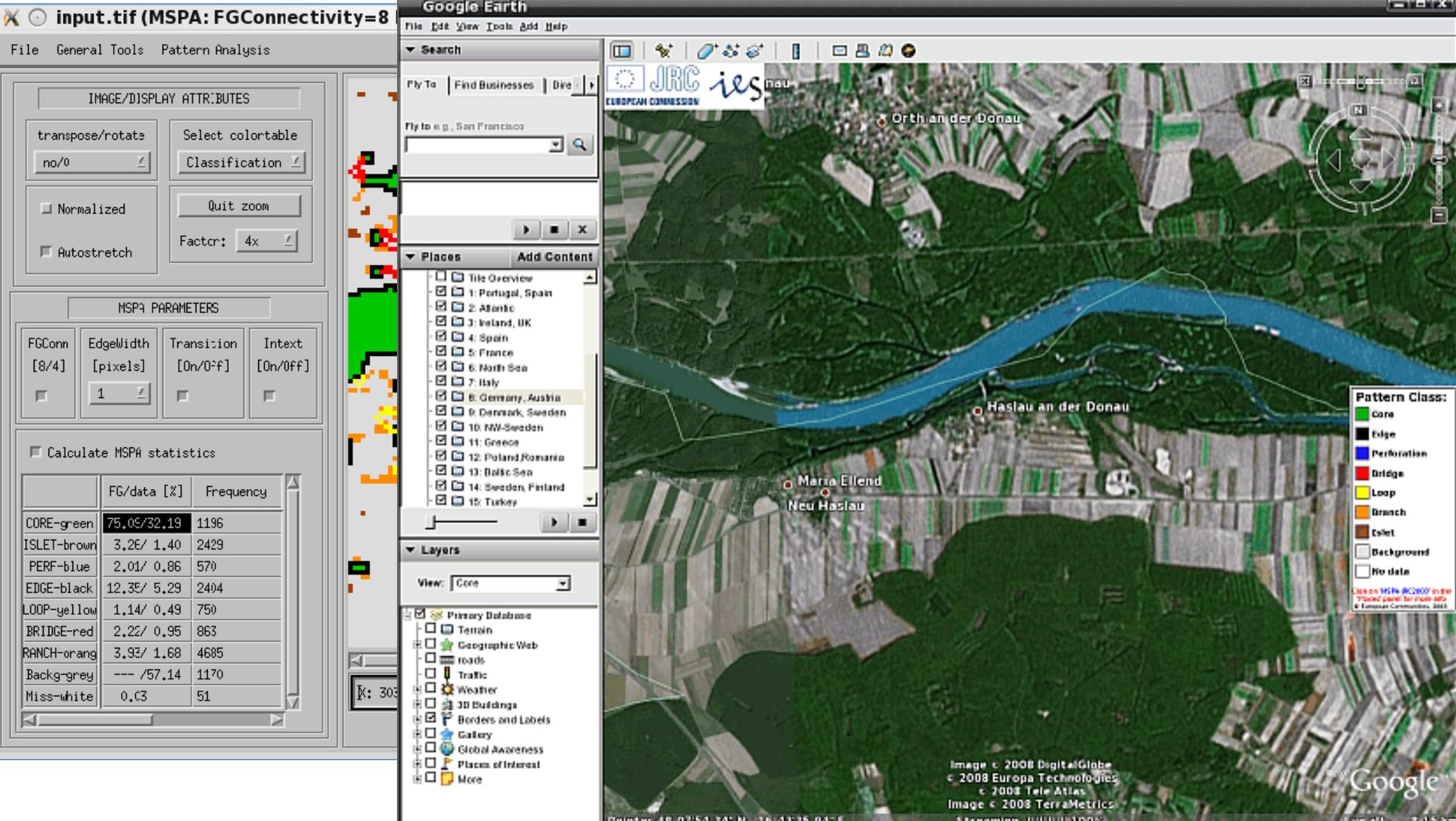


From analysis...

to end-user products



The image shows a composite of two software interfaces. On the left is the MSPA (Morphological Spatial Pattern Analysis) software interface, and on the right is a Google Earth satellite view of a landscape with a river and fields.

MSPA Software Interface:

input.tif (MSPA: FGConnectivity=8)

File General Tools Pattern Analysis

IMAGE/DISPLAY ATTRIBUTES

transpose/rotate: no/0
Select colorable: Classification
Normalized:
Autostretch:
Quit zoom: Factor: 4x

MSPA PARAMETERS

FGConn: [8/4] Edgewidth: [pixels] 1
Transition: [0n/0+f] Intext: [0n/0+f]

Calculate MSPA statistics

	FG/data [%]	Frequency
CORE-green	75,09/32,19	1196
ISLET-brown	3,2E/ 1,40	2429
PERF-blue	2,01/ 0,86	570
EDGE-black	12,3E/ 5,29	2404
LOOP-yellow	1,14/ 0,49	750
BRIDGE-red	2,22/ 0,95	863
RANCH-orange	3,9E/ 1,68	4685
Backg-grey	--- /57,14	1170
Miss-white	0,03	51

Google Earth Interface:

Search: Fly To: Find Businesses | Dirs | Fly to e.g., San Francisco

Places: Add Content

- Tile Overview
- 1: Portugal, Spain
- 2: Atlantic
- 3: Ireland, UK
- 4: Spain
- 5: France
- 6: North Sea
- 7: Italy
- 8: Germany, Austria
- 9: Denmark, Sweden
- 10: NW-Sweden
- 11: Greece
- 12: Poland/Romania
- 13: Baltic Sea
- 14: Sweden, Finland
- 15: Turkey

Layers: View: Core

- Primary Database
- Terrain
- Geographic Web
- roads
- Traffic
- Weather
- 3D Buildings
- Borders and Labels
- Gallery
- Global Awareness
- Places of Interest
- More

Pattern Class Legend:

- Core (Green)
- Edge (Black)
- Perforation (Blue)
- Bridge (Red)
- Loop (Yellow)
- Branch (Orange)
- Colet (Brown)
- Background (White)
- No data (White)

Map Labels: Orth an der Donau, Haslau an der Donau, Maria Ellend, Neu Haslau

Map Footer: Image © 2008 DigitalGlobe, © 2008 Europa Technologies, © 2008 Tele Atlas, Image © 2008 TerraMetrics, Streaming 100%, 2.15 km

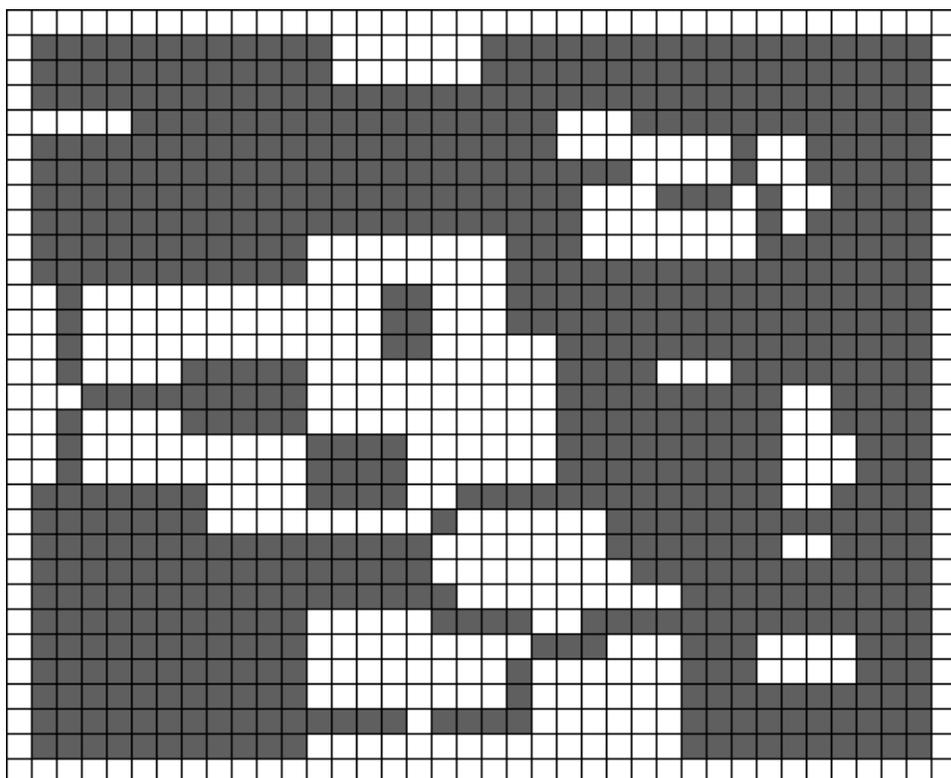
Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

Morphological Spatial Pattern Analysis (MSPA)

- Generic, scale-independent pixel-level analysis
- Automated description of pattern and connectivity

MSPA: →

-  **CORE:** interior area
-  **ISLET:** isolated small object
-  **LOOP:** connects same core
-  **BRIDGE:** connects different cores
-  **PERFORATION:** interior perimeter
-  **EDGE:** external perimeter
-  **BRANCH:** perimeter extension

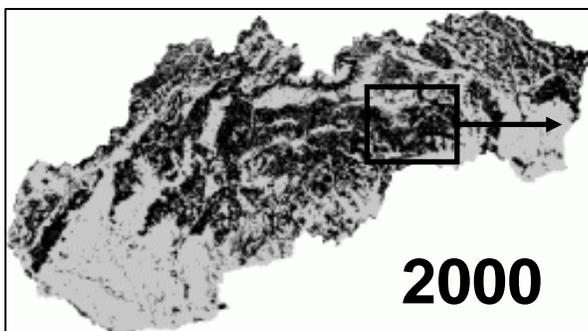
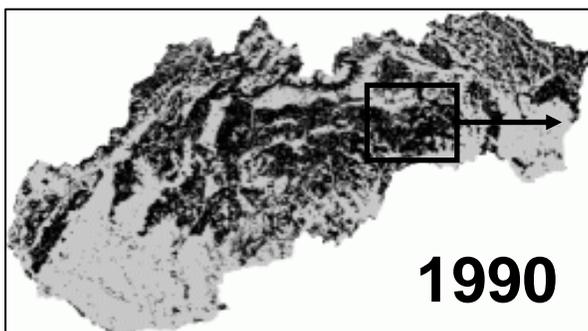


Segmentation of a binary mask

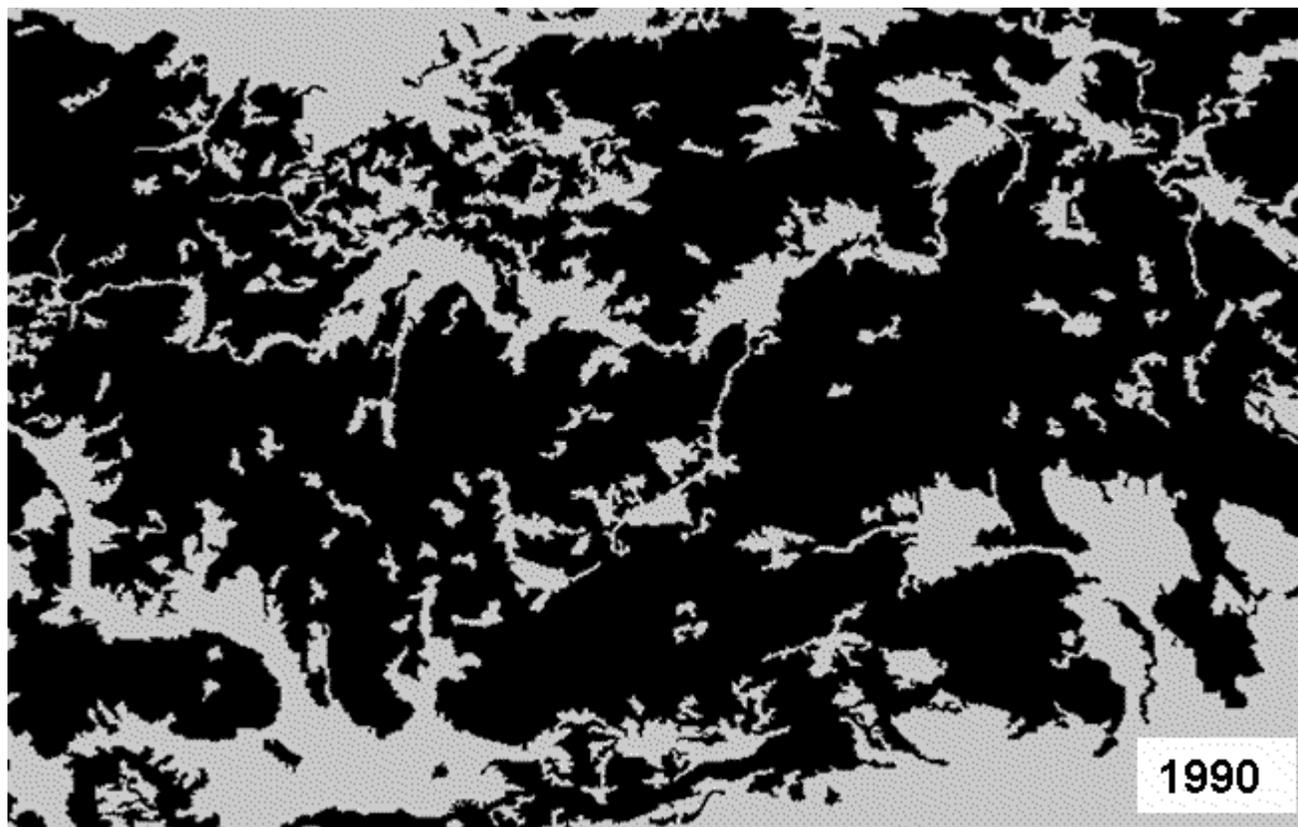
Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

FRAGSTATS: 100+ statistical parameters

Slovakia: 'Average Patch Size' & 'Total Forest Area' = constant



constant !?



