The Poker Flat Incoherent Scatter Radar

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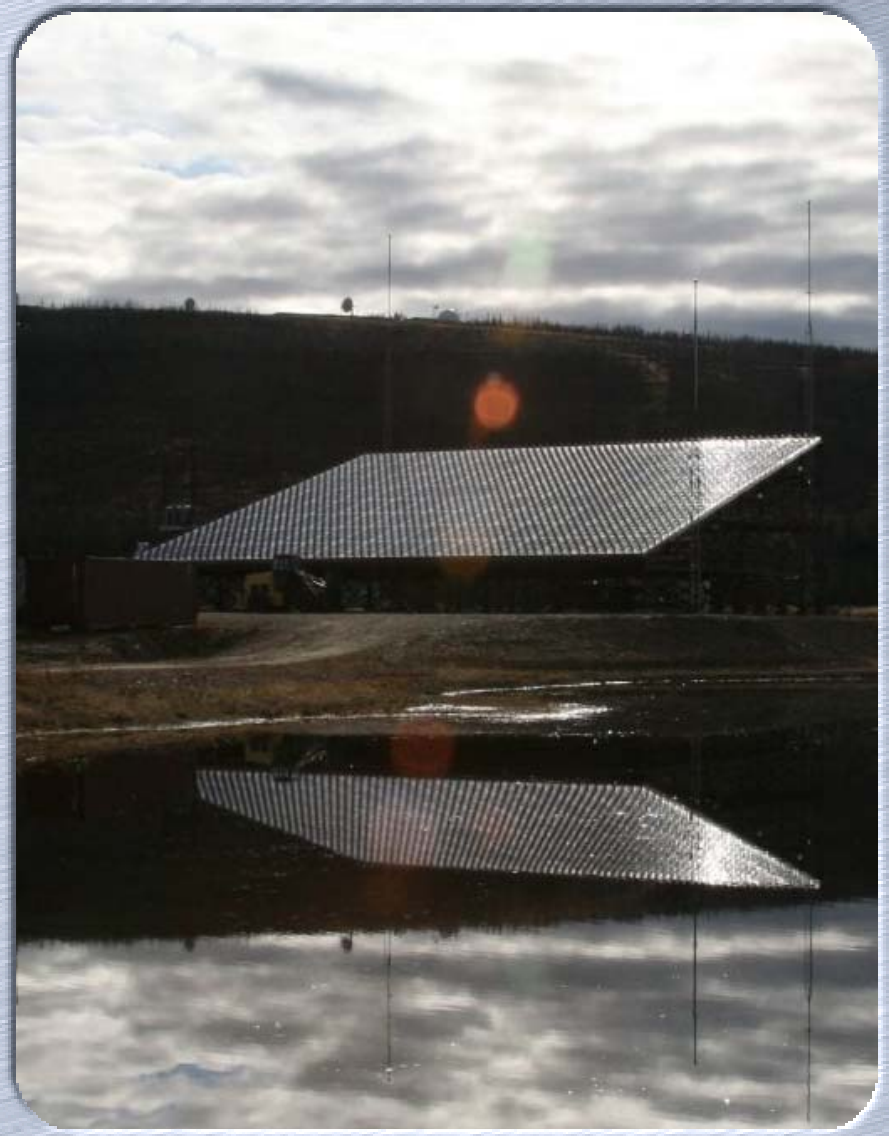
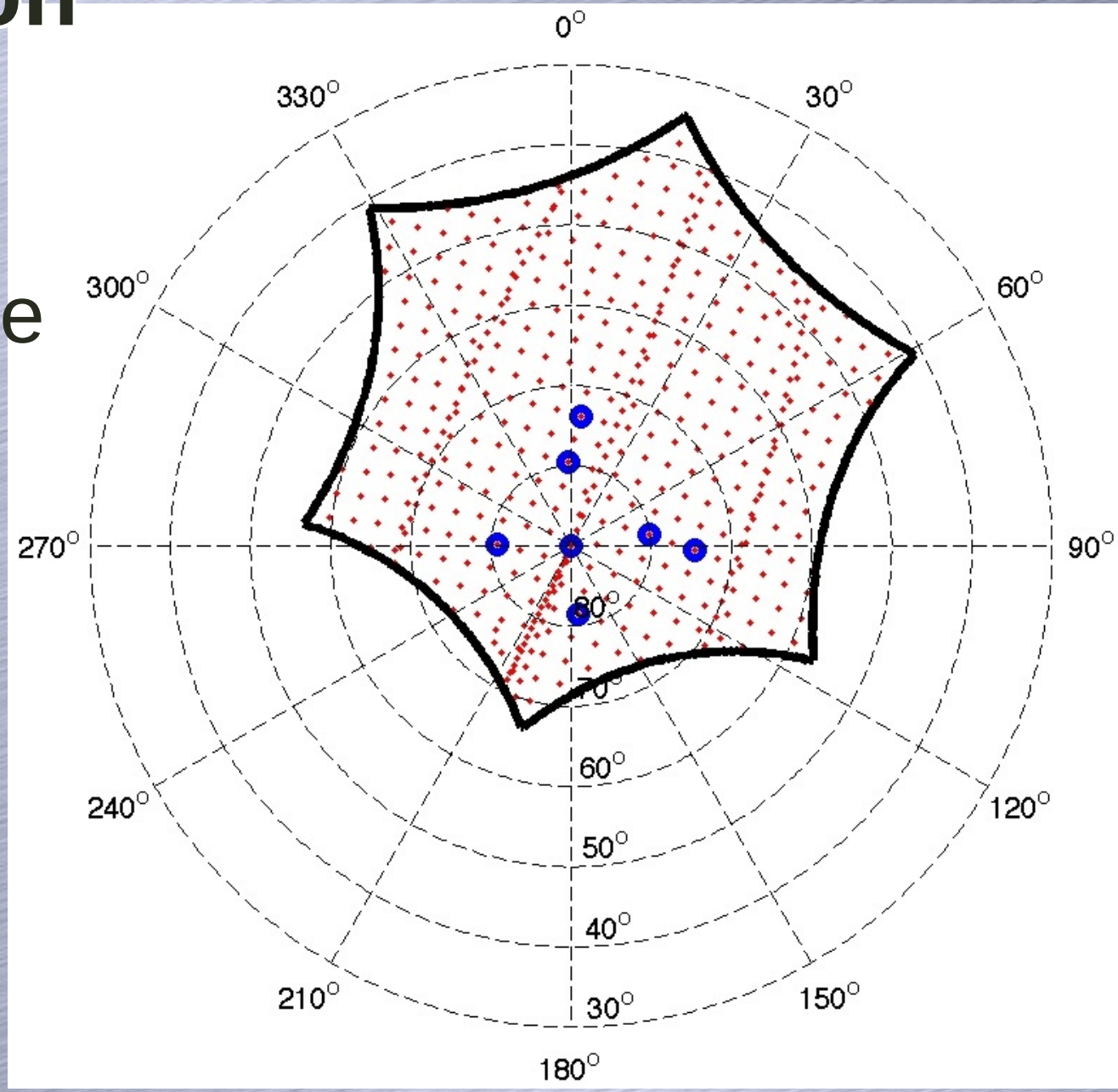
Outline

- D-region Measurements of densities (incoherent scatter?) and drifts
- E-region measurements of auroral arcs and sporadic *E*
- Other types of scattering (PMSE)

