Groundwater

TWAP

TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

Groundwater component

Transboundary aquifers &
Groundwater systems in Small Island Developing States

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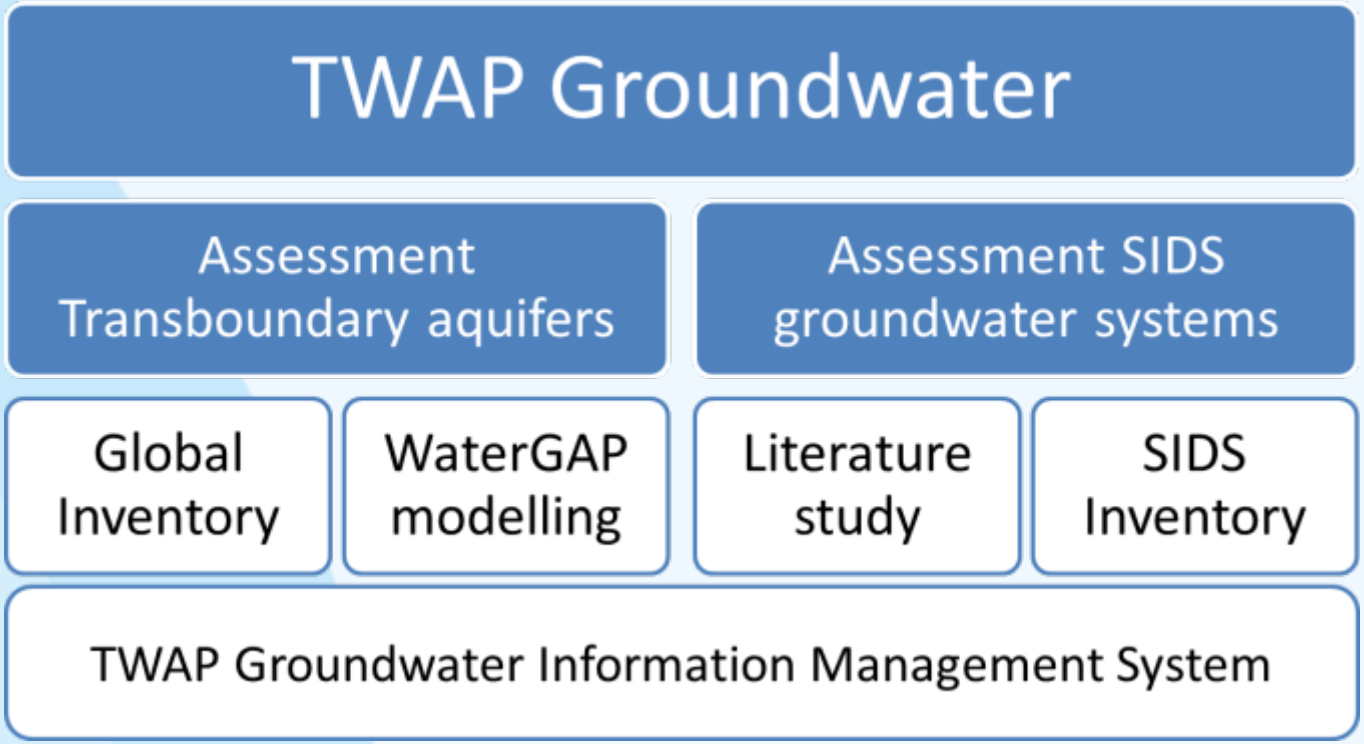
Washington DC - 12 July 2016





Approach



Core group:

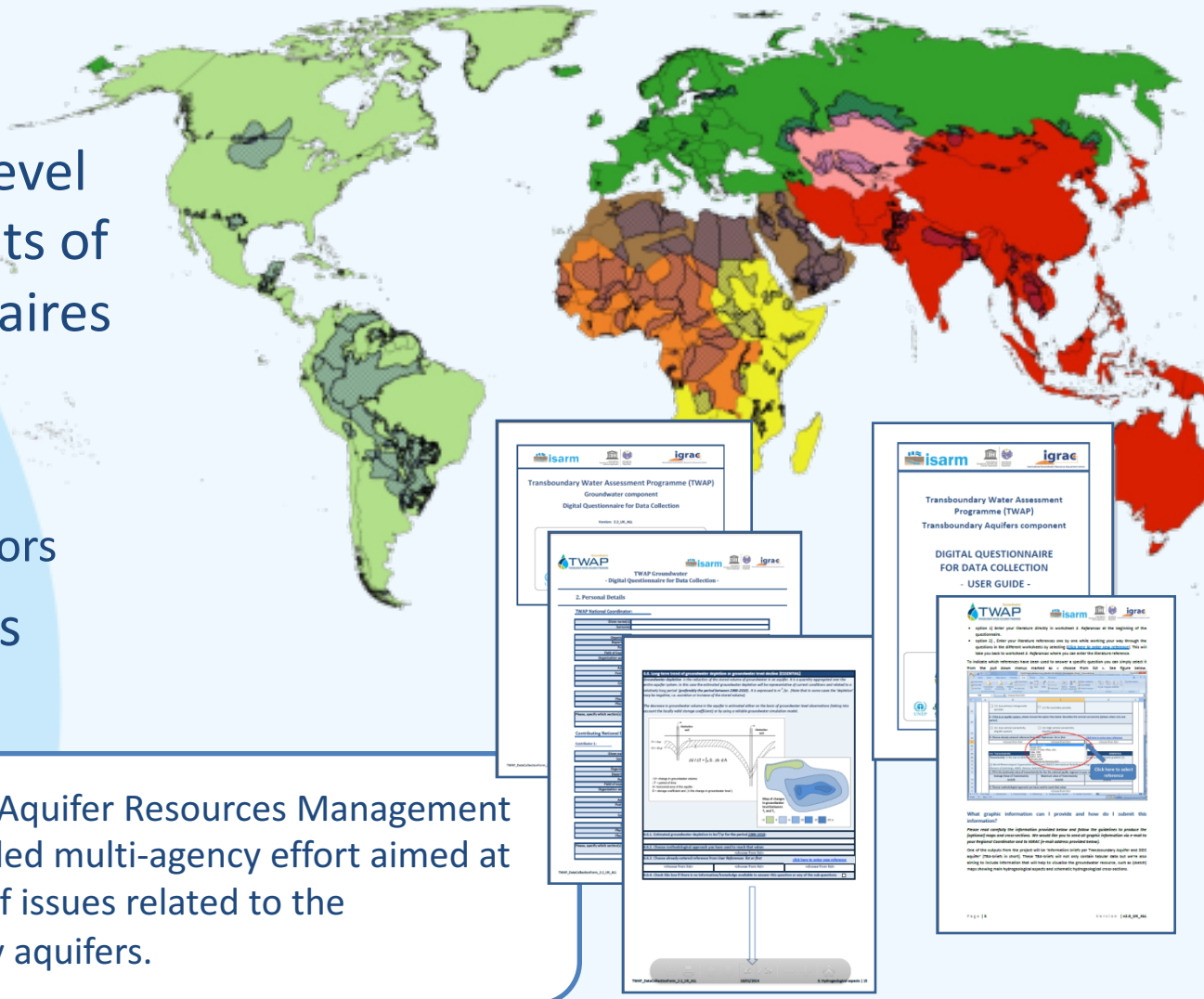
- UNESCO - International Hydrological Program (IHP)
- UNESCO - International Groundwater Resources Assessment Centre (IGRAC, Netherlands)

Expertise provided by:

- Goethe University Frankfurt (Germany)
- Simon Frasier University (Canada)
- National specialists , regional coordinators and regional organisations

Global Inventory: The ISARM* approach

- Data collection at level of national segments of TBAs via questionnaires
- Network of:
  - National experts
  - Regional coordinators
- Regional workshops



*ISARM: Internationally Shared Aquifer Resources Management Initiative is a UNESCO and IAH led multi-agency effort aimed at improving the understanding of issues related to the management of transboundary aquifers.

10 Core indicators for groundwater

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 (=abstraction / recharge)
GROUNDWATER GOVERNANCE	• Transboundary legal framework • Transboundary institutional framework

Also:
Projections for 2030 and 2050 and determination of hotspots

TWAP TBAs in numbers

Global Inventory :

