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# Forest Ecosystem Services Assessement and policy-Relevant Insights

## 26/03/2026 – FINAL CONFERENCE

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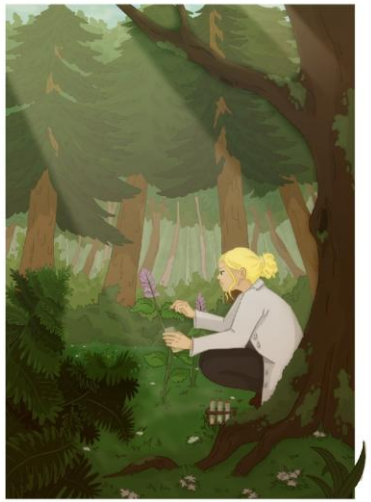
# FES "bio" assessment: a practical framework

**IDENTIFY**
key ecosystem services

**QUANTIFY**
them
using indicators

**MAP**
where they
are produced

**APPLY**
support planning
and decisions



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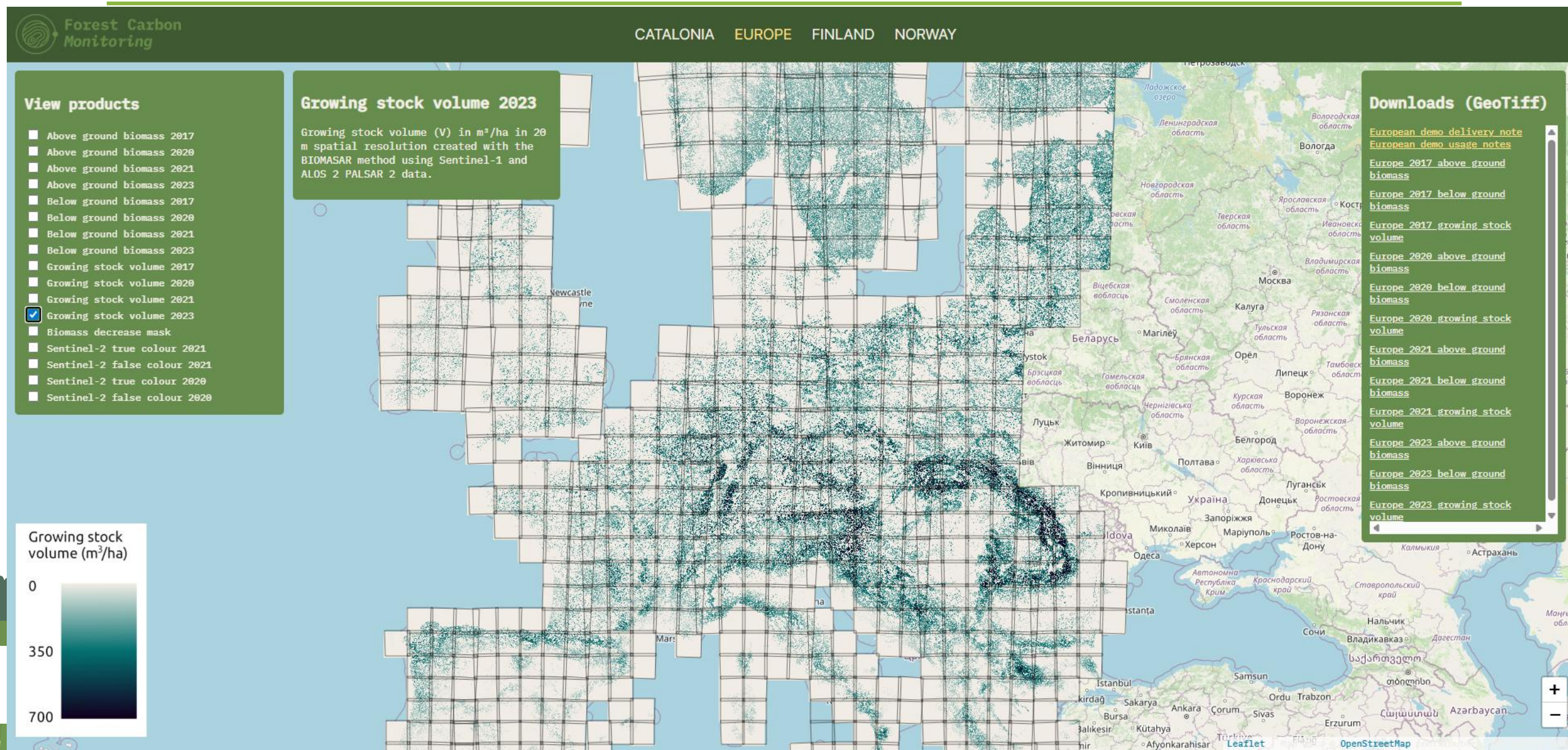
# Methodology based on Large-Scale Data (LSD)

