



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

GROUNDWATER, CLIMATE CHANGE AND SEAWATER INTRUSION IN

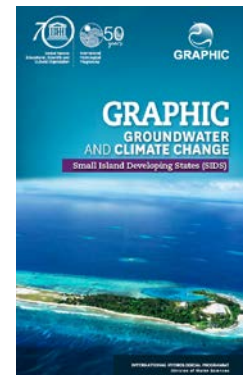
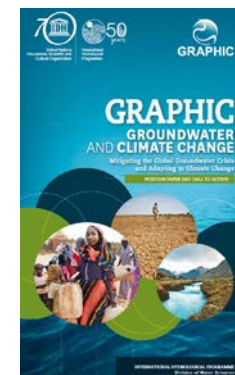
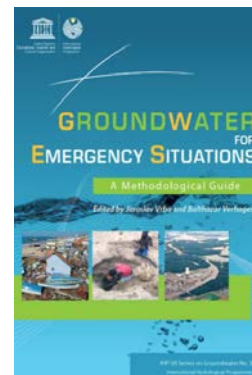
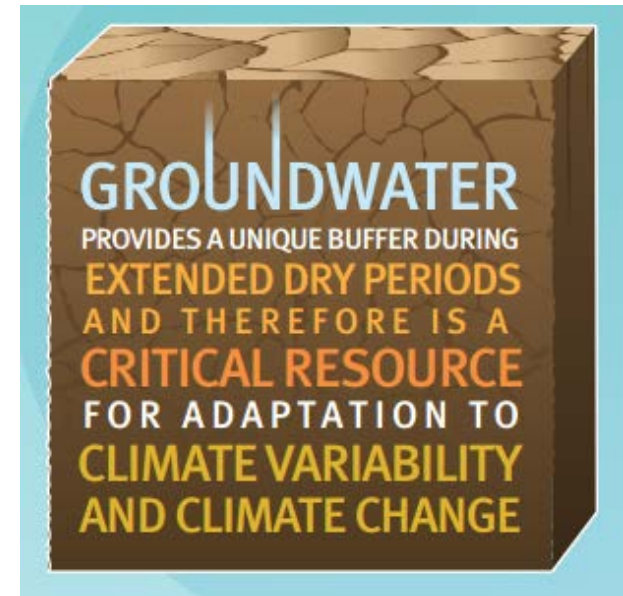
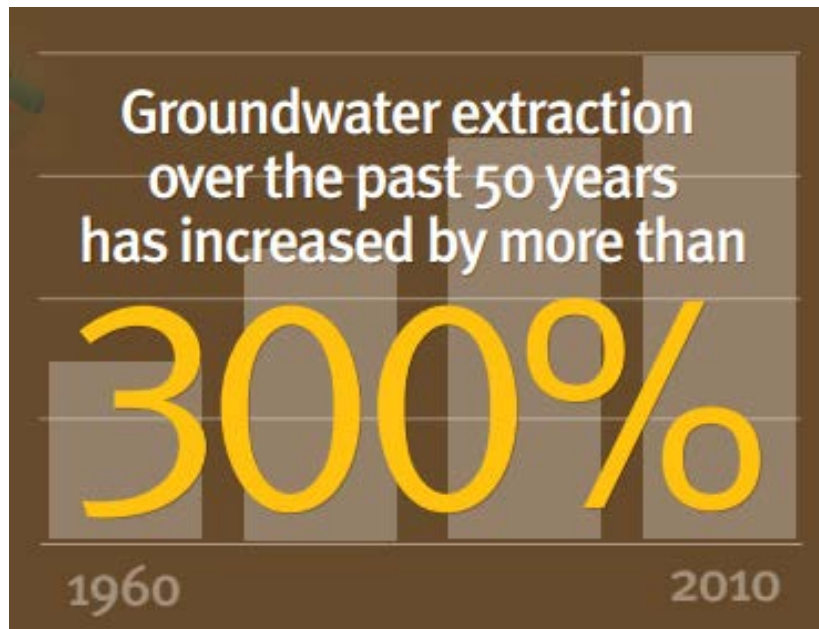
SMALL ISLAND DEVELOPING STATES (SIDS)

