An evolution volume balance approach for determination of relevant discharge for bed load transport: example of Alpine river Saalach

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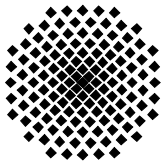
Najibullah Sadid, Felix Beckers, Markus Noack, Stefan Haun, Silke Wieprecht



Universität Stuttgart
Institut für Wasser- und
Umweltsystemmodellierung

Lehrstuhl für Wasserbau und
Wassermengenwirtschaft
Prof. Dr.-Ing. Silke Wieprecht

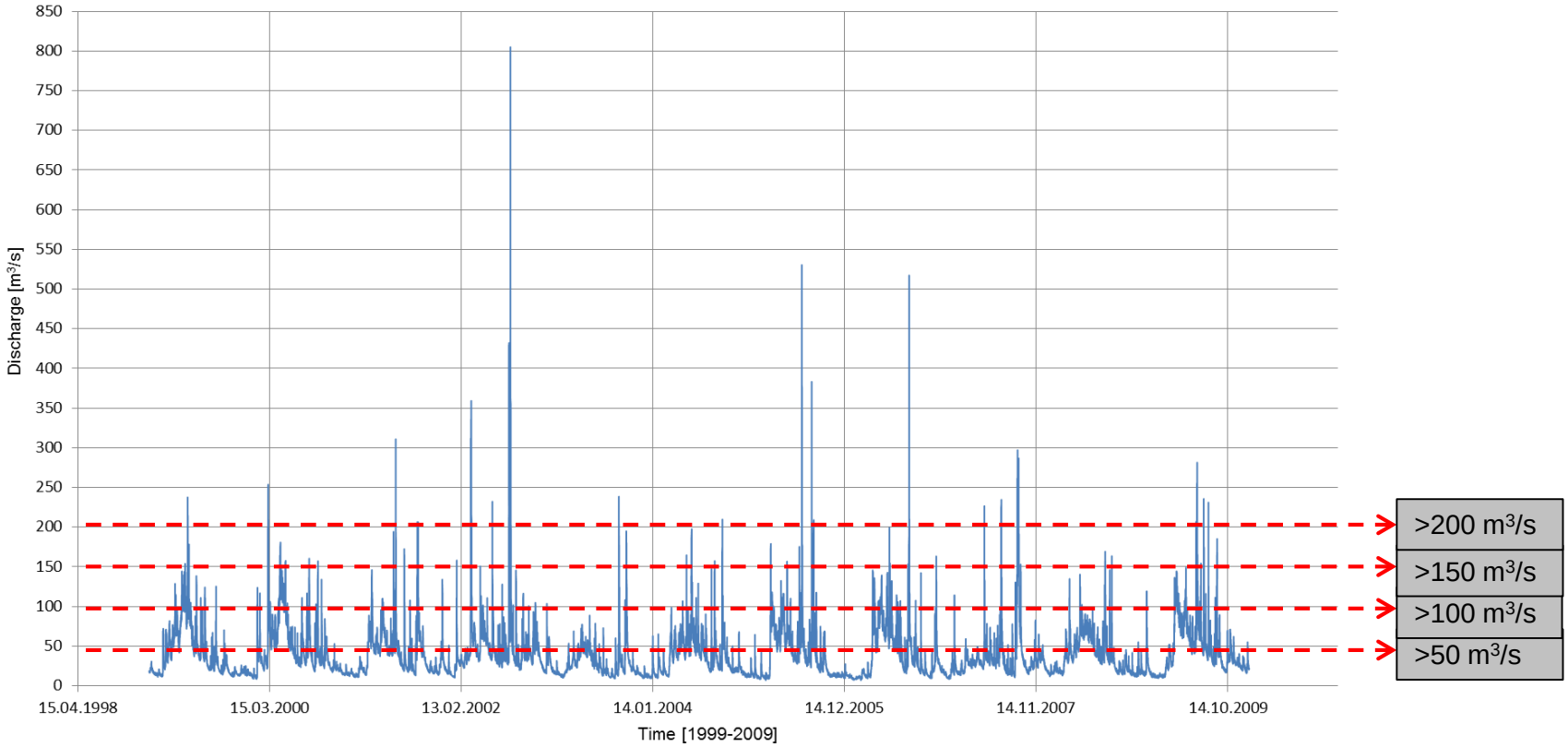
Agenda

- Introduction
- Study area
- Method
- Results
  - Evolution volume analysis
  - Bed load transport
  - Bed sediment sorting
- Conclusion

