

# eurac research

## Reference data

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# Need of reference data

- Representation of true land cover conditions
- Reference data = „Ground truth“
- Training data
- Verification data
- Validation data

# Considerations regarding reference data

## Quality:

- Thematic consistency
- Thematic correctness
- Temporal consistency
- Spatial scale
- Spatial registration

## Quantity:

- Spatial overlap
- Spatial extent
- Temporal extent

## Access:

- Open or restricted

## Costs:

- Data costs
- Work effort

# Types of reference data

- Land cover maps
- Aerial images
- High resolution images
- High resolution data
- Inventory data
- Field work
- Sensor networks
- Land cover/use data bases
- Citizen science and crowd sourcing information

# Land cover maps

## Quality:

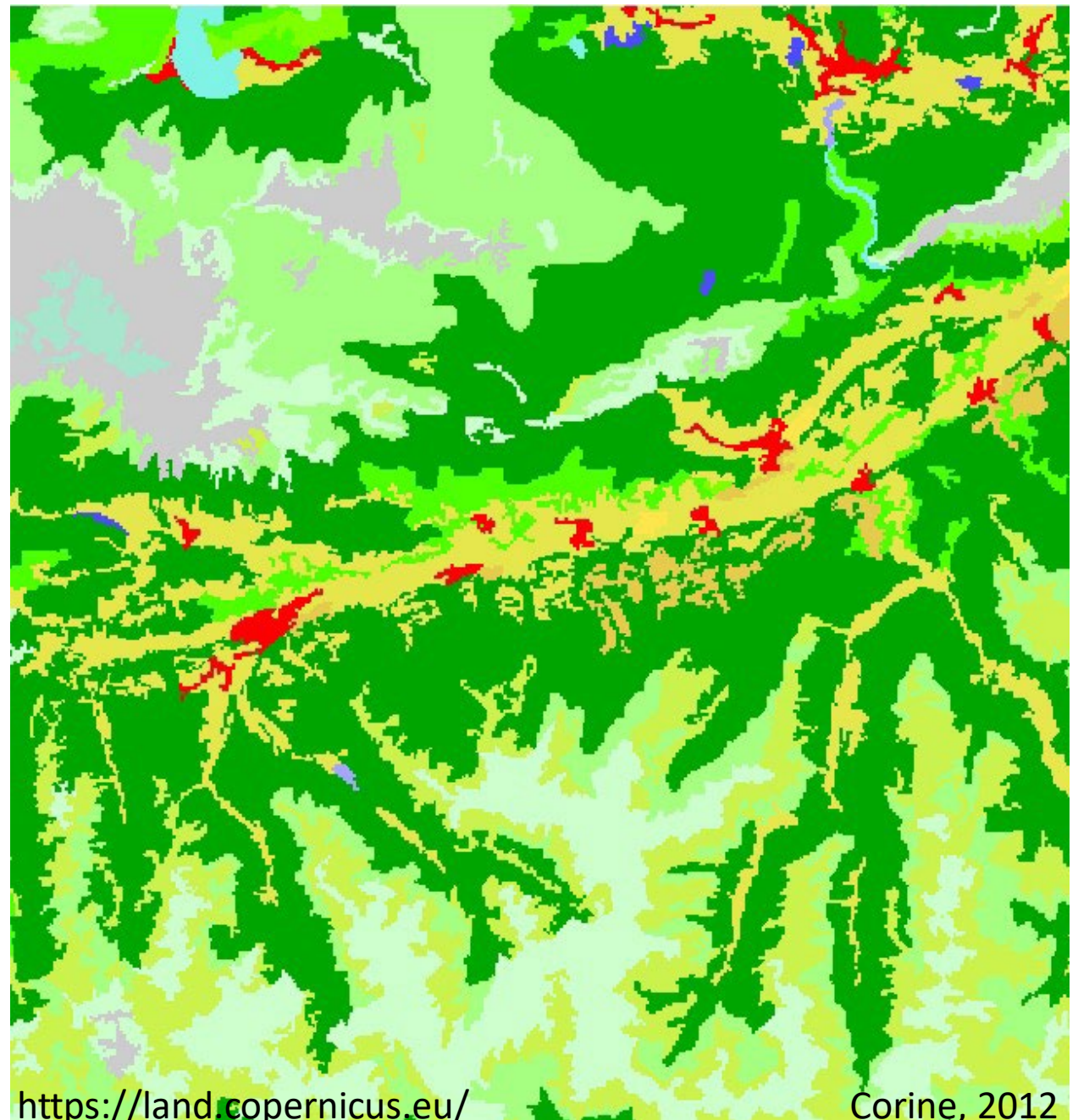
- Different classification scheme
  - Minimum mapping
  - Often not up to date
- Accuracy unknown

