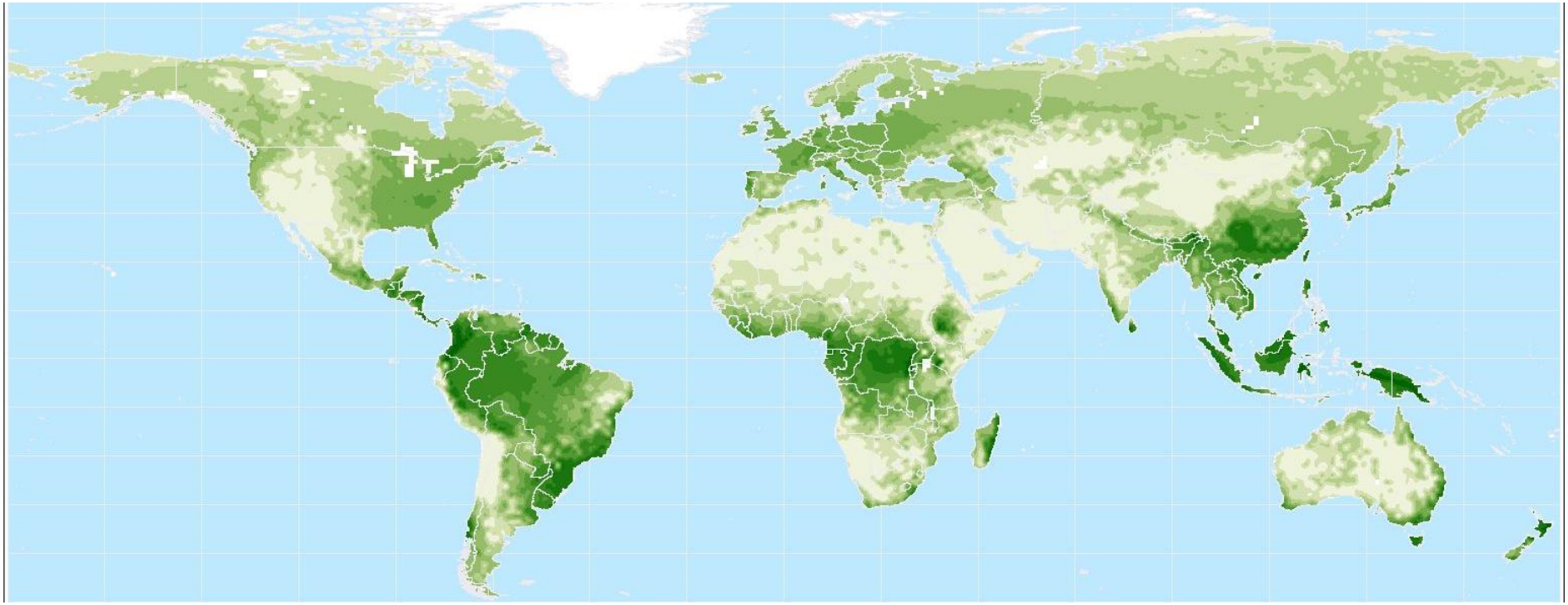
esf european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitivness
UNIVERSITAS MASARYKIANA BRUNENSIS
INVESTMENTS IN EDUCATION DEVELOPMENT

Mapping and modeling species distributions

Department of Botany and Zoology, Masaryk University

Bi9661 Selected issues in Ecology, Autumn 2013

Borja Jiménez-Alfaro, PhD



Part 1:

MAPPING

SCALE, EXTENT, GRAIN AND ACCURACY

Objectives of this practice

1)
Understand the format of observational data (Occurrences)
Import the occurrences into Diva-GIS and create a SHAPEFILE
First contact with GIS???

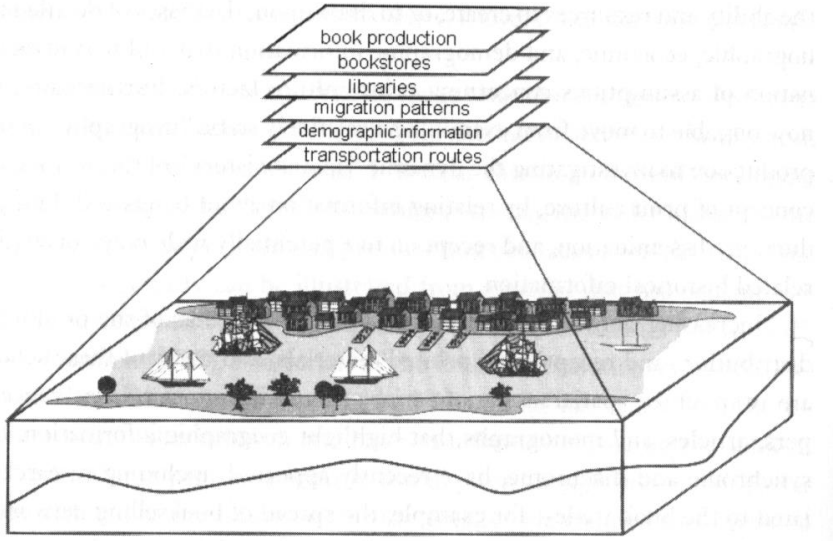
2)
Understand the format of GIS environmental variables
Assess the fit between occurrences and GIS layers

3)
INSTALLATION OF DIVA-GIS and MAXENT
PREPARATION of INPUT FILES

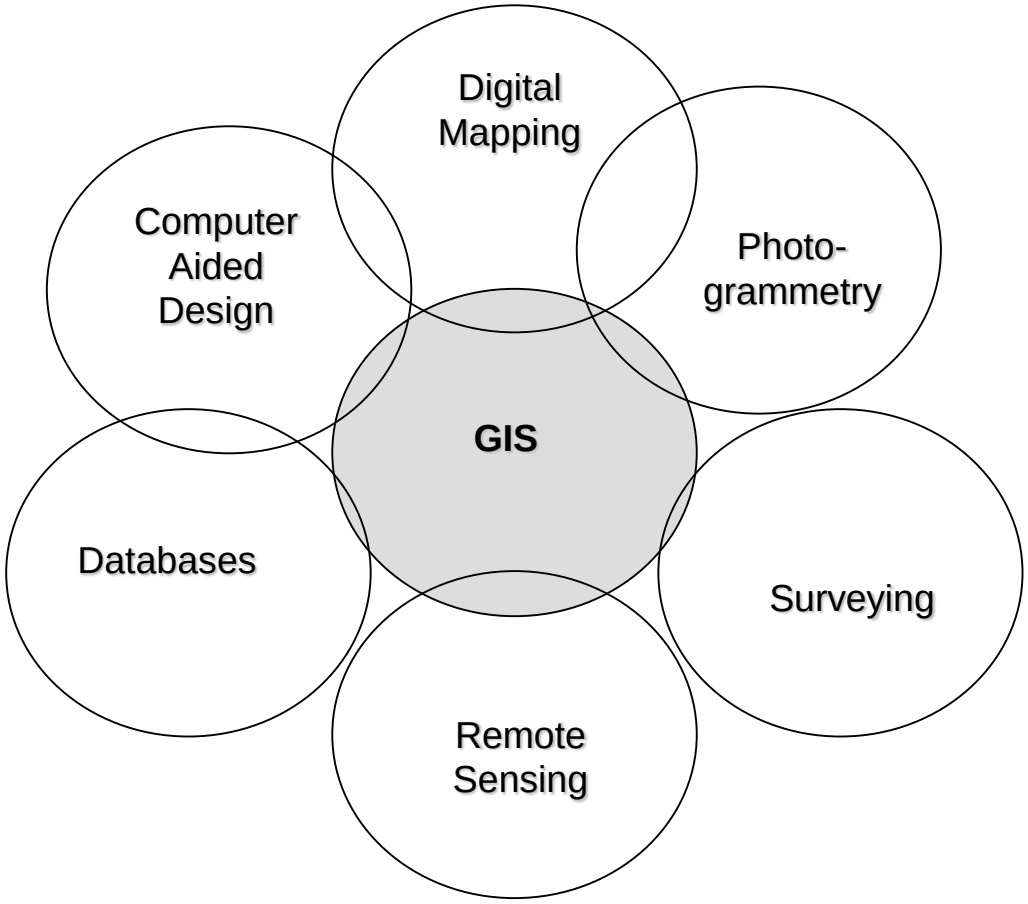
What is a GIS?

