Yorkshire & Humber Flood Resilience Forum:

Challenges and Opportunities

Colin Mellors

Chair of Yorkshire Regional Flood and Coastal Committee


JK's


the Dusty Miller


Mon - Sat
8 am - 6 pm
276
Station
50 yards

Flood Risk In Yorkshire

227,000 properties at flood risk

11,000 of which are at a high* risk of flooding

*High means greater than1 in 30 chance in any year

Yorkshire has it all…….

Fluvial flooding from rivers

Tidal flooding from estuaries and the sea

Surface water flooding

Sewer flooding

Ground water flooding

Coastal erosion

…..and across the region

Rapid response catchments: esp. in Pennines & West: eg Calder Valley, Upper Don and Upper Aire

Urban conurbations: eg Doncaster, Hull, Leeds, Rotherham, Sheffield & York

Industrial towns: inc. many culverted watercourses

Humber estuary: draining one fifth of England's land mass & major energy source

Agricultural land: with pumped catchments, esp. in East Yorkshire

Properties in flood zones

Council	FZ3	FZ2	TOTAL
Barnsley	419	627	**1046**
Derbyshire	845	749	**1594**
Bradford	2166	1770	**3936**
Calderdale	3700	2485	**6185**
Kingston upon Hull	107387	1068	**108455**
Craven	1519	1132	**2651**
Doncaster	12781	2019	**14800**
East Riding of Yorkshire	31453	5430	**36883**
Hambleton	879	1030	**1909**
Harrogate	1236	1406	**2642**
Kirklees	2584	4242	**6826**
Leeds	2170	3512	**5682**
Richmondshire	1039	410	**1449**
Rotherham	482	742	**1224**
Ryedale	1430	1076	**2506**
Scarborough	587	525	**1112**
Selby	5917	7140	**13057**
Sheffield	1542	4087	**5629**
Wakefield	2304	2456	**4760**
York	2319	2598	**4917**
Total	**182759**	**44504**	**227263**

Yorkshire Regional Flood & Coastal Committee

Environment Agency

Properties by risk level

Council	High	Med	Low	V Low	Total
Barnsley	78	694	254	29	**1055**
Derbyshire	339	885	369	37	**1630**
Bradford	619	2075	1252	63	**4009**
Calderdale	1931	2893	1383	7	**6214**
Kingston upon Hull	1480	16859	90152	1	**108492**
Craven	148	1708	817	0	**2673**
Doncaster	274	6890	3566	4034	**14764**
East Riding of Yorkshire	545	14316	21410	412	**36683**
Hambleton	171	1149	623	0	**1943**
Harrogate	206	821	1439	212	**2678**
					Cont'd

Council	High	Med	Low	V Low	Total
Kirklees	1130	2856	2851	15	**6852**
Leeds	798	1634	3188	76	**5696**
Richmondshire	225	1004	227	8	**1464**
Rotherham	261	419	545	0	**1225**
Ryedale	115	1817	507	114	**2553**
Scarborough	176	577	381	0	**1134**
Selby	224	2033	7385	3428	**13070**
Sheffield	768	2754	2140	0	**5662**
Wakefield	1057	840	2534	376	**4807**
York	1074	1042	2923	7	**5046**
Total	**11619**	**63266**	**143946**	**8819**	**227650**

Risk category	Definition
High	Greater than or equal to 1 in 30 (3.3%) chance in any given year
Medium	Less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
Low	Less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) chance in any given year
Very Low	Less than 1 in 1000 (0.1%) chance in any given year

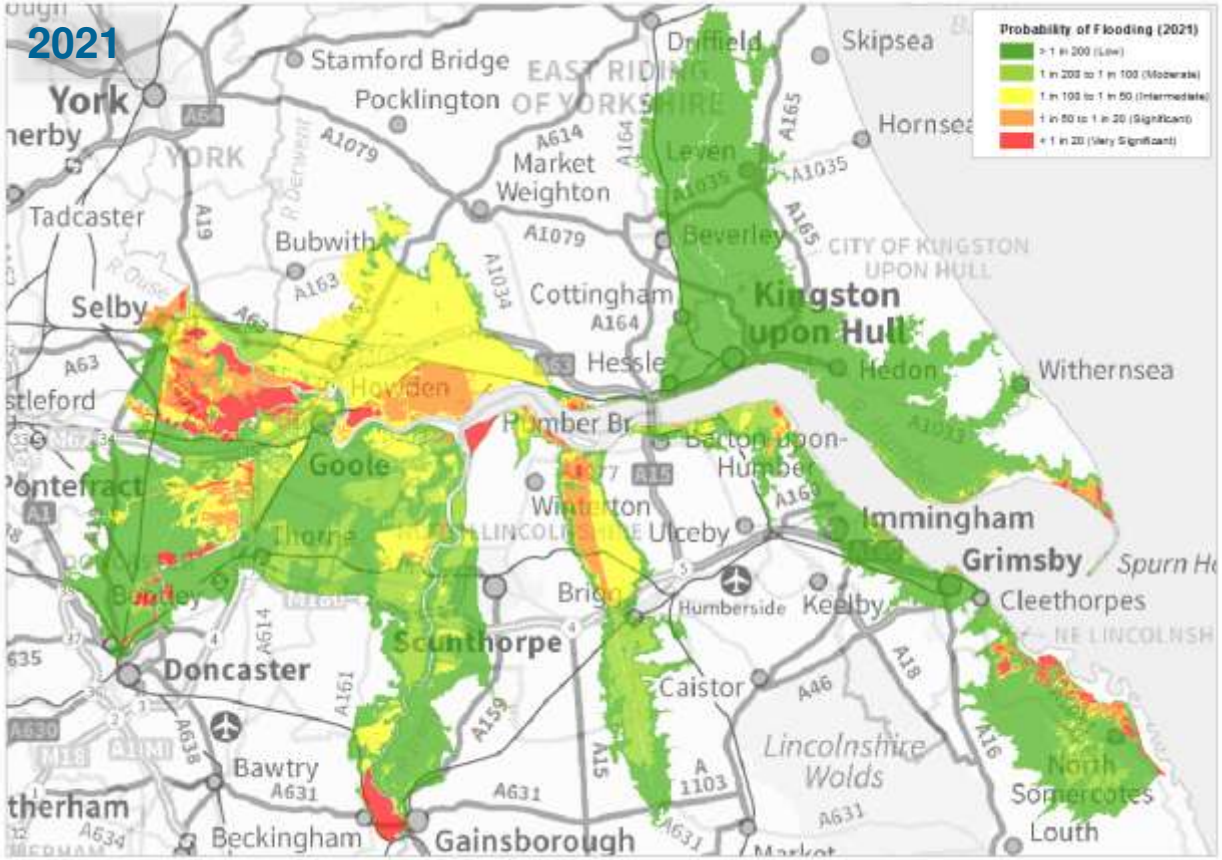
Please note: the Nafra dataset was last updated in 2018 in most locations.

Updates (yet to be published - 2nd June 2021) have been made in Leeds, Skipton, and on various places on the Ure and Swale catchments. These updates **are** reflected in these figures.

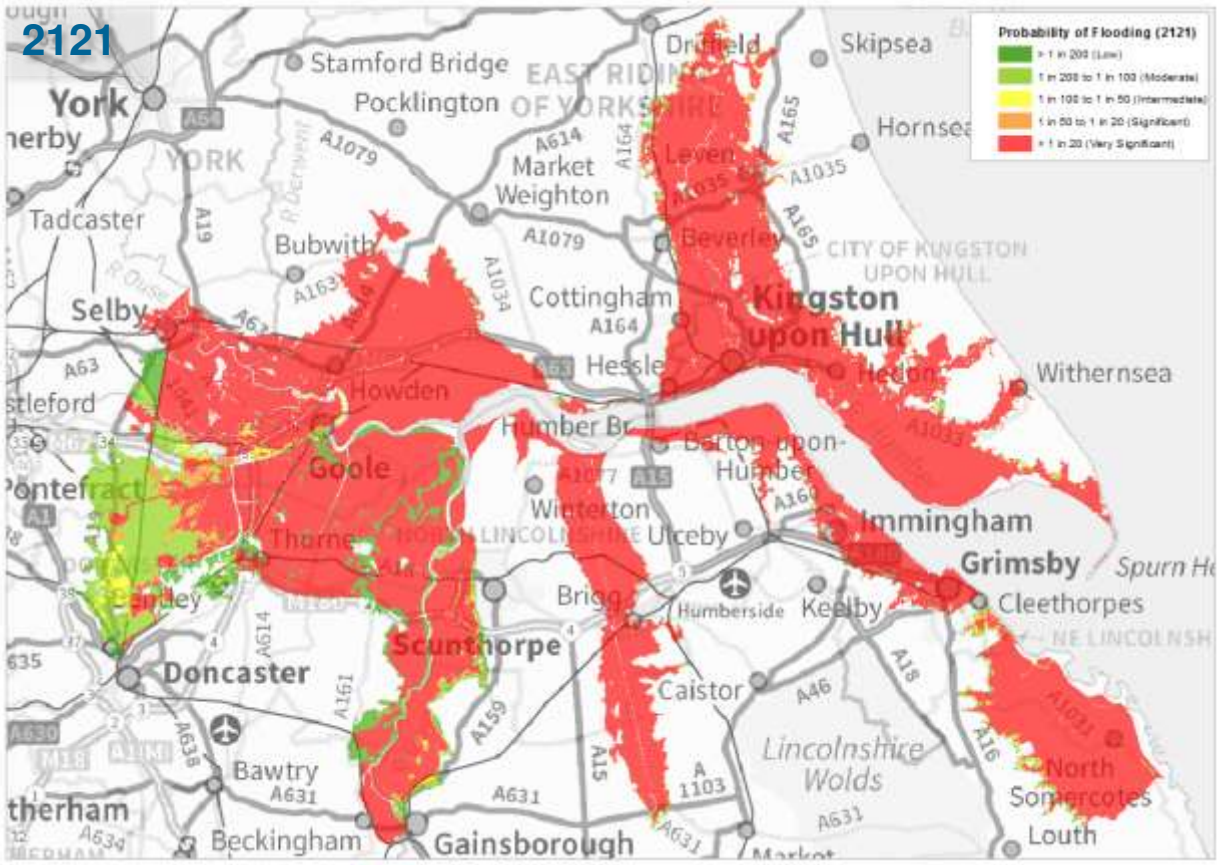
Environment Agency

Humber tidal flood risk

(assumes 1 metre sea-level rise over next 100 years)

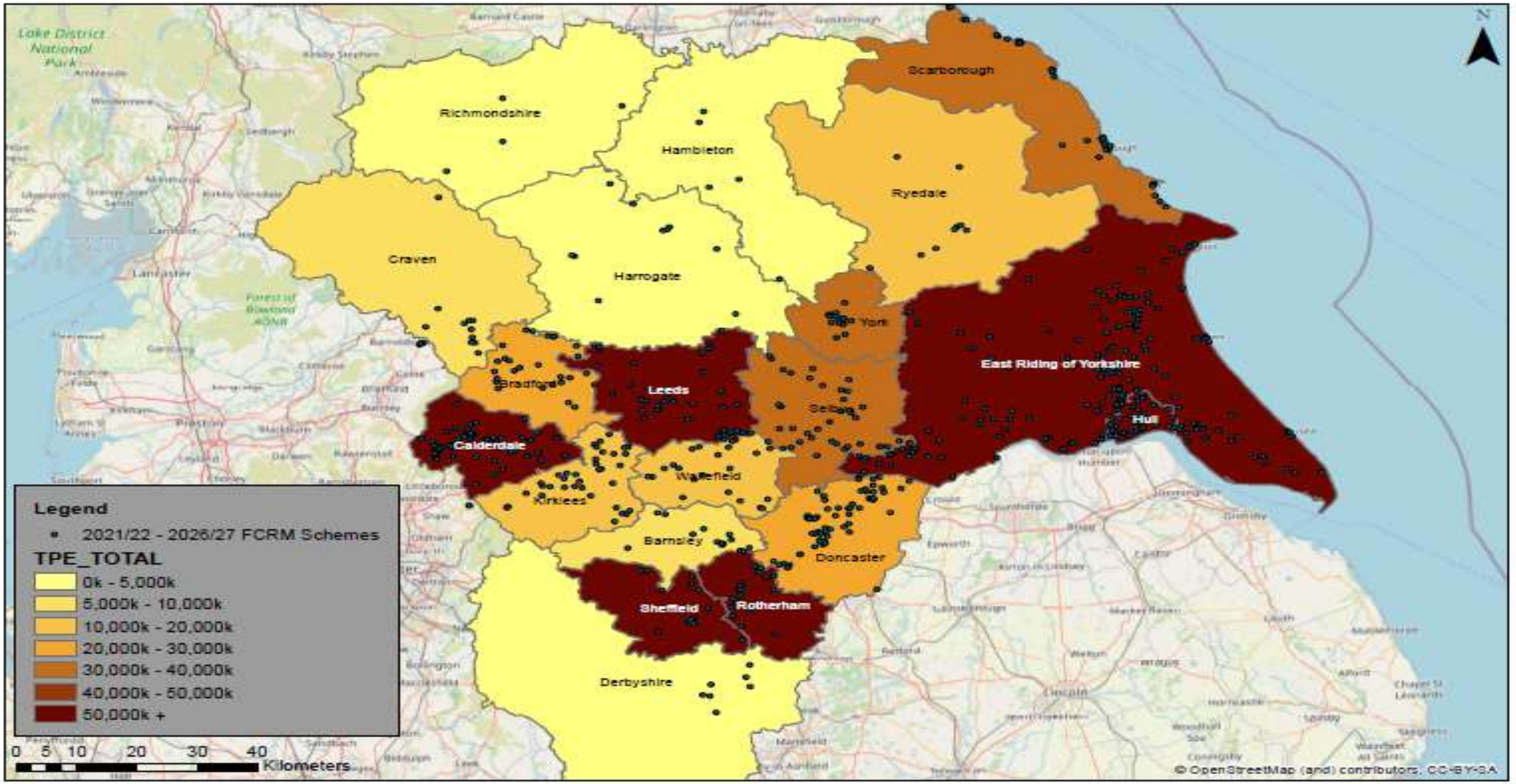


Indicative probability of flooding in the present day (2021) within the Humber 2100+ study area

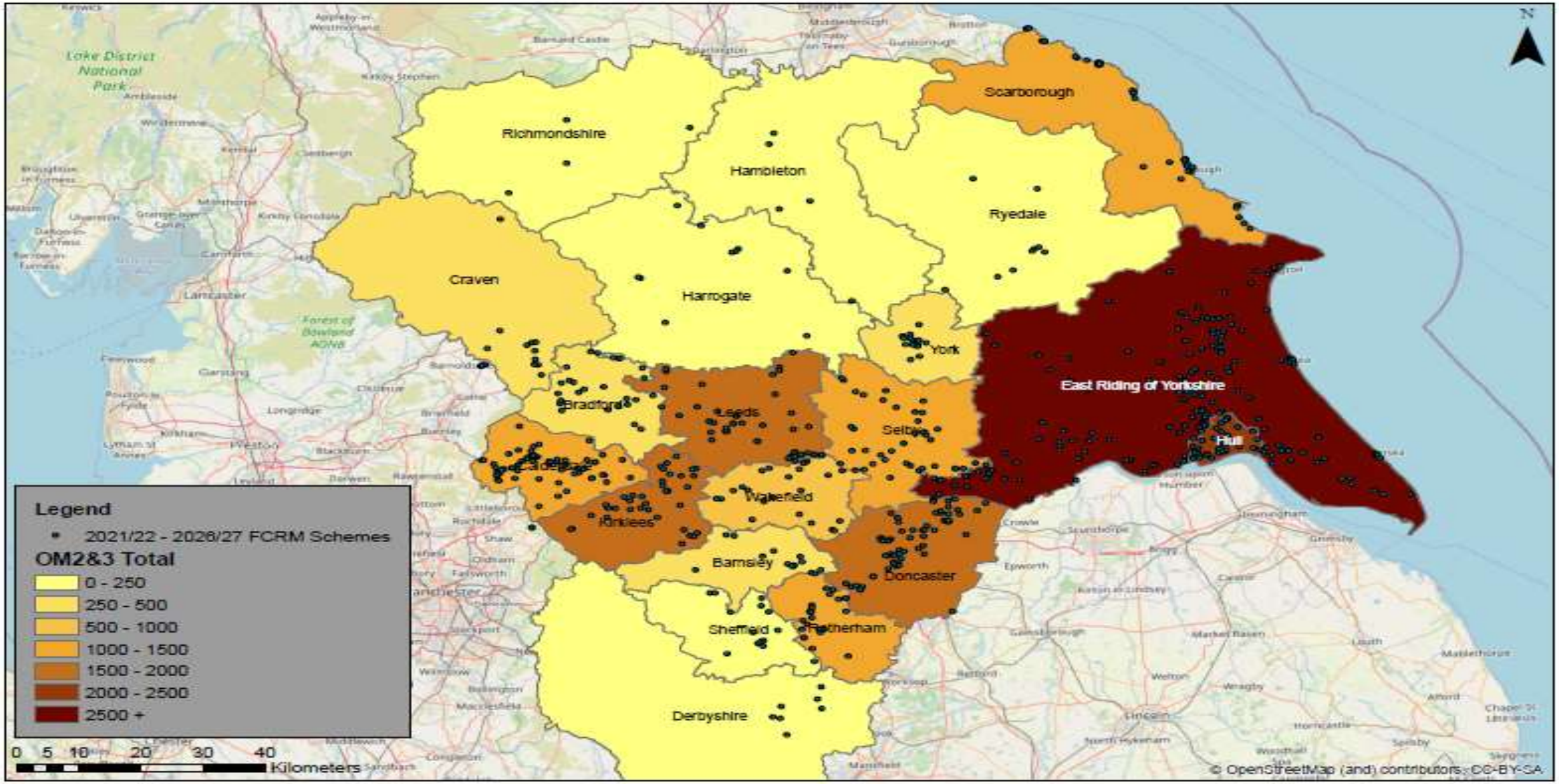


Indicative probability of flooding in the 100 year epoch (2121) in the Humber 2100+ study area under a 'maintain defences' scenario

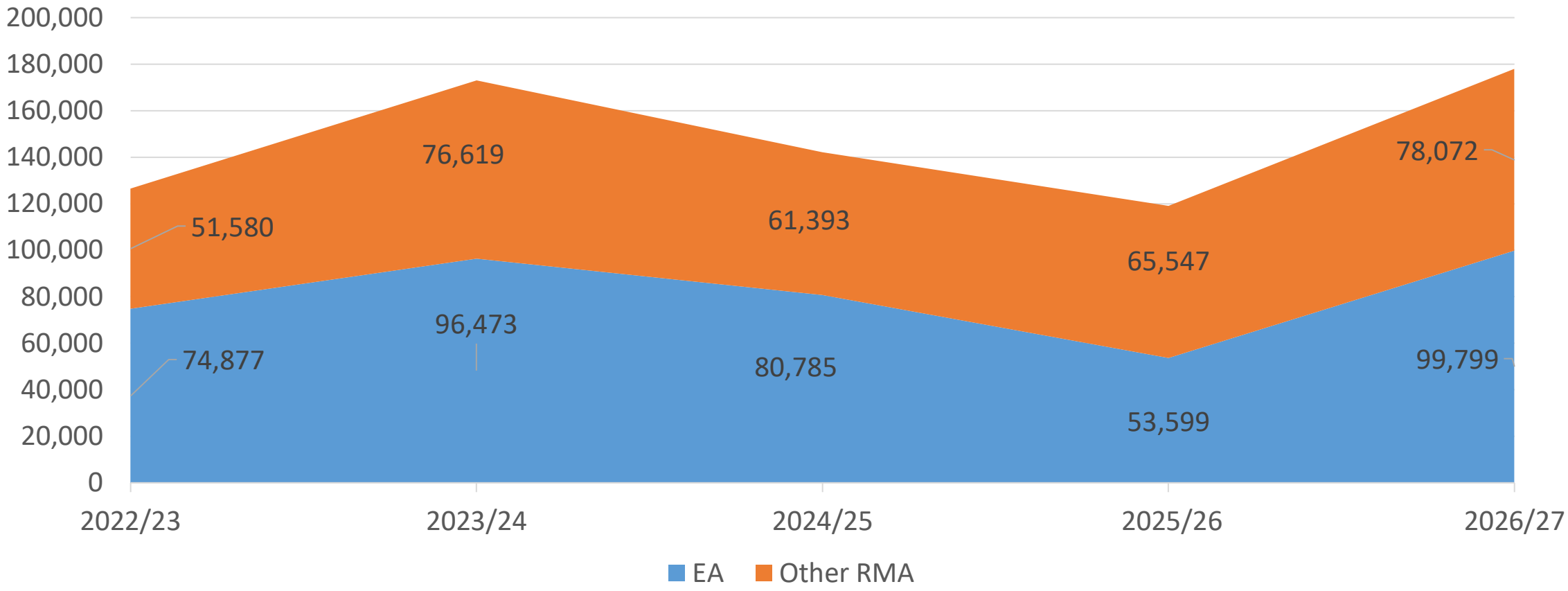
Yorkshire Area - 2021/22 - 2026/27 6 Year Programme - TPE (£k)



Yorkshire Area - 2021/22 - 2026/27 6 Year Programme - OM2 & OM3



FCERM Investment in Yorkshire 2022-27 (£739m)



Funding Sources 2022-2027
(by YRFCC Flood Risk Partnership Group)

Partnership	GiA (including Additional GiA)	Local Levy	Public & Private	Other EA	Further required
Hull & East Riding	116,404	2,385	43,014	600	83,533
North Yorkshire	85,005	966	1,887	1,320	25,376
South Yorkshire	107,402	888	10,796	60	25,517
West Yorkshire	169,394	1,548	24,176	763	19,452
Yorkshire-wide	10,785		2,250	2,725	2,500
Total	**488,990**	**5,786**	**82,122**	**5,468**	**156,378**

Yorkshire Regional Flood & Coastal Committee

Environment Agency

Investment is delivering….

