



# What are the most pressing issues for adaptation to a changing climate











richard.dawson@newcastle.ac.uk @profrichdawson y richard-dawson-newcastle im

### Overview



Adaptation definition and principles

#### Global

• IPCC Global Risk Analysis (from the 6<sup>th</sup> Assessment Report, AR6)

#### UK

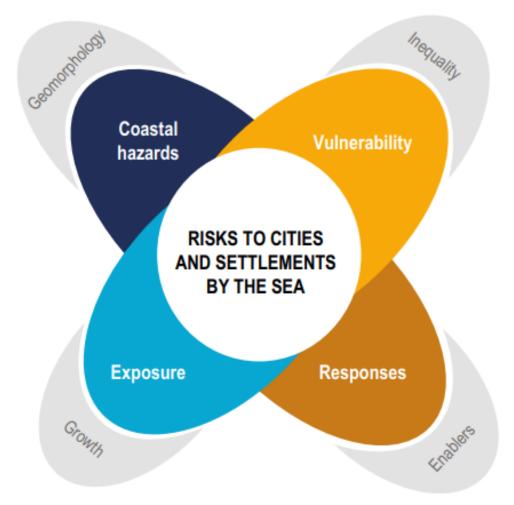
- Climate Change Risk Analysis (from the 3<sup>rd</sup> CCRA)
- Adaptation Progress (from the Climate Change Committee's 2023 Progress Report)

Challenges in monitoring adaptation

## Adaptation

#### Adaptation

- In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities.
- In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.



IPCC (2022) <u>Cities and Settlements by the sea</u>, 6<sup>th</sup> Assessment Report

## Adaptation

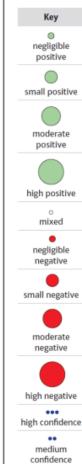
#### Adaptation

- In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities.
- In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

#### Adaptation options

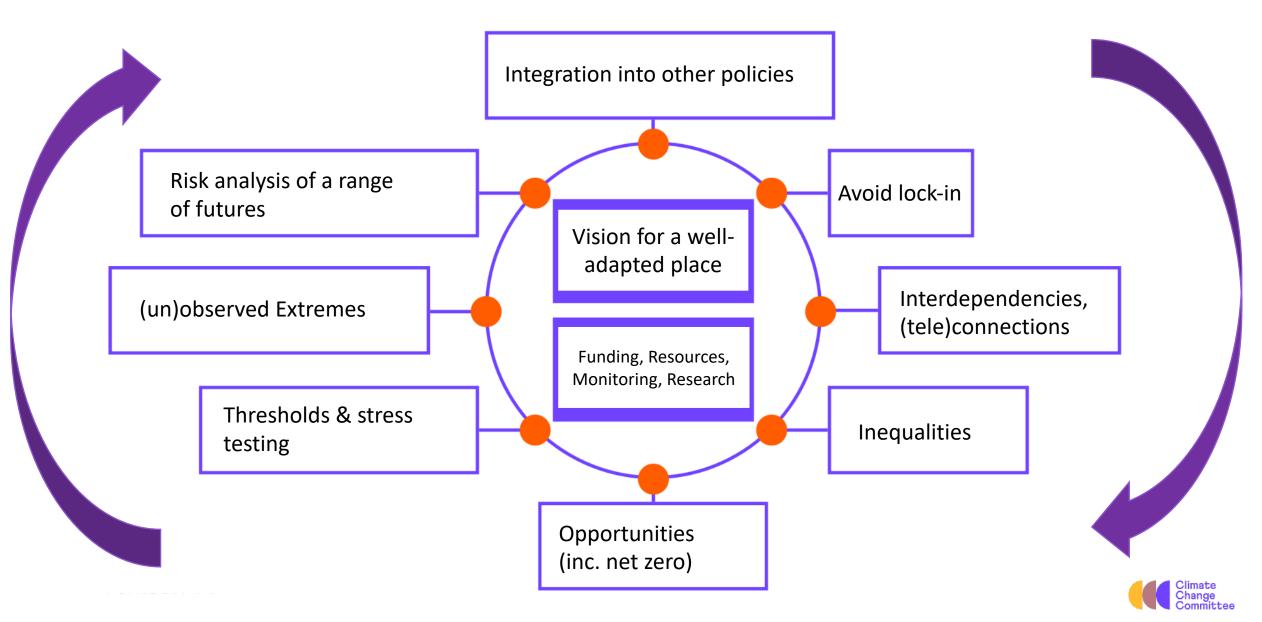
- The array of strategies and measures that are available and appropriate for addressing adaptation.
- They include a wide range of actions that can be categorised as structural, institutional, ecological or behavioural.





