United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

Climate-informed Decision Making under Deep Uncertainty

MAY 6 - 11, 2018 , CANMORE, ALBERTA, CANADA

Anil Mishra[1] Koen Verbist[1], Abou Amani[1,] Pablo Rojas[2], and Froukje Kuijk[2]

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2. Water Centre for Arid and Semi-Arid Regions in Latin America (CAZALAC)

Global Risks Landscape 2018: Risk and uncertainty

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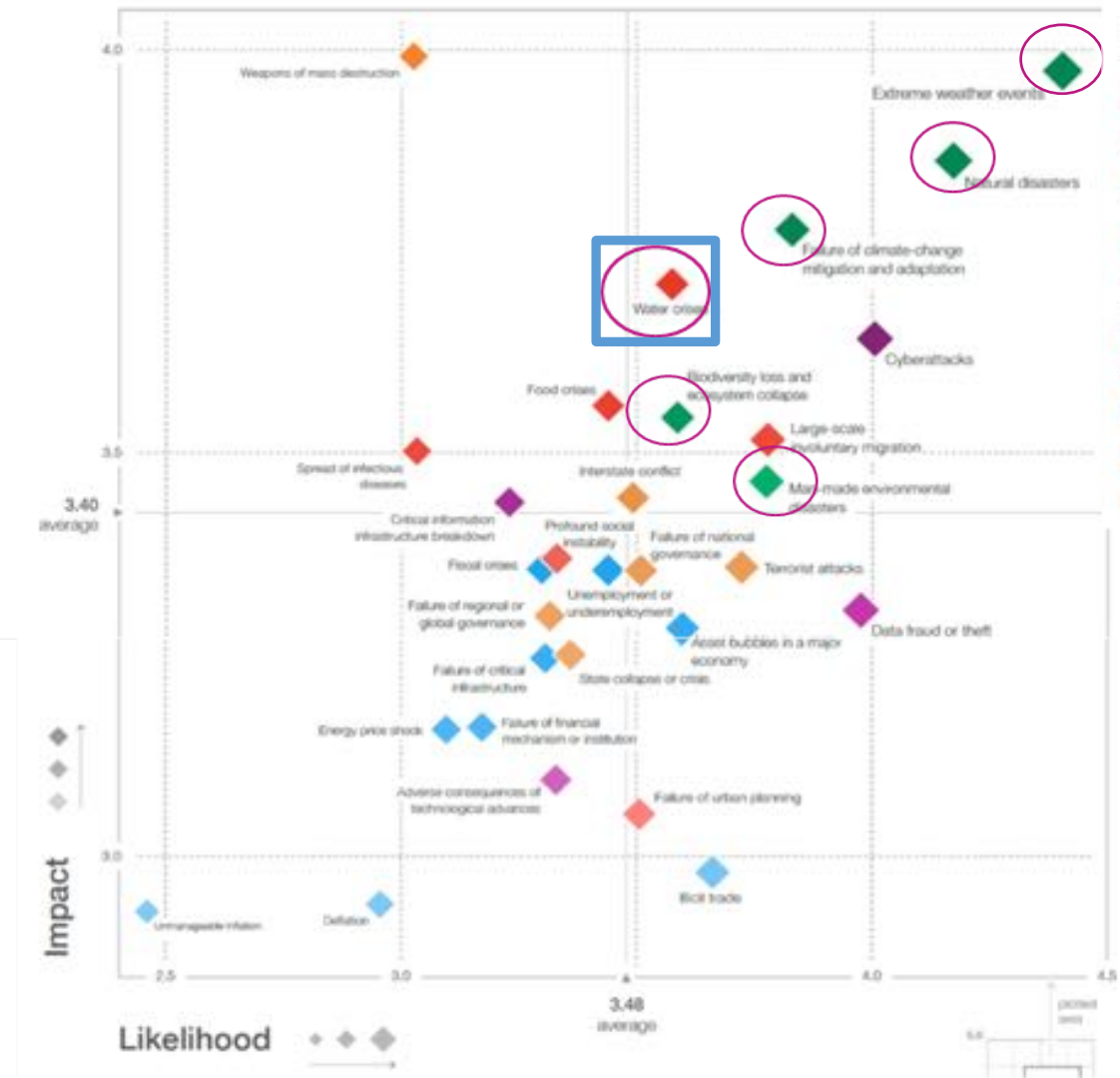
Figure I: The Global Risks Landscape 2018



Top 10 risks in terms of **Likelihood**

1. Extreme weather events
2. Natural disasters
3. Cyberattacks
4. Data fraud or theft
5. Failure of climate-change mitigation and adaptation
6. Large-scale involuntary migration
7. Man-made environmental disasters
8. Terrorist attacks
9. Illicit trade
10. Asset bubbles in a major economy

Top 10 risks in terms of **Impact**

1. Weapons of mass destruction
2. Extreme weather events
3. Natural disasters
4. Failure of climate-change mitigation and adaptation
5. Water crises
6. Cyberattacks

WORLD ECONOMIC FORUM
COMMITTED TO IMPROVING THE STATE OF THE WORLD

Insight Report

The Global Risks Report 2018
13th Edition

World Economic Forum Global Risks Perception Survey 2017–2018.

- Extreme weather events
- Natural disasters
- Failure of climate-change mitigation and adaptation
- Water crises
- Biodiversity loss and ecosystem collapse

UNITED NATIONS WORLD WATER DEVLOPMENT REPORT 2018

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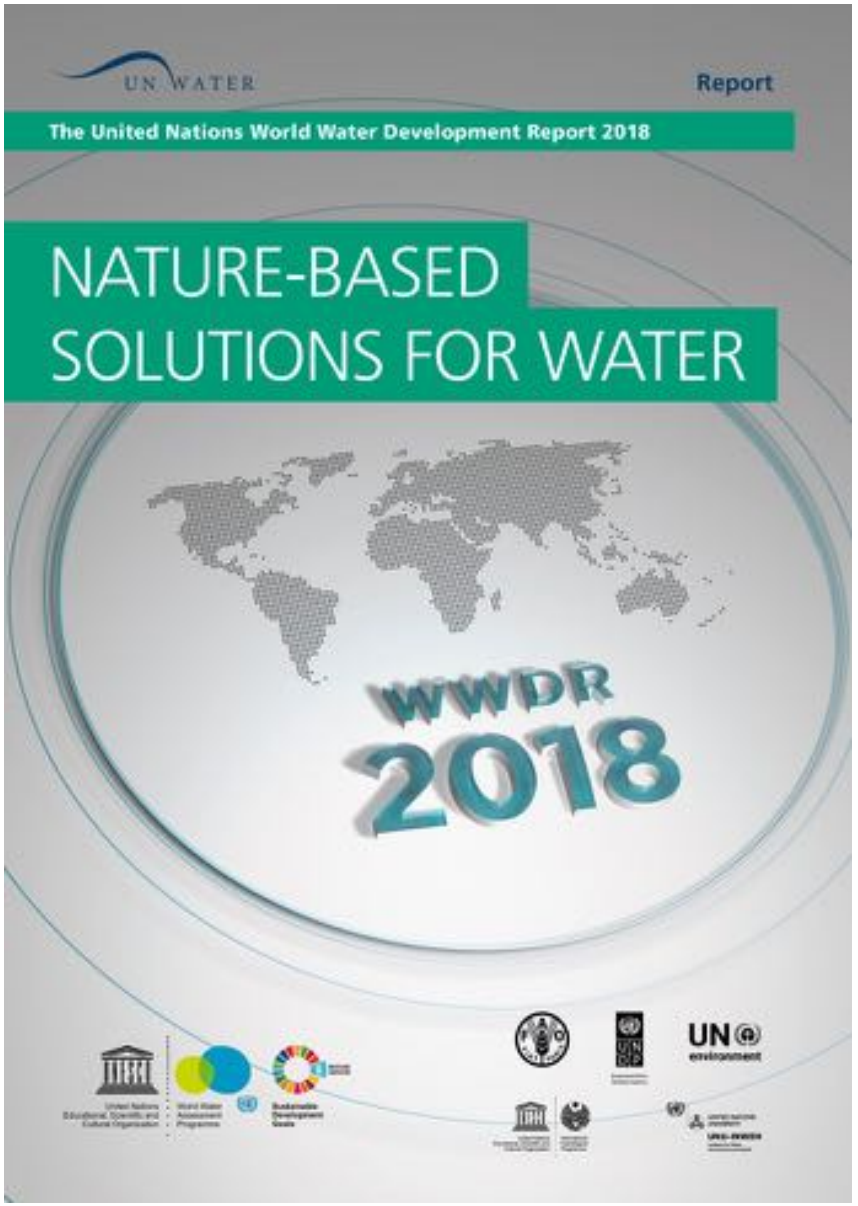

The world's water: Rising demand, increasing scarcity, degrading quality and increasing risks