2015-21 FCRM programme in Yorkshire

- £610m investment
- Reduced risk of flooding to 66,000 homes
- Benefit: cost ratio 6.6:1
- £119m of partnership funding (£13m from private sources, one third of English total)
- 304 hectares of water dependent habitat & 19k of protected river improvement

…… is Value for Money….

For every £1 spent the programme will deliver £3 in direct economic benefit

DfT considers Benefit Cost Ratio of 2:1 – 4:1 to be "High" Value for Money

HS2 - has a Benefit: Cost Ratio of 1.8:1[1]

Cross Rail has a Benefit: Cost ratio of 1.3:1[2]

[1] Institute for Government (Jan 2020)
[2]Association for Project Management (Aug 2021)

Yorkshire Regional Flood & Coastal Committee

Environment Agency

……. and is making a difference

Storm	Flooded	Protected
2007	55,000	100,000
2015/16	17,000	23,400
Nov 2019/Feb 2020	4,600	128,000
January 2021	675	49,000
February 2022	400	35,000

Not simply protecting property

- Economic benefits
- Social and health-related benefits
- Habitat and Biodiversity benefits
- Infrastructure benefits

For every family flooded, 16 are adversely impacted

The FCRM toolkit

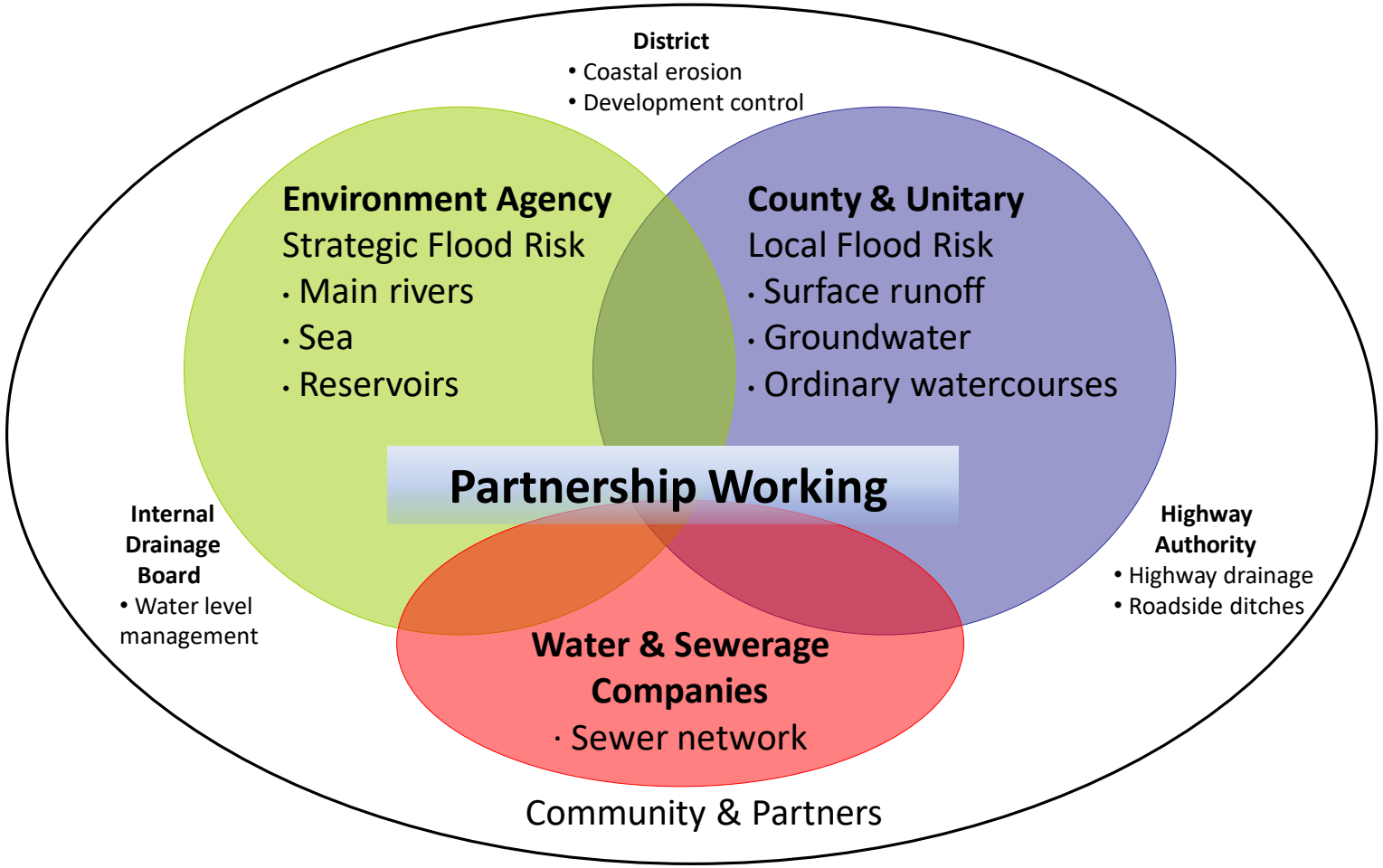
- **No single solution**:

- Nature-based as well as engineered
- Slowing the flow in some places, assisting storage in others, and constructions to speed safe throughput in some areas
- Property-level resilience
- Forecasting, warning, resilience and recovery
- Building better and in more appropriate places
- …and, of course, addressing climate change!

‘A nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100’

Regional Flood and Coastal Committee

"Joined up plans, programme and partners"



Local authorities are critical partners

Collaborating

Direct delivery of schemes

Contributing levy

Working with communities

Yorkshire's key climate challenges and the links to flood resilience

Rosa Foster
Co-Director, Yorkshire & Humber Climate Commission

YORKSHIRE & HUMBER CLIMATE COMMISSION

Content

Key climate challenges

A brief introduction to the Yorkshire & Humber Climate Commission & the Climate Action Plan

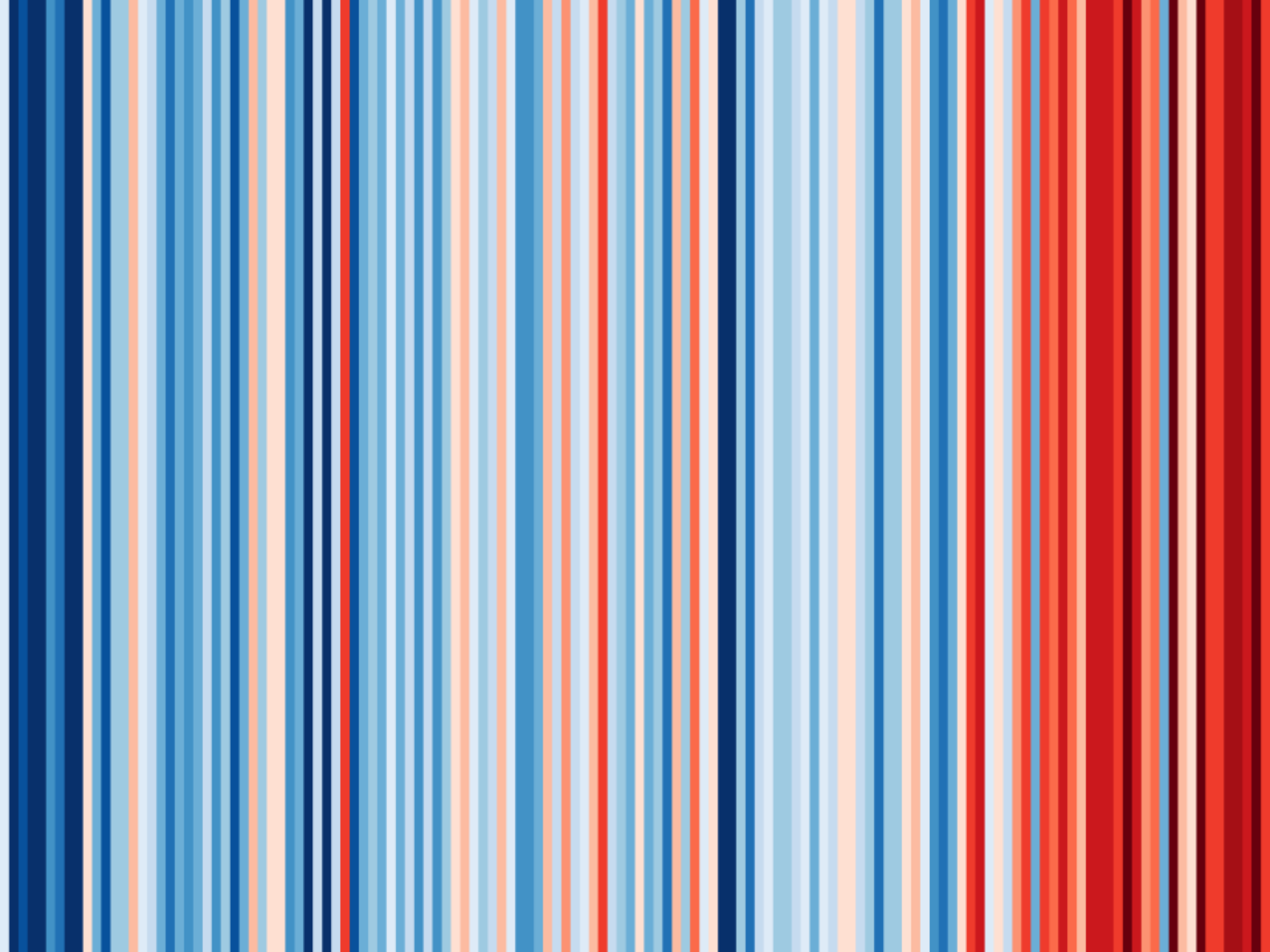
Four things to keep in mind

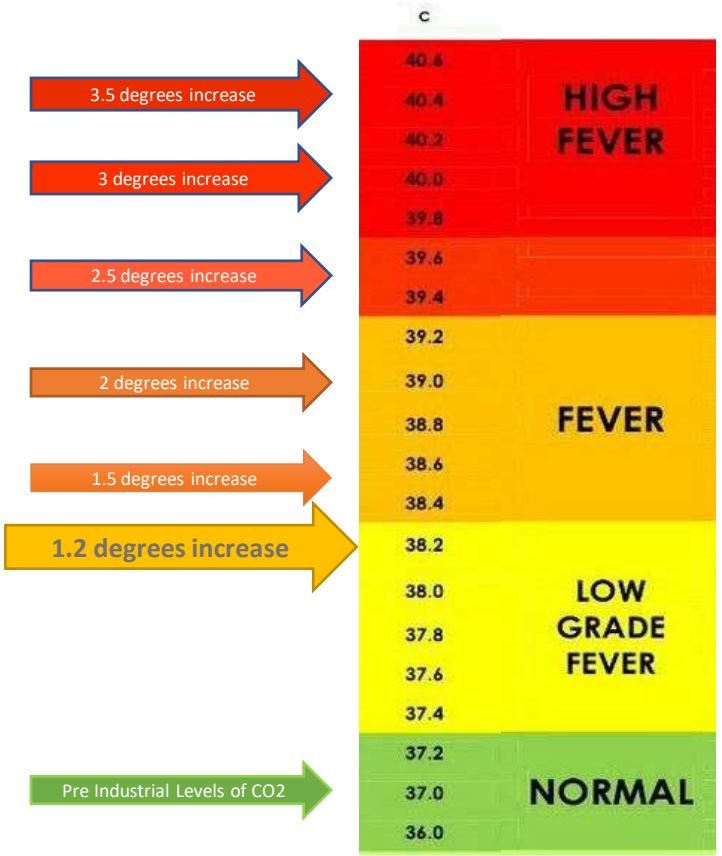
Our adaptation challenges

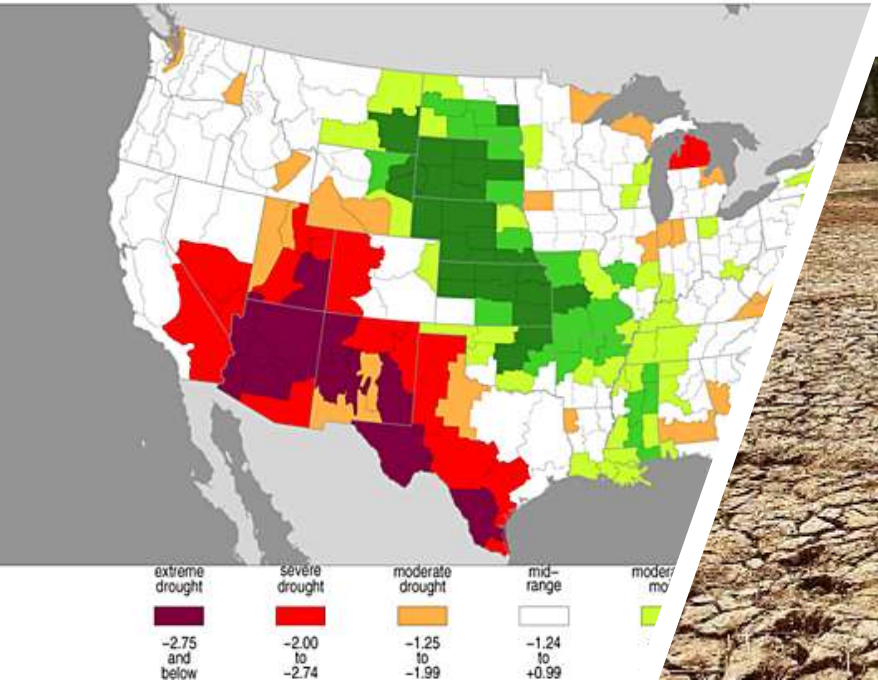
Acknowledgement & acceptance

Ability to respond at pace and scale

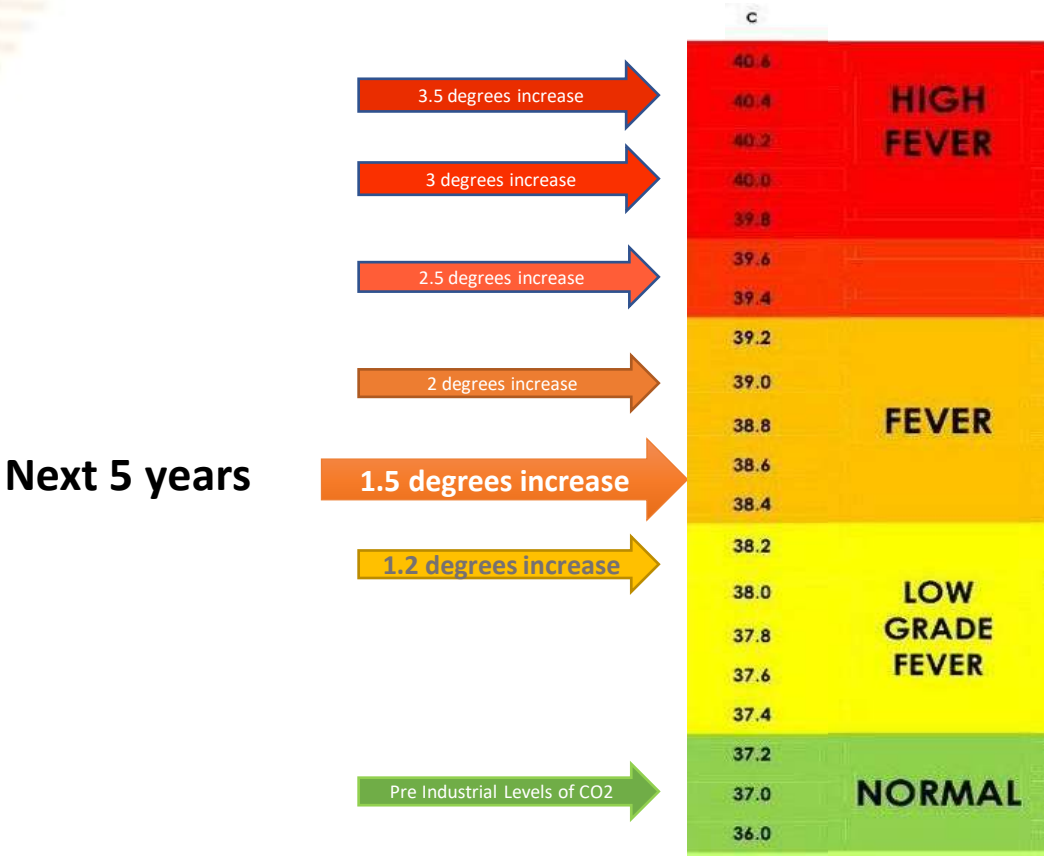
Ownership and accountability




C
3.5 degrees increase
3 degrees increase
2.5 degrees increase
2 degrees increase
1.5 degrees increase
1.2 degrees increase
Pre Industrial Levels of CO2
40.6
40.4
40.2
40.0
39.8
39.6
39.4
39.2
39.0
38.8
38.6
38.4
38.2
38.0
37.8
37.6
37.4
37.2
37.0
36.0
HIGH FEVER
FEVER
LOW GRADE FEVER
NORMAL


Palmer Z–Index
August, 2019
extreme drought
severe drought
moderate drought
mid–range
−2.75 and below
−2.00 to −2.74
−1.25 to −1.99
−1.24 to +0.99

Ability to respond at scale and pace




2100

Ability to respond at scale and pace

"The UK has a strong framework for emissions reduction… but adaptation remain the Cinderella of Climate Change, still sitting in rags by the stove: under resourced, underfunded and often ignored."

Baroness Brown,
UK Adaptation Committee

Ownership & Accountability

The trouble with climate change is it’s everywhere and nowhere.

It’s everyone’s and no one’s.

