



# **UN GEMS/Water Programme - Water Quality Monitoring and Assessment of Global Change**

Richard D. Robarts  
2006 National Monitoring Conference,  
San Jose, California, May 7-11, 2006



# Why is there a need for global water quality monitoring and assessment?

**“Globally, water quality is declining**, although in most industrial countries pathogen and organic pollution of surface waters has decreased over the last 20 years. Nitrate concentration has grown rapidly in the last 30 years. The capacity of ecosystems to purify such wastes is limited, as evidenced by widespread reports of inland waterway pollution. Loss of wetlands has further decreased the ability of ecosystems to filter and decompose wastes.”

Source: UN (2005) Millennium Ecosystem Assessment



# Globally, Water Quality and Pollution are Priority Issues

Africa:	Variability of water resources Water stress and scarcity Access to safe water and sanitation Deteriorating water <b>quality</b> Wetlands loss
Asia & Pacific:	Water scarcity <b>Pollution</b>
Europe:	Water quantity and <b>quality</b> Policy and legislative framework
Latin America & Caribbean:	Decreasing water availability per capita Water <b>quality</b>
North America:	Groundwater Great Lakes water <b>quality</b>
West Asia:	Increasing water demand Overexploitation of groundwater Water <b>quality</b>
Polar Regions:	Alien Species <b>Pollution</b>

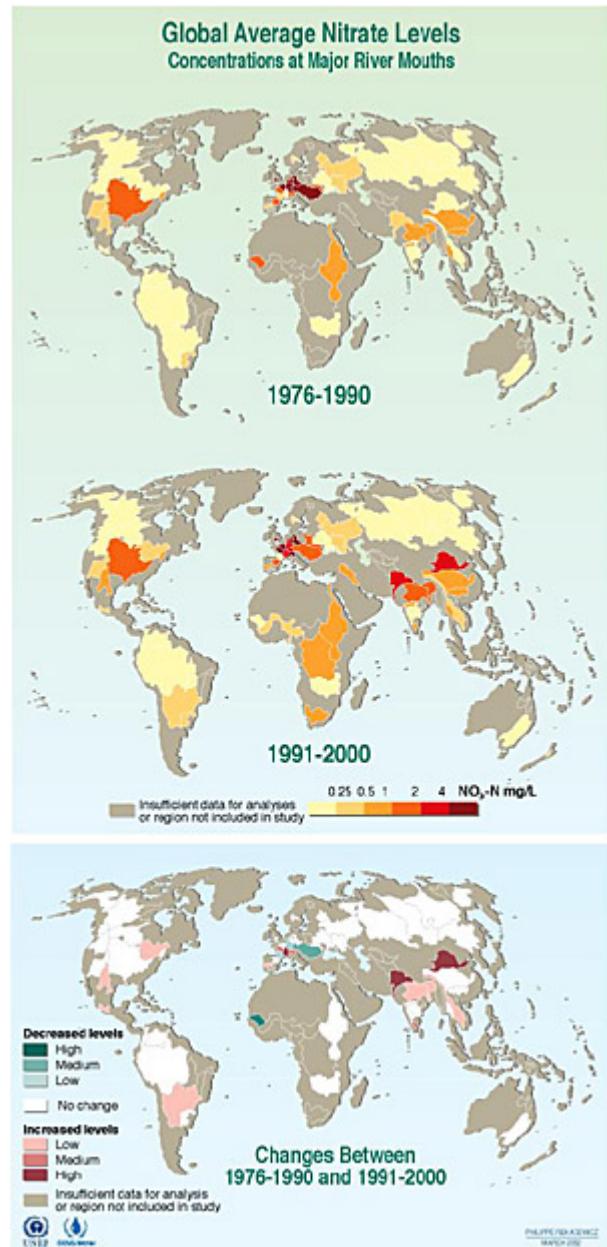
# Why is there a need for global water quality monitoring and assessment?

- Inland waters are a country's responsibility
- 263 international river basins
- Many rivers flow into coastal environments
- There is general consensus that our knowledge of the state of the world's freshwaters needs to improve
- Assess current status and trends, identify emerging issues, vulnerability and hotspots
- Assess effectiveness of multilateral environmental agreements.



# 4 Core Activities

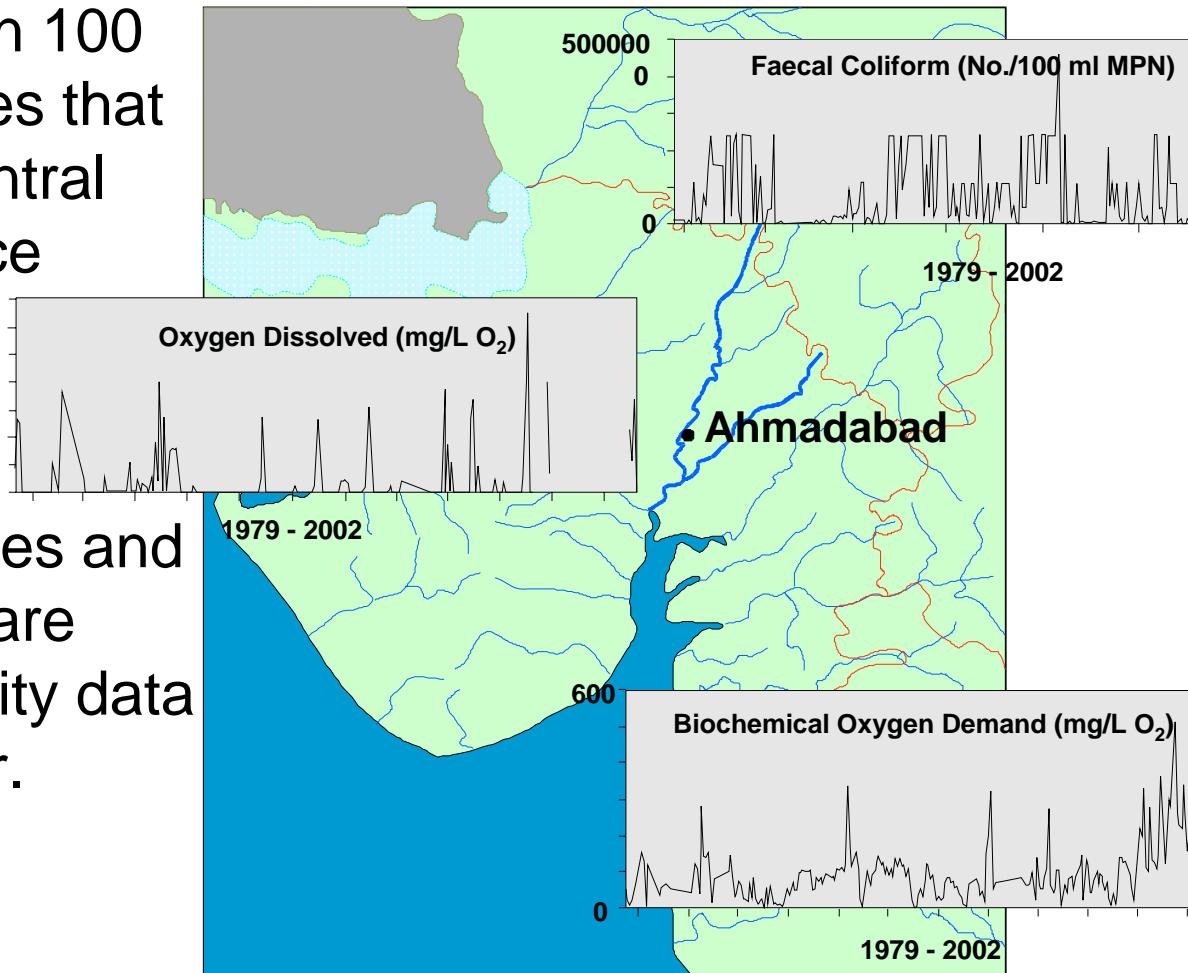
1. A global inland water quality **database** and international network.
2. A leading source of data for global environmental **assessment** processes.
3. Technical (**QA/QC**) **tools** and resources.
4. Building the **capacity** of developing countries to collect and manage water quality information.