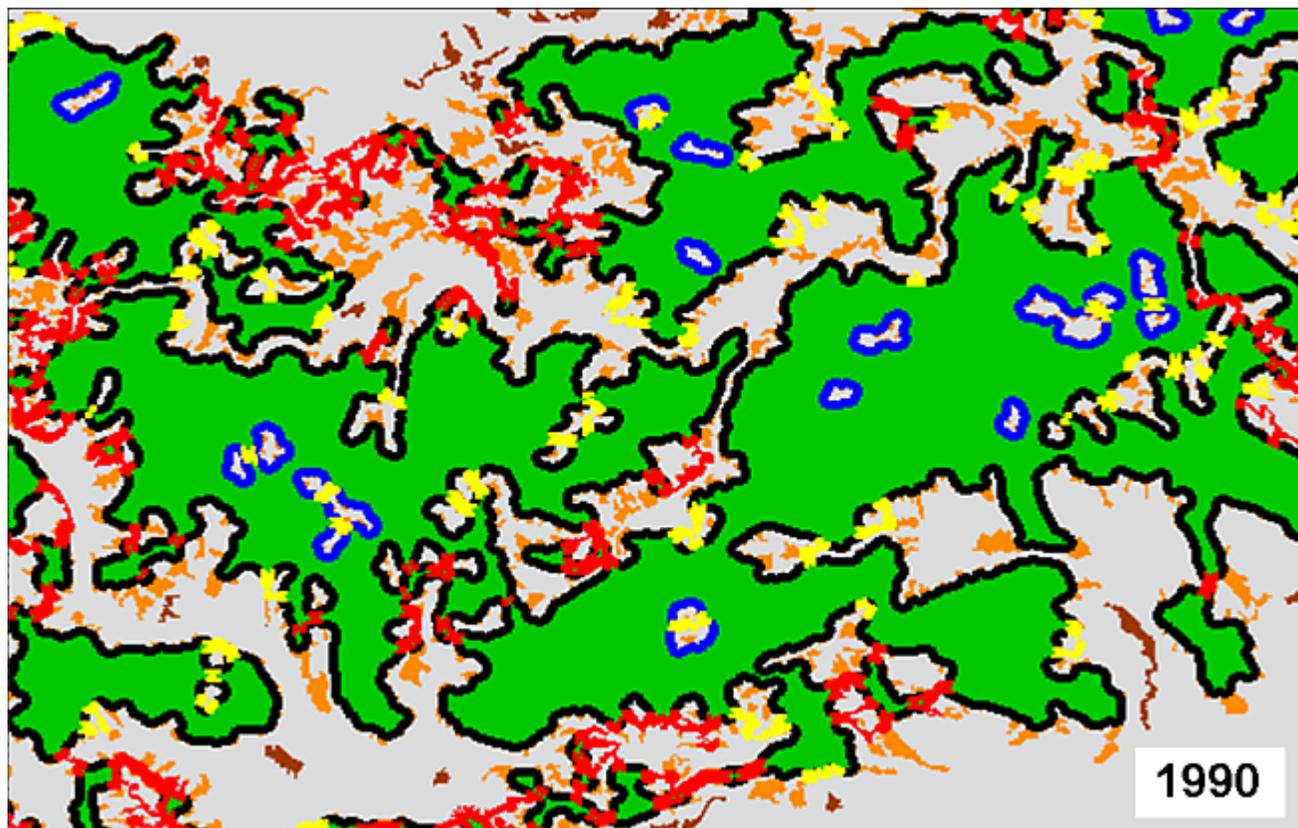
Pro: some meaningful statistics, widely accepted

Con: interdependent, non-intuitive for pattern analysis

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

MSPA: 7 classes:

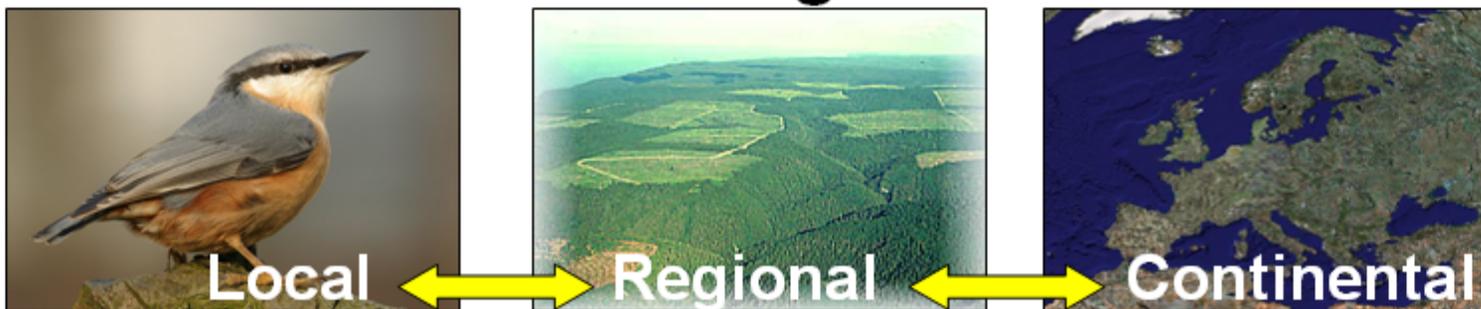
Core, Islet, Perforation, Edge, Branch, Loop, Bridge



New: reliable statistics, intuitive map product, user-driven and flexible analysis, internal/external, connectivity

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

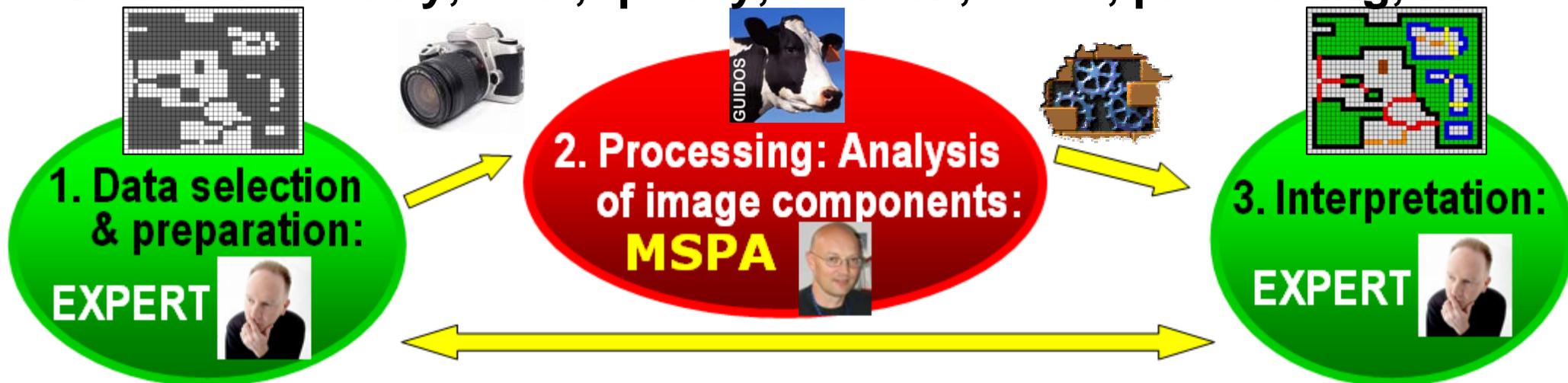
Functional Ecological Processes



Structural Spatial Pattern (SP)

Very complex system & very different fields of interests/issues for:

- **Understanding:** natural-human processes, economics/biodiv., ...
- **Users:** industry, science, management, politics, ...
- **Data:** availability, cost, quality, content, scale, processing, ...

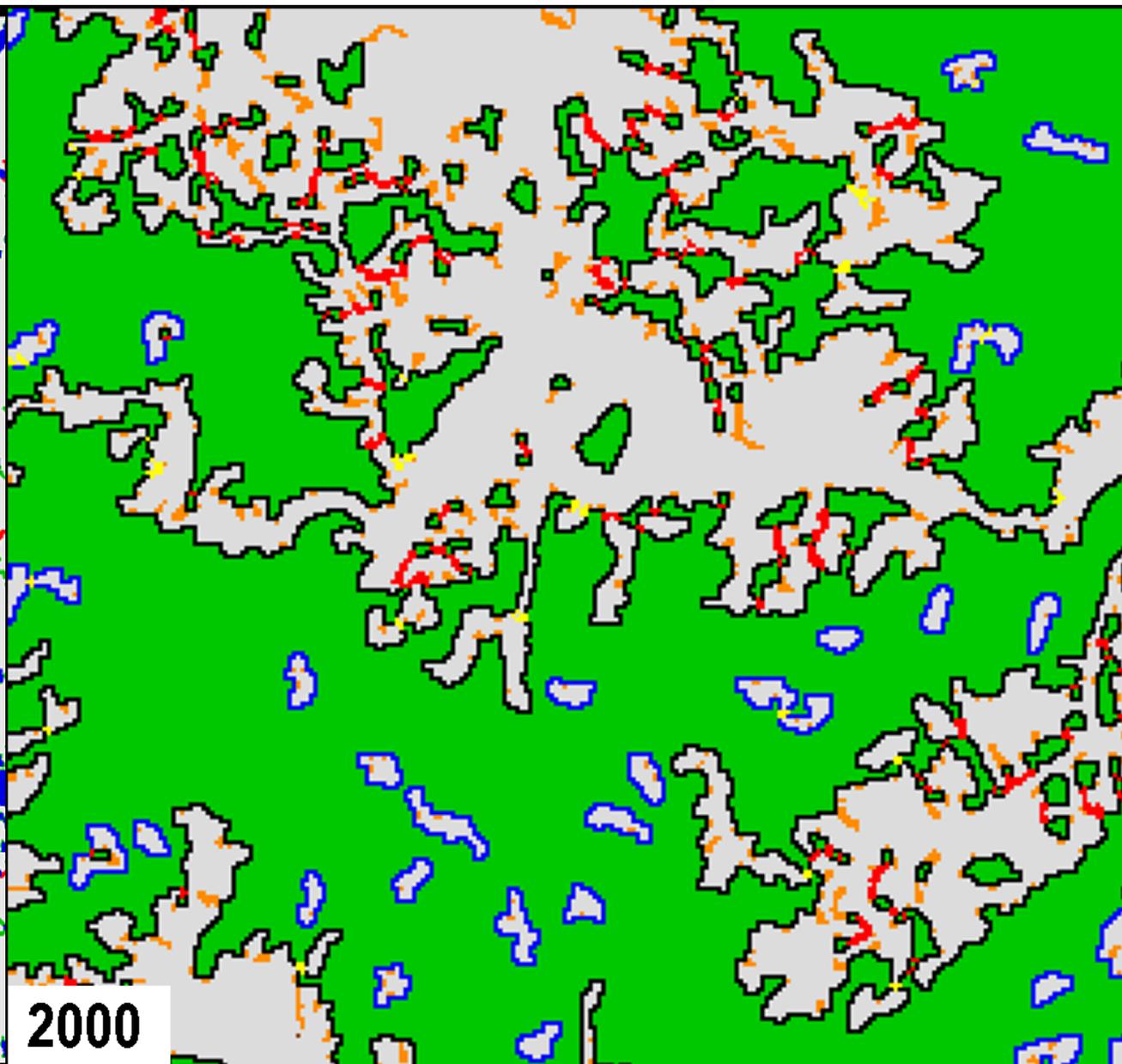
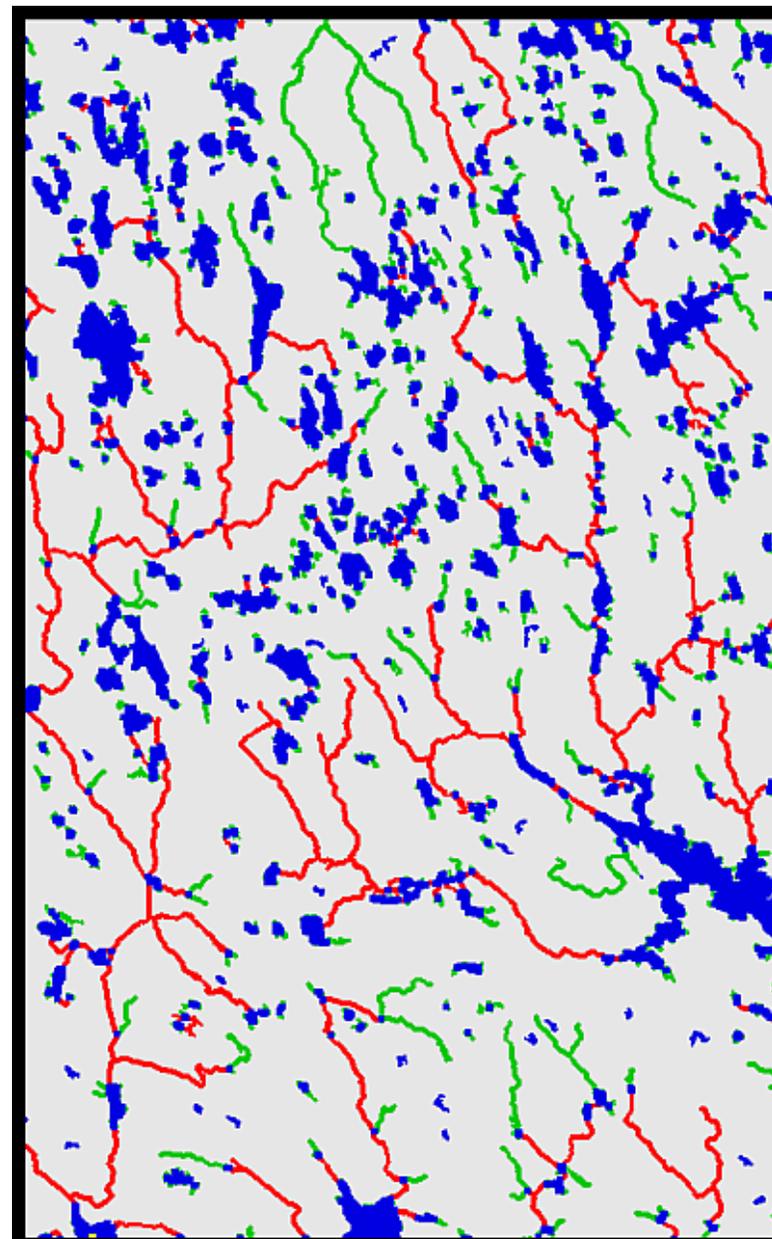


Aim: Toolbox for a generic description of spatial pattern

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

Rivers & wetlands...

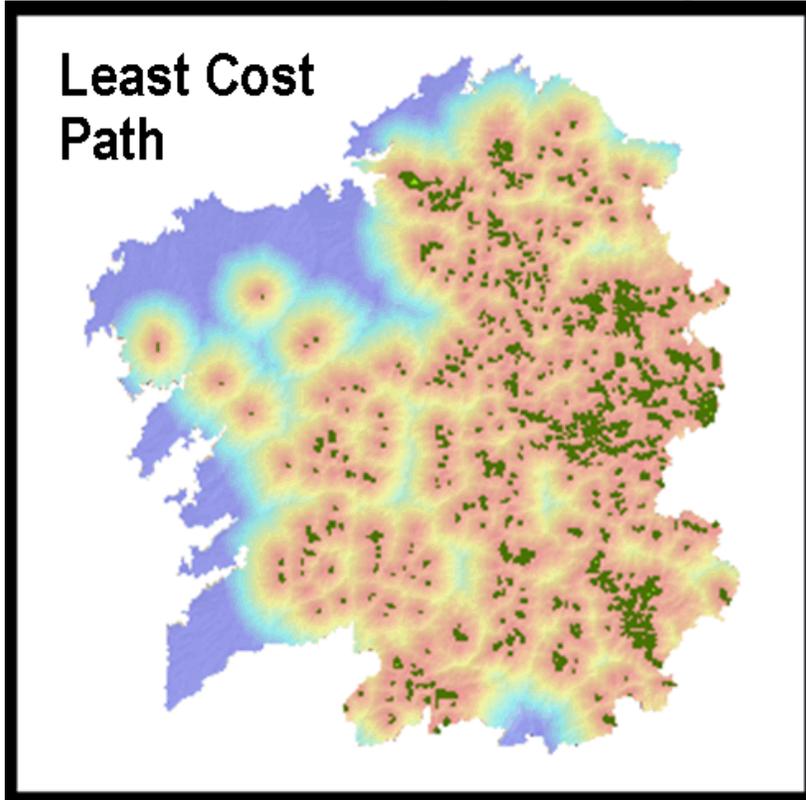
Forest decline...





Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

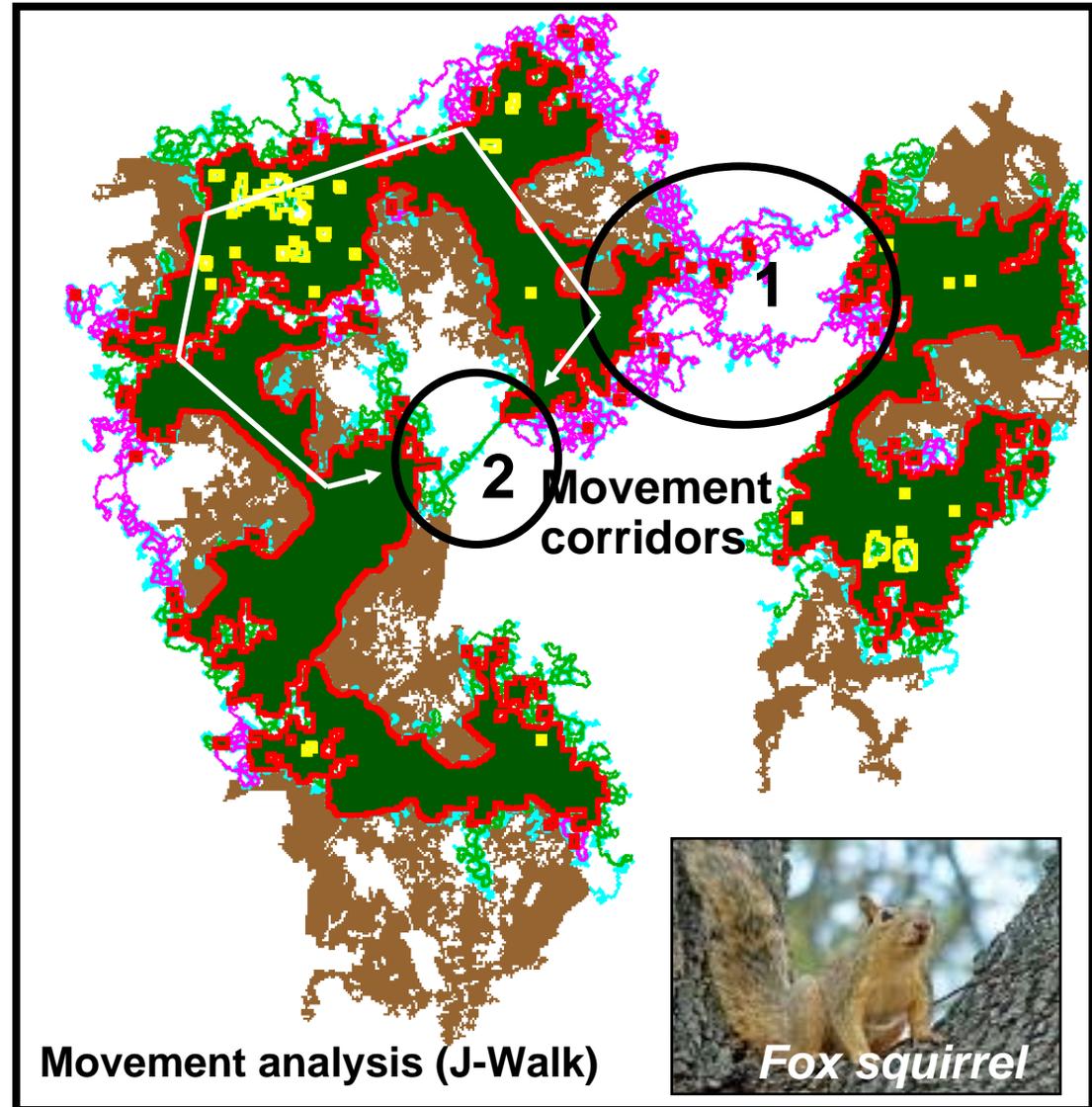
Pattern frequency on a least cost path map



Rodriguez et al., IUFRO-IALE Chengdu, 2008

Mapping functional connectivity
(Vogt et al., *Ecol. Indicators* (2009) 9:64-71)

Patterns of species movement

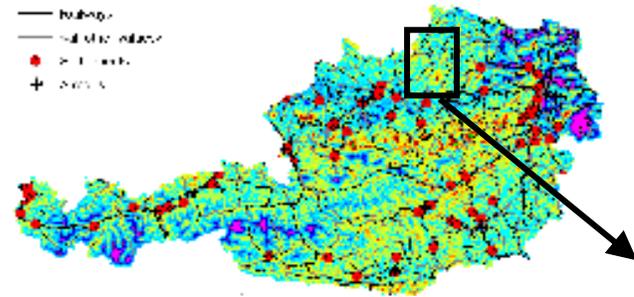
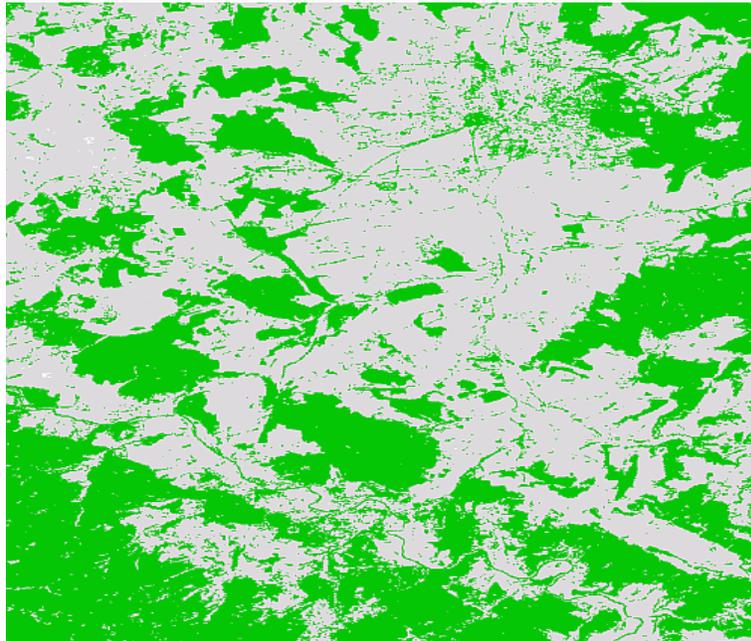


Movement analysis (J-Walk)

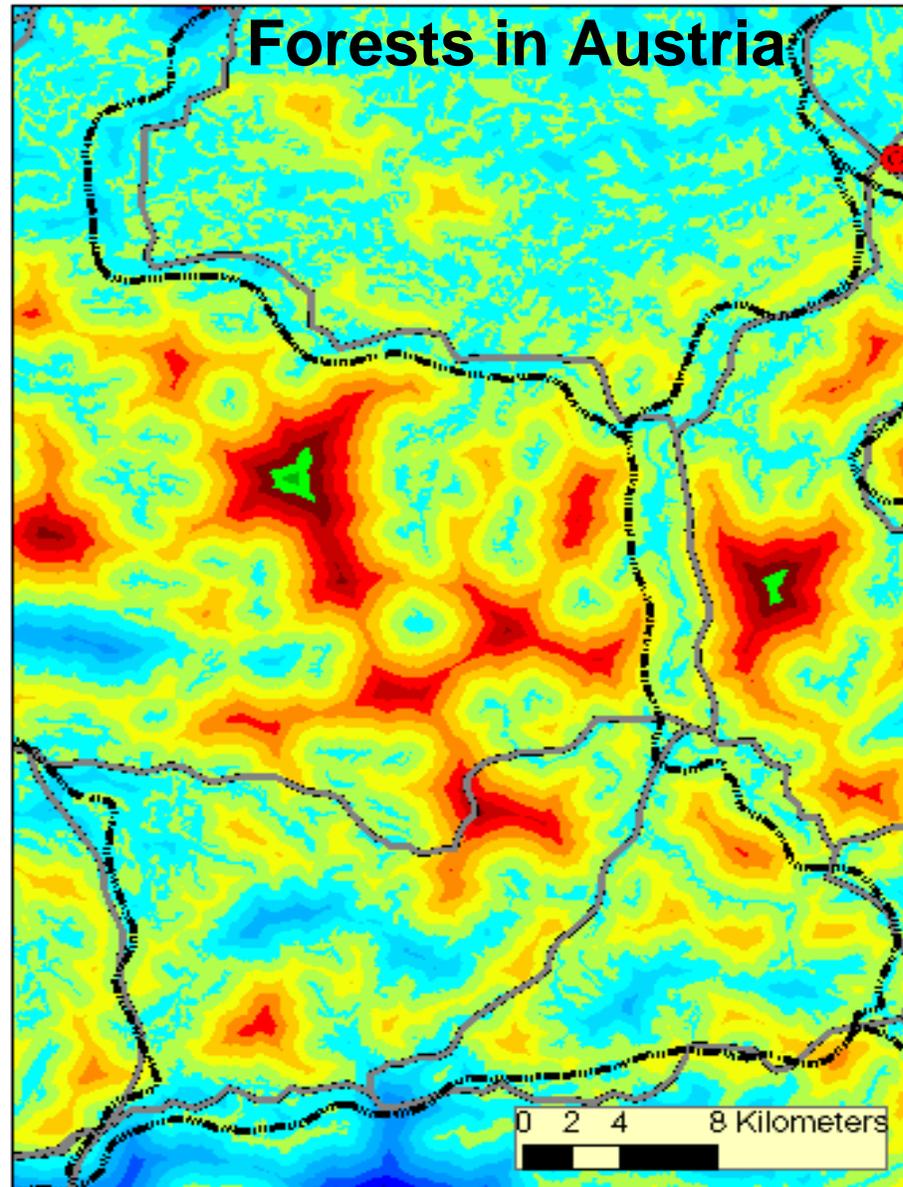
Fox squirrel



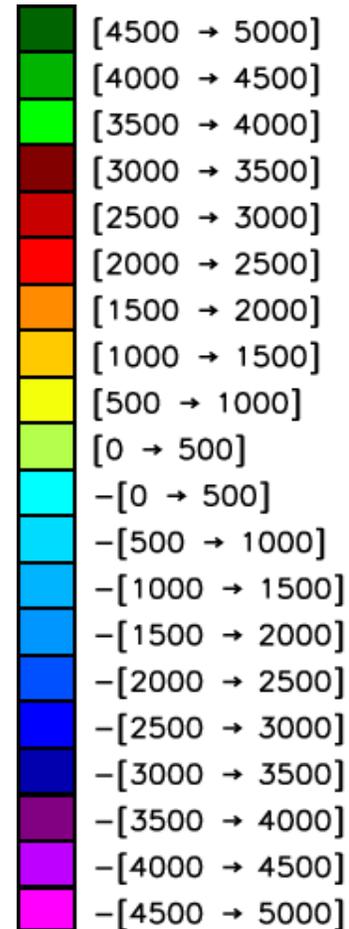
Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05



- Railways
- Roads
- Settlements
- Airports



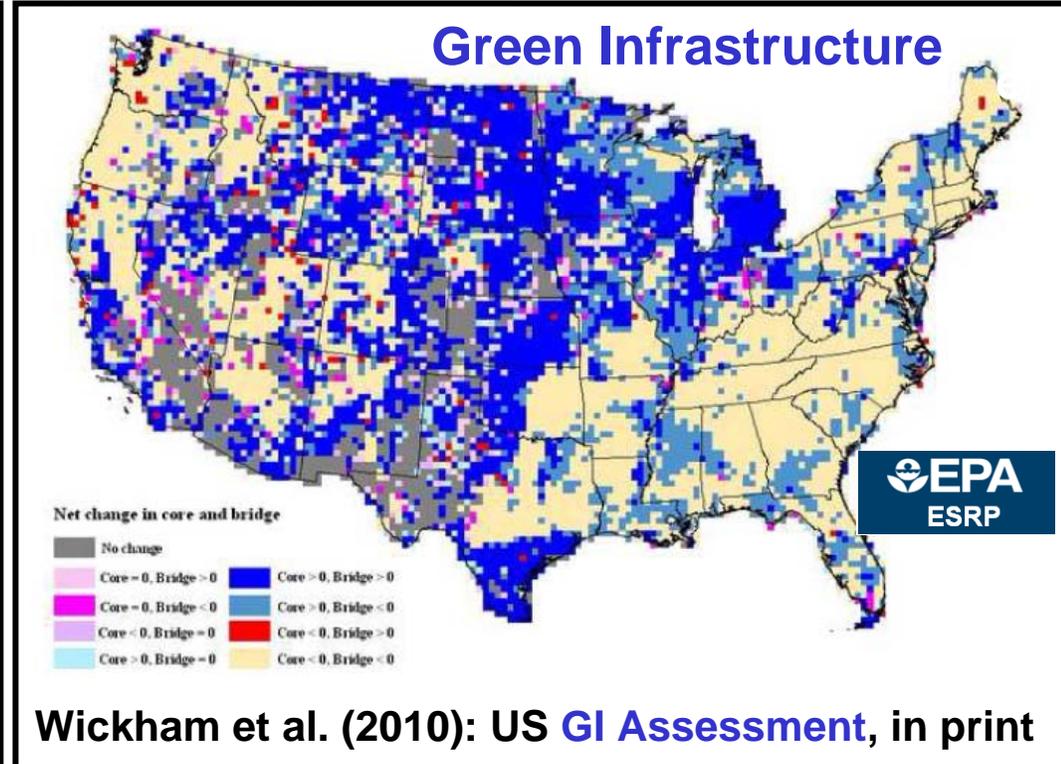
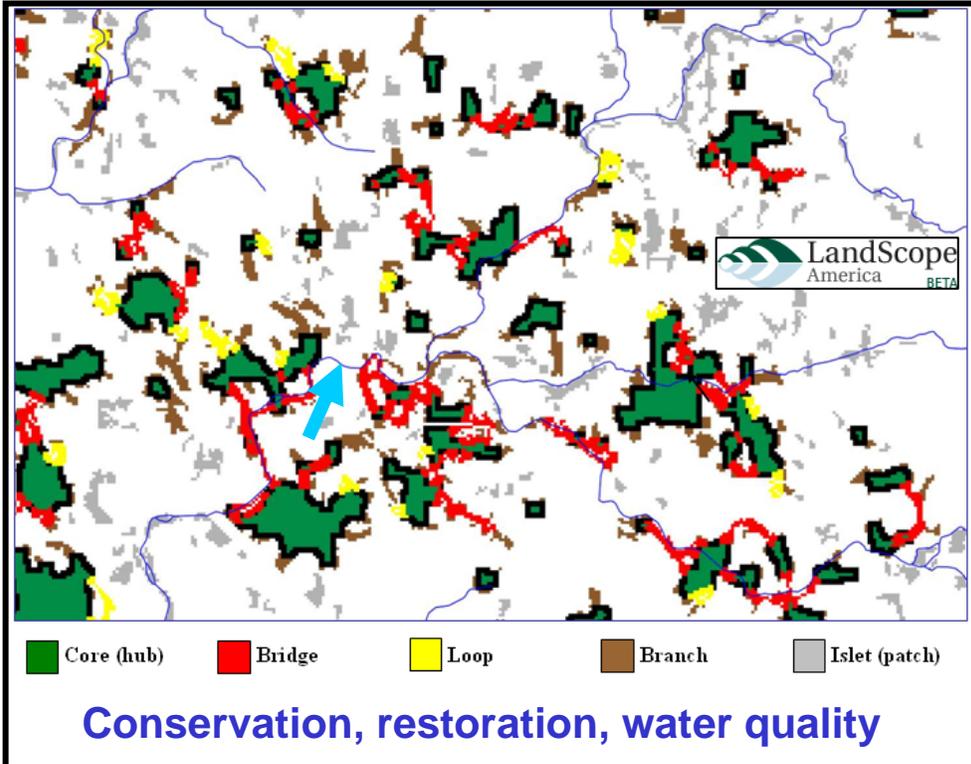
Depth [m]



