



United Nations  
Educational, Scientific and  
Cultural Organization

# Hydrological Research and Practice: Where is the Harmony

## Connections between hydrological science and practice

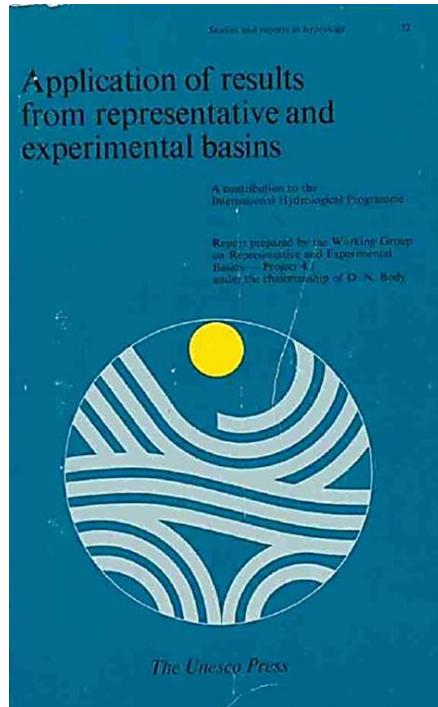
**Anil Mishra**





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## An overview from International Hydrological Programme (IHP) UNESCO



- **International Hydrological Decade (1965-1974)**
- **Application of results from representative and experimental basins**
- **World Water Balance**





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# UNESCO-IHP Flagship Science Programme

Experimental Basins, Categorization of  
Large Floods, World Water Balance

Hydrology and Water Resources Sustainable  
Development in a Changing Environment

International Cooperation  
in Hydrological Sciences

Hydrology and Water Resources  
Development in Vulnerable Environment

Water Interactions: Systems at  
Risk and Social Challenges

Water Dependencies: Systems  
under Stress and Societal  
Responses

2014  
IHP-VIII

Water Security:  
Responses to Local,  
Regional, and Global  
Challenges

2008  
IHP-VI

1996  
IHP-V

IHP-IV

1990

IHP-III

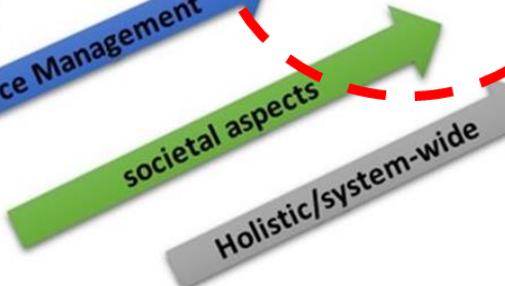
1984

1981  
IHP-II

1975  
IHP-I

1965

International  
Hydrological  
Decade (IHD)



