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Statistisches Bundesamt

The role of local reference values in assessing ecosystem capacity

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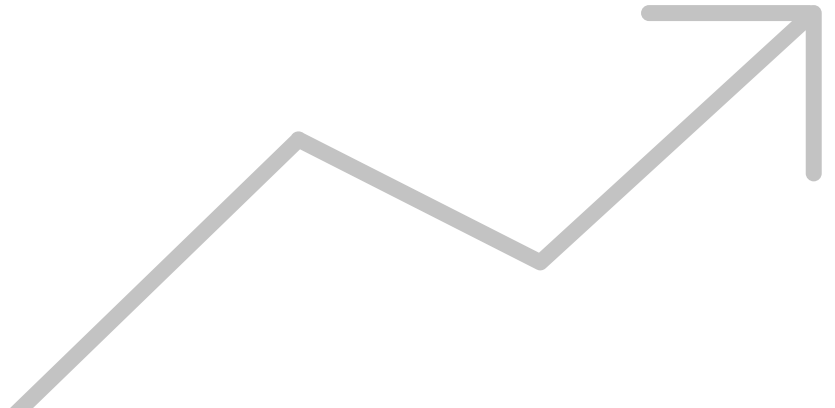


Introduction

- Objectives of ecosystem condition accounts:
  - Comprehensive monitoring of ecosystem condition (spatial time -series)
  - Link between ecosystem assets and services, service indicators and interpretation
  - **Inform on the sustainability of ecosystem service use**

- Importance of sustainable use of ecosystem services
  - Adjustment of management practices
  - The possibility to prevent harm on the ecosystems at an early stage
  - Policy advice to ensure that ecosystem and their services can be enjoyed by future generations

- How can condition accounts be designed to provide the necessary information?
  - Design of Condition Indicators
  - Setting of reference level

Definitions

- **Ecosystem capacity**
  „the ability of an ecosystem to generate an ecosystem service under current ecosystem condition , management and uses, at the highest yield or use level that does not negatively affect the future supply of the same or other ecosystem services from that ecosystem“ (para. 6.141)

- **Ecosystem condition indicator**
  „rescaled versions of ecosystem condition variables” (para. 5.60), pairings of condition variables and reference level

- **Reference level**
  „the value of a variable at the reference condition, against which it is meaningful to compare past, present or future measured values of the variable” (para. 5.65)

Sources: United Nations et al. (2021)

Capacity and the role of condition indicators

- Maximum flow that ensures stable long -term services potential
  - Under current ecosystem condition, extent and management
  - Subject to external shocks/influences (climatic/weather shocks, trends in condition)

- Challenges:
  - Defining sustainability for each service
  - Non-linear/unknown relationship between service use and future potential
  - Inclusion of resilience, generalization to multiple service/multiple ecosystems

- Condition indicators can support the estimation of capacity
  - For indicators directly affected by services: constraints in the maximization problem
  - For indicators not directly affected : external ecological influences to adjust capacity

Capacity and the role of condition indicators

- Advantages of using condition indicators
  - A holistic perspective , inclusion of resilience
  - Capacity for services where relation between current and future service potential is unknown
  - Reduction in complexity (multiple serivces), structure for causal link management <-> services

- Challenges:
  - 1. Identification of a sufficient set of condition indicators
  - 2. Difficulty to collect condition data at necessary temporal and spatial resolution
  - **3. Difficulty to identify relevant reference levels**

Challenge 1

SEEA ECT Groups and Classes	
Group A: Abiotic ecosystem classes	
	Class A1. Physical state characteristics: physical descriptors of the abiotic components of the ecosysteme (e.g. SOC, soil moisture)
	Class A2. Chemical state Characteristics: chemical composition of the abiotic components of the ecosystem (e.g. pH-Value, O_3 near surface)
Group B: Biotic ecosystem characteristics	
	Class B1. Compositional state characteristics: composition/diversity of ecological communities at a given location and time (e.g. Presence/ abundance characterstical birds)
	Class B2. Structural state characteristics: aggregate proporties of the biotic components of the ecosystem (e.g. NDVI, Tree Cover Density)
	Class B3. Functional state characteristics: summary statistics of the biological, physical and chemical interactions between ecosystem compartments (e.g. ...)
Group C: Landscape characteristics:	
	Class C1. Landscape characteristics: metrics describing mosaics of ecosystem types at coarse spatial scales (e.g. Fragmentation, Connectivity, Diversity)

Sources: Keith H. et al. 2020 changed

Challenge 2

Criterion	Short description
Conceptual criteria	
Intrinsic relevance	Characteristics and metrics should reflect existing scientific understanding of ecosystem integrity, supported by the ecological literature
Instrumental relevance	Characteristics and metrics should be related to the availability of ecosystem services (characteristics that provide most information about the highest number of services should be favoured)
Directional meaning	Characteristics and metrics need to have a potential for a consensual normative interpretation (it should be clear if a change is favourable or unfavourable)
Sensitivity to human influence	Characteristics and metrics should be responsive to known socio-ecological leverage points (key pressures, management options)
Framework conformity	Characteristics and metrics should be differentiated from other components of the SEEA ecosystem accounting framework
Practical criteria	
Validity	Metrics need to represent the characteristics they address in a credible and unbiased way
Reliability	Metrics need to be accurate, reliable, and reproducible, with potential sources of error explored and documented
Availability	Metrics covering the studied spatial and temporal extents with the required resolution need to be achievable in terms of the resources and time available
Simplicity	Metrics should be as simple as possible
Compatibility	The same characteristics should be measured with the same (compatible) metrics in the different ecosystem types and/or different ecosystem accounting areas (countries)
Ensemble criteria	
Comprehensiveness	The final set of metrics, as a whole, should cover all of the relevant characteristics of the ecosystem
Parsimony	The final set of metrics should be free of redundant (correlated) variables

