

Outdoor recreation



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Contributions of cultural services to the ecosystem services agenda

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Edited by P. J. Turner, Arizona State University, Tempe, AZ, and approved April 20, 2012 (received for review September 9, 2011)



MEA, 2005

“nonmaterial benefits people obtain from ecosystems,” and specifically lists “cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation and ecotourism”



1. Landscape aesthetics

- Emphasize visual scenic beauty
- Differences in aesthetics preferences
- Methods:
 - Monetary evaluation (e.g. property values)
 - More often as relative measure according to observers (e.g. ranking)



2. Cultural Heritage

- “the legacy of biophysical features, physical artifacts, and intangible attributes of a group or society that are inherited from past generations, maintained in the present, and bestowed for the benefit of future generations”
- Includes built environment and artifacts
- Tangible and intangibles (myths, legends and practices)
- Identity + livelihood + ecology:
 - E.g.1: Satoyama concept in Japan
 - E.g.2: Darjeeling region in India
 - E.g.3: wine regions...

Methods: expert knowledge elicitation



3. Recreation and Tourism

- In the field of conservation biology, recreation and tourism have been recognized mostly as a threat to ecosystems
- **Everyday short-term recreation** in nearby green spaces, **day tourism**, and **overnight tourism** are often lumped together
- Mental and physical health effects of outdoor recreation
- Role of infrastructure, accessibility and ecological conditions
 - Biodiversity → Ecotourism
- Methods: Visitor simulations models



4. Spiritual significance

- Religious conservation → Environmental stewardship
- E.g. Sacred groves as a long-term biodiversity pool preserved from short term interests
- Sacred sites and tourism
 - E.g. pilgrimage route to Santiago de Compostela
- Methods: qualitative analysis



Previous examples in ARIES

1. Sacred significance: an MCA to establish how sacred is each point of the landscape
 - based on distance from key natural and human made features
1. Recreation: a machine learning process to extract suitability of the landscape given known touristic places
 - links scenic beauty, religious activities, infrastructural elements and env. Conditions



Sacredness assessment

The screenshot displays the k.LAB Eclipse Platform interface. The main window shows a map of the Gangolihat region with a heatmap overlay representing sacredness levels. The map is titled "behavior:ValueOfReligiousActivity". The interface includes several tool windows:

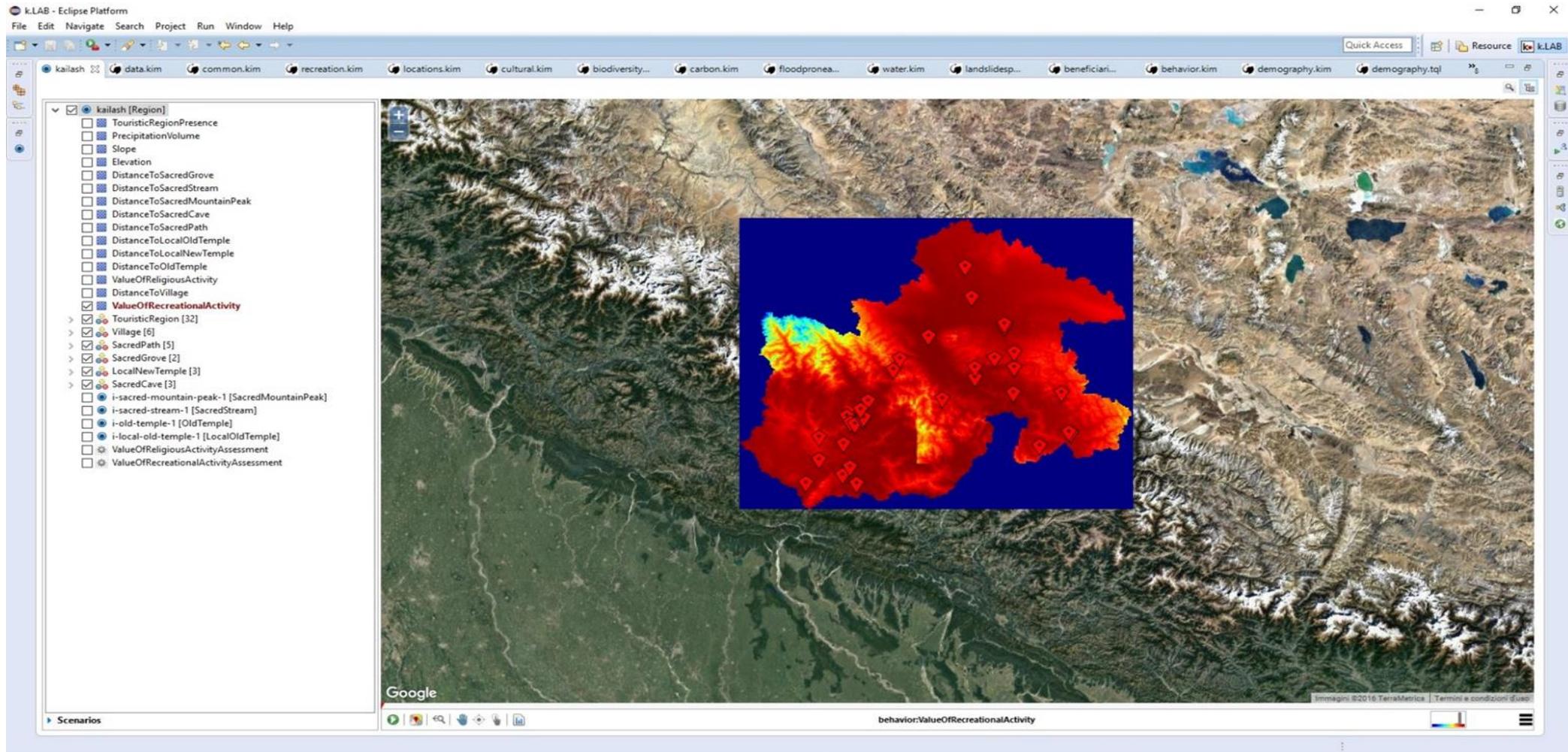
- Navigator:** Shows a project tree with folders like "im", "im.aries", "im.data", "org.aries.ibm", "org.icimod.es", "bn", "data", "icimod.es.beneficiaries", "icimod.es.biodiversity", "icimod.es.carbon", "icimod.es.common", "icimod.es.cultural", "icimod.es.data", "icimod.es.floodproneareas", "icimod.es.landslidesproneareas", "icimod.es.locations", "icimod.es.recreation", "icimod.es.sediment", and "icimod.es.water".
- Task:** Shows a task progress window for "icimod.es.cultural.value-of-religious-activity-assess" with a notification panel listing various processing steps and warnings.
- Engine:** Shows engine status: "k.LAB engine v0.9.10 running as stefano.balbi", version 0.9.10, memory 2217/2773 MB, up for 2 h 52 sec.
- Knowledge:** Shows a table of bookmarks for the "Observation Database".

Bookmark	Description
Intl. Biosphere Reserve of the Mediterranean	
ICIMOD - Whole Kailash	transboundary sacred landscape around Mount Kailash
ICIMOD - Indian Kailash	area of the Pithoragarh district of Uttarakhand Indian State
ICIMOD - HI-LIFE	far eastern Himalayas transboundary landscape
ICIMOD - Kanchenjunga	transboundary area around Mount Kanchenjunga, the third highest in the World, locate...
ICIMOD - Hindu Kush Himalayan Region	extends 3,500 km over eight countries from Afghanistan to Myanmar - http://www.icim...

