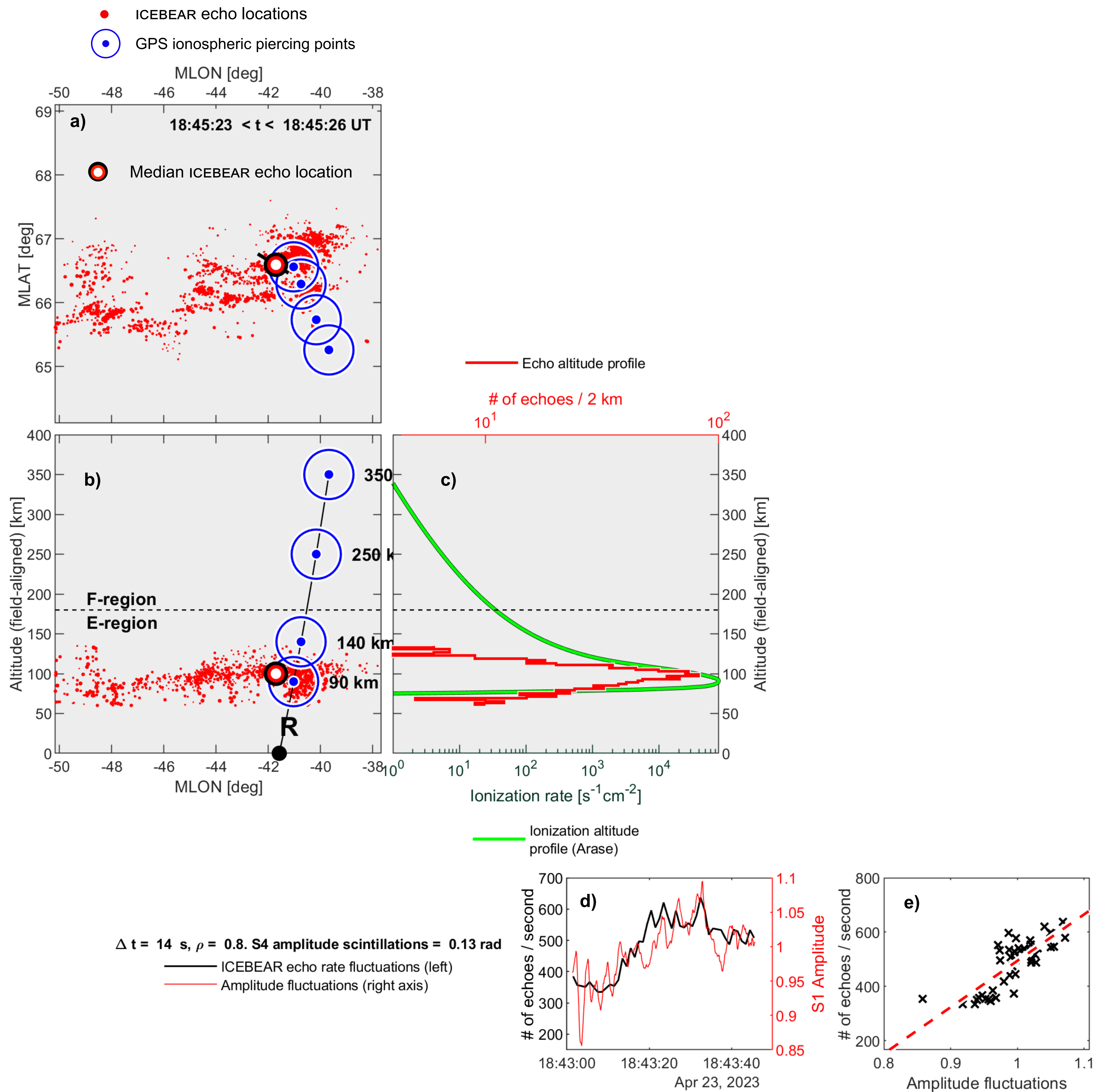


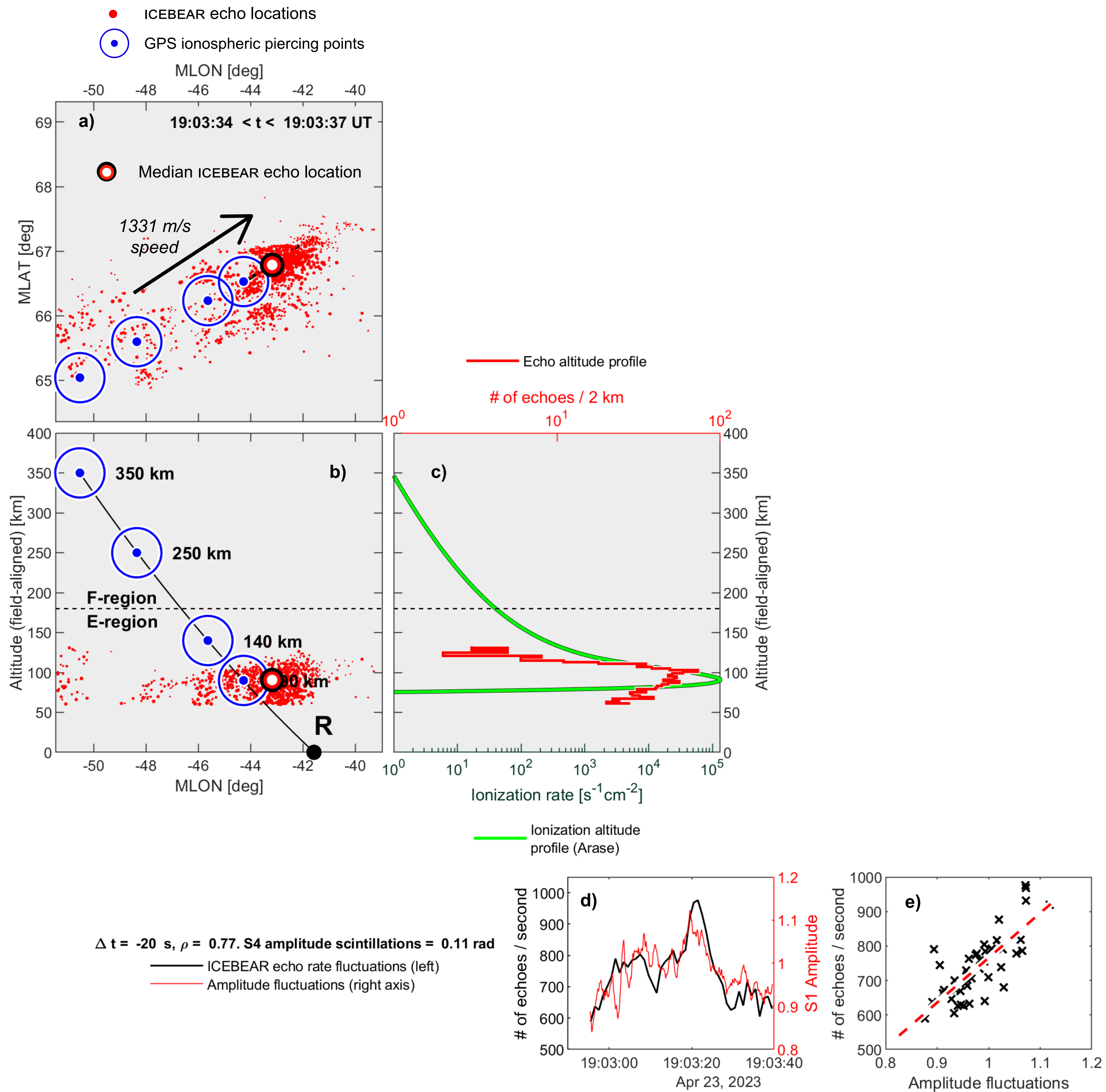
## Supplementary data

This document contains three additional examples of conjugate observations by icebear, Arase, and chain GPS scintillations, akin to Figure 6 in the Main Paper. For detailed key, see Figure 6 in the Main paper.



v9-cluster 524 on 2023 Apr 23 with 2419 echoes. Cluster velocity not determined.

