SESSION 2: ADDRESSING CLIMATE CHANGE CHALLENGES

PANEL 2.2: Monitoring and mitigation of the impact of climate change

Pavel KABAT
WMO

Chief Scientist and Research Director at the World Meteorological Organization (WMO) of the United Nations

Pavel Kabat is leading the overall strategic direction of the WMO science, and its underlying research activities, including the World Climate Research Programme, the World Weather Research programme and WMO's Global Atmosphere Watch which monitors greenhouse gas concentrations, air quality and the ozone layer; from 2012 to 2018, he was the Director General and the Chief Executive Officer of the International Institute for Applied Systems Analysis (IIASA)

Climate change: where do we stand and can we really act?

Professor Pavel Kabat

WMO Chief Scientist and Director Research

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

Where do we stand as of today?

Are we on track following Paris Agreement and Agenda 2030 (SDG13) ?

WMO GREENHOUSE GAS BULLETIN NOVEMBER 2018

	CO_2	CH_4	N_2O
Global abundance in 2017	405.5 ± 0.1 ppm	1 859 ± 2 ppb	329.9 ± 0.1 ppb
2017 abundance relative to year 1750*	146%	257%	122%
2016-17 absolute increase	2.2 ppm	7 ppb	0.9 ppb
2016-17 relative increase	0.55%	0.38%	0.27%
Mean annual absolute increase of last 10 years	2.24 ppm yr^{-1}	6.9 ppb yr^{-1}	0.93 ppb yr^{-1}

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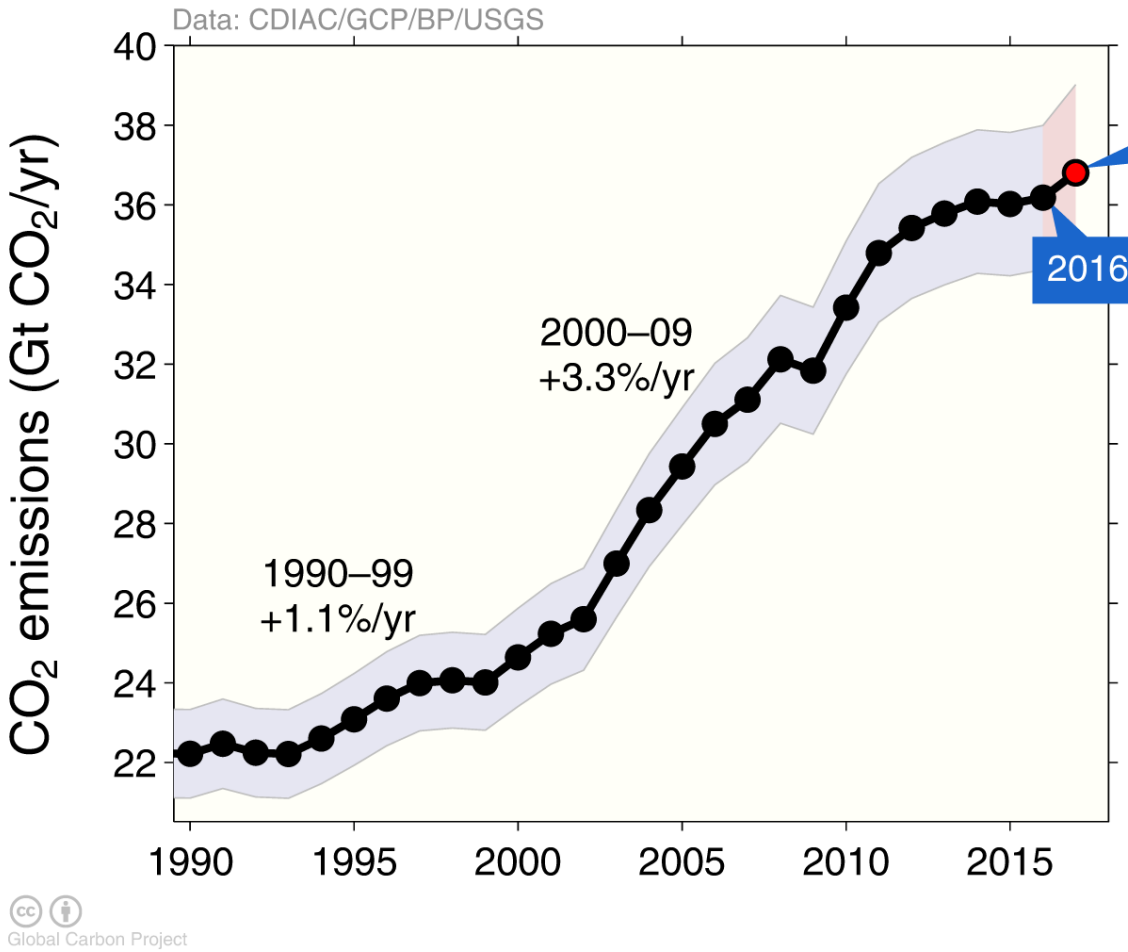
The number of stations used for the analyses is 129 for CO_2, 126 for CH_4 and 96 for N_2O. Assuming a pre-industrial mole fraction of 278 ppm for CO_2, 722 ppb for CH_4 and 270 ppb for N_2O.

Emissions from fossil fuel use and industry

Global emissions from fossil fuel and industry: 36.2 ± 2 $GtCO_2$ in 2016, 62% over 1990

Projection for 2017: 36.8 ± 2 $GtCO_2$, 2.0% higher than 2016



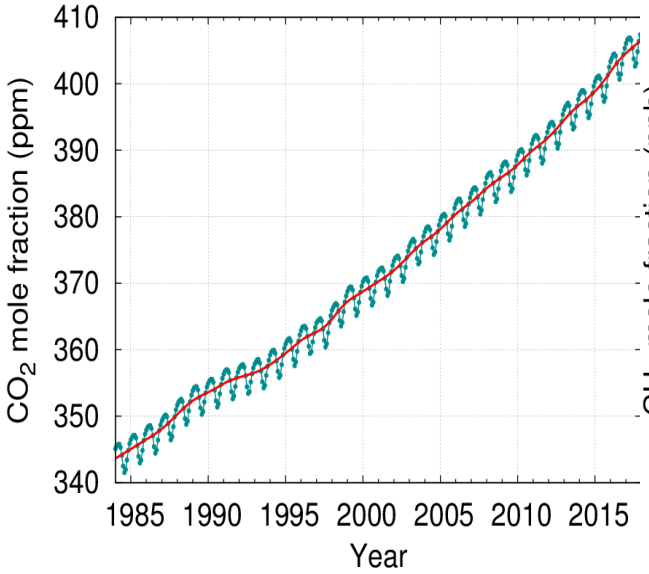
Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

Estimates for 2015 and 2016 are preliminary. Growth rate is adjusted for the leap year in 2016.

