



Google's Multi-Hazard Early Warning System Solutions

—
Google Crisis Response and AI for Social Good

Google's Solutions Throughout the MHEWS Value Chain

Google offers product solutions throughout the MHEWS value chain for free as a part of our AI for Social Good and Crisis Response portfolio. Many of these solutions are surfaced on our platforms and/or are offered to NGOs, IGOs, hydromet agencies, and disaster management agencies.



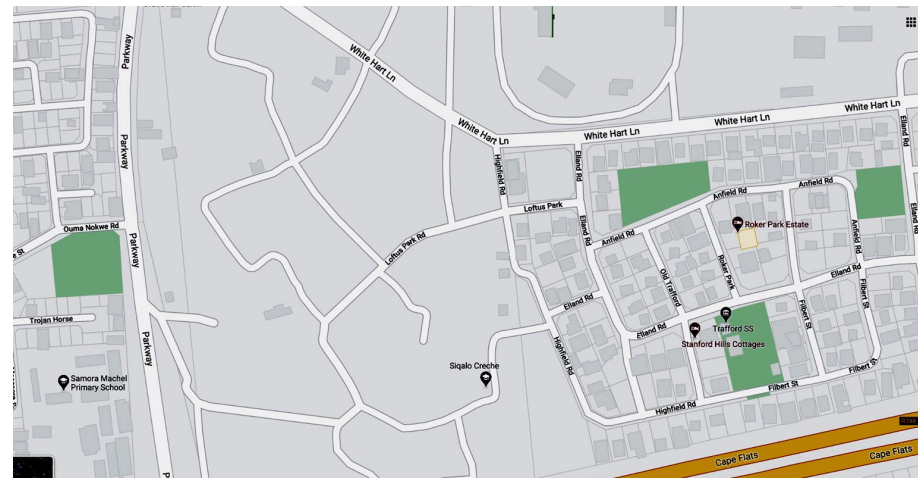
Overview: Google's MHEWS Solutions

	Provided to Ecosystem	On Google Search/Maps	Disaster Risk Knowledge	Detection & Monitoring	Warning Dissemination	Preparedness and Response
Open Building Dataset	✓	✓	✓			✓
AI Impact Evaluation	✓		✓			✓
Flood Forecasting	✓	✓		✓	✓	
Fire Maps & Detection	✓	✓		✓	✓	
Locust Forecasting	✓			✓		
Earthquake Warnings		✓		✓	✓	
Public Alerts		✓			✓	
Damage Assessment	✓					✓

