The World Water Quality Assessment

Pre-study for a World Water Quality Assessment

Approach, results and experiences

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

CESR Center for Environmental Systems Research

UNEP

UN WATER

Water quality challenge

- Wastewater production at least doubling by 2050 → Sewerage connections increasing
- But not wastewater treatment → More untreated wastewater to rivers and lakes

Health:

Health risk of contaminated rivers & lakes → contact with surface waters → washing, cleaning, drinking

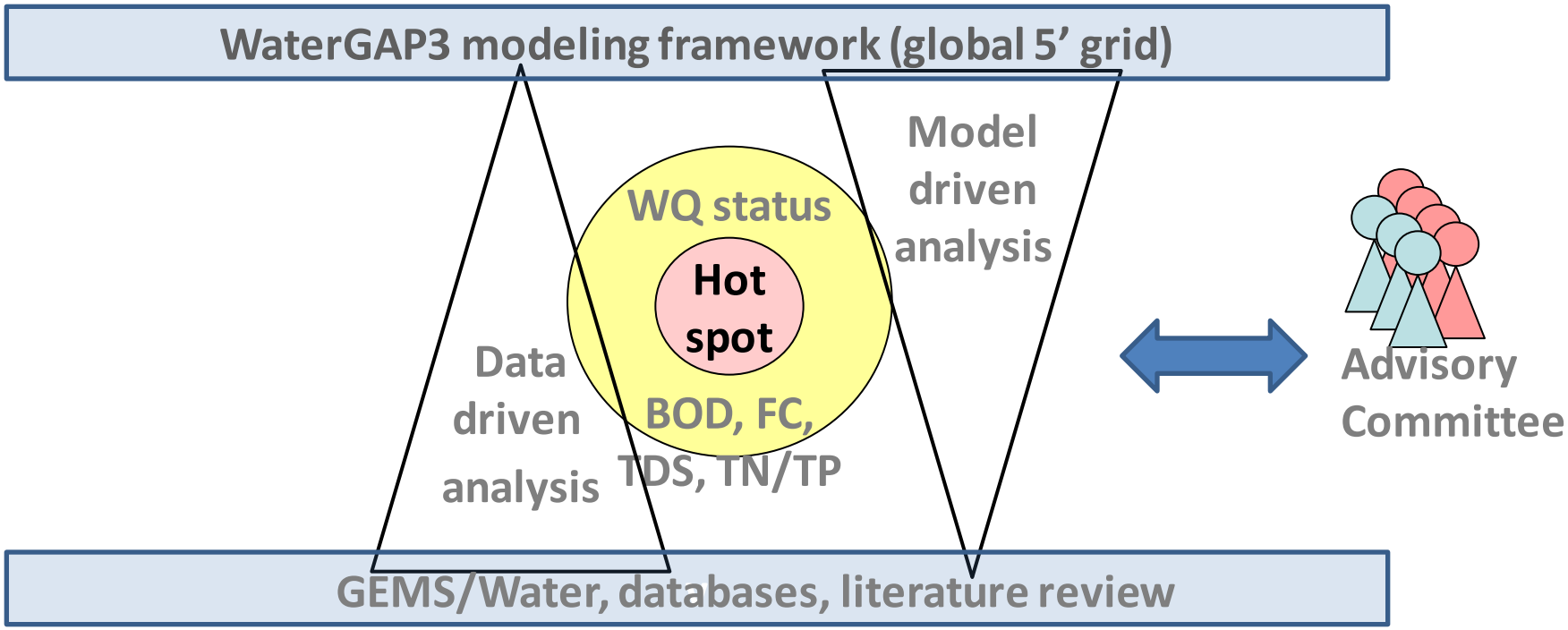
Food Security:

95% inland fishery production from developing world

200 million Africans consume fish regularly

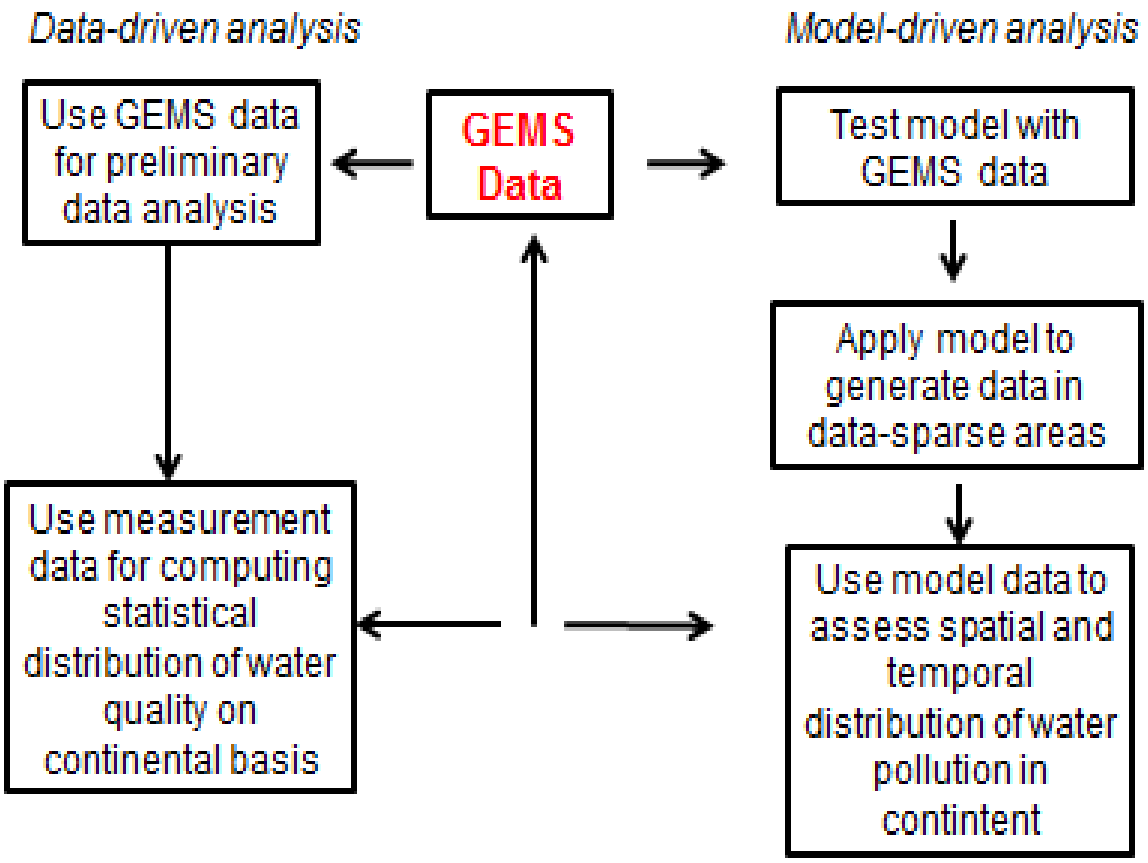
Our data and model driven approach

Global perspective – Top down



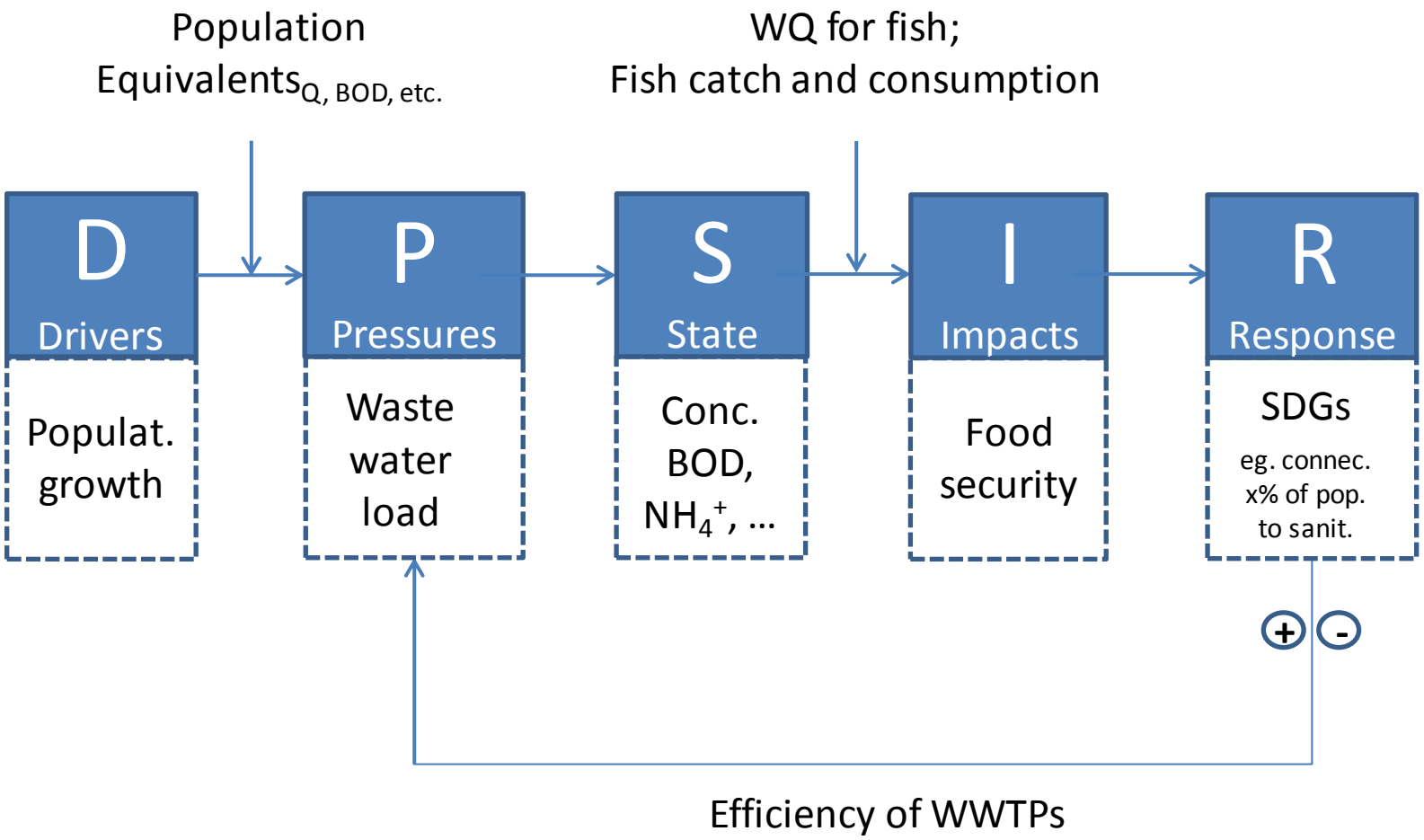
Local/Regional perspective – Bottom up

Combined Data-driven and Model-driven assessment



Generic concept

- The **generic concept** behind the assessment:



Selection of parameters and classification

The World Water Quality Assessment

Selection

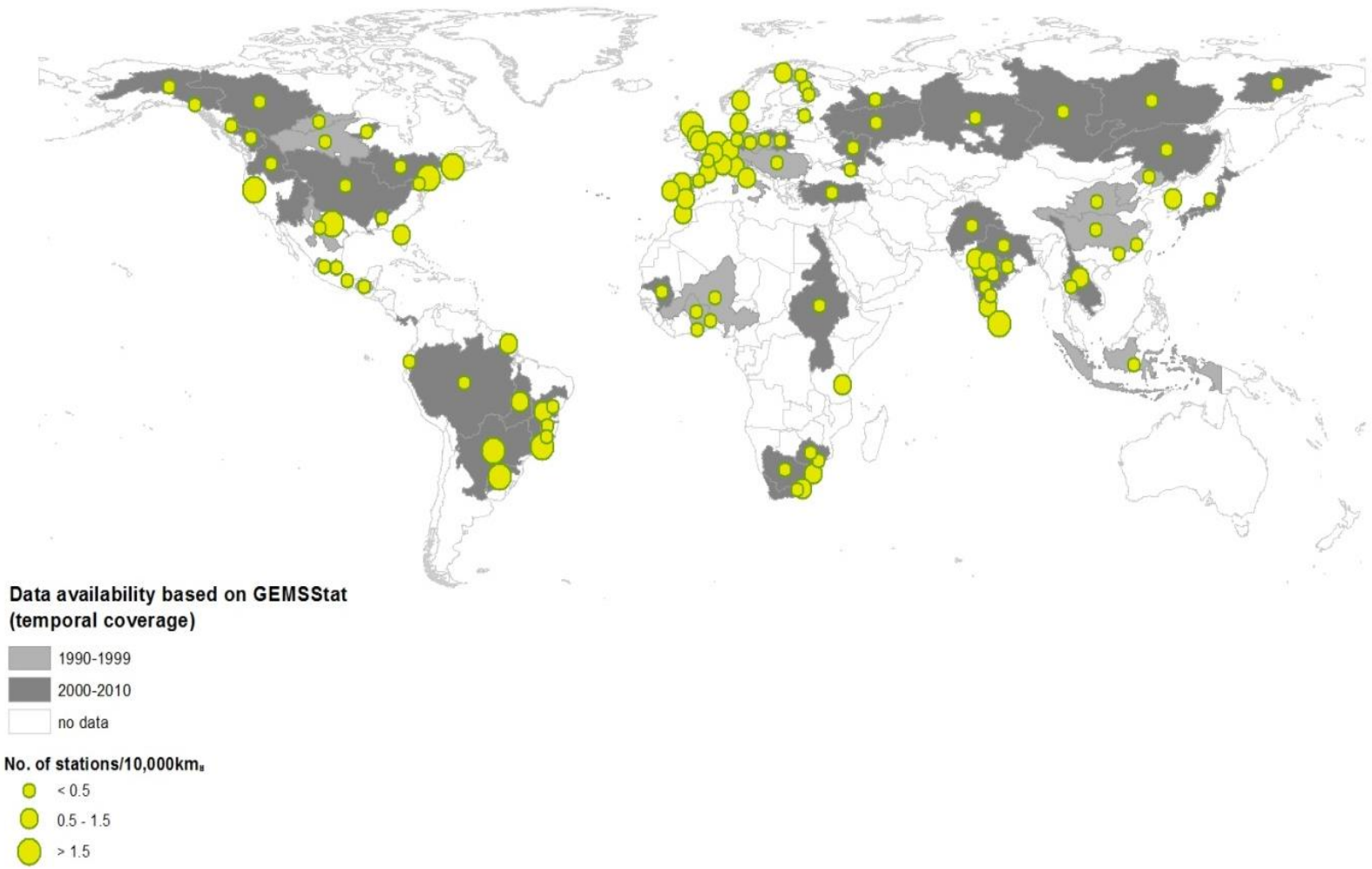
Parameter / Indicator	Food security	Human health
BOD => DO	**X**	X
TDS	X	
FC		X
N	X	
P	X	

- **Plus trends over time**

Classification

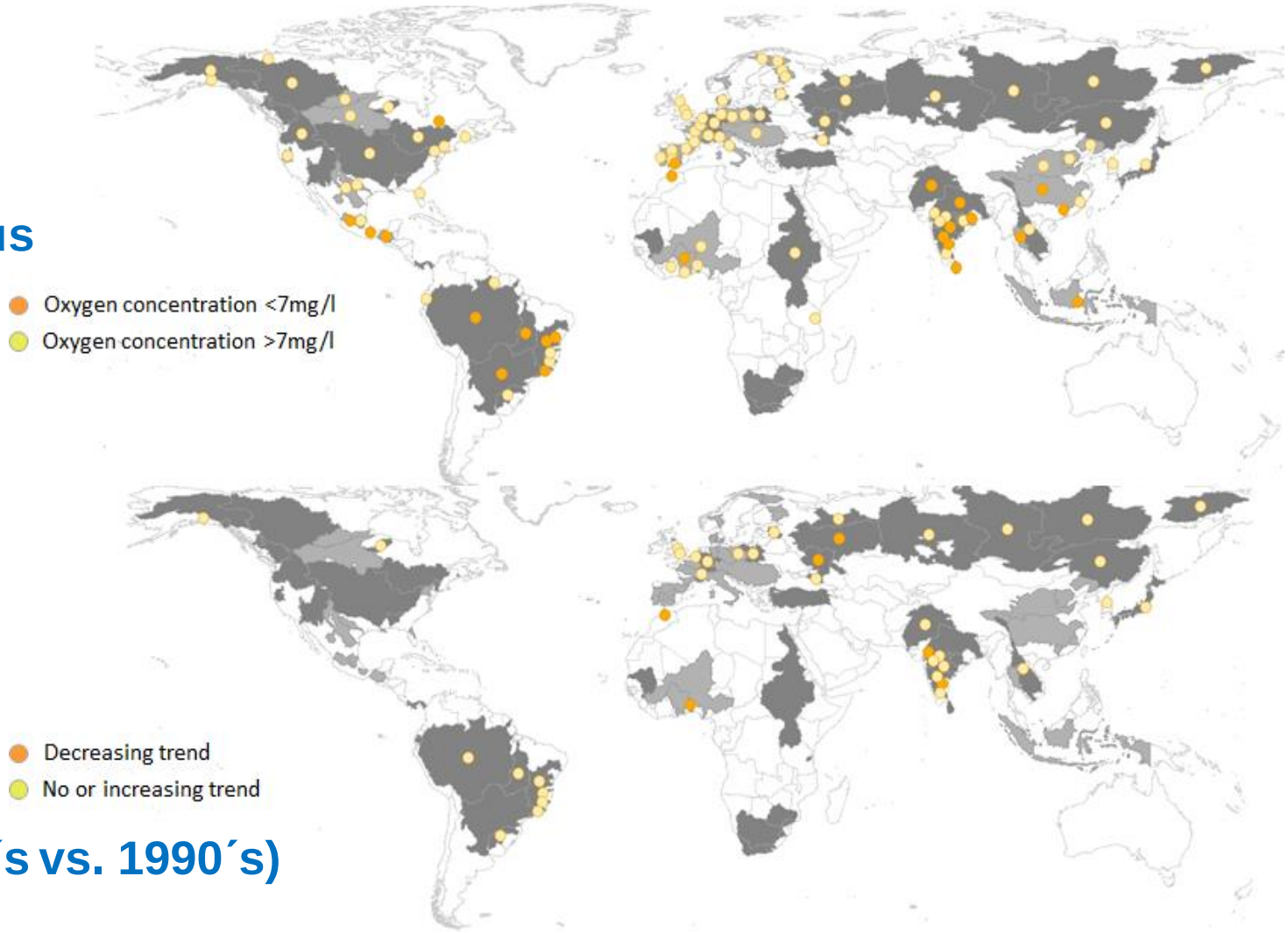
Water Quality Criteria	Dissolved Oxygen		Biological Oxygen Demand		Total Phosphorus		Total Nitrogen		TDS / Chloride
No adverse effects. Ecosystem functioning and natural processes within normal range	>6 mg/L	>7 mg/L	≤6 mg O_2 L^{-1}	≤3 mg O_2 L^{-1}	Mesotrophic to Meso - eutrophic (0.01 – 0.025 mg/L)	Oligotrophic (<0.004 – 0.01 mg/L)	<7.5 mg/L	≤ 3.0 mg/L	<100 mg/L
Aquatic life may experience some detrimental effects from current water quality	6-4 mg/L	6-5 mg/L	7 - 9 mg O_2 L^{-1}	4 - 6 mg O_2 L^{-1}	Eutrophic (0.025 – 0.05 mg/L)	Mesotrophic to Meso - eutrophic (0.01 - 0.025 mg/L)	7.5 – 15.0 mg/L	3.0 – 7.5 mg/L	<300 mg/L
Water quality impacting most aquatic organisms, mortality may occur.	<3 mg/L	<4 mg/L	>10 mg O_2 L^{-1}	>7 mg O_2 L^{-1}	Hyper-eutrophic (>0.050 mg/L)	Eutrophic (0.025 – 0.050 mg/L)	>15.0 mg/L	7.5 – 15.0 mg/L	>120 mg/L

