SedNet - Effective river basin management needs to include sediment

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SedNet

Mission:
European network aimed at incorporating sediment issues and knowledge into European strategies to support the achievement of a good environmental status and to develop new tools for sediment management.

Identity:
- Network of sediment professionals (since 2002)
- Independent platform to expert advice
- Positioned between science and stakeholders
- Window on sediment issues to EC DG Environment

Focus:
- Sediment quality AND quantity issues
- River basin scale
- Including marine / estuarine sediments in a ICZM context

More info: www.sednet.org
Outline:

• Sediment and its management
• Sediment continuum as a key-management issue example
• Key-messages
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- Key-messages
What is sediment?

Sediment is:

• suspended or deposited solid, of mineral as well as organic nature, acting as a main component of a matrix, which has been, or is susceptible to being transported by water*

• an essential, integral and dynamic part of our river basins**

Some appearances of sediment:

suspended particulate matter (SPM)  silt / mud  clay  sand  gravel

Sediment needs management

Due to:

<table>
<thead>
<tr>
<th>Too much sediment</th>
<th>Too little sediment</th>
<th>Sediment as resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstruction of channels</td>
<td>Beaches erode</td>
<td>Construction material</td>
</tr>
<tr>
<td>Rivers fill and flood</td>
<td>Riverbanks erode</td>
<td>Sand for beaches</td>
</tr>
<tr>
<td>Reefs get smothered</td>
<td>Wetlands are lost</td>
<td>Wetland nourishment</td>
</tr>
<tr>
<td>Turbidity</td>
<td>River profile degradation</td>
<td>Soil enrichment</td>
</tr>
</tbody>
</table>

Sediment = “no waste” = essential & integral element of river-sea systems

Source scheme: Martin (2002)
Sediment management

1. Requires a holistic approach taking into account*:
   - system understanding both in terms of quality and quantity
   - the integrated management of soil, water and sediment
   - upstream-downstream relationships
   - supra-regional and trans-boundary collaboration

2. Should be an essential element in River Basin Management planning **

** SedNet (2006 & 2009) Round Table Discussion reports
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Surplus

Deficit
Problem example 1
Sediment continuum – surplus
Problem example 2
Sediment continuum – deficit

Degradation 1953 bis 2001: ca. 3 m
Degradation flood August 2002: 3 - 4m, 2 pools

Foto: WRS, 2000
(Hengl, 2004)
Morphological Processes and Floods

Bank erosion, channel migration, morphodynamics
Sediments and fish

Mesohabitat modelling

Spawning

Stability

Microhabitat modelling

Hauer, Schober, Habersack 2011: World Large Rivers
## Consequences of System Changes

<table>
<thead>
<tr>
<th>Change</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landuse change</td>
<td>→ Change of sediment regime</td>
</tr>
<tr>
<td>Climate change</td>
<td>→ Change of sediment regime, - transport</td>
</tr>
<tr>
<td>Development of cross sectional</td>
<td>→ Change of sediment continuum and transport capacity</td>
</tr>
<tr>
<td>structures</td>
<td></td>
</tr>
<tr>
<td>Dredging</td>
<td>→ Bedload deficit (by excavation)</td>
</tr>
<tr>
<td>Increase of transport capacity (width</td>
<td>→ River bed degradation</td>
</tr>
<tr>
<td>reduction, increase of bed slope</td>
<td></td>
</tr>
<tr>
<td>length reduction ...)</td>
<td></td>
</tr>
<tr>
<td>Reduction of transport capacity</td>
<td>→ River bed aggradation</td>
</tr>
<tr>
<td>Stop of side erosion and morphodynamics</td>
<td>→ Sediment deficit, depth erosion</td>
</tr>
<tr>
<td>Disconnection of floodplains by dams</td>
<td>→ Increase of transport capacity and thus shear stress on river bed</td>
</tr>
</tbody>
</table>
# EU Water Framework Directive 2000