**Why?**

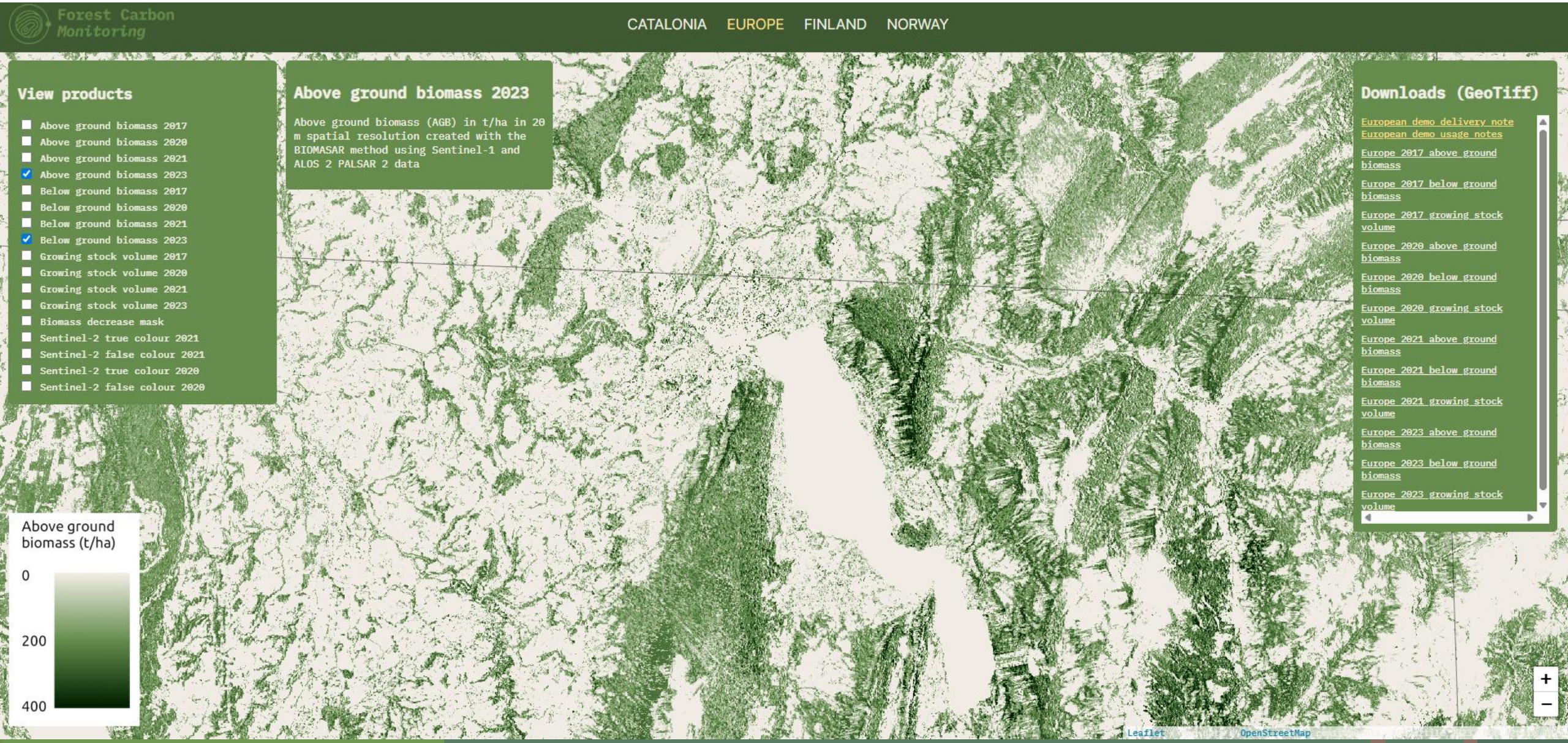
- Data sourced from multiple channels

- **Harmonized data enabling easy comparison of study sites and their SEF portfolios**
- **European dimension supporting SEF recognition initiatives in EU and regional policies** (see: *Support for a European Mountain Pact*)
- **Aligned with strategic policy decision-making:** long-term perspective, big-picture vision, key priorities, mediation, budget programming – addressing the system as a whole.

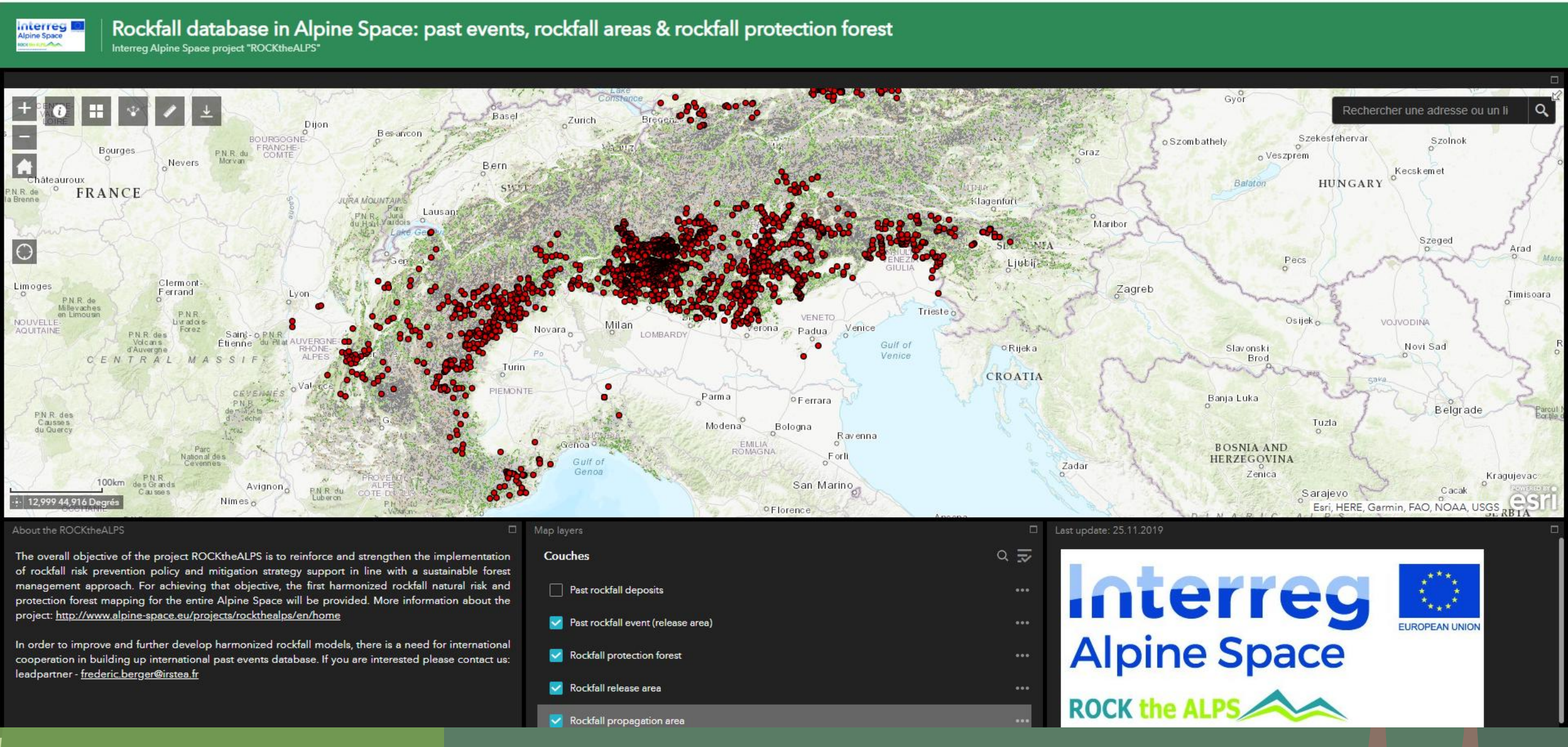
# Large-Scale Data Examples (1)



