Semester Project - Part 03

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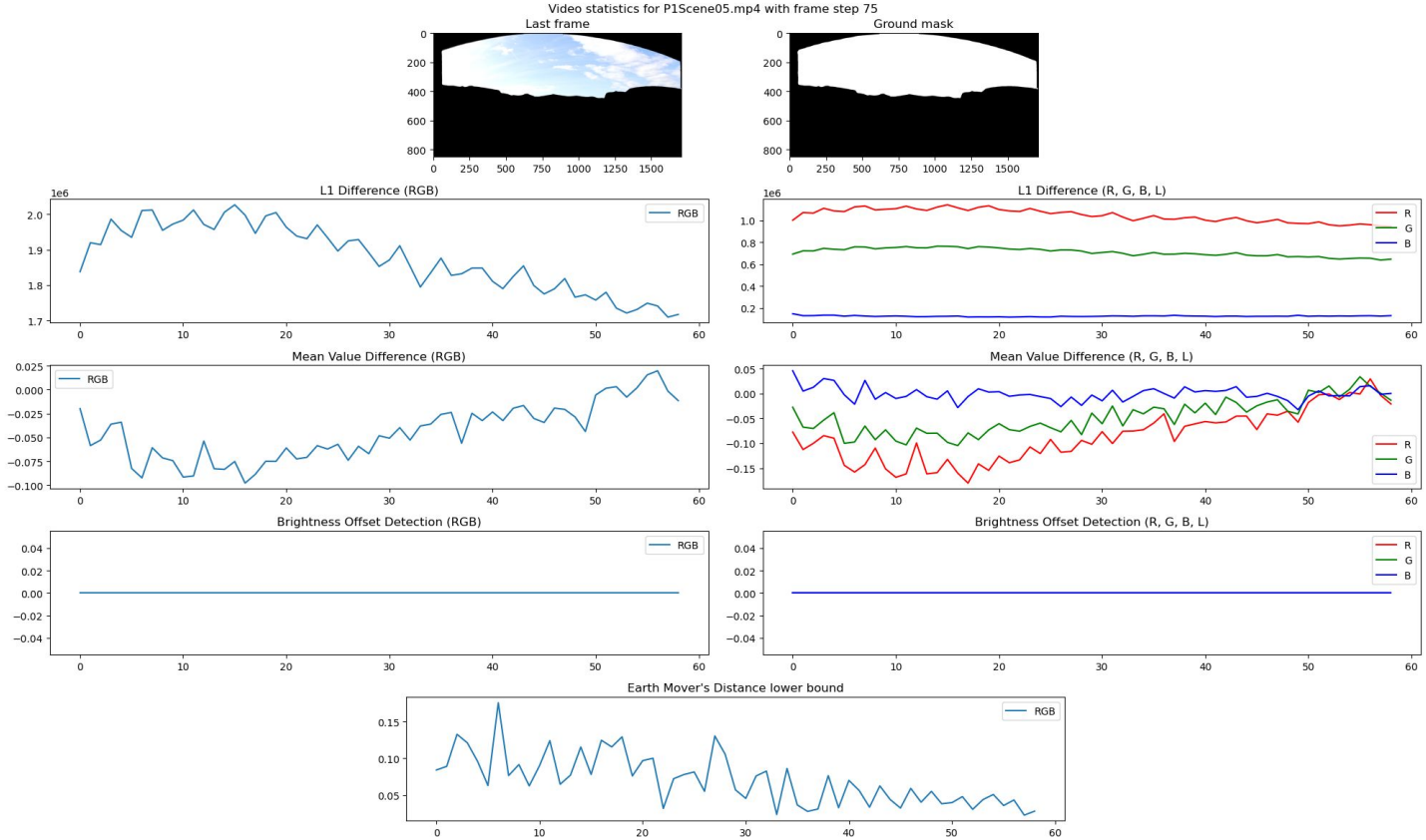
Video Specifications

Video Specifications

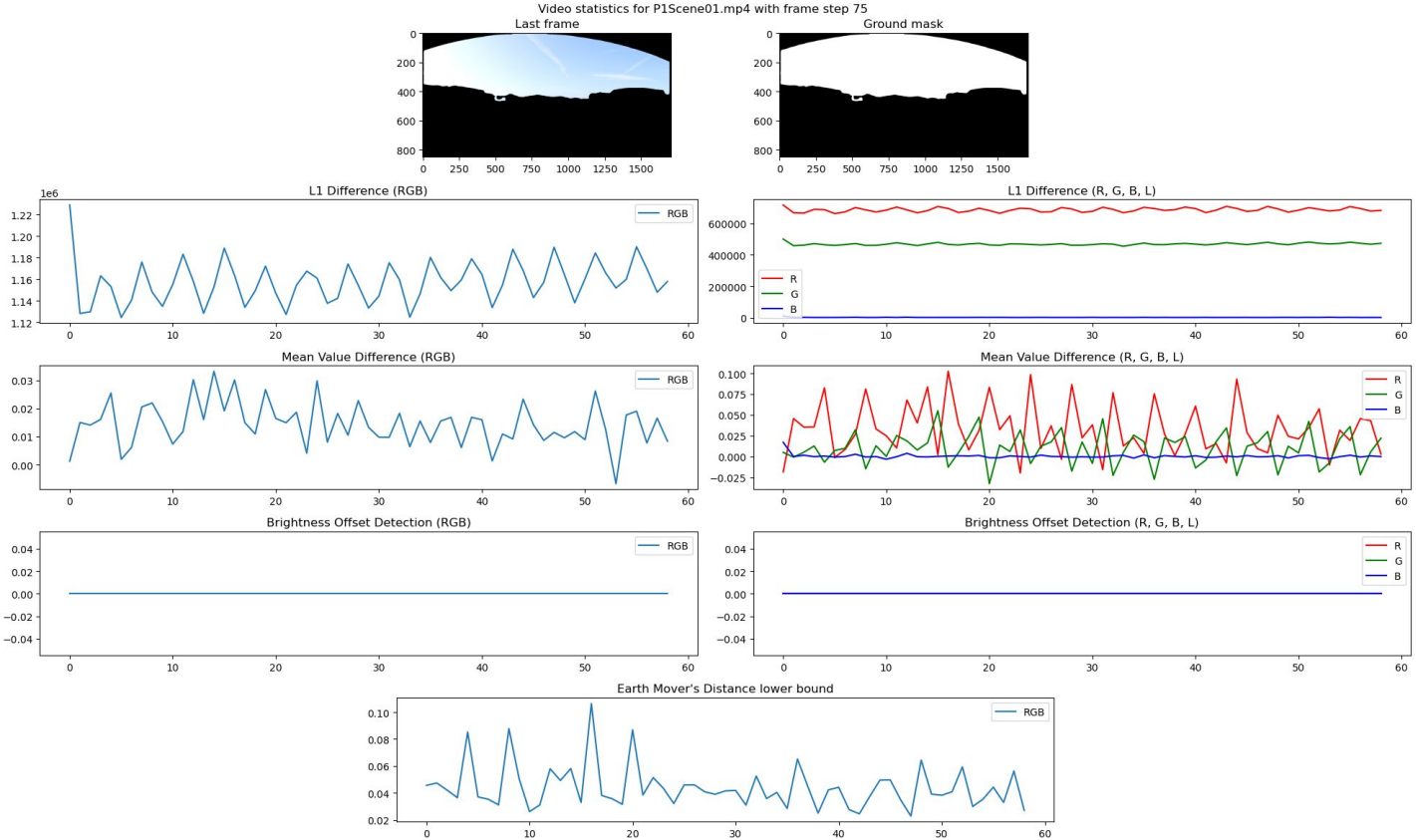
- **Duration:** 3 min 0 s
- **Width:** 6,144 pixels
- **Height:** 3,072 pixels
- **Frame rate:** 25.000 FPS
- **Overall bit rate:** 240 Mb/s
- **General Codec ID:** mp42 (mp42/mp41)
- **Video Codec ID:** avc1
- **Bit depth:** 8 bits
- **Color space:** YUV