## Hydromorphological Quality Components

<table>
<thead>
<tr>
<th>Element</th>
<th>High Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrological regime</td>
<td>The quantity and dynamics of flow, and the resultant connection to groundwaters, reflect totally, or nearly totally, undisturbed conditions.</td>
</tr>
<tr>
<td>River continuity</td>
<td>The continuity of the river is not disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms and <em>sediment transport</em>.</td>
</tr>
<tr>
<td>Morphological conditions</td>
<td>Channel patterns, width and depth variations, flow velocities, substrate conditions and both the structure and condition of the riparian zones correspond totally or nearly totally to undisturbed conditions.</td>
</tr>
</tbody>
</table>
Danube

Erosion and Deposition reaches

Habersack, Jäger, Hauer, Schwarz, 2010
Measures against reservoir sedimentation

- Catchment-wide measures
  - Technical retention
  - Natural retention
  - Land use and management
  - Interbasin diversion, indirect catchment
  - Forebay, pre-impoundment basin
    - By-passing (sediment diversion tunnel)

- Measures in the reservoir
  - By-passing (sediment diversion tunnel)
  - Dead storage capacity, intercepting space
  - Mechanical dredging
    - Hydraulic dredging (drawdown, flushing)
  - Redistribution of sediments
  - Control of turbidity currents with barriers
  - Prevention of sedimentation (jet screen)

- Measures at the dam
  - Sluicing or venting of turbidity currents
  - Evacuation of sediment-laden water through turbines
  - Dam elevation
  - Elevation of outlet/intake structures
  - Pressure flushing of outlet structures

(modified after Schleiss and Oehy 2002)
Measures against reservoir sedimentation

*Sediment diversion tunnel*
Measures against reservoir sedimentation

Management of turbidity currents

(Habersack, Schoder, Wagner, 2013)
**Optimization**

- **flushing efficiency** $F_e = \frac{(V_o C_o - V C) / \rho}{V_o}$

- **flushing duration** [days]

- **sedimentation** [m³]

- **lost money** [Euro]

- **lost energy production** [Mio kWh]

- **lost power production**

- **lost income**

- **stress index** = $\ln(C_s \ast t)$

- **Fisch mortality** [%]

- **15 min peak**

- **75 min peak**

- **total flushing duration**

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Habersack et al., EU project Warmice
Reservoir management

Habersack et al., EU project Warmice
Hydromorphological Evaluation Tool (HYMET)

- Catchment indicators
- River network indicators
- Reach indicators

Klösch und Habersack, Geomorphology, 2017
Actual examples of Sediment related Projects

SedAlp (Sediment Management in Alpine Basins):

DanubeSediment (Danube Sediment Management - Restoration of the Sediment Balance in the Danube River)

Hymocares (HydroMorphological assessment and management at basin scale for the Conservation of Alpine Rivers and related Ecosystem Services)

Christian Doppler Laboratory on Sediment Research and Management

BUT SEDIMENTS ARE underrepresented specifically in H2020
Outline:

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Summary and outlook

- Sediments form the backbone of natural river development
- The disbalance between surplus and deficit is increasing
- Reservoir Sedimentation is of urgent global importance for hydropower
- Innovation is needed to develop new types of hydropower plants to improve the sediment continuum
- Interrelation between catchment, river reaches and local structures should be improved
- Optimisation between technical, ecological and socioeconomic issues essential
- Only a cooperation between hydropower companies, industry, authorities, various stakeholders and research and innovation leads to needed advances in integrated sediment management
- New research facilities with large lab discharges combined with field work, numerical modelling are needed to close medium scale gaps in doing basic and applied sediment related research
Key-messages

• Effective river basin management needs to include sediment

• SedNet offers to share sharing its experience in this field

• Dedicated attention needed for sediment continuum R&I in H2020

.... and ....

• Be very welcome to join

Thank you for your attention