

The Great ShakeOut “Did You Feel It” Exercise

of

October 19, 2023



After Action Report

January 22, 2024

Steve Waterman,
Winlink Administrator,
Winlink Development Team
winlink@comcast.net

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Overview

On October 19, 2023, at 10:10 AM local time (anywhere), The Great ShakeOut, the world's largest annual earthquake exercise occurred, worldwide. Since 2020, the United States Geological Survey (USGS) and the Winlink Development Team have collaborated in this annual exercise by providing USGS "Did You Feel It" (DYFI) reports from the user services of the Winlink Global Radio Email System. These services included both Amateur radio and governments services. Winlink was used to bridge SMTP mail over radio to the Internet when normal Internet access is obstructed, or otherwise not available.

Since 2020, Winlink participation with USGS primarily has been concentrated within California. However, the 2023 Great ShakeOut exercise Winlink participation included an expanded effort by FEMA and their stakeholders, designed to highlight the significance of the Winlink system. With Winlink, participants can provide accurate, timely, situational awareness "ground truth" in the early stages of *any* casualty event. Thus, the United States Geological Survey (USGS), and the Federal Emergency Management Agency's Regional Emergency Communications Coordination Working Groups (FEMA RECCWG) and stakeholders collaborated with the Winlink team to provide both agency and volunteer radio operators an opportunity to participate and train on the procedures of information reporting and delivery with the option of not having to depend on conventional communications.

For USGS, the *primary objective* of the "Did You Feel It" (DYFI) exercise underscored how proficiency in using the Winlink facilitates made for effective utilization in the gathering and sharing of information. The Winlink DYFI report replicates the USGS web-based DYFI report by providing the same data and format through the Winlink Express client program. USGS uses this data to contribute to the Modified Mercalli Intensity Index used to determine earthquake severity. Data was leveraged to improve event response products, including the Prompt Assessment of Global Earthquakes for Response (PAGER), a system that provides fatality and economic loss impact estimates following significant earthquakes.

For FEMA and their stakeholders, a *secondary objective* of this exercise was to illustrate to emergency management officials nationwide the ability of the Winlink system to provide situational awareness information within their jurisdiction, which may not otherwise be available during initial phases of an emergency due to communications outages. Finally, the exercise assisted greatly in training all who participated in how to use Winlink to provide valuable information when requested.

There were approximately 1690 participants from 17 countries. However, most of the effort was concentrated within the United States with 47 participating states. Specific participant data is included within this report. In addition, USGS, [WAVETALKERS](#), and the South Carolina Emergency Management Division (SCEMD) provided a near real-time map view of the incoming data (<https://winlink.org/ShakeOut--LIVE>); and WAVETALKERS, a weekly amateur radio virtual training series, provided a real-time ZOOM/YouTube event covering the exercise for the public. (<https://www.youtube.com/watch?v=dnoDMcAaIAo&t=3688s>)

The event went smoothly as planned, and the Winlink participation exceeded all expectations. An ICS Form 309 was produced that logged each and every participant. Thus, with the push of a button in the Winlink Express end-user program, the Form 309 was created.

Objectives

The Great ShakeOut exercise is a well-publicized annual event for USGS. However, this year's event was greatly expanded to include additional areas, agencies, and reporting resources since the process for obtaining situational awareness ground truth for emergency management at all levels is continually growing to meet the challenges facing all of us in today's environment. Because many other federal, state and local requirements for geographic situational awareness use the same process for gathering "ground truth" as the DYFI Winlink exercise, the FEMA RECCWG and their stakeholders wished to use this exercise to demonstrate the capabilities of the Winlink System, which uses non-conventional communications options to reach the standard SMTP Mail system through the Internet. Thus, this expanded the purpose of this particular exercise. In 2022, the same process was used by FEMA Regions 4 and 6 in a combined annual exercise involving a Cyber Attack in four large major metropolitan areas. Winlink canvassed the two regions with over 1,000 participants to determine what additional outages were caused by the cyber-attack. In this exercise, a generic situational awareness form was used. With addition of the 2023 Great ShakeOut exercise now added to the FEMA Cyber-attack drill, participants continue to increase their ability to use the process of data gathering and delivery through the Winlink system.

For this exercise, an [example report along with detailed step by step instructions](#)¹ was provided to all participants.

