



Experiences in Integrated Water Resources Management in North America, Latin America & the Caribbean



for the North American Network of River Basin Organizations (NANBO)

Bob Pietrowsky, Director
USACE Institute for Water Resources
& the International Center for Integrated
Water Resources Management, *under*
the auspices of UNESCO

27 May 2013





Presentation Outline



- **Who We Are and What We Do**
 - ✓ Corps Water Resources Mission in U.S.
 - ✓ Institute for Water Resources (IWR)
 - ✓ International Center for Integrated Water Resources Mgt.
- **Engagement Context**
 - ✓ IWRM Approaches & Challenges
 - ✓ Adaptation to Global Change
 - ✓ USG Priorities, MDG's & UNESCO IHP Program
- **Illustrative International Activities**
 - ✓ North America
 - ✓ Latin America & the Caribbean
 - ✓ Global Activities
- **Questions/Discussion**



U.S. Army Corps of Engineers

Key Mission Areas



Military Programs

- Military Construction
- Base Relocation & Closing
- Field Force Engineering
- MILCON Transformation
- Environmental restoration

Homeland Security

- Critical Infrastructure
- Facility Security



Interagency Support

- DOD, Federal
- State & Local
- International



Water Resources R & D

- Watershed Hydrology
- Riverine Hydraulics
- Estuary-Coastal Hydraulics
- Socio-Economic
- Geospatial
- Environment

Civil Works



- Primary Water Resources Missions - Navigation, Flood & Coastal Storm Risk Mgt. and , Aquatic Ecosystem Restoration
- Allied Water Resources Purposes – Recreation, Water Supply, Fish & Wildlife Hydropower
- Disaster Response
- Regulatory – Clean Water Act & Navigable Waterways



IWR Supports USACE Water Resources Mission



627 Shallow Draft Harbors



¼ of Nation's Hydropower Production



383 Major Lakes & Reservoirs Across the U.S.

11,000 miles Inland Waterways



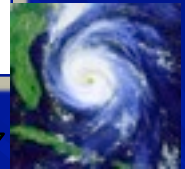
300 Deep Draft Harbors



400 miles Coastal Shore Protection



Emergency Operations



4340 Recreation Sites with 400 million visits/year



\$ 750 Million Annual Dredging Costs



11.7 Million Acres Public Lands



276 Locks

8,500 + Miles of Levees



Environmental Stewardship

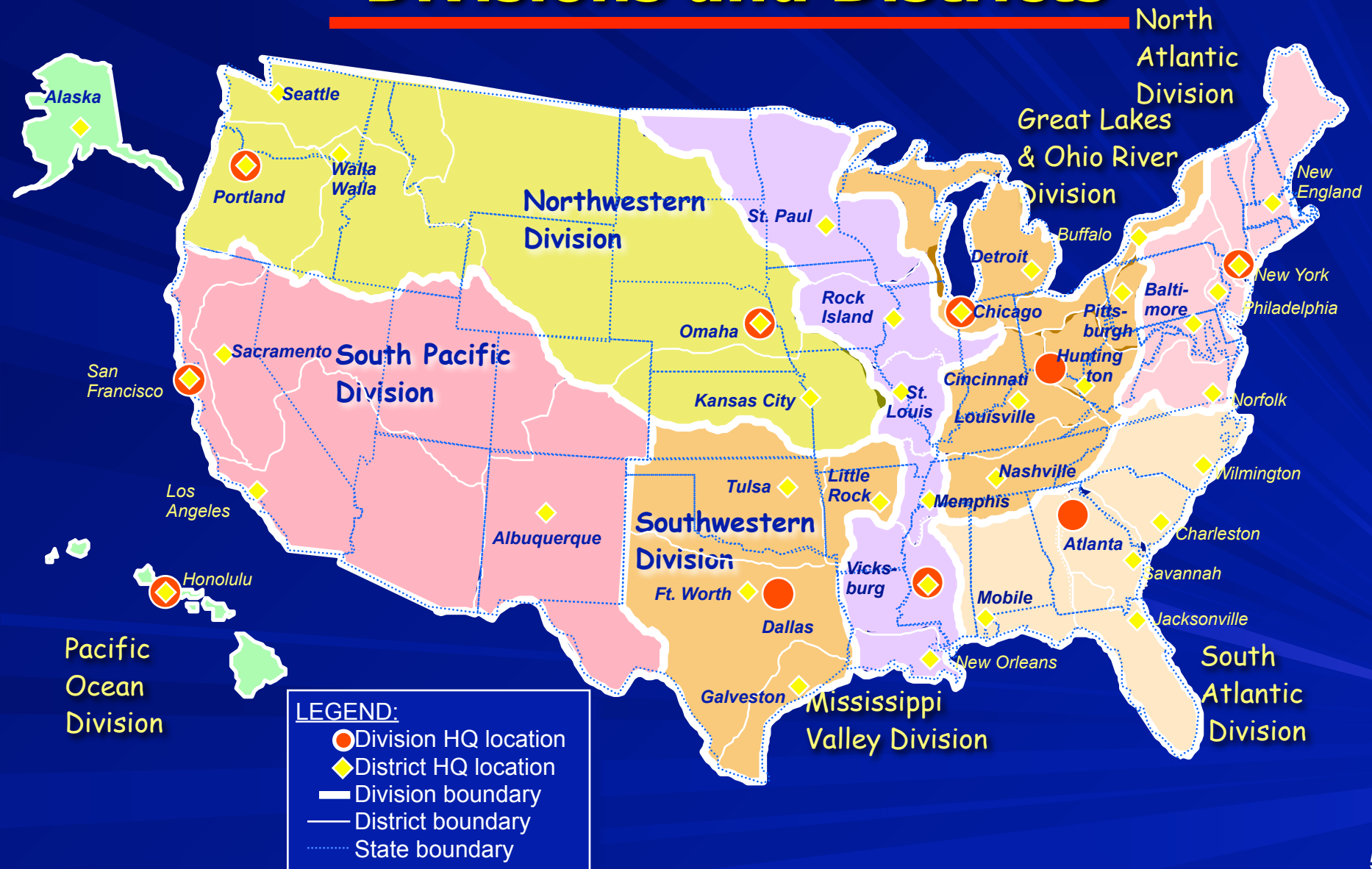


Regulatory Responsibilities

- ✓ **Management of ~ \$200 Billion Capital Stock**
- ✓ **Annual Civil Works Budget ~ \$5.5 Billion (base program)**



USACE Water Resources Divisions and Districts





About IWR



- **Established:** in 1969 to assist USACE in identifying emerging issues & adapting to the Nation's changing water resources needs.
- **FOA** – Physically & functionally distanced from Corps HQ by design
 - ✓ Offices at five locations, including:
 - Main Office – NCR, in Alexandria, VA on HECSA complex, including
 - International Center for Integrated Water Resources Mgt.,
 - Conflict Resolution & Public Participation CX, and the
 - Navigation & CW Decision Support Center (NDC)
 - Waterborne Commerce Statistics Center – New Orleans
 - Hydrologic Engineering Center – Davis, CA
 - Risk Management Center – Western Office in Golden, CO and Eastern office in Pittsburgh, PA
- **People:** ~ 250 Permanent staff, many with specialized skills, most with advanced degrees.

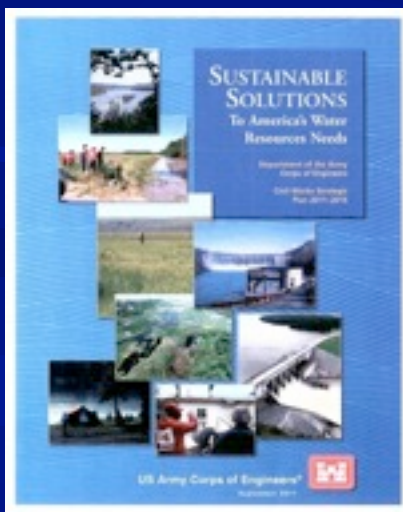


IWR MISSION



To support Civil Works by: anticipating changes in national & international water resources conditions, and to develop, apply & infuse new planning evaluation, investment decision, conflict resolution, hydrologic engineering and water management, risk engineering, navigation and CW data, and program management policies, methods, tools and systems to address these needs.

➤ **CIVIL WORKS STRATEGIC PLAN –**
focused on sustainability & integrated water resources management





IWR OFFICES & MISSION SPECIALTIES



➤ Program Direction

- Water Resource Trends & Emerging Issues
- CW Strategic Plan
- Policy Development Support
- National Studies

➤ Problem Solving

- Investment Decision Support Methods & Models
- Multi-Objective / IWRM
- USACE Chief Economist / Economic CoP
- Socio-Economic Analyses
- Environmental Evaluation
- Regulatory Program Analysis
- Global Climate Change
- Technical Assistance & Capacity Development

