Whychus Creek Preliminary UAS Velocimetry Analysis

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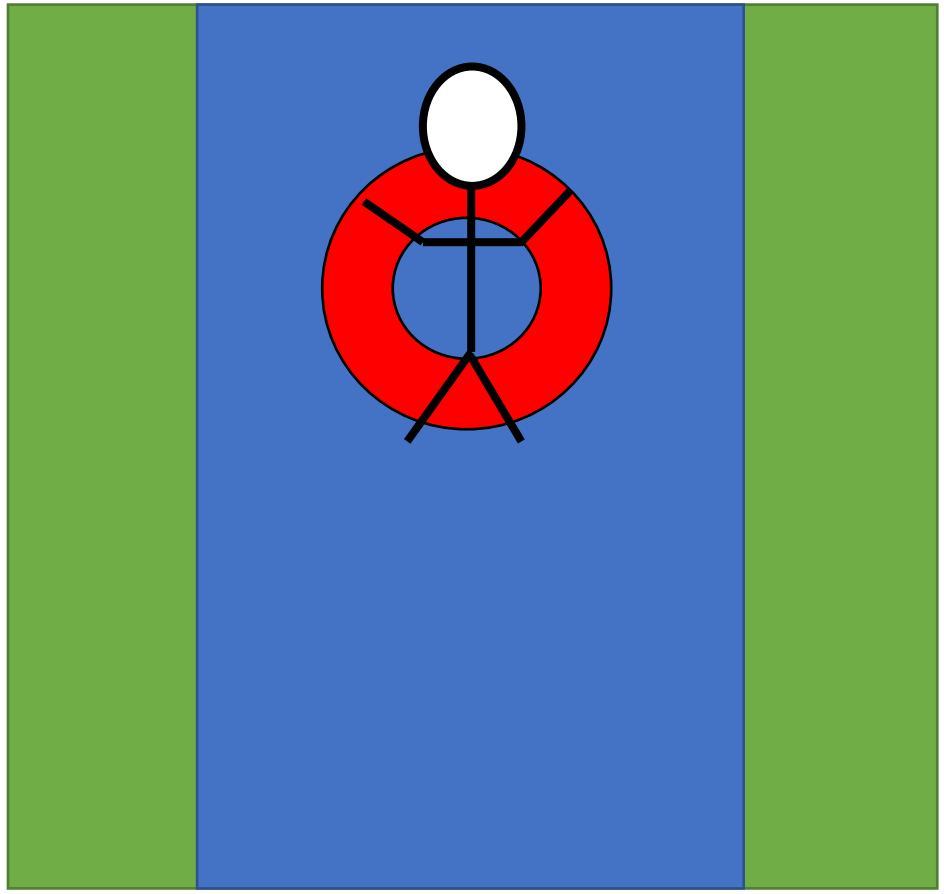
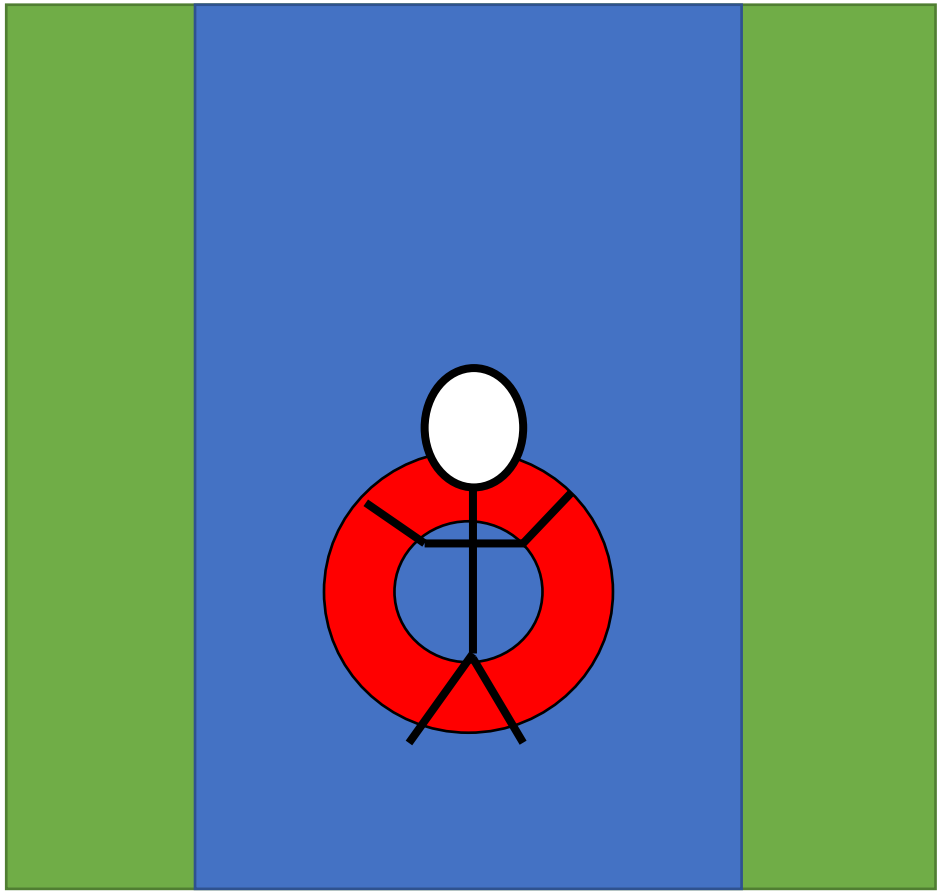
Particle Image Velocimetry