Introduction-Bed load relevant discharge

- Bankfull discharge
- Bed-forming discharge

- Bed Load relevant discharge

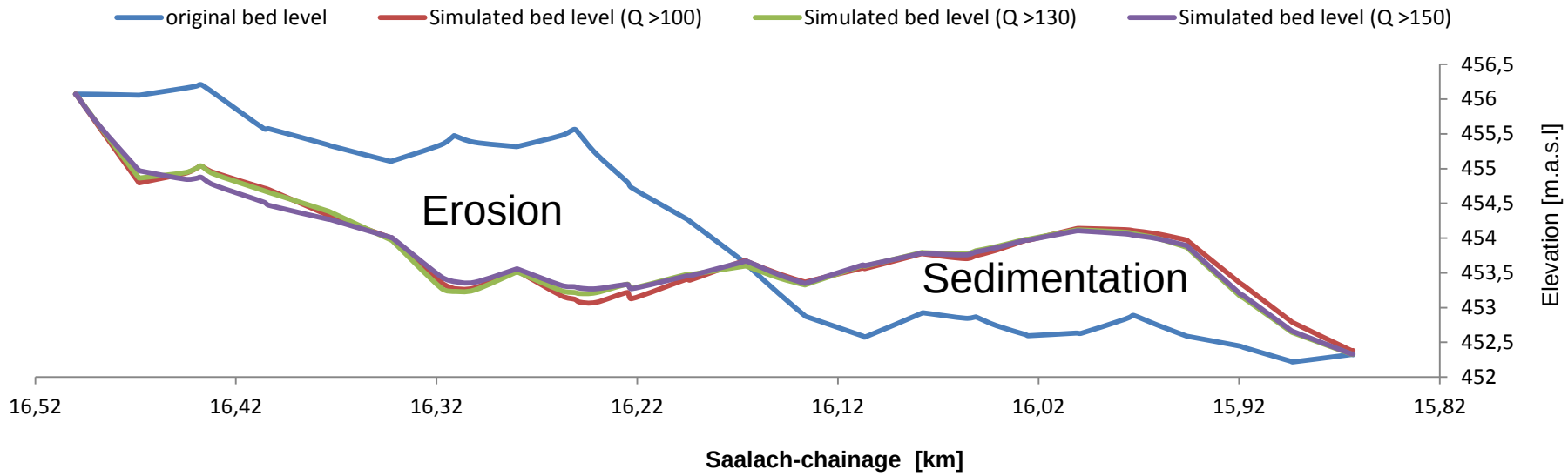


River Saalach hydrograph [1999-2009]

Introduction-Bed load relevant discharge

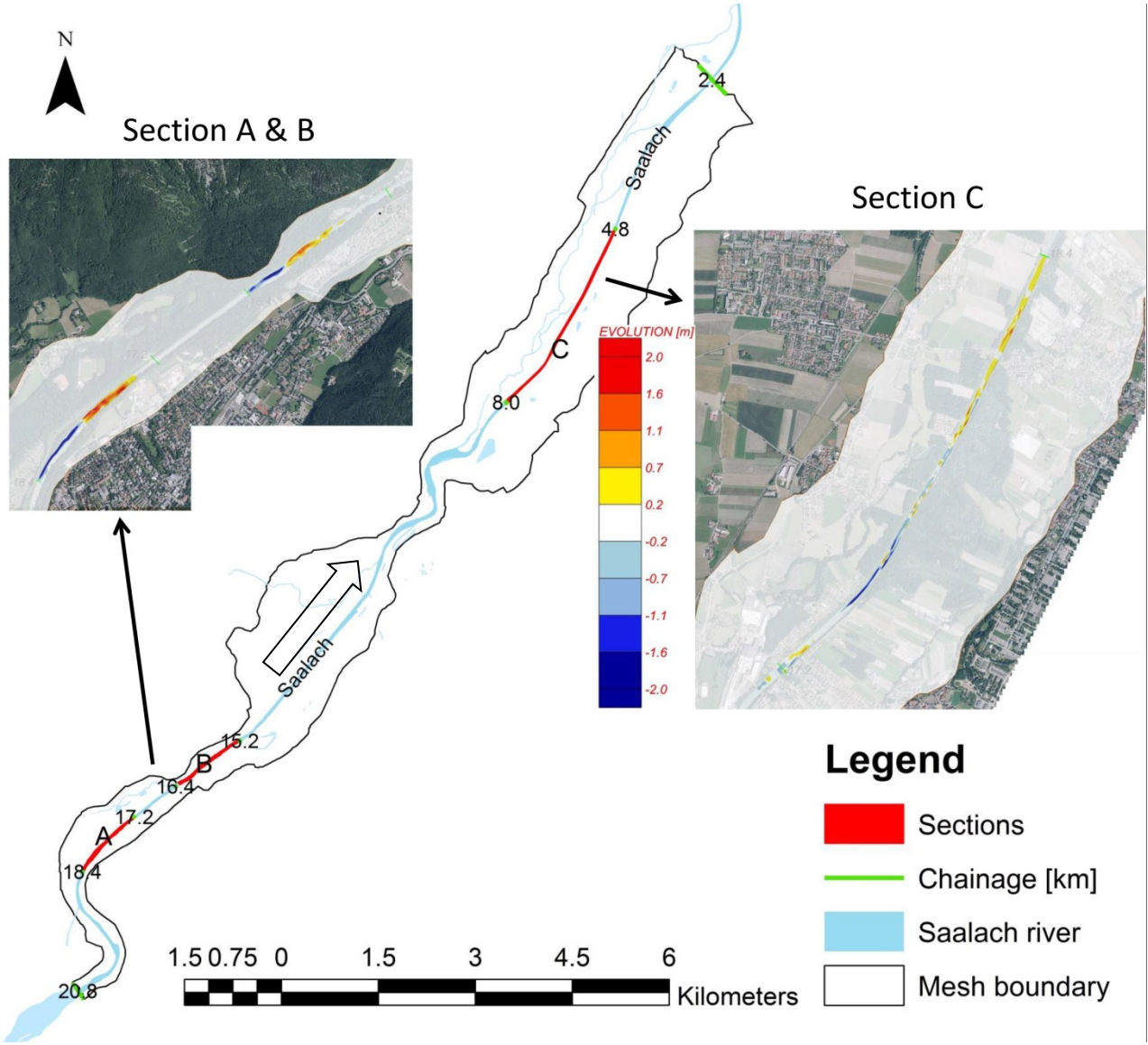
Approach:

1. **Evolution volume** :At which threshold discharge, the evolution (erosion and sedimentation volume) changes significantly
2. **Bed load transport** :At which discharge at the outflow of the model, the bed load transports becomes significant
3. **Bed sediment grain sorting** :Does the hydrograph reduction lead to coarsening or fining of the bed sediment grains



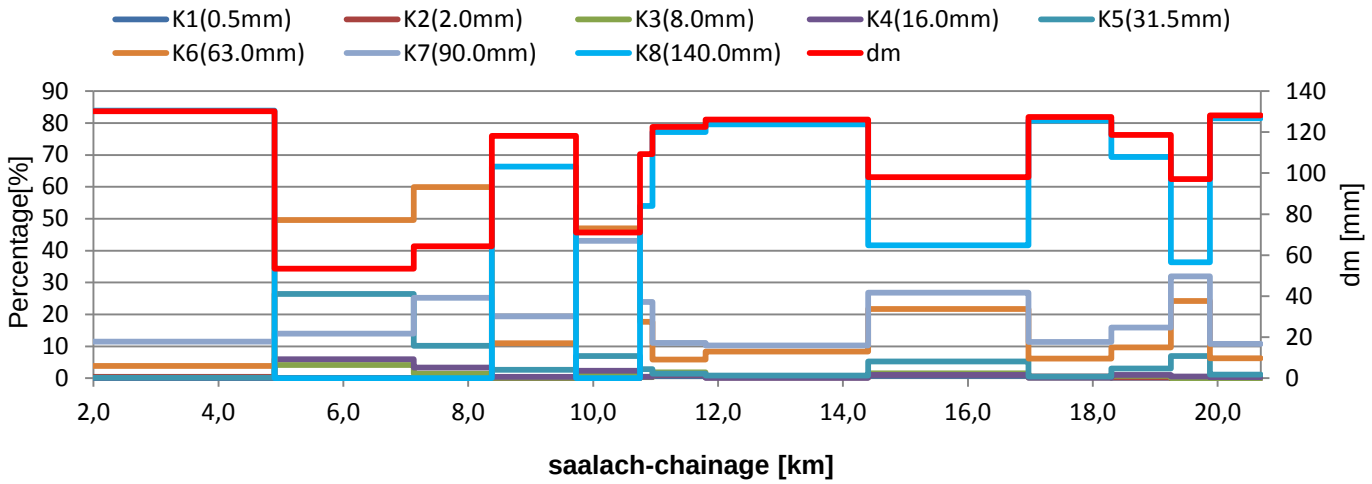
Study Area-River Saalach

- Average daily discharge: 39 m^3/s
- HQ_{100}: 917 m^3/s
- Length: 18.4 km
- Catchment area: 1,118 km^2
- Slope: 4.2 ‰

