

Collaboration Across North America – North American Drought Monitor, Drought Indices & Definitions Study, NACSP Drought Initiative

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*Drought in the Rio Grande/Bravo: First Technical Scoping
Workshop*

El Paso, TX – 15-16 August 2012



National Climatic Data Center



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Background

- ✓ The North American Drought Monitor (NADM) is unique example of collaboration between 3 countries (US, CN, MX) in drought monitoring, made possible because each country has:

- ❑ extensive data networks with near-real time daily observations
- ❑ historical and near-real time data exchange
- ❑ operational drought analyses creating National Drought Monitoring products
- ❑ collaborative drought monitoring and research
- ❑ common OGC-compliant IT infrastructure (web, email, ArcGIS)

North American Drought Monitor

October 31, 2011

Released: Thursday, November 10, 2011

<http://www.ncdc.noaa.gov/nadm.html>

Analysts:

Canada - Trevor Hadwen
Richard Rieger
Robyn Tulloch
Mexico - Reynaldo Pascual*
Adelina Albani*
U.S.A. - Brian Fuchs

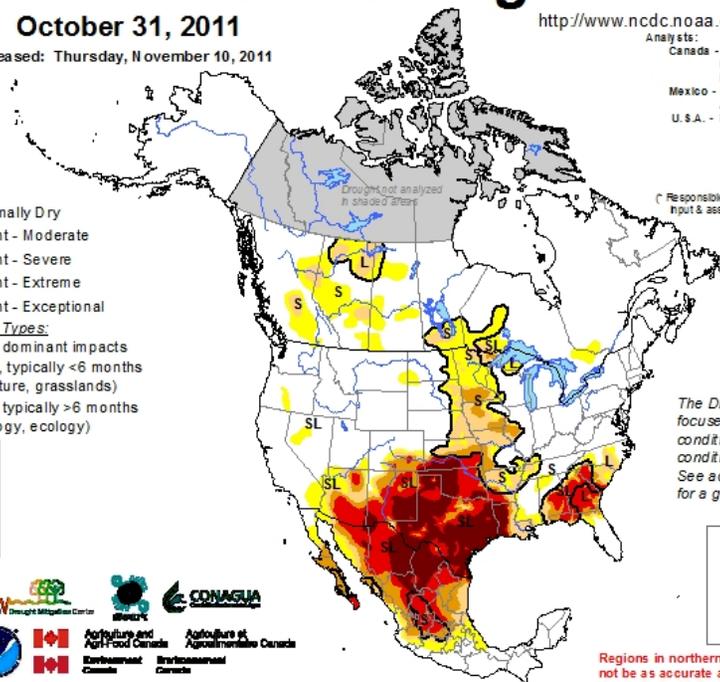
(* Responsible for collecting analysts' input & assembling the NA-DM map)

Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

- ☒ Delineates dominant impacts
- S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months (e.g. hydrology, ecology)



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



Regions in northern Canada may not be as accurate as other regions due to limited information.



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Background

- ✓ NADM depiction based on U.S. Drought Monitor (USDM) concepts:

Intensity:

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Drought Impact Types:

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- ❑ “Convergence of evidence” analysis of many objective drought indices
- ❑ Drought categories based on percentiles
- ❑ Collaborative analysis

Category	Percentile Rank
D0	21-30
D1	11-20
D2	6-10
D3	3-5
D4	0-2



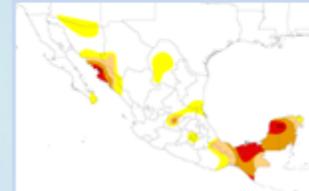
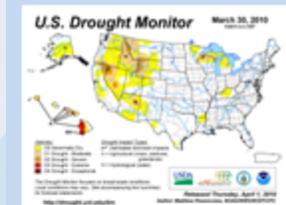
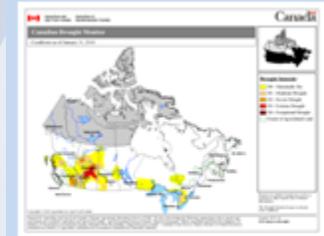
North American Drought Monitor History

- ✓ **“Troika” Meeting (US, CN, MX) – November 2001**
 - Agree in principle to establish climate extremes monitoring partnership
 - First, develop monthly continental drought monitoring capabilities
 - Eventually assess long-term variability and trends in extremes
- ✓ **NADM Workshop – April 2002**
 - Details for NADM worked out
- ✓ **North American Drought Monitor (NADM) – 2002**
 - First experimental NADM map – December 2002
 - NADM maps released to public – April 2003
 - US & Mexican portions “operational” – June 2005
 - Canadian portion “operational” – December 2006



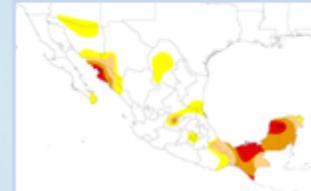
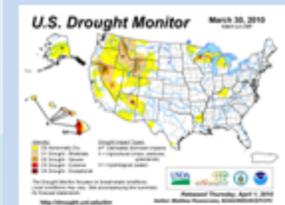
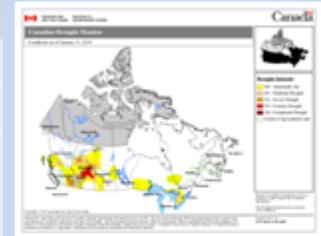
How NADM Functions

- ✓ National depictions of drought in each country (US, CN, MX) are prepared independently by experts within each country
- U.S.A.:
 - ❑ National Oceanic and Atmospheric Administration (NOAA) – National Climatic Data Center (NCDC) & Climate Prediction Center (CPC)
 - ❑ U.S. Department of Agriculture (USDA)
 - ❑ National Drought Mitigation Center (NDMC)
 - ❑ Use the USDM
- Canada:
 - ❑ Agriculture and Agri-Food Canada (AAFC)
 - ❑ Meteorological Services Canada (MSC) – provides data
- Mexico:
 - ❑ Servicio Meteorológico Nacional (SMN)