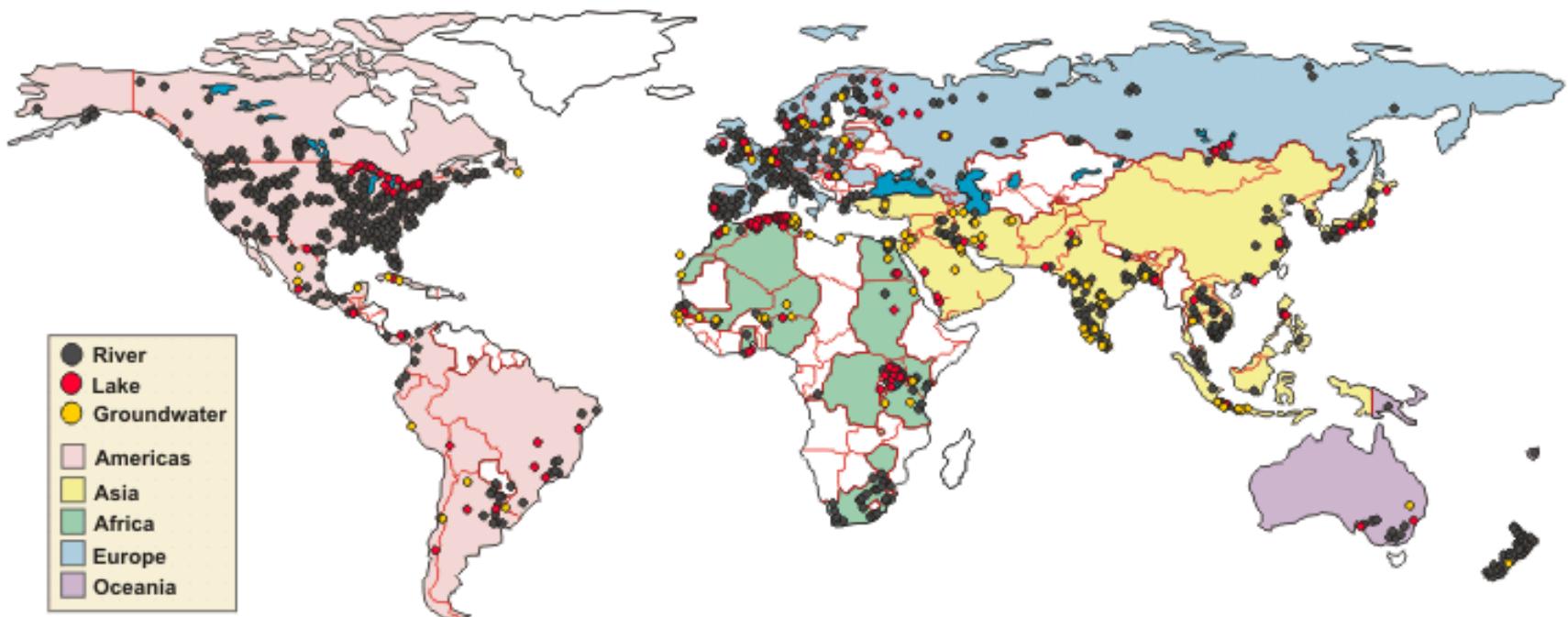
# A Network of Networks

GEMS/Water has created a network of more than 100 participating countries that provide data to a central global database since 1978.

More recently, universities and other organizations are providing water quality data sets to GEMS/Water.

