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An Introduction to the Drought Monitor

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An Introduction to the Drought Monitor

Origins

The idea of better monitoring and assessing drought has been a quest of NDMC director Don Wilhite for more than two decades. He has been an advocate of better climate monitoring, particularly drought monitoring, because drought is a normal, recurring hazard in virtually all of the United States. The challenge is to recognize drought, a slow-onset or "creeping" natural disaster, before a region is in the middle of one.

The most recent surge in interest in drought arose during the 1995–96 drought in the Southwest and southern Great Plains states. At the NDMC we discussed how we could do a better job of tracking and assessing the severity of droughts. One question we often hear is "How does this drought compare, or rank, to other droughts or the drought of record for this region or state?" Or "Just how strong or severe is this drought?" These are complicated questions to tackle. We have to take into account spatial extent, intensity, duration, and impacts on people and the affected environment. That discussion is for another time.

For purposes of understanding vulnerability or risk, another question we have tried to address is "What is the degree of usualness or unusualness of various droughts now and in the past?" How frequently or rarely do we see a drought of this magnitude, and does it occur often enough that we should plan for it rather than simply acknowledge it when it occurs? In short, can we define the difference between perception and reality? Our hope is that the Drought Monitor and future research will begin to let us find some of the answers to these questions.

Until recently, there were no comprehensive nationwide efforts to consolidate or centralize drought monitoring activities being conducted by or between various federal, state, or regional entities. In the summer of 1998, I began to correspond with Doug LeComte, senior meteorologist with the National Centers for Environmental Prediction/Climate Prediction Center (NCEP/CPC), who shared his ideas with us on how we might come up with a classification system for droughts, much in the same way the Fujita Tornado Intensity Scale (F0–F5) categorizes tornadoes and the Saffir-Simpson Hurricane System (Category 1–5) rates hurricane strength. Based on LeComte's first draft, and with the help of others, we worked on a classification scheme criteria, and as a result the Drought Monitor was created.

In spring 1999, Don Wilhite and I met with scientists at the U.S. Department of Agriculture's Joint Agricultural Weather Facility (USDA/JAWF) and the National Oceanic and Atmospheric Administration's Climate Prediction Center (NOAA/CPC) to discuss working together to address the issue of tracking drought. How could we better collaborate and implement an integrated drought monitoring system? The signing of the National Drought Policy Act in the summer of 1998 and the subsequent formation of the National Drought Policy Commission (NDPC) and its working groups in 1999 no doubt helped speed up the process and fueled interest in such an effort. Monitoring and Prediction was one of the NDPC working groups. Many of the key players in the climate monitoring realm were exposed to the Drought Monitor concept and initial prototypes through this working group. We introduced the drought classification system to them and welcomed the many suggestions that followed in this informal peer review process.

As a result of the meetings in spring 1999, an agreement was reached between the NDMC, USDA, and NOAA to produce and maintain a drought monitoring product that would incorporate climatic data and professional input from all levels. Requests for input were initially sent out to National Weather Service field offices. This was followed up by contacting NOAA's six regional climate centers (RCCs). We have invited state climatologists to comment on and review the weekly product (both map and narrative). Our intent was to create a general assessment of drought conditions in the United States using the most

relevant and current data that each entity involved had to offer. The selected data were then put into an experimental product using a new drought classification system approach. The first experimental drought map was put out for internal review and comment in May 1999. An e-mail exploder group was set up and is maintained at the NDMC. This allows all reviewers and authors of the product to discuss and share their relevant expertise, viewpoints, and concerns.

The experimental tag was short-lived. The Drought Monitor quickly evolved into a more permanent product as a result of the efficient partnerships between USDA, NOAA, NDMC, RCCs, and a few state climatologists. No doubt the drought in the Northeast in summer 1999 provided an extra incentive for the map. The Drought Monitor was officially launched at a joint White House press conference between the Department of Commerce (NOAA) and USDA in August 1999. The Drought Monitor had gone from an experimental bi-weekly map to a full-fledged operational product in a few months. With the support of USDA's chief meteorologist, the National Drought Mitigation Center at the University of Nebraska–Lincoln agreed to set up and maintain the home page for the Drought Monitor (http://enso.unl.edu/monitor/monitor.html).

Since its unveiling, the Drought Monitor has been well received by people from a wide variety of backgrounds and trades. The media has been especially quick to pick up on and use the new product to inform their readers and listeners. Producers, commodity brokers, congressional delegations, and federal/state agencies also are using this product. They seem to like the simplicity and ease of use of the product (see Figure 1), rather than having to learn about another new index.

The Concept

The Drought Monitor consists of a color map, showing which parts of the United States are suffering from various degrees of drought, and accompanying text. The text describes the drought's current impacts, future threats, and prospects for improvement. The Drought Monitor is a synthesis of several different scientific drought indices. It is by far the most user-friendly national drought monitoring product, and it is particularly well suited for use by mainstream media because it represents state-of-the-art scientific expertise and is packaged as a timely, colorful, unambiguous map. Currently, the World Wide Web is the main means of distributing the Drought Monitor. NOAA also distributes the map through their internal channels. The obvious advantages to using the web are that there are no distribution costs and the information is instantly available and always current. The obvious disadvantage is that not everyone has access to the web. Our focus to this point has been how to best disseminate the product in the most timely manner.