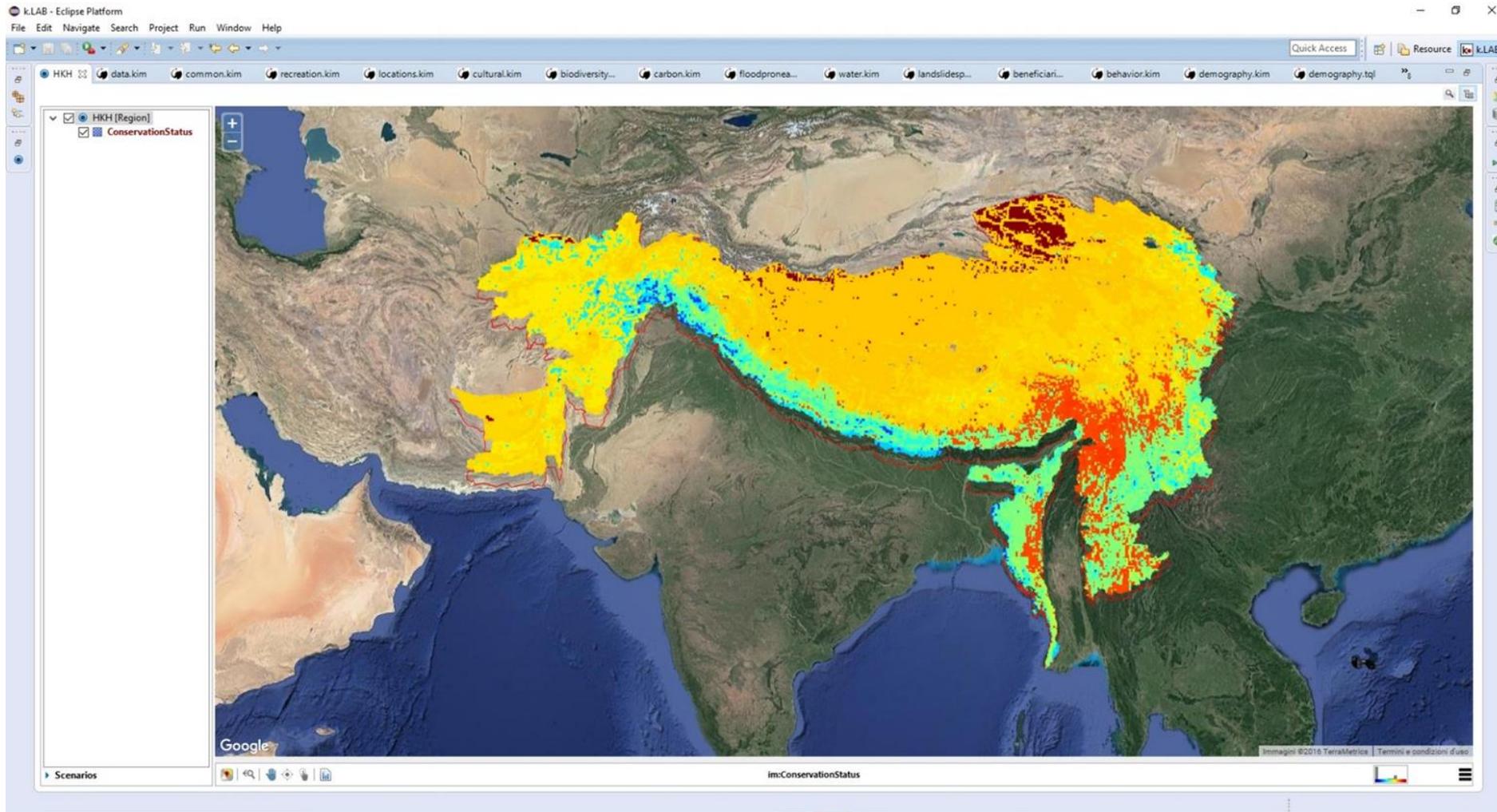
Scenarios: No scenarios active
Space: Grid 218 by 188 (40984 grid cells)
Time: 01/01/2010 to 01/01/2011 (366 steps)



Tourist attractiveness



Beneficiaries



The Kailash Sacred Landscape example

- List of factors for assessing cultural value in KSL for three targeted stakeholders:
 - Pilgrims
 - Local people
 - Tourism related (hikers, tour operators)
- Distinguish between **activities** (hiking, skiing, pray,...) and **features**.
- **Features** can be:
 - Natural
 - Human made



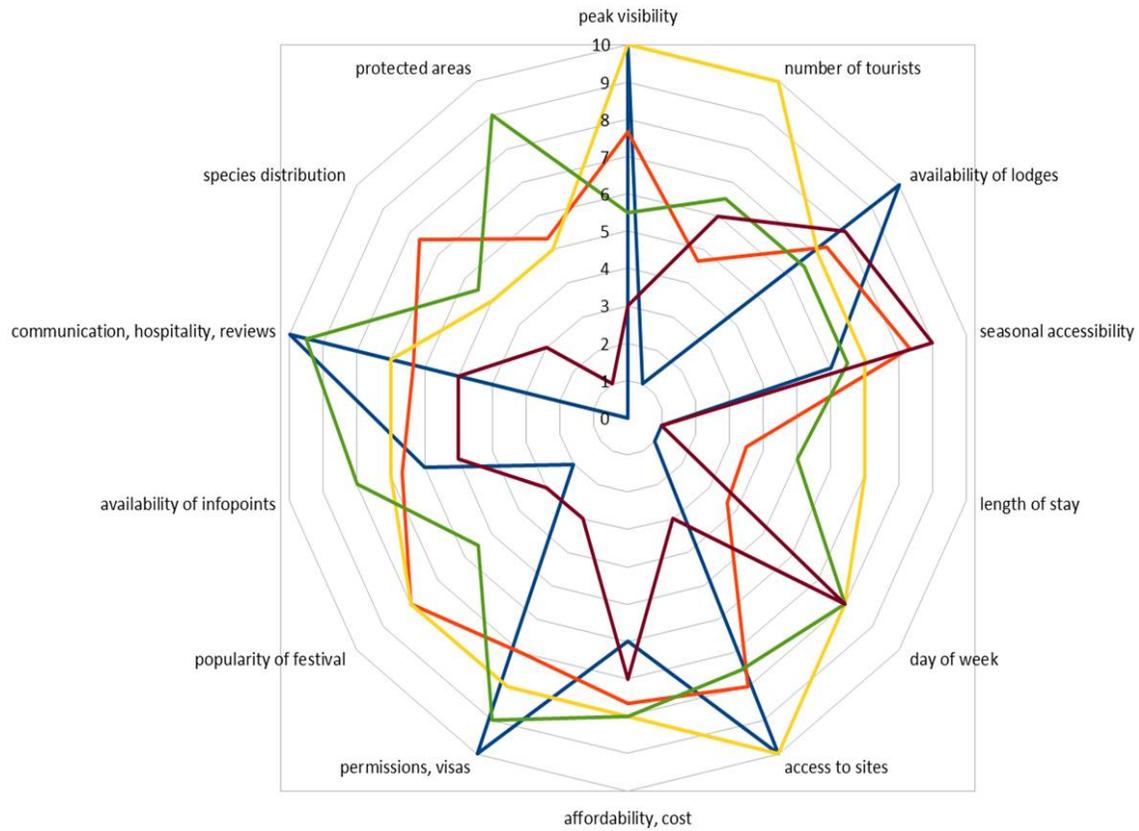
Practical Part (workshop in Kathmandu)

- Participants are divided in groups representing stakeholders and the list with all criteria (using the excel file) is used for assigning marks to them (1-10) or pairwise.
- A facilitator assists each group
- Participants can give individual weights and then compute the average/mode or agree on a common weight.