Sources: Czúcz et al. 2021 changed

Challenge 3

- Condition indicators should reflect a normative threshold or target range
- Condition indicators should base on natural , natural -historic , expert-based/regulatory or best-attainable condition
- Existing reference level + methods to define missing reference level

Local reference level in Forest ecosystems

- 608 different forest growing districts
- Use of undisturbed/least disturbed areas
- Calculate area weighted long -term mean for each growing district

Technical details

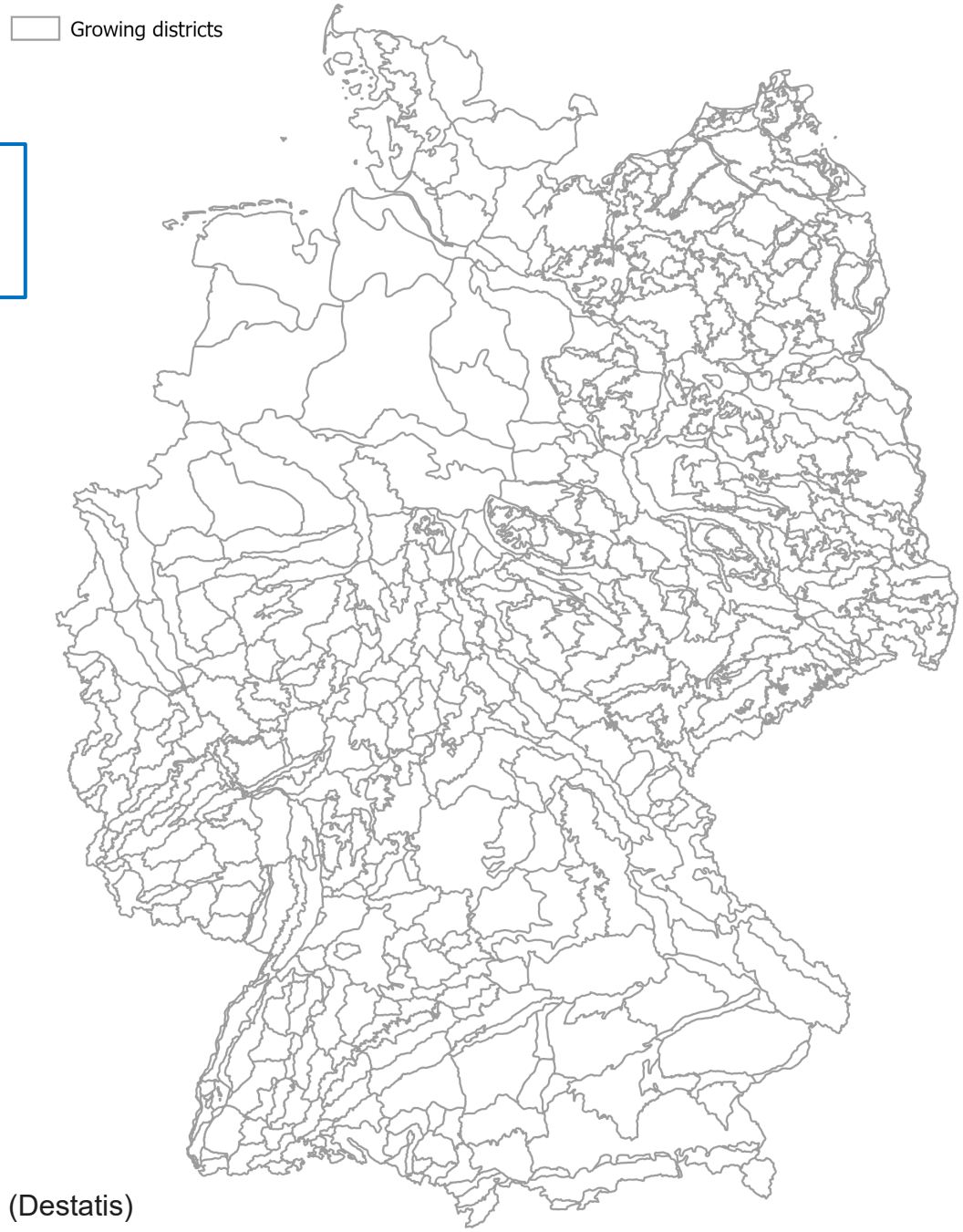
- Growing districts are divided by a compilation of climatic and geomorphologic variables

- Set of reference areas in each growing district
  - Select protected areas by category and time of protection

- Validity check:
  - Homogenity of data of reference areas
  - Sufficient sample size of reference areas

