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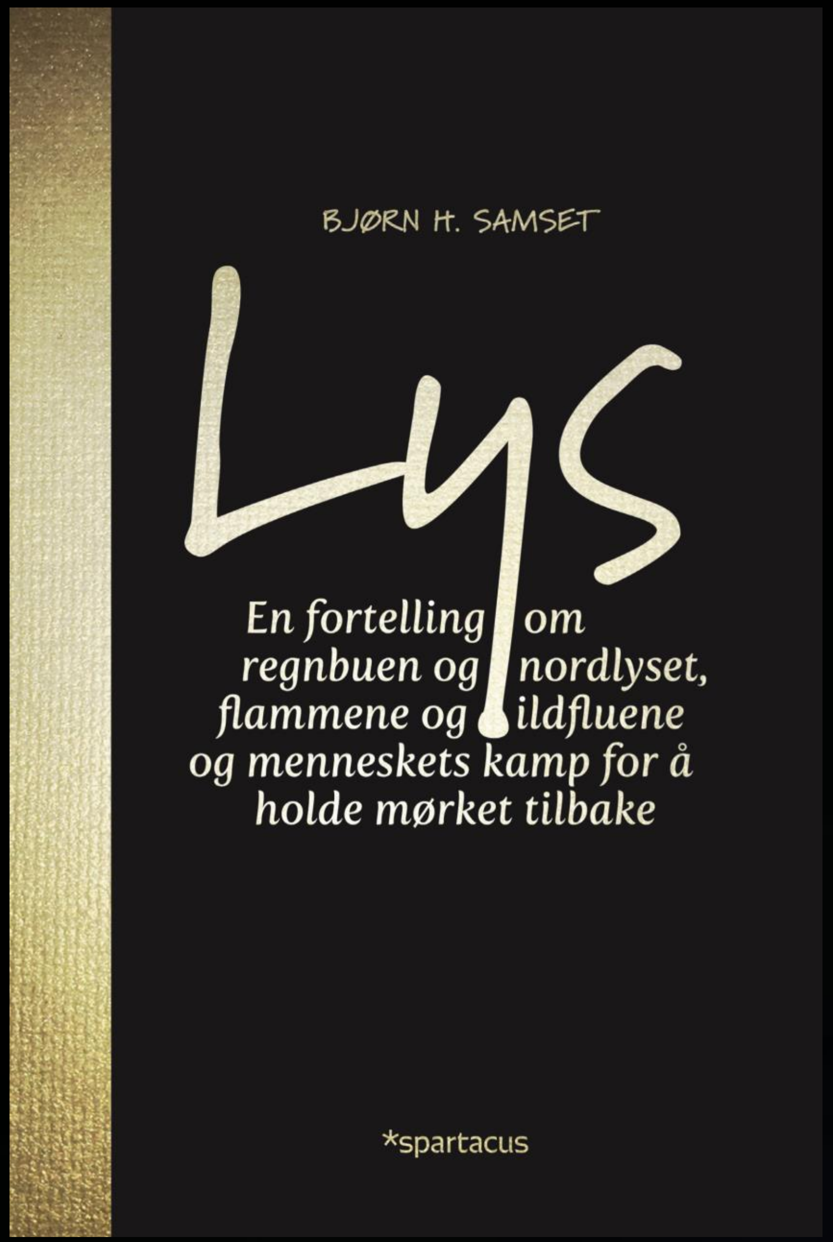
Energi

Nøkkelen til å forstå klimaendringene

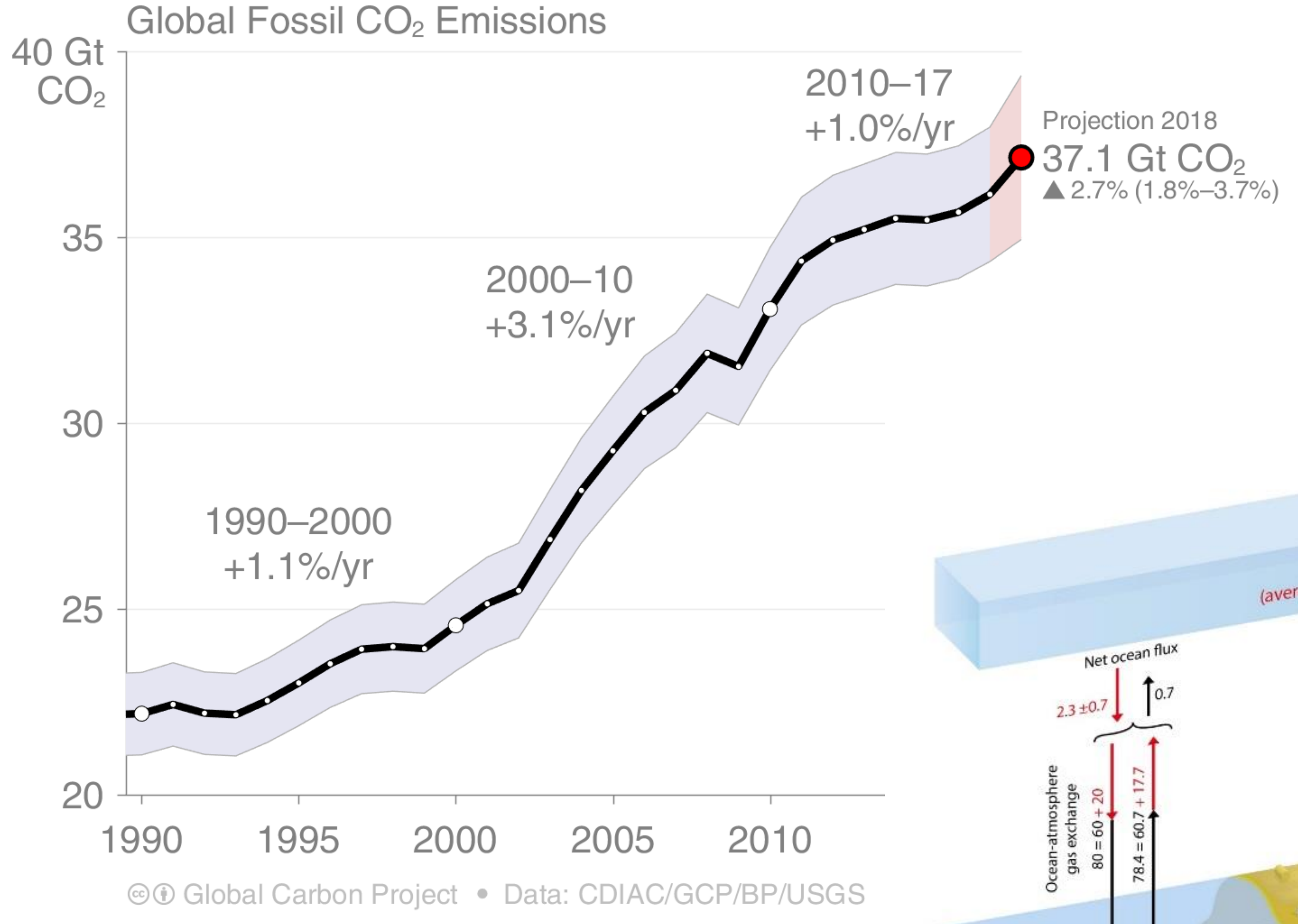
Bjørn H. Samset
Fysiker og klimaforsker, CICERO


BJØRN H. SAMSET
Lys
En fortelling om regnbuen og nordlyset, flammene og ildfluene og menneskets kamp for å holde mørket tilbake
*spartacus

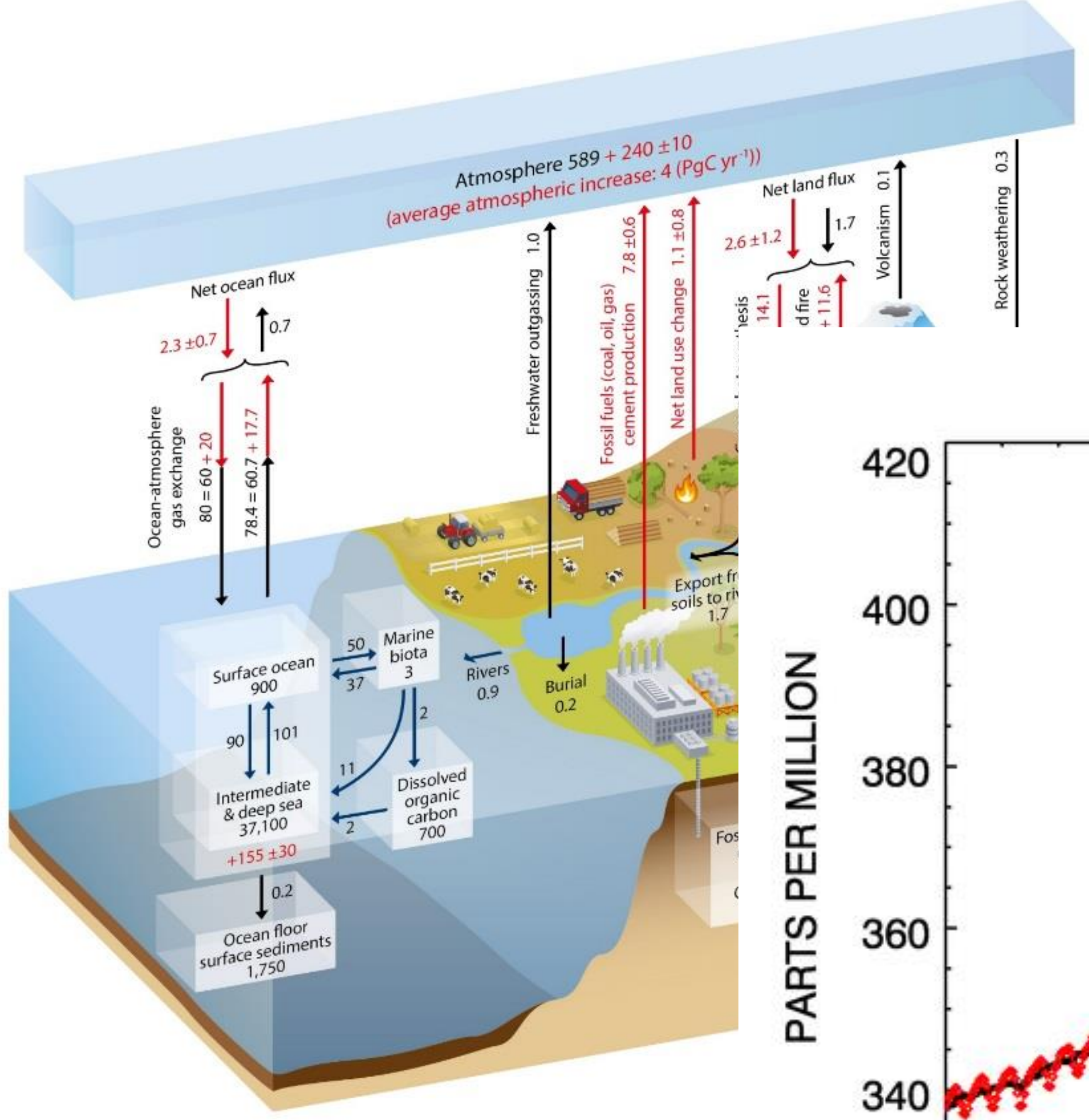

Alle delene av klimasystemet er i rask endring. Hav, land, is, vind, regn, orkaner, …