## Quantity:

- Area-wide
- Historical data

## Costs:

- Work effort





# Aerial images

## Quality:

- Detailed information

## Quantity:

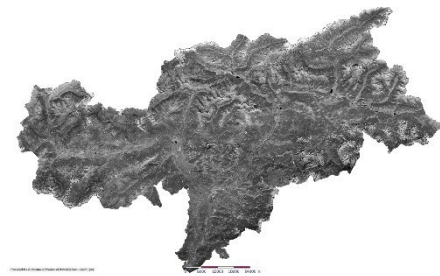
- Regional data
- Historical data

## Access:

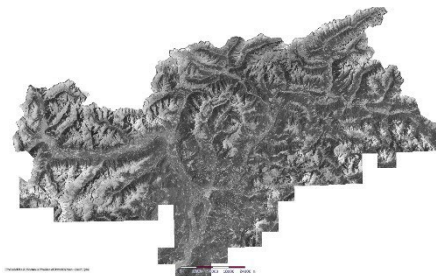
- Depending on data policies

## Costs:

- Data costs
- Work effort



1982



2003



2008



2011



# High resolution images

bing™ maps



## Examples:

- Google Earth images
- Bing images

## Quality:

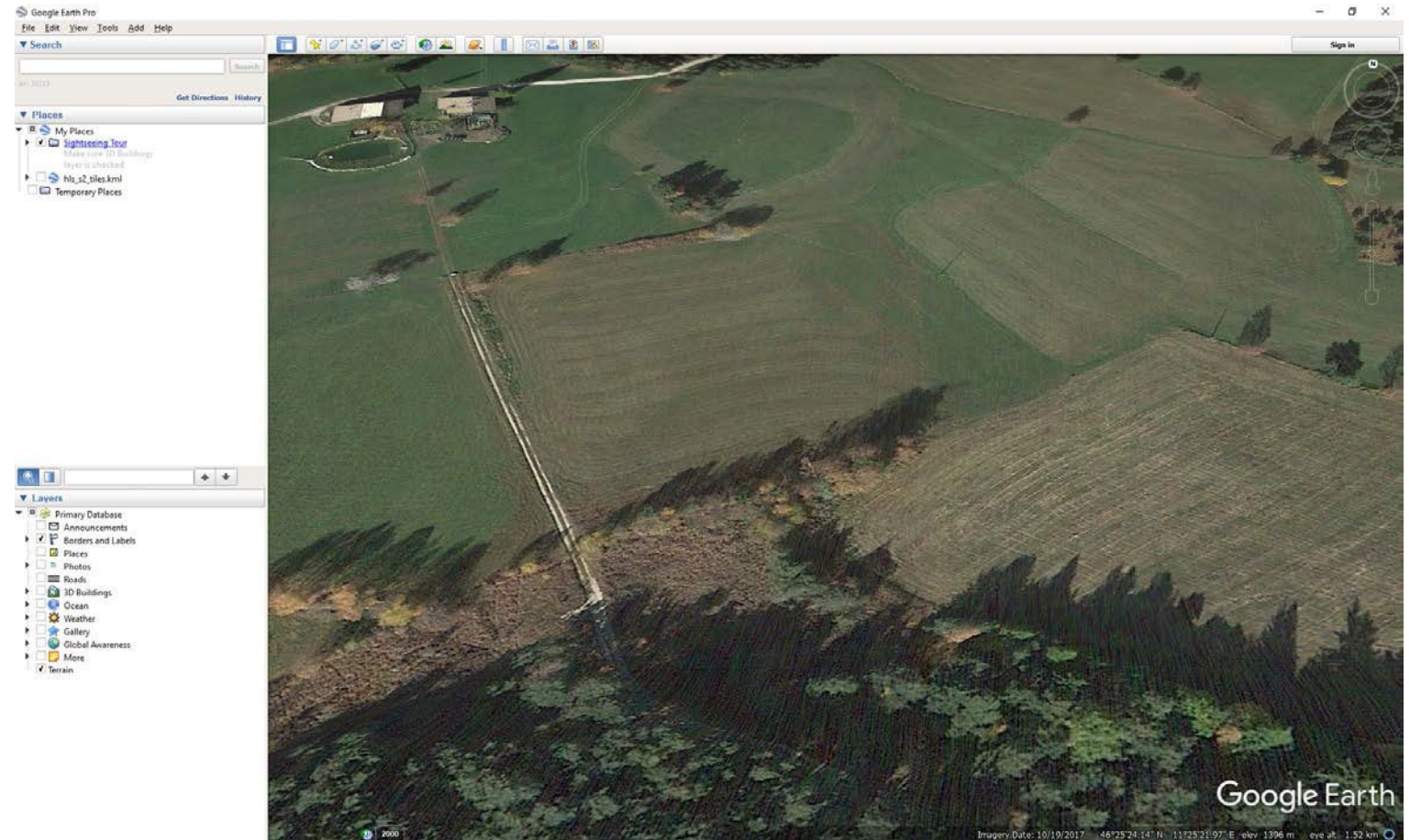
- Detailed information
- Temporal mismatch

## Quantity:

- Area-wide
- Historical data

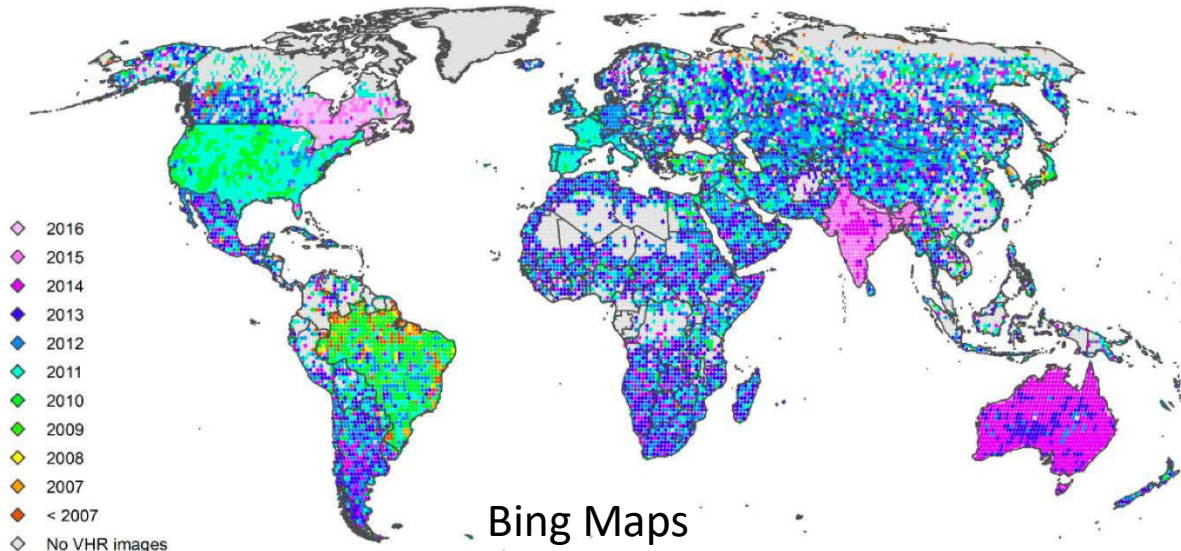
## Costs:

- Work effort

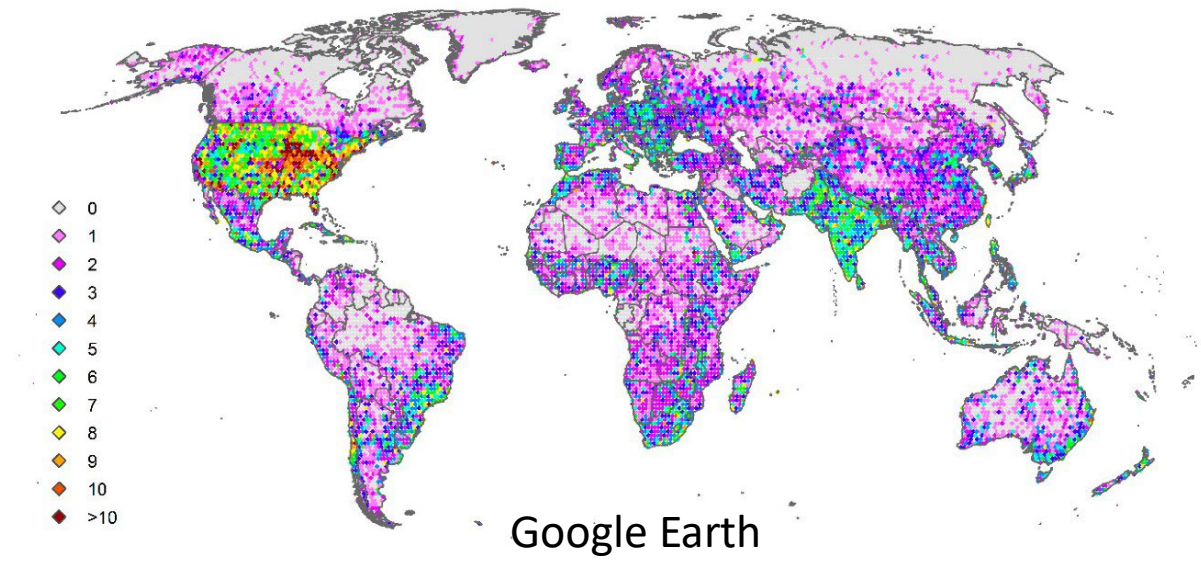
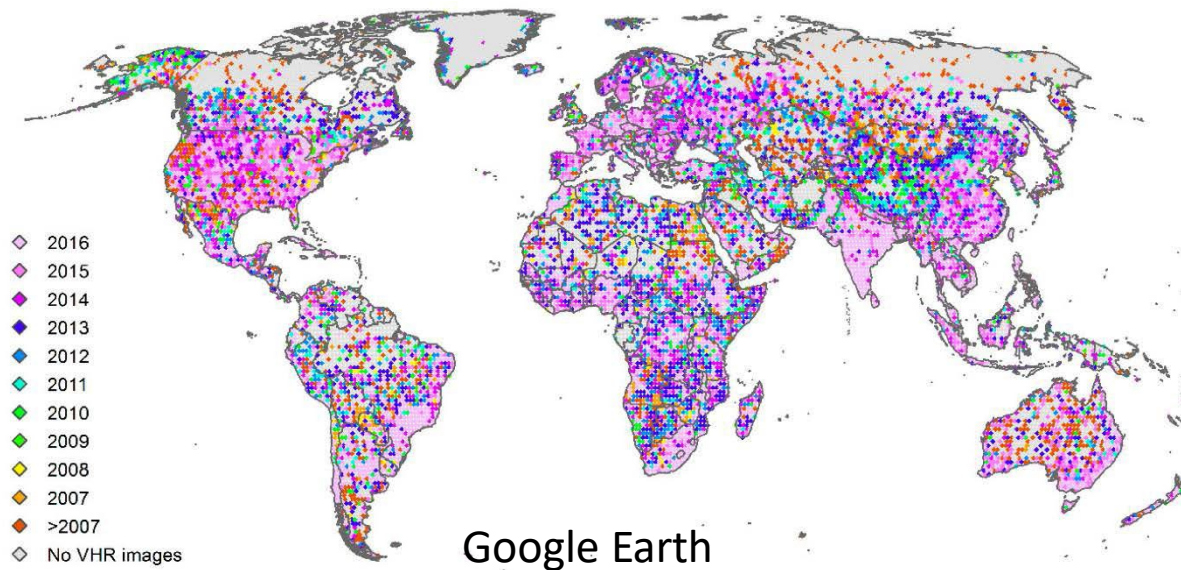
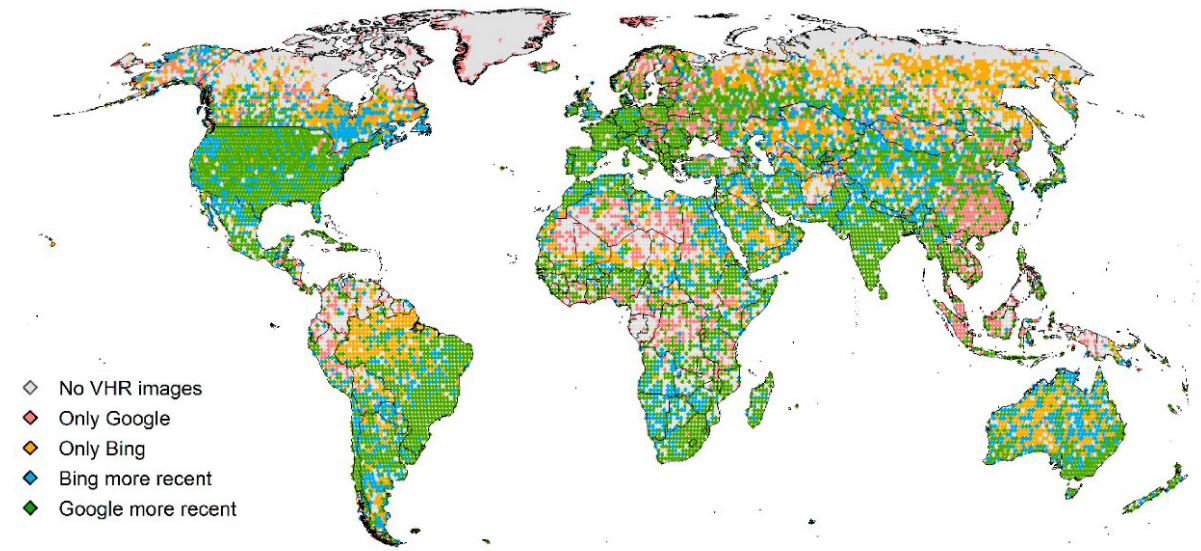