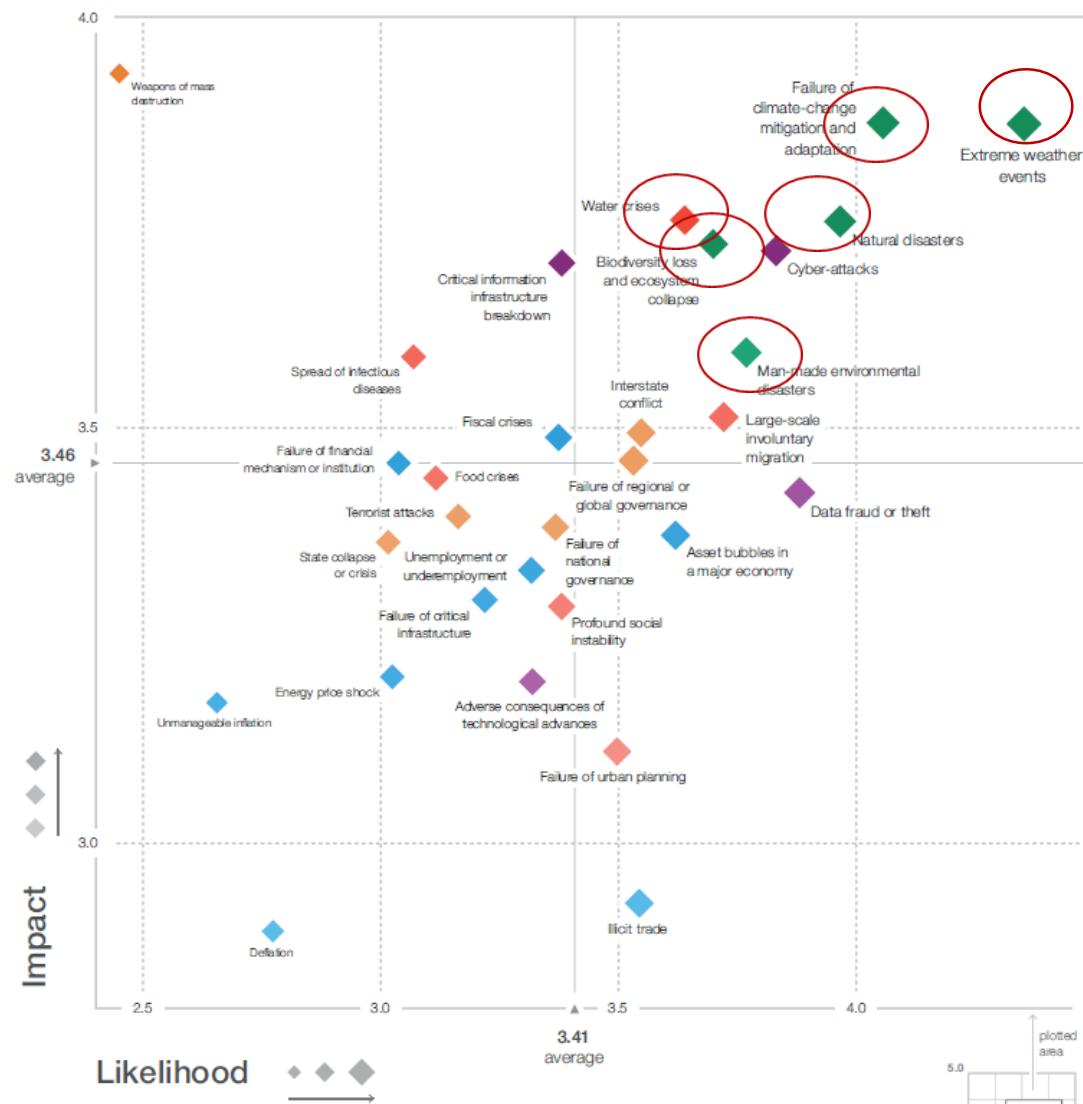
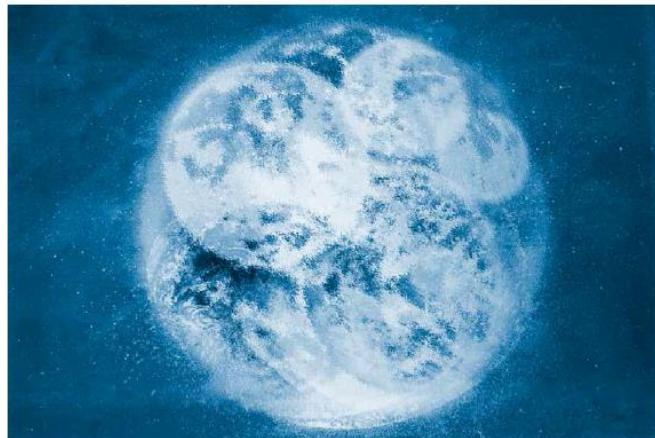
# Global Risks Landscape 2019: Risk and uncertainty



Insight Report

## The Global Risks Report 2019 14th Edition

In partnership with Marsh & McLennan Companies and Zurich Insurance Group



## Top 10 risks in terms of Impact

- 1 Weapons of mass destruction
- 2 Failure of climate-change mitigation and adaptation
- 3 Extreme weather events
- 4 Water crises
- 5 Natural disasters
- 6 Biodiversity loss and ecosystem collapse
- 7
- 8
- 9
- 10

## Top 10 risks in terms of Likelihood

- 1 Extreme weather events
- 2 Failure of climate-change mitigation and adaptation
- 3 Natural disasters
- 4 Data fraud or theft
- 5 Cyber-attacks
- 6 Man-made environmental disasters
- 7 Large-scale involuntary migration
- 8 Biodiversity loss and ecosystem collapse
- 9 Water crises
- 10



# IHP-VIII Responses: 6 Themes, 3 Axes 2014-2021

Axis Improve knowledge and innovation to address water security challenges

## AXIS 1

Mobilizing International cooperation to  
Improve knowledge and innovation to address  
water security challenges

## AXIS 3

Developing institutional and human capacities for water security and sustainability

WATER-RELATED DISASTERS AND HYDROLOGICAL CHANGE



GROUNDWATER IN A CHANGING ENVIRONMENT



ADDRESSING WATER SCARCITY AND WATER QUALITY



WATER AND HUMAN SETTLEMENTS OF THE FUTURE



ECOHYDROLOGY ENGINEERING HARMONY FOR A SUSTAINABLE WORLD



EDUCATION, KEY TO WATER SECURITY



<<< WATER SECURITY, ADDRESSING LOCAL, REGIONAL AND GLOBAL CHALLENGES >>>

## AXIS 2

Strengthening the Science-Policy interface to reach water security at local, national, regional, and global levels



# THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

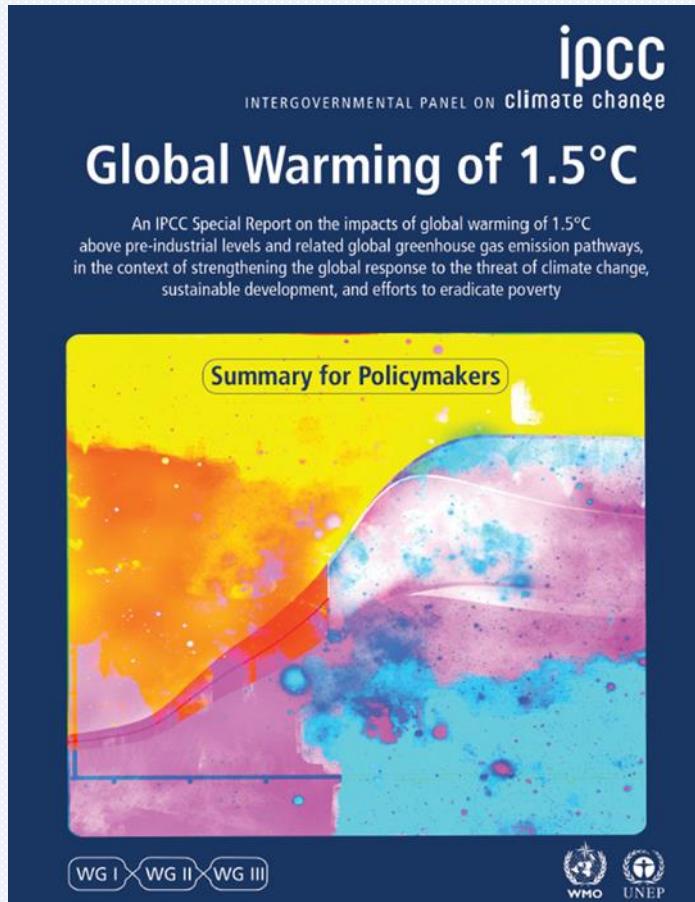


**SDG Target 6.3:** By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

*World Water Development Report (2017)*



# Climate Change : Global Warming of 1.5 °c



## 0.5°C difference matters

+1.0°C (today): impacts detected

+1.5°C: serious impacts

+2.0°C: impacts considerably worse;  
some will be irreversible

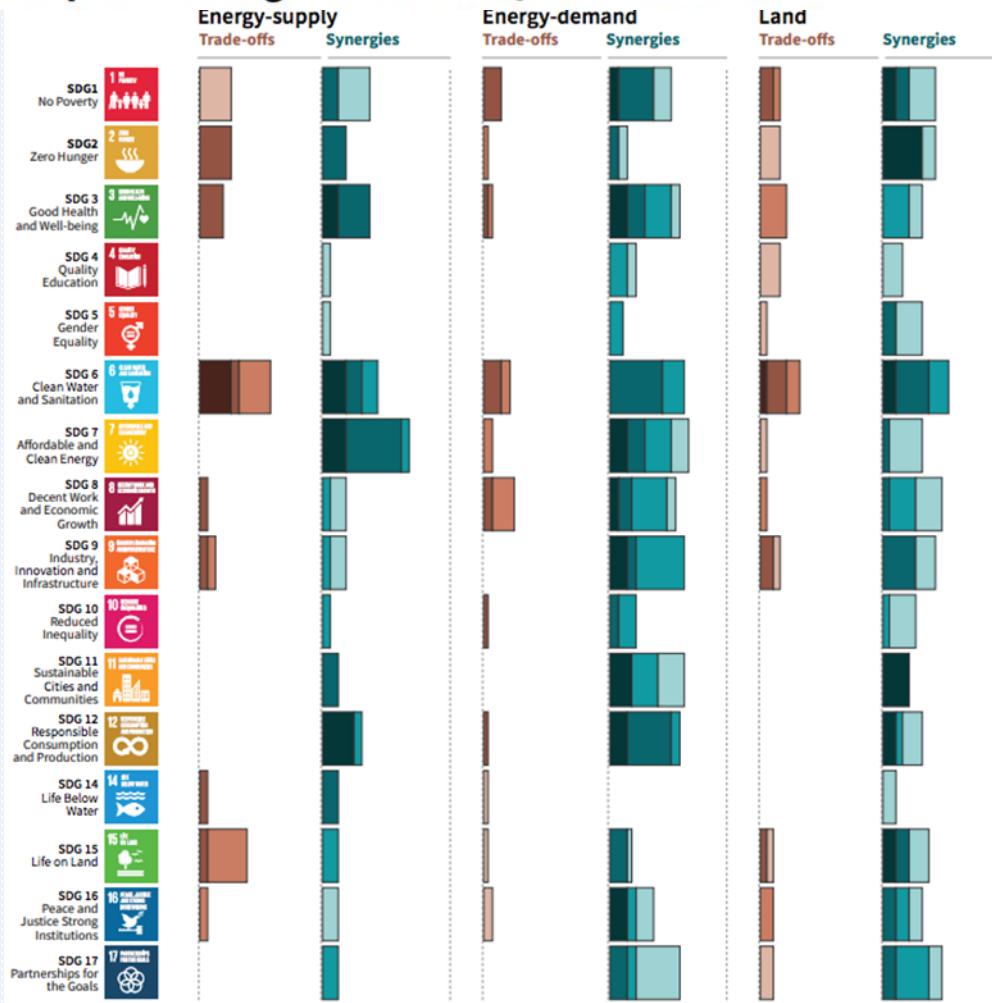
## +1.5°C can be reached

with 45% CO2 reduction by 2030 and 0 net emission by 2050 (one of several emission scenarios)



# +1.5°C Emission Paths and SDGs

## Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

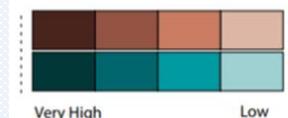


Length shows strength of connection



The overall size of the coloured bars depict the relative potential for synergies and trade-offs between the sectoral mitigation options and the SDGs.

Shades show level of confidence



The shades depict the level of confidence of the assessed potential for Trade-offs/Synergies.

*Trade-offs/synergies*

IPCC Global Warming 1.5 Report



# SDG, Paris Agreement Sendai Framework, do we have adequate tools?

- **How to translate those framework into measurable tools?**
- **Do we have sufficient tools and management option to identify risk and uncertainty of climatic projections and framework provided by global commitment for the water resources management systems?**
- **Tools and methodologies with engagement by hydrological or meteorological agencies or other relevant institutions.**