2016 World Water Week

Stockholm, 1 September 2016

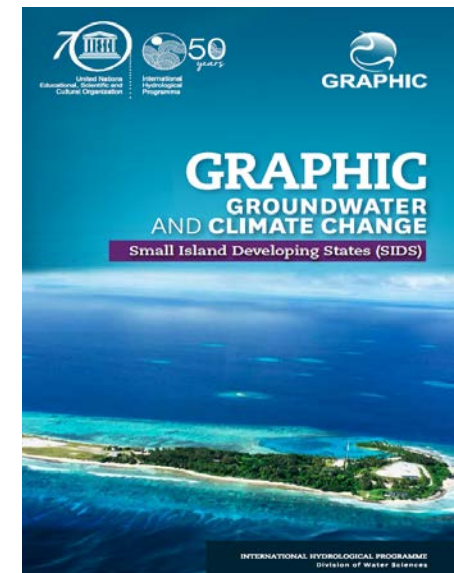
Tales Carvalho Resende
UNESCO International Hydrological Programme (IHP)

Groundwater & Climate Change



UNESCO-IHP & SIDS

- UNESCO-IHP undertook the first ever indicator-based assessment of groundwater resources in 42 SIDS.
- UNESCO-IHP Groundwater & Climate Change programme (GRAPHIC): SIDS report



71%

SIDS are at risk of water scarcity
91% for low-lying islands

73%

SIDS are at risk from groundwater
pollution often worsened by seawater
intrusion and salinization

10%

of Caribbean and Atlantic/Indian
Ocean SIDS

72%

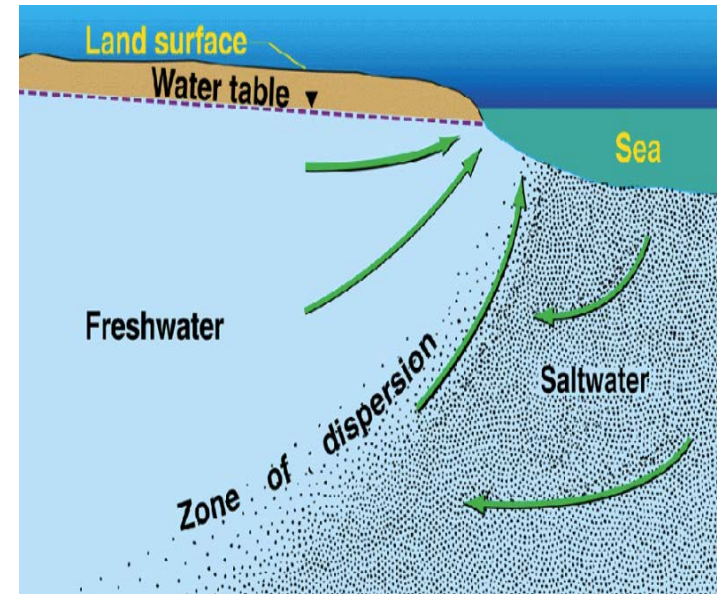
of Pacific SIDS

experience high
human groundwater dependence



Groundwater, Climate Change & SIDS

- SIDS are vulnerable to human-induced and natural stressors:
 - Most SIDS have a limited freshwater supply, which is present as a freshwater lens surrounded by saline groundwater.
 - SIDS share many similarities: physical size, remoteness, population growth, proneness to natural disasters and sensitivity to climate extremes, extreme openness of economies, and restricted capacity and resources:
 - ▣ *Enhance their vulnerability and reduce their resilience to climate variability and change*

