



**iDiv**

German Centre for Integrative Biodiversity Research (iDiv)  
Halle-Jena-Leipzig



MARTIN-LUTHER-UNIVERSITÄT  
HALLE-WITTENBERG

# ***Identification of groundwater dependent vegetation via remote sensing and geodata integration***

*10th Annual Conference AK Fernerkundung*

Léonard El-Hokayem, 06/10/2022

PIs: Christopher Conrad, Francesco Maria Sabatini, Carsten Meyer, Muhammad Usman, Jonathan Everts



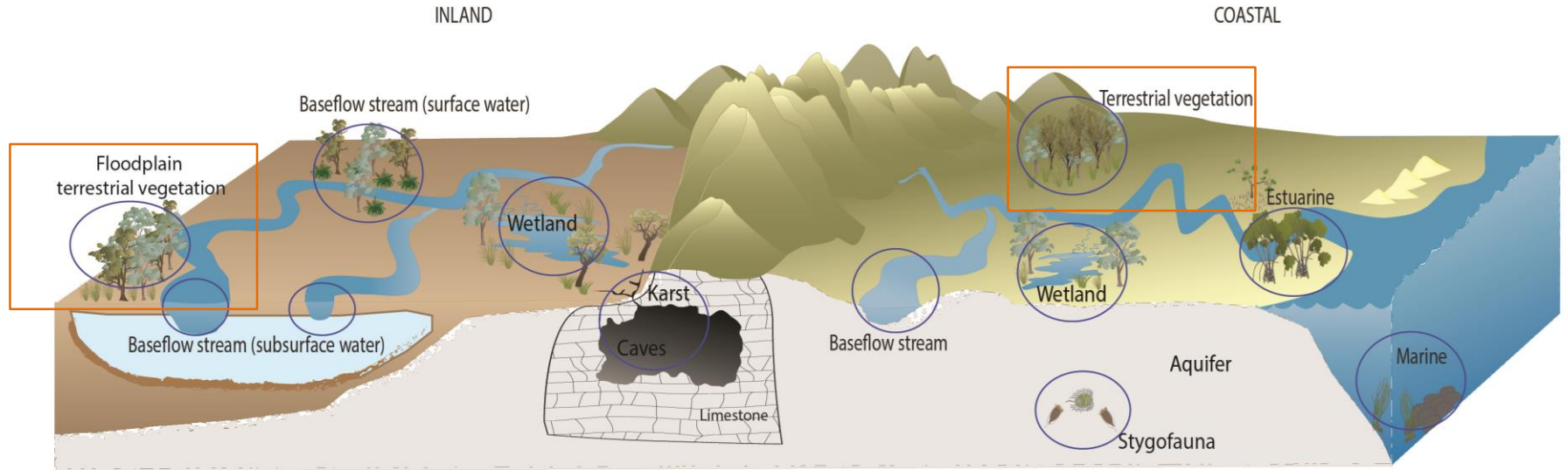
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# Structure

1. Groundwater dependent ecosystems
2. Motivation
3. State of Art
4. Workflow
5. Concept for biome-wise GDV mapping
6. Regional framework implementation
7. Global potGDV index

