(Geo)spatial diversity

Two dimensional data from images and occurences with use of GIS and spatial analyses

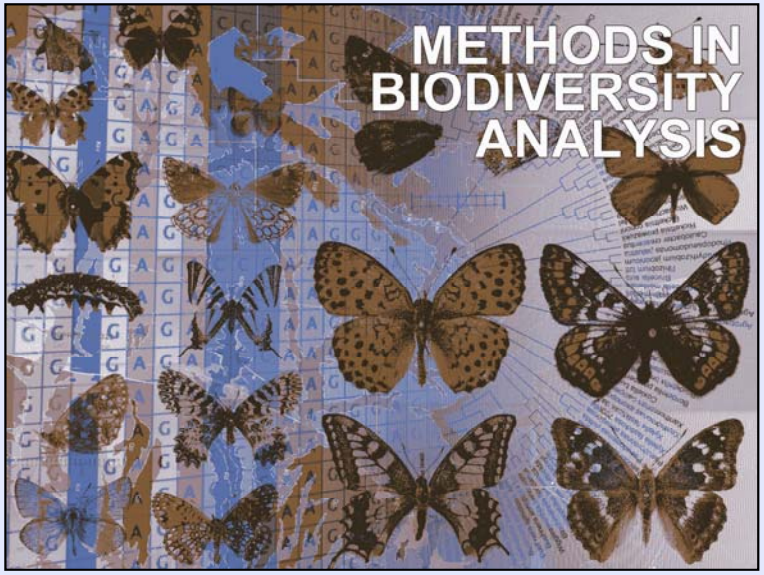
Course Methods in Biodiversity Analysis

Master Biology

Maarten van 't Zelfde, Rutger Vos, Nuno De Mesquita César de Sá & Rosaleen March

CML – Leiden University & Naturalis BC

November 2018



Contents of presentation Lecture 1-1 and Lecture 1-2

- Definition of GIS
- Why GIS and Biodiversity Analysis
- Spatial data objects
- Schedule week 2: **(Geo)spatial diversity**
- Examples of projects
- Technical Inventory
- Pause
- GIS functions
- The Geographic Approach to Environmental process studies
- Example-study: Monitoring of migration of elephants in Cameroon
- Steps of the Geographic Approach (including flowchart)

What is GIS ?

Geographical Information System

A GIS is a computer system with which data, **with a spatial reference to earth's surface,** can be inputted, stored, controlled, analysed, modelled, integrated and represented

GIS data (spatial features) encompass both:

- a spatial component: Where &
- an attribute component: What

Definition of GIS

GIS: What is where (and when)

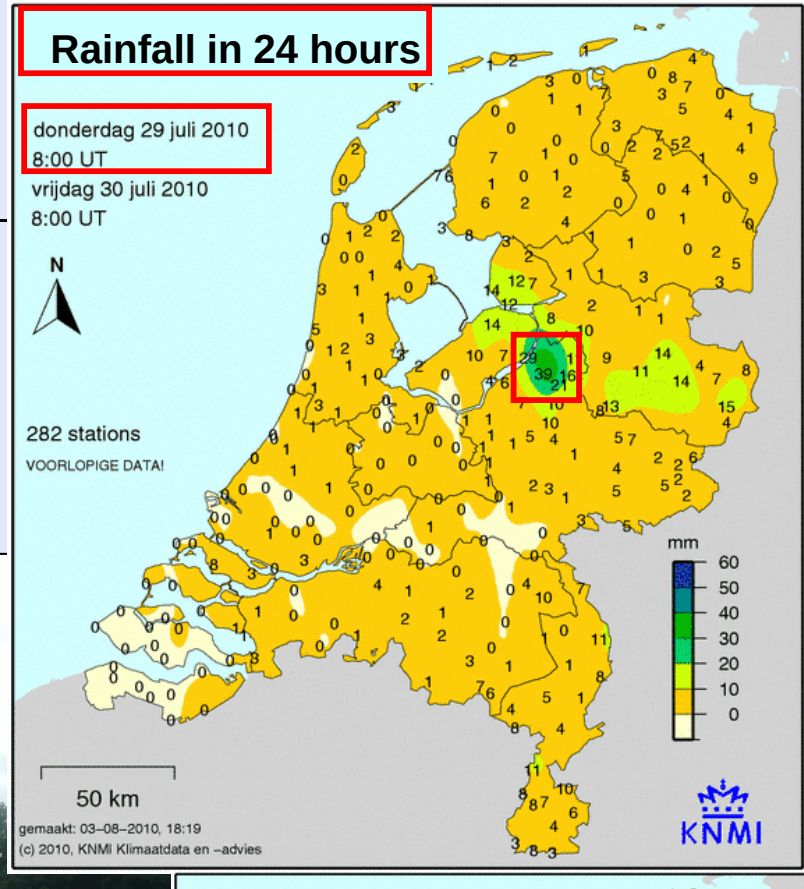
Is this a swamp ?

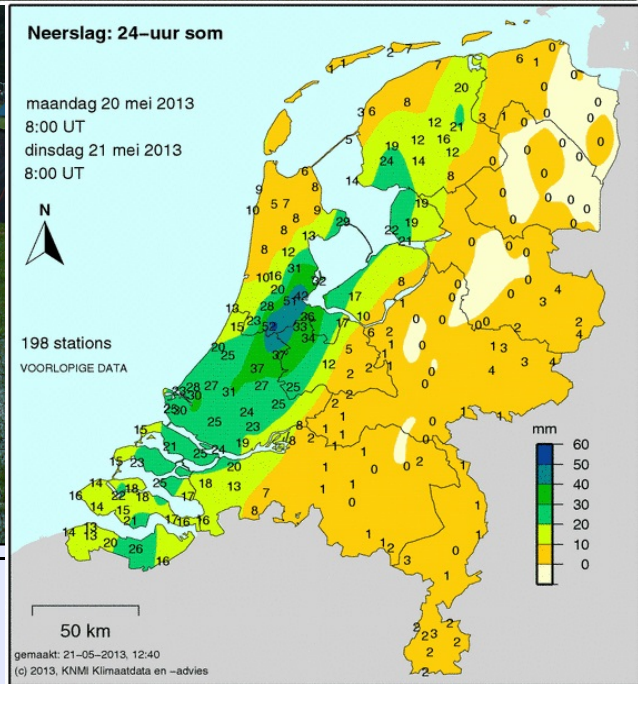
Or is it a campsite ?

Where is this campsite ?

X, Y or latitude/longitude

When was this ?

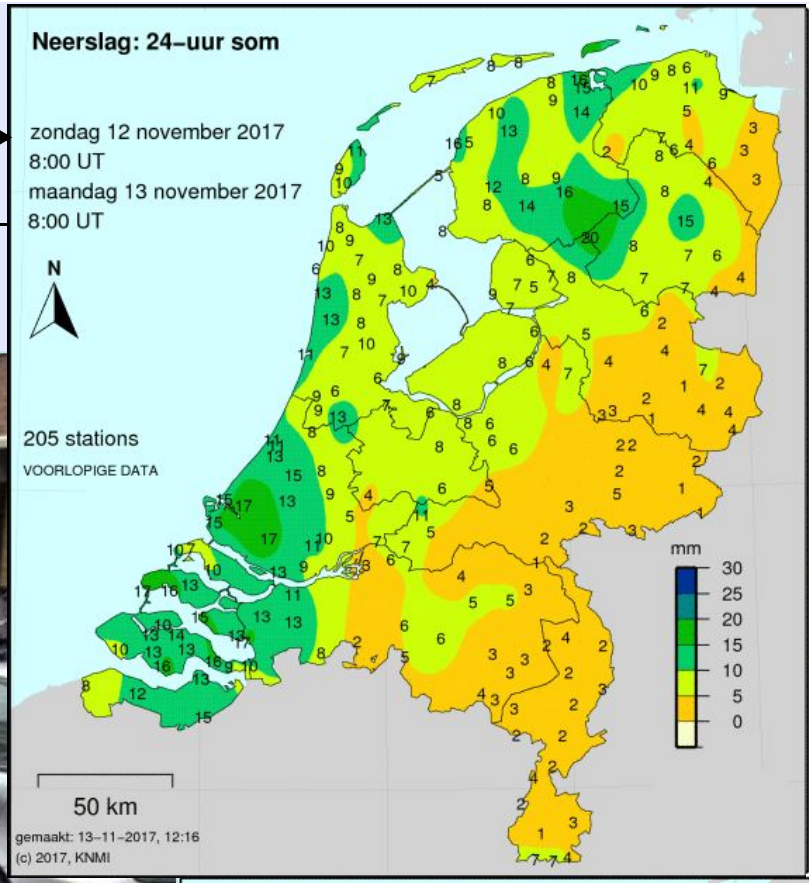


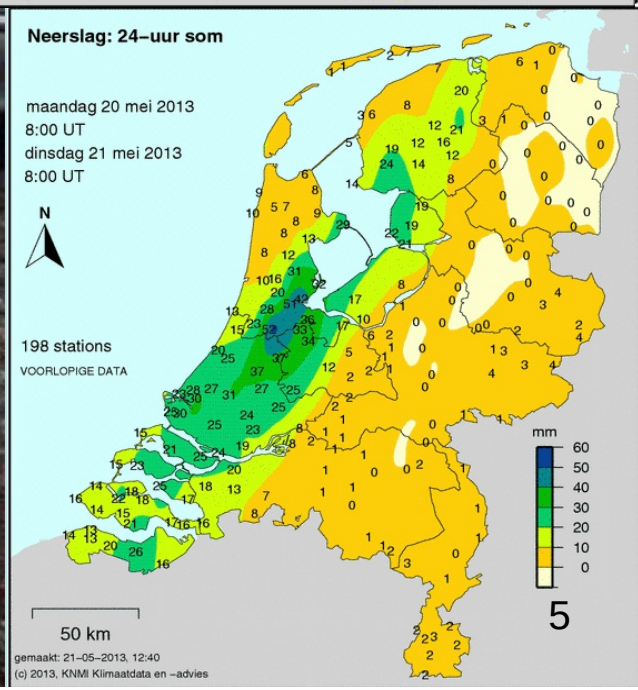


Definition of GIS

Recently →

GIS: What is where (and when)