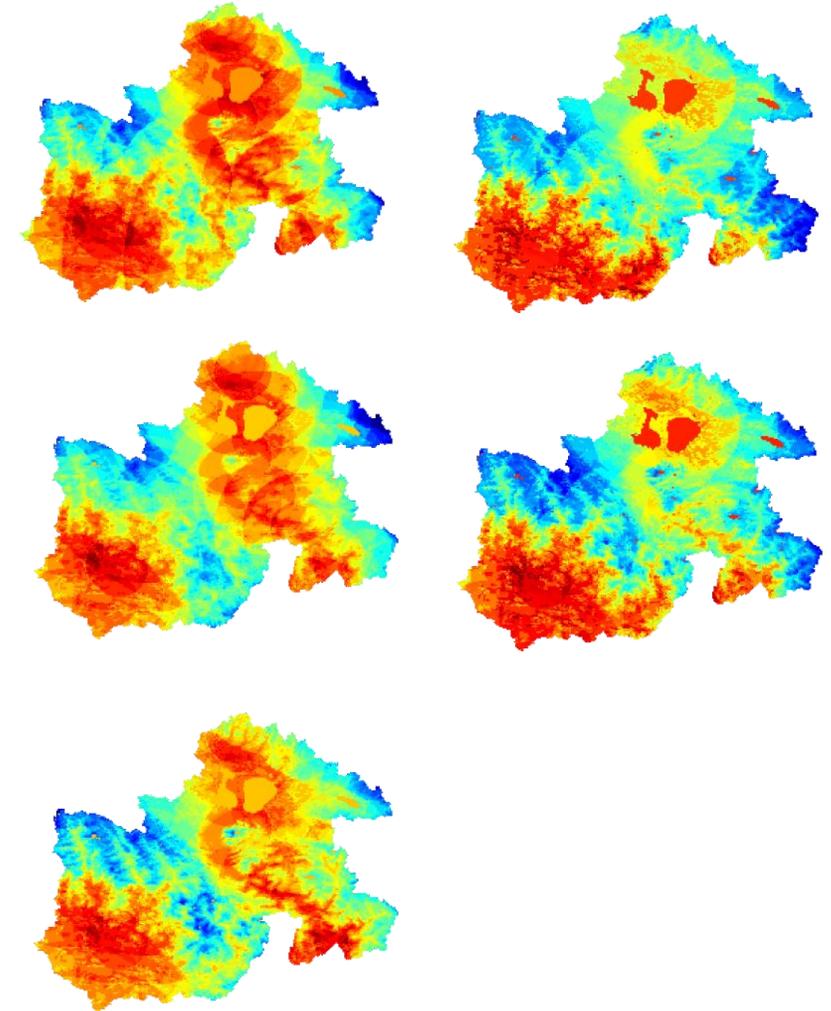
- Excel files will be merged and radar-plots will be shown representing the different weights assigned to each criteria based on each stakeholder perspective.
- A final discussion on the results and on the possible methodologies/indicators to measure each criteria.



Results



- pilgrims
- tourists
- tour operators
- governance
- locals

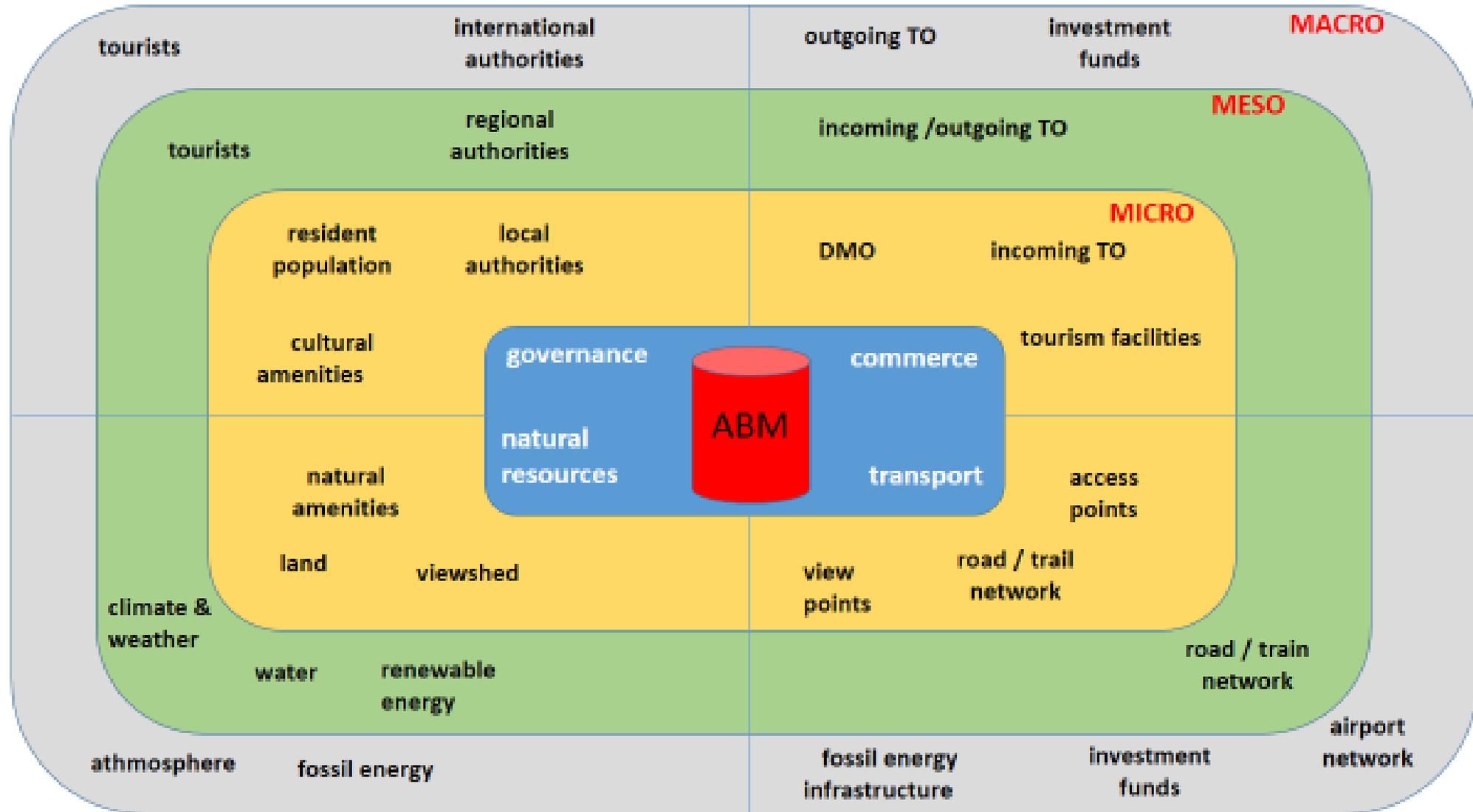


Follow up: Data and behavioural models

- Simulate how human behavior and global environmental change interact to affect the travelling dynamics in the region and explore the effect of related policy interventions.
- Linked to activities
- Official data
- Crowdsourced: Flickr pictures – Twitter data