# WATER and JOBS

## The United Nations World Water Development Report 2016



**Opportunities for current and future employment and decent jobs are dependent upon the sustainable management of water resources and the provision of water-related services**



# Water-Dependent Jobs



AGRICULTURE



FORESTRY



FISHERIES



ENERGY



RESOURCE-INTENSIVE  
MANUFACTURING



RECYCLING



BUILDING



TRANSPORT

WWDR 2016





**Three out of four jobs that make up the entire global workforce are water-dependent**

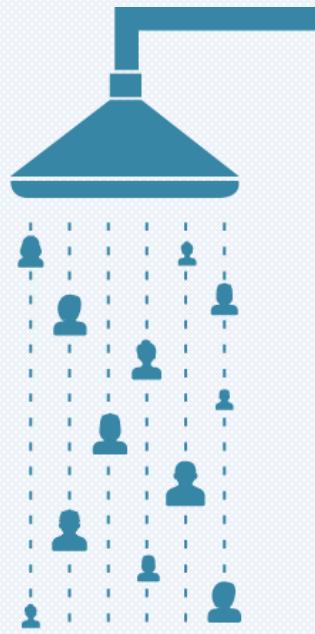
**WWDR 2016**

# THE MULTIPLIER EFFECT OF INVESTING IN WATER

Investing **US\$1 million** in water supply and sanitation infrastructure

10-26 jobs  
in the USA

100 jobs  
in Latin America



Investments in infrastructure and operations of water-related services can provide high returns for economic growth and for direct and indirect job creation



WWDR 2016



A young girl with long dark hair and hoop earrings is holding a 3D model of a DNA double helix. The model is green and orange, representing the nitrogenous bases and the phosphate and deoxyribose sugar components. She is looking directly at the camera with a slight smile.

# Water Education – Key for Water Security

Theme 6

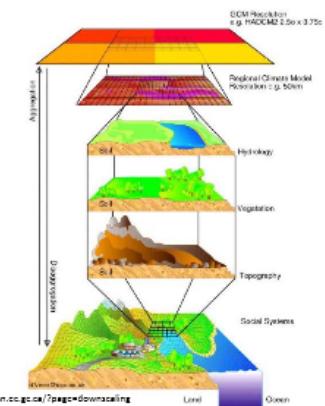


# Climate Risk Informed Decision Analysis (CRIDA)

- CRIDA moves away from the 'one size fits all' approach, since adaptation to climate stress is a local process that requires the design of tailored solutions. In this way, CRIDA helps the water resources planner to navigate through an uncertain world toward imperfect but robust and socially acceptable solutions in line with local needs.