Disaster Risk Knowledge

Open Building Dataset

Vukuzenzele, Cape Town, South Africa

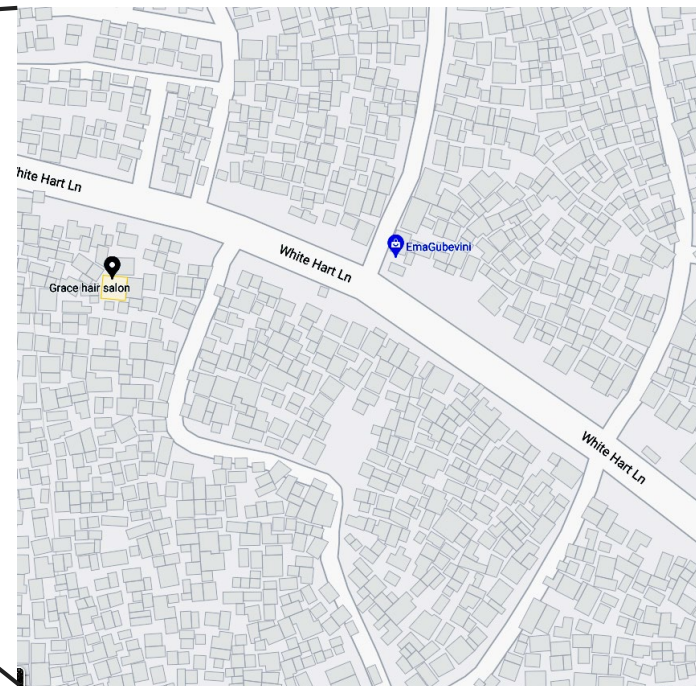


Open Building Dataset

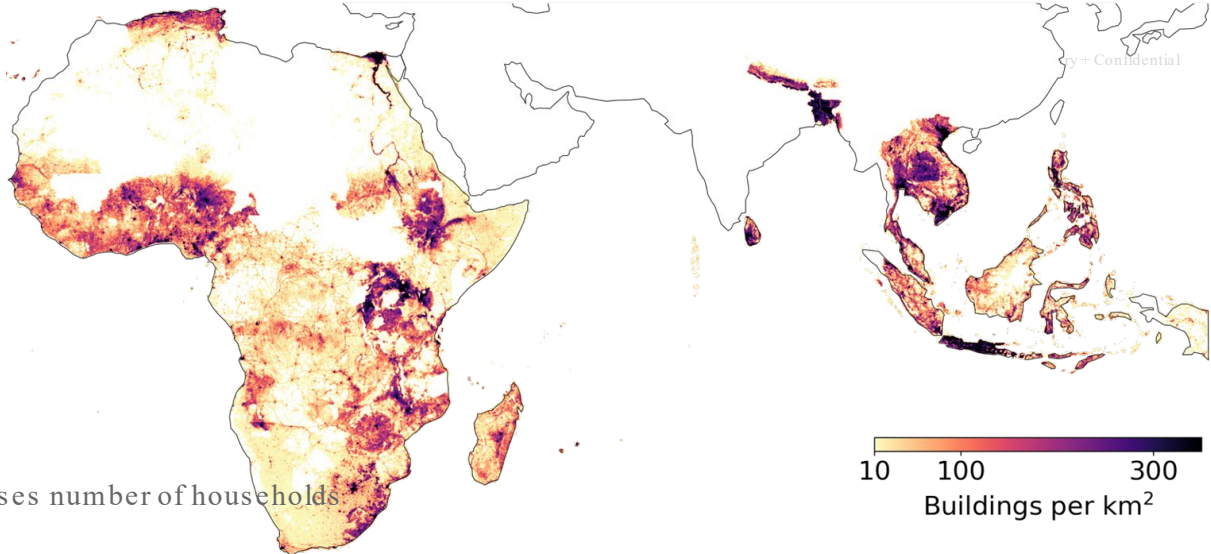
Before



After



Open Building Dataset



Use Cases and Impact:

- **Humanitarian response:** can help assess number of households affected
- **Impact-based alerting:** can inform disaster management agencies to create impact-based alerts
- **Environmental and climate science:** can help estimate the human impact on the environment
- **Population mapping:** can help derive better population estimates as many censuses in Africa are out of date
- **Addressing systems:** many regions in Africa don't have an address system, the building dataset could help with rollout of a digital addressing system such as Plus Codes
- **Vaccination planning:** can help with vaccination planning and deriving various statistical indicators

Open Building Dataset: Access for Social Good

Open Buildings

A dataset of building footprints to support social good applications.

Building footprints are useful for a range of important applications, from population estimation, urban planning and humanitarian response, to environmental and climate science. This large-scale open dataset contains the outlines of buildings derived from high-resolution satellite imagery in order to support these types of uses. The project being based in Ghana, the current focus is on the continent of Africa.

[Explore](#)[FAQ](#)[Data format](#)[Download](#)

Publicly available for social good at sites.research.google/open-buildings

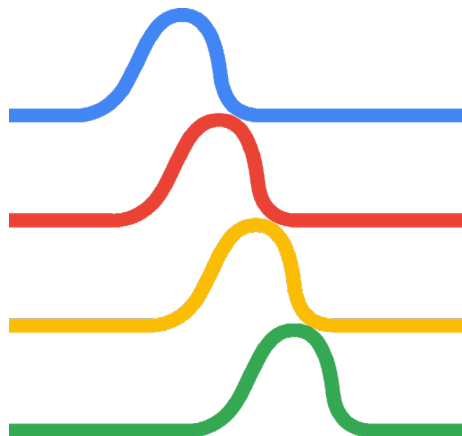
AI for Impact Evaluation

Developing an AI tool to help understand the impact of hazards and alerts on communities

Goals:

- Understand dynamics of movement / response during hazards
- Analyze the effects of (different) alerts and warning systems
- Scale globally, enable localized insights and analysis
- Do so in an aggregated, anonymized, differentially private way

Open to working with partners to understand needs and further build this product.

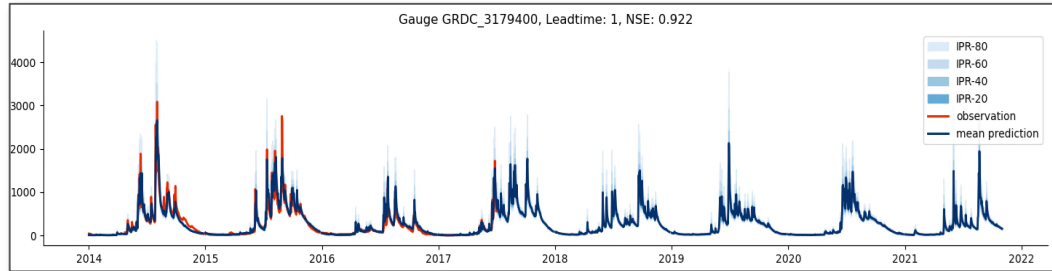


Detection, Monitoring, Analysis & Forecasting of Hazards and Possible Consequences

Flood Forecasting: Global Model

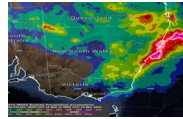
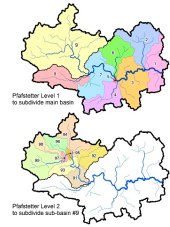
We have developed a **global & publicly available** datasets to achieve **flood forecasting** worldwide.

