

The Global Water System Project – *information needs & tools* –

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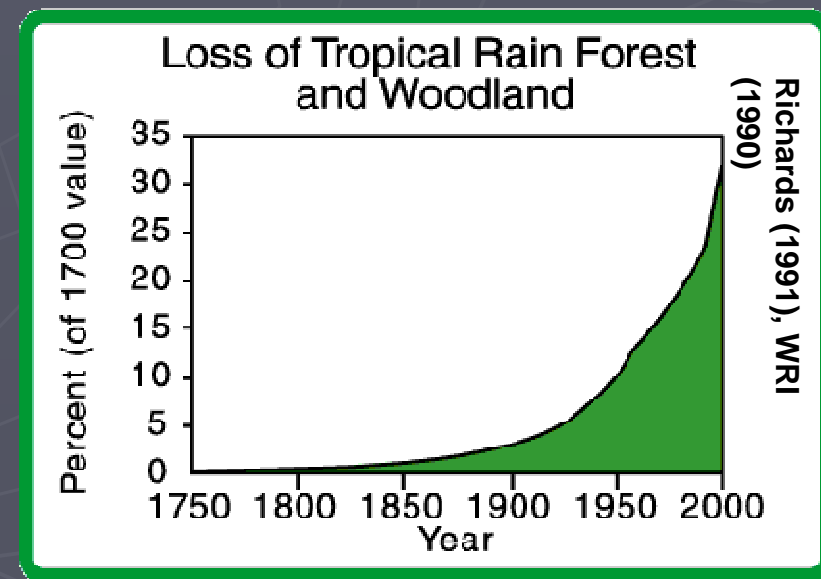
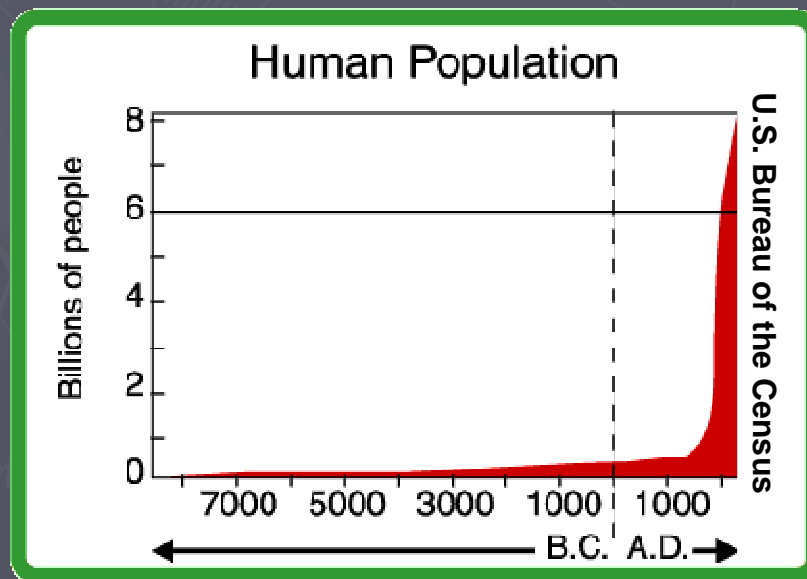
Overview

- ▶ Introduction
- ▶ The Global Water System Project (GWSP)
- ▶ Information Needs & Tools
 - § GWSP Lexicon
 - § GWSP Digital Water Atlas
- ▶ Conclusion



Global Change

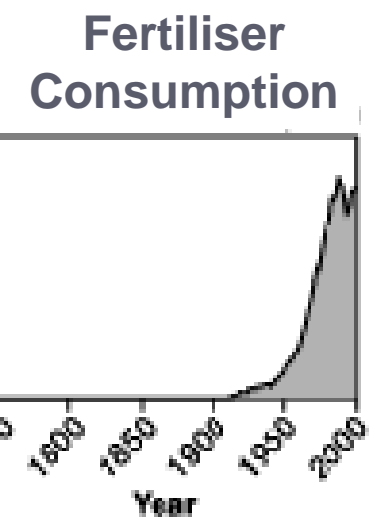
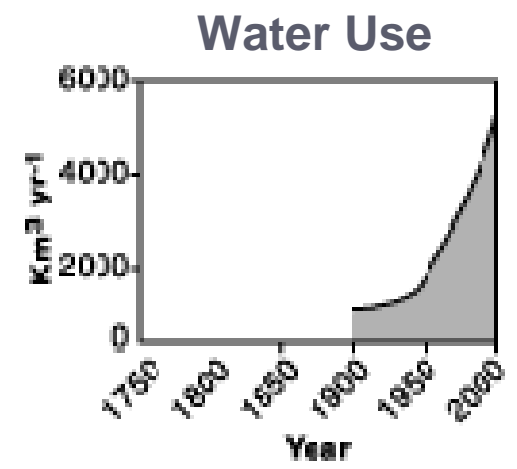
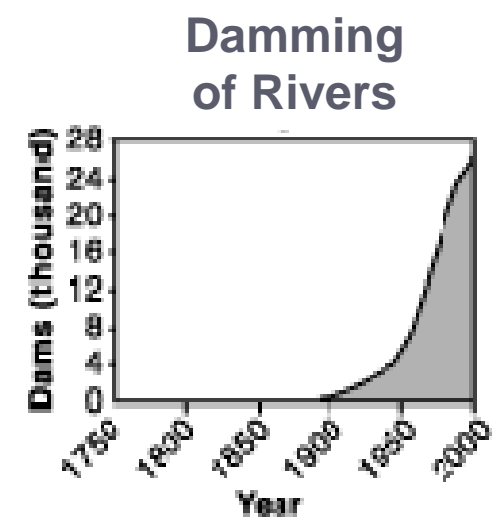
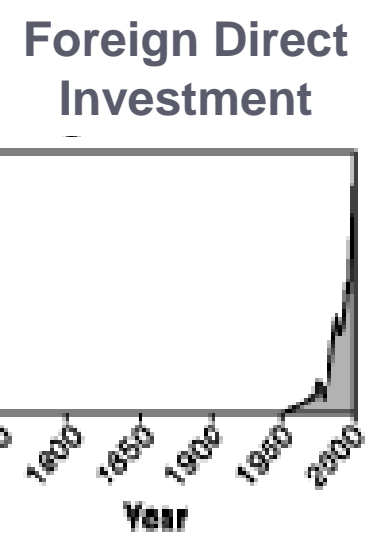
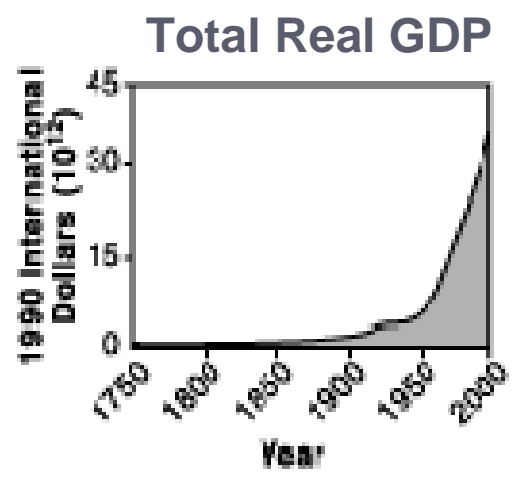
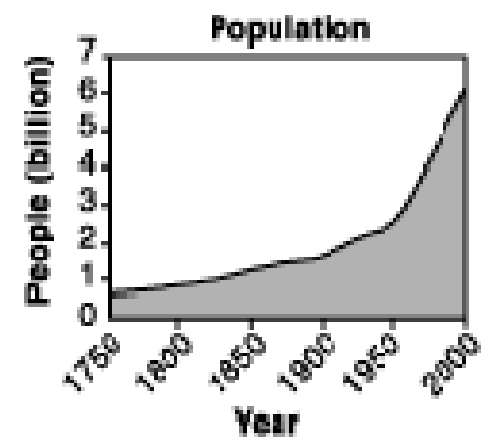
- ▶ Changes in nature and society that concern the entire mankind in the long run. (Krück et al., 2001)
- ▶ ... more than climate change
- ▶ ... far-reaching changes, often on a global scale
- ▶ ... natural and anthropogenic aspects





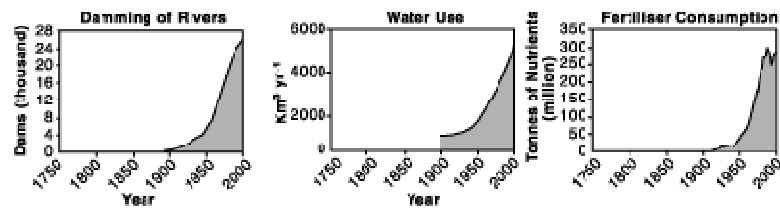
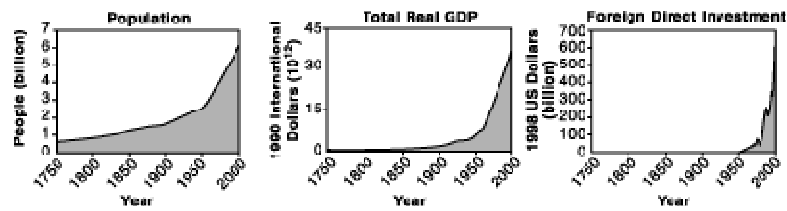
Global Change Aspects

Source: Steffen et al. 2004 (IGBP)