## Traditional Approach

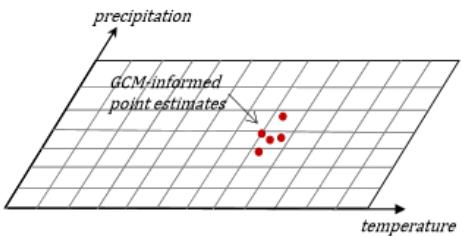
- Downscale a few climate model projections



- Generate a few water supply series

<http://www.ocean.gc.ca/2page-downscaling>

- Determine whether system performance is acceptable for these series.

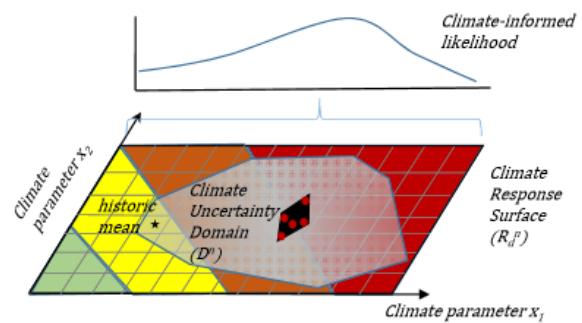


→ **Expected Net Benefits (ENB)**

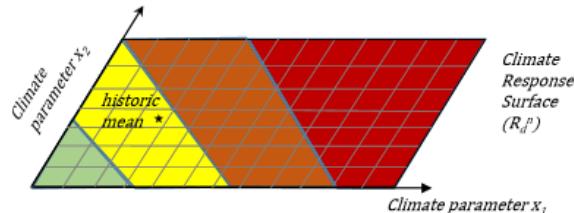
## Decision Scaling

$$\text{Risk to ENB} = \sum_{s=1}^{\Omega} \text{Impact} \times \text{Probability}$$

- Determine climate risks to project performance



- Map climate domain onto vulnerability domain



- Determine the vulnerability domain

## Climate Risk Informed Decision Analysis (CRIDA)

Collaborative Water Resources Planning for an Uncertain Future

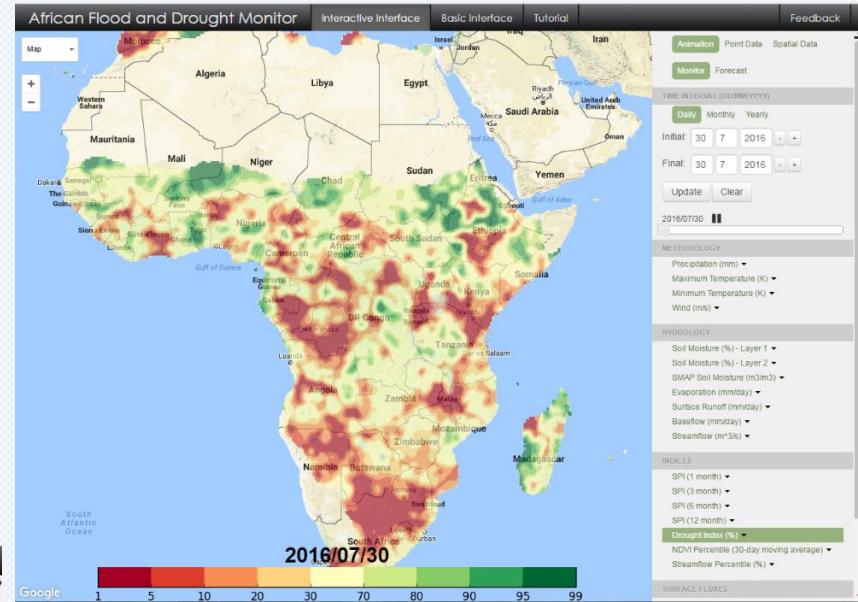


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# Improved climate services for risk management : African and LAC flood and drought Monitors