➤ Partnering

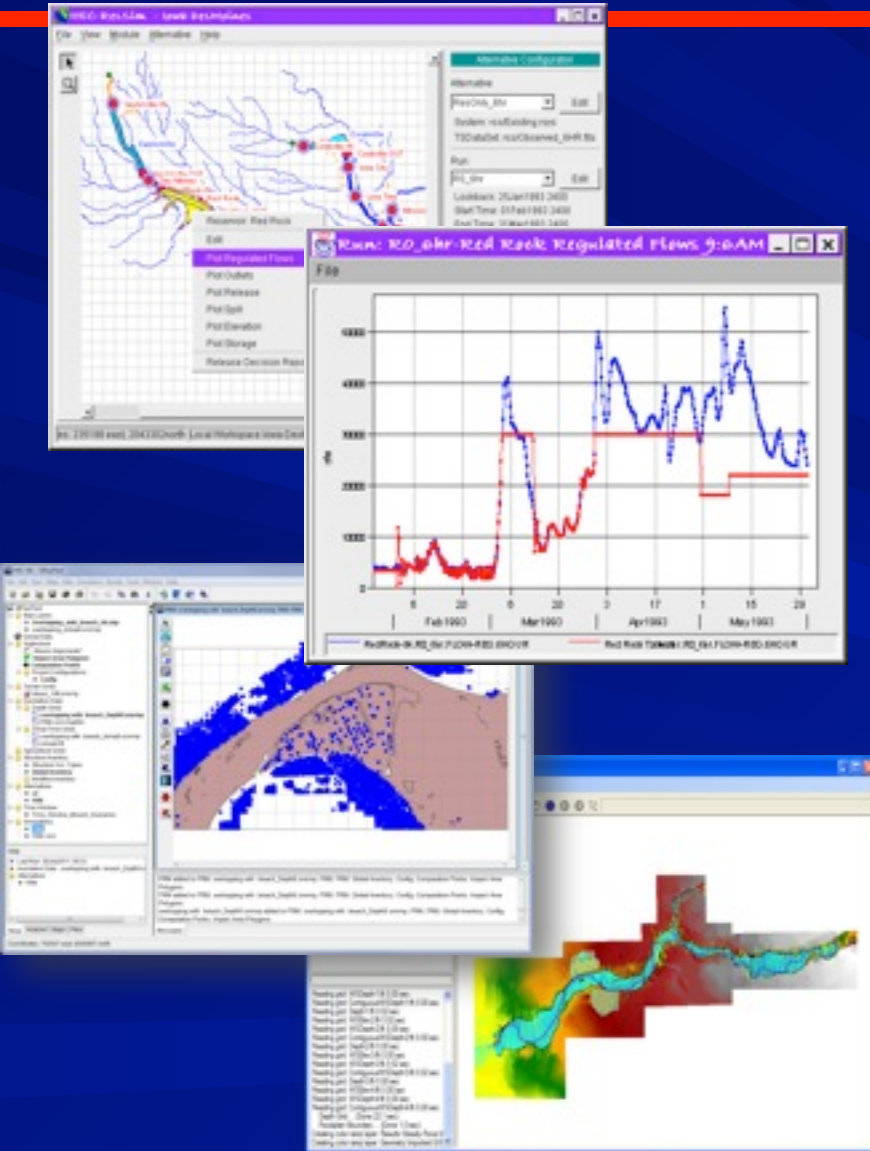
- National Interface -Tech Support to HQ
- Collaborative Planning
- Public Involvement
- Conflict & Dispute Resolution
- National Interface w/Academia
- International Water Resources & International Outreach

- ## ➤ H&H Methods & Models
- Surface Hydrology
 - Hydrologic Statistics
 - River Hydraulics
 - Ecosystem Function Models
 - River Forecasting
 - Reservoir Systems & Water Management - CWMS
 - Technical Assistance & Capacity Development

- ## ➤ Waterborne Commerce Statistics
- Foreign Trade
 - Domestic Commerce
 - Navigation Infrastructure
 - Dredging & Lock Performance
 - CW Business Information



Hydrologic Engineering Center- HEC Engineering Software



- ✓ Watershed hydrology
- ✓ Statistical software package
- ✓ River hydraulics
- ✓ Reservoir analysis
- ✓ Flood damage analysis
- ✓ Watershed assessment tool –
systems analysis
- ✓ Regime prescription tool
- ✓ Systems Integration: Corps Water
Management System (CWMS)
- ✓ Ecosystem Functions



Conflict Resolution & Public Participation Center (CEIWR-CPC)



- “Technically informed” consensus building
- Links IWRM collaboration to civil society
- “Shared Vision Planning” is one form of such structured collaboration
- Information models are developed collaboratively
 - ✓ Accessible to all stakeholders
- Public and experts work together to build models and supply data
- Particularly useful in trans-boundary and high-conflict situations





Collaborative Engagement: Paradigm Shift Towards Right



Procedural, Technical & Cultural Transformation



Collaborative
Problem
Solving

Inform the
public

Listen to
the public

Two-way,
transparent
dialogue with
stakeholders

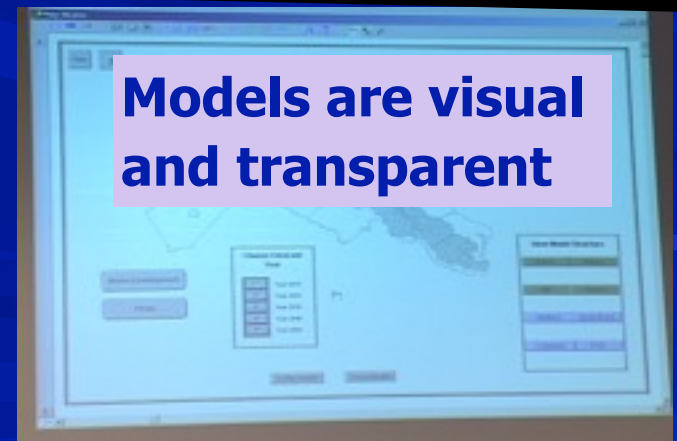
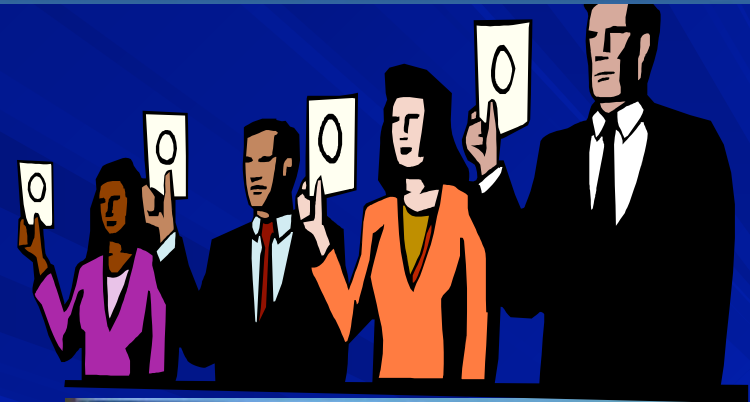
Inform → Consult → Involve → Collaborate → Empower



Representative Work: Conflict Resolution & Stakeholder Involvement

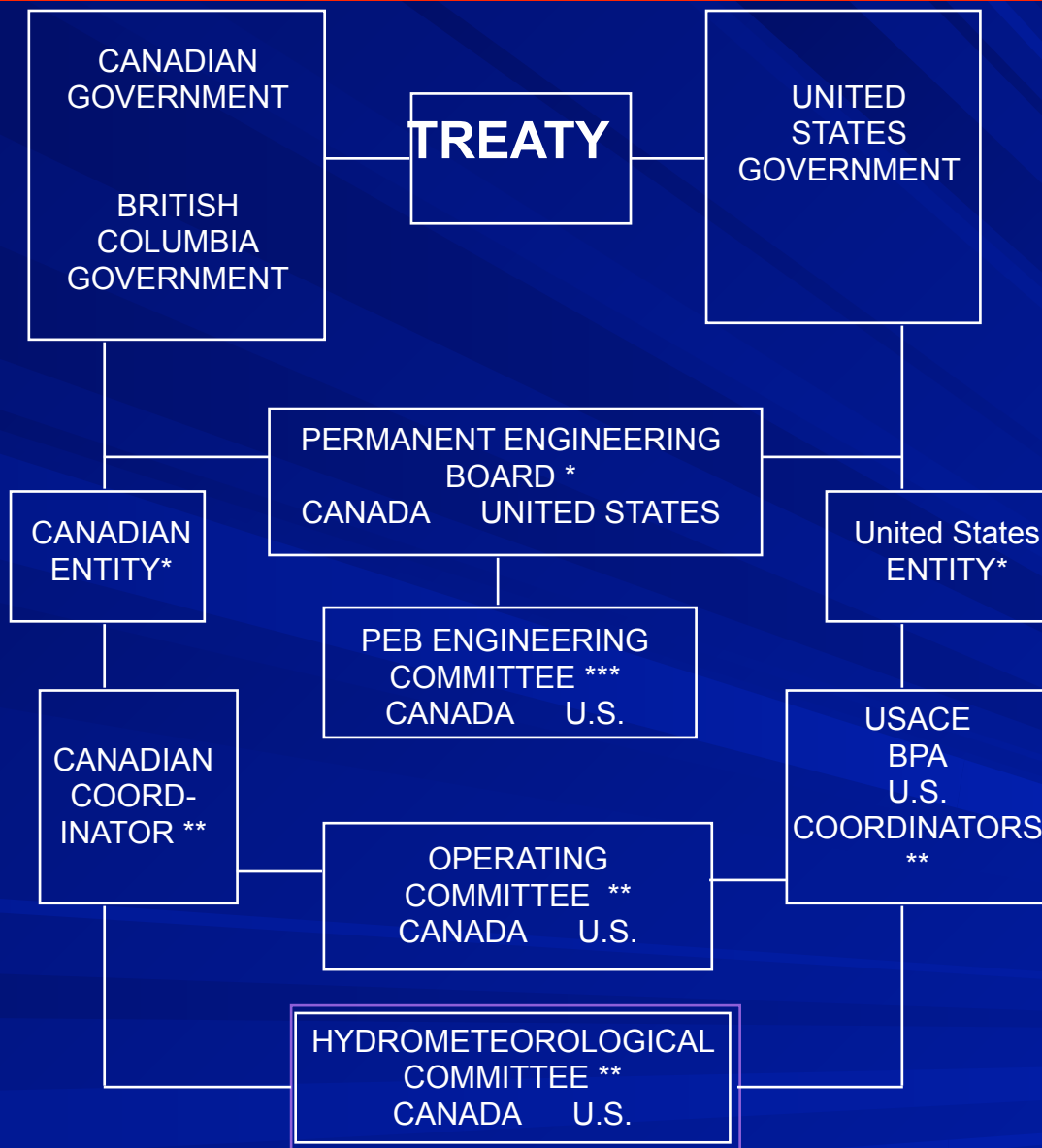


- Process of “technically informed” consensus building.
- Links IWRM Collaboration directly to civil society and the people.
- Information, models are developed collaboratively & accessible to all stakeholders.
- Public and experts work together to build models and supply data.
- Stakeholder concerns are directly
- Particularly useful in trans-boundary and high-conflict cases.





