Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu

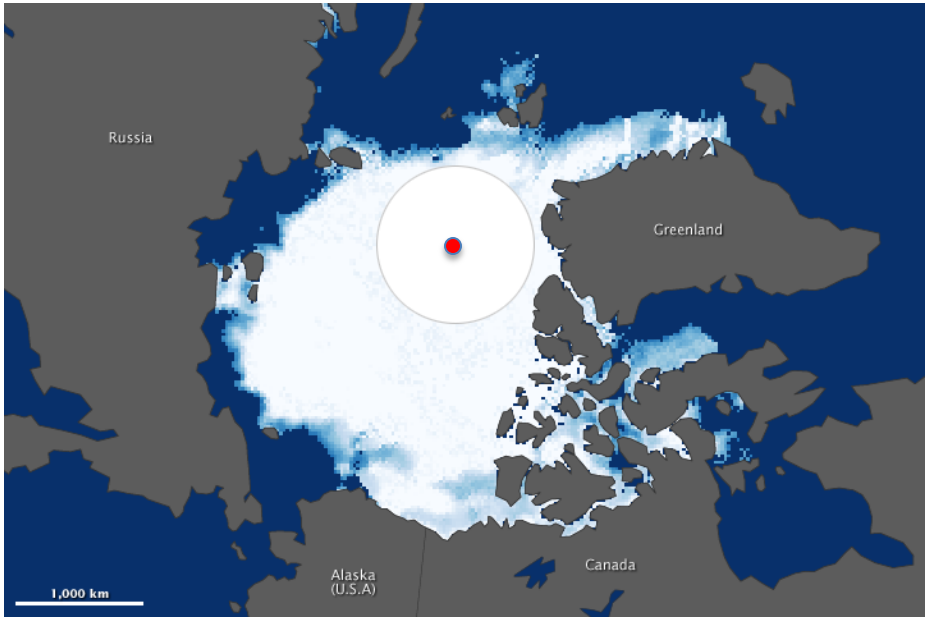
Het veranderende klimaat – hoe snel gaat het?

Gerard van der Steenhoven
Hoofddirecteur KNMI / UTwente

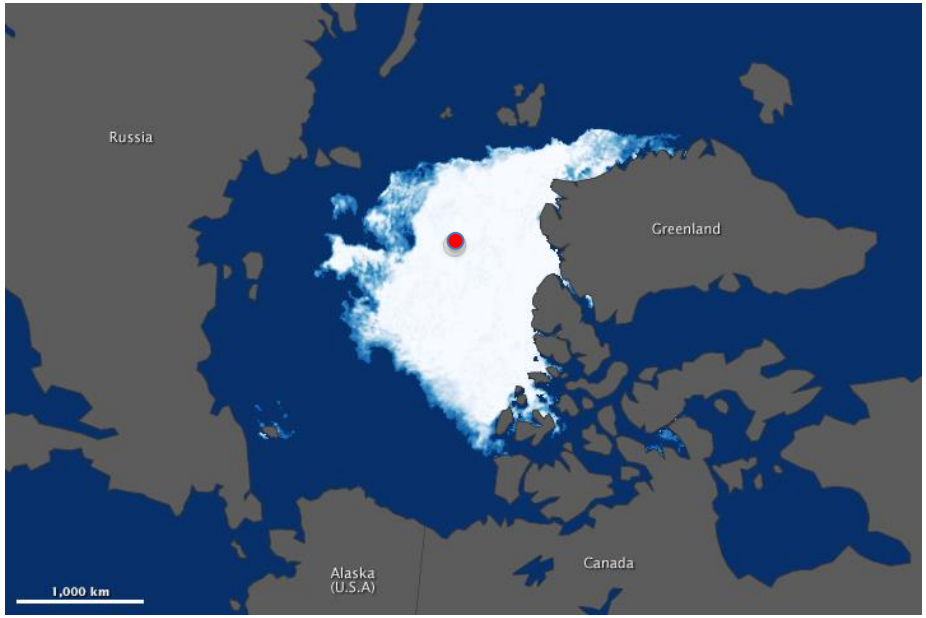
NNV symposium Energie en Klimaat, Utrecht, 9 juni 2017

