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Supplement of

Lahar events in the last 2000 years from Vesuvius eruptions – Part 3: Hazard assessment over the Campanian Plain

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Supplementary Material

S1. Sensitivity analysis for the Total Grain Size Distribution (TGSD)

In this supplementary material we present the results of an analysis on the effects of the TGDS on lahar dynamics. We take as reference simulation one of the simulations used in the hazard study, for which the initial TGSD is defined as the linear combination of two Weibull distributions with a weight p=0.339. We then performed 5 simulations varying the weight p from 0 (resulting in the finest-grain size Weibull only) to 1 (resulting in the coarsest-grain size Weibull only). The different TGSDs are presented in Fig.S1.

The corresponding simulated results are given in the following figures:

- deposit thickness after 24 hours from the flow onset in Fig.S2;
- maximum flow thickness during 24 hours from the flow onset in Fig.S3;
- maximum dynamic pressure with a flow thickness of at least 0.1m during 24 hours from the flow onset in Fig.S4;
- maximum dynamic pressure with a flow thickness of at least 0.5 m during 24 hours from the flow onset in Fig.S5;
- maximum dynamic pressure with a flow thickness of at least 1m during 24 hours from the flow onset in Fig.S6.

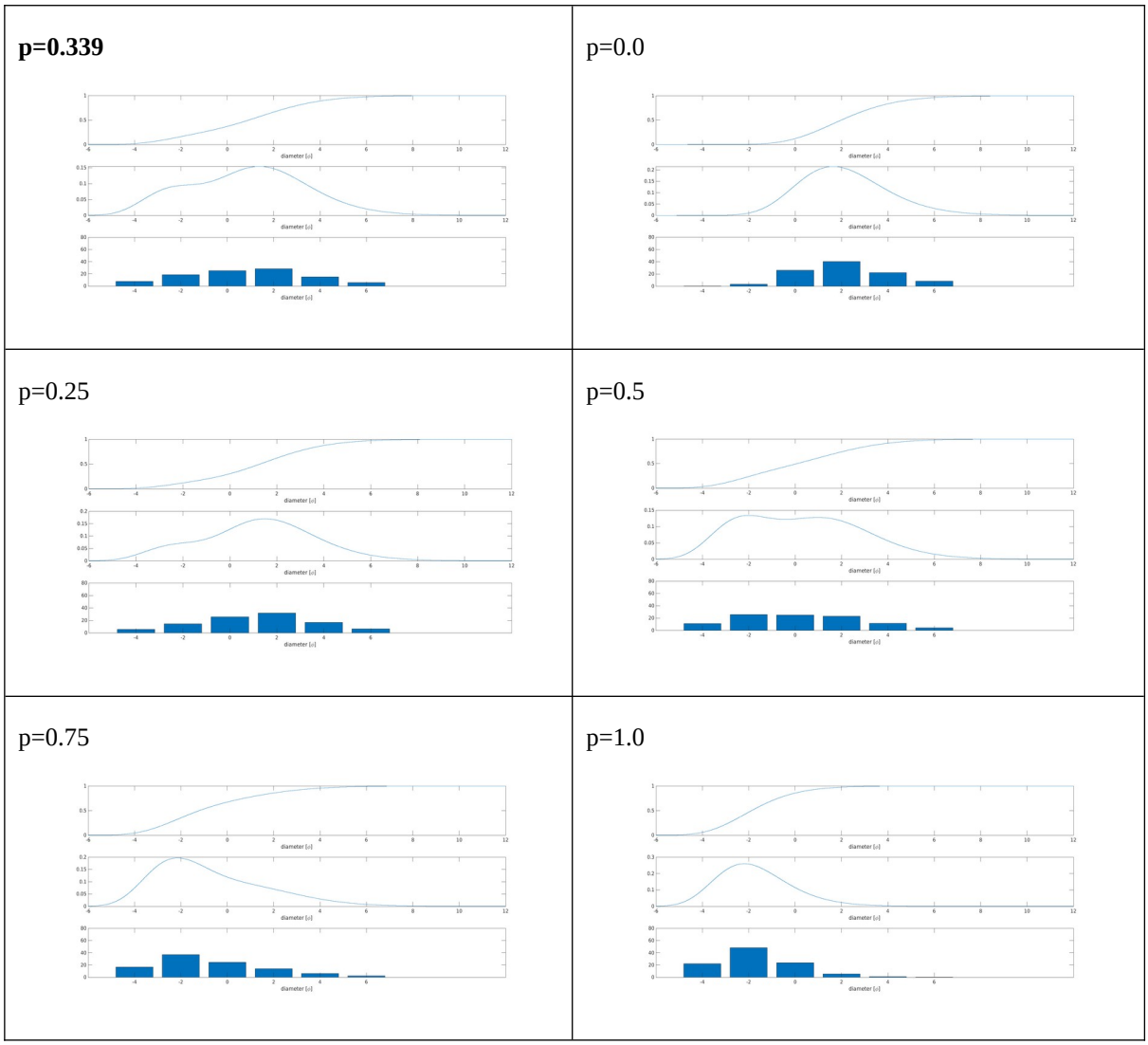

Figure S1. TGSDs investigated: (top-left) p=0.339 – reference simulation; (top-right) p=0.0; (middle-left) p=0.25; (middle-right) p=0.5; (bottom-left) p=0.75; (bottom-right) p=1.0.

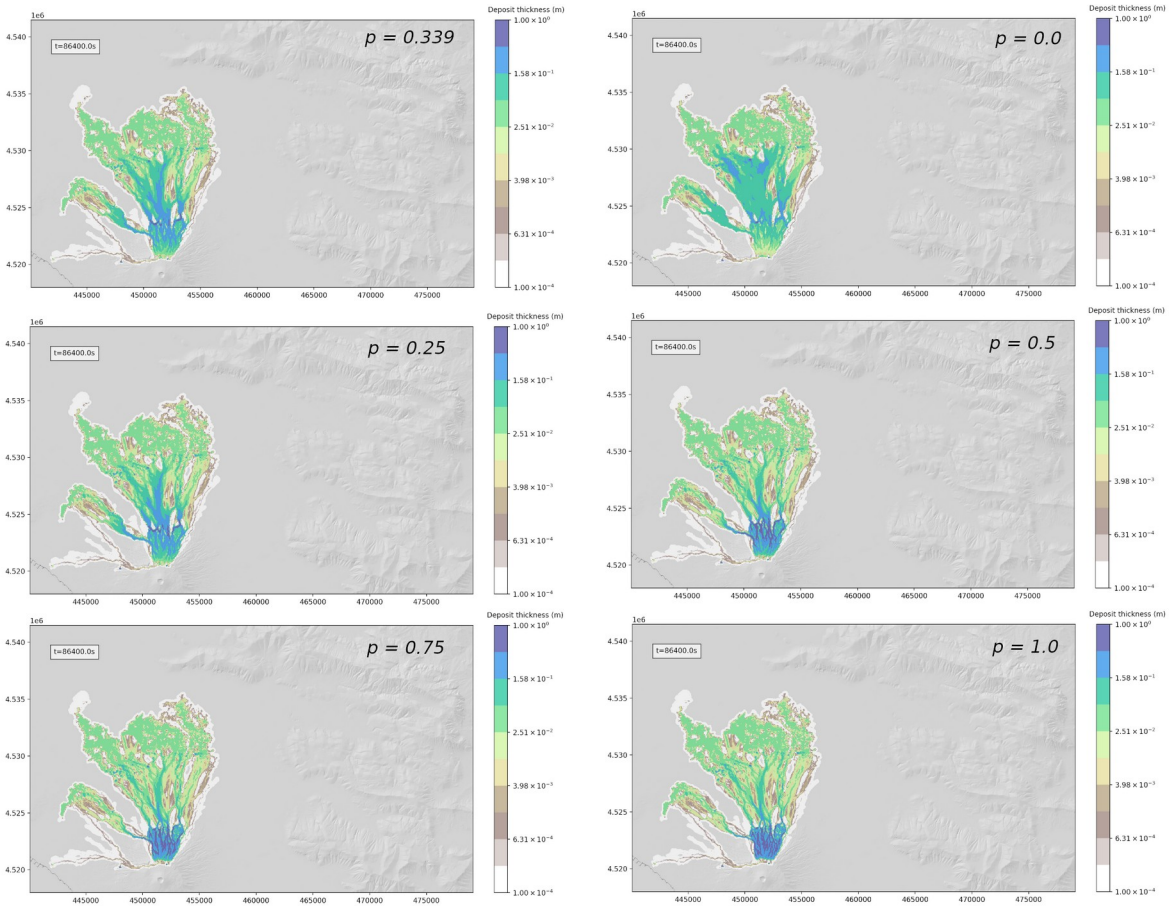

Figure S2. Flow thickness 24h from the mobilization of the lahar for: (top-left) p=0.339 – reference simulation; (top-right) p=0.0; (middle-left) p=0.25; (middle-right) p=0.5; (bottom-left) p=0.75; (bottom-right) p=1.0.

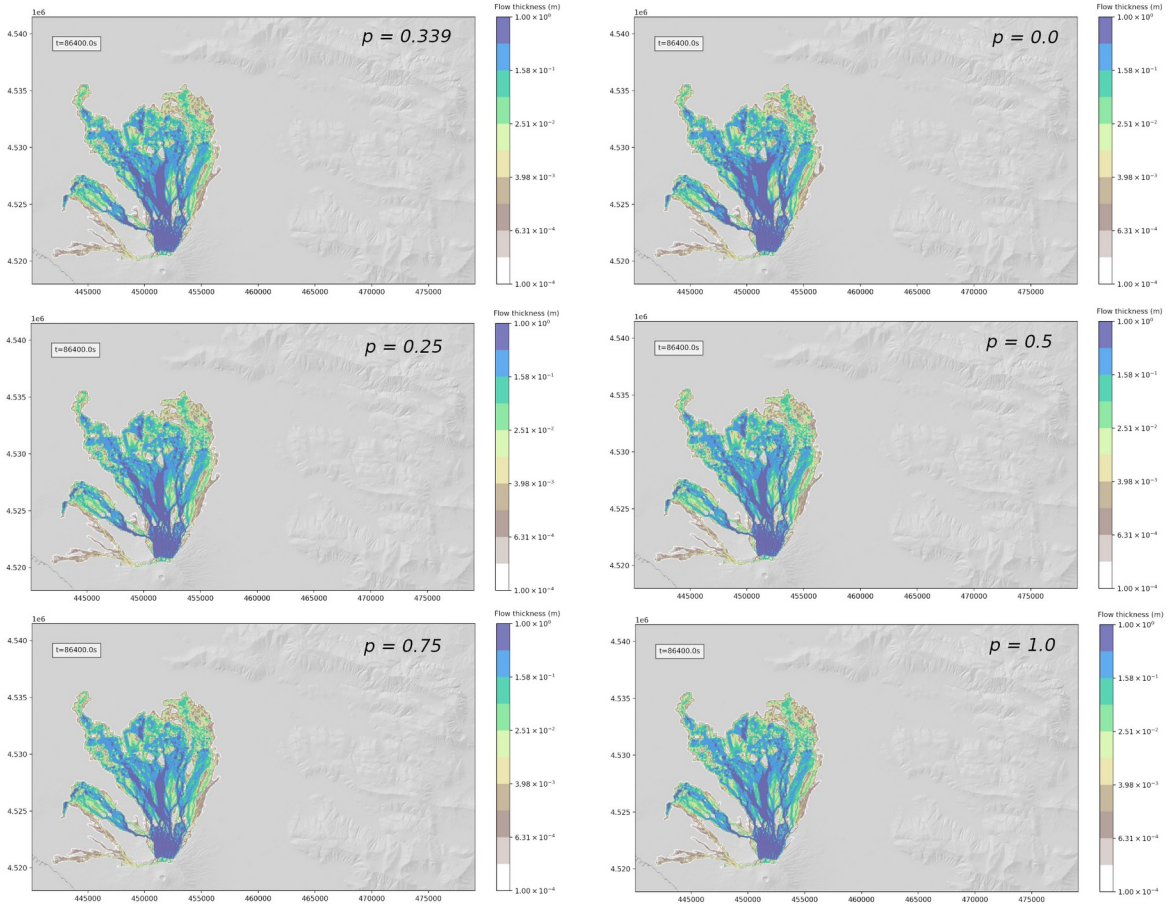

Figure S3. Maximum flow thickness during 24h from the mobilization of the lahar for: (top-left) p=0.339 – reference simulation; (top-right) p=0.0; (middle-left) p=0.25; (middle-right) p=0.5; (bottom-left) p=0.75; (bottom-right) p=1.0.

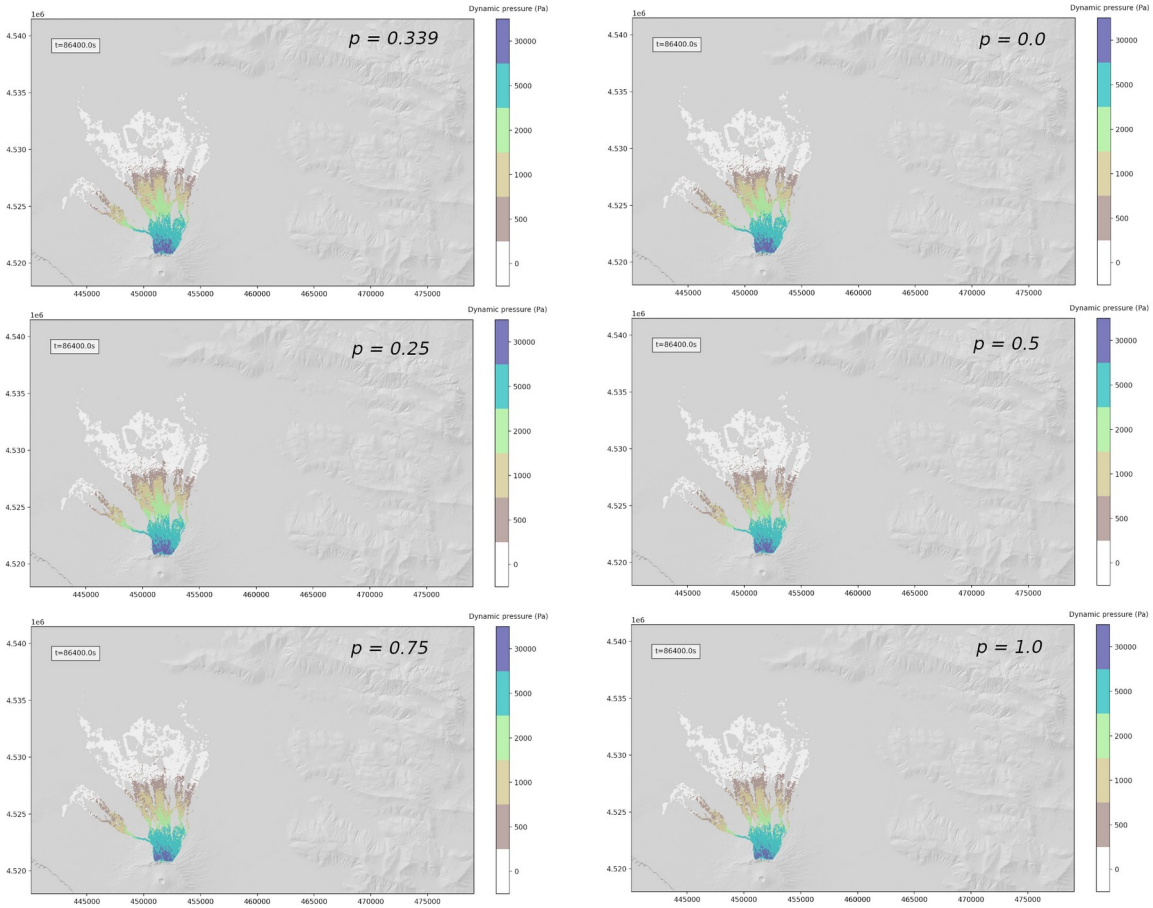

Figure S4. Maximum dynamic pressure reached, in each pixel, with a flow thickness of at least 0.1m, for: (top-left) p=0.339 – reference simulation; (top-right) p=0.0; (middle-left) p=0.25; (middle-right) p=0.5; (bottom-left) p=0.75; (bottom-right) p=1.0.

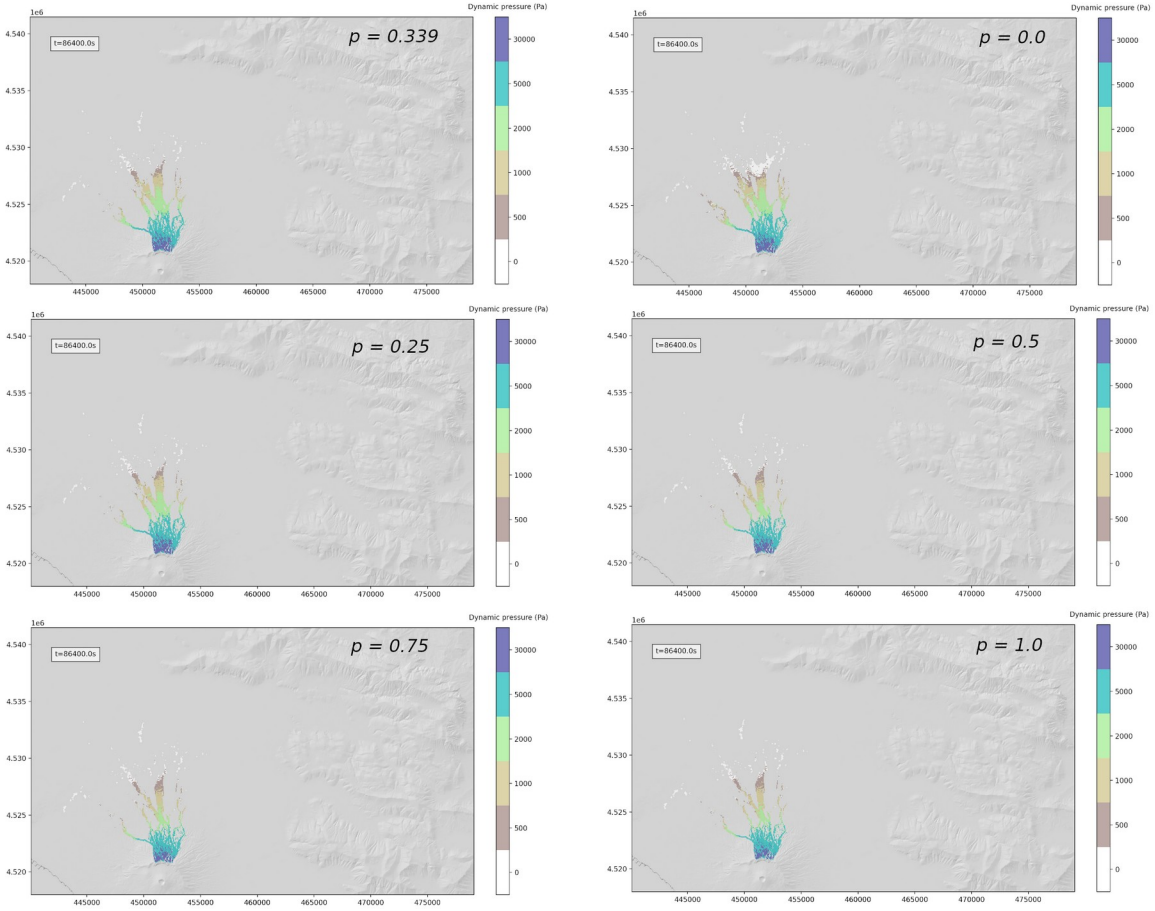

Figure S5. Maximum dynamic pressure reached, in each pixel, with a flow thickness of at least 0.5m, for: (top-left) p=0.339 – reference simulation; (top-right) p=0.0; (middle-left) p=0.25; (middle-right) p=0.5; (bottom-left) p=0.75; (bottom-right) p=1.0.

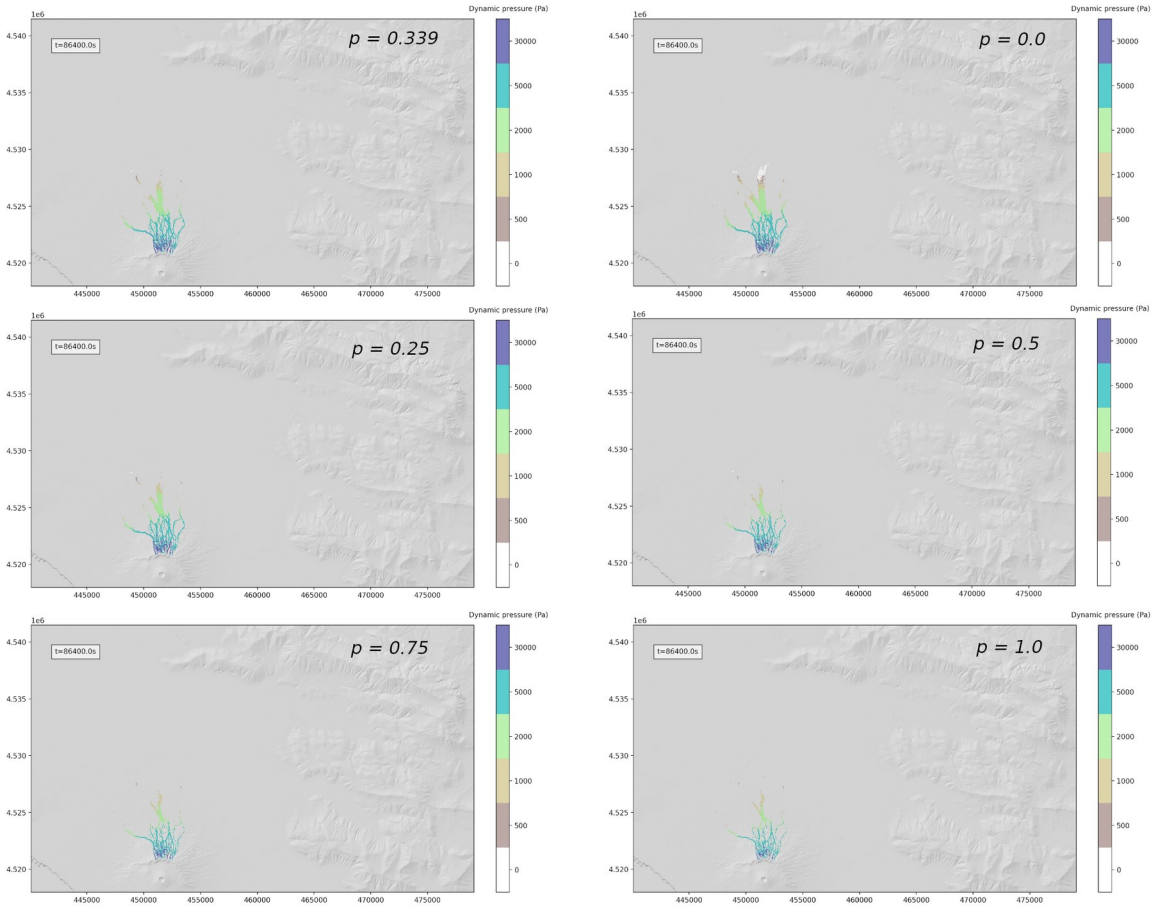

Figure S6. Maximum dynamic pressure reached, in each pixel, with a flow thickness of at least 1m, for: (top-left) p=0.339 – reference simulation; (top-right) p=0.0; (middle-left) p=0.25; (middle-right) p=0.5; (bottom-left) p=0.75; (bottom-right) p=1.0.

S2. Probability maps for different thresholds in maximum flow thickness, maximum flow thickness hazard maps for different thresholds in probability, and probability maps for joint threshold pairs in flow thickness and dynamic pressure