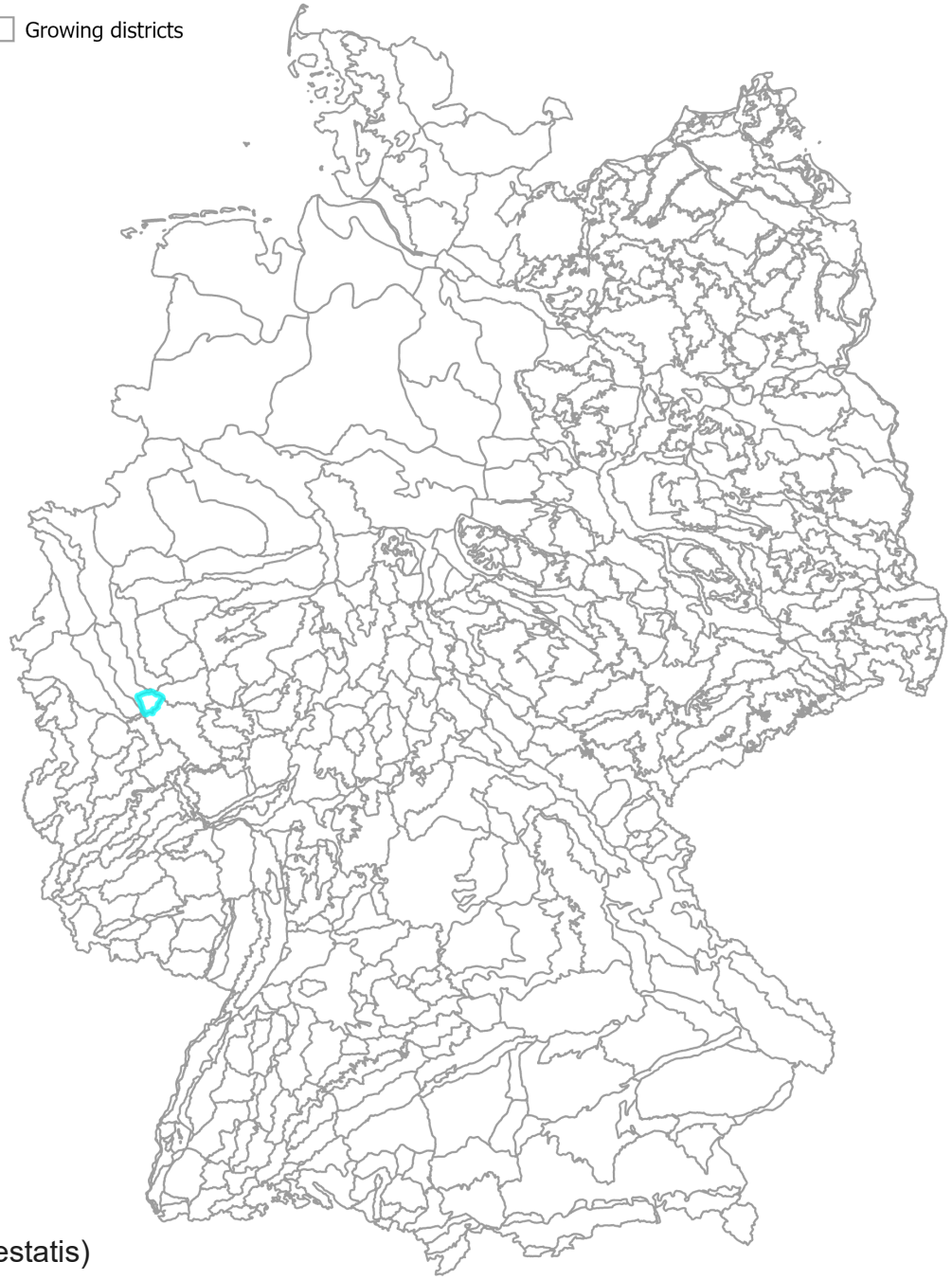
- Calculation of area weighted longterm mean per growing district