# Large-Scale Data Examples (2)



# Large-Scale Data Examples (3)



# Relevance of these Large-Scale Data?

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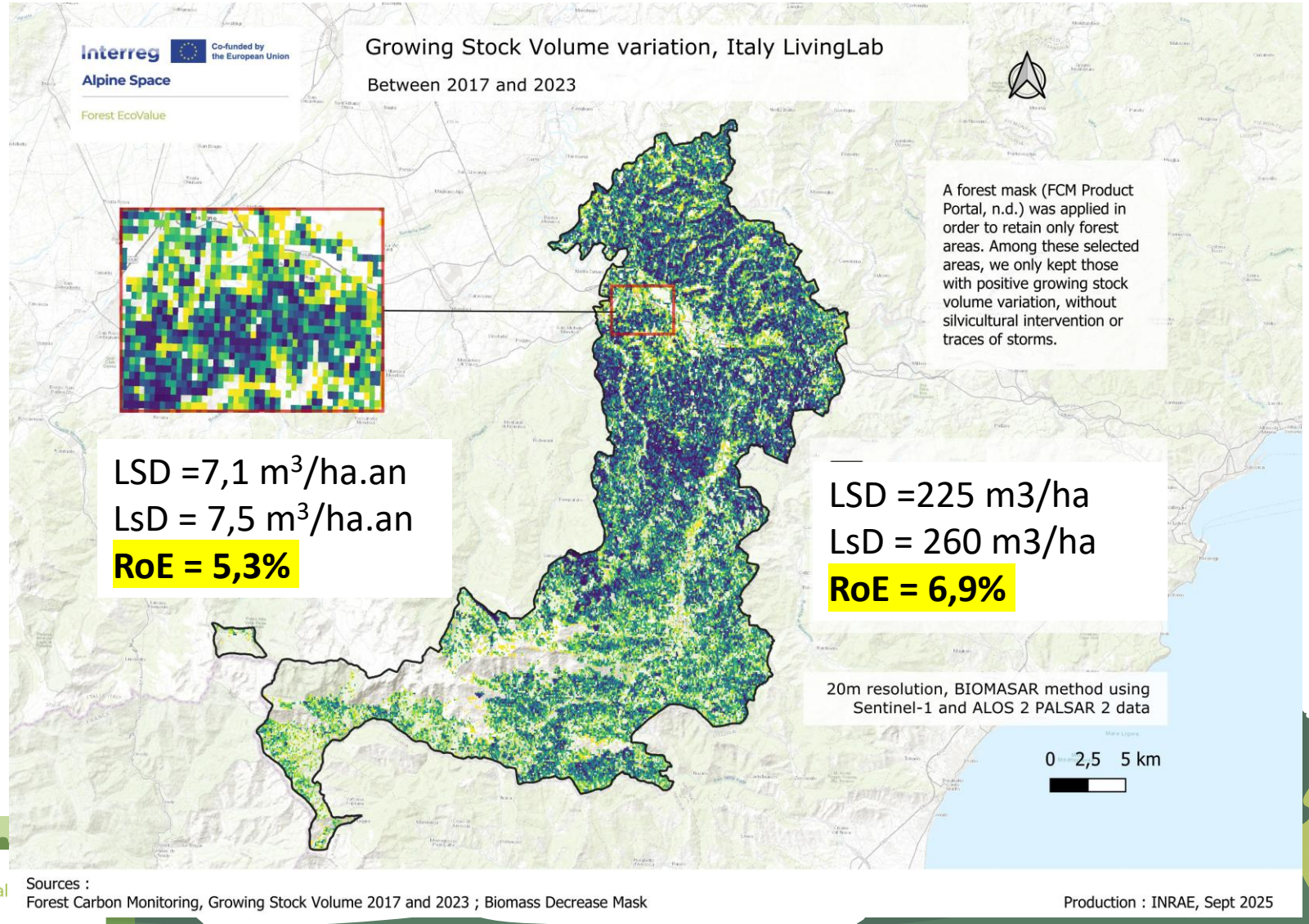

