Philosophy of globally customizable ES models

References

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

A user friendly access to ES modelling

1. ES-related user queries in a user-selected spatial and temporal context.
2. Queries can be entered in the Explorer interface as English sentences (or keywords)
3. Keywords call on logical statements (ontologies) that are conceptual models *resolved* with the data and algorithms available in the ARIES semantic web

Why are they needed?

- A conceptualization of ES supply and demand
- Rapid assessment
- No input/data preparation needed
- Models can run in any spatial context of the Earth with seasonal to annual temporal scale
- Customization of data, models and scenarios is currently possible using the k.LAB Modeler
  - soon with ARIES Explorer too

Current Contents

Fully specified model content concerning the following ES problem areas:
- Riverine flood regulation
- Carbon storage
- Outdoors recreation
- Pollination
- Sediment retention

Areas in development for a forthcoming release in the short term include:
- Mariculture suitability
- Water availability (based on hydrological calculations)
- Biodiversity value (based on machine learning of expert opinion)

What they are now

- Ready to use as a baseline but likely delivering a rough picture

- For all the queries, ARIES will build a spatially explicit observation,
  - mostly raster GIS coverage of user-selected resolution.

- The results will reflect the contents of the ARIES semantic web at the time of query
  - nearly all supporting data are currently available at spatial resolution ranging between 1km and 90m.

- Not complexity oriented
  - ➔static and aggregated: as per InVEST/Estimap approaches