199 Aquifers

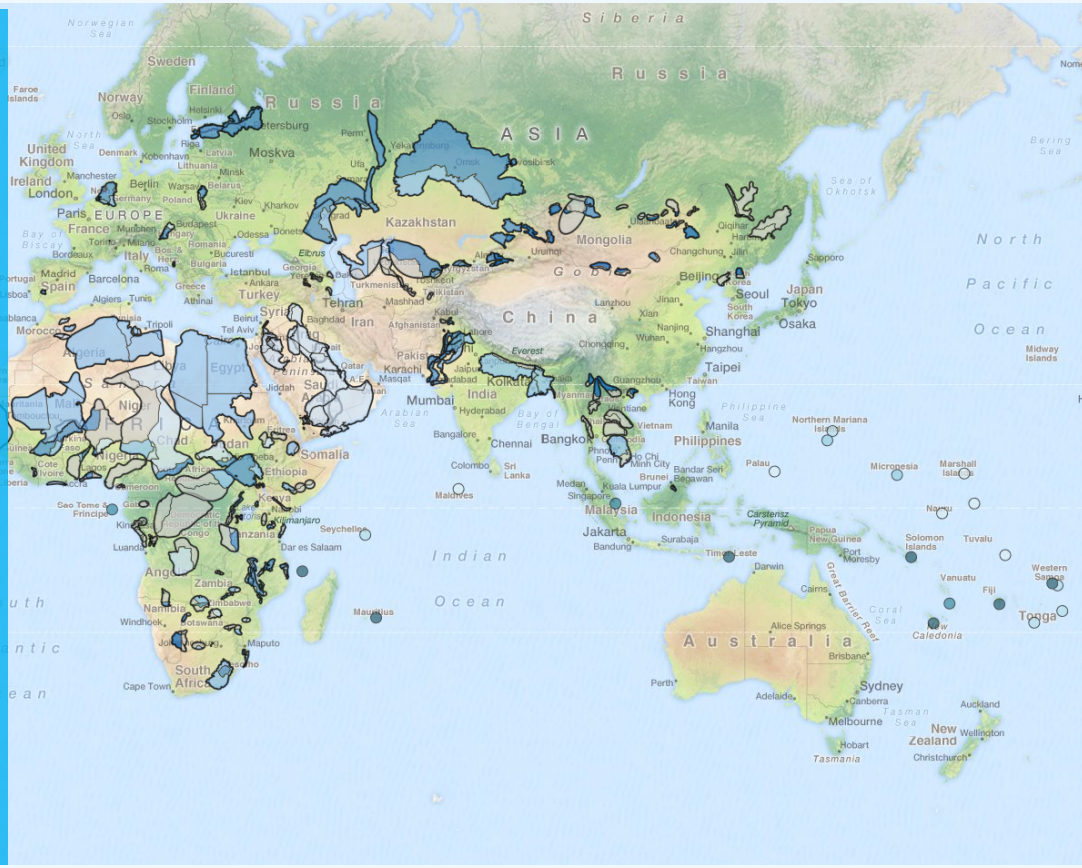
502 Country segments

126 Countries

> 200 Experts from 76 countries contributed

WaterGAP model study:

91 Aquifers (TBAs>20,000 km²)

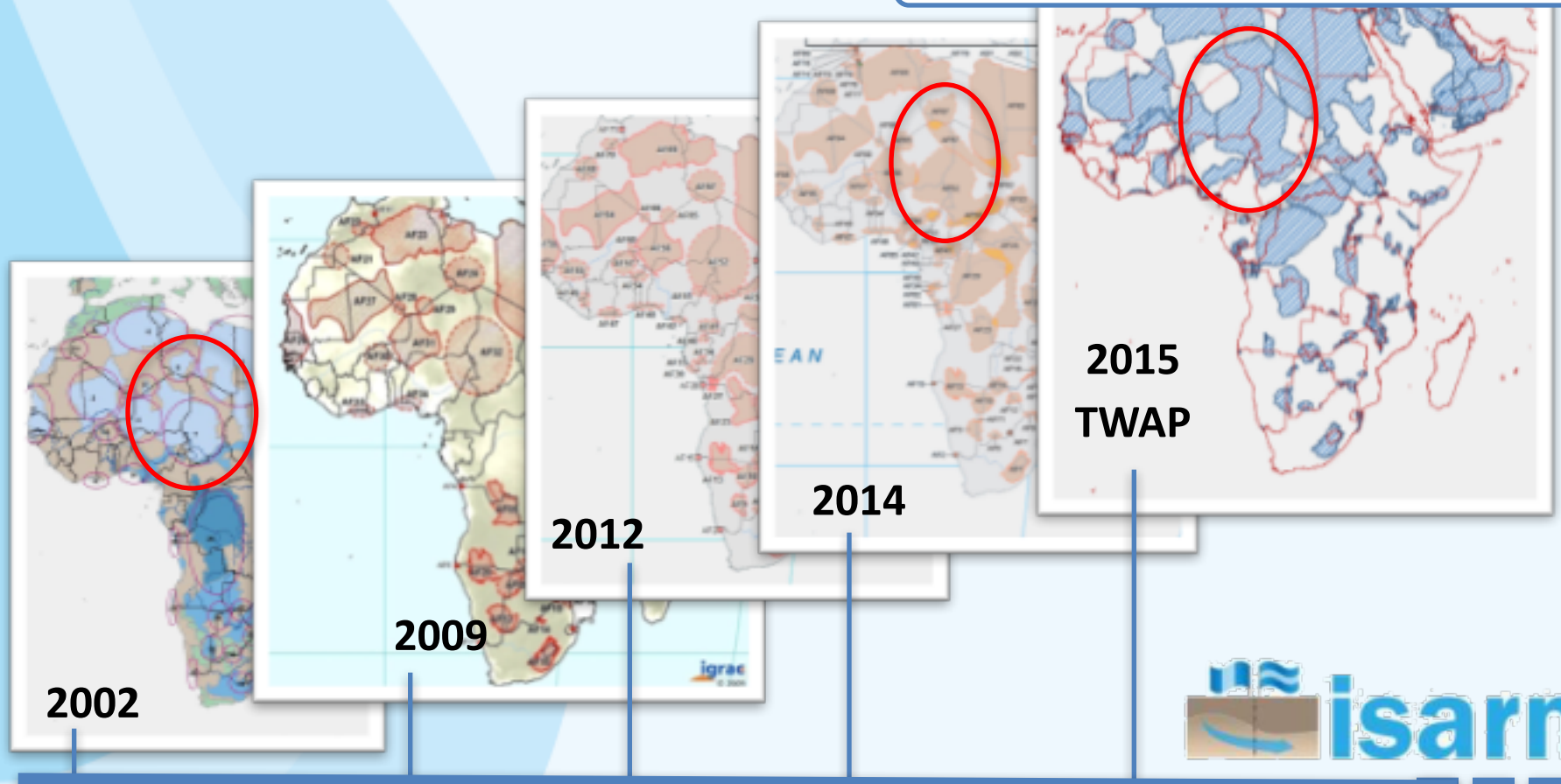


Results

Improved delineations of aquifer boundaries

History of a on-going process

TWAP workshops worldwide:
199 TBAs selected with
74 delineations improved



Transboundary aquifers
Key messages

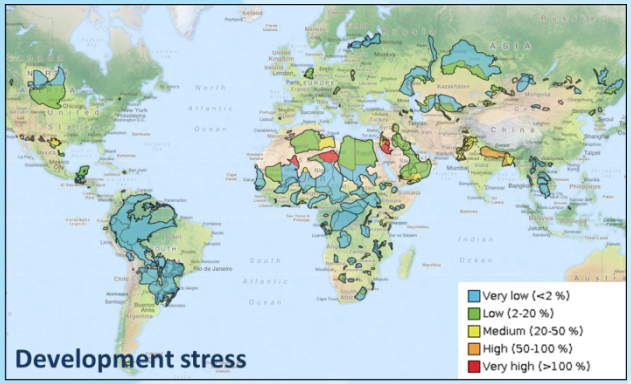
1. Transboundary aquifers represent **a largely untapped resource**
2. Areas of elevated groundwater development stress are presently limited, but are expected to **more than double by 2050**
3. There is an alarming **lack of modern data**
4. There is **near absence of governance frameworks for TBAs**

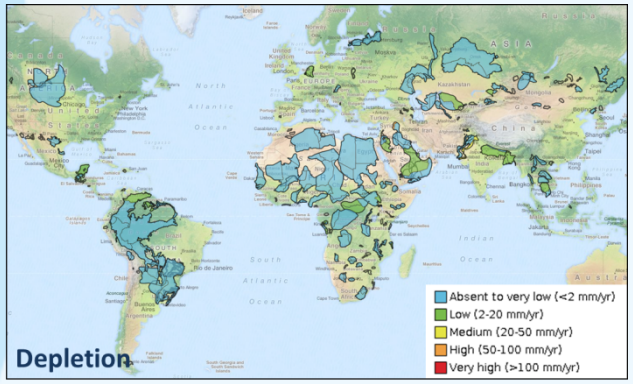
Key messages TBAs

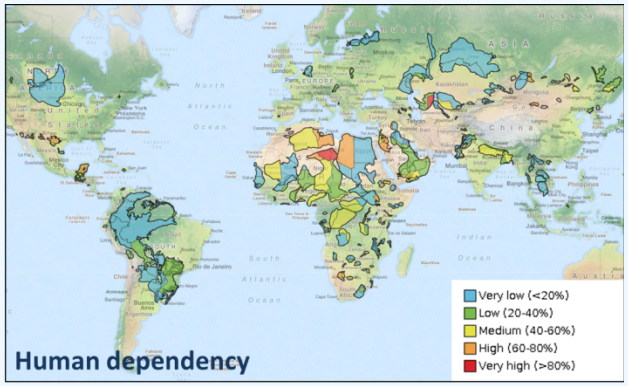
1. Transboundary aquifers represent a largely untapped resource

The majority of TWAP transboundary aquifers:

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

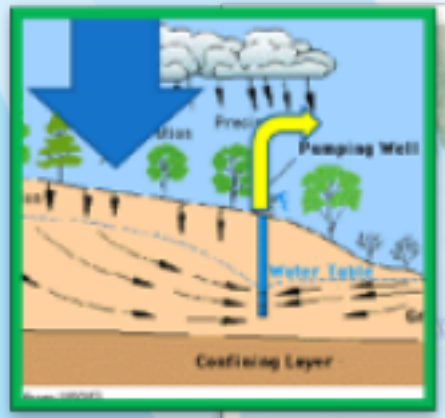


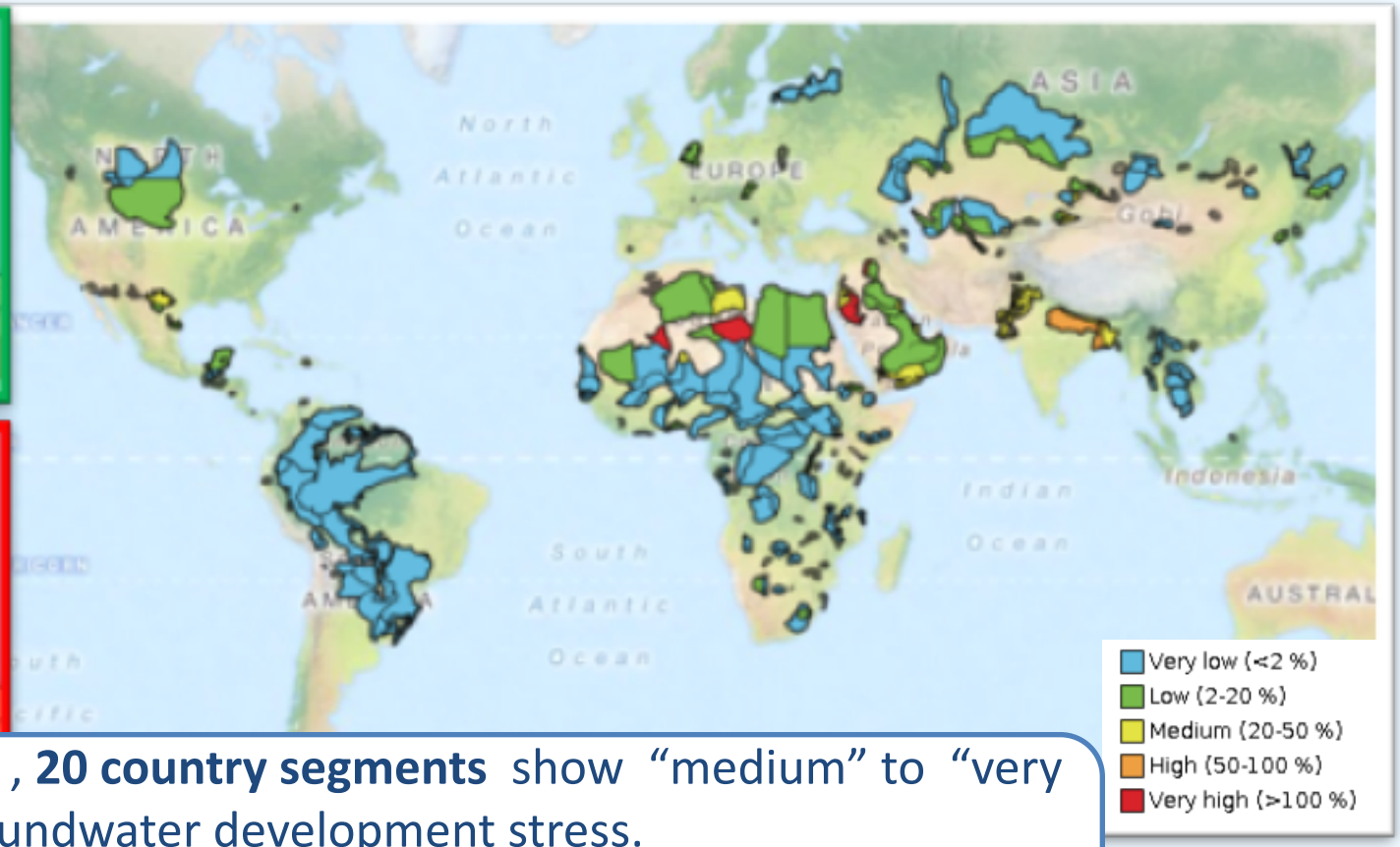




Key messages TBAs

2. Aquifers with elevated development stress presently limited but expected to more than double by 2050





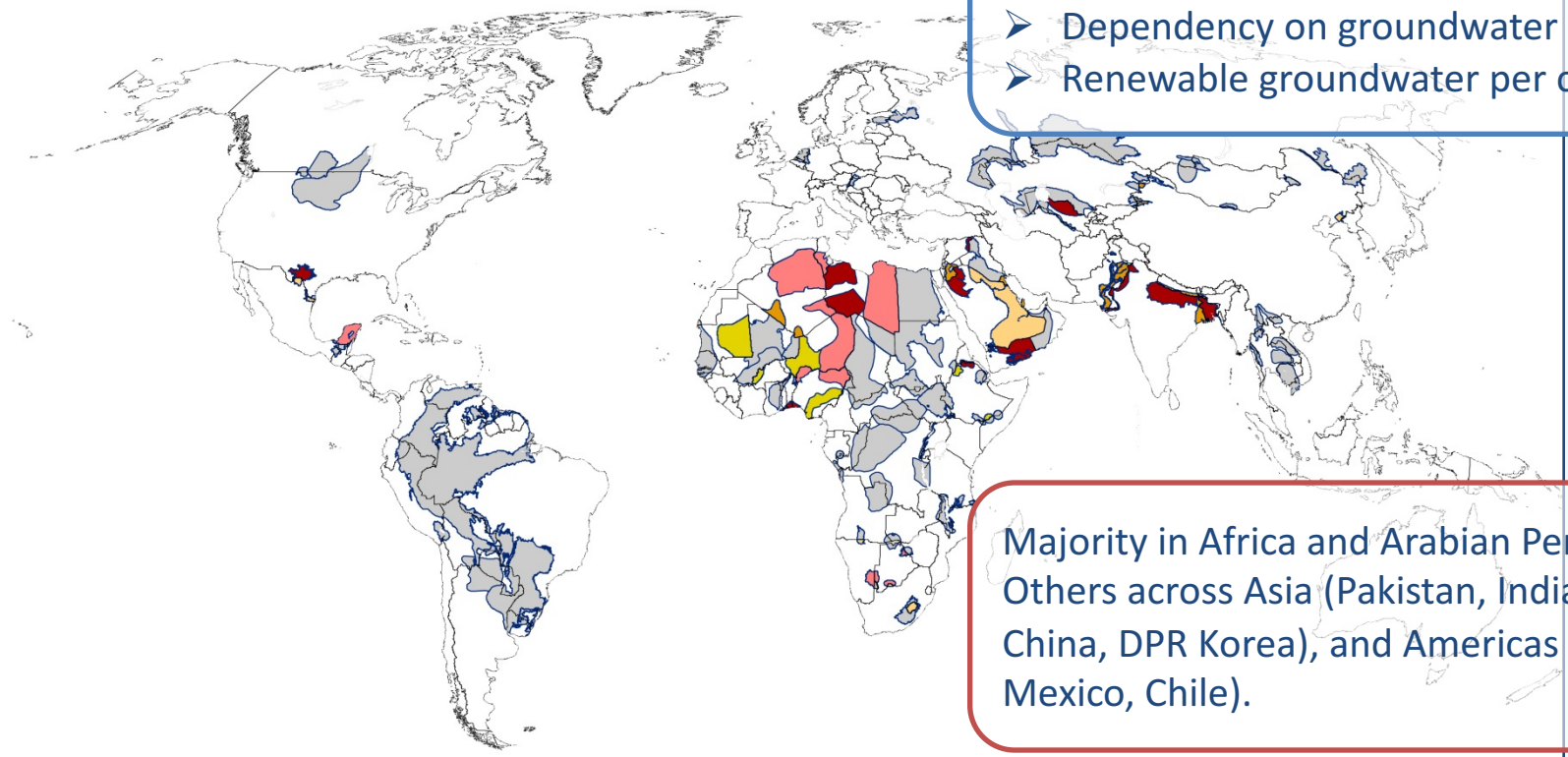
- Currently , **20 country segments** show "medium" to "very high" groundwater development stress.
- By **2050**, this number may increase to **58 country segments.**

Hotspots

Today and 2030, 2050

Combining indicators to define hotspots:

- Groundwater development stress
- Dependency on groundwater
- Renewable groundwater per capita



Majority in Africa and Arabian Peninsula. Others across Asia (Pakistan, India, Nepal, China, DPR Korea), and Americas (USA, Mexico, Chile).

