

Supporting Information 2

Probabilistic tephra fallout hazard maps for Sangay volcano, Ecuador

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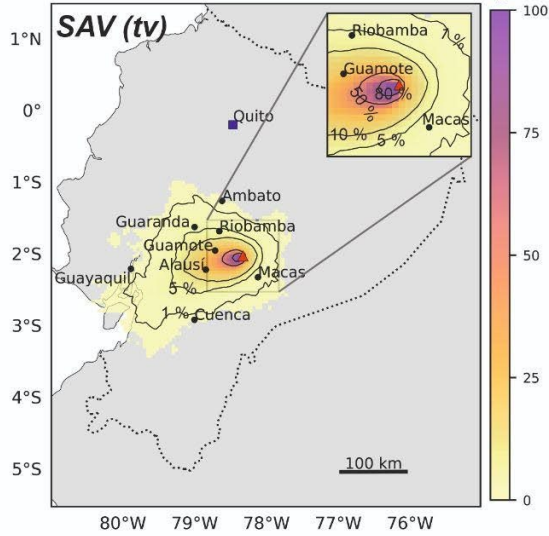
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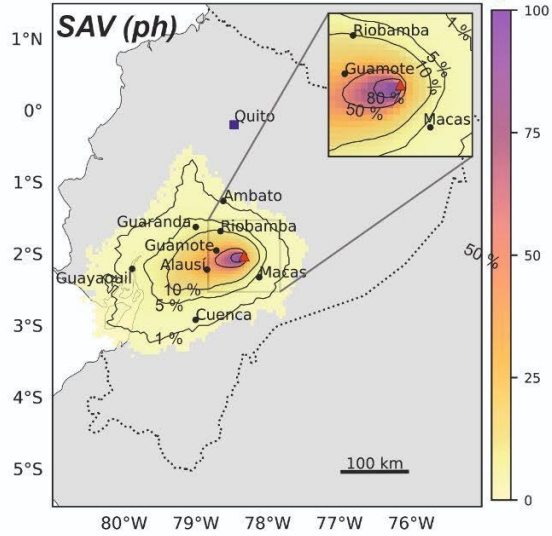
This supporting information collects additional figures with respect to those of the main manuscript, that are:

- Maps for single scenarios for the 0.1, 10, 100 kg/m² thresholds (Figs. 1S-3S);
- Maps for combined scenarios (SAV, VS and SPL) for the 0.1, 10, 100 kg/m² thresholds (Figs. 4S-7S);
- Hazard curves for 6 sites (Alausí, Ambato, Cuenca, Guaranda, Quito, Riobamba – see Fig.1 from main manuscript) for combined scenarios (SAV, VS and SPL – Figs. 7S-8S);
- Maps for combined scenarios (SAV and VS) for the 0.1, 1, 10, 100 kg/m² thresholds (Figs. 9S-12S);
- Hazard curves for 9 sites (Alausí, Ambato, Cuenca, Guamote, Guayaquil, Guaranda, Macas, Quito, Riobamba – see Fig.1 from main manuscript) for combined scenarios (SAV and VS – Figs. 13S-14S);
- Probability density functions of Mass Flow Rate and Average Plume Height for the PL scenario (Fig. 15S);
- Maps for PL scenario for the 0.1, 10 and 100 kg/m² thresholds (Fig. 16S);
- Maps for combined scenarios (SAV, VS, SPL and PL) for the 0.1, 10, 100 kg/m² thresholds (Figs. 17S-19S);
- Hazard curves for 6 sites (Alausí, Ambato, Cuenca, Guaranda, Quito, Riobamba – see Fig.1 from main manuscript) for combined scenarios (SAV, VS, SPL and PL – Figs. 20S-21S);
- Maps for combined scenarios (SAV and VS with plume height initialization, SPL and PL with total volume initialization) for the 0.1, 1, 10, 100 kg/m² thresholds (Figs. 22S-25S);
- Hazard curves for 9 sites (Alausí, Ambato, Cuenca, Guamote, Guayaquil, Guaranda, Macas, Quito, Riobamba – see Fig.1 from main manuscript) for combined scenarios (SAV and VS with plume height initialization, SPL and PL with total volume initialization – Fig. 26S-27S);

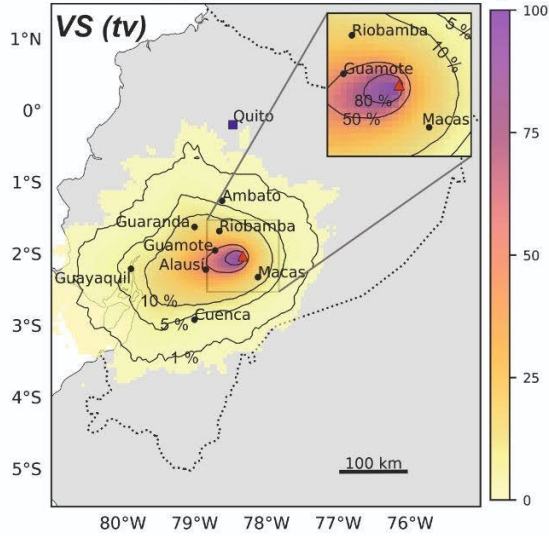
Probability (%) of exceeding 0.1 kg/m^2



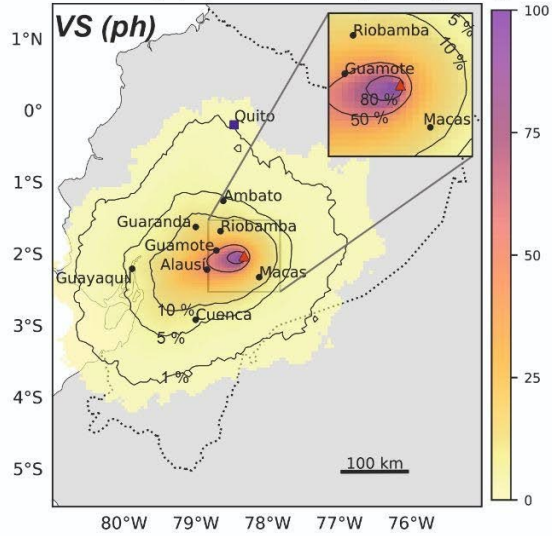
Probability (%) of exceeding 0.1 kg/m^2



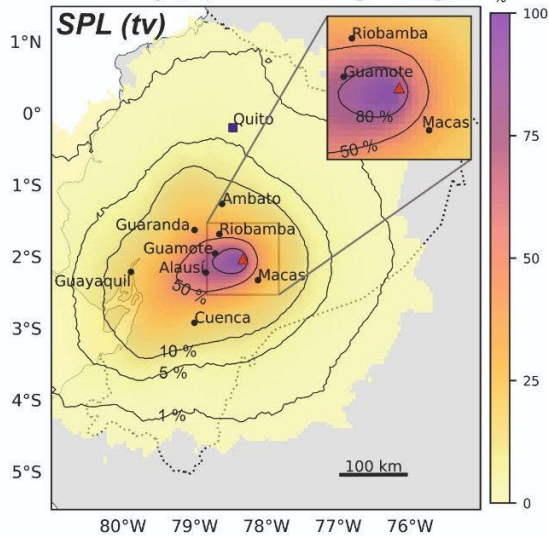
Probability (%) of exceeding 0.1 kg/m^2



Probability (%) of exceeding 0.1 kg/m^2



Probability (%) of exceeding 0.1 kg/m^2



Probability (%) of exceeding 0.1 kg/m^2

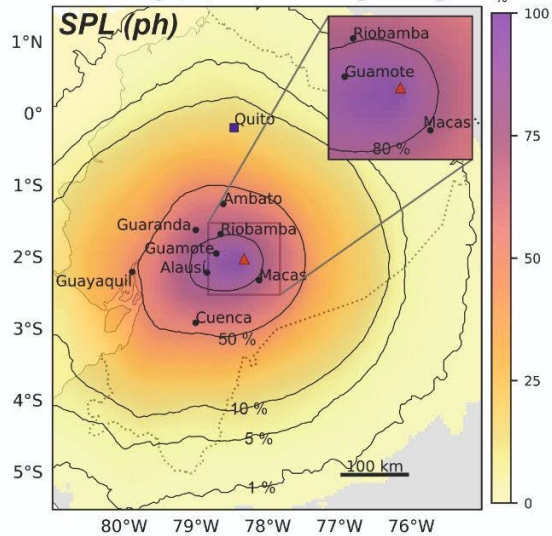


Figure 1S. Sangay tephra fallout hazard maps for SAV, VS and SPL scenarios for 0.1 kg/m^2 threshold. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

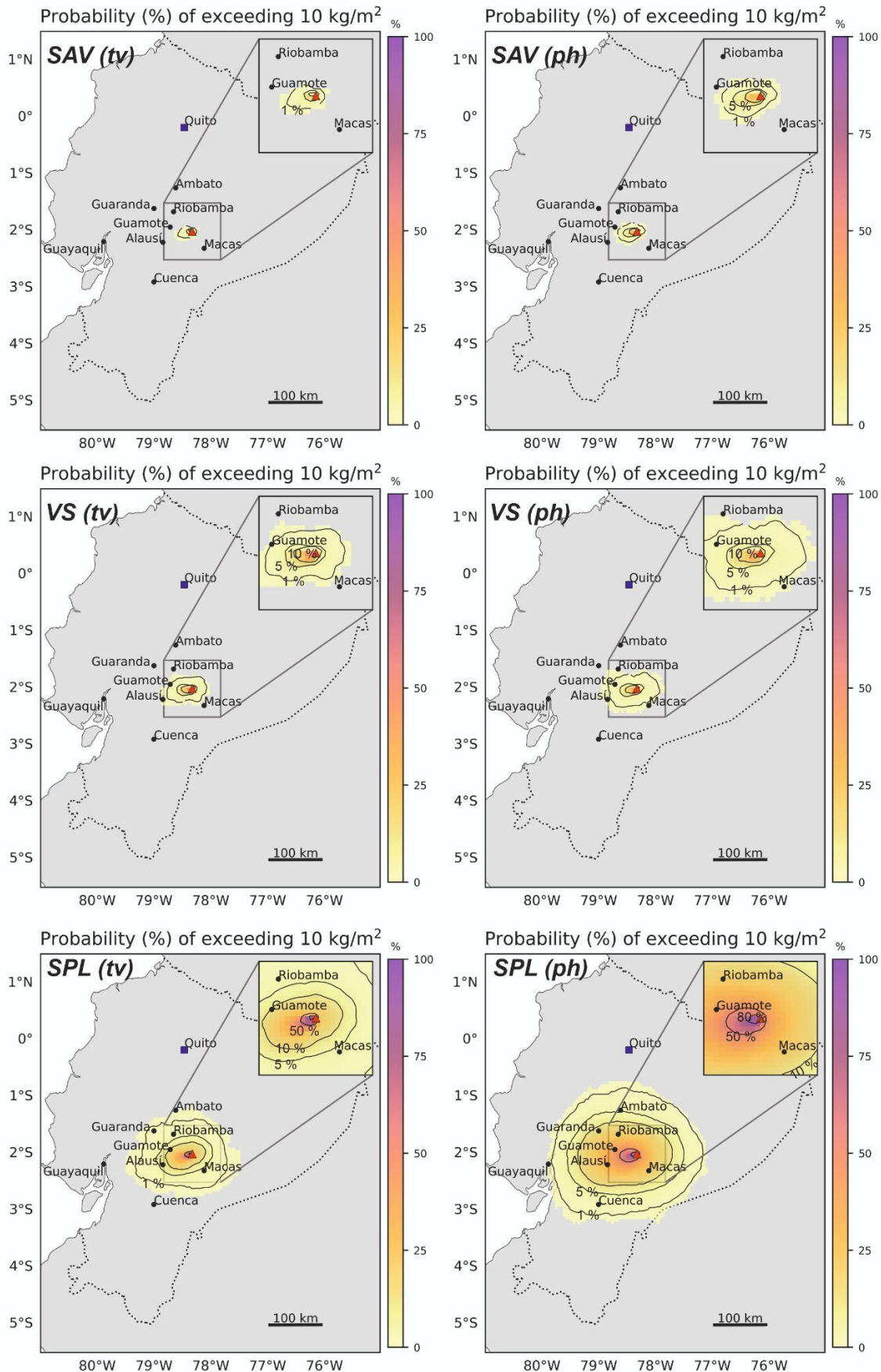


Figure 2S. Sangay tephra fallout hazard maps for SAV, VS and SPL scenarios for 10 kg/m² threshold. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