Global Water Quality Data Base – GEMS/Water



Data driven analysis – example oxygen

Actual status



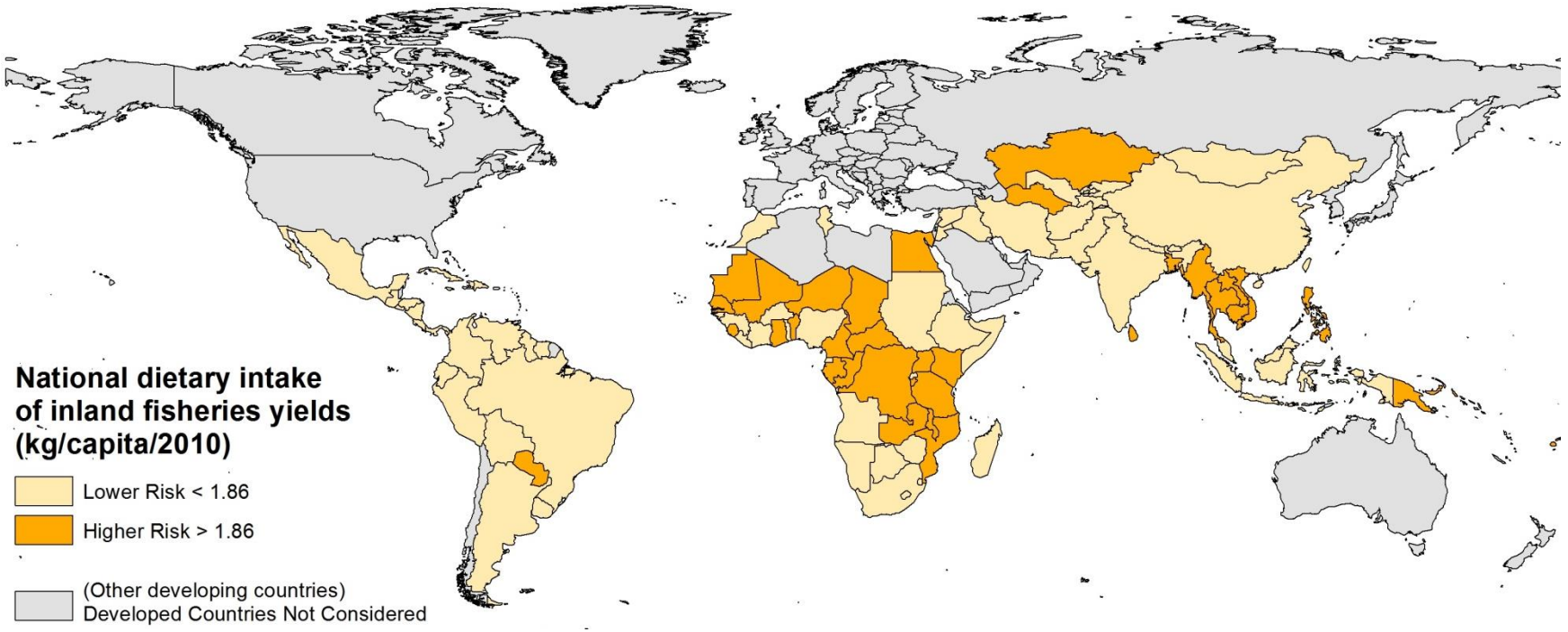
Trend (2000´s vs. 1990´s)

Water quality and food security: intake from inland fishery

Description : Estimation of the level of consumption of inland fisheries per person per country.

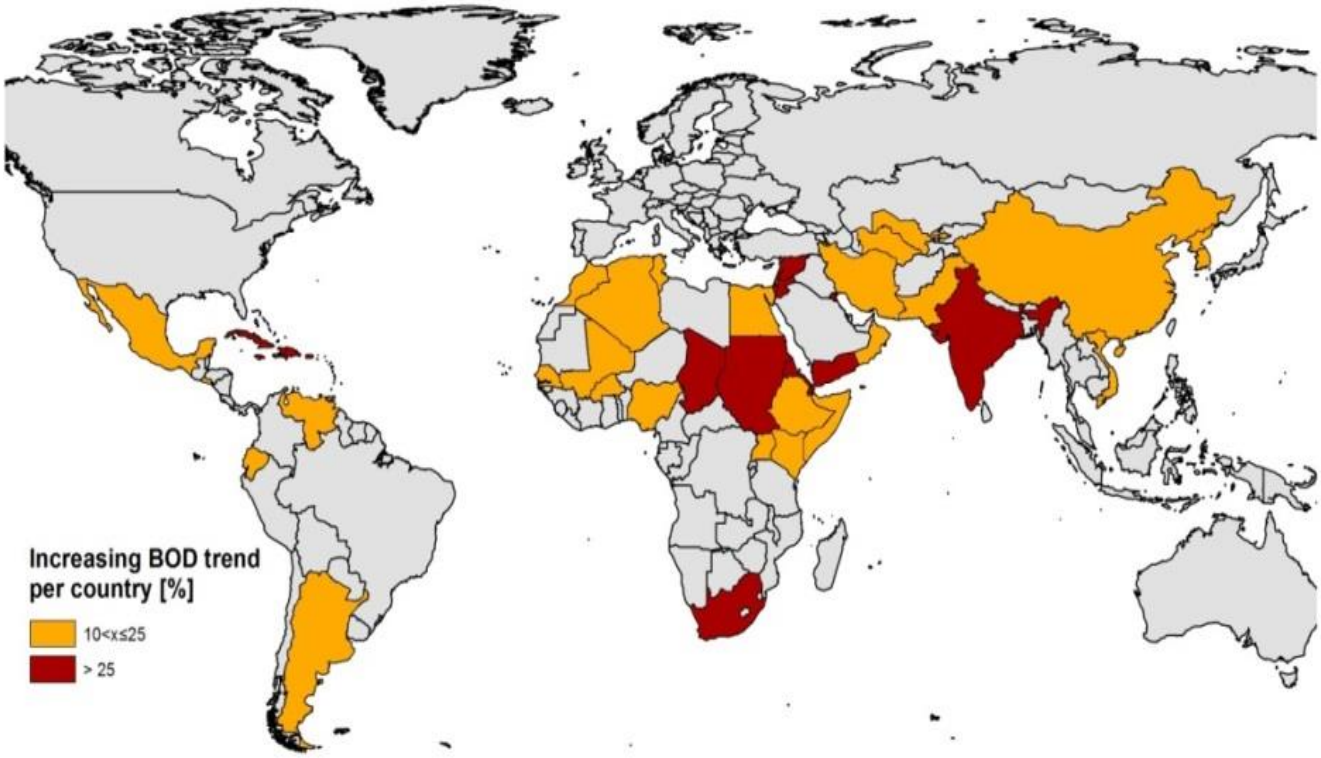
Method : Reported inland fisheries catch (t) divided by the official national population.