Hotspots under current and future conditions

- Very high risk (16 country segments)
- High risk (11 country segments)

Hotspots under future conditions only

- Very high risk (15 country segments)
- High risk (16 country segments)
- Groundwater crowding (8 country segments)

Key messages TBAs

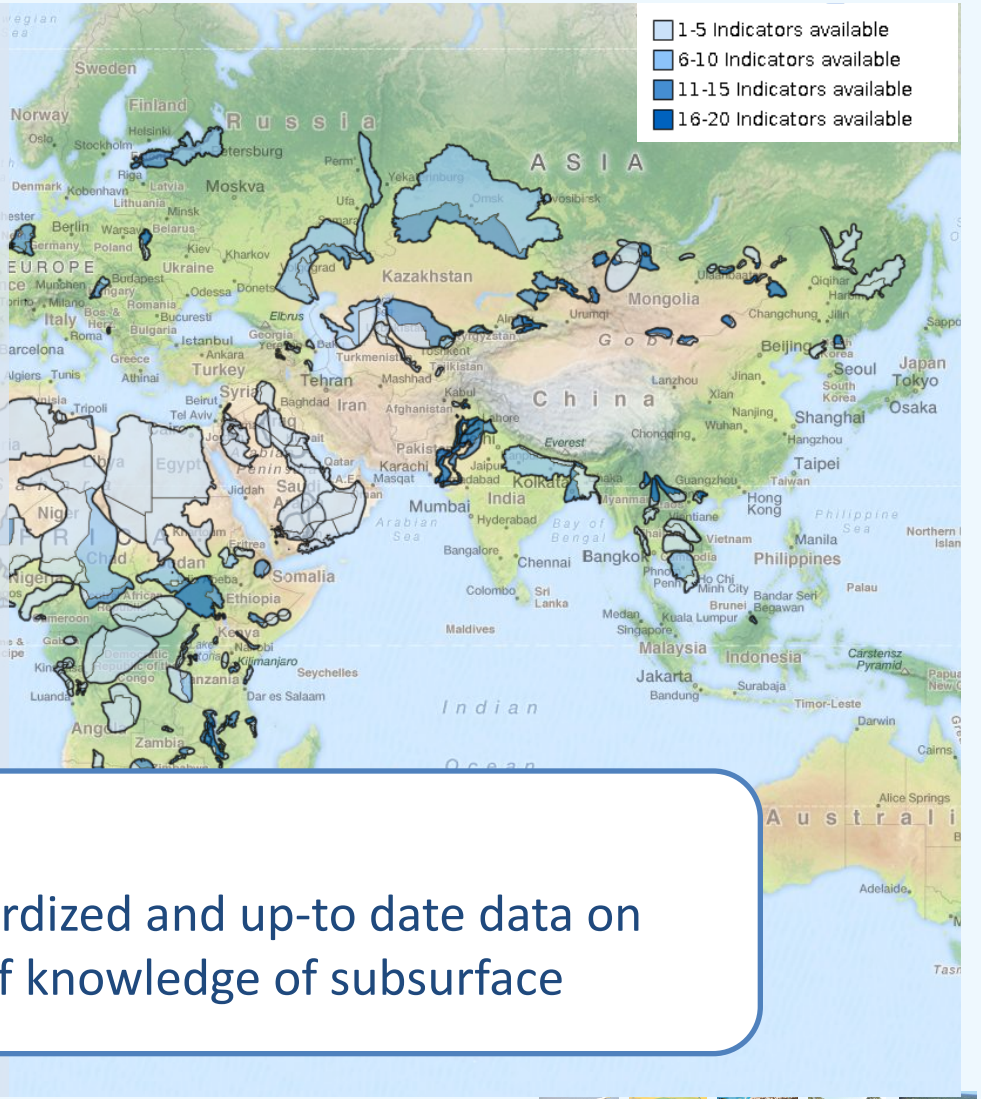
3. Alarming lack of modern data

Global Inventory:

- Questionnaires are valuable but data yield not sufficient to provide a globally complete picture
- 3-dimensional aspects of aquifers remains challenging

Modelling:

- Essential to the baseline assessment, but with limitations



Conclusion:
Lack of quantitative, modern standardized and up-to date data on key groundwater parameters, lack of knowledge of subsurface

Key messages TBAs

4. Near absence of governance frameworks frameworks

- The vast majority of TBAs have no transboundary governance framework:

  Only eight (8!) TBAs have transboundary legal agreements

Formal agreements:
- Guarani aquifer (21S),
- Genevese aquifer (EU24),
- Illumeden Aquifer System (AF56),
- Nubian Sandstone Aquifer System (AF63),
- North-western Sahara Aquifer system (AF69),
- Al-Disi Aquifer (part of AS126 Saq-Ram)

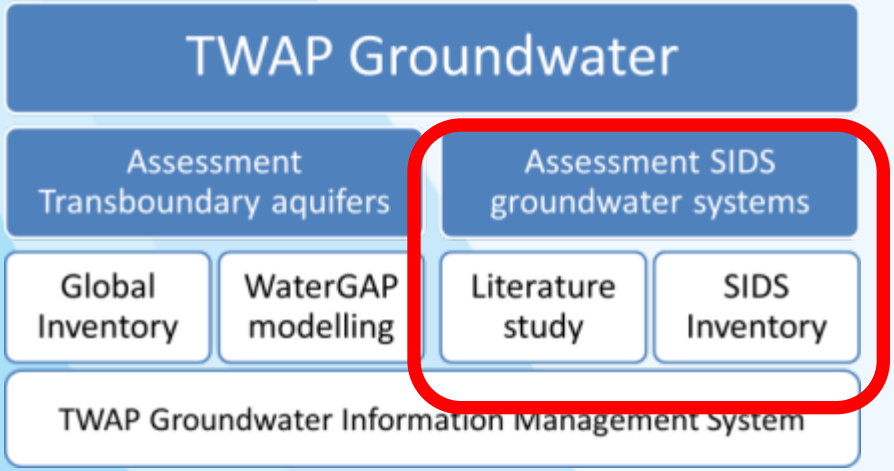
Informal agreements:
- Hueco-Bolson Aquifer (15N)
- Abbotsford-sumas aquifer (1N)

- The lack of adequate groundwater governance at the global, regional and local levels hinders the achievement of water security.
  - *GEF Groundwater Governance Project*

But also:

- *As groundwater development of TBAs is still quite low there still is a chance to do it right!*

Groundwater Systems of Small Islands Developing States



Thematic cluster	Core Indicators
QUANTITY	• Groundwater Recharge • Groundwater Depletion
QUALITY	• Groundwater natural background quality • Groundwater pollution • **Sea water intrusion**
SOCIO-ECONOMIC	• Population density • Renewable groundwater per capita • Human dependence on groundwater • Groundwater development stress (=abstraction / recharge)
GROUNDWATER GOVERNANCE	• ~~Transboundary~~ Legal framework • ~~Transboundary~~ Institutional framework

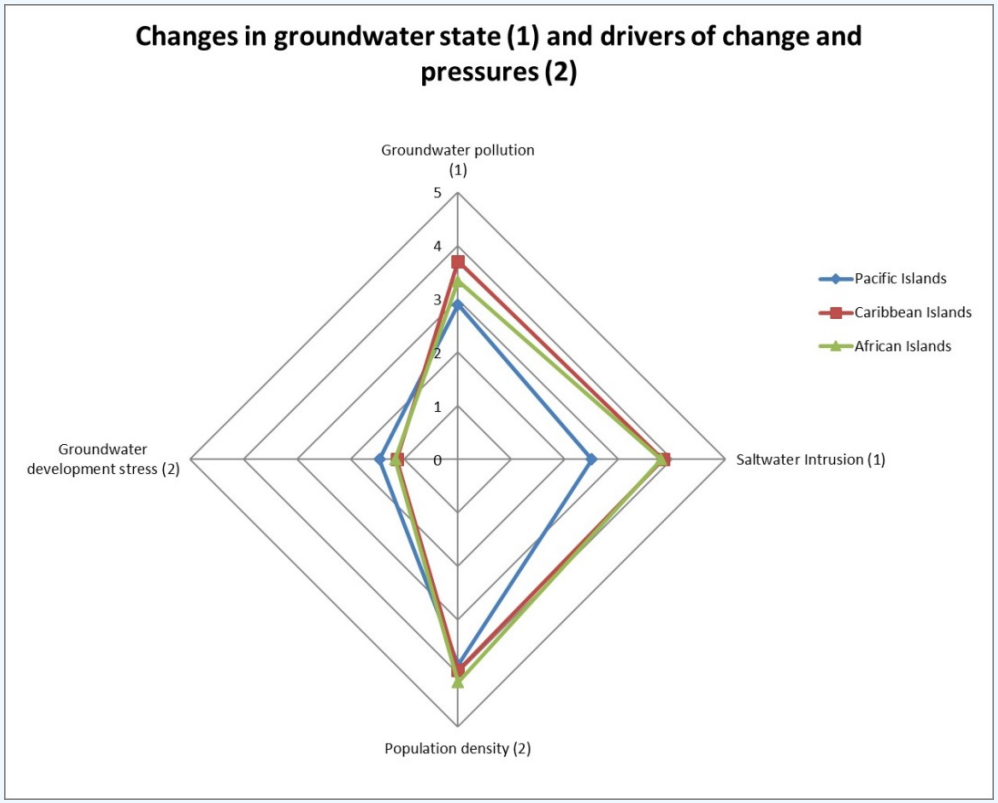
42 SIDS assessed

- For each, a representative island was selected
- A geological map and conceptual hydrogeological profile was developed
- Assessment of risk factors for mountainous vs. low-lying SIDS
- Additional indicator to address seawater intrusion

SIDS Groundwater systems
Key messages

Many Island States are facing serious issues in ensuring:

1. Safe water supply
2. Groundwater sustainability (Water scarcity, pollution and high human dependency)



On many islands, degradation of groundwater quality and growing demands are posing short-medium term threats to human health and impairing ecosystem services of great economic value.