Time 1

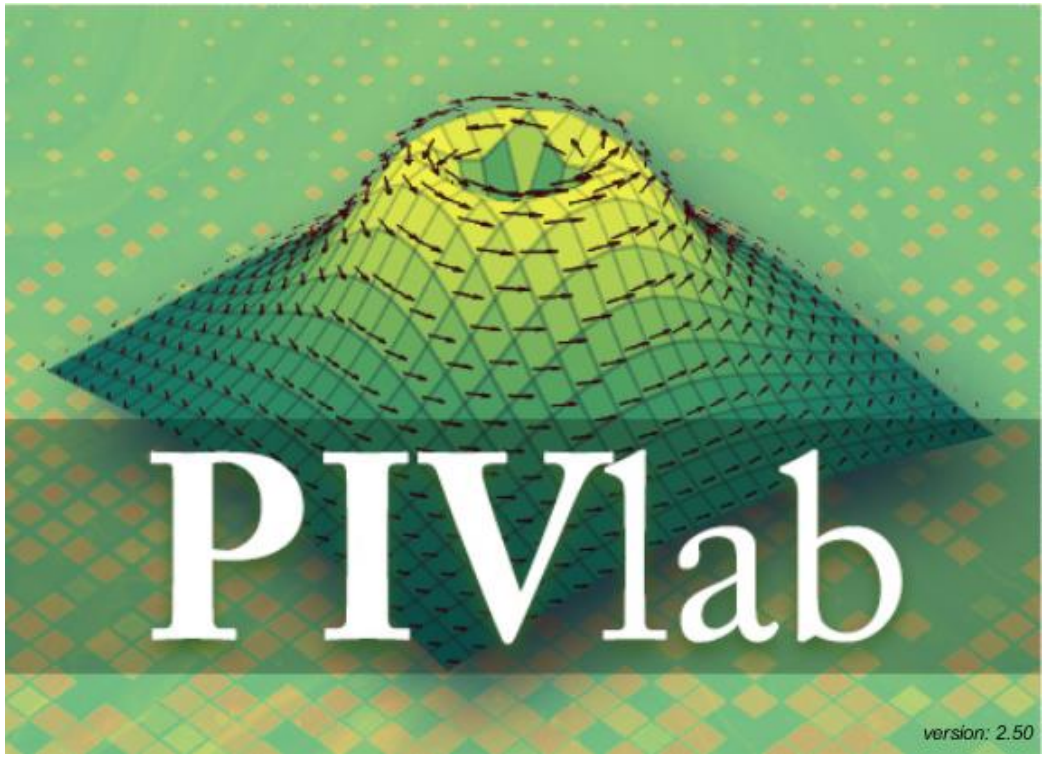


Time 2



Tools

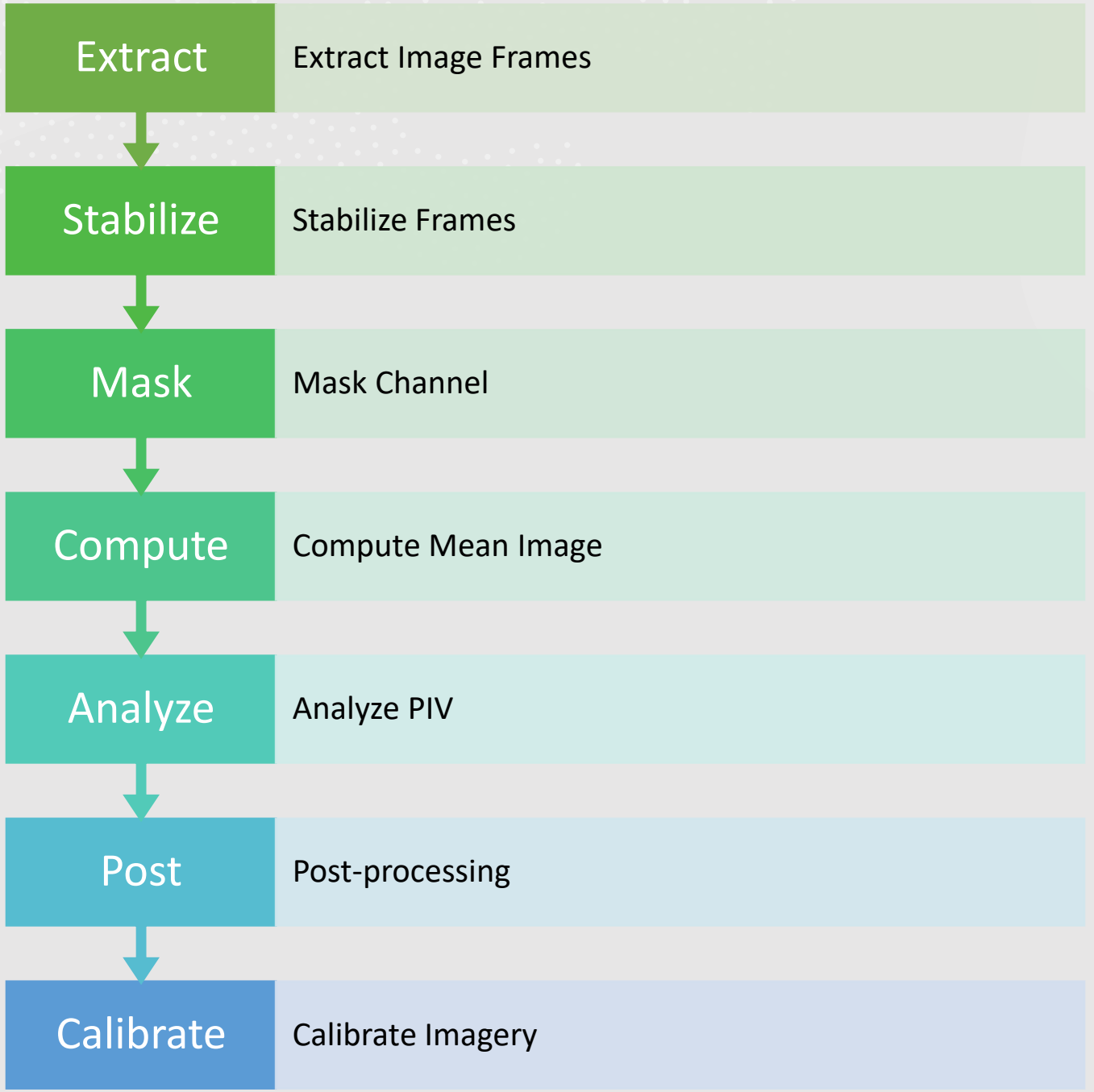
https://riverdischarge.blogspot.com/



https://pivlab.blogspot.com/

https://github.com/frank-engel-usgs/Video-Stabilizer

