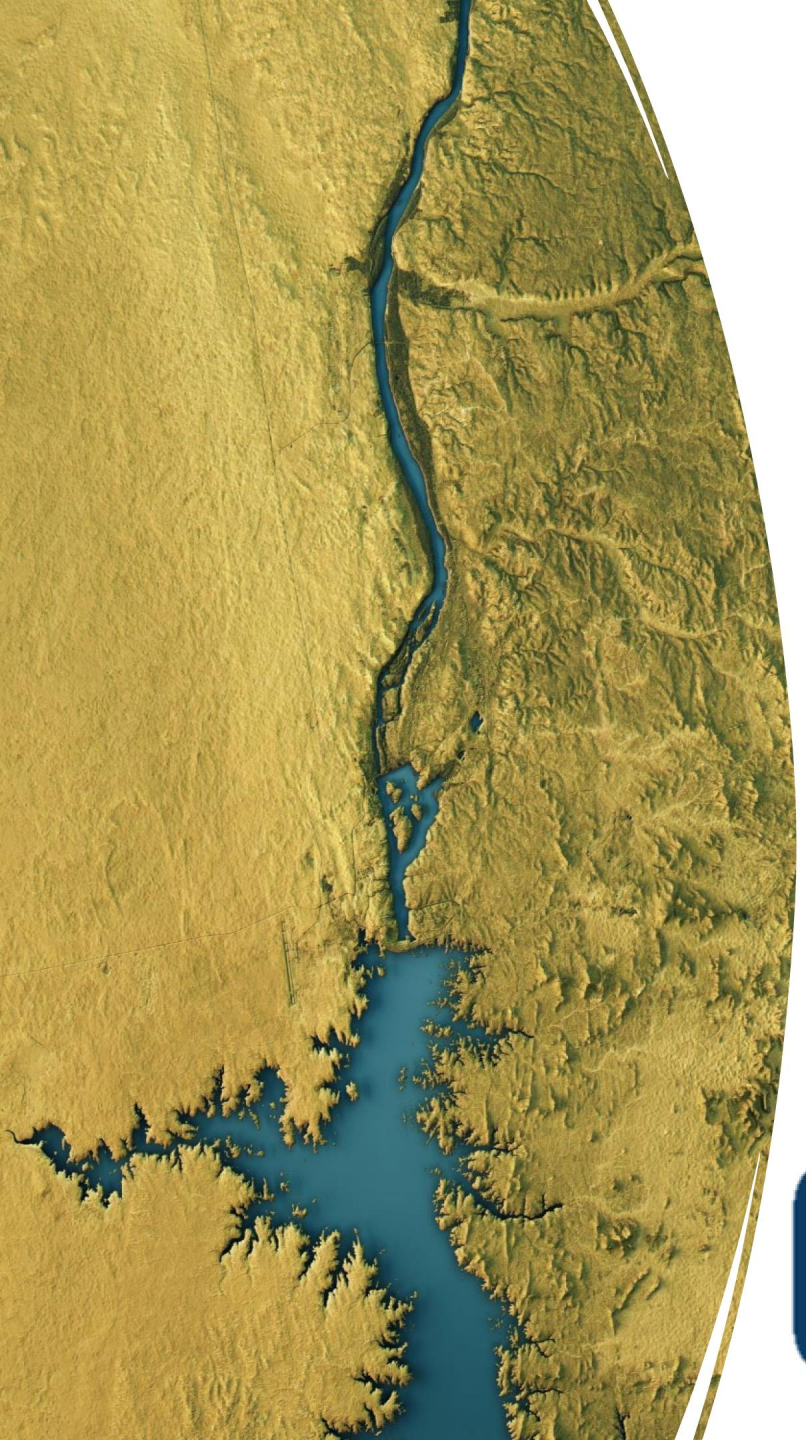


Advanced Methodologies for Integrating Crowdsourced Environmental Data with Remote Sensing Technologies

Di Yang, Ph.D. Department of Geography, University of Florida

07/10/2025

Citizen Science

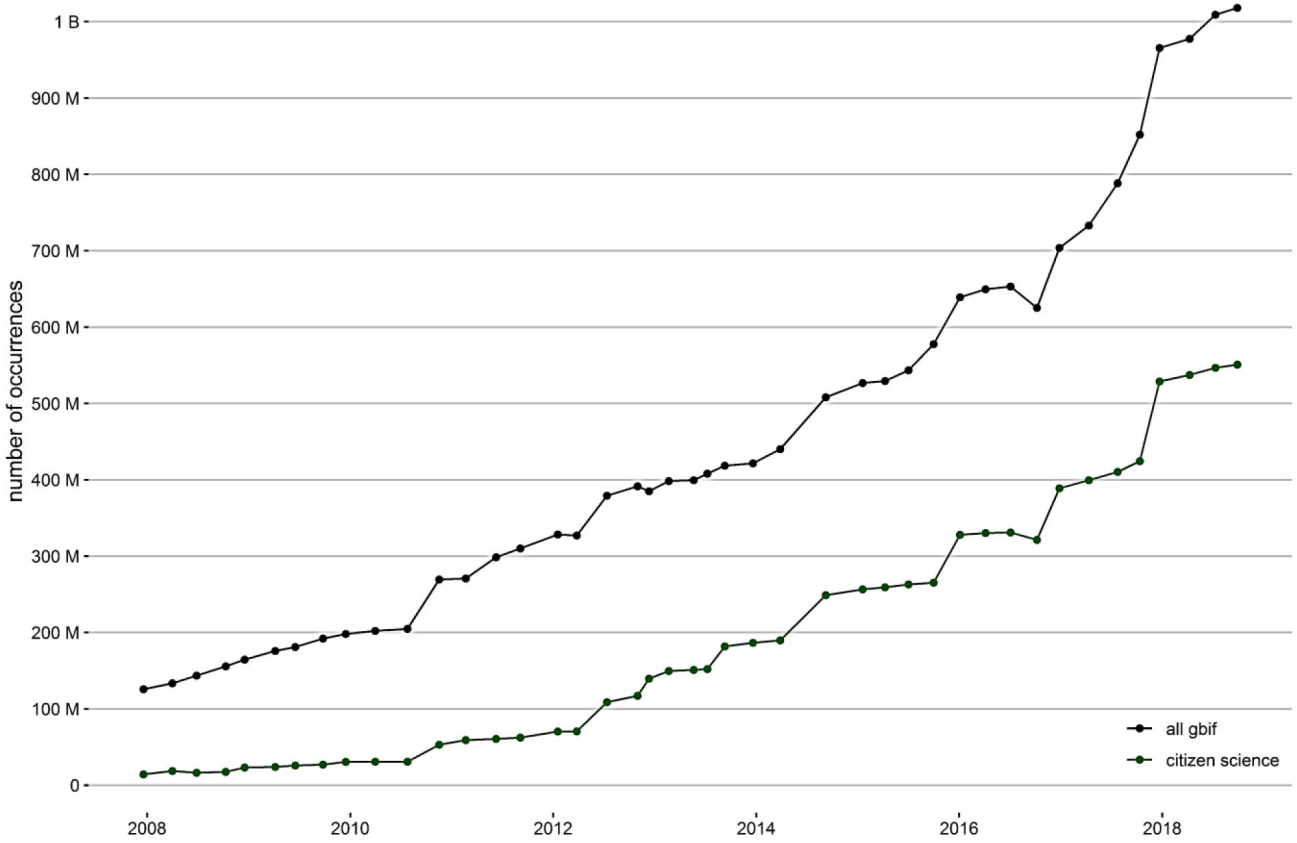
- What is citizen science? Scientific research conducted, in whole or in part, by amateur or nonprofessional scientists

Also known as:

- crowd science
- crowd-sourced science
- civic monitoring
- volunteer monitoring
- networked science
- participatory monitoring/research

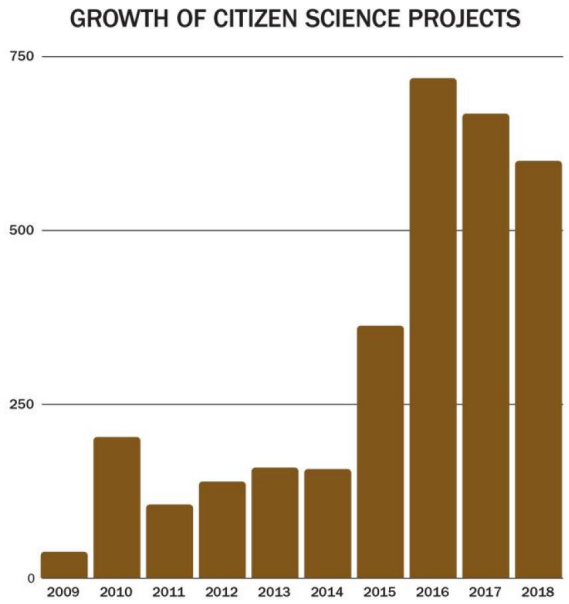
The Rise of Citizen Science

- GBIF – Global Biodiversity Information Facility
  - Citizen scientists have been contributing a large and growing percentage of records to the GBIF network.
  - 50% of occurrence records on GBIF are citizen science observations
    - eBird
    - iNaturalist
    - Swedish Species Observation System



The Rise of Citizen Science

- Number of Programs



https://www.scseagrant.org/citizen-science-encouraging-public-engagement/

Christmas Bird Count

Audubon

CLONED PLANTS PROJECT

The North American Breeding Bird Survey

eBird

Journey North

iNaturalist

And NASA!

