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Supplement of

Estimating velocity distribution and flood discharge at river bridges using entropy theory – insights from computational fluid dynamics flow fields

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Supplement

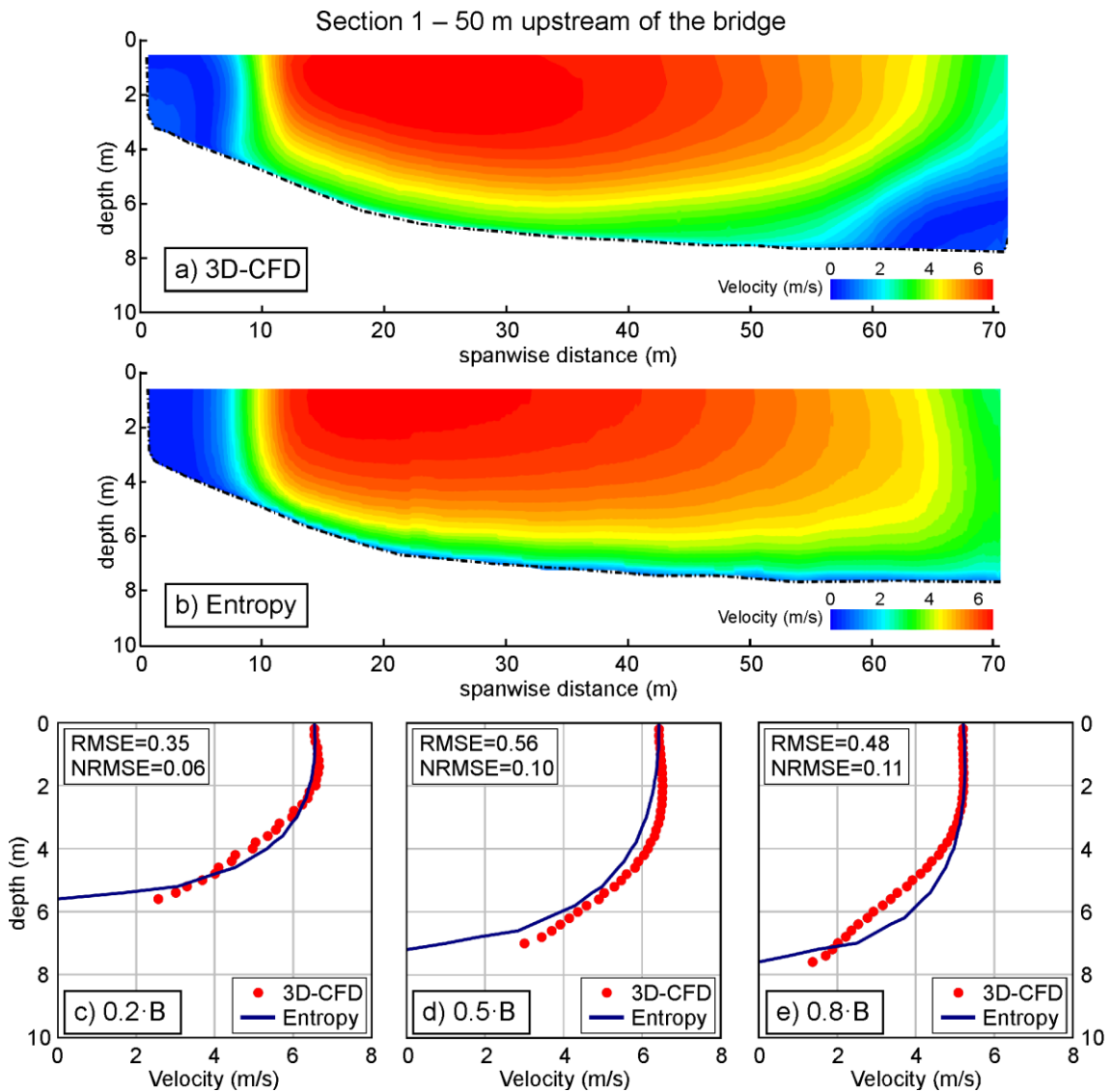## S1. Results for the peak-flow condition of the 2012 flood event

Figure S1. Flood event of 2012, cross-section 1 (50 m upstream of the bridge). Velocity distributions provided by (a) the 3D-CFD model, and (b) the entropy model forced with the river-wide distribution of the free-surface velocity. Comparison of vertical distributions of velocity at $0.2B$ (c), $0.5B$ (d), and $0.8B$ (e), where B is the width of the cross-section.
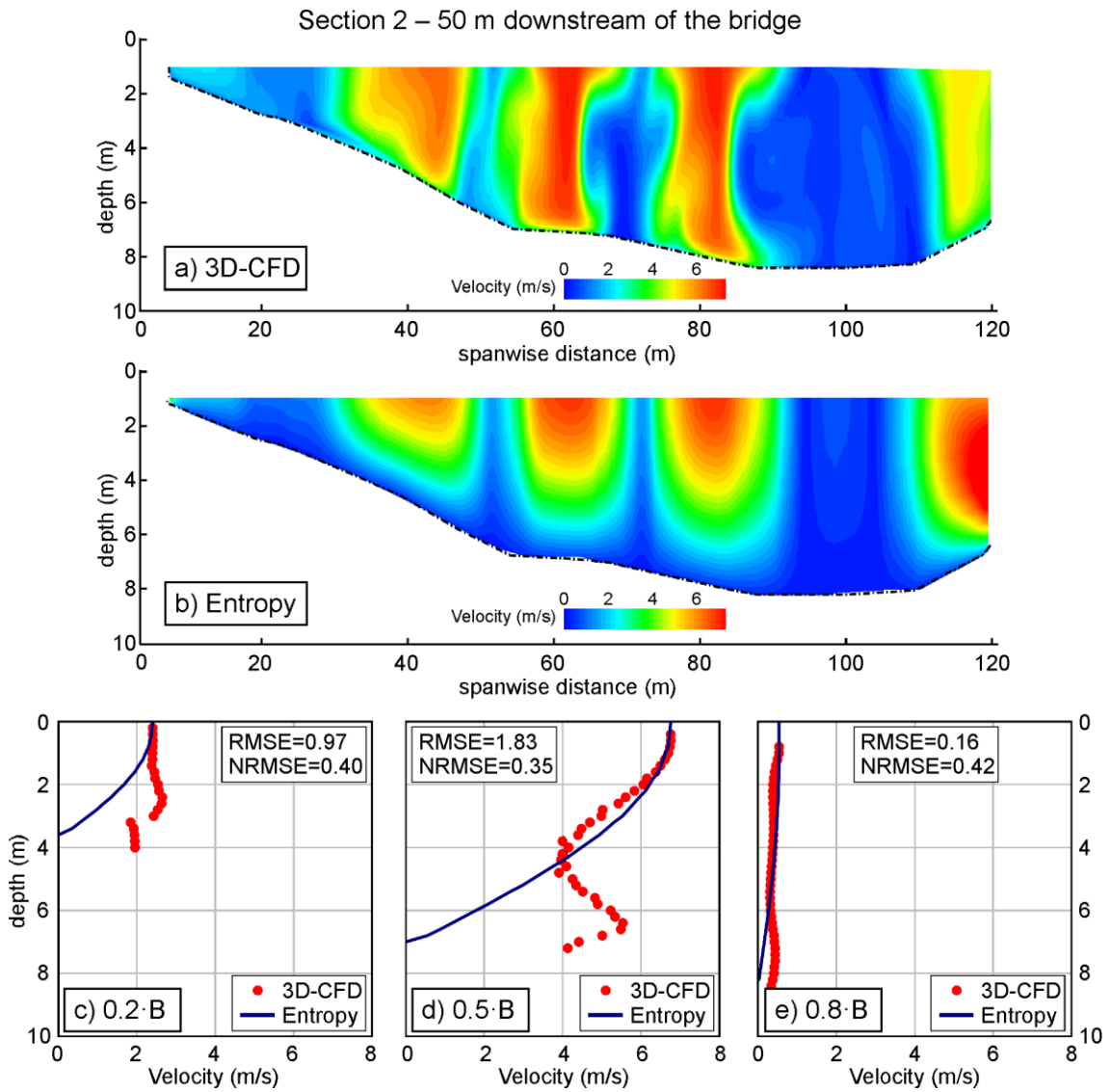
Figure S2. Flood event of 2012, cross-section 2 (50 m downstream of the bridge). Velocity distributions provided by (a) the 3D-CFD model, and (b) the entropy model forced with the river-wide distribution of the free-surface velocity. Comparison of vertical distributions of velocity at 0.2*B* (c), 0.5*B* (d), and 0.8*B* (e), where *B* is the width of the cross-section.