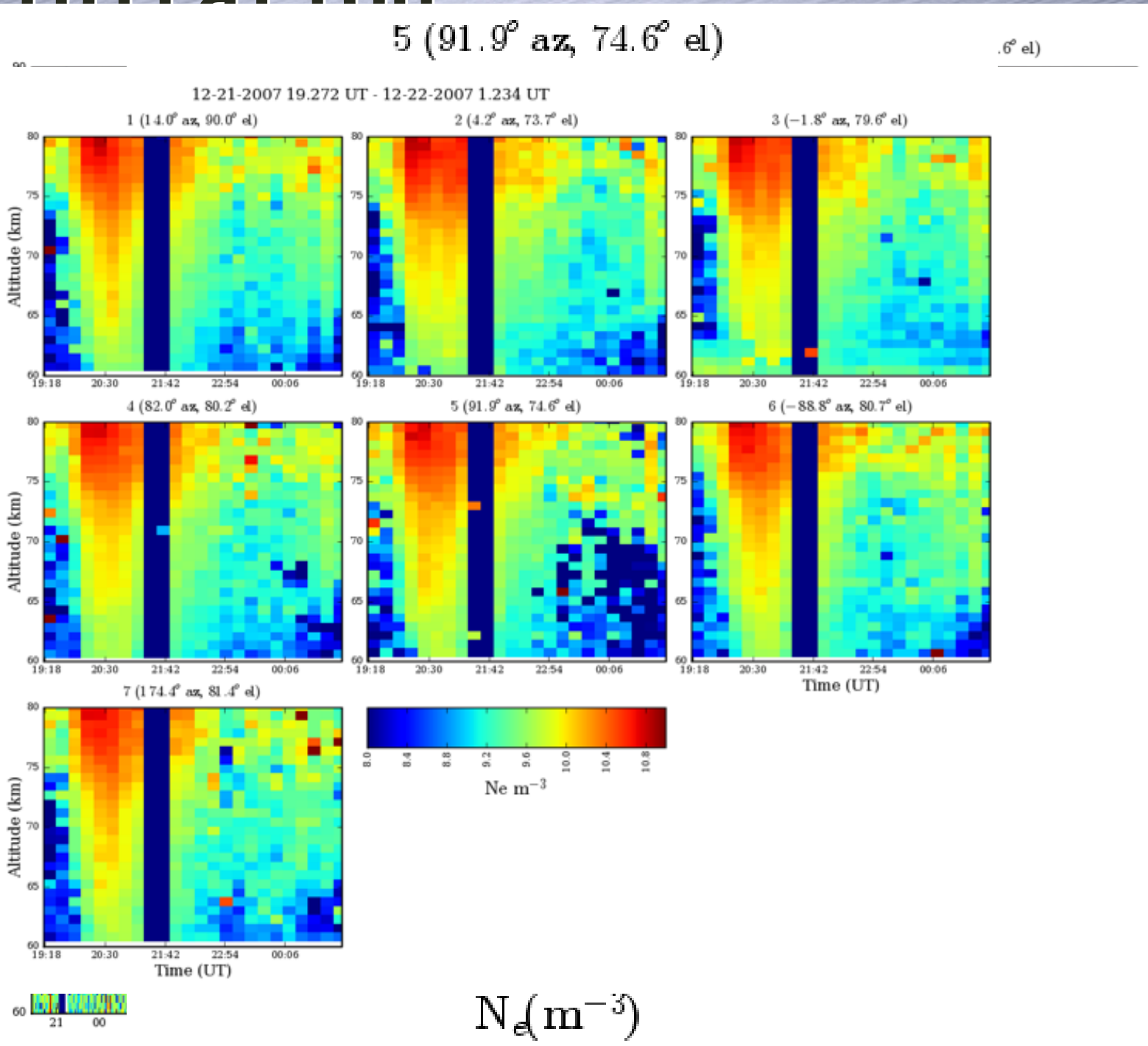


D region during auroral precipitation

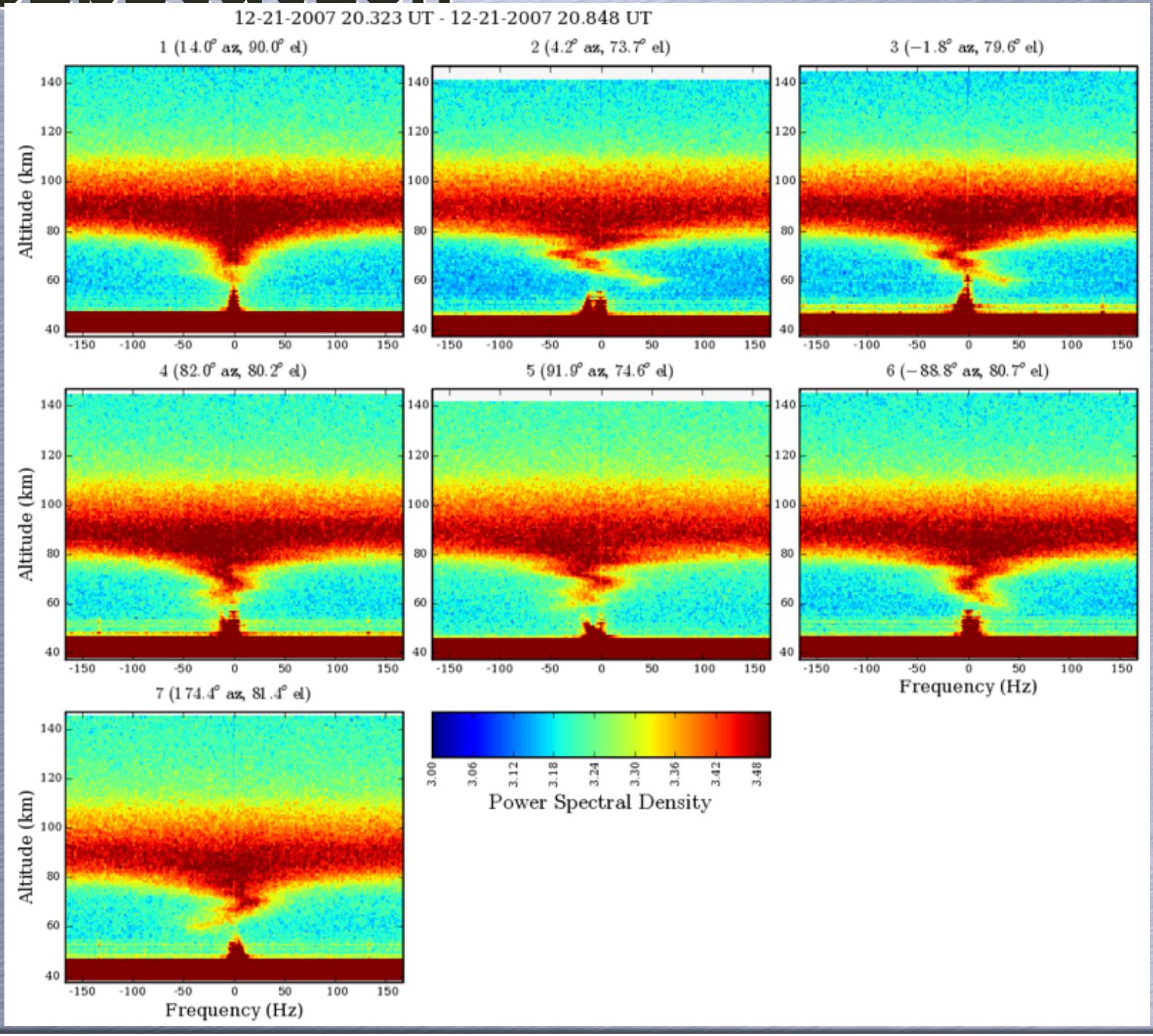
- 7 look directions
- 28-baud phase code for range resolution and sensitivity
- Pulse-to-pulse processing for spectra