Tourism systems and main agent classes



References: model sources of inspiration

- Parrachini et al. 2014

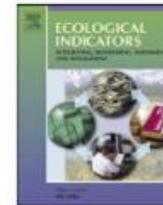
Ecological Indicators 45 (2014) 371–385



Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind



Mapping cultural ecosystem services: A framework to assess the potential for outdoor recreation across the EU

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- ESTIMAP

<http://publications.jrc.ec.europa.eu/r>



Main Concepts of Supply

1. Hemeroby, often associated to naturalness as the complementary term, with a high degree of hemeroby equating to a high **human influence** on a natural environment
2. Environmental features of attractiveness for outdoor recreation (**potential value of outdoor recreation**):
 - **Protected areas**
 - Rivers (**waterways**) and lakes (**water bodies**)
 - **Coastline**
 - **Mountain Peaks**



Main Concepts of Demand

1. Distance to Human Settlements

2. Travel time: a proxy of accessibility of a site

- These two can be combined into Impedance:
 - the probability of traveling to a site

3. Population that wants to recreate (**population density factor**)



Scalability of concepts

Connected to Collective Knowledge

- Waterways

```
@color(blue)
model each earth:Waterway
  "Automatically scales to find the types of settlements most relevant to each scale of observation."
  using
    gis.osm.query(
      feature-type="line",
      equal=("waterway", "river"))
    if [space.scale <= 11],
    gis.osm.query(
      feature-type="line",
      equal=("waterway", ("river", "stream")))
    if [space.scale > 11];
```

- Human Settlements

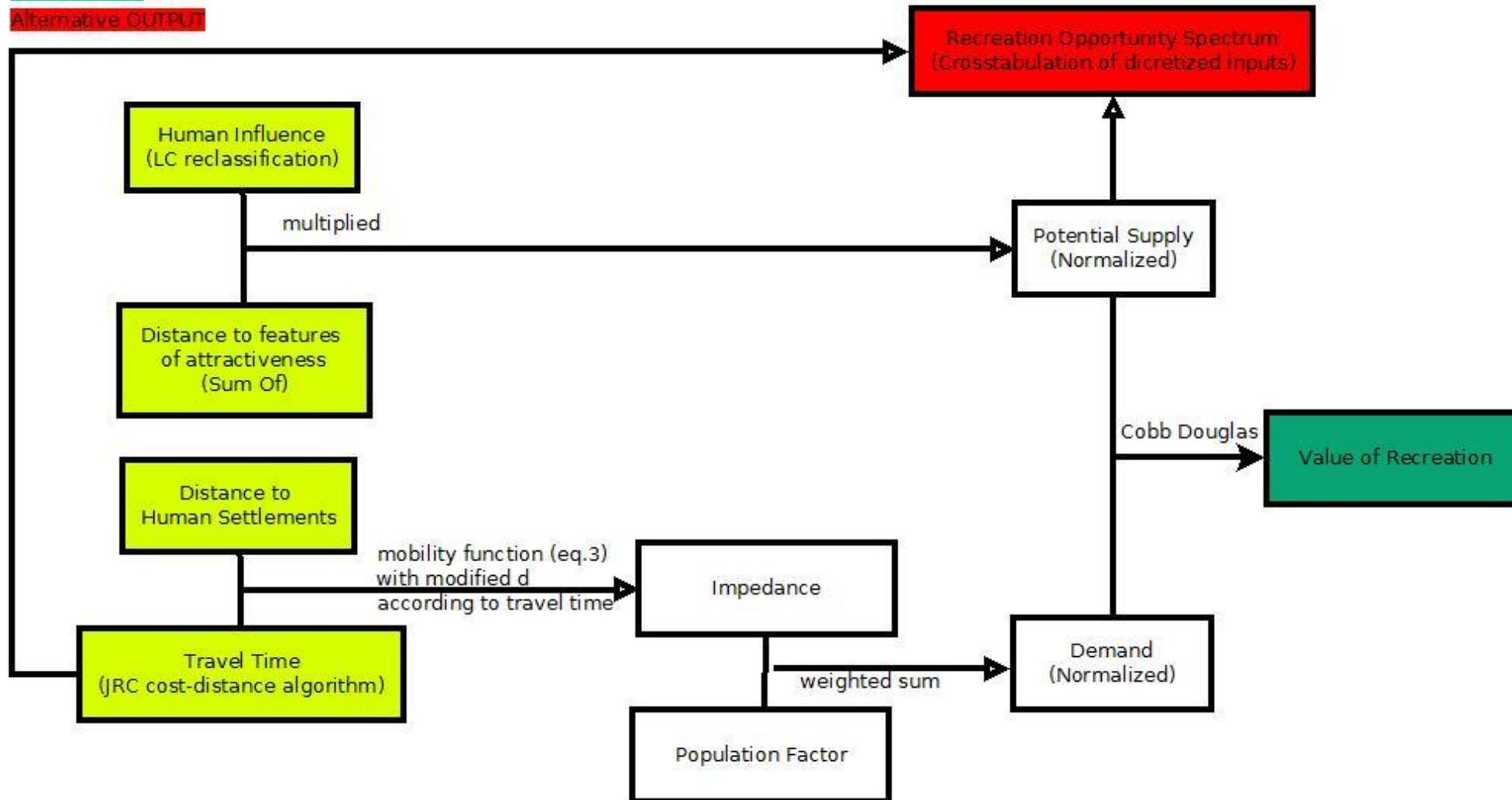
```
model each infrastructure:HumanSettlement
  "Automatically scales to find the types of settlements most relevant to each scale of observation."
  using
    gis.osm.query(
      feature-type="point",
      equal=("place", "city"))
    if [space.scale <= 5],
    gis.osm.query(
      feature-type="point",
      equal=("place", ("city", "town")))
    if [space.scale > 5 && space.scale < 9],
    gis.osm.query(
      feature-type="point",
      equal=("place", ("city", "town", "village")))
    if [space.scale >= 9];
```