Geographic Information System

"A system for capturing, storing, checking, integrating, manipulating, analysing and displaying data which are spatially referenced to the Earth. This is normally considered to involve a spatially referenced computer database and appropriate applications software"



What is a GIS?



Cross-disciplinary nature of GIS

Two main types of data

Attribute data (the INFORMATION)

Says what a feature is

Eg. statistics, text, images, sound, etc.

Spatial data (the GEOGRAPHY)

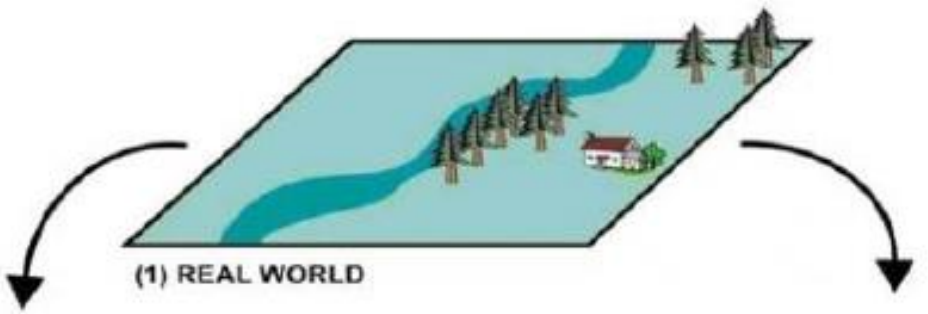
Says where the feature is

Co-ordinate based

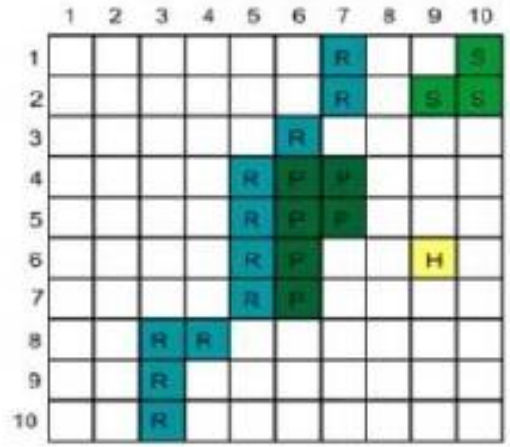
Vector data – discrete features (points, lines, polygons)