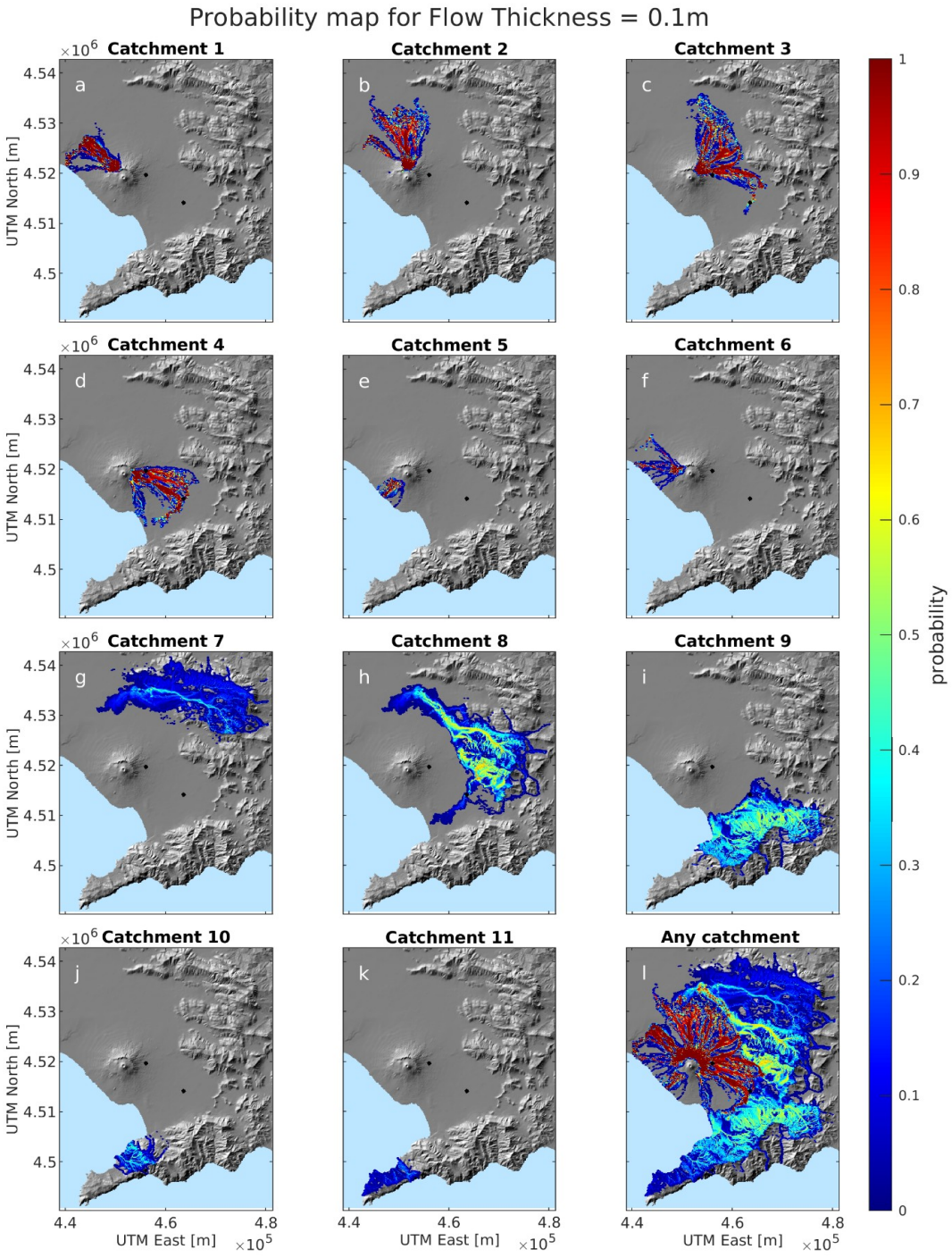

Figure S7: Probability maps for maximum flow thickness larger than 0.1 m

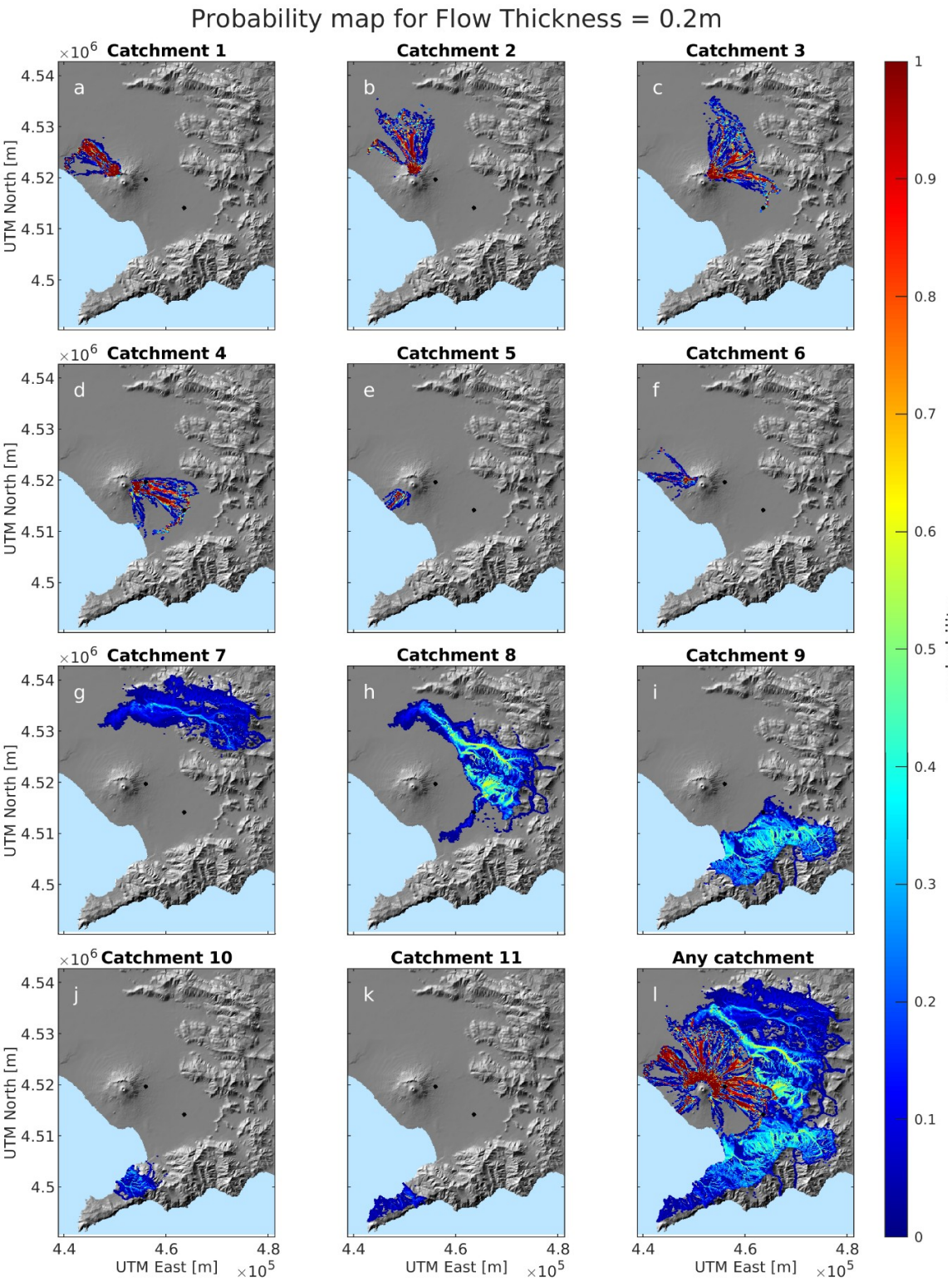

Figure S8: Probability maps for maximum flow thickness larger than 0.2m

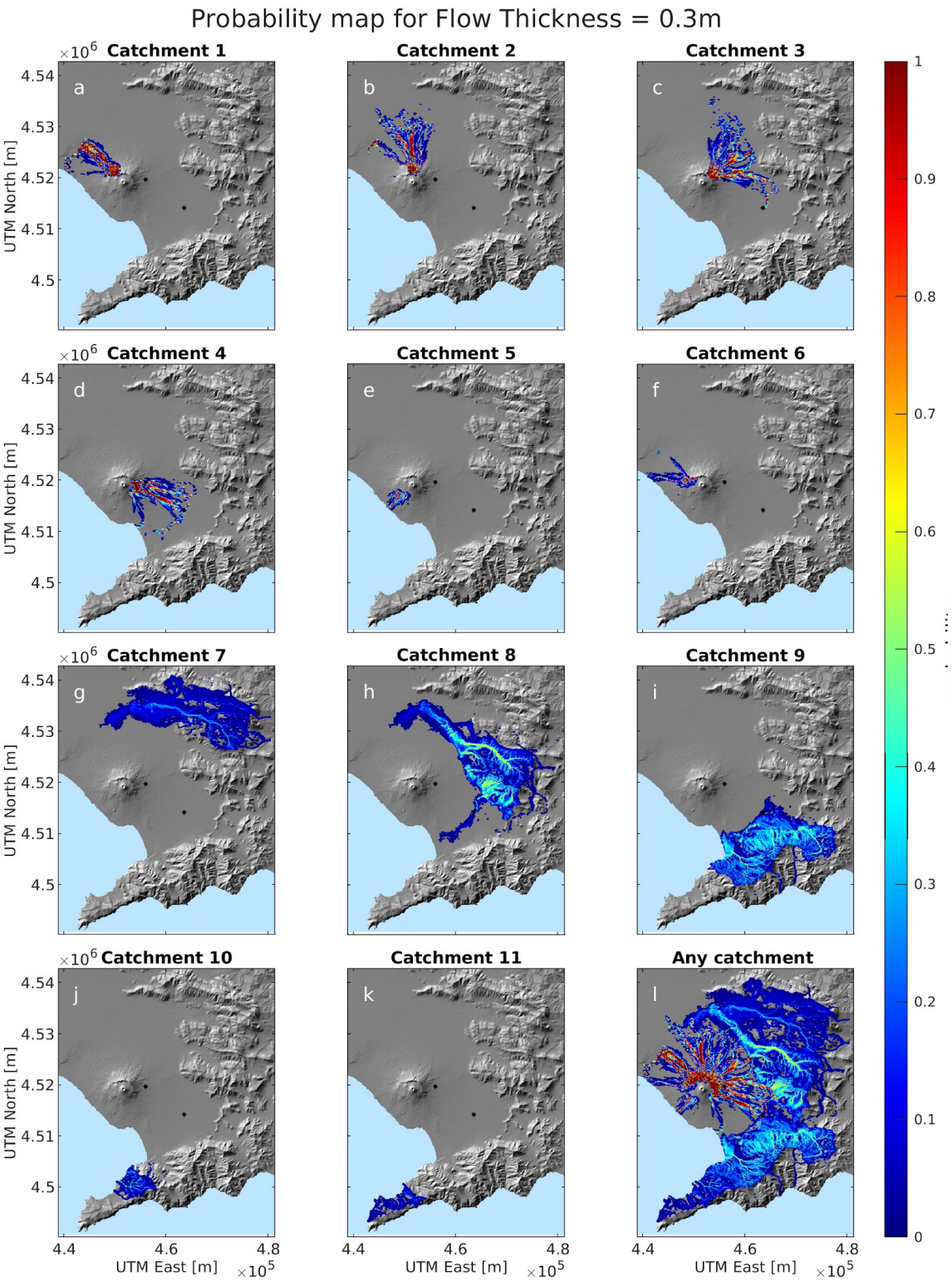

Figure S9: Probability maps for maximum flow thickness larger than 0.3 m

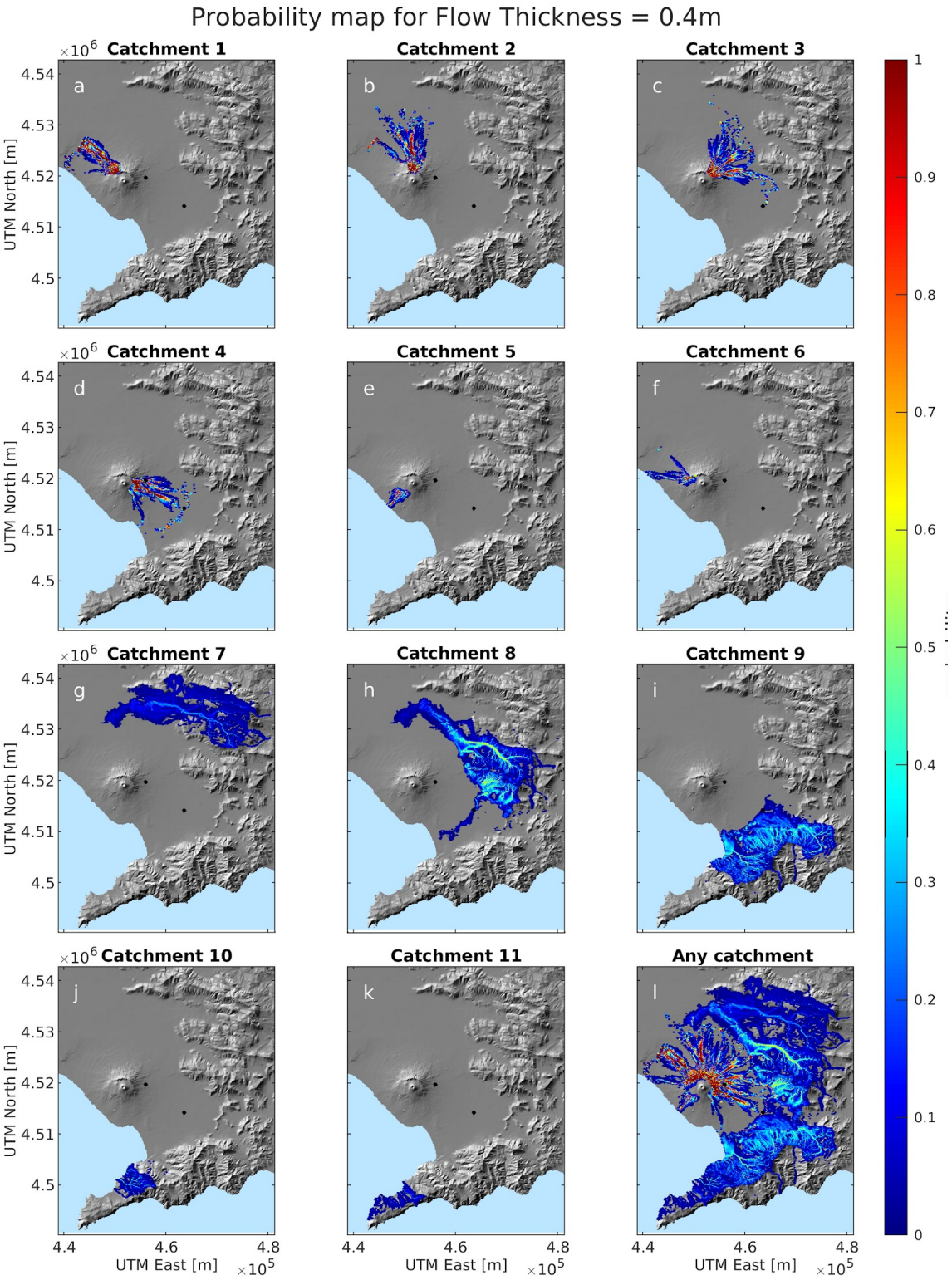

Figure S10: Probability maps for maximum flow thickness larger than 0.4 m

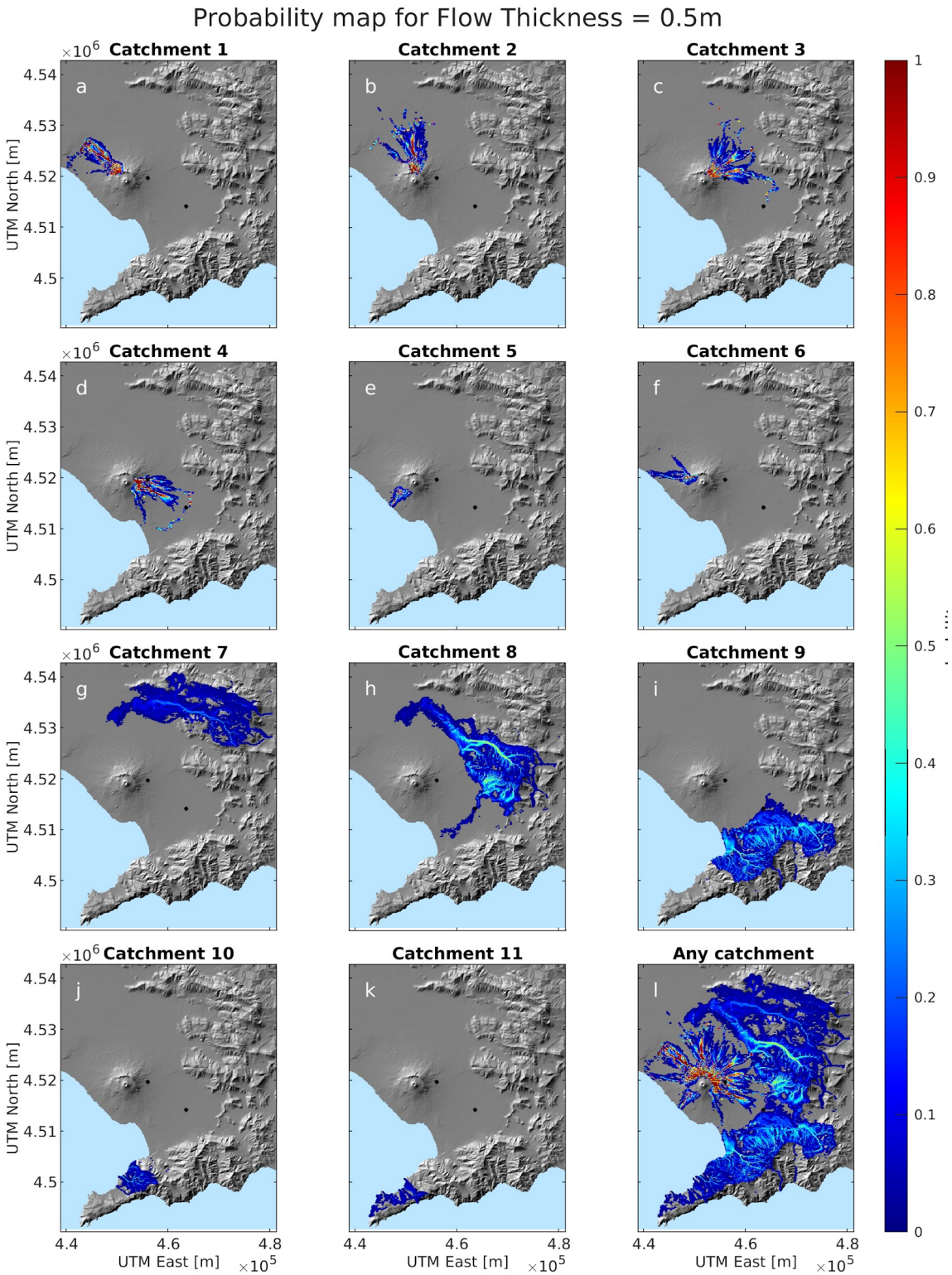

Figure S11: Probability maps for maximum flow thickness larger than 0.5 m

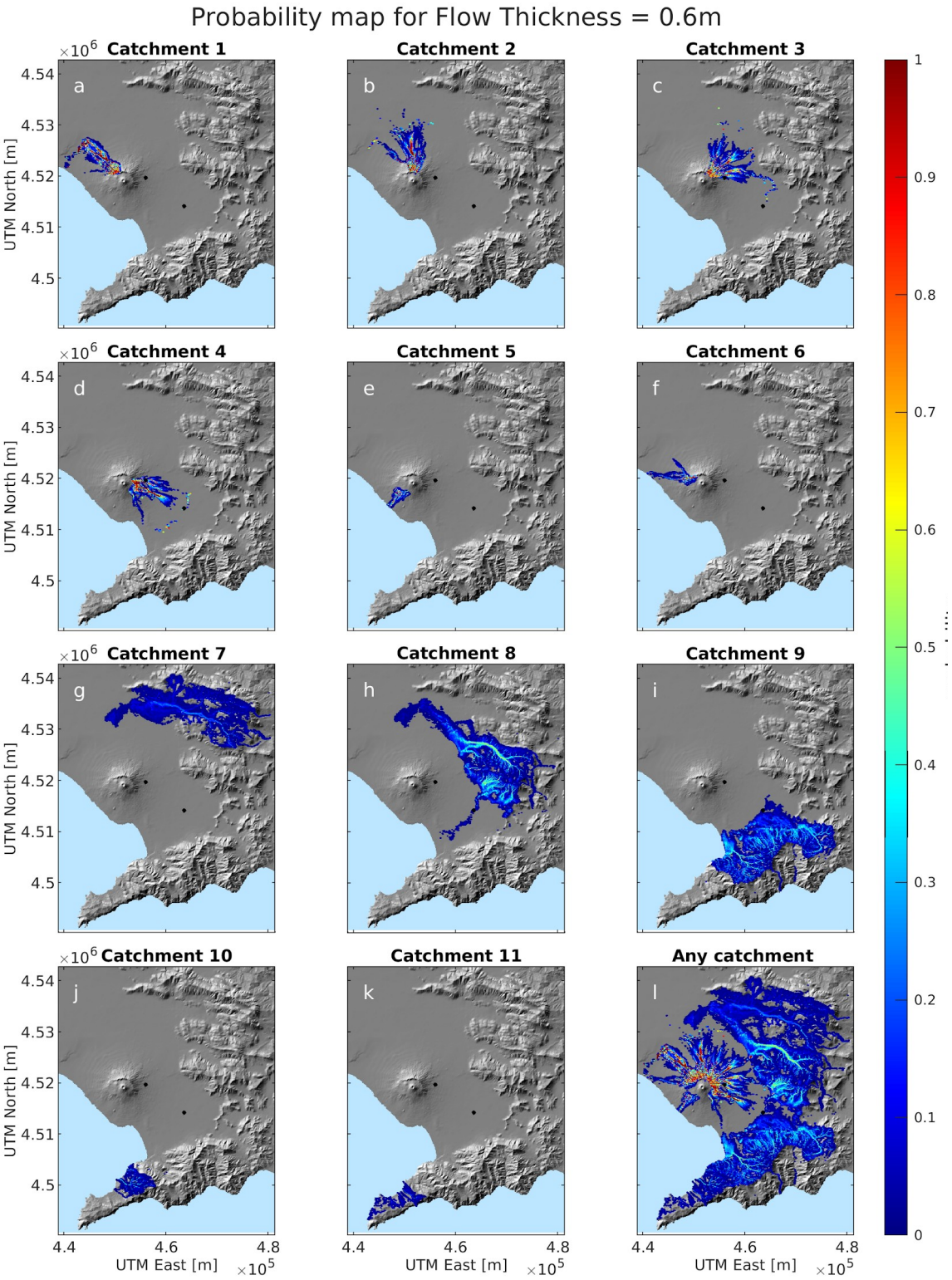

Figure S12: Probability maps for maximum flow thickness larger than 0.6 m

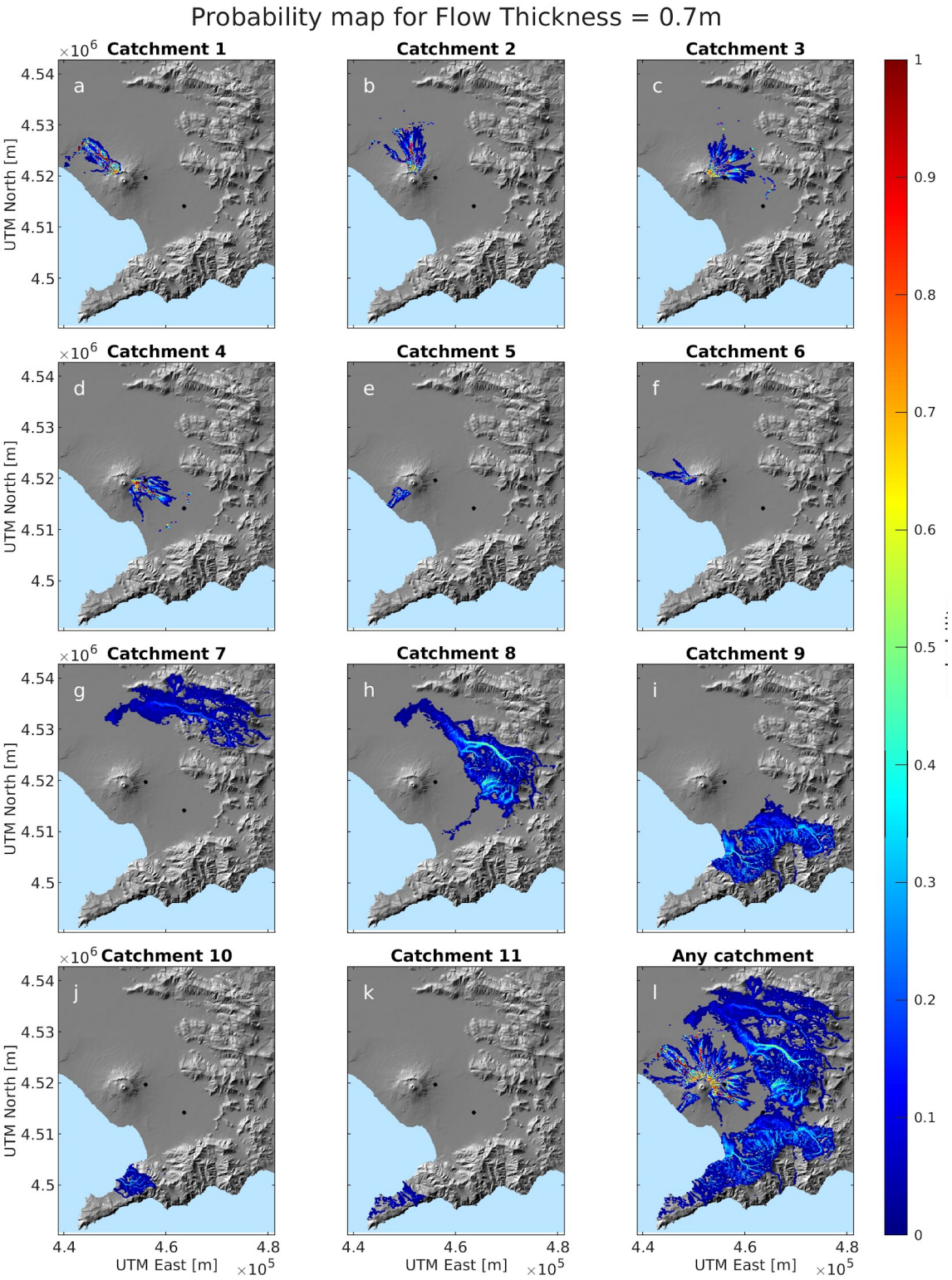

Figure S13: Probability maps for maximum flow thickness larger than 0.7 m

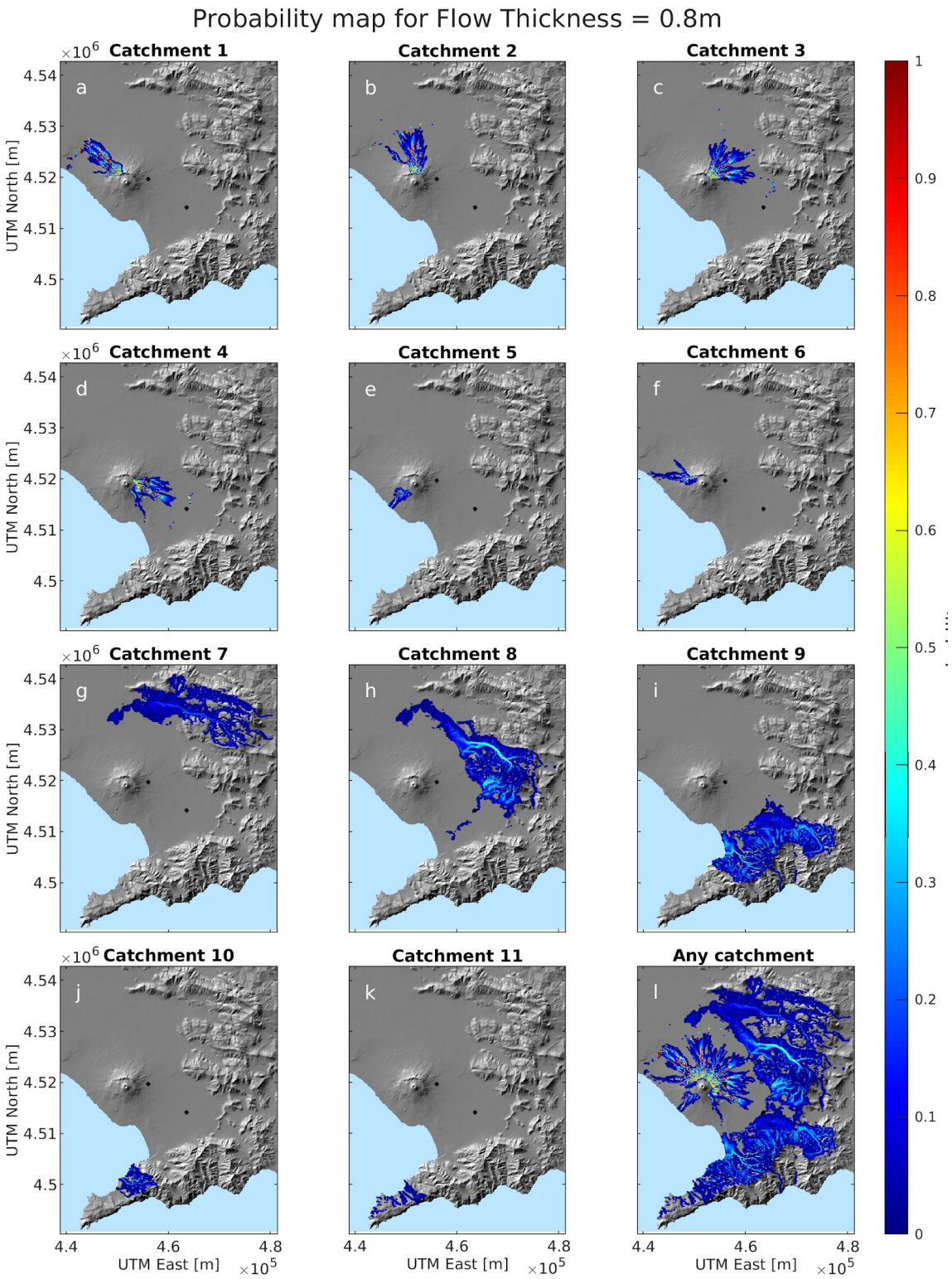

Figure S14: Probability maps for maximum flow thickness larger than 0.8 m

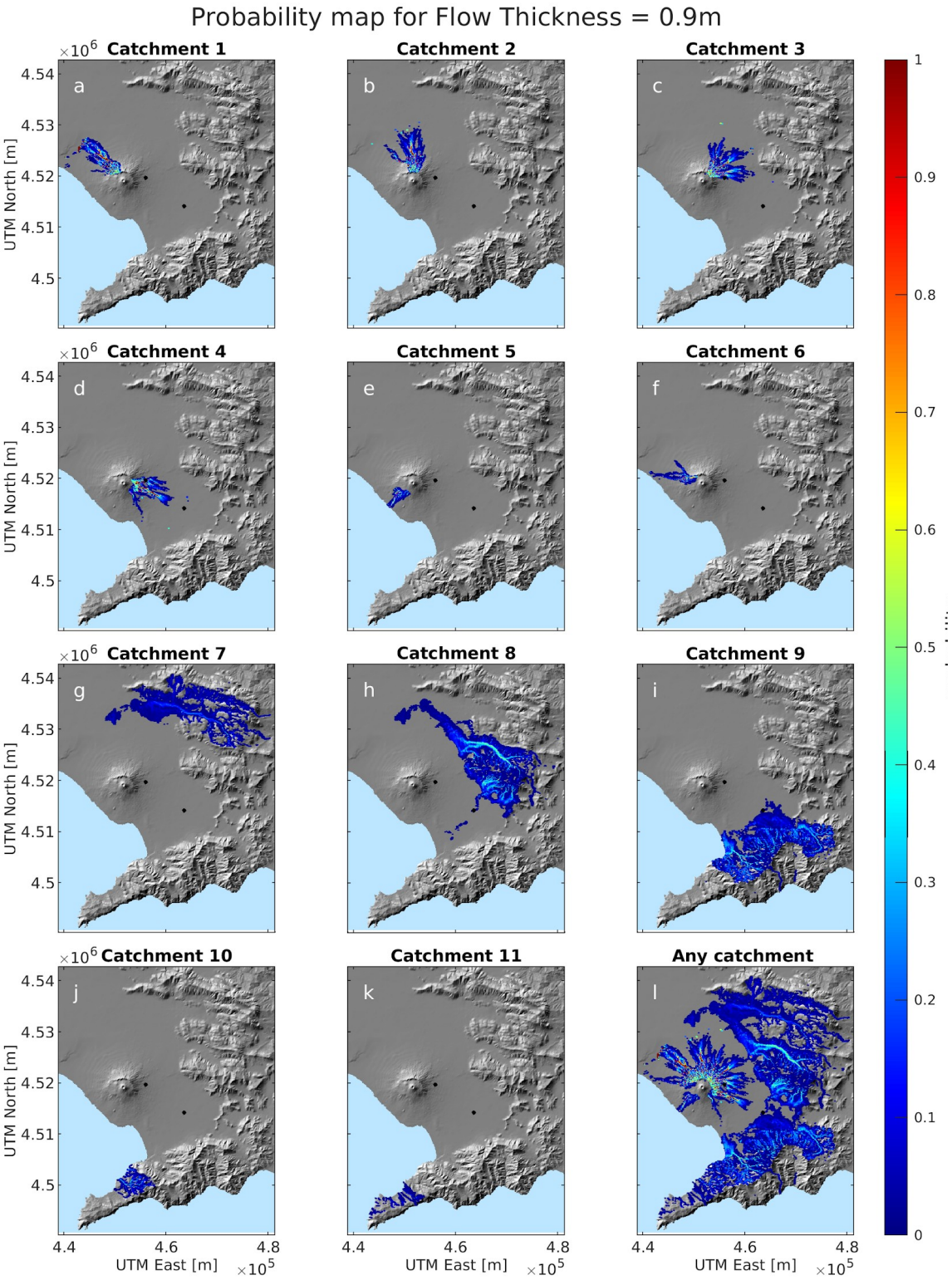

Figure S15: Probability maps for maximum flow thickness larger than 0.9 m