Increasing water scarcity

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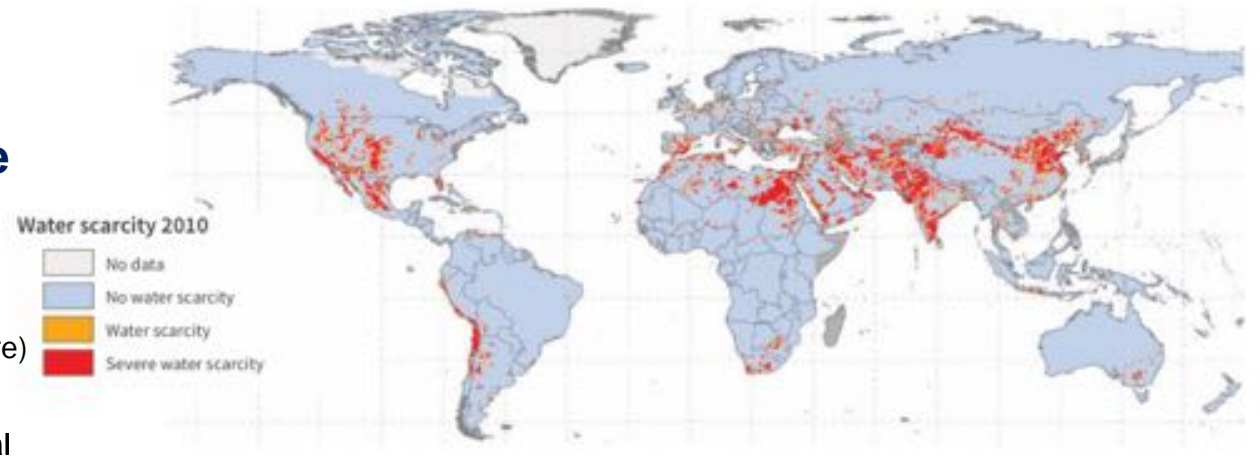
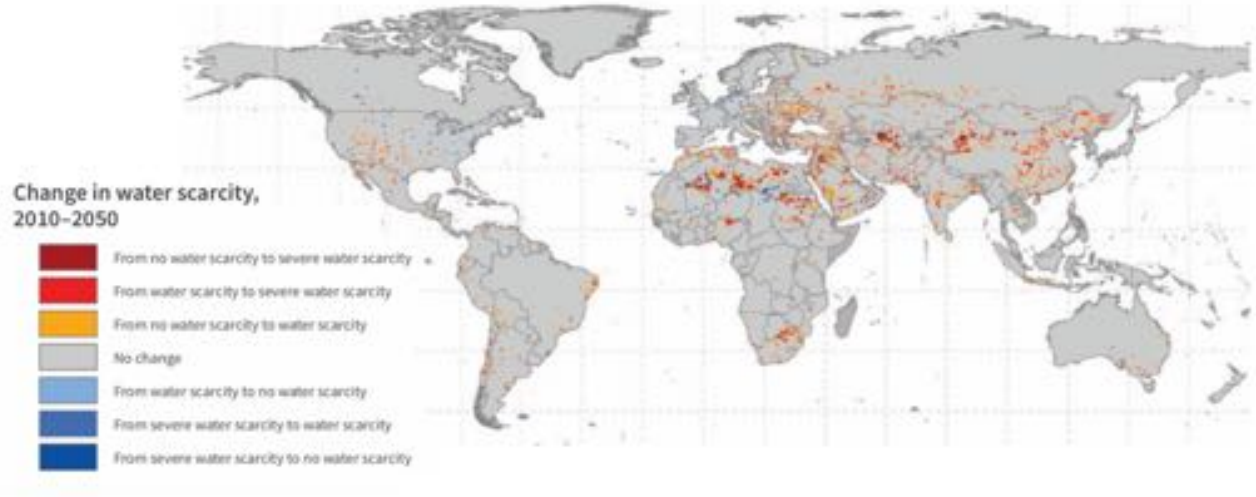
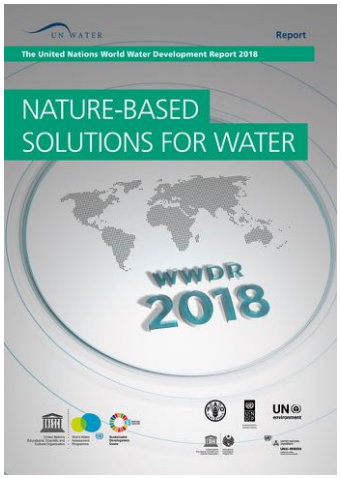
At present, an estimated 3.6 billion people (nearly half the global population) live in areas that are potentially water-scarce at least one month per year, and this population could increase to some 4.8 to 5.7 billion by 2050





Physical water scarcity in 2010 (upper figure) and projected change in water scarcity* by 2050 (lower figure) based on the *middle-of-the-road* scenario

*Regions are considered **water scarce** when **total annual withdrawals** for human use are between **20 and 40% of the total available renewable surface water resources**, and **severely water scarce** when withdrawals **exceed 40%**.



Source: WWDR 2018, Burek et al. (2016)

Increasing water scarcity- groundwater

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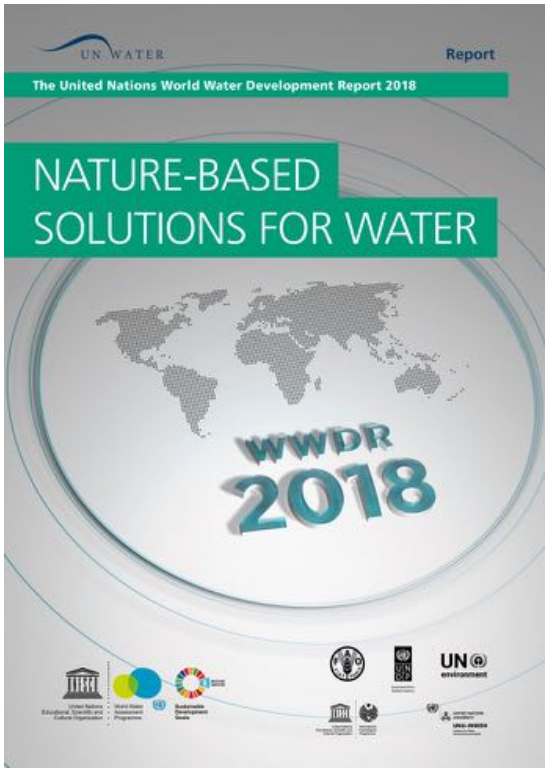
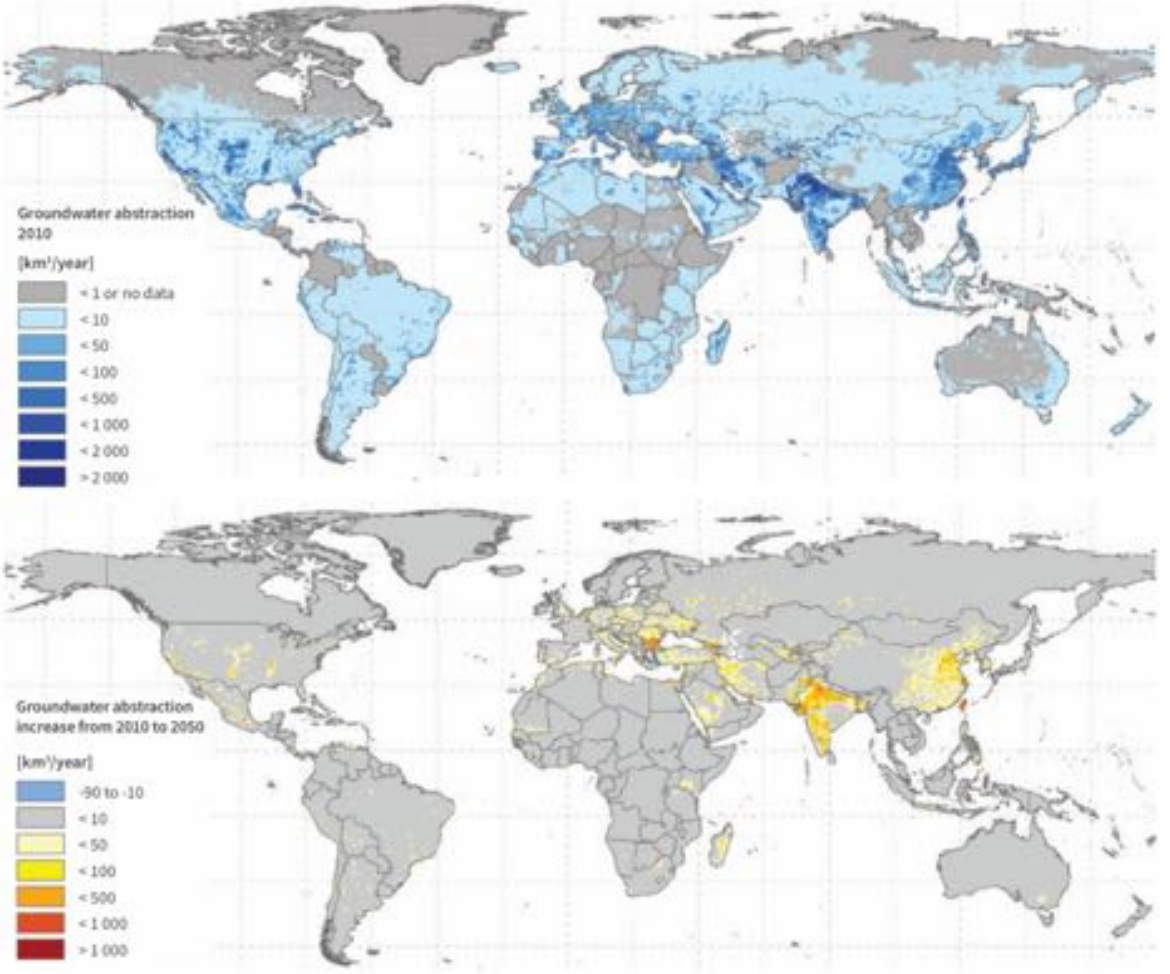
A **third** of the world biggest groundwater systems are already **in distress**

