

WMO Hydrological Research Strategy and Activities 2022-2030



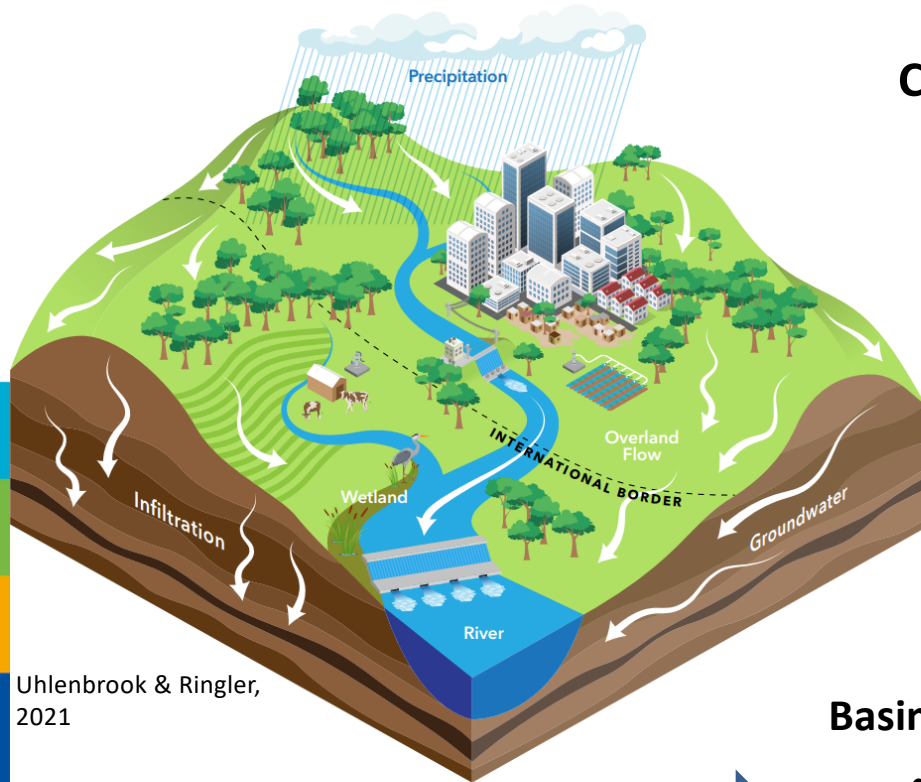
Stefan Uhlenbrook and MANY other

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World Meteorological Organization

Organisation météorologique mondiale

How to improve hydrological information and services? (observations, modelling and forecasting)



Uhlenbrook & Ringler,
2021

Challenges include:

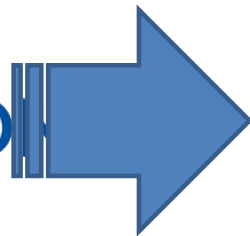
- Climate change and change of hydro-meteorological characteristics
- Need of an Earth systems approach
- Change of water availability and increasing water demand of society
- Human interventions, the need to develop water resources
- Lack of data and information, systems understanding
 - *Operational hydrology/water management needs to address these challenges*

Basin approach – data & information is critical:

- Water management, DRR
- Quantification and accounting of WEF&E resources interactions
- Upstream-downstream inter-dependencies
- Shared benefits and trade-offs across countries and sectors



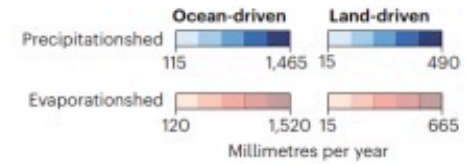
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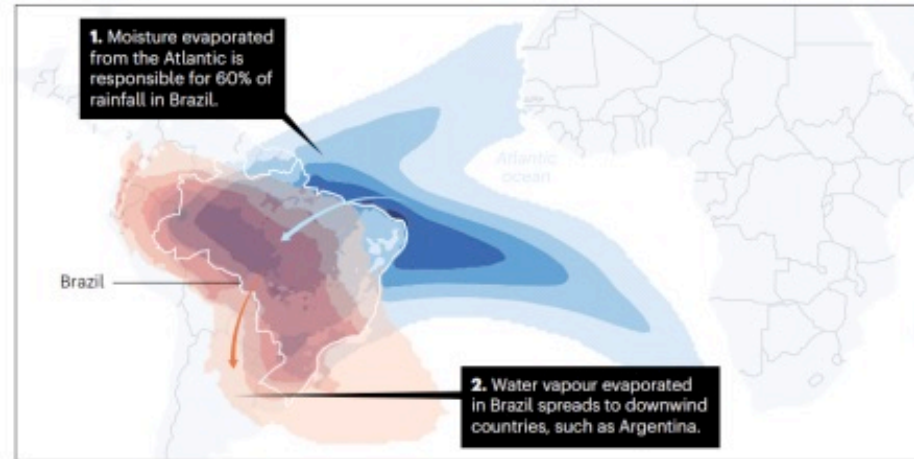
A reminder ...

ATMOSPHERIC WATERSHEDS

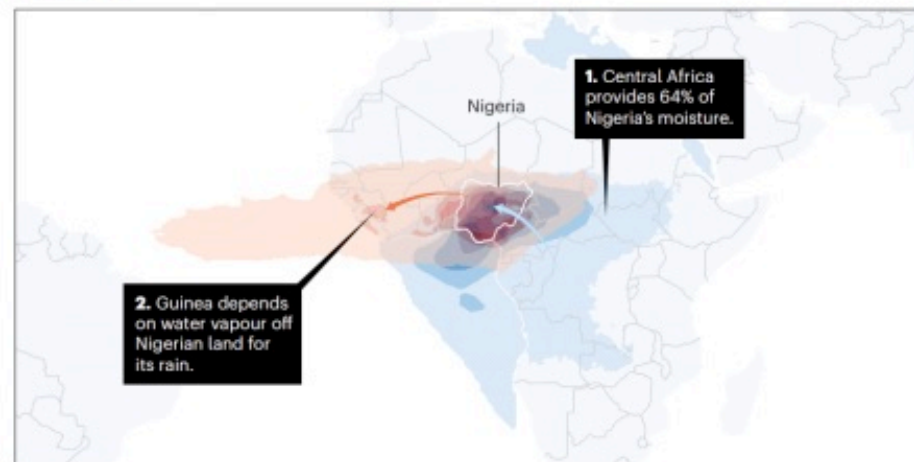
The atmosphere harbours precipitationsheds (regions that act as sources of precipitation to a certain area) and evaporationsheds (regions that receive this area's evaporation, which falls as precipitation). In addition to evaporation from the ocean, the water cycle is driven by moisture from evapotranspiration from terrestrial land and vegetation, and land-cover changes in one country can affect another's rainfall.