Source: CDIAC; Le Quéré et al 2017; Global Carbon Budget 2017

Carbon dioxide level highest in 3 million years

CO_2

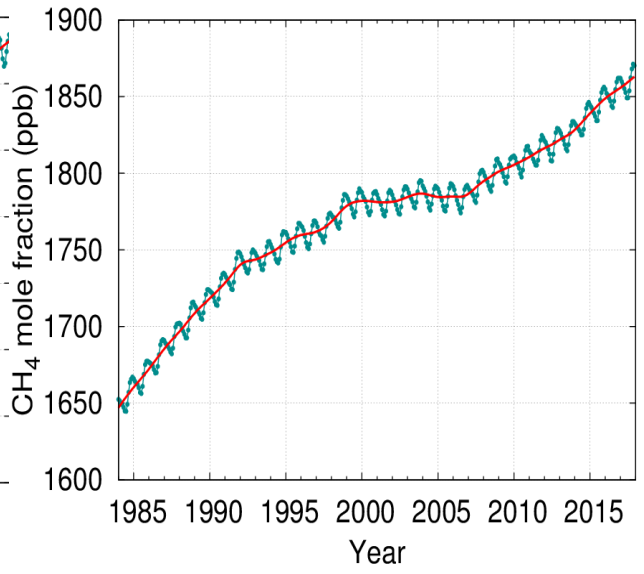


Increase 146 %

Life-time several thousands years

Contribution to warming 66 %

CH_4

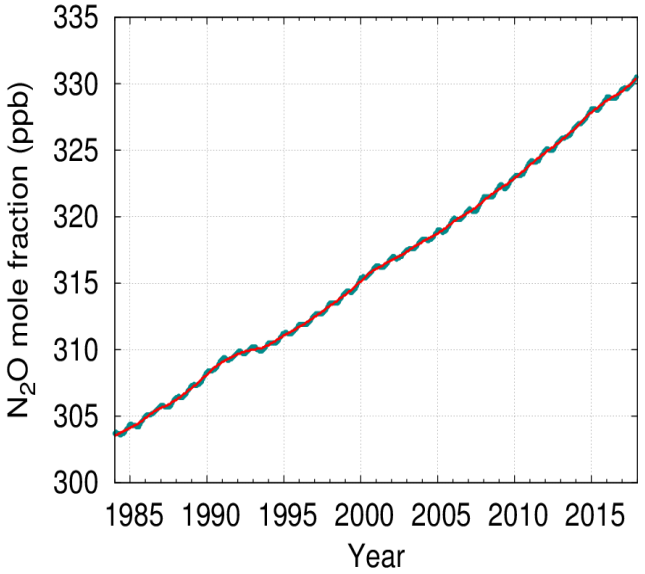


Increase 257 %

Lifetime 12 years

Contribution to warming 17 %

N_2O



Increase 122%

Lifetime 114 years

Contribution to warming 6 %

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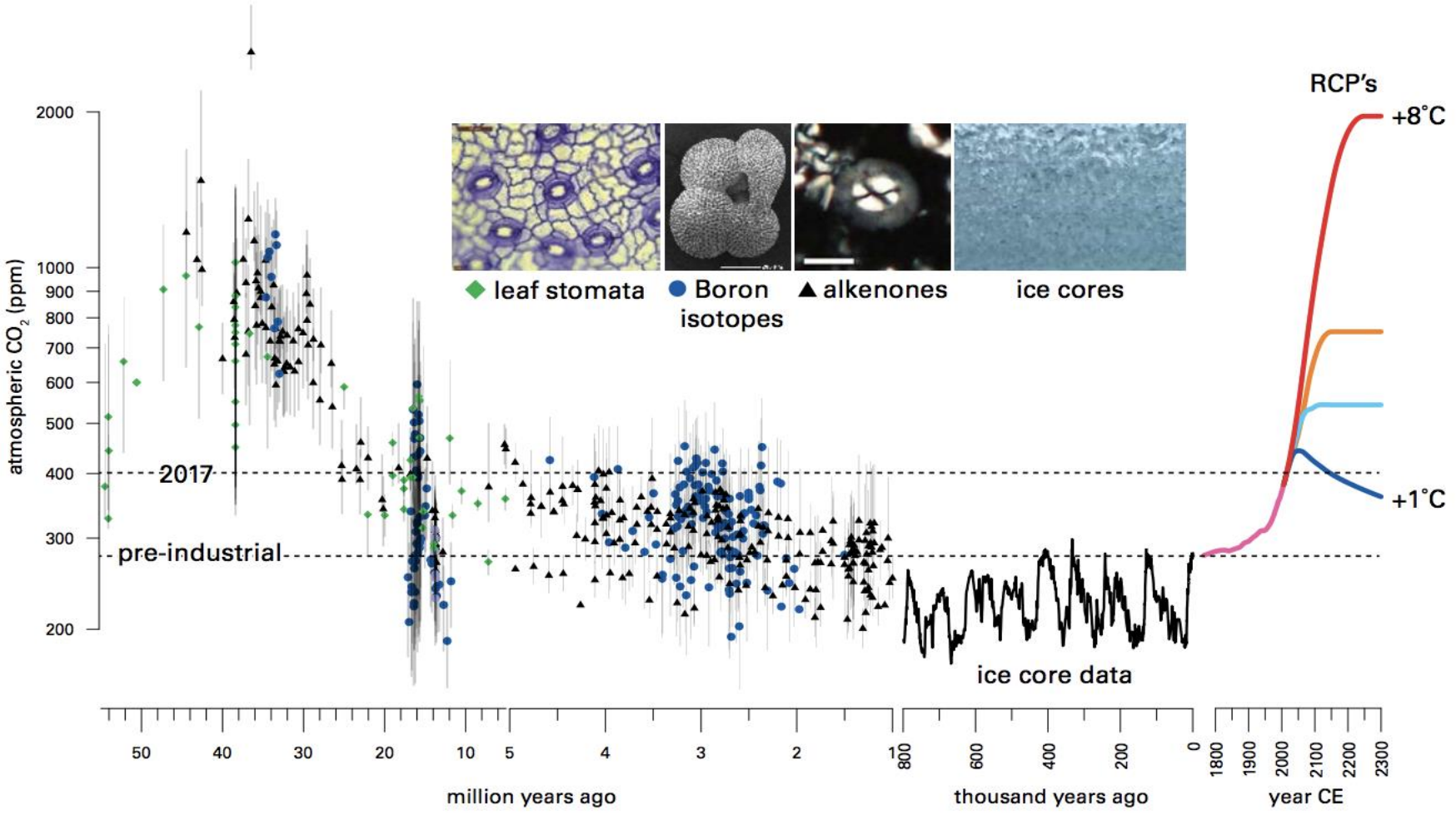
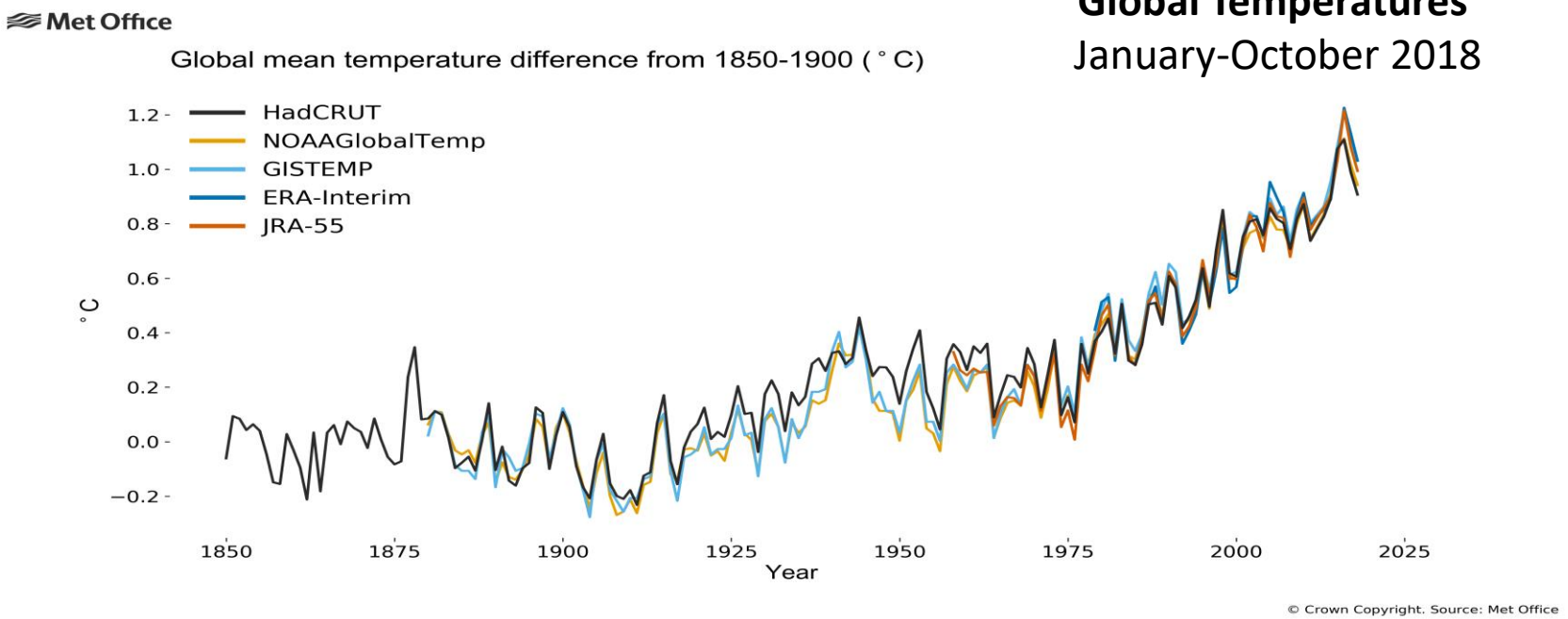
Reconstruction of atmospheric CO2



