### Citizen Science data supported forest monitoring: Potential, Challenges, and Limitations

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### Benefits of Citizens supported data acquisition

- Increased Data volume
- Diverse perspectives
- Cost effectiveness
- Engagement and Awareness
- Real-time data collection
- Enhanced coverage in hard-to-reach areas
- Innovation through collaboration
- Improved decision-making and policy development





Slide provided by

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Novel Data Ecosystems for Sustainability (NODES), IIASA, Laxenburg

### Citizens for Copernicus - C4C

#### Combing Copernicus and Crowdsource Data for Forest Resources Monitoring

Copernicus – European Union's flagship earth observation initiative





### C4C in a Nutshell



## Aboveground Biomass (AGB)

### Measured from (almost) everywhere

active/passive, optical/microwave

Wild, B., Milenković, M., Hofhansl, F., Weinacker, R.,
Sturn, T., Fritz, S., Batlogg, J., McCallum, I.,
Schadauer, K., Schadauer, T., Pfeifer, N., & Hollaus,
M. (2024). Crowdsourced Forest Information for
Improving Forest aboveground Biomass estimates. In *ForestSAT 2024 : Abstract Book* (pp. 166–166).
http://hdl.handle.net/20.500.12708/211076

Citizen Science Data

large-scale satellite models need plot/tree-level

### reference data



# Generation of reference data e.g. Tree-level AGB

1. Destructive measurements

### 2. (Terrestrial) Laser Scanning

Wild, B., Milenković, M., Hofhansl, F., Weinacker, R.,
Sturn, T., Fritz, S., Batlogg, J., McCallum, I.,
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Original Pointcloud

)3.06.2025



Segmented Pointcloud



3D model  $\rightarrow$  tree volume



# Generation of reference data: Tree-level AGB

### 1. Destructive measurments

### 2. (Terrestrial) Laser Scanning

**Allometric Models** 

Wild, B., Milenković, M., Hofhansl, F., Weinacker, R.,
Sturn, T., Fritz, S., Batlogg, J., McCallum, I.,
Schadauer, K., Schadauer, T., Pfeifer, N., & Hollaus,
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Diameter at Breast Height (DBH)





 $AGB = 0.0673 * (DBH^{2}H\rho)^{0.976}$ Chave et al. (2014)

Wood density

Diameter at

breast height

(DBH)



3.

Citizen Science Data supported Forest Monitoring

Tree Height (H)

### Smartphones: Tool for data collection

Number of smartphone mobile network subscriptions worldwide from 2016 to 2023, with forecasts from 2023 to 2028 (in millions)



Source: (June 1, 2025). https://www.statista.com/statistics/330695/n umber-of-smartphone-users-worldwide/



### Smartphones for single-tree parameter measurements

*mobile* AND *phone*\* OR *smartphone*\* OR *app*\* AND

forest\* OR tree AND parameter\* OR dbh OR tree AND height OR trunk AND diameter OR volume





## Crowdsourcing allometric AGB

mobile AND phone\* OR smartphone\* OR app\*

#### AND

forest\* OR tree AND parameter\* OR dbh OR tree AND height OR trunk AND diameter OR volume





# What do citizens need to collect individual tree information?





# App developed from our project partner IIASA

# Geo-Quest Explore the outdoors and contribute to scientific research.



### Scene-recognition with C ARCore



ARCore is Google's augmented reality SDK offering cross-platform APIs to build new immersive experiences on Android, iOS, Unity, and Web....

### **Visual-Inertial Sensor Fusion:**

Kamera + IMU (Accelerometer and Gyroskop)



# DBH measurement

 Wild, B., Neumayr, C., Pfeifer, N., Milencovic, M., Hofhansl, F., Batlogg, J., & Hollaus, M. (2025). Hosentaschenphotogrammetrie für die Waldinventur. In T. Weinold (Ed.), 23. Internationale Geodätische Woche Obergurgl 2025 (pp. 195–204). VDE Verlag. http://hdl.handle.net/20.500.12708/213394





Setting up AR session



Fitting DBH circle



## **Tree Height & Species**

Wild, B., Neumayr, C., Pfeifer, N., Milencovic, M., Hofhansl, F., Batlogg, J., & Hollaus, M. (2025). Hosentaschenphotogrammetrie für die Waldinventur. In T. Weinold (Ed.), 23. Internationale Geodätische Woche Obergurgl 2025 (pp. 195–204). VDE Verlag. http://hdl.handle.net/20.500.12708/213394