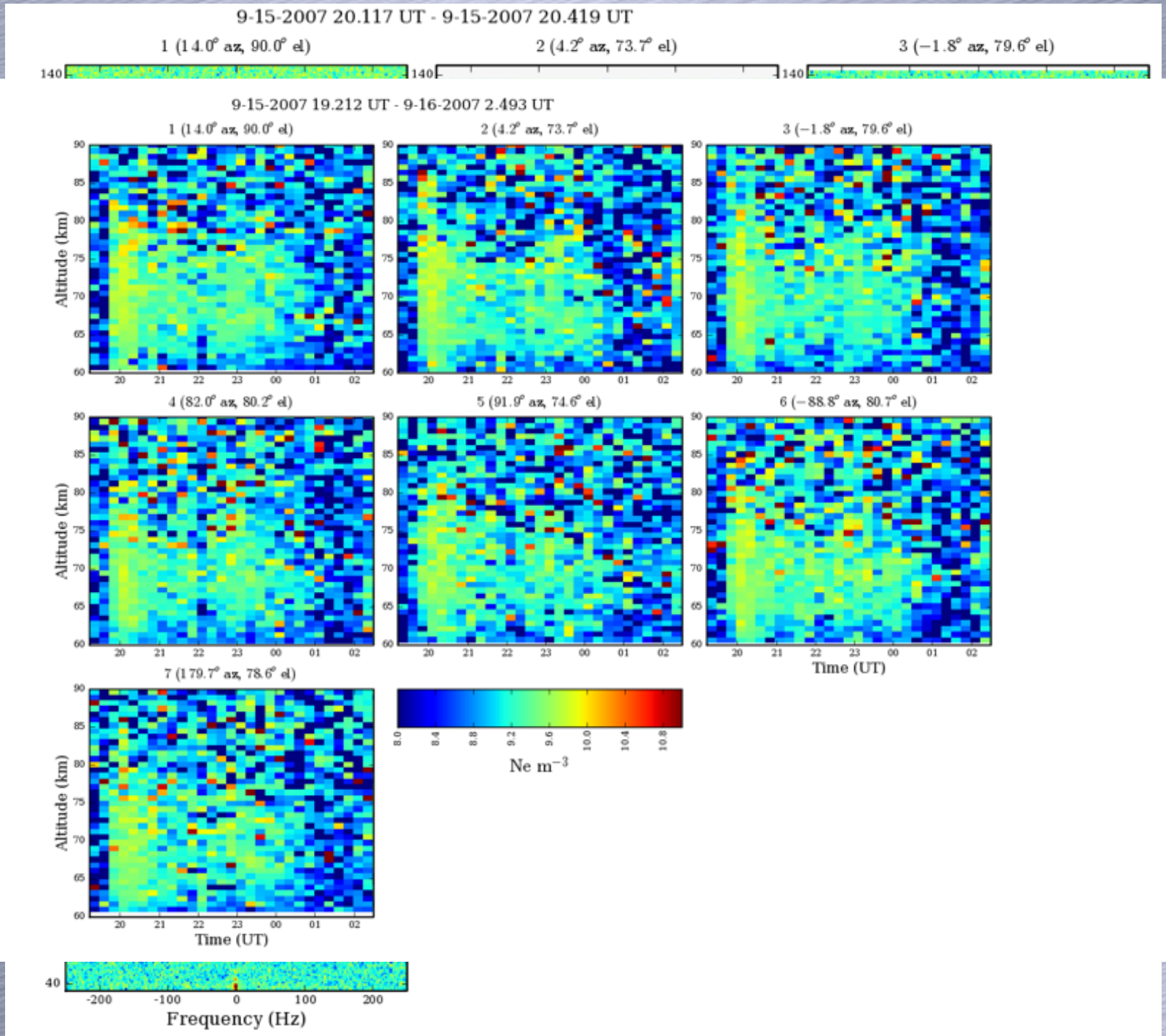
D region during auroral precipitation



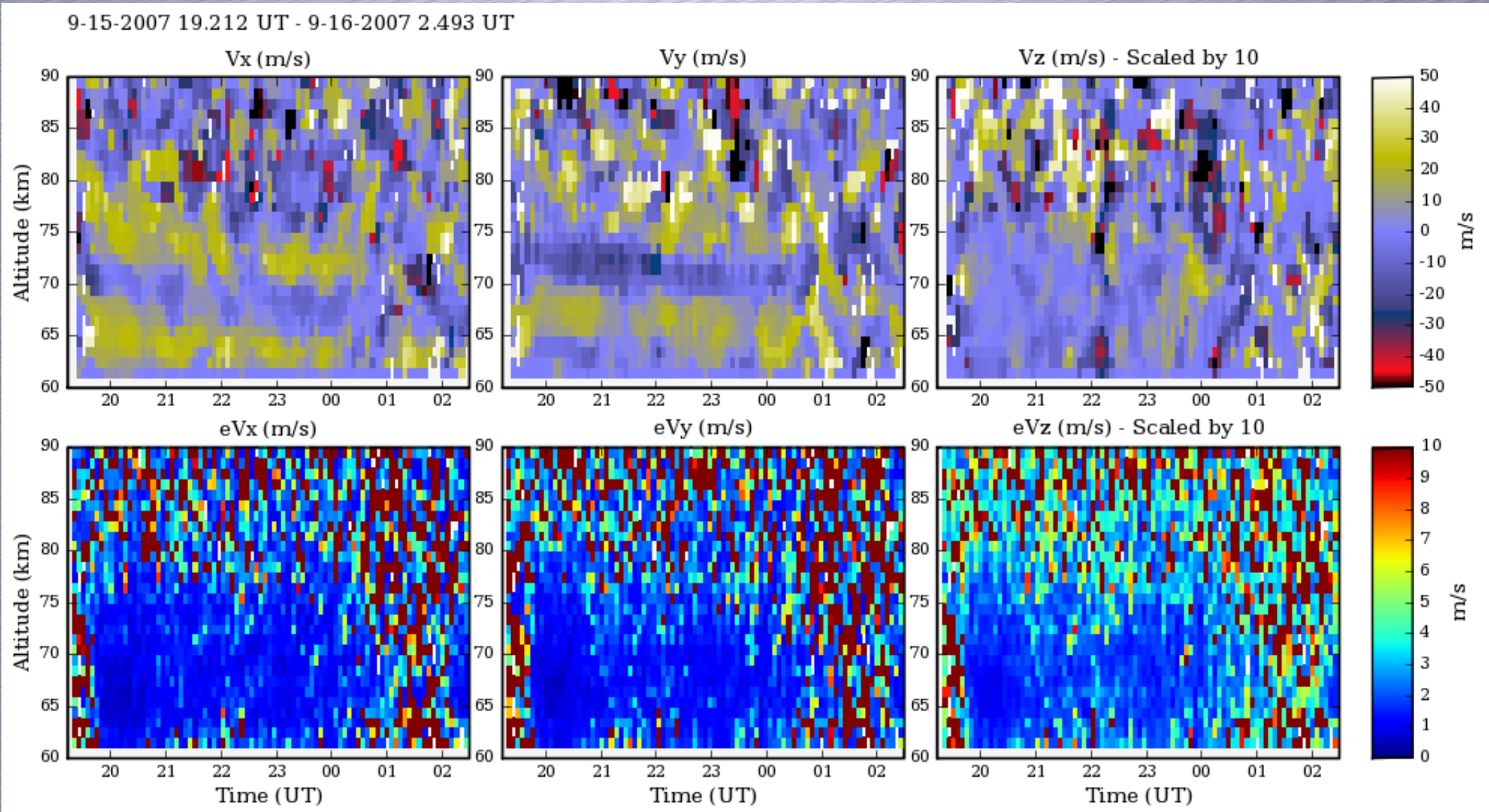
D region during auroral precipitation



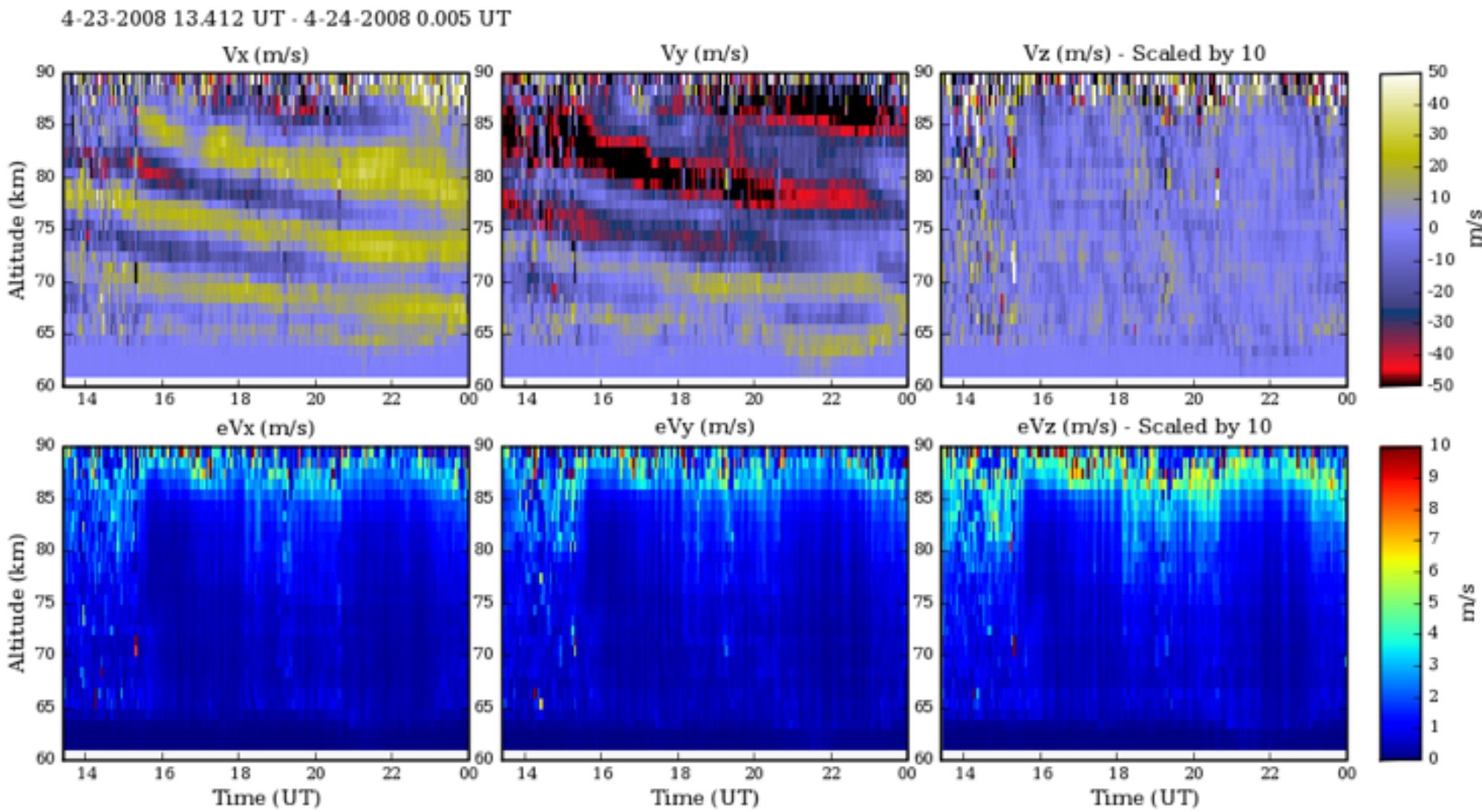
D region, no aurora