1. Data Collection method. This exercise illustrates the use of Winlink to show the resiliency of alternate data collection when other normal methods are unavailable. The collection of geographic data for USGS was obtained through a replica of the USGS DYFI questionnaire website form and format, which was sent over various alternate pathways using Winlink. These pathways included Telnet or radio depending on participant circumstances. The USGS DYFI Form is currently one of over 127 templates contained within Winlink Express end-user client program, and provides USGS with the same information as the [questionnaire on their website](#)². Data received was provided by USGS was used to exercise their capabilities using the [Modified Mercalli Intensity Index](#)³ values, which calculates specific information experienced at specific locations for the event. USGS also used the data to feed the Prompt Assessment of Global Earthquakes for Response ([PAGER](#)) [system](#)⁴, which provides fatality and economic loss impact estimates following significant earthquakes.

2. Locate and train participants for any situation. As requested by FEMA, part of their objective was to provide an opportunity to demonstrate and determine the density of available resources for gathering situational awareness using the capabilities of the Winlink Radio Email system by requesting its use by multiple services. In sum, forms used by emergency management streamline the communications process, and the Winlink Development Team has provided a process that will allow specific forms to be sent over radio in order to communicate specific information when there may be no other means of delivery. For Winlink, this means bridging to Internet email over radio frequencies (HF/VHF/UHF) through various services from within a (casualty) event zone to locations that have not been impacted. Winlink also provides normal Telnet (internet) SMTP mail to use when available in order to alleviate contention for limited radio spectrum needed by those who have no other options. Winlink does not charge for its services, which within the U.S. includes amateur radio, AFMARS, Public Safety LMR, NGO critical infrastructure, and government services at all levels to include the [CISA Shared Resources Program \(SHARES\)](#)⁵.

¹ https://winlink.org/sites/default/files/ShakeOutWinlinkExercise_cm6.pdf

² <https://earthquake.usgs.gov/earthquakes/eventpage/tellus>

³ <https://www.usgs.gov/programs/earthquake-hazards/modified-mercalli-intensity-scale>

⁴

<https://pubs.usgs.gov/publication/70045585#:~:text=The%20Prompt%20Assessment%20of%20Global,our%20ongoing%20research%20and%20development.>

⁵ <https://www.cisa.gov/resources-tools/programs/shared-resources-shares-high-frequency-hf-radio-program>

In the United States, Winlink hosts over 100 continually scanning Radio Message Servers (RMS Gateways) on the DHS CISA SHARES Winlink network, all available for end-user use. The DHS CISA SHARES Winlink system uses AES-256 transmission encryption, and is designed strictly for the SHARES stakeholders' traffic. For the amateur radio service, Winlink hosts 349 HF RMS Gateways on the amateur radio bands worldwide, with 245 of them operating within the U.S. On the amateur service, Winlink also hosts "last mile" VHF/UHF RMS stations on both services, with 1585 "line of site" RMS servers Worldwide, with 1355 located within the U.S. CISA SHARES also utilizes "last mile" channels, using federal government VHF channels. All station counts cited are as of 09 February 2024.

The Winlink Interoperable solution to resilient communications, with multiple services, and vast, dense coverage, operates without normal communications infrastructure making it an important tool for emergency communications where no Internet is available. Winlink also has a secondary "Radio-only" option that allows store and forward communications which does not require the use of Internet SMTP mail. Rather, it operates radio-to-radio using the same store and forward methodology. This exercise was another opportunity for these agencies, and their volunteer resources, to exercise and assess the capabilities offered through the Winlink system within their own geographic jurisdictions and beyond.

3. Identifying and training resources as Agency volunteers. For 2023, The Great ShakeOut Winlink exercise had over 1600 participants. This participation provided another opportunity to identify and train resources who can provide situational awareness when requested. A common problem with today's volunteers is having access to their nearby emergency management agencies. Likewise, agency personnel cannot call on volunteers to provide information within their jurisdiction if those who can supply it are unknown. The agency must be willing to directly recruit and manage volunteers. Likewise, volunteers must be willing to meet basic requirements imposed by the agency such as requiring [basic NIMS ICS courses](https://training.fema.gov/nims/)⁶, including the [AuxComm or Communications Unit leadership course curriculum](https://www.cisa.gov/safecom/comu-training-resources)⁷.