WMO State of Climate 2018 (pre-release today in Geneva)

Global Temperatures
January-October 2018



- 2018 0.98±0.12°C above pre-industrial (1850-1900), 2018 set to be 4th warmest year on record
- . 2015 and 2016 were affected by strong El Nino2015, 2016, 2017 and 2018 are the 4 warmest years on record
- In contrast to the two warmest years, 2018 began with weak La Niña conditions, typically associated with lower global temperatures.
- By October, sea-surface temperatures in the eastern Tropical Pacific were showing signs of a return to El Niño conditions. If El Niño develops, 2019 is likely to be warmer than 2018.

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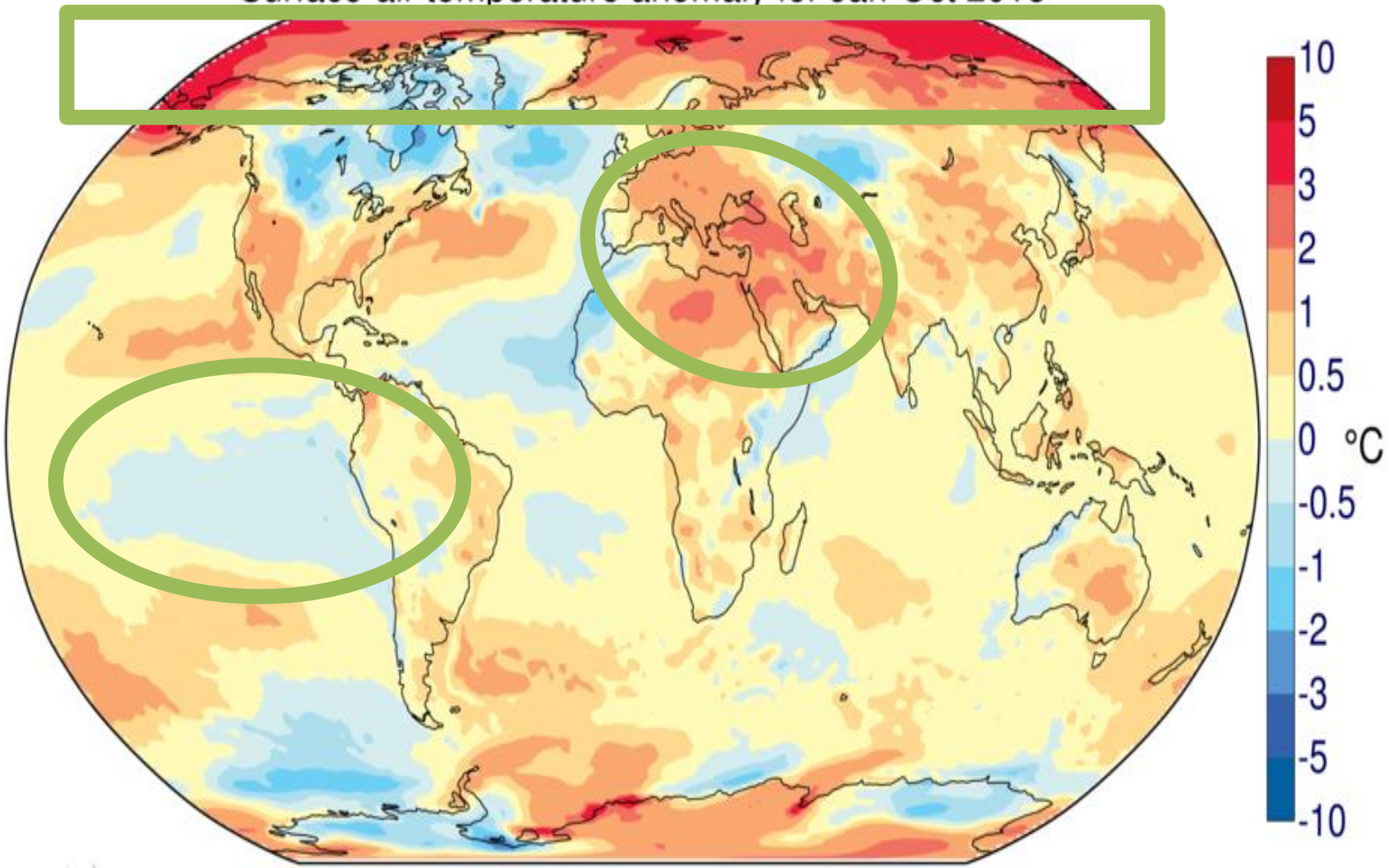
Surface-air temperature anomaly for Jan-Oct 2018