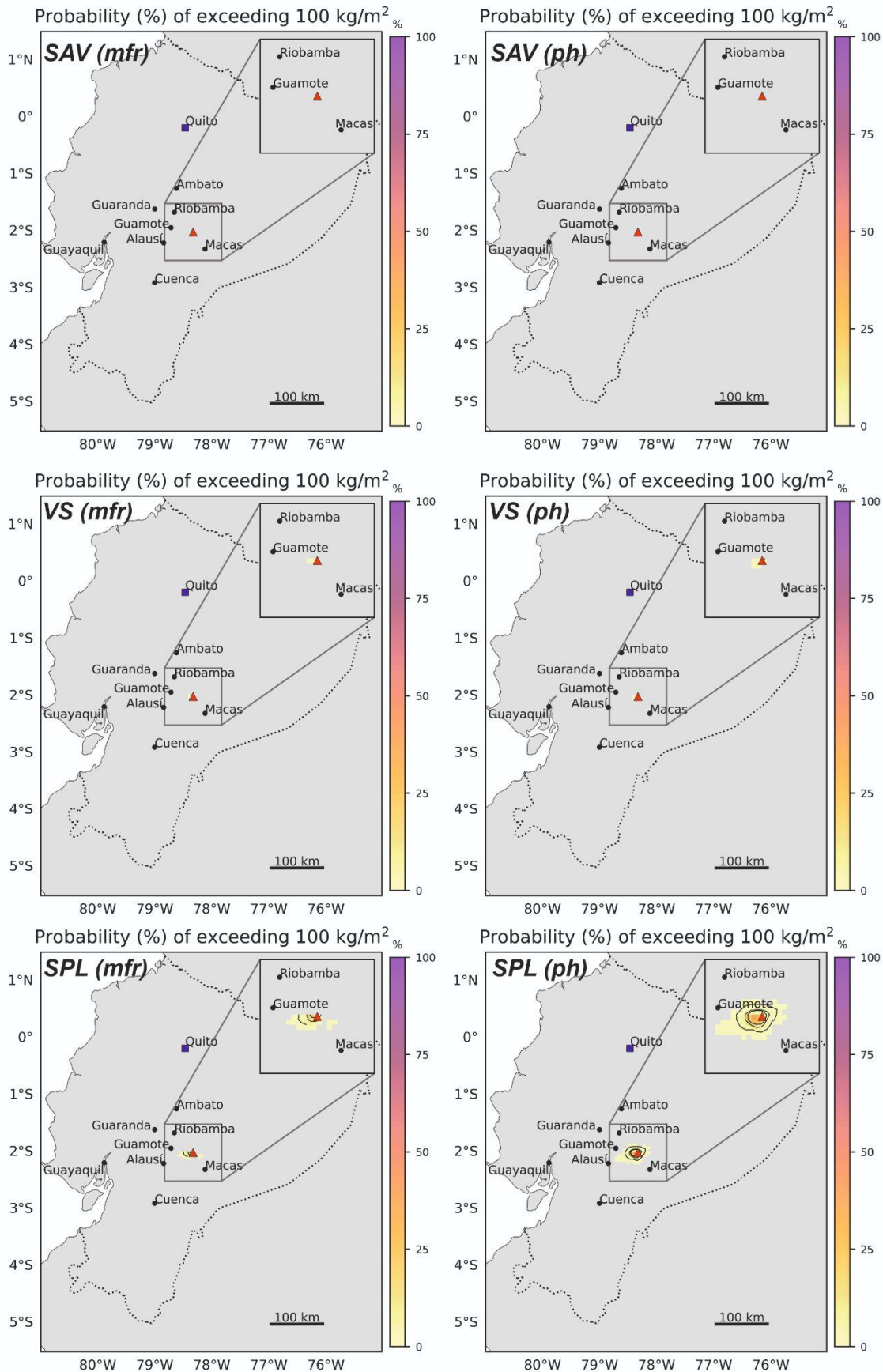


Figure 3S. Sangay tephra fallout hazard maps for SAV, VS and SPL scenarios for 100 kg/m² threshold. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

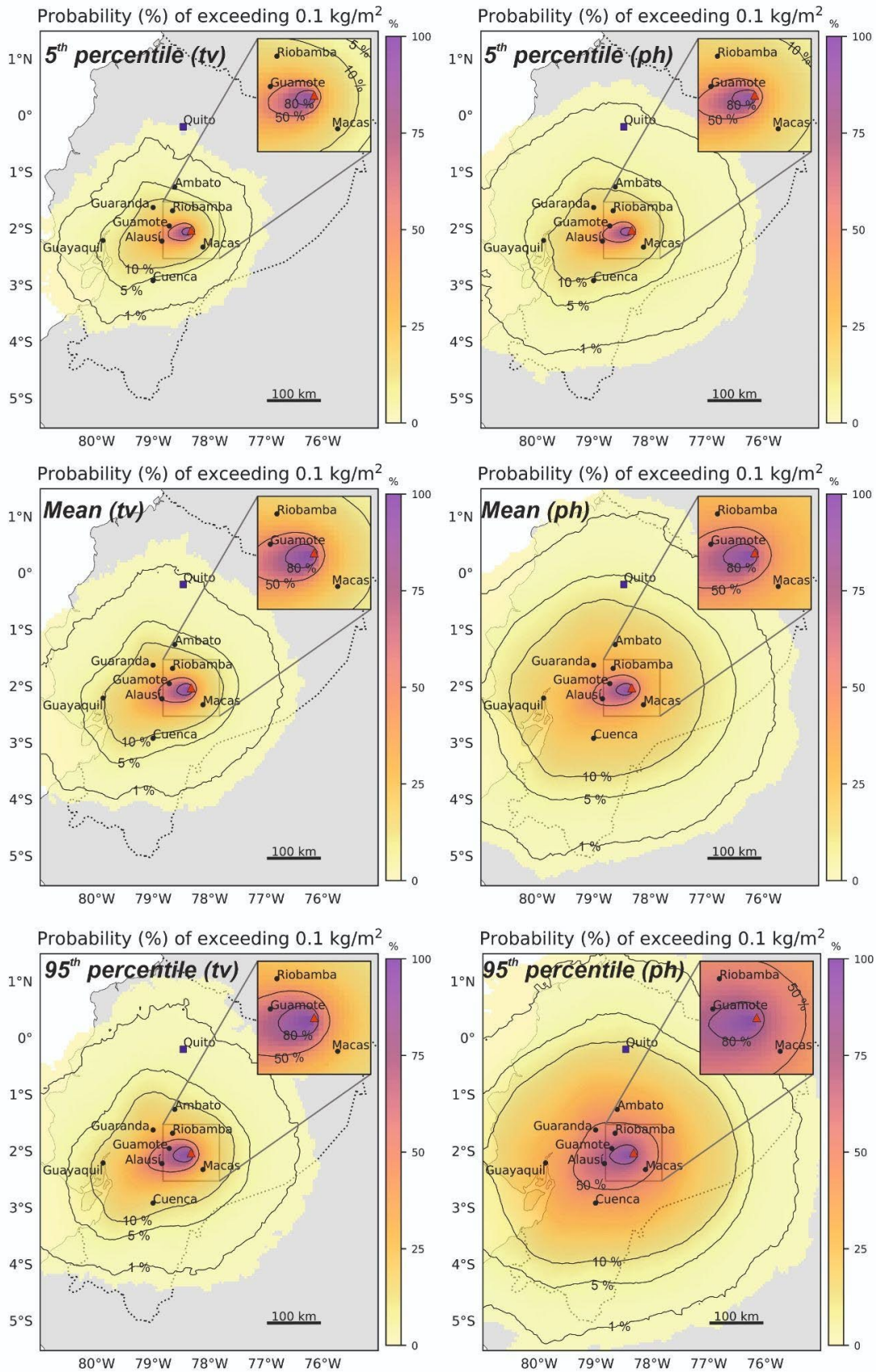


Figure 4S. Sangay tephra fallout hazard maps for the combined SAV, VS and SPL scenarios for 0.1 kg/m^3 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

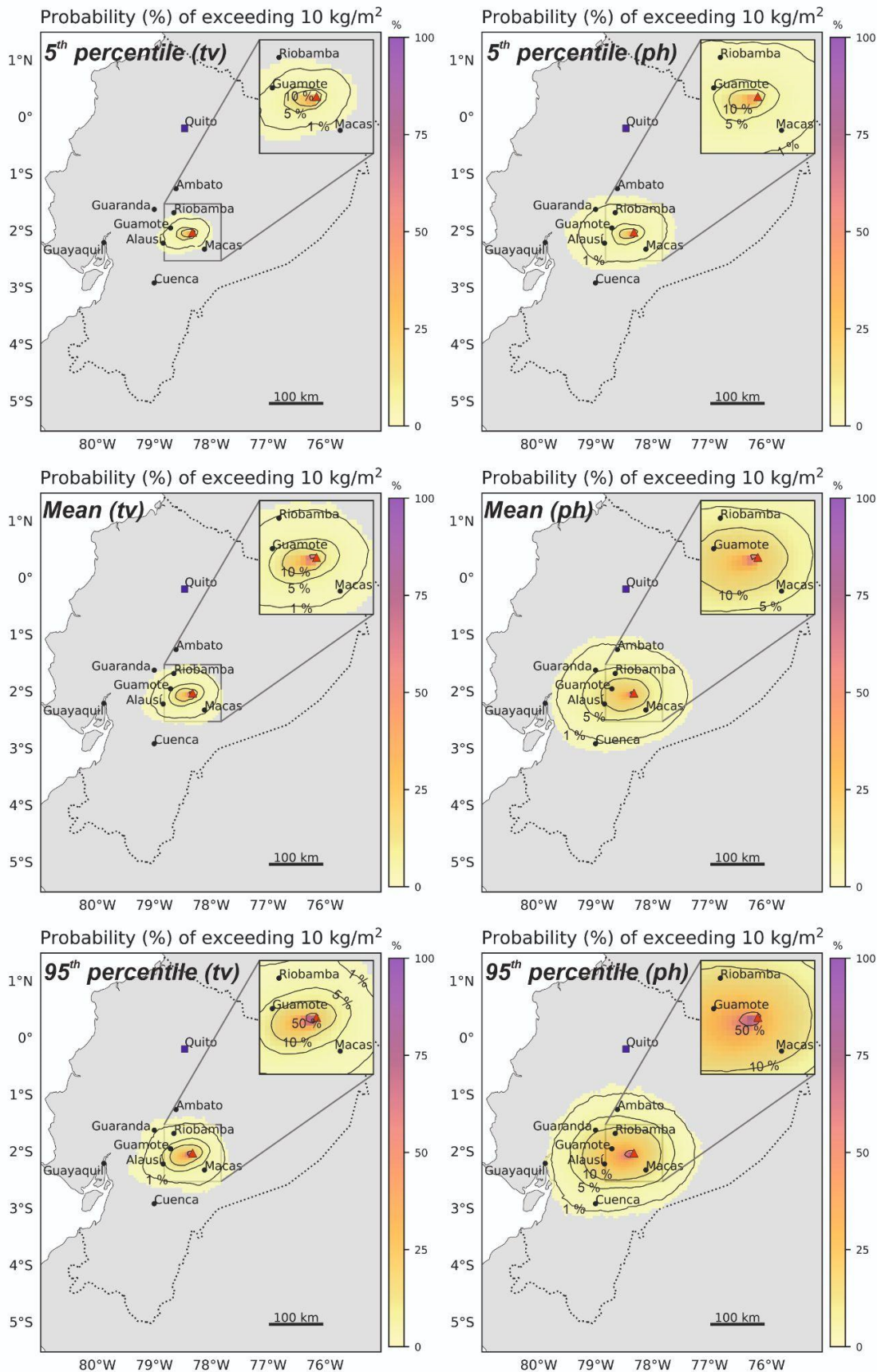


Figure 5S. Sangay tephra fallout hazard maps for the combined SAV, VS and SPL scenarios for 10 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

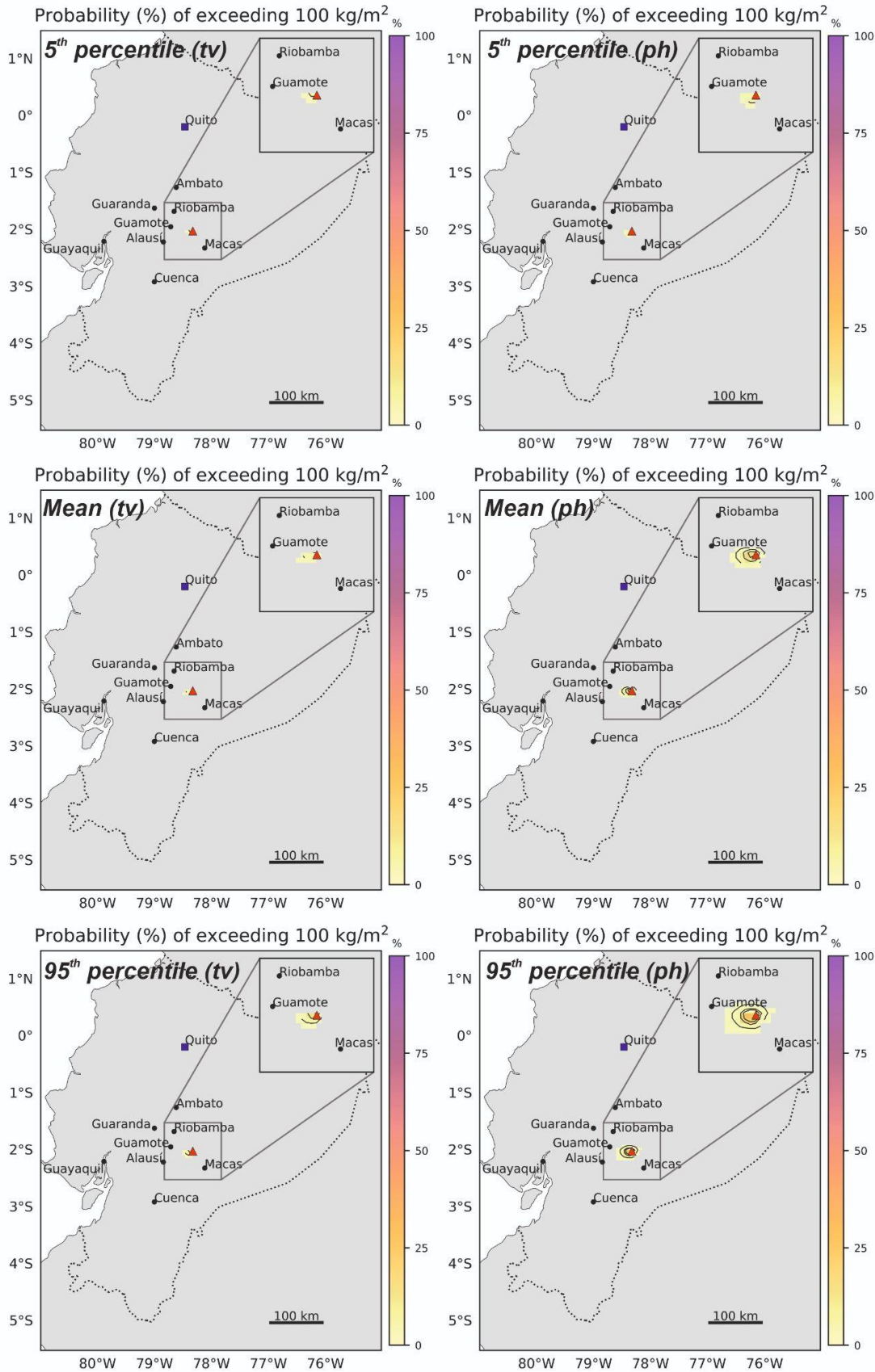


Figure 6S. Sangay tephra fallout hazard maps for the combined SAV, VS and SPL scenarios for 100 kg/m² threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