Sea ice coverage North-Pole

September 1984

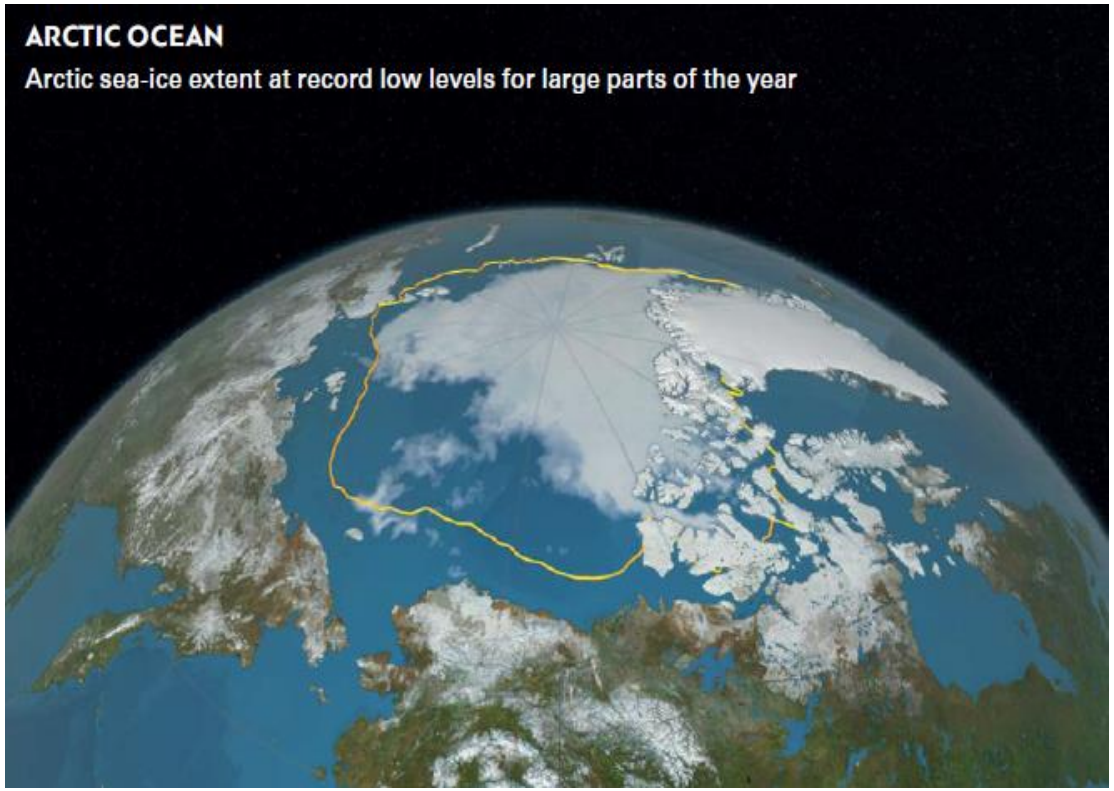


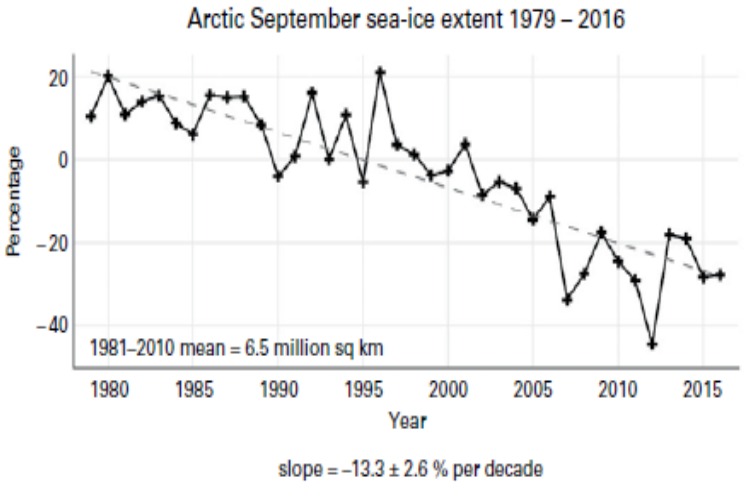
September 2012

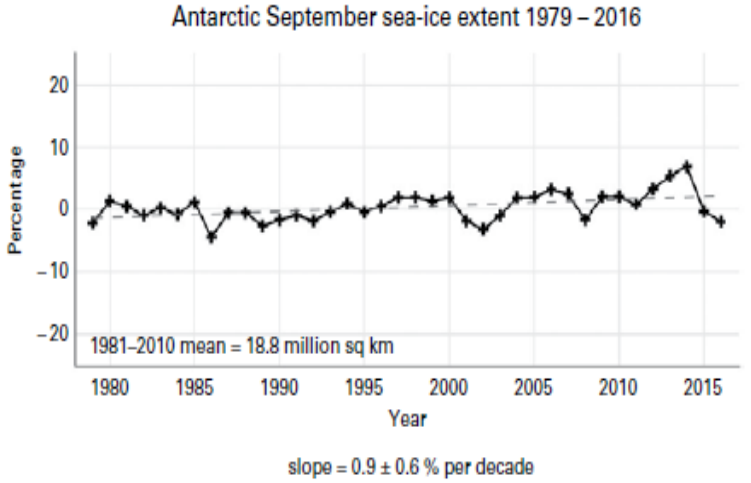


→ 50% reduction

September sea-ice extent 1979 - 2016

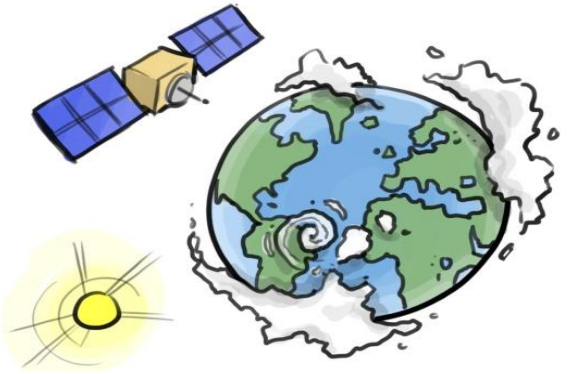




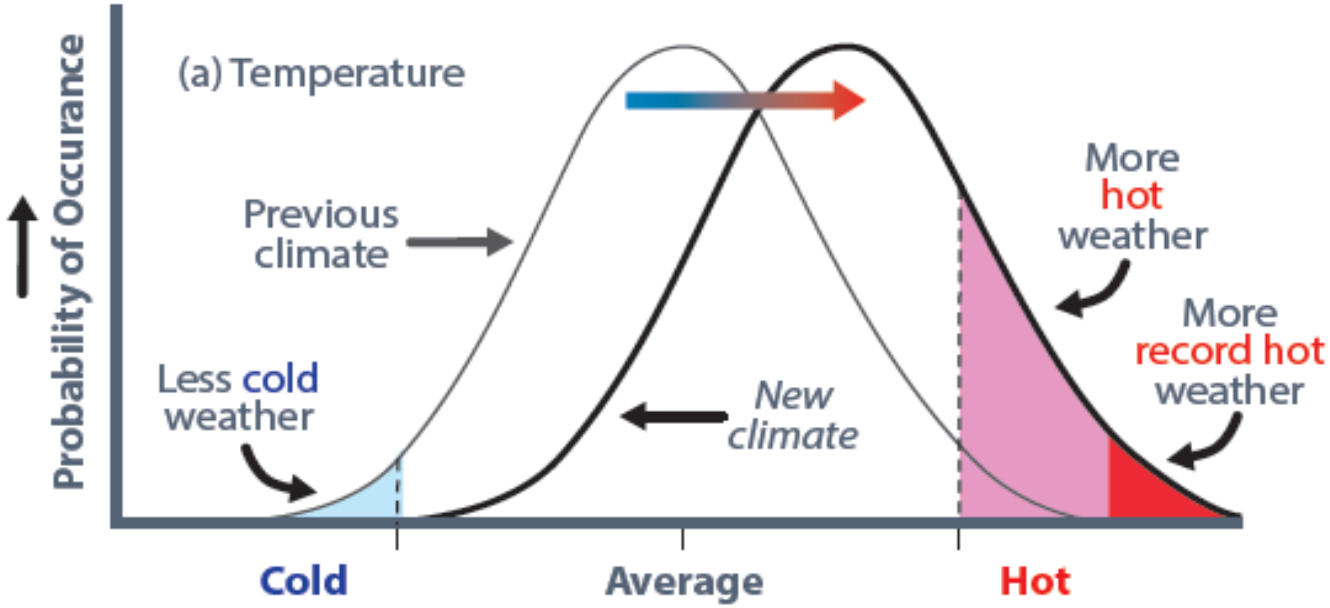


Ref: WMO, US National Snow & Ice Data Center

Definitions



- Climate = 30 yr average of the weather
- Climate change:
  - Variation of the 30 yr average over long periods (~ 100 yr)
  - Changes in the annual distribution (variability)