YORKSHIRE & HUMBER CLIMATE COMMISSION

- An independent advisory group, to support ambitious climate action across the region
- A team of climate leaders from across the public, private and third sectors, in the largest regional Commission of its kind in the UK

SUPPORTED BY

- The Yorkshire and Humber Leaders Board and the 22 councils across Yorkshire and the Humber
- Key partners include the Environment Agency, Yorkshire Water, Northern Powergrid, Northern Gas Networks, the Trades Union Congress, Yorkshire Universities and the University of Leeds

PCAN YORKSHIRE & HUMBER CLIMATE COMMISSION

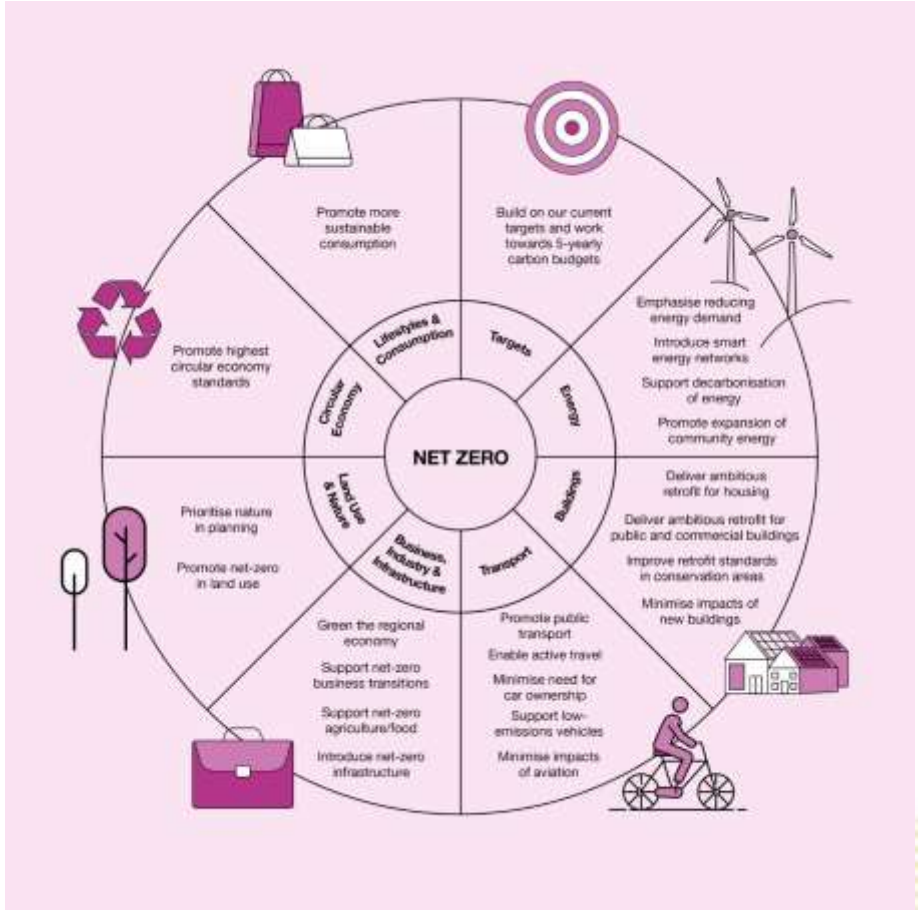
FOUR KEY AIMS

- → Climate resilience
- → Net-zero
- → Just and inclusive transition
- → Nature and biodiversity

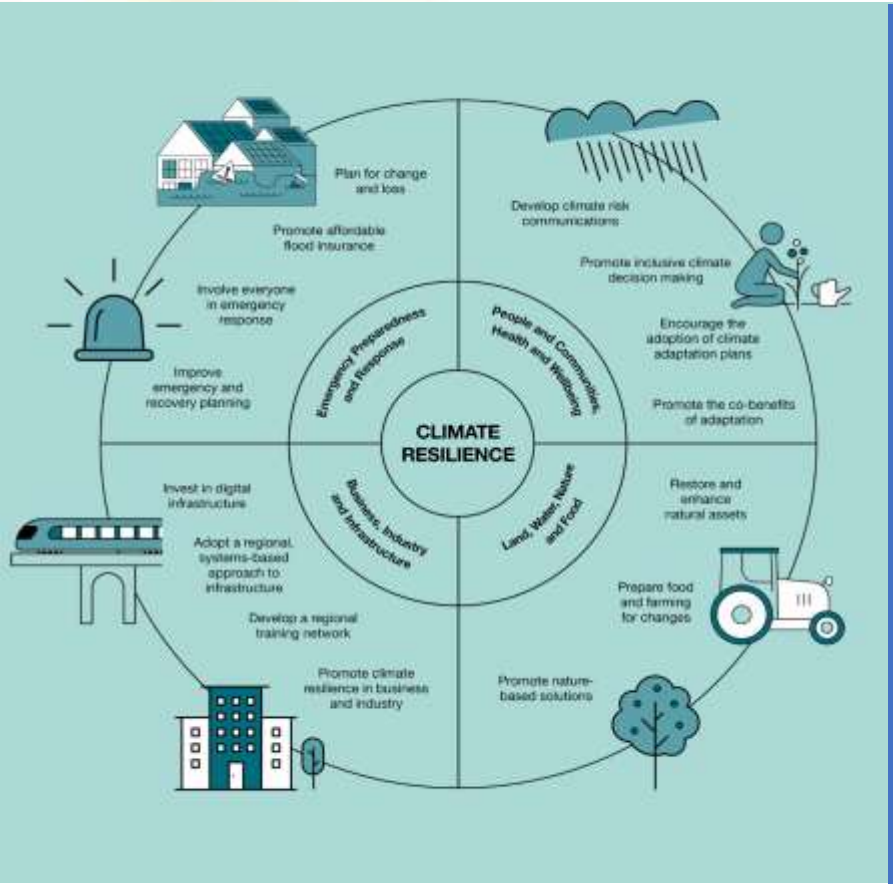

PCAN
YORKSHIRE
& HUMBER
CLIMATE
COMMISSION
THE YORKSHIRE
& HUMBER
CLIMATE ACTION PLAN
A THREE-MINUTE
INTRODUCTION
50
ACTIONS

A FRAMEWORK FOR CHANGE

NET ZERO



CLIMATE RESILIENCE: KEY ACTIONS



- Develop better climate risk communications.
- Encourage adoption of climate adaptation plans.
- Promote resilience actions with health and wellbeing benefits.
- Promote resilience in land use by restoring and enhancing the region's many key natural assets.
- Prepare food and farming sector for change
- Promote nature-based solutions and blue-green infrastructure.
- Promote climate resilience in business/industry
- Deliver climate readiness and resilience training.
- Promote resilient infrastructure systems.
- Support improved emergency & recovery planning.
- Promote affordable, comprehensive flood insurance.
- Strengthen plans for the long-term management of change and loss caused by sea level rise.

Four things to keep in mind

- We must adapt. The cost of doing nothing is too high and wrong decision bakes in the risk exposure for the years to come.

- Do not underestimate the positive impact you can have.

- Seize the moment…

- Green skills and jobs must include growing our adaptive capacity and resilience.

Reflections from the room

UNIVERSITY OF HULL

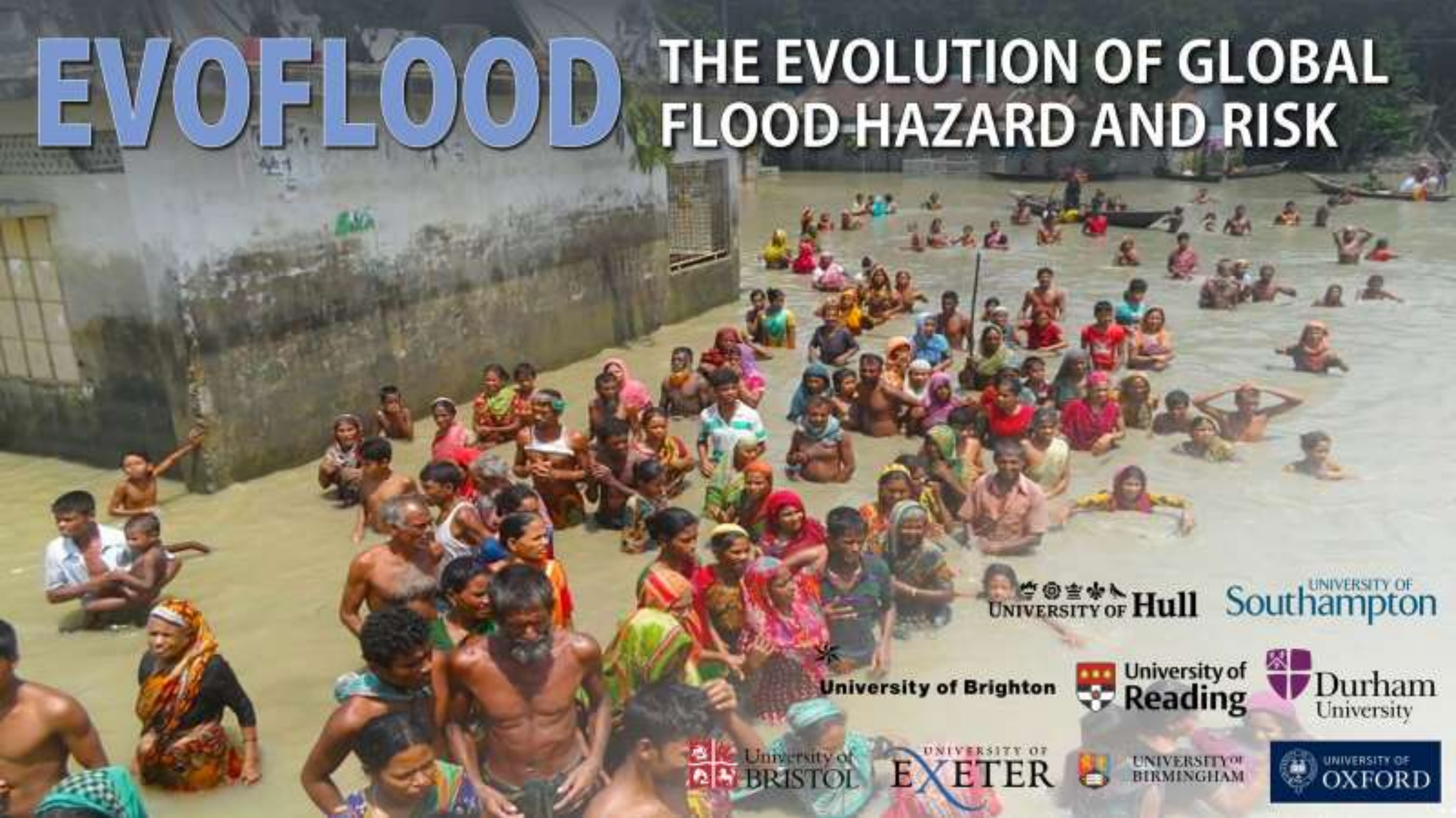
Global Flood Risk & Resilience

Daniel R. Parsons

Energy and Environment Institute, University of Hull

EVOFLOOD

THE EVOLUTION OF GLOBAL FLOOD HAZARD AND RISK



University of Hull

University of Southampton

University of Brighton

University of Reading

Durham University

University of Bristol

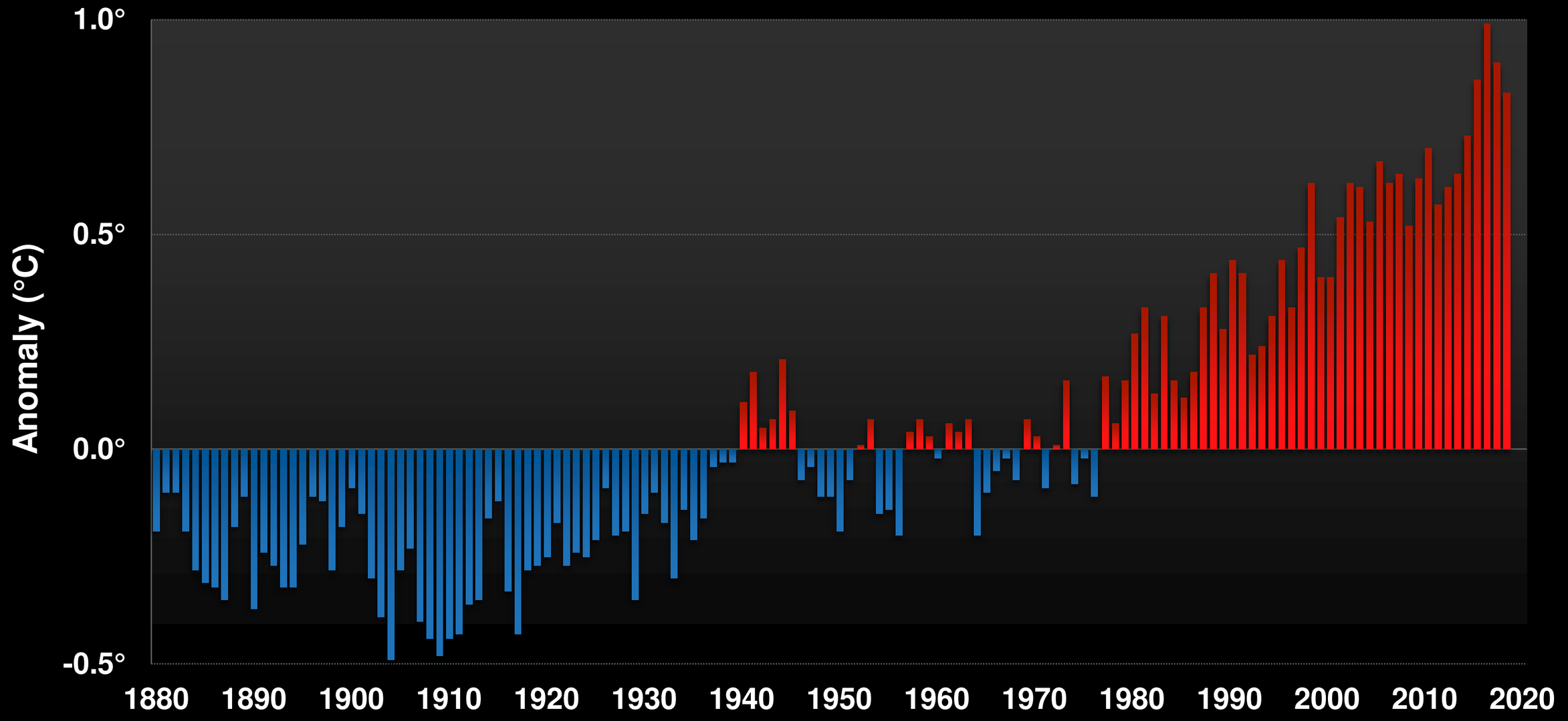
University of Exeter

University of Birmingham

University of Oxford

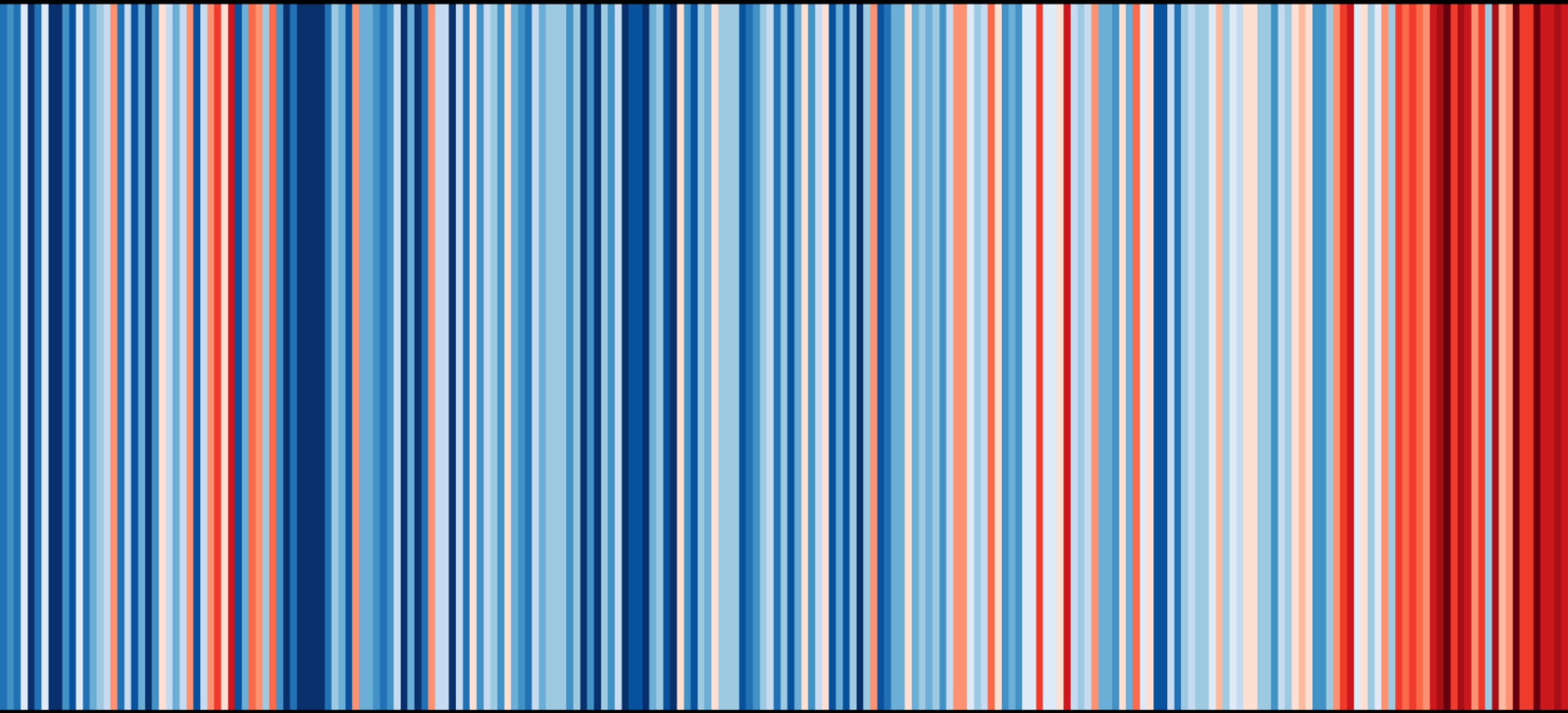
Global Surface Temperature – Departure from Average

1880 – 2018



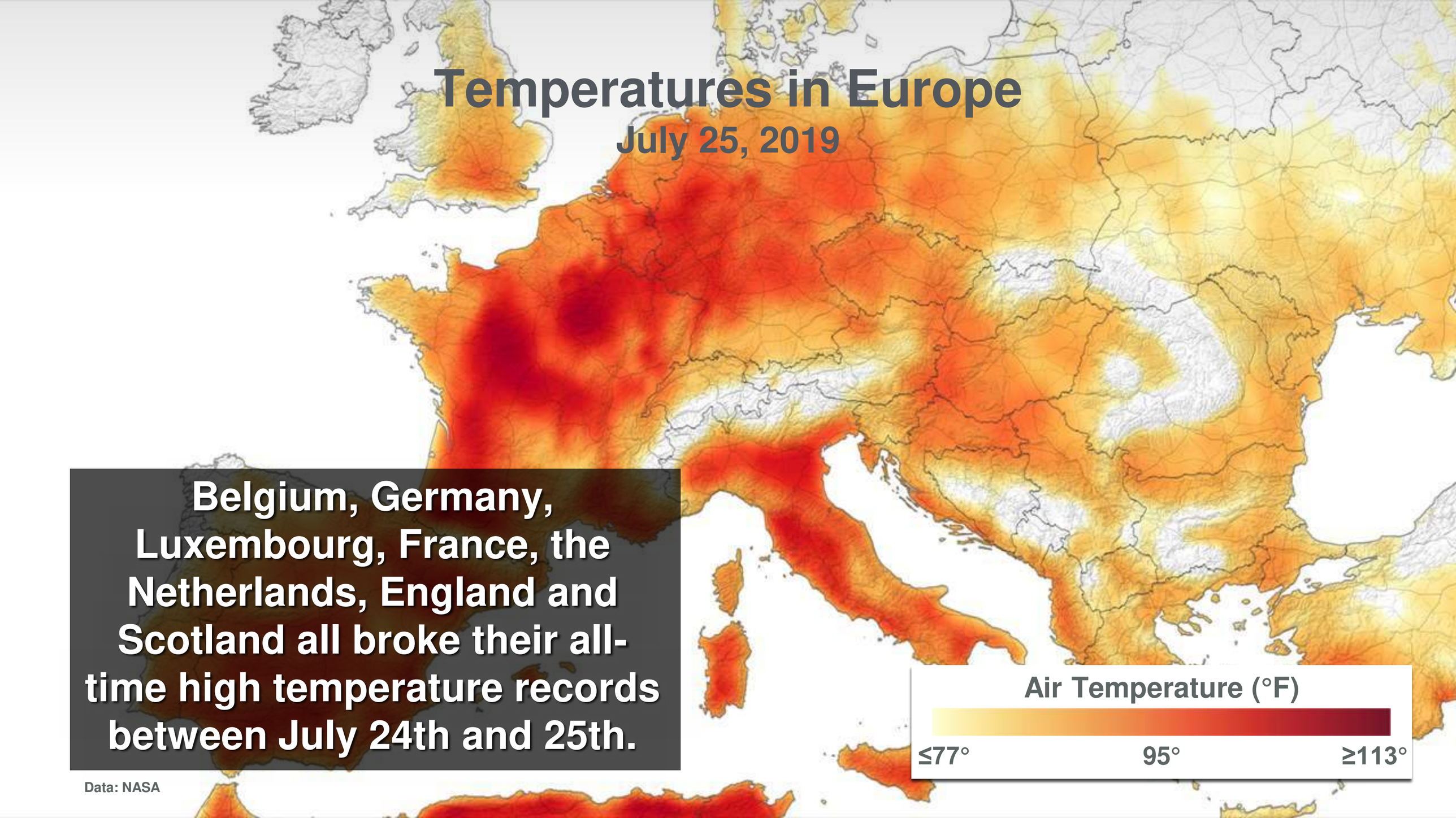
Data: National Oceanic and Atmospheric Administration