The baseline model

Primary INPUT

Main OUTPUT

Alternative OUTPUT



k.IM code (1)

```
@documented(hemeroby_table)
define HEMEROBY_TABLE as {{
    landcover | hemeroby
    -----|-----
    landcover:ArtificialSurface | 7,
    landcover:ArableLand | 6,
    landcover:NonIrrigatedArableLand | 5, //4b-5a-5b
    landcover:PermanentlyIrrigatedArableLand | 5, //4b-5a-5b
    landcover:RiceField | 5, //4b-5a-5b
    landcover:PermanentCropland | 4, //4a-4b-5a //ADD
    landcover:Vineyard | 4, //4a-4b-5a
    landcover:FruitAndBerryPlantation | 4, //4a-4b-5a
    landcover:OliveGrove | 4, //4a-4b-5a
    landcover:Pastureland | 4, //3-4a-4b
    landcover:AnnualCroplandAssociatedWithPermanent | 4, //4a-4b-5a
    landcover:ComplexCultivationPatternedLand | 4, //4a-4b-5a
    landcover:AgriculturalLandWithNaturalVegetation | 4, //4a-4b-5a
    landcover:AgroForestryLand | 4, //3-4a-4b
    landcover:BroadleafForest | 3, //2-3-4a
    landcover:ConiferousForest | 3, //2-3-4a
    landcover:MixedForest | 3, //2-3-4a
    landcover:NaturalGrassland | 3, //2-3-4a
    landcover:MoorAndHeathland | 2,
    landcover:SclerophyllousVegetation | 2,
    landcover:TransitionalWoodlandScrub | 2,
    landcover:BeachDuneAndSand | 2,
    landcover:BareArea | 1, //ADD
    landcover:BareRock | 1,
    landcover:LichenMoss | 1,
    landcover:SparseVegetation | 2,
    landcover:BurnedLand | 5,
    landcover:GlacierAndPerpetualSnow | 1,
    landcover:Wetland | 1,
    landcover:Mangrove | 1,
    landcover:InlandMarsh | 2,
    landcover:PeatBog | 2,
    landcover:SaltMarsh | 2,
    landcover:Saline | 5,
    landcover:IntertidalFlat | 1,
    landcover:WaterBody | 1
}}
```

k.IM code (2)

```
@documented(recreation.values.potential)
model im:Potential value of behavior:Outdoor behavior:Recreation
  observing
    magnitude of proportion of behavior:Outdoor in behavior:Recreation named human_influence,
    distance to conservation:ProtectedArea in m named distance_to_pristine_areas,
    distance to earth:Coastline in m named distance_to_coast,
    distance to earth:Waterway in m named distance_to_streams,
    distance to earth:WaterBody in m named distance_to_lakes,
    distance to earth:MountainPeak in m named distance_to_mountains
  set to [
    human_influence *
      ((nodata(distance_to_pristine_areas) ? 0 : distance_to_pristine_areas)
      + (nodata(distance_to_lakes) ? 0 : distance_to_lakes)
      + (nodata(distance_to_streams) ? 0 : distance_to_streams)
      + (nodata(distance_to_mountains) ? 0 : distance_to_mountains)
      + (nodata(distance_to_coast) ? 0 : distance_to_coast))
  ] then [ self.invert() ];
```



k.IM code (3)

```
@todo('semantics is tentative')
model im:Impedance of behavior:TravelConnection
  observing
    distance from infrastructure:HumanSettlement in m
      named distance_from_human_settlements,
    im:Duration of behavior:TravelConnection in day named travel_time
  set to [
    travel_time < 0.02085
      ? (451/(450 + Math.exp(1.12 * (10**-4) * distance_from_human_settlements)))
      : (451/(450 + Math.exp(1.12 * (10**-4) * (distance_from_human_settlements + 30000))))
  ];
```



Travel time in the baseline model

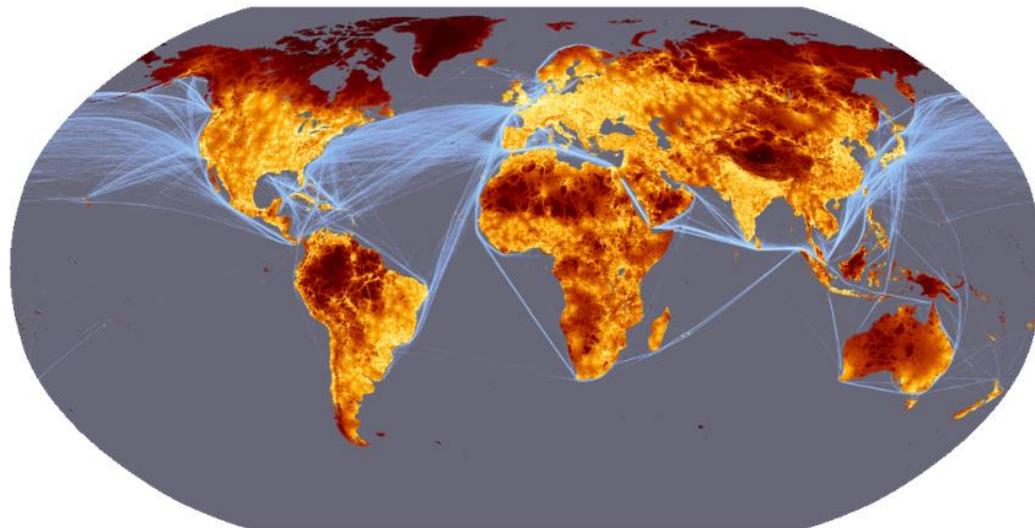
- <http://forobs.jrc.ec.europa.eu/products/gam/>

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Travel time to major cities: A global map of Accessibility



0 1 2 3 4 6 8 12 18 24 36 2d 3d 4d 5d 10d
Travel time to major cities (in hours and days) and shipping lane density

- An urban/rural population gradient around large cities of 50,000 or more people
- Global accessibility measures which combined with data on population density to create a much finer typology which is termed the Agglomeration Index (AI).
- The global map of travel time to major cities (cities of 50,000 or more people in year 2000) is a useful dataset in its own right, but it is also a component of the AI.
- This is described further in:
Uchida, H. and Nelson, A. Agglomeration Index: Towards a New Measure of Urban Concentration. Background paper for the World Bank's World Development Report 2009.

Results

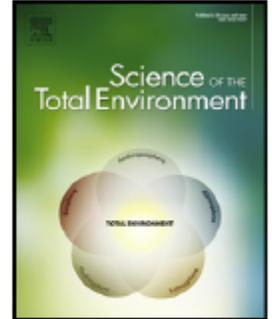


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Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv



Towards globally customizable ecosystem service models

Javier Martínez-López ^{a,*}, Kenneth J. Bagstad ^b, Stefano Balbi ^a, Ainhoa Magrach ^a, Brian Voigt ^c, Ioannis Athanasiadis ^d, Marta Pascual ^a, Simon Willcock ^e, Ferdinando Villa ^{a,f}

^a BC3-Basque Centre for Climate Change, Sede Building 1, 1st floor, Scientific Campus of the University of the Basque Country, 48940 Leioa, Spain

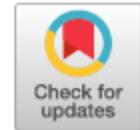
^b U.S. Geological Survey, Geosciences & Environmental Change Science Center, PO Box 25046, MS 980, Denver, CO 80225, USA

^c University of Vermont, Gund Institute for the Environment, 617 Main Street, Burlington, VT 05405, USA

^d Information Technology Group, Wageningen University, the Netherlands

^e School of Environment, Natural Resources and Geography, Bangor University, United Kingdom