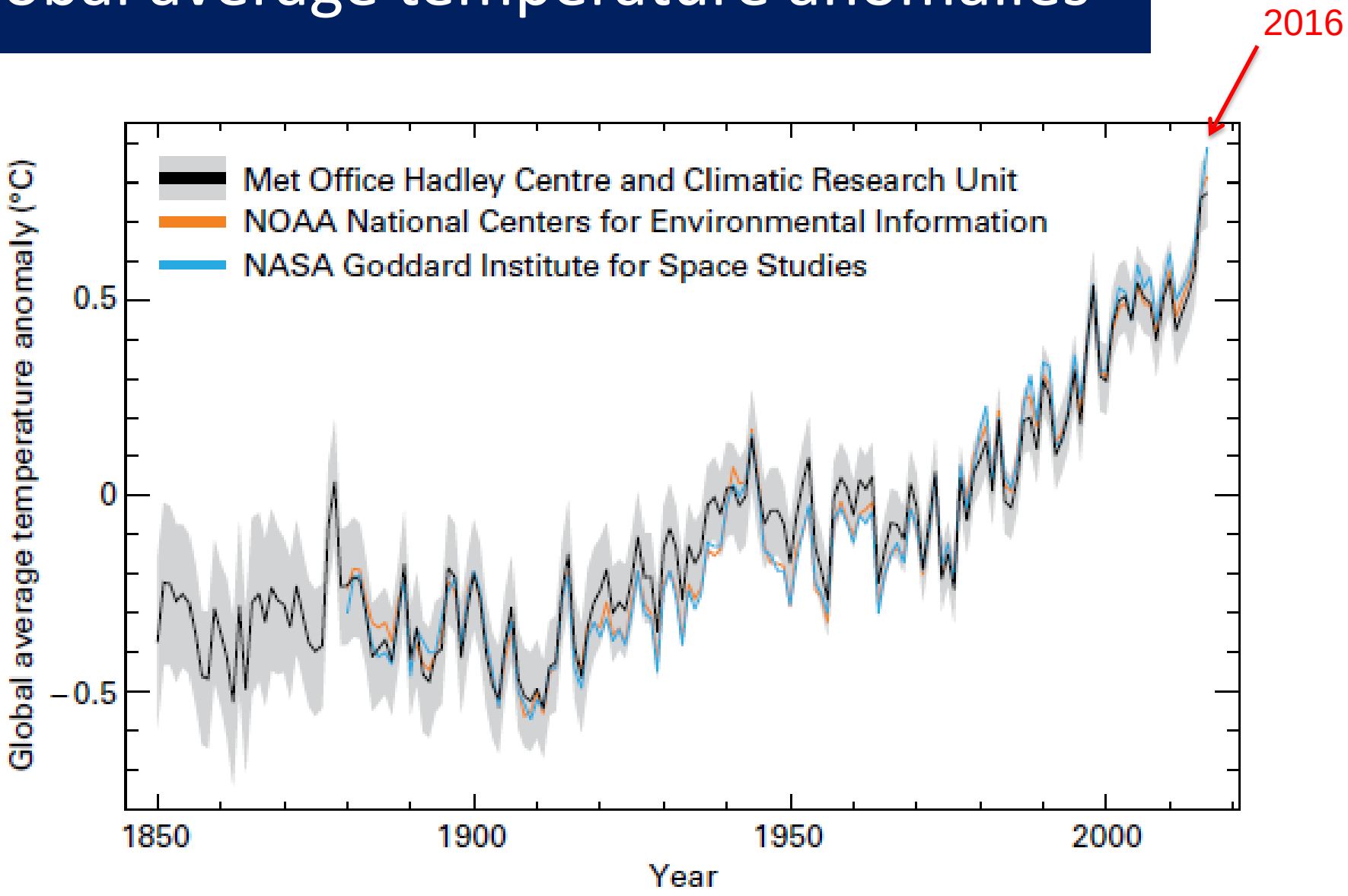


WMO Statement on the State of the Global Climate in 2016

WORLD METEOROLOGICAL ORGANIZATION

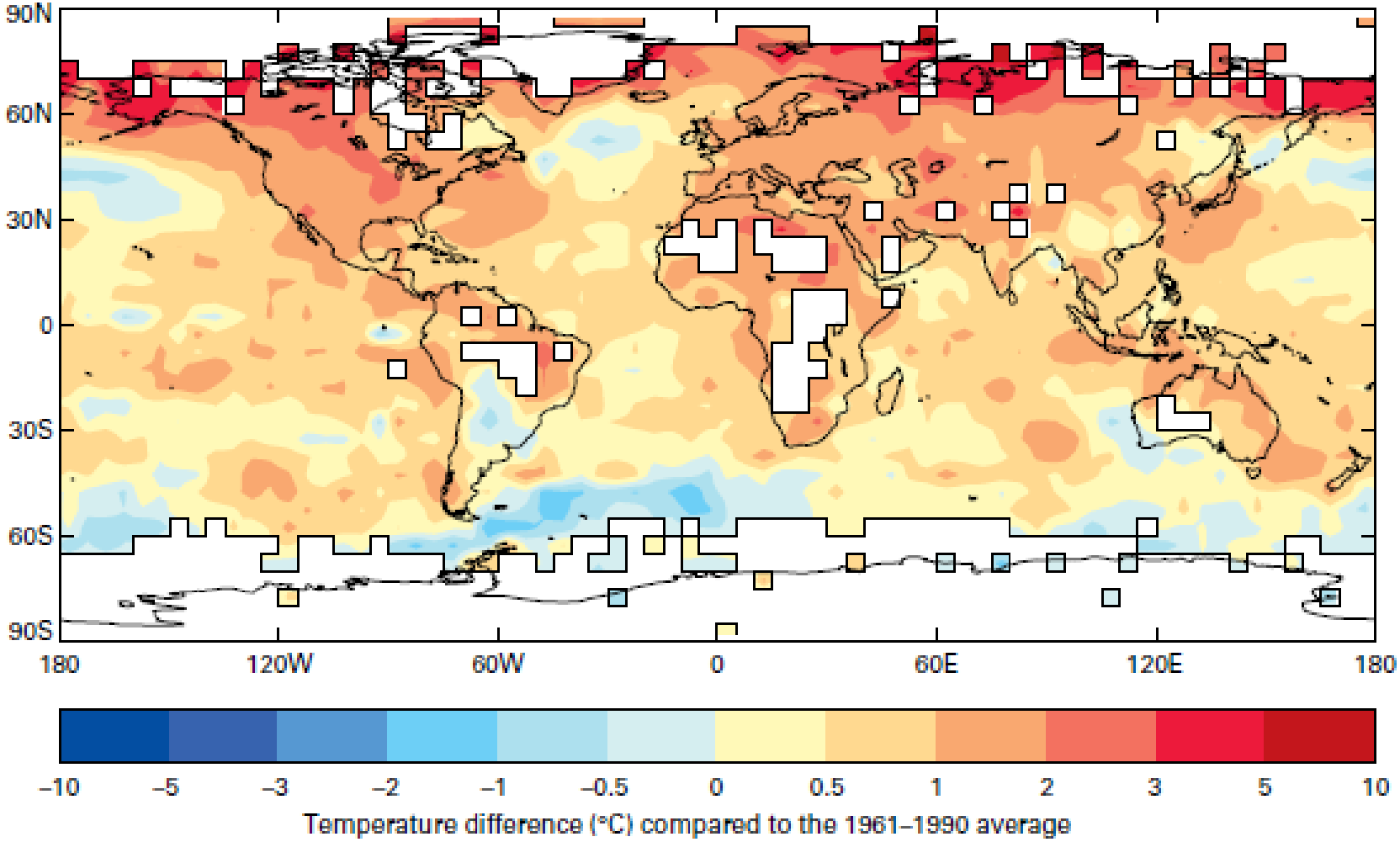
WMO-No. 1189

Global average temperature anomalies



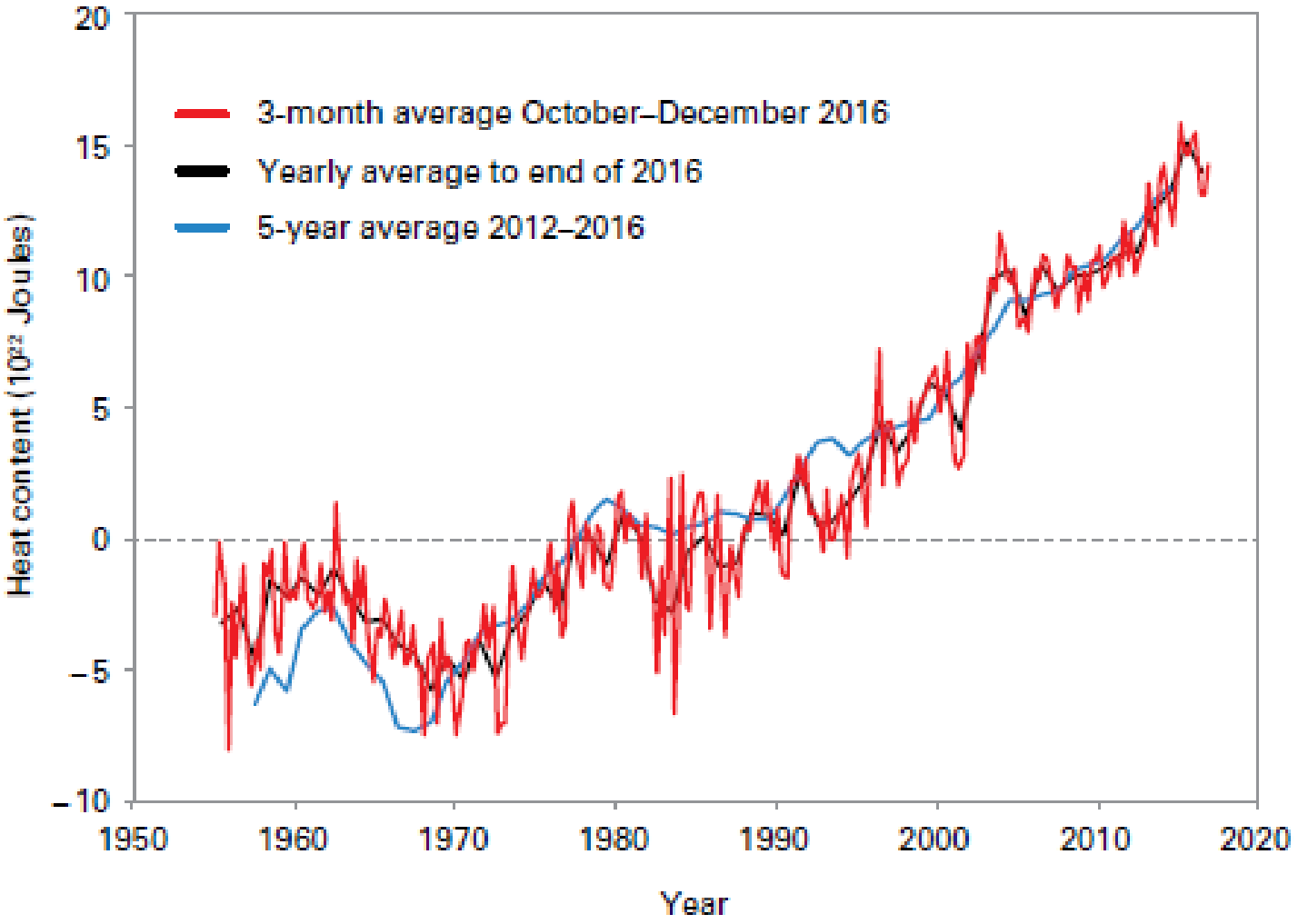
Temparature anomalies wrt 1961-1990. Source: UK Met Office, Hadley Centre.

Local temperature deviations accros the globe



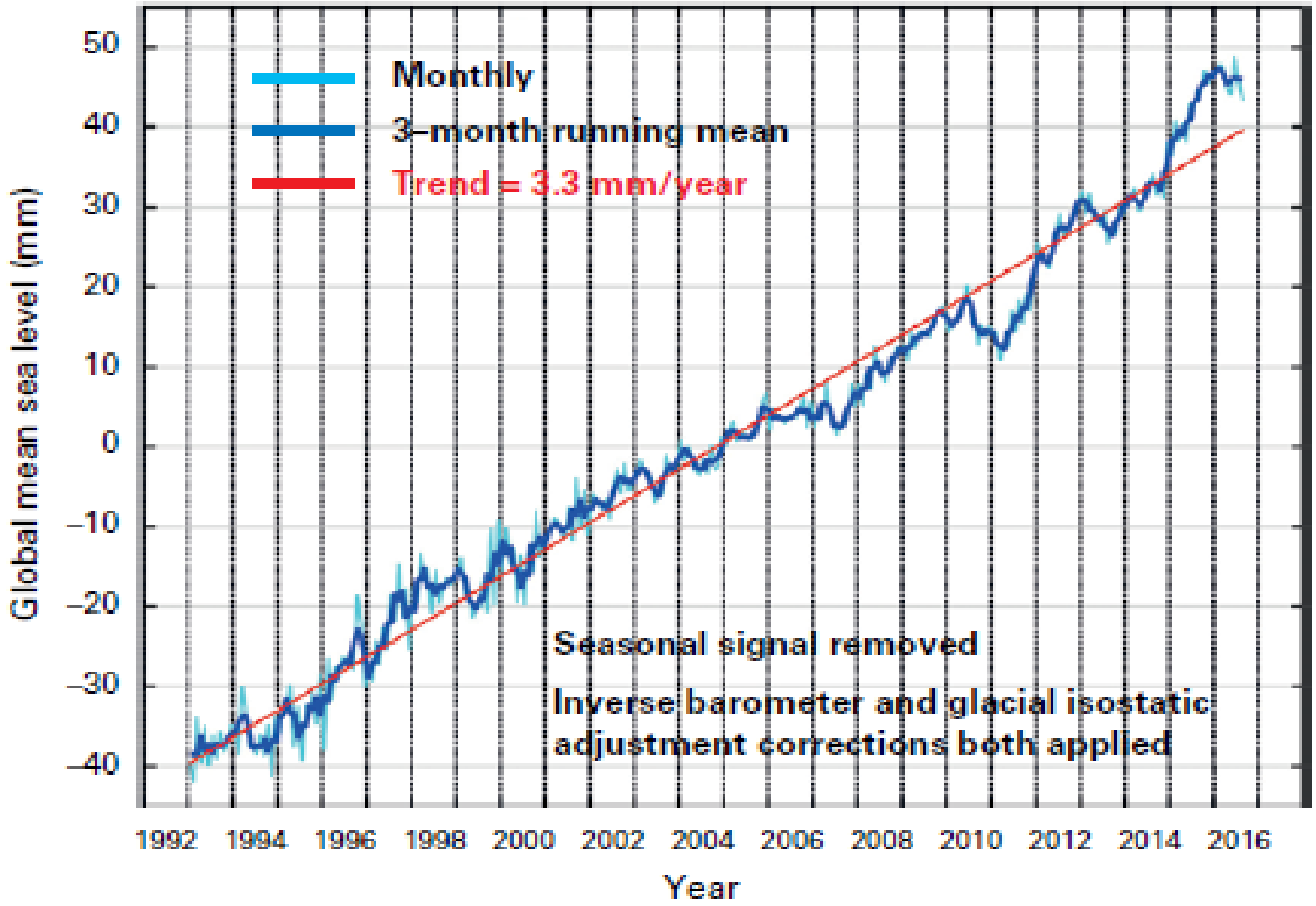
Temperature difference (°C) in 2016 as compared to 1961-1990. Ref.: UK Met Office

Heat content of the oceans



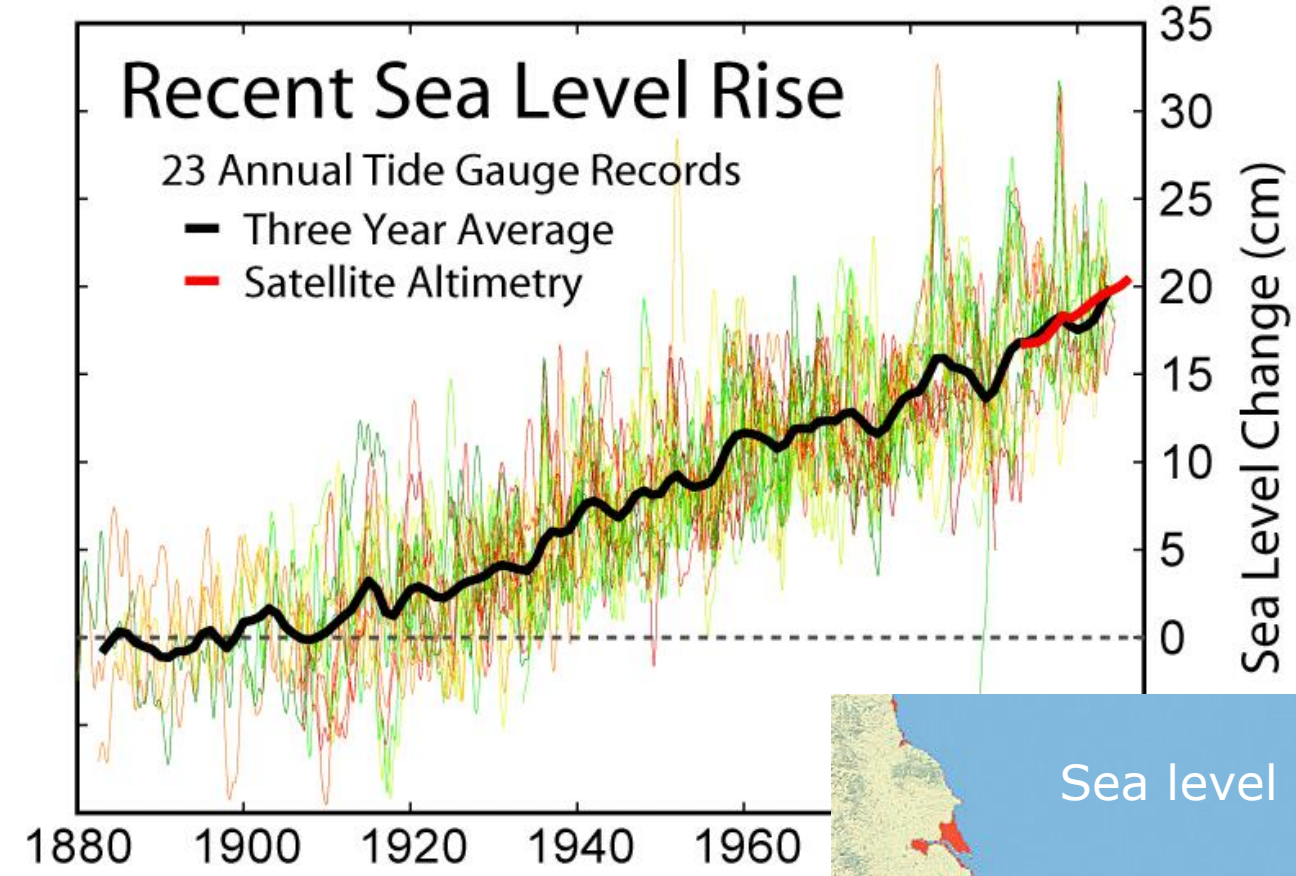
Total global heat content for top 700 m layer compared to 1955-2006. Ref.: WMO

