Evaluating The Joint Influence Natural Lake and Navigation Dams on the sediment dynamics in the Upper Mississippi River

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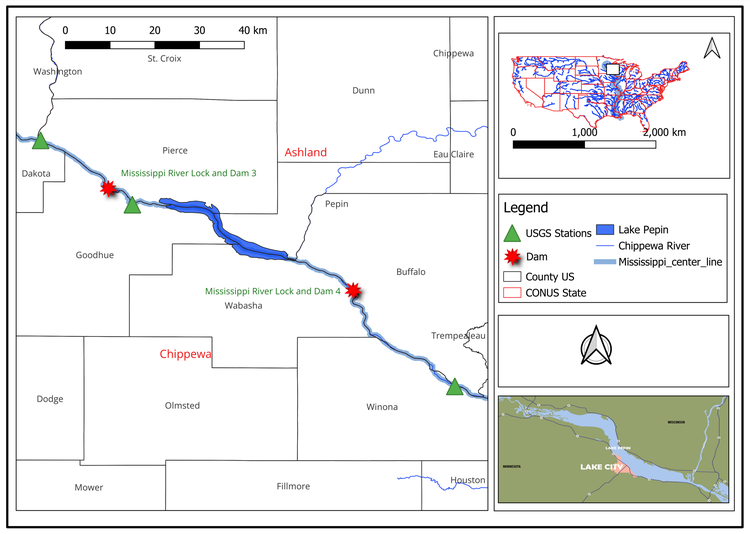
Introduction

Rivers transport sediment critical for ecosystems, deltas, and floodplain health.

KEY ISSUES:
- Dams trap 25-30% of global sediment, altering downstream dynamics.
- Natural lakes (Lake Pepin) act as sediment sinks but are understudied.
- Combined effects remain poorly understood.

WHY THIS MATTERS:
Suspended sediment affects water quality, aquatic habitats, navigation, and ecosystem health. This study examines how the compound system of Lock & Dam 3 - Lake Pepin - Lock & Dam 4 reshapes sediment patterns.

Study Area



- ❑ Lock and Dam 3 is near Red Wing, Minnesota
- ❑ Lock and Dam 4 is downstream near Alma, Wisconsin
- ❑ Lake Pepin
  1. Formed ~19,600 yrs ago
  2. length: ~34 (21 mi)
  3. Width: 1–2 mi km
  4. Depth: avg. 5.5 m, max 18m

Research Question

How does the Lock & Dam 3 – Lake Pepin – Lock & Dam 4 system reshape SSC?

- ❑ RQ1: How far downstream does SSC recover to its upstream reference?
- ❑ RQ2: How does SSC vary with Lake Pepin depth?
- ❑ RQ3: Do watershed sediment exports explain spatial and temporal SSC and suspended sediment flux (SSF) patterns?

Data and Tools

1. Satellite SSC dataset (RivSED 1984-2018)
2. NHD river reach Mississippi river
3. Discharge Data (Insitu Data)
4. Bathymetric Data 5 feet resolution

i.) Rainfall Erosivity (R-factor)

ii.) Soil Erodibility (K-factor)

iii.) Land Use Land Cover (LULC)

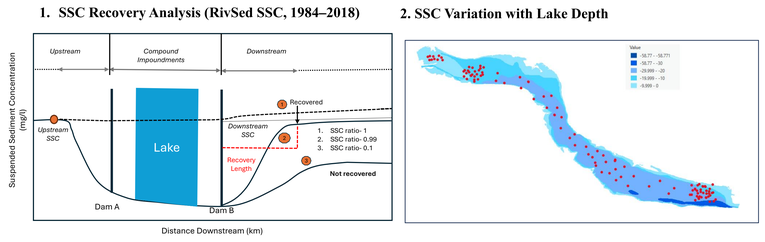
iv) Digital Elevation Model (DEM)

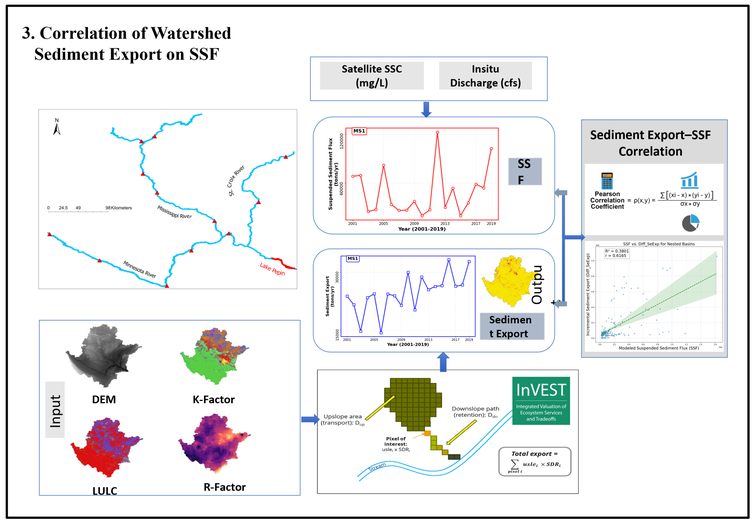
python™

ArcGIS Pro

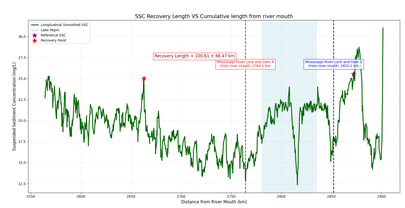
InVEST
Integrated Valuation of Ecosystem Services and Tradeoffs

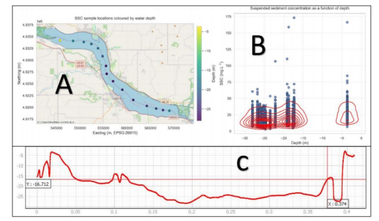
Methodology

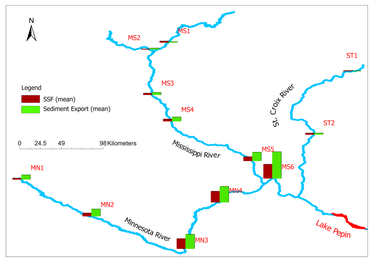


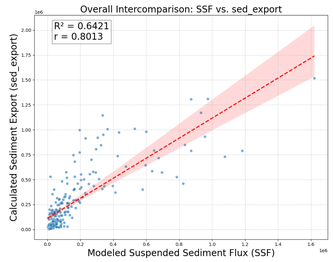


Preliminary Results









Conclusion

- ❑ SSC recovery downstream of L&D 3 – Lake Pepin – L&D 4 takes ~100 km.
- ❑ Landsat-derived SSF aligns well with InVEST SDR sediment export (r = 0.80, R^2 = 0.64).
- ❑ Correlation for each stations show spatial variability (r = 0.35–0.74).
- ❑ Findings highlight the need for targeted, seasonally timed sediment management.

References

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Acknowledgment

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