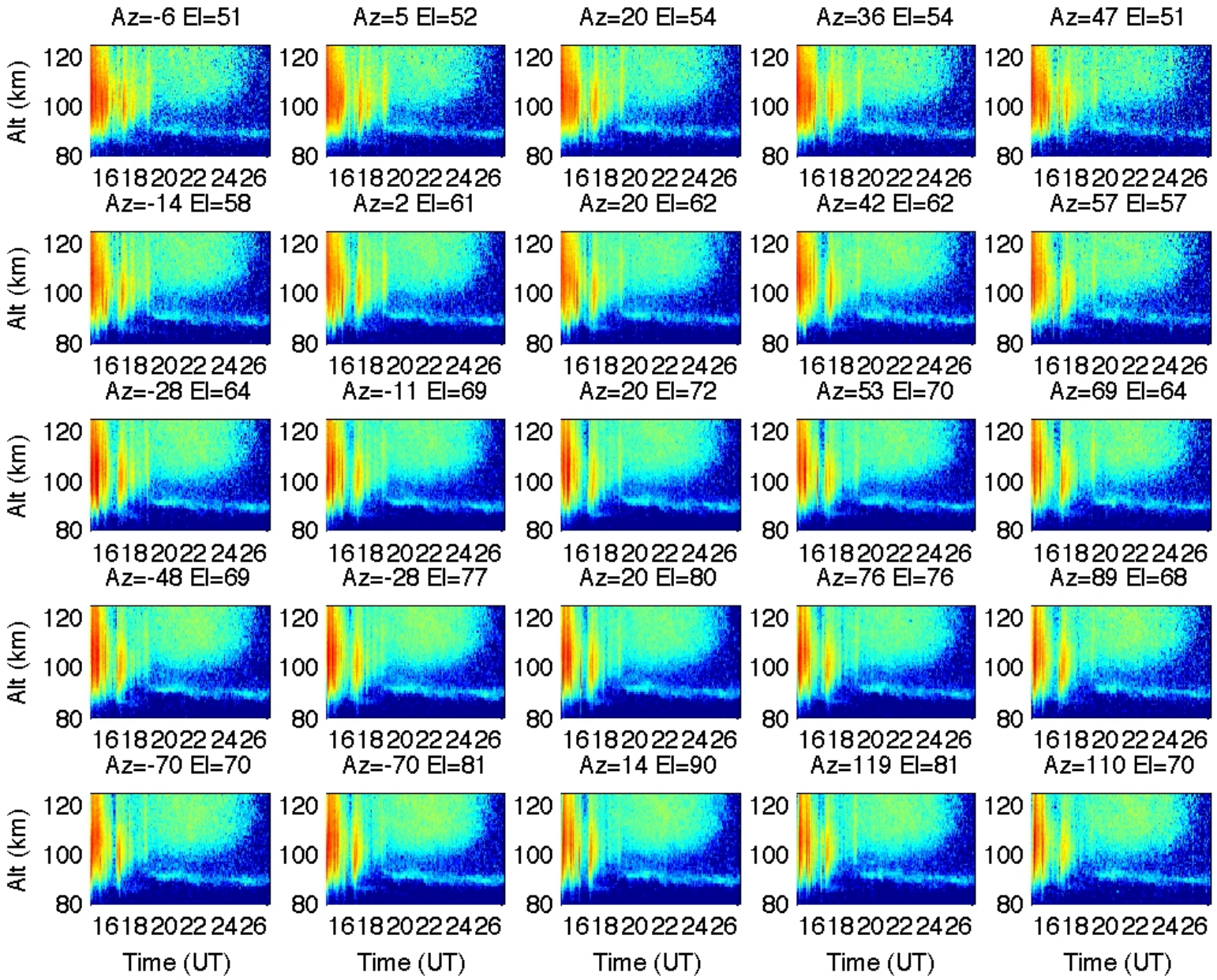
D region, no aurora



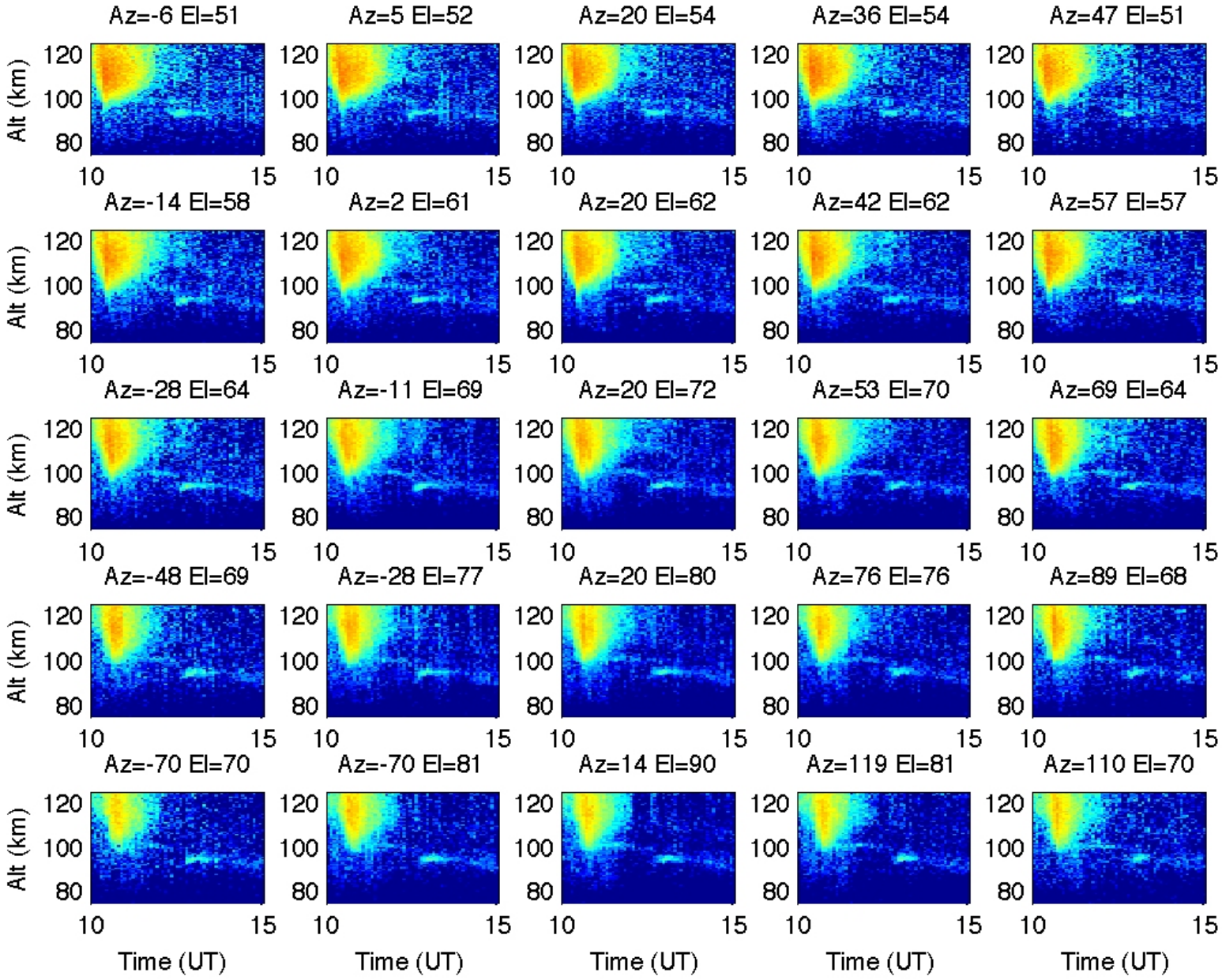
Another example



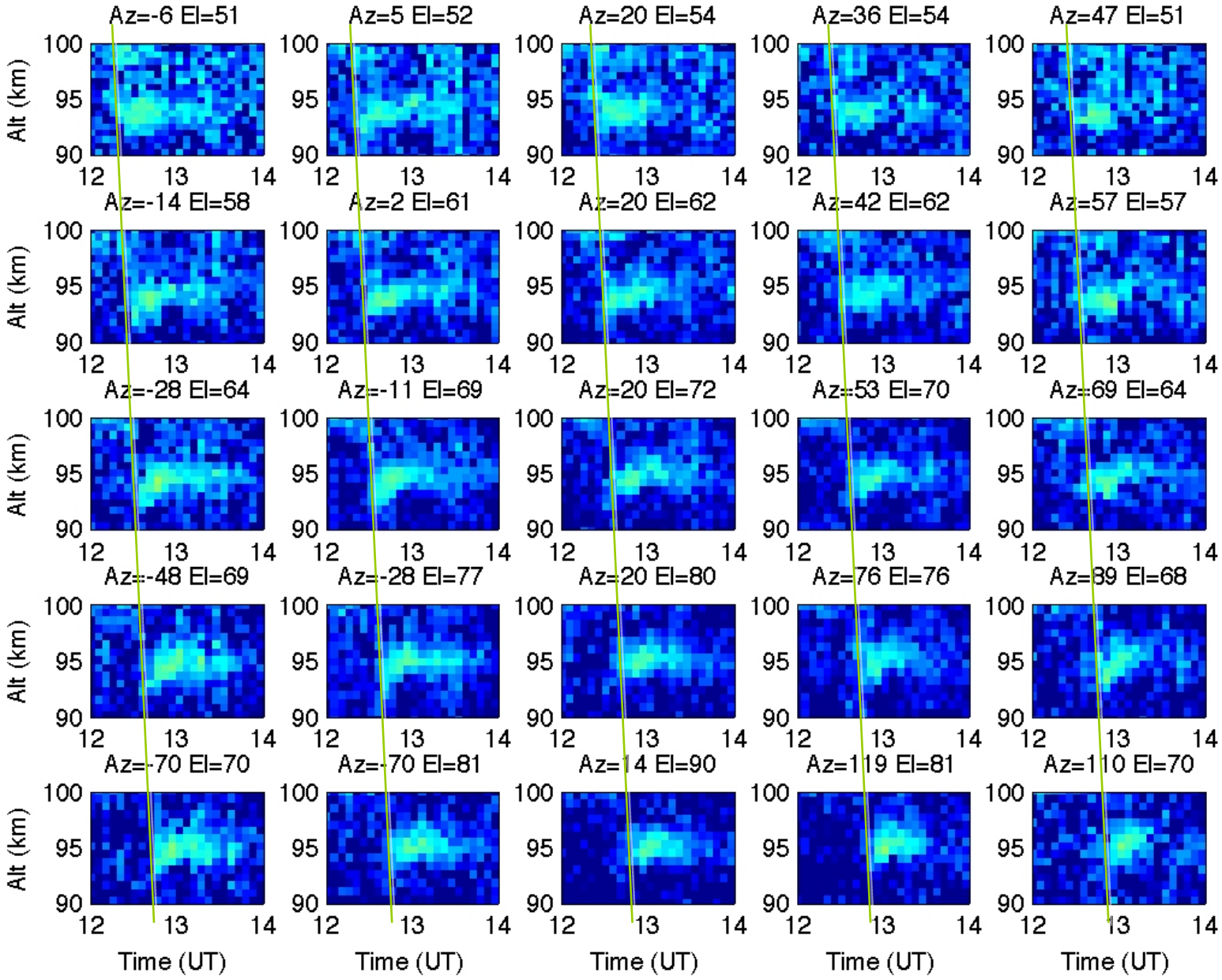
PFISR 2007-10-16



PFISR 2007-11-01