Categorisation : Higher risk: ≥ 1,86 kg/capita/2010 and Lower risk: < 1,86 kg/capita/2010
(75th percentile of countries reporting inland fisheries yields)



Water quality and food security: "BOD hot spots"

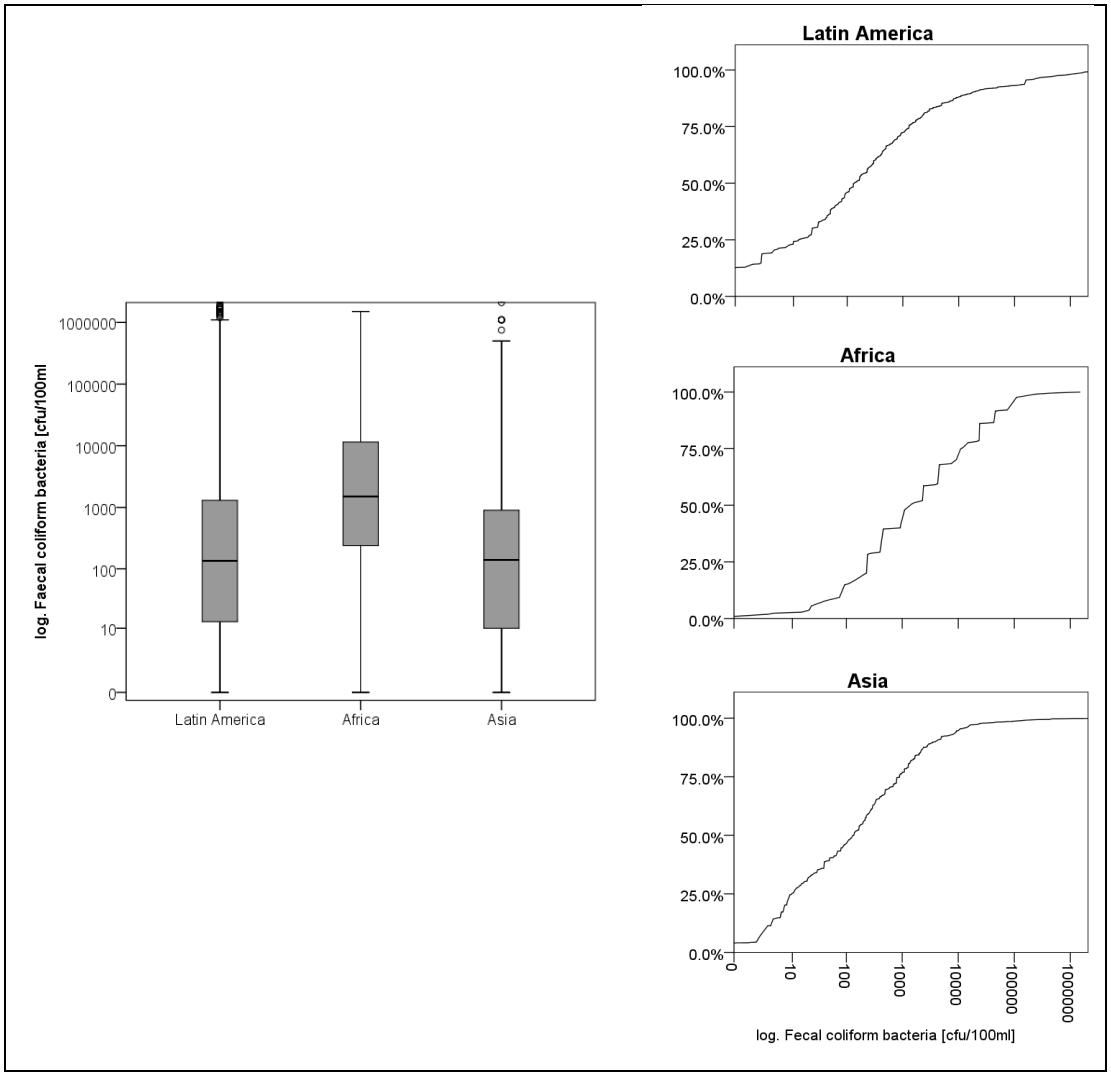
Description : Percentage of river stretches in each country with "increasing trend of BOD of particular concern" meaning that in these stretches the pollution level increased into the severe pollution category in 2008-10, or that they were already in the severe pollution category in 1990-1992 and further increased in concentration by 2008-2010