No single definition of drought works in all circumstances, so water planners rely on indices or data in various forms, and most often depicted in map or graphic form, to recognize droughts. The authors of the Drought Monitor also rely on the input of several key indices and ancillary indicators from different agencies to create the final map, which is posted each Thursday. The seven key parameters making up the current scheme are the Palmer Drought Index, Crop Moisture Index, CPC Soil Moisture Model (percentiles), USGS Daily Streamflow (percentiles), Percent of Normal Precipitation, USDA/NASS Topsoil Moisture (percent short and very short), and a remotely sensed Satellite Vegetation Health Index. The final color map summarizes all of this information in an easy-to-read format that shows where drought is emerging, lingering, and subsiding.

Classification: D0–D4

The idea is to classify droughts on a scale from zero to four (D0–D4), with zero indicating an abnormally dry area and four reflecting a region experiencing an exceptional drought event (likened to a drought of record). The drought intensity categories are based on six key indicators and many supplementary indicators. The Drought Monitor summary map and narrative identify general drought areas, labeling droughts by intensity from least to most intense. D0 areas (abnormally dry) are either drying out and

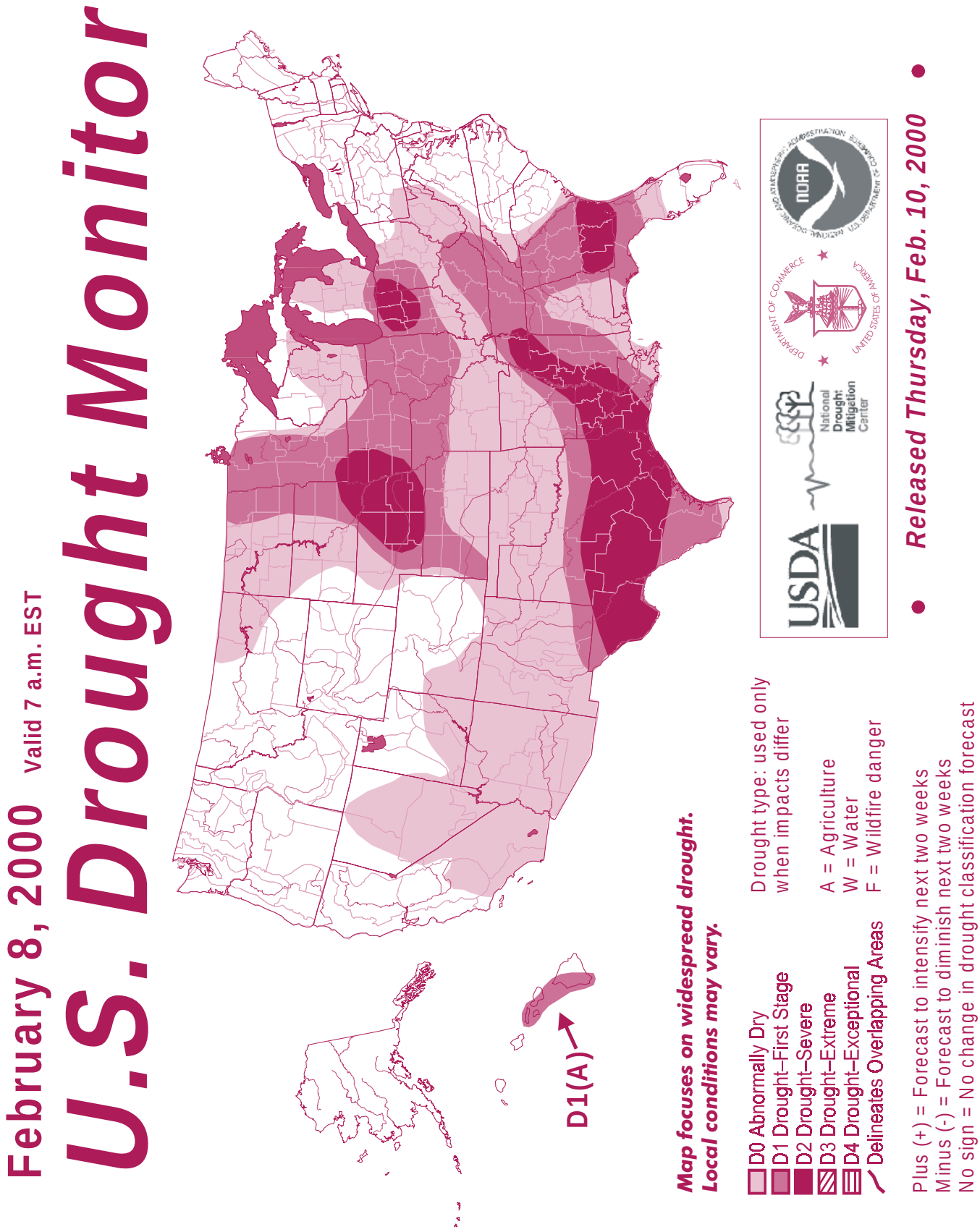

Figure 1. The Drought Monitor (http://enso.unl.edu/monitor/monitor.html).

possibly heading into drought or recovering from drought but still experiencing lingering impacts (or not yet back to normal or wet conditions).

