Presentation from

2016 World Water Week in Stockholm

www.worldwaterweek.org

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United Nations
Educational, Scientific and
Cultural Organization

International
Hydrological
Programme

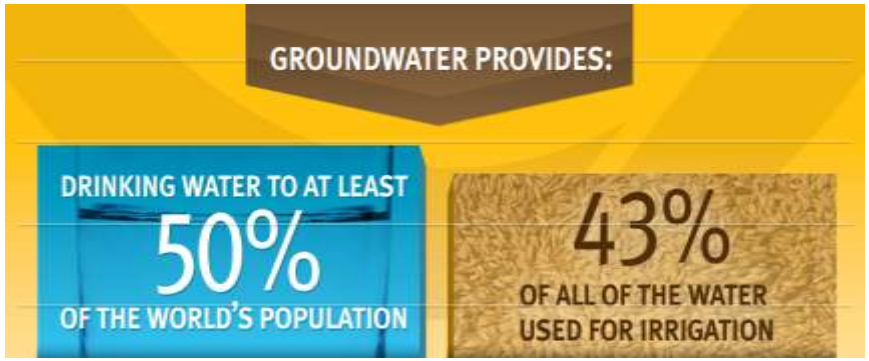
STATUS OF KNOWLEDGE ON TRANSBOUNDARY AQUIFERS:

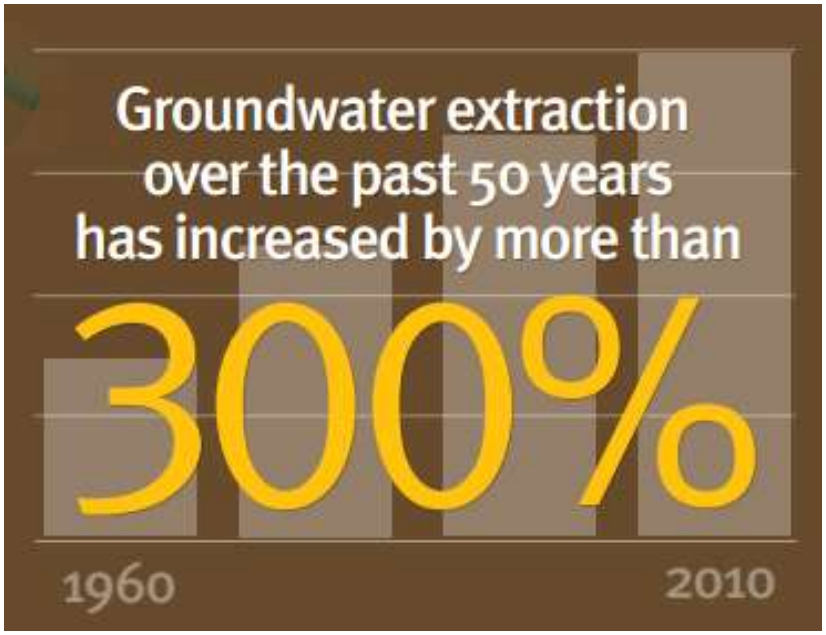
RESULTS OF GLOBAL ASSESSMENTS AND SATELLITE OBSERVATIONS

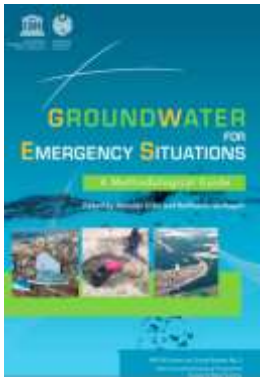
2016 World Water Week
Stockholm, 31 August 2016

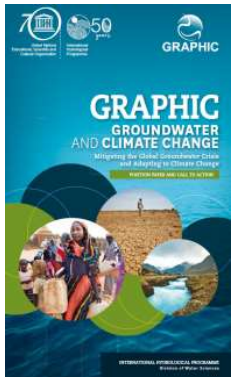
Tales Carvalho Resende
UNESCO International Hydrological Programme (IHP)

