GloboLakes

... the 1000 lake challenge

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The story

1 - GloboLakes project:

About | WP3

2 - Site selection:

Challenges | Methodology | Lake distribution

3 - Lake catchments:

Generation | Global datasets | Challenges

4 - Lake attributes:

Existing datasets | Challenges | Modelling

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GloboLakes

www.globolakes.ac.uk

Global Observatory of Lake Responses to Environmental Change

NERC SCIENCE OF THE ENVIRONMENT

- NERC-funded 5-yr Consortium project
- Aims to assess the status + change in the condition of 1000 sentinel lakes across the globe
- Attribute cause to lake change + assess coherency in lake response
- Inform management plans + forecast lake change in the future

Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL | University of Dundee | University of Glasgow | PML Plymouth Marine Laboratory | University of Reading | UNIVERSITY OF STIRLING

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- Lake water quality retrieval using EO techniques
- Spatial + temporal patterns
- Climatic + non climatic drivers of lake change in the catchments
- Attribution of causality to lake response + forecasting sensitivity to environmental change

Lake Catchment Database (WP3)

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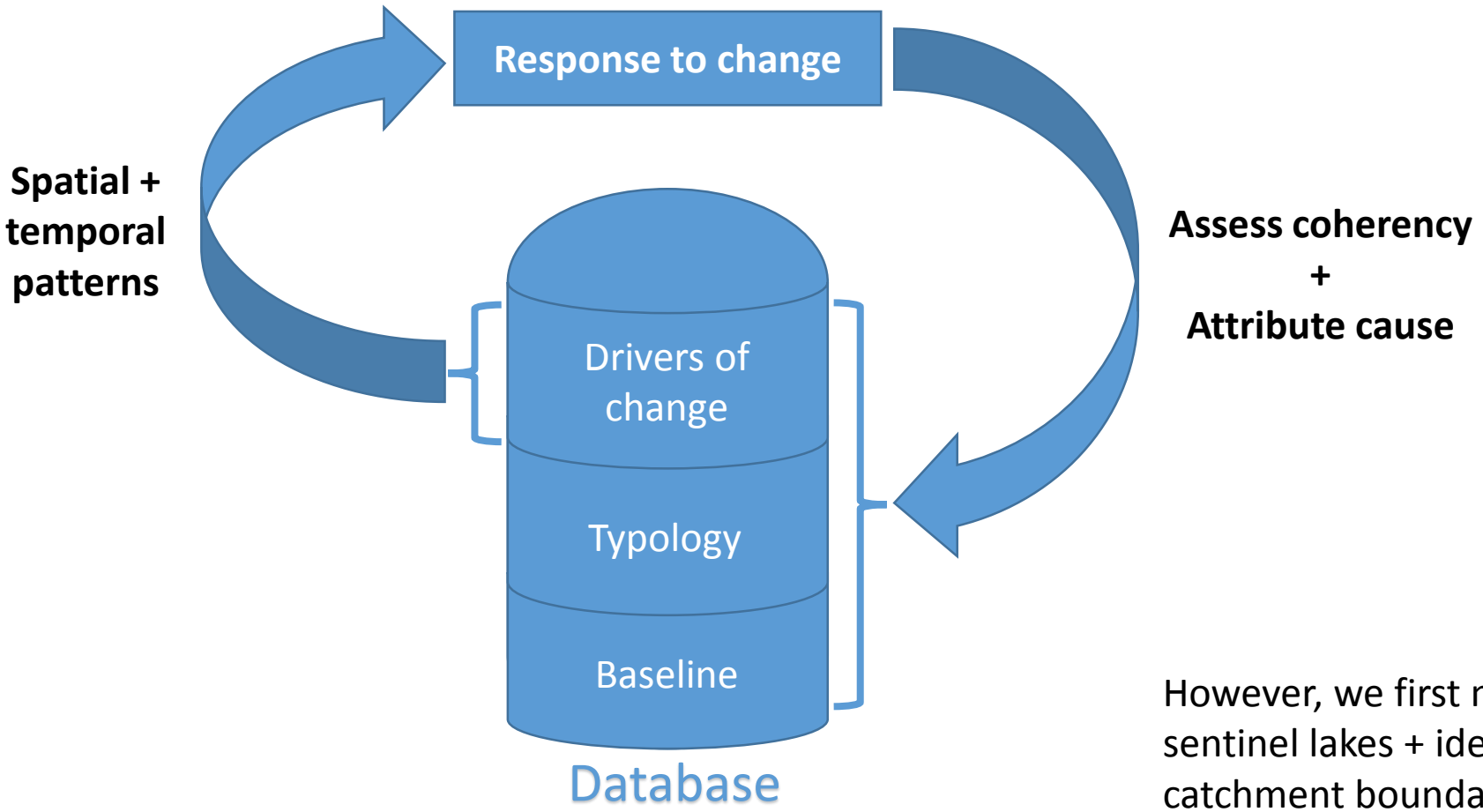

However, we first need to select 1000 sentinel lakes + identify their catchment boundaries

