



Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Waterstaat

Code rood voor het klimaat?

CBS Green Deal workshop
14 maart 2023

Prof. dr. Maarten van Aalst
Hoofddirecteur KNMI



τάχ' ἄν τις εἰκὸς αὐτὸ τοῦτ' εἶναι λέγοι,
βροτοῖσι πολλὰ τυγχάνειν οὐκ εἰκότα.

Aristotle, *Poetics*

It is in the very nature of probability that improbable things will happen.

But maybe a lot of the “improbable” things that happen are not very improbable in the first place.



Parijs,
december 2015
UNFCCC COP21

**Nous trouverons toujours un moyen de vous secourir.
Mais nous préférierions éviter que cela n'arrive.**

Avec le changement climatique, les catastrophes naturelles seront
de plus en plus nombreuses. Tout comme les personnes à secourir.
Il est encore temps de changer les choses.

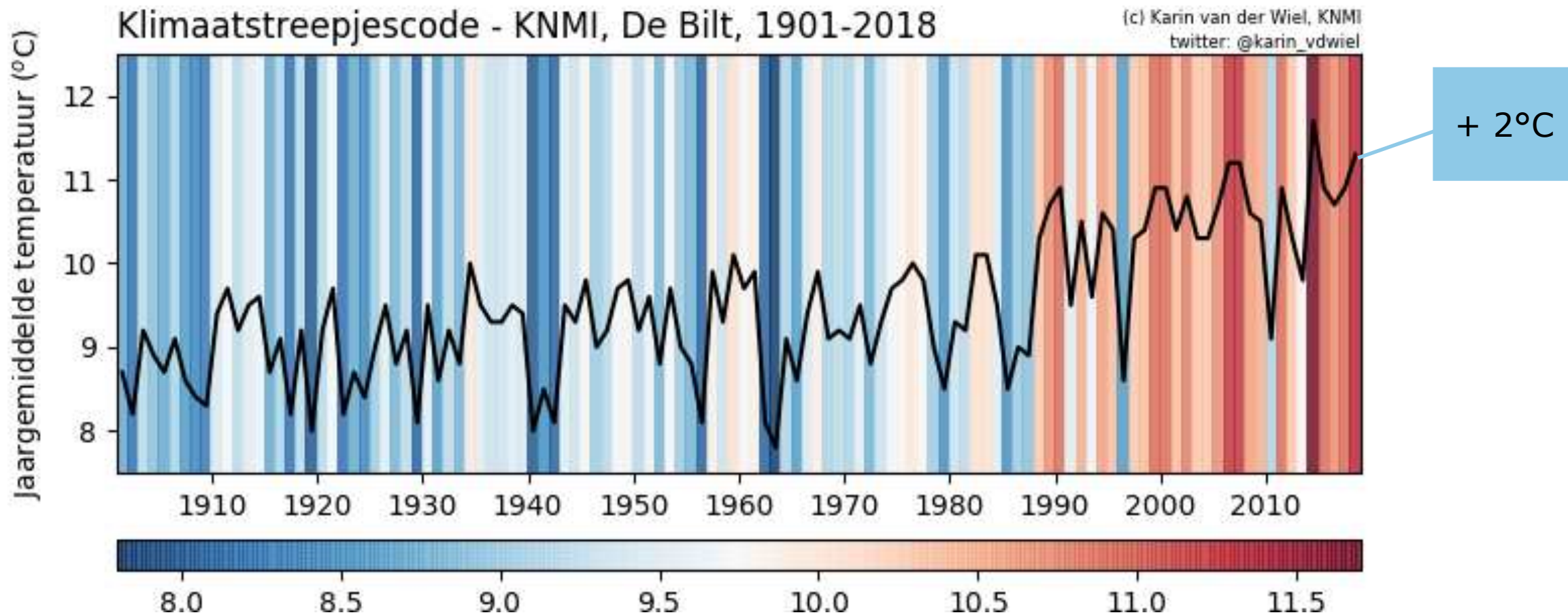




Parijs, juni 2016



Duidelijke trend: het is warmer geworden

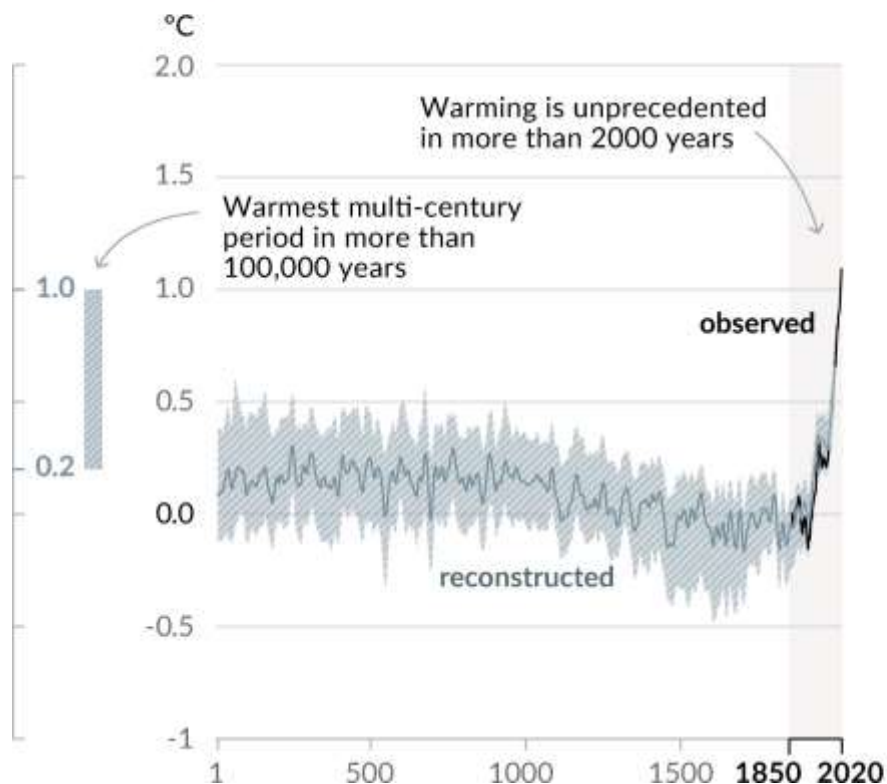




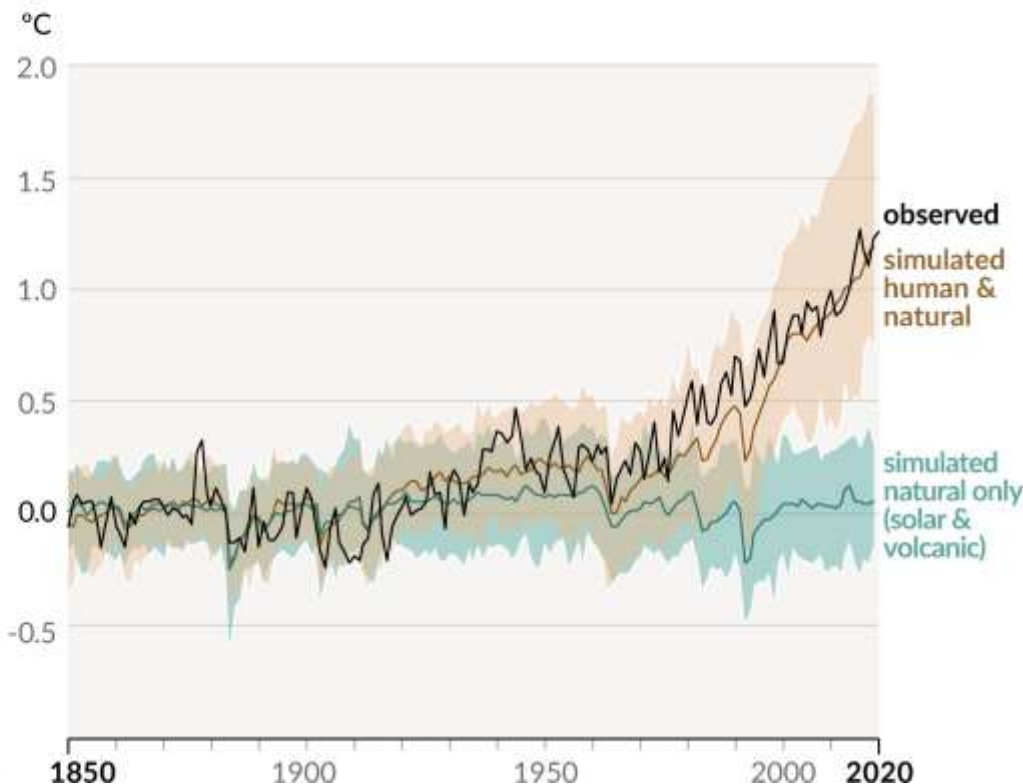
Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