Global Lighting Evaluation on Scenes

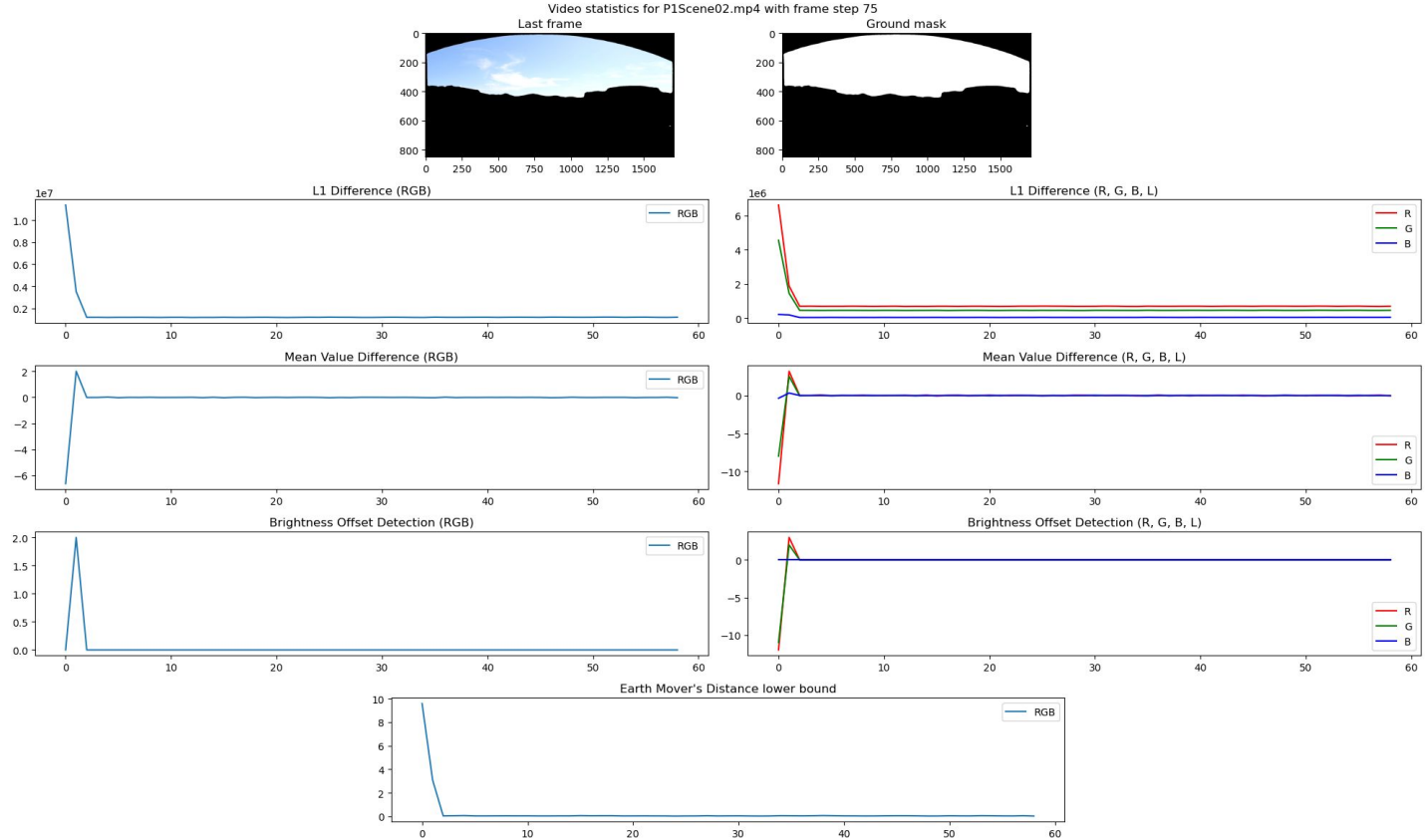
Global Lighting Evaluation on Scenes - Scene 05 Example



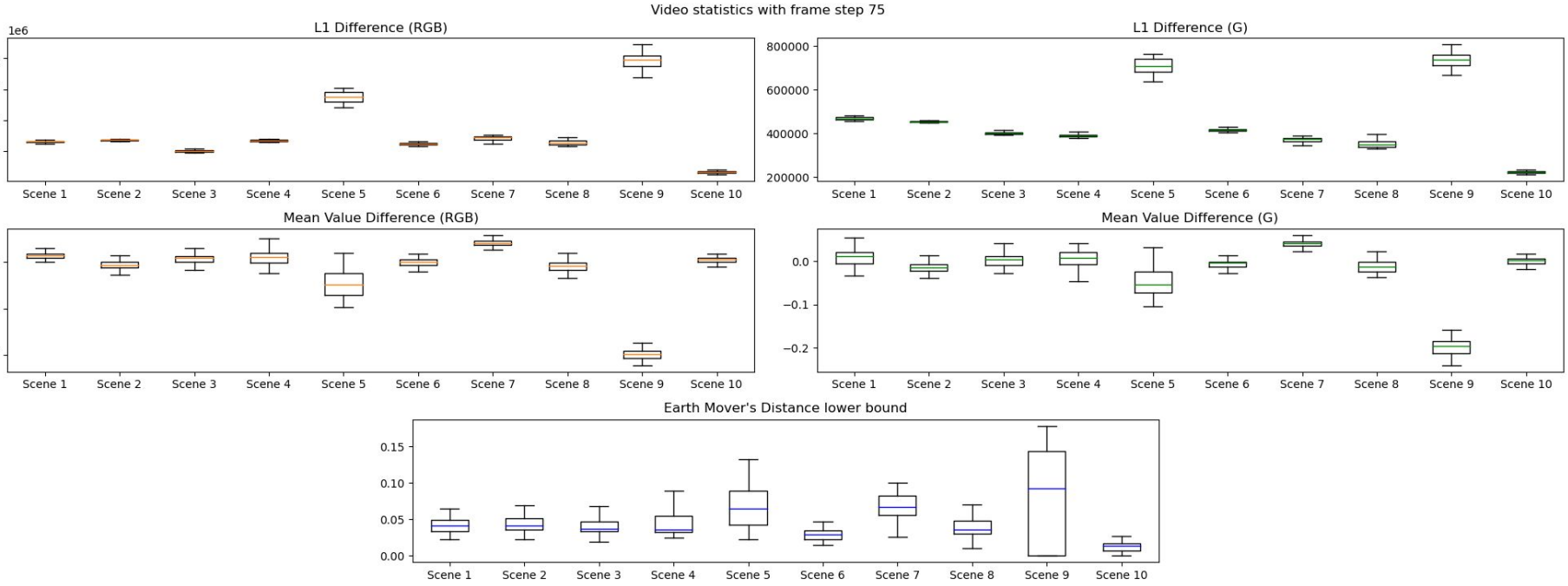
Global Lighting Evaluation on Scenes - Scene 01 Example



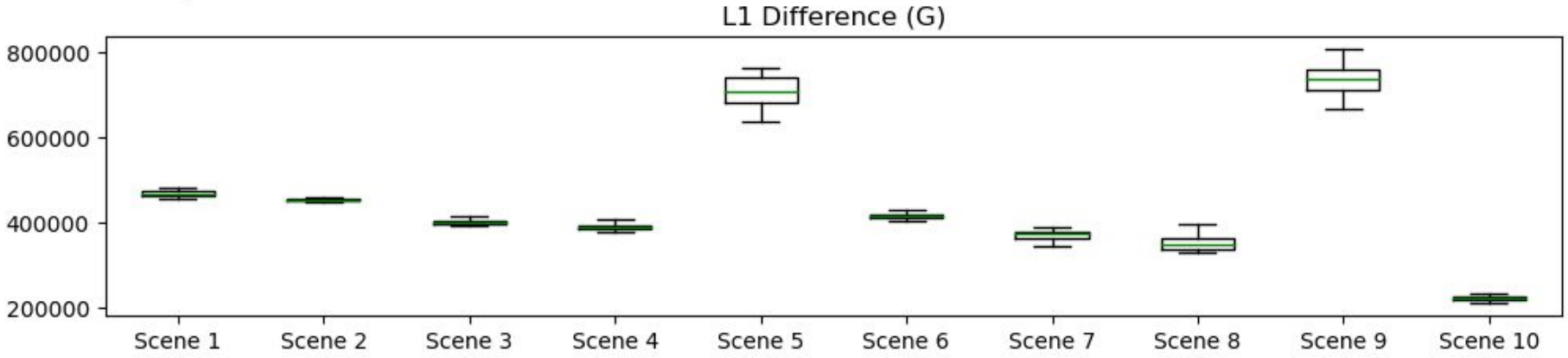
Global Lighting Evaluation on Scenes - Scene 02 Example



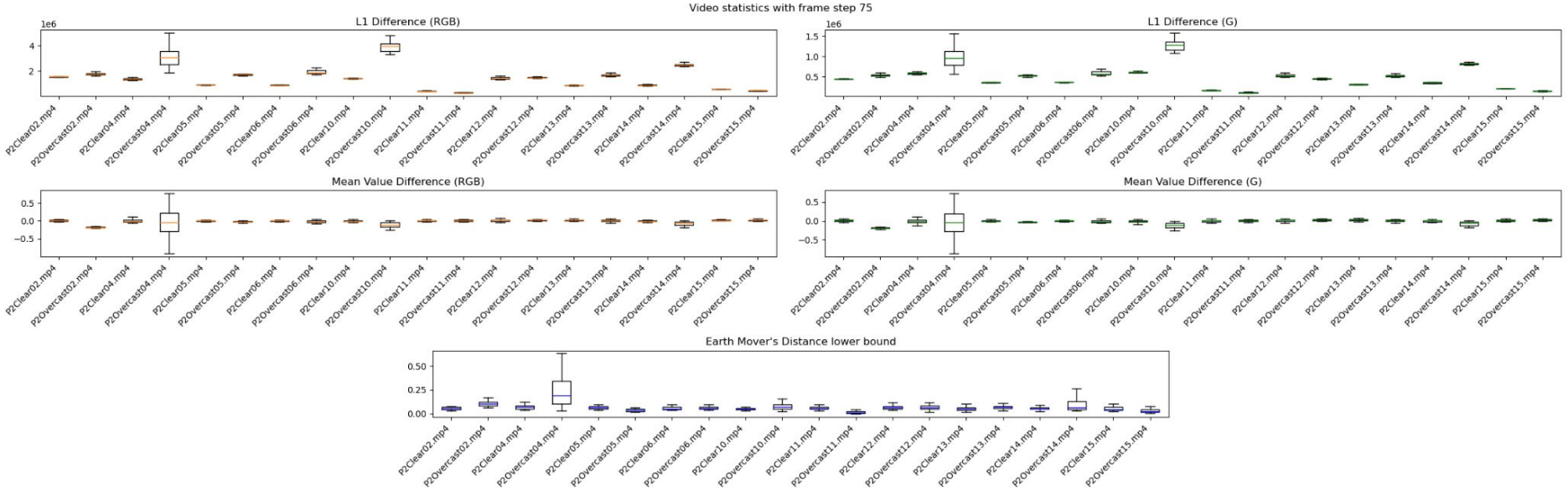
Global Lighting Evaluation on Scenes - Part 01



