Supplement of Atmos. Chem. Phys., 23, 12557–12570, 2023
https://doi.org/10.5194/acp-23-12557-2023-supplement


Atmospheric Chemistry and Physics Open Access

*Supplement of*

# Short- and long-term stratospheric impact of smoke from the 2019–2020 Australian wildfires

**Johan Friberg et al.**

*Correspondence to:* Johan Friberg (johan.friberg@nuclear.lu.se)

# Supplementary to: Short and long-term stratospheric impact of smoke from the 2019/2020 Australian wildfires

**By:** Johan Friberg, Bengt G. Martinsson, and Moa K. Sporre

**Text S1:**

The figures (S2-S42) were used to track the smoke layers from the Australian fires. The figures consist of UV-Aerosol index (UVAI) images (top figures) with included CALIOP swath paths from the same day. Here, the lower threshold for UVAI was set to 0.75 to exclude aerosol at low altitude. The curtain plots from the CALIOP swaths (attenuation and depolarization) are shown below in each figure. Some days contained too many CALIOP curtain plots with smoke layers to show in a single figure. The plots for those days were divided into two or three figures. Mainly CALIOP nighttime swaths have been used in the analysis since the daytime data have low signal to noise ratios. Note that the CALIOP nighttime images are not co-occurring with the UVAI data due to temporal displacement between the satellites. Thus, the smoke layers are often placed further east in the UVAI compared to when the CALIOP image was recorded due to westward transport of the fire clouds.

In the figures, blue circles/lines mark aerosol from the 1$^{st}$ event in the isolated dense cloud. Red circles/lines mark aerosol from the 1$^{st}$ event that did not belong to the isolated cloud. These could not be tracked for as many days as the smoke layers in the dense smoke cloud. Green circles/lines mark aerosol from the 2$^{nd}$ event. The CALIOP night time swaths were used to detemine the altitude of aerosol from the 2$^{nd}$ event and to track its movement over time. In the attenuated backscatter figures, the tropopause height in connection to the fire clouds has been determined (white lines). The layer bases could not be determined directly from the attenuated backscattering due to attenuation by smoke aerosol. We therefore determined the layer bases from the depolarization ratio plots. The layer tops (white lines long dashes), layer mid-points (white line) and layer bases (white lines with narrow dashes) are marked in these plots. The daytime curtain plots have not been used to determine altitude of the 2$^{nd}$ event due to high noise, in particular in the depolarization ration. The orange lines in the plots mark the separation between the smoke layers from the 1$^{st}$ and 1$^{nd}$ event.

The smoke layers are distinguished and separated from clouds by their depolarization ratios. Smoke layers have depolarization ratios <0.20. Since the UVAI values are influenced by the altitude of the aerosol, a high UVAI do not always result in a strong attenuation signal in the CALIOP data, and vice versa. The time difference between the CALIOP nighttime orbits and the UVAI data also contributes to this apparent mismatch. All CALIOP curtain plots with distinct aerosol layers were included in the analysis. As the smoke layers are dispersed over time they become more difficult to track and determining their altitude is no longer possible.

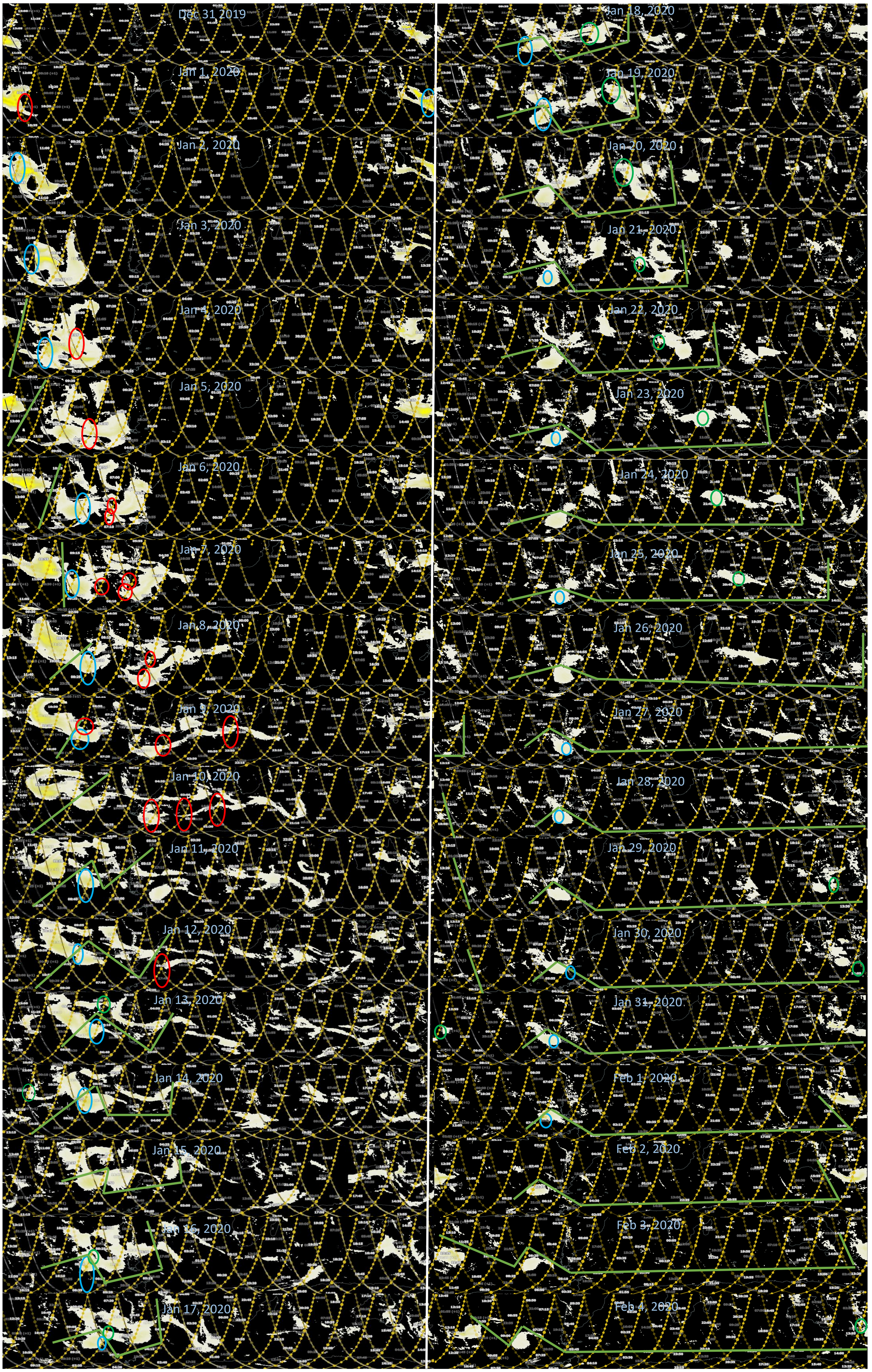


Figure S1. Daily OMPS-NM UVAI maps from 2019-12-31 to 2020-02-04. These data are used in connection with vertical information from CALIOP, where we had no meaningful data on 2019-12-29 and no data at all 2019-12-30 from the overpass of the region of elevated UVAI. Ovals indicate positions of individual layers used in Figure 7: Blue indicate the dense isolated smoke from the 1st event fires, red indicate other smoke from the 1st fire, and green indicate smoke from the 2nd event fires. The green line indicates approximate limit between layers from the 1st and 2nd fire.

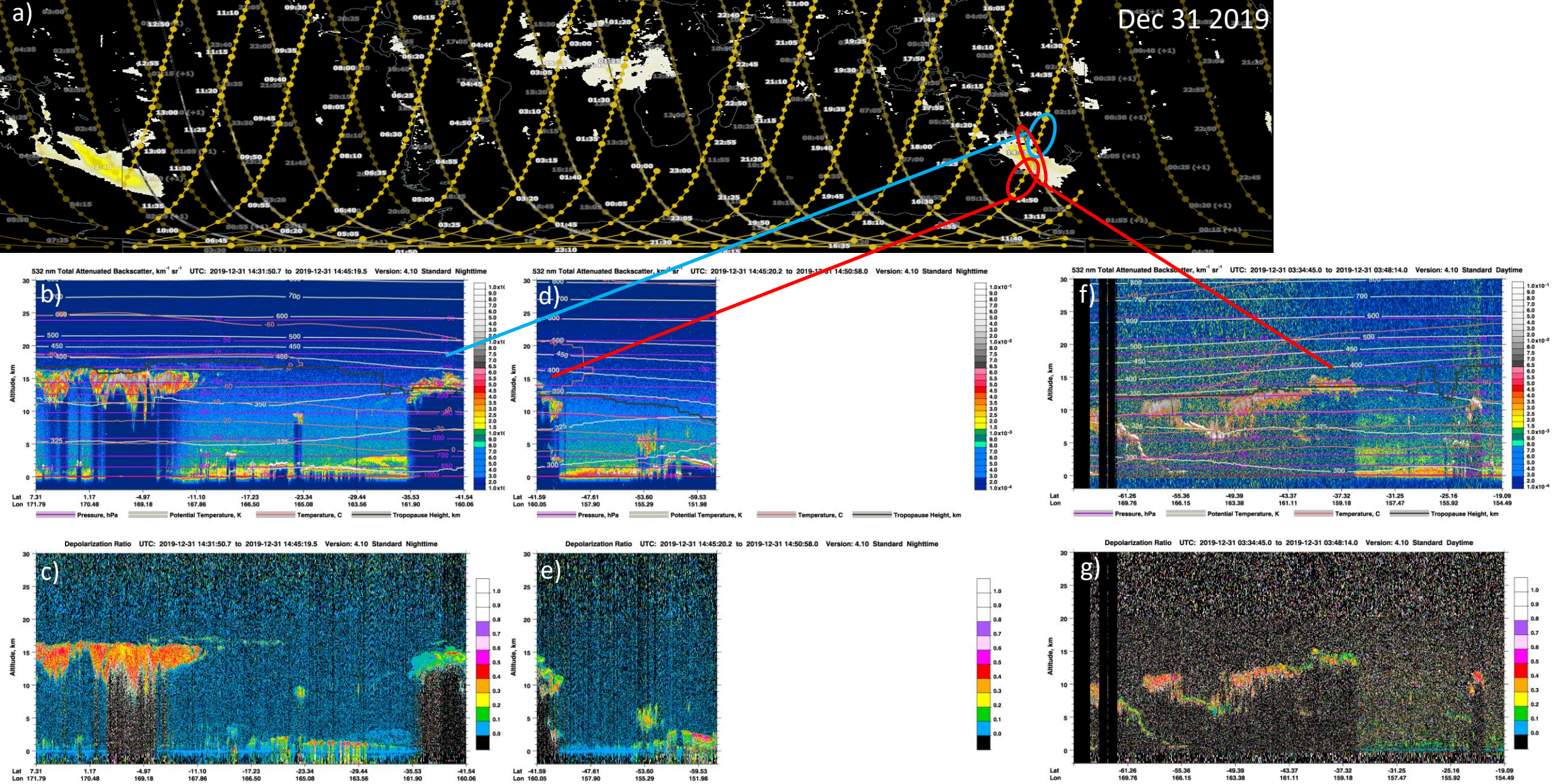


Figure S2. For figure description, see Text S1.

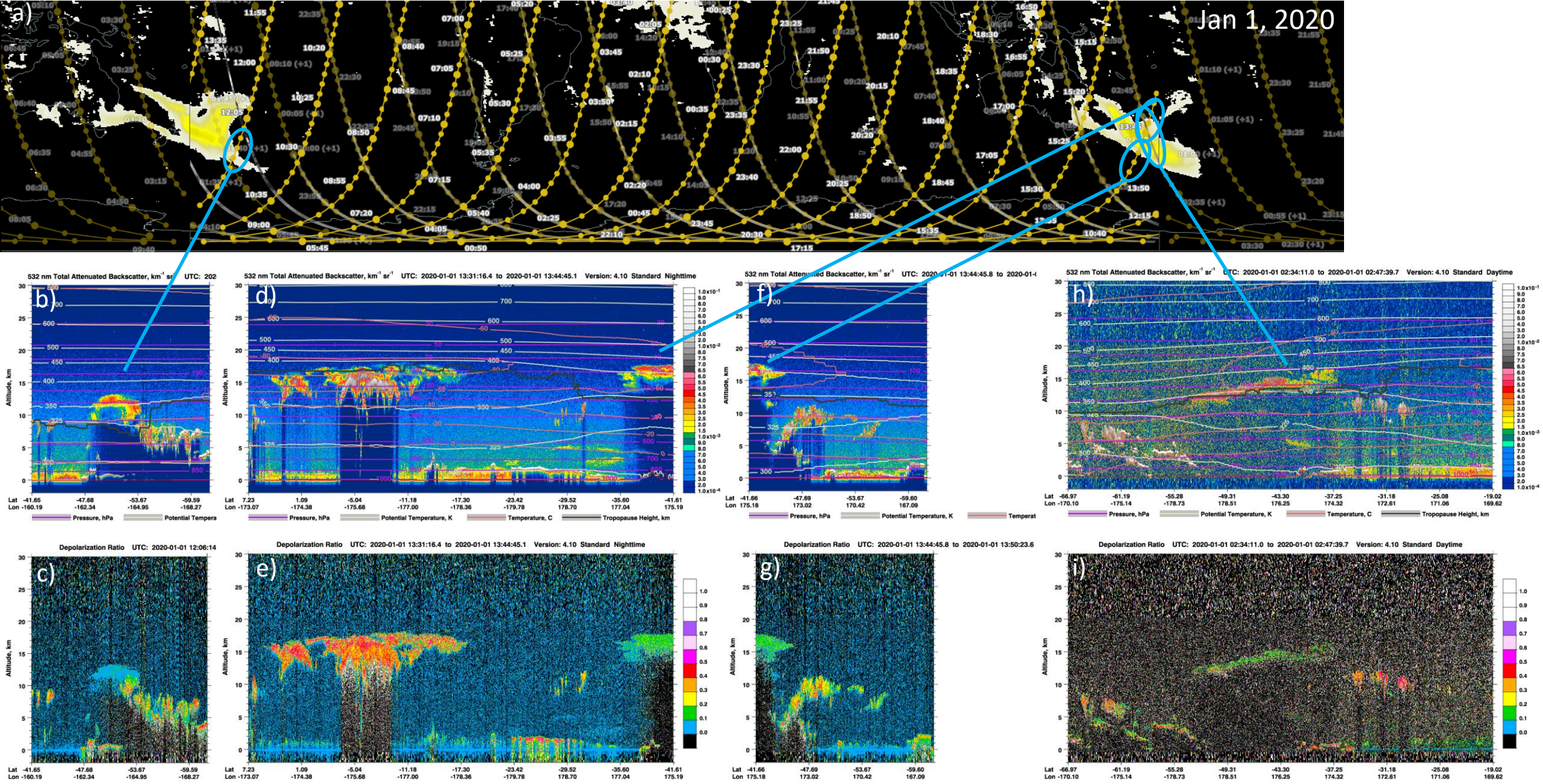


Figure S3. For figure description, see Text S1.

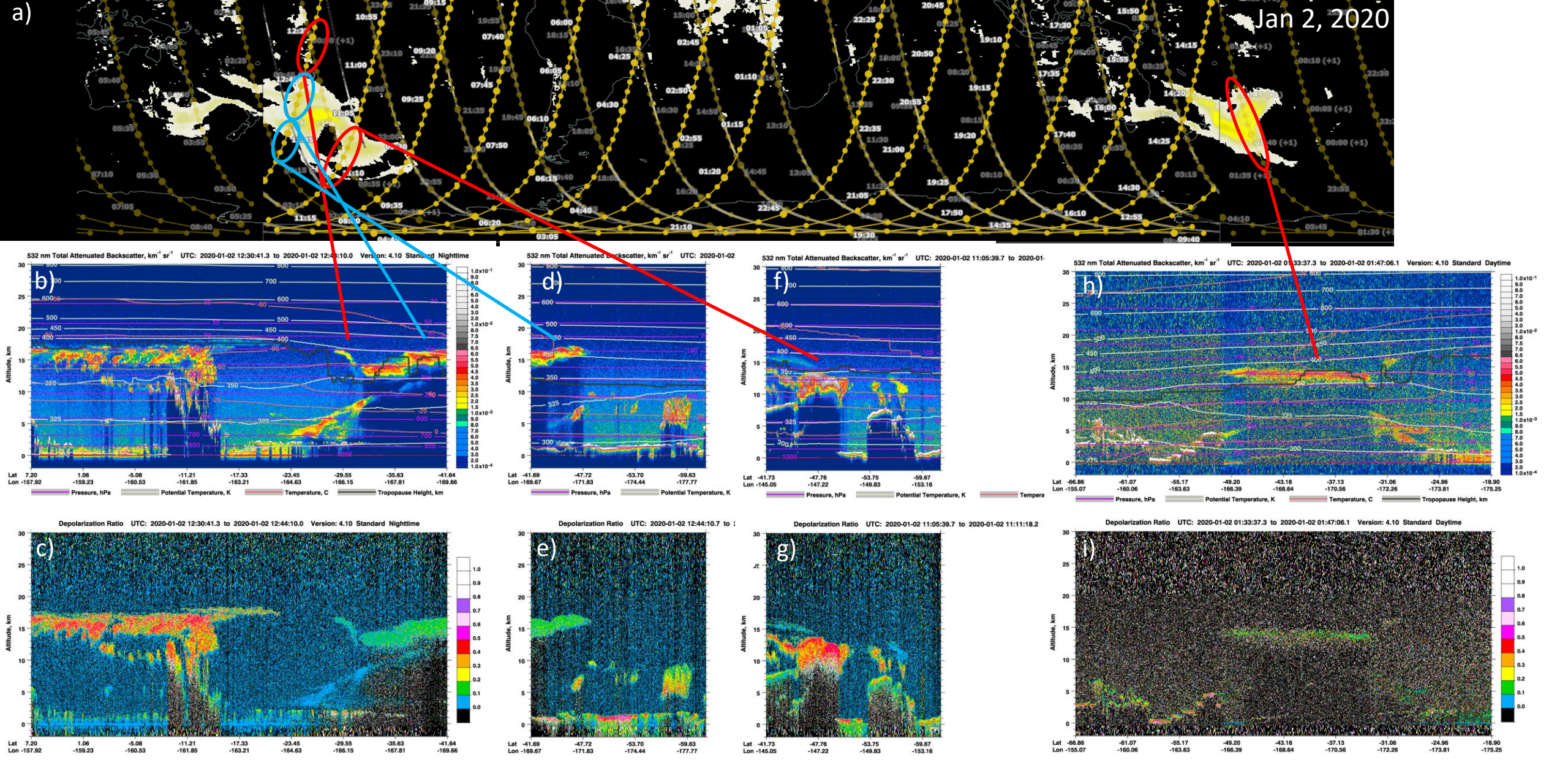


Figure S4. For figure description, see Text S1.

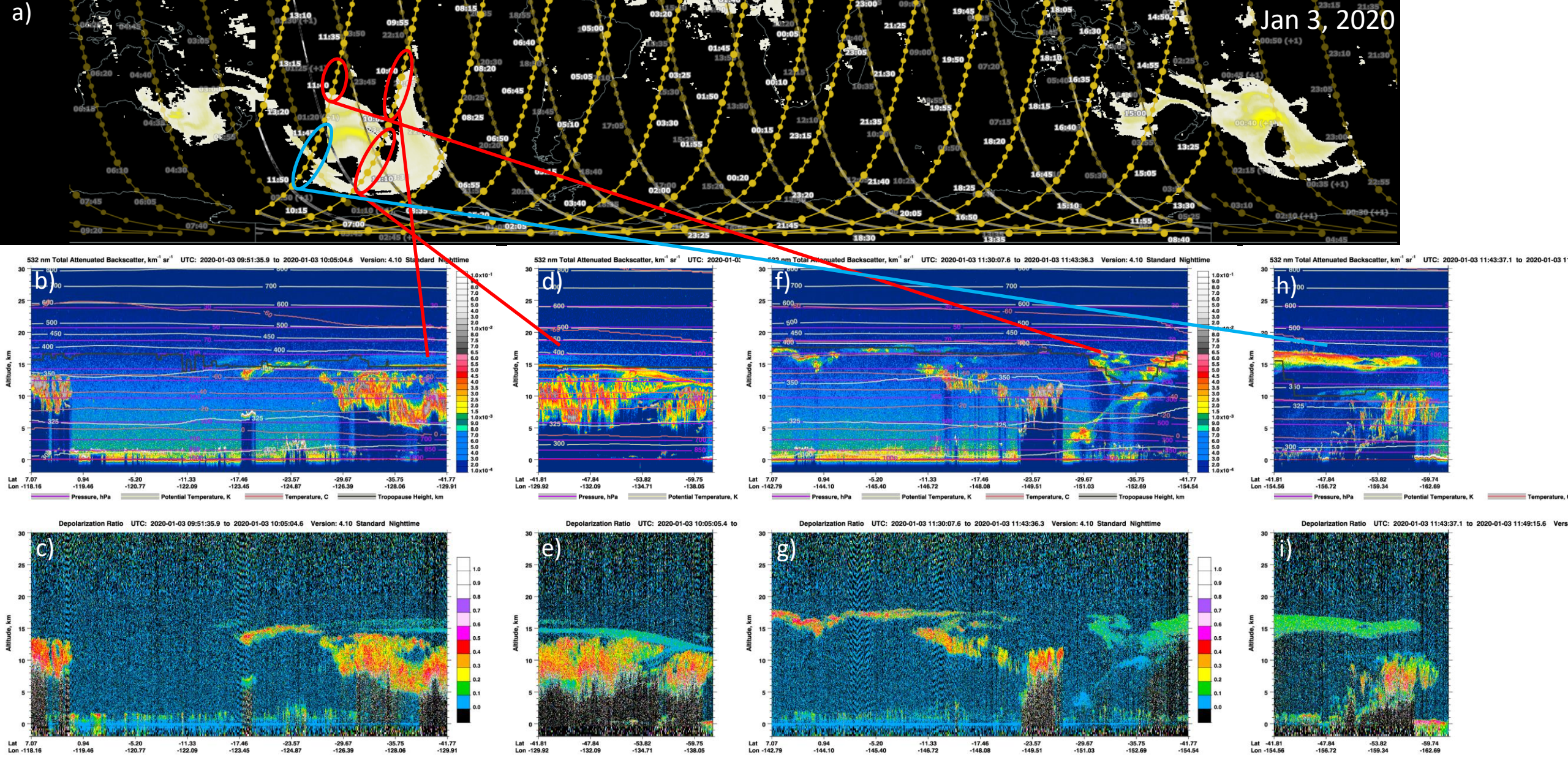


Figure S5 . For figure description, see Text S1.

