"Global Trends in Water Environmental Management"

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1. Hydrological Implications of Climate Change
2. Water as Resource
3. Water as Hazard
4. Water and “Sustainability”
5. Concluding Thoughts/Future Directions

1. ***Hydrological Implications of Climate Change***
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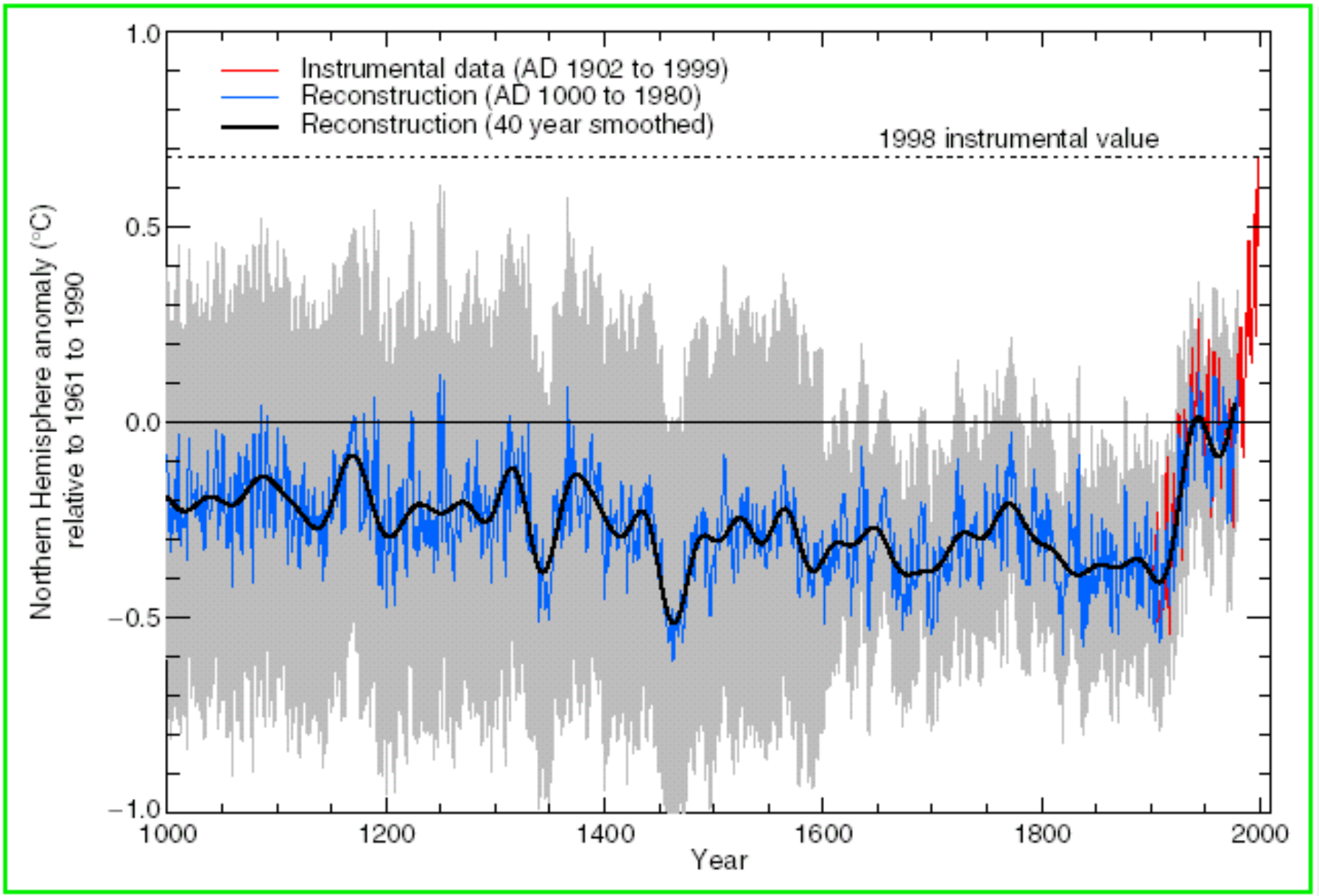
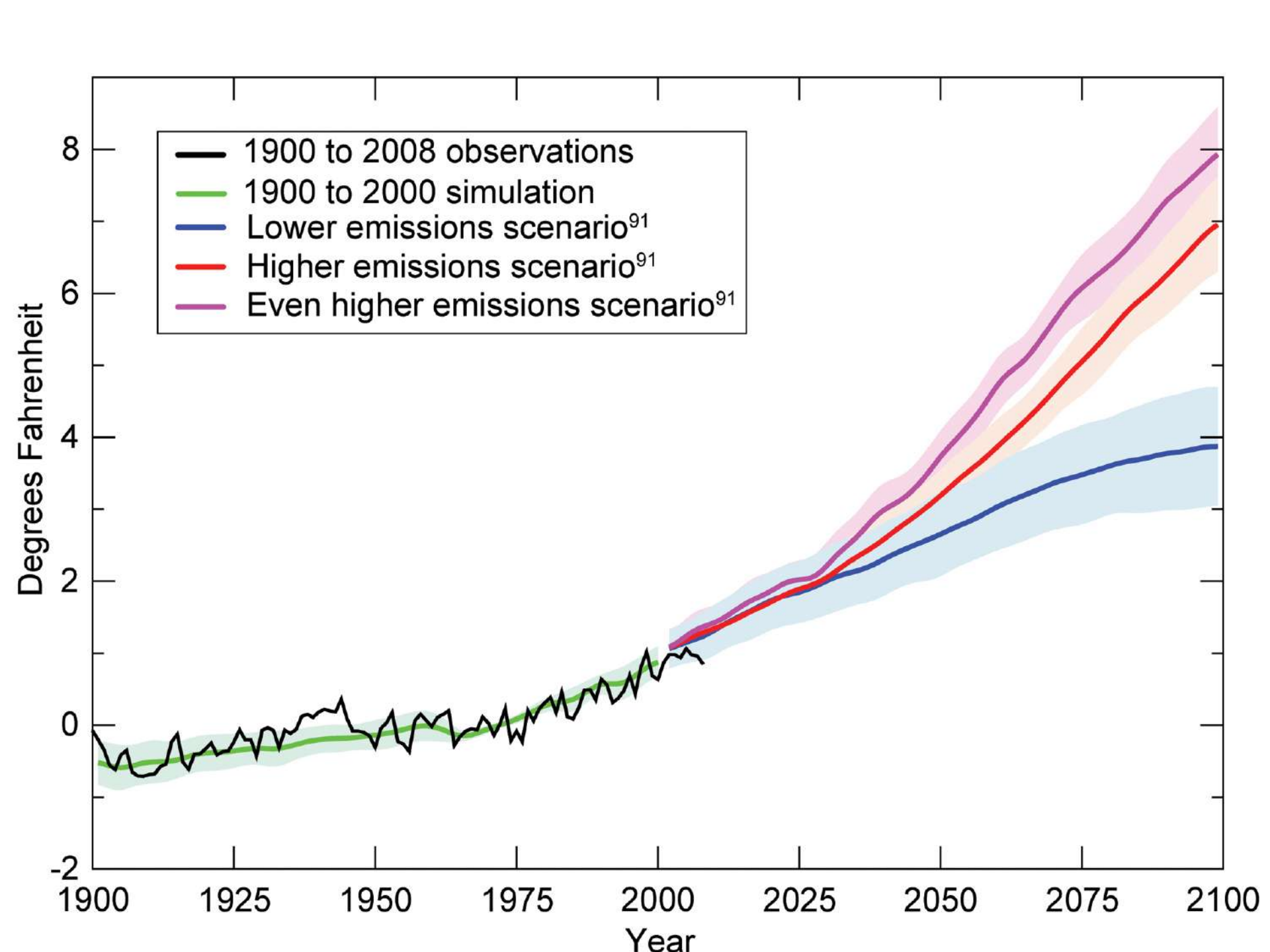
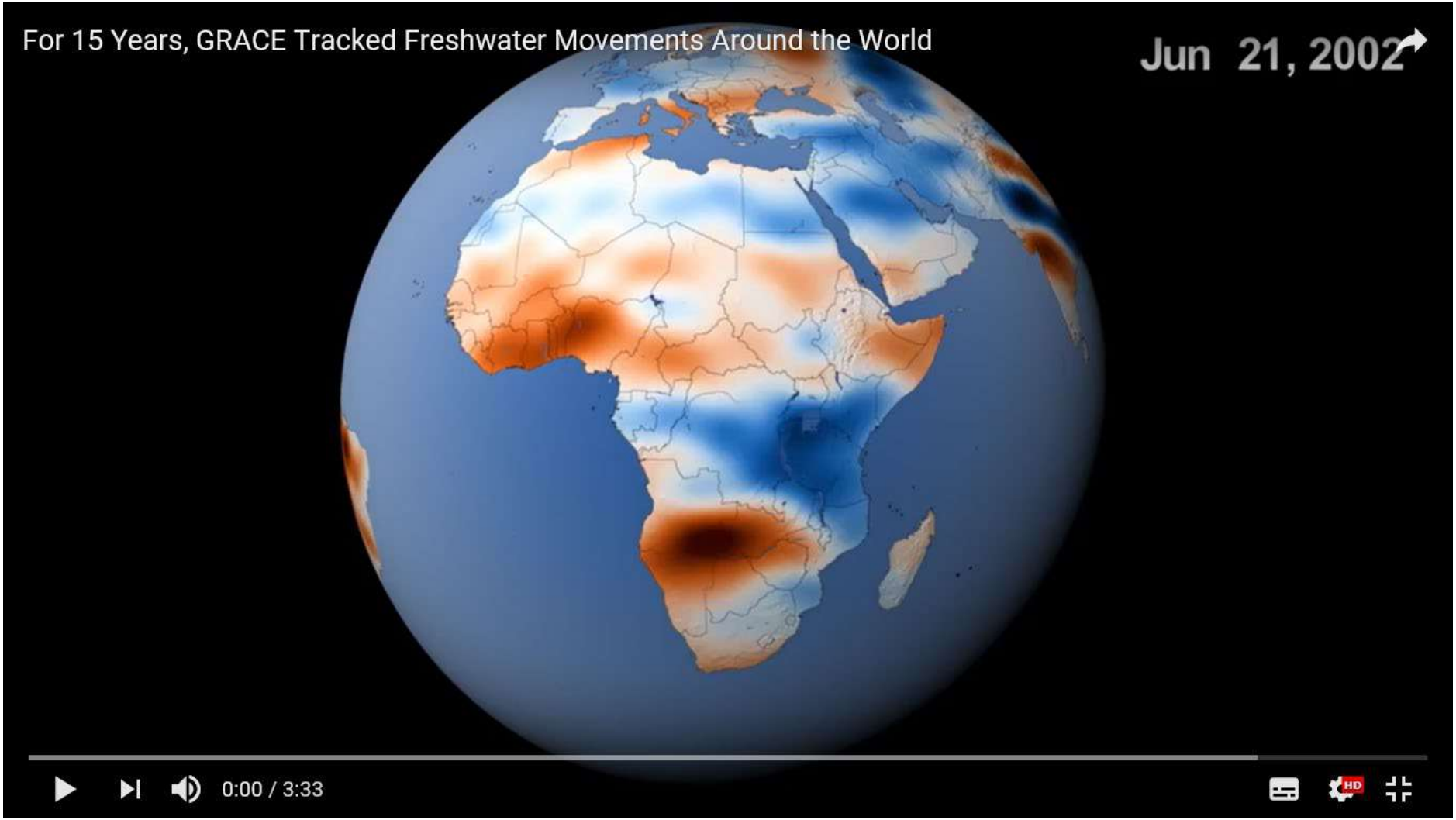
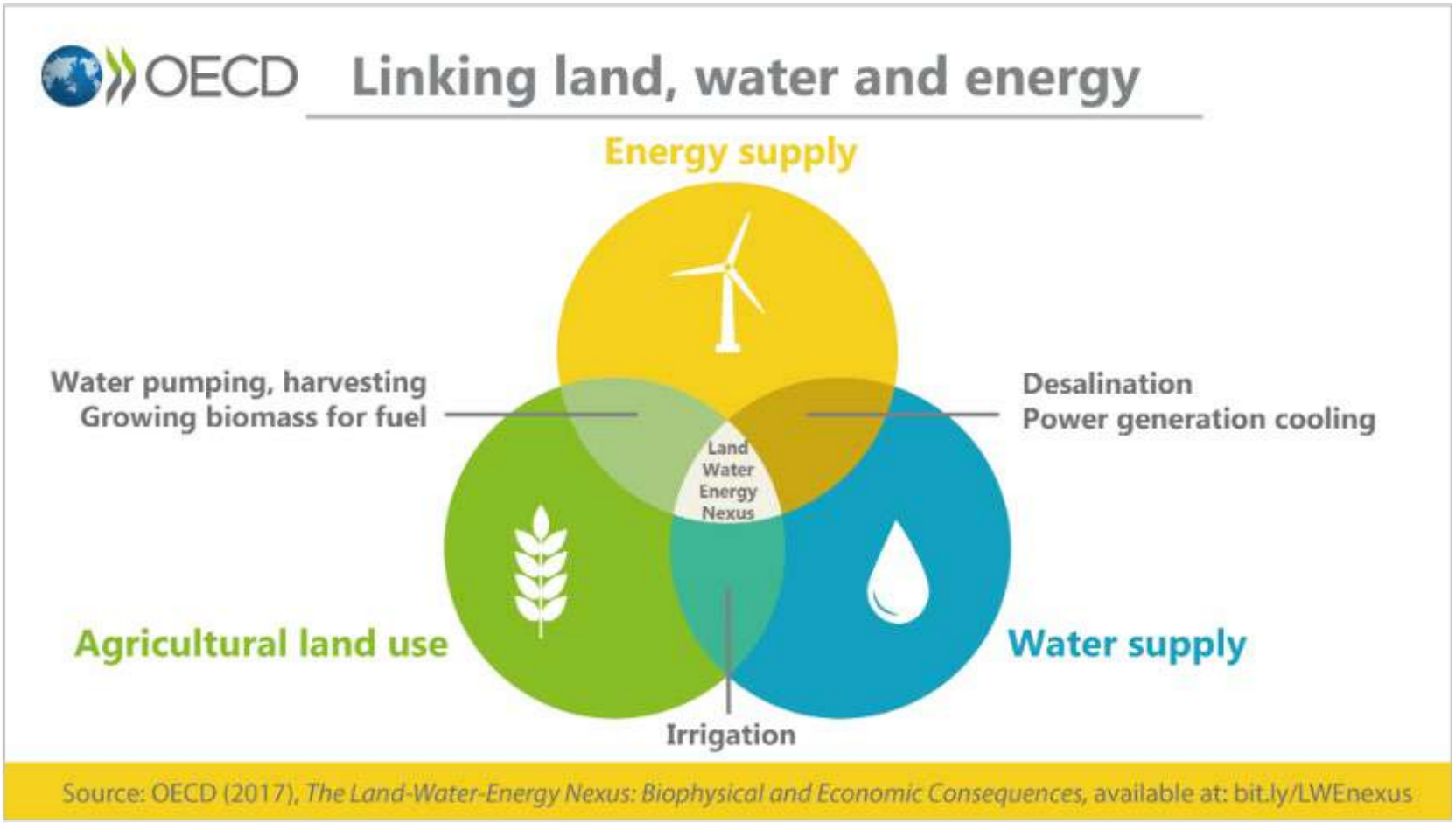