Changes in global surface temperature relative to 1850-1900

a) Change in global surface temperature (decadal average) as reconstructed (1-2000) and observed (1850-2020)



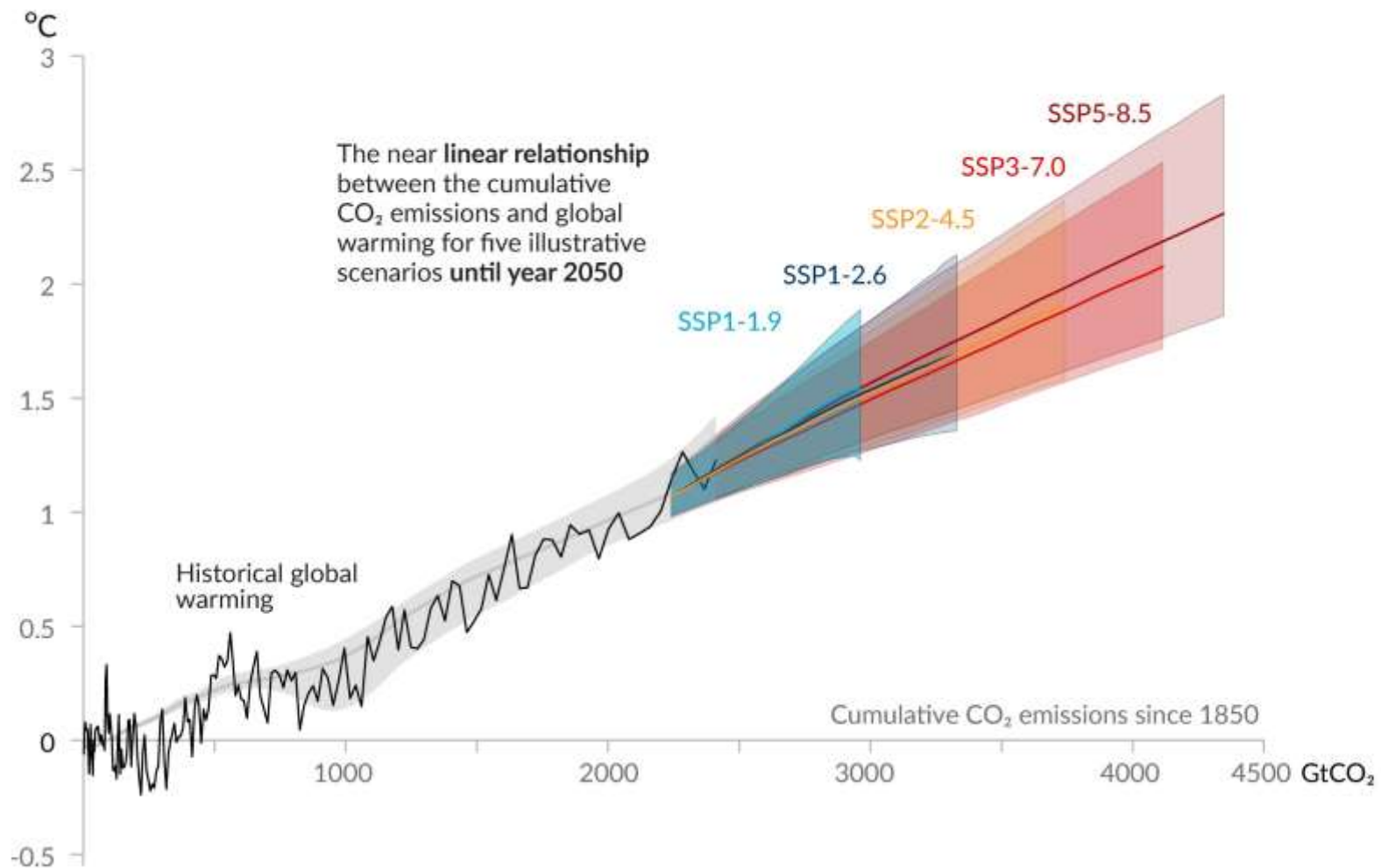
b) Change in global surface temperature (annual average) as observed and simulated using human & natural and only natural factors (both 1850-2020)





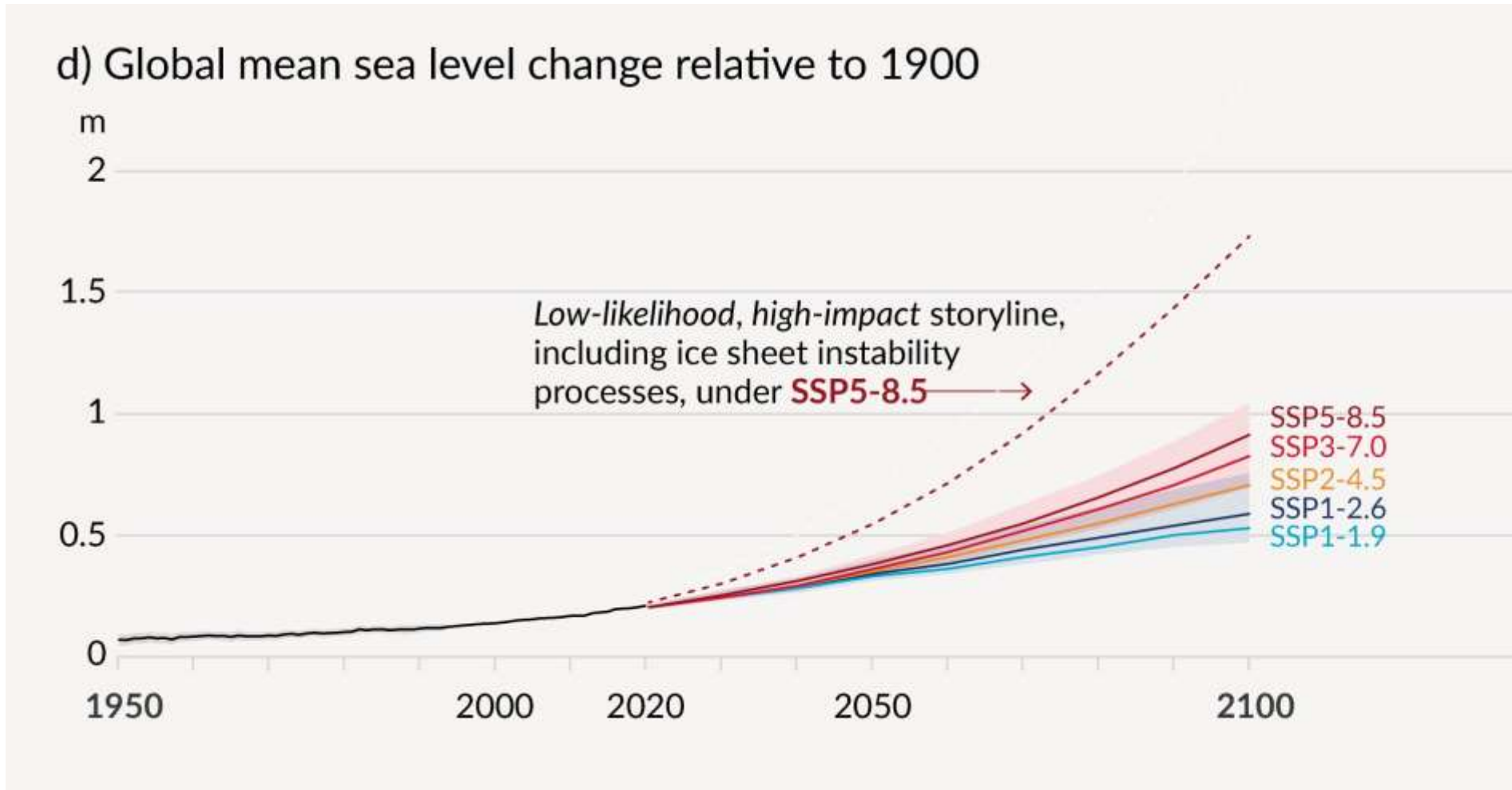
Every tonne of CO₂ emissions adds to global warming

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO₂ emissions (GtCO₂)





Human activities affect all the major climate system components, with some responding over decades and others over centuries





Is dat het hele
verhaal?

