Supplement for "Evidence of Tropospheric Uplift into the Stratosphere via the Tropical Western Pacific Cold Trap"

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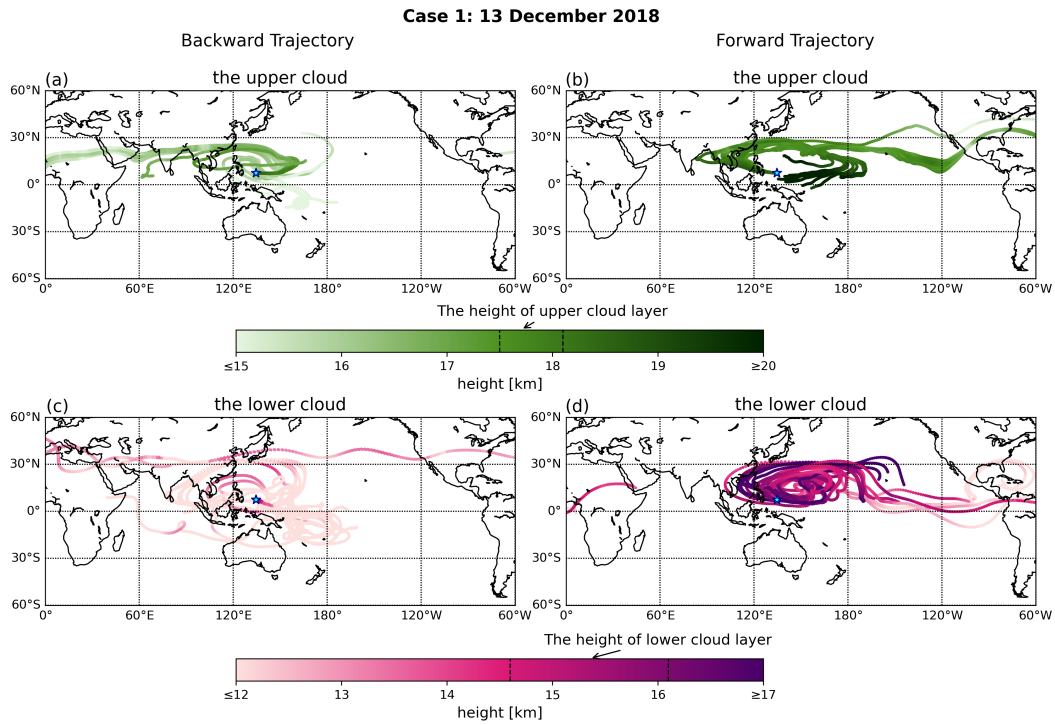
Figure S1: 20-d trajectories of the upper cloud (a–b), and the lower cloud (c–d) in the winter case corresponding to Fig. 2 (the main manuscript). The left and right columns show the backward (a and c) and forward (b and d) trajectory points released from the cloud layers, respectively. The color scale of the trajectory point scatter depicts the height of the trajectory points. The starting point of the trajectory is marked by the blue star, at Palau. Trajectory points are output at hourly intervals but sparsified at intervals of 5 points for the clarity of display.