Study Site Selection

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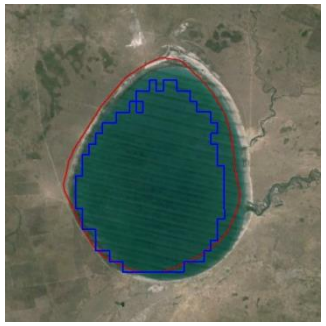
Challenge #1

Added: 40 smaller lakes with rich *in situ* datasets

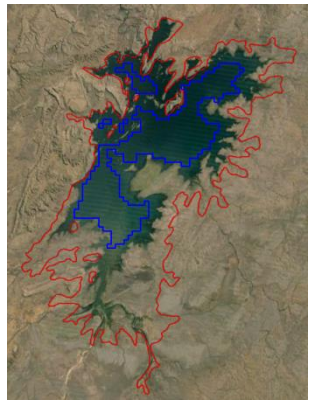
GLWD Level-1 (3,721 water bodies) → Water body type → R/S water mask → Water-mask-to-lake-area → No. of daytime R/S observations per year → 1000 lakes, lagoons & reservoirs

Aim: Select lakes that are (1) *appropriate* for R/S techniques + (2) *representative* of global lake population

GLWD ID 907, D_L = 1.03



GLWD ID 98, D_L = 3.8



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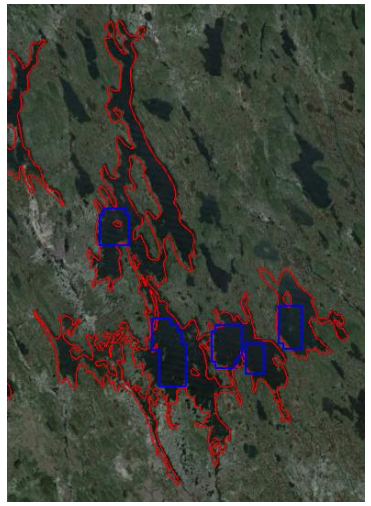
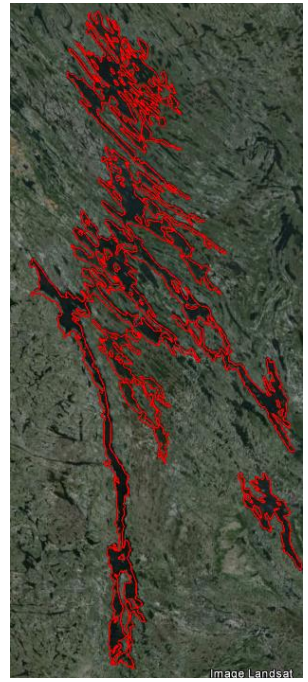


GLWD ID 115, D_L = 17



R/S mask (detectable area)