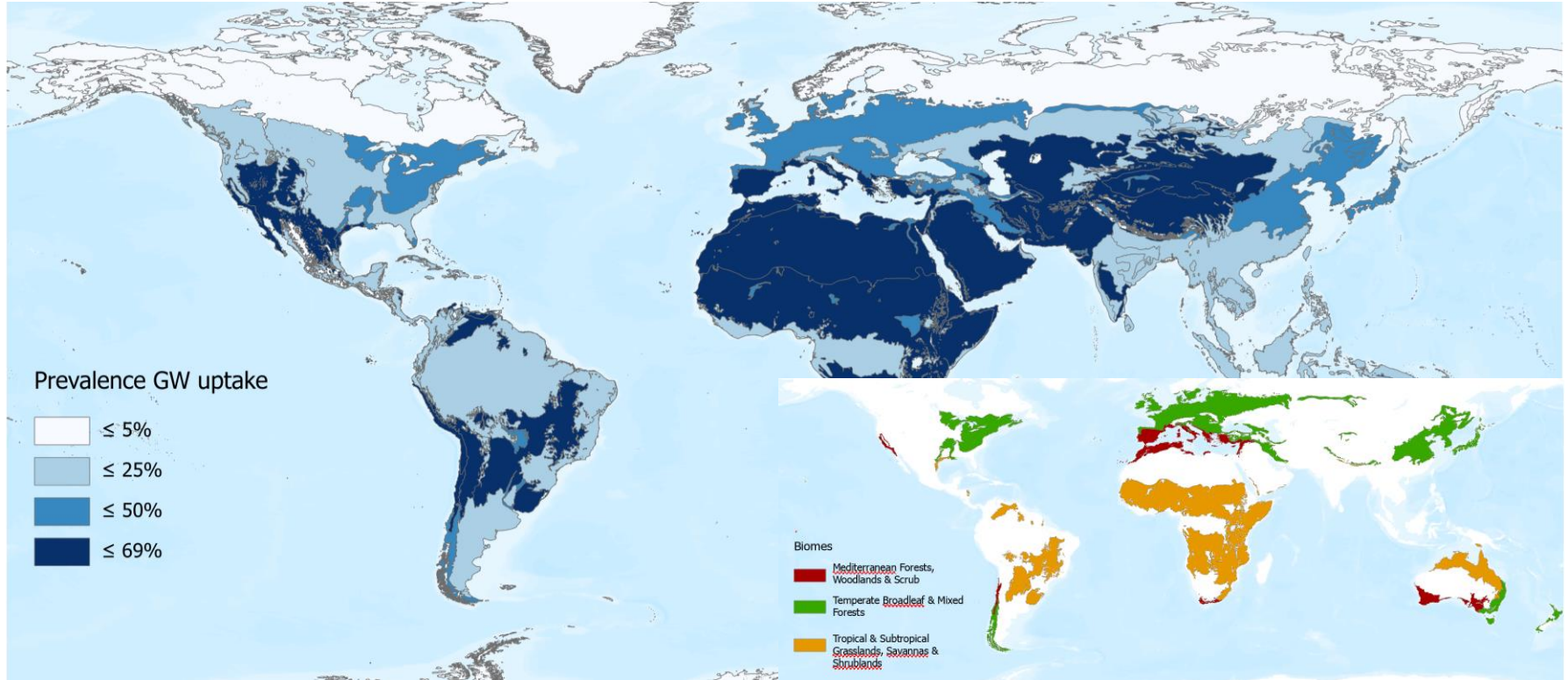
# 1 Groundwater dependent ecosystems (GDEs)

## Groundwater Dependent Ecosystems



Most symbols for diagrams courtesy of the Integration and Application Network ([ian.umces.edu/symbols/](http://ian.umces.edu/symbols/)),  
University of Maryland Center for Environmental Science  
(NSW, 2021)