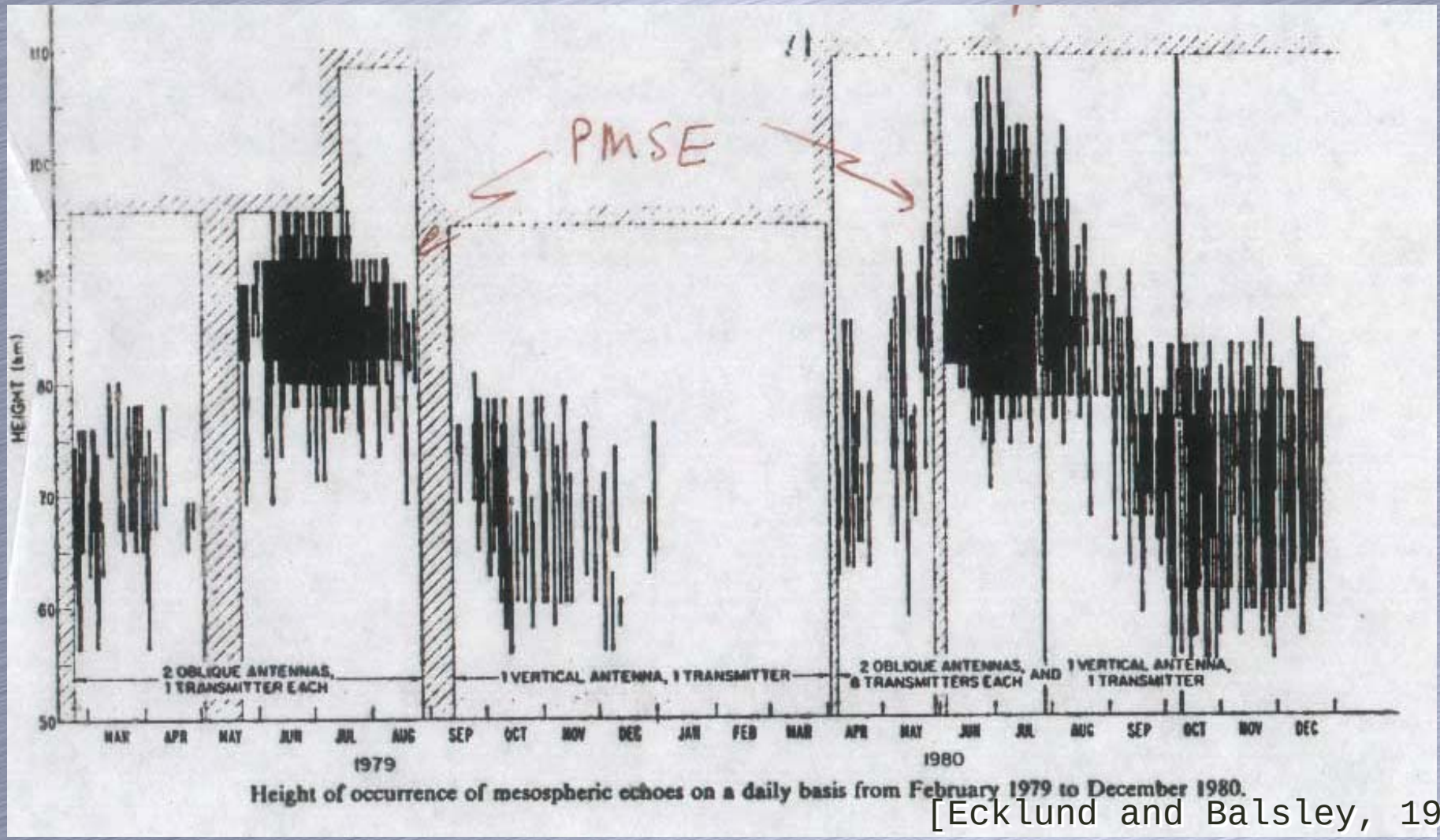


PFISR 2007-11-01



Polar Mesosphere Summer Echoes (PMSE)

- Coherent scatter with time scales (milliseconds) much longer than thermal fluctuations due to incoherent scatter