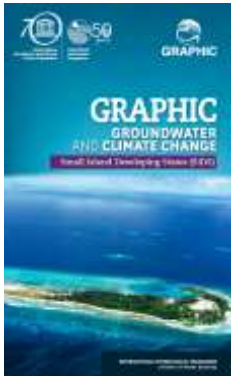
Groundwater & Climate Change





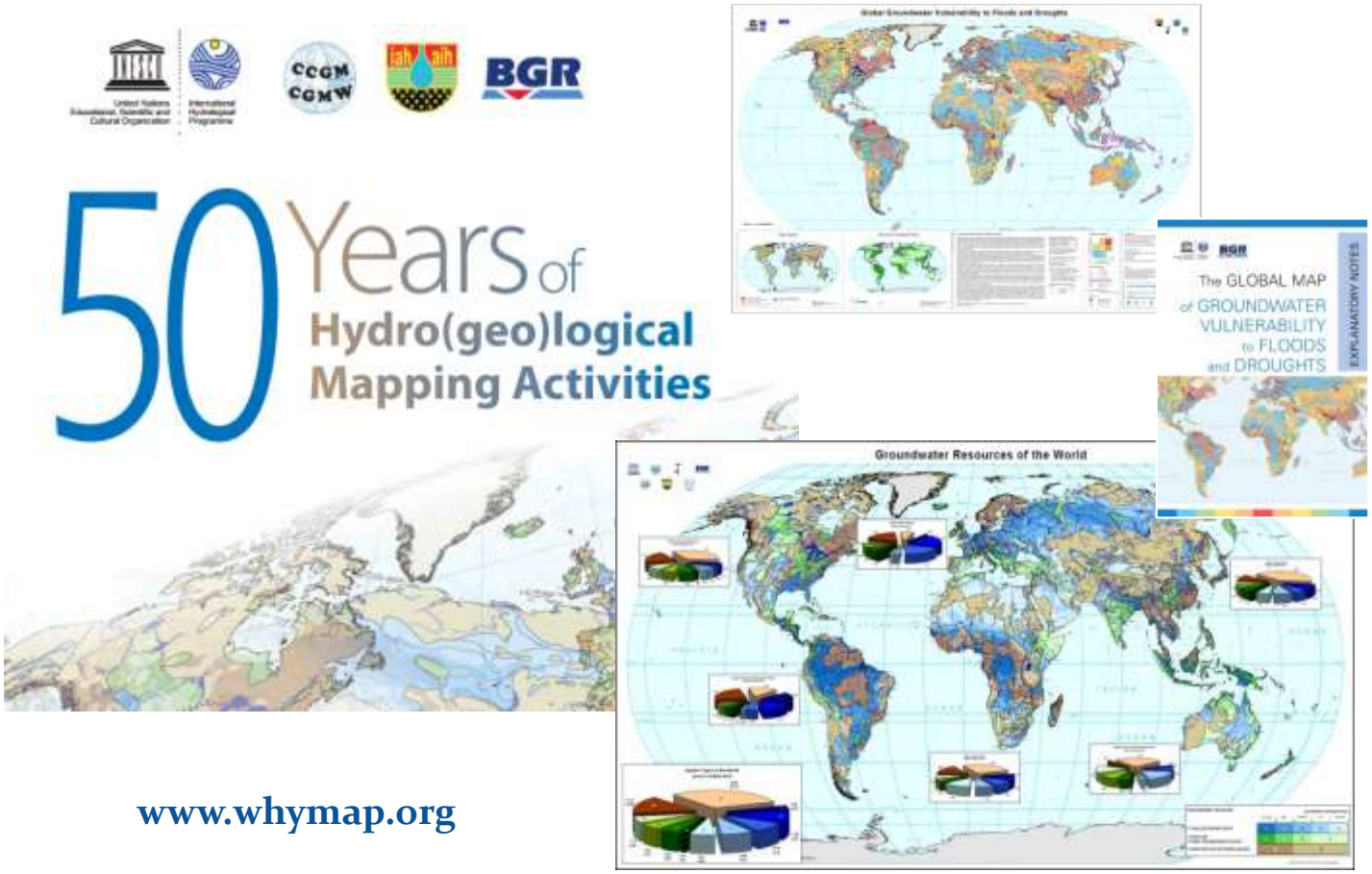






UNESCO-IHP Groundwater & Climate Change programme (GRAPHIC): www.graphicnetwork.net