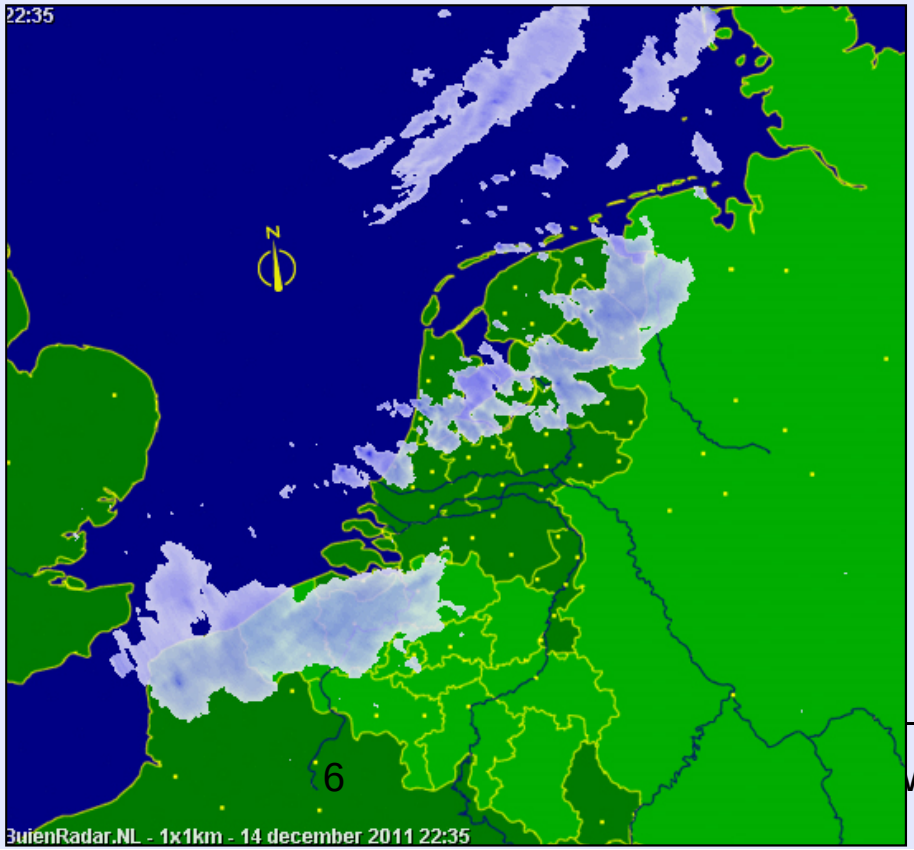


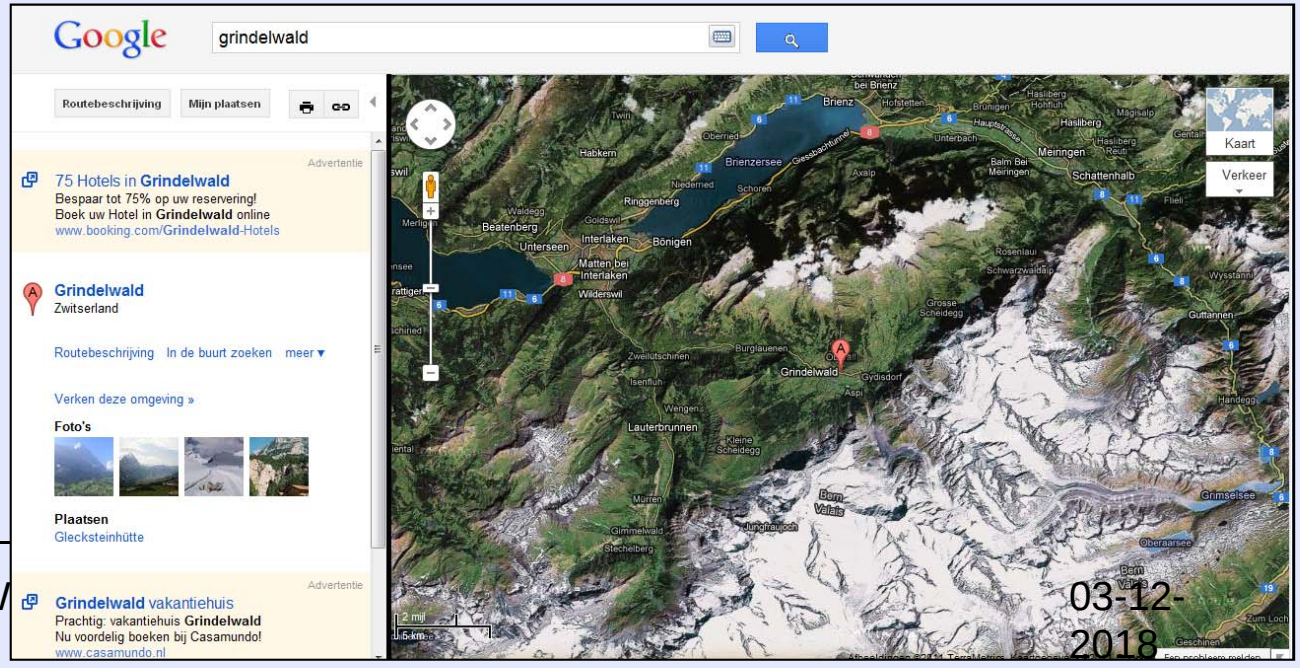


Definition of GIS

We use geographical analysis in our personal daily live, like:

- Using a vehicle navigation system like: Tom Tom
- Looking for the location of our holidays with: Google Maps
- Looking to the expected rainfall with: Buienradar

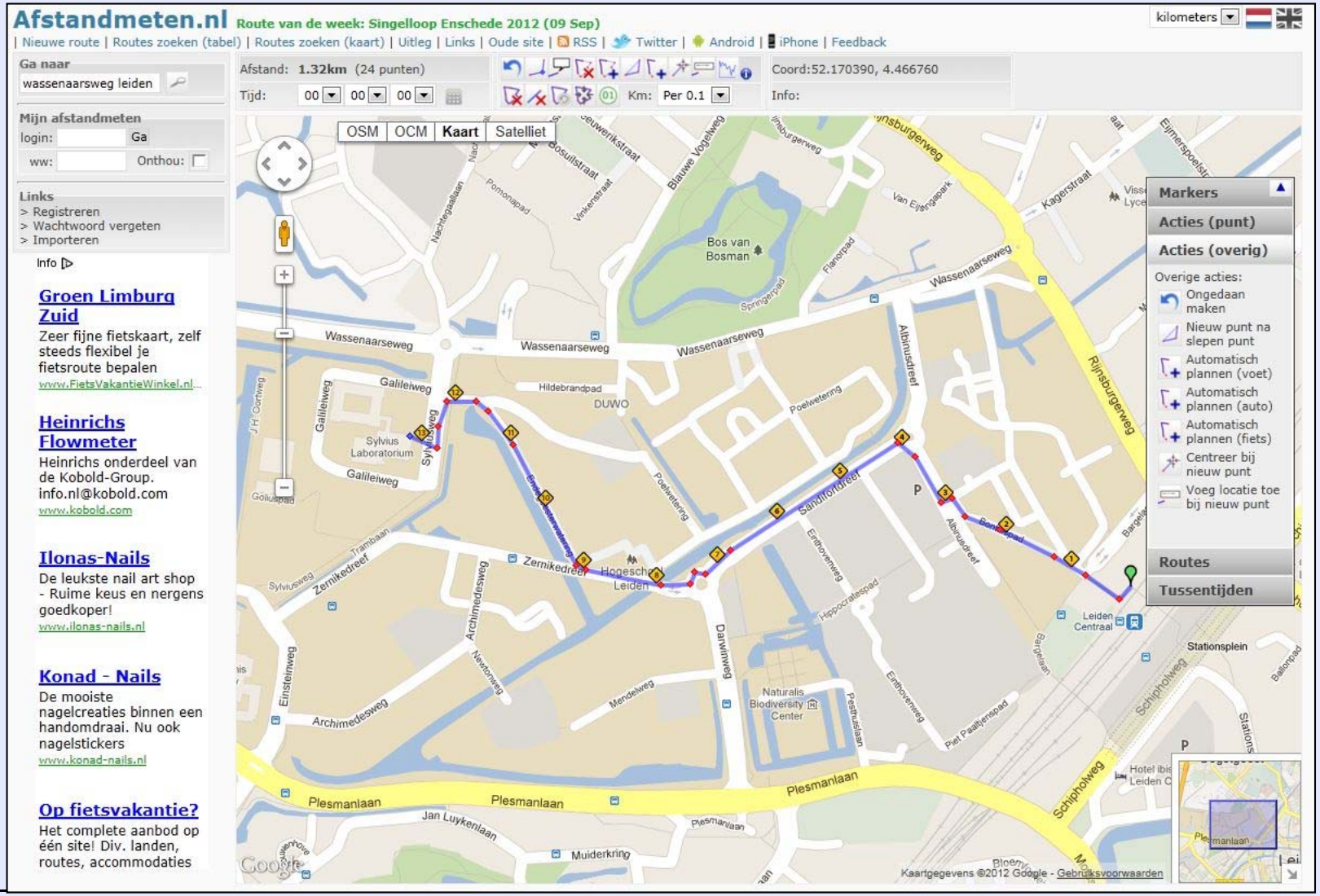




Definition of GIS

We use geographical analysis in our personal daily live, like:

- Measuring the distance of our daily walk



Why GIS and Biodiversity Analysis

- Biodiversity exists in the real world on a certain place on a certain scale → Geography

- GIS can help to inventory, analyze and manage problems which are related to Biodiversity and Environmental Processes stressing this Biodiversity