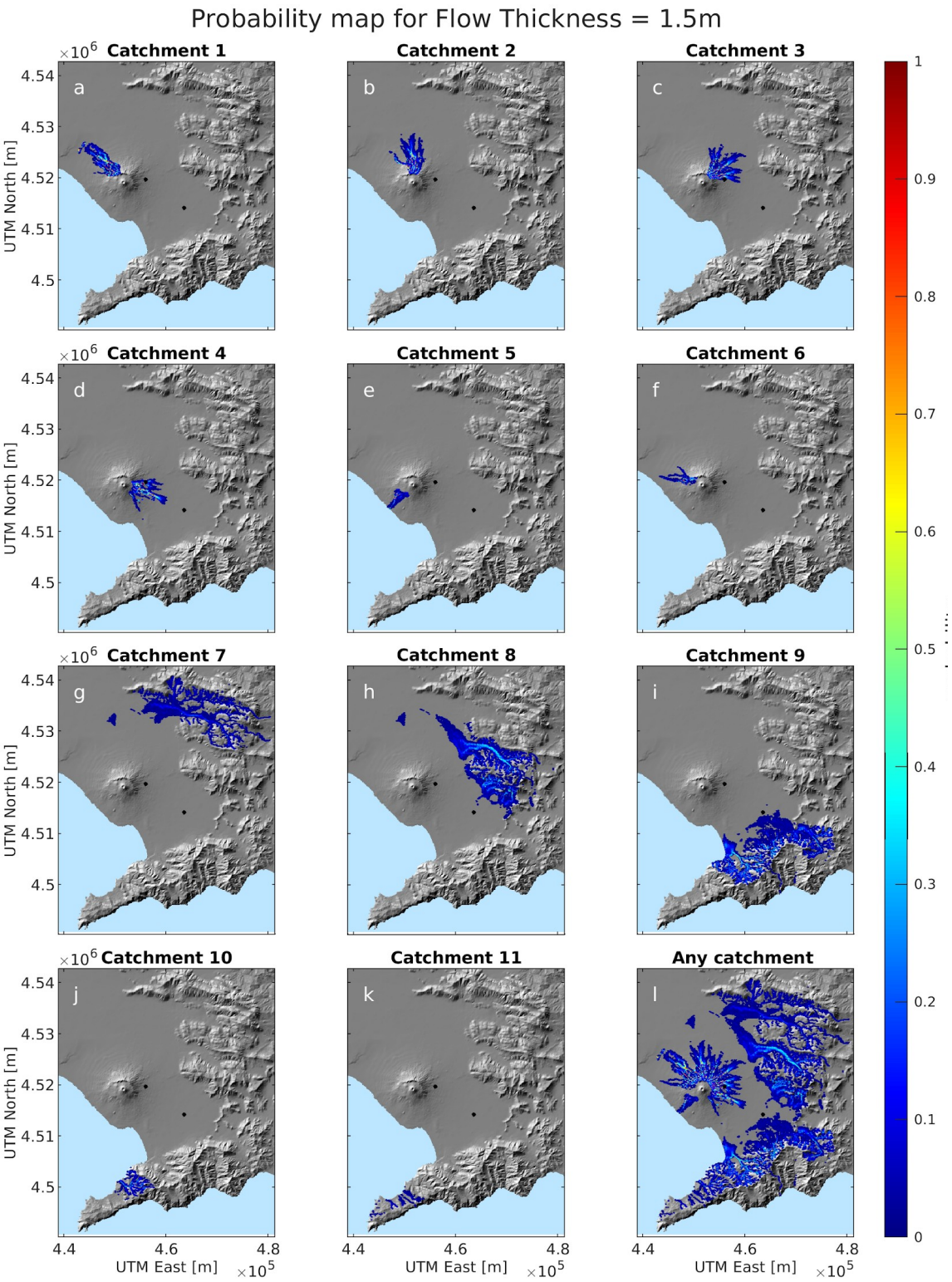

Figure S16: Probability maps for maximum flow thickness larger than 1.5 m

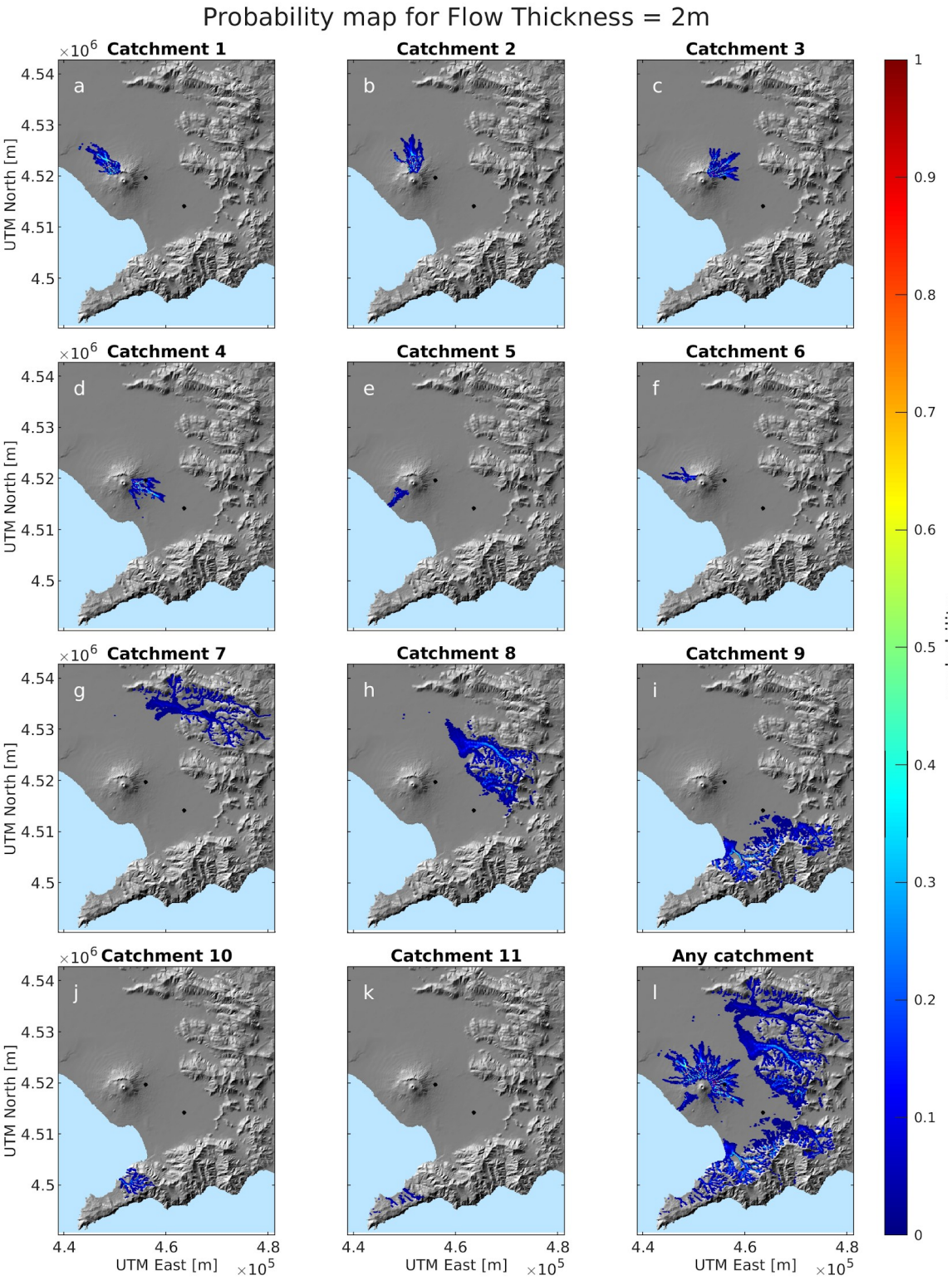

Figure S17: Probability maps for maximum flow thickness larger than 2 m

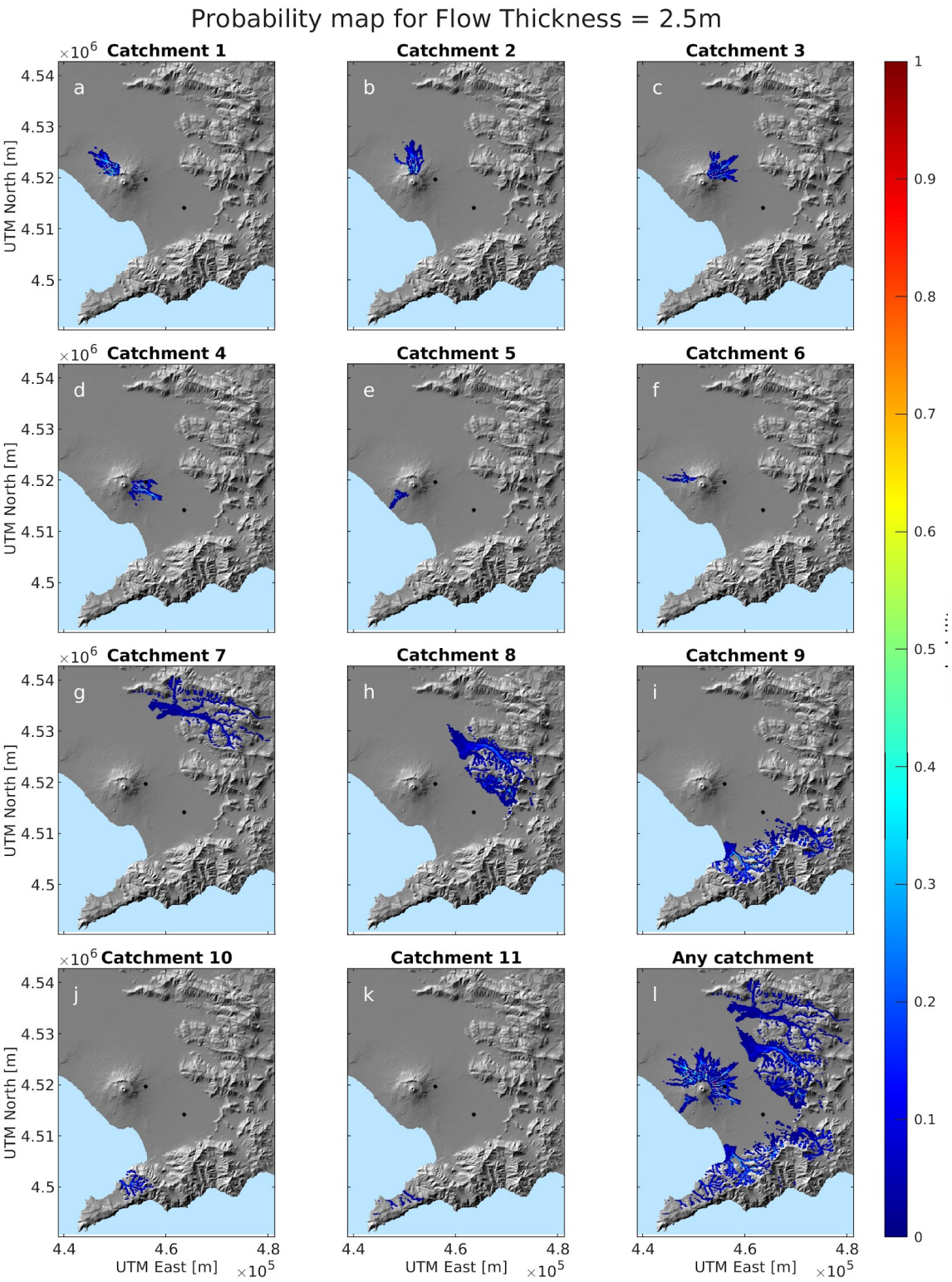

Figure S18: Probability maps for maximum flow thickness larger than 2.5 m

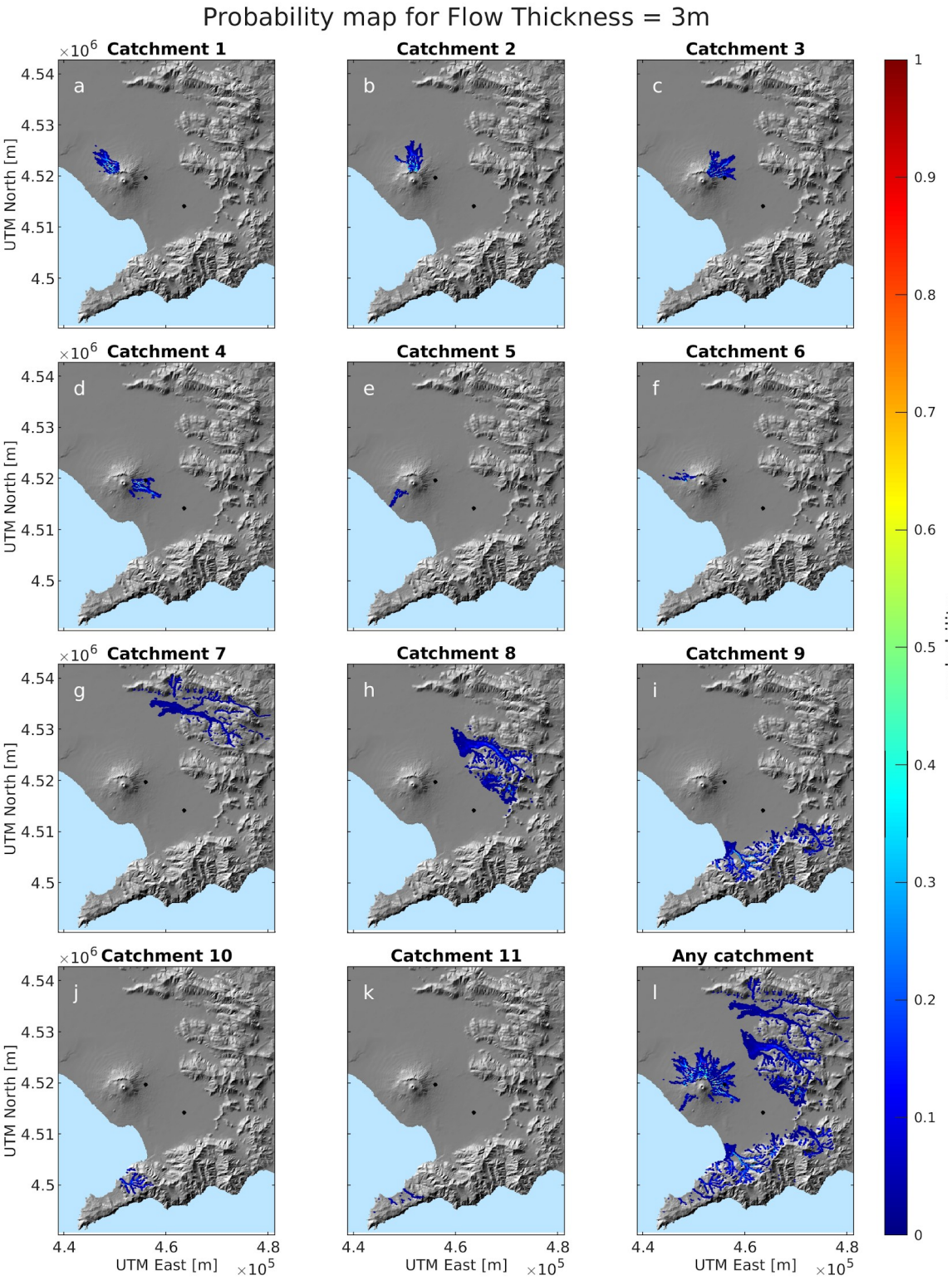

Figure S19: Probability maps for maximum flow thickness larger than 3 m

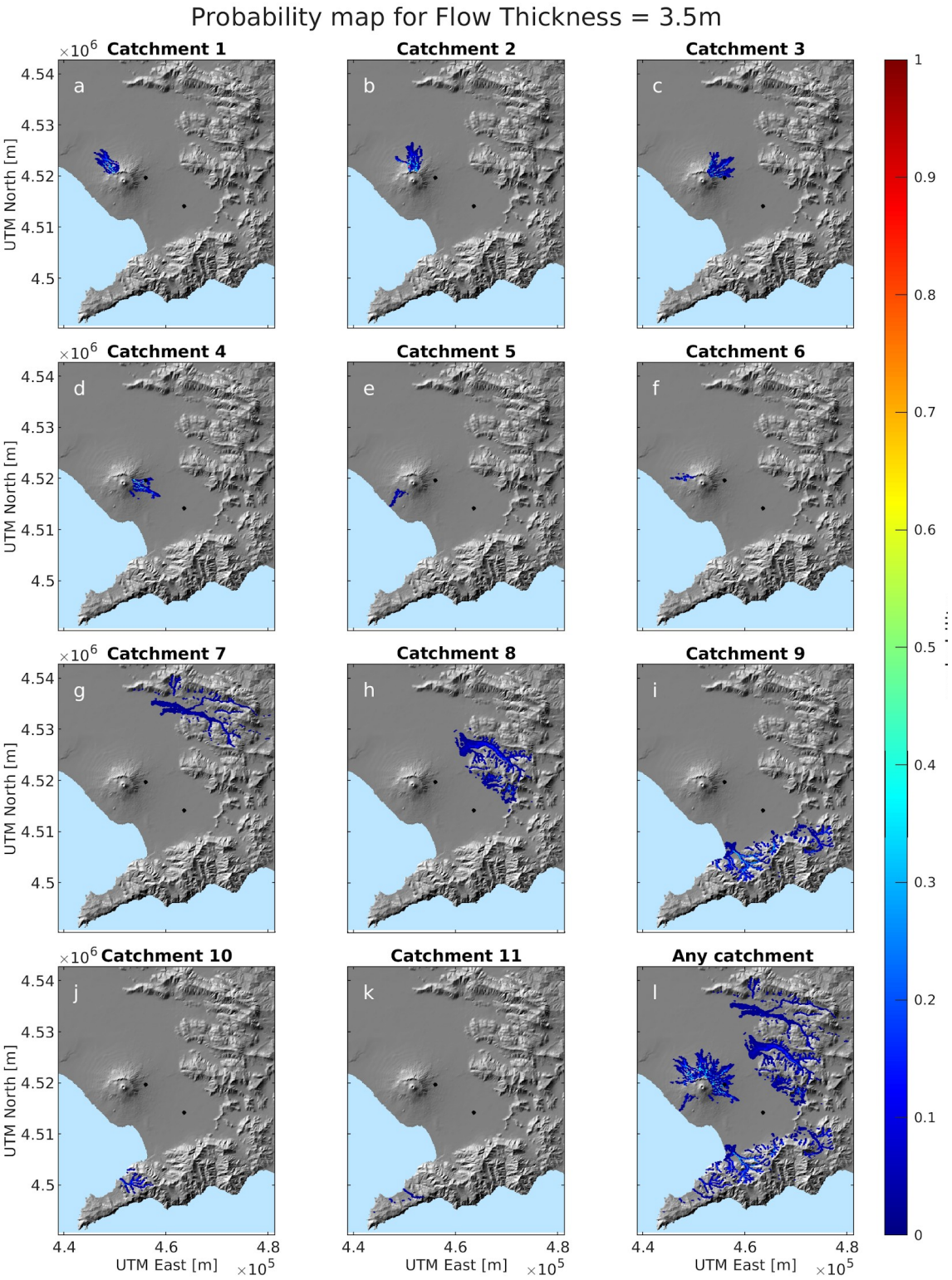

Figure S20: Probability maps for maximum flow thickness larger than 3.5 m

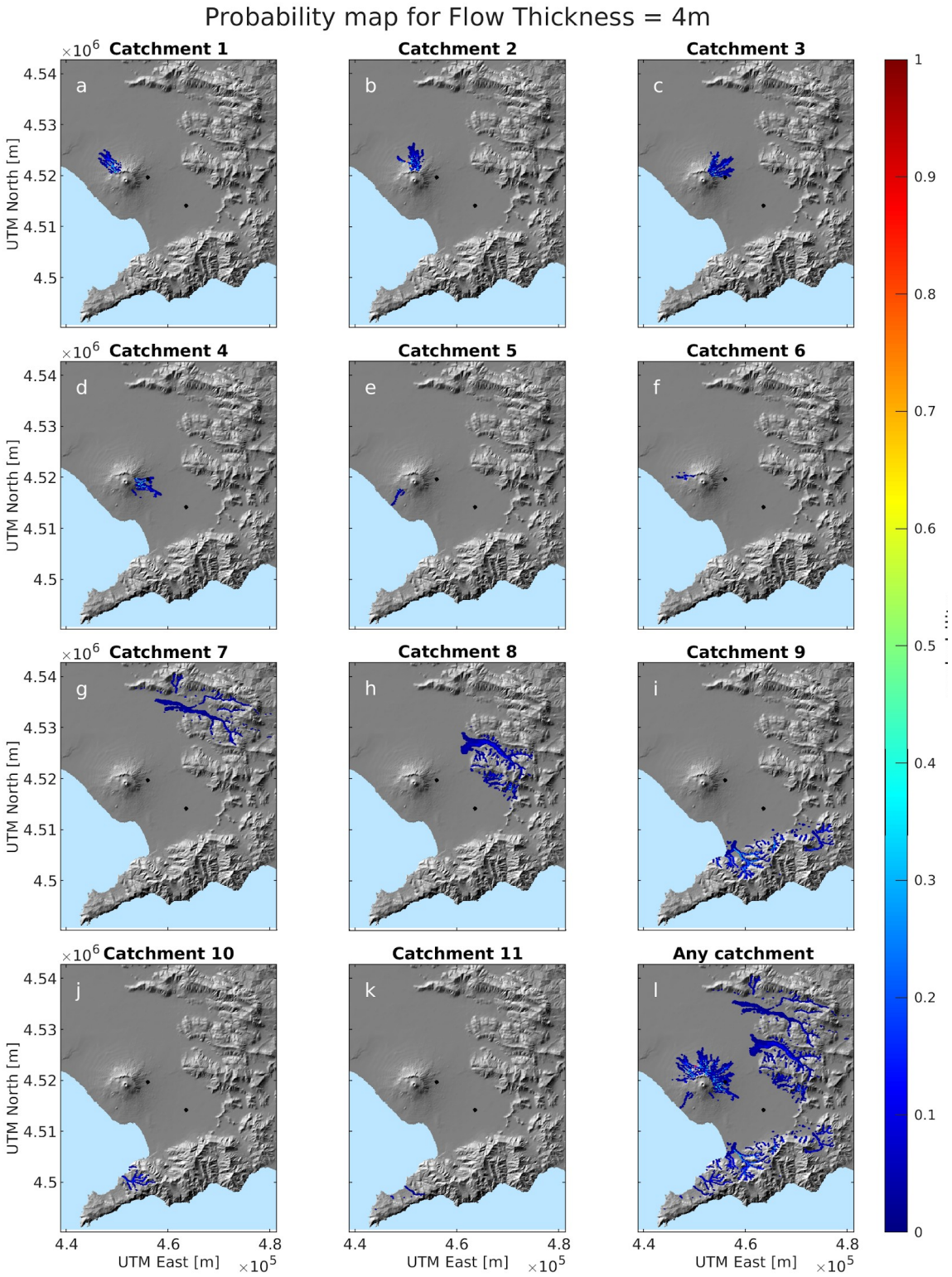

Figure S21: Probability maps for maximum flow thickness larger than 4 m

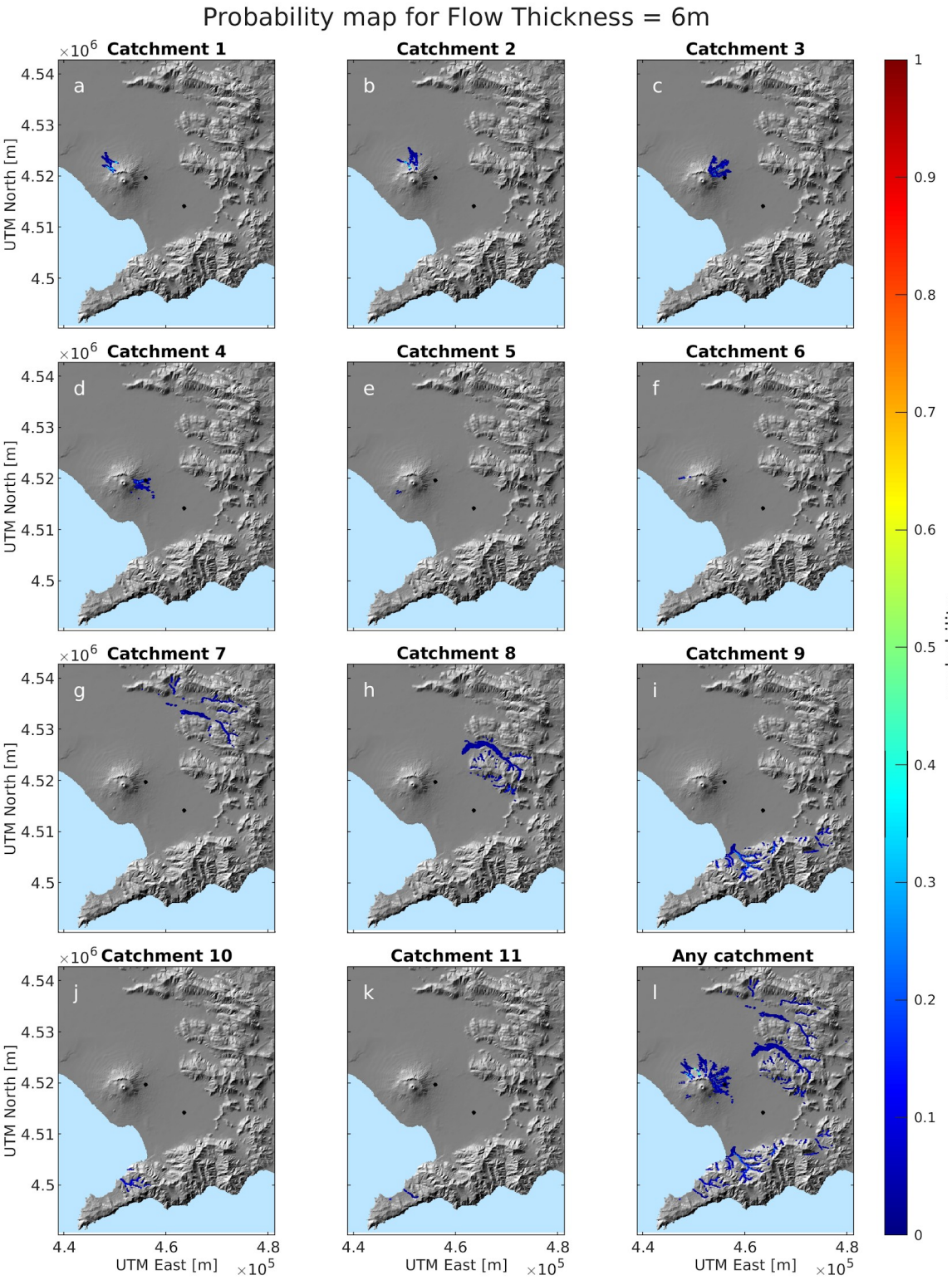

Figure S22: Probability maps for maximum flow thickness larger than 6 m

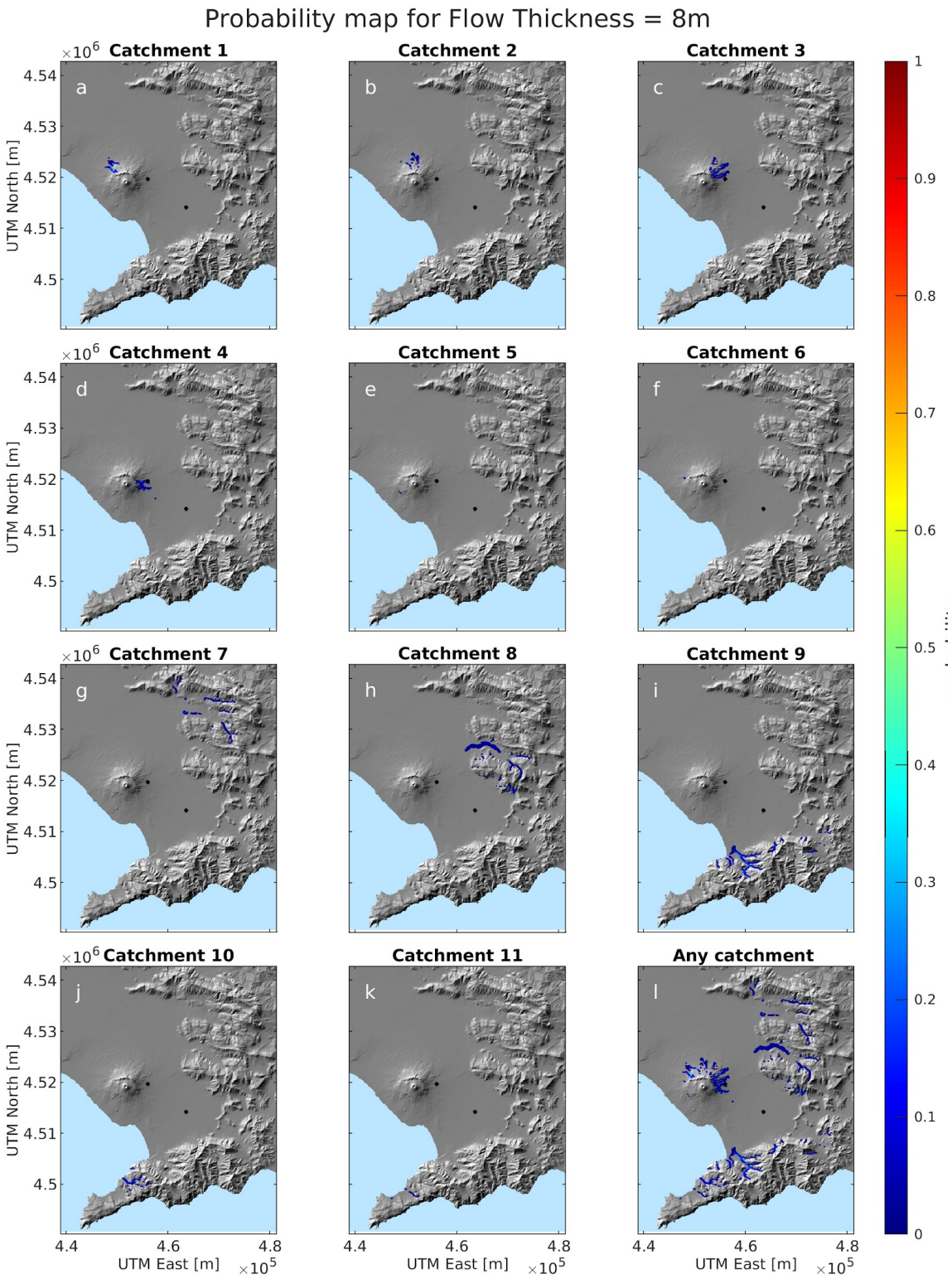

Figure S23: Probability maps for maximum flow thickness larger than 8 m

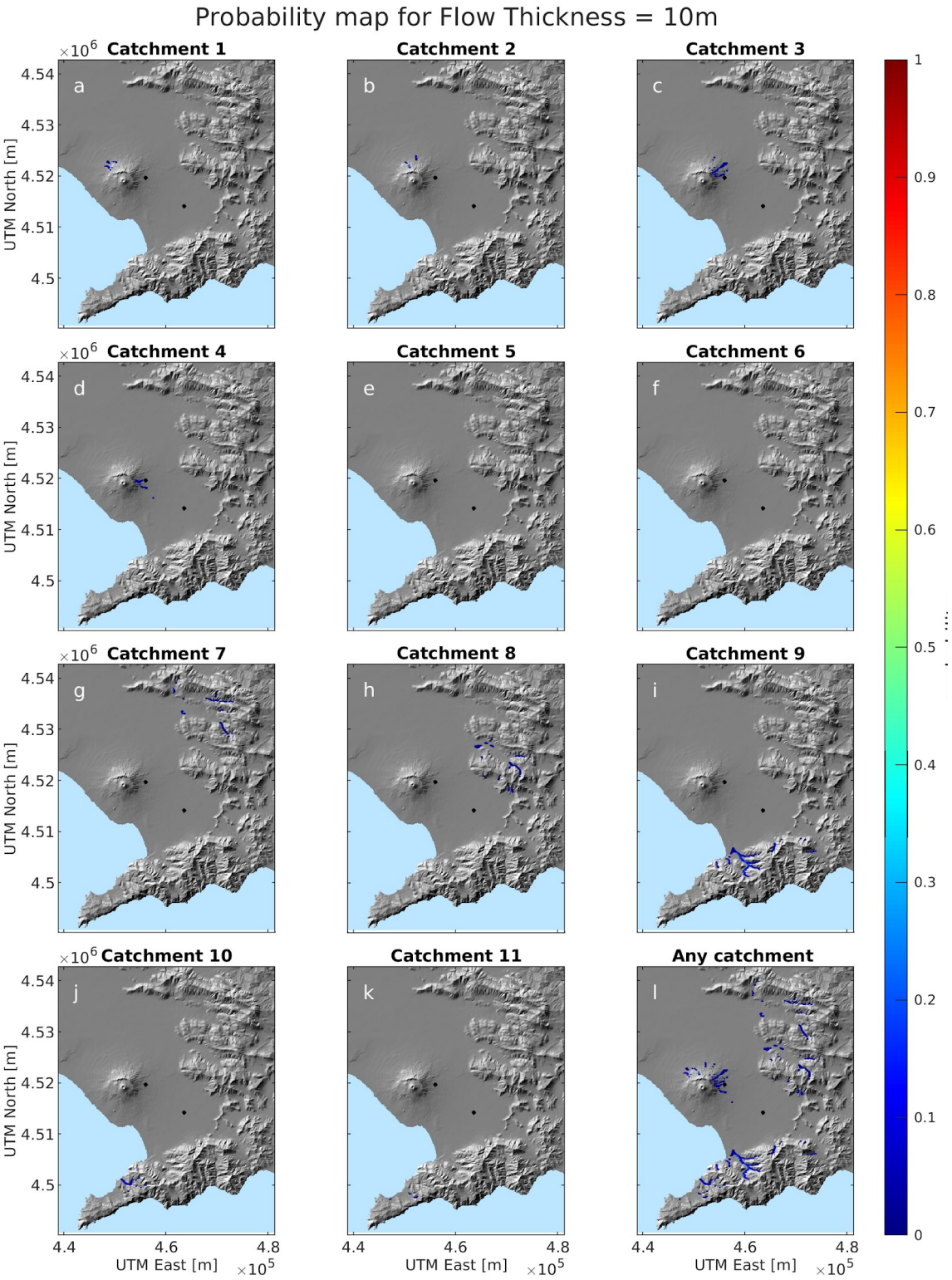

Figure S24: Probability maps for maximum flow thickness larger than 10 m