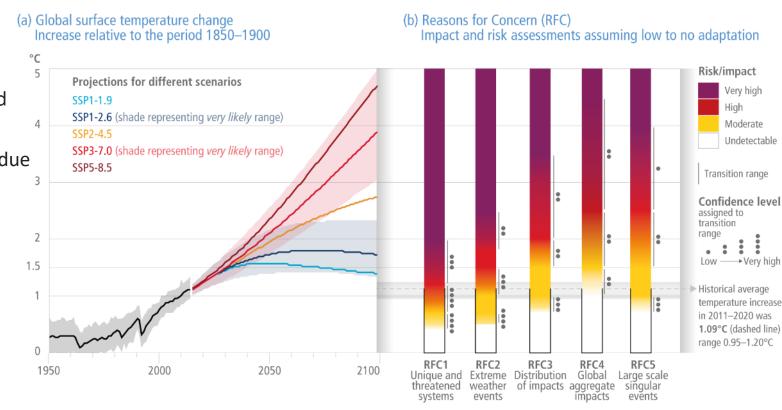
low confidence

## Principles for good adaptation



# IPCC Global risks for increasing global warming levels

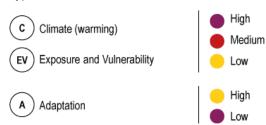
- RFC1: e.g. coral reefs, the Arctic and its Indigenous Peoples, mountain glaciers and biodiversity hotspots.
- RFC2: e.g. risks/impacts to human health, livelihoods, assets and ecosystems from extreme weather events such as heatwaves, heavy rain, drought and associated wildfires, and coastal flooding.
- RFC3: e.g. disproportionately affect particular groups due to uneven distribution of physical climate change hazards, exposure or vulnerability.
- RFC4: impacts to socio-ecological systems that can be aggregated globally into a single metric, such as monetary damages, lives affected, species lost or ecosystem degradation at a global scale.
- RFC5: e.g. ice sheet disintegration or thermohaline circulation slowing.



## IPCC Key risks

#### 120 Risks identified, clustered into 8 Representative Key Risks

Type and level



Not fully assessed

#### Scope

Broadly applicable (risks are severe pervasively and even globally)