Fremskrivinger av hvor raskt jorden blir varmere har stort sett slått til

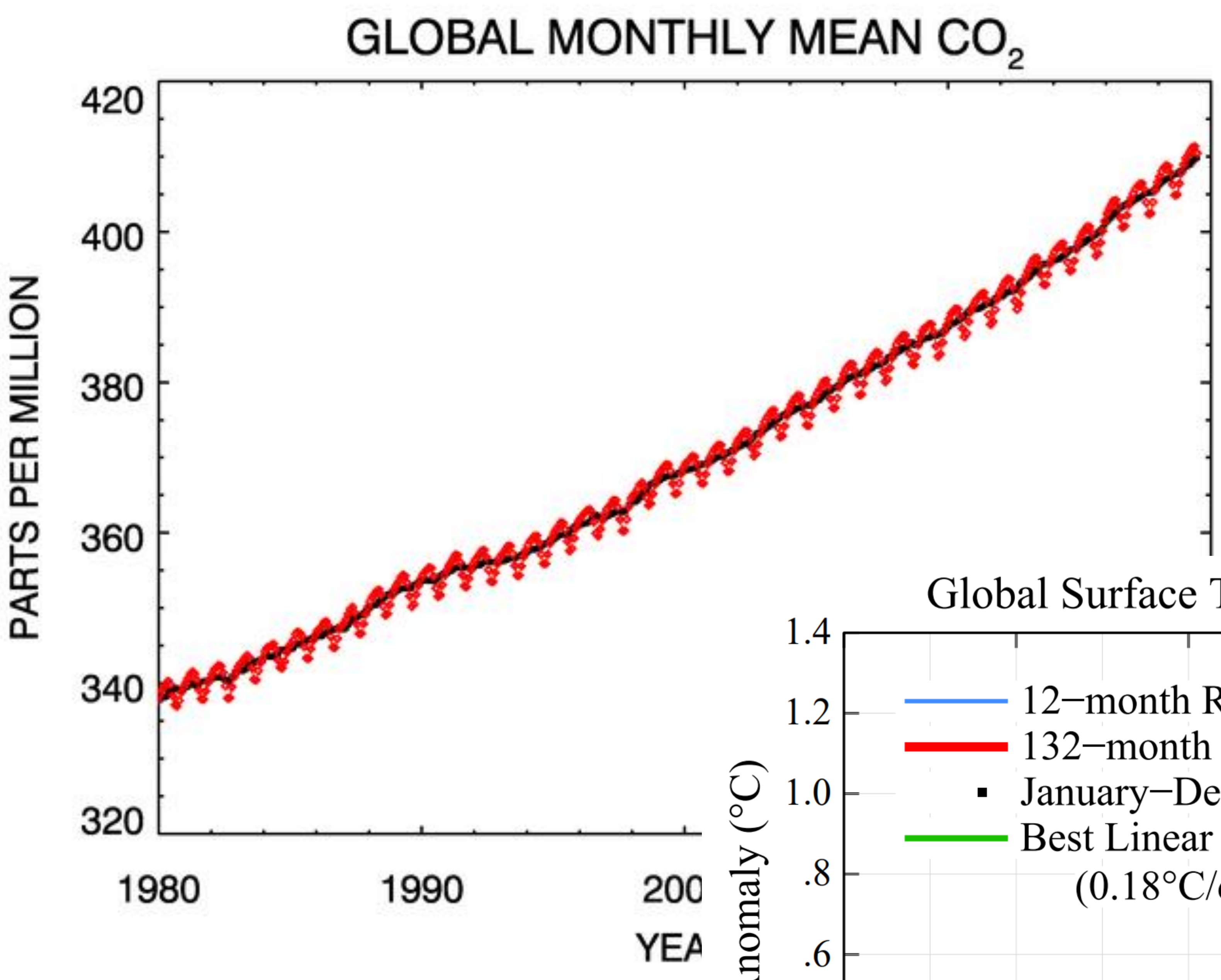
Konsekvensene av oppvarmingen kommer raskere enn de fleste forutså



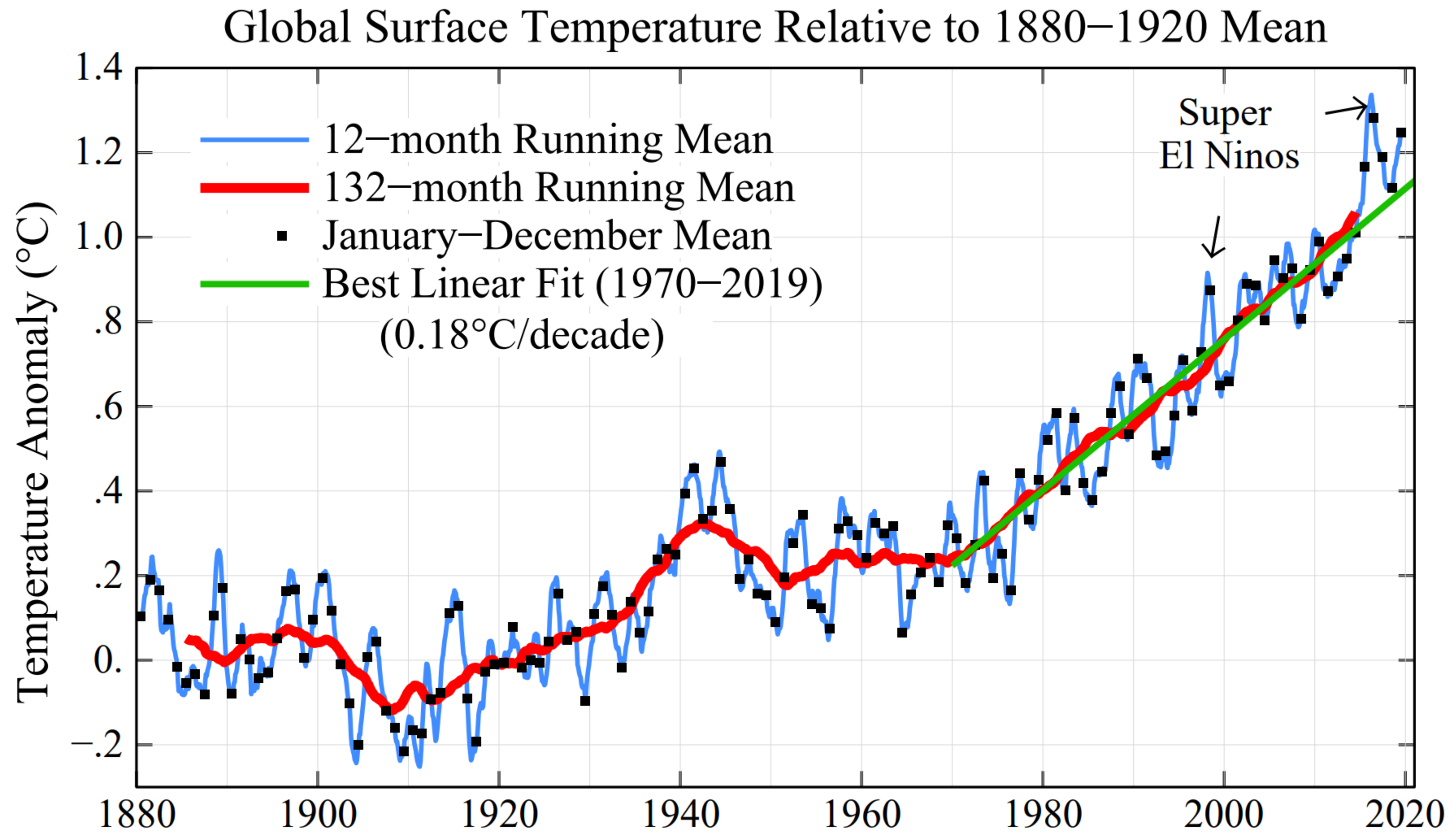
Vi slipper ut rundt 40 millarder tonn CO_2 (2018), fra energi- og sementproduksjon