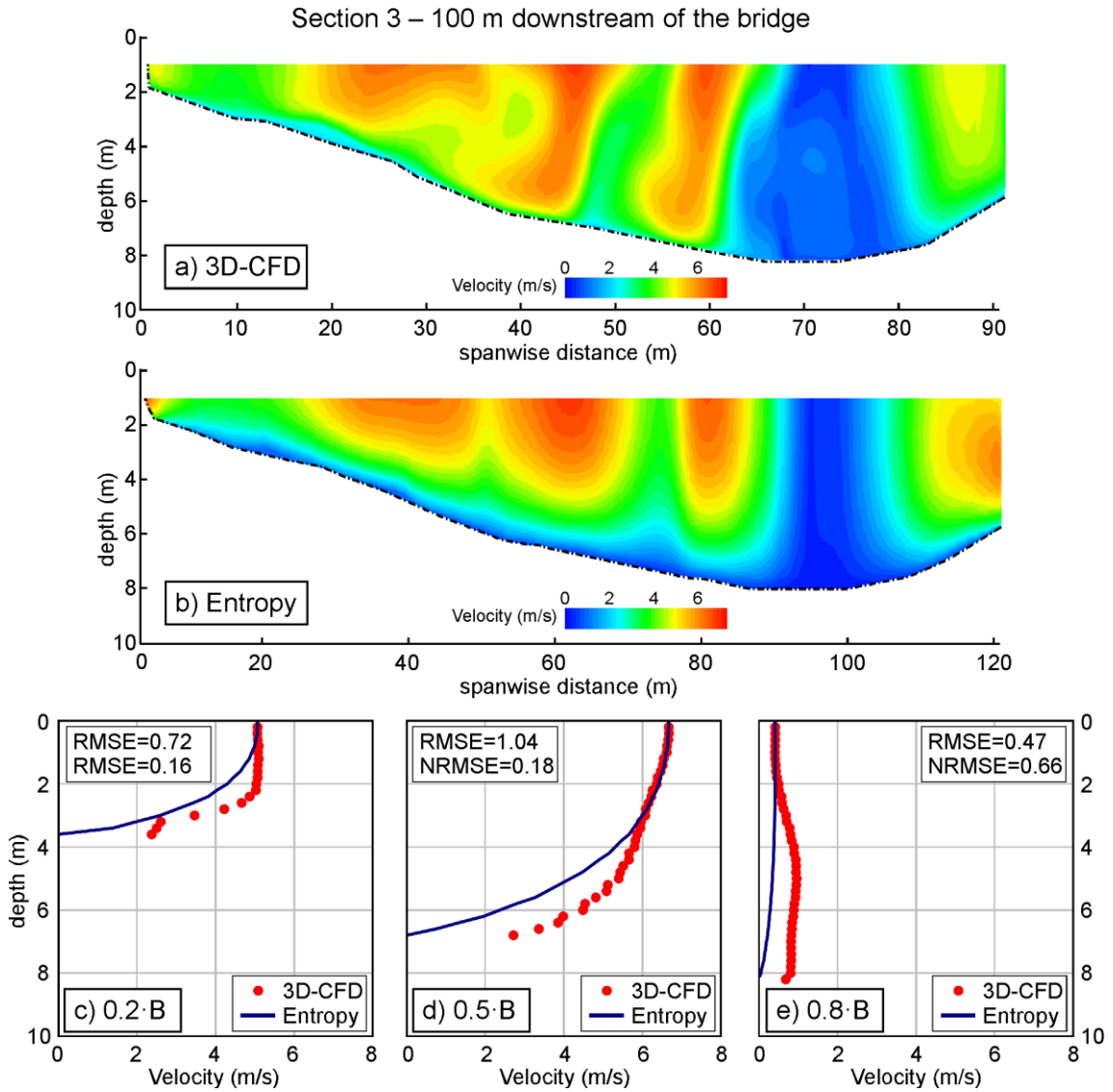
Figure S3. Flood event of 2012, cross-section 3 (100 m downstream of the bridge). Velocity distributions provided by (a) the 3D-CFD model, and (b) the entropy model forced with the river-wide distribution of the free-surface velocity. Comparison of vertical distributions of velocity at 0.2B (c), 0.5B (d), and 0.8B (e), where B is the width of the cross-section.
