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Nature and culture: how remote sensing and social media shape future of cultural ecosystem services research

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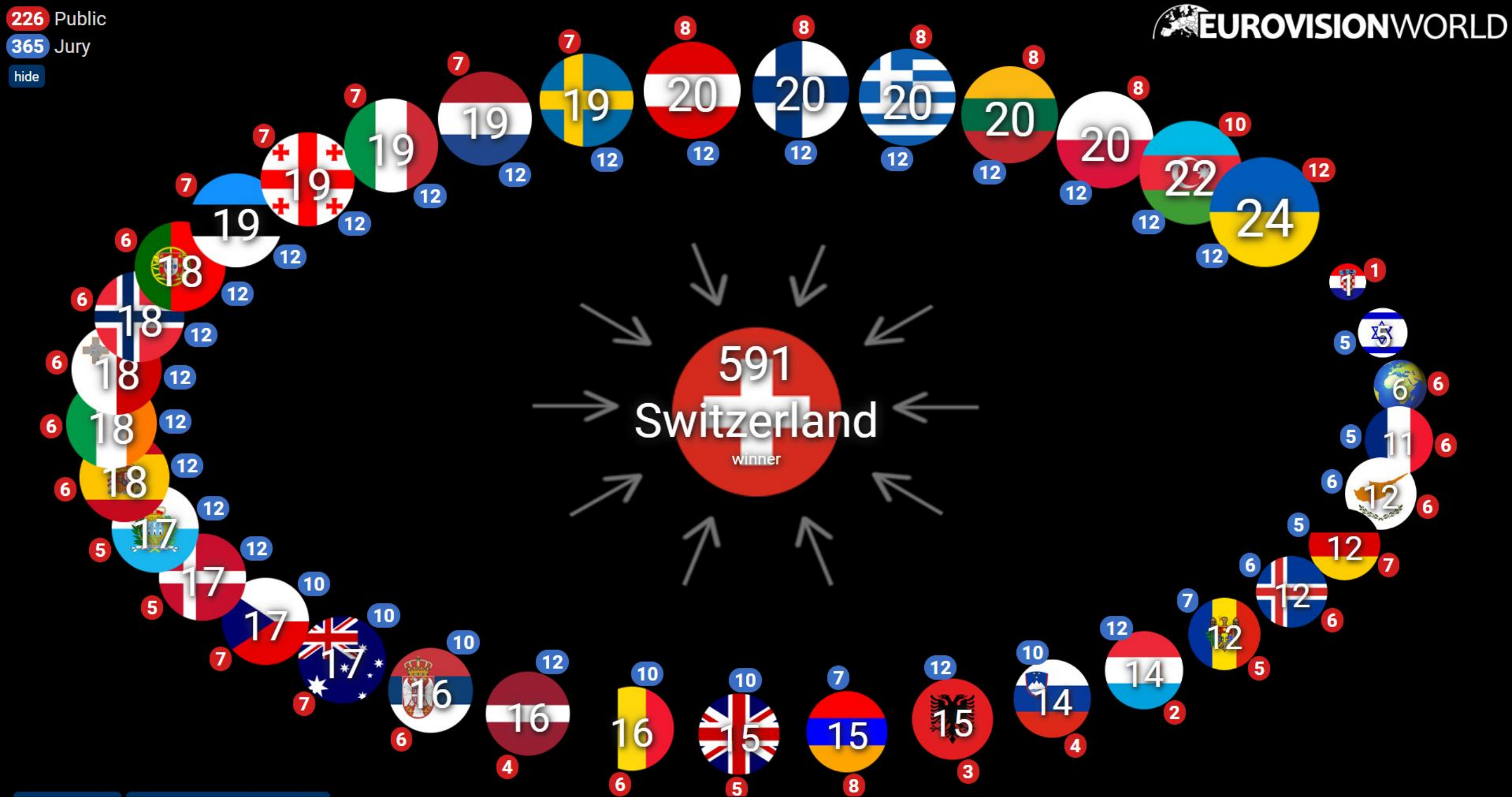
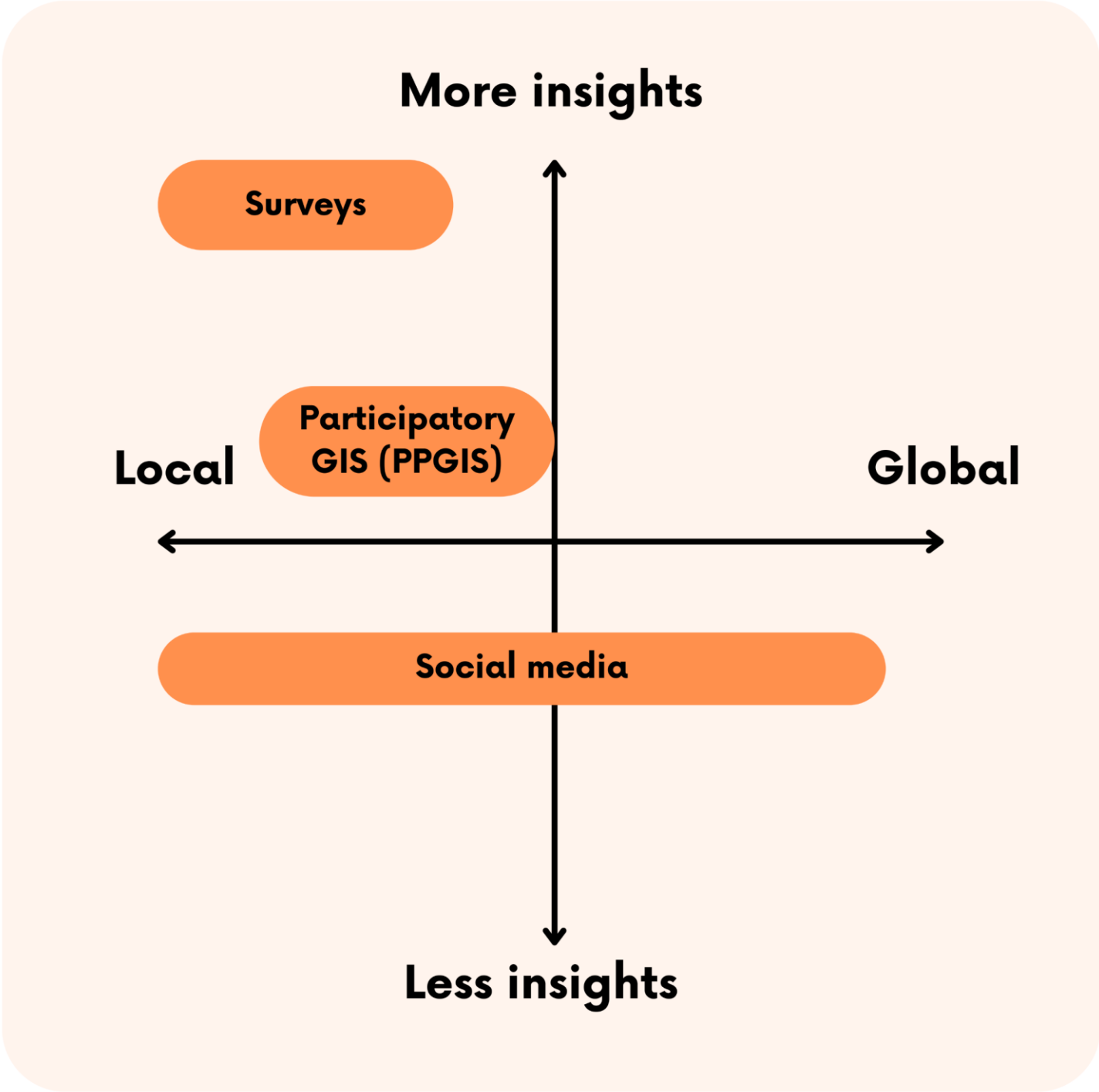
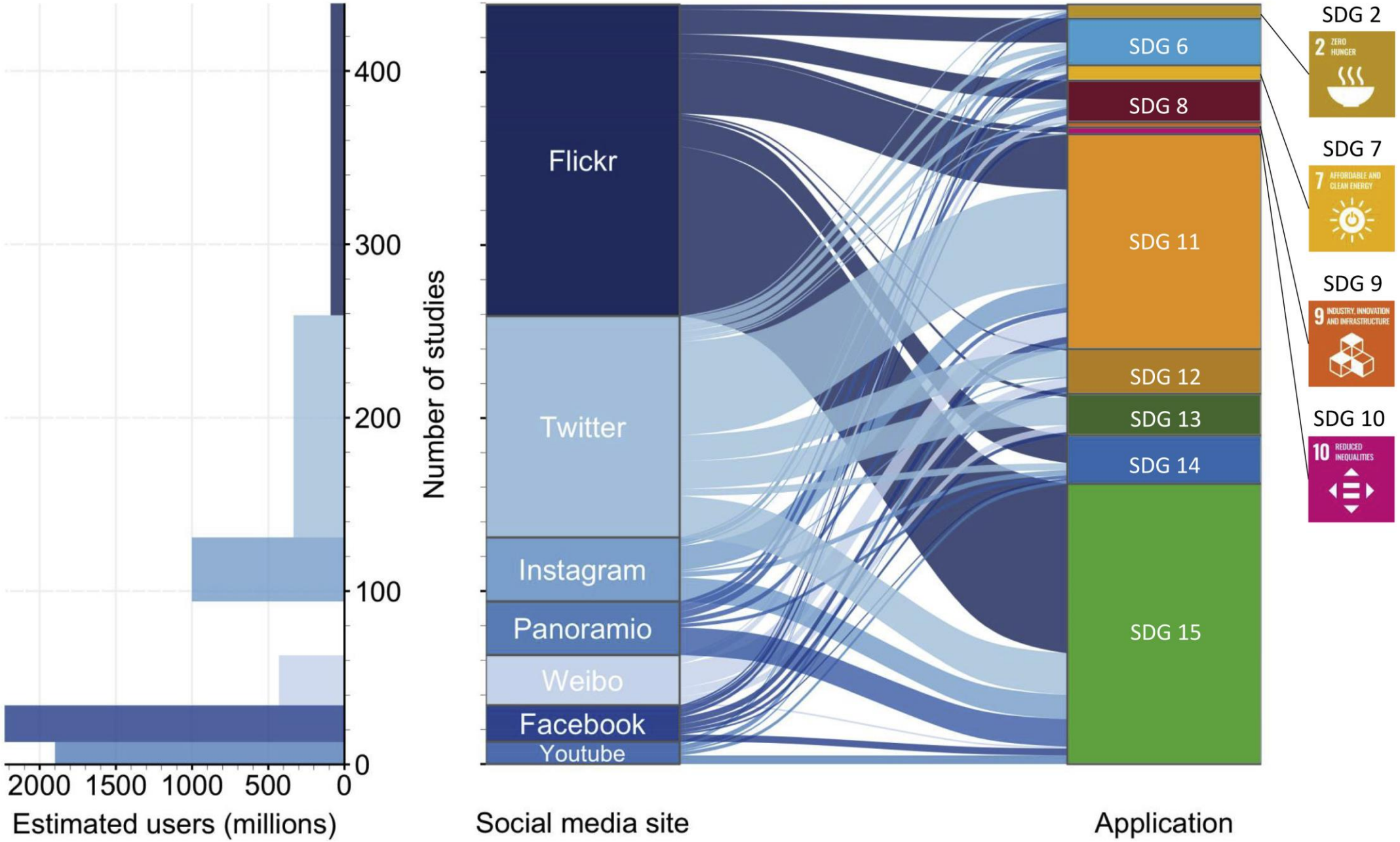
Digital Geography Lab