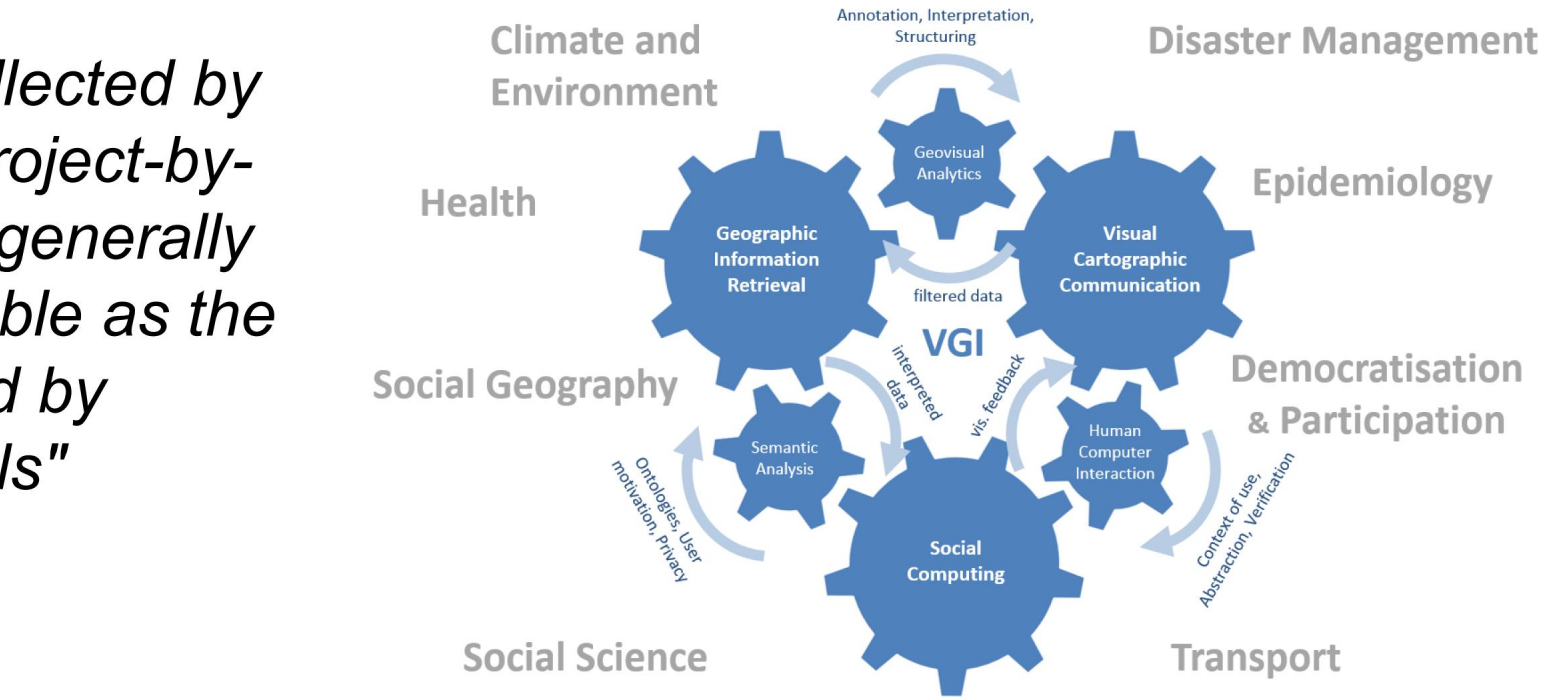
NASA Citizen Science

UF UNIVERSITY of FLORIDA

The Value of Citizen Science

- Significance of citizen science to research greater than perceived

"Quality of data collected by volunteers, on a project-by-project basis, has generally been found as reliable as the data collected by professionals"



https://www.vgiscience.org/about.html

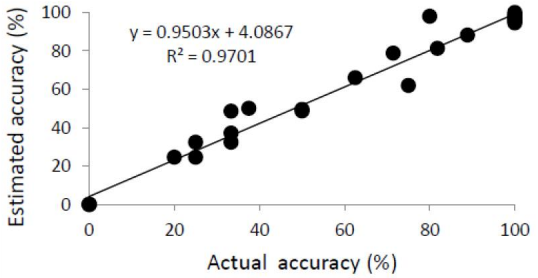
How Can we Make Optimal Use of Citizen Science Data?

Increasing Quality

Expert

Crowd

Treated Crowd



Foody, See, Fritz et al., 2013

Foody, G. M., See, L., Fritz, S., Van der Velde, M., Perger, C., Schill, C., & Boyd, D. S. (2013). Assessing the accuracy of volunteered geographic information arising from multiple contributors to an internet based collaborative project. *Transactions in GIS*, *17*(6), 847-860.

Citizen Science - iNatrualist

Eos

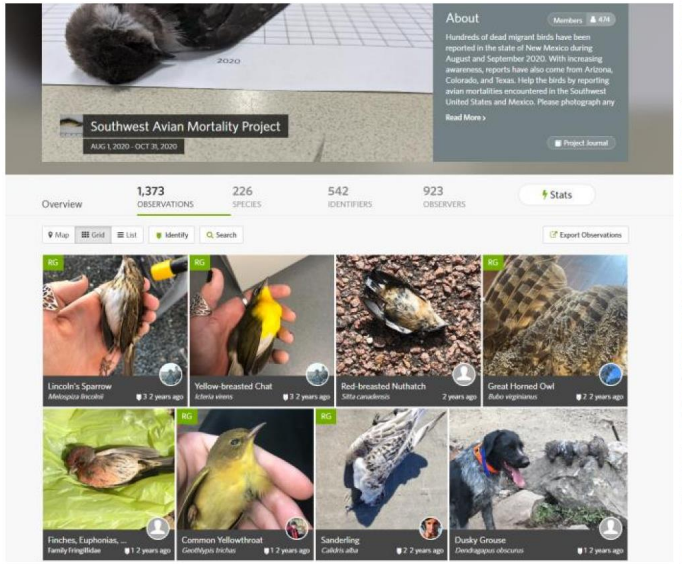
ABOUT SPECIAL REPORTS TOPICS PROJECTS NEWSLETTER SUBMIT TO *EOS*

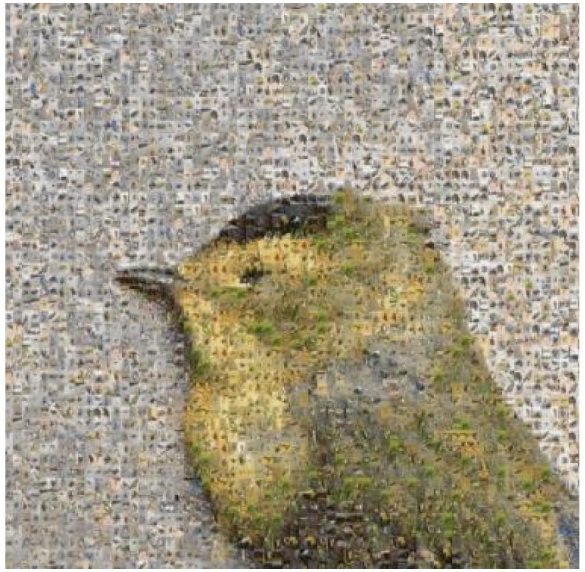
Mass Bird Die-Off Linked to Wildfires and Toxic Gases

Using observations from crowdsourced science and weather location data, researchers concluded that wildfires caused a mass die-off of birds in the western and central United States in 2020.

By Joshua Rapp Learn 26 March 2021

Researchers found a connection between a mass bird die-off in the western and central United States and wildfires. Credit: elitatt/Flickr, CC BY-SA 2.0





NEWS OF GEODI LAB

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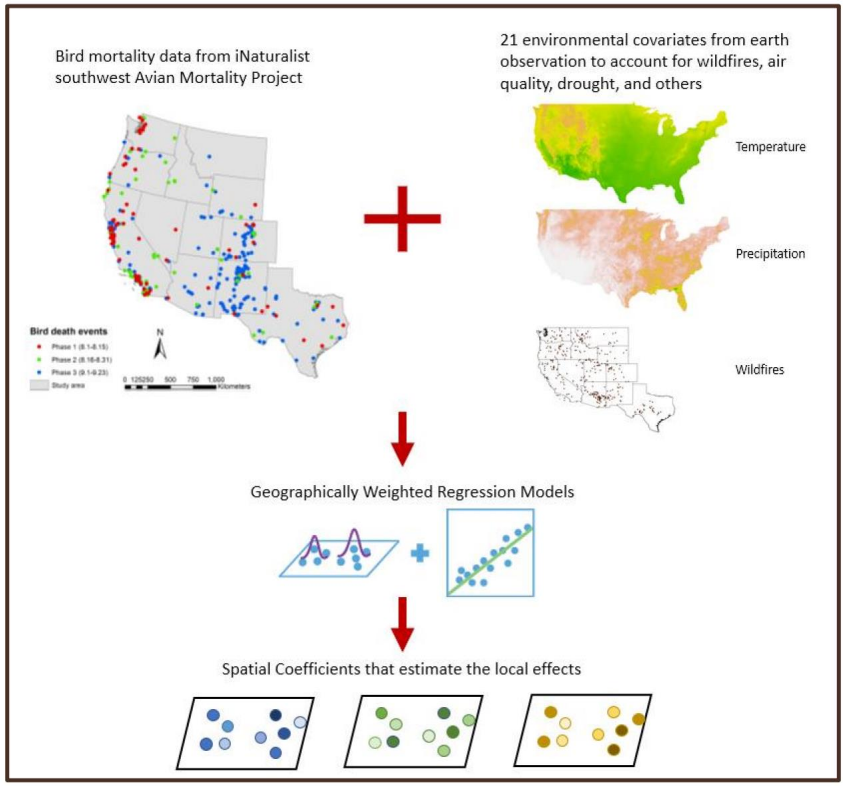
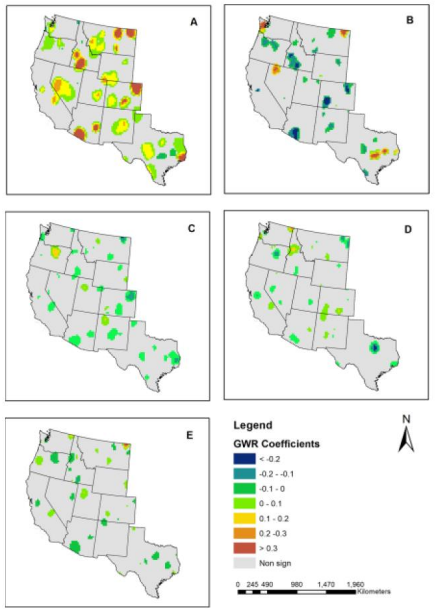
Spatial-Temporal Modeling