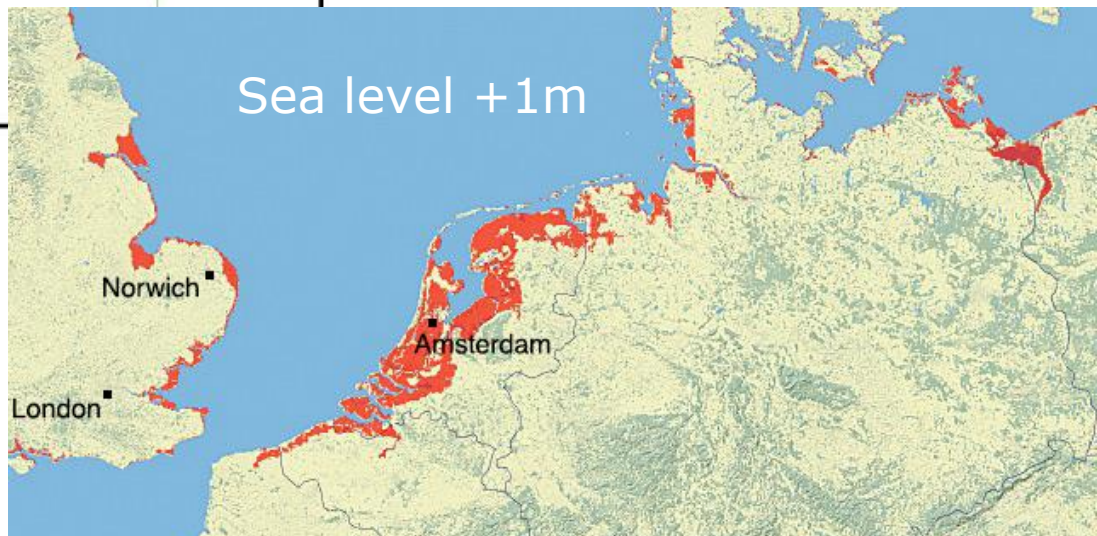
Global mean sea-level change 1993 - 2016



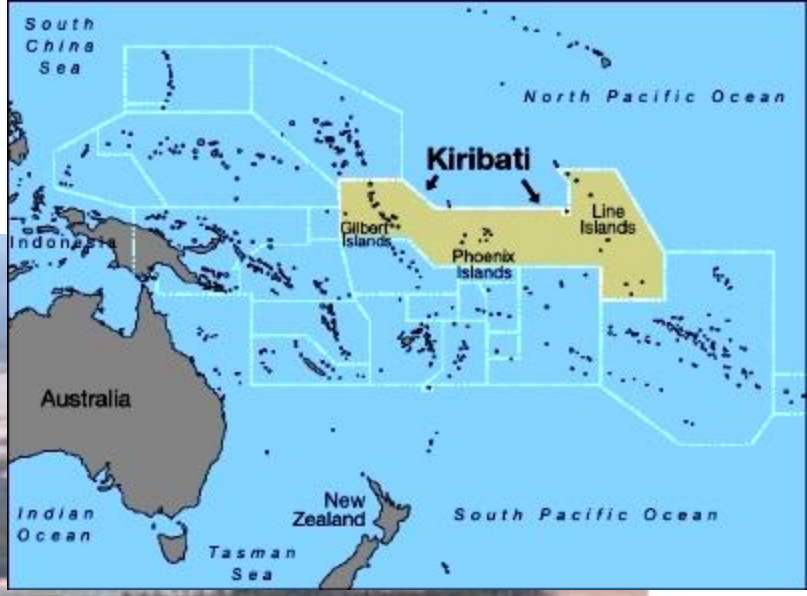
Corrected for annual cycle, Ref.: CS&IRO, Australia.

Effect sea level rise in North Sea countries





Tarawa island, Kiribati

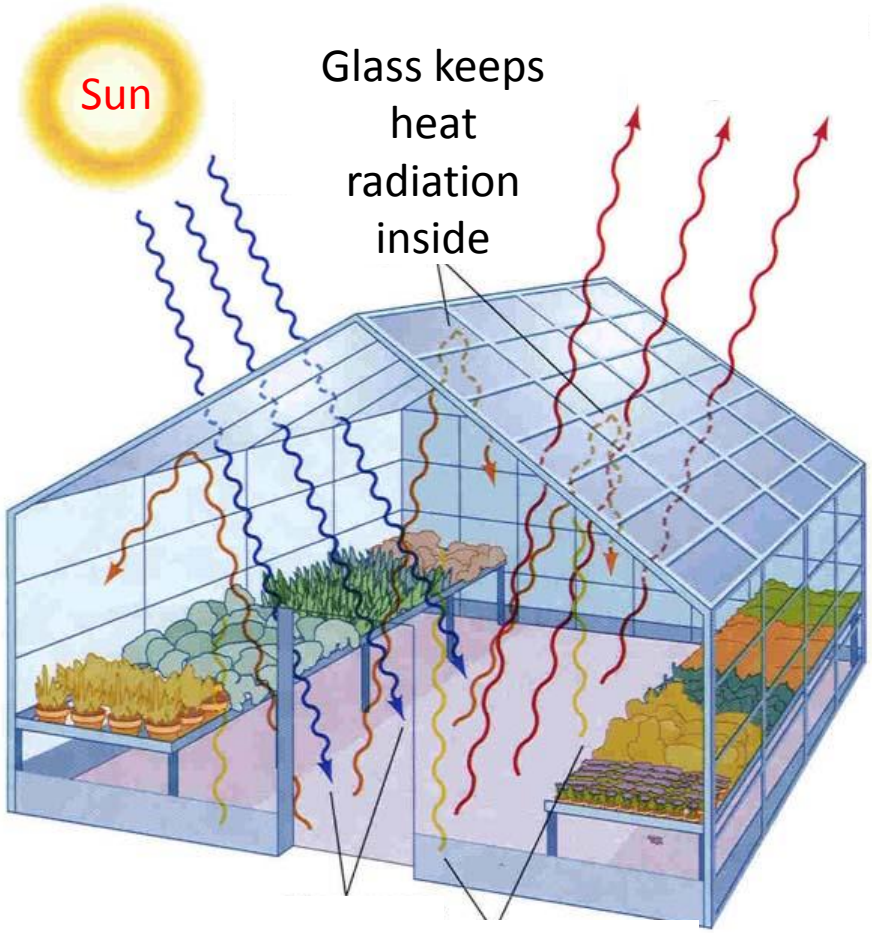


TARAWA, KIRIBATI

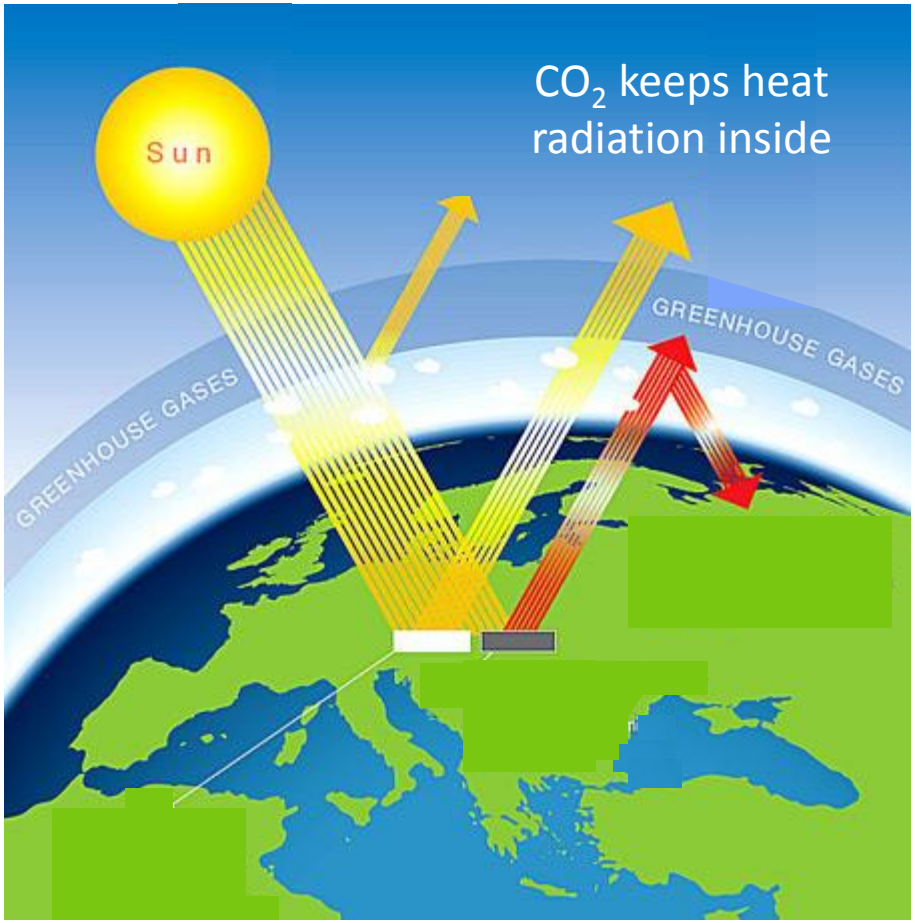
With surrounding sea levels rising, it has been predicted that Kiribati will become uninhabitable in 30–60 years.

