

World Meteorological Organization

Working together in weather, climate and water

Drought Monitoring and Early Warning Systems

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- Review of High-Level Meeting on National Drought
 Policies
- Introduction to Drought Monitoring and Early Warning Systems
- Different Drought Indices and Data Issues
- Successful examples/ongoing initiatives



World Meteorological Organization

- United Nations agency for weather, climate, hydrology and water resources and related environmental issues.
- 191 Members from National Meteorological and Hydrological Services (NMHS) – New Member – South Sudan (Dec 2012)
- 10 major scientific & technical programmes (Secretariat)
- 8 Technical Commissions advise & guide activities of programmes (Experts)
- 6 Regional Associations involved in implementation

Global Framework for Climate Services

- Goal:
 - Enable better management of the risks of climate variability and change and adaptation to climate change at all levels, through development and incorporation of science-based climate information and prediction into planning, policy and practice.



World Meteorological Organization Weather • Climate • Water

WORLD CLIMATE CONFERENCE - 3 Geneva, Switzerland 31 August-4 September 2009



Priorities

- Agriculture
- Disaster risk reduction
- Water
- Health



High-Level Meeting on National Drought Policies



United Nations Convention to Combat Desertification

- March 11-15 2013
- Over 414 participants from 87 countries
- Main Partners UNCCD, FAO, WMO
- Key message: Help countries move from reactive to proactive drought policies





- 12 representatives of UN agencies and international and regional organizations (UNU, IFRC, IOM, CBD, WFP, IAEA, UNECA, JRC, ICARDA, GWP, ACMAD, ISDR)
- Final Declaration adopted www.wmo.int/hmndp



HMNDP Main Organizers and Partners

- World Meteorological Organization (WMO)
- United Nations Convention to Combat Desertification (UNCCD)
- United Nations Food and Agriculture Organization (FAO)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- United Nations Development Programme (UNDP)
- UN-Water Decade Programme on Capacity Development (UNW-DPC)
- United Nations International Strategy for Disaster Reduction (UNISDR)
- World Food Programme (WFP)
- Global Water Partnership (GWP)
- International Fund for Agricultural Development (IFAD)
- A total of 17 Organizations



Scientific Segment

- •9 substantive sessions in the Scientific Segment plus 2 synthesis/reporting sessions (regional breakout groups and summary)
- •28 posters in three poster sessions. 16 Side events
- •All sessions produced summaries and recommendations
- •Compendium from July 2011 Workshop revised as HMNDP Science Document



HMNDP Science & Policy Documents

www.wmo.int/hmndp.org

See items 18-26

6th Regional Workshop on NDMP – West/Central Africa - May 2015



Launch of initiatives

- 2013 World Day to Combat Desertification, UN Decade for Deserts and the Fight against Desertification, and UN Decade on Biodiversity
- Integrated Drought Management Programme (IDMP) with WMO & GWP
- National Drought Management Policies Initiatives (NDMP) with UNW-DCP, FAO, UNCCD, & WMO



Introduction



Why Monitor Drought?

- Drought is a Normal Part of the Climatic Cycle
- Drought Impacts are Significant & Widespread
- Many Economic Sectors Affected
- Drought is **Expensive**
 - Droughts cause more deaths and displace more people than any other kind of natural disaster.
 - Since 1980, major droughts and heat waves within the U.S. alone have resulted in costs exceeding 100 billion dollars



Importance of a Drought Monitoring System

- 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 Monitoring System

- timely data and timely acquisition
- synthesis/analysis of data used to "trigger" set actions within a plan
- efficient dissemination network (web, media, extension, etc.)



Potential Monitoring System Products and Reports

- *Historical analysis* (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)



Components of a Drought Early Warning and Information System

- Monitoring AND Forecasting
- **Tools** for decision makers
- Drought risk assessment and planning
- Education and awareness

Source: Wilhite, 2013



Indices and Data Issues



Approaches to Drought Monitoring

- Single index or parameter
- Multiple indices or parameters
- Composite index









Figure 8: Hydrogramme du Fleuve Niger à Niamey de la Troisième décade de juillet 2014



6. CONDITIONS HYDRIQUE DES CULTURES DU RIZ ET DU MAÏS

6.1 Situation hydrique du 01 au 10 avril 2015

TABLEAU 2 : Indice moyen de satisfaction des besoins en eau de la culture de maïs de 4 mois (120 jours) 01 au 10 avril 2015

JOURS APRES SEMIS	10	20	30	40	50	60	70	80	90	100	110	120
BONDOUKOU												
DALOA												
DIMBOBRO												
YAMOUSSOUKRO												
GAGNOA												
ADIAKE												
ABIDJAN												
SASSANDRA												
SAN PEDRO												
TABOU												
KORHOGO												
BOUAKE												