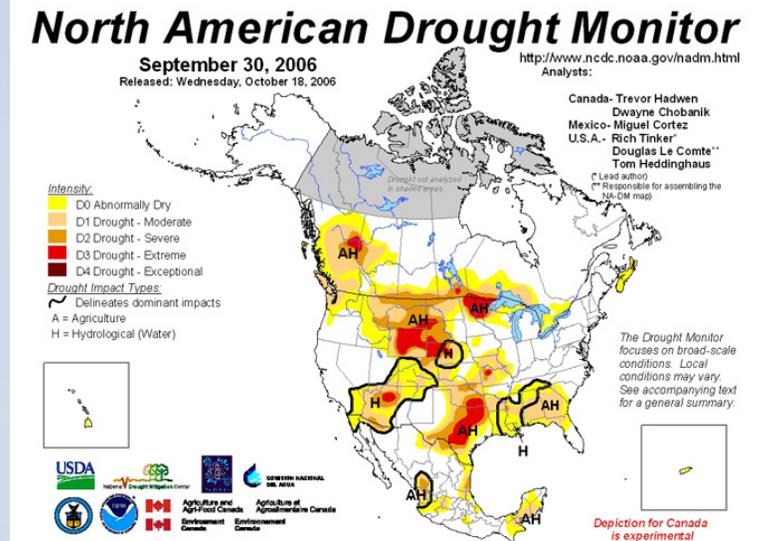
ArcGIS Environment

- ✓ Each national depiction of drought is prepared using ArcMap software
- ✓ The ArcGIS shape files have a common format, map projections, file naming convention, etc. to allow efficient merging



Preparation of the NADM Map & Narrative

- ✓ Lead author coordinates & prepares monthly continental map & narrative
 - ❑ Author rotates each month between the partner organizations: NCDC, CPC, USDA, NDMC, AAFC, SMN
 - ❑ Integrates the national maps into one continental map & the national narratives into one continental narrative
 - ❑ Iterative peer review process
- ✓ Map & Narrative available in the three languages (English, Spanish, French)



<http://www.ncdc.noaa.gov/oa/climate/monitoring/drought/nadm/index.html>



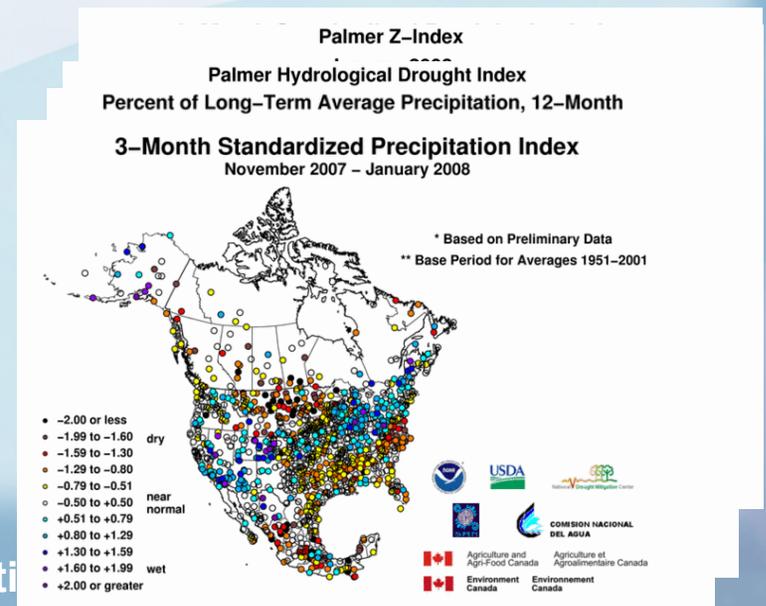
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Drought at the International Boundaries