## 2 Prevalence of groundwater use by vegetation (Evaristo & McDonnell, 2017)

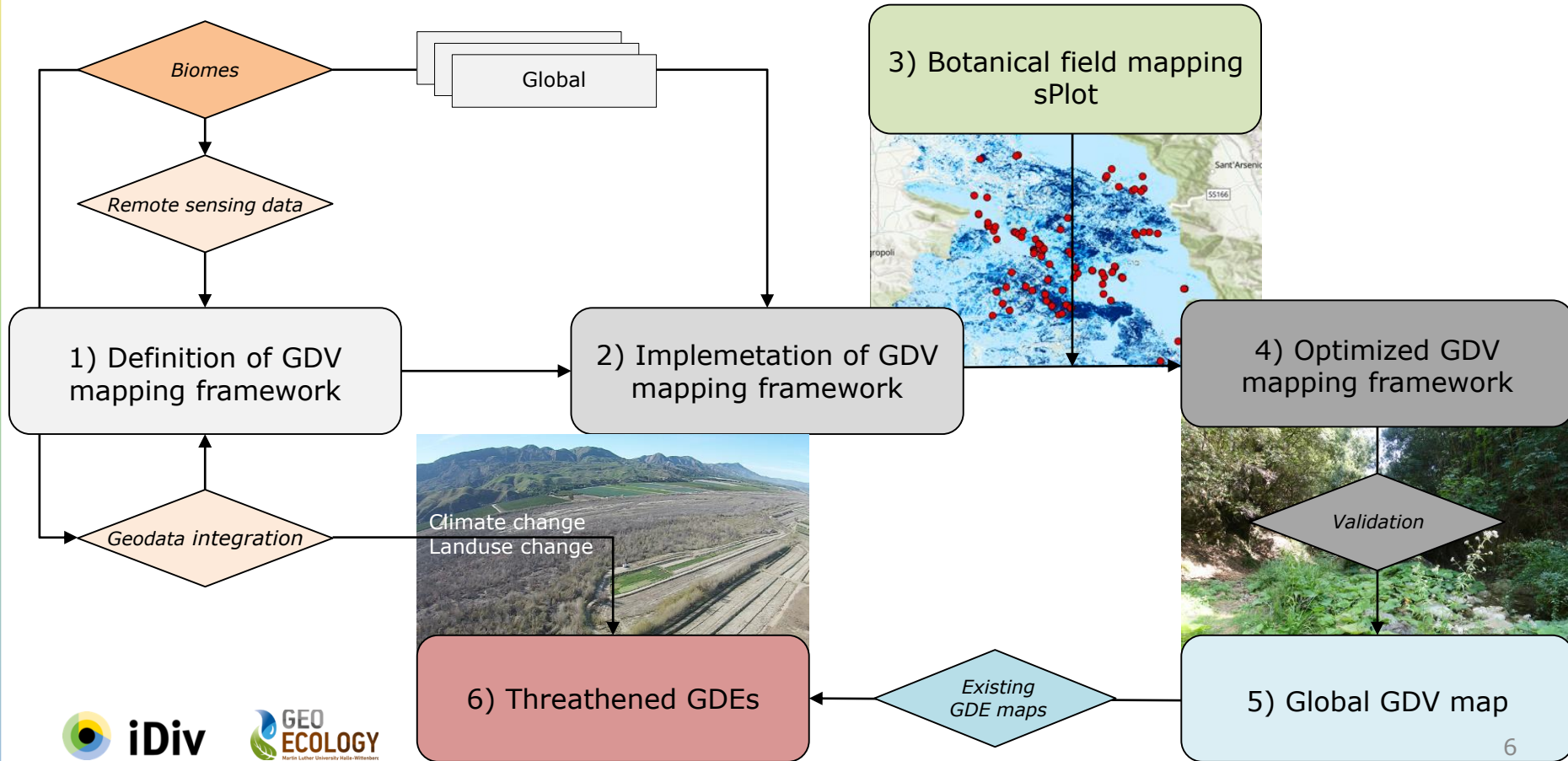


### 3 State of Art

- Direct methods: groundwater depth, density springs, identification water sources, phreatophyte area, geological mapping
- Indirect methods: remote sensing, geodata integration

→ **No harmonized global up-to-date map of GDV**

# 4 Workflow





# 5 Multi-scale, multi-instrument concept for biome-wise GDV mapping

## Local – Hydrobasins Lvl. 10



- Sentinel 1&2 - 10 m (2017-2021)
- Available local geodata (hydrogeology, DEM)
- Fieldwork validation
- Unsupervised classification

## Regional – County

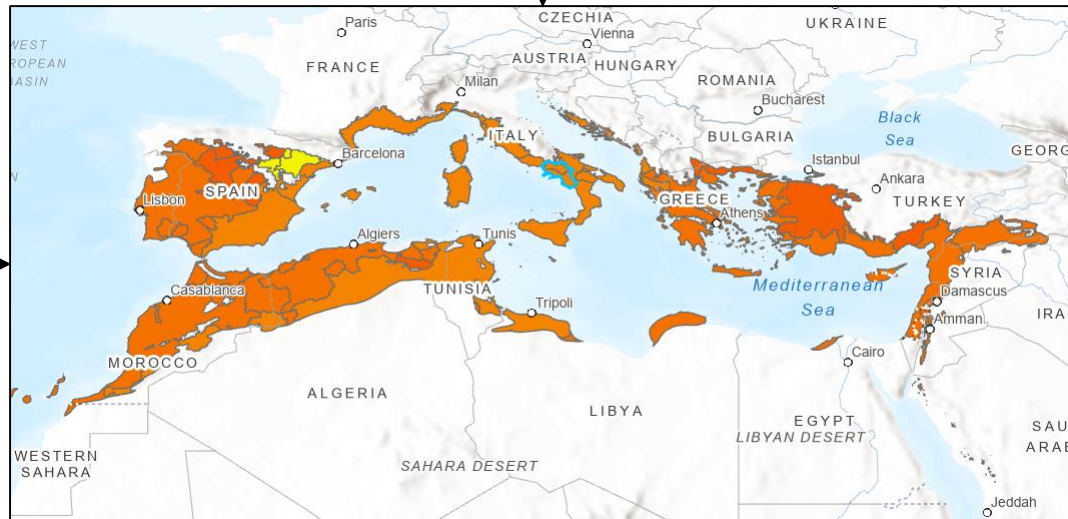


- Sentinel 1&2 - 10 m (2017-2021)
- Available local geodata
- Fieldwork validation
- Supervised classification based on local scale results

