Bridiging water related data and knowledge gaps for informed mitigation and adaption measures on global change

- selected contributions of the ICWRGC -

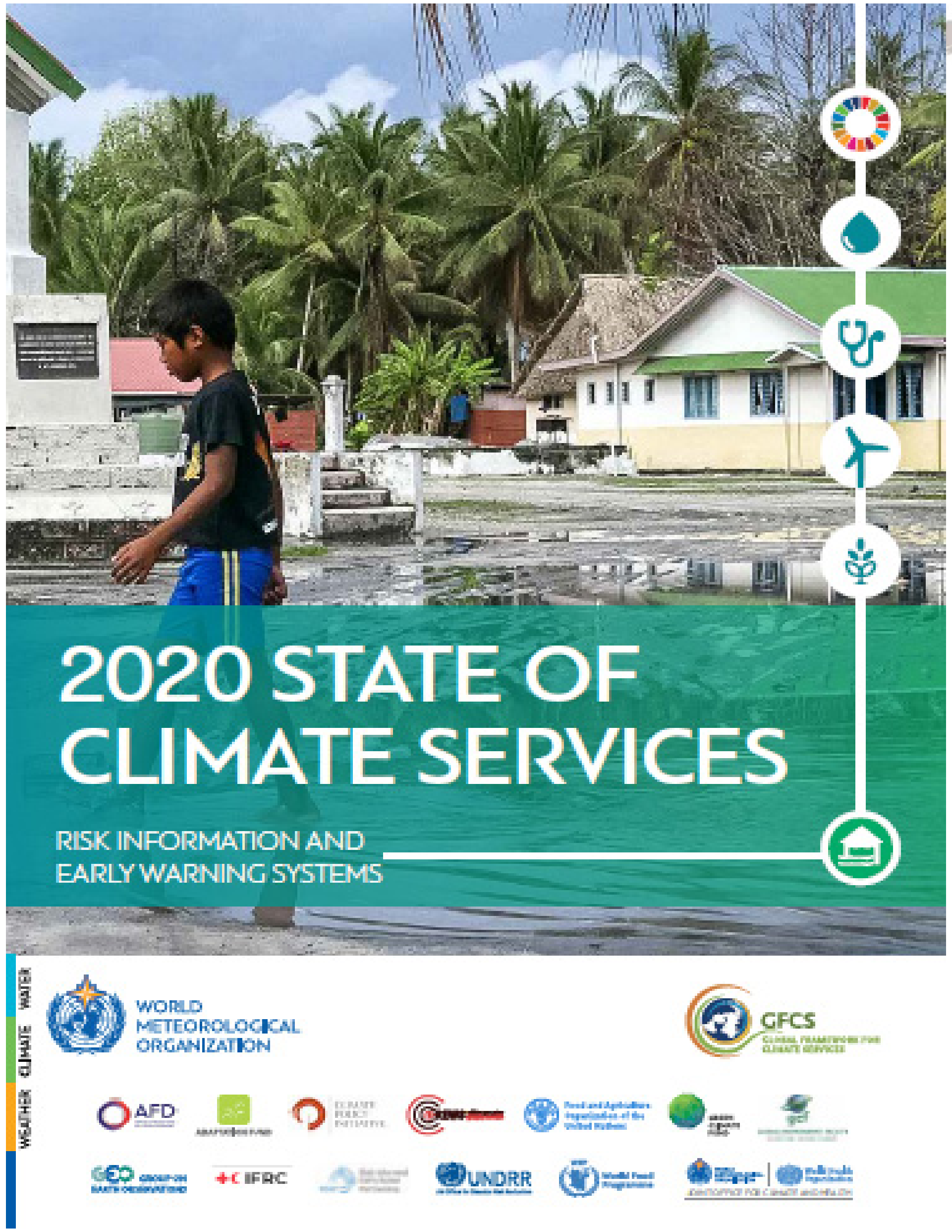
Stephan Dietrich, Marianela Fader, Robert Reinecke, Harald Köthe
*) International Centre for Water Resources and Global Change (ICWRGC)

From the Myths of Hercules to the reality of climate change
Webinar 26-27 NOVEMBER 2020, CIMWRM, THESSALONIKI, GREECE

Requirement for consistent and long-term observation strategies

WMO: 2020 State of Climate Services

https://library.wmo.int/doc_num.php?explnum_id=10385



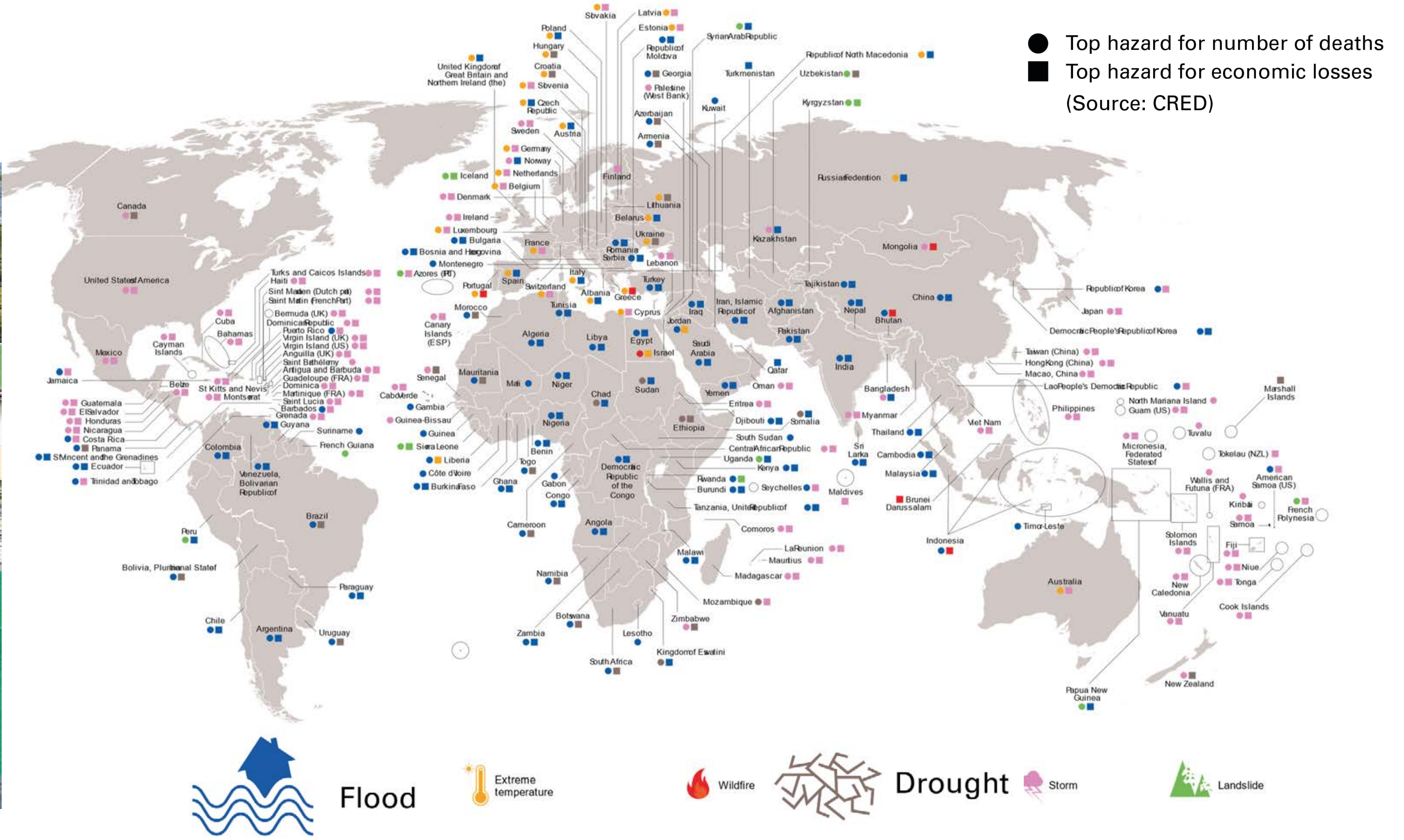


Fig. 3. Map of deadliest and most costly weather, water and climate related hazards for each country (WMO analysis of 1970-2019 data from the CRED Emergency Events Database). WMO, 2020, WMO-No. 1252, edited by highlighting floods and droughts.