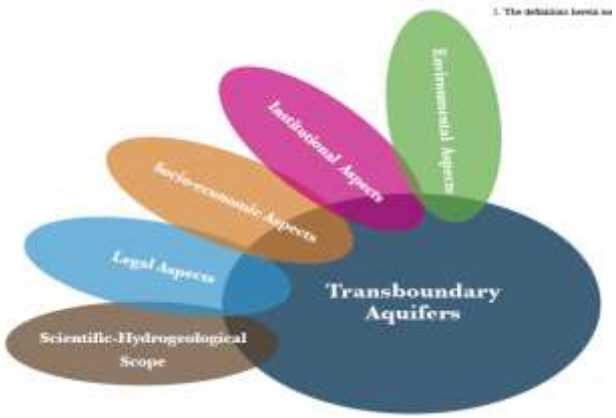
Groundwater at UNESCO - IHP



www.whymap.org

UNESCO-IHP and Transboundary Aquifers

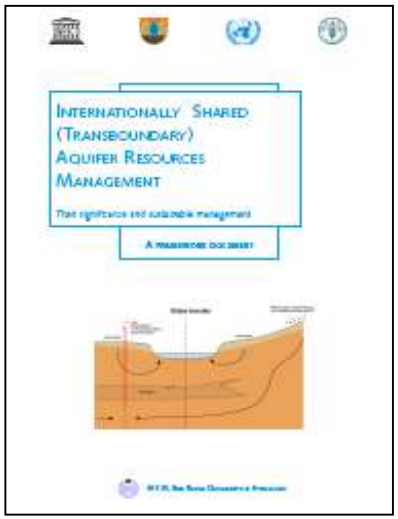
UNESCO-IHP launched the International Shared Aquifer Resources Management (ISARM) programme in the year 2000 aiming at undertaking the **inventory of transboundary aquifers** and **develop recommendations for improving their management and governance considering scientific, socio-economic, legal, institutional and environmental components**



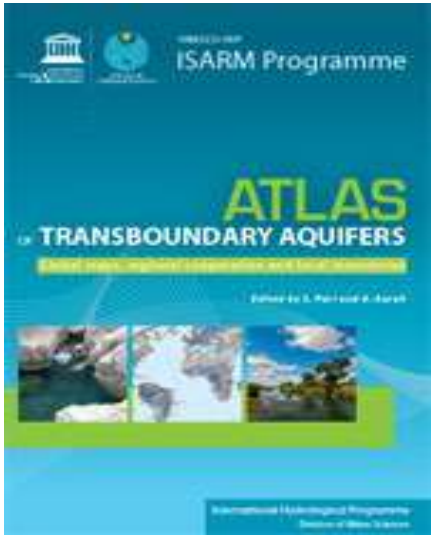
International Shared Aquifer Resources Management (ISARM) Programme