Waar zitten de
risico's?

- 1 Meer **extremen**
- 2 Meer **verrassingen**
(mede door **complexe
risico's**)
- 3 “**Limits to adaptation**”
- 4 **Onze respons kan
risico's versterken**



Fig. 1.1.22. Banen der verschillende druksystemen

Eens maar nooit weer?

Maarten van Aalst

Herdenking Watersnoodramp, 1 februari 2023

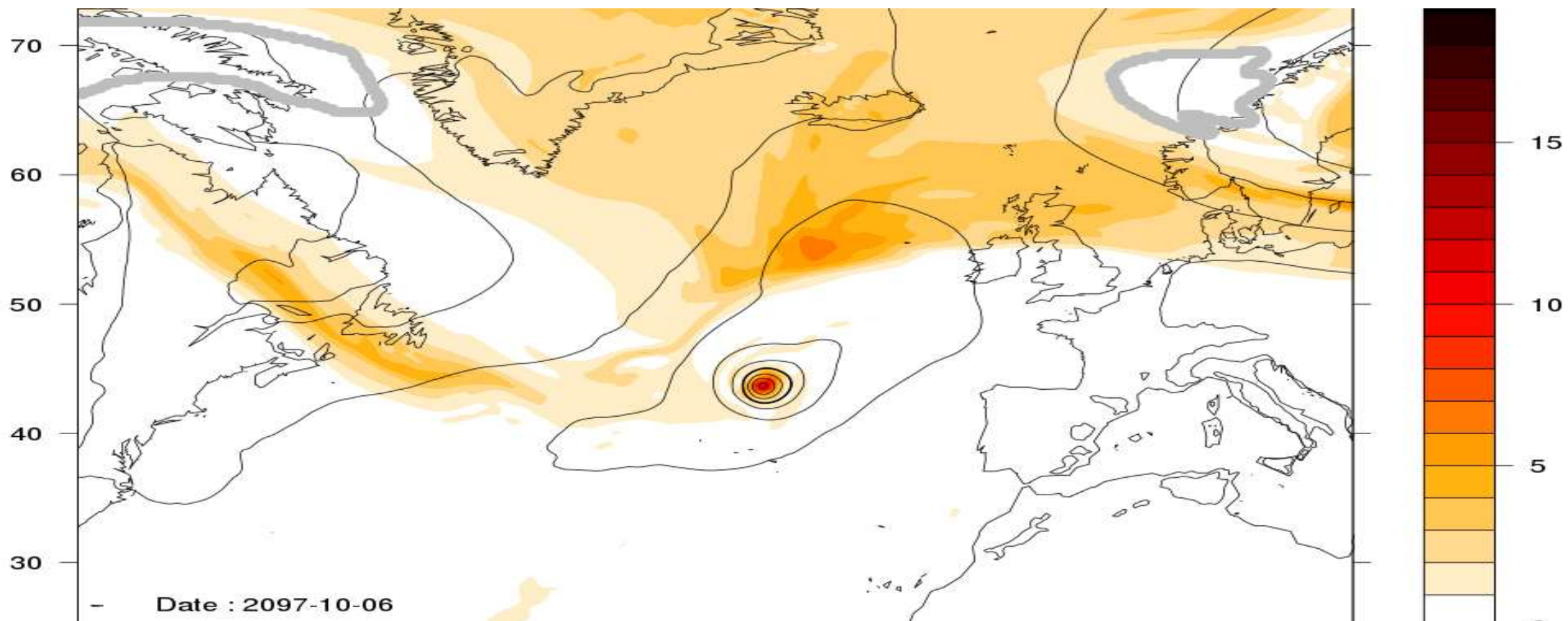


Storm Ophelia, oktober 2017





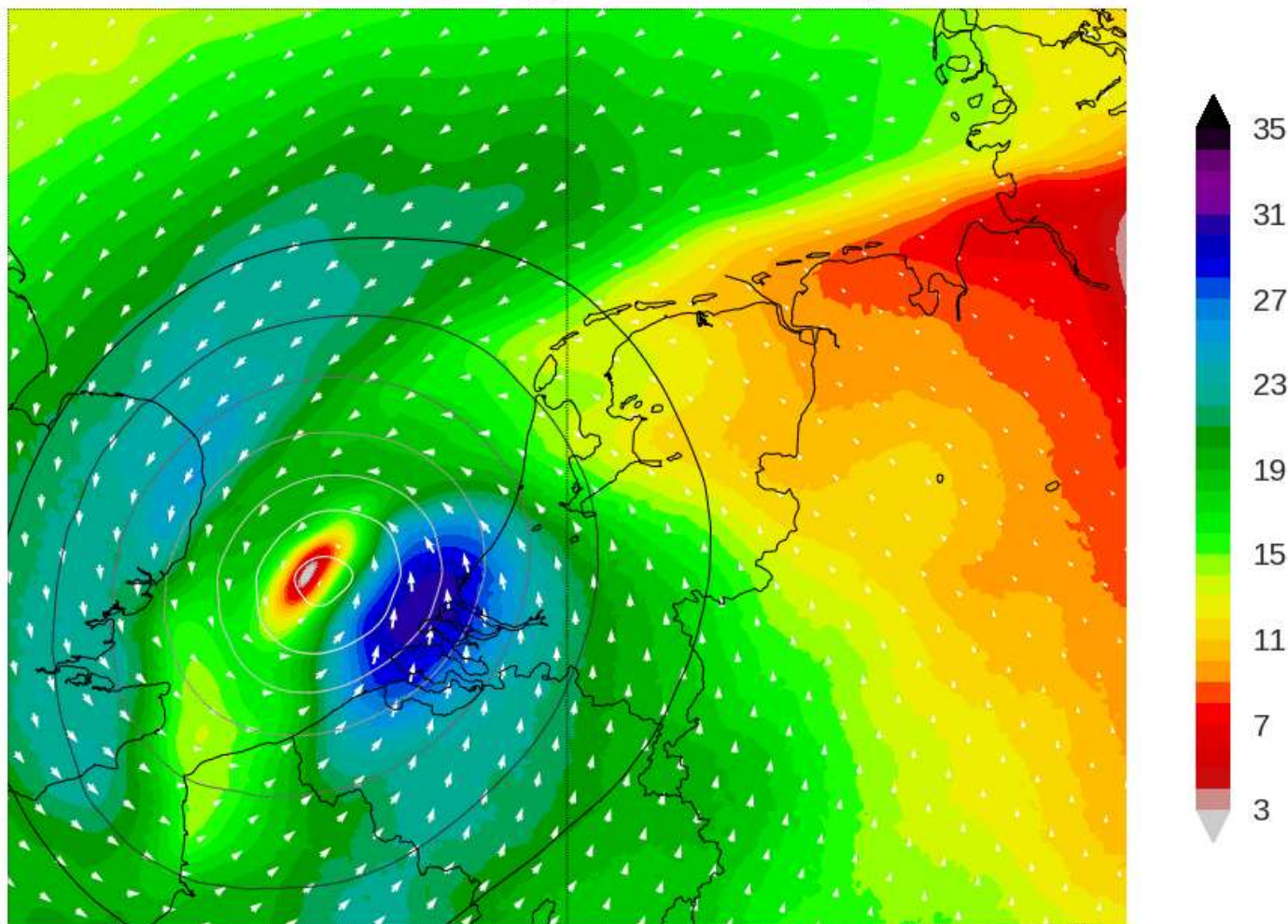
Toekomstig weer – oktober 2098





Storm Ophelia verschoven richting Nederland

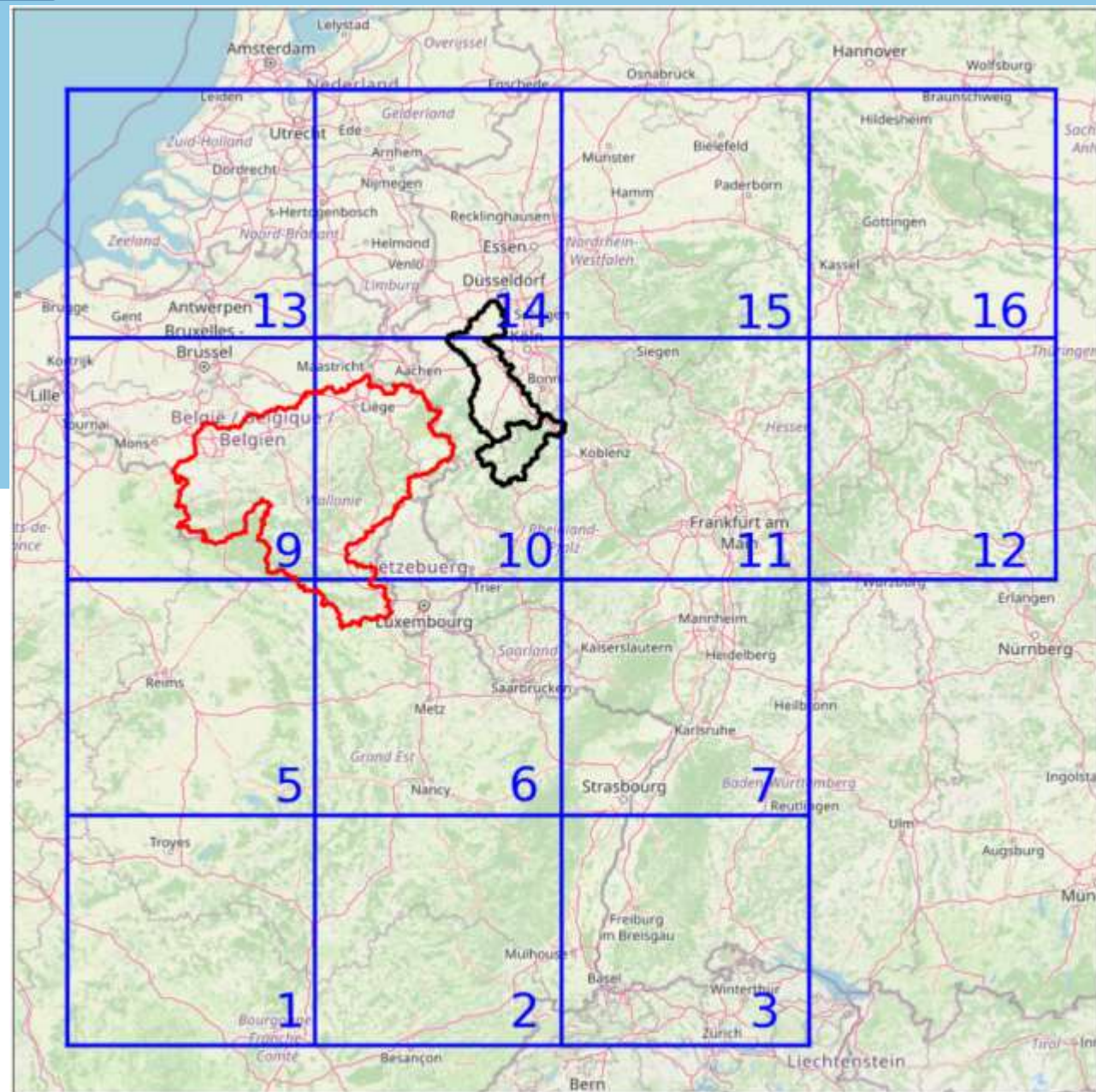
Wind speed (t=20171016-00)
HCLIM38h1_OPH_an2017101600_expb





Overstromingen juli 2021

- › Deze regenval is al 20-800% waarschijnlijker
- › Wat als het elders was gevallen?



NEWS | 06 July 2021

Climate change made North America's deadly heatwave 150 times more likely

Rising global temperatures probably contributed to a week of record-breaking heat in Canada and the United States.

Quinn Schiermeier



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NEWS

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Climate change: US-Canada heatwave 'virtually impossible' without warming

By Matt McGrath
Environment correspondent

6 July Comments



The scorching heat that scorched western Canada and the US at the end of June was "virtually impossible" without climate change, say scientists.

In their study, the team of researchers says that the deadly heatwave was a one-in-a-1,000-year event.



World Africa Americas Asia Australia China Europe India Middle East United Kingdom

Germany's deadly floods were up to 9 times more likely because of climate change, study estimates

By Angus Owen, CNN
Updated 06:00 GMT (07:00 HKT) August 24, 2021

Flooding in July straggled the main road leading through the Ahr river valley in Germany.