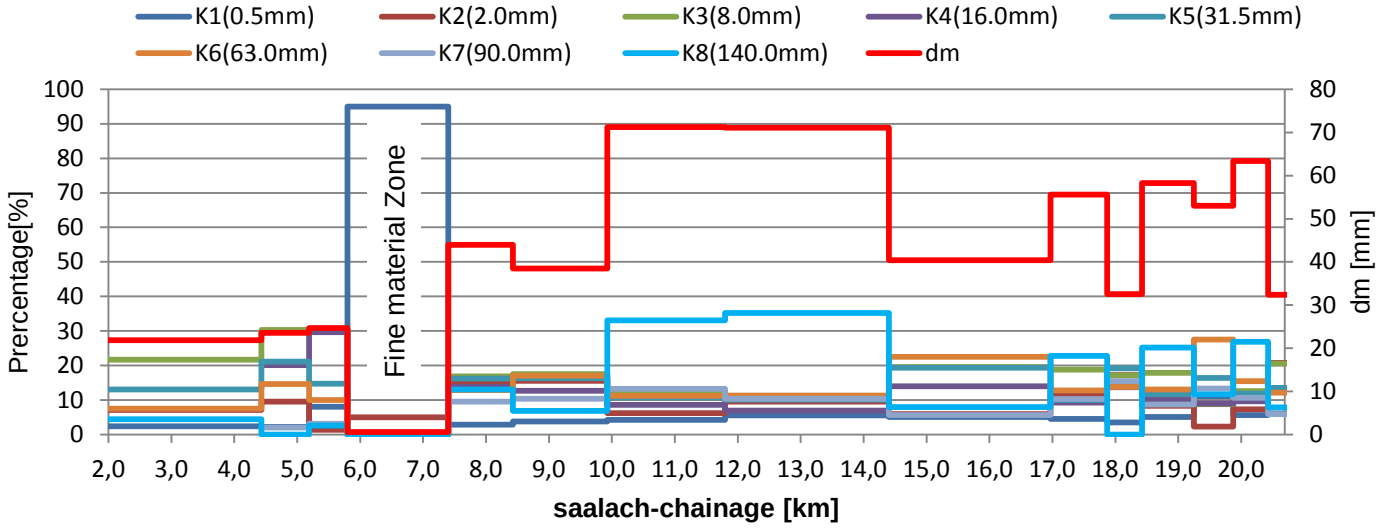


Method- Model inputs

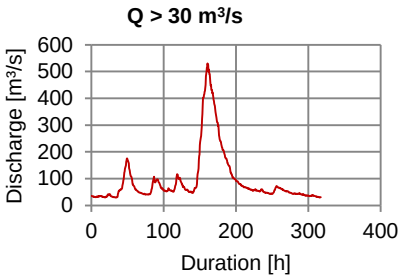
- 1st-Active Layer spatial grain size distribution

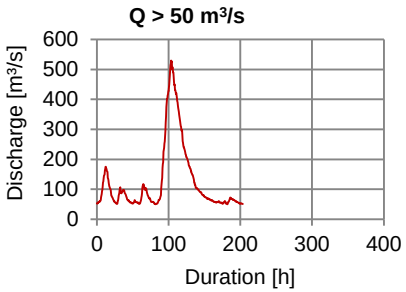


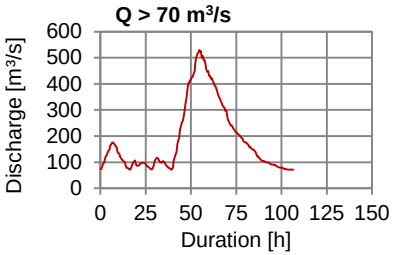
- 2nd- Active Layer spatial grain size distribution