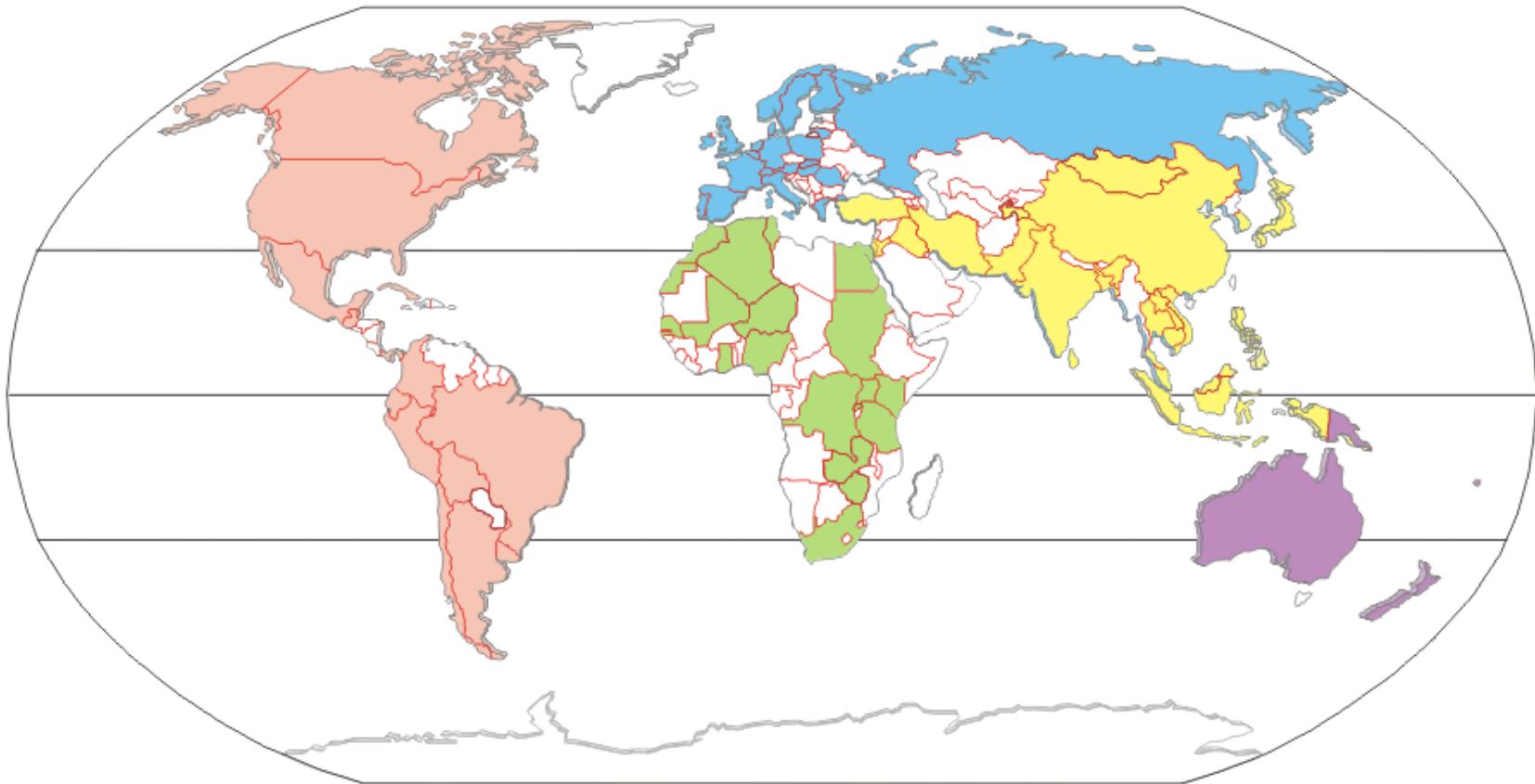


# UNEP's GEMS/Water Global Network



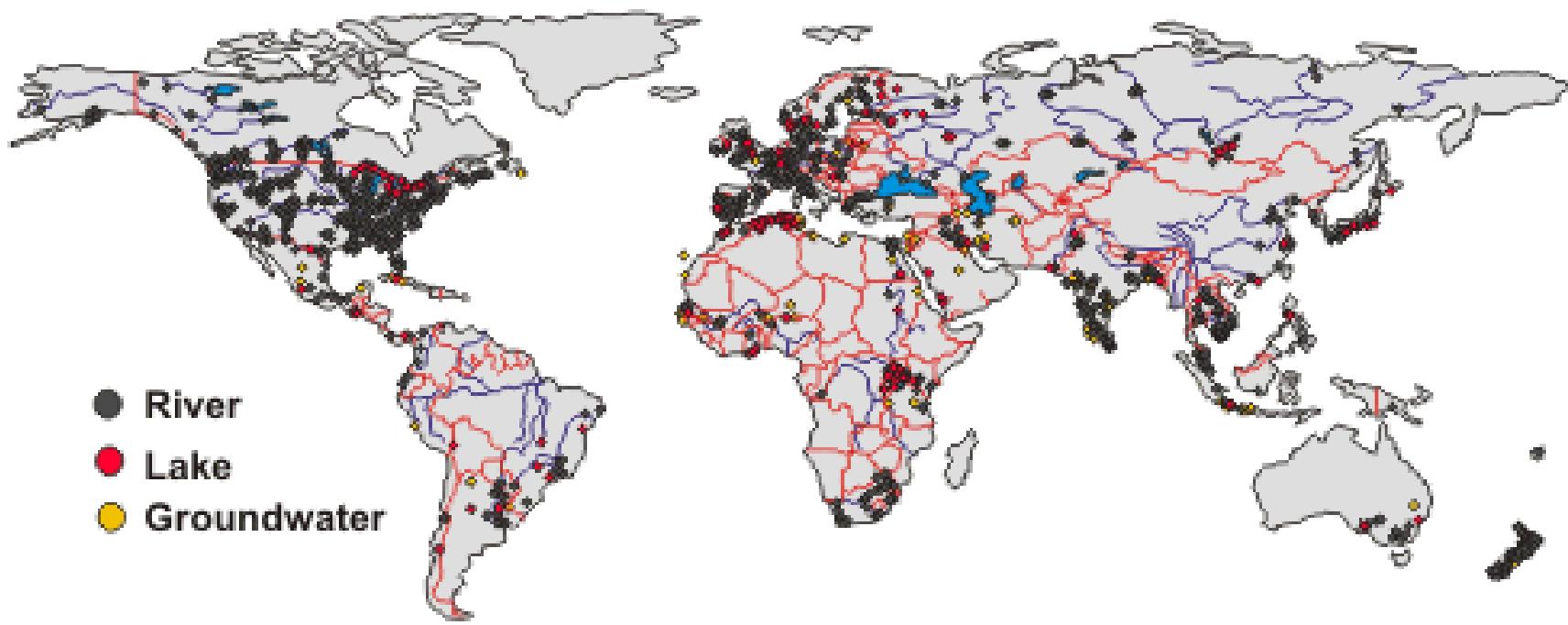
Total stations: 2743

# *Who Participates?*



Region	Africa	Americas	Asia	Europe	Oceania	Totals
# of Stations	176	1828	329	316	94	2743
# of Values	170378	329059	654757	837074	331758	2323026
Date Range	1977-2005	1965-2004	1971-2004	1978-2003	1979-2004	1965-2005

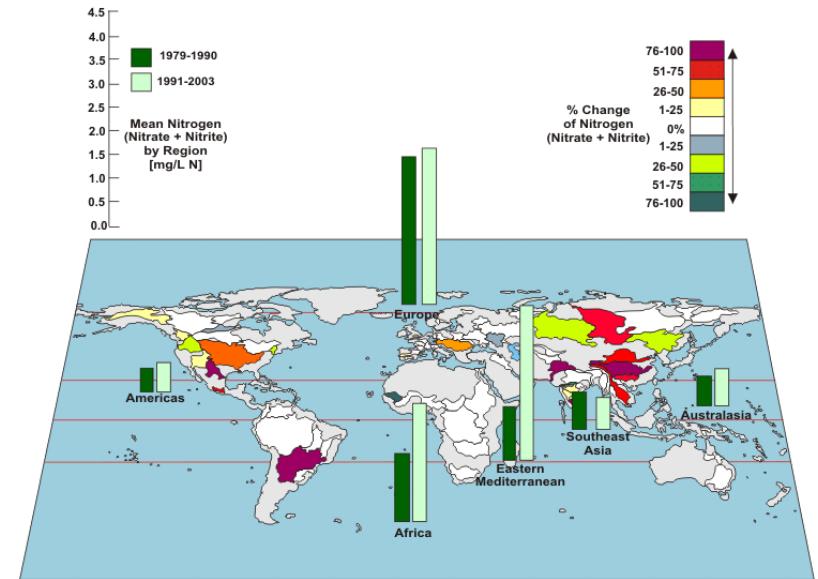
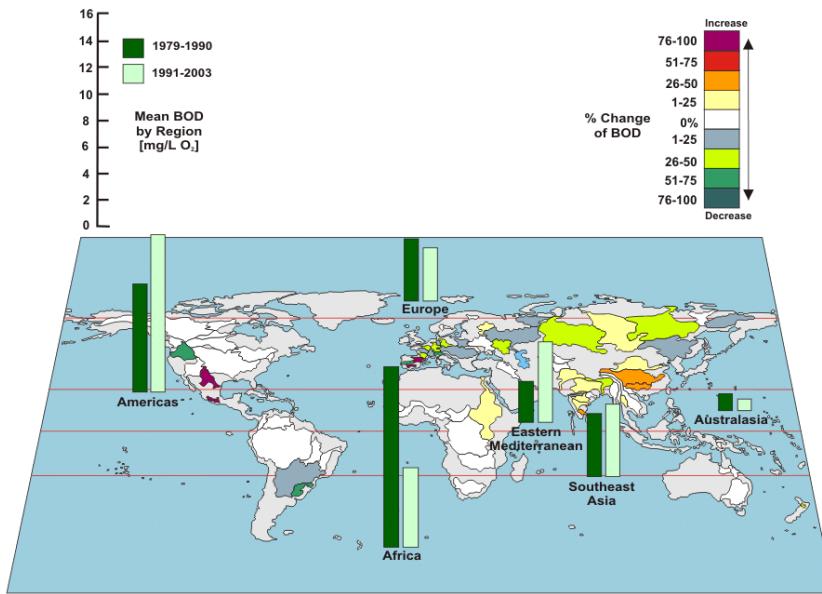
# Global Water Quality Network



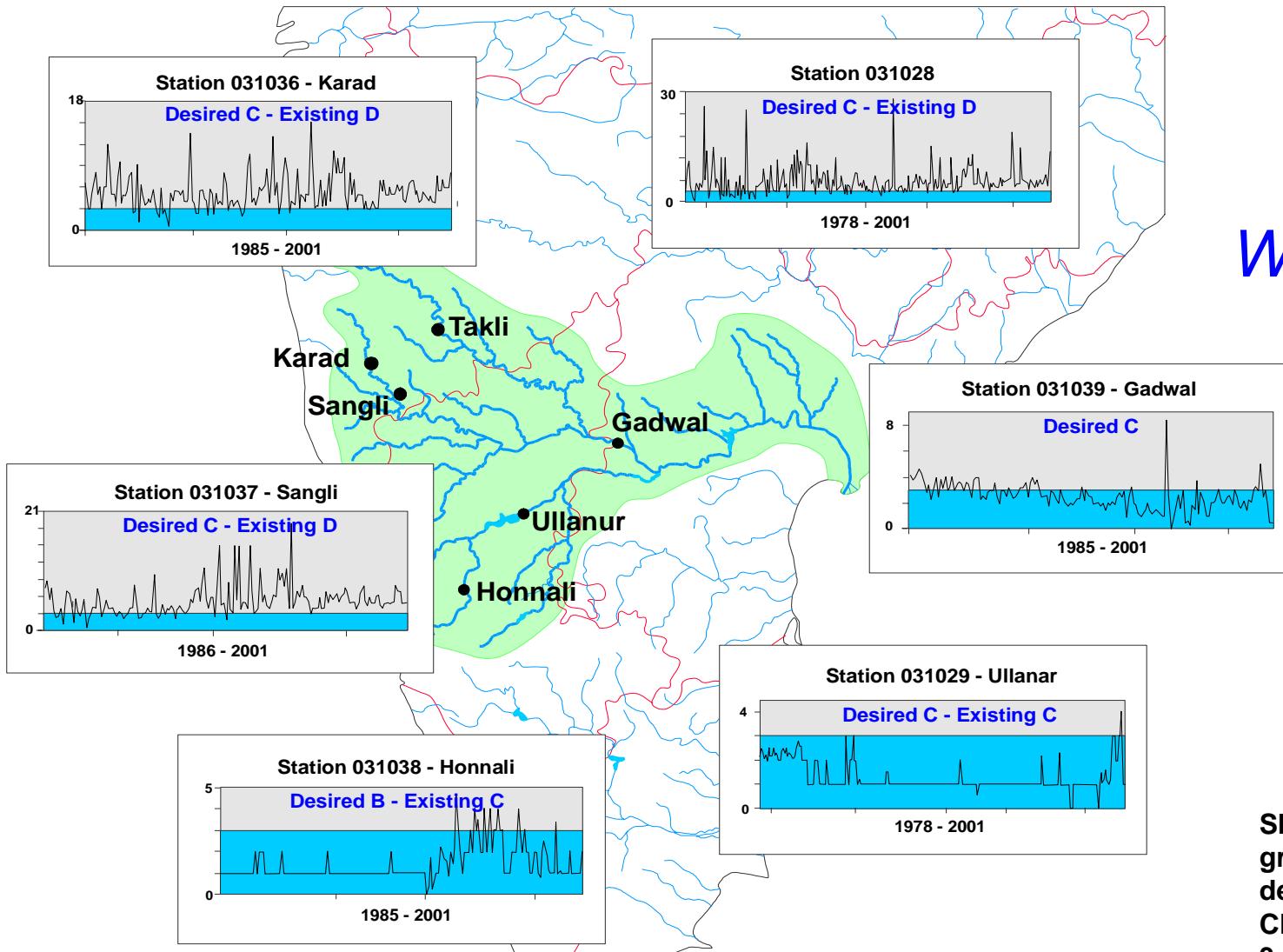
Region	Physical/Chemical	Nutrients	Major Ions	Metals	Organic Matter	Organic Contaminants	Microbiology	Hydrological & Sampling Variables	Date Range
Africa	45529	39504	75152	6580	1757	556	1107	193	1977-2005
Americas	79405	57867	68297	92214	7316	4548	11771	7641	1965-2004
Asia	206742	110237	141029	90909	45334	10030	36864	13612	1971-2004
Europe	226260	131702	129594	164289	64349	20513	35846	64521	1978-2004
Oceania	189178	80327	11026	2986	14134	1438	1649	31020	1979-2004
Total	747114	419637	425098	356978	132890	37085	87237	116987	1965-2005