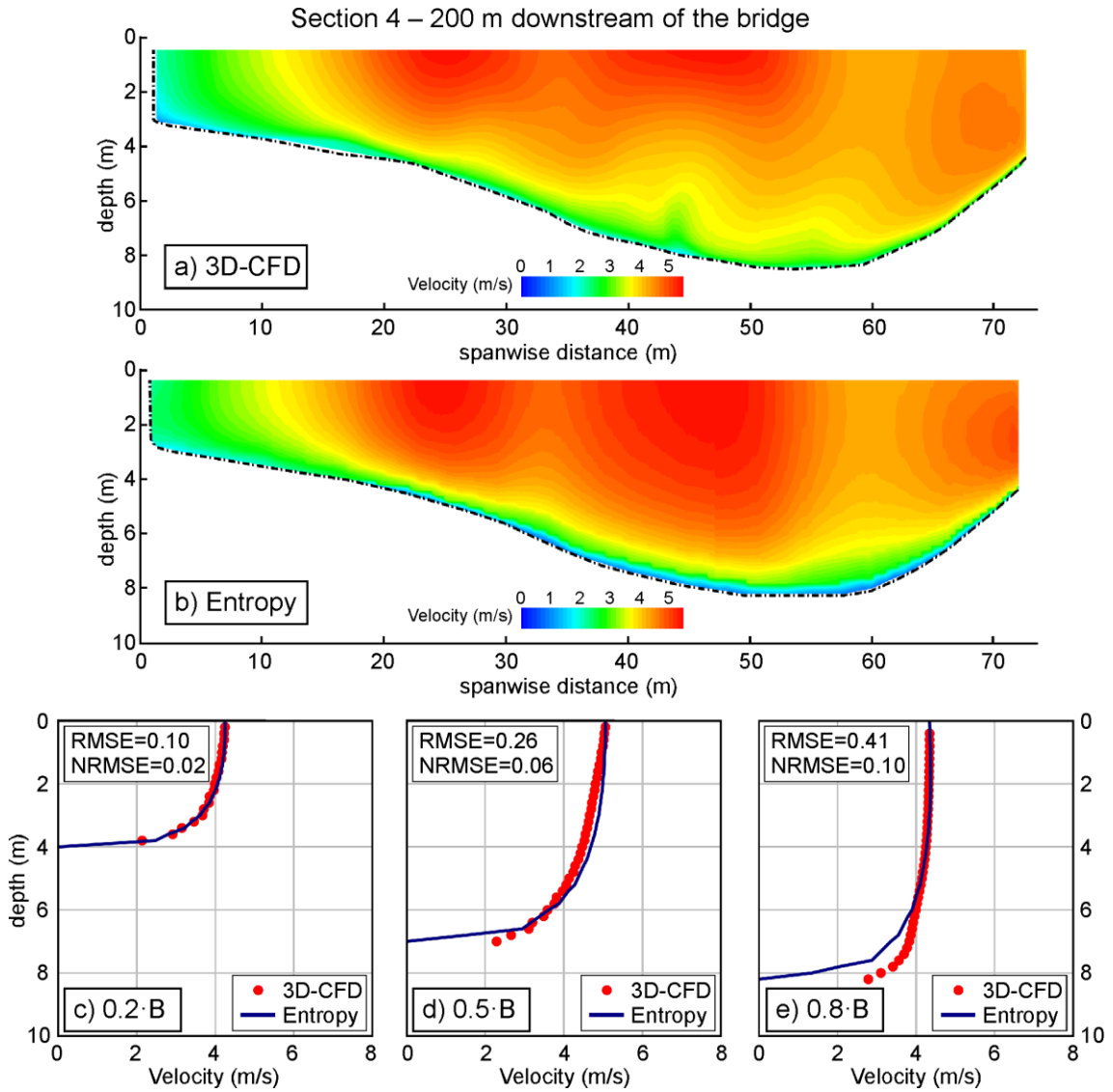
Figure S4. Flood event of 2012, cross-section 4 (200 m downstream of the bridge). Velocity distributions provided by (a) the 3D-CFD model, and (b) the entropy model forced with the river-wide distribution of the free-surface velocity. Comparison of vertical distributions of velocity at $0.2B$ (c), $0.5B$ (d), and $0.8B$ (e), where B is the width of the cross-section.
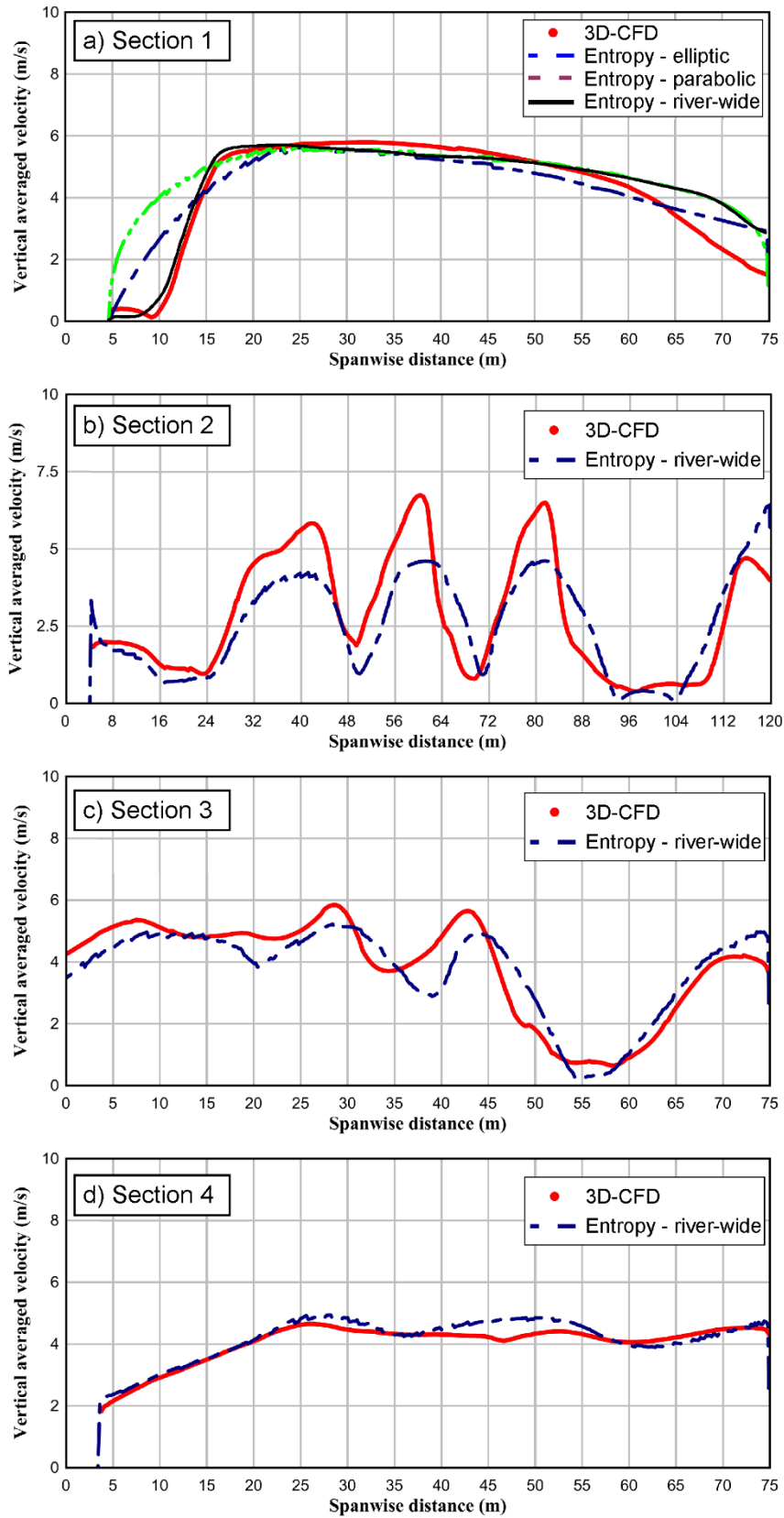
Figure S5. Flood event of 2012. Depth-averaged spanwise velocity distribution at the four cross-sections.