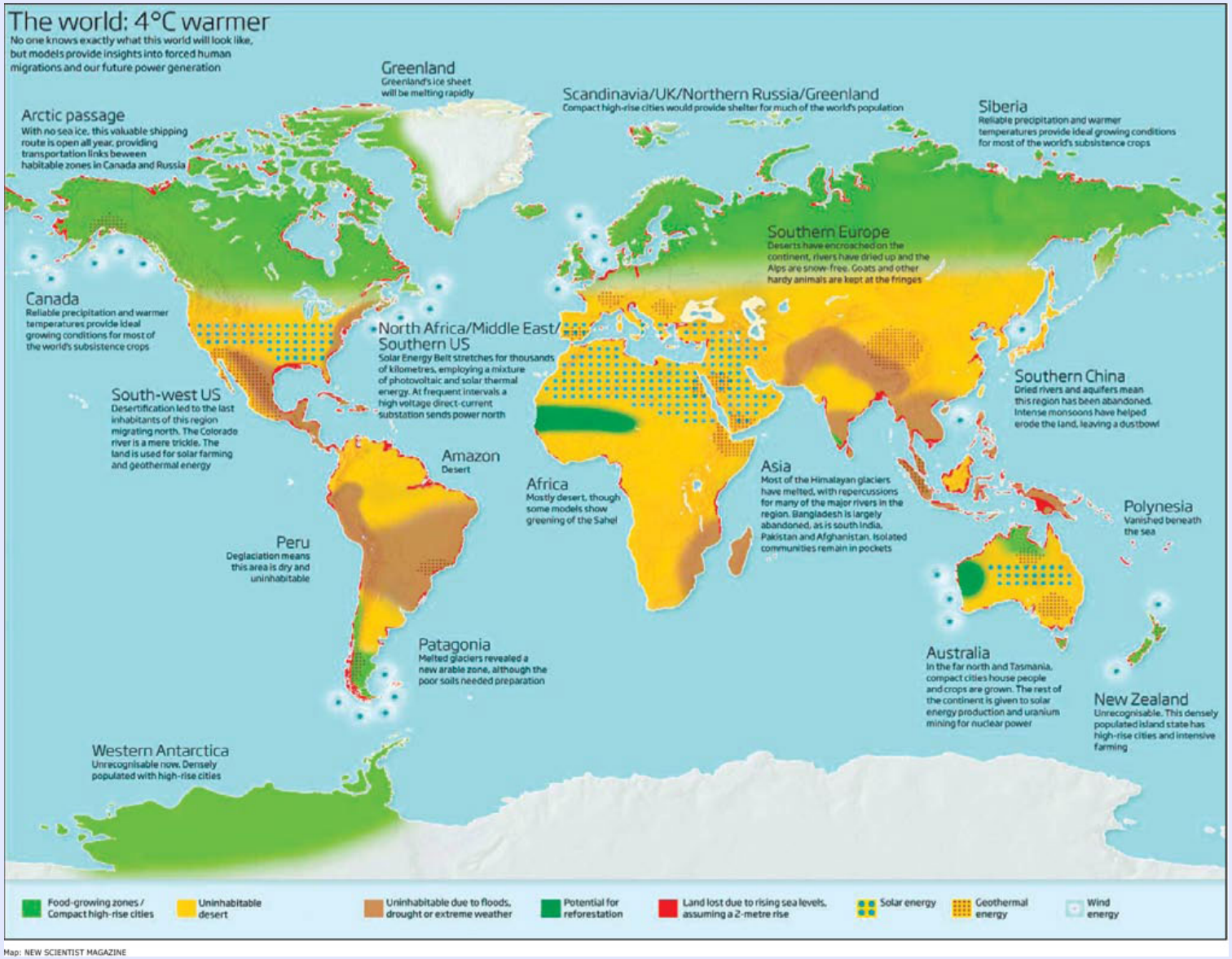
- Most important: GIS helps to visualize the extent and location of the processes and the quantity of the Biodiversity.

- New techniques and datasets are (freely) available to perform above mentioned tasks.

Why GIS in Master Biology

- Spatial analysis is becoming more important in policy/research
  - Interpretation and understanding of outcome of environmental process models
  - Choice of different future scenarios for scarcity / global warming e.g.
- This week we will have practicals to get some hands on experience with a GIS software package used at many governance institutes: ArcGIS
- But we will also discuss other GIS packages and tools
- Leiden University has a site license for Arc GIS since 2014.
- Much spatial data is digitally becoming freely available for the Netherlands and European Union (since 2013)
- GIS can be used as a tool for the GIS assignment in this course.

Why GIS and Biodiversity Analysis



Map: NEW SCIENTIST MAGAZINE

Visualisation:

The power of reading a map

Why GIS and Biodiversity Analysis

2009

GeoEye imagery Japan
before and after Tsunami 2011

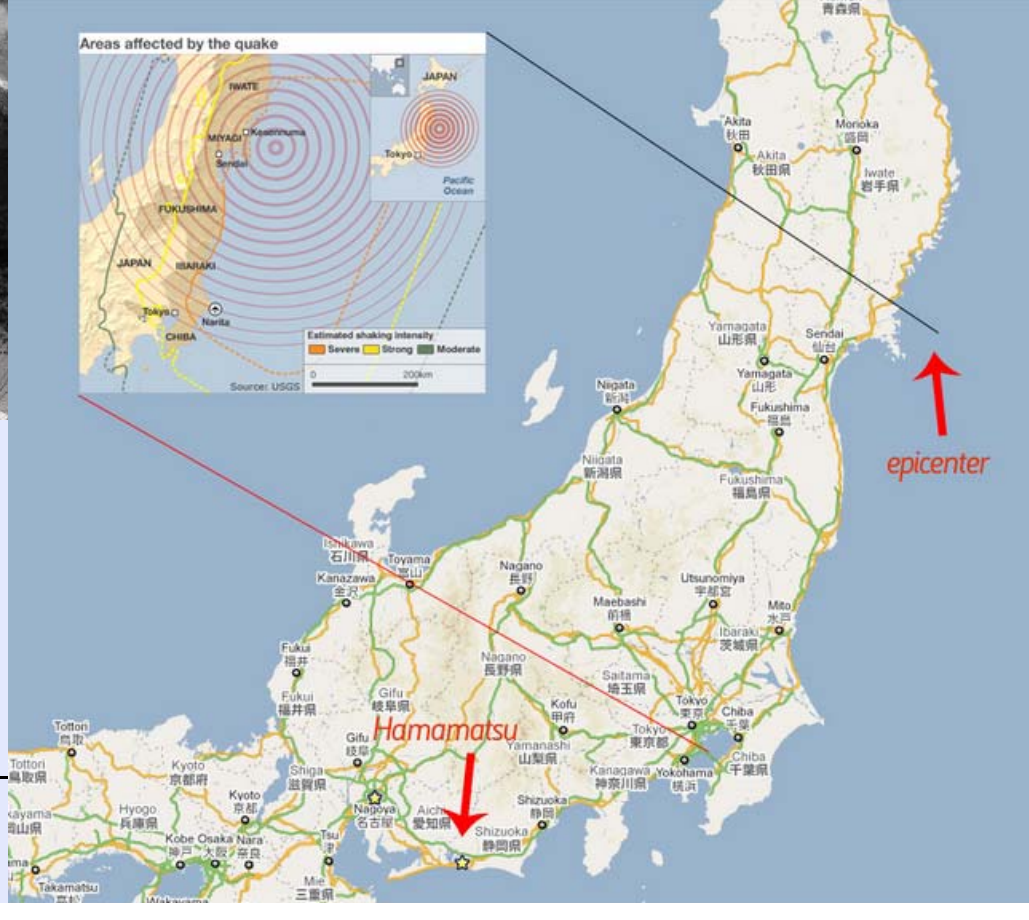
GIS: Showing changes in time

2011

Why GIS and Biodiversity Analysis

GeoEye imagery Japan
before and after Tsunami 2011

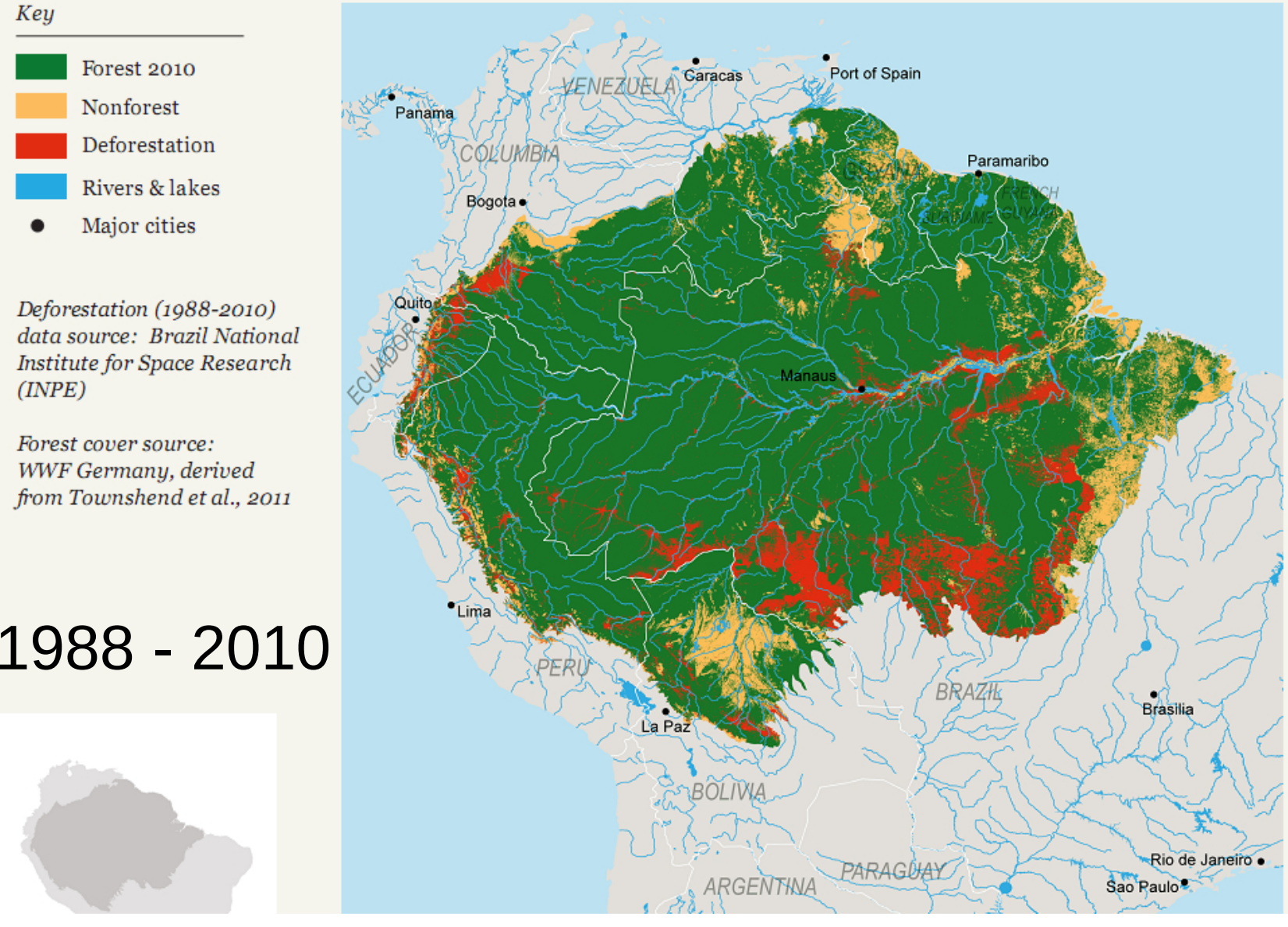
GIS: Showing changes in time



Why GIS and Biodiversity Analysis

GIS: Showing changes in time

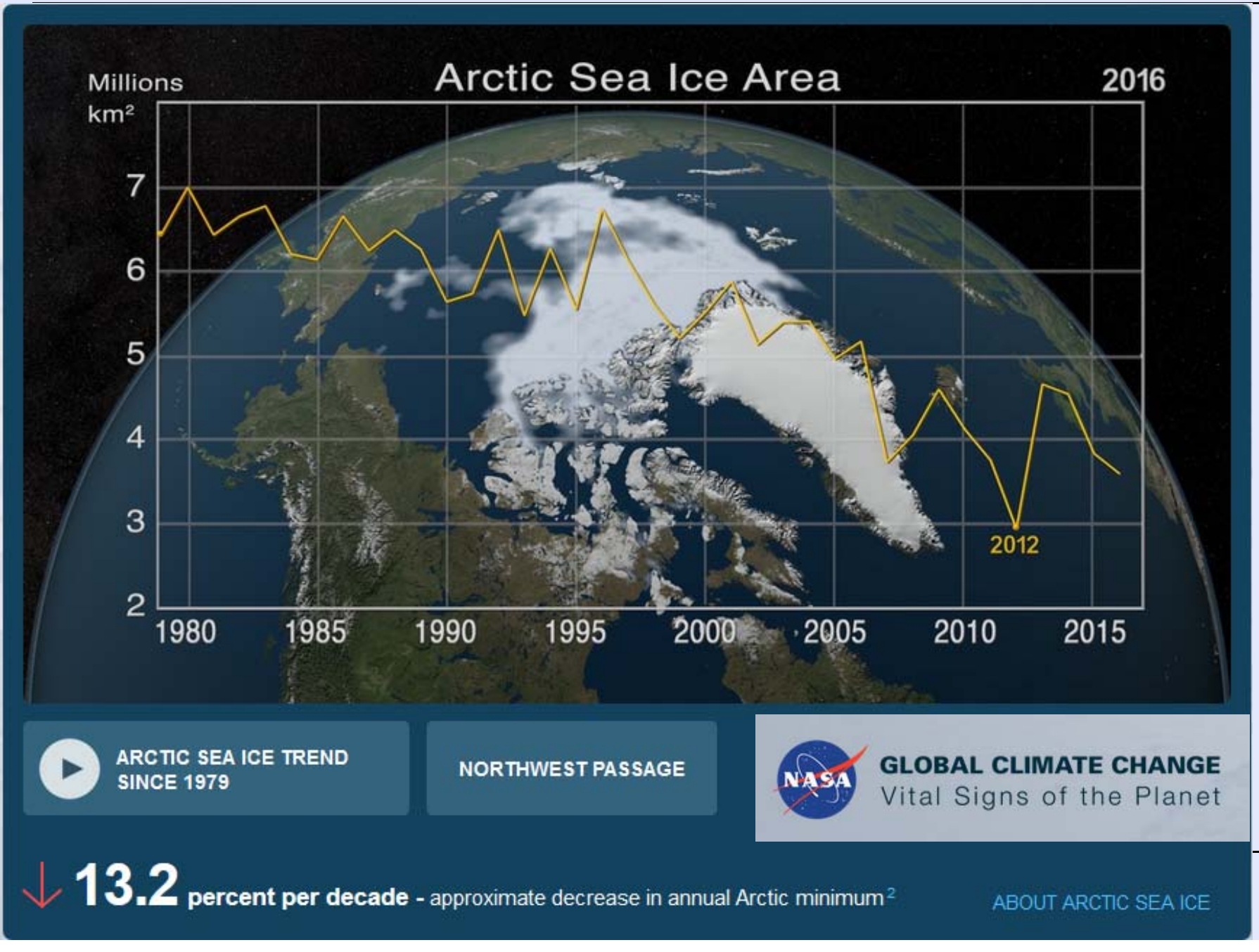
Deforestation in the Amazon



1988 - 2010

Why GIS and Biodiversity Analysis

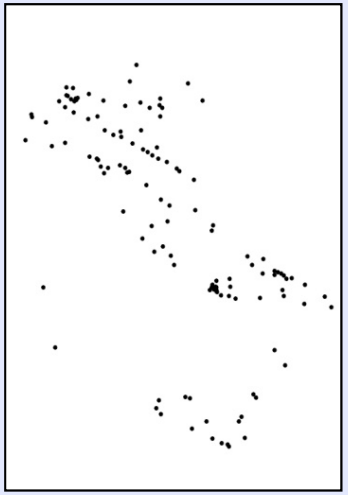
GIS: Showing changes in time

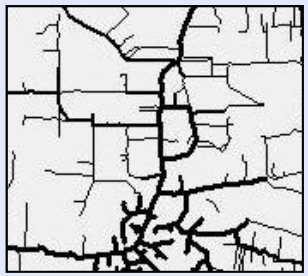


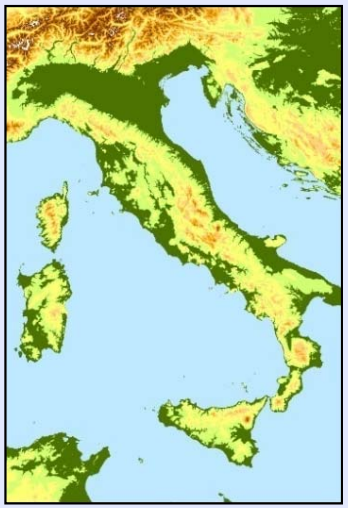
Spatial Data Objects

How is a feature stored and represented

- Point → Cities
- Line → Roads
- Polygon → Country (Italy)
- Network → Infrastructure
- Surface → Height Map or other quantitative information







GIS functions

What is GIS:

- Data input

- Data control and data management
  - Attribute management
  - Data storage (spatial)

- Data analysis and modelling

- Data output

Schedule week 2: **(Geo)spatial diversity**

Day	Morning	Afternoon
Monday 3-12	Introduction	Practical ArcGIS 1
Tuesday 4-12	(Spatial) Data input	Select a species of GBIF
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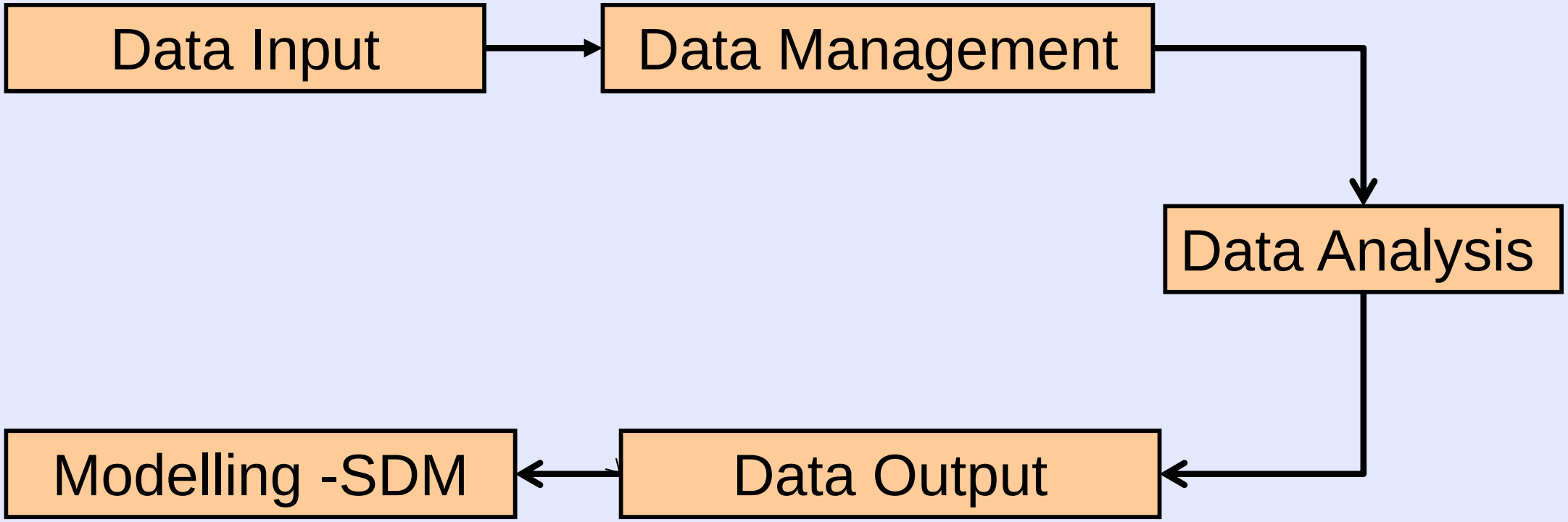
Schedule week 2: (**Geo)spatial diversity**

Red line this week: GIS and Species Distribution Modelling



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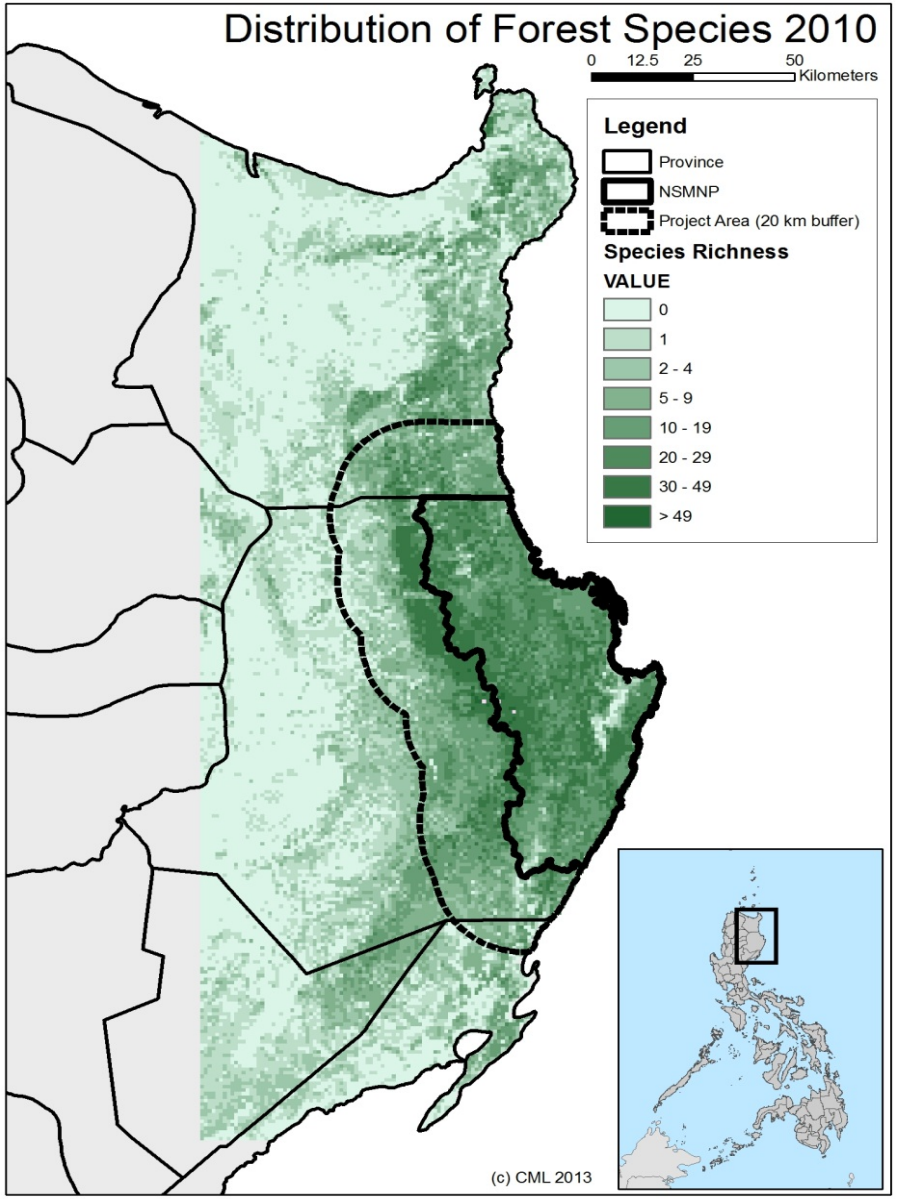
Day 1 – Introduction

