Carolinas Integrated Sciences & Assessments

Citizen Science Condition Monitoring Project

"Phase 2" Progress and Documentation

February 2017 Update

Contents

Phase 2 Objectives/Goals

The goal of Phase 2 is to improve the usefulness and accessibility of CoCoRaHS condition monitoring reports. Phase 2 activities build on feedback received from drought decision makers in Phase 1 of the project. Phase 2 of the Citizen Science Condition Monitoring project includes four major activities:

1) Develop new tools to streamline the processes of submitting and accessing condition monitoring reports
2) Continue communications and outreach with condition monitoring volunteers
3) Analyze condition monitoring reports
4) Engage with users of condition monitoring information

These four activities have been informed by feedback CISA has obtained through volunteer surveys and conference calls, interviews with drought decision makers, and discussions with other potential users of condition monitoring reports and drought impacts information. The project will continue to be evaluated at the Carolinas level to assess the effectiveness and usefulness of the information and resources developed through this project. This will include surveys of volunteers to assess

communications and outreach strategies, discussions with decision makers about how the information in the reports can be used, and comparison of the new condition monitoring scale bar with other objective indicators to determine if the information submitted by reporters corresponds with other metrics of drought conditions.

Activities and accomplishments through January 2017 are listed below. Additional information and details about these activities are provided in the sections that follow.

September 2015 – March 2016	Developed the "condition monitoring scale bar" to be available on the CoCoRaHS condition monitoring online reporting form
	Developed Version 1.0 of the web map
April 2016	Web Map 1.0 publically available (www.cisa.sc.edu/map)
March – Sept 2016	Developed training materials and guidance documents for observers in collaboration with other project partners (CoCoRaHS, NDMC)
June 2016 – January 2017	Refined Web Map to improve functionality and provided enhanced access and features
October 2016	Launched new scale bar, reporting form, and resources with CoCoRaHS (https://www.cocorahs.org/Content.aspx?page=condition)
	Contacted current volunteers and recruited new participants for Phase 2 (with focus on existing CoCoRaHS observers)
	Conducted webinars with project volunteers (current and new recruits)
	Initiated Phase 2 regular and targeted communications and outreach for project volunteers, e.g. monthly newsletters, blog posts, and webinars
November 2016 – January 2017	Developed set of three volunteer feedback surveys
	Developed plan to recruit volunteers from coastal areas
	Began to develop protocol for coding and analyzing reports
	Began to develop protocol for user feedback surveys and interviews
January 2017	Web Map 2.0 publicly available (http://www.cisa.sc.edu/map/)
	Conducted 1st quarter volunteer conference call
	Disseminated the first of three volunteer feedback surveys for Phase 2
	Initiated discussions with NIDIS, CoCoRaHS, NDMC, and other partners to consider how best to transition from the Carolinas pilot to a national effort

Activity 1: Develop New Tools for Condition Monitoring

CISA has led the effort to pilot two new tools: 1) a condition monitoring scale bar and 2) a web map to visualize condition monitoring reports. These tools are intended to streamline the processes of submitting and accessing condition monitoring reports.

CISA graduate student David Eckhardt conducted much of the research and outreach to develop the scale bar (Activity 1.1) and prototype web map (Activity 1.2). This work started in summer 2015 as a master's project in the University of South Carolina, Department of Geography. Summary information is provided in this document; more detailed information about the process to develop the scale bar is available in Eckhardt's final master's project paper.[1]

Activity 1.1 Develop the Condition Monitoring Scale Bar

Based on decision maker feedback received during Phase 1 of the project, a need was identified to improve the report submission process so that report content can be more easily processed. Submitting raw text reports produces rich data, but there are inherent drawbacks. The open-ended report format produces inconsistency in what is reported in terms of content, as well as spatial and temporal characteristics of the data. More importantly, it is very difficult and time consuming to process report text into a summarized form for end users. Open-ended reports are valuable, but a need for close-ended questions in addition to the test reports was suggested to provide more structure and comparability between different reports. The idea for a condition monitoring scale bar was proposed to meet this need.

Review of Drought Indices, Categories, and Metrics

Initial development of the scale bar was based on a select review of well-known drought indices and categories including the Reclamation Drought Index (RDI), Palmer Drought Severity Index (PDSI), and the US Drought Monitor (USDM) categories. These three drought metrics were selected because they are widely used by federal and state agencies as well as for scientific research, depending on the index. Their use is often pivotal in triggering drought declarations, and consequently the supply of drought disaster relief aid. Ideally, citizen science data should be relatively comparable to existing objective and subjective indicators, allowing the citizen science data to be more easily integrated into decision maker and stakeholder protocols.