Sękocin Stary, Poland, May 15 – 17, 2024



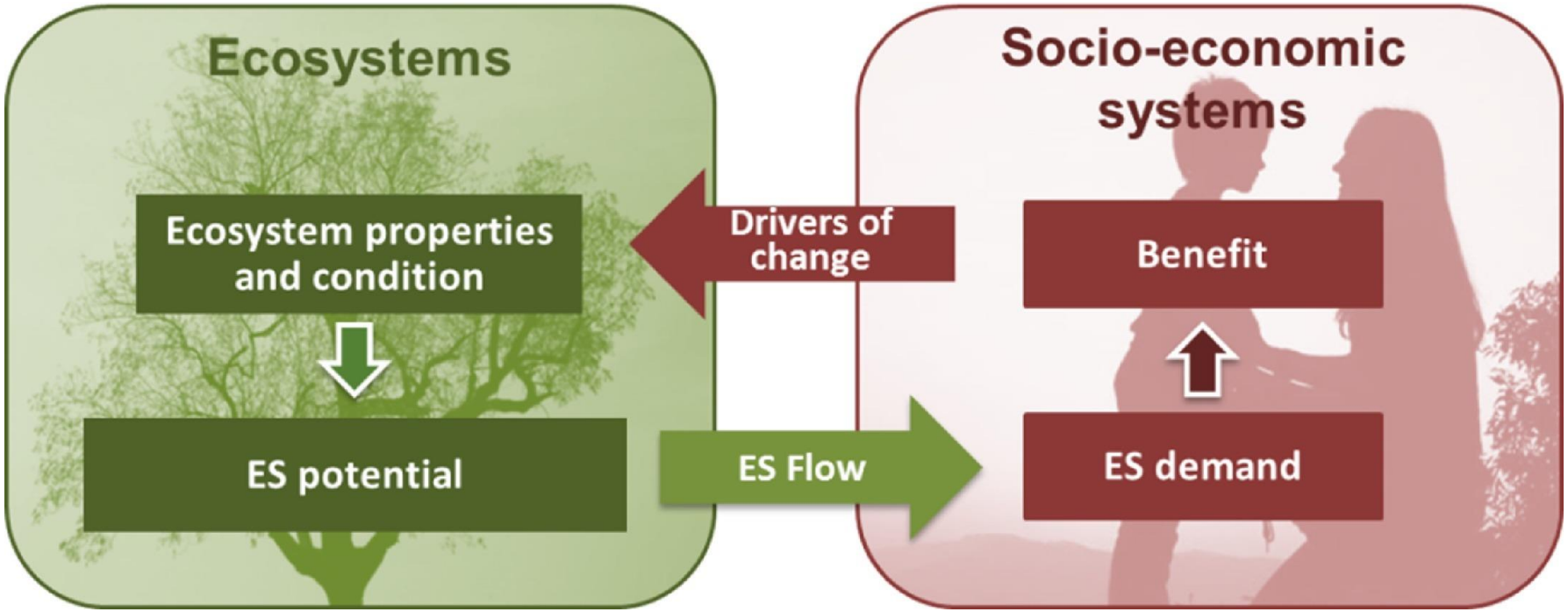
https://eurovisionworld.com/eurovision/2024#switzerland


More insights
Surveys
Participatory GIS (PPGIS)
Local
Global
Social media
Less insights



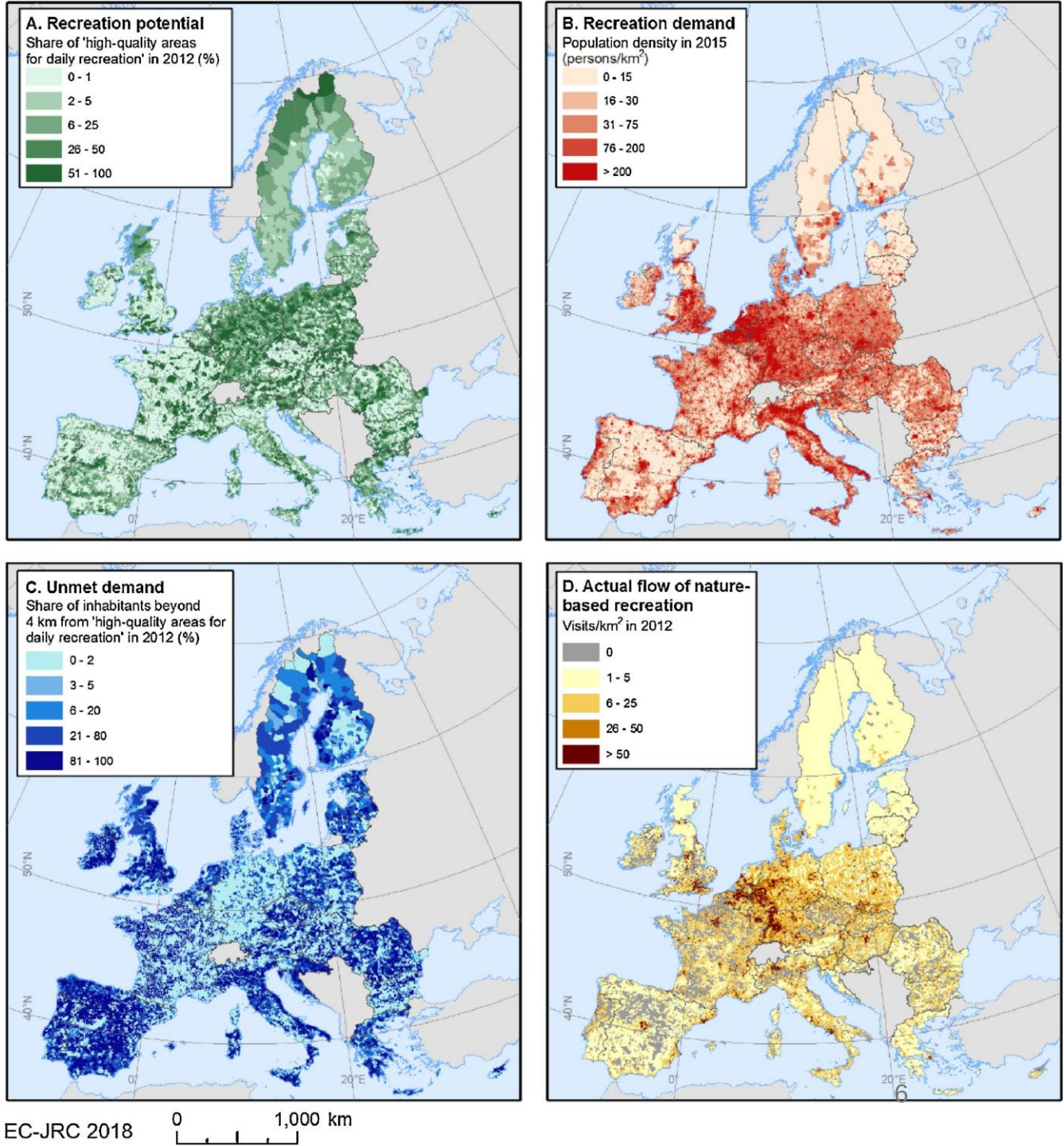
Ghermandi et al. (2023). Social media data for environmental sustainability: A critical review of opportunities, threats, and ethical use. One Earth, 6(3), 236-250. https://doi.org/10.1016/j.oneear.2023.02.008

Mapping aspects of ecosystem services



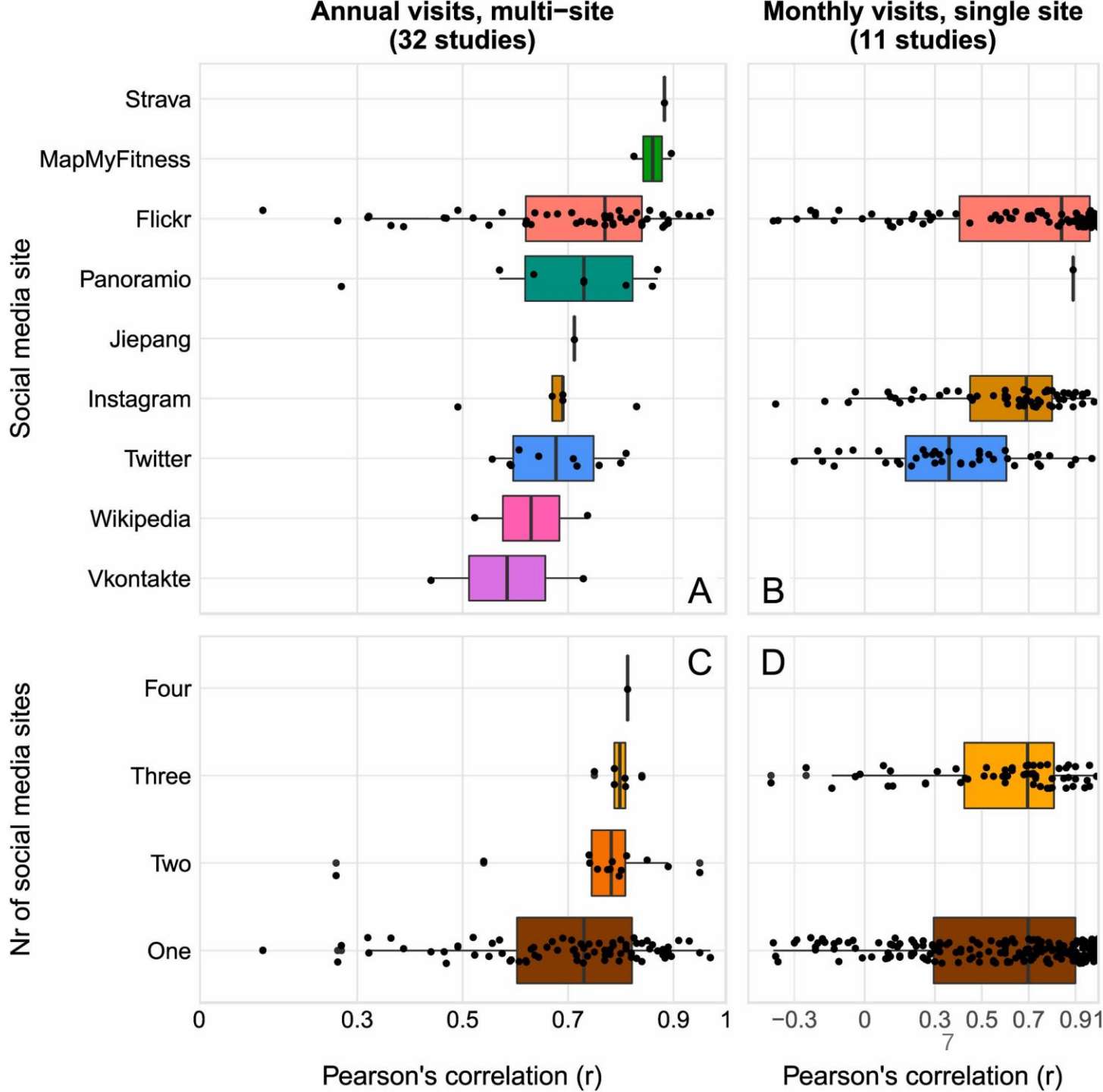
Vallecillo, S., La Notte, A., Zulian, G., Ferrini, S., & Maes, J. (2019). Ecosystem services accounts: Valuing the actual flow of nature-based recreation from ecosystems to people. *Ecological Modelling*, *392*, 196-211. https://doi.org/10.1016/j.ecolmodel.2018.09.023

Data:
land use / land cover +
population + visitation



https://doi.org/10.1016/j.ecolmodel.2018.09.023

Social media are robust proxy for visitation, especially if combined



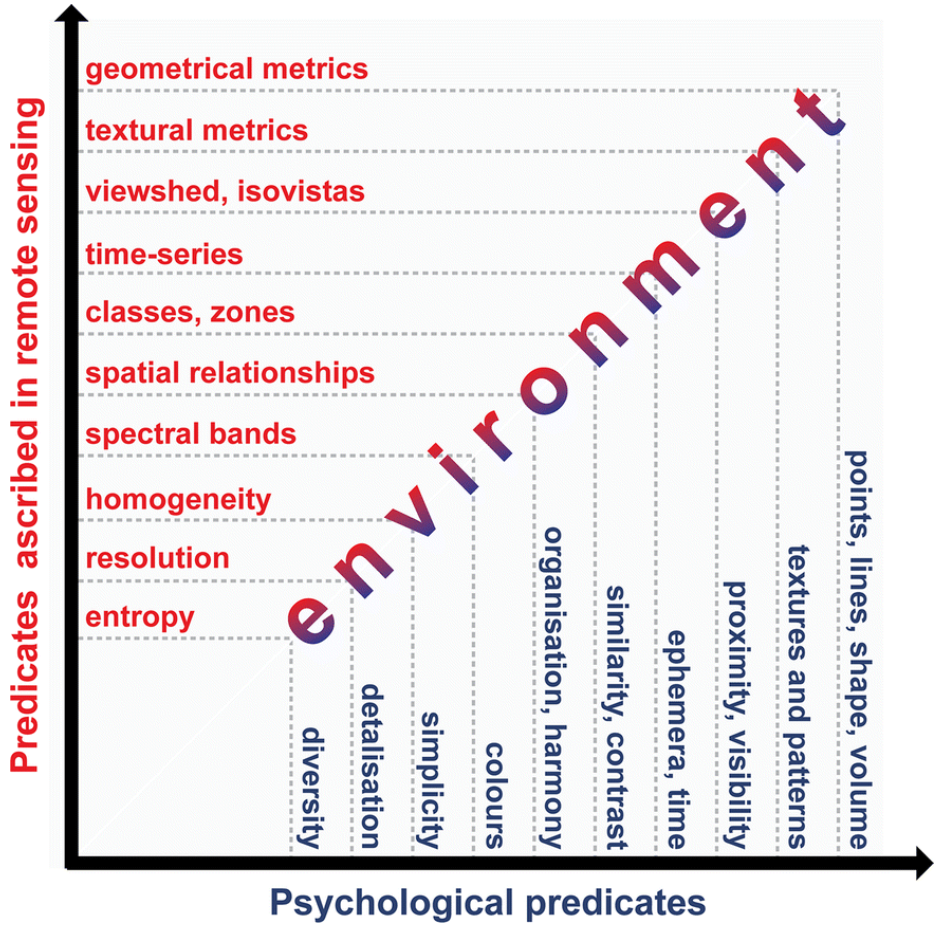
Ghermandi, A. (2022). Geolocated social media data counts as a proxy for recreational visits in natural areas: A meta-analysis. *Journal of Environmental Management*, *317*, 115325. https://doi.org/10.1016/j.jenvman.2022.115325