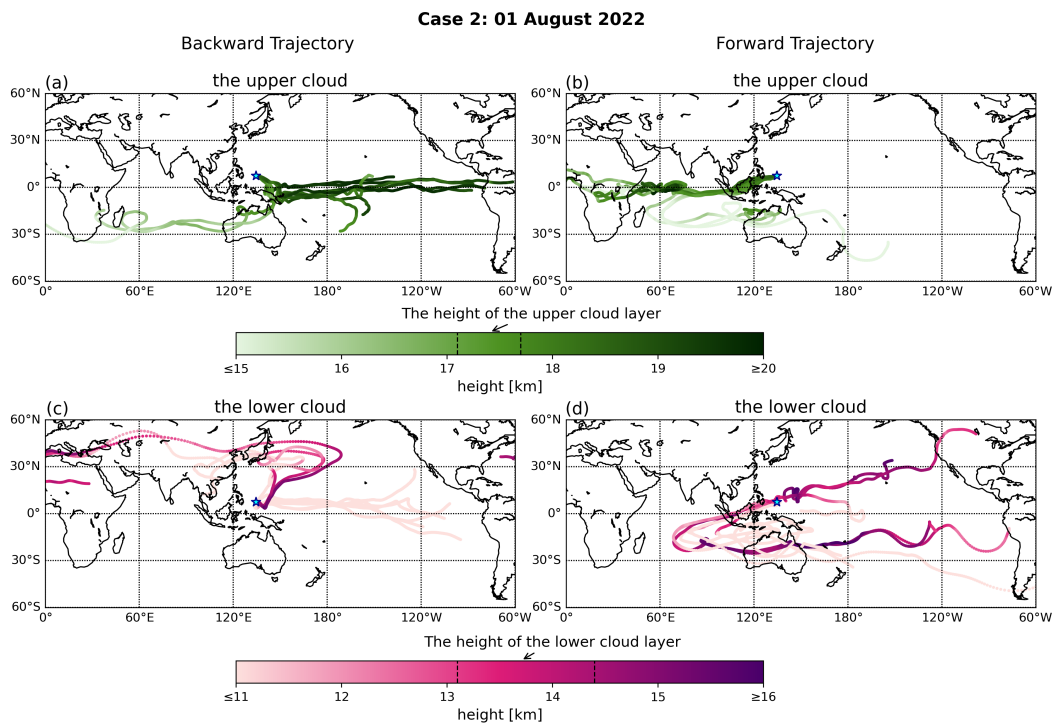
Figure S2: 20-d trajectories of the upper cloud (a–b), and the lower cloud (c–d) in the summer case corresponding to Fig. 4 (the main manuscript). The description of the plots is the same as in Fig. S1.
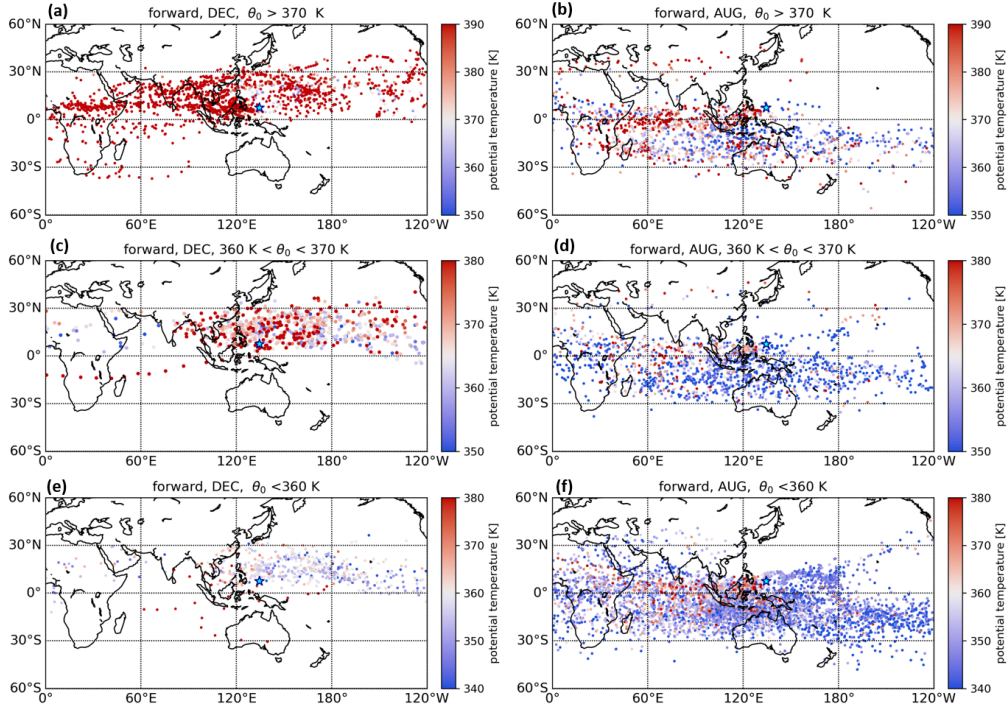
Figure S3: 20-d Forward trajectories initiated from the cloud layer in December 2018 (left column, a, c, e) and August 2022 (right column, b, d, f). The trajectories are divided by potential temperature of the starting point (θ_0) into three layers presented in three rows: $\theta_0 > 370$ K (a and b), 360 K $< \theta_0 <$ 370 K (c and d), $\theta_0 < 360$ K (e and f). The potential temperatures of the trajectory points are given in color. Note the changes in color scales for different layers. Trajectories are initialized at cloud layer measurements of ComCAL at the PAO, shown by the cyan marker. For the clarity of display, the trajectory points in the figure are sparsified at intervals of 24 points (24 h). For 10-d trajectories with similar results, please see Figure 6 in the main manuscript.