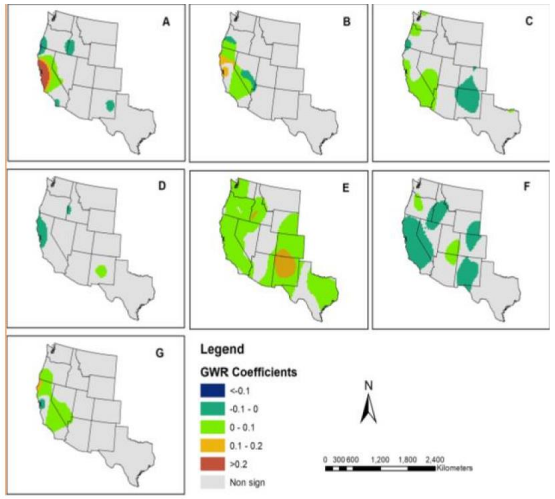
Yang, D., Yang, A., Yang, J., Xu, R., & Qiu, H. (2021). Unprecedented migratory bird die-off: A citizen-based analysis on the spatiotemporal patterns of mass mortality events in the western United States. *GeoHealth*, *5*(4), e2021GH000395.

Phase 1 (8.1 – 8.15)



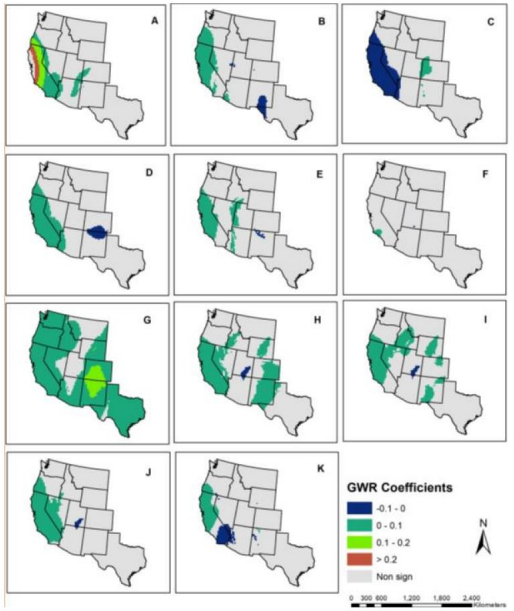
The coefficients of the top-selected GWR model for Phase 1. A) urban; B) water; C) distance to wildfire; D) CO; E) pressure.

Phase 2 (8.16 – 8.31)



The coefficients of the top-selected GWR model for Phase 2. A) distance to fire; B) minimum humidity; C) NO_2; D) water; E) urban; F) agriculture G) barren

Phase 1 (8.16 – 8.31)



The coefficients of the top-selected GWR model for Phase 3. A) distance to fire; B) maximum humidity; C) wind; D) SO_2; E) CO; F) water; G) urban; H) grassland; I) forest; J) barren land; K) mean smoke

Geospatial Machine Learning

- **Partial Dependency plots of covariates used in the RF models**

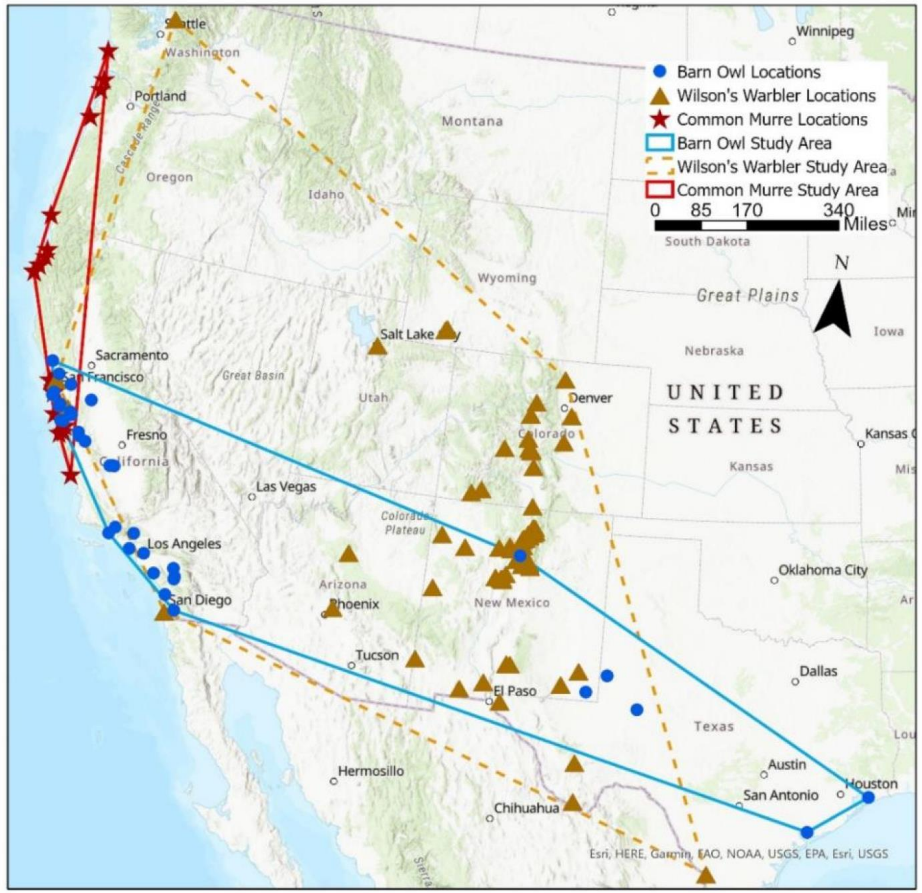
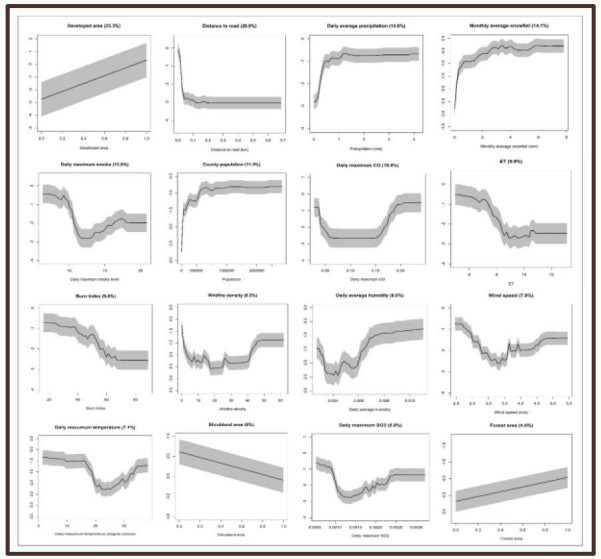
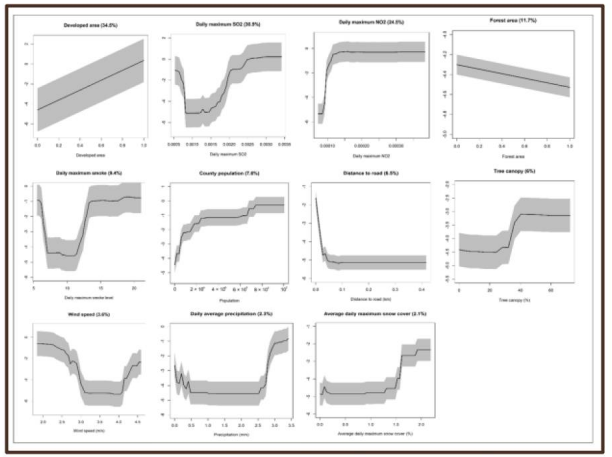


Fig 1. Citizen science observations for the mortality of Wilson's Warbler, Barn Owl, and Common Murre. Each symbol may represent multiple carcasses.



Partial dependency plots for Wilson's warbler



Partial dependency plots for Barn Owl

- Wilson's Warbler was determined by early winter storms, with more deaths identified in areas with high average maximum daily snow cover.
- Barn Owls responded to the effects of both environmental events but were most prominently impacted by the effects of wildfire-induced air pollution.

Yang, A., Rodriguez, M., Yang, D., Yang, J., Cheng, W., Cai, C., & Qiu, H. (2022). Leveraging Machine Learning and Geo-Tagged Citizen Science Data to Disentangle the Factors of Avian Mortality Events at the Species Level. *Remote Sensing*, *14*(10), 2369.