For this exercise, although volunteers were the primary target for participation, there is no information regarding their association with specific agencies other than the initial guidance and request for participation from USGS and FEMA.

⁶ <https://training.fema.gov/nims/>

⁷ <https://www.cisa.gov/safecom/comu-training-resources>

Results

The results of this exercise were successful in numbers and classifications of participants, geographical areas covered, and initial notification for participation. However, there were some areas where improvements may be made along with a very valuable lesson learned. Below are the areas of concern when reviewing the exercise objectives:

1. Data accuracy and areas covered. The exercise data was sent to several sources, enabling it to be tested against known factors. For example, if a participant entered an incorrect coordinate, with a proper address, or only had an address listed, steps were taken to correct the data and enhance its location accuracy. There were several safeguards in place to ensure location accuracy. USGS asked that participant location accuracy be within a 10 meter (approximately 33') tolerance.

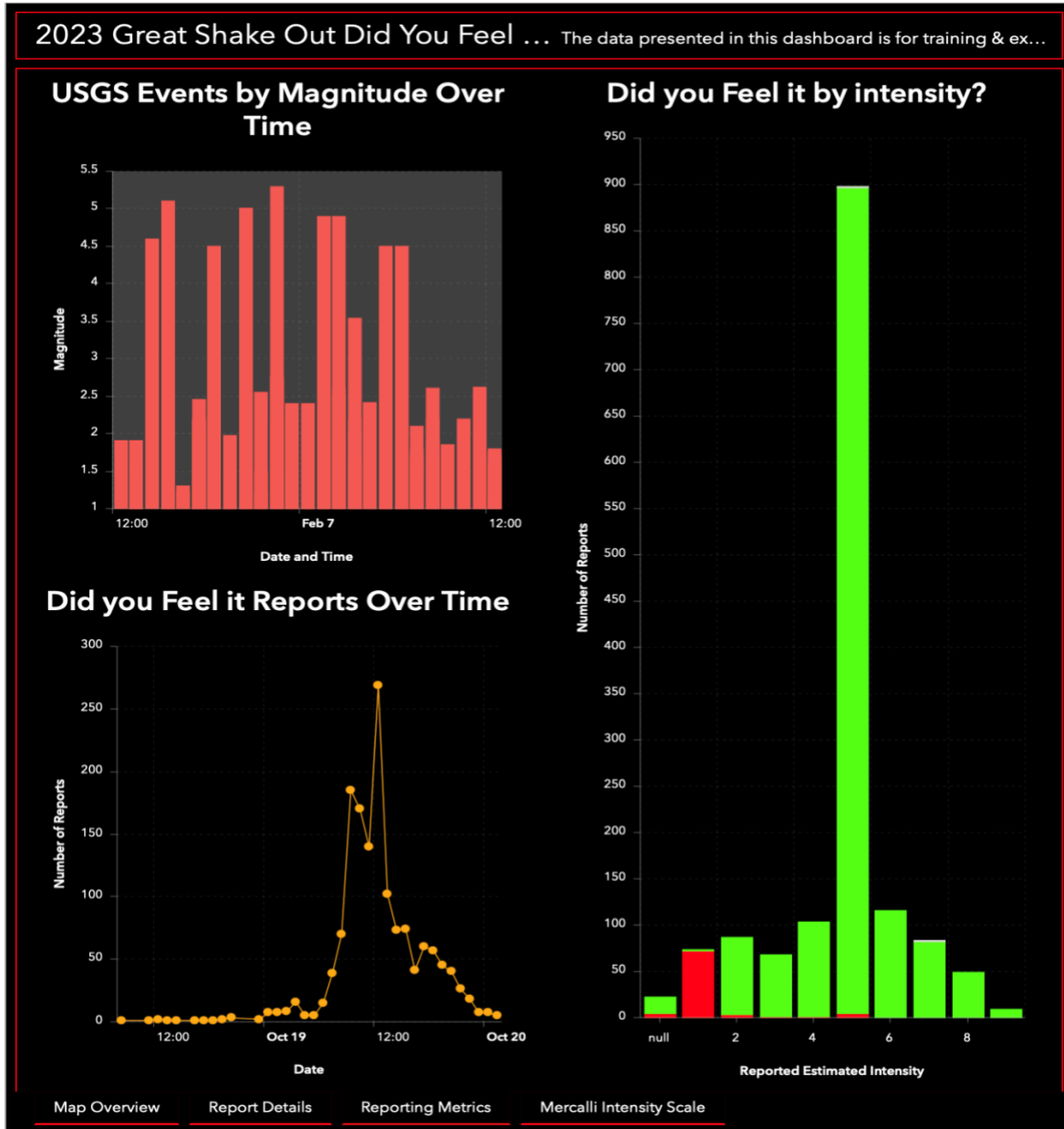
The Winlink Development Team wrote a program to do address lookups for every ShakeOut record and compute the distance between that location and the location used by participants based on coordinates. The locations used are very close to the locations from address lookups. Here is a summary of the distances in feet.