Ocean-driven



Land-driven



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Rockstrom et al.,
2023, *Nature*

Example: Integrated Water Storage Management

PERSPECTIVES PAPER  Global Water Partnership   IWM International Water Management Institute

Storing water: A new integrated approach for resilient development

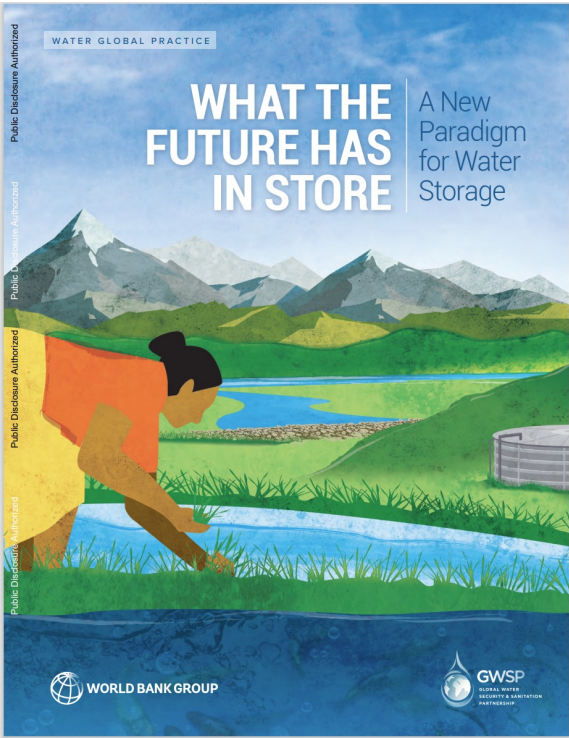


This Perspectives Paper was prepared by Winston Yu, William Rex, Matthew McCartney, Stefan Uhlenbrock, Rachel von Gnechten, and Jerry Dell'Priscoli. It is intended to galvanize discussion within the GWP Network and the larger water and development community on the role of storage in managing water and building resilience.

www.gwp.org www.gwptoolbox.org

WATER GLOBAL PRACTICE

WHAT THE FUTURE HAS IN STORE | A New Paradigm for Water Storage




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WORLD BANK GROUP 



Integrated Water Storage Management

A growing water storage gap
needs an *integrated approach*

Present

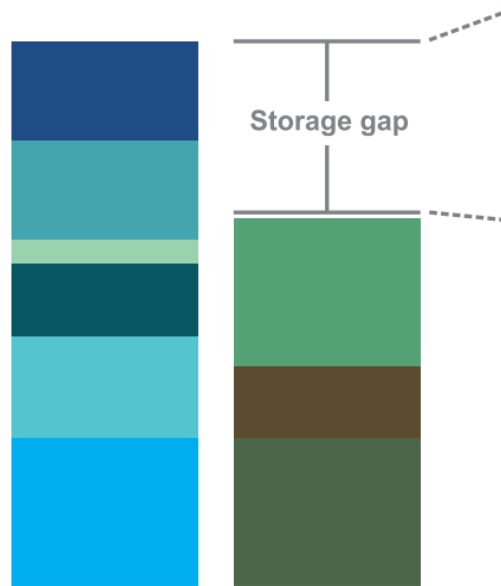


Storage needs

- Flood
- Environment
- Industrial
- Municipal
- Energy
- Agriculture

Operational storage

- Nature-based
- Built
- Intermediate



Source: Yu et al., 2021

WMO Resolution 25 (CG-18) in 2019

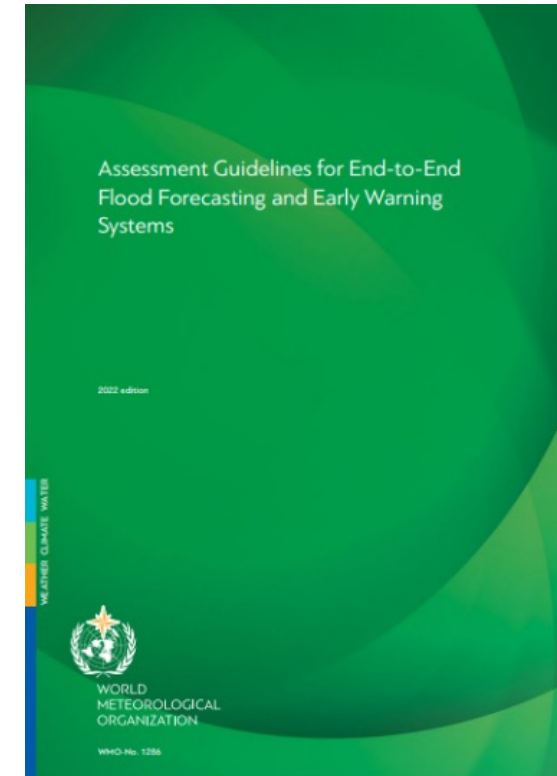
Basis for WMO Plan of Action for Hydrology - eight **Long-term Ambitions**:

1. No one is surprised by a **flood**
2. Everyone is prepared for **drought**
3. Hydro-climate and meteorological data support the **food security** agenda
4. **High-quality** data supports science
5. **Science** provides a sound basis for operational hydrology
6. We have a thorough **knowledge of the water resources** of our world
7. **Sustainable development** is supported by hydrological information
8. **Water quality** is known