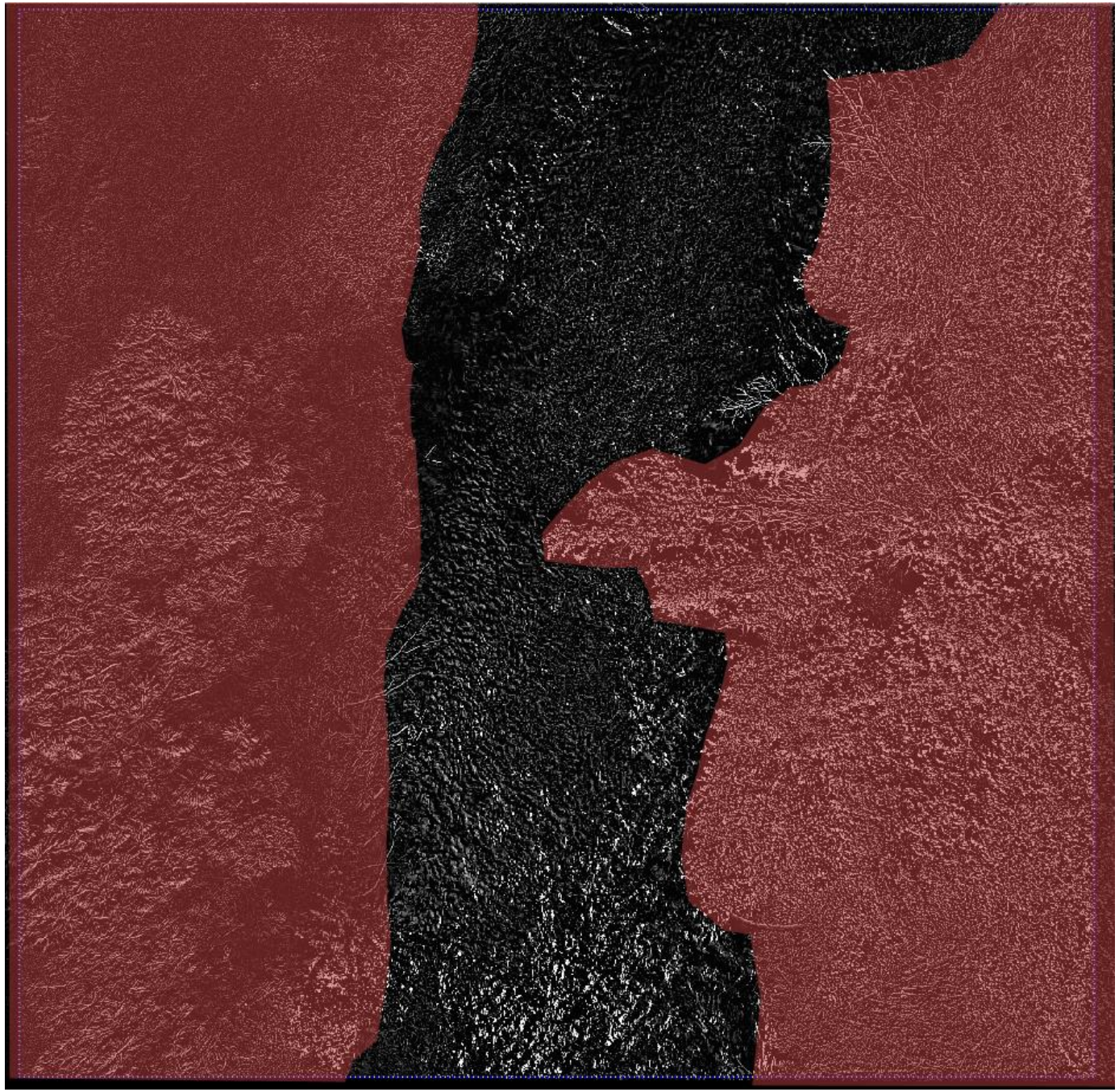
Workflow


Extract
Extract Image Frames
Stabilize
Stabilize Frames
Mask
Mask Channel
Compute
Compute Mean Image
Analyze
Analyze PIV
Post
Post-processing
Calibrate
Calibrate Imagery

