Koninklijk Nederlands
Instituut voor
Onderzoek der Zee

Dr. M.F. (Femke) de Jong

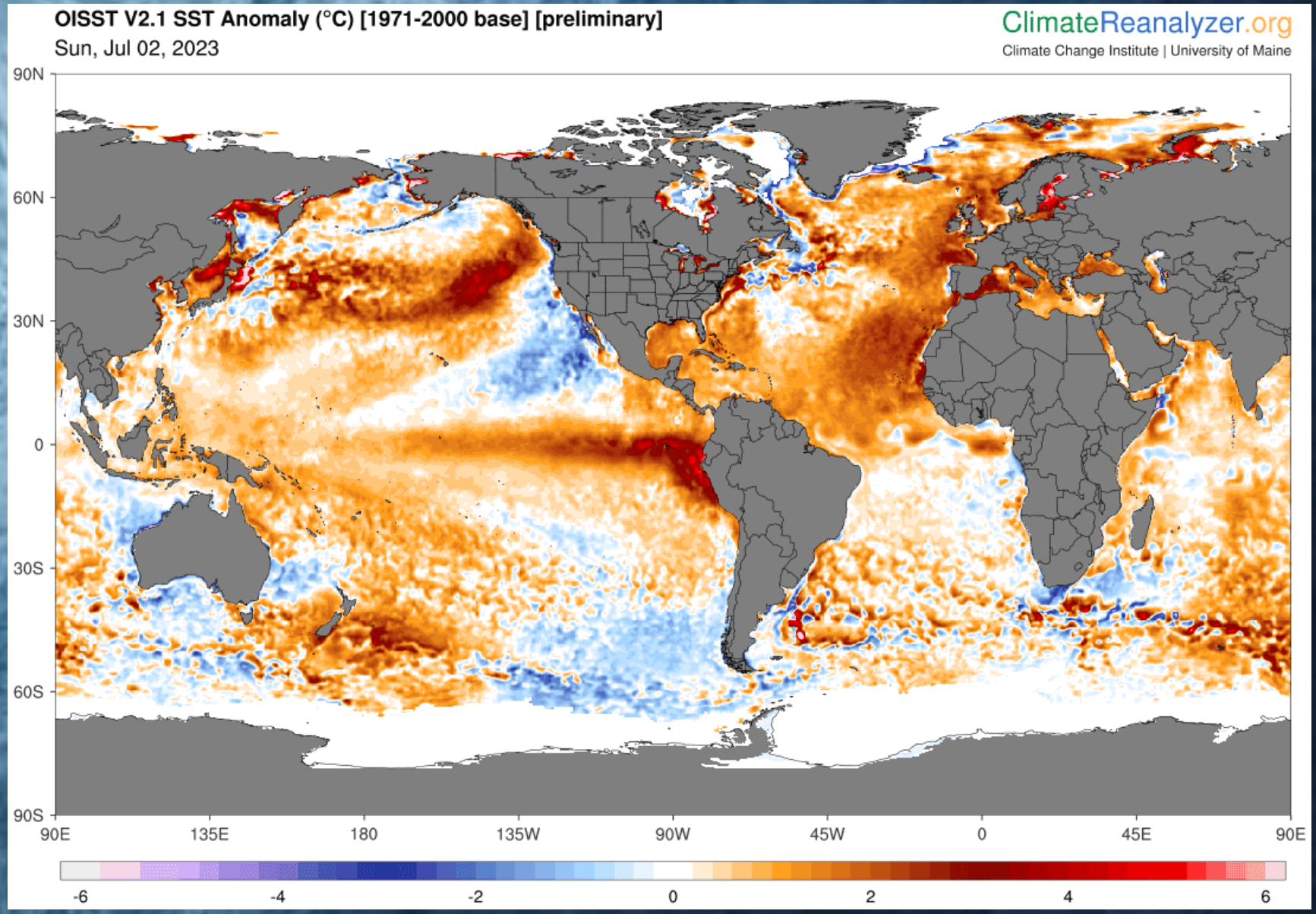
KNAG Onderwijsdag 2023

KLIMAATVERANDERING IN DE OCEAAN

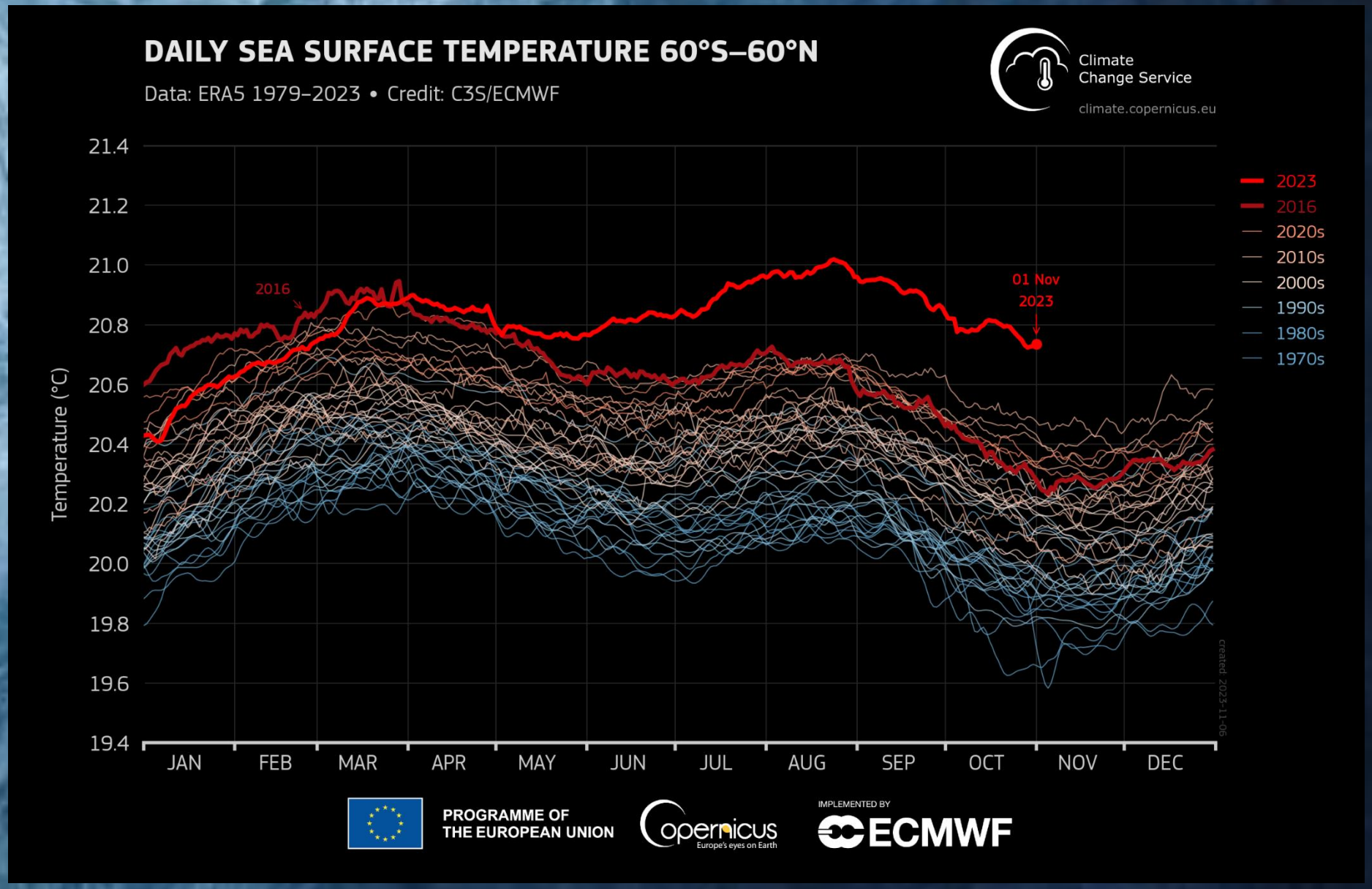
NIOZ Texel

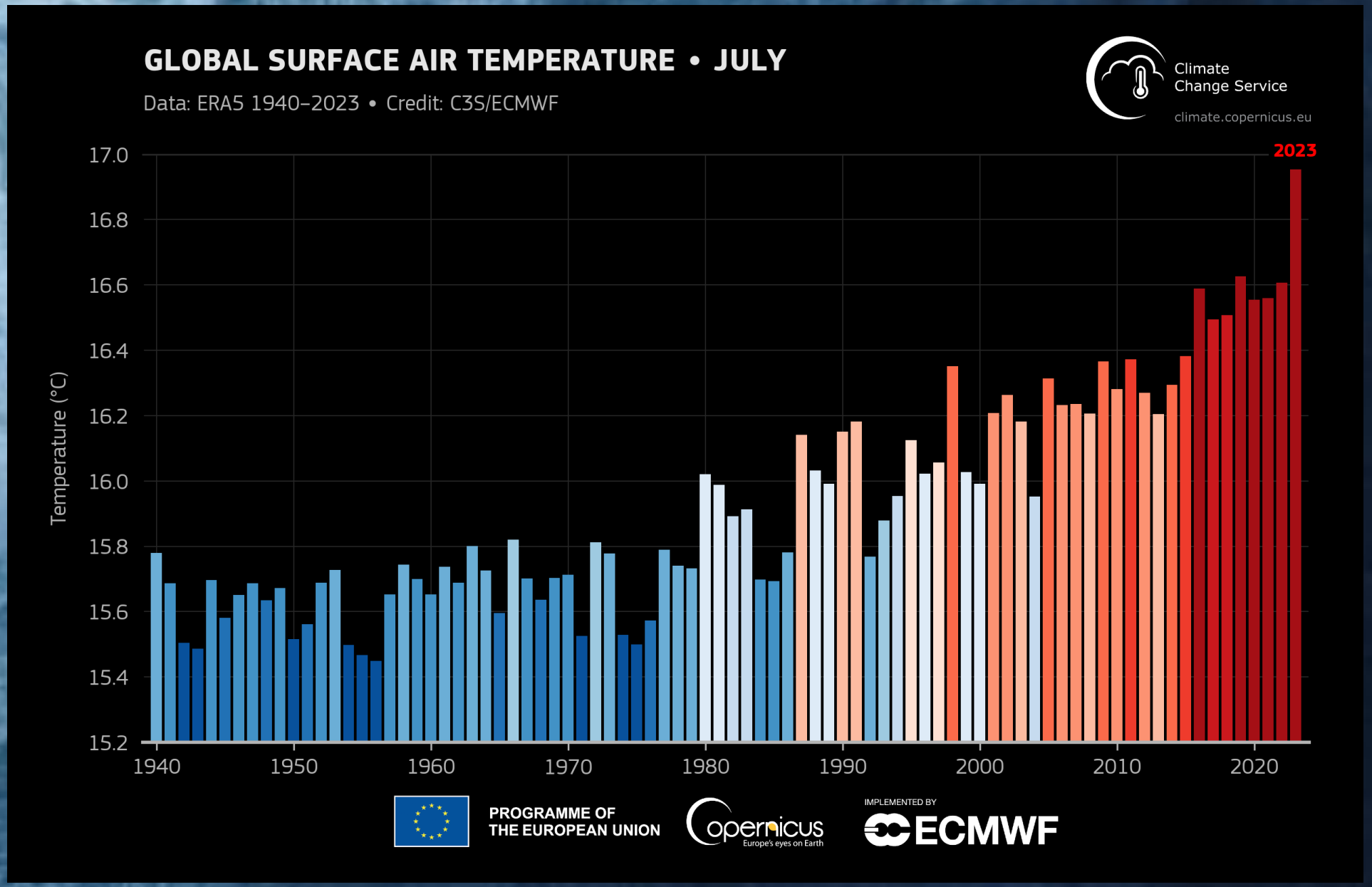
Zeegaand oceanografisch onderzoek

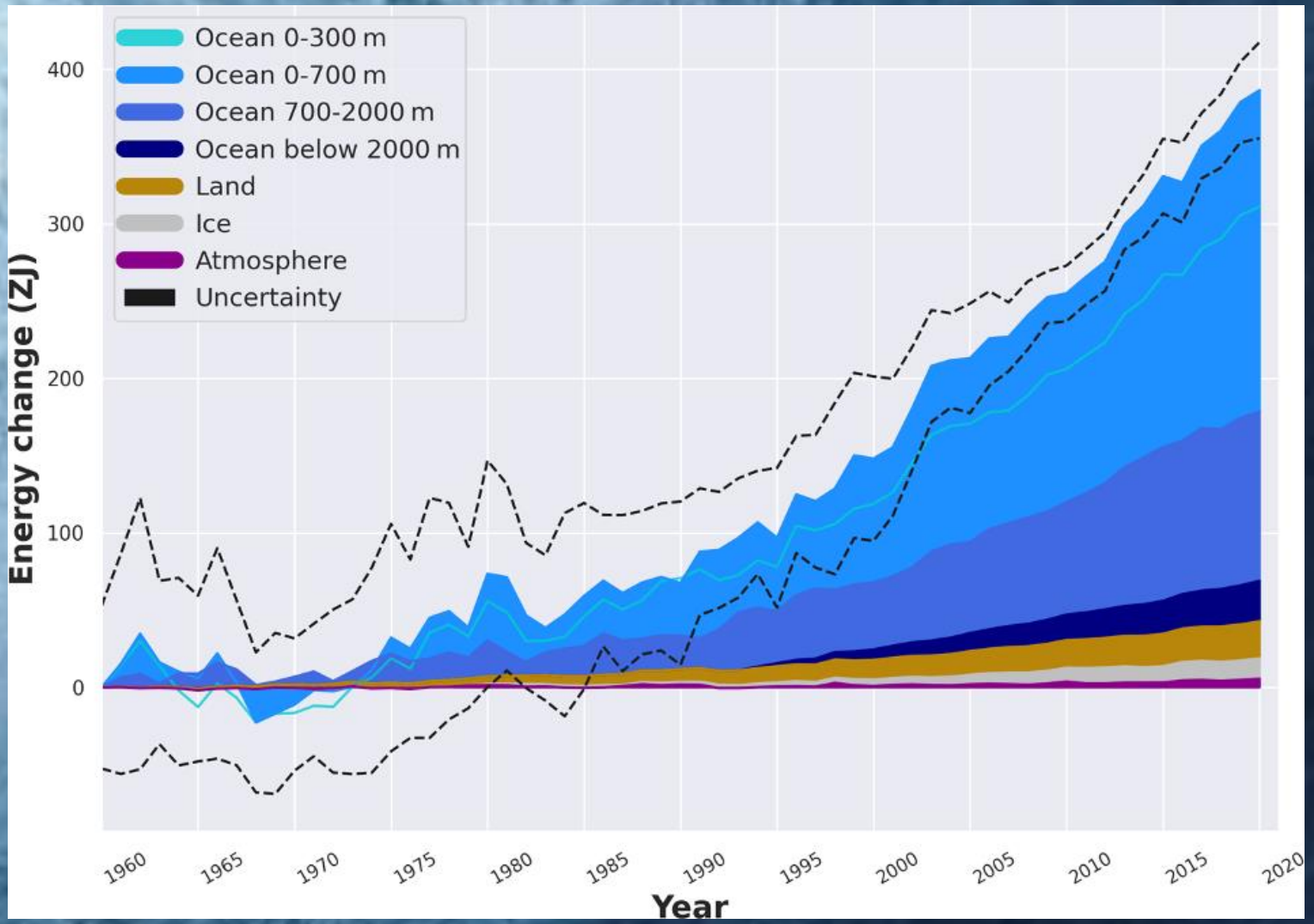
Oceanen in het nieuws



Oceanen in het nieuws




GLOBAL SURFACE AIR TEMPERATURE • JULY
Data: ERA5 1940–2023 • Credit: C3S/ECMWF
Climate Change Service
climate.copernicus.eu
2023
Temperature (°C)
17.0
16.8
16.6
16.4
16.2
16.0
15.8
15.6
15.4
15.2
1940
1950
1960
1970
1980
1990
2000
2010
2020
PROGRAMME OF THE EUROPEAN UNION
Copernicus
Europe's eyes on Earth
IMPLEMENTED BY
ECMWF



Schuckmann et al., 2023

Waar is de “extra” energie die CO_2 in het klimaatsysteem vastgehouden heeft?