S2. Results for the peak-flow condition of the 2019 flood event
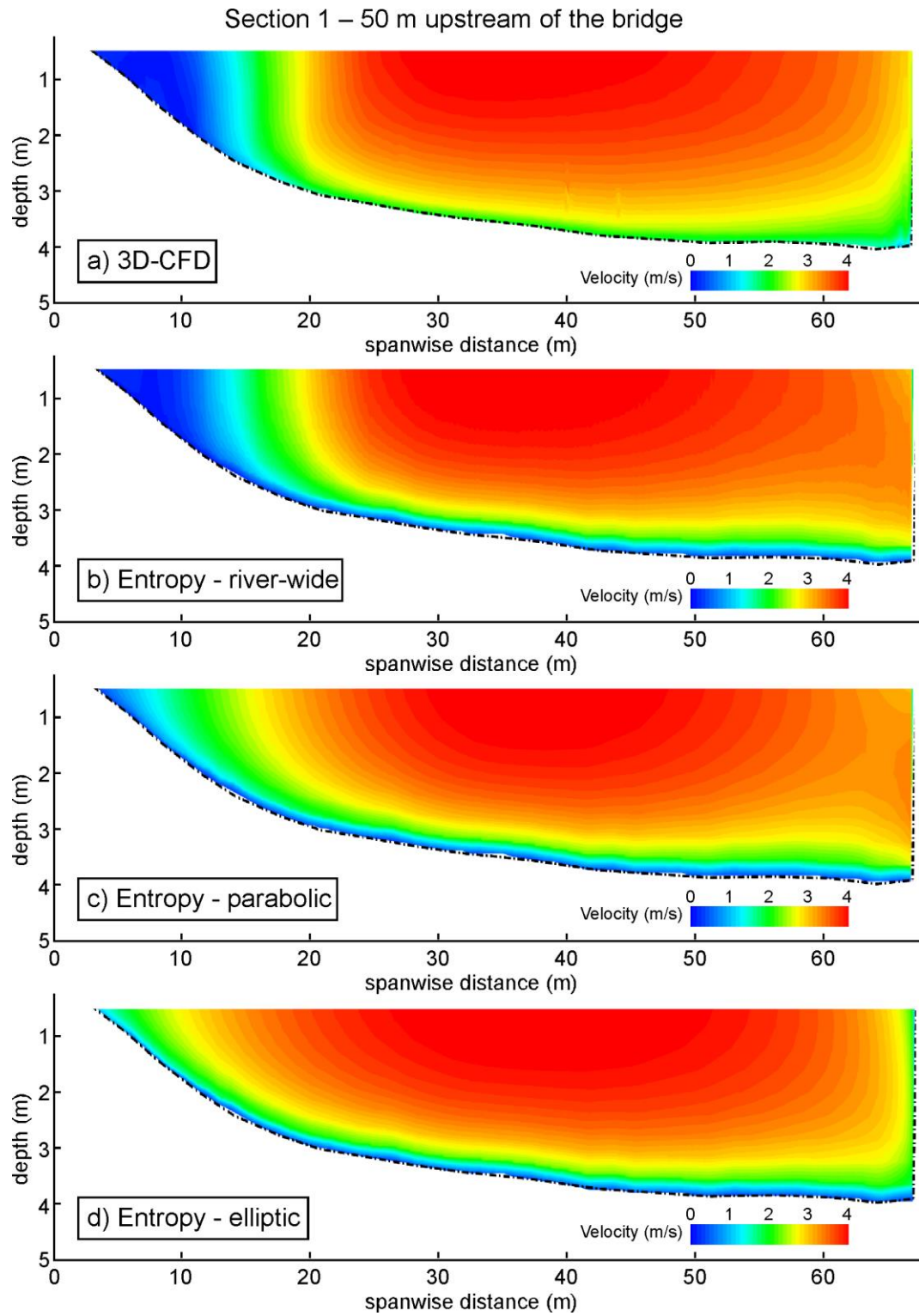
Section 1 – 50 m upstream of the bridge

Figure S6. Flood event of 2019, cross-section 1 (50 m upstream of the bridge). Cross-sectional velocity distribution computed with the 3D-CFD model (a), and the entropy theory forced with (b) the river-wide surface velocity, (c) the parabolic, and (d) and elliptic spanwise velocity distribution.
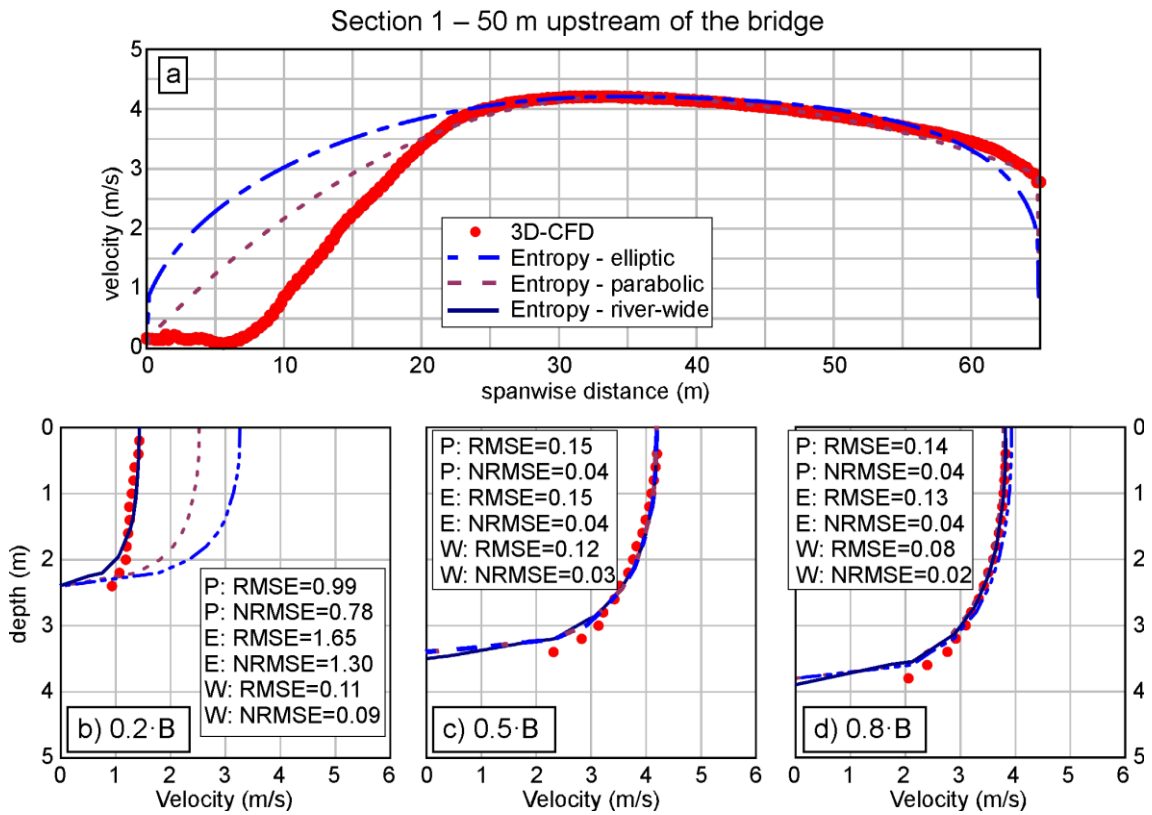
Figure S7. Flood event of 2019, cross-section 1 (50 m upstream of the bridge). Spanwise distribution of the surface velocity (a); comparison of vertical distributions of velocity at 0.2B (b), 0.5B (c), and 0.8B (d).
