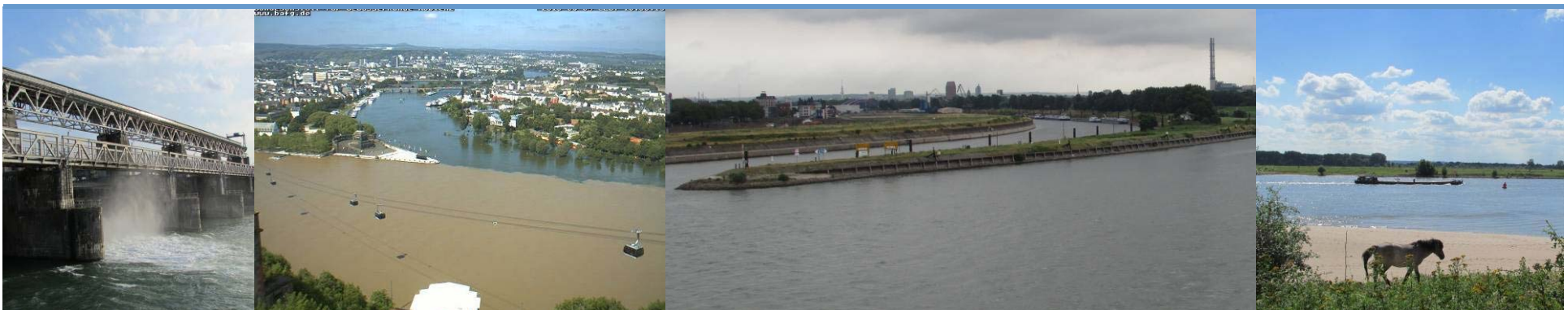




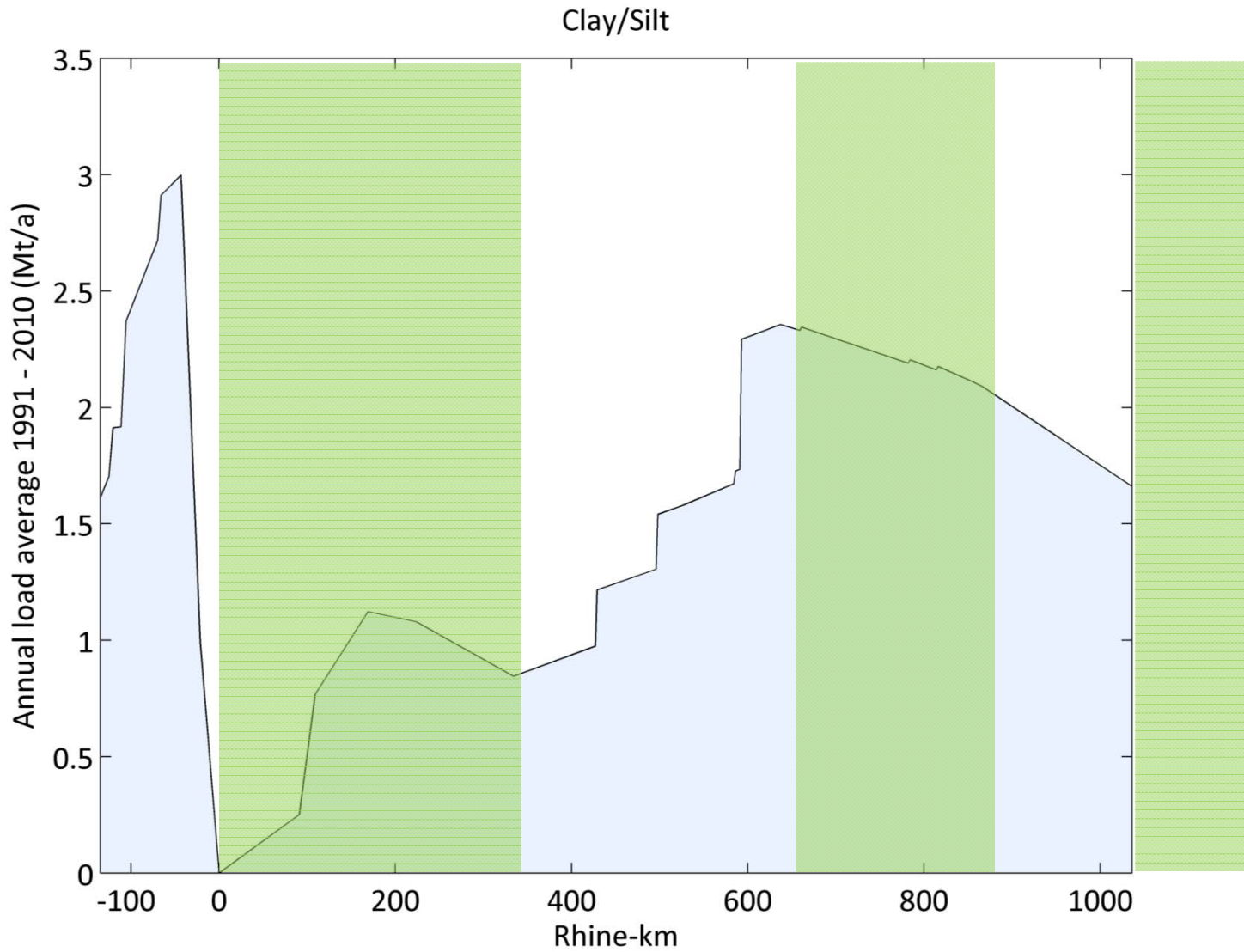
From source to mouth, sediment budget of fines