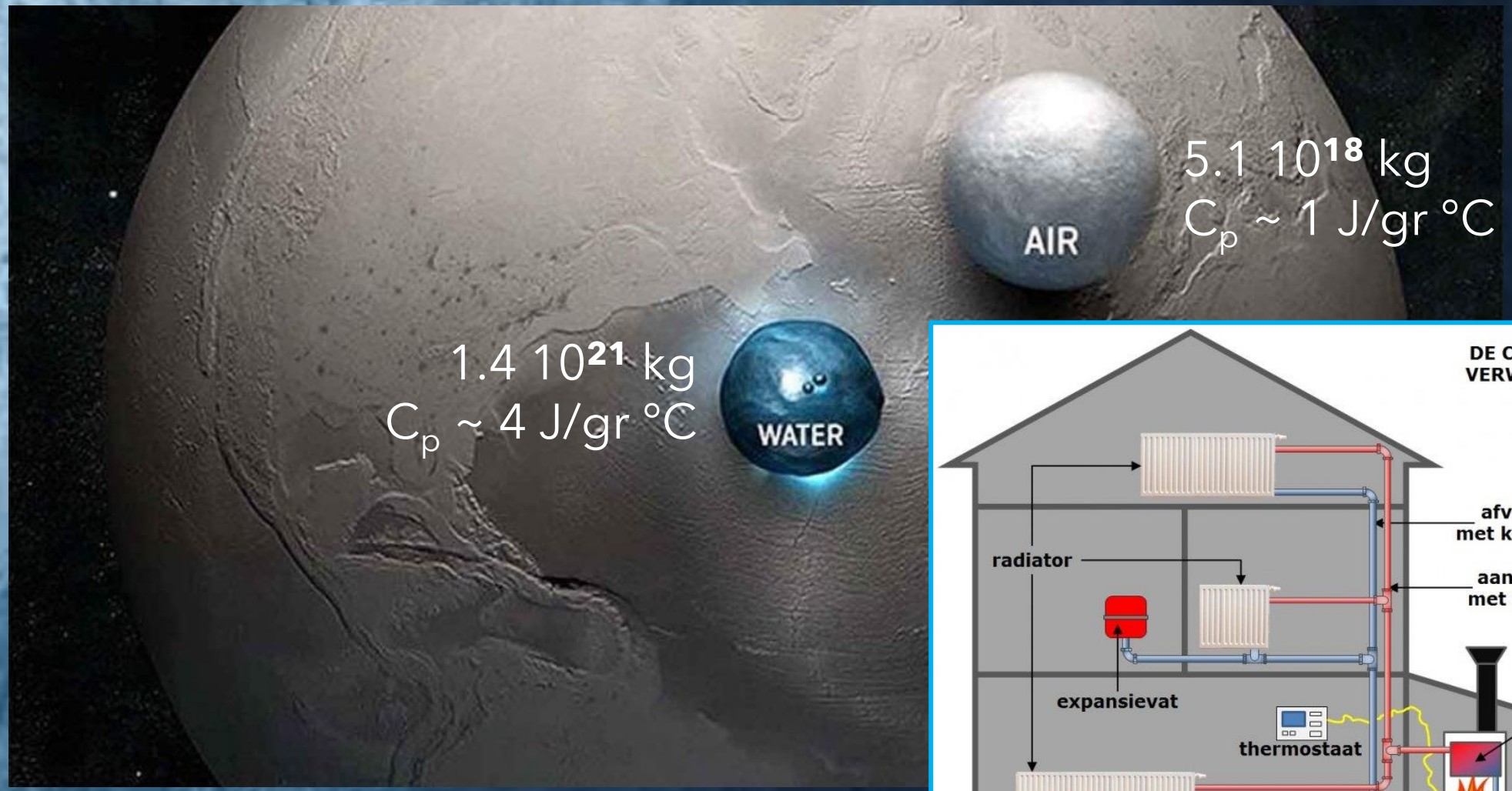
89% oceaan

6% land

4% ijs

1% atmosfeer


AIR
5.1 10^18 kg
Cp ~ 1 J/gr °C
WATER
1.4 10^21 kg
Cp ~ 4 J/gr °C


AIR
5.1 10^18 kg
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1.4 10^21 kg
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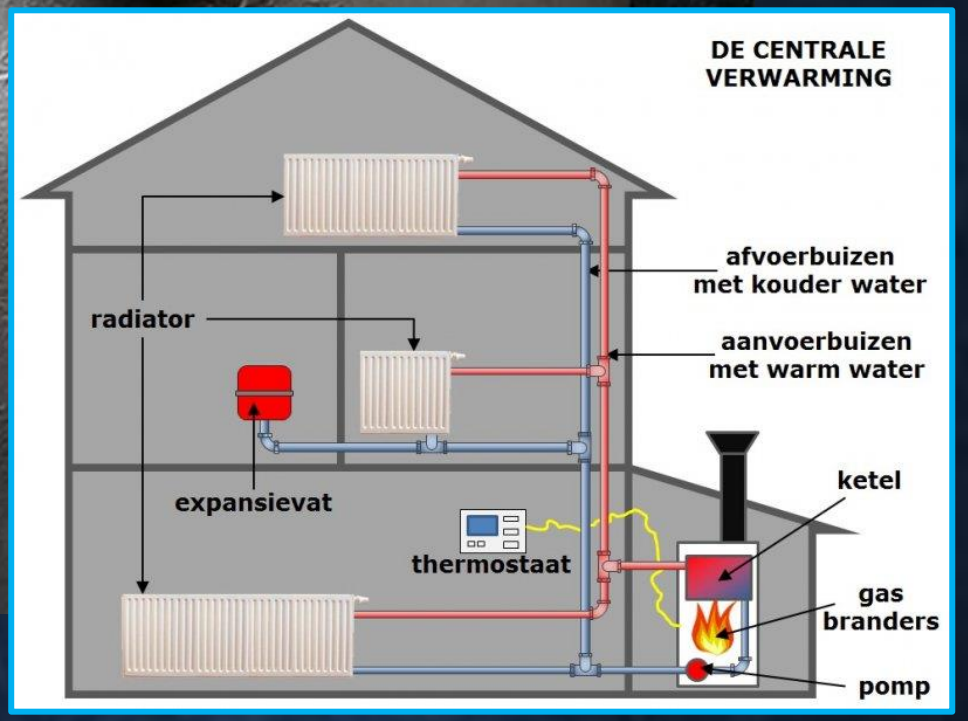
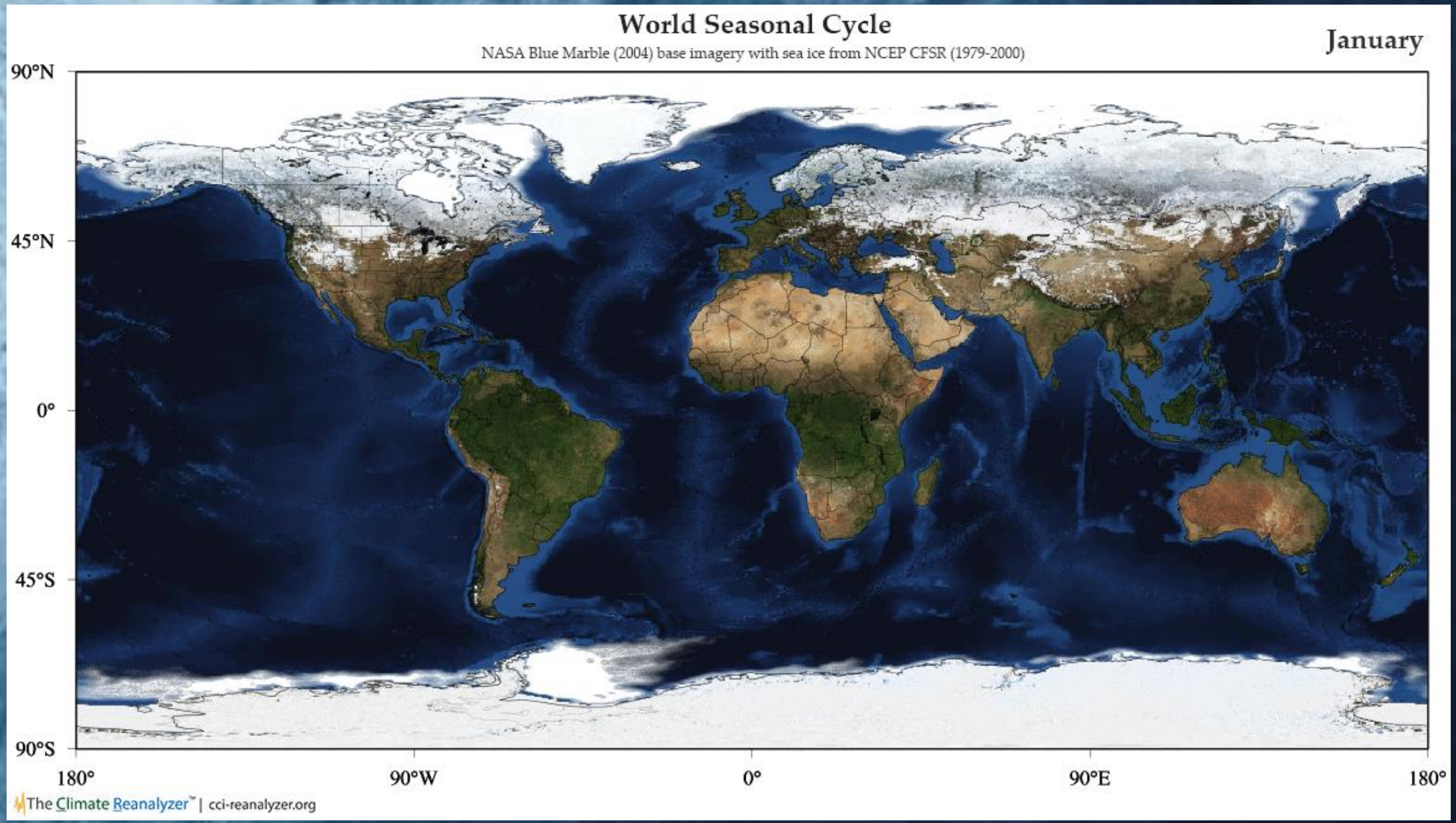
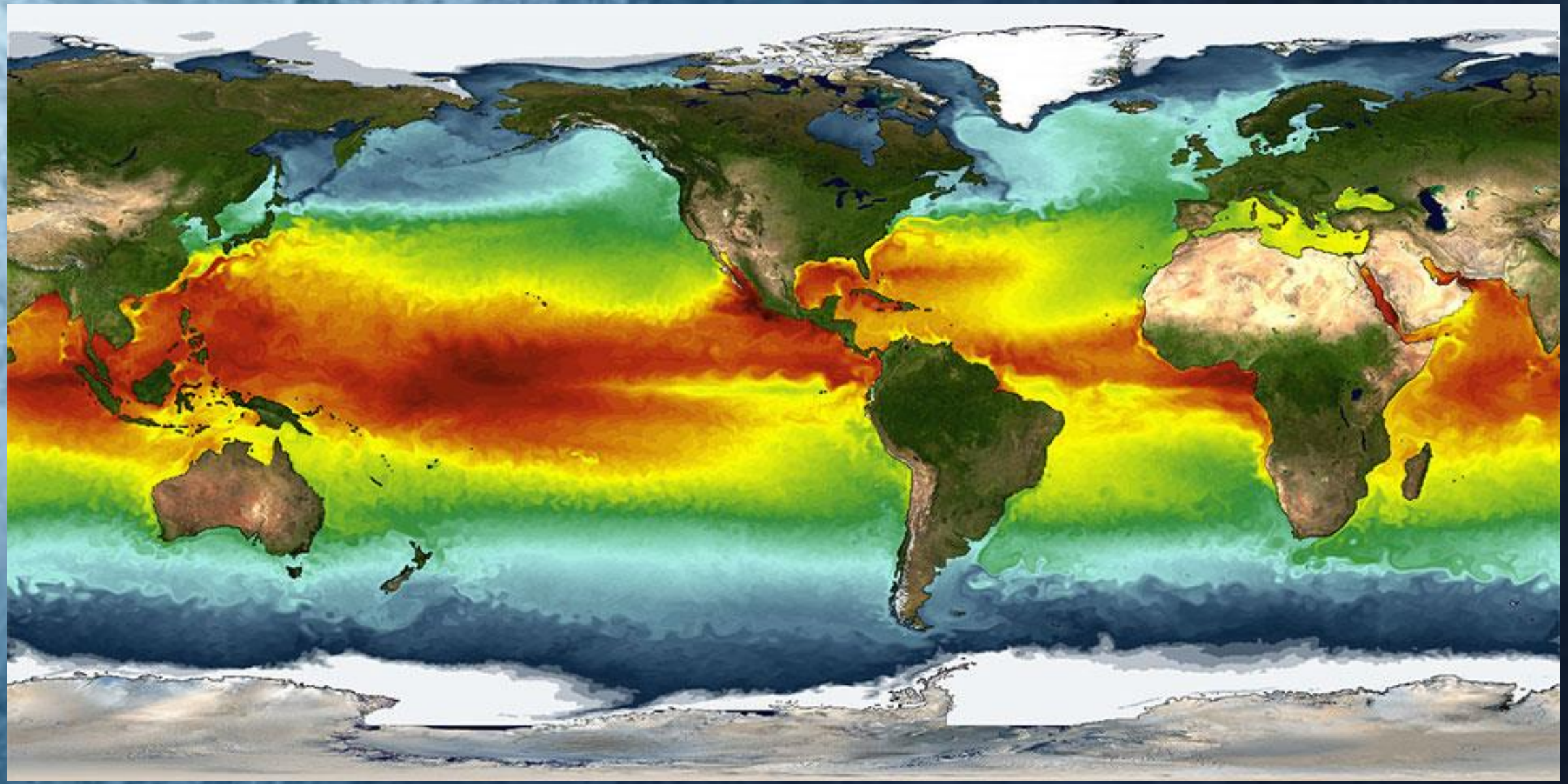