Instrumental data (AD 1902 to 1999)
Reconstruction (AD 1000 to 1980)
Reconstruction (40 year smoothed)
1998 instrumental value
Northern Hemisphere anomaly (°C)
relative to 1961 to 1990
1.0
0.5
0.0
−0.5
−1.0
1000
1200
1400
1600
1800
2000
Year

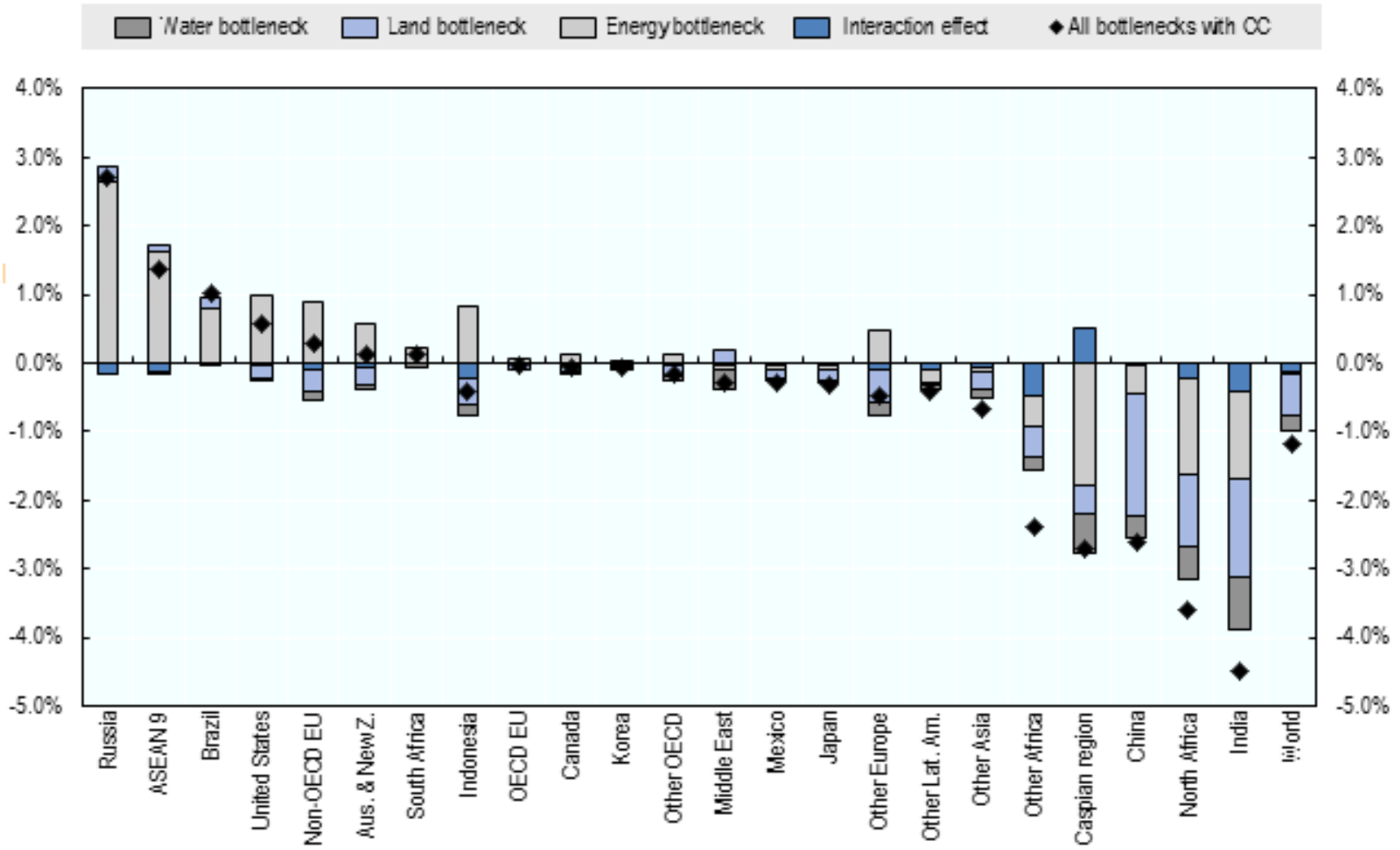

1900 to 2008 observations
1900 to 2000 simulation
Lower emissions scenario91
Higher emissions scenario91
Even higher emissions scenario91
Degrees Fahrenheit
8
6
4
2
0
-2
1900
1925
1950
1975
2000
2025
2050
2075
2100
Year


For 15 Years, GRACE Tracked Freshwater Movements Around the World
Jun 21, 2002
0:00 / 3:33
HD

Water is also a "nexus" issue …….