Dates of the most recent VHR satellite images (< 5m)



Comparison of the recent VHR satellite imagery (< 5m)



Lesiv et al., 2018

Numer of unique years of VHR satellite imagery (< 5m)



# High resolution data

## Example:

- Drone data

## Quality

- Detailed information

## Quantity:

- Small extent

## Costs:

- Equipment
- Field work
- Data preparation
- Work effort




Photo: Mejia-Aguilar

Peitz, 2019



## Legend

 Area of Interest

 Flightpath 1&2

 Start and landing area

 RGB Orthophoto 2018 (UAV)

 CIR Orthophoto 2014 (Bolzano)



# High resolution data

<https://www.planet.com/markets/mapping/>

## Example:

- Satellite data

## Quality

- Detailed information

## Quantity:

- Small extent
- Historical information

## Costs:

- Data costs
- Work effort



21.08.2009



03.08.2011



27.07.2013



03.08.2015



24.08.2017

Ikonos, Quickbird,  
Worldview, RapidEye,  
Planet, ....

# Inventory data

## Example:

- Forest inventories

## Quality:

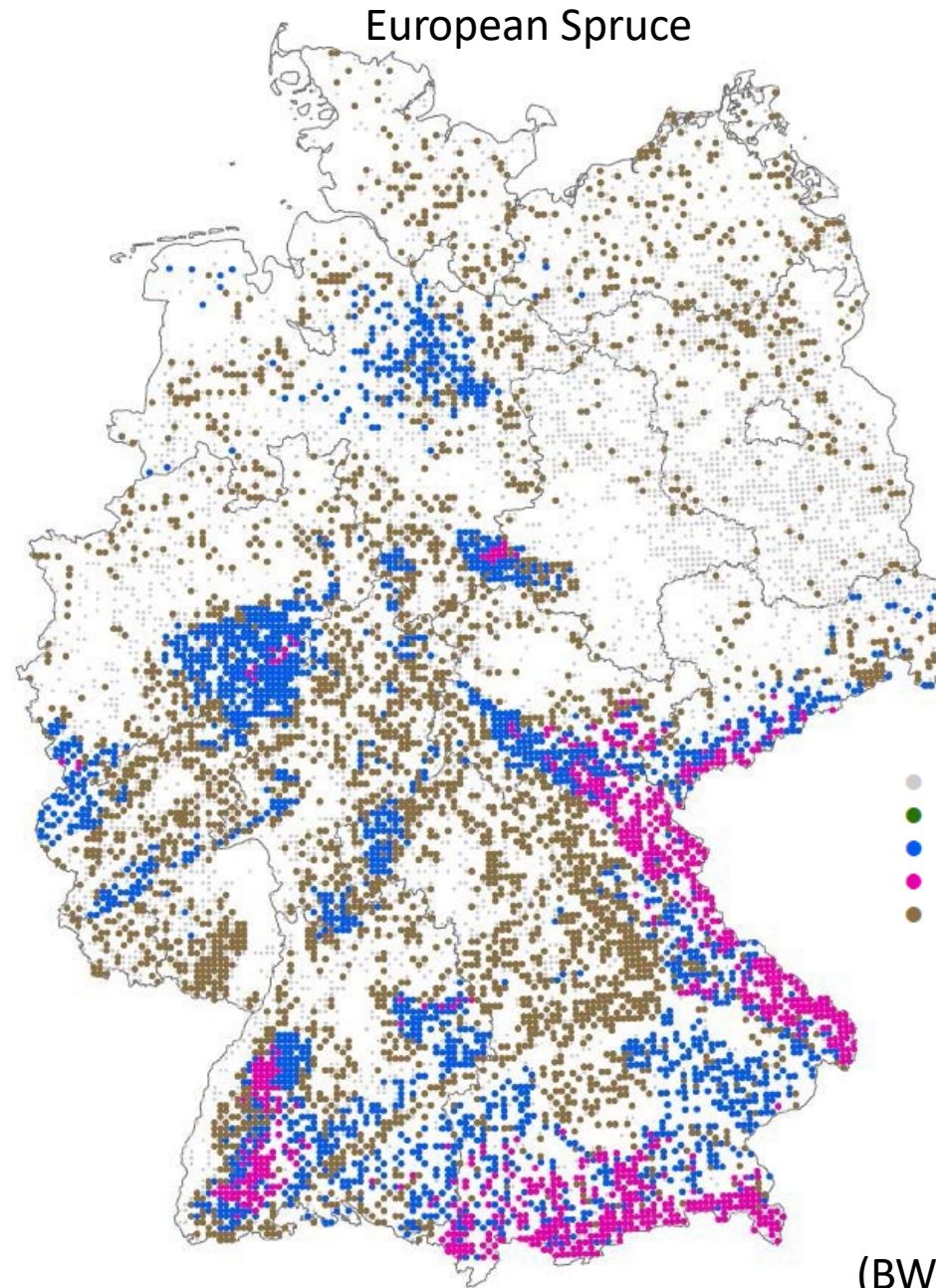
- Detailed information
- Temporal mismatch