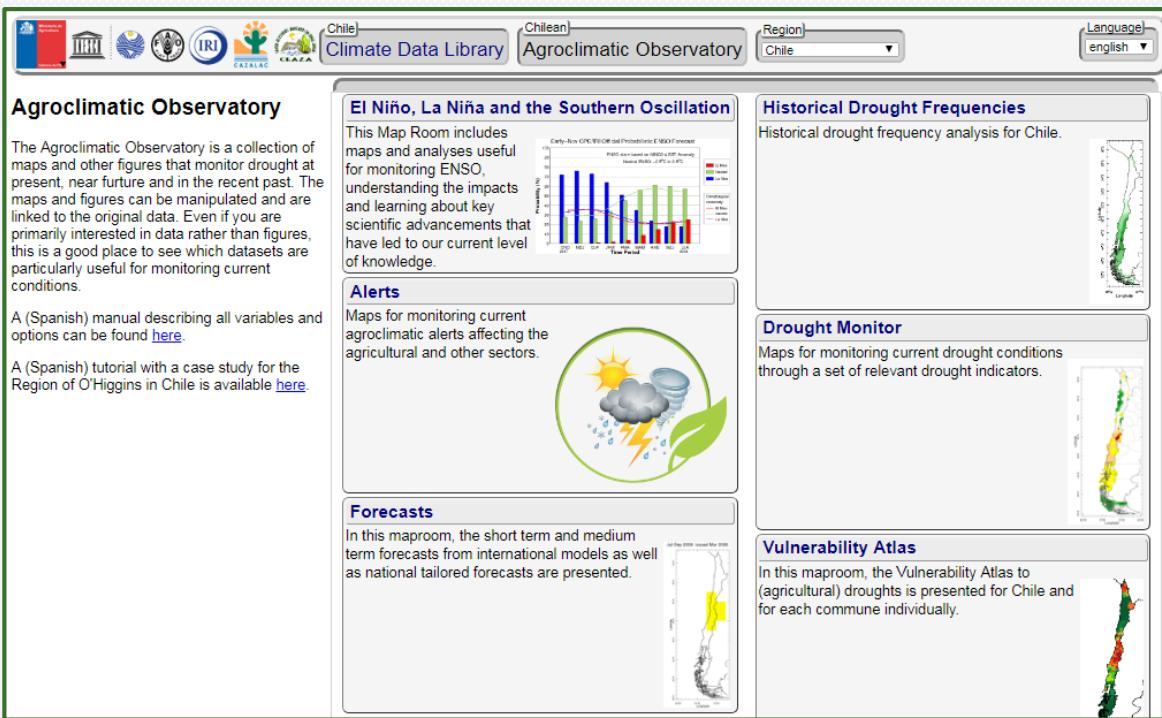
- Designed to strengthen the capacity of African and LAC countries for near real-time monitoring and seasonal forecasting to raise awareness of the impact of floods and droughts on vulnerable and disadvantaged groups.



*User Interface:*  
<http://stream.princeton.edu>

# National drought monitoring and flood and drought early warning strengthened

- Development of relevant, timely and actionable information
- High resolution local versions in pilot countries
- Support governments in LAC and Africa to integrate information in decision-making
- Publication of guidelines



The screenshot shows the Chilean Agroclimatic Observatory website. At the top, there are logos for UNESCO, FAO, IRI, and CLAIC. The header includes "Chile Climate Data Library", "Chilean Agroclimatic Observatory", "Region Chile", and "Language English".

**Agroclimatic Observatory**

The Agroclimatic Observatory is a collection of maps and other figures that monitor drought at present, near future and in the recent past. The maps and figures can be manipulated and are linked to the original data. Even if you are primarily interested in data rather than figures, this is a good place to see which datasets are particularly useful for monitoring current conditions.

A (Spanish) manual describing all variables and options can be found [here](#).

A (Spanish) tutorial with a case study for the Region of O'Higgins in Chile is available [here](#).

**El Niño, La Niña and the Southern Oscillation**

This Map Room includes maps and analyses useful for monitoring ENSO, understanding the impacts and learning about key scientific advancements that have led to our current level of knowledge.

**Alerts**

Maps for monitoring current agroclimatic alerts affecting the agricultural and other sectors.

**Forecasts**

In this maproom, the short term and medium term forecasts from international models as well as national tailored forecasts are presented.

**Historical Drought Frequencies**

Historical drought frequency analysis for Chile.