Rundt halvparten blir igjen i atmosfæren, resten tas opp av hav og plantevekst



Totalt har vi økt mengden CO2 i atmosfæren med 47%



Konsekvensen er (blant annet) en global oppvarming på over en grad

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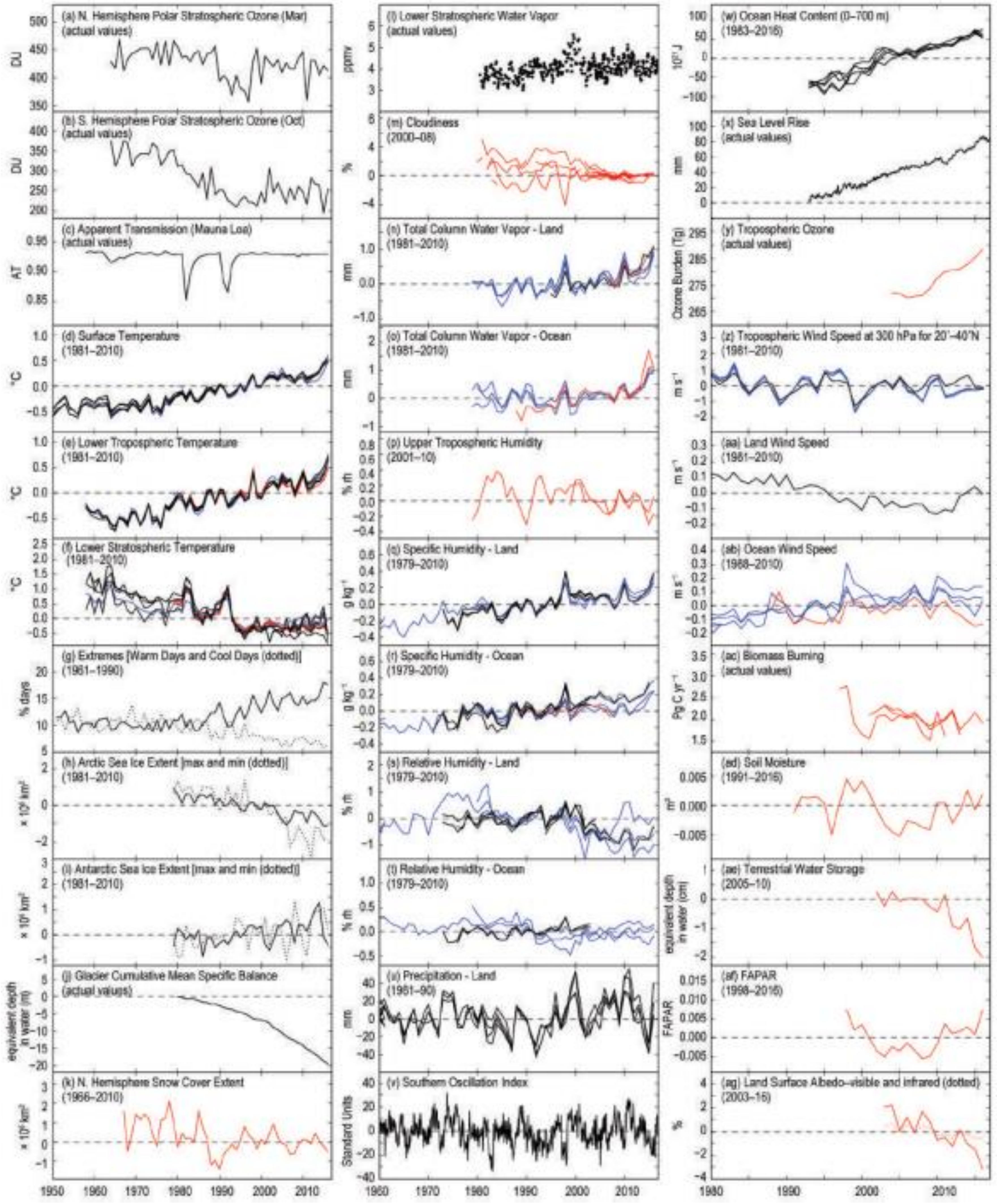
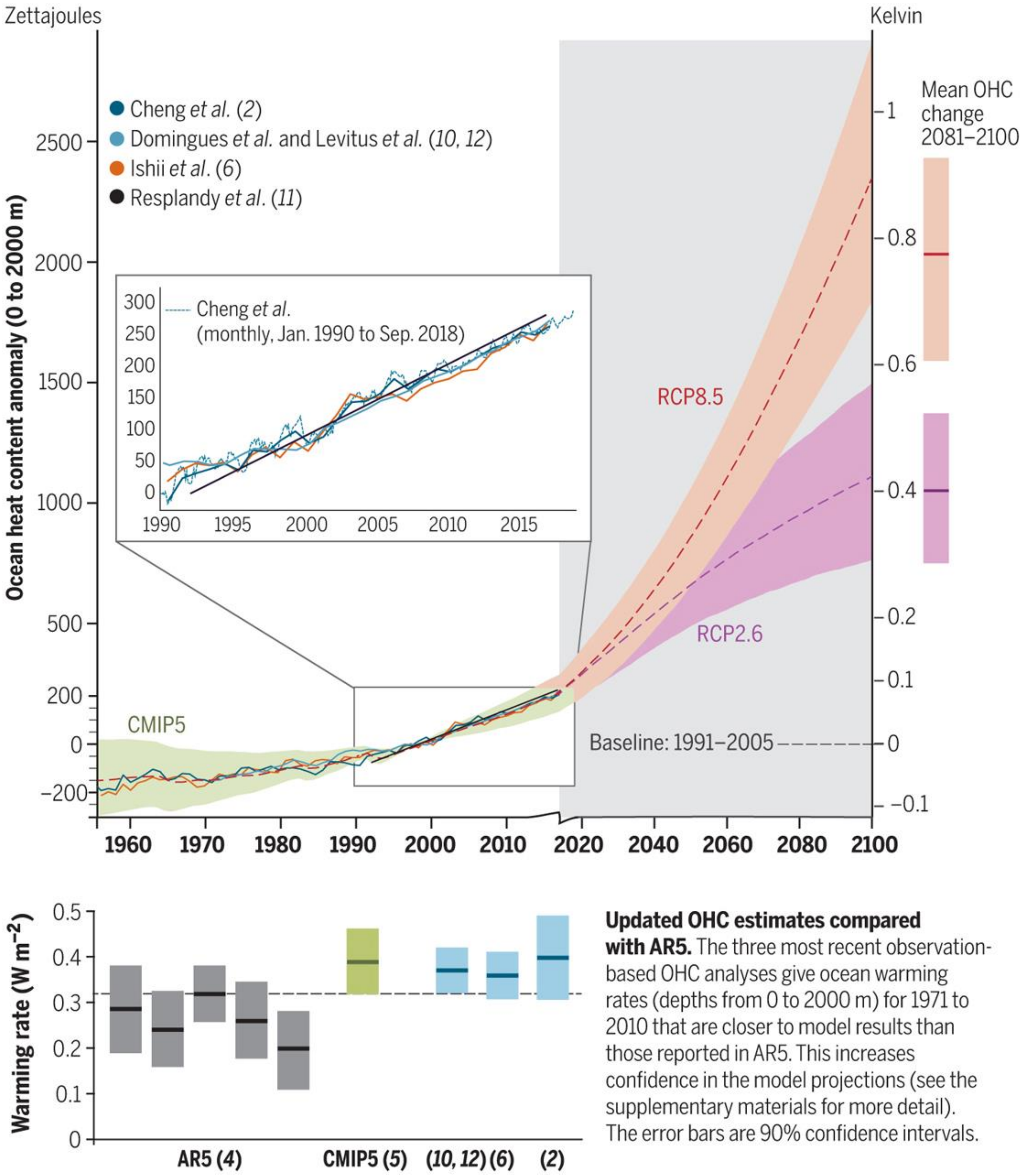
Klimaendringenes nøkkelspørsmål: Hvor kommer energien fra???



BAMS State of the climate, 2018



Updated OHC estimates compared with AR5. The three most recent observation-based OHC analyses give ocean warming rates (depths from 0 to 2000 m) for 1971 to 2010 that are closer to model results than those reported in AR5. This increases confidence in the model projections (see the supplementary materials for more detail). The error bars are 90% confidence intervals.

PERSPECTIVE | CLIMATE CHANGE

How fast are the oceans warming?

Lijing Cheng[1], John Abraham[2], Zeke Hausfather[3], Kevin E. Trenberth[4]

+ See all authors and affiliations

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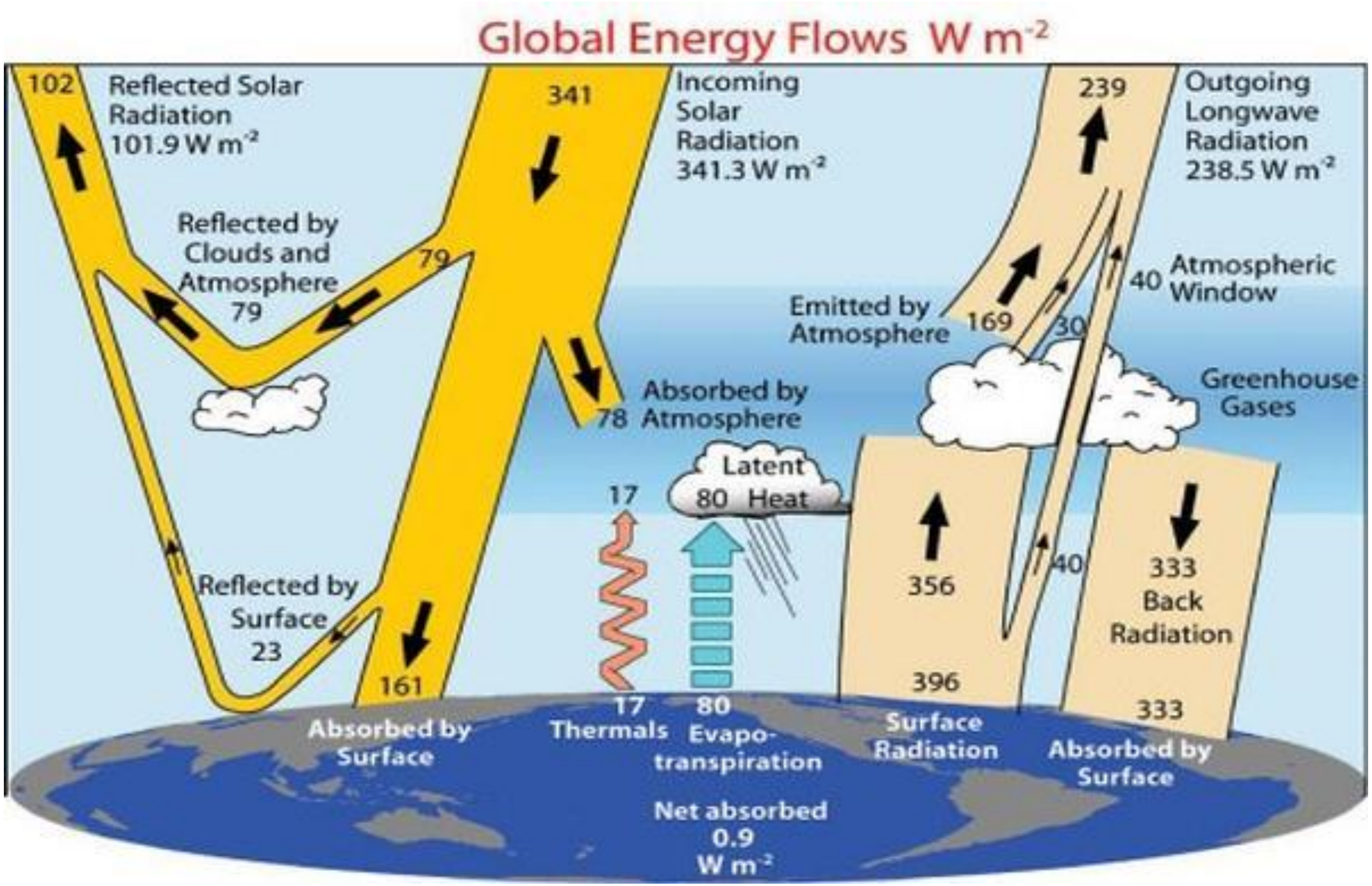
Jordens klima kan sees på som et energibudsjett