Average distance fore-/background (adf/adb): 5.9/5.2 *500m

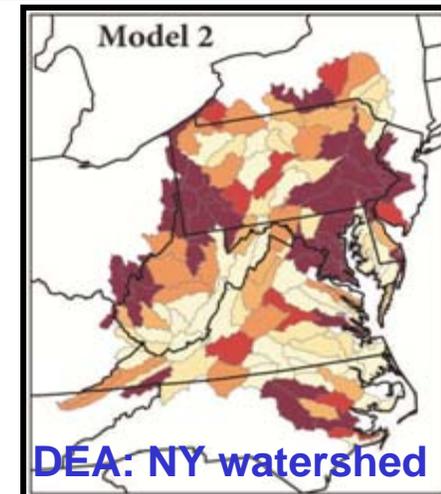
Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

Analyze conservation, landscape planning, ecosystem services.



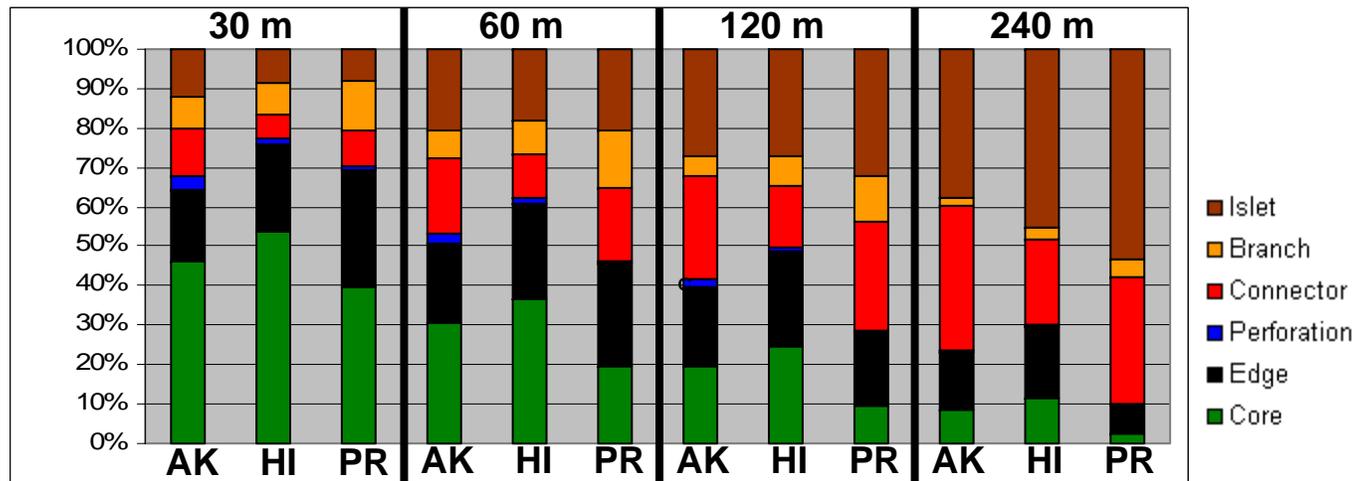
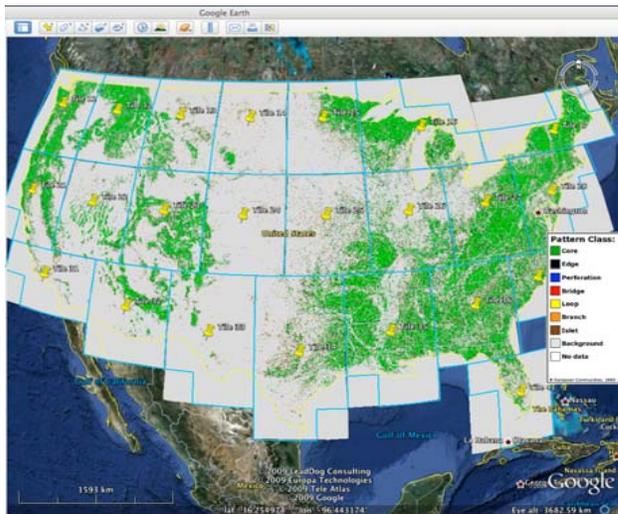
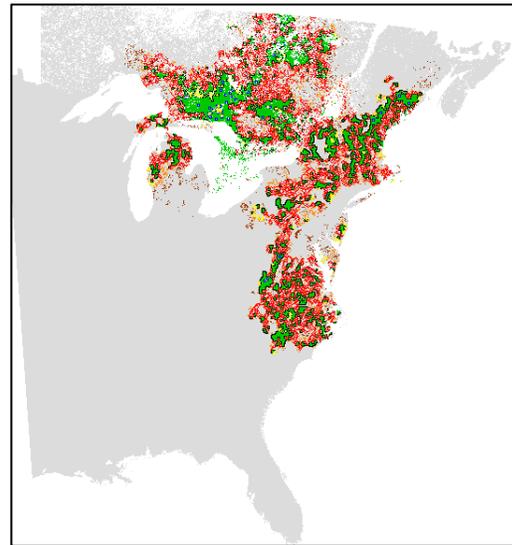
Application fields:

- MSPA + GIS: maximize benefits, land trusts in guiding land purchase, urban growth.
- Data Envelopment Analysis (DEA): evaluate efficiency of decision making units.



Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

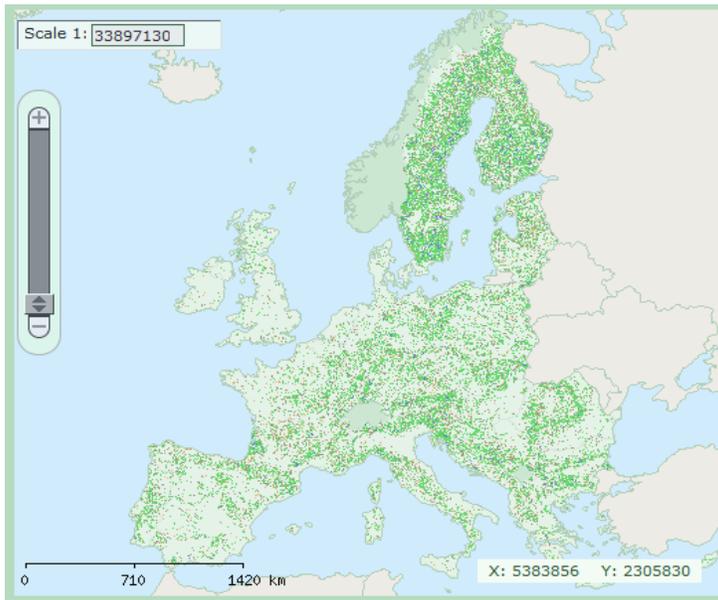
Disease spread: disease/alien species spread models simulate infection/spread scenarios. MSPA: detect narrow pathways to combat spread, evaluate costs and efficiency using simulation models & including ancillary data sources



Forest/Grassland: f(edge width, State), data source: 2001 NLCD.

Riitters, K. 2009: Landscape Pattern and Context of Forest and Grassland in Alaska, Hawaii, and Puerto Rico. In: Potter, K (ed), Forest Health Monitoring National Techn. Report 2009. US Forest Service, Southern Research Station, in preparation.

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05



JRC EUROPEAN COMMISSION

EFDAC MapViewer

EUROPA/ European Commission/ JRC/ IES/ Land Management & Natural Hazards Unit/ Forest Action

Location: EFDAC Home > Map Viewer

Viewer Information Metadata Help

Search for: []

Scale 1: 120310

4 km

X: 4274820 Y: 3670690

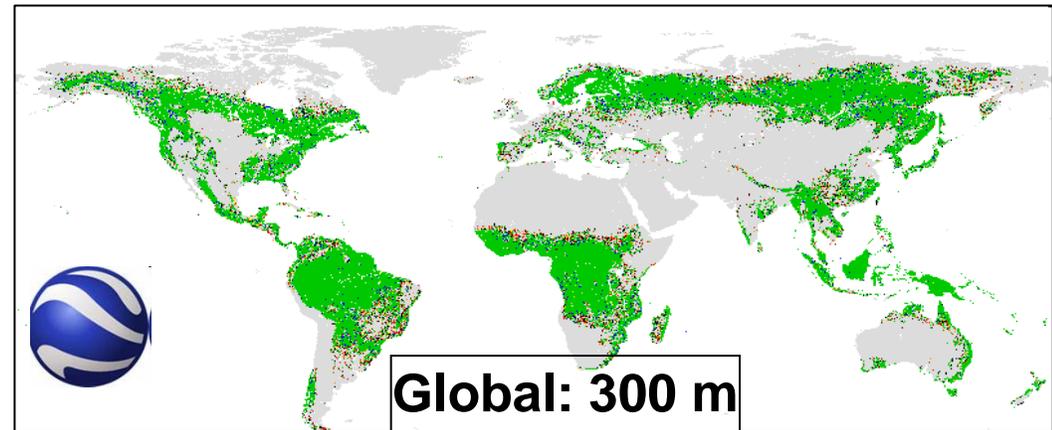
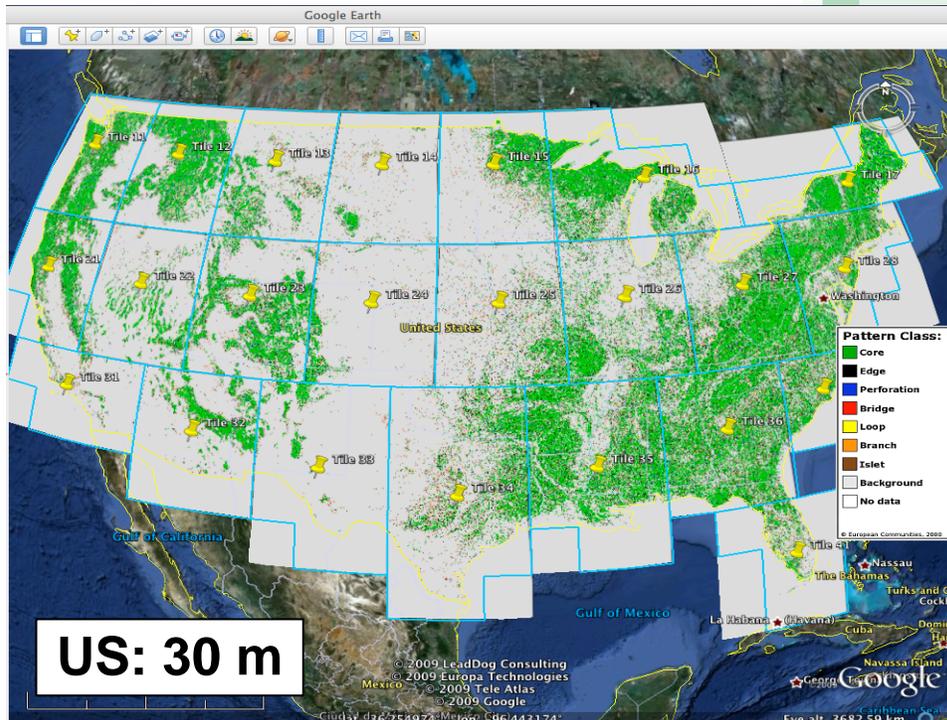
Europe: 25/100 m

ies
Institute for Environment and Sustainability
Important legal notice

- Contents
- Forest/Non-Forest Map
 - Landscape Pattern of Forest
 - Forest Pattern (CLC 2000)
 - Non-Forest
 - Core Forest
 - Islet Forest
 - Perforation Forest
 - Edge Forest
 - Connection Forest: Loop
 - Connection Forest: Bridge
 - Branch Forest
 - Aggregated Forest Pattern: Core (CLC 2000 Acc: 100m Edge: 100m)
- Forest Condition
- Physical Environment
- Administrative Boundaries
 - Country
 - Nuts Level 1
 - Nuts Level 2
 - Nuts Level 3
- Urban Environment

Query Builder

Layer Information





European Commission
Joint Research Centre
Institute for Environment and Sustainability

Forest

Forest Data and Information Systems

Europa ▶ EC ▶ JRC ▶ IES ▶ LMNH ▶ Forest ▶ Download ▶ Data

Forest

- Home
- News
- Team
- Publications
- Studies & Research Projects
- Download
- Software
- Data

Research

- Forest Mapping
- Forest Pattern
- Forest Fires
- Forest & Climate Change

Systems

- EFDAC
- EFFIS

DATA



Please select one of the following links to access full resolution datasets or Google Earth overlays produced by the Forest Action at the JRC:



Forest Cover Maps



European Forest cover maps derived from high resolution satellite data.



MSPA Pattern Maps



Morphological Spatial Pattern (MSPA) maps based on the Forest Cover maps.



Google Earth Overlays



Overlays of Forest Cover and MSPA maps for display in Google Earth.

