

# **Evaluating Visual Classification of Suspended Sediment – Discharge Hysteresis via Crowdsourcing and In-Stream Monitoring**

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MANDAR DEWOOLKAR, DONNA RIZZO

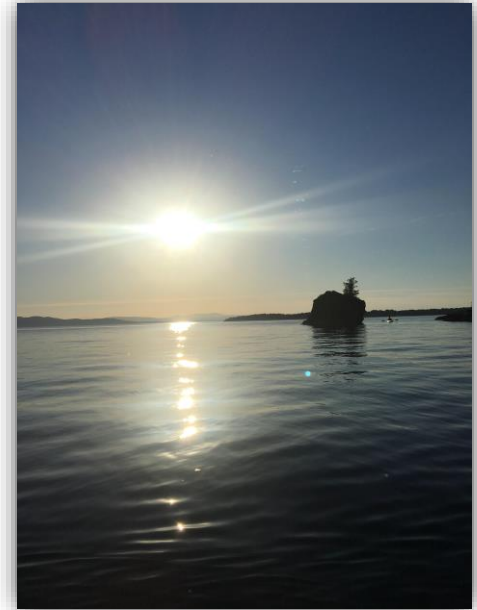
UNIVERSITY OF VERMONT



# Introduction

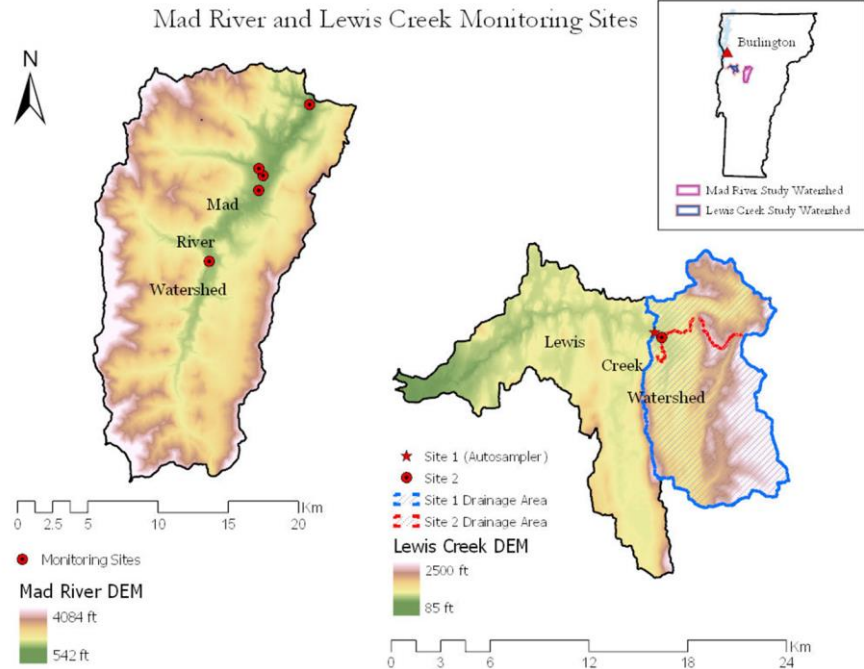


- **Goals**
  - Reliability
  - Consistency
  - Efficiency
- **Why?**
  - Understand
  - Reveal
  - Address
- **How?**
  - Study
  - Categorize
  - Characterize