Outline: selected CC activities of the ICWRGC

Step 1

Climate Observations:
Improving quality, quantity, access and reuse of water data

GCOS · WORLD METEOROLOGICAL ORGANIZATION · GTN-H

Step 2

Enhance development and use of scientific research methods

friend water

IHP Flagship FRIEND-Water
(Flow Regimes from International Experimental and Network Data)

Step 3:

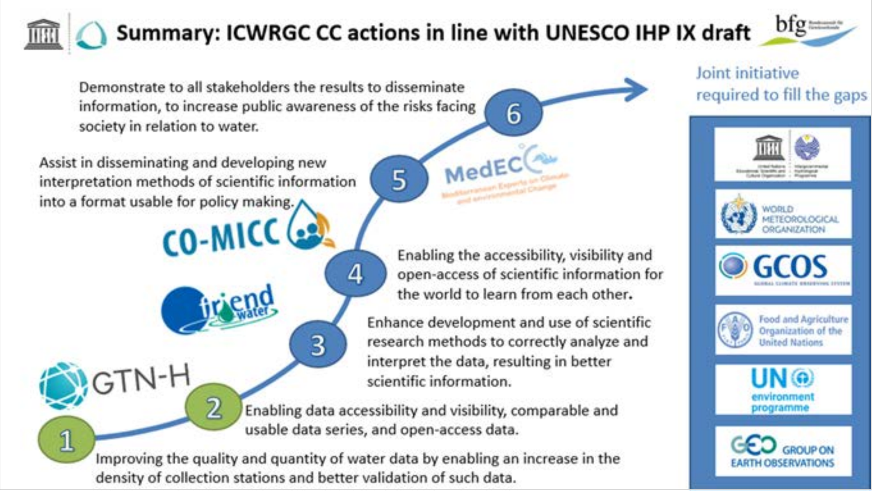
Enabling the accessibility, visibility and open-access of scientific information

CO-MICC

Step 4

Increase public and political awareness

MedECC
Mediterranean Experts on Climate and environmental Change



Step 1

Climate Observations:
Improving quality, quantity, access and reuse of water data

GTN-H and the existing operational global data centers of essential water variables

GTN-H

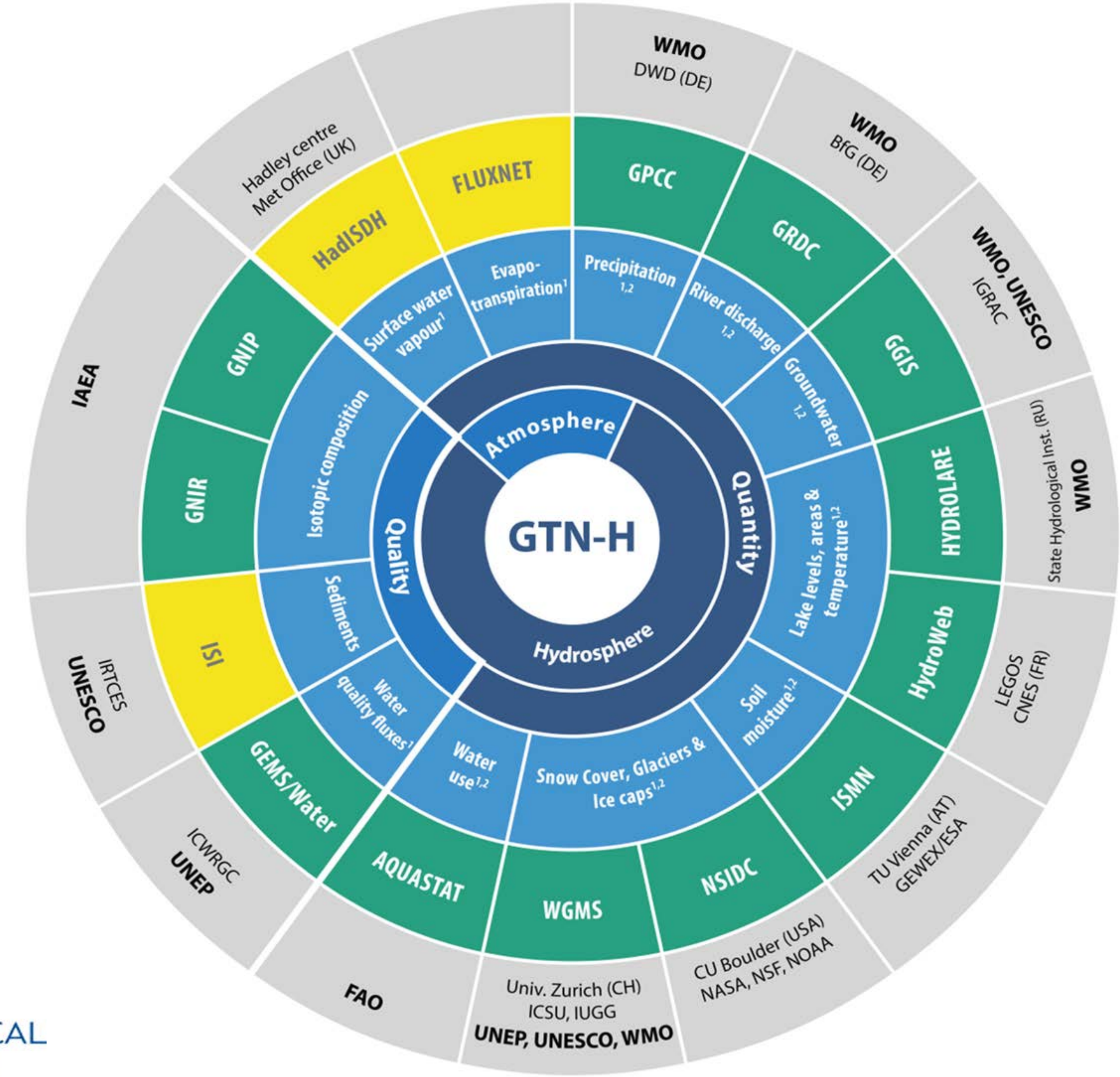
Network of the global water data centres, coordinated by Dr. Stephan Dietrich (ICWRGC)

Joint project of the World Meteorological Organization (WMO) and the Global Climate Observing System (GCOS); implemented in 2001

GCOS
KEEPING WATCH OVER OUR CLIMATE

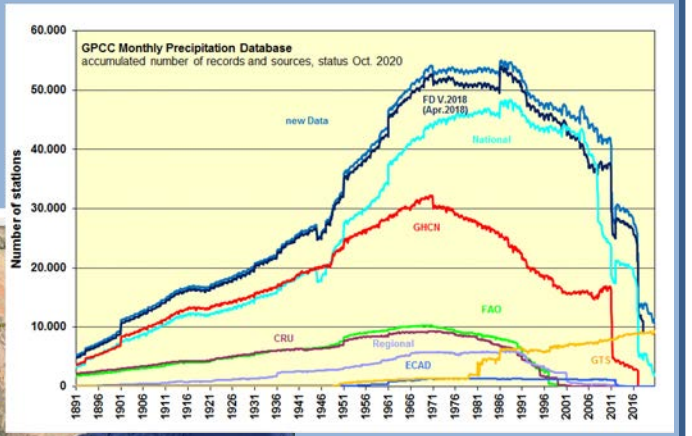
WMO IOC International Science Council UN environment