'Triple filtration' of places:

- came
- created (photo, video, etc.)
- shared (selected ones)

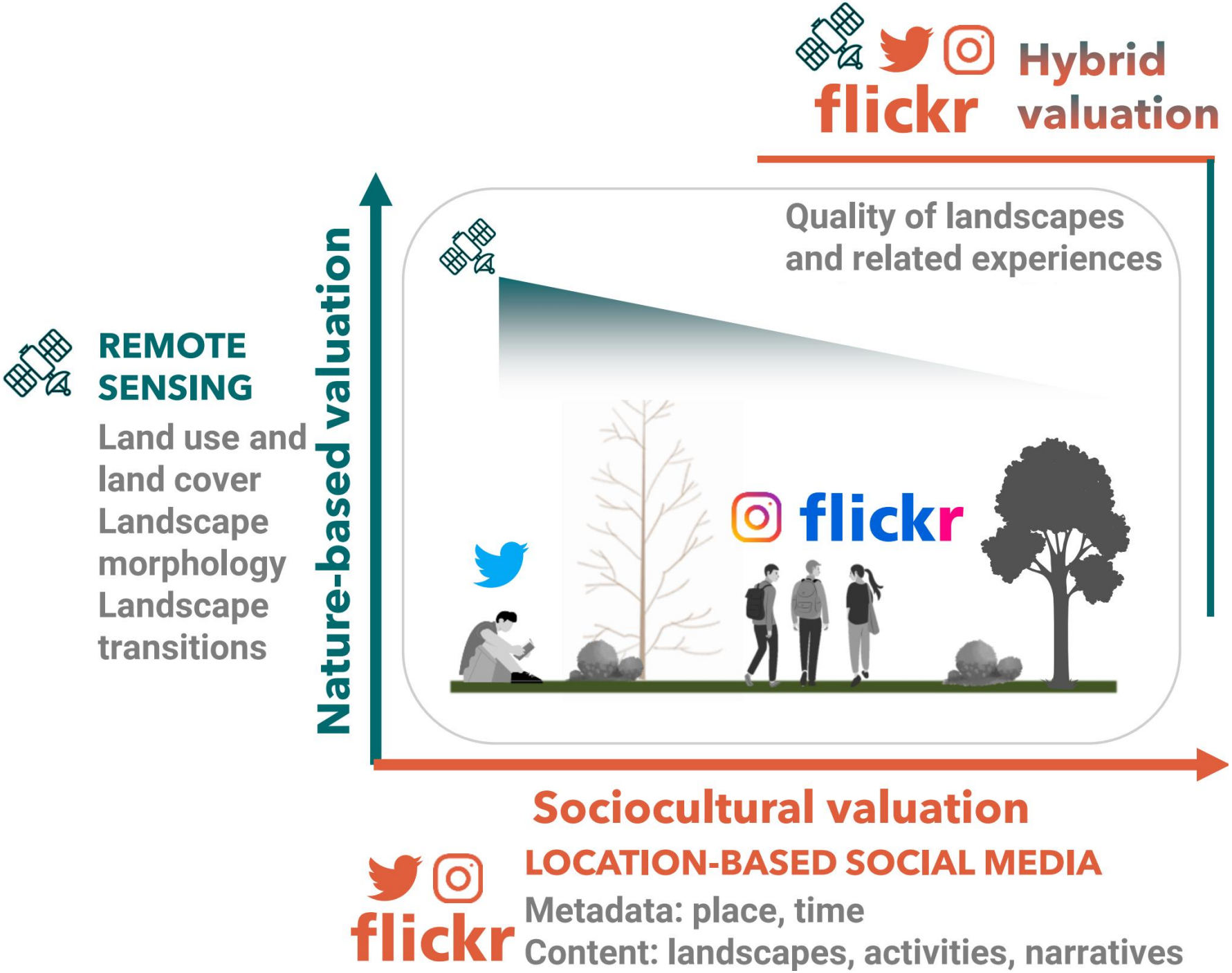

Semantic:
narratives,
feelings
SOCIAL
MEDIA
INFORMATION
Pragmatic:
outdoor
activities
Syntactic:
visual
landscape

Remote sensing for landscape studies

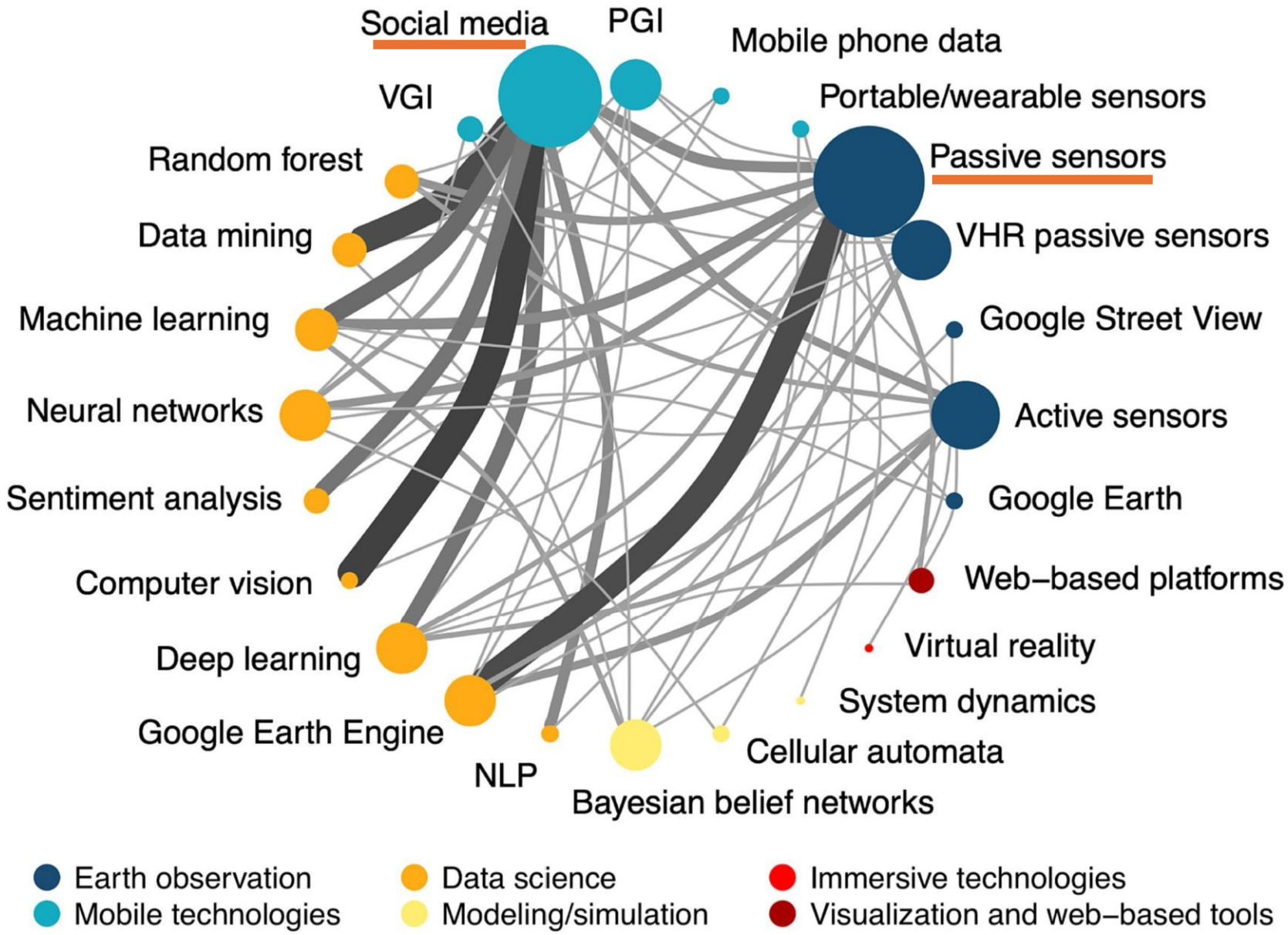


Karasov, O., Külvik, M., & Burdun, I. (2021). Deconstructing landscape pattern: applications of remote sensing to physiognomic landscape mapping. *GeoJournal*, *86*(1), 529-555. https://doi.org/10.1007/s10708-019-10058-6

Credit: Dr Ewa Grabska-Szwagrzyk via Twitter, @from_sen.
ESA (Sentinel-2 image over Hel peninsula, Poland)


Hybrid valuation
flickr
Quality of landscapes and related experiences
REMOTE SENSING
Land use and land cover
Landscape morphology
Landscape transitions
Nature-based valuation
flickr
Sociocultural valuation
LOCATION-BASED SOCIAL MEDIA
flickr
Metadata: place, time
Content: landscapes, activities, narratives

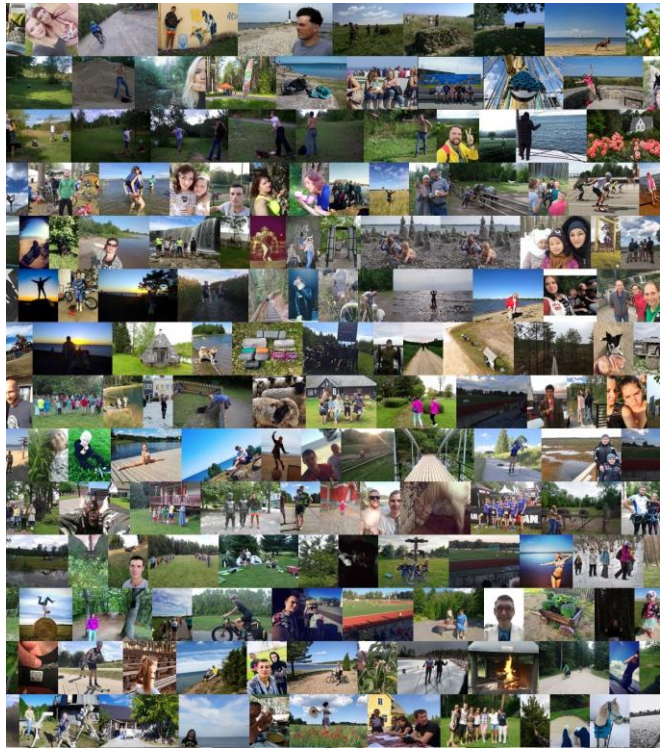
Hybrid valuation



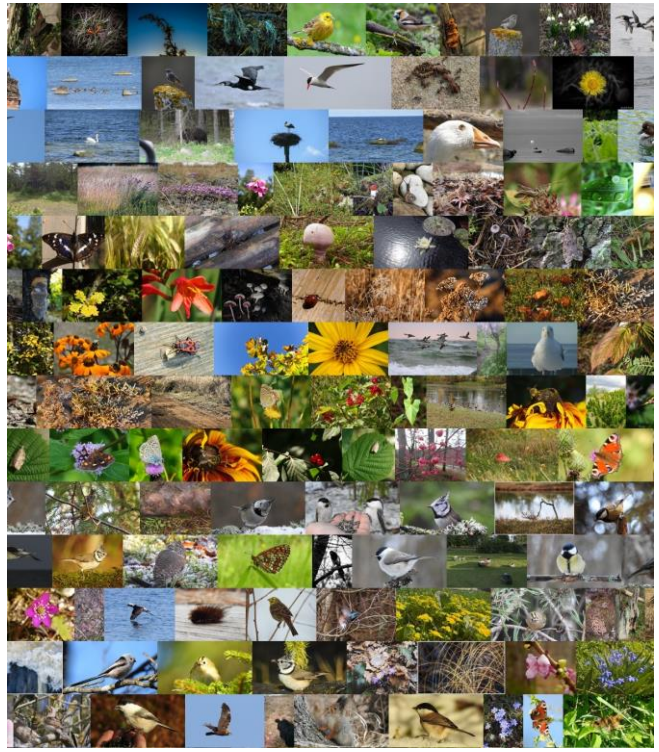
Schirpke, Uta, et al. "Emerging technologies for assessing ecosystem services: A synthesis of opportunities and challenges." *Ecosystem Services* 63 (2023): 101558. DOI: https://doi.org/10.1016/j.ecoser.2023.101558

Cultural ecosystem services assessment – case of Estonia

Landscape watching: nature, outdoors, landscape, tree, nobody, wood, sky, travel, water, summer
Photos: 6154