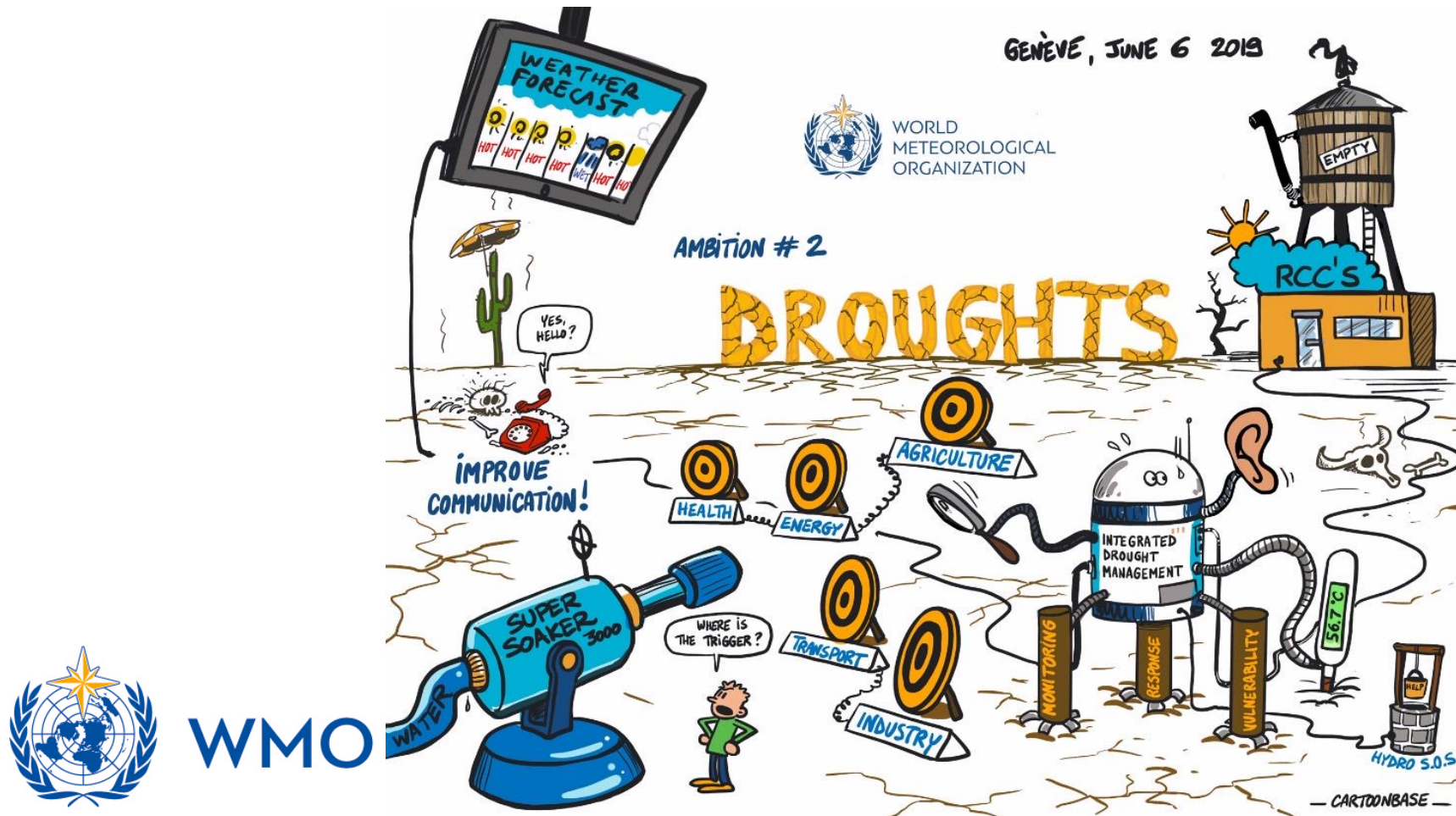


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1. No one is surprised by a flood

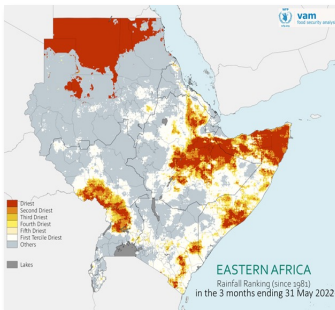


2. Everyone is prepared for drought



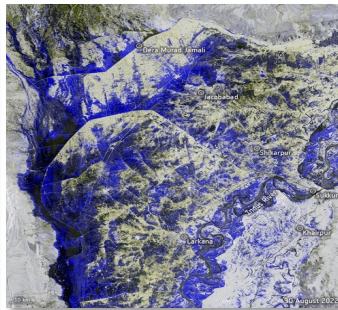
5 top high impact events in 2022

1



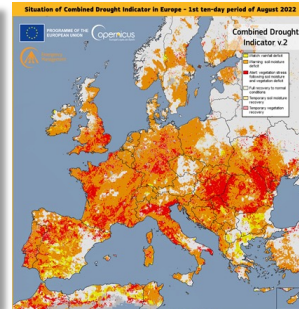
Drought in
Greater Horn
of Africa

2



Floods
in
Pakistan

3



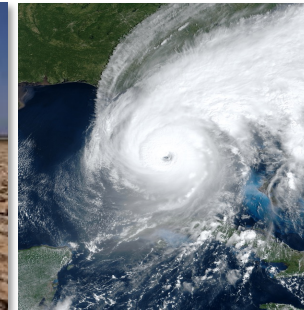
Heat,
drought and
wildfire -
Europe

4



Heat and
drought
- China:

5

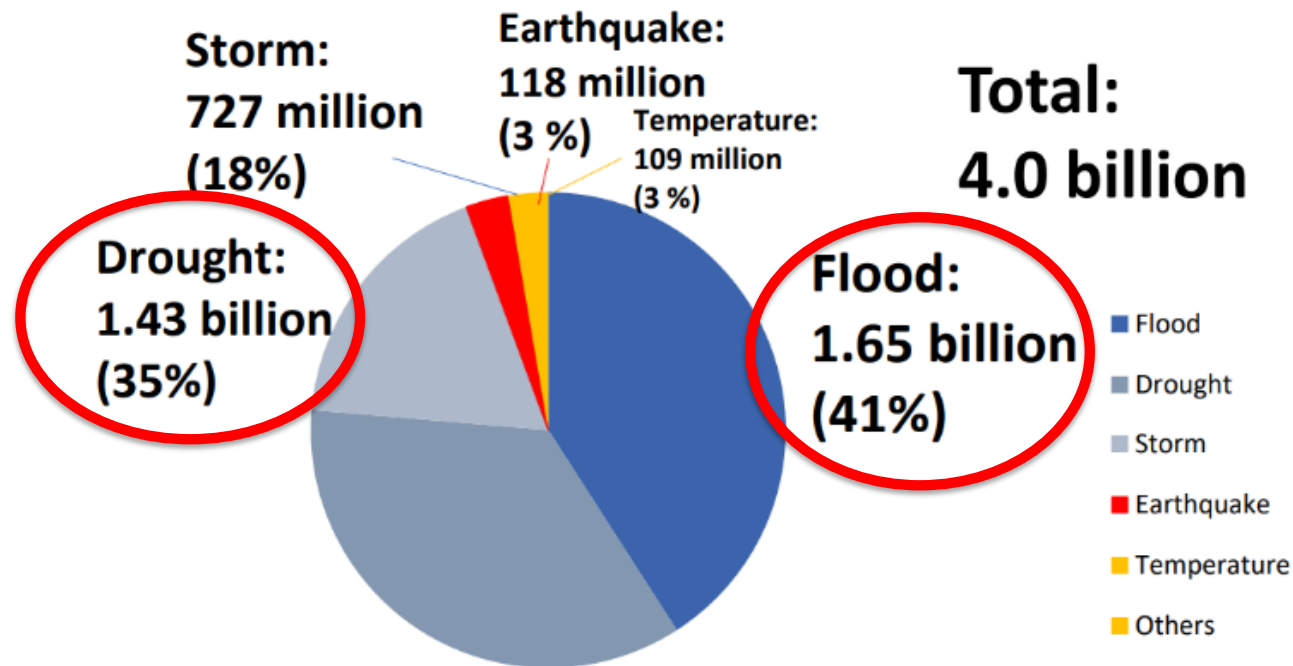


Hurricane
Ian
USA, Cuba



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Number of people affected by disasters (2000-2019)



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Courtesy: Kenzo Hiroki, 2022

WMO Resolution 25 (CG-18) in 2019

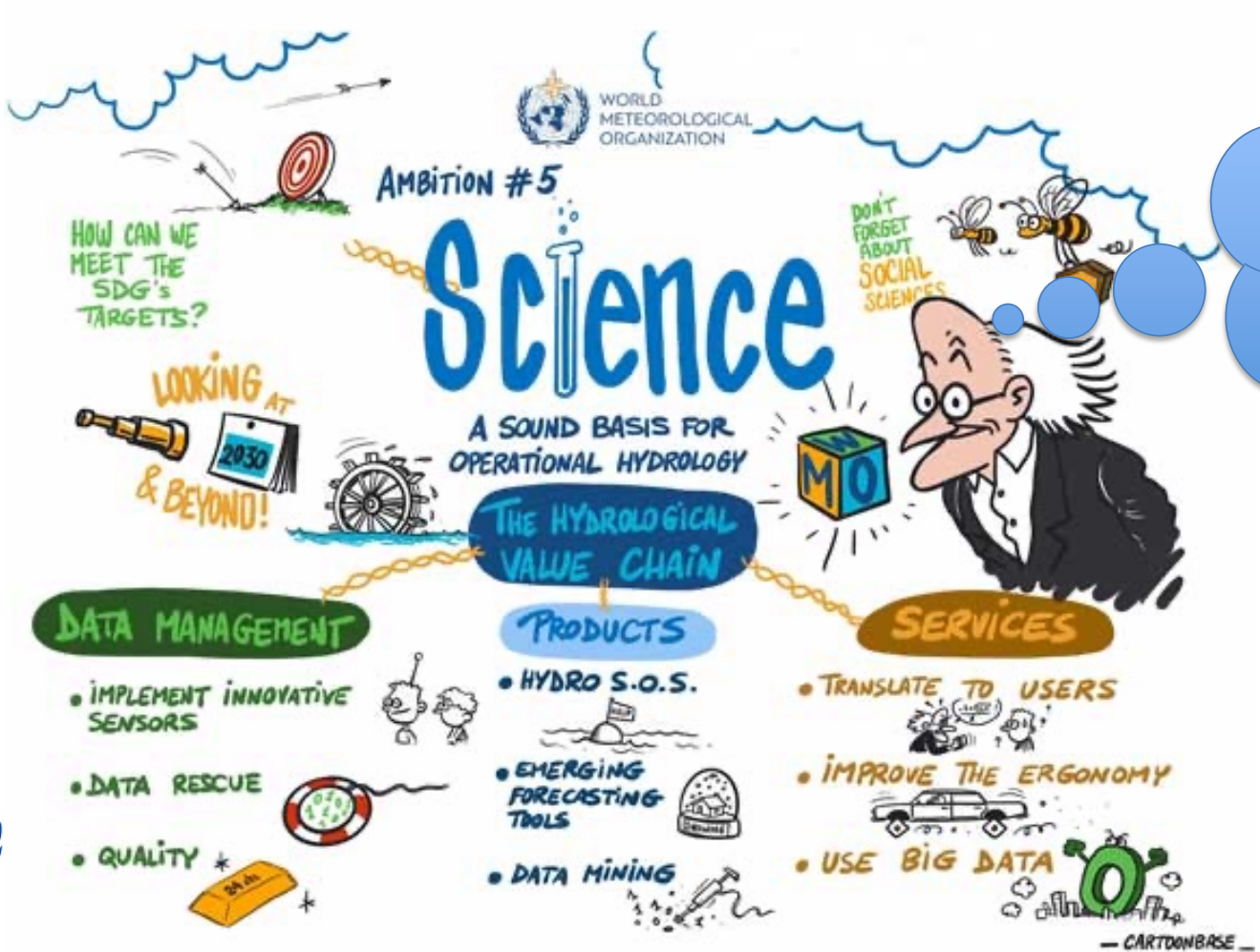
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5. Science provides a sound basis for operational hydrology



Enable the conduct of science that advances the implementation of the hydro research agenda



The Hydrology Research Strategy

Purpose: To accelerate research that improves the delivery and use of hydrologic data, information, and services and responds directly to the needs of National Hydrological and Meteorological Service providers – particularly in low-resource settings.

Objectives:

Generate hydrologic and cryospheric information to better assess and manage of water resources



Increase access to hydrometeorological data that can inform decision making

Improve hydrological forecasting



Photos :

• Georgian Hydrometeorological Department (NMHS)

• Junior A. Mathurin, Water Resources Management Agency - St.Lucia

• Photo: Kari Norwegianwoman/NVE - Licensing: [CC BY-SA 4.0](https://creativecommons.org/licenses/by-sa/4.0/)

WMO Hydrological Research Strategy 2022-2030

1. Improve **hydrological monitoring** to enhance understanding and assessments
 1. Data collection
 2. Design and evaluation of monitoring networks
2. Improve **hydrological forecasting**
 1. Hydro/cryosphere modelling and forecasting
 2. Precipitation estimation and forecasting
 3. Understanding and predicting hydrological extremes
 4. Human-water-ecosystem interactions
3. Methods, procedures for **collection/analysis/communication of data** to users
 1. Data processing and quality control
 2. Data storage, access and dissemination
 3. Communication