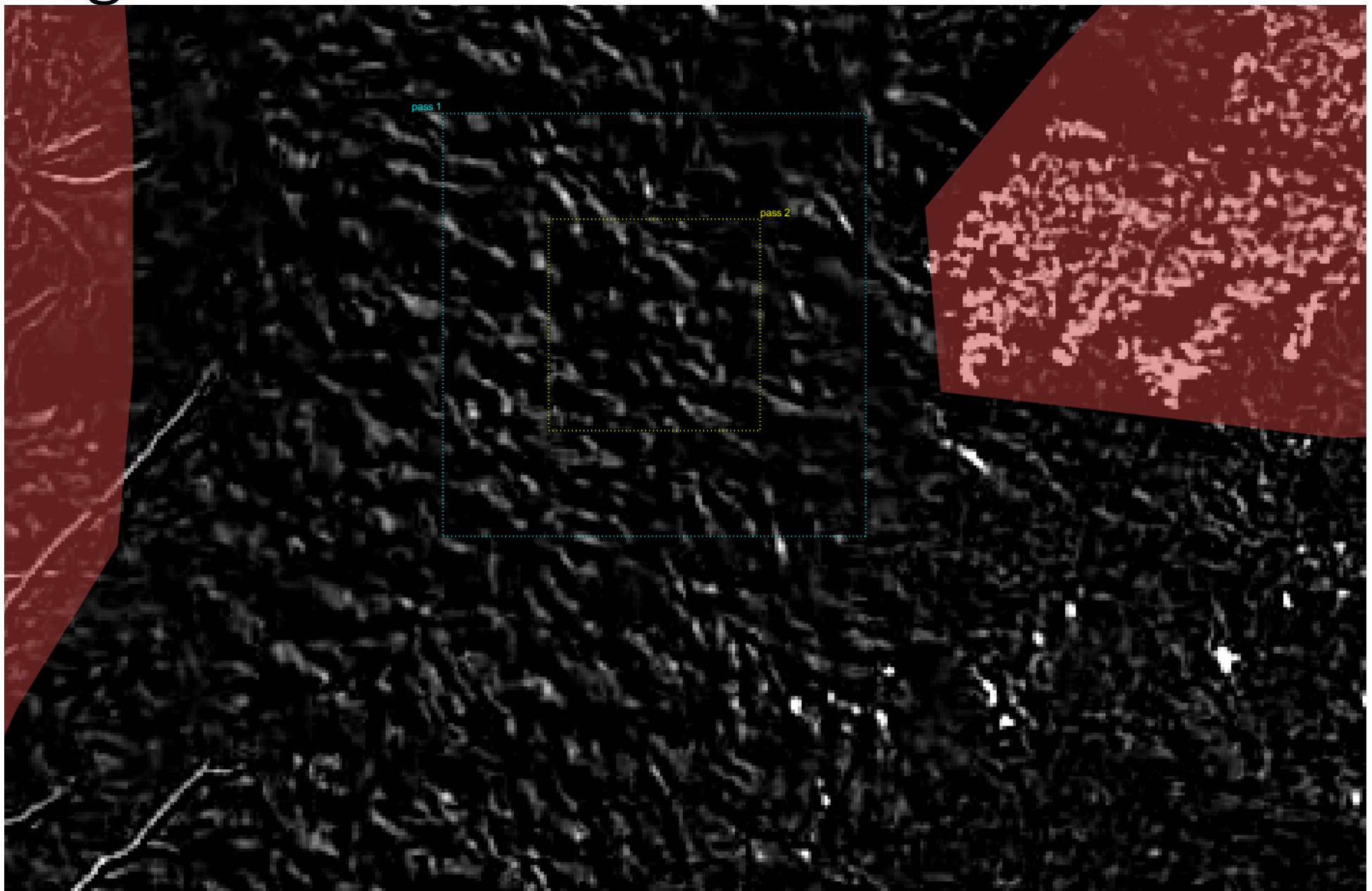
Create a channel mask

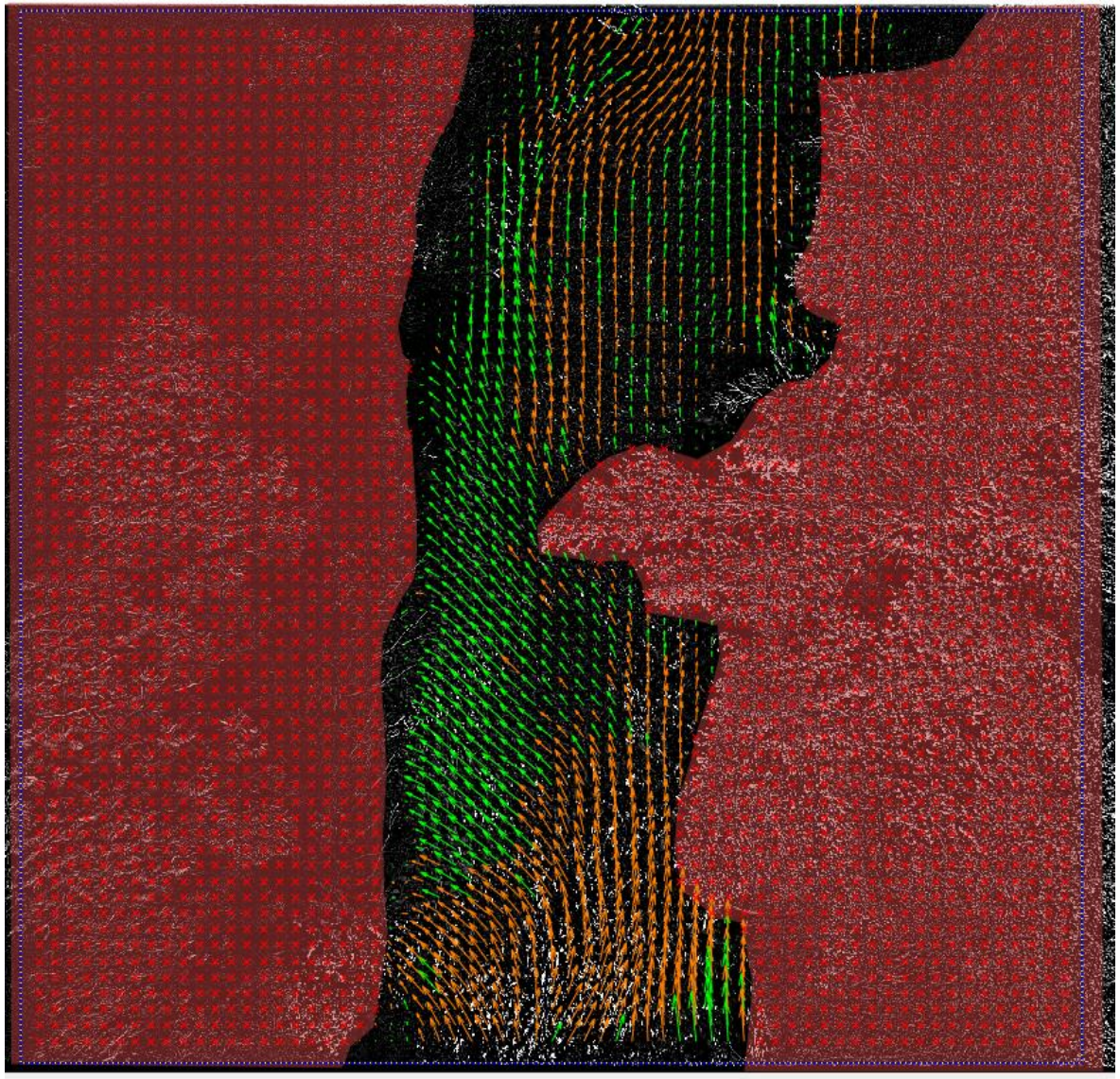
Compute mean image

Subtract Mean Intensity Image



Interrogation Area





PIVlab 2.50 [Path: E:\users\boverstreet\Projects\Whychus_UAS\2021_LSPIV\Analysis\DataIn\Videos\W57\stab]

File Image acquisition Image settings Analysis Calibration Post-processing Plot Extractions Statistics Synthetic particle image generation Help / Referencing

Calibration (CTRL+Z)

Load calibration image (optional)

Setup Scaling

Select reference distance

Real distance [mm] 1000

time step [ms] 33.3667

Setup Offsets

x increases towards ri...

y increases towards b...