# Methodology based also on Local-scale Data (LsD)

**Why?**

- Not all stakeholders are **GIS savvy**
- Question of **resolution and accuracy** of the available data
- Some **scale-sensitive** indicators
- Easy to use for **rapid in-situ assessment**

# Selected set of criteria and indicators
## (example related to accessibility)

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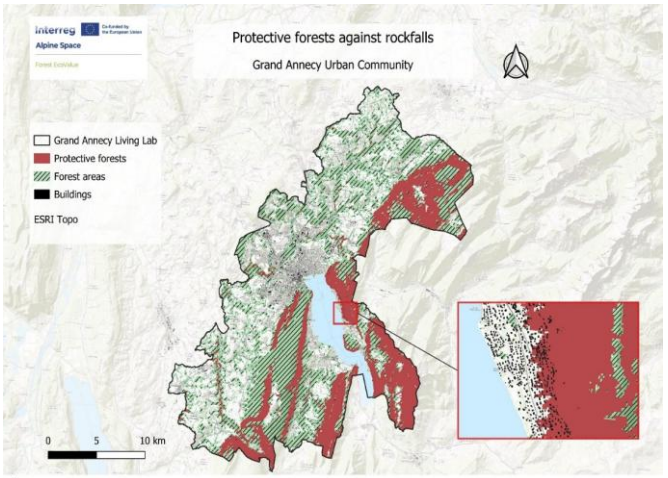
### IMPACT OF ACCESSIBILITY ON FOREST BIODIVERSITY
Key Metrics for Assessment

| Criterion | Calculation Method | Thresholds & Impact Level | Ecological Impact | References |
|---|---|---|---|---|
| Linear Density of Infrastructure | Density = km Roads + Tracks + Trails / km² Forest Area [km/km²] | < 0.5 Low; 0.5 - 1.5 Moderate; 1.5 - 3.0 High; > 3.0 Very High | Fragmentation ↑; Edge Effects ↑; Disturbance ↑ | Forman & Alexander, 1998; Trombulak & Frissell, 2000 |
| Weighted Density by Access Type | Weighted Density = Σ(km × Coefficient) / km²; Road = 1.0; Track = 0.6; Trail = 0.2 | < 0.4 Low; 0.4 - 1.0 Moderate; 1.0 - 2.0 High; > 2.0 Very High | Disturbance Intensity by Type | Gurrutxaga et al., 2019; Forman, 2003 |
| % Forest Area <100 m from Access | % Area within 100 m buffer / Total Forest Area x 100 | < 20% Low; 20 - 40% Moderate; 40 - 60% High; > 60% Very High | Exposure to Disturbance | Benitez-López et al., 2010; Forman, 2003 |
| Core Forest Area (< 500 m from Access) | Average Size of Forest Patches > 500 m from Infrastructure [ha] | < 500 ha Very High; 100 - 500 ha High; 25 - 100 ha Low; < 25 ha Very Low | Habitat Resilience: Biodiversity ⇑; Connectivity ⇑ | Lindennayer & Fischer, 2006; Benhamou & Riotte-Lambert, 2012 |

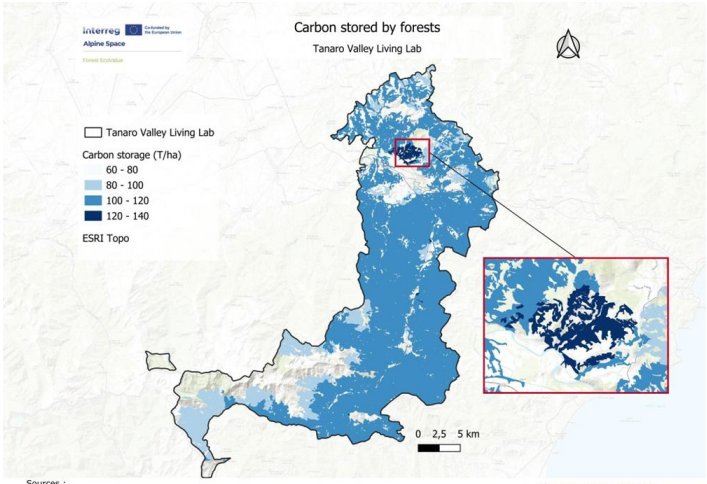
Impact Level: Low | Moderate | High | Very High