  - Enhanced radar returns in cold summer

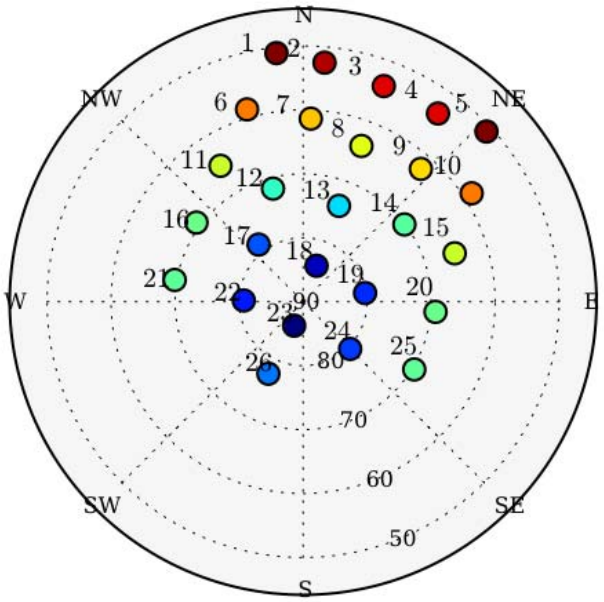


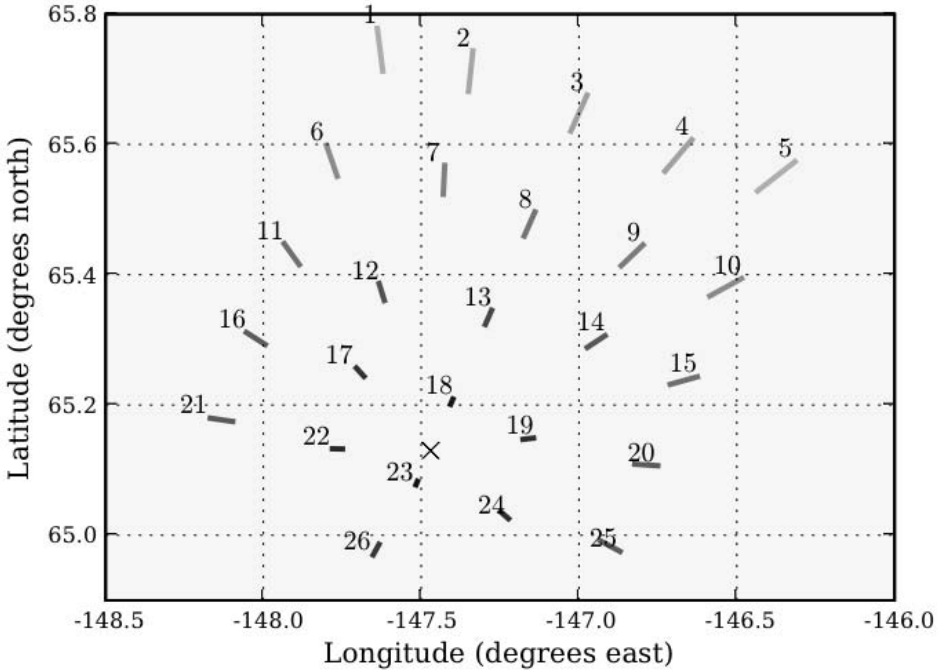
Height of occurrence of mesospheric echoes on a daily basis from February 1979 to December 1980.