Temperature change in Durham since 1795



Temperatures in Europe

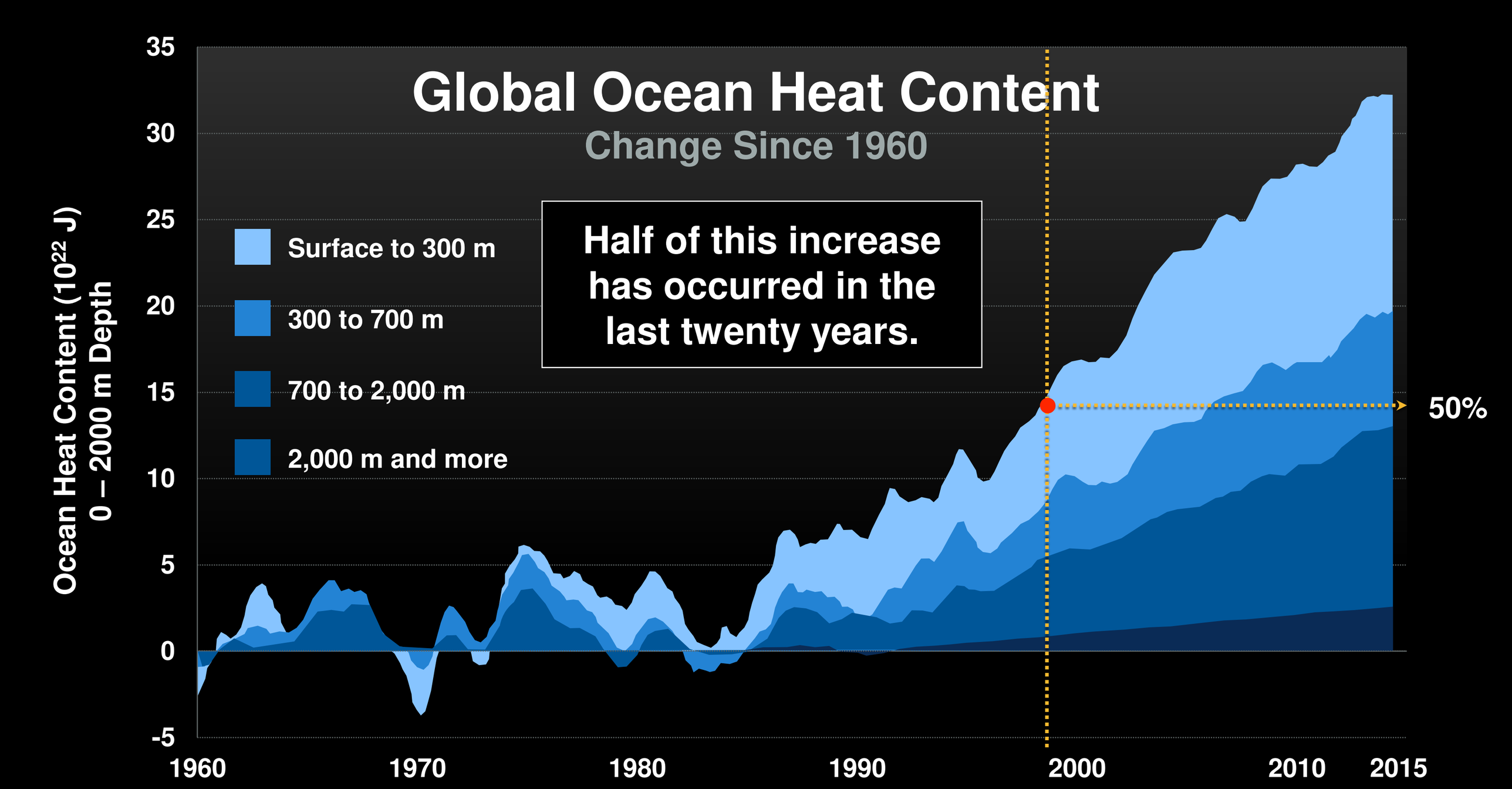
July 25, 2019



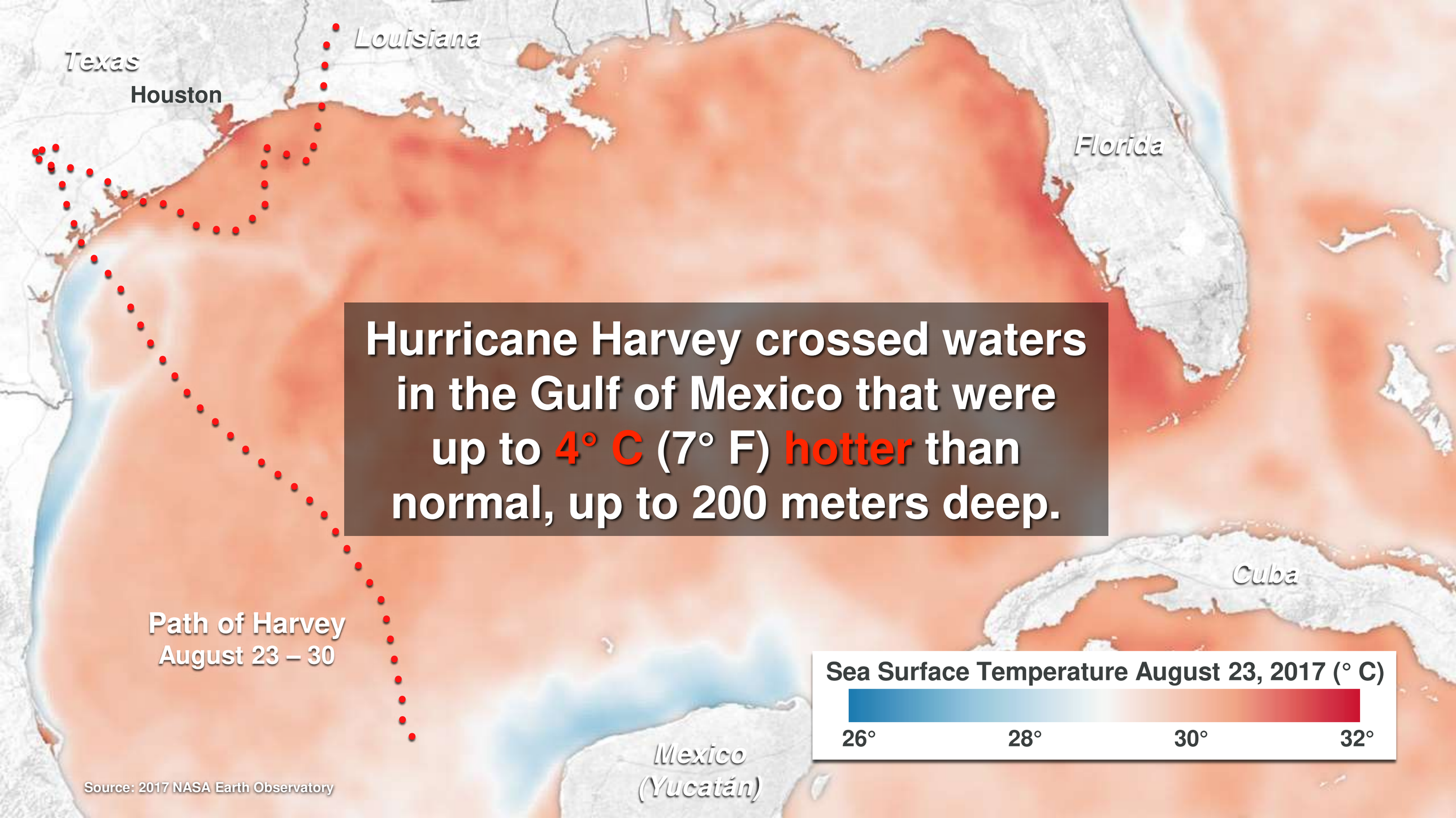
Data: NASA

Midland, Texas

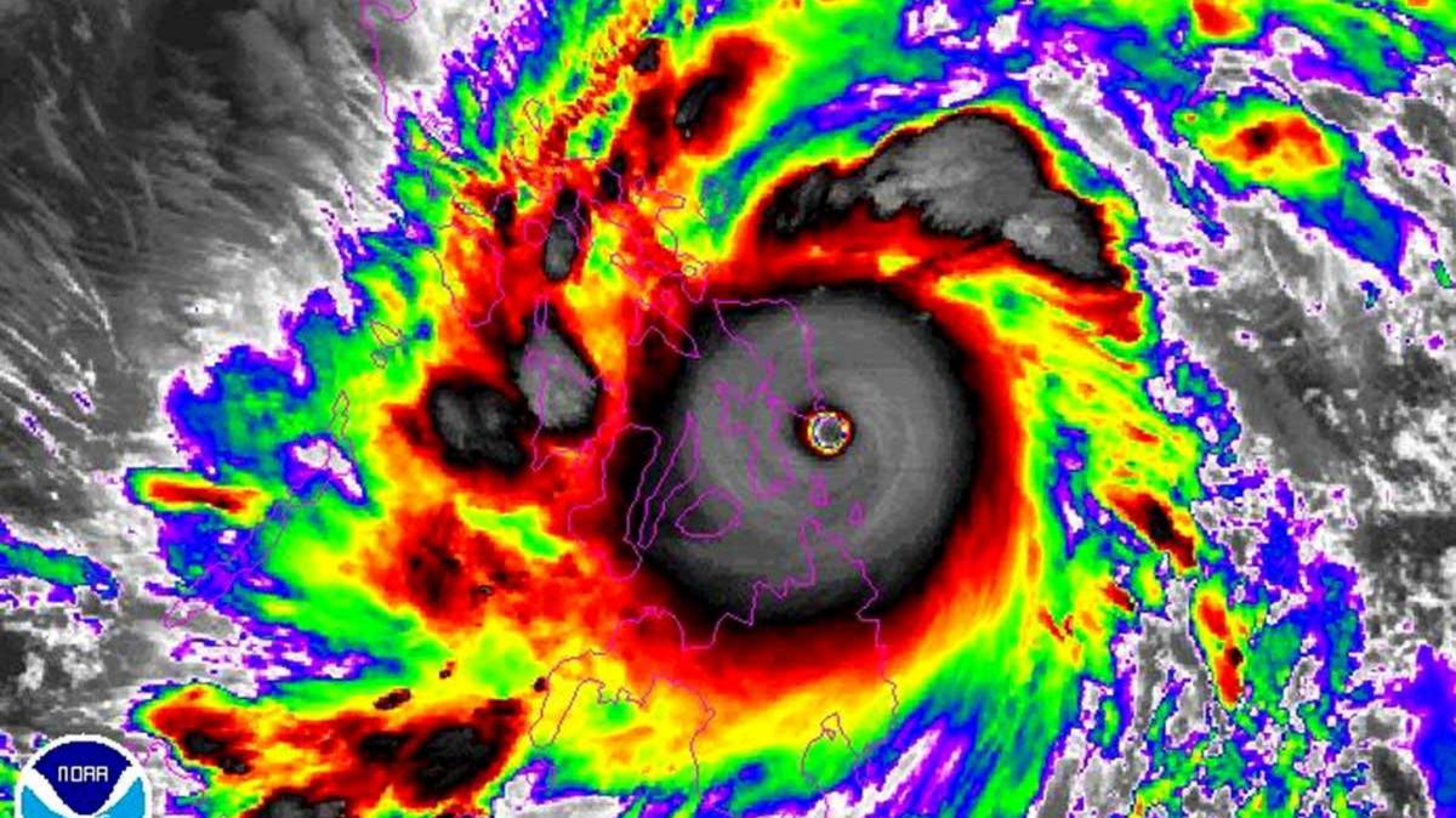
June 1, 2021

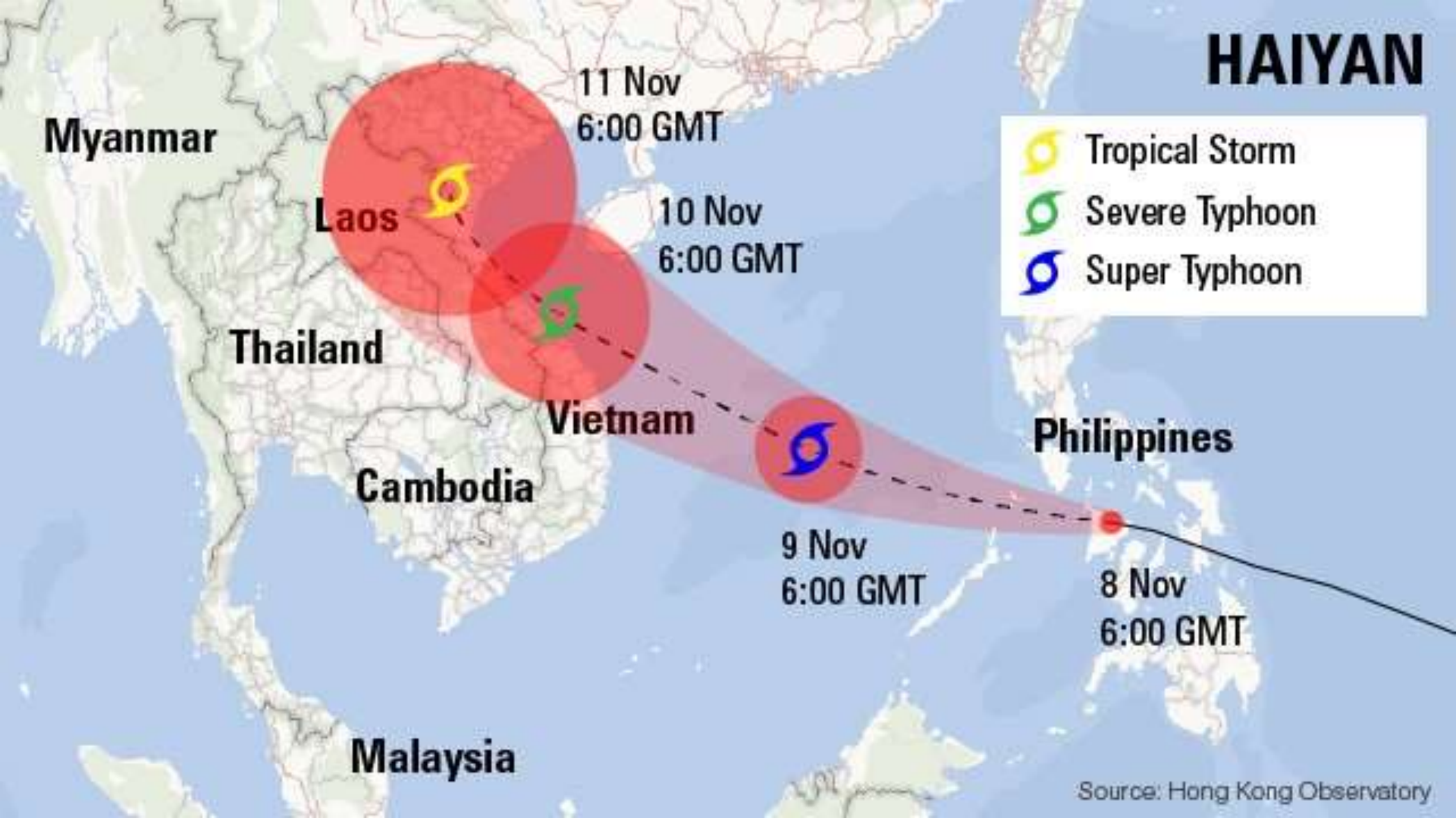


Data: P. Gleckler, et al., Industrial-era global ocean heat uptake doubles in recent decades, Nature Climate Change 6, 394–398 (2016) fig. 4.


Texas
Houston
Louisiana
Florida
Cuba
Mexico
(Yucatán)
Hurricane Harvey crossed waters in the Gulf of Mexico that were up to 4° C (7° F) hotter than normal, up to 200 meters deep.
Path of Harvey
August 23 – 30
Sea Surface Temperature August 23, 2017 (° C)
26°
28°
30°
32°
Source: 2017 NASA Earth Observatory


Houston, Texas
August 27, 2017
© 2017 AP Photo/David J. Phillip


NOAA

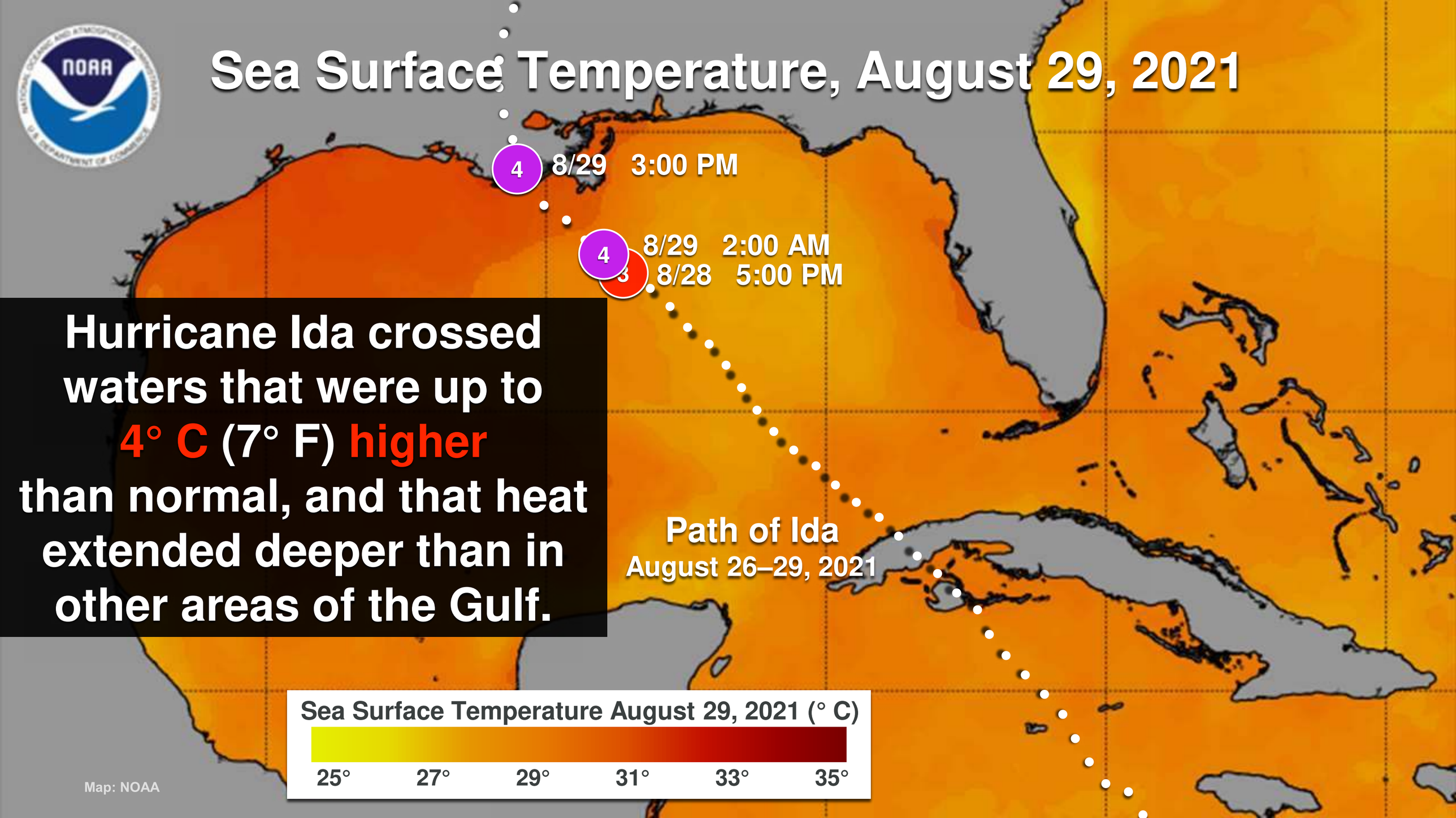

HAIYAN
Tropical Storm
Severe Typhoon
Super Typhoon
11 Nov
6:00 GMT
10 Nov
6:00 GMT
9 Nov
6:00 GMT
8 Nov
6:00 GMT
Myanmar
Laos
Thailand
Vietnam
Cambodia
Philippines
Malaysia
Source: Hong Kong Observatory