Distance <= 33 feet: 1324 (93.70%)
Distance <= 50 feet: 1345 (95.19%)
Distance <= 100 feet: 1361 (96.32%)
Distance <= 200 feet: 1384 (97.95%)
Distance <= 500 feet: 1394 (98.66%)

Total number of reports with valid street addresses: 1413. So 93.7% of the time, participant location accuracy was within the 10 meter (33') tolerance USGS stated they wanted to obtain. 98% of the time, the difference was within 200 feet. It's an unusual earthquake that is different 200 feet away from the provided location.

Near real-time mapping occurred, both through the use of the Winlink Express client program, and by external mapping provided by the Winlink Express CSV data file for WAVETALKERS, South Carolina EMA's ArcGIS mapping, and for USGS. Lastly, this information gave jurisdictions, participating or not, a view of situational awareness within their own geographic areas.

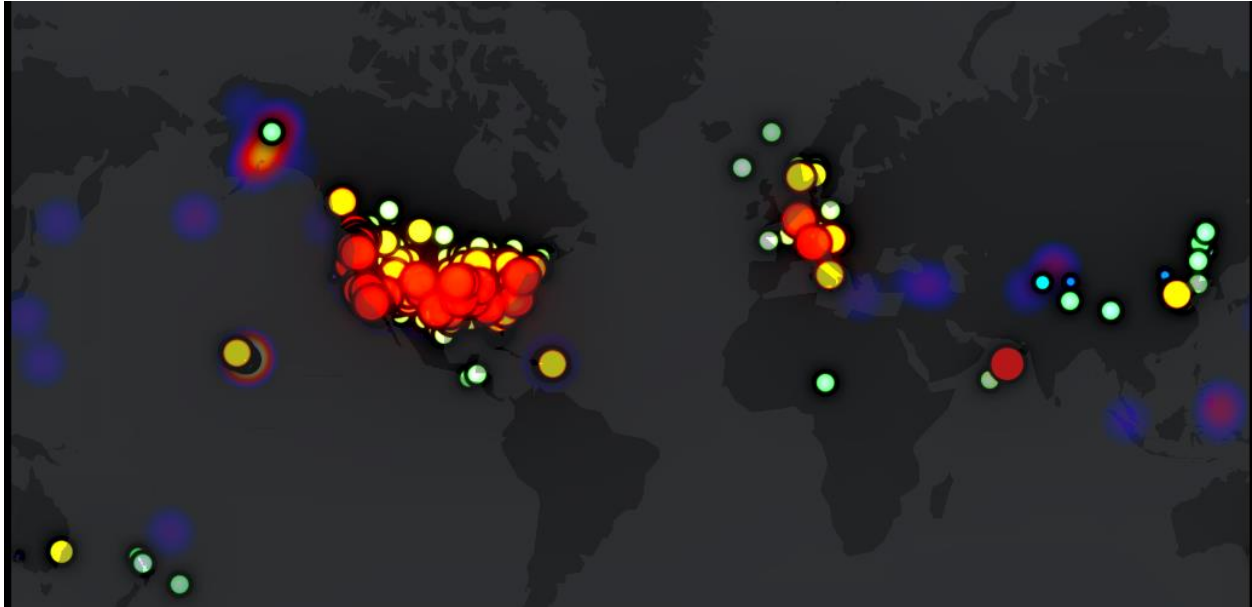
South Carolina Emergency Management provided 2023 ShakeOut DYFI Exercise Statistics*



*From near real-time view using ArcGIS. [View it live](#)⁸.