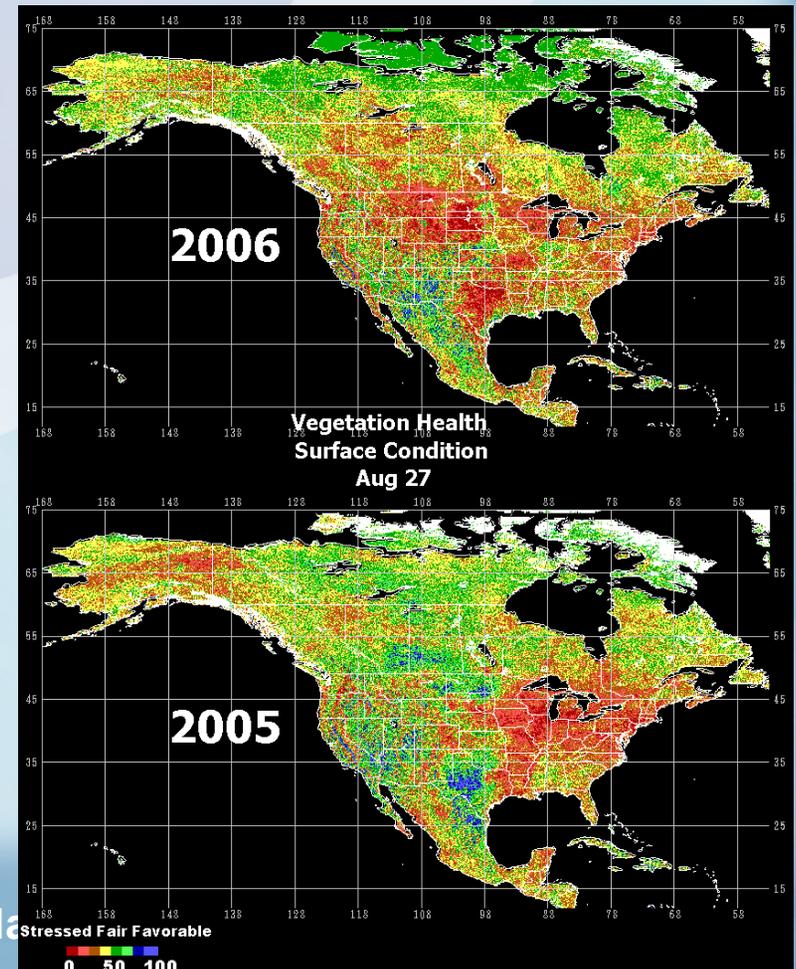
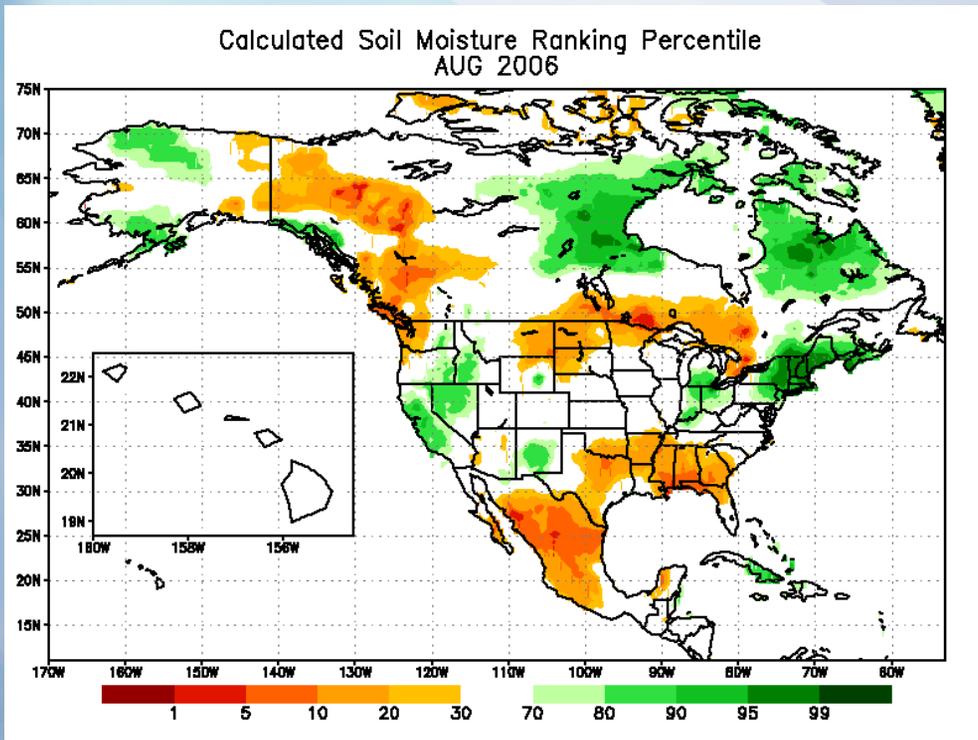
- ✓ Drought indices covering entire continent are needed – Continental Drought Indicators
 - Same indices, same analysis period, same methodologies
 - SPI, Palmer Drought Indices, Percent of Long-term Average Precipitation
 - Standardizing period is 1951-2001
 - This consistency needed for depiction across international boundaries
 - Data provided by MSC, SMN, NOAA
 - NCDC computes the indices

<http://www.ncdc.noaa.gov/oa/climate/monitoring/drought/nadm/index.html>



Other Continental Drought Indicators

- ✓ Other indicators from other sources are also used
 - NOAA/NESDIS Satellite Vegetation Health Index
 - NOAA/CPC Leaky Bucket Soil Moisture Percentiles



NADM Operational Timeline*

- ✓ **National Drought Monitors prepared independently**
 - Weekly U.S. Drought Monitor, Monthly Canadian and Mexican Drought Monitors
- ✓ **By 5th of month: national data from all 3 countries provided to NCDC for continental indicators**
- ✓ **By 5th or 6th of month: NADM continental indicators prepared by NCDC**
- ✓ **By 7th of month: the shapefiles from each national Drought Monitor are provided to NADM lead author**
- ✓ **By 8th of month: national shapefiles merged within ArcGIS by the lead author & draft NADM map provided to partners in the 3 countries for peer review & evaluation**
- ✓ **By 10th of month: NADM map finalized**
- ✓ **By 11th of month: final NADM monthly map put online by NCDC**

*** Determined & agreed to on May 21, 2010**



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North American Drought Monitoring Portal



National Integrated Drought Information System

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NADM > Home

Language: Español | Year: 2011 | Month: August

Monitor de Sequía de América del Norte

Agosto 31, 2011

Liberado: viernes, 9 de Septiembre de 2011

<http://www.ncdc.noaa.gov/nadm.html>

Analysts:
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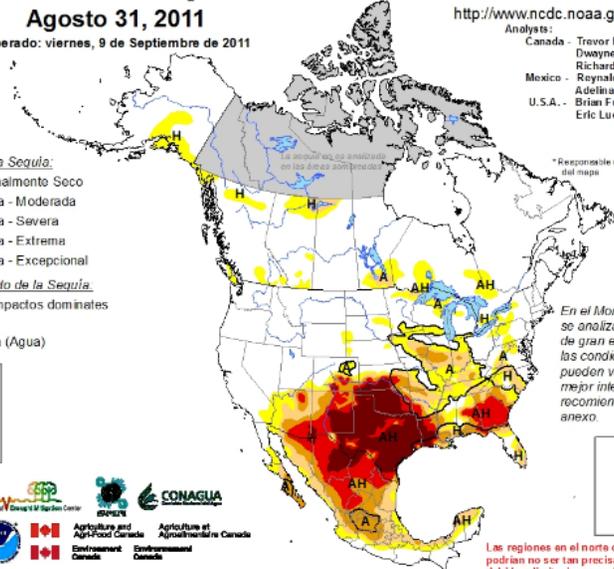
* Responsable de la integración del mapa

Intensidad de la Sequía:

- D0 Anormalmente Seco
- D1 Sequía - Moderada
- D2 Sequía - Severa
- D3 Sequía - Extrema
- D4 Sequía - Excepcional

Tipos de Impacto de la Sequía:

- Delimita impactos dominantes
- A = Agrícola
- H = Hidrológica (Agua)



En el Monitor de Sequía se analizan condiciones de gran escala, por lo que las condiciones locales pueden variar. Para una mejor interpretación se recomienda ver el texto anexo.

