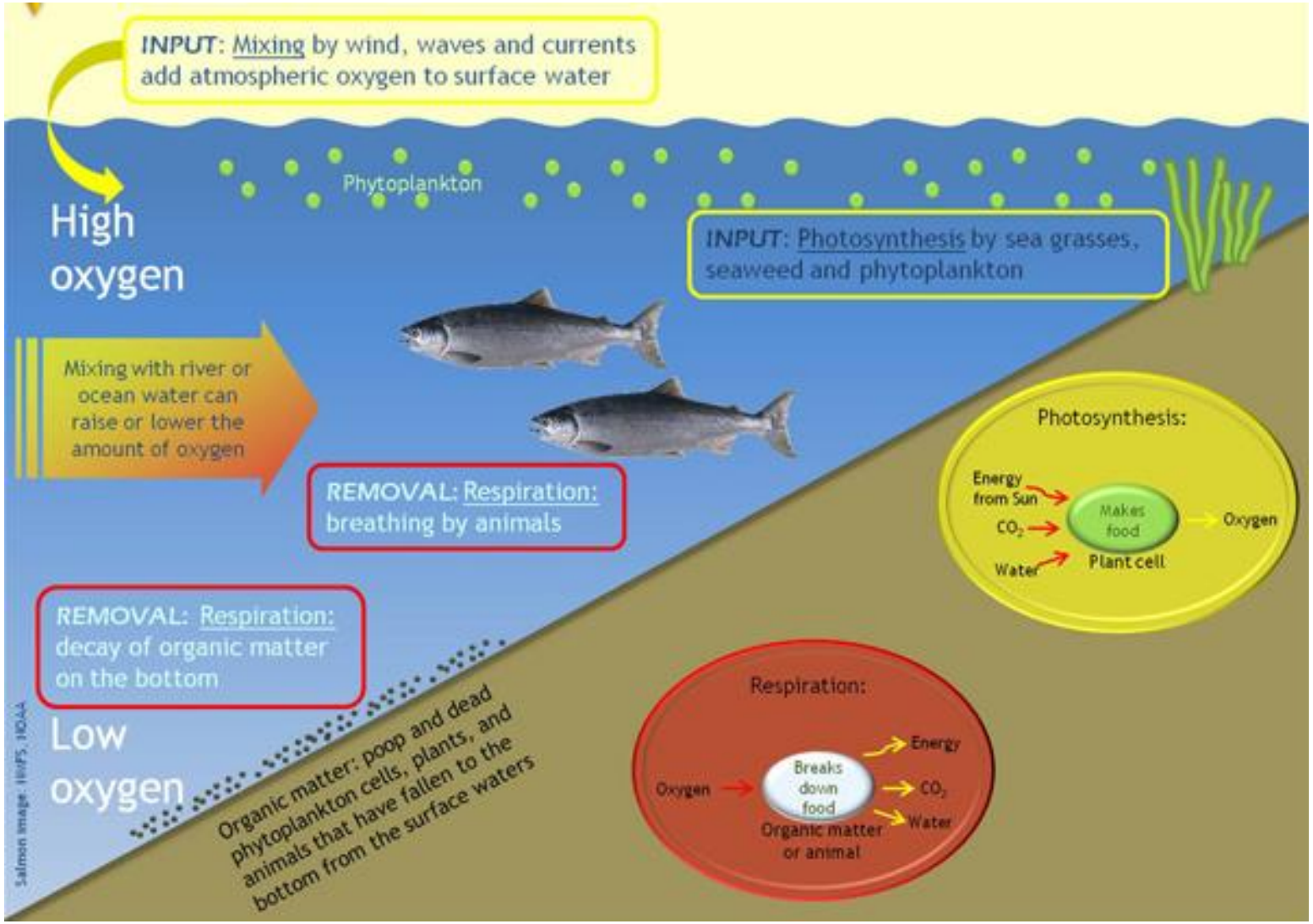
Abiotisch

- Gaswisseling & mixing
- Temperatuur

Biotisch

- Oorsprong
- Verbruik

Verklaringen:



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    - Oorsprong
    - En nu?