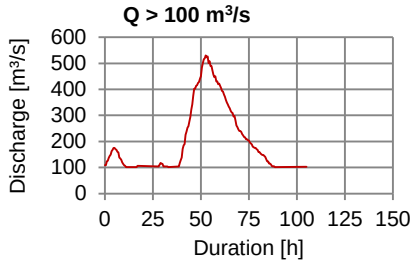


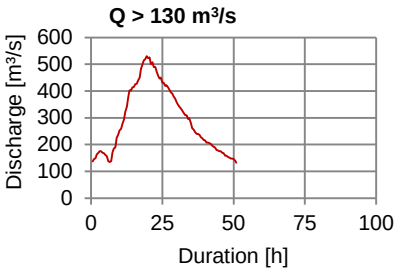
Method-Hydrograph reduction

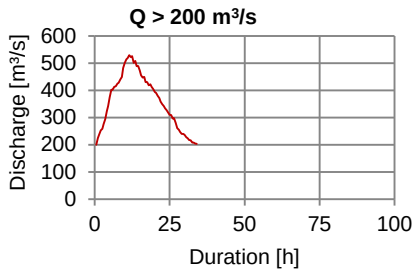


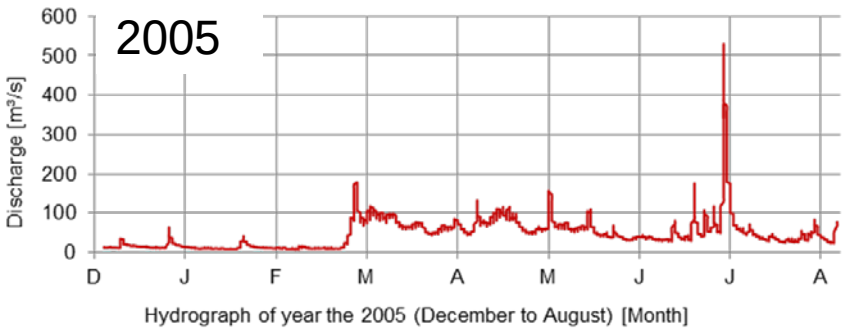


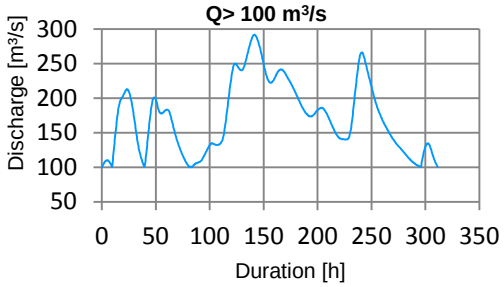


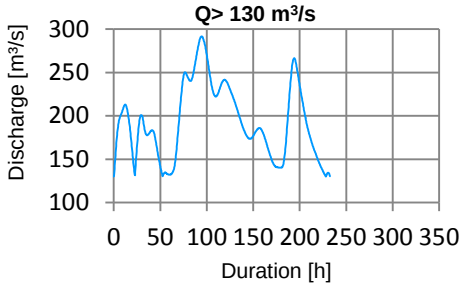


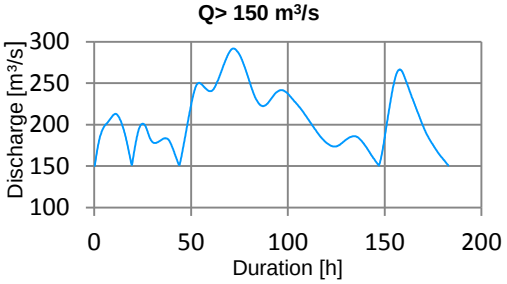


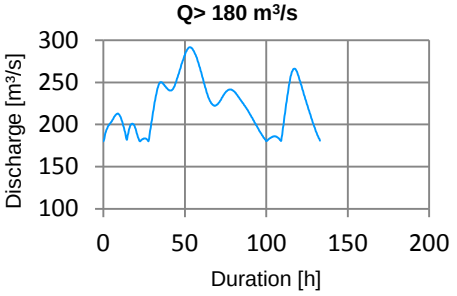