Dr. Stefan Vollmer

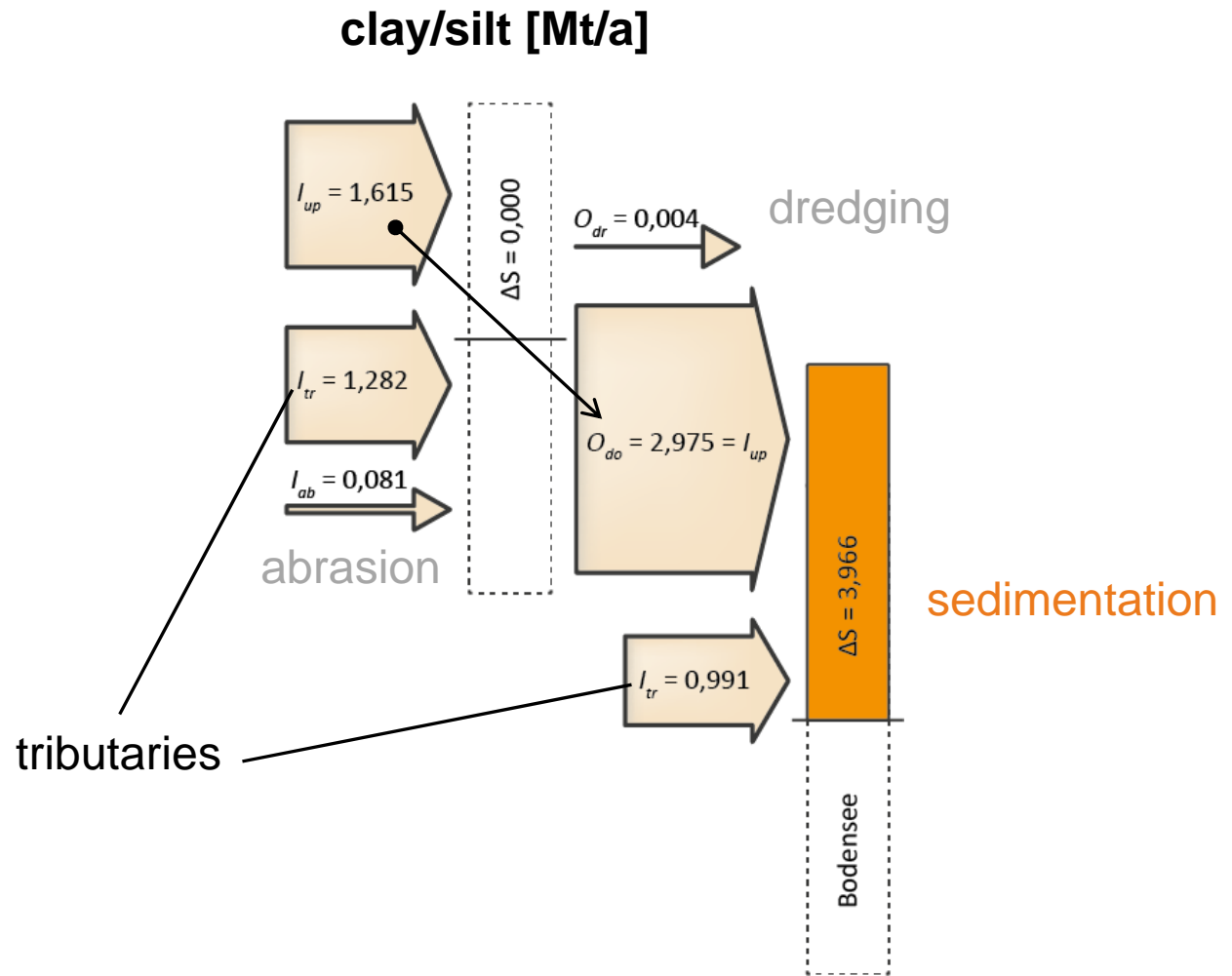
Federal Institute of Hydrology, Koblenz



Sediment budget of fines - sections



Alpine Rhine/Lake Constance



Hochrhein/impounded Oberrhein

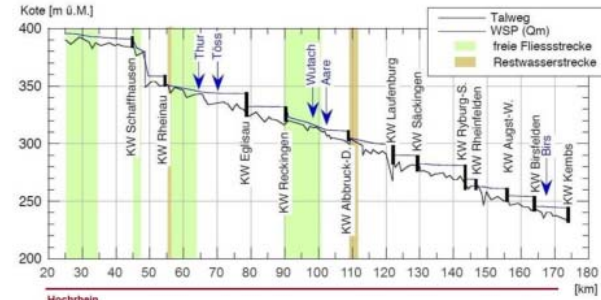
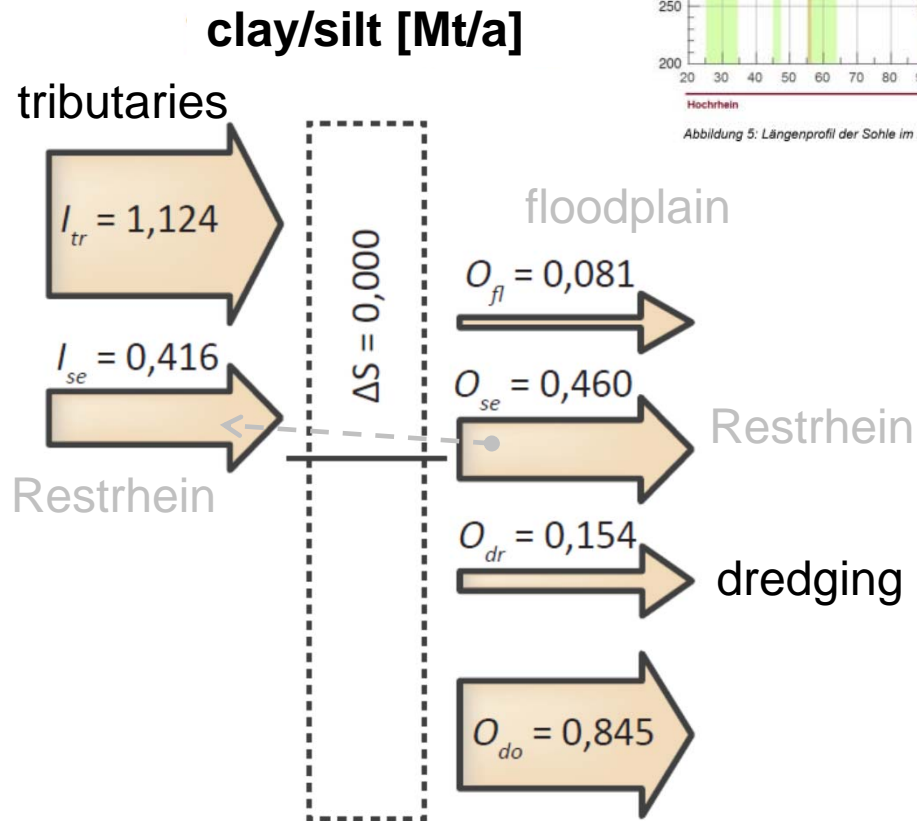
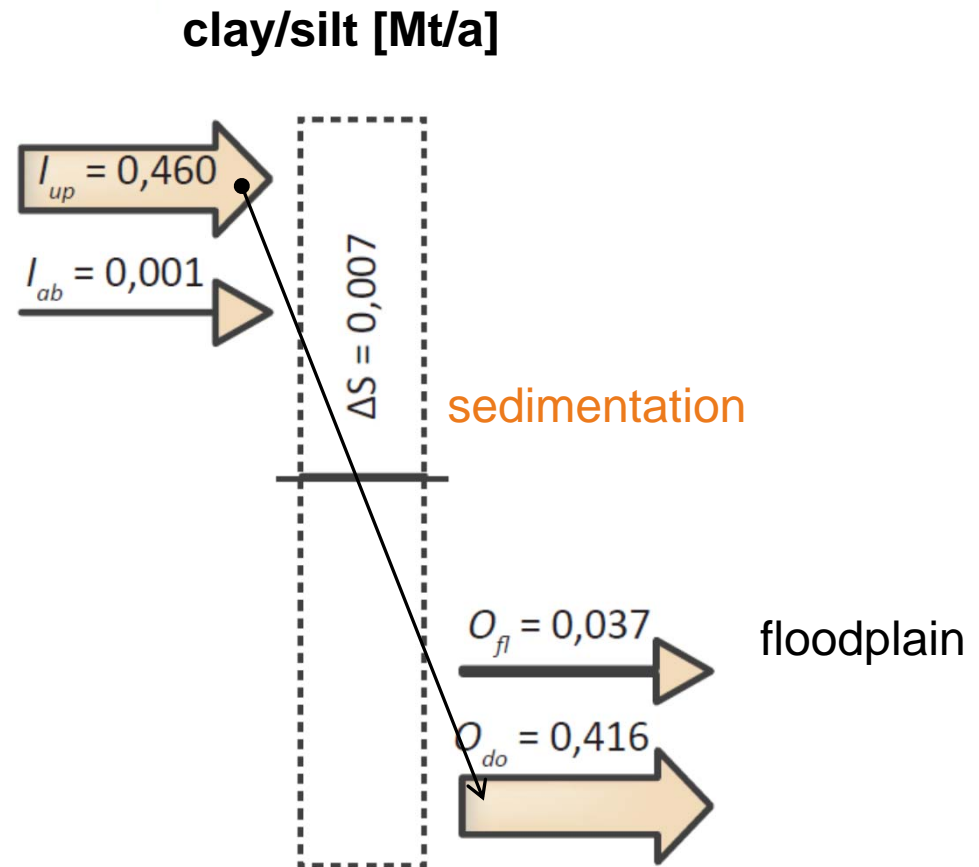