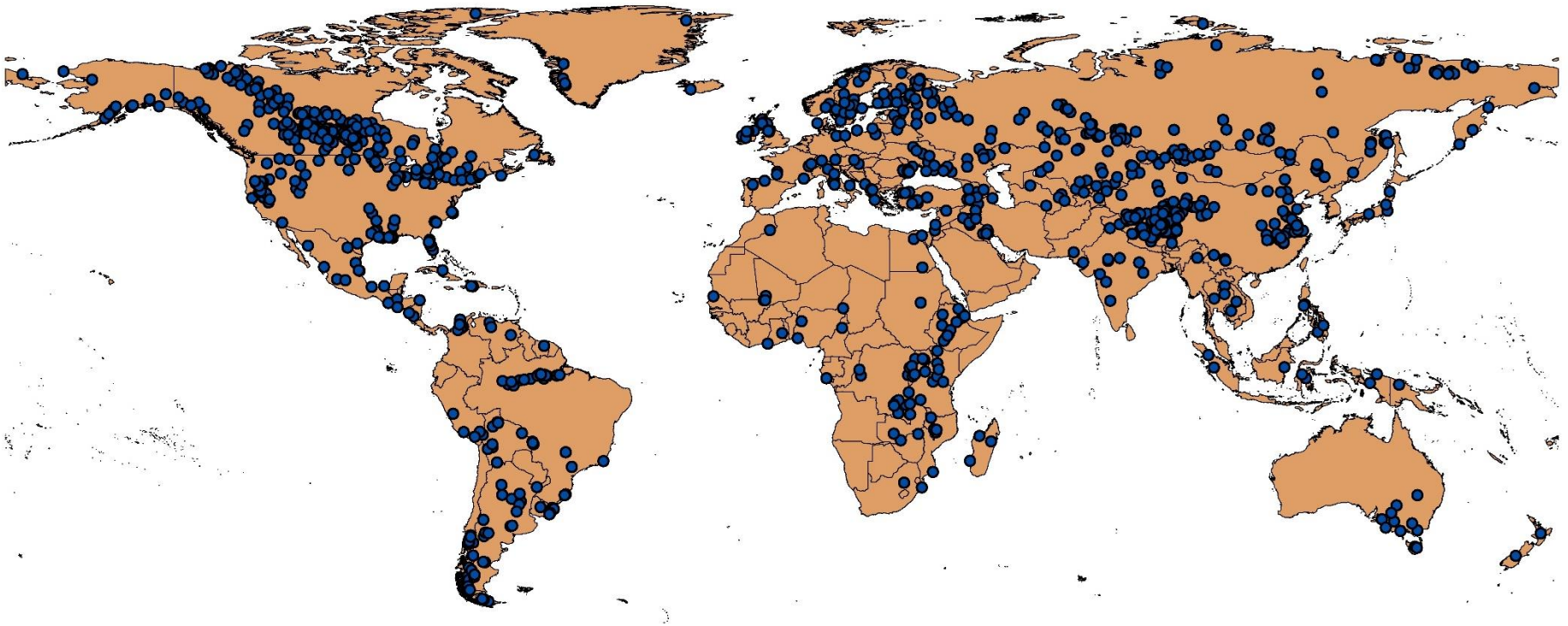
GLWD Level-1 lake shoreline

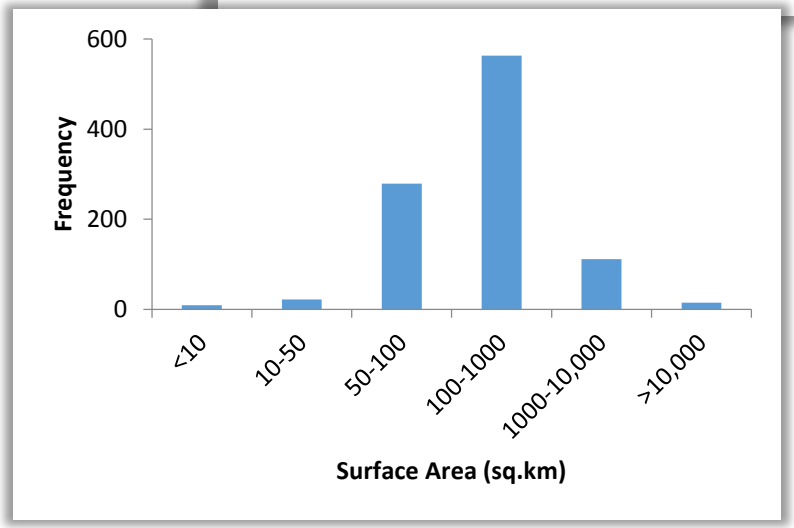
Regular shoreline = Larger area detected by R/S

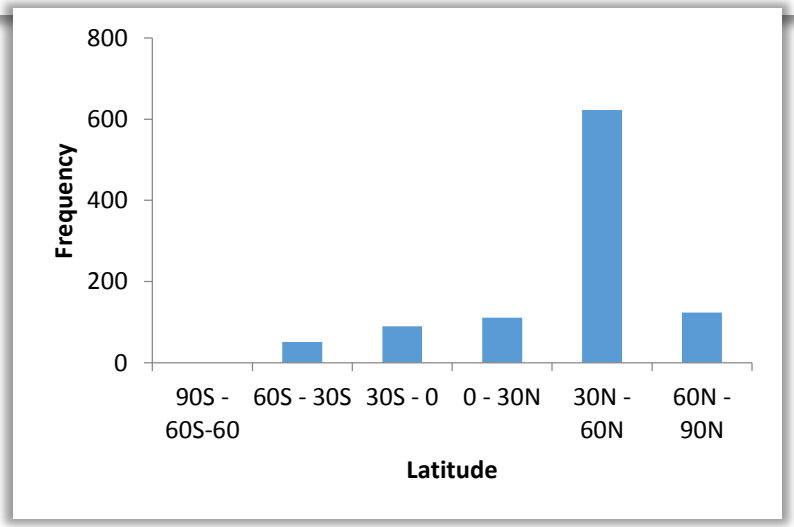
Irregular shoreline = Smaller area detected by R/S