09.15 – 10.00 Introduction to the week and to GIS, technical inventory

10.15 – 11.00 Introduction to GIS (2) and the geographical approach

11:15 - 12.00 GIS+SDM project example: *Birds of the Philippines* - Merlijn van Weerd (CML)

GIS+SDM project example: *Birds of the Philippines*



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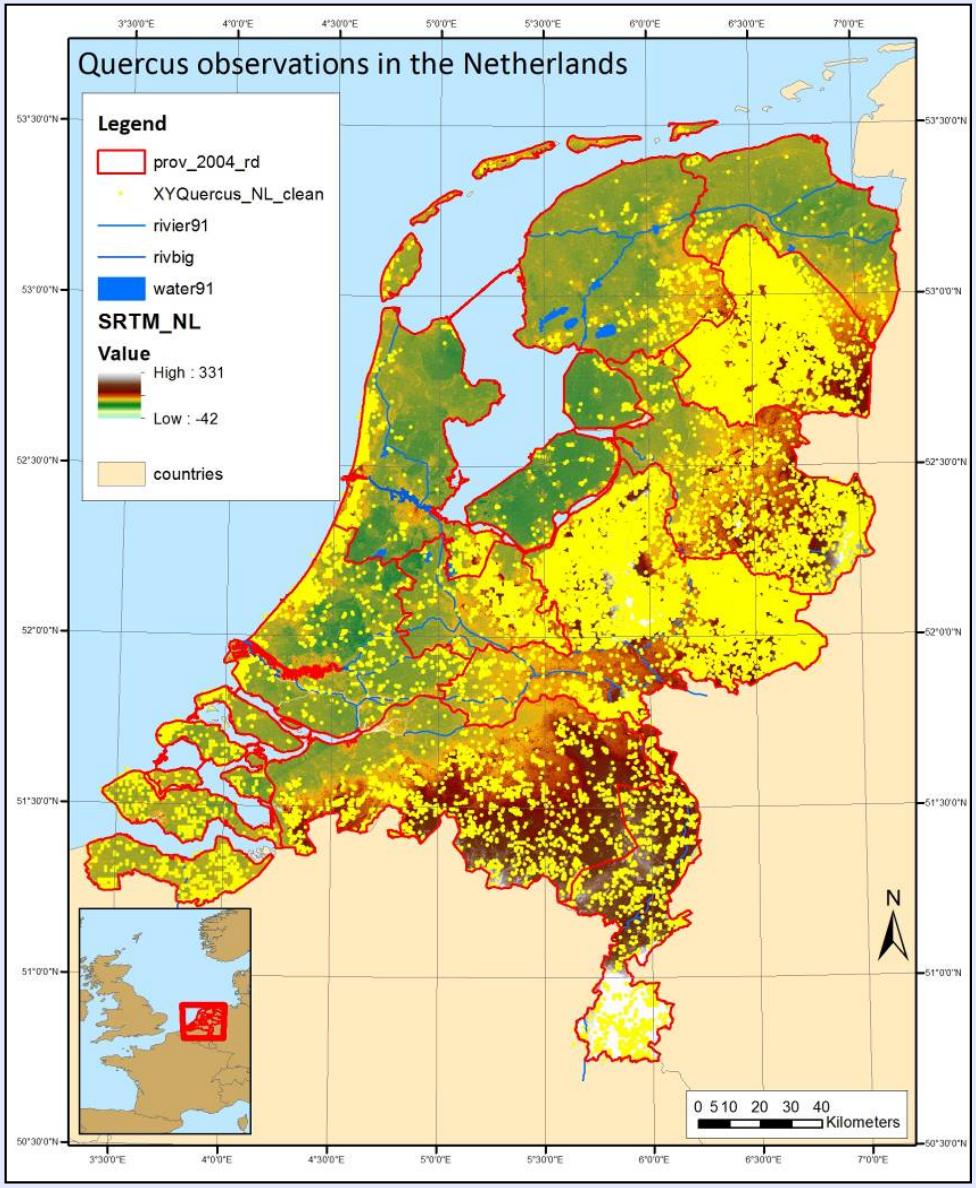
Afternoon	Practical: Getting your data into ArcGIS: *Plotting species distributions on a map*

Practical: Plotting species distributions on a map



You make a map with your downloaded species

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Day 2 – (Spatial) Data input

09.15 – 10.00	Data sources (e.g. web services, spatial datasets, attribute data, incl. GBIF)
10.15 – 11.00	Satellite images and remote sensing – Joris Timmermans (CML)
11:15 - 12.00	Digitalization, georeferencing and GPS - Jeroen Creuwels (Naturalis BC)
Afternoon	Homework: Download for your species the occurrence data from GBIF

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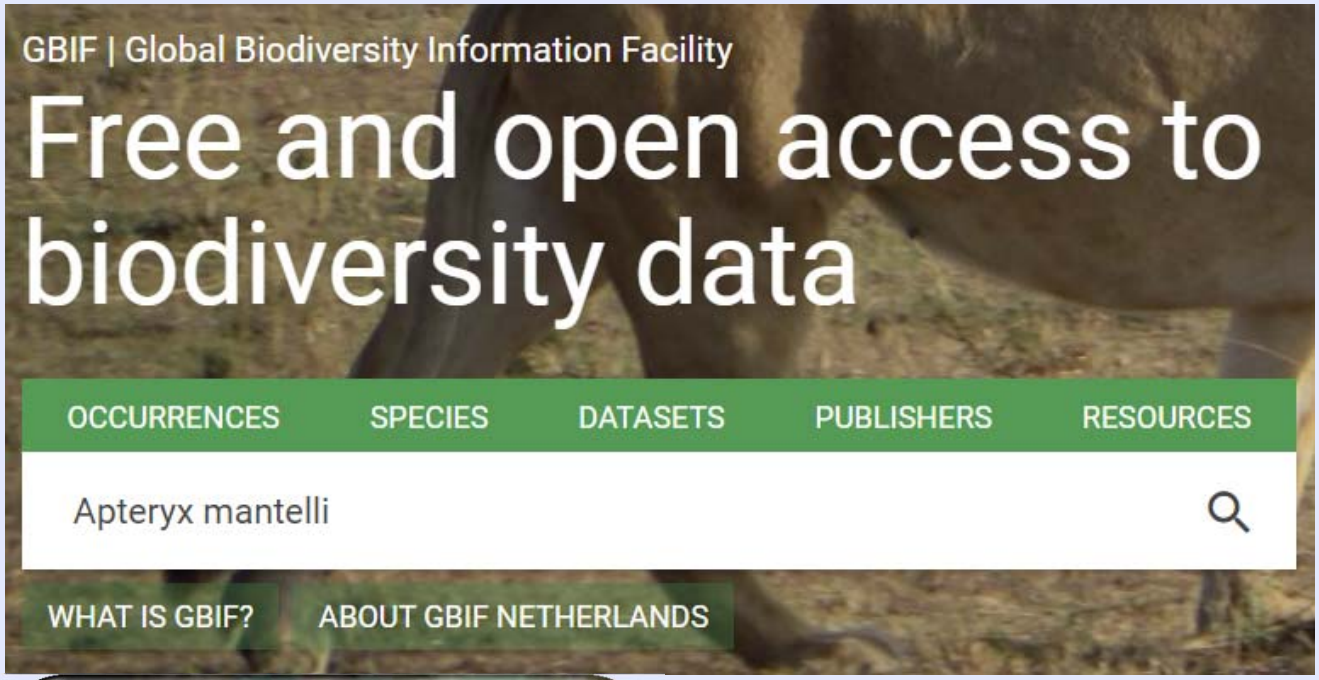
Practical: Download species from GBIF



Book2 - Microsoft Excel

File | Home | Insert | Page La | Formula | Data | Review | View | Acrobat

Get External Data | Refresh All | Connections | Sort | Filter | Sort & Filter | Text to Columns | Remove Duplicates | Data Tools | Outline

A1 | species

	A	B	C	D	E
1	species	longitude	latitude		
2	Apteryx mantelli	175.734966	-39.011999		
3	Apteryx mantelli	175.734966	-39.011999		
4	Apteryx mantelli	173.663335	-35.735993		
5	Apteryx mantelli	173.644	-35.7268		
6	Apteryx mantelli	174.784809	-41.320091		
7	Apteryx mantelli	173.644	-35.7268		
8	Apteryx mantelli	173.52795	-35.60044		
9	Apteryx mantelli	175.120719	-38.26465		
10	Apteryx mantelli	176.244092	-38.135004		
11	Apteryx mantelli	175.638685	-40.722933		
12	Apteryx mantelli	174.006696	-35.193529		
13	Apteryx mantelli	173.644	-35.7268		
14	Apteryx mantelli	174.078627	-35.265629		
15	Apteryx mantelli	173.644	-35.7268		
16	Apteryx mantelli	173.591108	-35.718364		
17	Apteryx mantelli	173.644	-35.7268		
18	Apteryx mantelli	174.030594	-35.252011		
19	Apteryx mantelli	174.081135	-35.276681		
20	Apteryx mantelli	174.080797	-35.165637		
21	Apteryx mantelli	175.056	-36.2199		
22	Apteryx mantelli	174.89007	-36.600714		
23	Apteryx mantelli	175.056	-36.2199		
24	Apteryx mantelli	174.078627	-35.265629		
25	Apteryx mantelli	176.257707	-38.136964		