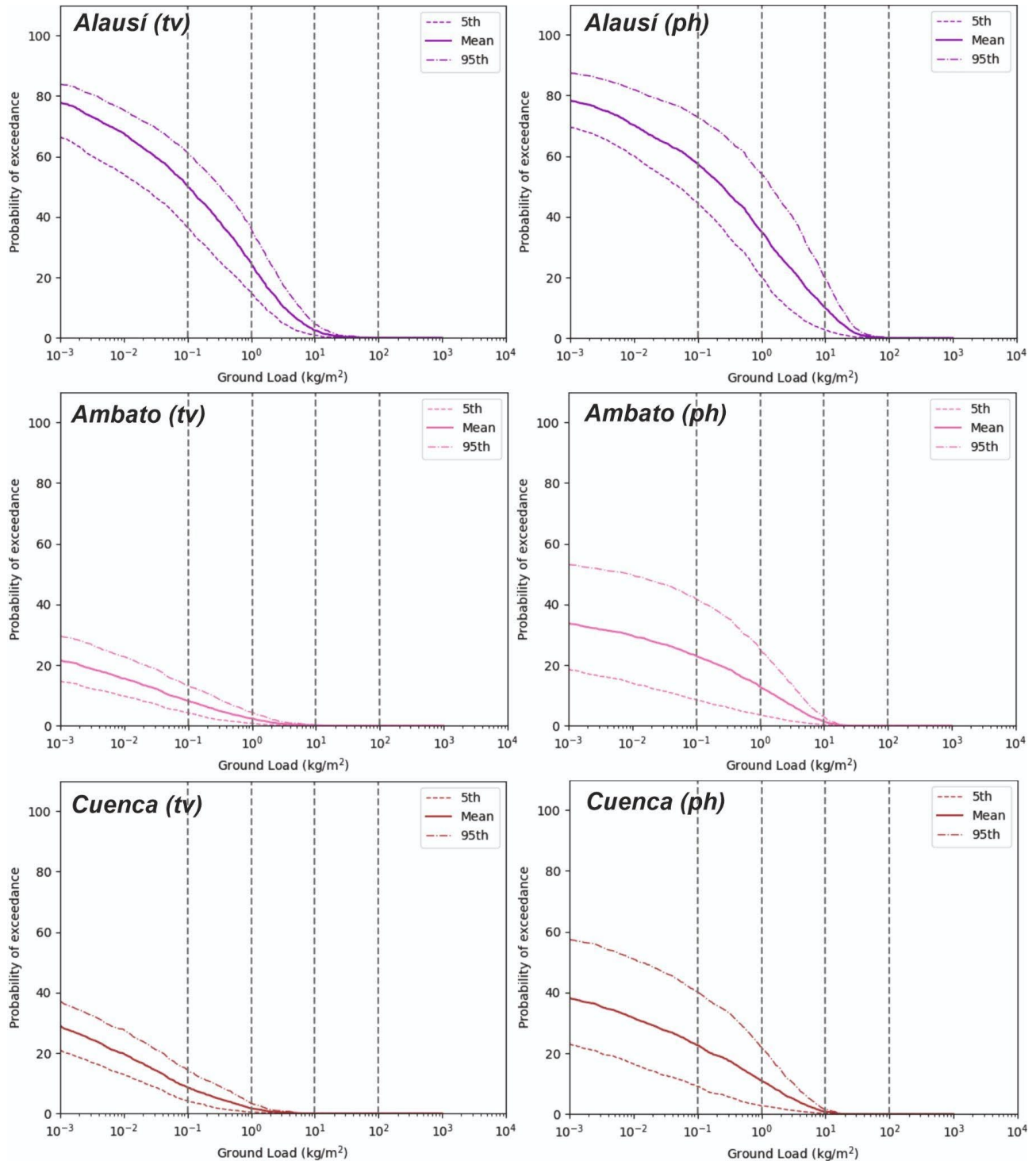


Figure 7S. Hazard curves for 3 sites (Alausí, Ambato and Cuenca - see Figure 1) for the combined SAV, VS and SPL scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves in the left column are produced by initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column by using Plume Height (ph). Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.

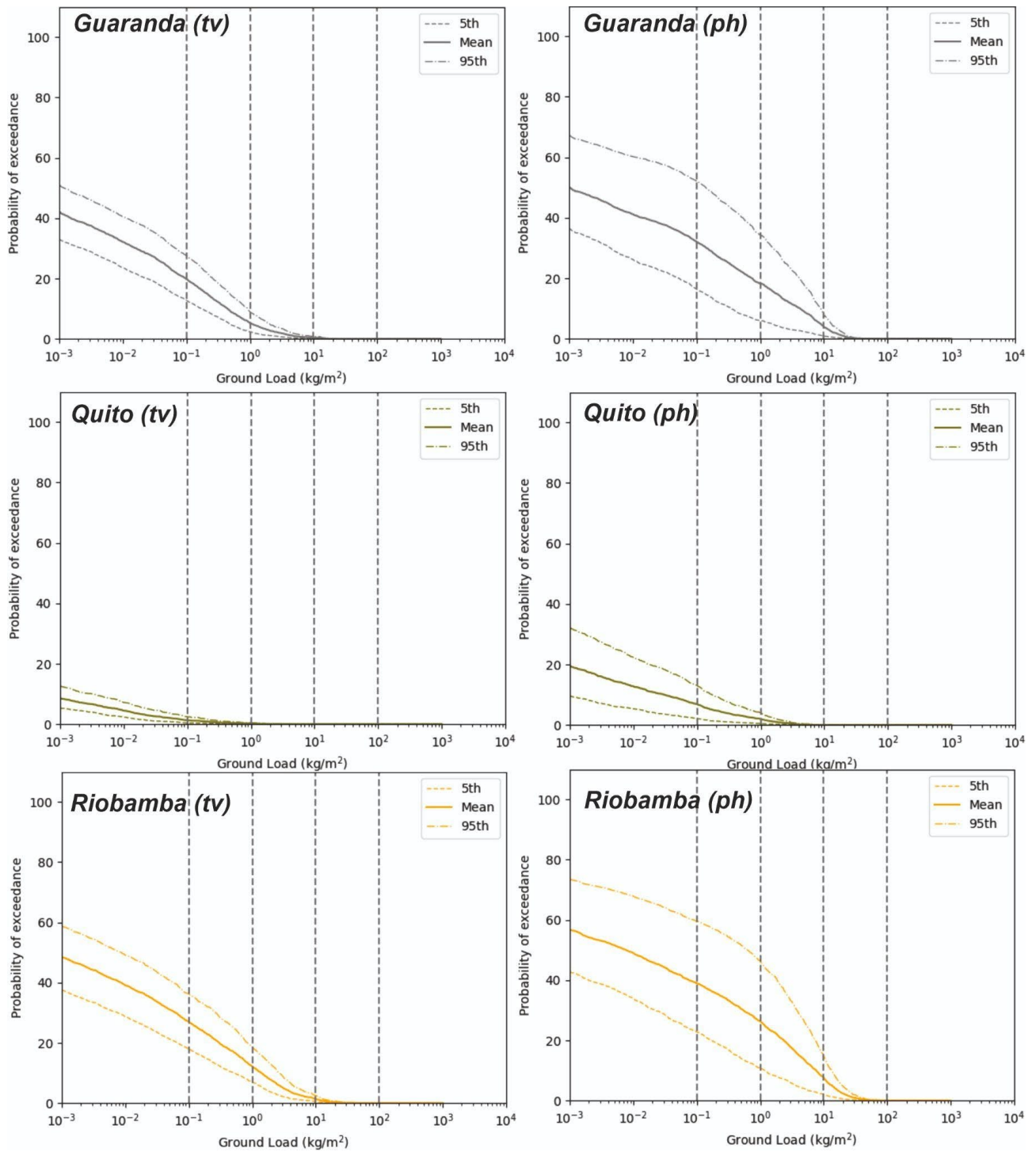


Figure 8S. Hazard curves for 3 sites (Guaranda, Quito and Riobamba - see Figure 1) for the combined SAV, VS and SPL scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves in the left column are produced by initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column by using Plume Height (ph). Interpolated values at 0.1, 1, 10 and 100 kg/m^2 are reported in Supporting Information 3.

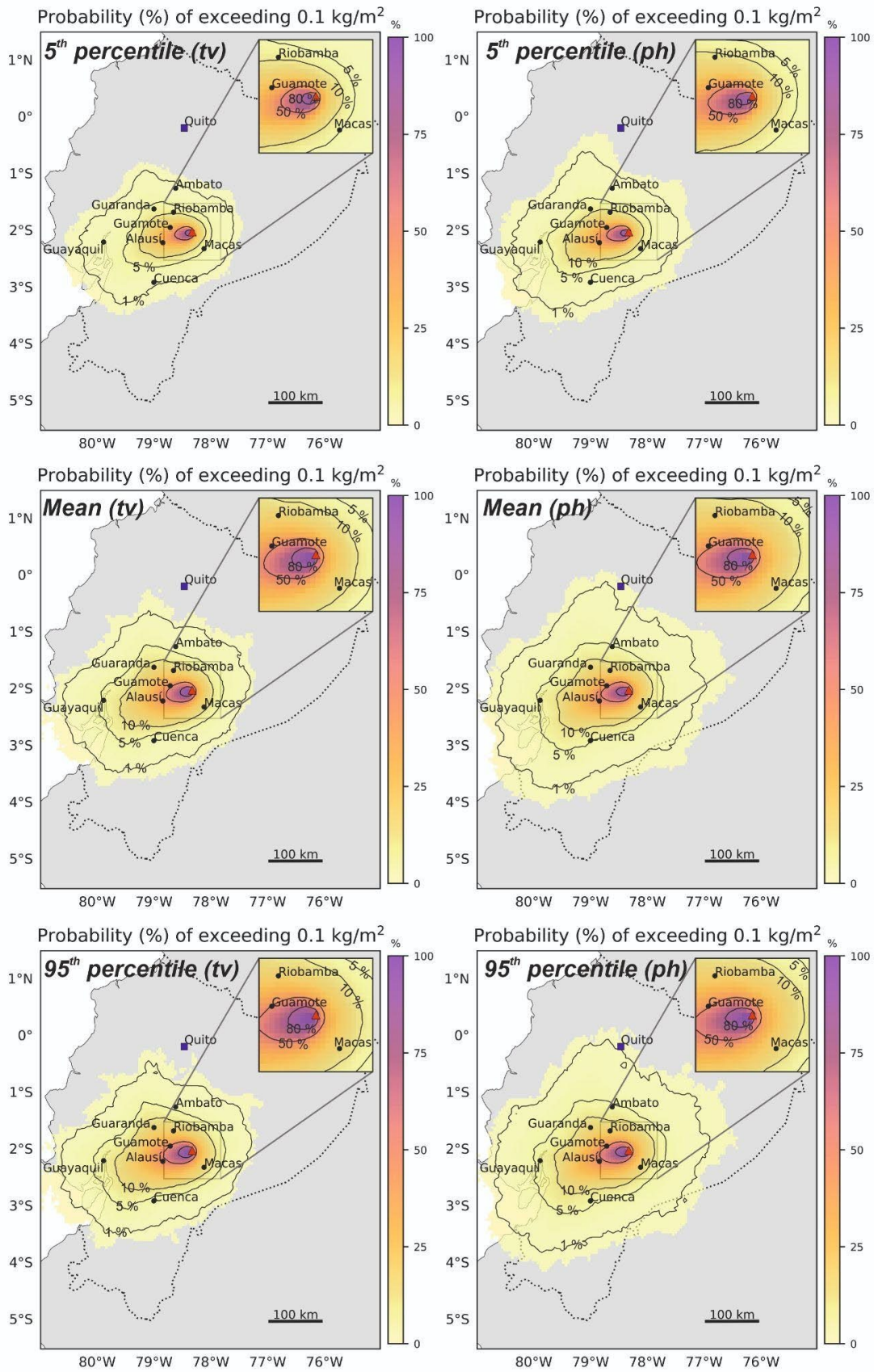


Figure 9S. Sangay tephra fallout hazard maps for the combined SAV and VS scenarios for 0.1 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

