

2014

LOCAL OBSERVERS FILL IN THE DETAILS ON DROUGHT IMPACT REPORTER MAPS

Kelly Helm Smith

University of Nebraska-Lincoln, ksmith2@unl.edu

Mark D. Svoboda

University of Nebraska-Lincoln, msvoboda2@unl.edu

Michael J. Hayes

University of Nebraska - Lincoln, mhayes2@unl.edu

Henry Reges

Colorado State University

Nolan Doesken

Colorado State University

See next page for additional authors

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Smith, Kelly Helm; Svoboda, Mark D.; Hayes, Michael J.; Reges, Henry; Doesken, Nolan; Lackstrom, Kirsten; Dow, Kirstin; and Brennan, Amanda, "LOCAL OBSERVERS FILL IN THE DETAILS ON DROUGHT IMPACT REPORTER MAPS" (2014).

Drought Mitigation Center Faculty Publications. 98.

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Authors

Kelly Helm Smith, Mark D. Svoboda, Michael J. Hayes, Henry Reges, Nolan Doesken, Kirsten Lackstrom, Kirstin Dow, and Amanda Brennan

Citation:

"Local Observers Fill in the Details on Drought Impact Reporter Maps," by Kelly Helm Smith, Mark Svoboda, Michael Hayes, Henry Reges, Nolan Doesken, Kirsten Lackstrom, Kristin Dow, and Amanda Brennan. *Bulletin of the American Meteorological Society*, 95: 11, Nov. 2014, 1659-1662.