# Global Water Quality Assessments

- World Water Development Reports
- UNEP Freshwater Assessments – GEO 4
- Global Biodiversity Outlook
- WHO/UNICEF Joint Monitoring Programme
- Indicators and index development

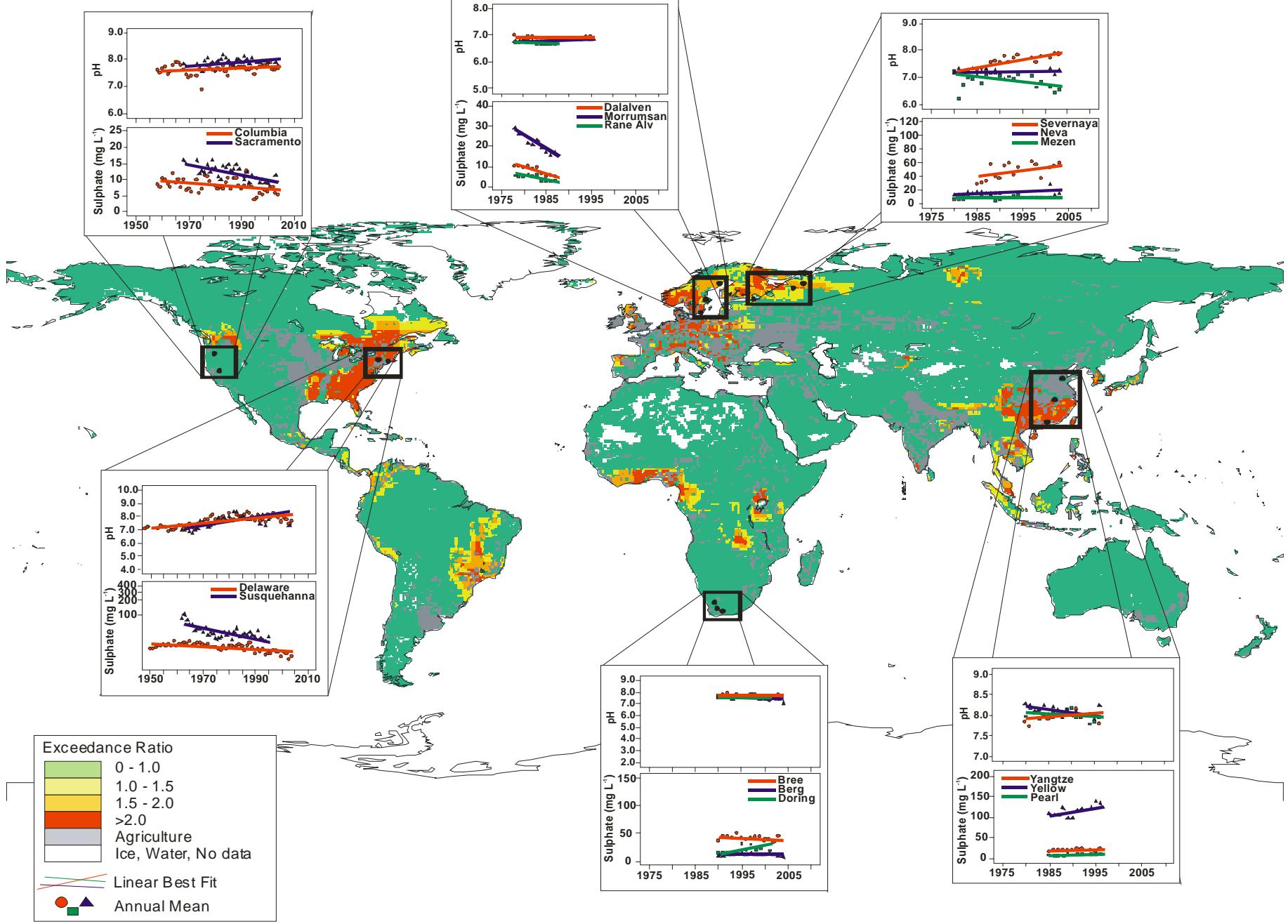


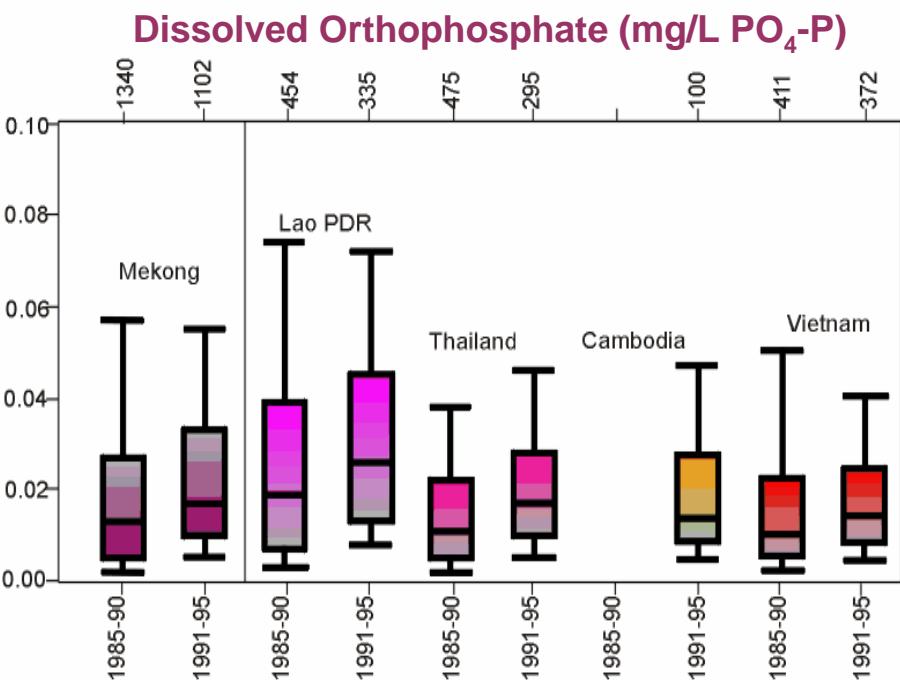
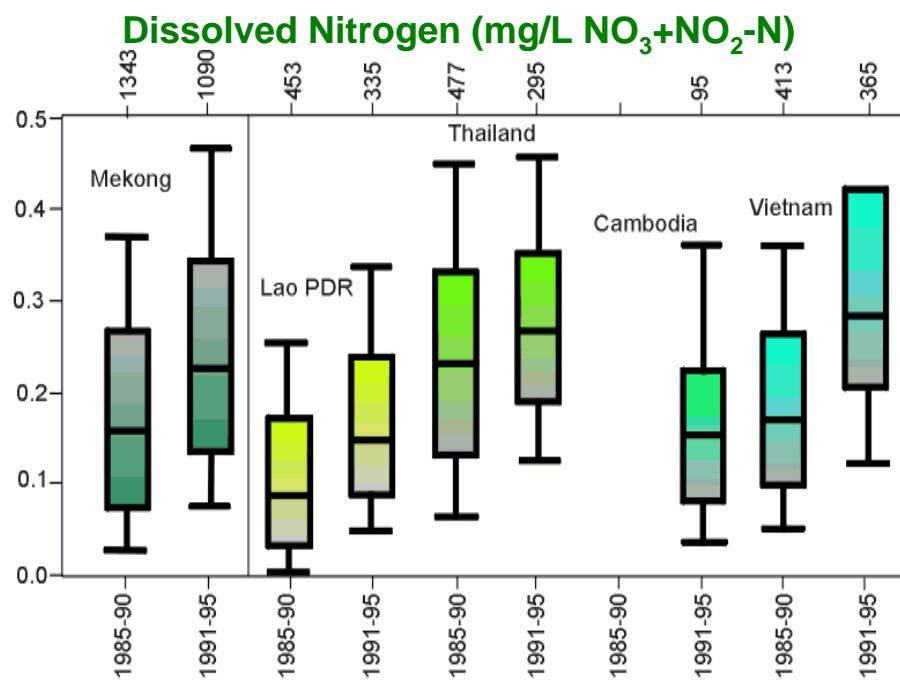