Specific (risks are to particular areas, sectors or groups of

#### Confidence levels

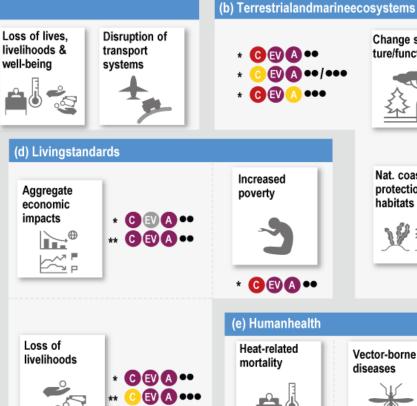


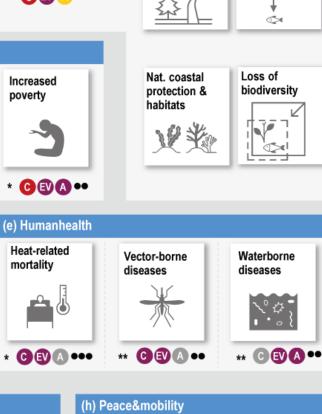




Nat. coastal

habitats





Change struc-

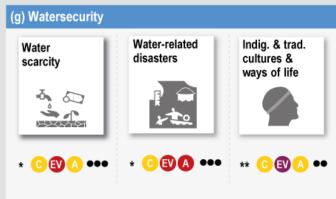
ture/functioning

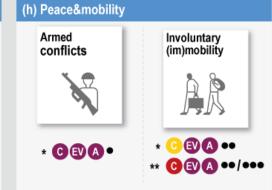
Loss

ecosystem

goods/services

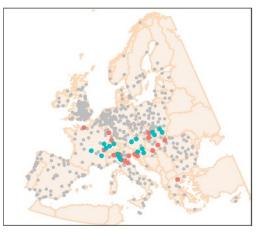




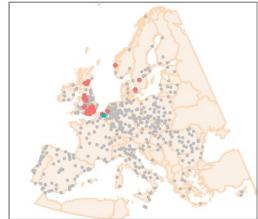


## Inequalities Hazards

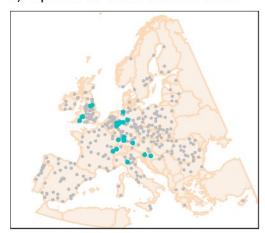
a) Top 50% for all indices



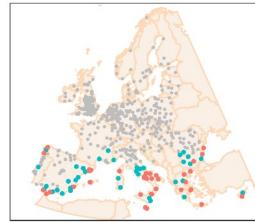
d) Bottom 50% for all indices



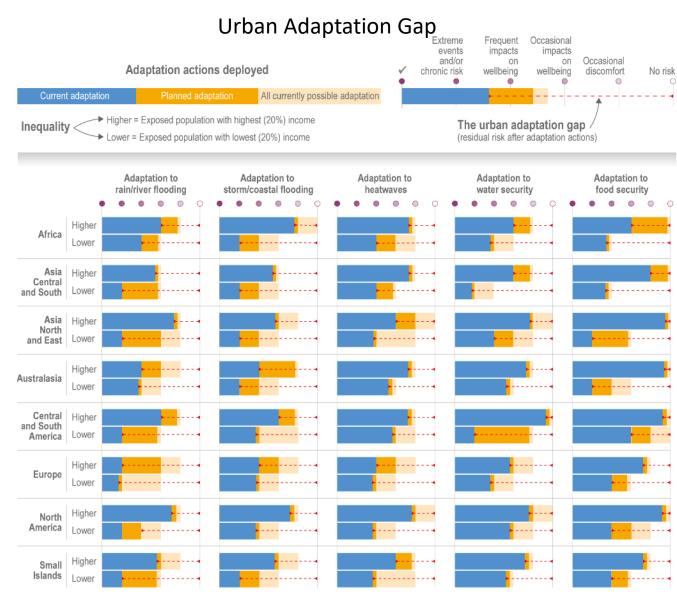
c) Top 25% for floods and HW Tmax



b) Top 25% for droughts and HW days



Guerreiro et al. Env. Res. Let. DOI 10.1088/1748-9326/aaaad3



IPCC AR6 WG2 Chapter 6

## UK CCRA: 61 Risks and Opportunities

mobility

N1 Risks to terrestrial species and habitats	N2 Risks to terrestrial species and habitats from pests, pathogens and INNS	N4 Risk to soils from changing conditions, including seasonal aridity and wetness	N5 Risks to natural carbon stores and sequestration from changing conditions	N6 Risks to and opportunities for agricultural and forestry productivity	N7 Risks to agriculture from pests, pathogens and INNS		8 Risks to forestry from ests, pathogens and INS		risks to freshwater es and habitats
N12 Risks to freshwater species and habitats from pests, pathogens and INNS	N14 Risks to marine species, habitats and fisheries	N16 Risks to marine species and habitats from pests, pathogens and INNS	N17 Risks and opportunities to coastal species and habitats	II Risks to infrastructure networks from cascading failures	12 Risks to infrastruct services from river a surface water flood	nd n	15 Risks to transport networks from slope and embankment failure		sks to terrestrial es and habitats
112 Risks to transport from high and low temperatures, high winds, lightning	H1 Risks to health and wellbeing from high temperatures	H3 Risks to people, communities and buildings from flooding	H4 Risks to people, communities and buildings from sea level rise	H6 Risks and opportunities from summer and winter household energy demand	H8 Risks to health fro vector-borne diseas		H11 Risks to cultural heritage		risks to public water ies from reduced r availability
H13 Risks to education and prison services	B1 Risks to business sites from flooding	B2 Risks to business locations and infrastructure from coastal change	B6 Risks to business from disruption to supply chains and distribution networks	ID1 Risks to UK food availability, safety, and quality from climate change overseas	ID5 Risks to international law and governance from climate change overseas that will impact the UK		ID4 Risks to the UK from international violent conflict resulting from climate change		sk to UK public h from climate ge overseas
ID7 Risks from climate change on international trade routes	ID10 Risk multiplication from the interactions and cascade of named risks across systems and geographies	N3 Opportunities from new species colonisations in terrestrial habitats	N9 Opportunities for agricultural and forestry productivity from new species	N10 Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	N15 Opportunities for marine species, hab and fisheries	itats o	N18 Risks and opportunities from climate change to landscape character		es to infrastructure es from coastal ing and erosion
4 Risks to bridges and pipelines from flooding and erosion	16 Risks to hydroelectric generation from low or high river flows	V Risks to subterranean and surface infrastructure from subsidence	P Risks to energy generation from reduced water availability	110 Risks to energy from high and low temperatures, high winds, lightning	113 Risks to digital from high and low temperatures, high lightning	h	H2 Opportunities for health and wellbeing from higher temperatures		ks to building fabric
H7 Risks to health and wellbeing from changes in air quality	H? Risks to food safety and food security	H10 Risks to health from poor water quality and household water supply interruptions	B3 Risks to businesses from water scarcity	B5 Risks to business from reduced employee productivity- infrastructure disruption and higher	B7 Opportunities for business - changing demand for goods and services		N13 Opportunities to marine species, habitats and fisheries		sks to offshore tructure from storms nigh waves
B4 Risks to finance, investment, insurance,	ID8 Risk to the UK finance sector from climate change overseas	ID2 Opportunities for UK food availability and exports	ID3 Risks to the UK from climate-related international human mobility	ID6 Opportunities (including Arctic ice melt) for international trade routes					
access to capital					Natural En	vironmer	Health,		