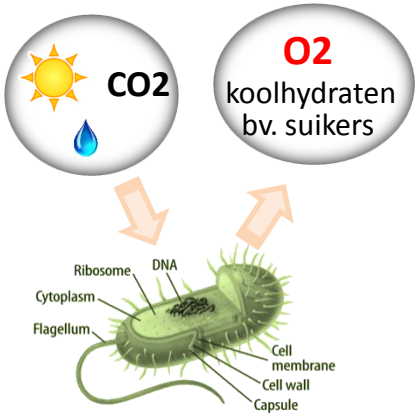
Oorsprong:

Oorsprong:

Prokaryoten
(Bacteriën
& Archaea)

Cyanobacteriën

fotosynthese!



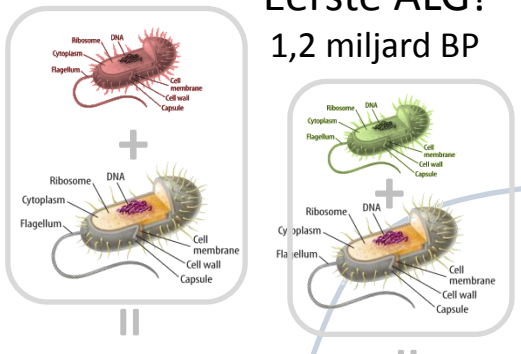
Eukaryoten

Meercelligen

900 miljoen BP

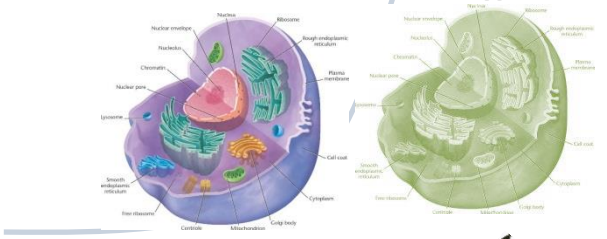
Eerste ALG!

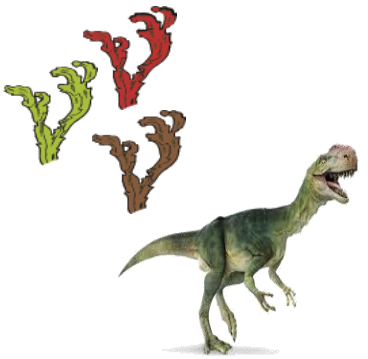
1,2 miljard BP



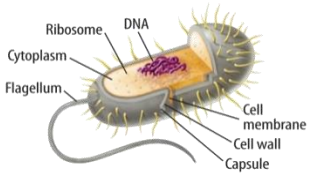
21%

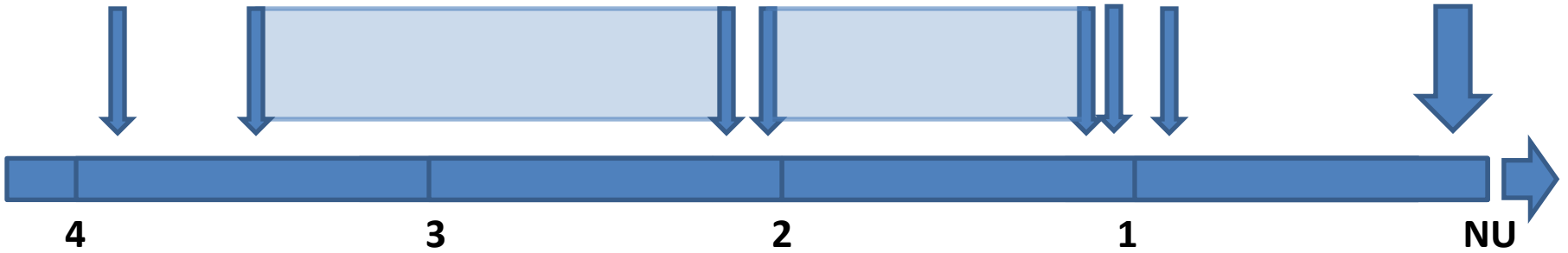
O2





230-66 Ma





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    - Biotisch: verbruik
- Evolutie:
    - Oorsprong
    - En nu?

