Individually, many nations will be unable to improve their drought coping capacity.

Collectively, through global, regional, and national partnerships, we can share information and experiences to reduce the impacts of drought.
Potential Regional Networks

- North American Network
- Mediterranean Network
- Eastern and Central European Network
- Sub-Saharan African Network
- Asian Network
- South American Network
- West Asia Network
The rapid onset of National Drought Centers/Strategies:

- Australia
- South Africa
- Canada
- United States
- Slovenia/Southeast Europe
- Spain
- EU/JRC
- Portugal
- South Korea
- China
- India
- Pakistan
- Morocco
- Syria
- Brazil (Sao Paulo state)
- Jordan
- Iran
The Importance of Drought Early Warning Systems (DEWS)

- allows for *early* drought detection
- improves response (*proactive*)
- “triggers” actions within a drought plan
- a critical *mitigation* action
- *foundation* of a drought plan
Components of a Drought Early Warning System

- Monitoring AND Forecasting
- Synthesis/analysis of data used to “trigger” set actions within a drought plan
- Efficient dissemination/communication (WWW, media, extension, education, etc.)
- Drought risk planning
Potential DEWS System Products and Reports

*Historical analysis* (drought climatology, impacts, magnitude, frequency)

*Operational assessment* (cooperative data, SPI and other indices, automated networks, satellite and soil moisture data, media and official requests)

*Predictions/Projections* (SPI and other indices, soil moisture, streamflow, seasonal forecasts, SST’s)
NIDIS Objectives

Creating a drought early warning information system

- Coordinating national drought monitoring and forecasting system
- Providing an interactive drought information clearinghouse and delivery system for products and services—including an internet portal and standardized products (databases, forecasts, Geographic Information Systems (GIS), maps, etc)
- Designing mechanisms for improving information to support coordinated preparedness and planning
Drought Monitoring State of the Science: Where are we now?

- Heightened awareness as a result of IPCC AR4
- An explosion of good work/tools/products out there over the past 5 years
- Impediments remain
  - Lack of coordination
  - Lack of trigger ties to any drought plans
  - Resources
  - Lack of data/long-term data
  - Lack of institutional cooperation
  - Lack of drought “mitigation” plans
Drought Monitoring State of the Science: Where are we now?

- WCC-3, GDPN/GEOSS is a way to learn/leverage from one another
  - Canada/Mexico/United States
  - UN/WMO/others
- Many regions/countries are working together to better monitor drought
- Monitoring of impacts globally is virtually non-existent
- Early warning/monitoring just one key: THEN WHAT? Need linkages to risk/vulnerability assessment and planning for adaptation
- Many indicators don’t reflect reality in various regions, or for various season(s)……or for both!
Future Opportunities/Challenges

- Climate change
- Public health issues
- Transboundary issues
- Food security and water
  - Global Water Institute/Water for Food
- Risk management
  - Mitigation applications
  - Planning activities
  - Improved monitoring and prediction
  - Decision support
- National Integrated Drought Information System
- Global Integrated Drought Information System
- Global “Drought Services” (GFCS)
Future Drought Monitoring Challenges

The Big Five:

- Impact collection/quantification
- Soil moisture (especially *in situ*)
- Hydrology (surface and groundwater)
- Application of R.S./Modeled products operationally (trust)
- Ecological/Environmental (D-x E?)

“If a drought occurs in the desert, does anybody see it?”
Thank You!

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Future Challenges in Water Resources Management

- Population growth
- Population migration
- Transboundary issues
- Reallocation of water supplies
- Few water development projects
- Institutional fragmentation
- Climate change and variability
- Land degradation
- Regional conflicts/war
Mitigation

Planning

**Monitoring/Early Warning**

Supply augmentation
- Infrastructure improvements

Demand reduction

Education

Communication

Coordination

Legislation
Components of Successful Drought Mitigation Plans

**Monitoring, early warning, and prediction**
- Foundation of a drought mitigation plan
- Indices/indicators linked to impacts and triggers

**Risk and impact assessment**
- Who and what is at risk and why?

**Mitigation and response**
- Pro-active programs and actions to reduce risks
- Safety net/programs

Most drought plans contain only the monitoring and response components.
Importance of Drought Indices

Simplify complex relationships and provide a good communication tool for diverse audiences

Quantitative assessment of anomalous climatic conditions
- Intensity
- Duration
- Spatial extent

Historical reference (probability of recurrence)
- Planning and design applications
**Indicators & Triggers**

**Definitions**

**Indicators**: Variables to describe drought conditions.

Examples: precipitation, streamflows, groundwater, reservoir levels, soil moisture, Palmer indices, …

**Triggers**: Specific values of the indicator that initiate and terminate each level of a drought plan, and associated management responses.