Consequences of nexus bottlenecks for regional GDP in 2060



Source: OECD (2017), Land-water-energy nexus: Biophysical and Economic Consequences

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Areas around the globe suffering from depleted water resources

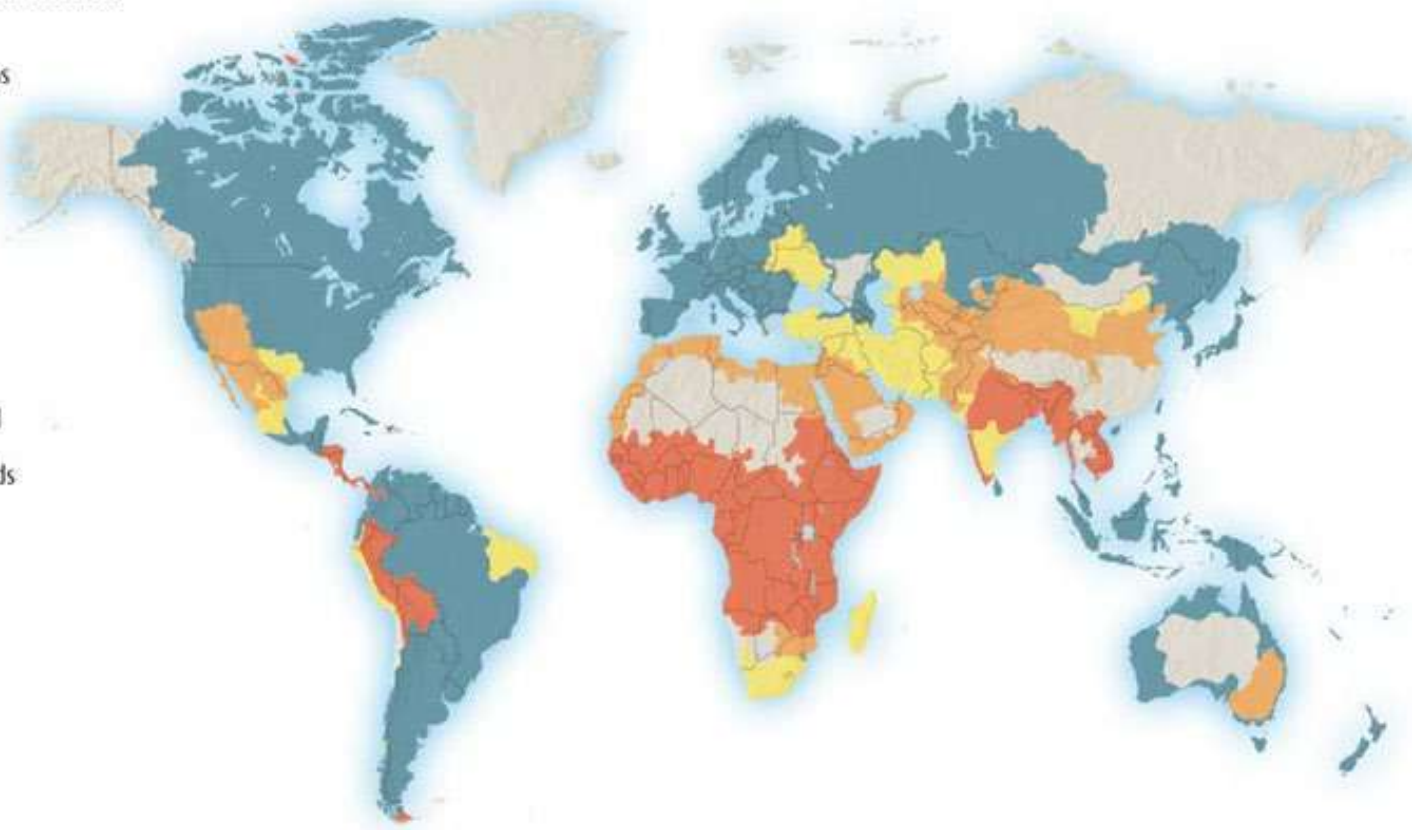
Physical water scarcity
Water resource development is approaching or has exceeded sustainable limits. More than 75% of river flow is extracted for agriculture

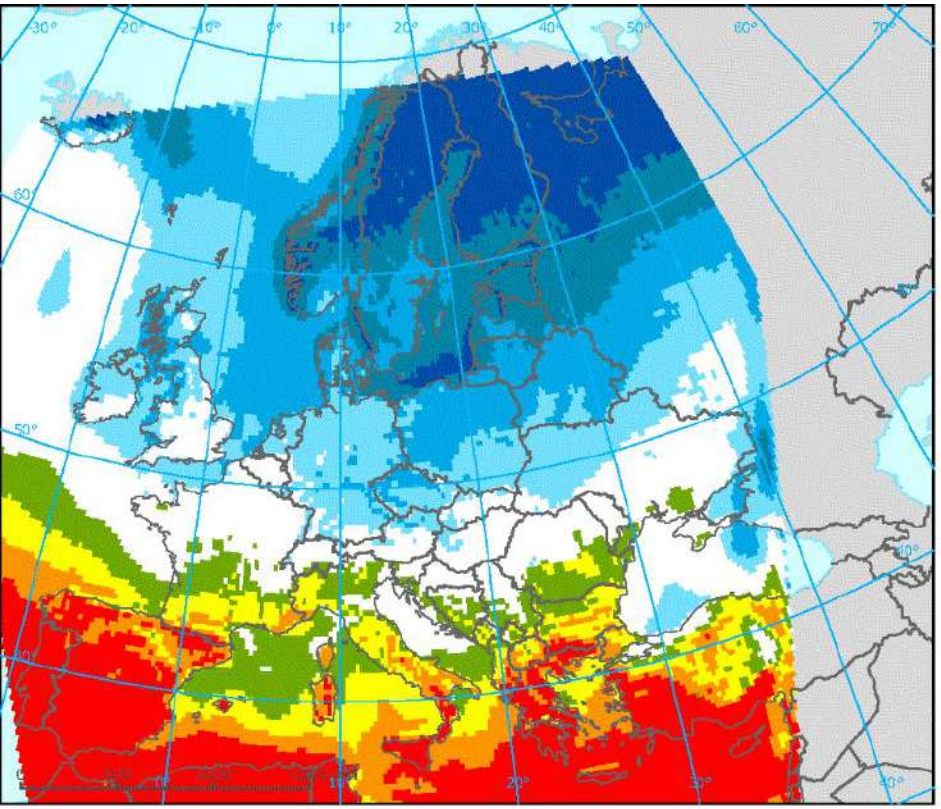
Approaching physical water scarcity
More than 60% of river flow is extracted. These areas will experience physical water scarcity in the near future

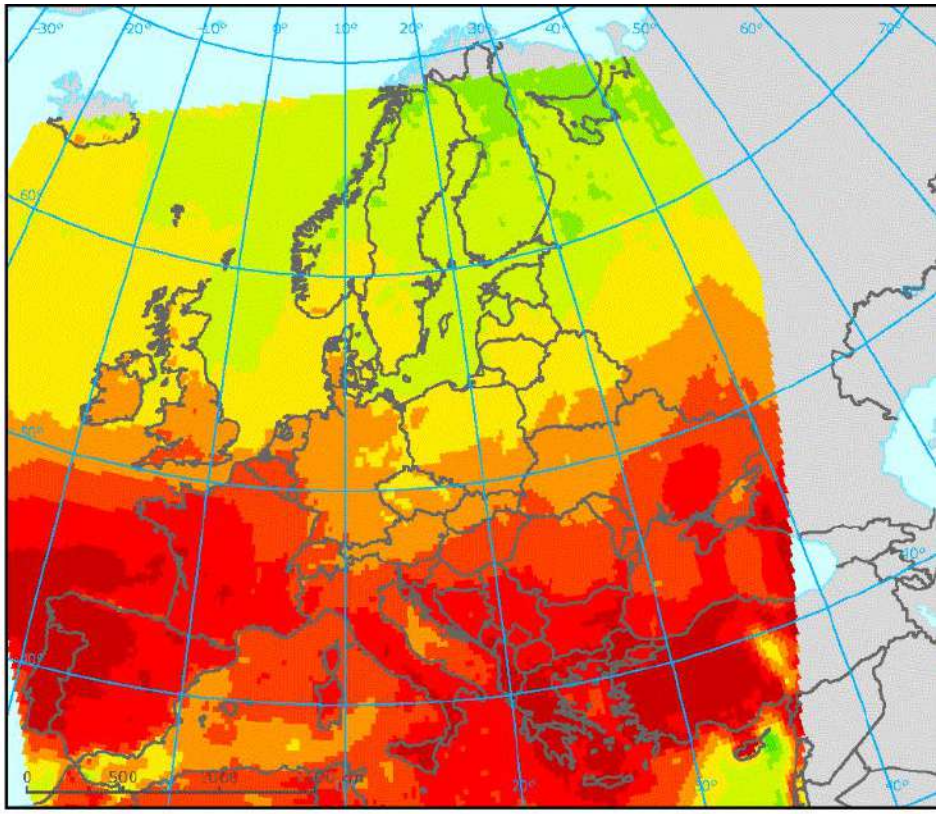
Economic water scarcity
Limited access to water even though natural local supplies are available to meet human demands. Less than 25% of water extracted for human needs