Copernicus
Europe's eyes on Earth

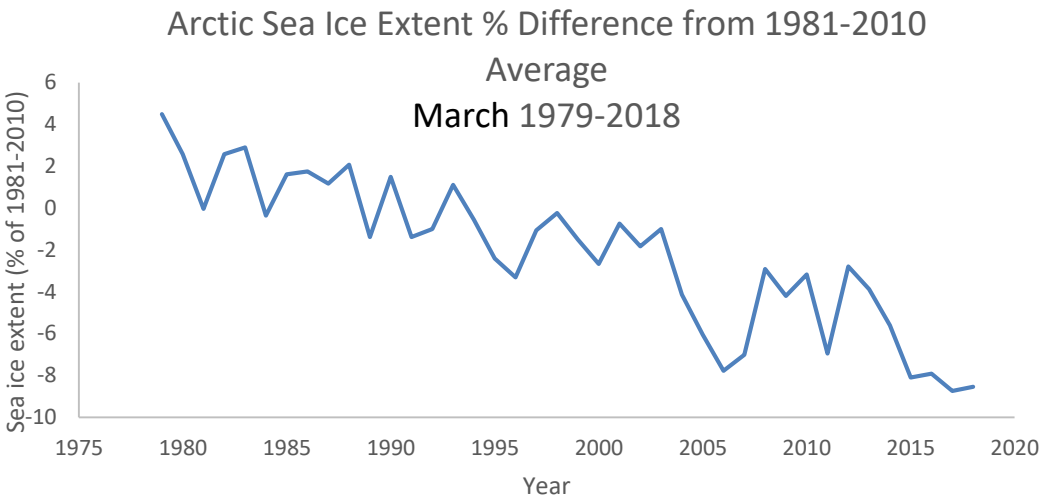
Climate Change Service

ECMWF

Arctic Sea Ice in 2018

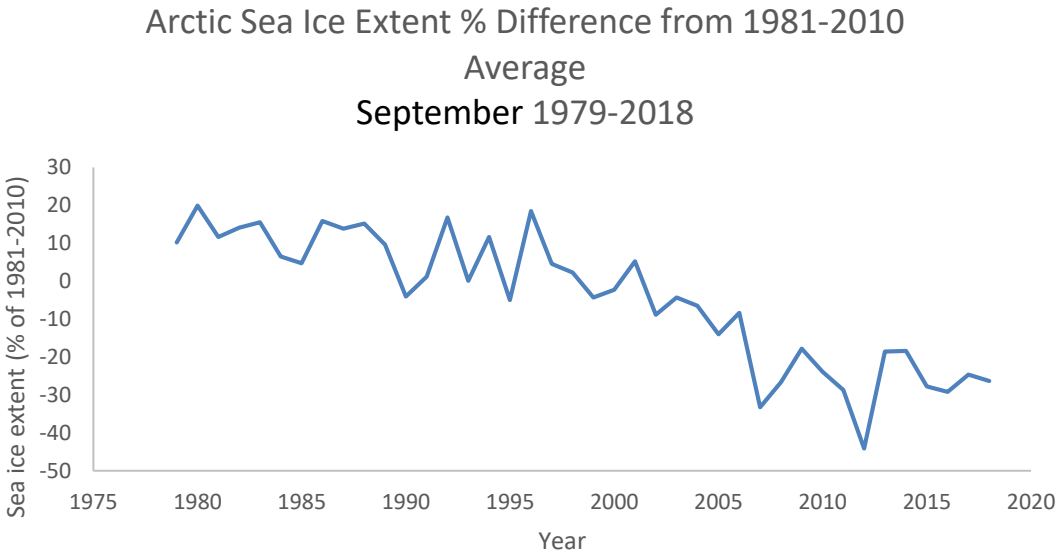
March

14.48 million square kilometres, approximately 7% below the 1981-2010 average (15.64 million square kilometres), the 3rd lowest on record



September

4.62 million square kilometres, approximately 28% below average (6.40 million square kilometres), the 6th smallest September extent on record.



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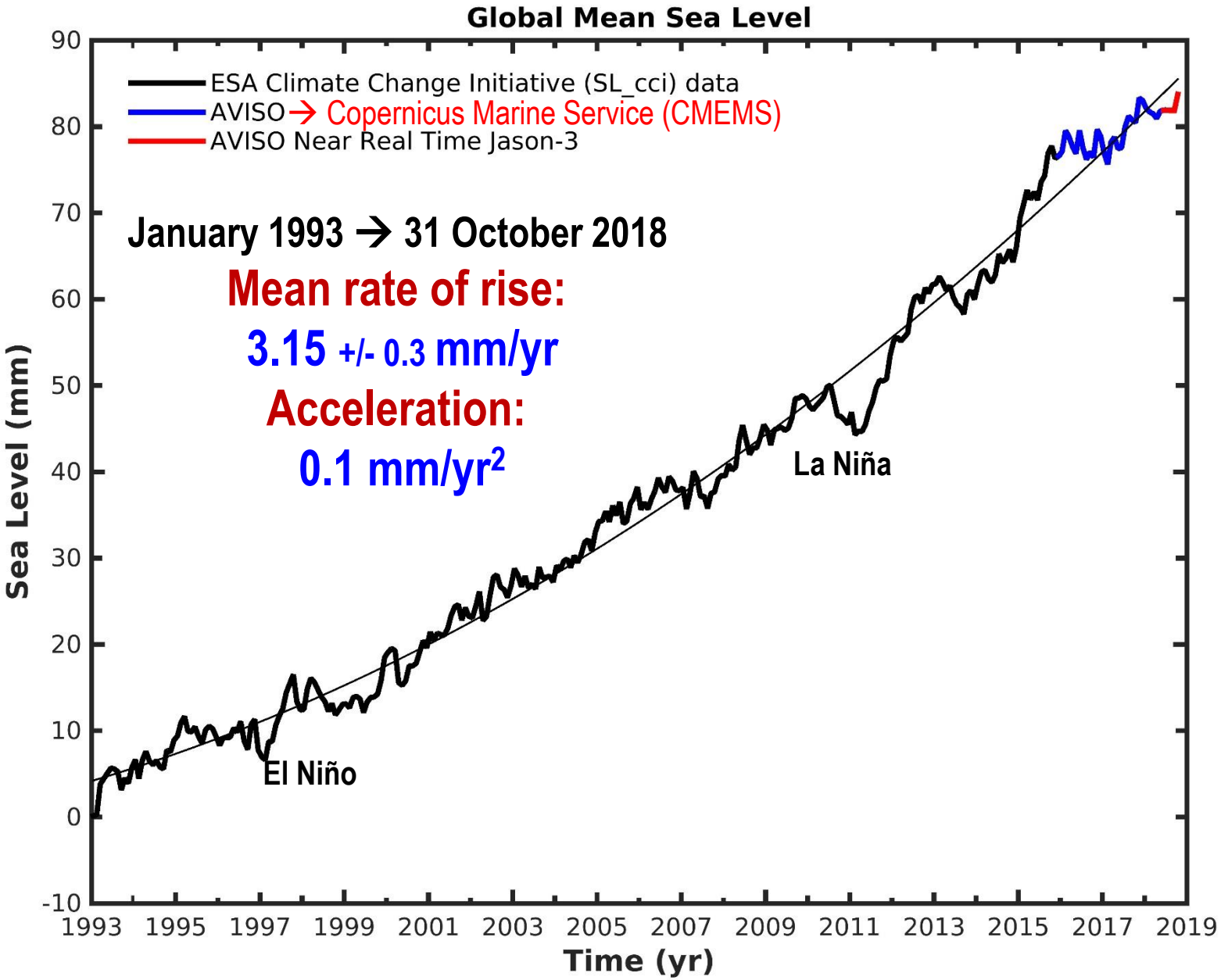
Global Mean Sea Level (Altimetry Era)



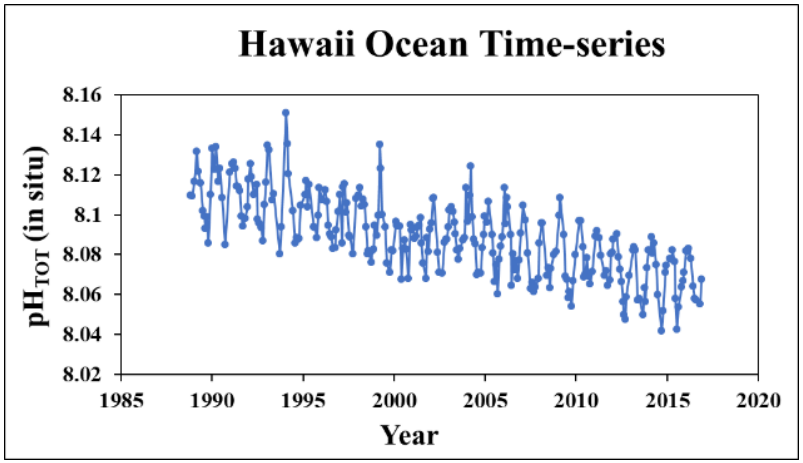
Global Mean Sea Level Rise

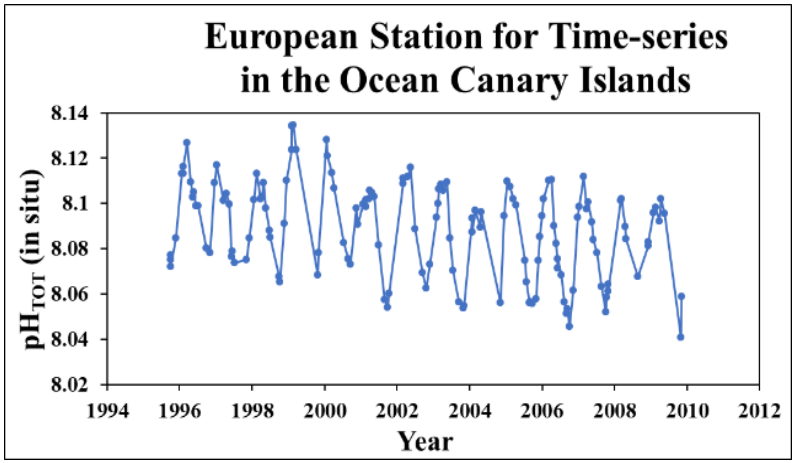
1993-2018 → 3.15 +/- 0.1 mm/yr
1993-2017 → 3.1 +/- 0.1 mm/yr