Example: precipitation below the 5th percentile for two consecutive months → Level 4 Drought.

*(From GA State Plan)*
Considerations in Choosing Indicators / Triggers

- Proper and Timely Detection of Drought
- Spatial and Temporal Sensitivity
- Supplies and Demands
- Drought In / Drought Out
- Composite and Multiple Indicators
- Data Availability, Validity, and Clarity
- Ease of Implementation

(From GA State Plan)
The National Integrated Drought Information System (NIDIS): What is it? What does it do?

Mark Svoboda (NDMC), Climatologist, Monitoring Program Area Leader, NIDIS Implementation Team

Roger Pulwarty (NOAA-NPO Director) and Jim Verdin (USGS-Assistant NPO Director)
NIDIS Program Office NOAA/ESRL, Boulder, Colorado
NIDIS VISION and GOALS

“A dynamic and accessible drought information system that provides users with the ability to determine the potential impacts of drought and the associated risks they bring, and the decision support tools needed to better prepare for and mitigate the effects of drought.” Public Law 109-430 (Signed by the President December 2006)

(www.drought.gov)
Early Warning System components

- Monitoring and forecasting
- Risk assessment: Indicators and triggers
- Drought risk planning and preparedness
- Drought Portal
- Communication and Education
Key issues

• What climate and drought-related triggers are used for management and response seasonal operations, long-term planning (watershed, industry, state, county)?

• How can we most effectively develop and coordinate information for early warning (onset, duration, demise, impacts) into drought plans? (e.g. Exceptional Drought Operation Plan, Interim Operating Plan, Power needs etc?)

• Proposed NIDIS Pilots: Partnerships to maintain a regional dialog on drought, climate and water resources
National Climate Service: Information services in support of adaptation

- RESEARCH & DEVELOPMENT & PROTOTYPING & SERVICES

RISAs, universities, and labs
Integrating knowledge and products (CDC, ETL, RCCs, RFCs, SCs)
Operational (RCCs, NCDC, CPC, WFOs, SCs, other private sector)

new or enhanced regional products
information delivery technology
sustained & systematic communication and feedback
What is GEOSS?: The Global Earth Observation System of Systems

The Global Earth Observation System of Systems will provide decision-support tools to a wide variety of users. As with the Internet, GEOSS will be a global and flexible network of content providers allowing decision makers to access an extraordinary range of information at their desk.
WCC3 Executive Summary concluded:

• that present capabilities to provide effective climate services fall far short of meeting present, and future needs and benefits, particularly in developing countries;

• that the most urgent need is for much closer partnerships between the providers and users of climate services;

  – that great scientific progress has been made especially by the World Climate Programme and its associated activities over the past 30 years, which provides already a firm basis for the delivery of a wide range of climate services; and

  – that major new and strengthened research efforts are required to increase the time-range and skill of climate prediction through new research and modelling initiatives; and

  – to improve the observational basis for climate prediction and services, and the availability and quality control of climate data;
• **called for major strengthening of the essential elements of a global framework for climate services:**
  – The Global Climate Observing System and all its components and associated activities; and
  – **provision of free and unrestricted exchange and access to climate data;**
  – The World Climate Research Programme, underpinned by adequate computing resources and increased interaction with other global climate relevant research initiatives.
  – Climate services information systems **taking advantage of enhanced existing national and international climate service arrangements** in the delivery of products, including sector-oriented information to support adaptation activities;
  – **Climate user interface** mechanisms focused on building linkages and integrating information, at all levels, between the providers and users of climate services; and
  – Efficient and enduring **capacity building** through education, training, and strengthened outreach and communication.

• **supported the development of the proposed Global Framework for Climate Services.**