These forecasts can be accessed by NGOs, UN agencies, hydromet, disaster management agencies through a dataset and FloodHub dashboard.

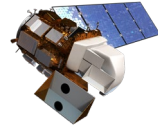


Example of initial result: our 2-day forecast aligned with the actual measurements at a standard station

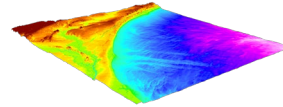
Flood Forecasting: Global Model



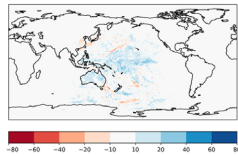
IMERG- NASA precipitation global data



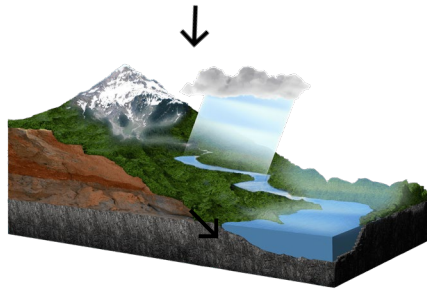
Satellite imagery (Multiple sources)



Google DEM generation



ECMWF global weather forecast



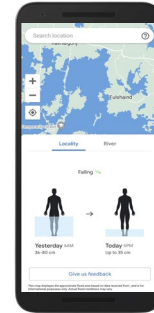
Hydrologic Model

How will the river change?



Inundation Model

Where will the river water reach?

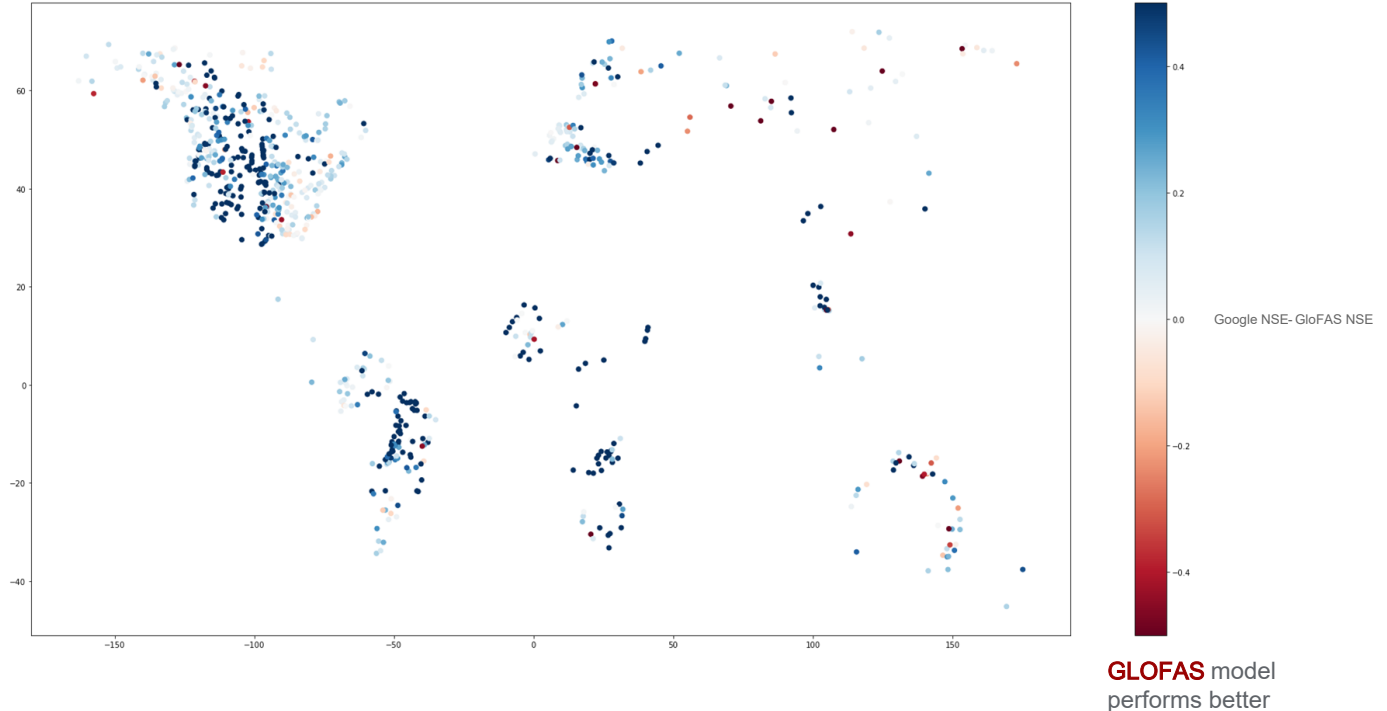


Visualized forecasts

Clearly describing when and where the flood will be

Flood Forecasting: Global Benchmarking with GLOFAS

Looking at 800 random gauges around the world, the Google Flood Forecasting model usually performs better than GLOFAS, especially in developing regions.