WMO Resolution 25 (CG-18) in 2019

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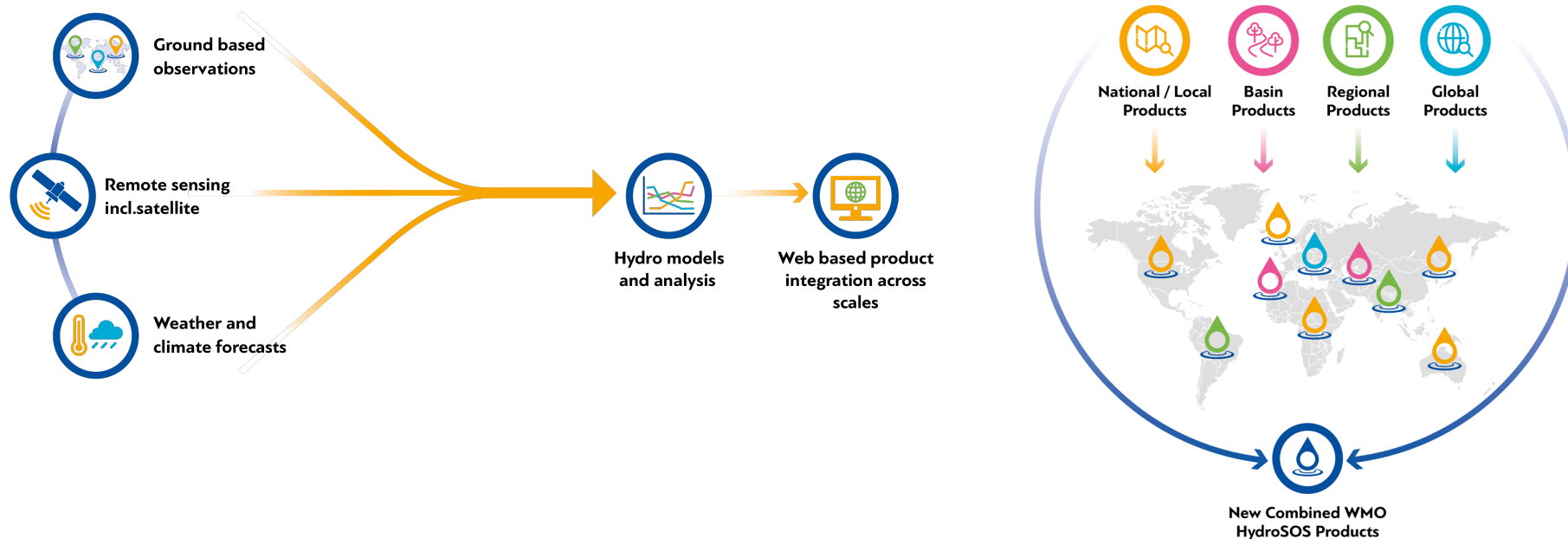
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Vision of HydroSOS:

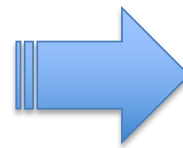
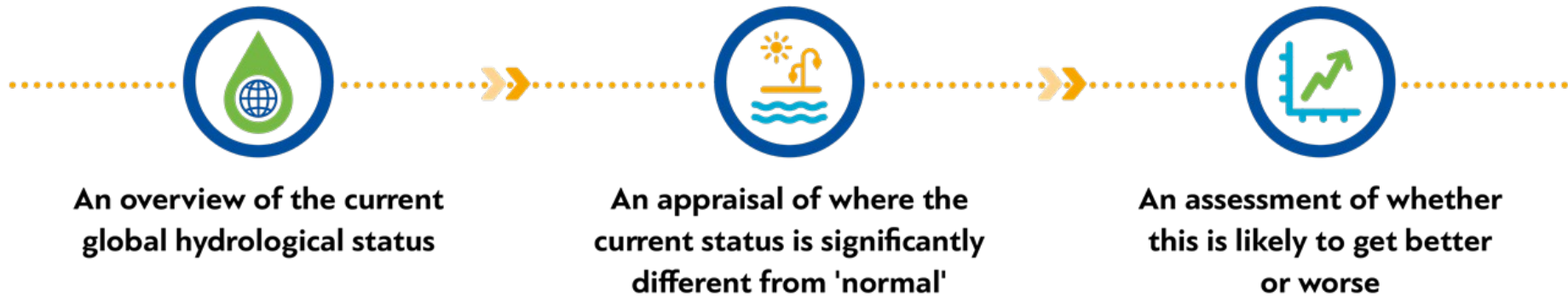
From Data to Information to Decision and Policy Support



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Globally consistent and accessible water information across scales: basin, national, regional and global scales

What will HydroSOS provide?