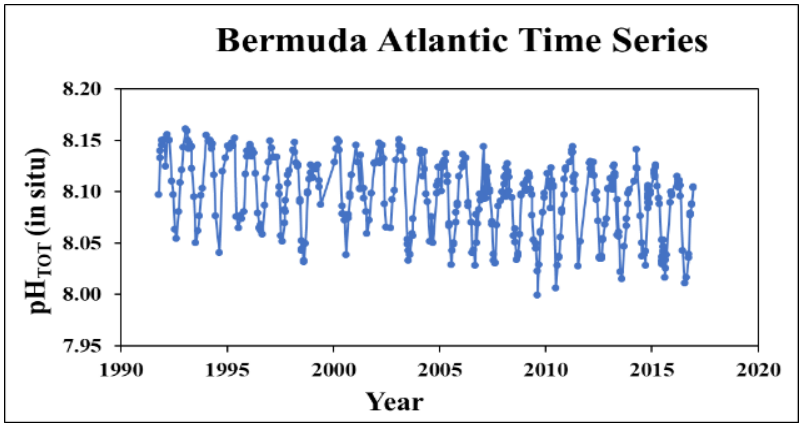
2014-2018 → 4.5 +/- 0.3 mm/yr
2014-2017 → 5.1 +/- 0.3 mm/yr

(formal error, 1 standard deviation)

Ocean acidification







Open-ocean sources over the last 30 years have shown a clear trend of decreasing pH.

Credit: Richard Feely (NOAA- PMEL) and Marine Lebrec (IAEA OA-ICC)

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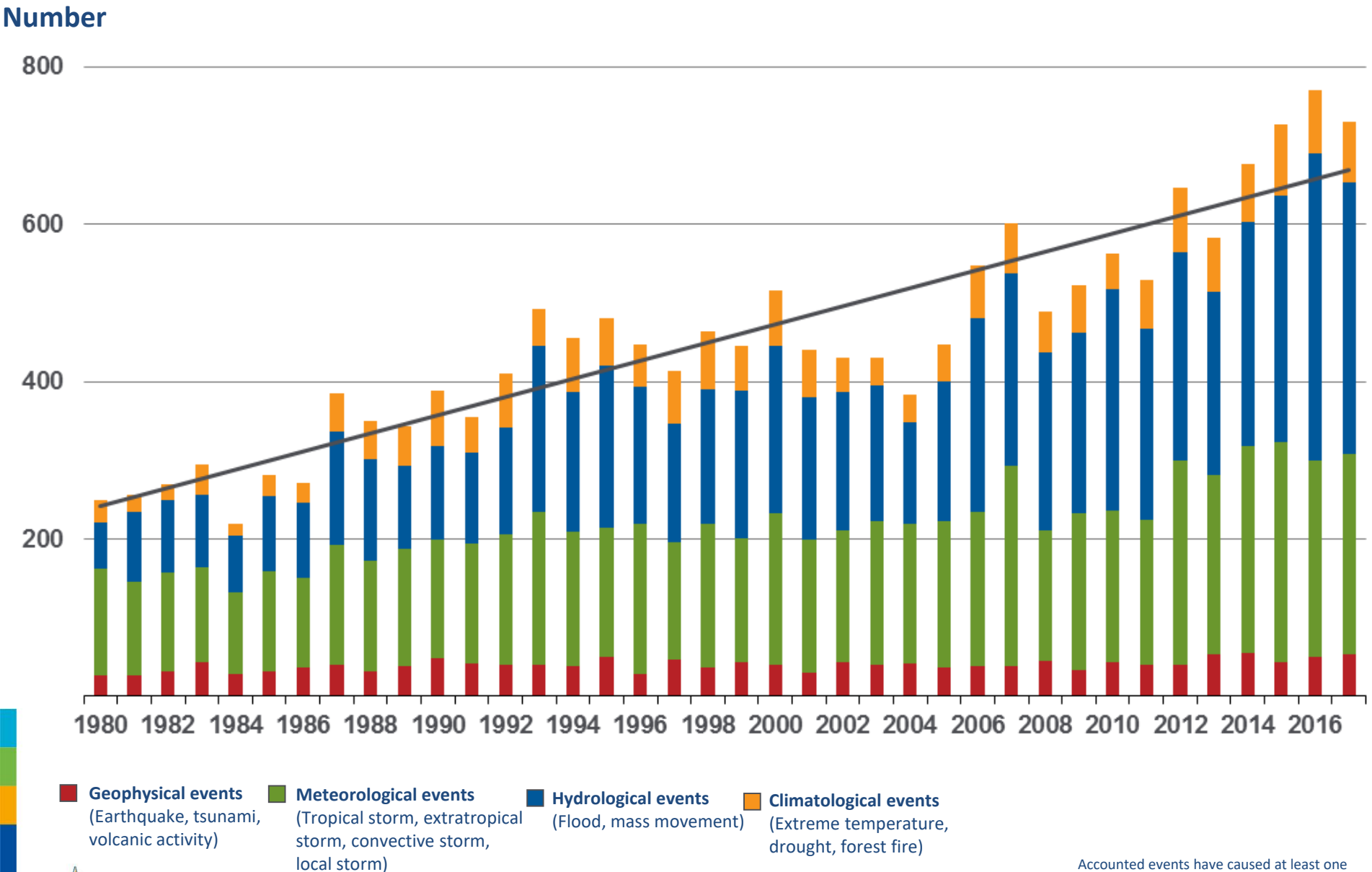
Loss events worldwide 1980 – 2017



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Accounted events have caused at least one fatality and/or produced normalized losses ≥ US$ 100k, 300k, 1m, or 3m (depending on the assigned World Bank income group of the affected country).

High impacts due to Heat, Drought, floods and cyclones

- **At 1 600 excess deaths** mainly were associated with heat waves, and more than 100 with the wildfires
- **Food insecurity increased to 1.3 million** in southern regions of Madagascar, associated with dry spells and tropical cyclones
- **Over 2 million people** were displaced in association with extreme weather and climate events
- **Up 200 000 refugees** in Bangladesh were exposed to the monsoon rains with heightened risk of landslides and flooding.
- **Exceptional drought in Europe: 43 % crop losses in Germany** relative to the 2013-17 average, likely to be costed in the **billions of euros**
- **Hurricane Florence and Michael** the most significant hurricane landfalls on the United States mainland in 2018 with heavy economic losses.
- **Typhoon Manghkut** which crossed the Philippines in mid-September agricultural losses that could reach at least **US$ 265 million**.
- **Tropical cyclone Gita in the South Pacific** the most intense tropical cyclone ever to affect Tonga causing severe damage.