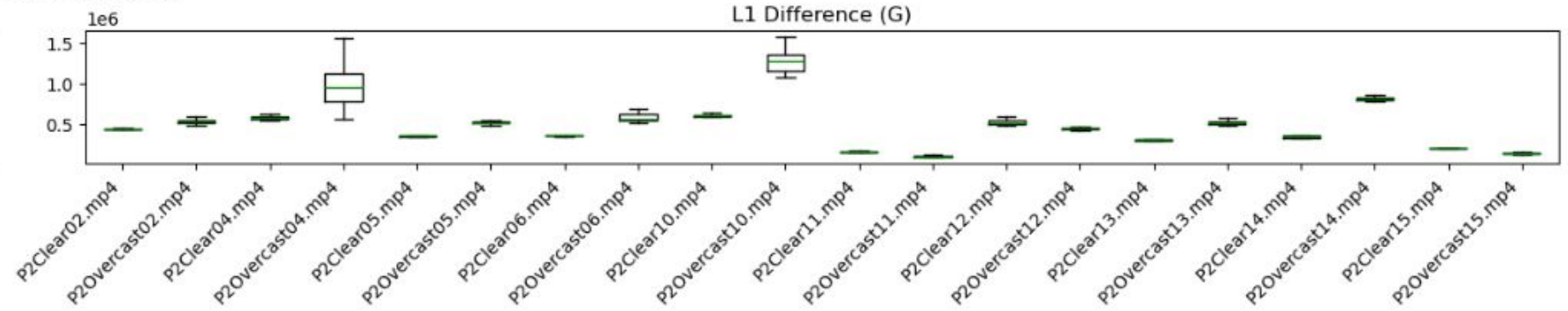
Global Lighting Evaluation on Scenes - Part 01



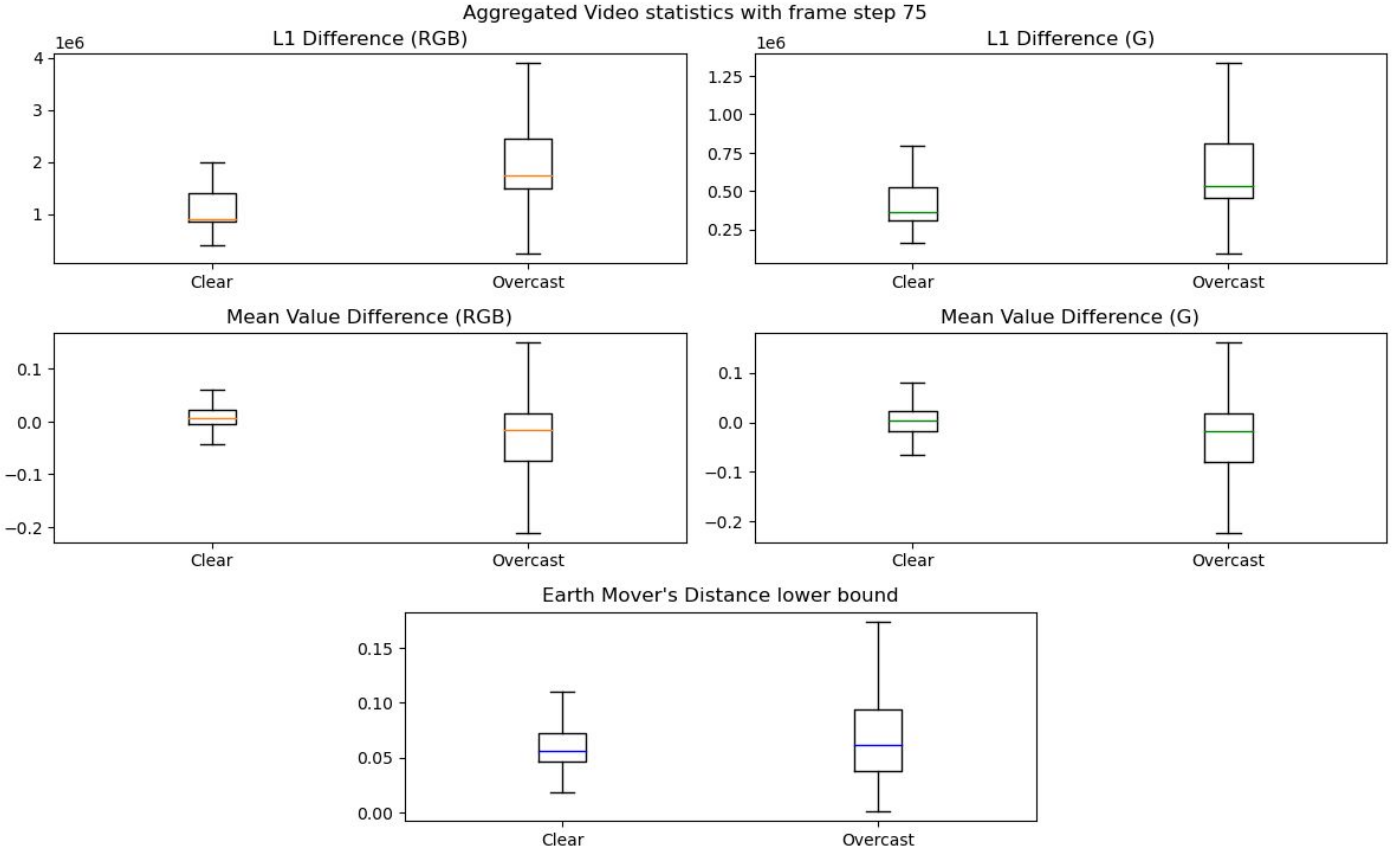
Global Lighting Evaluation on Scenes - Part 02



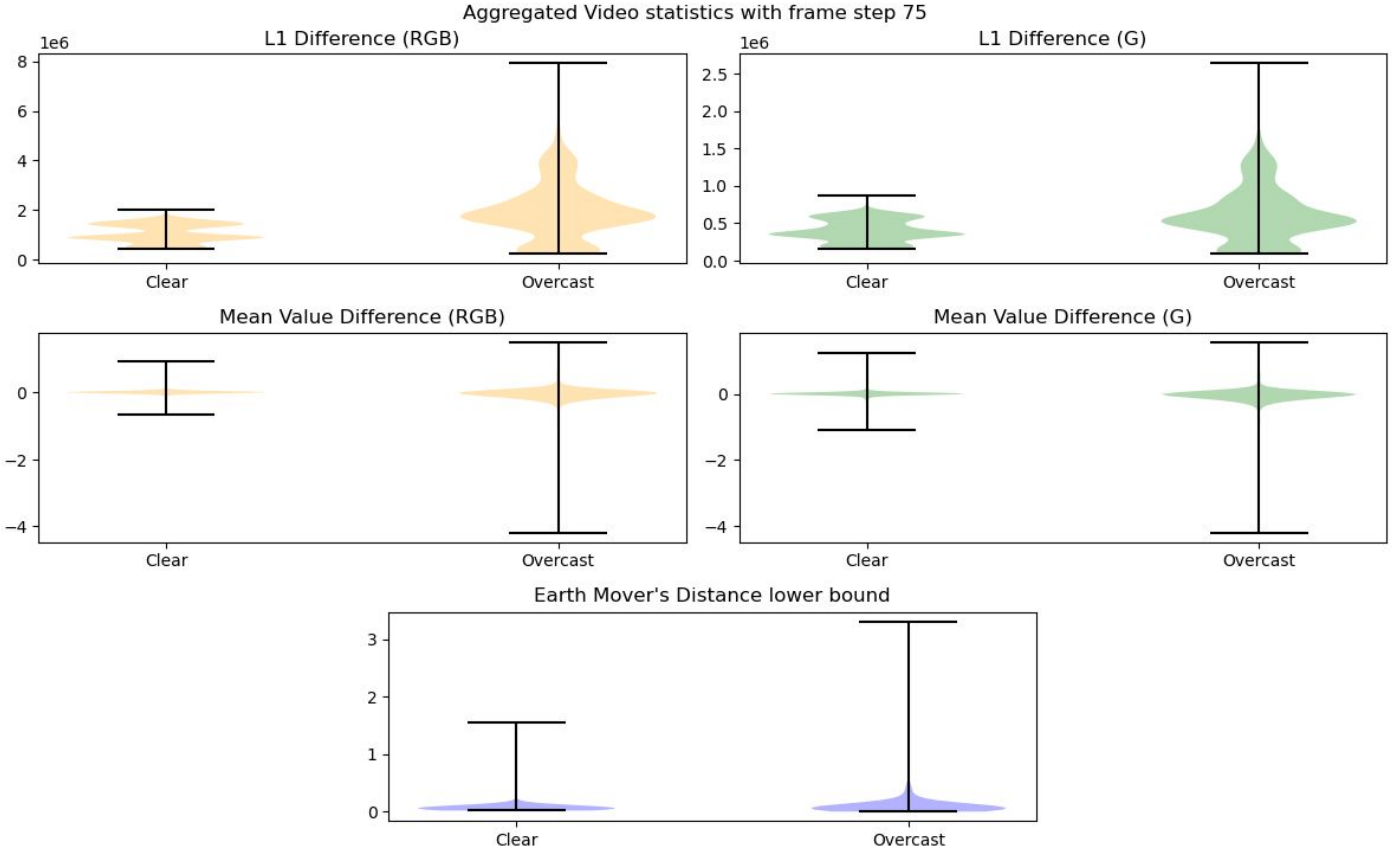
Global Lighting Evaluation on Scenes - Part 02