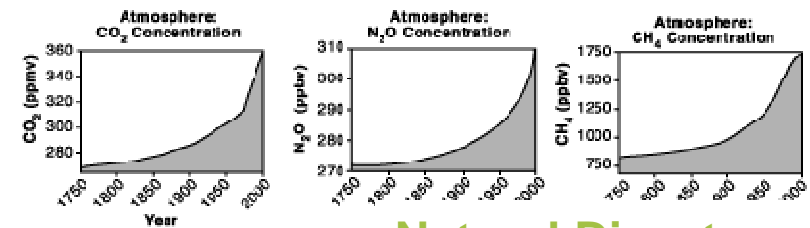
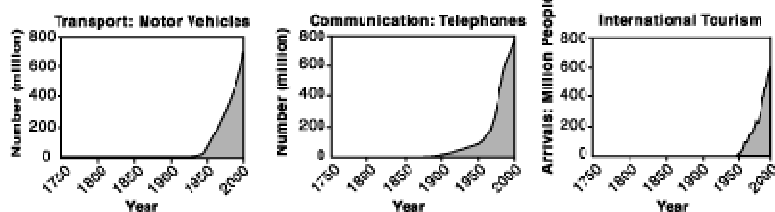
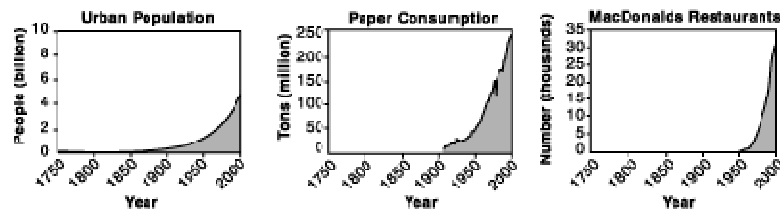




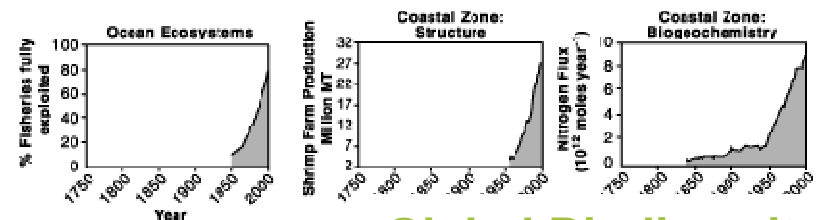
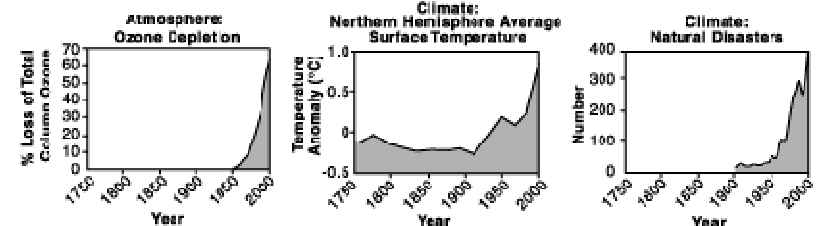
More Global Change Aspects