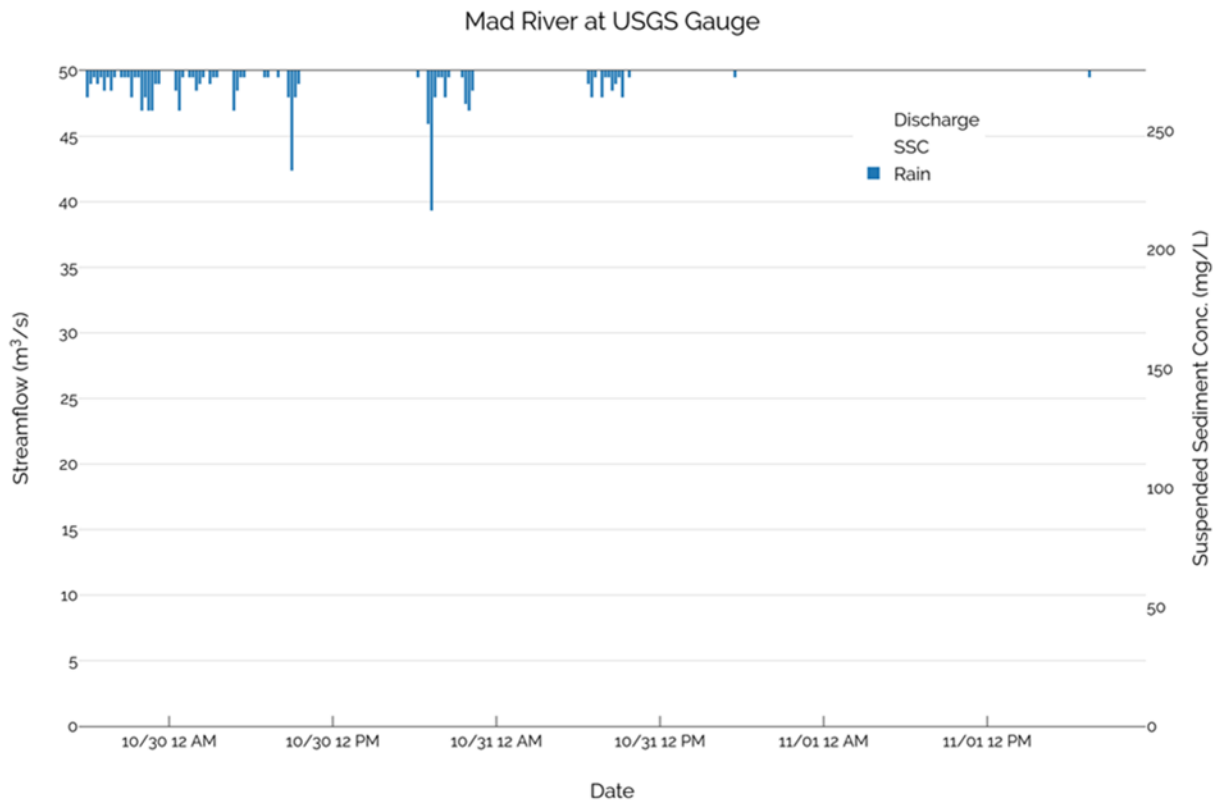


# Background & Study Site

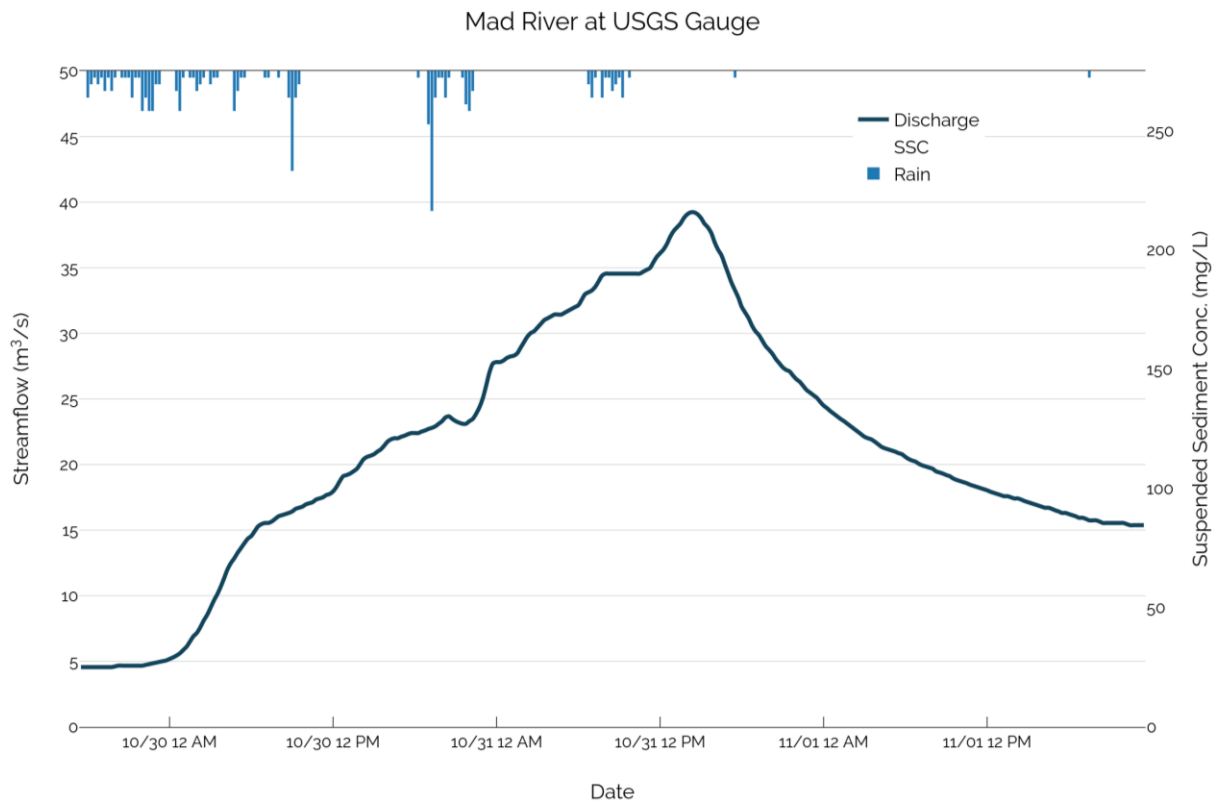
- Two study subcatchments
  - Mad River (left)
  - Lewis Creek (right)
- Generated hysteresis plots for Mad River data
- Focus on soil groups and land cover



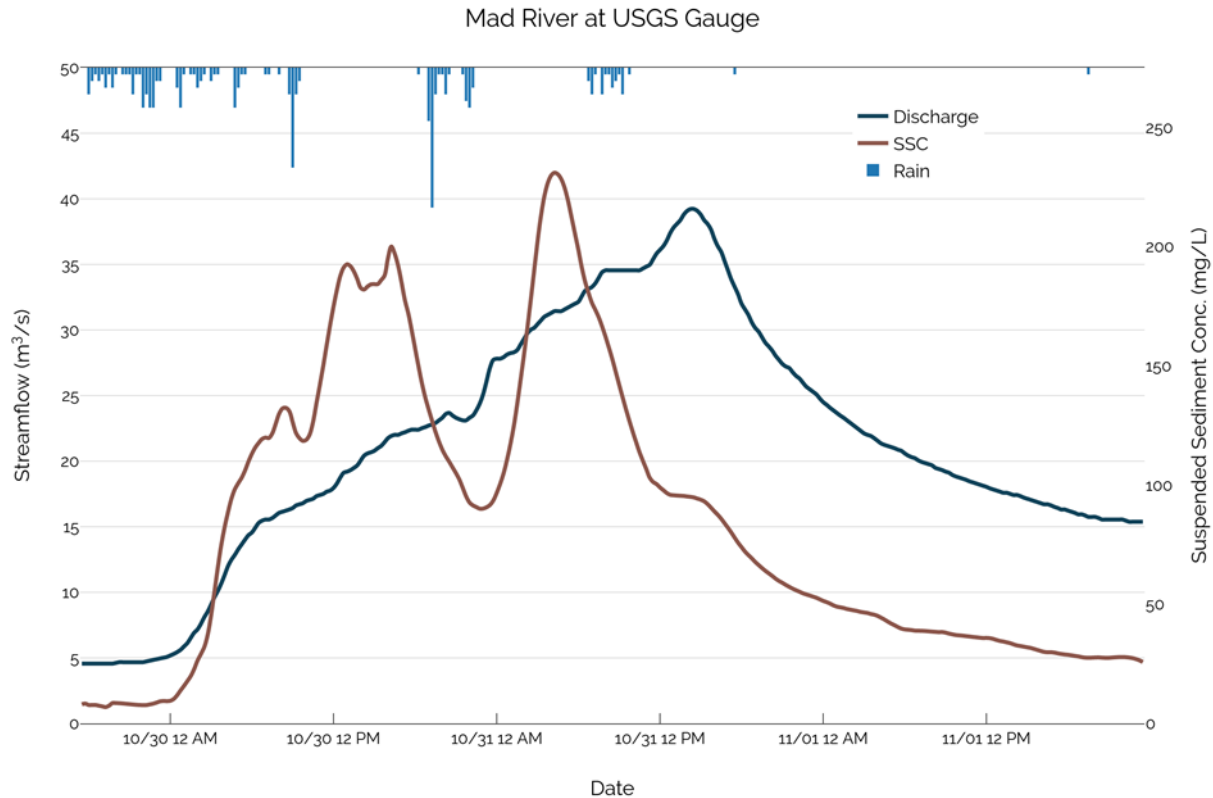
# Hysteresis, What is it?