# Freshwater Assessments



BOD  
Krishna  
Watershed,  
India

Shaded blue area on graph represents desired level of BOD for Class C Drinking Water - 3 mg/L or less.

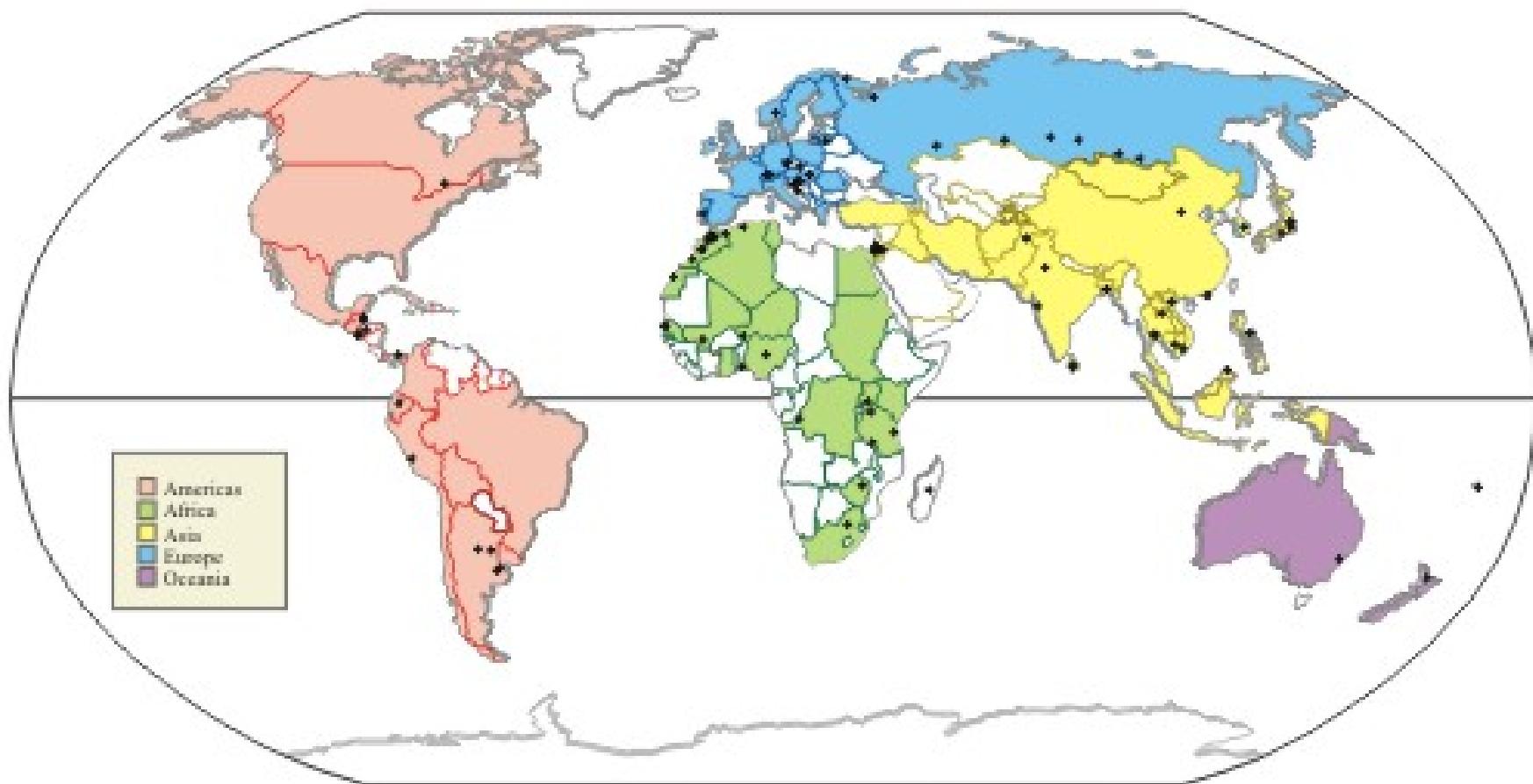




# CAPACITY BUILDING and DATA QUALITY



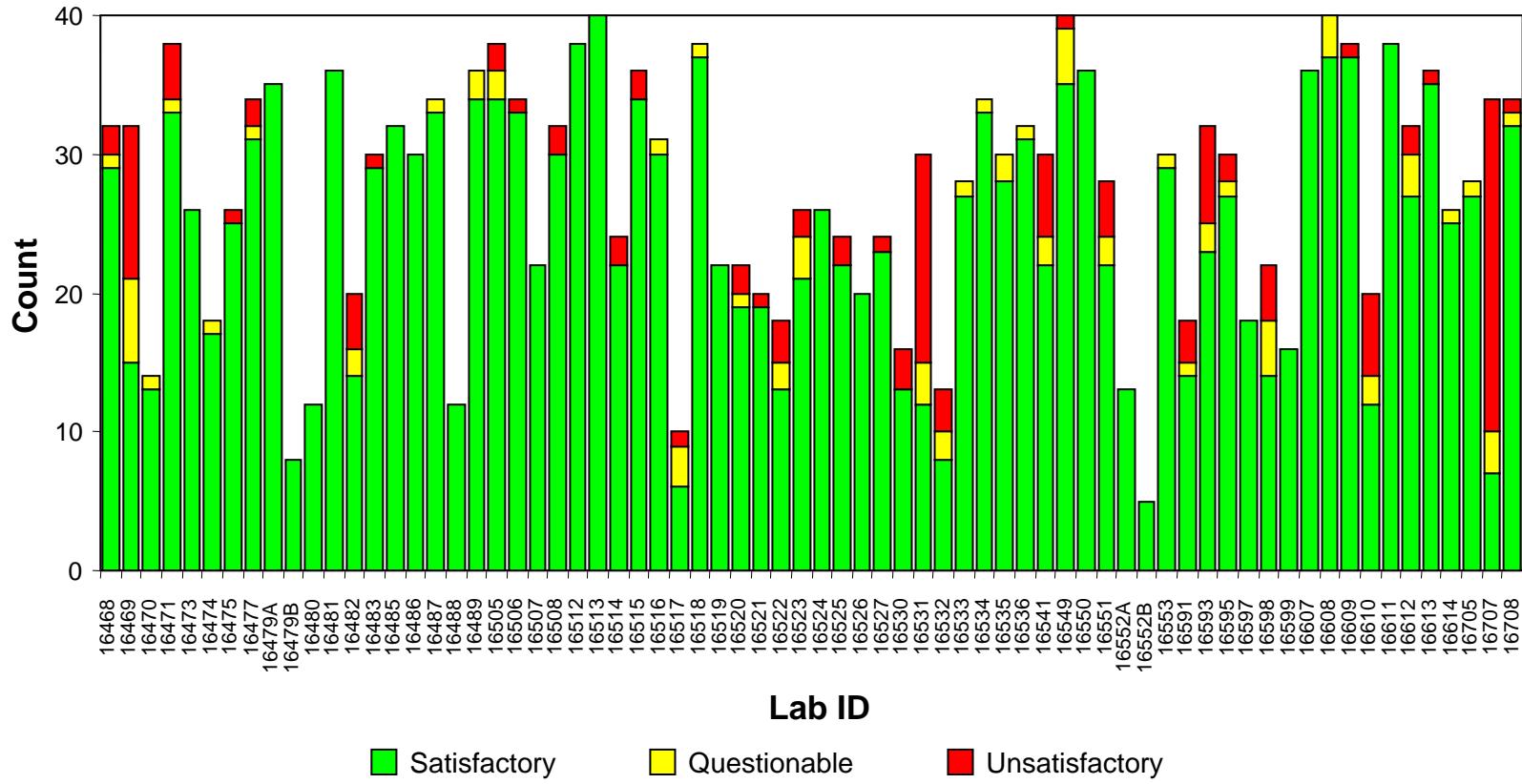
# Participation in Laboratory PE Study No. 6