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

Google Earth **MSPA overlay: North/South America...**

File Edit View Tools Add Help

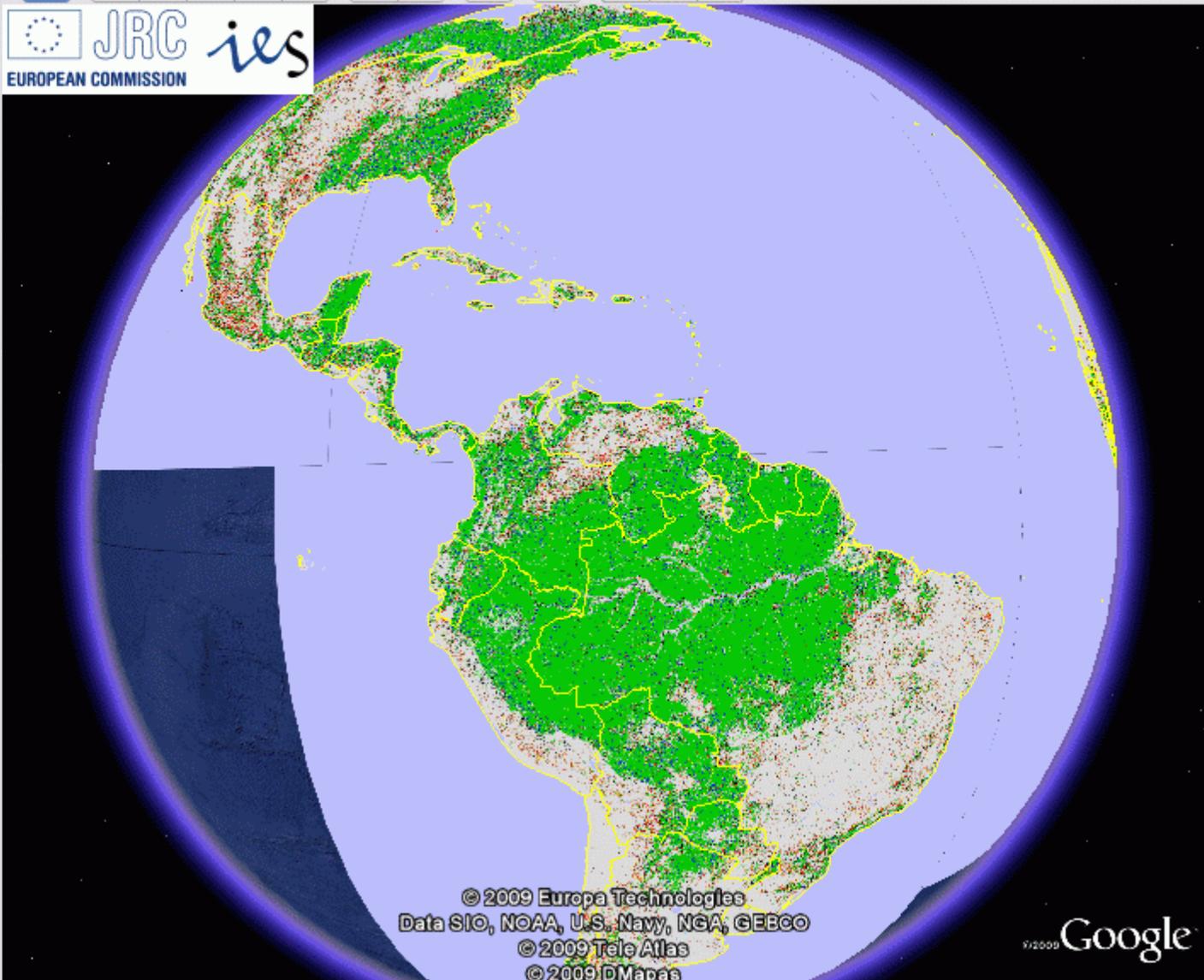
Search

Places Add Content

- Temporary Places
 - MSPA: Global Forest
 - Morphological Spatial Pattern Analysis (MSPA) of
 - Information
 - Legend
 - North America
 - South America
 - Europe, Africa
 - Asia
 - Australia
 - MSPA-JRC2000
 - Morphological Spatial Pattern Analysis (MSPA) of

Layers

- Primary Database
 - Geographic Web
 - Roads
 - 3D Buildings
 - Street View
 - Borders and Labels
 - Traffic
 - Weather
 - Gallery
 - Ocean
 - Global Awareness
 - Places of Interest
 - More
 - Terrain

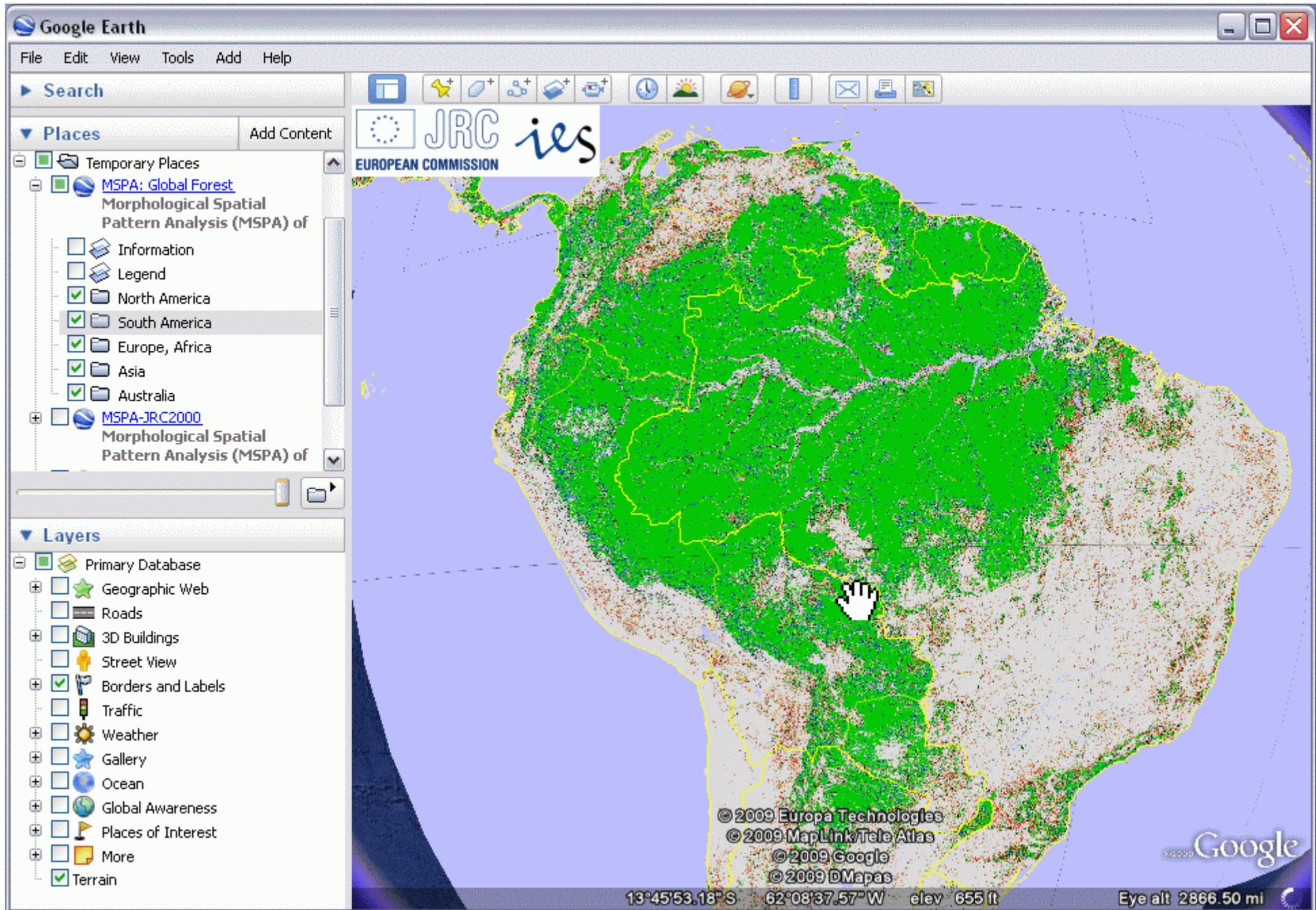


© 2009 Europa Technologies
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2009 Tele Atlas
© 2009 DMaPas

Google

3°04'28.07" N 68°13'25.30" W elev - 497 ft Eye alt 4990.81 mi

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05



Google Earth

File Edit View Tools Add Help

Search

Places Add Content

- Temporary Places
 - MSPA: Global Forest
 - Morphological Spatial Pattern Analysis (MSPA) of
 - Information
 - Legend
 - North America
 - South America
 - Europe, Africa
 - Asia
 - Australia
 - MSPA-JRC2000
 - Morphological Spatial Pattern Analysis (MSPA) of

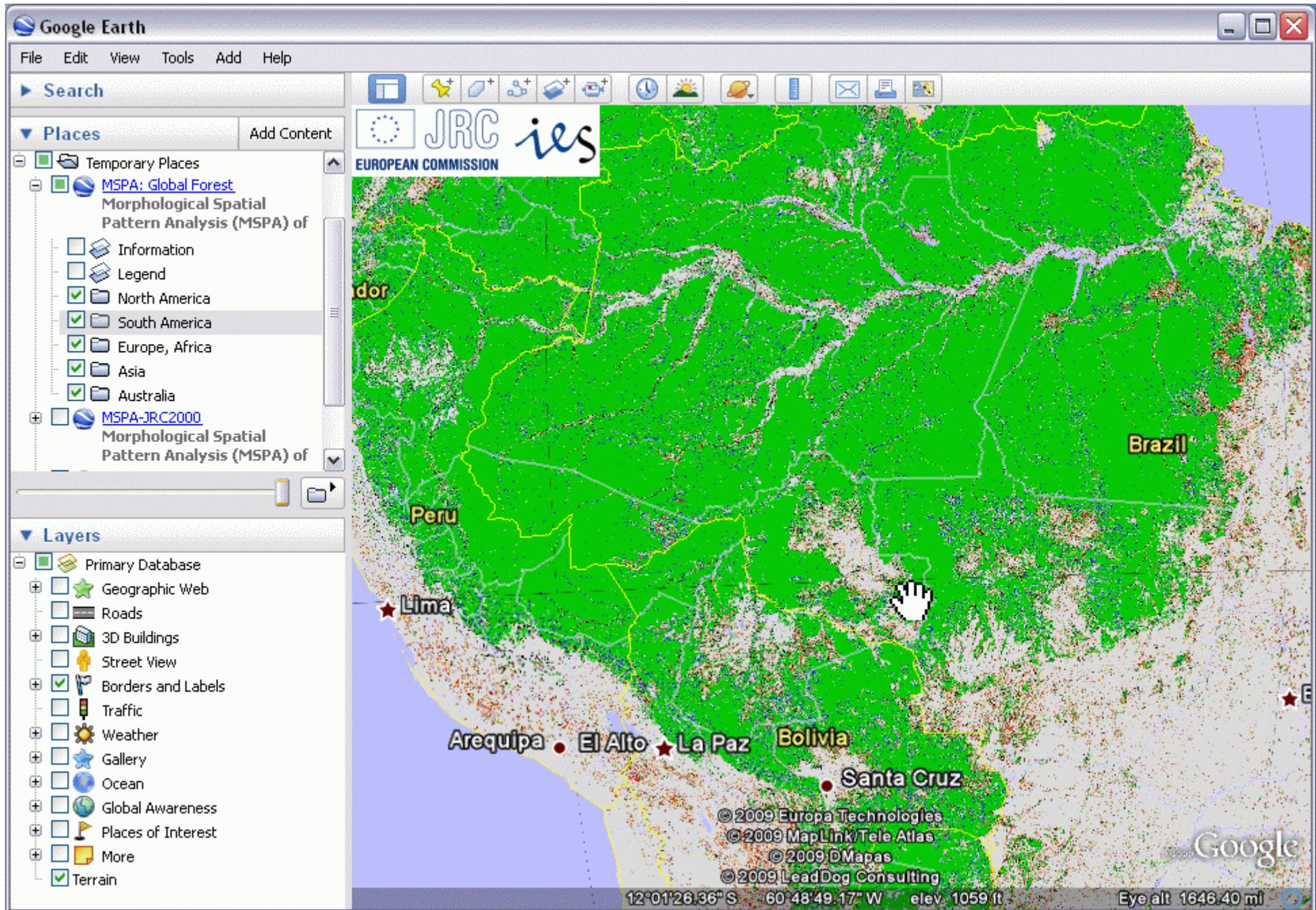
Layers

- Primary Database
 - Geographic Web
 - Roads
 - 3D Buildings
 - Street View
 - Borders and Labels
 - Traffic
 - Weather
 - Gallery
 - Ocean
 - Global Awareness
 - Places of Interest
 - More
 - Terrain

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© 2009 MapLink/Tele Atlas
© 2009 Google
© 2009 DMapas

13°45'53.18" S 62°08'37.57" W elev 655 ft Eye alt 2866.50 mi

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05



Google Earth

File Edit View Tools Add Help

Search

Places Add Content

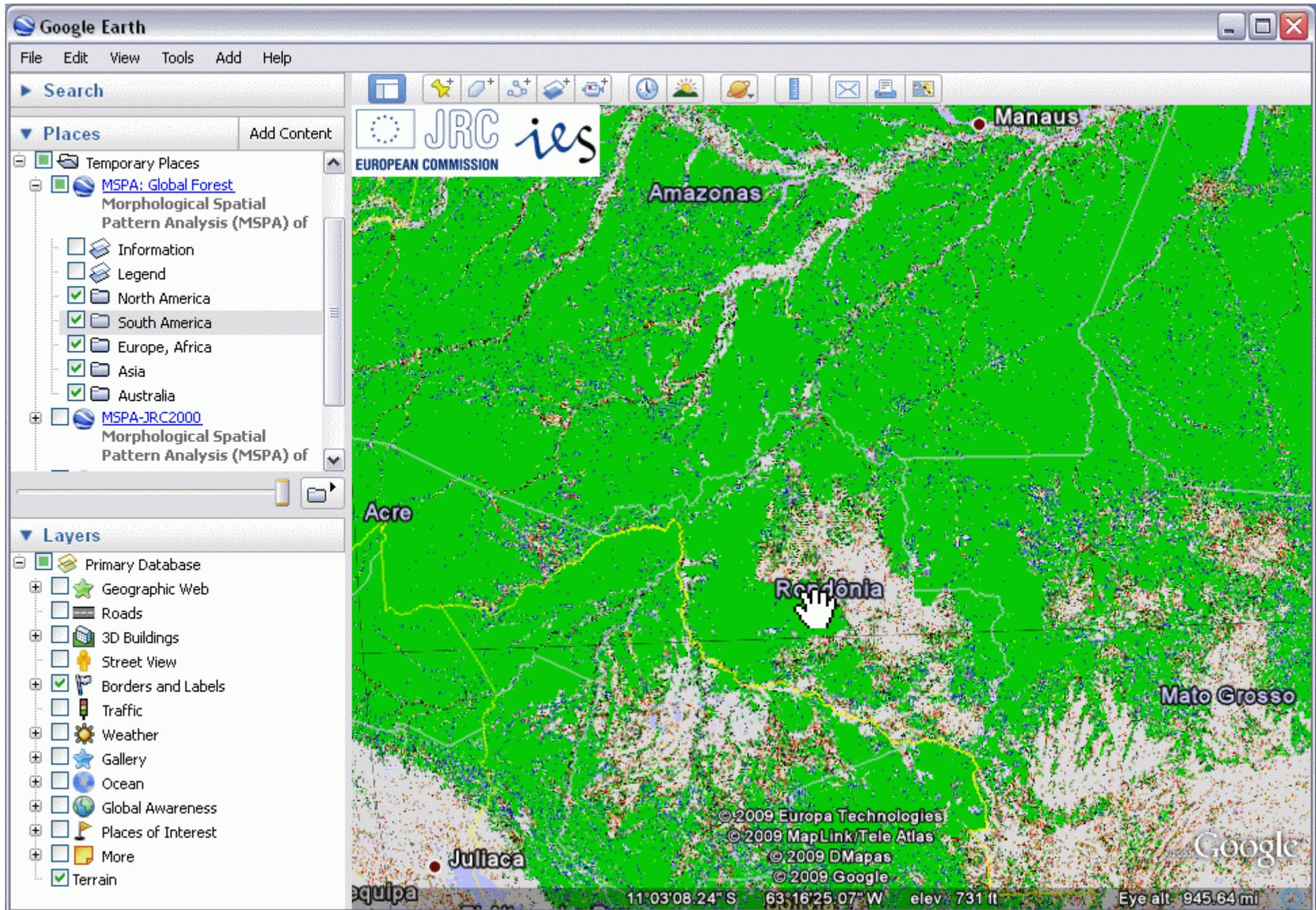
- Temporary Places
 - MSPA: Global Forest
 - Morphological Spatial Pattern Analysis (MSPA) of
 - Information
 - Legend
 - North America
 - South America
 - Europe, Africa
 - Asia
 - Australia
 - MSPA-JRC2000
 - Morphological Spatial Pattern Analysis (MSPA) of