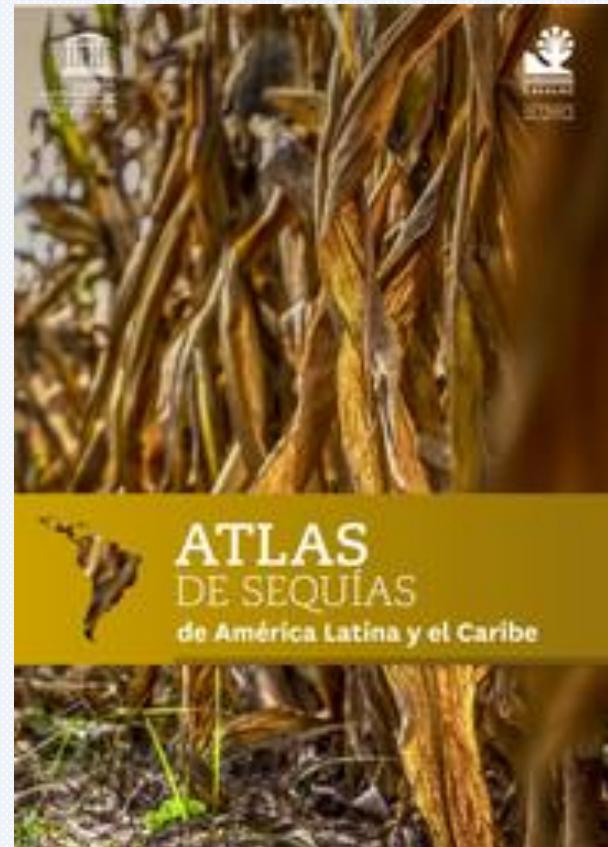
**Drought Monitor**

Maps for monitoring current drought conditions through a set of relevant drought indicators.

**Vulnerability Atlas**

In this maproom, the Vulnerability Atlas to (agricultural) droughts is presented for Chile and for each commune individually.

Chilean Agroclimatic Observatory



Drought Vulnerability Atlas

# Engagement with local communities through participatory approach and citizen-science



iRain launched at UNFCCC COP22



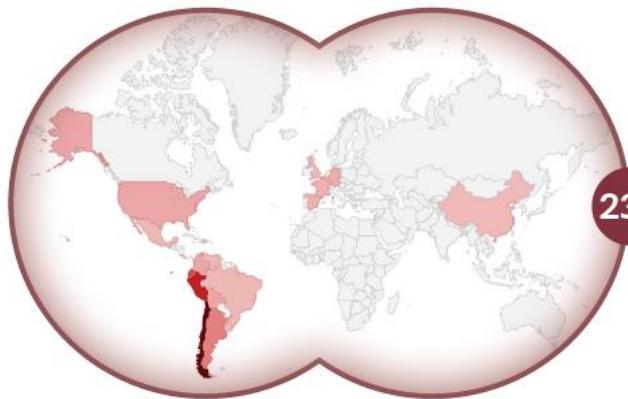
# The Impact of Glacier Retreat in the Andes: results

## Outcomes:

- Tools developed to support mountain communities to assess climate risk/vulnerability
- Stakeholders trained in the use of climate information for decision making
- The Andean glacier and Water Atlas: the impact of glacier retreat on water resources

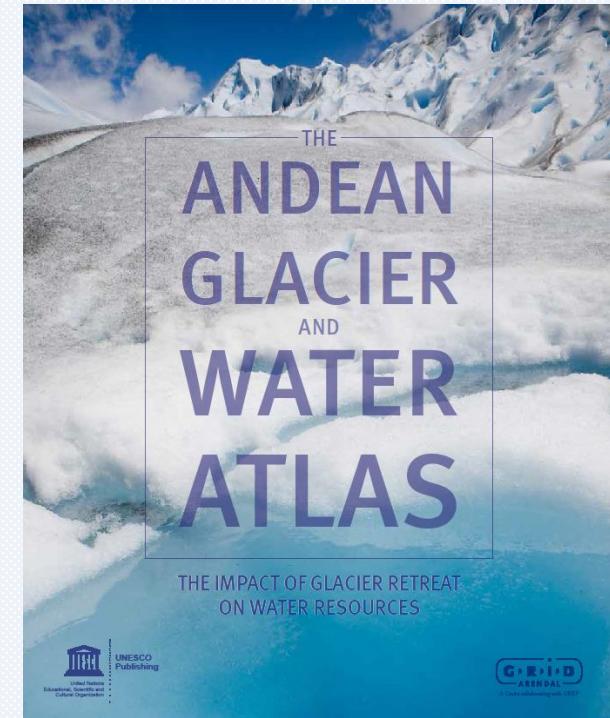
### *Countries involved in Capacity Building*

Participants from **19** countries received training



**235** participants were involved

Argentina / Belgium / Bolivia /  
Brazil / Chile / China / Colombia /  
Costa Rica / Dominican Republic /  
Ecuador / France / Germany /  
Mexico / Peru / Spain / United  
Kingdom / Uruguay / United States /  
Venezuela



# Fifth Workshop on Water Resources in Developing Countries: Hydroclimate Modeling and Analysis Tools

27 May - 07 June 2019  
Trieste, Italy



## Topics:

- How can precipitation measurements be used to validate model simulations.
- How to use ensembles of high-resolution regional climate model as input of a hydrological model.
- Which is the role of the coupled water cycle in the Regional Earth System models.
- How can the uncertainty in global and regional climate projections be taken into account for hydro-climate simulation.