⁸ <https://winlink.org/ShakeOut--LIVE>

South Carolina Emergency Management Division's ArcGIS provided a real-time World View

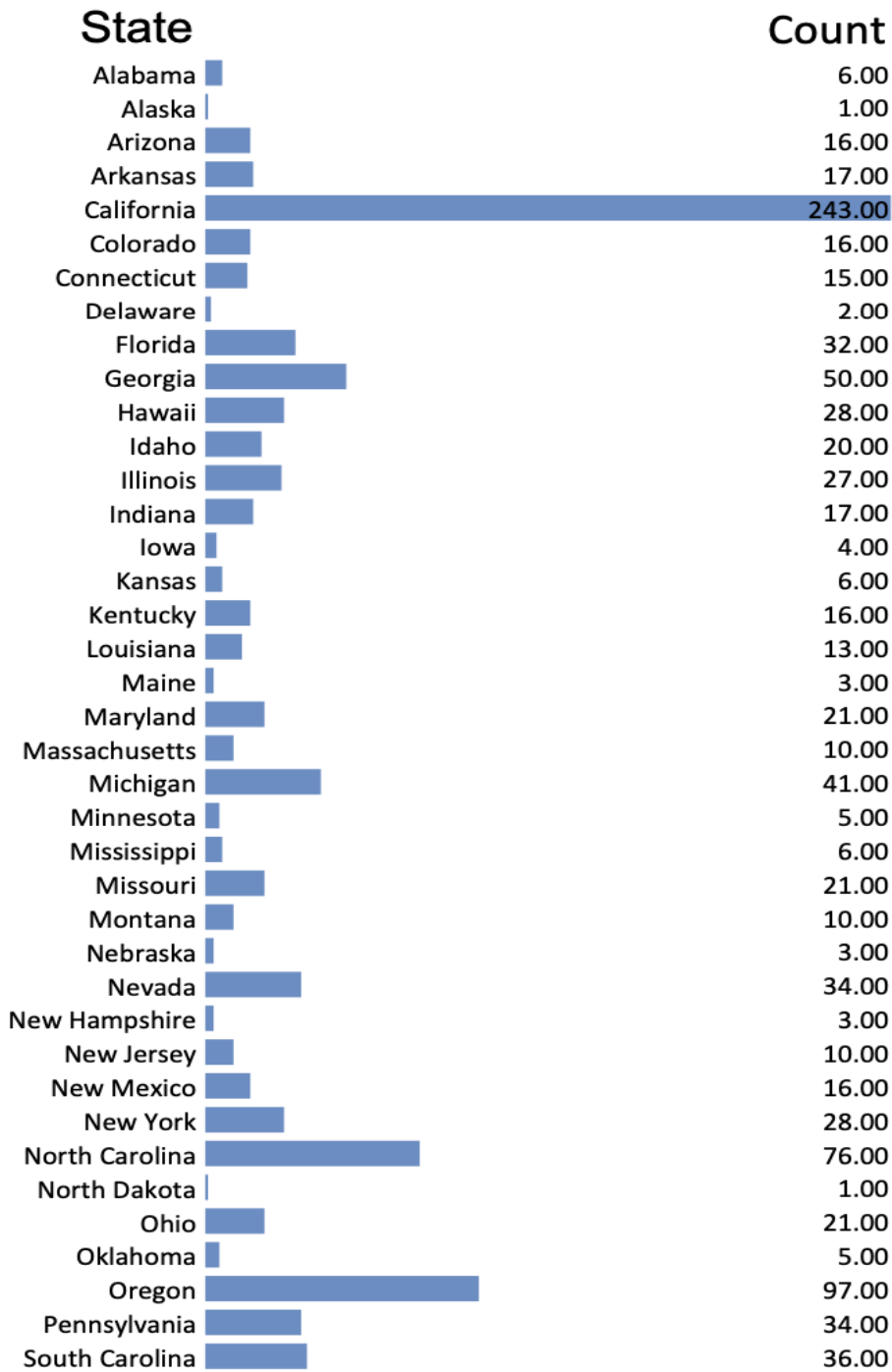


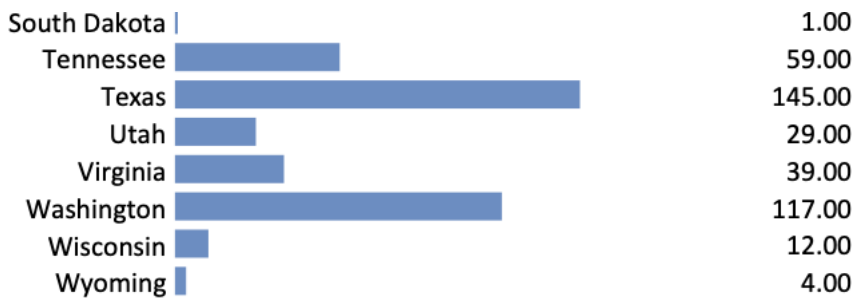
Distribution of Participants by Country: *

Country	Count
Australia	2
Austria	8
Belgium	1
Canada	44
France	3
Germany	2
Guatemala	1
Honduras	1
Netherlands	11
New Zealand	3
Nigeria	1
Norway	7
Philippines	3
Poland	1
Puerto Rico	13
U.S. Virgin Islands	1
United States	1416

*Puerto Rico and the U.S. Virgin Islands are United States territories. Solicitation for this exercise occurred mainly within the United States. However, we are all grateful for the number of international participants, and welcome their participation.

47 States participated in the 2023 USGS DYFI Exercise





Since 2020, California has been participating in the Great ShakeOut exercise with the use of Winlink. In addition, earthquakes occur significantly more frequently in California than in most other states as illustrated by the number of participants in this state of over 40 million people.

Lesson learned: The takeaway for data accuracy is to ensure that both the requester (user) of the data and the entities responsible for providing an distributing it agree on the format, content, geography and timely retrieval, and that those objectives are understood and met by those participants providing the data. The Winlink Forms capability assured that these objectives were met.

2. Initial Notification, always an issue. Timely notification for specific requests for assistance in obtaining situational awareness data is always an issue, especially when real-life events have taken normal communications away from target areas where information is needed. When local communications, and specifically the Internet is unavailable to a community, how does an agency notify a potential participant that there is the need for detailed ground truth? Predefined methods may be employed ([NWS SKYWARN⁹](https://www.weather.gov/SKYWARN) is an excellent example), especially if requested within a specific jurisdiction. Amateur repeater systems or daily state SSB nets, GMRS, NOAA All-Hazards alerts, broadcast station alerts, and perhaps, public safety LMR or auto-text/email may assist, if available, but only if there is a plan in place to obtain distribution from a request for situational awareness in that jurisdiction. This requires that there be trusted resources available to the requesting emergency management agency and that such relationships exist. As the area under consideration gets larger, the issue of notification becomes more complex, especially when normal communications are interrupted.