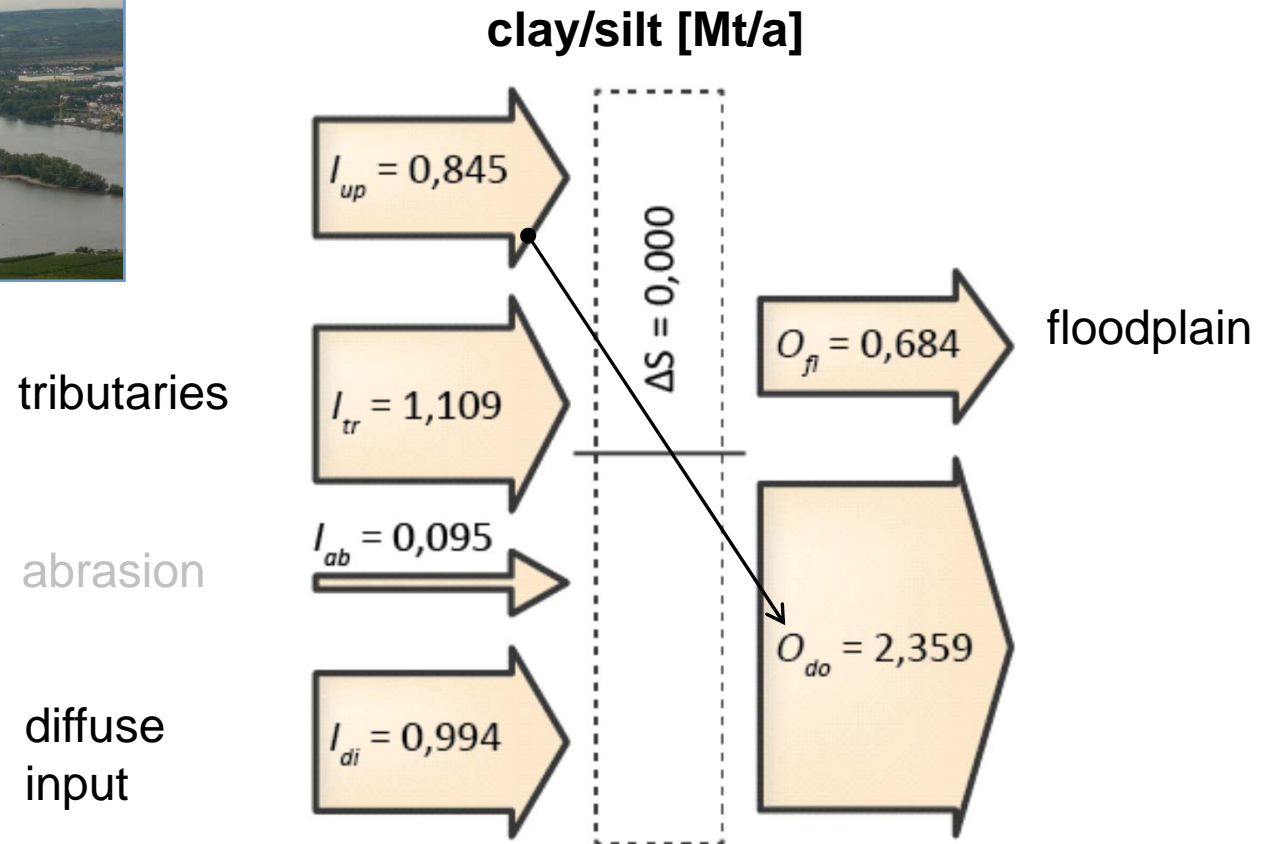
Abbildung 5: Längenprofil der Sohle im Hochrhein (Talweg). bearbeitet nach ABEGG (2013)