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**Deadline:**  
**15 March 2019**

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 **International Centre  
for Theoretical Physics**  
[www.ictp.it](http://www.ictp.it)  
Trieste, Italy



# The UNESCO Water Family



# The Water Family by Regions

## Europe &

North

America

- 25 Chairs

- 11 Centres

36 Centres

## Arab States

- 4 Chairs

- 5 Centres

55 Chairs

WWAP

169 IHP  
NatComs

## Latin America &

the Caribbean

- 10 Chairs

- 5 Centres

## Asia and the Pacific

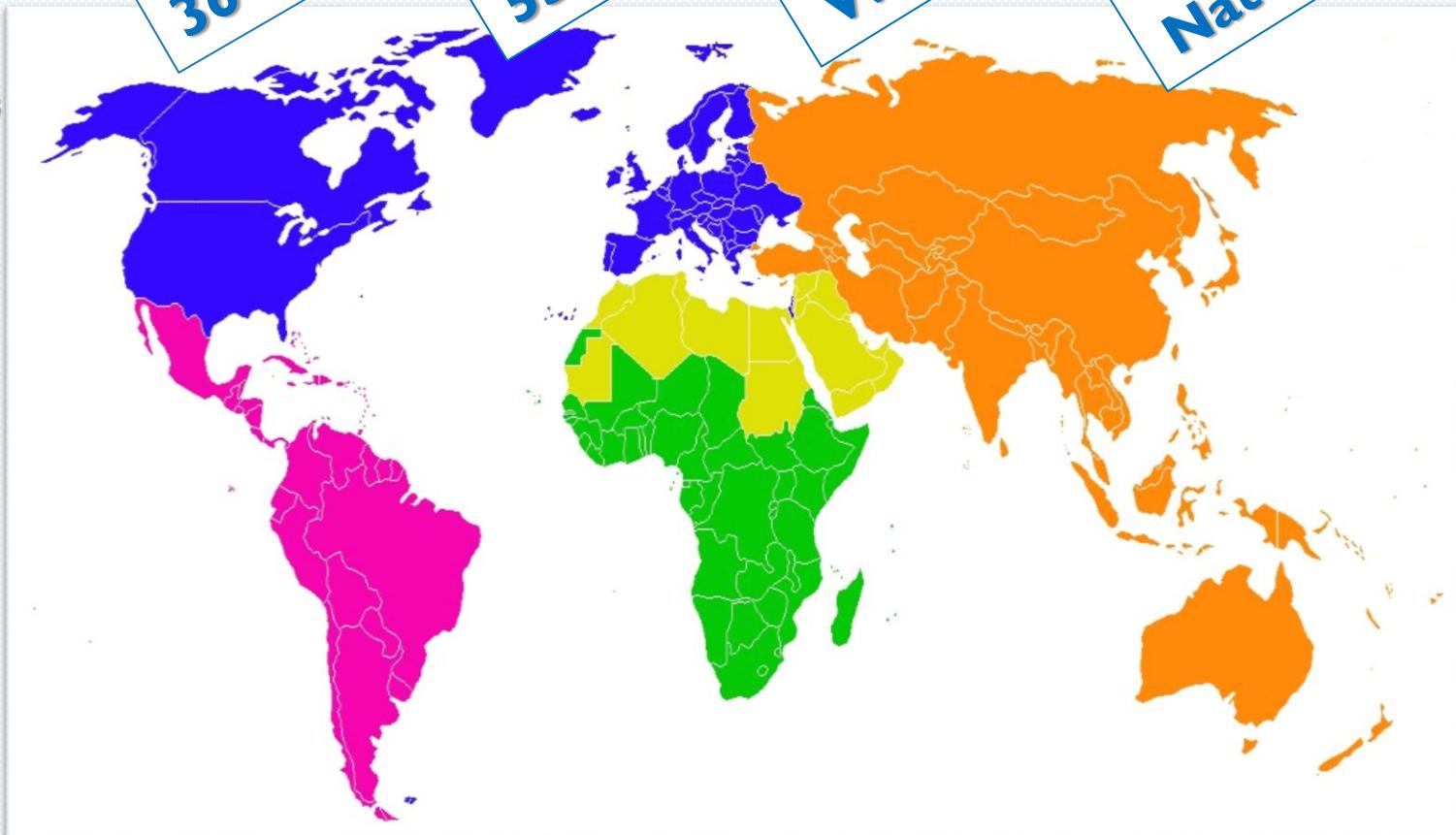
- 10 Chairs

- 11 Centres

## Africa

- 6 Chairs

- 4 Centres



Thanks

**Thank you for your kind attention**

