Poster Showcase
#iaem25

# *Crowdsourced Geospatial Data during Disasters: How it is Improving Response & Recovery Today*

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Competitive Category

## *History*

A few notable moments in crowdsourced crisis and humanitarian mapping...

**1999** — **USGS** launches "Did you Feel It?"

**2003** — **GISCorps** initiative conceptualized by Shoreh Elhami adopted by URISA (Now GPN)
First **Map Action** deployment to Lesotho in response to a food security emergency

**2004** — **OpenStreetMap** (OSM) founded by Steve Coast

**2005** — First GISCorps Mission requested for **Tsunami relief efforts** in Indonesia

**2006** — The term "**crowdsourcing**" first coined by Jeff Howe in "Wired" magazine article

**2007** — **"Volunteered Geographic Information" (VGI)** coined by geographer Michael Goodchild
Proliferation of "mash-ups" following the release of **Google My Maps**

**2010** — **Ushahidi Crisis Map** customized for Haiti Humanitarian needs and supported by student volunteers to map massive amounts of incoming information
Humanitarian OpenStreetMap **HOT OSM** first used for disaster response following Haiti Earthquake
**Standby Task Force** formed to provide volunteer online digital responses to humanitarian crises & emergencies

**2012** — USGS launches **the National Map Corps (TNMCorps)** to crowdsource improving USGS infrastructure data
**Digital Humanitarian Network (DHN)** created

**2014** — **MapGive** launched by the U.S. Dept. of State to connect volunteers with humanitarian and development efforts

**2015** — **Youth Mappers** formed by TTU, WU, and WVU to create open-sourced geographic data in support of SDGs and humanitarian efforts
The 'data revolution' for Sustainable Development Goals first expressed by the UN to close the gap leveraging

**2017** — **Crowdsourcing and Citizen Science Act**
GISCorps requested by NAPSG to support Harvey, Irma, and Maria, forming what would be called **#PhotoMappers**

**2019** — Maryland launches **MyCoast** initiative for residents to document flooding caused by storms
**UN Mappers**, the crowdsourcing community of UN Maps, is established by the UN Global Service Center's Geospatial Information Section

**2020** — Ukrainian Government portal allows Ukrainians to document war crimes via the **"eVorog" (Enemy)** chatbot on their smartphones

**2025** — **NASA Response Mappers** to crowdsource conditions pre- & post-hurricane

*Something missing? Add to this timeline!*

## Introduction

Since the **Crowdsourcing and Citizen Science Act of 2017**, efforts by digital volunteers have increasingly become more organized, trusted, and integrated into official disaster response and recovery workflows. Passive and active volunteered information is abundant and valuable in crisis management, where every dollar and every minute counts. **Digital volunteers are closing the gap on critical information needs** in the earliest hours of a disaster and reducing costs and time lag for delivering an efficient and effective response. Freely available information-rich crowdsourced data is available to every jurisdiction, but they need to know it exists and build it into their processes during blue skies for this information to be used to inform decisions.

**#PhotoMappers (PM)** is one such highly coordinated effort, run by GIS Professionals, that has become an integral part of public safety workflows. Their geolocated photos of damage in the earliest hours of a disaster provide critical situational awareness, inform first responders of conditions before they reach the scene, and are used by FEMA to conduct geospatial damage assessments in support of disaster declarations. **All data and apps are made freely available**.

Your jurisdiction can request PM!

## Process

**#PhotoMappers** are staffed by GISCorps **GIS professionals** volunteering their skills. Since its inception in 2017, the backend applications have been configured to streamline the process, aid in mitigating duplicates, and support collaboration and peer help during and incident.

**Activation Requested.** Federal, State, Local, Tribal or Territorial entity requests GISCorps PhotoMappers for an incident.

**Assemble Volunteers.** The Admin Team coordinates and makes a call for volunteers from the PhotoMapper cadre.

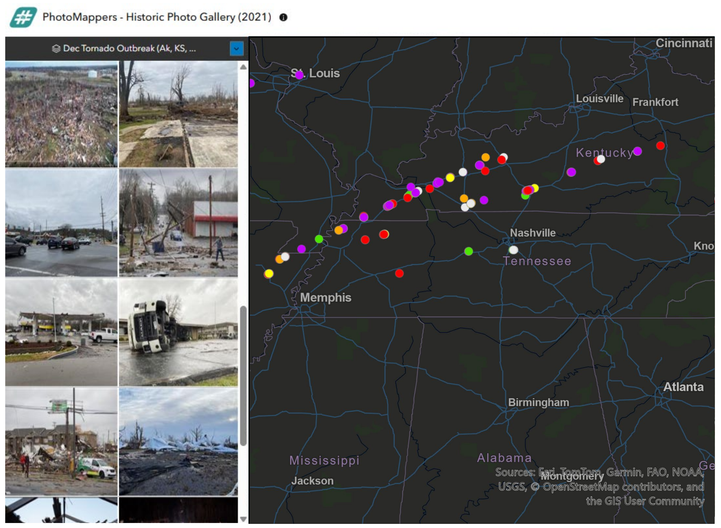
**Coordinate.** NAPSG liaisons with the requesting jurisdiction to focus searches to support their requirements, e.g., specific communities or types of infrastructure.