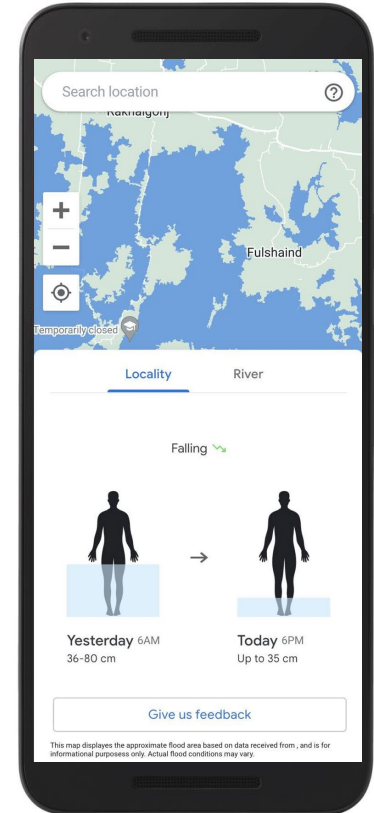
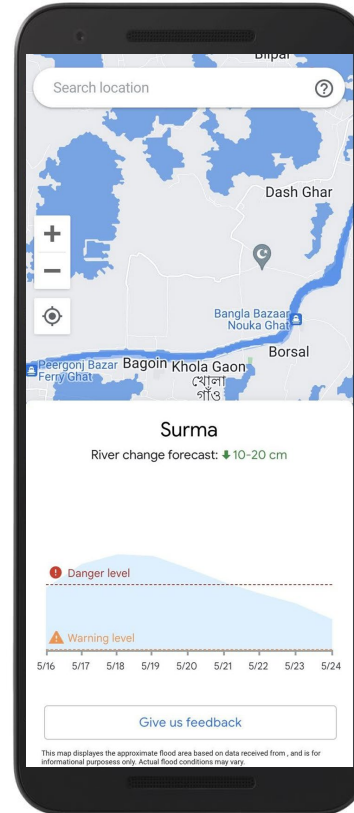


* The map above represents the world map

Flood Forecasting: Flood Hub

- Highly visual and intuitive
- Hyper-local and user-relevant
- Includes water trends and depth
- Easily shareable over social networks
- Tailored for local NGOs, disaster management agencies, hydromet agencies, and IGOs
- Includes an accessible dataset with current and historical data
- Available at g.co/floodhub

"As a disaster manager the panchayat-wide information is very useful, it will help us in identifying panchayat where rapid need assessment should be done to ascertain needs of the people."



Flood Forecasting

Flood forecasts using Google's model are currently launched on Search and Maps in a limited number of countries.

Why Google?

- Public-facing interfaces
- Computational resources
- Access to global data
(Elevation, user-generated data, etc.)
- Scalability
- Machine learning expertise

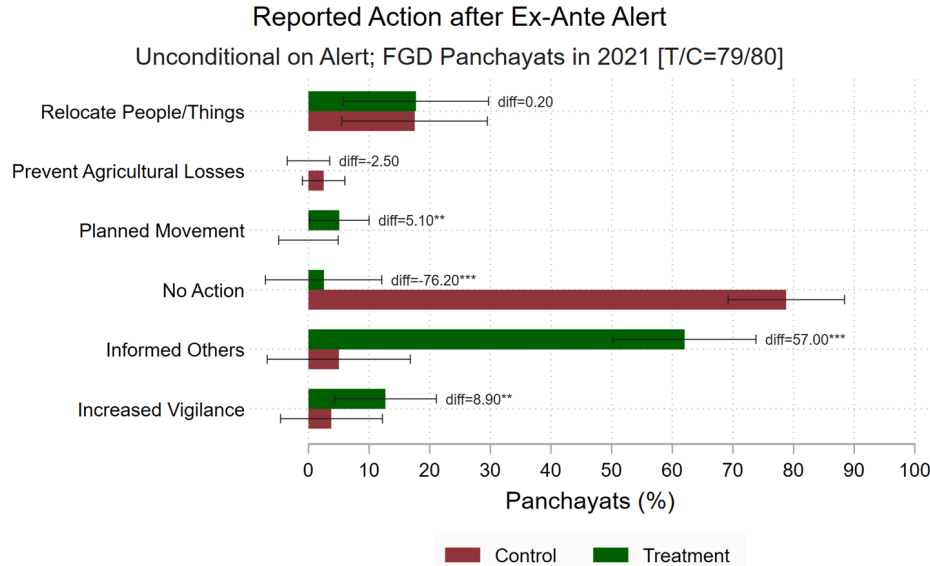
Why not (just) Google?