Largest relative losses 1998-2017

Name and date	Countries/territories affected	Economic losses (billion US$)	Economic losses (%GDP)
Hurricane Irma – Sep.2017	Sint Maarten	2.50	797
Hurricane Irma – Sep.2017	Saint Martin	4.10	584
Hurricane Irma – Sep.2017	British Virgin Islands	3.00	309
Hurricane Maria – Sep.2017	Dominica	1.46	259
Hurricane Ivan – Sep.2004	Grenada	1.15	148
Hurricane Ivan – Sep.2004	Cayman Islands	4.43	129
Hurricane Georges – Sep.1998	Saint Kitts and Nevis	0.60	110
Hurricane Erika – Aug. 2015	Dominica	0.50	90
Hurricane Mitch – Oct. & Nov. 1998	Honduras	5.68	73
Hurricane Maria – Sep.2017	Puerto Rico	68.00	69

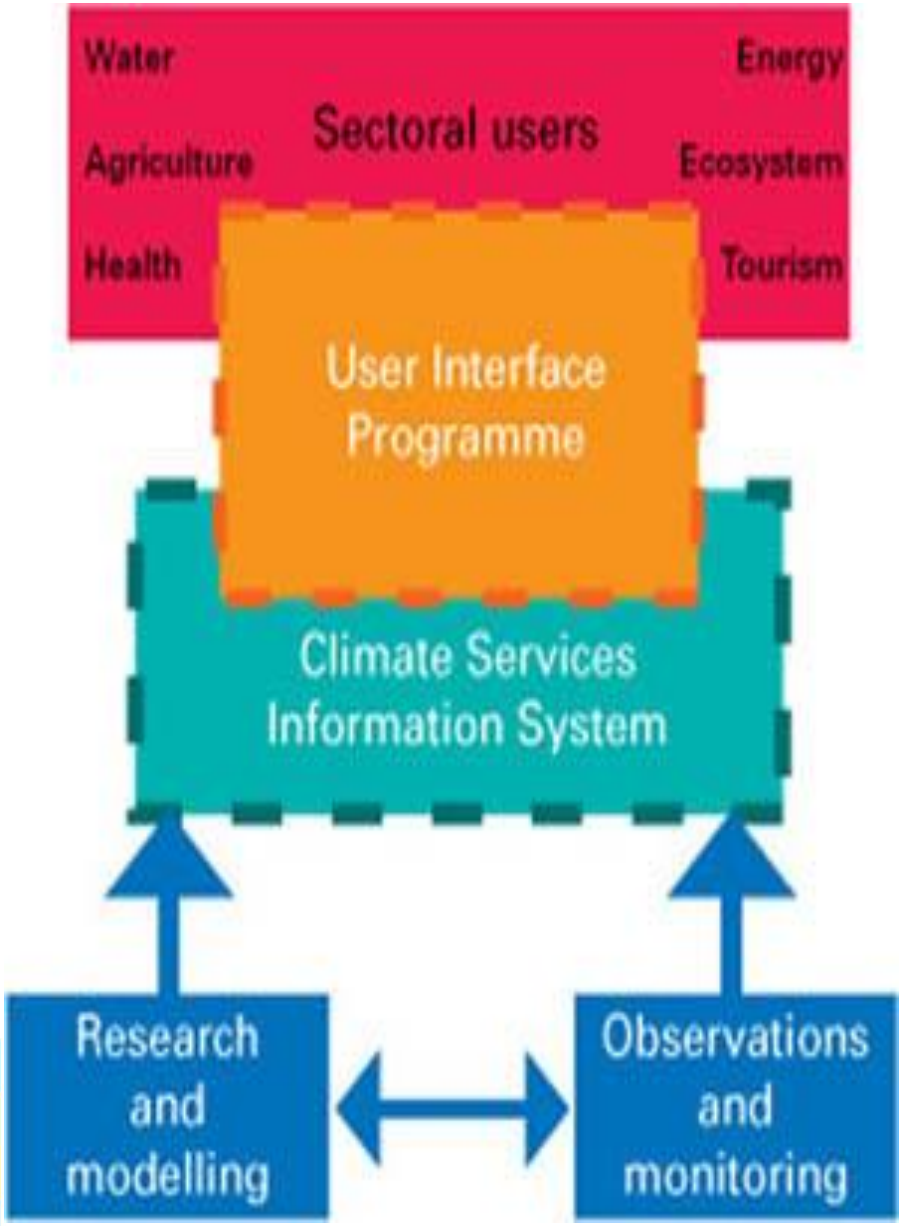
Where do we stand as of today?

Are we on track following Paris Agreement and Agenda 2030 (SDG13) ?

NO, BY FAR…….

Can we really act?

Do we know enough to act and to invest in climate mitigation and adaptation solutions, infrastructure and climate friendly economic development?



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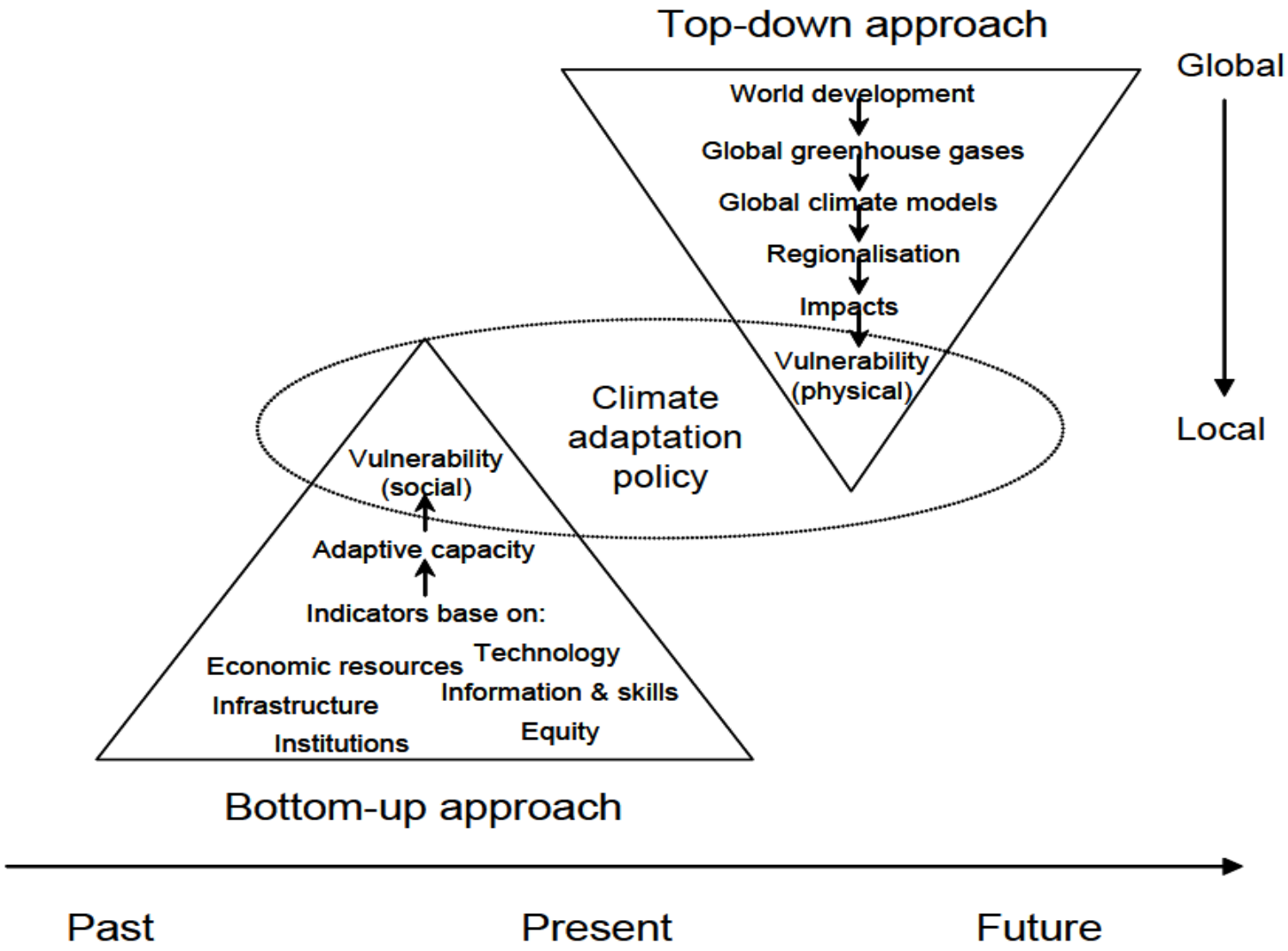
Shall I Compare Thee To A Summer's Day?