Data Input 1: Growing districts



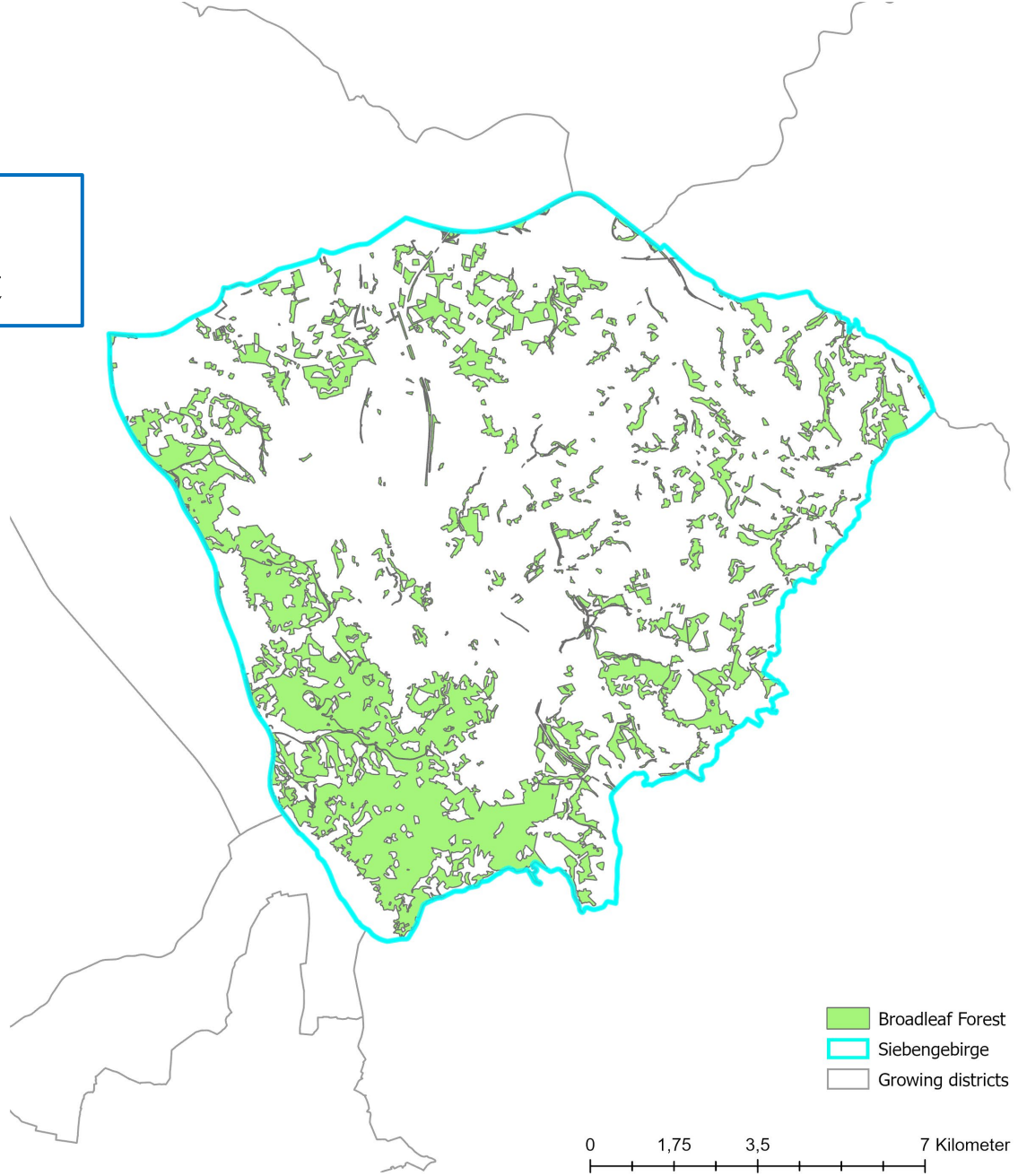
Sources: Thünen-Institut (2020)

Data Input 1: Growing districts



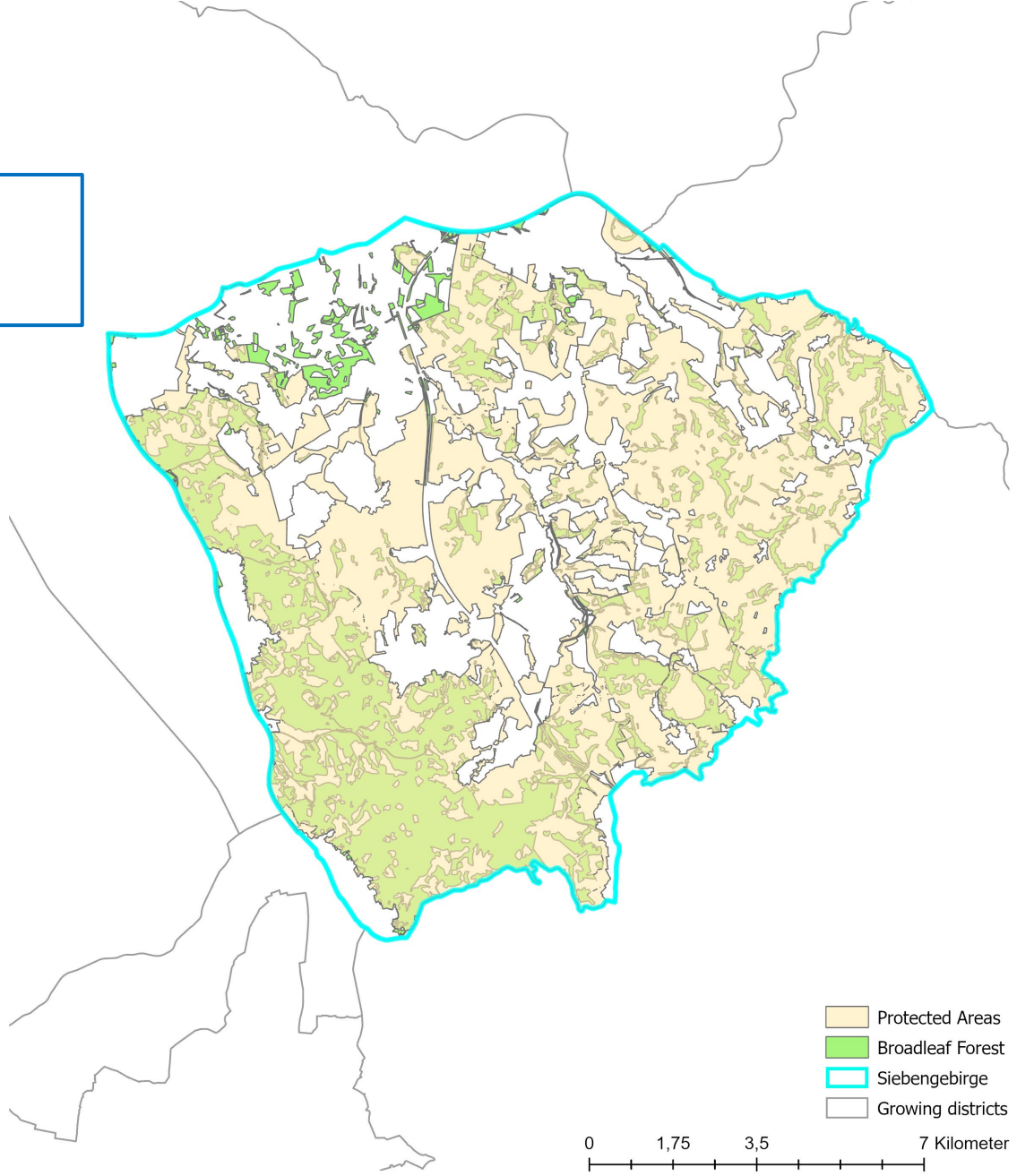
Sources: Thünen-Institut (2020)