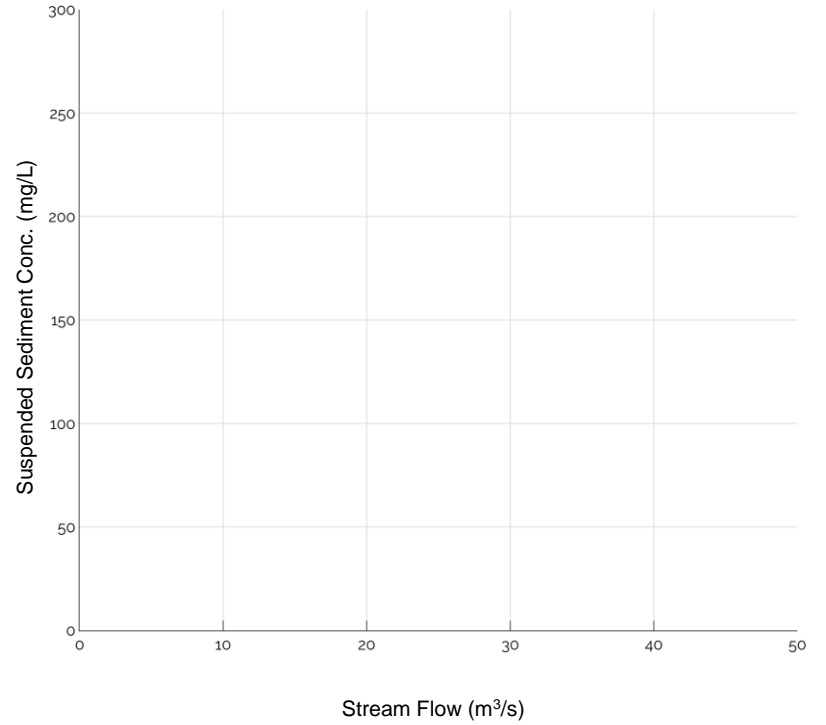
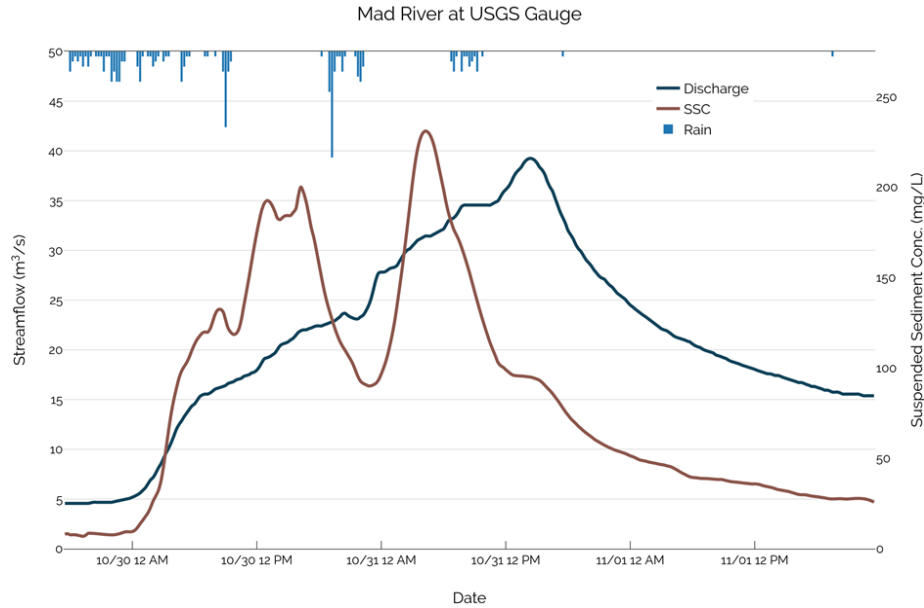
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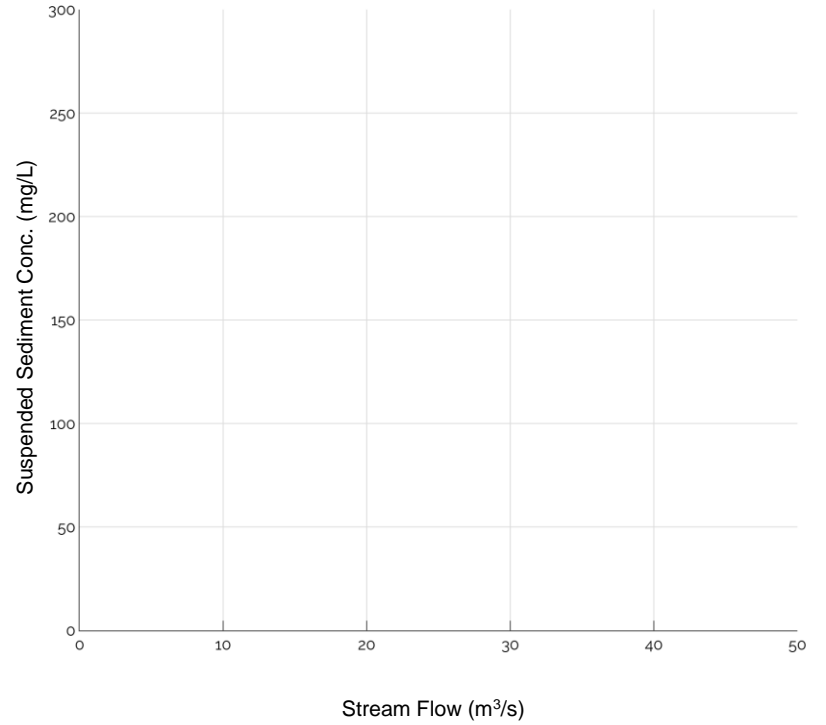