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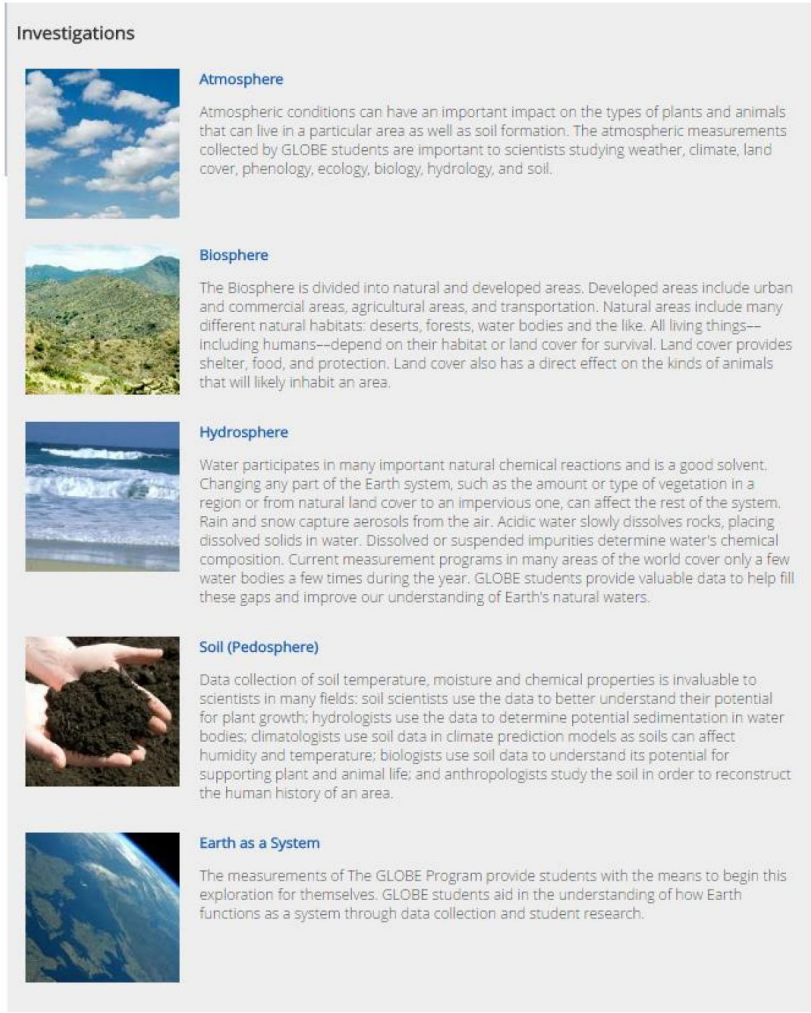
GLOBE Observer Products

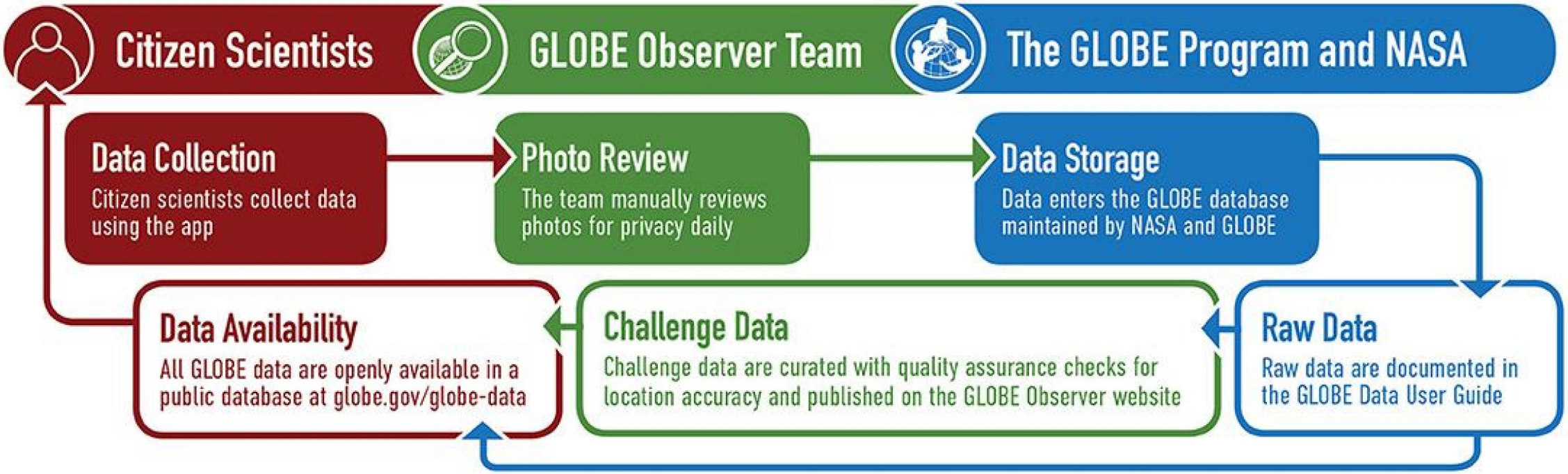
- **GLOBE Observer** invites citizens to make environmental observations that complement NASA satellite observations to help scientists studying Earth and the global environment.

- By using the GLOBE Observer app, you are joining the GLOBE community and contributing important scientific data to NASA, GLOBE, your local community, and students and scientists worldwide.
  - Core Protocols - Four Spheres + System
  - Arctic and Earth SIGNs (STEM Integration of GLOBE and NASA) - GLOBE, NASA, Culturally Responsive Curriculum
  - Winter Berries - GLOBE berry monitoring protocols
  - Science Research Project
  - Local Issues
  - Science Symposium

Land Cover & Mosquito Habitat

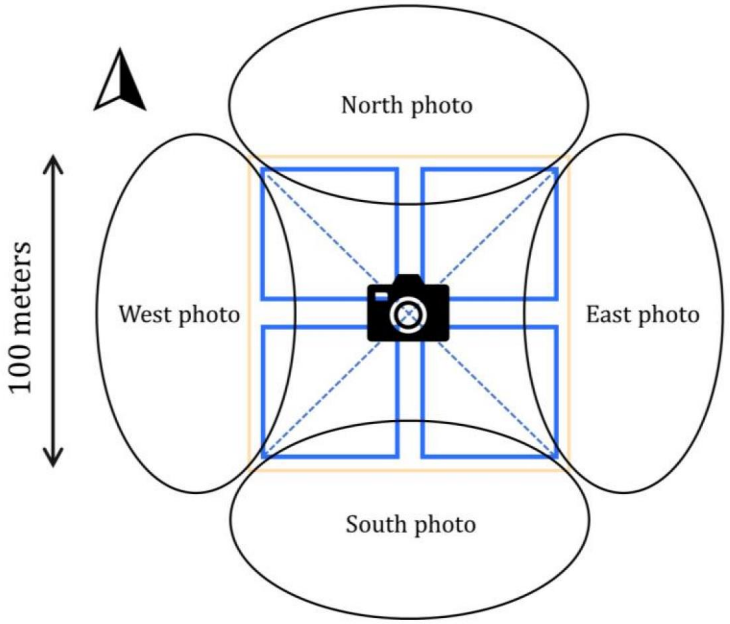


NASA GLOBE Observer



The GLOBE Observer – Land Cover

(a)