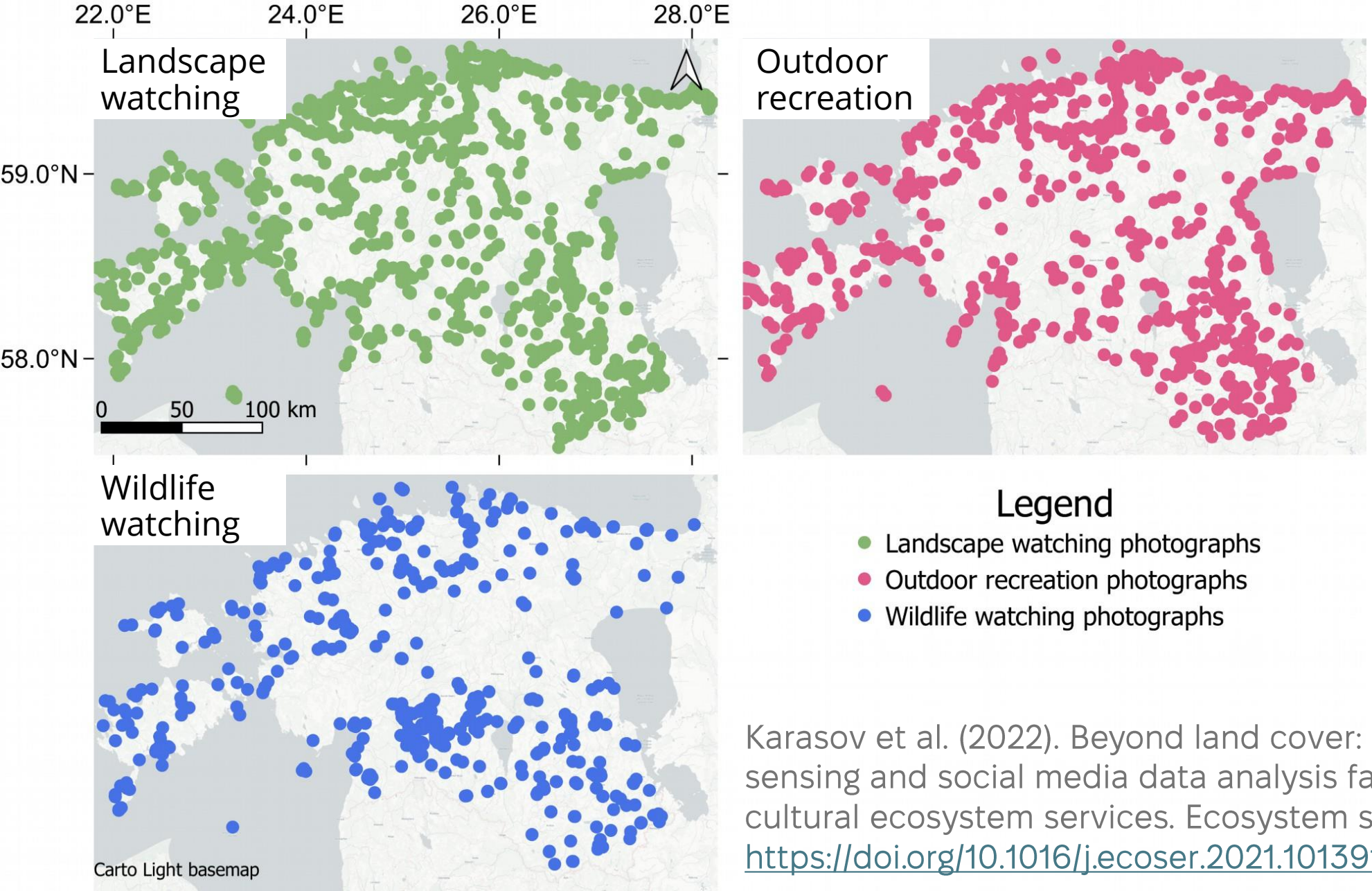
Outdoor recreation: people, recreation, adult, fun, man, leisure, outdoors, one, sport, action
Photos: 2346



Wildlife watching: nature, outdoors, nobody, flora, leaf, wild, wildlife, season, animal, growth
Photos: 1485

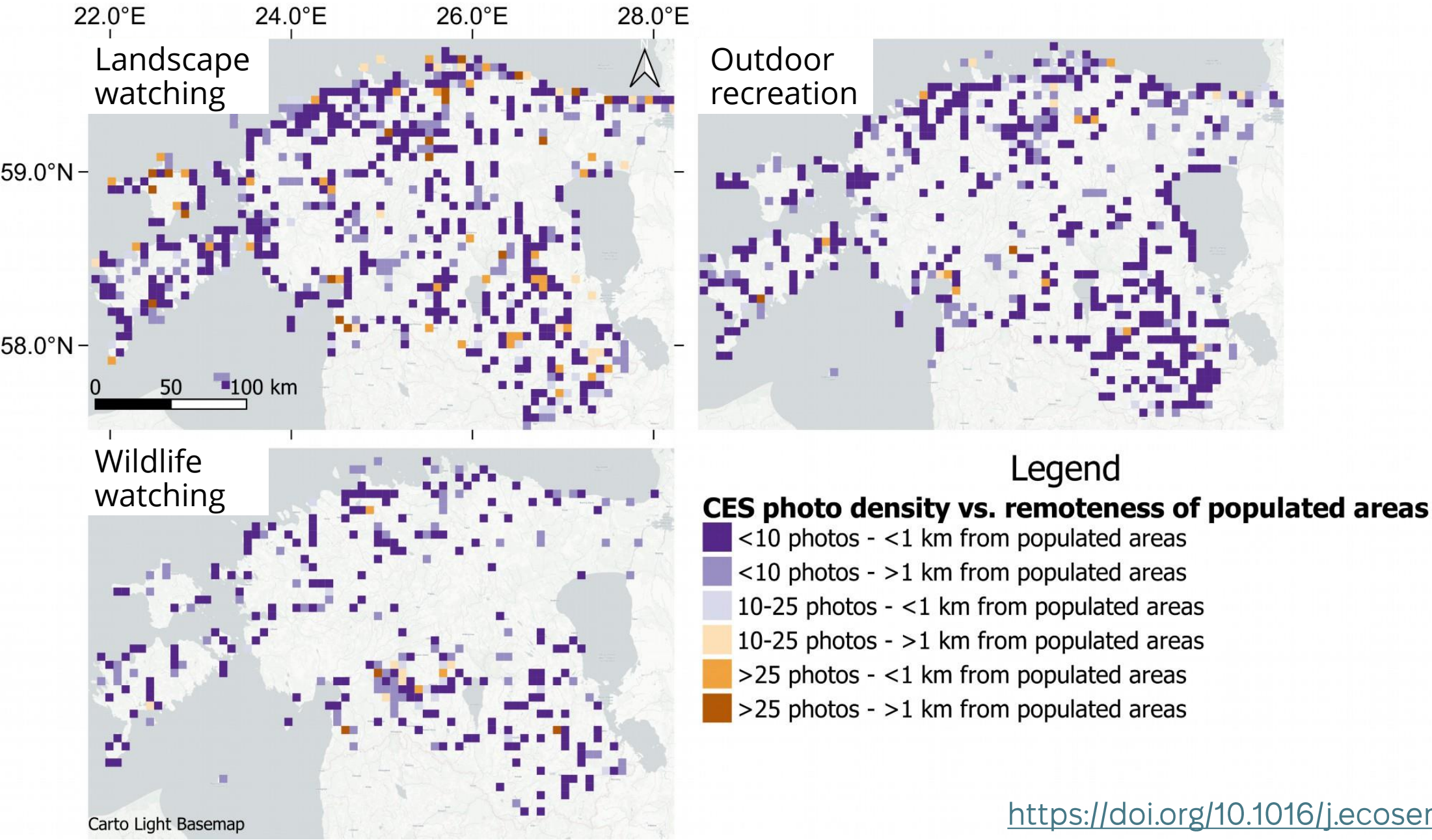
9,983 **Flickr and VK.com** photographs from 1,120 unique users, processed with **Clarifai** platform

Cases of CES use = CES flows



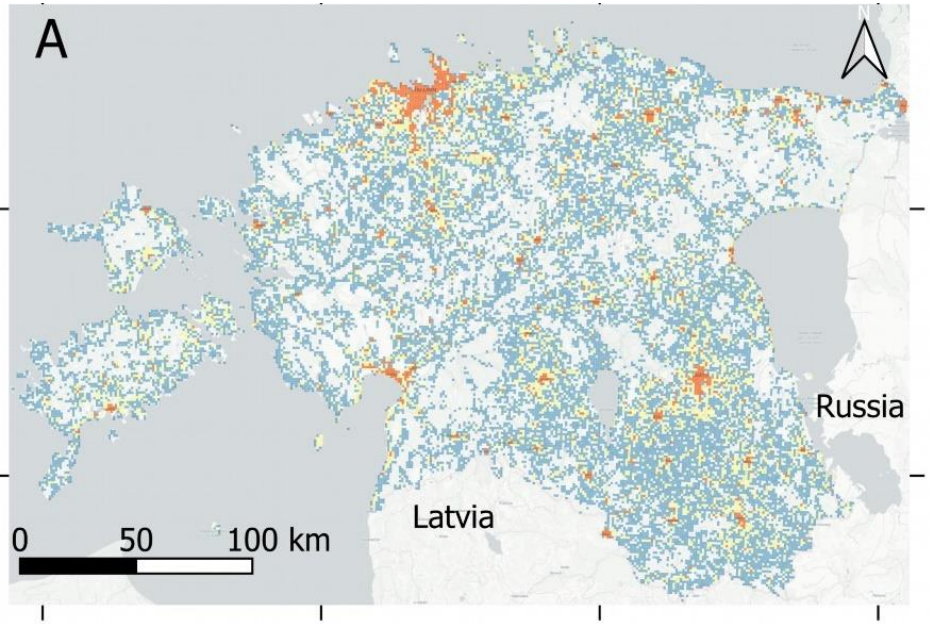
Karasov et al. (2022). Beyond land cover: How integrated remote sensing and social media data analysis facilitates assessment of cultural ecosystem services. Ecosystem services, 53, 101391. https://doi.org/10.1016/j.ecoser.2021.101391

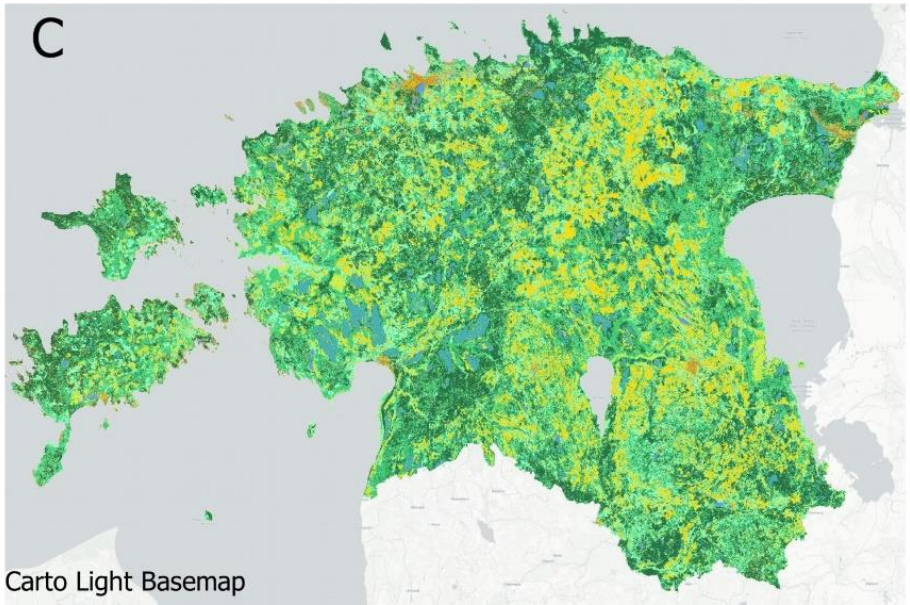
Photo density + travelling efforts = met demand for CES