***2000: Starting of the first Worldwide Inventory of Transboundary Aquifers* (UNESCO-IHP Resolution XIV-12 - 2000)**

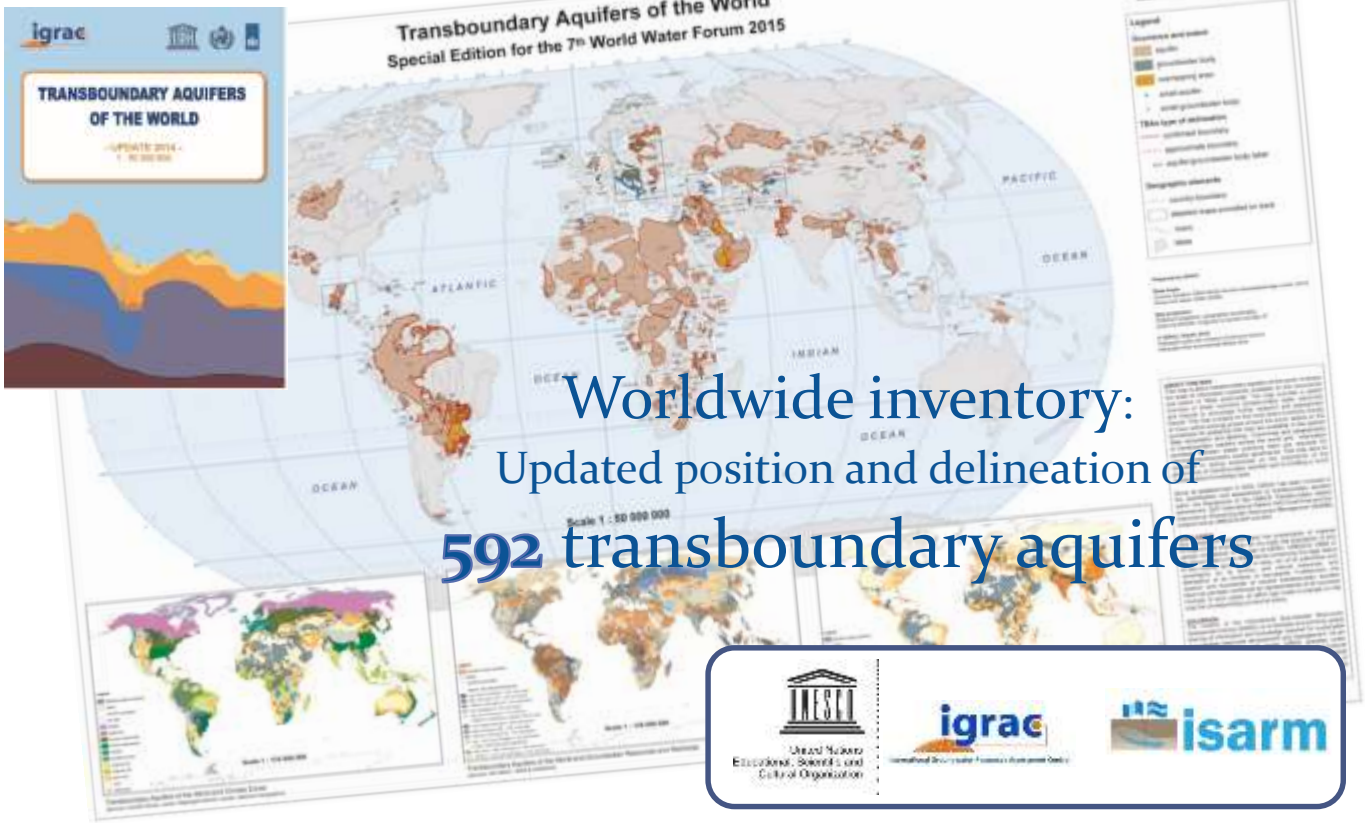
2000: Framework document



2008: First TBAs Map



Transboundary Aquifers of the World



Worldwide inventory:

Updated position and delineation of

592 transboundary aquifers

UNESCO igrac isarm

Transboundary Waters Assessment Programme (TWAP)

- Two year project funded by the Global Environment Facility (GEF) (2013-2015), aimed at **raising global attention the vulnerability of transboundary water systems, and catalyze action.**
- **5 components:**
  - ***Transboundary Aquifers and SIDS Groundwater Systems,***
  - *Transboundary River Basins,*
  - *Transboundary Lake Basins,*
  - *Large Marine Ecosystems,*
  - *Open Ocean.*
- **First-ever baseline assessment of groundwater resources with information of 199 transboundary aquifers and 42 SIDS**
  - *Accessible online at the UNESCO Groundwater Portal www.groundwaterportal.org*

Groundwater TWAP TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

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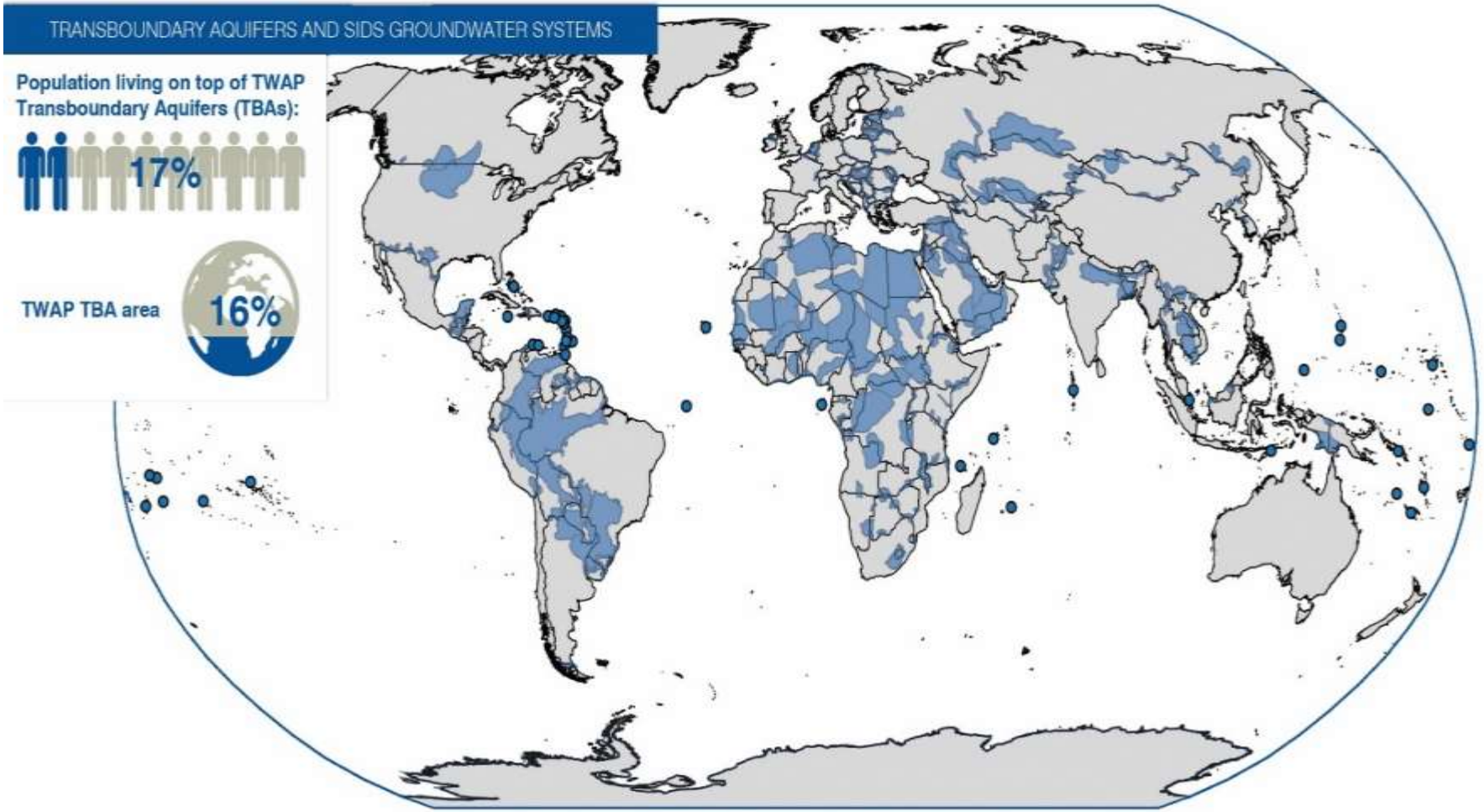
Programme Hydrologique International