**Search for Photos.** The team mines social media for photos showing damage from the incident and stock the photo queue.

**Map Photos.** Volunteers check out photos from the queue and geolocate them based on clues in the photo and/or description.

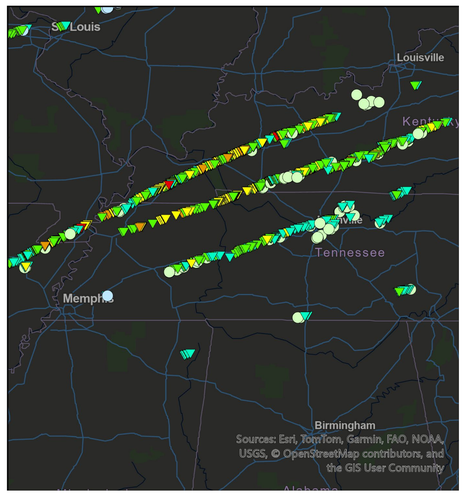
**QA/QC.** Trained Admins vet the photos for accuracy, ensure falsified/fake photos are not used, and apply a damage score and community lifeline tags.

**Demobilize Volunteers.** Once new photos are no longer being found or the requesting agency begins receiving other sources of imagery.




GPN GISCorps Volunteers mapped **180+ photos** of damage **in less then 36 hours**. Photos were tagged with an estimated damage severity and Community Lifeline impacts.

National Weather Service Damage Assessment Toolkit (DAT)




Damage points gathered by the National Weather Service used in conjunction with high-resolution imagery and radar data to generate an EF rating and estimated tornado swath. An official track can take **days to weeks** to produce.

## Technology

**Slack**
- Help, Tips & Tricks, Shortcuts
- Coordination & Collaboration

**ArcGIS Survey123**
- Collect photos from the public
- Add geolocated photos to the map

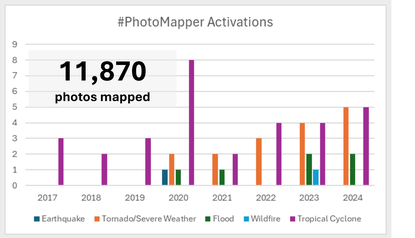
**ArcGIS Experience Builder**
- Dashboard of Mission Statistics
- Photo Gallery/ Queue / Upload
- Admin Vetting App


Mapping Leader Board

Upload/Map Photo Form




Vetting App




**Disasters Supported (2017 – 2024)**

**"During a disaster, crowdsourced real-time data could be informative when the data itself is immediately accessible and if steps are in place to harness the data" (Hultquist & Cervone, 2020).**

## Benefits

Source: FEMA NRCC GIS

According to FEMA, "Post-event social media images provide a first look at what is happening on the ground and the nature of damage. Combined with spatial analysis, crowdsourced photos help decision makers understand disaster impacts" (Office of Science & Technology Policy, 2022, p. E-24).

- **Remote participation:** Enables volunteers anywhere in the world to contribute without traveling to disaster sites.
- **Flexible engagement**: Allows people to give time and expertise according to their availability, regardless of location.
- **Enhanced coordination**: Digital tools support real-time communication and collaboration among experts, responders, and affected communities.
- **Expanded access**: Widely available technologies open multiple channels for the public to engage in emergency management.
- **Impact-driven analysis**: Crowdsourced data interpretation helps officials assess damage, prioritize resources, and target response efforts.
- **Filling response gaps**: Professional skills, creativity, and unique volunteer capacities can offset limitations in government-led crisis management while reducing costs.

## Potential Limitations

- **Organizational differences**: Emergency digital volunteer efforts require unique structures, management protocols, and adapted regulations compared to traditional volunteering.
- **Data quality and trust**: Crowdsourced information may be inaccurate, biased, or unverified, creating challenges for integration with official data.
- **Accountability concerns**: Efforts rely heavily on personal responsibility and intrinsic motivation, with limited oversight.
- **Technical and access barriers**: ICT equipment failures and unequal access to technology hinder participation and create inequities.
- **Bias in data**: Sample, spatial, and demographic biases can lead to incomplete or misleading insights, often underrepresenting vulnerable populations.
- **Skill gaps**: Recruiting volunteers with the necessary professional expertise remains a challenge during major crises.