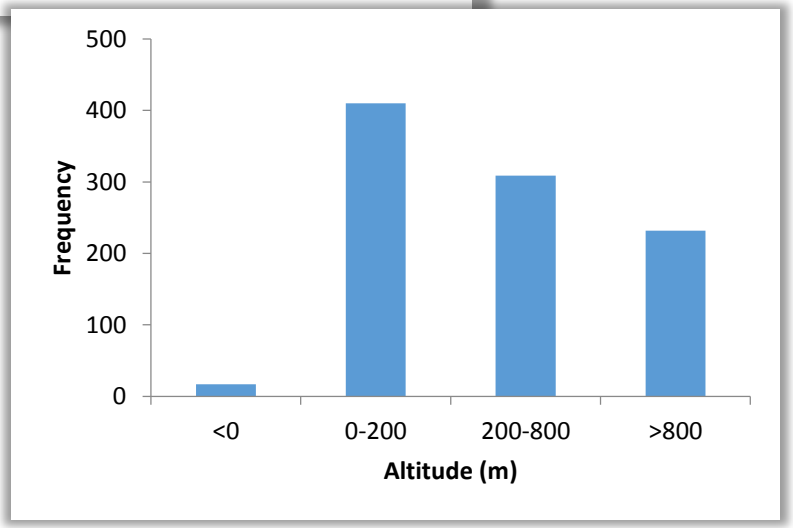
Water mask developed by ARC Lake

1000 GloboLakes study sites









Lake Catchment Generation

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Challenge #2

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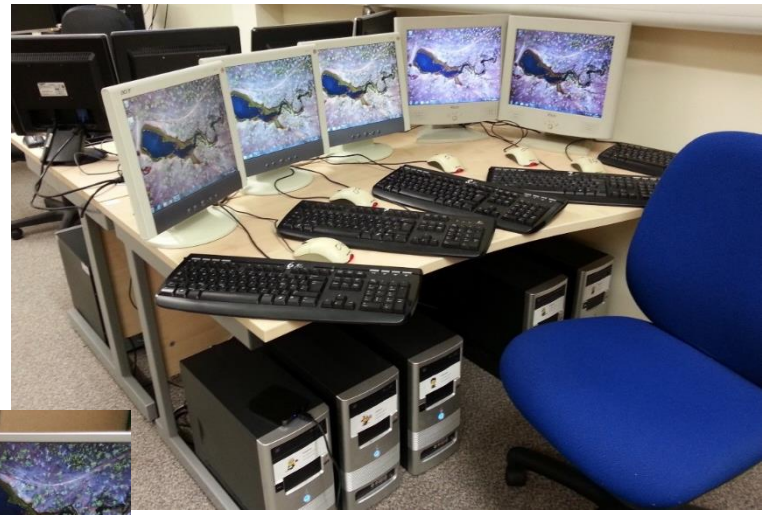
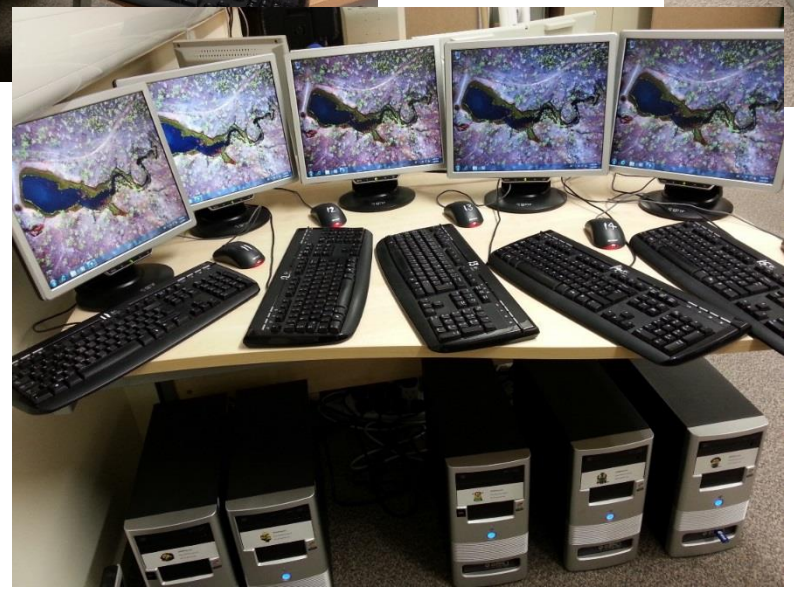




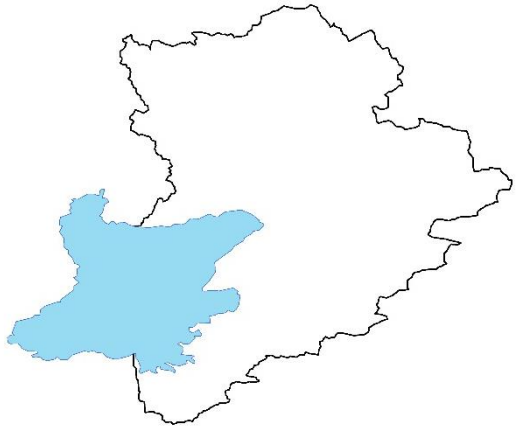
- A cluster of 15 computers dedicated to GloboLakes GIS modelling
- SRTM 90m and ASTER 30m DEMs

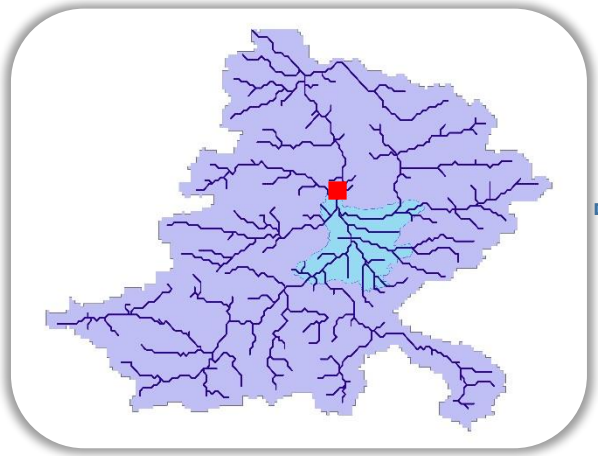
Lake Catchment Generation

Global Observatory of Lake Responses to Environmental Change

(North of 60°N) ASTER 30m GDEM → SRTM 90m elevation

GLWD lake shapefiles





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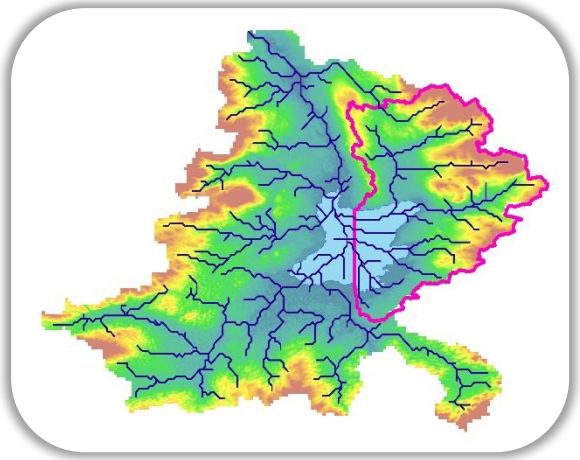