Raster data – A continuous surface

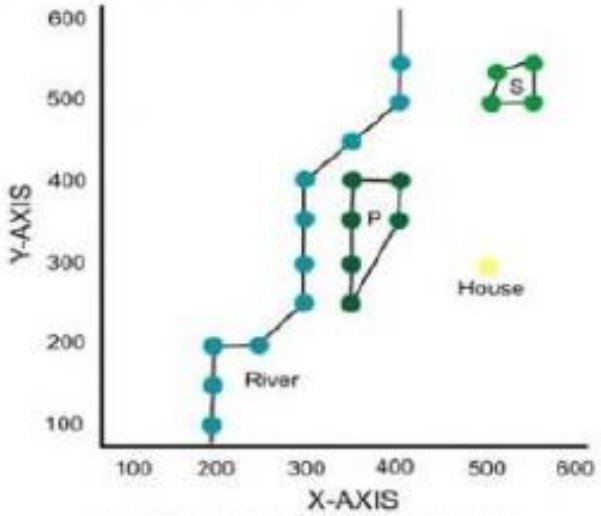
Layers: RASTER vs. VECTORIAL



cookbook.hlurb.gov.ph

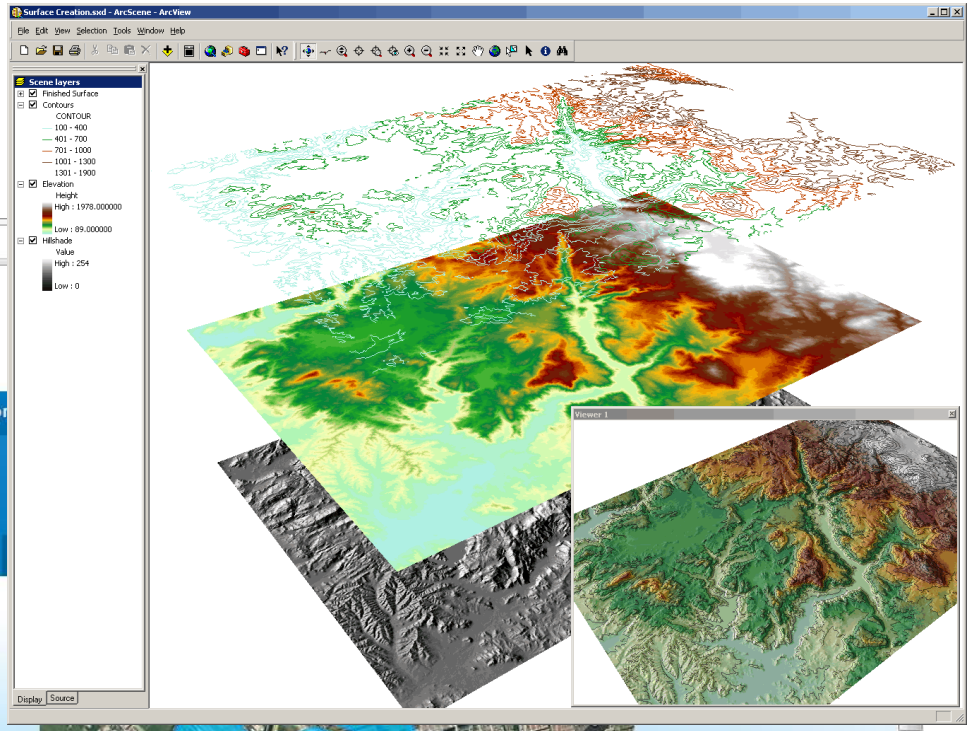


(2) RASTER REPRESENTATION

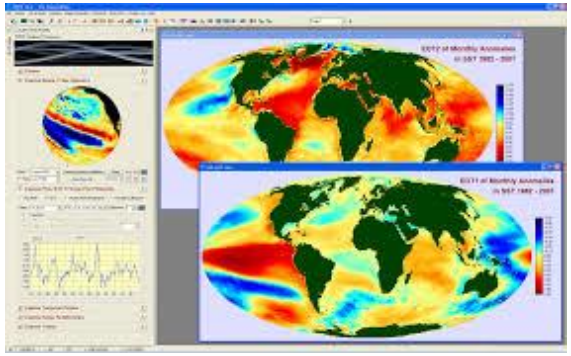


(3) VECTOR REPRESENTATION

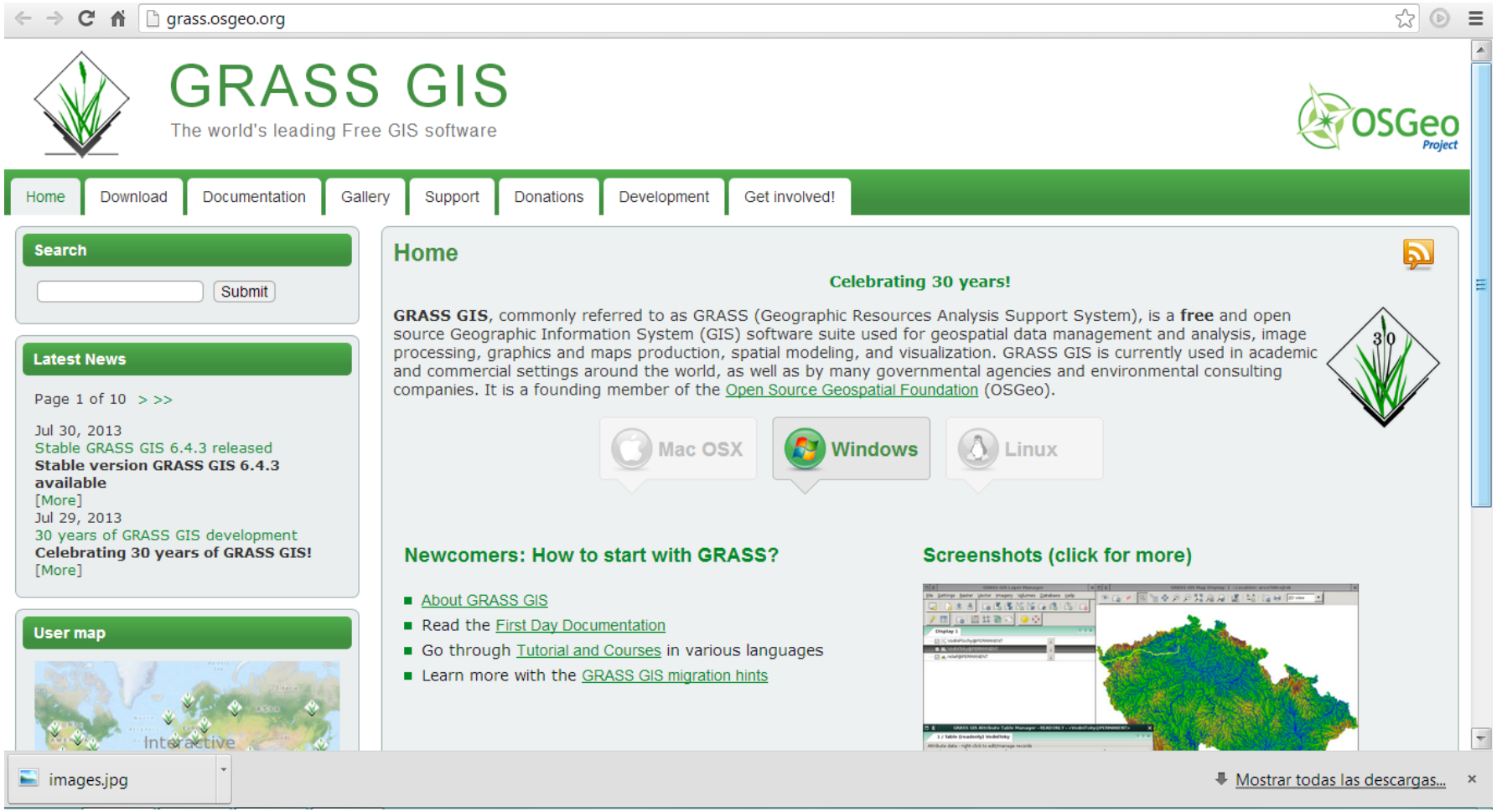
Software – ArcGIS



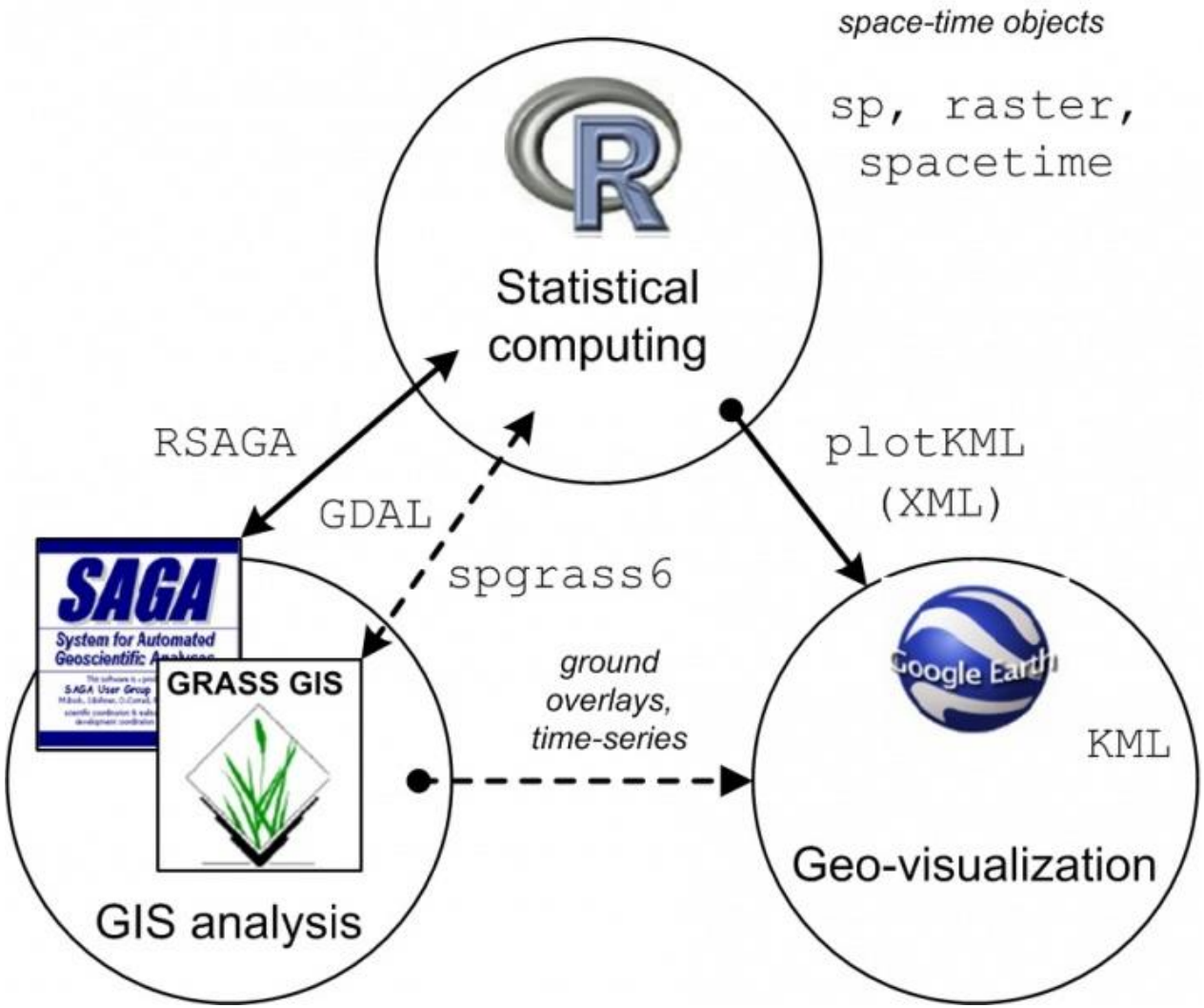
Software - IDRISI



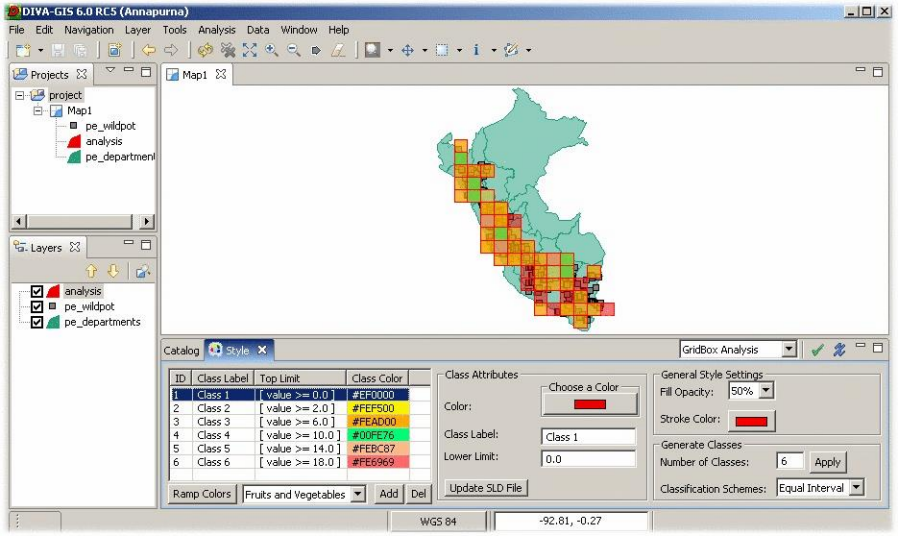
Software – GRASS GIS (Free)



100% Free


space-time objects
sp, raster,
spacetime
Statistical
computing
RSAGA
GDAL
spgrass6
plotKML
(XML)
SAGA
System for Automated
Geoscientific Analyses
GRASS GIS
ground
overlays,
time-series
Google Earth
KML
GIS analysis
Geo-visualization

Software – DIVA-GIS (free)



www.diva-gis.org

DIVA-GIS

free, simple & effective

Download program | Documentation | Free Spatial Data

DIVA-GIS

DIVA-GIS is a free computer program for mapping and geographic data analysis (a geographic information system (GIS). With DIVA-GIS you can make maps of the world, or of a very small area, using, for example, state boundaries, rivers, a satellite image, and the locations of sites where an animal species was observed. We also provide **free spatial data** for the whole world that you can use in DIVA-GIS or other programs.