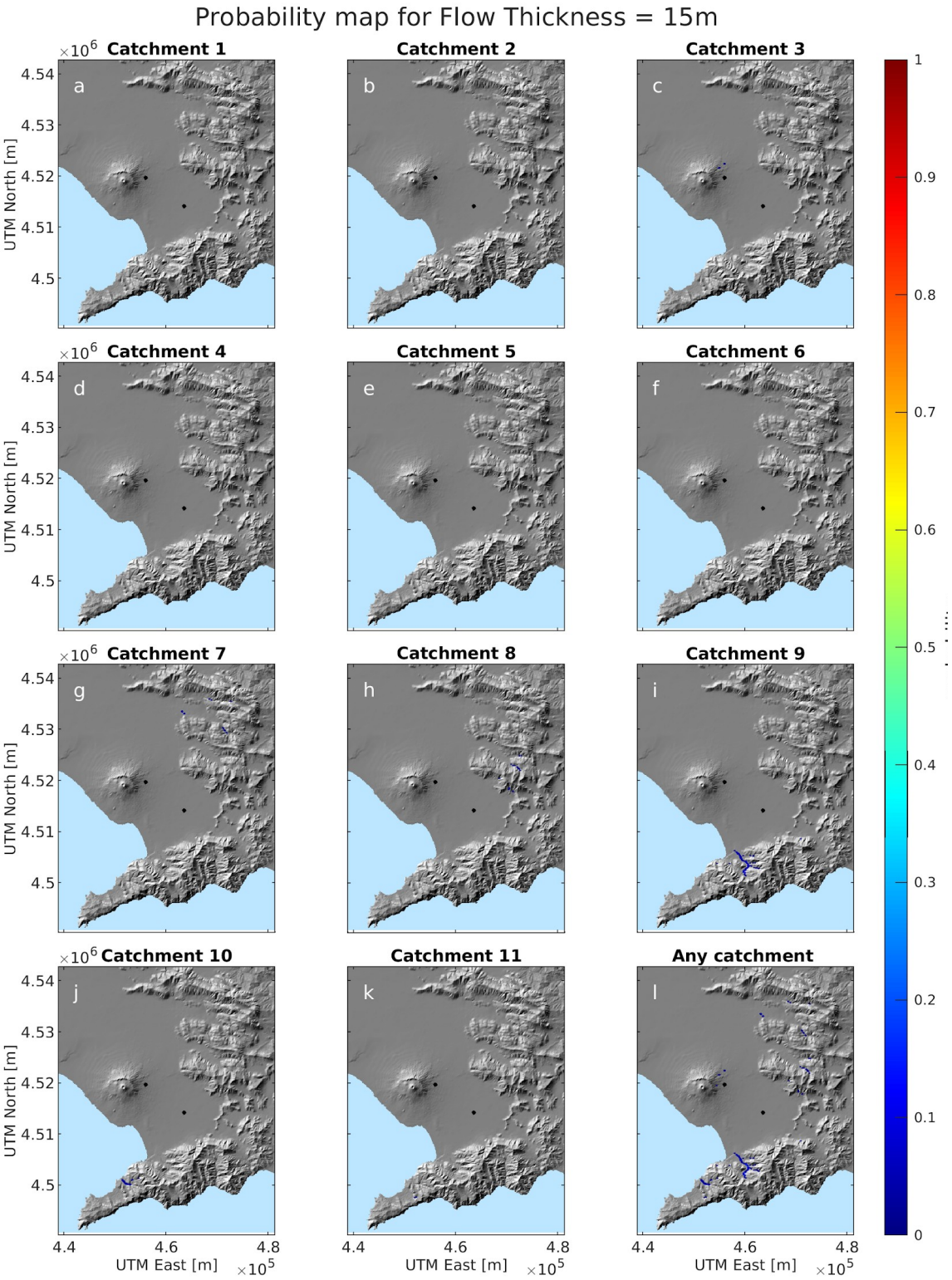

Figure S25: Probability maps for maximum flow thickness larger than 15 m

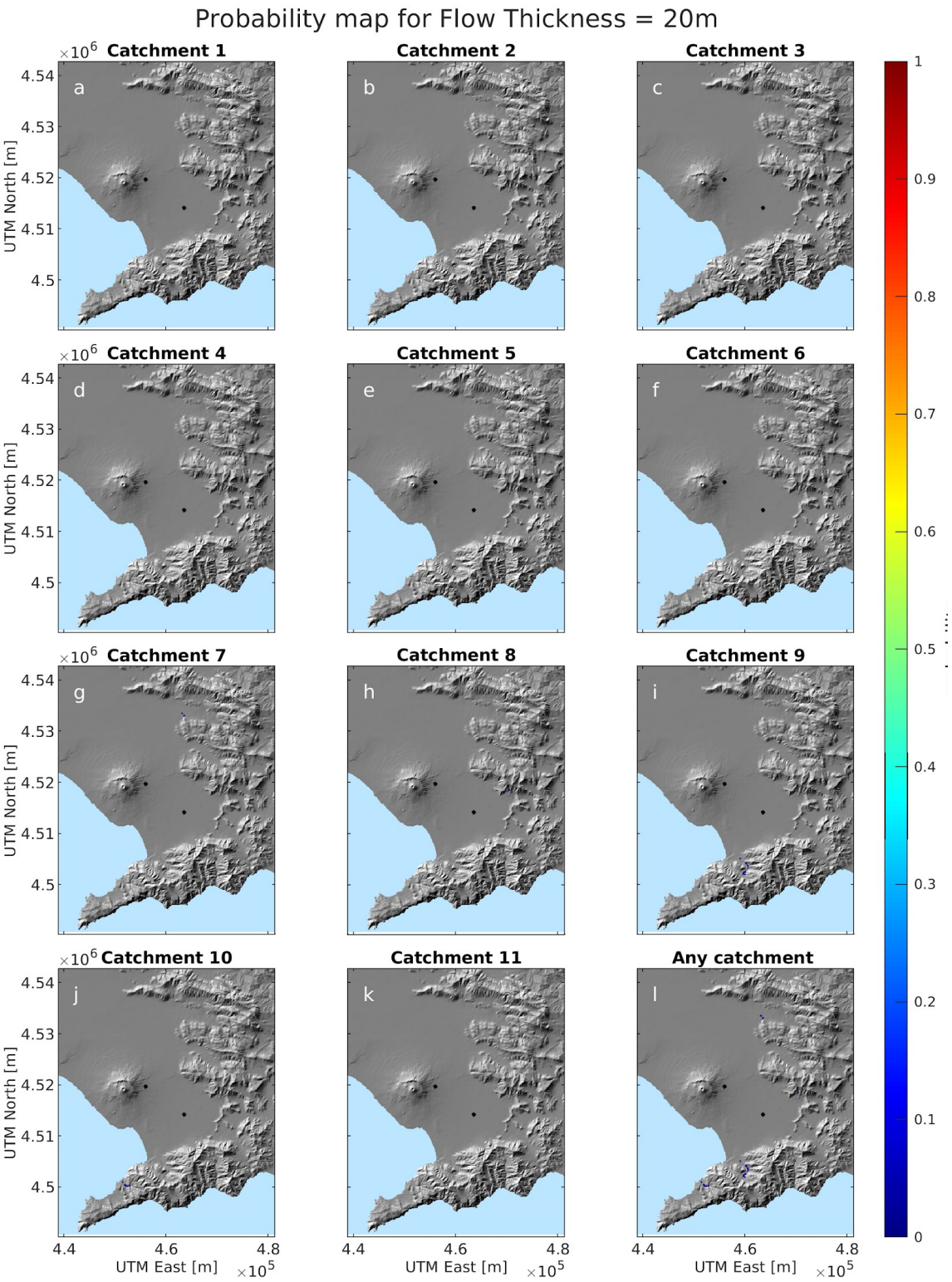

Figure S26: Probability maps for maximum flow thickness larger than 20 m

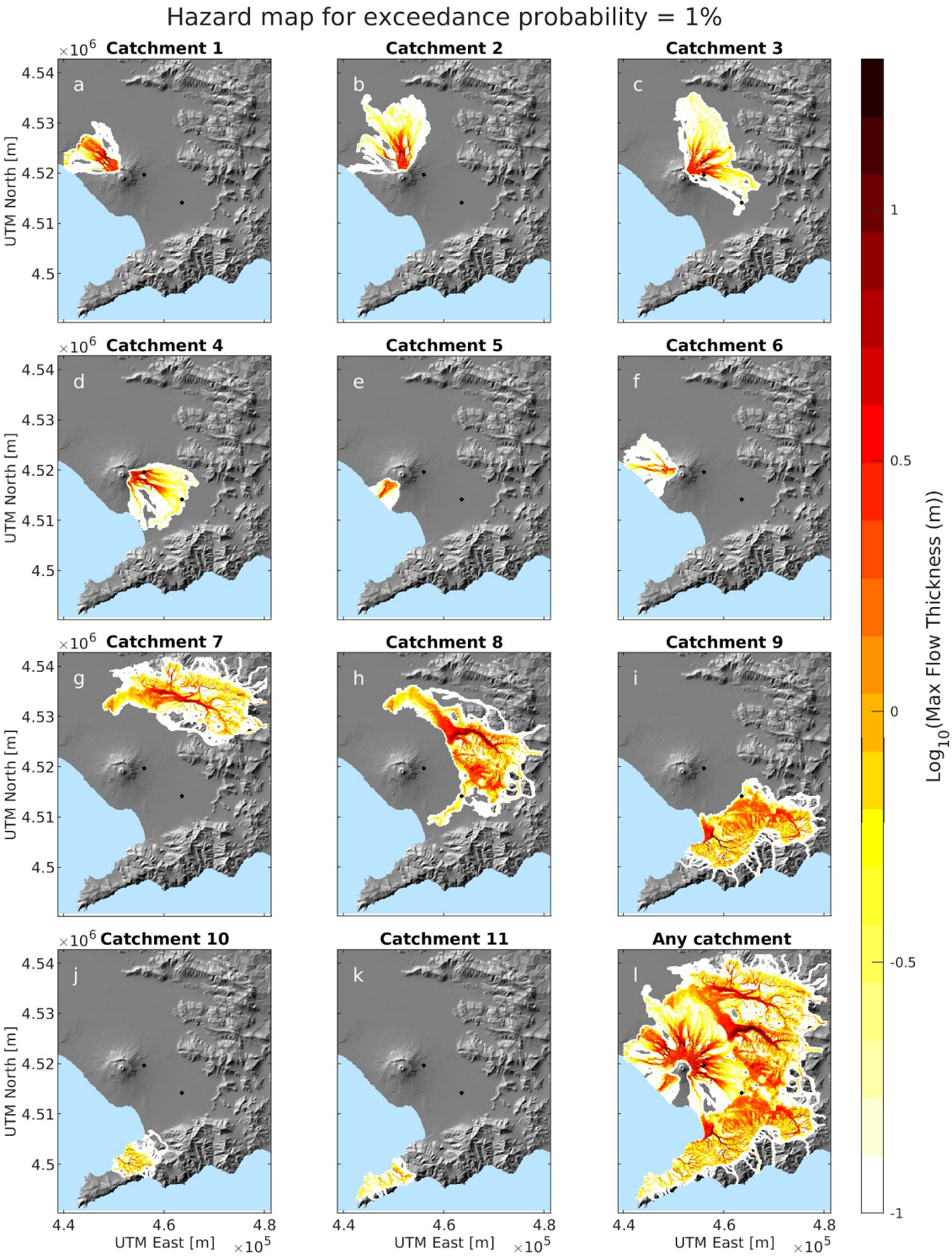

Figure S27: 1% hazard maps in maximum flow thickness

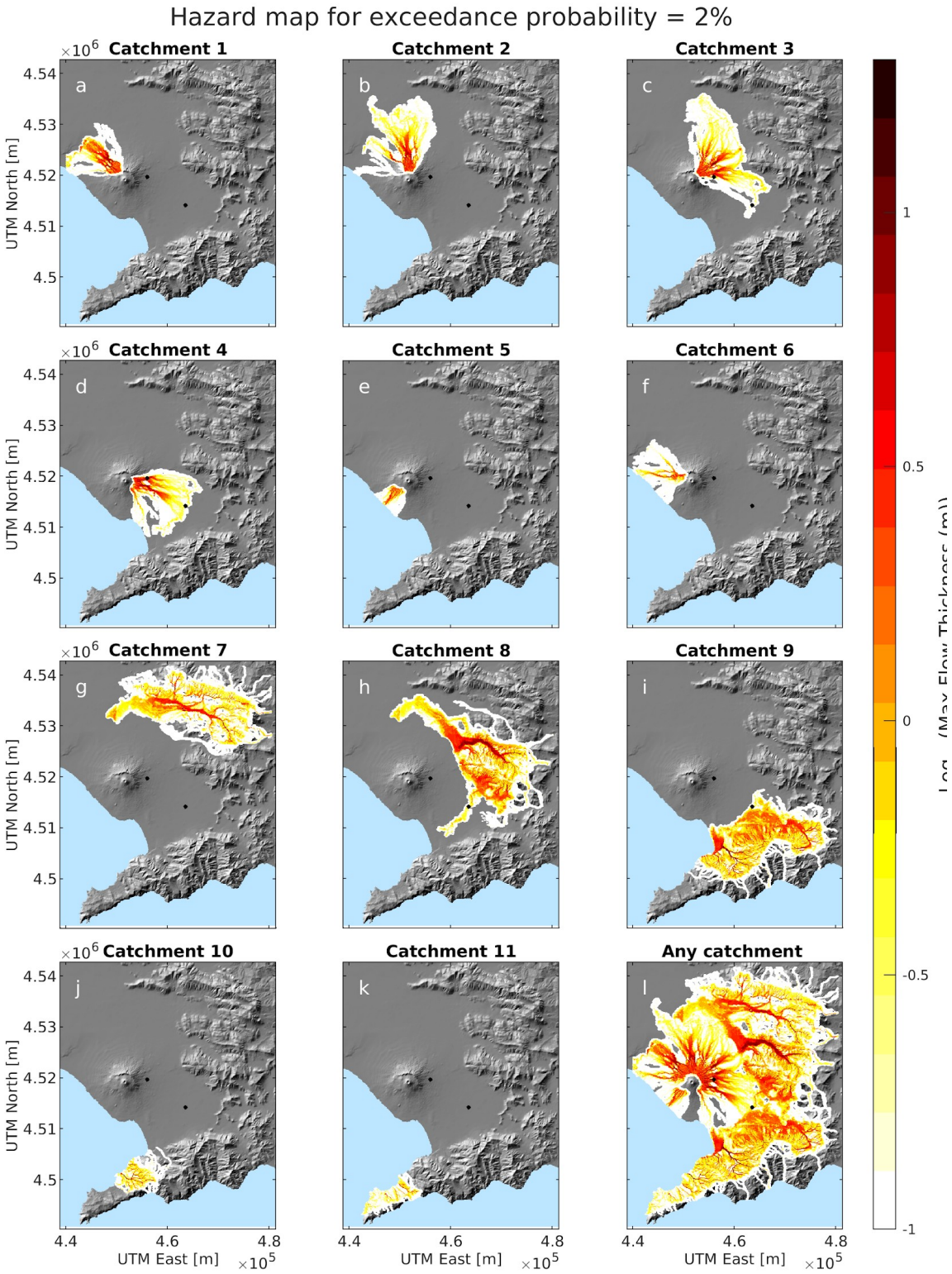

Figure S28: 2% hazard maps in maximum flow thickness

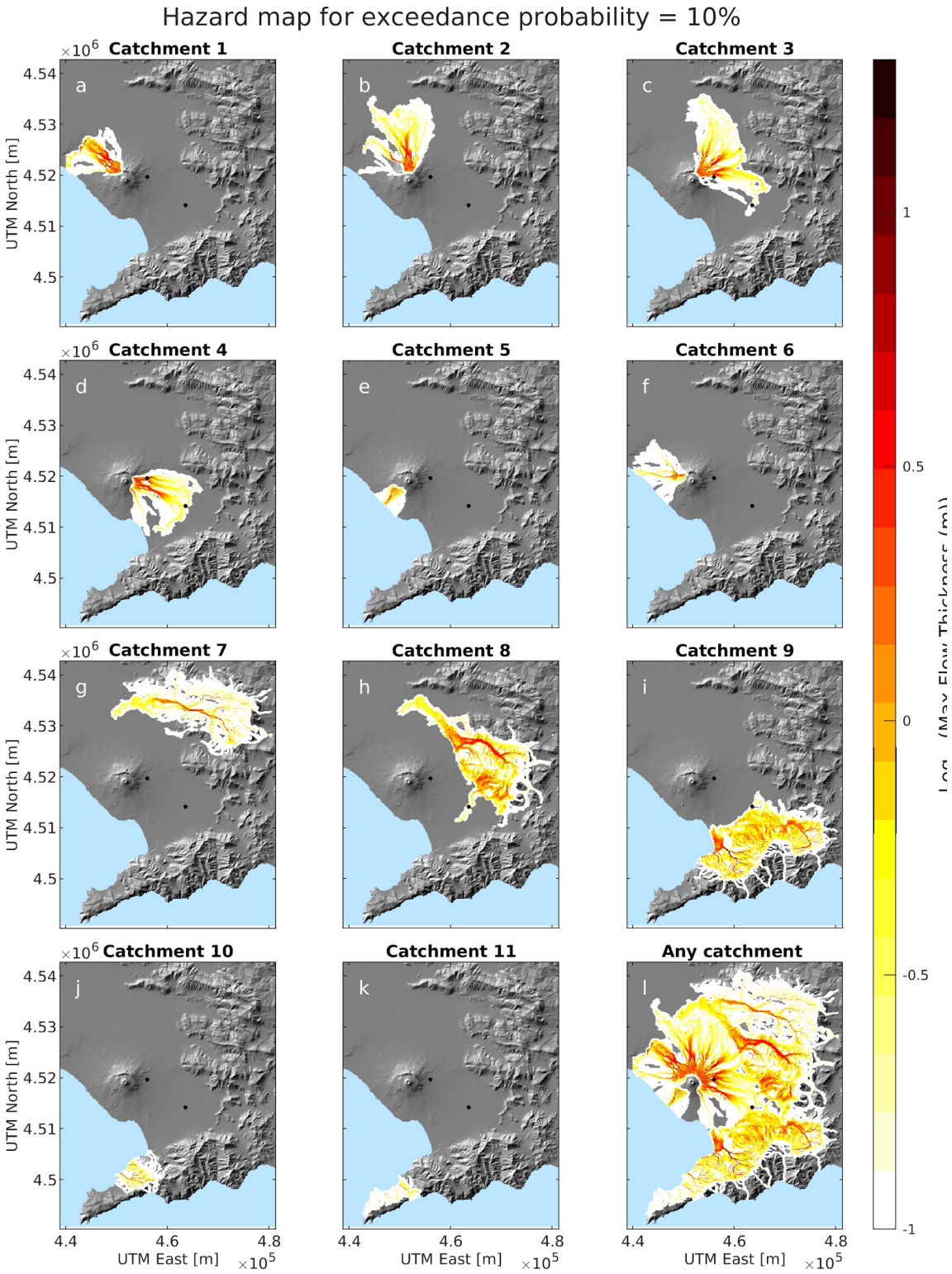

Figure S29: 10% hazard maps in maximum flow thickness

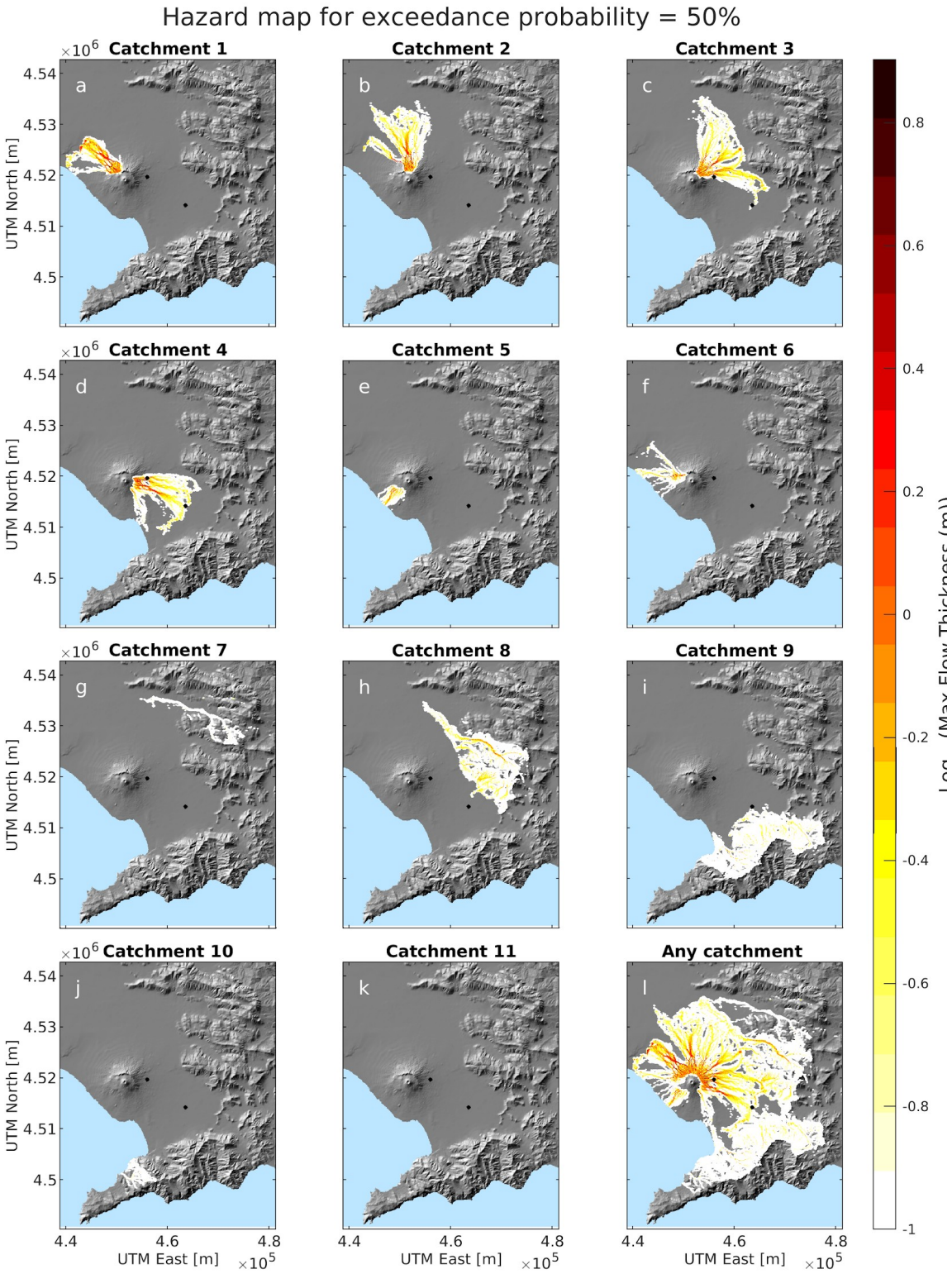

Figure S30: 50% hazard maps in maximum flow thickness

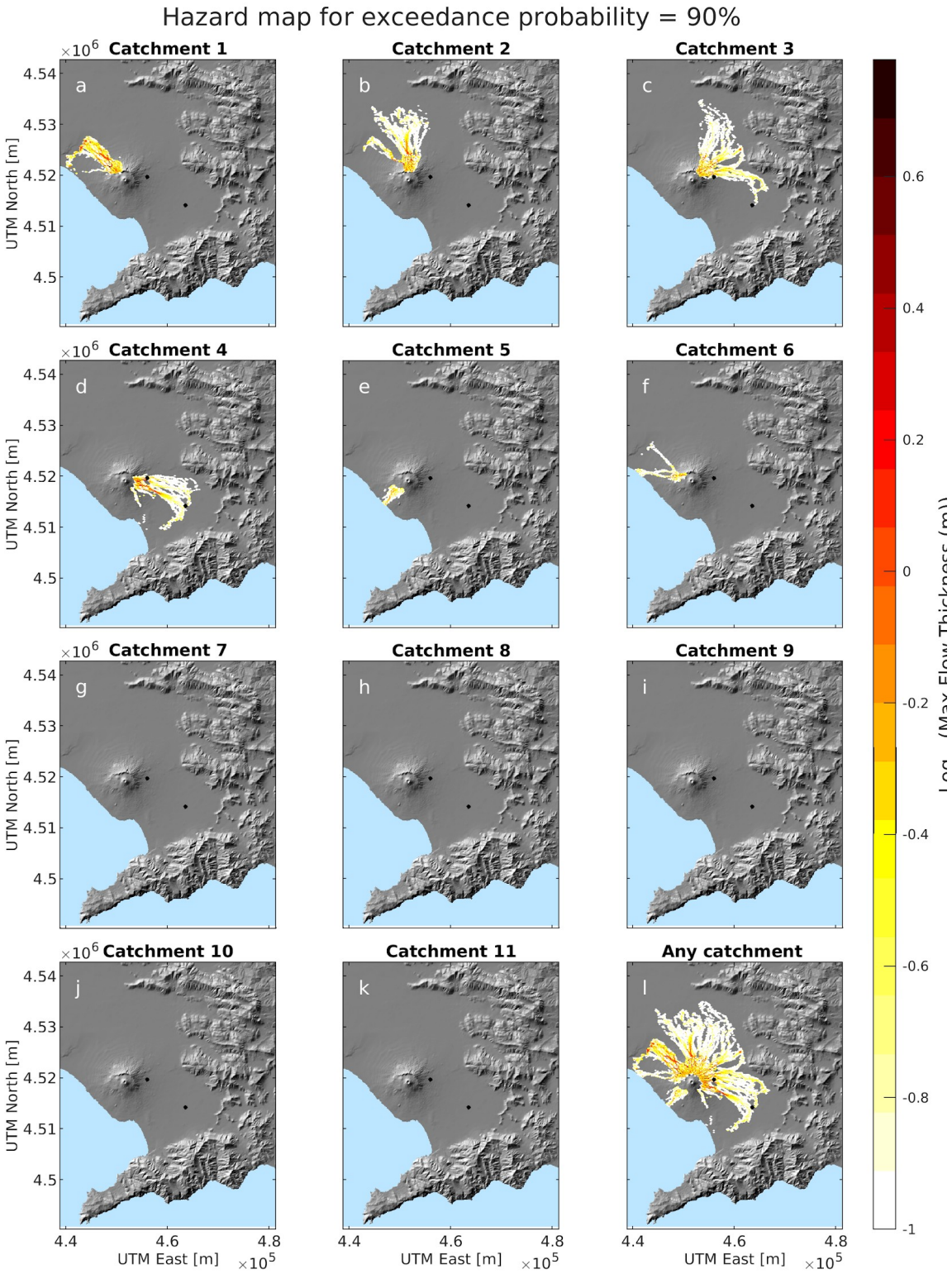

Figure S31: 90% hazard maps in maximum flow thickness

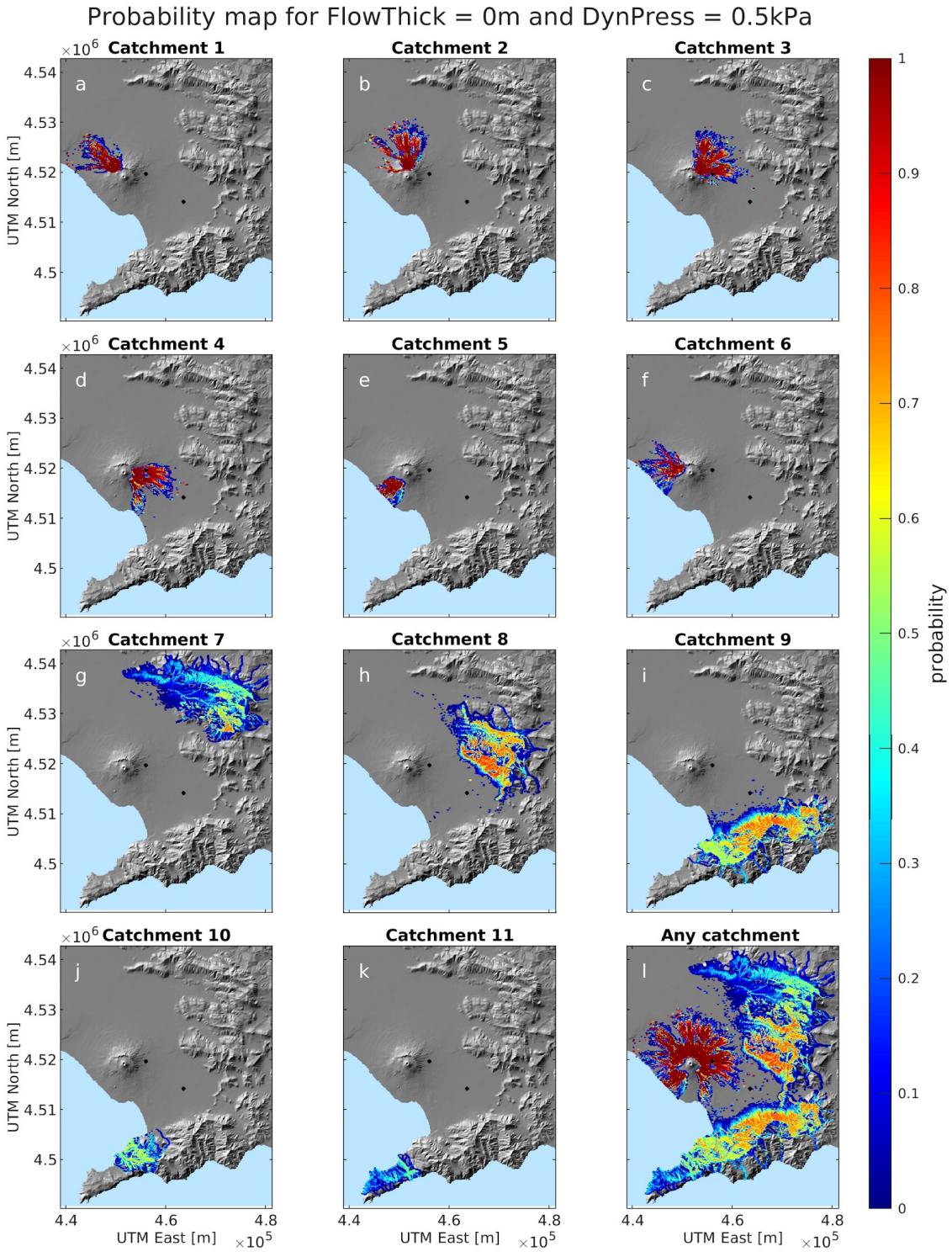

Figure S32: Probability maps for dynamic pressure larger than 0.5 kPa

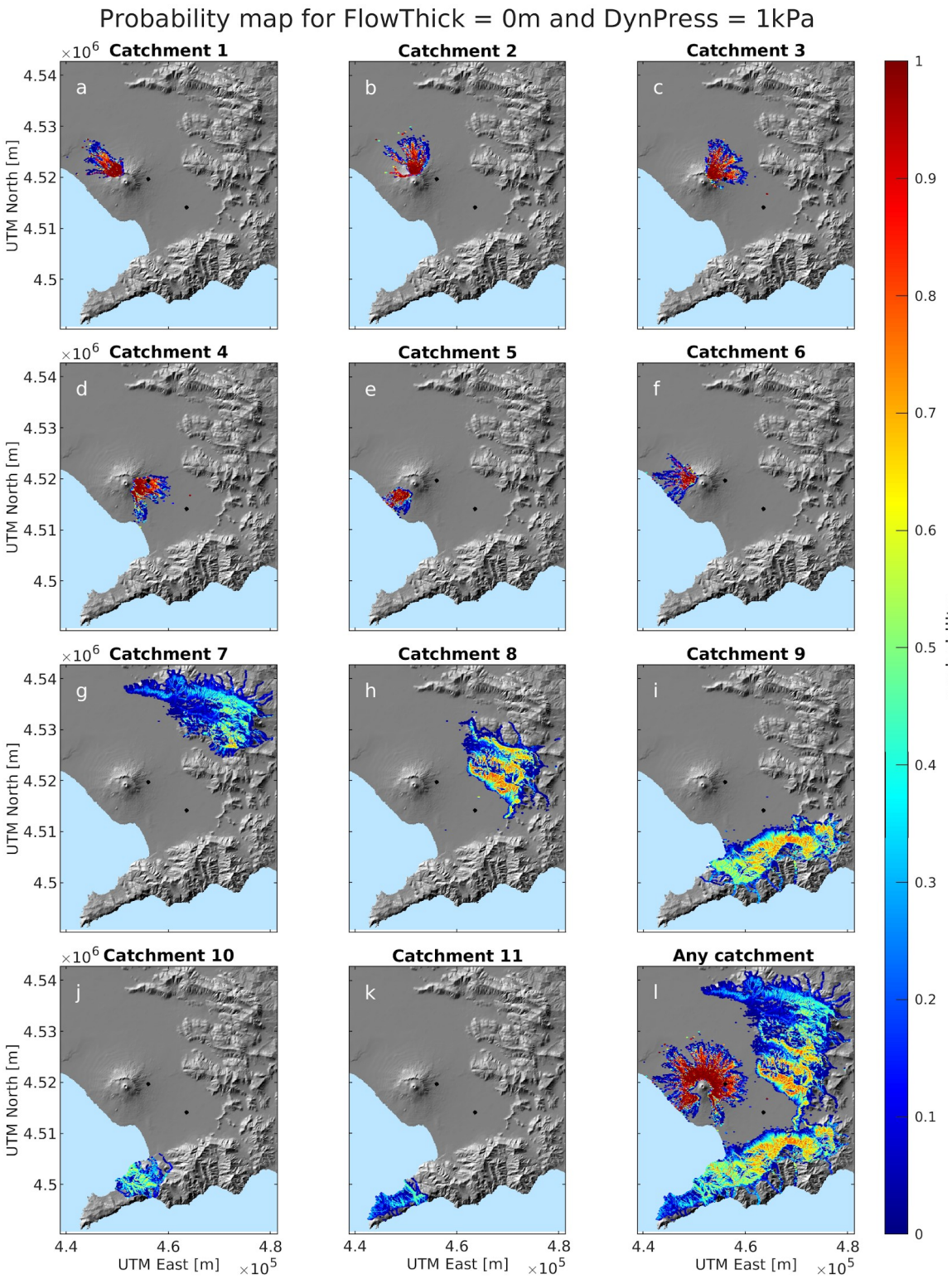

Figure S33: Probability maps for dynamic pressure larger than 1 kPa

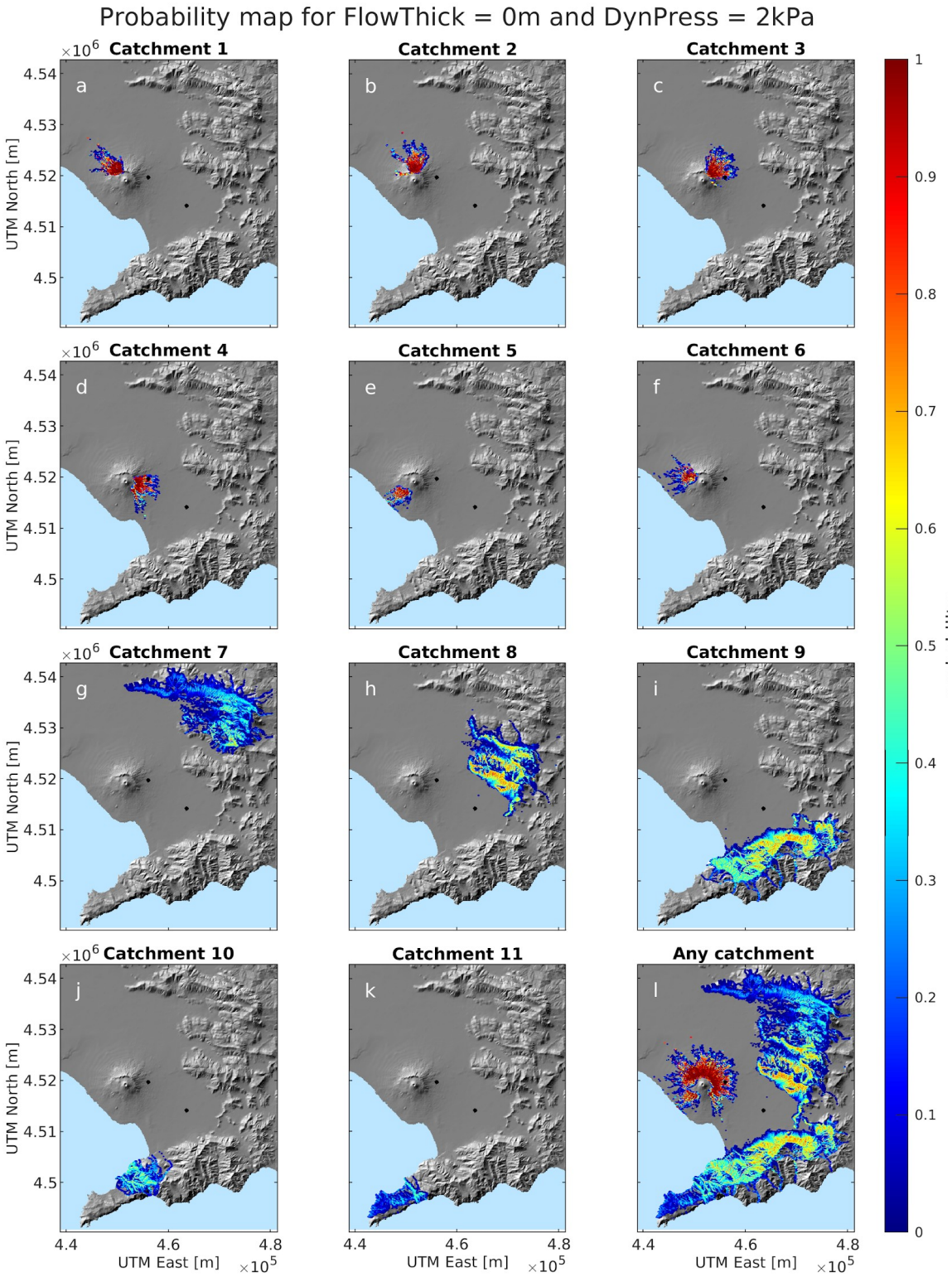

Figure S34: Probability maps for dynamic pressure larger than 2 kPa