routes

Infrastructure

systems

and Assets

**Business** and

**Industry** 

Climate Change Committee

Communities and Built Environment

International

**Dimensions** 

## UK CCRA: 61 Risks and Opportunities

climate-related

mobility

international human

N1 Risks to terrestrial species and habitats	N2 Risks to terrestrial species and habitats from pests, pathogens and INNS	N4 Risk to soils from changing conditions, including seasonal aridity and wetness	N5 Risks to natural carbon stores and sequestration from changing conditions	N6 Risks to and opportunities for agricultural and forestry productivity	N7 Risks to agriculture from pests, pathogens and INNS	N8 Risks to forestry from pests, pathogens and INNS	N11 Risks to freshwater species and habitats
N12 Risks to freshwater species and habitats from pests, pathogens and INNS	N14 Risks to marine species, habitats and fisheries	N16 Risks to marine species and habitats from pests, pathogens and INNS	N17 Risks and opportunities to coastal species and habitats	II Risks to infrastructure networks from cascading failures	12 Risks to infrastructure services from river and surface water flooding	5 Risks to transport networks from slope and species and habitatembankment failure	
112 Risks to transport from high and low temperatures, high winds, lightning	H1 Risks to health and wellbeing from high temperatures	H3 Risks to people, communities and buildings from flooding	H4 Risks to people, communities and buildings from sea level rise	H6 Risks and opportunities from summer and winter household energy demand	H8 Risks to health from vector-borne diseases	H11 Risks to cultural heritage	H12 Risks to public water supplies from reduced water availability
H13 Risks to education and prison services	B1 Risks to business sites from flooding	B2 Risks to business locations and infrastructure from coastal change	B6 Risks to business from disruption to supply chains and distribution networks	ID1 Risks to UK food availability, safety, and quality from climate change overseas	ID5 Risks to international law and governance from climate change overseas that will impact the UK	ID4 Risks to the UK from international violent conflict resulting from climate change	ID9 Risk to UK public health from climate change overseas
ID7 Risks from climate change on international trade routes	ID10 Risk multiplication from the interactions and cascades of named risks across systems and geographies	N3 Opportunities from new species colonisations in terrestrial habitats	N9 Opportunities for agricultural and forestry productivity from new species	N10 Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	N15 Opportunities for marine species, habitats and fisheries	N18 Risks and opportunities from climate change to landscape character	13 Risks to infrastructure services from coastal flooding and erosion
14 Risks to bridges and pipelines from flooding and erosion	16 Risks to hydroelectric generation from low or high river flows	17 Risks to subterranean and surface infrastructure from subsidence	19 Risks to energy generation from reduced water availability	110 Risks to energy from high and low temperatures, high winds, lightning	I13 Risks to digital from high and low temperatures, high winds, lightning  H2 Opportunities for health and wellbeing from higher temperatures		H5 Risks to building fabric
H7 Risks to health and wellbeing from changes in air quality	H9 Risks to food safety and food security	H10 Risks to health from poor water quality and household water supply interruptions	B3 Risks to businesses from water scarcity	B5 Risks to business from reduced employee productivity- infrastructure disruption and higher	B7 Opportunities for business - changing demand for goods and services  N13 Opportunities to marine species, habitats and fisheries		II1 Risks to offshore infrastructure from storm and high waves
B4 Risks to finance,	ID8 Risk to the UK finance	ID2 Opportunities for UK	ID3 Risks to the UK from	ID6 Opportunities			

(including Arctic ice melt)