Validation  
Basis for supervised classification

Validation

## Global – Biome



- MODIS products – 250-1,000 m (2003-2021)
- Geodata
- Supervised classification

Global list of phreatophytes

GDE studies

GDV index

sPlot

Validation

Weighting

Training

# 6 Regional framework implementation

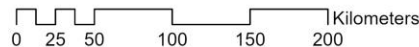
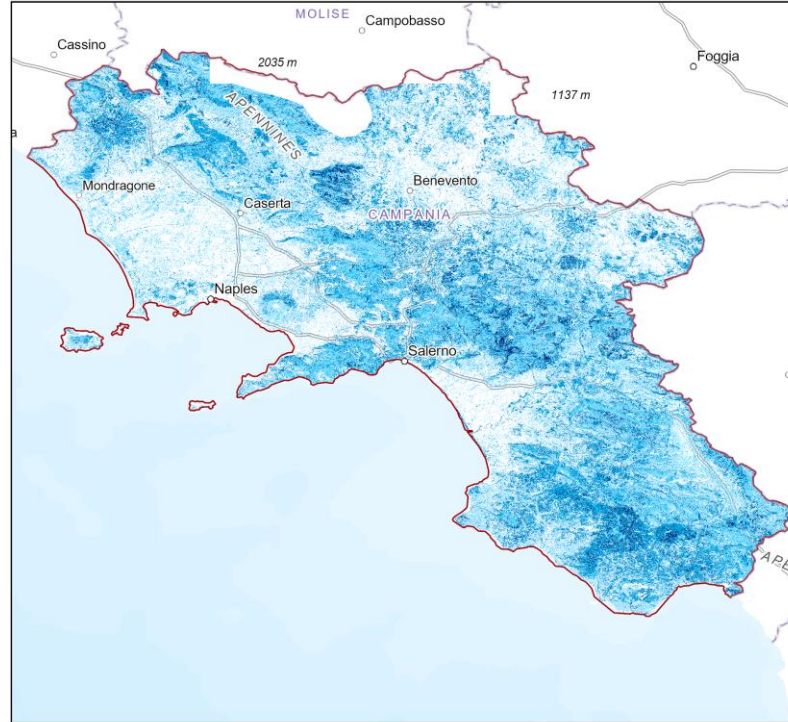
Criterion 0  
**Begin 16 weeks dry period**  
**Driest / wettest years**

Criterion 1  
**High vitality, moisture dry period**

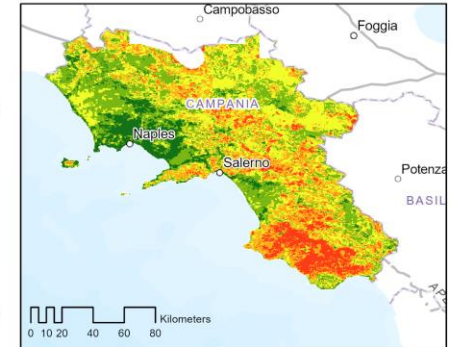
Criterion 2  
**Low seasonal change vitality**

Criterion 3  
**Low interannual change vitality**

Criterion 4  
**Water accumulation through topography / geology**



Editor: El-Hokayem, Léonard  
 Spatial Reference: GCS WGS 1984  
 Scale: (CART) 1 : 1,300,000; (Study area)  
 1 : 30 million; (GDV zones) 1: 2,800,000  
 Date: 02/10/2022  
 Source: Esri, HERE, Garmin, FAO, NOAA,  
 USGS, Esri, Garmin, FAO, NOAA, USGS



## Legend

- |              |                     |
|--------------|---------------------|
| Campania     | Potential GDV zones |
| Non-GDV      | Very low            |
| Unlikely GDV | Low                 |
| Likely GDV   | Moderate            |
| GDV          | High                |
|              | Very high           |