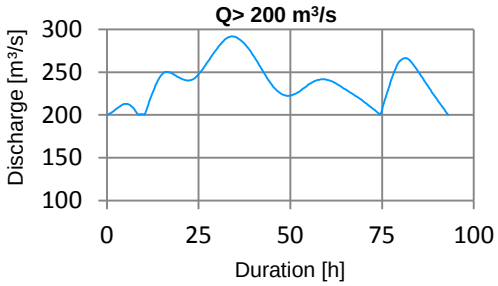


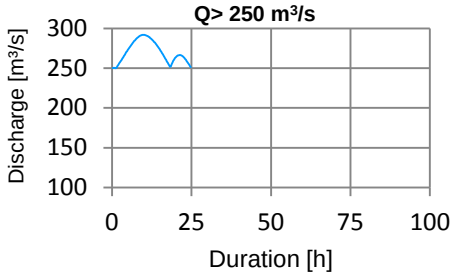


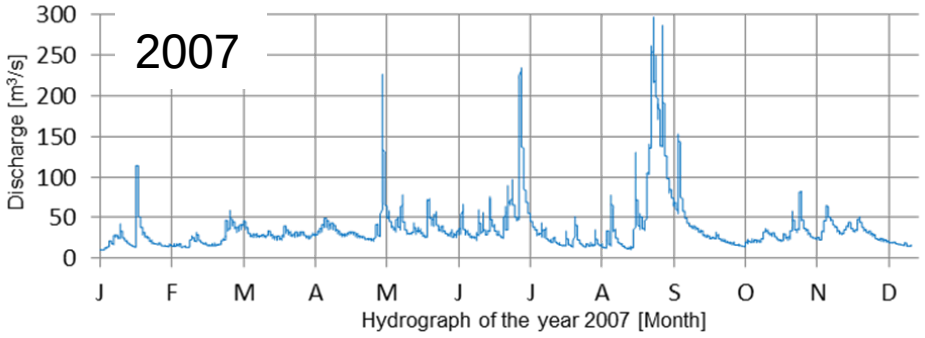






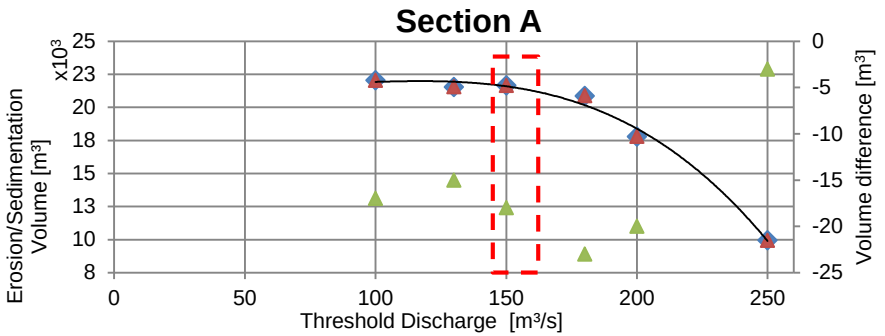


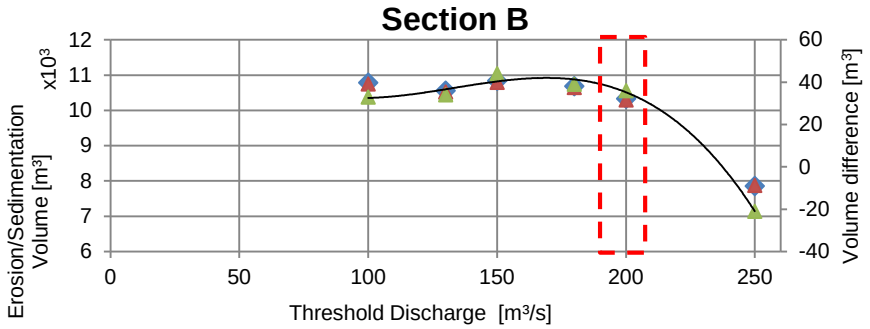


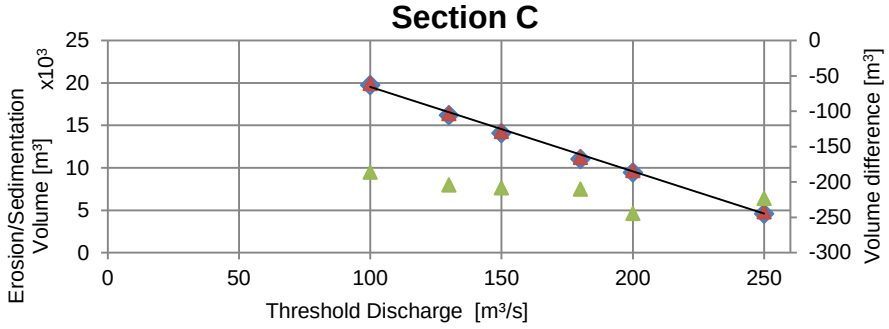


Result- Evolution volume analysis

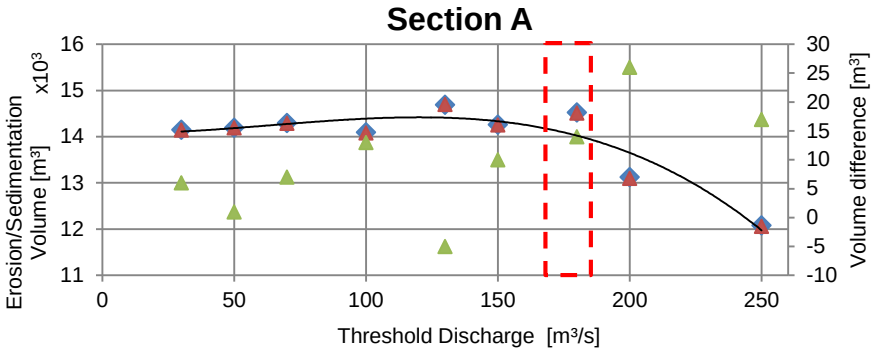
Model results with reduced sets of hydrographs of the year 2007

