Automated processing and visualization of data from environmental biomonitoring networks: case study on freshwater ecosystems

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Project description

Quality of surface waters is a topic of high importance and it is also one of priorities of European Union (for example Water Framework Directive)

Demands on systems for evaluation of quality of surface waters

Good state of waters in EU countries

The application of remedial technologies requires evaluation of the state of the waters

Necessity of complex evaluation system

IBA is the part of the team developing this evaluation system

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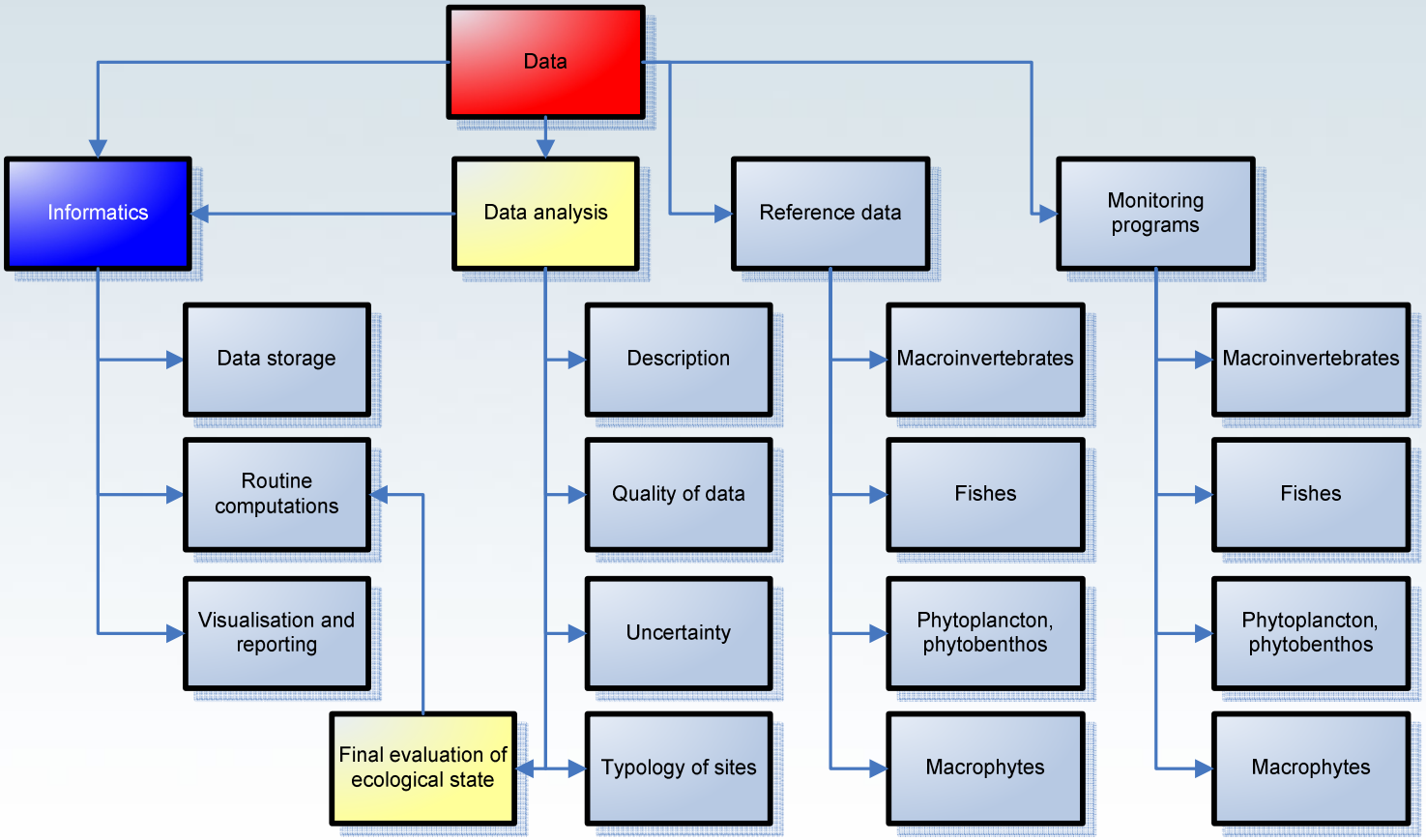
Components of the evaluation system



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HISTORY AND BACKGROUND

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Monitoring of surface waters

- Problems of water quality and their monitoring started long time ago
- Usage of water organisms for monitoring of water quality
  - Connection between organisms and environment

- Several different systems for evaluation
  - Indicative species
  - Simple indices
  - Complex systems: combination of indices, multivariate prediction etc.

- RIVPACS and other approaches

- Nowadays general demand on these complex systems according to WFD EU

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History of biomonitoring in the Czech Republic

- First complex data – PERLA – set of projects oriented towards reference data – local database and system
- International projects – AQEM, STAR …..