Set x offset Set y offset

1 px = 0.00899 m
1 px/frame = 0.26929 m/s
x offset: 0 m
y offset: 0 m

Apply calibration

Clear calibration

Main tasks quick access

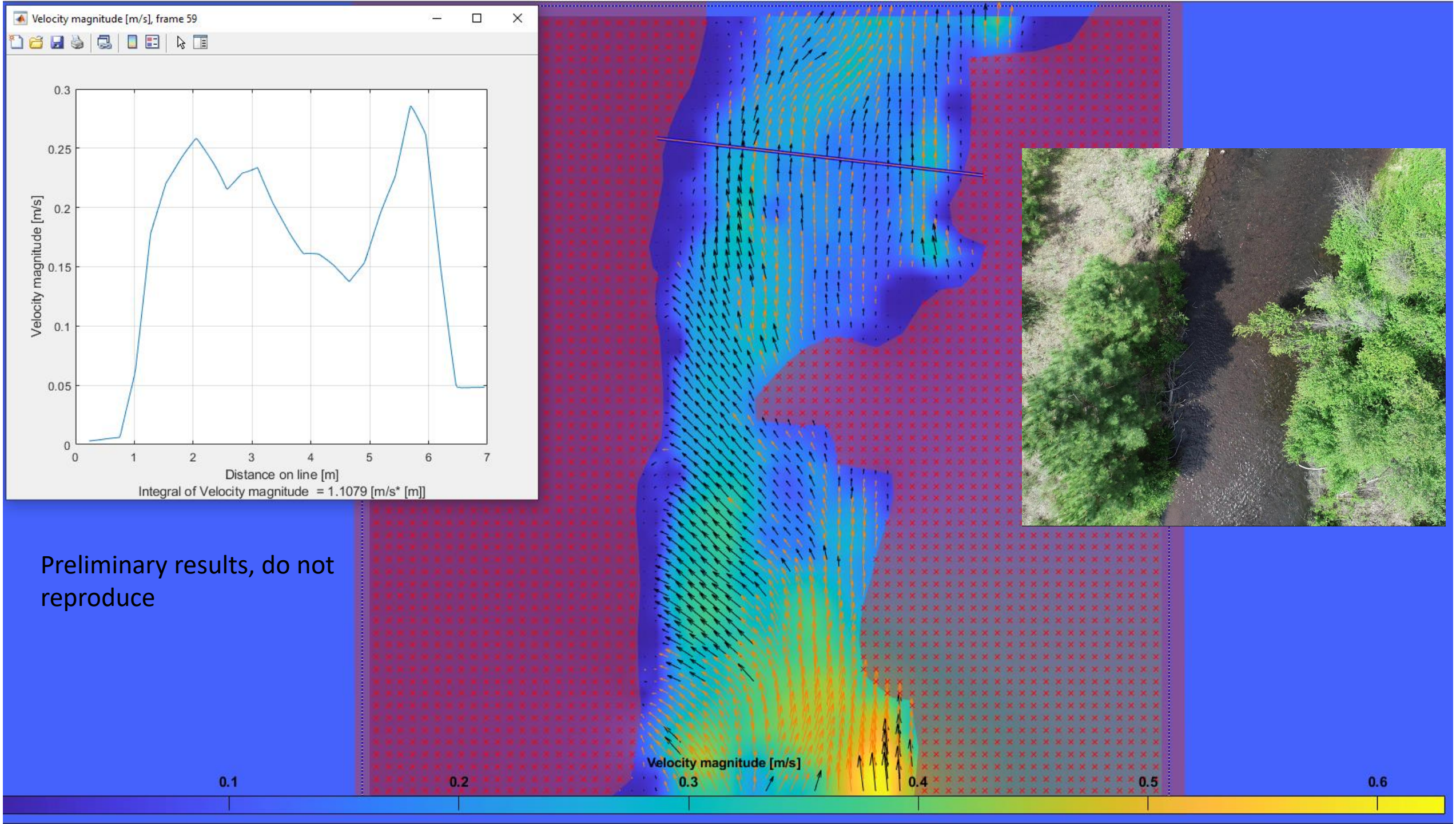
Tools

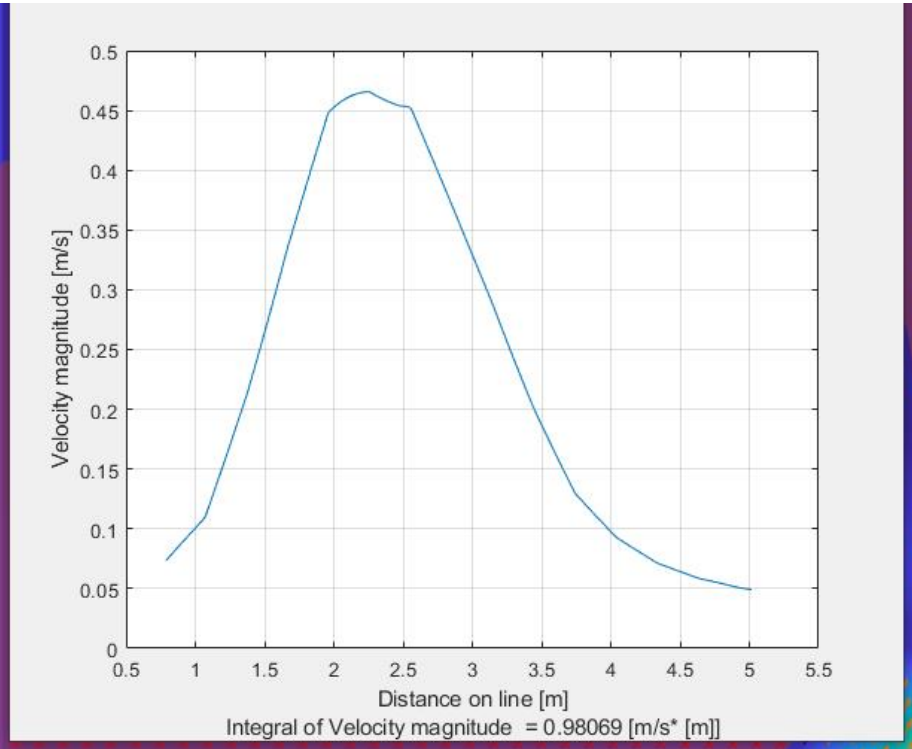
Current point:
N/A N/A
N/A N/A
N/A

Frame (298/298):
A: s_W57_00299.jpg

Toggle

Preliminary results, do not reproduce





Preliminary results, do not reproduce

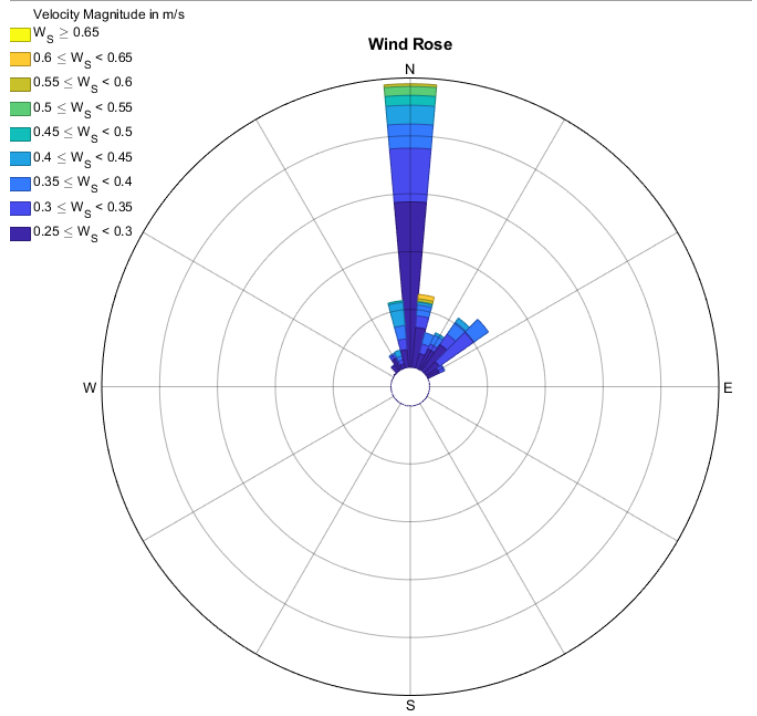
Phase 2B (W77)