## Quantity:

- Area-wide
- Historical information

## Access:

- Restricted



## National forest inventory of Germany:

- Systematic sampling of forest conditions
- 4 km x 4 km grid
- 51 tree species

(BWI, 2012)



# Inventory data

## Example:

- Agricultural inventories

## Quality:

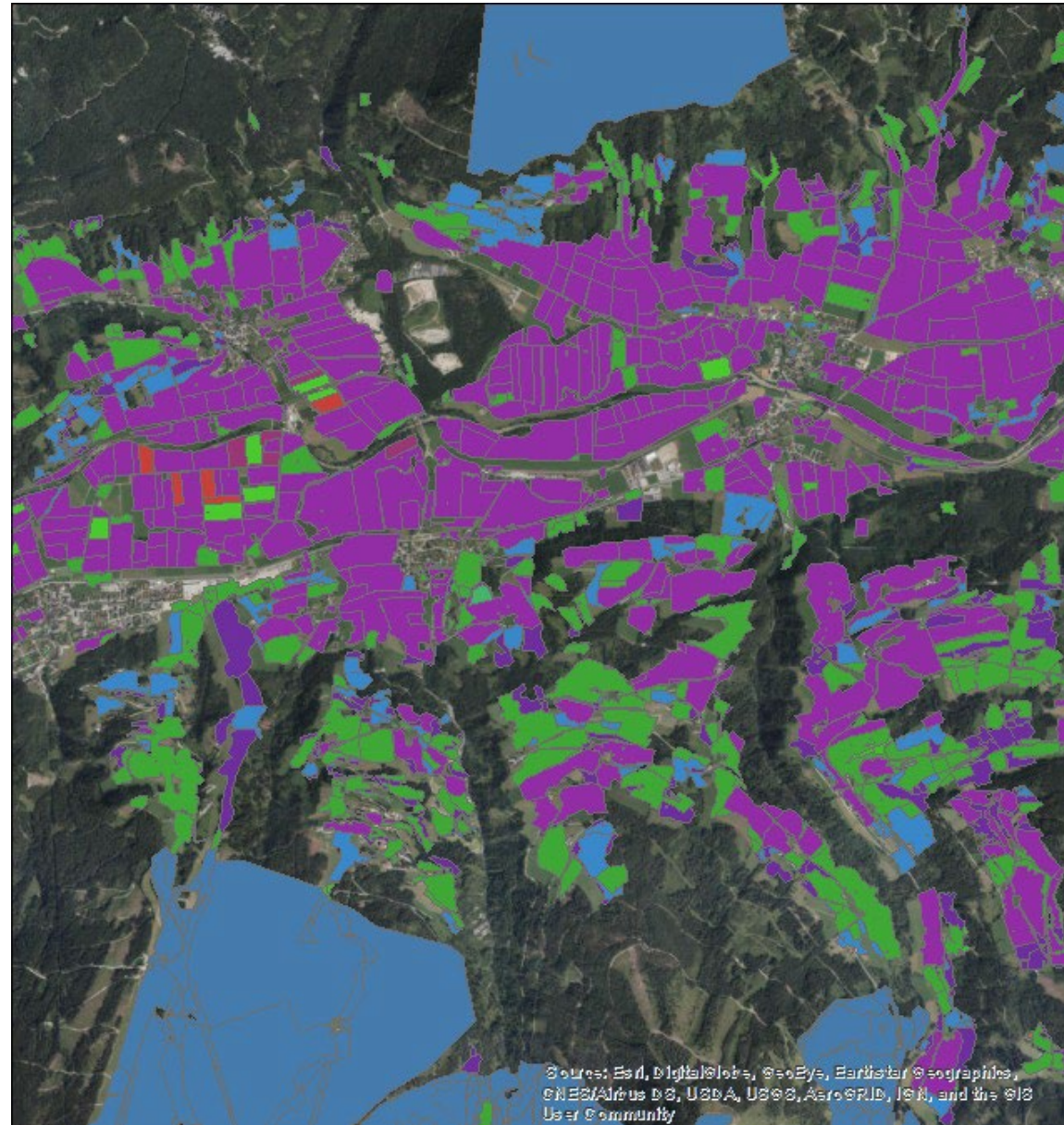
- Detailed information

## Quantity:

- Area-wide
- Historical information

## Access:

- Mostly restricted



Invekos: Integrated administration and control system for a consistent European Agricultural Policy (CAP)