Data Input 2: Broadleaf forest



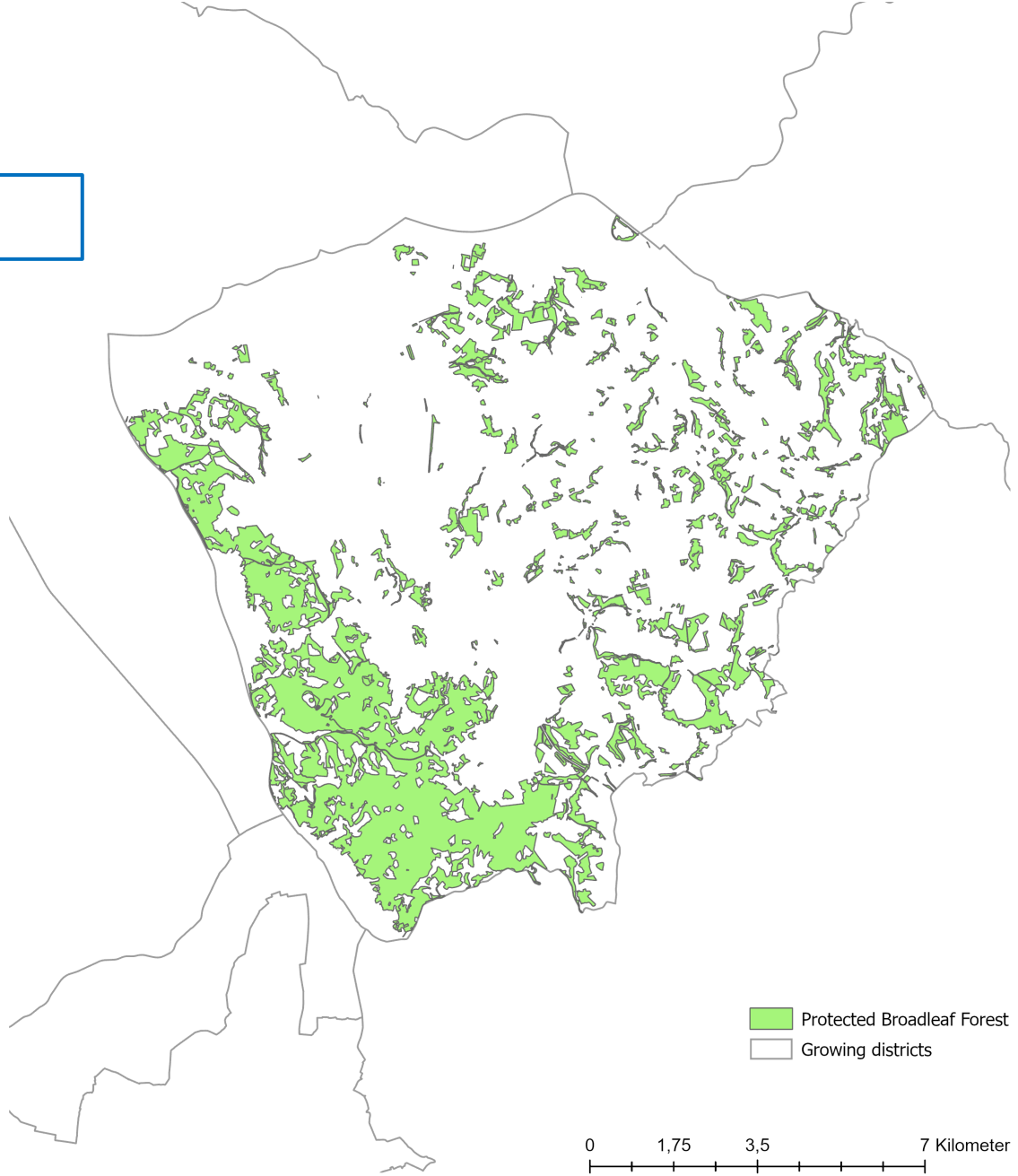
Sources: Thünen-Institut (2020), Destatis (2021)