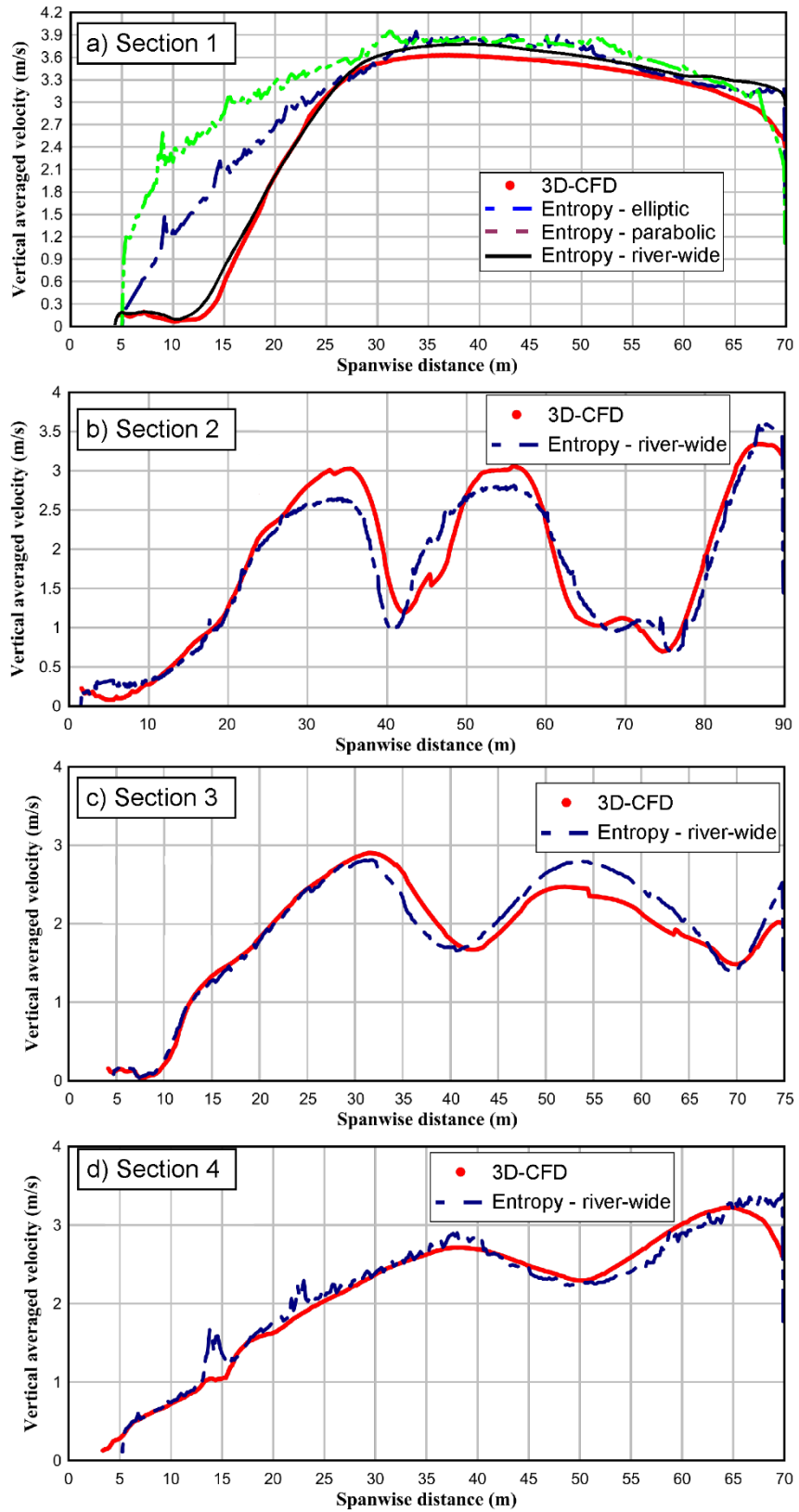
Figure S8. Flood event of 2019. Depth-averaged spanwise velocity distribution at the four cross-sections.

S3. Results for the peak-flow condition of the 2022 flood event
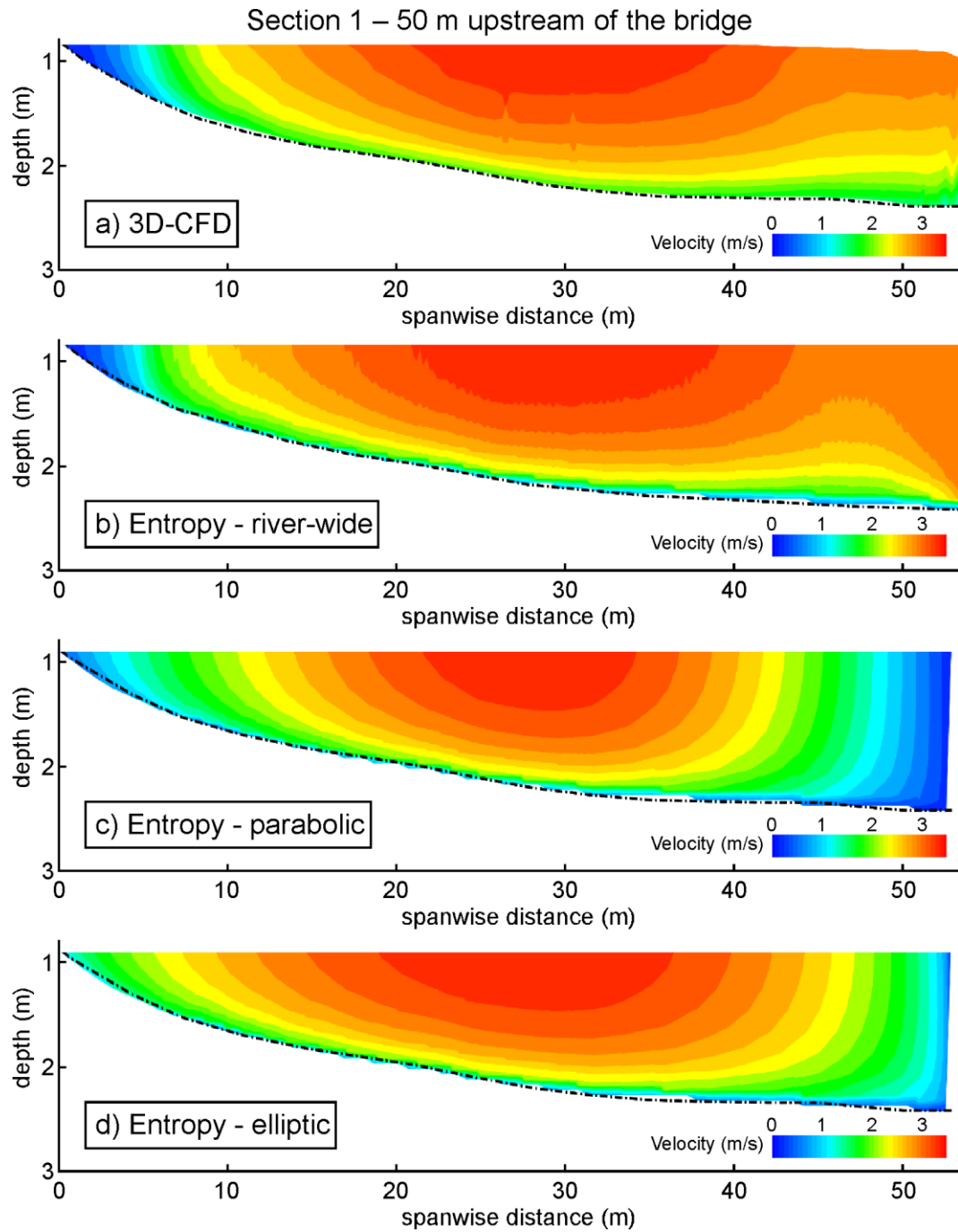

Figure S9. Flood event of 2022, cross-section 1 (50 m upstream of the bridge). Cross-sectional velocity distribution computed with the 3D-CFD model (a), and the entropy theory forced with (b) the river-wide surface velocity, (c) the parabolic, and (d) and elliptic spanwise velocity distribution.