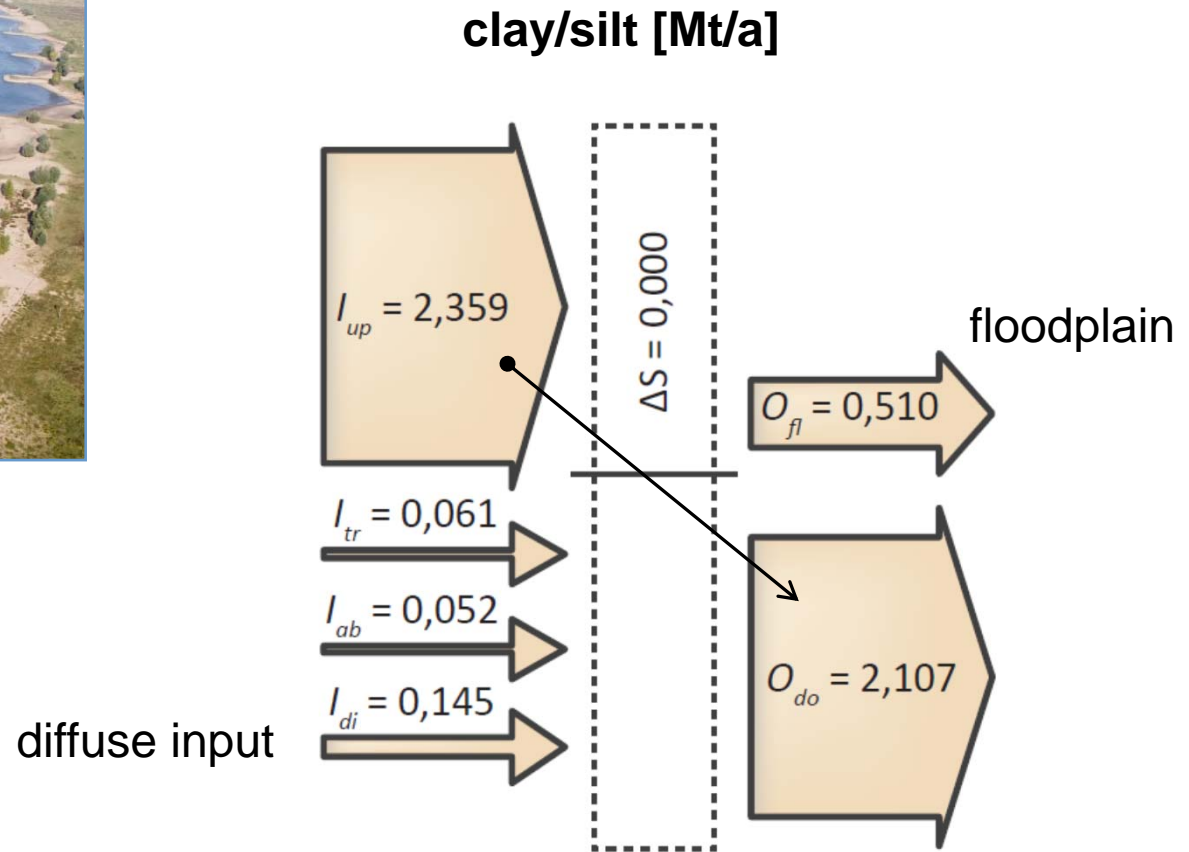
Restrhein



Ober-/Mittelrhein

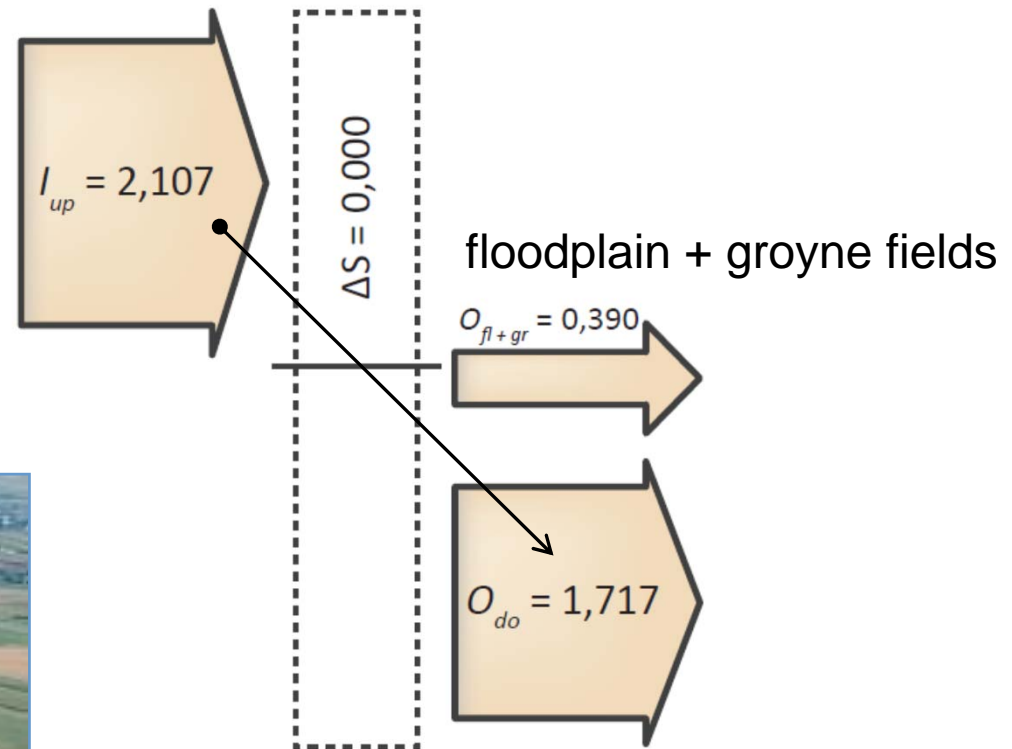


Niederrhein