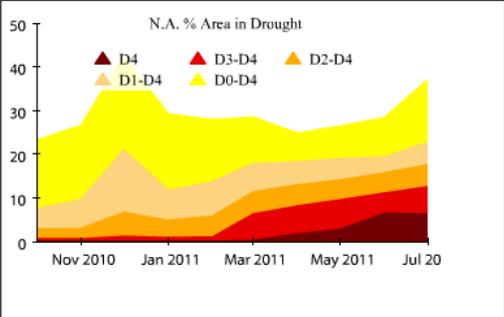
Las regiones en el norte de Canadá podrían no ser tan precisas como el resto, debido a limitaciones en la información.

Display Map:

[English](#)
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[French](#)

Open Narrative:

[English](#)
[Spanish](#)
[French](#)



[Larger View](#)

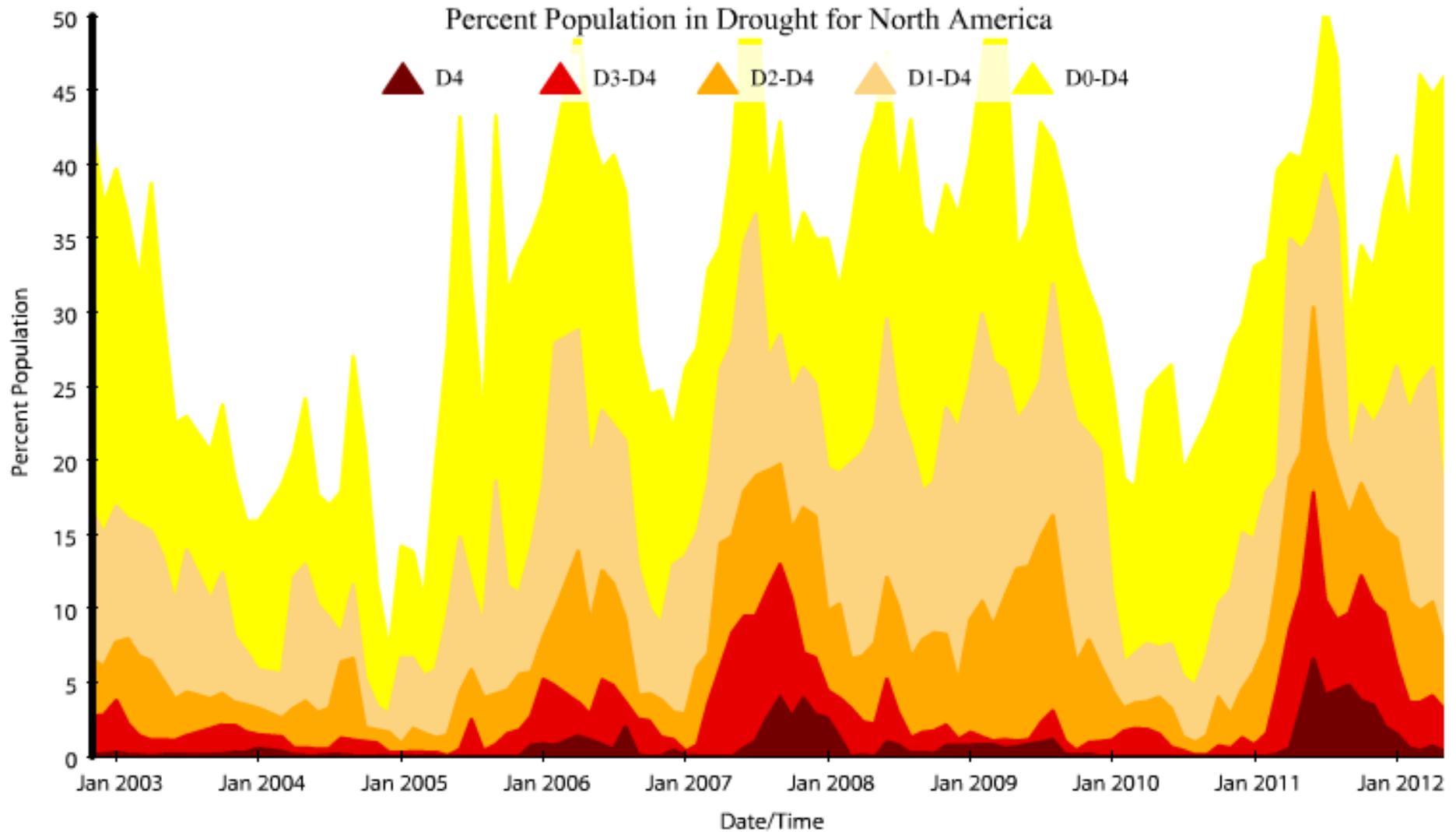
[Click map to enlarge](#)

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<http://www.drought.gov/portal/server.pt/community/nadm/303>

North American Drought Monitoring Portal



<http://www.drought.gov/portal/server.pt/community/nadm/303>





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- [Static Indicators](#)