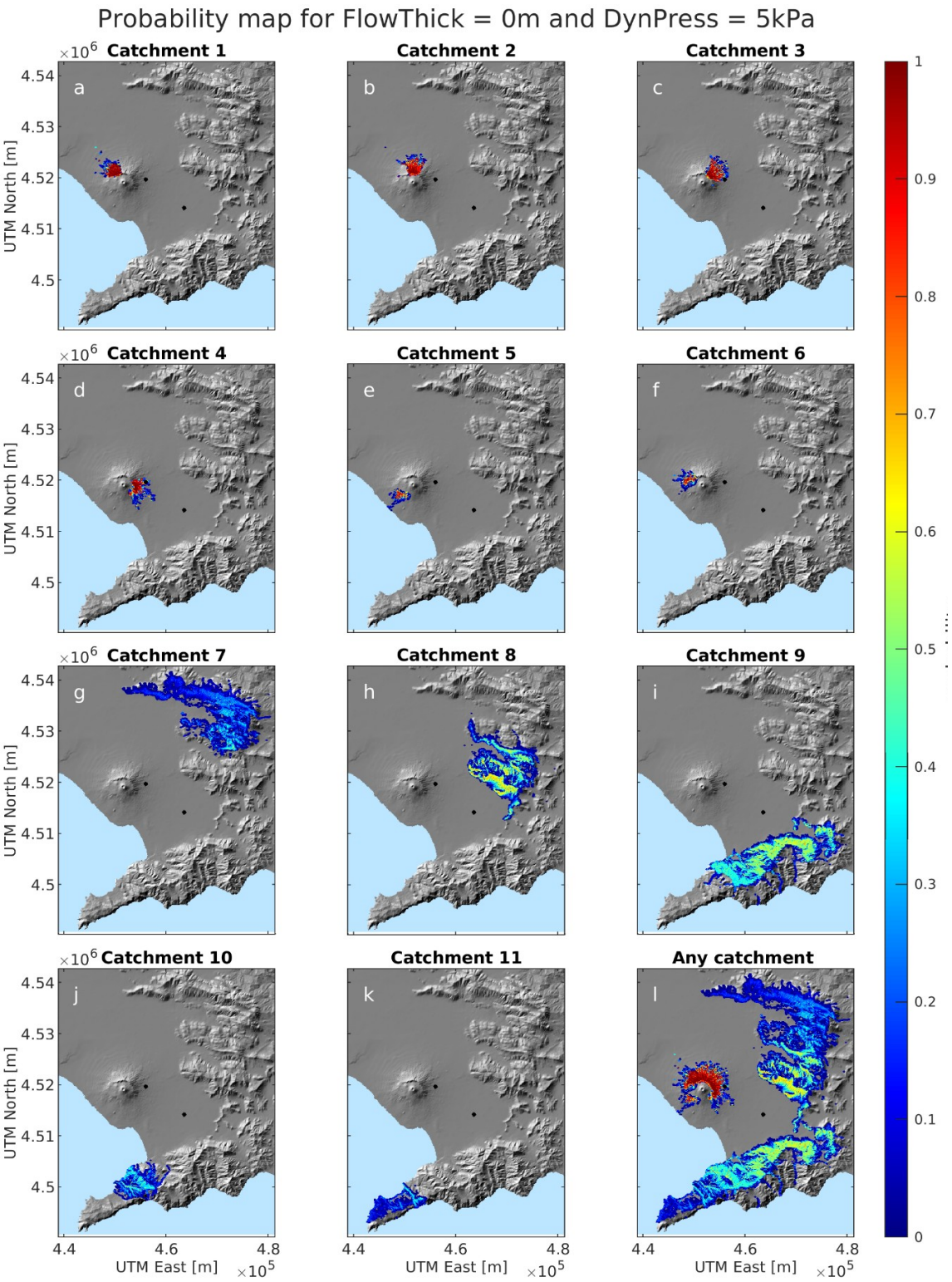

Figure S35: Probability maps for dynamic pressure larger than 5 kPa

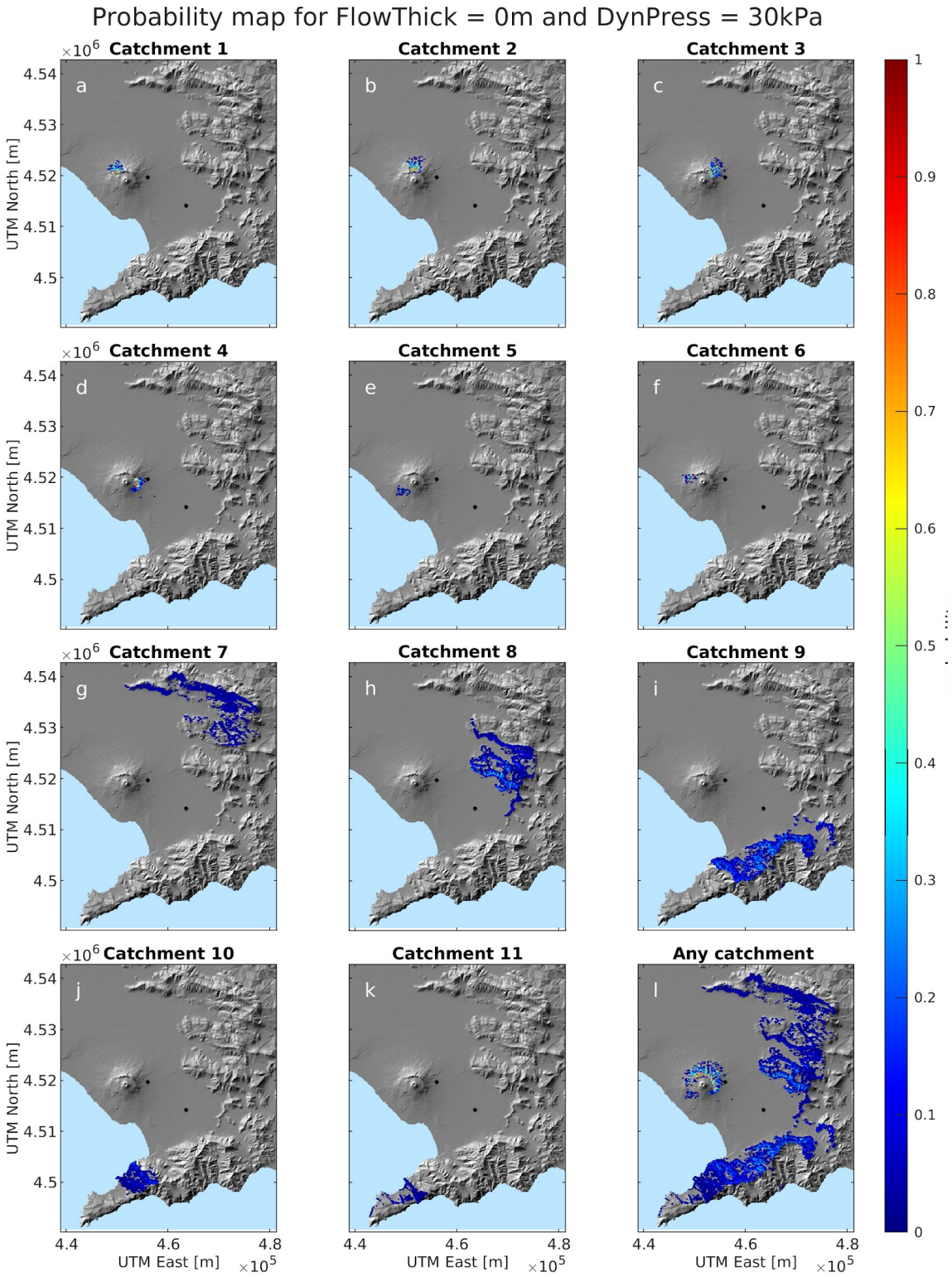

Figure S36: Probability maps for dynamic pressure larger than 30 kPa

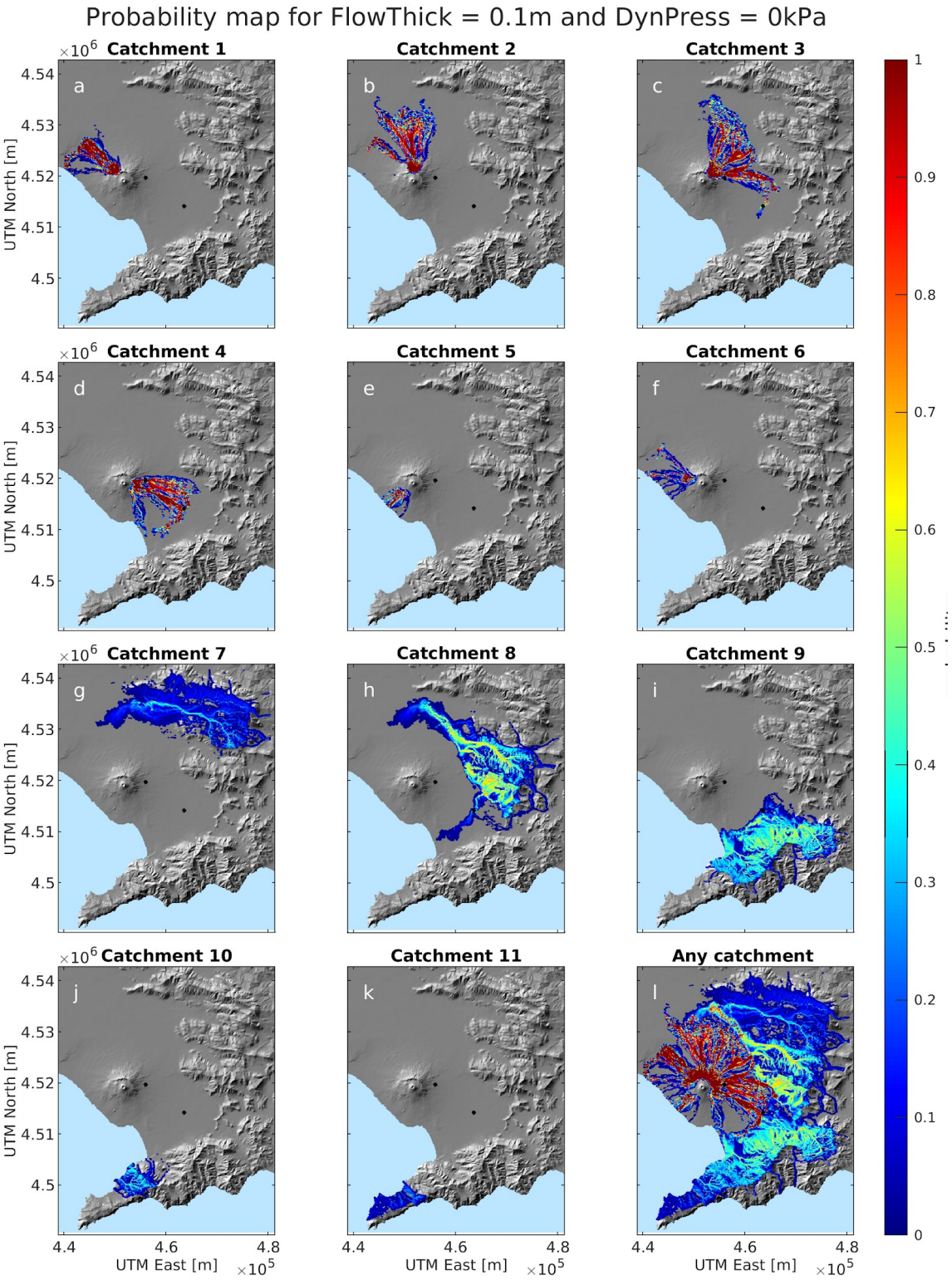

Figure S37: Probability maps for overcoming a maximum flow thickness of 0.1 m

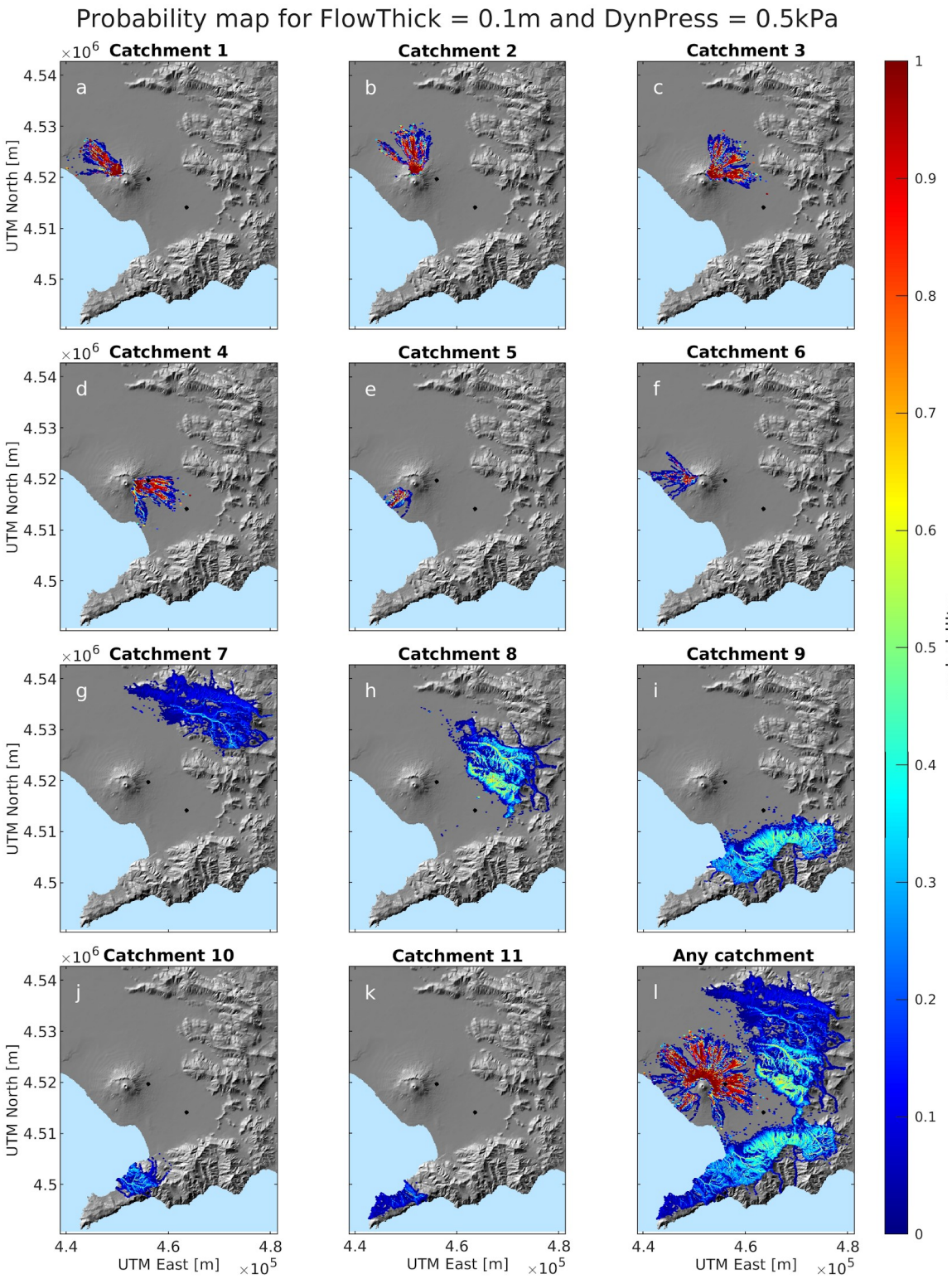

Figure S38: Probability maps for simultaneously overcoming a maximum flow thickness of 0.1 m and a dynamic pressure of 0.5kPa

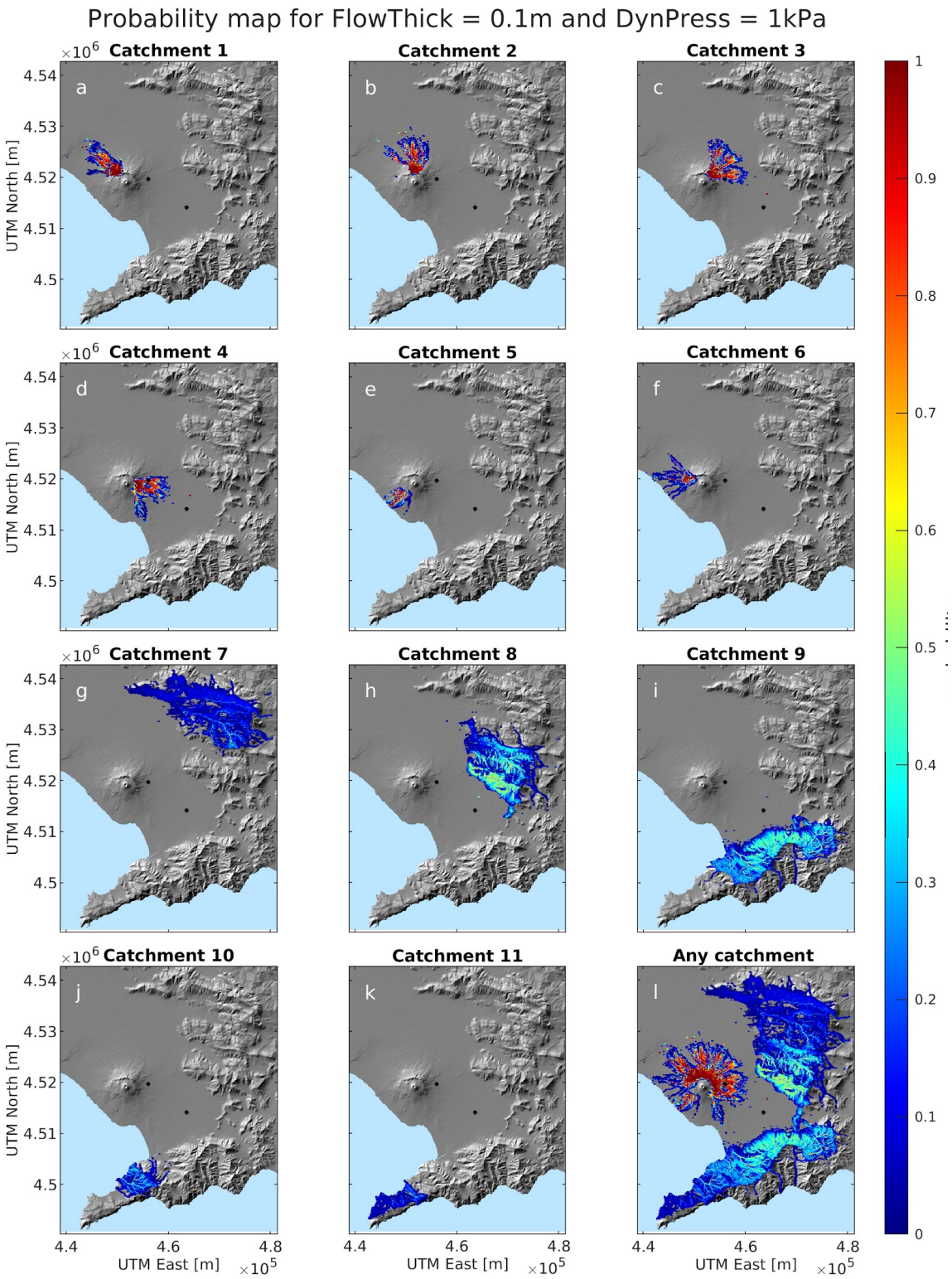

Figure S39: Probability maps for simultaneously overcoming a maximum flow thickness of 0.1 m and a dynamic pressure of 1kPa

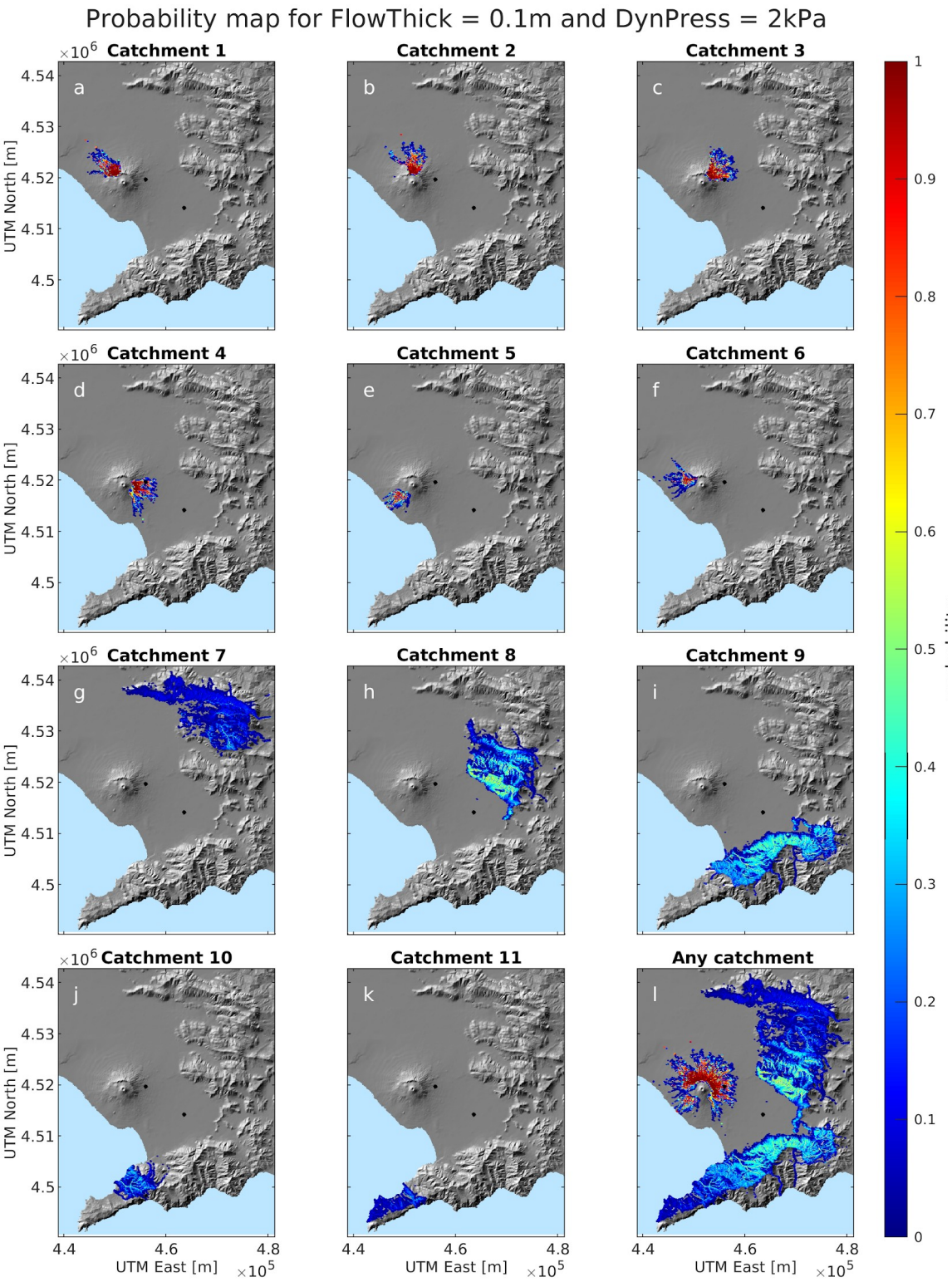

Figure S40: Probability maps for simultaneously overcoming a maximum flow thickness of 0.1 m and a dynamic pressure of 2kPa

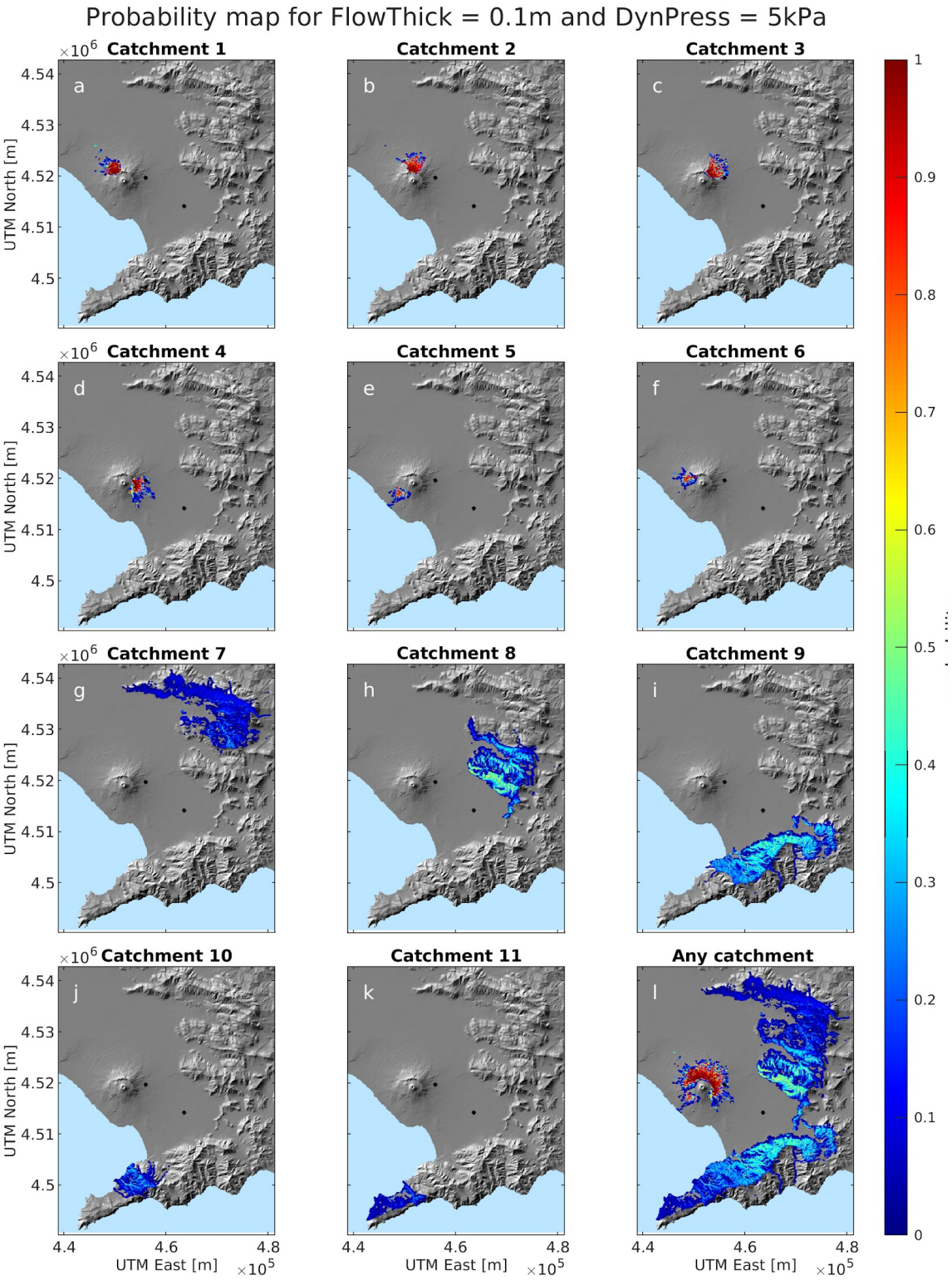

Figure S41: Probability maps for simultaneously overcoming a maximum flow thickness of 0.1 m and a dynamic pressure of 5kPa