95 laboratories from 48 countries

# Performance in Laboratory PE

## Study No. 5 was good



# Analytical Methods for Environmental Quality

## Content

- Title of analytical method
- Instrumentation used
- Principle of the method
- Method Detection Limit (MDL)
- Agency requesting the method
- Literature reference



Available at: [www.gemswater.org](http://www.gemswater.org)

# Information Sharing

- GEMStat – new interactive website for water quality statistics
- On-line flux computation module

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## GLOBAL ENVIRONMENT MONITORING SYSTEM

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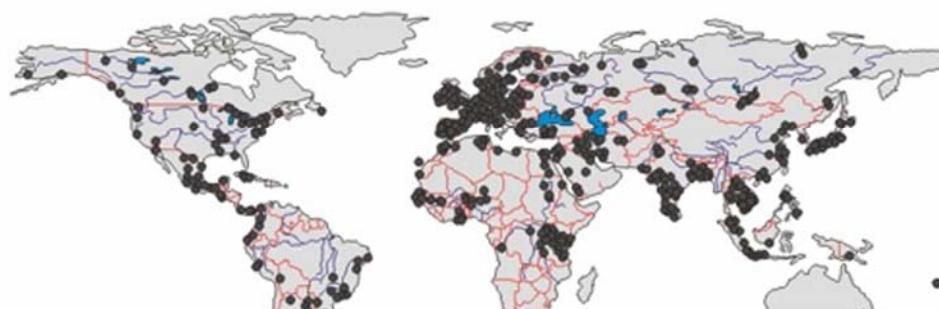
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## Global Water Quality Data and Statistics

The United Nations Global Environment Monitoring System (GEMS) Water Programme is dedicated to providing environmental water quality data and information of the highest integrity, accessibility and interoperability. These data are used in water assessments and capacity building initiatives around the world.

GEMStat is designed to share surface and ground water quality data sets collected from the GEMSWater Global Network, including over 1,400 stations, two million records, and over 100 parameters.

Display them on-the-fly as maps, graphs, data tables (available in the future) or download the data in different formats (available in the future).



**Station:** Sabarmati R. At Vautha

Latitude: 22°44'0" N  
 Longitude: 72°28'0" E  
 Date Opened: 01/10/1988  
 Type: GRF  
 Water Type: RIVER

 Sabarmati R. Near Dharoi Dam

Latitude: 23°50'0" N  
 Longitude: 73°50'0" E  
 Date Opened: 27/02/1979  
 Type: BASELINE  
 Water Type: RIVER

 Subernarekha R At Mango Bridge

Latitude: 22°47'0" N  
 Longitude: 86°17'0" E  
 Date Opened: 31/01/1985  
 Type: TREND  
 Water Type: RIVER

 Subernarekha R. D/S Ranchi

Latitude: 23°40'0" N  
 Longitude: 85°30'0" E  
 Date Opened: 20/09/1979  
 Type: BASELINE  
 Water Type: RIVER

 Tapi R. Near Burhanpur

Latitude: 21°20'0" N  
 Longitude: 76°15'0" E  
 Date Opened: 01/01/1979  
 Type: IMPACT

 Sabarmati R. In Ahmedabad

Latitude: 23°51'0" N  
 Longitude: 72°38'0" E  
 Date Opened: 15/02/1979  
 Type: IMPACT  
 Water Type: RIVER

 Suberarekha At Chandil Bridge

Latitude: 22°30'0" N  
 Longitude: 85°50'0" E  
 Date Opened: 23/03/1986  
 Type: TREND  
 Water Type: RIVER

 Subernarekha R. At Jamshedpur

Latitude: 22°30'0" N  
 Longitude: 86°40'0" E  
 Date Opened: 22/09/1979  
 Type: IMPACT  
 Water Type: RIVER

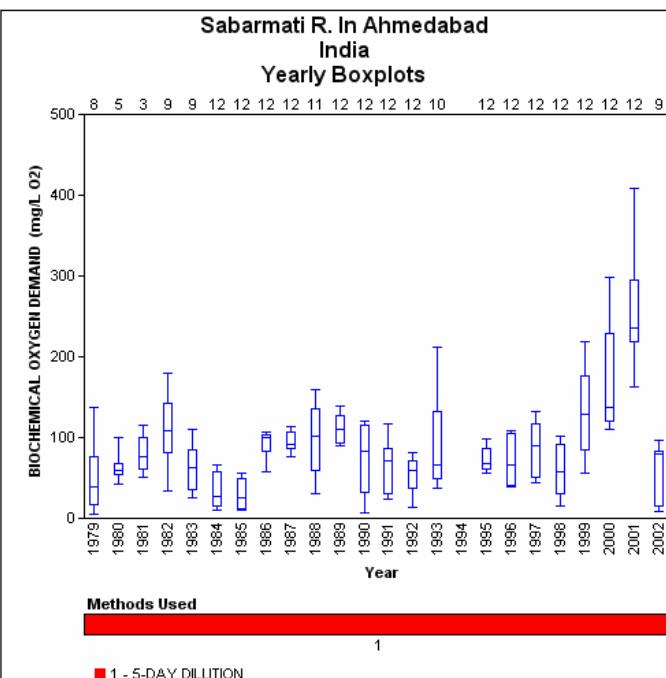
 Tapi At Ukai,Sherula Bridge

Latitude: 21°10'0" N  
 Longitude: 73°40'0" E  
 Date Opened: 15/11/1986  
 Type: TREND  
 Water Type: RIVER

