Source: Lechlade 2013, Nostalgic Teresa

CLIMATE AND FLOOD PREDICTION:

USING FLOOD FORECASTING SYSTEMS TO INFORM DISASTER RISK REDUCTION SOLUTIONS

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Scenario DOCTORAL TRAINING PARTNERSHIP

UKRI Natural Environment Research Council

JBA trust

JBA consulting

Flood Foresight

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TALK OUTLINE:

- Types of flooding (UK)
- How a warmer climate impacts flooding (UK)
- 2022 a year of new extremes
- Disaster Risk Reduction
- Global flood forecasting systems
- Detecting flooding from Space
- Forecast flood map evaluation

SURFACE WATER / PLUVIAL FLOODING

London, July 2021. Source: UKNewsInPictures

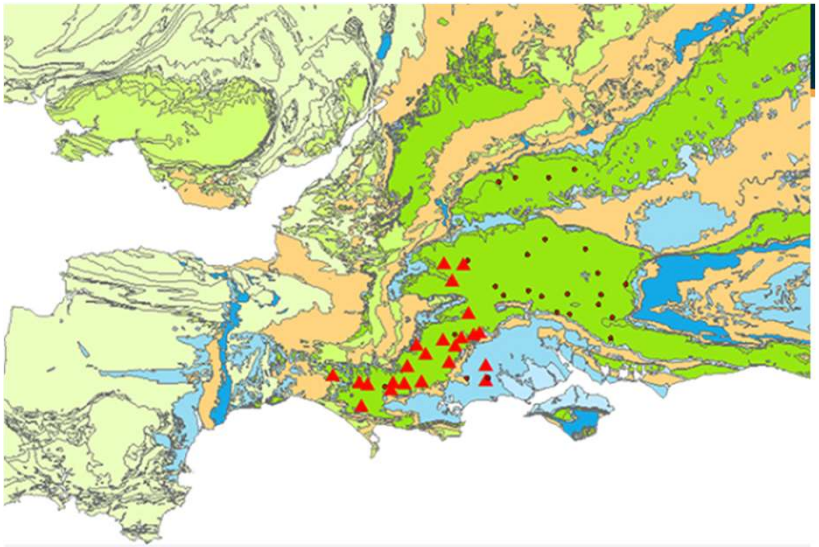
COASTAL FLOODING

Wells Norfolk, Jan 2022. Source: Reg Holl

RIVER / FLUVIAL FLOODING

Bewdley, Feb 2022. Source: Thomas Parkes

GROUND WATER FLOODING



Map showing groundwater flood warnings (triangles) and alerts (dots) on the Chalk aquifer (dark green) in Wessex, on 18 Feb 2020.

Coverack Flood, July 2017

CAUSE OF FLOODING?

- Localised, prolonged extremely heavy rainfall
- Nearest rain gauge, just 8 km away….dry!
- 3-hour rainfall estimates from radar 165 – 201 mm
- Rapid surface water accumulations and overland flow
- ½ million m^3 of water

IS THAT A LOT?

- Rainfall rate >60mm/hr
- Storm Alex (2020) brought the UK's wettest day ever and Reading recorded a new 2-day record rainfall amount of 86.4mm.

Source: JBA Technical Summary Report March 2018

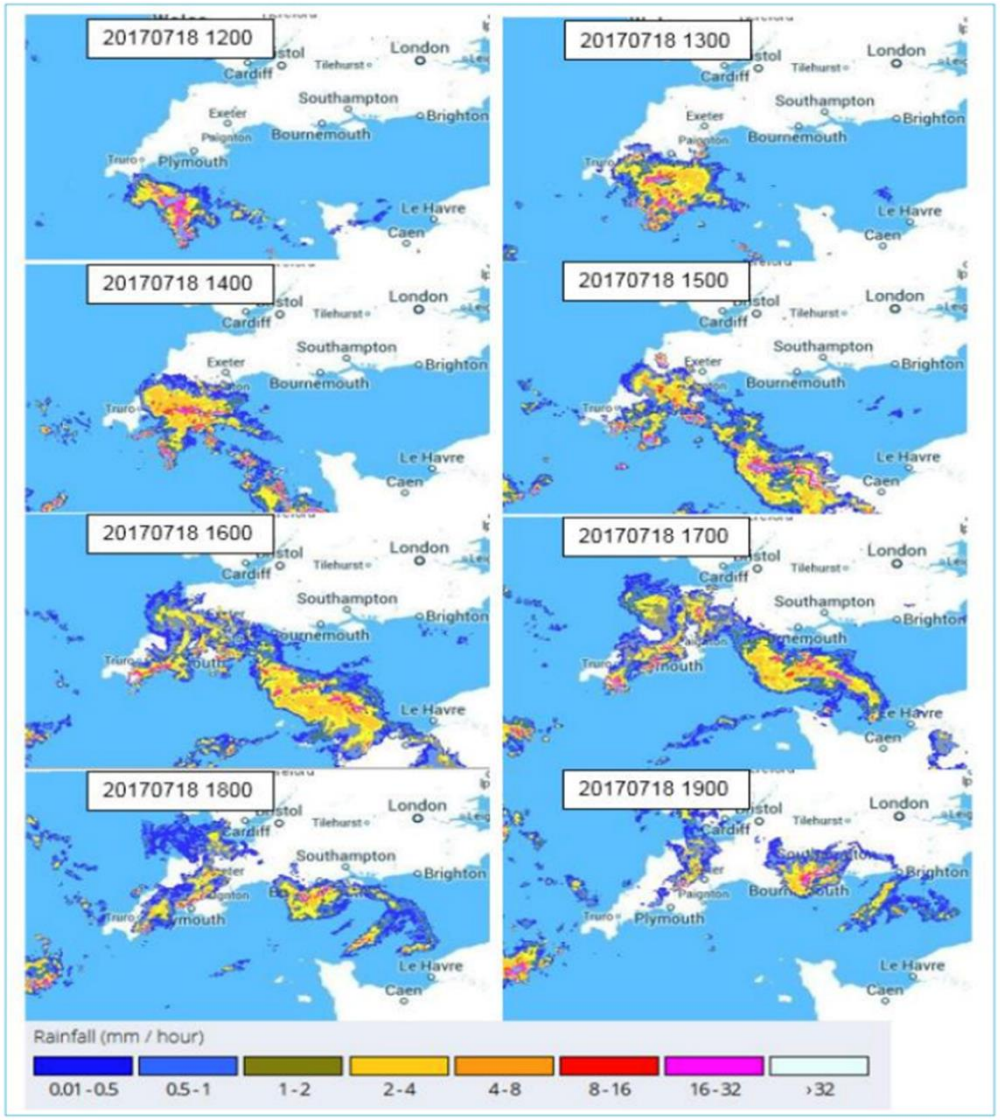


Figure 3-1 - Screenshot of radar rainfall (Source: JBA Risk Management post-event analysis note[2], original source Met Office)

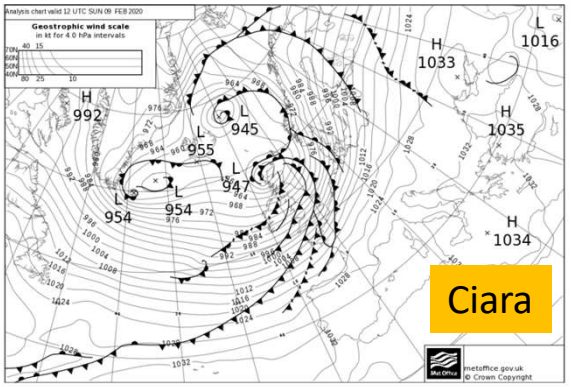

Source: Rob Cheetham


Source: Rob Cheetham

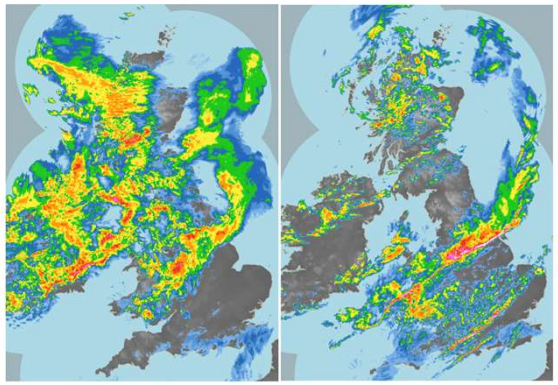
IMPACTS:

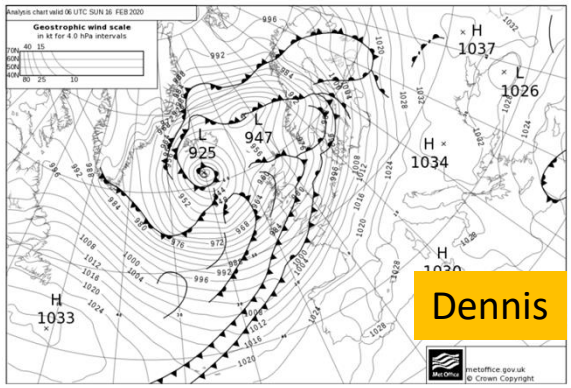
- High risk to life
- Significant erosion
- Vehicle damage
- 50 properties affected
- Hail damage
- Pollution
- Landslips
- Reduced visitors
- Community supported recovery