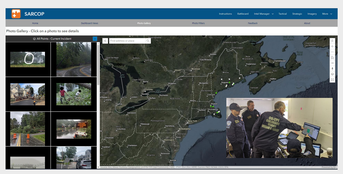
## Future Innovations

#PhotoMappers are increasingly requested to support incidents. The program is exploring new partnerships and technologies to ensure its sustainability.
- Integration of AI Tools to aid in geolocation process and remove PII.
- Collaboration with social media platforms to tag posts about disaster conditions.
- Support locals who want to collect damage photos internally while contributing to the national dataset.

*View the current portal!*

## Current Uses

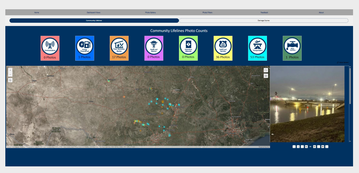
## Situational Awareness




**Urban Search and Rescue (US&R)**

PhotoMappers supports advanced remote recon to prepare US&R Teams on the conditions in the field prior to deployment.

The PhotoMappers dashboard is embedded in the Search and Rescue Common Operating Platform (SARCOP), which is used by all 28 FEMA US&R Teams and hundreds of state and local teams.




**Size, Scope, and Extent of a Hazardous Event**

During the July 2025 **Texas Flood** event, PhotoMappers provided the first images coming in of the flood damage while cloud cover prohibited traditional imagery collection.

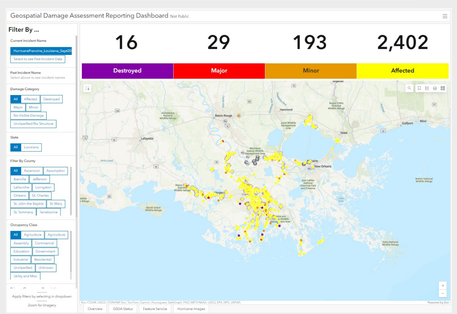
PhotoMappers also confirmed for TDEM, the requesting agency, the widespread flooding occurring outside the initial focus area of Kerrville in places like San Angelo.

## Recovery

**Geospatial Damage Assessments.** FEMA has a goal of providing Geospatial Damage Assessments (GSDAs) within 72 hours of impact for all decision-makers including their external partners (FEMA Response Geospatial Office, 2022).

GSDAs are performed remotely by trained analysts leveraging artificial intelligence, crowdsourced photos, and high-resolution imagery from satellite, air and ground.

**The Impact.** FEMA's geospatial damage assessment process, which during incidents like Hurricane Ian resulted in $78.3 million in assistance to survivors without requiring an in-person inspection.




FEMA's Geospatial Damage Assessment Reporting Dashboard which includes PhotoMappers data as an input for determining damage level.

## Research

- **Satellite Tasking.** #PhotoMapper points used by MIT Lincoln Labs to prototype quick-turnaround satellite-based tasking using its very low-Earth orbit (VLEO) Agile MicroSat (AMS) to collect images post- Hurricane Ian (Main et al., 2023)

- **Water Depth Validation**. Volunteered Geographic Information (VGI) from Hurricane Harvey, including #PhotoMapper data with images and videos, was used to extract water depth. No significant difference was found between VGI and USGS stream gauge data, validating the quality of VGI data and value for flood analysis (Alyaqout et al., 2021).

  Crowdsourced data augmented traditional data sources, i.e., sensor networks, satellite remote sensing imagery, and models during Hurricane Florence. Specifically, flood depths were derived from #PhotoMappers images contributing to the identification of flooded areas, beyond what was initially identified by other sources (Hultquist & Cervone, 2020).

**Figure 23. Sept. 30th, 2022 picture taken over incident area showing sediment after the hurricane.**

- **Training Data.** Crowdsourced photos provided rich, localized, and timely data on hurricane damage from Hurricane Florence. Using machine learning, crowdsourced photos enhanced the ability of predictive models to identify high-risk areas. (Dahal, 2019)

- **Structural Damage Prediction.** Spatial analysis of #PhotoMapper data and FEMA damage assessments following Hurricane Michael showed that real-time geolocated crowdsourced photos have potential as early indicators of the patterns of structural damage caused by a hurricane (Spasenovic et al., 2020).

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