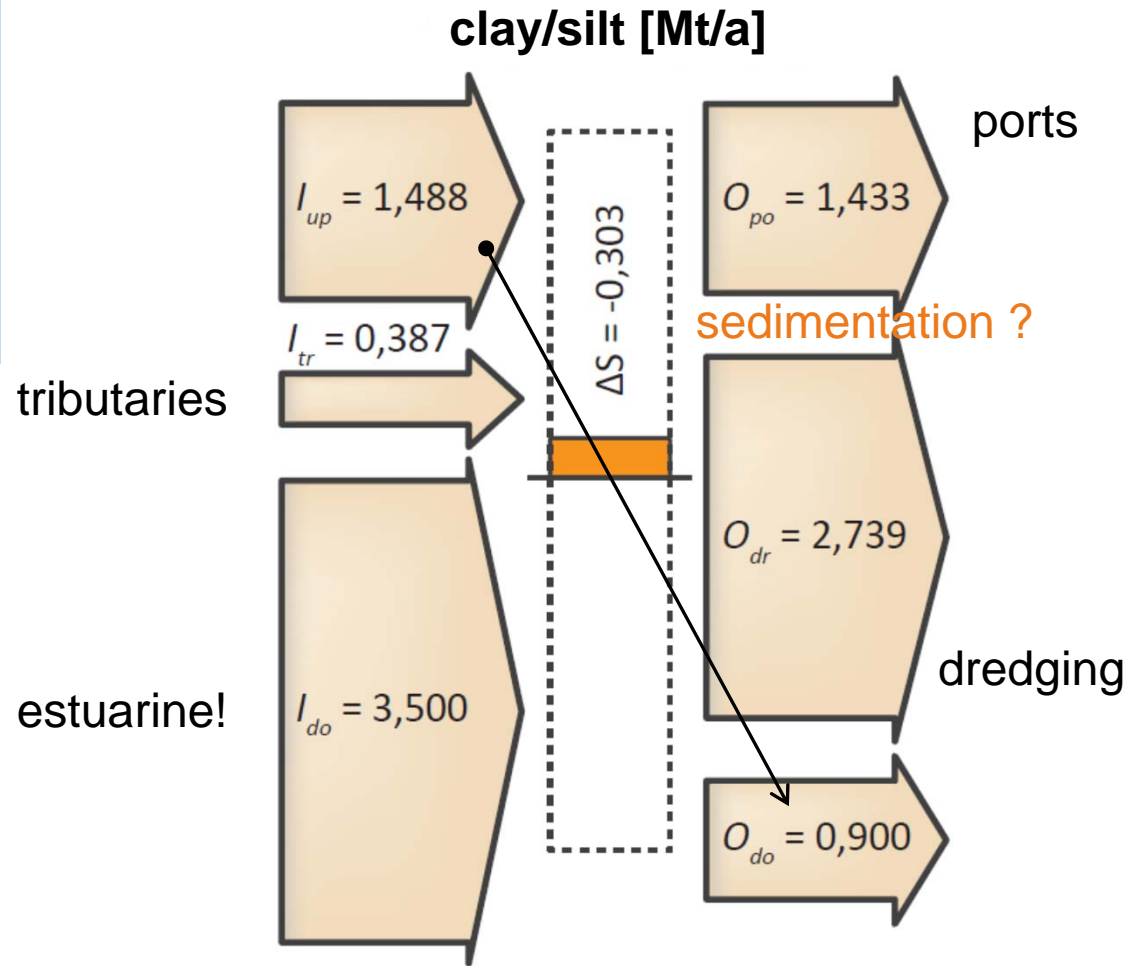


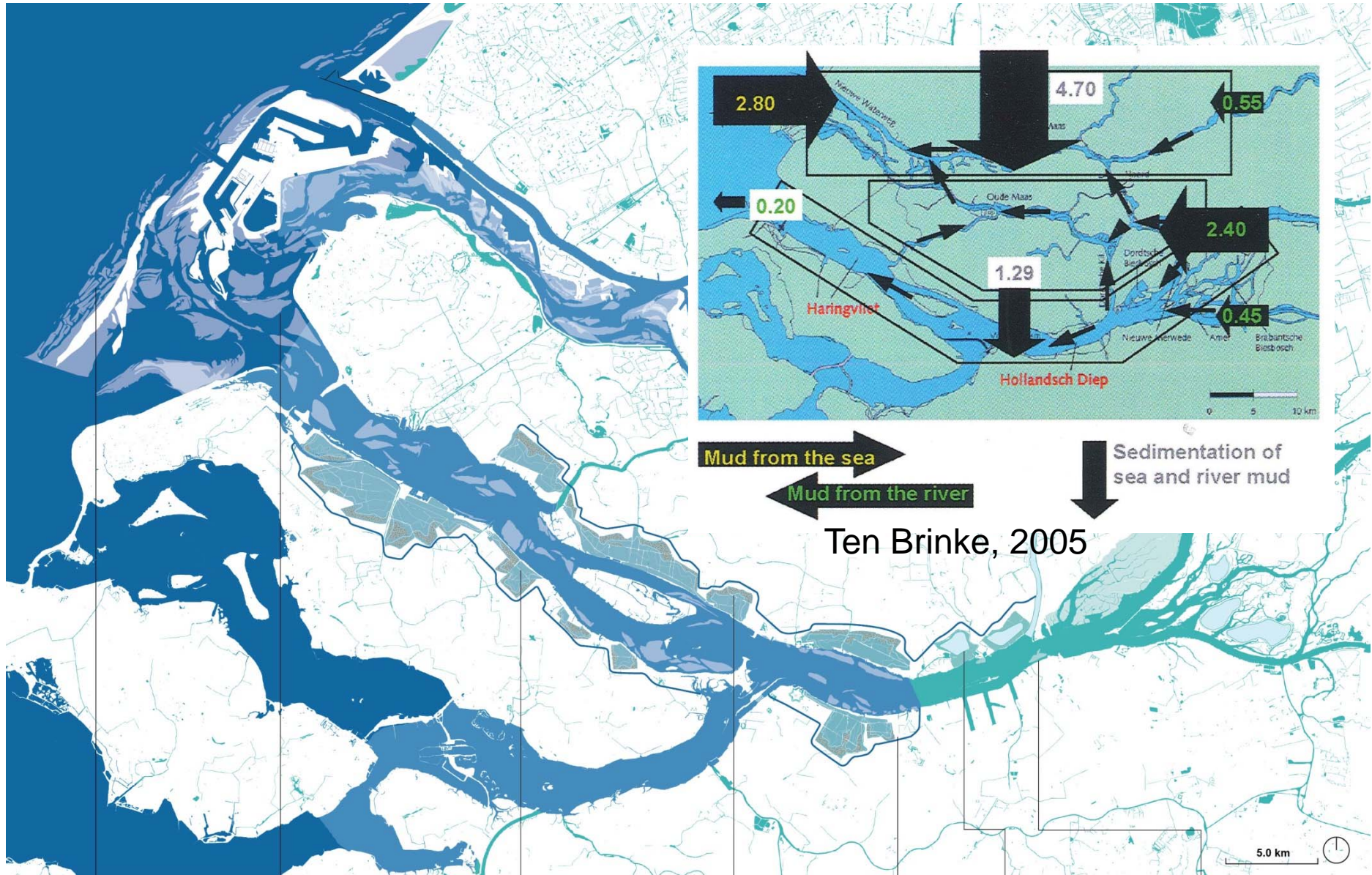
Upper Delta

clay/silt [Mt/a]