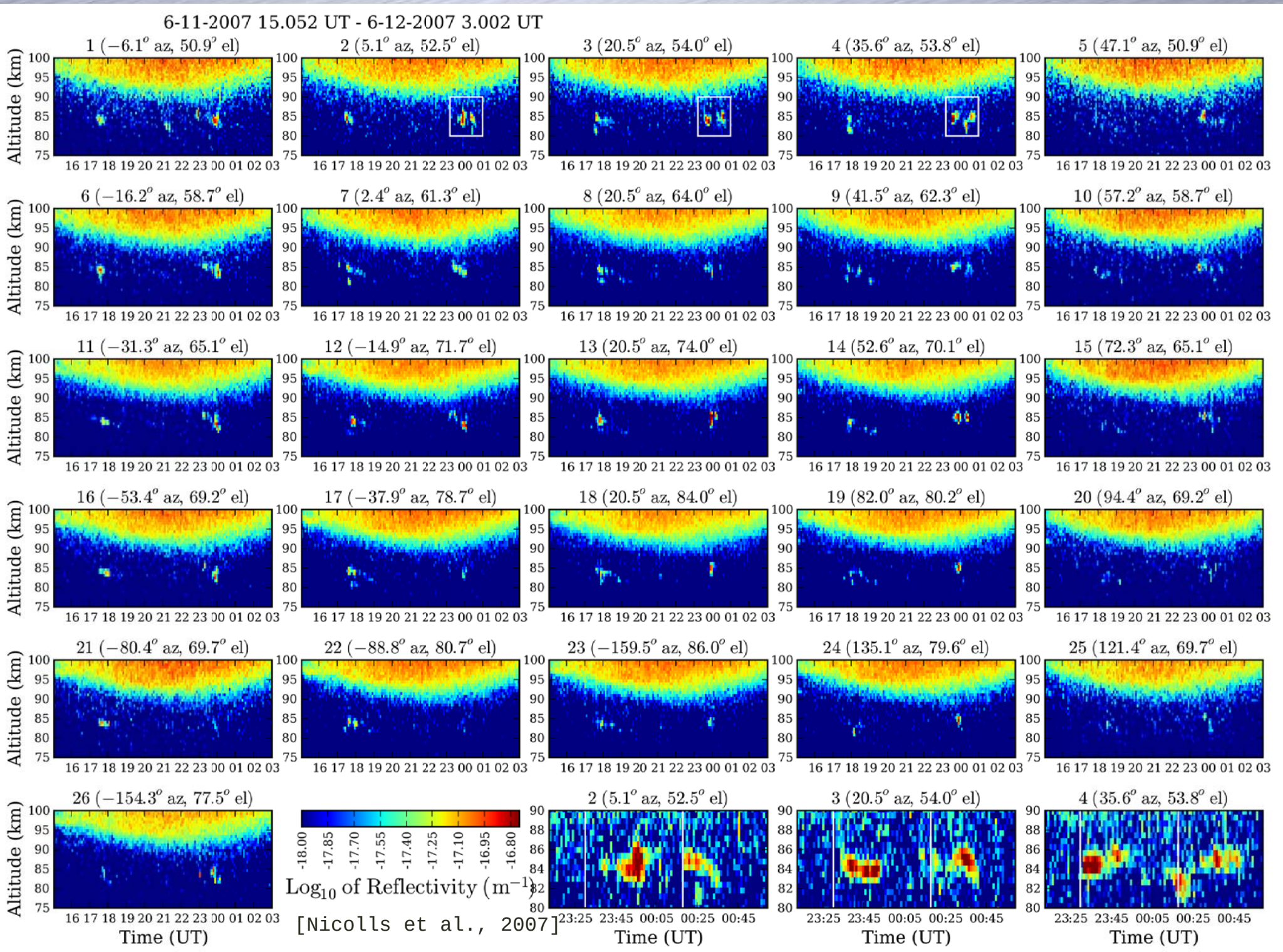
[Ecklund and Balsley, 1981]

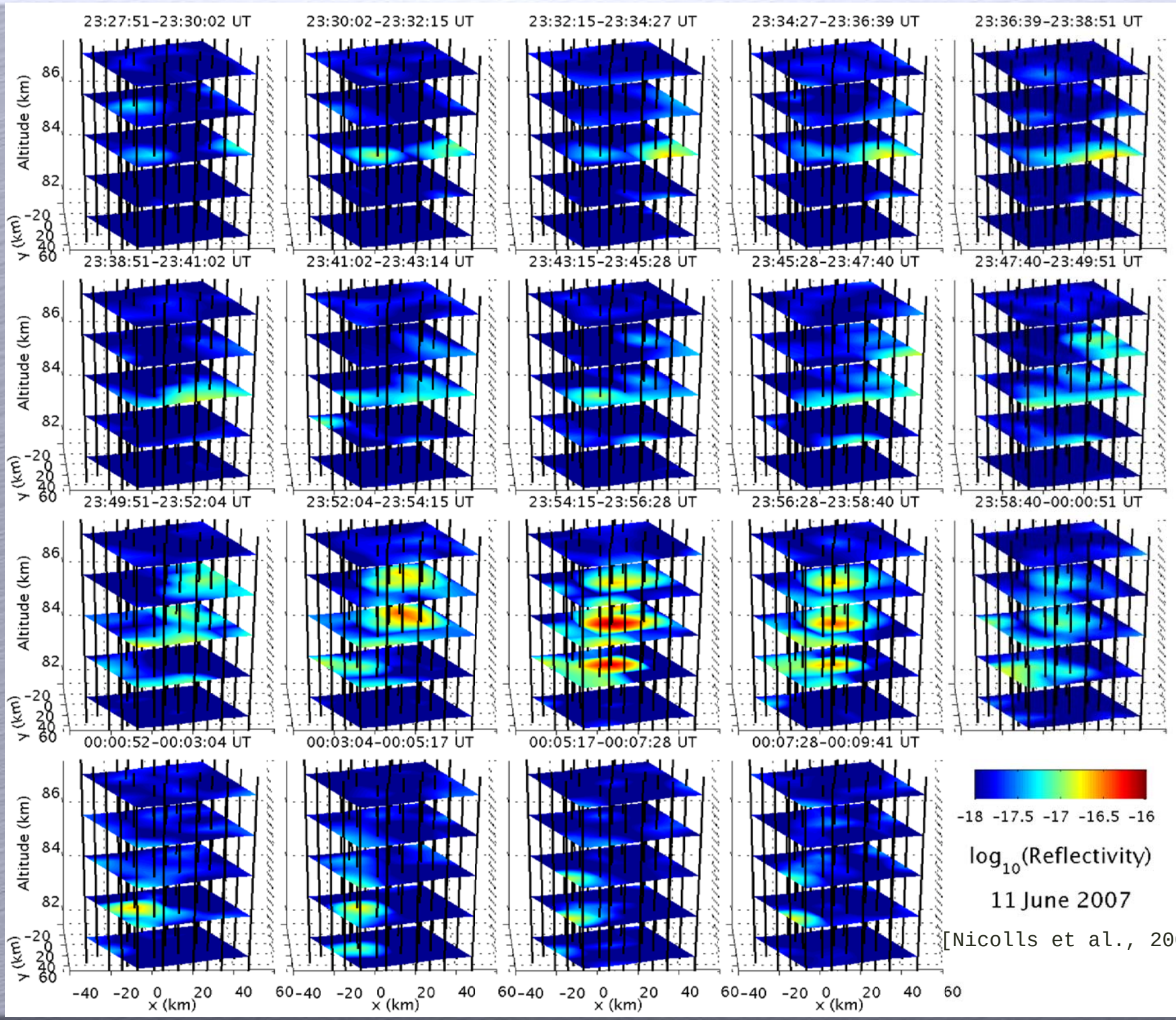
Imaging Mode

- 26 beams
- No spectral information
- ~1.5 km range resolution reflectivity measurements