WORLD METEOROLOGICAL ORGANIZATION

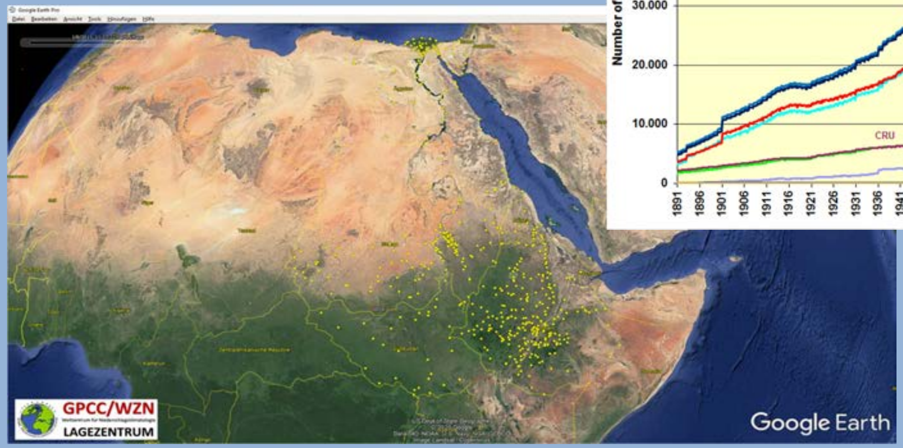


GTN-H status: some examples

Precipitation



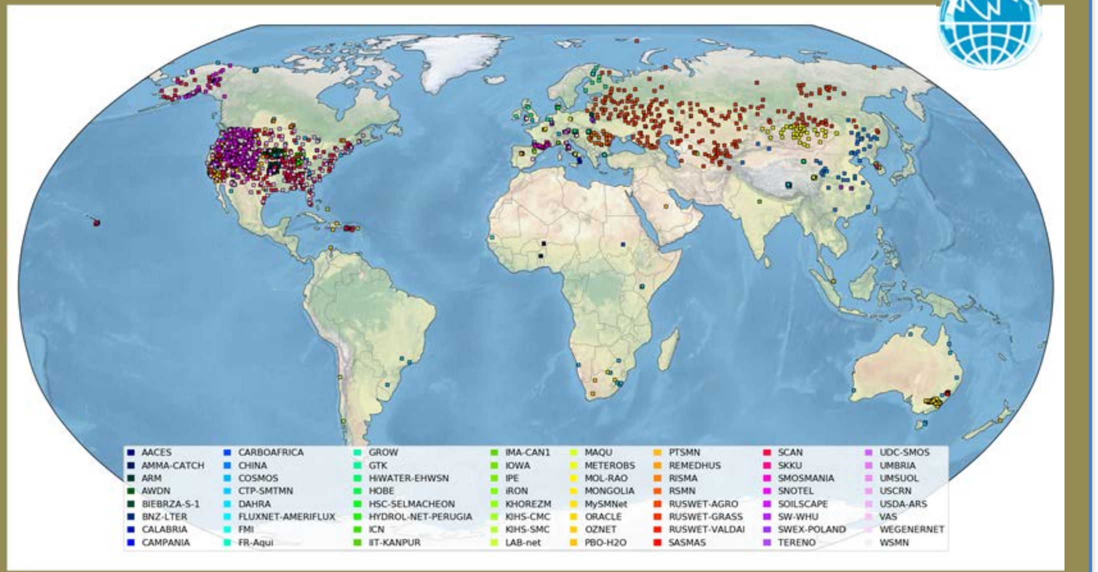
Data allocation over time in the GPCC data base



GPCC Precipitation Stations in the Nile catchment

Soil Moisture

Dorigo et al., in prep. "The International Soil Moisture Network (ISMN): serving Earth system science for over a decade". HESS

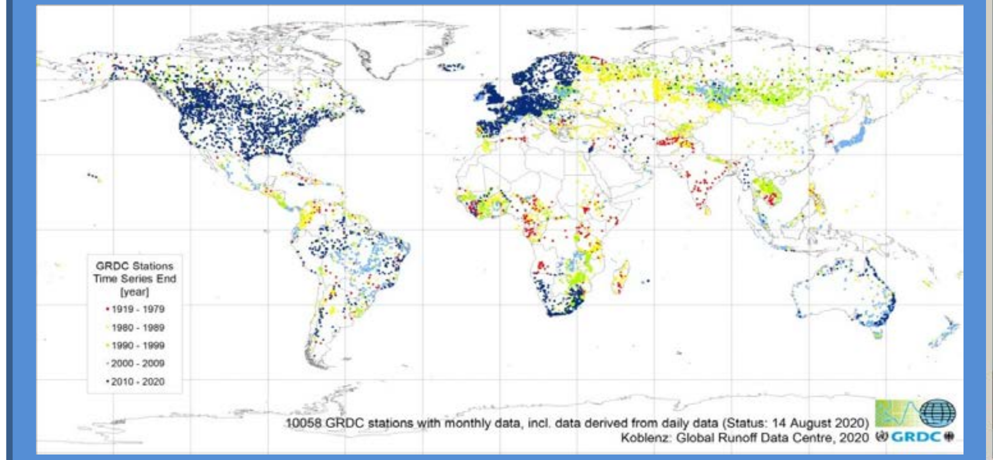


*Soil Mositure observation networks contributing to the **ISMN***

Discharge

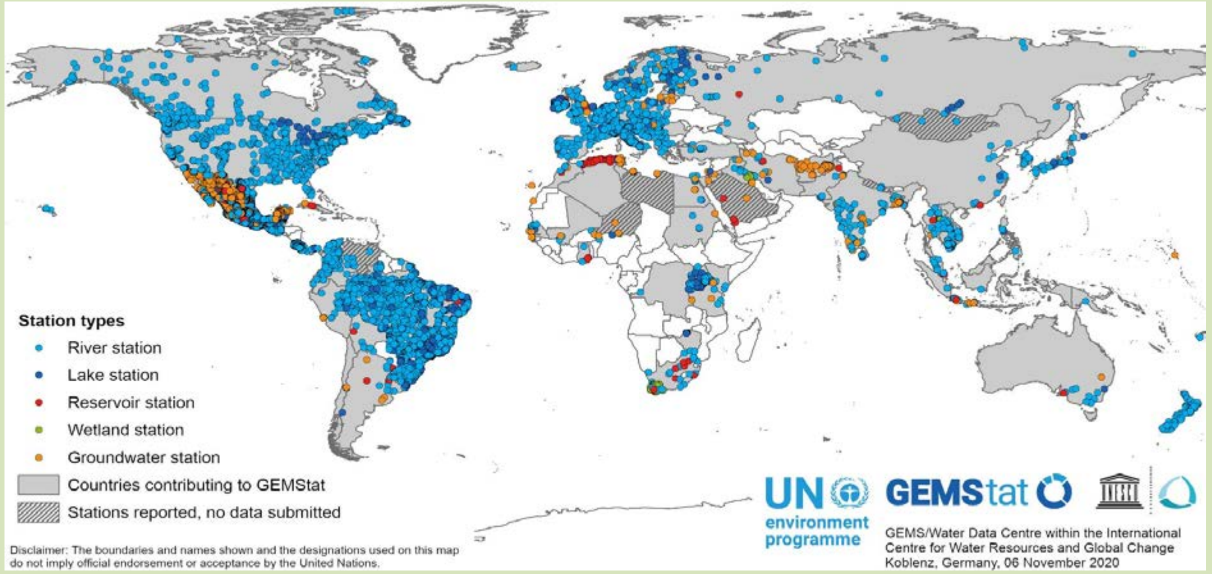
Global Runoff Data Centre (GRDC)