JEANNIE

Hurricane Ida from the International Space Station

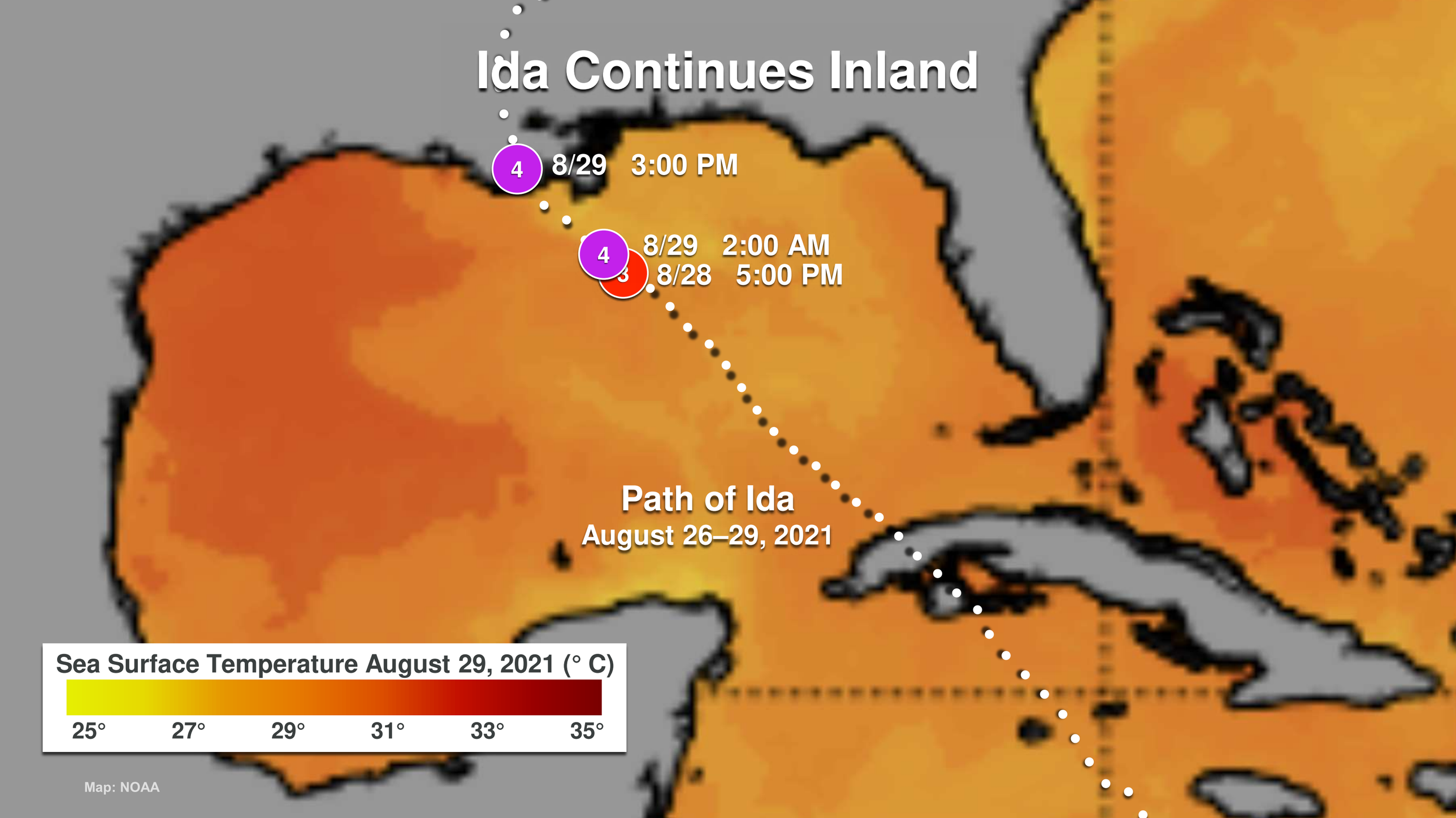
August 29, 2021

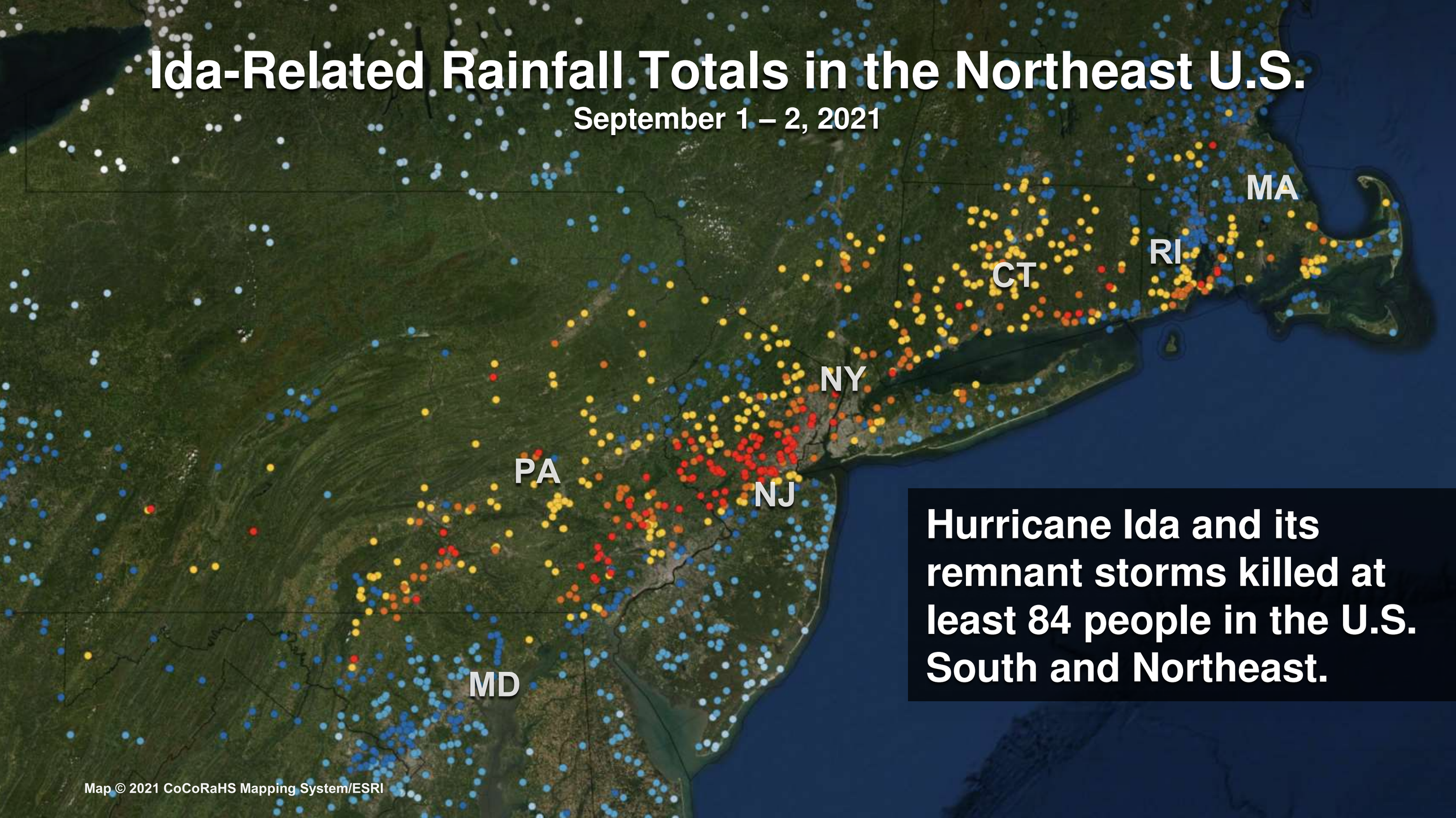
Hurricane Ida made landfall in Louisiana as a Category 4 storm with winds of 241 km (150 miles) per hour


Sea Surface Temperature, August 29, 2021
4 8/29 3:00 PM
4 8/29 2:00 AM
3 8/28 5:00 PM
Hurricane Ida crossed waters that were up to 4° C (7° F) higher than normal, and that heat extended deeper than in other areas of the Gulf.
Path of Ida
August 26–29, 2021
Sea Surface Temperature August 29, 2021 (° C)
25° 27° 29° 31° 33° 35°
Map: NOAA

New Orleans, Louisiana

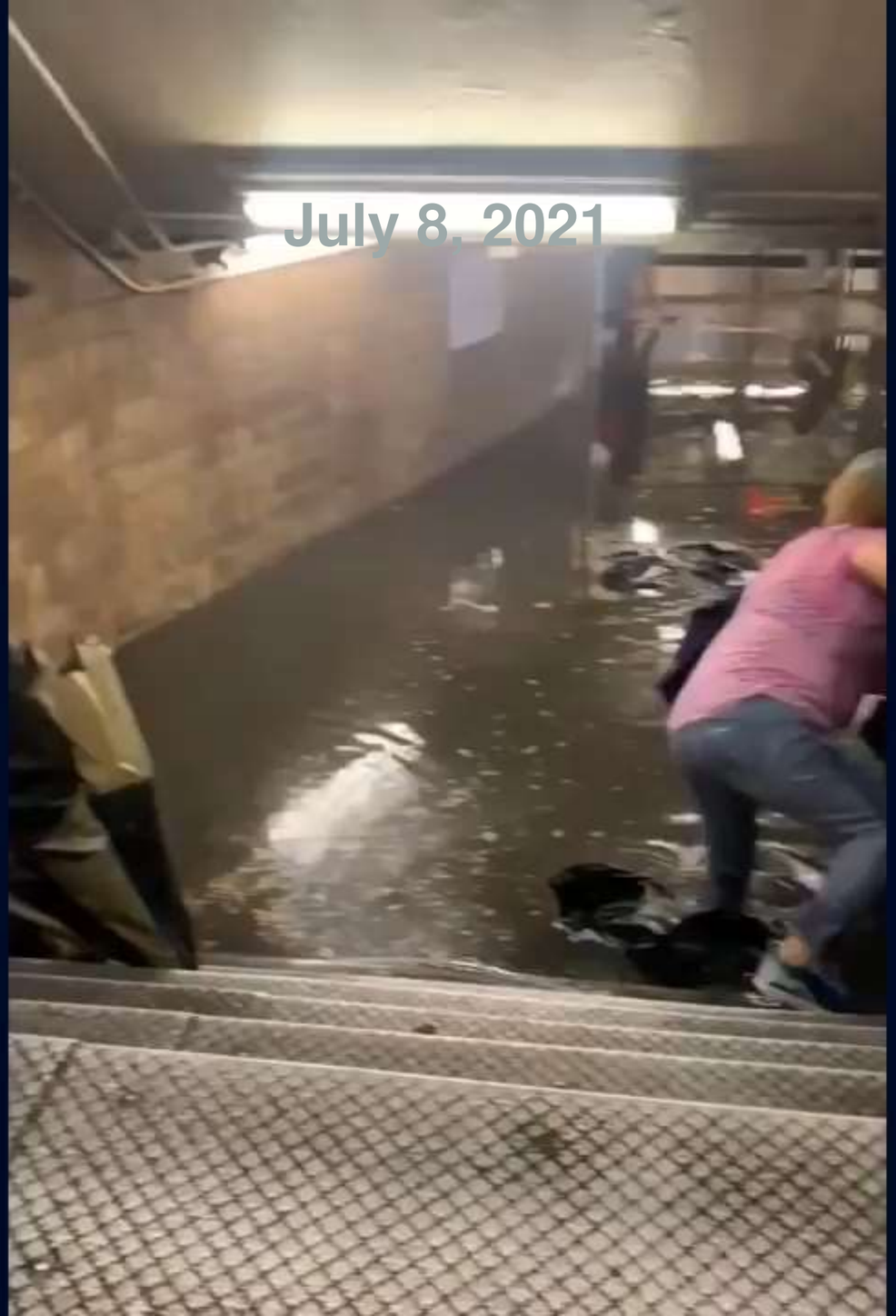
August 30, 2021


Ida Continues Inland
4
8/29 3:00 PM
4
8/29 2:00 AM
3
8/28 5:00 PM
Path of Ida
August 26–29, 2021
Sea Surface Temperature August 29, 2021 (° C)
25°
27°
29°
31°
33°
35°
Map: NOAA


Ida-Related Rainfall Totals in the Northeast U.S.
September 1 – 2, 2021
MA
RI
CT
NY
PA
NJ
MD
Hurricane Ida and its remnant storms killed at least 84 people in the U.S. South and Northeast.
Map © 2021 CoCoRaHS Mapping System/ESRI

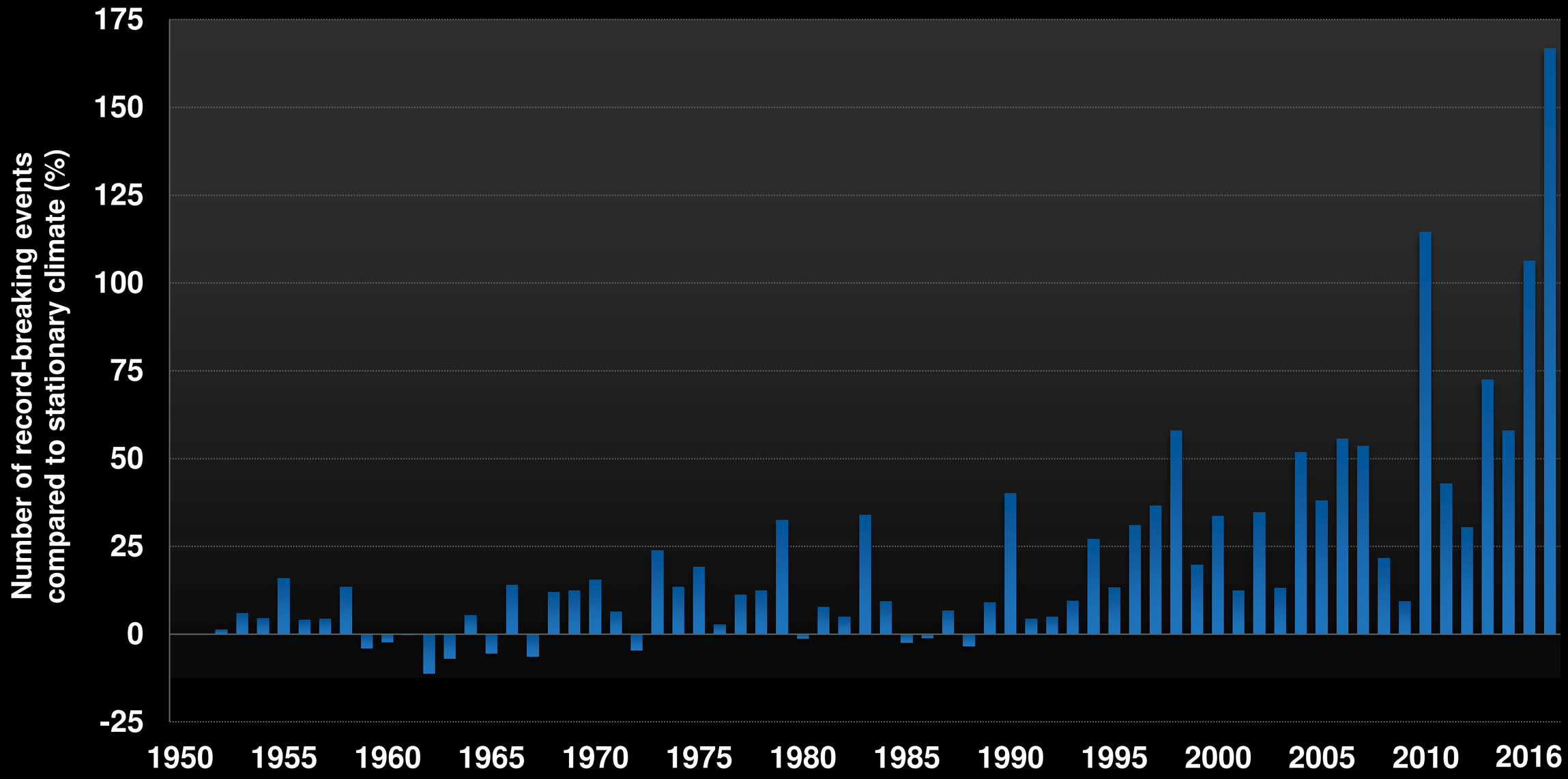
Philadelphia, Pennsylvania

September 2, 2021



Video © Paullee Wheatley-Rutner via Storyful

Global Record-Breaking Precipitation Anomalies



Data: Jascha Lehmann, Potsdam Institute for Climate Impact Research

Insol, Germany

July 15, 2021

Severe flooding in western Europe killed at least 220 people in July 2021.