Volume 95 Number 11 November 2014

BAMS

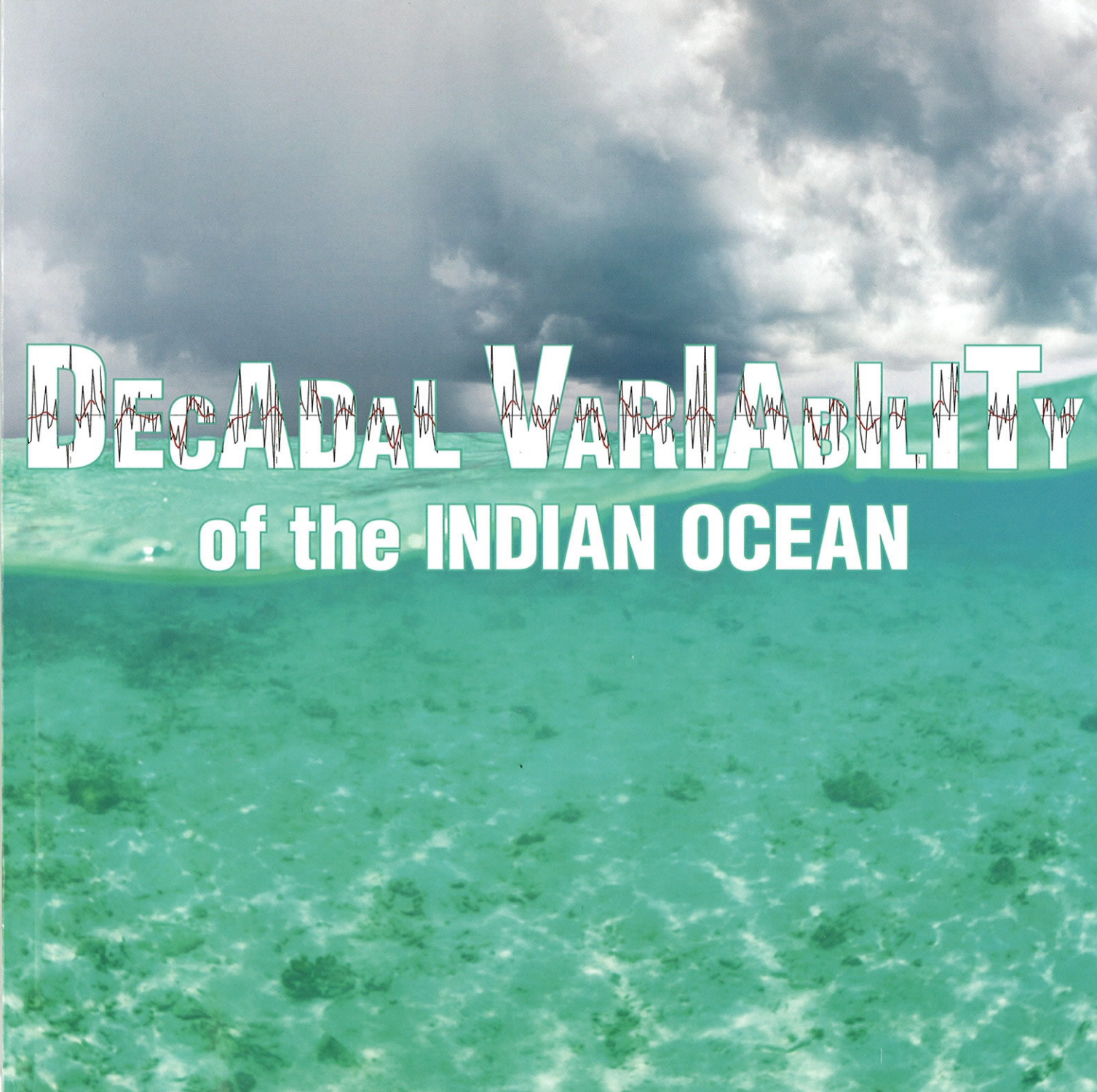


Bulletin of the American Meteorological Society

SUNSHINE AT BLUE HILL

MAKING CLIMATE SCENARIOS

TYPICAL GAFFE ABOUT TORNADOES



DECADAL VARIABILITY

of the INDIAN OCEAN

LOCAL OBSERVERS FILL IN THE DETAILS ON DROUGHT IMPACT REPORTER MAPS

BY KELLY HELM SMITH, MARK SVOBODA, AND MICHAEL HAYES (NATIONAL DROUGHT MITIGATION CENTER, UNIVERSITY OF NEBRASKA—LINCOLN); HENRY REGES AND NOLAN DOESKEN (COMMUNITY COLLABORATIVE RAIN, HAIL AND SNOW NETWORK, COLORADO STATE UNIVERSITY); AND KIRSTEN LACKSTROM, KIRSTIN DOW, AND AMANDA BRENNAN (CAROLINAS INTEGRATED SCIENCES AND ASSESSMENTS, UNIVERSITY OF SOUTH CAROLINA)

We all know that talking politics and religion in social settings—with friends, family, or strangers—can be a firestarter. By contrast, talking about the weather is a reliably safe conversational opener.

But there's another reason that the National Drought Mitigation Center (NDMC) wants people to talk about weather. Individuals can provide a rich source of weather-related anecdotes and observations that prove critical to evaluating droughts and enabling appropriate responses.

The mechanism for this valuable conversation with the public is the Drought Impact Reporter (DIR). Lately, the NDMC has been working to refine the way this online service encourages citizen observers and incorporates information directly from them.

DIR 1.0: THE CONCEPT. The NDMC launched the Drought Impact Reporter (DIR) in 2005 as an online archive of drought impacts (<http://drought-reporter.unl.edu>) because drought policy researchers and advocates, including the Western Governors' Association and Don Wilhite, founder of the NDMC, identified the need for better assessments of drought impacts—including a consistent methodology for quantifying economic losses due to drought—and better understanding of drought's indirect social and environmental effects. Such information helps people allocate water resources, provide relief, and understand effects on ecosystems, communities, and various industries. This information enables planners to better target actions to reduce vulnerability to drought. It can also help inform educators, the general public, and the media. Furthermore, the DIR helps authors of the U.S. Drought Monitor, both as a repository for impact reports and as an additional data source.

