

Citizen Science to support Digital Soil Mapping

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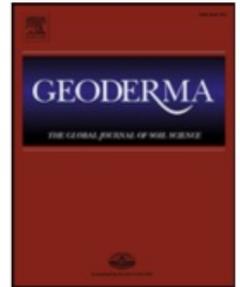


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Can citizen science assist digital soil mapping?

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Citizen Science

- “the participation of **non-scientists** in **scientific research**”
- the **citizen** acts as an **observer** or **experimentalist**, within structures established by a citizen science project run by **professional scientists**
- purposes:
 1. to enlist non-scientists to **amplify scientific research**
 2. to build **citizen support** for, and **understanding** of, science

Why the increasing interest in and success of citizen science?

- **Technology:** GPS-enabled mobile phones with data capture apps; web database backends
- **Mentality:** *empowerment* of citizens to participate as non-specialists in activities that once were restricted to specialists
 - encyclopedia entries (e.g., Wikipedia)
 - reviews of media (books, music), products, businesses (hotels, restaurants)
 - expressing opinions via **blogs**
 - “crowd sourcing”; “the wisdom of crowds”

Use of citizen science by professional scientists

- **Massive databases** (e.g., eBird) with much larger spatio-temporal coverage/density
 - improved models, e.g., habitat suitability
- **Monitoring** (time-series)
 - early-warning

Can citizen science be applied to soil science?

- **Popular knowledge** of the soil resource is much less than for other natural resources
- Soil is not “fashionable”, there are no soil hobbyists (contrast with birders)
- Only the **surface soil** is easily visible to the non-specialist
- **Training** is generally needed to make consistent observations
- Difficult to have repeat or similar observations for **quality control** (but can compare with existing maps...)

Why involve citizens in (digital) soil mapping? — 1

- For the **professional soil mappers**:
 - increasing the **density** and **geographic spread** of observations to **improve mapping accuracy**
 - More (reliable) **observations** should result in better **predictive models**
 - Correcting **mistakes** on published maps
 - Disaggregating/**downscaling** published maps

Why involve citizens in (digital) soil mapping? — 2

- For **society**:
 - building a wider **citizen appreciation** of soil geography
 - More people with field experience of soils, their diversity, their (im)proper use
 - improve “**connectivity**” between soil and citizen

Who could be citizen scientists for DSM?

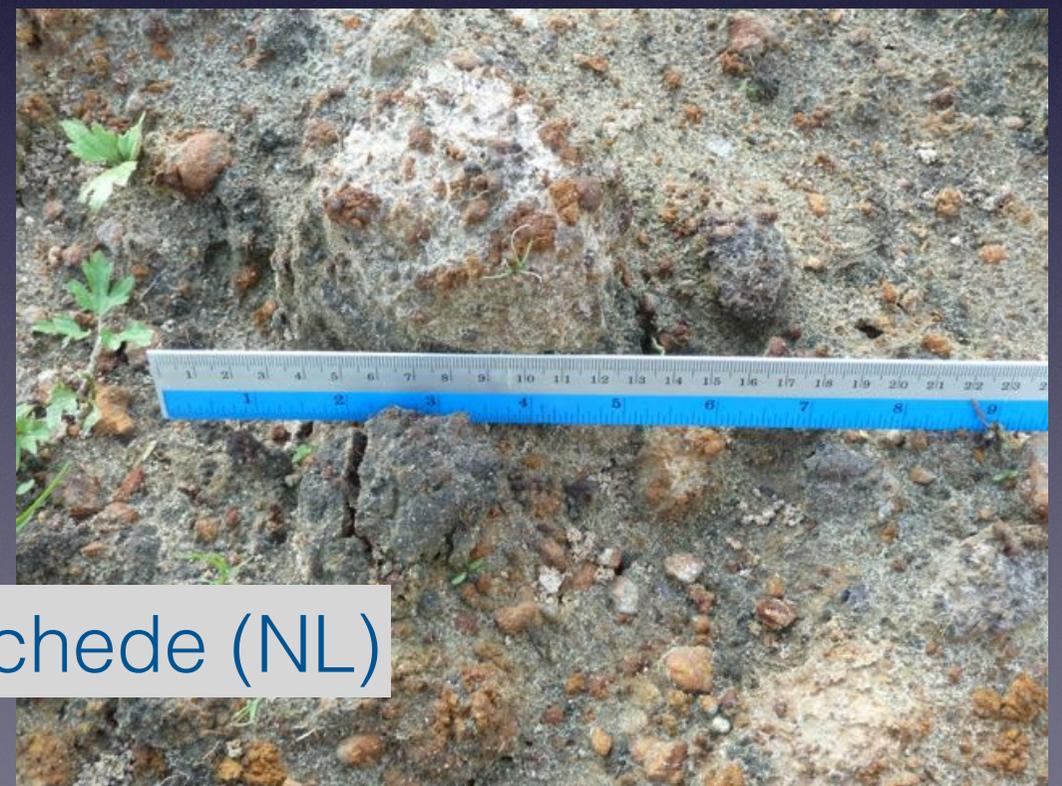
1. consulting and research soil scientists
2. farmers / land managers
3. civil engineers and others involved in construction
4. gardeners
5. participants in outdoor activities
6. “greens”
7. “organizers”

What information can be provided to DSM by citizen scientists?