Erftstadt-Blessem, Germany

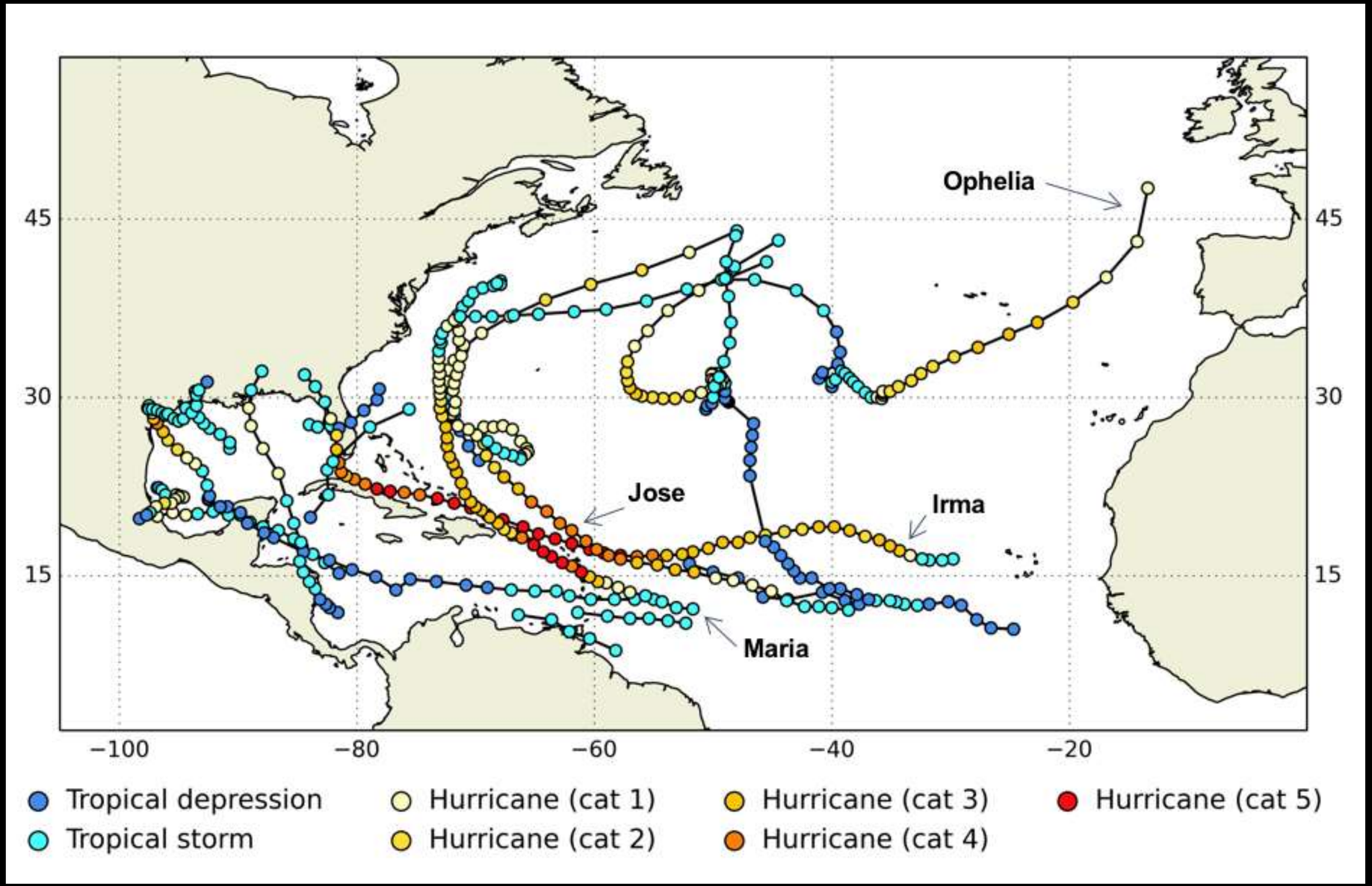
Before July 2021

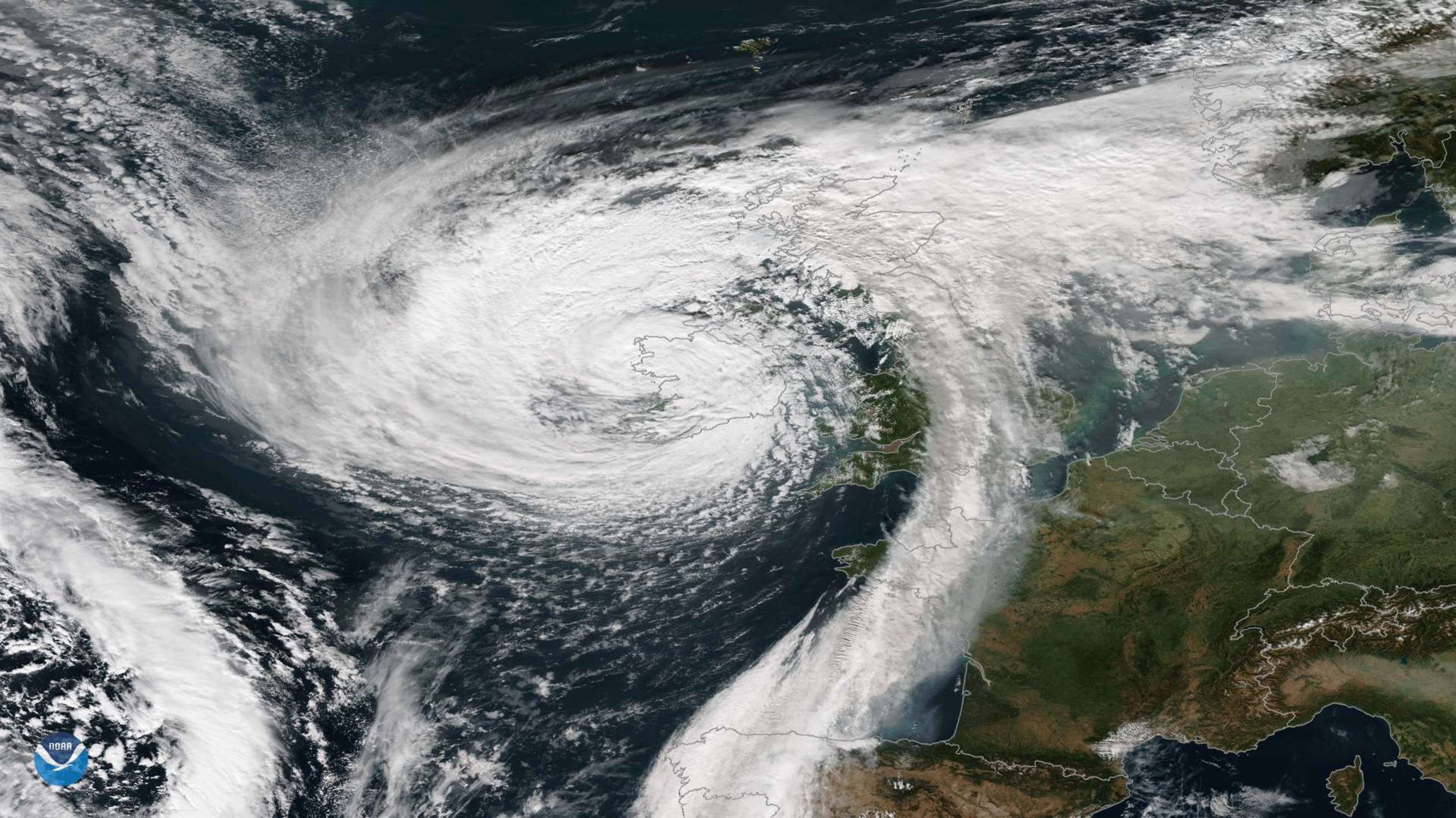
Photo © LANDSAT/Copernicus via Google Earth

Breil-sur-Roya, France

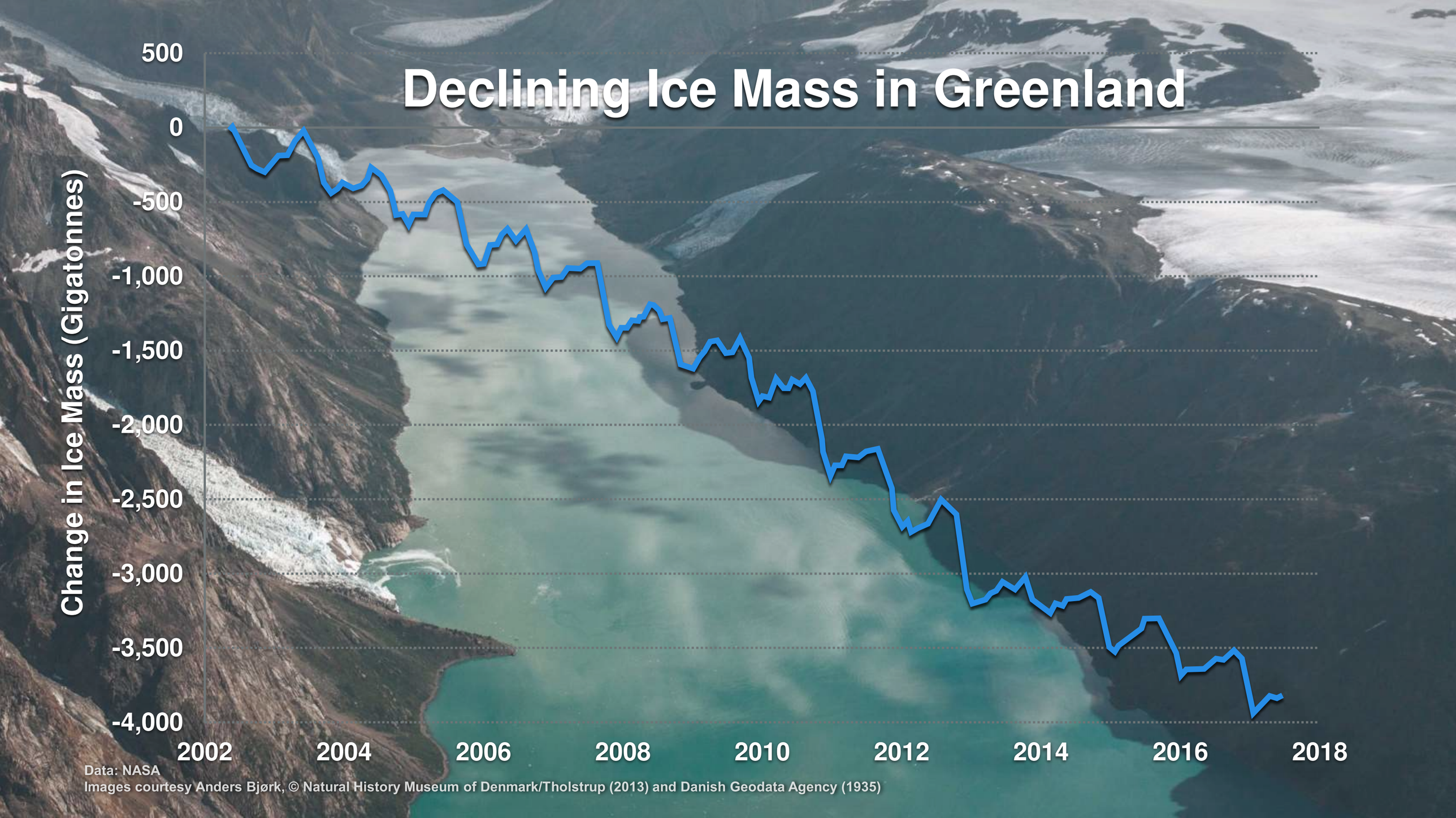
October 4, 2020

France and Italy experienced flooding and landslides after some areas received 58 cm (23 inches) of rain in 24 hours.


Ophelia
Jose
Irma
Maria
45
30
15
−100
−80
−60
−40
−20
Tropical depression
Tropical storm
Hurricane (cat 1)
Hurricane (cat 2)
Hurricane (cat 3)
Hurricane (cat 4)
Hurricane (cat 5)

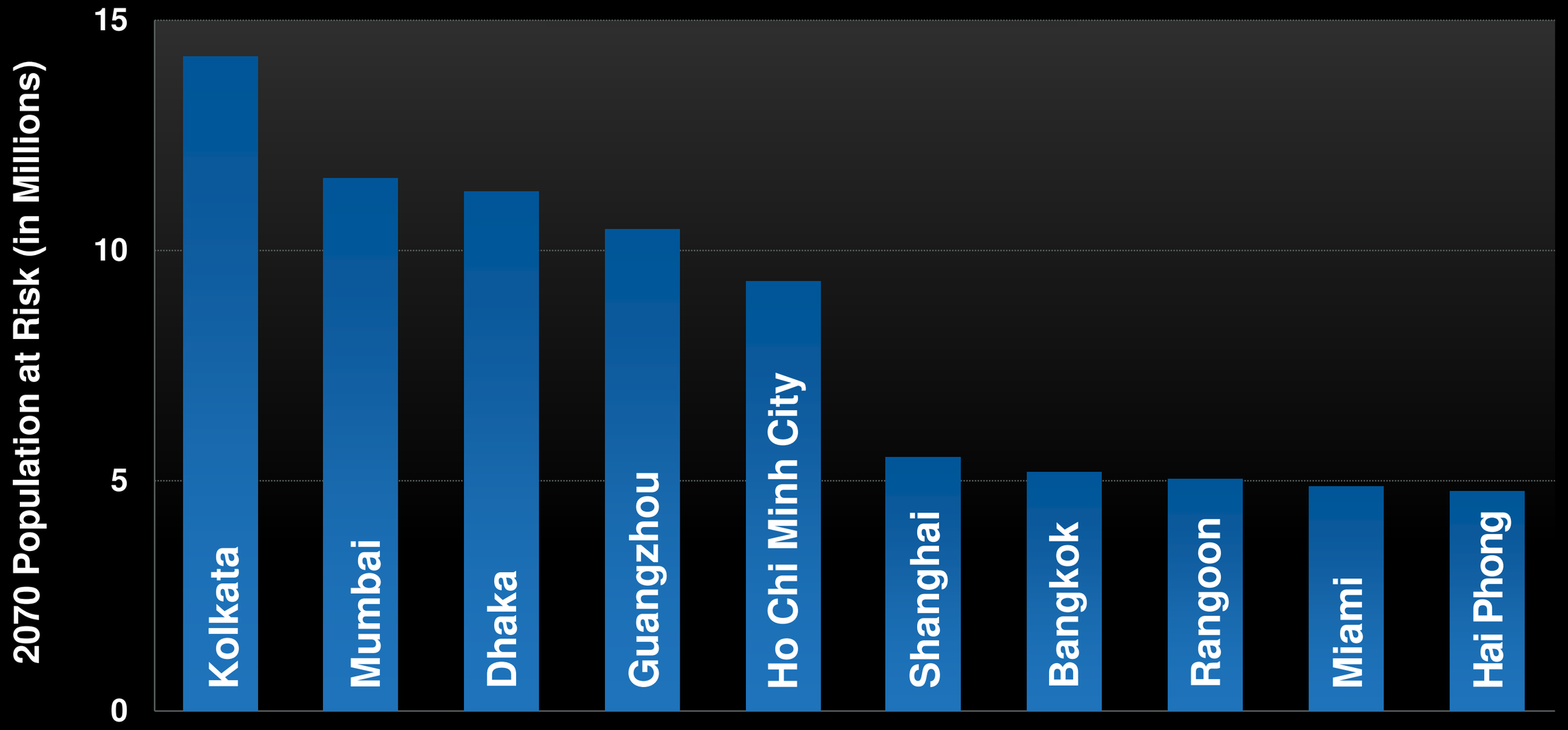

NOAA


Gloucestershire, England
February 21, 2020
Britain experienced
“unprecedented” flooding
in February 2020 as it was hit
by three major storms in a row,
including one designated
a “weather bomb.”
Photo © 2020 Ian Forsyth/Getty Images

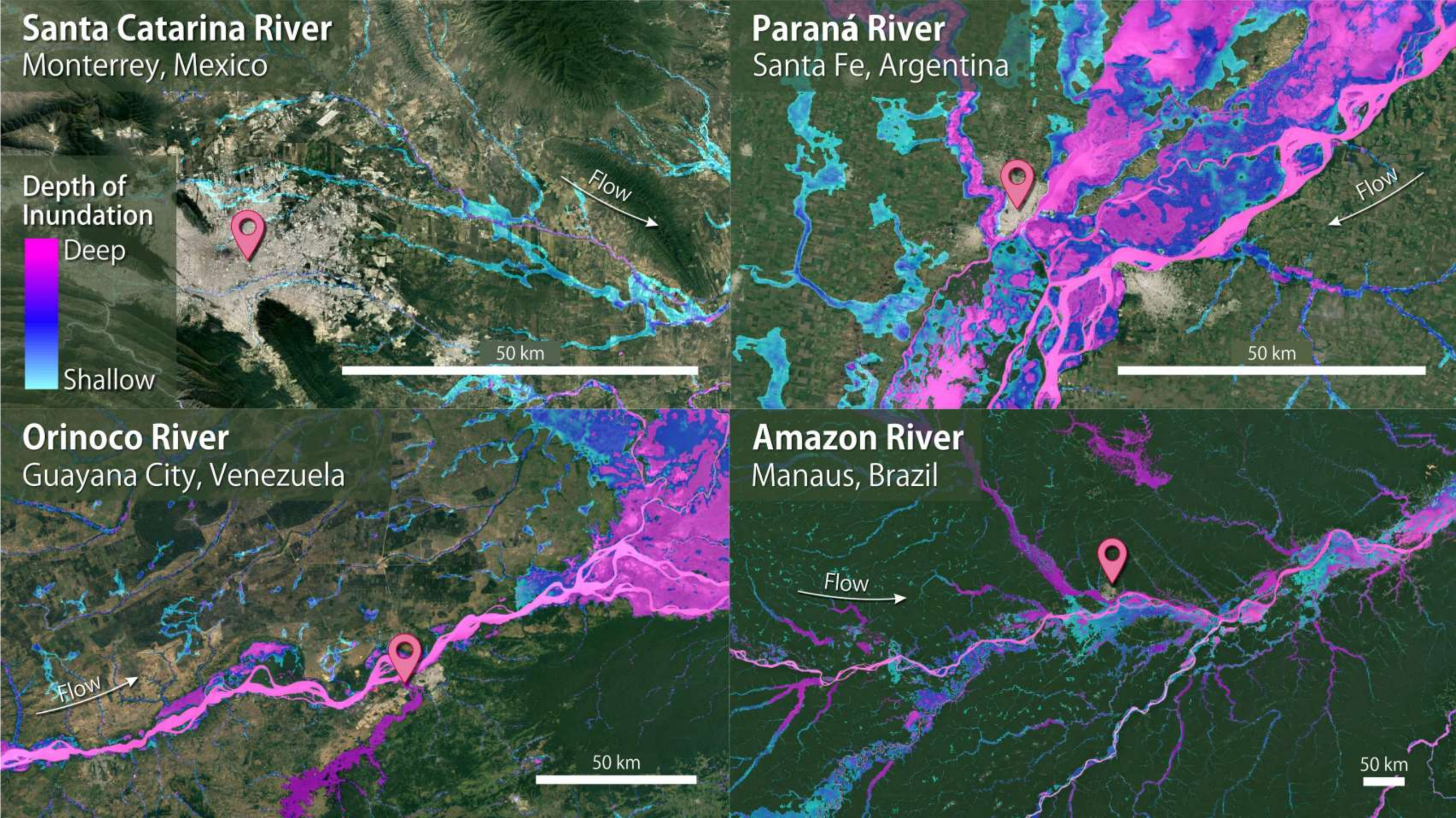

Declining Ice Mass in Greenland
Change in Ice Mass (Gigatonnes)
500
0
-500
-1,000
-1,500
-2,000
-2,500
-3,000
-3,500
-4,000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Data: NASA
Images courtesy Anders Bjørk, © Natural History Museum of Denmark/Tholstrup (2013) and Danish Geodata Agency (1935)