Notification for this exercise took approximately 6 days. Since it was an exercise, there was no immediate threat. However, without a widely publicized promotion, and time spent identifying

⁹ <https://www.weather.gov/SKYWARN>

individuals to notify for this exercise, it would not have had the large numbers of services and their participants aware of the Winlink DYFI portion of the exercise. For agencies that would want ground truth within their jurisdictions, relationships with groups that can provide it must be identified, and procedures must be put in place to provide information when the occasion arises. If you look at the map of participating stations, there are areas missing data, which usually indicates that there are no ongoing communications to participate with volunteer resources because no such planned procedure was in place. For states that are familiar with earthquake scenarios, self-motivation is not unusual. But, for many other types of disaster, sitting down to fill out a report to a predetermined and agreed upon source takes organization, planning, and exercising the process.

Lesson learned: For emergency management and participant groups, regardless of the area under consideration, when seeking situational awareness within a specific area (jurisdiction), developing a plan for notification through alternate means is becoming an ever increasingly important process and should not be ignored.

3. Timely Use of Real-time data. For this exercise, plans for publicly providing data as it came in was planned well in advance. FEMA had asked South Carolina Emergency Management if they would use their ArcGIS mapping program to receive incoming data from Winlink Express, which produces an on-going CSV file that may be continually updated and exported. In addition, the amateur radio weekly [WAVETALKERS ZOOM/YouTube group¹⁰](#) offered to stay on-line, both directly via their ZOOM and on You Tube live, to cover the exercise as it progressed. Thus, when the exercise was planned, among other recipients, USGS, WAVETALKERS, and SCEMD were sent continual near-real time updates during the exercise period so that the ongoing exercise results were always immediate.