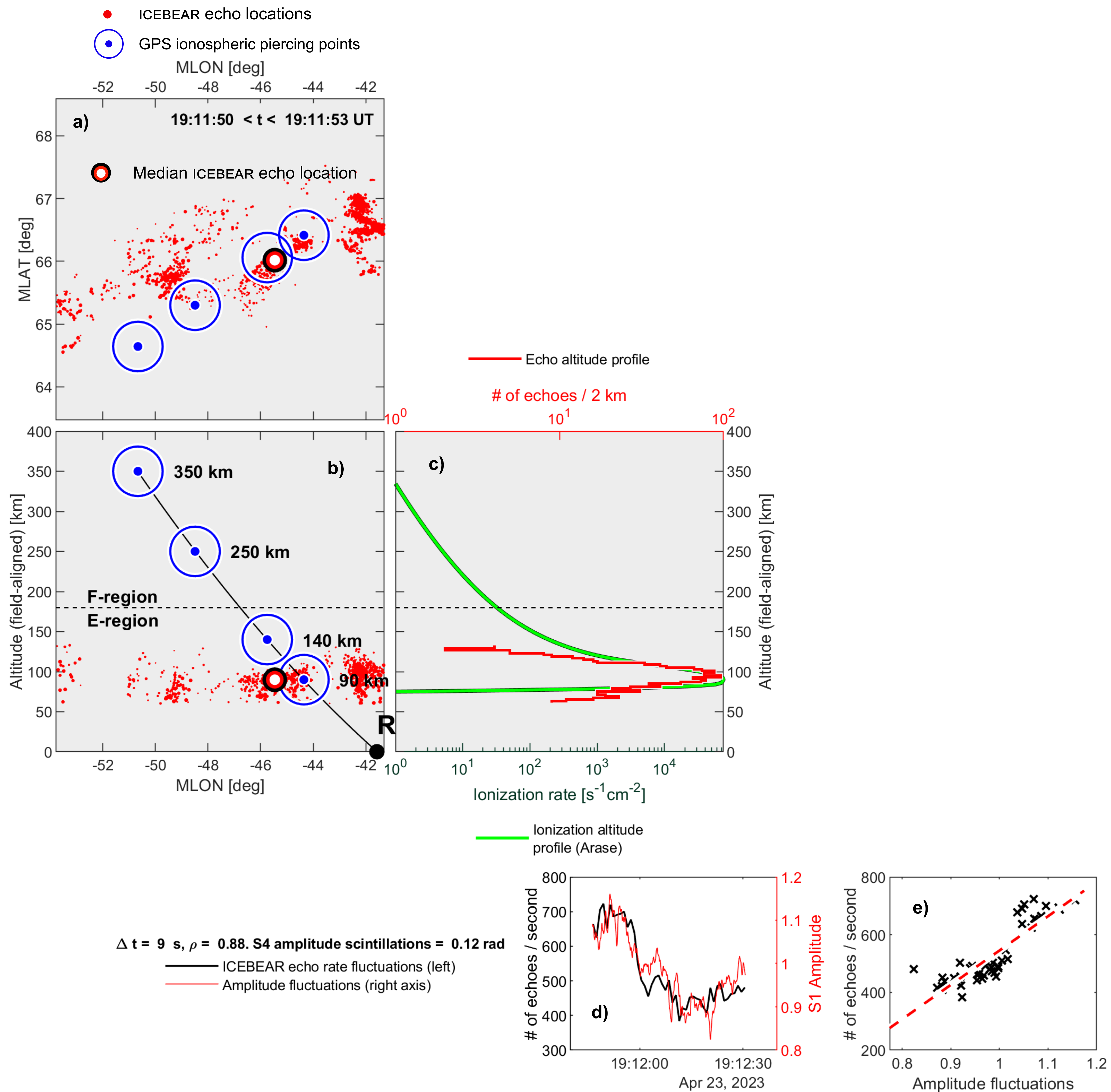
**Figure S1.** See Figure 6 in the Main Paper for detailed key.



v9-cluster 1030 on 2023 Apr 23 with 10124 echoes. Displacement:  $\Delta x = 11$  km,  $\Delta y = 9$  km,  $\Delta t = 10$  s,  $v = 1331$  m/s,  $E = 74$  mV/m.

**Figure S2.** See Figure 6 in the Main Paper for detailed key.





v9-cluster 1233 on 2023 Apr 23 with 1182 echoes. Cluster velocity not determined.

**Figure S3.** See Figure 6 in the Main Paper for detailed key.