Global Lighting Evaluation on Scenes - Part 02 Merged



Global Lighting Evaluation on Scenes - Part 02 Merged

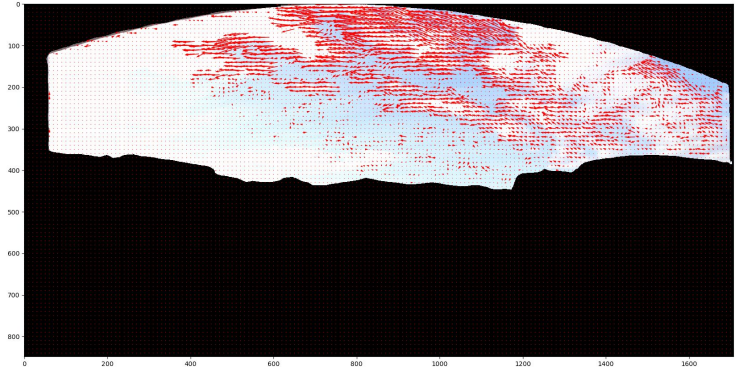


Deep Learning-Based Optical Flow

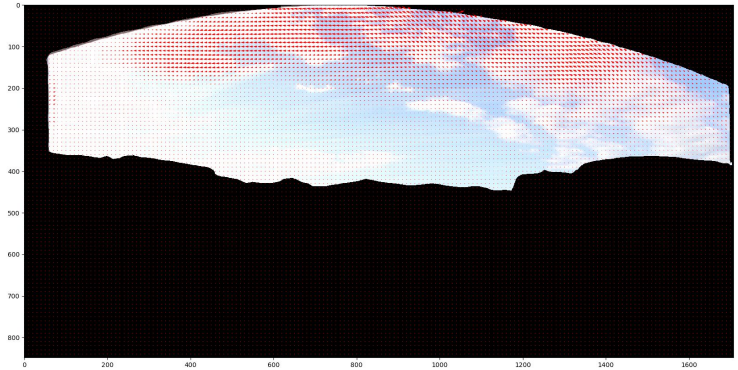
Deep Learning-Based Optical Flow - Farneback vs RAFT

- Farneback
  - Utilizes grayscale (**G channel**)
  - Captures primarily **cloud edges**
- RAFT
  - Deep learning-based approach
  - Employs **RGB channels**
  - Yields more **fluent** directional flow