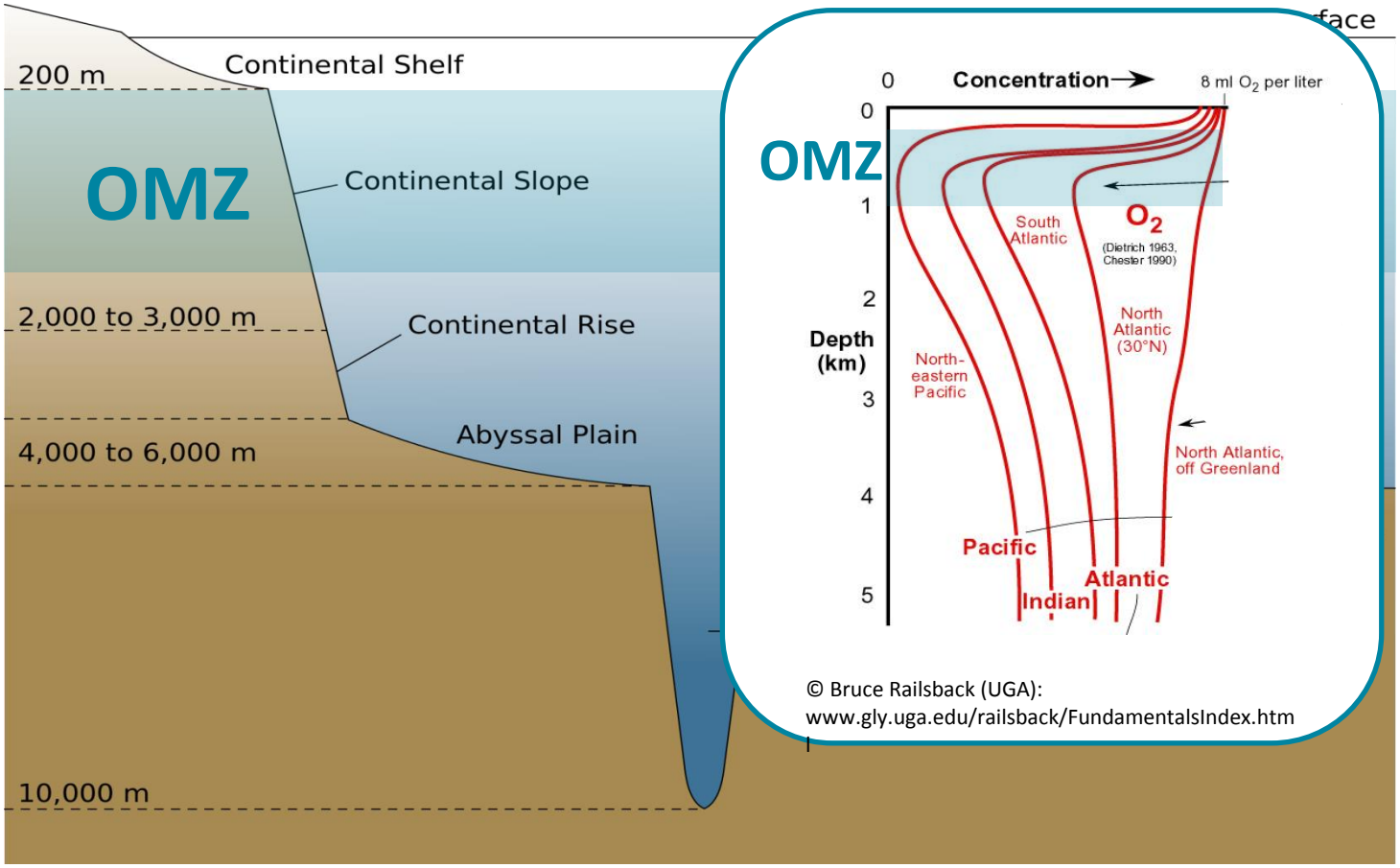
En nu?