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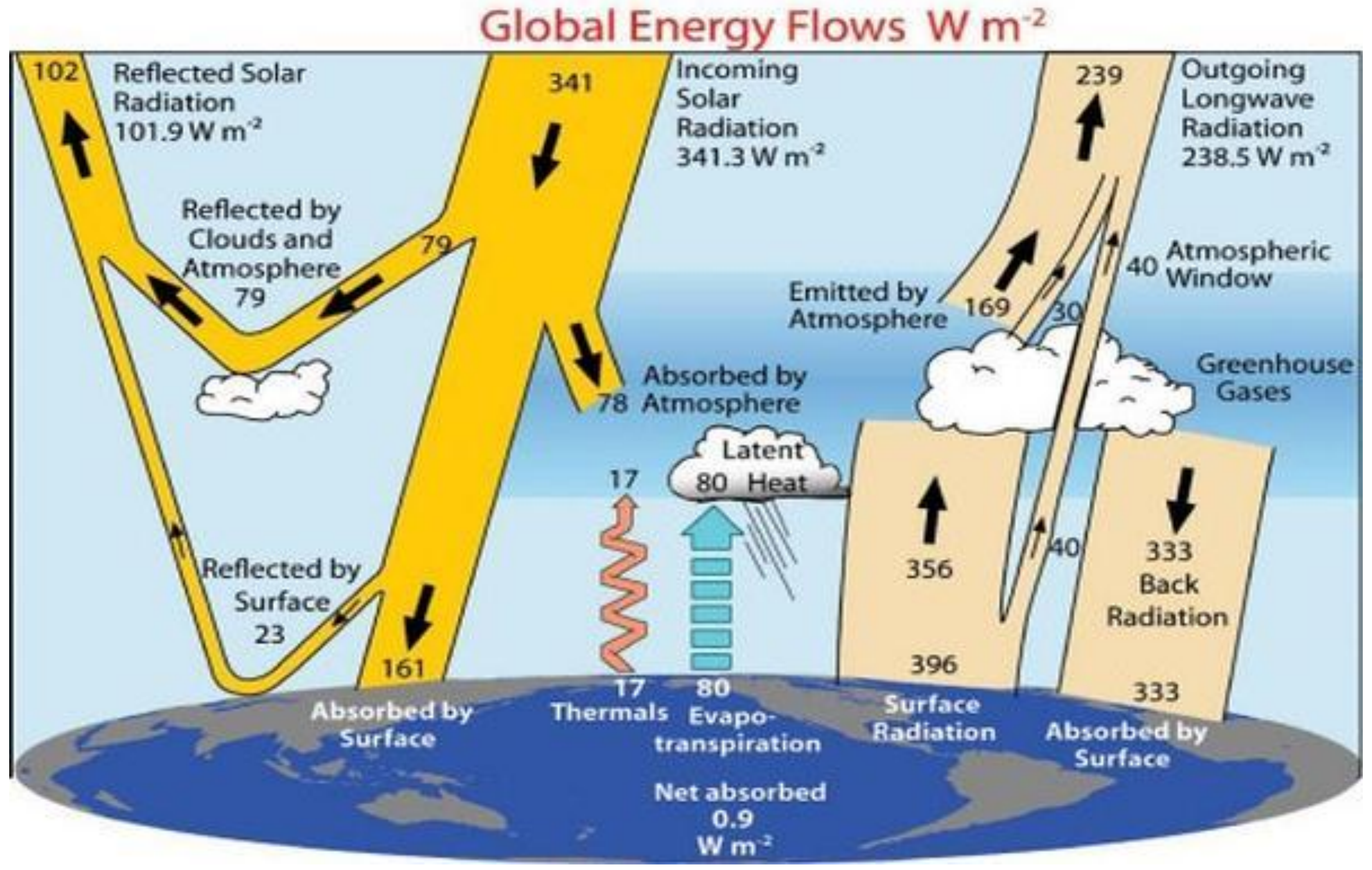
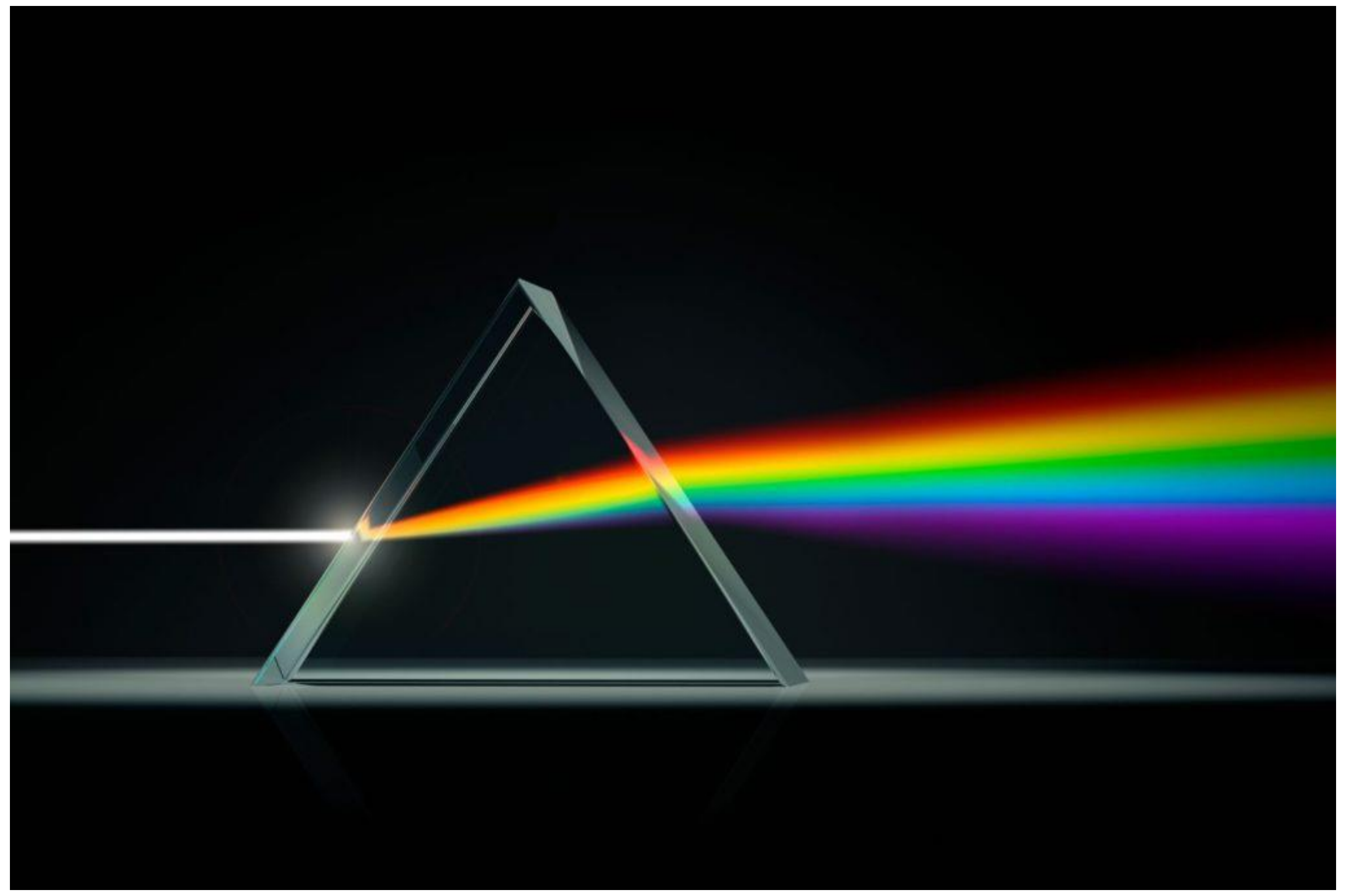
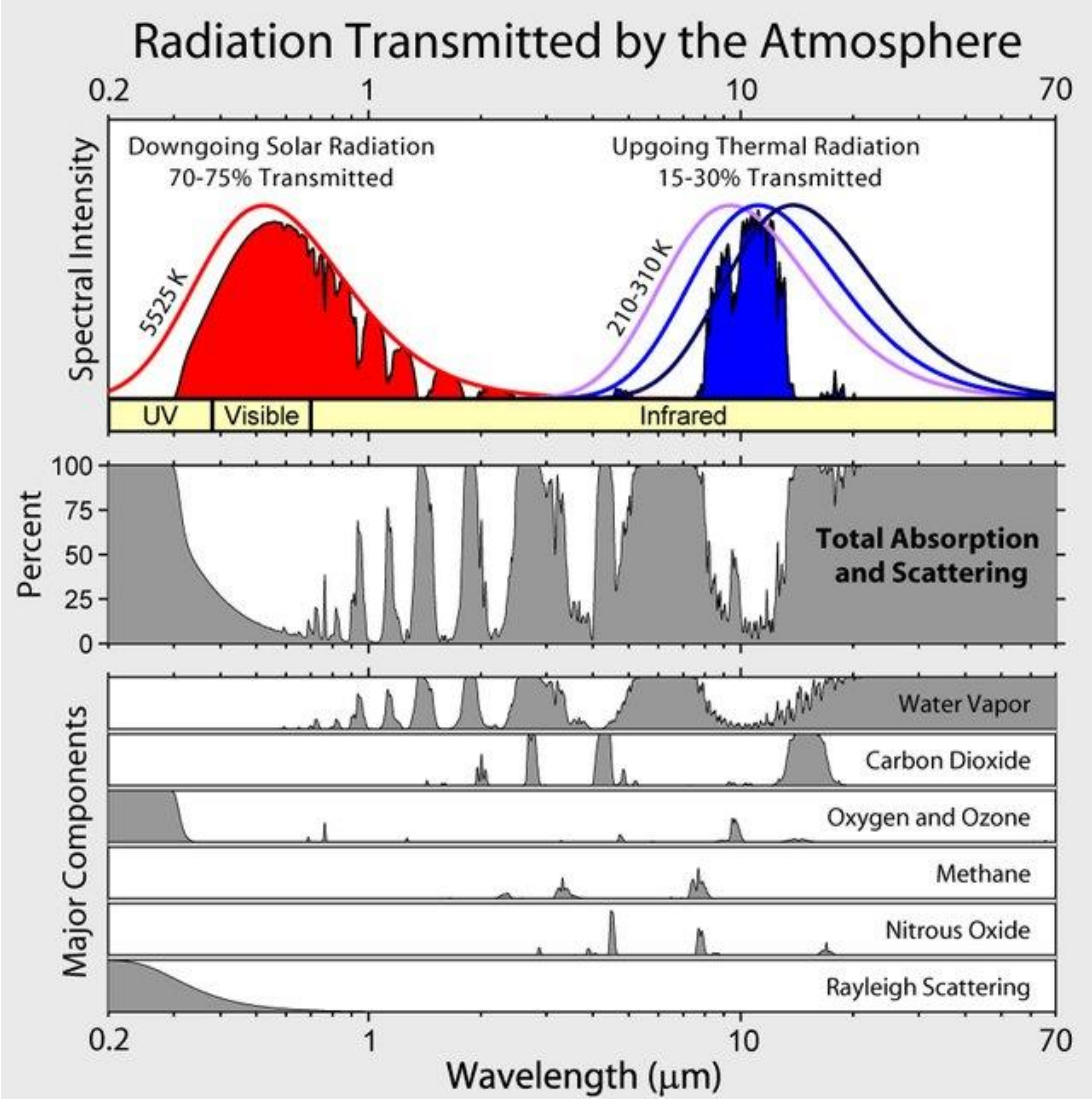