- Governmental mandate
- Relevant infrastructure
- Operational expertise
- Relationship with organizational consumers



Flood Forecasting: Impact Evaluation Research

97% of treatment panchayats took action before floods, compared to 22% of control panchayats

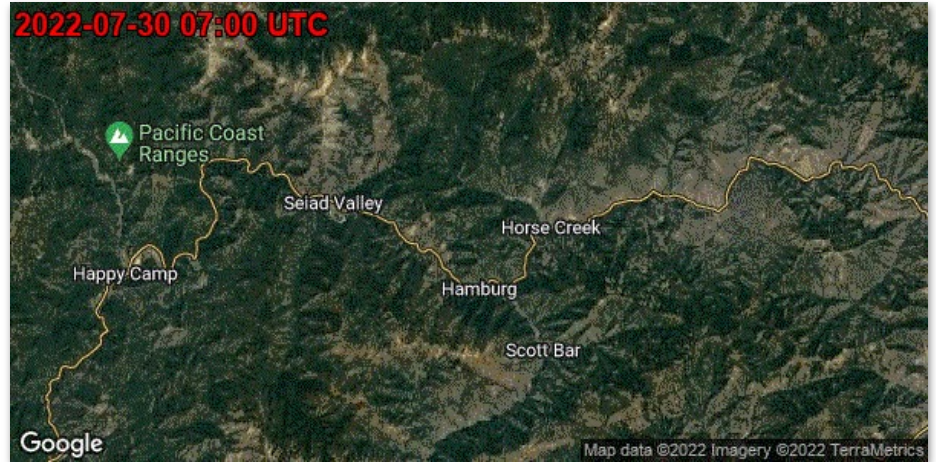


Yale Economic Growth Center

Asterisks denote statistical significance at 0.10 (*), 0.05 (**), and 0.01 (***). Text lists the difference in point estimate between treatment and control. Source: Focus Group Discussions conducted in 80 treatment and 80 control panchayats. One panchayat in the treatment sample was dropped due to incomplete data. News are often ex-post alerts of flooding in nearby villages or panchayats, not ex-ante. Graph considers action taken ex-post from news alerts to be 'no action'.

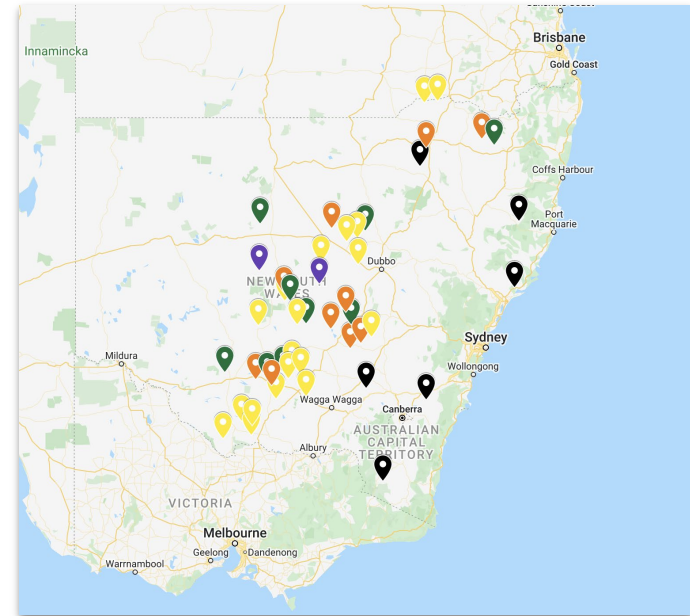
Wildfires: Boundary Mapping

- Satellite based fire boundary map visualized on Google platforms
- Useful in rural areas
 - “How close is the wildfire to the town”



Wildfires: Early Ignition Detection

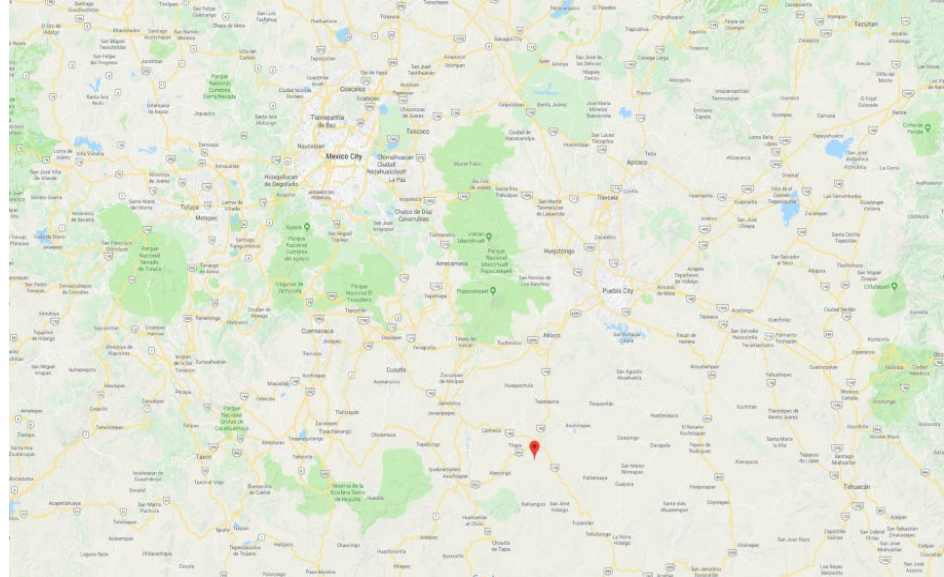
- Goal is to identify fires through satellites and machine learning earlier than manual methods for fire agencies to make informed decisions.
- Currently being developed
- Soliciting feedback from fire agencies