# Results : maps



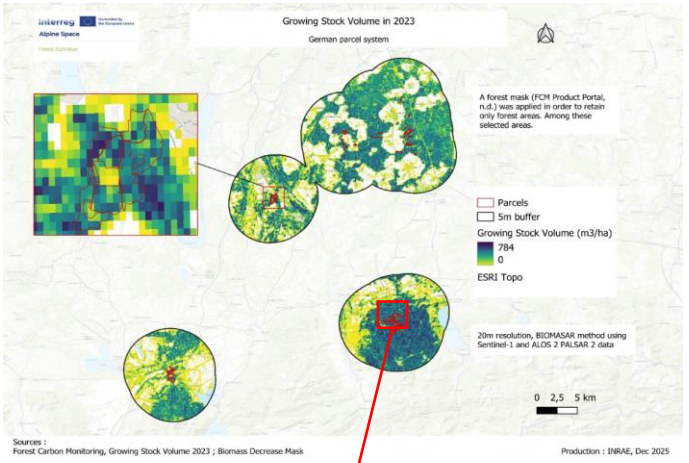

Sources :
IFN : Stands ; OpenStreetMap : Buildings ; LIDAR HD ONF : Dendrometry

Production : INRAE, Nov 2025



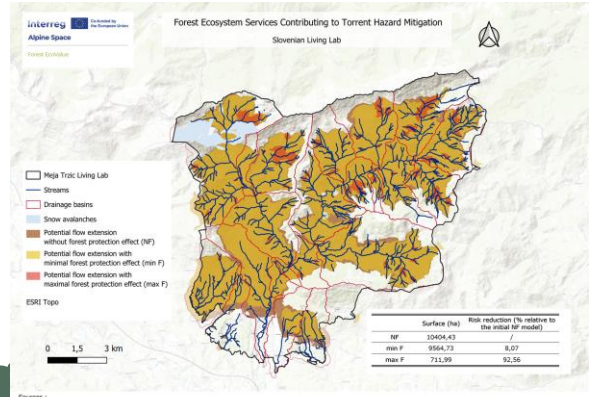

Sources :
Carbon storage : CEREMA

Production : INRAE, Oct 2025



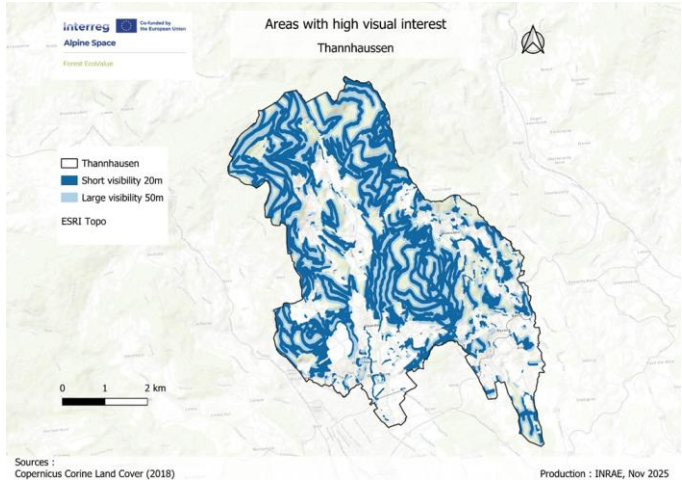

Sources :
Forest Carbon Monitoring, Growing Stock Volume 2023 ; Biomass Decrease Mask

Production : INRAE, Dec 2025



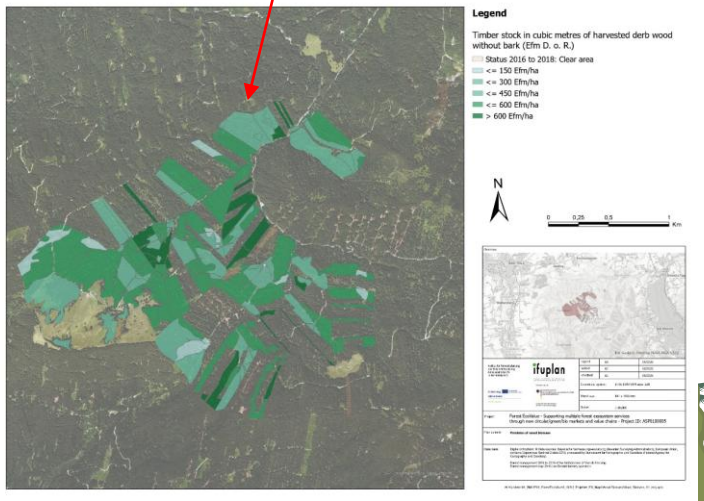

Sources :
MassMov modelisation, INRAE

Production : INRAE, Nov 2025

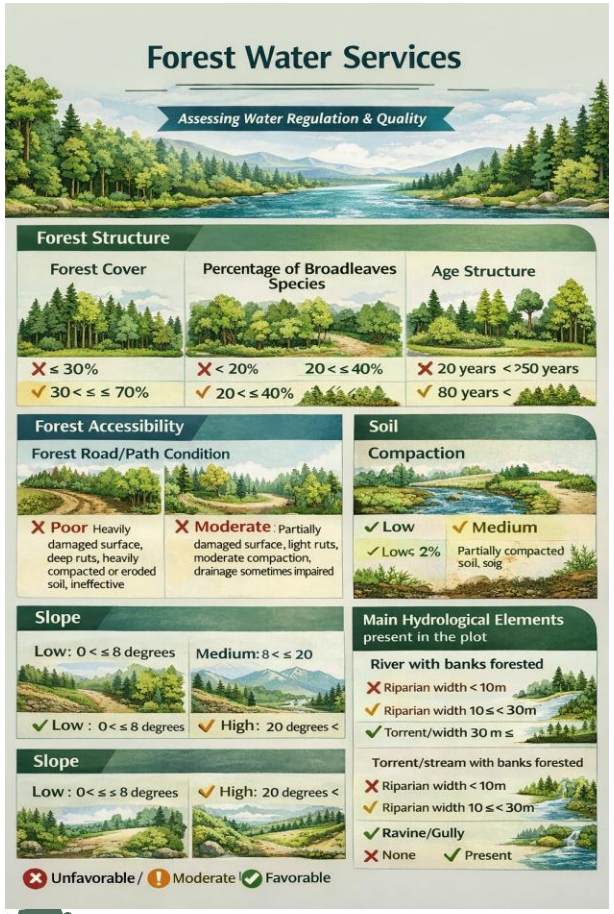



Sources :
Copernicus Corine Land Cover (2018)

Production : INRAE, Nov 2025



# Results : Operationalizing with Simple, User-Friendly Evaluation Tools

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**Forest Ecosystem Service Assessment – Carbon storage and sequestration**