London (CNN) — Record rainfall that triggered deadly floods in Western Europe in July was made between 5.3 and 9 times more likely by human-caused climate change, according to a new study.

At least 220 people were killed between July 12 and 15 — mostly in Germany, though dozens also died in Belgium — and homes and other buildings were destroyed in flash flooding that followed heavy rainfall. Some parts of the region experienced more rain in a single day than they would typically expect in a whole month.

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Meet the 17-year-old business and 16-year-old entrepreneur.
The 82-year-old who can feel 5,000 orgasms a day while riding.
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The Seattle Times

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Prepare your body for the record heatwave
The Seattle Times
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Without climate change, record Pacific Northwest heat wave would have been near impossible, researchers say

July 8, 2021 at 3:00 pm | Updated July 7, 2021 at 5:47 am



A person uses an umbrella for shade while walking near Pike Place Market on June 29. (Ted S. Warren / AP)

In a First Study of Pakistan's Floods, Scientists See Climate Change at Work

A growing field called attribution science is helping researchers rapidly assess the links between global warming and weather disasters.



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Home

Menu Klimawandel Extremwetter: So hoch ist der Anteil des Klimawandels an der Flutkatastrophe

Schnellstudie zu Extremwetter

So hoch ist der Anteil des Klimawandels an der Flutkatastrophe

Das Hochwasser an der Ahr war mit hoher Wahrscheinlichkeit ein Klimawandel-Ereignis. Das bestätigen Forscher in einer ersten Schnellstudie. Sie räumen ein, dass der Trend eindeutig, aber die Unsicherheiten groß sind.