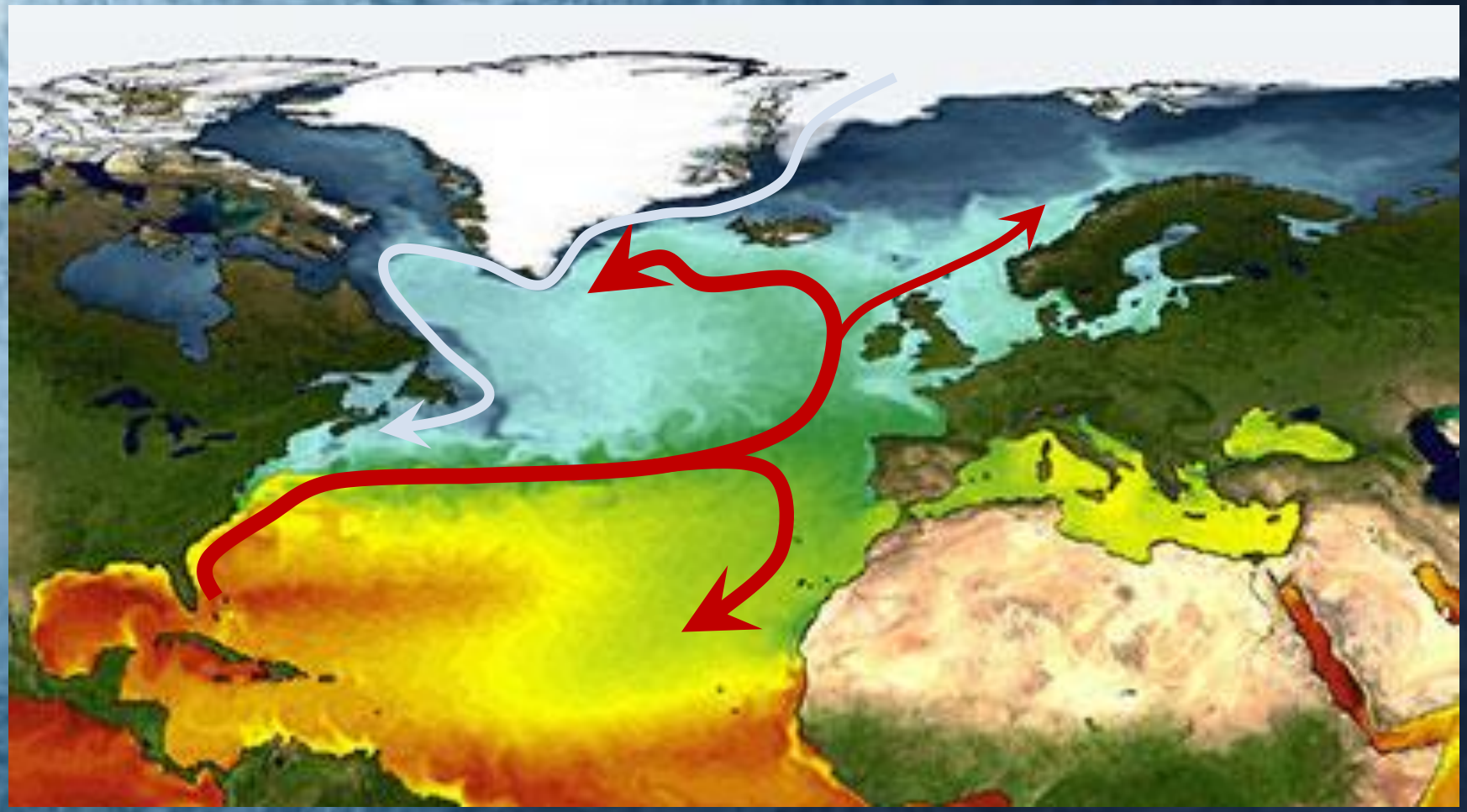

DE CENTRALE VERWARMING
afvoerbuizen met kouder water
aanvoerbuizen met warm water
radiator
expansievat
thermostaat
ketel
gas branders
pomp


World Seasonal Cycle
NASA Blue Marble (2004) base imagery with sea ice from NCEP CFSR (1979-2000)
January
90°N
45°N
0°
45°S
90°S
180°
90°W
0°
90°E
180°
The Climate Reanalyzer™ | cci-reanalyzer.org