Tableau 3 : Indice moyen de satisfaction des besoins en eau de la culture du riz de 4 mois (120 jours) 01 au 10 avril 2015

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TABOU												
KORHOGO												
BOUAKE												

STRESS

PAS DE STRESS HYDRIQUE



Fig.9 : NDVI à la 2^{ème} décade d'avril 2015



Fig.10 : Anomalies des différences d'images d'indices de végétation entre la 2^{eme} décade d'avril 2015 et la moyenne 2001-2010





SEASONAL PRECIPITATION FORECAST FOR MARCH-APRIL-MAY 2015 ISSUED ON MARCH 11 2015 PREVISION CLIMATIQUE SAISONNIERE DES PRECIPITATIONS DE MARS-AVRIL-MAI 2015, ELABOREE LE 11 MARS 2015



Figure 1: Seasonal forecast of precipitation for March-April May 2015



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 is a Level 4 Drought.





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



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



Key Variables for Monitoring Drought

- climate data
- soil moisture
- stream flow / ground water
- reservoir and lake levels
- snow pack
- short, medium, and long range forecasts
- vegetation health/stress and fire danger
- remote sensing products
- impacts



Lincoln Workshop

 Inter-Regional Workshop on Indices and Early Warning Systems for Drought held in Lincoln, Nebraska, USA from 8 to 11 December 2009

Co-Sponsors:

- National Drought Mitigation Center (NDMC)
- United States Department of Agriculture (USDA)
- United States National Oceanic and Atmospheric Administration (NOAA)
- United Nations Convention to Combat Desertification (UNCCD)
- University of Nebraska-Lincoln, School of Natural Resources
- World Meteorological Organization

http://www.wmo.int/pages/prog/wcp/agm/meetings/wies09/index_en.html



Source: Wilhite 2006



Lincoln Declaration - Recommendations

- The National Meteorological and Hydrological Services (NMHSs) are encouraged to use SPI to characterize meteorological droughts and provide this information in addition to indices currently in use.
- A comprehensive user manual for the SPI should be developed that describes the index, computation methods, specific examples of current use, the strengths and limitations, mapping capabilities, and how it can be used.



Probability of Recurrence

SPI	Category	# of times in 100 yrs.	Severity of event
0 to -0.99	Mild dryness	33	1 in 3 yrs.
-1.00 to -1.49	Moderate dryness	10	1 in 10 yrs.
-1.5 to -1.99	Severe dryness	5	1 in 20 yrs.
< -2.0	Extreme dryness	2	1 in 50 yrs.



Standardized Precipitation and Evapotranspiration Index (SPEI)

- New variation of the SPI index by Vicente-Serrano et al. (2010) includes a temperature component.
- The inputs required are precipitation, mean temperature, and latitude of the site(s) to run the program on.
- More information can be explored through obtaining the SPEI at <u>http://sac.csic.es/spei/index.html</u>.
- Vicente-Serrano, S.M., Beguería, S., and López-Moreno, J.I. (2010). A multi-scalar drought index sensitive to global warming: The Standardized Precipitation Evapotranspiration Index – SPEI. *Journal of Climate* 23(7), 1696-1718, DOI: 10.1175/2009JCLI2909.1



WMO Publications on Drought

TOWARDS A COMPENDIUM ON NATIONAL DROUGHT POLIC



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Standardized Precipitation Index User Guide



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WMD-No. 1090



Data Issues I

- Accurate and long-term weather data is needed
- Need at least years 30 years of rainfall data for SPI
- Can use fewer years but SPI will become unreliable
- For Agricultural and Hydrological drought need other data
 - Potential evapotranspiration (ETP)
 - Departure of ETP from normal?
 - Affected crops conditions, growth stages
 - Soil moisture (measurement/simulation/departure from normals)



Data Issues II

- **Gridded datasets can be used (i.e. GPCC-**Global Precipitation Climatology Centre)
- Remotely sensed data
- Reanalysis of weather model data
- Vulnerability and impact data are limited in area and length of record



Ongoing Initiatives



Integrated Drought Management Programme (IDMP)

6th Regional Workshop on NDMP – West/Central Africa - May 2015



IDMP Objectives



- To support stakeholders at all levels by providing policy and management guidance and by sharing scientific information, knowledge and best practices for Integrated Drought Management.
- Contributes to global coordination of drought-related efforts of existing organizations & agencies:
 - Better scientific understanding & inputs for drought management;
 - Drought risk assessment, monitoring, prediction and early warning;
 - Policy and planning for drought preparedness and mitigation across sectors; and
 - Drought risk reduction and response



Areas of Work

- 1) Development of Tools
- 2) Capacity Building
- 3) Demonstration Projects
- 4) Responding to Regional and National Needs
- 5) Development of Drought HelpDesk