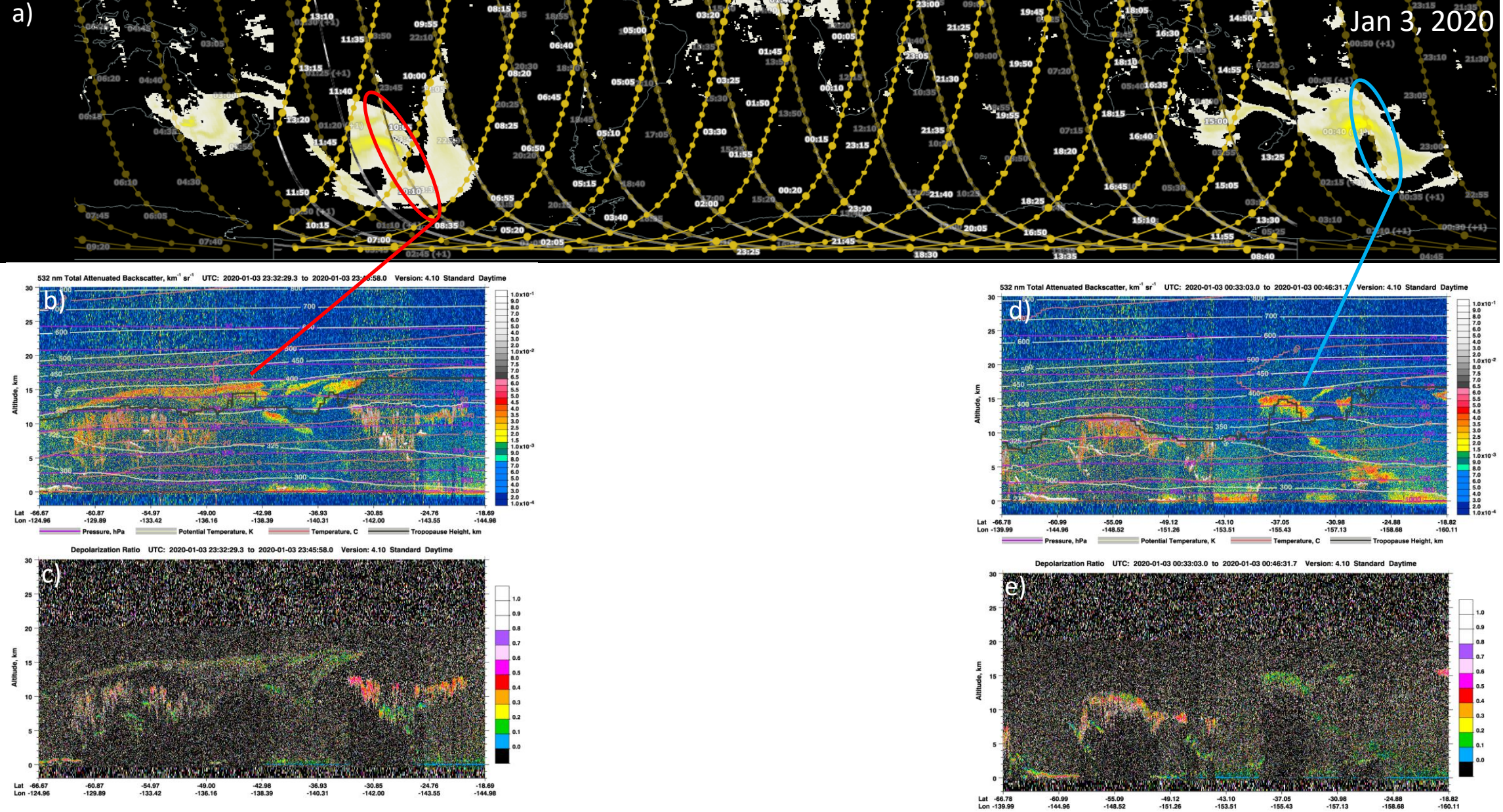


Figure S6. For figure description, see Text S1.

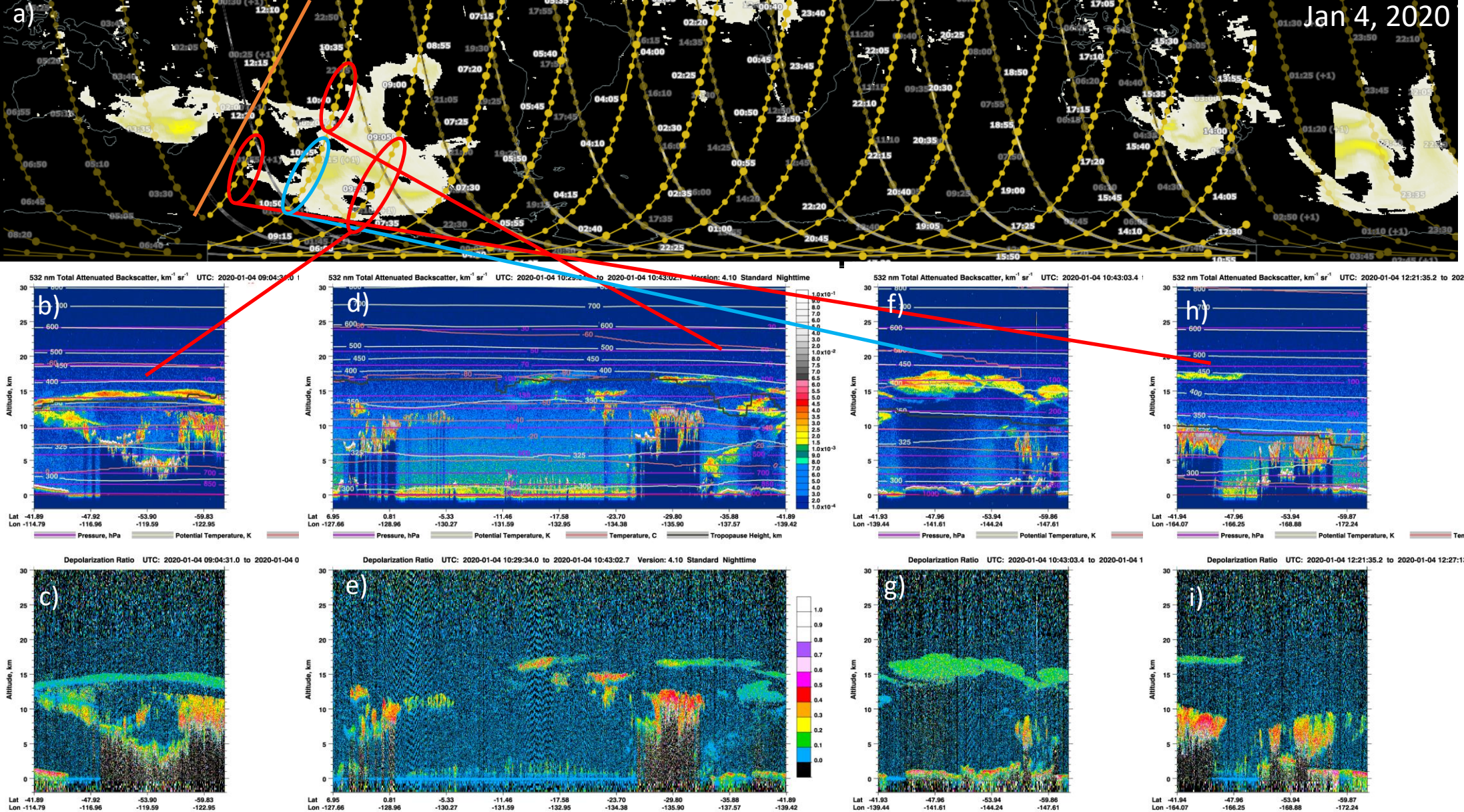


Figure S7. For figure description, see Text S1.

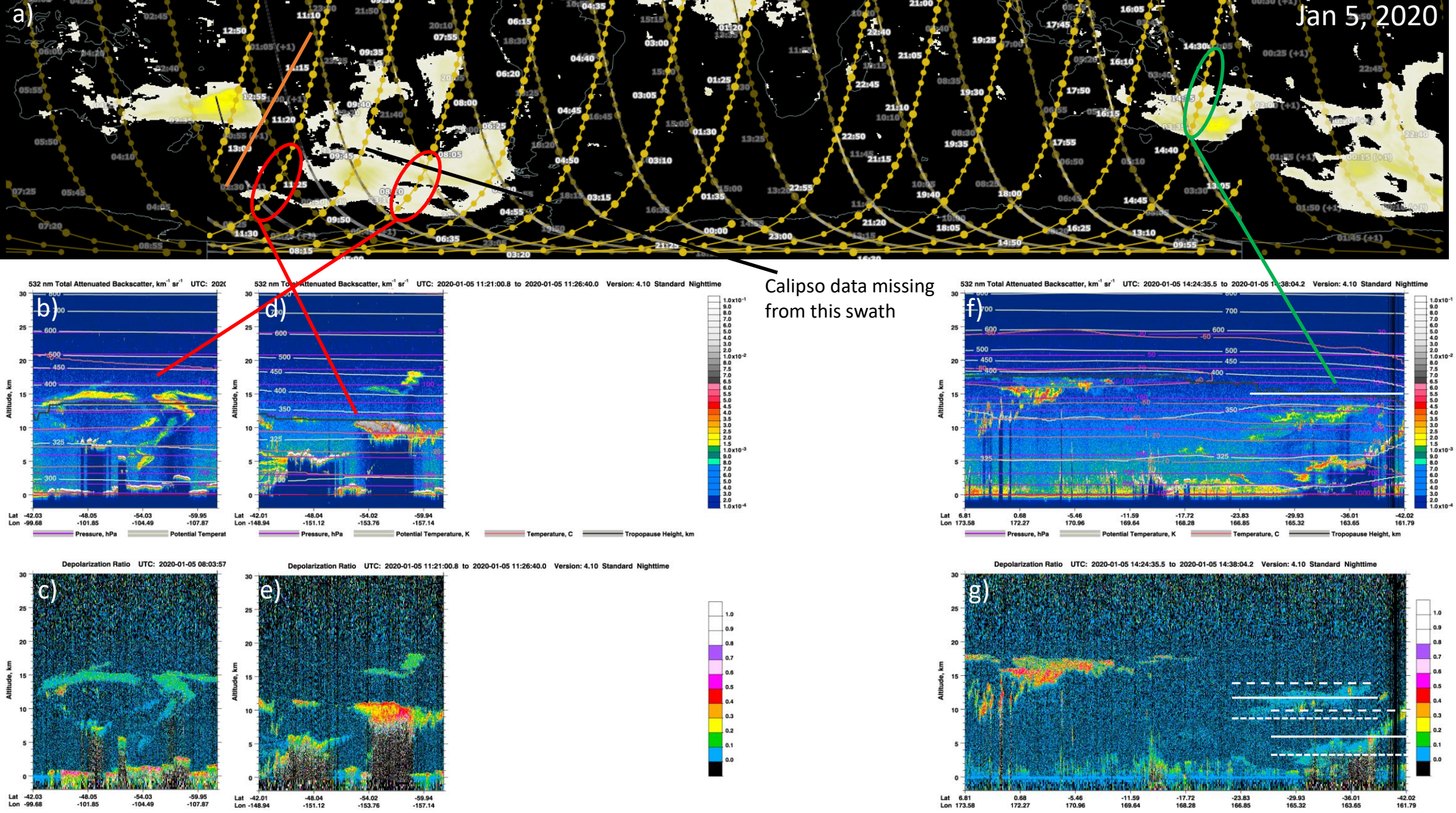


Figure S8. For figure description, see Text S1.

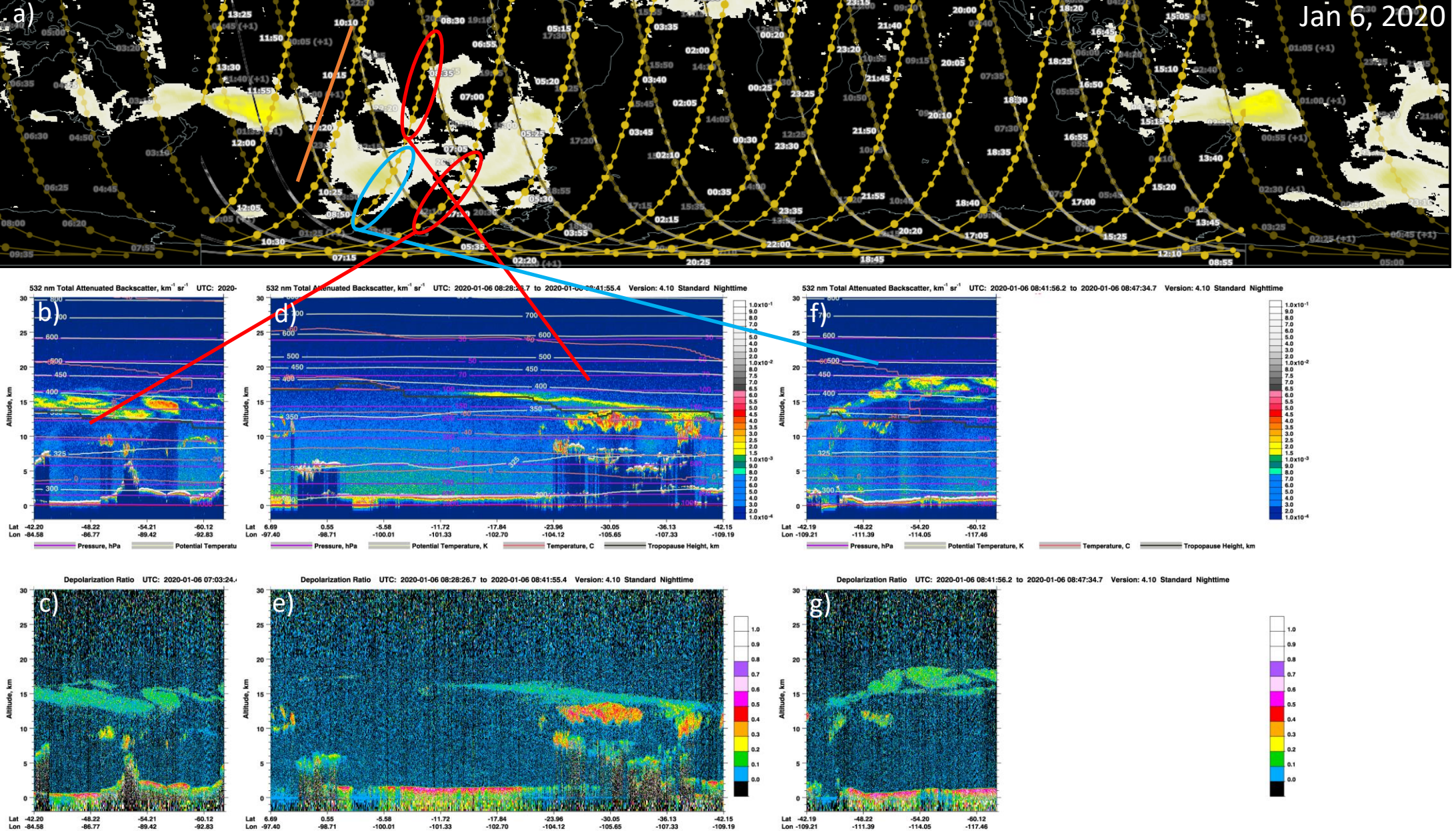


Figure S9. For figure description, see Text S1.

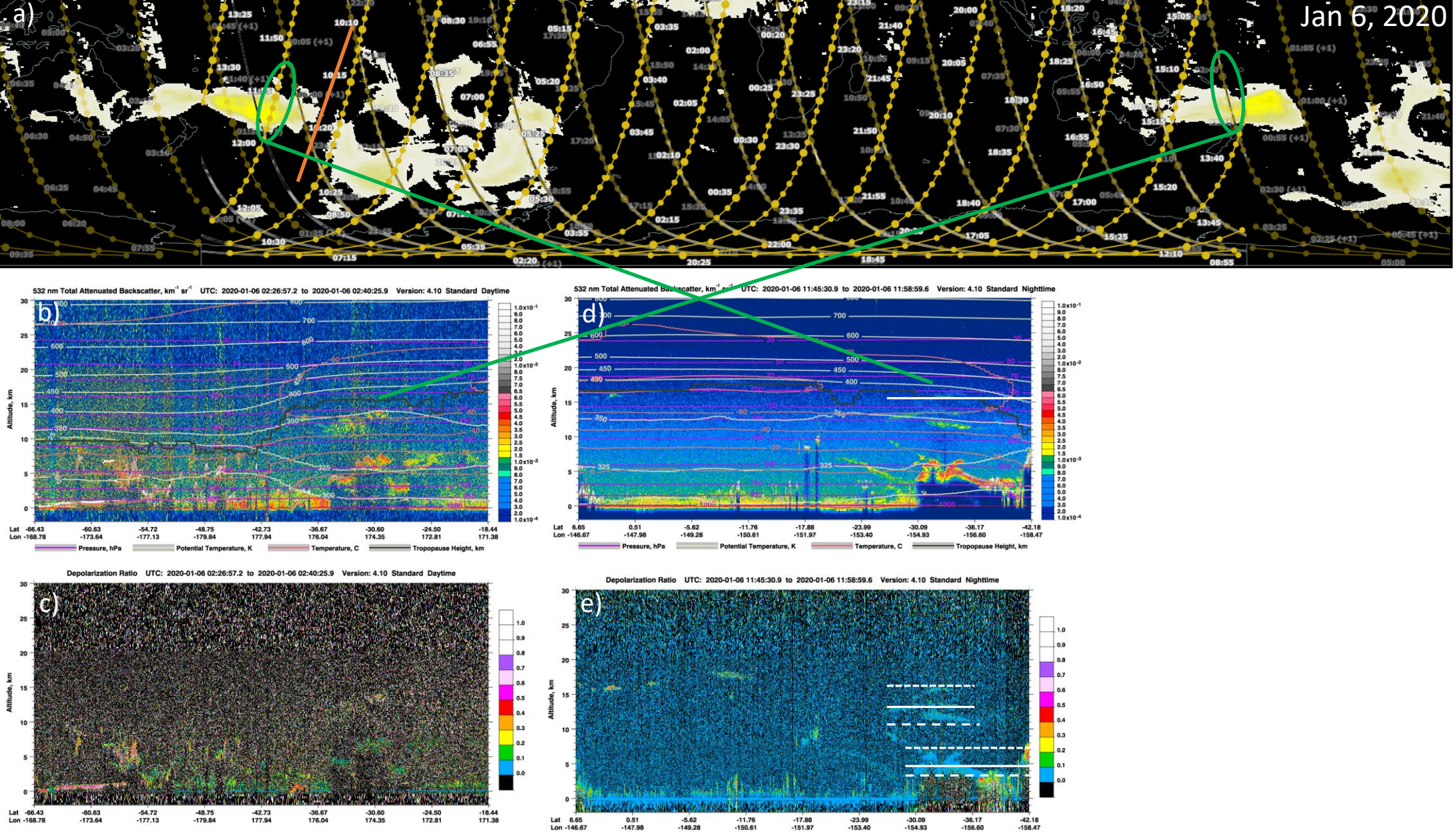


Figure S10. For figure description, see Text S1.

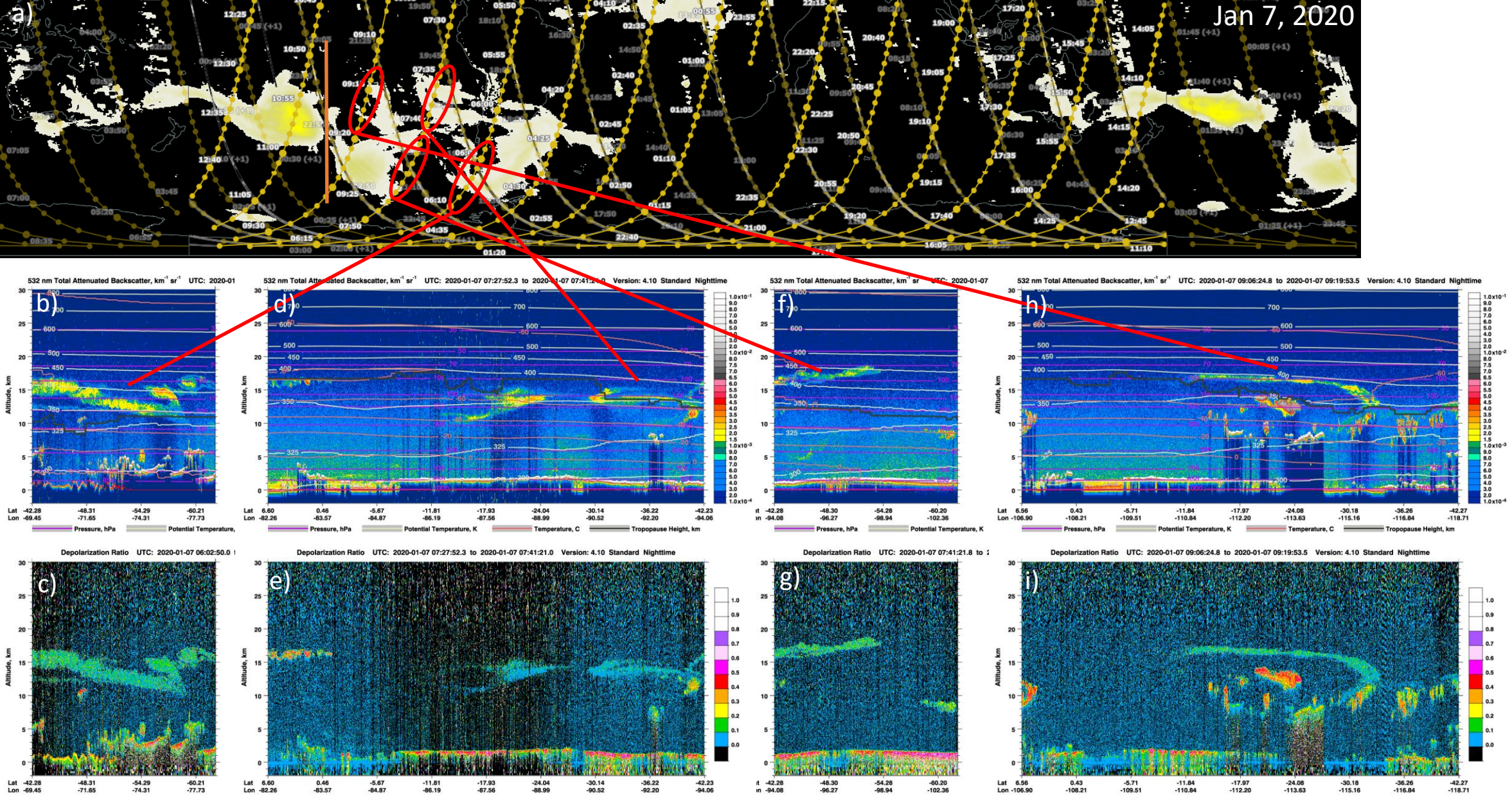


Figure S11. For figure description, see Text S1.

