

# **Overview of Technology Currently Used in Citizen Science**

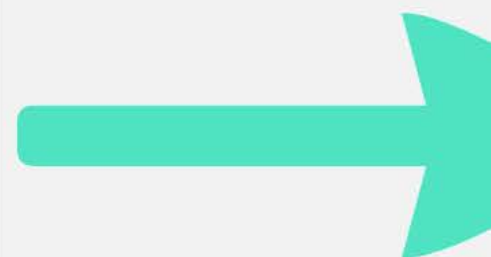
**Barbara Martinez**  
**ORISE Fellow<sup>\*</sup>, U.S. EPA Office of the Science  
Advisor**

\*ORISE Post-doctoral Fellow: the research for this presentation was supported in part by an appointment to the ORISE participant research program supported by an interagency agreement between EPA and DOE. The information in this presentation may not necessarily reflect the views of EPA. No official endorsement should be inferred.



## Why are we doing this?

- Contract with Argonne National Lab to compile a list of technologies currently used for citizen science efforts
- Create a report & resource for citizen science practitioners



# Technology

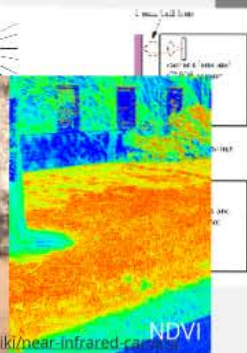
## Crowdsourcing

A process where individuals or organizations submit an open call for contributions of information from a large group of individuals ("the crowd"). Think of it as "outsourcing" tasks to volunteers.

## Citizen Science

A form of open collaboration where the public can participate actively in the scientific process, including:

- Identifying research questions
- Collecting and analyzing data
- Interpreting results
- Making new discoveries
- Developing technologies and applications
- Solving complex problems



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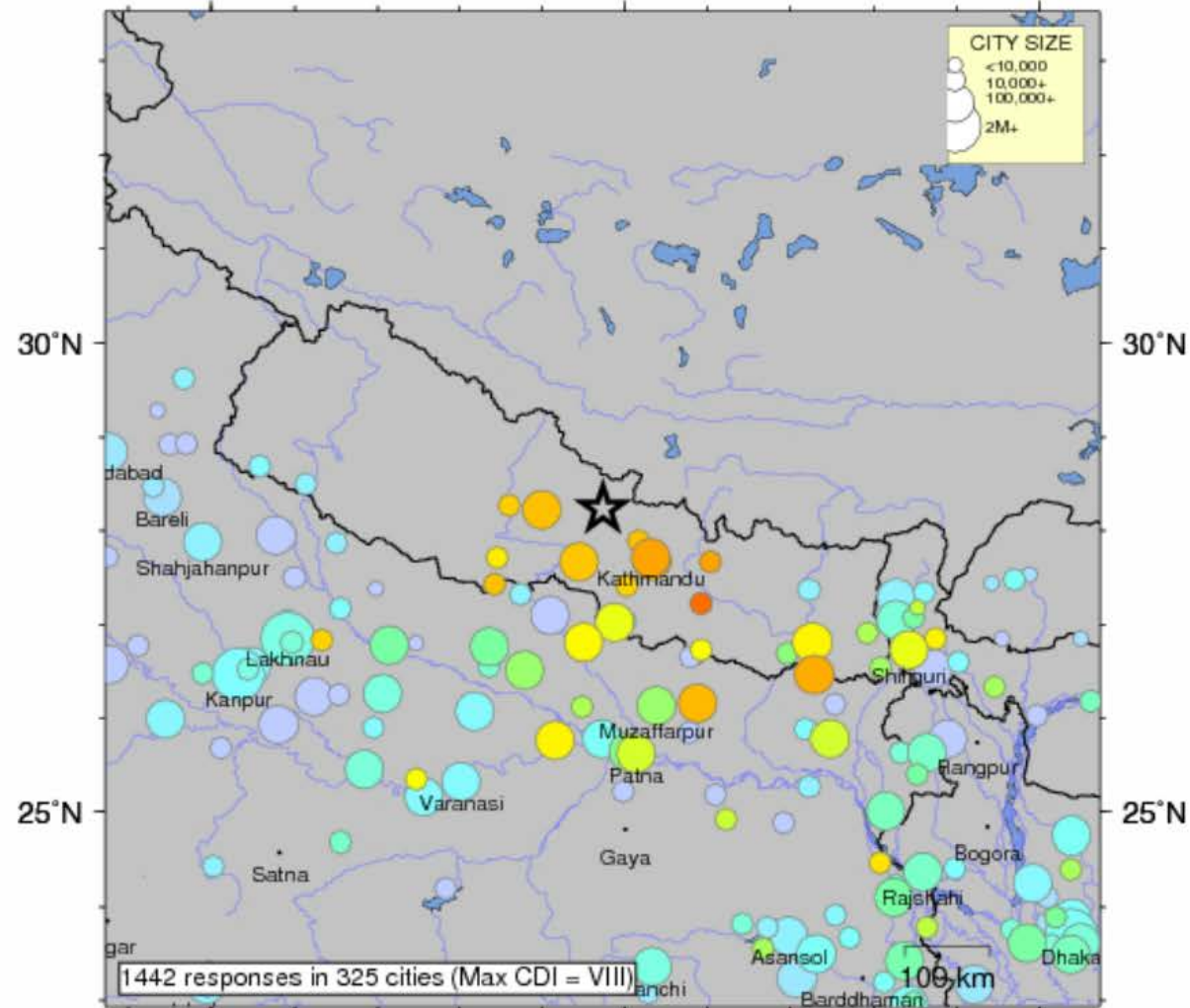
## **Example: Did you Feel it? Earthquake data**