Forest Ecosystem Service Assessment – Carbon storage and sequestration

| Criterion | Indicator | Score | Weight | Weighted score |
|---|---|---|---|---|
| Integration of Species Composition | Functional Classification of Tree Species | 3 | 0,05 | 0,15 |
| Dendrometric structure favorable to carbon storage | A forest stand structure characterized by dendrometric parameters that maximizes carbon storage and sequestration in both living biomass and soil | 3 | 0,05 | 0,15 |
| | Diameter distribution | 1 | 0,05 | 0,05 |
| Annual carbon sequestration | The amount of carbon dioxide ($CO_2$) removed from the atmosphere and stored in a forest ecosystem over a one-year period. | 3 | 0,20 | 0,60 |
| Forest biomass carbon stock | Aboveground forest biomass carbon stock | 1 | 0,15 | 0,15 |
| | Belowground (root) forest biomass carbon stock | 2 | 0,10 | 0,20 |
| | Deadwood (standing and lying) carbon stock | 1 | 0,05 | 0,05 |
| Annual carbon removal | The amount of carbon removed or transferred out of a forest ecosystem each year due to human activities that extract biomass or wood from the forest stock. | 1 | 0,10 | 0,10 |
| Carbon loss risk | Stored carbon in a forest ecosystem released back into the atmosphere due to natural disturbances or environmental changes. | 3 | 0,10 | 0,30 |
| Soil Carbon | The carbon stored in the soil of a forest ecosystem, including both the organic layer (litter, humus) and the mineral topsoil, excluding the carbon contained in forest root biomass. | 2 | 0,10 | 0,20 |
| Carbon-oriented forest management | Forest management approach that prioritizes the maintenance, enhancement, and long-term storage of carbon in forest ecosystem | 2 | 0,05 | 0,10 |
| **Total weighted score (on a 1-point scale)** | | | | **0,68** |

| | Indicative value |
|---|---|
| Annual carbon sequestration [tC·ha$^{-1}$·yr$^{-1}$] | 0,86 |
| Forest total carbon (trees,dead wood,soil) [tC.ha$^{-1}$] | 206,27 |

| Total score | Carbon Service Level |
|---|---|
| < 0,30 | Very low |
| 0,30 ≤ < 0,50 | Low |
| 0,50 ≤ < 0,70 | Moderate |
| 0,70 ≤ < 0,85 | High |
| 0,85 ≤ ≤ 1 | Very high |

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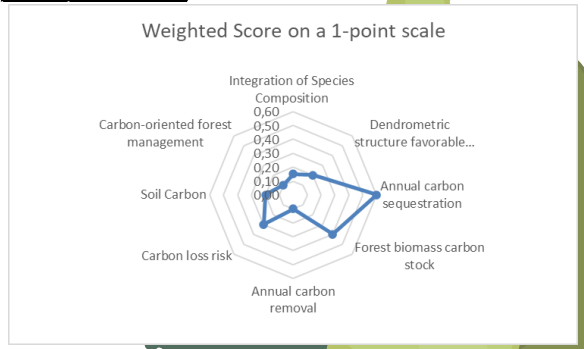

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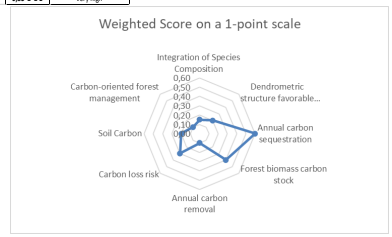