for international trade



investment, insurance,

access to capital





sector from climate

change overseas

food availability and

exports

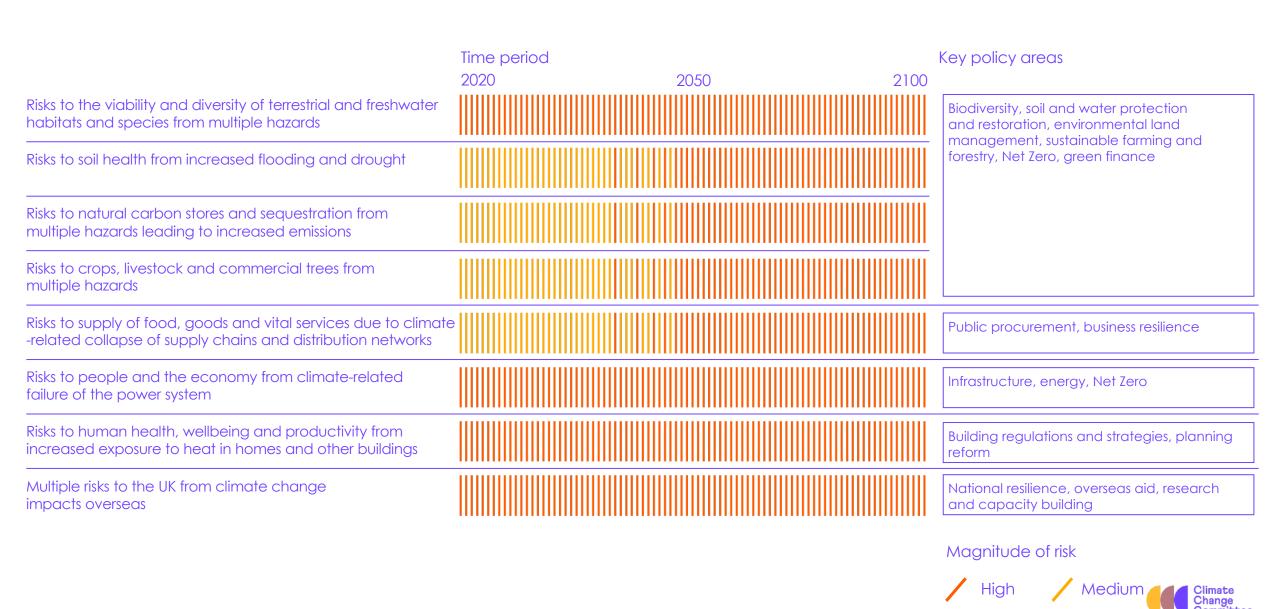


**Natural Environment** 

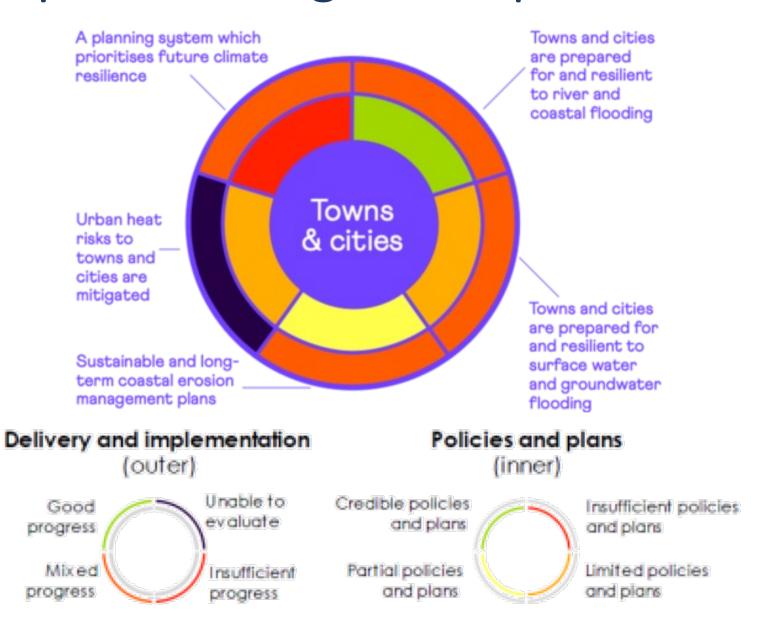
Health,



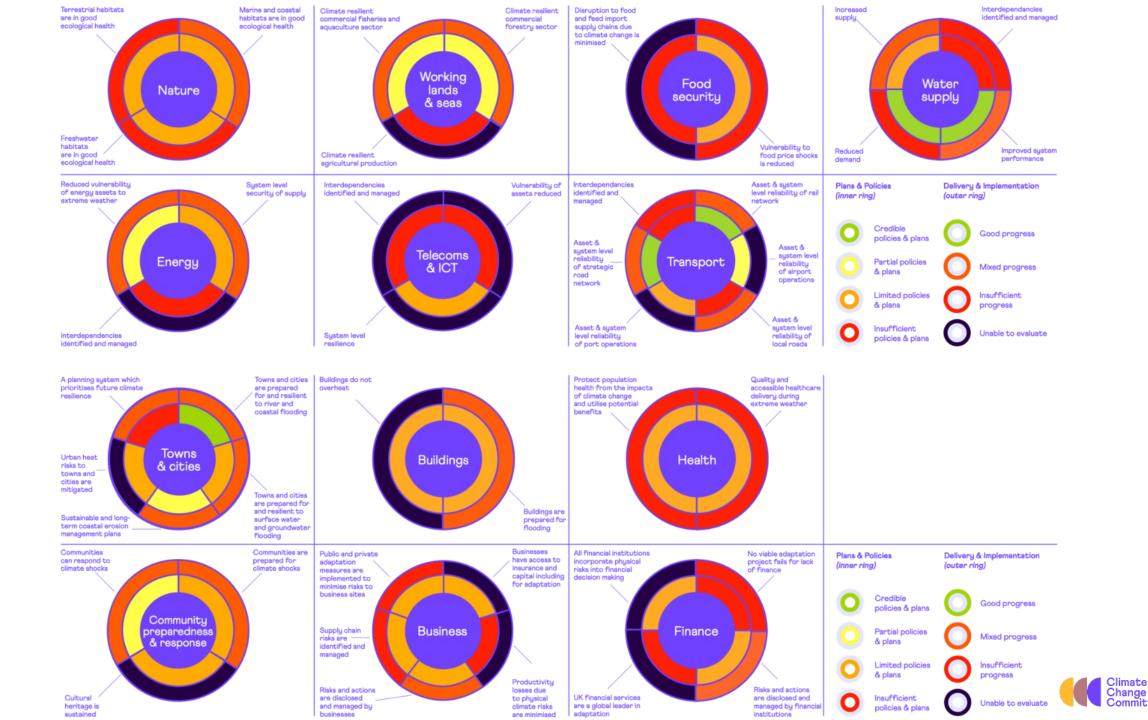
### UK CCC's Priority risks for urgent further action