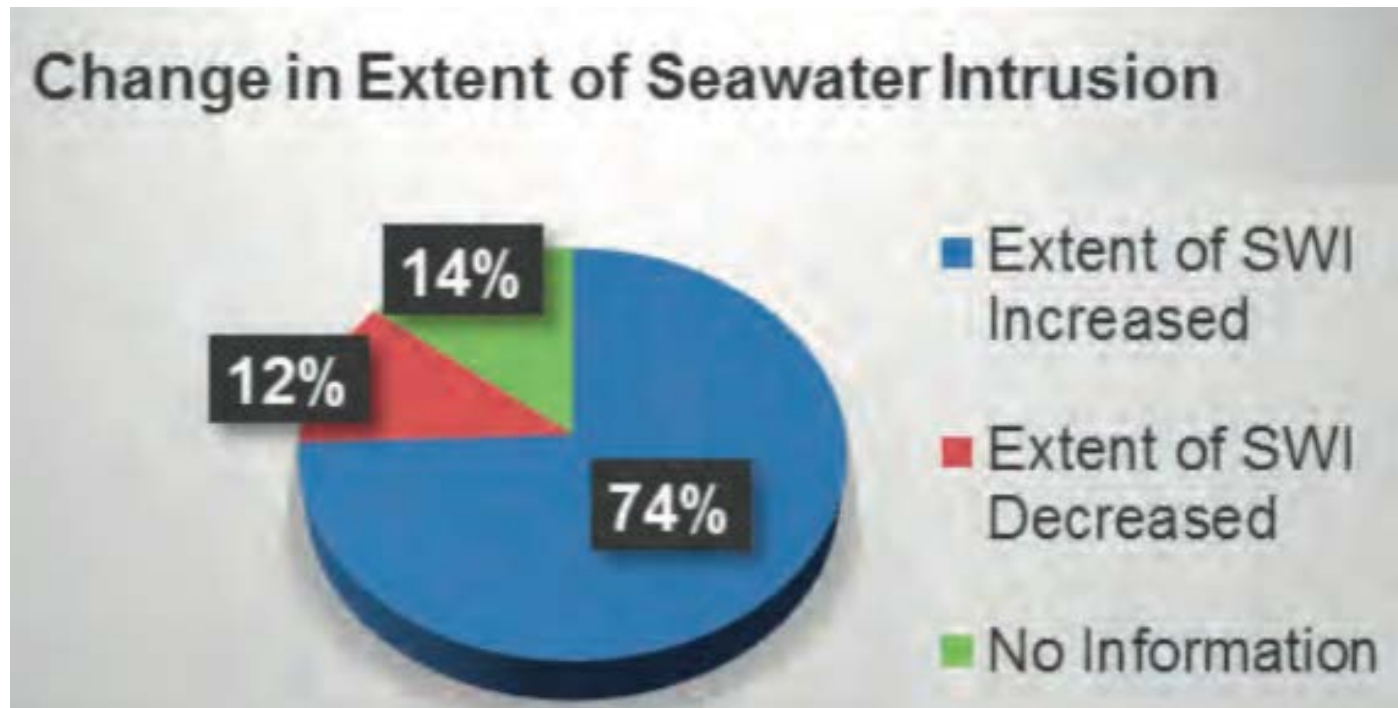


Groundwater, Climate Change & SIDS

- **Groundwater availability on SIDS is threatened by overuse and contamination:**
 - Groundwater availability on SIDS, as with many coastal regions worldwide, is threatened by withdrawal and depletion rates that have increased markedly in recent decades.
 - Groundwater overdraft to support irrigated agriculture, municipal use, and the economically important tourism industry is particularly problematic for SIDS
 - Seawater intrusion in coastal aquifers is caused by groundwater withdrawals and overdraft to help meet the freshwater demand for more than one billion people living in coastal zones