Von **Susanne Götz**
24.08.2021, 00:24 Uhr

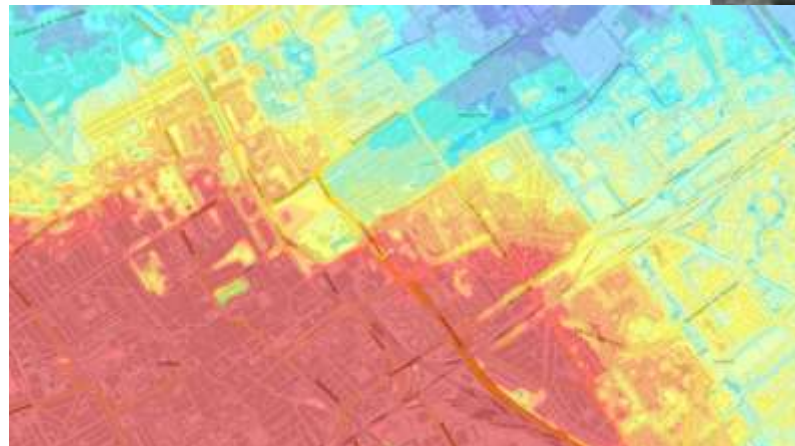




*Wat waren de drie dodelijkste
natuurrampen de afgelopen
eeuw in Nederland?*



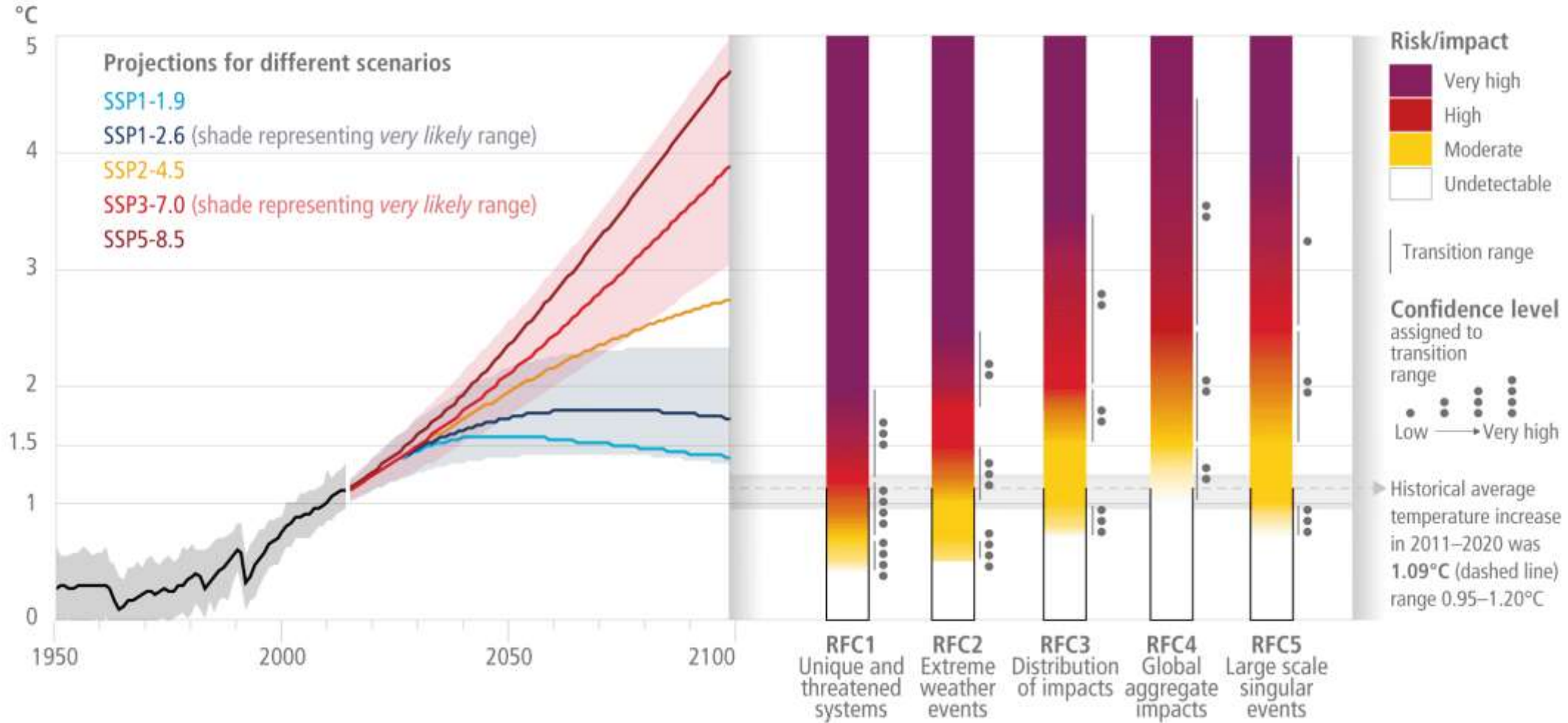
Hitte in Den Haag



Global and regional risks for increasing levels of global warming

(a) Global surface temperature change
Increase relative to the period 1850–1900

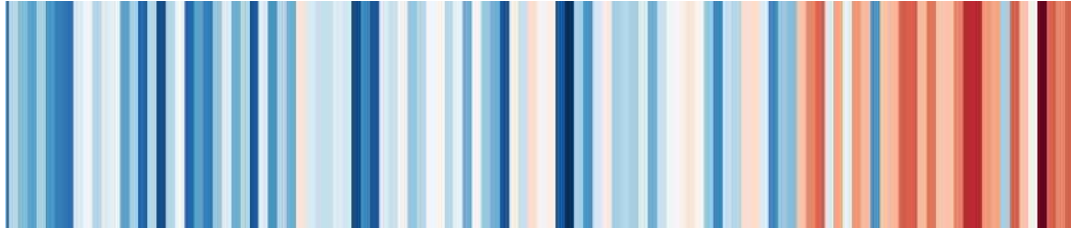
(b) Reasons for Concern (RFC)
Impact and risk assessments assuming low to no adaptation





Wat vraag dat?

- 1 Koppelen van korte en lange termijn
- 2 Inzicht in systemen
- 3 Communicatie en samenwerking



Klimaatverandering > Toename in frequentie en zwaarte van extreem weer

Visie



Wat?

Nauwkeurige, tijdige verwachtingen en waarschuwingen
Meer dan weer (geofysisch, multi-hazard)
Impact en handelingsperspectief

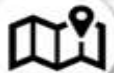
Hoe?

Verbeterde modellen, nieuwe IT-technieken
Internationale samenwerking
Samenwerking met partners zoals Rijkswaterstaat en RIVM

Doel

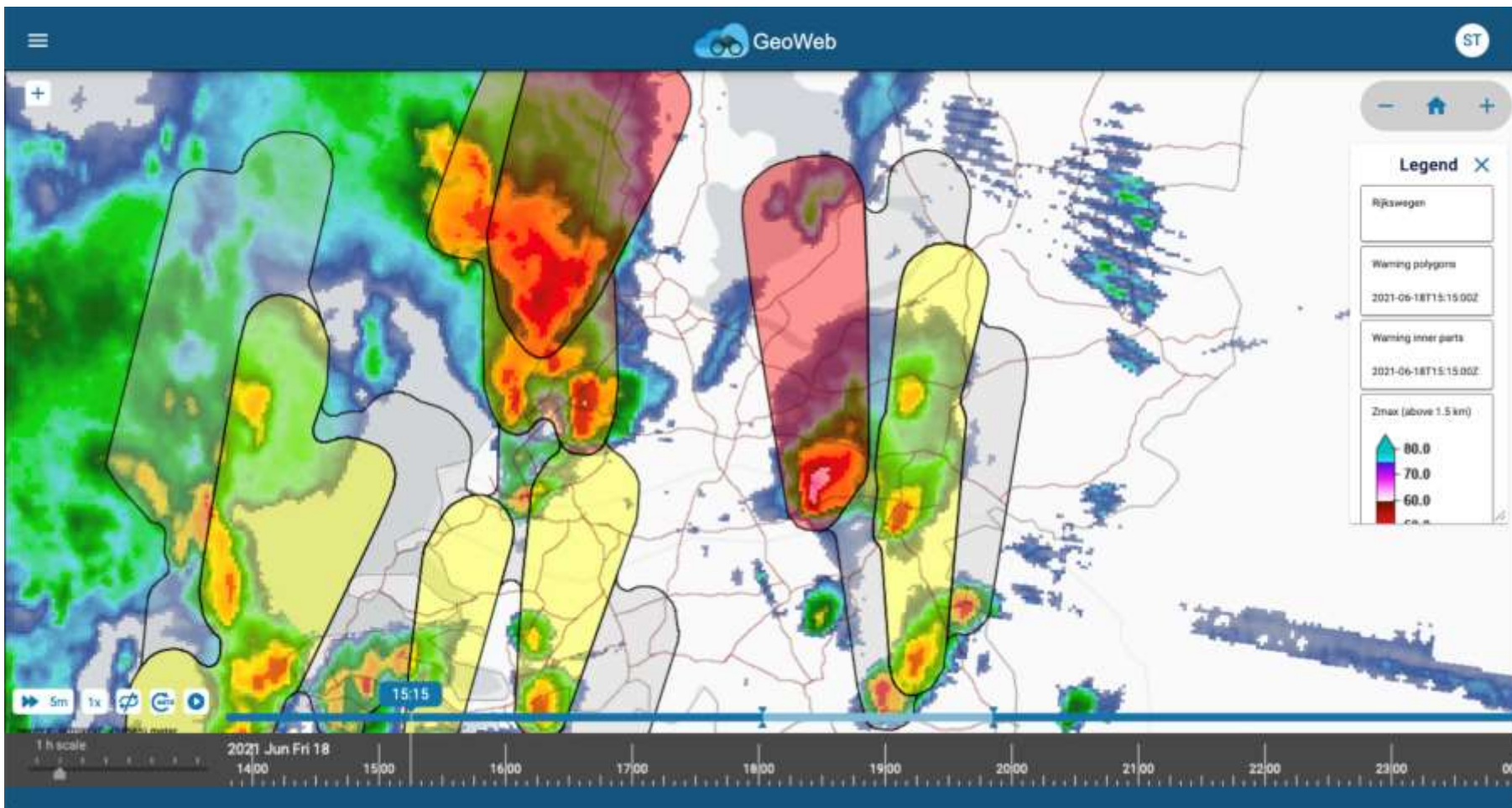
Vergroot veiligheid en voorkom schade.