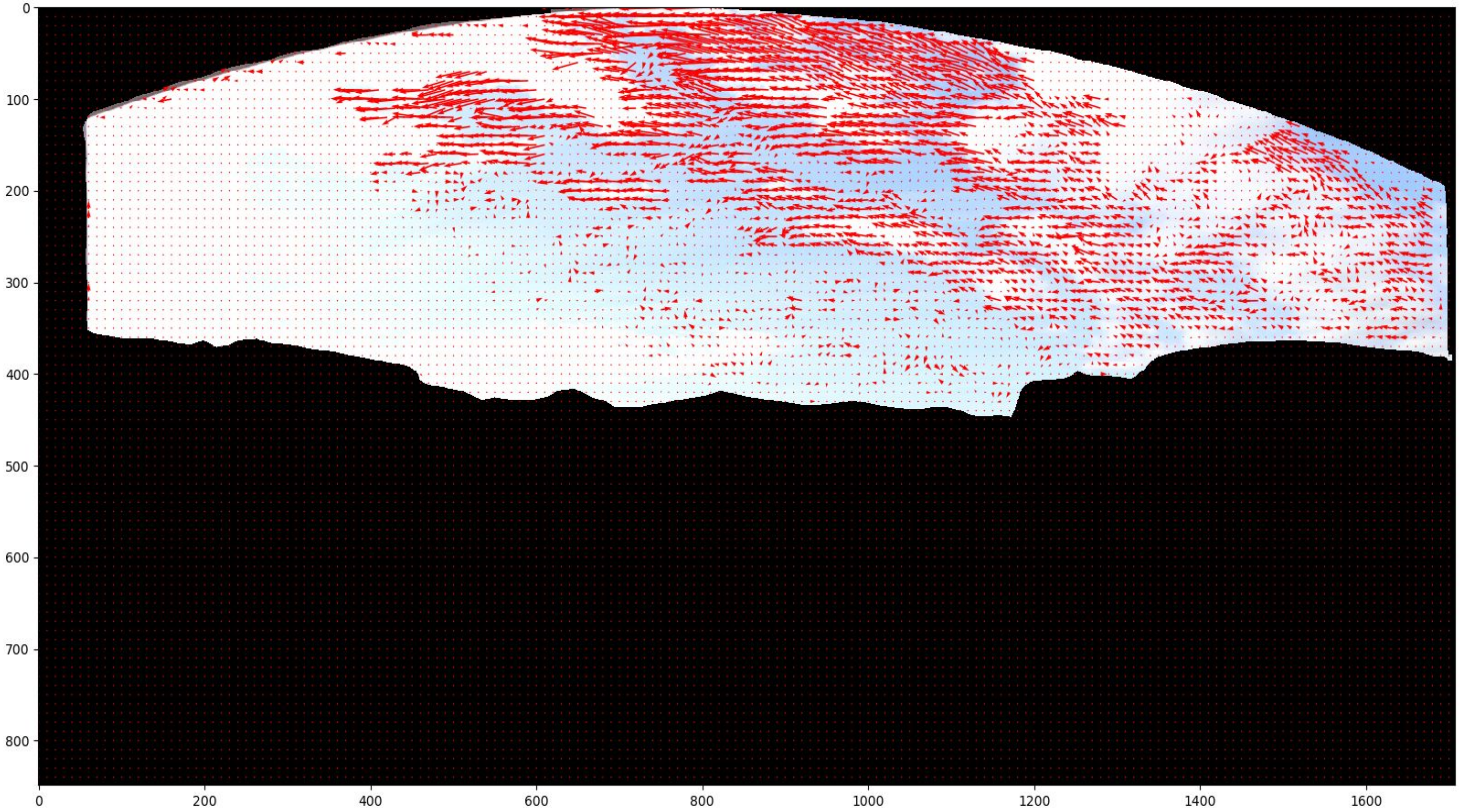
Farneback



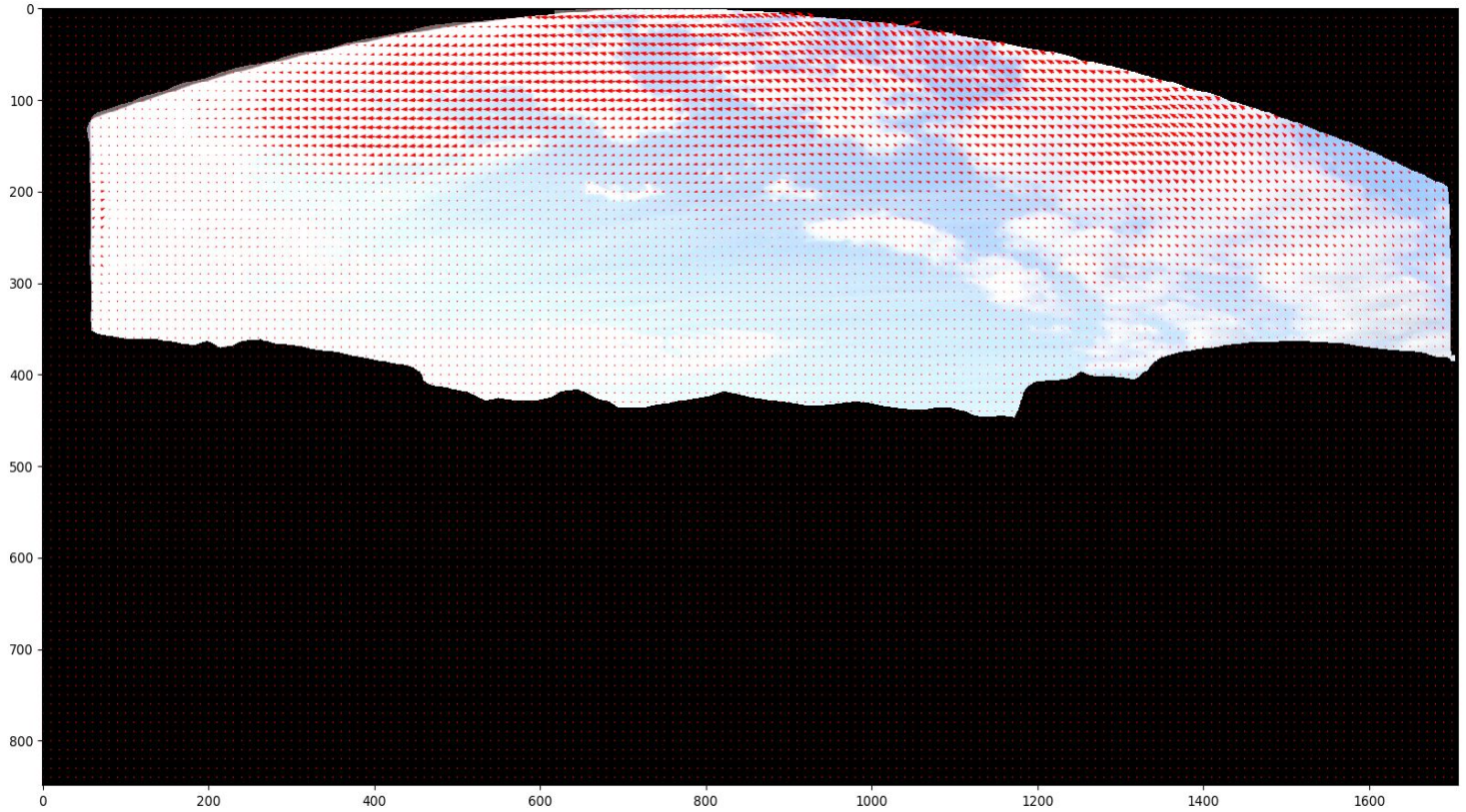
RAFT



Deep Learning-Based Optical Flow - Farneback

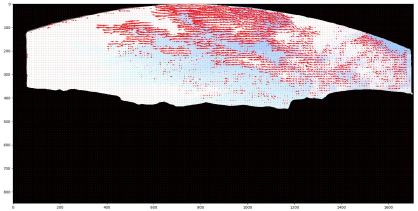


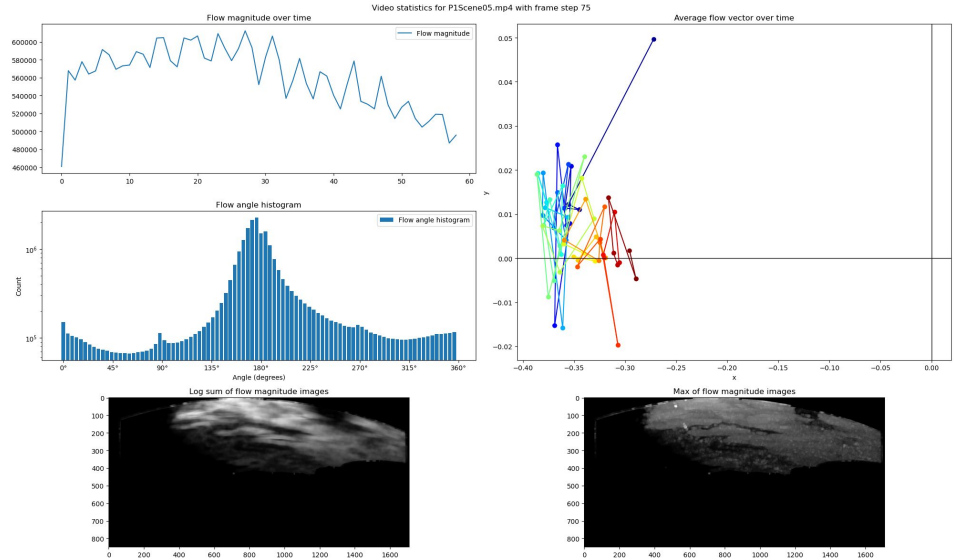
Deep Learning-Based Optical Flow - RAFT



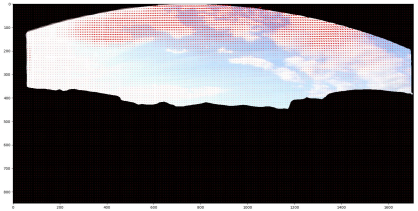
Deep Learning-Based Optical Flow - Scene 05 Example

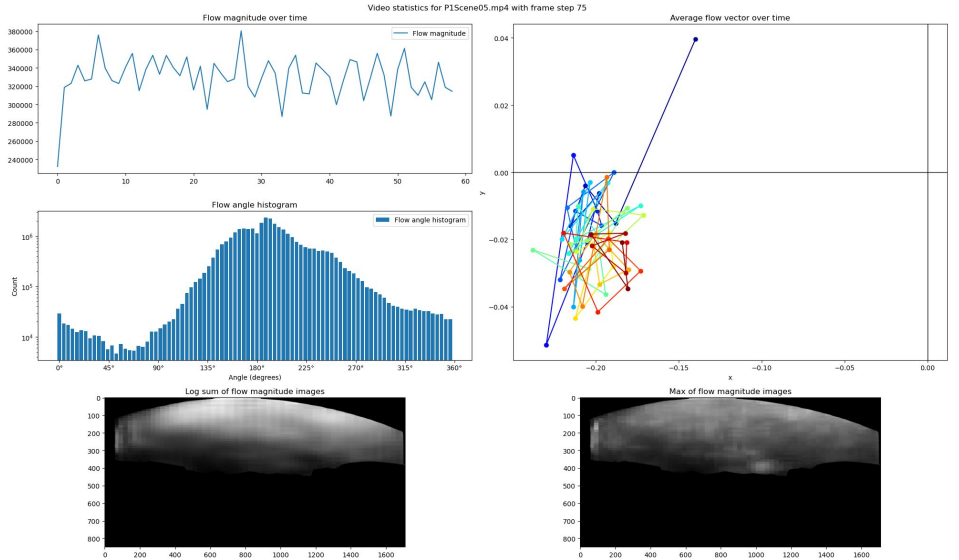
Farneback





RAFT

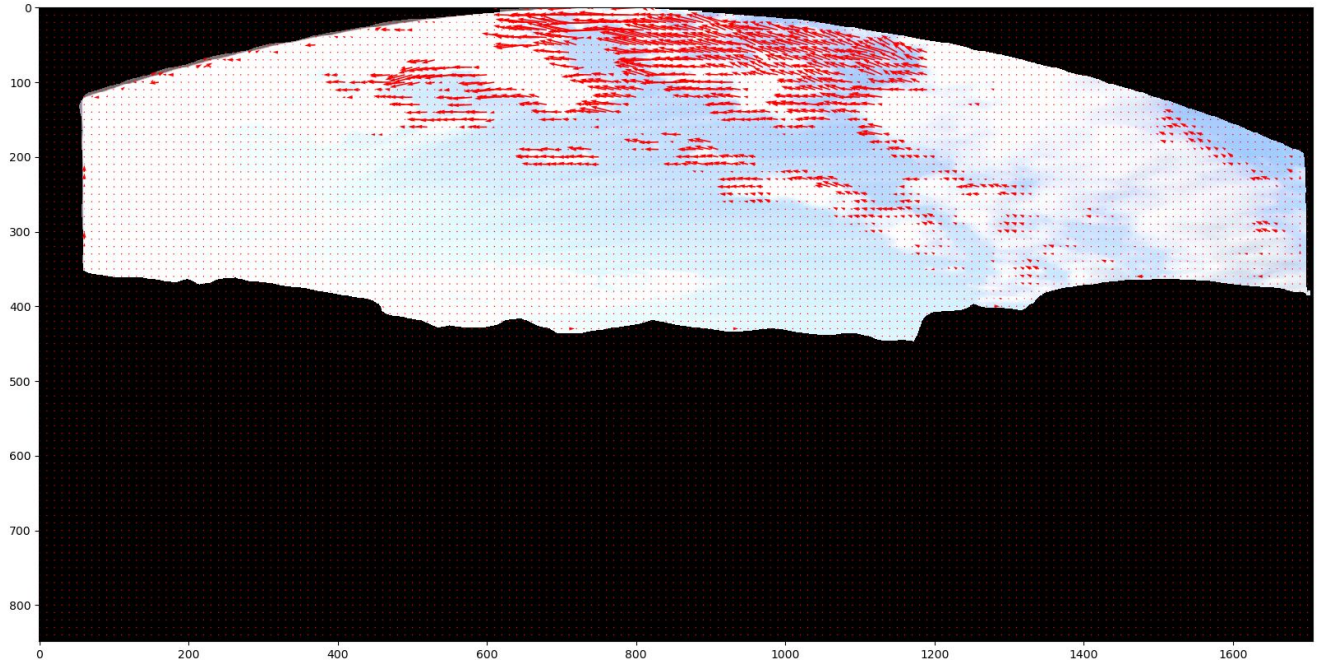




Unwarping

Unwarping - Warped Frames

- Issue: image is warped



Unwarping - Intrinsic Parameters

- Focal lengths (in pixels)
- Principal point
- Skew of the axis
- Distortion coefficients

$$K = \begin{pmatrix} \alpha_u & s & p_u \\ 0 & \alpha_v & p_v \\ 0 & 0 & 1 \end{pmatrix}$$