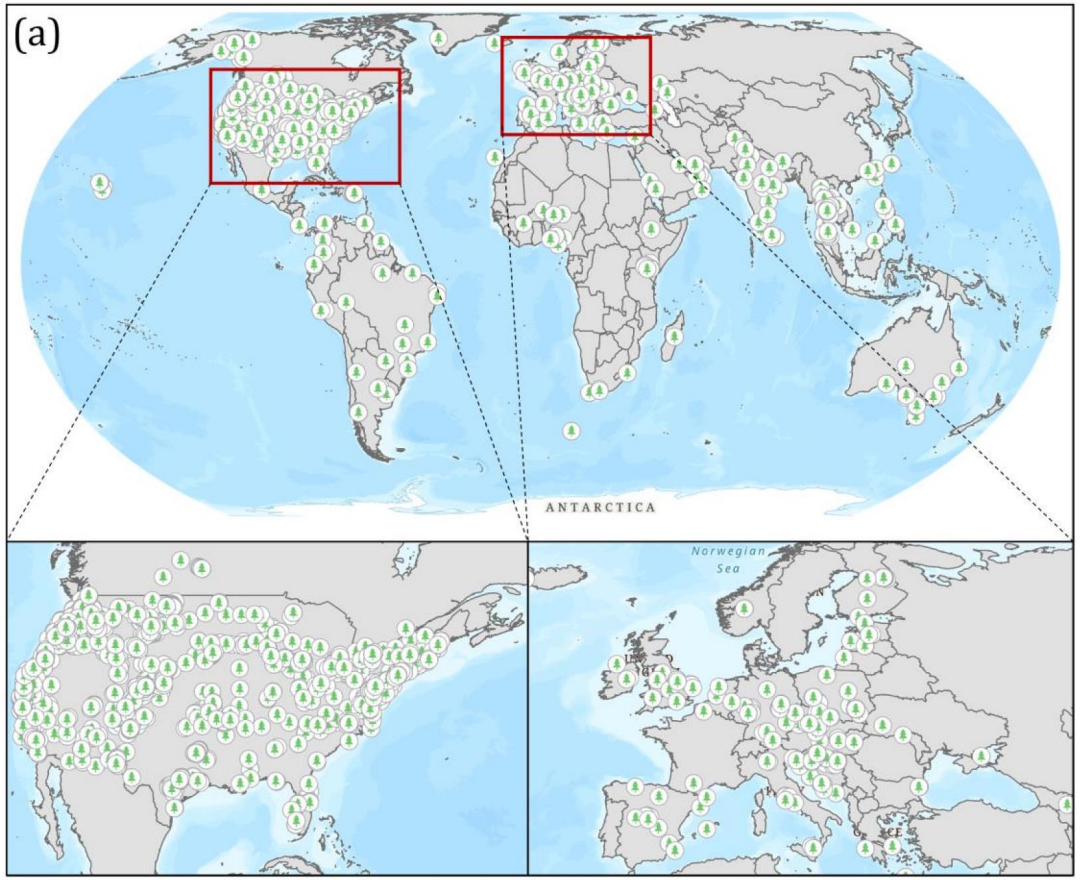


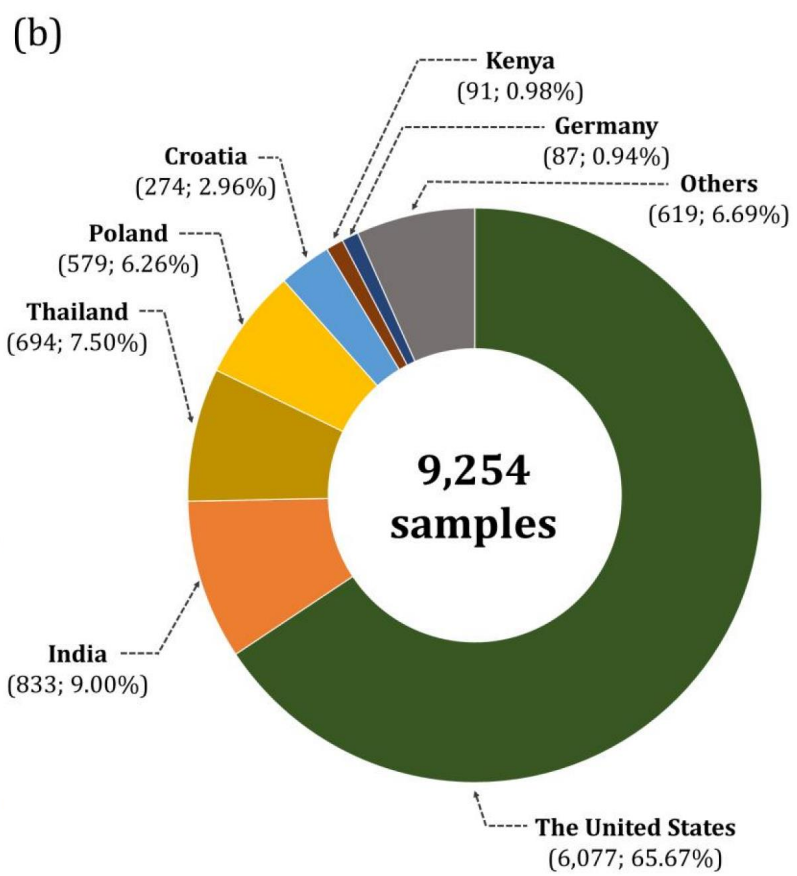
(b)

Example directional views

Categories	*North*	*South*	*East*	*West*
Herbaceous vegetation (2,336 samples)				
Urban (2,261 samples)				
Closed forest (1,263 samples)				
Woodland (442 samples)				
Cultivated land (518 samples)				
Barren land (547 samples)				
Open water (357 samples)				

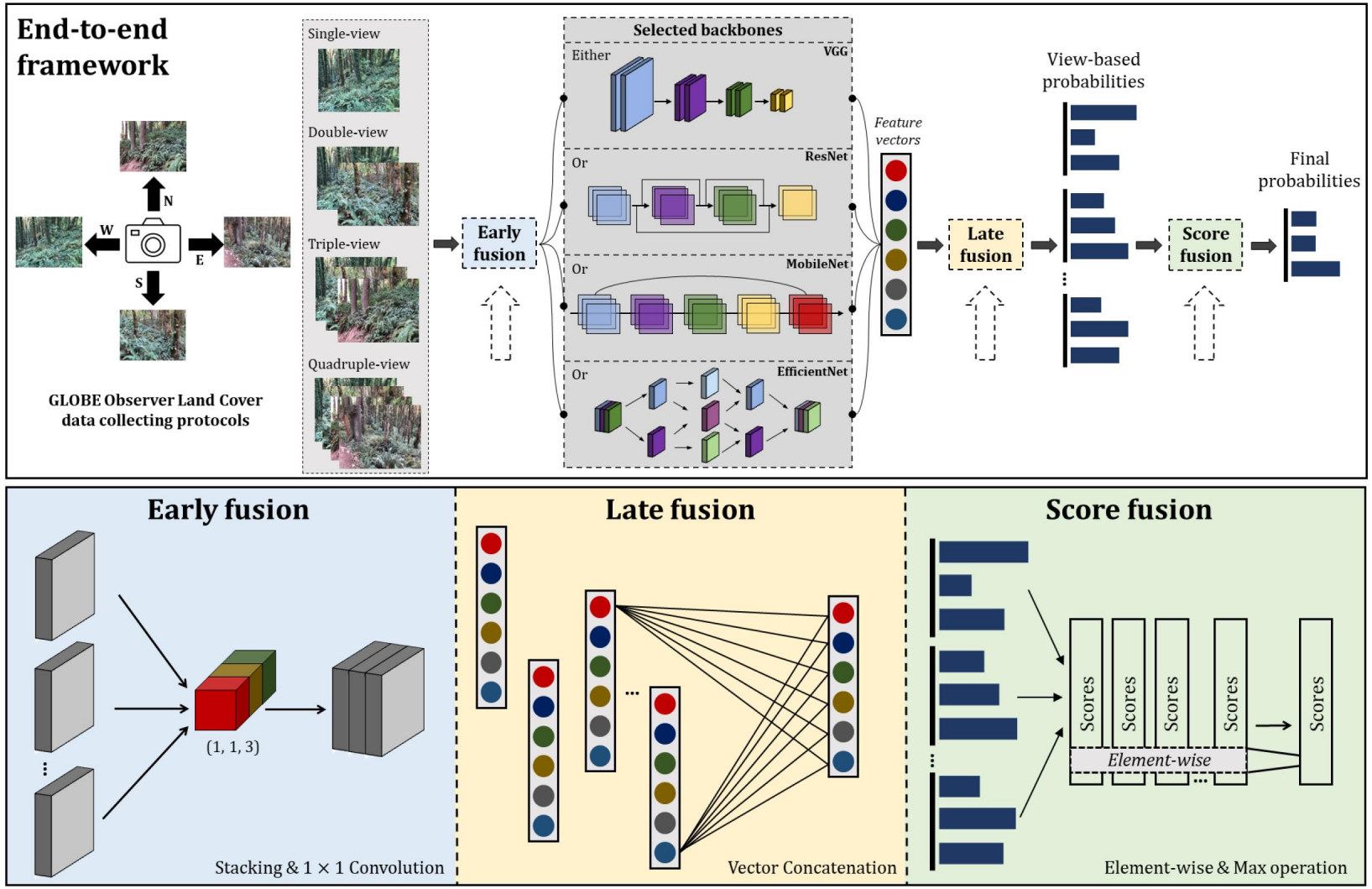
GLOBE Multi-View Land Cover Classification



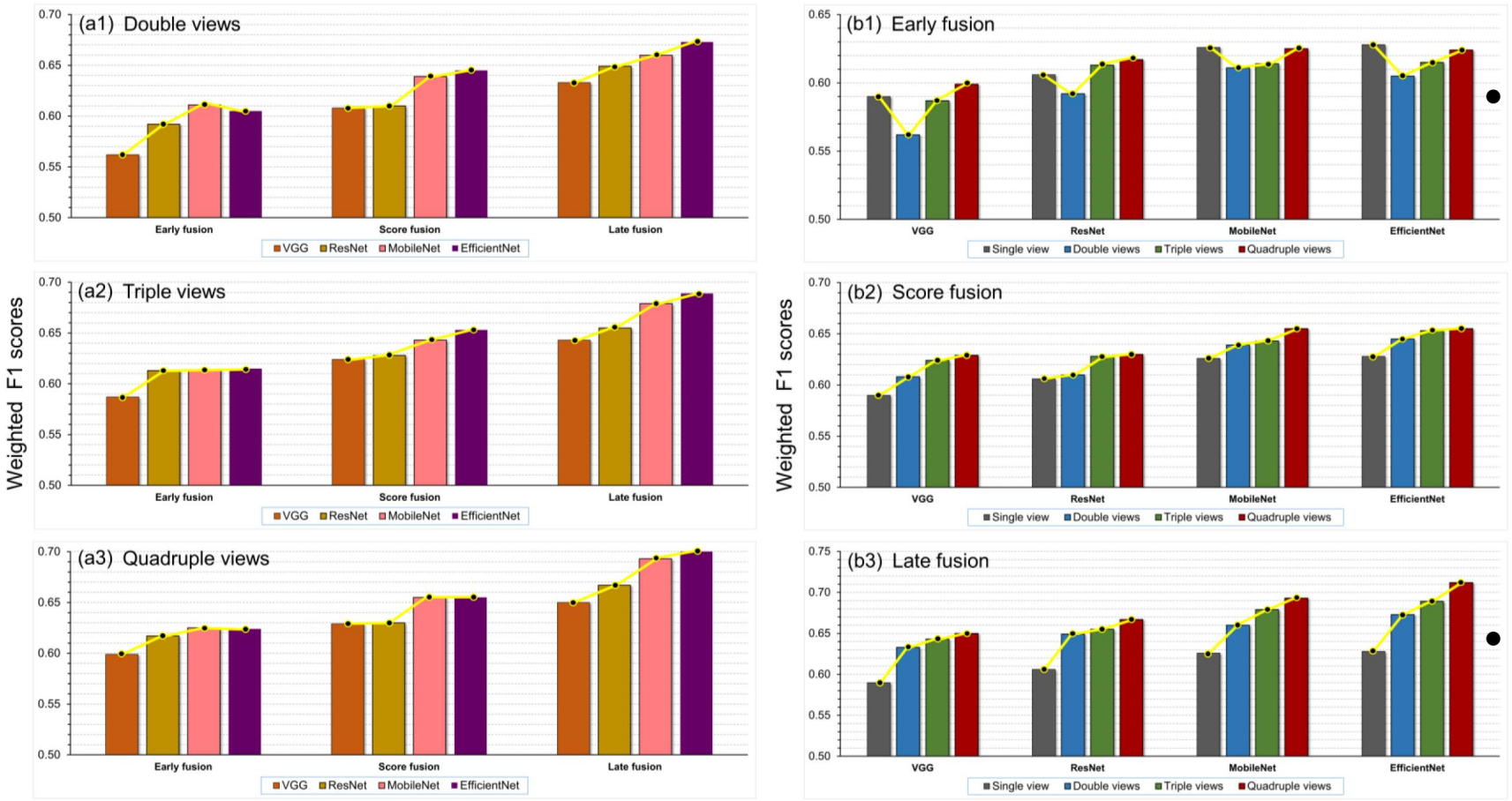


- 9,254 samples contains full 6 directional with complete label information.