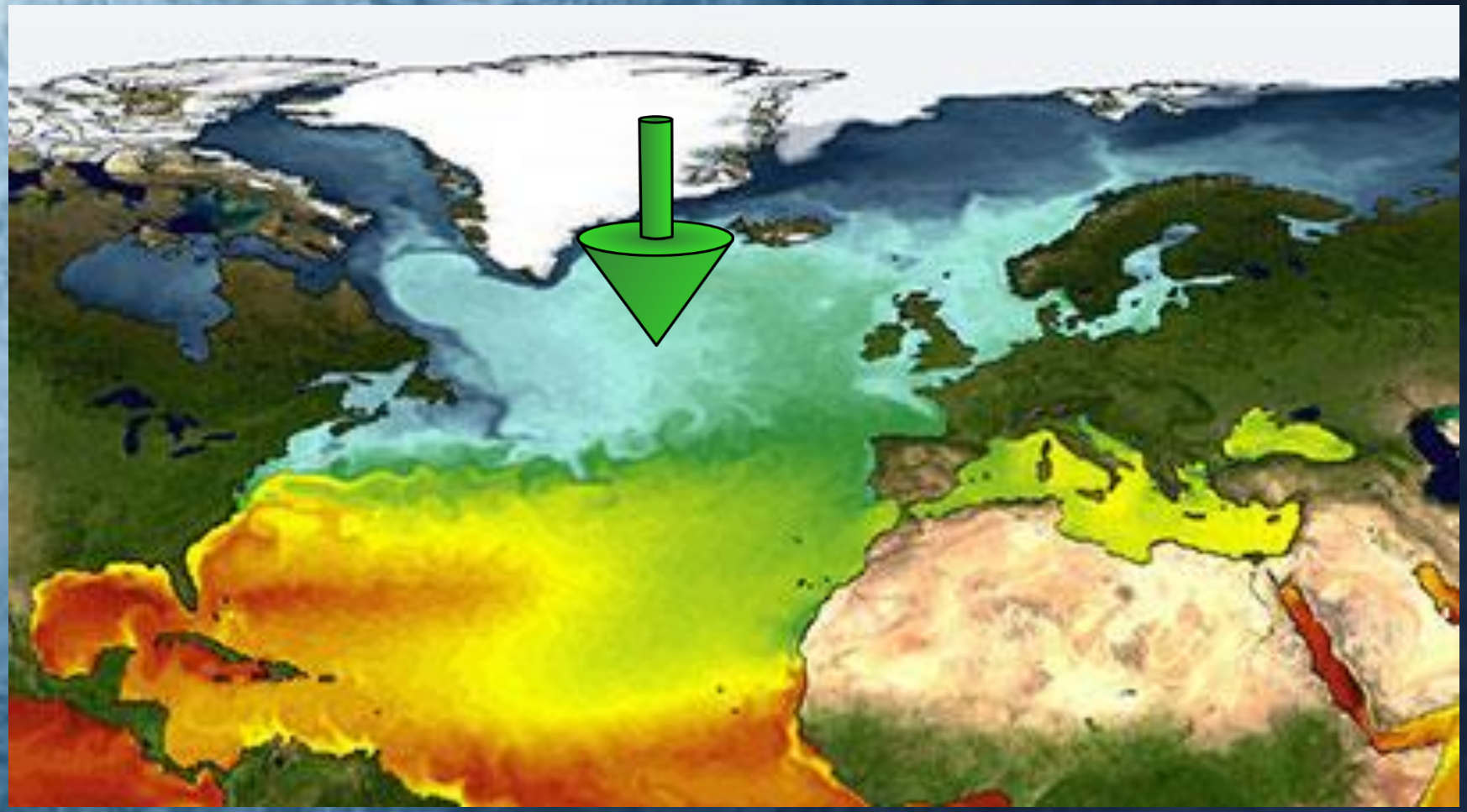
Oppervlakte temperatuur oceanen

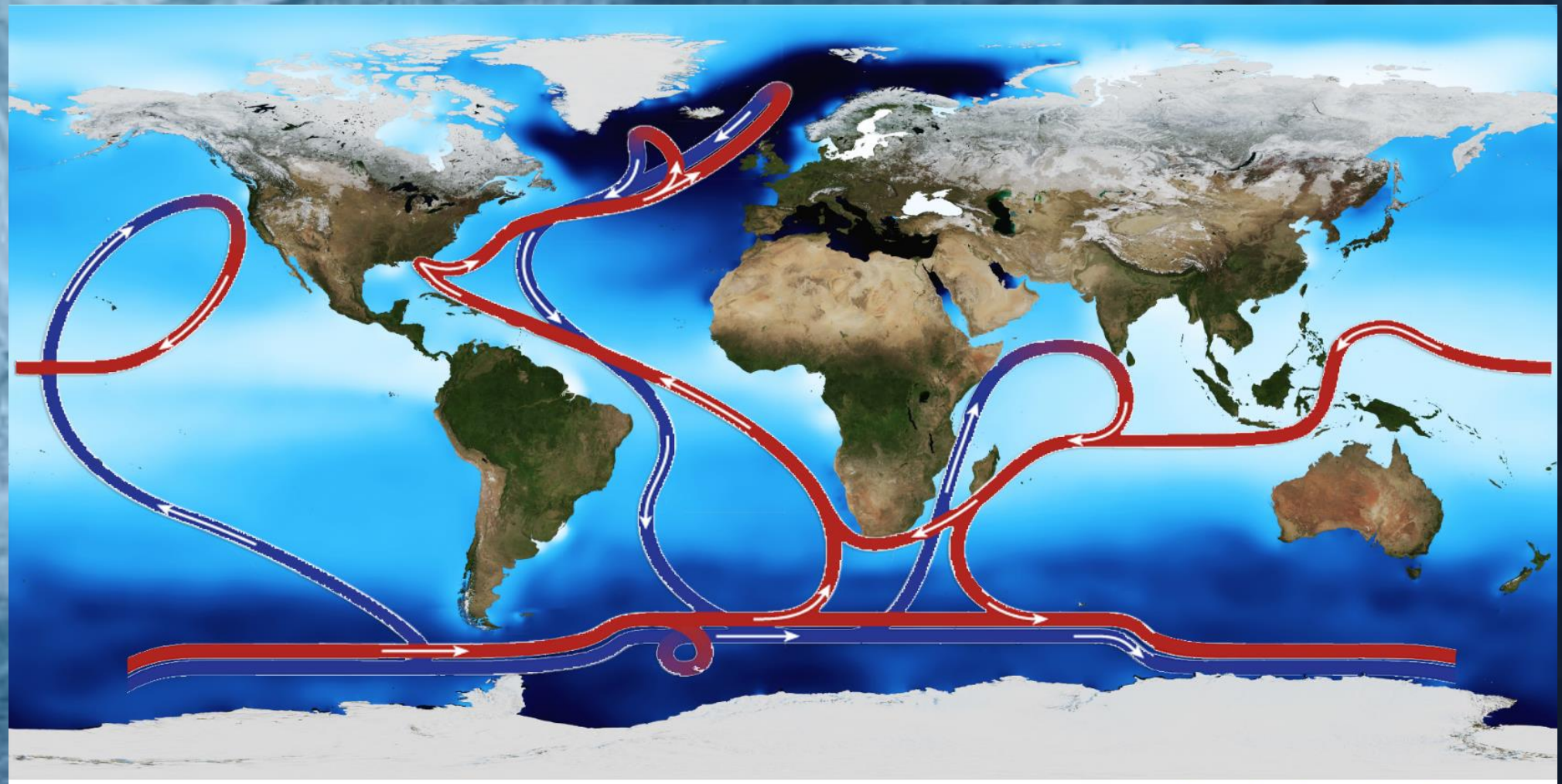


Noord Atlantische Oceaan

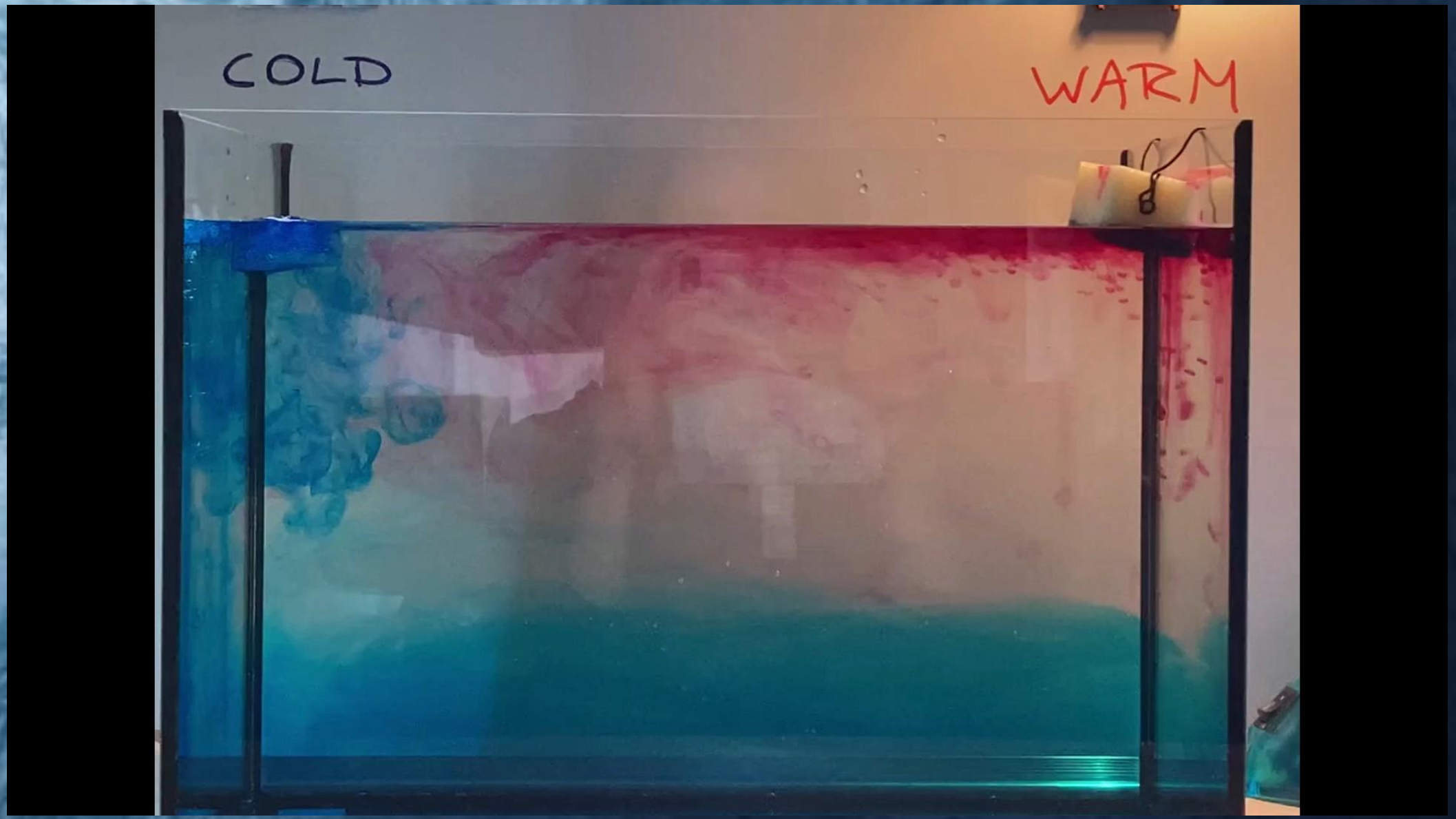


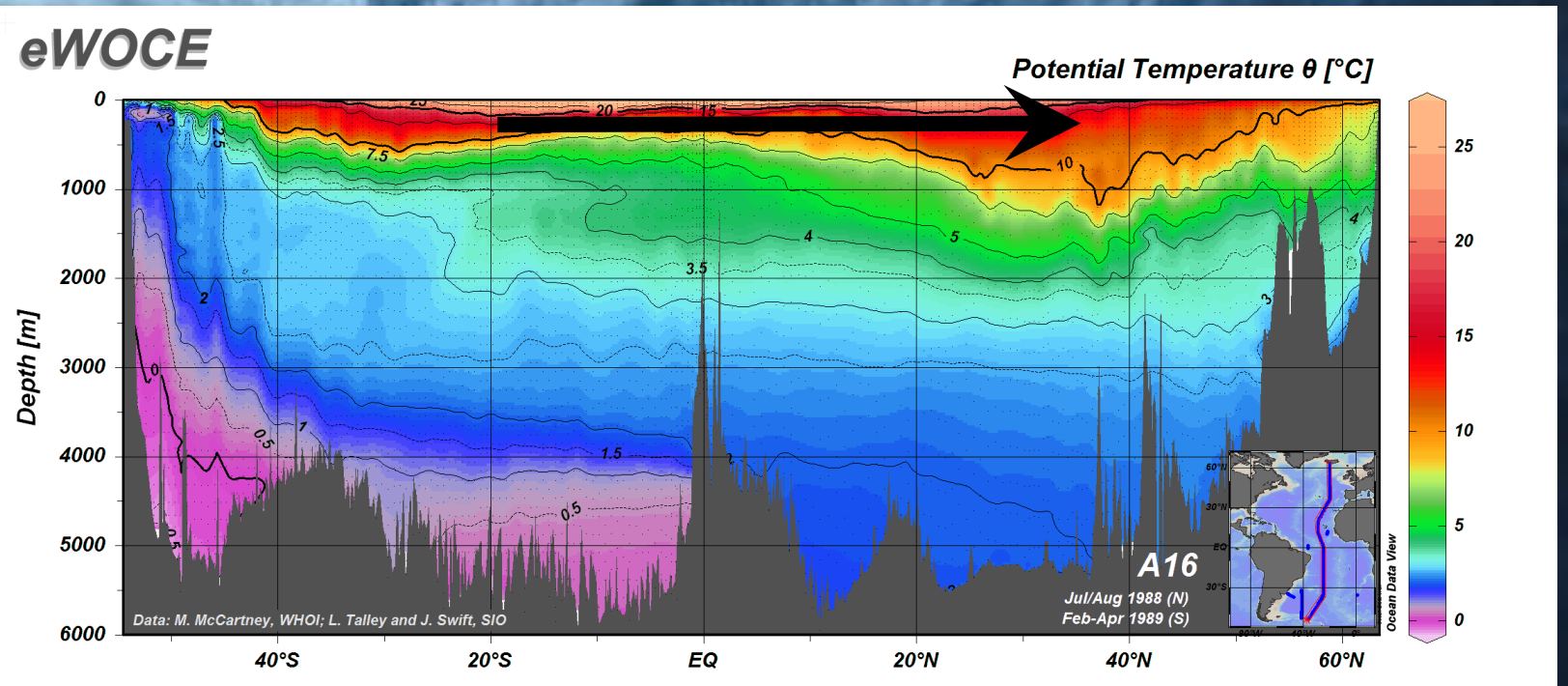
Noord Atlantische Oceaan

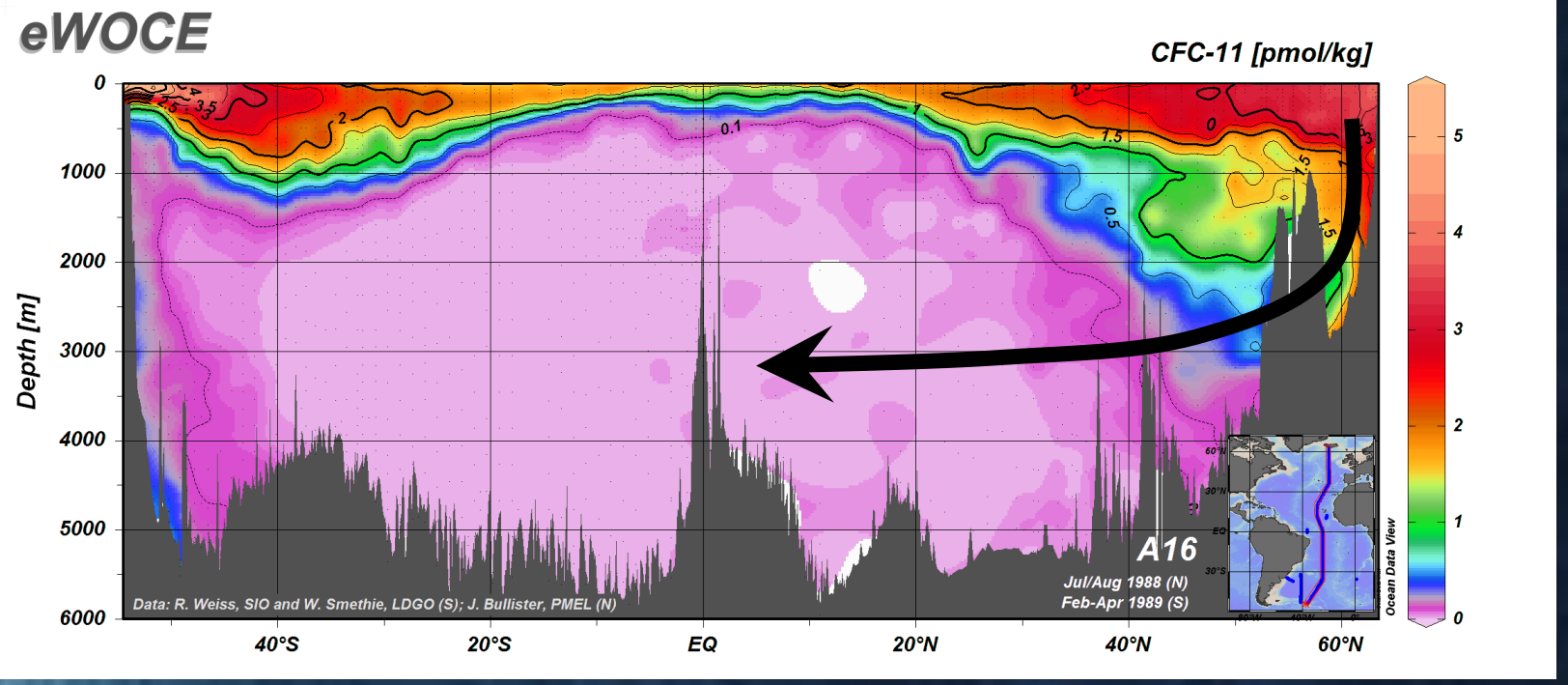




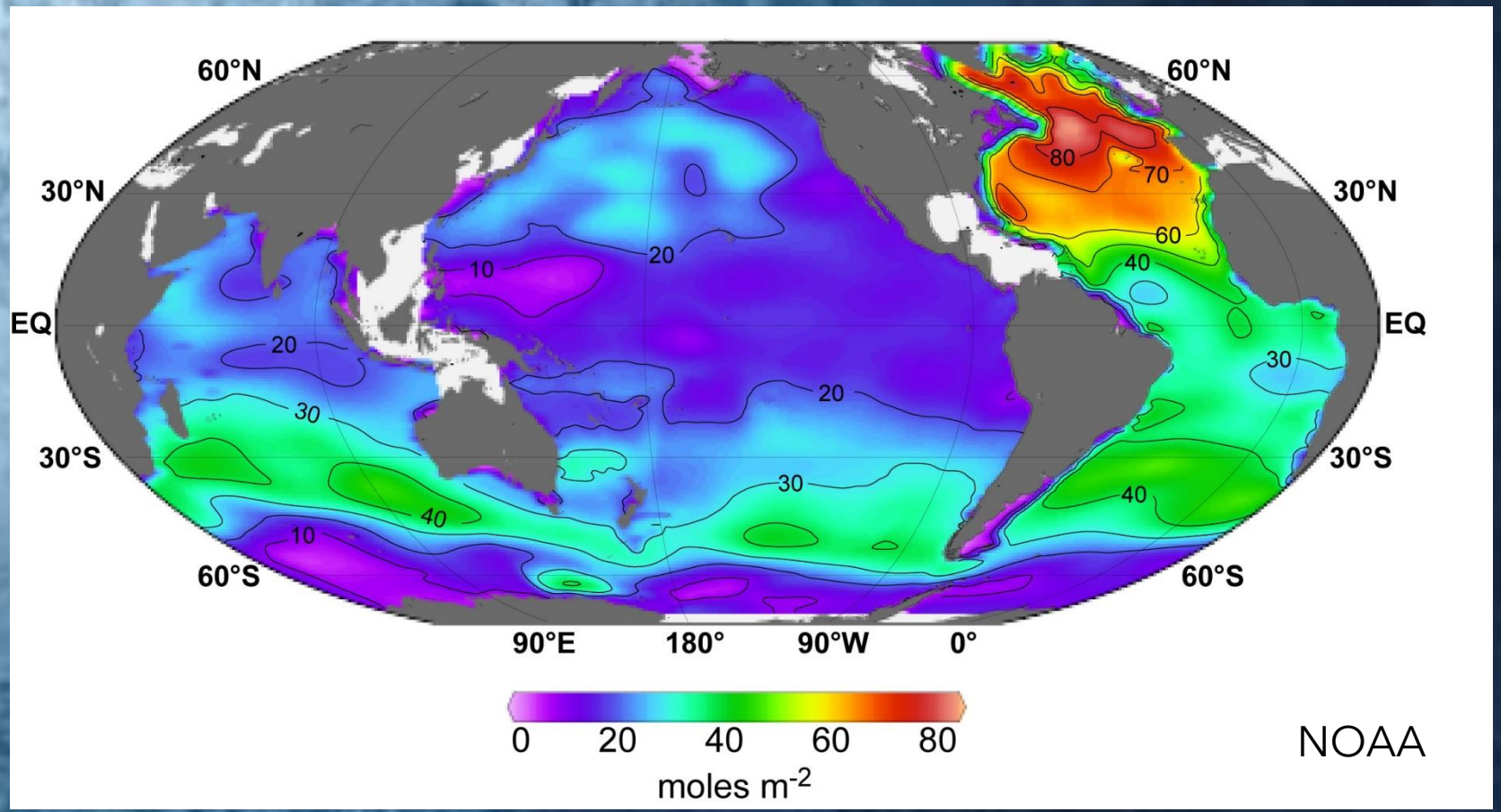
Meridionale Overturning Circulatie


COLD
WARM


eWOCE
Potential Temperature θ [°C]
Depth [m]
0
1000
2000
3000
4000
5000
6000
40°S
20°S
EQ
20°N
40°N