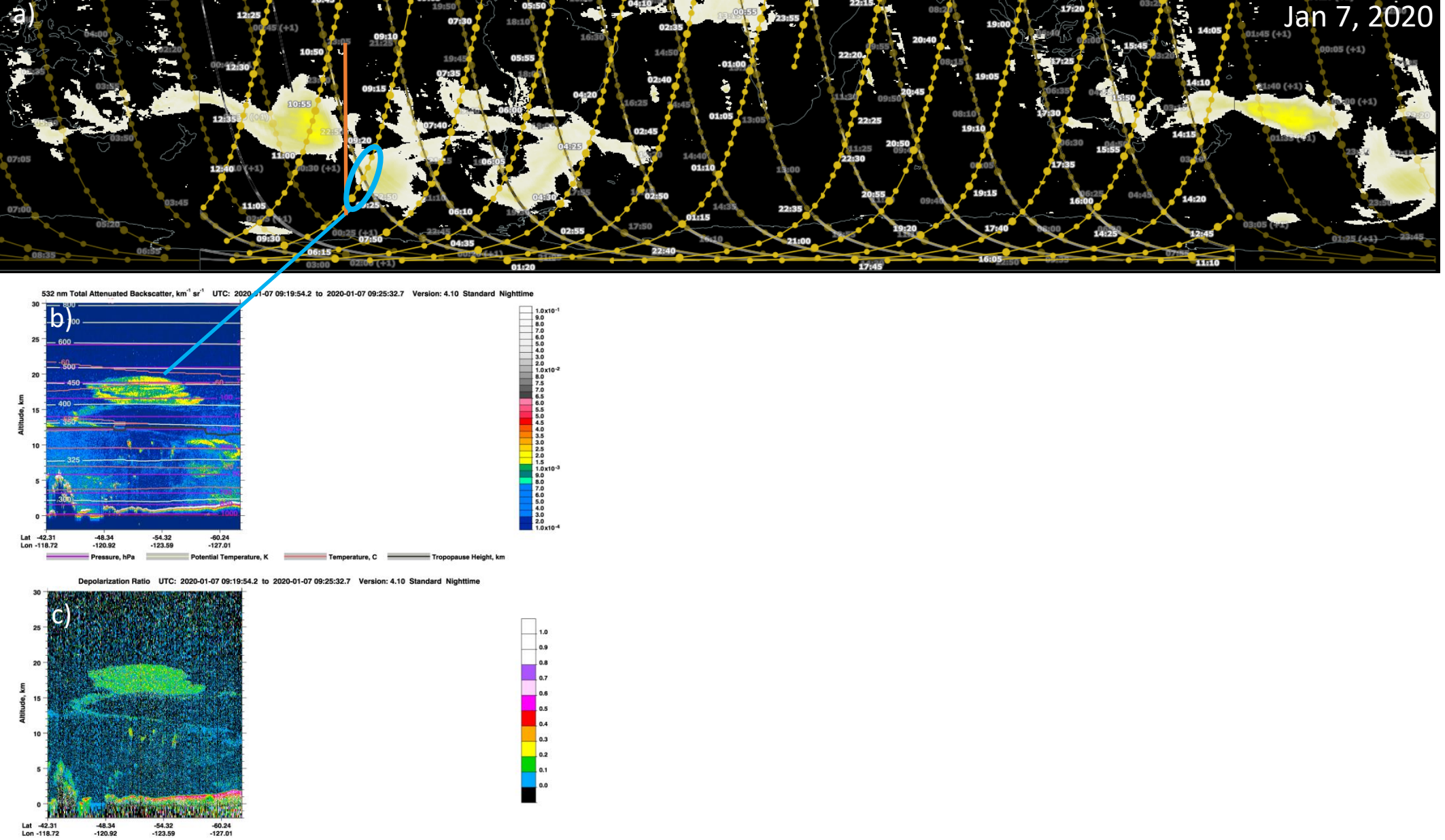


Figure S12. For figure description, see Text S1.

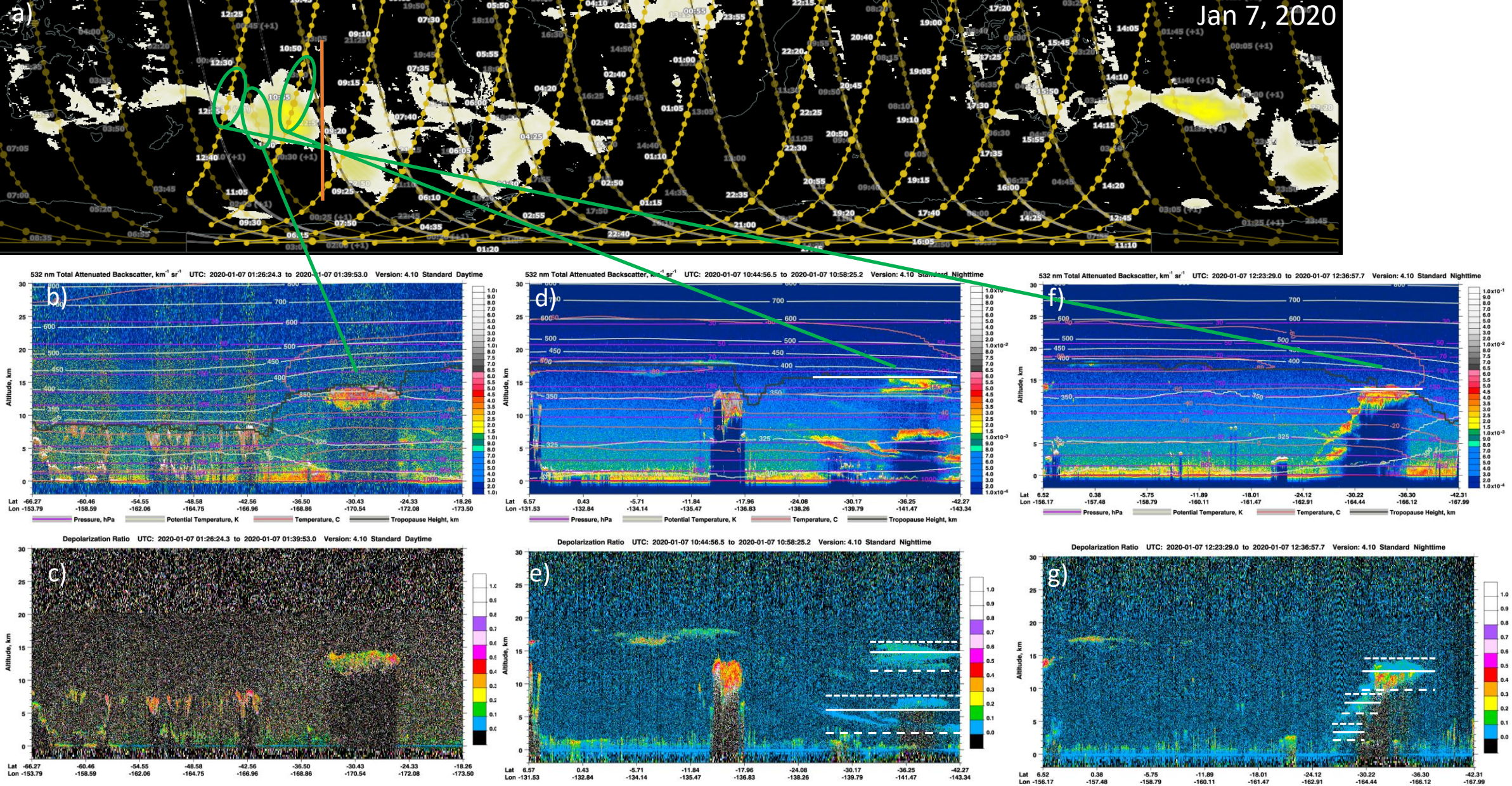


Figure S13. For figure description, see Text S1.

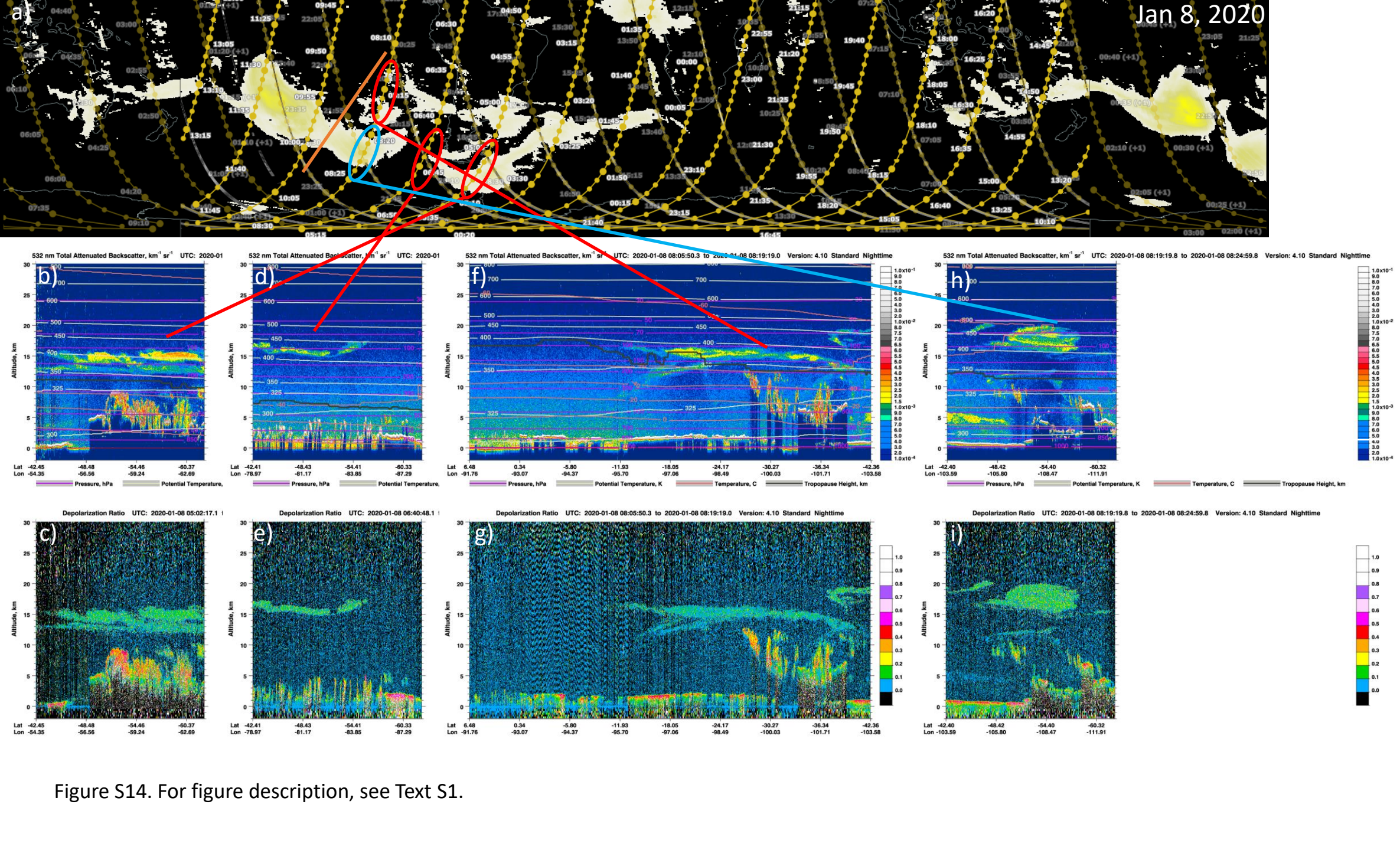


Figure S14. For figure description, see Text S1.

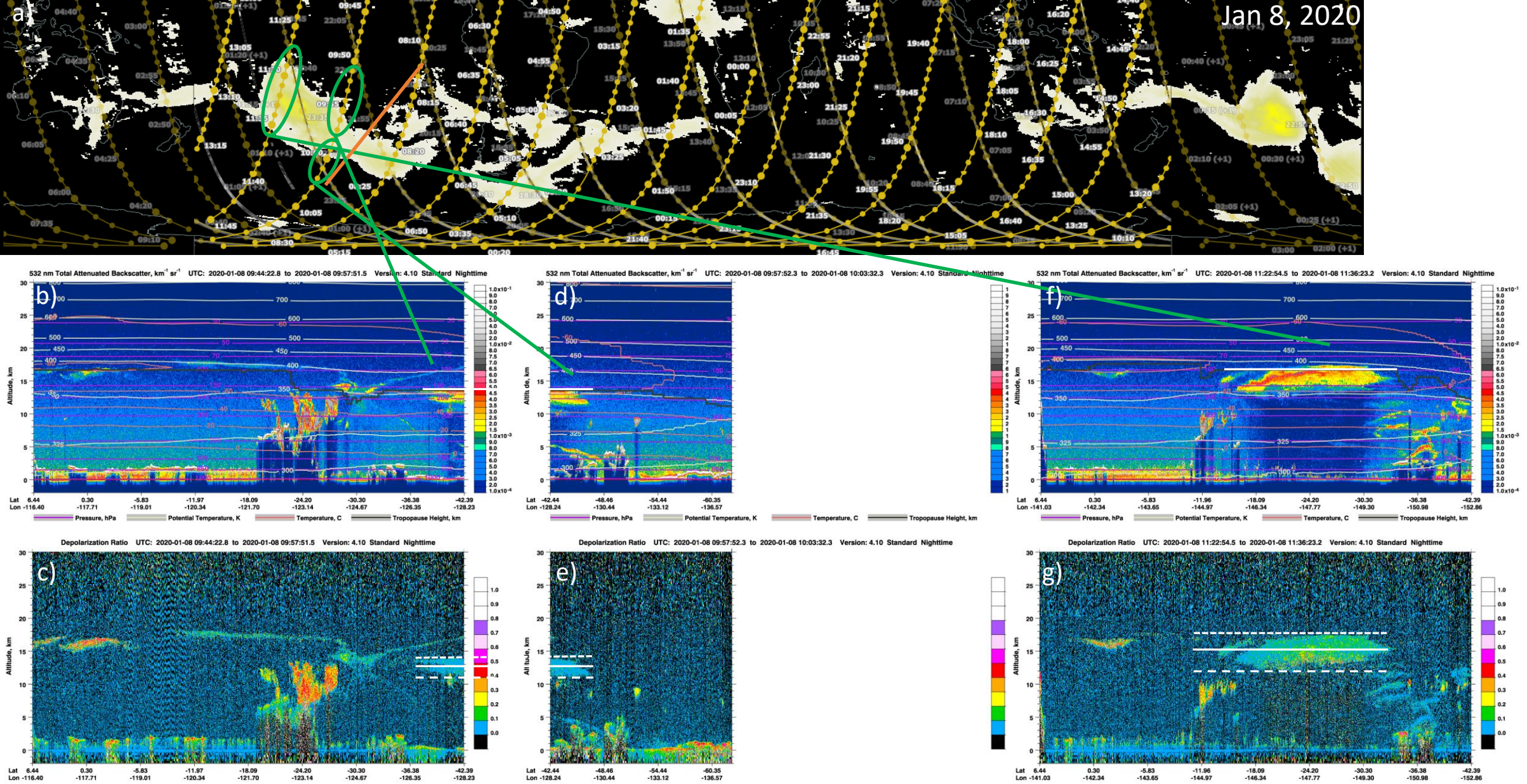


Figure S15. For figure description, see Text S1.

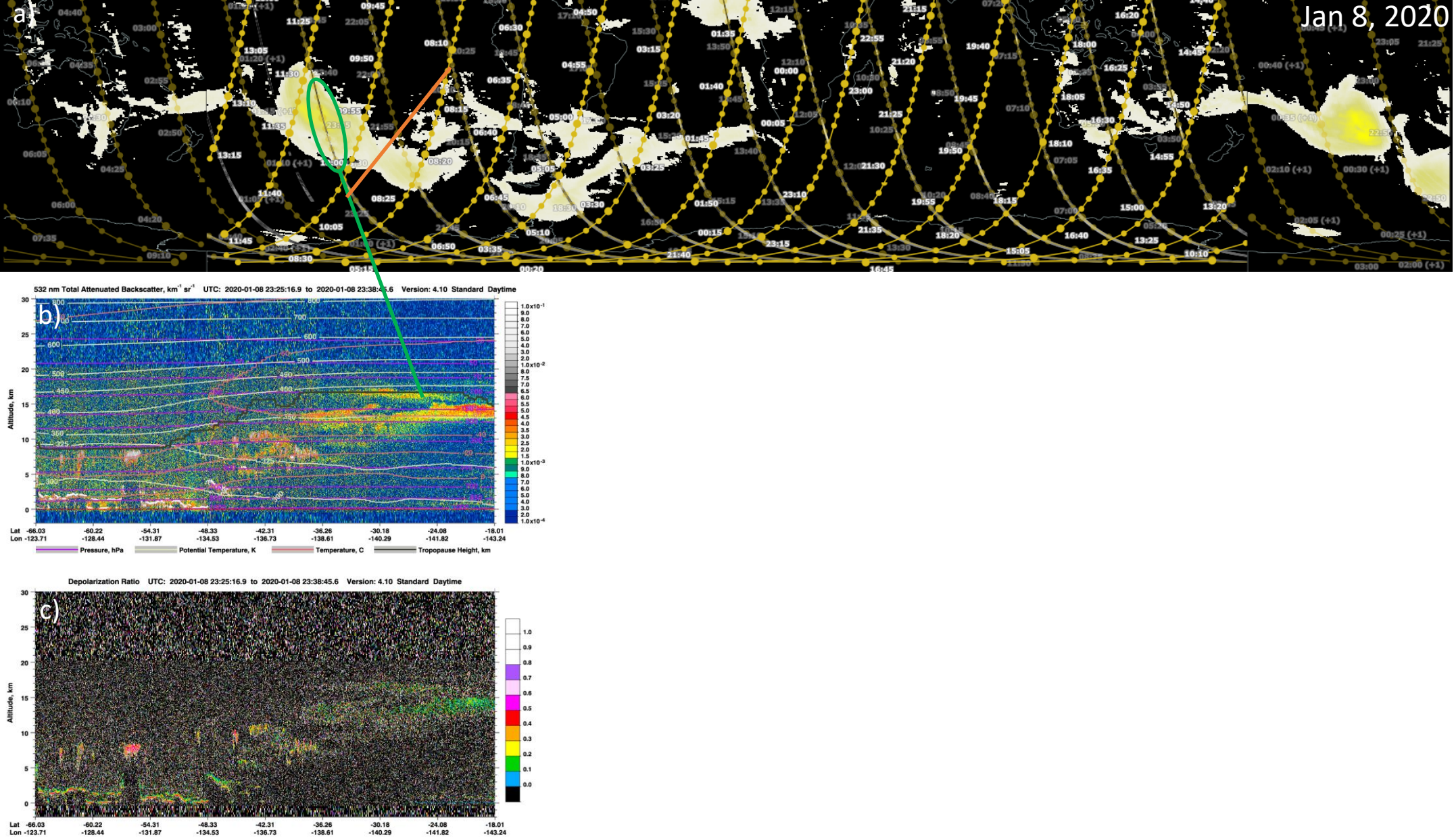


Figure S16. For figure description, see Text S1.

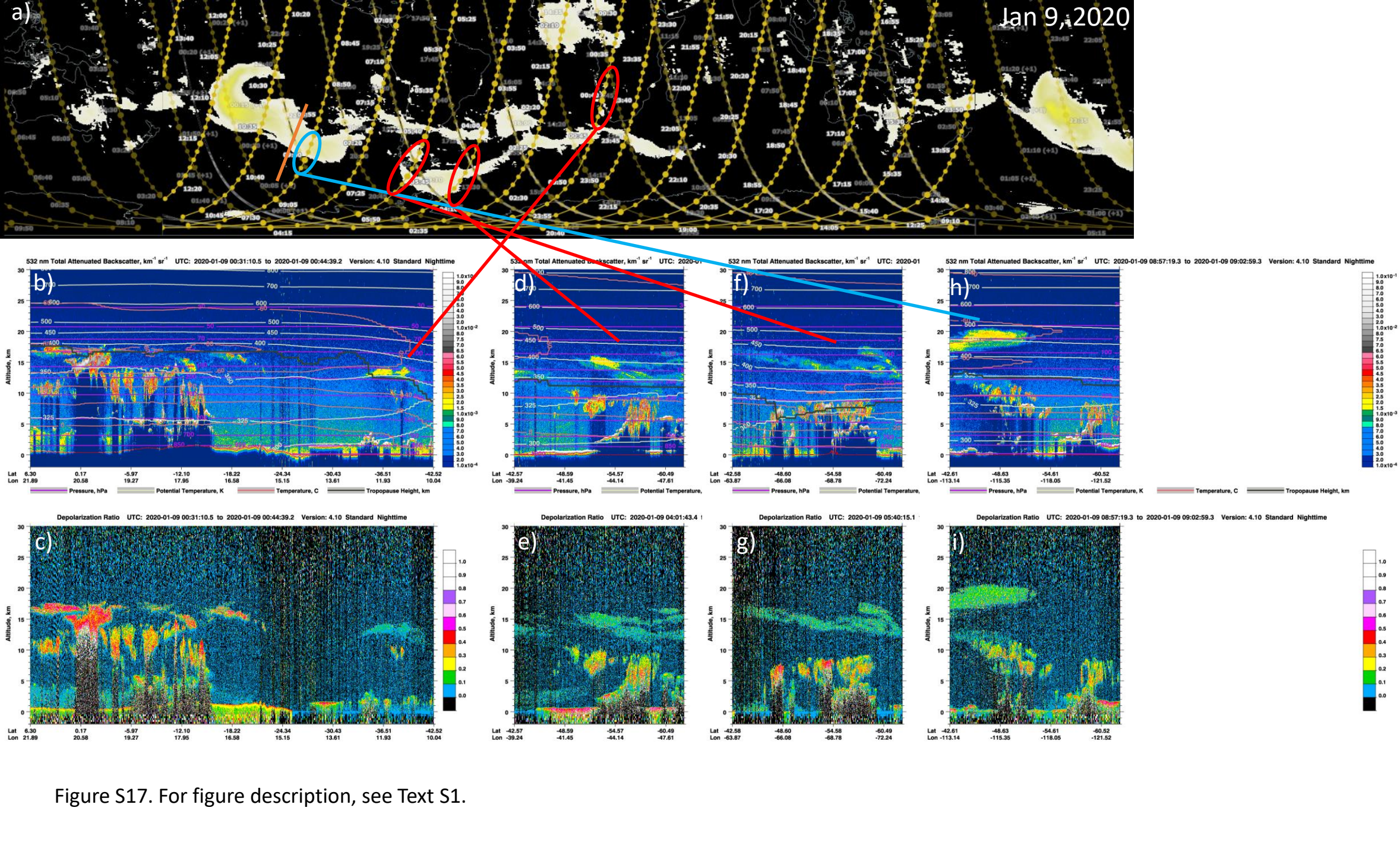


Figure S17. For figure description, see Text S1.

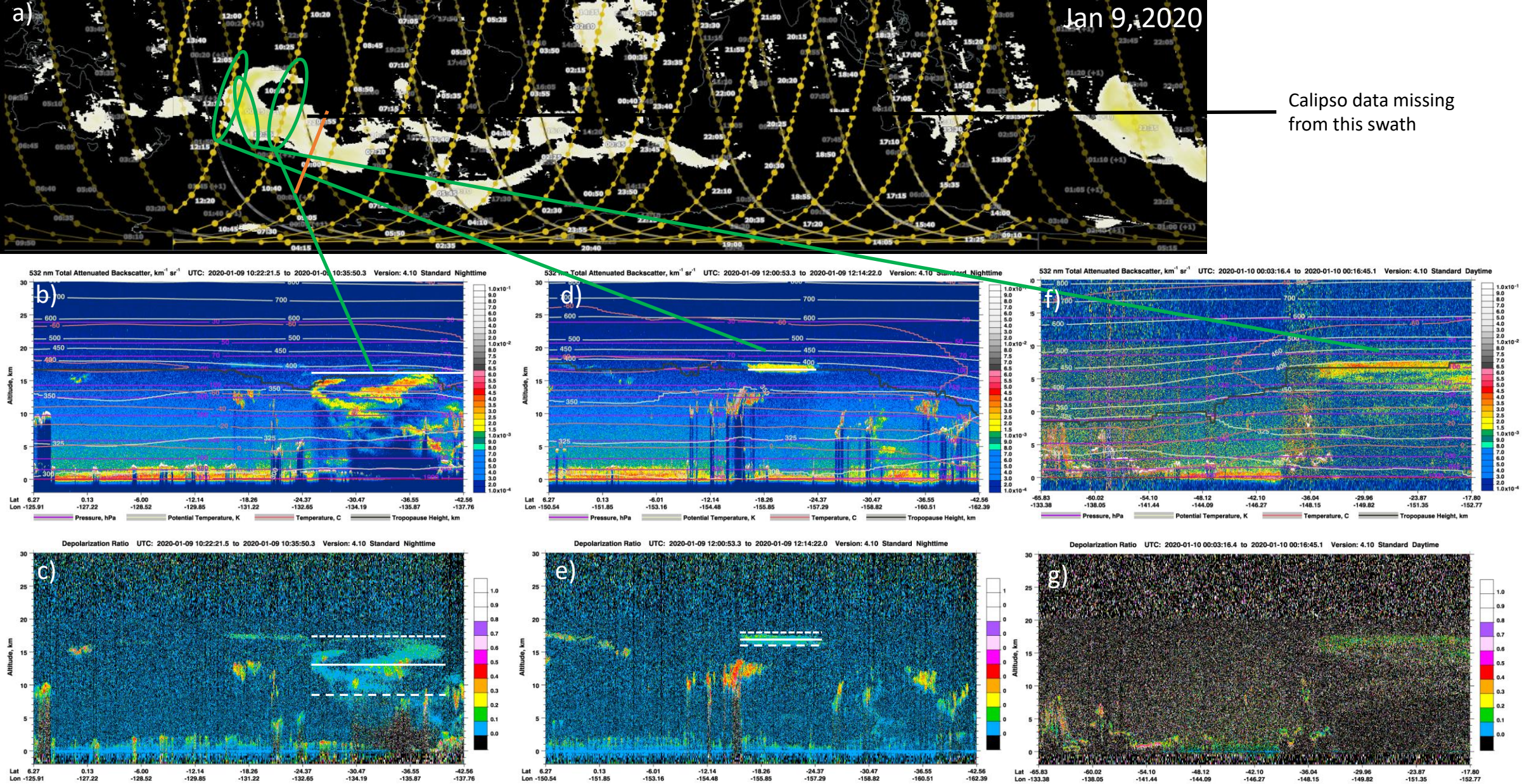


Figure S18. For figure description, see Text S1.