Organizations interested to participate (Status November 2014)

- Food and Agriculture Organization of the United Nations (FAO)
- United Nations Convention to Combat Desertification
 (UNCCD)
- Australian Bureau of Meteorology
- Convention on Biological Diversity (CBD)
- International Center for Agricultural Research in the Dry Areas (ICARDA)
- International Commission for Irrigation and Drainage (ICID)
- International Water Management Institute (IWMI)
- Joint Research Centre (JRC)
- Mexico's National Water Commission (CONAGUA)
- Stockholm Environment Institute (SEI)

- U.S. National Drought Mitigation Center (NDMC)
- UNDP Cap-Net
- United Nations Development Progamme (UNDP)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- United Nations Environment Programme (UNEP)
- United Nations Office for Disaster Risk Reduction
 (UNISDR)
- University of Nebraska Daugherty Water for Food
 Institute
- University of Southern Queensland
- UN-Water Decade Programme on Capacity
 Development
- World Bank

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Regional Programmes and Initiatives

Support action and implementation on the ground, adding to existing efforts the strength of IDMP and its partners

Central and Eastern Europe (2013): Bulgaria, Czech Republic, Hungary, Lithuania, Moldova, Poland, Romania, Slovakia, Slovenia, Ukraine

Horn of Africa (2014): Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan and Uganda.

West Africa (2014): First in Burkina Faso, Niger and Mali, and then share lessons learned with other neighbouring countries through the WMO partners, GWP Country Water Partnerships and other partners.

South Asia Drought Monitoring System (2014) with IWMI in Bhutan, Bangladesh, Nepal, India, Pakistan and Sri Lanka

Central America (2013) Regional workshop leading to training on SPI and assessment of current drought.

South America (tbc 2015) Regional workshop in Bolivia potentially leading to follow-up activities with partners.



IDMP Drought Help Desk

Help Yourself

- Drought Management Tools
- Questions and Answers bank
- Reference Centre databases
- Discussion group using **social media**

Get Help

- **Personal assitance** for Drought Management (policies, laws, strategies)
- Capacity building
- A rapid guidance to the tools of the Help Yourself





Outcomes of Sep 2014 IDMP Meetings

- Proposed publications:
 - Integrated Drought Management Framework Document
 - Drought Indices Handbook
 - Series of Case Studies
- Engage with partners to exchange information on drought to further enhance HelpDesk
- Develop cooperation mechanism with partners to allow contributions to IDMP in consistent way avoiding duplications.
- Consider organizing an international conference on drought management in 2016



Examples



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

http://drought.unl.edu/dm

Released Thursday, September 10, 2009 Author: Rich Tinker, CPC/NCEP/NWS/NOAA



The Drought Monitor is widely used:

- Policy: Farm Bill/IRS/USDA/NOAA DGT/State
 drought plan triggers
- ~3.75M page views and ~2M visitors/year
- Media: The Weather Channel and all major newspapers/Internet Media/ Network News/ CNN/NPR/etc.
- Presidential/Congressional briefings
- A model of interagency/level collaboration



Some Examples of Decision Making Using the Drought Monitor

- USDA Dried Milk Program 2002-03
- USDA CRP Release hot spot trigger
- Numerous states use as a drought trigger (Governor's declarations)
- 2006-07 USDA Livestock Assistance
- 2006-07 IRS (tax deferral on livestock losses)
- 2008 Farm Bill
- NWS Drought Information Statements



Global Drought Information System (GDIS) Pasadena, California - 11-13 Dec 2014

- The focus of the workshop is to review current understanding of drought worldwide, and developing plans for moving forward with an experimental global drought information system (GDIS).
- Workshop sponsors:
 - WCRP
 - NIDIS
 - WMO
 - GEO
 - JRC
 - USCLIVAR



FAO-Agriculture Stress Index System (ASIS)

Developed by:

In collaboration with:









UNIVERSITY OF TWENTE.

Presented by:

Oscar Rojas (FAO)

HAT ANY ALL ALL

Agricultural Stress Index System is based on the Vegetation Health Index (VHI) (Kogan et al. 1995)



ASIS assess the severity (intensity, duration and spatial extent) of the agricultural drought







Breakout Sessions



Group Questions

• **Group A:** What are the current procedures/challenges on early warning systems?

• **Group B:** What are the meteorological and hydrological networks, data quality, sustainability needed?

• **Group C:** What mechanisms are in place for communicating and liaising drought monitoring and early warning information between national institutions?



Breakout Group Guidelines

- Each Group will have a facilitator.
- Group identifies leader and rapporteur.
- Either group leader or rapporteur makes presentation in Session 3c.
- Each group will spend 45 minutes on main group question and 15 minutes each on other questions