$$D = (k_1, k_2, k_3, k_4)$$

Unwarping - Intrinsic Parameters

- Focal lengths (in pixels)
- Principal point
- Skew of the axis
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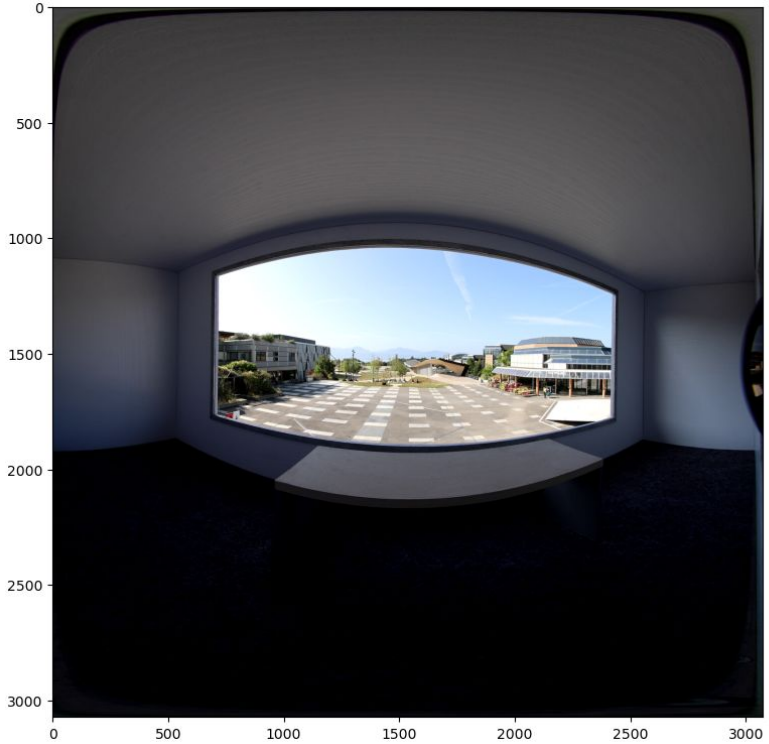
$$K = \begin{pmatrix} \alpha_u & s & p_u \\ 0 & \alpha_v & p_v \\ 0 & 0 & 1 \end{pmatrix}$$

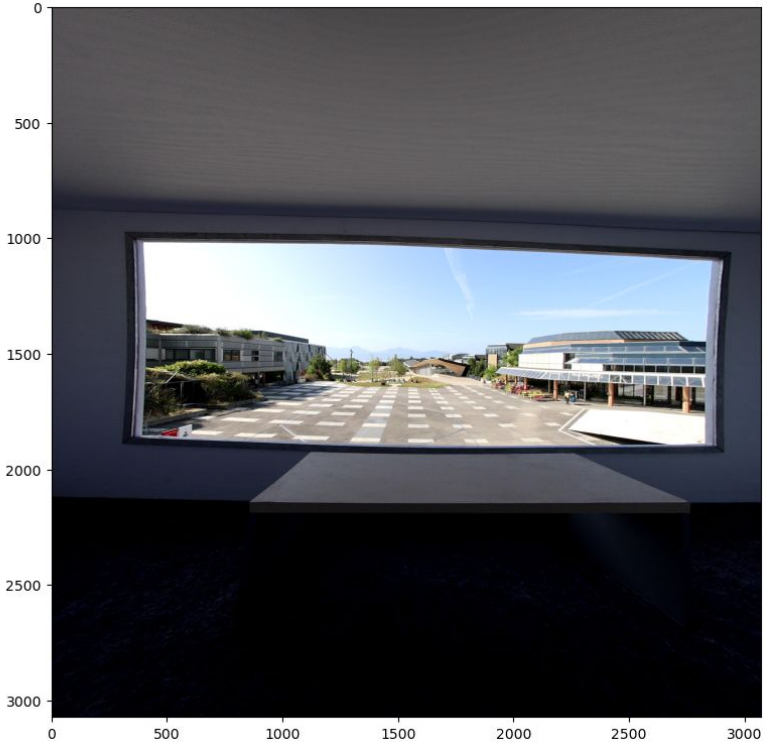
$$D = (k_1, k_2, k_3, k_4)$$

$$\alpha_u = focal\_length \cdot \frac{W_{resolution}}{W_{sensor}} \qquad \alpha_v = focal\_length \cdot \frac{H_{resolution}}{H_{sensor}}$$

$$p_u = \frac{W_{resolution}}{2} \qquad p_v = \frac{H_{resolution}}{2} \qquad s = 0$$

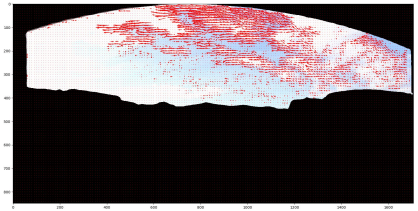
Unwarping - Results Scene 01

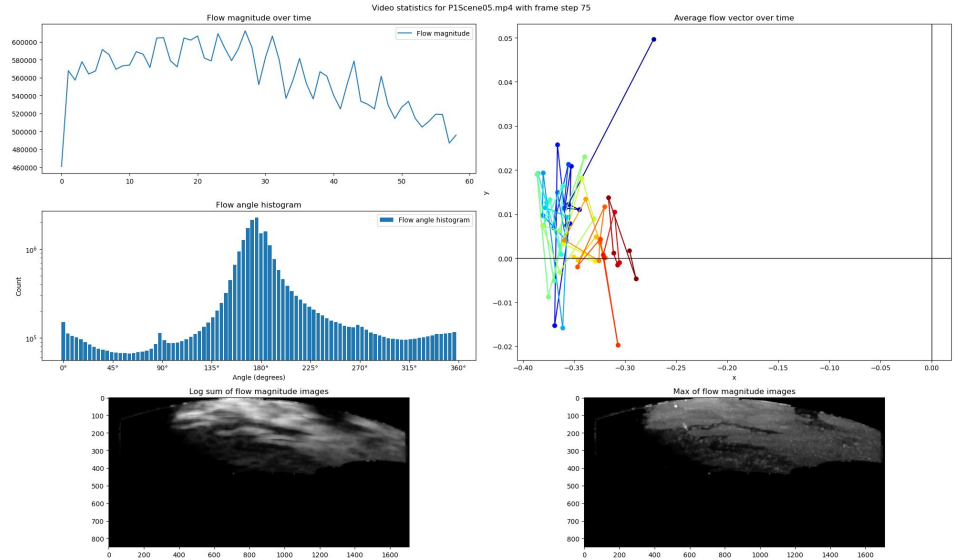




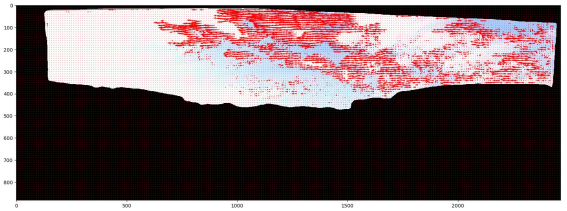
Unwarping - Optical Flow Scene 05 Example

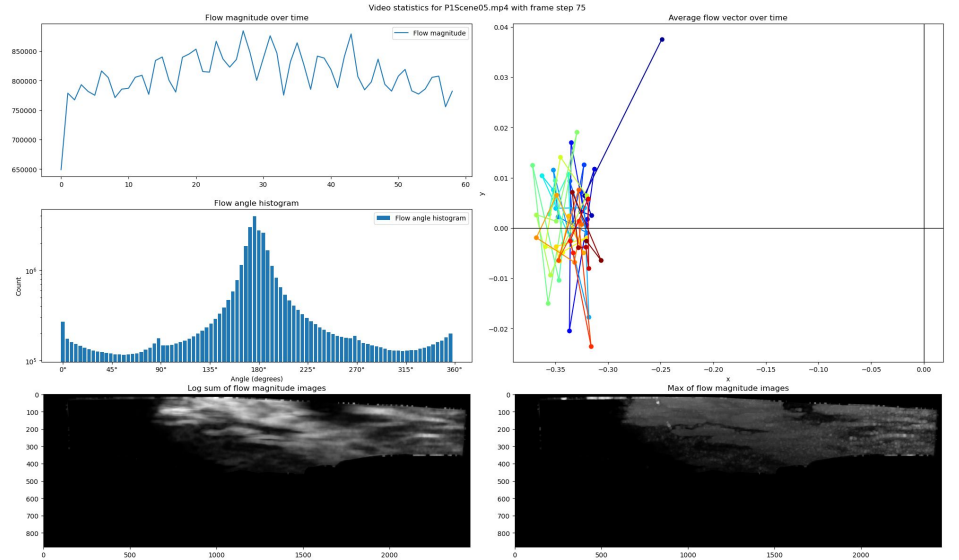
Farneback (warped)





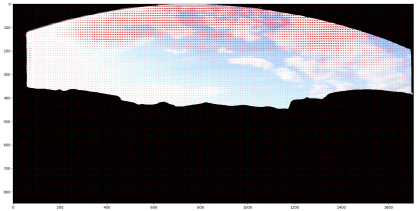
Farneback (unwarped)