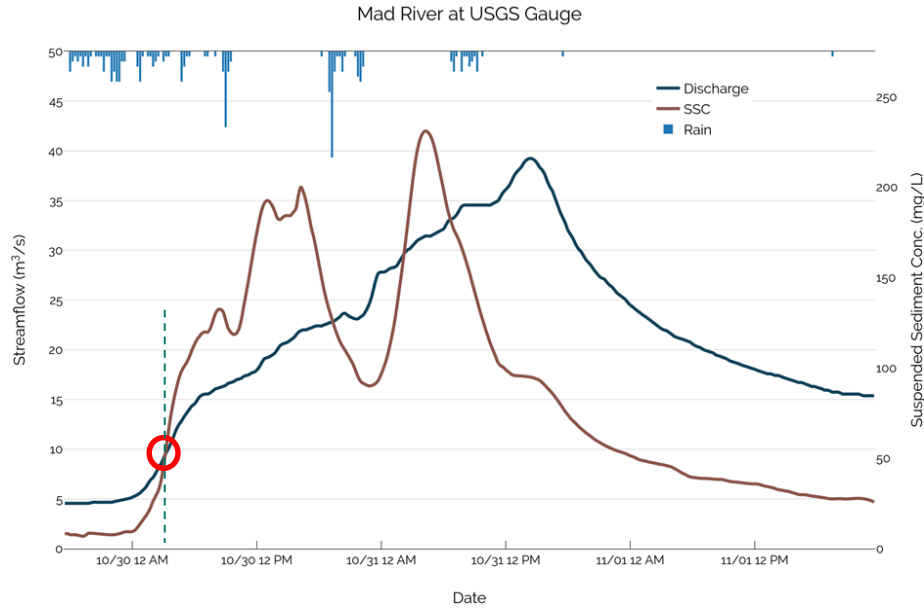
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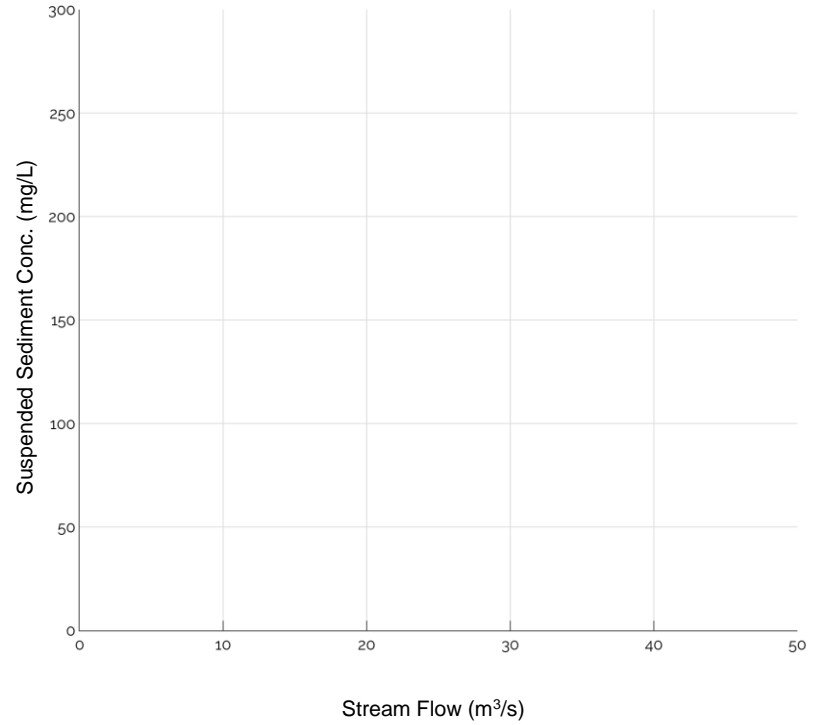
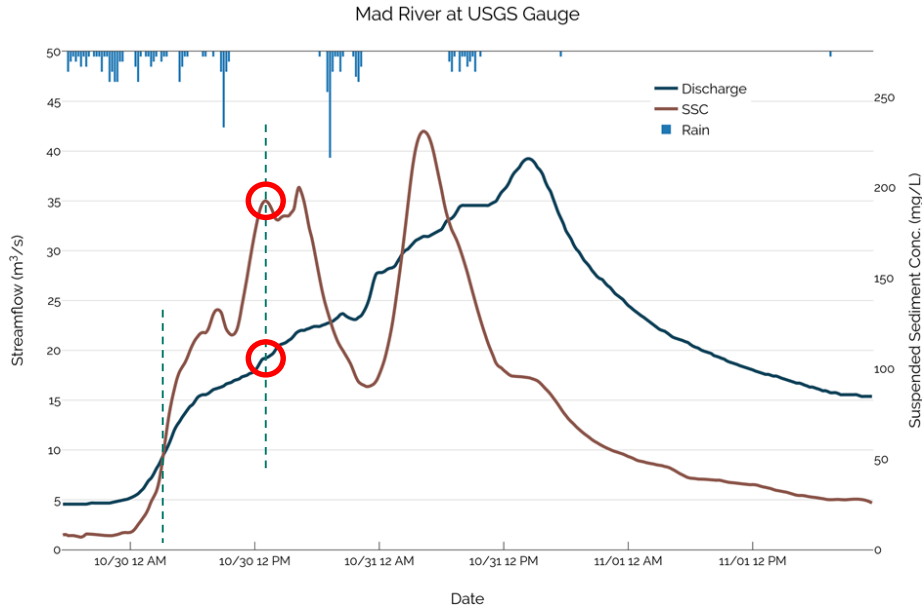