Columbia River Treaty



* Established by TREATY

** Established by ENTITY

*** Established by PEB



Domestic Water Resource Challenges

Increased Competition for Water

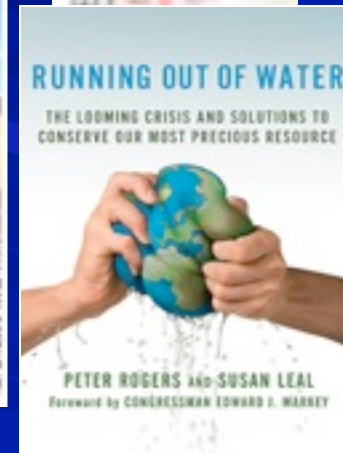
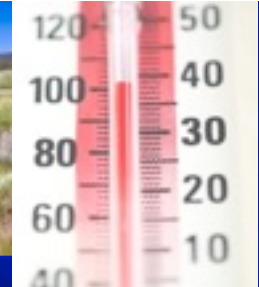
- U.S. population to reach 400 million by 2050
- Population more urbanized, concentrated in coastal areas and areas already experiencing scarcity of fresh water
- New technologies stimulating demand

Aging Infrastructure

- Much of U.S. 20th Century infrastructure is approaching or exceeding original design lives
- Failure poses risk to populations, economy & environ.

Adaptation to Climate Change

- Need means to anticipate & adapt to climate change impacts to the frequency, intensity & spatial occurrence of extreme events
- Observed changes in snowmelt, floods & droughts are likely to progress over time, potentially affecting all aspects of water resources management





Mega-Nexus of Future Water Demand

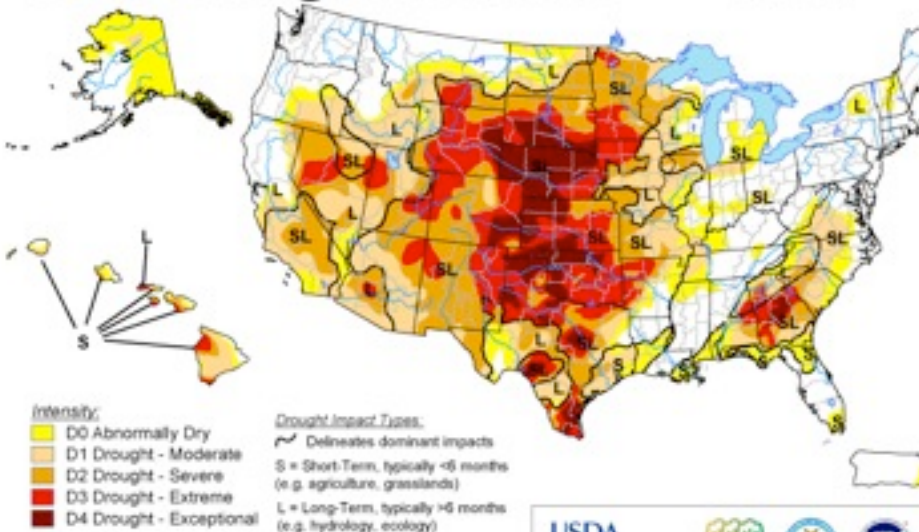


IWRM Context: Not just the “Water-Energy Nexus” – but the “Mega Nexus” - Water - Food - Energy - Transportation & Health

U.S. Drought Monitor

January 1, 2013

Valid 7 a.m. EST

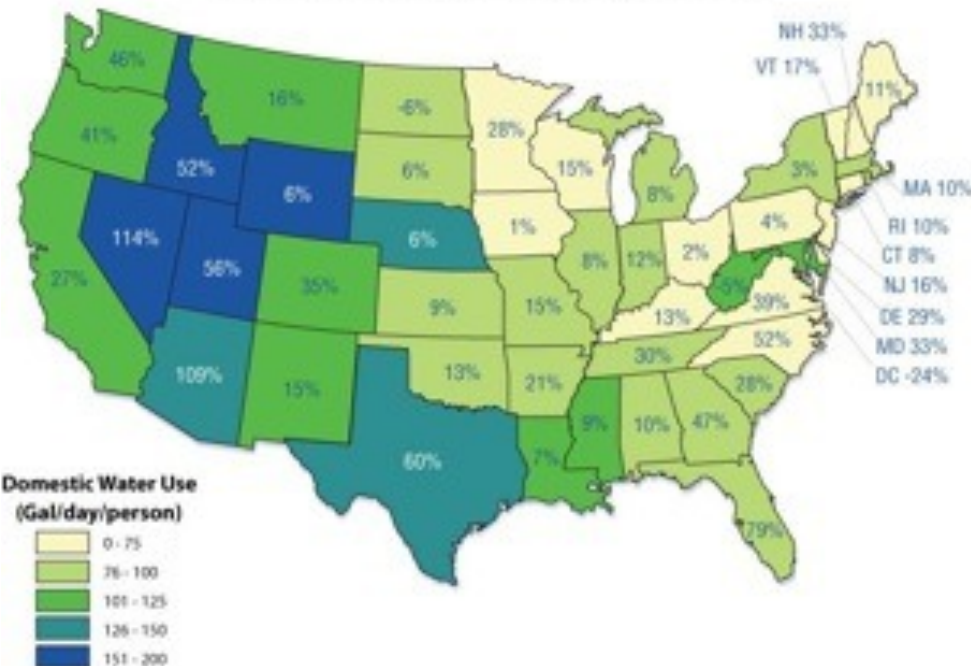


The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu/>

Released Thursday, January 3, 2013
Author: Richard Heim, NOAA/NESDIS/NCDC

Domestic Water Use in Gallons per Day per Person and Projected Percent population Change by 2030





The Promise of IWRM



“ IWRM is a process which promotes the coordinated development and management of water , land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.” (GWP)

“...water sector reform is very complex. Even with sound governance, participation, institutions and skills – all largely missing in Bank client countries – such reform takes 10-20 years, even in OECD countries.” (World Bank Report, 2002).



Integrated WRM



- **Vertical Integration:** coordination and implementation of policies, programs and projects from national to regional to local levels
- **Horizontal Integration:** coordination and implementation of sectoral programs within project planning, across multiple agencies (e.g. IFM)
- **Multidisciplinary Integration:** forming teams of specialists from various relevant disciplines
- **Multi-objective Integration:** achieving social, environmental, economic and equity goals for sustainable development

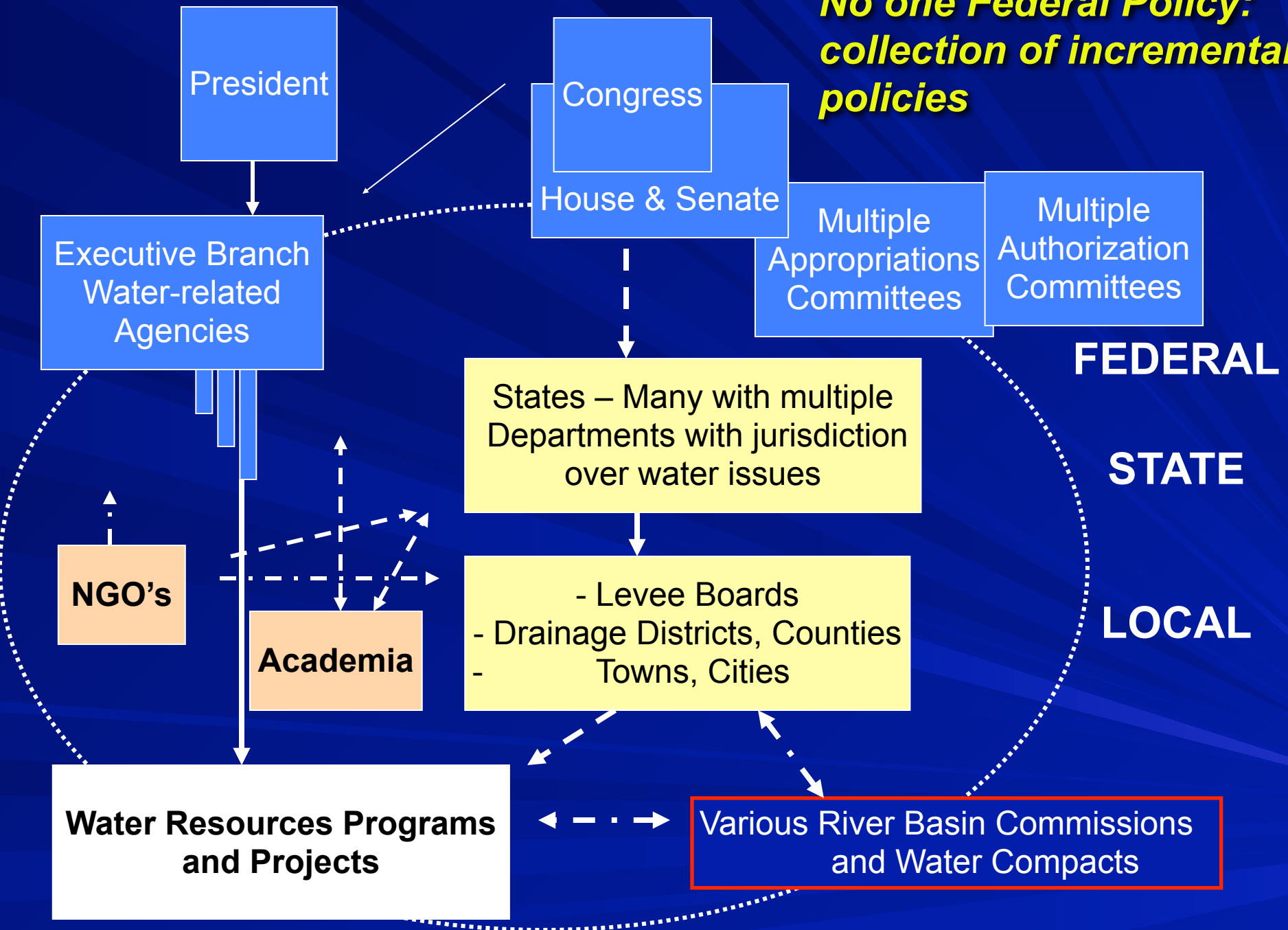


About Water Resources Management in U.S.