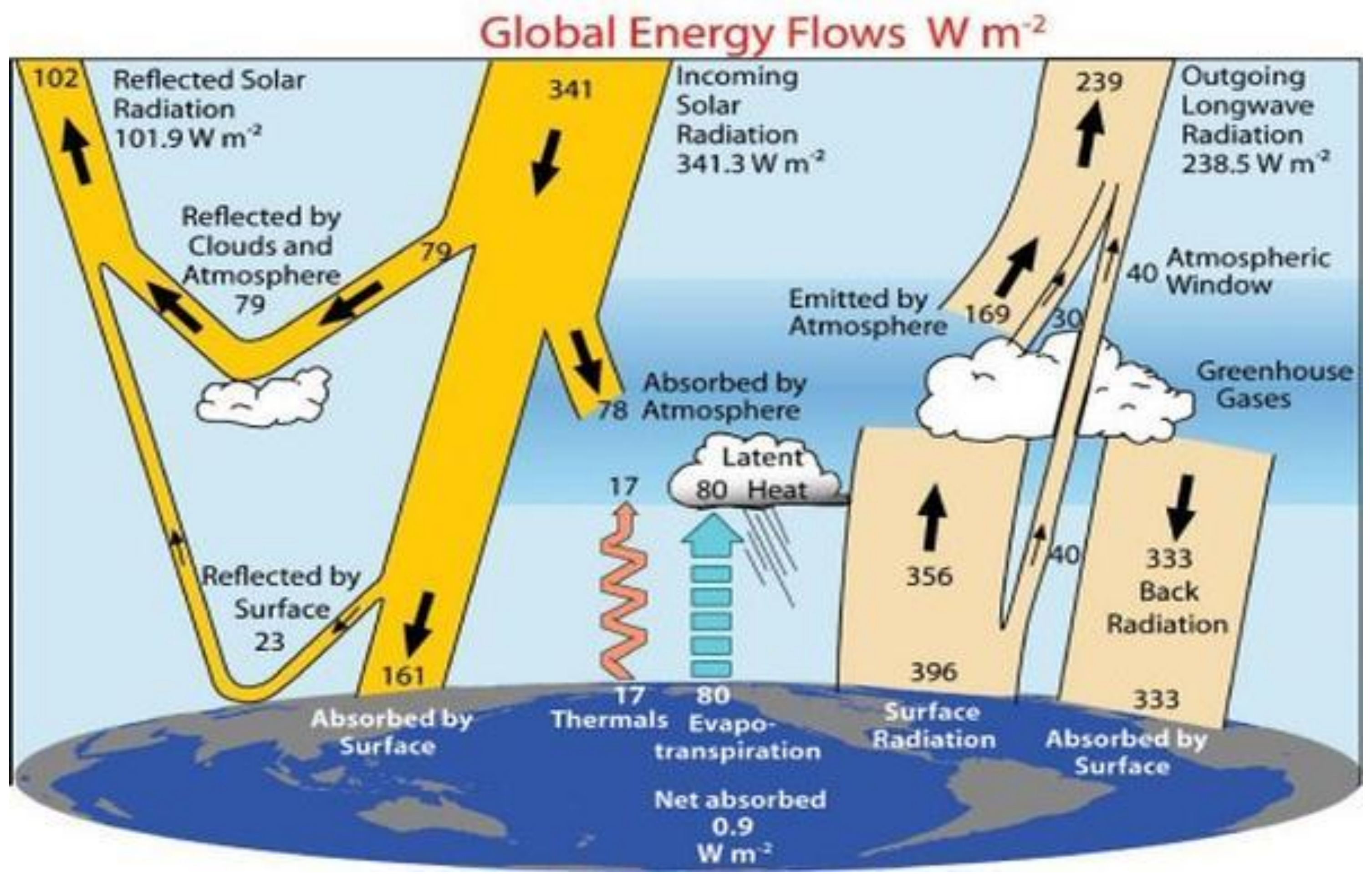
Global Energy Flows W m-2
102
Reflected Solar Radiation 101.9 W m-2
341
Incoming Solar Radiation 341.3 W m-2
239
Outgoing Longwave Radiation 238.5 W m-2
Reflected by Clouds and Atmosphere 79
79
Atmospheric Window
40
Emitted by Atmosphere
169
30
Greenhouse Gases
Absorbed by Atmosphere
78
Latent Heat
80
17
356
40
333 Back Radiation
Reflected by Surface 23
161
Absorbed by Surface
17 Thermals
80 Evapo-transpiration
396 Surface Radiation
333 Absorbed by Surface
Net absorbed 0.9 W m-2