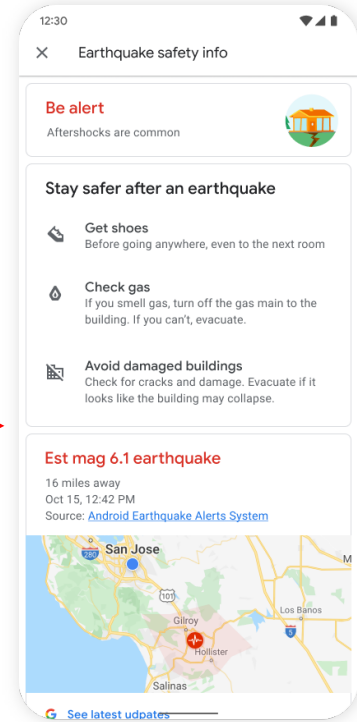
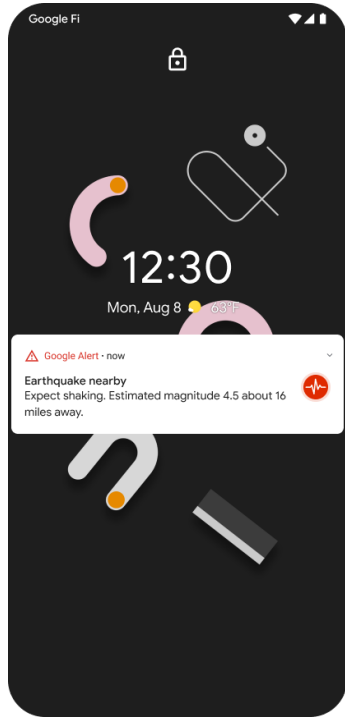
Earthquake Early Warnings: Android

Android phones are live mini -seismometers detecting earthquakes around the world

- System aggregates accelerometer sensor data from Android phones
- Phones that detect shaking send a signal to servers that then analyze the reports to determine if an earthquake is taking place.
- System has detected hundreds of quakes with zero false positives to date



Earthquake Early Warnings: UX Flow



Locust Forecasting

Proprietary + Confidential

- Developing forecasts of locust breeding grounds and swarms
- Collaborating with the UN Food & Agriculture Organisation
- Goal is to support real-time clearing and spraying operations



Warning Dissemination and Communication

3.9B

crisis alert views on Google since 2017

30+

countries

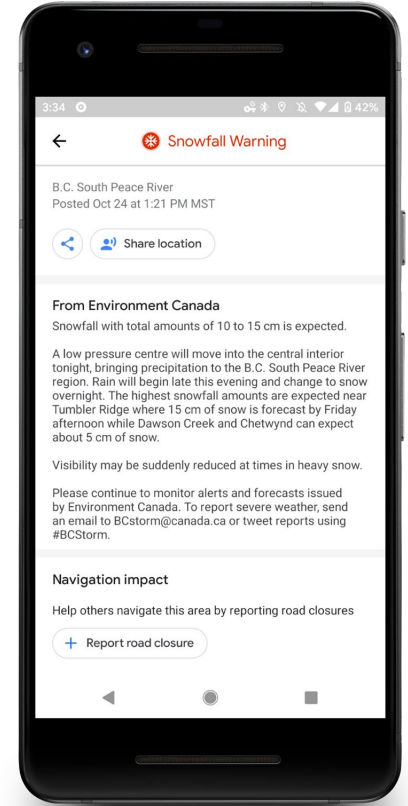
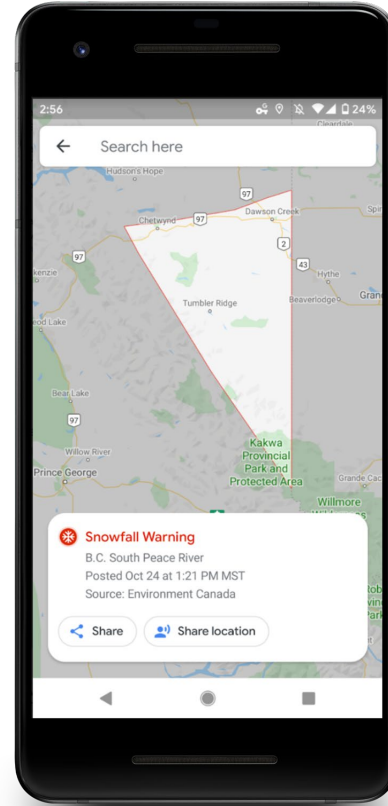
25+

authoritative partners



Public Alerts: CAP to Users

- Automated CAP feeds from public and gov't agencies around the world
- Language, description, attribution, and visualization is provided by the publisher
- Reaches users via Android notifications, Search, Maps, Weather (on Search) and Assistant