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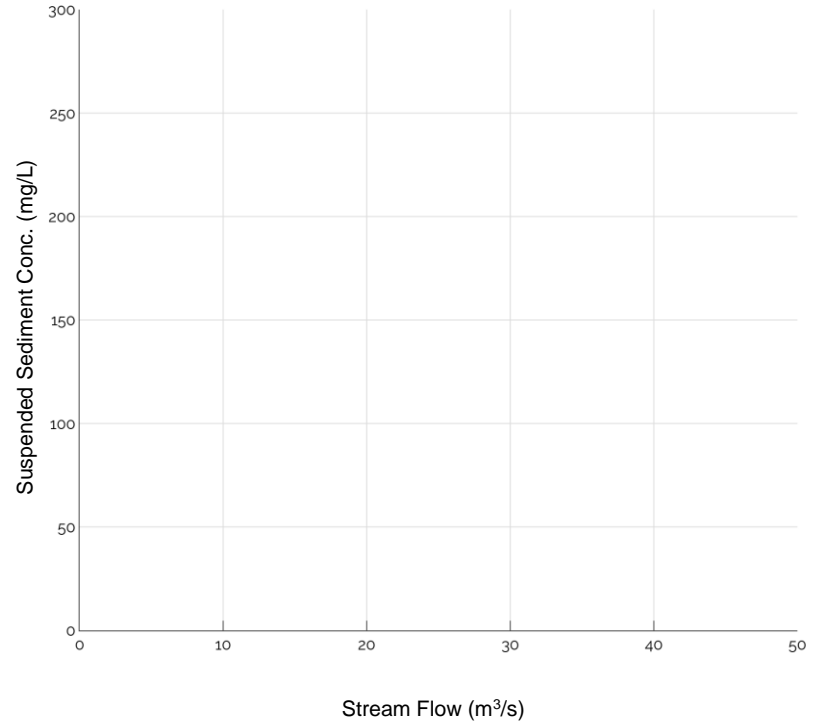
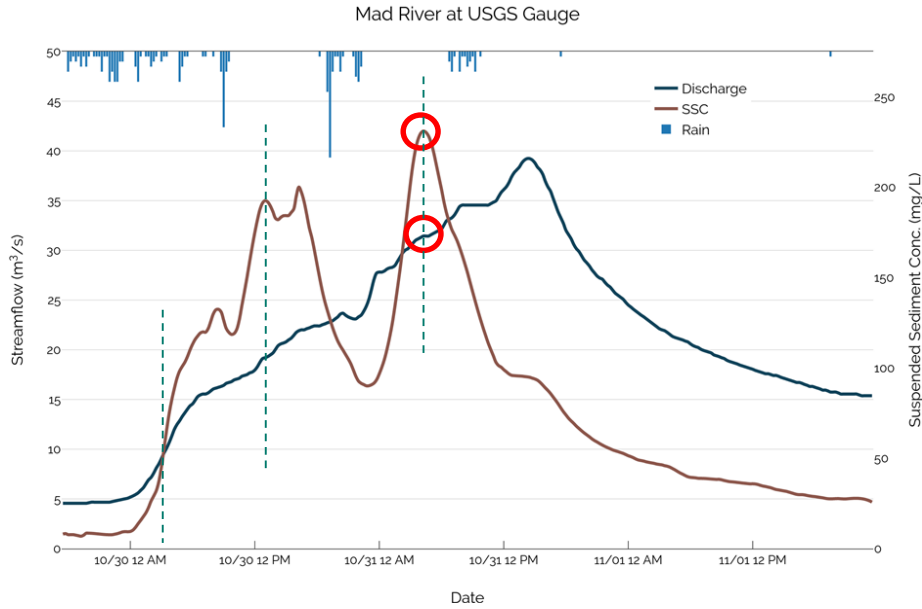