Initial Prototype Development

The Likert Scale question format was chosen as the format for initial development of the scale bar because of its ubiquitous use in surveys and its well established protocol. Several prototypes were developed based on categories in the indices listed above (Figures 1-3). The Reclamation Drought Index and the Palmer Drought Severity Index required no additions to their respective categories, as they already included classifications for wet conditions. The U.S Drought Monitor categories, however, only contain classification for dry or drought conditions. In order to create a scale bar that captured wet conditions as well, wet condition categories were created that mirrored the dry USDM categories. A total of six prototype scale bars were created; three examples are shown below.

[1] Eckhardt, D. 2015. Improving Citizen Science Condition Monitoring Reporting: Condition Monitoring Scale Bar. Master's Project Paper, Department of Geography University of South Carolina, Columbia, SC.

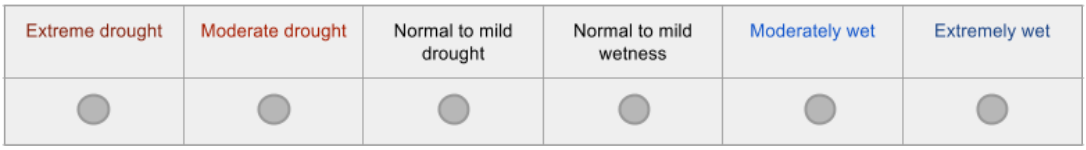

Figure 1: Reclamation Drought Index-based scale bar prototype

Figure 2: Palmer Drought Severity Index-based prototype

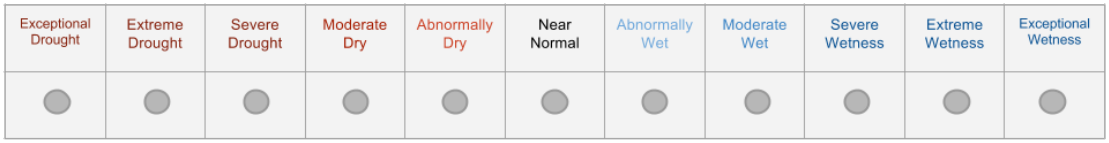

Figure 3: US Drought Monitor-based prototype

Prototype Feedback

Drought Experts and Decision Makers

The scale bar prototypes were presented to drought decision makers during feedback interviews. Response, concerns, and suggestions were noted. The scale bar based on the USDM categories was favored among most interviewees. Additionally, a division began to emerge between interviews related to the use of the full suite of eleven USDM categories (shown above) or a condensed version of the scale bar that showed nine drought categories. Despite the large amount of choices, decision makers favored the scale bar with eleven categories, due to their familiarity with these categories. They were also concerned with transferability of the citizen scientist data if the scale bar categories did not directly match the USDM categories.

CoCoRaHS Volunteers

Based on feedback from decision makers that the USDM-based prototype would be most useful, a prototype of the scale bar with nine category choices was then shared with project volunteers along with a Google Forms questionnaire to solicit feedback. Category selections were limited to nine choices to align with Likert scale development best practices. Participants generally responded well to the idea of a condition monitoring scale bar. The majority of people indicated they would feel confident in using the Condition Monitoring scale bar and felt that Likert scale question would help them in describing conditions in their area. Volunteers did indicate that there were too many choices, making it difficult to distinguish between categories like “severely wet” and “extremely wet”. Observers also indicated a need for additional guidance to inform their selection of a scale bar category.

Revisions Based on Feedback

The volunteers’ response to the number and ordering of the categories in the USDM-based scale bar raised substantial concerns in terms of understandability for the CoCoRaHS observers. Finding a balance

between decision maker and stakeholder utility and observer usability was an important consideration for the development of the final scale bar. A revised version of the USDM-based scale bar was created with three categories on each side (wet/dry) and a neutral category in the middle. The USDM categories were used as the basis for the new design because they have the most potential for producing citizen science data that is useful for drought decision makers. The U.S. Drought Monitor is already a mixed methods composite index, thus allowing for greater potential integration of subjective citizen science data into the USDM composite index. Additionally, feedback interviews with drought decision makers indicated that using the USDM categories was their preferred option.

The scale bar purposely uses the same form of three adjectives to describe dry and wet conditions throughout the scale bar (mildly, moderately, severe). Usability principles state that designs should aspire to have simplicity, consistency, learnability, and memorability. A consistent severity rating avoids the mixing of adjective forms present in drought indices such as the Palmer Drought severity index. These adjectives are common day language, avoiding terms like abnormal or incipient. Leaving out the term "drought" avoids forcing citizen scientist to decide if conditions should be called a drought. Instead, the Condition Monitoring scale bar gages the intensity of dryness or wetness in the area. A revised version of the Condition Monitoring scale bar was developed, using seven categories: severely dry, moderately dry, mildly dry, near normal, mildly wet, moderately wet, severely wet (Figure 4).