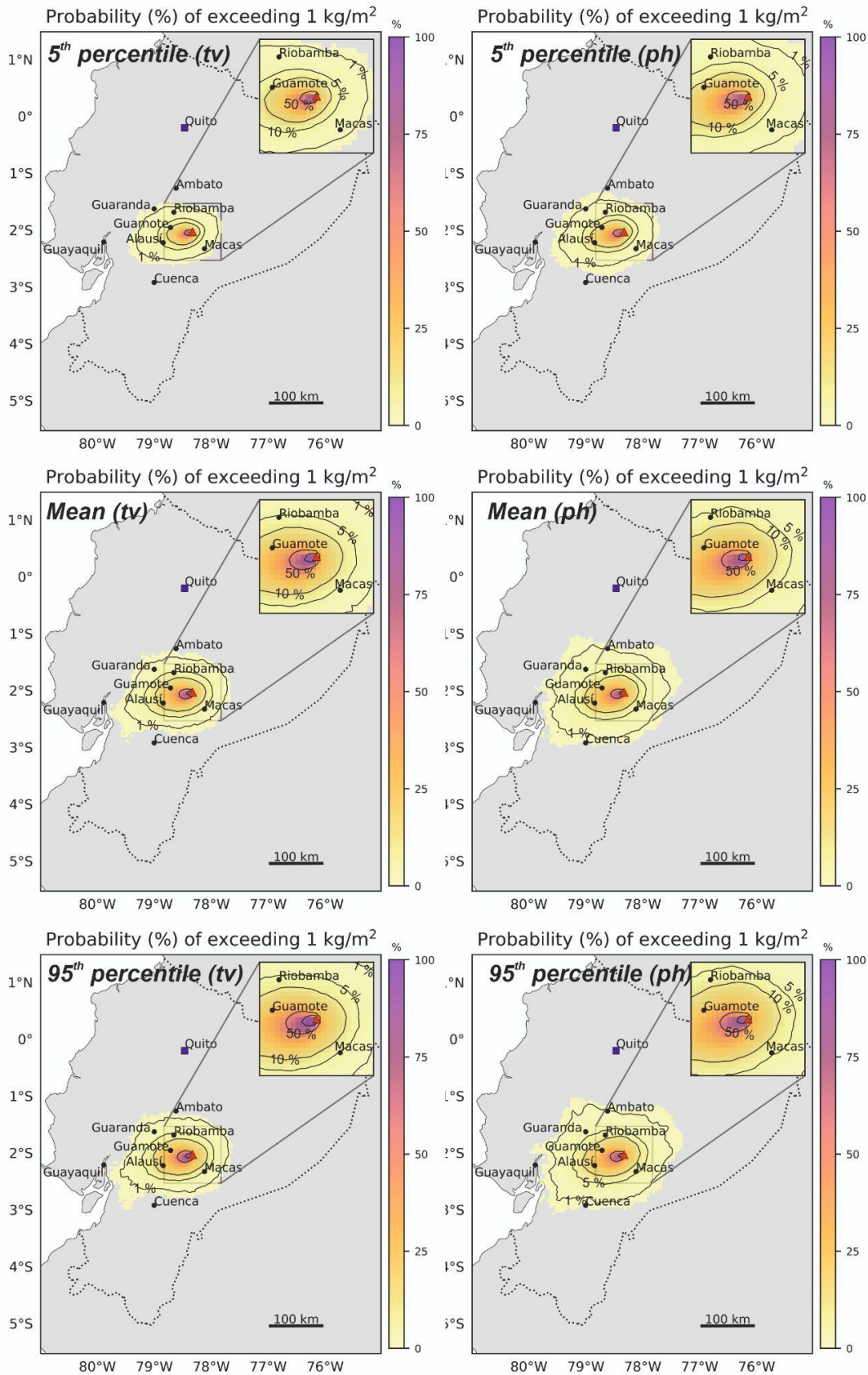


Figure 10S. Sangay tephra fallout hazard maps for the combined SAV and VS scenarios for 1 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

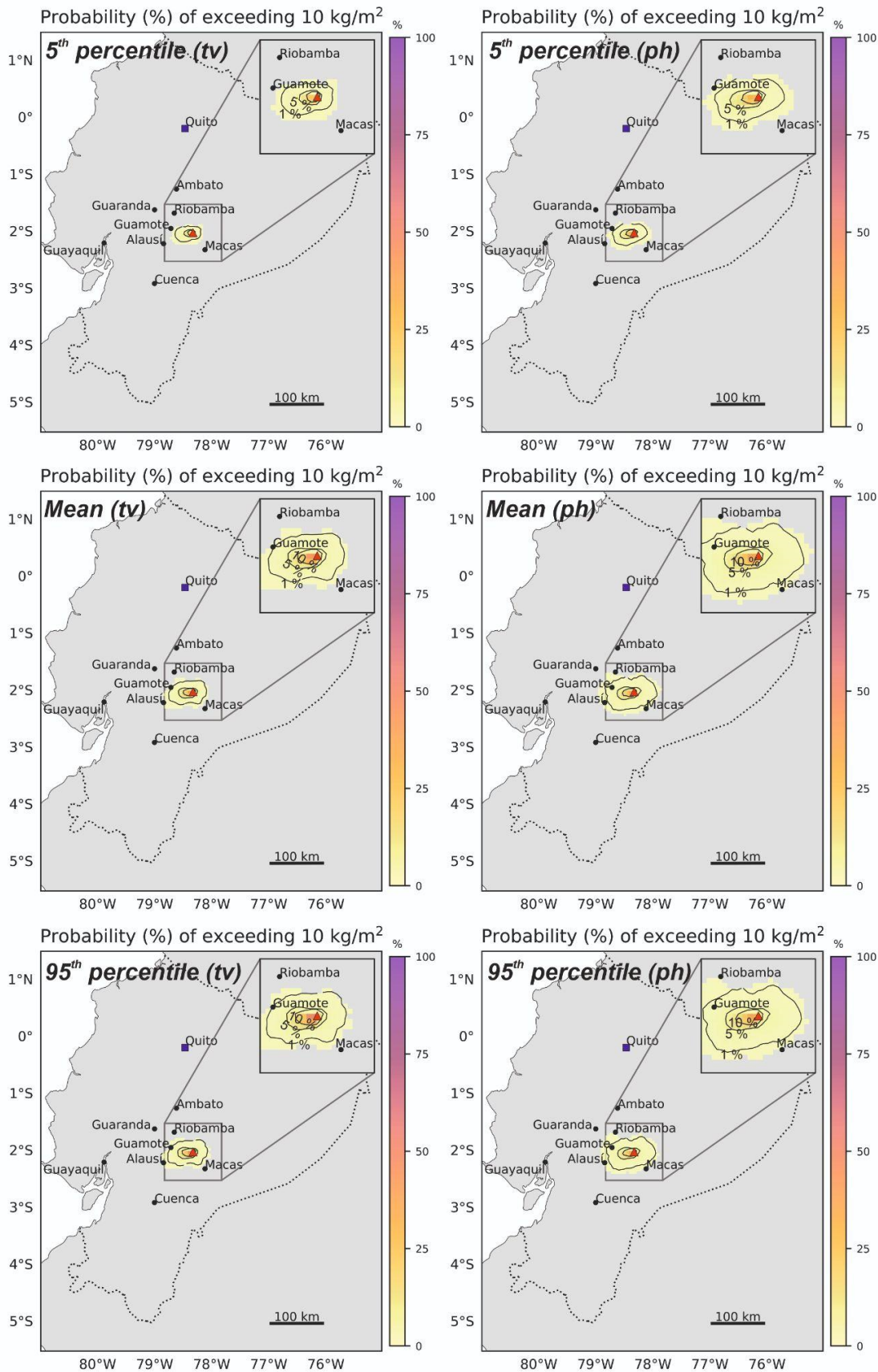


Figure 11S. Sangay tephra fallout hazard maps for the combined SAV and VS scenarios for 10 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

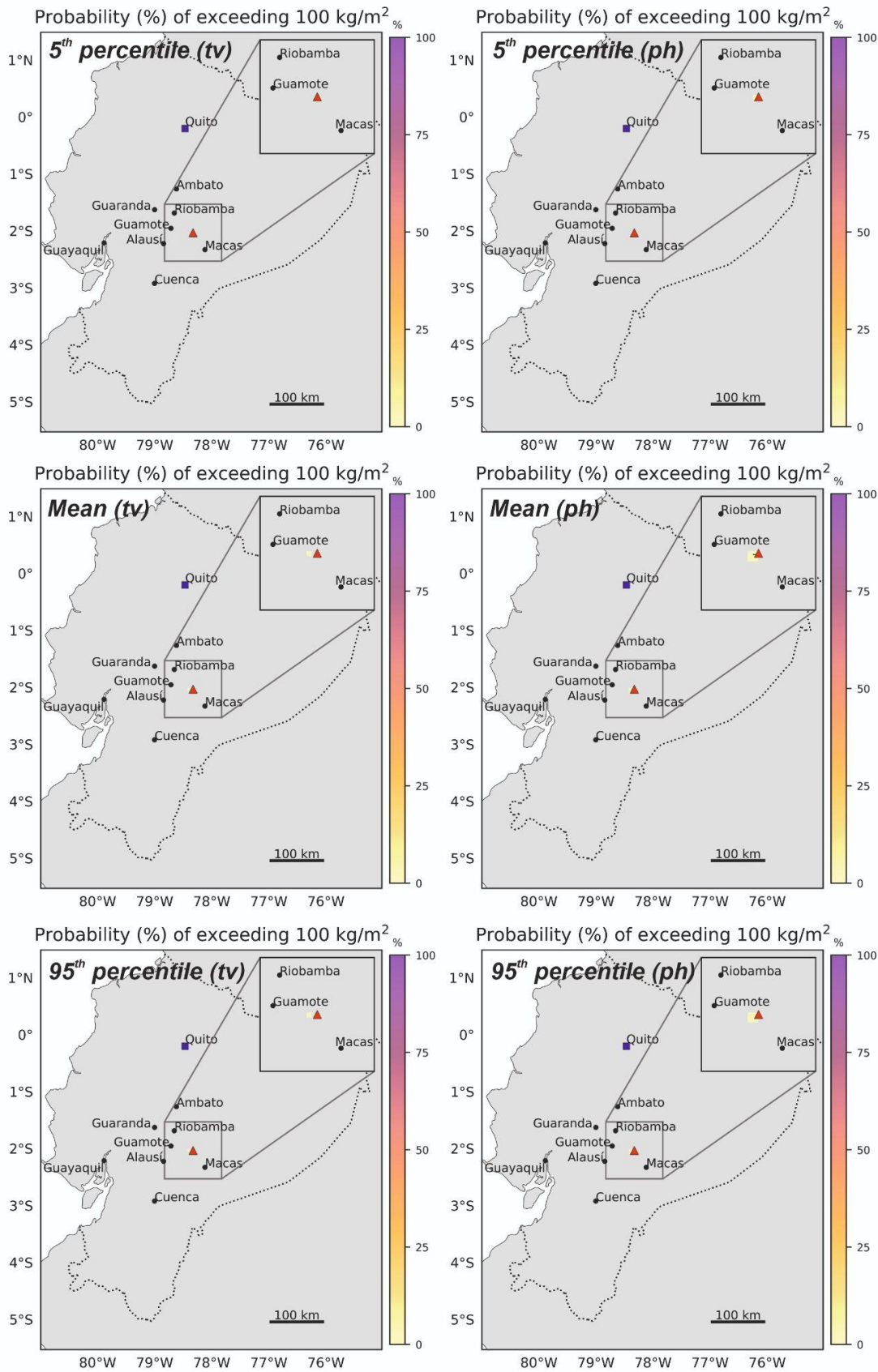


Figure 12S. Sangay tephra fallout hazard maps for the combined SAV and VS scenarios for 100 kg/m² threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

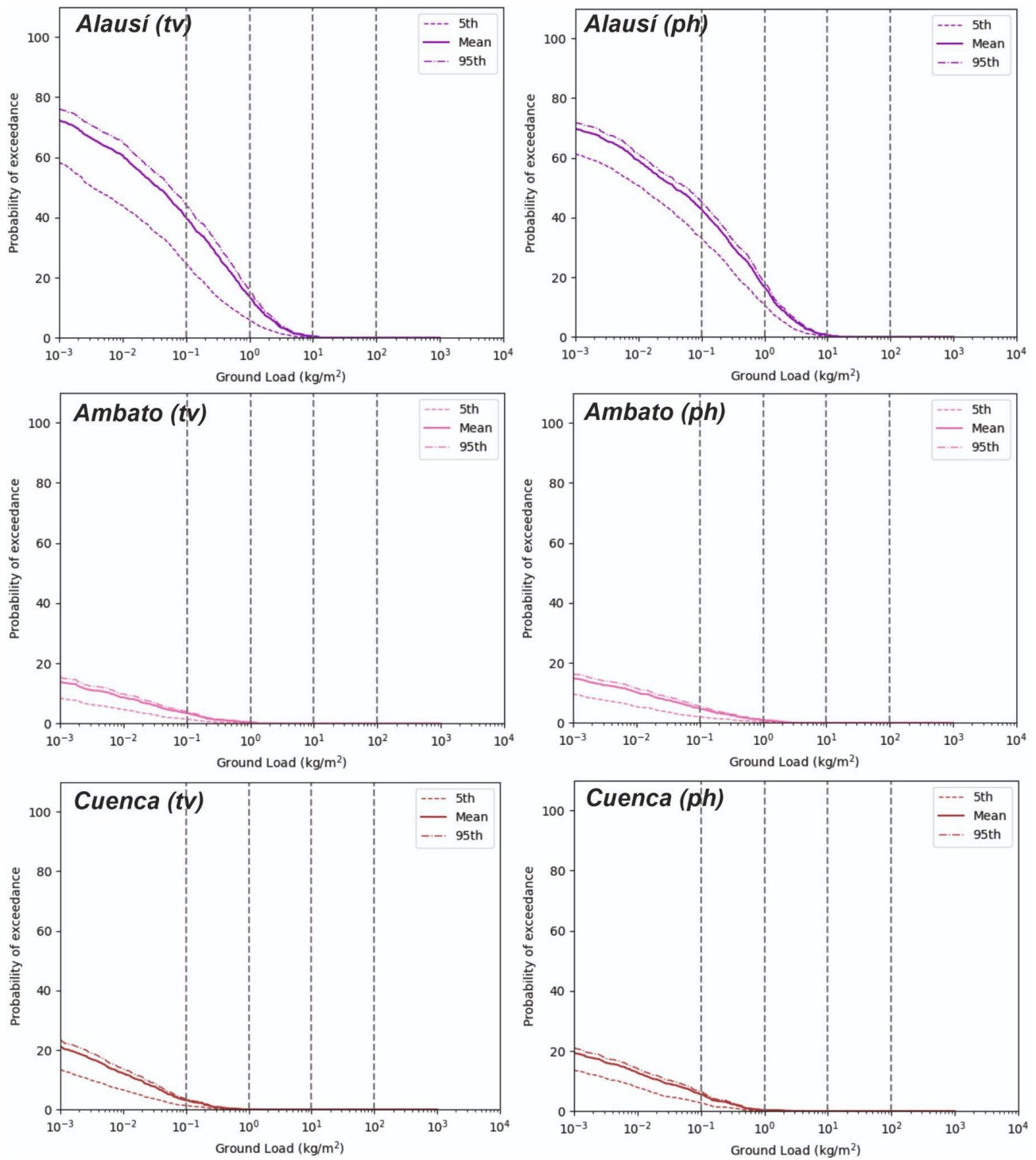


Figure 13S. Hazard curves for 3 sites (Alausí, Ambato and Cuenca - see Figure 1) for the combined SAV and VS scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves in the left column are produced by initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column by using Plume Height (ph). Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.