Operational since 1988 under the auspices of the WMO



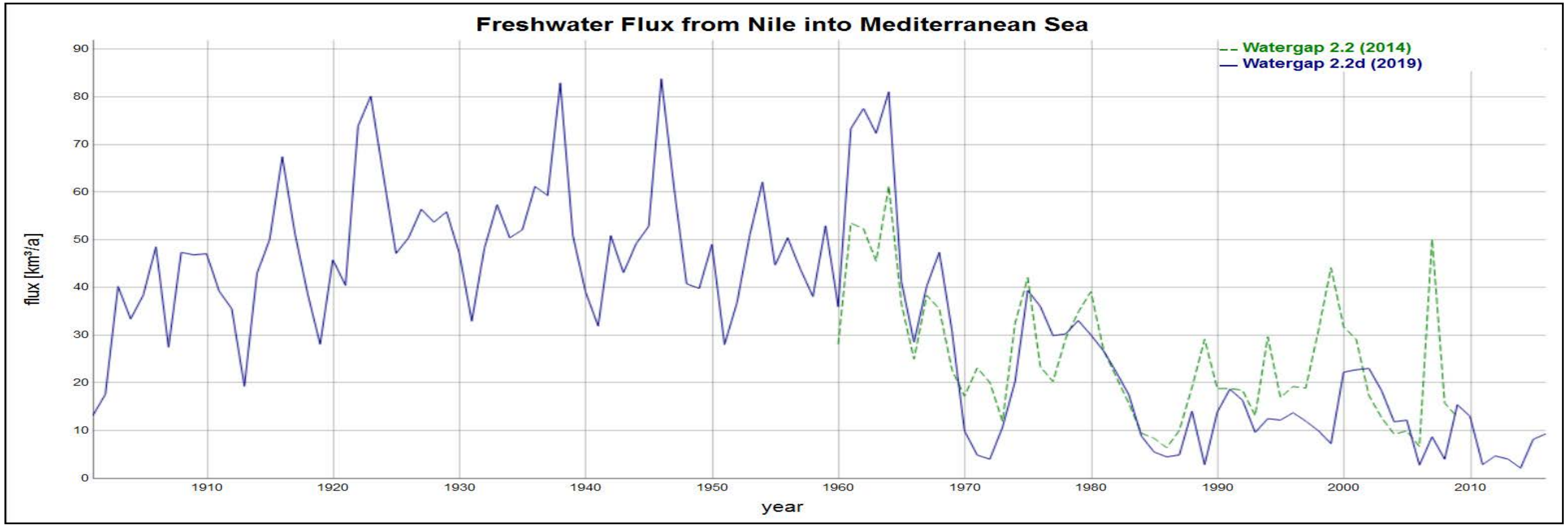
Water Quality

GEMStat



Freshwater Fluxes from Nile River into Mediterranean Sea

WaterGAP model is calibrated with GRDC river discharge data



Discharge data in GRDC database			
Country	**Stations**	**Data Start**	**Data End**
Burundi	51	1970	1991
Egypt	6	1869	1984
Ethiopia	48	1928	2009
Kenya	5	1934	1980
Rwanda	3	1965	1984
South Sudan	28	1905	1982
Sudan	11	1900	1982
Tanzania	96	1940	1991
Uganda	12	1946	1982

In-situ river discharge data are crucial to understand the hydrology of the Nile River

National Hydrological Services from Nile River countries are hesitant in providing quality controlled *in-situ* river discharge data to GRDC.
This valuable data would help to better understand and model the behaviour of the Nile River under changing hydrological conditions.

Continuation/improvement of this monitoring network and sharing of data are essential.

Consistent monitoring of global water cycle and resources variability across scales: Where do we stand?

Wouter Dorigo, Stephan Dietrich, Valentin Aich, et al. (BAMS, in review)

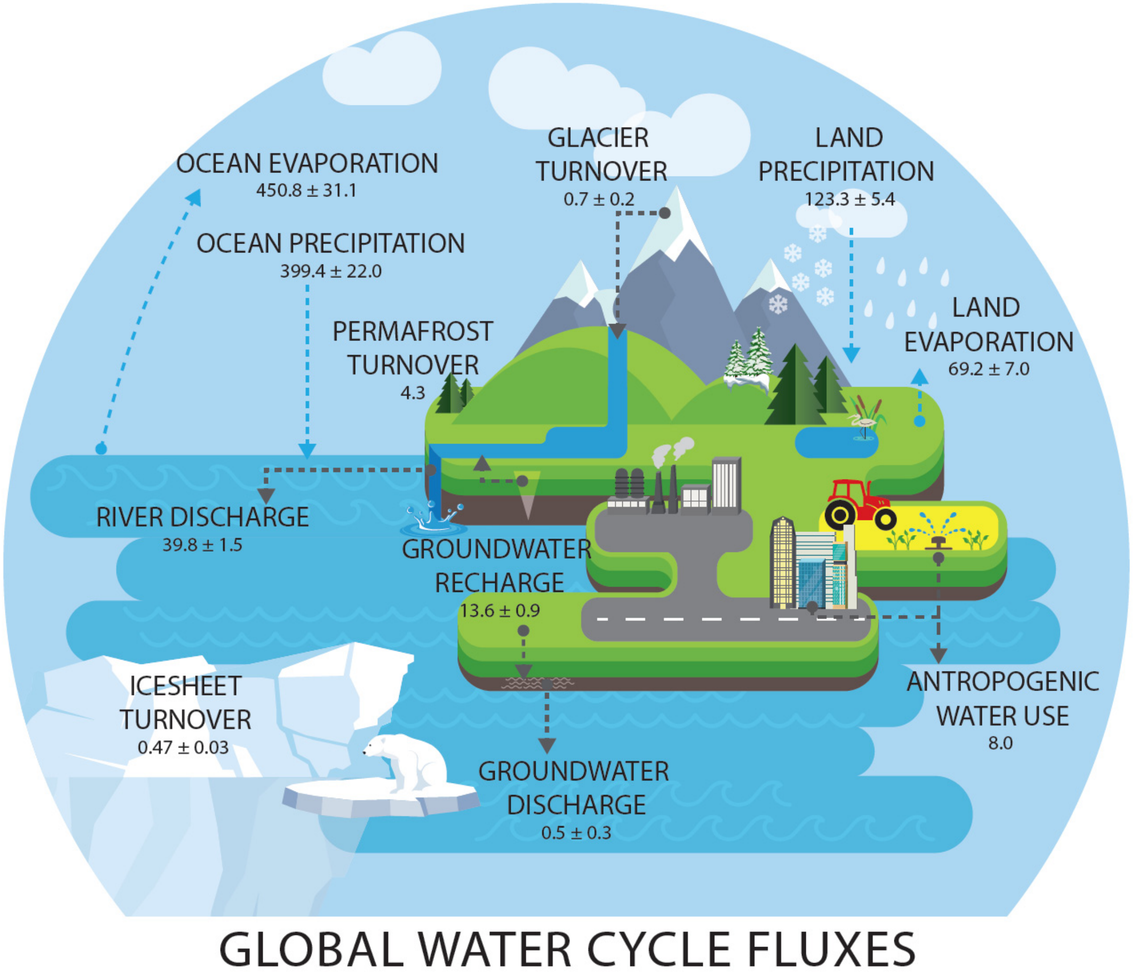


Fig. 1. Observed estimates of annual global water cycle fluxes in 10^3 km^3 (subm.).