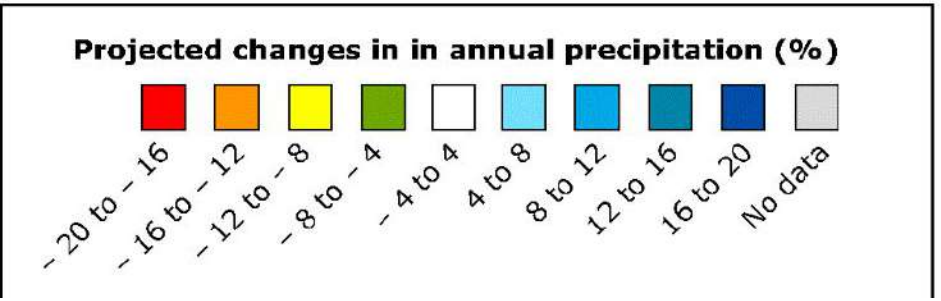
Little or no water scarcity
Abundant water resources relative to use, with less than 25% of water extracted for human purposes

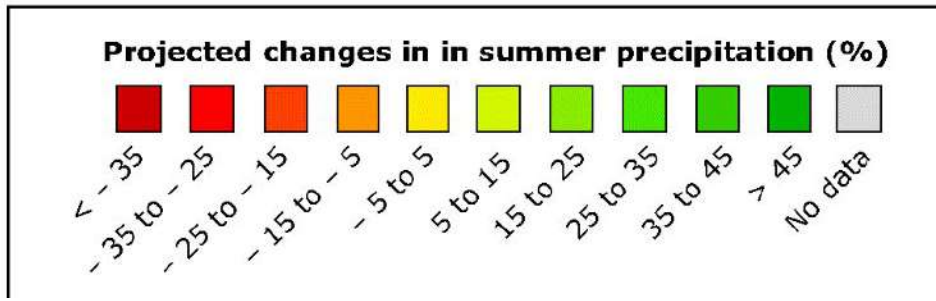
Not estimated



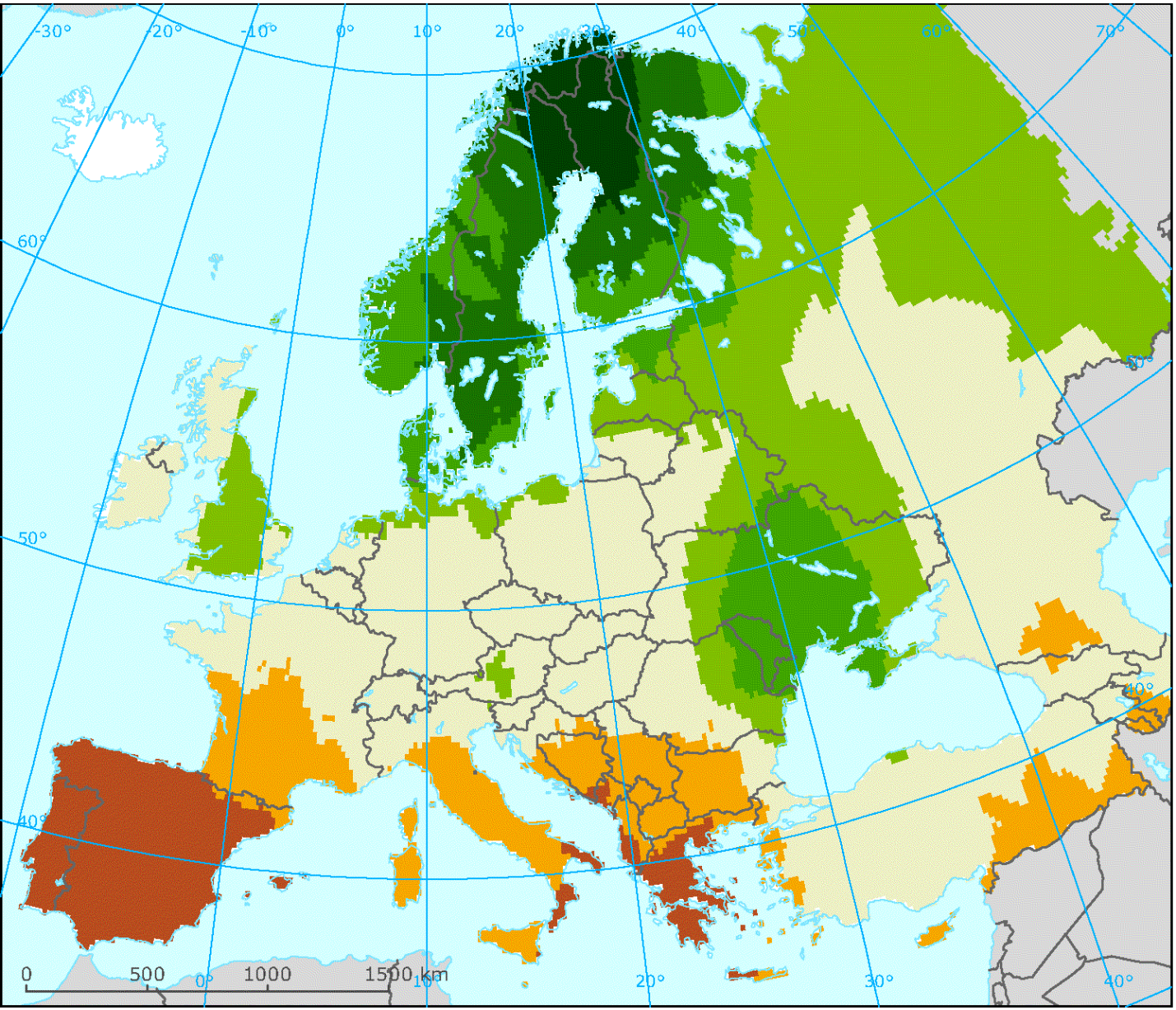








https://www.circleofblue.org/2012/world/eu-climate-forecasts-point-to-a-drier-future/



Projected changes in water-limited crop yield

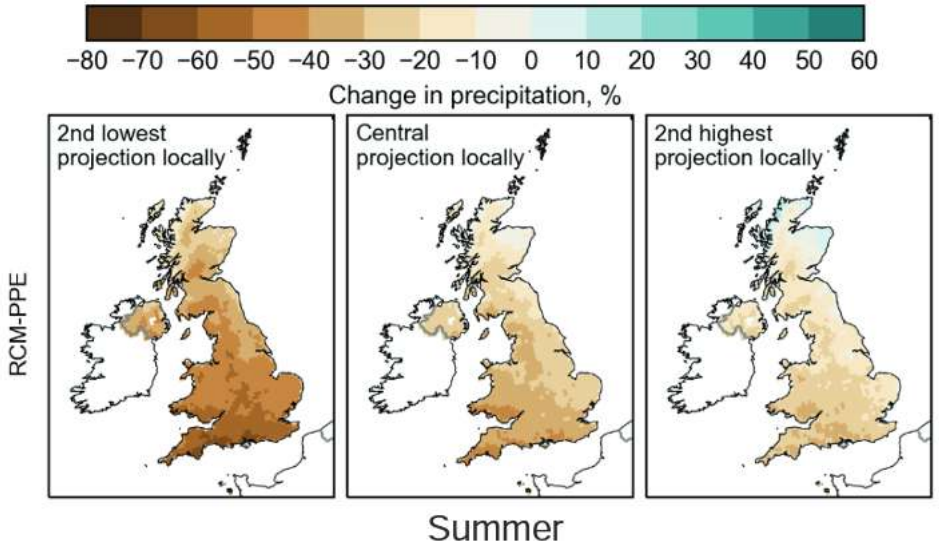
(%)

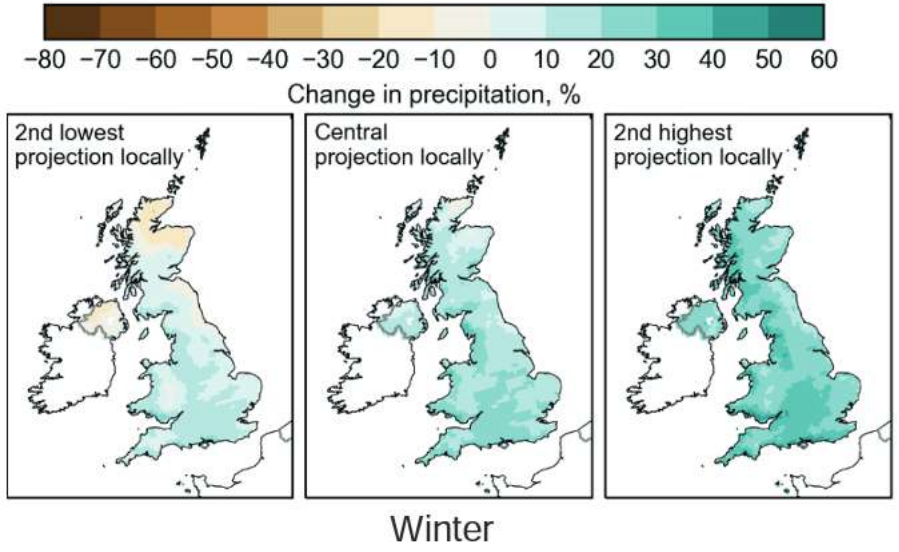
- – 25 to – 15
- – 15 to – 5
- – 5 to 5
- 5 to 15
- 15 to 25
- 25 to 35
- > 35