You can use the **discussion forum to ask questions, report problems, or make suggestions**. Or contact us, and read the blog entries for the latest news. But first **download** the program and read the documentation.

DIVA-GIS is particularly useful for mapping and analyzing biodiversity data, such as the distribution of species, or other 'point-distributions'. It reads and write standard data formats such as ESRI shapefiles, so interoperability is not a problem. DIVA-GIS runs on Windows and (with minor effort) on Mac OSX (see instructions).

You can use the program to analyze data, for example by making grid (raster) maps of the distribution of biological diversity, to find areas that have high, low, or complementary levels of diversity. And you can also map and query climate data. You can predict species distributions using the BIOCLIM or DOMAIN models.

714px-R_SAGA....jpg | images.jpg

Basic concepts

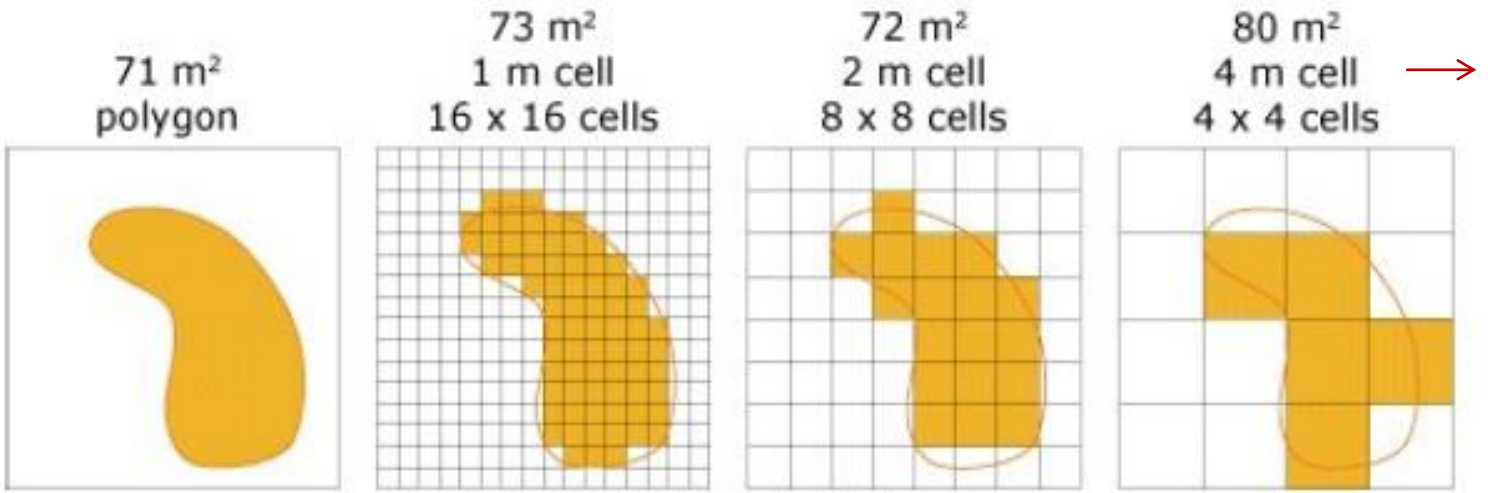
Scale and extent

In spatial ecology, **scale** refers to the spatial **extent** of ecological processes and the spatial interpretation:
LOCAL, REGIONAL, GLOBAL