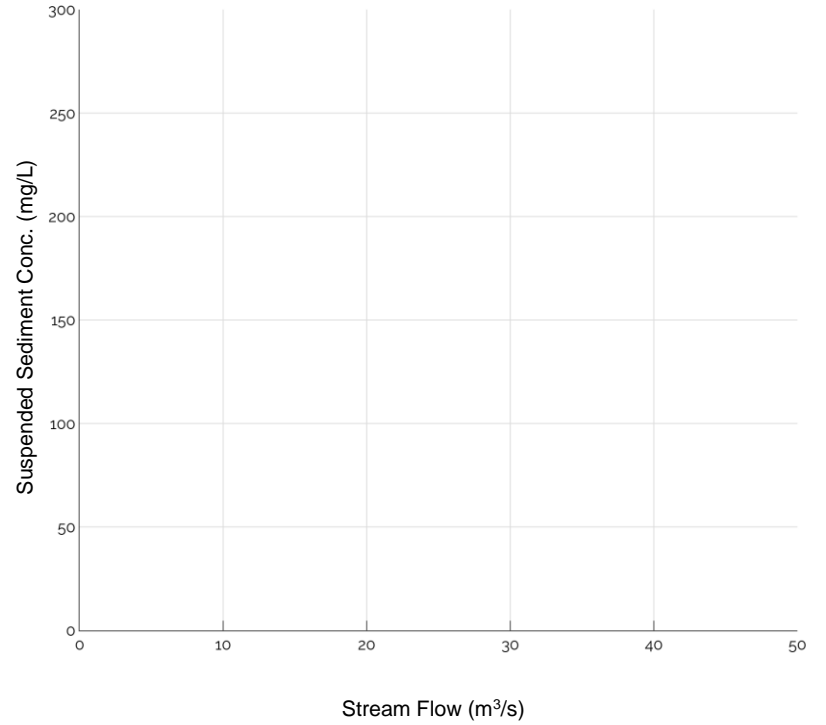
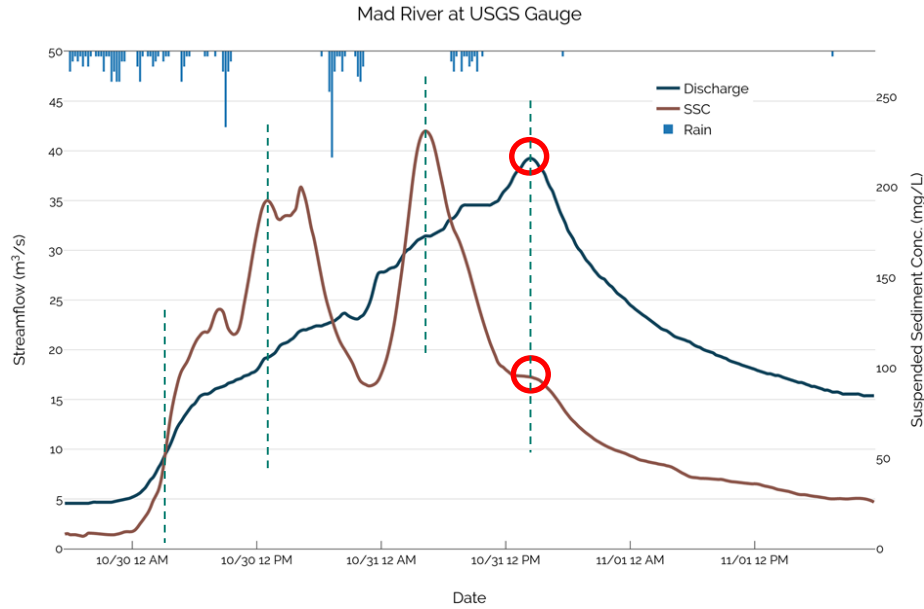
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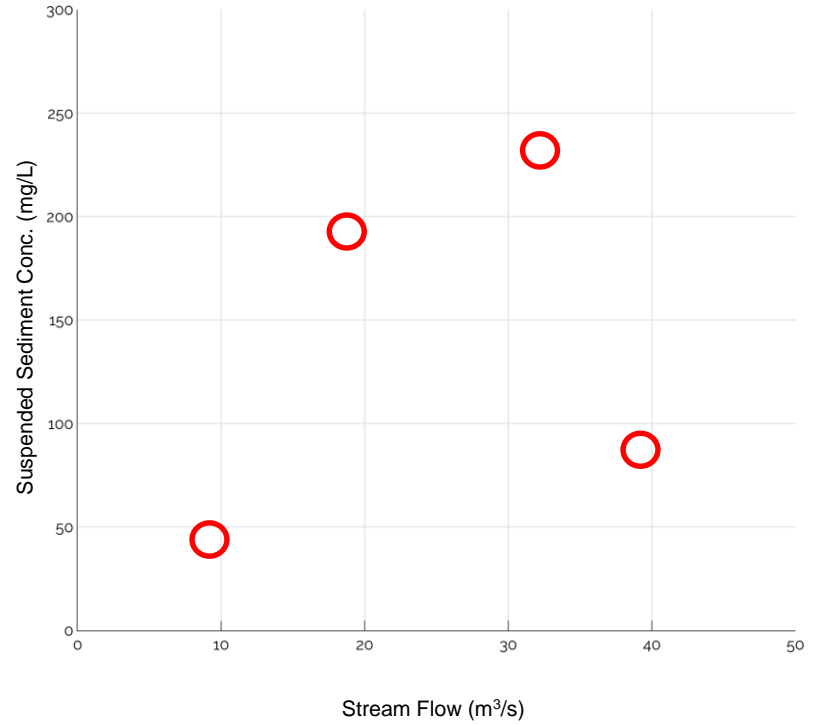
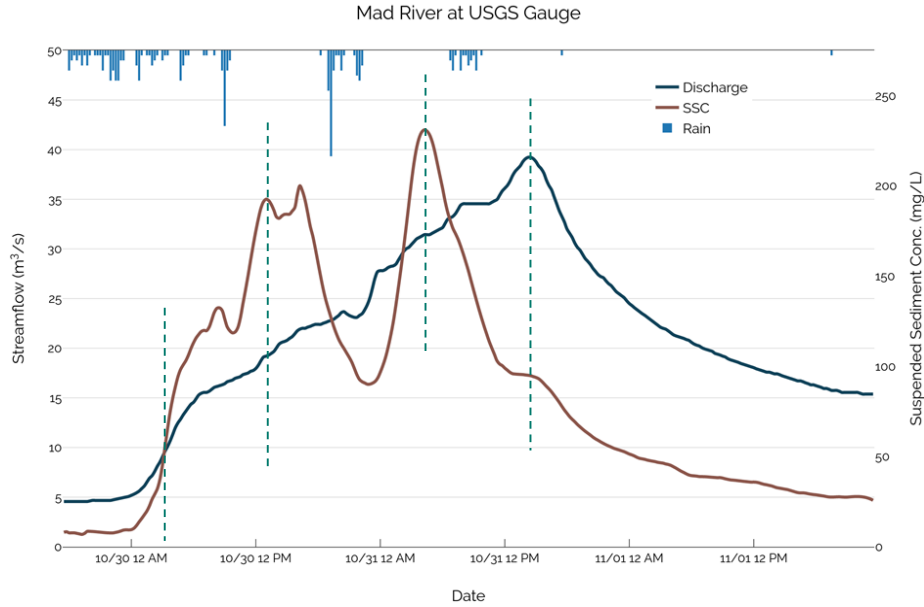
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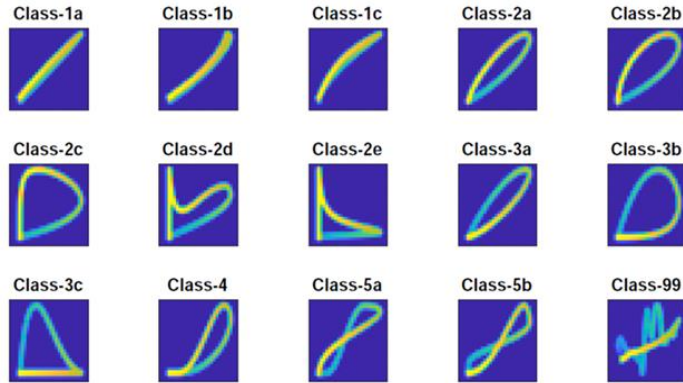
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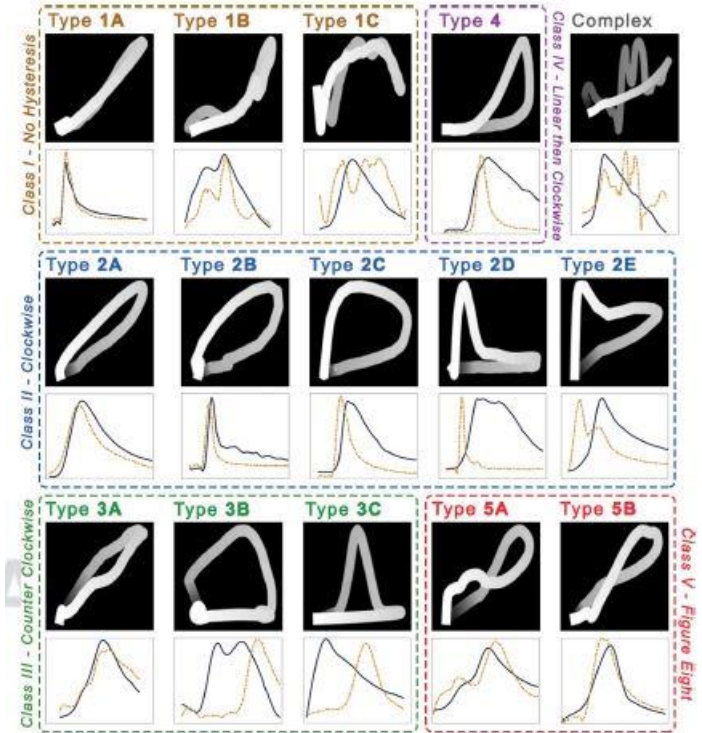