Source: BBC website

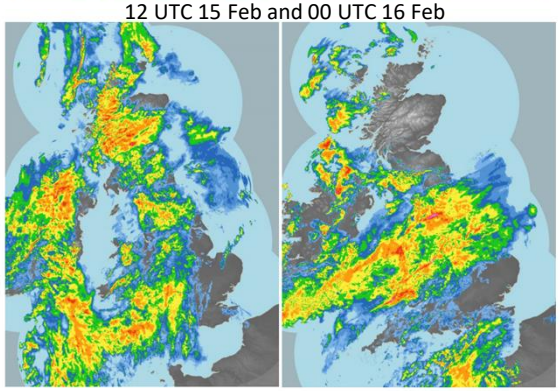


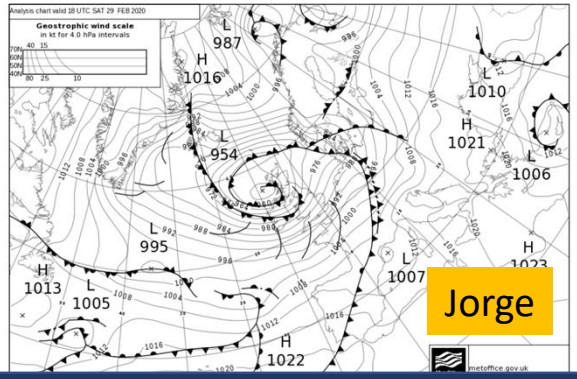
c) 0600 UTC 9 February 2020 d) 1200 UTC 9 February 2020