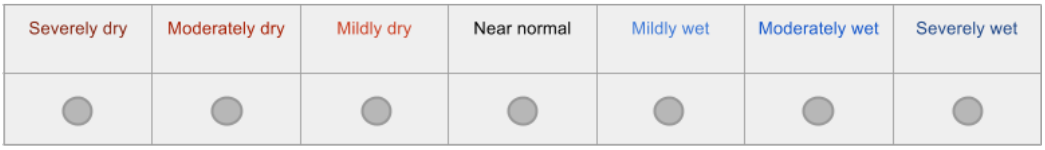

Figure 4: Revised Condition Monitoring Scale Bar (Likert-scale format)

An alternate version was created based on a sliding scale design, also known as the visual analog scale (Figure 5). The second version retains the seven condition categories, but uses a sliding scale for selection rather than radio buttons. The primary argument for a sliding scale is that it is less repetitive and more engaging to survey respondents than the traditional radio-button option. This assumption is based on the argument that a sliding scale allows for more interactivity, which could lead to less user fatigue and nonresponse. Proponents also argue that sliding scales provide more precision because it measures responses at the interval level, rather than the ordinal level, leading to superior data.

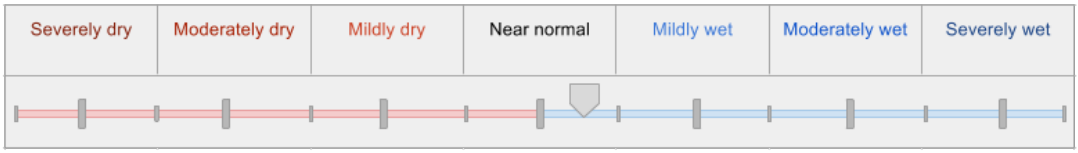

Figure 5: Revised Condition Monitoring Scale Bar (sliding scale format)

Feedback on the Revised Scale Bar

Drought Experts and Decision Makers

Decision makers were interviewed using both the Likert scale and sliding scale options. Decision makers were also shown the original three prototypes based on the all the categories in the RDI, PDSI, and USDM categories. The initial prototypes were shown to decision makers in order to explain the development process, reference objective indices during discussion, and compare the various versions

of the scale bar. Feedback continued to be divided among interviewees. Some thought the scale bar should adhere to all categories used in the USDM scale, while others saw the value in providing a more approachable option for Condition Monitoring observers. Decision makers in favor of fewer categories were not confident that citizen scientist could distinguish between eleven categories.

Similarly, decision makers were divided between using a Likert scale and a sliding scale. Proponents of using the sliding scale argued that it would produce better quality data because the interval data would be easier to use in conjunction with other research, also claiming the precision would better capture the observers' answers. Proponents liked the idea of being able to place the sliding scale near or in between categories when conditions do not match up perfectly with categories. Decision makers in favor of the Likert scale option liked the simplicity of radio button in terms of decision making and visual appearance.

HCI Expert

Given there was no clear consensus among decision makers, the help of a human-computer interactions expert at the University of South Carolina, Dr. Jenay Beer, was solicited to provide more clarity in regards to the number of categories and the use of a sliding scale bar or radio buttons. Dr. Beer favored using only seven categories with a Likert scale format. Five to seven choice options is the standard used in questionnaires. Dr. Beer pointed out that despite both the sliding scale and the radio button scale having the same number of categories, the sliding scale format places more cognitive load on the citizen scientist than the Likert scale format.

CoCoRaHS Volunteers

Observers' input was solicited during one of CISA's quarterly calls with project volunteers. Based on the feedback obtained to this point of the project, only the seven-category radio button scale bar was presented to the volunteers. A modified data entry form, which included the new scale bar, and guidance on using the scale bar were also provided. The call was conducted similar to that of a focus group exercise. The Condition Monitoring Scale Bar and guidance were emailed to observers prior to the call. Observers were provided time to view the Condition Monitoring Scale Bar, and along with guidance during the call, were asked about their perceptions, opinions, attitudes on the material provided.