NADM > Static Indicators

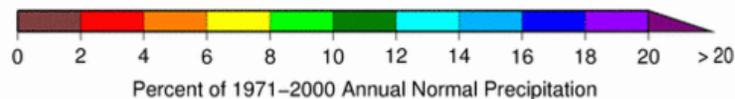
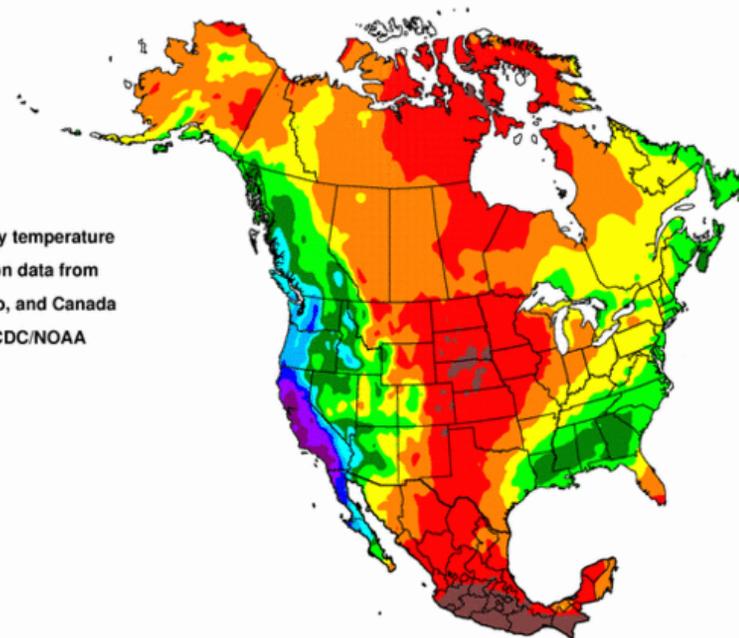
This Section Includes

- Palmer Drought Indices
 - Stations
 - Interpolated
- Standardized Precipitation Index
 - Stations
 - Interpolated
- Percent Average Precipitation
 - Stations
 - Interpolated
- Climatology

Images

Percent of Annual Normal Precipitation, January

Based on monthly temperature and precipitation data from the U.S.A., Mexico, and Canada gridded by NCDC/NOAA



◀

Percent of Annual Normal Precipitation, January

Percent of Annual Normal Precipitation, February

Percent of Annual Normal Precipitation, March

Percent of Annual Normal Precipitation, August

▶



Collaboration Across North America –
North American Drought Monitor,
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**Monitoring Drought in the Diverse Climates of North America –
The Bilateral Drought Indices and Definitions Study**

Richard R. Heim Jr.

NOAA/NESDIS/National Climatic Data Center – Asheville, North Carolina, USA

Allan Howard & Trevor Hadwen

Agriculture and Agri-Food Canada – Regina, Saskatchewan, CANADA

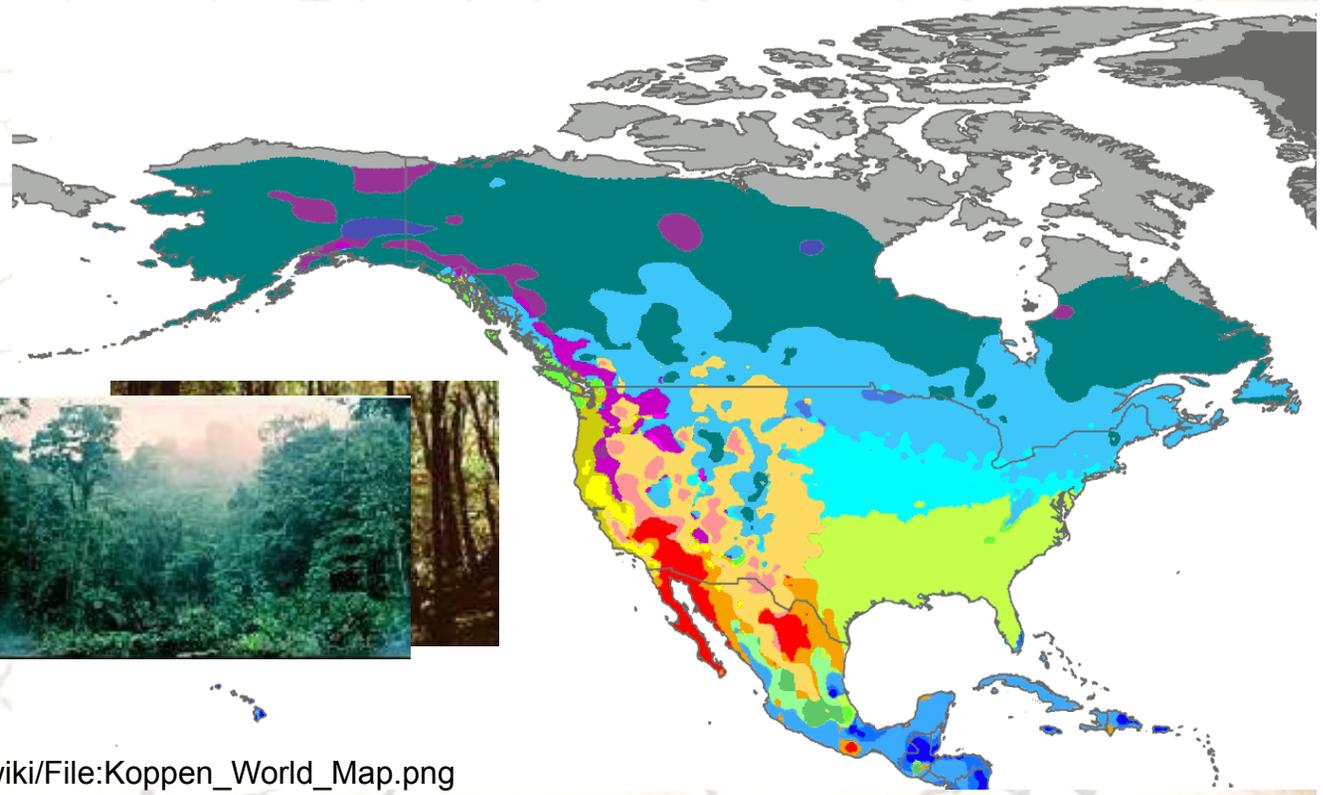


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Introduction

- One of the primary challenges for monitoring drought across a large area with diverse climates is which drought indices to use, and even how to define drought.