Sheet1 | Sheet2 | Sheet3

Ready | 100%

Schedule week 2: **(Geo)spatial diversity**

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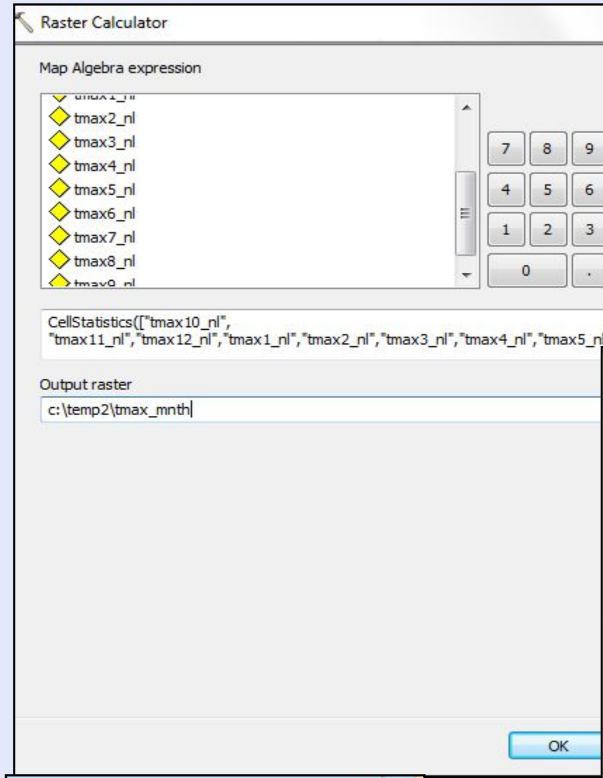
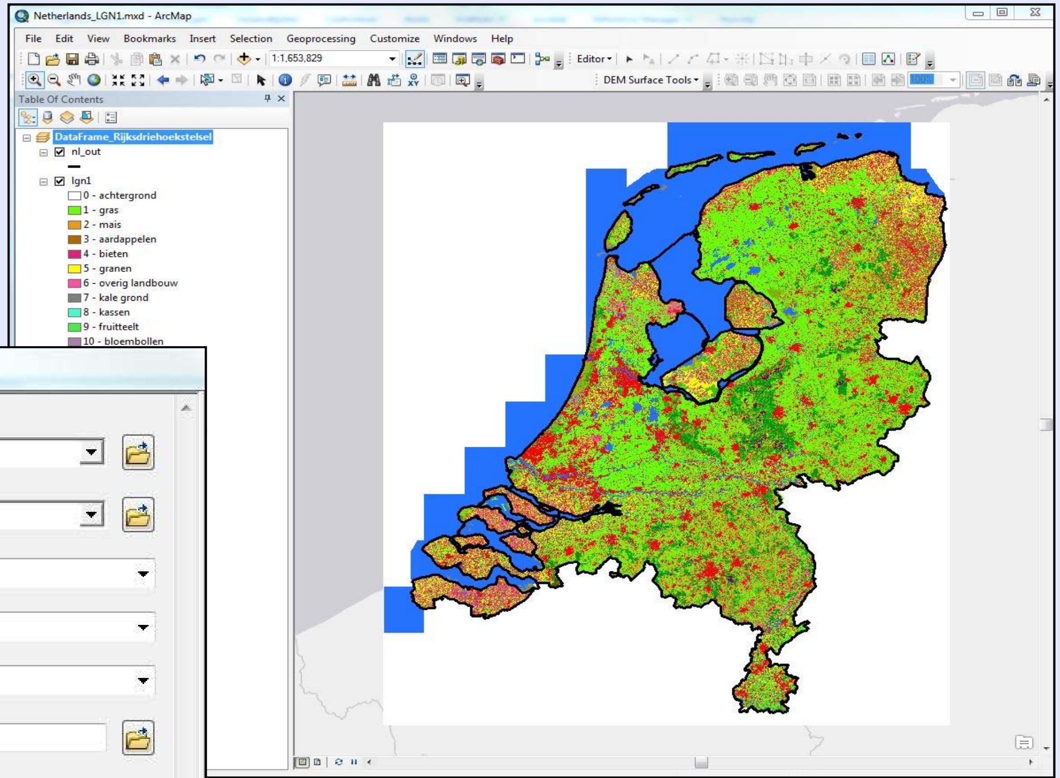
Friday 7-12	(Spatial) Data output	Practical Species distribution modelling

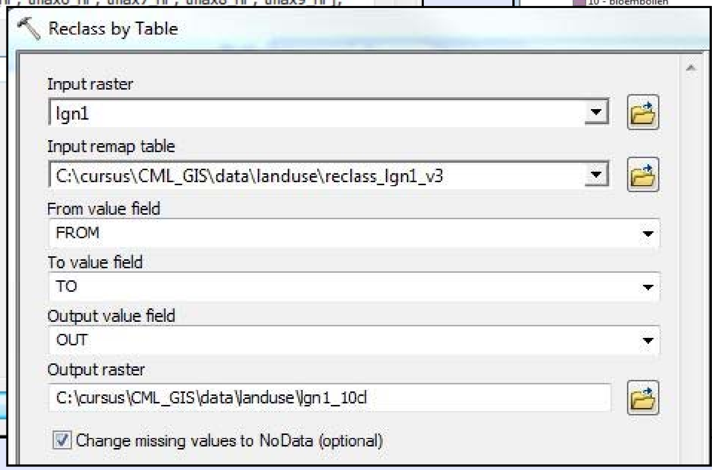
Day 3 – (Spatial) Data management

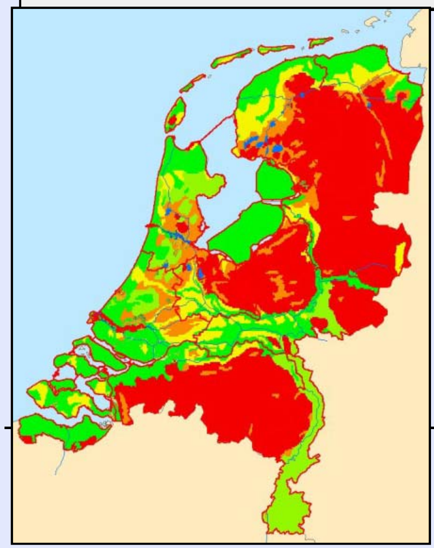
09.15 – 10.00	Basic database management (e.g. records, variables, types, querying, geodatabases)
10.15 – 11.00	Data conversions and transformations (e.g. vector-raster, reclassification, reprojections
11:15 - 12.00	Data and file versioning (e.g. versions, backup, history, provenance) - Rutger Vos
Afternoon	Practical: Analysing in ArcGIS: *Data preparation with use of spatial tools for SDM*

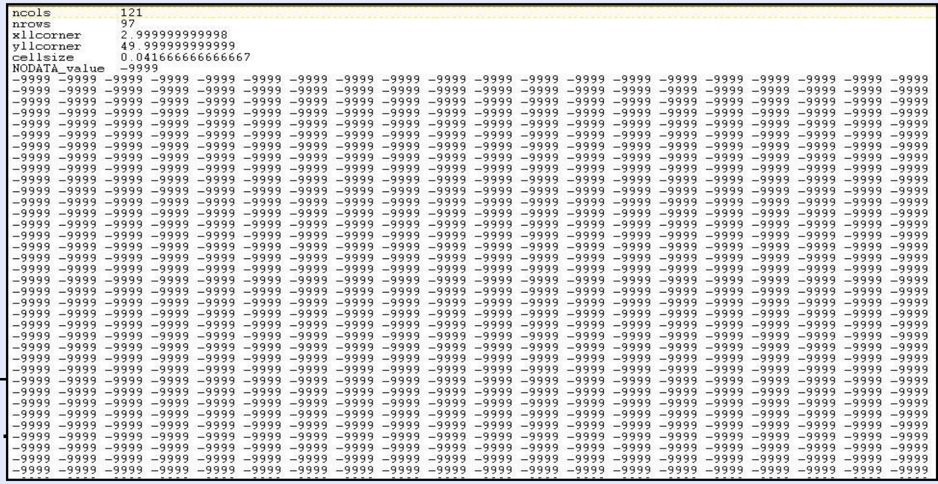
Practical: Data preparation with use of spatial tools f. SDM











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Schedule week 2: **(Geo)spatial diversity**

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Tuesday 5-12	(Spatial) Data input	Select a species of GBIF
Wednesday 6 - 12	(Spatial) Data management	Practical ArcGIS 1
Thursday 7-12	(Spatial) Data analysis	Practical ArcGIS 2
Friday 8 -12	(Spatial) Data output	Practical Species distribution modelling

Day 4 – (Spatial) Data analysis

09.15 – 10.00	Methods for spatial data analysis (e.g. overlay spatial join, clip, neighbourhood analysis)
10.15 – 11.00	Automated spatial data analysis (e.g. flowcharts, model builder, python scripting)
11:15 - 12.00	Other tools for spatial data (e.g. ArcGIS extensions, QGIS, PostGIS, R, MAXENT) Maarten & Nuno De Mesquita César de Sá
Afternoon	Homework: Download for your species the occurrence data from GBIF

Schedule week 2: **(Geo)spatial diversity**

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Friday 7-12	(Spatial) Data output	Practical Species distribution modelling

Day 5 – (Spatial) Data output

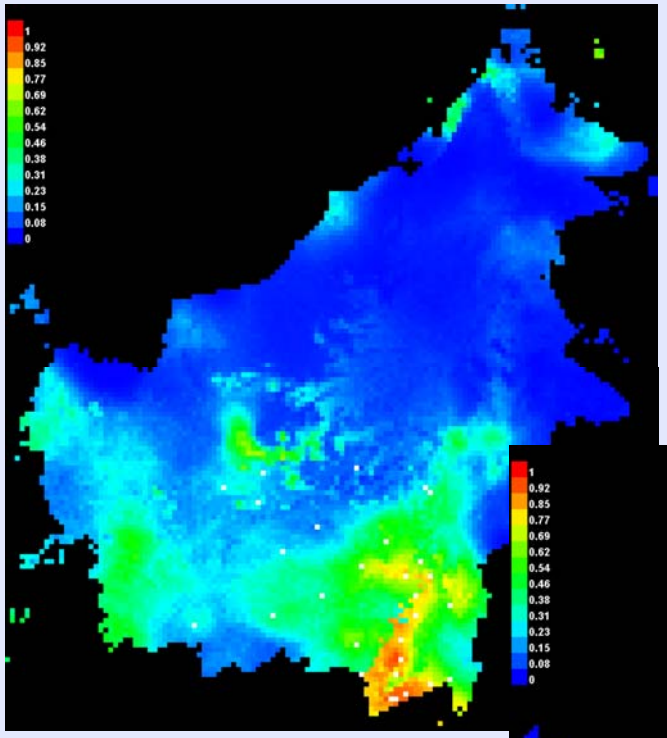
09.15 – 10.00 Export and visualisation (e.g. maps, histograms, tables, WebGIS, etc.)

