

# StatEO

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## Seeing forests clearly

### Insights from a Systematic Review of FI-EO Integration

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# Two measuring systems, one set of questions

## FOREST INVENTORIES (FI)

### Plot-based ground measurements

Representative of forest areas, design-based considerations, (sometimes) remeasured, rich in species and forest structure information. Ground truth at landscape scale.



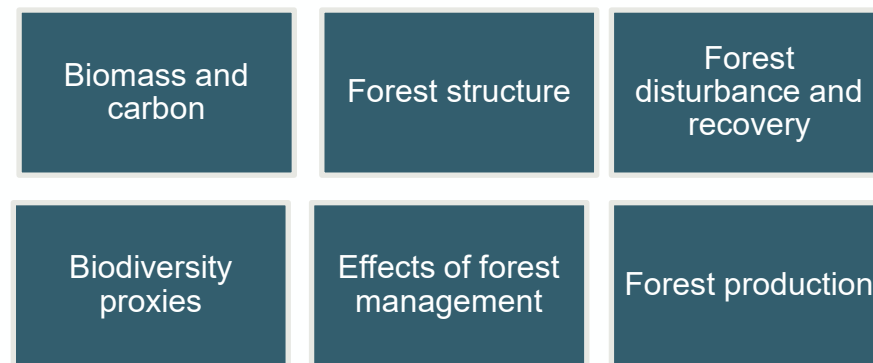
## EARTH OBSERVATION (EO)

### Wall-to-wall, repeat coverage

Optical, radar, lidar: large-scale, multi-temporal, but largely blind to what's under the canopy. Can provide information on spatial dynamics.



The combination of FI and RS data can answer questions that neither source of information can answer alone.



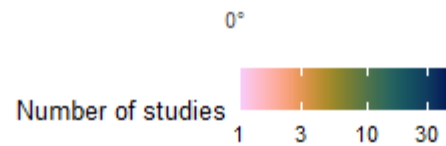
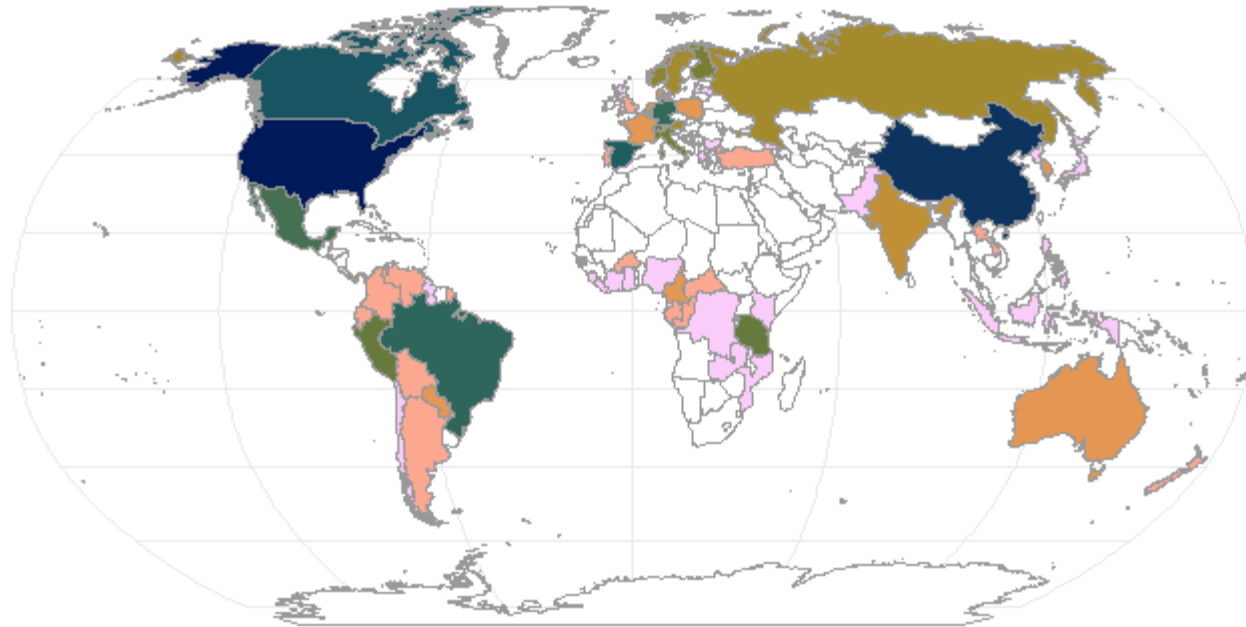
*As well as support the implementation of national and international policies*