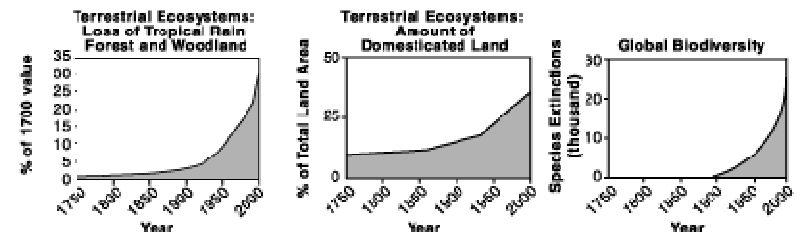
MacDonalds



Natural Disasters



Global Biodiversity



Source: Steffen et al. 2004



Earth System Science Partnership

ICSU



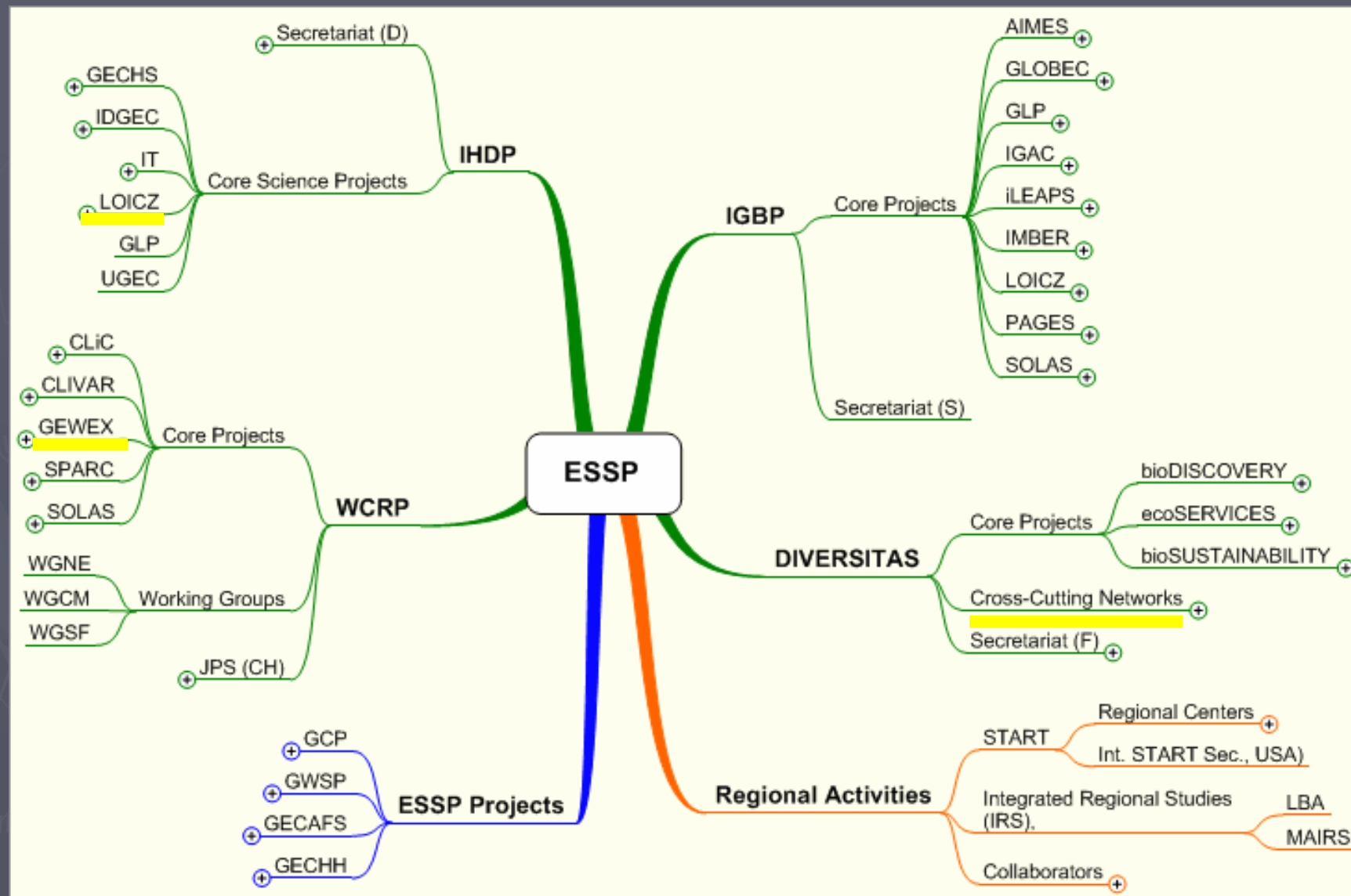
ESSP Programmes



ESSP Joint Projects
GCP, GECAFS, GWSP, Health



The ESSP Family



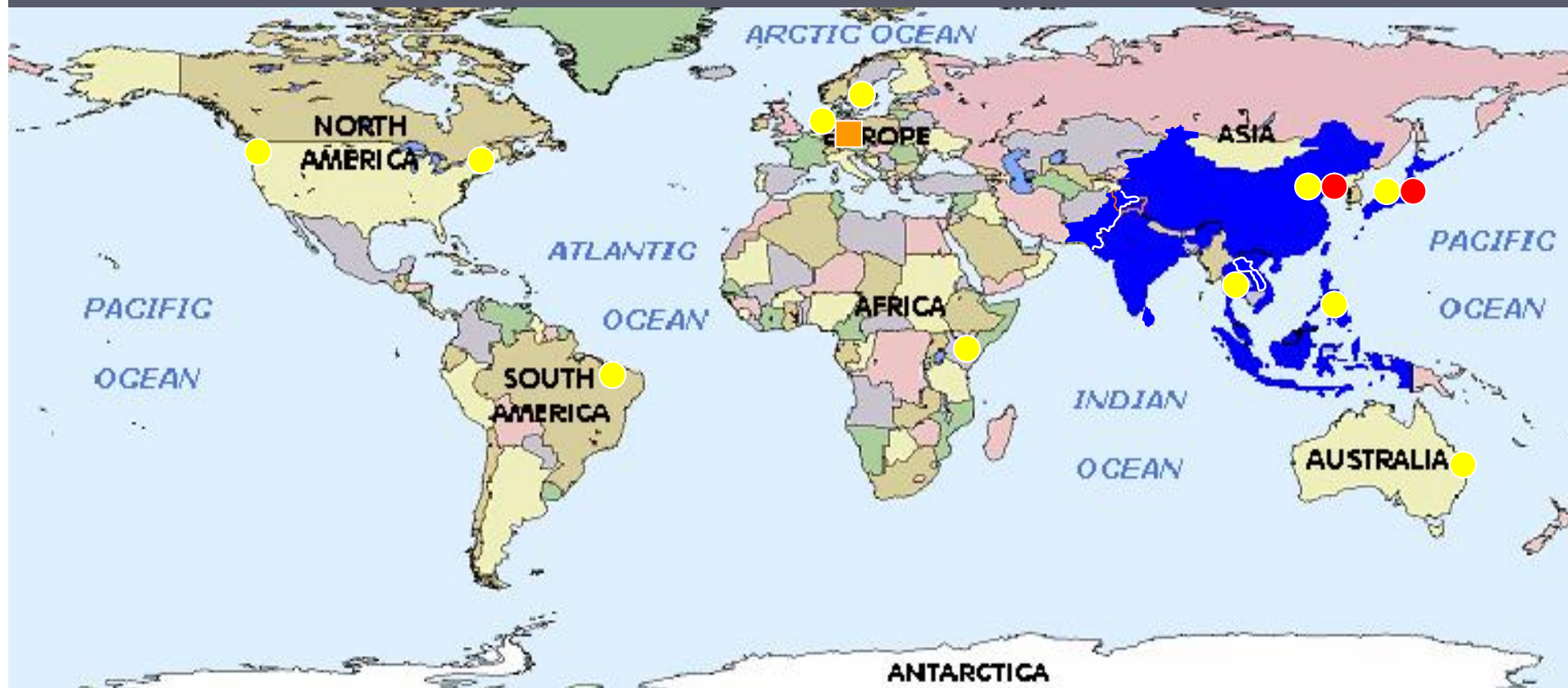


Overview

- ▶ Introduction
- ▶ **The Global Water System Project**
- ▶ Information Needs & Tools
 - § GWSP Lexicon
 - § GWSP Digital Water Atlas
- ▶ Conclusion



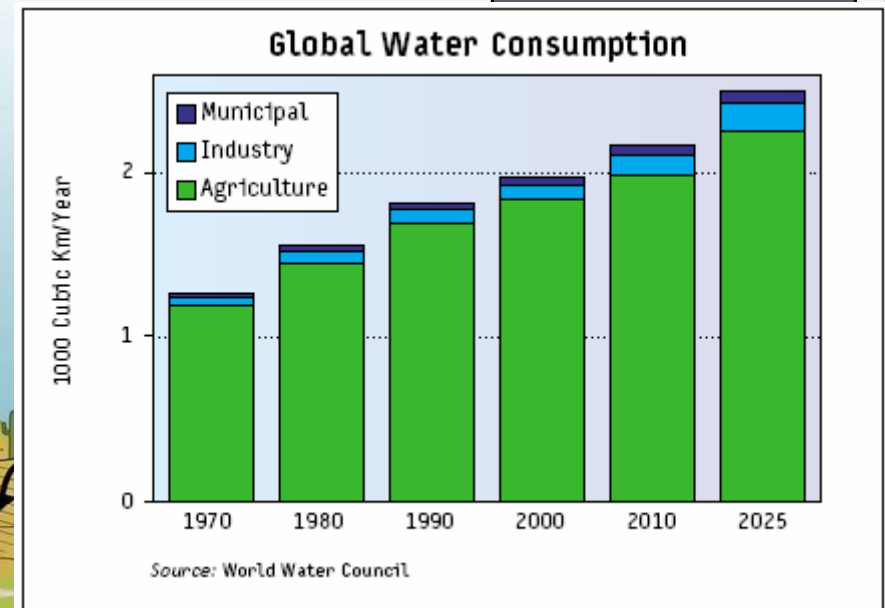
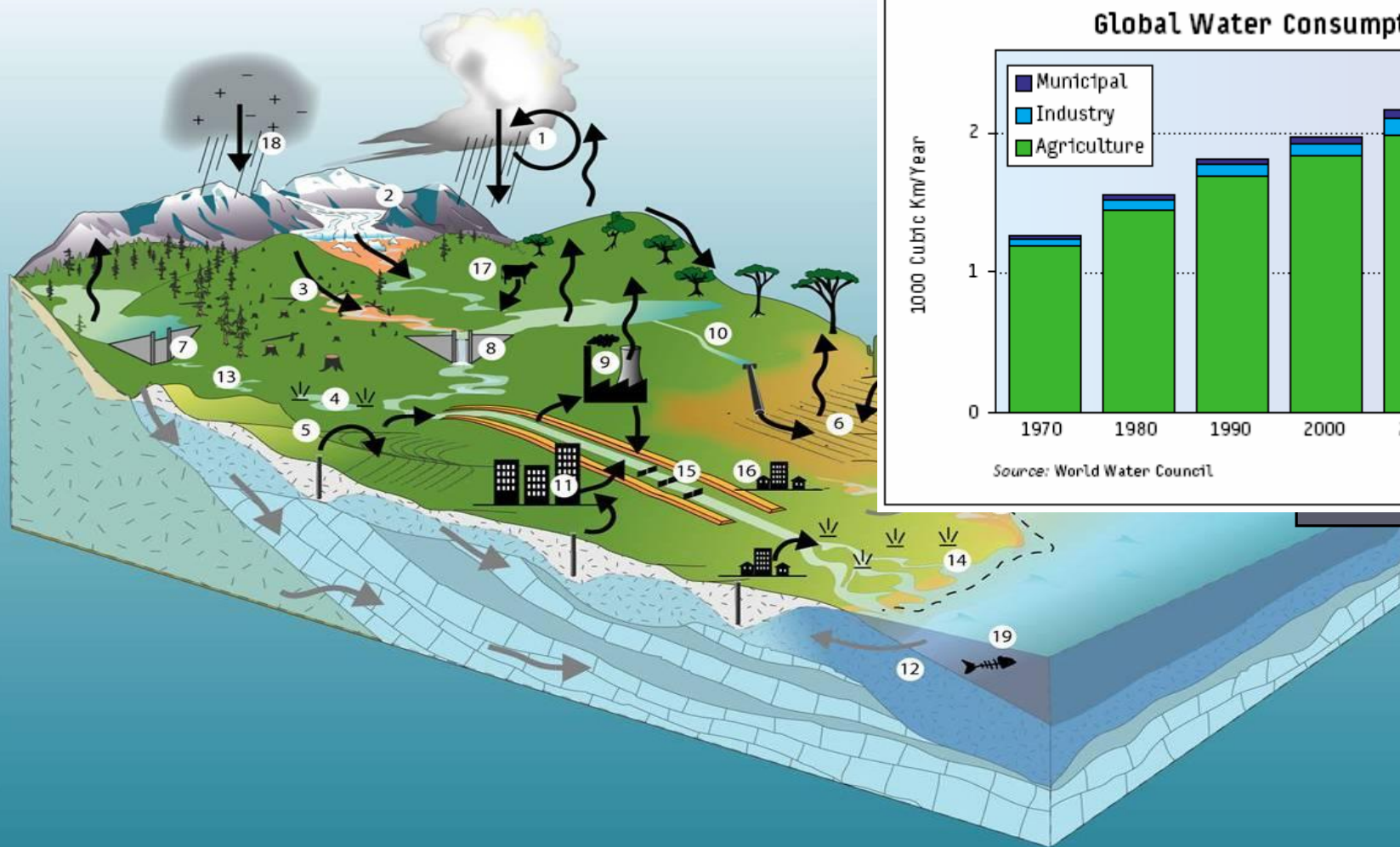
GWSP – A World Wide Network



Legend

- Member of Scientific Steering Committee (currently 14 members)
- GWSP International Project Office (staff: 4 full-time, 3 part-time)
- National GWSP Committee (Japan, China)
- GWSP Asia Network (representatives from 10 Asian countries)

The Global Water System



Working definition: The global suite of water-related human, physical, biological, and biogeochemical components and their interactions.



GWSP – Central Tenet

Human-induced changes to the water system are now *global in extent*, yet we lack an adequate *understanding* of how the *system works* and *responds* to disturbances, and how *society* can best *adapt* to rapidly-evolving new system states.



Overarching Question

How are **human actions** changing the global water system and what are the **environmental and socio-economic feedbacks** arising from the anthropogenic changes in the global water system?



Framing Questions (Themes)

1. What are the magnitudes of anthropogenic and environmental changes in the GWS and what are the key mechanisms by which they are induced?
2. What are the main linkages and feedbacks within the Earth system, arising from changes in the GWS?
3. How resilient and adaptable is the GWS to changes, and what are sustainable management strategies?