SIDS Groundwater systems
Key messages

High dependence on groundwater

- 10% of Caribbean and Atlantic/Indian Ocean SIDS experience high human groundwater dependence
- 72% of Pacific SIDS experience high human groundwater dependence

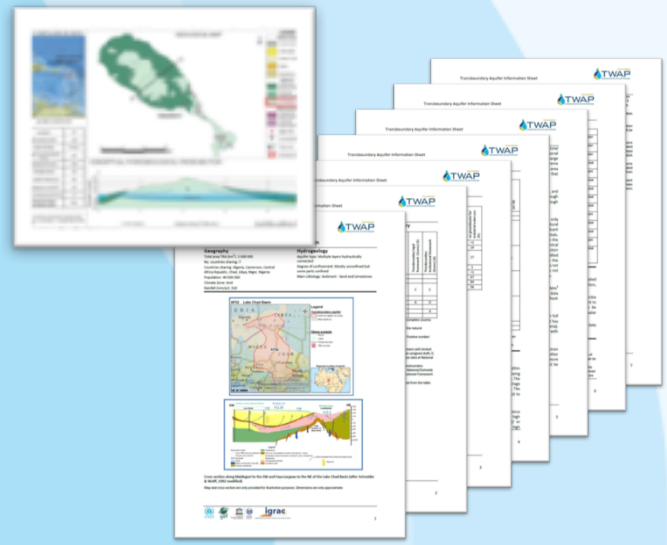
Extremely vulnerable groundwater resources

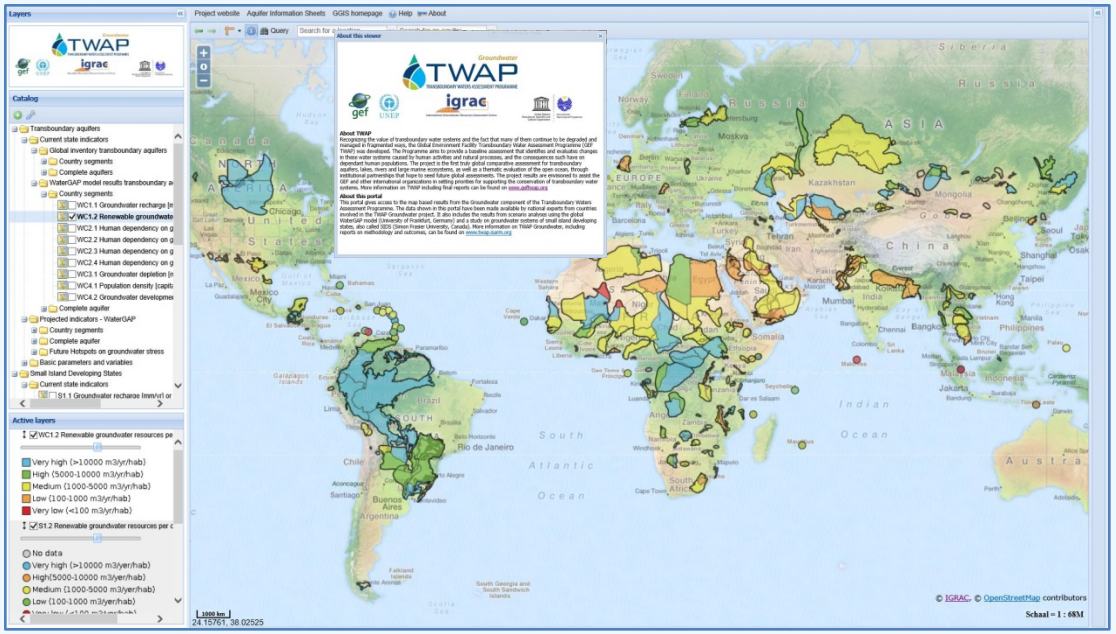
- 71% of all SIDS are at risk of water scarcity / 91% of low-lying islands are at risk of water scarcity
- 73% of SIDS are at risk of groundwater pollution, often worsened by seawater intrusion

Population density is the main driver of water stress in the SIDS assessed

TWAP Groundwater Knowledge products

- Structured database
- Information Management System - web-based



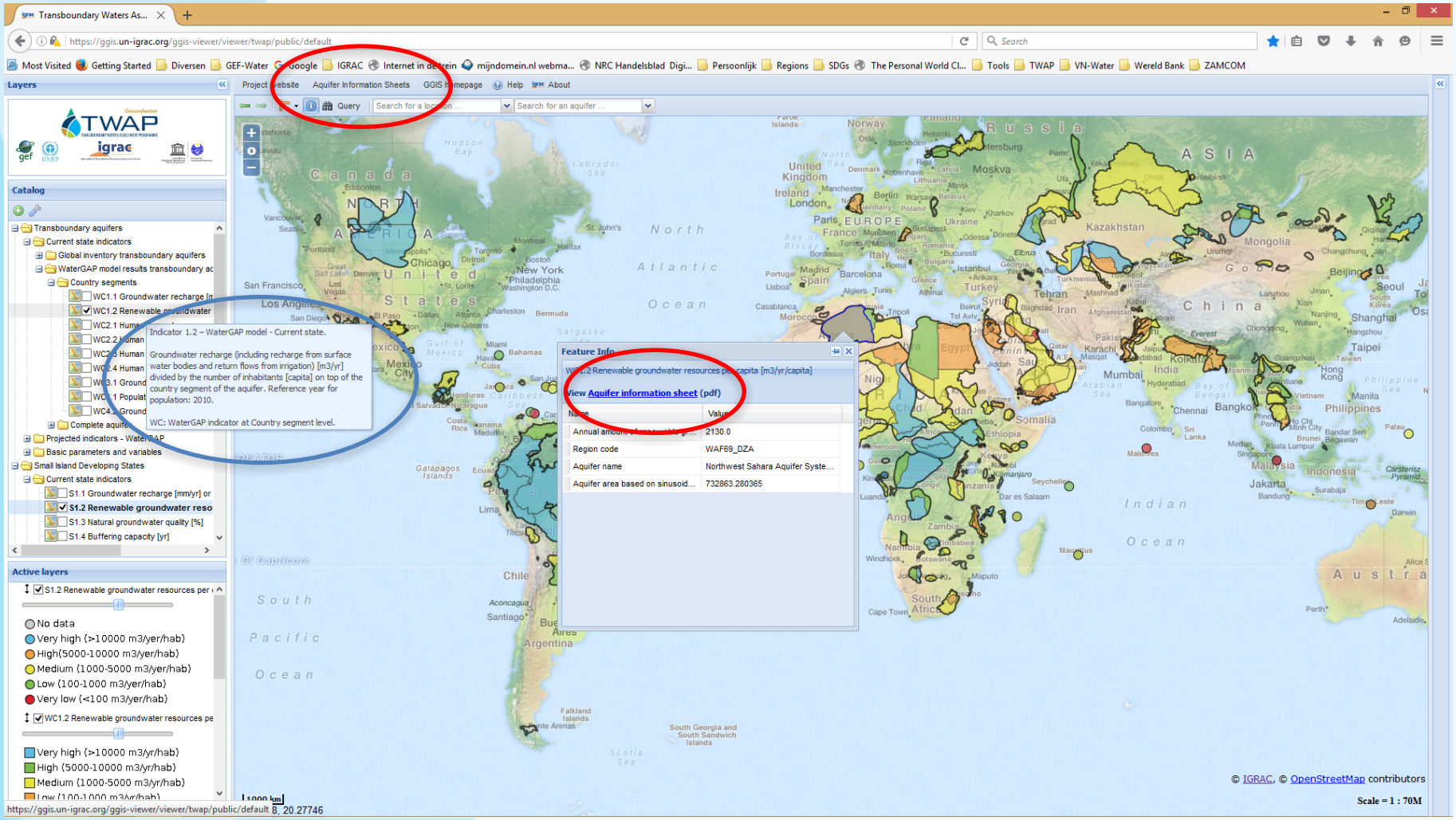


- Multi-disciplinary assessment methodology & questionnaire
- Assessment report of transboundary aquifers
- Summary for Policy makers
- TBA and SIDS information sheets,
- Reinforced international networks (ISARM)

Information Management System
http://twapviewer.un-igrac.org

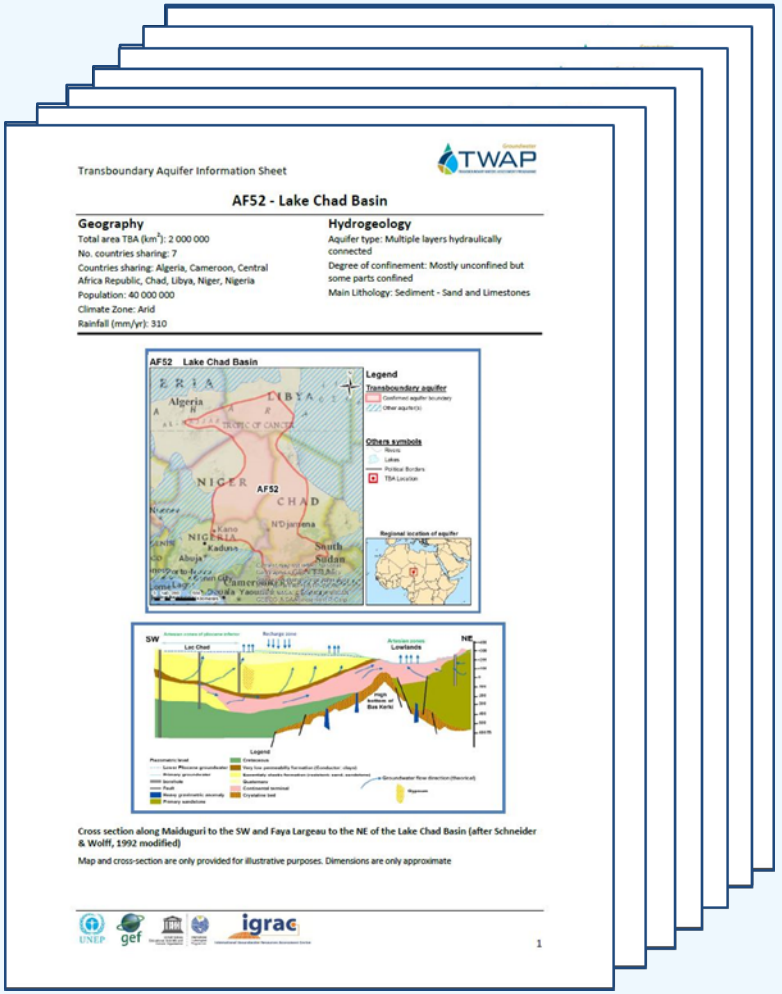
TWAP Groundwater Website
www.twap.isarm.org