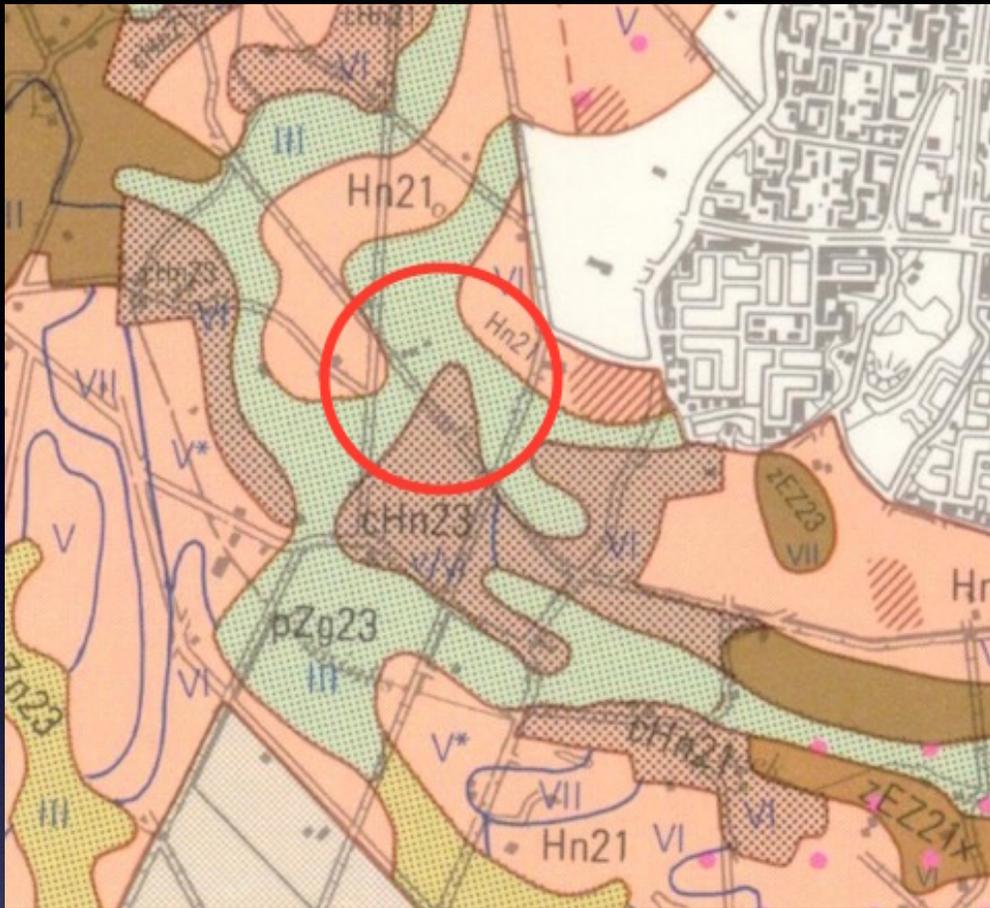
1. tacit (“**expert**”) knowledge
2. **opportunistic** newly-acquired information
3. **protocol-guided** newly-acquired information
4. information accumulated in **precision agriculture** practice
5. **physical samples** submitted for analysis

Opportunistic newly-acquired information

- “See something, say something”
- Just need to motivate people to report what they see, wherever they are (with georeference)
 - maybe just a photo of the soil surface and landscape, we can see stones, colour, structure, erosion features, land use...
- No protocol, interpretation and quality control by organizers



Bog iron, Helmerhoek, Enschede (NL)



pZg23/III:

‘beekerdgronden’,
loamy fine sand,
groundwater <40 cm winter,
80-120 cm summer

cHc23/V: ‘laarpodzolgronden’,

(fine lines of iron-rich sands in
spodic horizon)