No data

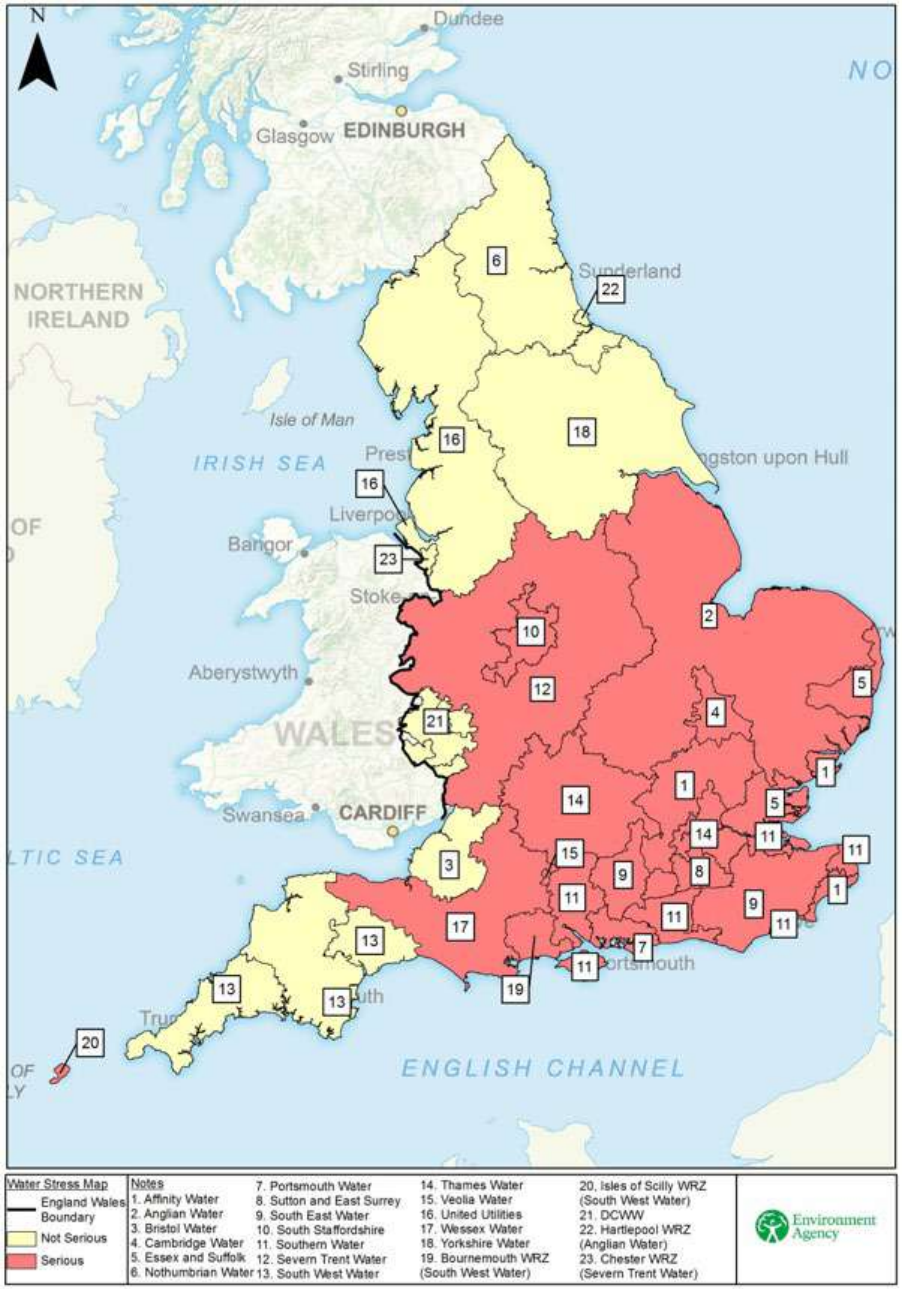
Outside coverage

https://www.circleofblue.org/2012/world/eu-climate-forecasts-point-to-a-drier-future/



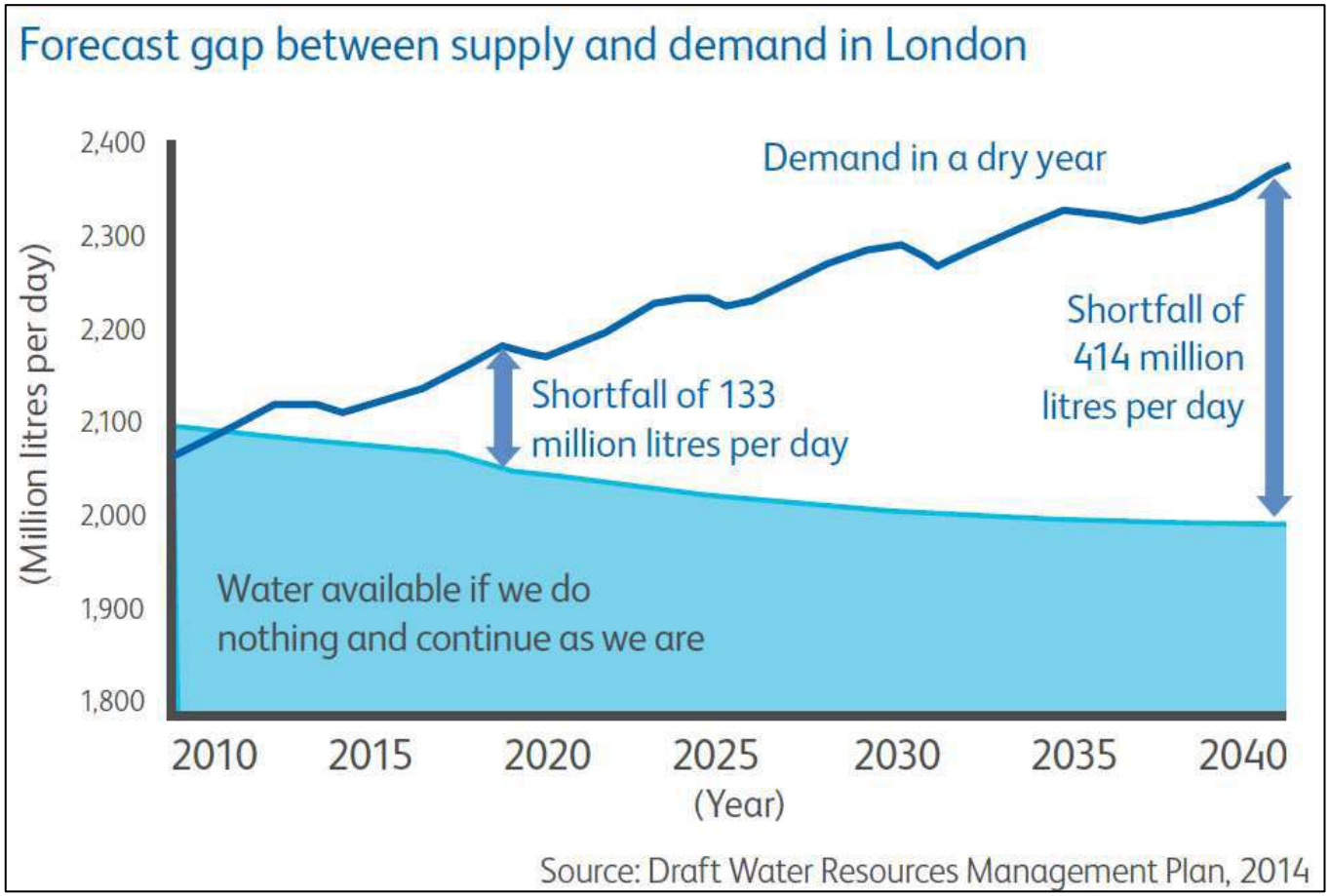


- Drier summers and wetter winters
- Increased frequency of heavy rain events
- Increased frequency of droughts



from *Water Stressed Regions – final classification*, 2021, UK Government

- Most water supply regions in serious water stress by 2030
- Discussions about regional water transfers
- New systems for water abstraction management
- Indirect wastewater re-use?


Forecast gap between supply and demand in London
2,400
2,300
2,200
2,100
2,000
1,900
1,800
(Million litres per day)
Demand in a dry year
Shortfall of 133 million litres per day
Shortfall of 414 million litres per day
Water available if we do nothing and continue as we are
2010
2015
2020
2025
2030
2035
2040
(Year)
Source: Draft Water Resources Management Plan, 2014