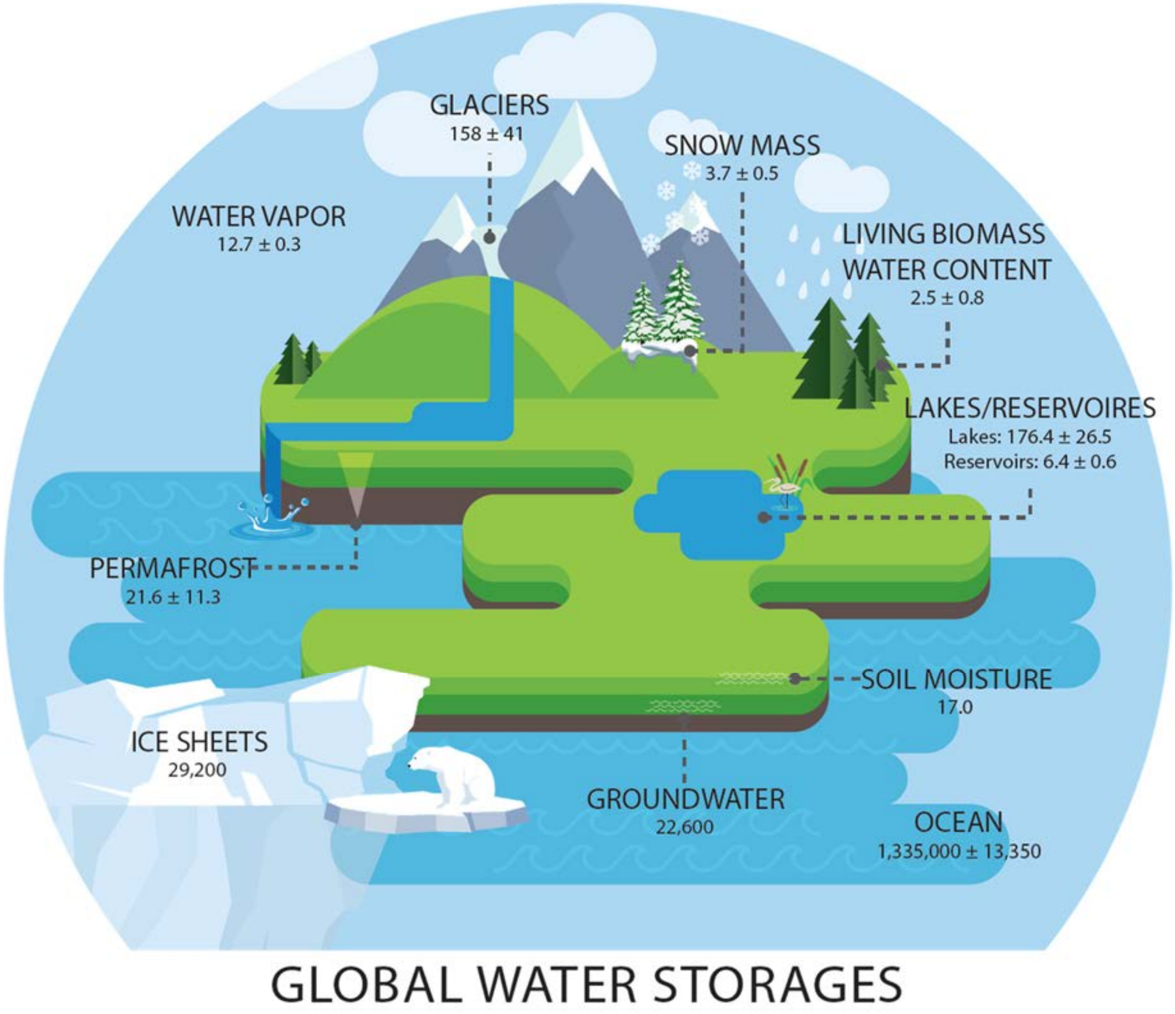


Fig. 2. Observed estimates of global water cycle storages (in 10^3 km^3) and their uncertainties (subm. to BAMS).

Consistent monitoring of global water cycle and resources variability across scales: Where do we stand?

Wouter Dorigo, Stephan Dietrich, Valentin Aich, et al. (BAMS, in review)
Contact: wouter.dorigo@geo.tuwien.ac.at; dietrich@bafg.de

By assessing the capability of available ground and Earth observations of water cycle ECVs, we discuss gaps in existing observation systems and formulate guidelines for future water cycle observation strategies.

Recent Status

- Even at coarse scales, uncertainties of many water cycle components are large.
- In particular, relevant in situ observations lag of spatial and temporal coverage and required data sharing capabilities.
- Many expert groups working on different water cycle components.

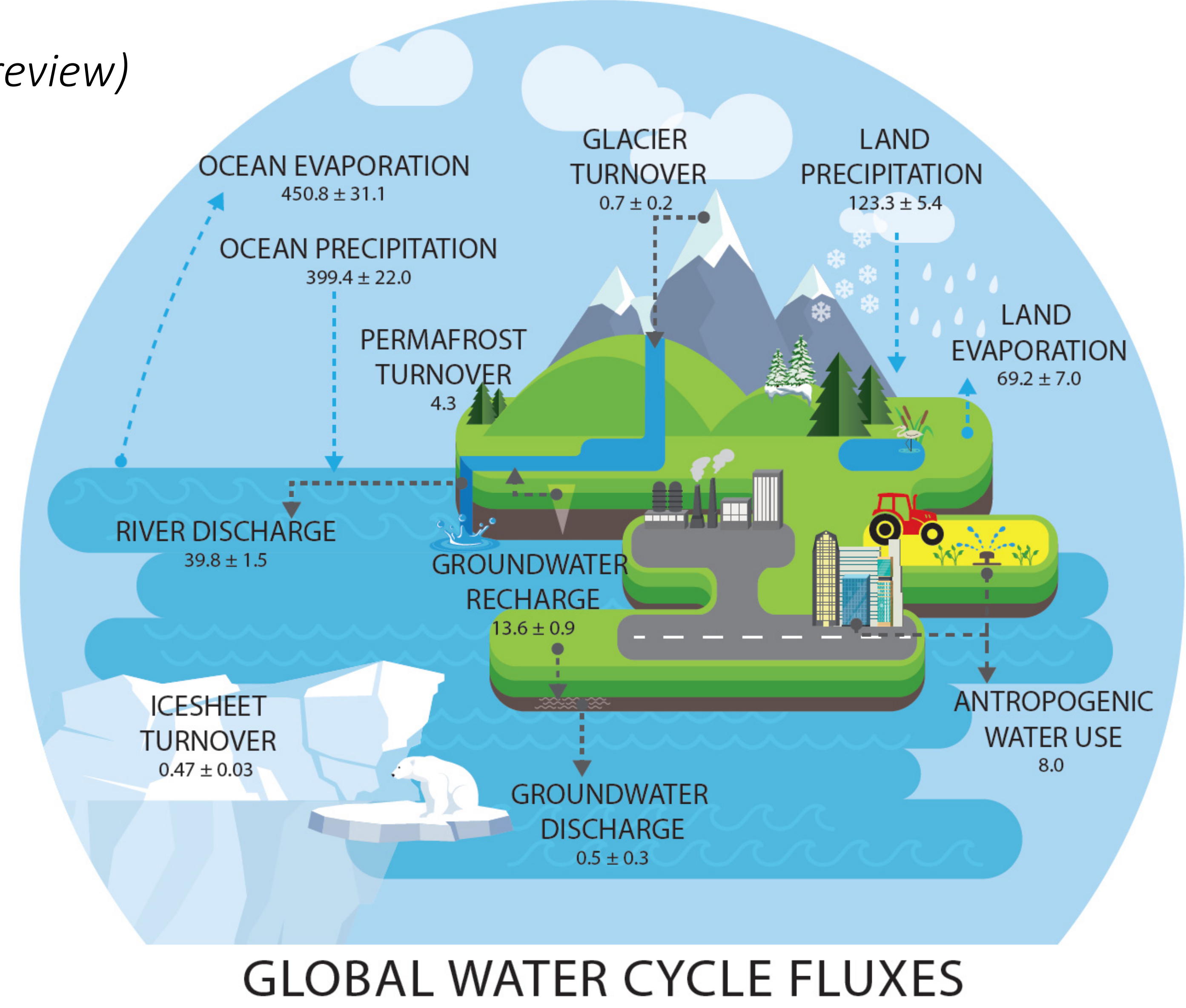


Fig. 1. Observed estimates of annual global water cycle fluxes in 10^3 km^3 (subm. to BAMS).