The NDMC's initial efforts to populate the DIR focused mainly on culling information from his-

toric media clippings and daily automated searches of electronic media. Individual observers from the general public, agencies, NGOs, or other walks of life were also invited to submit "user reports." The DIR casts a wide net, with a moderator sifting through the results of an automated web search each day for news stories about drought impacts. Associated web pages include a growing collection of links to regularly updated federal and state drought-impact information ([http://drought.unl.edu/MonitoringTools/SourcesofDroughtImpactInformation\(US\).aspx](http://drought.unl.edu/MonitoringTools/SourcesofDroughtImpactInformation(US).aspx)). Similar efforts underway internationally include the Canadian Agroclimate Impact Reporter and the European Drought Reference Database and Drought Impact Report Inventory. Some U.S. states also track impact-related information. For example, the Texas Commission on Environmental Quality maintains online information about water systems that have imposed voluntary or mandatory restrictions (www.tceq.texas.gov/response/drought/drought.html). In California, the Association of California Water Agencies publishes a similar list and map during droughts (www.acwa.com/content/local-drought-response).

SCARCITY OF DOLLAR ESTIMATES. In the first few years of operating the DIR, the NDMC realized that estimates of dollar losses associated with drought impacts are fairly rare, other than summary statistics published by the U.S. Department of Agriculture. Coming up with systematic estimates of dollar losses will require in-depth work with reporting networks within relevant sectors. Some industries, such as tourism, may be challenged to identify precisely which losses are related to drought, or may lack incentive to share that information. Separate attempts to come up with a consistent methodology for quantifying losses have documented the inherent difficulties, and no single preferred methodology has yet emerged. How losses are tallied depends on the

purpose of a given effort, which varies by sector and scale. An excellent recent compilation of impacts within a single sector was the ongoing Economic Research Service synthesis and analysis of USDA data, "U.S. Drought 2012: Farm and Food Impacts," which is available online at www.ers.usda.gov/topics/in-the-news/us-drought-2012-farm-and-food-impacts.aspx#.VA-K7ktarG4.

The DIR has been much more successful in cataloging the breadth and variety of the impacts of drought than in compiling economic losses. As of May 2014, the DIR had logged more than 18,000 impacts, most related to events occurring since 2005. We have observed that even in the absence of units associated with impacts, users of the DIR tend to look at the number of impacts that have been recorded, and what categories they fall into (i.e., agriculture, water supply, wildfire, etc). Thus, the DIR is both a historic archive of impacts and a gauge of what kind of impacts are most on the minds of contributors and news editors.

DIR 2.0: REPORTS VS. IMPACTS. The NDMC incorporated a distinction between reports and impacts into an updated database in 2008, and a new map and web interface were implemented in 2011. When a report reflects a quantifiable or observable change at a specific place and time that can be attributed to drought, a moderator will record it as an impact. Sometimes reports contain valuable information about, for example, diminished streamflow, that indicate that an impact such as increased fish mortality is likely. Distinguishing between reports and impacts allows the DIR to collect data on conditions leading up to impacts and on drought recovery, instead of only focusing on the most extreme circumstances (i.e., impacts). This approach, comparable to time-lapse photography rather than a single snapshot, provides information on the processes leading to impacts, which is valuable for decision making and research. The distinction between reports and impacts also allows the NDMC to observe which news stories are widely circulated—a rough measure of awareness or concern—but to avoid logging duplicate impacts.

CULTIVATING VOLUNTEER OBSERVERS. The DIR accepts volunteer-submitted reports both directly, as user reports, and via the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS), which invites observers to submit supplemental drought reports in addition to their regular observa-

tions. Although they collect similar information, the individuals submitting the reports do so for different reasons. Many individuals submitting user reports directly to the DIR do so as part of their jobs. More than 400 individuals have submitted about 800 user reports since 2005, and some of the most consistent observers have been Extension agents, Farm Service Agency representatives, and National Weather Service personnel. NDMC moderators read volunteer-submitted reports, remove the occasional off-topic editorial comment, and create impacts from reports that meet the impact criteria. Even if reports don't become impacts, observations about local conditions are valuable because they help us understand the progression of the effects of dryness and drought in different ecosystems and circumstances.