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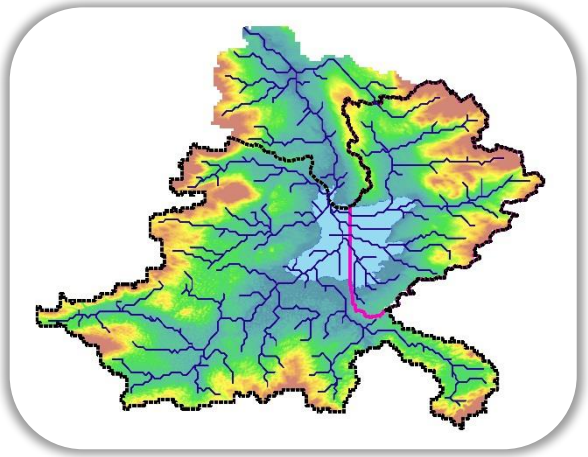
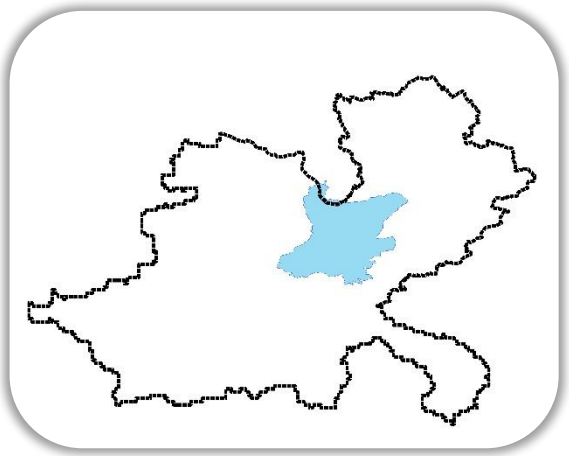