by William Shakespeare

Shall I compare thee to a summer's day?
Thou art more lovely and more temperate.
Rough winds do shake the darling buds of May,
And summer's lease hath all too short a date.
Sometime too hot the eye of heaven shines,
And often is his gold complexion dimm'd;
And every fair from fair sometime declines,
By chance or nature's changing course untrimm'd;
But thy eternal summer shall not fade
Nor lose possession of that fair thou ow'st;
Nor shall Death brag thou wander'st in his shade,
When in eternal lines to time thou grow'st:
So long as men can breathe or eyes can see,
So long lives this, and this gives life to thee.

Summer

summer
temperate
Rough winds
summer
hot
fair
fair
nature
summer
fair
shade
time
life


Top-down approach
Global
World development
Global greenhouse gases
Global climate models
Regionalisation
Impacts
Vulnerability (physical)
Local
Climate adaptation policy
Vulnerability (social)
Adaptive capacity
Indicators base on:
Economic resources
Technology
Infrastructure
Information & skills
Institutions
Equity
Bottom-up approach
Past
Present
Future

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Can we really act?

Do we know enough to act and to invest in climate mitigation and adaptation solutions, infrastructure and climate friendly economic development?

YES, subject to….

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…we understand and act in a wider (cross-sectoral) context in which mitigation and adaptation has to take place ...

..., technical and technology innovation, technical regulation, economic and investment and finance opportunities, cultural preferences, risk psychology, adaptive management, spatial planning, risk management…..

…..adaptive and flexible, robust smart solutions which will shield us from over/miss-investments in light of remaining uncertainties…..

A need for a new narrative:

Climate change as an opportunity...
(to innovate and grow sustainably)

Netherlands: Climate proofing concept….

"The climate is changing and we should make our country climate proof. The national government together with science, policy and other stakeholders"

Jan-Peter Balkenende - Dutch Prime Minister, november 2005"

Vol. 438| 17 November 2005 nature

COMMENTARY

Climate proofing the Netherlands

Regional climate change should not be seen only as a threat; changes to weather patterns could generate opportunities for large-scale innovations, say **Pavel Kabat**, **Pier Vellinga** and their colleagues.

Working together with water

A living land builds for its future

Findings of the *Deltacommission* 2008

www.deltacommissie.com/en/advies

Nature Geoscience | VOL 2 | JULY 2009 |

commentary

Dutch coasts in transition

Pavel Kabat, Louise O. Fresco, Marcel J. F. Stive, Cees P. Veerman, Jos S. L. J. van Alphen, Bart W. A. H. Parmet, Wilco Hazeleger and Caroline A. Katsman

The Netherlands has a long and varied history of coastal and river flood management. The anticipation of sea-level rise during the twenty-first century has renewed the push for sustainable solutions to coastal vulnerability.

The Netherlands is a densely populated country situated primarily in coastal lowlands. The Dutch coast, which is entirely along the North Sea, is 350 km long. At present, nine million residents of the Netherlands live in the coastal areas — vast regions at an elevation below sea level. Roughly 65% of the country's gross national product — about €400 billion — is generated in this region; the harbours and airports scattered throughout the lowlands are vital to the country's infrastructure and serve as important international transport routes for

However, as revealed in the 2006 audit conducted by the Ministry of Transport, Public Works and Water Management, between 24 and 56% of current coastal defences do not even meet the old standards (see Fig. 1). And of course, the number of people and the value of the property that need to be protected from flooding has grown steadily.

A changing climate and the anticipated rise in sea level will only add to the challenges faced by the aging flood defence system. The Dutch government not only recognized the growing vulnerability of

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“Building with Nature”

- Flexible regarding changing conditions and societal values, and increased understanding
- Cost-effective
- Opportunities for integrated and multifunctional approach

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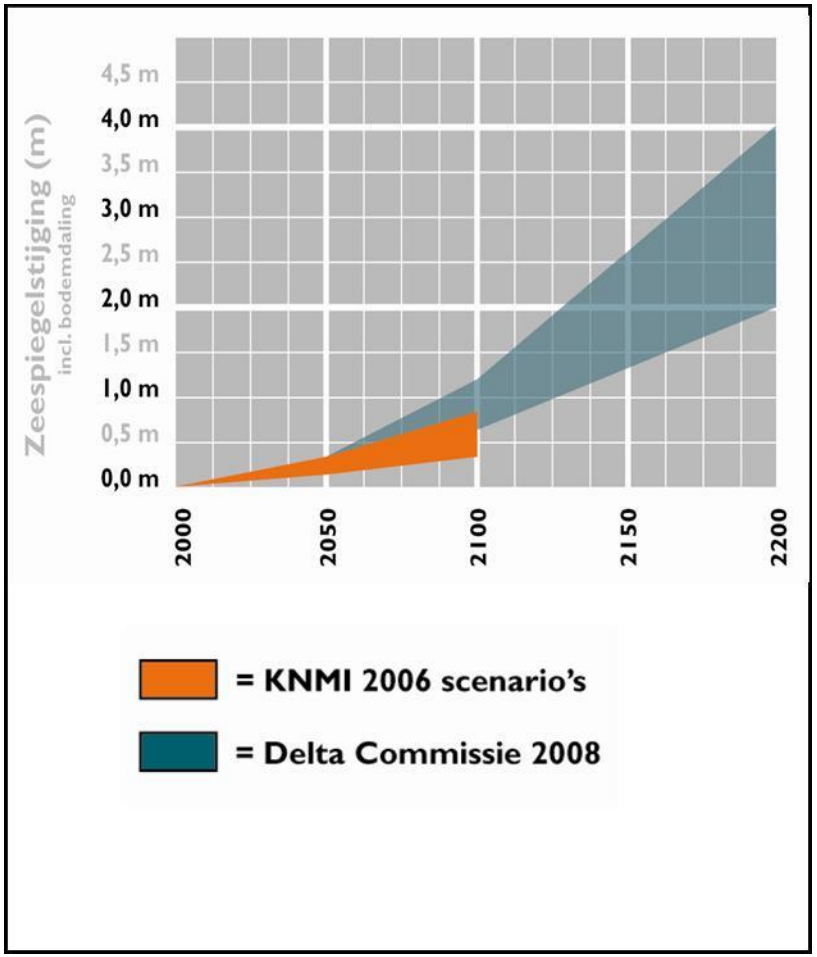
Sea level rise: “plausible high end scenarios”



- 2100: + 0.55 - 1.20 m
- (0.65 – 1.35 incl. soil subs.)