Filling the gaps in global data coverage

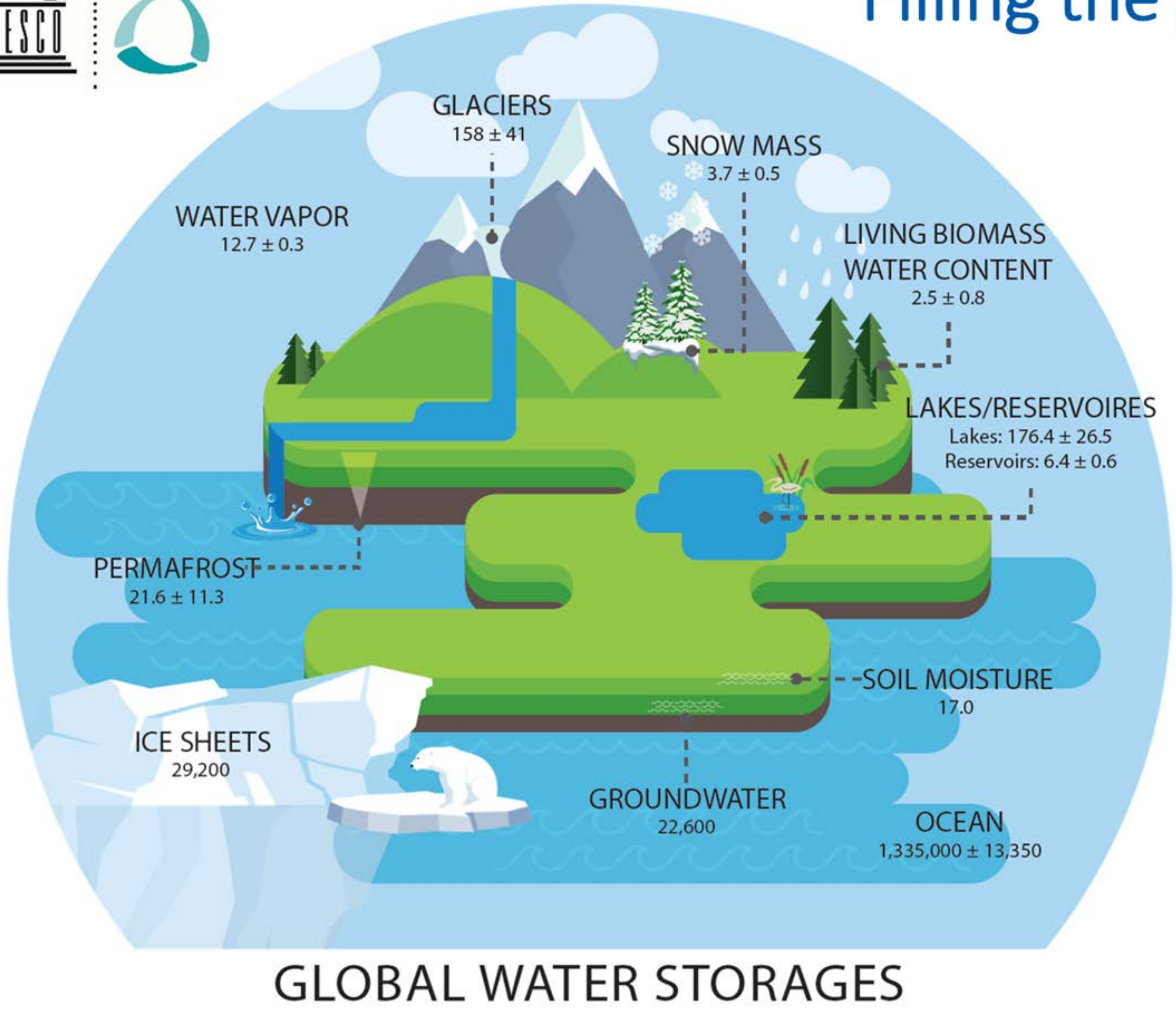


Fig. 2. Observed estimates of global water cycle storages (in 10^3 km^3) and their uncertainties (subm. to BAMS).

Aim: Integration of water cycle datasets into a single consistent dataset representative of the entire water cycle.

- optimize existing water cycle products/identify deficiencies in current observations.
- Integration requires careful choices regarding individual products/variables, combination strategies, and appropriate spatial and temporal resolutions and domains.
- Data exchange capacities have to be improved.

Continuation and expansion of existing observation systems

- Observational needs are currently expressed by the individual communities
- Future observations should consider a holistic approach (observe water components in conjunction with the energy and carbon cycles).
- Should be adopted and implemented by high level organizations like GCOS, the WMO research agenda and the agendas of the WMO member states .

Step 2

Enhance development and use of scientific research methods

IHP Flagship FRIEND-Water

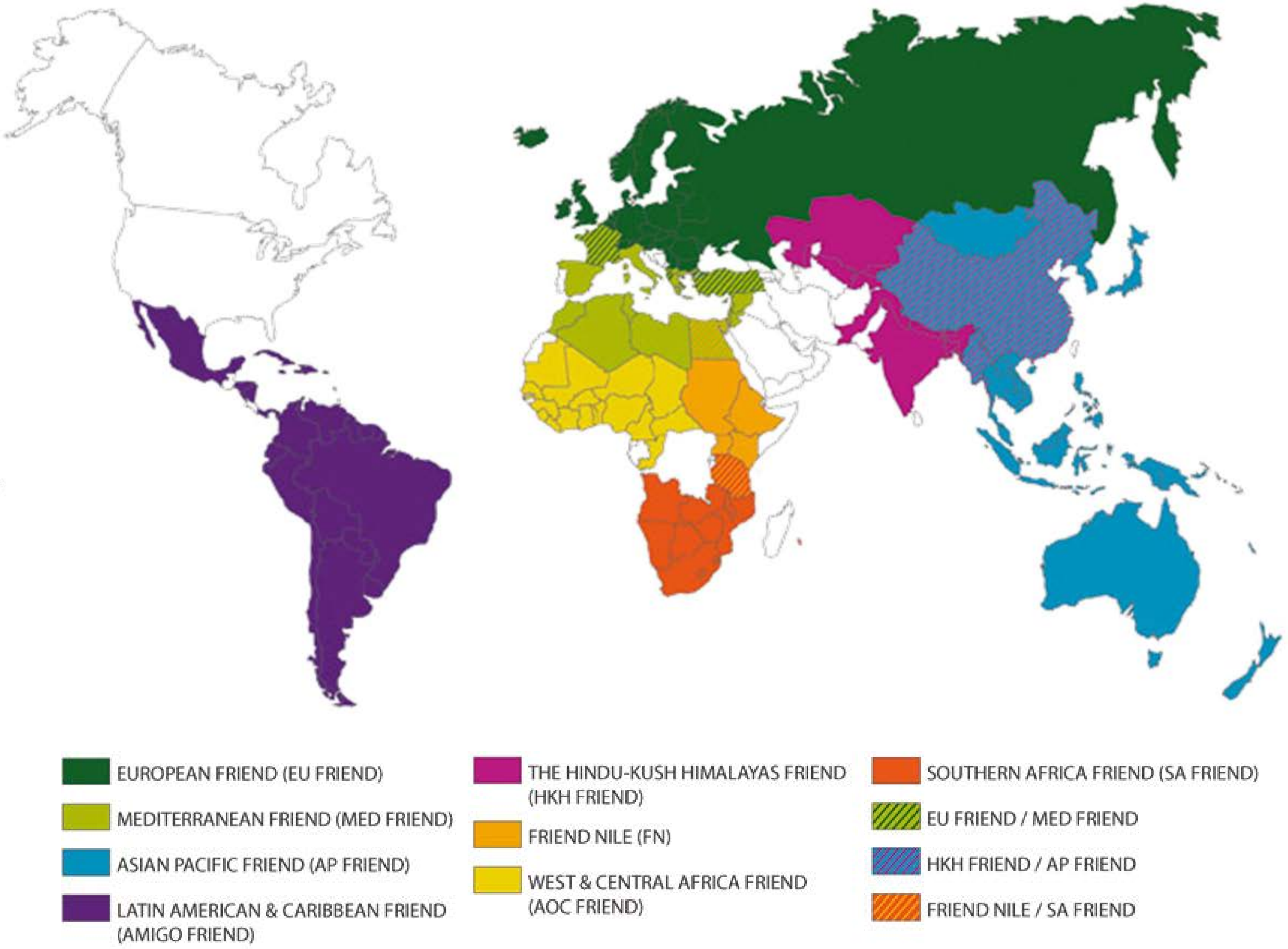
(**F**low **R**egimes from **I**nternational **E**xperimental and **N**etwork **D**ata)

FRIEND-WATER: set up regional networks for analyzing hydrological data

- Research programme is organized within regional groups

- EURO-FRIEND achievements in 2020
  - P1: European Water Archive (GRDC)
    - e.g. 130 new GRDC and EWA stations in Spain
  - P2: Low Flow and Drought
    - e.g several drought & water scarcity sessions at EGU and AGU
  - P3: Large-scale variation
    - e.g. Position Paper "Moving beyond the catchment scale: Value and opportunities in large-scale hydrology to understand our changing world" (Kingston et al. 2020); https://doi.org/10.1002/hyp.13729

- ICWRGC engagement: Co-Chair (2021-24) of EURO-FRIEND-WATER by Dr. Henny van Laanen (Wageningen University, NL) & Dr. Stephan Dietrich (ICWRGC)