- **21,500 small watersheds and 21 large river basins that fall within the U.S.**
- **U.S. is blessed with abundant water resources.**
 - ✓ **But regional & local gaps in water availability and quality persist, and competition for water is increasing in key regions.**
- **U.S. does not have a single national water policy or a unified IWRM approach for managing these watersheds and basins.**
- **Rather, IWRM is accomplished thru collaborations between local, state, and national levels to achieve both local and national goals, while protecting public and private interests.**

***No one Federal Policy:
collection of incremental
policies***





Evolution of Thinking About Water & Climate



- Stationarity paradigm – future will look like the past? **Not Likely!**
- Recognized role of cyclical climate changes:
 - ✓ El Nino
 - ✓ Pacific Decadal Oscillation
 - ✓ Atlantic Multi-Decadal Oscillation
- IWRM is the accepted paradigm / context for dealing with climate adaptation and adaptive management
- Transitional pragmatic evaluation, planning and engineering design tools needed in absence of good information from GCMs and forecasting models

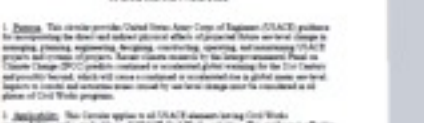




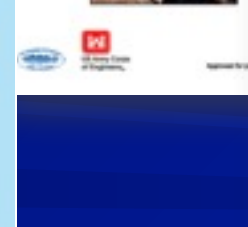
Corps "Response to Climate Change" Program



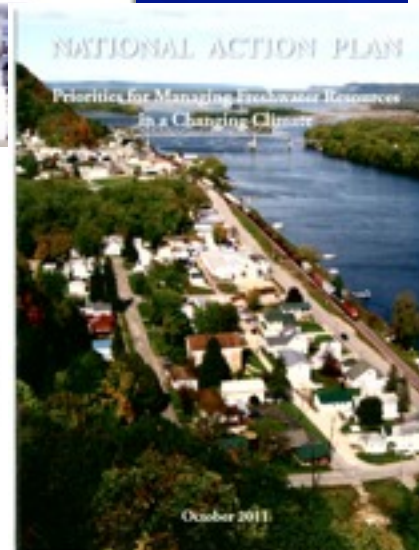
Developing and implementing nationally consistent, practical, and cost-effective approaches that reduce vulnerabilities to water infrastructure resulting from climate change and variability.



Addressing Climate Change in Long-Term Water Resources Planning and Management

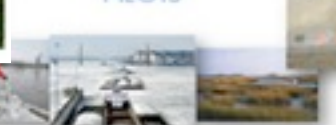


USACE CLIMATE CHANGE ADAPTATION PLAN AND REPORT 2012



Short-Term Water Management Decisions

Your Needs for Improved Climate, Weather, and Hydrologic Information

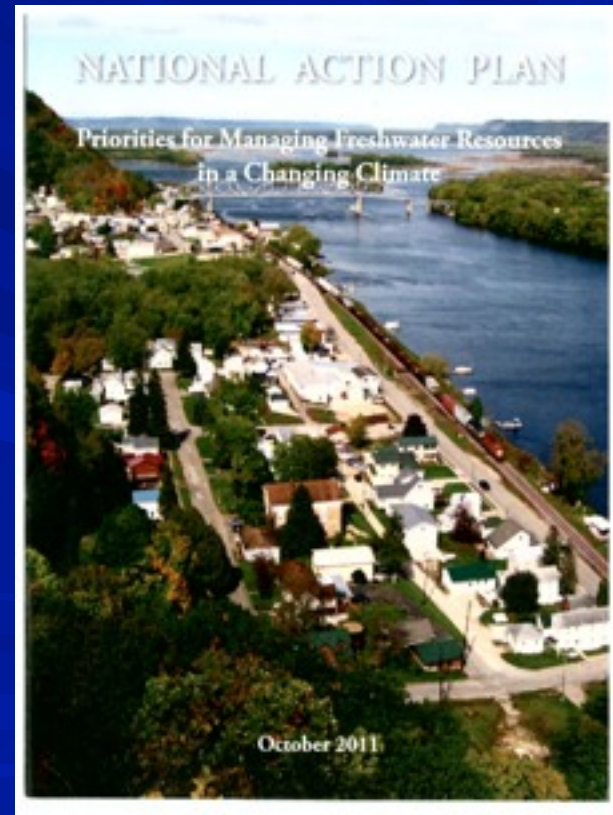


Program designed as intergovernmental collaboration w/other Federal agencies, other levels of government, academia, and stakeholders.

U.S. National Action Plan

Priorities for Managing Freshwater Resources in a

- Establish a Planning Process to Adapt Water Resources Management to a Changing Climate
- Improve Water Resources & Climate Change Information for Decision-Making
- Strengthen Assessment of Vulnerability of Water Resources to Climate Change
- Expand Water Use Efficiency
- Support Integrated Water Resources Mgt
- Support Training and Outreach to Build Response Capacity

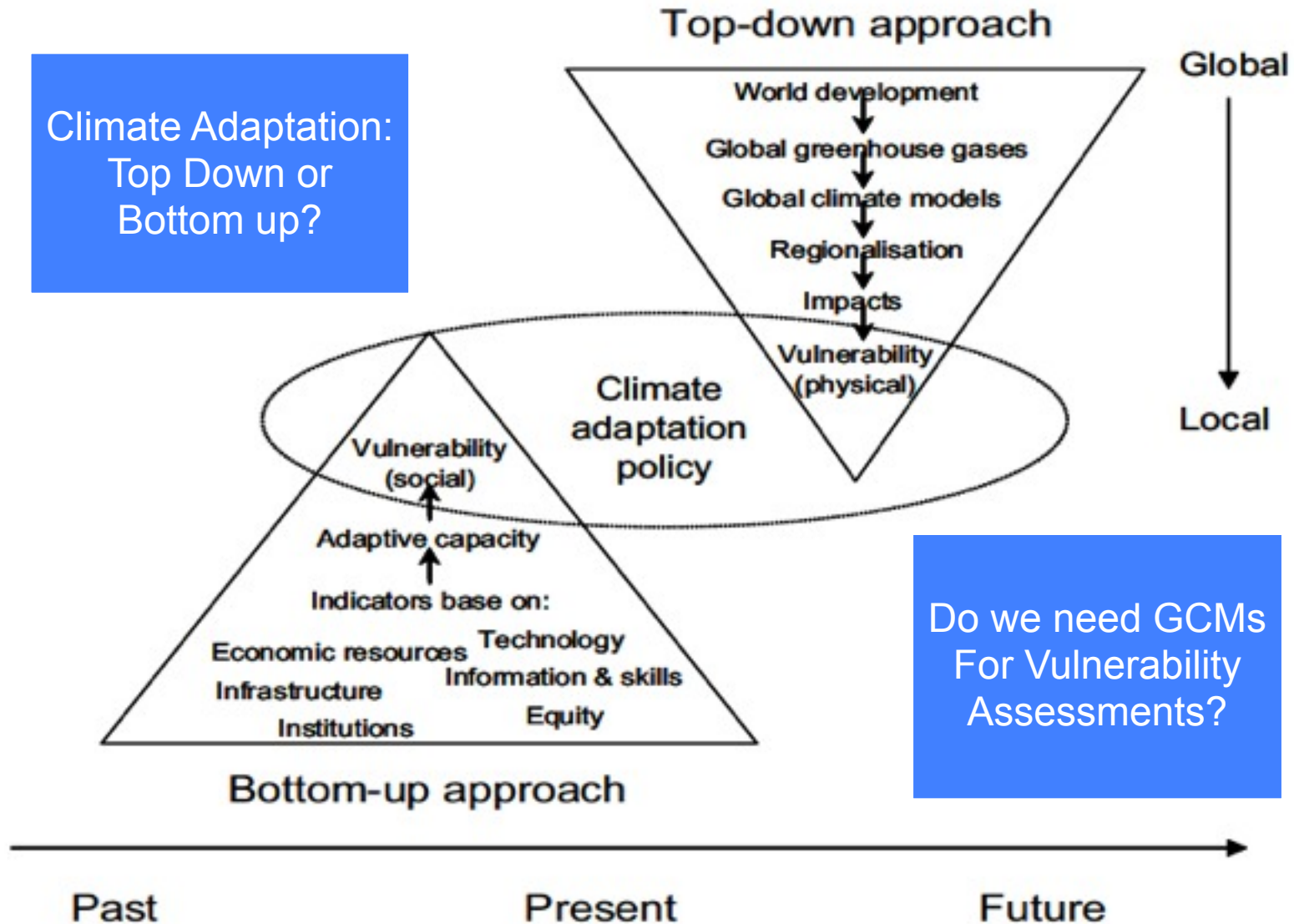




Policy & Operational Challenge: Convergence of Atmospheric & Hydrologic Modeling Capabilities



Climate Adaptation:
Top Down or
Bottom up?



Do we need GCMs
For Vulnerability
Assessments?



Combination of Different Methods for Incorporating Climate Information into Water Systems & Project Planning/Operations

- ☑ **GCM scenario analysis** (test plans for robustness, resiliency, reliability)
- ☑ **Traditional Stochastic analysis** of historic data
- ☑ **Hindcasting based on dendro-climatology & statistical 'voodoo'** to extend records
- ☑ **Extending existing statistical tools & models** (e.g. Log-Pearson 3 → 'fat-tailed' distributions-GEV)
- ☒ **GCM downscaling** & derived frequency analysis at watershed/specific project (not ready for 'prime time')



Some Differences in IWRM

Goals: Developed &



Developed

- Comprehensive planning
- Resource use efficiency
- Regulatory/Legal focus
- Flood control, navigation, multipurpose storage
- Private Sector Investment
- Eco-restoration/biodiversity
- Watershed Mgmt/Protection
- Hazard Risk reduction plans
- Recreation & Esthetics
- Transparency/Accountability
- Participatory planning
- Expensive technologies

Developing

- Disaster Resiliency
- Poverty reduction
- Access to clean water
- Women's roles promoted
- Irrigation/drainage
- Water Supply/Sanitation
- Public sector investment
- Waterborne diseases
- Rural Development
- Humanitarian disaster relief
- Water User associations for operation and maintenance
- "Appropriate" technologies

Water & Sanitation Sector : Key Ingredient in all MDGs



Goal 1 Eradicate extreme poverty and hunger

- WSS essential for improving quality of life – for health & economic development

Goal 2 Achieve universal primary education

- WSS keeps children fit & underpins healthy school environment.