Case 1: 13 December 2018 at 11 UTC
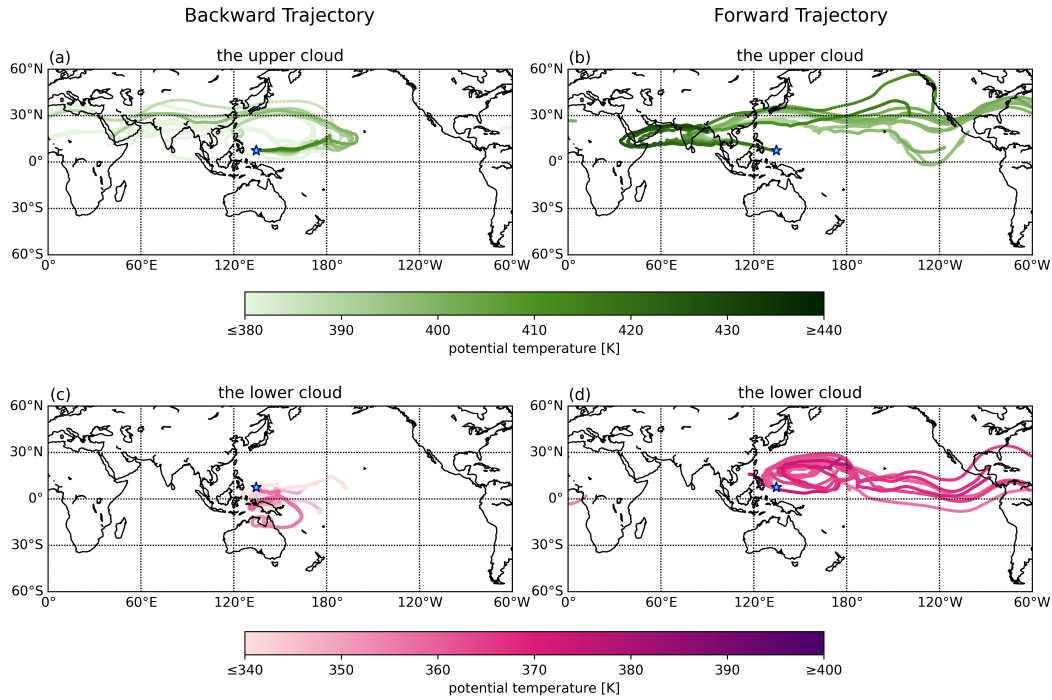
Figure S4: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 11 UTC for the winter case (13 December) by ATLAS. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.

Case 1: 13 December 2018 at 12 UTC
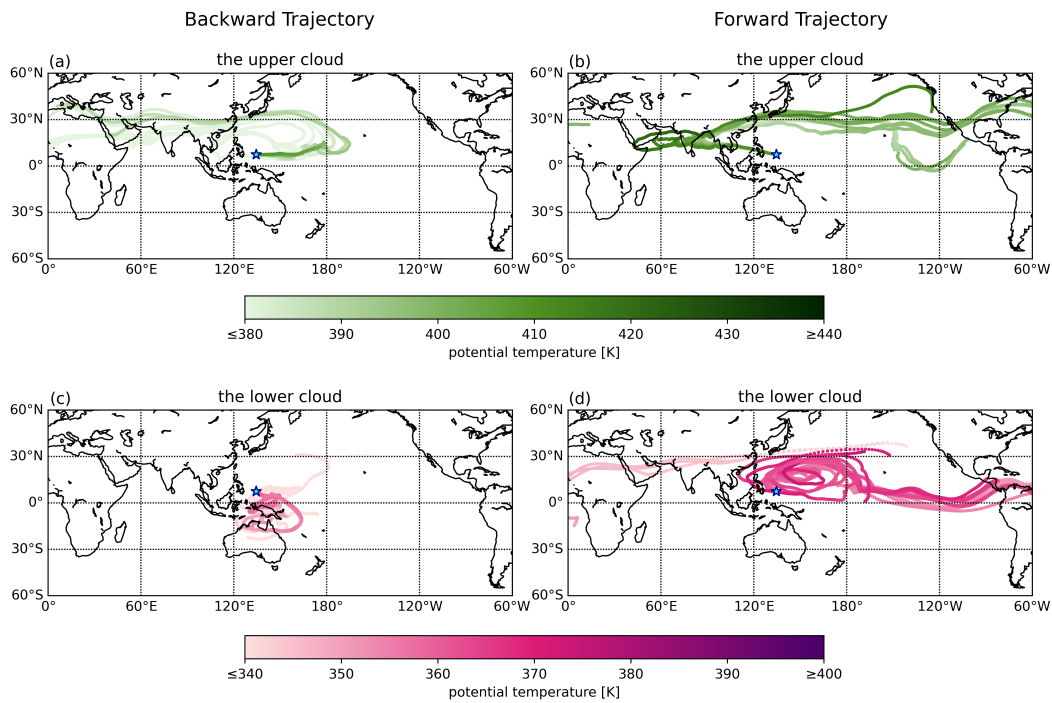