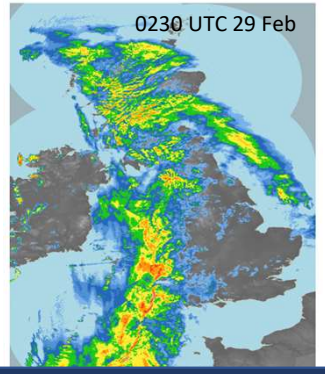




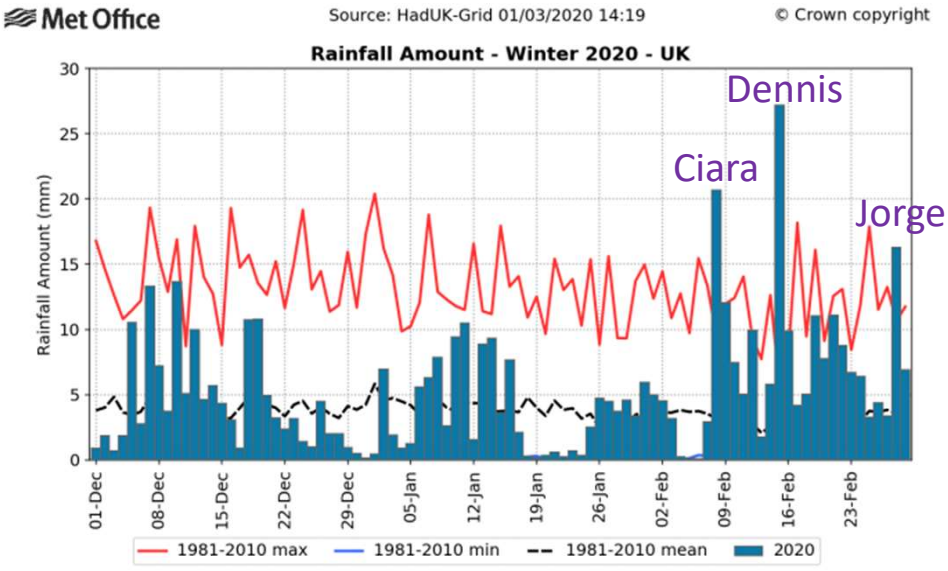
12 UTC 15 Feb and 00 UTC 16 Feb

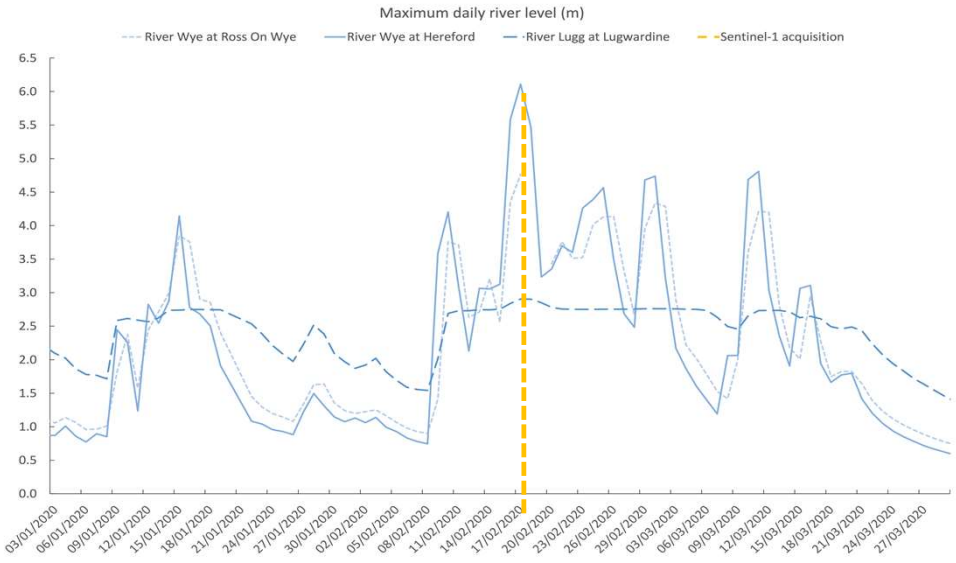


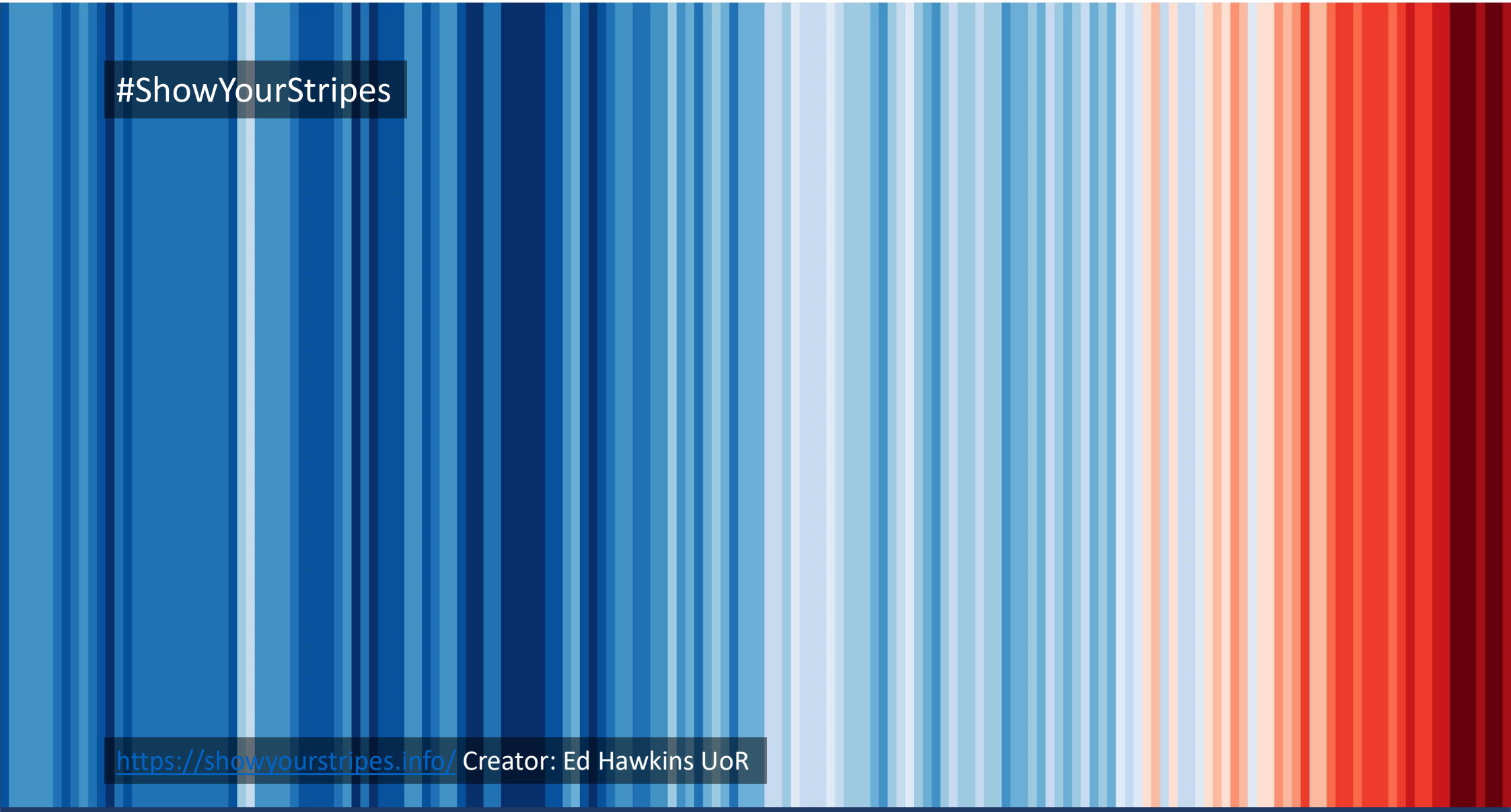


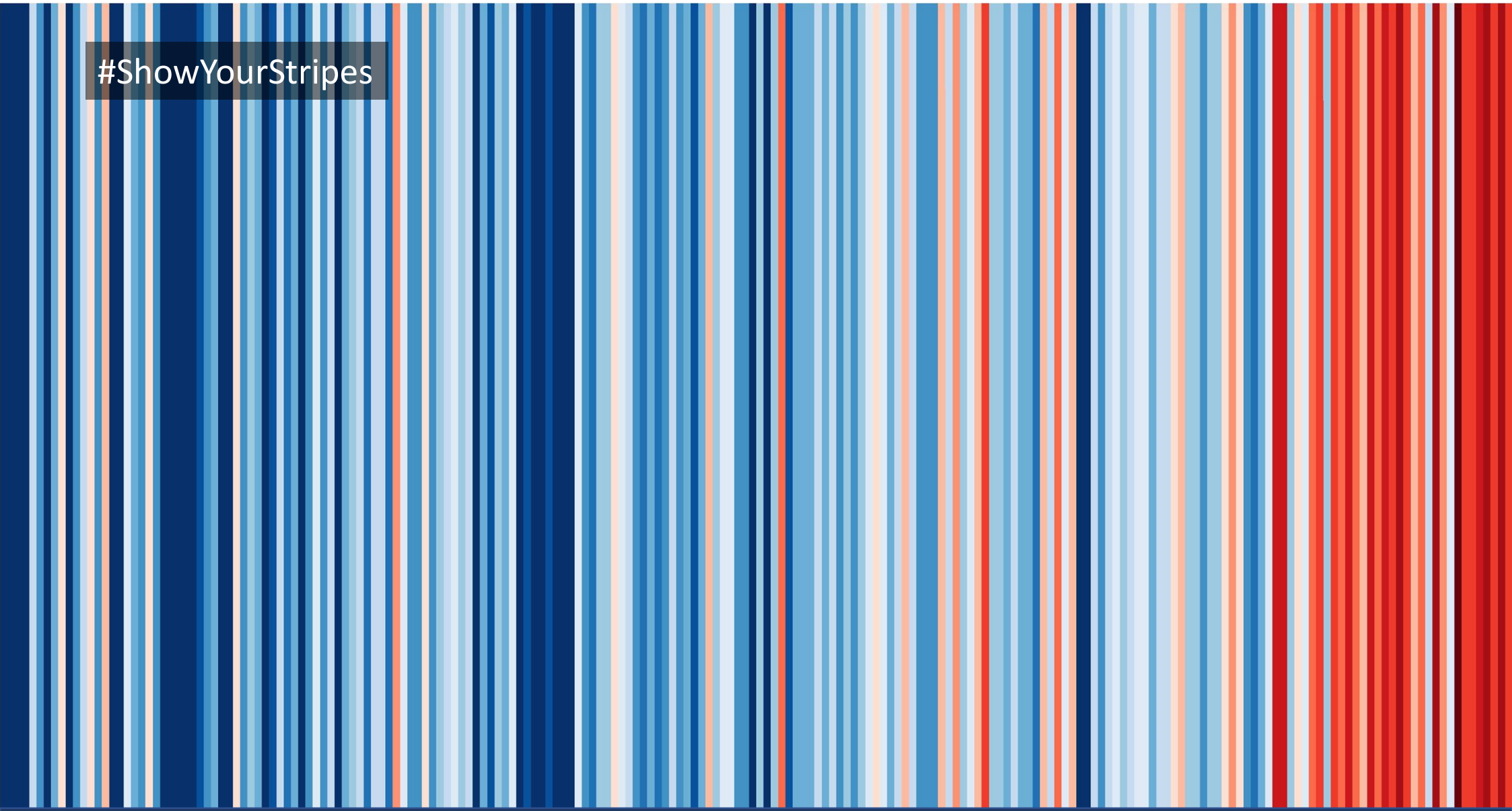


Three named Storms February 2020






#ShowYourStripes
https://showyourstripes.info/ Creator: Ed Hawkins UoR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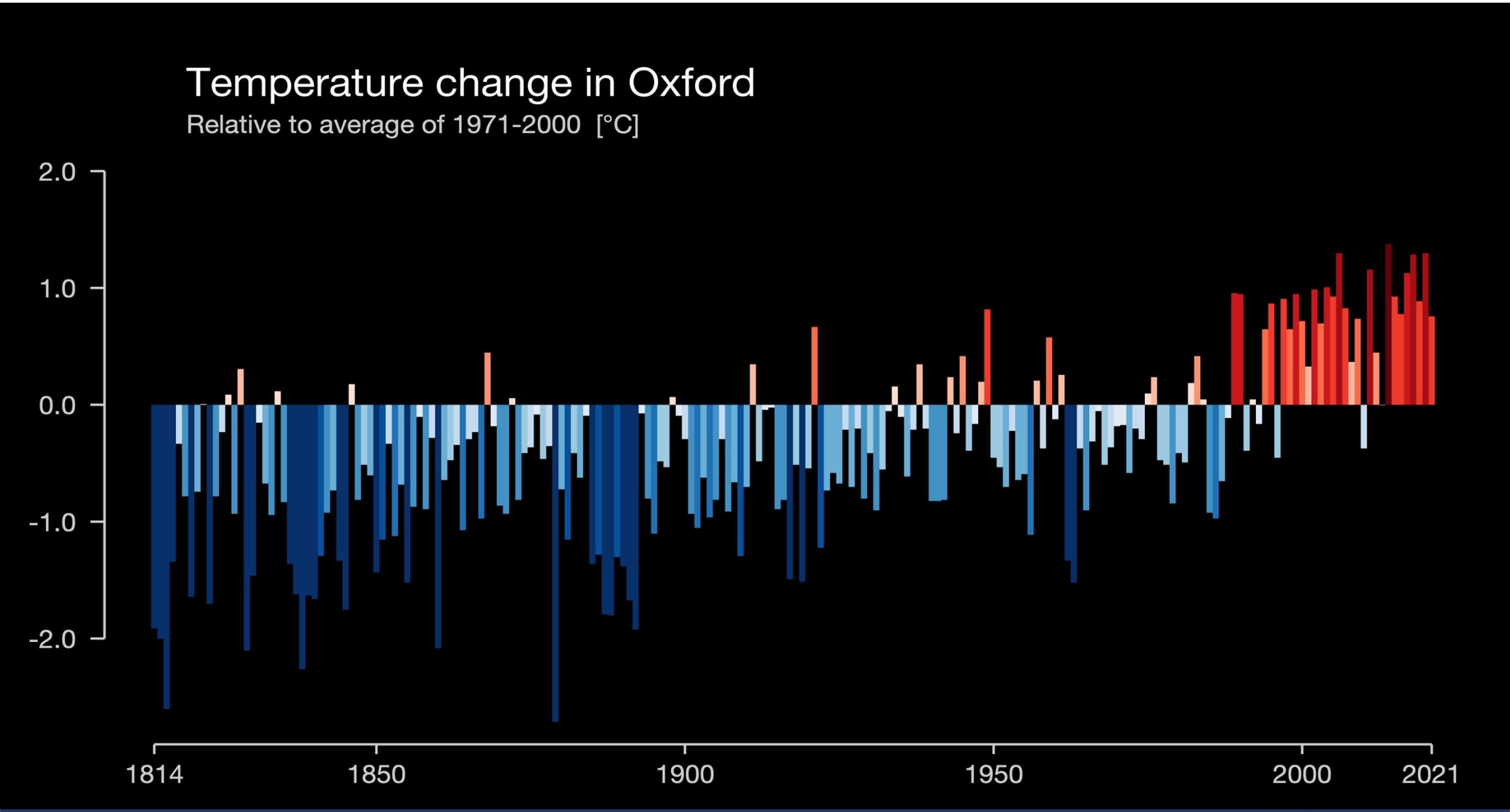
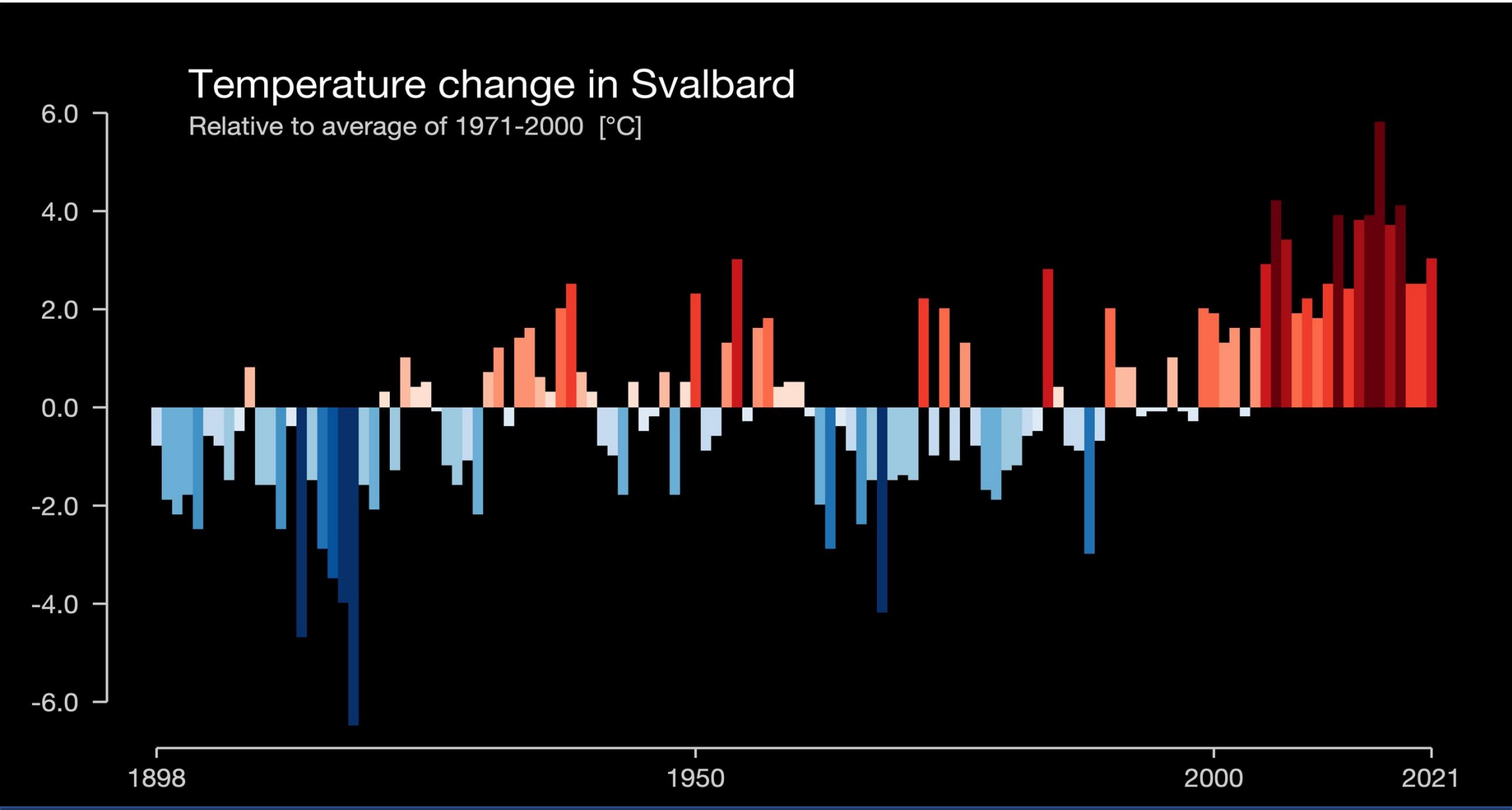