Data Input 3: Protected areas



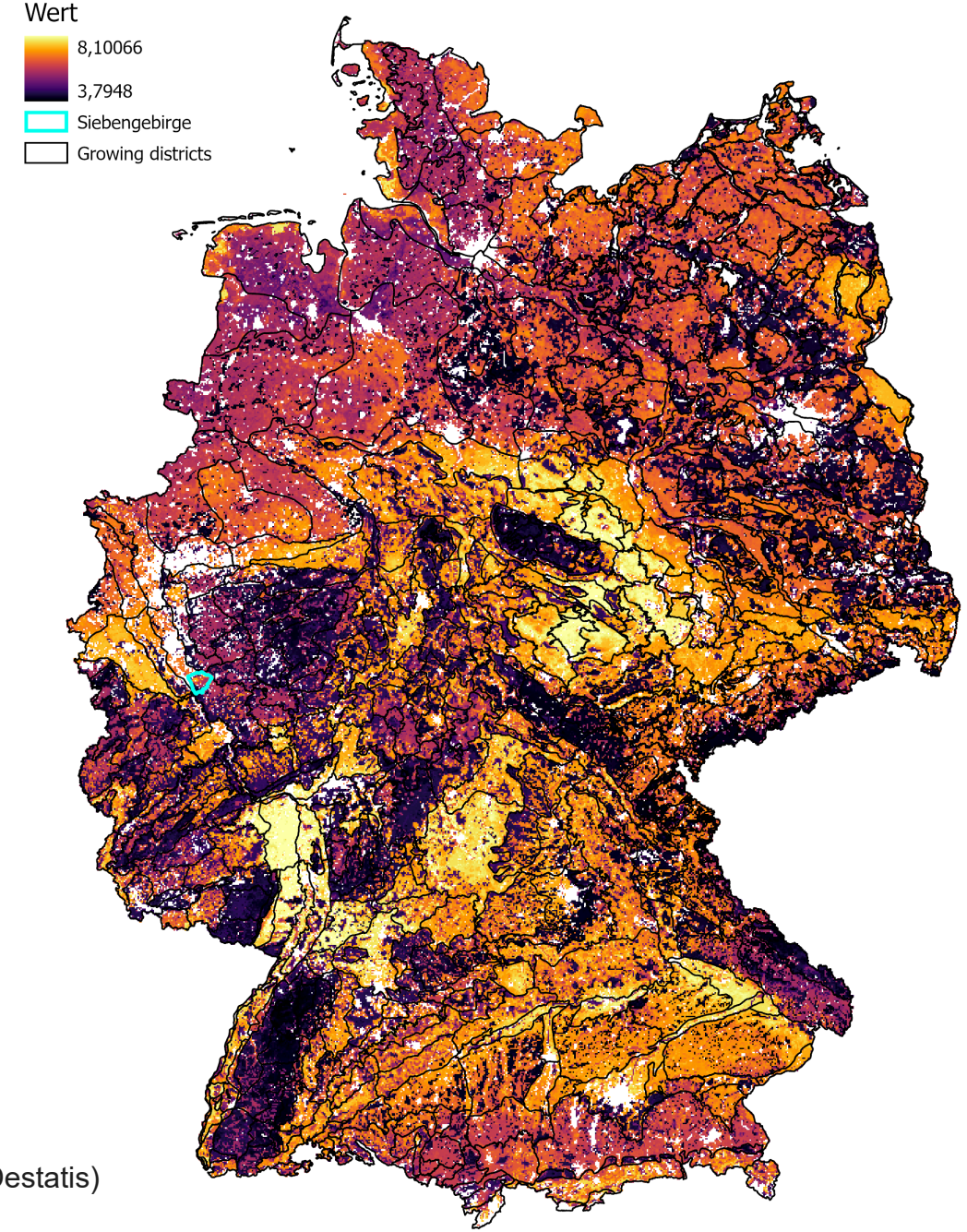
Sources: Thünen-Institut (2020),
Destatis (2021),
UNEP-WCMC and IUCN (2022)