10.15 – 11.00 Principles of SDM – Niels Raes (Naturalis)

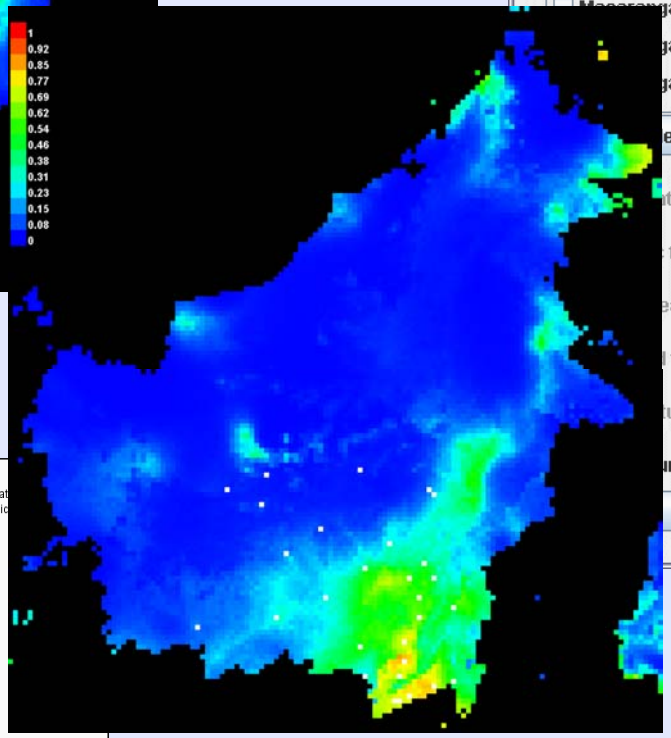
11:15 - 12.00 Future projections, climate models, introduction to SDM practical – Rosaleen March

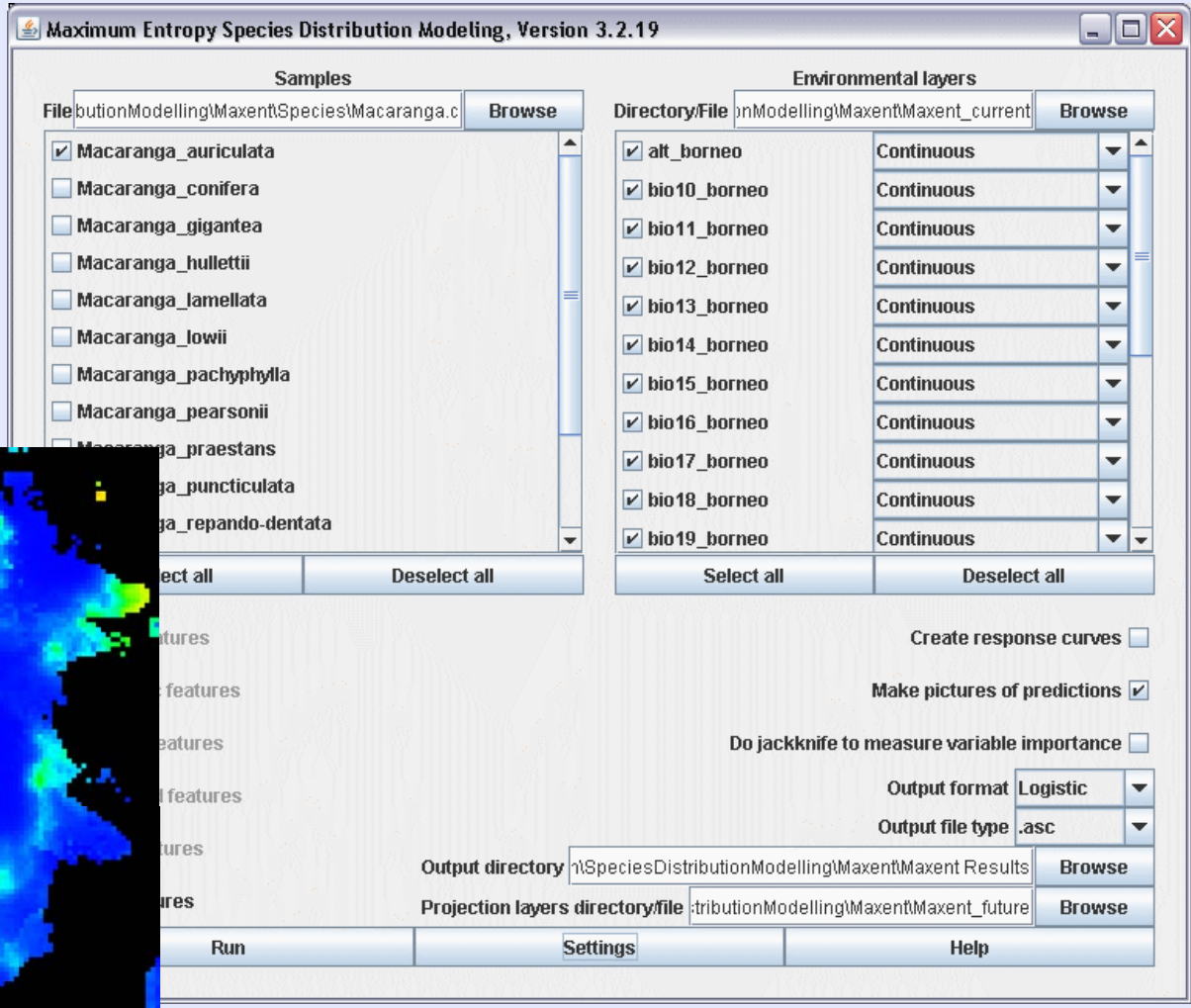
Afternoon Practical: Ecological Niche Modelling: *Species distribution modelling (MAXENT)*

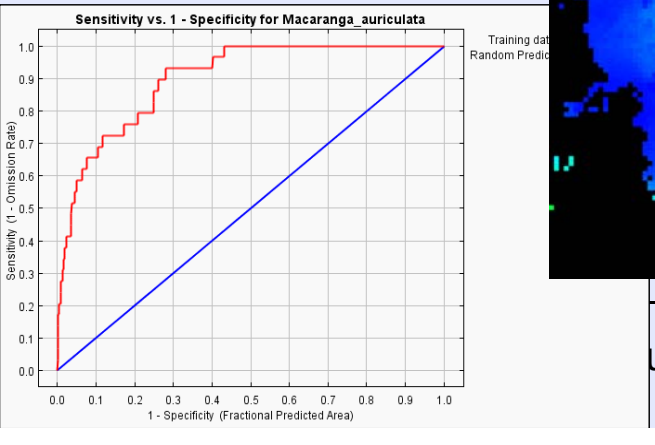
Practical: Data preparation with use of spatial tools f. SDM



The Present







The Future

uction to GIS Week

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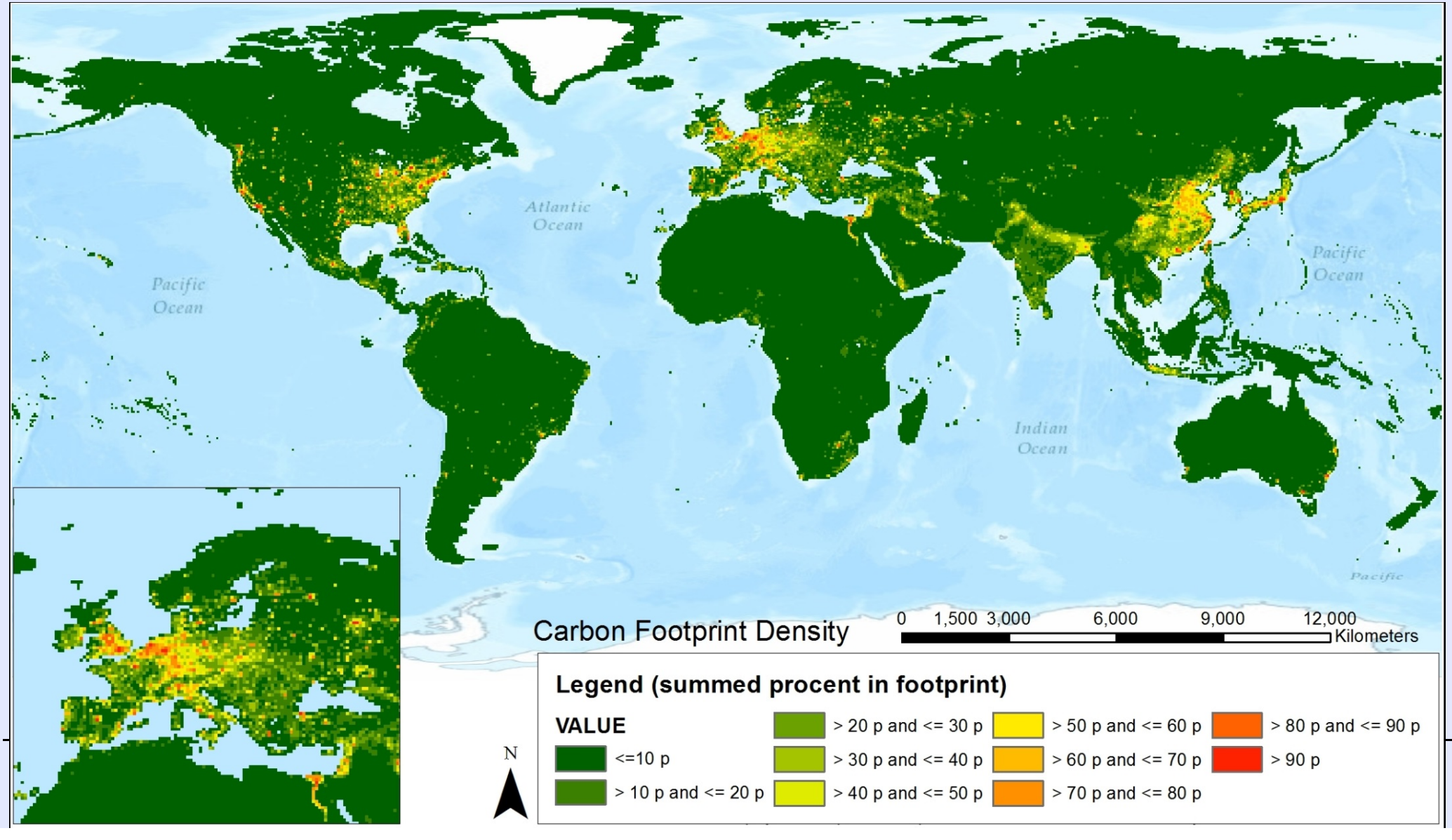
Examples of Climate Change/ Env. Processes projects