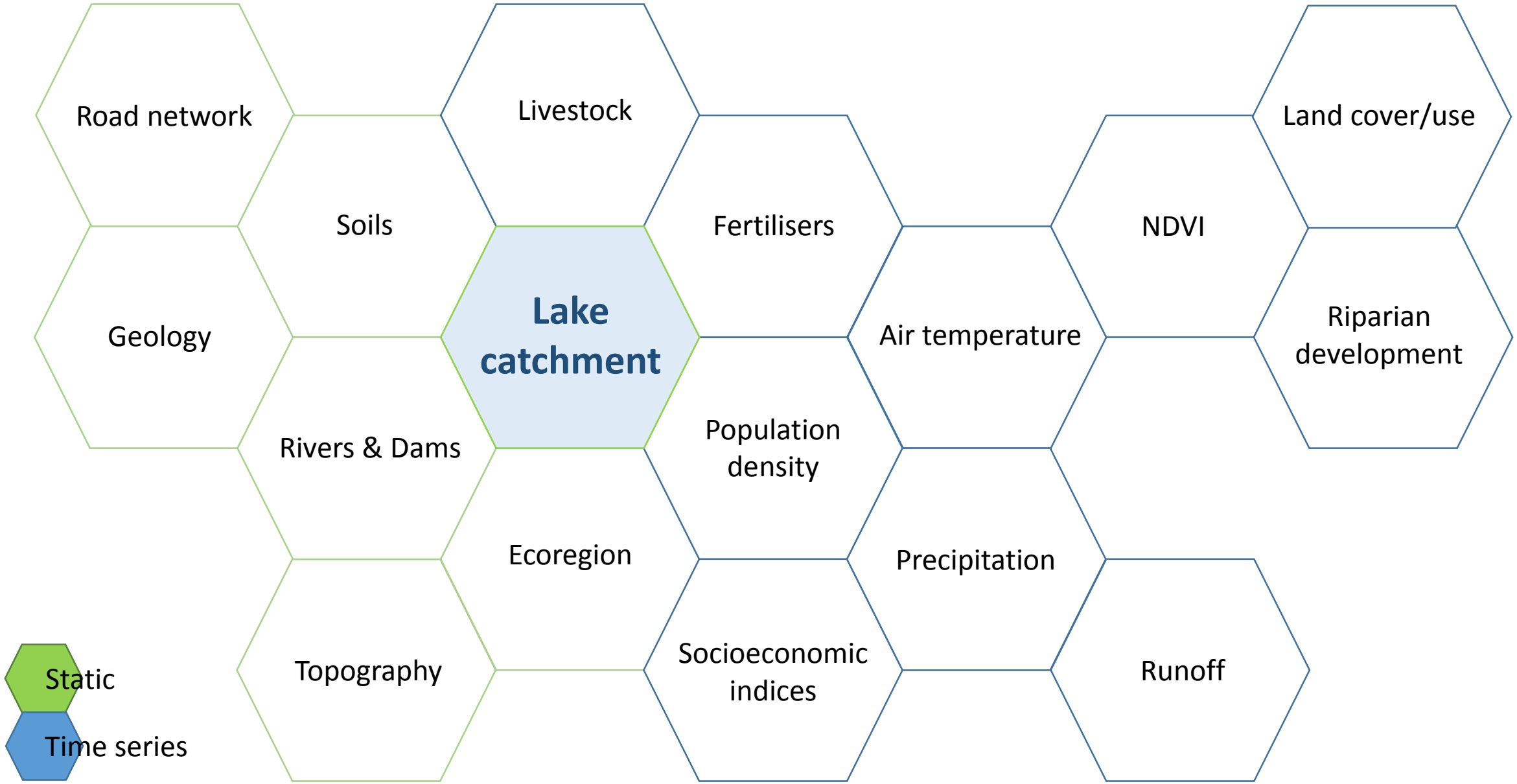


HydroSHEDS rivers, basin and location of pour point (red)

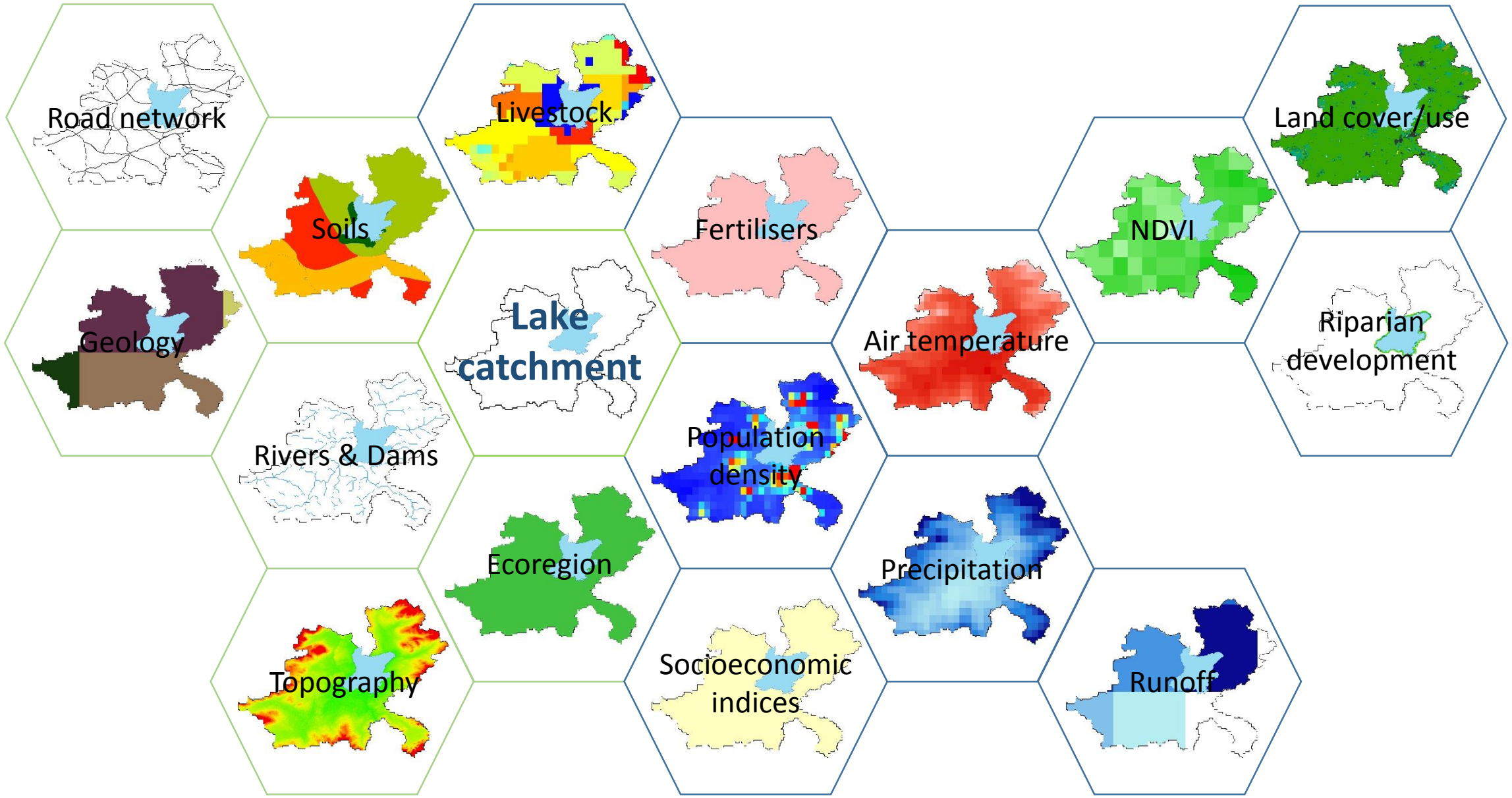
Elevation data and generated catchment (pink)