However, realistically, during an actual event, ground truth data received may not be readily available unless there is a planned process for gathering and viewing the input when it arrives and patterns start to develop. This is not necessarily for public viewing, but more so for the requesting agency(s) who need their requested data to make timely decisions regarding people and resources movements, HAZMAT issues, injuries to victims, or any other areas of concern that would call for immediate action. This would be especially true if they were directly involved in an active event.

4. A not-so-unusual example of miscommunications. During this exercise, a very important lesson was learned, and it is not an unusual experience, especially for a relatively large agency that does not primarily get involved with emergency management. USGS was also

¹⁰ <https://www.youtube.com/watch?v=dnoDMcAaIAo>

planning to map this exercise in real-time, and provide it on their website to the public, but they ran into an internal issue.

When the exercise started, USGS found that they were not receiving the near real-time data from Winlink. They had designated a specific email address that had been set up to receive data as it was provided by the participants in this exercise. Winlink had this specific address set up to provide the data as it came in. However, USGS was not seeing any input to the email address and called to ask if we were sending them data. We verified that we were continually providing data to their designated email address. Upon hearing this, they then contacted their IT department to find that the USGS IT group had blocked the address, thinking it was spam.

Obviously, there was an intra-agency miscommunication, but that would not be unusual since most of the DYFI reports during the year comes through their website slowly, and hundreds of email messages came in all at once through a USGS SMTP mail address. In addition, their IT department continued to hold the data well past the exercise period. The Winlink team did provide USGS with the missing data, and at that point, they did publish the results of the exercise participation on their global mapping system.

Again, this is not an unusual occurrence with a large federal agency that is not set up for ongoing emergency traffic. USGS is confident that this will not occur in the future. However, for emergency management agencies anywhere, regardless of the event, a predetermined internal procedure can thwart such an issue.

Lesson learned: Having an internal process in place for unusual circumstances involving alternate communications such as requesting and then receiving larger than normal amounts of requested data will determine the effectiveness of such timely information.

Conclusion

This was the third annual USGS Great ShakeOut Exercise that has involved Winlink as an alternate resilient option in providing information required by USGS. The 2023 USGS DYFI Winlink exercise, which provided USGS with specific data using their replicated USGS DYFI form and format, provided the agency with the data necessary to exercise the agency's capabilities in measuring the Modified Mercalli intensity scale (MM, MMI, or MCS) to determine the severity of a potential earthquake.

This year's exercise included a second objective, spawned by FEMA, which also illustrated the same process that may be used to provide situational awareness "ground truth," regardless of

subject matter, and at the same time illustrate the geographical areas that current participants cover in the various jurisdictions, and better preparing the participant for additional reporting should it be requested by any jurisdiction needing “ground truth” data.

Agencies at all levels have used their own staff as well as volunteer resources for exercises and real world events that involve this same process. This trend is increasing due to increasingly improved predicted radio propagation and because of the increased use of Winlink on government services such as the DHS CISA Shared Resources (SHARES) network.

The FEMA Regional Emergency Communications Coordination Working Groups (RECCWG) are participating with their stakeholders on another upcoming earthquake exercise, and other agencies and associations have plans to use the same processes of obtaining data described within this report; that is, to be able to use multiple services to provide valued and timely information when normal Internet SMTP mail is unavailable.

The Winlink Development Team is grateful that we can offer this service at no cost, and are prepared to continue to provide such functionality as it is requested. Lastly, it is the larger, sometimes not recognized, heterogeneous group of volunteers that should be applauded as the real heroes. For the most part, it is their personal time and radio equipment that is used to send forth the data that is requested. With their increased opportunity to become educated to the NIMS ICS processes through FEMA courses, and through their association to their nearby agencies, emergency communications is broadened, and it provides a win for all.

Supporting Documents

The following includes information from the exercise sponsors, USGS and FEMA, that spawned the exercise expansion, and motivated the Winlink Development Team to become directly involved. We wished to provide and promote the power of the Winlink Global Radio Email system through agencies’ users of the system, and their volunteers’ resources in the amateur radio, AFMARS (through amateur radio and SHARES), and CISA SHARES communities.