Map Source: http://en.wikipedia.org/wiki/File:Koppen_World_Map.png



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Af	BWh	Csa	Cwa	Cfa	Dsa	Dwa	Dfa	ET
Am	BWk	Csb	Cwb	Cfb	Dsb	Dwb	Dfb	EF
Aw	BSh	Cwc	Cfc	Dsc	Dwc	Dfc		
	BSk			Dsd	Dwd	Dfd		

US-Canada GEO* Workshop, 2008

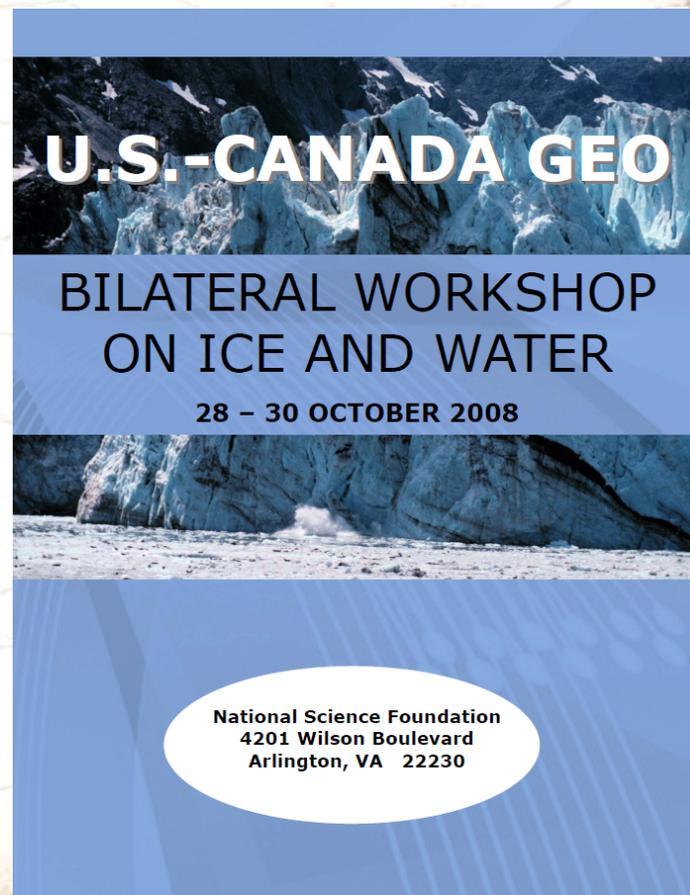
High Priority Recommendations:

1. International Testbeds
2. A Shared Data Assimilation Platform
3. Bi-national Data Products
4. Commitment to the Global Cryosphere Watch
5. **Bilateral studies to support the assessment of monitoring systems for droughts and other extremes**

*Group on Earth Observations



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Agri-Food Canada

GEO Bilateral Drought Indices & Definitions Study

- Two co-leads, one in U.S. (NOAA) and one in Canada (AAFC).
- 93 participants from NOAA Regional Climate Centers, the National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA), Natural Resources Canada (NRCan), and Environment Canada (EC), to provincial agencies, state climatologists, and academic researchers.
- April 2010 technical workshop in Asheville, NC – GEO guidance on implementation principles, outputs, and process.



Study's Objective

- To **improve the definition of drought** for the diverse climate regions of North America including arid, semiarid, subhumid, humid, subarctic and arctic climate zones (and tropical).
- Assess existing drought indices to **determine the appropriateness** of the indices for the various climate regions in North America.
- Provide information on feasibility of expanding regional indicators to a **continental scale**.
- Continent-wide study for the comparative analysis across regions with close **links to the testbed activities**.



Goals and Deliverables

- Produce an **inventory of indices and indicators** used to monitor drought in the two countries to determine which indices and data sets are appropriate for monitoring drought in each of the climate regions of North America, including consideration of seasonality, timescales, climate criteria, and related impacts.
- Conduct a literature review of drought studies to produce a **bibliography of references** addressing the definition of drought relevant to the diverse climates of North America.
- Provide assessment and recommendation for the development of regional drought indices that can be produced on a continental scale.



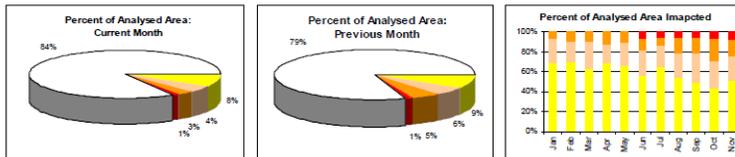
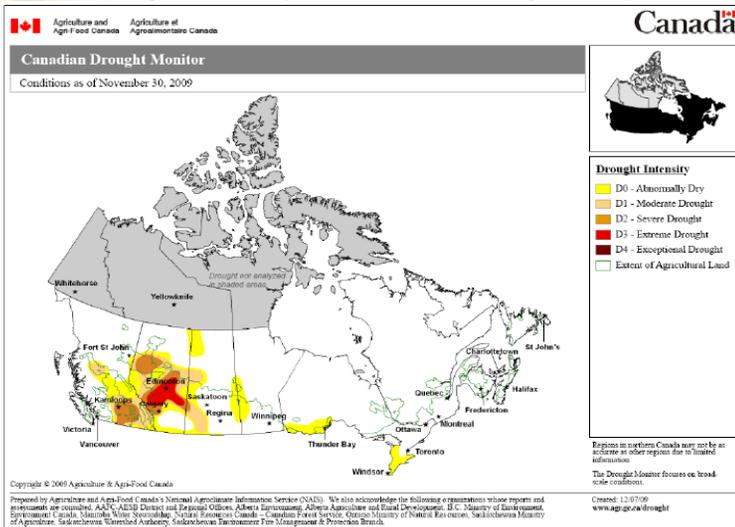
Goals and Deliverables

- **The inventory and bibliography will provide the basis for a peer-reviewed drought monitoring toolkit available to the water resources community. The toolkit will contain:**
 - a description of drought in the diverse climates of North America – from drought in wet climates to drought in dry climates, drought in hot climates to drought in cold climates – which addresses the varied perception issues associated with drought;
 - a rational process (generalized methodology) for choosing which drought indicators to use in each sector and climatic type, thus aiding water managers and decision-makers in preparing a drought monitoring response.