loamy fine sand,
groundwater <40 cm winter,
> 120 cm summer

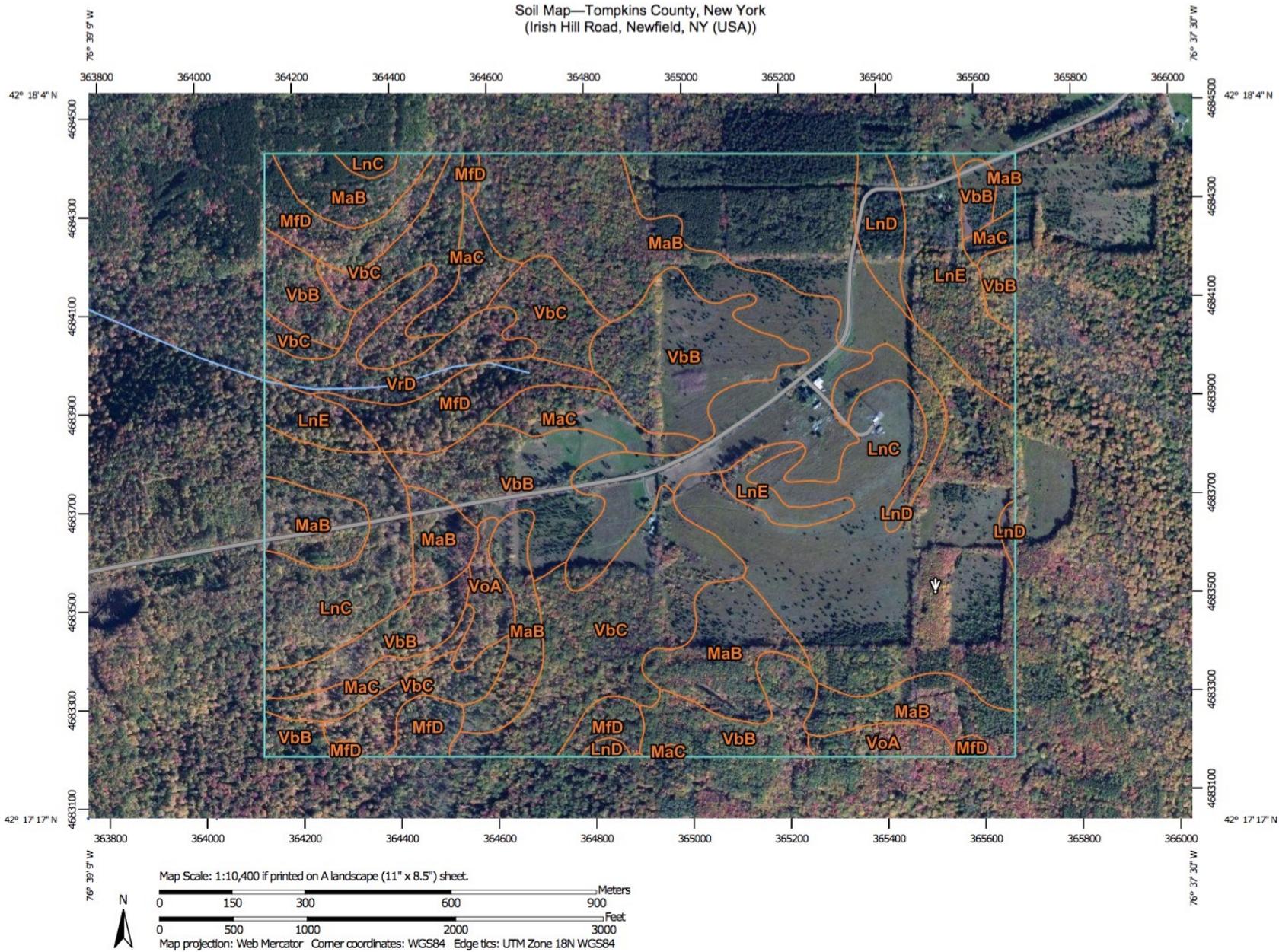
**neither soil type is expected
to have bog iron**

Soil map 1:50k, 34 Oost (Enschede) (NL)

Idea for areas with published maps: “**improve your soil survey**”