Ruimtelijk gedetailleerder
Subregionale waarschuwingen

Postcode
App
Push





"Early", tijdig
Kansverwachtingen

Van 2 naar 7 dagen vooruit waarschuwen Maand/seizoenverwachtingen

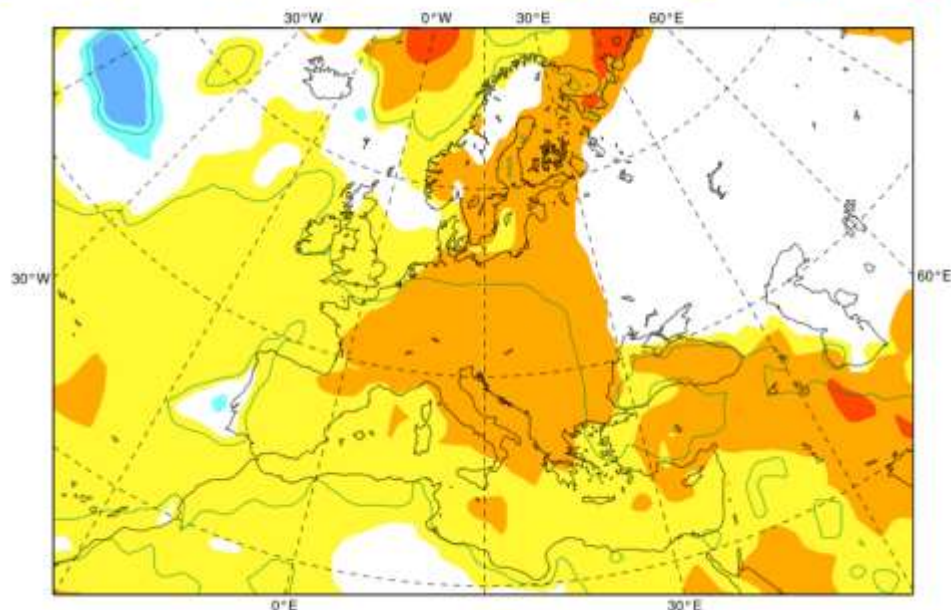
ECMWF Seasonal Forecast
Mean 2m temperature anomaly

Forecast start is 01/08/21, climate period is 1993-2016
Ensemble size = 51, climate size = 600

System 5
DJF 2021/22

Shaded areas significant at 10% level
Solid contour at 1% level

Legend for temperature anomalies: <math><-2.0^{\circ}\text{C}</math>, $-2.0..-1.0$, $-1.0..-0.5$, $-0.5..0$, No Signal, $0..0.5$, $0.5..1.0$, $1.0..2.0$, $>2.0^{\circ}\text{C}$



Vooruitzichten

Wisselvallig, met temperaturen rond normaal en eerst kans op winterse neerslag. In het weekend tijdelijk zachter en veel wind met grote kans op zware tot zeer zware windstoten

Warning

Wo	Do
26-02-2020	27-02-2020
Max. 6°	Max. 3/5°
Min. 1°	Min. 1°

Kans op gevaarlijk weer

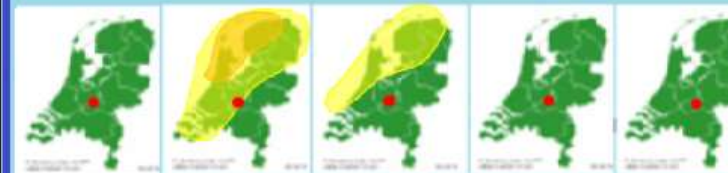


Warning toelichting

Donderdag in de vroege ochtend grote kans op bevroingsgladheid in Limurg

Early warning

Vr	Za	Zo	Ma	Di
28-02-2020	29-02-2020	01-03-2020	02-03-2020	03-03-2020
Max. 7/8°	Max. 10/13°	Max. 8/9°	Max. 7/9°	Max. 3/5°
Min. 1/2°	Min. 2/4°	Min. 3/4°	Min. 1/4°	Min. 1°



Early Warning toelichting meteoroloog

Komend weekend trekt storm Ciara via de Noordzee naar Denemarken. Hoe dit laag precies gaat trekken is nog onzeker. Er is hierdoor wel een grote kans op zware tot zeer zware windstoten met name in het noordwestelijk kustgebied

Delen via



Personalisering, op maat bedienen prof. gebruiker

Met inzet moderne communicatiemiddelen



Element: Windstoten



Drempel: 100 km/uur



Kans: >50%



Uitvoer: Tabel & grafiek



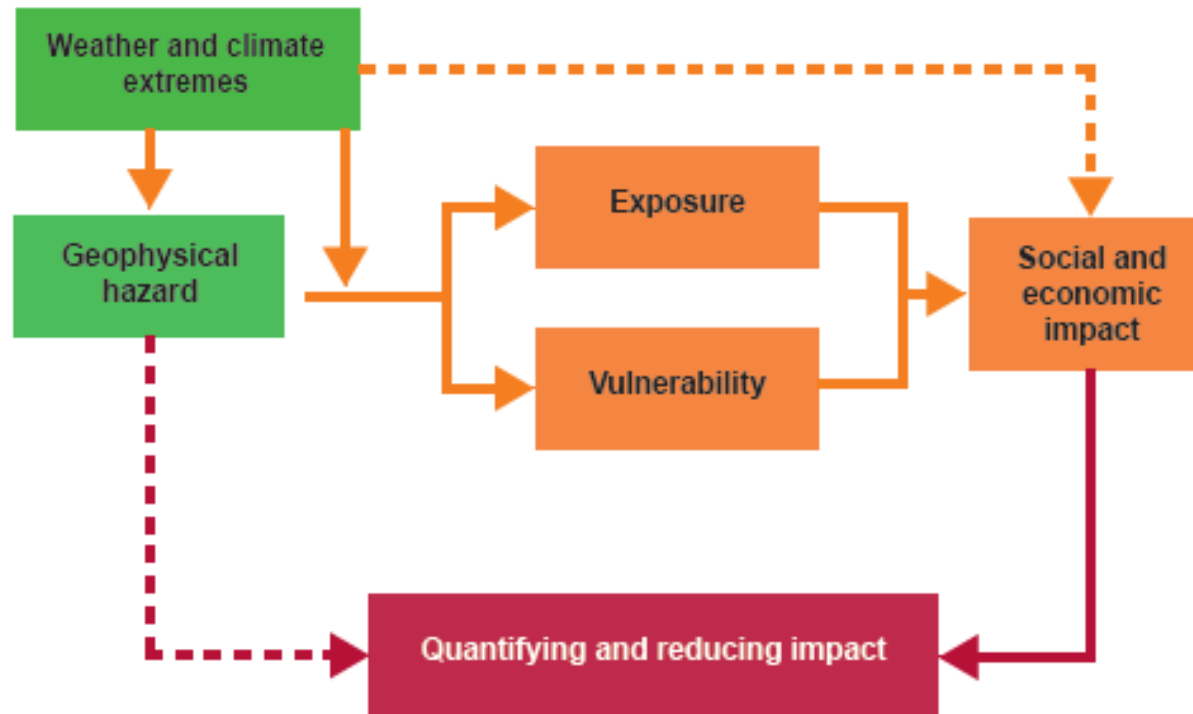


Impact en handelingsperspectief centraal



Adviserende rol meteoroloog

Ondersteund door geautomatiseerde processen/producten



“Not what the weather will be, but what the weather will do”