Temperature change in Oxford
Relative to average of 1971-2000 [°C]
2.0
1.0
0.0
-1.0
-2.0
1814
1850
1900
1950
2000
2021

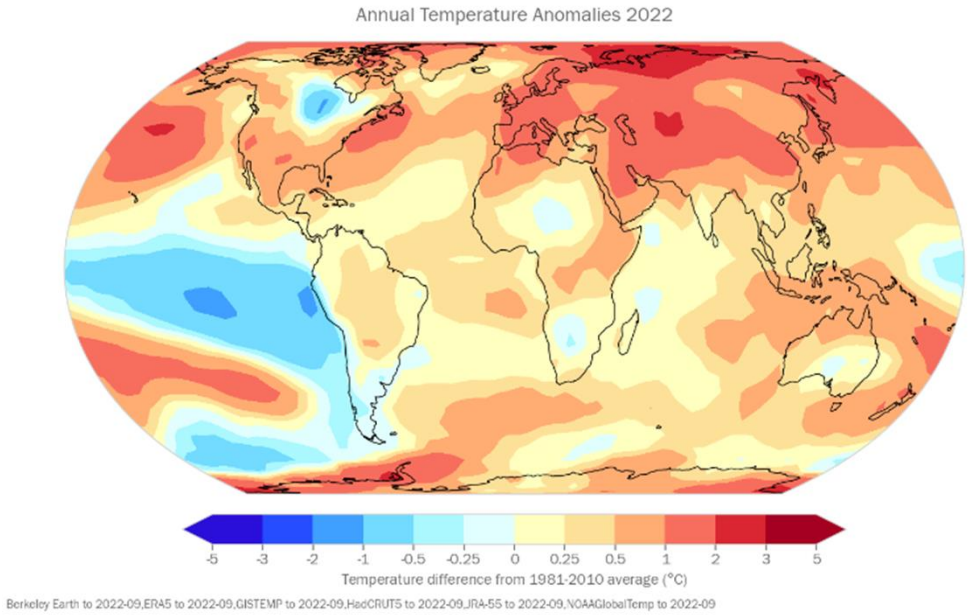

Temperature change in Svalbard
Relative to average of 1971-2000 [°C]
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
1898
1950
2000
2021

Global Mean Surface Temperature 2022

From January-September 2022, GMST was **1.15 ± 0.13 °C** warmer than the pre-industrial baseline (1850-1900).

Despite La Niña conditions keeping global temperature low for the second consecutive year, **2022 is still likely to be 5th or 6th warmest year on record.**

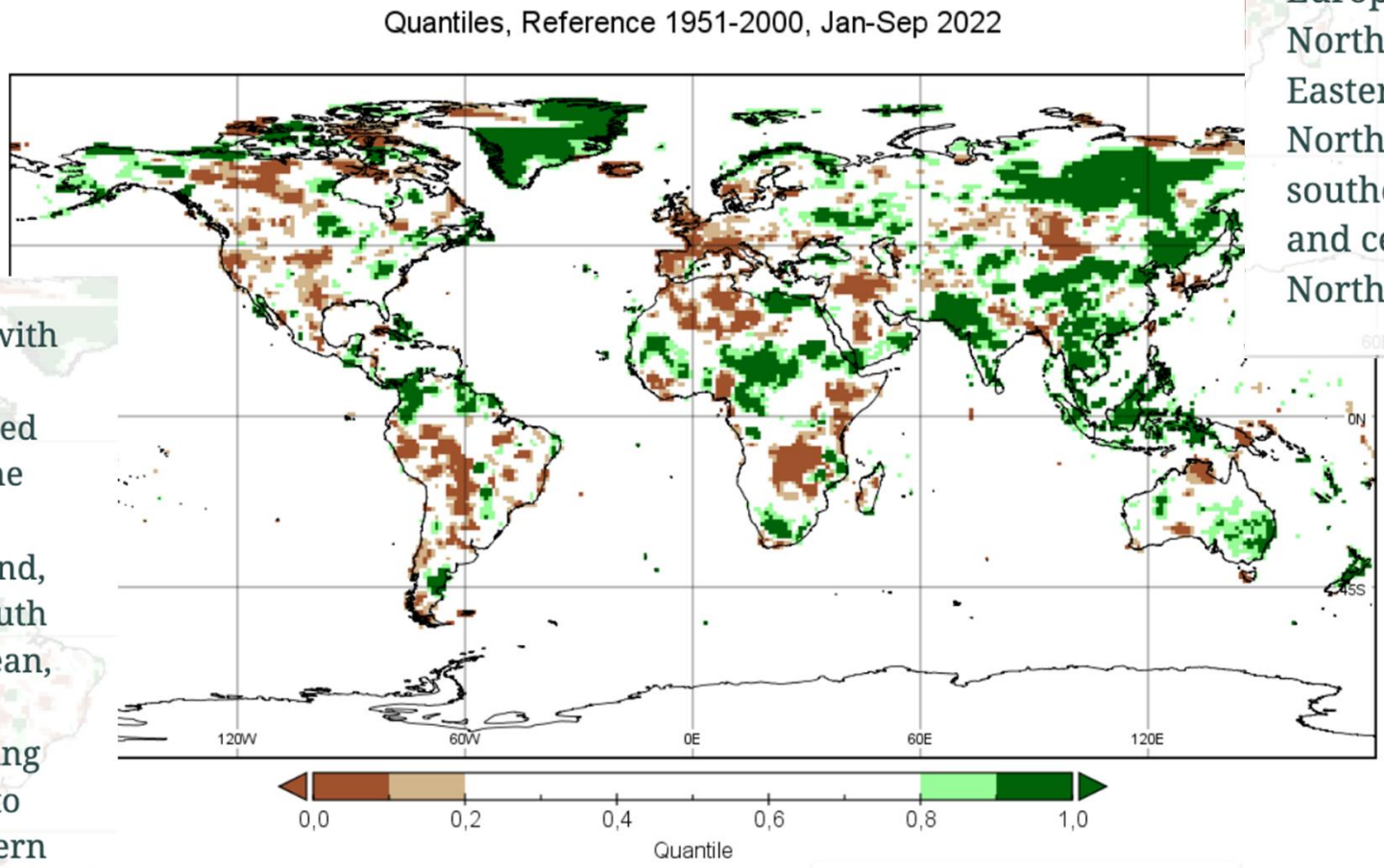
The last 8 years are likely to be the 8 warmest years on record.



Reference: WMO Provisional state of the Global Climate 2022

GLOBAL PRECIPITATION

Meanwhile, regions with **rainfall deficit** included Europe, Central Asia, Northern Australia, Eastern Africa, most of North Africa, central and southern South America, and central and western North America.



In 2022, large areas with **above normal precipitation** included large parts of Asia, the Maritime Continent, Australia, New Zealand, areas of northern South America, the Caribbean, west Africa, Sudan, coastal areas extending from western Libya to Egypt, and the southern Arabian Peninsula.