Measured surface velocity = 1.16 m/s

Mean LSPIV Vel. = 0.32 m/s

Max LSPIV Vel. = 0.66 m/s

StdDev Velocity = 0.06 m/s



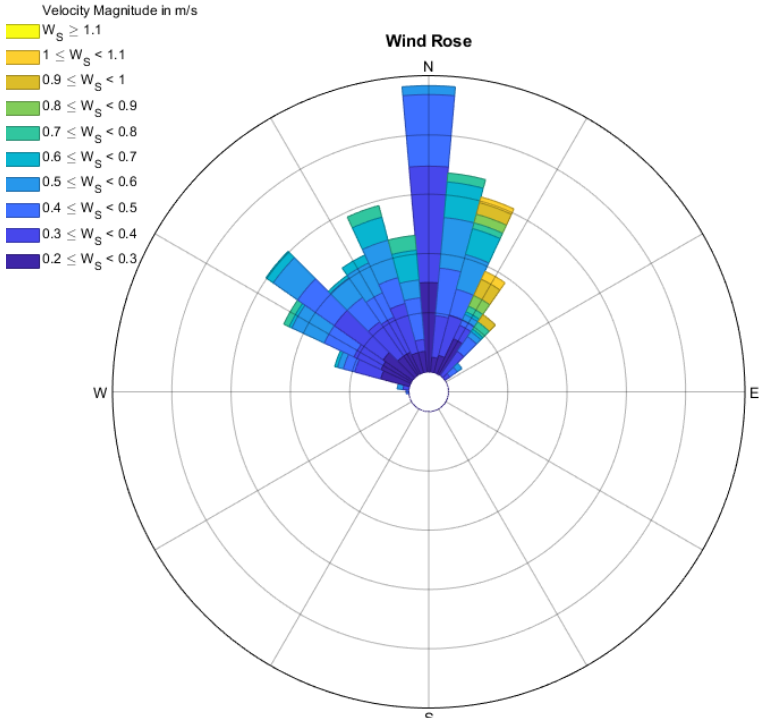
Whychus Canyon (W57)

Measured surface velocity = 0.89 m/s

Mean LSPIV velocity = 0.45 m/s

Max LSPIV Vel = 1.07 m/s

StdDev Velocity = 0.16 m/s



Preliminary results, do not reproduce

Considerations and next steps

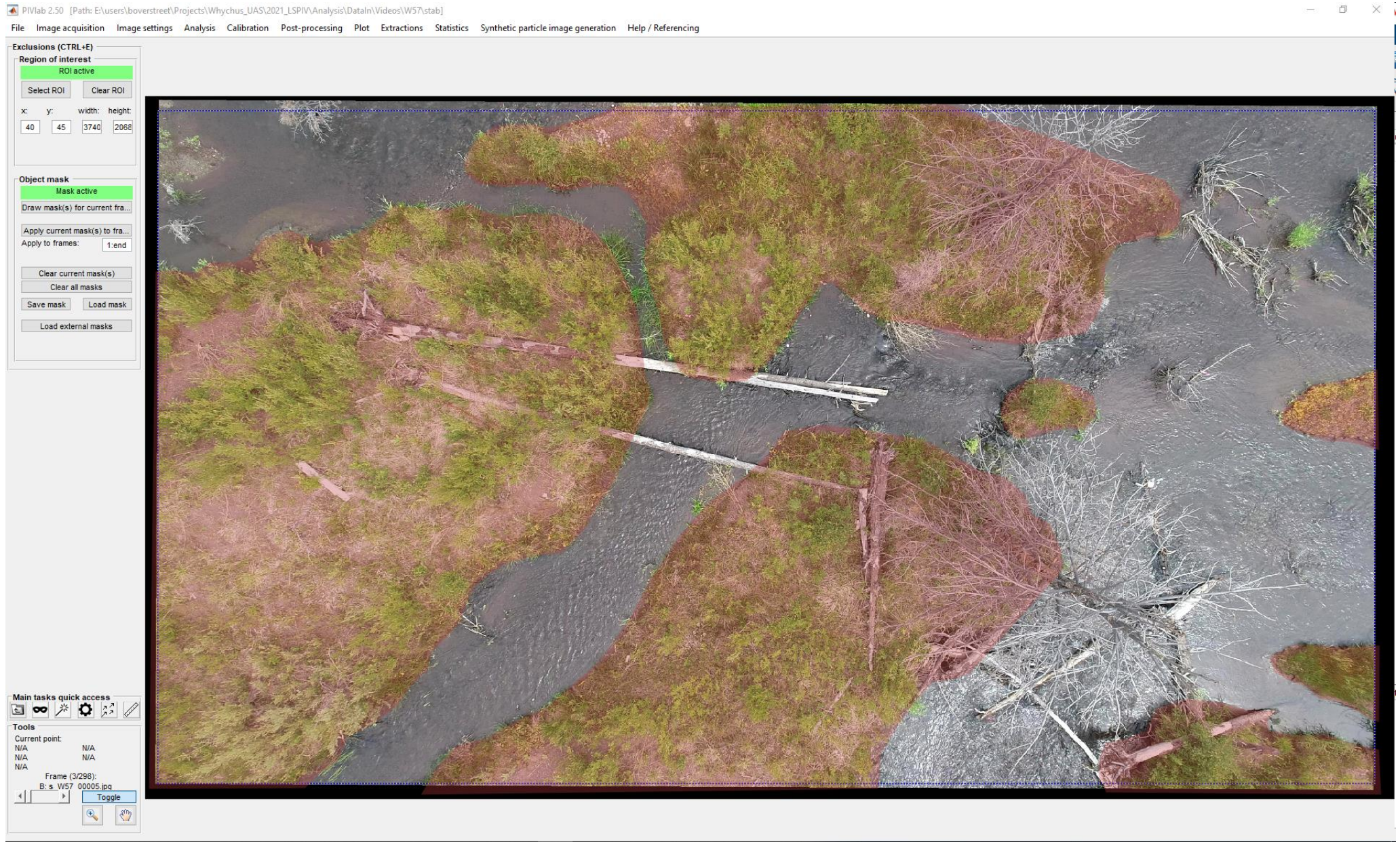
- Requires visible texture on the water surface. Many pool areas do not have adequate tracers
- Camera orientation is key to highlight texture while minimizing sun glint saturation
- Pools may require seeding
- 30 second videos at 30 fps provided more than enough data for LSPIV analysis. Lower frame rates seems to produce similar results.
- Current analysis uses ground scaling. Could use UAS height (AGL) to calculate GSD
- Aircraft position and attitude could allow georeferencing velocity outputs which would facilitate surface velocity mapping

References

- Thielicke, W., Sonntag, R. (2021) Particle Image Velocimetry for MATLAB: Accuracy and enhanced algorithms in PIVlab. Journal of Open Research Software, 9: 12. DOI: https://doi.org/10.5334/jors.334
- Thielicke, W. and Stamhuis, E.J. (2014): PIVlab – Towards User-friendly, Affordable and Accurate Digital Particle Image Velocimetry in MATLAB. Journal of Open Research Software 2(1):e30, DOI: http://dx.doi.org/10.5334/jors.bl
- Patalano, A., García, C. M., & Rodríguez, A. (2017). Rectification of Image Velocity Results (RIVeR): A simple and user-friendly toolbox for large scale water surface Particle Image Velocimetry (PIV) and Particle Tracking Velocimetry (PTV). *Computers & Geosciences*, *109*, 323-330.
- Legleiter, C. J., & Kinzel, P. J. (2020). Inferring surface flow velocities in sediment-Laden Alaskan rivers from optical image sequences acquired from a helicopter. *Remote Sensing*, *12*(8), 1282.