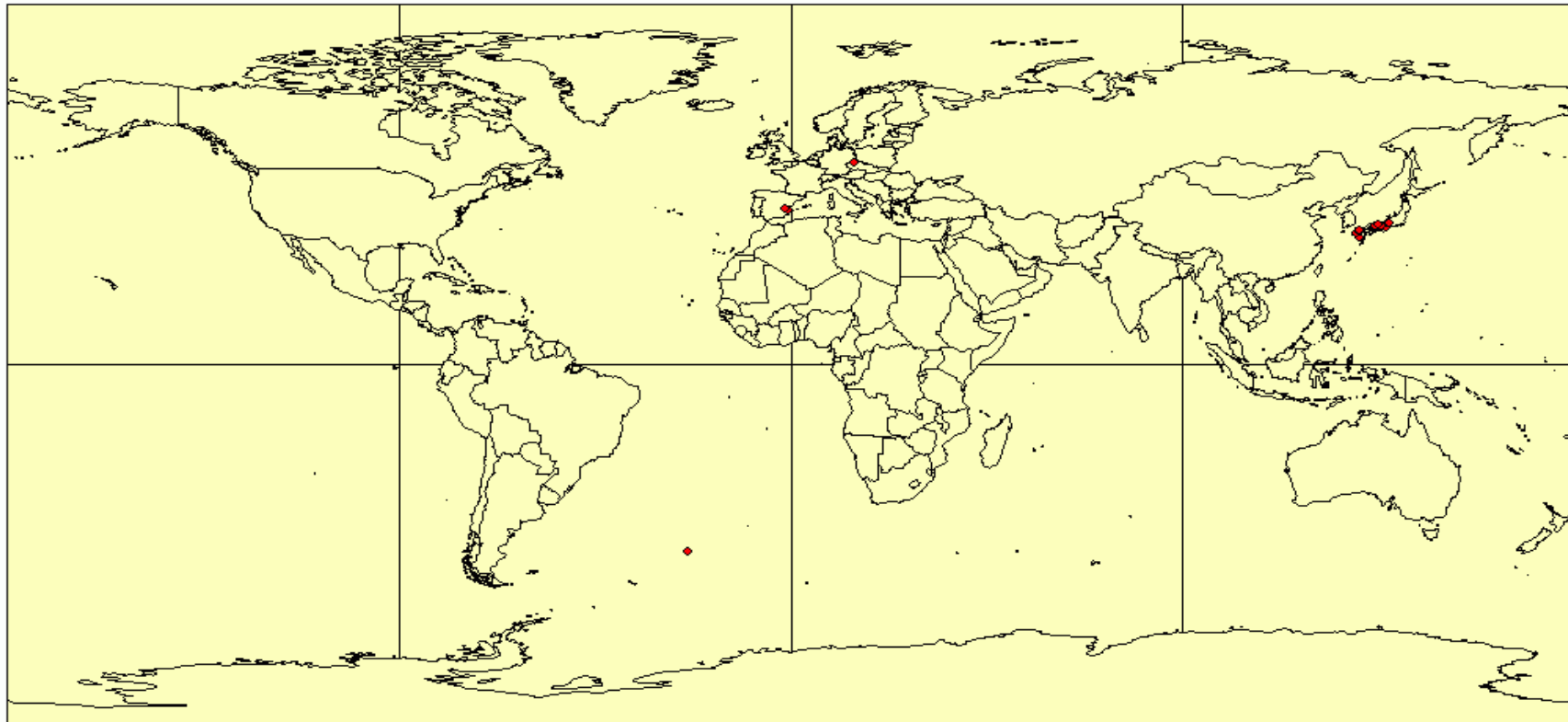
Increase in Reservoirs



Global Reservoir Database

~1750年

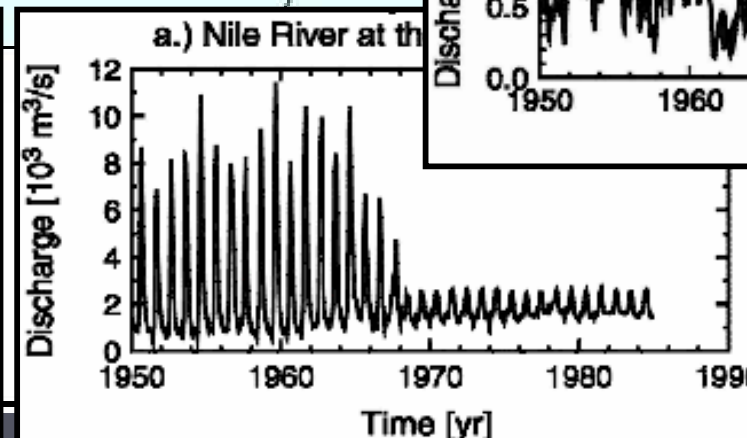
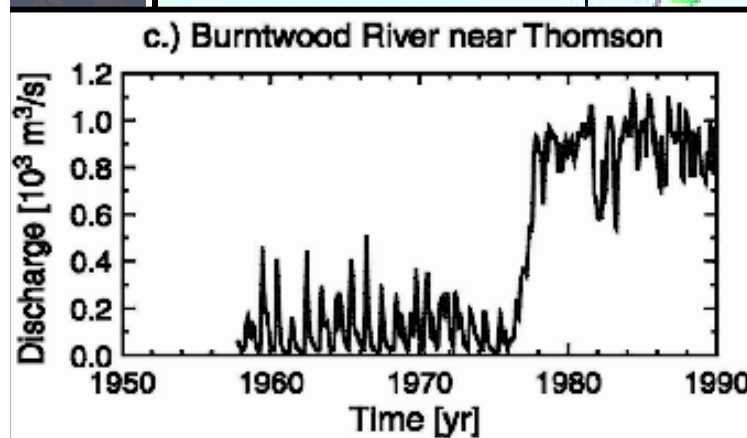
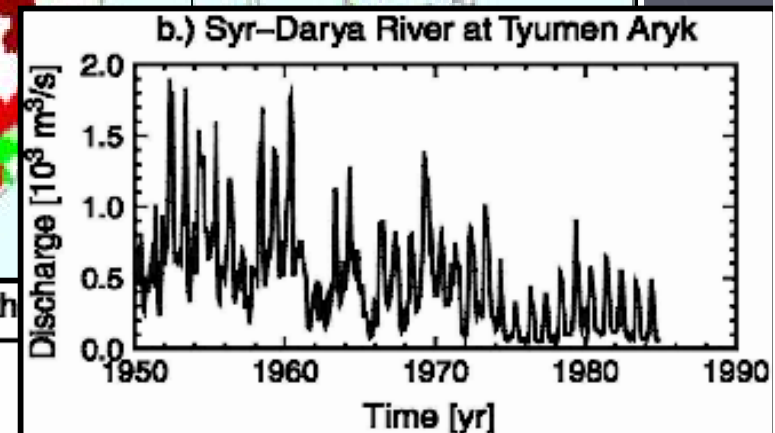
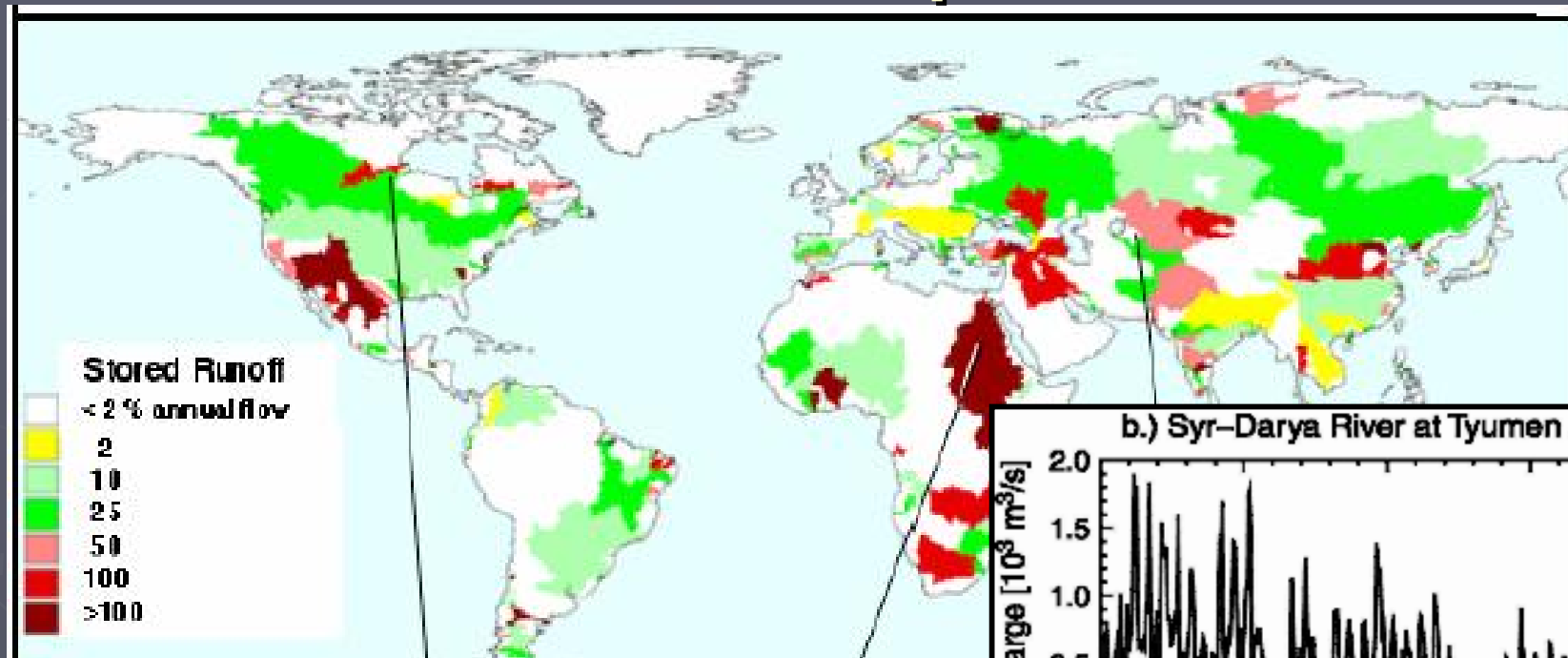
13,382dams



Today, there are >45,000 dams above 15 m high capable of holding back >6500 km³ of water, or about 15% of the total annual river runoff globally
Nielsson et al., 2005 (Science, Vol. 308, pp 405-408)



Human Impacts





Theme 1

Magnitudes and Mechanisms of Change

▶ Aim

§ Documentation & Attribution

▶ Activities

§ 1.1: **Water Governance** & the GWS

§ 1.2: **Land Cover Changes** ...

§ 1.3: **Climate Change** ...

§ 1.4: **Water Diversions** ...