Data-driven analysis – example fecal coliforms

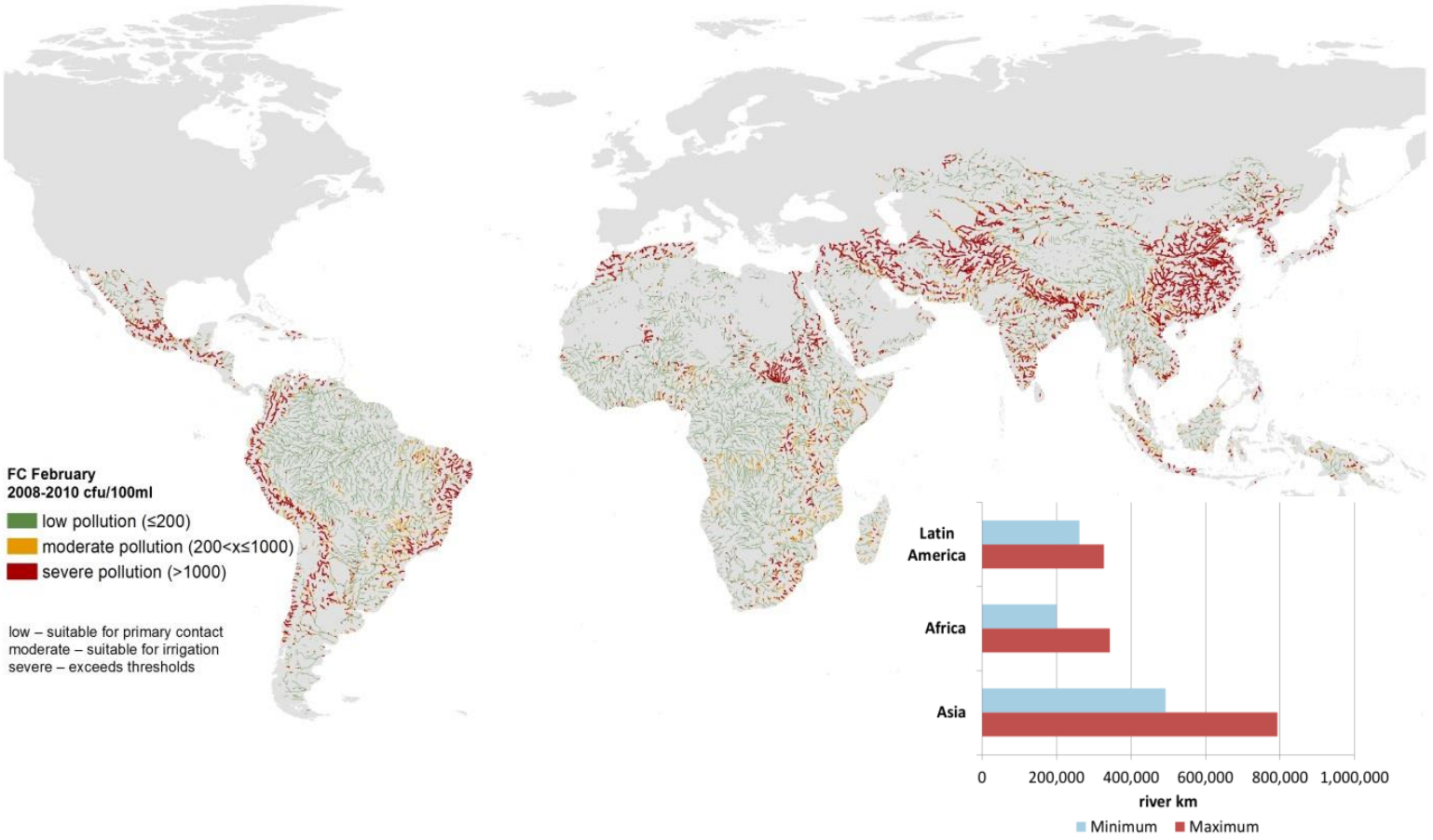
The World Water Quality Assessment

Description : Statistical distributions of all GEMStat faecal coliform data in Latin America, Africa, and Asia from the period 2000-2010.



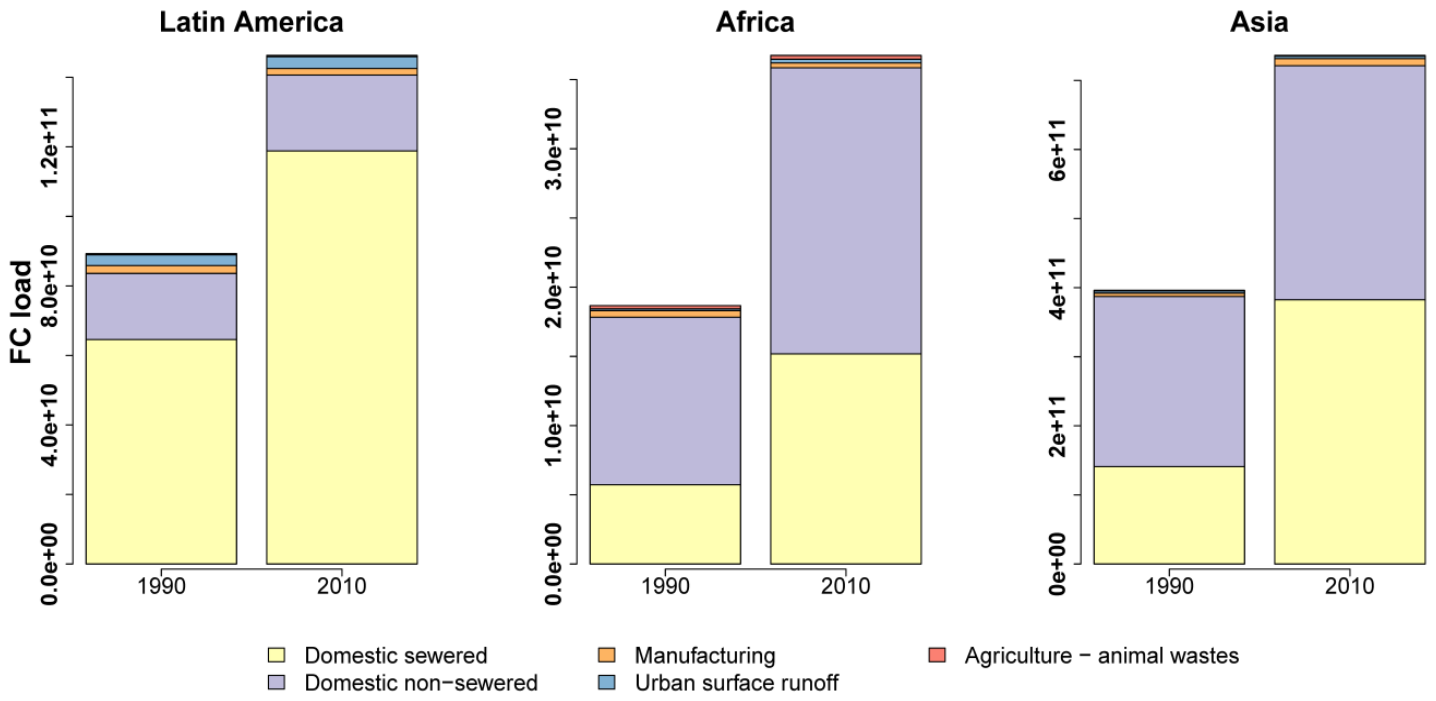
Model driven analysis – example fecal coliforms

Description : Estimated in-stream concentrations of faecal coliform bacteria (FC) for Latin America, Africa and Asia for February 2008-2010. Bar charts show minimum and maximum monthly estimates of river stretches in the severe pollution class per continent in the 36-month period from 2008-2010.