## 2023 Adaptation Progress Report







#### Climate resilient agricultural production

- Livestock mortality (%) and crop failure (per hectare) due to climate impacts.
- Abundance and diversity of pollinators and pest predators

#### Take up of sustainable farming measures

- Area of oropland under oover orops, reduced fillage, addition of compost or manure
- Area of agroforestry, hedgerows, buffer strips and species-righ field margins
- Reduced use of pesticides / synthetic fertilisers
- Greater on-farm water storage papapity /lower
- Appropriate slurry store /silage olamp engineering
- Overgrazing/stooking rates

#### Healthy soils

Soil erosion rates (t/ha/y)

Required Outcor

Increase in soil organio carbon, naturalsoil biota diversity /abundance and soil infiltration

#### Climate resilient commercial forestry sector

- Area of commercial forestry under sustainable adaptive management meeting UK Forestry Standard
- Area of commercial forestry planted with climate appropriate and ecologically suitable tree species (avoiding invasive or water-hungry species and damage to native biodiversity)
- Genetic diversity and species diversity of trees in commercial

#### Climate resilient commercial fisheries and aquaculture sector

- UK fish stocks maintained at healthy
- UK aquaculture stocks healthy and
- Freshwater, marine and estuarine waters achieve good auglity
- Water temperatures controlled

#### Responsible practices

- Sustainable harvesting of UK fish stooks in line with scientific evidence
- Sustainable adaptive management of aquapulture production
- Restrict /ban bottom trawling activities

#### Effective wildfire planning in place

- Prevalence of local wildfire response plans, and sufficient fire-fighting equipment /personnellevels
- Management of vegetation and fuels (but minimising adverse biodiversity impacts )

Climate resilient

For parbon offsets, plant sufficient area to appount for risk of reversal due to fires etc.

#### Climate resilient operations

- Safe and seoure vessel and aquabulture
- Reduced vulnerability of vessels and ports

#### Manage and reduce the impacts from pest, diseases and invasive non-native species

Geographical scread of

#### Number of high priority p

#### Funding & Investr

- Payments for ecosysten
- R&D funding for agroec agricultural adaptation
- Small part resilience infr
- Public-private partnersh
- Climate resilience incor
- Synerales with nature re
- Plan to ensure the agricu Plans for adapting come

#### Agriculture policy revision New agriculture policy s

- biodiversity and climate Climate resilient Flexible agri-environmer allowing natural flood m
- Funding support for agroecology, onfarm water infrastructure, hedgerows and agroforestry

commercial fisheries and commercial forestry sector aquaculture sector



improved land management standards

nurseries to replenish fish stocks

Flexible fisheries management arrangements

Better protection for Marine Protected Areas (as

Climate resilient

iomass crop productivity changing ocean temperature istry on fisheries 'productivity gy and agraforestry R&D pacts by location

spropriate species research

#### Fisheries Act provisions

Support delivery of climate objectives outlined in UK Fisheries

#### Places are prepared for and resilient to future climate risks

#### Places are prepared for and resilient to river and coastal flooding

- People and buildings at risk
- Buildings better protected by defences
- Defences maintained to standard
- Capital and maintenance investment
- Number of catchment-based approaches
- Coverage and quality of warning

#### Places are prepared for and resilient surface water and groundwaterflooding

- · People and buildings at risk
- Extent of urban impermeable surfaces
- Urban drainage and sewer capacity
- Number and type of sustainable urban drainage systems installations

#### Sustainable and lona term coastal erosion management plans

- People and buildings at risk
- Funding committed to support adaptation in coastal communities
- Delivery of long-term coastal