In the GIS world, **scale** is the relationship of the distance on the map/data to the actual distance on the ground, and **extent** refers to the dimension of the layers

Basic concepts

Resolution



→ **= Grain**

- Smaller cell size
- Higher resolution
- Higher feature spatial accuracy
- Slower display
- Slower processing
- Larger file size

- Larger cell size
- Lower resolution
- Lower feature spatial accuracy
- Faster display
- Faster processing
- Smaller file size

Basic concepts

Precision

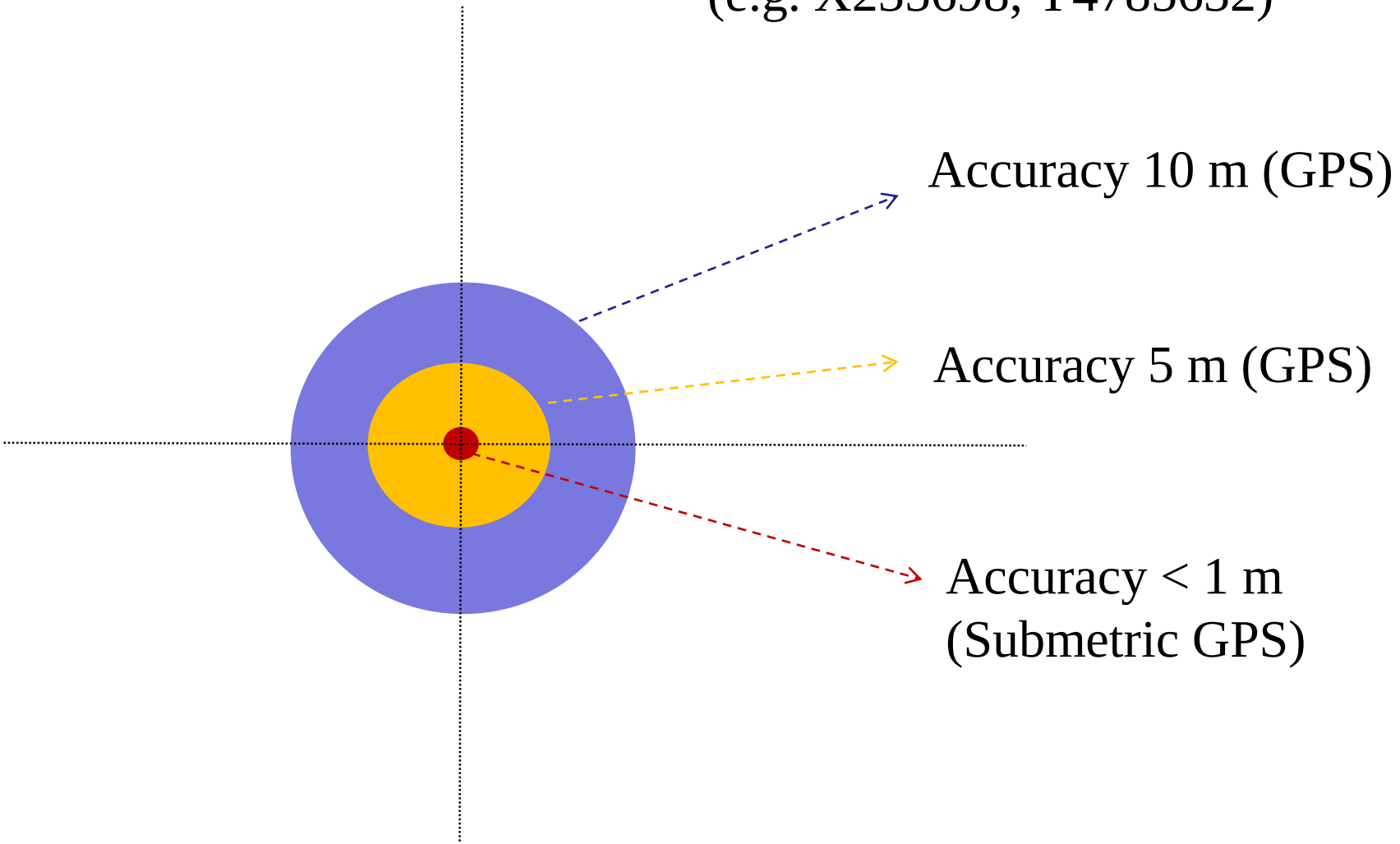
refers how exact is the description of data

Accurary

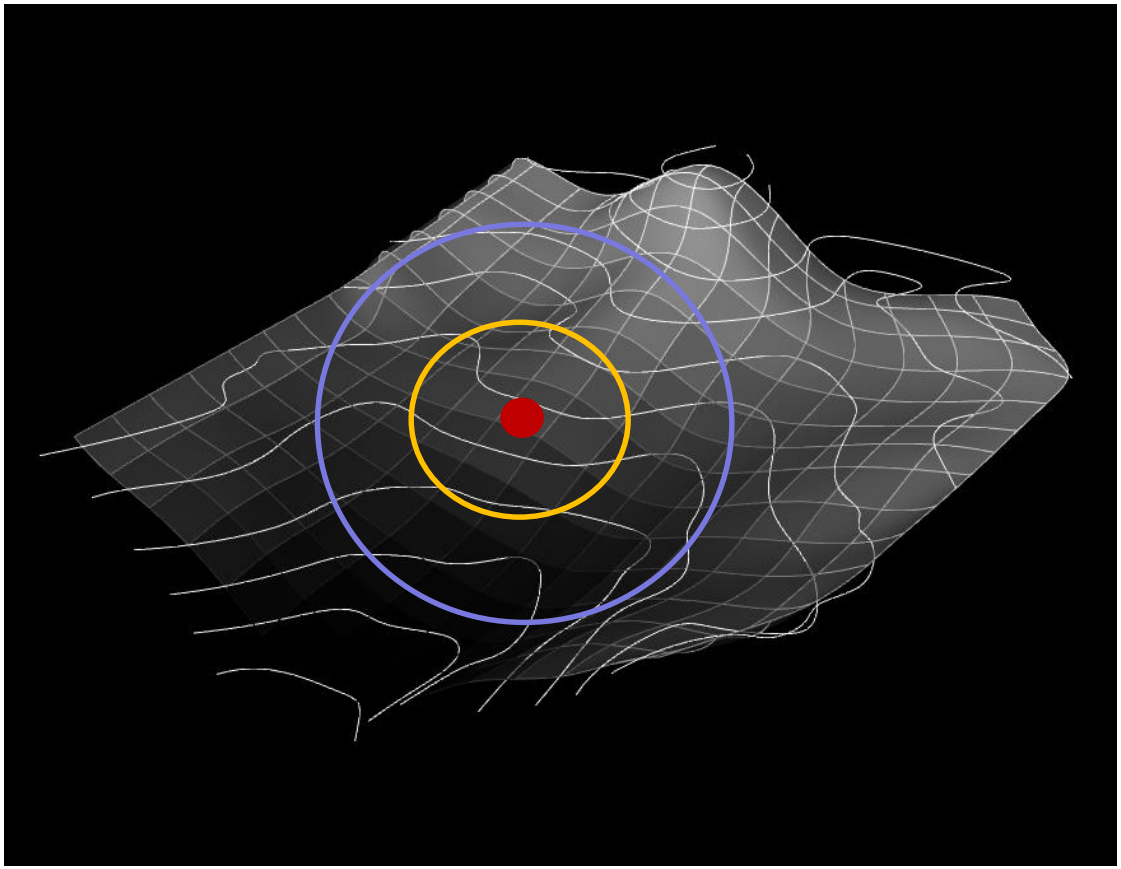
the degree or closeness to which the information on a map matches the real world