https://doi.org/10.1016/j.ecoser.2021.101391

Population density = potential demand





Legend

A. Population density
- 4 - 10
- 11 - 100
- 101 - 17786

B. Landsat 8 composite
- Major settlements
- Protected areas

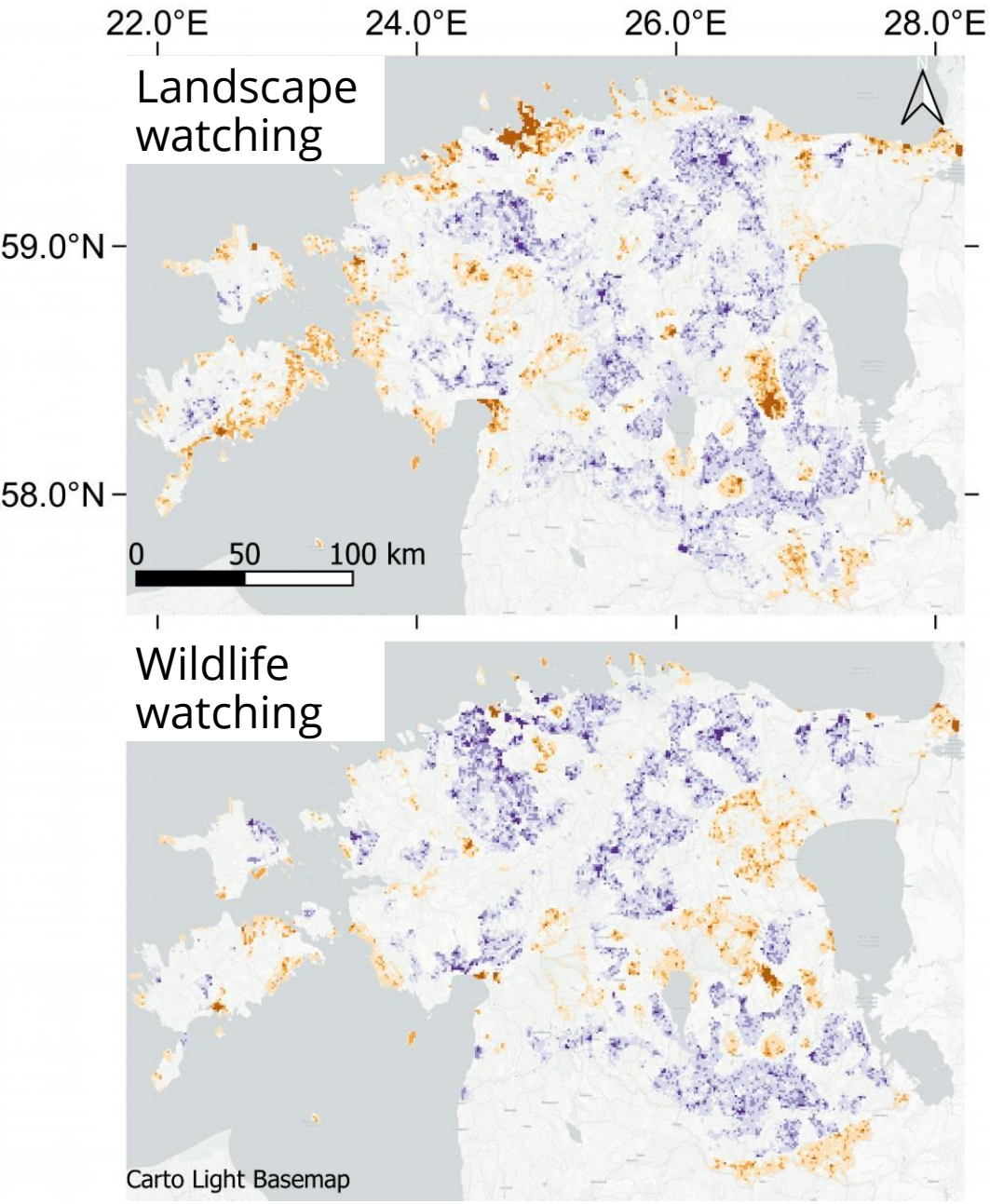
C. S2GLC
- Artificial surfaces
- Cultivated areas
- Broadleaf tree cover
- Coniferous tree cover
- Herbaceous vegetation
- Moors and Heathland
- Marshes
- Peatbogs
- Natural material surfaces
- Water bodies

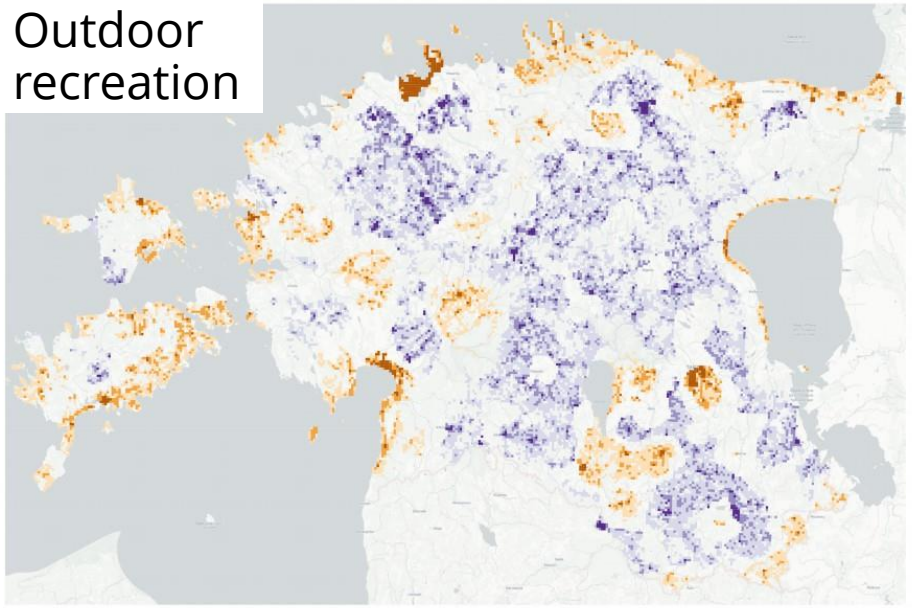
Data for environmental suitability modelling:

- Cloudless summertime Landsat 8 mosaic (2018)
- Land Cover Model of Europe 2017 "S2GLC" (Malinowski et al., 2020)
- Sentinel-1 backscatter data
- NASA SRTM Digital Elevation 30m
- Digital Surface Model ALOS DSM: Global 30m

https://doi.org/10.1016/j.ecoser.2021.101391

Accessibility-demand discrepancies





Legend

CES accessibility clusters vs. population density

- High accessibility - >100 persons per sq. km
- High accessibility - 10-100 persons per sq. km
- High accessibility - <10 persons per sq. km
- Low accessibility - <10 persons per sq. km
- Low accessibility - 10-100 persons per sq. km
- Low accessibility - >100 persons per sq. km

Getis-Ord Gi* hotspot analysis for **median distance to CES photos by road network** per population grid cell

50.3% of Estonians reside in close proximity of landscape watching. 15.0% live in remote access

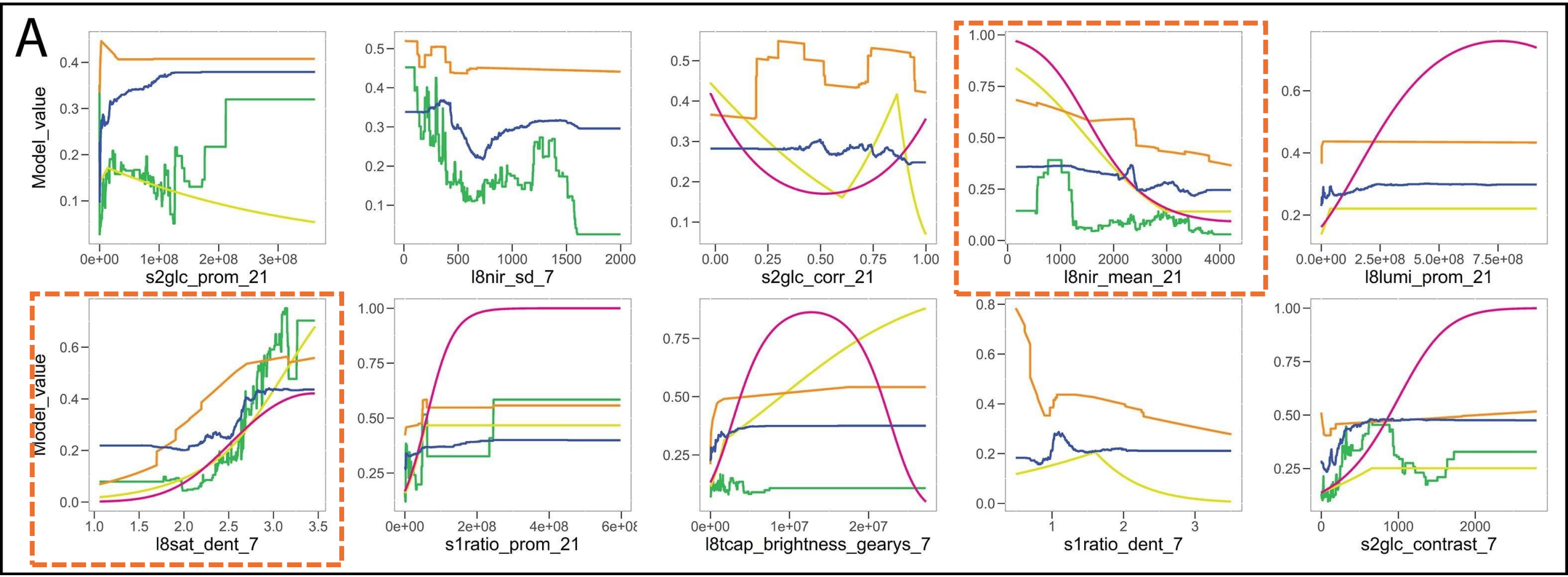
46.6% and 21.1% for outdoor recreation,

24.9% and 18.7% for wildlife watching.

https://doi.org/10.1016/j.ecoser.2021.101391

Landscape watching indicators

Random Forest (cross-validation mean) AUC = 0.9
Boosted Regression Trees (cross-validation mean) AUC = 0.87

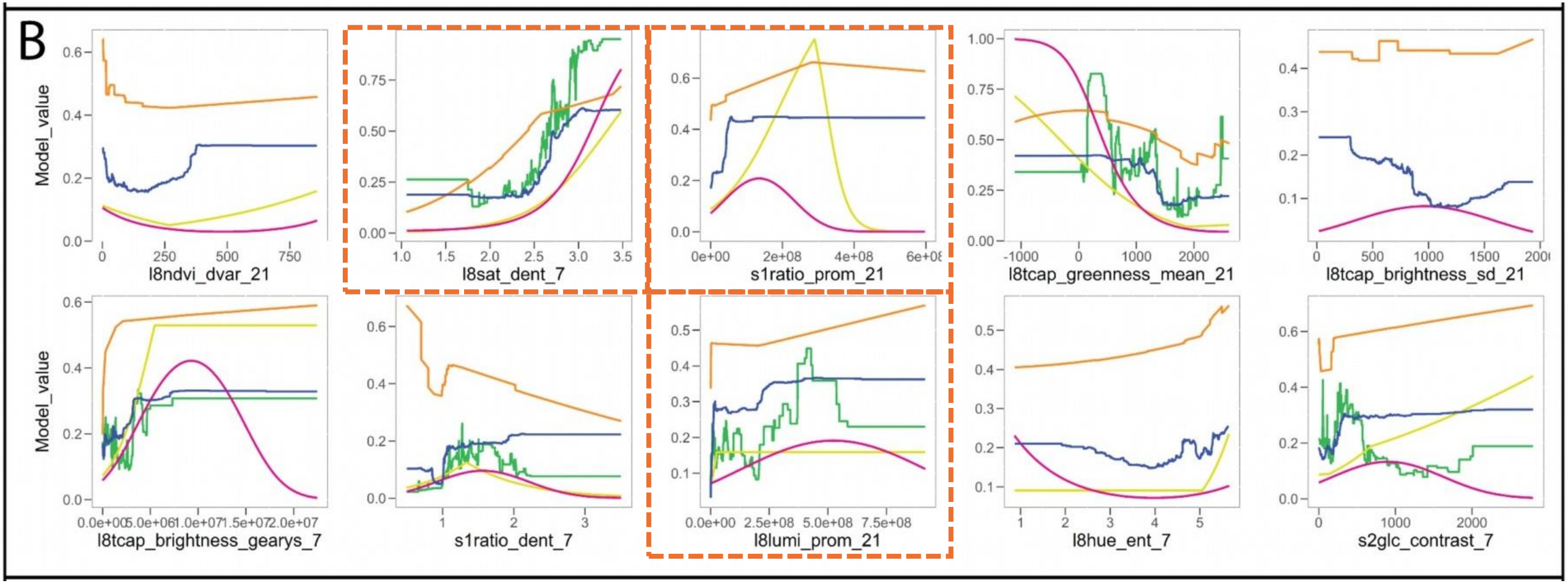


l8sat_dent_7 – positive;
l8nir_mean_21 – negative.

https://doi.org/10.1016/j.ecoser.2021.101391

Outdoor recreation indicators

Random Forest (cross-validation mean) AUC = 0.88
Maxent (cross-validation mean) AUC = 0.84