60°N
A16
Jul/Aug 1988 (N)
Feb-Apr 1989 (S)
Data: M. McCartney, WHOI; L. Talley and J. Swift, SIO
Ocean Data View
25
20
15
10
5
0

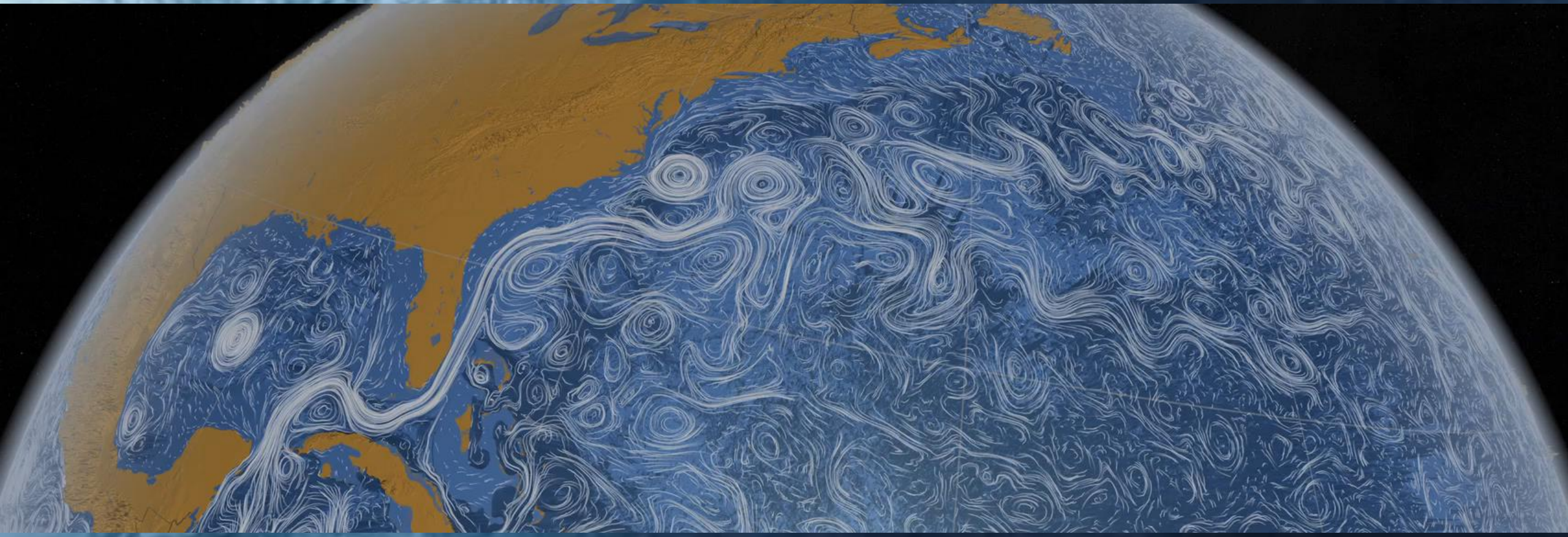

eWOCE
CFC-11 [pmol/kg]
Depth [m]
0
1000
2000
3000
4000
5000
6000
40°S
20°S
EQ
20°N
40°N
60°N
A16
Jul/Aug 1988 (N)
Feb-Apr 1989 (S)
Data: R. Weiss, SIO and W. Smethie, LDGO (S); J. Bullister, PMEL (N)
Ocean Data View
5
4
3
2
1
0

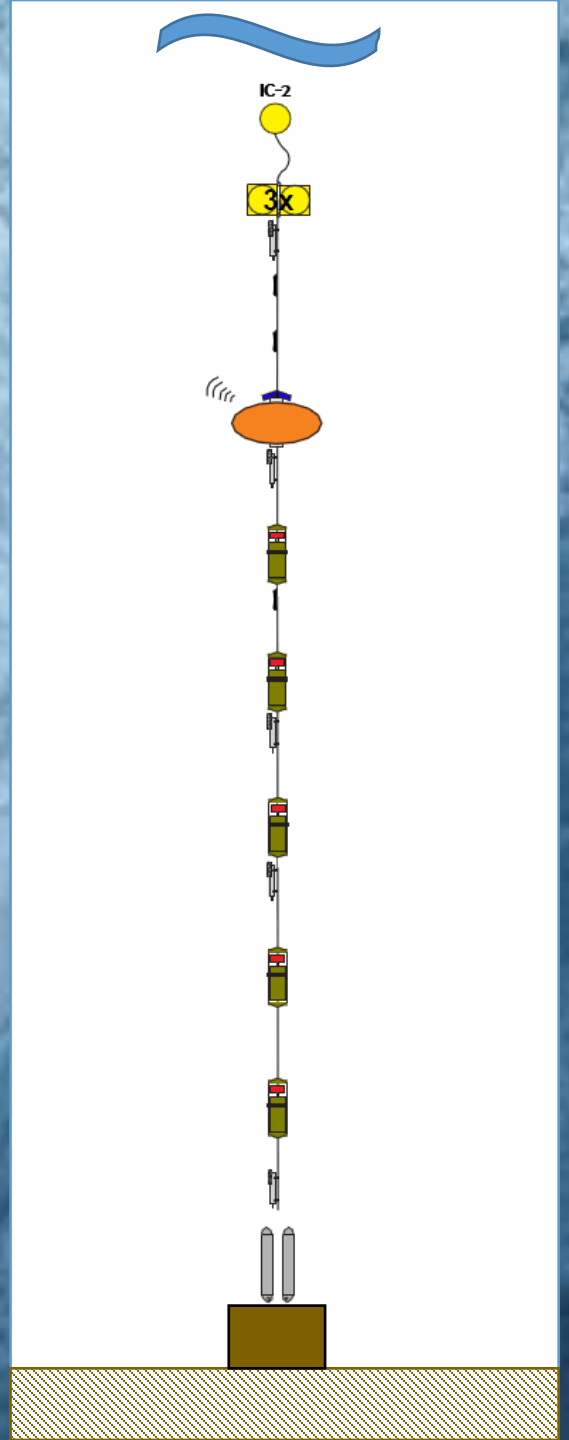
Door de ocean opgenomen anthropogeen CO_2