- Monitoring networks of different organizations
  - VUV
  - ZVHS
  - ČHMU
  - AOPK

- Integration of biomonitoring networks and standardization according to demands of WFD EU

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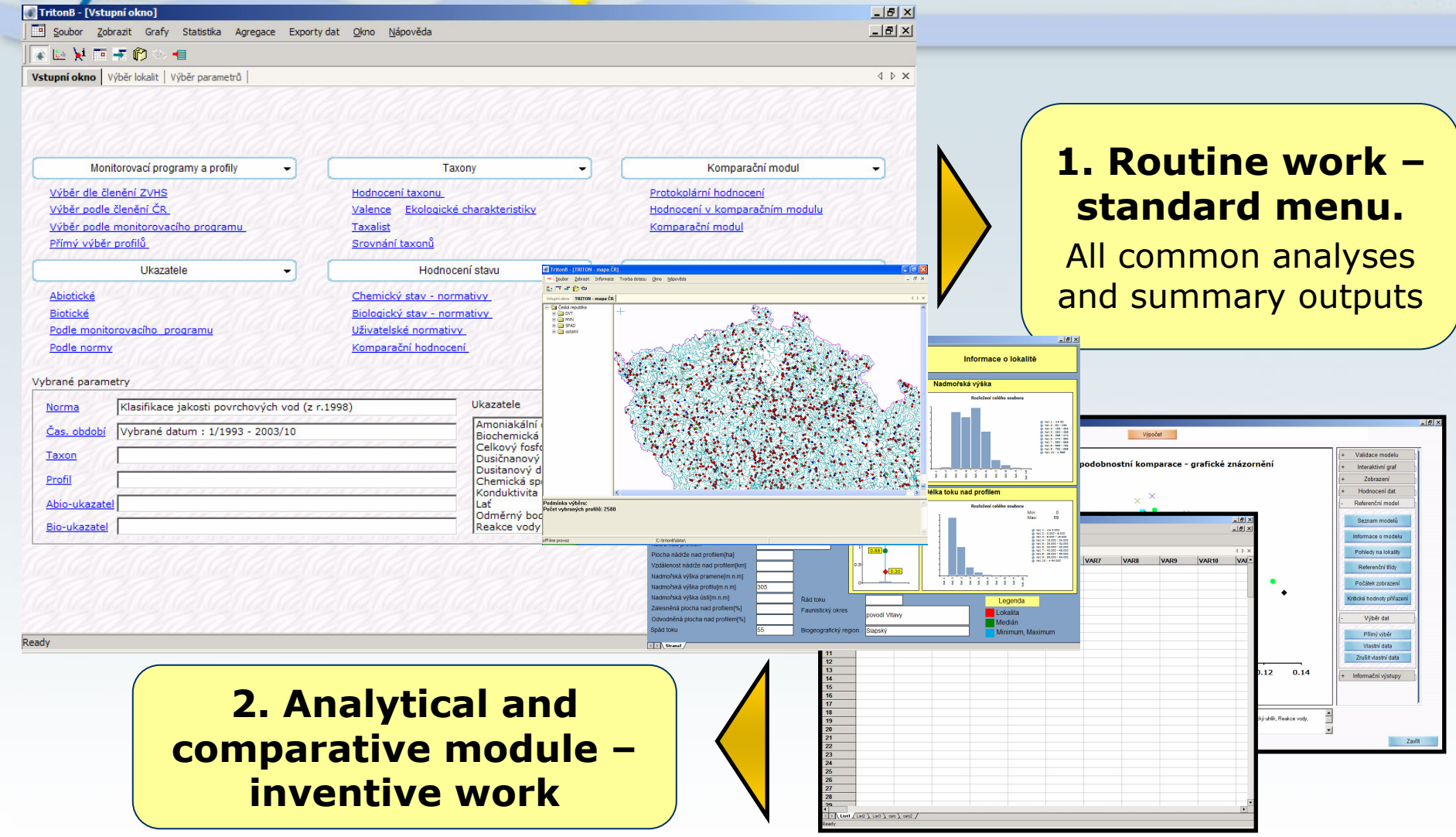
IBA history in this field

- Collaboration with Agricultural Water Management Authority
  - 1999-2000 First version of system Triton that was working only with data from abiotic monitoring. This version has implemented functions for time series analyses, summary statistics. Simple GIS module was included too.
  - 2001 First version of Analytical module – user could import all available data into special worksheet that served for more sophisticated analyses in the way of other statistical programs (Statistica for Windows etc.). These groups of statistical functions were added: comparative analysis, regression analysis, correlation analysis etc.
  - 2003-2004 Development of complex system Triton B. New system can work with data from biomonitoring too. Many new functions were added: online actualization, more sophisticated GIS module, multivariate comparative module, presentation module (user can create its own report in the way similar with Microsoft PowerPoint), user hierarchy – data distribution according to user rights, centralized database.
- Collaboration on implementation of WFD EU in collaboration with Ministry of the Environment of the Czech Republic