Groundwater abstractions in 2010 (upper figure) and increases in groundwater abstraction by 2050 above 2010 levels (lower figure) based on the *middle-of-the-road* scenario





Source: Burek et al. (2016)

Water-related risks

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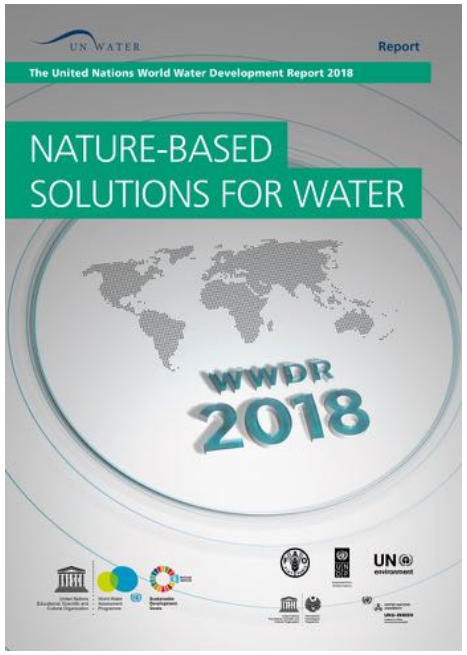
Floods have accounted for 47% of all weather-related disasters since 1995, affecting a total of **2.3 billion people**.



Internationally reported global disaster mortality for events with fewer than 100 deaths (UNISDR 2015, based on EM-DAT)

WWDR, 2018

Water-related risks

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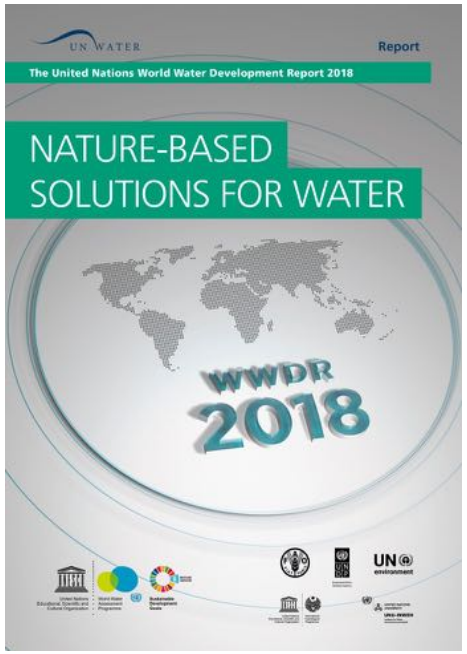
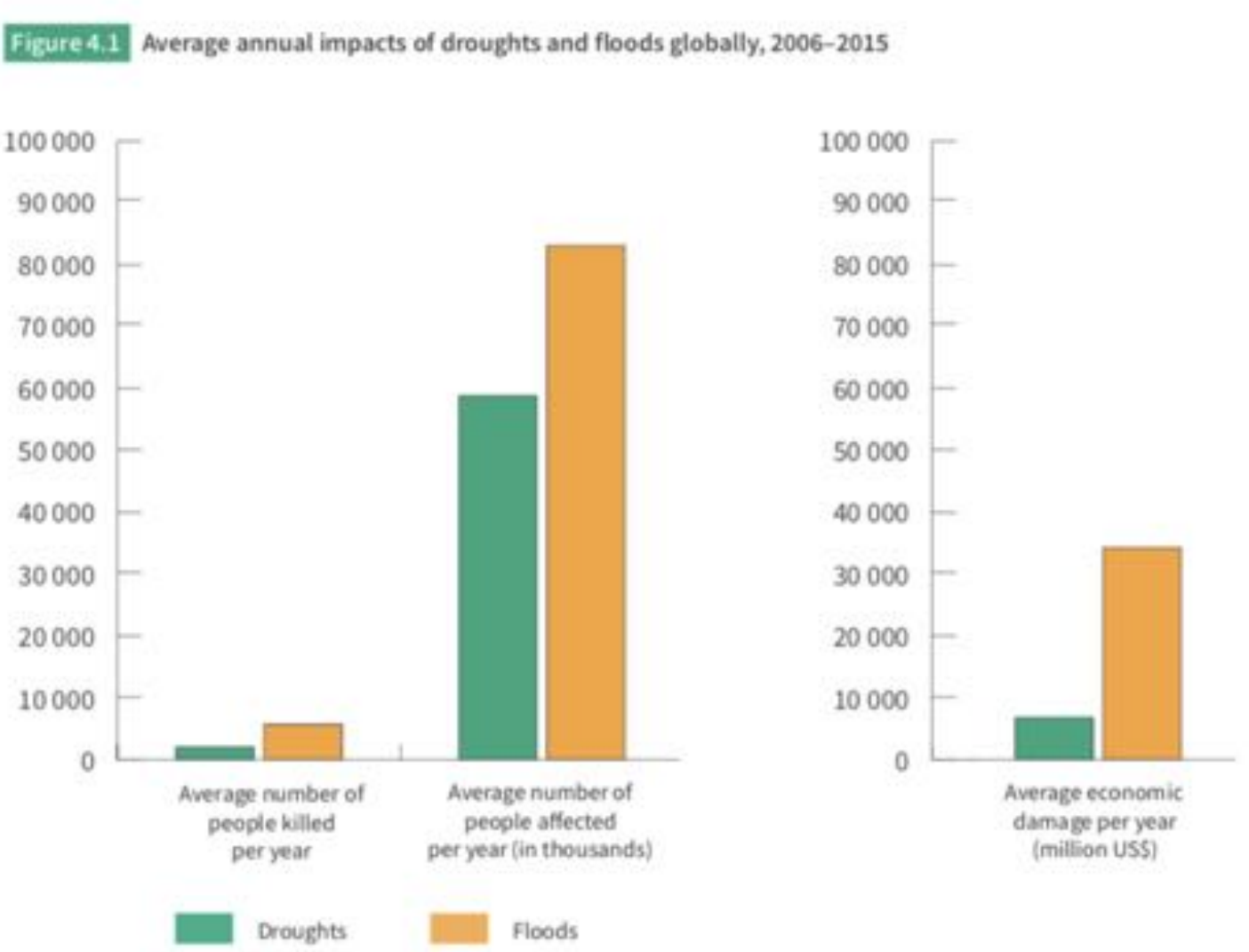
Average global economic loss from floods and droughts is over US$40 billion per year across all economic sectors.





WWDR, 2018

17 Sustainable Development Goals and 169 targets

Sendai Framework for Disaster Risk Reduction 2015-2030

UN World Conference on Disaster Risk Reduction
2015 Sendai Japan

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Global Targets

(a) Substantially reduce global disaster mortality by 2030,

(b) Substantially reduce the number of affected people globally by 2030

(c) Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.

(d) Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.

(e) Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.

(f) Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030.

UN Climate Change Conference of Parties (COP 21)

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Paris Agreement

Paragraph 7 (Article 7, 8):

- **(c) Strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making**
- **(d) Assisting developing country Parties in identifying effective adaptation practices, adaptation needs, priorities, support provided and received for adaptation actions and efforts, and challenges and gaps, in a manner consistent with encouraging good practices;**
- **Loss and Damage in the Paris Agreement Provides a legal basis for long-term action on loss and damage.**

SDG, Paris Agreement Sendai-Framework - Do we have adequate tools?

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- **How to translate those framework into measurable tools/ Indicators?**
- **Do we have sufficient tools and management option to identify risk and uncertainty of climatic/ non climatic projections including from policy framework provided by global commitment?**
- **Tools and methodologies with engagement by hydrological or meteorological agencies or other relevant institutions.**

Global Framework and Publication

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Review

Physical water scarcity metrics for monitoring progress towards SDG target 6.4: An evaluation of indicator 6.4.2 "Level of water stress"

D. Vanham [a,*], A.Y. Hoekstra [b,c], Y. Wada [d,e], F. Bouraoui [a], A. de Roo [a], M.M. Mekonnen [f], W.J. van de Bund [a], O. Batelaan [g], P. Pavelic [h], W.G.M. Bastiaanssen [i,j], M. Kummu [k], J. Rockström [l], J. Liu [m,d], B. Bisselink [a], P. Ronco [a], A. Pistocchi [a], G. Bidoglio [a]

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[d] International Institute for Applied Systems Analysis, Laxenburg, Austria
[e] Faculty of Geosciences, Utrecht University, Utrecht, Netherlands
[f] Robert B. Daugherty Water for Food Global Institute, University of Nebraska, Lincoln, United States
[g] Flinders University of South Australia, National Centre for Groundwater Research and Training, College of Science and Engineering, Adelaide, Australia
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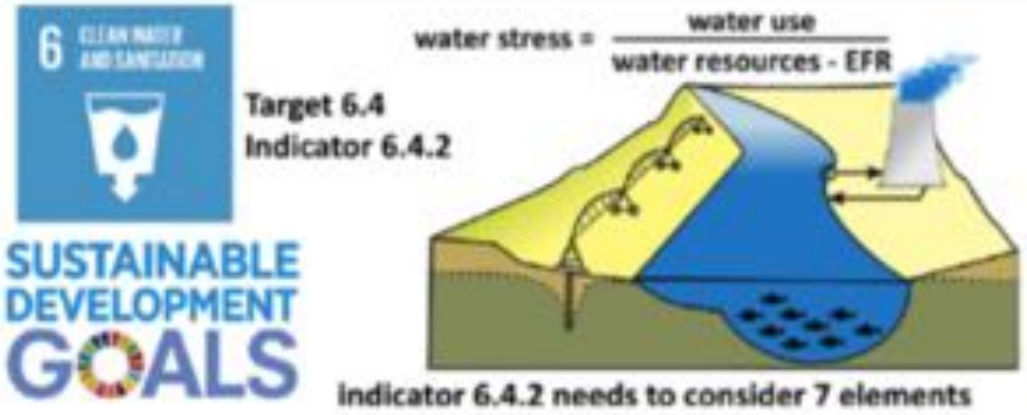
[m] School of Environmental Science and Engineering, South University of Science and Technology of China, Shenzhen, 518055, China

HIGHLIGHTS

- SDG target 6.4 aims at reducing water scarcity.
- Indicator 6.4.2 "Level of water stress", relates water use to availability.
- We identify 7 key elements that need to be considered for a water stress indicator.
- Indicator 6.4.2 considers these 7 elements, but there is need for improvement.
- We give clear recommendations for improvement.