TWAP Groundwater Information Management System

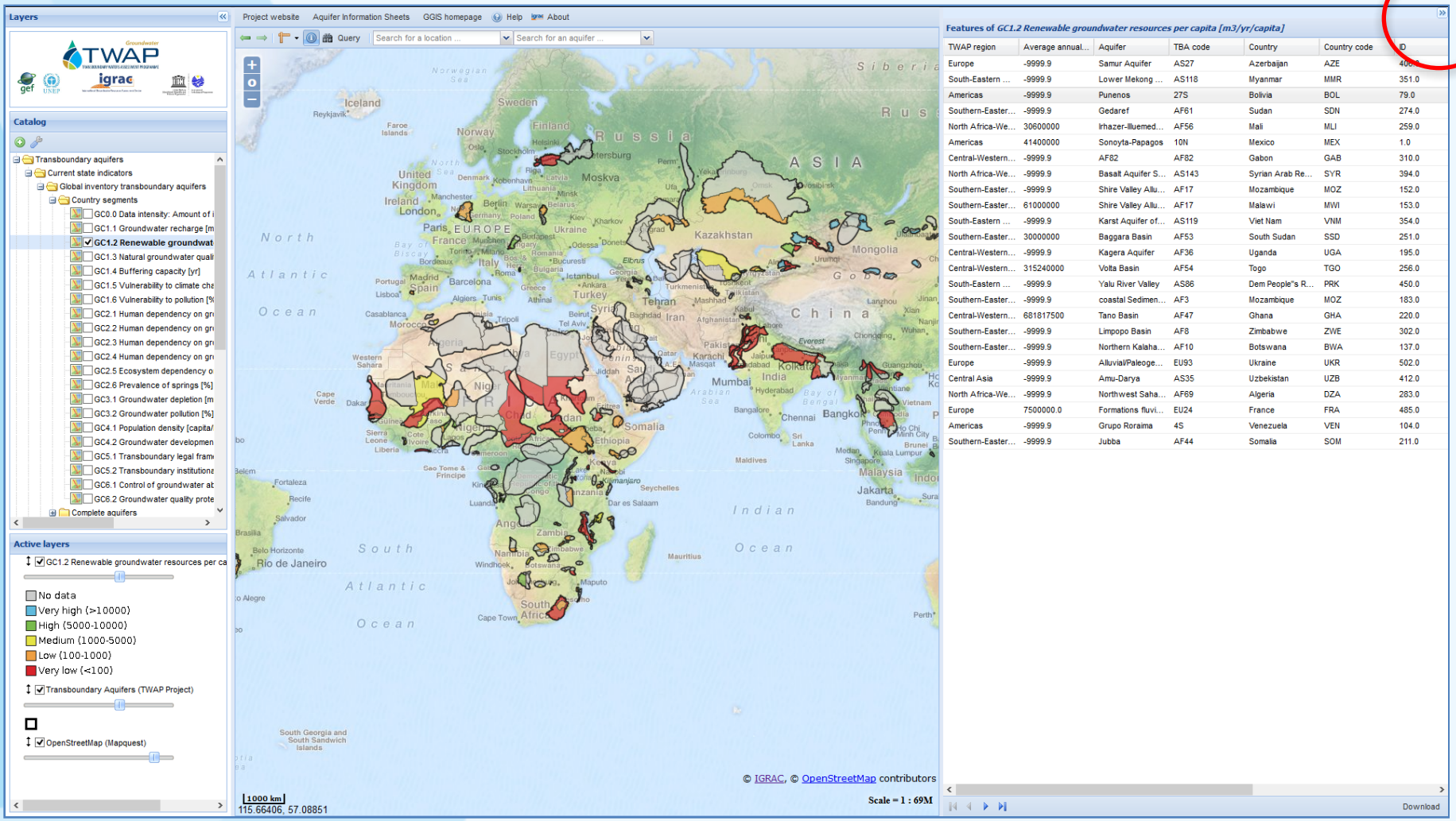


TBA information sheets

- Basic geographical and hydrogeological info
- Location map with delineation
- Cross-section (if available)
- Table with core indicators
  - Global Inventory
  - WaterGap Model
- Table with key variables
- Narratives of:
  - ✓ Aquifer geometry
  - ✓ Hydrogeological aspects
  - ✓ Linkages with other water systems
  - ✓ Environmental aspects
  - ✓ Socio-economic aspects
  - ✓ Legal and Institutional aspects
  - ✓ Priority issues and Hotspots
- Contributors (national experts)
- Colophon, incl. reference & call for additional information



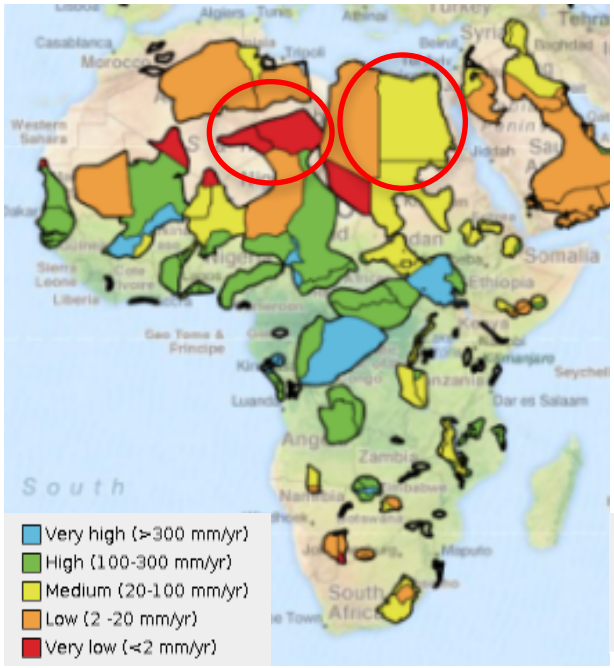
TWAP Groundwater IMS
Download feature information / data



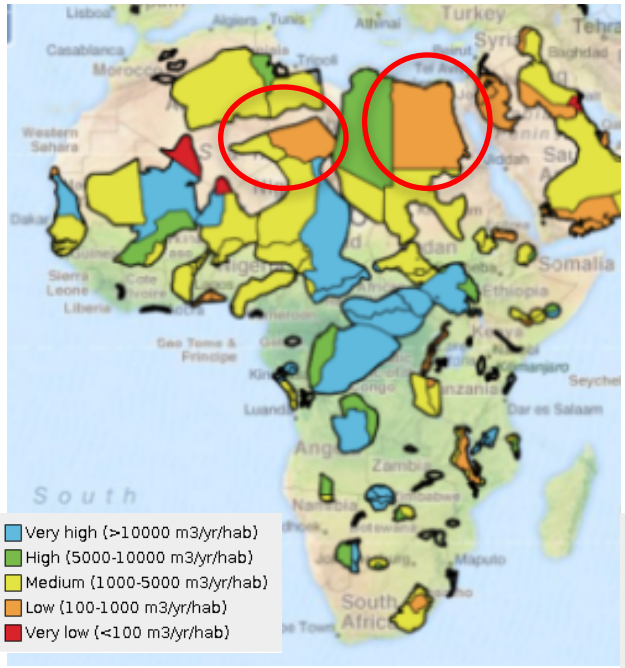
Additional insights through indicators and maps

Groundwater TWAP
TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

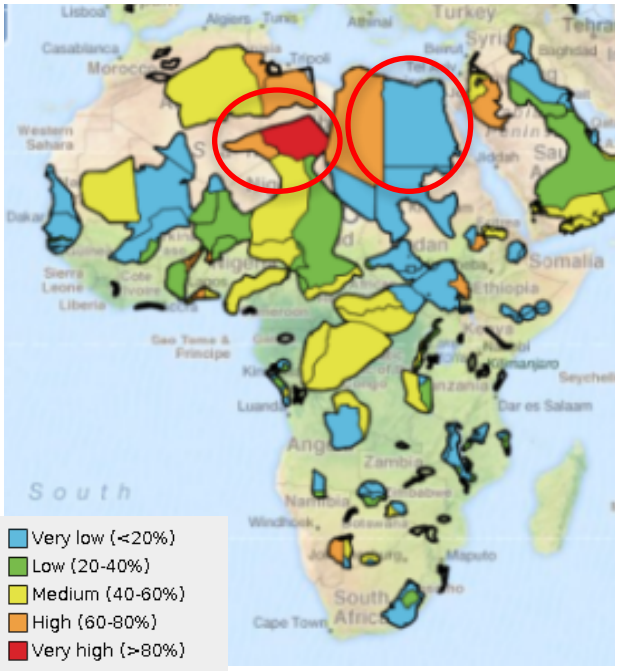
WaterGAP model data - Goethe University Frankfurt