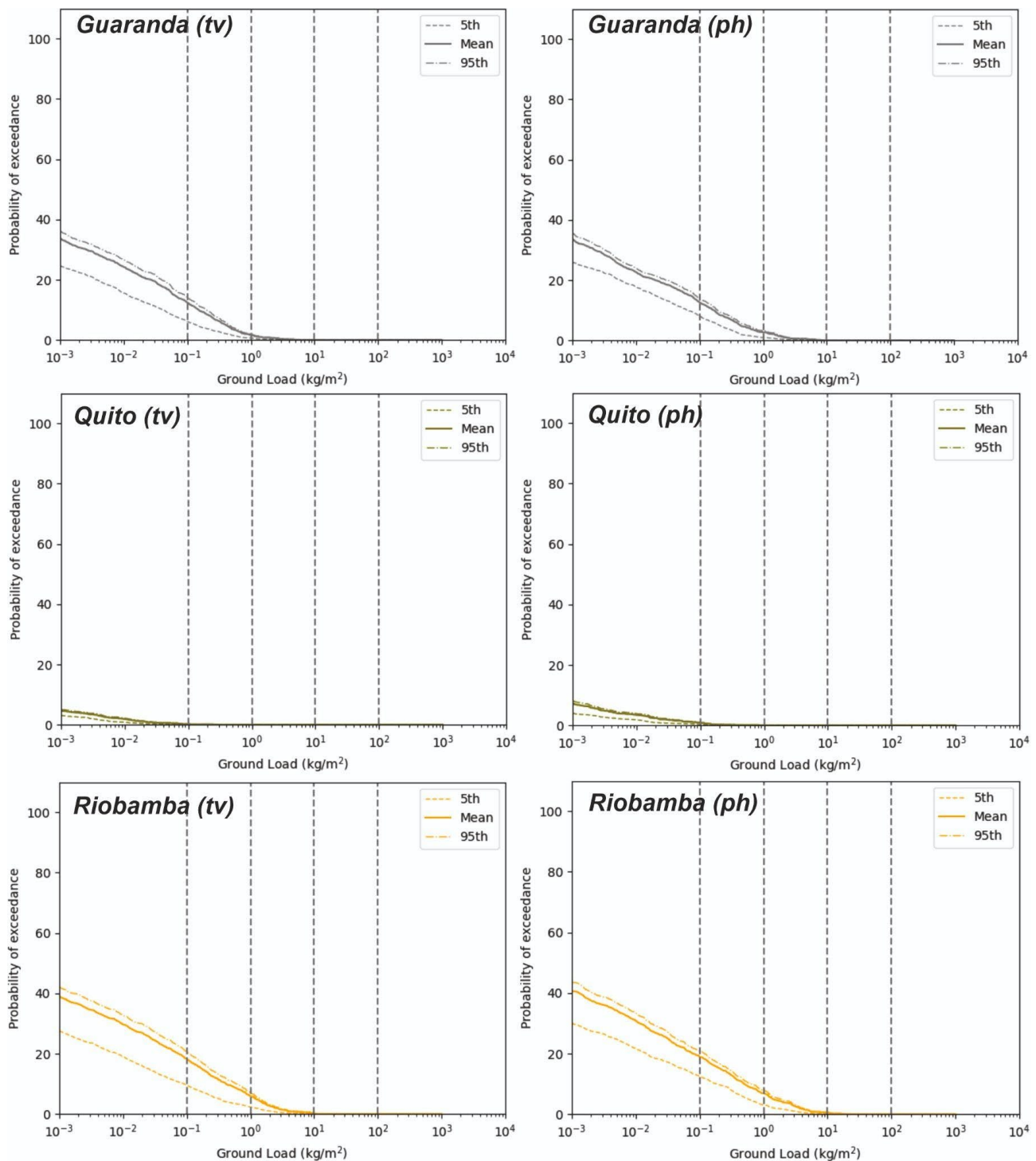


Figure 14S. Hazard curves for 3 sites (Guaranda, Quito and Riobamba - see Figure 1) for the combined SAV and VS scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves in the left column are produced by initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column by using Plume Height (ph). Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.

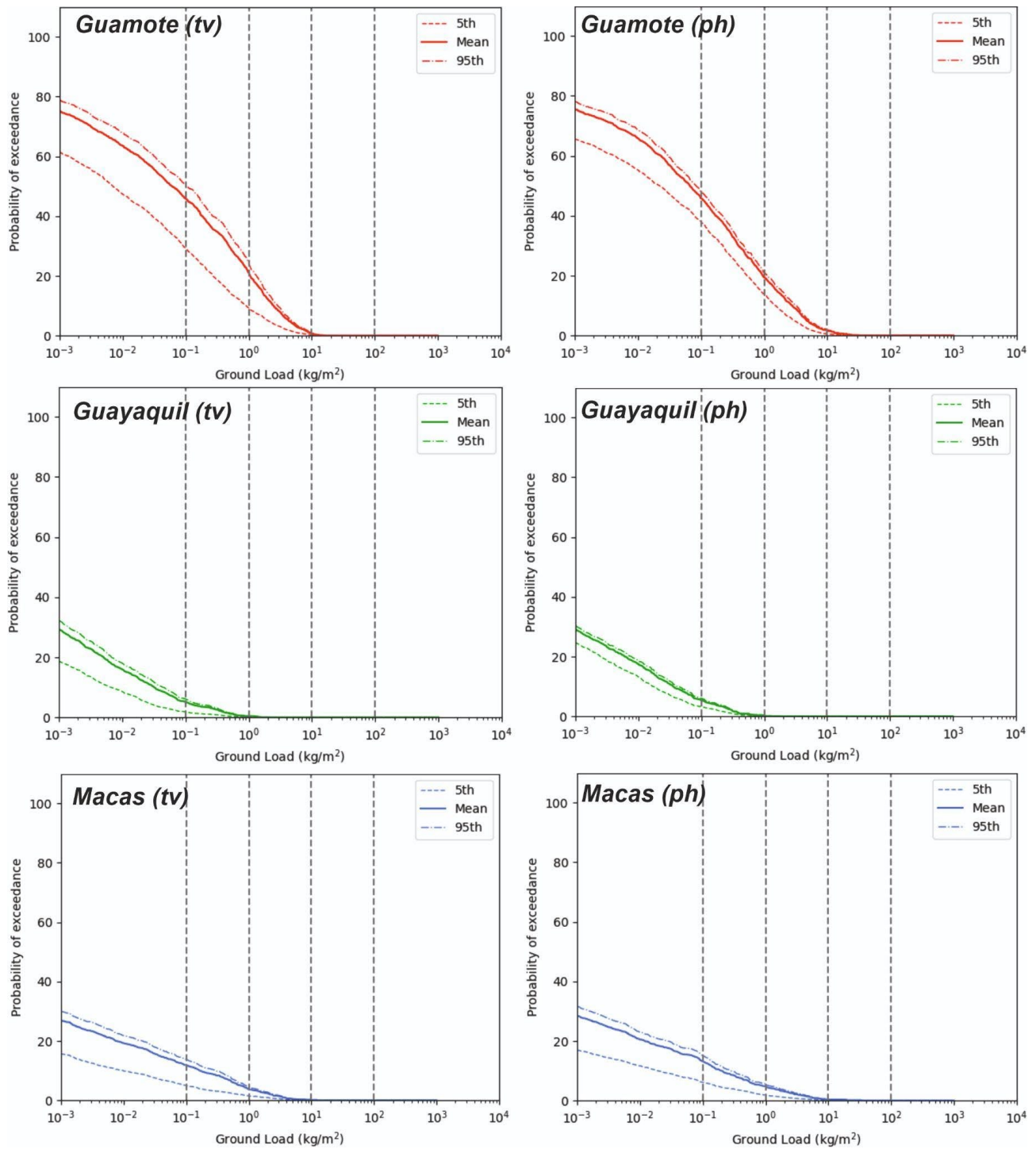


Figure 15S. Hazard curves for 3 sites (Guamote, Guayaquil and Macas - see Figure 1) for the combined SAV and VS scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves in the left column are produced by initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column by using Plume Height (ph). Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.

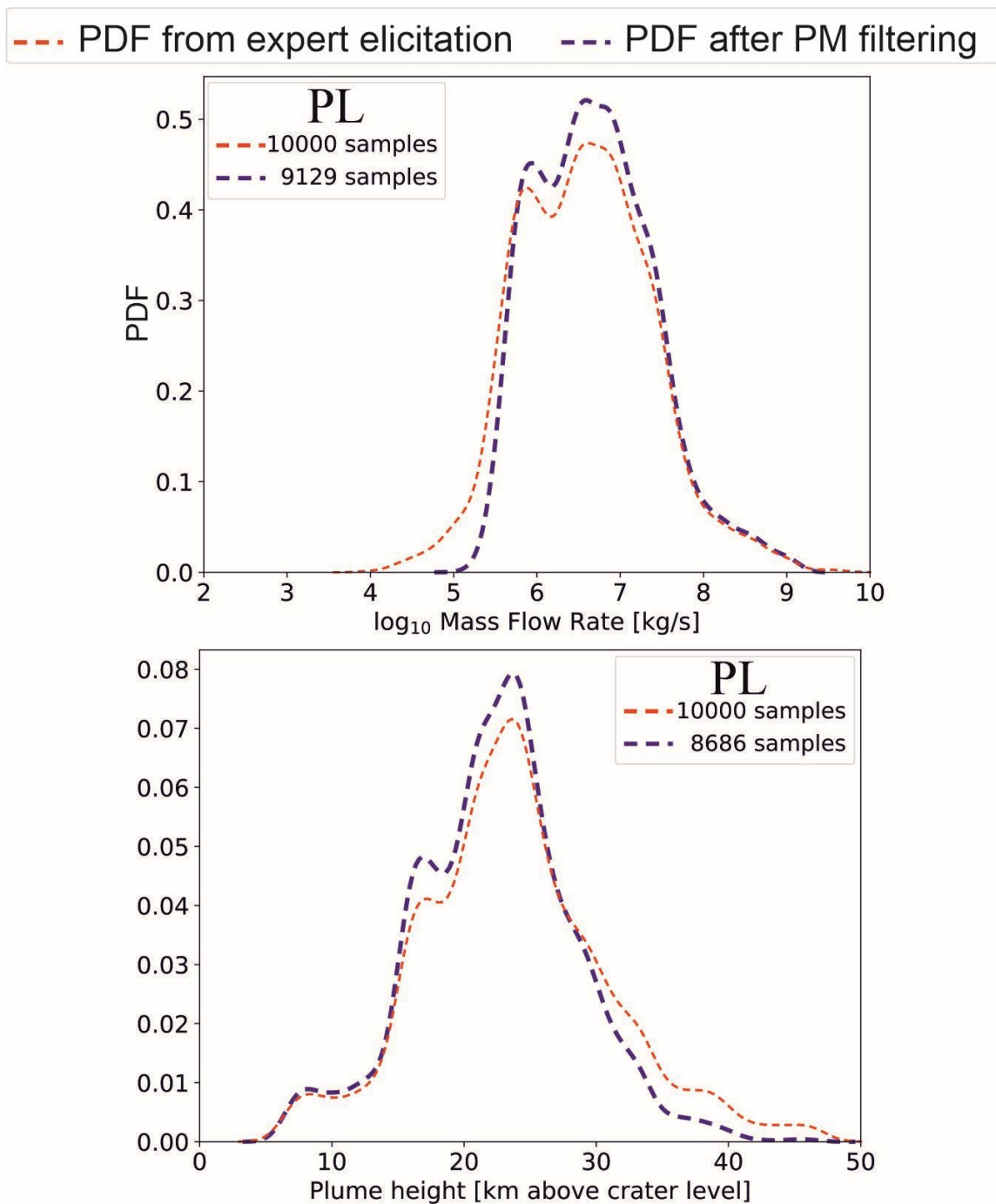


Figure 16S. Probability density functions of mass flow rate (expressed as $\log_{10}$) and plume height (in km above crater) of the PL eruptive scenario. The upper panel refers to the model initialization performed using the Mass Flow Rate (derived from the total volume of the deposit and eruption duration) and the control done considering the plume height, whereas the lower panel refers to the model initialization performed using the plume height and the control done considering the total volume erupted. In each panel, the red dashed line indicates the original density distribution obtained from the 10000 samples produced from the results of the elicitation. The blue dashed line indicates the filtered density distribution obtained from the samples that passed the control on plume height (in PLUME-MoM-TSM or PM).