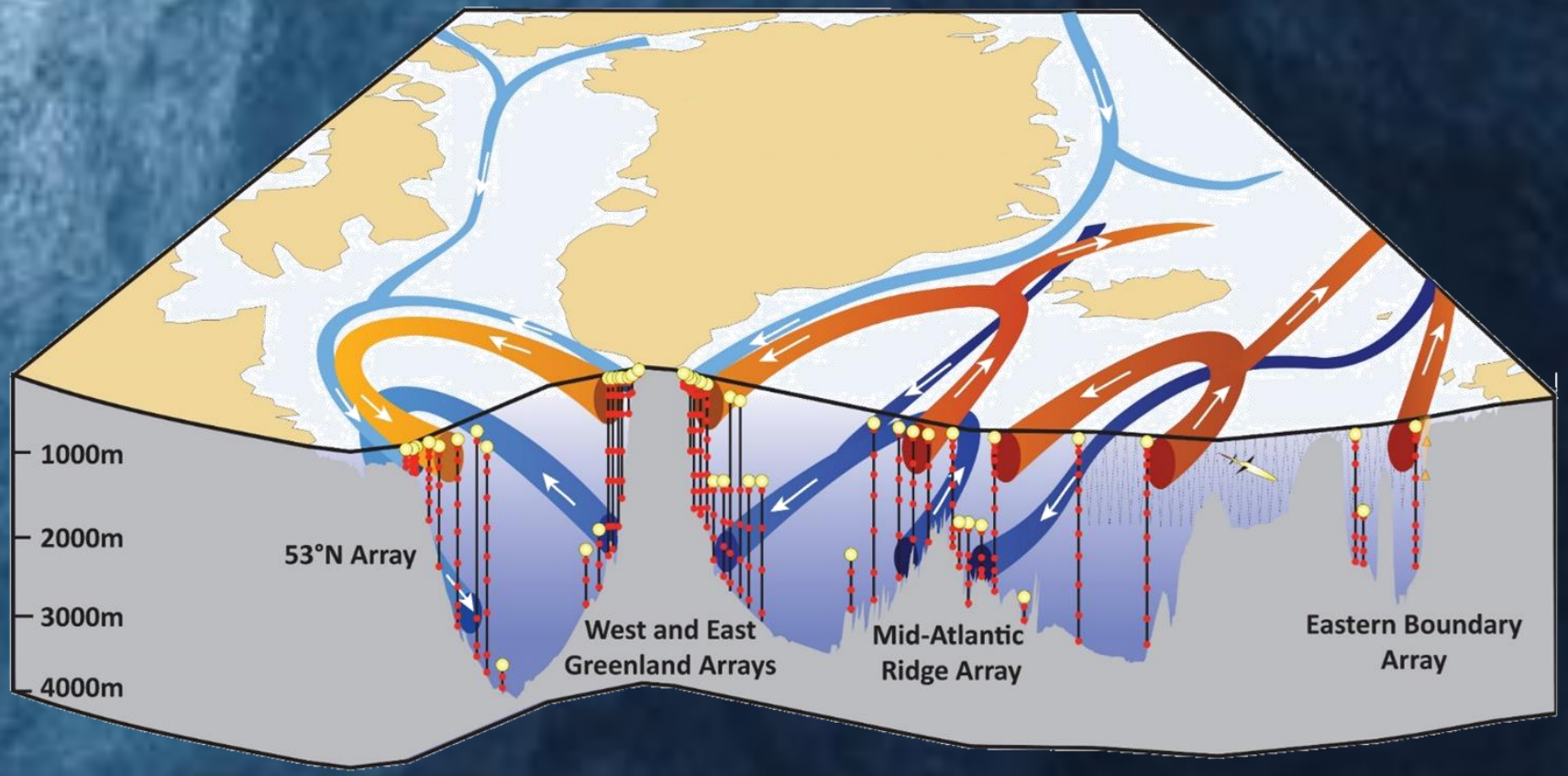


Oceaanwervels

Perpetual ocean @NASA

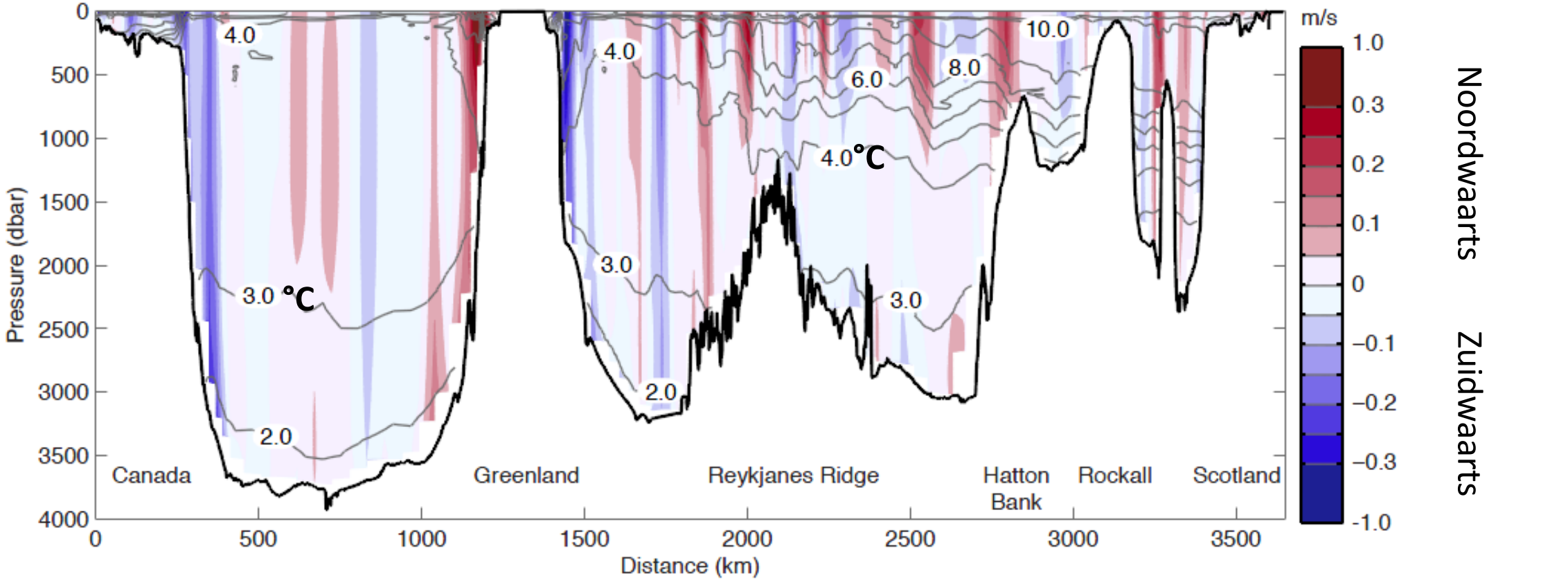




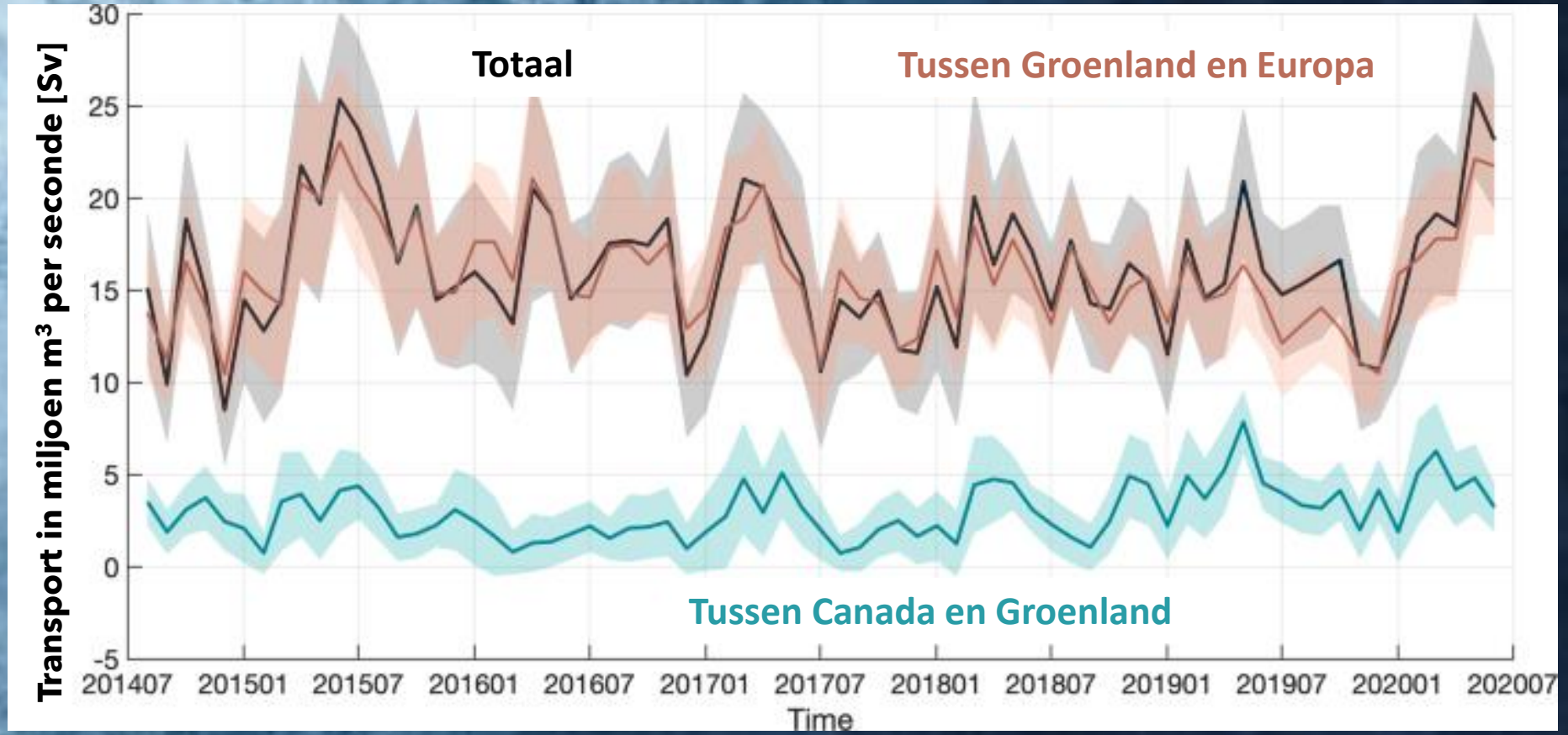


Een meetsysteem op oceaanschaal

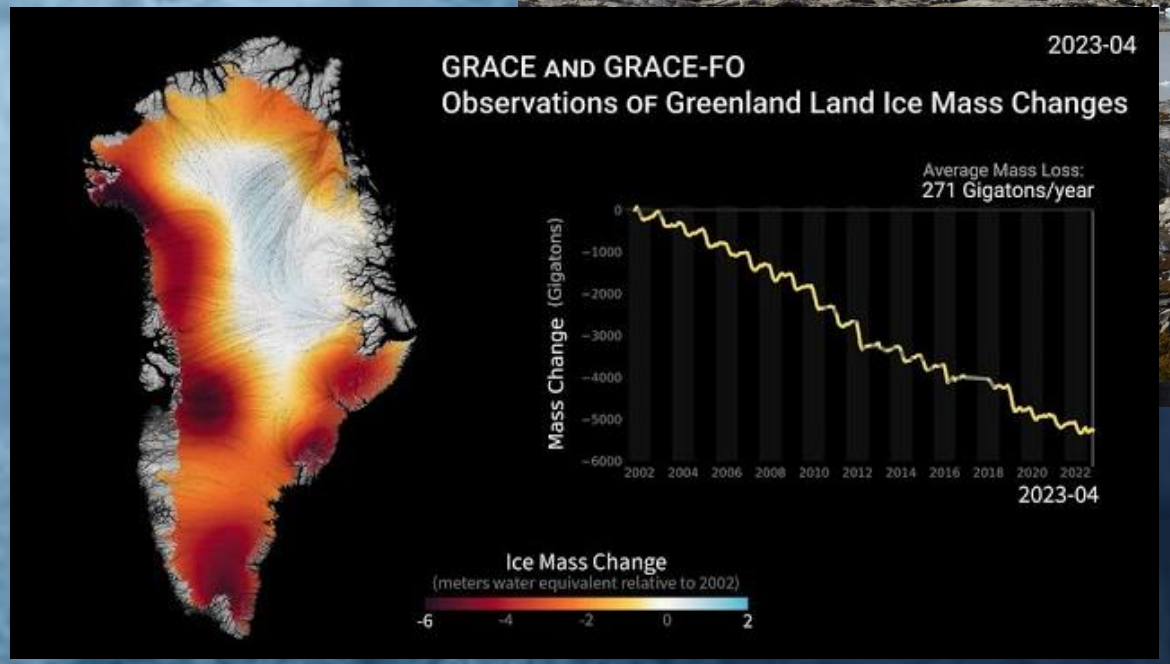
Gemiddeld stromingsveld

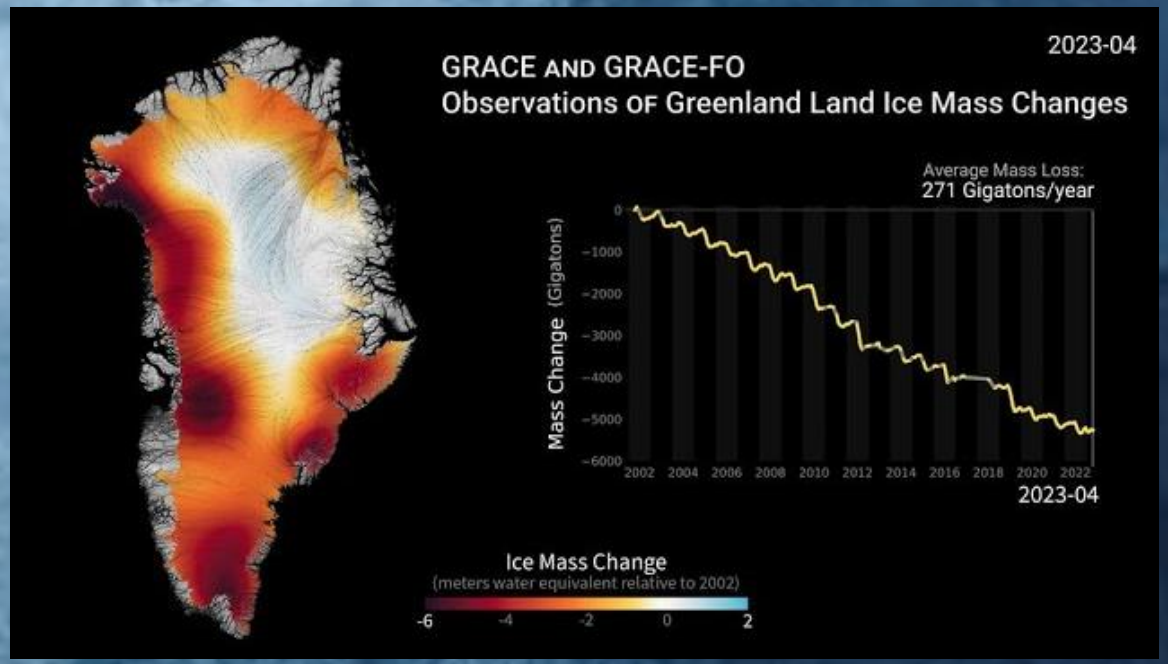


Tijdserie



Gemiddeld
15 miljoen kubieke meter per seconde


2023-04
GRACE AND GRACE-FO
Observations OF Greenland Land Ice Mass Changes
Average Mass Loss:
271 Gigatons/year
Mass Change (Gigatons)
0
−1000
−2000
−3000
−4000
−5000
−6000
2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
2023-04
Ice Mass Change
(meters water equivalent relative to 2002)
-6 -4 -2 0 2