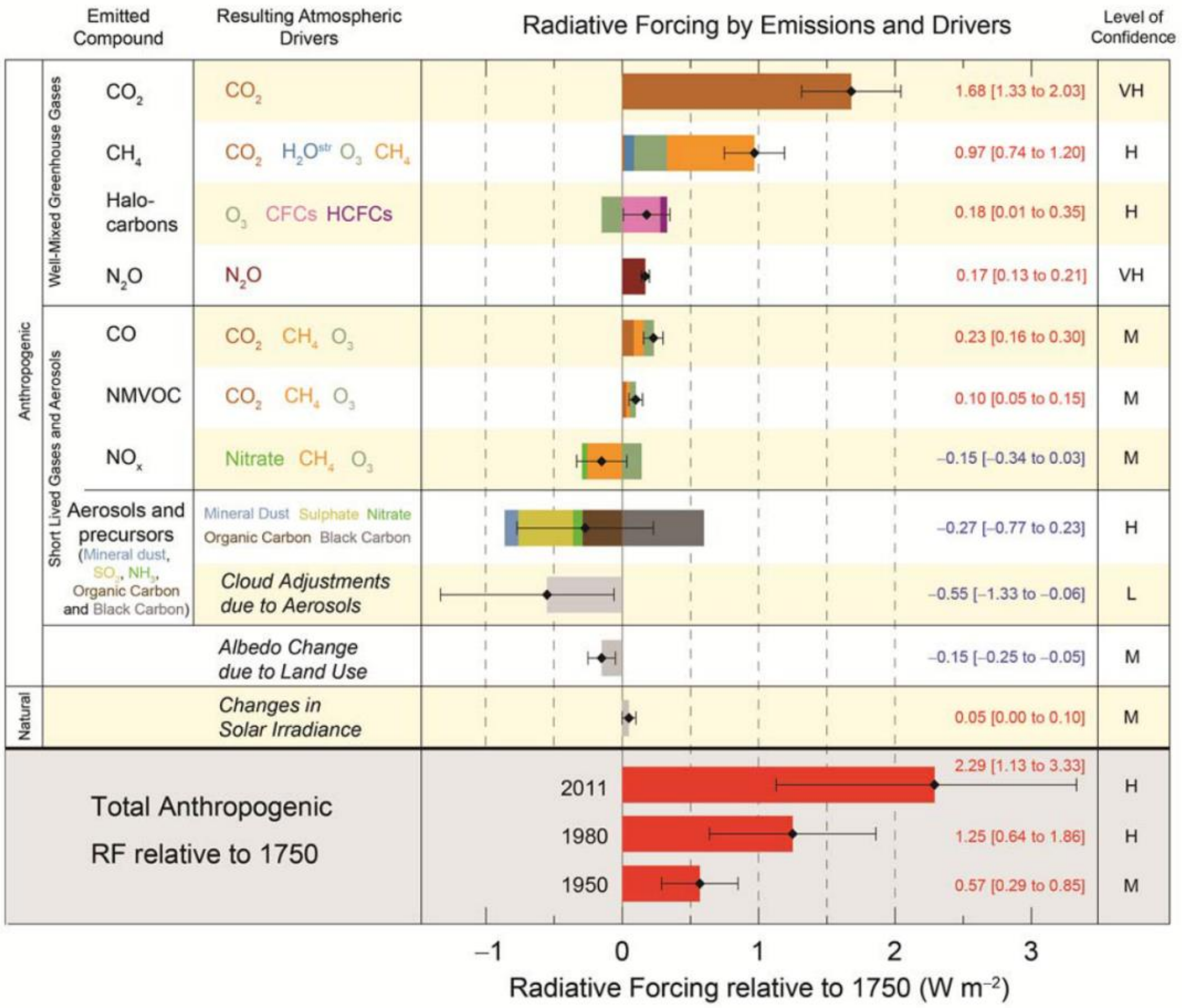




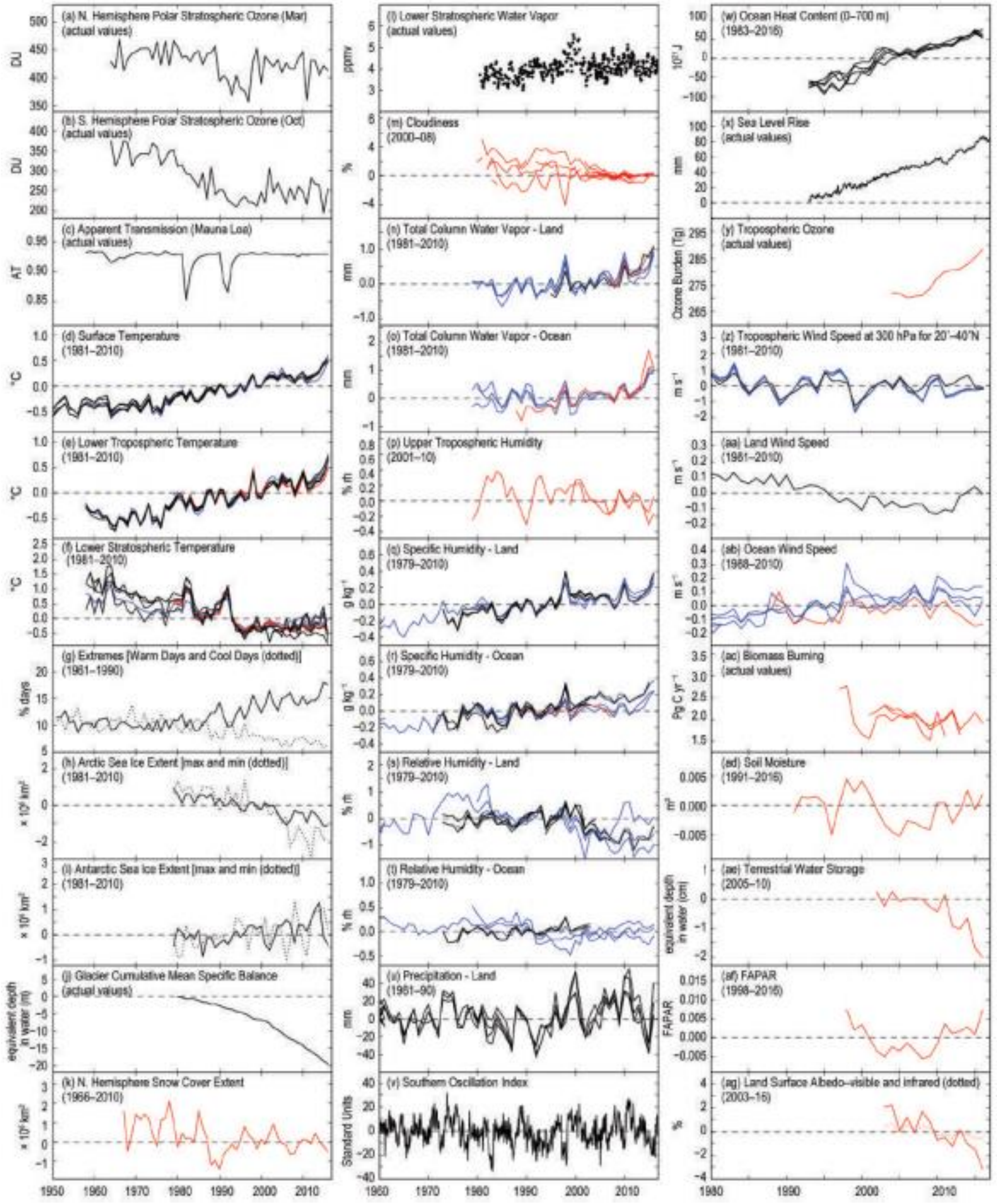
Radiation Transmitted by the Atmosphere
Spectral Intensity
Downgoing Solar Radiation 70-75% Transmitted
Upgoing Thermal Radiation 15-30% Transmitted
5525 K
210-310 K
UV
Visible
Infrared
Percent
100
75
50
25
0
Total Absorption and Scattering
Major Components
Water Vapor
Carbon Dioxide
Oxygen and Ozone
Methane
Nitrous Oxide
Rayleigh Scattering
0.2
1
10
70
Wavelength (μm)

Klimaendringene som energibudsjett

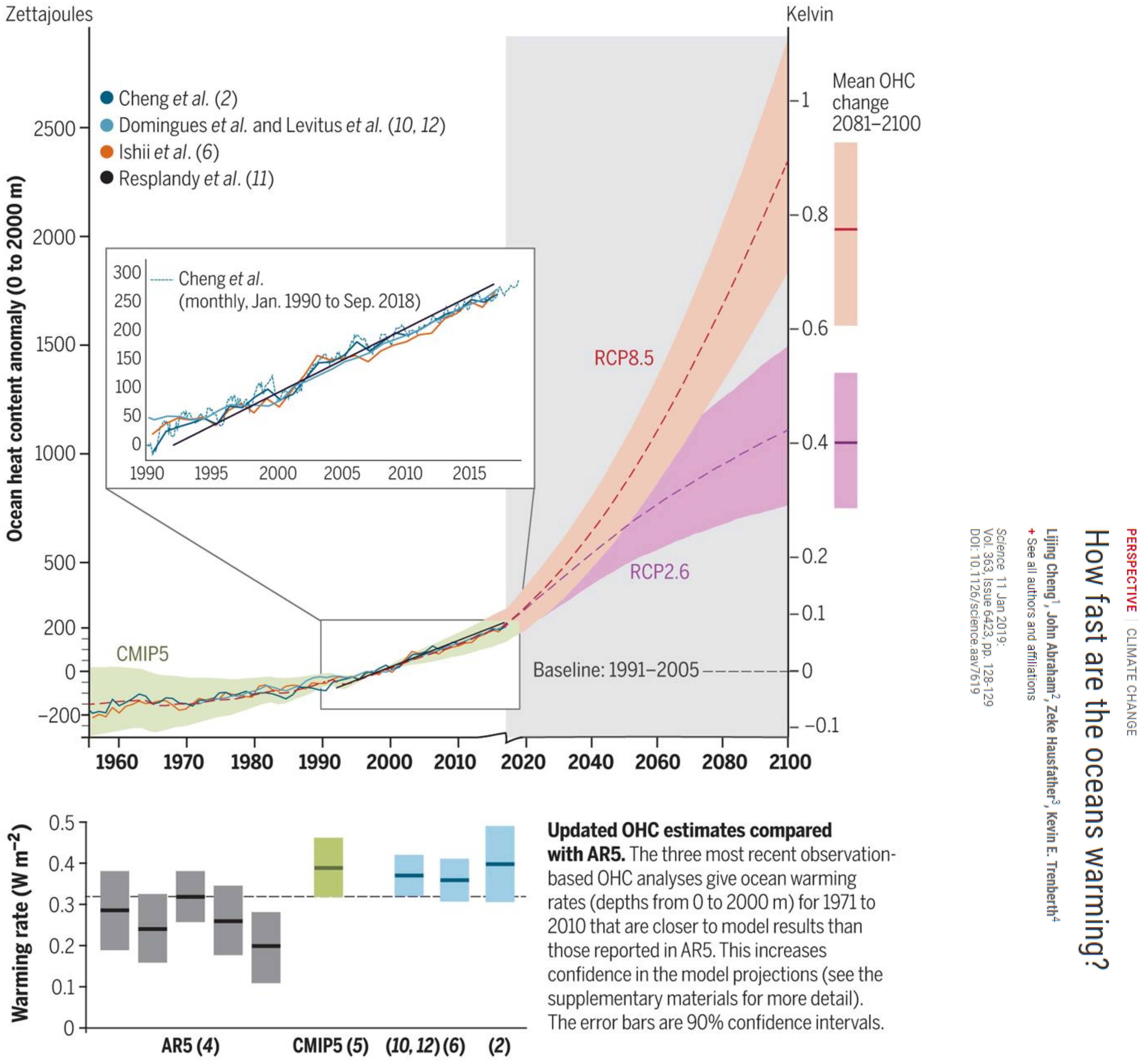




Hvor kommer energien fra?