Reference areas



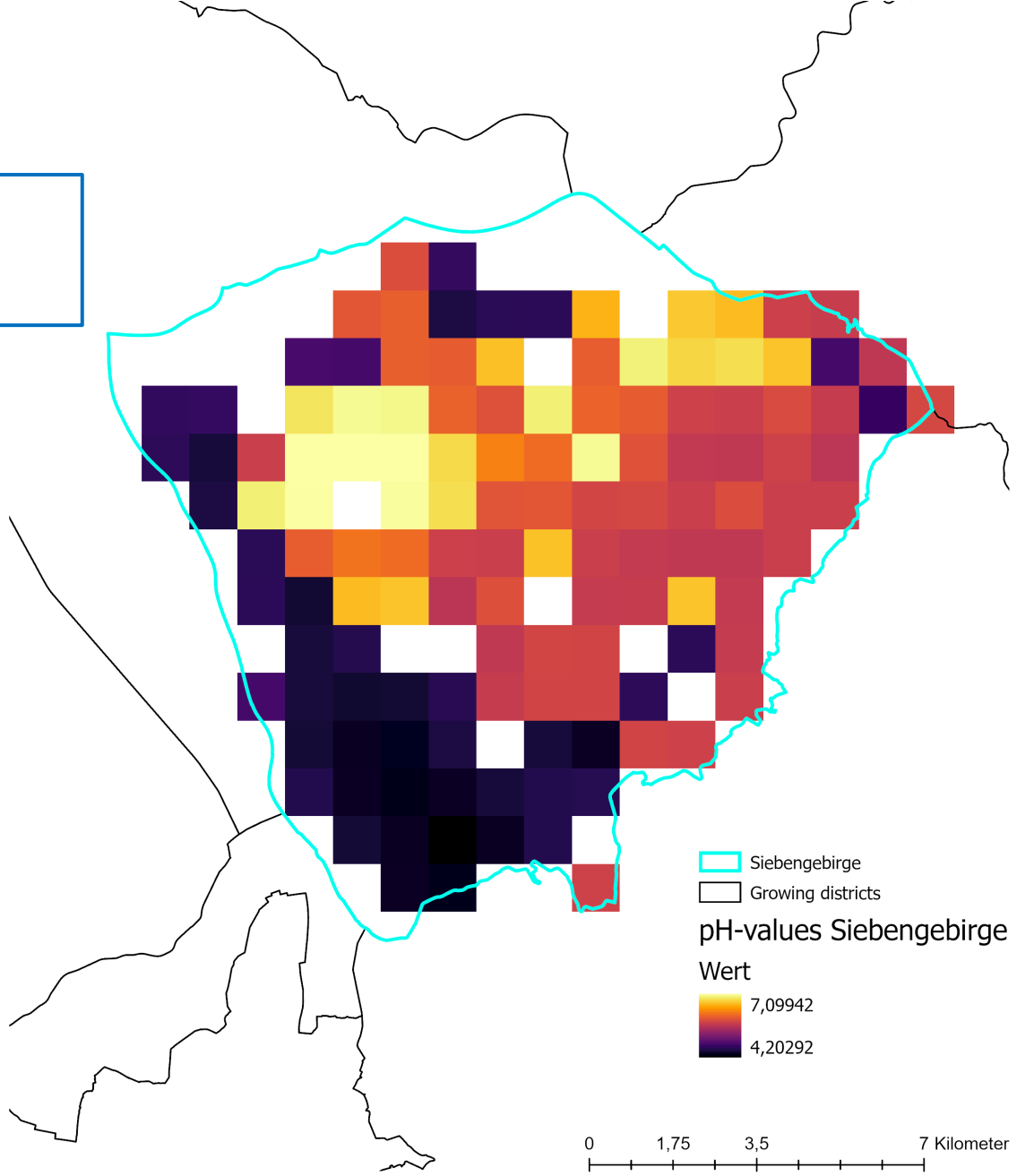
Sources: Thünen-Institut (2020), Destatis (2021)

Top 0-30 cm soil pH-values



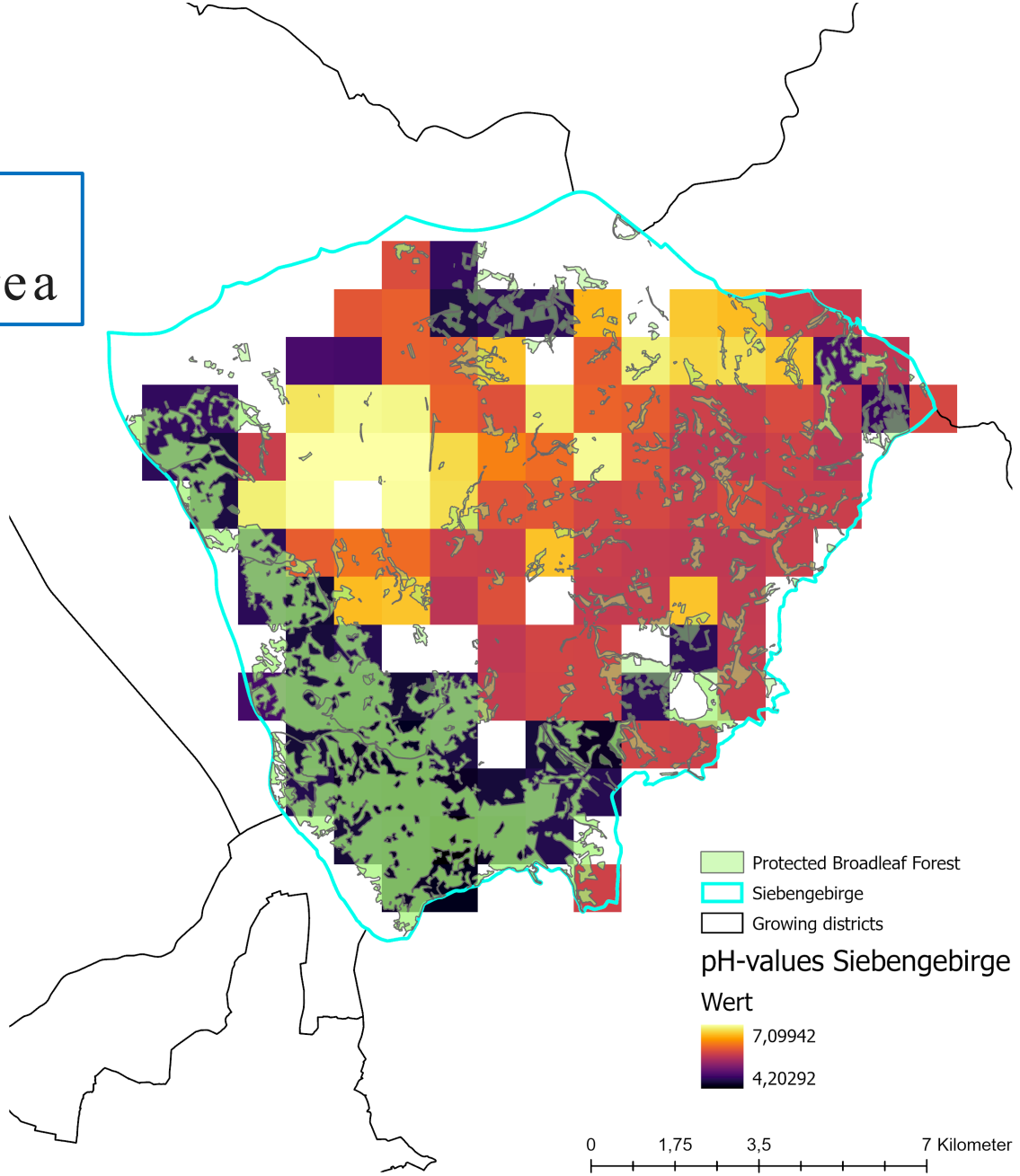
Sources: Thünen-Institut (2020) & (2021)