#### Jrban heat risks to Towns and Cities are mitigated

- Extent of the urban heat
- Proportion of urban areer space and water bodies
- Number and type of areen infrastructure installations in urban

#### A planning system which prioritises future climate resilience

- Proportion of new developments in flood risk zones
- Planning applications granted against flood risk advice
- Proportion of new developments with flood resilience and cooling measures
- · Number and type of retrofit green infrastructure interventions installed
- · Investment in adaptation interventions

#### Sufficient public capital and resource funding for longterm flood and erosion resilience

- Private sector investment
- Local authority funding for adaptation planning and delivery

#### Proactive planning system Workforce and skills

capacity to deliver Clear responsibilities for

#### adaptation

#### A planning system which Towns and cities prioritises future climate are prepared for and resilient resilience to river and coastal flooding

#### Legislation and regulation

- Statutory coastal and adaptation plans
- Mandatory adaptation me in new developments
- Mandatory assessment of climate risks (e.g. sea leve temperatures) in planning applications
- Regulation of wider actors utilities, infrastructure, deve

#### Urban heat risks to towns and cities are mitigated Sustainable and long

#### Towns & cities Towns and cities are prepared for and resilient to surface water term coastal erosion and groundwater management plans flooding

#### High resolution risk and

#### vulnerability mapping for all risks (flood

#### mapping Data sharing across regions and sectors standardised

Standardised risk

adaptation monitorina

#### on and reporting

atory reporting ptation

anisms for data ion on green ucture and able drainage

a and resource tment to risk ng, modelling arnina

ocation, magnitude and frequency of hazard resulting from observed and projected changes to

- Sea level rise
- Extreme and average temperatures
- Human intervention (e.g. channelisation of rivers)
- Storm surge frequency
- Geological hazards (e.g. landslides, subsidence)
- Interacting hazards (e.g. rain + surge

- Number and location of settlements
- Population density
- Urban sprawl
- Interacting risks via exposure of connected infrastructure
- Supply chain disruption

- Characteristics of populations and assets at risk
- Socio-economic factors e.g. population age, mobility, tenancy status, length of residency
- Type of buildings at risk
- Vulnerability of surrounding infrastructure, nature and risks in other locations (e.g. for supply chains)

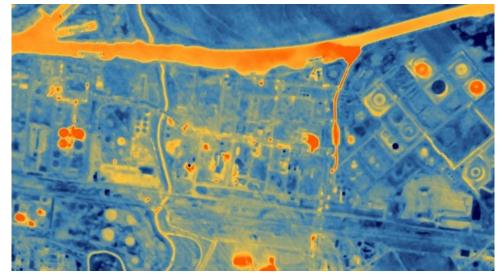
#### www.theccc.org.uk/publication/ccc-adaptation-monitoring-framework/

## Spatial resolution





Urban flood management features (from Hidrologias Ostenible)



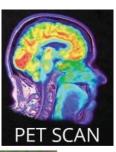
HotSat-1, (from Satellite Vu)

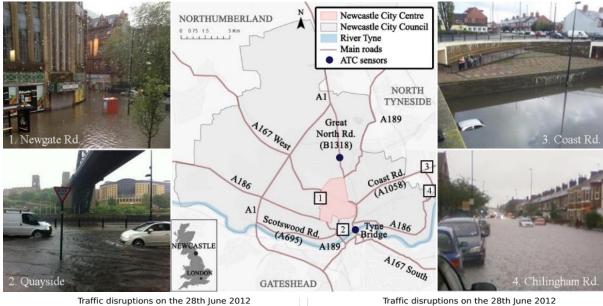
## Spatial resolution

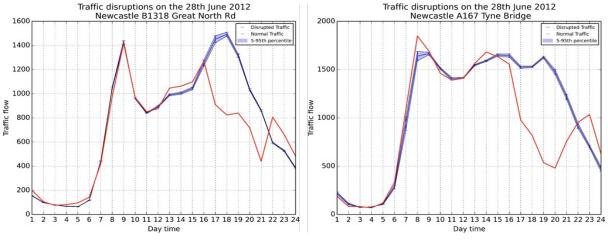


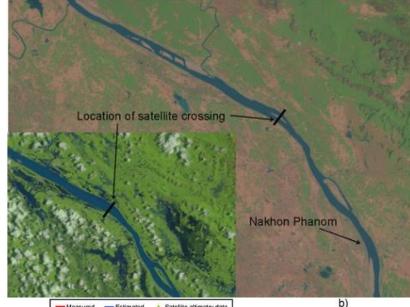
## From Structure to Function and Process