1. Routine work – standard menu.

All common analyses and summary outputs

2. Analytical and comparative module – inventive work

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DATA

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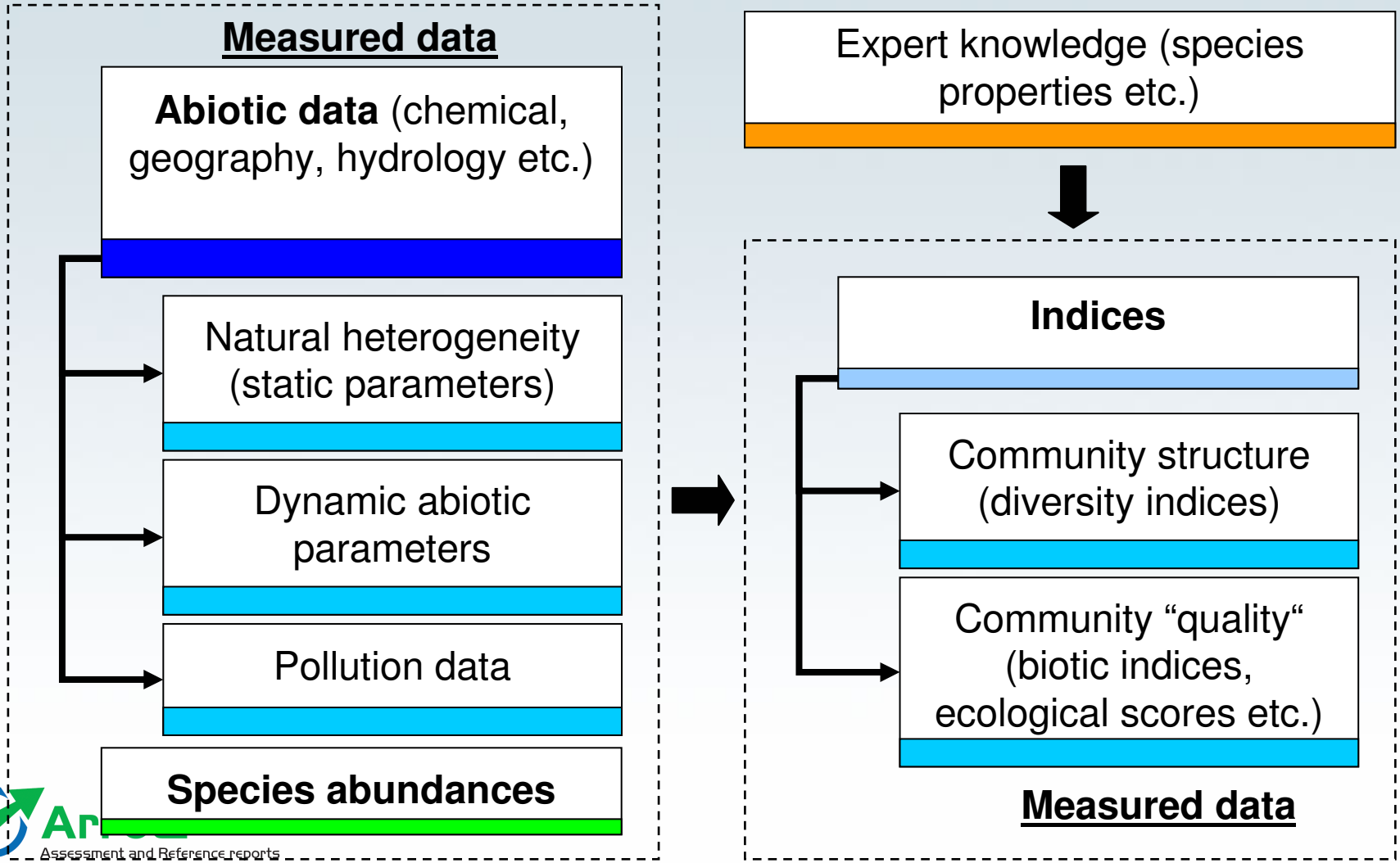
Huge amount of input data