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 - Roads
 - 3D Buildings
 - Street View
 - Borders and Labels
 - Traffic
 - Weather
 - Gallery
 - Ocean
 - Global Awareness
 - Places of Interest
 - More
 - Terrain

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© 2009 MapLink/Tele Atlas
© 2009 DMapas
© 2009 LeadDog Consulting

12°01'26.36" S 60°48'49.17" W elev 1059 ft Eye alt 1646.40 mi



Google Earth

File Edit View Tools Add Help

Search

Places Add Content

- Temporary Places
 - MSPA: Global Forest
 - Morphological Spatial Pattern Analysis (MSPA) of
 - Information
 - Legend
 - North America
 - South America
 - Europe, Africa
 - Asia
 - Australia
 - MSPA-JRC2000
 - Morphological Spatial Pattern Analysis (MSPA) of

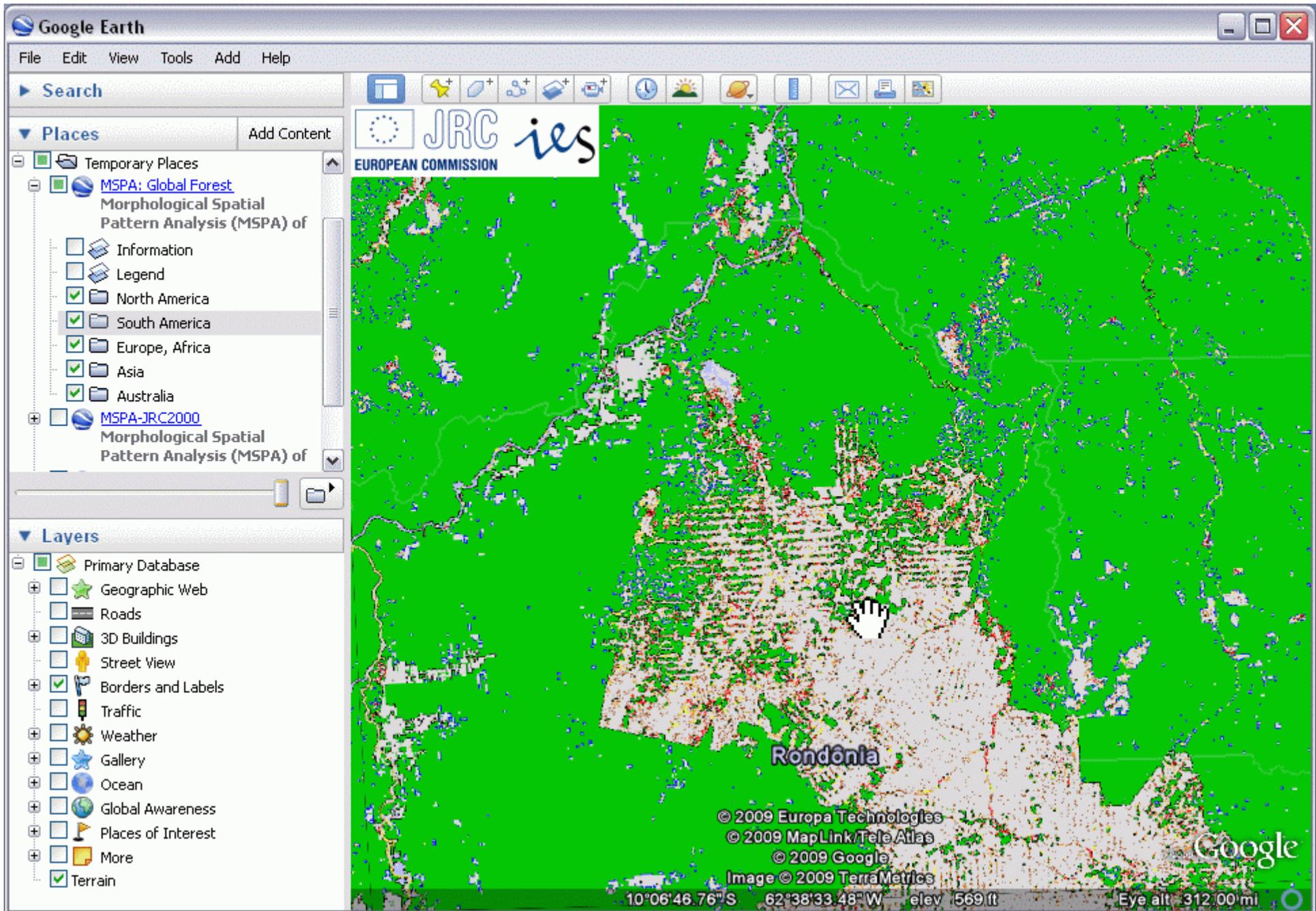
Layers

- Primary Database
 - Geographic Web
 - Roads
 - 3D Buildings
 - Street View
 - Borders and Labels
 - Traffic
 - Weather
 - Gallery
 - Ocean
 - Global Awareness
 - Places of Interest
 - More
 - Terrain

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©2009 DMaps
©2009 Google

Google

11°03'08.24" S 63°16'25.07" W elev: 731 ft Eye alt: 945.64 mi



Google Earth interface showing a map of Rondônia, Brazil, with a green overlay representing forest. The interface includes a search bar, a 'Places' sidebar with 'MSPA: Global Forest' selected, and a 'Layers' sidebar with 'Terrain' checked. A mouse cursor is over the map. Logos for JRC and ies are visible in the top left of the map area.

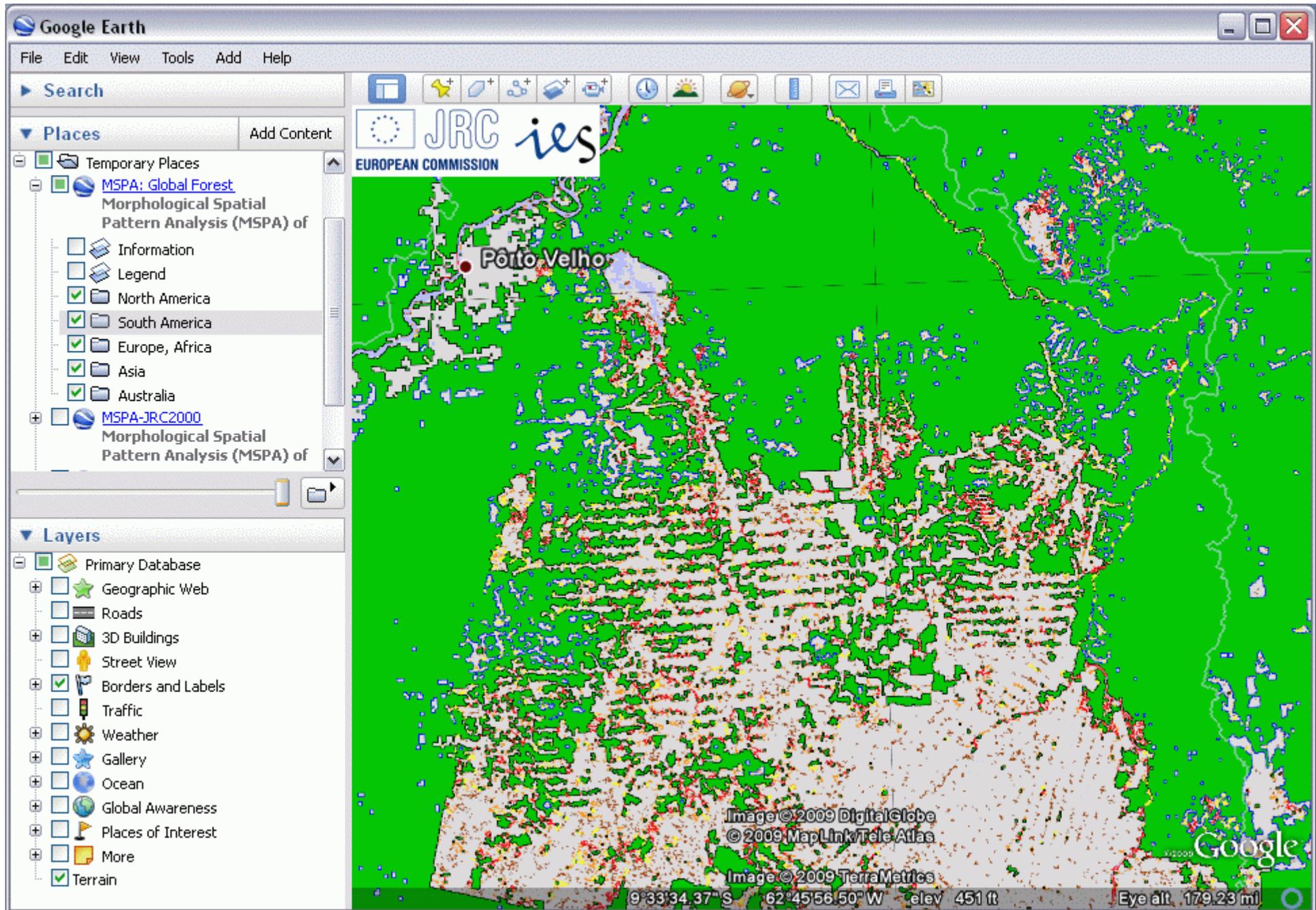
Places

- Temporary Places
 - MSPA: Global Forest
 - Morphological Spatial Pattern Analysis (MSPA) of
 - Information
 - Legend
 - North America
 - South America
 - Europe, Africa
 - Asia
 - Australia
 - MSPA-JRC2000
 - Morphological Spatial Pattern Analysis (MSPA) of

Layers

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 - Roads
 - 3D Buildings
 - Street View
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 - Traffic
 - Weather
 - Gallery
 - Ocean
 - Global Awareness
 - Places of Interest
 - More
 - Terrain

© 2009 Europa Technologies
© 2009 MapLink/TeleAtlas
© 2009 Google
Image © 2009 TerraMetrics
10°06'46.76"S 62°38'33.48"W elev 569ft Eye alt 312.00mi



Google Earth

File Edit View Tools Add Help

Search

Places Add Content

- Temporary Places
 - MSPA: Global Forest Morphological Spatial Pattern Analysis (MSPA) of
 - Information
 - Legend
 - North America
 - South America
 - Europe, Africa
 - Asia
 - Australia
 - MSPA-JRC2000 Morphological Spatial Pattern Analysis (MSPA) of

Layers

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 - Roads
 - 3D Buildings
 - Street View
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 - Traffic
 - Weather
 - Gallery
 - Ocean
 - Global Awareness
 - Places of Interest
 - More
 - Terrain

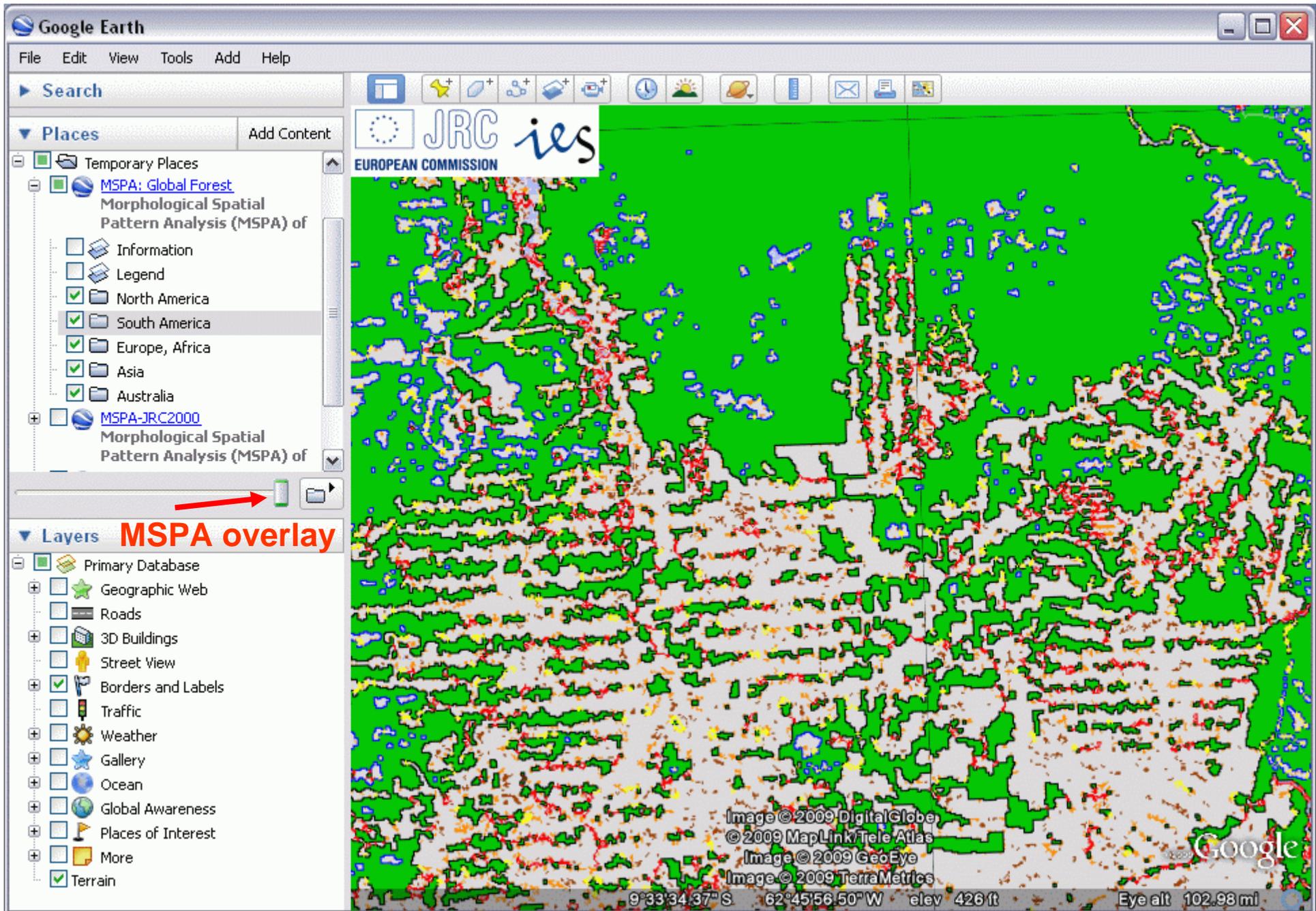
Porto Velho

Image © 2009 DigitalGlobe
© 2009 MapLink/Tele Atlas

Image © 2009 TerraMetrics

Google

9°33'34.37" S 62°45'56.50" W elev 451 ft Eye alt 179.23 m



Google Earth

File Edit View Tools Add Help

Search

Places Add Content

- Temporary Places
 - MSPA: Global Forest
 - Morphological Spatial Pattern Analysis (MSPA) of
 - Information
 - Legend
 - North America
 - South America
 - Europe, Africa
 - Asia
 - Australia
 - MSPA-JRC2000
 - Morphological Spatial Pattern Analysis (MSPA) of