Groundwater TWAP TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

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Objectives

- Provide a description of the present conditions of main transboundary aquifers (TBAs with areal extent > 5,000 km2)
- Bring to the global attention the major issues, concerns and hotspots associated with these transboundary aquifer systems, and to catalyse action
- The results of the TWAP Groundwater assessment provide elements to help interested parties to find answers to the following questions, among others:
    - *What human and ecosystem uses of the water resources are currently affected or impaired (use conflicts, depletion, degradation, etc.)?*
    - *Where will all these problems be occurring?*
    - *How will water conditions and uses evolve over the coming decades?*
    - *Which international groundwater systems are likely to prevent, buffer or mitigate water-related problems under increasing stresses during the coming decades?*

An indicator-based assessment

Thematic cluster	Core Indicators
QUANTITY	Groundwater Recharge Groundwater Depletion
QUALITY	Groundwater natural background quality Groundwater pollution
SOCIO-ECONOMIC	**Population density** **Renewable groundwater per capita** **Human dependence on groundwater** **Groundwater development stress**
GROUNDWATER GOVERNANCE	Transboundary legal framework Transboundary institutional framework

Projections for 2030 and 2050 and determination of hotspots

Groundwater TWAP TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

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Data sources

- **Global inventory:**
  - Established on the basis of a questionnaire sent to a network of >200 regional and national experts.
  - Data collected: a map of the boundaries of the transboundary aquifer, an indicative cross-section, and values for the core and additional current indicators.
  - Regional workshops with national experts were held to discuss these data.

- **Modelling (WaterGAP):**
  - Current and future state (2030 and 2050) for Transboundary Aquifers > 20,000 km2
  - University of Frankfurt was commissioned by UNESCO-IHP to apply the WaterGAP model (Döll et al., 2014).

TWAP TBAs IN NUMBERS

199 Aquifers in the global inventory (TBAs > 5,000 km²)

91 Aquifers (TBAs>20,000 km²) for WaterGAP study

126 Countries

> 200 Experts from 76 countries consulted

Groundwater TWAP
TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

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Key messages

1. Transboundary aquifers represent **a largely untapped resource**
2. Areas of elevated groundwater development stress (=abstraction/recharge) are presently limited, but will **more than double by 2050**
3. There is an alarming **lack of modern data and of governance frameworks**

Key messages

1. Transboundary aquifers represent **a largely untapped water resource**

The majority of transboundary aquifers with surface expression greater than 5000 km²:

- Are located outside regions highly affected by groundwater development stress
- Show very low depletion rates of less than 2 mm/yr in most regions of the world
- Show generally low to very low human dependency on transboundary groundwater

2. Areas of elevated groundwater development stress are presently limited, but will **more than double by 2050**

Currently , **20 country segments** show "medium" to "very high" groundwater development stress.

By 2050, this number may increase to **58.**

Groundwater stress indicators

Translating indicators into risk categories

"VERY HIGH RISK"

- Groundwater development stress > 20%
- Dependence on groundwater > 40%

"HIGH RISK"