GLOBE Multi-View Land Cover Classification

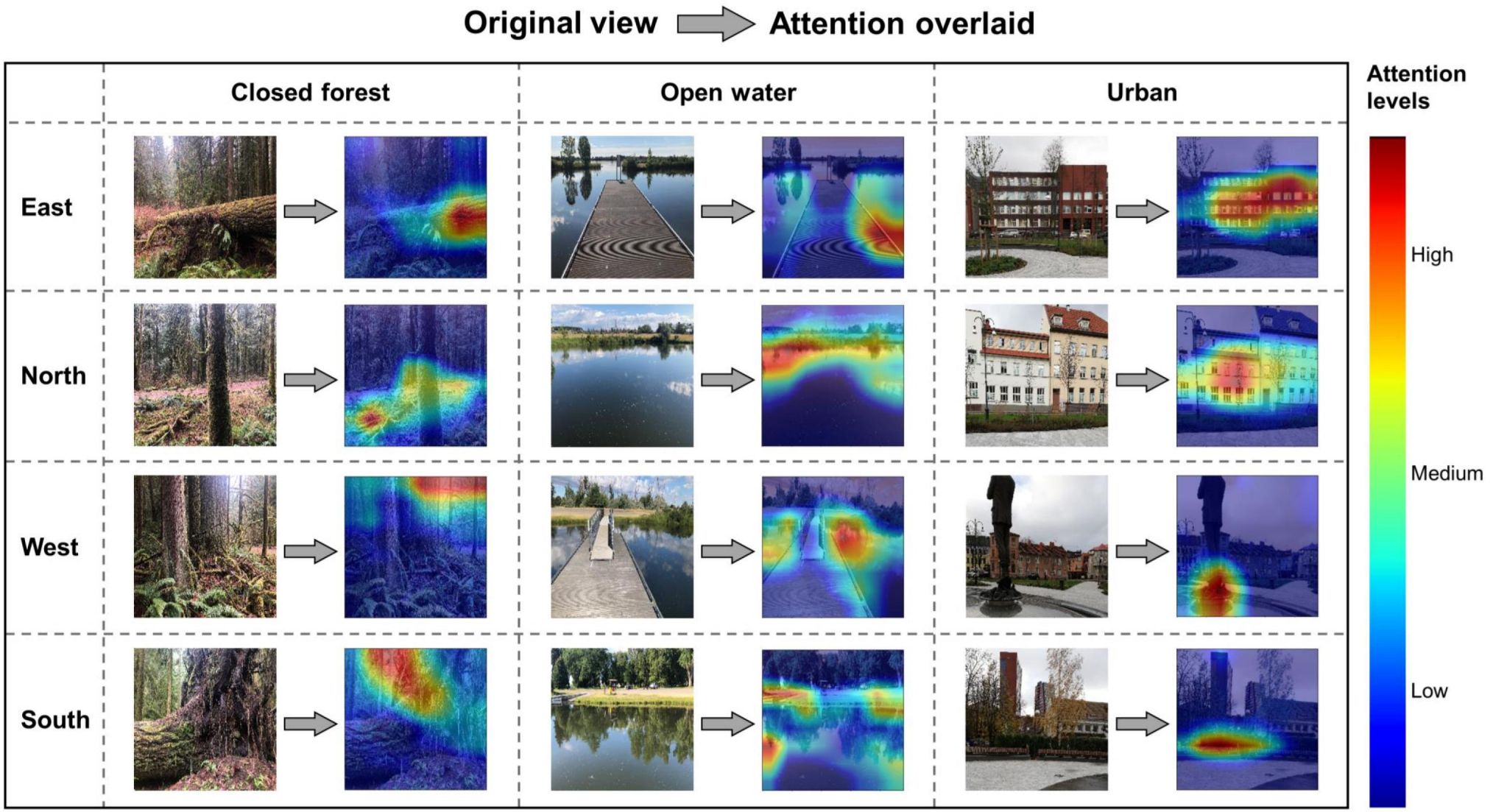


GLOBE Multi-View Land Cover Classification

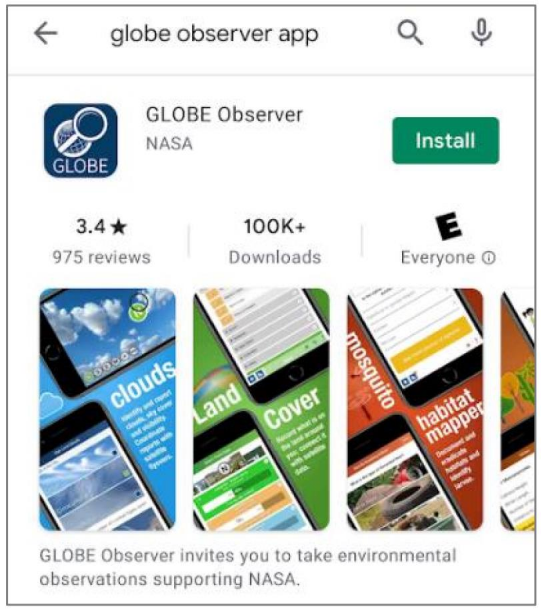


- Weighted F1 scores for investigated deep learning architectures using different levels of directional view involvement under different fusion strategies.
- For ALL fusion methods, 4 directional accuracy > the other directionals

GLOBE Multi-View Land Cover Classification



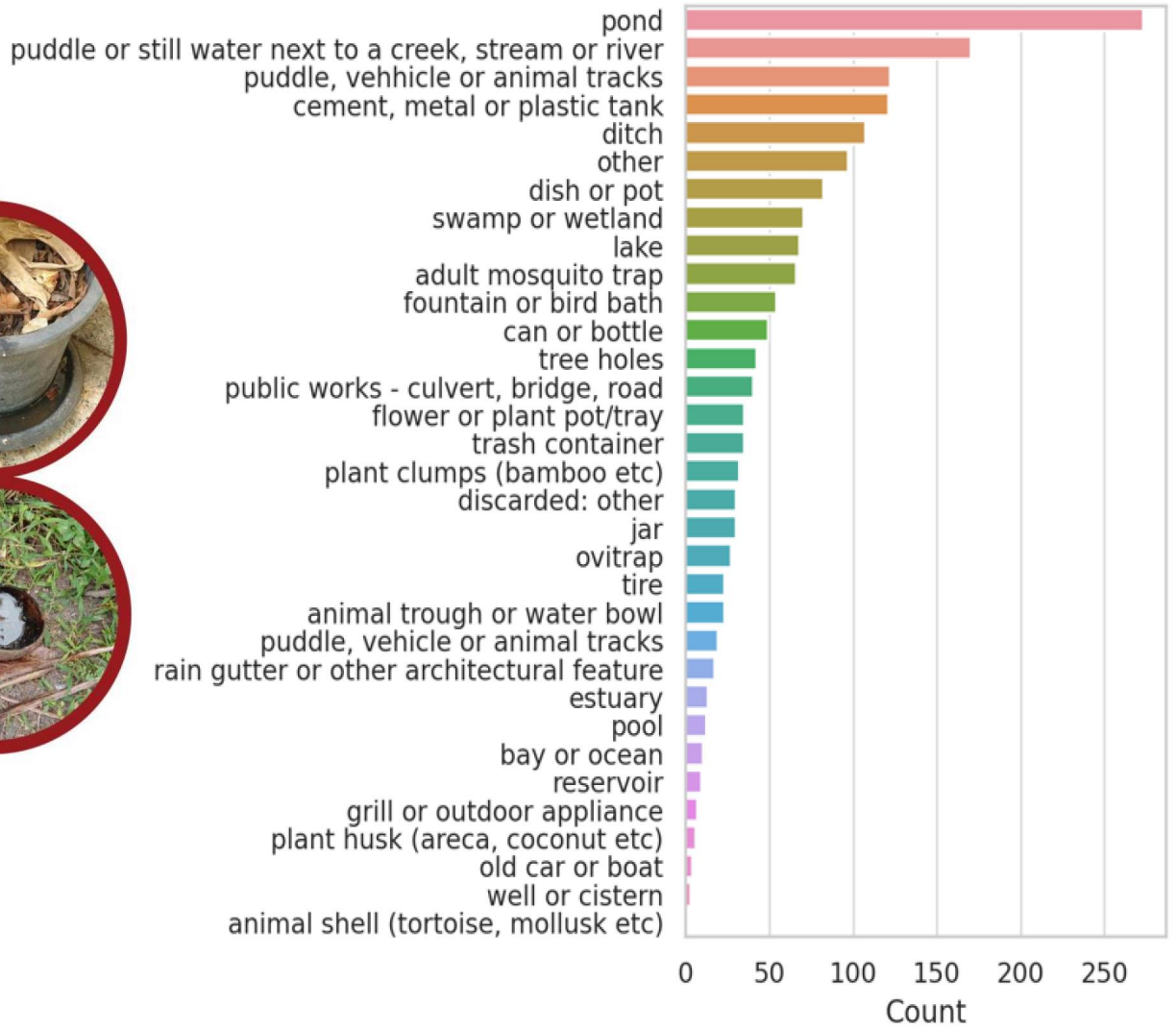
The GLOBE Observer - Mosquito



GLOBE Observer Mosquito

Mosquito -> MicroHabitat

A bar plot showing how frequently each category appears in the dataset.