Water Quality

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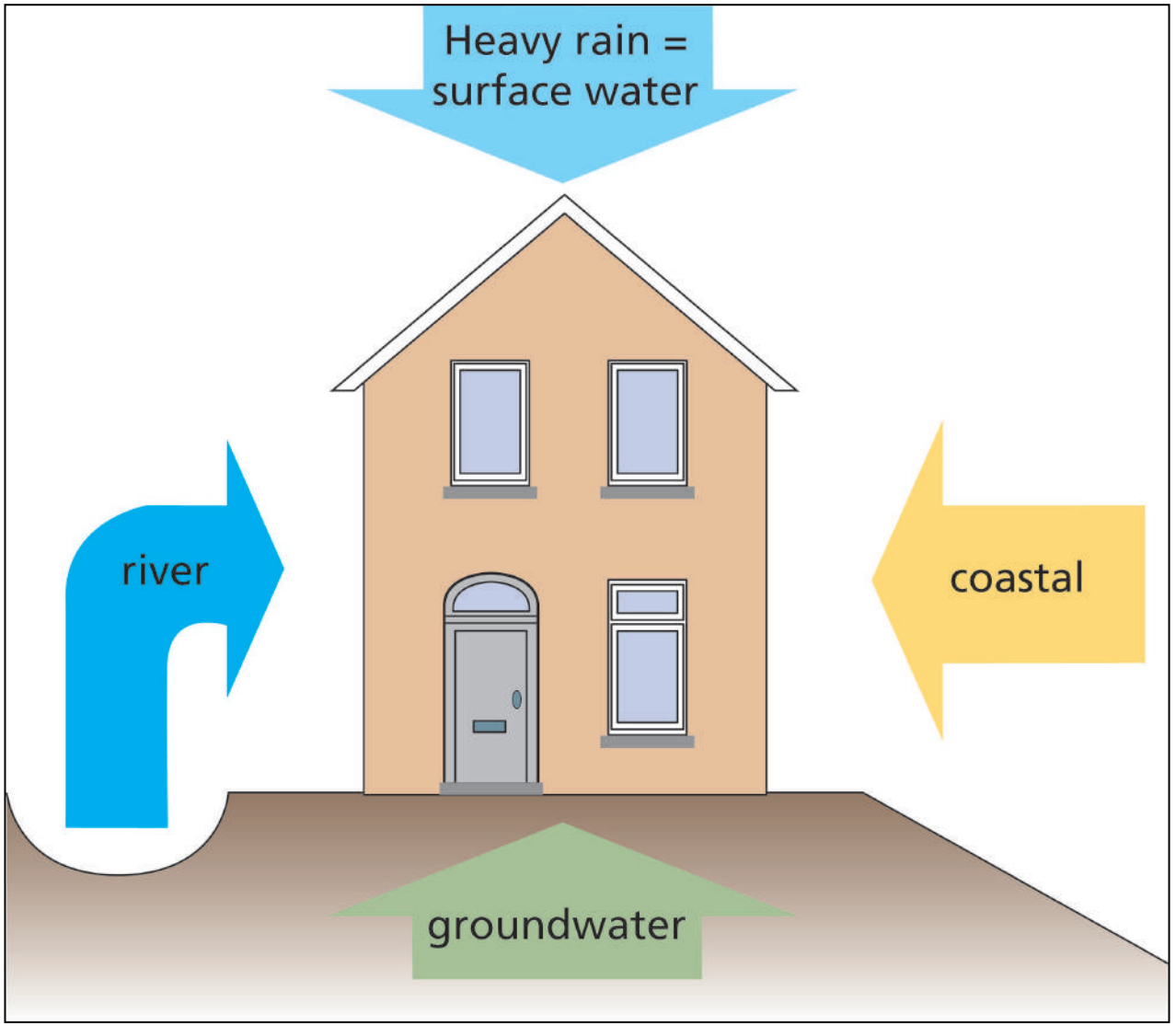
Types of Flooding:

- pluvial
- fluvial
- groundwater
- coastal




Newcastle
Redcar
Whitby
Leeds
Hull
Manchester
Hunstanton
Heacham
Snettisham
King's Lynn
Birmingham
Cardiff
Bristol
London
Ramsgate
Folkestone
Southampton
Hastings
Portsmouth
Plymouth
SOURCE: Environment Agency/Science Media Centre.
Potential extent of flooding in areas predicted to be at risk
Most at risk from tidal flooding/history of flooding (Environment Agency)
At risk of serious flooding (Science Media Centre)

.....and of course drought!

Summer 2022

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4. Water and “Sustainability”: near & long term prospects

- the *EC Water Framework Directive* (2000)

- sustainable urban drainage schemes (SuDS)

- circular economy in water

EC Water Framework Directive (2000)

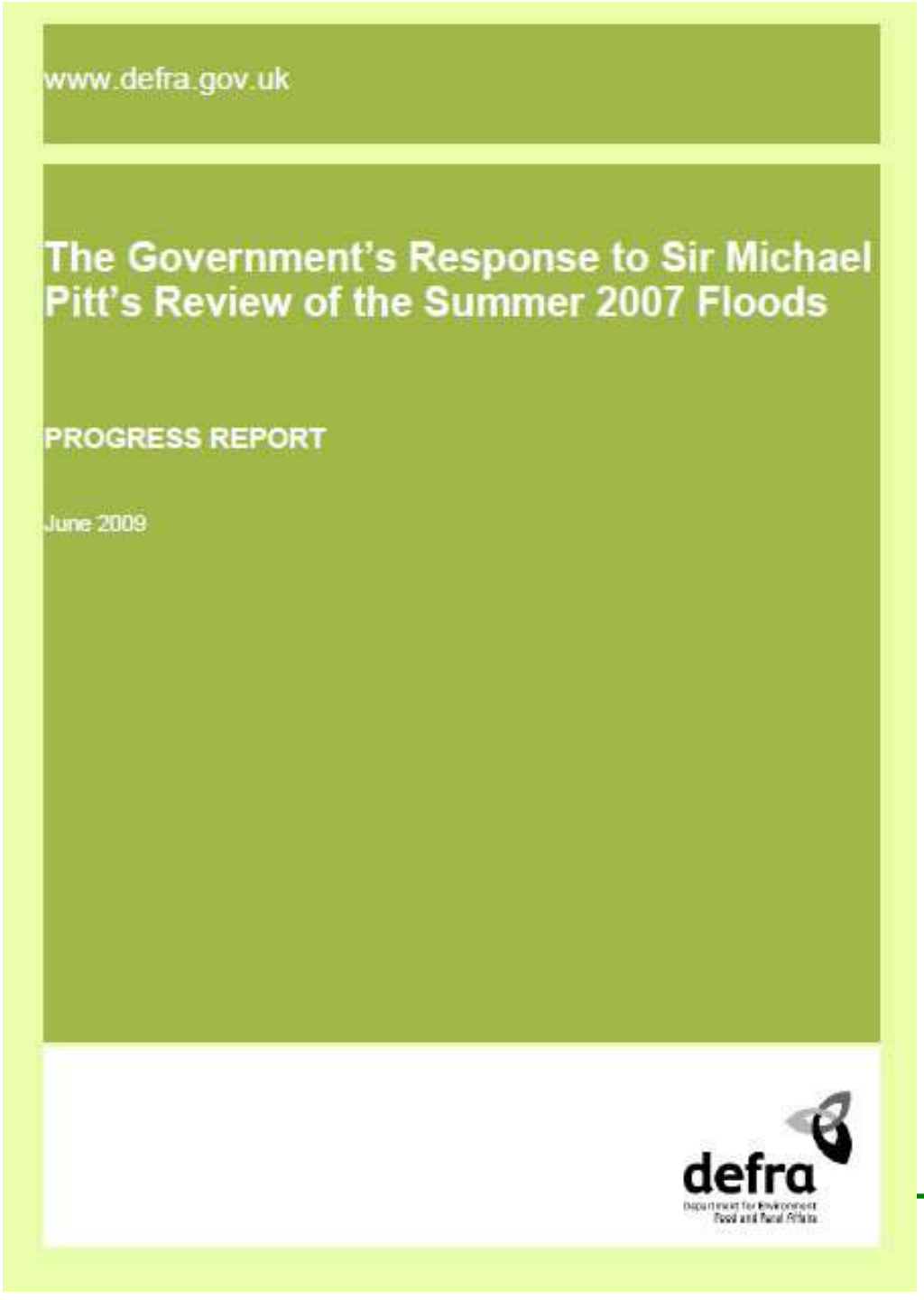
- an attempt to create a unified approach to water quality management out of the plethora of specific technical water quality directives developed over the past 20 years.

- it requires all inland and coastal water bodies to reach at least "good status" (defined in chemical and biological terms) by 2015.

- does this by establishing a stakeholder-based river basin district management structure within which demanding environmental objectives will be set, including ecological targets for surface waters.

EC Water Framework Directive (2000)

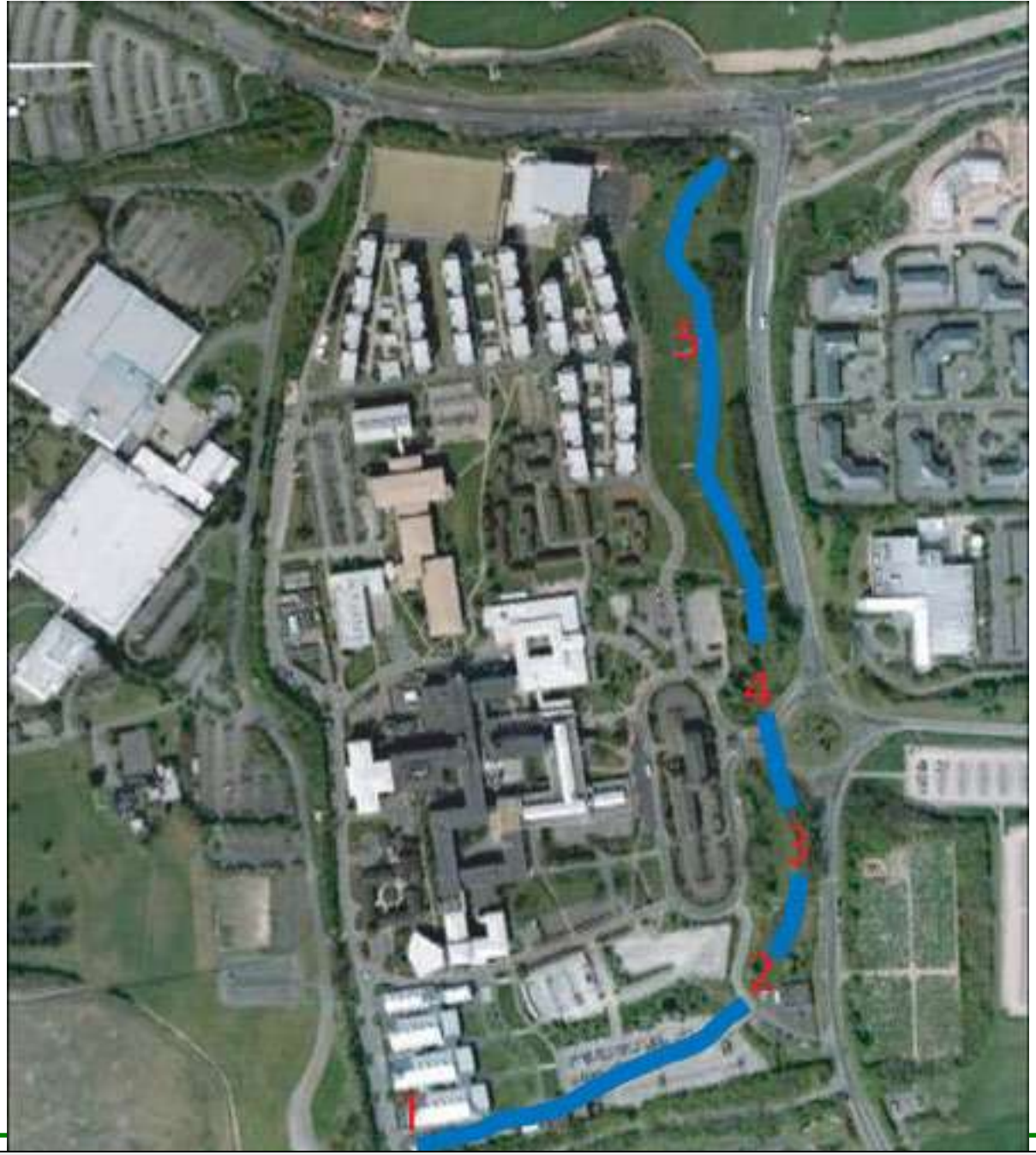
Although its primary aims are environmental, the WFD embraces all three principles of sustainable development: *environmental, economic* and *social* needs must all be taken into account when river basin management plans are being developed (Article 9). cf. "IWRM"