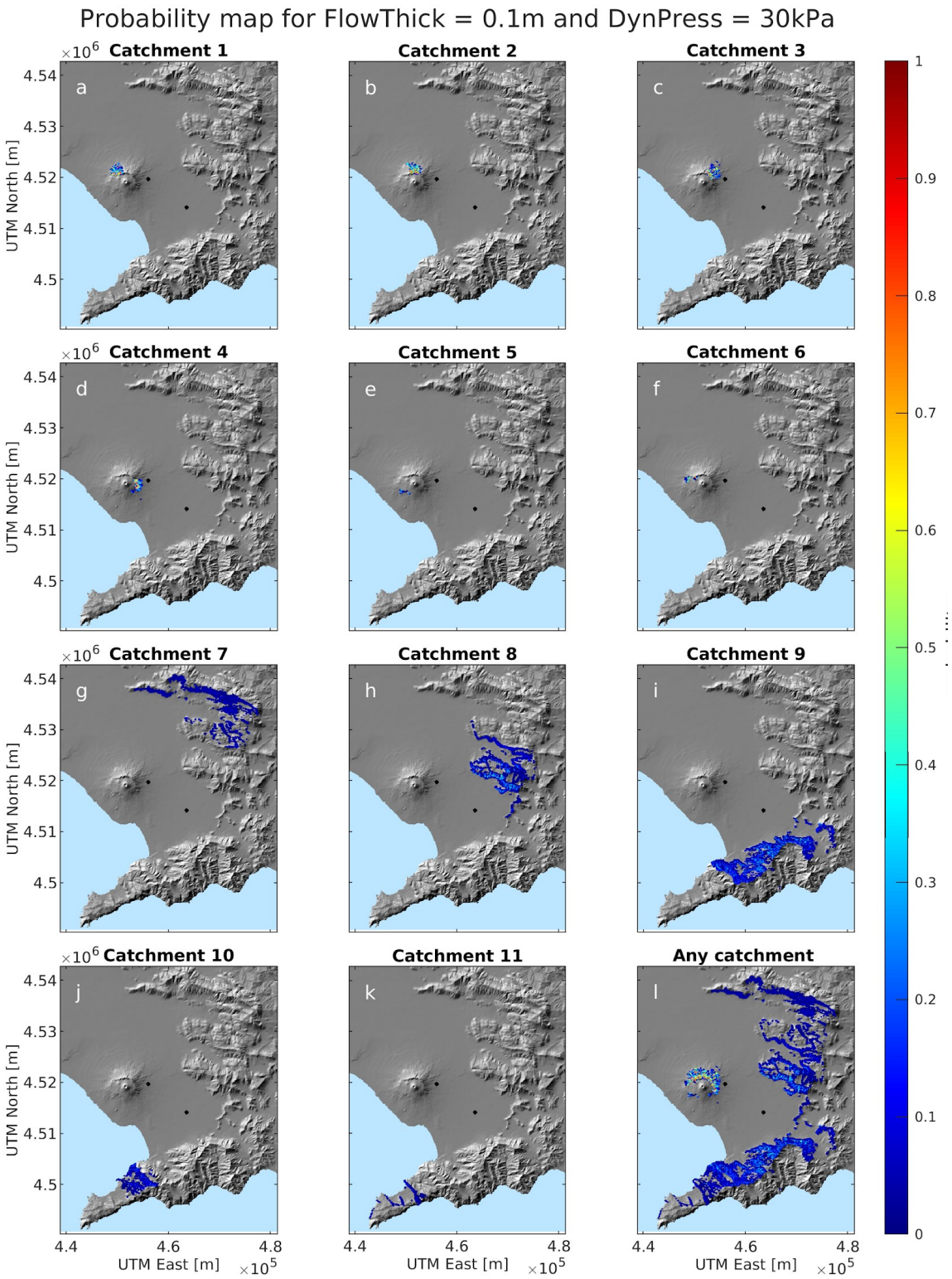

Figure S42: Probability maps for simultaneously overcoming a maximum flow thickness of 0.1 m and a dynamic pressure of 30kPa

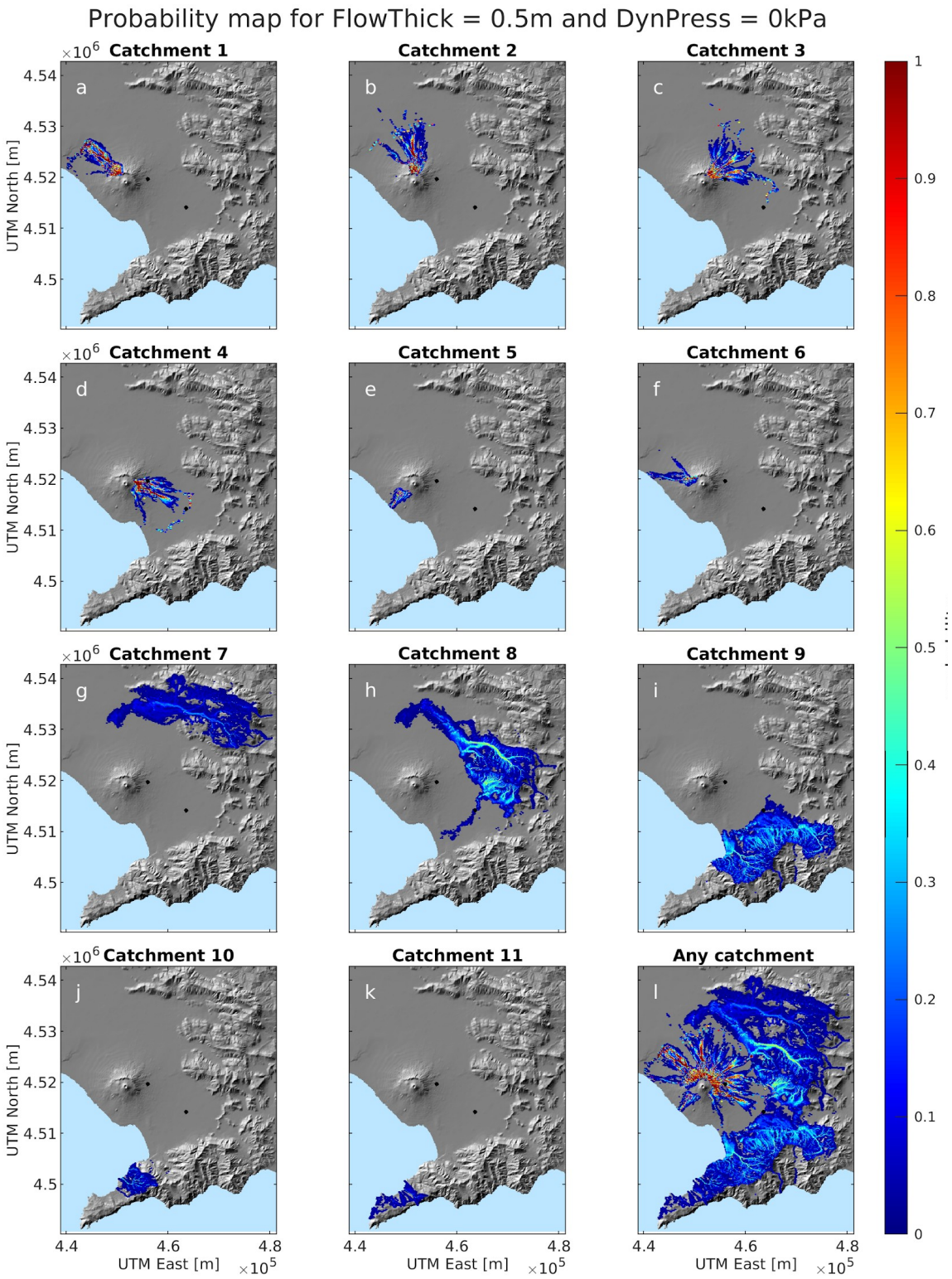

Figure S43: Probability maps for overcoming a maximum flow thickness of 0.5 m

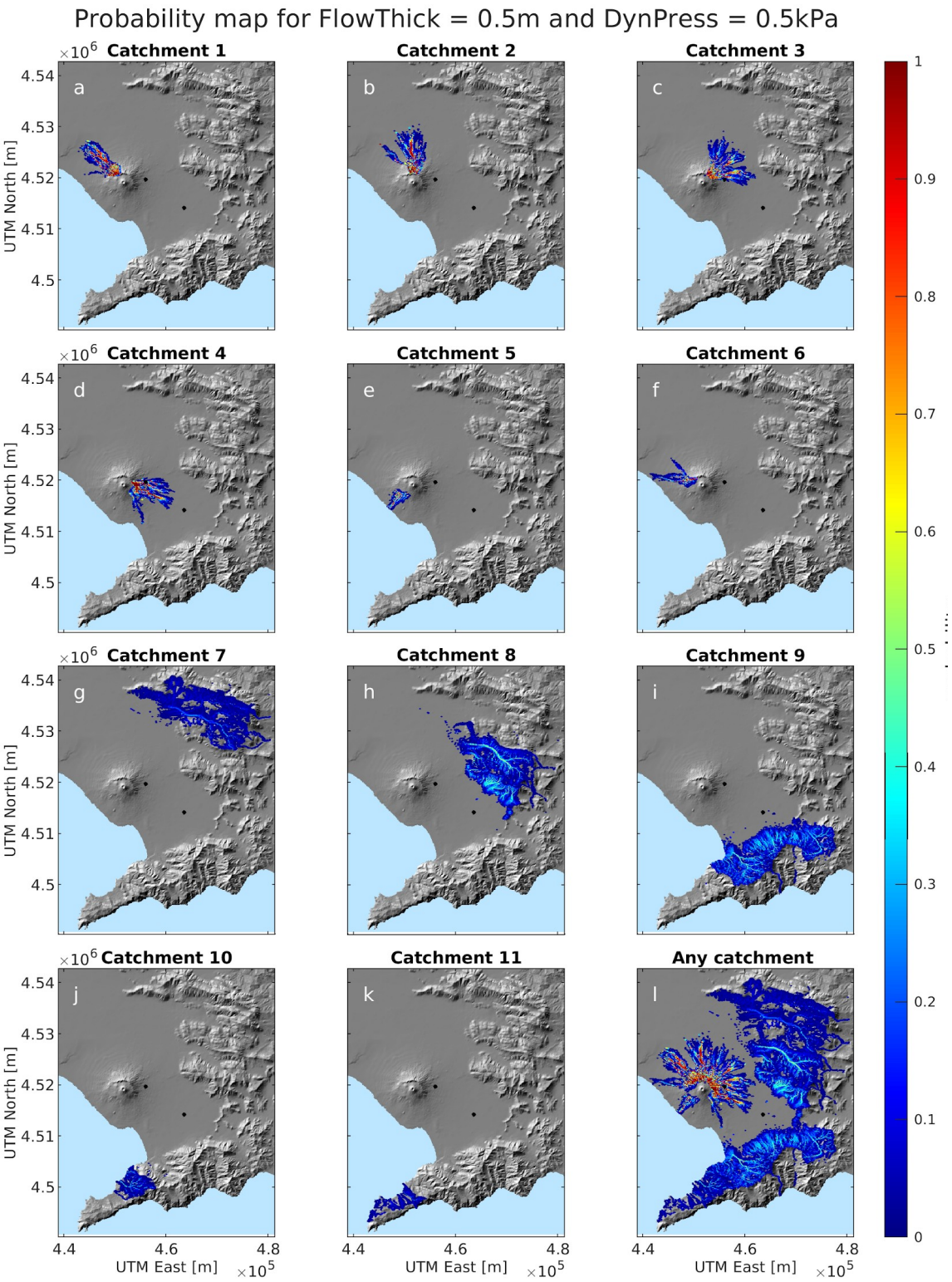

Figure S44: Probability maps for simultaneously overcoming a maximum flow thickness of 0.5 m and a dynamic pressure of 0.5kPa

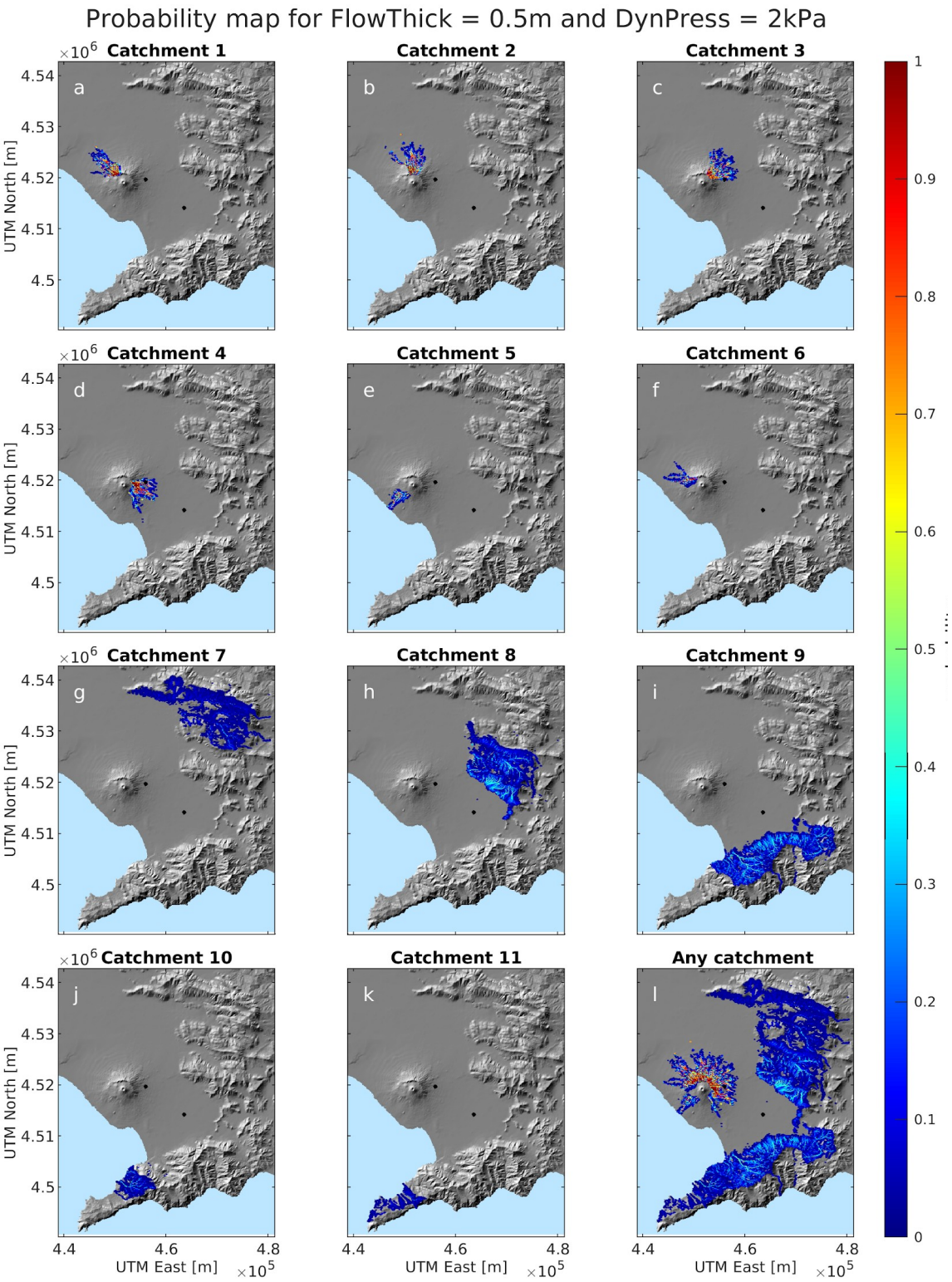

Figure S45: Probability maps for simultaneously overcoming a maximum flow thickness of 0.5 m and a dynamic pressure of 2 kPa

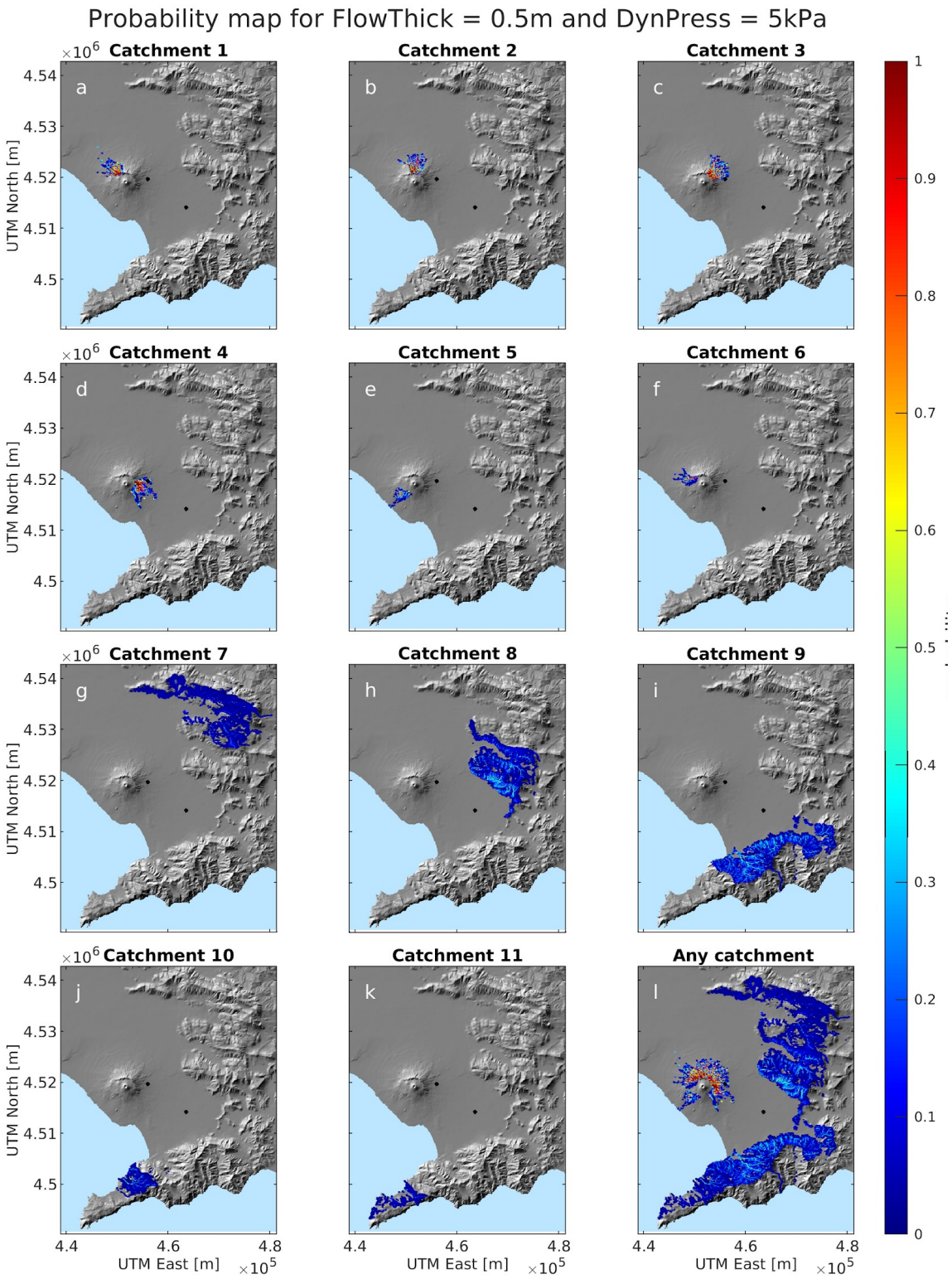

Figure S46: Probability maps for simultaneously overcoming a maximum flow thickness of 0.5 m and a dynamic pressure of 5 kPa

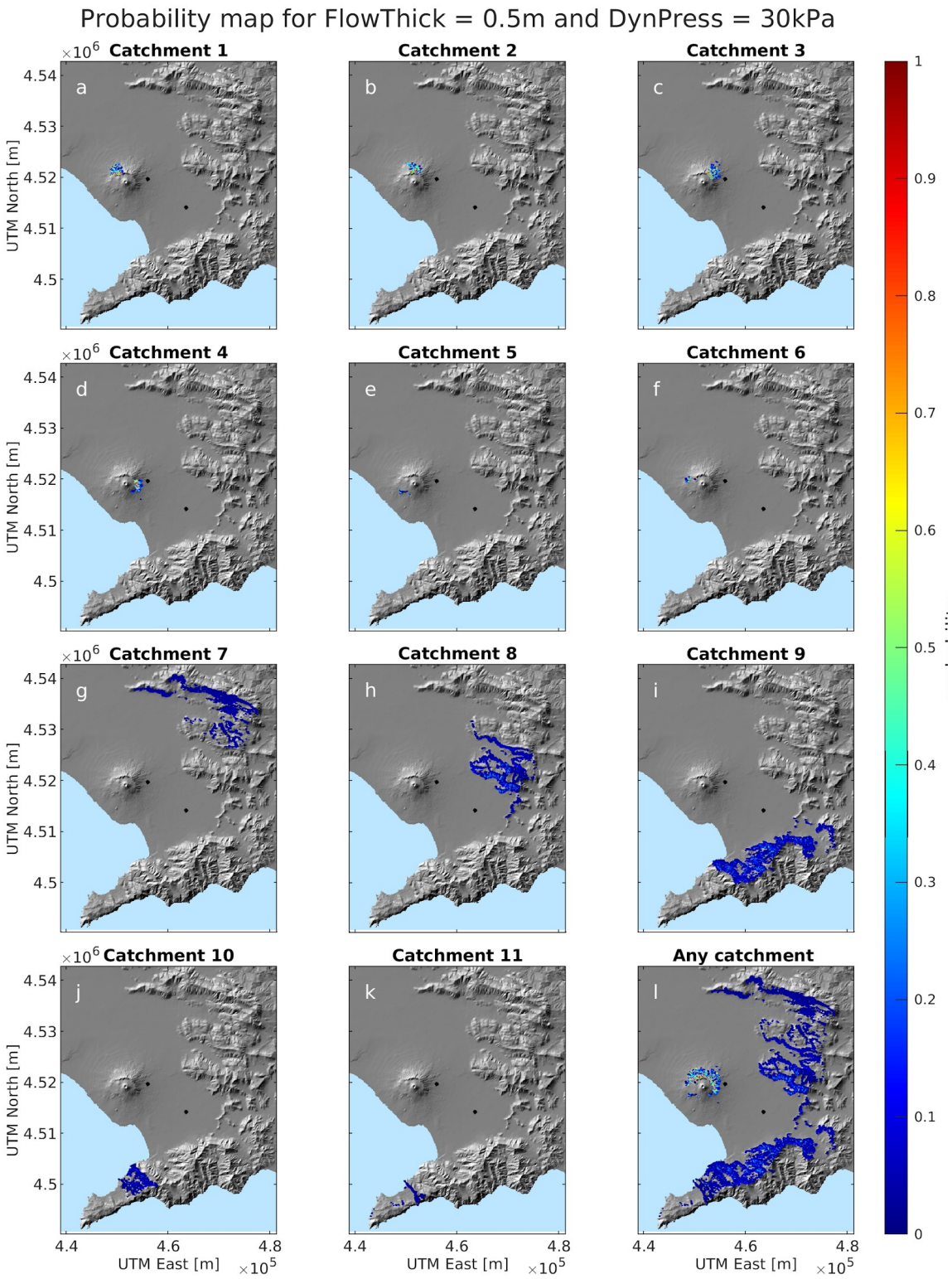

Figure S47: Probability maps for simultaneously overcoming a maximum flow thickness of 0.5 m and a dynamic pressure of 30 kPa

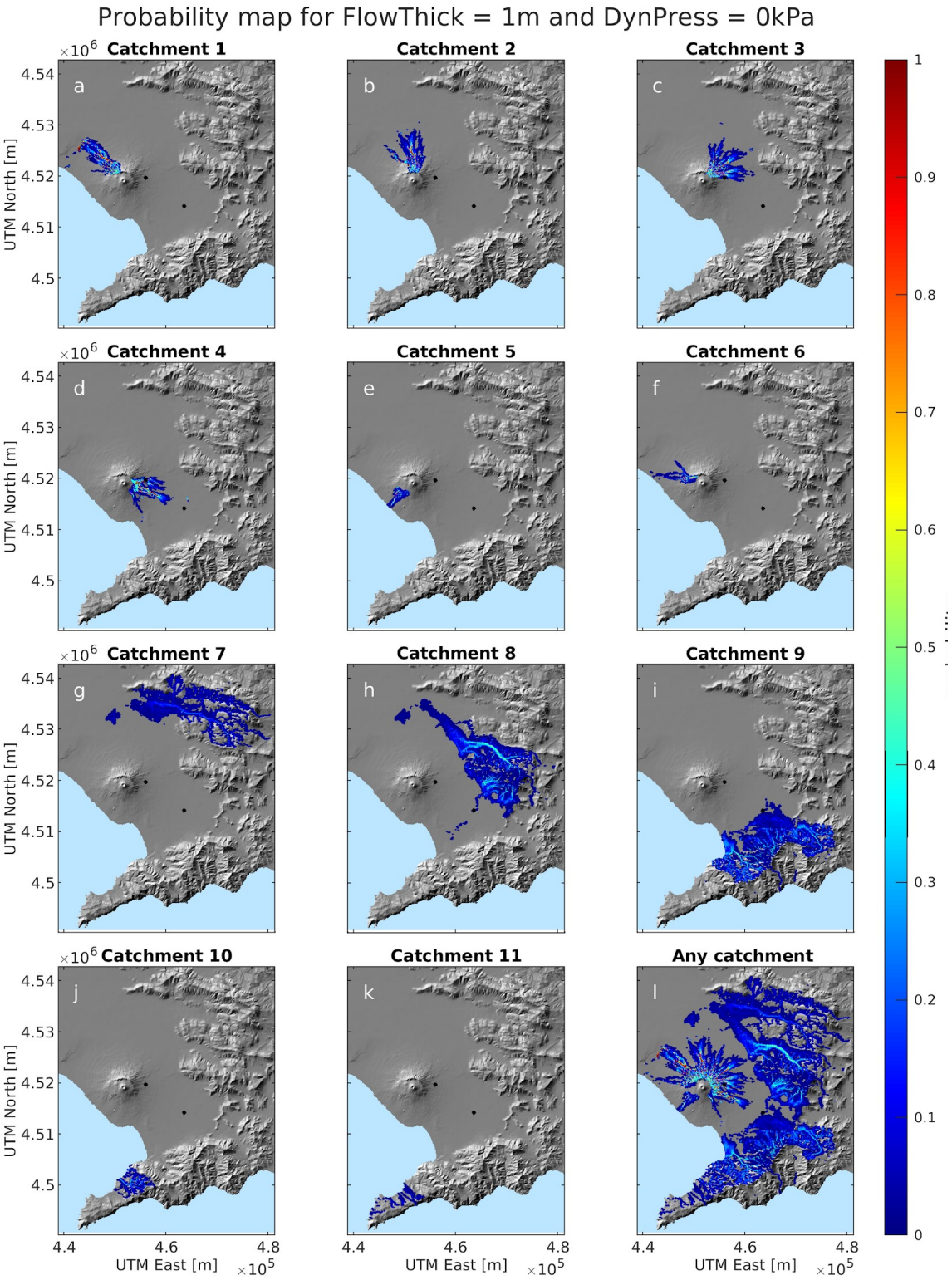

Figure S48: Probability maps for overcoming a maximum flow thickness of 1 m

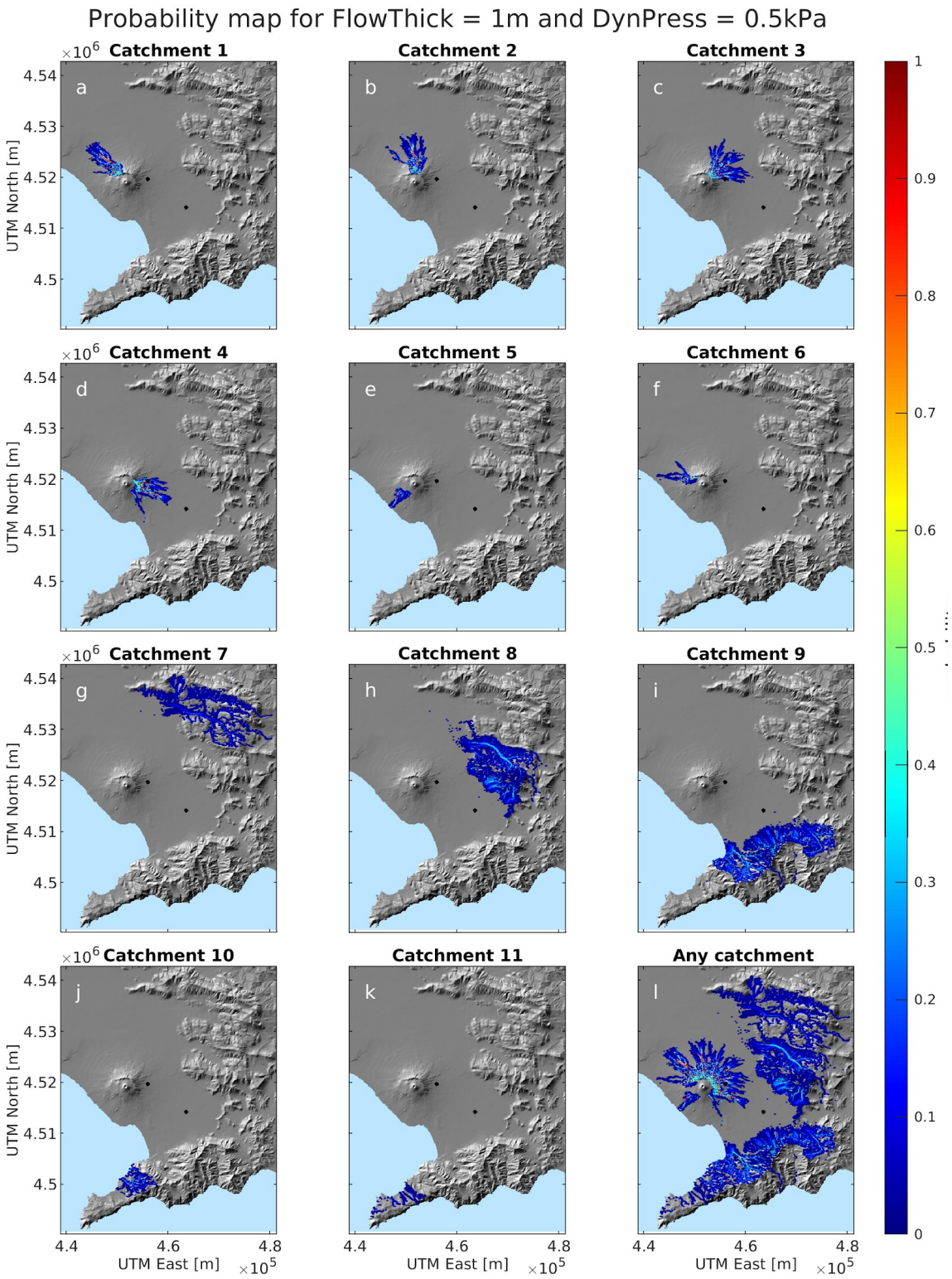

Figure S49: Probability maps for simultaneously overcoming a maximum flow thickness of 1 m and a dynamic pressure of 0.5 kPa