Scalability, Context Awareness and Crowd-sourced Data

- ## 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];
```

e.g. Zoom Level

Pagina | Discussione — Leggi | Visualizza wikitesto | Cronologia — Cerca all'interno di OpenStreetMap Wiki

Zoom levels

Available languages — *Zoom levels*

· Deutsch · **English** · español · français · Nederlands · polski · português · Tiếng Việt · русский · українська

Other languages — Help us translate this wiki

Level	# Tiles	Tile width (° of longitudes)	m / pixel (on Equator)	~ Scale (on screen)	Examples of areas to represent
0	1	360	156 412	1:500 million	whole world
1	4	180	78 206	1:250 million	
2	16	90	39 103	1:150 million	subcontinental area
3	64	45	19 551	1:70 million	largest country
4	256	22.5	9 776	1:35 million	
5	1 024	11.25	4 888	1:15 million	large African country
6	4 096	5.625	2 444	1:10 million	large European country
7	16 384	2.813	1 222	1:4 million	small country, US state
8	65 536	1.406	610.984	1:2 million	
9	262 144	0.703	305.492	1:1 million	wide area, large metropolitan area
10	1 048 576	0.352	152.746	1:500 thousand	metropolitan area
11	4 194 304	0.176	76.373	1:250 thousand	city
12	16 777 216	0.088	38.187	1:150 thousand	town, or city district
13	67 108 864	0.044	19.093	1:70 thousand	village, or suburb
14	268 435 456	0.022	9.547	1:35 thousand	
15	1 073 741 824	0.011	4.773	1:15 thousand	small road
16	4 294 967 296	0.005	2.387	1:8 thousand	street
17	17 179 869 184	0.003	1.193	1:4 thousand	block, park, addresses
18	68 719 476 736	0.001	0.596	1:2 thousand	some buildings, trees
19	274 877 906 944	0.0005	0.298	1:1 thousand	local highway and crossing details

Distances per degree of longitude, for the latitudes marked in the picture.

Difference of longitudes	Actual distances			
	at 0° lat.	at 30° lat.	at 60° lat.	at 87.5° lat.
0.01 °	~ 1 000 m	~ 870 m	~ 500 m	~ 43.62 m
0.001 °	~ 100 m	~ 87 m	~ 50 m	~ 4.36 m
0.000 1 °	~ 10 m	~ 8.7 m	~ 5 m	~ 0.44 m
0.000 01 °	~ 1 m	~ 0.87 m	~ 0.5 m	~ 0.04 m
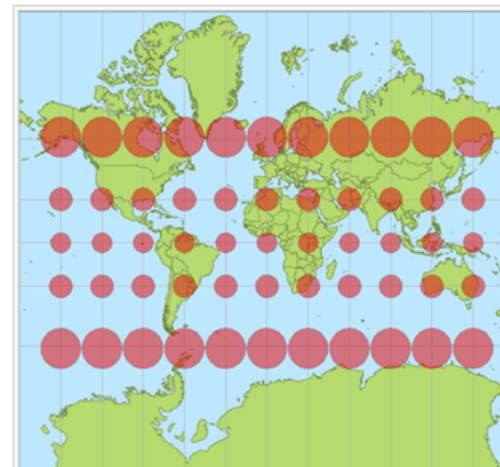
Variation with latitude of represented distances (in degrees or pixels) on the Mercator projection per actual distances (in meters) on Earth surface.
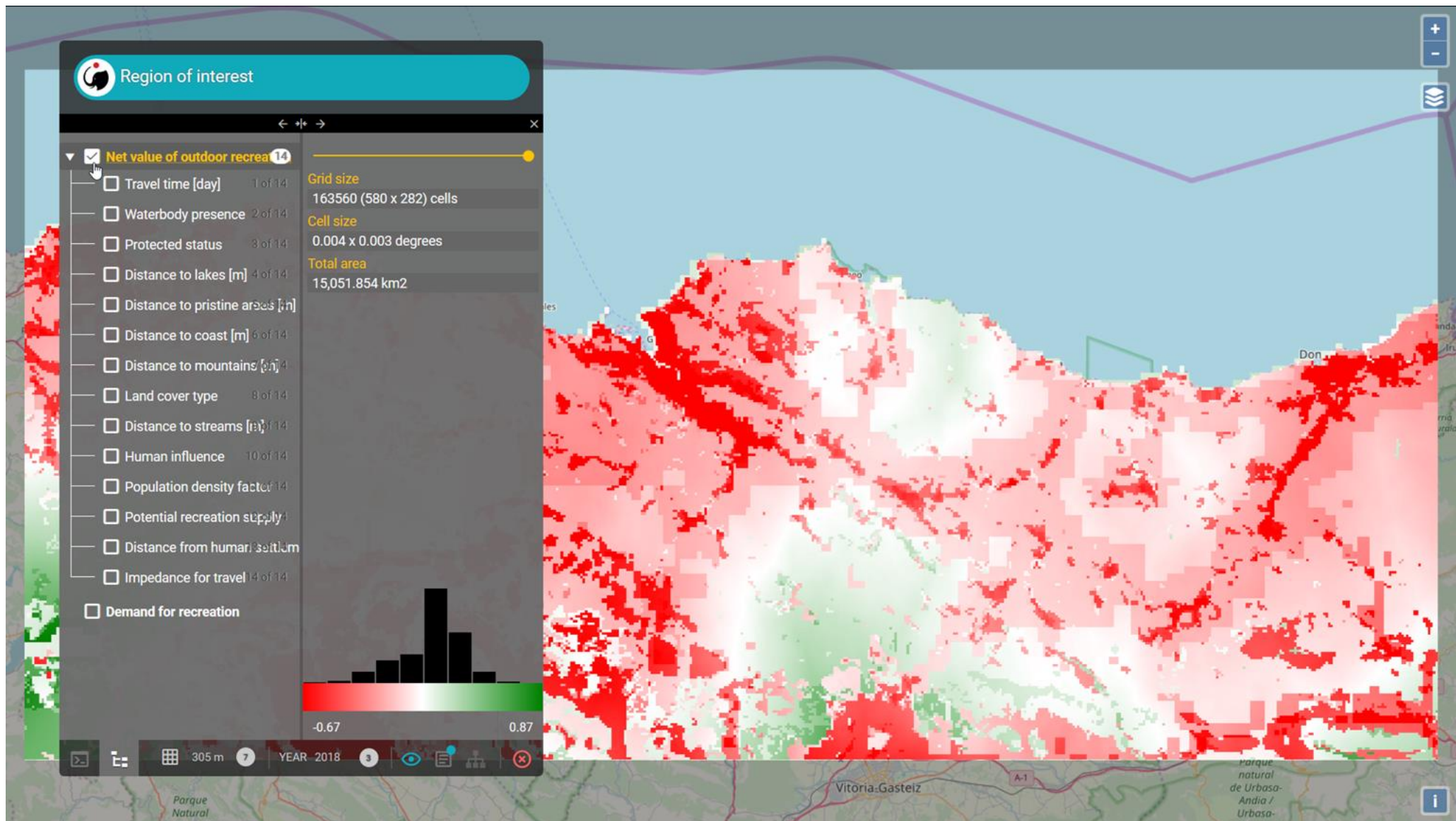
- The "# Tiles" column indicates the number of tiles needed to show the entire world at the given zoom level. This is useful when calculating storage requirements for pre-generated tiles.
- The "° Tile width" column gives the map width in degrees of longitude, for a square tile drawn at that zoom level.
- Values listed in the column "m / pixels" gives the number of meters per pixel at that zoom level. These values for "m / pixel" are calculated with an Earth radius of 6372.7982 km and hold at the Equator; for other latitudes the values must be multiplied by the cosine (approximately assuming a perfect spheric shape of the geoid) of the latitude.
- "~ Scale" is only an approximate size comparison and refers to distances on the Equator. In addition, the given scales assume that 256-pixel wide tiles are rendered and will be dependent on the

What they can become

- The model content does not implement monolithic "models" of ES

- Starting point for improvement, also conceptual improvement

- Capture more complexity, including multi-agents networks and dynamic transitions

    → this is the real PTB framework implementation

- We envision a critical role of remotely sensed data in the near future for real time and high frequency assessments