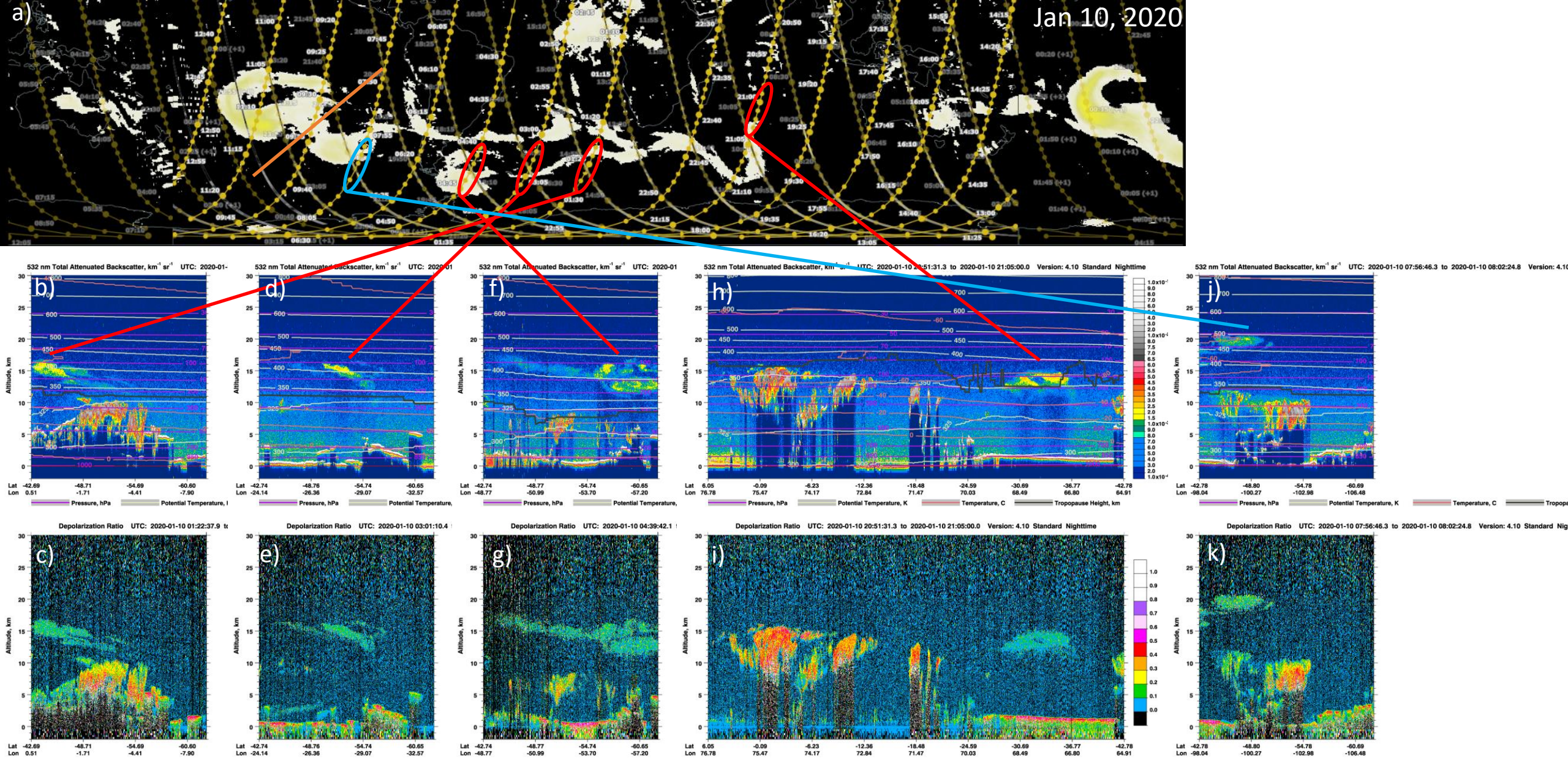


Figure S19. For figure description, see Text S1.

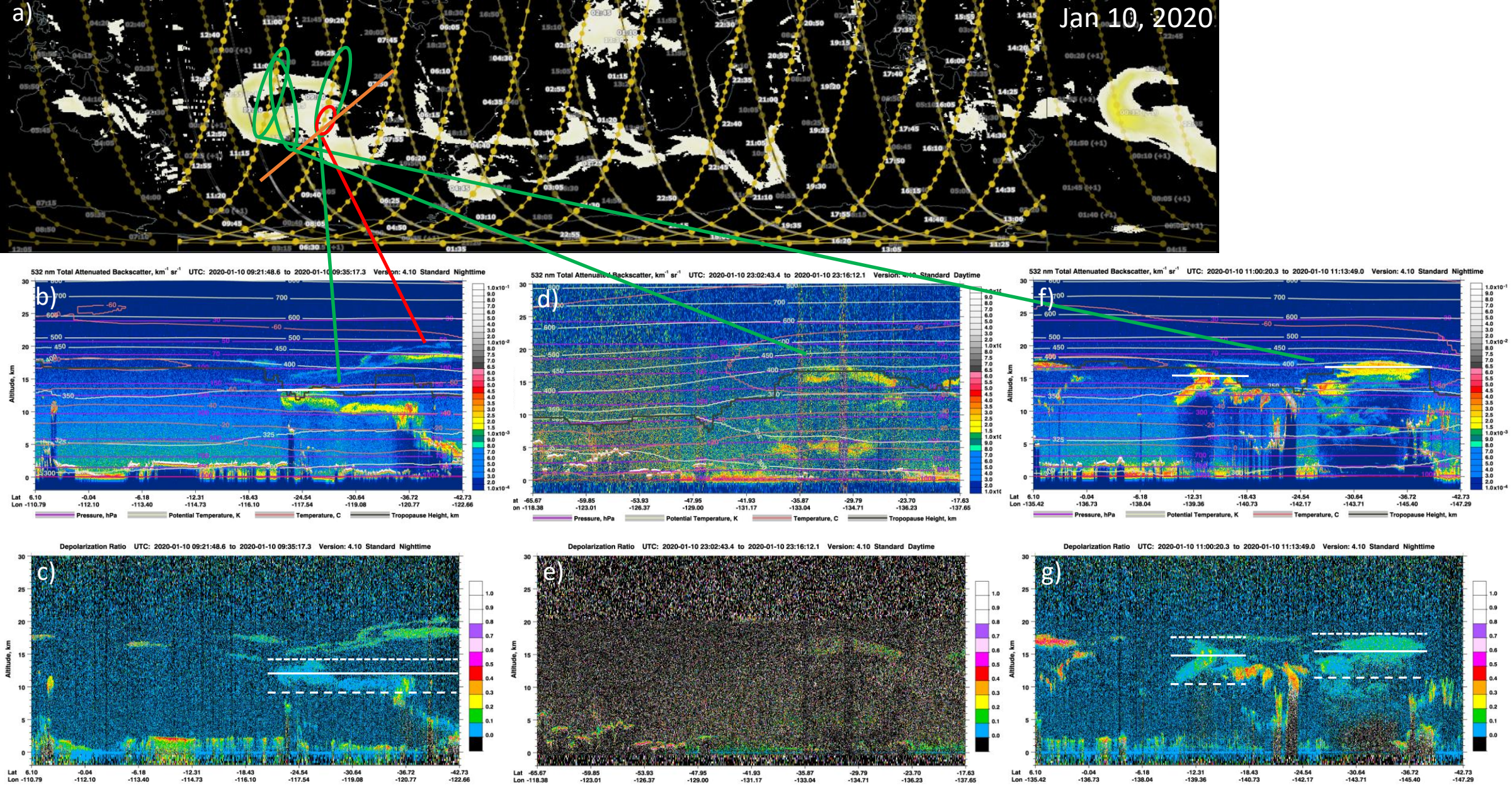


Figure S20. For figure description, see Text S1.

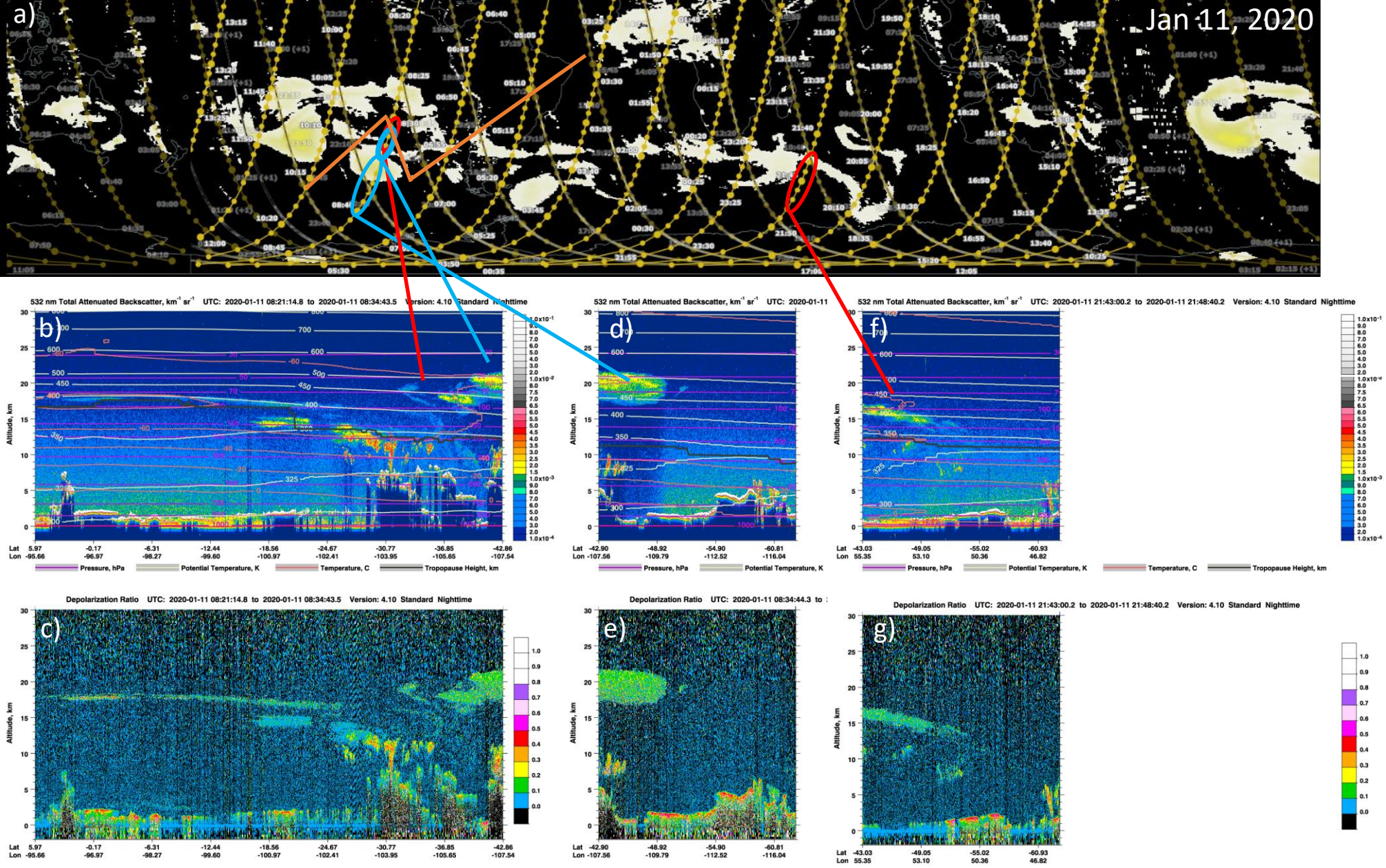


Figure S21. For figure description, see Text S1.

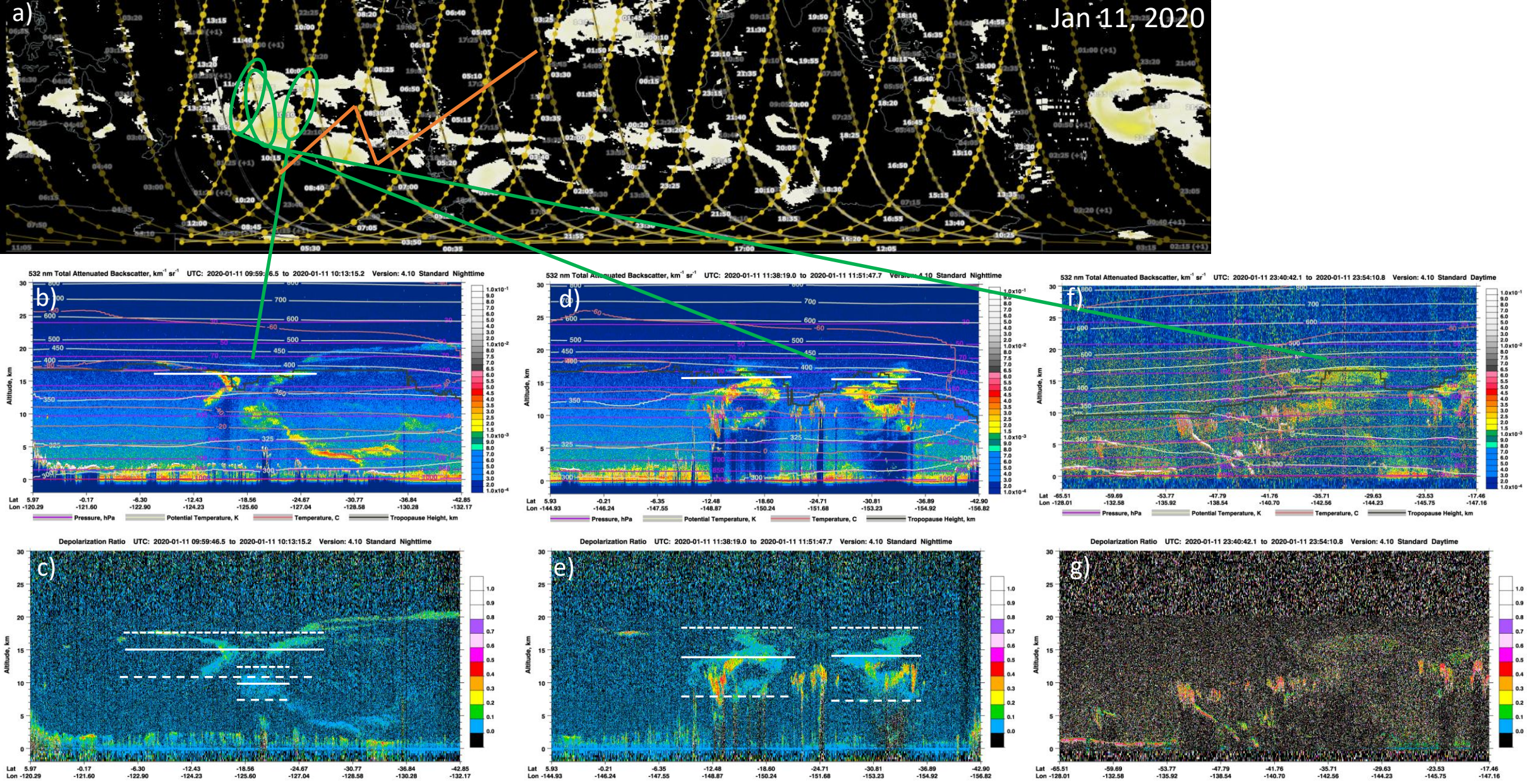


Figure S22. For figure description, see Text S1.

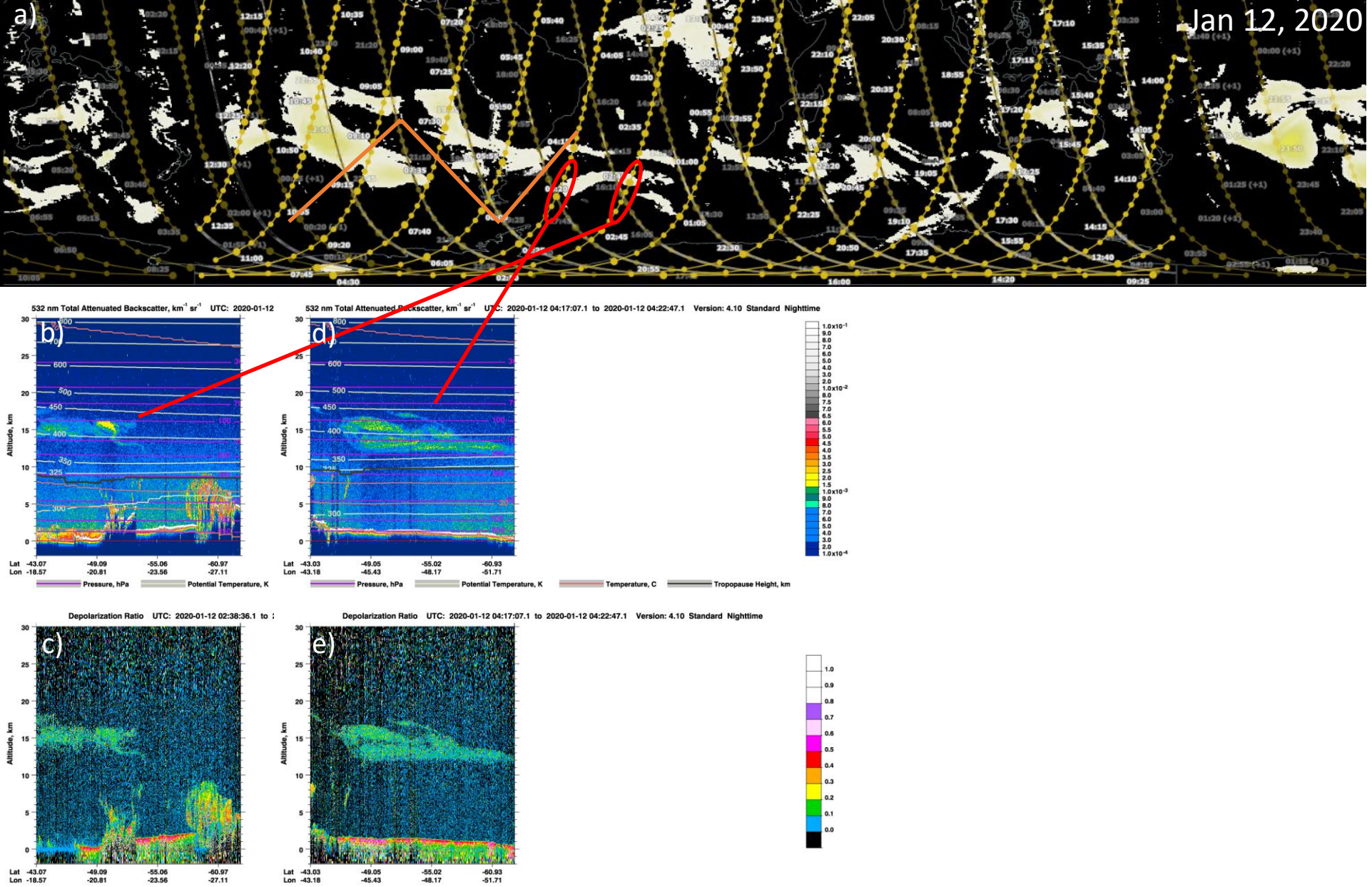


Figure S23. For figure description, see Text S1.

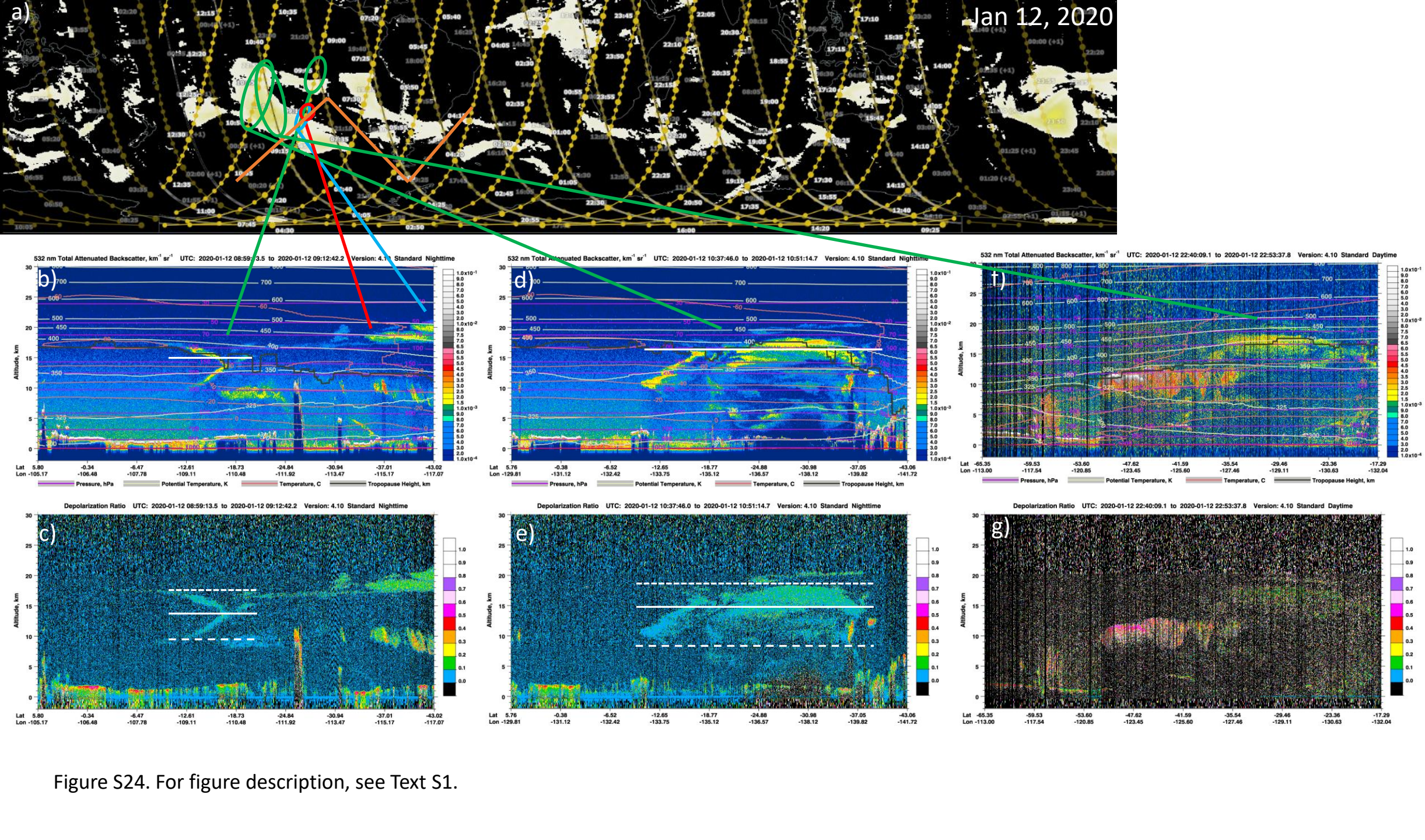


Figure S24. For figure description, see Text S1.

