River basin monitoring
3.2. River basin Monitoring

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Online Module Water Quality Assessment
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1. General characteristics and importance of rivers
2. Monitoring of river basins
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1. General characteristics and importance of rivers (Tamara)
2. Monitoring of river basins
Stream Order

Lower order streams have
• less tributaries
• little width and depth
• allochtonous nutrient inputs

Higher order streams have
• more tributaries
• larger width and depth
• allochtonous AND autochtonous production
River Continuum Concept

First order stream --> Higher stream order

Allochtonous --> Autochtonous

Shredders --> grazers --> filter feeders
Importance of Rivers

Lifelines of Humanity
- Cradle of mankind between Euphrate and Tigris
- Importance of the river Nile in ancient Egypt
- Yangtze River and its importance for China
- Spiritual, cultural and economic values of the River Ganghes in India
- Amazon River in South America
- Etc!

Why?
- Drinking water
- Agriculture - Irrigation or flooding
- Industrial uses
- Wildlife habitats - Fishing and Hunting
- Recreational and Aesthetic uses
Flooding

Low water mark above
High water mark below

High water mark in the San Jose River floodplain, Uruguay
River bed lies behind high tree line about 800m away!
Flooding

River Nile in Egypt - Corn chamber
The seasonal floods provide it with sediments and nutrients
vs. deadly floods that displace people
Half of world's rivers polluted or running dry

Mary Dejevsky in Washington
Tuesday, 30 November 1999

MORE THAN half the world’s rivers are either polluted or at risk of running dry, according to the preliminary report of an international committee charged with finding a way to ensure the world’s water supply through the next century.

The World Commission on Water, which is backed by the World Bank and Unesco and other United Nations agencies, said that foul water supplies were one reason why last year for the first time the number of people displaced for environmental reasons exceeded the number of those displaced by war - 21 million.

"The land and water crisis in river basins contributed to the total of 25 million environmental refugees last year, which for the first time exceeded the number of war-related refugees," the report says. "By 2025, the number of environmental refugees could quadruple."
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1. General characteristics of rivers
2. Monitoring (Peter)
Basic things to keep in mind

Å Why monitor?
- water quality and quantity necessary to sustain
  Â aquatic life
  Â human life

Å How to select monitoring stations?
- Rather riffles than pools
- If possible in a uniform straight stretch
- Preferably upstream or sufficiently downstream from confluences or obstacles (*i.e.* bridges)
After having set the **objectives:**

*Macrolocation* of the stations such as:
- Background or baseline stations
- State/district boundaries
- Impacts of major pollution loads (cities, industries, irrigation areas, …)
- Recreational areas

*Microlocation*, with **exact** position monitoring site:
- Usually after complete mixing of the river
- Sites with guaranteed accessibility (e.g. at bridges)
Sufficiently well mixed after a discharge (few 100 metres for narrow brooks to > 10 km for wide rivers)

Q vs TDS: Classical dilution graph

More complicated trend:
- Generally for high Q: low [PCB]
- Sometimes high [PCB] for high Q. Why??
Choose stations:

- At the border (country, district)
- Background stations for natural water quality
- Impact stations: before/after industries, cities, etc. Also: effluent monitoring for industries

Distance border-sea: about 40 km
Impact irrigation areas

Control of environmental objectives (nature, swimming; seawater intrusion,..)

 Monitoring site selection - Rivers

<table>
<thead>
<tr>
<th>Station</th>
<th>Type</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>impact</td>
<td>immediately downstream of an international boundary</td>
</tr>
<tr>
<td>2</td>
<td>impact</td>
<td>abstraction for public supply of large town</td>
</tr>
<tr>
<td>3</td>
<td>impact</td>
<td>important fishing, recreation and amenity zone</td>
</tr>
<tr>
<td>4</td>
<td>impact</td>
<td>abstraction for large-scale agricultural irrigation</td>
</tr>
<tr>
<td>5</td>
<td>trend</td>
<td>fresh water tidal limit of major river</td>
</tr>
<tr>
<td>6</td>
<td>impact</td>
<td>abstraction for large industrial supply</td>
</tr>
<tr>
<td>7</td>
<td>impact</td>
<td>downstream of industrial effluent discharges and important tributary influencing main river</td>
</tr>
<tr>
<td>8</td>
<td>baseline</td>
<td>station where water is in a natural state (no direct or indirect pollution; no water use)</td>
</tr>
</tbody>
</table>
MULTIPLE WASTE DISCHARGES CLOSE TOGETHER
Choose monitoring station M.S. downstream of clustered discharges.

Since waste streams not yet fully mixed, it is possible to recognize fingerprints of the individual discharges at M.S.
Example:
River Rhine monitoring station ÑWormsö (Germany); river flows S→N
ÑSome 15 km downstream of main industrial zone Mannheim (BASF, ...)
ÑWater quality on left, right bank, and two in the middle of river Rhine.
See: [www.rheinquetestation.de](http://www.rheinquetestation.de) (in German); contact via: rgs.worms@wwv.rlp.de

**Equipment:**
- **Online:** T, DO, EC, pH, turbidity..
- **Photometers, GC/MS**..
- **Biotests (daphnia, algae); see later**
- **Etc.**
SELF-MONITORING INDUSTRIES

- Under strict control and enforcement by the regulatory body

  - Can be of the discharger’s own interest (valuable information about production efficiencies, etc.)

Discharge permit can regulate:
Maximum amount of pollutants' discharges (emission) and Maximum input into environment (immision)

This approach common practice in e.g. The Netherlands
OPTIMIZATION OF NETWORK RIVER RHINE

By statistical Evaluation* → only 3 stations in The Netherlands (*see Course 4)