GRAPHICAL ABSTRACT



Target 6.5: By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

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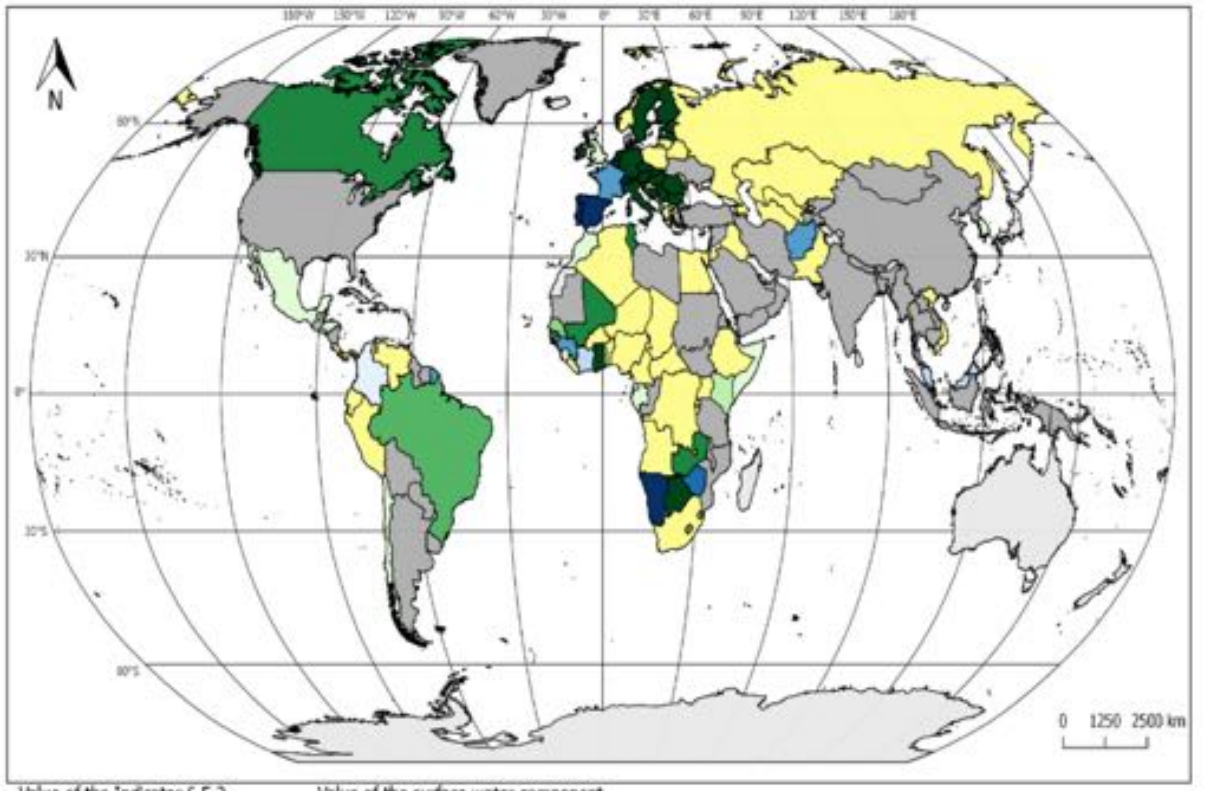
6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation

Most of the world's water resources are shared: transboundary lake and river basins account for 60% of global freshwater. Some 286 transboundary main river basins and 592 transboundary aquifers have been identified.



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UNECE

How to deal with the large uncertainty in the different model projections?

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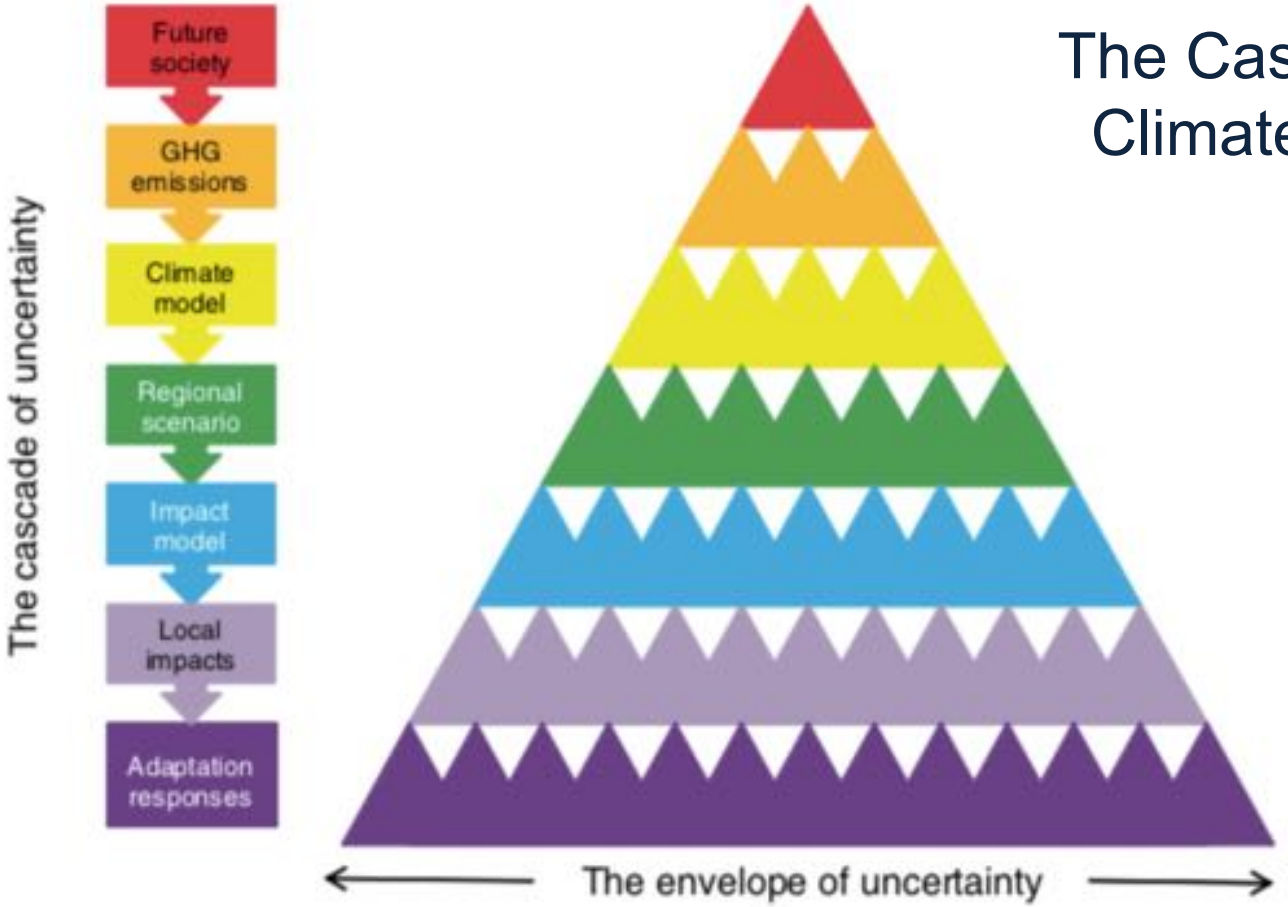

The Cascade of Uncertainty in Climate Change Projections

A cascade of uncertainty proceeds from different socio-economic and demographic pathways, their translation into concentrations of atmospheric greenhouse gas (GHG) concentrations, expressed climate outcomes in global and regional models, translation into local impacts on human and natural systems, and implied adaptation responses.