Public Alerts: CAP to Users

Alert Title

Alert area description <areaDesc>

Description

From <description> verbatim

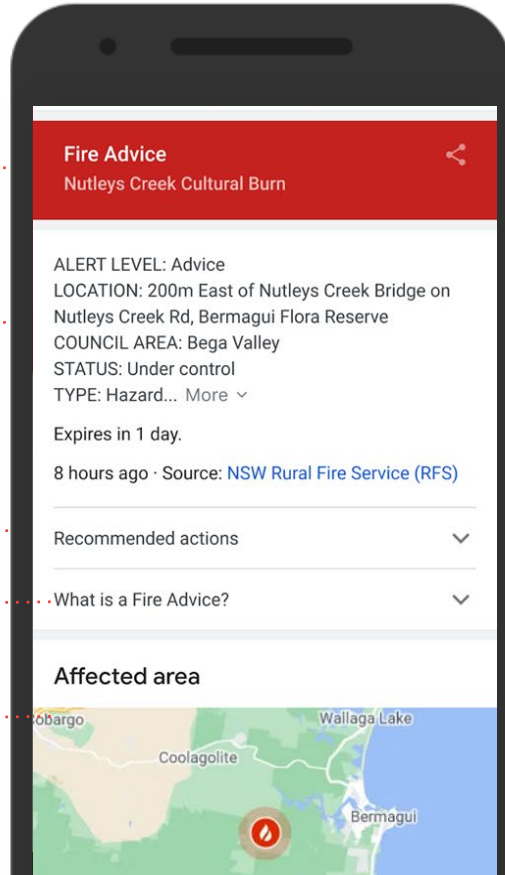
Instructions

From <instruction> verbatim

Alert Definition

Affected Area

From <polygon> or <geocode>



Set during onboarding

Alert Title

Alert Attribution

Extracted from CAP

Alert Subtitle

Alert Description

Instructions

Affected Area

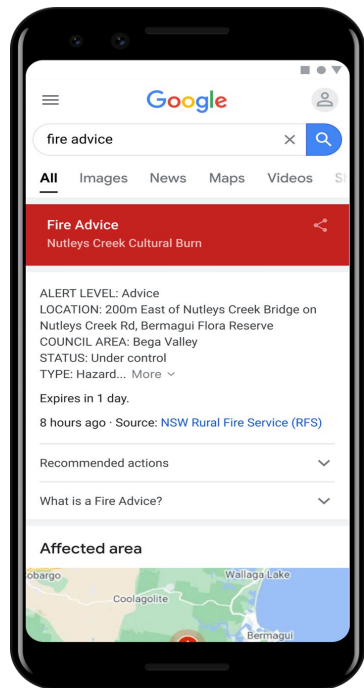
Optional Static Content

Alert Definition

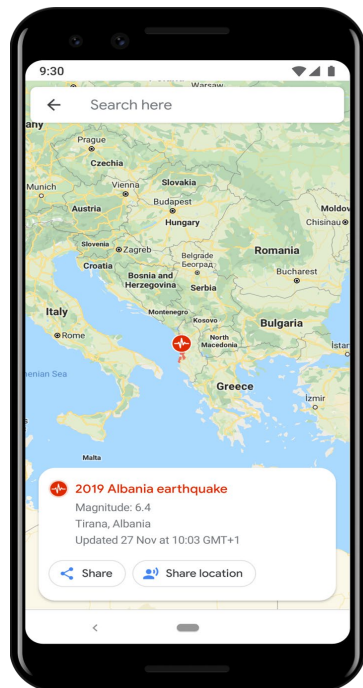
Safety Tips

Public Alerts: Across Platforms

Proprietary + Confidential



Search



Maps



Google App
Notifications on iOS



Android Notifications

Sharing Authoritative Safety Tips and Instructions

Sharing authoritative safety tips and recommended actions (CAP instructions field) during hazards

Grass Fire Advice
 Gocup Rd, South Gundagai
 Posted Feb 3 at 9:56 PM GMT+11
 Source: NSW Rural Fire Service (RFS)

Send to your phone Share

Recommended actions
 A fire has started There is no immediate danger. Stay up to date in case the situation changes
 Source: NSW Rural Fire Service (RFS)

Info & updates
 ALERT LEVEL: Advice
 LOCATION: Gocup Rd, South Gundagai, 2722
 COUNCIL AREA: Coolamundra-Gundagai
 STATUS: Under control
 TYPE: Grass Fire
 FIRE: Yes
 SIZE: 0 ha
 RESPONSIBLE AGENCY: Rural Fire Service
 UPDATED: 3 Feb 2021 21:56
 More information: <http://www.rfs.nsw.gov.au/fire-information/fires-near-me>
 Source: NSW Rural Fire Service (RFS)