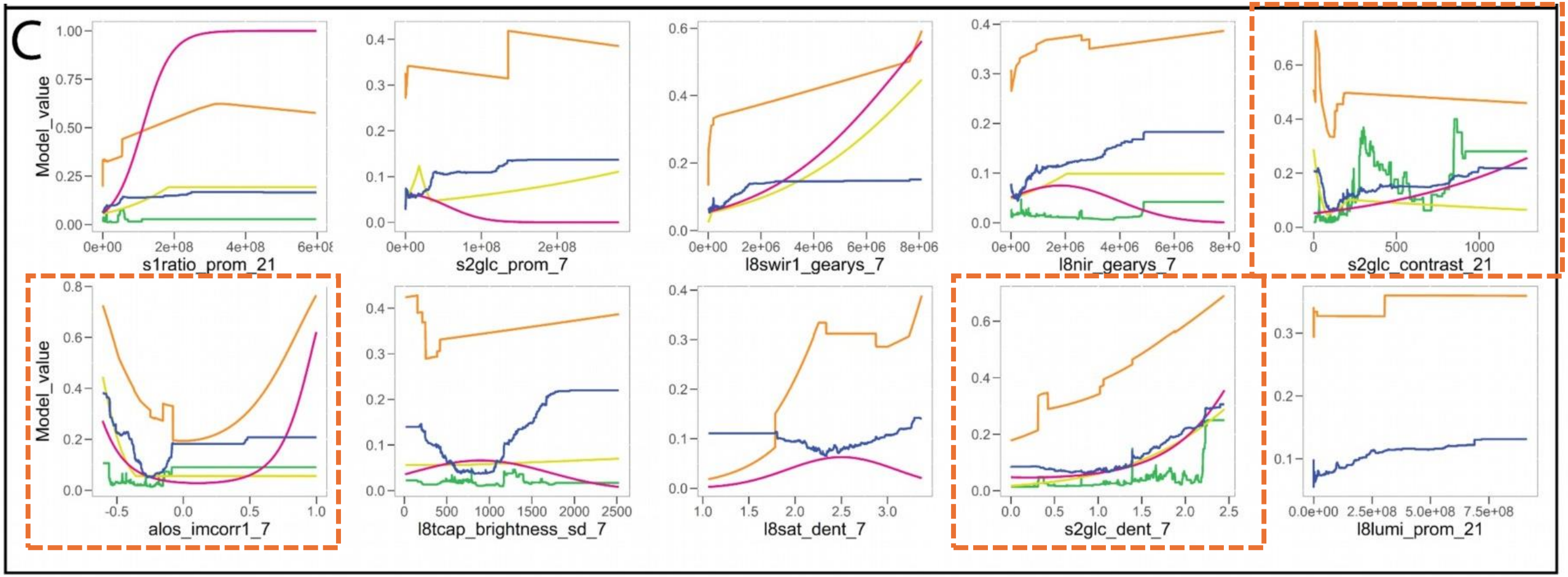


l8sat_dent_7 – positive;
s1ratio_prom_21, l8lumi_prom_21 – positive/optimum.

https://doi.org/10.1016/j.ecoser.2021.101391

Wildlife watching indicators

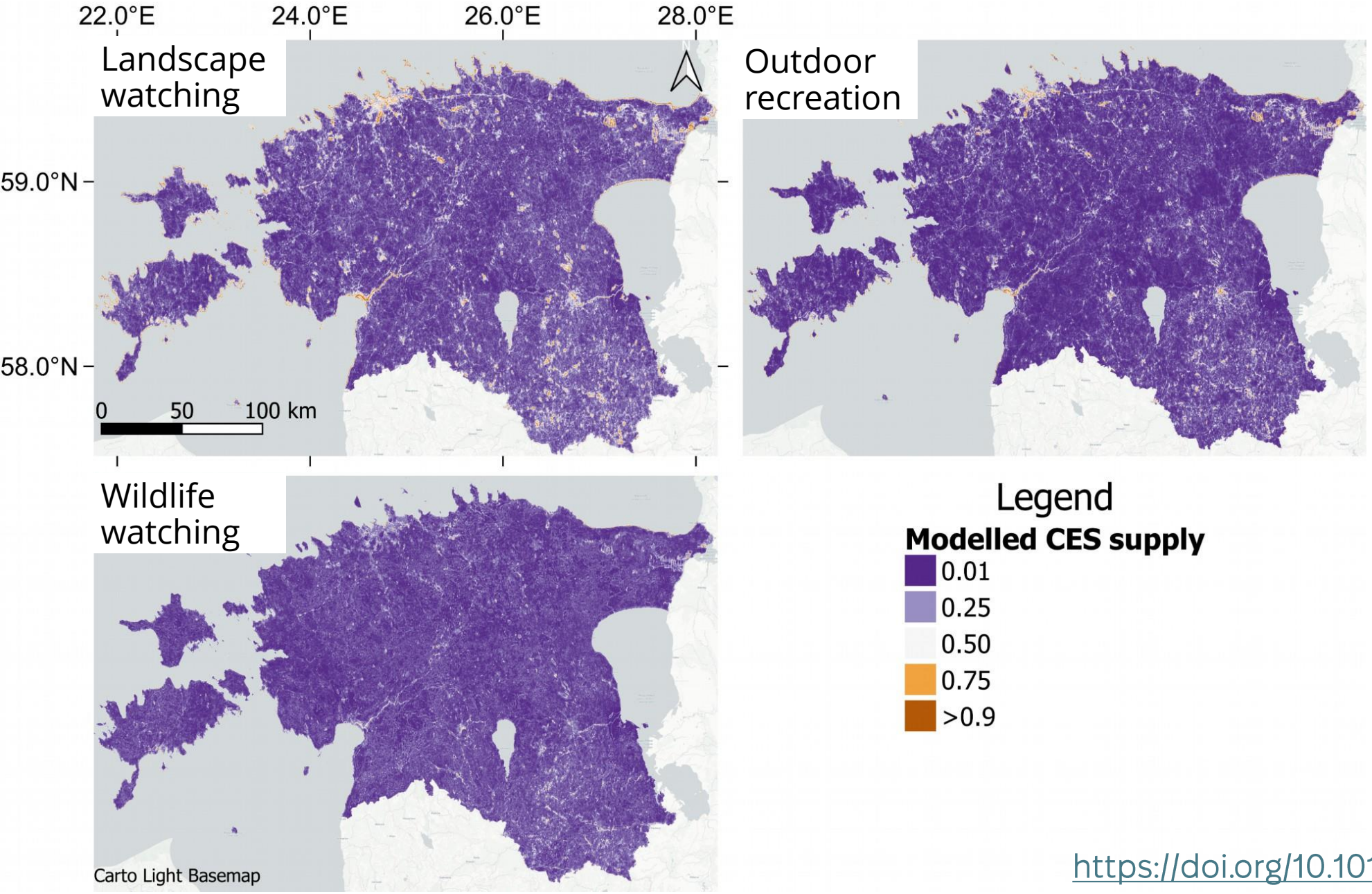
Random Forest (cross-validation mean) AUC = 0.85
Boosted Regression Trees (cross-validation mean) AUC = 0.84



s2glc_dent_7 – positive;
s2glc_contrast_7 – rather positive

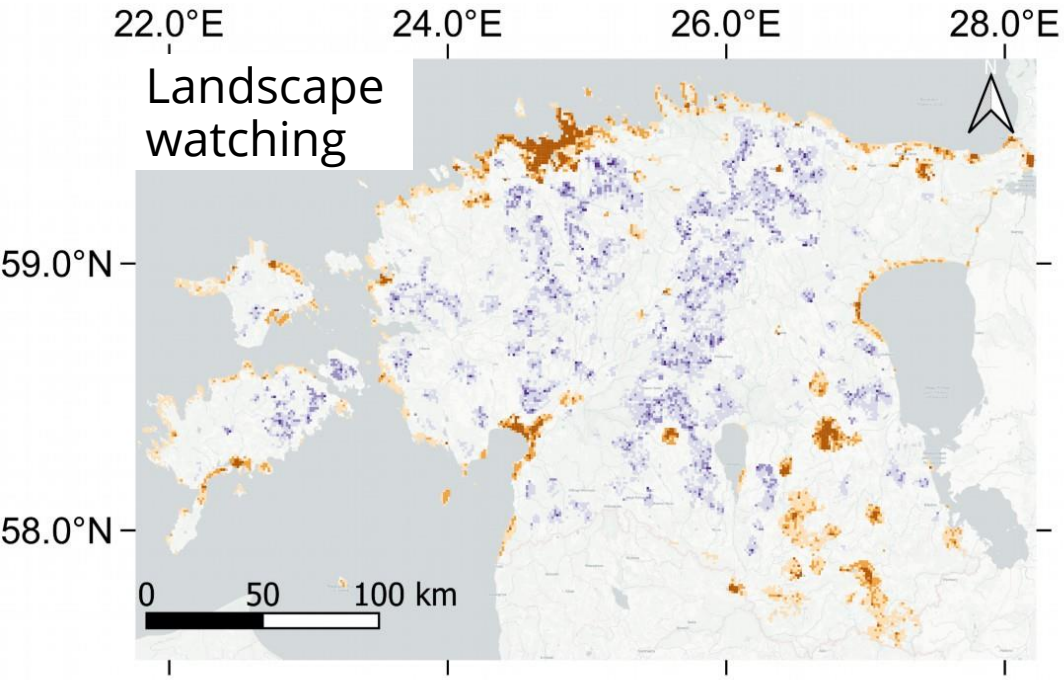
https://doi.org/10.1016/j.ecoser.2021.101391

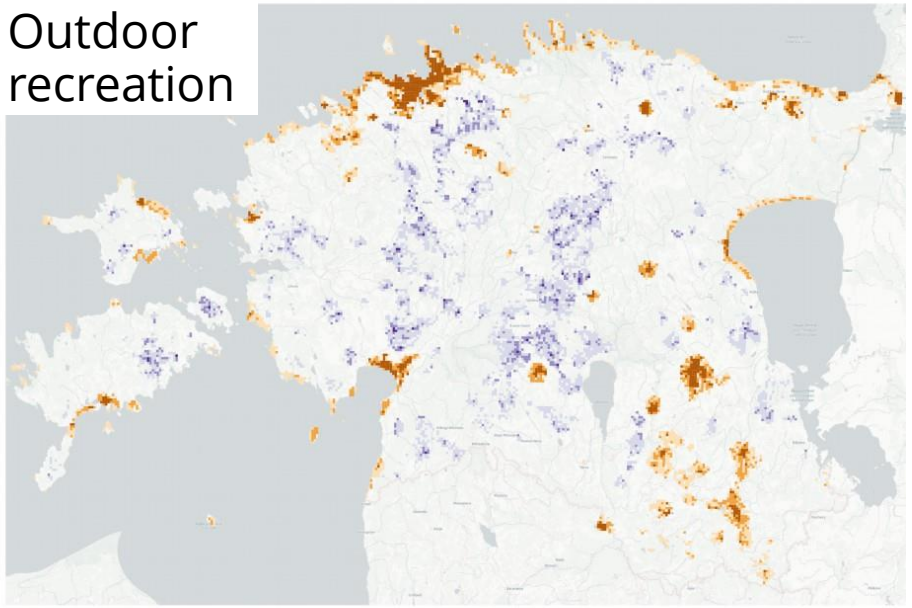
Environmental suitability for taking photos of:

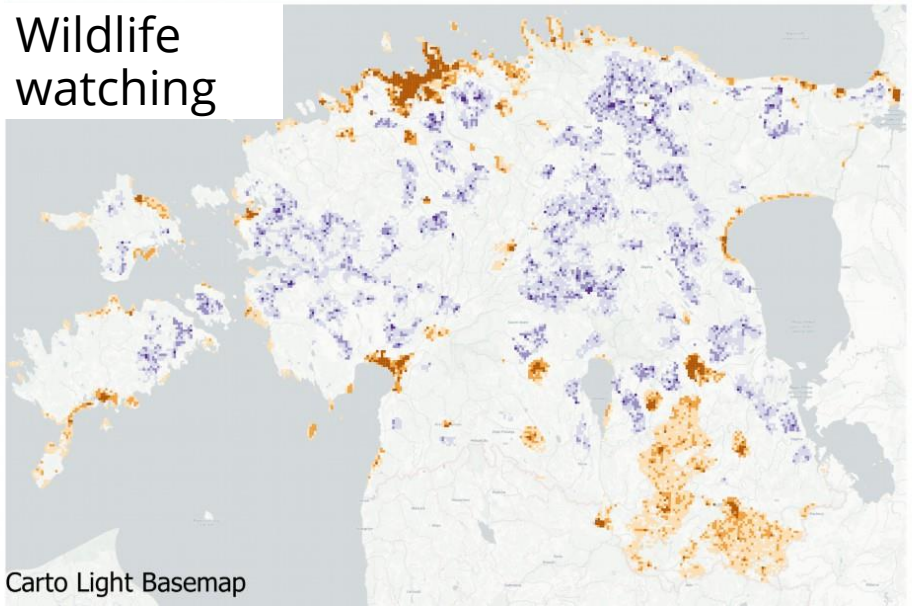


https://doi.org/10.1016/j.ecoser.2021.101391

Supply-demand discrepancies







Legend

CES supply clusters vs. population density

- Cold spots - >100 persons per sq. km.
- Cold spots - 10-100 persons per sq. km.
- Cold spots - <10 persons per sq. km.
- Hot spots - <10 persons per sq. km.
- Hot spots - 10-100 persons per sq. km.
- Hot spots - >100 persons per sq. km.