OMZ: Oxygen Minimum Zone

‘Dead zones’

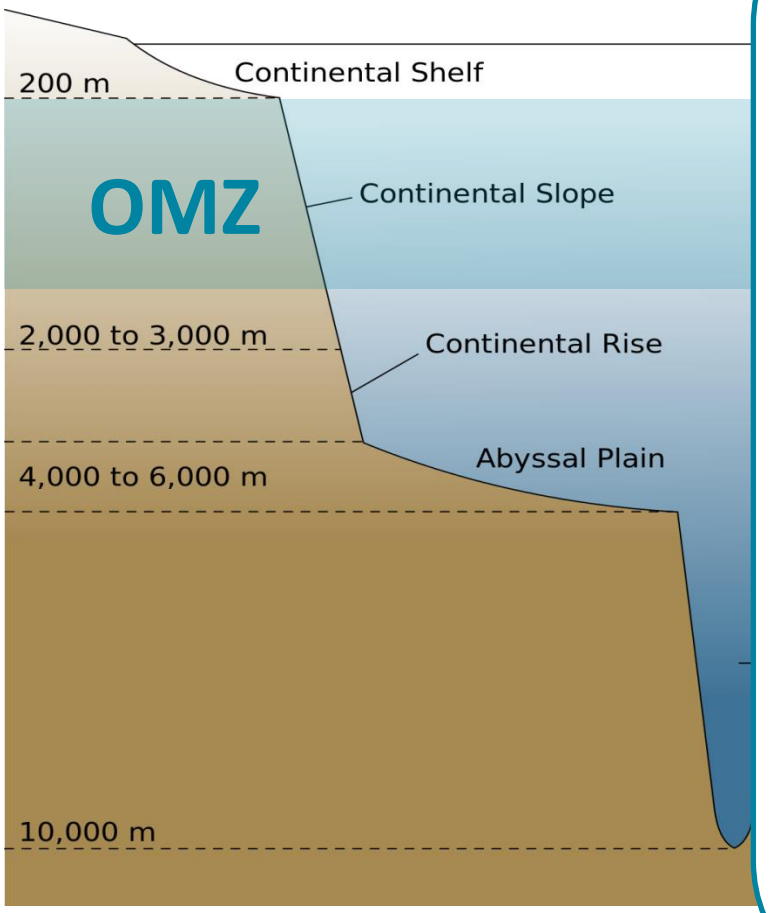
En nu?

OMZ: Oxygen Minimum Zone



En nu?