Correct catchment

Global Datasets

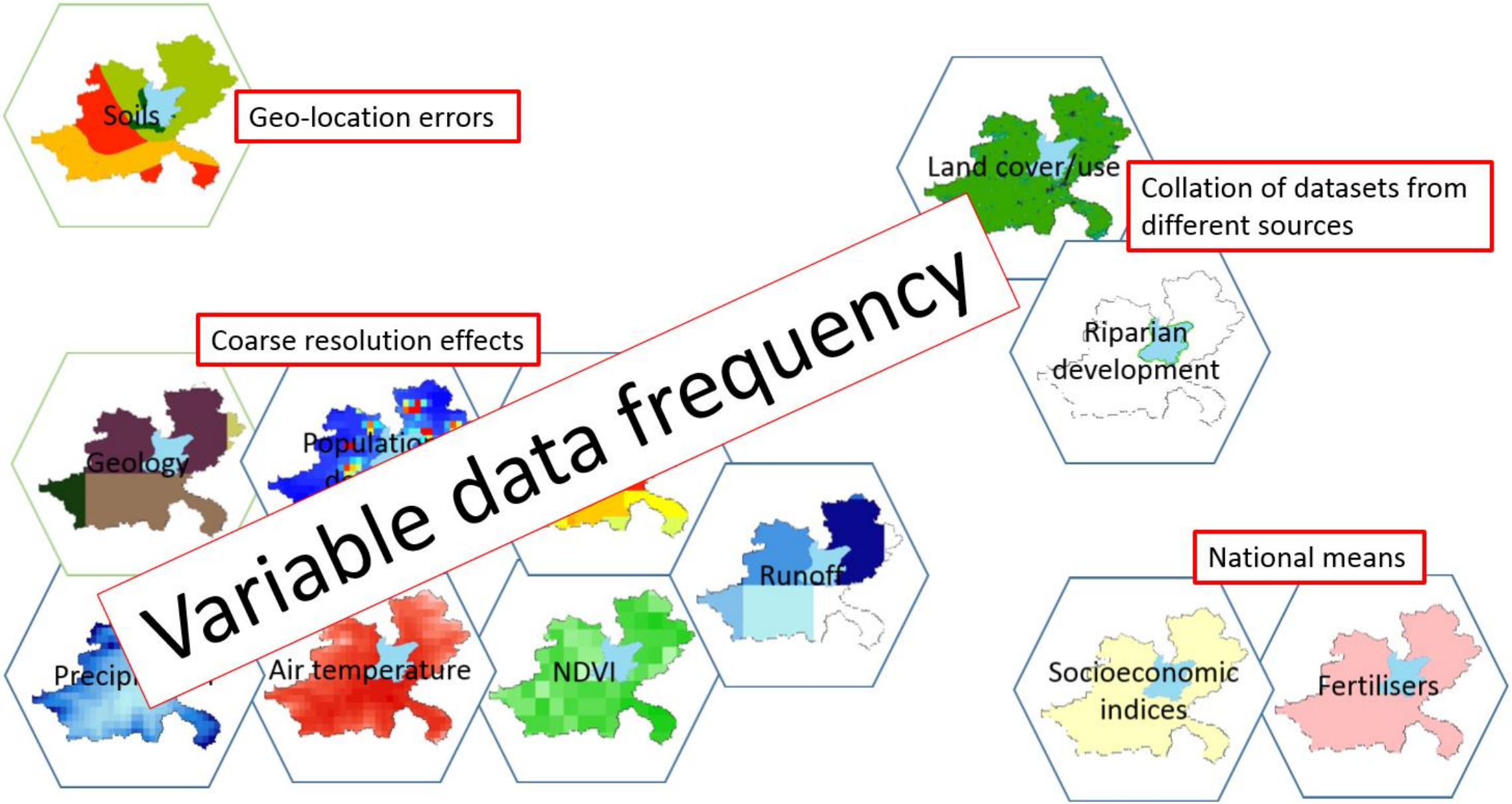


Global Datasets



Global Datasets

Challenge #3



Global Datasets: Runoff

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Challenge #4

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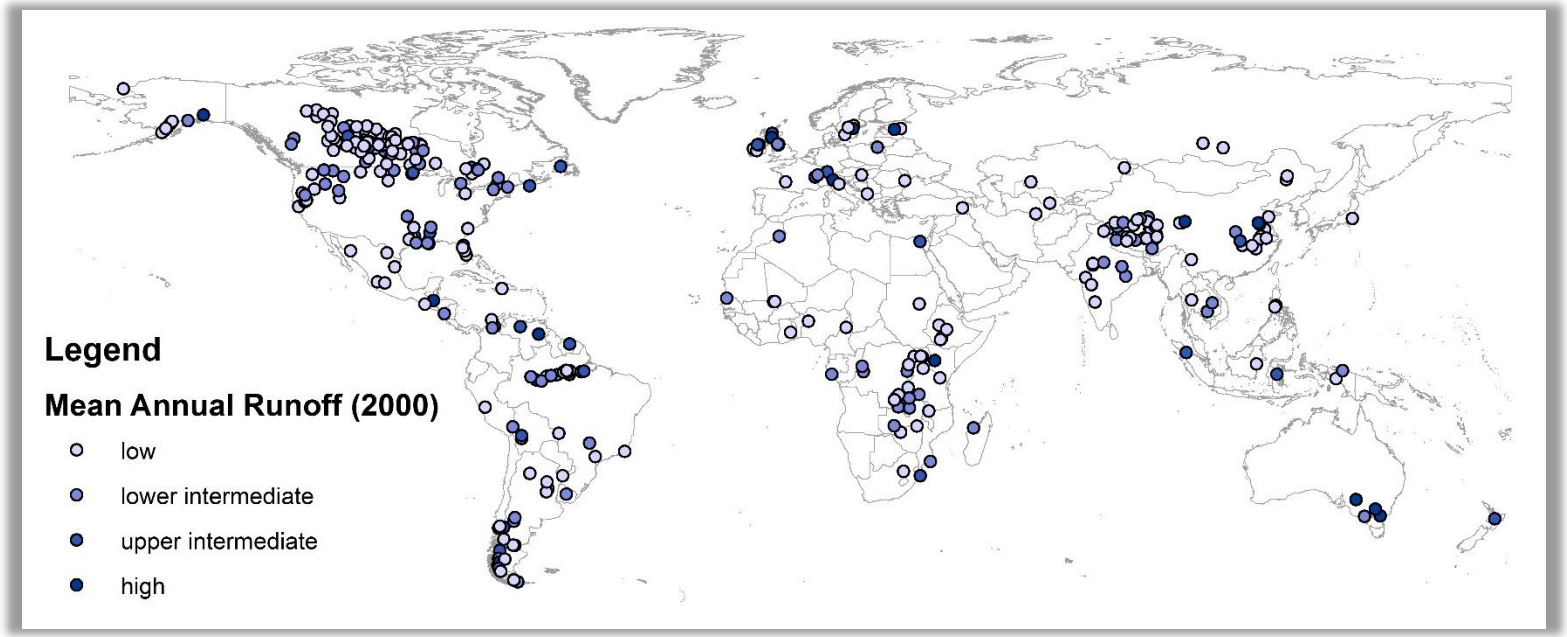
‘Reference’ period*:

- ✓ Surface runoff (1950-2000)
- ✓ River runoff (1961-1990)

Time series:

- ✓ World Runoff Fields v1.0, Year 2000 @0.5°
- ✓ ECMWF (1957-2002) @2.5°
- ➲ Models



* Source: Global Water System Project

Global Lake Typology

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Examples of attributes used in lake typology schemes

- Ecoregion
- Lat/Lon
- Origin
- Geology (alkalinity)
- Depth (mean)
- Depth (max)
- Lake surface area
- Catchment:Lake area ratio (Ohle's index)
- Lake surface shape (shoreline development)
- Altitude
- Natural/'Artificial'
- Age (reservoirs)
- Stream length
- Continentality
- 'Reference period' mean rainfall
- 'Reference period' mean air temperature
- Residence time
- Catchment relief ratio
- 'Reference period' runoff & water discharge
- Water level fluctuation
- Ice phenology
- Trophic status
- Soils
- Mixing/Stratification

EU WFD
US EPA
both
neither

Data gaps for building lake typology

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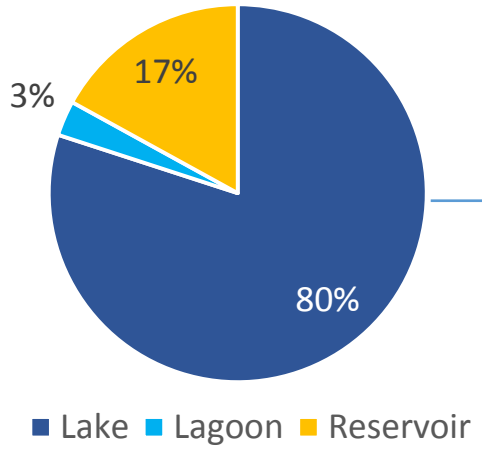
Challenge #5



100%
- Lake surface area
- Lake perimeter
- Ecolocation
- Catchment size
- Shoreline development