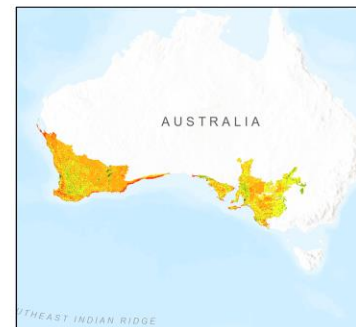
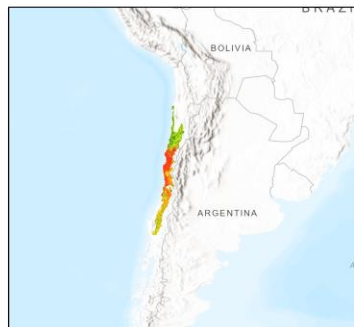
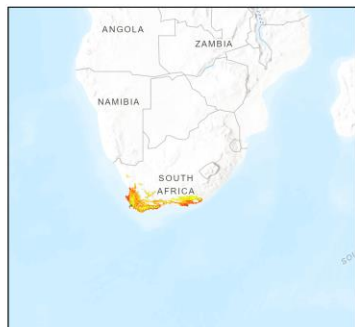
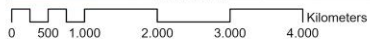
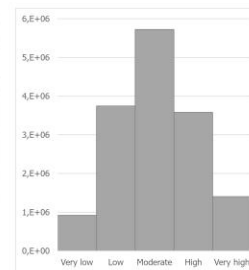
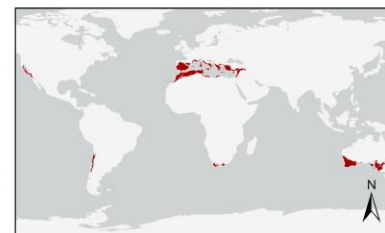
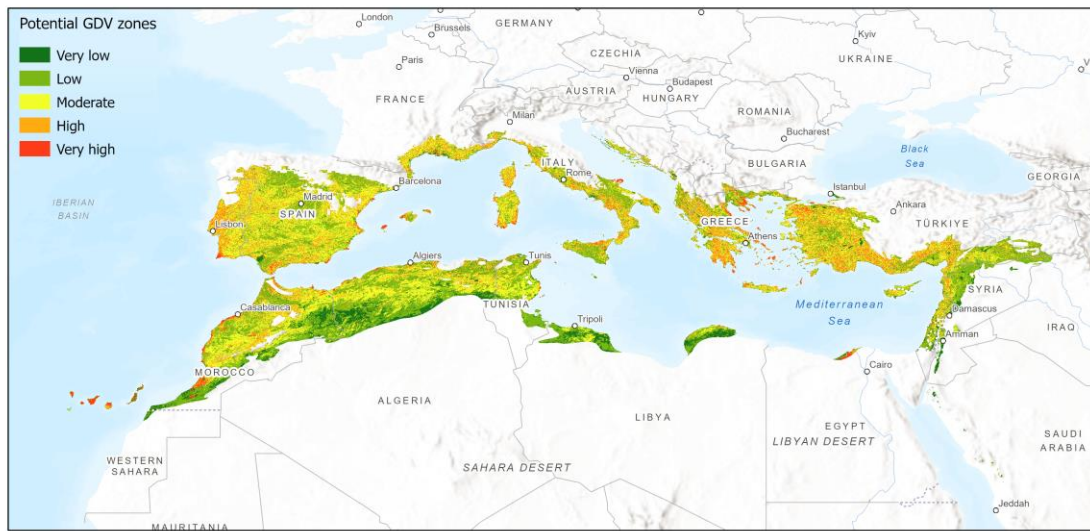


# 7 Global potGDV index

$$\text{potGDV} = \frac{(2 * pIDE) + \left(\frac{\text{Permeability} + \text{Porosity}}{2}\right) + \text{Landcover} + \left(\frac{\text{Sand} + \text{Clay} + \text{Soil thickness}}{3}\right) + \left(\frac{\text{Fault density} + \text{Flow accumulation} + \text{Landforms}}{3}\right) + (2 * (\text{GWTD} + \text{Capillary Fringe (Soil)} - \text{Rooting Depth}))}{8}$$

- Three potential classes per parameter
- manual, natural breaks, quantile for classification
- Raster overlay → reclassify to five classes (natural breaks)

Potential GDV zones



Editor: El-Hokayem, Léonard  
 Spatial Reference: GCS WGS 1984  
 Scale (Mediterranean Basin): 1 : 25 million, Scale (World): 1 : 300 million, Scale (Rest Mediterranean): 1 : 50 million  
 Date: 29/09/2022  
 Source: Esri, FAO, NOAA, USGS; Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community; Esri, USGS, Esri, Garmin, FAO, NOAA, USGS

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SACHSEN-ANHALT

# Discussion / Questions

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