Observers' responses were recorded during the call and also captured immediately after the call in a Google Forms survey. In comparison to the first survey of CoCoRaHS volunteers, a higher percentage of people in the second survey indicated they would feel confident in using the Condition Monitoring Scale Bar and that the Likert scale question would help them describe conditions in their area. Observers generally liked the scale bar idea, but felt the Condition Monitoring Scale Bar should supplement, not replace, the open ended text box. Some observers felt the Condition Monitoring Scale Bar would help them report more often, and identify conditions better than just the text reports alone.

Using subject matter expert interviews (SMEs), additional feedback was solicited in November 2015 from observers who regularly submitted condition monitoring reports. SME interviews are often used to obtain insights into the functionality of an existing or updated system, with the goal of improving that system. Seven observers participated in the SME interviews. Observers completed a mock entry of the condition monitoring report form and were asked to talk aloud, detailing their thought process, especially in regards to making a selection on the scale bar. After completing the form, observers were immediately asked a series of open-ended questions.

Based on responses, observers felt comfortable using the Condition Monitoring Scale Bar and thought the guidance was helped. When asked if more categories would allow them to report more information, all observers said having seven categories was sufficient, and did not think that additional categories would improve their ability to report conditions. The only observer that expressed a desire for more categories was a professional meteorologist, but he stated that the seven category scale bar achieved a good balance between simplicity and having too many choices on the scale.

Final Scale Bar

In order to provide a standardized drought metric and enhance condition monitoring reporting, the final Condition Monitoring Scale Bar was developed using a seven category Likert scale format (Figure 6). This scale bar design limits cognitive load, and additionally the Likert scale protocol is well established. Striking a balance between decision maker utility and observer usability is important. The final iteration of the scale bar achieves this balance. The construction of the scale bar was based upon USDM categories by constructing the categories, and more importantly the category guidance, to reflect that of the USDM. Although, it could be argued that the scale bar has elements of any of the three original quantitative indices: the RDI, the PDSI, or the USDM.

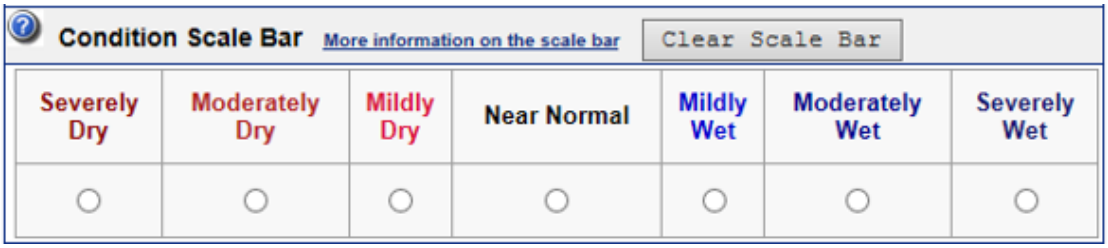

Figure 6: Final iteration of the Condition Monitoring Scale Bar

National Condition Monitoring Report Form

In spring and summer 2016, CISA worked with CoCoRaHS and the NDMC Drought Impact Reporter to design and plan the launch of the new Condition Monitoring Scale Bar on the CoCoRaHS website. Modifications included the addition of the Scale Bar to the reporting form as well as changes to the "Report Date" and "Report Categories" sections of the form. Most significantly, the form's title and focus shifted from "Drought Impacts" to "Condition Monitoring" (Figure 7). This change reflects a growing need and recognition for a more systematic approach to the monitoring of local conditions and the effects of drought at different stages of drought.

The Drought Impact Report Form on the CoCoRaHS website was officially replaced with the Condition Monitoring Report Form on Monday, October 10, 2016. As of Friday, January 27, 2017, 5,971 condition monitoring reports have been submitted nationally. 759 of these were submitted in the Carolinas.