Next steps

- Matheson, Adrian, Martin Thoms, and Michael Reid. “Does Reintroducing Large Wood Influence the Hydraulic Landscape of a Lowland River System?” Geomorphology 292 (September 1, 2017): 128–41. https://doi.org/10.1016/j.geomorph.2017.03.035.


PIVlab 2.50 [Path: E:\users\boverstreet\Projects\Whychus_UAS\2021_LSPIV\Analysis\DataIn\Videos\W57\stab]
File
Image acquisition
Image settings
Analysis
Calibration
Post-processing
Plot
Extractions
Statistics
Synthetic particle image generation
Help / Referencing
Exclusions (CTRL+E)
Region of interest
ROI active
Select ROI
Clear ROI
x:
y:
width:
height:
40
45
3740
2068
Object mask
Mask active
Draw mask(s) for current fra...
Apply current mask(s) to fra...
Apply to frames:
1:end
Clear current mask(s)
Clear all masks
Save mask
Load mask
Load external masks
Main tasks quick access
Tools
Current point:
N/A
N/A
N/A
N/A
Frame (3/298):
B: s_W57_00005.jpg
Toggle

PIVlab 2.50 [Path: E:\users\boverstreet\Projects\Whychus_UAS\2021_LSPIV\Analysis\DataIn\Videos\W57\stab]
File Image acquisition Image settings Analysis Calibration Post-processing Plot Extractions Statistics Synthetic particle image generation Help / Referencing
PIV settings (CTRL+S)
Help:
Suggest settings
PIV algorithm
FFT window deformation
Ensemble correlation
DCC (deprecated)
Pass 1
Interrogation area
Step
128
64
= 50%
Pass 2...4
Interrogation area
Step
Pass 2
64
32
Pass 3
32
16
Pass 4
32
16
Sub-pixel estimator
Gauss 2x3-point
Disable auto-correlation
Correlation robustness
Standard (recommended)
Analyze current frame
Main tasks quick access
Tools
Current point:
N/A
N/A
N/A
N/A
N/A
Frame (1/298):
A: s_W57_00002.jpg
Toggle
pass 1
pass 2

pass 1
pass 2

Image pre-processing (CTRL+I)

- [x] Enable CLAHE
  Window size [px] 20
- [ ] Enable highpass
  Kernel size [px] 15
- [ ] Enable intensity capping
- [ ] Wiener2 denoise and low pass
  Window size [px] 3
- [x] Auto contrast stretch