Reference: WMO Provisional state of the Global Climate 2022

IPCC Climate change Report 2022

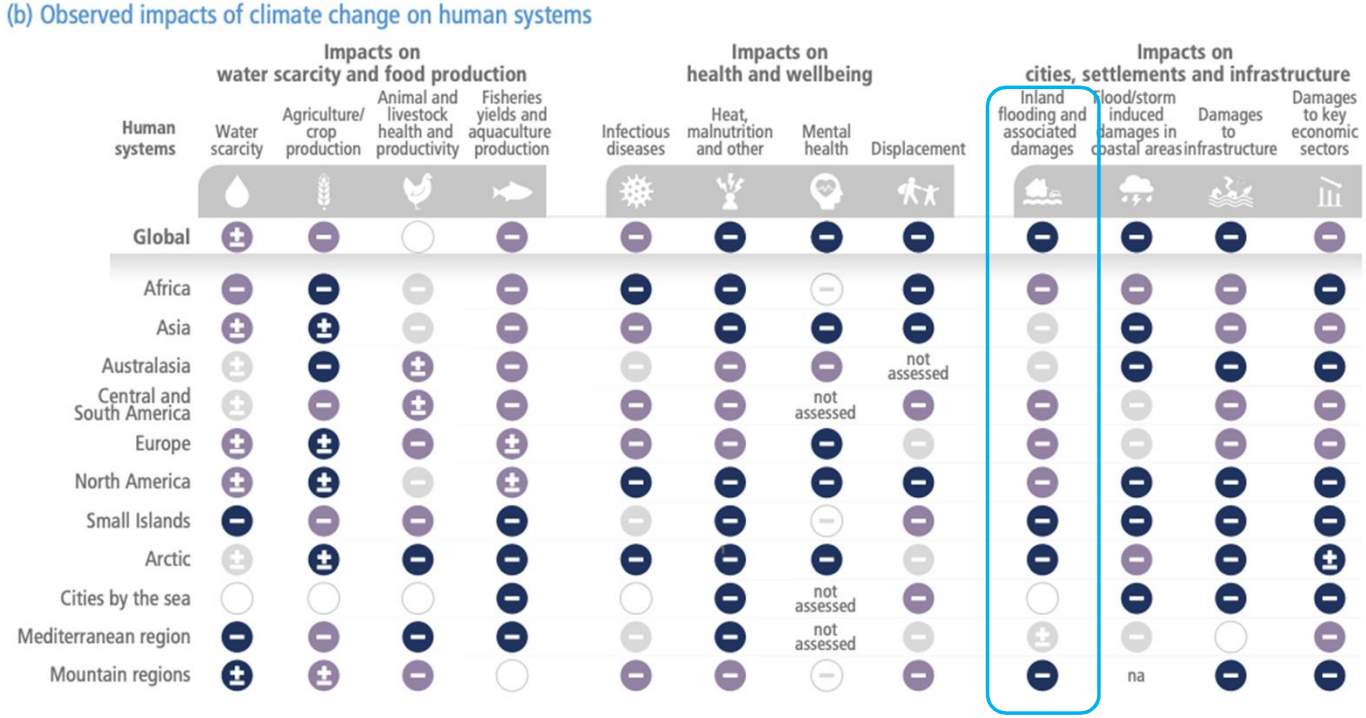
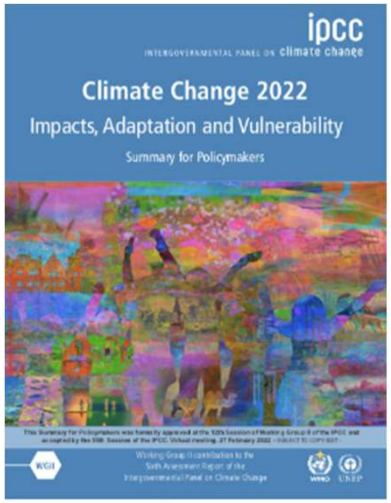


Figure SPM.2 | Observed global and regional impacts on ecosystems and human systems attributed to climate change. Confidence levels reflect uncertainty in attribution of the observed impact to climate change. Global assessments focus on large studies, multi-species, meta-analyses and large reviews. For that reason they can be assessed with higher confidence than regional studies, which may often rely on smaller studies that have more limited data. Regional assessments consider evidence on impacts across an entire region and do not focus on any country in particular.



Impacts to human systems in panel (b)

− Increasing adverse impacts

± Increasing adverse and positive impacts

Confidence in attribution to climate change

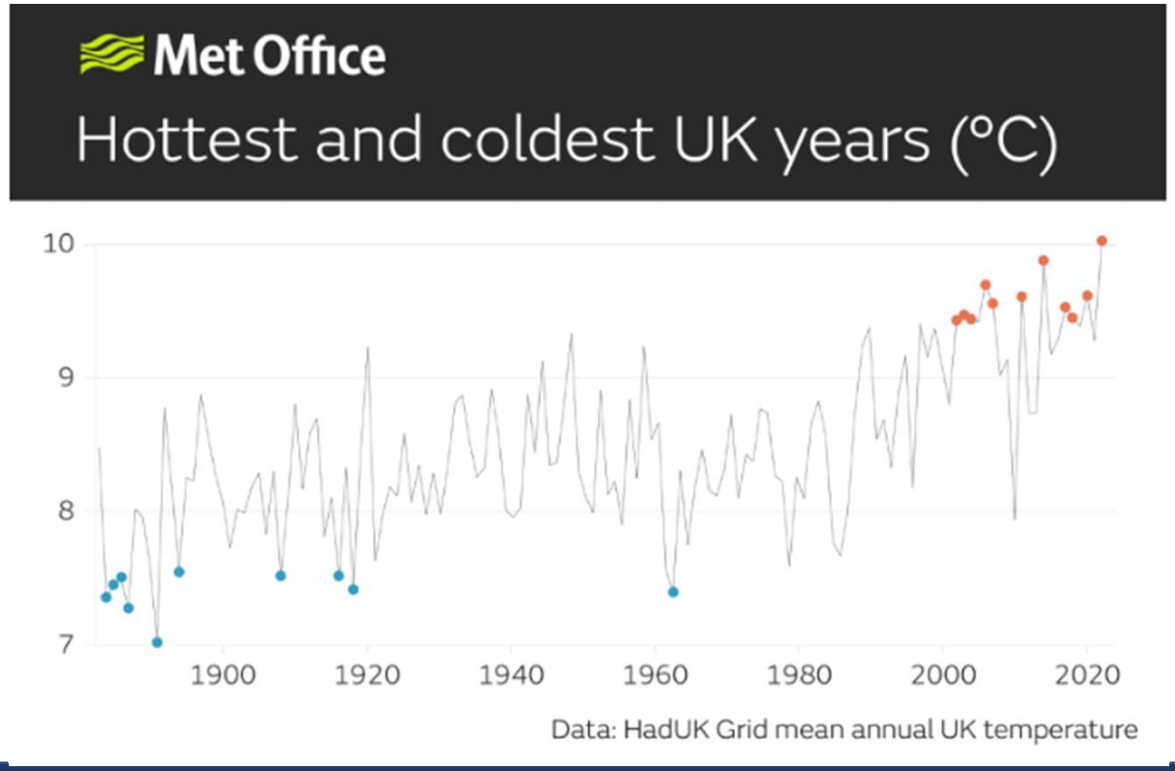
- High or very high
- Medium
- Low
- Evidence limited, insufficient

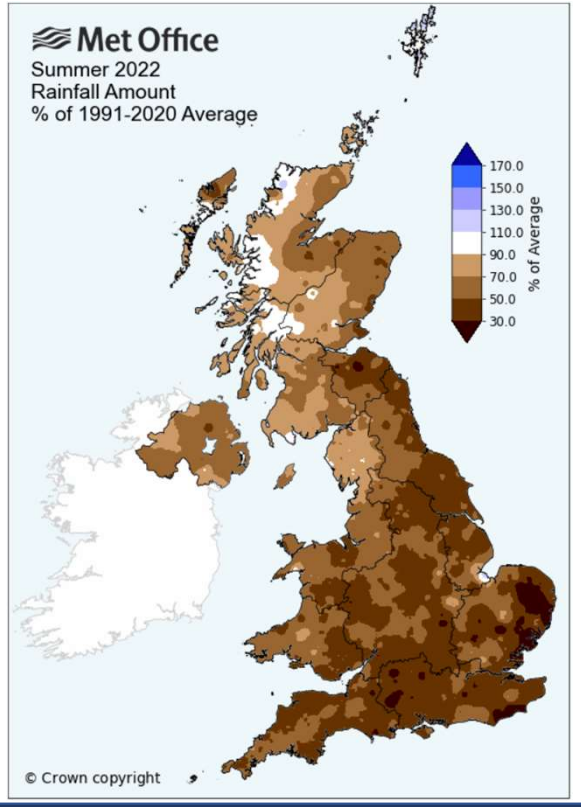
na Not applicable

Human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and related losses and damages to nature and people, beyond natural climate variability.

2022 – the warmest year ever recorded in the UK 10.03C

- Warmest NYD on record at St James's Park, London 16.3C.
- Hottest day on record at Coningsby, Lincolnshire 40.3C in July exceeding previous record by 1.6C.
- March – August rainfall total for England and Wales, 3rd driest on record
- February - three named storms in a week!





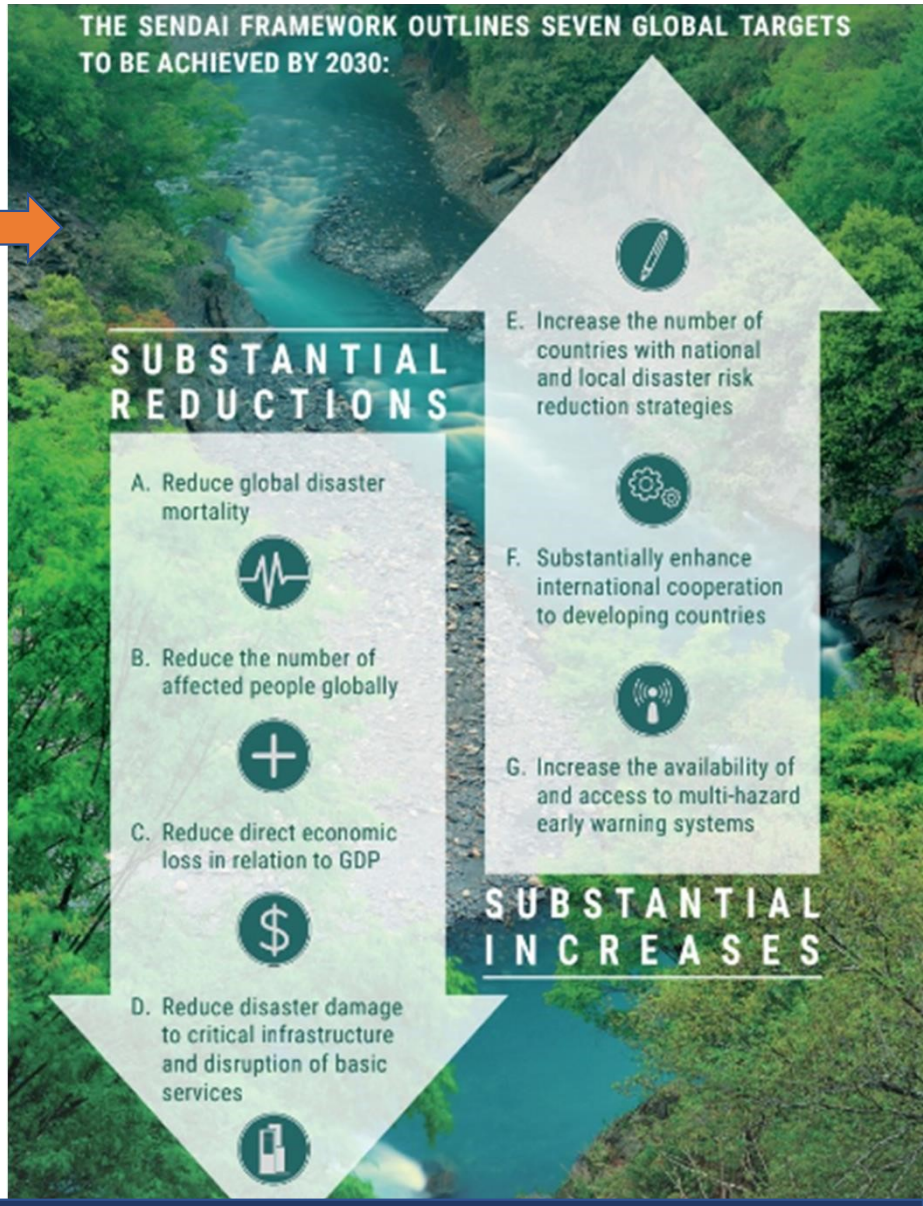
FUTURE INLAND FLOOD RISK IN A WARMING CLIMATE (UK)