Wilby and Dessai, 2010

Decision making and large uncertainty in the different model

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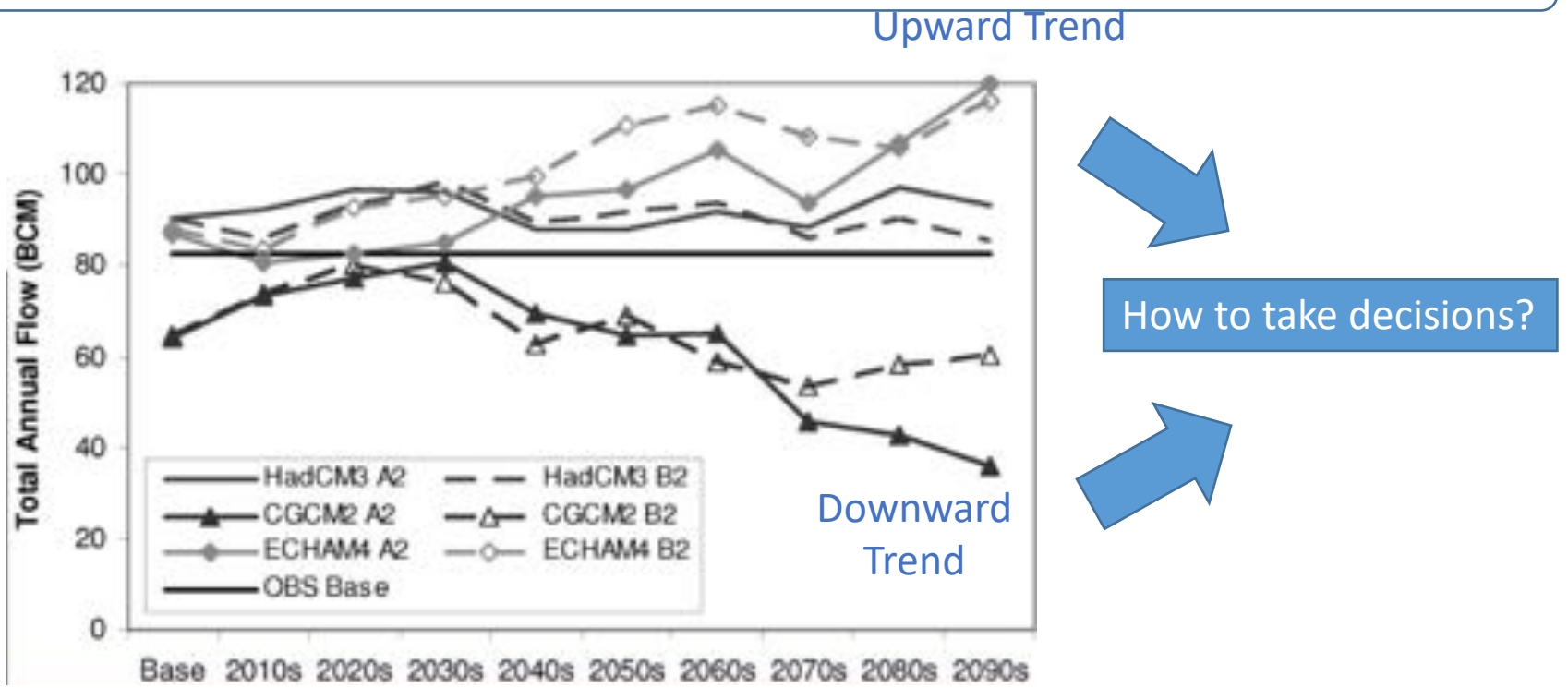
International Hydrological Programme

Example: Six different models projections for the River Nile discharge



(Di Baldassare, 2012)

Fig. 1 Simulated decadal mean flows at Dongola on the main Nile from six GCM experiments. The values represent averages of 10 realizations of statistically downscaled scenarios for each experiment while the base refers to the baseline period 1992–2001.

Climate Risk Informed Decision Analysis (CRIDA)

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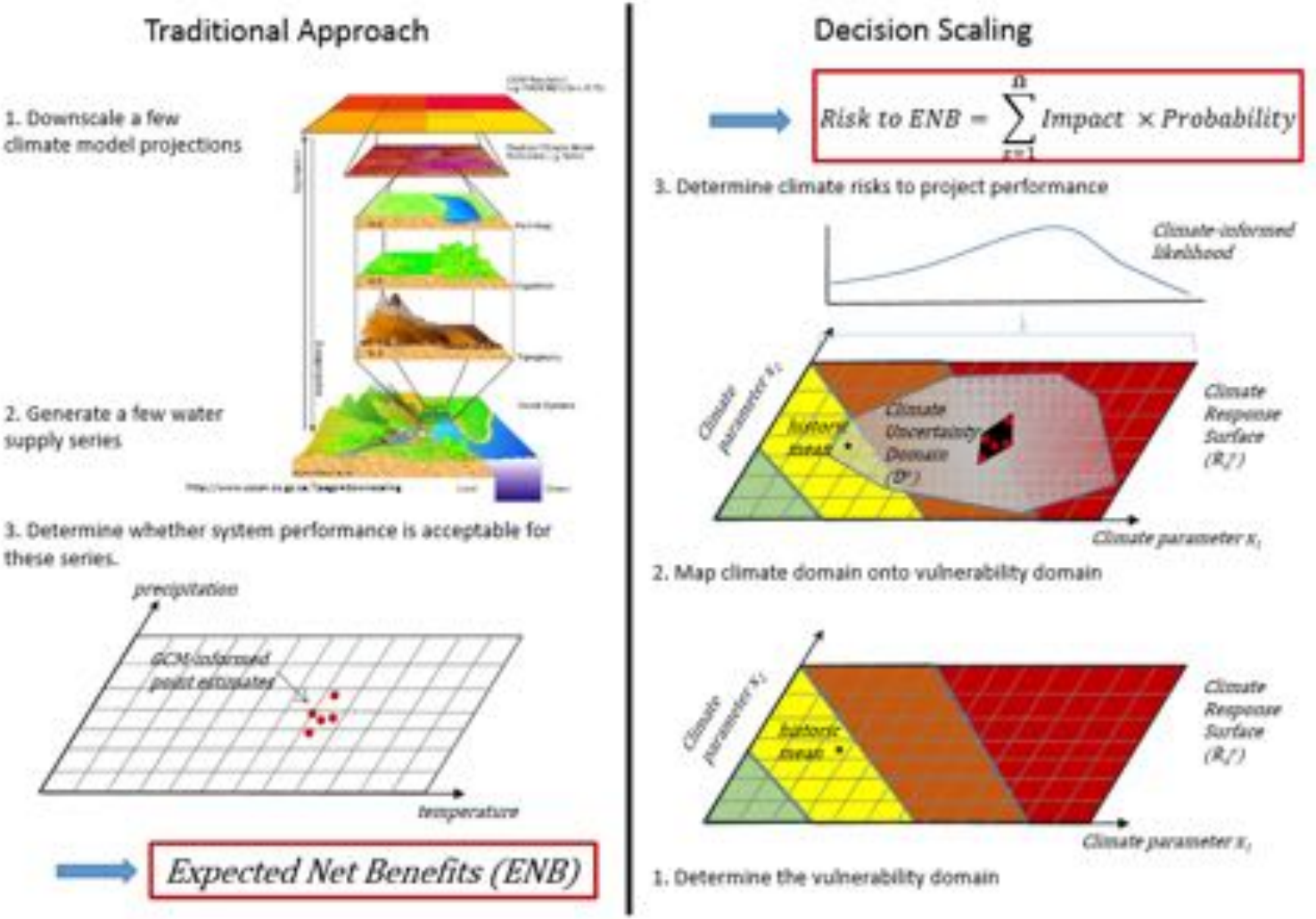
A bottom-up approach to utilize the information in the GCMs



International Hydrolgical Programme (IHP)

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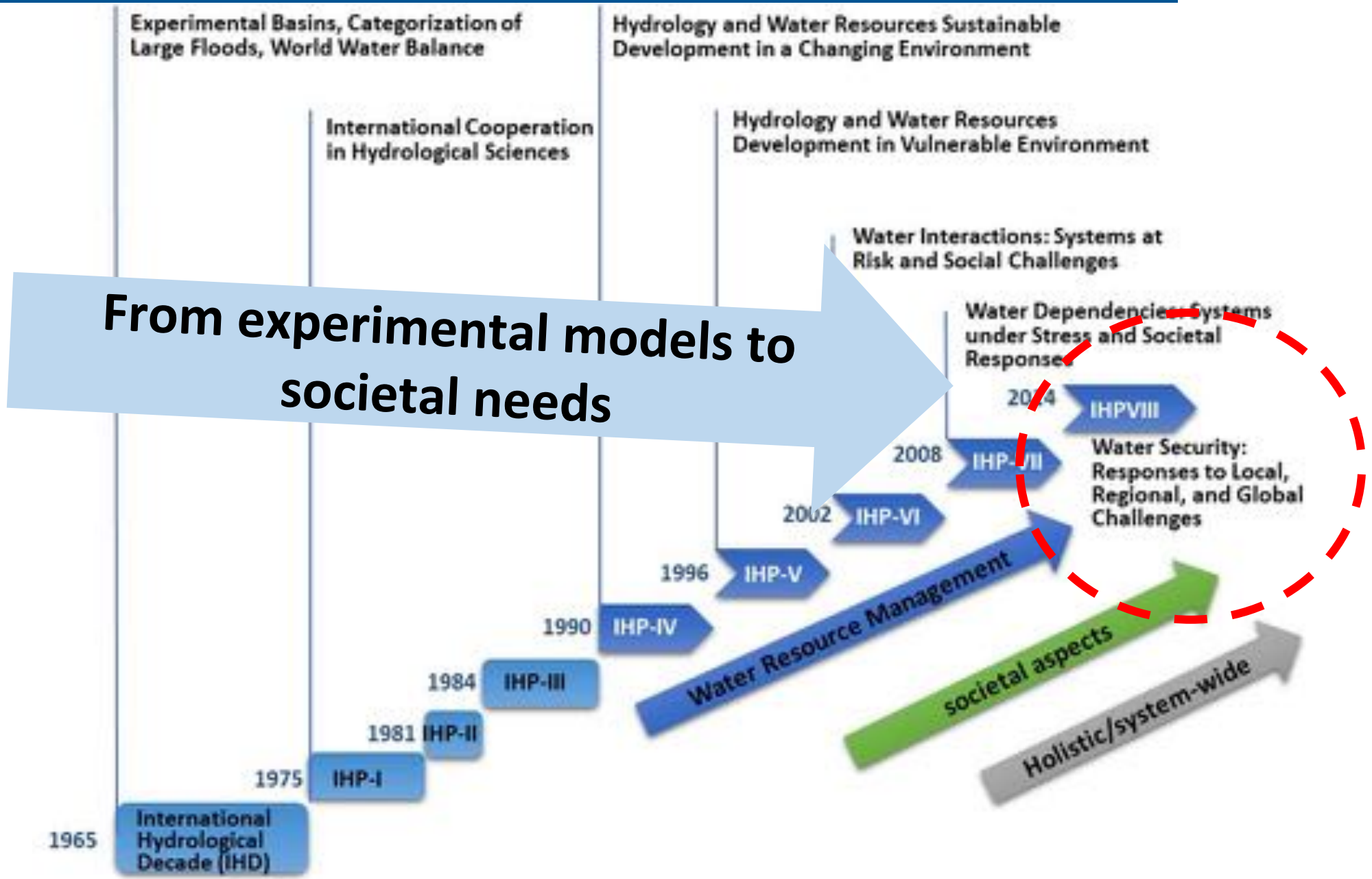
International Hydrological Programme