Below are supporting documents from FEMA, USGS, AFMARS as well as several publications including the FEMA Newsletter and the ARRL E-Newsletter that contained information about the 2023 Great ShakeOut DYFI Winlink portion of the exercise.

The Documents may be found on the Winlink Website by clicking on the title.

Pre-Exercise:

[FEMA Request for Participation](#).¹¹ Email from FEMA Region 4 RECCWG to the other FEMA RECCWG Regions requesting their participation and that of their stakeholders.

[FEMA R5 RECCWG to R5 AuxComm Requesting Participation](#).¹² Email from FEMA Region 5 requesting participation of their members and AuxComm communities.

[Article in FEMA Newsletter about exercise](#).¹³ FEMA October 1, FEMA Disaster Emergency Communications News Clippings and Topics of Interest article describing the Winlink portion of the exercise.

[RATPAC 2023 Great ShakeOut Instruction Video](#)¹⁴ for Potential Participants by Dennis Kidder

Post Exercise:

[Email of Appreciation from David Wald, PhD, Supervisory Research Geophysicist, USGS](#).¹⁵

[ARRL December 20, 2023, ARRL E-Newsletter](#)¹⁶ detailing the exercise results, second article. (The ARRL ARES® was a major participant in this exercise.)

[“Thank you for your participation” from FEMA](#)¹⁷ Region 4 to FEMA Regions and their Stakeholders.

¹¹ https://winlink.org/sites/default/files/downloads/fema_to_fema_shakeout_0.pdf

¹² https://winlink.org/sites/default/files/downloads/karl_fema_all_region_invitation_1.pdf

¹³ https://winlink.org/sites/default/files/downloads/fema_newsletter_dyfi.pdf

¹⁴ <https://www.youtube.com/watch?v=tBZZnvK29Hs&t=1s>

¹⁵ https://winlink.org/sites/default/files/downloads/usgs_ty_0.pdf

¹⁶ <http://www.arrl.org/ares-el?issue=2023-12-20>

¹⁷ https://winlink.org/sites/default/files/downloads/fema_ty_0.pdf

[Notice of participation from Chief, AFMARS \(Through SHARES & amateur radio.\)](#)¹⁸

Chief AFMARS requests that his membership may use amateur radio and CISA SHARES under TITLE 32 to participate in the exercise. (DoD MARS is under TITLE 10, which does not include random participation in domestic incidents unless specifically requested by a Combatant Command.)

[WAVETALKERS Live tutorial during the 2023 Great ShakeOut Winlink Exercise.](#)¹⁹

This YouTube video is excellent for understanding the purpose of our participation, and is a fabulous method of learning how to deploy Winlink Express to provide ground truth reports and more.

Acknowledgements

In behalf of the Winlink Development Team, much appreciation goes to USGS and FEMA for providing an opportunity to demonstrate the resiliency of Winlink and those who use it in the various services where it resides. Kudos go to the volunteer organizations that participated in the 2023 DYFI Exercise. This includes **Josh Johnston**, Director of Emergency Management, ARRL, and the ARES® field organization; **Skip Sharpe**, FEMA Region 5 AuxComm Winlink coordinator and his FEMA Region 5 AuxComm team; the ETO Winlink Thursday group, the various Winlink Wednesday groups, **Chris Mattia**, **David Goldenberg**, **Dan Thomlison** of the WAVETALKERS Team, Dan Marler, RATPAC host, **David Antry**, Chief, AFMARS who summoned his members to participate through amateur radio or CISA SHARES; the SHARES Winlink community, including member agencies and their volunteers; and to the many states and their AuxComm communities throughout the country. The Winlink team is also grateful to amateur radio operators in the 16 additional countries that took the time to become involved.

A final note of recognition and appreciation goes to the Winlink Development Team for their hard work and expertise in making this exercise a success including **Greg Kruckewitt**, author of the Winlink Forms Templates, **Phil Sherrod**, current author of the Winlink programs set, **Lor Kutchins**, current Webmaster and Winlink Global Radio Email Network BOD President, **Lee Inman**, Winlink Common Message Server (CMS) Administrator, and **Ross Merlin**, for assistance in editing this document.

¹⁸ https://winlink.org/sites/default/files/downloads/internal_fema_appreciation.pdf

¹⁹ <https://www.youtube.com/watch?v=dnoDMcAaIAo&t=2632s>