- **Key importance of *adaptive management:* *adaptation measures* must be flexible, no-regret (robust) and hand in hand with monitoring & ability to incorporate new scientific insifghts**

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North Sea coast

- Follow sealevel rise
- Building with nature → beach nourishments
- Optional: reclamation of new coastal land

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WMO OMM

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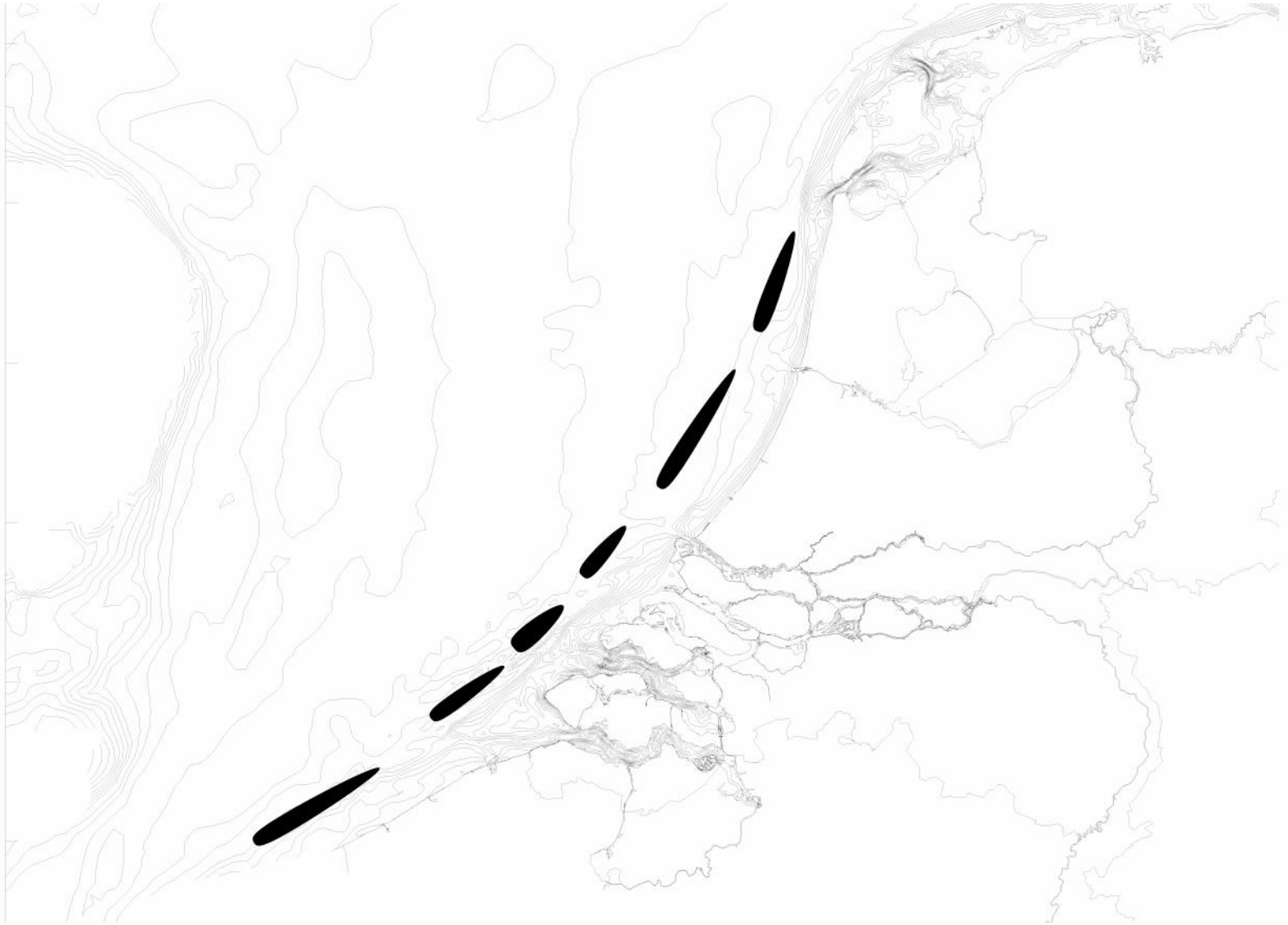

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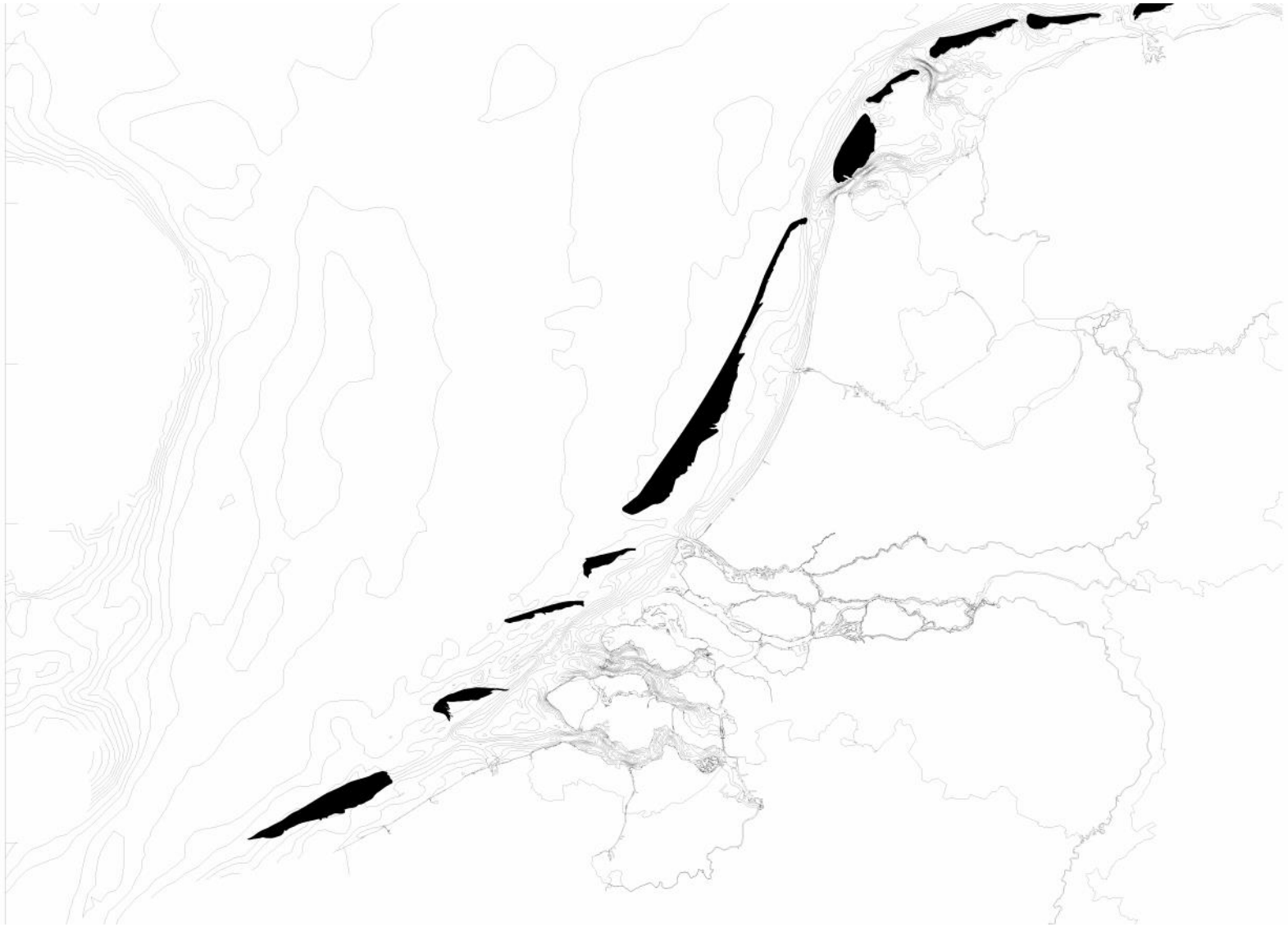

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URSA

40.000 ton

80.000 ton

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Thank you
Merci

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World Meteorological Organization
Organisation météorologique mondiale