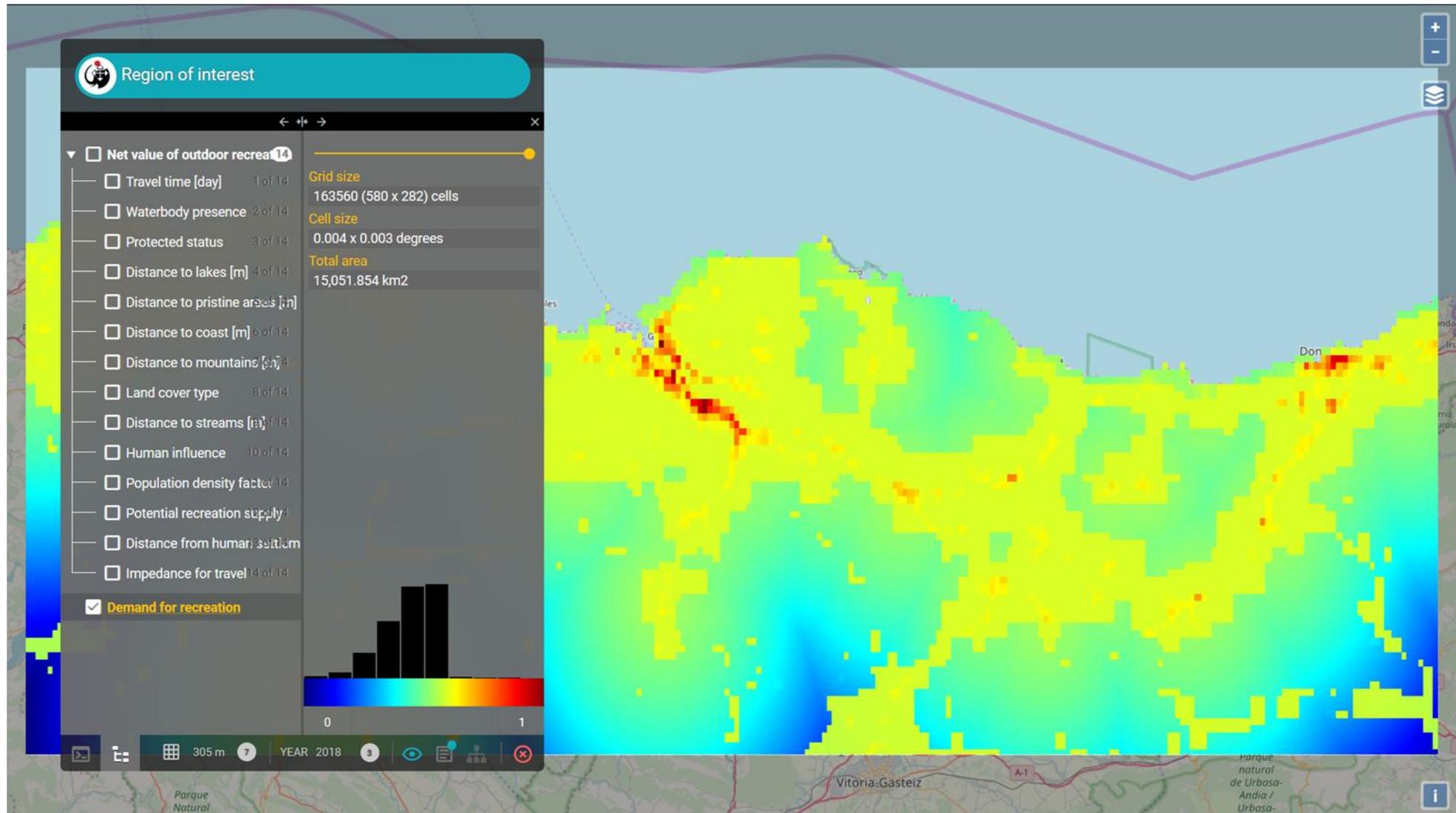
^f IKERBASQUE, Basque Foundation for Science, Bilbao, Spain