Categories: A, W, and F

The Drought Monitor also shows which sectors are presently seeing the majority of impacts due to drought, using labels of *A*, *W*, or *F*. An *A* represents impacts on agriculture (crops, livestock, range or pasture). Water (*W*), or hydrological, impacts show that the region is experiencing an impact on some part of the water supply system. In determining whether to use this label, we look at how droughts affect streamflow, snowpack, groundwater, and reservoirs. An *F* is used when abnormally high risks of fire danger are observed.

Forecasts

We use the two week forecasts (5 day and 6–10 day) to determine if the drought is intensifying or dying out. Intensifying drought is indicated by a plus (+) sign after the drought classification; decreasing drought is indicated by a minus (-) sign after the drought classification.

An Example

An area shaded and labeled as D2 + (A) is in general experiencing severe drought conditions that are affecting the agricultural sector but at present are not affecting water supplies. The area is not seeing a heightened fire risk in association with this dryness. In addition, the drought looks like it will intensify in the next two weeks, according to the forecasts.

Droughts are generally slow in developing and can be slow in receding, but there are cases (like the hurricanes in the Northeast this past summer) in which a drought-breaking type of event can speed up the recovery process. Even after the physical event is over, impacts may linger for months or years, depending on the timing, duration, and intensity of the drought. Efforts are underway to better forecast, with higher confidence, further into the future.

Currently, seasonal forecasts issued by the CPC are taken into account, but they are not used in determining intensity trends. We do know that some strong relationships exist between dryness or drought in certain parts of the United States, depending on the season and whether or not we are in an El Niño or La Niña phase. The relationship isn't nearly as strong, however, in the continental grain-producing regions that make up our corn and wheat belts. The problem is addressing the non-phase year, especially in the summer. In fact, the summer months are the toughest to predict, regardless of whether an ENSO event is taking place. Today's models are much better than ever before, and they will continue to improve as computing power increases and we better identify and understand the complex relationships that exist between our oceans, continents, and atmosphere.

Classification Parameters

Table 1 illustrates the drought severity classification system that exists now. The system was intended to be flexible, allowing it to continually evolve by responding to and incorporating the latest technologies and data available in the monitoring world.

The Future

The CPC has been experimenting with blending up to three inputs to produce a weighted objective drought index, but this is continually going through adjustments and is only one part of the equation we look at when making the Drought Monitor. We expect to see CPC and others improve the accuracy and confidence of forecasts at all time scales. This process and product are still evolving as both monitoring and forecasts improve. For example, we also hope to integrate USDA and other soil moisture network data into the Drought Monitor in the near future. Interestingly, it is the availability and input of these parameters (i.e., soil moisture) that in turn serve as inputs into better models at better resolutions. We

Table 1. Drought severity classification.

Category	Description	Impacts	Palmer Drought Index or Crop Moisture Index	CPC Soil Moisture Model (Percentiles)	Daily Streamflow (Percentiles)	Percent of Normal Precipitation	USDA/ NASS Topsoil Moisture (% short & very short)	Satellite Vegetation Health Index
D0	Abnormally Dry	Short-term dryness slowing planting, growth of crops or pastures; fire risk above average; or recent drought relief, some lingering water deficits; pastures not fully recovered	-.6 – -1.9	21–30	21–30	<50% 30 days	25–50%	36–45
D1	Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent; or voluntary water-use restrictions in some locations	-2.0 – -2.9	11–20	11–20	50-60% 2–3 months	51–65%	26–35
D2	Severe Drought	Moderate crop or pasture losses likely; fire risk very high; water shortages common; or water restrictions imposed in many areas	-3.0 – -3.9	6–10	6–10	40-50% 3–4 months	66–80%	16–25
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or water restrictions	-4.0 – -5.0	2–5	2–5	30-40% 4–5 months	81–90%	6–15
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, wells creating water emergencies	-5.0 or less	0–1	0–1	<40% 6 months	>90%	1–5

would like to include seasonal (long-lead) forecasts in the Drought Monitor to give people as much information as possible (and as soon as possible) to use in decision making.

Although the maps are based on many inputs, the final maps are tweaked to reflect real-world conditions as reported by numerous experts throughout the country. States or water suppliers may be looking at our indicators while also using many other local data resources and tailored drought triggers. Our intent is not to replace any local or state information or subsequently declared drought emergencies or warnings. Instead, we are providing a general assessment of the current state of drought around the United States, Pacific possessions, and Puerto Rico.

We hope we have found a way to better picture this "freeze-frame" disaster and relay the information to users. Ultimately, it is the users who determine how to use the information; it is our job to provide them with the best available data and product in a timely fashion.

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