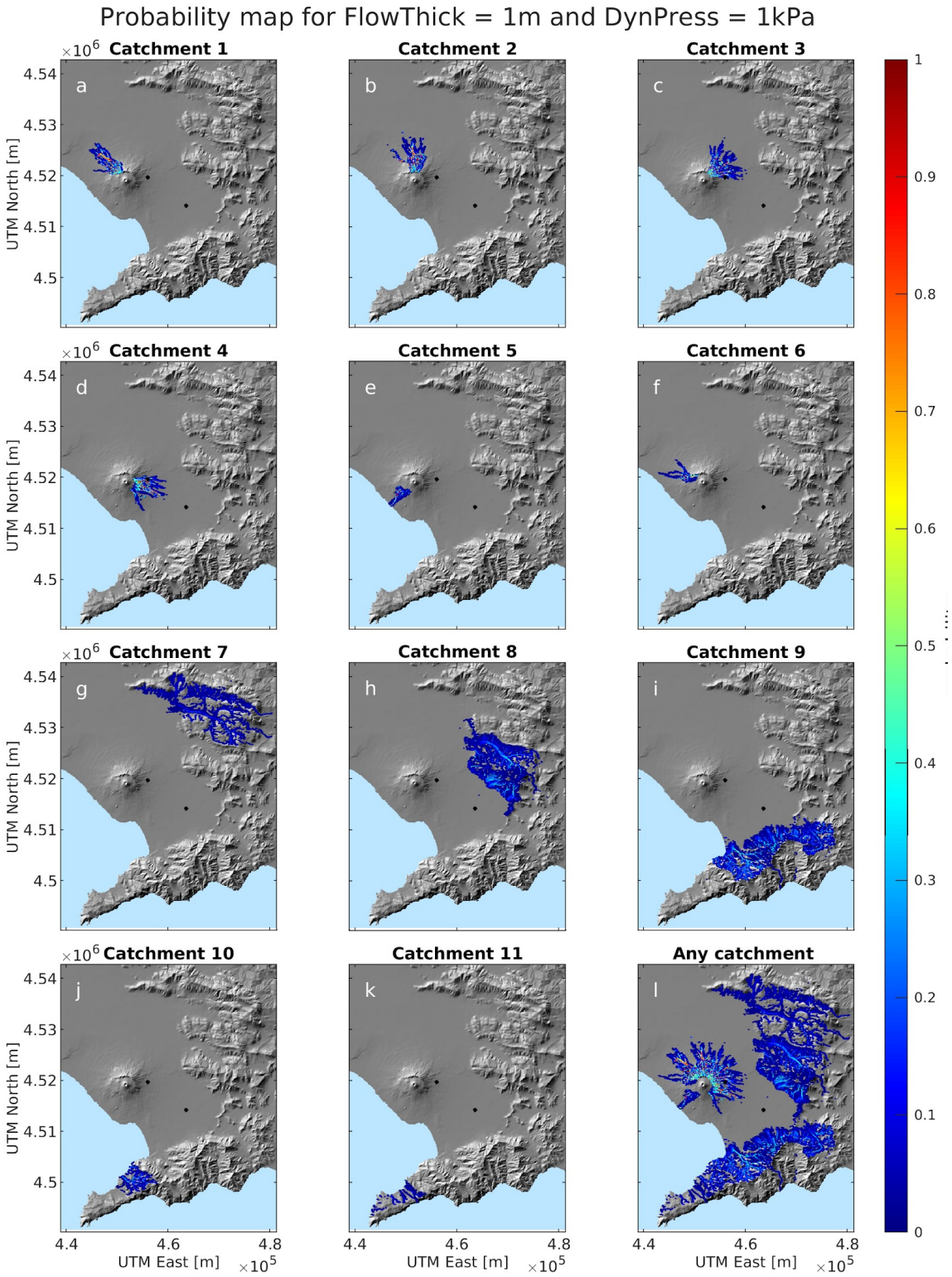

Figure S50: Probability maps for simultaneously overcoming a maximum flow thickness of 1 m and a dynamic pressure of 1 kPa

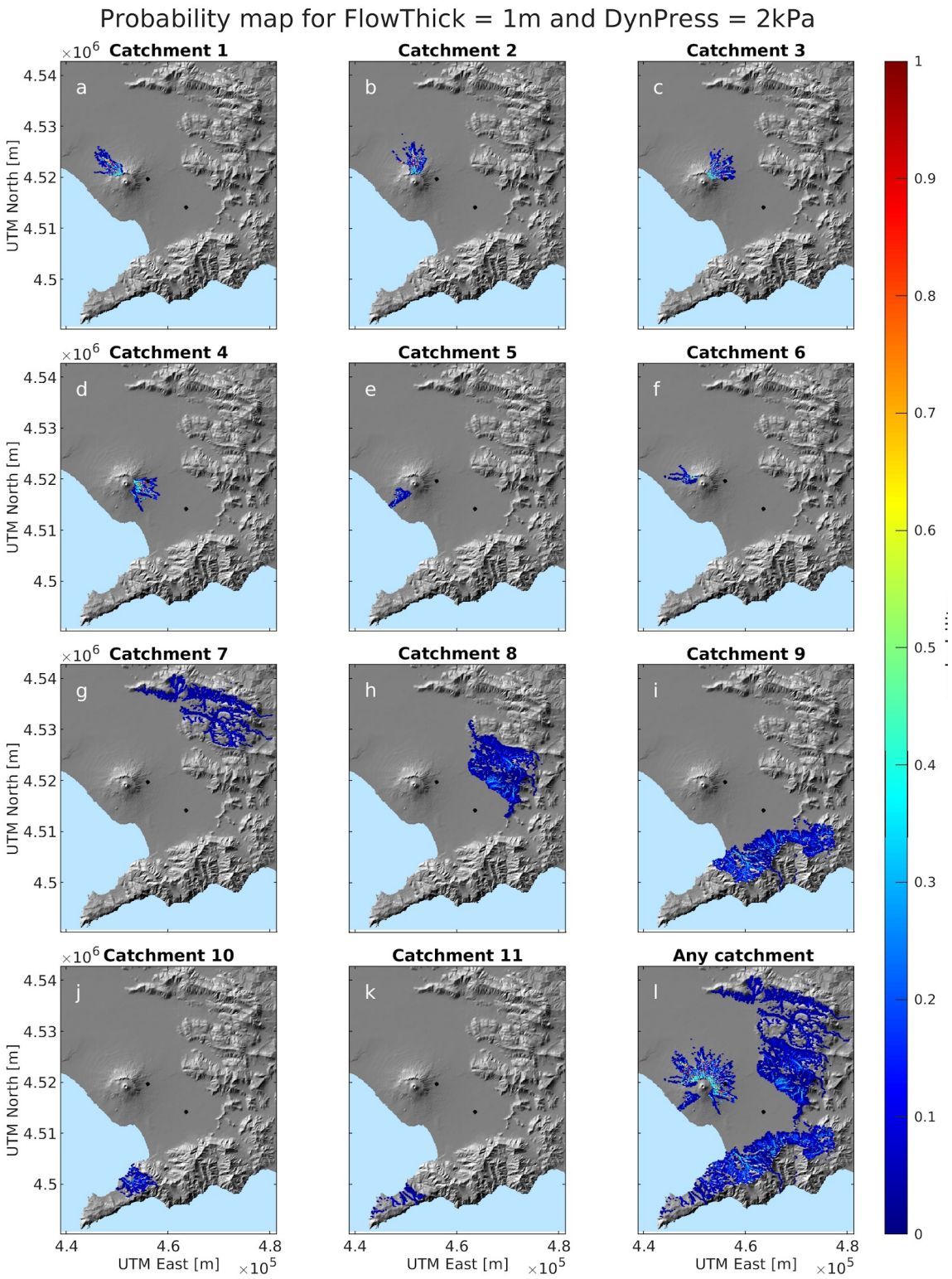

Figure S51: Probability maps for simultaneously overcoming a maximum flow thickness of 1 m and a dynamic pressure of 2 kPa

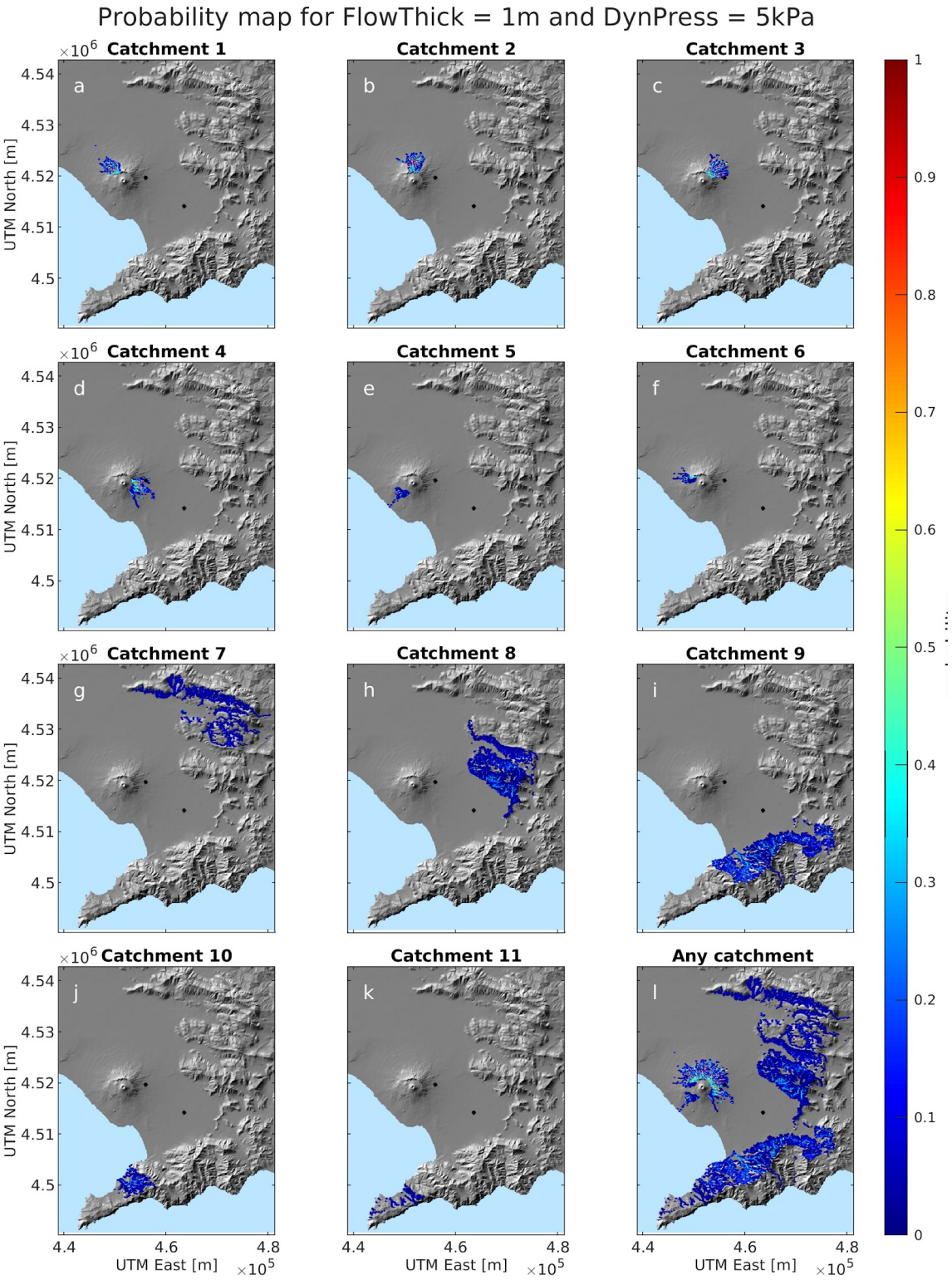

Figure S52: Probability maps for simultaneously overcoming a maximum flow thickness of 1 m and a dynamic pressure of 5 kPa

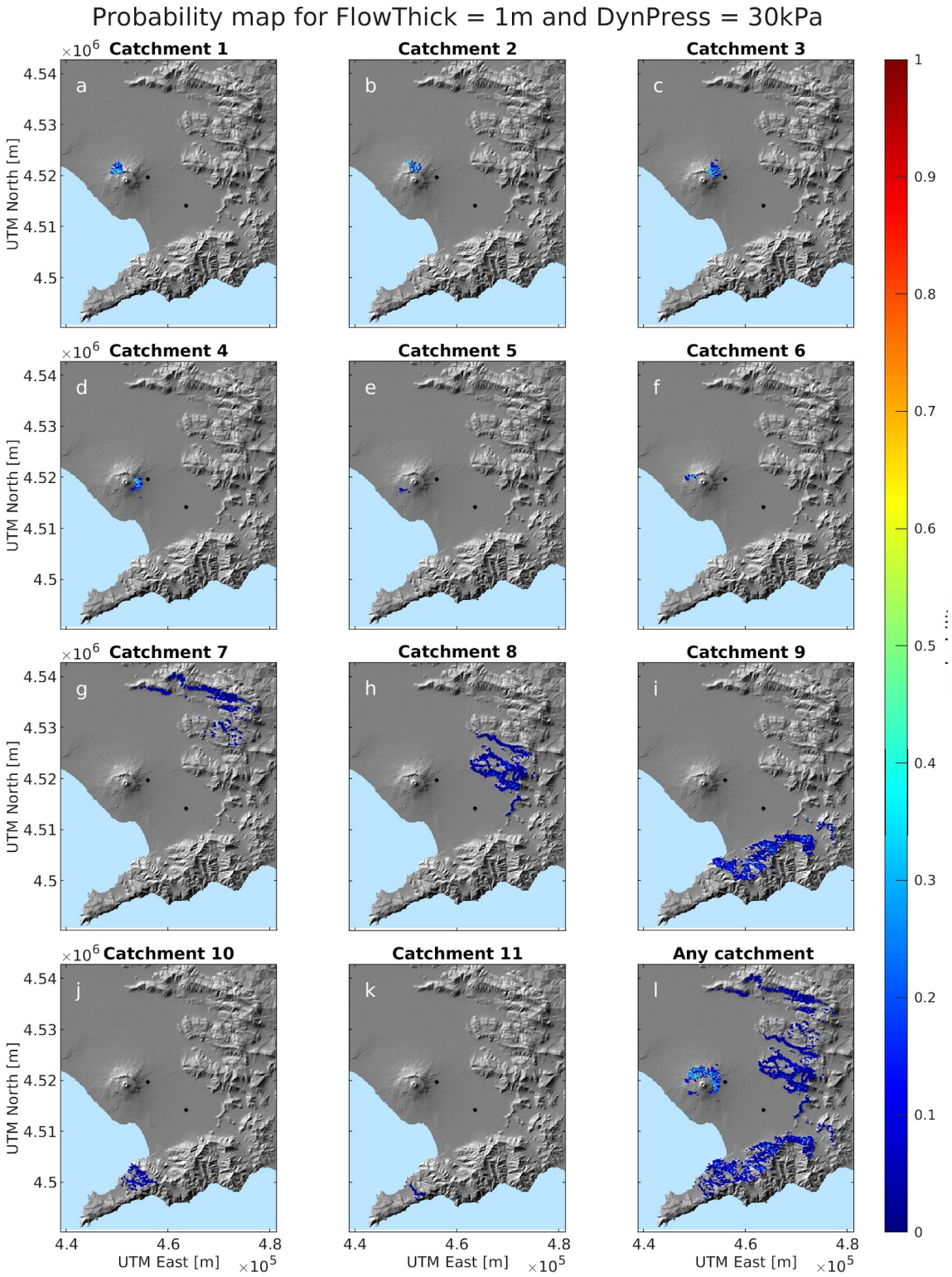

Figure S53: Probability maps for simultaneously overcoming a maximum flow thickness of 1 m and a dynamic pressure of 30 kPa

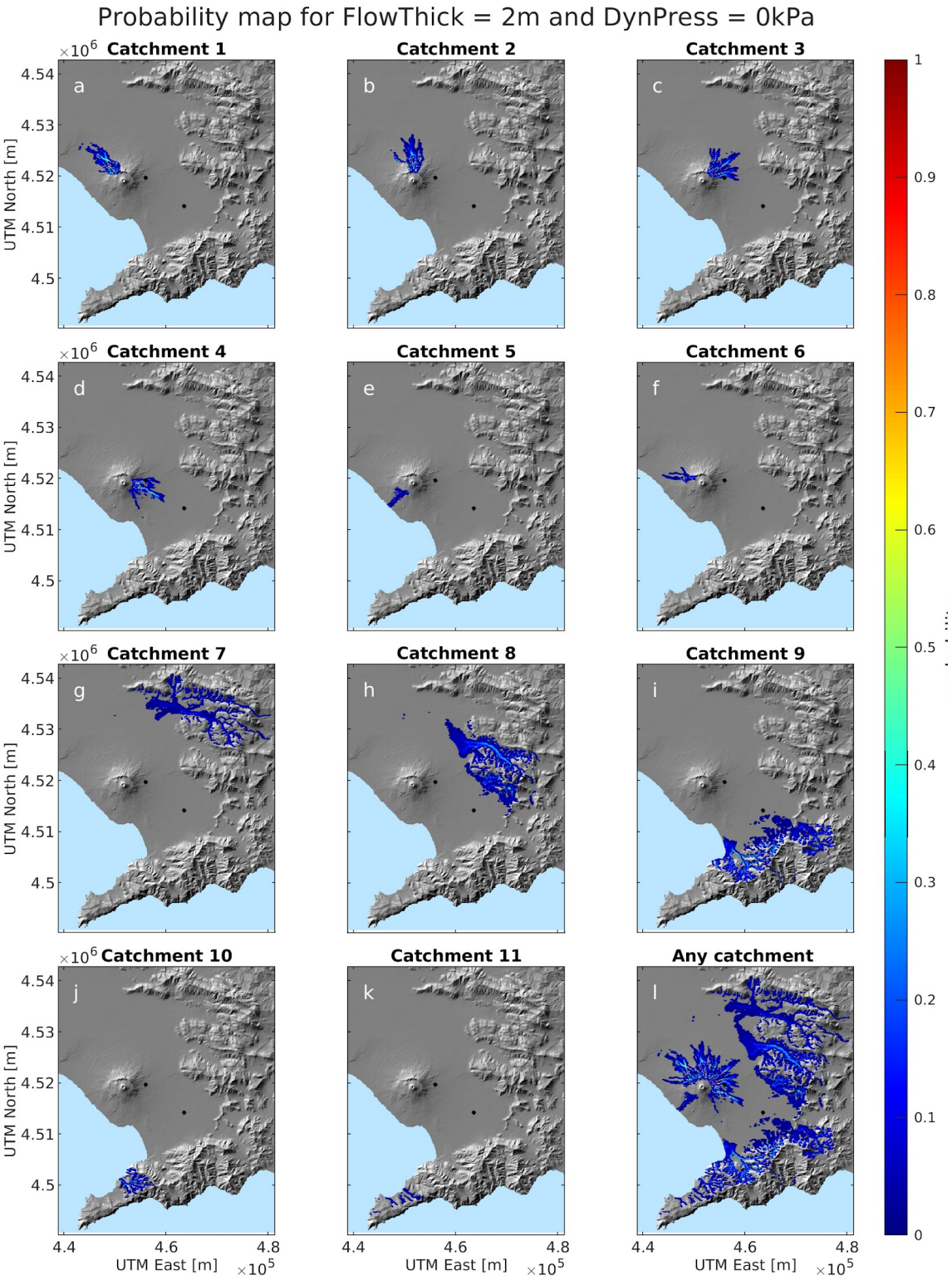

Figure S54: Probability maps for overcoming a maximum flow thickness of 2 m

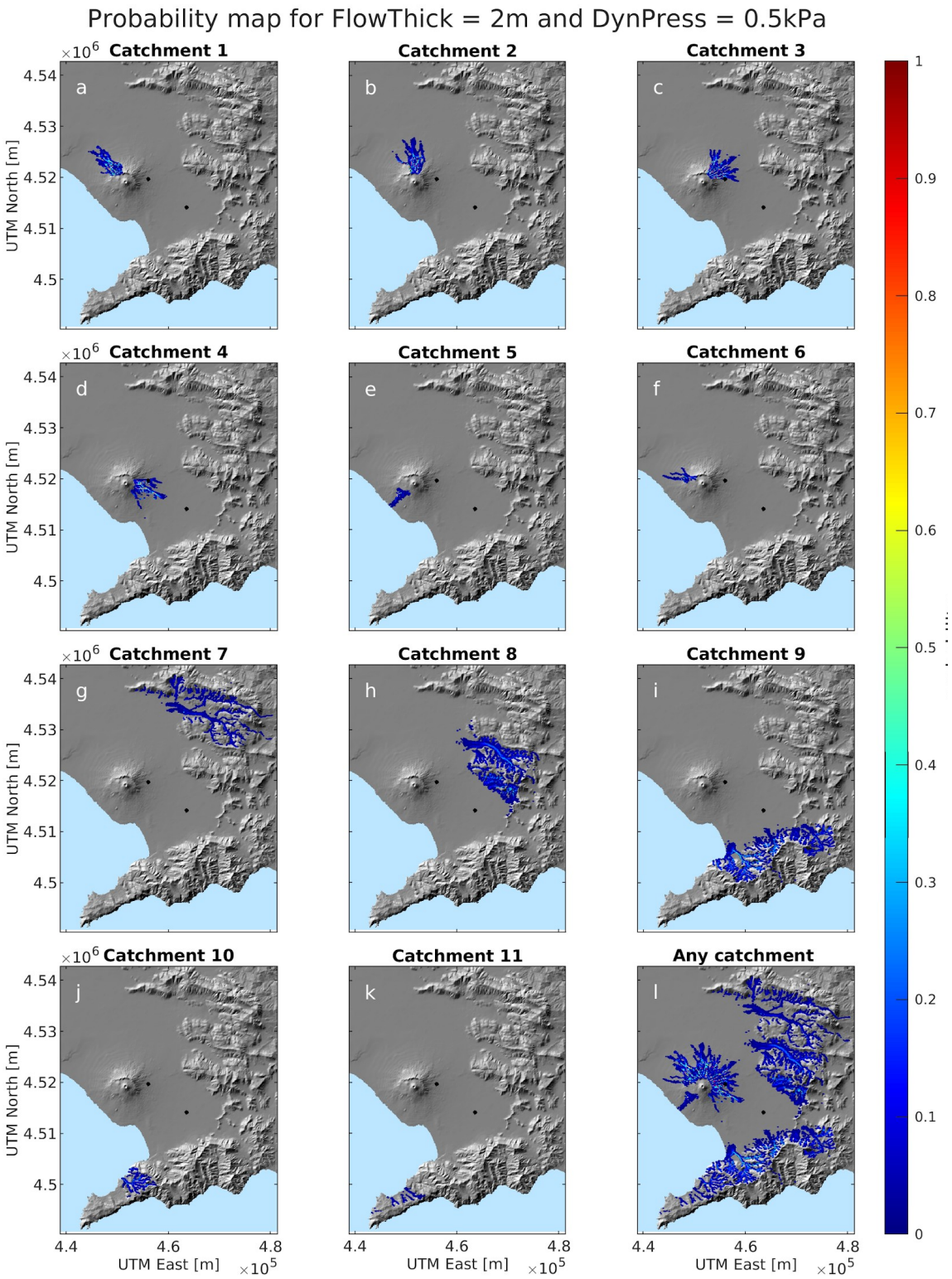

Figure S55: Probability maps for simultaneously overcoming a maximum flow thickness of 2 m and a dynamic pressure of 0.5 kPa

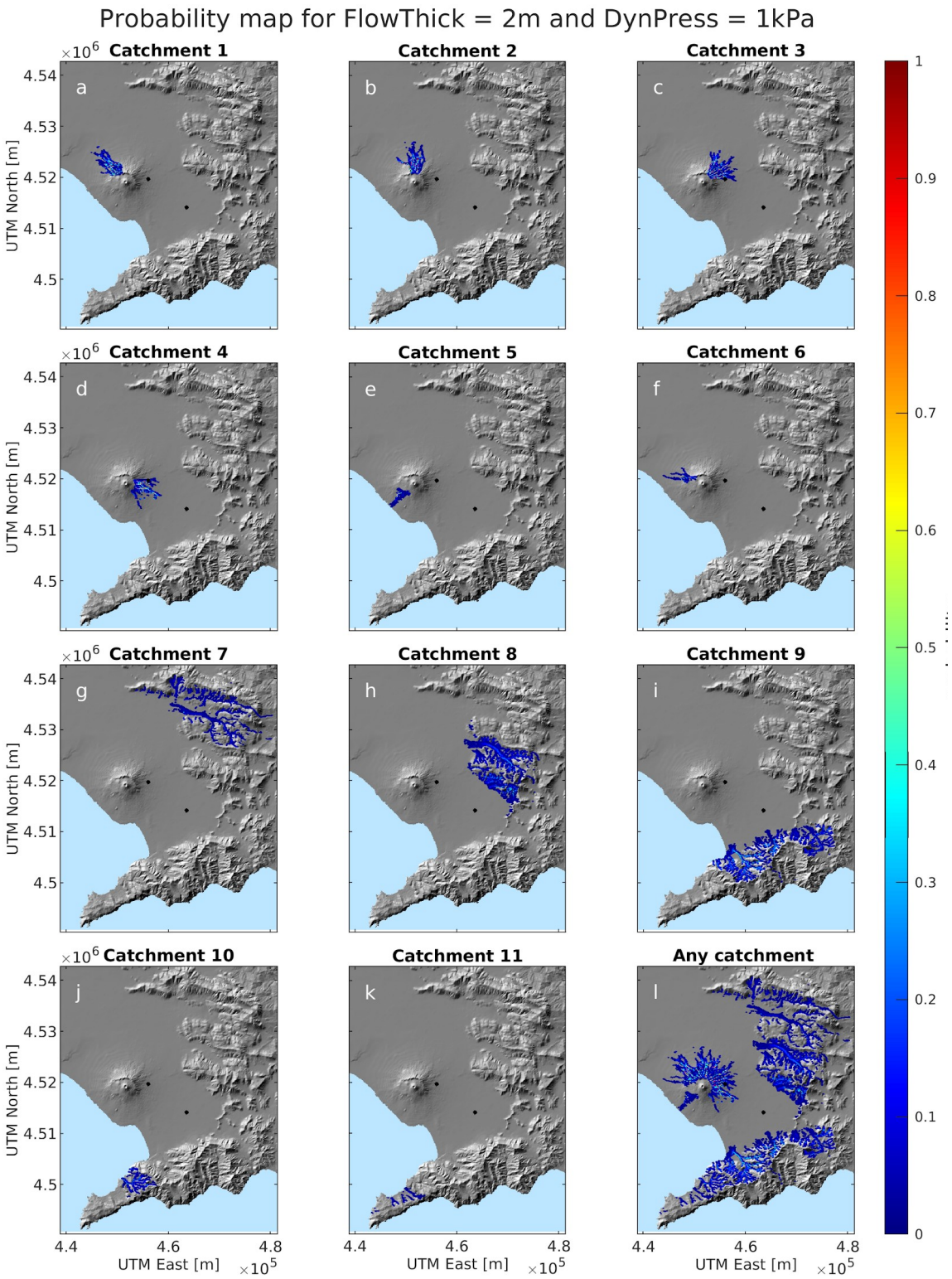

Figure S56: Probability maps for simultaneously overcoming a maximum flow thickness of 2 m and a dynamic pressure of 1 kPa

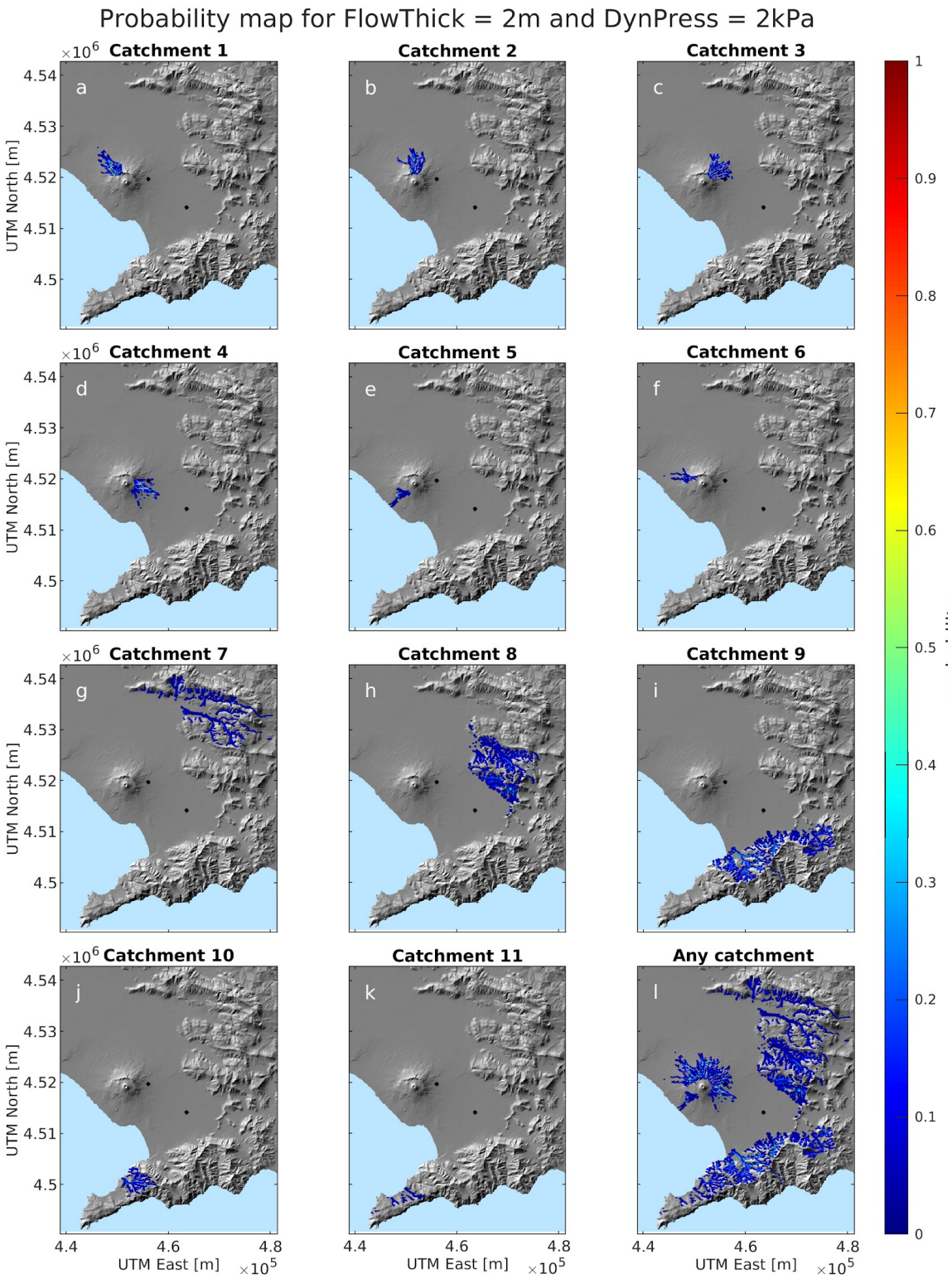

Figure S57: Probability maps for simultaneously overcoming a maximum flow thickness of 2 m and a dynamic pressure of 2 kPa