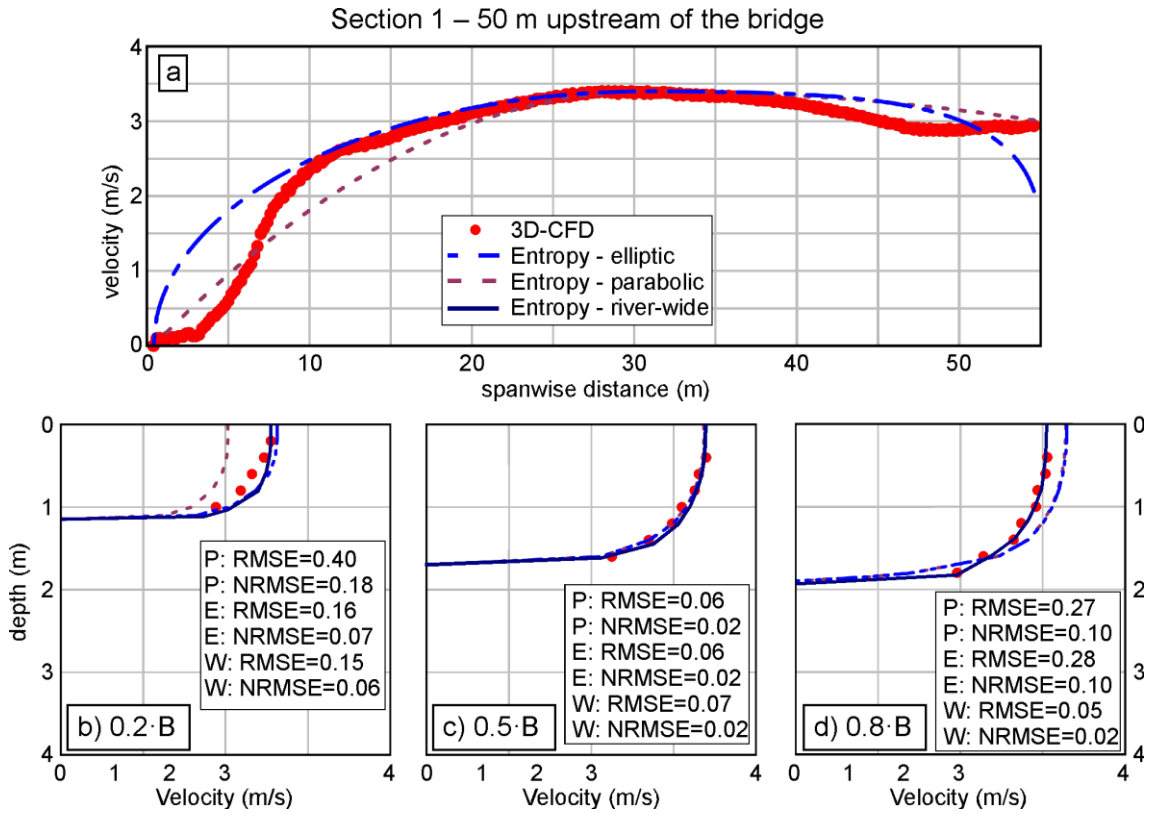
Figure S10. Flood event of 2022, cross-section 1 (50 m upstream of the bridge). Spanwise distribution of the surface velocity (a); comparison of vertical distributions of velocity at 0.2B (b), 0.5B (c), and 0.8B (d).
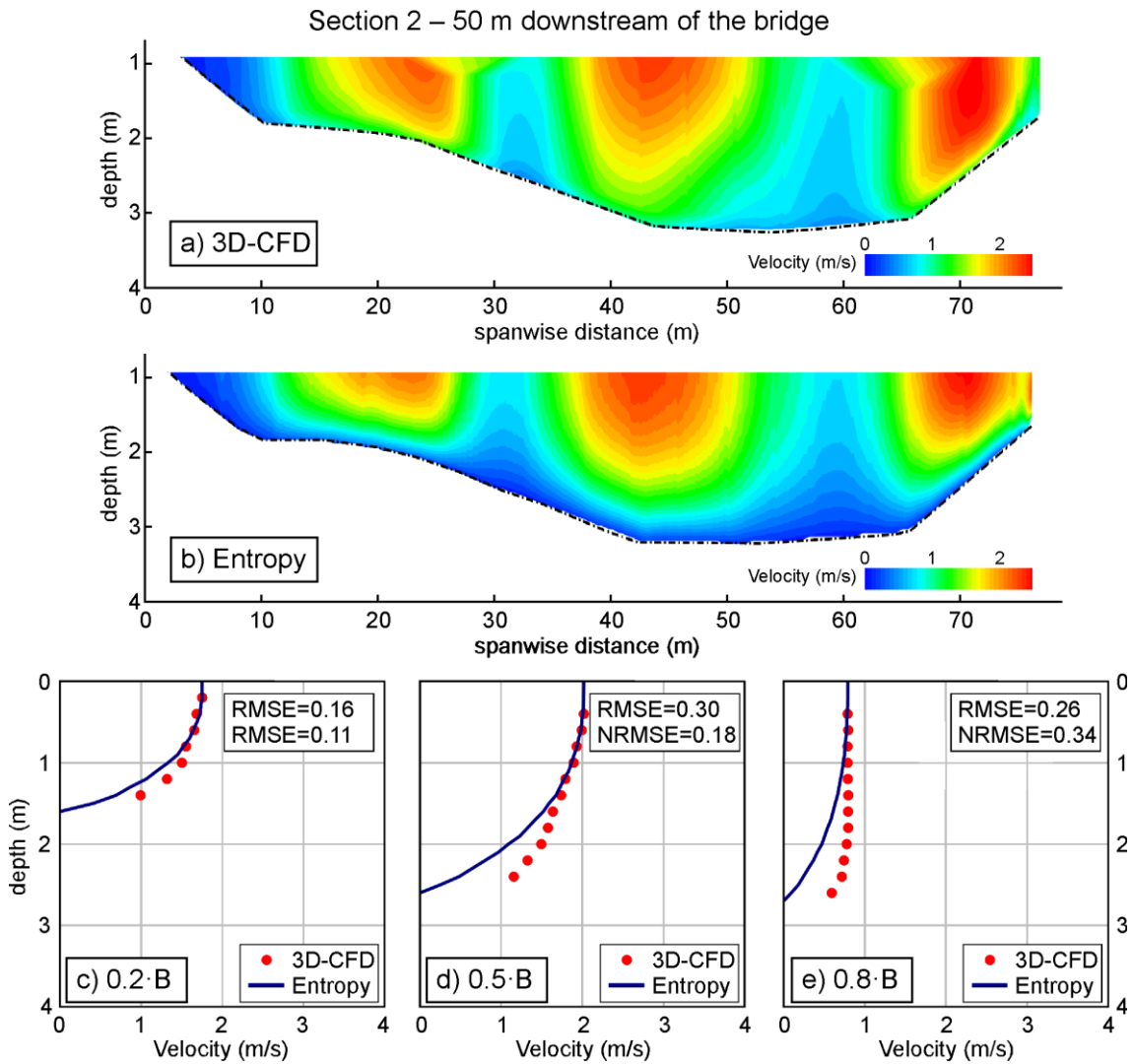
Figure S11. Flood event of 2022, cross-section 2 (50 m downstream of the bridge). Velocity distributions provided by (a) the 3D-CFD model, and (b) the entropy model forced with the river-wide distribution of the free-surface velocity. Comparison of vertical distributions of velocity at $0.2B$ (c), $0.5B$ (d), and $0.8B$ (e), where B is the width of the cross-section.