Important issues for spatial analyses
e.g. to test the fit between your **occurrences** and the **variables**

Imagine one location and its coordinates at precision = 1 **m**
(e.g. X235698, Y4785632)



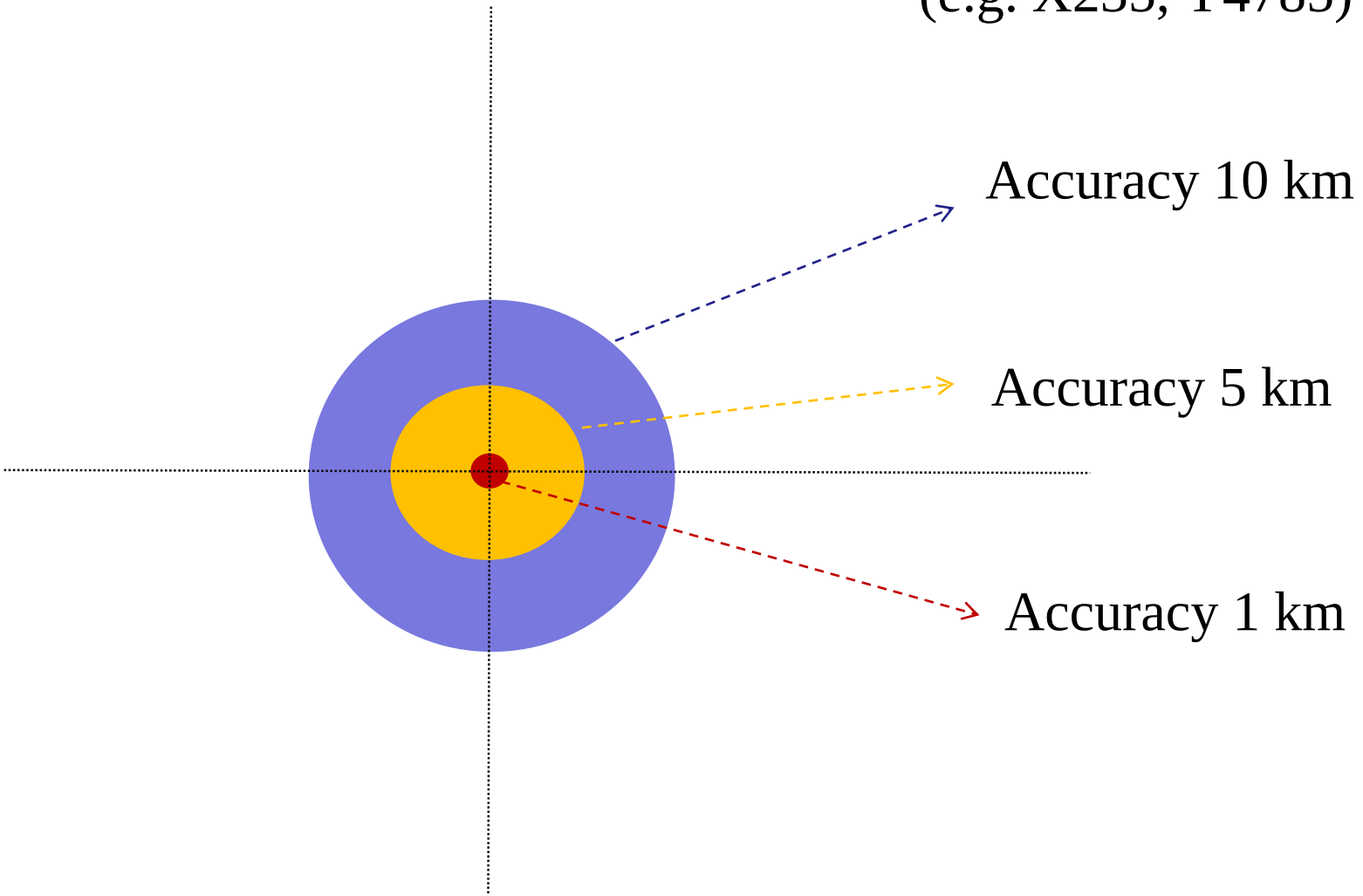
Topographic gradient: **accuracy matters¡**



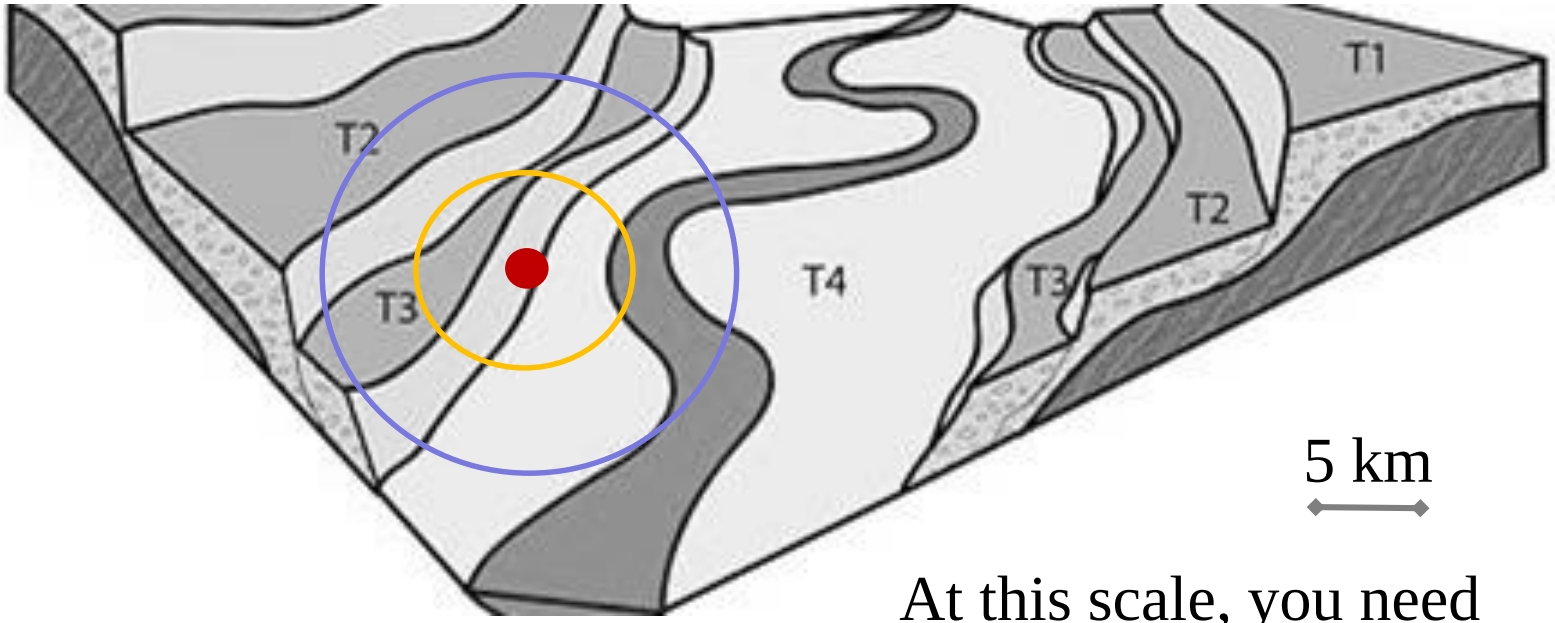
5 m

At this scale, you need precision and accuracy of < 5 m

Imagine one location and its coordinates at precision = 1 **km**
(e.g. X235, Y4785)