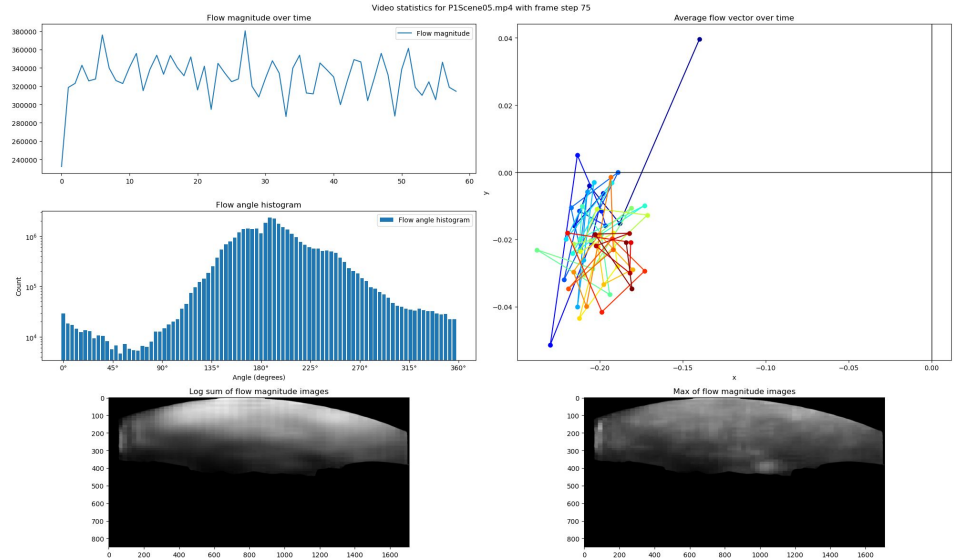




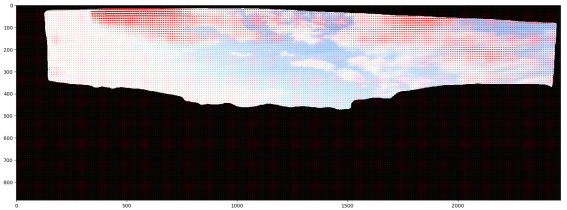
Unwarping - Optical Flow Scene 05 Example

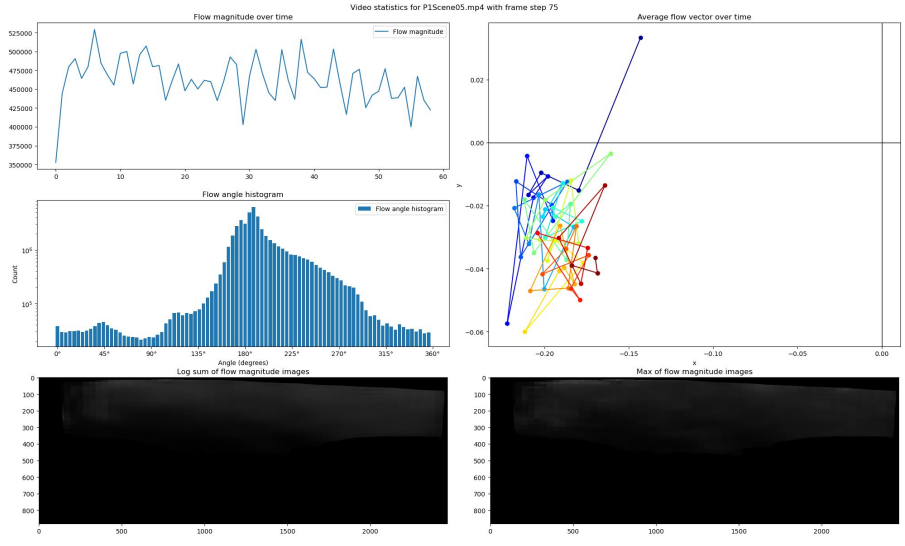
RAFT (warped)





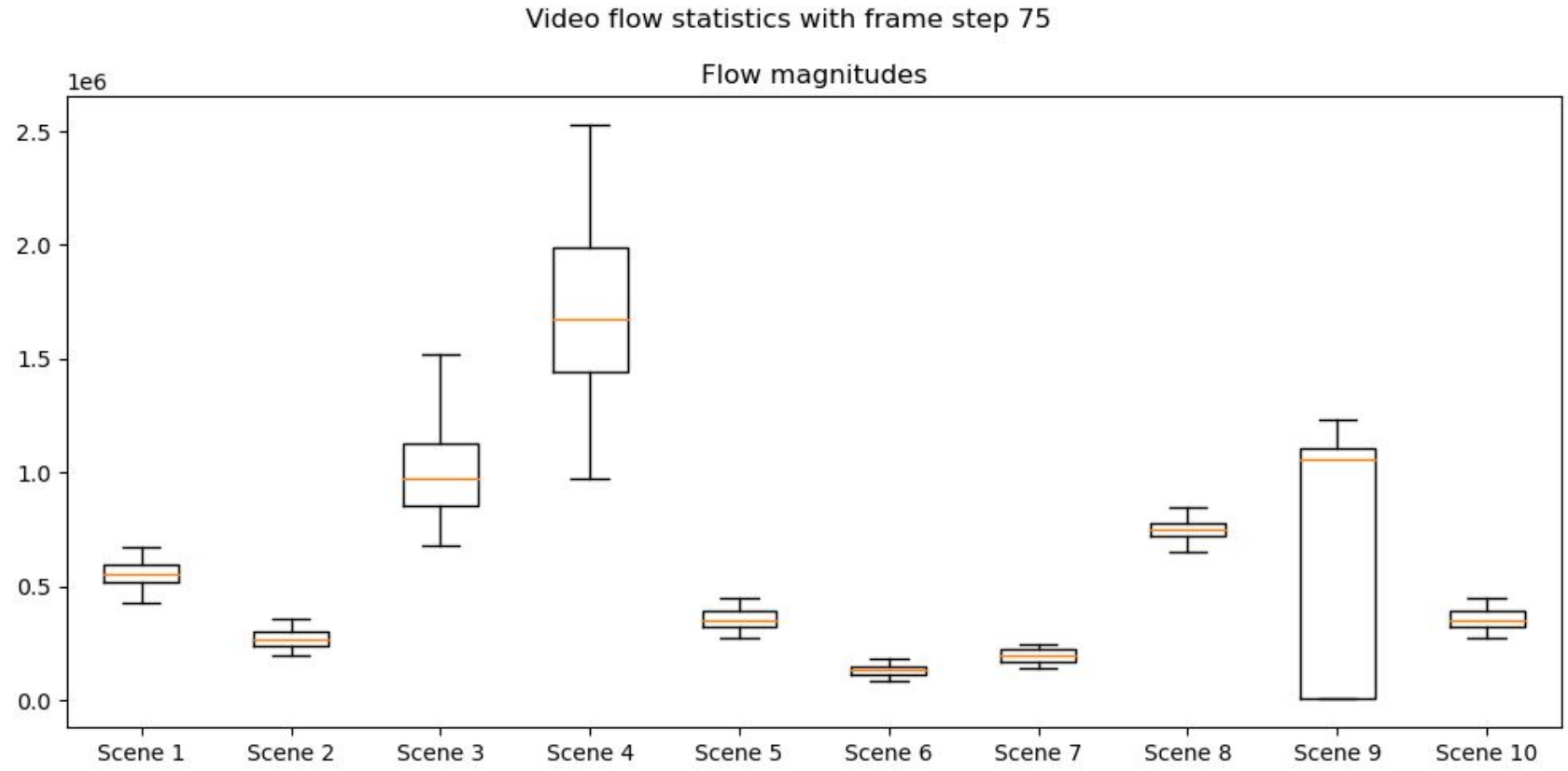
RAFT (unwarped)