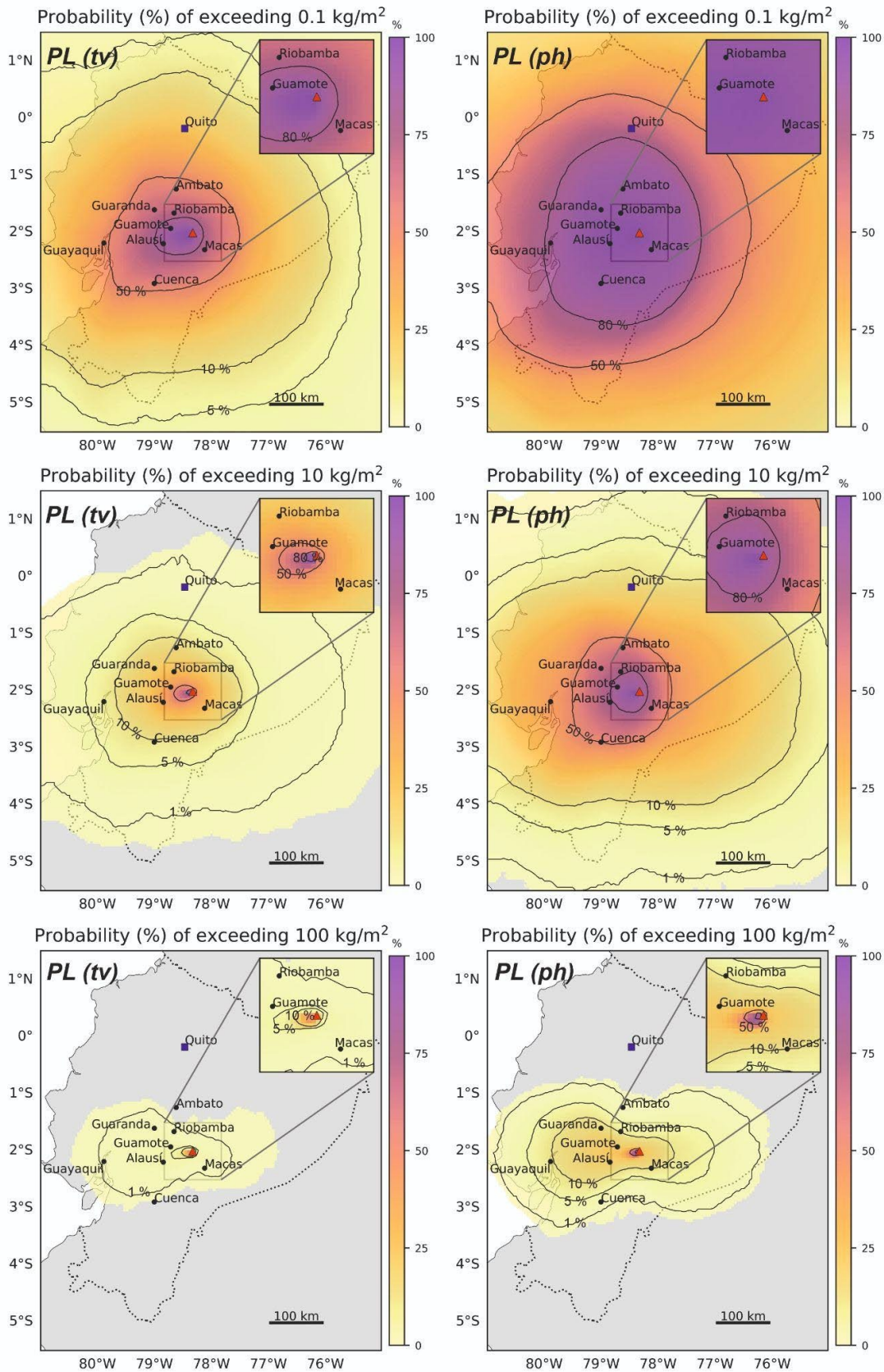


Figure 17S. Sangay tephra fallout hazard maps for PL scenario for 0.1, 10 and 100 kg/m² thresholds. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

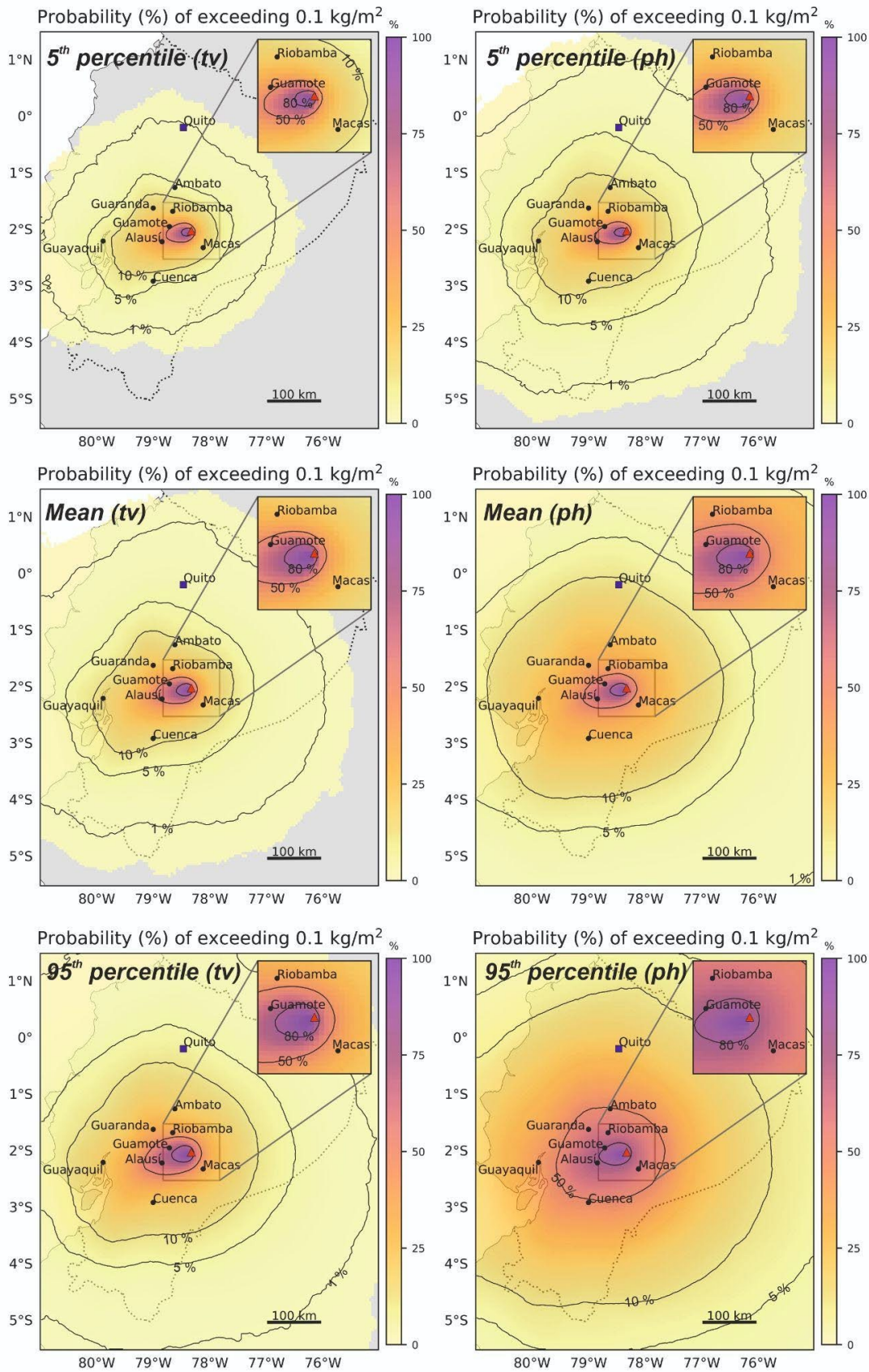


Figure 18S. Sangay tephra fallout hazard maps for the combined SAV, VS, SPL and PL scenarios for 0.1 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

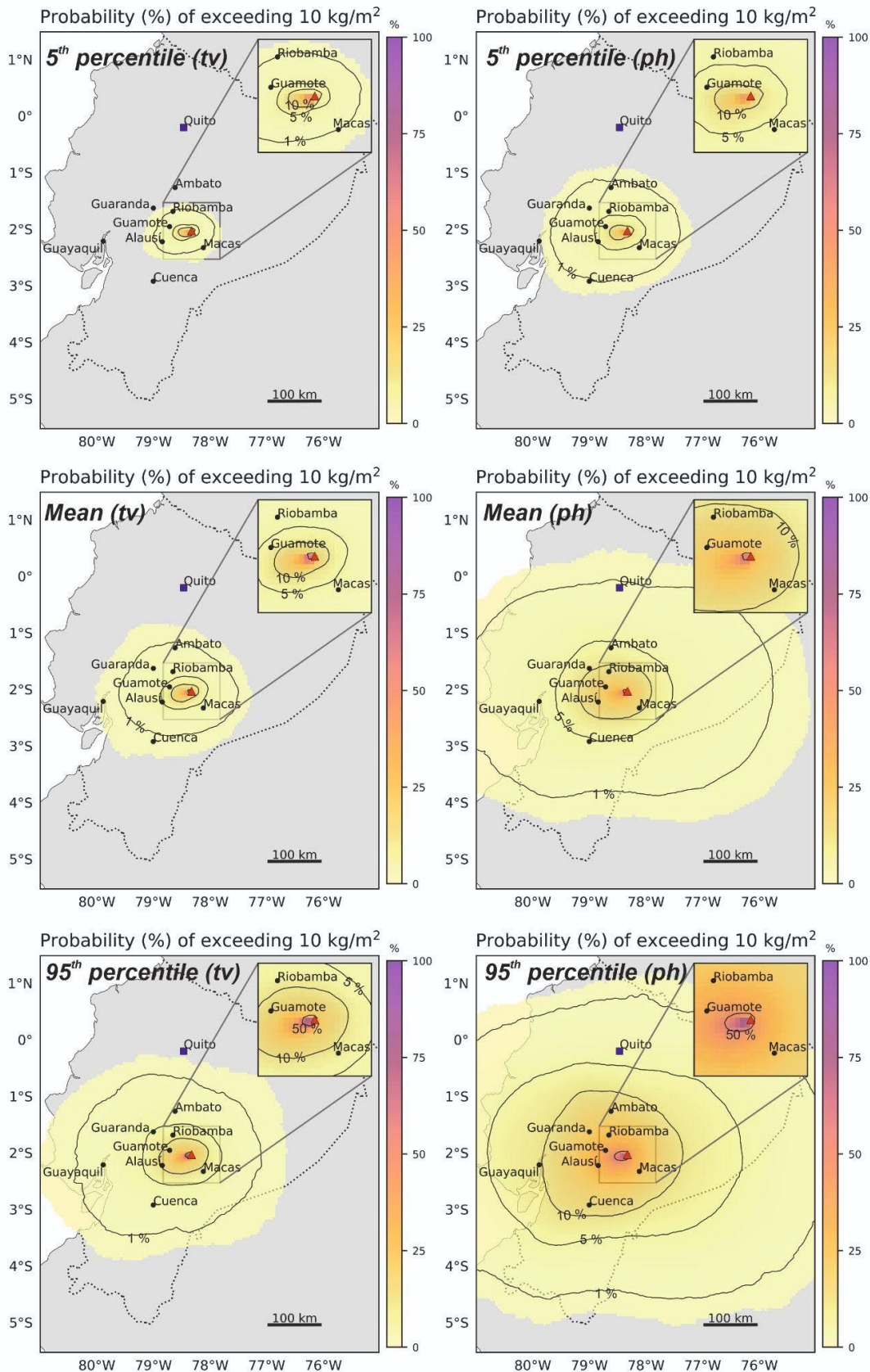


Figure 19S. Sangay tephra fallout hazard maps for the combined SAV, VS, SPL and PL scenarios for 10 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

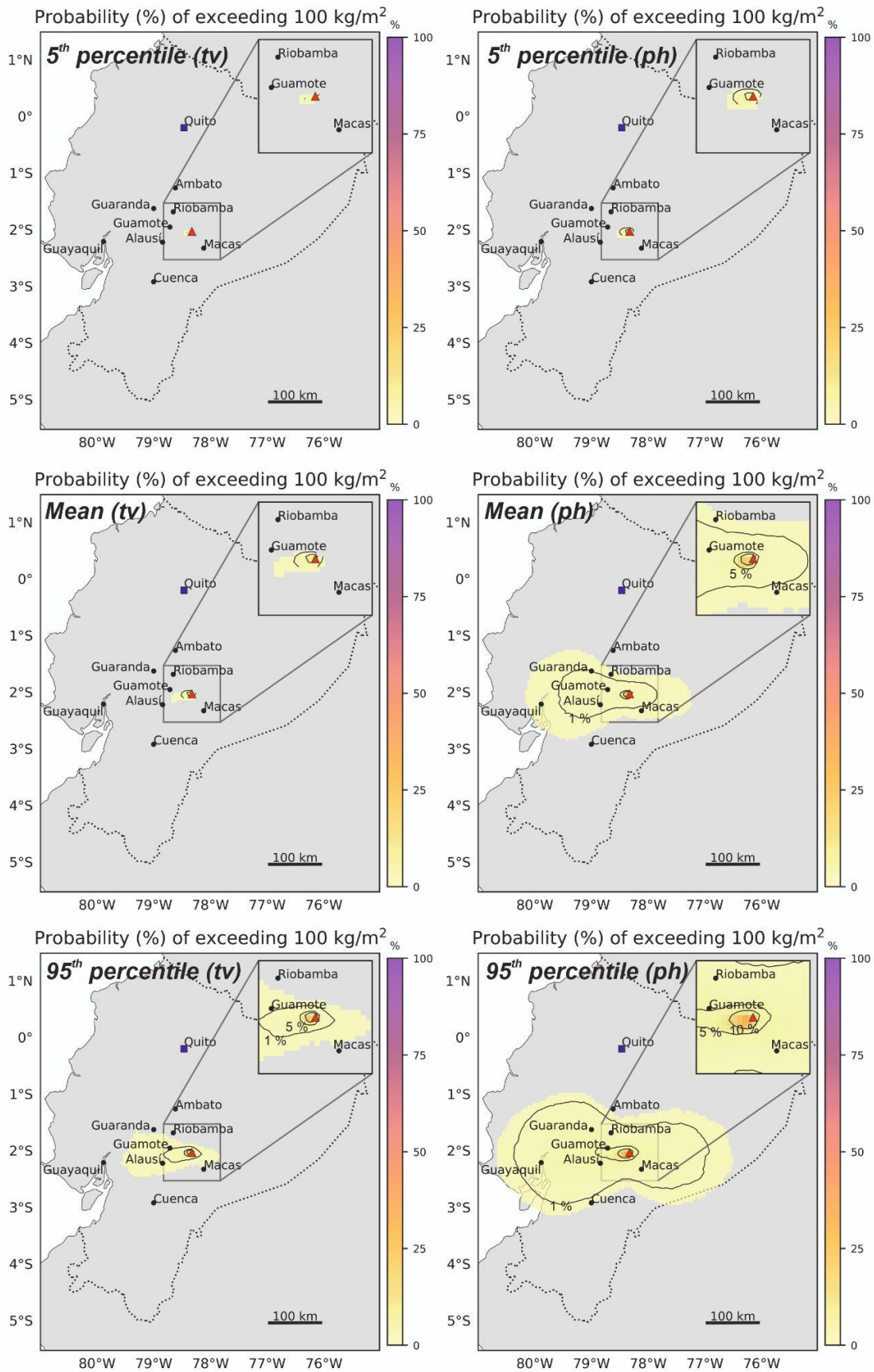


Figure 20S. Sangay tephra fallout hazard maps for the combined SAV, VS, SPL and PL scenarios for 100 kg/m² threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps in the left column are produced initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column using Plume Height (ph). Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