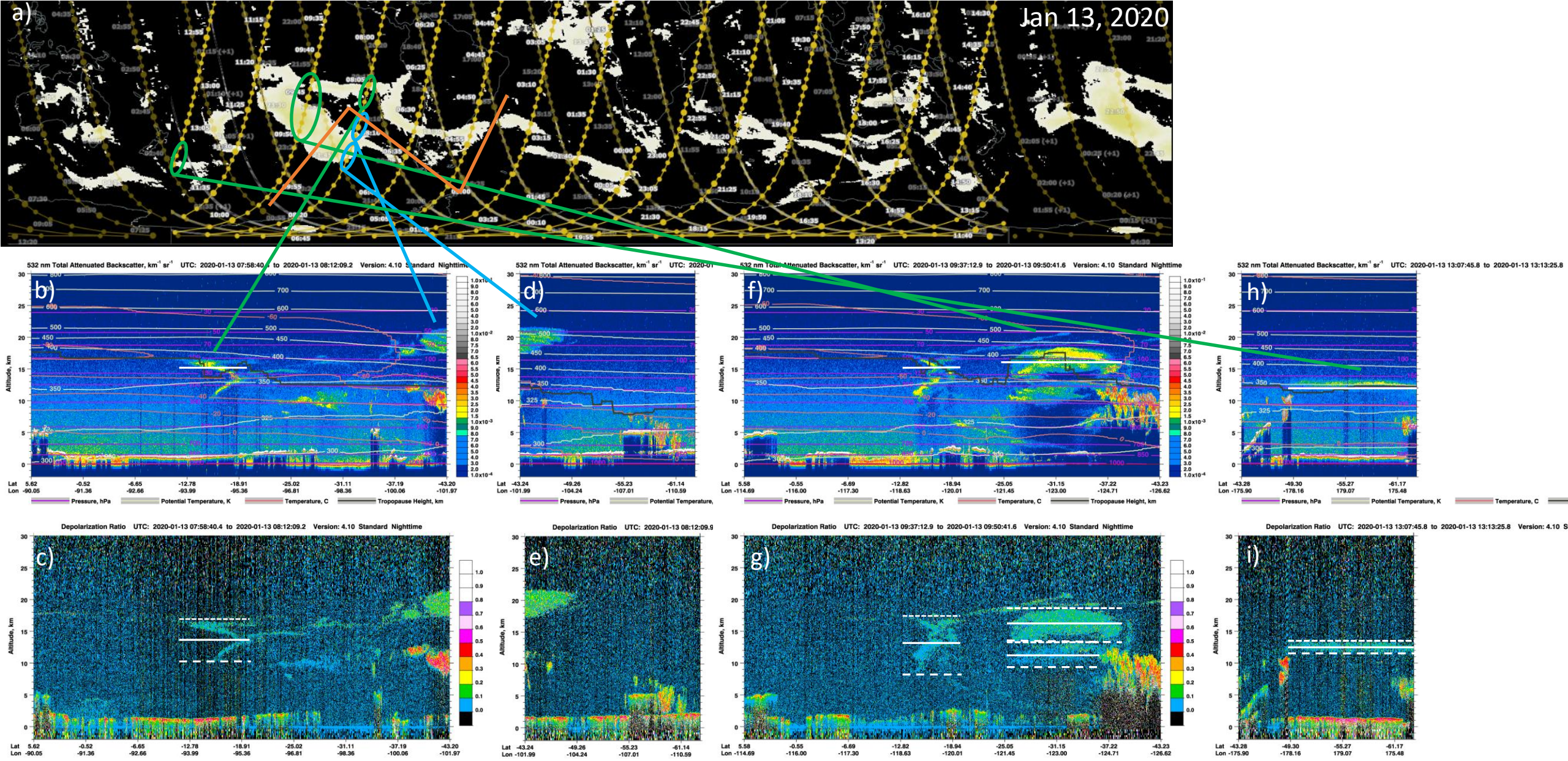


Figure S25. For figure description, see Text S1.

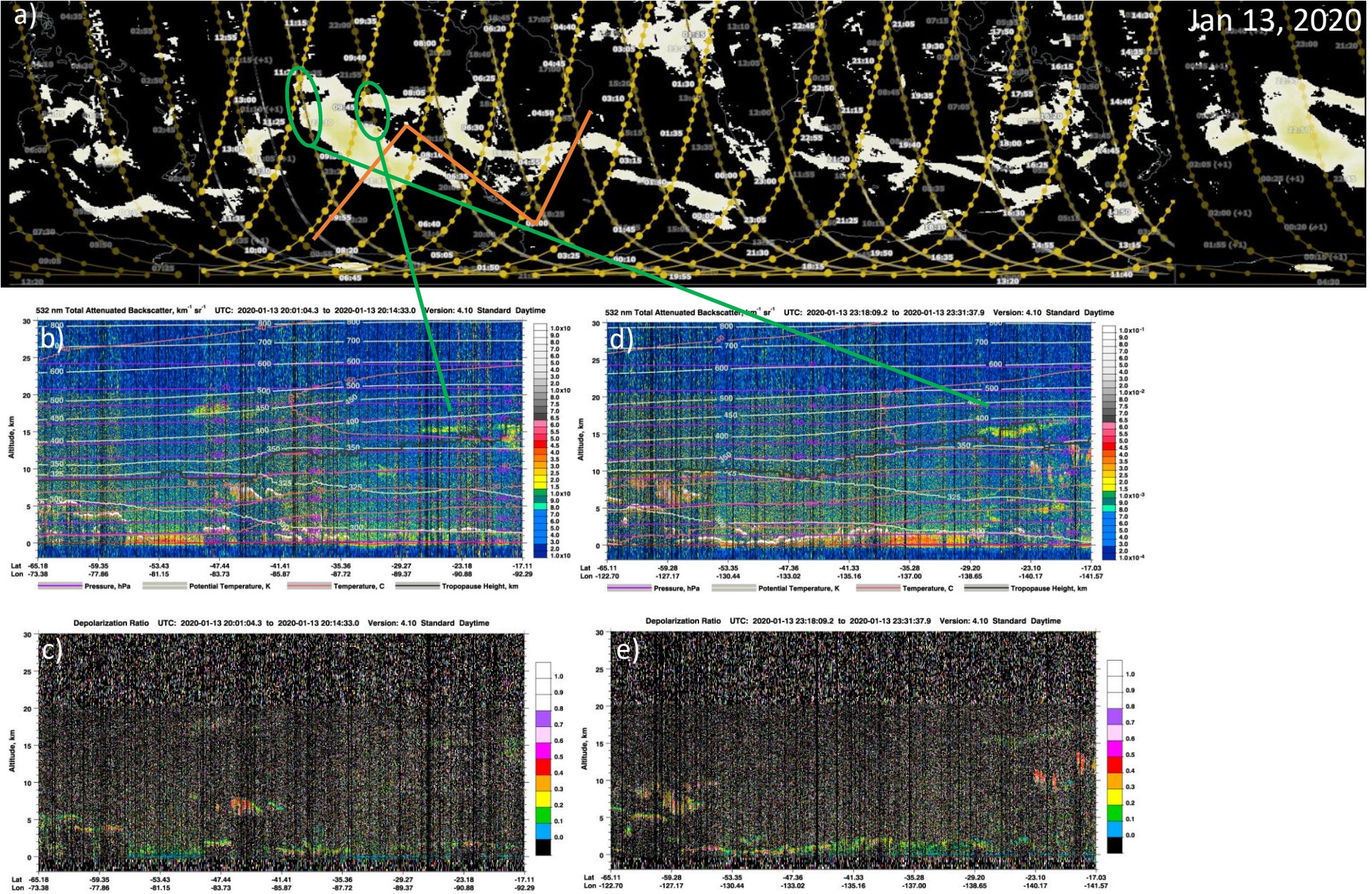


Figure S26. For figure description, see Text S1.

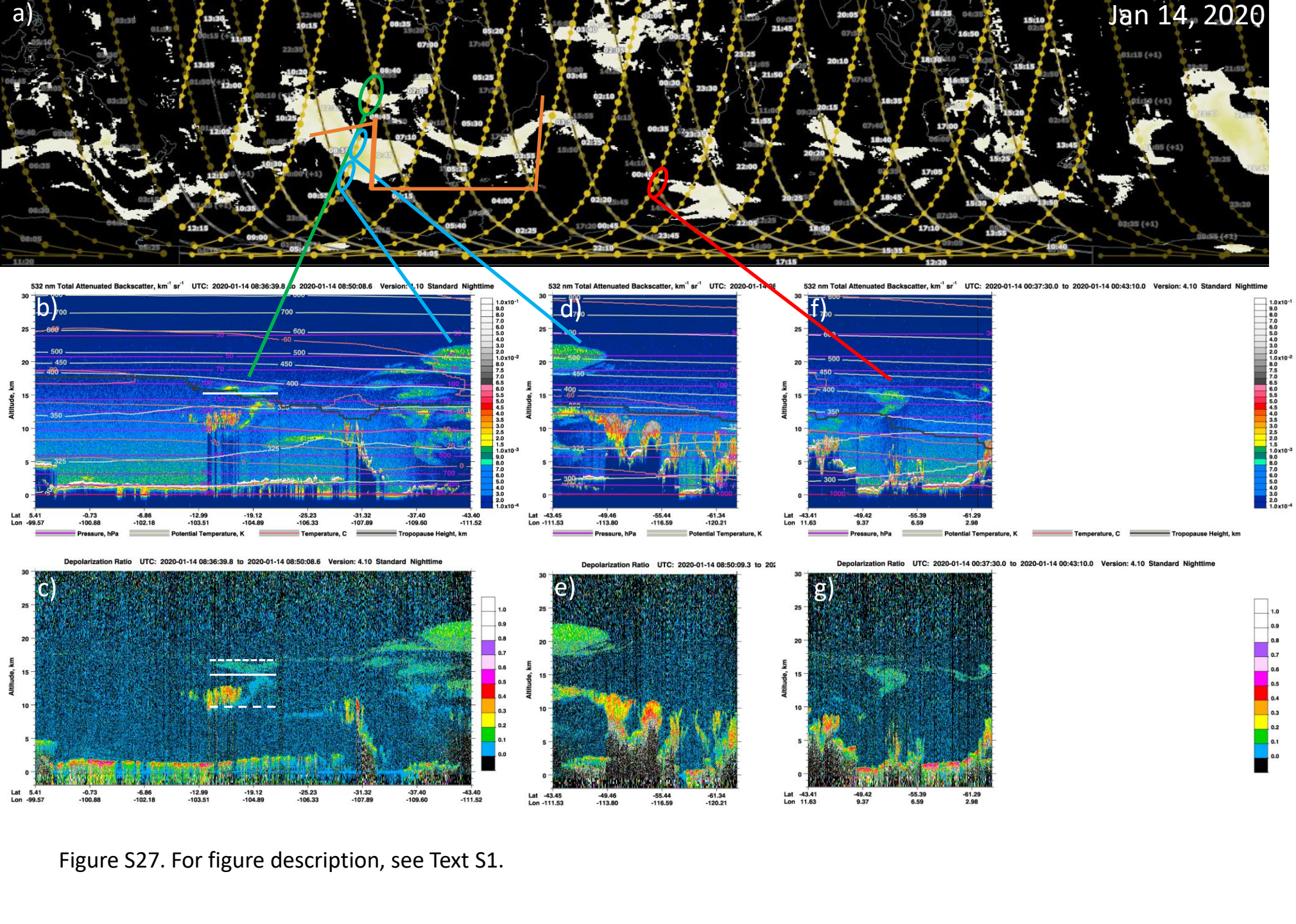


Figure S27. For figure description, see Text S1.

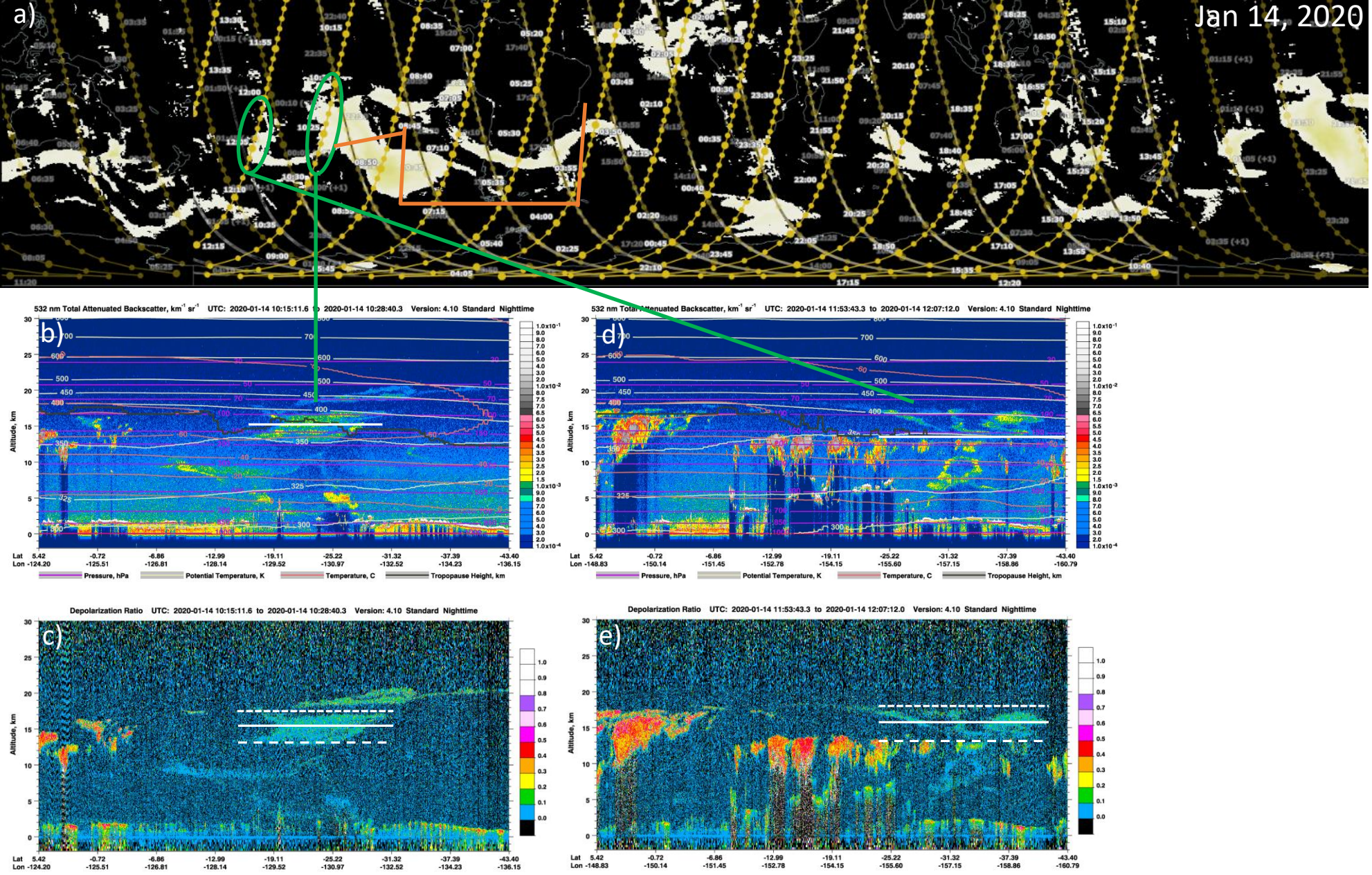


Figure S28. For figure description, see Text S1.

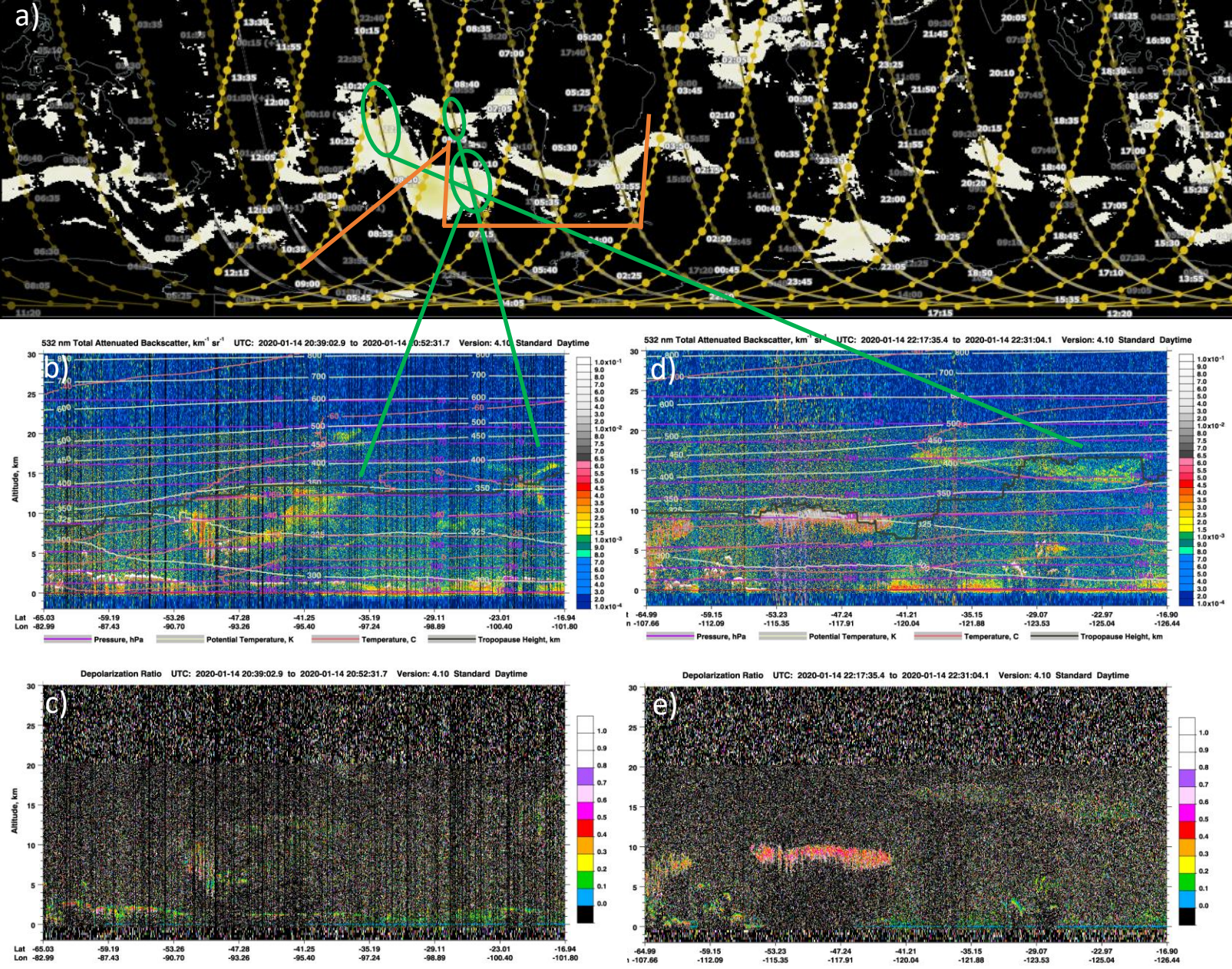


Figure S24. For figure description, see Text S1.

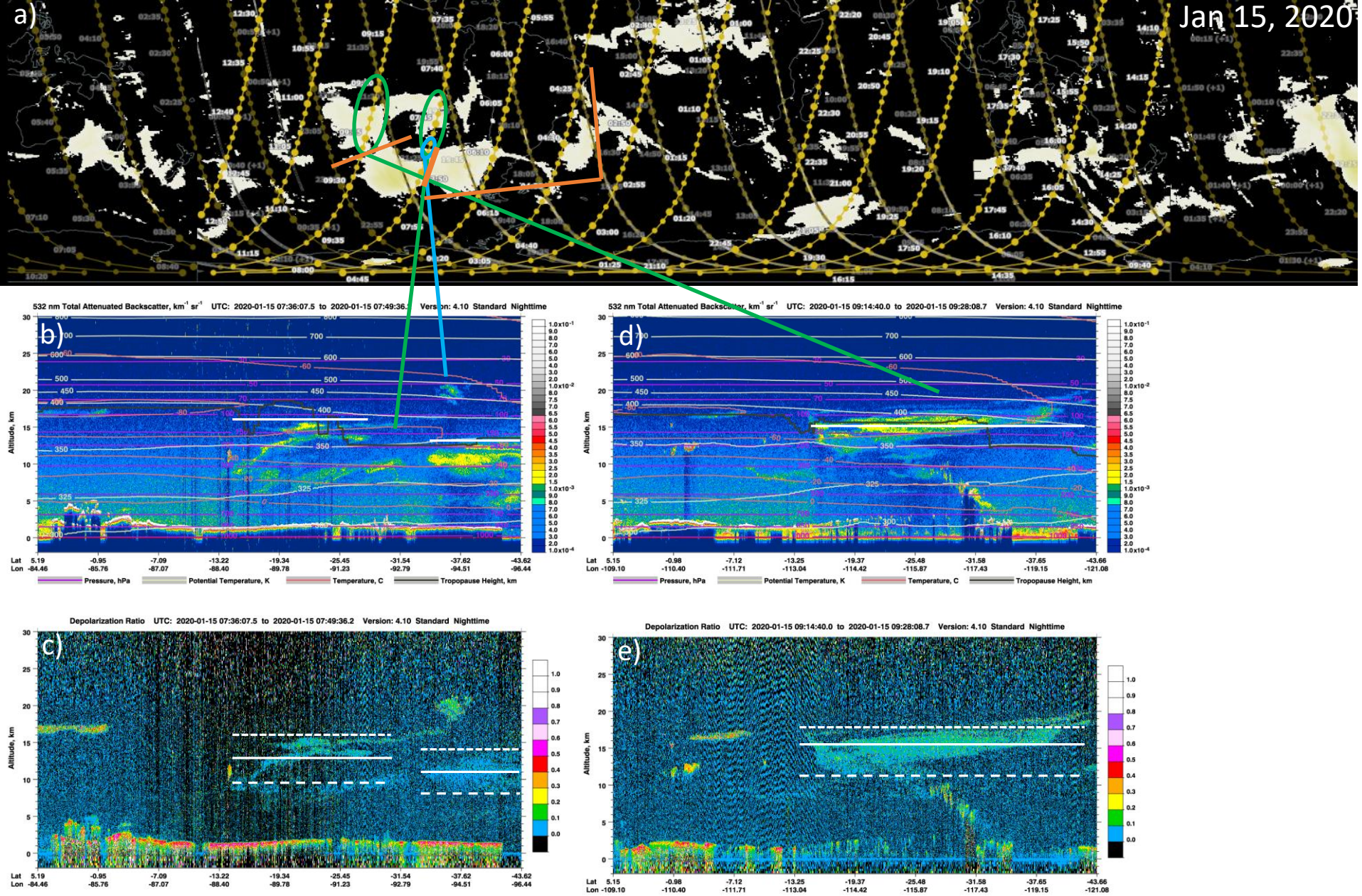


Figure S30. For figure description, see Text S1.