# Methods



Original Hamshaw classification key

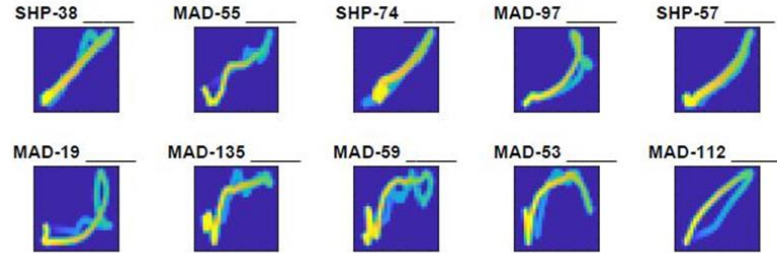
Hamshaw et. al., (2018) “A New Machine-Learning Approach for Classifying Hysteresis in Suspended-Sediment Discharge Relationships Using High-Frequency Monitoring Data”



Mad River hysteresis classification with corresponding SSC-Q plot

# Methods

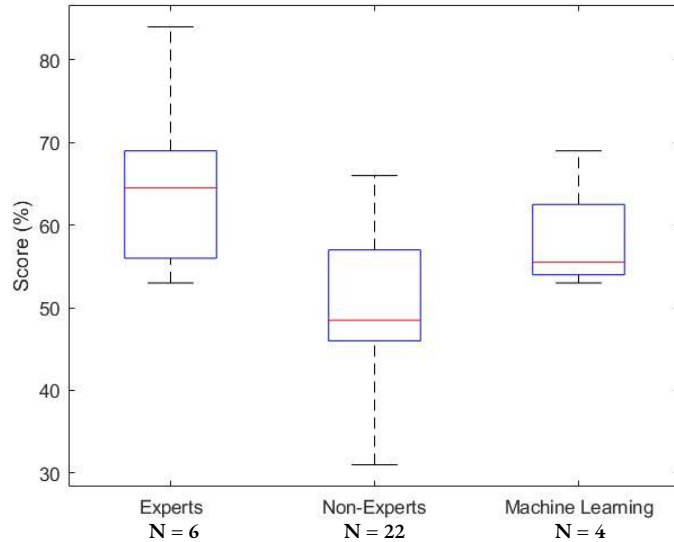
- Hysteresis patterns identification test
  - 6 experts and 22 non-experts
  - Hamshaw original labeling/classification key
- Statistical analysis
  - Identify problematic hysteresis events
  - Weighted expert results
- Install turbidity monitors in Lewis Creek
  - Generate and validate SSC-Q hysteresis