Figure S5: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 12 UTC for the winter case (13 December) by ATLAS. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.

Case 1: 13 December 2018 at 13 UTC
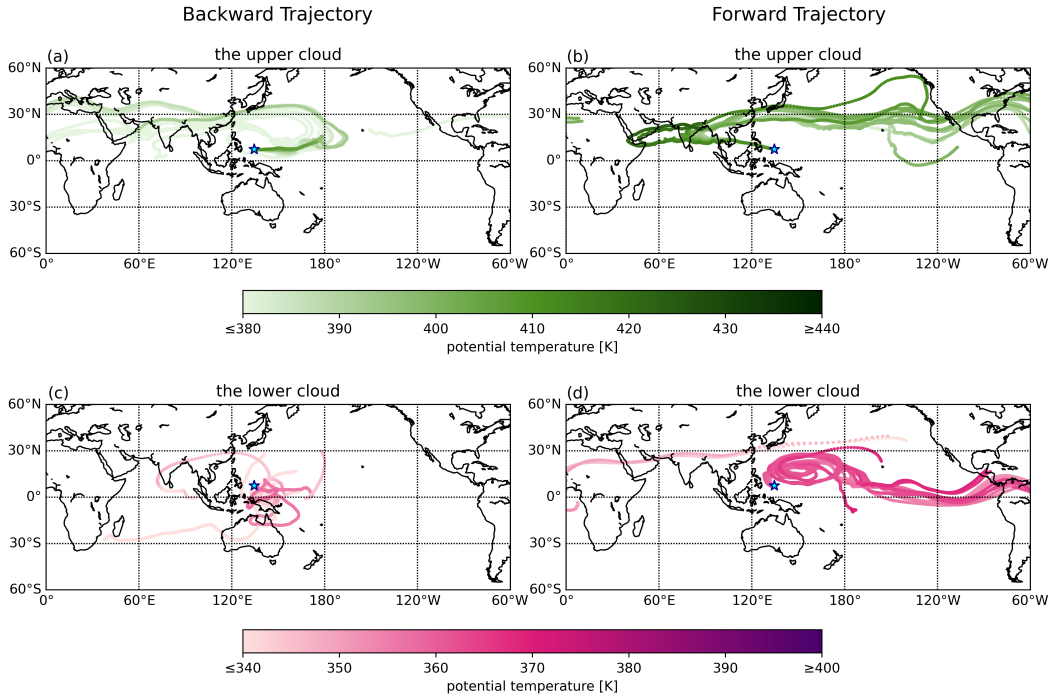
Figure S6: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 13 UTC for the winter case (13 December) by ATLAS. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.

