DRINET: Developing Community-based DRought Information Network Protocols and Tools for Multidisciplinary Regional Scale Applications

URL: http://drinet.hubzero.org/

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Slides prepared by the DRI NET team for
6th U.S. Drought Monitor Forum
Oct. 7-8, 2009
Texas, Austin
Drinet Project Overview

- NSF funded:
  - Data Interoperability Networks
  - co-funded by OCI and Hydrologic Sciences, 3 year project
- Mission
  - Create a platform, DRI NET, for collecting, synthesizing and disseminating local and regional drought related data
- Objectives
  - Standardize process for collecting drought related information at local and regional scale
  - Repurpose data for modeling, decision making, and further research in causal effects and drought triggers
  - Disseminate information and knowledge to aid decision making, research and education
Carol Song (Rosen Center for Advanced Computing)
Daniel Aliaga (Computer Science)
Jacob R. Carlson (Libraries)
Indrajeet Chaubey (Agriculture and Biological Engineering)
Rao S. Govindaraju (Civil Engineering)
Christoph Hoffmann (Computer Science)
Dev Niyogi (Agronomy)
Lan Zhao (Rosen Center For Advanced Computing)
Advisory Board:

Jan Curtis (NRCS, Portland, Oregon)
Michael Hayes (Director, National Drought Mitigation Center)
Douglas R. Kluck (NOAA)
V.V. Srinivas (Asst. Prof., IISc, Bangalore, India)
S.I. Sritharan (Prof., Central State University, OH)
J. Untenierrier (Indiana Water Shortage Task Force)
Data Sources & Study Area

- **Precipitation**
  - NCDC hourly precipitation dataset
    - 53 stations with record length greater than 50 years
  - NCDC daily precipitation dataset
    - 73 stations with record length greater than 80 years

- **Streamflow**
  - USGS unimpaired daily mean flow
    - 36 stations with record length greater than 50 years
Standardized Index Method

- Proposed by McKee et al. (1993)
- Generalizable to various types of observations
  - For precipitation: SPI
  - For a given window size, the observed precipitation is transformed to a probability measure using Gamma distribution, then expressed in standard normal variable

<table>
<thead>
<tr>
<th>Probabilities of Occurrence (%)</th>
<th>SI Values</th>
<th>Drought Monitor Category</th>
<th>Drought Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 ~ 30</td>
<td>-0.84 ~ -0.52</td>
<td>D0</td>
<td>Abnormally dry</td>
</tr>
<tr>
<td>10 ~ 20</td>
<td>-1.28 ~ -0.84</td>
<td>D1</td>
<td>Drought - moderate</td>
</tr>
<tr>
<td>5 ~ 10</td>
<td>-1.64 ~ -1.28</td>
<td>D2</td>
<td>Drought - severe</td>
</tr>
<tr>
<td>2 ~ 5</td>
<td>-2.05 ~ -1.64</td>
<td>D3</td>
<td>Drought - extreme</td>
</tr>
<tr>
<td>&lt; 2</td>
<td>&lt;-2.05</td>
<td>D4</td>
<td>Drought - exceptional</td>
</tr>
</tbody>
</table>

- Though SIs for different windows are dependent, no representative window can be determined
Limitations of the conventional SI approach

- Significant auto-correlation exists in samples
- Cannot account for seasonal variability
- Gamma distribution may not be suitable

Modified algorithm

- Samples grouped by the “ending month”

Modified SI
Joint Deficit Index (I)

- Modified SI provides better statistical footing and helps alleviate the effect of seasonal variability.

- The joint deficit index (JDI) is constructed by using copulas to express the joint behavior of modified SIs over various time windows.

- JDI can offer an objective and probability-based overall drought description. It is capable of capturing both emerging and prolonged droughts in a timely manner.

- JDI has potential to be applied on different types of hydrologic variables, and can be used to derive an inter-variable drought index.
Joint Deficit Index (II)
Joint Deficit Index (III)

- Comparison between 1-Mn, 12-Mn, and joint SPI
  - 12-Mn SPI changes slowly, weak in reflecting emerging drought
  - 1-Mn SPI changes rapidly, weak in reflecting accumulative deficit
  - Joint SPI reflects joint deficit
A risk-based assessment of droughts can be useful for planning purposes. To assess these risks more accurately, we propose the use of the joint deficit index to characterize droughts.

**Example: Precipitation droughts**

- Required 1-month precipitation for normalcy, i.e. projected water deficit
- Probability of recovering from drought in one month
DRINET
Precipitation deficit viewer
US Drought Monitor versus JDI
Comparison of PDSI computed from TD-9640 and JDI. Average Spearman’s rank
Modeling the Appearance and Behavior of Urban Spaces

Daniel Aliaga (Computer Science)

- Incorporate additional non-geometric data
- How does drought/water affect urban growth?
- Can cities/states be designed to be more tolerant to drought?
- How do we incorporate other climate-related factors?
Precipitation vs. Streamflow

$r = 0.73$
Future Efforts from DRINET Team

- How is the evolution of cities (urban growth) influenced by water shortages?
- What relationships exist between droughts based on precipitation, stream flows, and groundwater levels?
- Can we construct a space-time statistical model for droughts?
- How can we display streamflow-based JDI analysis?
- What are the water quality and air quality impacts of droughts?
- How can uncertainty be visualized and conveyed for drought information?
Thank you!

The work is supported in part by NSF grant OCI-0753116