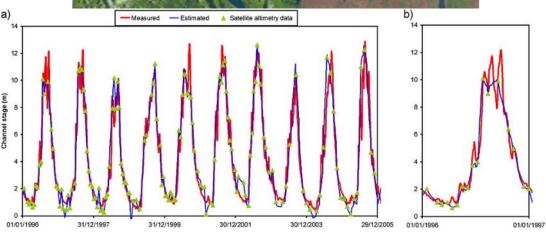












Hydrological Processes, DOI: 10.1002/hyp.9647

## Incident managemen Coutput data: Image description C'A couple of men in orange vests standing in a flooded street"

esa

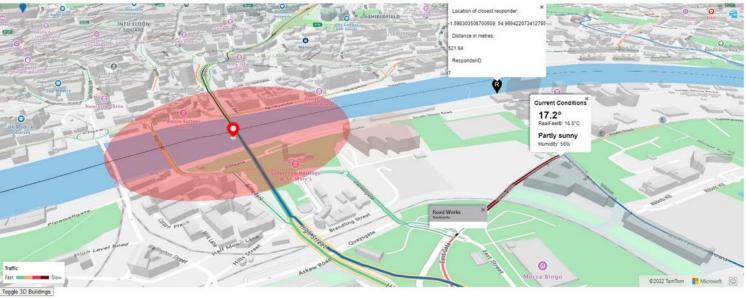


#### **Output data: Object detection**

ground' with confidence 57.31%

'outdoor' with confidence 99.61% 'vehicle' with confidence 99.56% land vehicle' with confidence 99.31% person' with confidence 98.33% car' with confidence 97.90% 'clothing' with confidence 97.63% 'wheel' with confidence 95.49% 'van' with confidence 92.13% 'high-visibility clothing' with confidence 89.45% ford with confidence 87.05% 'emergency service' with confidence 85.32% 'water' with confidence 81.52% 'wet' with confidence 73.17% 'street' with confidence 72.91%





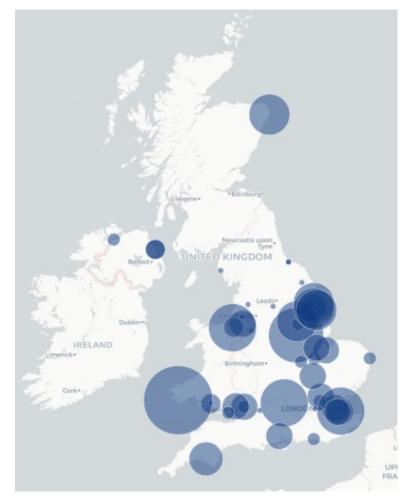
Wolf et al. (2022) Towards a digital twin for supporting multi-agency incident management, https://doi.org/10.1038/s41598-022-20178-8

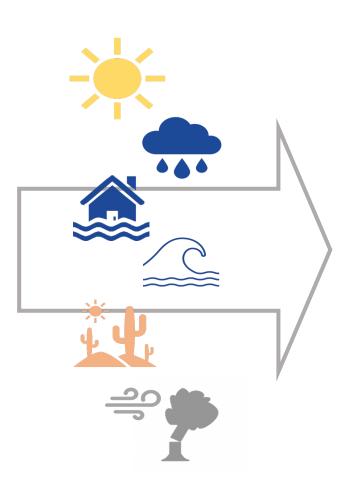
## Exam question...

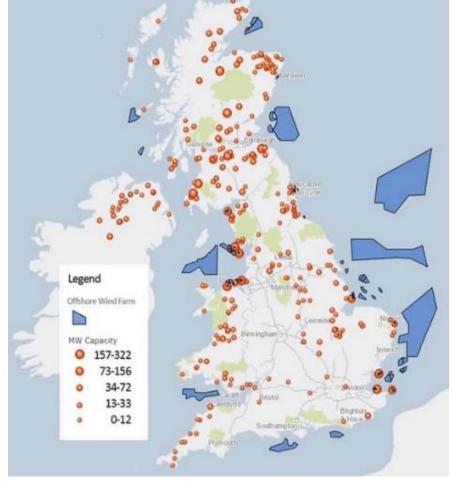
- Food and water security (inc. supporting ecosystems)
- Living standards (inc. buildings and infrastructure services)
- Low-lying coastal systems

- Use of remote sensing data well established in many sectors for hazard / risk mapping
- A key general question for all sectors is whether our adaptation is effective
- Conversations between adaptation sectors/CCI expertise needed to explore:
  - Adaptation outcome
  - Measurable variable
  - Spatial x Temporal resolution
  - Data/modelling -> Adaptation insight

# change of our land, cities, coasts, infrastructure – and risks







**Gas power stations** 

Source: www.carbonbrief.org

#### Wind generation

Source: Renewable Energy Hub

Our systems must be resilient after this transition



Or... where will all the Tesla's charge





# What are the most pressing issues for adaptation to a changing climate











richard.dawson@newcastle.ac.uk @profrichdawson y richard-dawson-newcastle im