USGS gets a more complete description of what people experienced, the effects of the earthquake, and the extent of damage, than traditional ways of gathering felt information.

<http://earthquake.usgs.gov/earthquakes/dyfi/>

# USGS Community Internet Intensity Map NEPAL

Apr 25 2015 11:56:25 AM local 28.2305N 84.7314E M7.8 Depth: 8 km ID:us20002926



| INTENSITY | I        | II-III | IV    | V          | VI     | VII         | VIII           | IX      | X+       |
|-----------|----------|--------|-------|------------|--------|-------------|----------------|---------|----------|
| SHAKING   | Not felt | Weak   | Light | Moderate   | Strong | Very strong | Severe         | Violent | Extreme  |
| DAMAGE    | none     | none   | none  | Very light | Light  | Moderate    | Moderate/Heavy | Heavy   | V. Heavy |

Processed: Fri Jul 3 10:51:22 2015

<http://earthquake.usgs.gov/earthquakes/dyfi/events/us/20002926/us/index.html>

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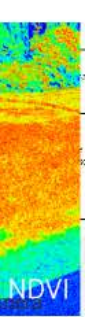
## **Example: Citizen Archivist Dashboard**

National Archives and Records Administration (NARA) coordinates crowdsourcing for tagging archival records and transcribing documents. More than 170,000 volunteers indexed 132 million names of the 1940 census in 5 months, something NARA could not have done alone.



across the mountains has been  
entirely suspended for some time  
I regret to hear of the severe illness  
of your dear Gertrude - and will  
venture to hope for her recovery before  
this reaches you - Should it however  
be otherwise - I can only offer you  
my sympathy, and that consolation

<http://www.archives.gov/citizen-archivist/>



## What do we mean by “technology” in citizen science?

- Broad interpretation of tools for data collection
- Low-cost
- Examples







# Water

- **Precipitation:** Rain gauge, snowfall instrument, Acoustic Disdrometer
- **Turbidity/clarity:** Secchi disk, turbidity tubes, buoy for digital cameras
- **Nutrients:** Nitrate & phosphate test kits



<http://www.instructables.com/id/Make-a-buoy-for-your-digicam/?ALLSTEPS>

<https://freshwaterwatch.thewaterhub.org/product/56-whole-sampling-kits>





# Air/Atmosphere

<http://www.epa.gov/head/airsensortoolbox/>

- Air pressure, altitude: Smartphone barometer
- VOCs: Bucket "grab" sample
- Multiple measurements: Air Quality Egg, Sensordrone
- PM: Dust Duino
- Thermal imaging & wind: Handheld Kestrel Sensor