2023-04
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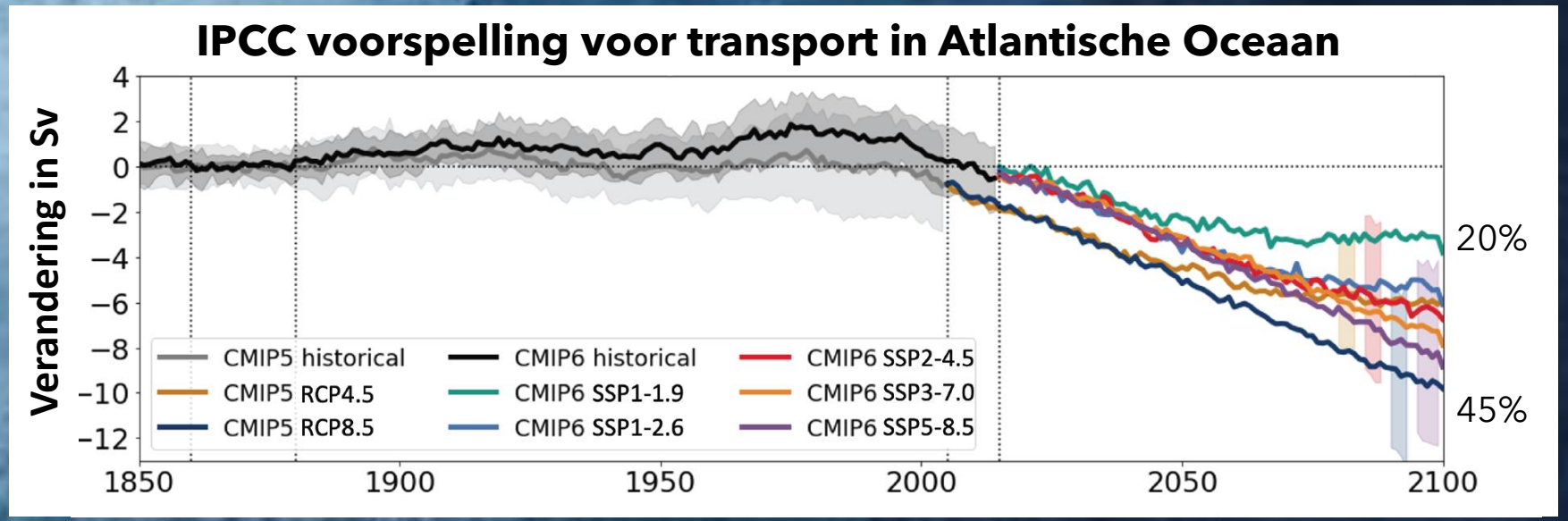
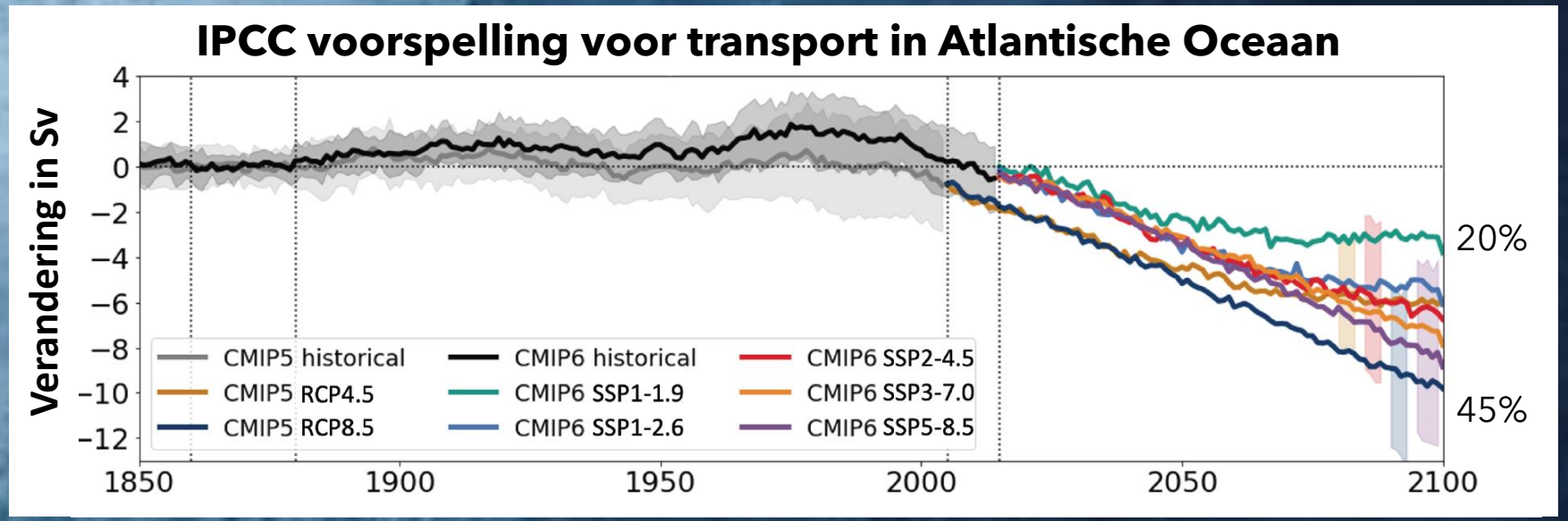
0
−1000
−2000
−3000
−4000
−5000
−6000
2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
2023-04
Ice Mass Change
(meters water equivalent relative to 2002)
-6 -4 -2 0 2

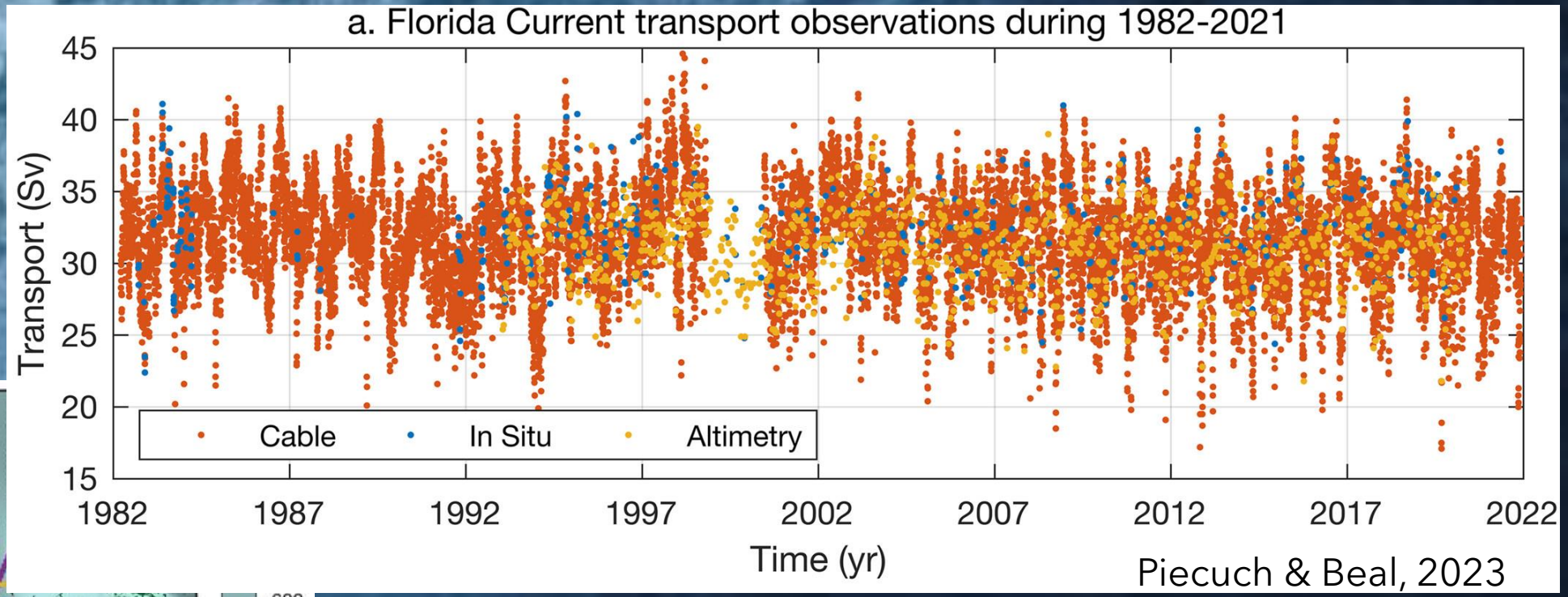
Effect van zoutverschillen


IPCC voorspelling voor transport in Atlantische Oceaan
Verandering in Sv
4
2
0
−2
−4
−6
−8
−10
−12
1850
1900
1950
2000
2050
2100
CMIP5 historical
CMIP5 RCP4.5
CMIP5 RCP8.5
CMIP6 historical
CMIP6 SSP1-1.9
CMIP6 SSP1-2.6
CMIP6 SSP2-4.5
CMIP6 SSP3-7.0
CMIP6 SSP5-8.5
20%
45%

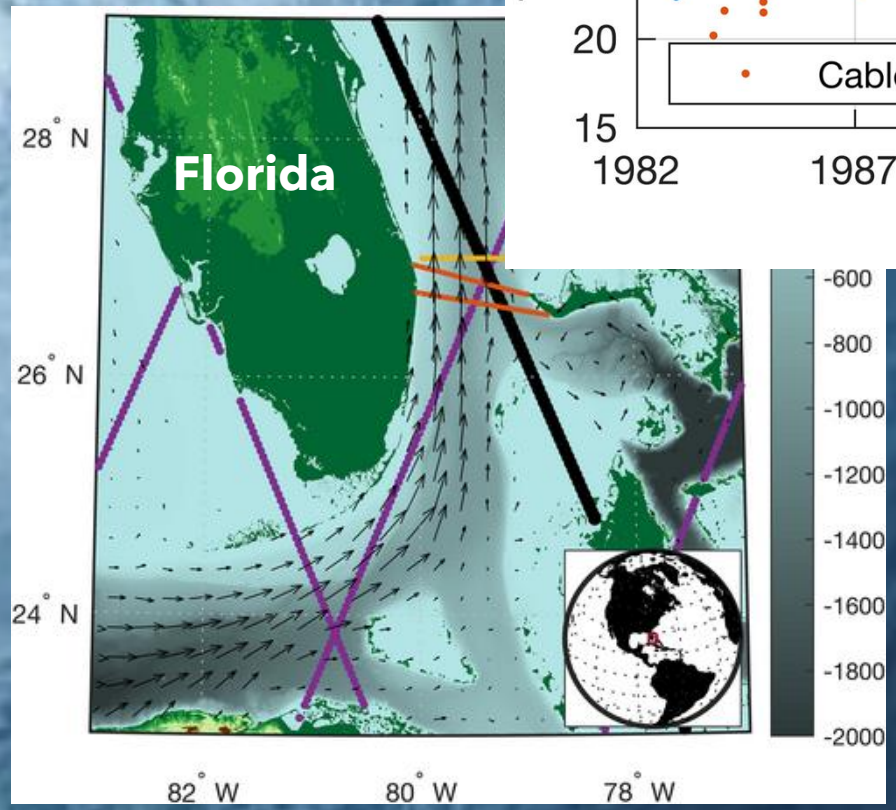
IPCC AR6 over de wereldwijde impact

"A decrease in marine productivity in the North Atlantic, more winter storms in Europe, a reduction in Sahelian and South Asian summer rainfall, a decrease in the number of tropical cyclones in the Atlantic, and an increase in regional sea level around the Atlantic especially along the northeast coast of North America. Such impacts would be superimposed on the global warming signal."