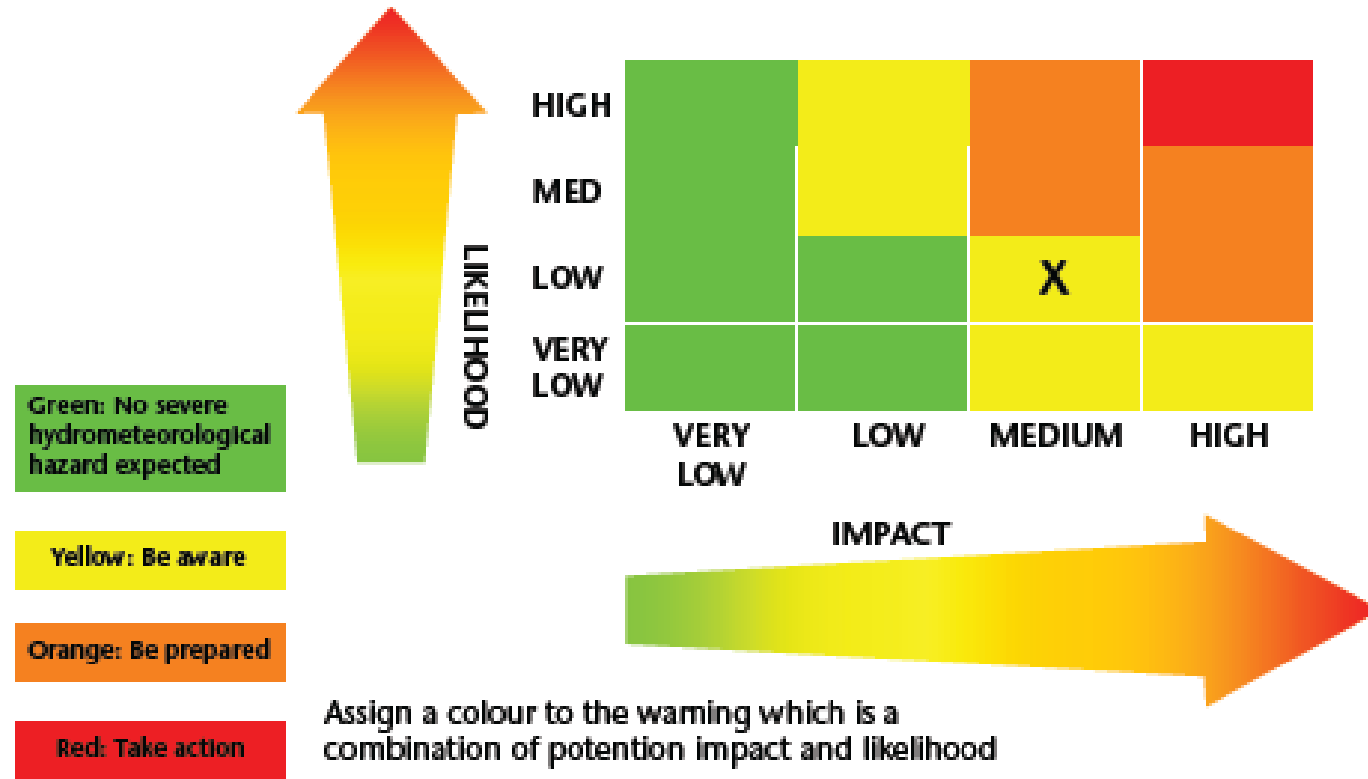


Impact en handelingsperspectief centraal



Adviserende rol meteoroloog

Ondersteund door geautomatiseerde processen/producten



(Source: Met Office, United Kingdom)

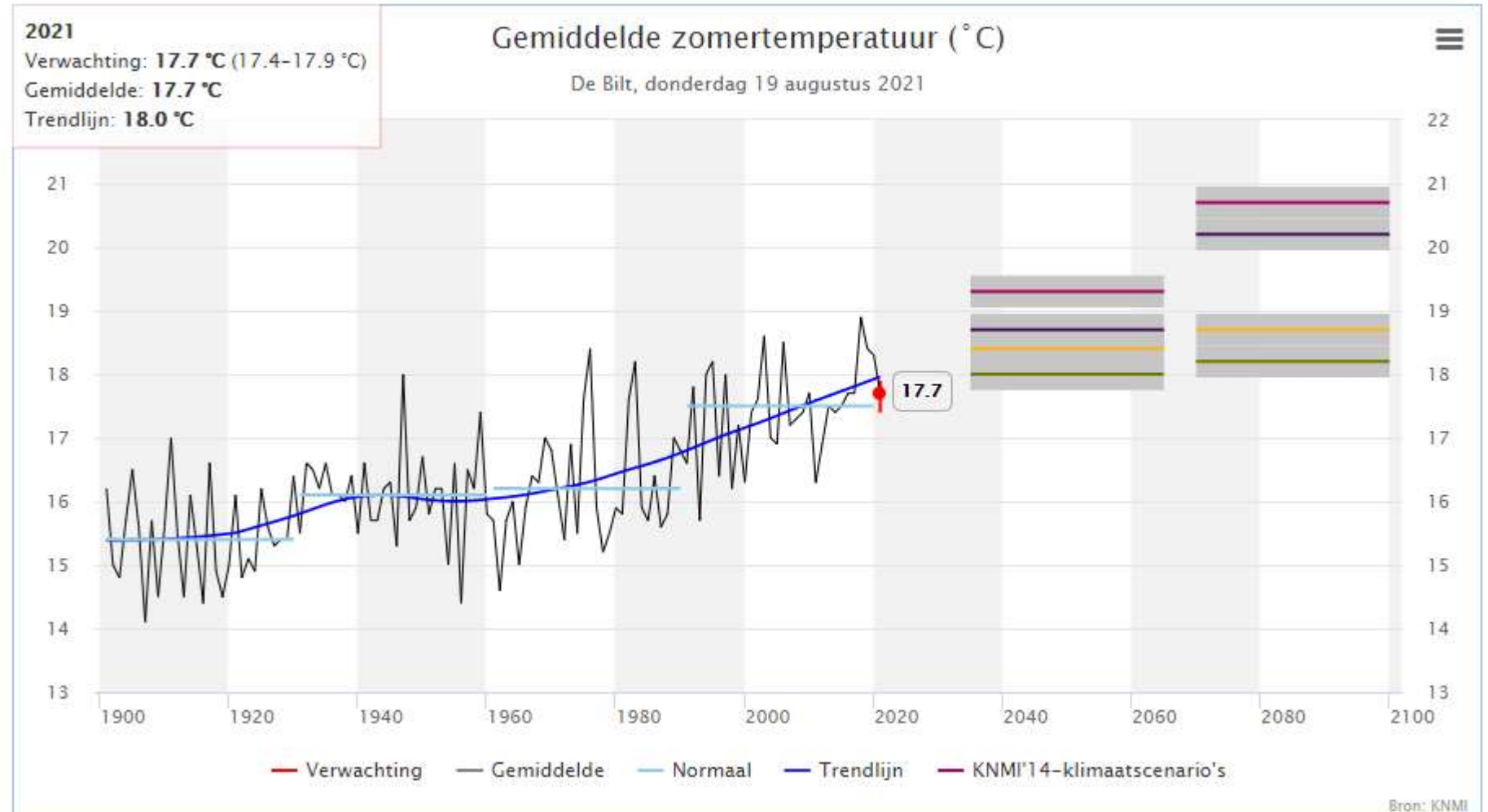
IenW DCC
Veiligheidsregio's
Waterschappen

“Not what the weather will be, but what the weather will do”