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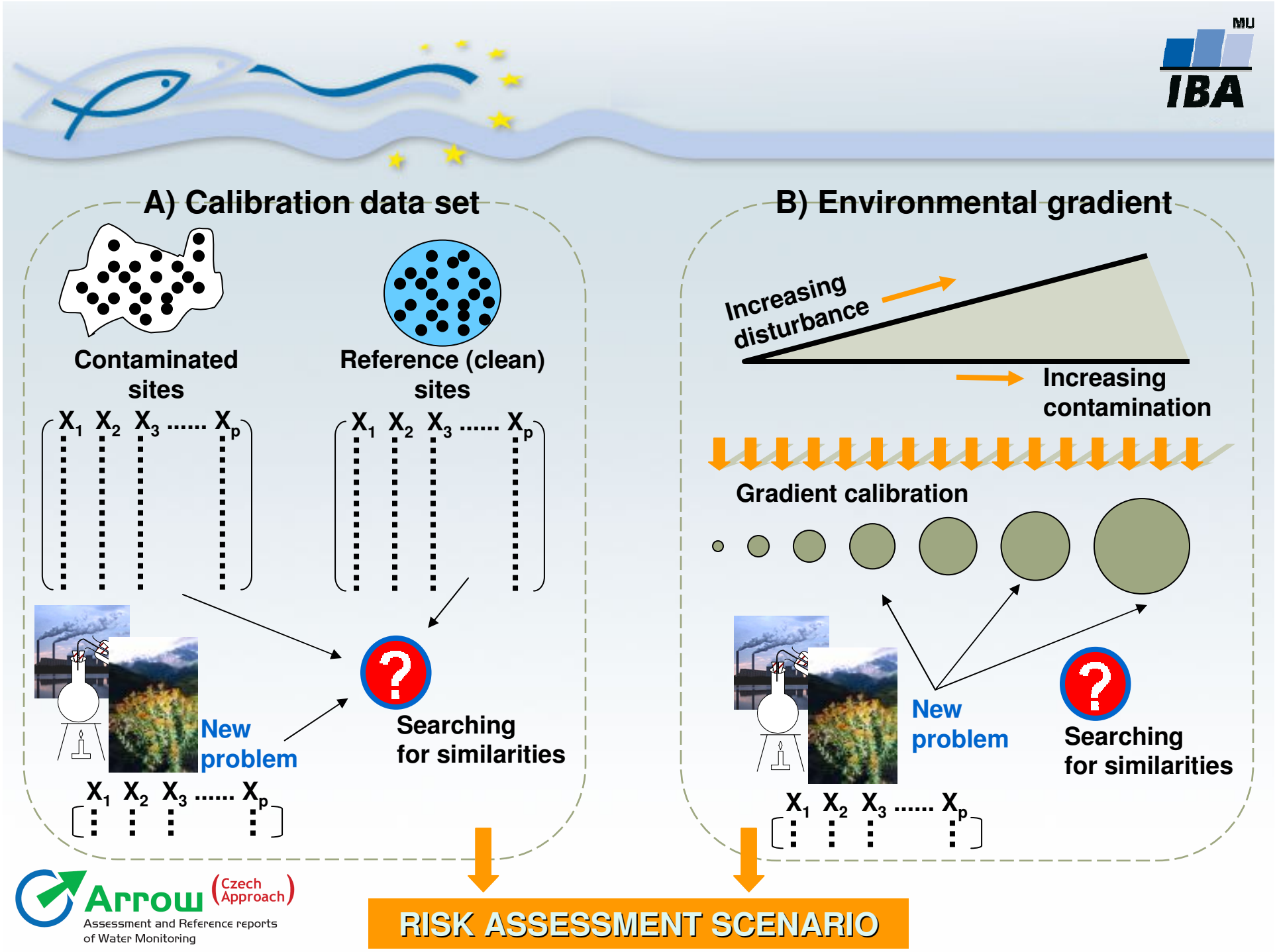
A) Calibration data set
Contaminated sites
Reference (clean) sites
X1 X2 X3 ..... Xp
New problem
Searching for similarities
X1 X2 X3 ..... Xp
B) Environmental gradient
Increasing disturbance
Increasing contamination
Gradient calibration
New problem
Searching for similarities
X1 X2 X3 ..... Xp
RISK ASSESSMENT SCENARIO
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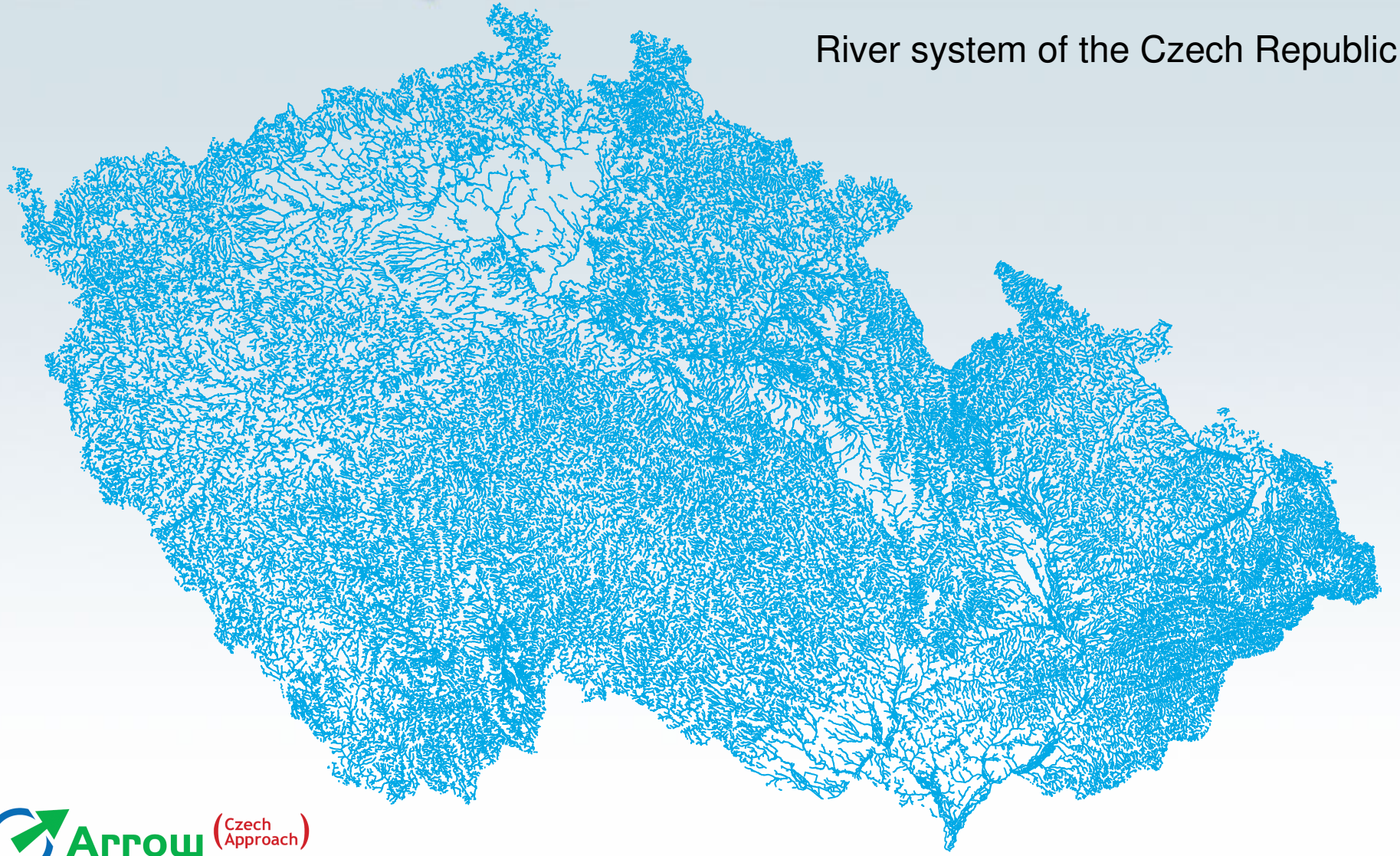
Biomonitoring network