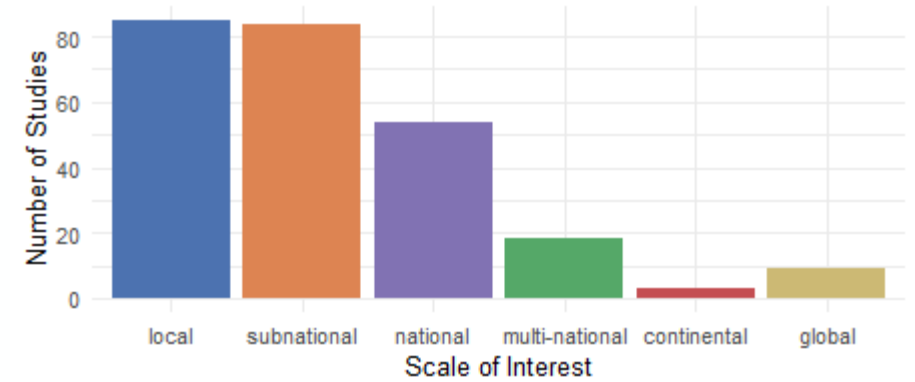




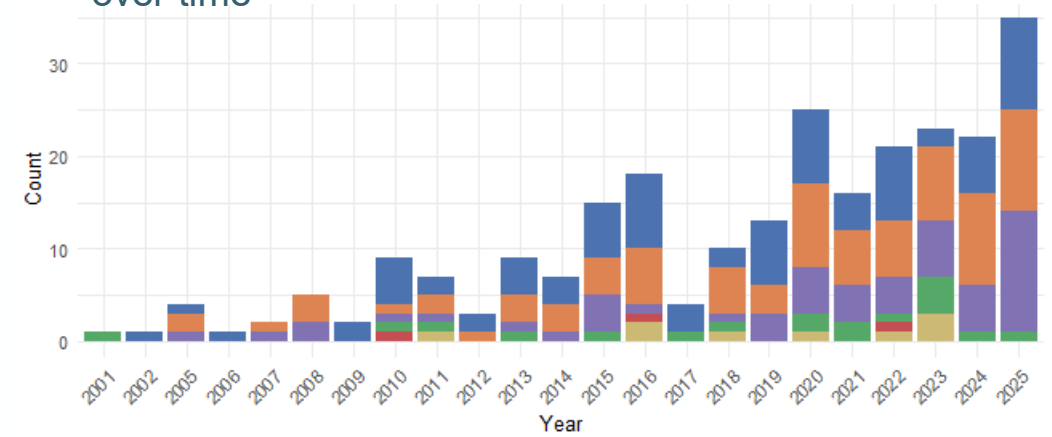
# Preliminary findings: Geography & Scale of FI-EO research



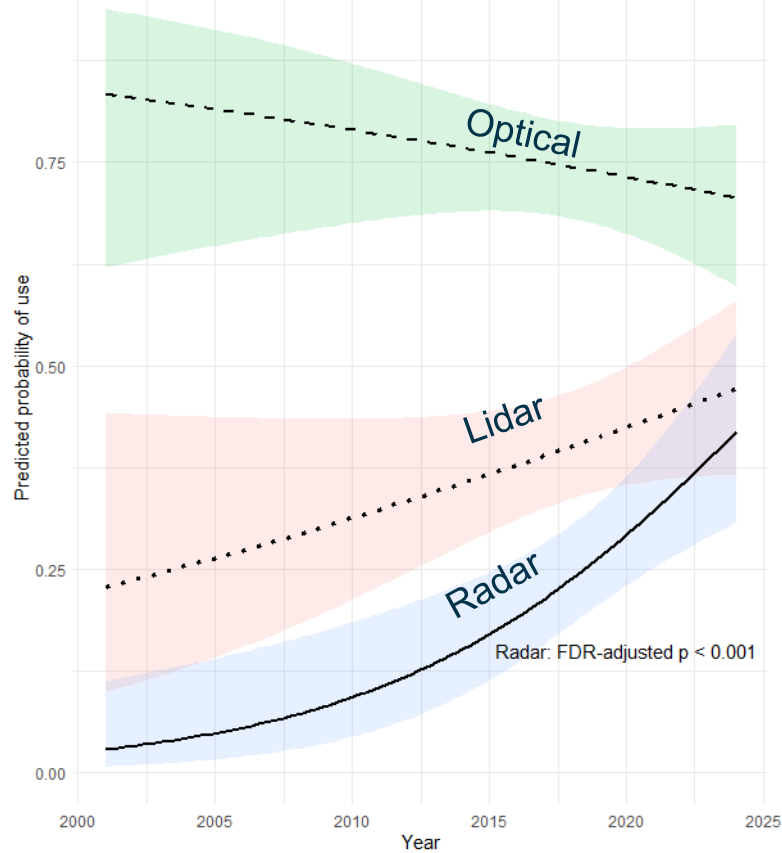
- **68 countries** represented, out of which 42 (62%) had 1-2 studies
- North America, Europe and China dominate the English-speaking literature
- Africa and South East Asia are underrepresented despite global importance