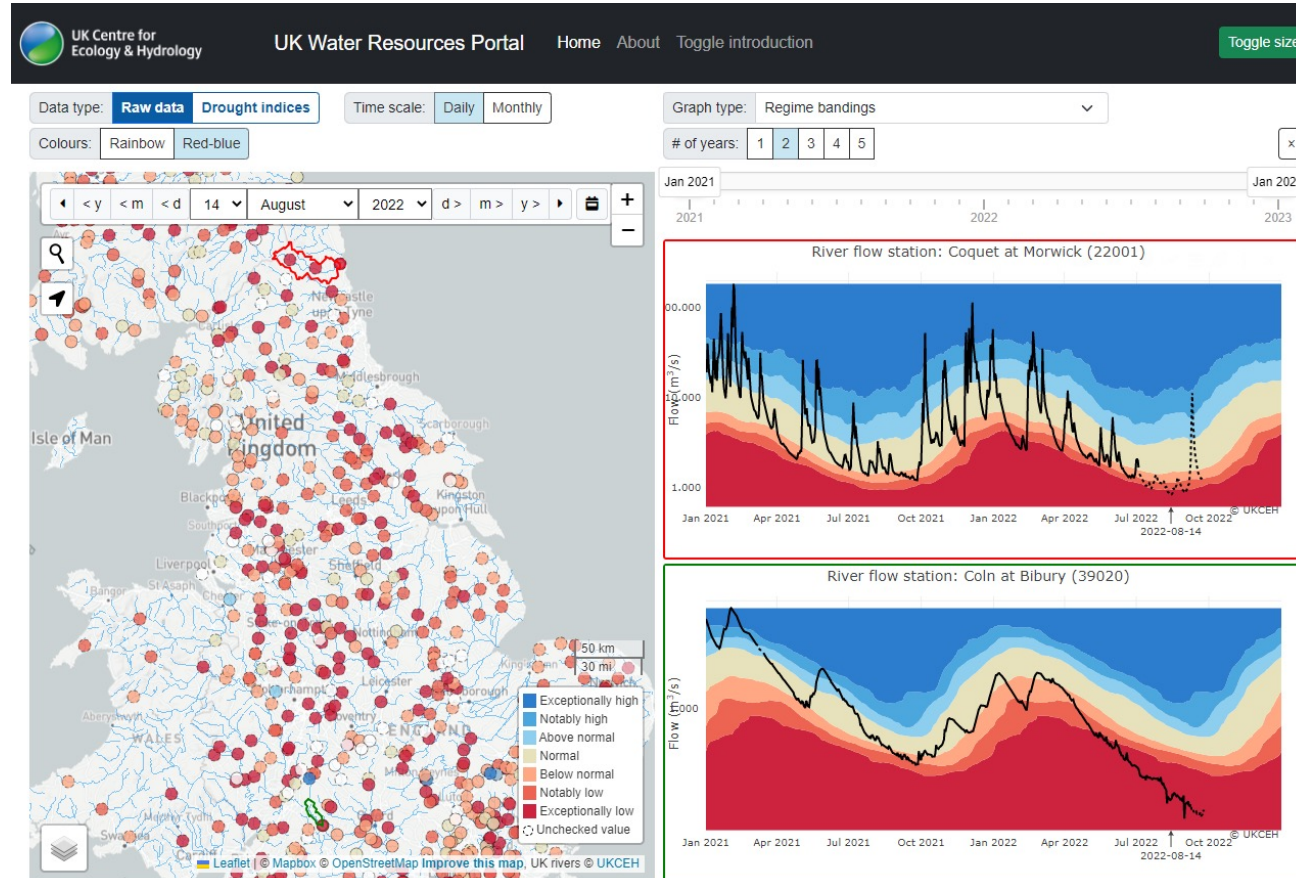


**Current Status and
Seasonal to Sub-seasonal
Forecasts**



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Example Products: Hydrological Status



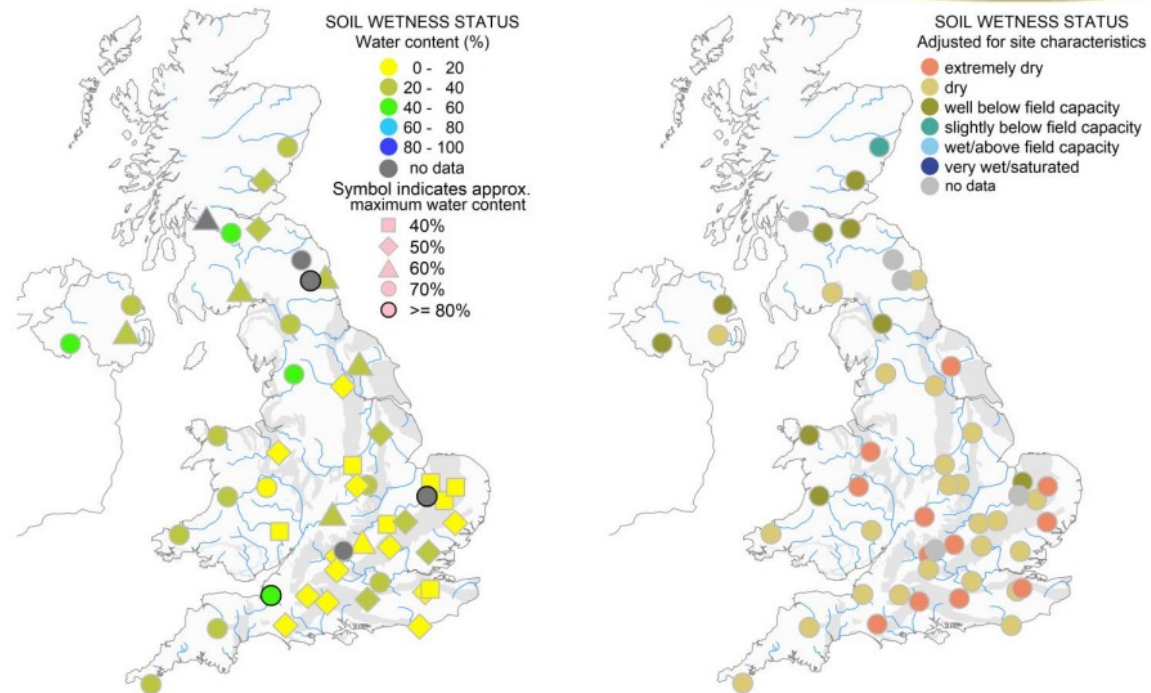
<https://eip.ceh.ac.uk/hydrology/water-resources/>



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Courtesy: Alan Jenkins, CEH, Oct 2022

Example Products: Soil Moisture Status



Soil moisture on 01 September 2022 (see back page for explanatory comments).

Notes on period to 31 August 2022

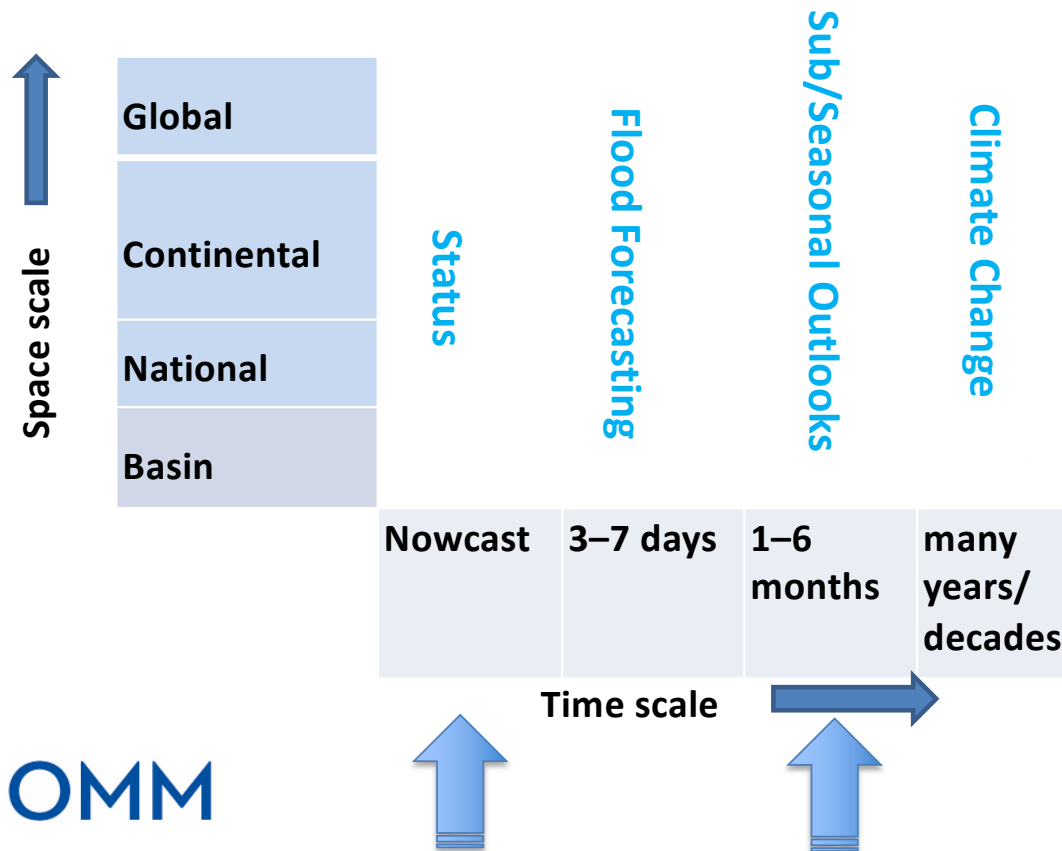
At the end of August many soils across the UK are notably or extremely dry for the time of year.