Getis-Ord Gi* hotspot analysis for **median environmental suitability** per population grid cell

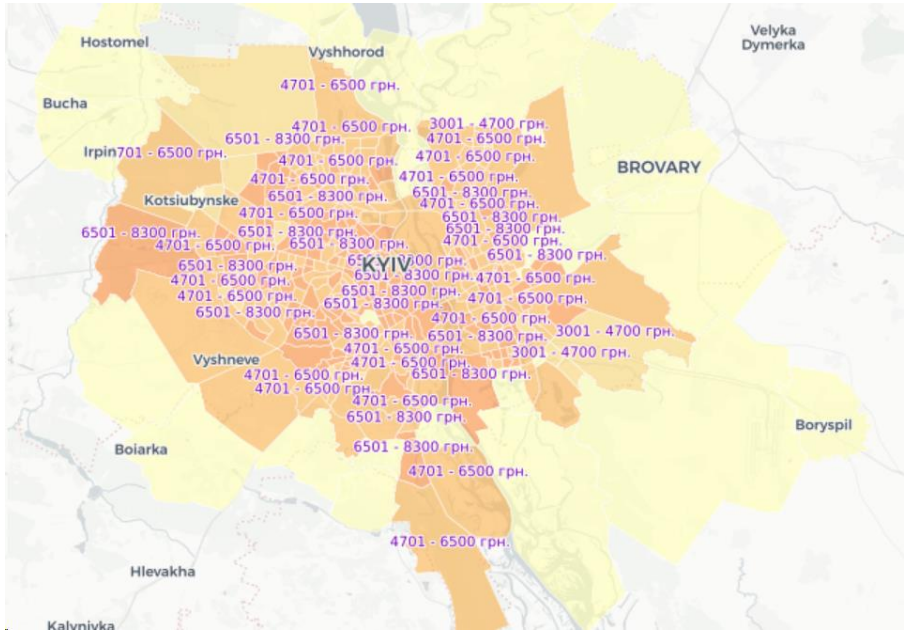
69.4% of Estonians reside in landscape watching hot spots, and 5.5%—in cold spots.

70.4% and 3.1% for outdoor recreation,

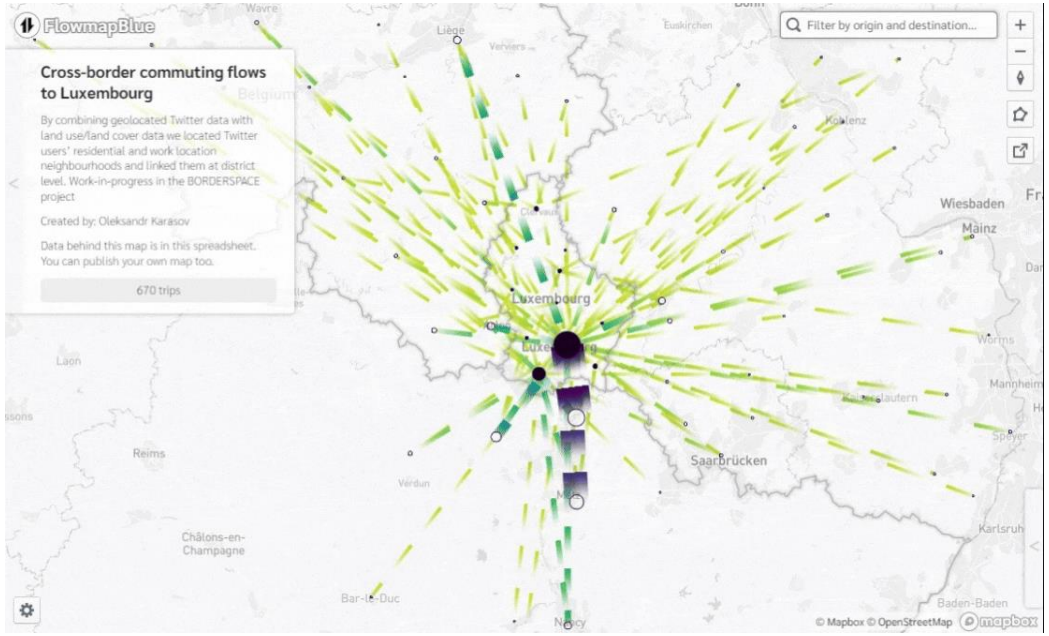
67.1% and 7.3% for wildlife watching

https://doi.org/10.1016/j.ecoser.2021.101391

How social media and remote sensing shape future of cultural ecosystem services research: data integration

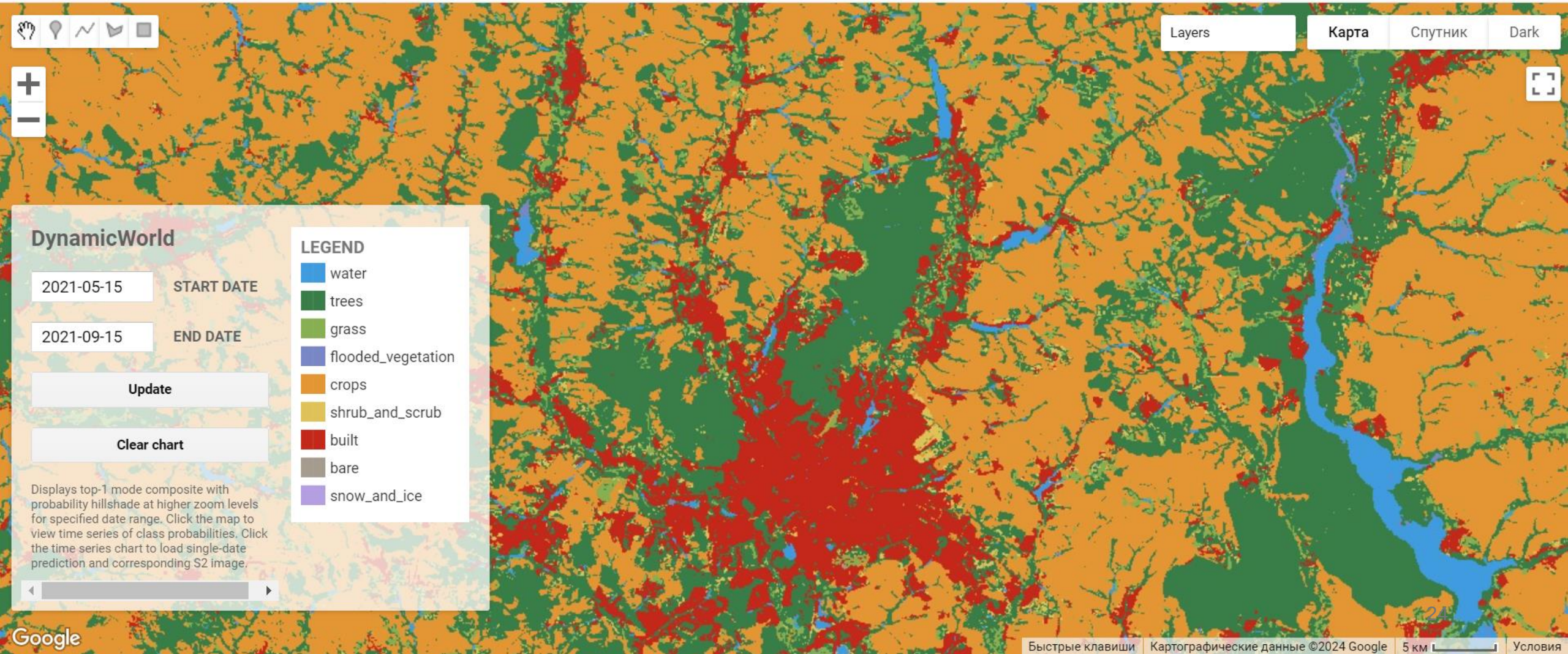


Median income in Kyiv

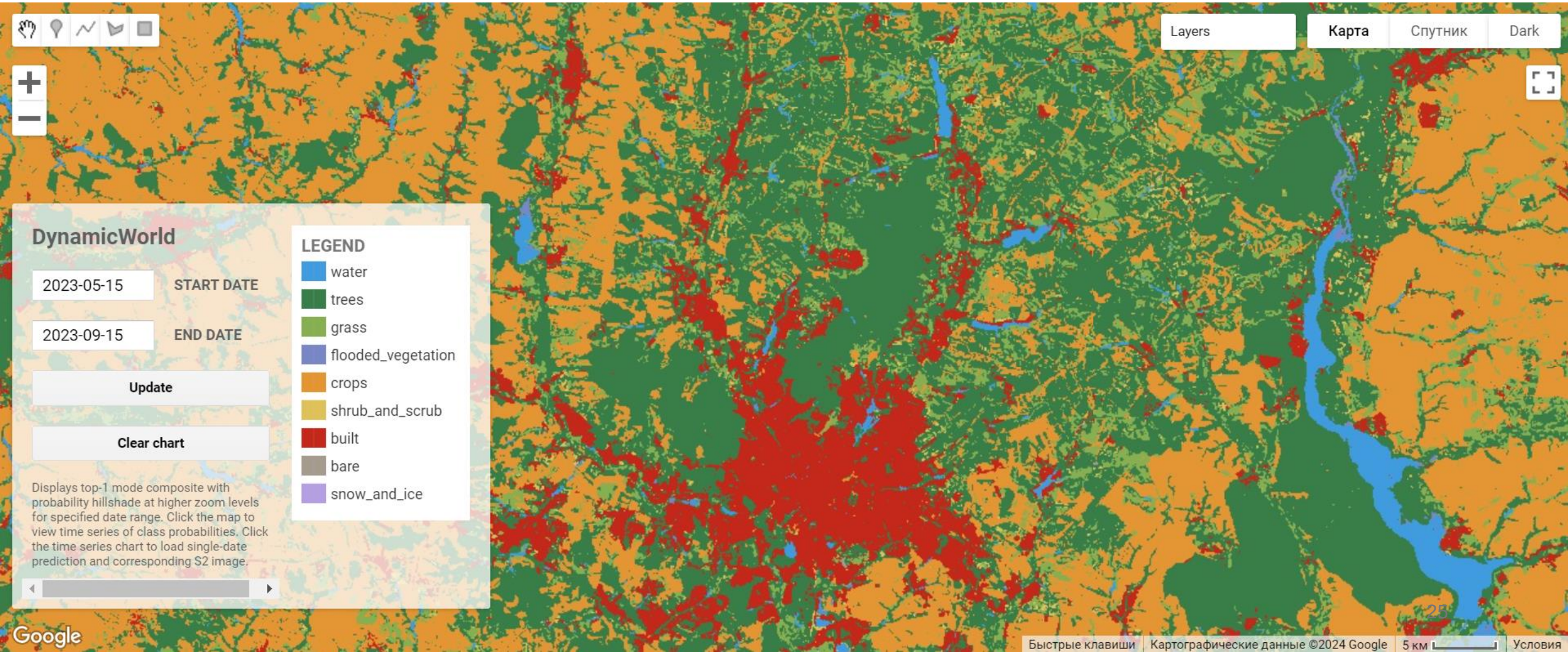


Cross-border commuters in the Greater Region of Luxembourg (Twitter data)

How social media and remote sensing shape future of cultural ecosystem services research: data integration



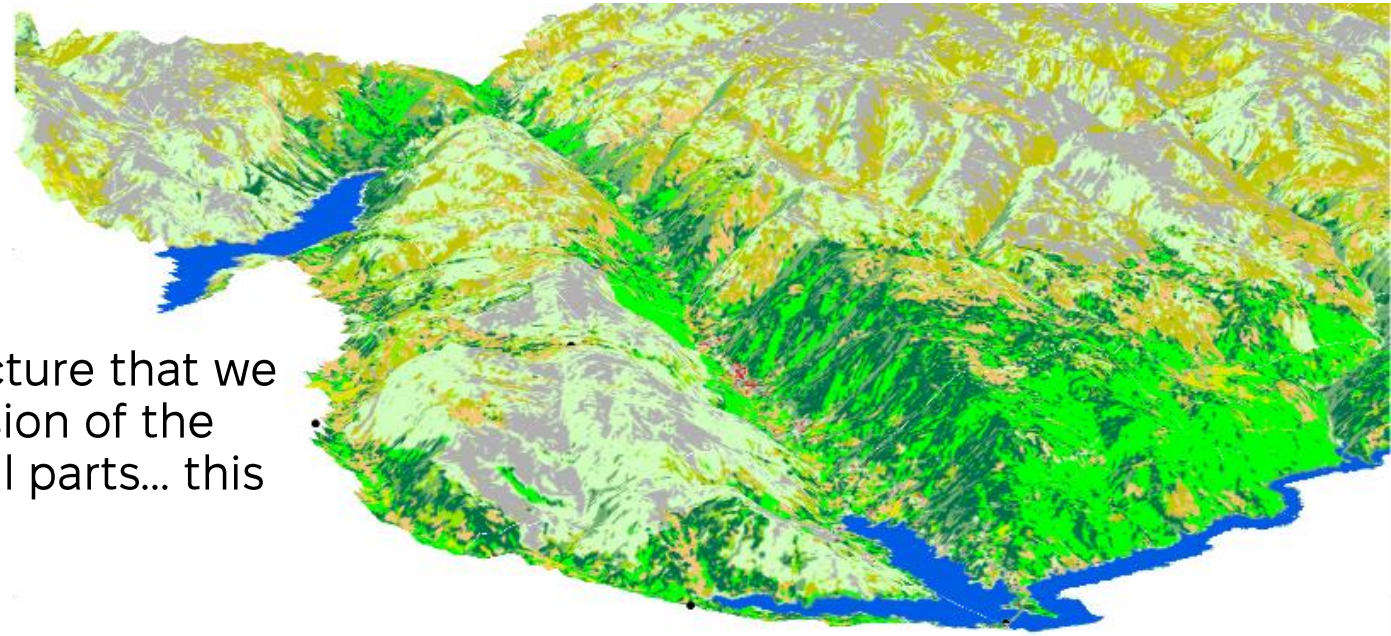
How social media and remote sensing shape future of cultural ecosystem services research: data integration



How social media and remote sensing shape future of cultural ecosystem services research: visual landscape

Landscape coherence – "… an ordered structure that we can understand and where the comprehension of the whole is more significant, than the individual parts… this is a feature of all landscapes " (Bell, 1999).