Landscape units: **accuracy matters¡**

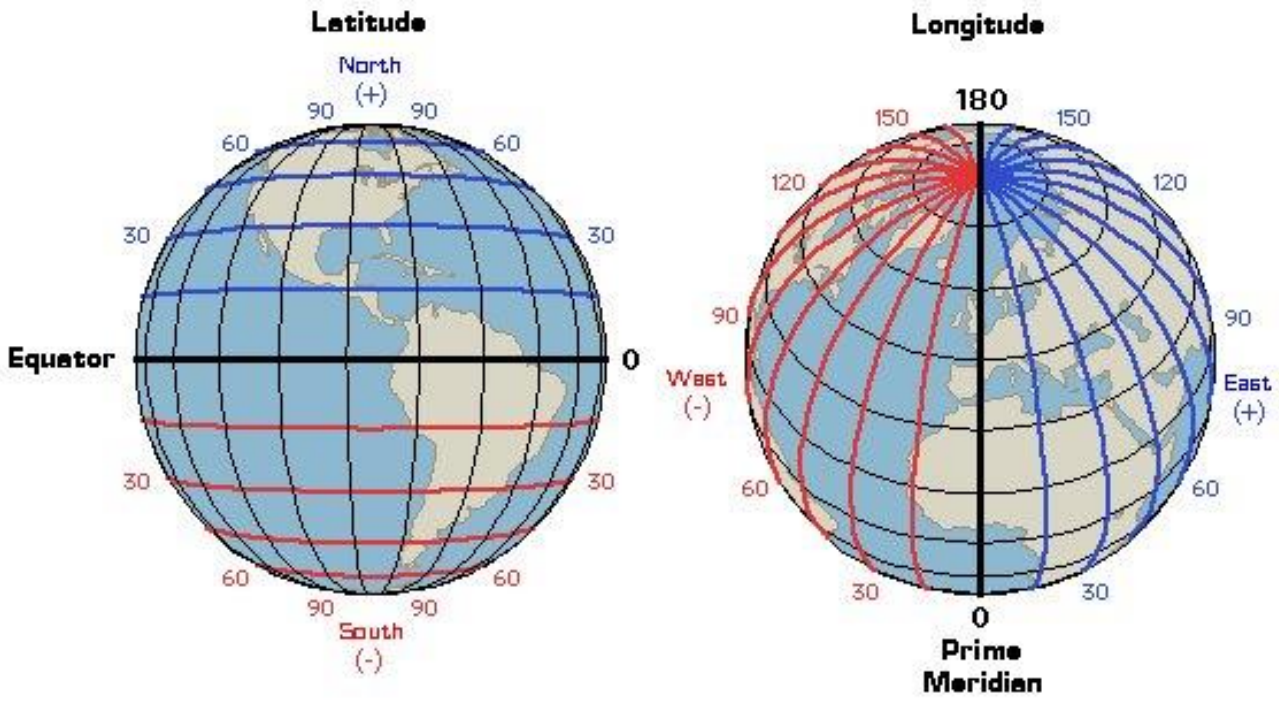


5 km

At this scale, you need precision and accuracy of < 5 km

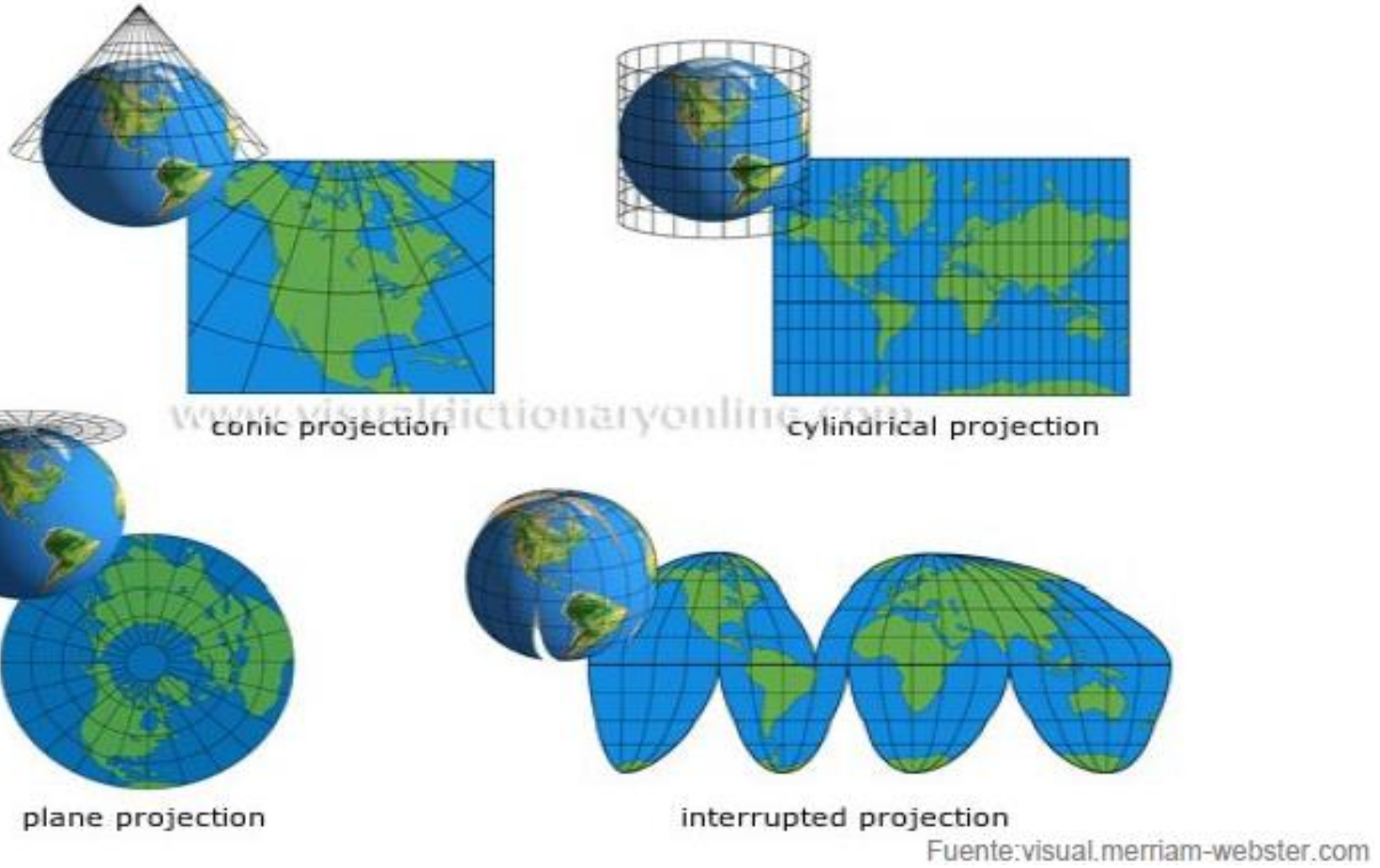
Coordinate System

The main format is Latitude and Longitude,
Generally in **decimal degrees**
However it produces **cells** of different sizes