[www.data.gv.at/](http://www.data.gv.at/)



# Field work

## Quality:

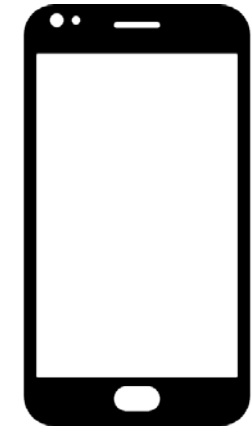
- Dedicated land cover reference data
- Required for specific mapping goals

## Quantity:

- Small extent

## Costs:

- Field work
- Effective using App



Photos: Rossi



# Sensor networks

## Example:

- Webcams

## Quality:

- High temporal detail
- Target: panorama views, ski areas, nature

## Quantity:

- Local information

## Costs:

- Labor intensive data analysis

<https://www.webcams-suedtirol.com/>





# Sensor networks

Example:

- Phenocams

Quality:

- High temporal detail

Quantity:

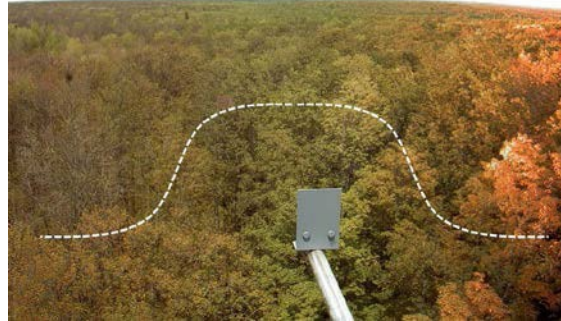
- Very local information

Access:

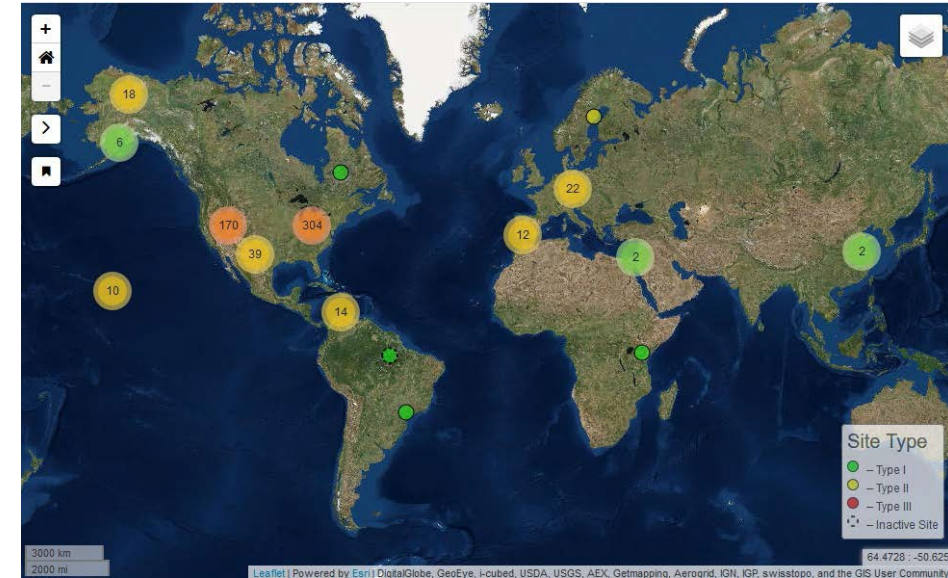
- Not clear

Costs:

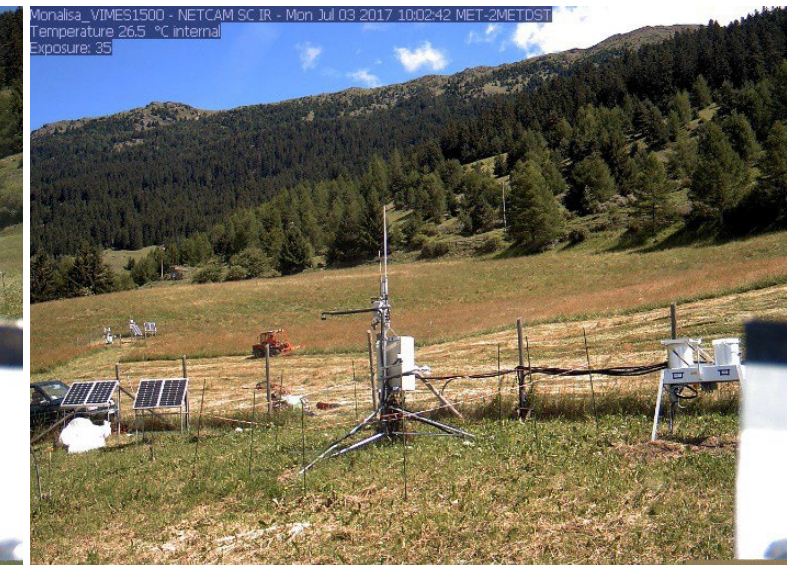
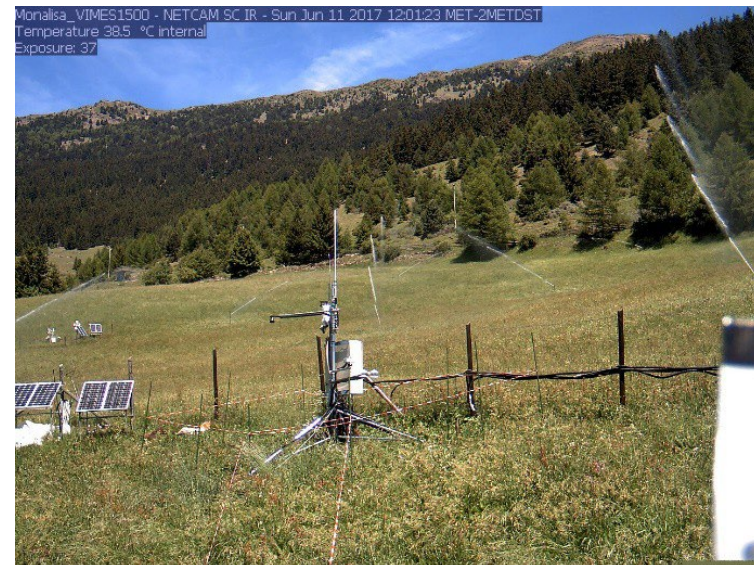
- Labor intensive data analysis



<https://phenocam.sr.unh.edu/webcam/>



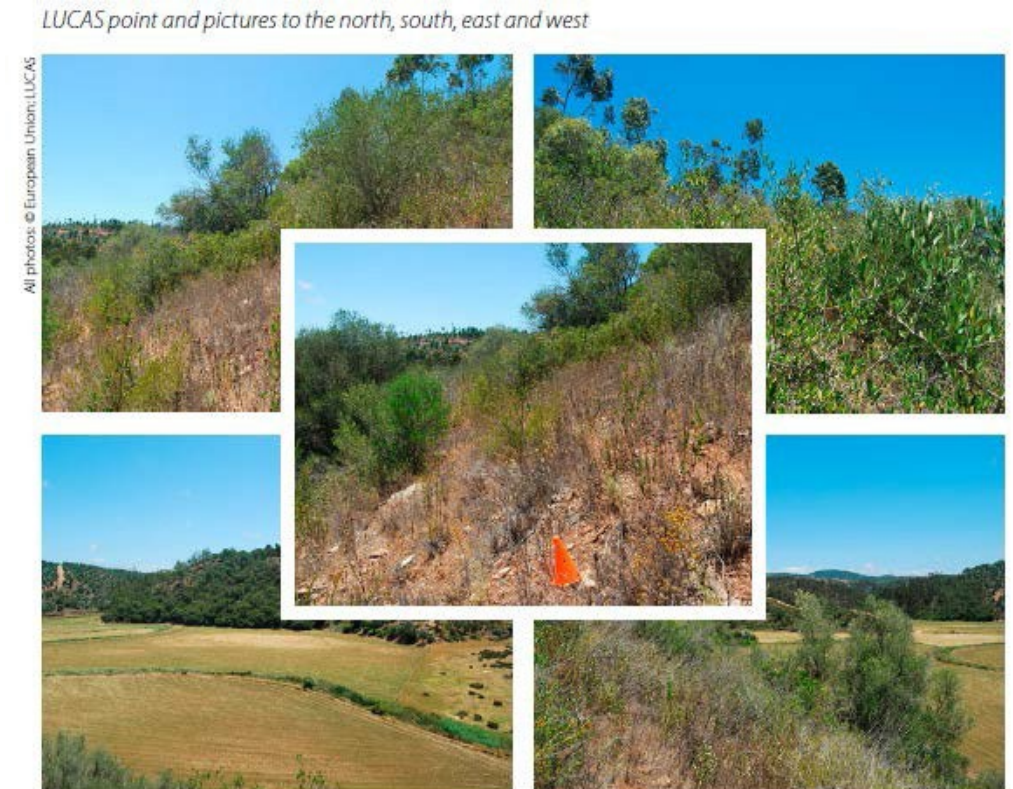
Photos: Rossi





# Land cover/use data bases

- European initiative LUCAS: Land Use and Coverage Area frame Survey  
<https://ec.europa.eu/eurostat/web/lucas>
- Every three years since 2006, 2km grid
- Information collected:
  - Land use / land cover (33 / 76 subclasses)
  - Environmental information
  - Photos
  - Topsoil sample
  - Grassland survey