BAMS State of the climate, 2018



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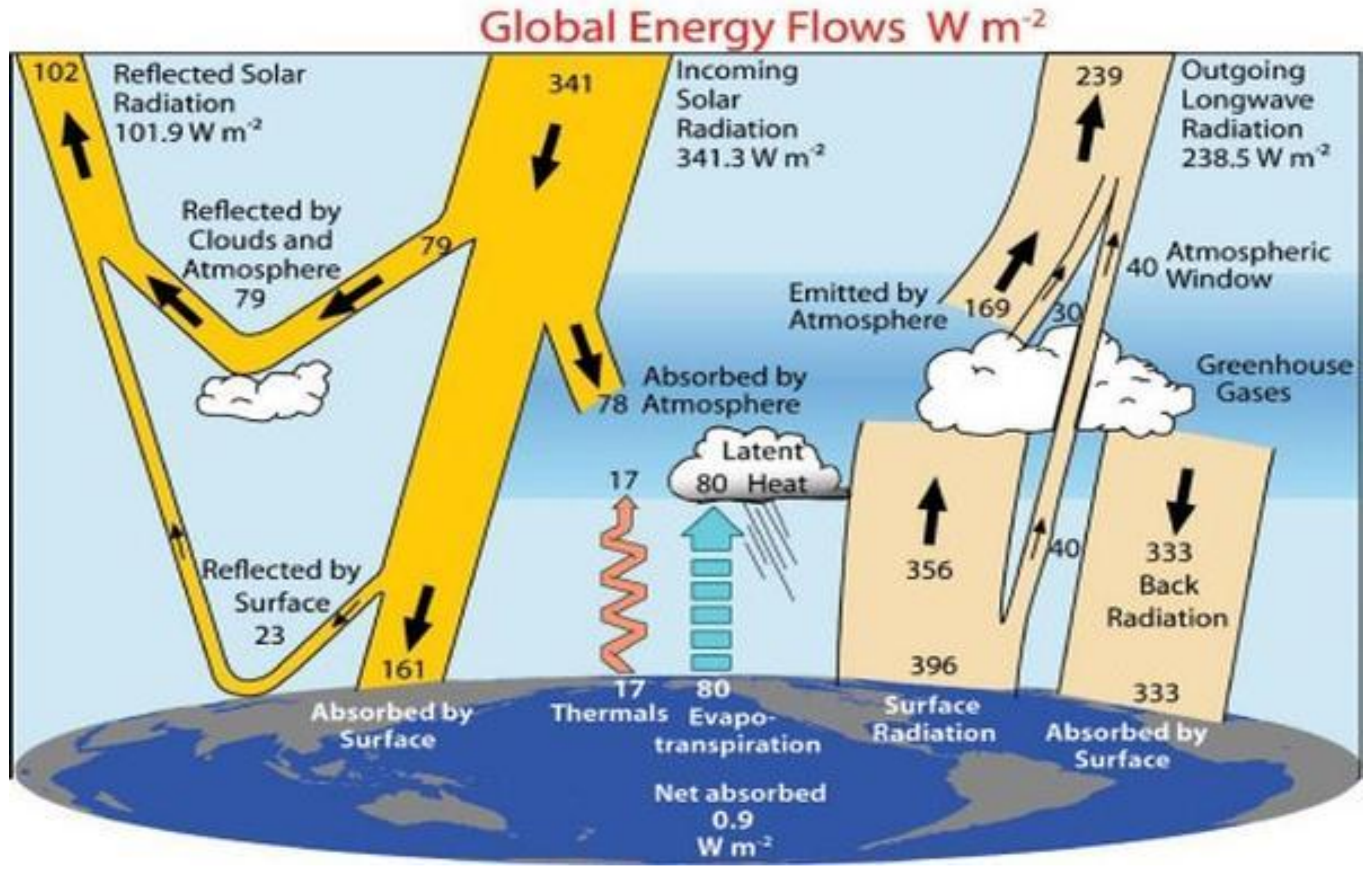
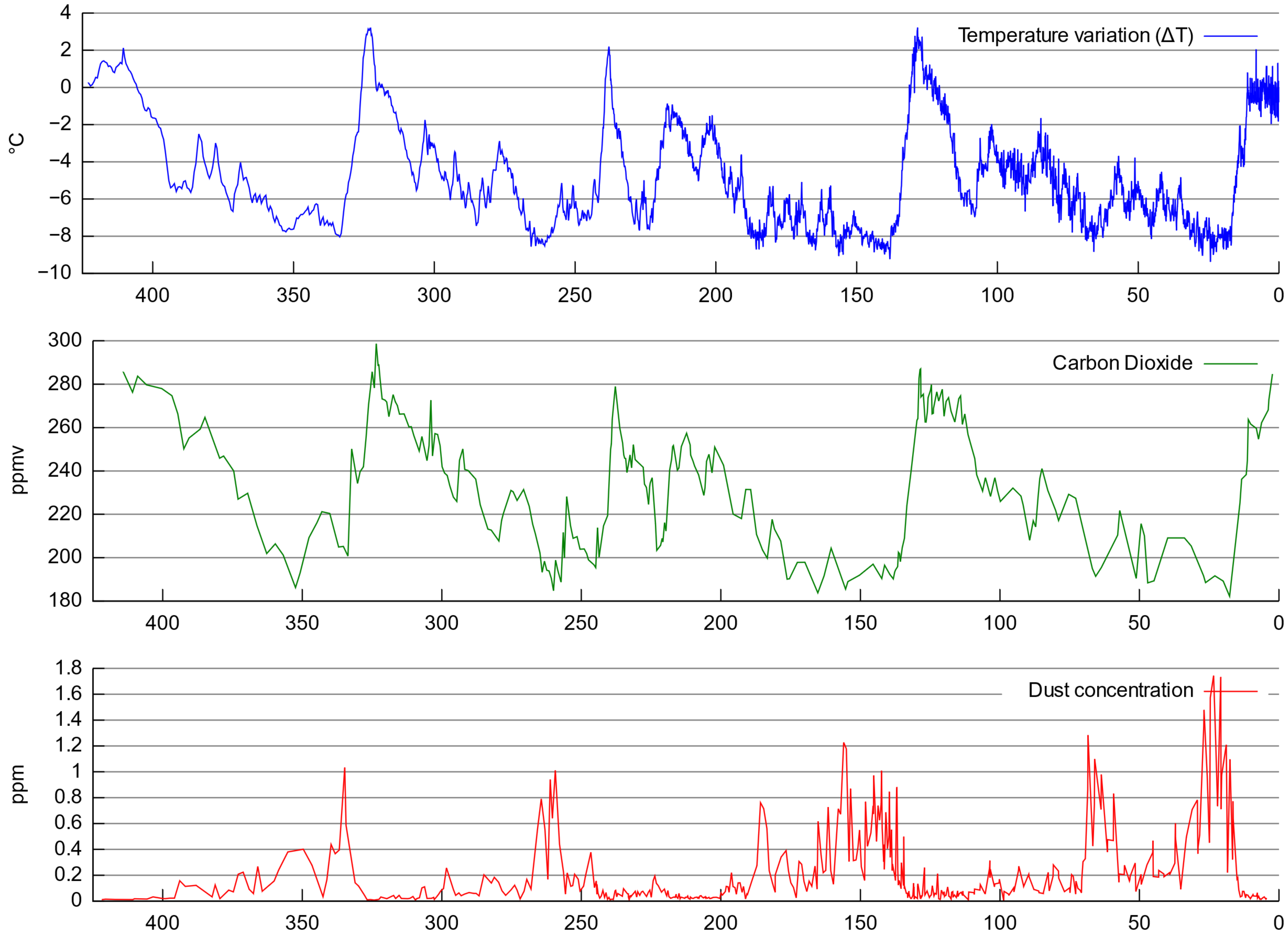
Energibalansen er nøkkelen til å forstå istidene