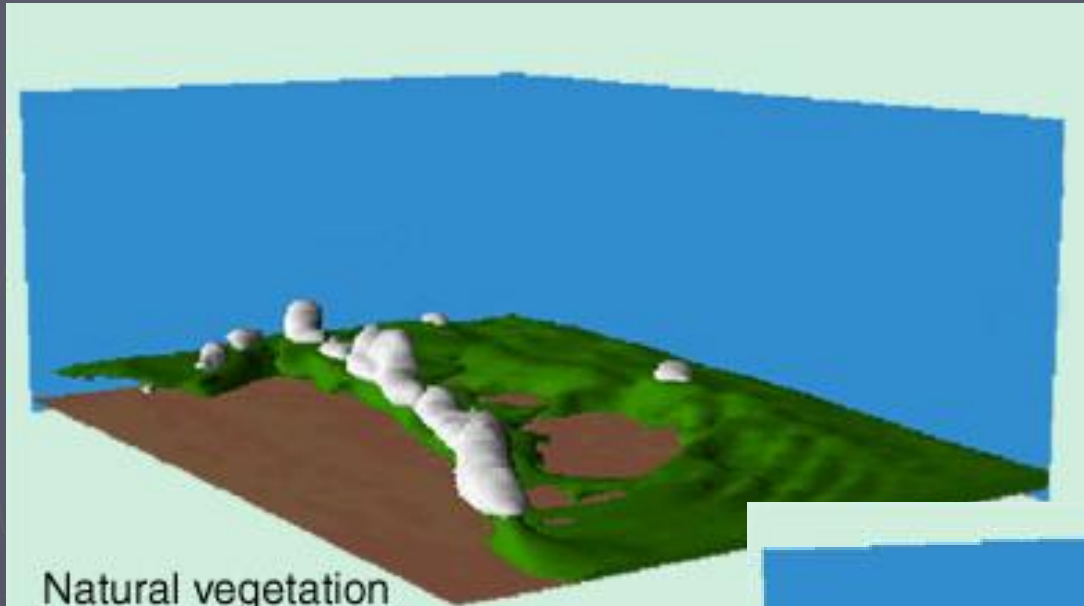
§ 1.5: **Nutrient and Sediment Transport** ...



Framing Questions (Themes)

1. What are the magnitudes of anthropogenic and environmental changes in the GWS and what are the key mechanisms by which they are induced?
2. **What are the main linkages and feedbacks within the Earth system, arising from changes in the GWS?**
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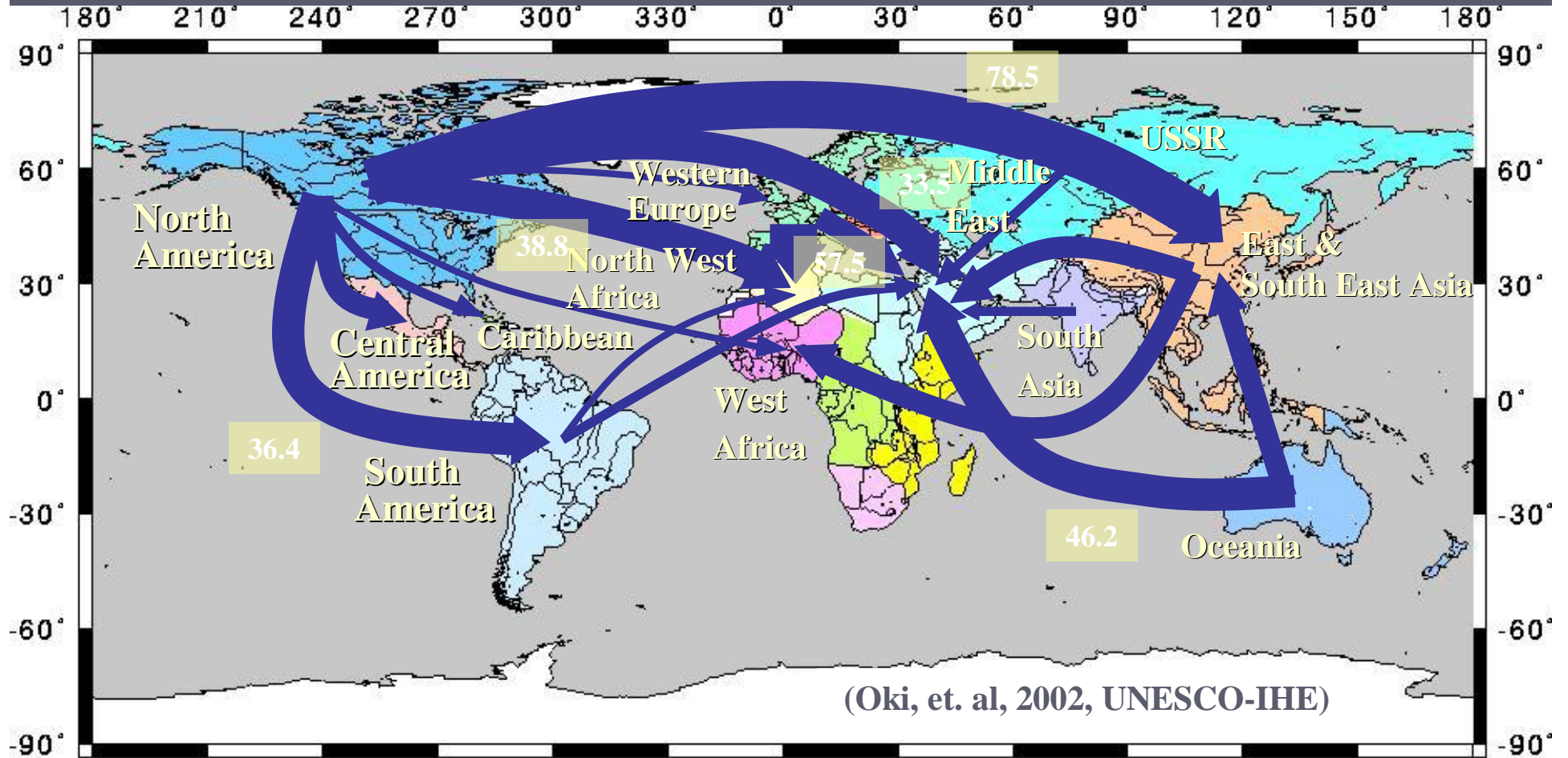
Land Use-Atmosphere Interactions



Pielke et al. 2001



Virtual Water Flow (Cereals Only)



(Oki, et. al, 2002, UNESCO-IHE)



(Based on Statistics from FAO etc., for 2000)



Theme 2

Linkages & Feedbacks

▶ Aim

§ Gain holistic understanding

▶ Activities

§ 2.1: **Linkages at Different Spatial Scales** in GWS

§ 2.2: **Legacy of Human and Natural Interactions ...**

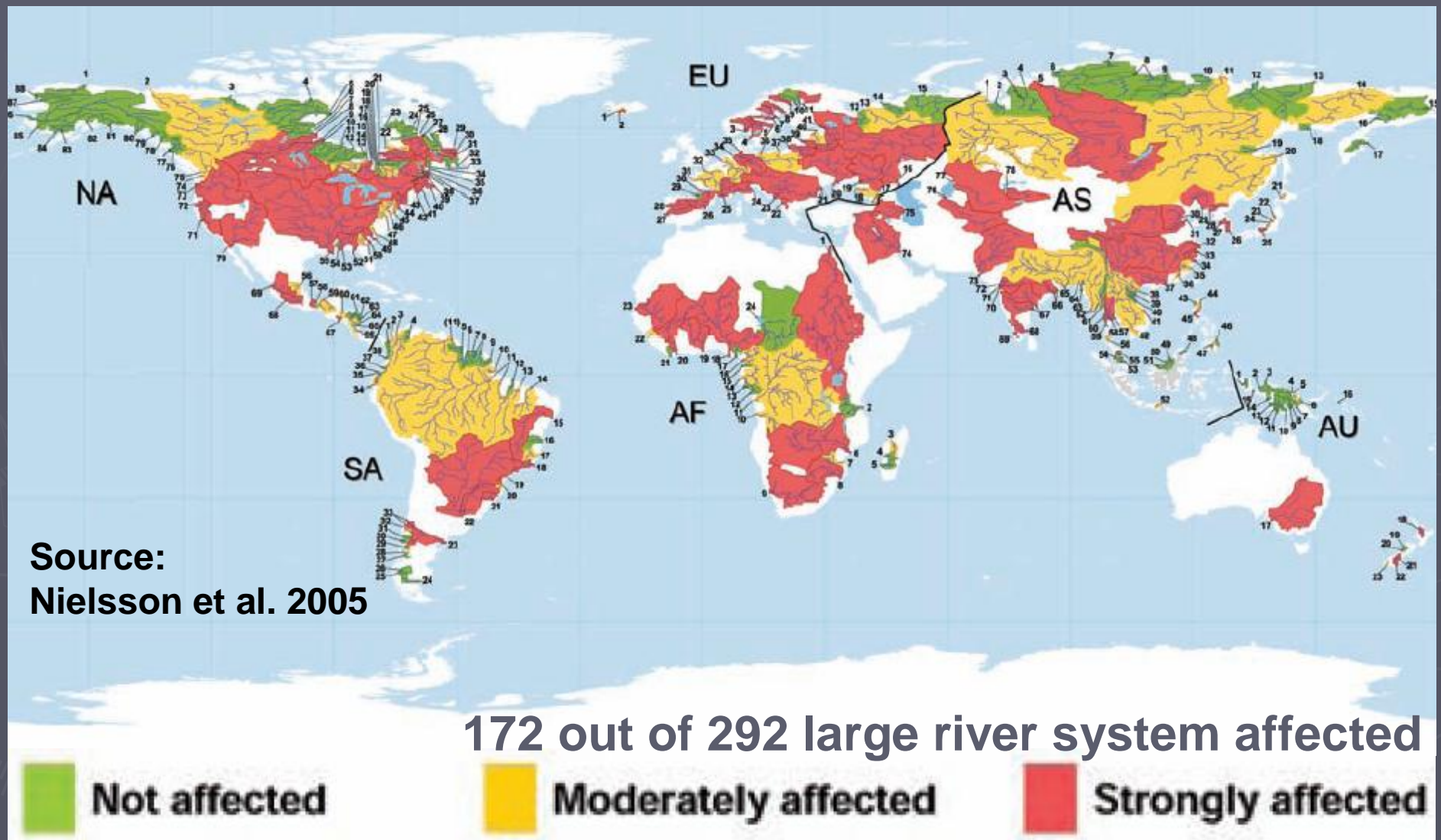


Framing Questions (Themes)