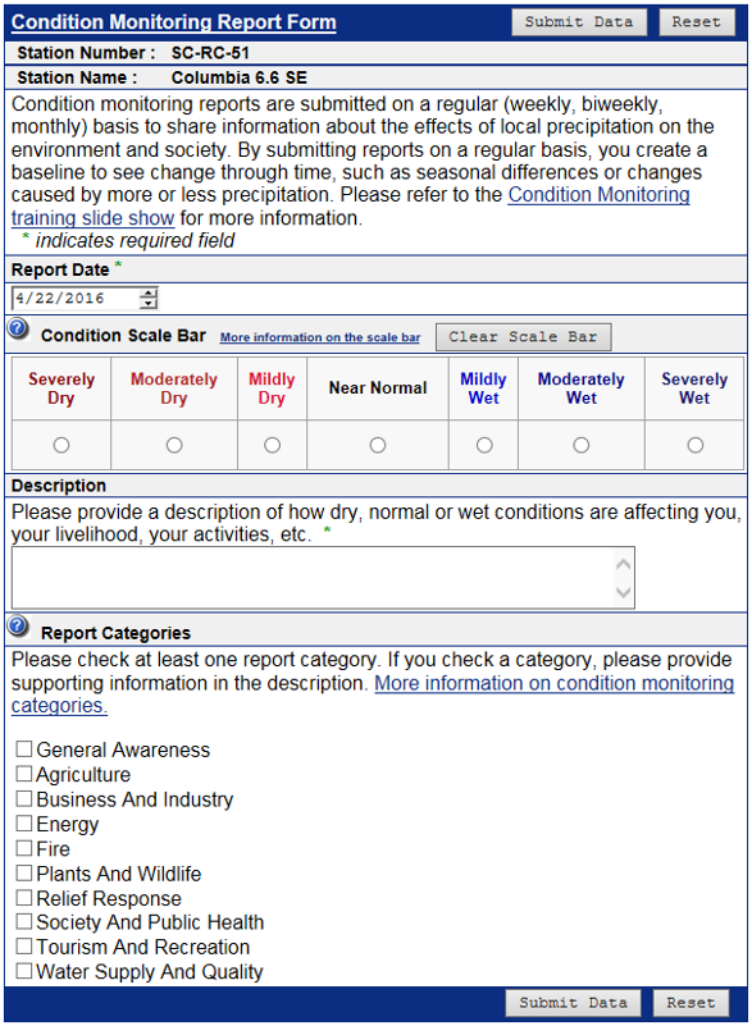

Figure 7: CoCoRaHS Condition Monitoring Report Form

Activity 1.2 Develop the Condition Monitoring Web Map

The impetus for the Web Map came from interviews with individuals who regularly monitor drought conditions. Interviewees indicated that a streamlined and efficient way to access the condition monitoring reports would potentially enhance their use in monitoring and decision making.

Two options were initially considered for the online mapping component of the condition monitoring project. Two options were considered in selecting the best applications for building out a web map, Leaflet and ESRI. Design considerations such as how report data should be visualized, additional data layers needed to provide context for decision makers, and usability of the different applications were considered. Technical aspects such as how the data are retrieved and processed to import into the web map were also assessed.

A prototype web map was developed in conjunction with the Condition Monitoring Scale Bar. The idea was to use the Condition Monitoring Scale Bar responses to display wet-to-dry conditions, according to an observer's location, on an interactive web map that could then be used to access additional information associated with that observer's report (e.g., qualitative description of conditions, county).

Web Map 1.0

For the first iteration of the web map, a combination of ESRI's ArcGIS Online and Web AppBuilder were used. This allowed for the creation of a semi-custom web map application with relatively little demand for web design and development experience. A basic prototype of the map was created using existing condition monitoring reports. The data were modified to include hypothetical examples of Condition Monitoring Scale Bar data (i.e., colored dots to correspond to scale bar category selection). This enabled CISA, during interviews with decision makers and citizen scientists (described in Activity 1.1, above), to more easily explain the concepts related to the scale bar, as well the intended use of the data in the mapping application.

During the second and third round of interviews, decision makers indicated that they liked the ability to quickly see the spatial pattern of dry and wet conditions, and appreciated seeing reports in a spatial context. The online map allowed decision makers to quickly ascertain conditions, a sentiment which was repeated throughout interviews. Most decision makers indicated that having some form of temporal analysis would greatly enhance the utility of data, and also suggested including additional data (e.g., precipitation data). Aggregation of the data was suggested at various levels: county, river basins, or drought management regions. Overall, decision makers responded very positively to the web map, and felt it would enhance the usefulness of the condition monitoring reports.

Version 1.0 of the Condition Monitoring Web Map (Figure 8) was completed and made publicly available from the CISA website in April 2016 (www.cisa.sc.edu/map). The NC State Climate Office began using the web map and condition monitoring reports to share information about drought impacts on weekly calls with the NC Drought Management Advisory Council (DMAC) to draw drought designations on the NC drought monitor map.