River system of the Czech Republic



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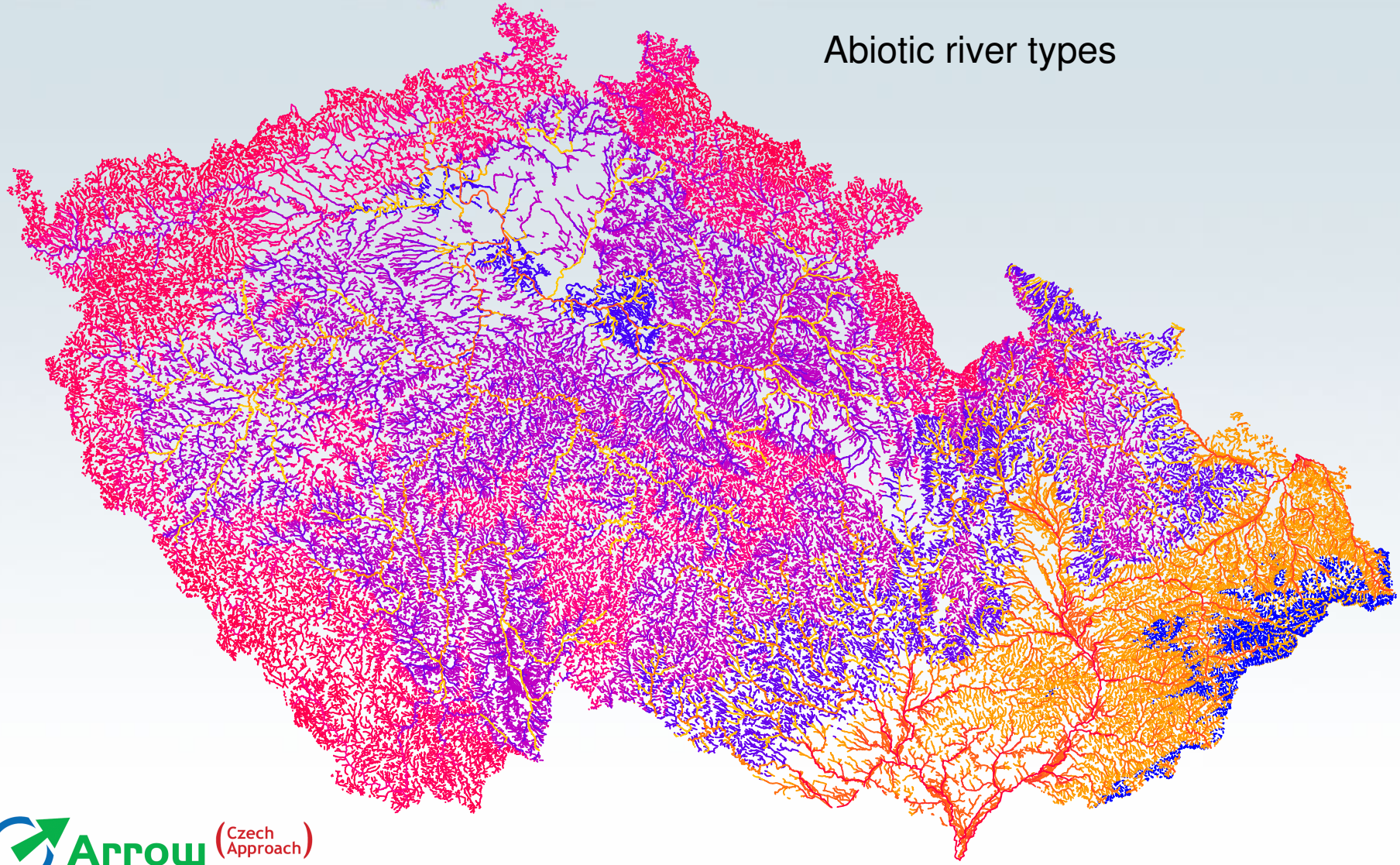
Biomonitoring network