Applications – National & Continental Drought Monitors

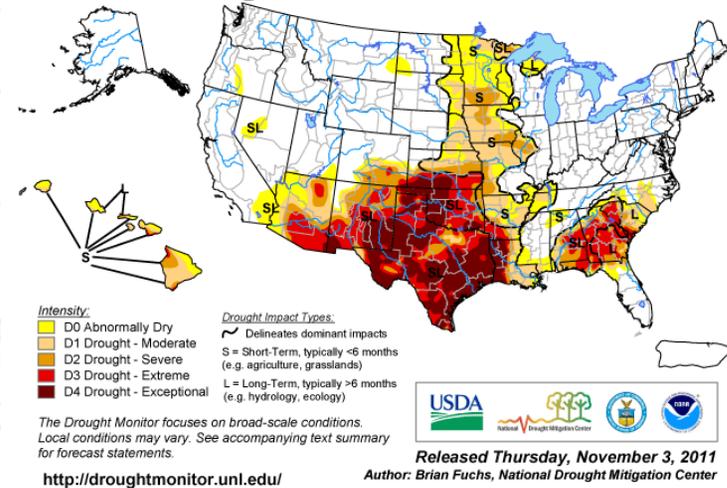
This study can improve the drought monitoring products in Canada, Mexico, and the U.S. and the NADM.



Report	Unaffected		D0 (Abnormally Dry)		D1 (Moderate Drought)		D2 (Severe Drought)		D3 (Extreme Drought)		D4 (Exceptional Drought)	
	Area (%)	Sq Km (000)	Area (%)	Sq Km (000)	Area (%)	Sq Km (000)	Area (%)	Sq Km (000)	Area (%)	Sq Km (000)	Area (%)	Sq Km (000)
Oct	79.9	4650.2	8.8	509.6	5.5	321.8	4.7	270.6	1.1	66.5	0.0	0.0
Nov	83.3	4847.8	8.5	492.8	4.2	243.4	2.8	164.5	1.2	70.2	0.0	0.0

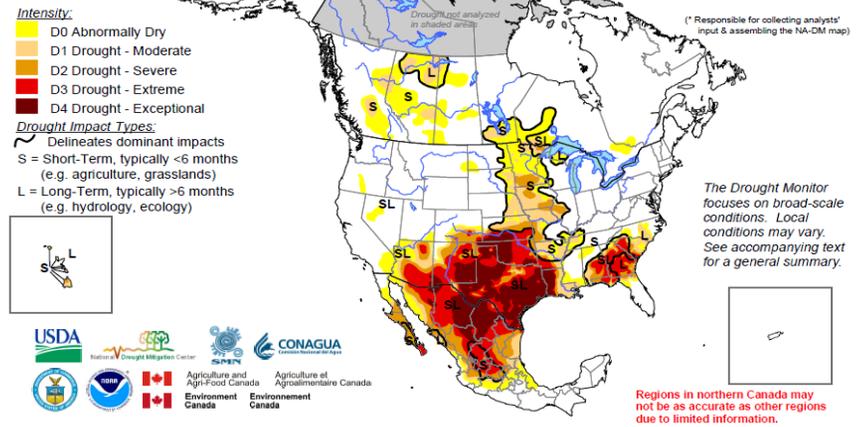
U.S. Drought Monitor November 1, 2011

Valid 8 a.m. EDT



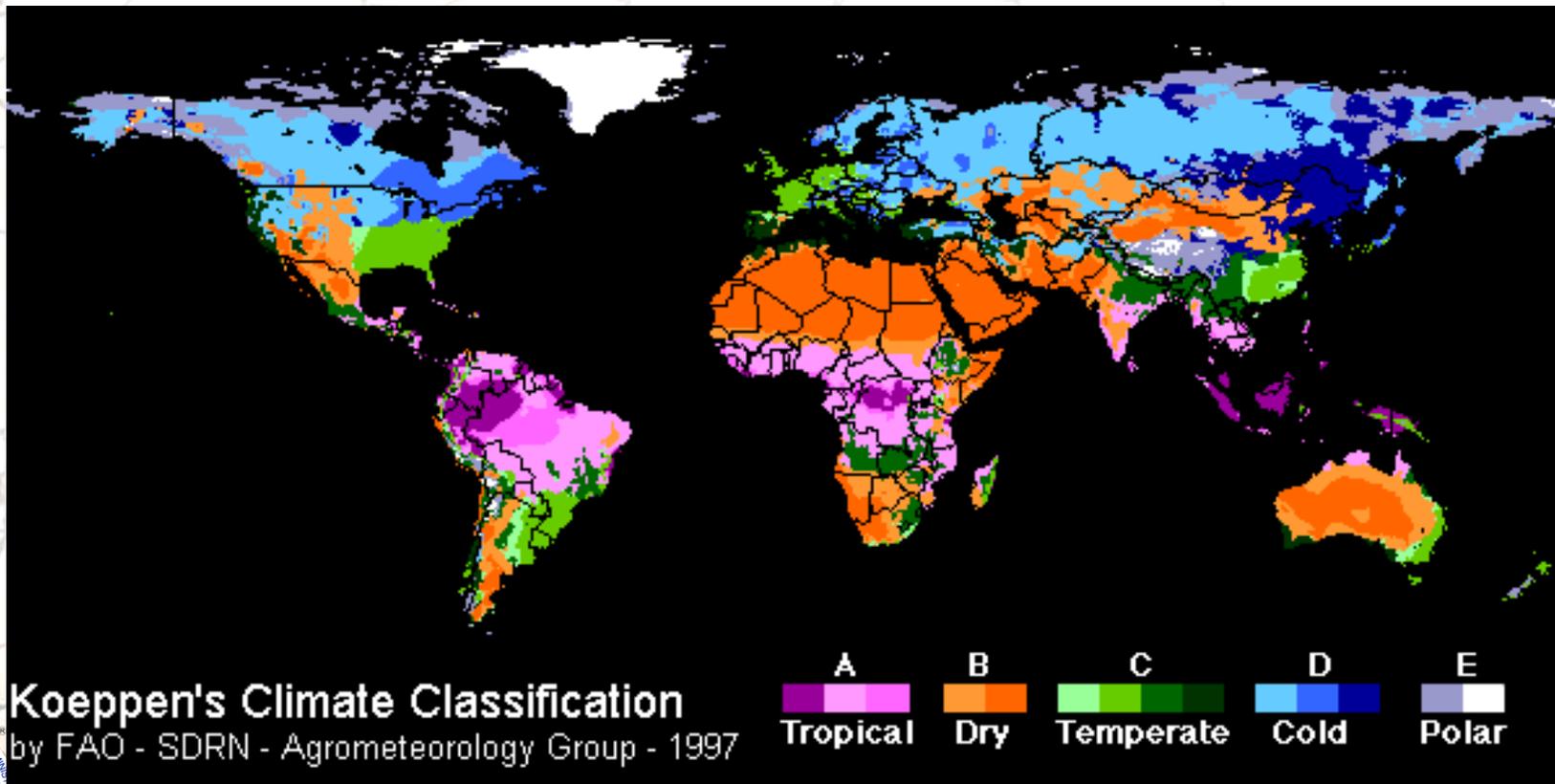
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Applications – Global Climatic Diversity