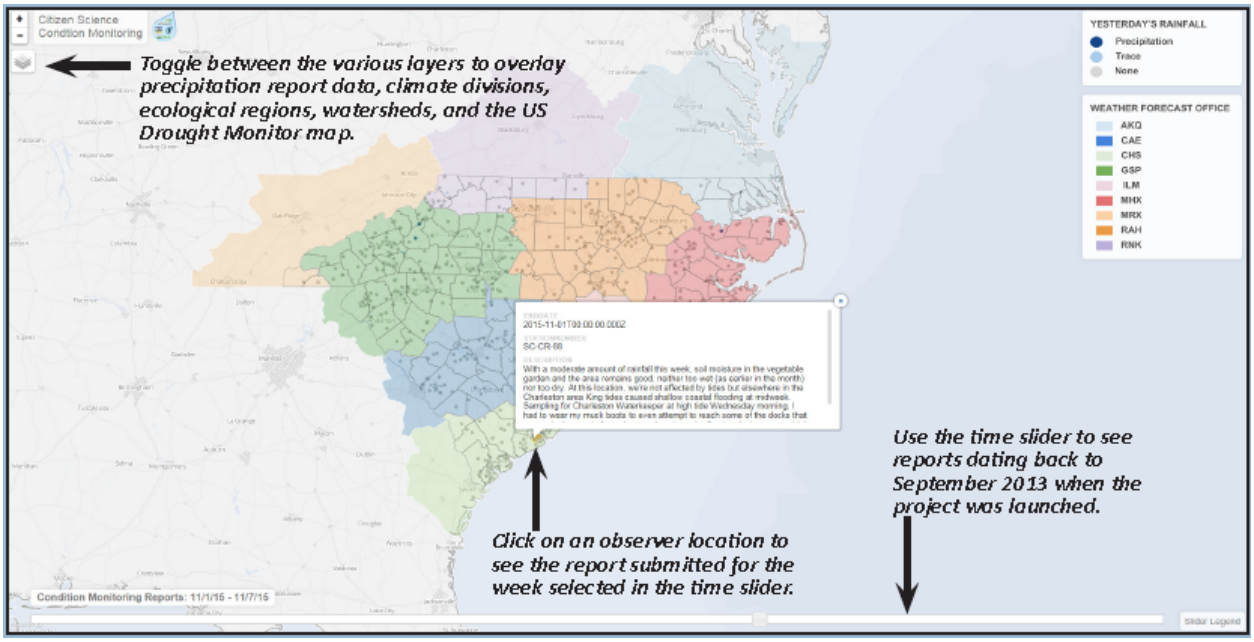

Figure 8: Version 1.0 of the Condition Monitoring Web Map

Web Map 2.0

Refinements to the web map were made from June 2016 to January 2017; version 2.0 was launched in January 2017 (Figure 9). Web map 2.0 allows users enhanced access to condition monitoring reports and provides a spatial context for the information provided by citizen scientists. Improvements to the web map were made in the following areas: mobile first design, quicker site performance, increased report legibility, searchable report content, improved symbology, additional basemaps, and data downloading. Web map 2.0 was built using Bootleaf an open source mapping template that combines Bootstrap (responsive front end framework) and Leaflet JS (mapping library). Additionally, the web map uses the CartoDB SQL API (application program interface) to deliver data to the mapping application, greatly improving the speed/performance of the Condition Monitoring Web Map.

Citizen science reports are now listed individually in the reports bar on the left side of the screen. The reports bar is a new feature that makes the citizen science reports much easier to read, providing increased functionality. Users can scroll through reports to find information of interest. The report location is highlighted on the map when a user hovers a report listing. Reports can be filtered by searching for specific keywords or category type in the search bar at the top of the column. Additionally, the pop up used in the map to display the report has been improved to make the content more legible. Lastly, points that depict the location of reports use an improved symbology that are color blind friendly.

In the top right of the screen there is now the option to switch between a street map and USGS aerial basemap. The web map still includes five reference layers that are displayed as overlays in the map: counties layer, NOAA climate divisions, weather forecast offices, ecological regions, and a HUC-6 basins layer. The map can also display the current US Drought Monitor map. The CartoDB API is also used to deliver the reference layers and has led to increased performance. Just above the layer manager, a user can search for specific locations in the map (e.g., Florence, SC) and the map will zoom to that location. Lastly, there is a top toolbar that allows users to visit an about page, provide feedback, and download condition monitoring data in CSV, shapefile, and GeoJSON formats.