- Geology
- Runoff
- Precipitation
- Air temperature
- Continentality

12%
- Mean depth
- Max depth
- Volume

9%
- Mean depth
- Max depth
- Volume
- **Origin**

<1%
- Mean depth
- Max depth
- Volume
- Origin
- **Mixing**
- **Trophic state**

97%
- Volume

10%
- Mean depth
- Max depth
- Volume

Note: Data are based on subset (353) of GloboLakes sites (1000) and availability from existing online lake databases (GLWD, Arc-Lake, LakeNet, ILEC)

Summary

Global Observatory of Lake Responses to Environmental Change

Challenge #1 Identify 1000 sentinel lakes that are appropriate for remote sensing (R/S) techniques and representative of the global lake population

Lakes selected = appropriate for ≤1x1km R/S data, methodology applicable to new generation of satellites (Sentinel series)

Challenge #2 Generate (incl. quality assurance) catchment boundaries for the 1000 lakes

15-computer cluster working night and day, >800 catchments generated

Challenge #3 Deal with geolocation errors, variable spatial and temporal resolution, different sources, national means

Challenge #4 Model necessary information (e.g. runoff) at required spatiotemporal scales using existing global datasets

Scoring system for long-term trends, interpolation methods, data reclassifying, …

Challenge #5 Fill in gaps in lake attributes required to build global lake typology

Crowd sourcing, modelling, …

Thank you for your attention

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