Recharge



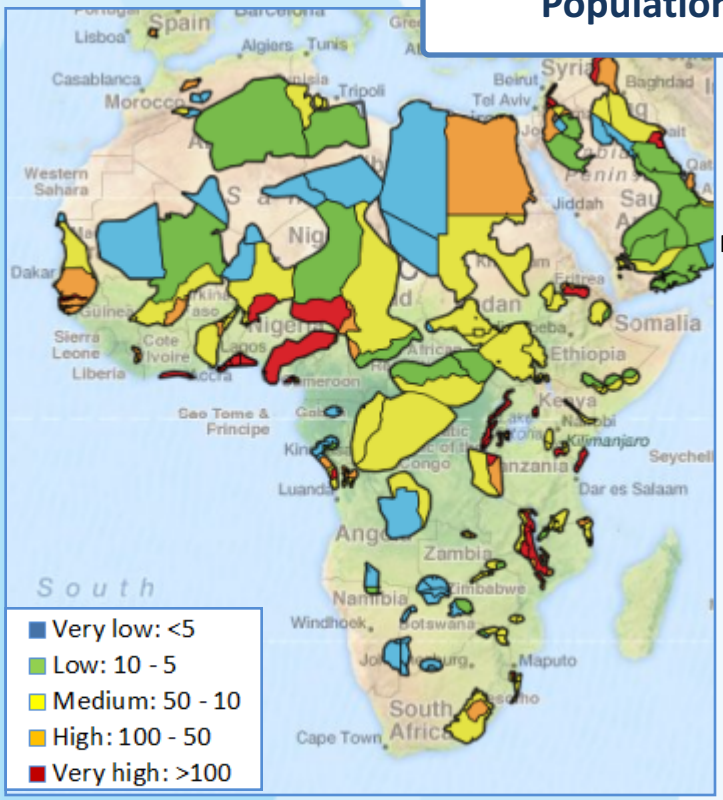
Renewable groundwater per capita

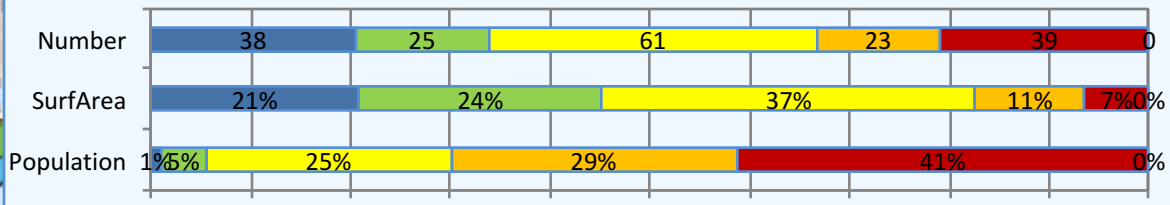


Human dependency on groundwater

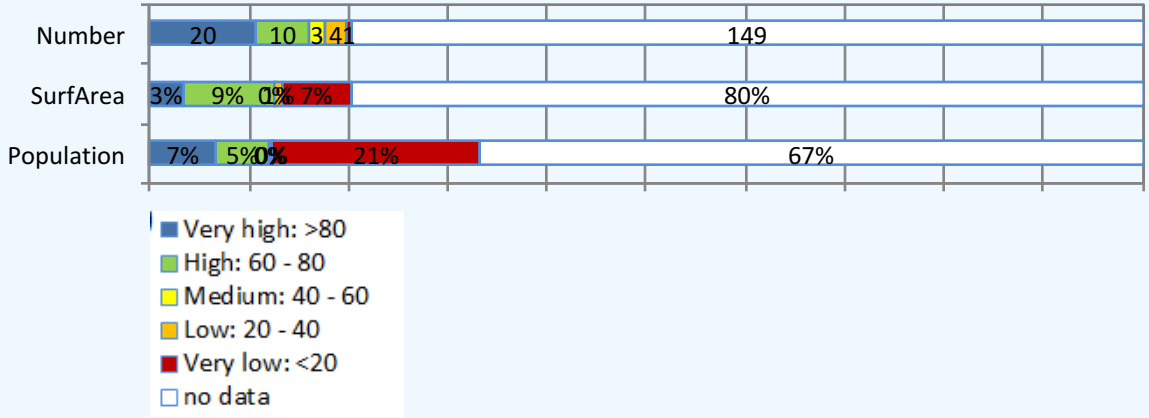
Different visualisation of indicators creates additional insights

Population density [cap/km^2]



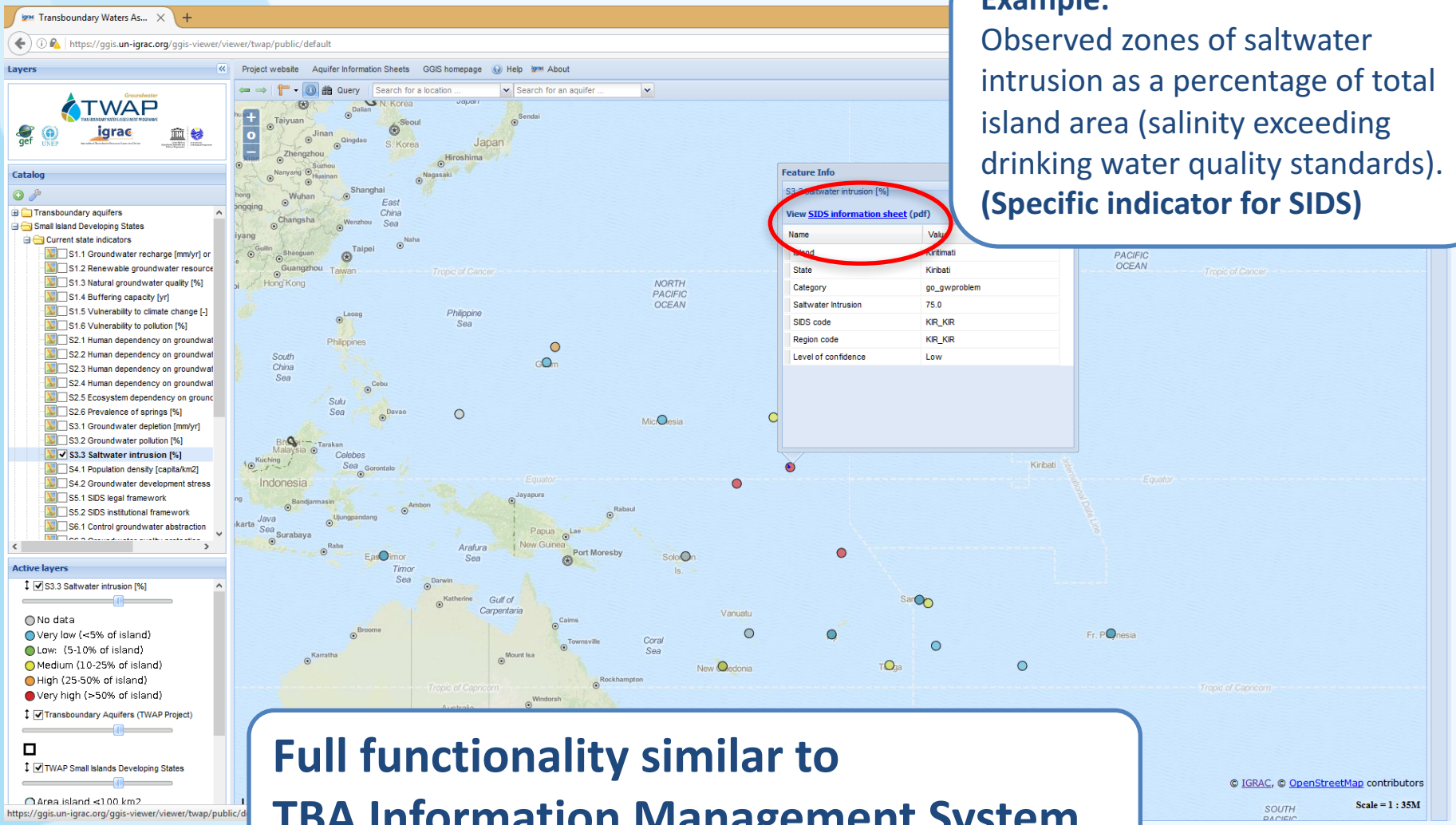


Natural background quality [% of surface area with good quality]



TWAP Groundwater
SIDS data base & IMS

Example:
Observed zones of saltwater intrusion as a percentage of total island area (salinity exceeding drinking water quality standards).
(Specific indicator for SIDS)