Top 10 Cities at Risk from Sea Level Rise in 2070

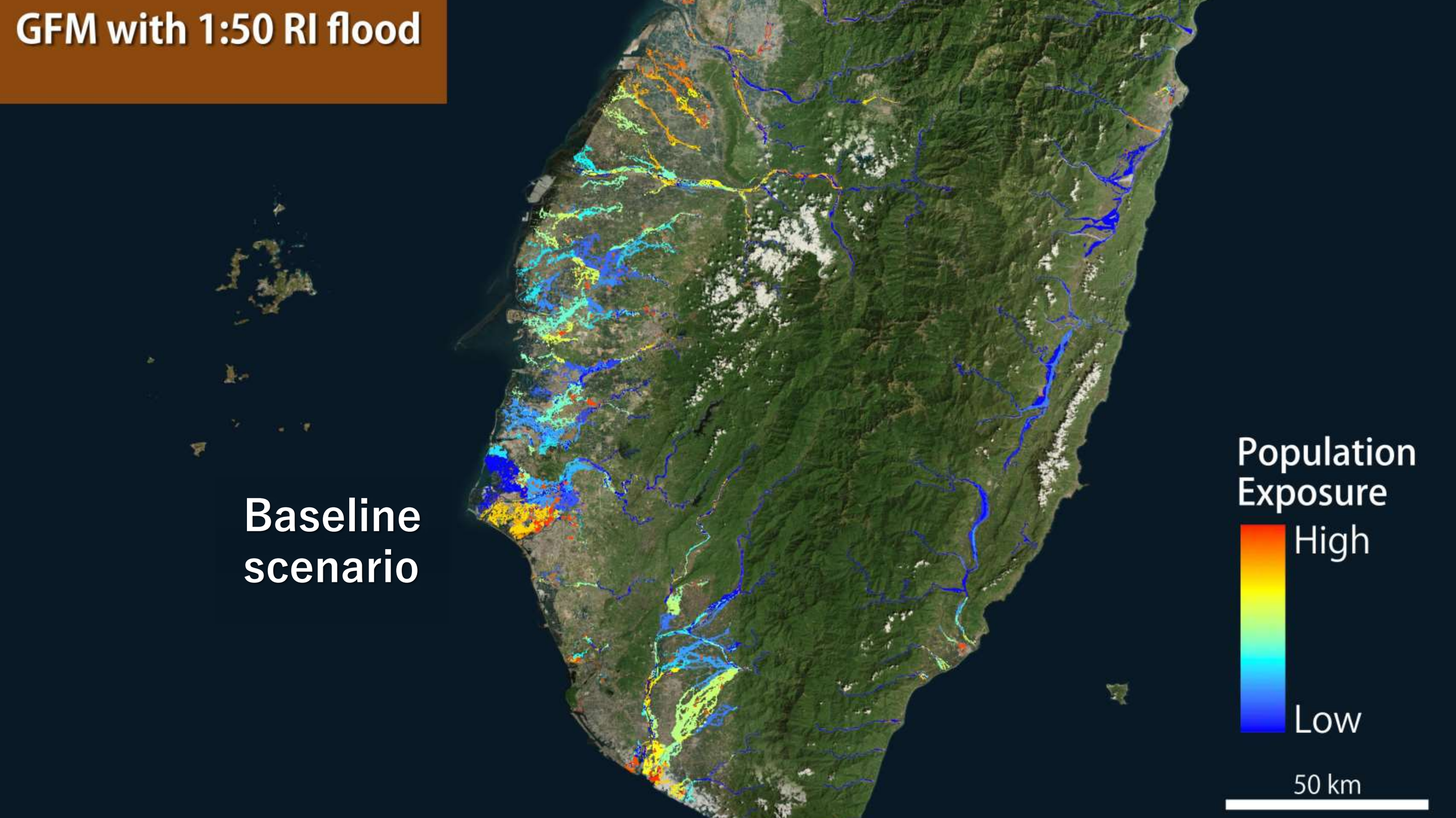
By Population at Risk

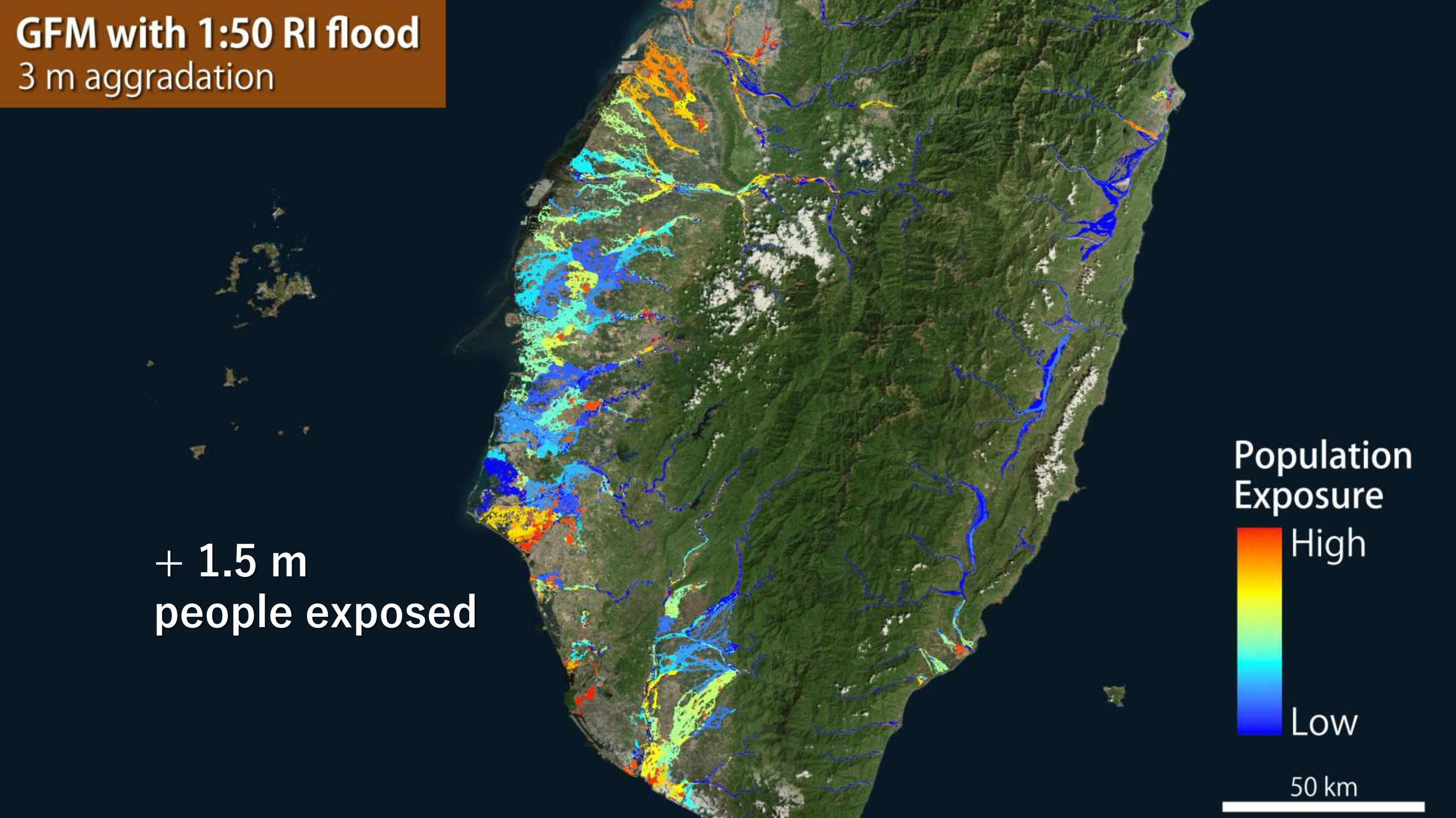


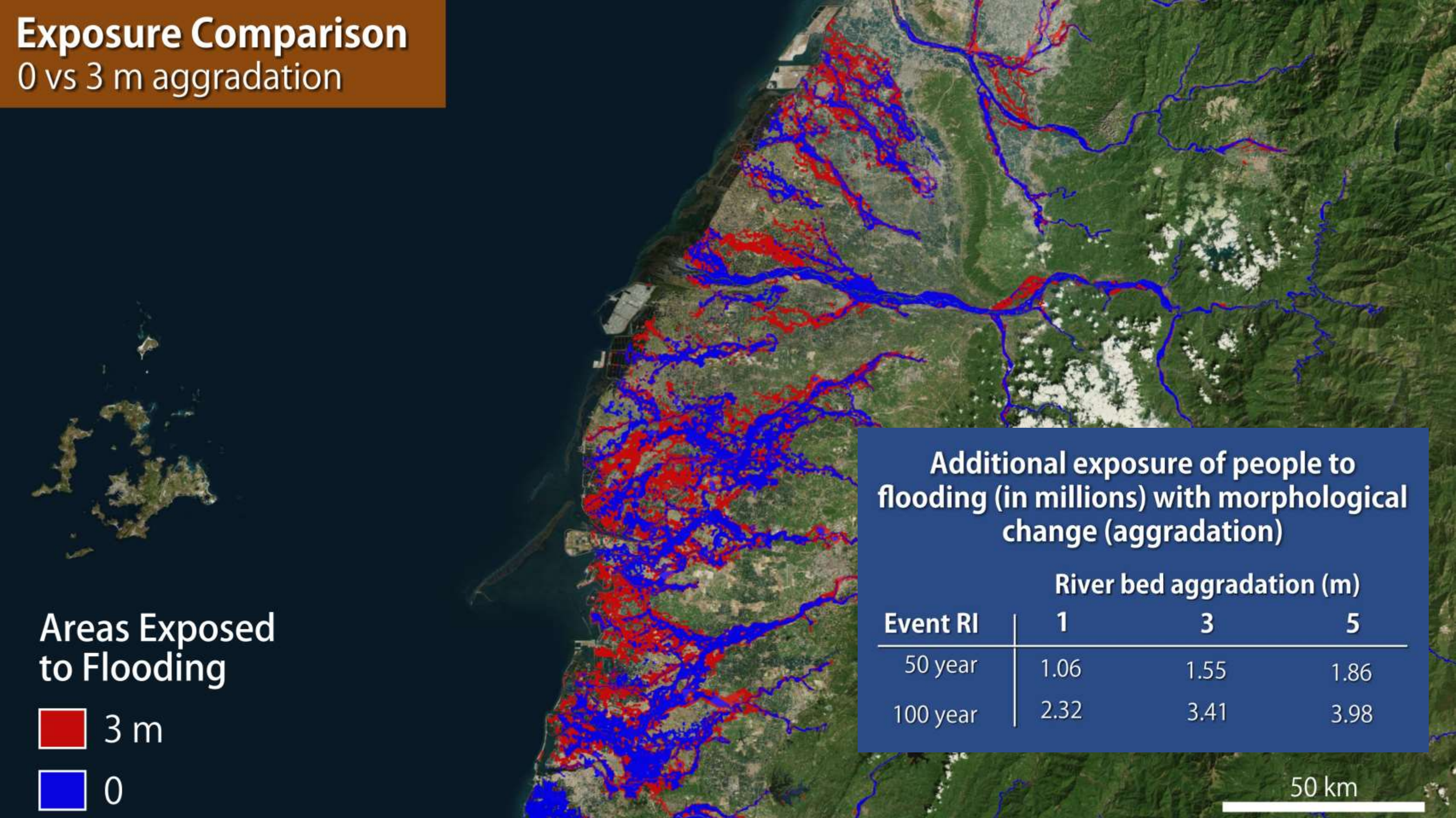
Data: Nichols, et al., OECD Environment Working Paper No. 1 (ENV/WKP(2007)1)


Santa Catarina River
Monterrey, Mexico
Depth of Inundation
Deep
Shallow
Flow
50 km
Paraná River
Santa Fe, Argentina
Flow
50 km
Orinoco River
Guayana City, Venezuela
Flow
50 km
Amazon River
Manaus, Brazil
Flow
50 km


Changhua County
1.3 million people
Chiayi County
0.5 million people
Taiwan
Tainan City
1.9 million people
Pingtung County
0.9 million people
50 km

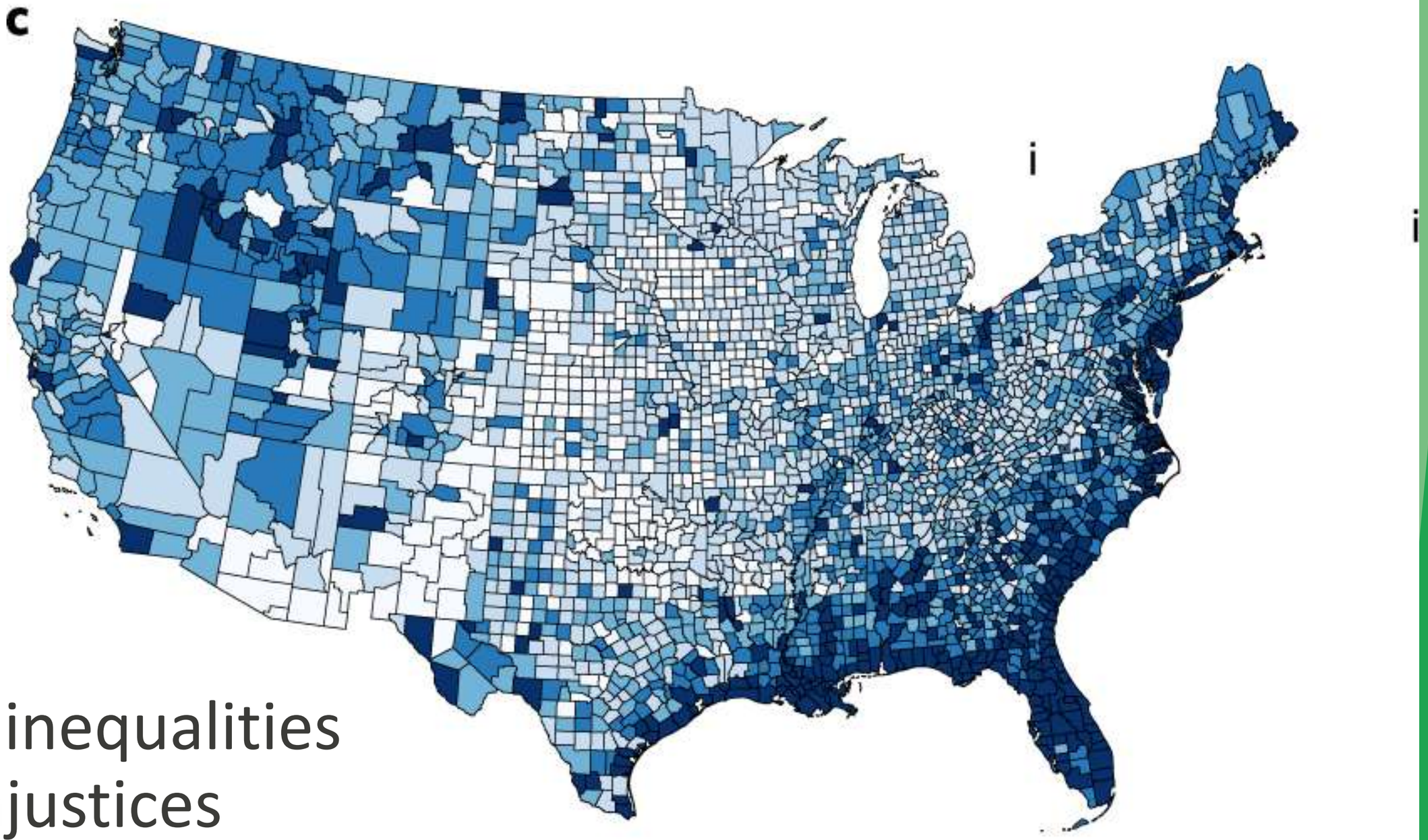

GFM with 1:50 RI flood
Baseline scenario
Population Exposure
High
Low
50 km


GFM with 1:50 RI flood
3 m aggradation
+ 1.5 m
people exposed
Population
Exposure
High
Low
50 km



Additional exposure of people to flooding (in millions) with morphological change (aggradation)

Event RI	River bed aggradation (m) 1	3	5
50 year	1.06	1.55	1.86
100 year	2.32	3.41	3.98



Flood inequalities and injustices

Thank You.

D.Parsons@Hull.ac.uk
@bedform

- Acknowledgements:

Climate Reality Project, NASA, ESA, BAS, NOAA, SIWRR

LIVING with WATER

Lee Pitcher
General Manager
Head of Partnerships

Global Impact

Background

1 metre
Forecast sea level rise to 2110

>95%
Area of city below highest tides

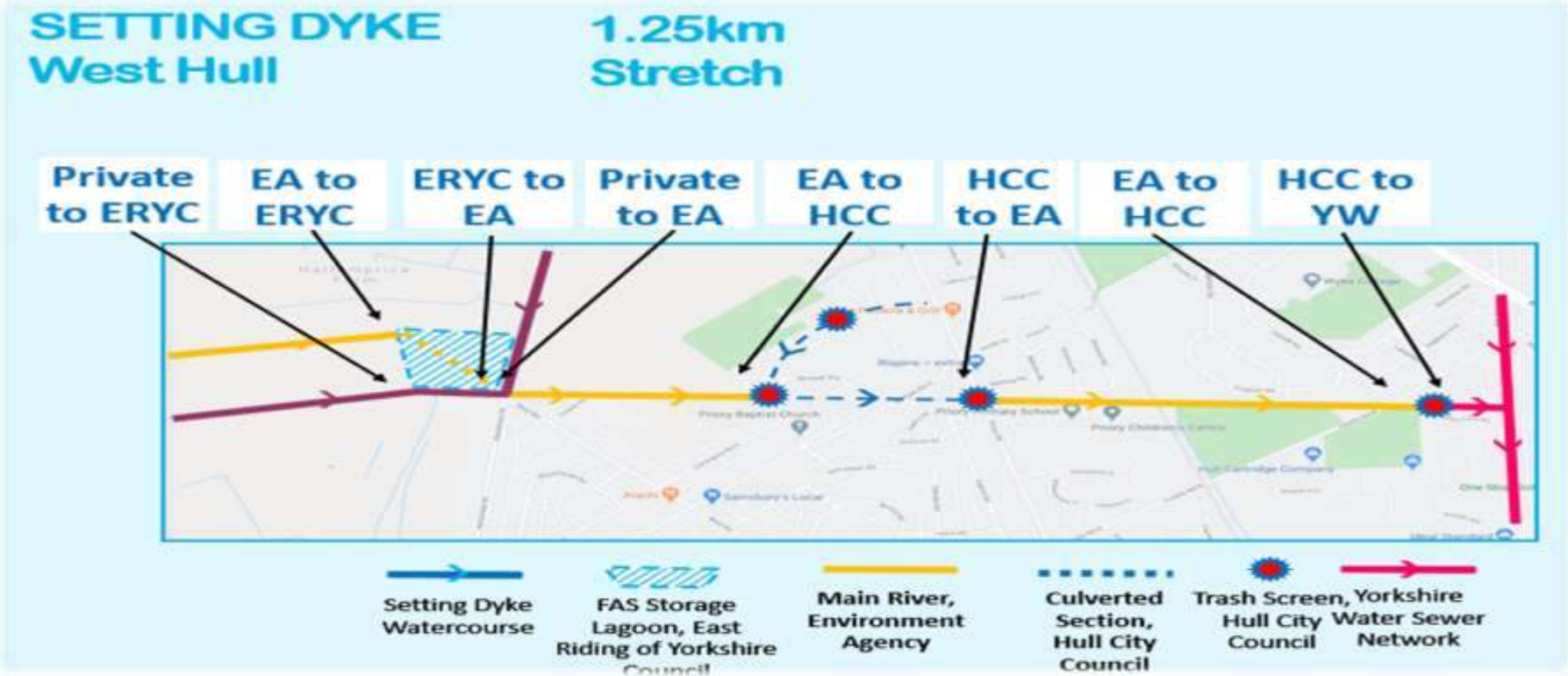
>20%
Of England's land drains through the Humber Estuary

95-98%
Dwellings at high risk of flooding

Background

84%

Surface water flows to combined sewers



Customer Impact

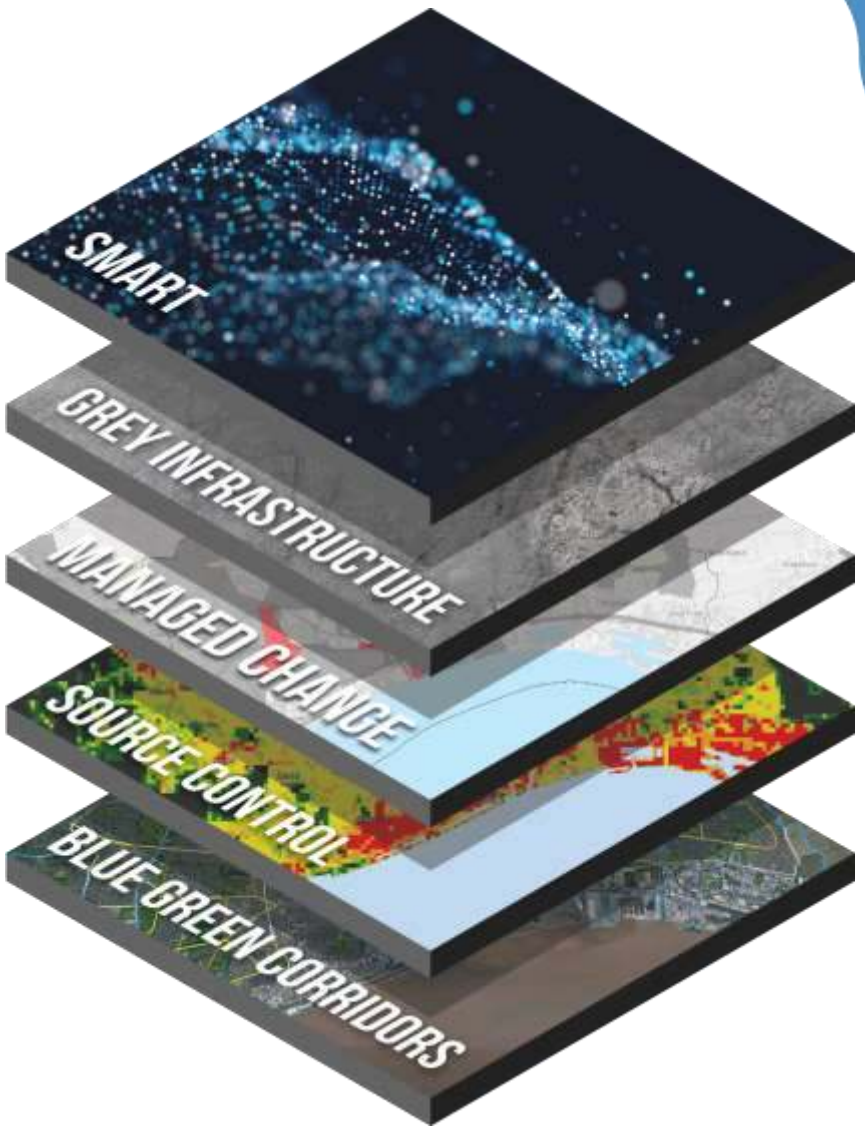
Living with Water – Transformation

..To thrive from water, not fear it

YorkshireWater · EAST RIDING OF YORKSHIRE COUNCIL · Environment Agency · Hull City Council · UNIVERSITY OF HULL