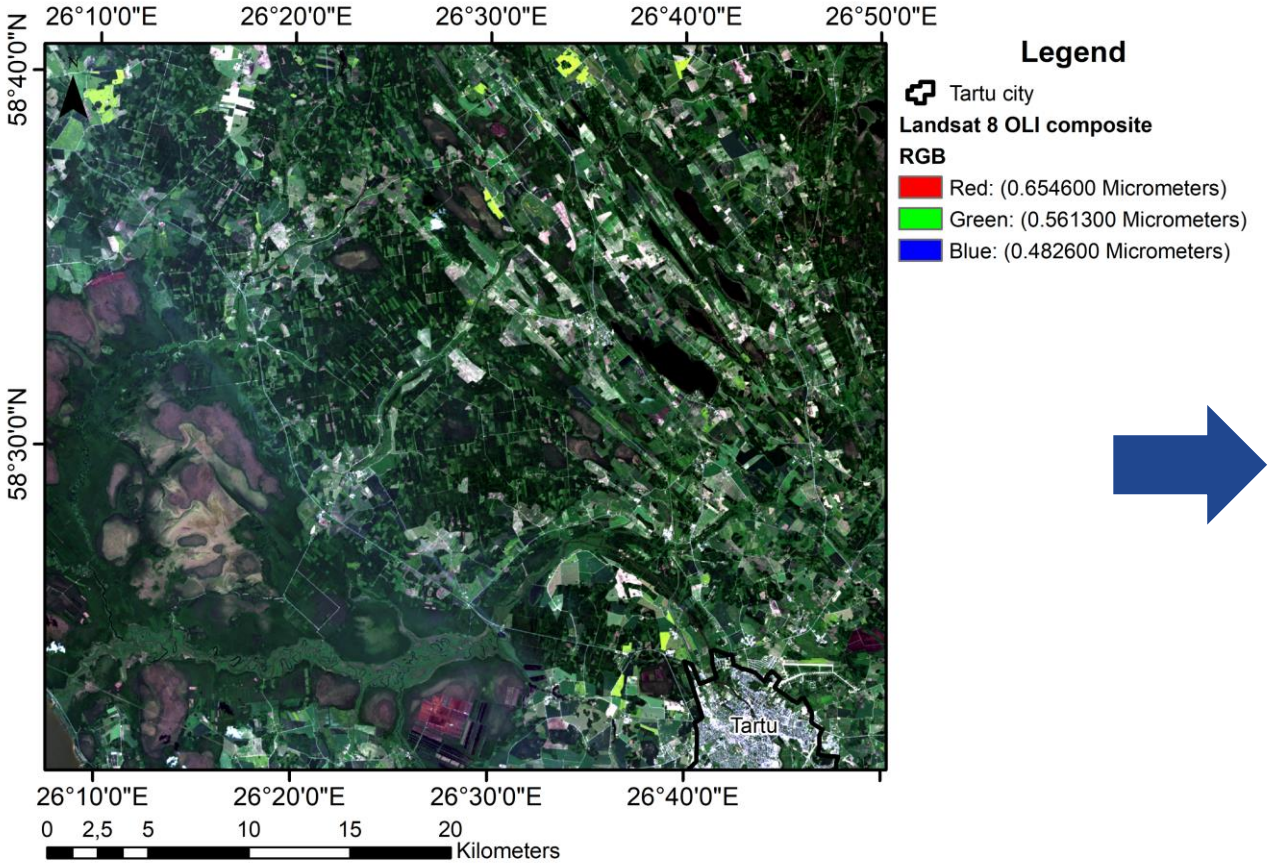
$$Landscape\ coherence = \frac{I_{landscape}}{I_{land\ cover} + I_{landforms}}$$



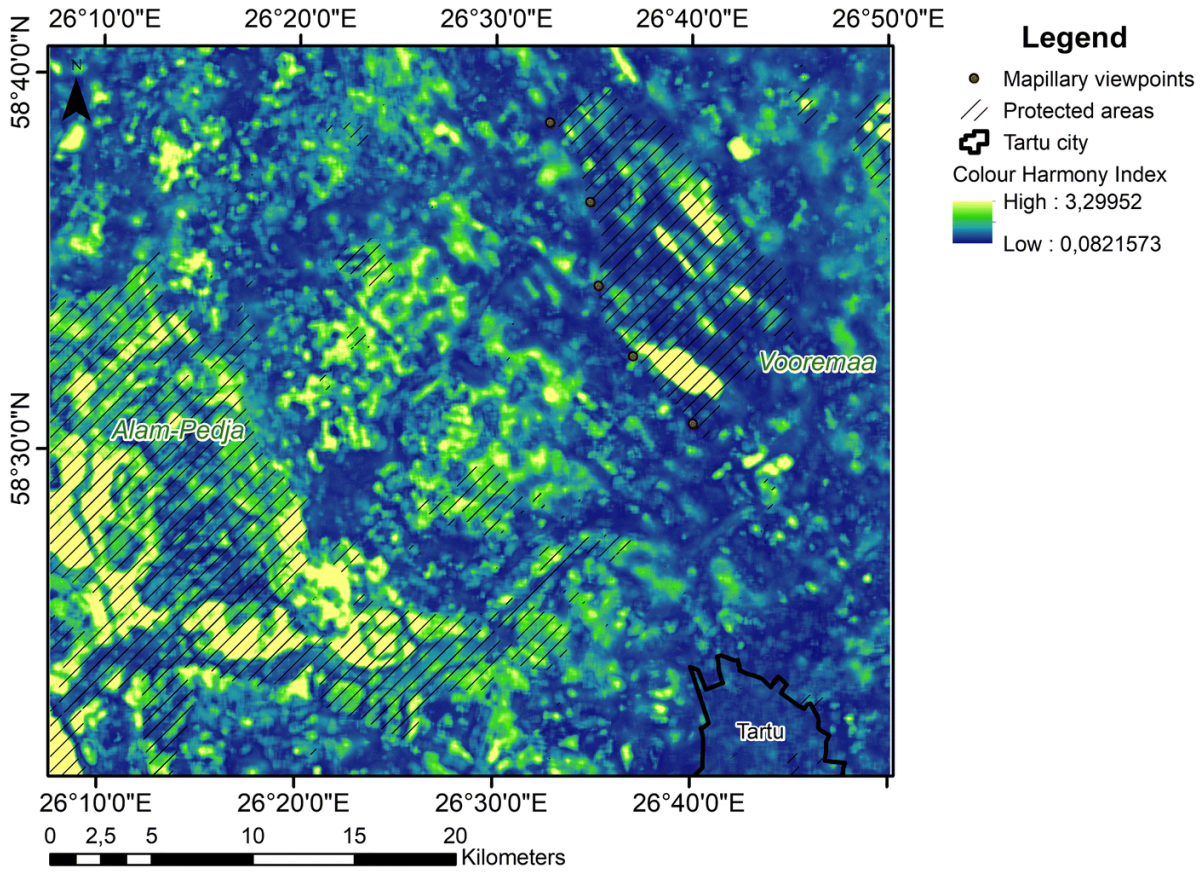
Digital landscape model of Gerês mountains – Peneda-Gerês National Park, Portugal

Karasov, O., Vieira, A. A. B., Külvik, M., & Chervanyov, I. (2020). Landscape coherence revisited: GIS-based mapping in relation to scenic values and preferences estimated with geolocated social media data. *Ecological Indicators*, *111*, 105973. https://doi.org/10.1016/j.ecolind.2019.105973

How social media and remote sensing shape future of cultural ecosystem services research: visual landscape



RGB satellite image



Colour harmony mapping

Karasov, O., Külvik, M., Chervanyov, I., & Priadka, K. (2019). Mapping the extent of land cover colour harmony based on satellite Earth observation data. *GeoJournal*, *84*, 1057-1072. https://doi.org/10.1007/s10708-018-9908-x

How social media shape future of cultural ecosystem services research: changing APIs issues

Meta Content Library and API

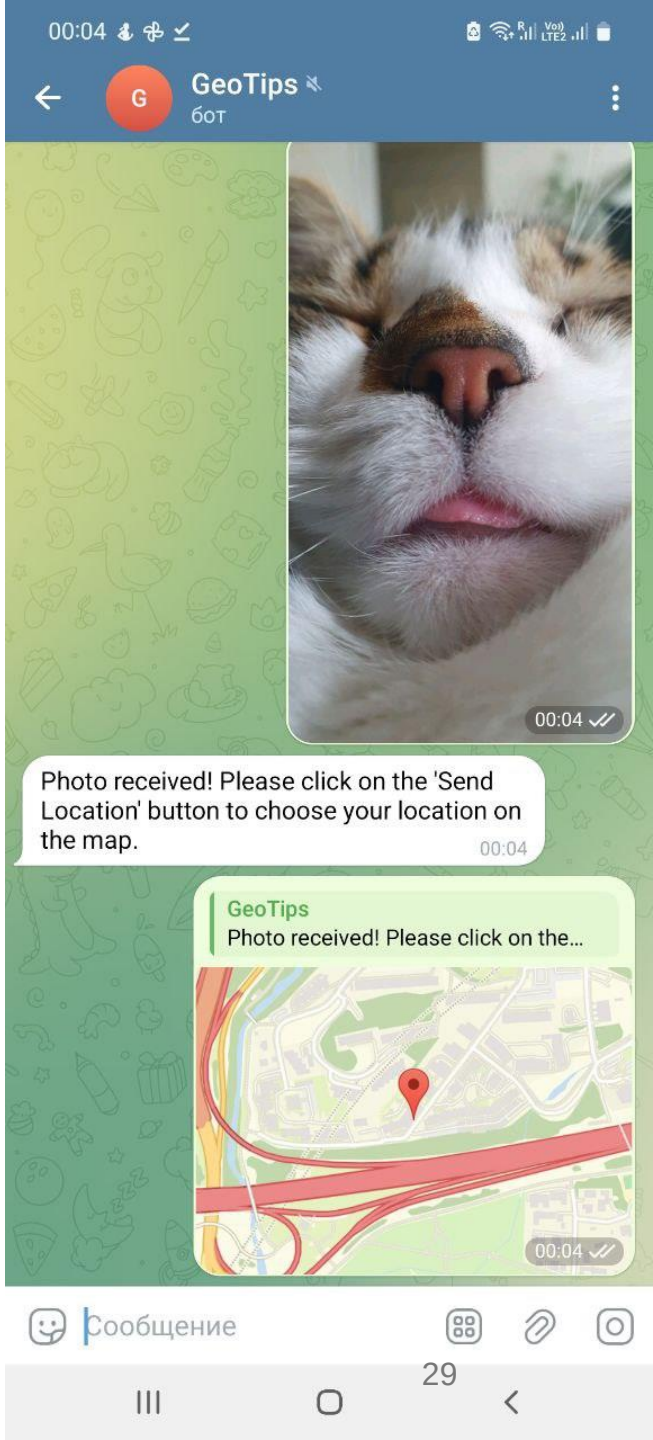
UPDATED MAY 1, 2024

Meta Content Library and Content Library API provide comprehensive access to the full public content archive from Facebook and Instagram. Researchers can apply for access to the tools with the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan. Learn more

Apply

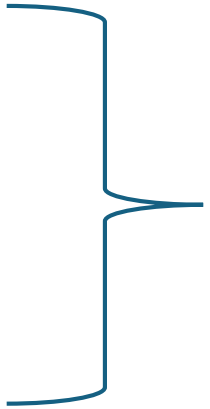
How social media shape future of cultural ecosystem services research: PPGIS is on board!

E.g., Telegram provides an API for collecting any media files and geolocation (with informed consent!)



How social media and remote sensing shape future of cultural ecosystem services research

- Automatisation, reproducibility, data integration
- Going beyond land cover / NDVI
- Mobility matters!
- Landscape aesthetics
- Advanced participation opportunities – validation



Operationalising CES

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