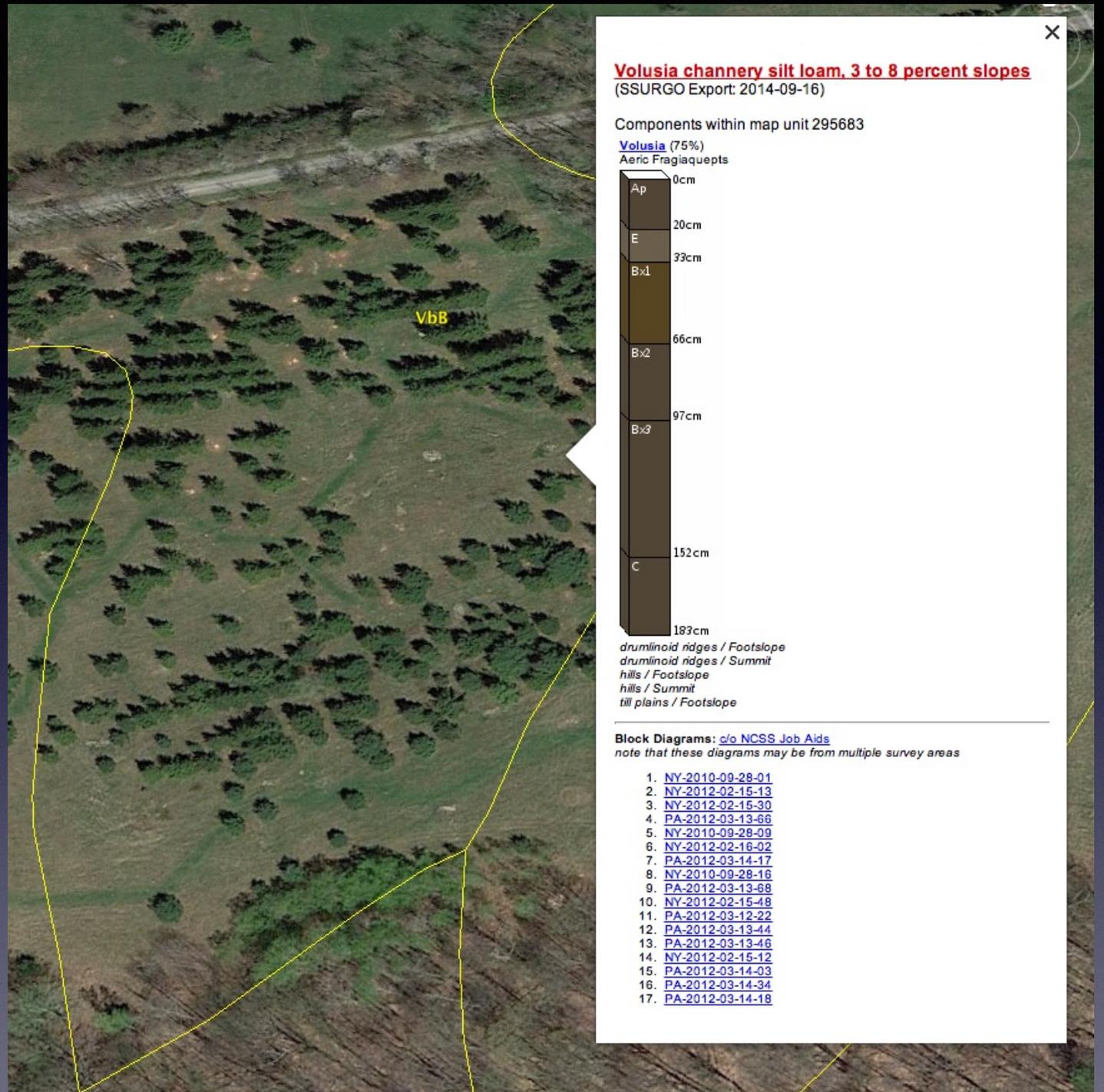
- Citizens access the **on-line map** and display it for their location (determined by GPS) on smartphone or tablet
- Citizens **check soil description** with whatever they can **observe** (often only surface, e.g., coarse fragments, texture) or easily measure
- Citizens enter any **discrepancies** with published map, **confirm** others
- Professional surveyors **review** the reports, collate, decide if and how to update the maps

A published soil series map (on line)



Mapped soil series in a “natural” cemetery

SoilWeb as KML file displayed on Google Earth



<http://casoilresource.lawr.ucdavis.edu/drupal/>



Observation:

Depth to bedrock **much shallower than mapped**

Consistent through the area

Change soil series on map

Protocol-guided newly-acquired information

- **Much more difficult** than opportunistic observations
 - to organize, to establish protocols, to recruit observers
- But much of the **quality control** is now done by the observer; more consistent and **higher-quality information**
- Requires a **protocol**, simple enough for the non-specialist
 - **safe** (e.g., no harsh chemicals, no dangerous tools, no problems with access); reproducible
- May require **training** for consistency
- What is the **motivation** for the observers?

Physical samples submitted for analysis

- Must be **protocol-guided**
- Must have **consistent field methods**
 - site location, site preparation, sampling, sample handling...
- Farmers / consultants have experience with **soil fertility samples**
 - these are usually keyed to a field; just need to give the field **location** (GPS) and **sample support** size (composite samples)

Information accumulated in **precision agriculture**

- **On-the-go soil sensors**; yield monitors (both linked to GPS)
- Data collected digitally, downloaded for farm management
- Lots of research on how to clean, quality control
- But **proprietary** — trade secret!

Conclusions

1. The citizens form a crowd which can greatly **increase the spatio-temporal density of observations to support DSM**
2. Soil is less glamorous than animals or plants or weather, but there is a community of people who appreciate its value
3. The “environmental” and “sustainability” movements could increase this number
4. **The citizen — scientist relation** is heavily dependent on **culture** (national, scientific, civil society, ...)



Thank you for
your attention!