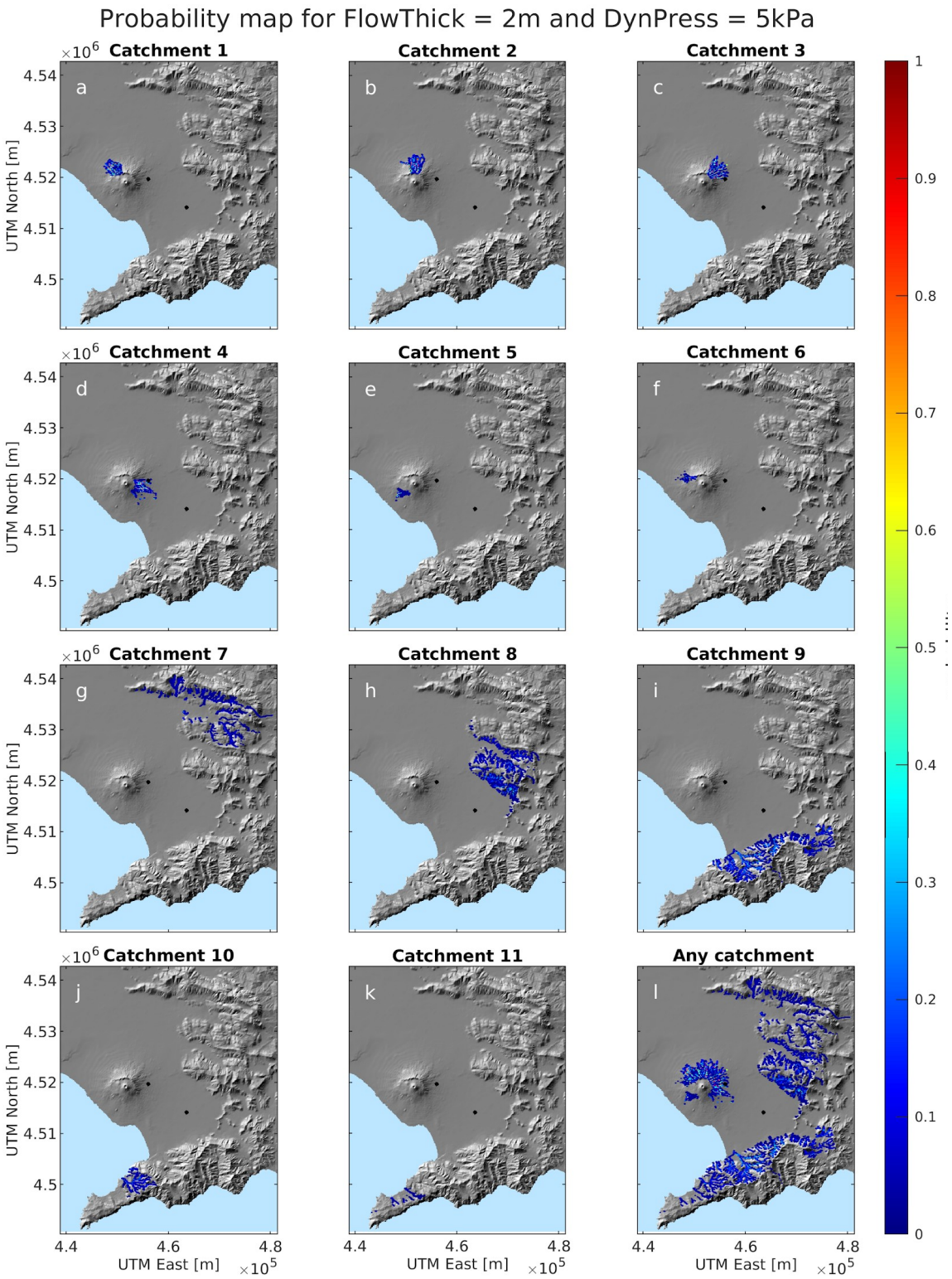

Figure S58: Probability maps for simultaneously overcoming a maximum flow thickness of 2 m and a dynamic pressure of 5 kPa

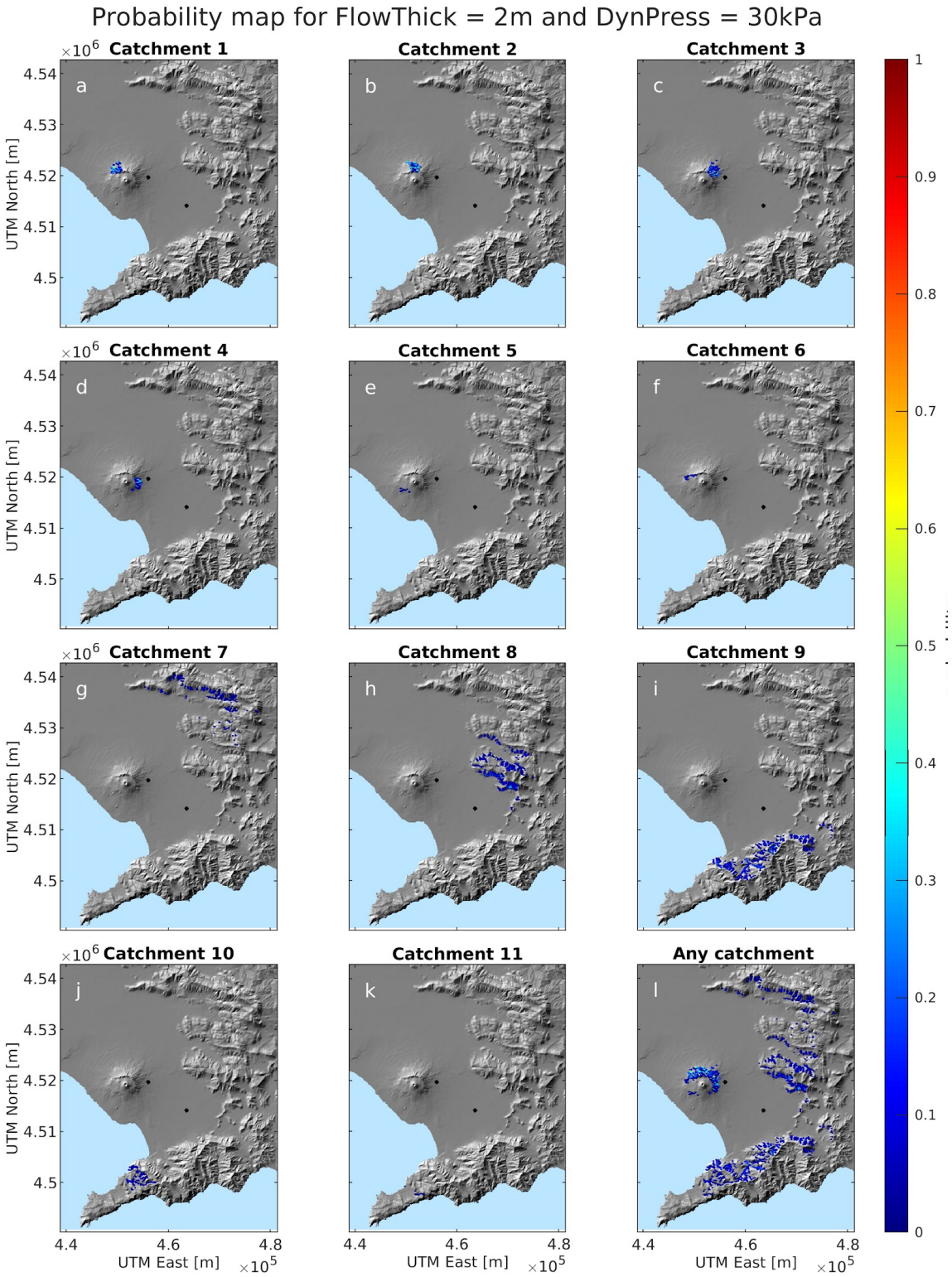

Figure S59: Probability maps for simultaneously overcoming a maximum flow thickness of 2 m and a dynamic pressure of 30 kPa

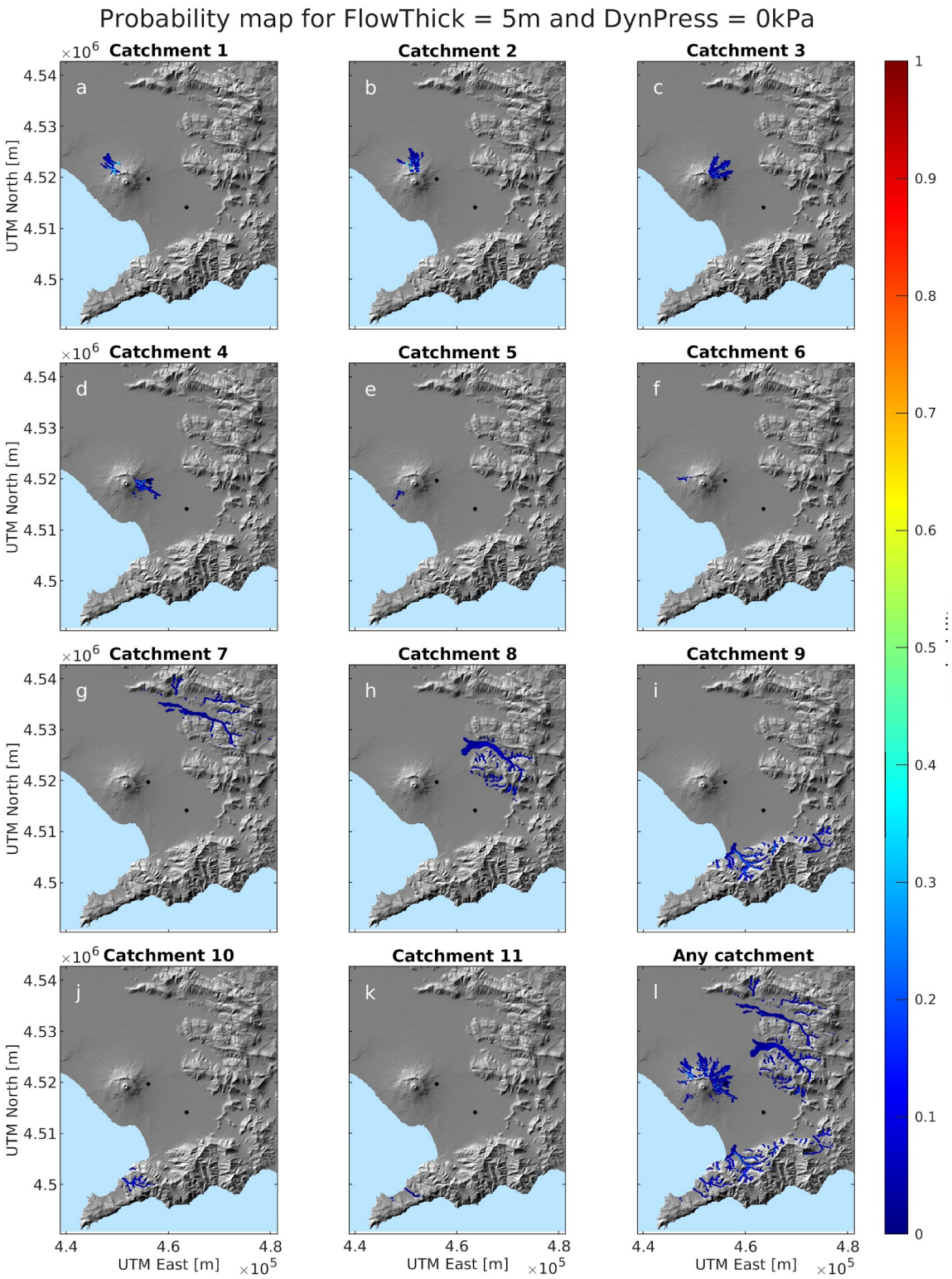

Figure S60: Probability maps for overcoming a maximum flow thickness of 5 m

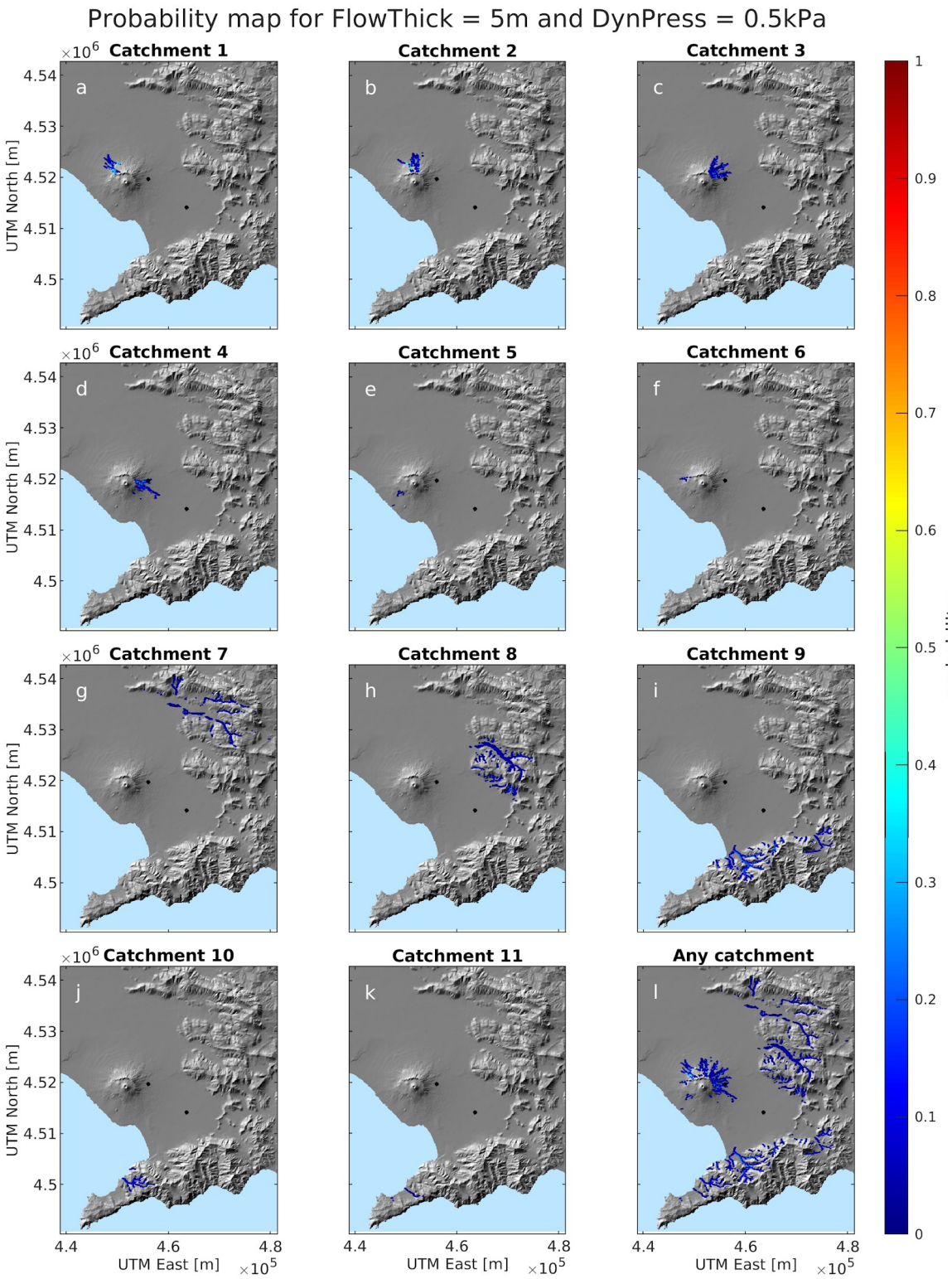

Figure S61: Probability maps for simultaneously overcoming a maximum flow thickness of 5 m and a dynamic pressure of 0.5 kPa

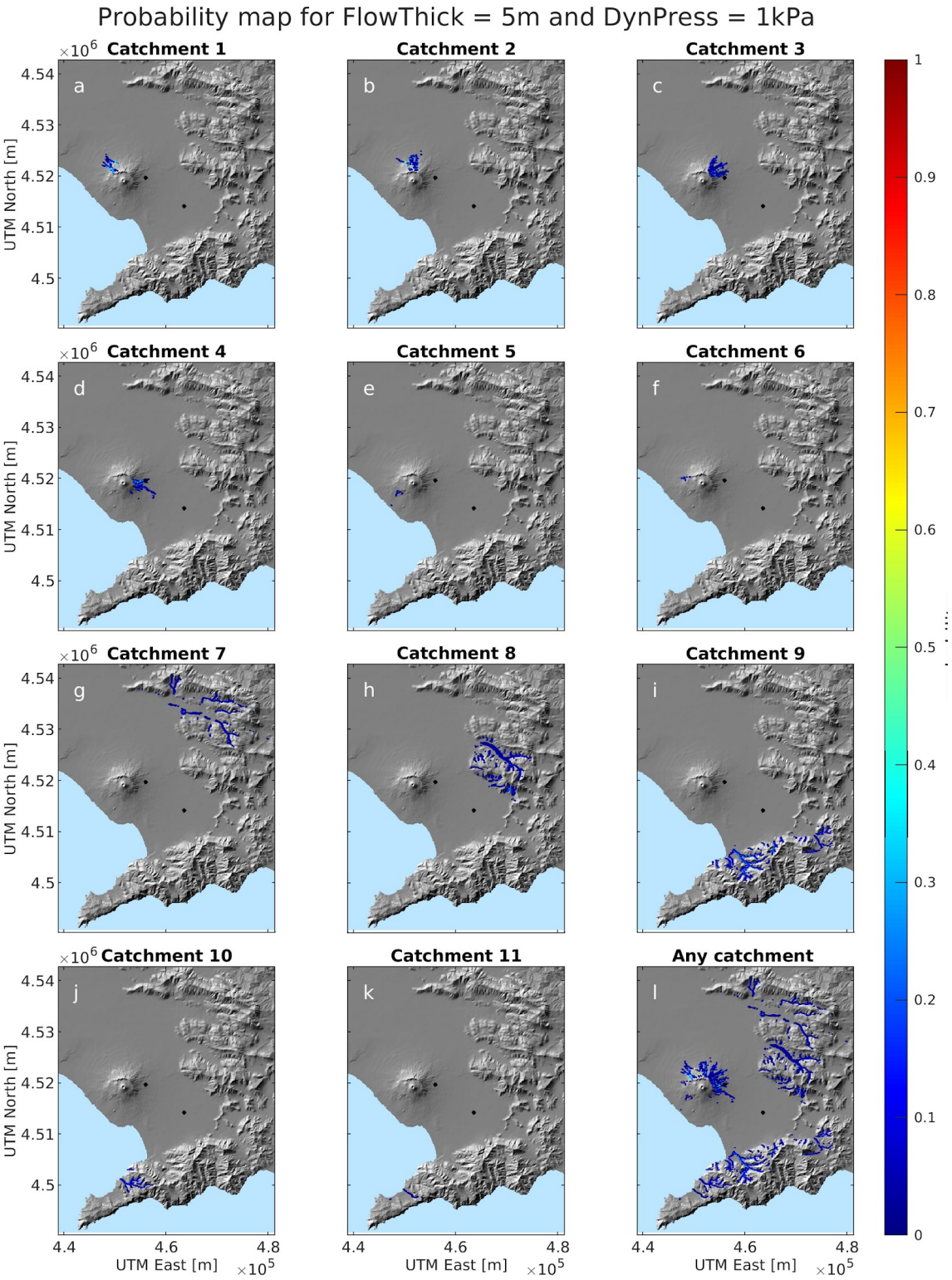

Figure S62: Probability maps for simultaneously overcoming a maximum flow thickness of 5 m and a dynamic pressure of 1 kPa

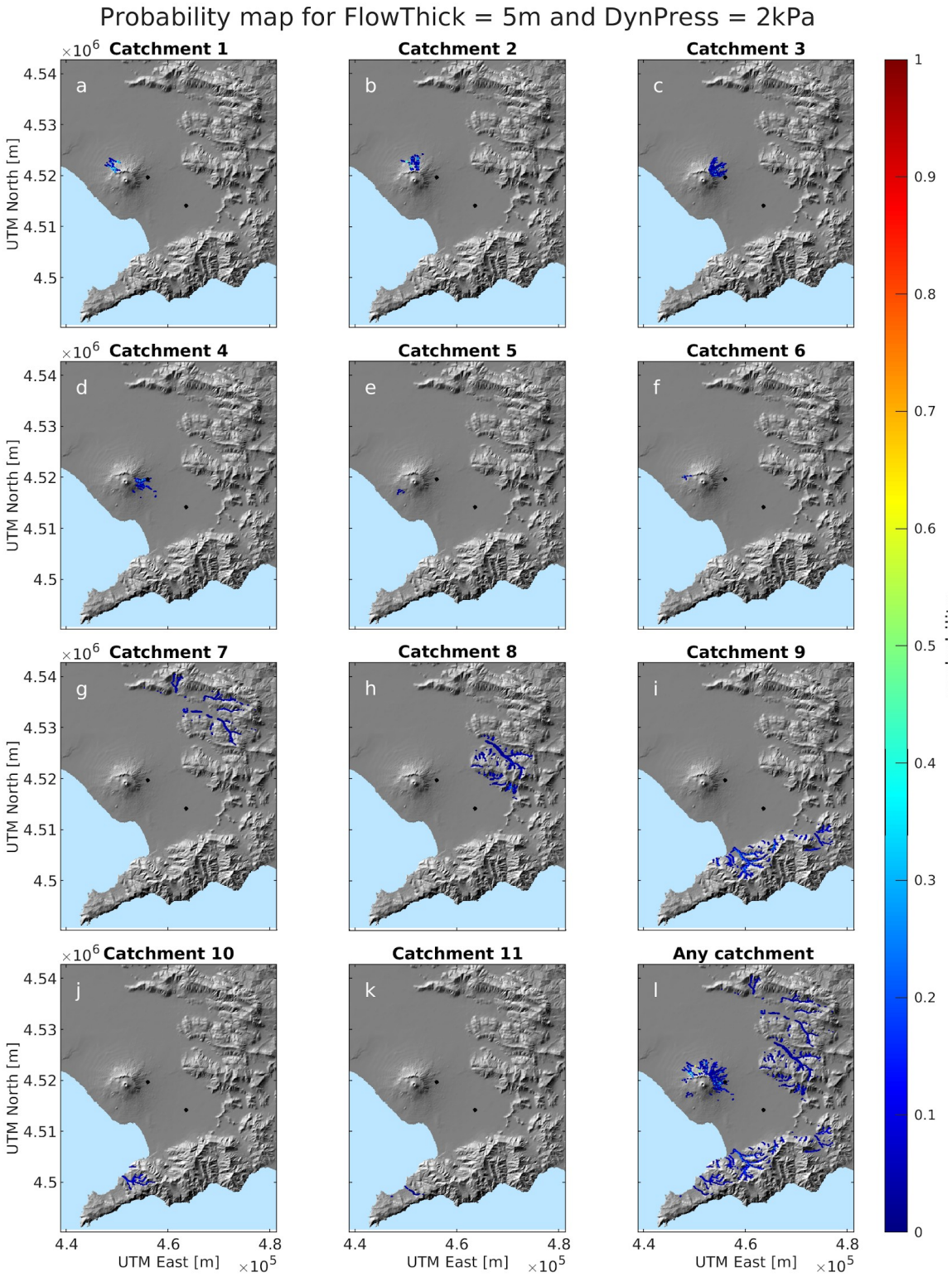

Figure S63: Probability maps for simultaneously overcoming a maximum flow thickness of 5 m and a dynamic pressure of 2 kPa

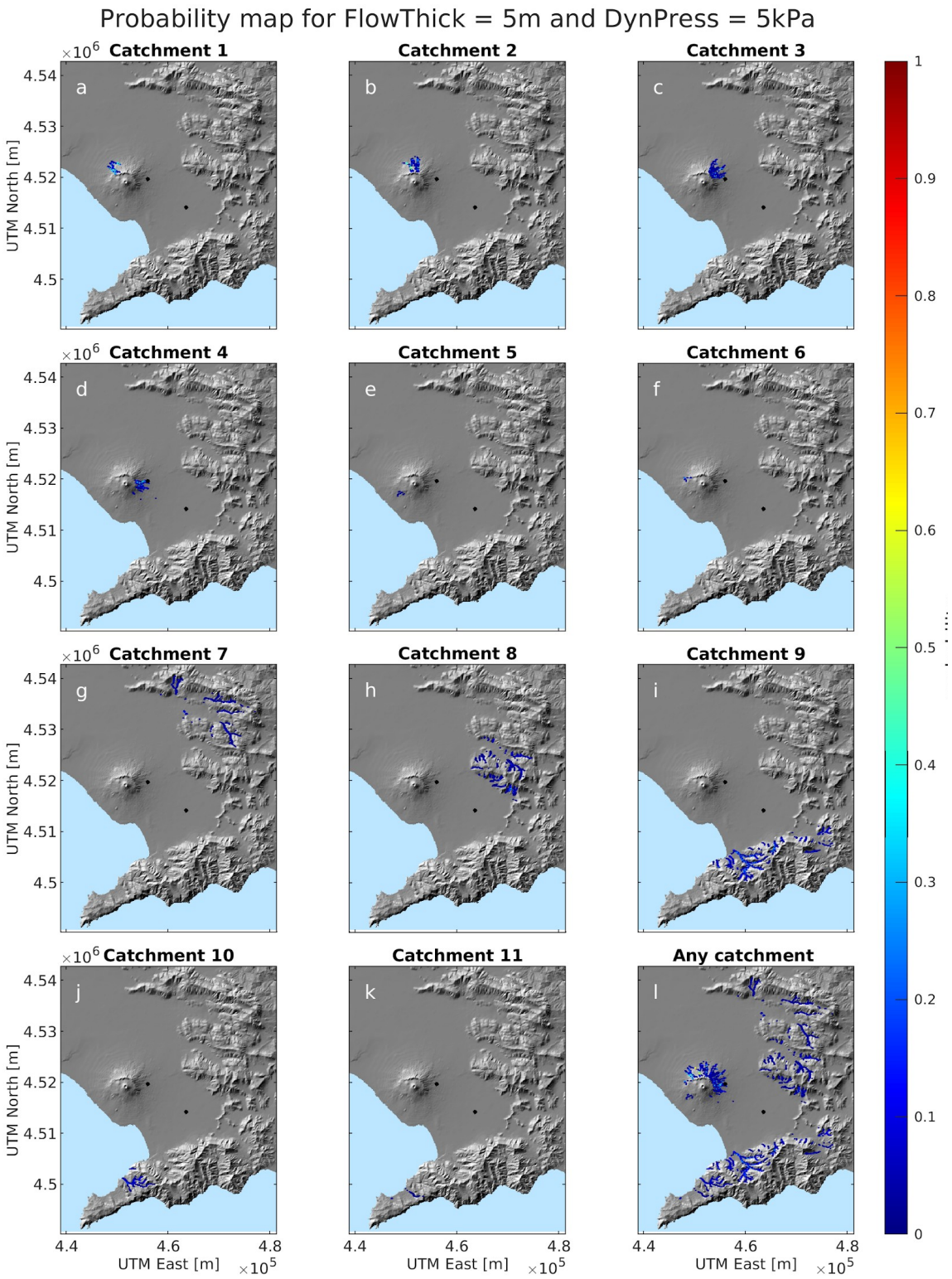

Figure S64: Probability maps for simultaneously overcoming a maximum flow thickness of 5 m and a dynamic pressure of 5 kPa

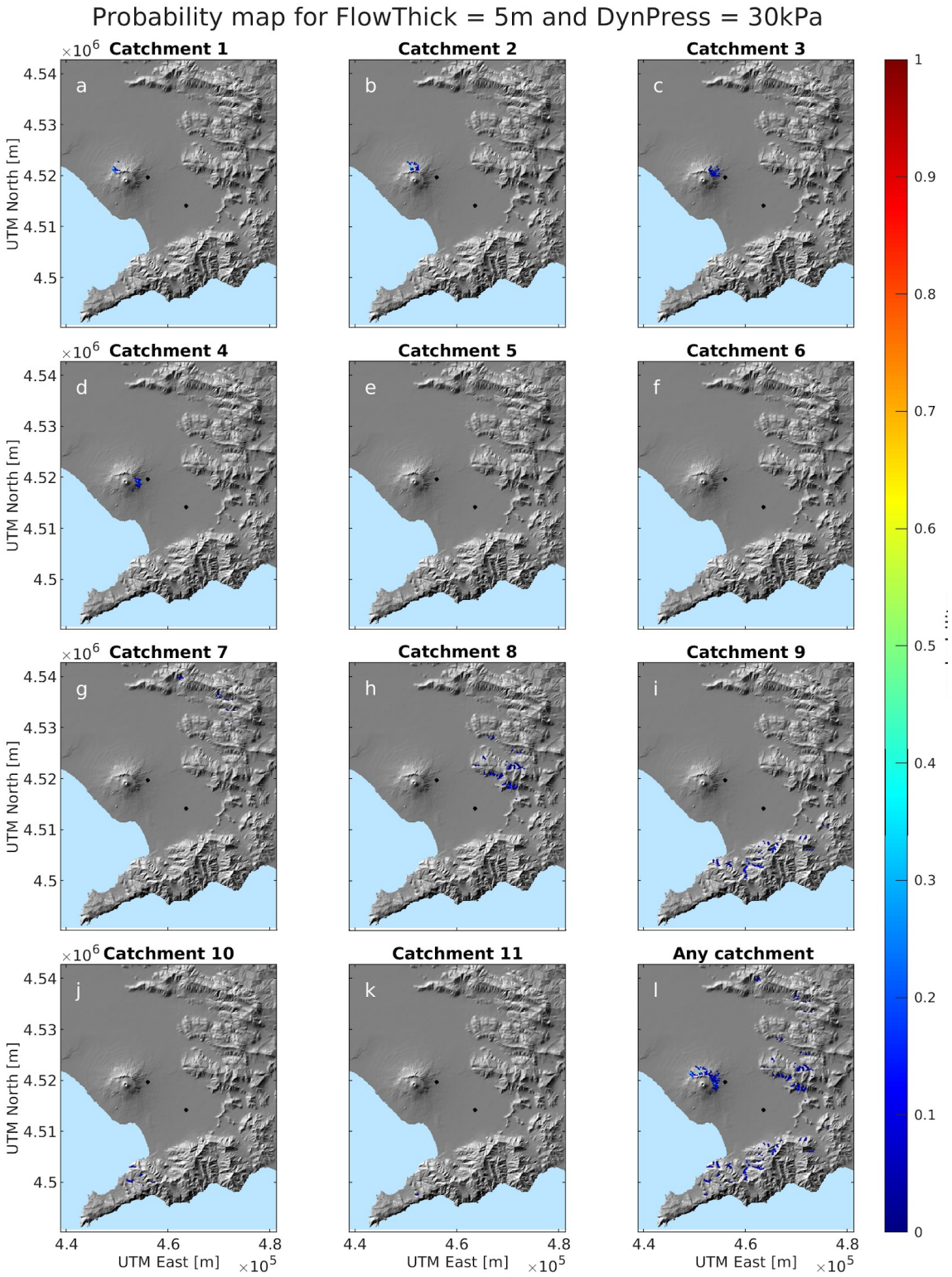

Figure S65: Probability maps for simultaneously overcoming a maximum flow thickness of 5 m and a dynamic pressure of 30 kPa