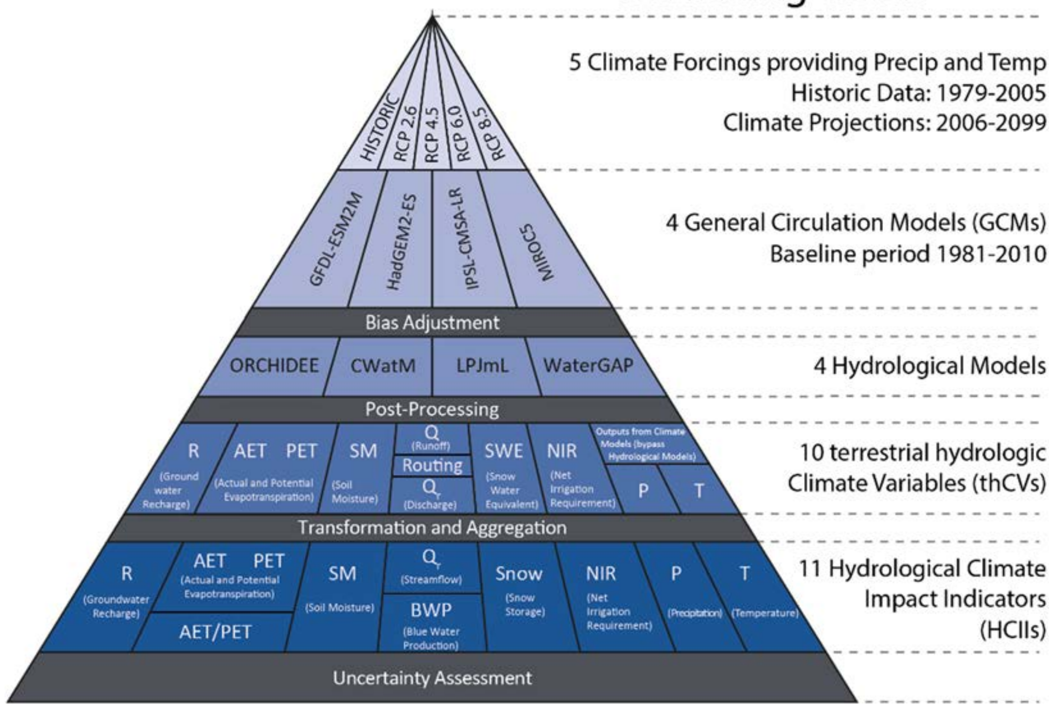
Step 3:

Enabling the accessibility, visibility and open-access of scientific information

CO-MICC: from Science to Information

How to inform stakeholders about climate change freshwater-related hazards in a suitable and sustainable way?

CO-MICC Climate Projection Modelling Chain

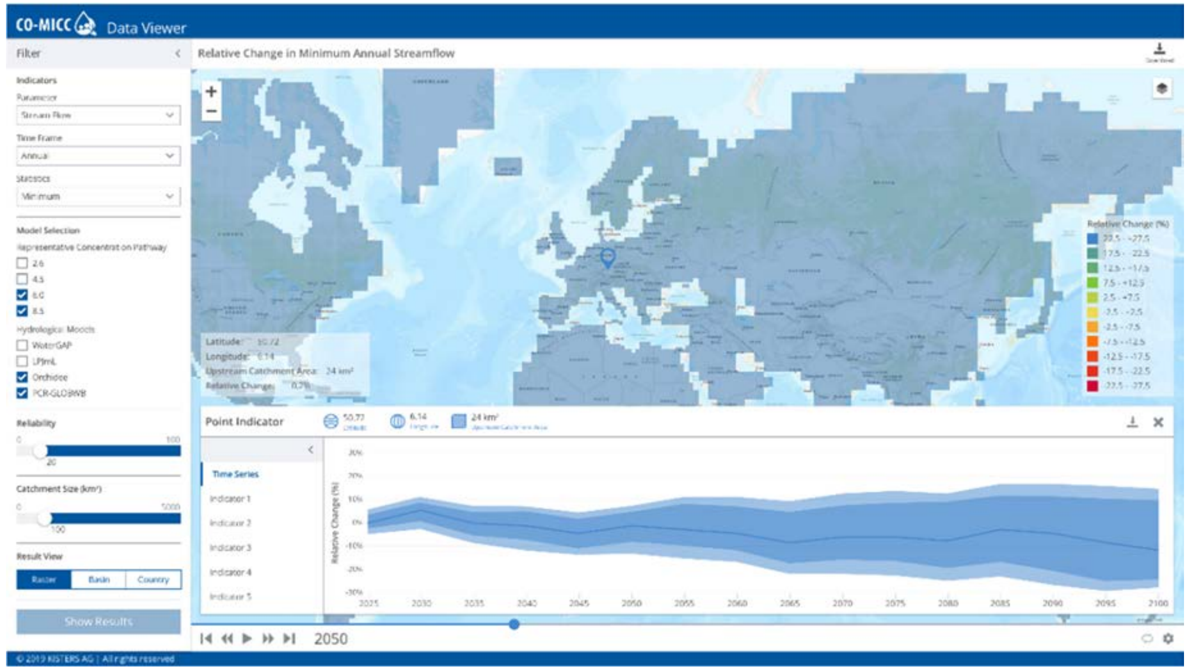


Models

Variables (raw data)

Indicators + Uncertainty

Open-access interactive data portal
Global maps + pixel (0.5°) time series



Climate impact science

Policy information

Scientists
(knowledge providers)

Co-development
with stakeholders

Boundary organizations & stakeholders (knowledge end-users)

Step 4

Increase public and political awareness

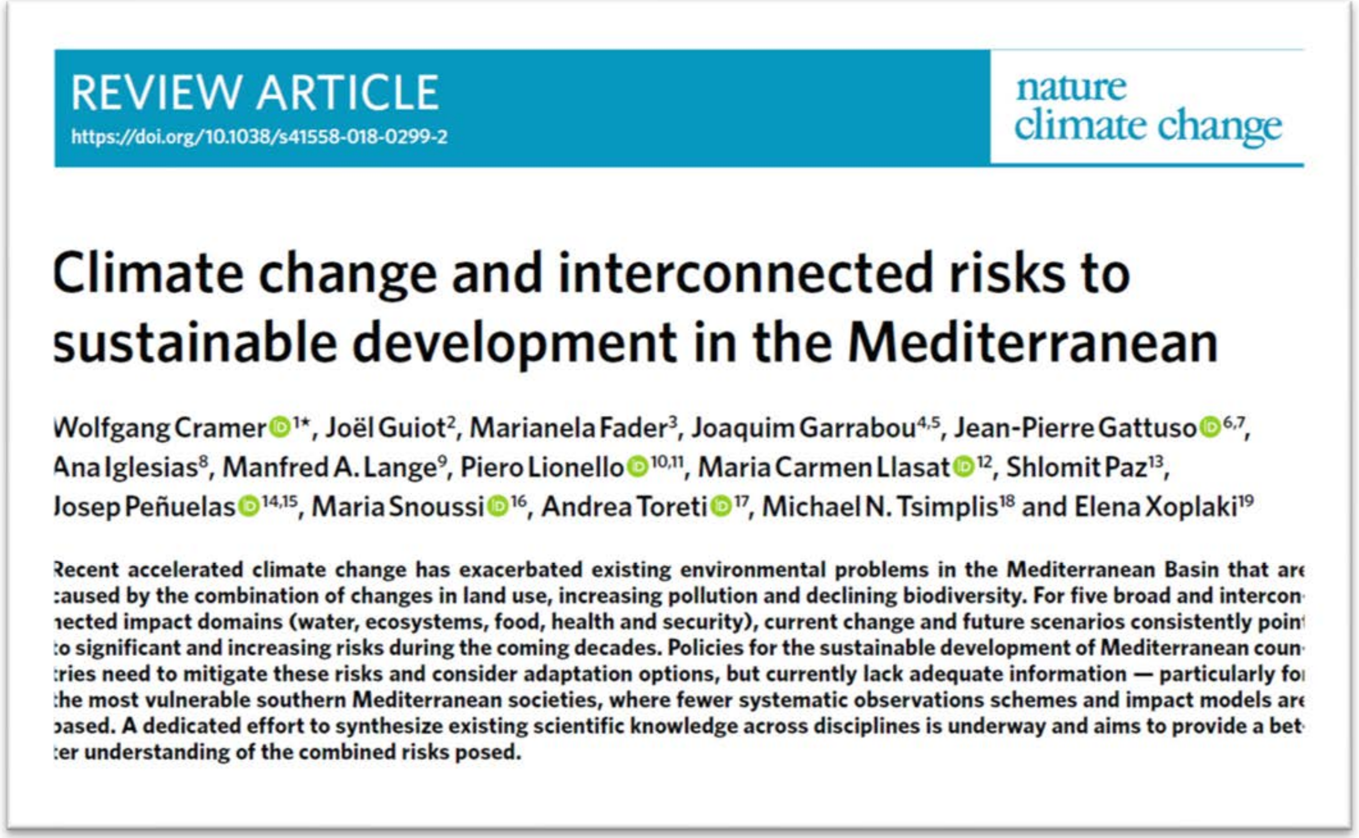
MedECC

Mediterranean Experts on Climate and environmental Change

CC in the Mediterranean

- Mediterranean region: hotspot for climate change impacts, environmental degradation, but also biodiversity.
  – Damages have already occurred

- MedECC (www.medecc.org) wants to:
  1. Provide an assessment and synthesis of climate and environmental change in the Mediterranean Basin -> Report
  2. Offer a regional science-policy interface on climate and environmental change.