<http://gizmodo.com/5851281/trump-card>



<http://sensorcon.com/products/sensordrone-tricorder-bluetooth-se>



<http://publiclab.org/notes/schmoyer/11-23-2013/measure-d>



<http://kestrelmeters.com/products/kestrel-4600-heat-stress-meter>





## **Soil/Surfaces**

- **Ground movement: Acelerometer**
- **Soil: sieves plus Munsell color system**
- **Soil moisture: sensors**







<http://mea.com.au/soil-plants-climate/soil-moisture-monitoring/product-list>





em



## Animals

- Locations, population estimates: Radio or GPS collars; Camera "traps"; tags
- Monitor temperature: Turtle egg sensor







## Geography

- Do-it-yourself (DIY) balloon and kite mapping: balloon & camera take aerial photographs (Public Lab)
- Underwater mapping: DIY OpenROV
- Remote sensing: currently available satellite imagery







SPOT-5 **HD**  
(2.5m/5m)



LANDSAT 7 **ETM+ MED**  
(30m)



## Health

- Fecal coliforms in water: kit -- Coliscan Easygel
- Detect allergens in food: Allergen Beagle
- Personal activity: from Apple watch, to Fitbit, to Zamzee.
- Personal exposure: silicone wristbands



<http://fses.oregonstate.edu/wristbands>

# ENVIRONMENTAL Science & Technology



Article

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## Silicone Wristbands as Personal Passive Samplers

Steven G. O'Connell, Laurel D. Kincl, and Kim A. Anderson\*

Department of Environmental and Molecular Toxicology and <sup>‡</sup>College of Environmental and Forestry  
University, Corvallis, Oregon 97331, United States