Courtesy:
Alan Jenkins, CEH,
Oct 2022



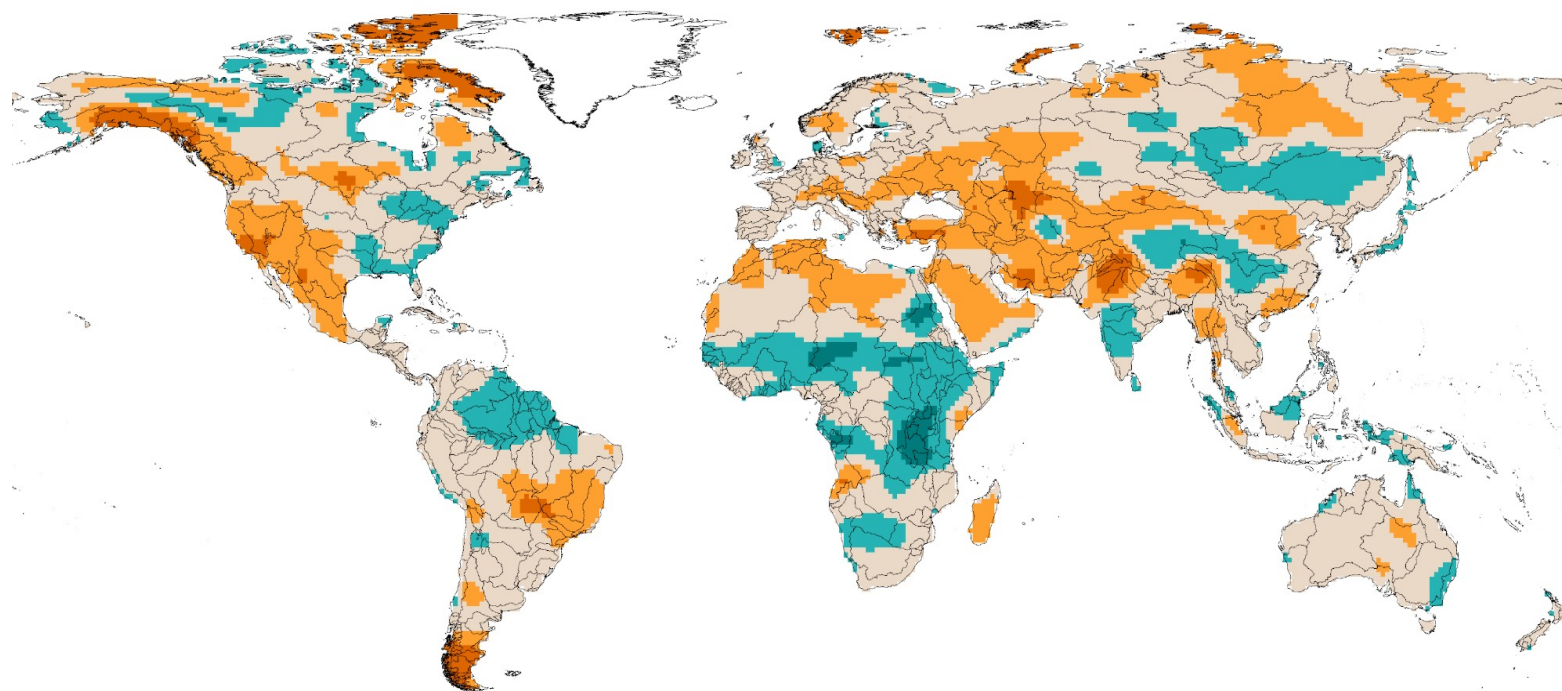
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Hydroclimate services across various scales



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Example global outputs 1st Annual State of Water Report (WMO, 2022)