Lower Delta

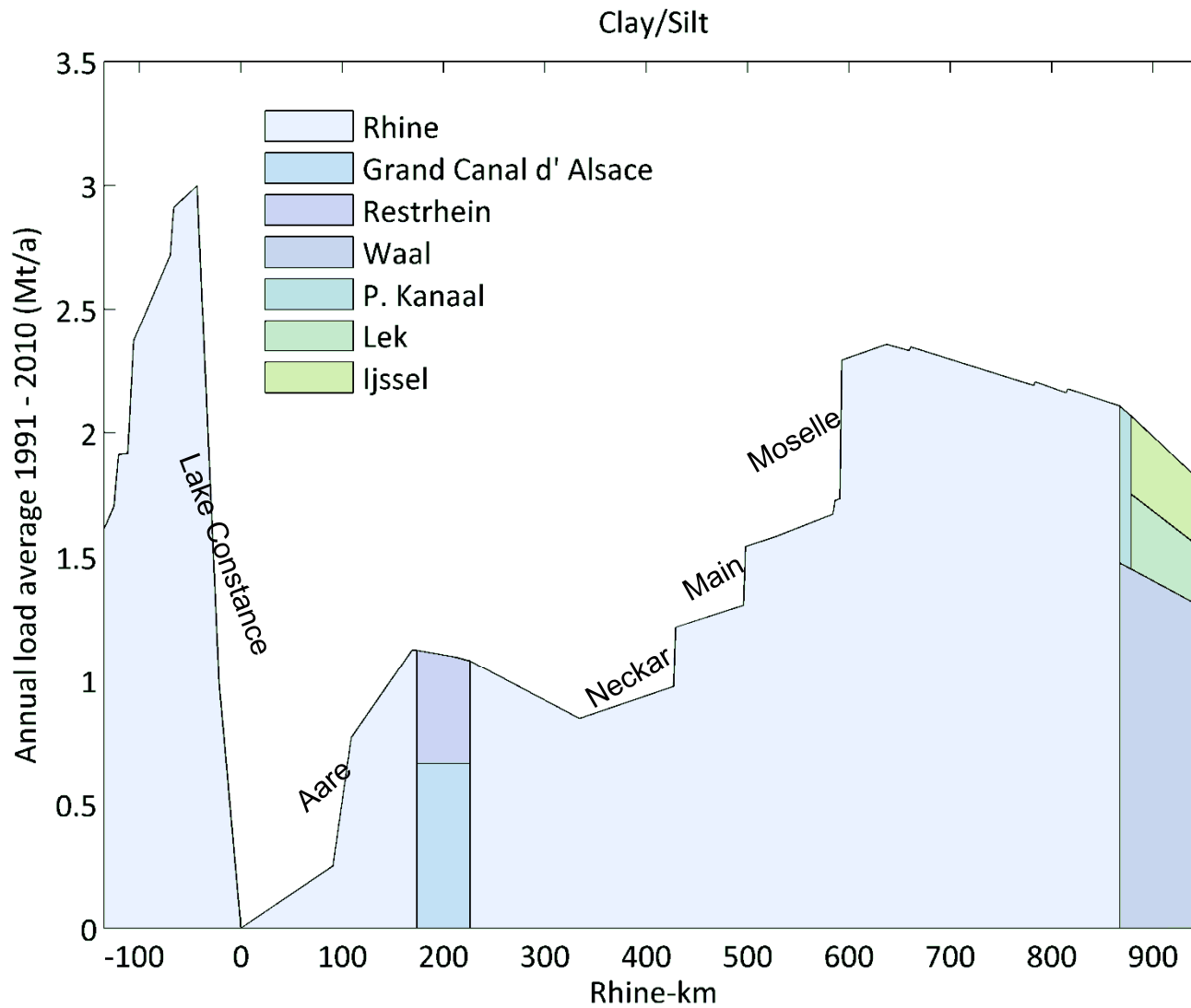




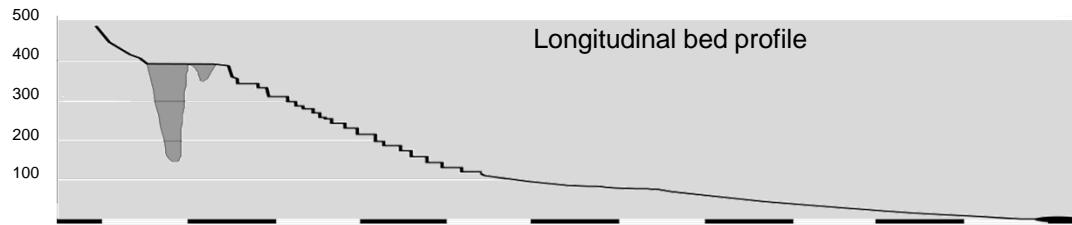
Delta as Estuary

by Tak Park

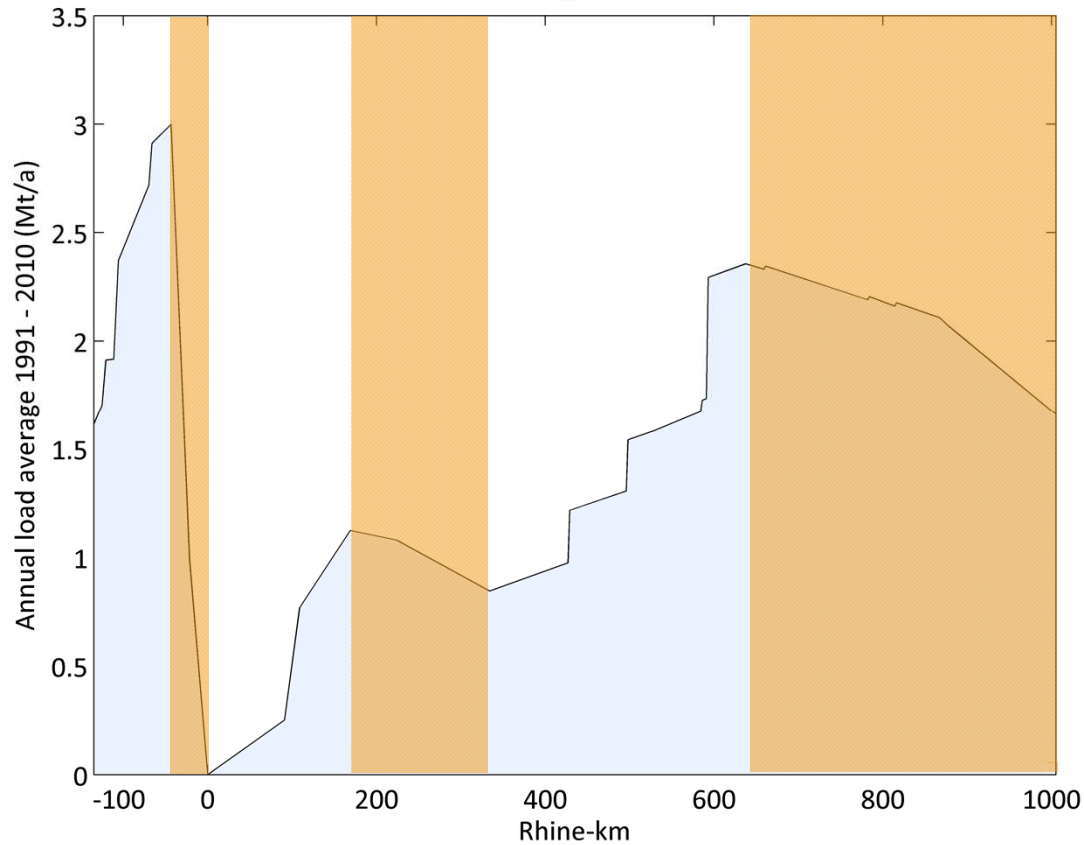
Sediment budget of fines - branches



Sediment budget of fines



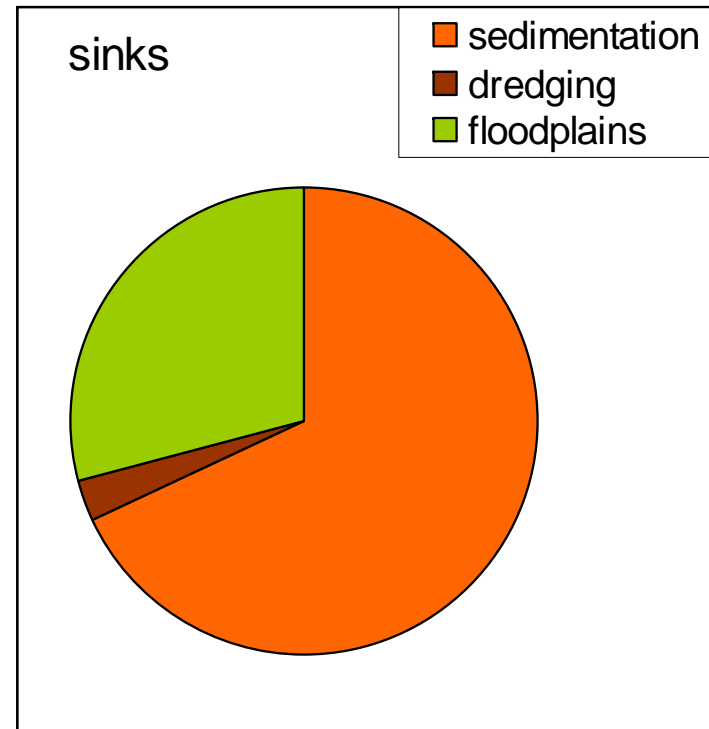
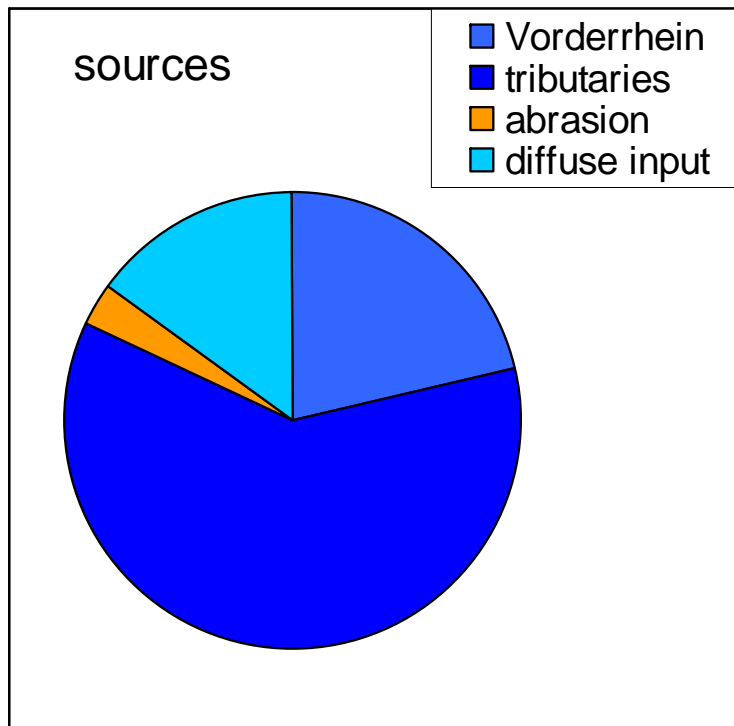
Clay/Silt