- Pollution of surface water : Pesticides atlas of the Netherlands
  → www.pesticidesatlas.nl
- Study of survival of Honeybee Colonies during the year in the Netherlands for 4 years (Honeybees Surveillance)
- Deforestation of the Amazone and the Philippines
- Increase of the Oak Processionary in the Netherlands (practical)
- Calculation of global footprint based on consumption

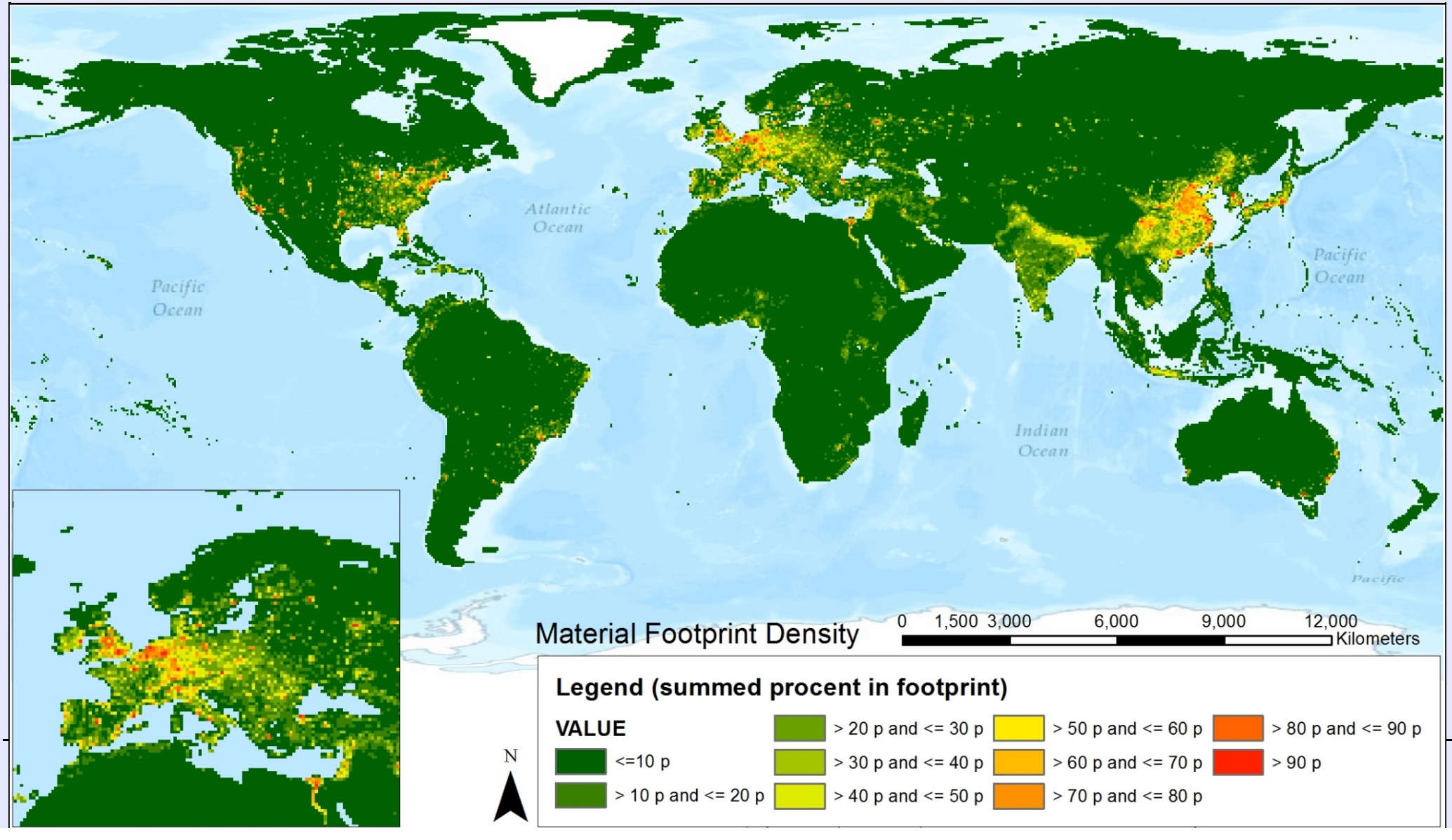
Examples of GIS projects

- Calculation of global footprint based on consumption



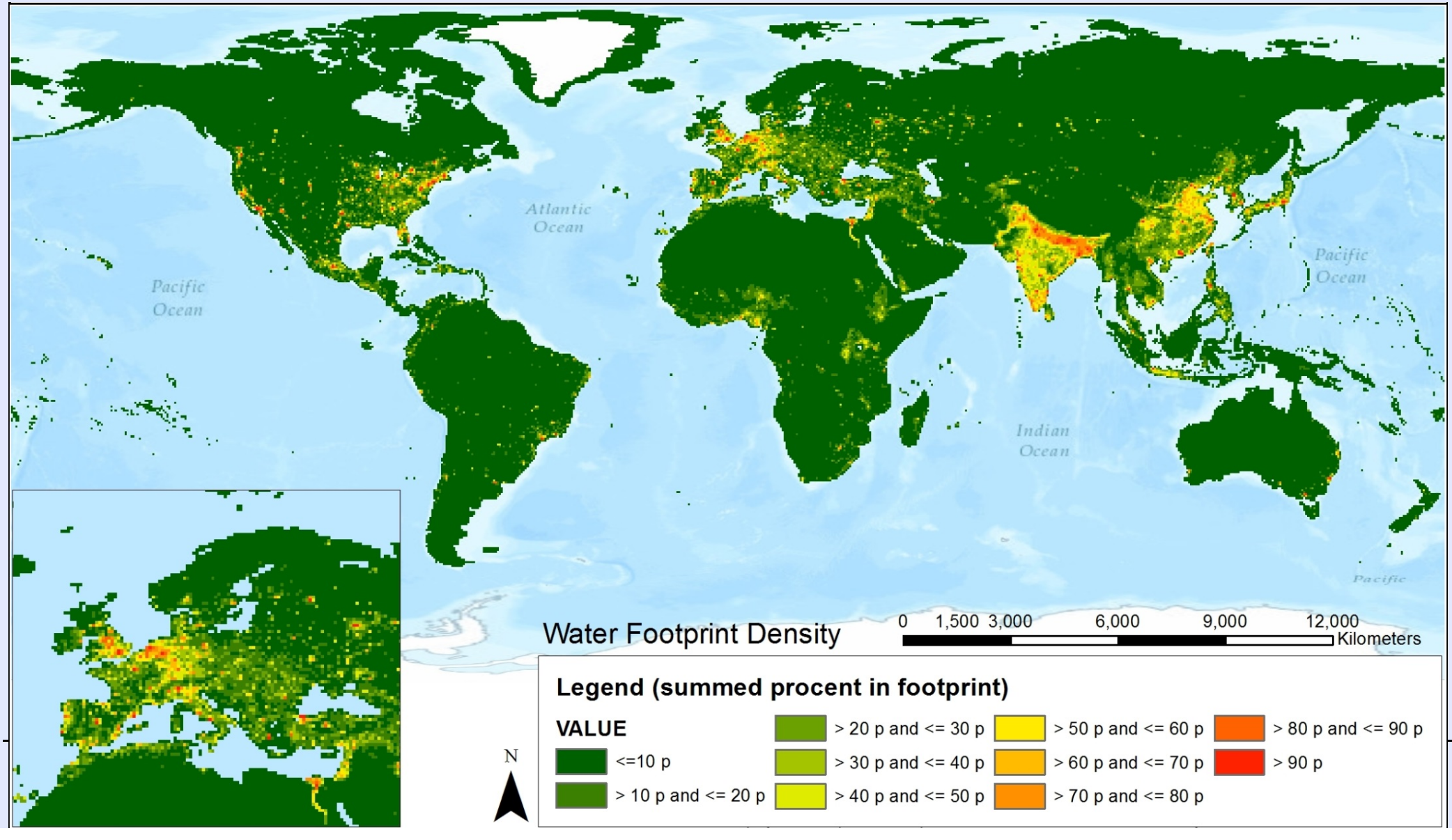
Examples of GIS projects

- Calculation of global footprint based on consumption



Examples of GIS projects

- Calculation of global footprint based on consumption



Other examples of Env. Processes projects

Monitoring

- Ice condition on North Pole with Satellite images and radar
- Water quality by means of extrapolation of the data of several monitoring spots (spatial extrapolation)

Modelling and prediction

- Determination of the probability of flooding of areas along the rivers (Rhine and Meuse) after a rainy period in the Netherlands (probability modelling)

Planning

- Determination of the most suitable location for a windmill parc in Europe (Multi criteria analysis)

Technical Inventory of Laptops including installation tips

- Laptops Operating System
- Java version (for MaxEnt = Species Distibution Modelling)
- R libraries for running spatial R functions

Coffee Break - 15 Minutes !

Introduction Maarten

- Name: Maarten van ‘t Zelfde
- Organisation: Leiden University – Institute of Environmental Sciences
- Profession: GIS/database specialist

- Main Projects:
  - Database with spatial ecological data for Netherlands (1*1 km) (1990 – 1994)
  - Ecohydrological modelling of water management (1992 – 1996)
  - Elephant telemetry Cameroon (1996 – 1999)
  - Lion telemetry Cameroon/Kenya (2005 – 2009)
  - European database for vulnerable vegetation for nitrification (2003 – 2008)
  - Website Atlas with maps of pesticides concentrations in surface water on Internet (2001 – 2013)
  - Model for climate effects on birdspecies and forest types in the Philippines
  - Creating Geographical Portal for Naturalis Biodiversity Center (NBC)