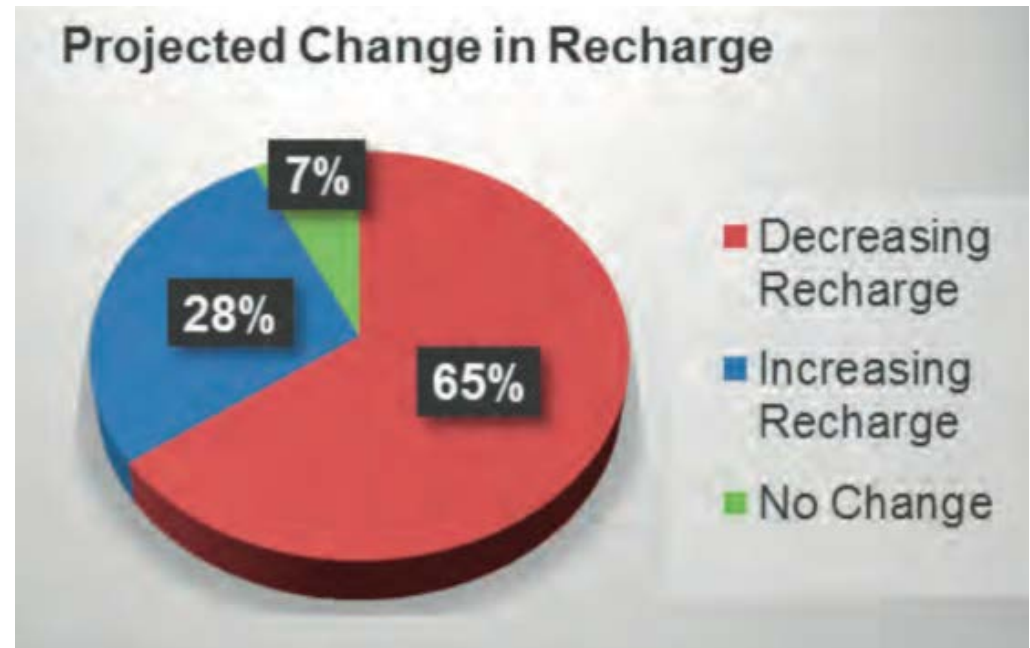
Groundwater, Climate Change & SIDS

- **Groundwater availability on SIDS is threatened by overuse and contamination:**
 - Seawater intrusion on SIDS has generally increased between 2000 and 2010.



Groundwater, Climate Change & SIDS

- **Reliability of freshwater on SIDS is a critical problem**
 - The reliability of a clean and available water supply is a critical problem on many SIDS
 - Freshwater resources in SIDS are likely to be seriously compromised due to the projected changes in distribution of rainfall, which may decrease recharge



Groundwater, Climate Change & SIDS

- **Climate induced sea-level rise will reduce groundwater supplies on SIDS**
 - Sea-level rise is projected to extend the areas of seawater intrusion and salinization of coastal groundwater, resulting in a decrease of freshwater availability for humans and ecosystems in SIDS and other coastal areas.
 - Rising sea levels may also affect groundwater quality because of the negative effects on urban stormwater drainage and sewage disposal caused by rising sea levels.

Groundwater, Climate Change & SIDS

- **Groundwater on SIDS is particularly vulnerable to extreme rainfall variations, storm surges, and other similar effects of climate change and variability**

Groundwater supply contamination on North Andros Island, Bahamas as a result of storm surge from Hurricane Frances in 2004





Results indicate that the storm surge did not directly compromise the freshwater lens, but rather the trench and conduit system allowed direct infiltration and rapid intrusion of saltwater to the system after it became flooded with sea water. As a result, the trench and conduit systems on North Andros Island were pumped down to encourage recharge and dilution of the brackish groundwater

Groundwater in CC adaption strategies for SIDS

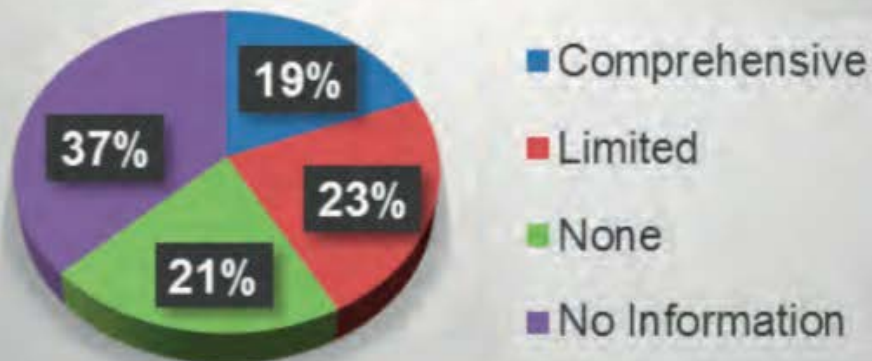
- Policy and governance
- Land use
- Advancing science and engineering on SIDS