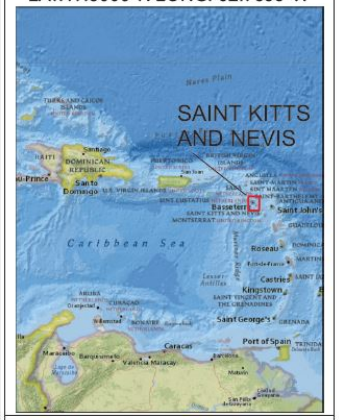


Full functionality similar to TBA Information Management System

SIDS information sheets

SAINT KITTS ISLAND - FEDERATION OF SAINT KITTS AND NEVIS

LAT:17.3000°N LONG: 62.7333°W



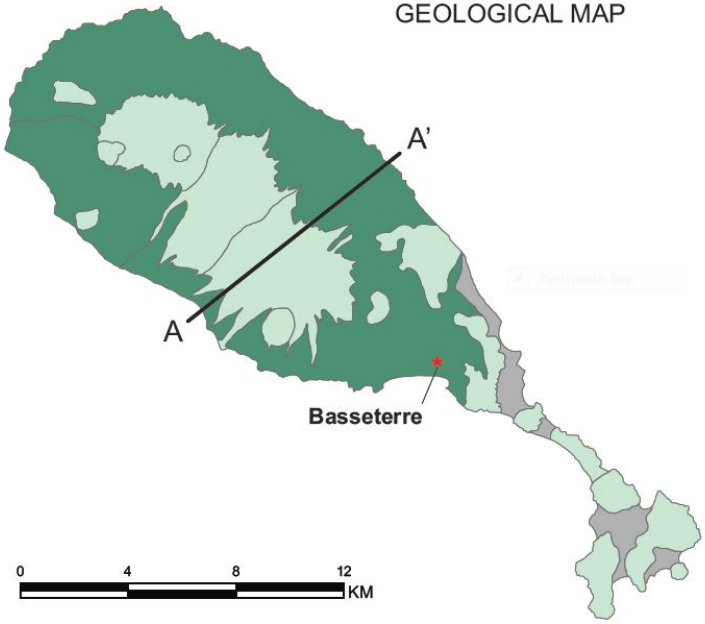
ISLAND STATISTICS

Area (km^2)	176
Max. Elevation (masl)	1156
Aquifer Lithology	Volcanic
Average Annual Precipitation (mm/a)	2165
Calculated AET (mm/a)	1346
Recharge (mm/a)	766
Max. Aquifer Thickness (m)	300
Groundwater Vol. ($x10^9$ m^3)	5.28
GW Vol. Abstracted ($x10^6$ m^3/a)	20
Predominant Natural Groundwater Quality	Fresh

REF: DEM: USGS (2004), Shuttle Radar Topography Mission

GEO: Roobol, J. M. and Smith, A. L. Geological Map of St. Kitts, West Indies.

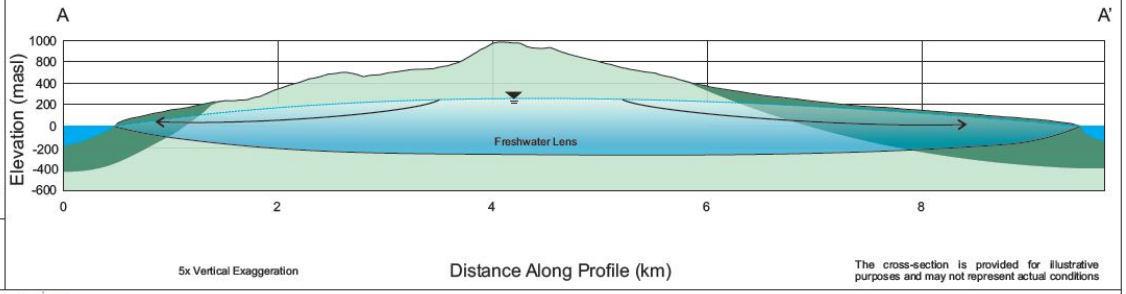
GEOLOGICAL MAP



LEGEND

- **Sedimentary**
  - Coarse Alluvium
  - Carbonate
  - Karstic Carbonate
  - Shale
  - Sandstone
- **Igneous**
  - Unfractured Igneous (Undif.)
  - f Fractured Igneous (Undif.)
  - Permeable Volcanic
- **Metamorphic**
  - Unfractured Metamorphic (Undif.)
  - f Fractured Metamorphic (Undif.)
- Major City
- Groundwater Table
- Flow Line
- Dominant Aquifer

CONCEPTUAL HYDROGEOLOGICAL CROSS-SECTION



The cross-section is provided for illustrative purposes and may not represent actual conditions

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

Groundwater

TWAP

TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

igrac
International Groundwater Resources Assessment Centre

Thank you for your attention

&

Thank you to

all TWAP Groundwater partners across the world

http://twapviewer.un-igrac.org

www.twap.isarm.org / www.geftwap.org





UNEP

gef

UNEP-DHI CENTRE for Water and Environment

UNEP DHI

UNESCO
United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

UNESCO
United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

ILEC

10 Additional indicators

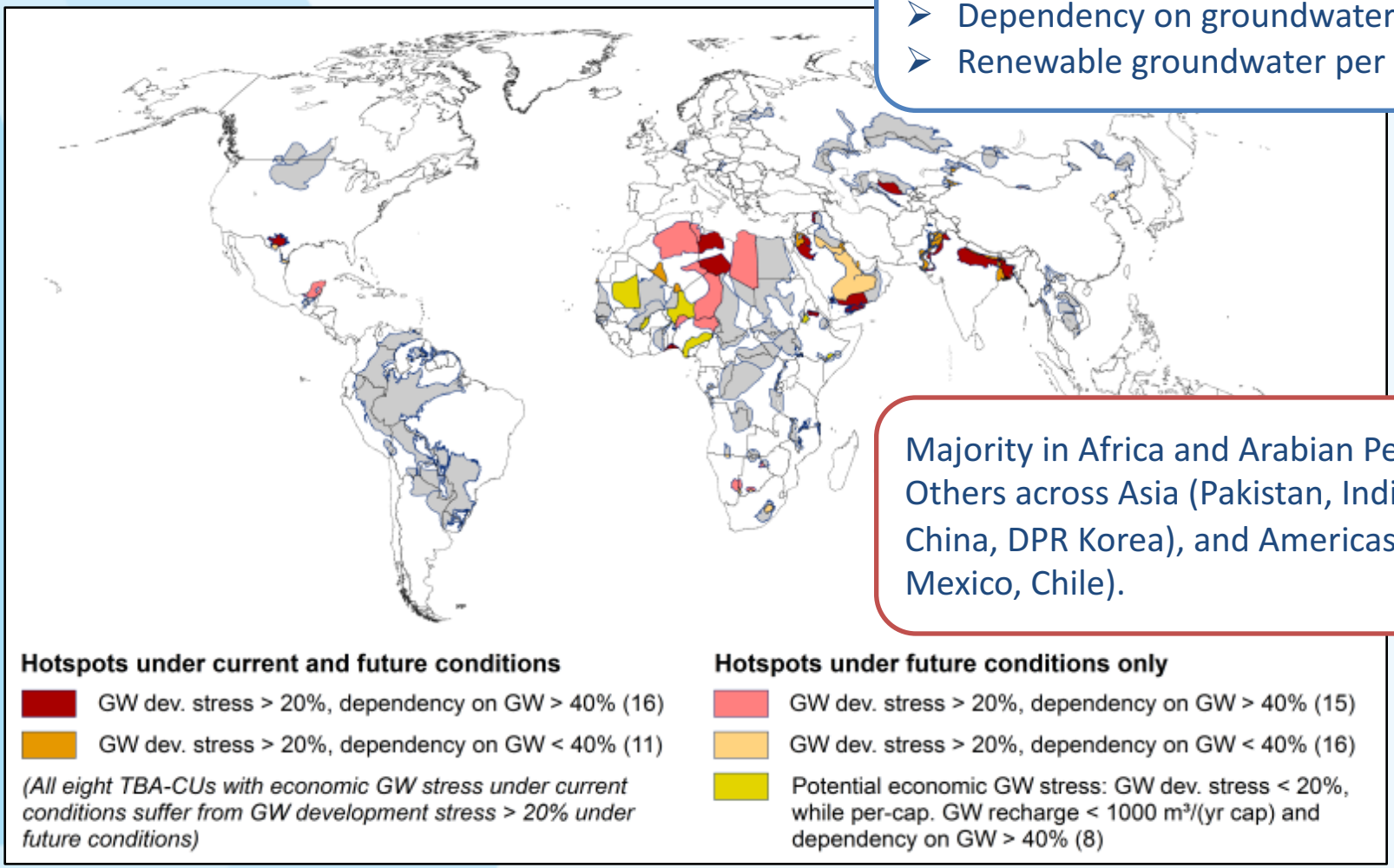
Thematic cluster	Additional Indicators
QUANTITY	• Aquifer buffering capacity • Aquifer vulnerability to climate change • Ecosystem dependency on groundwater • Prevalence of springs
QUALITY	• Aquifer vulnerability to pollution
SOCIO-ECONOMIC	• Human dependency on groundwater – Domestic use • Human dependency on groundwater – Agricultural use • Human dependency on groundwater – Industrial use
GROUNDWATER GOVERNANCE	• Control of groundwater abstraction • Protection of groundwater quality

Hotspots

Today and 2030, 2050

Combining indicators to define hotspots:

- Groundwater development stress
- Dependency on groundwater
- Renewable groundwater per capita



Majority in Africa and Arabian Peninsula. Others across Asia (Pakistan, India, Nepal, China, DPR Korea), and Americas (USA, Mexico, Chile).