OMZ: Oxygen Minimum Zone

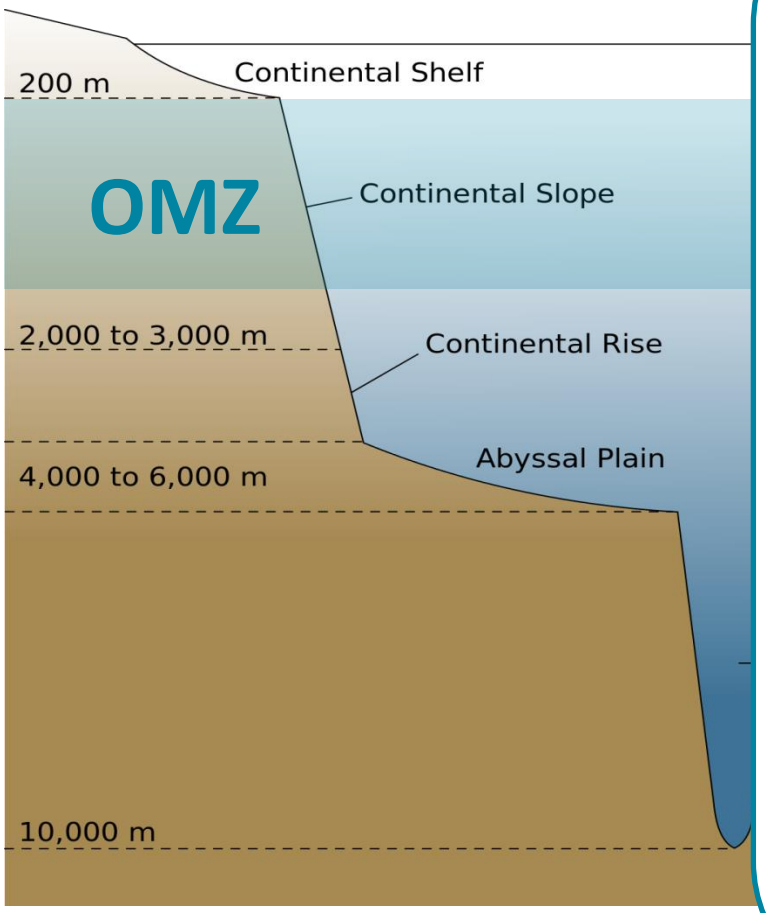


Laatste 50 jaar:

- Groeit met 1 meter/jaar
- Zuurstofarme gebieden in oceaan:
  + 4,5 miljoen km2
  (= 2x Congo)
- Algemeen zuurstofgehalte van de oceaan: -2%
- Deels natuurlijk proces, maar versneld door klimaatopwarming: hogere temperatuur aan oppervlakte ‘zuigt’ O2 uit de diepte.

En nu?

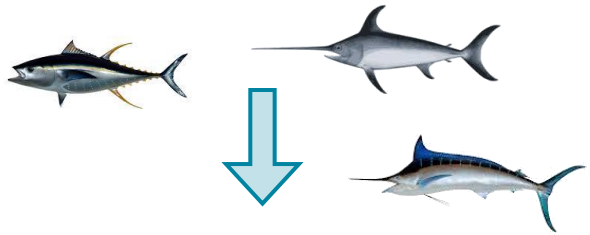
OMZ: Oxygen Minimum Zone



Gevolgen:

- Verschuiving van leefgebied van (roof)vissen

Bv. tonijn, zwaardvis, zeilvis, haai

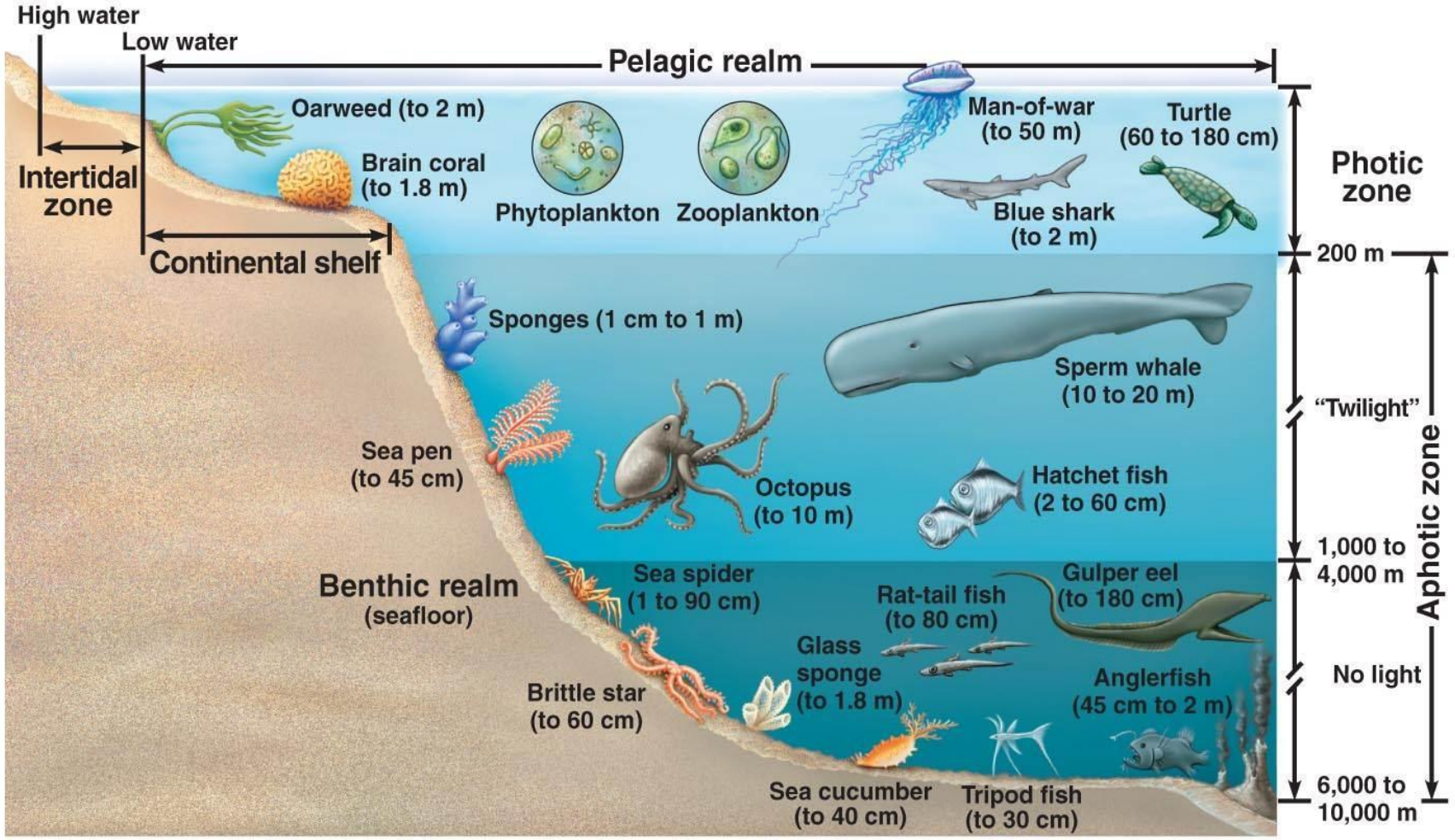


- Kwetsbaarder voor overbevissing
- Veranderd biotoop / dieet

(bv. zwaardvis in Costa Rica: van 800 m naar ondiepe wateren / Californië: O2-gehalte op 200 meter diepte: -30% in 50 jaar.)

En nu?

OMZ: Oxygen Minimum Zone



En nu?

OMZ: Oxygen Minimum Zone

‘Dead zones’

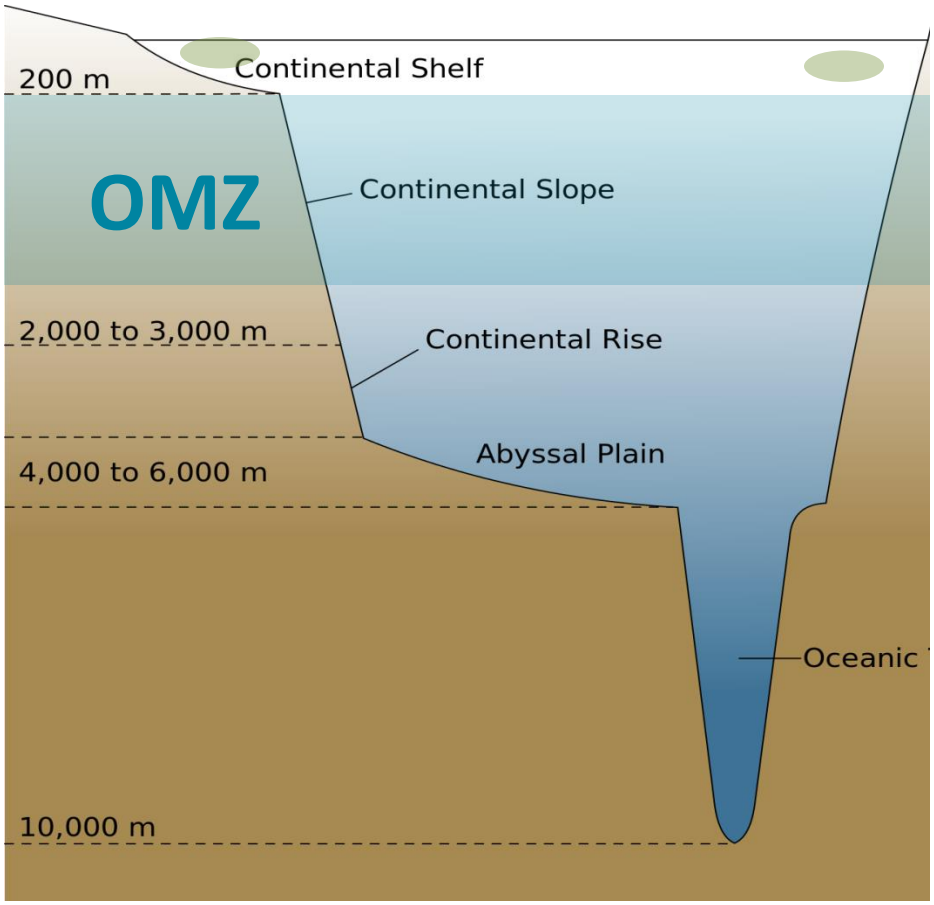
Laatste 50 jaar:

- Aantal ‘dead zones’ x 4

En nu?

OMZ: Oxygen Minimum Zone

‘Dead zones’



En nu?

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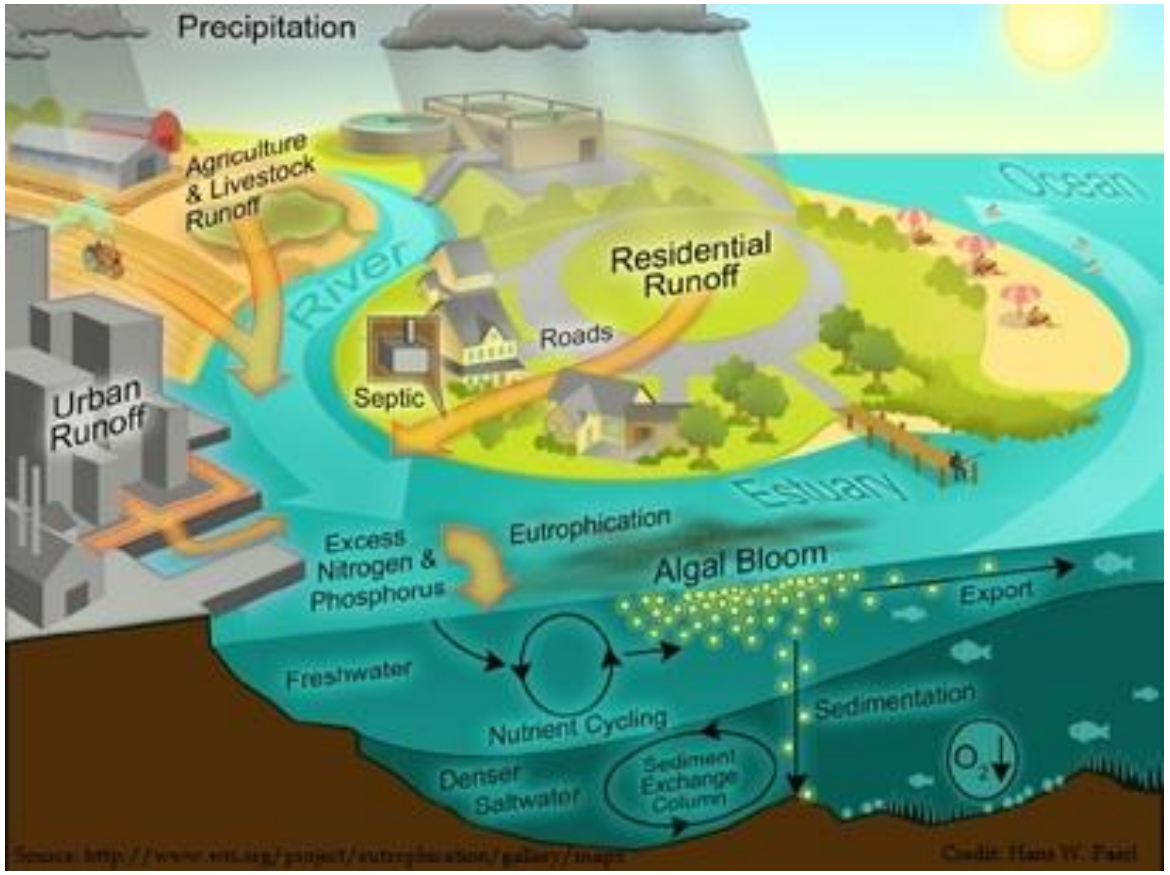