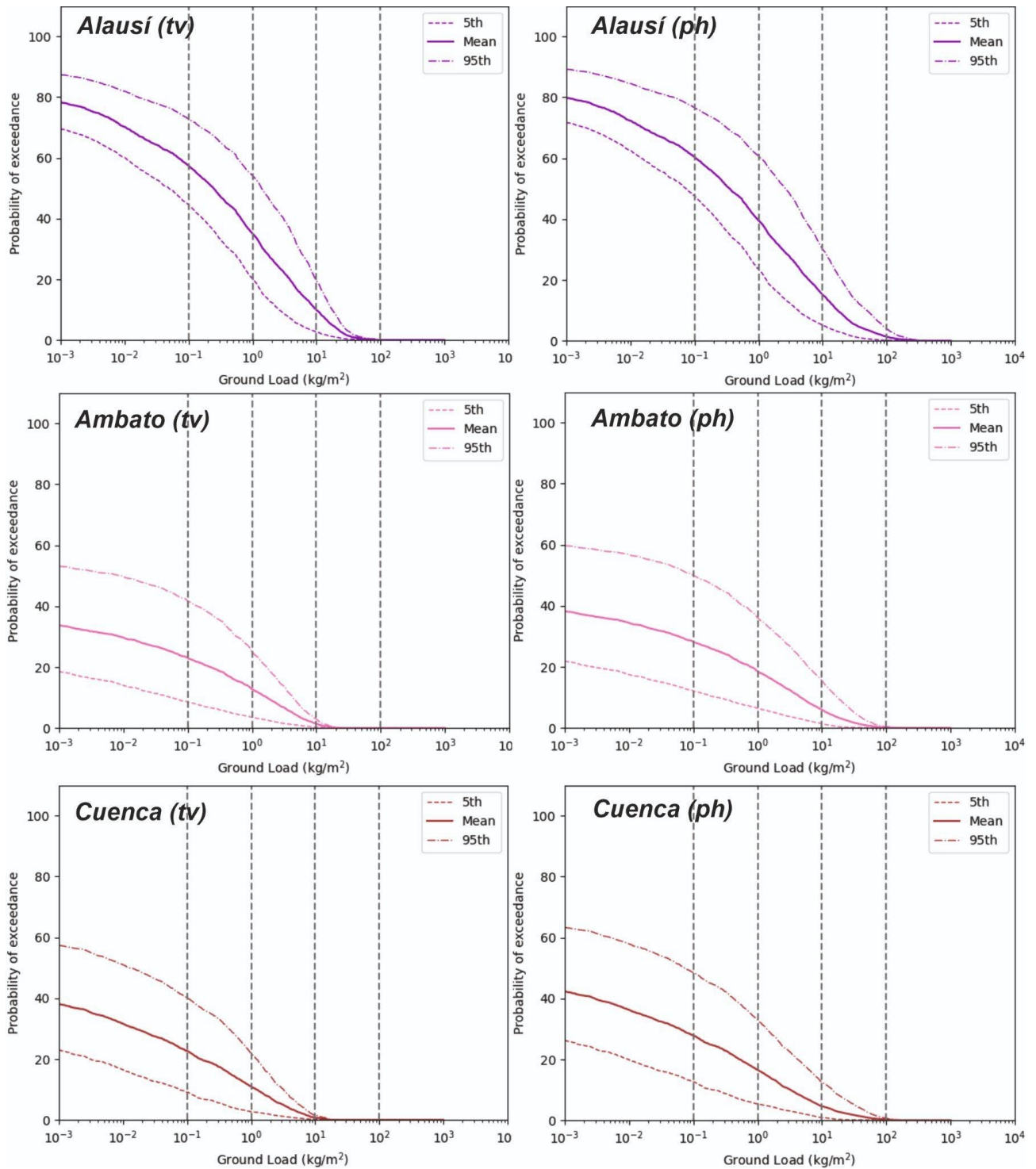


Figure 21S. Hazard curves for 3 sites (Alausí, Ambato and Cuenca - see Figure 1) for the combined SAV, VS, SPL and PL scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves in the left column are produced by initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column by using Plume Height (ph). Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.

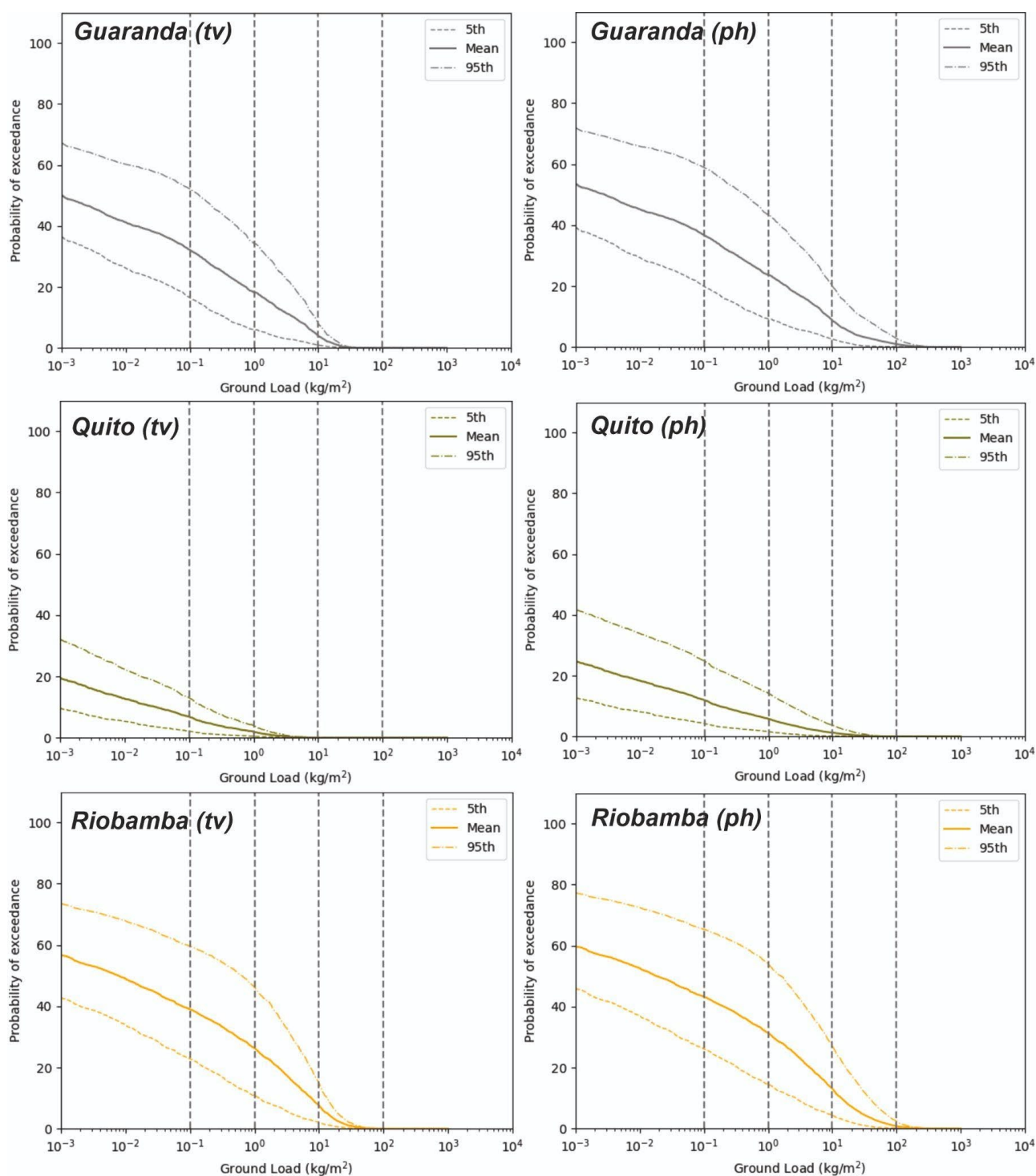


Figure 22S. Hazard curves for 3 sites (Guaranda, Quito and Riobamba - see Figure 1) for the combined SAV, VS, SPL and PL scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves in the left column are produced by initializing PLUME-MoM-TSM with total volume (tv), whereas those in the right column by using Plume Height (ph). Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.

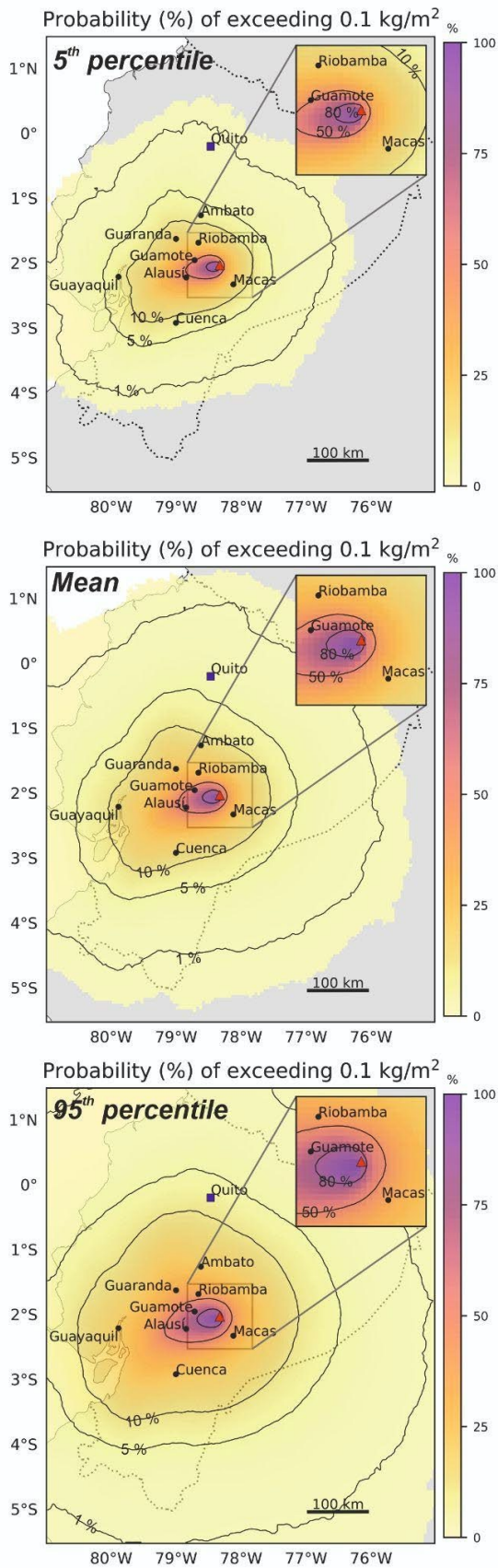


Figure 23S. Sangay tephra fallout hazard maps for the combined SAV, VS, SPL and PL scenarios for 0.1 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps for single scenarios are produced initializing PLUME-MoM-TSM with, respectively, plume height for SAV and VS and total volume for SPL and PL. Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

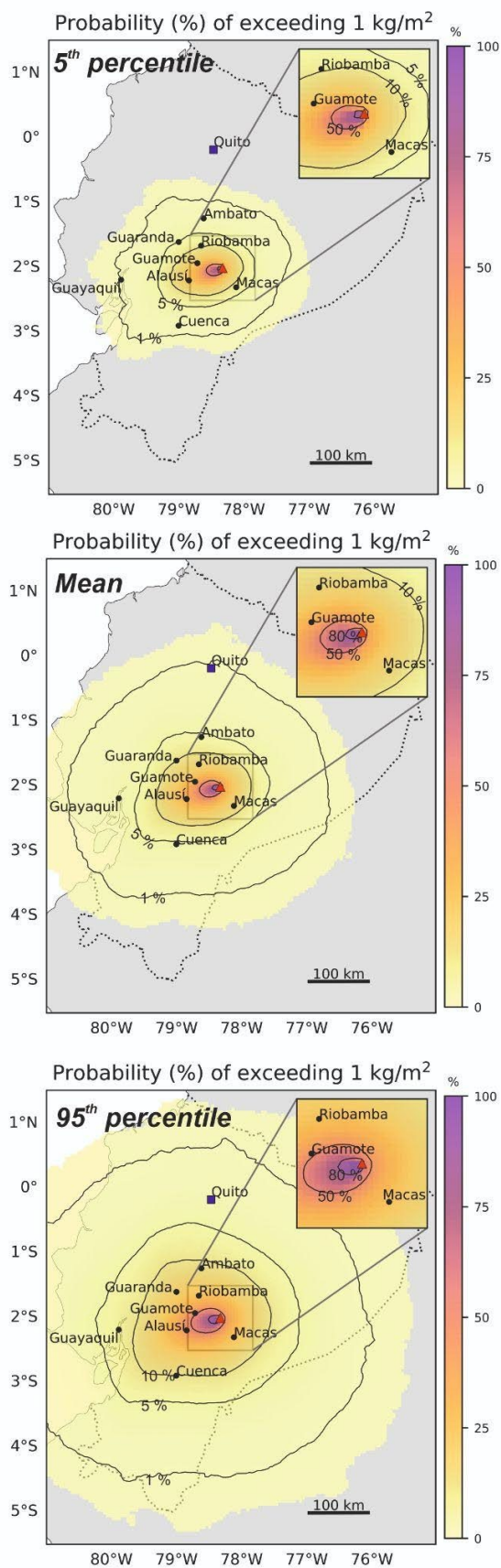


Figure 24S. Sangay tephra fallout hazard maps for the combined SAV, VS, SPL and PL scenarios for 1 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps for single scenarios are produced initializing PLUME-MoM-TSM with, respectively, plume height for SAV and VS and total volume for SPL and PL. Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