David Gray (Reuters)

Greenhouse effect

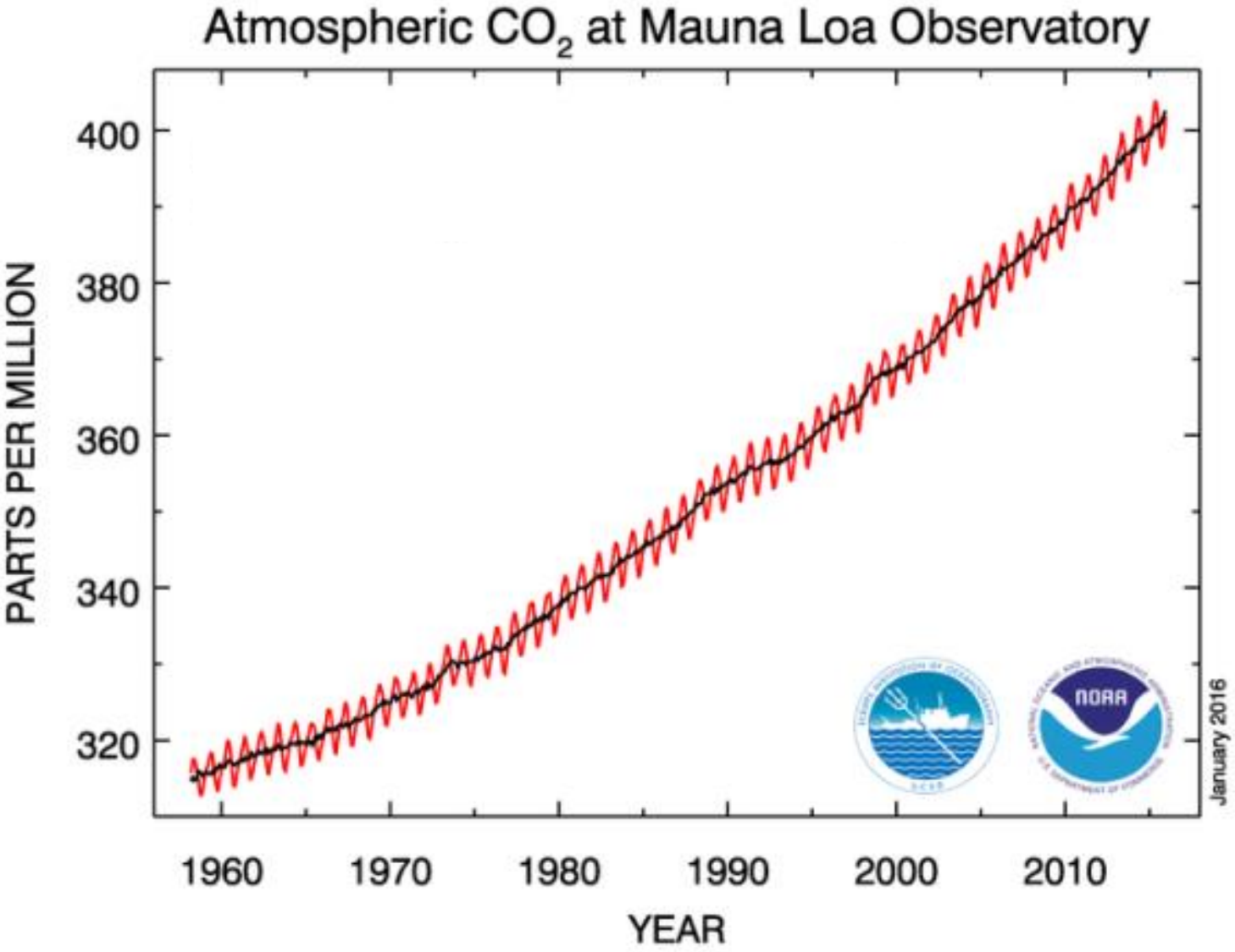


Sun warms floor, plants & air

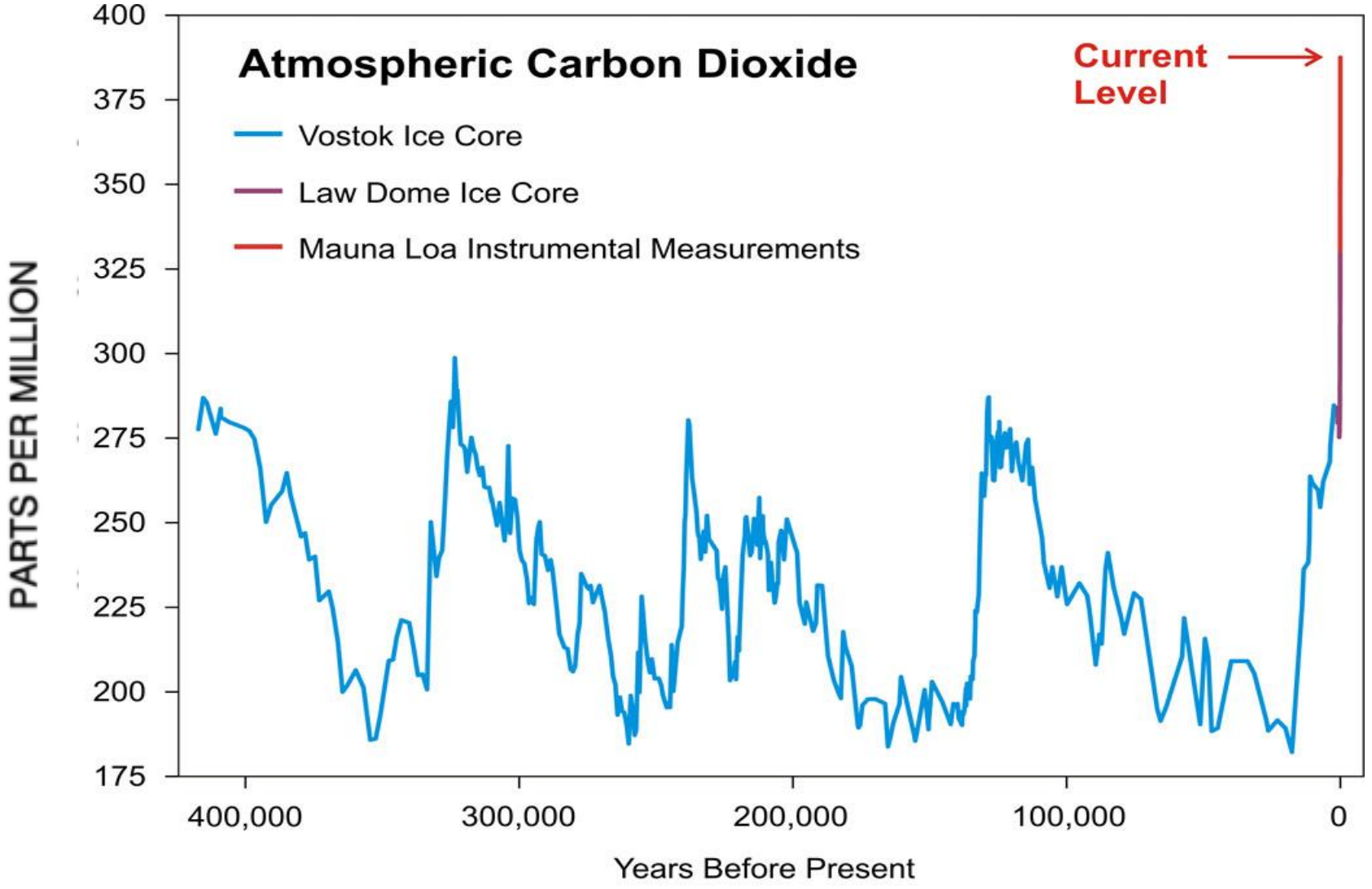


Sun warms land, sea & air

CO_2 concentration in atmosphere



CO_2 concentration in atmosphere

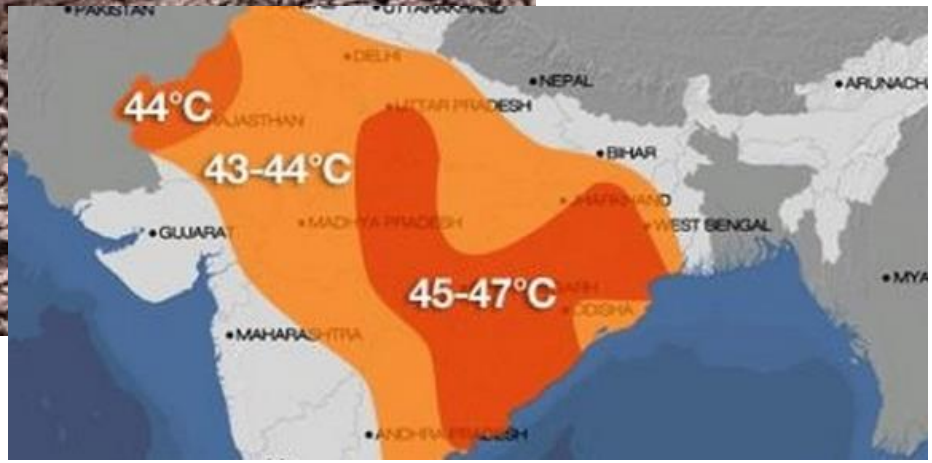


Scott Pruitt, EPA director Trump administration

(NOS.nl: donderdag 9 maart 2017)