Bron: Portland State University / http://deadzonesinoceans.weebly.com/

En nu?

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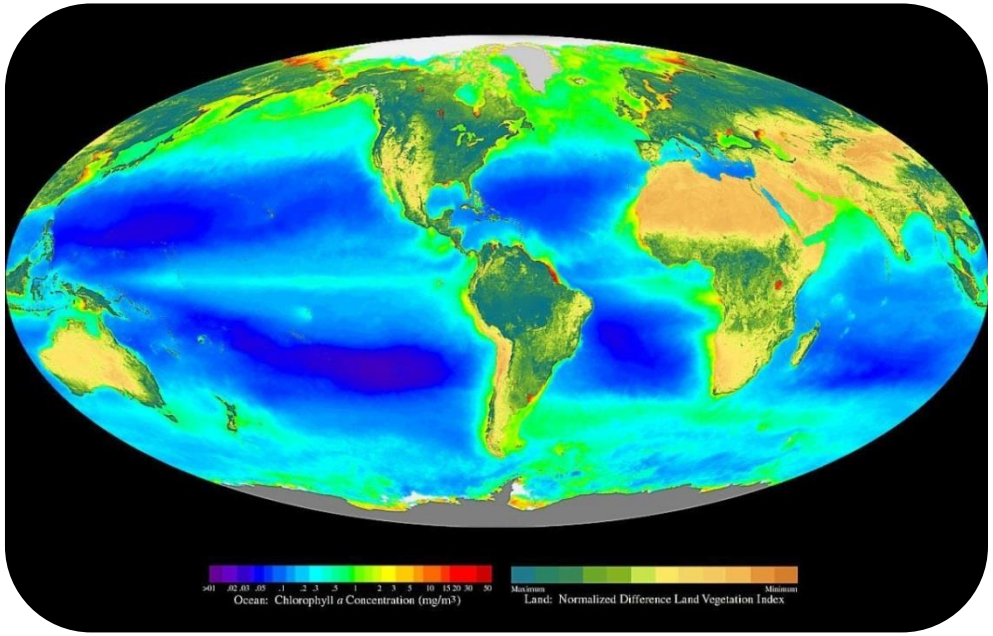
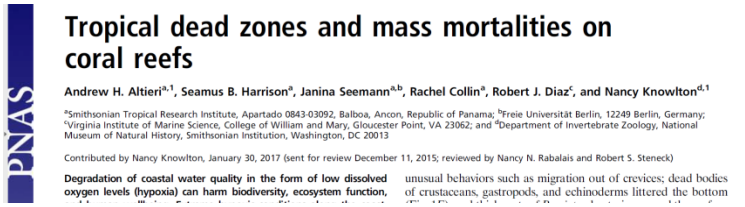
‘Dead zones’



Estimates of autotrophic biomass (1997-2000)
Ocean: Chlorophyll-a concentration (mg/m3)

Figuur: © SeaWiFS

Gevolgen:



PNAS

Tropical dead zones and mass mortalities on coral reefs

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Contributed by Nancy Knowlton, January 30, 2017 (sent for review December 11, 2015; reviewed by Nancy N. Rabalais and Robert S. Steneck)

Degradation of coastal water quality in the form of low dissolved oxygen levels (hypoxia) can harm biodiversity, ecosystem function, unusual behaviors such as migration out of crevices; dead bodies of crustaceans, gastropods, and echinoderms littered the bottom

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Sardienen in Chili, 2016

Dankuwel!