Goal 3 Promote gender equality & empower women

- WSS saves women's time & provides opportunities for women to lead.

Goal 4 Reduce child mortality

- WSS reduces morbidity/mortality.

Goal 5 Improve maternal health

- WSS reduces miscarriages, deaths, & impacts on fetuses/newborns.

Goal 6 Combat HIV/AIDS, malaria, & other diseases

- WSS prevents vector born & water/hygiene-related diseases.

Goal 7 Ensure environmental sustainability

- WSS requires local management of environment & water resources.

Goal 8 Develop a global partnership for development

- WSS needs partnerships of governments/NGOs/business/donors/people.

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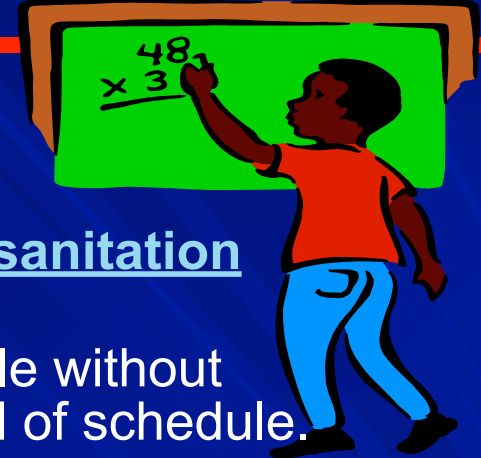
- ✓ 2000-2015: Halve proportion of people without sustainable access to safe drinking water
- ✓ 2020: Have achieved a significant improvement in the lives of at least 100 million thru access to improved sanitation.

Some Good News for the Gloomy Global

Target 7.C:

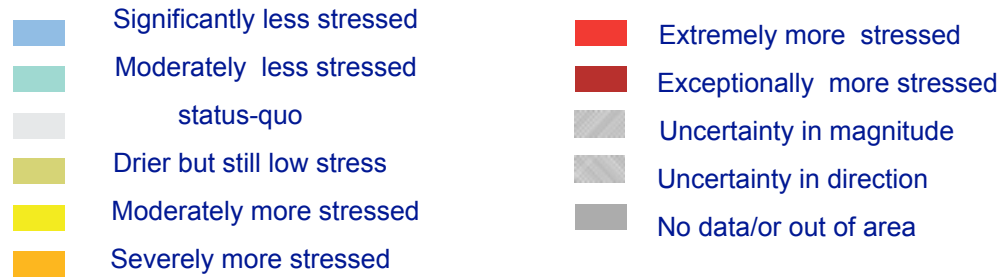
Halve, by 2015, the proportion of the population without sustainable access to safe drinking water & sanitation

- ✓ The world has met target of halving proportion of people without access to improved sources of water, five years ahead of schedule.
- ✓ Between 1990 and 2010, more than two billion people gained access to improved drinking water sources.
- ✓ The proportion of people using an improved water source rose from 76 per cent in 1990 to 89 per cent in 2010
- ✓ Over 40 per cent of all people without improved drinking water live in sub-Saharan Africa.
- ✓ Eleven per cent of the global population—783 million people—remains without access to an improved source of drinking water and, at the current pace, 605 million people will still lack coverage in 2015

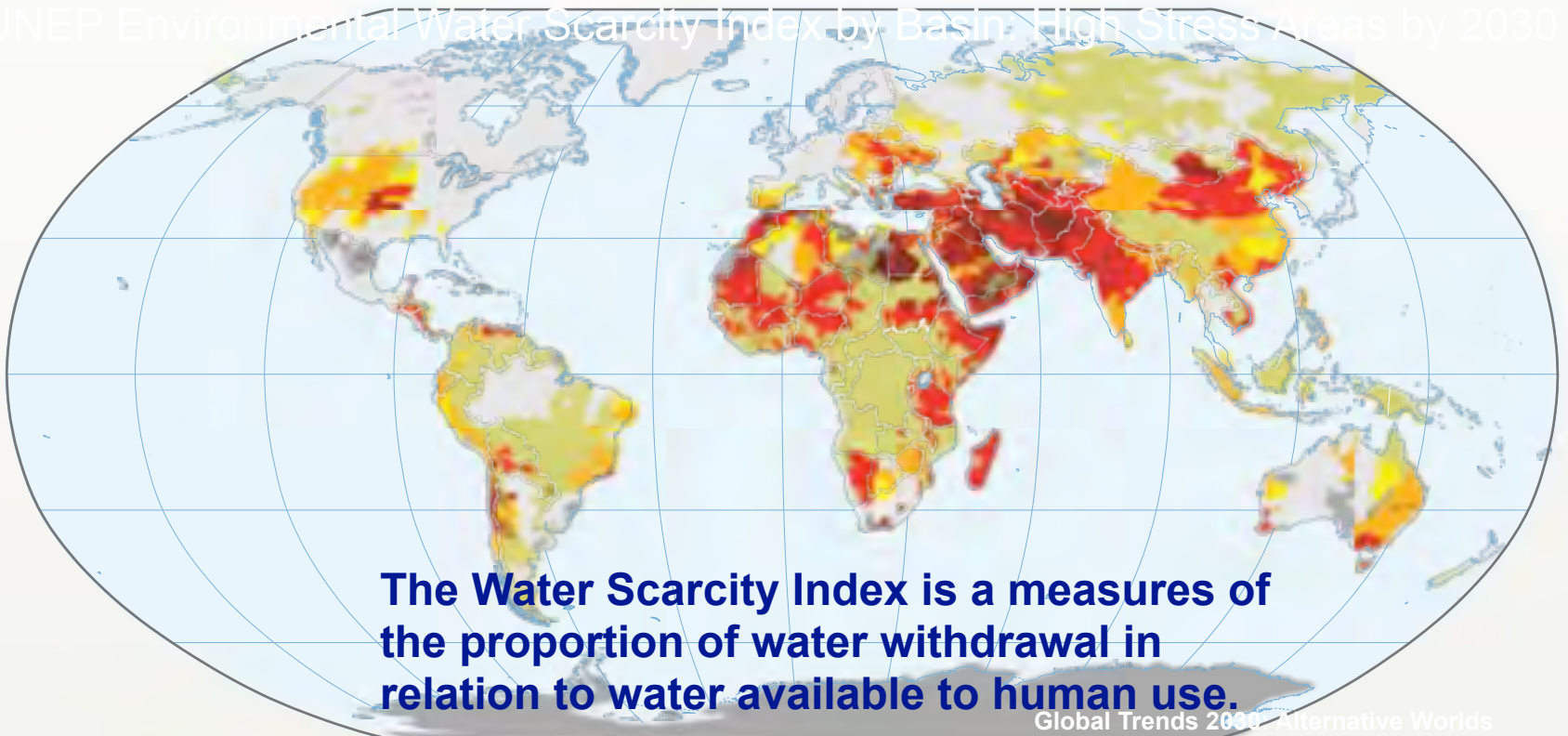




Future Global Water Scarcity



UNEP Environmental Water Scarcity Index by Basin: High Stress Areas by 2030



The Water Scarcity Index is a measures of the proportion of water withdrawal in relation to water available to human use.

Global Trends 2000: Alternative Worlds
by the National Intelligence Council, 2012

Water Security

Billion \$

% GDP

700

14

600

12

400

10

300

8

200

6

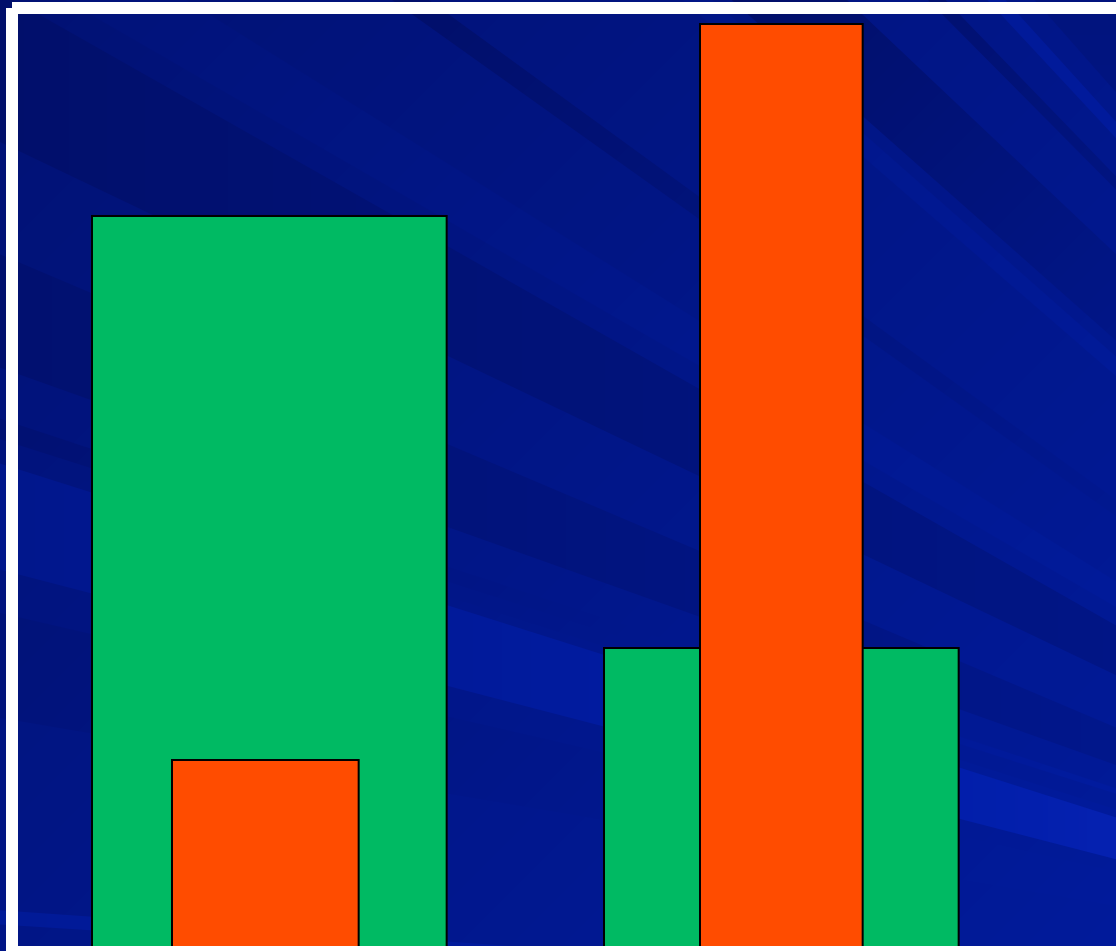
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Richest Nations