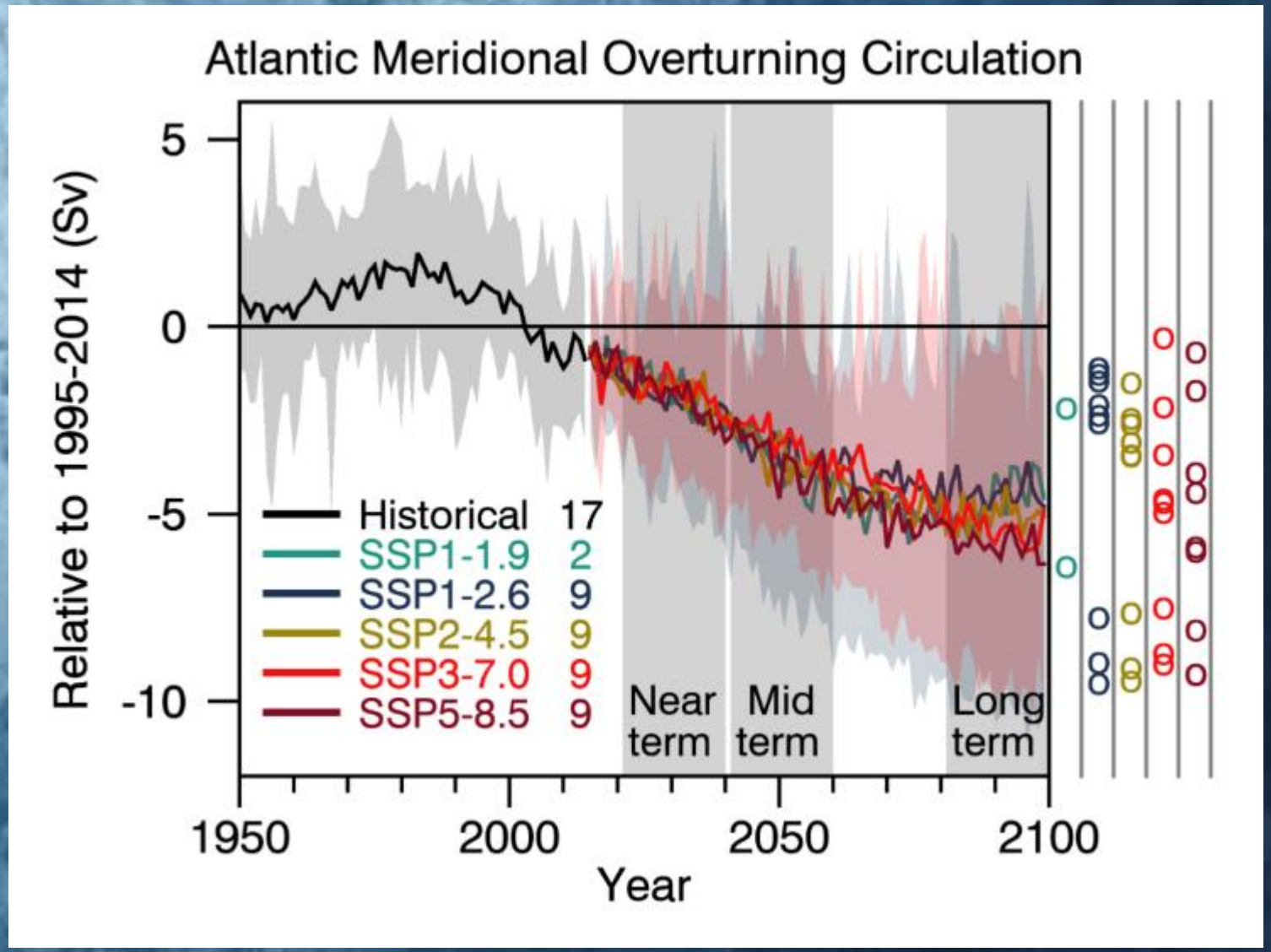


Piecuch & Beal, 2023

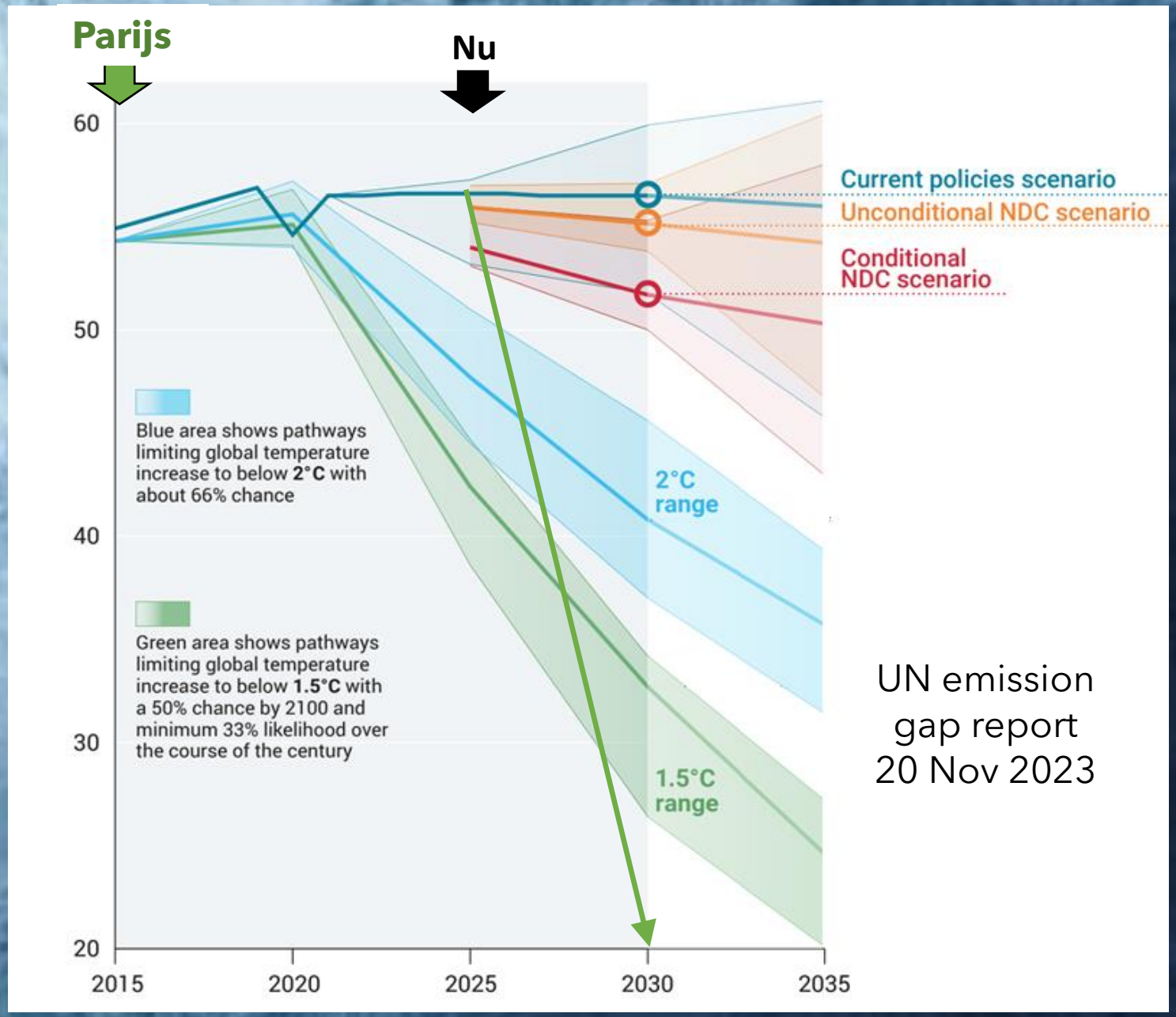


Gemiddelde transport over 40 years is 31.8 ± 0.27 Sv.

Na zeer zorgvuldige statistische analyze is er een afname van 1.2 ± 1.0 Sv, ofwel 4.0 ± 3.2%, gevonden over 40 jaar



Verschillen in circulatie response tussen klimaatmodellen

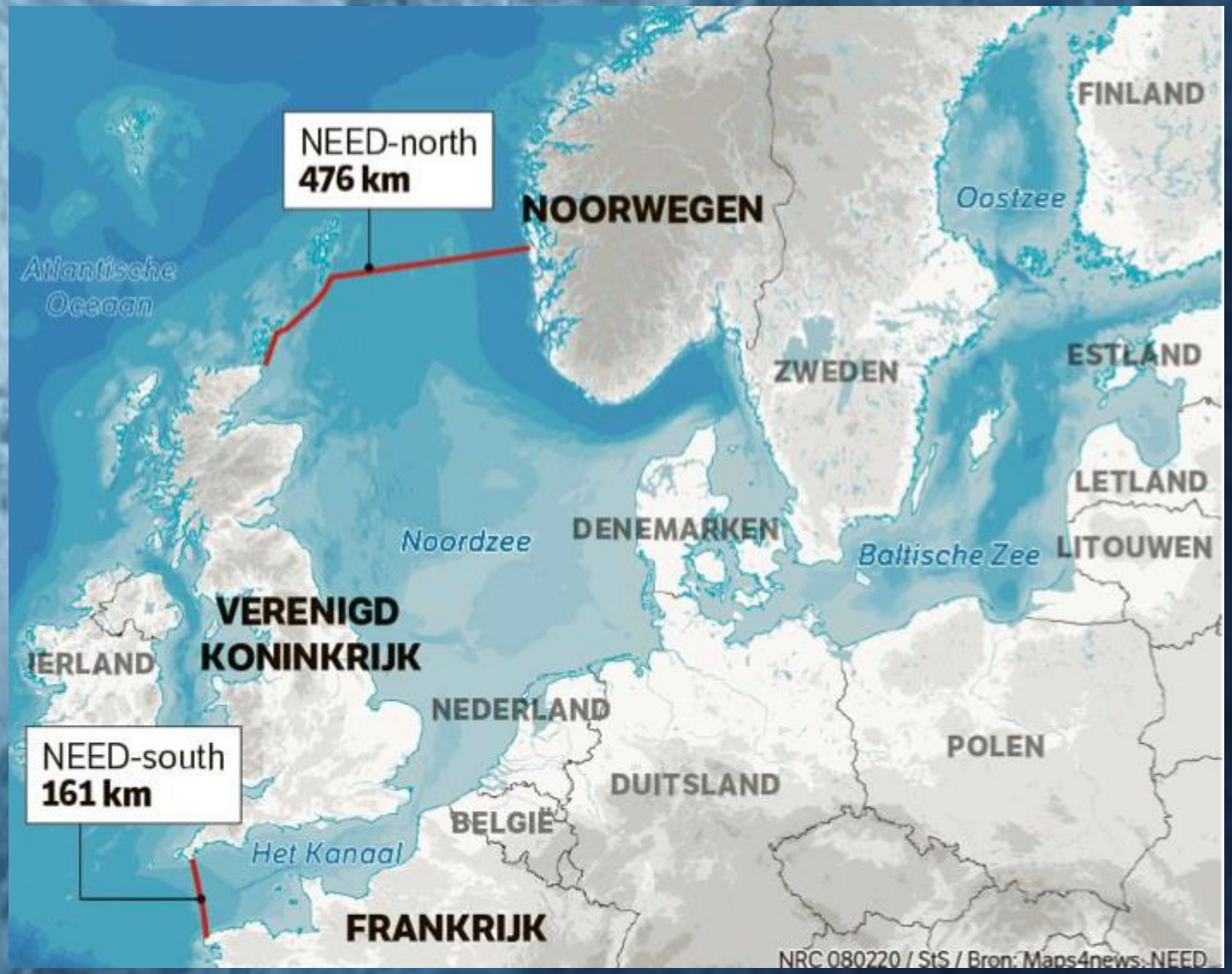


UN emission gap report 20 Nov 2023

- Fully implementing and continuing efforts implied by unconditional Nationally Determined Contributions (NDCs) would put the world on track for limiting temperature rise to **2.9°C**.

- The additional achievement and continuation of conditional NDCs would lead to temperatures not exceeding **2.5°C** above pre-industrial levels.

- In the most optimistic scenario, where all conditional NDCs and net zero pledges are met, limiting temperature rise to **2.0°C** could be achieved. However, net-zero pledges are not currently considered credible: none of the G20 countries are reducing emissions at a pace consistent with their net-zero targets.



Waarschuwing voor de toekomst of de bosatlas van de toekomst?

Northern European Enclosure Dam (NEED)

@Sjoerd Groeskamp NIOZ
Klimaatvoorstelling.nl