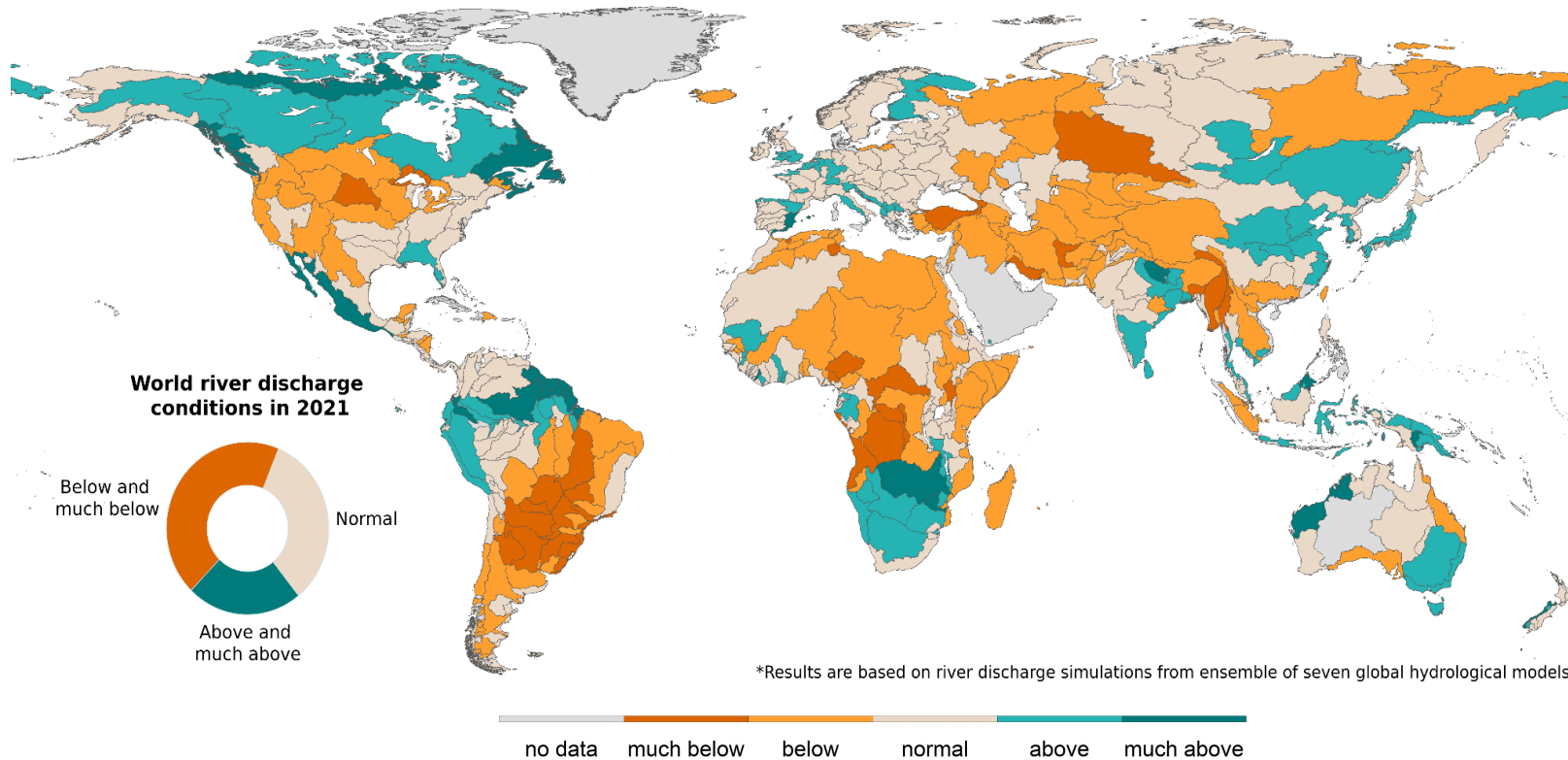
much below below normal above much above



TWS in 2021 ranked with respect to the historic period (2002-2020)
WMO UMI

Data source: GFZ, 2022

Example global long term outputs 1st Annual State of Water Report (WMO, 2022)

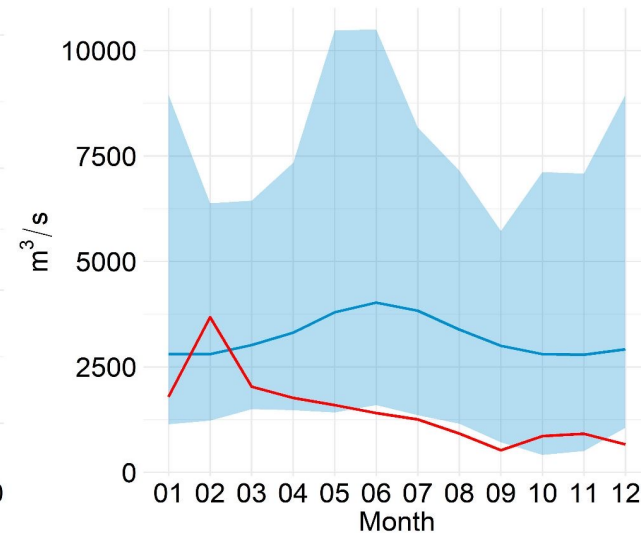
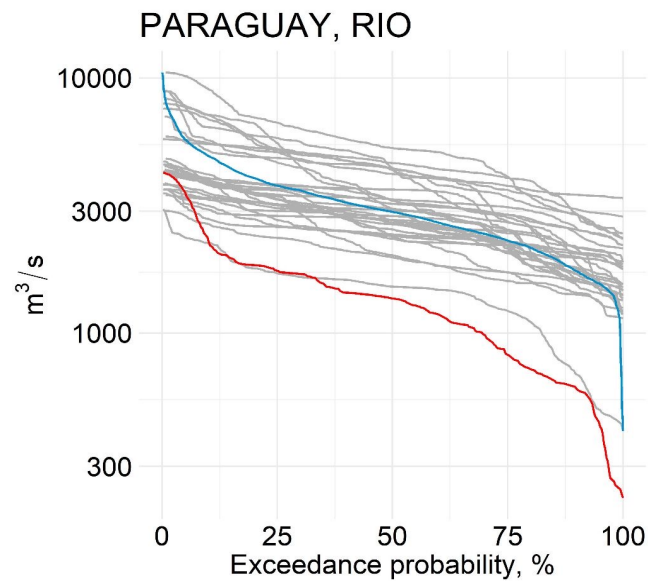


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Streamflow in 2021 w.r.t. the hydrological normal for 515 basins
(calculated based on 30 years historic data, 1991-2020)

Streamflow Trends 2021 – Country Examples

Example: Paraguay



Period — 1991-2020 — 2021
— All 1991-2020

Year spread ■ 1991-2020
Monthly mean — 1991-2020 — 2021



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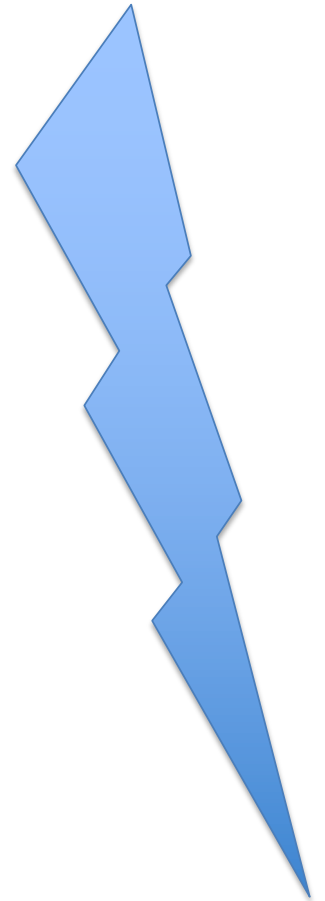
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A generation lost or found?

Picture: Carl Ganter, Circle of Blue, 2022