See latest updates

What do you think?
 Share your thoughts about the info you've seen here.
 Send feedback

2:25

Oxford
 Buckingham Palace

1 hr 14 1 hr 33 1 hr 46 18 hr 1 hr

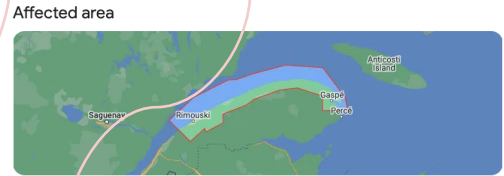
1 hr 41 min Tolls

1 hr 14 min Tolls

Route may be affected by Winter Storm Ciara

1 hr 14 min (55 mi)

Start Steps & parking



- Safety tips**
- Check supplies including medications, radio, flashlight and batteries.
 - You may have to evacuate. Keep your emergency kit close at hand.
 - Make sure the basement windows are closed.
 - Fuel your car. If evacuation becomes necessary, it will be hard to stop for gas.
 - Stay inside where you are protected from the water. It's best to be on the downwind side of the house, away from windows.
 - Monitor the storm's progress and listen for warnings or instructions from local officials.
 - Before driving anywhere, listen carefully to rescue officials who will be coordinating evacuation plans.
 - Do not drive through flood waters.
 - Be aware of risks such as hypothermia from cold water or drowning from running water.
- Source: getprepared.gc.ca Feedback
- Show less

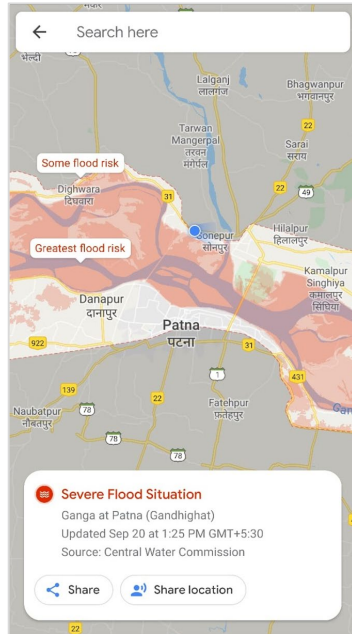
Alerting Visuals



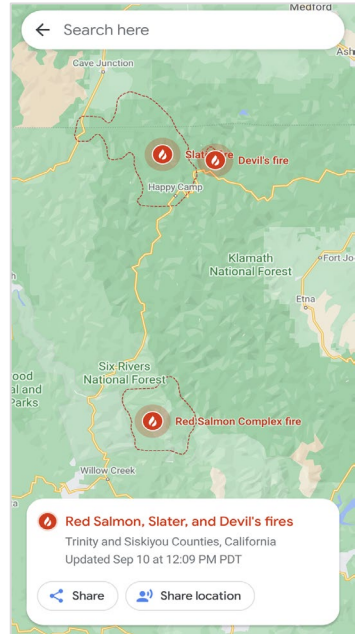
Tropical storm forecasts



Earthquake shakemaps



Flood forecasts

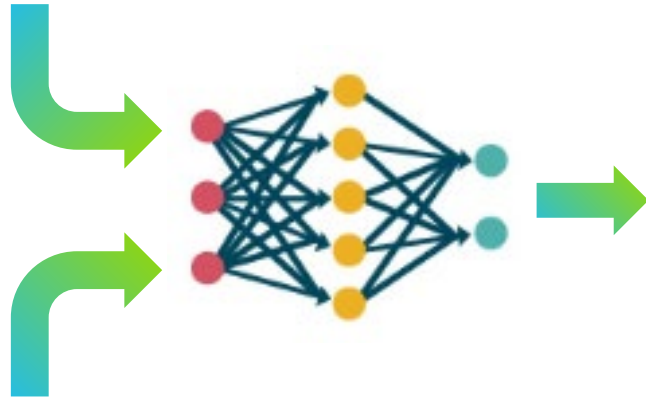
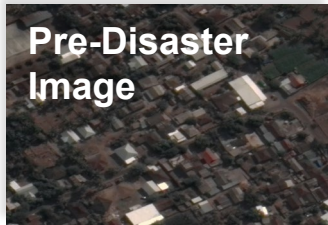


Wildfire boundary maps

Preparedness and Response Capabilities

SKAI: AI Damage Assessment

We use machine learning to automate building damage assessment, which dramatically increases speed, accuracy, and coverage of post-disaster damage assessments to save lives and maximize humanitarian resources



Damage assessment



SKAI: AI Damage Assessment

Proprietary + Confidential

BEFORE

AFTER

SKAI: AI Damage Assessment

Proprietary + Confidential

Earthquakes



Hurricanes



Wildfires



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Locust Forecasting	✓			✓		
Earthquake Warnings		✓		✓	✓	
Public Alerts		✓			✓	
Damage Assessment	✓					✓

Thank You