 Tapi R. Near Nepanagar

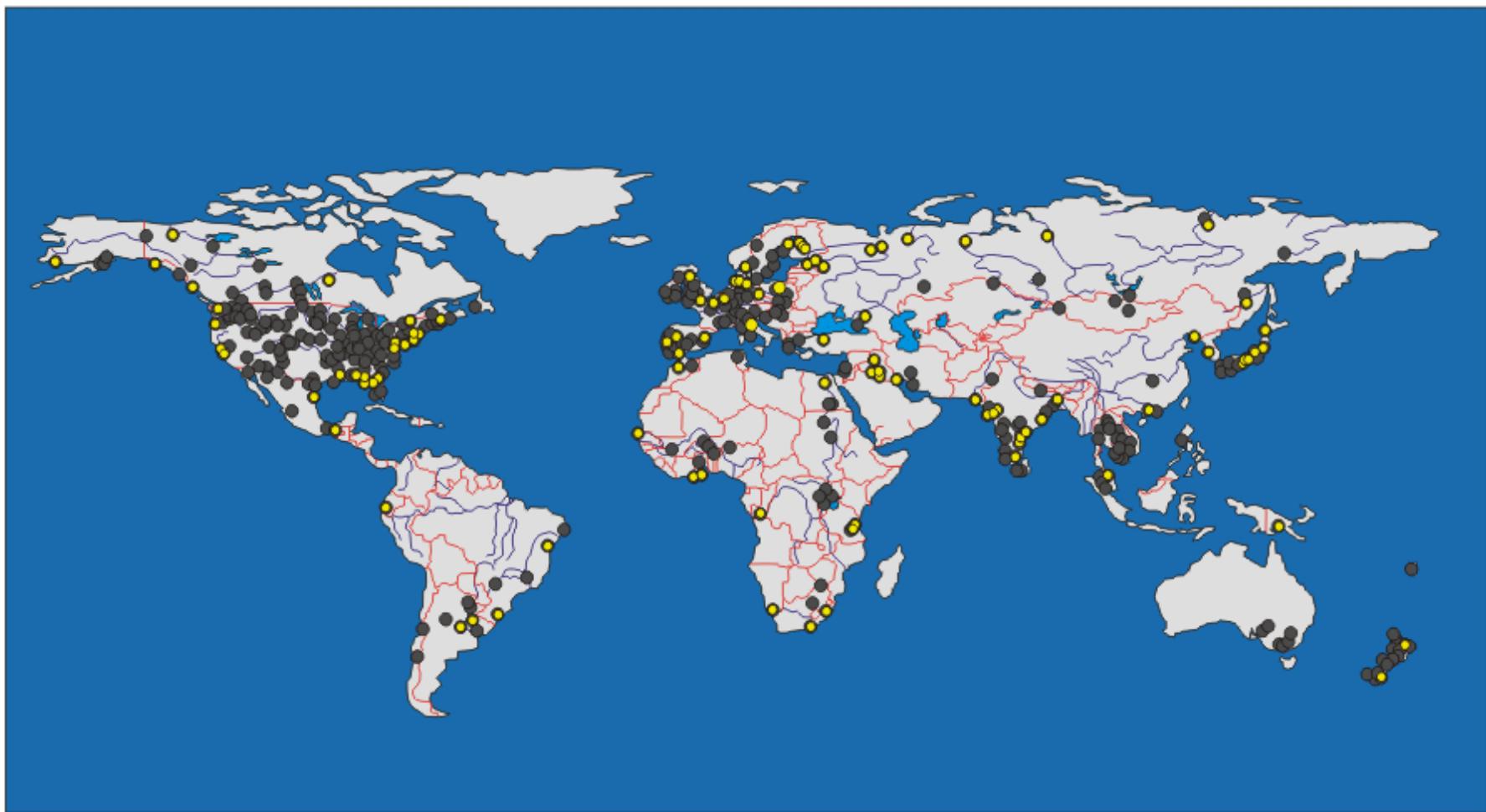
Latitude: 21°31'0" N  
 Longitude: 76°46'0" E  
 Date Opened: 01/01/1979  
 Type: BASELINE

**Parameter:****Hydrologic and Sampling Variables** INSTANTANEOUS DISCHARGE**Major Ions** CALCIUM - DISSOLVED CHLORIDE MAGNESIUM - DISSOLVED SODIUM - DISSOLVED SULPHATE**Metals** BORON - DISSOLVED**Microbiology** COLIFORM - TOTAL FAECAL COLIFORM BACTERIA**Nutrients** AMMONIA NITROGEN TOTAL KJELDAHL NITROGEN,NITRATE + NITRITE PHOSPHATE - TOTAL**Organic Matter** BIOCHEMICAL OXYGEN DEMAND CHEMICAL OXYGEN DEMAND

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To save a graph, right-click over the graph and select the menu item for saving an image  
(e.g., "Save Picture As..." in Internet Explorer).

## Joint GEMS/Water and GRDC Stations (446)



# GEMStat – Loading Estimate

GEMStat: Global Water Quality Database - Microsoft Internet Explorer

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Back Favorites Search Go Links

Address http://www.gemstat.org/queryrgn.aspx

Available Stations Selected Station Capital

Reset Map View: Americas World

Region: Americas

Select by  Country or  Watershed Canada

Station:

- Churchill River   
Latitude: 55°36'29" N  
Longitude: 102°11'44" W  
Date Opened: 26/04/1974  
Type: TREND  
Water Type: RIVER
- Fraser River - Hope   
Latitude: 49°23'15" N  
Longitude: 121°27'0" W  
Date Opened: 01/10/1965  
Type: IMPACT  
Water Type: RIVER
- Great Bear River   
Latitude: 65°8'0" N  
Longitude: 123°31'0" W  
Date Opened: 01/05/1971  
Type: BASELINE  
Water Type: RIVER
- Lake Huron - Sarnia  
Latitude: 43°0'5" N  
Longitude: 82°25'10" W  
Date Opened: 11/10/1967  
Type: IMPACT  
Water Type: LAKE
- Lake Ontario - Mid Lake  
Latitude: 43°43'0" N  
Longitude: 78°1'36" W  
Date Opened: 18/04/1974  
Type: IMPACT  
Water Type: LAKE
- Lake Superior - Mid Lake  
Latitude: 47°50'48" N  
Longitude: 87°27'24" W  
Date Opened: 18/05/1973  
Type: IMPACT  
Water Type: LAKE
- Mackenzie River
- Nelson River - Above Weir

Internet

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# GEMStat – Loading Estimate

GEMStat: Global Water Quality Database - Microsoft Internet Explorer

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Back Search Favorites Favorites W

Address http://www.gemstat.org/queryrgn.aspx Longitude: 94°34'59" W Longitude: 96°41'30" W Date Opened: 06/07/10 00:00 Date Opened: 16/07/10 00:00

Parameter:

**Hydrologic and Sampling Variables**

Instantaneous Discharge  Temperature - Air

**Major Ions**

Calcium - Dissolved  Chloride - Dissolved  
 Cyanide  Fluoride - Dissolved  
 Magnesium - Dissolved  Potassium - Dissolved  
 Sodium - Dissolved  Sulphate

**Metals**

Cadmium - Total  Chromium - Total  
 Copper - Total  Iron - Total L  
 Lead - Total  Manganese - Total  
 Mercury - Total  Nickel - Total  
 Zinc - Total L

**Nutrients**

Nitrogen, Nitrate + Nitrite L  Phosphorus - Total L ←

Silica - Reactive

**Physical - Chemical Characteristics**

Alkalinity Total (CaCO<sub>3</sub>)  Electrical Conductance  
 Fixed Suspended Solids  pH  
 Suspended Solids 105°C  Temperature