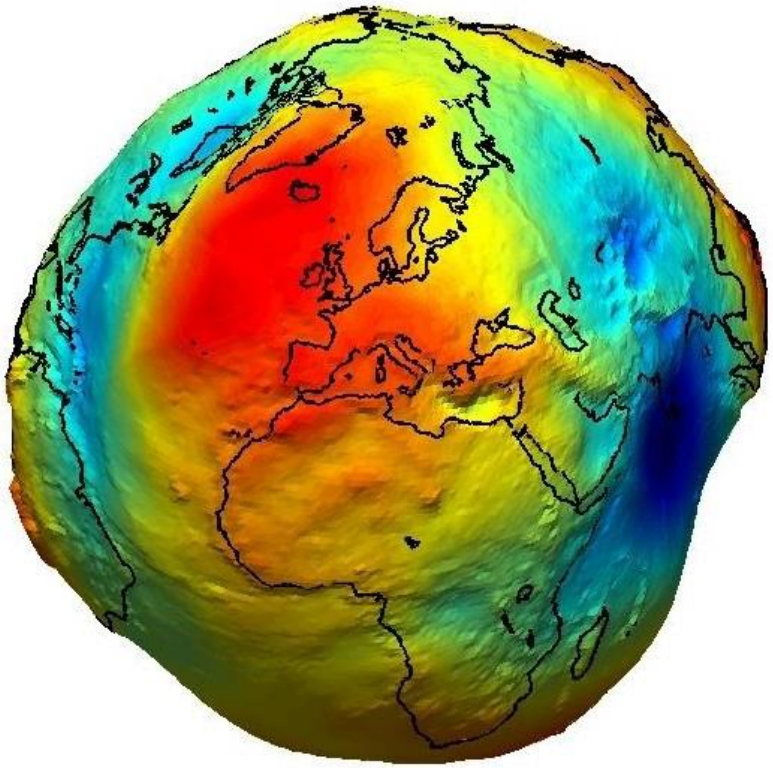
Coordinate systems

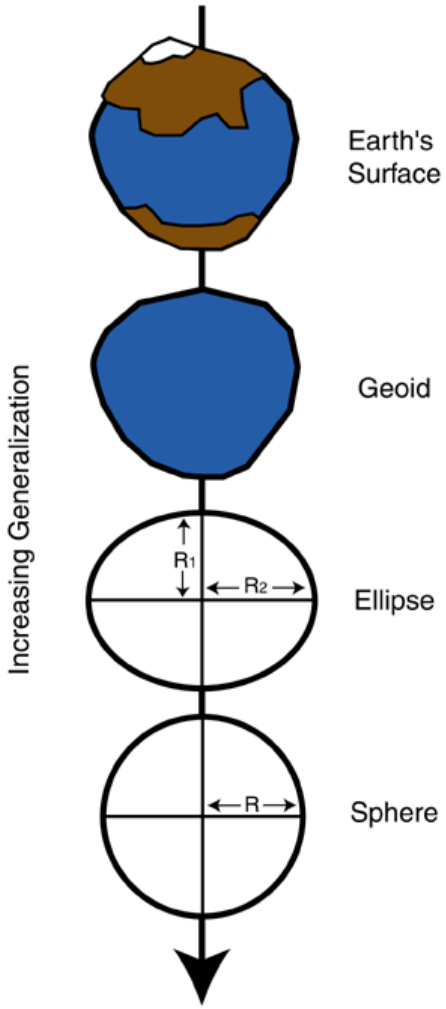
Different **projections** are used to represent a given region



Coordinate systems

The projection is corrected with the **DATUM**
to represent the real surface of the Earth
In Europe: datum **ETRS89** is the new standard





IMPLICATIONS

1. Verify the **reference system** for your coordinates
2. Verify the **datum** used for that reference system
3. Try to understand the **accuracy** of that coordinates
4. You can **transform** coordinates and datums in GIS
5. The same procedure fotr VECTORIAL and RASTER layers

Our data

We will use geographical coordinates (log/lat) in **decimal degrees**
In DIVA-GIS manual it is indicated how to transform from DDGGSS

The 19 Bioclimatic Variables[3]

BIO1 = Annual mean temperature
BIO2 = Mean diurnal range (max temp – min temp) (monthly average)
BIO3 = Isothermality (BIO1/BIO7) * 100
BIO4 = Temperature Seasonality (Coefficient of Variation)
BIO5 = Max Temperature of Warmest Period
BIO6 = Min Temperature of Coldest Period
BIO7 = Temperature Annual Range (BIO5-BIO6)
BIO8 = Mean Temperature of Wettest Quarter
BIO9 = Mean Temperature of Driest Quarter
BIO10 = Mean Temperature of Warmest Quarter
BIO11 = Mean Temperature of Coldest Quarter
BIO12 = Annual Precipitation
BIO13 = Precipitation of Wettest Period
BIO14 = Precipitation of Driest Period
BIO15 = Precipitation Seasonality (Coefficient of Variation)
BIO16 = Precipitation of Wettest Quarter
BIO17 = Precipitation of Driest Quarter
BIO18 = Precipitation of Warmest Quarter
BIO19 = Precipitation of Coldest Quarter

Decimal degrees = [(Degrees (°) + Minutes (') / 60 + Seconds (") / 3600)] * H

H = 1 when the coordinate is in the Eastern (E) or Northern (N) Hemisphere
H = -1 when the coordinate is in the Western (W) or Southern (S) Hemisphere

Longitude	Degrees, Minutes & Seconds	Decimal Degrees	Latitude	Degrees, Minutes & Seconds	Decimal Degrees
Eastern Hemisphere	60°20'15" E	+ 60.3375	Northern Hemisphere	24°00'45" N	+ 24.0125
Western Hemisphere	60°20'15" W	- 60.3375	Southern Hemisphere	24°00'45" S	- 24.0125

The PRACTICE

Prepare the coordinates in EXCEL

Create a **SHAPEFILE** of occurrences in Diva-GIS

Import the raster variables from **ASCII** file to DIVA-GIS

Save the layers and the project in your computer

Check the extent and grain of rasters and the accuracy of data

ADVANCED STUDENTS:
Revision of projections and datum, spatial autocorrelation in ArcGIS