Sample of hysteresis classification test



# Results



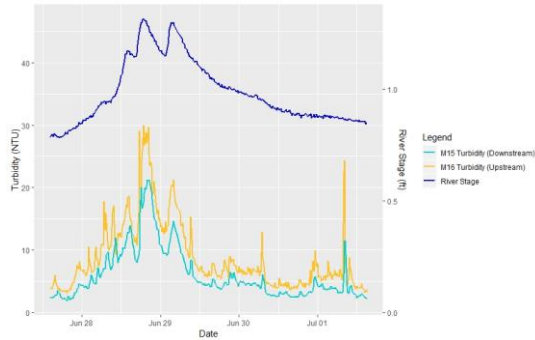
**Box and Whisker Plot  
of Hysteresis Test  
Results**

Storm Event	Original Label	Revised Label
'MIL-151'	4	99
'MIL-103'	4	2A
'FOL-80'	4	1B
'MIL-47'	4	2D
'HBR-10'	99	5A
'MAD-147'	2B	2A
'FOL-11'	2B	2D
'MAD-152'	2B	2A
'SHP-64'	2C	2D
'FOL-46'	2E	4
'MIL-64'	3C	99
'MAD-159'	3C	3B
'FOL-84'	5B	99

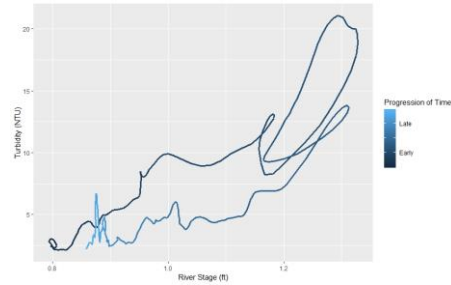
**Revised Labels for  
Problematic Storm  
Event Hysteresis**

# Results

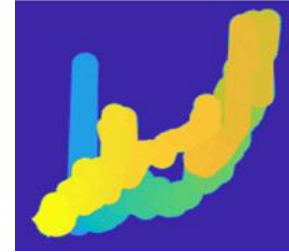
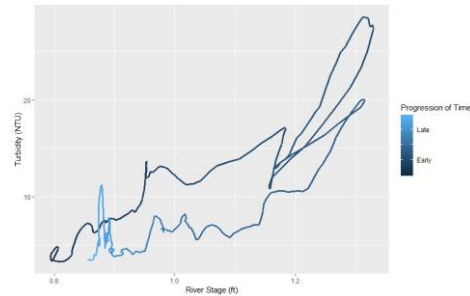
## Lewis Creek hysteresis generation



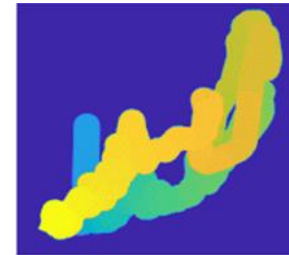
Stage-turbidity Data from  
Lewis Creek



Raw Hysteresis Plots for Lewis  
Creek: downstream (above) and  
upstream (below)



Hysteresis image for Lewis Creek:  
downstream (above) and upstream  
(below)





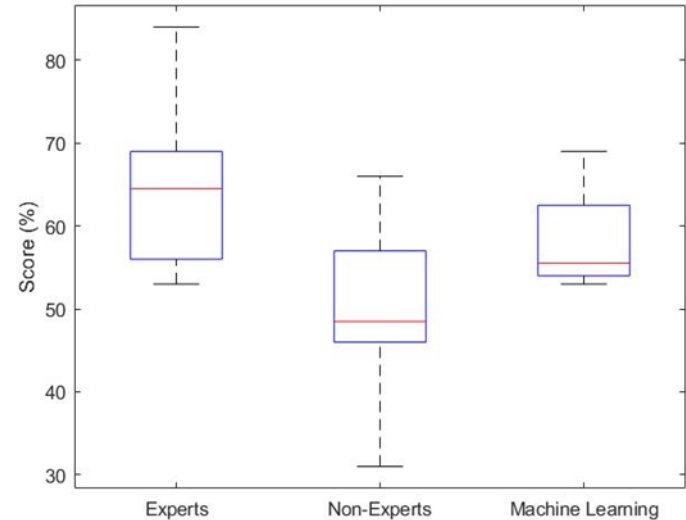
# Summary

- Successfully identified thirteen storm event hysteresis for reclassification

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'MAD-159'	3C	3B
'FOL-84'	5B	99

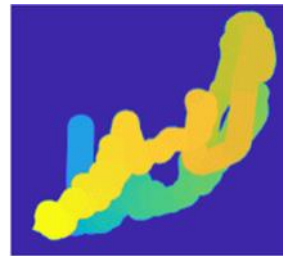
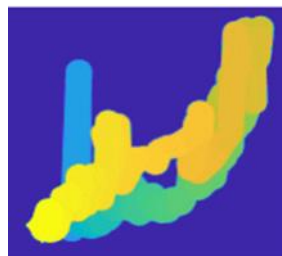
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- Visually observe the variation in test results between experts, non-experts and machine learning algorithms



# Summary

- Successfully identified thirteen storm event hysteresis for reclassification
- Visually observe the variation in test results between experts, non-experts and machine learning algorithms
- Verify the use of in-situ sensors for hysteresis generation within the Lewis Creek Watershed
  - Limited number of storm events for summer of 2018 due to drought conditions



# Future Work

- **Further data compilation from field sites**
  - Generate more hysteresis for validation and application
- **Observe results of machine learning identification test with revised hysteresis labels**
- **Variation of hysteresis analysis**
  - 3D hysteresis generation, analysis and applications
  - Multivariable axis (SSC,Q and Time)

# THANK YOU!

## Questions?



Funding provided by NSF Grant OIA 1556770