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Basins Affected by Dams





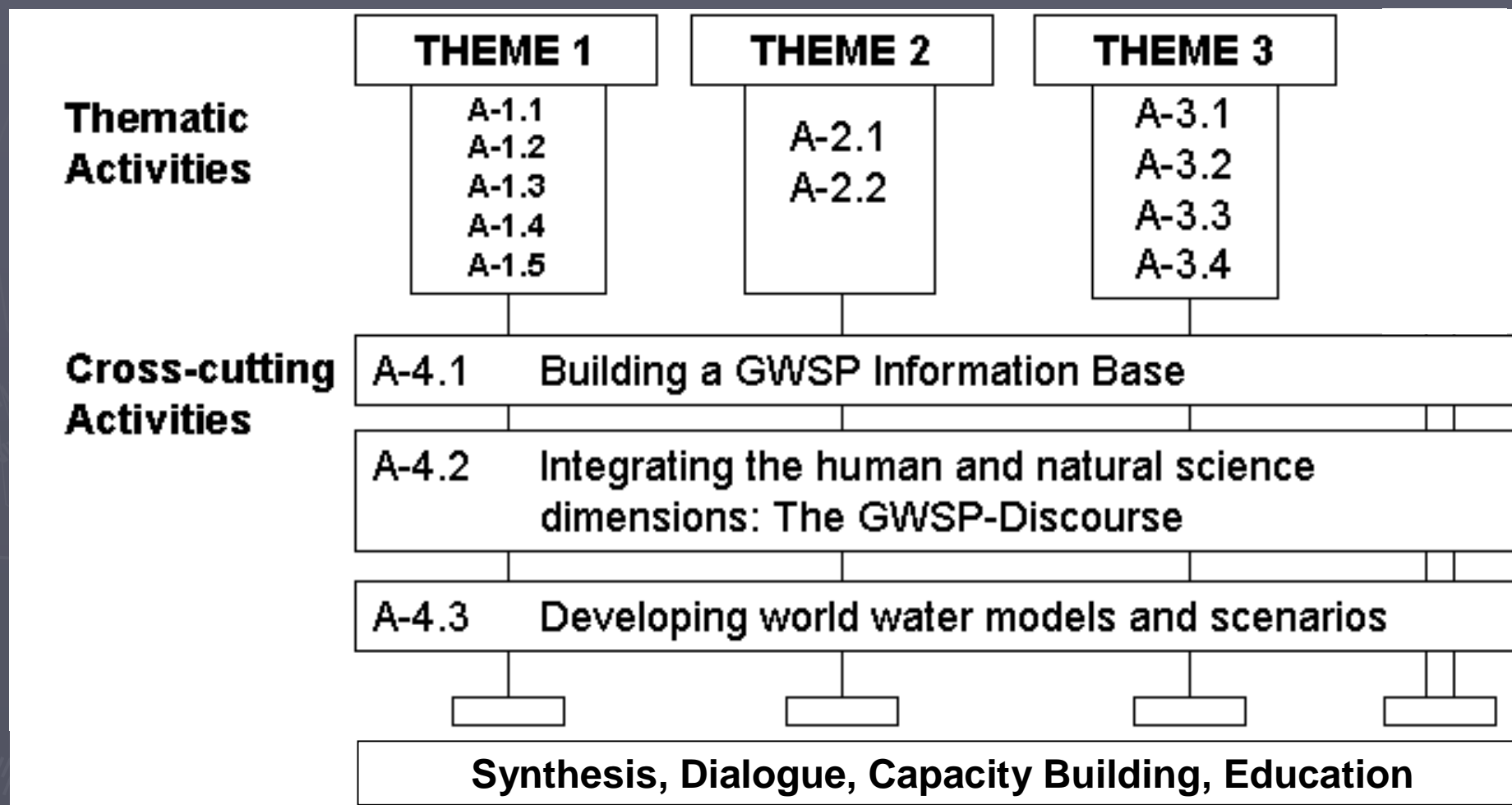
Theme 3

Resilience & Adaptation

- ▶ Aim: Understand implications for the future & inform policy
- ▶ Activities
 - § 3.1: Water Requirements for Nature & Humans
 - § 3.2: The Nature of Adaptive Capacity of GWS
 - § 3.3: Approaches to Enhance Adaptive Capacity
 - § 3.4: The Provision of Ecosystem Goods & Services by the GWS



Cross-cutting Research Activities





Fast-Track Activities

- ▶ Digital water atlas
- ▶ Improved world water balance
- ▶ An assessment of global water governance
- ▶ Input to international initiatives such as NEESPI
- ▶ A global study of environmental flows
- ▶ Advanced (educational) institute on „Global Environmental Change and Water“
- ▶ Harmonisation of GWS terminology through a GWS lexicon



Overview

- ▶ Introduction
- ▶ The Global Water System Project
- ▶ **Information Needs & Tools**
 - § **GWSP Lexicon**
 - § **GWSP Digital Water Atlas**
- ▶ Conclusion



Information & Data Needs

- ▶ Information to support science (IPO Database)
 - § Project management
 - § Project support
 - § Networking
- ▶ Information & Data to do science (Atlas/Lexicon)
 - § Analyse states/changes of the GWS
 - § Assess scenarios of future states and potential mitigation/adaptation strategies
- ▶ Information about science
 - § For the public, Stakeholders, etc.



IPO Database

► Objective

§ Provide data for the management and support of the global network

► Main info elements

§ Network members

§ Endorsed projects (see endorsement procedure)

§ Associated/related projects/initiatives

§ Metadata about available resources

► Implementation

§ Web-based (using Open Source software)



GWSP Digital Water Atlas

Objectives

- ▶ describe the **basic elements** of
 - § the Global Water System
 - § the interlinkages of the elements
 - § changes in the state of the Global Water
- ▶ create a **consistent** set of **annotated maps**
 - § Description/interpretation, related maps
 - § (Meta)data



Data Needs

– GWSP Digital Water Atlas –

- ▶ Climate/weather
(measurements & statistics)
- ▶ Water quantity
 - § Availability
 - § Demand
 - § Withdrawals
 - § Consumption
(for different users)
- ▶ Water quality
- ▶ Irrigated areas
- ▶ Dams & reservoirs
- ▶ Biodiversity
- ▶ Land cover / use
- ▶ Water stress
- ▶ Human-induced disturbances
- ▶ Water governance
- ▶ International treaties
- ▶ Base data
 - § Watersheds
 - § Country borders
 - § Aquatic eco-regions



Atlas Implementation

- ▶ **Web-based interactive Atlas**
- ▶ Software environment:
 - § ESRI **ArcIMS** (Internet Map Server)
 - § MySQL
 - § Linux OS
 - § Apache webserver
- ▶ Set of **fundamental maps/datasets** defined
- ▶ Release of first subset
 - § end of 2006
 - § www.gwsp.org



Atlas – System Overview

GWSP Digital Atlas - Mozilla Firefox


http://wiki.gwsp.org/atlas/

GWSP Digital Water Atlas

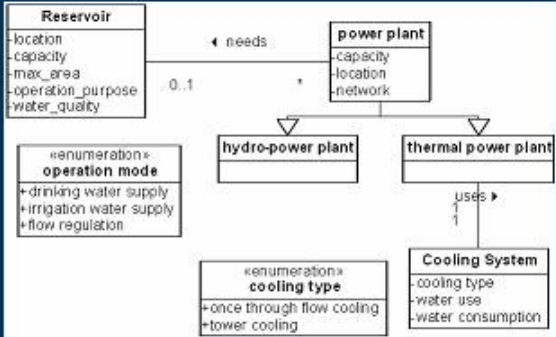
System Overview

Please choose between the simple overview graphic and the detailed conceptual model overview (expressed in the Unified Modelling Language, UML).

Simple Overview Graphic



Detailed Conceptual Model



```
classDiagram
    class Reservoir {
        -location
        -capacity
        -max_area
        -operation_purpose
        -water_quality
    }
    class power_plant {
        -capacity
        -location
        -network
    }
    class hydro_power_plant {
    }
    class thermal_power_plant {
    }
    class Cooling_System {
        -cooling_type
        -water_use
        -water_consumption
    }
    Reservoir "0..1" -- "*" power_plant : needs
    power_plant <|-- hydro_power_plant
    power_plant <|-- thermal_power_plant
    thermal_power_plant "1" -- "1" Cooling_System : uses
```

Home
Intro
System Overview
- Graphic
- UML
List of Maps
References
Links
Search
v0.1 alpha

Fertig



Atlas – Graphical Overview

GWSP Digital Atlas - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Folders

Address <http://wiki.gwsp.org/atlas/> Go

GWSP Digital Water Atlas

System Overview (Graphical)

- Home
- Intro
- System Overview
 - Graphic
 - UML
- List of Maps
- References
- Links
- Search
- v0.1 alpha

http://wiki.gwsp.org/atlas/html/map_lists/maps_population_f.htm Internet



Atlas – Thematic Maps

GWSP Digital Atlas - Mozilla Firefox




Datei Bearbeiten Ansicht Gehe Lesezeichen Extras Hilfe

http://wiki.gwsp.org/atlas/

GWSP Digital Water Atlas

Maps related to 'Population'

Click the map or the map header to enlarge/explore the map or the links on the right-hand side for further information.