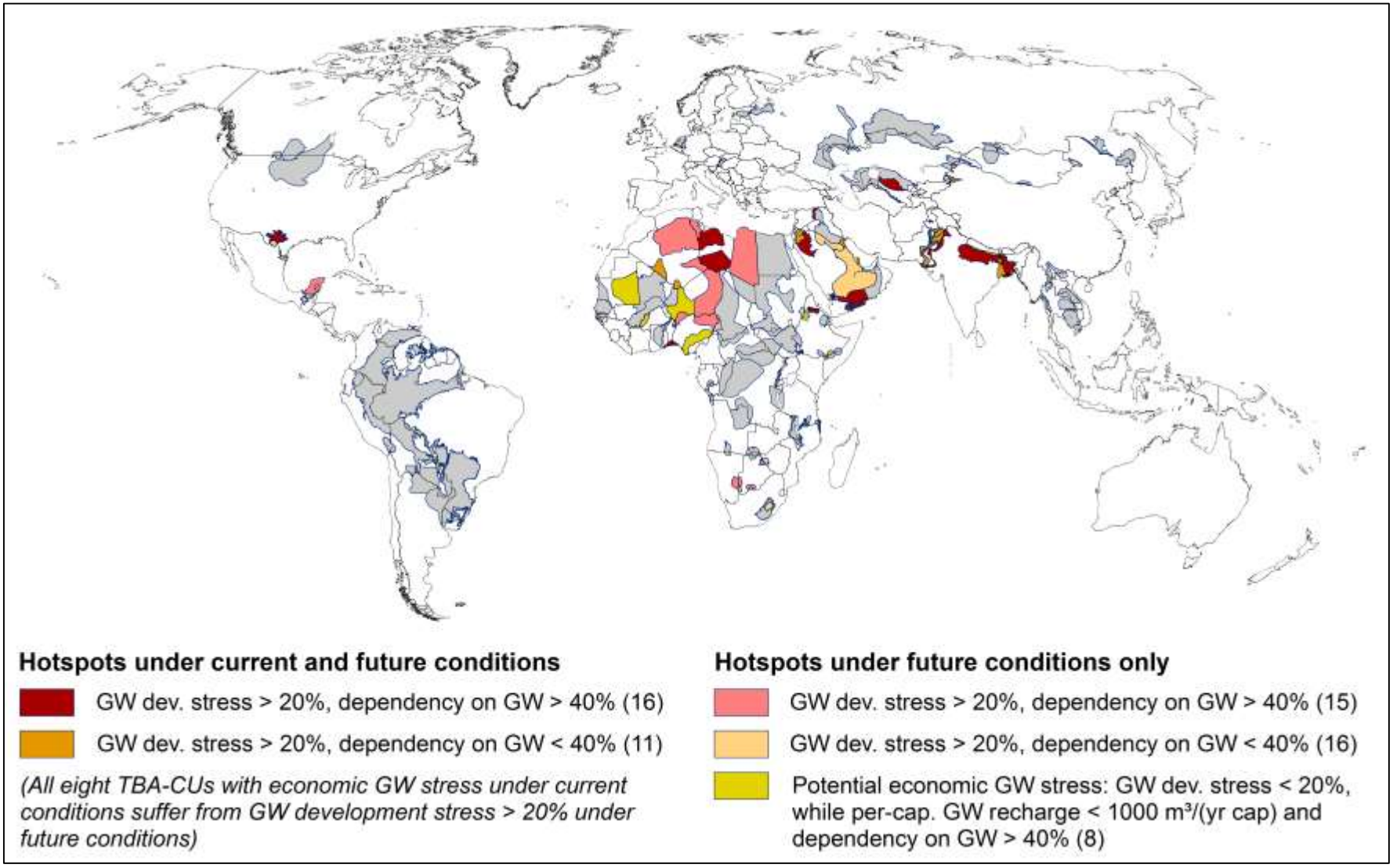
- Groundwater development stress > 20%
- Dependence on groundwater < 40%

"GROUNDWATER CROWDING"

- Per capita resources < 1,000 m^3/yr/cap
- Dependence on groundwater > 40%
- Groundwater development stress < 20%

Groundwater stress hotspots

Today, 2030 and 2050



Groundwater stress hotspots

Conclusions

Two-thirds of the identified hotspots are located on the African continent and the Arabian Peninsula.

The others are distributed over Asia (Pakistan, India, Nepal, China, DPR Korea), and America (USA, Mexico, Chile).

Key messages

3. There is an alarming **lack of modern data and of governance frameworks**

- The vast majority of TBAs have no transboundary governance framework
- Only eight TBAs have transboundary legal agreements
- The lack of adequate groundwater governance at the global, regional and local levels hinders the achievement of water security.