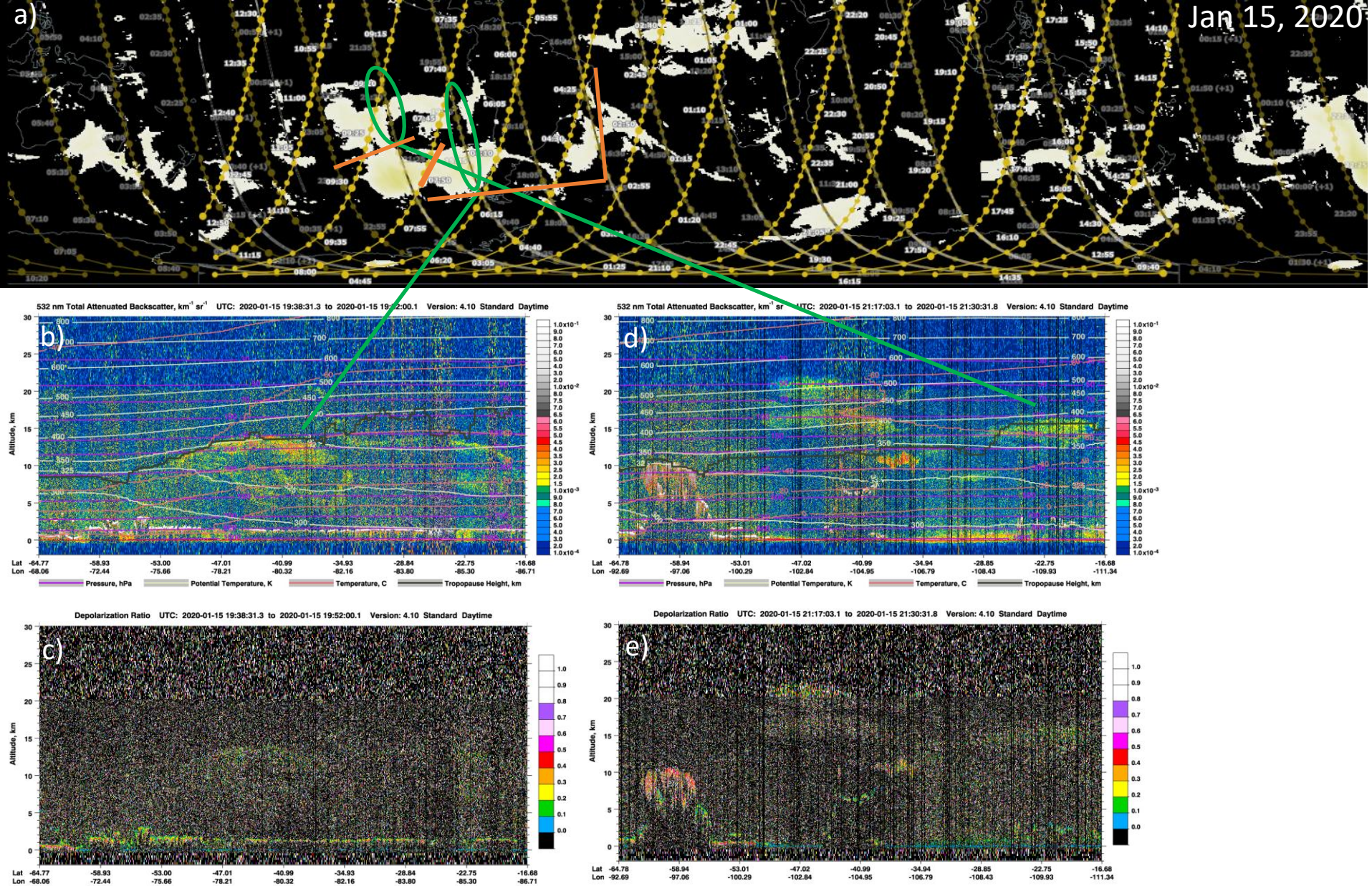


Figure S31. For figure description, see Text S1.

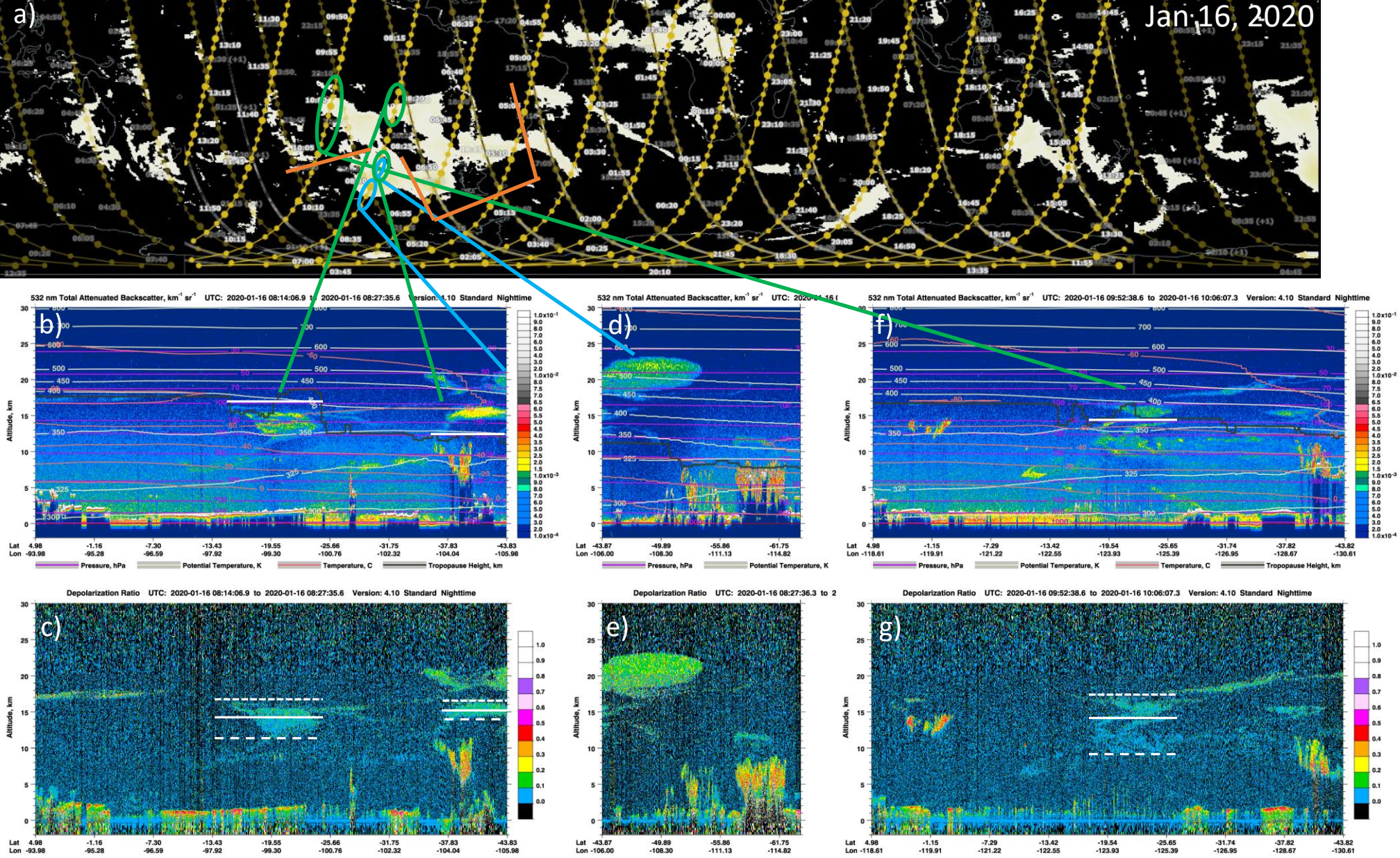


Figure S32. For figure description, see Text S1.

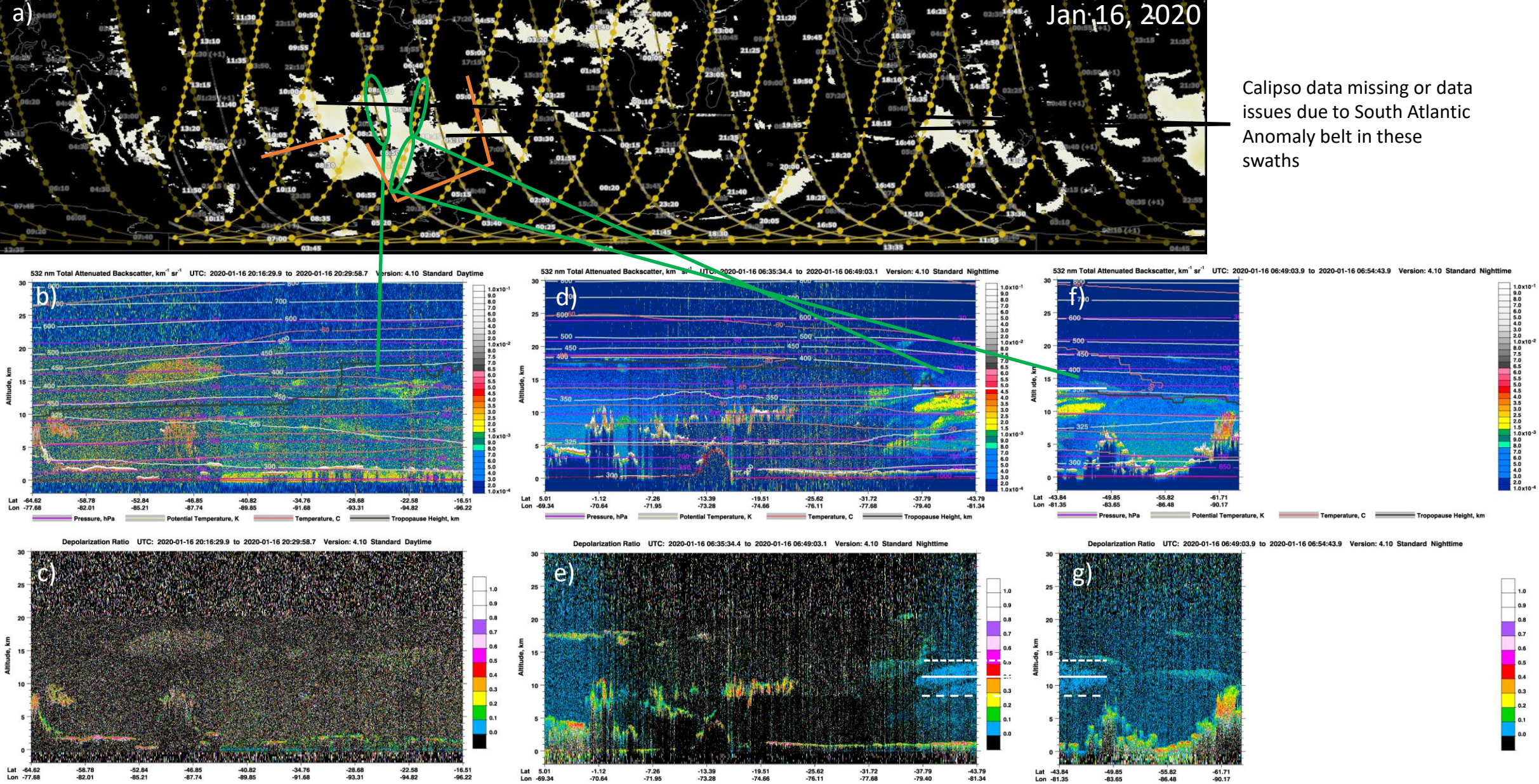


Figure S33. For figure description, see Text S1.

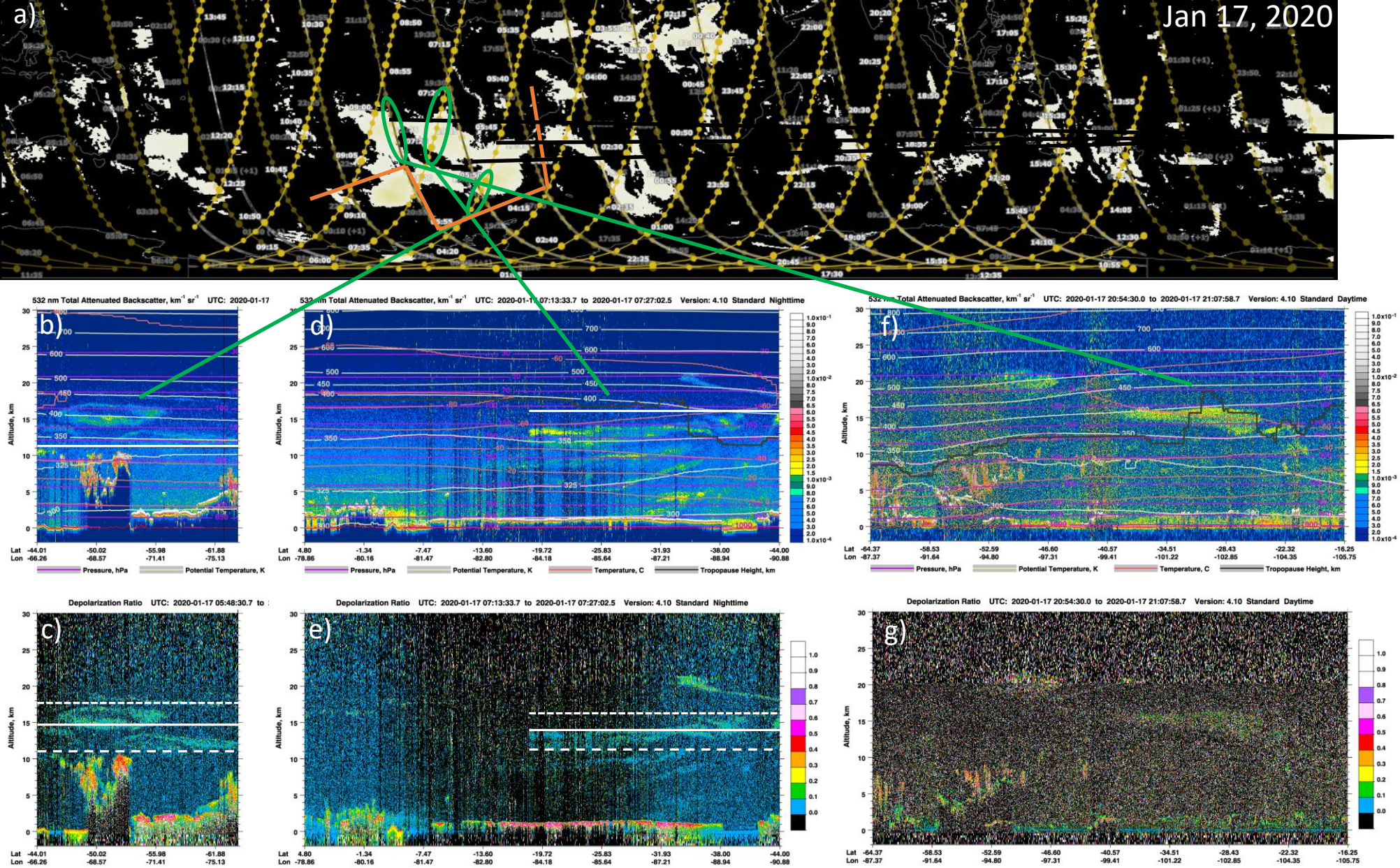


Figure S34. For figure description, see Text S1.


Calipso data missing or data issues due to South Atlantic Anomaly belt in these swaths

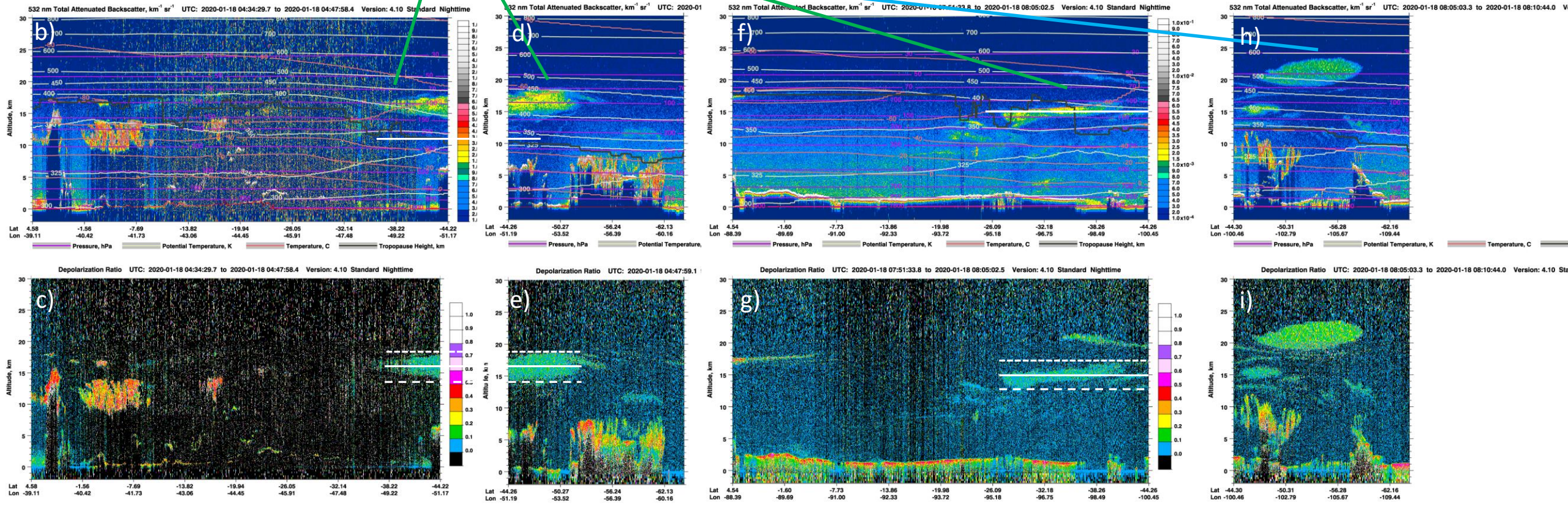





Figure S35. For figure description, see Text S1.

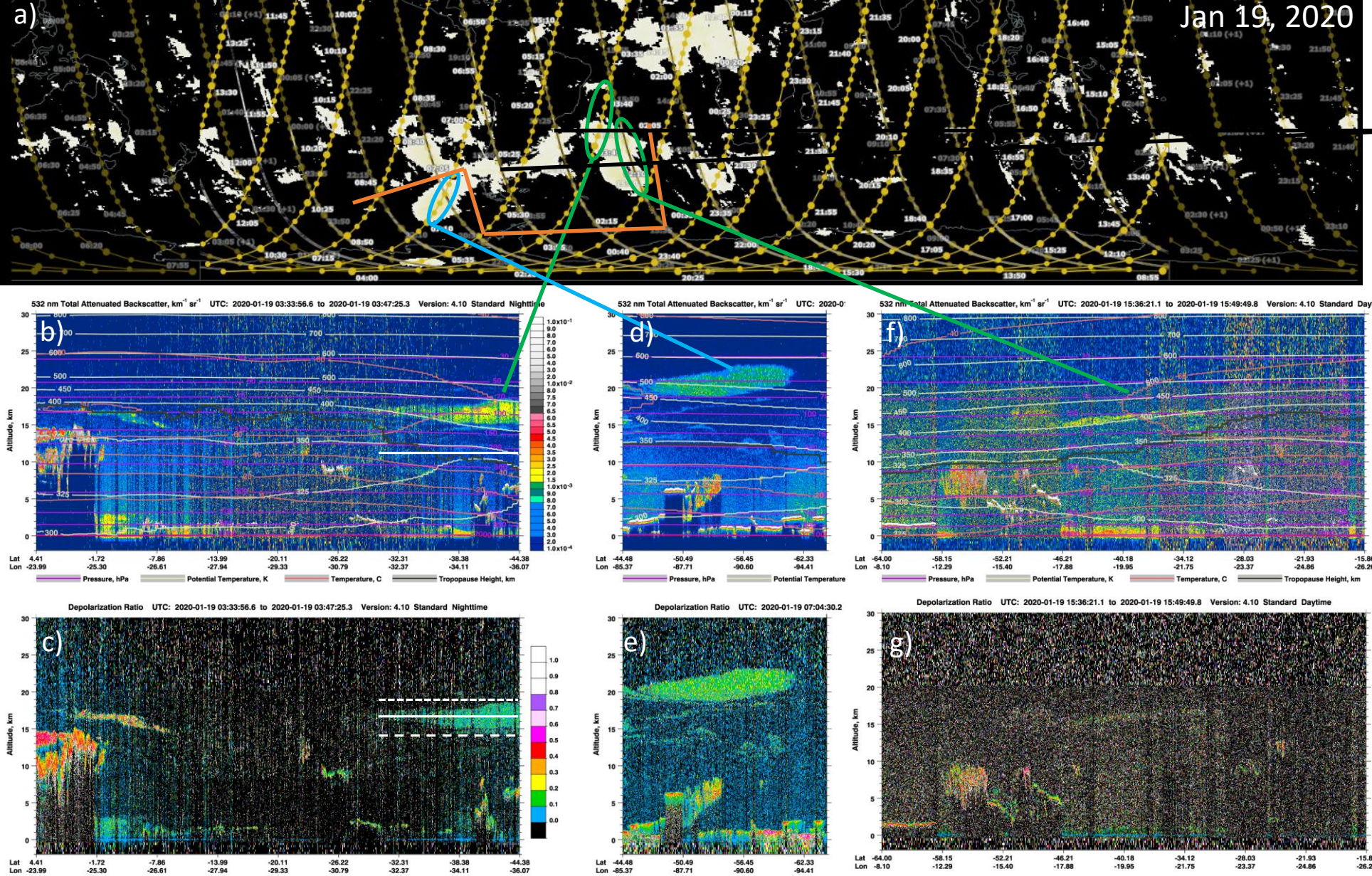


Figure S36. For figure description, see Text S1.

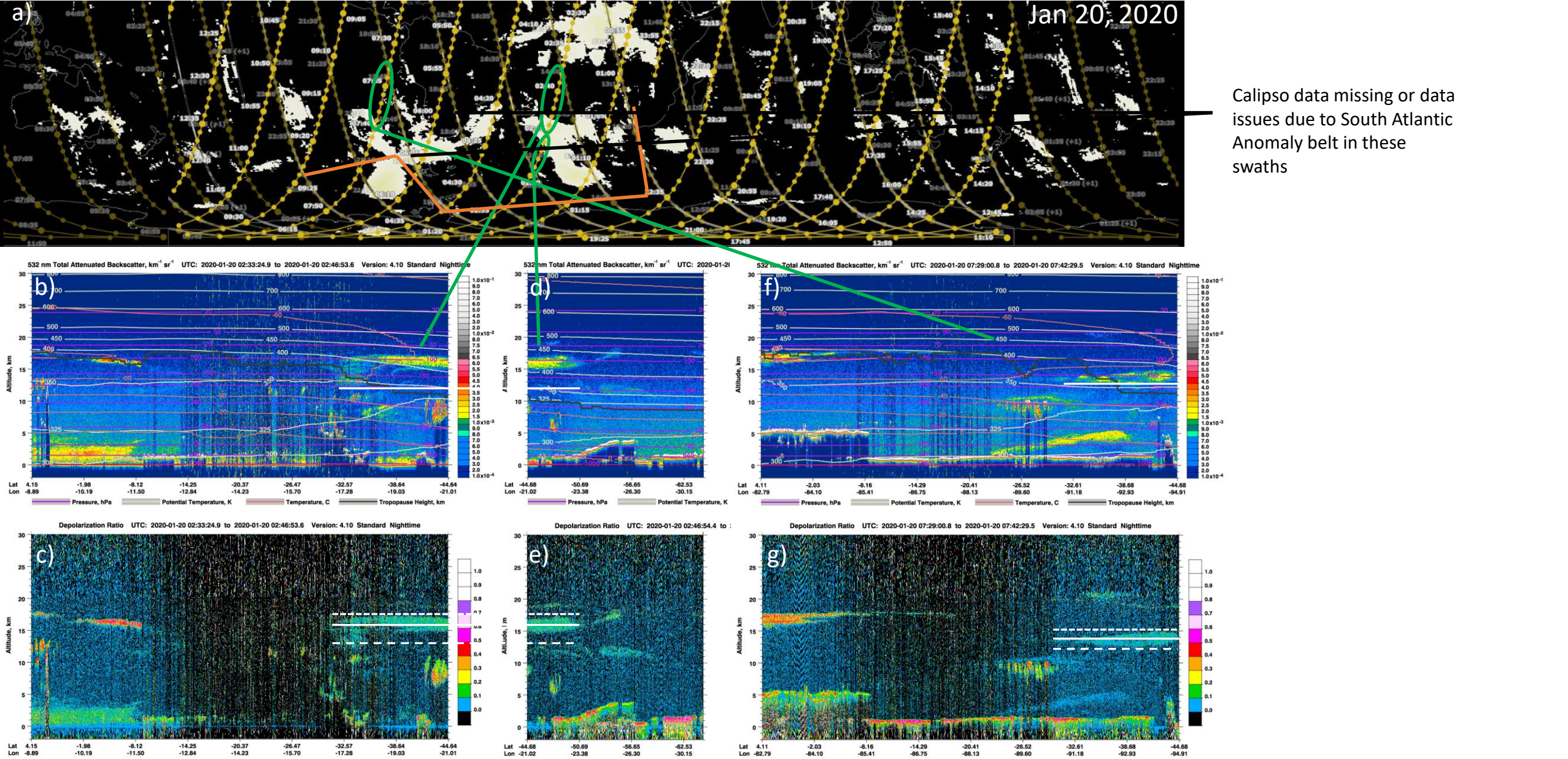


Figure S37. For figure description, see Text S1.