HULL AND EAST RIDING
LIVING with WATER

Reduce Flood Risk



Build Community Resilience

Improve Place

Enhance Economy

Share Knowledge

YorkshireWater
EAST RIDING OF YORKSHIRE COUNCIL
Environment Agency
Hull City Council
UNIVERSITY OF HULL

HULL AND EAST RIDING
LIVING with WATER

Build Community Resilience

Reduce Flood Risk

Improve Place

Enhance Economy

Share Knowledge

YorkshireWater
EAST RIDING OF YORKSHIRE COUNCIL
Environment Agency
Hull City Council
UNIVERSITY OF HULL

Enhance Economy

Reduce Flood Risk

Build Community Resilience

Improve Place

Share Knowledge

HULL AND EAST RIDING
LIVING with WATER

Improve Place

Reduce Flood Risk

Build Community Resilience

Enhance Economy

Share Knowledge

YorkshireWater

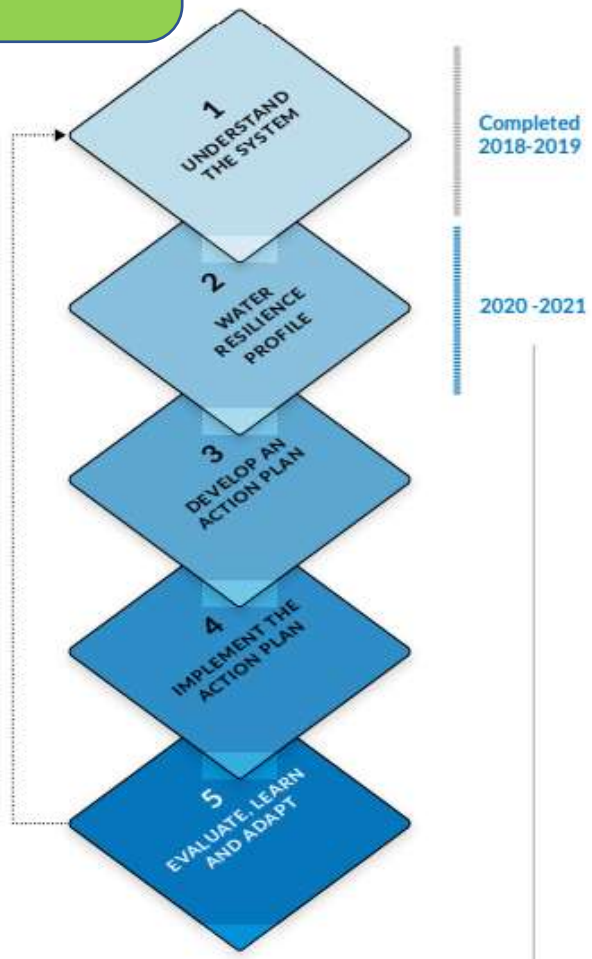
EAST RIDING OF YORKSHIRE COUNCIL

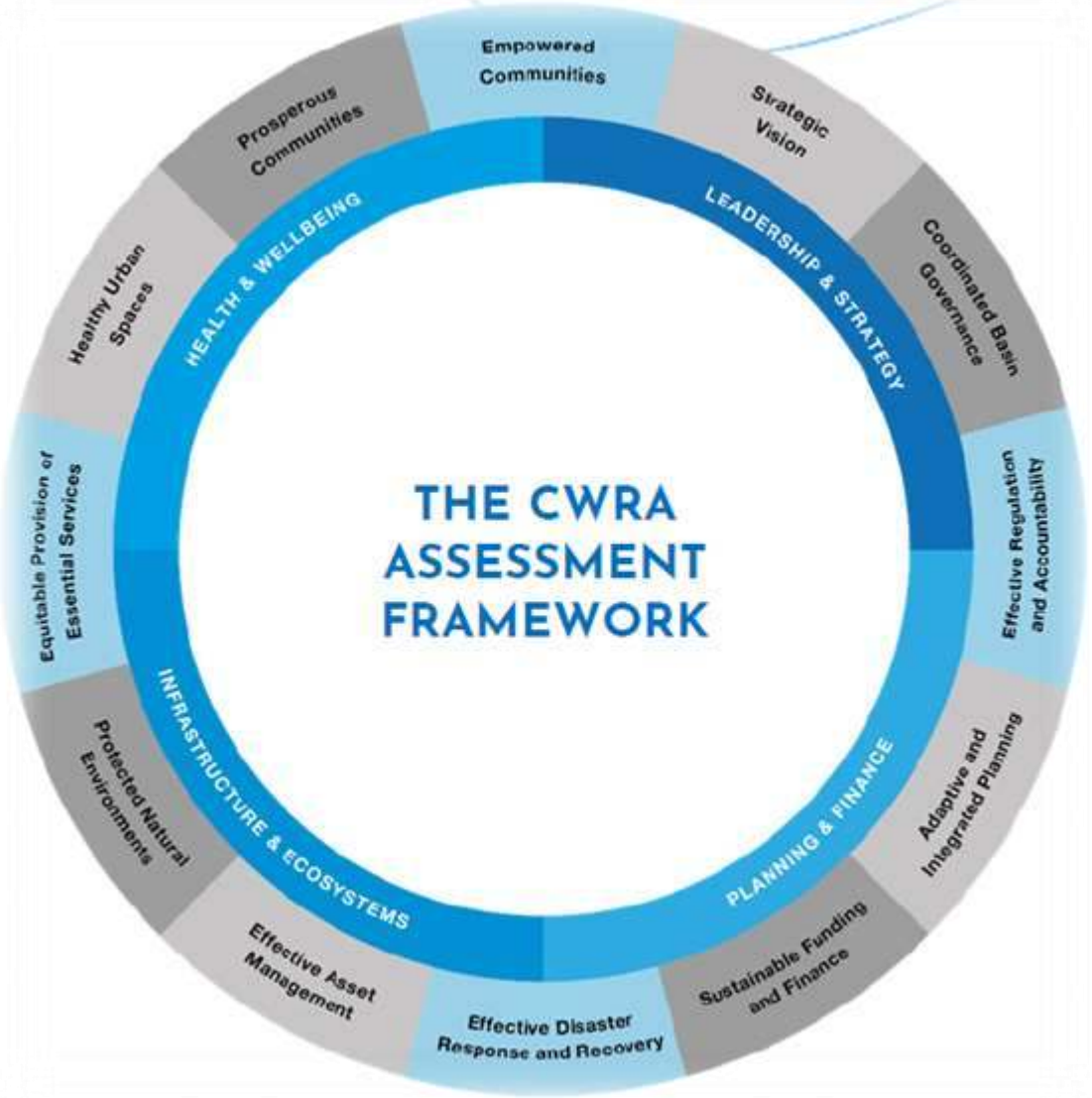
Environment Agency

Hull City Council

UNIVERSITY OF HULL

Share Knowledge





HULL AND EAST RIDING LIVING with WATER

Reduce Flood Risk

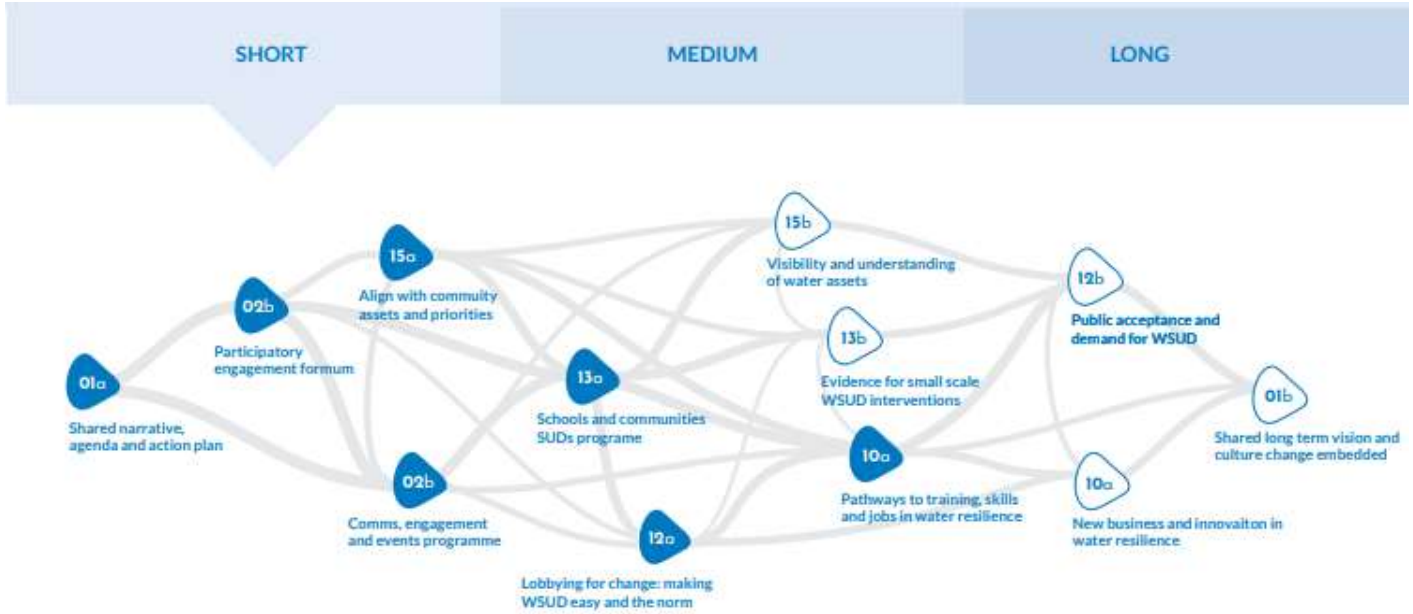
Build Community Resilience

Enhance Economy

Improve Place

YorkshireWater · EAST RIDING OF YORKSHIRE COUNCIL · Environment Agency · Hull City Council · UNIVERSITY OF HULL

Leadership and Strategy



CITY WATER RESILIENCE ASSESSMENT
HULL AND HALTEMPRICE

WATER RESILIENCE PROFILE

Working in partnership to make Hull a resilient city living in harmony with water

www.LivingWithWater.co.uk

Regional case studies

Break out rooms

National Trust

Landscape Restoration in the South Pennines

Rosie Holdsworth; Countryside & Partnerships Manager

Jess Yorke; Land Outdoors and Nature Project Manager

Common Cause Partnership

We are **two of the biggest land owners in Yorkshire** who own land for public benefit (40,000ha in total), providing us with an **opportunity to engage with a large proportion of the Yorkshire population** (1/4 million NT members, 5 million YW customers).

Working in partnership not only adds value **by coordinating management approaches at a landscape scale**, but provides business cost benefits too

Delivery of landscape restoration projects across our landholdings are a key partnership workstream

Growing Resilience

Project sites at YW **Gorpley Reservoir** (Todmorden), NT **Hardcastle Crags** (Hebden Bridge) and NT/YW **Wessenden Valley** (Marsden)

Project Headlines

- Over 1,200 NFM interventions:
  - Timber, living willow, stone, plastic and turf dams
  - Peat bunds
  - Ephemeral ponds
- 160Ha Peatland restoration
- 50Ha Heathland restoration
- Invasive species control
- Erosion control
- Woodland creation
- SuDS Car Park
- University of Leeds monitoring project

West Yorkshire Combined Authority

National Trust

YorkshireWater

White Rose Forest

Woodland Trust

National Trust

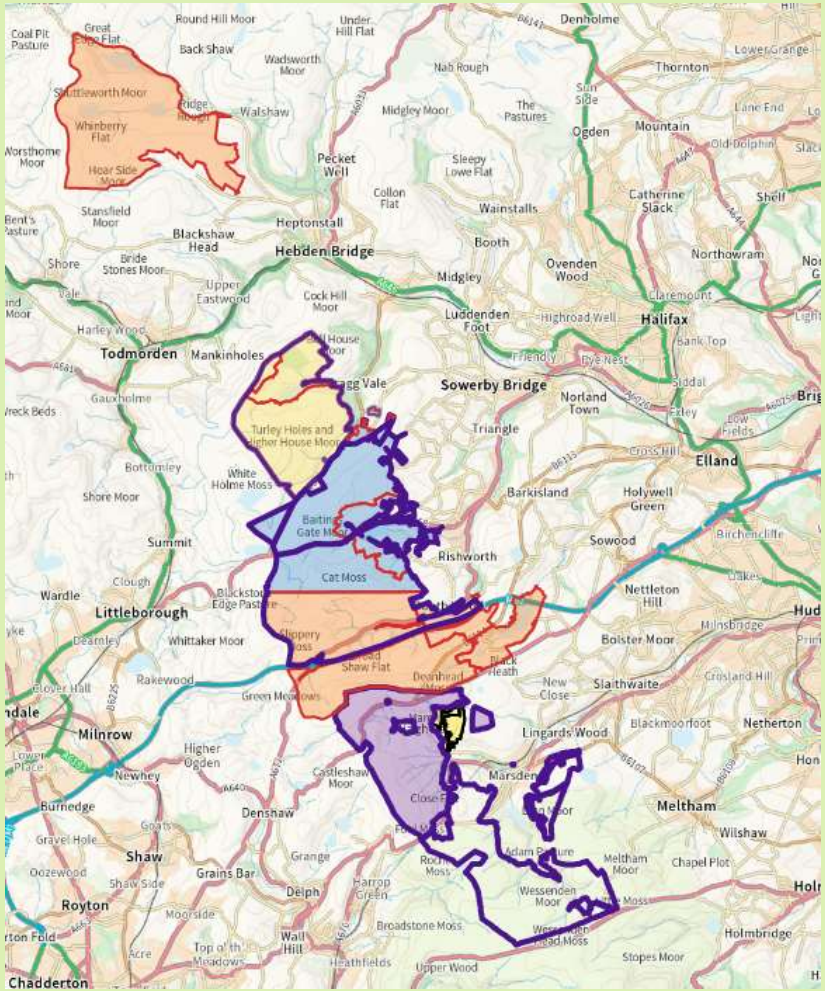
Growing Resilience; Outcomes & Learning

Carbon sequestered and properties better protected proved difficult to accurately demonstrate within the bounds of the project

Modelling NFM is difficult!

Ongoing monitoring is key to demonstrating success

Landscape scale habitat restoration is difficult, but it is realistic and possible!



Landscapes for Water

Project sites across NT, YW & third party land across the South Pennines

- **Widdop and Gorple** (YW)
- **Withens Clough** (YW)
- **Baitings Reservoir** (YW)
- **M62 corridor** (YW)
- **March Haigh** (NT & third party)

Initial Project Scope

- £12.5m, 5 year delivery project
- c.670ha of new broadleaf woodland
- c.500ha peatland restoration
- c.9000 NFM interventions
- c.110 volunteer days
- 5 year NFM monitoring project

Calderdale Council

National Trust

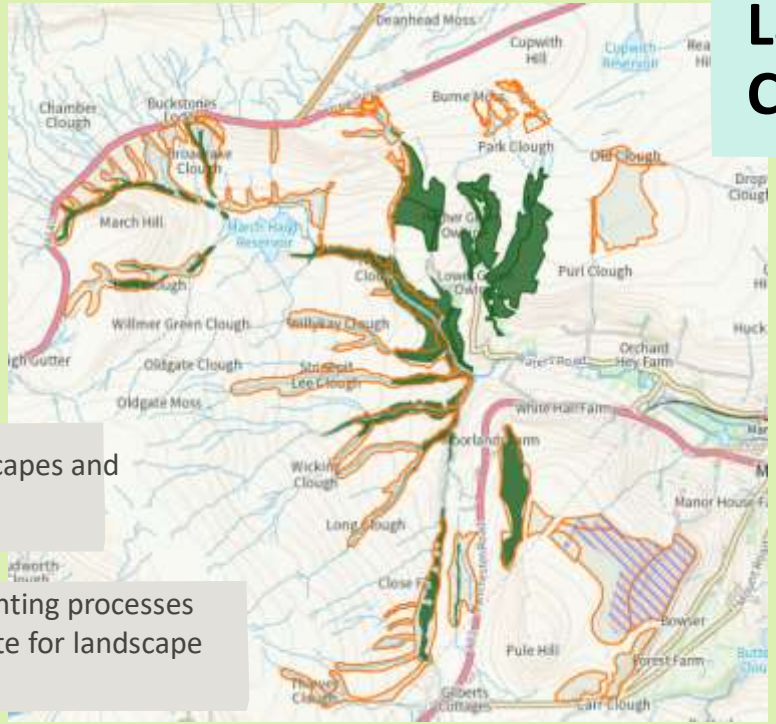
YorkshireWater

White Rose Forest

Woodland Trust

National Trust

Landscapes for Water; Challenges & Learning

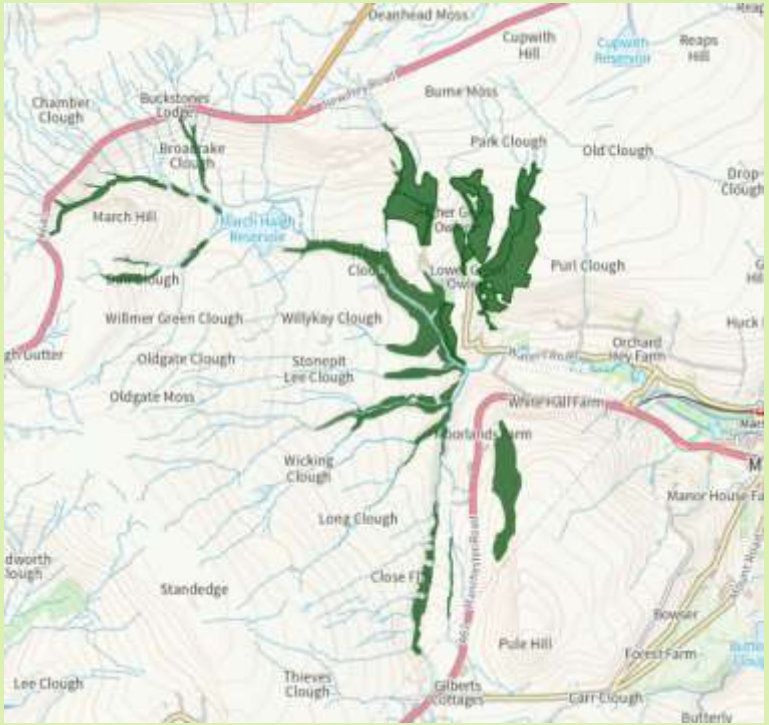


Designated landscapes and statutory scrutiny

Design and consenting processes are not appropriate for landscape scale projects

Outcome focused approach is required

Holistic view of project deliverables is needed to recognise **multiple benefits** rather than looking at things in isolation



Natural Environment Investment Readiness Fund

National Trust

Finance Gap for UK Nature

Income Stream Overview

Three income stream groups were identified as having potential to attract private finance for the L4WProject.

Woodland & Peatland Carbon

1. Woodland creation and peatland restoration generate carbon benefits
2. Carbon credits are verified with an existing code meaning revenue potential is much firmer as an existing market
3. Credits are sold over a defined timescale based on project carbon profiles

Biodiversity Net Gain (BNG)

1. Woodland creation and peatland restoration create biodiversity benefits
2. Improvements in biodiversity can be measured through the Biodiversity Metric 3.0, though few transactions have taken place to date
3. BNG units are sold over time to developers required to mitigate biodiversity impact from development activity

Natural Flood Management & Water Outcomes

1. NFM interventions deliver flood resilience and other water benefits
2. These benefits generate cost savings for organisations (e.g. water company, local organisations, insurance companies)
3. On a bespoke basis, these organisations share the financial benefits with the project based on the level of outcomes experienced

National Trust

YorkshireWater

WOODLAND TRUST

White Rose Forest