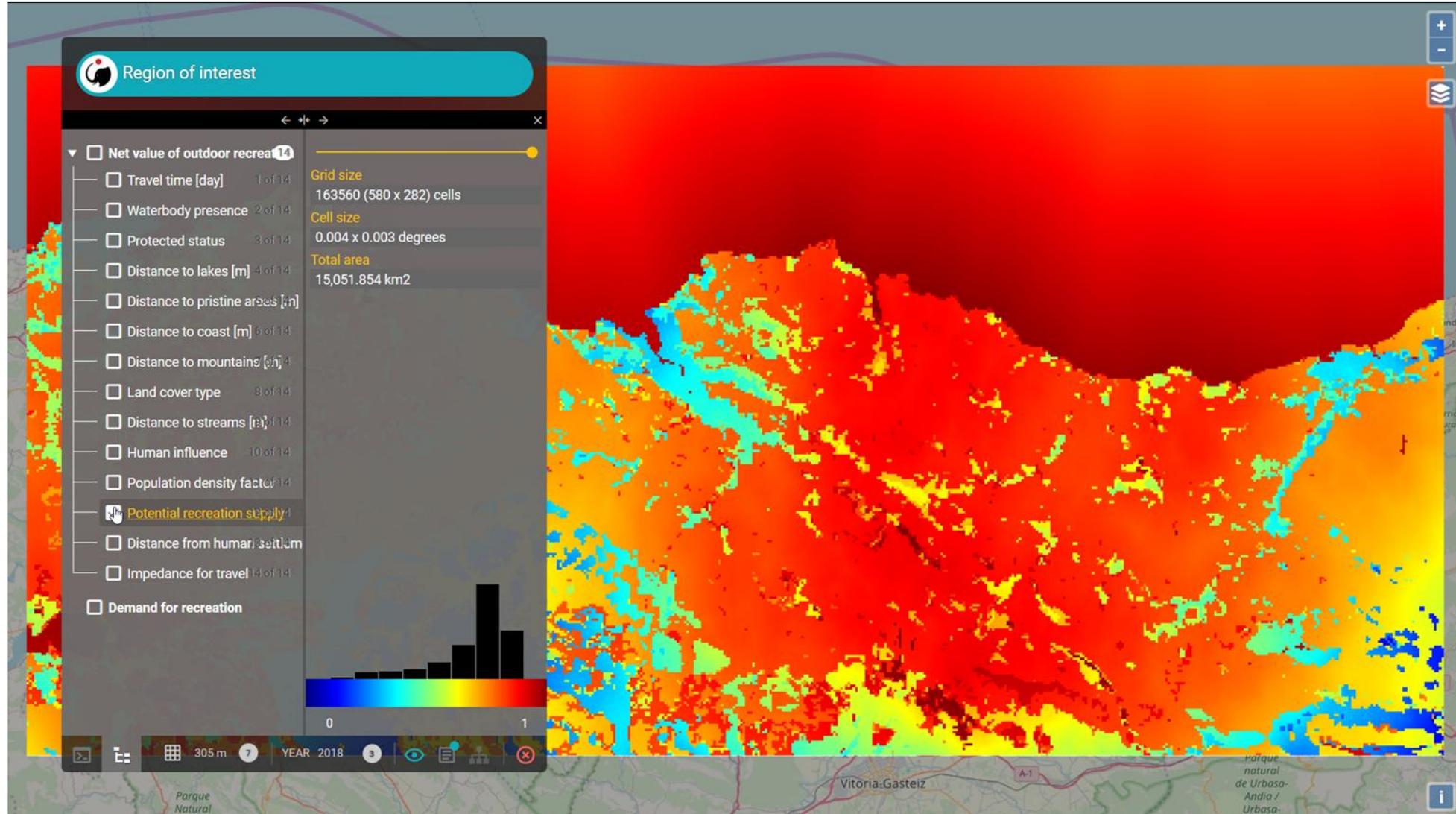
Locations of the Basque Country



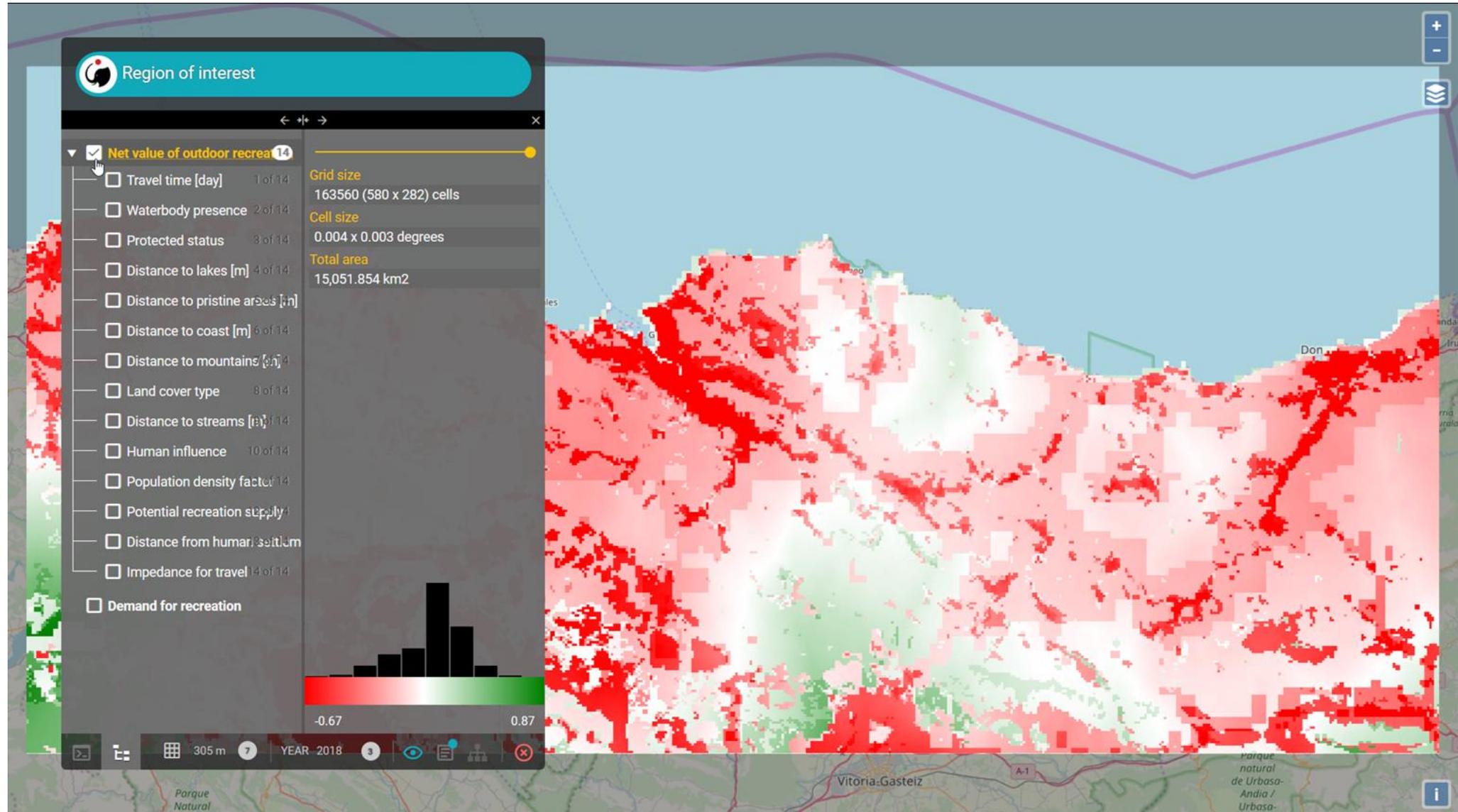
Results: Demand



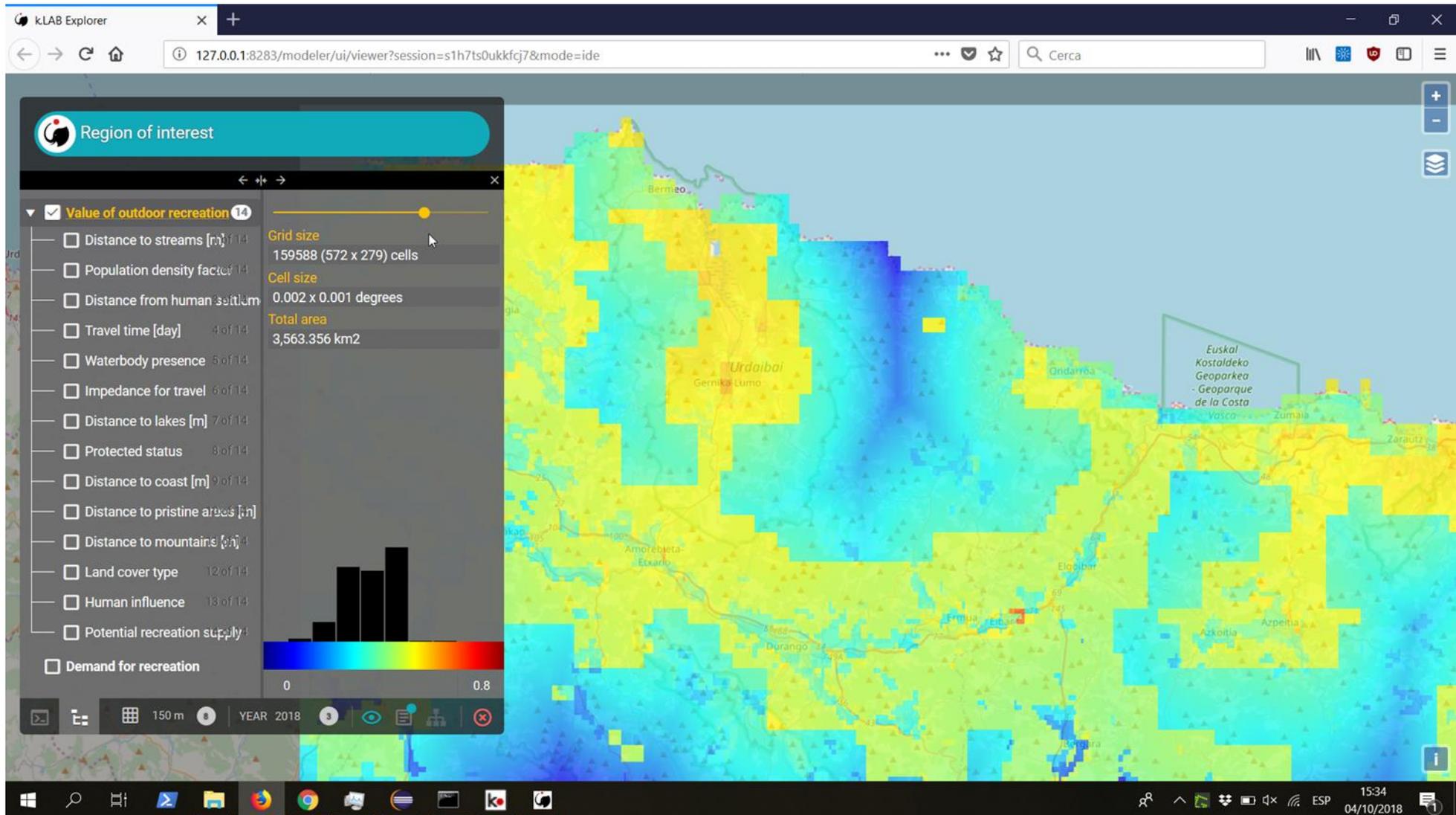
Results: Supply



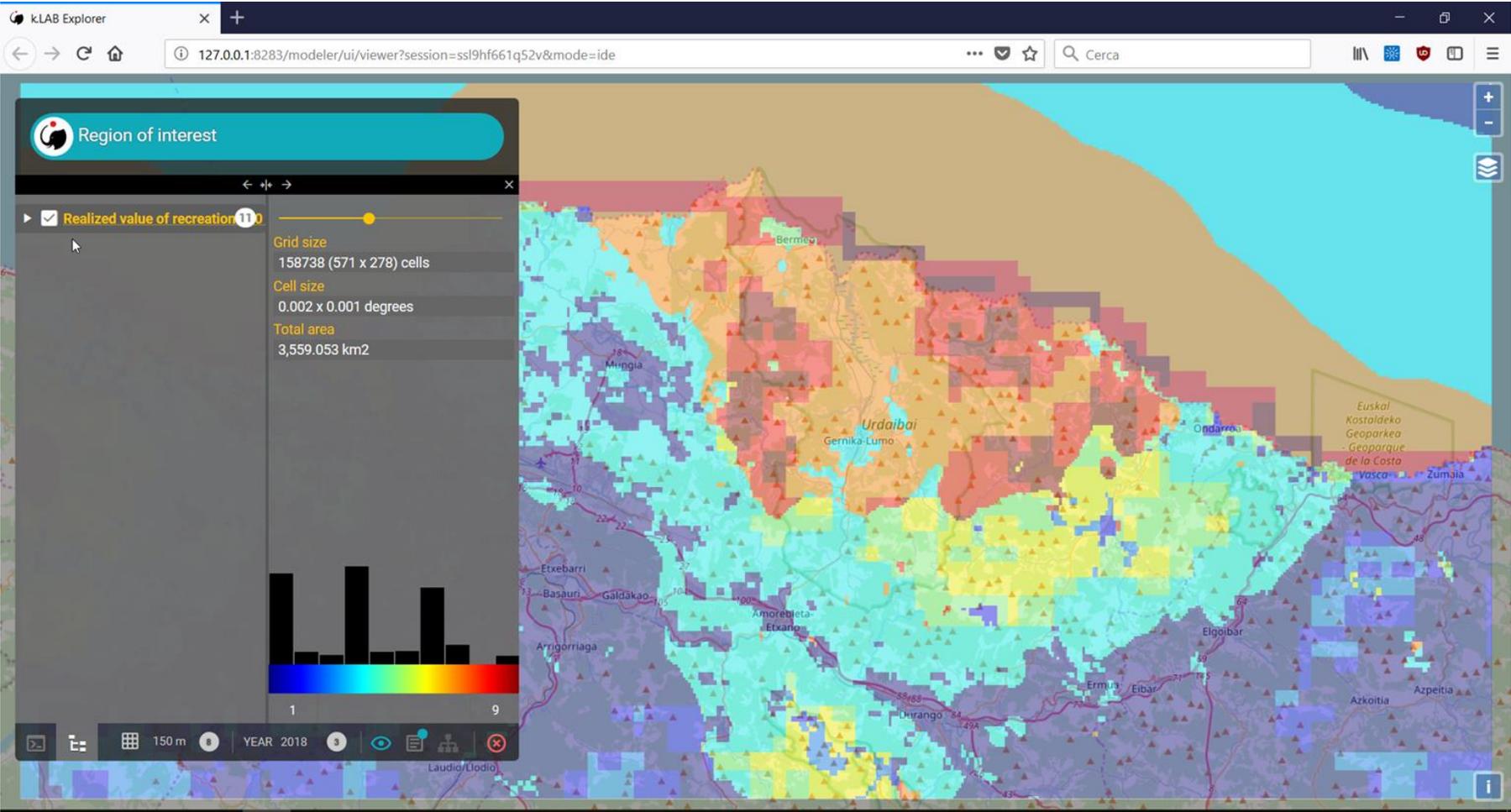
Results Surplus/Deficit



Results: Cobb-Douglas



Results: ROS



k.IM Code (4)

```
@documented(recreation.tables.opportunity)
define RECREATION_OPPORTUNITY_TABLE as {{
  remoteness | recreation_potential | score | description
  -----
  <= 0.25 | <0.75 | 1 | 'low provision, easily accessible',
  0.25 to 0.5 | <0.75 | 2 | 'low provision, accessible',
  >0.5 | <0.75 | 3 | 'low provision, not easily accessible',
  <= 0.25 | 0.75 to 0.88 | 4 | 'medium provision, easily accessible',
  0.25 to 0.5 | 0.75 to 0.88 | 5 | 'medium provision, accessible',
  >0.5 | 0.75 to 0.88 | 6 | 'medium provision, not easily accessible',
  <= 0.25 | >0.88 | 7 | 'high provision, easily accessible',
  0.25 to 0.5 | >0.88 | 8 | 'high provision, accessible',
  >0.5 | >0.88 | 9 | 'high provision, not easily accessible'
}};
```



Differences with ESTIMAP model

- We don't use CAPRI agricultural model to differentiate attractiveness of different types of crops
- European-derived, land cover-based estimates of naturalness and proximity thresholds, which may differ by ecoregion and socioeconomic setting, respectively.
- Both would be best informed by local parameterizations provided by region-specific experts



Examples of model customization

- Local Land Cover and human influence



Land Use Policy

Volume 57, 30 November 2016, Pages 405-417



Regular research paper

Mapping ecosystem service capacity, flow and demand for landscape and urban planning: A case study in the Barcelona metropolitan region

Francesc Baró ^{a, *}, Ignacio Palomo ^{b, c}, Grazia Zulian ^d, Pilar Vizcaino ^d, Dagmar Haase ^{e, f}, Erik Gómez-Baggethun ^{g, h}

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Ecosystem Services

Volume 13, June 2015, Pages 108-118



Mapping recreation supply and demand using an ecological and a social evaluation approach

Lorena Peña ^{a, *}, Izaskun Casado-Arzuaga, Miren Onaindia

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<https://doi.org/10.1016/j.ecoser.2014.12.008>

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- Feature of attractiveness by activity (e.g. kayaking, surfing...)
- Cost-distance layer (travel time)



Conclusions

- baseline model of outdoor recreation
- not capturing touristic flows by only day trips

Homework:

- identify the weak points
- propose alternative solutions