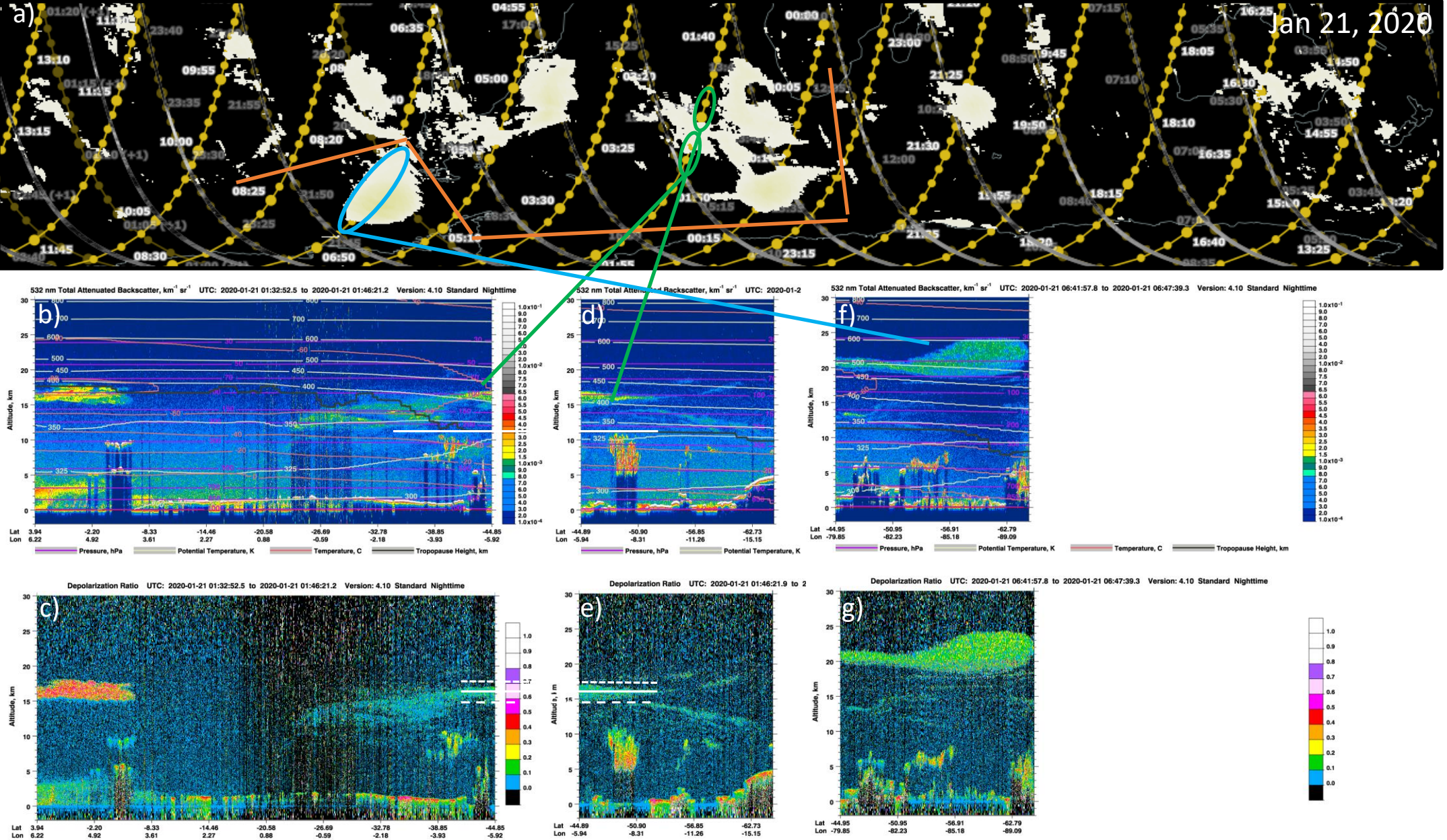


Figure S38. For figure description, see Text S1.

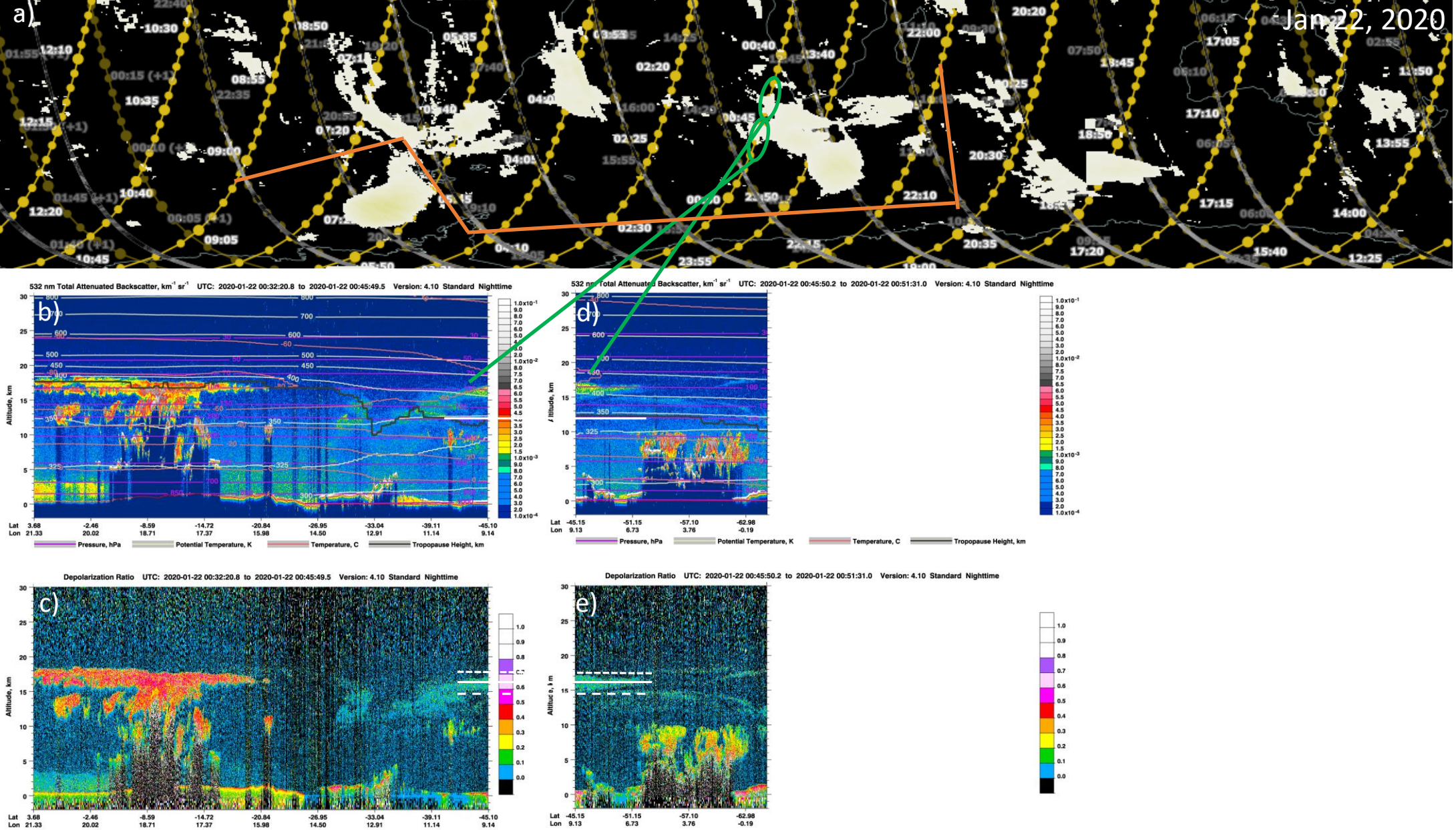


Figure S39. For figure description, see Text S1.

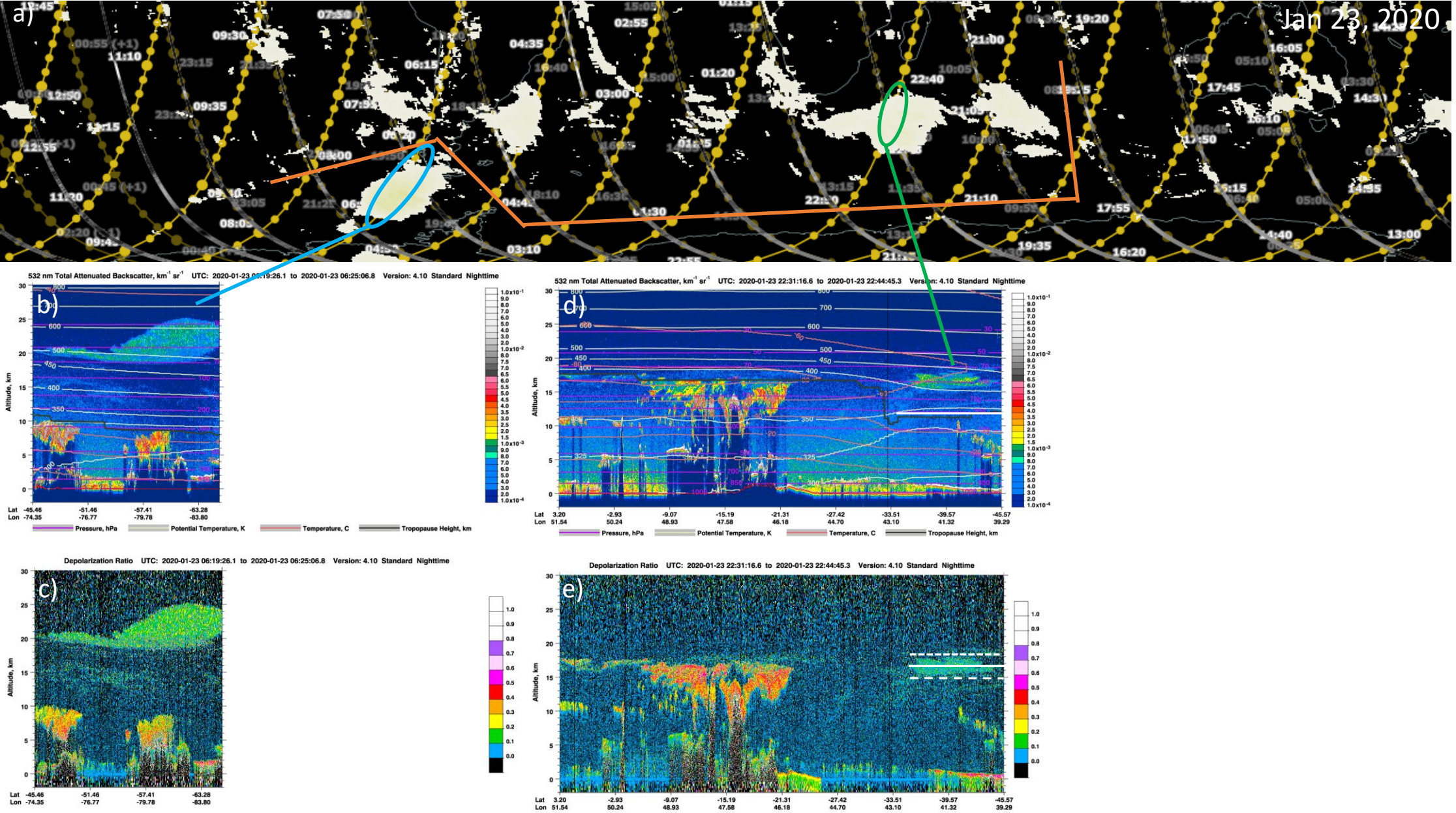


Figure S40. For figure description, see Text S1.

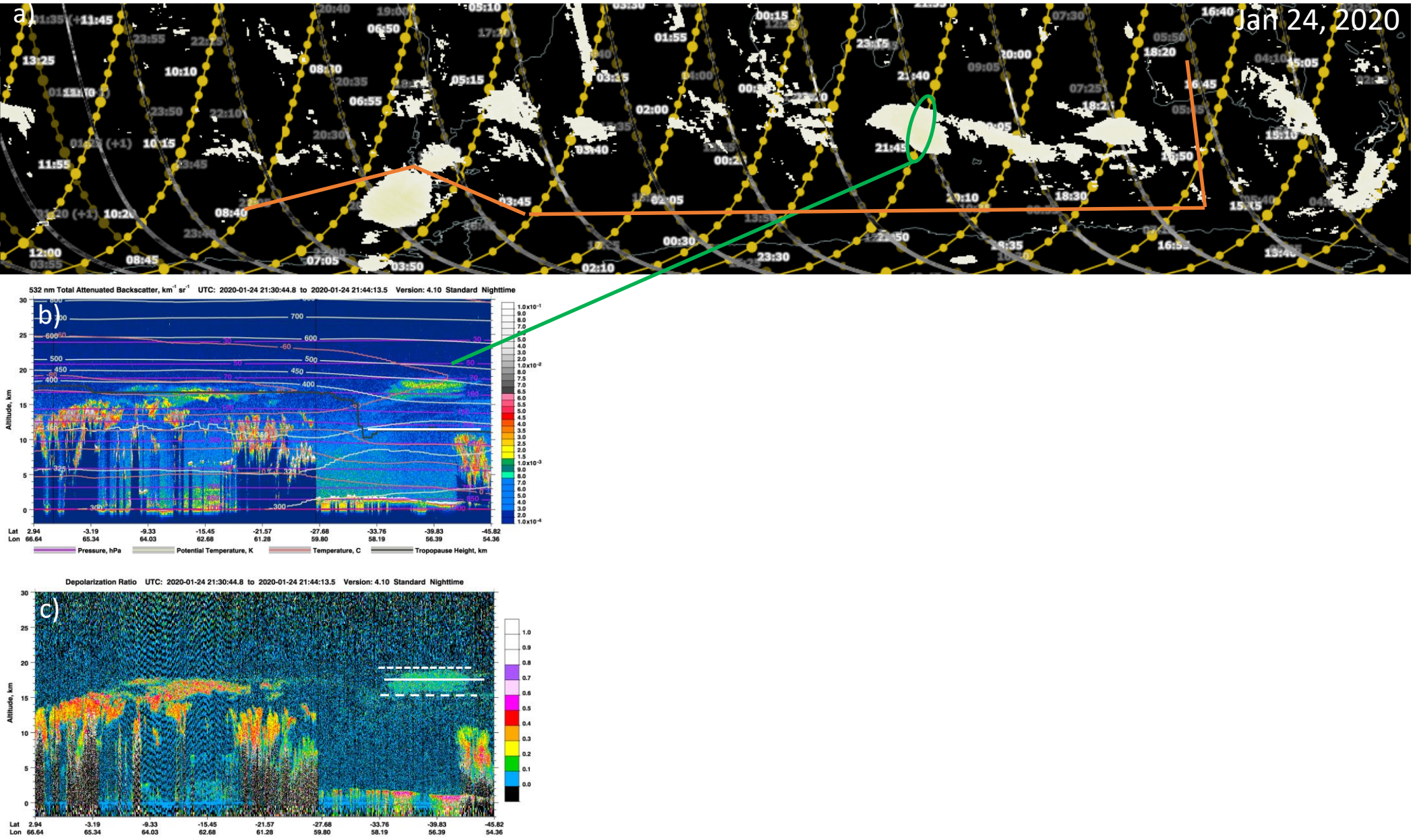


Figure S41. For figure description, see Text S1.

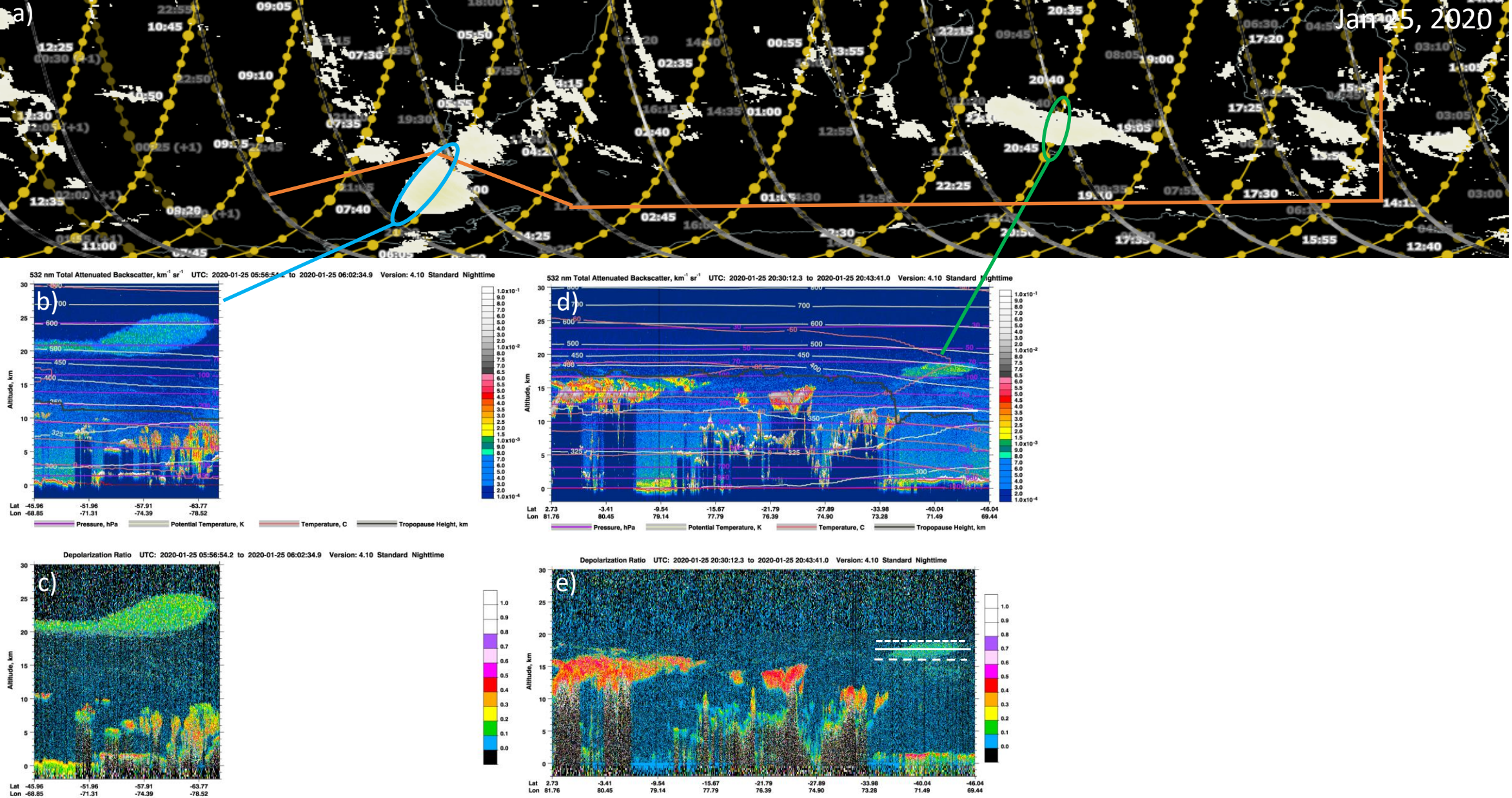


Figure S42. For figure description, see Text S1.

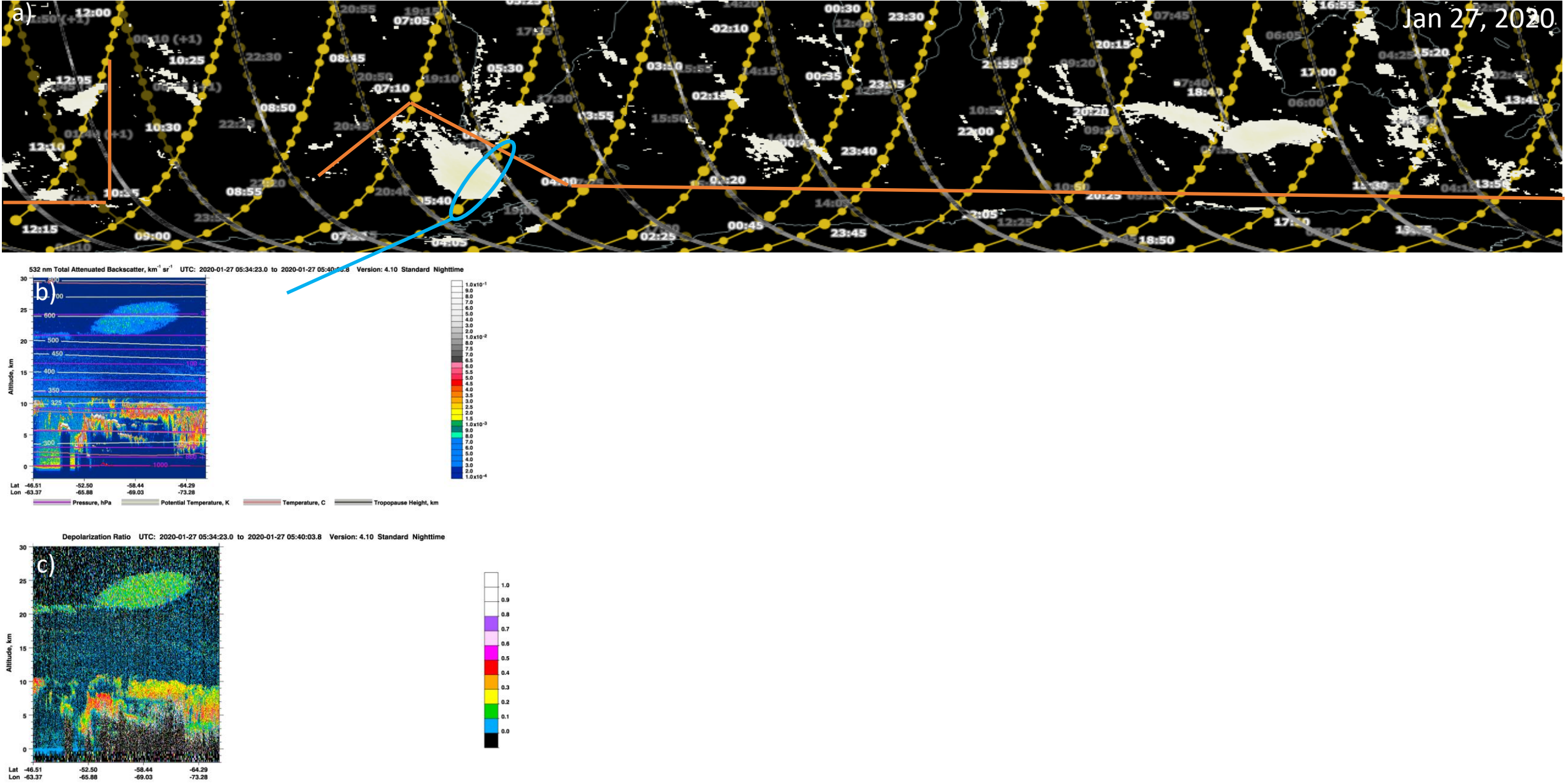


Figure S43. For figure description, see Text S1.