Drought in California 2014

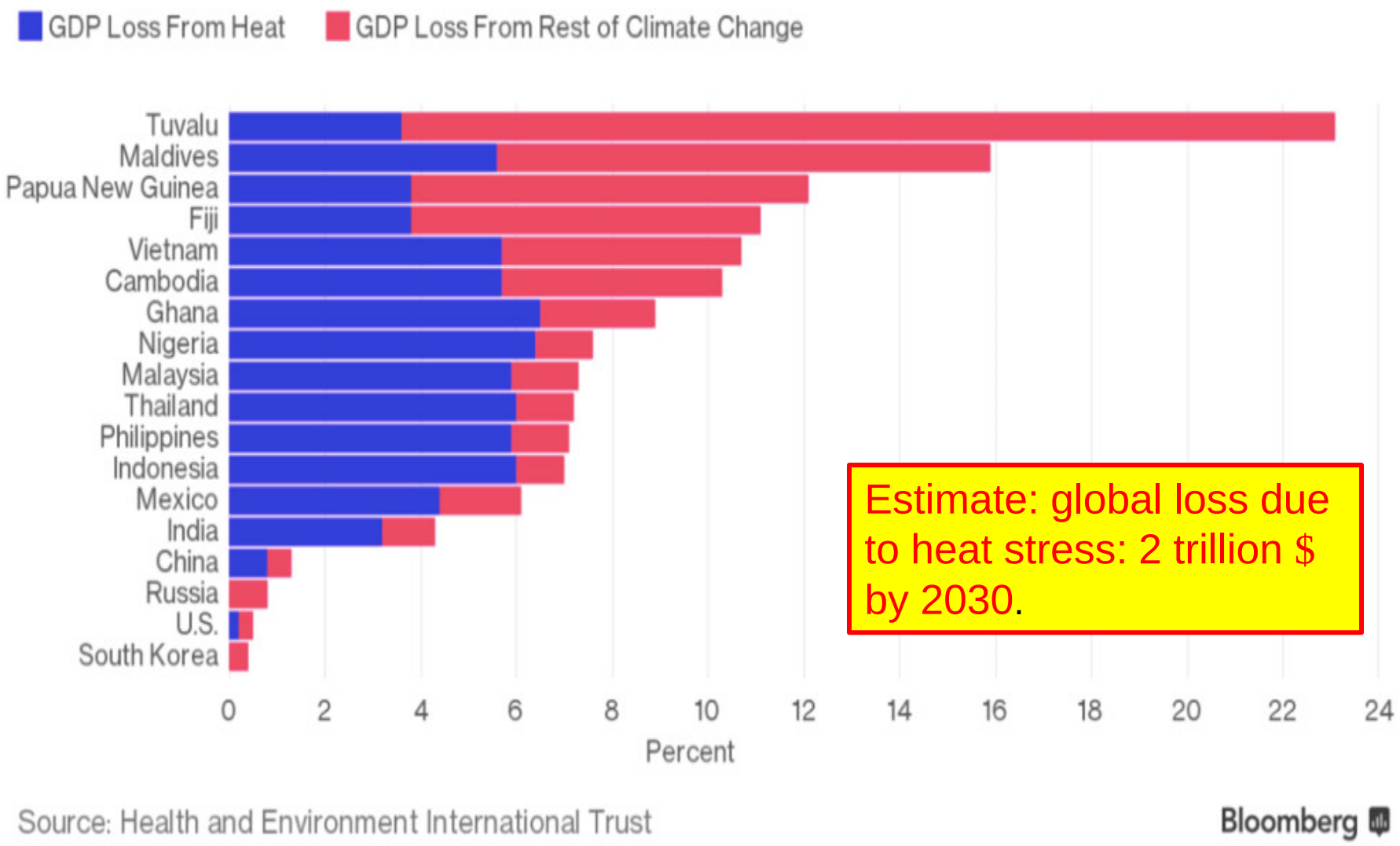
Heat wave in India 2015



Forest fires in Indonesia 2015

Floods in France 2016

Bloomberg's heat-loss chart 2016



Estimate: global loss due to heat stress: 2 trillion $ by 2030.

Chief of Defence of the Netherlands

dinsdag 6 december 2016 NIEUWS 7

INTERVIEW TOM MIDDENDORP

Klimaatverandering veroorzaakt oorlog en migratie en is een voedingsbodem voor terrorisme, zegt Tom Middendorp, Nederlands hoogste militair. „Trump moet dat ook horen."

'Klimaatverandering bron van burgeroorlog in Syrië'

Hanneke Keultjes

Toen generaal Tom Middendorp in 2007 in Afghanistan was, werd er hard gevochten om Chora. „We hebben de strijd gewonnen", klinkt het niet zonder trots, „maar daarmee was het probleem niet opgelost." Dat probleem bleek het schaarse water. Pas toen de Nederlandse militairen afspraken maakten met de bevolking over de ver-

En bij de oorlog in Syrië denken we aan president Assad, vatbommen, rebellengroepen en terreurgroep IS, maar niet aan de opwarming van de aarde. Maar dat is wél de bron van de desastreuze burgeroorlog die nu al vijf jaar duurt. Na jaren van extreme droogte mislukten oogsten. „Veel boeren verhuisden met hun familie naar steden en kwamen terecht in de arme buitenwijken. Daar is het conflict begonnen", weet Middendorp. „Ik zeg niet dat het één op één de oorzaak is, maar uit veel studies blijkt dat klimaatverandering er wel aan heeft

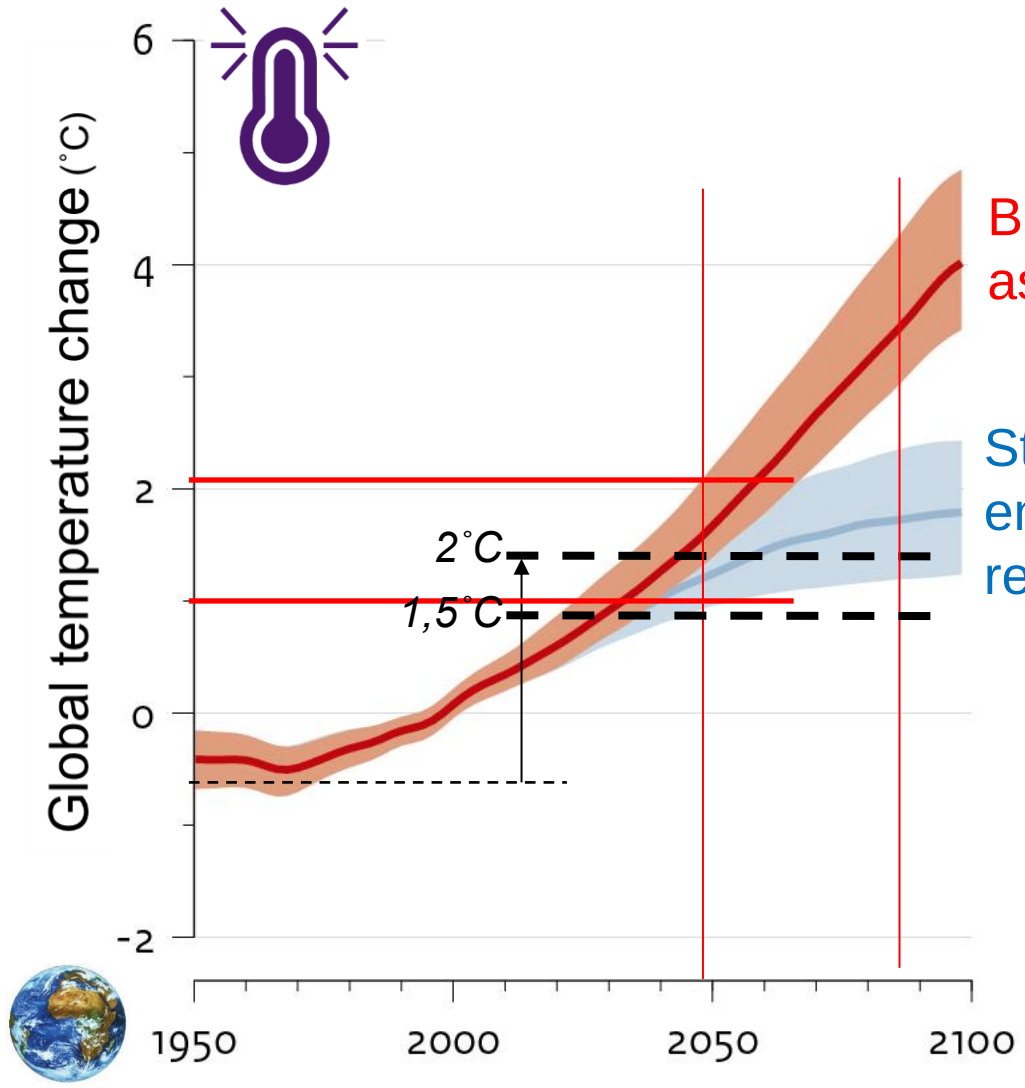
▲ Tom Middendorp: „Zonder klimaatveiligheid kan er geen veiligheid zijn." FOTO EVERT JANSNIELS

Want nieuwe conflictgebieden zijn al zichtbaar. „We zien al dertig jaar de gemiddelde temperatuur omhoog gaan. We zien de instabiliteit aan de randen van Europa toenemen", waarschuwt Middendorp.

„De woestijn rukt op in Noord-Afrika. Water wordt schaarser en dus wordt voedsel schaarser, maar er komen tegelijkertijd miljoenen mensen bij die moeten worden gevoed. Je ziet dat terroristen zich daar gaan vestigen; die maken gebruik van de onvrede bij de bevolking. Landen vallen uiteen.