**View Summary Data**

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GEMS Water

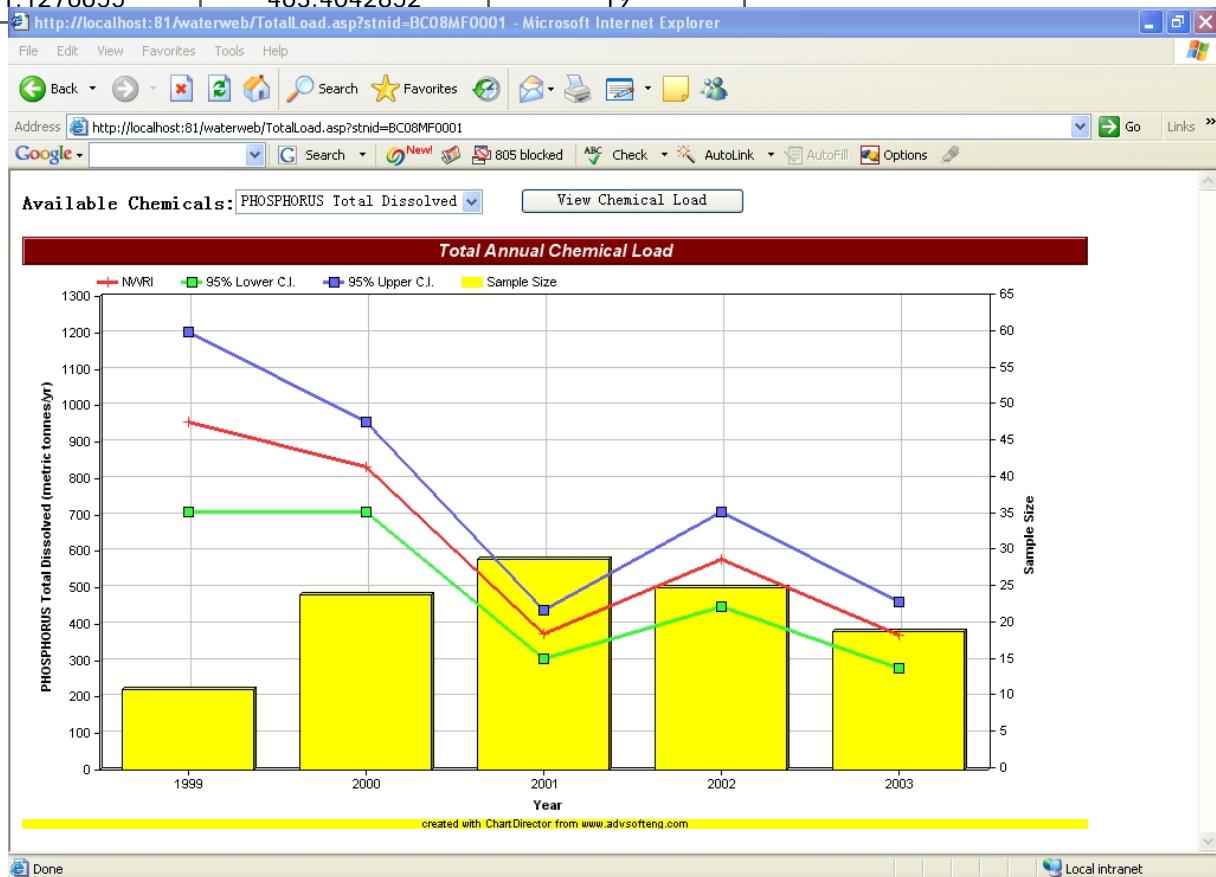
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Global Environment Monitoring System  
Water Programme

Done Internet

start Inbox - Microsoft ... Microsoft PowerPoi... GEMStat: Global W... Corel PHOTO-PAIN... 10:08 AM

# GEMStat – Loading Estimate

Load Estimate (metric tonnes / year)				
Year	NWRI	95% Lower C.I.	95% Upper C.I.	Num. Data points
1999	956.7480071	710.2311315	1203.264883	11
2000	833.4675201	709.1791186	957.7559217	24
2001	373.3230429	306.7886668	439.8574189	29
2002	579.8683659	450.8629868	708.8737451	25
2003	372.2659753	281.1276655	463.4042852	19



Fraser River  
at  
Hope  
British Columbia  
Canada

# GEMStat – Loading Estimate

GEMStat: Global Water Quality Database - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Favorites Address http://www.gemstat.org/queryrgn.aspx Go Links

Longitude: 94°34'59" W Date Opened: 06/07/2007 Longitude: 96°41'30" W Date Opened: 16/06/2008

**Parameter:**

**Hydrologic and Sampling Variables**

Instantaneous Discharge  Temperature - Air

**Major Ions**

Calcium - Dissolved  Chloride - Dissolved  
 Cyanide  Fluoride - Dissolved  
 Magnesium - Dissolved  Potassium - Dissolved  
 Sodium - Dissolved  Sulphate

**Metals**

Cadmium - Total  Chromium - Total  
 Copper - Total  Iron - Total   
 Lead - Total  Manganese - Total  
 Mercury - Total  Nickel - Total  
 Zinc - Total

**Nutrients**

Nitrogen, Nitrate + Nitrite  Phosphorus - Total   
 Silica - Reactive

**Physical - Chemical Characteristics**

Alkalinity Total (CaCO<sub>3</sub>)  Electrical Conductance  
 Fixed Suspended Solids  pH  
 Suspended Solids 105°C  Temperature

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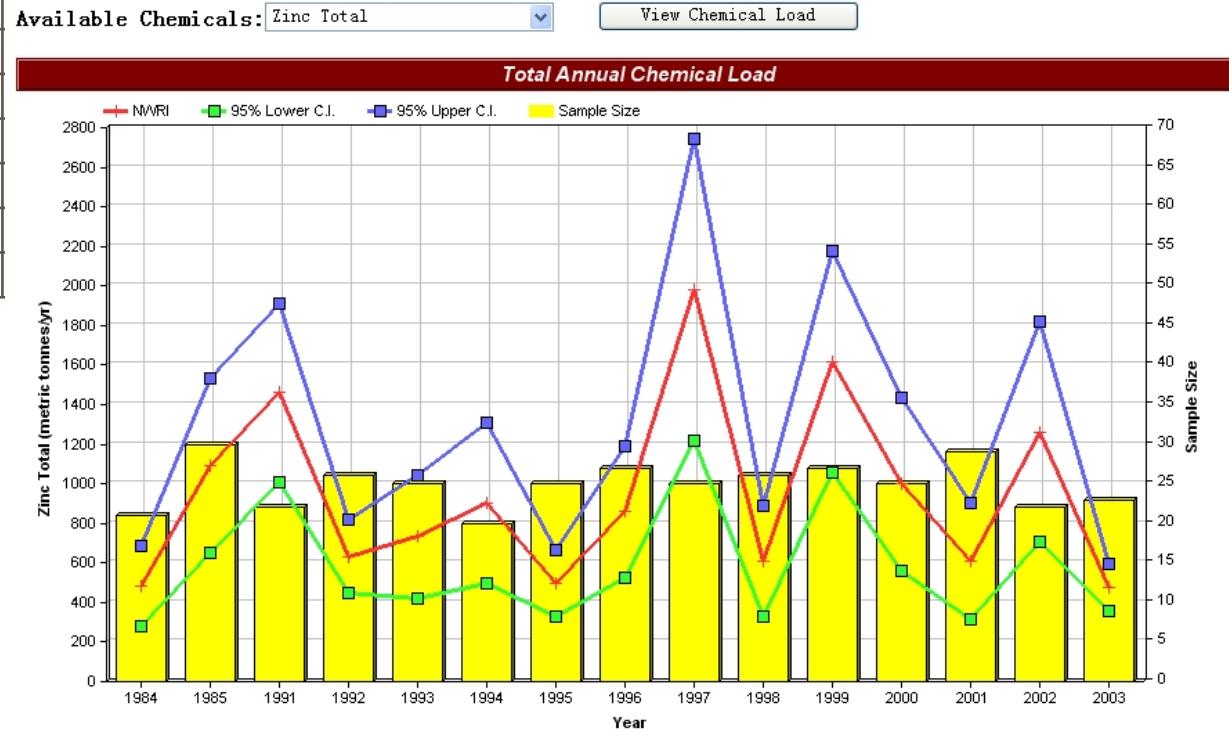
Done Internet

start Inbox - Microsoft ... Microsoft PowerPoi... GEMStat: Global W... Corel PHOTO-PAIN... 10:08 AM

# GEMStat – Loading Estimate

**Fraser River  
at  
Hope  
British Columbia  
Canada**

Load Estimate (metric tonnes / year)				
Year	NWRI	95% Lower C.I.	95% Upper C.I.	Num. Data points
1984	485.0341341	282.9358462	687.132422	21
1985	1092.126518	650.4778014	1533.775234	30
1991	1460.569752	1006.724359	1914.415145	22
1992	633.5857654	450.5443637	816.6271671	26
1993	734.3739204	423.0837151	1045.664126	25
1994	903.2339023	498.2507767	1308.217028	20
1995	498.1157096	332.4556632	663.775756	25
1996	858.2721629	526.9958467	1189.548479	27
1997	1980.880111			
1998	609.7674059			
1999	1617.902962			
2000	1000.864596			
2001	609.2252899			
2002	1263.527565			
2003	477.5911308			



# UN GEMS/Water Programme



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Canada, UNEP Nairobi