### How to motivate citizen to do the data collection?

- Motivate students within courses
  - E.g. Bsc & Msc theses
- Workshops during conferences
  - E.g. During the Living Planet Symposium <a href="https://lps25.esa.int/">https://lps25.esa.int/</a>
- Measurement campaigns in cities e.g. Wels
- Social media postings
- Press releases
- News articles
  - E.g. at TU Wien



#### **News articles**

TU Wien / News / News articles

#### 23. December 2024

### Oh Tannenbaum, wie schwer sind deine Äste?

Die Weihnachtszeit ist da, und Weihnachtsbäume schmücken wieder viele unserer Wohnzimmer. Doch während wir uns an ihrem Glanz erfreuen, stellt sich der Wissenschaft eine wichtige Frage: Wie schwer ist ein Baum eigentlich?



WIEN

Punktwolke



© Benjamin Wild



## Constraints / pratical solutions

- some large forest owners do not want data about their forest to be publicly accessible
- Legal constraints in the Austrian Forest Law (1975):
  - In principle, every person has the right to enter and stay in forests for recreational purposes.
  - Any use of the forest that goes beyond this is expressly prohibited unless the forest owner agrees

 $\rightarrow$  citizens that to the forest – take photos – we extract information that is used for research or commercial purposes is not allowed

- Solutions
  - Motivate forest owners to acquire and share data about their own forest
  - Concentrate on trees outside the forests e.g. urban trees, park trees, etc.
  - ...



# Citizen Science Project: **BIOM-Garten** Biodiversitätsmonitoring Amphibien und Reptilien in Österreichs Gärten

Universität für Weiterbildung Krems













## Aim of Biom-Garten

- With the help of citizens, the BIOM-Garten project is closing gaps in existing amphibian and reptile monitoring and investigating home/private gardens more closely as habitats for endangered animals, as these are generally inaccessible to researchers.
- The environmental parameters for the species reports are collected using garden questionnaires and remote sensing methods.
   Harmonize the reported data from different platforms.
- This is the first time that the role of gardens in habitat connectivity has been specifically investigated for these animal groups. In addition, the garden descriptions provide information on which structures in the garden are particularly beneficial for which species.
- <u>https://www.citizen-science.at/projekte/biom-garten</u>



## Giom-Garten project

- The project is led by an NGO with a professional PR department
- Several project partners have experience in long term citizen science projects
- Regular newsletters and press releases increase the number of submitted reports
- Public webinars are very well received
- Public excursions for citizen scientists are highly appreciated
- Storing the collected data to a public accessible long term database e.g. Biodiversitätsatlas <u>https://biodiversityatlas.at</u>



# Learnings / Potential / Challenges

- Using existing networks leads to high number of derived observations
- Experts have to check the quality of the data
- People often don't finish the questionnaire due to
  - Unclear questions
  - Complex answers needed
  - Input masks that are not user-friendly
- Precise georeferencing is often not available
  - Manual corrections needed
  - Reduction of useable data
- NGOs have professionalized their public relations work
  - Very valuable knowledge for the project



## Lessons learned

- Promoting citizen science campaigns are costly and time consuming
- Motivating Citizens for data collection is challenging
  - It is advisable to use existing networks
  - Citizen science experienced partners are very helpful
  - PR is a key component
- Simple user interfaces for the smartphones app are key
- If the programming of the apps is done from external companies / institutions very clear task descriptions are needed – the number of iterations is strongly limited !!
- the duration of individual projects is often too short to be able to build up useful databases within the project → long term perspectives needed



# Thank you for your attention and enjoy to be a (citizen) scientist! Zähle mit, um Reptilier



### Measure Trees Map Carbon Make a Difference!

Geo-Quest is a mobile app for collecting high-quality ground reference data to improve AI models and remote-sensing applications.

Whether you are a scientist, a researcher, or an outdoor enthusiast, Geo-Quest turns your field observations into valuable datasets for the global community.



GET IT ON Google Play Zähle mit, um Reptilien und Amphibien zu schützen. Melde jetzt Arten in deinem Garten!