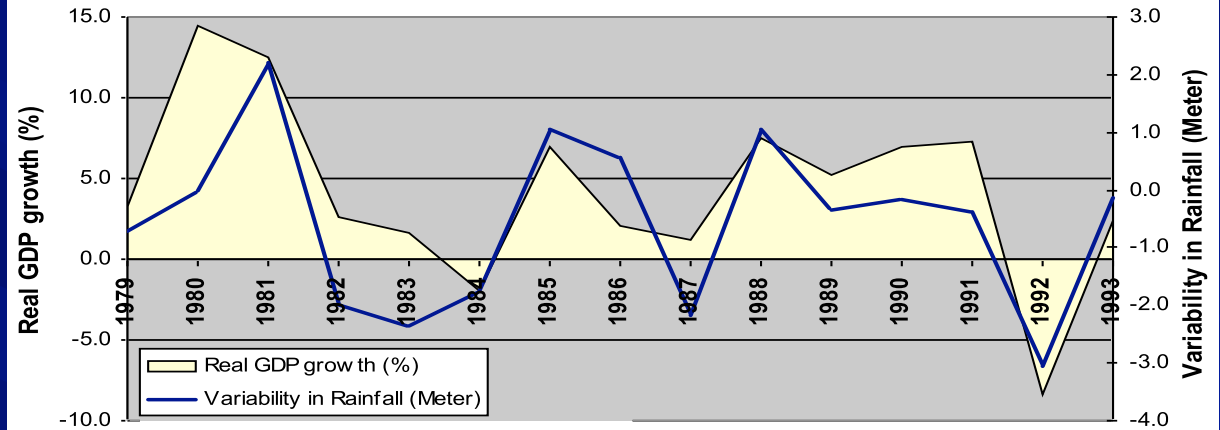
Poorest Nations

Losses %
GDP

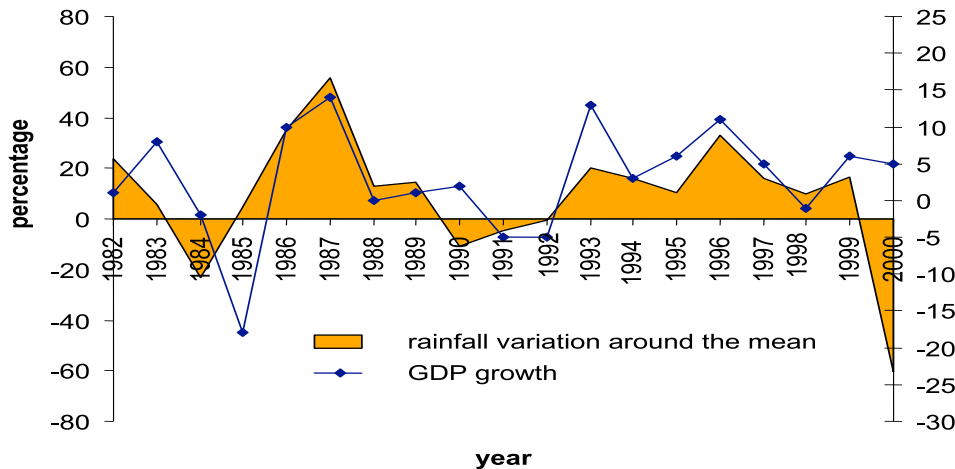
Economic
Losses

Disasters Losses, Total and as Share of GDP, In the Richest and Poorest Nations, 1985 – 99 (world watch 2001)

Economy-wide impacts



Rainfall & GDP growth: Zimbabwe 1978-1993

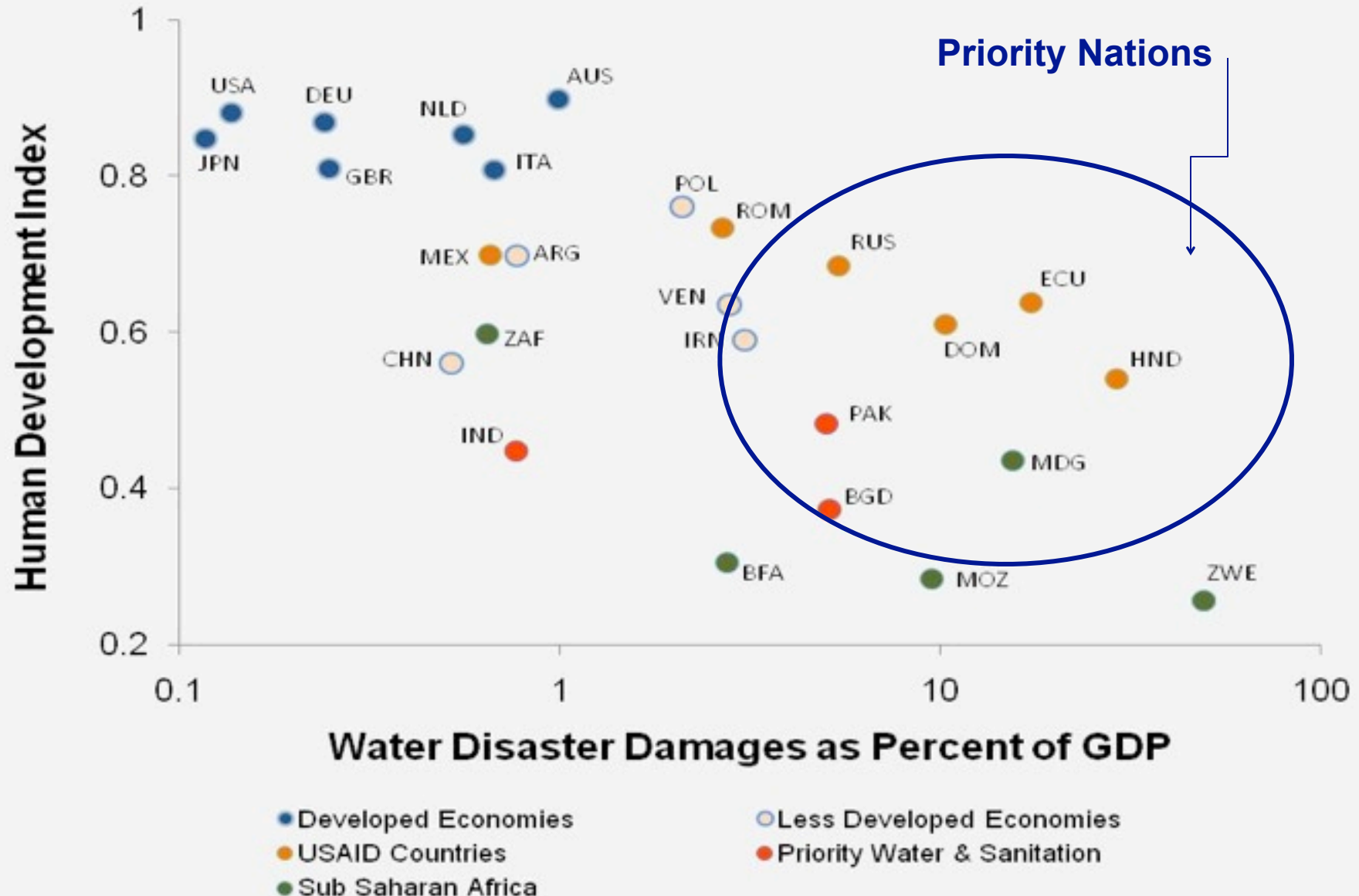


Rainfall & GDP growth: Ethiopia 1982-2000





Challenge for Developing Nations: Lack of Resilience and Economic Vulnerability to Extreme Events

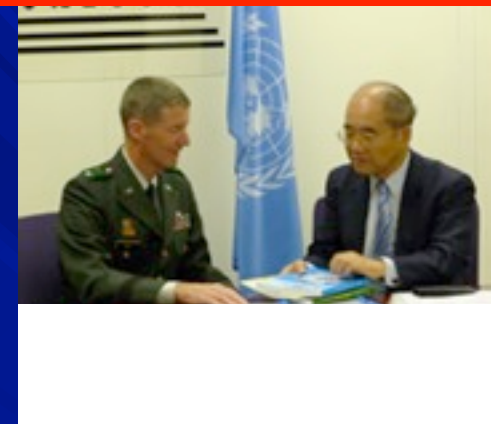




International Center for Integrated Water Resources Management (IWR - ICIWaRM)



Mission: Advancement of the science and practice of IWRM to address water security and other water-related challenges around the globe.....within the framework of UNESCO's International Hydrological Program (IHP).



ICIWaRM facilitates USACE involvement in international water resources activities in association with the U.N.



Technology transfer: hydrologic model training in Kenya & Ethiopia via the Combined Joint Task Force – Horn of Africa.

Supporting the UNESCO IHP global river basin network which includes Iowa-Cedar River (Rock Island District involvement).



Sharing best planning practices developed by the Corps, such as Shared Vision Planning workshops for Peru & World Bank.