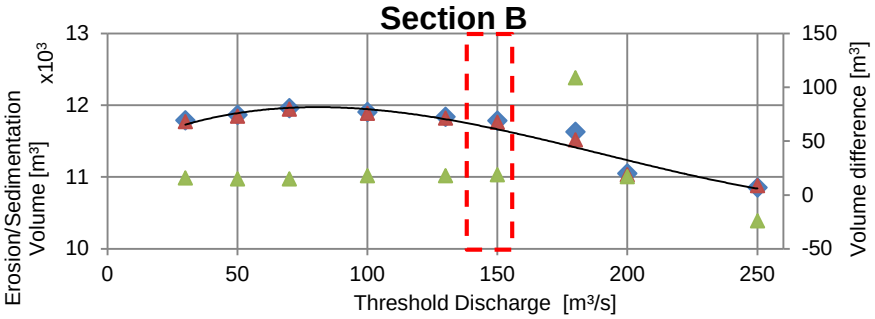


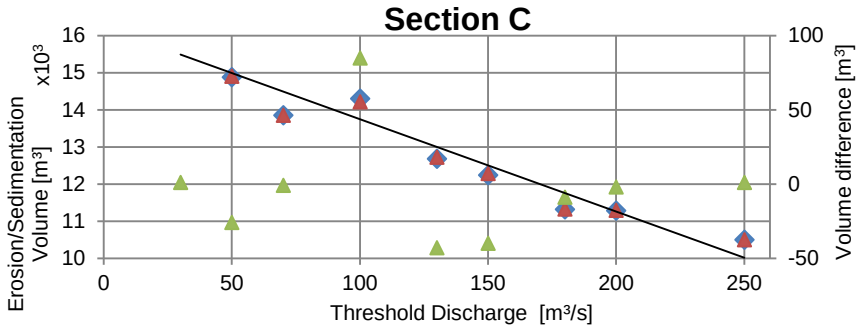




Model results with reduced sets of hydrographs of the year 2005

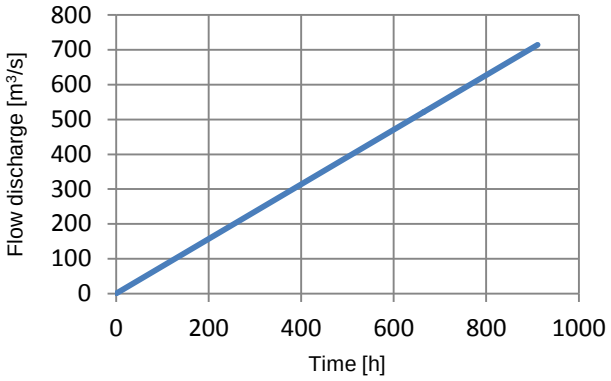


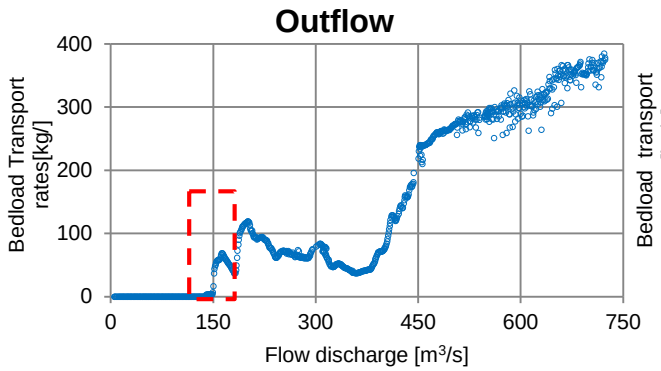


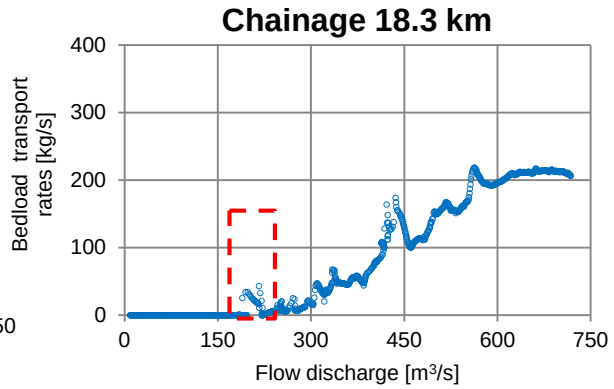


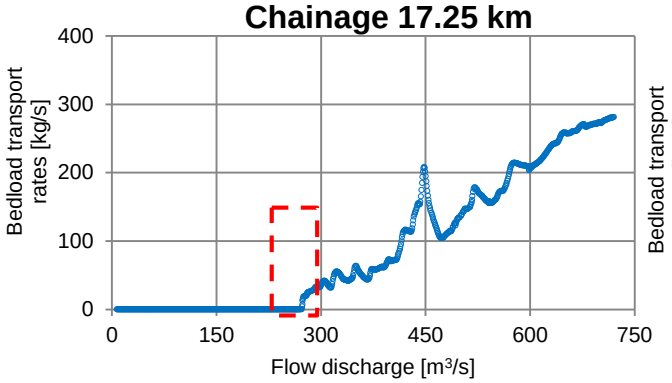
Erosion [m³] Sedimentation [m³] Difference (Erosion-Sedimentation) [m³]