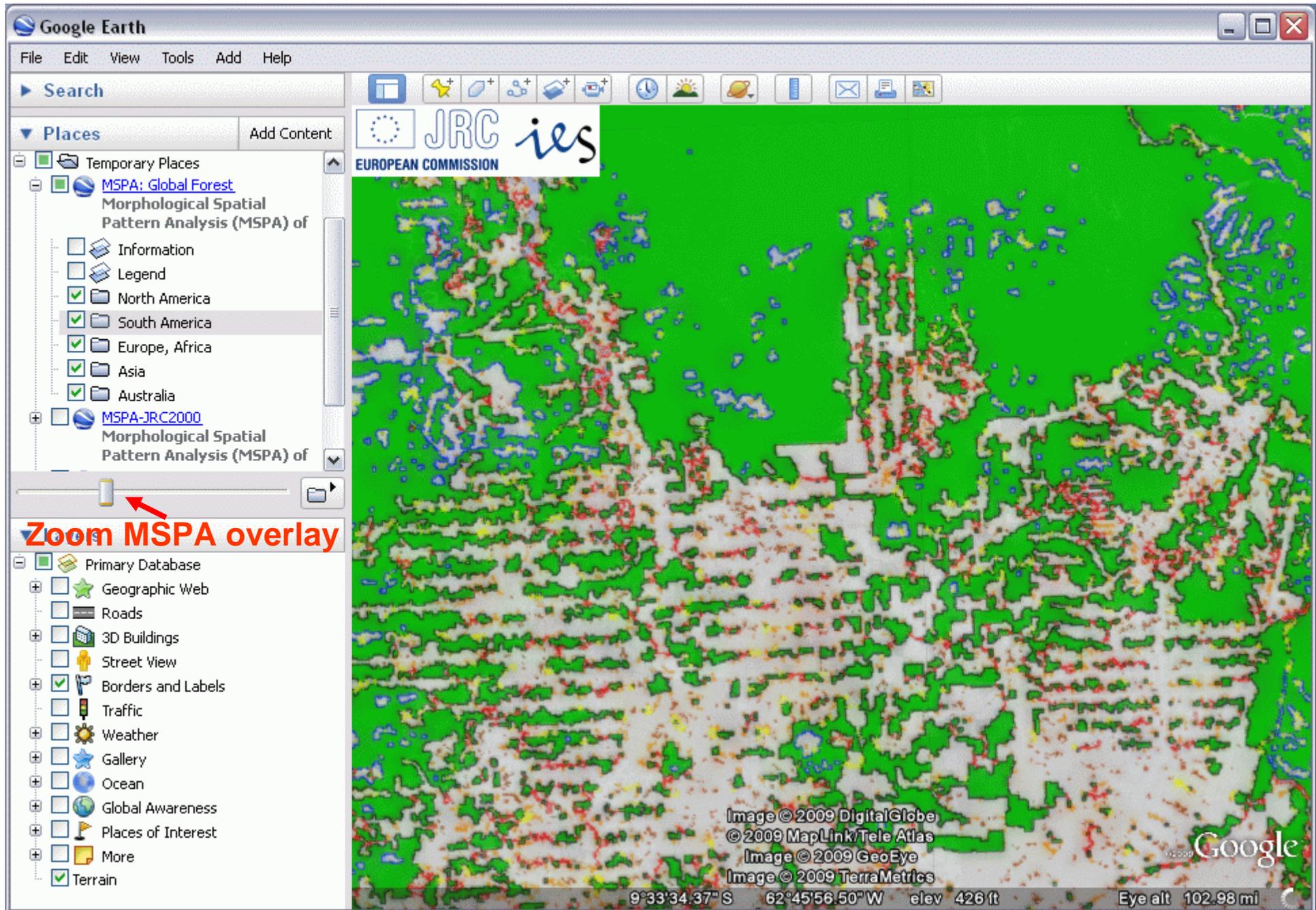
Layers **MSPA overlay**

- Primary Database
 - Geographic Web
 - Roads
 - 3D Buildings
 - Street View
 - Borders and Labels
 - Traffic
 - Weather
 - Gallery
 - Ocean
 - Global Awareness
 - Places of Interest
 - More
 - Terrain

Image © 2009 DigitalGlobe
© 2009 MapLink/Tele Atlas
Image © 2009 GeoEye
Image © 2009 TerraMetrics

Google

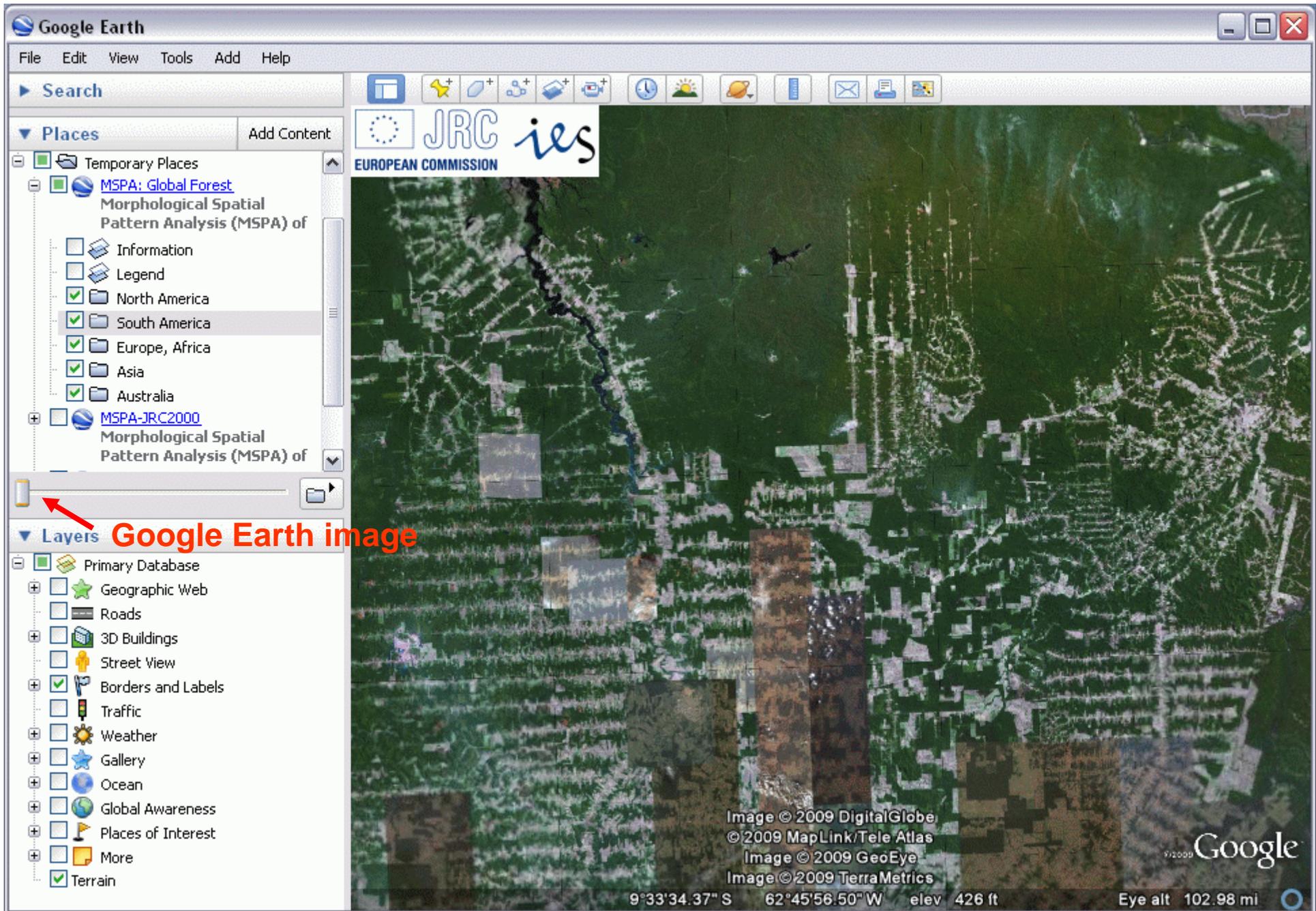
9°33'34.37" S 62°45'56.50" W elev 426 ft Eye alt 102.98 mi



Zoom MSPA overlay

Image © 2009 DigitalGlobe
© 2009 MapLink/Tele Atlas
Image © 2009 GeoEye
Image © 2009 TerraMetrics

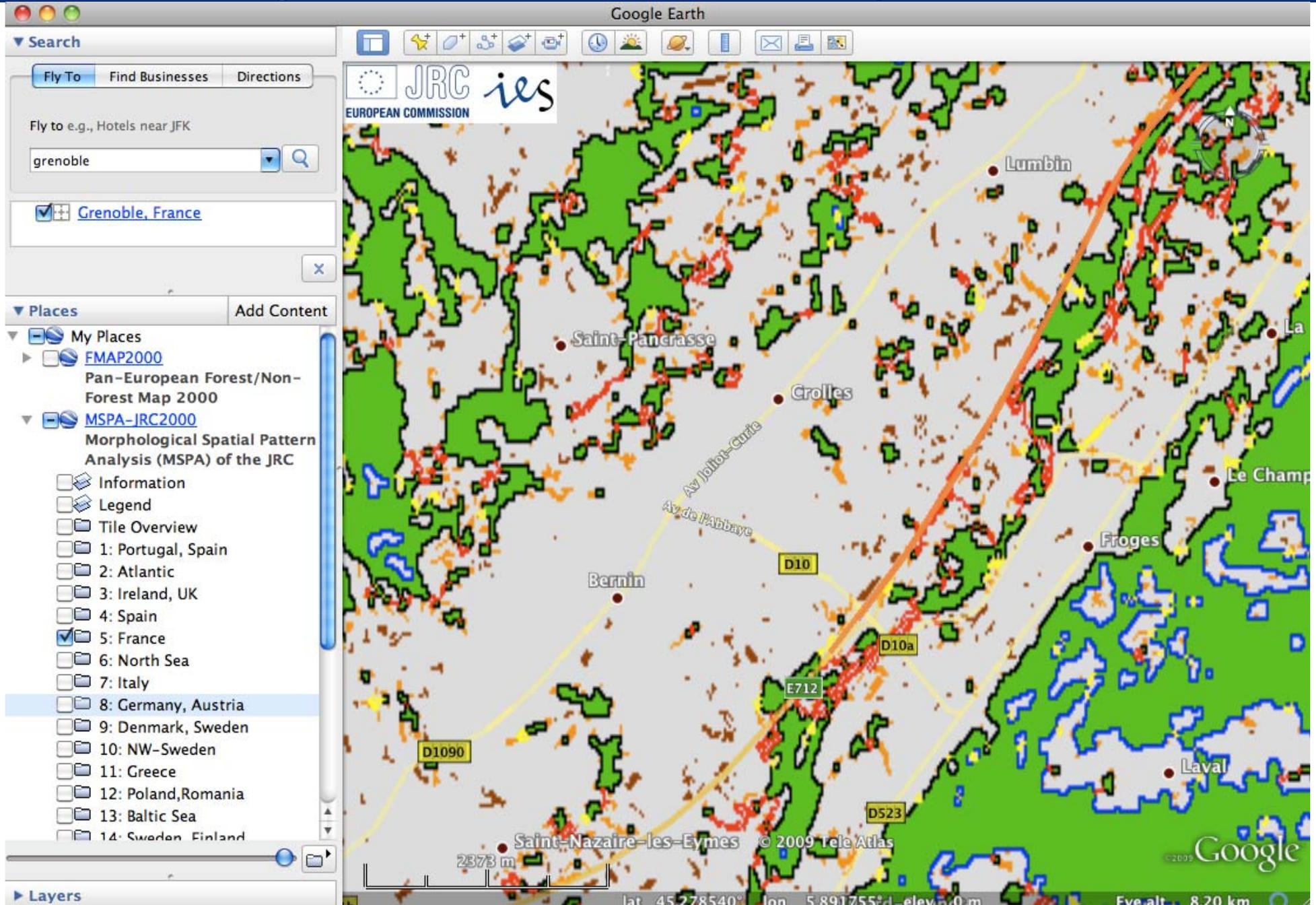
9°33'34.37" S 62°45'56.50" W elev 426 ft Eye alt 102.98 mi



The screenshot shows the Google Earth interface with the following elements:

- Search:** Search bar at the top left.
- Places:** A list of saved places. The selected place is "MSPA: Global Forest Morphological Spatial Pattern Analysis (MSPA) of". It contains sub-items: Information, Legend, North America, South America, Europe, Africa, Asia, and Australia. Below it is "MSPA-JRC2000 Morphological Spatial Pattern Analysis (MSPA) of".
- Layers:** A list of map layers. The "Terrain" layer is checked. Other layers include Primary Database, Geographic Web, Roads, 3D Buildings, Street View, Borders and Labels, Traffic, Weather, Gallery, Ocean, Global Awareness, Places of Interest, and More.
- Map:** A satellite image of a forested area with a river. A red arrow points to the "Layers" panel with the text "Google Earth image".
- Logos:** JRC and ies logos are overlaid on the map.
- Footer:** Copyright information: "Image © 2009 DigitalGlobe, ©2009 MapLink/Tele Atlas, Image © 2009 GeoEye, Image © 2009 TerraMetrics". The Google logo is also present.
- Coordinates:** 9°33'34.37" S 62°45'56.50" W elev 426 ft
- Altitude:** Eye alt 102.98 mi

Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05



Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

input.tif: Conefor Sensinode: Connectivity (CCore_max=19.8548, CBridge_max=1)

File General Tools Pattern Analysis Help

IMAGE/DISPLAY ATTRIBUTES

transpose/rotate: no/0

Select colortable: Classification

Normalized

Autostretch

Quit zoom

Factor: 4x

MSPA PARAMETERS

FGConn [8/4]