The Secret Weapon: You!

Leveraging our network to supercharge citizen engagement

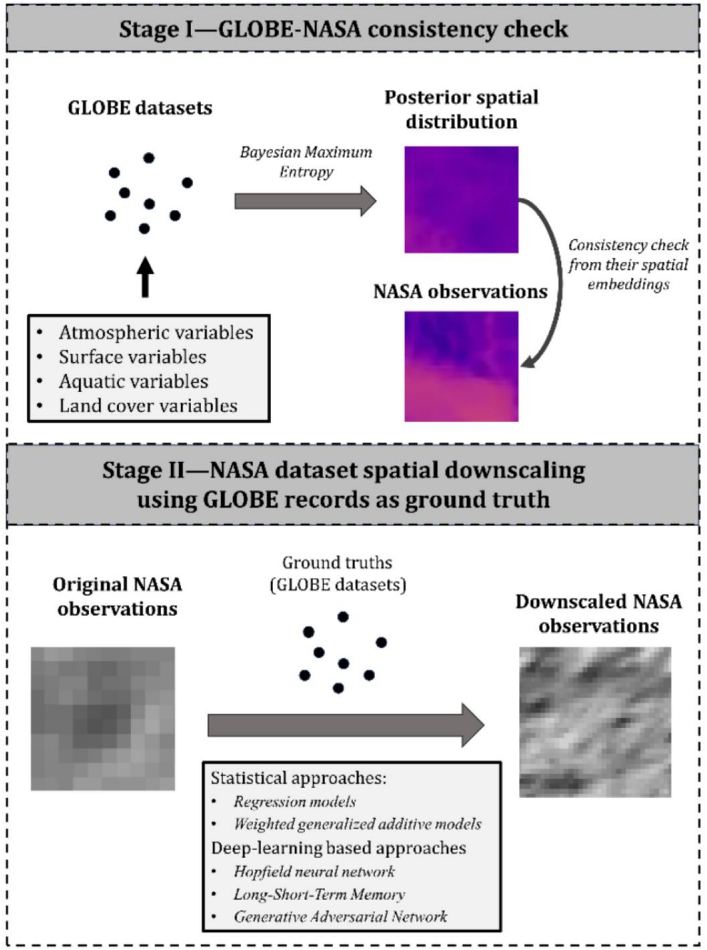
GLOBE's global army of citizen scientists

GLOBE

Turning every smartphone into a mosquito-tracking supercomputer

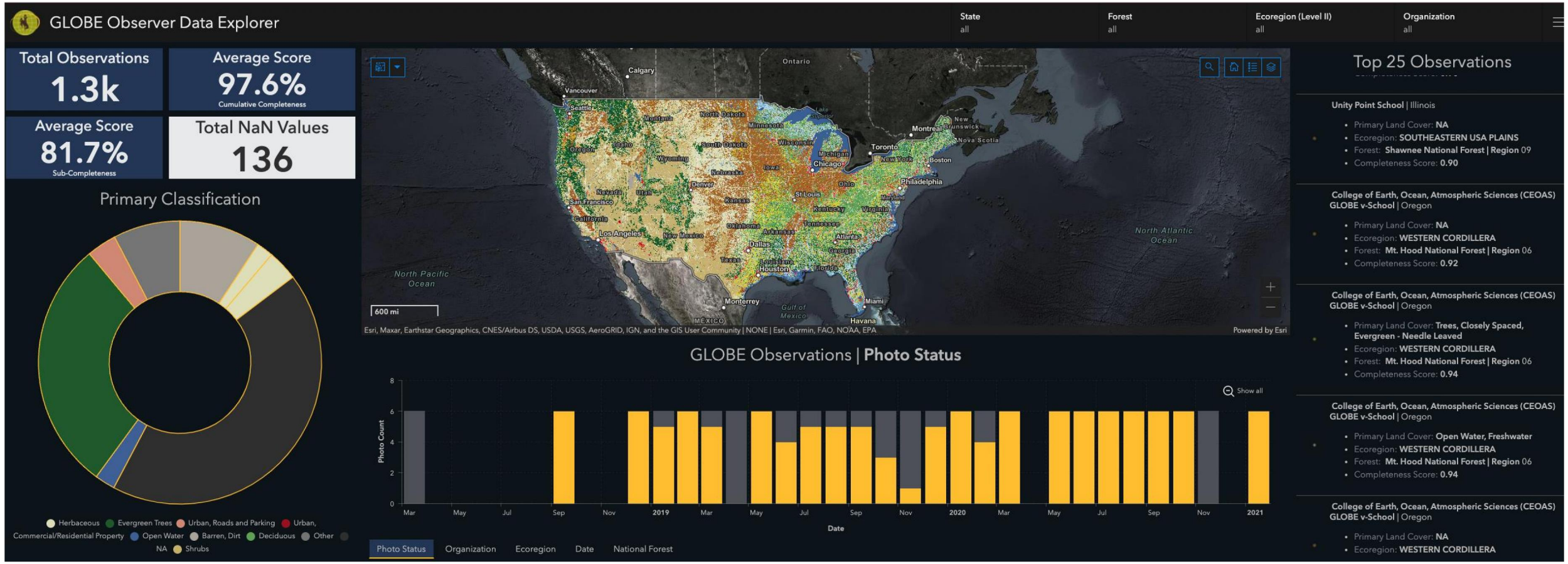
Data Consistency

- Bayesian Maximum Entropy (BME) approach
  - Converts discrete GLOBE data to continuous spatial distribution
  - Combines information theory and Bayesian statistics
- Three-stage BME process:
  - Prior: Calculate joint probability density using general knowledge
  - Meta-prior: Incorporate specific measured and soft data
  - Posterior: Apply Bayes' theorem for final probability distribution
- Outcome: Statistically comparable surfaces between GLOBE and NASA observations
  - Ensures consistency before data assimilation
  - Crucial for reliable mosquito habitat mapping