Case 1: 13 December 2018 at 11 UTC
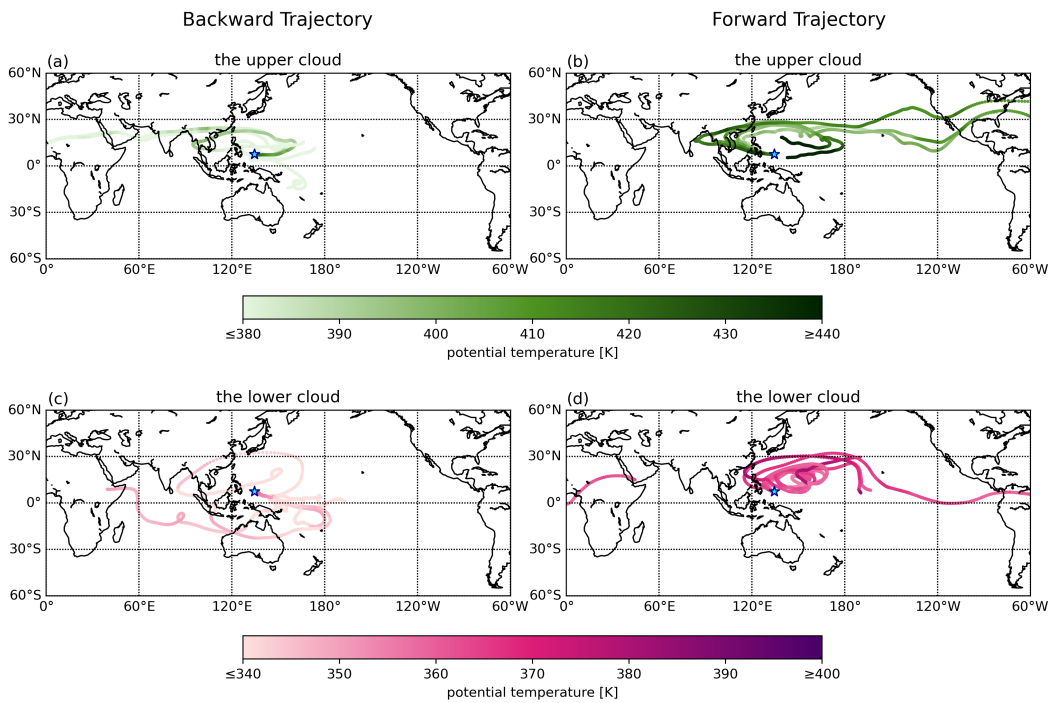
Figure S7: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 11 UTC for the winter case (13 December) by HYSPLIT. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.

Case 1: 13 December 2018 at 12 UTC
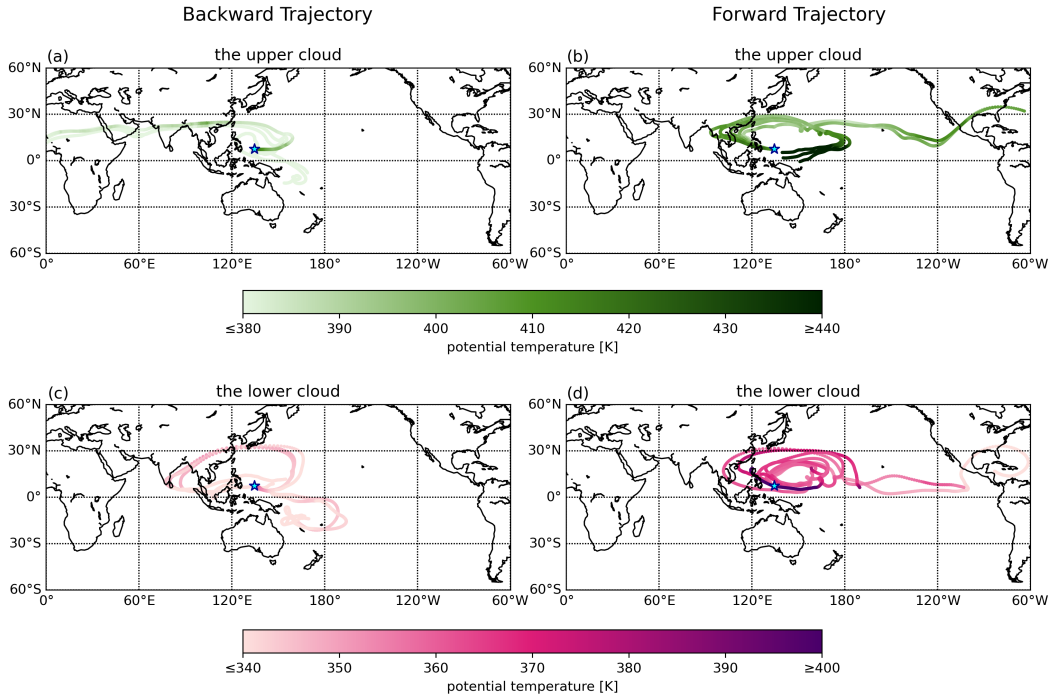
Figure S8: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 12 UTC for the winter case (13 December) by HYSPLIT. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.