Abiotic river types



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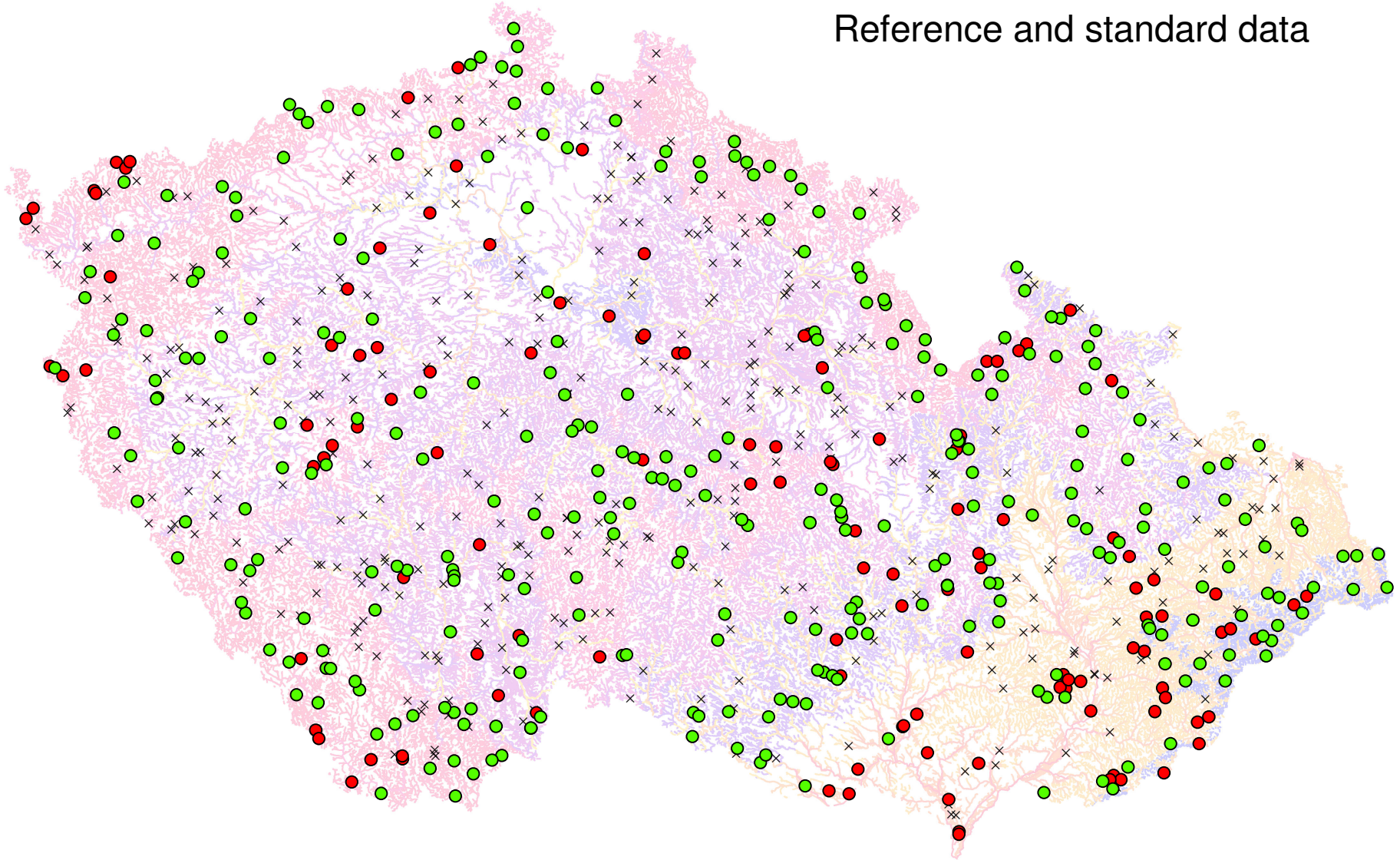
Biomonitoring network



Data of biological communities

- Macrozoobentos
  - 362 sites
  - 120 new sites every year
    - Repeated sampling every three years
  - Goal to reach 360 repeatedly sampled localities

→

- Already sampled
- Several years of repeated sampling

- Fishes
  - 80 sites
- Algae
  - 40-120 sites
- Macrophytes
  - 120 sites

→

- Sampling in progress
- Discussion on available sites
- Limited number of available sites

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DATA ANALYSES

Searching for sufficient level of taxa determination
Model for prediction of surface water quality