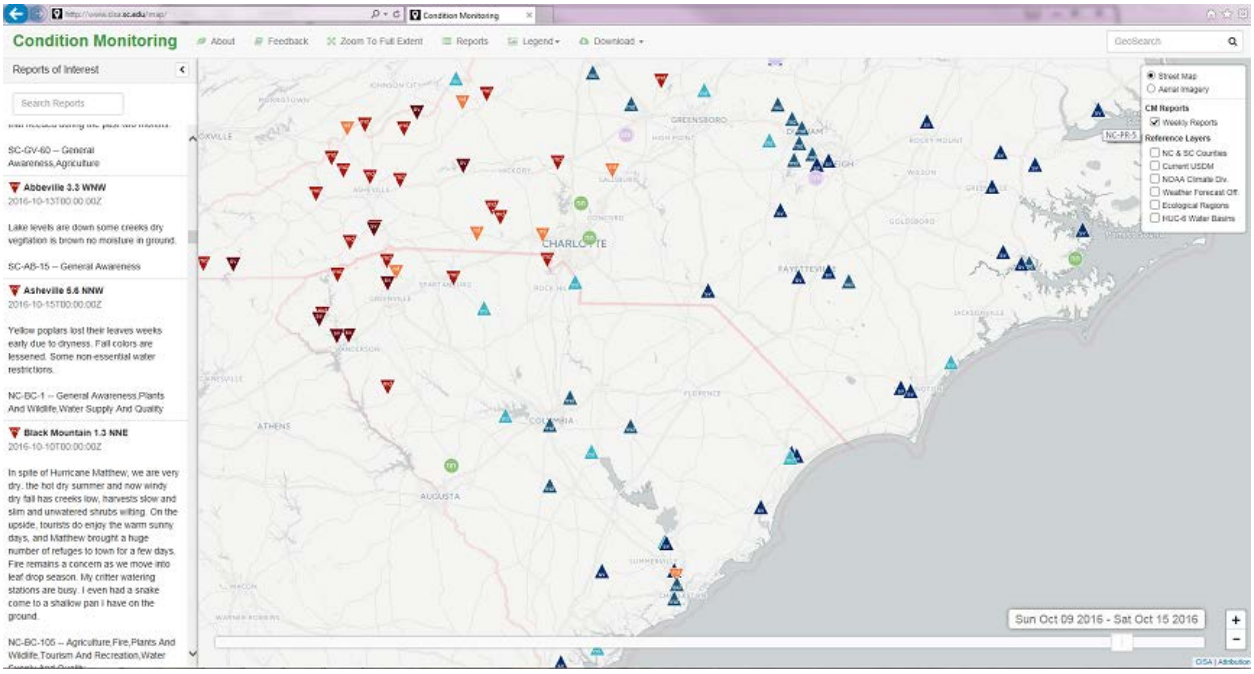

Figure 9: Version 2.0 of the Condition Monitoring Web Map

Expanding to a National Condition Monitoring Web Map

CISA has initiated discussions with CoCoRaHS and NIDIS about expanding the Condition Monitoring Web Map, currently only available to the Carolinas, to other regions. Web Map 2.0 needs to accomplish the following in order to be success at a national level. CoCoRaHS condition monitoring data for the entire nation must be imported to the CoCoRaHS CartoDB account and updated on a regular basis. This will allow continued use of the CartoDB SQL API to query and deliver condition monitoring data to the mapping application. Additionally, any other data (i.e. reference layers) used in the web map should be hosted in the CoCoRaHS CartoDB account. Data will have to be developed for the entire nation if other reference layers are included for the national map.

General work to the web map will need to occur to adjust for the new scope of the national map. The map will be hosted and maintained by CoCoRaHS. Additionally, the initial map scale and zoom restrictions will need to correspond to the Continental United States. Buttons and links that are specific to the Carolina's map will need to be changed or removed. The legend and data download will potentially need to be handled differently for the entire nation. Lastly, reference layers may need to be included in the web map as a tiled map service rather than a layer of GeoJSON data due to possible performance issues.

Activity 2: Continue Communications and Outreach with Condition Monitoring Volunteers

Observer guidance and communications and outreach efforts are very important for observer retention in all citizen science efforts. CISA has worked to ensure high volunteer retention rates through distribution of materials such as a monthly newsletter and quarterly observer conference calls. As the new report form was launched, communications about modifications to the form were provided in advance of the change. National scale efforts have also been informed by outreach strategies developed by CISA.

To support the launch of the "scale bar" and web map, work to date has focused on recruiting and training new volunteers and continuing outreach activities and communications efforts. CISA has also initiated the process of obtaining volunteer feedback on the project.

Activity 2.1 Volunteer Recruitment

In summer and fall 2016, the CISA project team worked with the SCOs and regional CoCoRaHS coordinators to disseminate information about Phase 2 of the project and recruit participants from the existing network of CoCoRaHS observers.

CISA also conducted outreach to existing Condition Monitoring volunteers to encourage continued participation, using their experience with the project to solicit feedback during the development of the scale bar and revisions to the Condition Monitoring report form.

CISA has developed a plan for recruiting participants from other citizen science initiatives and groups who monitor and manage environmental resources, particularly those in coastal areas who might be able to contribute to the Coastal Carolinas DEWS program. This includes presentations to the Master Gardeners of Florence, SC, in November 2016, and at the Waccamaw Conference in Myrtle Beach, SC, in February 2017.