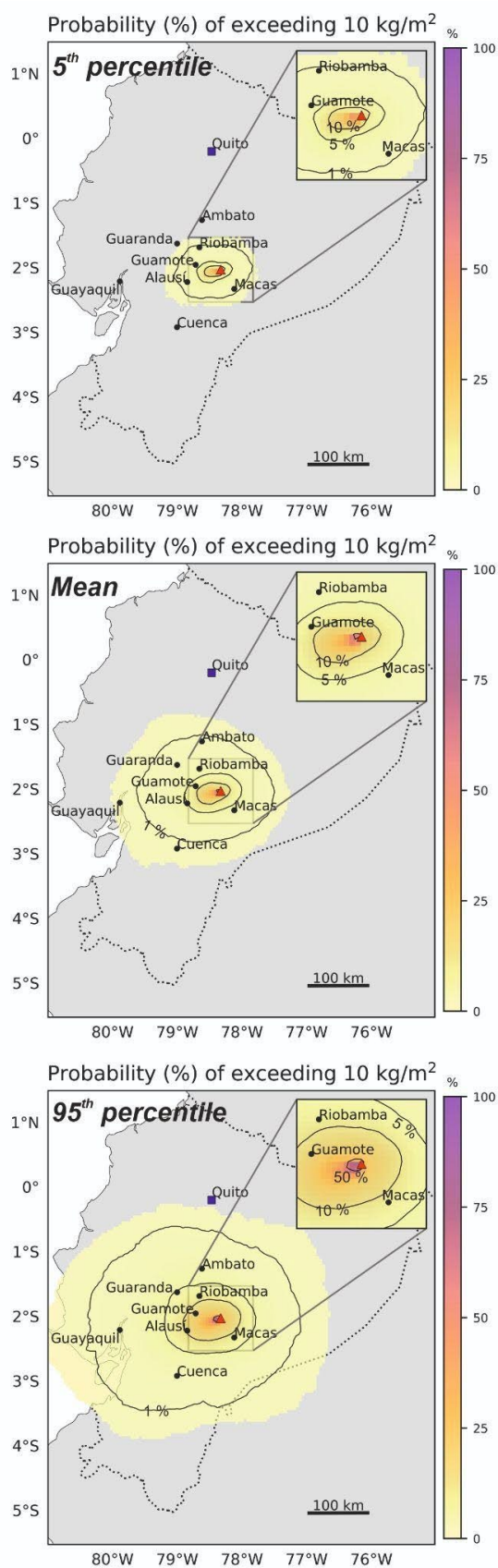


Figure 25S. Sangay tephra fallout hazard maps for the combined SAV, VS, SPL and PL scenarios for 10 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps for single scenarios are produced initializing PLUME-MoM-TSM with, respectively, plume height for SAV and VS and total volume for SPL and PL. Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

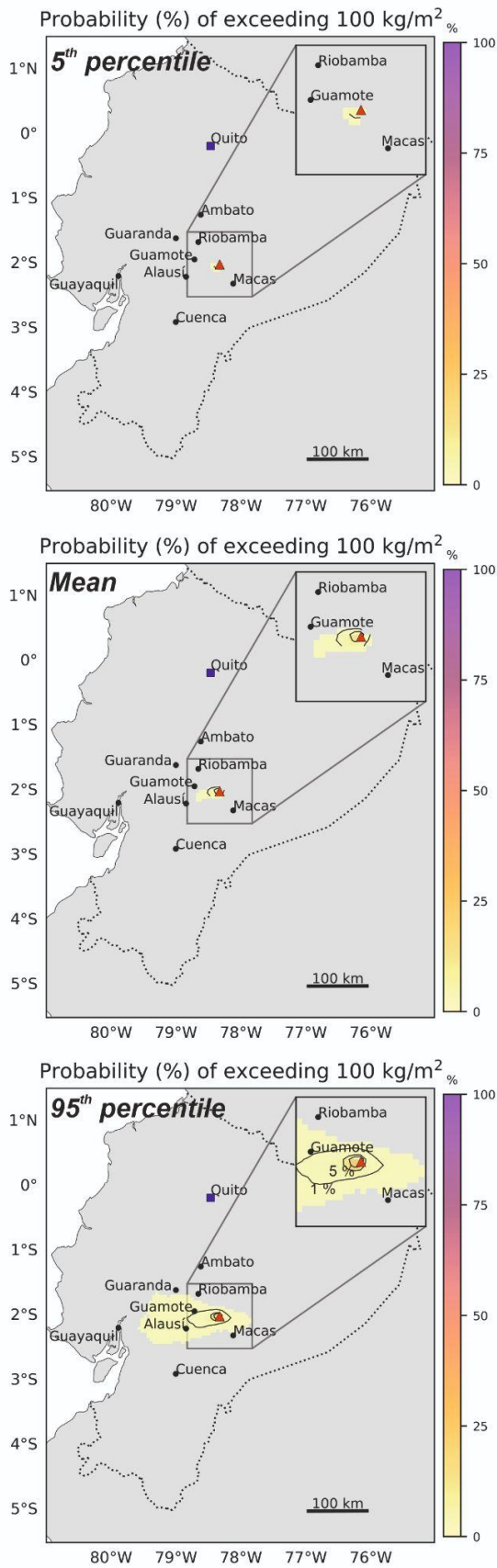


Figure 26S. Sangay tephra fallout hazard maps for the combined SAV, VS, SPL and PL scenarios for 100 kg/m^2 threshold corresponding to the 5th percentile, the mean and the 95th percentile. Maps for single scenarios are produced initializing PLUME-MoM-TSM with, respectively, plume height for SAV and VS and total volume for SPL and PL. Contour lines, where not indicated, follow the progression 1%, 5%, 10%, 50%, 80%.

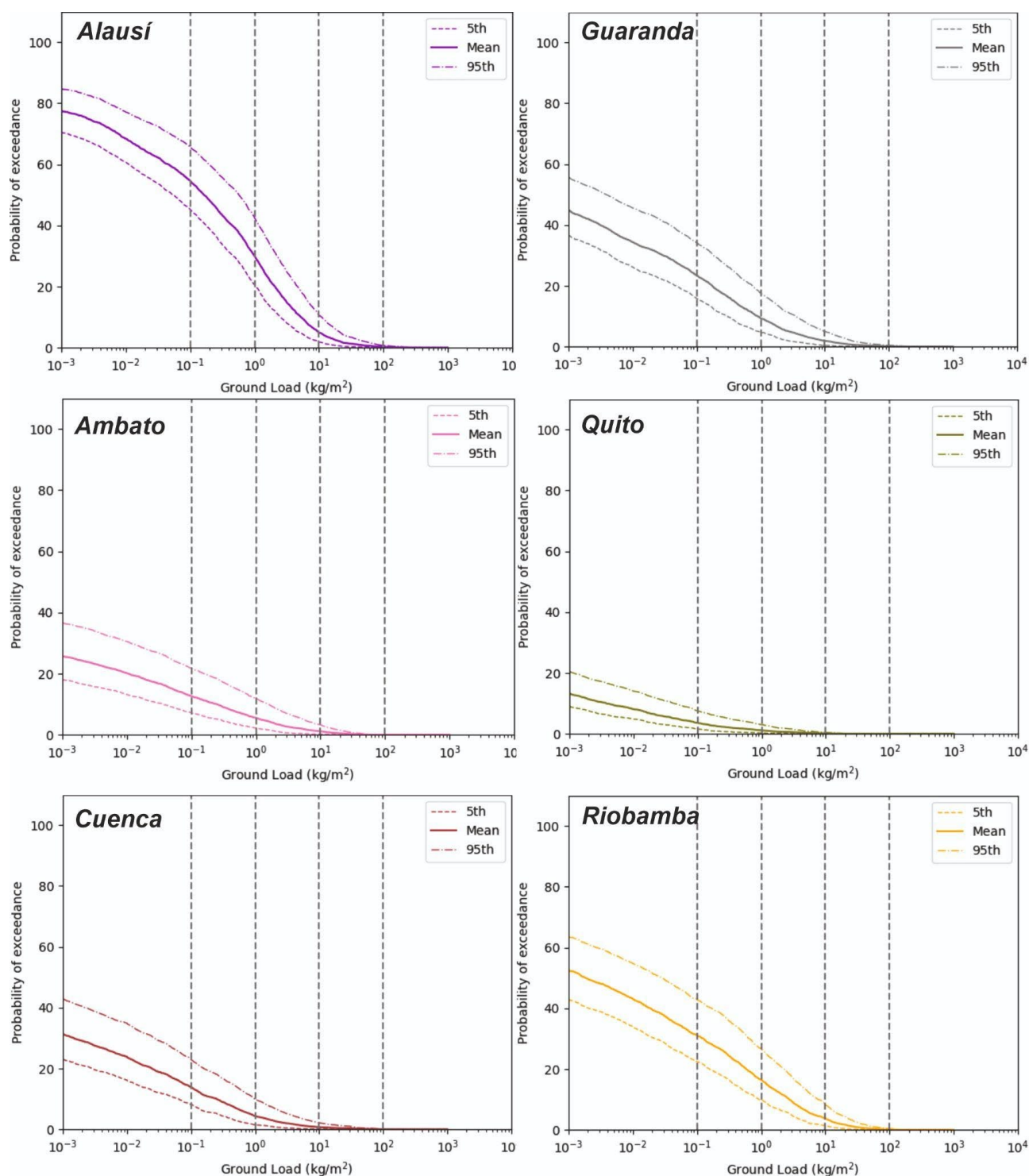


Figure 27S. Hazard curves for 6 sites (Alausí, Ambato, Cuenca, Guaranda, Quito and Riobamba - see Figure 1) for the combined SAV, VS, SPL and PL scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves for single scenarios are produced initializing PLUME-MoM-TSM with, respectively, plume height for SAV and VS and total volume for SPL and PL. Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.

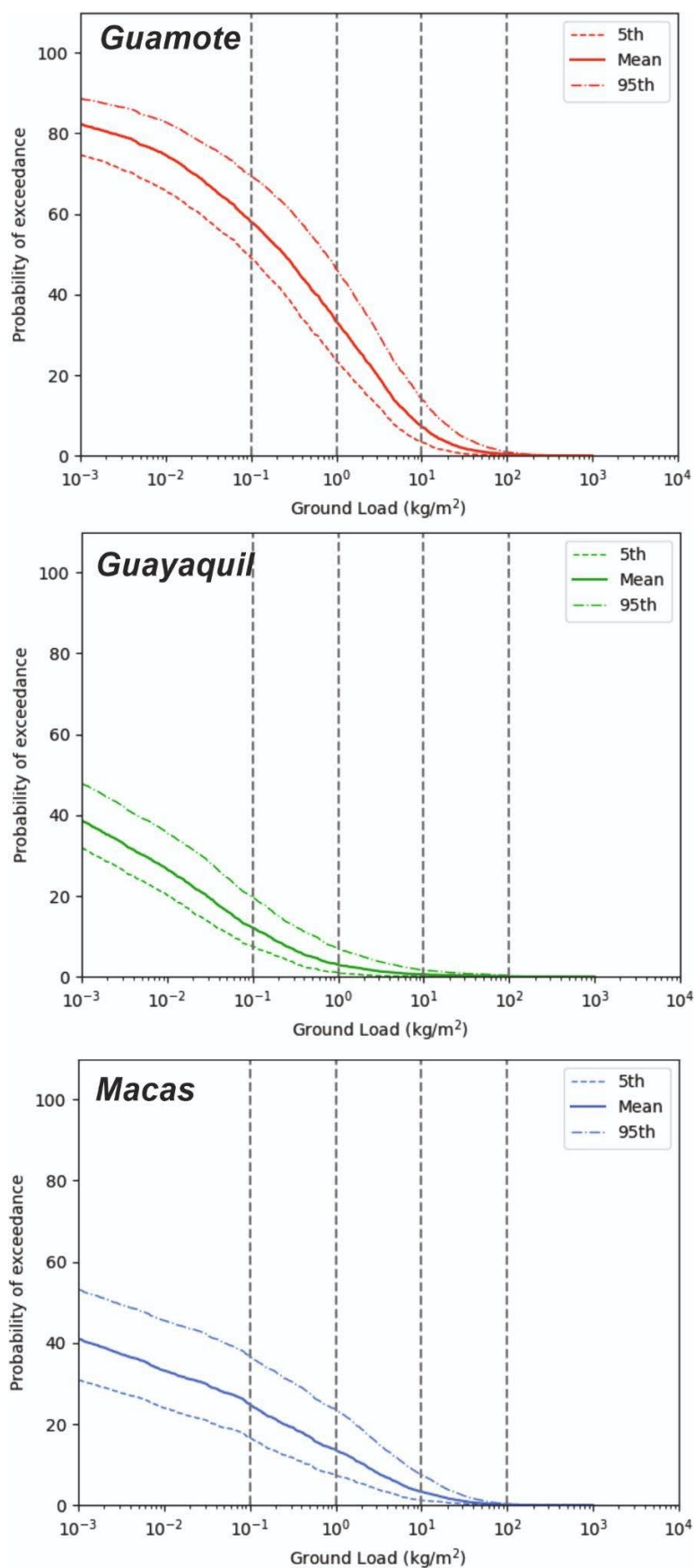


Figure 28S. Hazard curves for 3 sites (Guamote, Guayaquil, and Macas - see Figure 1) for the combined SAV, VS, SPL and PL scenarios corresponding to the 5th percentile, the mean and the 95th percentile. Curves for single scenarios are produced initializing PLUME-MoM-TSM with, respectively, plume height for SAV and VS and total volume for SPL and PL. Interpolated values at 0.1, 1, 10 and 100 kg/m² are reported in Supporting Information 3.