- 88% of all studies **local**, **subnational** or **national** in scope
- There is an increase of **national** and **subnational** studies over time



The use of optical data is prevalent, but there is an increase in the use of radar and lidar data

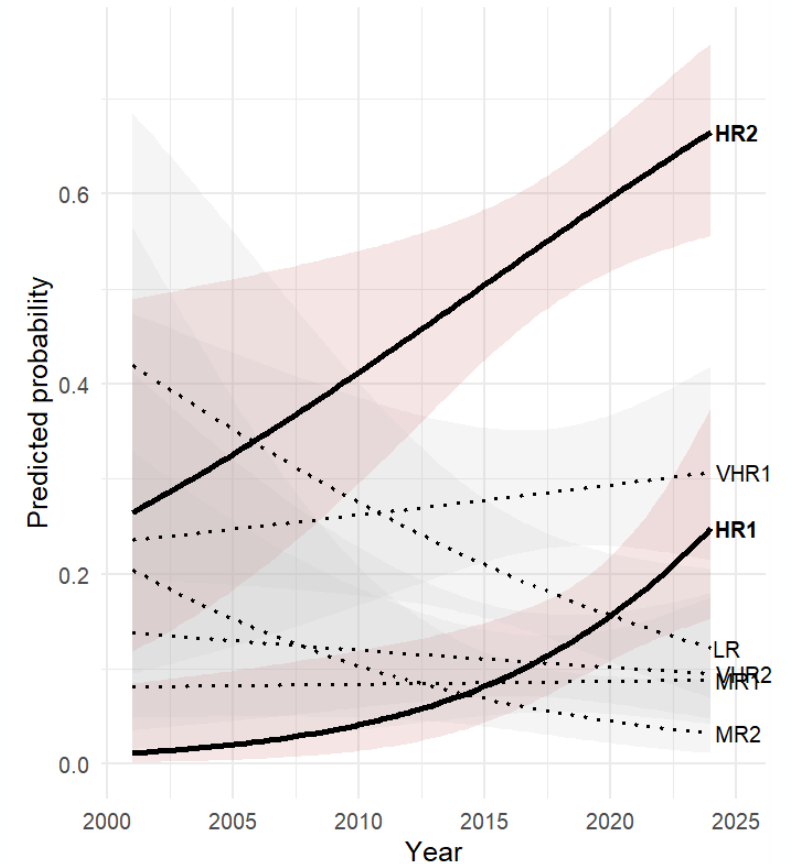


Predictions based on a logistic regression model. Shaded areas represent 95% confidence intervals.