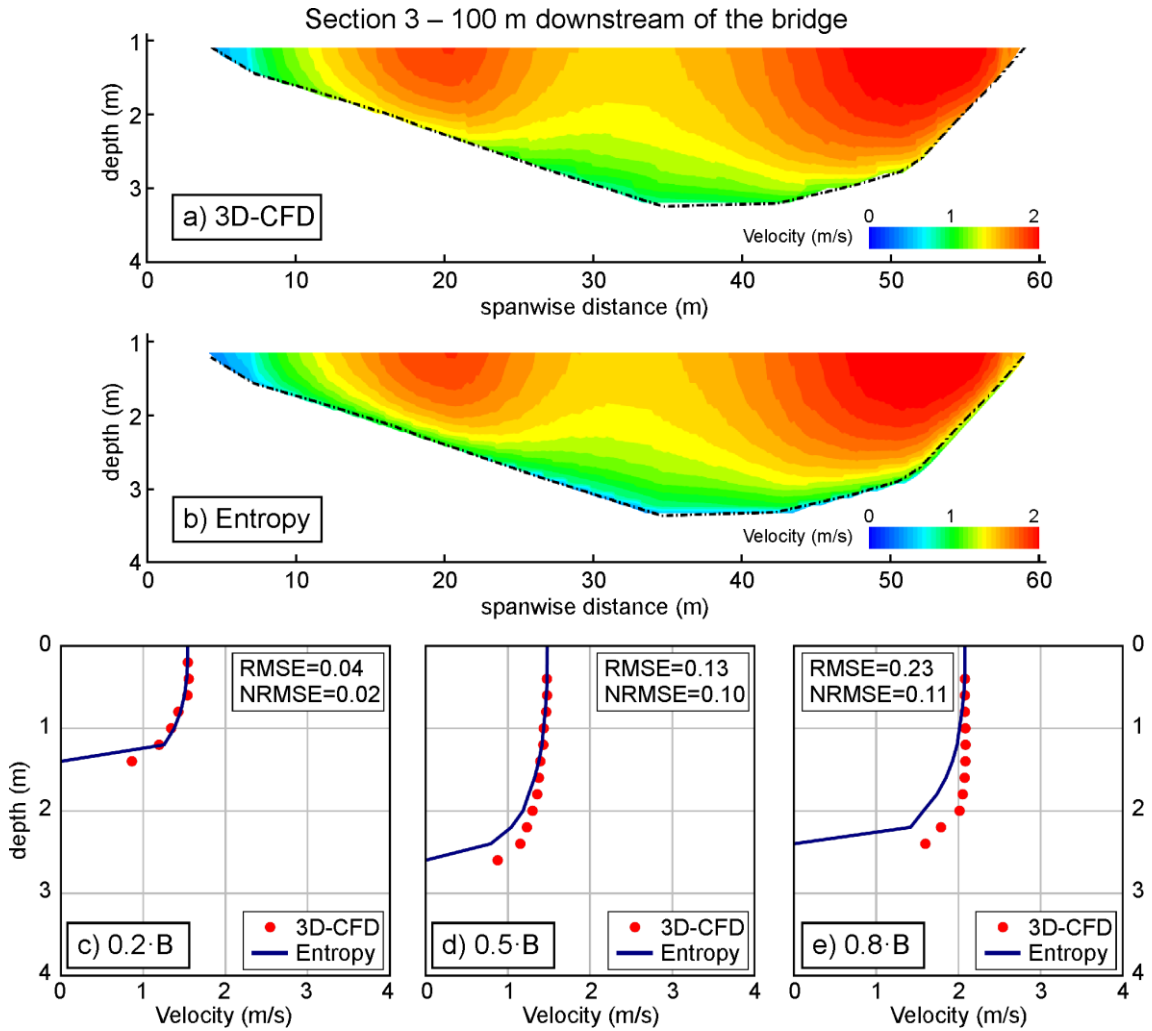
Figure S12. Flood event of 2022, cross-section 3 (100 m downstream of the bridge). Velocity distributions provided by (a) the 3D-CFD model, and (b) the entropy model forced with the river-wide distribution of the free-surface velocity. Comparison of vertical distributions of velocity at 0.2*B* (c), 0.5*B* (d), and 0.8*B* (e), where *B* is the width of the cross-section.