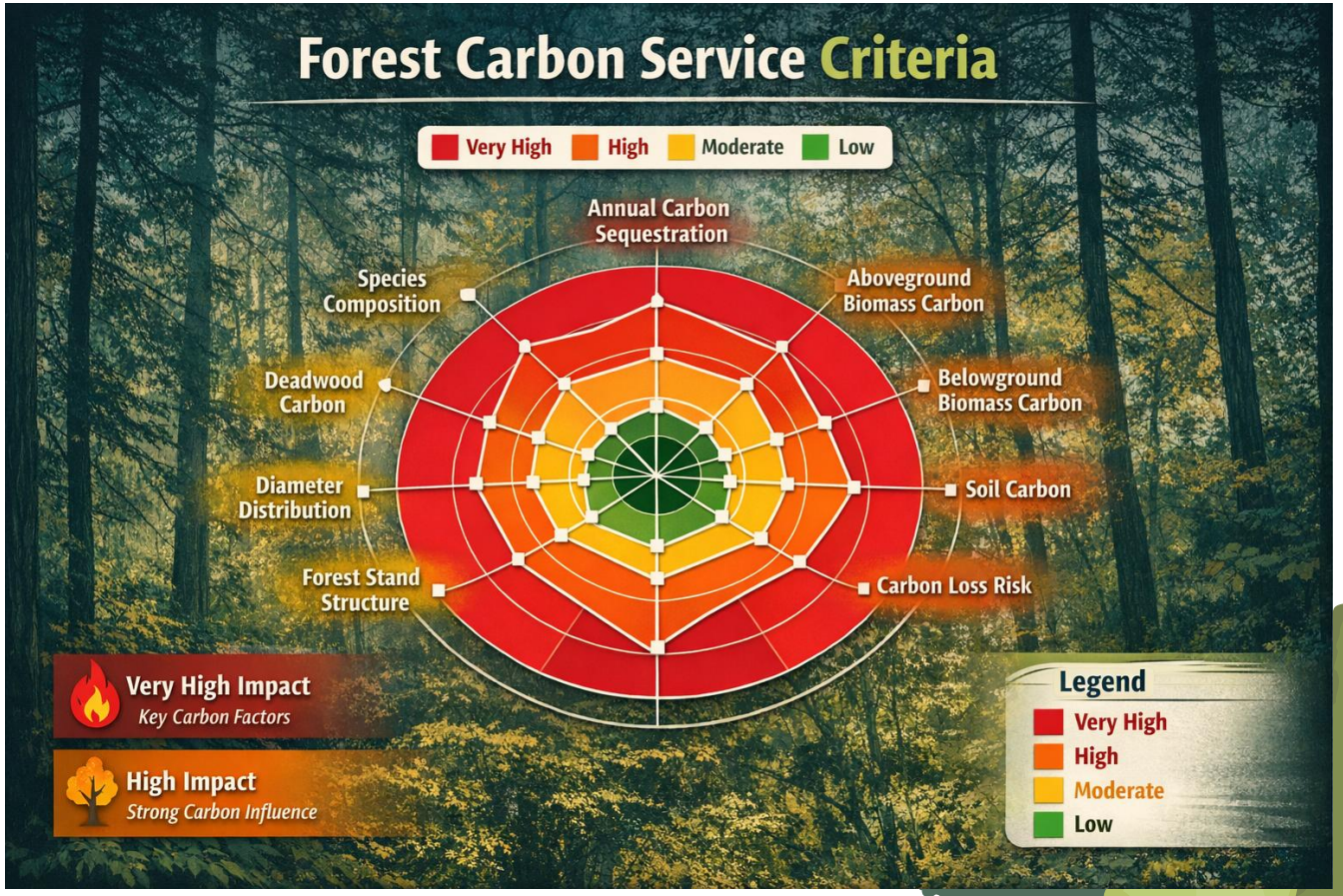


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# FEV Insights(1)

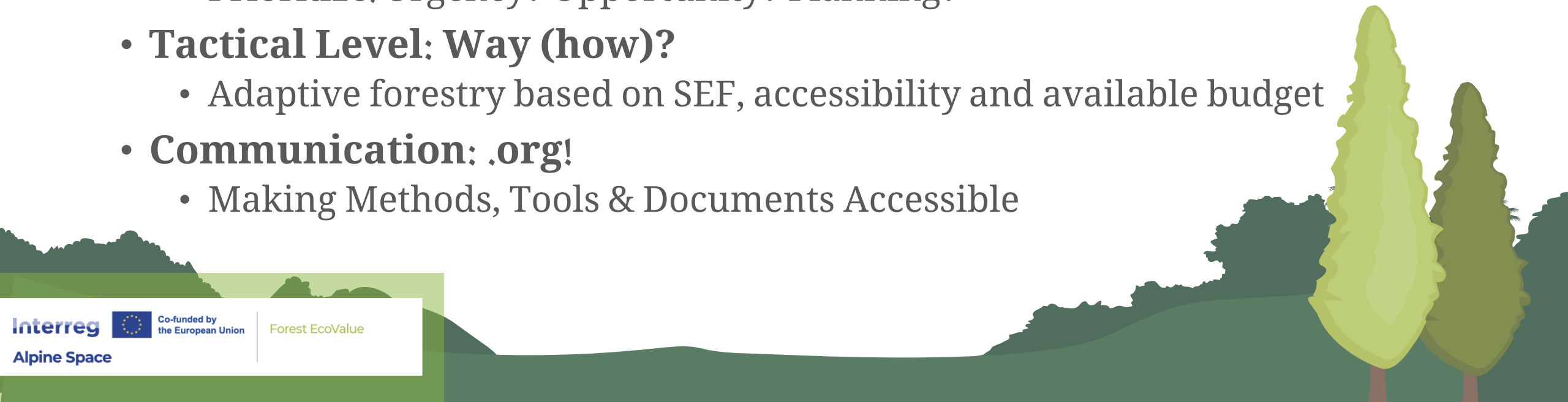
- **High-Res Large-Scale Data (LSD)**
  - Finer spatial & temporal resolution → HI-RES
  - Now compatible with operational & tactical scales (short/medium term, strategy, planning, forestry)
  - LiDAR & satellite data rapidly expanding across countries
  - Advances: tech, modeling, open source!
  - Limits: not all SEFs covered
    - Public access: visitor counts
    - Water resources: measured catchments, forest share
  - Limitations: Not all stakeholders are GIS-savvy

# FEV Insights(2)

- **Local-scale Data (LsD)**
  - Finer, non-exhaustive data
  - Update frequency issues
  - Leverages local knowledge
  - Rapid in-situ analysis, visual & usable
  - Qualitative indicators & local weighting easy to include

# FEV Insights (3): mapping and indicators to answer to WWW.WWW.org !

- **Strategic Level: What, Why & Who?**
  - Identify a territory's SEF portfolio, associated indicators, and key actors
- **Operational: Where & When?**
  - Use available data
  - Map = Data + Indicators
  - Prioritize: Urgency? Opportunity? Planning?
- **Tactical Level: Way (how)?**
  - Adaptive forestry based on SEF, accessibility and available budget
- **Communication: .org!**
  - Making Methods, Tools & Documents Accessible



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# The Forest Ecosystem Services Fresk


# Dialogue in Action: How a 2-step process shapes the project's Policy Memo

**Policy inventory**

- Identification of relevant policy sectorial fields
- Identification of policy leverage instruments
- Map of policy actors
- Interview to relevant policy makers
- Input from Living Labs
- Analysis: obstacles, opportunities, good solutions

**Policy forum**

- **Regional policy forum:** intense policy dialogue involving Living Lab stakeholders and regional – national level policy makers- discussing on obstacles, opportunities and possible solutions
- **Transnational policy forum:** policy dialogue involving regional – national – transnational policy makers developing a shared policy memo