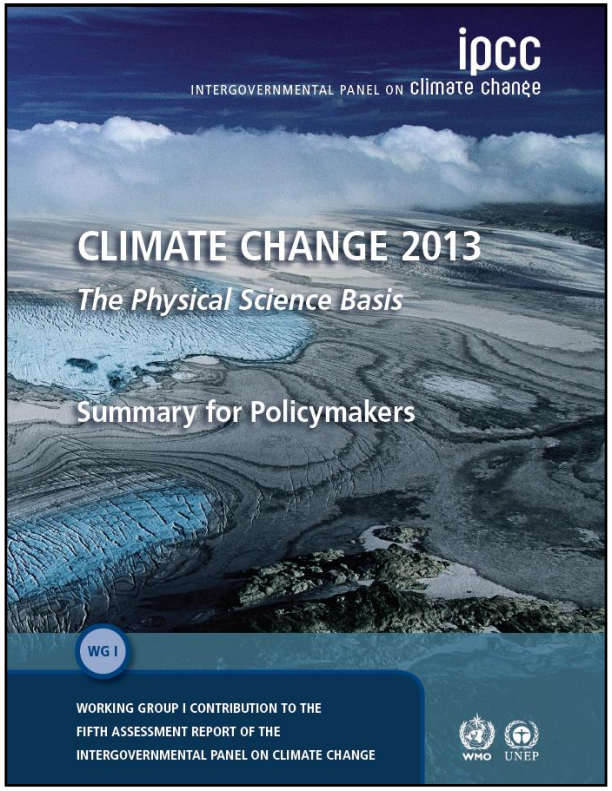
Ref. Colin P. Kelley et al., PNAS 112 (2015) 3241

Modelling globale temperature increase



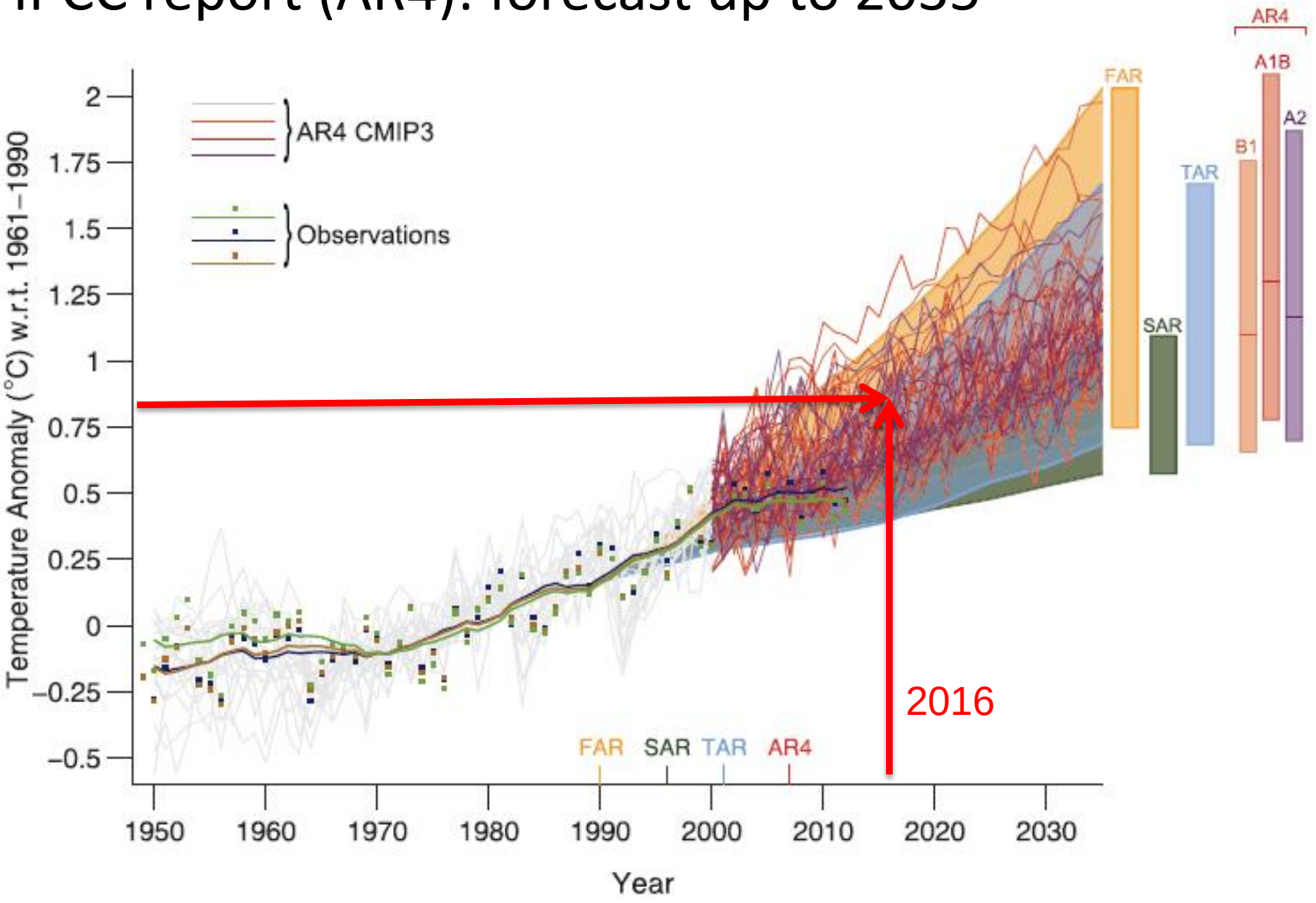
Business as-usual

Strong emission reduction



Quality of global climate models

2007 IPCC report (AR4): forecast up to 2035



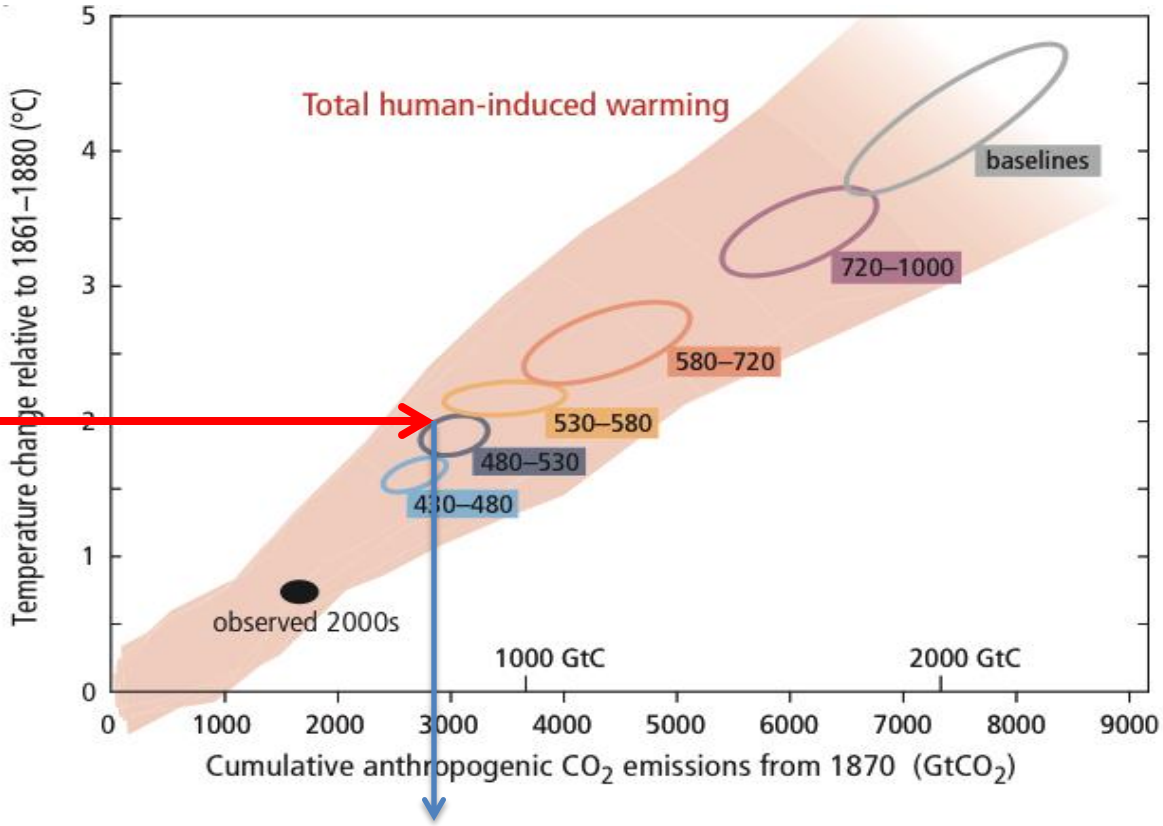
UN climate agreement in 2015: COP21

→ Paris 2015: limit ΔT_{global} to 1.5 - 2 °C

How much time is left?

1. Assume:

   ΔT_{global} = 2 °C



2. Maximum CO_2 emissions: 2900 $GtCO_2$
3. Emitted until now: 2000 $GtCO_2$

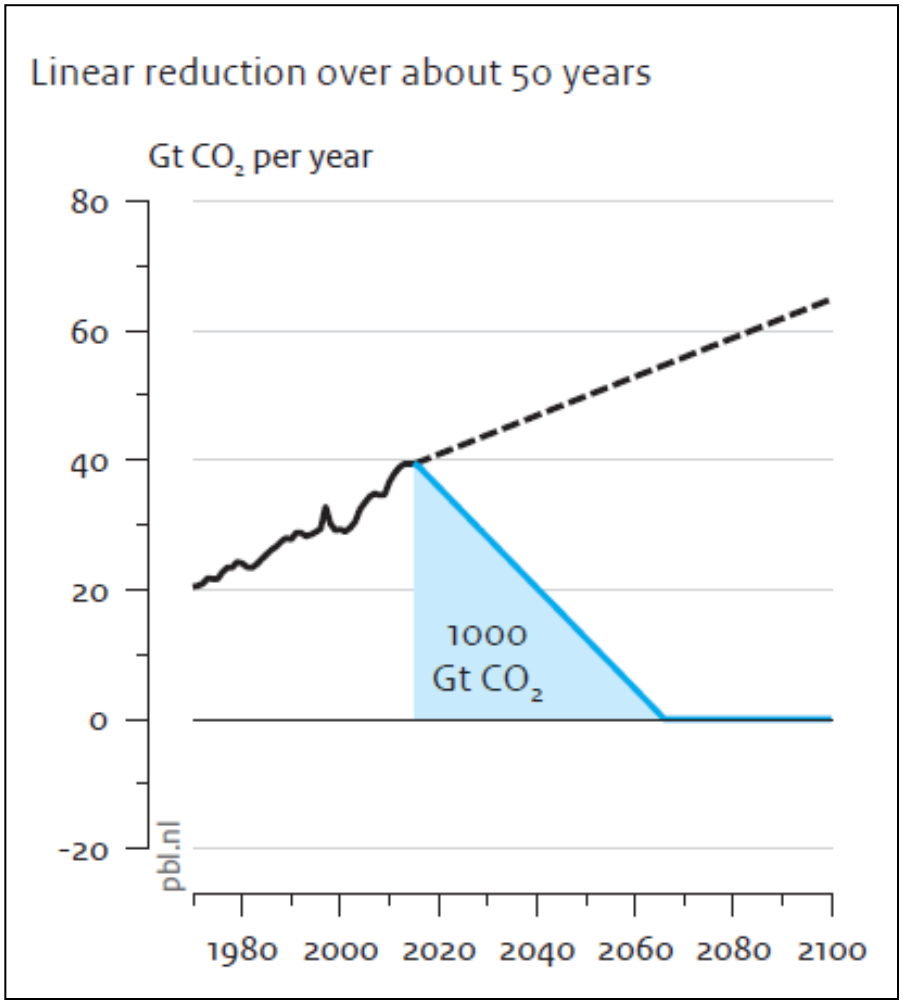
} 900 $GtCO_2$ left

4. With 50 $GtCO_2$/yr: we have (900/50 =) **18 years → 2035**

How much time is left?