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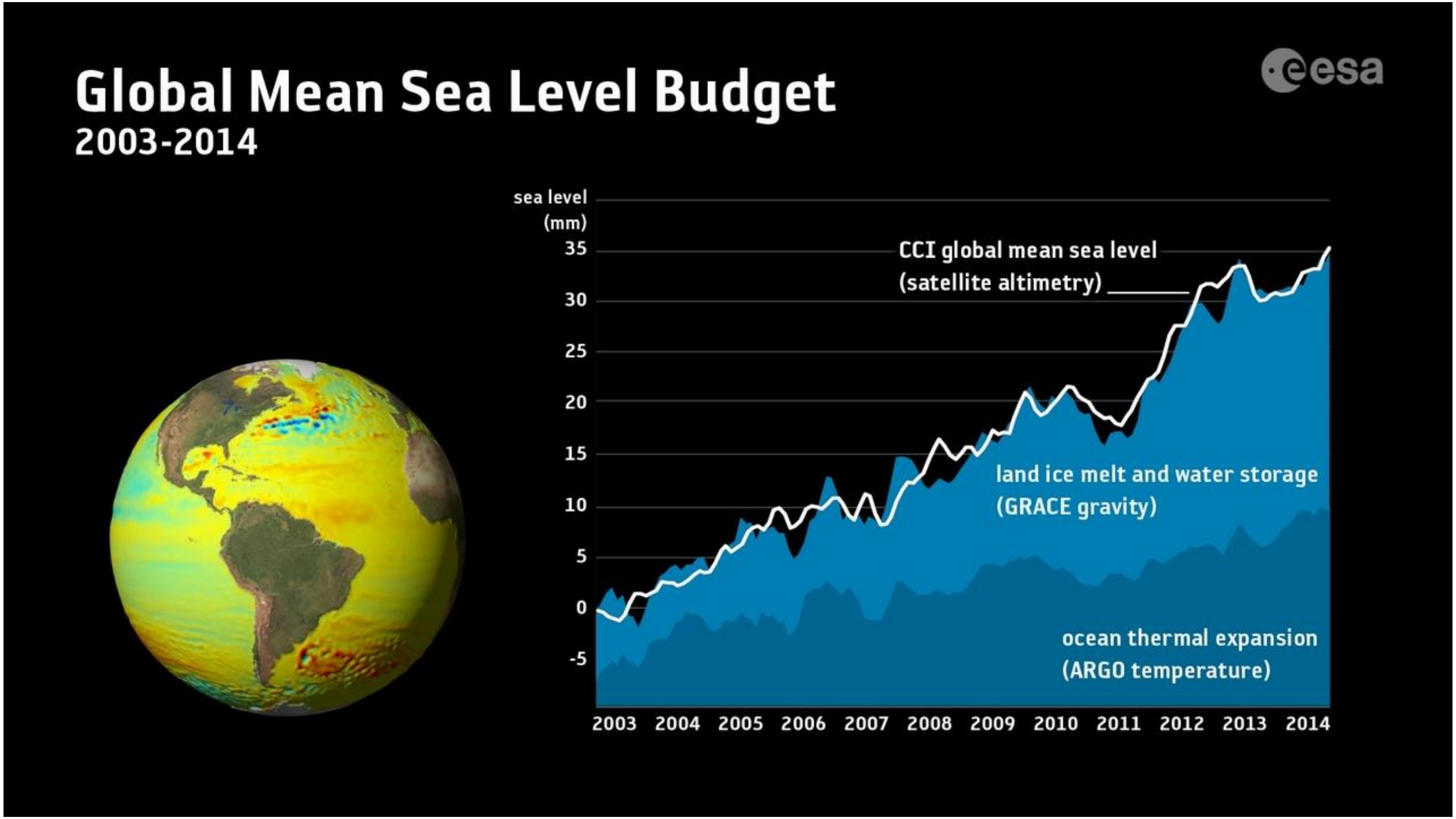
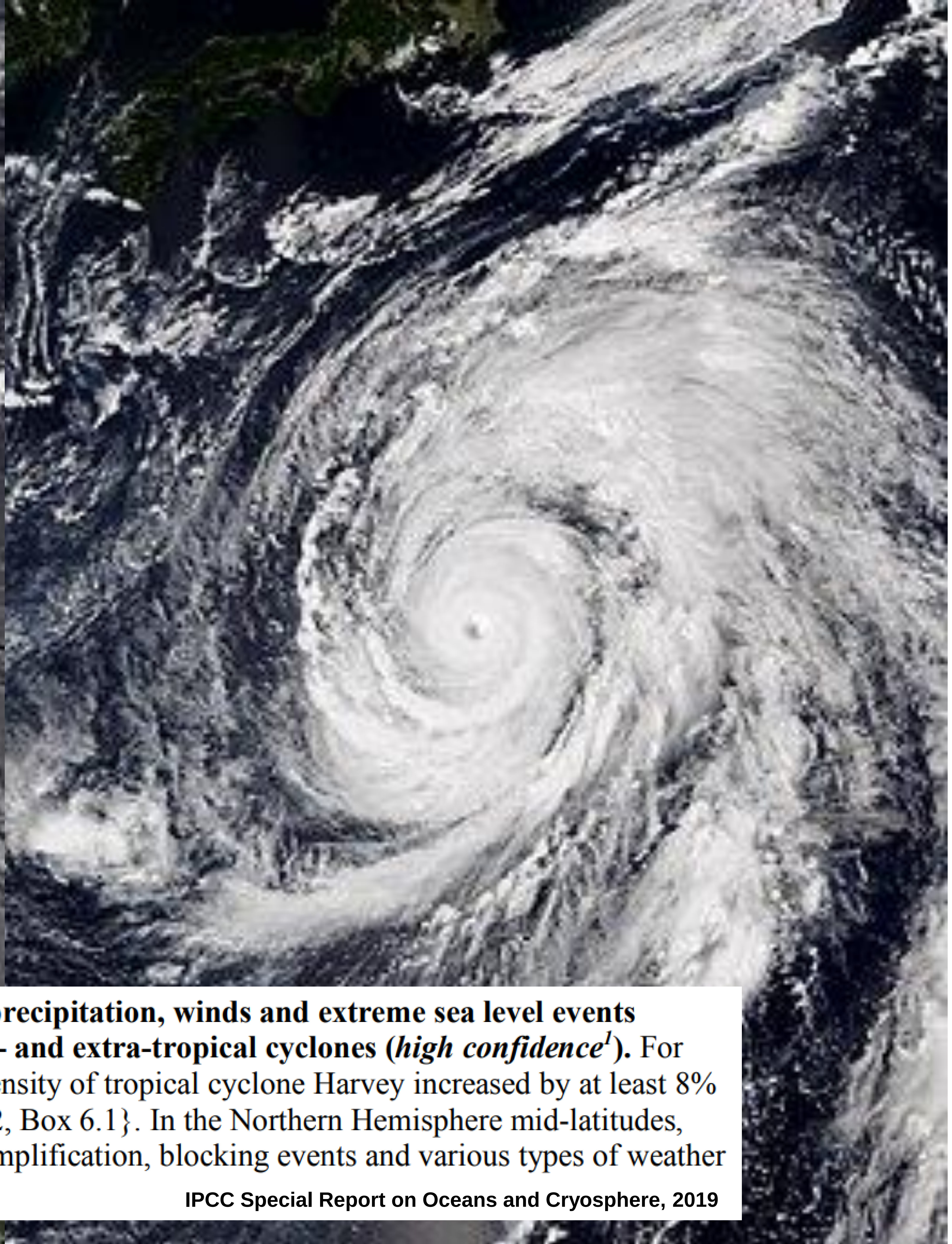
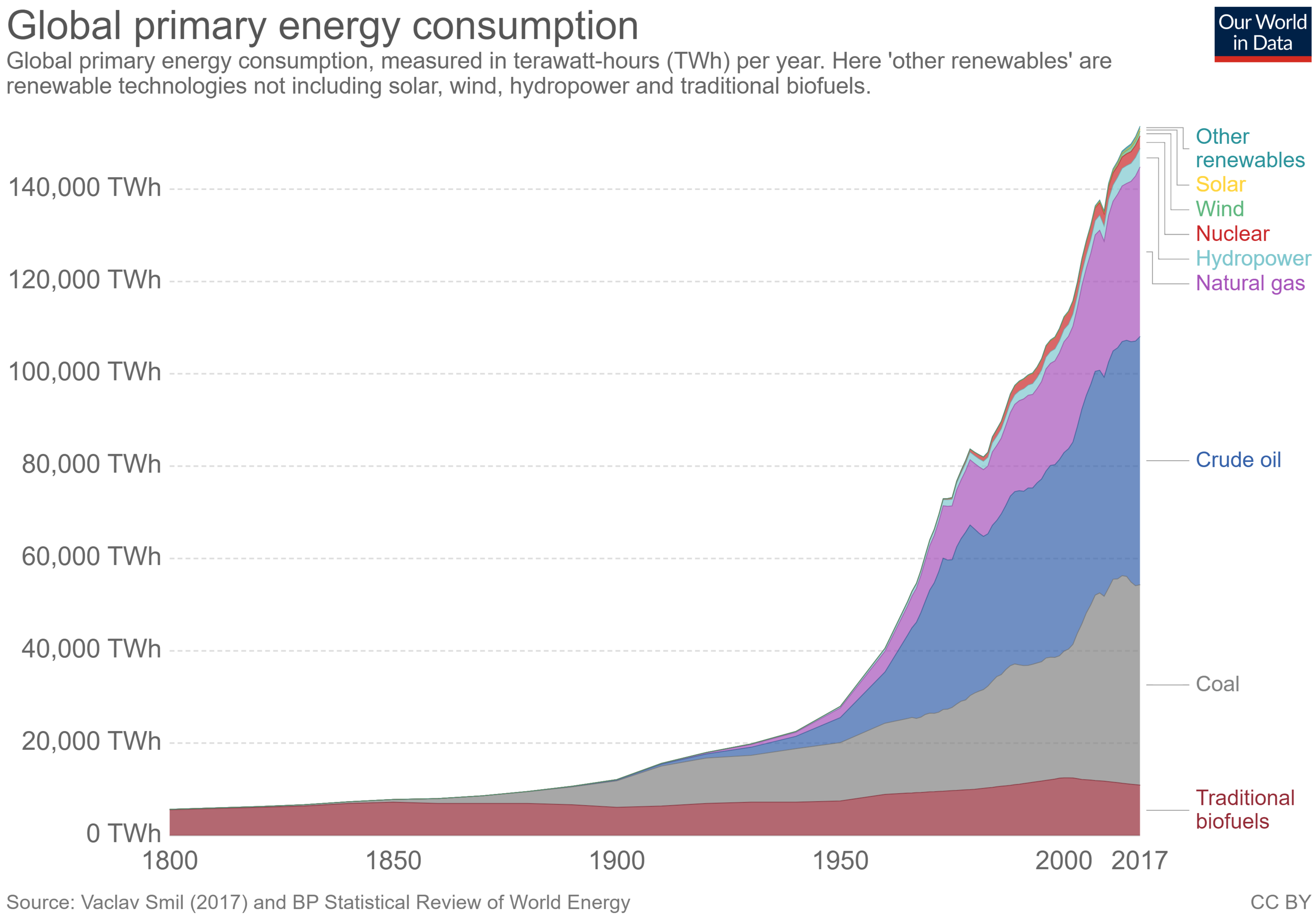

Global Mean Sea Level Budget
2003-2014
esa
sea level
(mm)
35
30
25
20
15
10
5
0
-5
CCI global mean sea level
(satellite altimetry)
land ice melt and water storage
(GRACE gravity)
ocean thermal expansion
(ARGO temperature)
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014



Anthropogenic climate change has increased precipitation, winds and extreme sea level events associated with a number of observed tropical- and extra-tropical cyclones (*high confidence*[1]). For example, studies have shown that the rainfall intensity of tropical cyclone Harvey increased by at least 8% due to climate change. {6.3, Table 6.2, Figure 6.2, Box 6.1}. In the Northern Hemisphere mid-latitudes, there is *low confidence* in links between Arctic amplification, blocking events and various types of weather extremes in recent decades. {6.3}

IPCC Special Report on Oceans and Cryosphere, 2019

Samfunnets nøkkelspørsmål: Hvor skal vi få energien fra?



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Energy is the mediator of climate change

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Energy is the mediator of climate change

$E = m c^2$

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