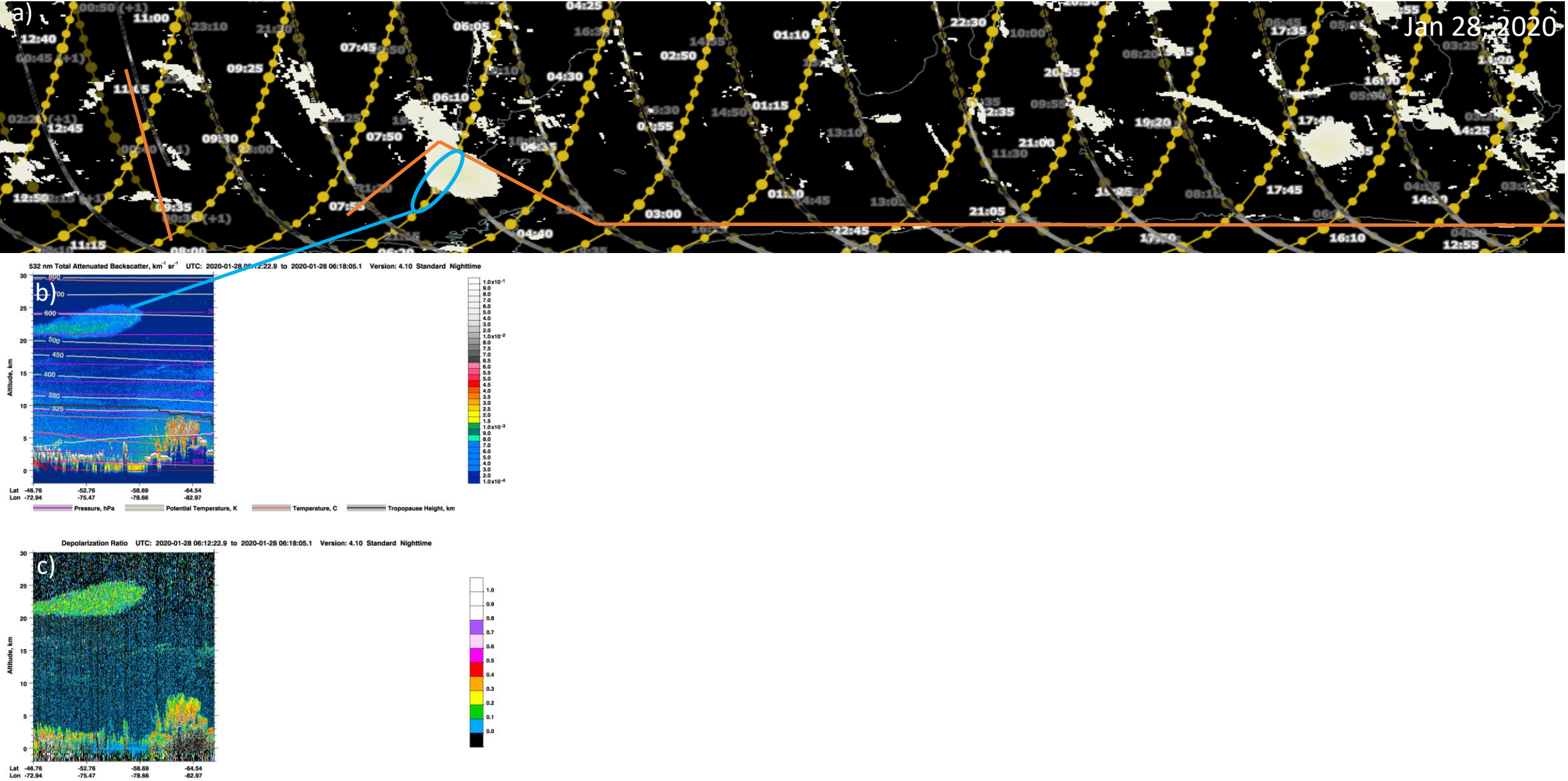


Figure S44. For figure description, see Text S1.

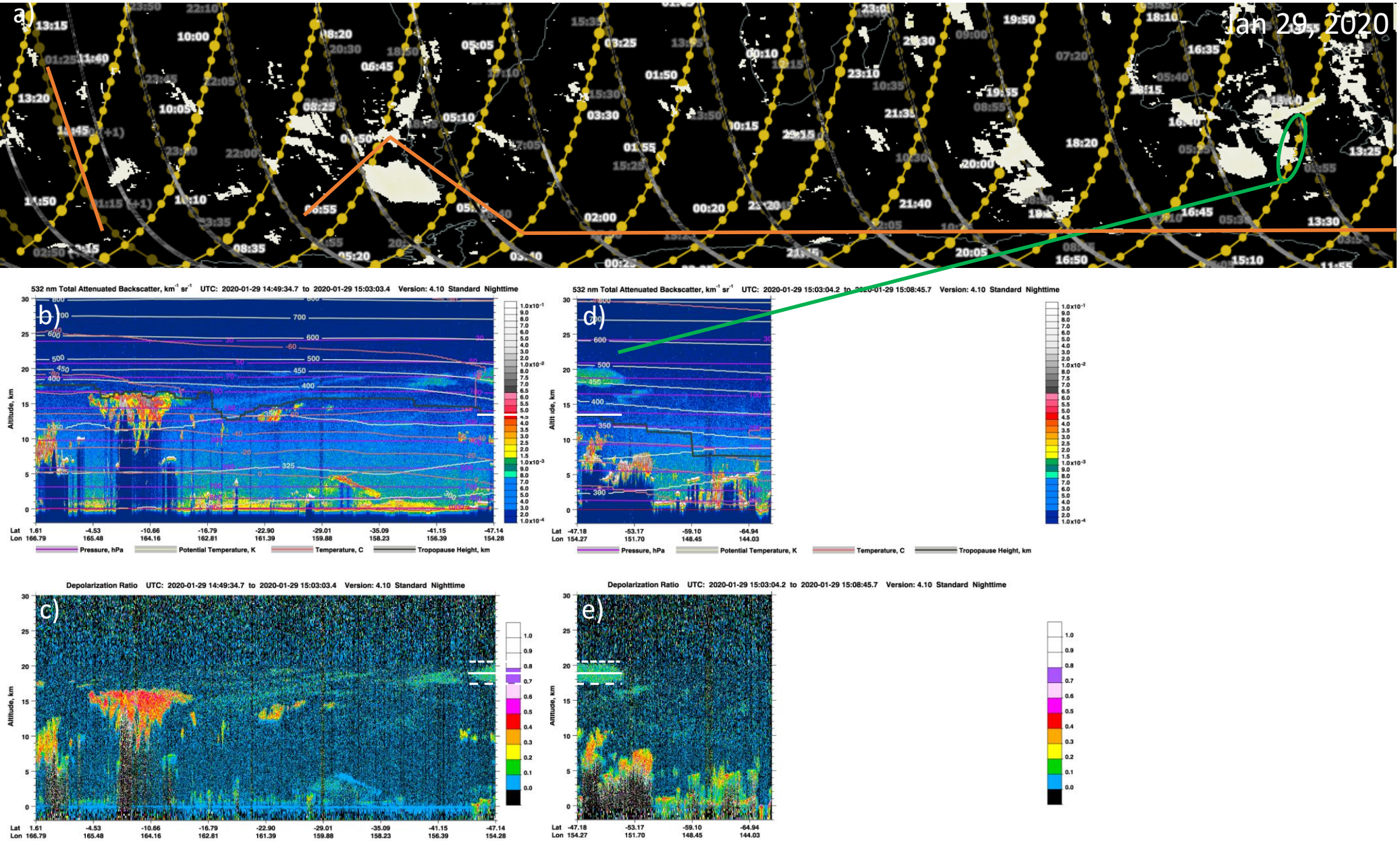


Figure S45. For figure description, see Text S1.

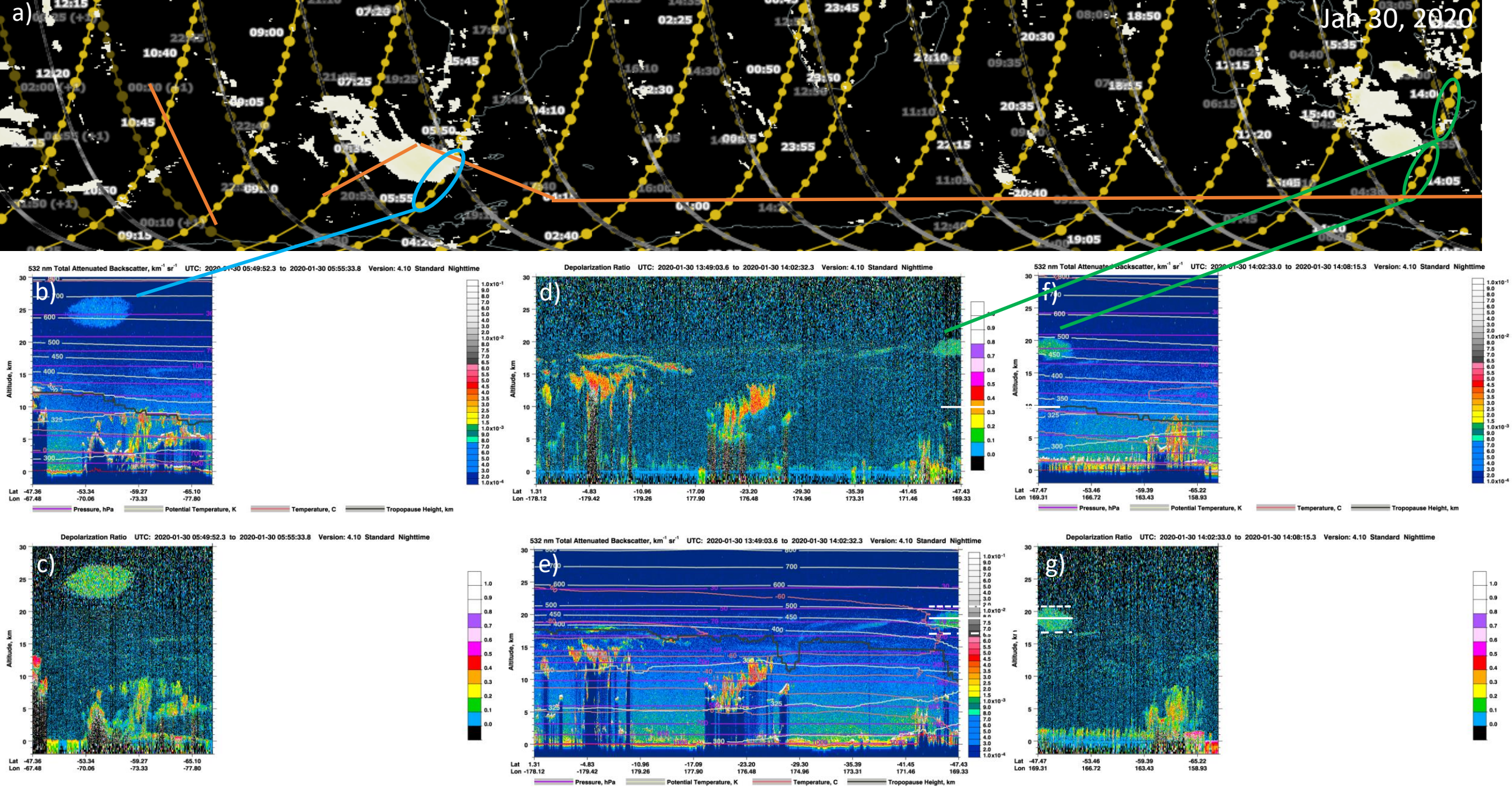


Figure S46. For figure description, see Text S1.

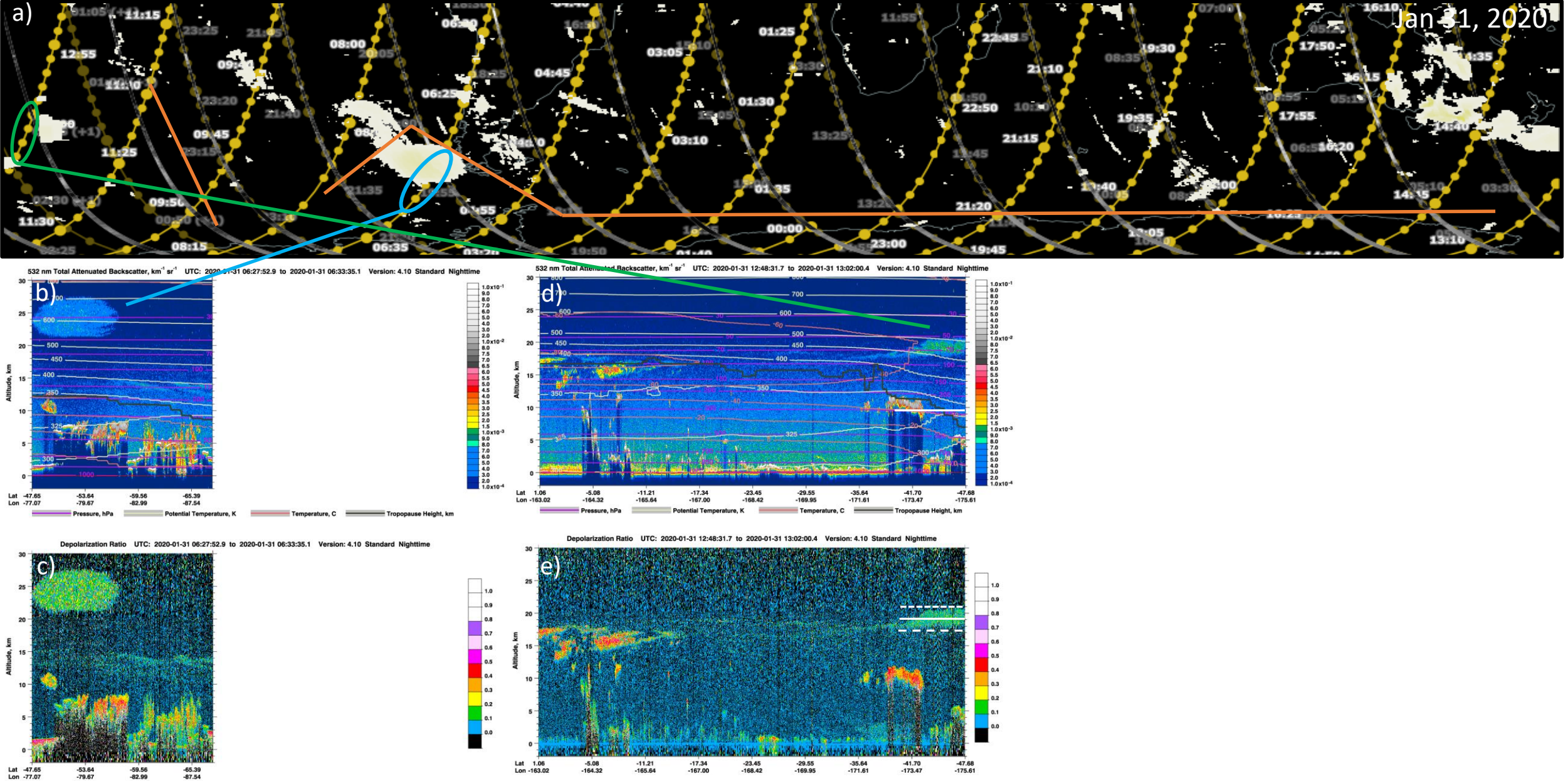


Figure S47. For figure description, see Text S1.

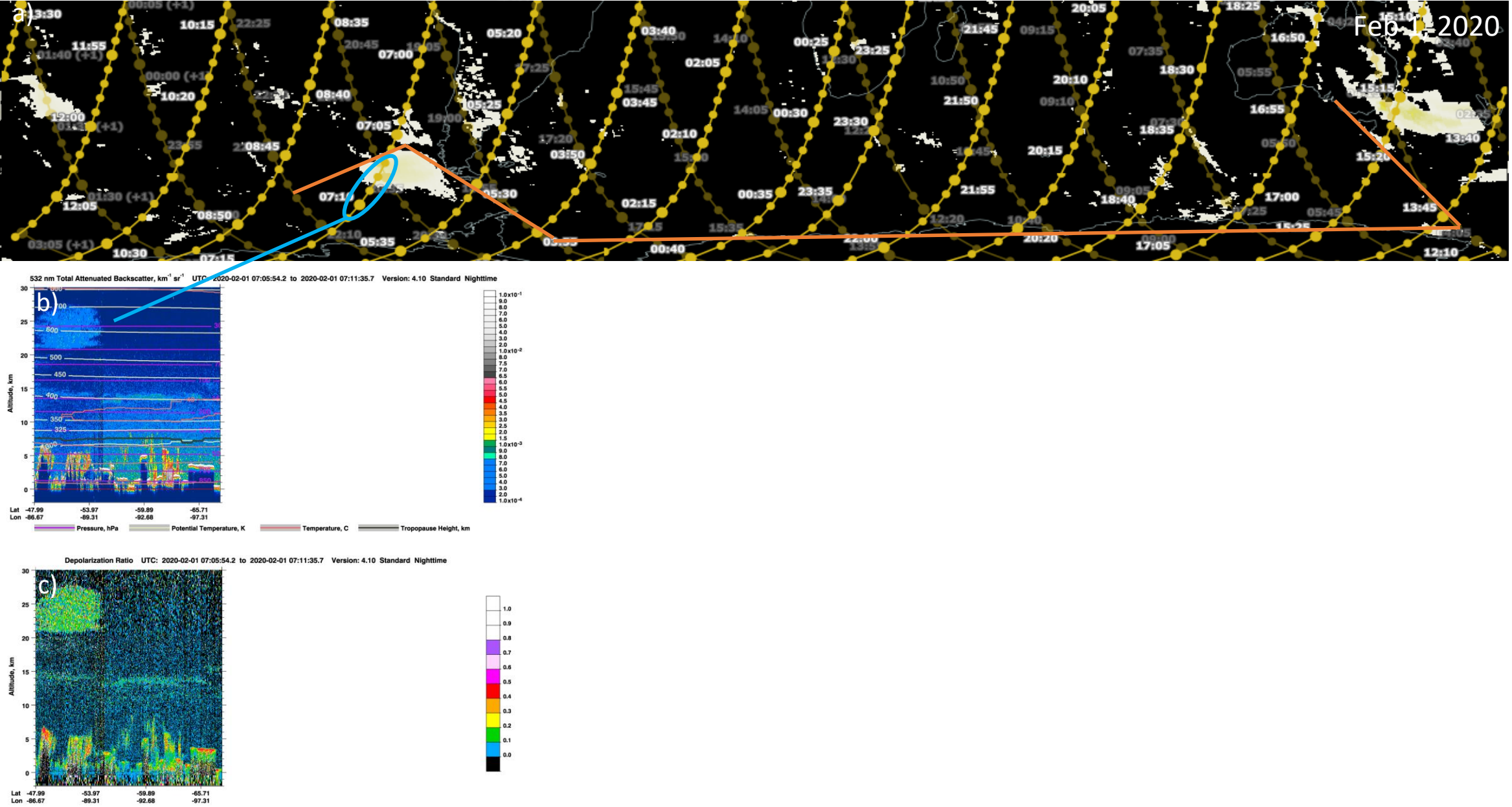


Figure S48. For figure description, see Text S1.

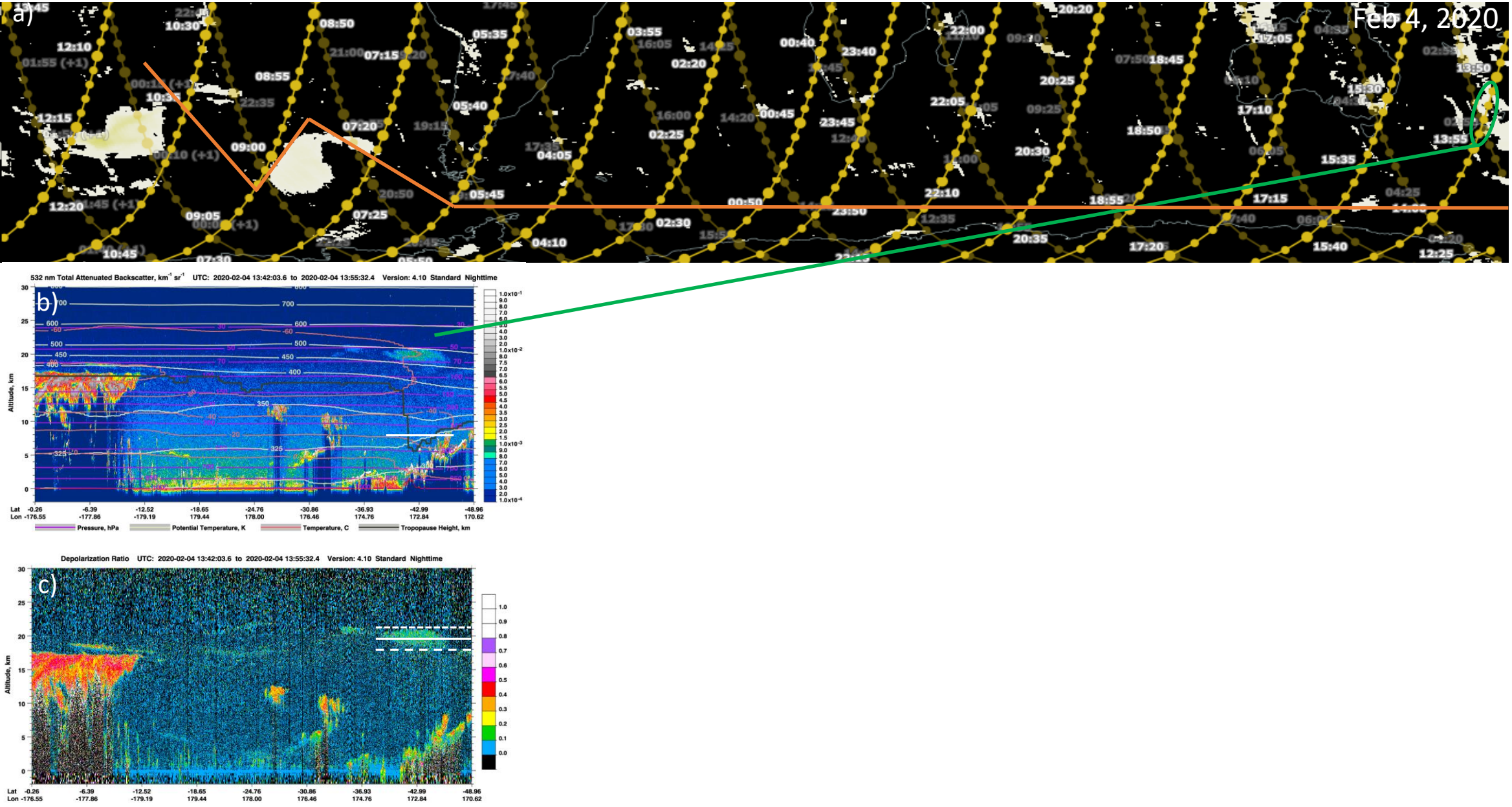


Figure S49. For figure description, see Text S1.