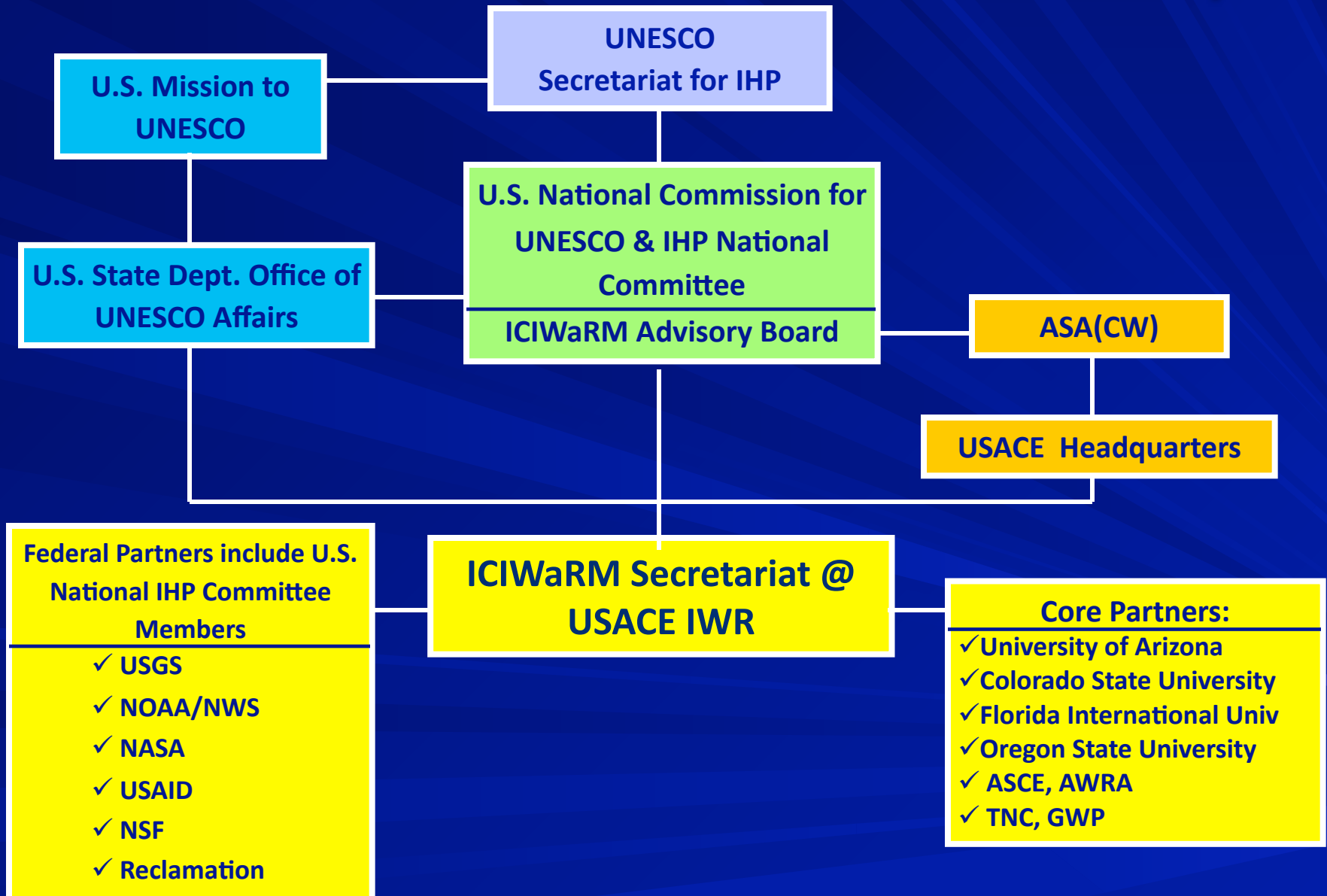


United Nations
Educational, Scientific and
Cultural Organization



International Center for Integrated
Water Resources Management
under the auspices of UNESCO

ICIWaRM Organizational Structure & Relationships





United Nations
Educational, Scientific and
Cultural Organization

International Hydrological Programme

UNESCO » Natural Sciences » Environment » Water » IHP

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Water

IHP

- [About IHP](#)
- [IHP-VII Themes](#)
- [IHP Programmes](#)

WWAP

UNESCO-IHE

Water Centres

Water Chairs

UNESCO's Intergovernmental Scientific Cooperative Programme in Hydrology and Water Resources



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International
Hydrological
Programme

The International Hydrological Programme (IHP) is the only intergovernmental programme of the UN system devoted to water research, water resources management, and education and capacity building. The programme, tailored to Member States' needs, is implemented in six-year phases – allowing it to adapt to a rapidly changing world.

IHP-VII: Water Dependencies: Systems under Stress and Societal Responses

This phase of IHP (2008-2013) will continue to promote and lead international hydrological research, facilitate education and capacity development and enhance governance in water resources management. The aim of these efforts is to help meet the UN Millennium Development Goals (MDGs) on environmental sustainability, water supply, sanitation, food security and poverty alleviation.

[▲ Back to top](#)

IHP PROGRAMMES

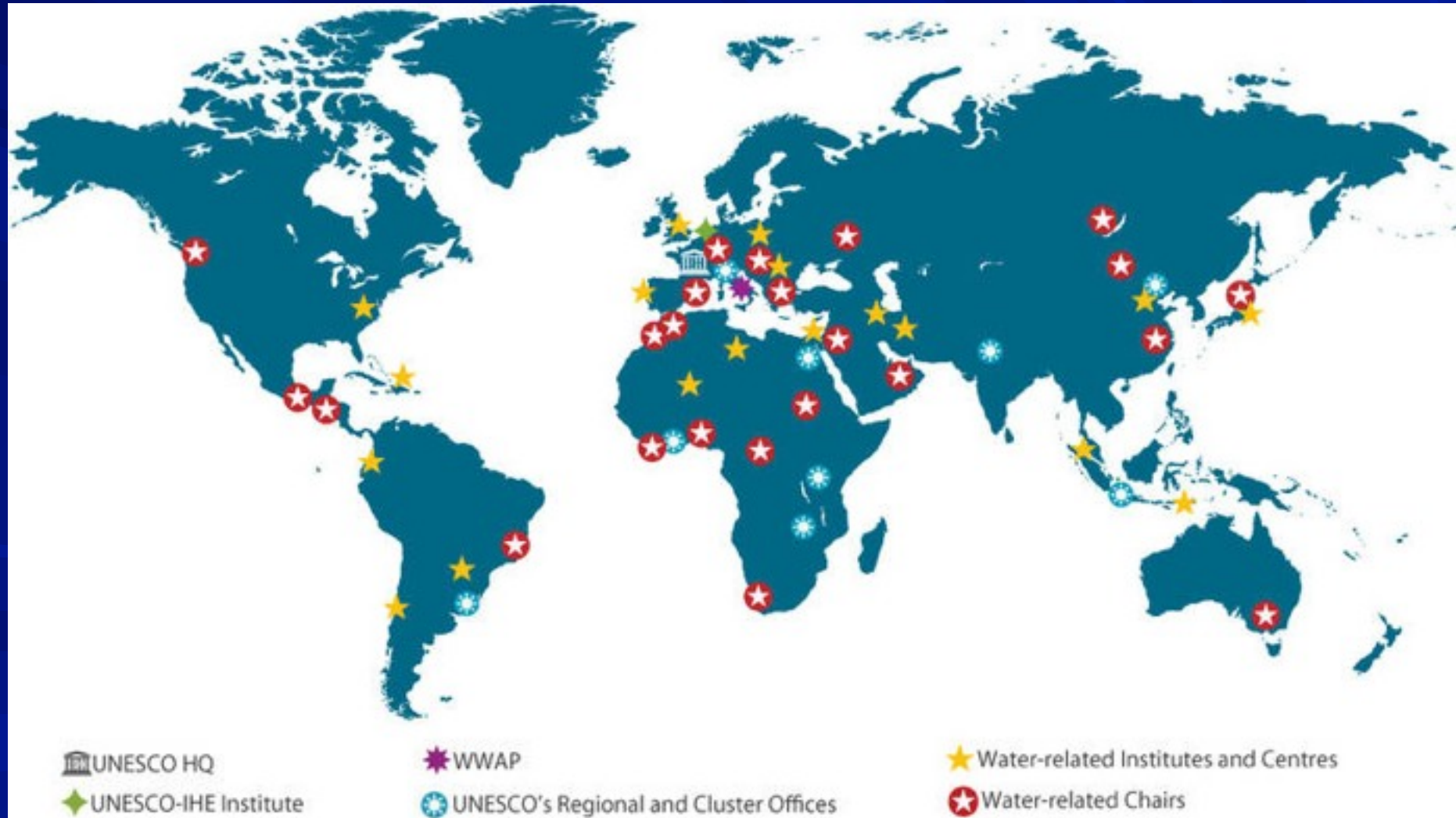
- ▶ [FRIEND](#)
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- ▶ [G-WADI](#)
- ▶ [HELP](#)
- ▶ [IFI](#)
- ▶ [ISARM](#)
- ▶ [ISI](#)
- ▶ [JIHP](#)
- ▶ [PCCP](#)
- ▶ [UWMP](#)
- ▶ [WHYMAP](#)



UNESCO's International Hydrological Program



UNESCO's water family operates as a global network that works together to implement the organization's strategic goals





United Nations
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International Center for Integrated
Water Resources Management
under the auspices of UNESCO

Program Focus

- **Focus on practical science and technology** development which can be readily transferred to improve integrated water resources management (IWRM) in developing nations and contribute towards meeting Millennium Development Goals.
- Partner and **support existing UNESCO-IHP programs** which serve to **implement IHP programmatic objectives** related to IWRM.
- **Seek collaborations for joint applied research, capacity-building and training programs through existing UNESCO Centers** and established programs, with particular emphasis on Latin America and the Caribbean, and Africa.
- Recently extended emphasis to Asia-Pacific region.