Activity 2.2 Volunteer Training

The team has trained both new and existing volunteers in the Carolinas, as well as worked with CoCoRaHS to provide training to the national network of observers. Trainings materials include general information sheets, reporting instructions, and training slideshows to be available via webinar or online.

Scale Bar Guidance

During the conceptual development stage for the scale bar it became clear that guidance for citizen scientists would be needed. Clear definitions as to what constitutes each category of dry and wet conditions are necessary in order to obtain consistent responses from observers. This sentiment was independently echoed by some drought decision makers in feedback interviews as well. Citizen science research also states that projects need to develop protocols for citizen participation.

Guidance was created for each dry, wet, and neutral category for the scale bar, producing seven descriptions of likely conditions. Guidance is a composite of the "Possible Impacts" categories used in the U.S. Drought Monitor Classification Scheme, and the categories derived from qualitative coding of Condition Monitoring reports during Phase I of CISA's Condition Monitoring pilot study. Guidance for Mildly Dry is written to match D0 (Abnormally Dry), the least severe USDM category. Moderately Dry is tied to the possible impacts list for D1 (Moderate Drought), and Severely Dry is associated primarily with

D2 (Severe Drought) but extends description to include the possibility of impacts listed under D4 (Extreme Drought) and D5 (Exceptional Drought).

Decision makers and CoCoRaHS-condition monitoring observers provided feedback on the guidance and both agreed that it would be beneficial in using the scale bar. However, specific issues with arose during feedback discussions such as how to account for variation in regional differences in drought or dry conditions. For example, what is defined as dry would be very different in Arizona versus South Carolina. Moreover even within the Carolinas, the definition of what is dry can vary greatly from the coastal to mountain regions. Additionally, seasonal changes can have a significant impact. How to account for temporal aspects in the guidance, which the category descriptions are currently lacking, was also raised. As the condition monitoring program is expanded nationally, addressing this need for regionally specific guidance for the scale bar categories should be considered.

Phase 2 Training Materials

Training materials developed by CISA to include a PowerPoint training and list of frequently asked questions have been developed for the Carolinas and modified for a national audience by the CoCoRaHS team (see CoCoRaHS Condition Monitoring resource page). Messages of the Day about the availability of the condition monitoring report form are circulated to volunteers regularly by CoCoRaHS.

Additional guidance for observers with respect to report content and timing has also been refined over the life of the project and engagement with decision makers with respect to how to make the reports most useful. One such addition has been the recommendation to submit reports on Saturday or Sunday so that reports are available at the beginning of each work for review by US Drought Monitor authors and members of the NC Drought Management Advisory Council as they work to develop the weekly USDM map.

Activity 2.3 Communications and Outreach

The team continues to regularly communicate with volunteers through the monthly newsletter, the Cuckoo for CoCoRaHS in the Carolinas blog, the project webpage, volunteer conference calls, and presentations (in-person and via webinar).

A volunteer conference call was held on January 25, 2017.

Activity 2.4 Volunteer Feedback

CISA has developed a set of three online surveys for the citizen scientists volunteers in order to obtain feedback regarding the overall project, the new tools developed for Phase 2 (i.e., Condition Monitoring Scale Bar and Web Map), and the training and communications materials provided by CISA.

The first survey was sent on January 26, 2017. 800 responses were received.

Activity 3: Analyze Condition Monitoring Reports

As of January 2017, the team is in the process of developing a protocol for collecting and analyzing report content and "scale bar" data. Data analysis will begin in 2017 and be completed in 2017-2018.

Activity 4: Engage with Users of Condition Monitoring Information

As of January 2017, the team is the process of developing a protocol for obtaining feedback about the project from users of the Condition Monitoring Web Map and other information generated through the project. Components of this activity include a Web Map feedback form (available as a Google Form and linked to the Web Map) and online surveys and interviews with the target audience of web map users such as the SCOs, NWS Forecast Offices, NC and SC drought response committee members, US Drought Monitor authors, and CC DEWS stakeholders.

A first round of surveys and interviews will be conducted in spring 2017; findings will be incorporated into other project activities (web map refinement, communications and outreach) in summer 2017 and in 2017-2018. The team will develop a report to share preliminary findings and recommendations from the volunteer and user feedback. The intent is that these preliminary findings will help inform any modifications made to the project in 2017-2018. The intended audience is the NIDIS program and other project partners (i.e., SCOs, CoCoRaHS, and the National Drought Mitigation Center).