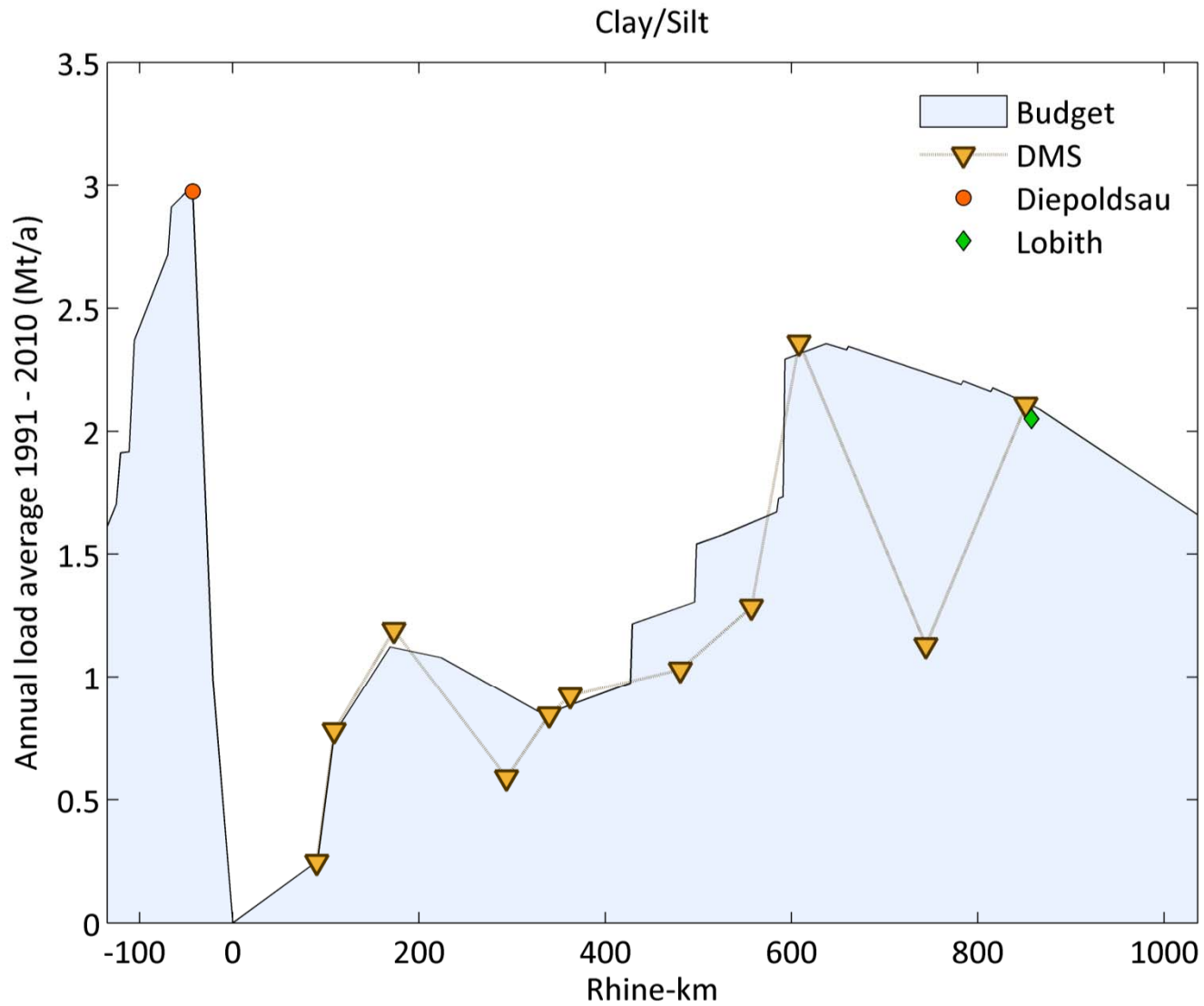
- no erosion!
- tributaries
 - diffuse input
 - abrasion