minimum: 0 maximum: 0.34117

Background Subtraction

- [x] Subtract mean intensity

View background image

Apply and preview current frame

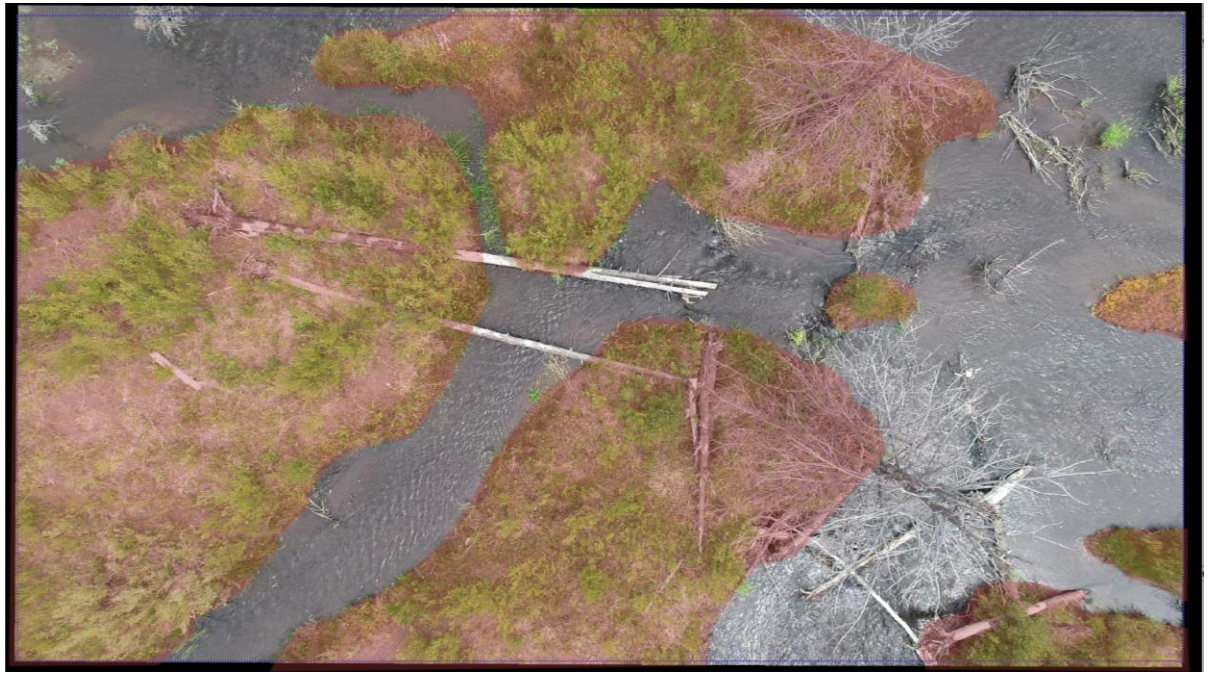
Main tasks quick access

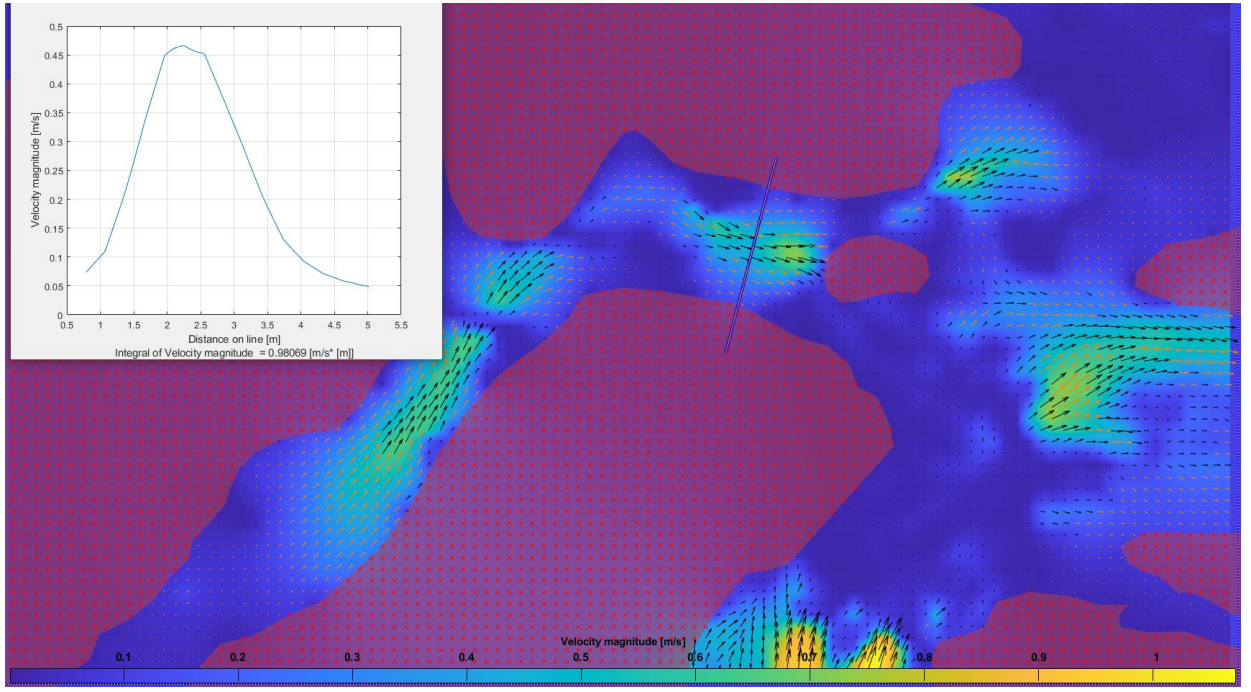
Tools

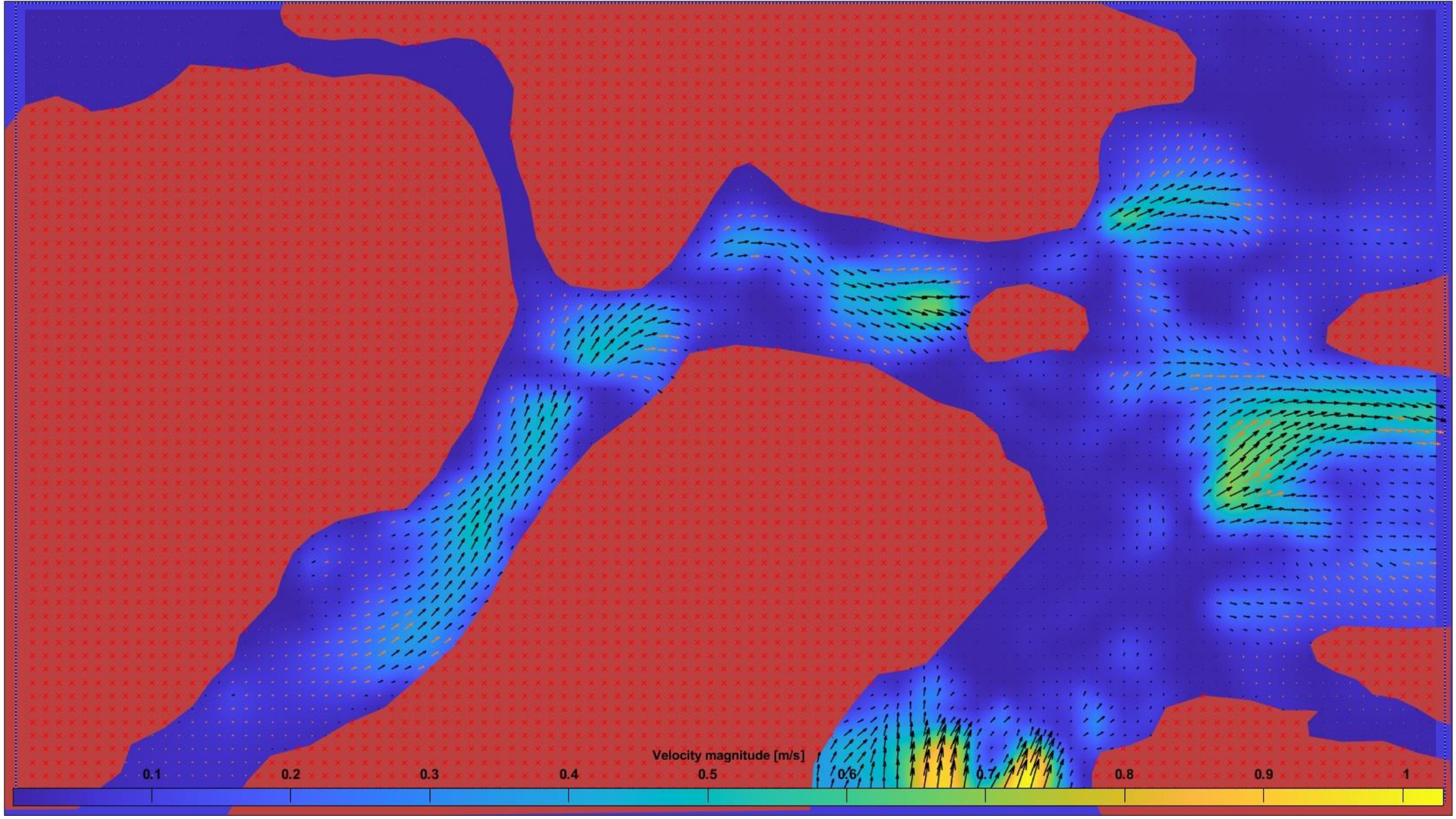
Current point:
N/A N/A
N/A N/A
N/A

Frame (208/301):
A: s_W57_00209.jpg

Toggle




Velocity magnitude [m/s]
Distance on line [m]
Integral of Velocity magnitude = 0.98069 [m/s* [m]]
Velocity magnitude [m/s]


Velocity magnitude [m/s]
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1