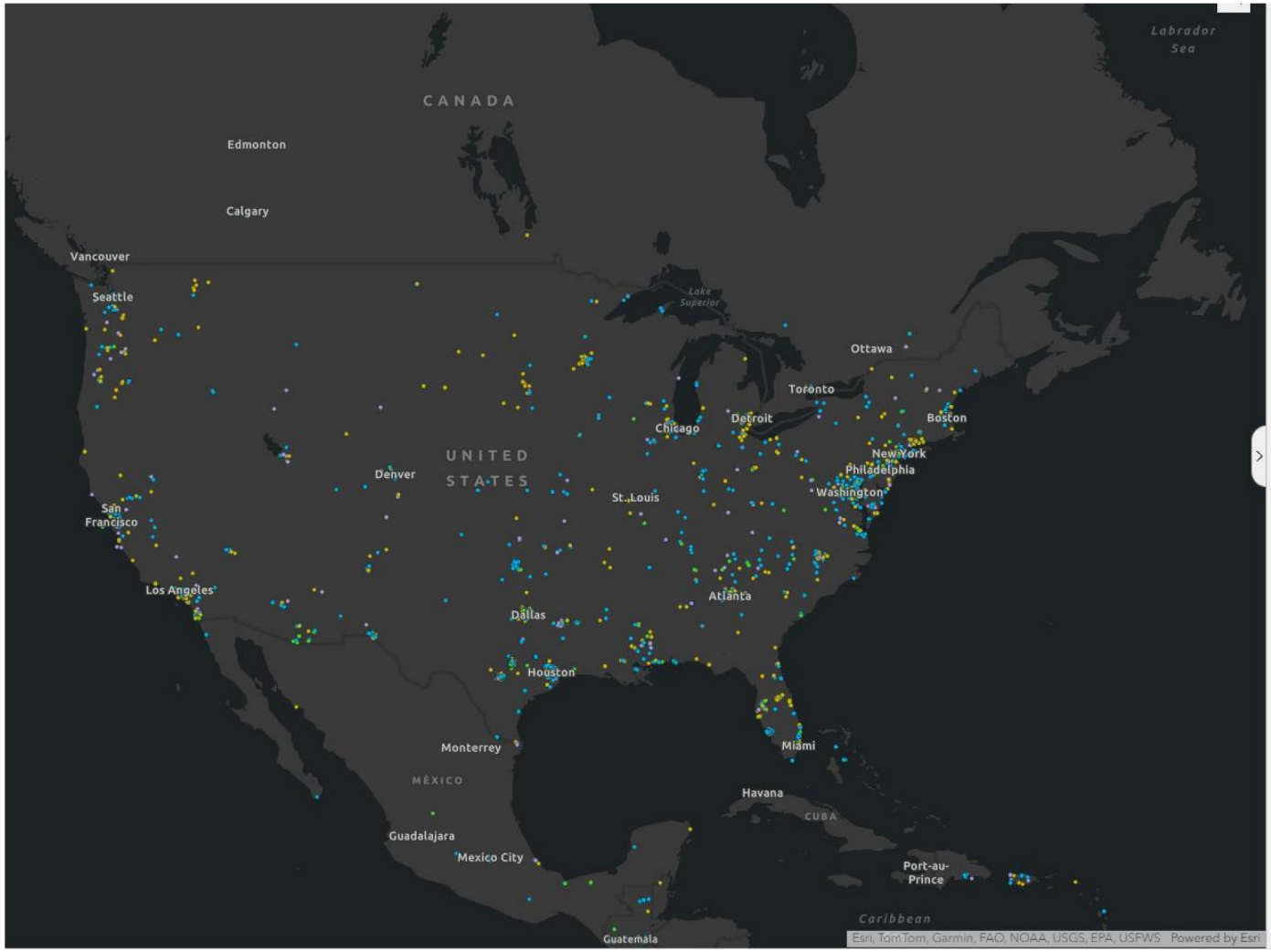


GLOBE-NASA consistency check and downscaling framework

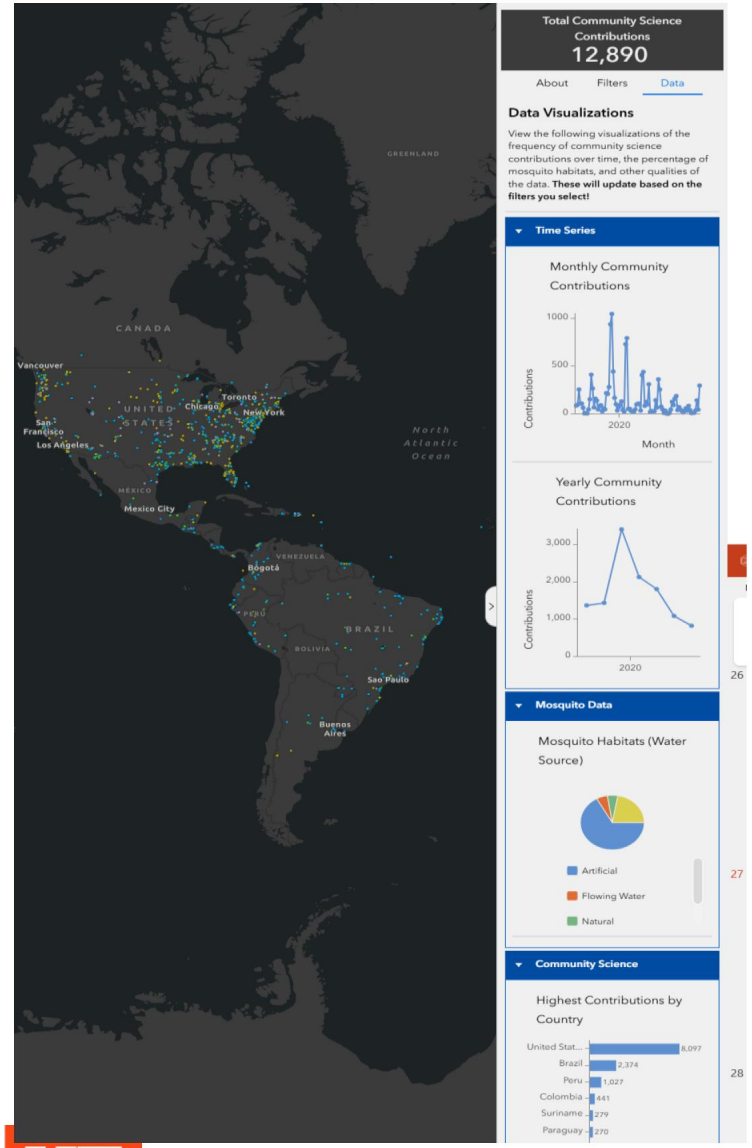
GLOBE Observer Data Explorer



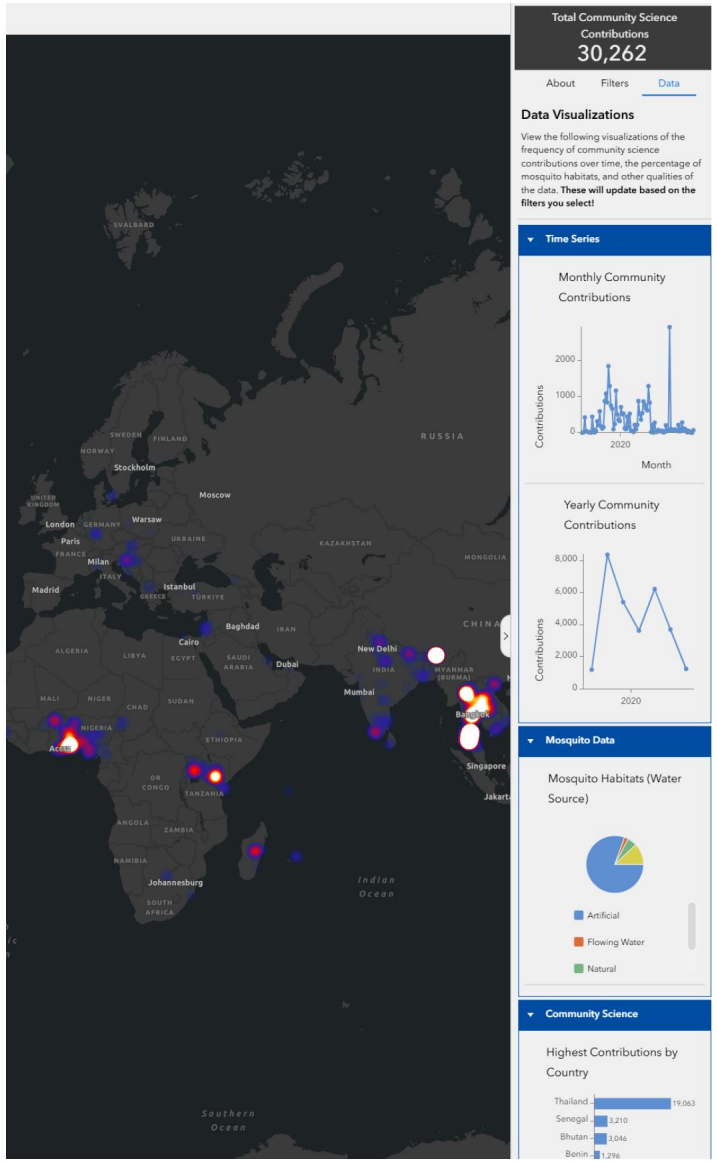
The GLOBE Observer - Mosquito



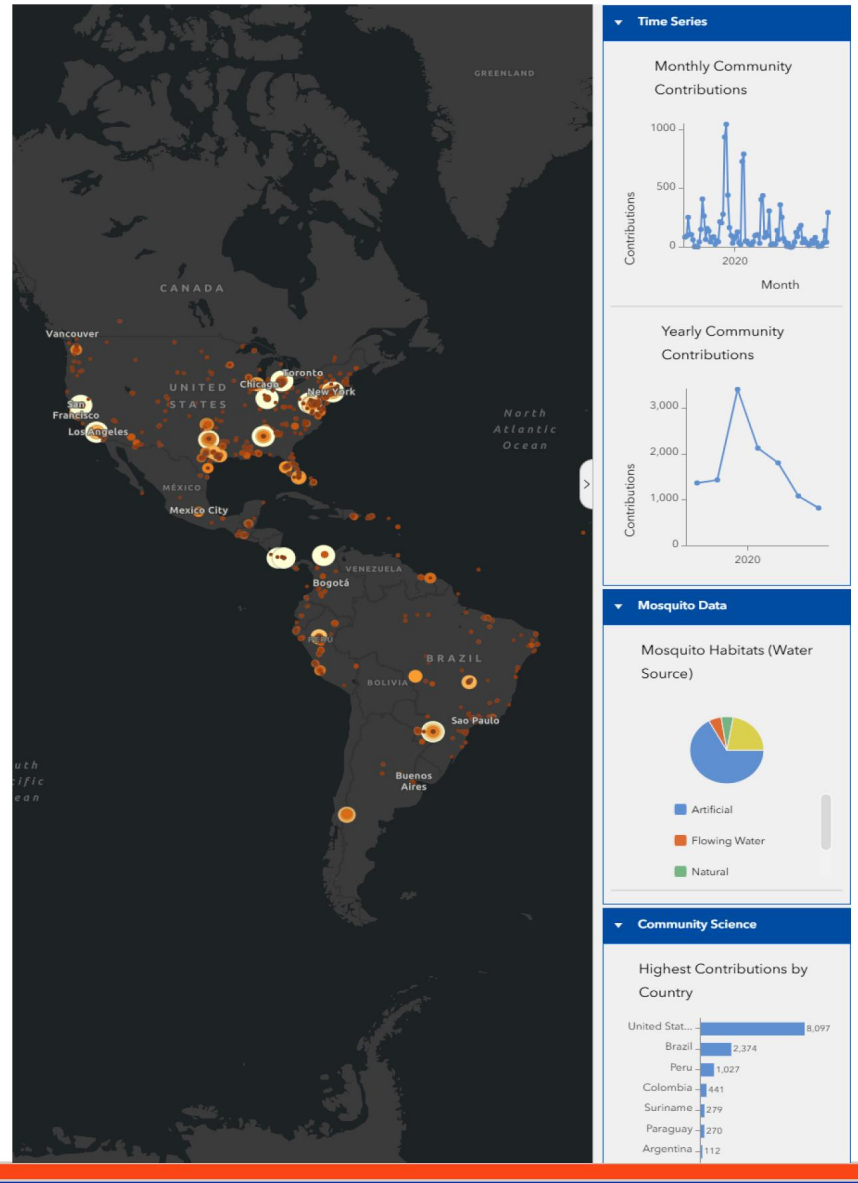
Mosquito Habitats



GLOBE Community Contributions



Mosquito Data Count



Take-Home Message

- **Power of Collaboration**: citizen network amplifying impact across the Americas
- **Your Contribution Matters**: Every observation helps build a healthier future
- **Beyond Mosquitoes**: Paving the way for global health innovation

- **Join Us**: Be part of the solution - download GLOBE Observer app today! And become our partner!
- *Together, we're not just predicting the future of health – we're creating it.*

- Questions?
- Contact: yangdi1031@ufl.edu