By improving the definition of drought and appropriate regional application of various indicators to the diverse climates of North America, this study hopefully will improve drought monitoring across most climate zones in the world, and support the GDM.



Koeppen's Climate Classification
by FAO - SDRN - Agrometeorology Group - 1997



NOAA's National Climatic Data Center



**Agriculture and
Agri-Food Canada**

Partners – U.S., Canada, and Mexico

- The Drought Indices & Definitions Study started out with U.S. and Canadian participants
- Mexican participation will help provide a complete continental picture

Principales tipos de clima de México



Collaboration Across North America – North American Drought Monitor, Drought Indices & Definitions Study, **NACSP Drought Initiative**

**Spearheaded by
Allan Howard**

Agriculture and Agri-Food Canada – Regina, Saskatchewan, CANADA



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North American Climate Services Partnership

- Established between Canada (EC) the US (NOAA) and Mexico (NM de M) in January 2012
- Intended to facilitate the exchange of information, technology and management practices related to the development of climate information and the delivery of integrated climate services for North America.
- Four initiatives put in place:
 - Drought selected because of the NADM
 - NAIS is Canadian Lead
 - Drought Plan drafted to move NADM to "next level"
 - End user analysis
 - Improved reporting

The NADM as an NACSP Collaborative Trilateral Project

- ✓ User engagement in Climate Services across North America – important priority of NACSP
 - NIDIS (National Integrated Drought Information System) pilot projects & USDM (U.S. Drought Monitor) – much experience, lessons (monitoring, communication, governance, engagement with users)
- ✓ International synthesis and assessment important to NACSP
 - The NADM model is the epitome of coordinated international monitoring activities



NADM & International Linkages

- ✓ NACSP linkages to WMO GFCS (Global Framework for Climate Services) – How? If?
 - NADM linkages to GDM (Global Drought Monitor); GDM linkages to GFCS
- ✓ Climate monitoring across North America
 - NADM linkages to North America Climate Extremes Monitoring (NACEM) system



NACSP Drought Initiative – Expectations

- ✓ With the NADM serving as the centerpiece for NACSP Drought Initiative...
- ✓ ... assess current situation and possible areas where value can be added at reasonable cost:
 - Defining who our end users and potential end users are
 - Looking at existing applications, and ID'ing gaps
 - Where are the quick wins in building applications to address the gaps
- ✓ ... build a plan that is manageable within the current capacity of all governments
 - Being end-user focused
 - Include linkage to the test beds, including the Rio-Grande/Bravo basin case study
 - A plan to engage end users and assess their acceptance of our products



NACSP Drought Initiative

- ✓ Address continental drought issues – agricultural drought, disaster risk reduction, health, water resources
- ✓ Need for improved coordination of early warning, planning for water resources
 - Linkages to NAEFS & NASFS (North American Ensemble/Seasonal Forecast System)
- ✓ Can we improve real-time exchange of daily data?
 - Linkages to frequency of NADM production
- ✓ NADM linkages to geographic pilots (Rio Grande/Bravo & Great Lakes) & broader international efforts (Drought Indices & Definitions Study, NACEM, GFCS through GDM)



NACSP Drought Initiative

- ✓ Building on the NADM, can we construct a continental version of the Canadian “Drought Watch”?
 - Daily climate maps of North America (Canada, Mexico, & the U.S.) based on a continental near-real time reporting system of a continental network of weather stations, maybe including continental gridded precipitation products.
- ✓ Building the NADM into a regional/continental drought information center?
 - Similar to GDIS (Global Drought Information System) & NIDIS, where not just drought monitoring information is featured, but also:
 - Forecasts
 - History
 - Education
 - Mitigation
 - Research
 - Planning



NACSP Drought Initiative – Next Steps

1. Get agreement from all partner countries on the plan.
2. Prioritize the activities, select suitable pilot activity(ies), determine timelines and ID leads for each.
3. Develop detailed goals and workplans for each activity and ID areas where external resources are required.
4. Prepare proposals.



Thank You!

Richard.Heim@noaa.gov

<http://www.drought.gov/portal/server.pt/community/nadm/303>

<http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm/>

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