LUCAS, 2017

# Land cover/use data bases

## Quality:

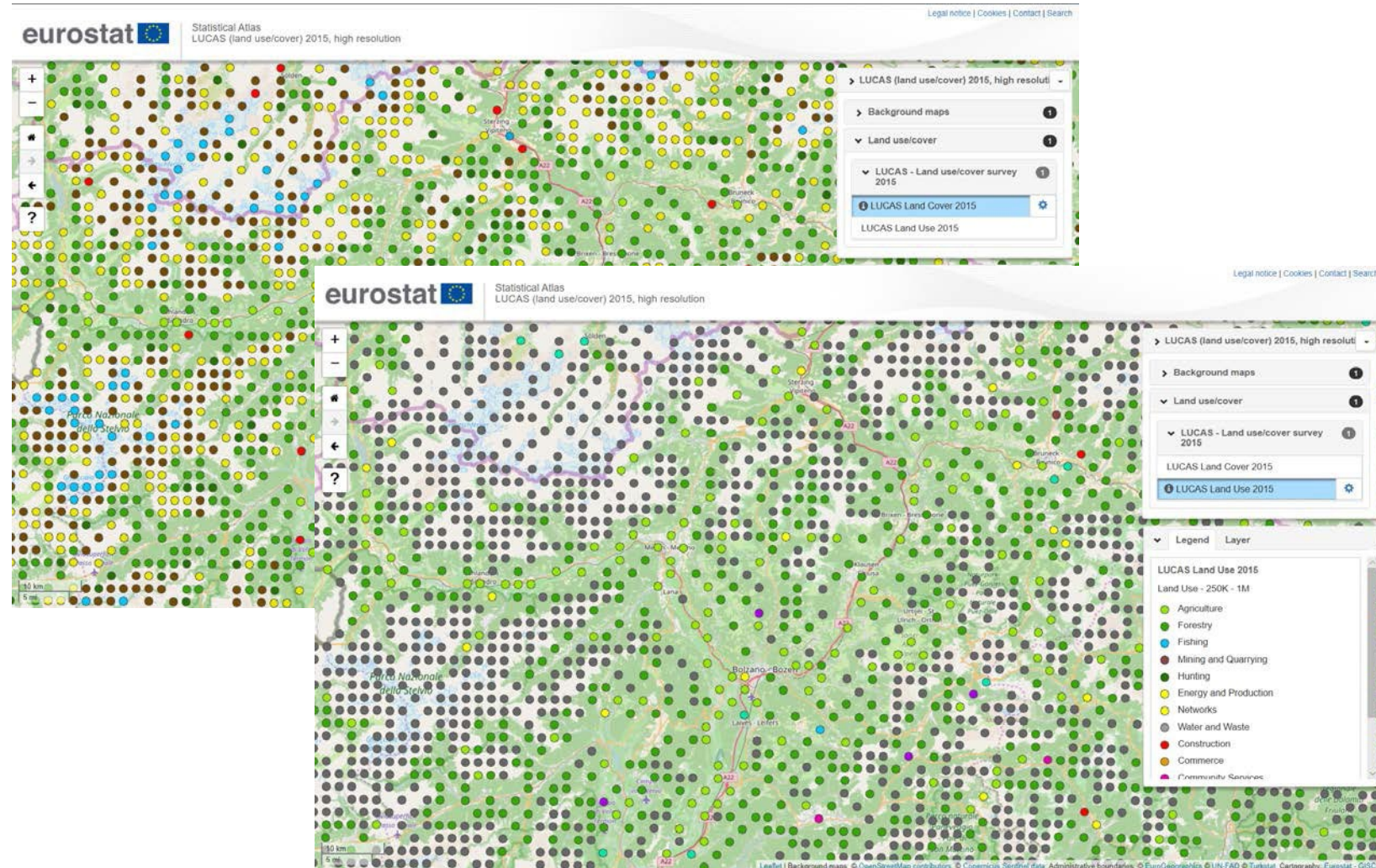
- Excellent quality
- Defined land cover information

## Quantity:

- Area-wide (Europe)
- Historical information

## Access:

- No restrictions



[ec.europa.eu/eurostat/statistical-atlas/gis/viewer/](https://ec.europa.eu/eurostat/statistical-atlas/gis/viewer/)



# Citizen science and crowdsourcing

- Geo-Wiki
- LACO-Wiki
- LandSense
- Groundtruth2.0

## Quality:

- Targeted land cover information campaigns

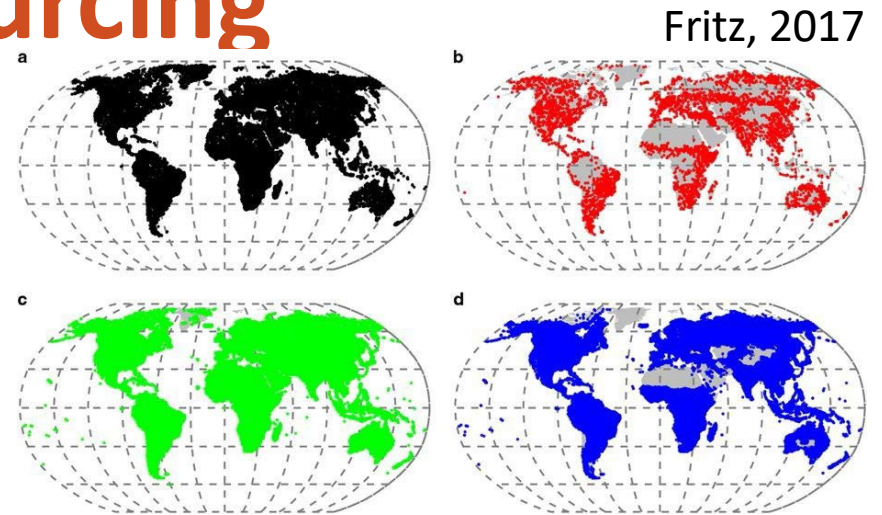
## Quantity:

- Large number

## Access:

- No restrictions / unknown

- (a) Human impact  
(b) disagreement  
(c) wilderness  
(d) reference



D'Andrimont, 2018

# Summary

- Plenty of possible reference data available
- ‚Best‘ data sets may be restricted and not accessible
- Reference data may be very costly (data costs or labor intensive)
- Combination of different reference data sources is possible