EdgeWidth [pixels] 1

Transition [0n/Off]

Intext [0n/Off]

Calculate MSPA statistics

	FG/data [%]	Frequency
CORE-green	n/a	n/a
ISLET-brown	n/a	n/a
PERF-blue	n/a	n/a
EDGE-black	n/a	n/a
LOOP-yellow	n/a	n/a
BRIDGE-red	n/a	n/a
RANCH-orang	n/a	n/a
Backg-grey	n/a	n/a
Miss-white	n/a	n/a

X: 13 Y: 759 CS22: CoreID: 691, Conn.(Importance): 0.304605 (2 %)

CS22 nodes/links: ID and relative importance



Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05

input.tif (isolated networks (iNW - color): 135, isolated cores (iCore - black): 28)

File General Tools Pattern Analysis Help

IMAGE/DISPLAY ATTRIBUTES

transpose/rotate: no/0

Select colortable: Classification

Normalized

Autostretch

Zoom mode

Factor: 1x

MSPA PARAMETERS

FGConn [8/4]

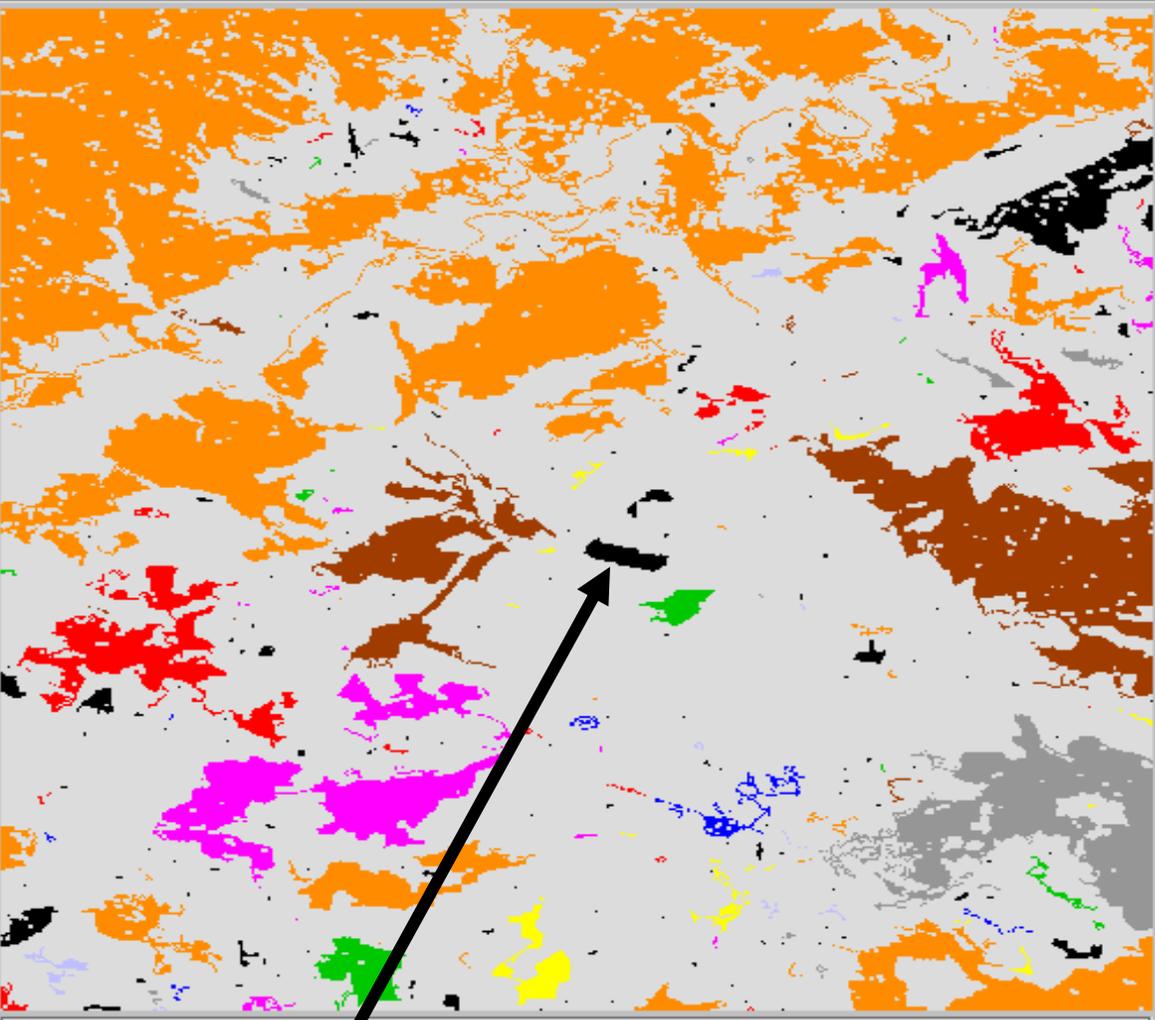
EdgeWidth [pixels]: 1

Transition [0n/Off]

Intext [0n/Off]

Calculate MSPA statistics

	FG/data [%]	Frequency
CORE-green	n/a	n/a
ISLET-brown	n/a	n/a
PERF-blue	n/a	n/a
EDGE-black	n/a	n/a
LOOP-yellow	n/a	n/a
BRIDGE-red	n/a	n/a
RANCH-orang	n/a	n/a
Backg-grey	n/a	n/a
Miss-white	n/a	n/a



X: 541 Y: 453 iCore [ID, size]: 164, 1180

Isolated networks & cores, ID and size

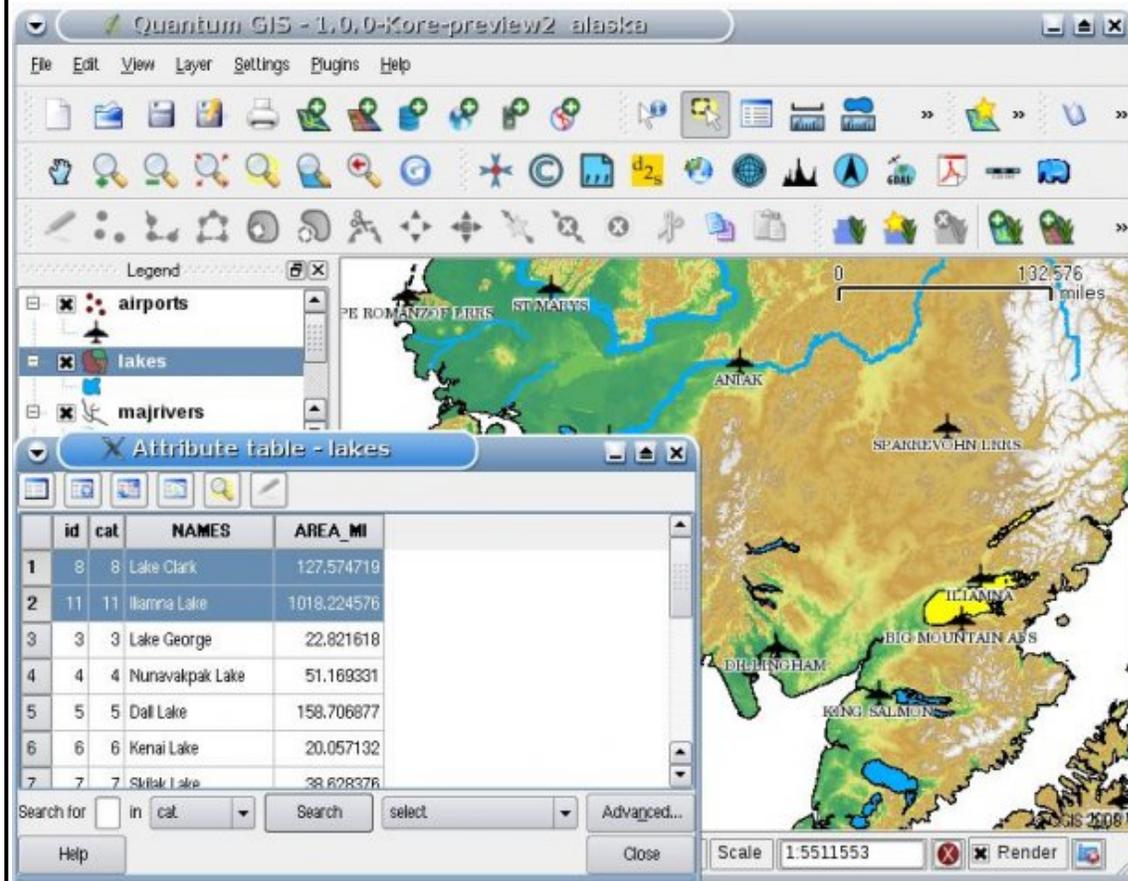


Vogt: Guidos-MSPA, ECONNECT workshop, 2009/11/05



GUIDOS LiveCD GUIDOS installer → GUIDOS portable

 **Quantum GIS:** raster, vector, WMS, OpenStreetMap, WFS, GRASS, ESRI, GML, POSTGIS, GPS-tools, etc.



Quantum GIS - 1.0.0-Kore-preview2 alaska

File Edit View Layer Settings Plugins Help

Legend

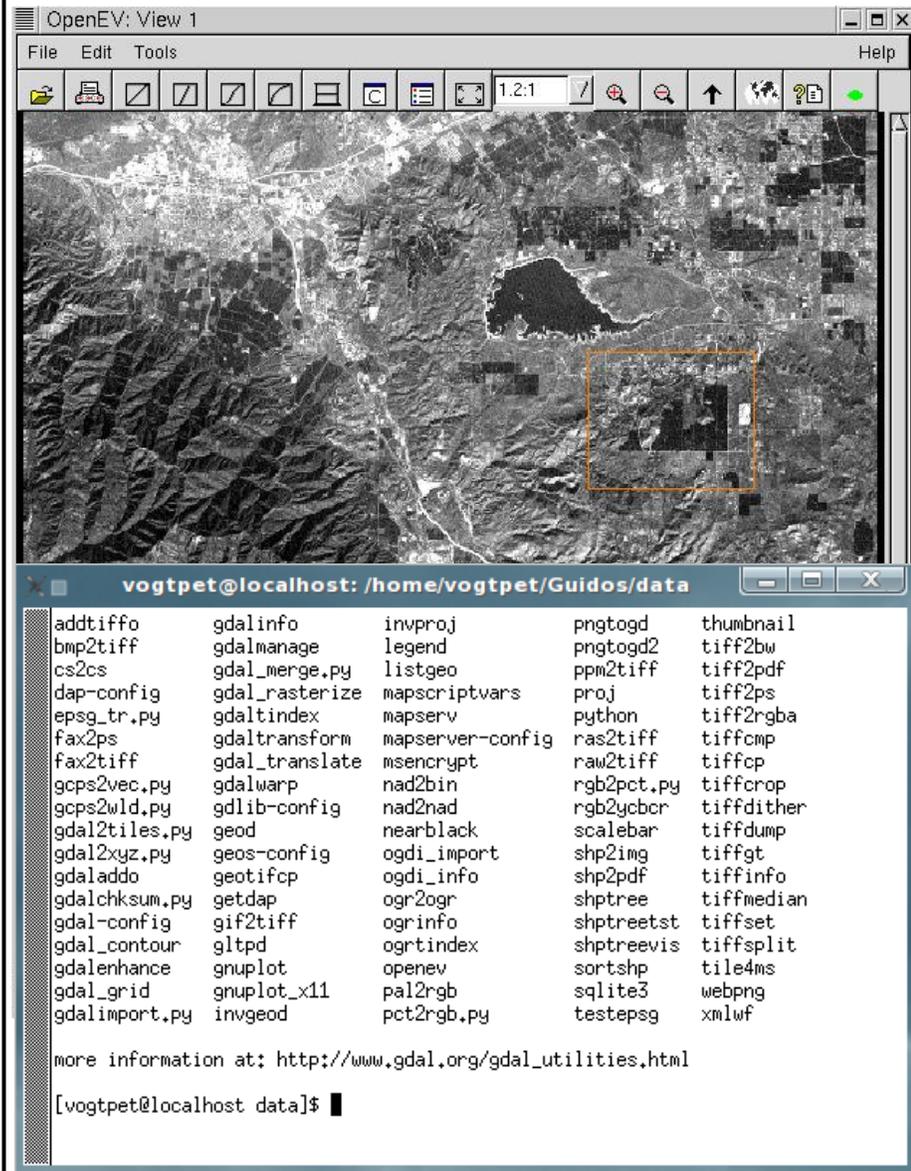
- airports
- lakes
- majorivers

Attribute table - lakes

id	cat	NAMES	AREA_MI
1	8	Lake Clark	127.574719
2	11	Iliamna Lake	1018.224576
3	3	Lake George	22.821618
4	4	Nunavakpak Lake	51.169331
5	5	Dall Lake	158.706877
6	6	Kenai Lake	20.057132
7	7	Skikak Lake	38.828378

Scale 1:5511553

FWTOOLS/OpenEV/GDAL: re-project, merge, convert, ... & display in raster/vector-viewer



OpenEV: View 1

File Edit Tools Help

1:2:1

vogtpet@localhost: /home/vogtpet/Guidos/data

```

addtiff      gdalinfo    invproj     pngtogd     thumbnail
bmp2tiff     gdalmanage  legend     pngtogd2   tiff2bw
cs2cs       gdal_merge.py listgeo     ppm2tiff    tiff2pdf
dap-config  gdal_rasterize mapscripvars proj         tiff2ps
epsg_tr.py  gdaltindex  mapserv    pytho      tiff2rgba
fax2ps      gdaltransform mapserver-config ras2tiff    tiffcnp
fax2tiff    gdal_translate msencrypt   raw2tiff    tiffcp
gcps2vec.py gdalwarp    nad2bin    rgb2pct.py tiffcrop
gcps2wld.py gdlib-config nad2nad    rgb2ycbcr  tiffdither
gdal2tiles.py geod        nearblack  scalebar   tiffdump
gdal2xyz.py geos-config ogdi_import shp2img     tiffgt
gdaladdo   geotifcp   ogdi_info  shp2pdf    tiffinfo
gdalchksum.py getdap     ogr2ogr    shptree    tiffmedian
gdal-config gif2tiff    ogrinfo    shptreetst tiffset
gdal_contour gltpd      ogrtindex  shptreevis tiffsplit
gdalenhance gnuplot    openev     sortshp    tile4ms
gdal_grid  gnuplot_x11 pal2rgb    sqlite3     webpng
gdalimport.py invgeod    pct2rgb.py testpsg     xmlwf
    
```

more information at: http://www.gdal.org/gdal_utilities.html

[vogtpet@localhost data]\$



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Free download:



<http://forest.jrc.ec.europa.eu/download/software/guidos>

Key features:

- MSPA & IP-tools
- Distance maps
- Statistics
- Connectivity
- Gdal, kml-export
- GIS-environment,...

Used by:



Contact:
Peter.Vogt@jrc.ec.europa.eu