- Warmer air can hold more water (+7% for every +1C).
- Warmer oceans add more water vapour to the atmosphere.
- Increased frequency and severity of flooding in the winter in the west and north.
- Increased chance of river flooding up to 40% by 2100 (Speight and Krupska, 2021).
- SE England more susceptible to summer droughts.
- Recent widespread flooding events such as 2013/2014 Thames flooding, Storm Desmond, 2015 and Ciara and Dennis in 2020 are more likely to occur in the current climate.

UNDRR United Nations Office for Disaster Risk Reduction

Early warning system:
An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events.

What is the Sendai Framework for Disaster Risk Reduction?



EARLY WARNINGS FOR ALL

The UN Global Early Warning Initiative for the Implementation of Climate Adaptation

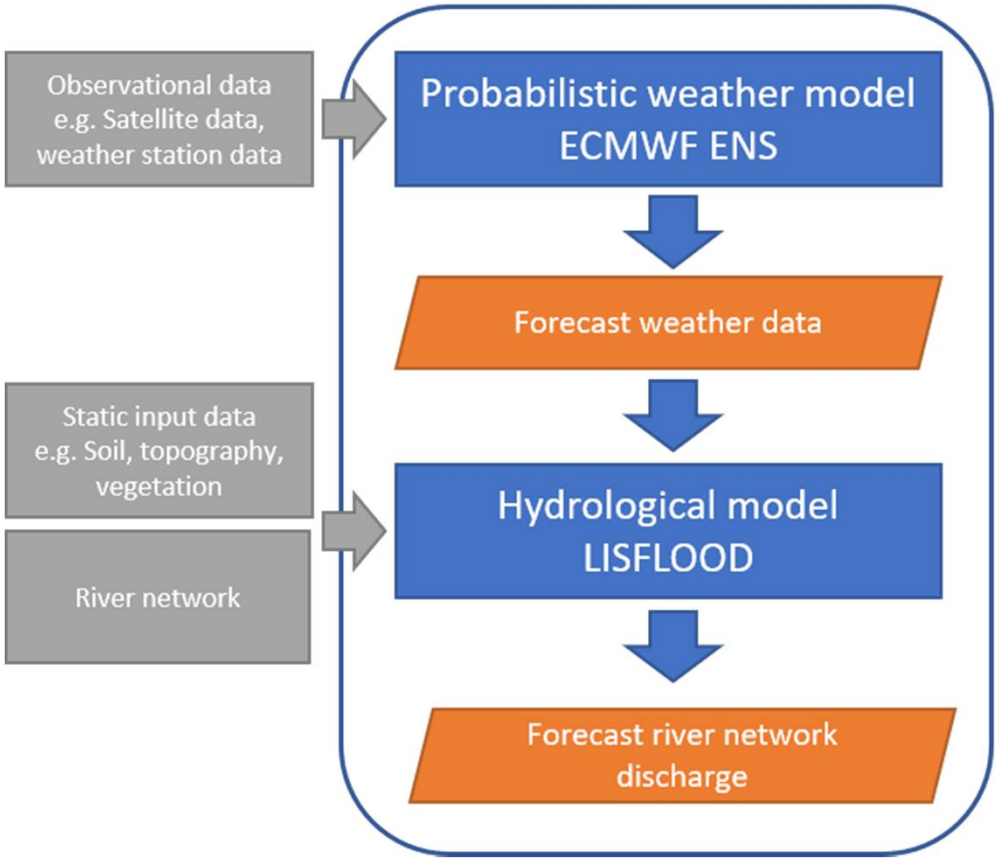
"Today, one third of the world's people, mainly in least developed countries and small island developing states, are still not covered by early warning systems… This is unacceptable, particularly with climate impacts sure to get even worse…."

UN Secretary-General António Guterres

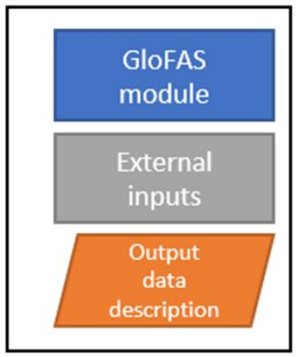
GLOBAL FLOOD AWARENESS SYSTEM (GloFAS)