- GEF Groundwater Governance Project

Groundwater TWAP TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

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Key messages

3. There is an alarming **lack of modern data and of governance frameworks**

- Questionnaires: valuable but not sufficient to provide a globally complete picture
- Modelling: Essential to the baseline assessment, but with limitations

Key messages

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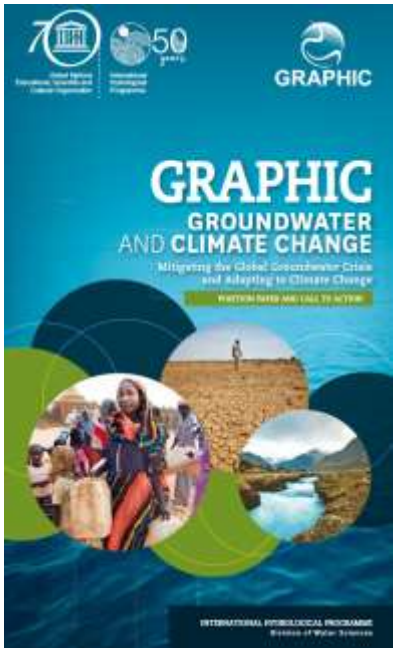
- Questionnaires: valuable but not sufficient to provide a globally complete picture
- Modelling: Essential to the baseline assessment, but with limitations

Conclusion: Lack of modern standardized data on key groundwater parameters, lack of knowledge of subsurface, lack of quantitative and time-series data

Time series/monitoring data is crucial to understand the impacts of climate change and climate variability on groundwater resources



UNESCO-IHP Groundwater & Climate Change programme (GRAPHIC)

Objective:

Assess the impact of climate variability in recharge despite the lack of data to support sound management strategies

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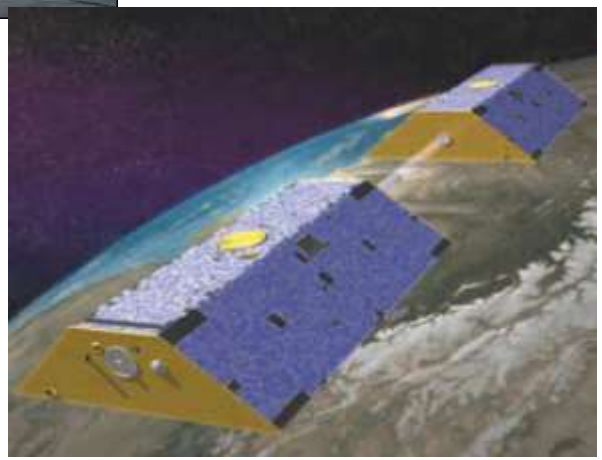
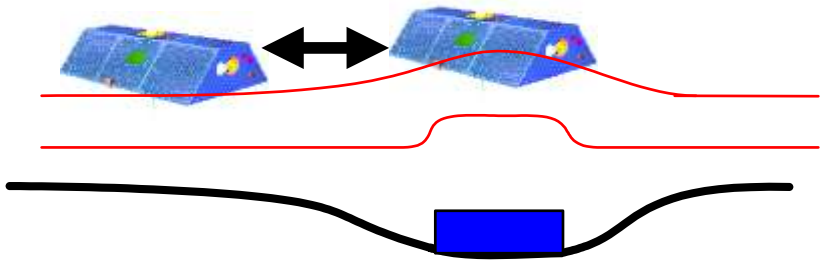
Methods:

- **Gravity Recovery and Climate Experiment (GRACE):**
  - *First satellite mission able to monitor total water-storage changes (including groundwater) remotely*
- **Global datasets for precipitation, runoff and evapotranspiration**
- **Simplified water balance models**
- **Limited water level / borehole data**





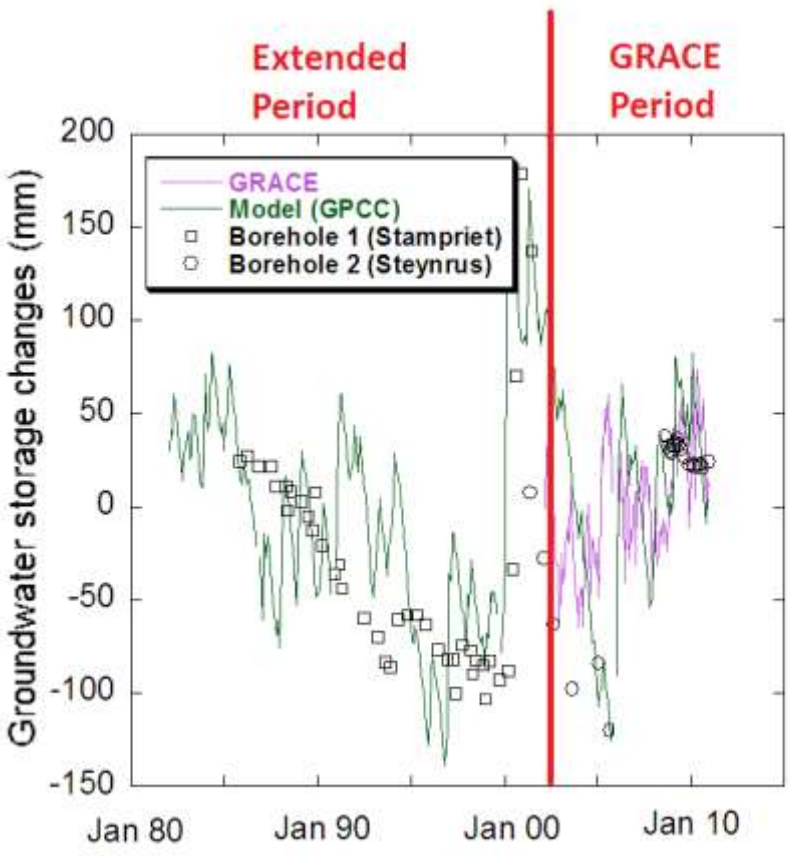
Challenge:

- GRACE's limited time scale (10 years)
- A better understanding on how natural climate variability (ENSO, etc…) affects precipitation and groundwater storage needs time scales > 10 years

Solution:

"Extend" GRACE time frame to the past with adequate models to "reconstruct" groundwater level fluctuations

Longuevergne et al., 2016 (to be published)



UNESCO-IHP Groundwater & Climate Change programme (GRAPHIC)

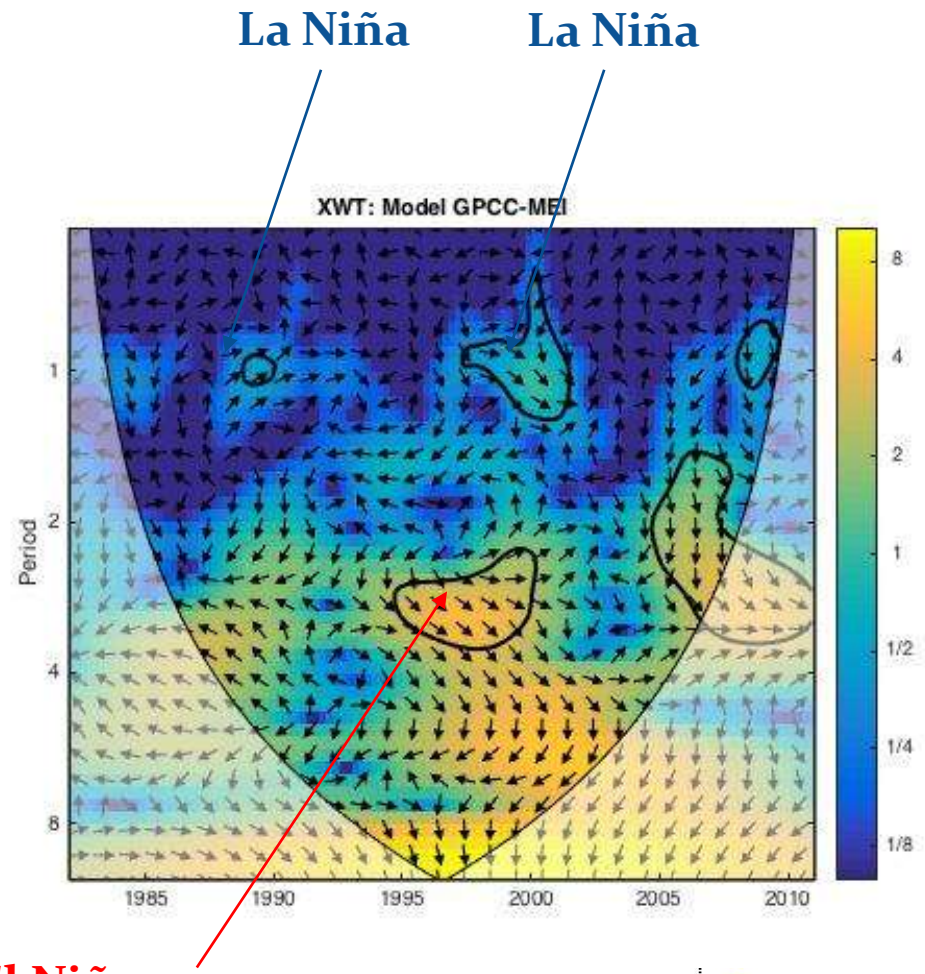
Main findings:

- Shallow aquifers are highly responsive to rainfall
- Strong correlation between ENSO and groundwater levels
- El Niño years: falling water table
- La Niña years: rising water table

Key messages:

- Need to strengthen links with metereological agencies
- Work will provide further guidelines for agriculture and livestock planning (especially during drought periods)
- The concept of "groundwater depletion" should be interpreted carefully

Stampriet Transboundary Aquifer in Southern Africa
Longuevergne et al., 2016 (to be published)



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Thank you!

t.carvalho-resende@unesco.org

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