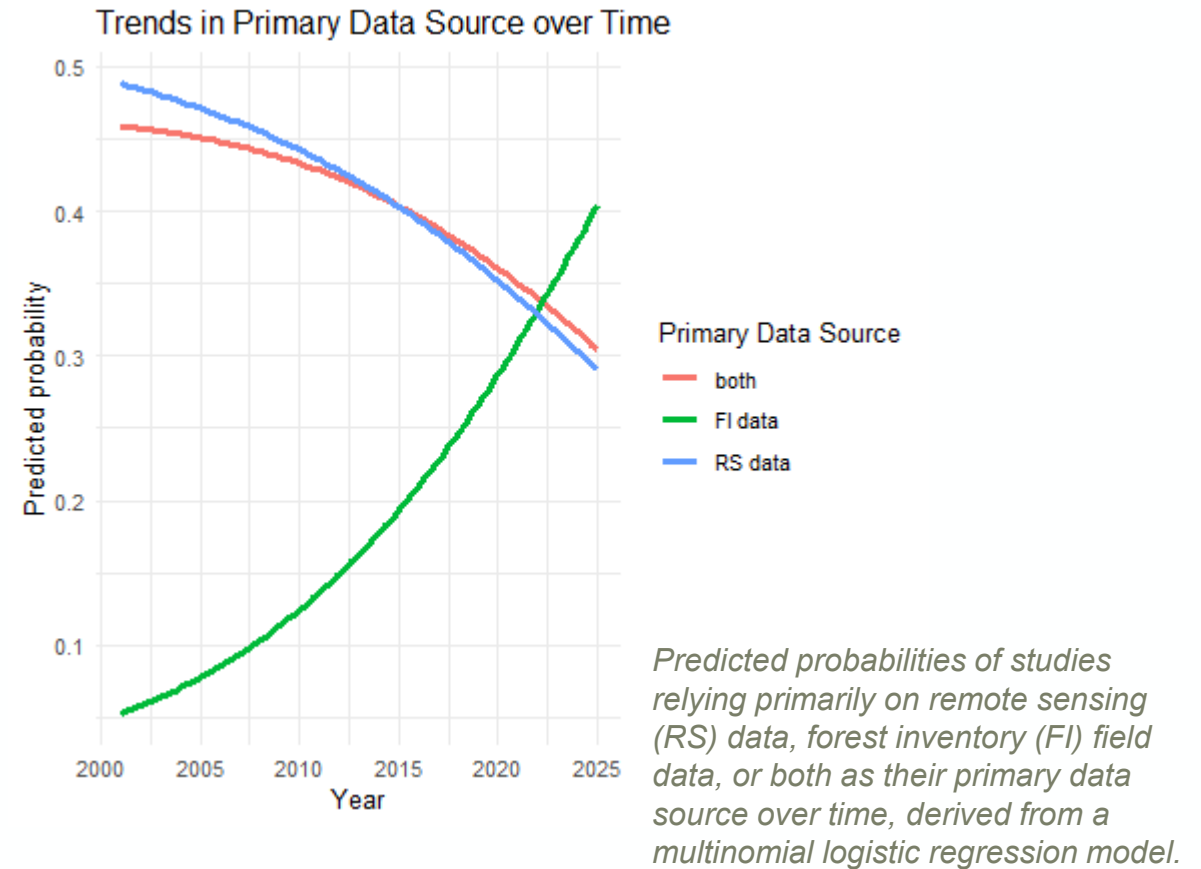
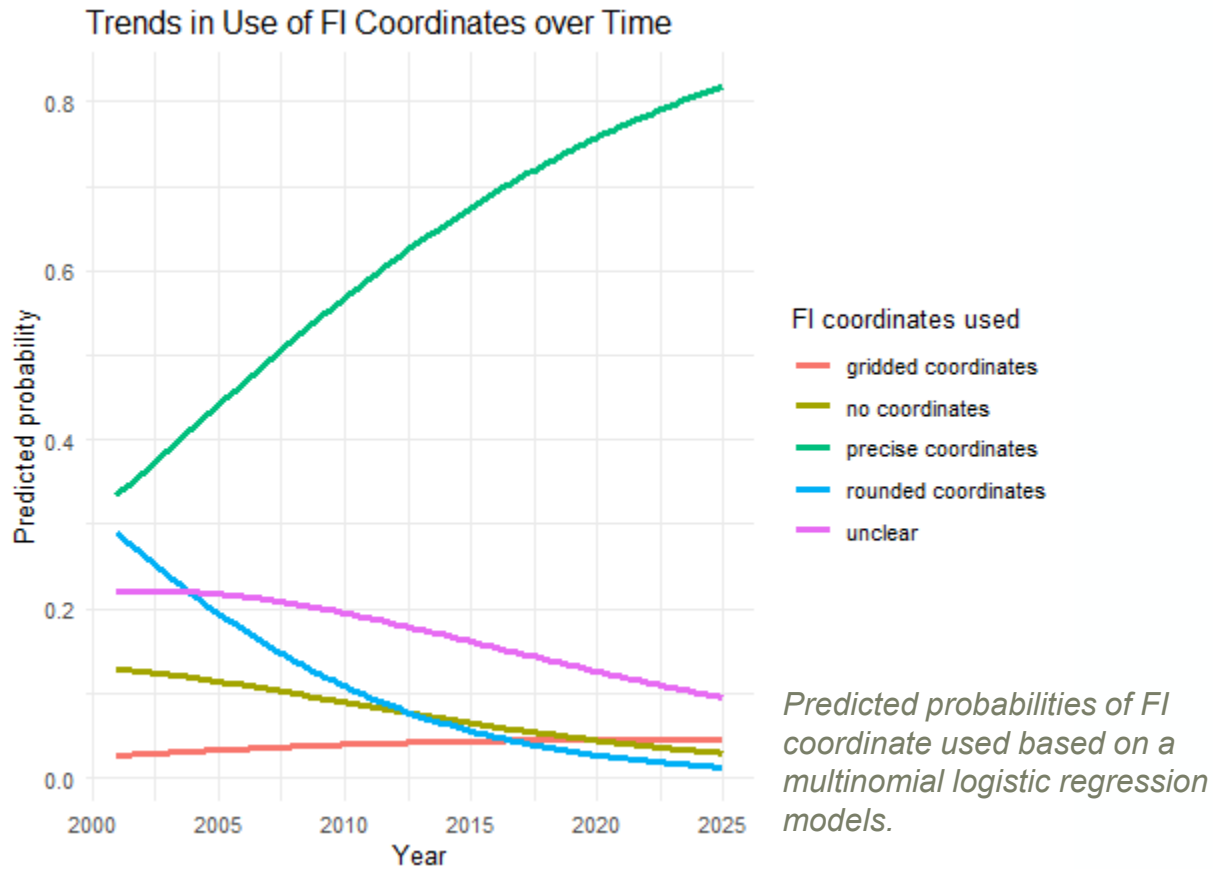
The diversification of open-source remote sensing datasets is evident