- Pitt Review: focus on infrastructure and resilience
- New Infrastructure Planning Commission
- Vulnerable citizens
- Civil defence

The *CIRIA SUDS Manual* suggests that a well-designed SUDS should:

1. “store or safely pass the runoff from extreme storm events, without putting public or property at risk
2. reduce if possible, or at least not increase, the pre-development risk of flooding associated with the receiving watercourse
3. prevent downstream stream bank and channel erosion
4. reduce urban runoff pollutants and improve stormwater water quality before discharge
5. provide amenity and ecological benefits, wherever practicable.



UWE Bristol, Frenchay Campus (2010)

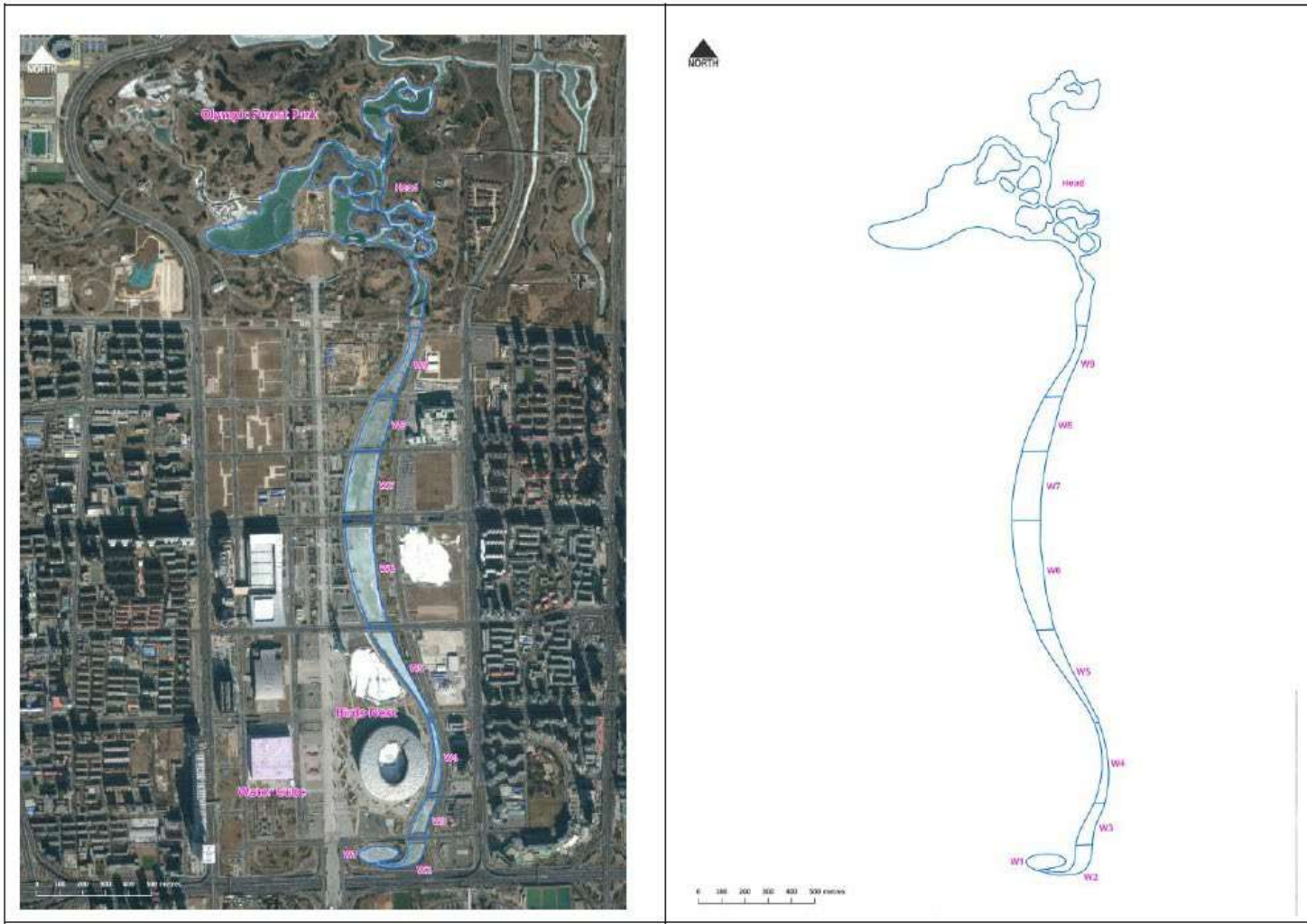
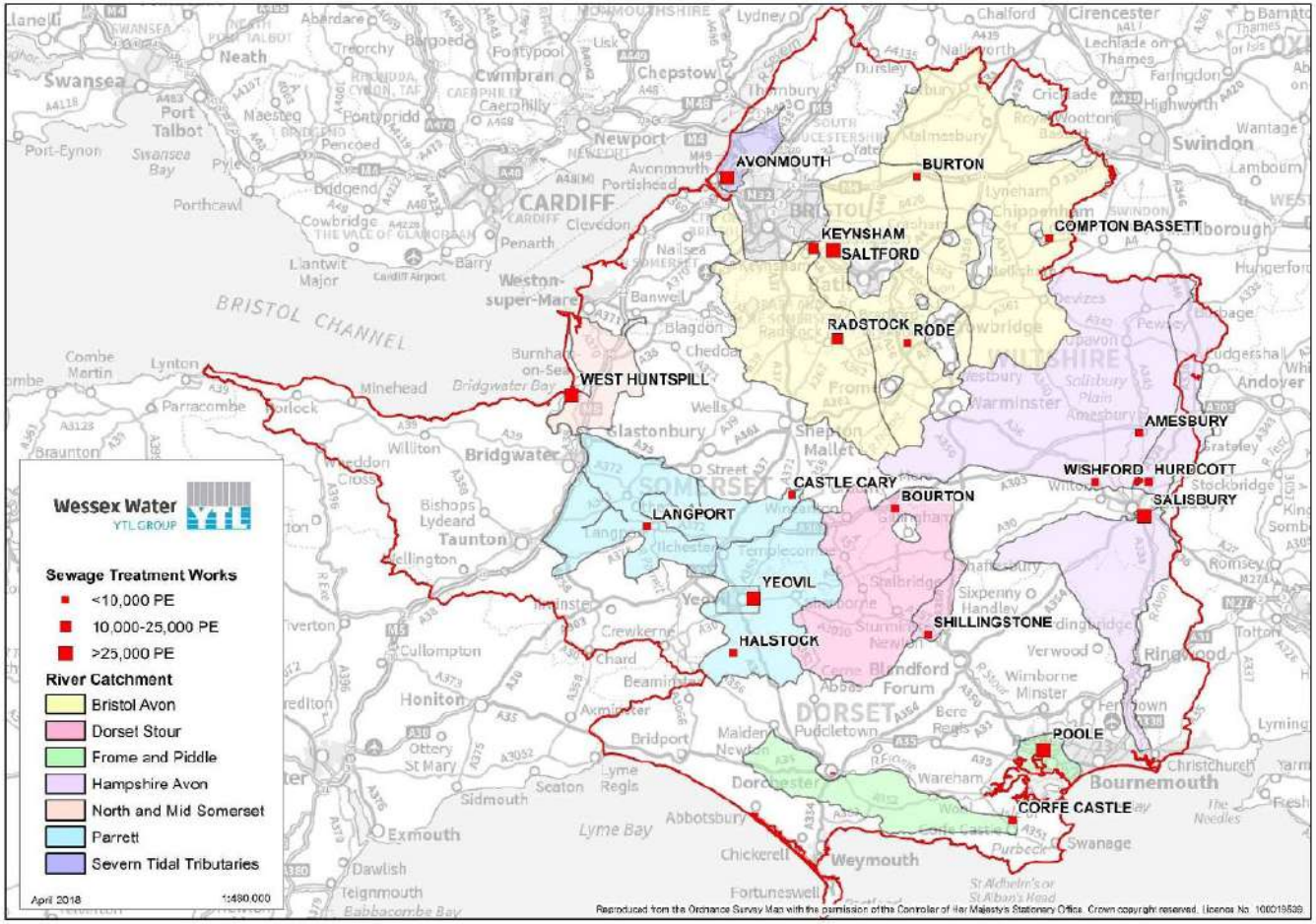