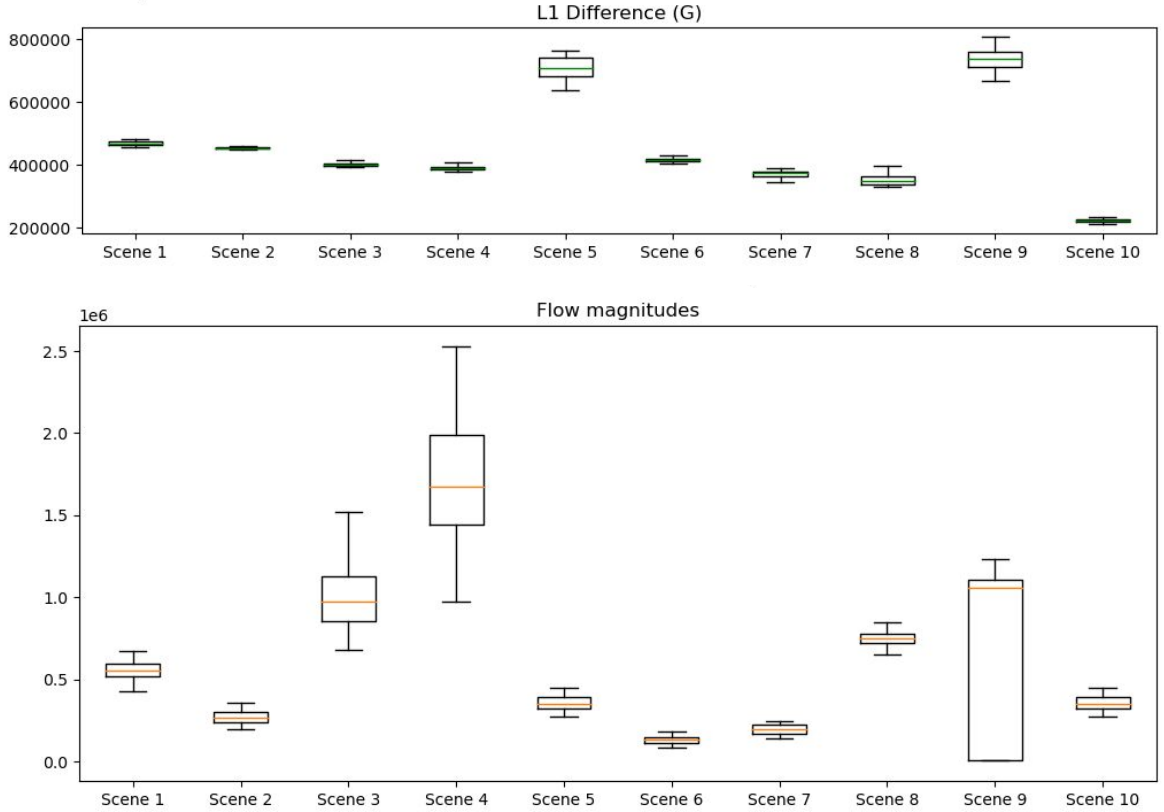


RAFT

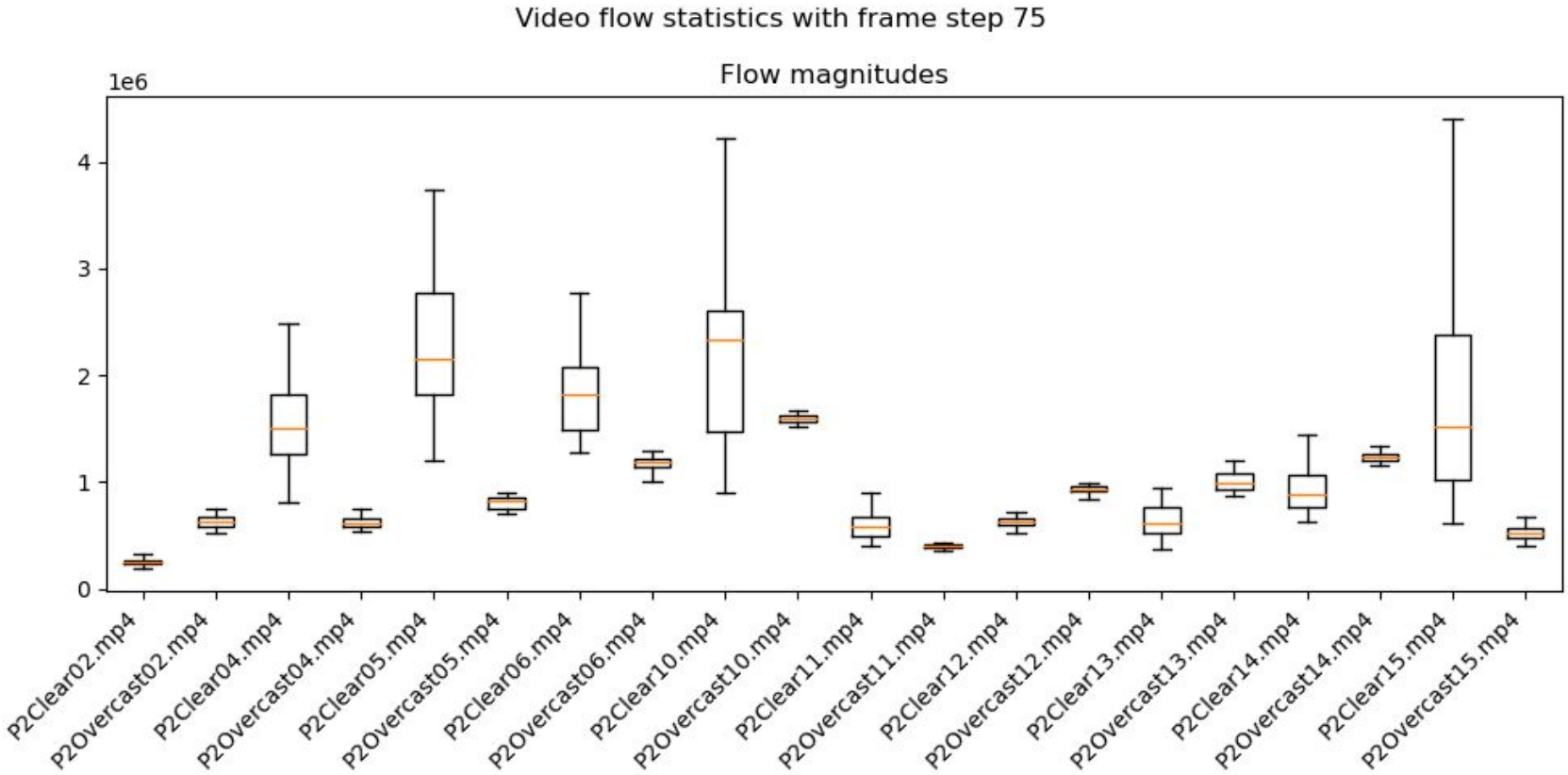
RAFT - Part 01


Video flow statistics with frame step 75
Flow magnitudes
1e6
2.5
2.0
1.5
1.0
0.5
0.0
Scene 1
Scene 2
Scene 3
Scene 4
Scene 5
Scene 6
Scene 7
Scene 8
Scene 9
Scene 10

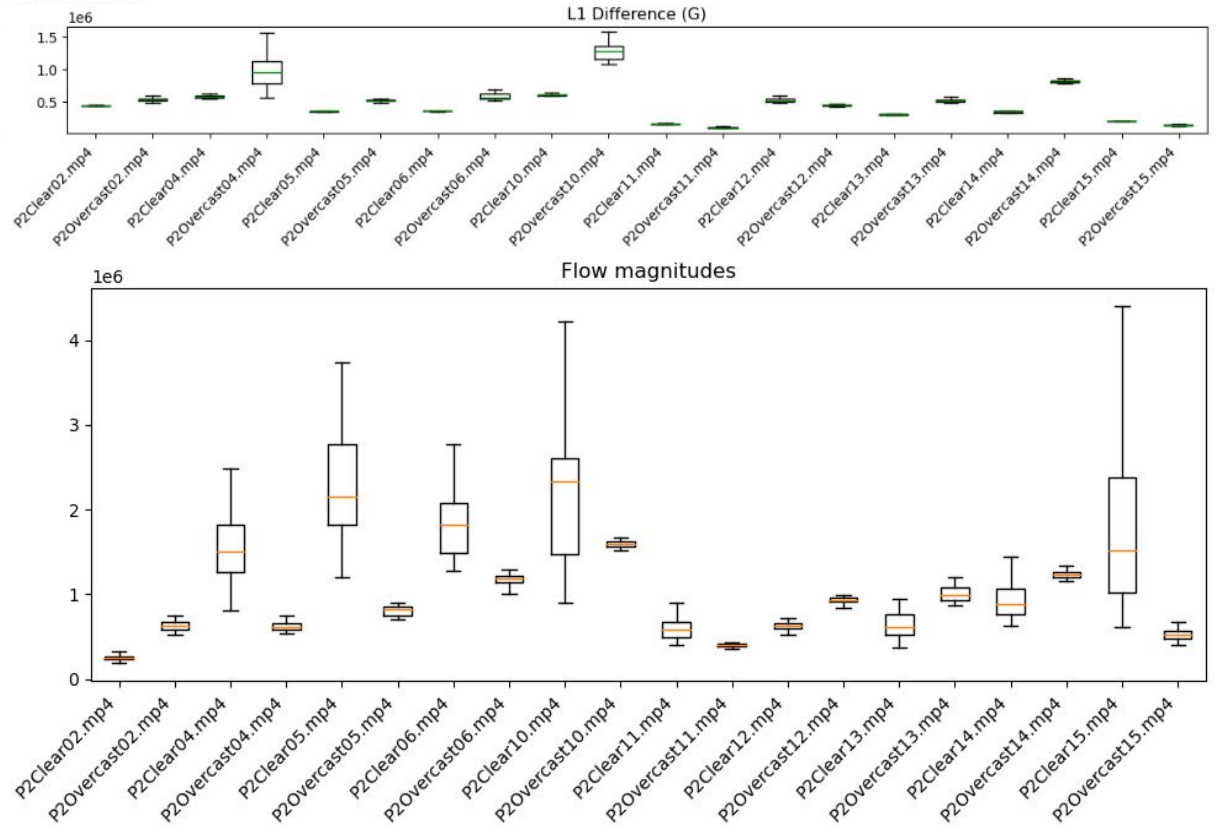
RAFT - L1 Differences vs Flow magnitudes



RAFT - Part 02


Video flow statistics with frame step 75
Flow magnitudes
1e6
4
3
2
1
0
P2Clear02.mp4
P2Overcast02.mp4
P2Clear04.mp4
P2Overcast04.mp4
P2Clear05.mp4
P2Overcast05.mp4
P2Clear06.mp4
P2Overcast06.mp4
P2Clear10.mp4
P2Overcast10.mp4
P2Clear11.mp4
P2Overcast11.mp4
P2Clear12.mp4
P2Overcast12.mp4
P2Clear13.mp4
P2Overcast13.mp4
P2Clear14.mp4
P2Overcast14.mp4
P2Clear15.mp4
P2Overcast15.mp4

RAFT - L1 Differences vs Flow magnitudes



RAFT - Part 02 Merged