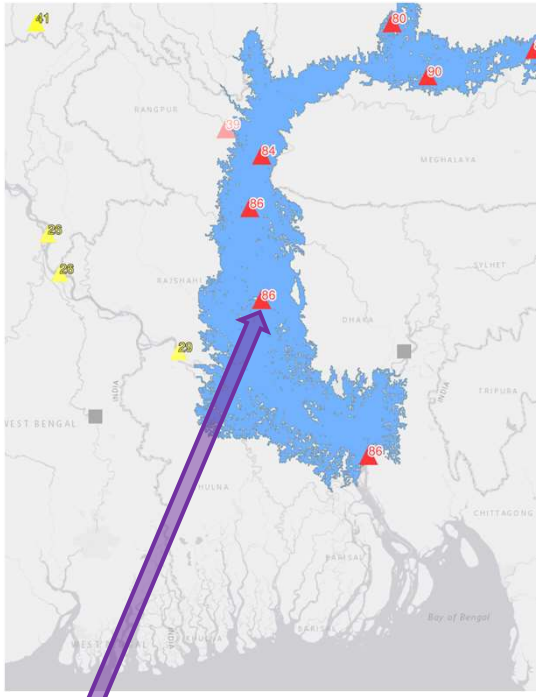
Copernicus
Europe's eyes on Earth

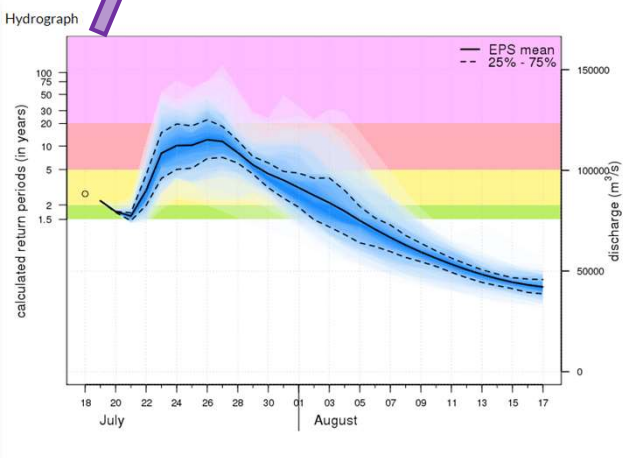
Emergency Management Service



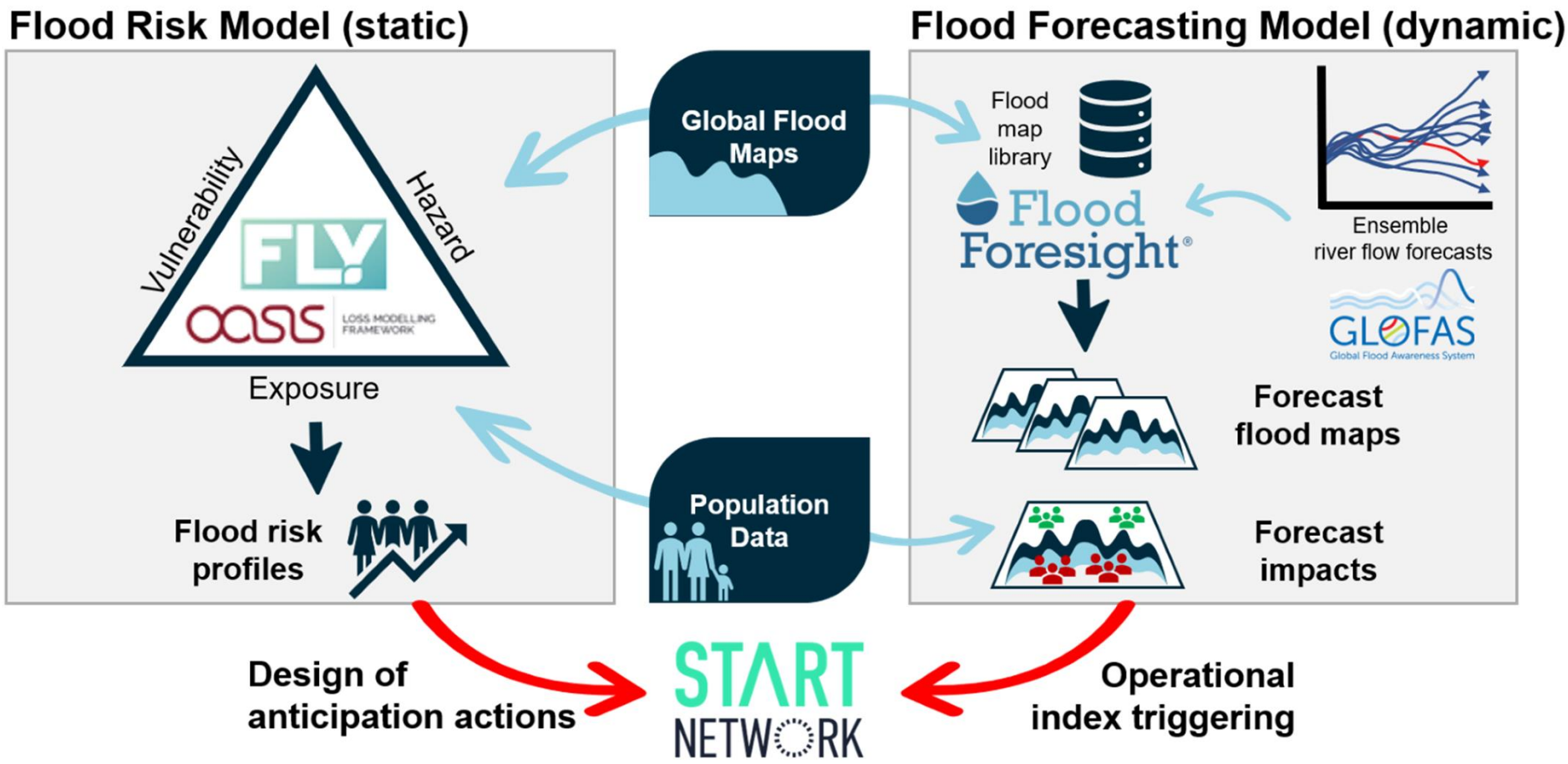
GloFAS hydro-meteorological forecasting chain





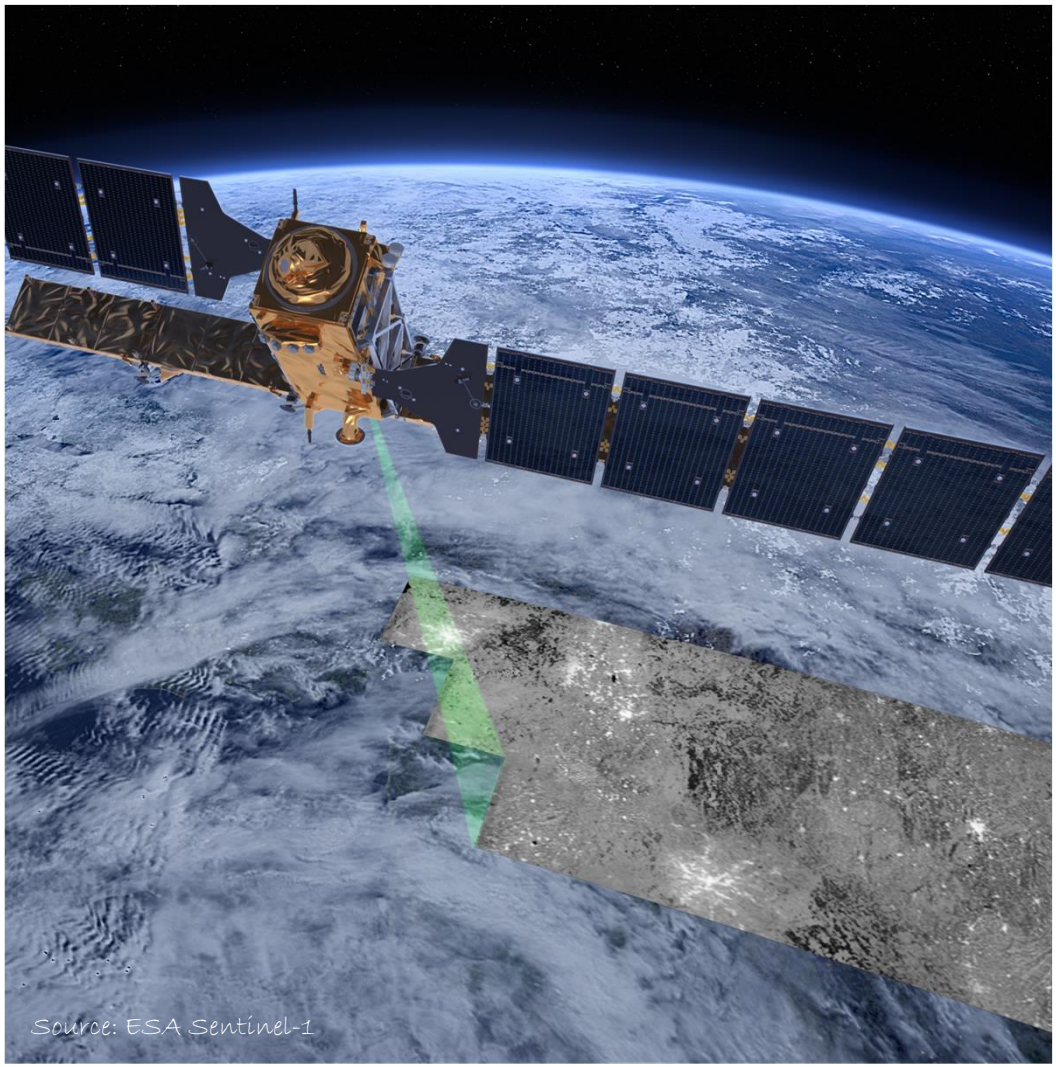


FORECAST BASED FINANCING (FbF)