Figure 1: Main Beijing Olympic Site, showing Dragon-shaped River system, with Dragon Lake and Olympic Forest Park at top. Source: Paul Satchell, UWE, Bristol

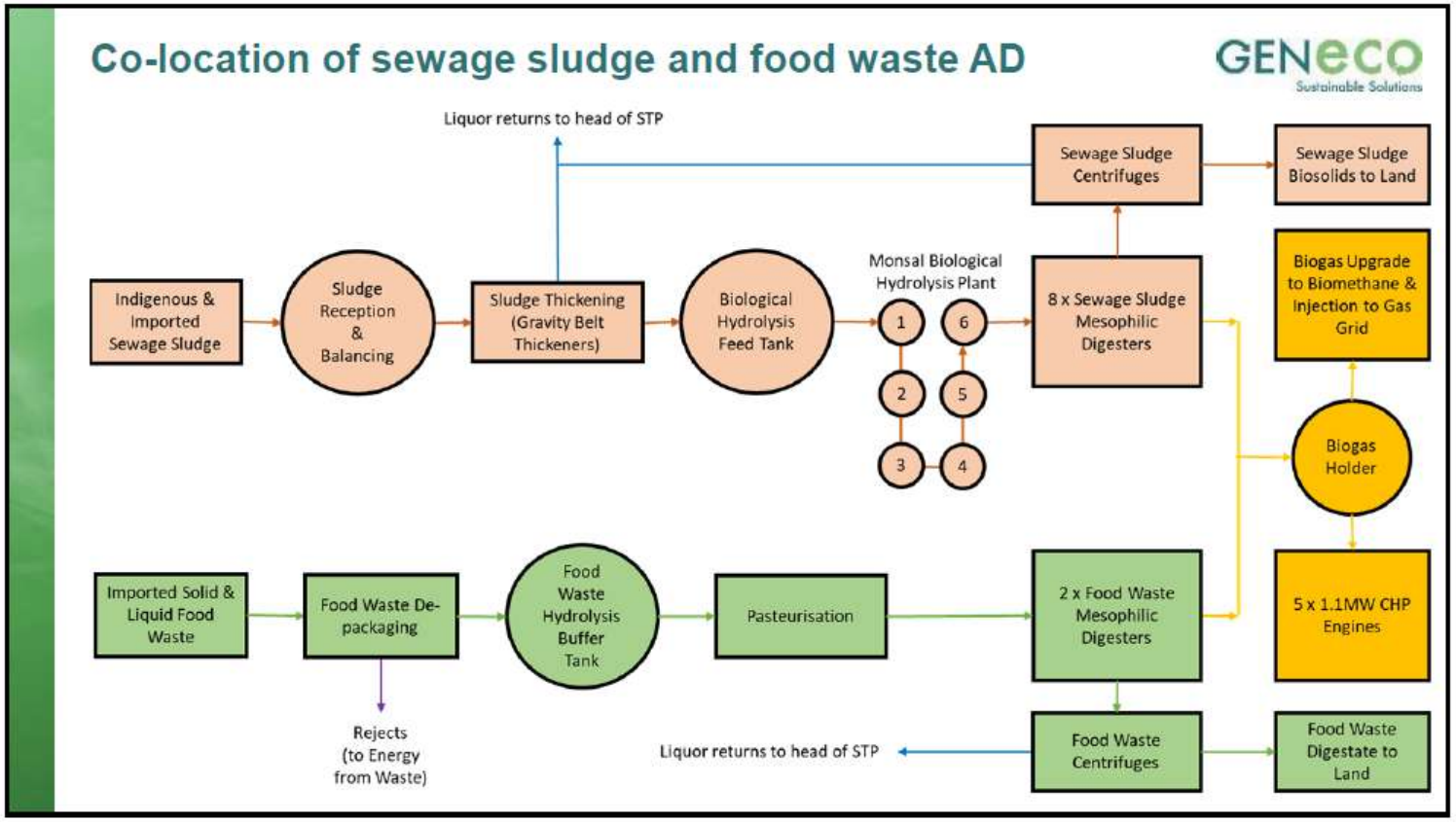
Learning from Windhoek and Singapore: circular water systems “from toilet to tap”


AVONMOUTH
BURTON
KEYNSHAM
SALTFORD
COMPTON BASSETT
RADSTOCK
RODE
WEST HUNTSPILL
AMESBURY
WISHFORD
HURDCOTT
CASTLE CARY
BOURTON
SALISBURY
LANGPORT
YEOVIL
SHILLINGSTONE
HALSTOCK
POOLE
CORFE CASTLE
Wessex Water
YTL GROUP
Sewage Treatment Works
<10,000 PE
10,000-25,000 PE
>25,000 PE
River Catchment
Bristol Avon
Dorset Stour
Frome and Piddle
Hampshire Avon
North and Mid Somerset
Parrett
Severn Tidal Tributaries
April 2018
1:480,000
BRISTOL CHANNEL
Reproduced from the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. Crown copyright reserved. Licence No. 100019539


Step 4: Secondary Treatment
Step 5: Final treatment and outfall
Step 3: Primary Settlement Tanks
Step 2: Screening and Grit Removal
Step 6: Bioenergy Facility
Step 1: Initial Wastewater Reception on Site

Co-location of sewage sludge and food waste AD

GENeco
Sustainable Solutions



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Towards Urban Water Security

This project is funded by Lloyd's Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research.

International Water Security Network

Water security is defined by the UN as "the capacity of a population to safeguard sustainable access to adequate quantities of and acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."

Water security is an ever more important global issue, of relevance and importance to individuals, businesses, governments and organisations.

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The marvel of drinking water
IWSN on the move in South America
Introducing Rossi Taboada

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Monash South Africa: Bimo Nkhata, Linda Downsborough, Charles Breen, Duncan Hay

United States: University of Arizona in Tucson, Arizona

United Kingdom: University of the West of England in Bristol

Rajasthan, India: Restoration of groundwater recharge practices

Uttarkhand, India: Hydropower-Irrigation Nexus

Mexico: El Colegio de Sonora in Hermosillo

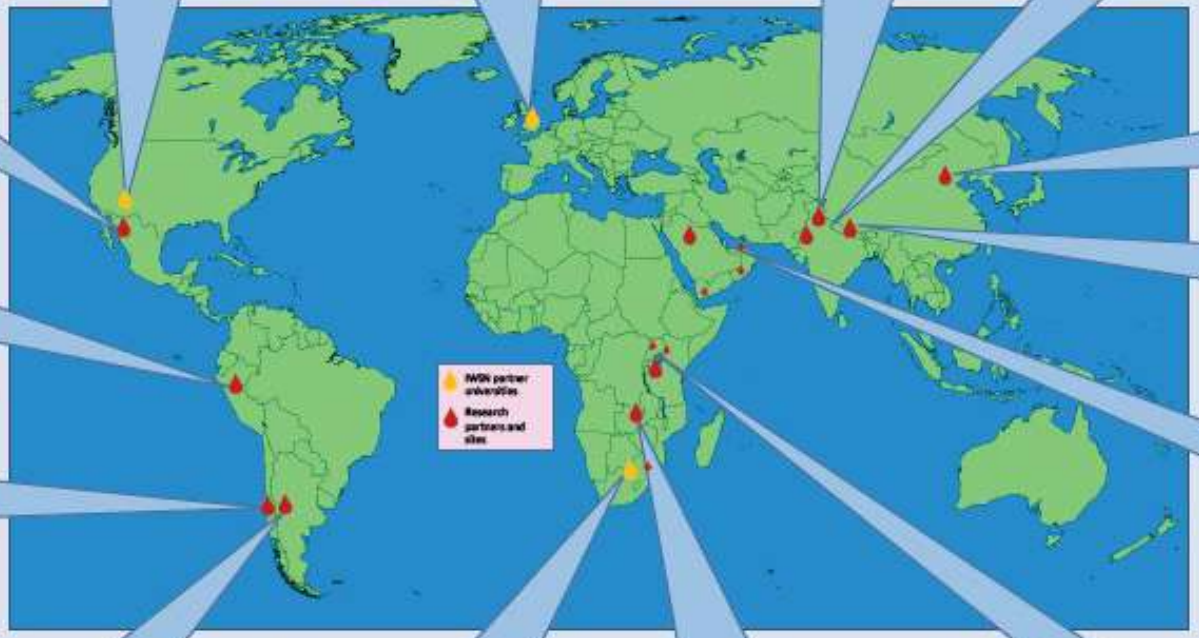
China: University of Science and Technology Beijing

Peru: Centro de Competencias del Agua in Ayacucho

Nepal: ICIMOD – HI-AWARE Project in Kathmandu

Chile: Pontifical Catholic University of Chile in Santiago

Middle East & North Africa



Argentina: Natl. Sci. & Technical Research Council in Mendoza

South Africa: Monash South Africa in Johannesburg

Zambia: Water quality security in the Kafue River Basin

Africa: UWE-Africa Water Security Programme

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Poster prepared by Adriana Zuniga-Teran and Robert Varady. Udall Center for Studies in Public Policy, University of Arizona

The challenges of safe and secure water services are many and large……

……but with the right combination of "hard" and "soft" engineering the global community CAN meet these challenges!

To learn more:

www.watersecuritynetwork.org
www.twitter.com/water_network

Acknowledgement
The International Water Security Network is funded by Lloyd's Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research.
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