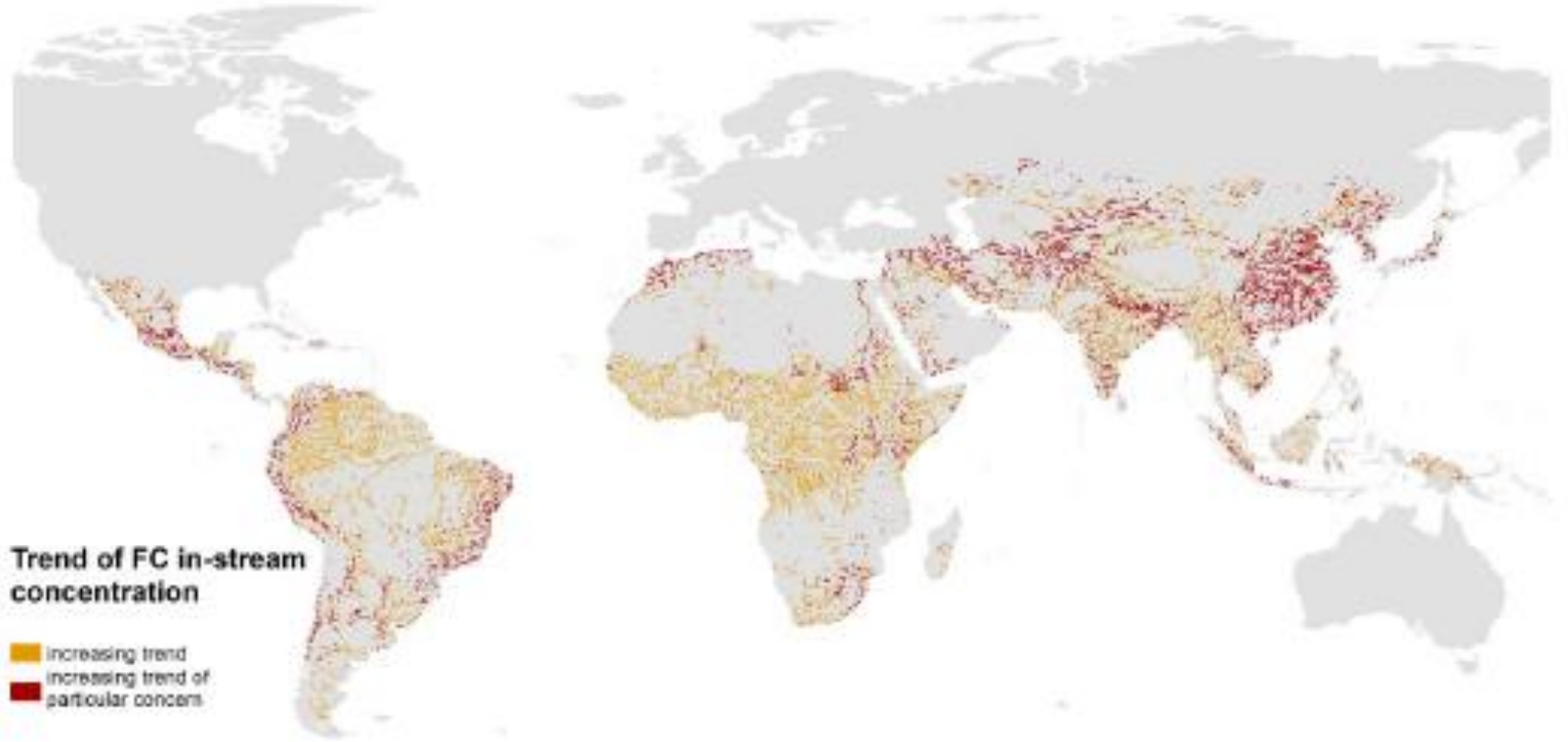
Sources of fecal coliform loadings

Description : Faecal coliform bacteria loadings ("FC load") for Latin America, Africa, and Asia for 1990 and 2010. Units: 10^{10} cfu/year..



Model driven analysis – trends of fecal coliforms

Description : Trend in faecal coliform bacteria levels on rivers between 1990-1992 and 2008-2010. River stretches marked with orange or red have increasing concentrations between these two periods. River stretches with a decreasing trend are not shown.



Main messages of the WWQA Phase 1

The World Water Quality Assessment

- **Water pollution has worsened since the 1990s** in almost all rivers in Latin America, Africa and Asia.
- **Severe pathogen pollution already affects around one-third of all river stretches** in Latin America, Africa and Asia.
- **The number of people at risk to health** by coming into contact with polluted surface waters **may range into the tens of millions** on these continents.
- **Severe organic pollution already affects around one-seventh of all river stretches** in Latin America, Africa and Asia.
- **The food security from inland fisheries is threatened** in a number of countries in Africa and Asia