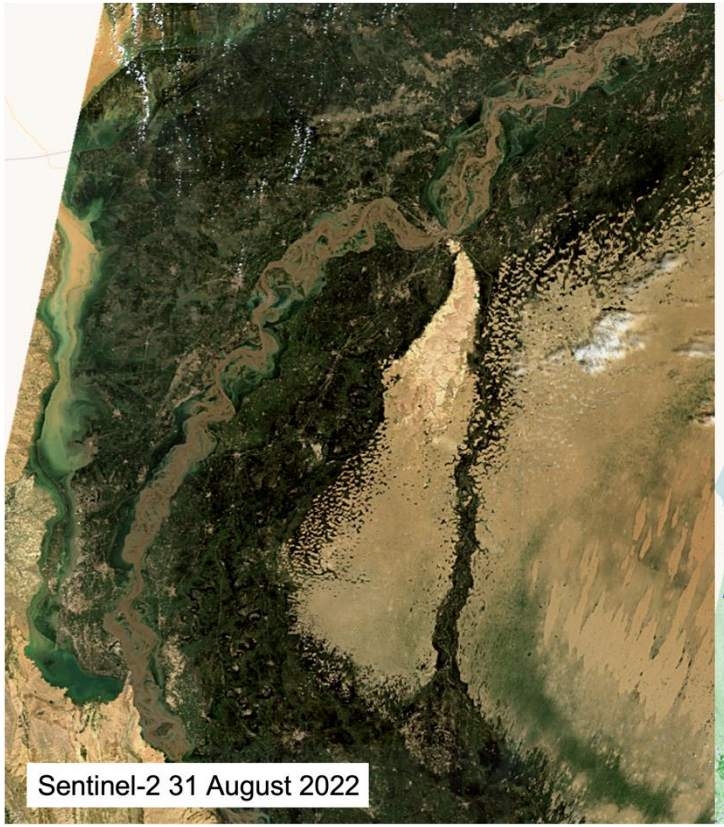


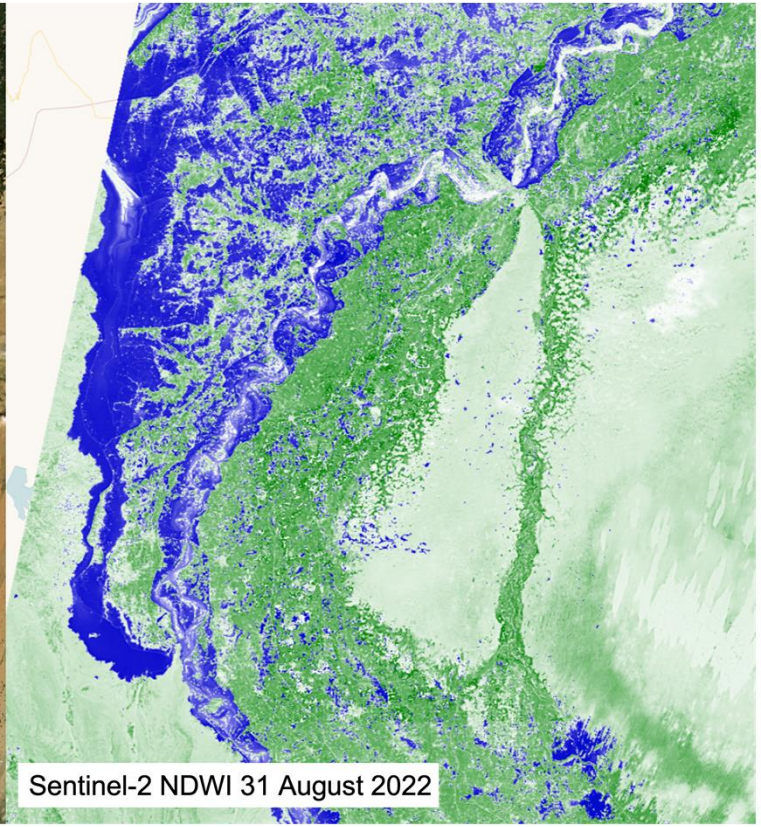
DETECTING FLOODING FROM SPACE

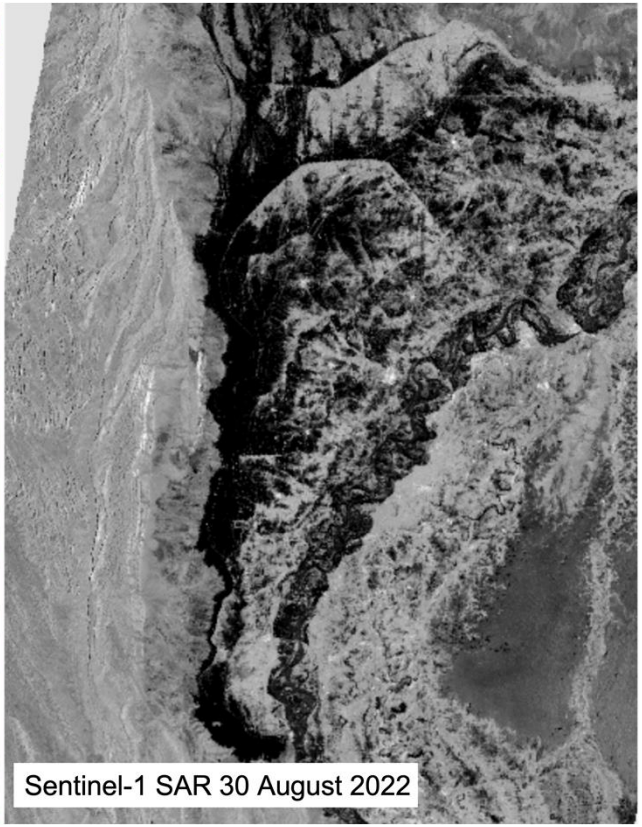
- Synthetic Aperture Radar (SAR)
- Satellite based sensor
- ESA Sentinel-1
- ACTIVE sensor
- Flood waters smooth/low backscatter



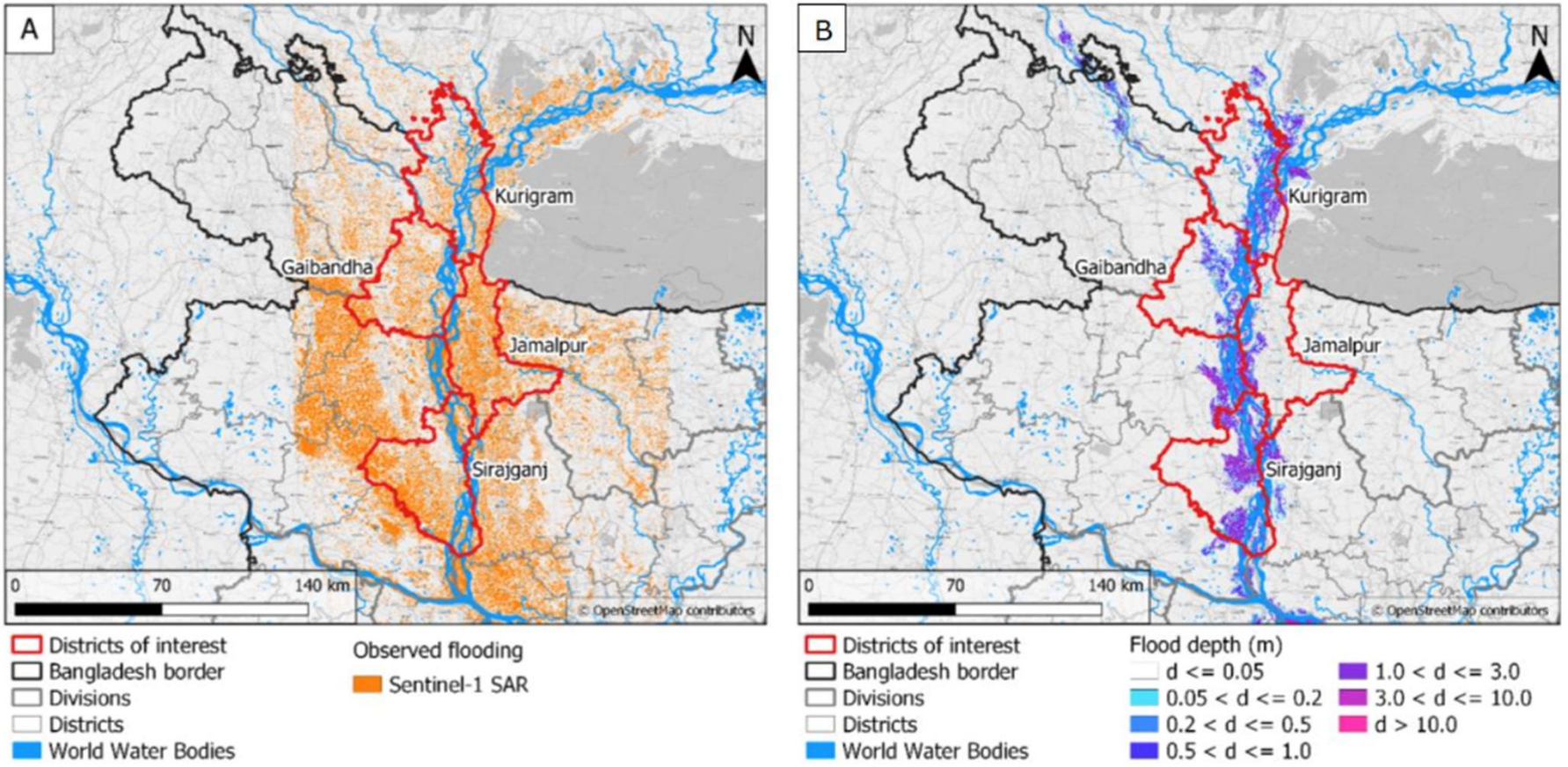
FLOODING FROM SPACE – PAKISTAN FLOOD 2022





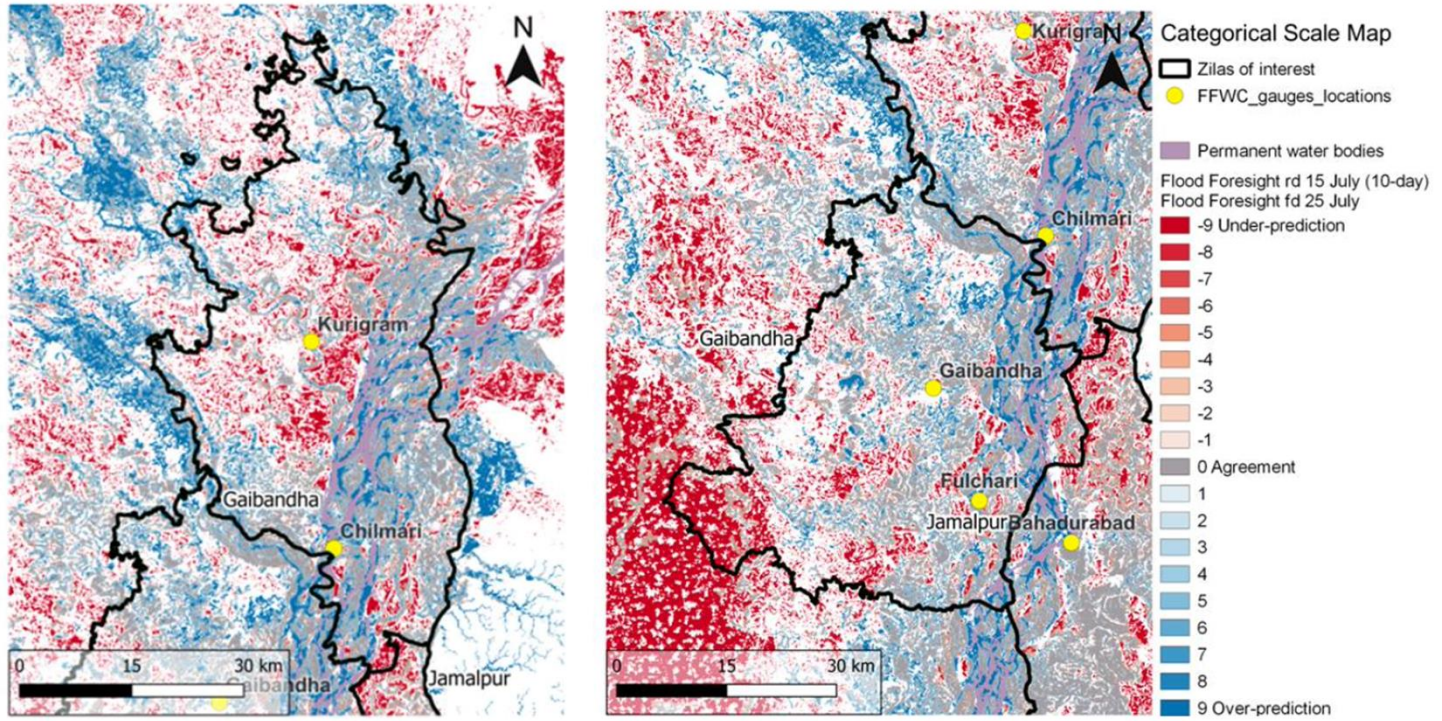


FORECAST FLOOD MAP EVALUATION- BANGLADESH FLOOD 2020



FORECAST FLOOD MAP EVALUATION- BANGLADESH FLOOD 2020

Flood Foresight versus Sentinel-1



JBA consulting

www.jbaconsulting.com

August 2022

SUMMARY

- Types of flooding (UK)
- How a warmer climate impacts flooding (UK)
- 2022 a year of new extremes
- Disaster Risk Reduction
- Global flood forecasting systems
- Detecting flooding from Space
- Forecast flood map evaluation

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