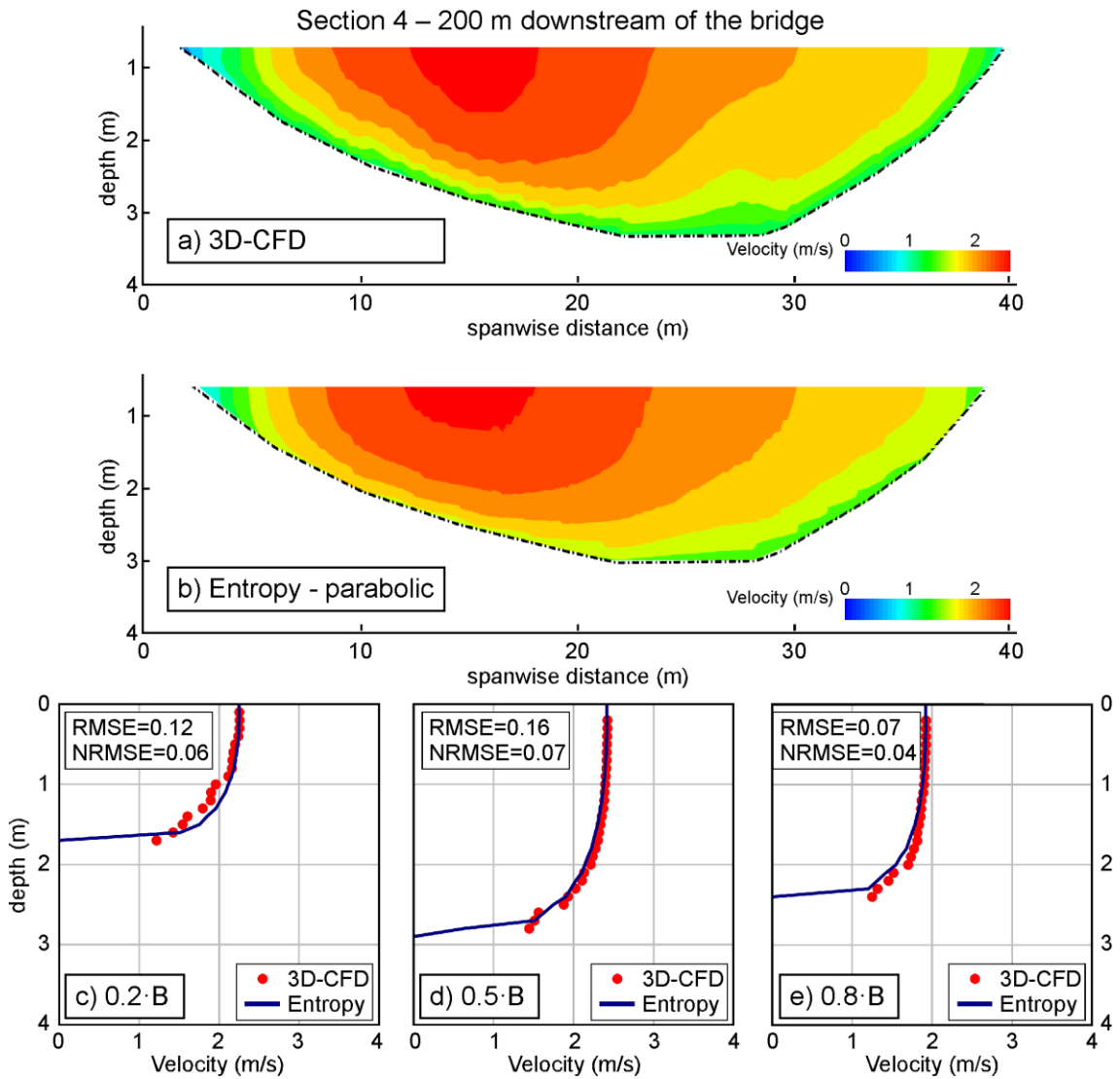
Figure S13. Flood event of 2022, cross-section 4 (200 m downstream of the bridge). Velocity distributions provided by (a) the 3D-CFD model, and (b) the entropy model forced with the river-wide distribution of the free-surface velocity. Comparison of vertical distributions of velocity at 0.2B (c), 0.5B (d), and 0.8B (e), where B is the width of the cross-section.
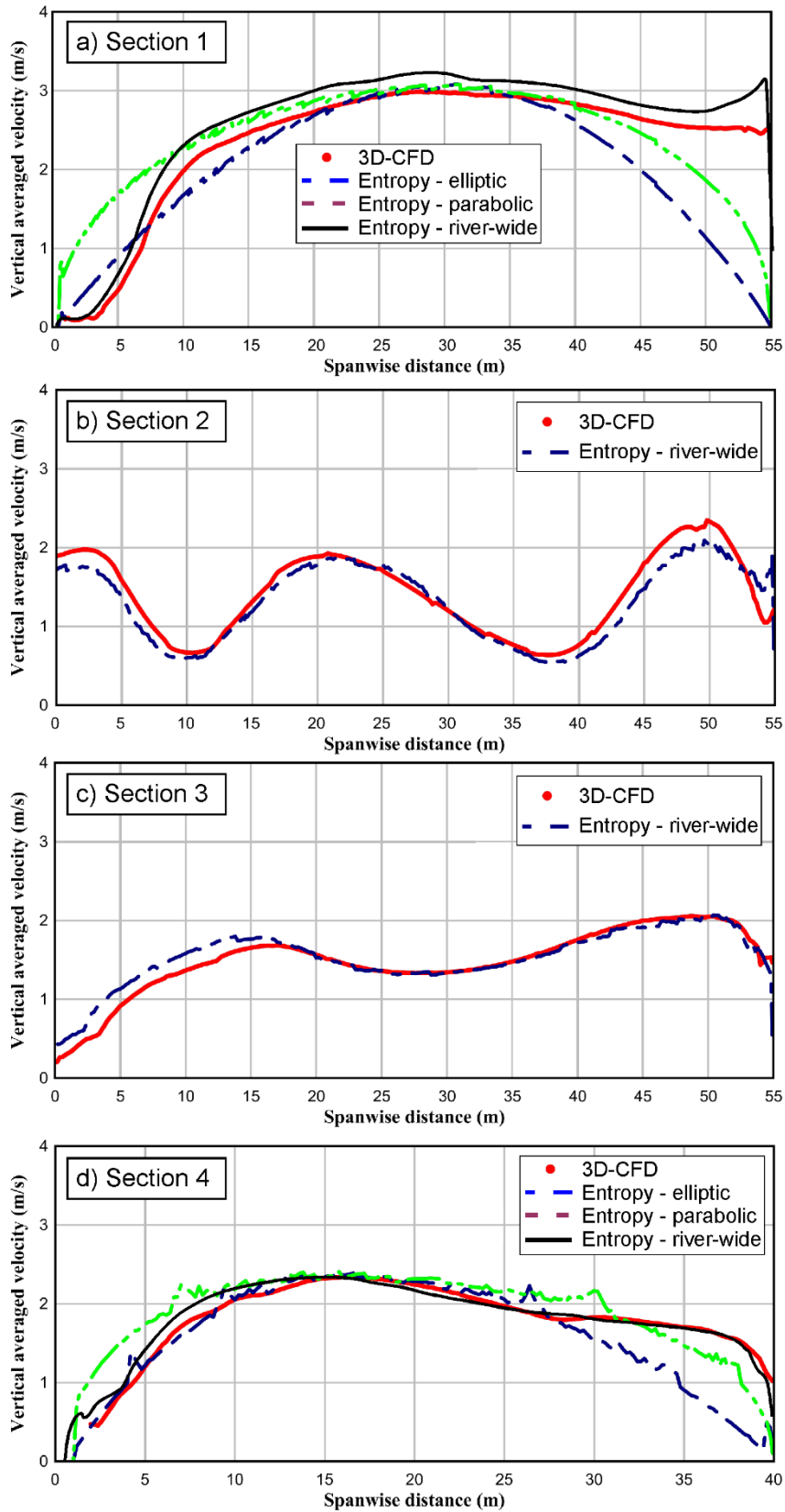
Figure S14. Flood event of 2019. Depth-averaged spanwise velocity distribution at the four cross-sections.