At the same time, there is an evident increase in the use of high-resolution EO data (4m-30m)

Derived from logistic regression models. Shaded areas represent 95% confidence intervals; solid lines indicate statistically significant trends.  
 VHR1= $\leq 1\text{m}$ , VHR2= $> 1\text{m} \ \& \ \leq 4\text{m}$ ,  
 HR1= $> 4\text{m} \ \& \ \leq 10\text{m}$ , HR2= $> 10\text{m} \ \& \ \leq 30\text{m}$ ,  
 MR1= $> 30\text{m} \ \& \ \leq 100\text{m}$ ,  
 MR2= $> 100\text{m} \ \& \ \leq 300\text{m}$ , LR= $\geq 300\text{m}$ .



# Preliminary findings: The role of FI data over time

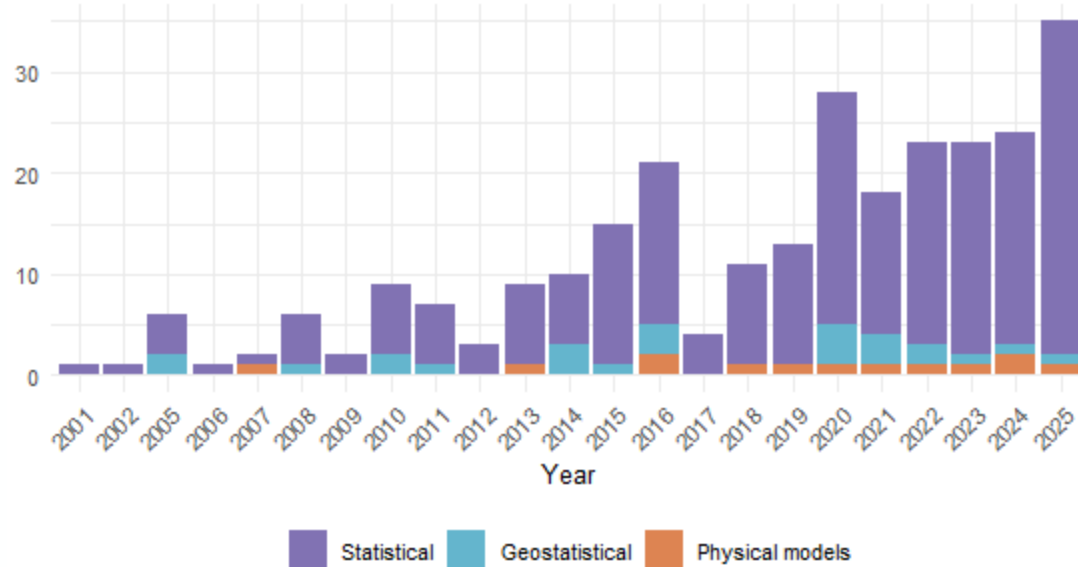


**Precise coordinates** are increasingly being used in environmental studies

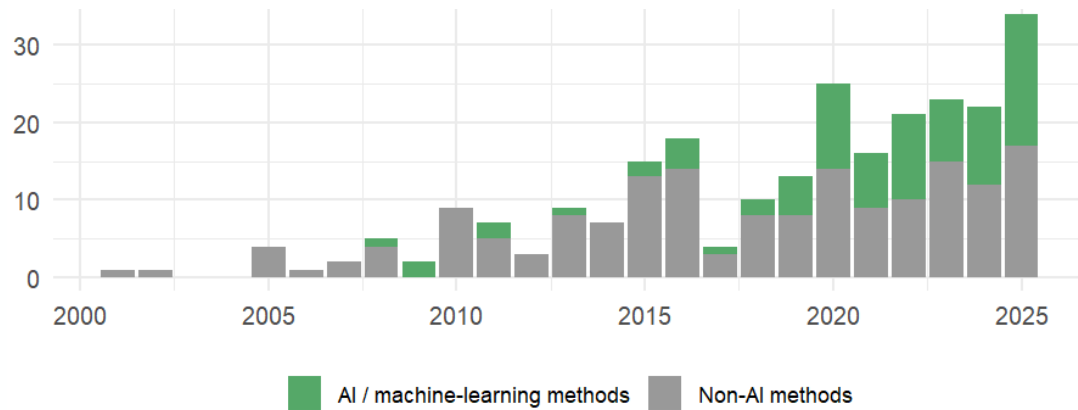
**FI data** is increasingly being considered as the primary source of information, and not as supplementary datasets.

# Preliminary findings: Methodological shifts in EO-FI data integration

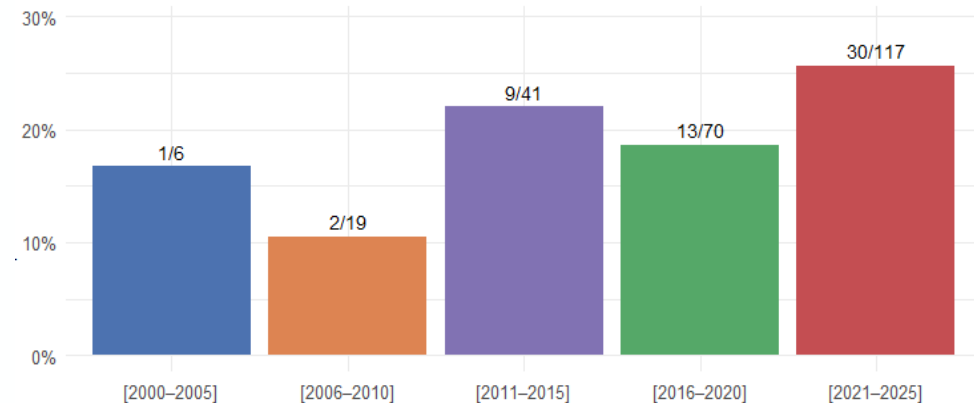
Methodological approaches over time



- **Statistical integration frameworks** dominate across the full time series.
- **Geostatistical/spatial models** showed a significant decline in proportional use, while **Physical/process-based frameworks** remain rare (~5% of studies) with no temporal trend detectable
- **AI/ML integration approaches** now account for around 50% of recent publications
- **Roughly one fifth of all studies** had an evident policy motivation, with an increase in proportion over time



Proportion of studies motivated by environmental policies



# Key takeaways and general recommendations

- Official reporting mechanisms need rigorous and timely information which can be supported by advancements in FI/EO integration methods.
- Evident increases in (sub)national case studies and studies with policy-oriented motivations are supporting this process.
- The diversification of the uptake of available EO data indicates exploration and ingestion of novel FI/EO integration methods for forest monitoring and estimation.

## General recommendations

1. Invest in tropical regions lacking comparable examples: targeted funding and partnerships for tropical regions in Africa and SE Asia are needed
2. Enable or support sovereignty-respecting frameworks so research can make use of plot locations without violating national policies
3. Support co-design of realistic and technically achievable climate and biodiversity indicators with a clear policy/outcome in mind.

# Thank you for your attention



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**GFOI R&D Session on  
integrating EO and ground data  
for enhanced forest-related  
biomass estimation**

07 May 2026, 11:45-13:30 , James  
Cook Room

## Acknowledgements:



European Space Agency