To engage a broader cross-section of the public, the DIR partners with organizations that can recruit, train, and motivate users. For example, the organizers of the CoCoRaHS observer network provided volunteers with the option to submit additional drought-related observations to the DIR beginning in February 2010. Via CoCoRaHS, volunteer observers have submitted more than 4,900 drought-related reports since then. CoCoRaHS keeps in touch with its volunteers through a message of the day and other communication that lets them know how their information is used and helps build a sense of being part of a learning community. In 2013, the Carolinas Integrated Sciences and Assessments (CISA) initiated a project to recruit CoCoRaHS observers in North and South Carolina to report on indicators that would be affected by drought, creating a network within a network. Between August 2013 and August 2014, approximately 70 participants joined the project and submitted almost 450 condition monitoring reports. CISA has a project blog and newsletter to stay in touch with its volunteers. Ongoing efforts are focusing on analyzing the information provided in the submitted reports and surveying participants to learn about their motivations to volunteer, what they feel they have achieved and learned, and whether or not they will continue to submit reports.

A few examples of volunteer-submitted reports in the DIR:

- *From a Colorado user report, submitted 11 December 2013:*
Drought-affected native range in Crowley County received late season moisture. Because of the depressed grass condition and the large amount of open ground, Russian thistle emerged. The areas

having seen livestock liquidation in excess of 50% herd reductions saw growth of these weeds into mature weeds or tumbleweeds. Recent winds and lack of moisture has caused the blowing and traveling of these weeds into windbreaks, fences, and roadways. Crowley County Commissioners reports some 42 miles of County Roadways closed due to tumbleweed blockage. There remains a huge concern of the possibility of fires with vehicles attempting to pass through these areas.

- *From a New Jersey CoCoRaHS observer, 6 November 2013:*

Grass died back and new grass seed did not sprout. Some tree leaves are going brown immediately rather than the transitional seasonal color. Vegetable garden died back early due to dryness as did perennial ground cover plants in beds. State forest fire sign is now on “moderate.” Reservoirs are very low—can see bottom and “moonscape.”

- *From a South Carolina CoCoRaHS observer, 4 December 2013:*

Very dry, humidity is low for our area, creating sinus problems. Ground moisture is two to three inches dry. Ground water at shallow well depth seems to be plentiful. However, iron content seems to be higher.

LESSONS LEARNED. Two key evaluations of drought-impact reporting were published in 2013: The *BAMS* article, “Field of Dreams or Dream Team?” by Alison Meadow, Dan Ferguson, and Mike Crimmins of the Climate Assessment for the Southwest, an evaluation of Arizona DroughtWatch (AZDW); and “The Missing Piece: Drought Impacts Monitoring,” led by CISA team members (Lackstrom et al.), a drought-impacts community workshop held in Tucson in March. These evaluations, and experience with the DIR, are refining how we anticipate working with citizen science observers in the future. In addition to accepting occasional reports from observers who notice drought impacts, we are exploring “condition monitoring reports” (i.e., continuous reporting at regular intervals in both wet and dry conditions to better capture subtle transitions).

Meadow et al. found that the concept of labeling a phenomenon as a drought impact poses a challenge:

Drought can be difficult to definitively characterize for at least two reasons . . . [T]he time-lag

between precipitation deficits and impacts to social and ecological systems can be substantial, particularly in semi-arid and arid regions, making it difficult for observers to confidently attribute conditions to “drought.” We also found intended users of AZDW were reluctant to report observations when they did not perceive drought impacts in their region. The challenge of deciding whether a specific location is “in” or “out” of drought and the complexity and uncertainty of identifying drought impacts seem to have contributed to the relatively low numbers of impact observers who were willing to report regional conditions to AZDW.

Lackstrom et al. noted that the DIR “appears to be used primarily to compile single reports, rather than as a system for ongoing status monitoring, which limits the value of the DIR as a source of long-term data.” Another shortcoming was that “the extent to which groups at lower levels of decision making, such as state drought task forces and local planners, are aware of or use the database (or find it useful) is unclear.” Lackstrom et al. also found a lack of clear connections between decision makers and drought-impact information, which makes it harder to supply volunteer observers with external motivations for collecting data.