International Hydrolgical Programme (IHP, VIII 2014-2021)

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G-WADI

gwadi.org

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REAL TIME PRECIPITATION ESTIMATES | HYDROLOGIC MONITORING & FORECASTING | FREQUENCY ANALYSES | CHEMICAL & ISOTOPIC TRACERS | WATER HARVESTING | CLIMATE CHANGE

G-WADI's mission is to strengthen the capacity to manage the water resources of arid and semi-arid areas around the globe through a network of international and regional cooperation.

G-WADI Networks

Center for Hydrometeorology and Remote Sensing (CHRS) - University of California, Irvine, USA, Princeton University -

International Center for Integrated Water Resources Management

Water for Sustainable Development and Adaptation to Climate Change - Serbia

Asian G-WADI Network Cold and Arid Regions Environmental and Engineering Research Institute Chinese Academy of Sciences

Ministry of Regional Municipalities and Water Resources Sultanate of Oman

International Center for Integrated Water Resources Management

Managing Water Resources in Arid and semi-Arid Regions of LAC and the Caribbean

The Water Center for Arid and Semi-Arid Zones in Latin America and the Caribbean

African Network AGRYHMET Regional Centre - Niamey, Niger.

Providing tools to identify Climate Risks

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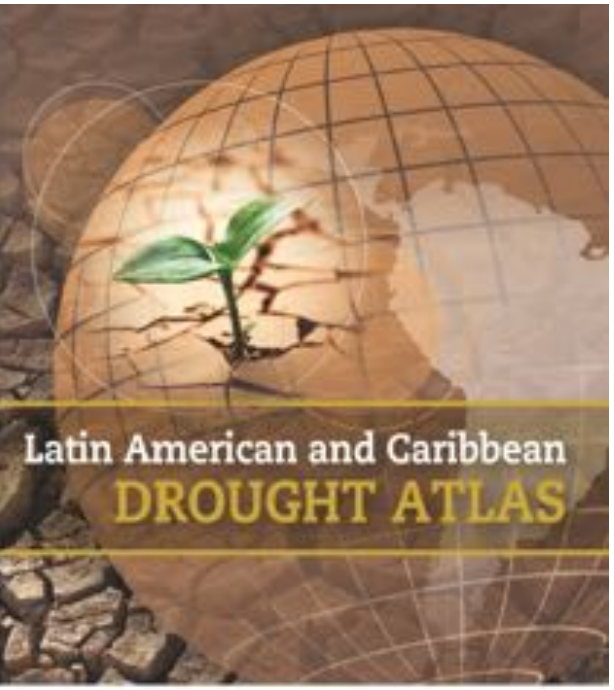
The Latin American and Caribbean Drought Atlas



Identifying the frequency of drought events:

a. How rare is the current drought?
b. How large a drought should we plan for?
c. How rare is the drought of record?

A long-term regional activity, spanning the 2008-2015 period:

- 12494 precipitation stations analyzed
- From 21 countries in the region
- More than 10 regional workshops were organized
- Funding provided through multiple sources