<https://www.fitbit.com/>

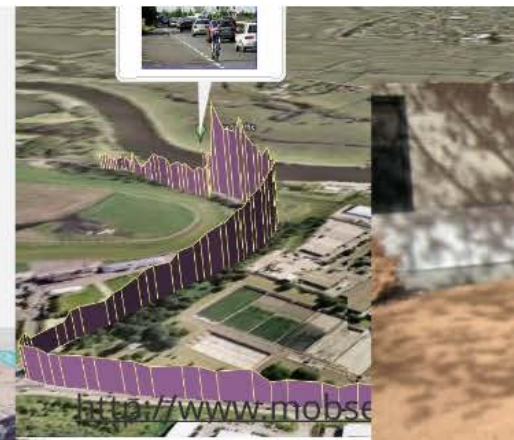




**Noise monitoring: Mobile phone app +  
phone microphone = NoiseSPY**

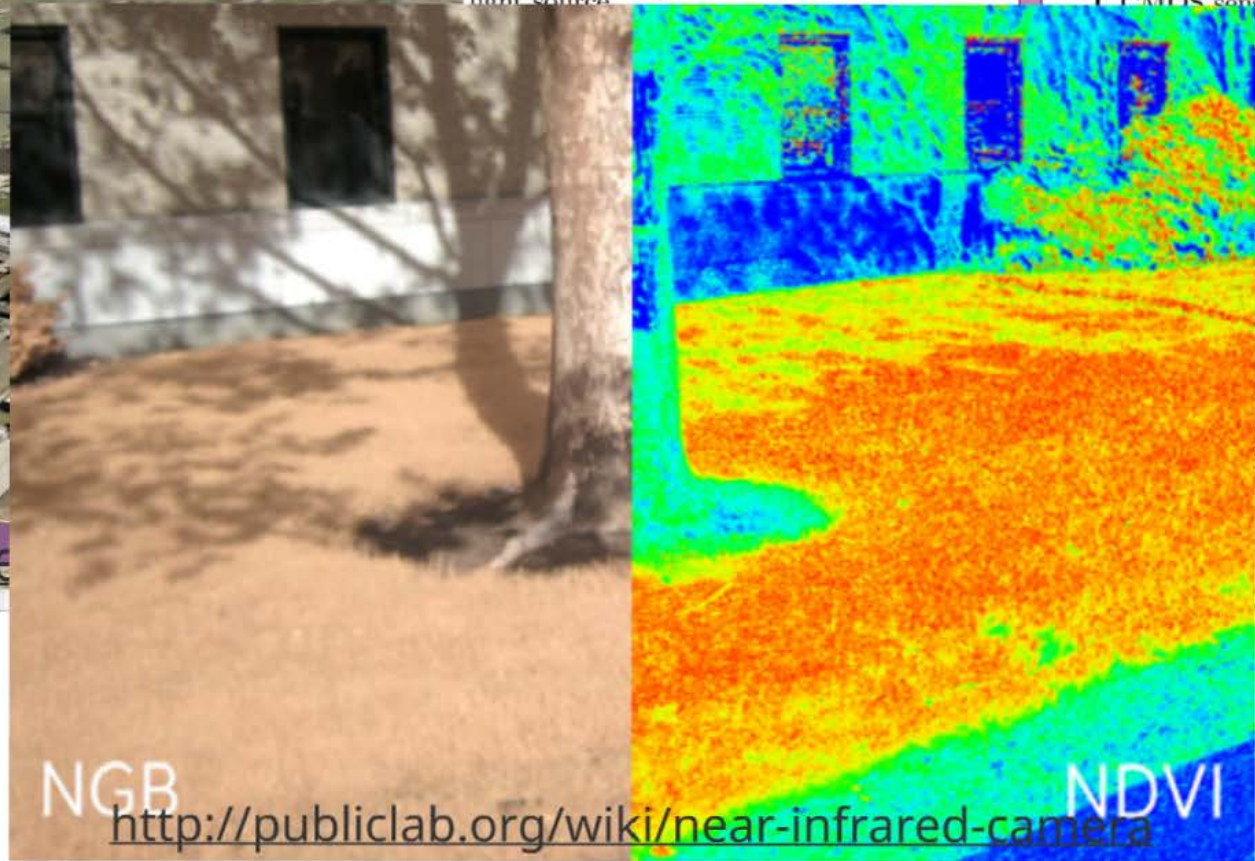
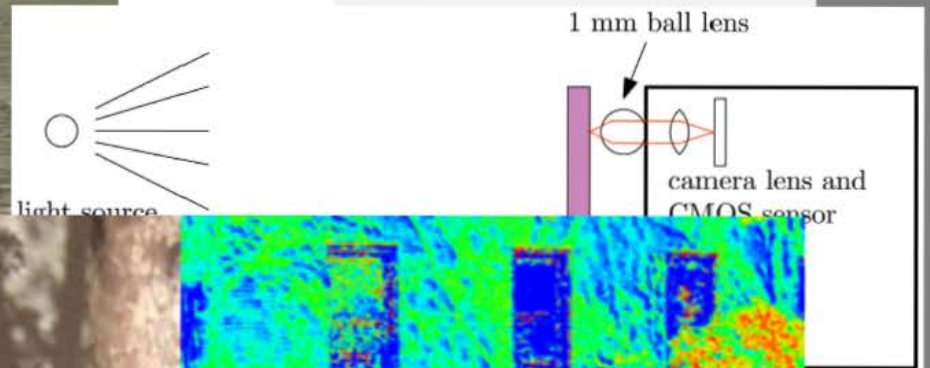
**Microscopy and spectroscopy: Mobile  
phone's integrated lens and image sensor  
plus attachments**

**Heat: DIY infrared cameras (Public Lab)  
and Infrared laser thermometers**



NGB  
<http://>





<http://www.harborfreight.com/infrared-thermometer-93984.html>



## What's Next?

- Develop a resource for practitioners
  - How would this information be useful for the users: teachers, community groups, researchers, other practitioners?
- What are the opportunities?
  - Existing technology that can be used for citizen science?
- What are the gaps?
  - New and emerging technologies up next for citizen science?