Home		Population Total Population per country [mio people]
Intro		Population Change Annual population change rate per country [%]
System Overview - Graphic - UML		Domestic Water Withdrawals Annual water withdrawals of the domestic sector per drainage basin [mm/a]

[List of Maps](#)

[References](#)

[Links](#)

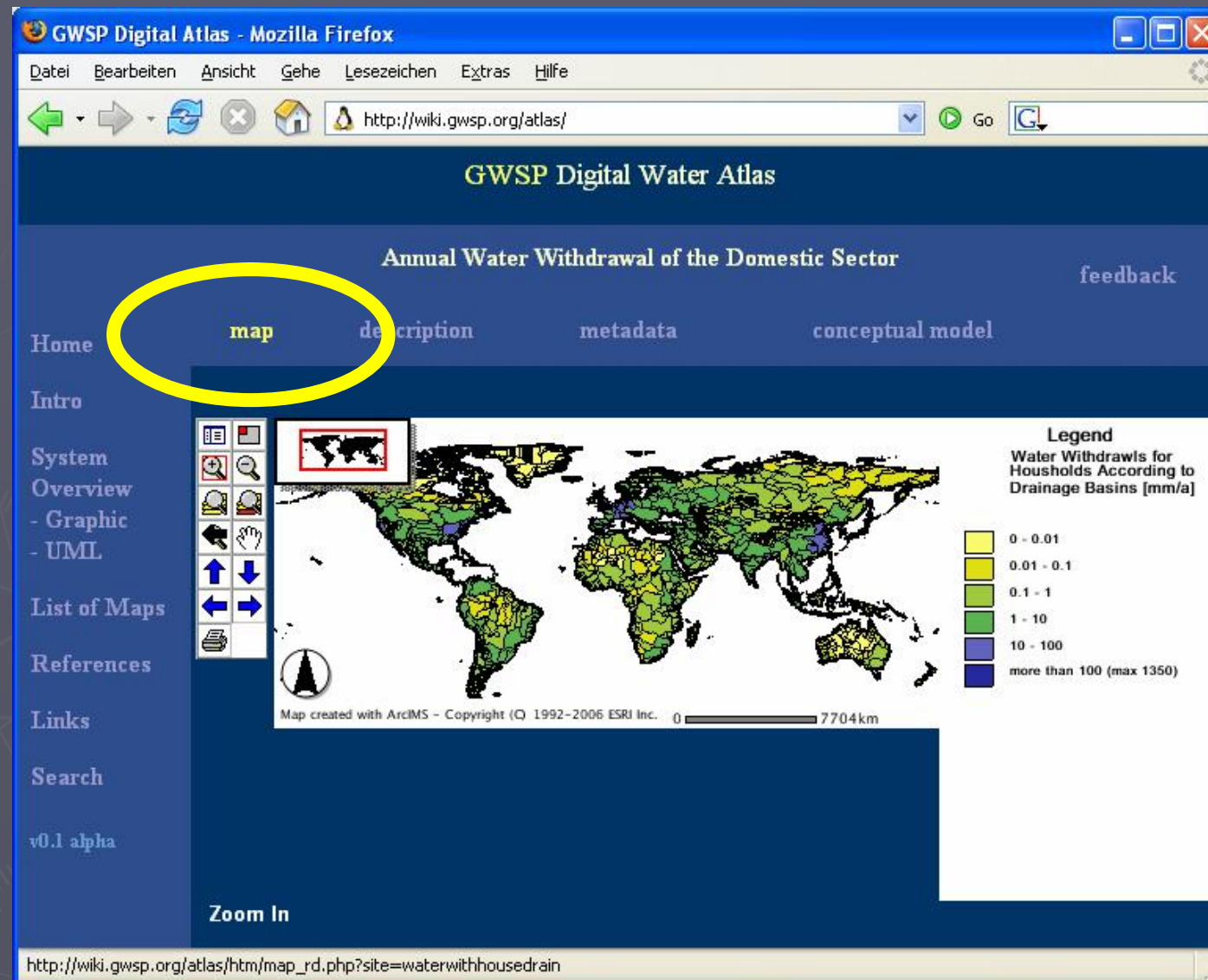
[Search](#)

v0.1 alpha

Fertig



Atlas – Example Map I





Atlas – Map Description

The screenshot shows a Mozilla Firefox browser window displaying the GWSP Digital Water Atlas website. The browser's address bar shows the URL <http://wiki.gwsp.org/atlas/>. The website's main heading is "GWSP Digital Water Atlas". Below this, the title of the current page is "Annual Water Withdrawal of the Domestic Sector". A navigation menu includes links for "Home", "map", "description", "metadata", and "conceptual model". The "description" link is highlighted with a yellow circle. On the left side, there is a sidebar menu with categories like "Intro", "System Overview", "List of Maps", "References", "Links", and "Search". The main content area contains a "Description" section with text about annual water withdrawals for household and commercial uses in 1995, and an "Interpretation" section discussing water use in urban dwellers. The browser's status bar at the bottom indicates "Fertig".



Atlas - Metadata

The screenshot shows a Mozilla Firefox browser window displaying the GWSP Digital Water Atlas website. The address bar shows the URL <http://wiki.gwsp.org/atlas/>. The page title is "GWSP Digital Water Atlas". The main heading is "Annual Water Withdrawal of the Domestic Sector" with a "feedback" link. The navigation bar includes "Home", "map", "description", "metadata" (circled in yellow), and "conceptual model". The left sidebar contains links for "Intro", "System Overview", "List of Maps", "References", "Links", "Search", and "v0.1 alpha". The main content area displays the "Metadata" section with the following details:

Metadata

Creator: Kerstin Schulze (CESR)
Contact details:
Address: CESR, University of Kassel, Kurt-Wolters-Str. 3, 34125 Kassel, Germany
Phone: +49.561.804.3898
Fax: +49.561.804.3073
Email: schulze@usf.uni-kassel.de
Source: WaterGAP domestic and industry water use model, version 2.1d
Copyright: Joseph Alcamo
Dataset lineage:

- country specific estimates of domestic (and industrial) water withdrawal and consumptive use
Shiklomanov, I. (2000) Appraisal and assessment of world water resources. Water Int. 25, 11–32. (Supplemented by CDROM: Shiklomanov, I. World Freshwater Resources, available from: International Hydrological Programme,

Fertig



Atlas – IMS Functionalities

Printing maps

GWSP Digital Atlas - Mozilla Firefox

http://wiki.gwsp.org/atlas/

GWSP Digital Water Atlas

Total Population per Country

map description metadata conceptual model

Home Intro System Overview - Graphic - HTML List of Maps References Links Search v0.1 alpha Fertig

Map created with ArcIMS - Copyright (C) 1992-2006 ESRI Inc. 0 7985 km

Rec	NAME	ABBREVIATION	FIPS_CODE	ISO_COUNTRY	WORLDREQ	SQKM_K	POP_K	GRWRA
1	Mexico	Mexico	MX	MEX	Latin Amer	1959	93670	2.06

Identify

Retrieving data

Map Output - Mozilla Firefox

http://wiki.gwsp.org/website/runoff/MapFrame.f

ArcIMS HTML Viewer Map

Legend

- Country Borders
- Long-Term Average Runoff [mm/a]
- Less than 0
- 0 - 10
- 10 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 500
- 500 - 1000
- more than 1000 (max 6160)

Map created with ArcIMS - Copyright (C) 1992-2006 ESRI Inc. 0 1481 km

Fertig



Atlas – Links

GWSP Digital Atlas - Mozilla Firefox

Datei Bearbeiten Ansicht Gehe Lesezeichen Extras Hilfe

http://wiki.gwsp.org/atlas/ Go

GWSP Digital Water Atlas

Links [feedback](#)

[Home](#)
[Intro](#)
[System Overview](#)
- Graphic
- UML
[List of Maps](#)
[References](#)
[Links](#)
[Search](#)
v0.1 alpha

The following list provides links to other online atlases and data sources

Other Atlases

- ◆ [SAGE Atlas of the Biosphere](#)
- ◆ [Digital Atlas of the World Water Balance](#)(Version 1.0, May 1997)
- ◆ [Atlas of International Freshwater Agreements](#)
- ◆ [IOBIS -- Ocean Biogeographic Information System](#)
- ◆ [World Atlas of Biodiversity](#)
- ◆ [GISP Interactive Maps](#)
- ◆ [Atlas of the World Ocean Circulation Experiment \(WOCE\)](#)
- ◆ [Australien Natural Resources Atlas — Water Part](#)

Other Information Systems & Data Sources

- ◆ [River-Basin Information System](#)
- ◆ [Global Runoff Data Center](#)
- ◆ [River-Basin Information System — Final Report](#)
- ◆ [CUAHSI Hydrologic Information System \(HIS\)](#)
- ◆ [World Glacier Monitoring Service](#)

http://wiki.gwsp.org/atlas/htm/links_f.htm



GWSP Lexicon

Objectives

- ▶ Provide **consistent set** of term **definitions**
- ▶ Provide basis / support development of **conceptual model**
- ▶ Encourage **discourse** between scientific disciplines

Implementation

- ▶ One/more definition(s) for each term
- ▶ Graphical notation to show important links
- ▶ Software environment
 - § Wiki (wikimedia)
 - § LAMP (Linux, Apache, MySQL, PHP)



Lexicon and Conceptual Model

The screenshot displays two overlapping browser windows from Mozilla Firefox. The background window shows the 'Ecosystem' article on WaterWiki, and the foreground window shows a conceptual model diagram for 'GWS conceptual model img.png'.