Assume a linear reduction of CO_2 emissions: factor 2 →

Society must be CO_2-neutral in **2050**



What needs to be done?

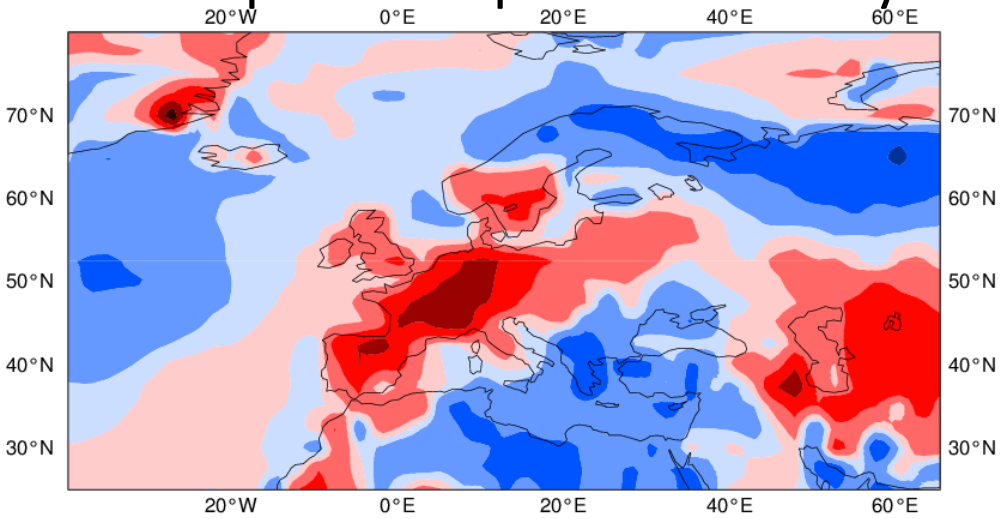
- Policy measures: reduce CO_2 emissions, adapt infrastructure
- Research & Development: improve forecasts & warnings
- Societal change: create climate awareness

ECMWF: 2-week forecast high-impact weather

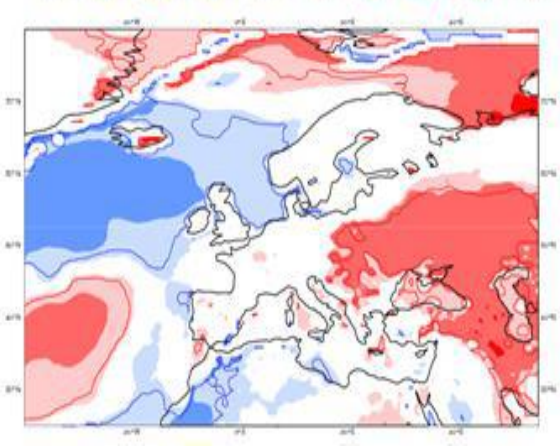
Summer heat wave

29 June – 5 July 2015

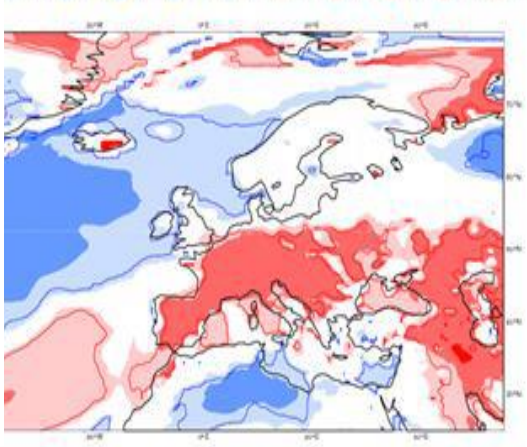
European temperatures 2 July



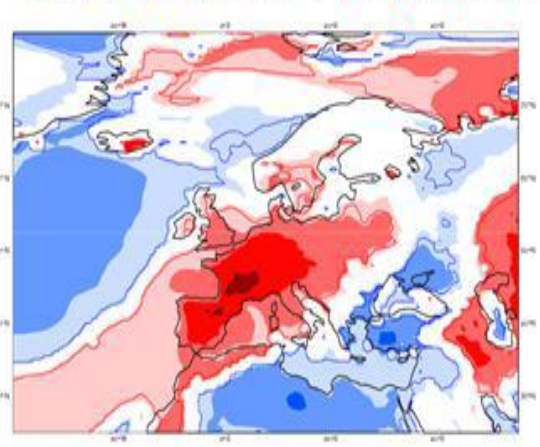
Forecast of 15 June



Forecast of 18 June



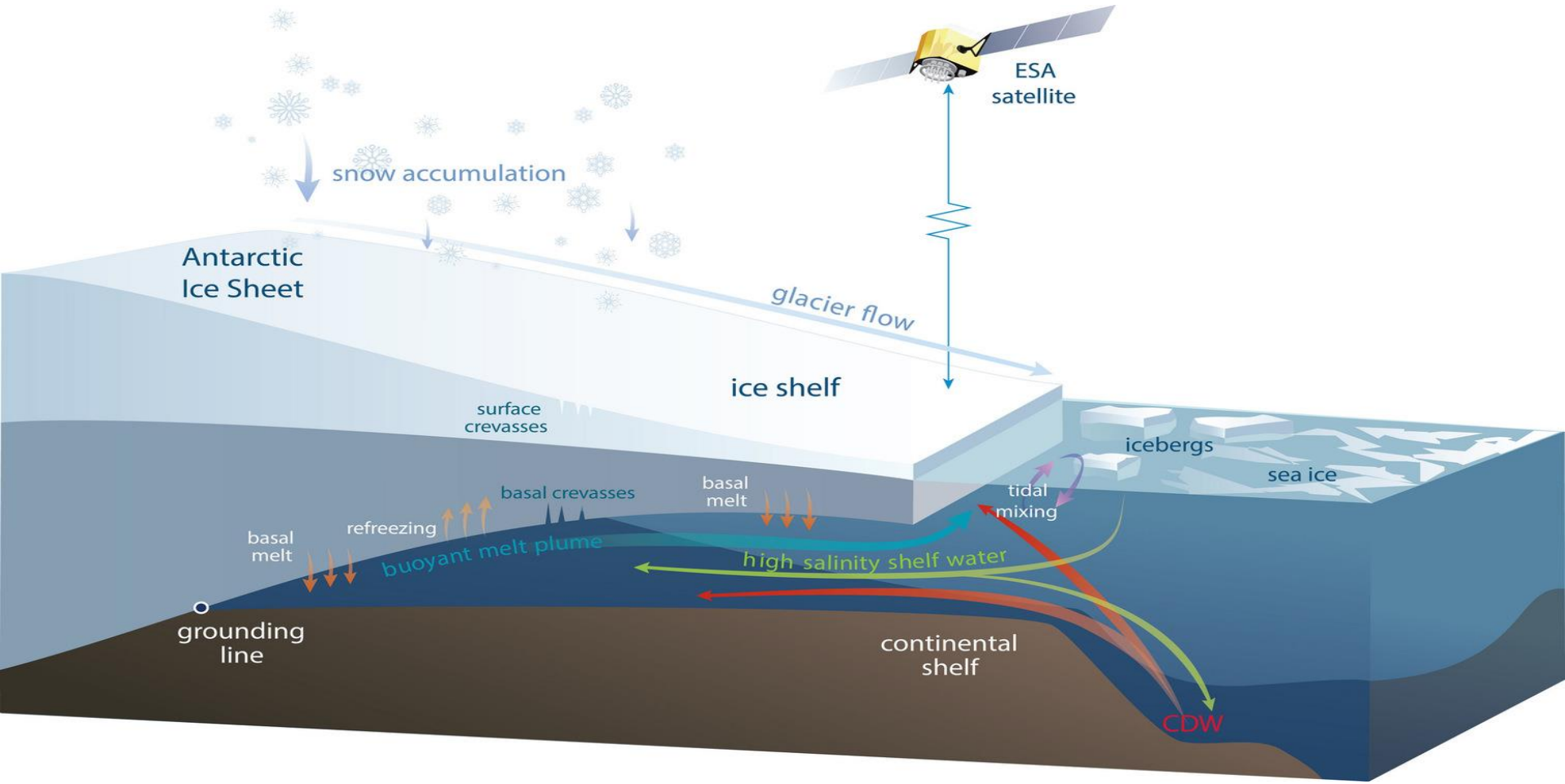
Forecast of 22 June



See-level rise in 2100

Le Bars et al. (KNMI) : new mechanism for ice shelf melt

$\longrightarrow +$ 3m sea-level rise in 2100



Conclusions

1. Climate change (CC) poses risk of worldwide disruptions
2. Compelling evidence: CC caused by increased CO_2 levels
3. Call for CO_2 reductions & changes in infrastructure
4. Call for climate research & sustainable technology R&D

→ ©APS 2015

For NNV and physics community at large:

– *Take your responsibility & follow APS example*

(Like politicians did in Paris, like VNO-NCW did, etc.)

APS statements on climate change

On Climate Change:
Earth's changing climate is a critical issue and poses the risk of significant environmental, social and economic disruptions around the globe. While natural sources of climate variability are significant, multiple lines of evidence indicate that human influences have had an increasingly dominant effect on global climate warming observed since the mid-twentieth century. Although the magnitudes of future effects are uncertain, human influences on the climate are growing. The potential consequences of climate change are great and the actions taken over the next few decades will determine human influences on the climate for centuries.

On Climate Science:
As summarized in the 2013 report of the Intergovernmental Panel on Climate Change (IPCC), there continues to be significant progress in climate science. In particular, the connection between rising concentrations of atmospheric greenhouse gases and the increased warming of the global climate system is more compelling than ever. Nevertheless, as recognized by Working Group 1 of the IPCC, scientific challenges remain in our abilities to observe, interpret, and project climate changes. To better inform societal choices, the APS urges sustained research in climate science.

On Climate Action:
The APS reiterates its 2007 call to support actions that will reduce the emissions, and ultimately the con-centration, of greenhouse gases as well as increase the resilience of society to a changing climate, and to support research on technologies that could reduce the climate impact of human activities. Because physics and its techniques are fundamental elements of climate science, the APS further urges physicists to collaborate with colleagues across disciplines in climate research and to contribute to the public dialogue.