Case 1: 13 December 2018 at 13 UTC
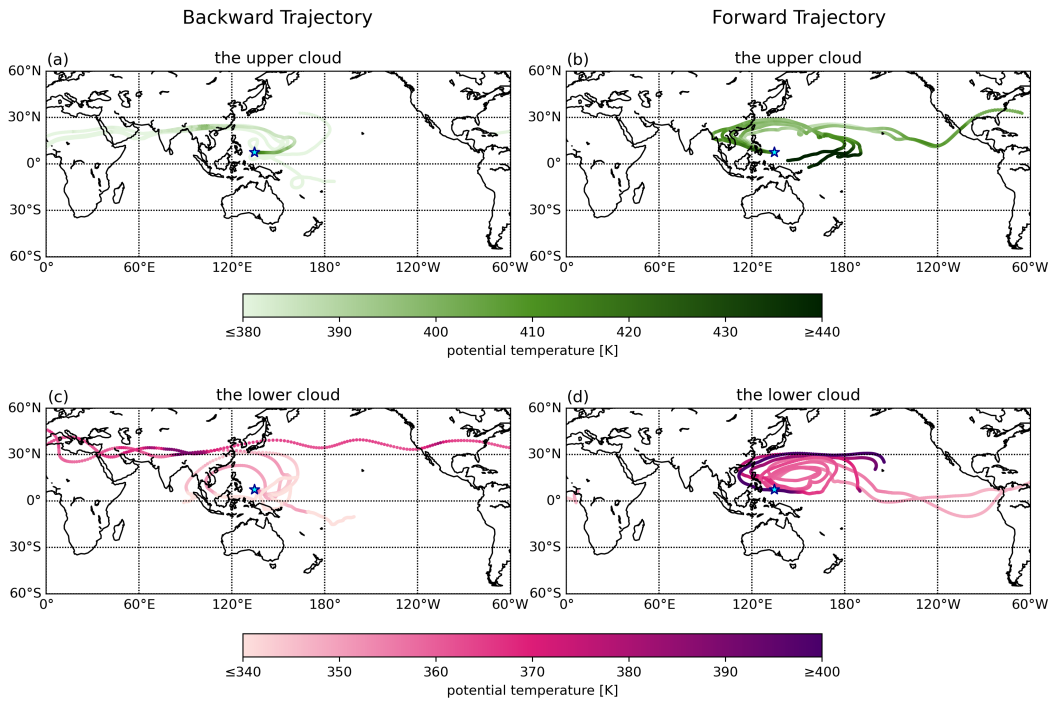
Figure S9: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 13 UTC for the winter case (13 December) by HYSPLIT. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.