Programa Hidrológico Internacional

CAZALAC

Comisión Europea

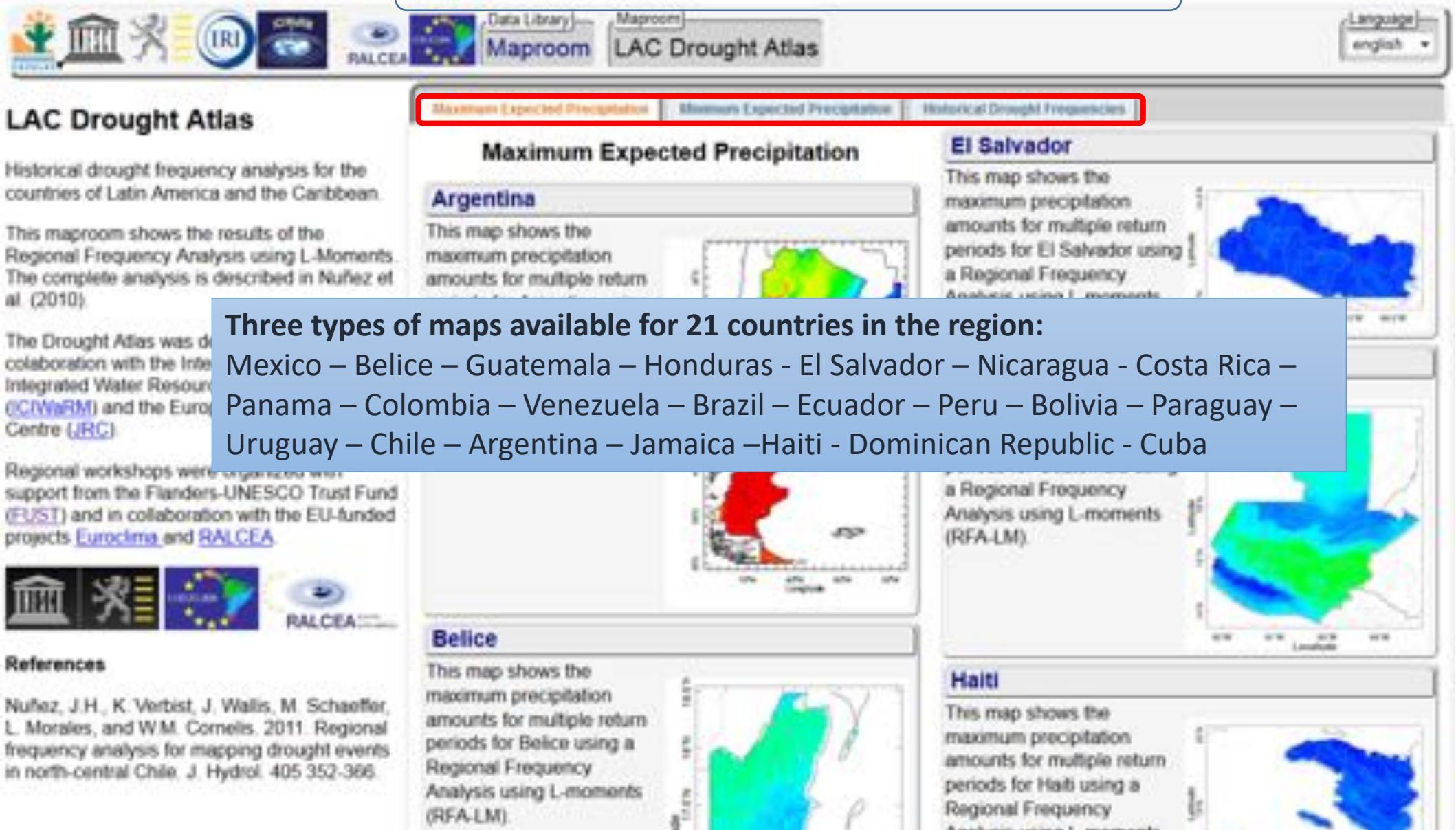
Flemish government

EUROCLIMA

The Latin American and Caribbean Drought Atlas

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

Accessible on-line in Spanish and English



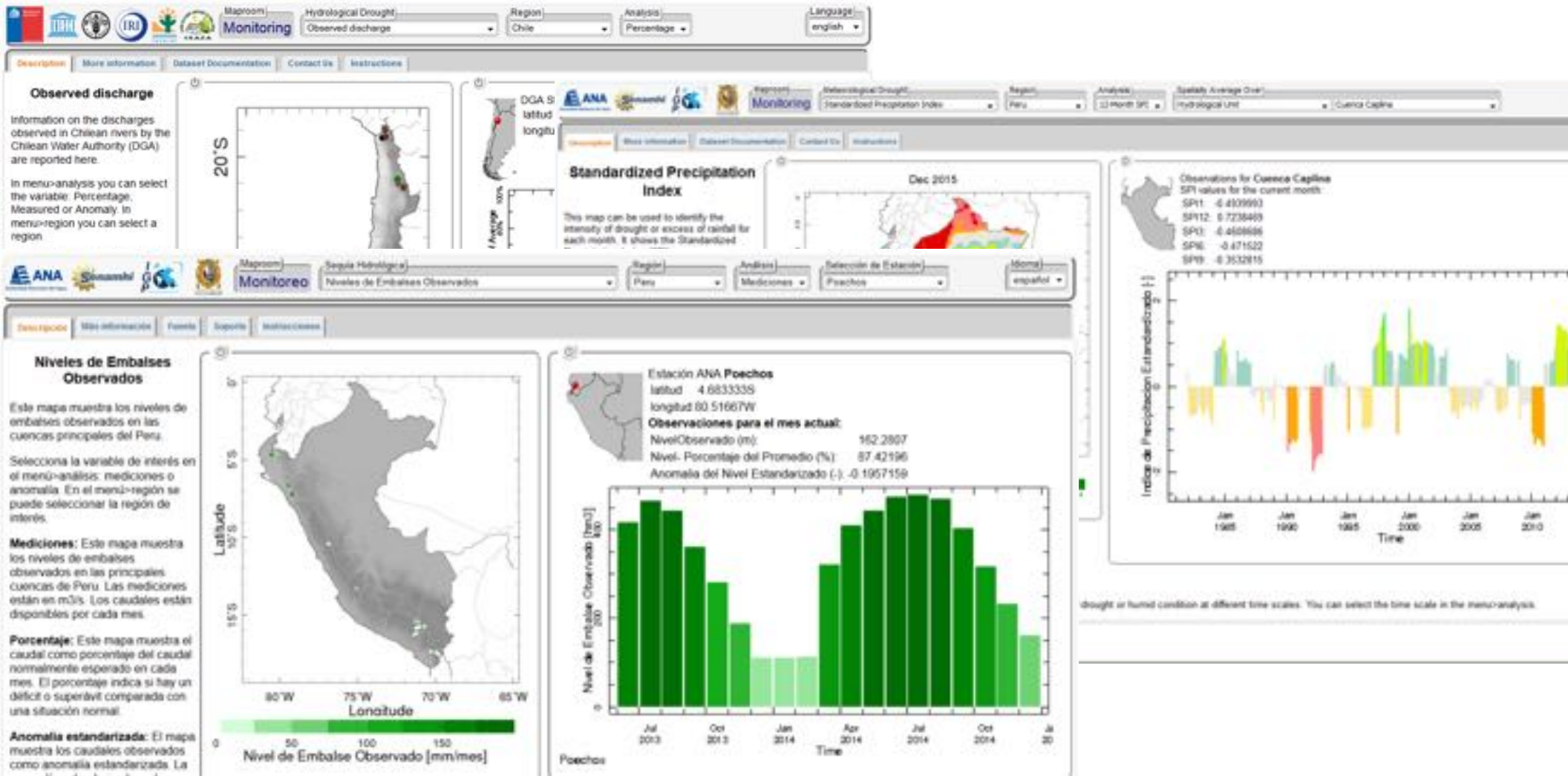
Three types of maps available for 21 countries in the region:
Mexico – Belice – Guatemala – Honduras - El Salvador – Nicaragua - Costa Rica – Panama – Colombia – Venezuela – Brazil – Ecuador – Peru – Bolivia – Paraguay – Uruguay – Chile – Argentina – Jamaica –Haiti - Dominican Republic - Cuba

The national and regional drought observatories

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

a. Place current droughts into context
b. Unlocking national datasets for monitoring different aspects of drought and climate risks
c. Drought early warning for pro-active drought management and policy



The African and Lac flood and drought Monitors

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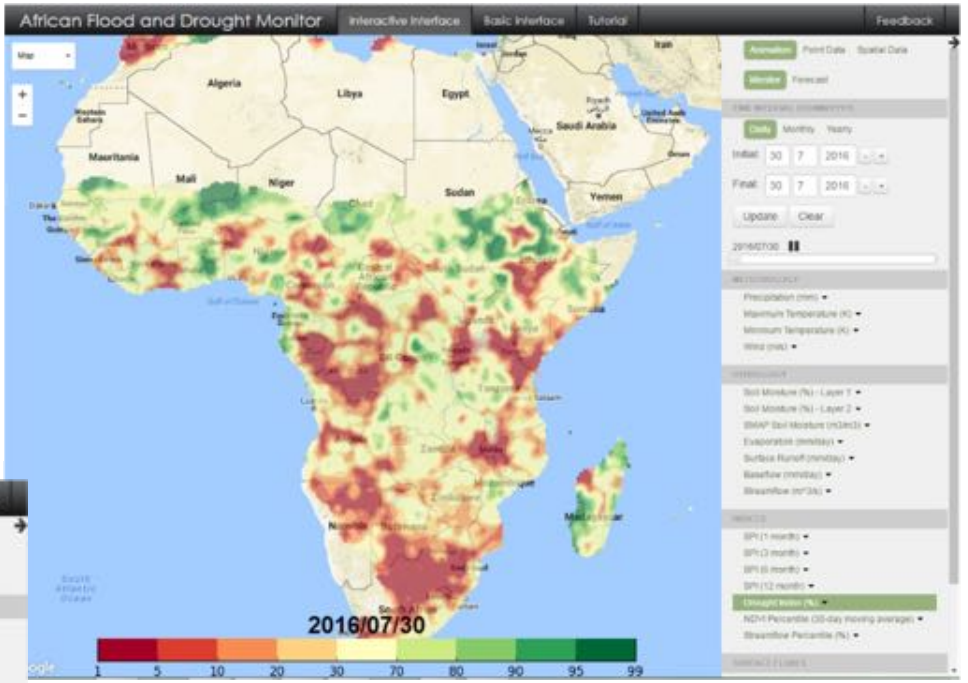
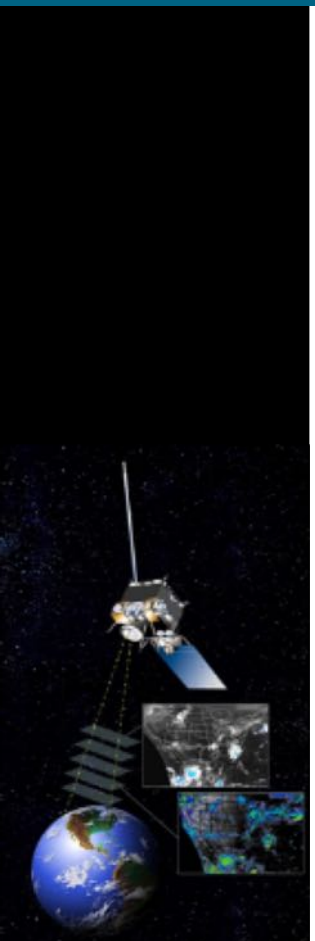
African and LAC Droughts monitors:

Strengthen the capacity of African and LAC countries for near real-time monitoring and seasonal forecasting to raise awareness of the impact of floods and droughts on vulnerable and disadvantaged groups.

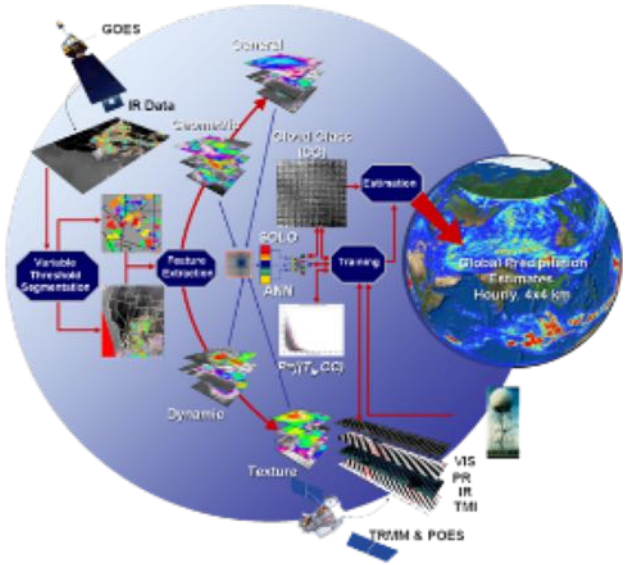


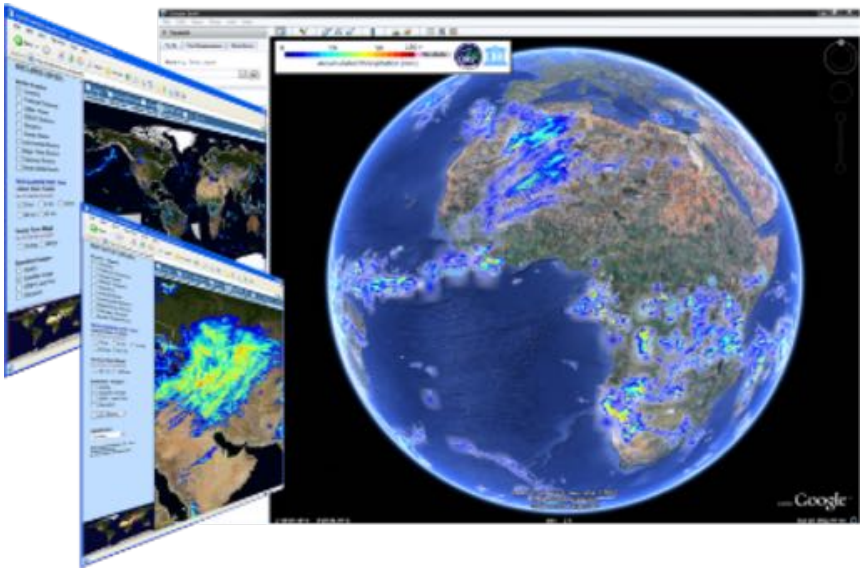
User Interface:
http://stream.princeton.edu