ADDRESSING MOTIVATION, REFINING TECHNIQUE. One of the challenges in creating a network of volunteer observers is finding volunteers whose interests and inclinations align with the effort, and who have time to participate. Developers of the DIR have worried that some observers might try to create a perception of drought being worse than it actually is, in order to increase the likelihood of being eligible for federal relief. Others may resist providing information to what they perceive as a government effort to learn about their activities. It appears, though, that the value of participating is as yet undefined for most potential contributors. The motivation to participate may come effectively from place-based organizations or interest-based networks that value or monitor resources that are vulnerable to drought. For example, wildlife refuges or bird-watching organizations may find it useful to organize members to submit observations on habitat conditions or headcounts at regular intervals. Gathering this data could help preserve habitat and populations by detecting changing conditions sooner rather than later, and by creating a

repository of readily available data. Organizing observations of particular species or phenomena is also a way to cultivate awareness and appreciation and to build shared understanding related to the subject of observations. Documenting conditions over time can help people understand what has changed, and how present conditions compare with the past. Capabilities added to the database and the web interface in recent years have bolstered the ability of the tool to collect distinct sets of reports about drought.

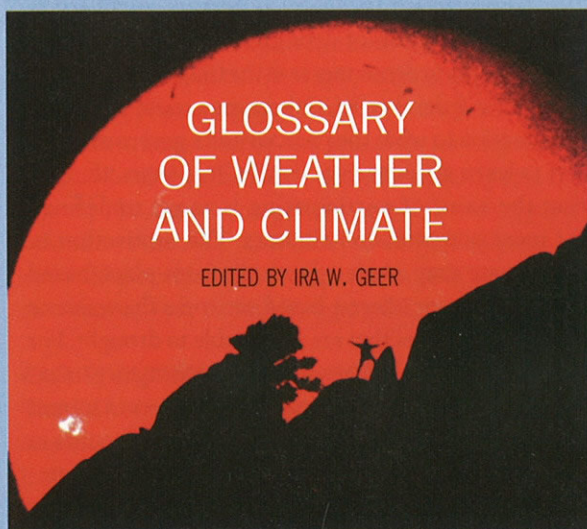
Recognizing the need to offer the capability to support status-based observations of drought indicators, the NDMC, CoCoRaHS, and CISA collaborated to develop a list of suggested indicators that would be affected by drought and that volunteers could observe and report. Possible indicators include the height or density of vegetation; progress of unirrigated crops; availability of water for livestock or in wells; number of people boating, floating, or rafting a given lake or river; mood when people talk about the weather; pounds of bait sold; and the presence or absence of burn bans or fireworks restrictions (see the full list at [://public.droughtreporter.unl.edu/submitreport/conditionreport.aspx](http://public.droughtreporter.unl.edu/submitreport/conditionreport.aspx)). This list will no doubt be refined over time as different groups experiment with it and offer suggestions. We believe that the data from systematic status monitoring, consistently focused on one or more phenomena varying with drought, will help researchers understand how drought conditions contrast with normal conditions, and the time lags and stages involved as ecosystems

go in and out of drought. From this, baselines can be established for comparison with future conditions.

The Drought Impact Reporter currently provides a unique historic archive, searchable by time, place, and other characteristics, composed of news accounts and a growing number of observations from individuals. The existing data collection and visualization capabilities could provide good infrastructure for groups or networks that want to begin collecting observations about features or phenomena that are affected by drought—to tap into people’s natural inclination to talk about the weather, and record some of their valuable observations. The NDMC welcomes inquiries from potential citizen science collaborators to help determine whether using the DIR’s infrastructure could be a good complement to their interests and activities.

FOR FURTHER READING

- Lackstrom, K., and Coauthors, 2013: The missing piece: Drought impacts monitoring. Report from a Workshop in Tucson, AZ, March 5–6, 2013. 23 pp. [Available online at <http://www.seachangecop.org/sites/default/files/documents/2013%2003%20Drought%20Impacts%20Monitoring.pdf>.]
- Meadow, A. M., M. A. Crimmins, and D. B. Ferguson, 2013: Field of dreams or dream team? Assessing two models for drought impact reporting in the semiarid Southwest. *Bull. Amer. Meteor. Soc.*, **94**, 1507–1517.



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