Case 2: 01 August 2022 at 13 UTC
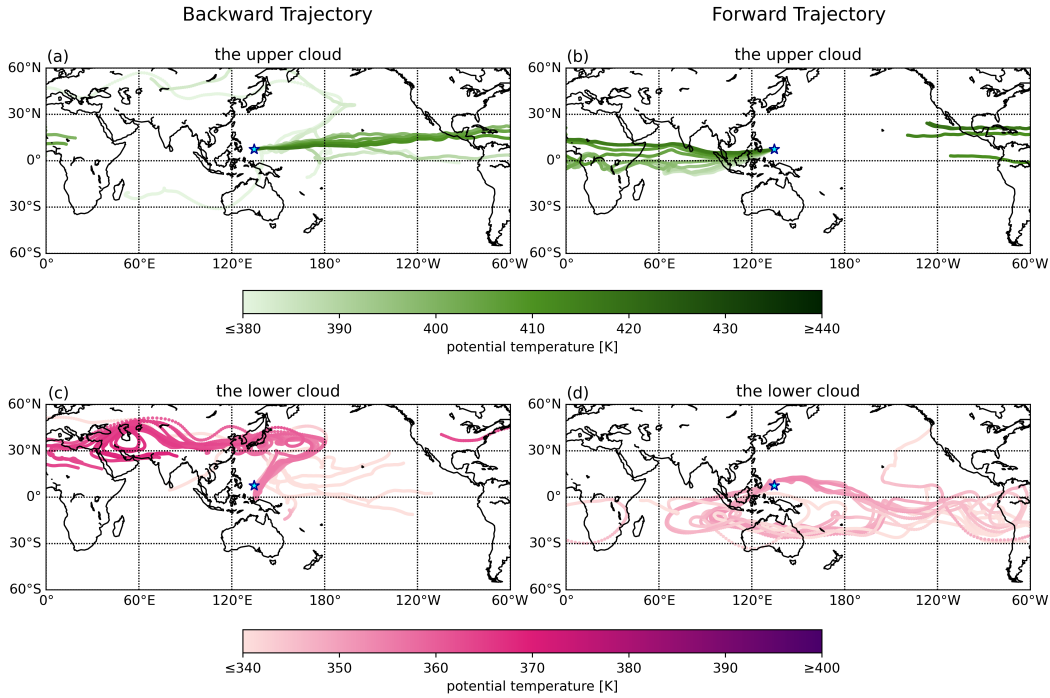
Figure S10: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 13 UTC for the summer case (1 August) by ATLAS. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.

Case 2: 01 August 2022 at 13 UTC
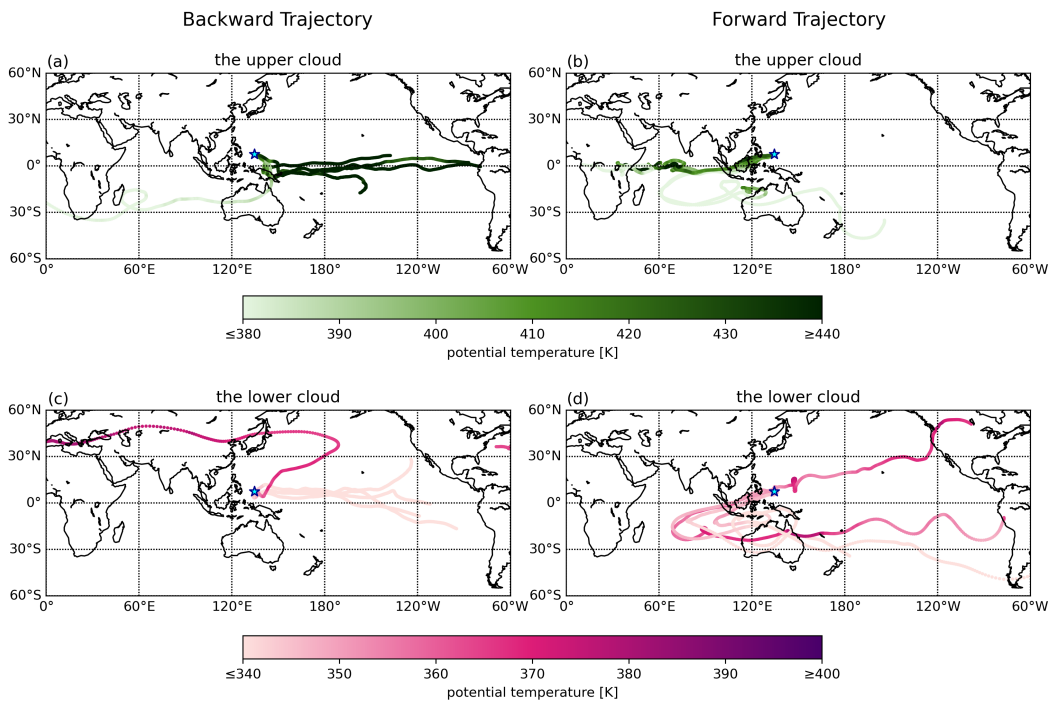
Figure S11: 20-d trajectories of the upper cloud (a and b, upper row), and the lower cloud (c and d, lower row) at 13 UTC for the summer case (1 August) by HYSPLIT. The left column (a and c) shows backward trajectories and the right column (b and d) shows forward trajectories.