Ecosystem

Definition
supposed to be used within GWSP
further definitions

1. A dynamic complex of plant, environment interacting as a f
2. the unit of ecology, which inc part of their environment over

References

- FAO, <http://www.fao.org/ag/wfe20>
- 1963 New Scientist 28 Mar. 684/

Synonyms

Derived terms

- [ecosystem service](#)
- [freshwater ecosystem](#)

See also

Translations

- German: [Ökosystem](#) (n)

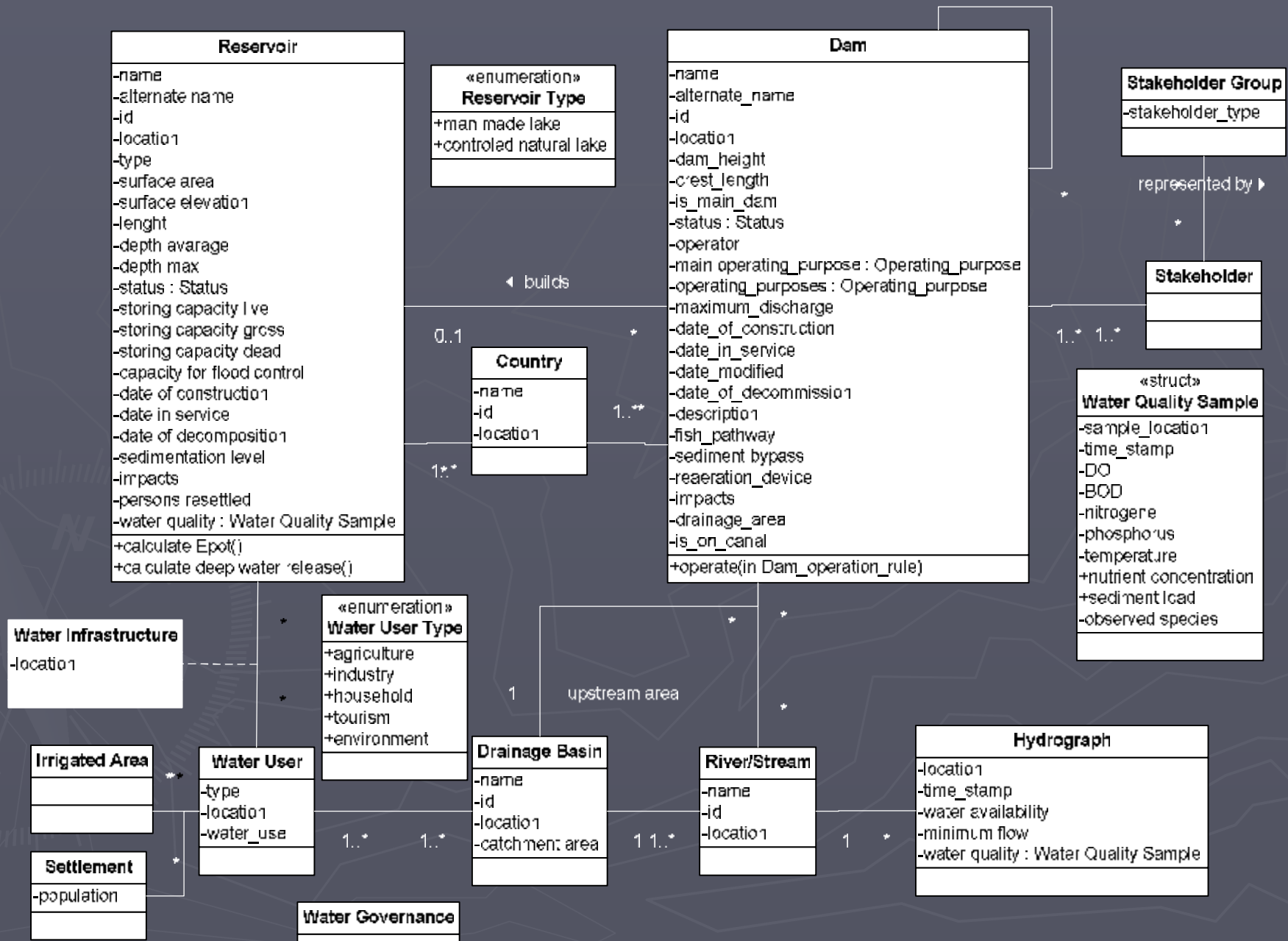
Image:GWS conceptual model img.png

```
graph TD
    ecosystem["ecosystem  
-health indicator[0..*]"]
    terrestrial["terrestrial ecosystem"]
    aquatic["aquatic ecosystem"]
    coastal["coastal ecosystem"]
    estuarine["estuarine ecosystem"]
    freshwater["freshwater ecosystem"]
    marine["marine ecosystem"]
    river["river ecosystem"]
    lake["lake ecosystem"]
    wetland["wetland ecosystem"]

    ecosystem --> terrestrial
    ecosystem --> aquatic
    aquatic --> coastal
    aquatic --> estuarine
    aquatic --> freshwater
    aquatic --> marine
    freshwater --> river
    freshwater --> lake
    freshwater --> wetland
```

streams are considered as rivers
pools are considered as lakes

Conceptual Model – UML Example





Overview

- ▶ Introduction
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 - § GWSP Digital Water Atlas
- ▶ **Conclusion**



Conclusion

▶ GWSP

§ Study (changes in) the global freshwater water system using a systems approach

▶ Information and data needed

§ to support, undertake and inform about science

§ Datasets from different scientific fields

▶ Current Tools

§ Databases, GIS

§ Web technologies (WMS, WIKI)

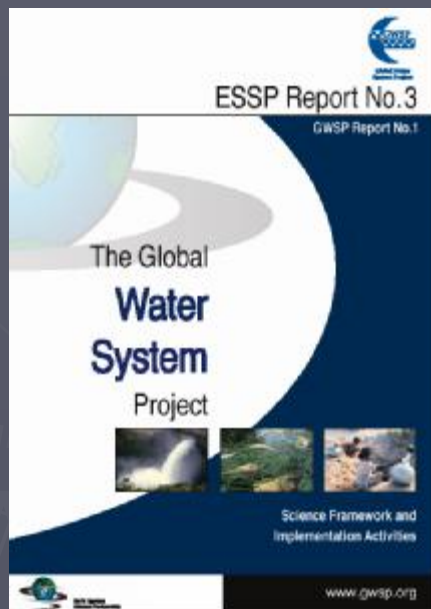
§ UML



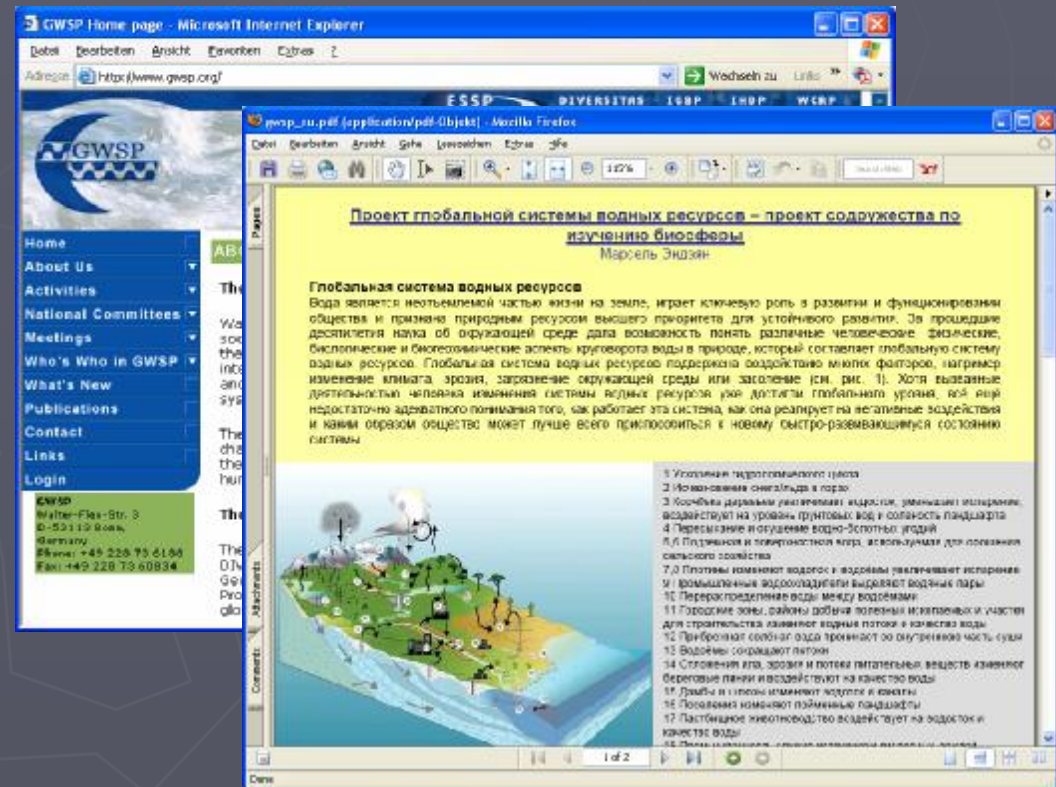
Further Information

Science Framework

Website: www.gwsp.org



**Global Water System Project
International Project Office
Walter-Flex-Str. 3
53113 Bonn, Germany
Phone: +49.228.73.6188
gwsp.ipo@uni-bonn.de**



**GWSP Publication Series
Printed Newsletter
(2/year)**



Thank You