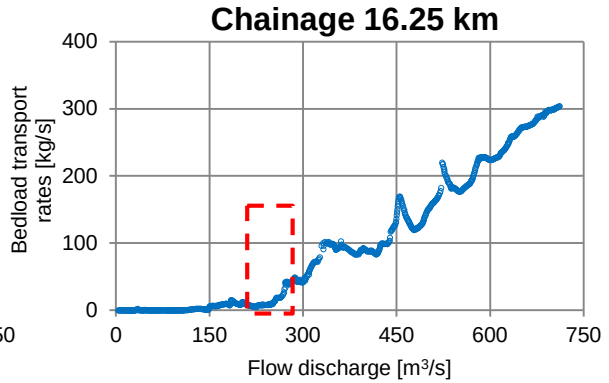
Bed load transport

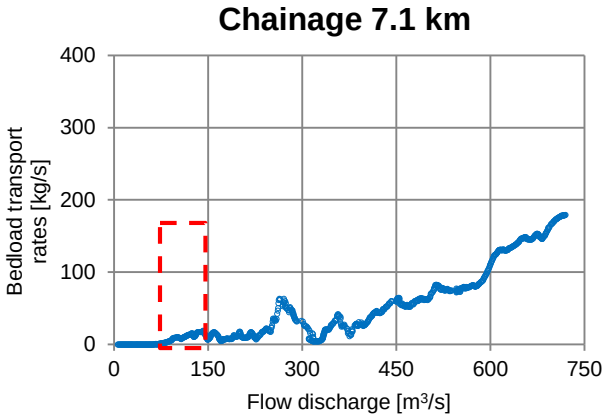








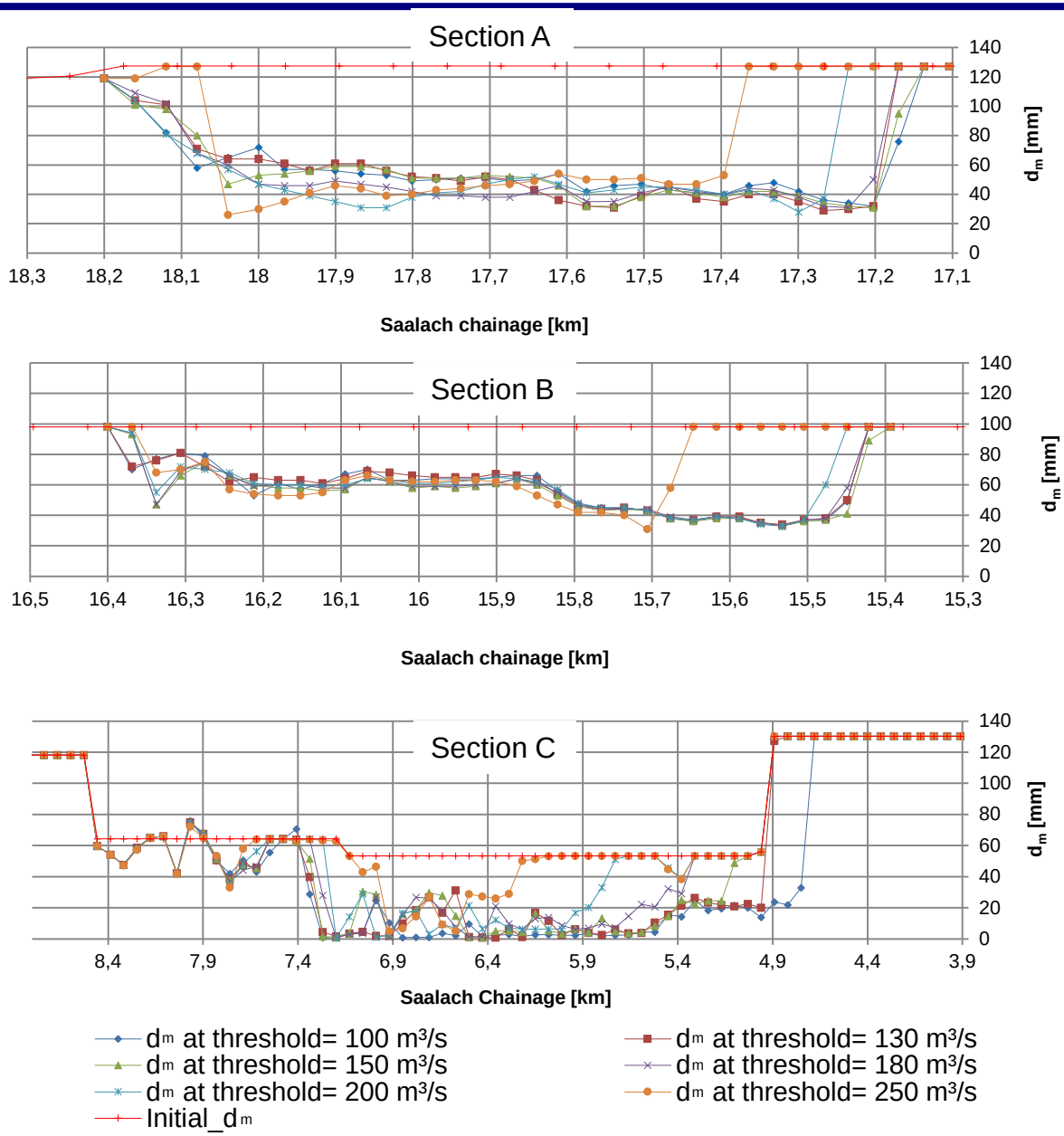




- Outflow (Q= 150 m^3/s)
- Sections A & B (Q=200 to 300 m^3/s)
- Section C (Q=75 to 150 m^3/s)

Result- Bed sediment grain size sorting

- Fining of bed sediment from initial condition -> due to mixing with a second finer layer
- But no specific coarsening or fining of bed sediment among different simulations can be identified



Conclusion

- The evolution volume analysis shows a threshold discharges in the range of 100 to 130 m^3/s.
- If the fine material zone is excluded from the analysis, the threshold can further be increased to 150 to180 m^3/s.
- Bed load transport starts at discharge ranges of 150 m^3/s to 280 m^3/s at the outflow and most of inner sections. However,for the area containing fine material, the bed load transport starts already at a discharge of 75 to100 m^3/s.
- No specific coarsening or fining of bed sediments could be identified for all threshold discharges.
- The threshold discharges determined by this method maybe applied for further investigation of river Saalach without affecting the quality of results.
- A transferablity to other examples will be tested in future works.