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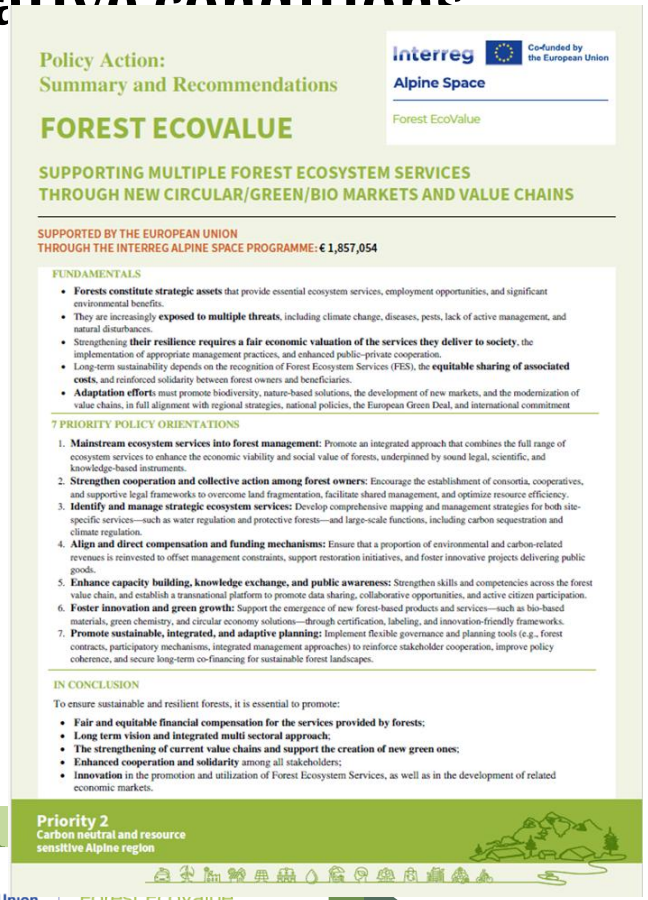
# Policy-relevant Insights

**The project's Policy memo : 7 proposals offered to the whole Alpine Region to be selected and implemented following the territorial, cultural and legislative conditions**



Policy Action:
Summary and Recommendations

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FOREST ECOVALUE

SUPPORTING MULTIPLE FOREST ECOSYSTEM SERVICES THROUGH NEW CIRCULAR/GREEN/BIO MARKETS AND VALUE CHAINS

SUPPORTED BY THE EUROPEAN UNION
THROUGH THE INTERREG ALPINE SPACE PROGRAMME: € 1,857,054

FUNDAMENTALS

- **Forests constitute strategic assets** that provide essential ecosystem services, employment opportunities, and significant environmental benefits.
- They are increasingly **exposed to multiple threats**, including climate change, diseases, pests, lack of active management, and natural disturbances.
- Strengthening **their resilience requires a fair economic valuation of the services they deliver to society**, the implementation of appropriate management practices, and enhanced public-private cooperation.
- Long-term sustainability depends on the recognition of Forest Ecosystem Services (FES), the **equitable sharing of associated costs**, and reinforced solidarity between forest owners and beneficiaries.
- **Adaptation effort**s must promote biodiversity, nature-based solutions, the development of new markets, and the modernization of value chains, in full alignment with regional strategies, national policies, the European Green Deal, and international commitment

7 PRIORITY POLICY ORIENTATIONS

1. **Mainstream ecosystem services into forest management:** Promote an integrated approach that combines the full range of ecosystem services to enhance the economic viability and social value of forests, underpinned by sound legal, scientific, and knowledge-based instruments.
2. **Strengthen cooperation and collective action among forest owners:** Encourage the establishment of consortia, cooperatives, and supportive legal frameworks to overcome land fragmentation, facilitate shared management, and optimize resource efficiency.
3. **Identify and manage strategic ecosystem services:** Develop comprehensive mapping and management strategies for both site-specific services—such as water regulation and protective forests—and large-scale functions, including carbon sequestration and climate regulation.
4. **Align and direct compensation and funding mechanisms:** Ensure that a proportion of environmental and carbon-related revenues is reinvested to offset management constraints, support restoration initiatives, and foster innovative projects delivering public goods.
5. **Enhance capacity building, knowledge exchange, and public awareness:** Strengthen skills and competencies across the forest value chain, and establish a transnational platform to promote data sharing, collaborative opportunities, and active citizen participation.
6. **Foster innovation and green growth:** Support the emergence of new forest-based products and services—such as bio-based materials, green chemistry, and circular economy solutions—through certification, labeling, and innovation-friendly frameworks.
7. **Promote sustainable, integrated, and adaptive planning:** Implement flexible governance and planning tools (e.g., forest contracts, participatory mechanisms, integrated management approaches) to reinforce stakeholder cooperation, improve policy coherence, and secure long-term co-financing for sustainable forest landscapes.

IN CONCLUSION

To ensure sustainable and resilient forests, it is essential to promote:

- **Fair and equitable financial compensation for the services provided by forests;**
- **Long term vision and integrated multi sectoral approach;**
- **The strengthening of current value chains and support the creation of new green ones;**
- **Enhanced cooperation and solidarity** among all stakeholders;
- **Innovation** in the promotion and utilization of Forest Ecosystem Services, as well as in the development of related economic markets.

Priority 2
Carbon neutral and resource sensitive Alpine region

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Policy proposal 1
**Foster cooperation between multiple ecosystem services**

Policy proposal 2
Foster cooperation **between forest owners**

Policy proposal 3
**Identify strategic services**

Policy proposal 4
**Dedicate compensation** and carbon market money

Policy proposal 5
**Capacity building and raising awareness platform**

Policy proposal 6
**Promote innovative products and services**

Policy proposal 7
**Strategic and flexible planning and co-planning**

# Policy-relevant Insights (3)

- Ensure **Fair Compensation**
- Foster **Cooperation & Solidarity** Among Stakeholders
- Drive **Innovation** in Forest Ecosystem Services & Markets

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