G-WADI Geo-Server



Algorithm





Web Services

Applications

Drought Management Flood Forecasting Water Resources

G-WADI Geoserver application in Namibia- Science communication

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

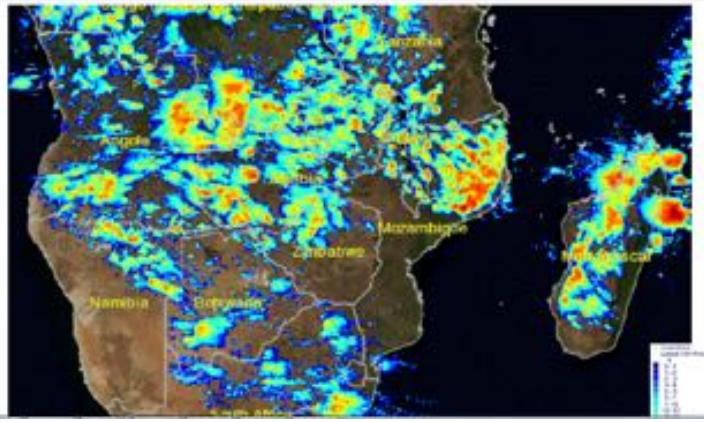
HYDROLOGICAL SERVICES NAMIBIA

DAILY FLOOD BULLETIN 26 January 2018

Private Bag 13184, Ministry of Agriculture, Water and Forestry, Government Office Park, Namibia

Satellite images over the last 24 hours showed isolated showers over the north-central, northeast and eastern parts of Namibia.

G-WADI-rainfall accumulation for the past 24 hours preceding 08h00 on 26.01.2018



Science communication: Launch of app for mobile device during COP22

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Science communication- Exhibition Climate Change Impacts on Mountains during COP21

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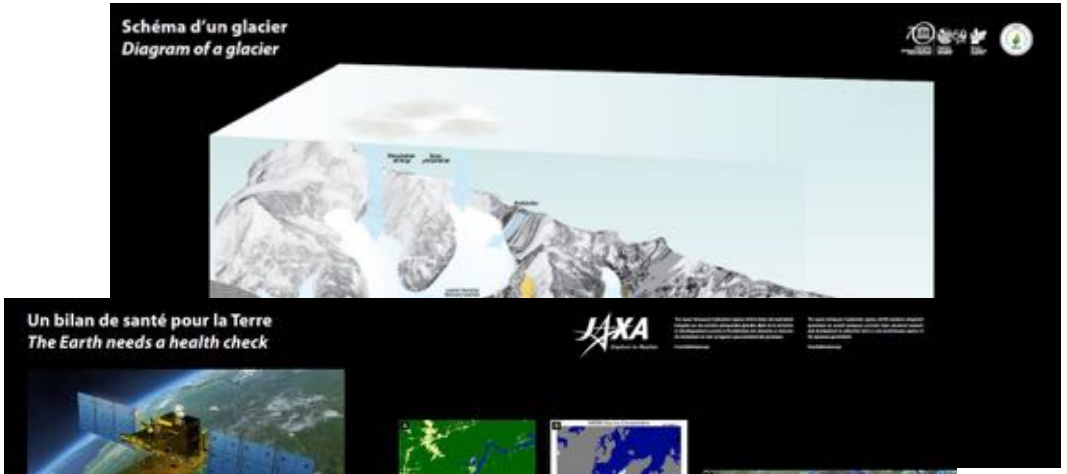
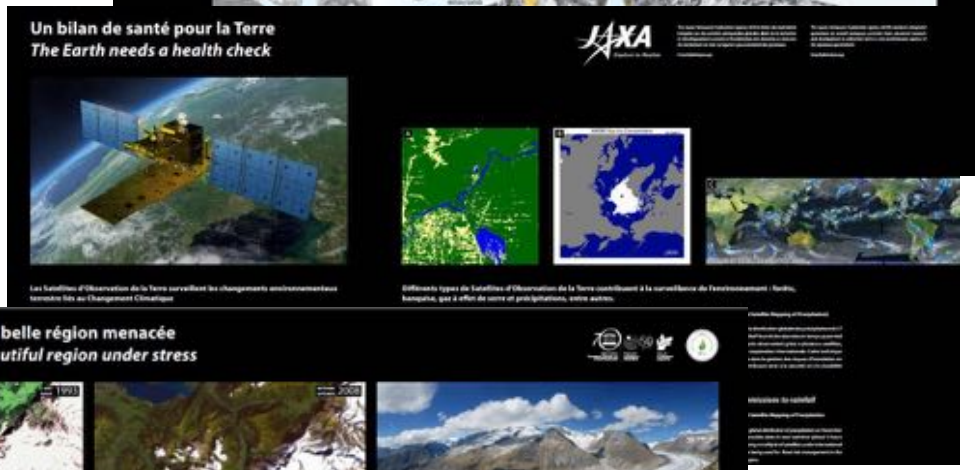
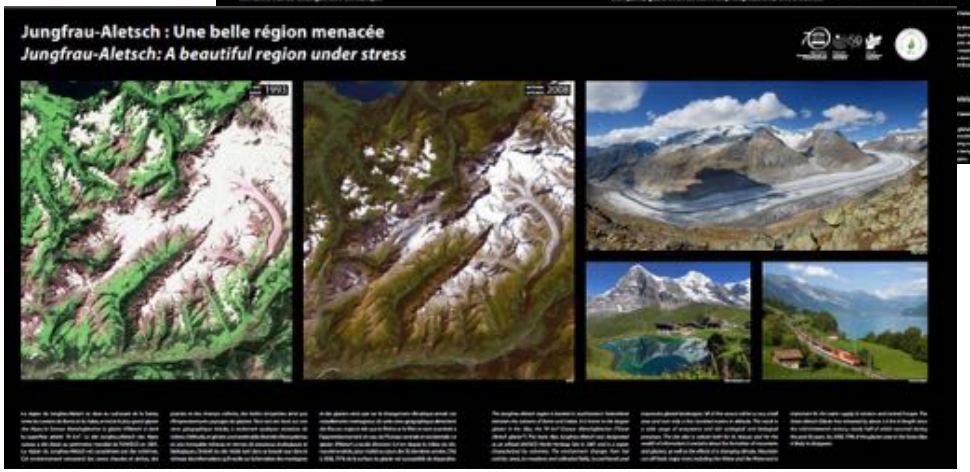
Among the raising awerness activities: exhibition showcasing satelite images aerial and ground pictures were presented during COP21 in Paris.







COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

Science communication- Launch of app for mobile device during COP21

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The Glacier App

wgms

Information system on worldwide glacier changes, bringing scientifically sound facts and figures to decision-makers

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

Flanders
State of the Art

ACCOMPLISHMENT REPORT

THE IMPACT OF GLACIER RETREAT IN THE ANDES

International Multidisciplinary Network for Adaptation Strategies

Enhancing Climate Services for Improved Water Resources Management in Vulnerable Regions to Climate Change: Case studies from Africa and Latin America

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

Flanders
State of the Art

Improved CLIMATE SERVICES for flood and drought risk management

CAPACITY BUIDING on climate services

Strengthen drought and flood risk MANAGEMENT STRATEGIES AND POLICIES

Empower the local communities using a **CITIZEN SCIENCE** *approach*

Assessment of Snow Glacier and Water Resources in Central Asia

United Nations Educational, Scientific and Cultural Organization

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Strengthening the Resilience of Central Asian Countries by Enabling Regional Cooperation to Assess High Altitude Glacio-Nival Systems to Develop Integrated Methods for Sustainable Development and Adaptation to Climate Change

IHP contributes to SDGs and 2030 Agenda

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

PARIS 2015

IHPI contributes to SDGs and the 2030 Agenda as a whole

REAL TIME PRECIPITATION ESTIMATES

HYDROLOGIC MONITORING & FORECASTING

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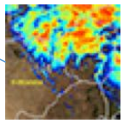

Namibia Uses IHP-supported G-WADI's Precipitation Estimates in their Daily Flood Bulletin

Rainmapper A New Mobile Device Application for Real-time Global Precipitation Monitoring

New brochures for 'Latin American Flood and Drought Monitor' and 'Latin American & Caribbean Drought Atlas'

Technical training session on PERSIANN held during Thai Hydrologist Association's (THA) 2015 conference

SDGs

Sendai Framework for Disaster Risk Reduction

2015 - 2030

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UNESCO Water on the Map

United Nations Educational, Scientific and Cultural Organization · World Water Assessment Programme

NATURAL SCIENCES

www.unesco.org/water