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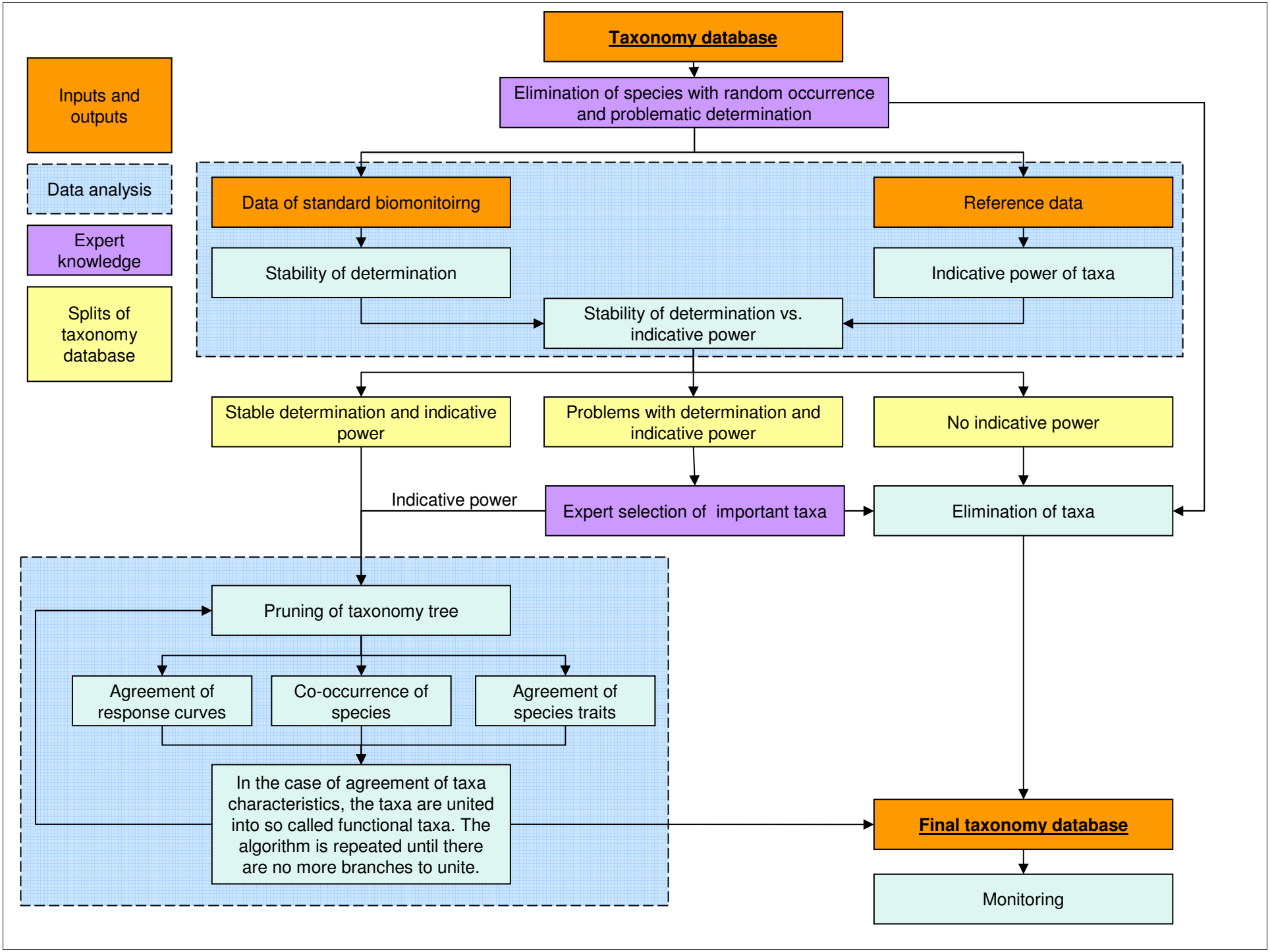
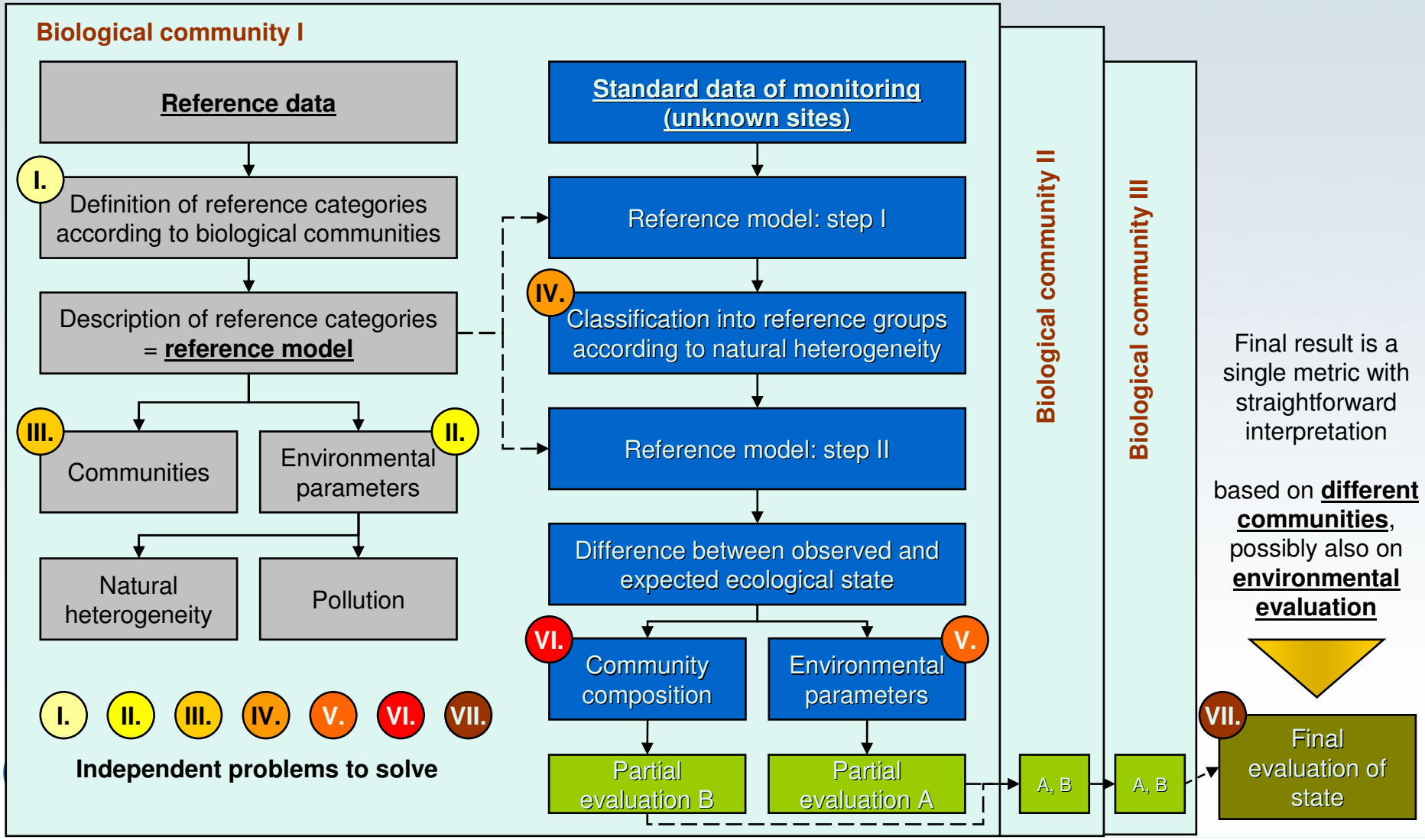
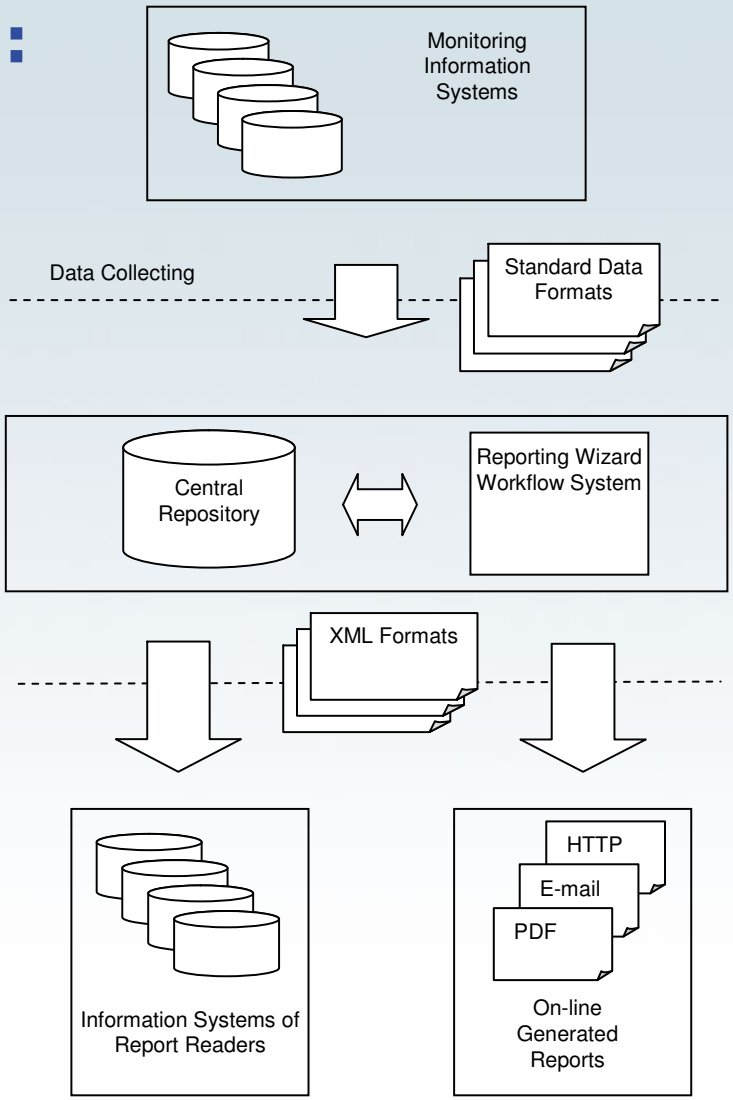

Inputs and outputs
Data analysis
Expert knowledge
Splits of taxonomy database
Taxonomy database
Elimination of species with random occurrence and problematic determination
Data of standard biomonitoirng
Reference data
Stability of determination
Indicative power of taxa
Stability of determination vs. indicative power
Stable determination and indicative power
Problems with determination and indicative power
No indicative power
Indicative power
Expert selection of important taxa
Elimination of taxa
Pruning of taxonomy tree
Agreement of response curves
Co-occurrence of species
Agreement of species traits
In the case of agreement of taxa characteristics, the taxa are united into so called functional taxa. The algorithm is repeated until there are no more branches to unite.
Final taxonomy database
Monitoring

Diagram of analysis - macrozoobenthos



Informatic background:

Architecture of the ARROW information system



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Conclusion

- ☑ The presented methodology is **universal** for any type of date (i.e. any biological communities) and respects the problems of data distribution and variability.

- ☑ The software implementation use standardized tools and have central management of rights, data and reporting

Complex system for evaluation of ecological state of surface waters with standardized procedure of data processing.

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