REVIEW ARTICLE

https://doi.org/10.1038/s41558-018-0299-2

nature climate change

Climate change and interconnected risks to sustainable development in the Mediterranean

Wolfgang Cramer[1*], Joël Guiot[2], Marianela Fader[3], Joaquim Garrabou[4,5], Jean-Pierre Gattuso[6,7], Ana Iglesias[8], Manfred A. Lange[9], Piero Lionello[10,11], Maria Carmen Llasat[12], Shlomit Paz[13], Josep Peñuelas[14,15], Maria Snoussi[16], Andrea Toreti[17], Michael N. Tsimplis[18] and Elena Xoplaki[19]

Recent accelerated climate change has exacerbated existing environmental problems in the Mediterranean Basin that are caused by the combination of changes in land use, increasing pollution and declining biodiversity. For five broad and interconnected impact domains (water, ecosystems, food, health and security), current change and future scenarios consistently point to significant and increasing risks during the coming decades. Policies for the sustainable development of Mediterranean countries need to mitigate these risks and consider adaptation options, but currently lack adequate information — particularly for the most vulnerable southern Mediterranean societies, where fewer systematic observations schemes and impact models are based. A dedicated effort to synthesize existing scientific knowledge across disciplines is underway and aims to provide a better understanding of the combined risks posed.

MedECC

Mediterranean Experts on Climate and environmental Change

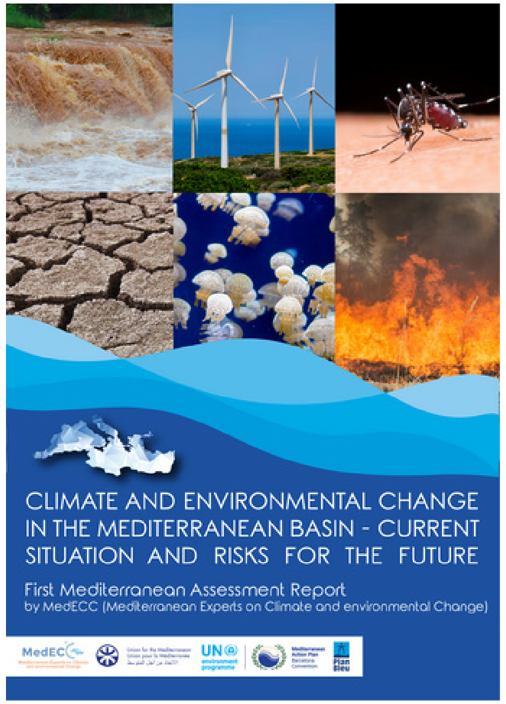
First Mediterranean Assessment Report (MAR1)

Published on November 17th 2020 under www.medecc.org/first-mediterranean-assessment-report-mar1

- Dr. Marianela Fader/ICWRGC is a Coordinating Lead Author of the Water Chapter.

IPCC Style

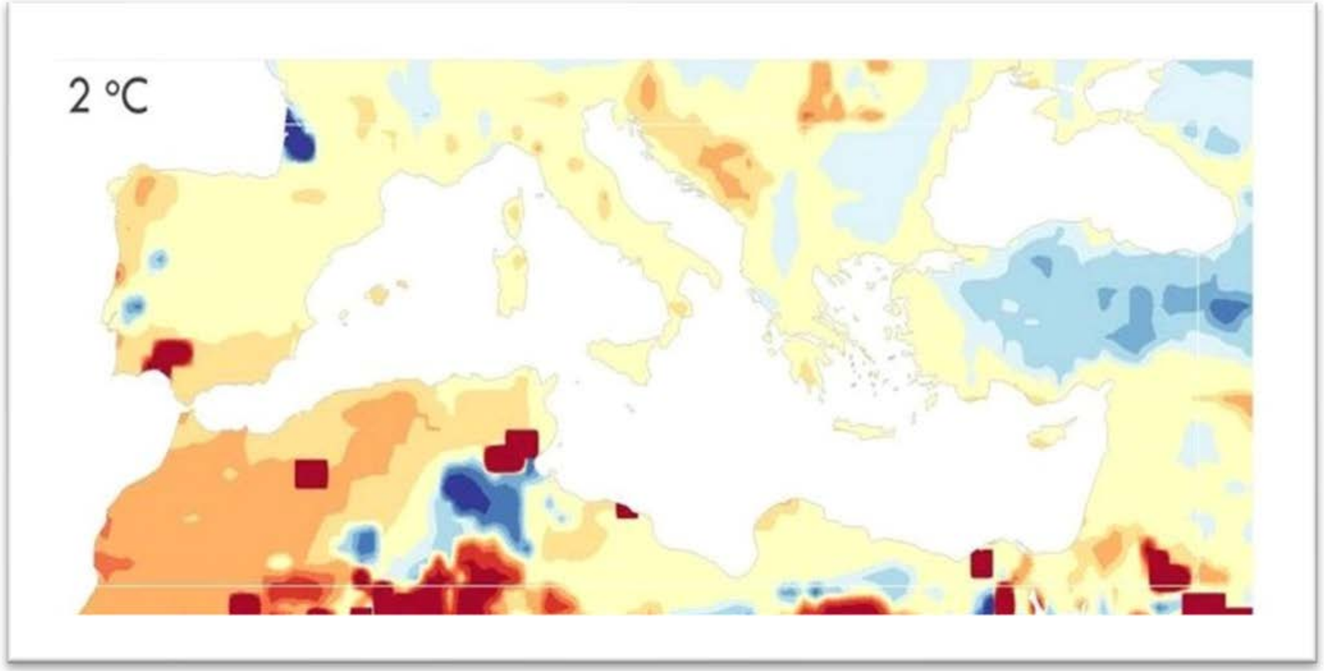
"Climate change as well as demographic and socio-economic developments is likely to impact most of the Mediterranean Basin, through reduced runoff and groundwater recharge, increased crop water requirements, increased conflicts among users, and increased risk of overexploitation and degradation (high confidence)."



Key messages

1.5-2°C global warming (stronger effects >2°C global warming)

- Reduced precipitation, increased evaporation, decline of runoff water.
- More frequent low flow in summer and no-flow events, higher drought risks
- More urban populations exposed to severe droughts
- Aquifer recharge reduced by warming and reduced rainfall. Overexploitation of groundwater stronger influence than climate change
- Decline in groundwater quality in coastal areas (salt-water intrusion, enhanced extraction, sea-level rise, water pollution)



Regional patterns of changes in multi-model mean simulated annual runoff *relative to the 1981-2010 in [%], at 2°C warming level relative to pre-industrial.*

Summary: ICWRGC CC actions in line with UNESCO IHP IX draft

1. Improving the quality and quantity of water data by enabling an increase in the density of collection stations and better validation of such data.
2. Enabling data accessibility and visibility, comparable and usable data series, and open-access data.
3. Enhance development and use of scientific research methods to correctly analyze and interpret the data, resulting in better scientific information.
4. Enabling the accessibility, visibility and open-access of scientific information for the world to learn from each other.
5. Assist in disseminating and developing new interpretation methods of scientific information into a format usable for policy making.
6. Demonstrate to all stakeholders the results to disseminate information, to increase public awareness of the risks facing society in relation to water.

Joint initiative required to fill the gaps

Thank you for your attention

United Nations
Educational, Scientific and
Cultural Organization

International Centre
for Water Resources and Global Change
under the auspices of UNESCO

www.waterandchange.org
icwrgc@bafg.de