- sedimentation
- dredging
 - floodplains + groyne fields

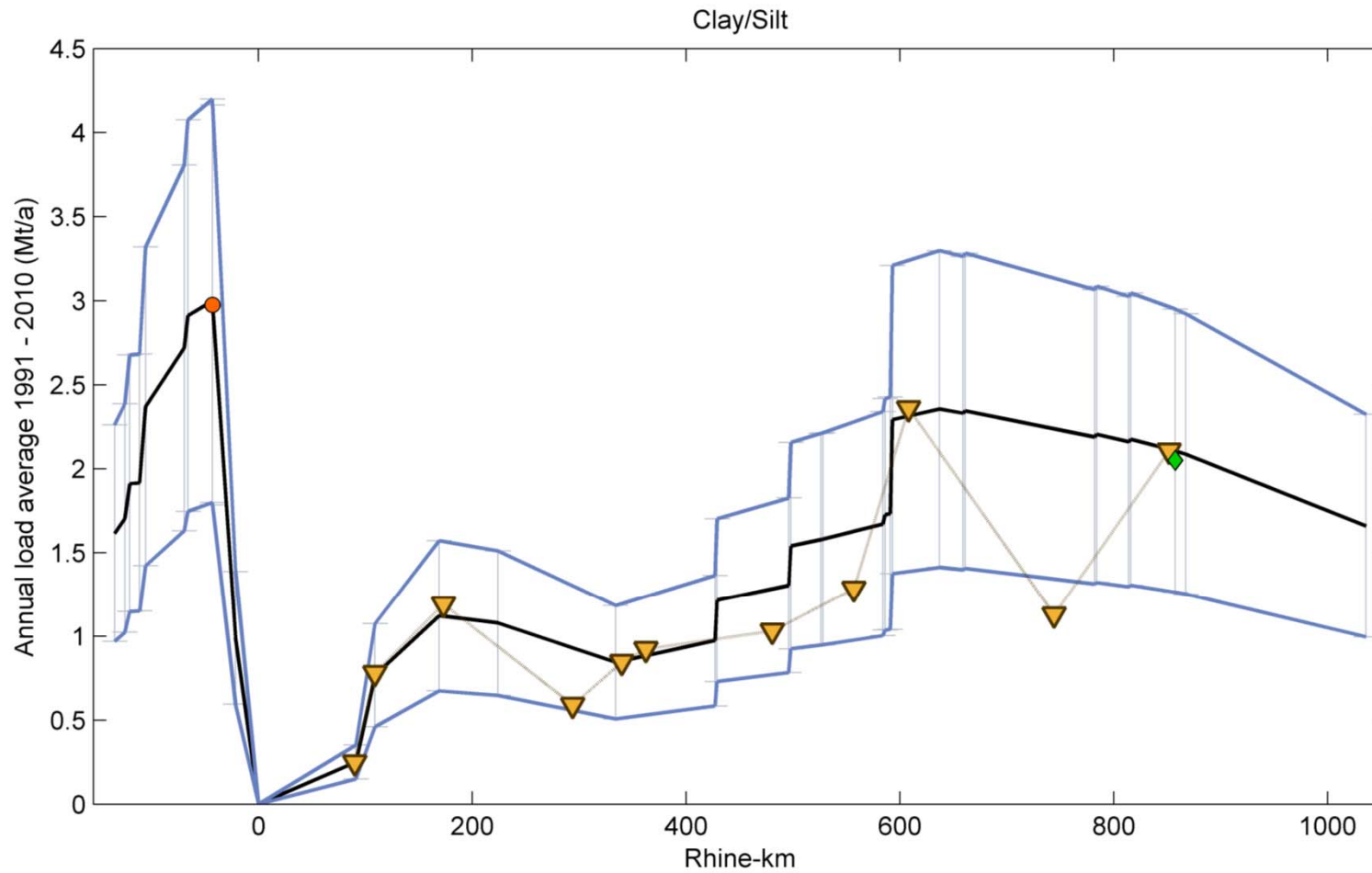
sources and sinks for fine sediments



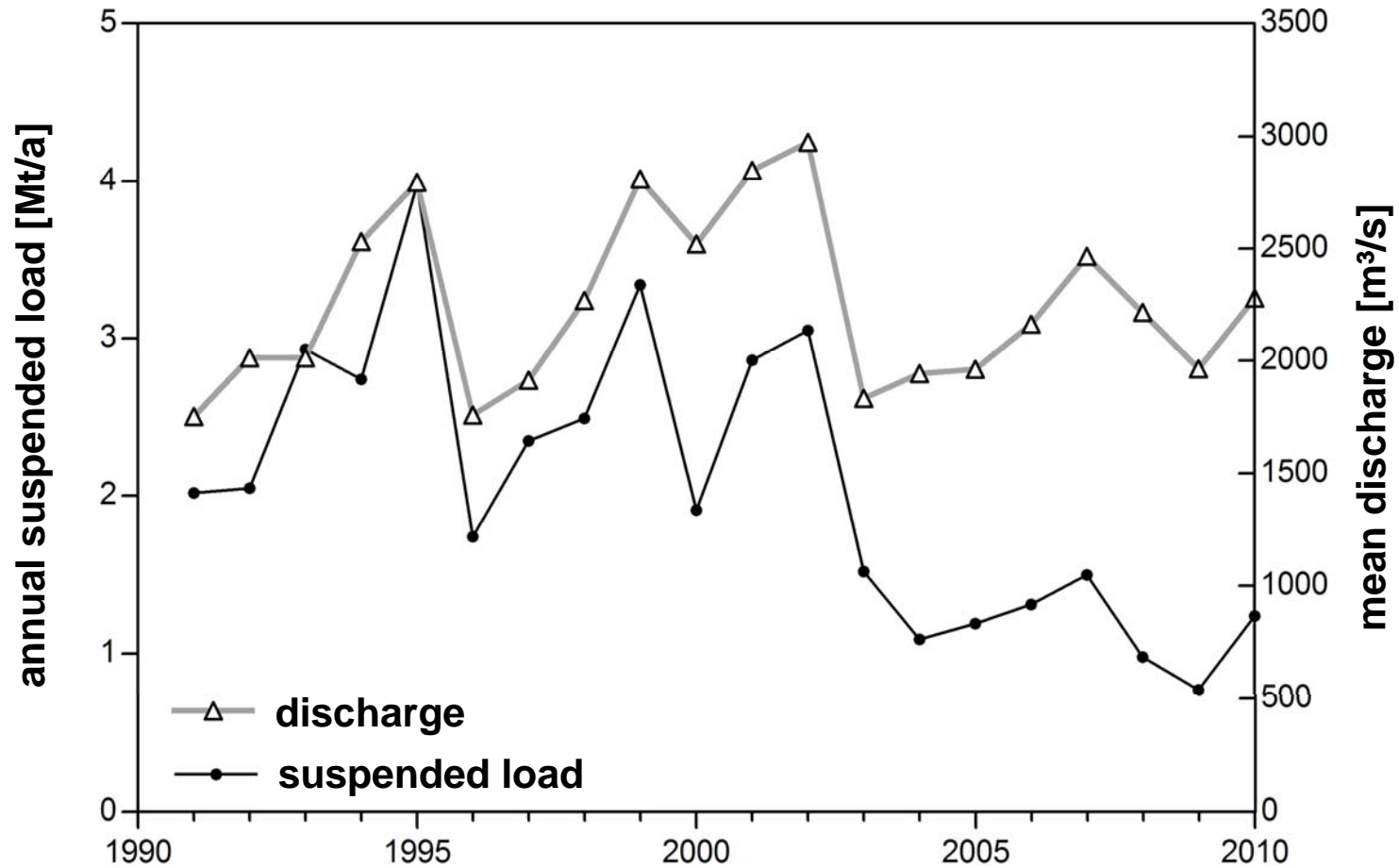
Sediment budget of fines - validation



Sediment budget of fines - uncertainties



annual suspended load at Lobith - trends



Frings et al. 2015

open issues/ questions

Alpine Rhine/Lake Constance:

- tributaries and sedimentation rate Lake Constance

Ober-/Mittelrhein:

- information on diffuse input

Niederrhein:

- abrasion from cinder; increase from Düsseldorf to Emmerich/Lobith
- value at Düsseldorf below uncertainty envelope (40%)

Upper/LowerDelta:

- ratio load/discharge at bifurcations / dredging in the channel
- sedimentation within the channel, echosounding monitoring

Monitoring:

- suspended load: tributaries and bifurcations
- diffuse input: Ober-/Mittelrhein and Duisburg
- echosoundings: Lake Constance, Upper and Lower Delta

Analyses:

- sediment continuity; present situation vs past/reference
- methodology available for other river catchments

Sediment management:

- transport path of clay/silt available for sediment quality issues
- understanding systems (Upper Rhine, Lower Delta) - > dredging



Thank you!

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