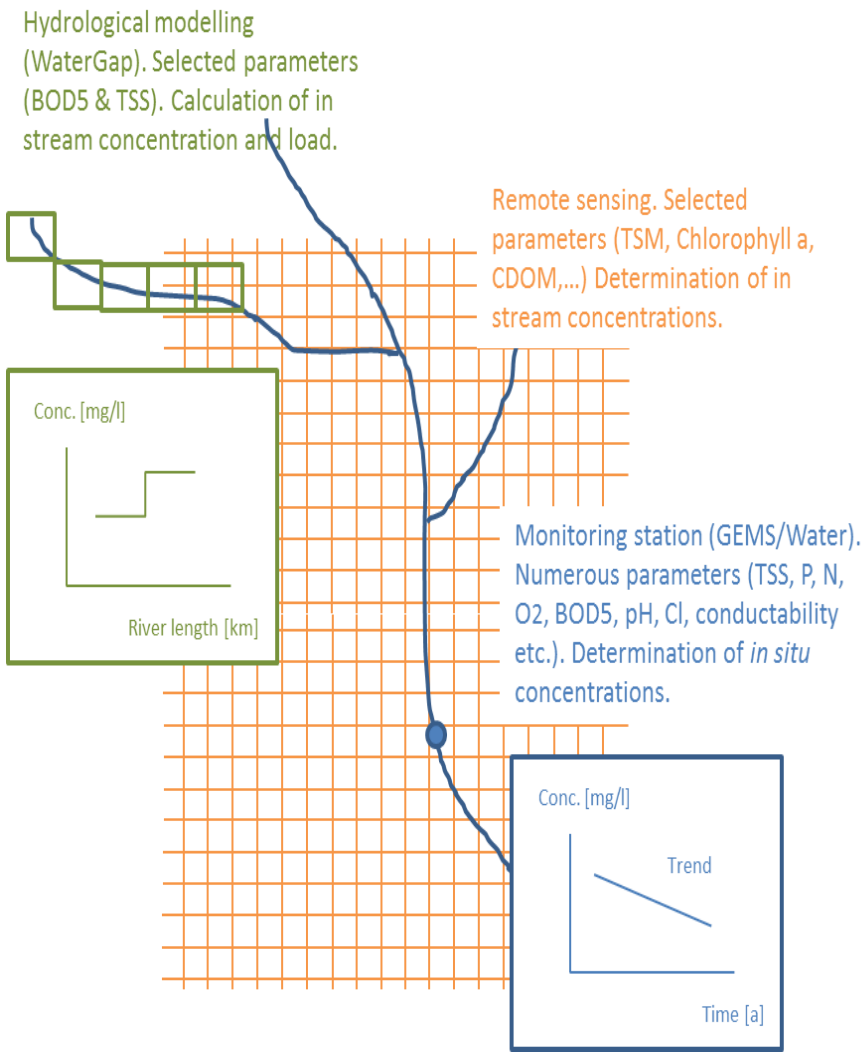
Main messages of the WWQA Phase 1

- **There is a substantial data and information gap**
- **Very low density of monitoring stations** in the only global data bank (GEMStat)
  - typical minimum density of around 1.5 to 4 stations per 10,000 km^2 of river basin area in the USA and Europe.
  - The average density for the Latin American continent is 0.3 stations per 10,000 km^2, for Africa 0.02 stations per 10,000 km^2, and for Asia, 0.08 stations per 10,000 km^2
- **Significant inconsistencies** between global assessment and regional knowledge/information needs
- **Efforts and priorities on data-deficient rivers/catchment needed** => crucial for management

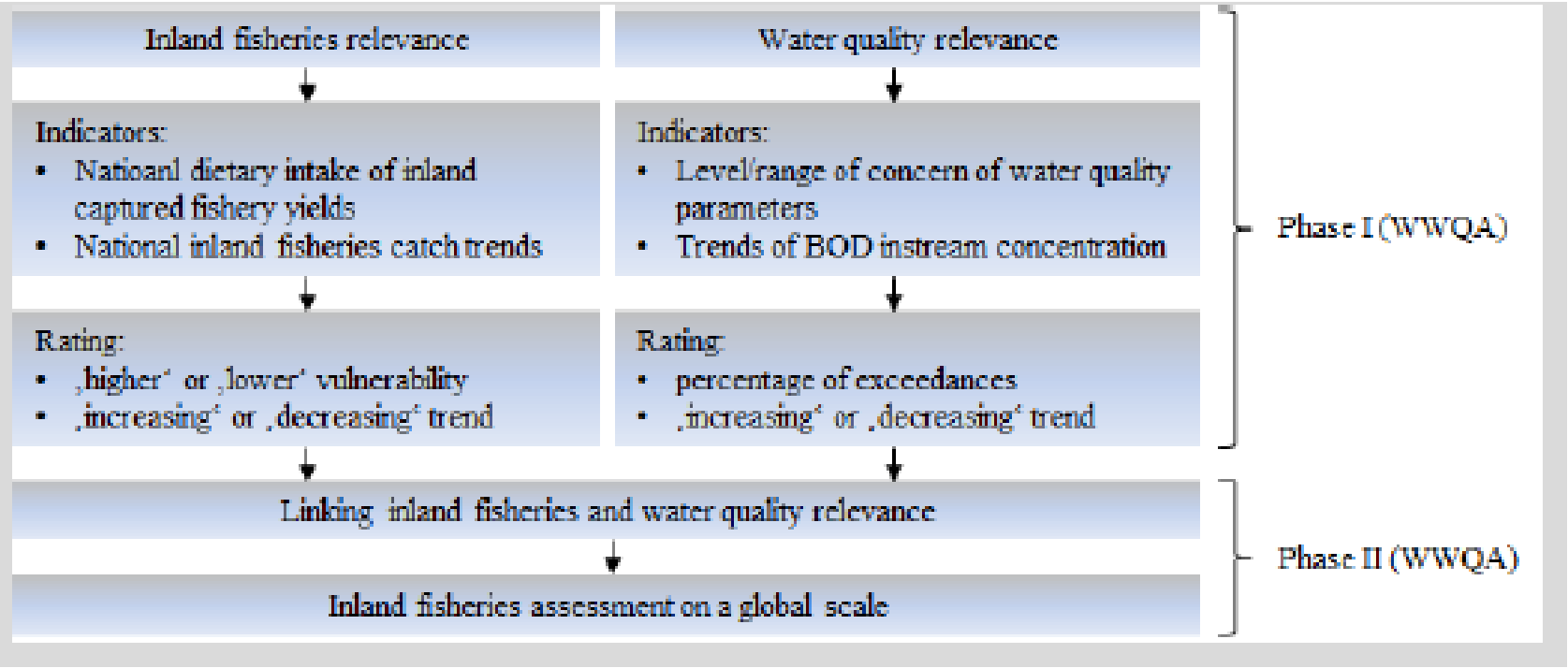
Framework for the stage 2 full assessment: data

Methodological setup and data sources:

- **„Ground truth“**
  - Monitoring (multitude of WQ parameters, reliable, but less comprehensive)
  - Remote sensing (few WQ parameters, but more reliable, comprehensive)
- **„Modelling“**
  - Large scale hydrological modelling (global 5’ grid) (few WQ parameters, less reliable, but comprehensive, scenarios/projections with consideration of drivers)



Framework for the stage 2 full assessment: concept



Conclusions and outlook

- **A wide range of technical options are available** for water pollution control and for short-cutting the negative trends of the water quality challenge. These include “best practices” regarding:
  - Pollution prevention and source control
  - Wastewater treatment
  - Safe reuse
  - Protecting and restoring aquatic ecosystems

- **Multiple entry points for management linked** with society’s priorities such as health, food security and water security
  => **nexus approach**

- **Information/data base ⇔ technological approaches/solutions** crucial, but innovative/effective approaches available