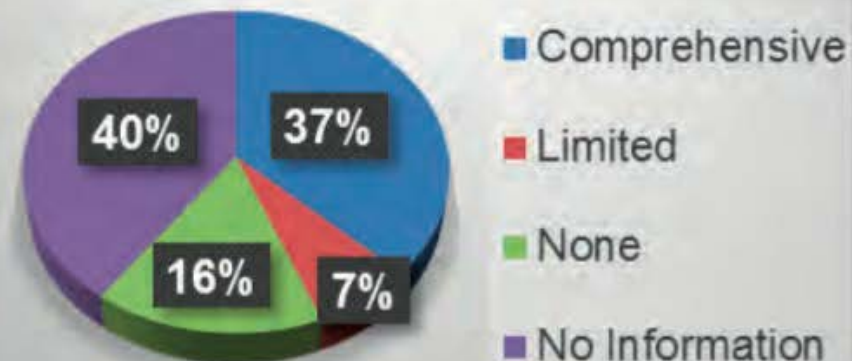
Policy and governance

- **Improved governance is needed for sustainable groundwater resources on SIDS**
 - Groundwater resources on many SIDS are vulnerable to climate change and coupled human activities because of inadequate legislation and regulations, inappropriate national water policies that provide no clear priorities or directions to government agencies of responsibility, and very limited financial and human resources to manage groundwater resources and water supply systems

(a) Measures to Control Groundwater Abstraction



(b) Measures for Groundwater Protection



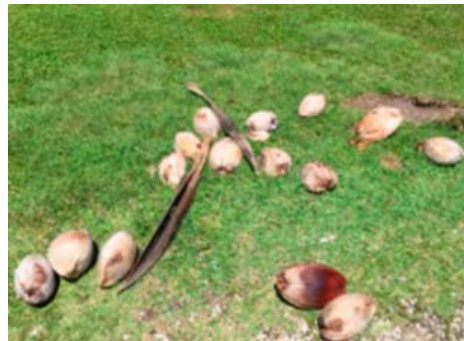
Policy and governance

- **Community involvement on SIDS is necessary to establish groundwater sustainability goals**
 - Community involvement is critical in establishing sustainability goals for short- and long-term management strategies to succeed. This is especially true in many regions that lack participation of communities in water resource management and planning because of a disconnection between government ministries and communities



Land use

- Land use on SIDS must optimize economic and adaptive benefits for the water sector
 - Land-use policy and management practices that stabilize water availability is an adaptation strategy to increased precipitation variability and drought that may affect SIDS in the 21st century.
 - Example: selective clearing of phreatophytes (water-loving vegetation), such as coconut trees, on some SIDS may increase recharge and the sustainable yield and decrease groundwater salinity. However, the potential benefit for groundwater availability must be weighed against the subsistence communities and tourism that benefits from the trees.



Land use

- **Land ownership may hinder sustainable groundwater resource management**
 - On some SIDS in the Pacific region, land is often owned by traditional owners
 - This often leads to conflicts between governments and landowners when establishing water reserves on privately owned land. Because customary law in many SIDS in the Pacific region assigns ownership of groundwater to land owners, governments are often reluctant to enact water legislation specifying that water belongs to all people or the government or banning polluting land uses for fear of infringing on property rights.
 - As a consequence, some SIDS have no legal protection of groundwater from over pumping or from contamination.

Advancing science and engineering on SIDS

- **Improve the linkage between groundwater monitoring and sustainable abstraction on SIDS**
 - Groundwater abstraction using horizontal wells is an important management strategy to prevent early up-coning of saline water.
- **Managed aquifer recharge (MAR) is a promising adaptation approach for some SIDS**
 - MAR offers the potential for a relatively low cost approach to capture and store excess stormwater in local aquifers during wet periods, which can be used to enhance the freshwater lens and off-set limited surface-water supplies during dry periods.
- **Improve human and institutional capacity and technical knowledge on SIDS**

Thank you!

t.carvalho-resende@unesco.org



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