pH-values in growing district



Sources: Thünen-Institut (2020) & (2021)

Mean pH-value per reference area



Sources: Thünen-Institut (2020) & (2021)

Local reference level

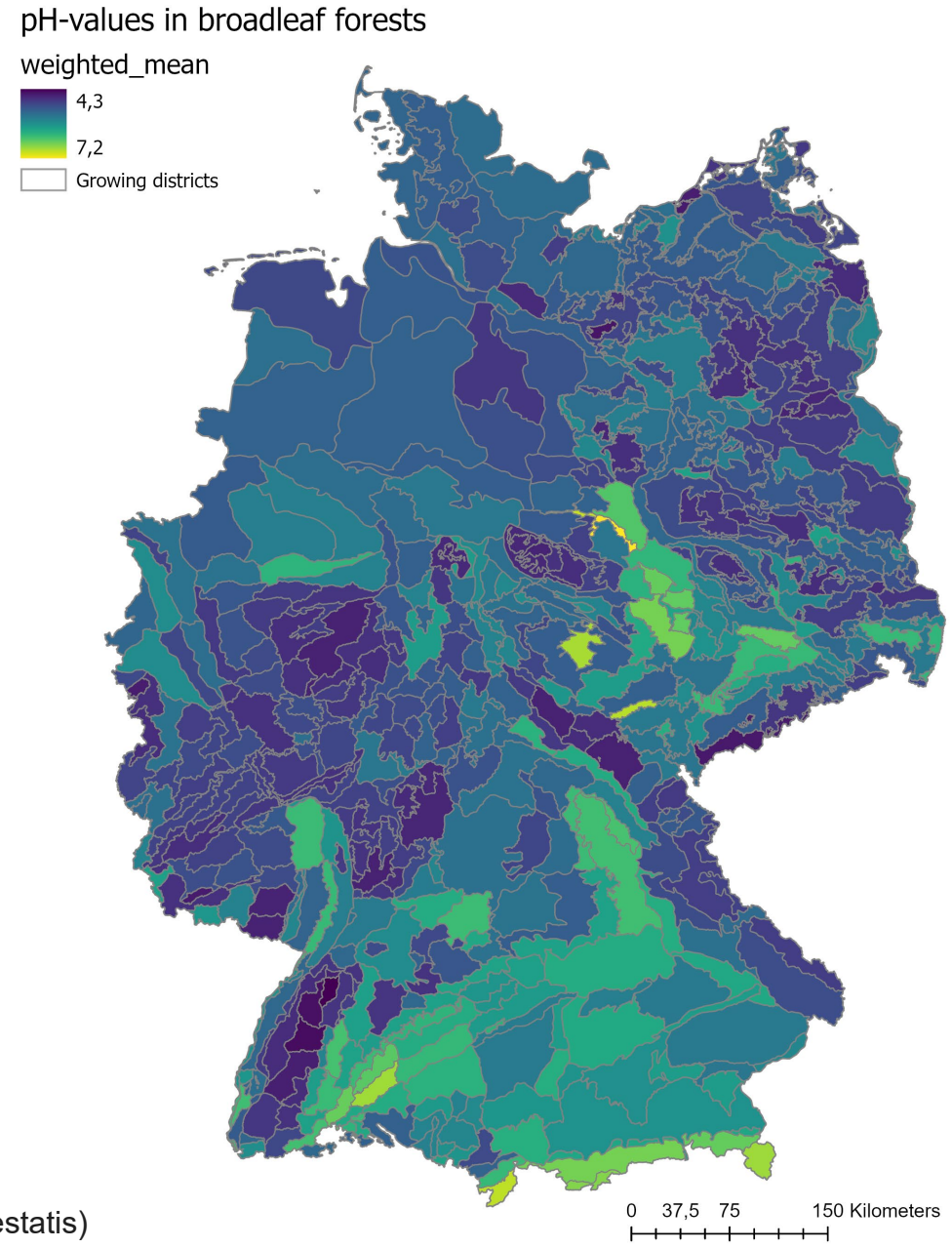
- Statistics for all growing districts :
  - Area weighted mean
  - Area weighted percentiles

  → Reference level

  - Area weighted standard deviation
  - Sum and ratio of reference areas

  → Validity Check

Resulting reference level



Discussion & Conclusion

- Condition Indicators can help to assess capacity
- Design of condition indicators , reference level as crucial challenge
- Methods to define reference level
- Local reference values do not apply on every condition variable
- Concider requirements for Condition Accounts

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Thank you!

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