Klimaat



Klimaatattributie
Klimaatscenario's
Klimaatmonitoring

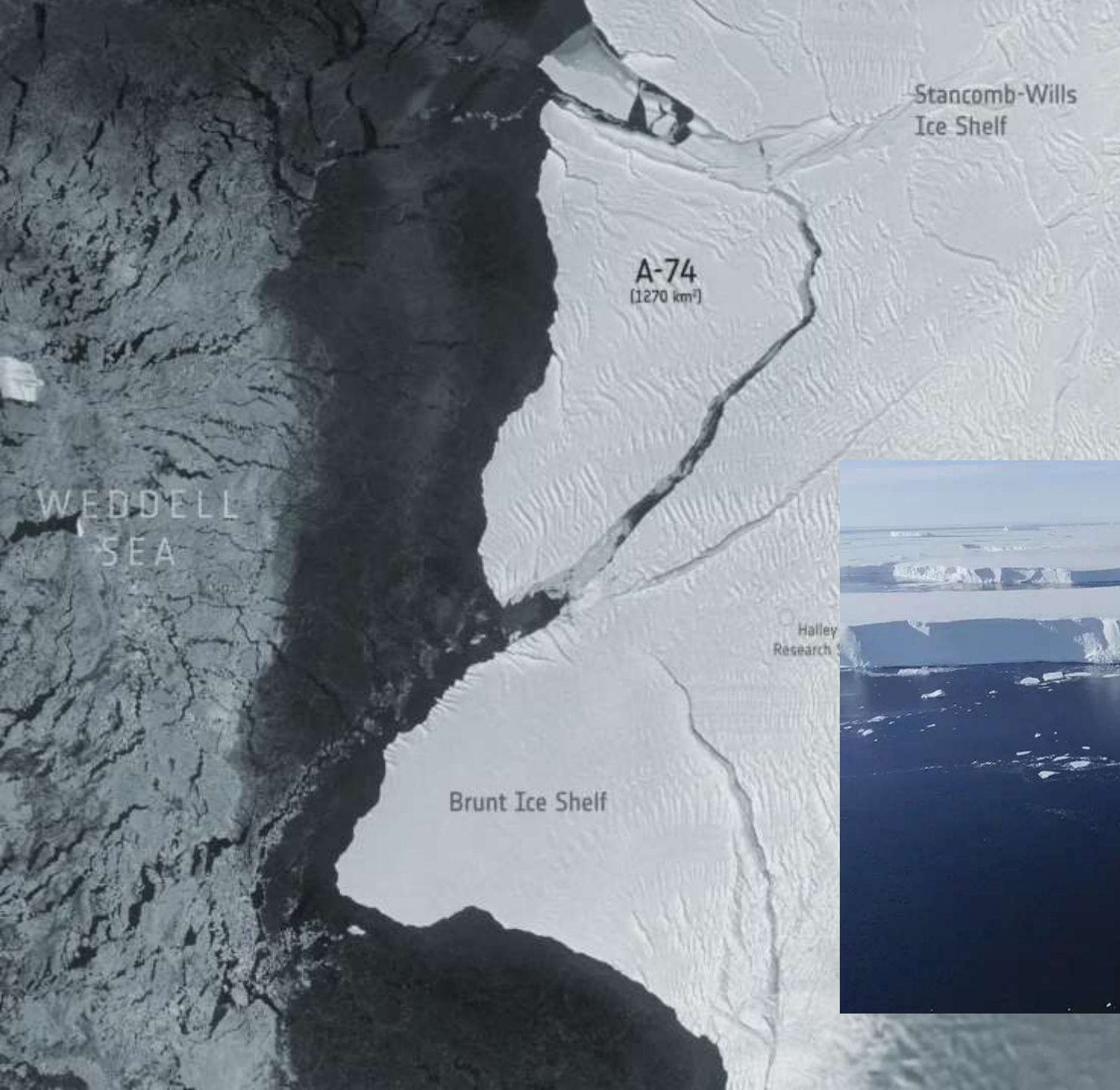


In ketens



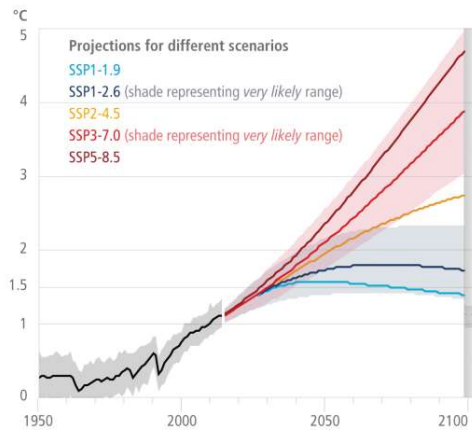
En door tijdschalen heen

- > **Thwaites**
- > “the Doomsday glacier”

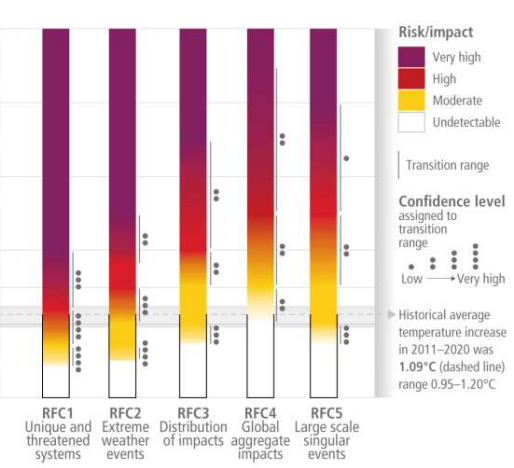


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(b) Reasons for Concern (RFC)
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in Utrecht: tot 5 °C warmer

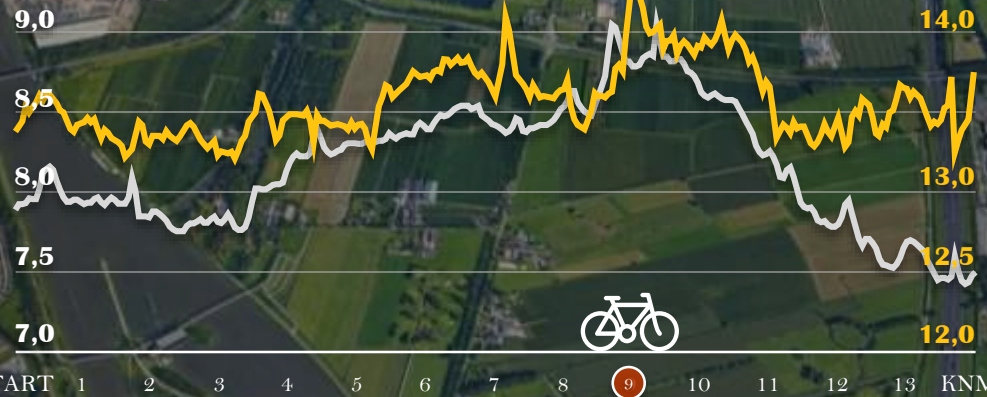
STEDELIJK WARMTE EILAND



De kaart toont een fietsroute door Utrecht, waarlangs vier jaar lang de temperatuur is gemeten. De metingen laten tussen het centrum van Utrecht en het KNMI in het buitengebied in De Bilt verschillen zien van gemiddeld zo'n 1,5°C in de ochtend en zo'n 0,6°C in de namiddag. De hoogste temperaturen werden gemeten tussen Vredenburg en het Neude. In drie uitzonderlijke gevallen, alle drie met zeer weinig wind, werd 's nachts een verschil van wel 5°C tussen het centrum van Utrecht en het buitengebied gemeten.

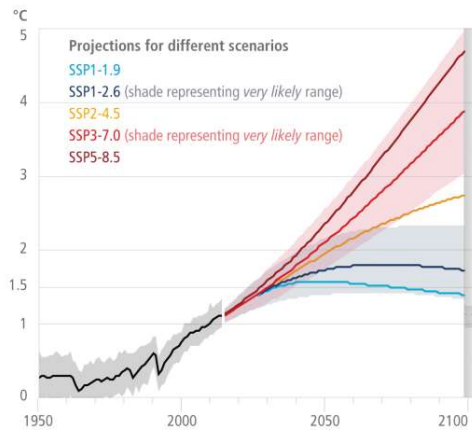
Bron: Theo Brandsma, Dirk Wolters, Measurement and Statistical Modeling of the Urban Heat Island of the City of Utrecht (2012), Journal of Applied Meteorology and Climatology

Gemiddelde temperatuur in °C
OCHTEND

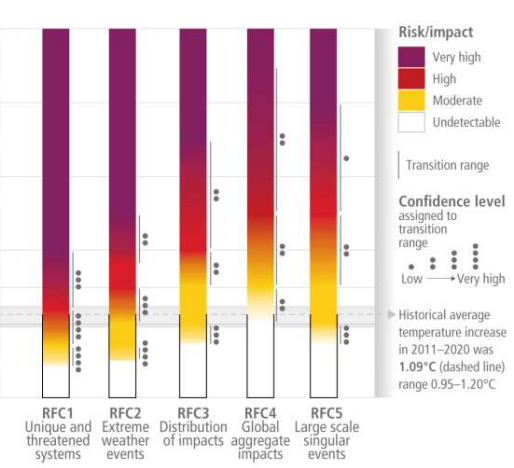


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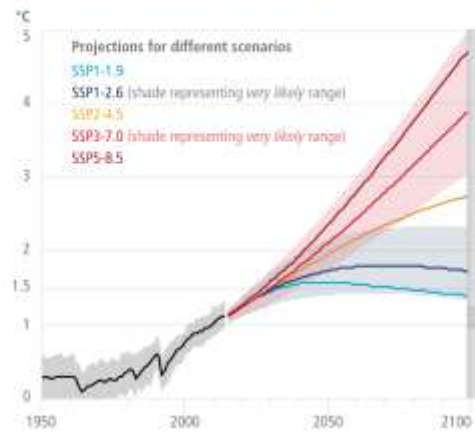


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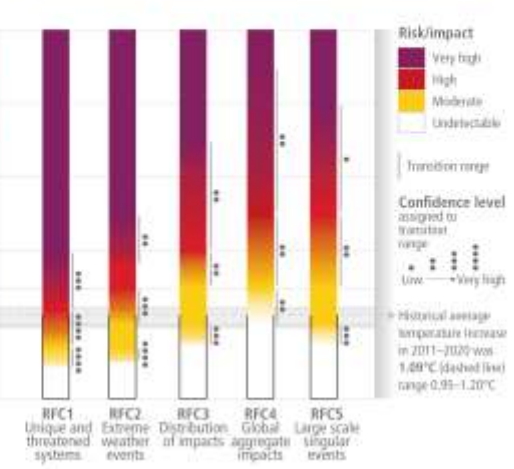


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Risk/impact
Very high
High
Moderate
Undetectable

Confidence level assigned to transition range
Low → Very high

Historical average temperature increase in 2011–2020 was 1.09°C (dashed line) range 0.95–1.20°C





Zijn we klaar voor Code Rood?

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Maarten van Aalst

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