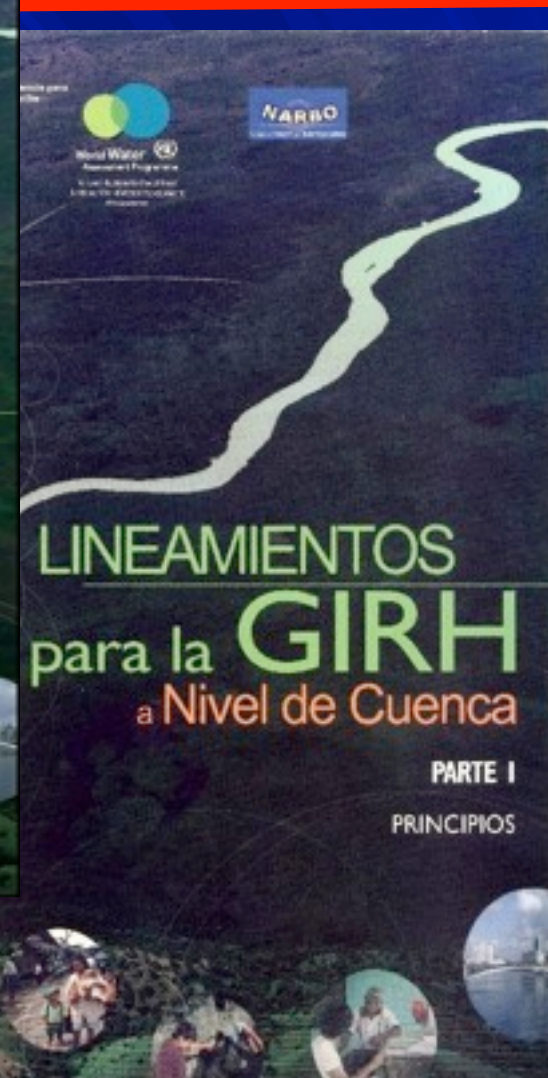
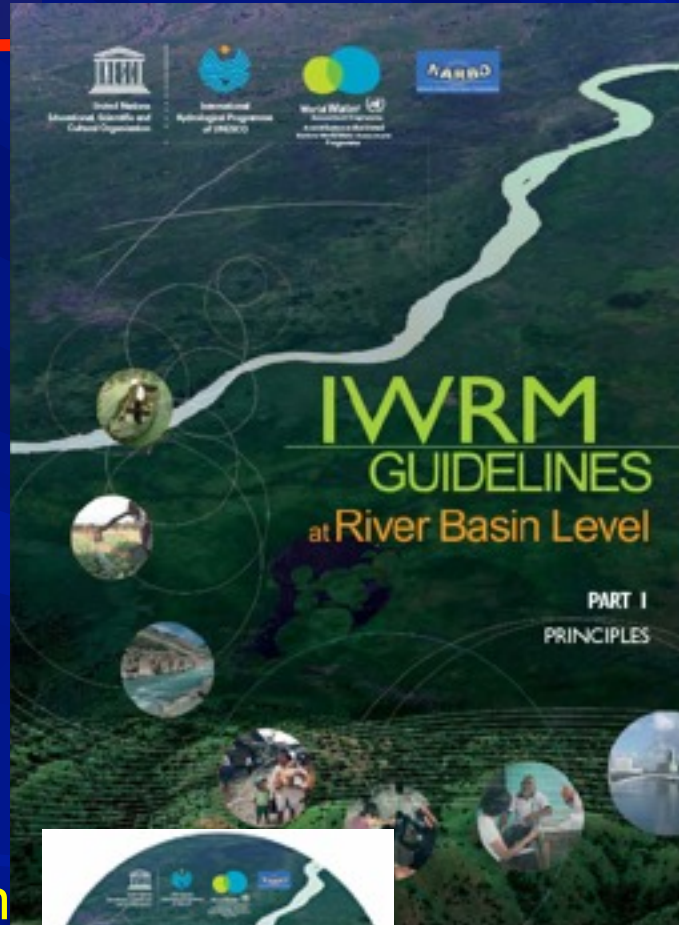
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International Center for Integrated
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Best Practices in Integrated Water Resources Management

- Steering Committee Co-Chair of UNESCO/WWAP/ NARBO publication series “IWRM Guidelines at River Basin Scale”
- Coordinated Spanish translations with UNESCO and IDB
- Drafting new volume on Collaborative Planning in IWRM





ICIWaRM-UNAM MOU for Mexico National Wetlands Inventory



- ICIWaRM helped coordinate first Mexico International Conference on Wetlands
- Some benefits:
 - Leverage Federal experience and knowledge from US National Wetlands Inventory
 - Coordinate cross-border efforts, such online North American wetland plants database, managed by USACE.





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Study of the Causes of the Rising Water Level of Lake Enriquillo, Dominican Republic





Hydrologic & Hydraulic Modeling

- Basic theory and applications, problem solving and advice on ongoing projects
- Ethiopia, Kenya, Paraguay Dominican Republic (WB)
- Spanish Translations





Collaborative Planning in Peru



- Providing training, guidance, and supervisory assistance in Shared Vision Planning (SVP) for IWRM plans at six pilot basins
- Partners: World Bank, Inter-American Development Bank, ANA (US\$40M)
- Update: evaluated the first phase of Peru National Water Authorities' Modernization of Integrated Water Resource Management Project.

SVP integrates:

- Systems modeling
- Structured participation
- IWRM planning





ICIWaRM is the Technical Secretariat for IHP's "Water & Development Information for Arid Lands" (G-WADI).



Regional networks:
"Asian G-WADI"
"Arab G-WADI"
"G-WADI-Africa" and
"G-WADI-LAC"



Quick Links



News & Announcements



[Regional G-WADI Training Workshop on Climate Change Held in Tehran, Iran](#)
Monday, June 20, 2011

Inaugural meeting, Arab G-WADI,
Cairo, 2010

www.gwadi.org

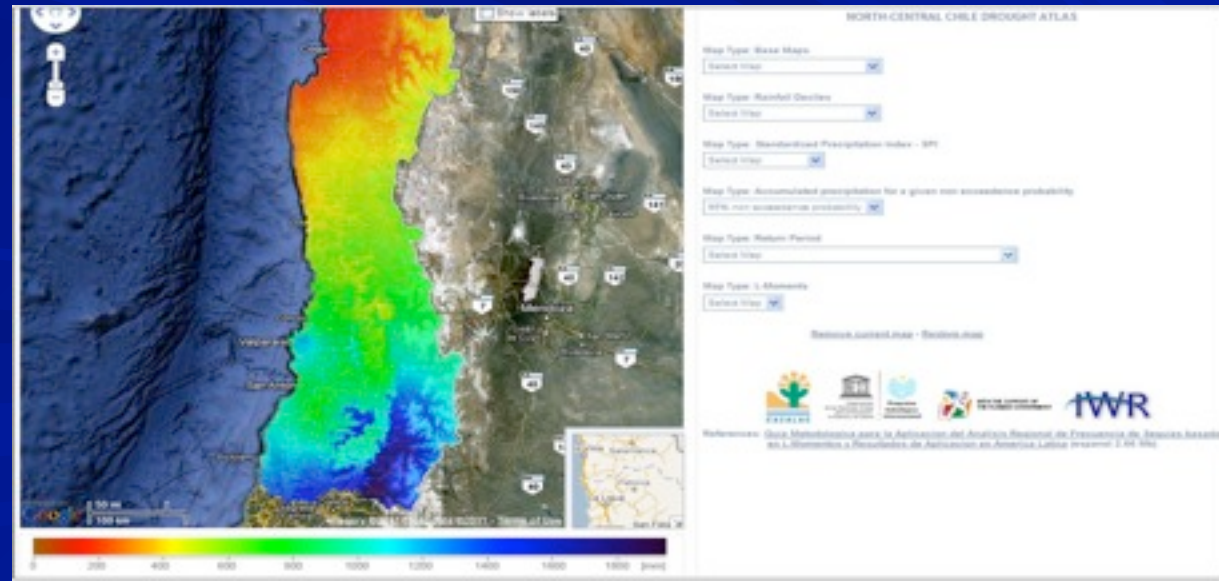


Drought Atlas for Pilot Regions of Latin America



- CAZALAC with ICIWaRM support has been leading development of drought atlases for parts of Chile, Perú, Ecuador, Argentina, and México
 - ICIWaRM has helped with technical workshops on the methodology and brought in experts on L-moments.
 - ICI-RAFT software (ICIWaRM – Regional Frequency Analysis Tool), a USACE approved, non-proprietary, publicly available software package is being used.
 - ICIWaRM has convened multiple workshops in Latin American to train water professionals in regional rainfall frequency analysis.

Regional Drought Atlas
for Northern Chile.
Source: CAZALAC





Supporting USAID & the Mekong River Commission on Scenario Planning



June 18-21 Workshop for:
MRC Secretariat
Policy/technical experts from Nat. Comms.
(Cambodia, Laos, Thailand and Viet Nam)



Purpose: strengthen MRC's capabilities in IWRM thru a scenario based framework and process, and IWR's Shared Vision Planning techniques

Follow-on meetings completed for a case study in the Nam Kam River watershed in Thailand held with USAID & MRC- Thailand staff and stakeholders.





Rwanda Integrated Water Security Program



Florida International University (USAID-Sponsored GLOWS program)



World Water Day March 22: Govt. Launches Water Conservation Policy





US Army Corps of Engineers

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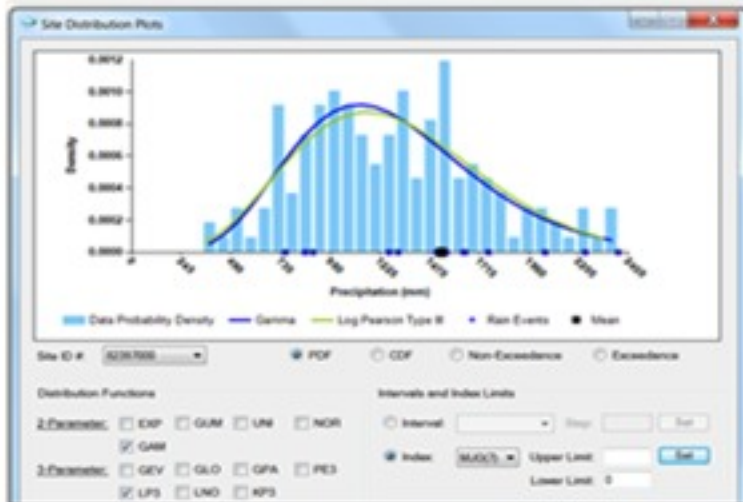
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