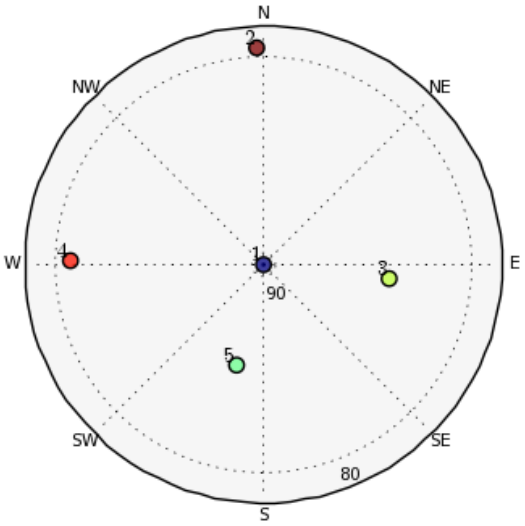


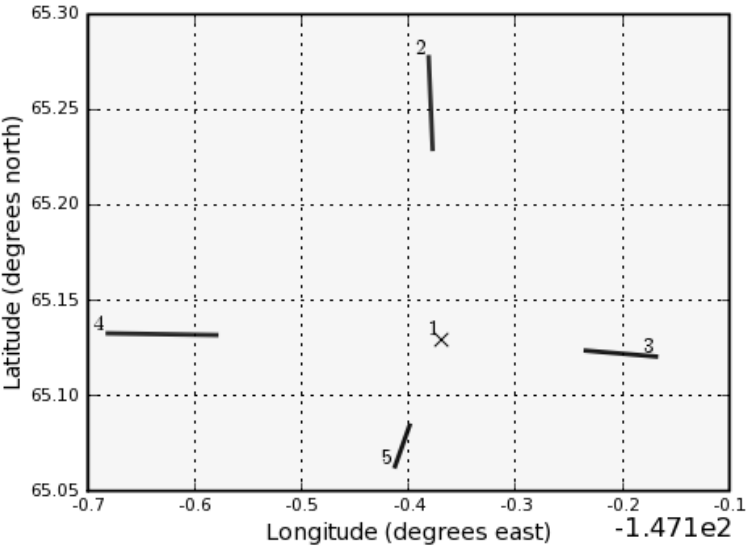

6-11-2007 15.052 UT - 6-12-2007 3.002 UT
1 (−6.1° az, 50.9° el)
2 (5.1° az, 52.5° el)
3 (20.5° az, 54.0° el)
4 (35.6° az, 53.8° el)
5 (47.1° az, 50.9° el)
6 (−16.2° az, 58.7° el)
7 (2.4° az, 61.3° el)
8 (20.5° az, 64.0° el)
9 (41.5° az, 62.3° el)
10 (57.2° az, 58.7° el)
11 (−31.3° az, 65.1° el)
12 (−14.9° az, 71.7° el)
13 (20.5° az, 74.0° el)
14 (52.6° az, 70.1° el)
15 (72.3° az, 65.1° el)
16 (−53.4° az, 69.2° el)
17 (−37.9° az, 78.7° el)
18 (20.5° az, 84.0° el)
19 (82.0° az, 80.2° el)
20 (94.4° az, 69.2° el)
21 (−80.4° az, 69.7° el)
22 (−88.8° az, 80.7° el)
23 (−159.5° az, 86.0° el)
24 (135.1° az, 79.6° el)
25 (121.4° az, 69.7° el)
26 (−154.3° az, 77.5° el)
Altitude (km)
16 17 18 19 20 21 22 23 00 01 02 03
-18.00 -17.85 -17.70 -17.55 -17.40 -17.25 -17.10 -16.95 -16.80
Log10 of Reflectivity (m−1)
[Nicolls et al., 2007]
Time (UT)
23:25 23:45 00:05 00:25 00:45

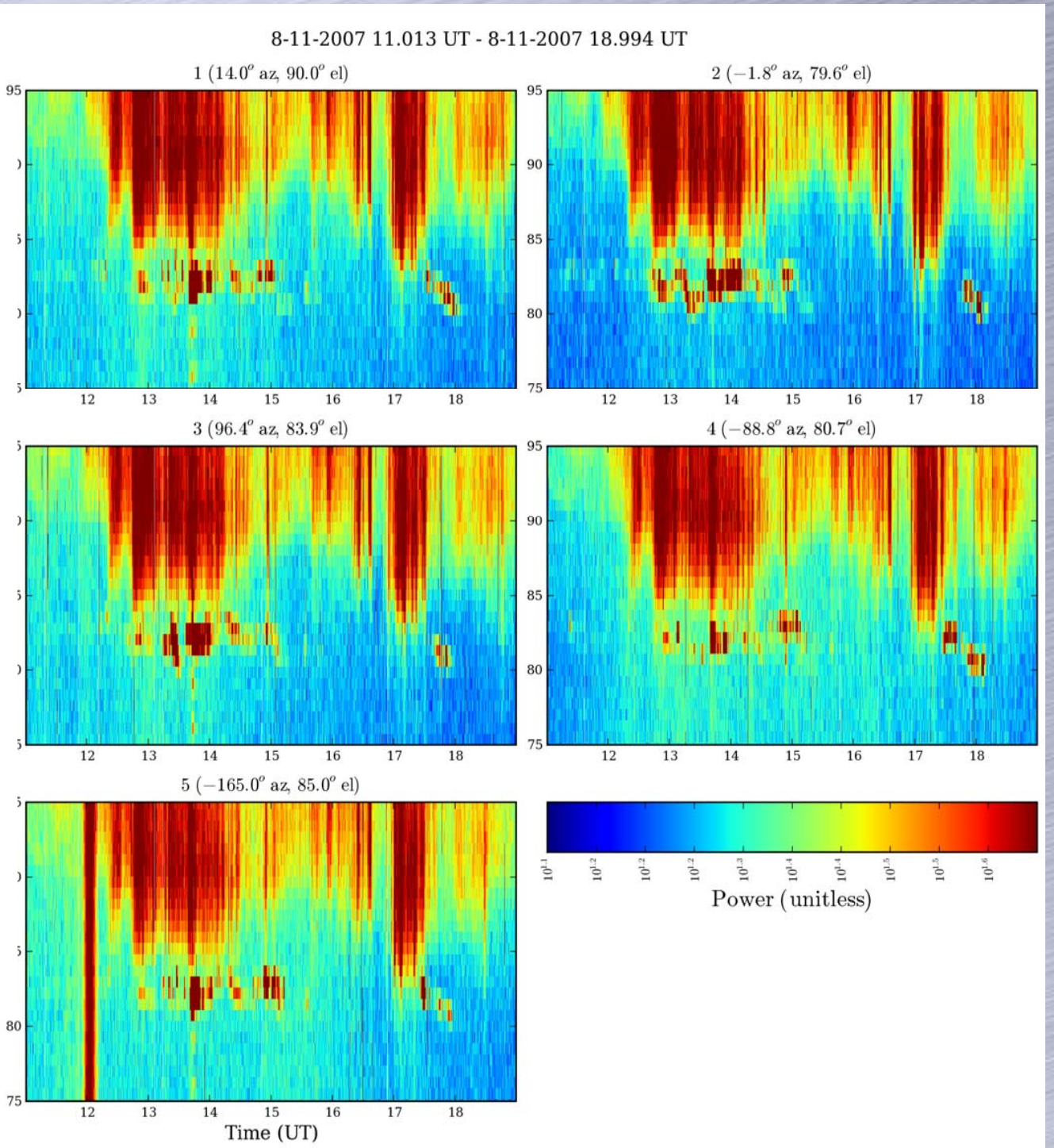


[Nicolls et al., 2007]

Spectral Observations

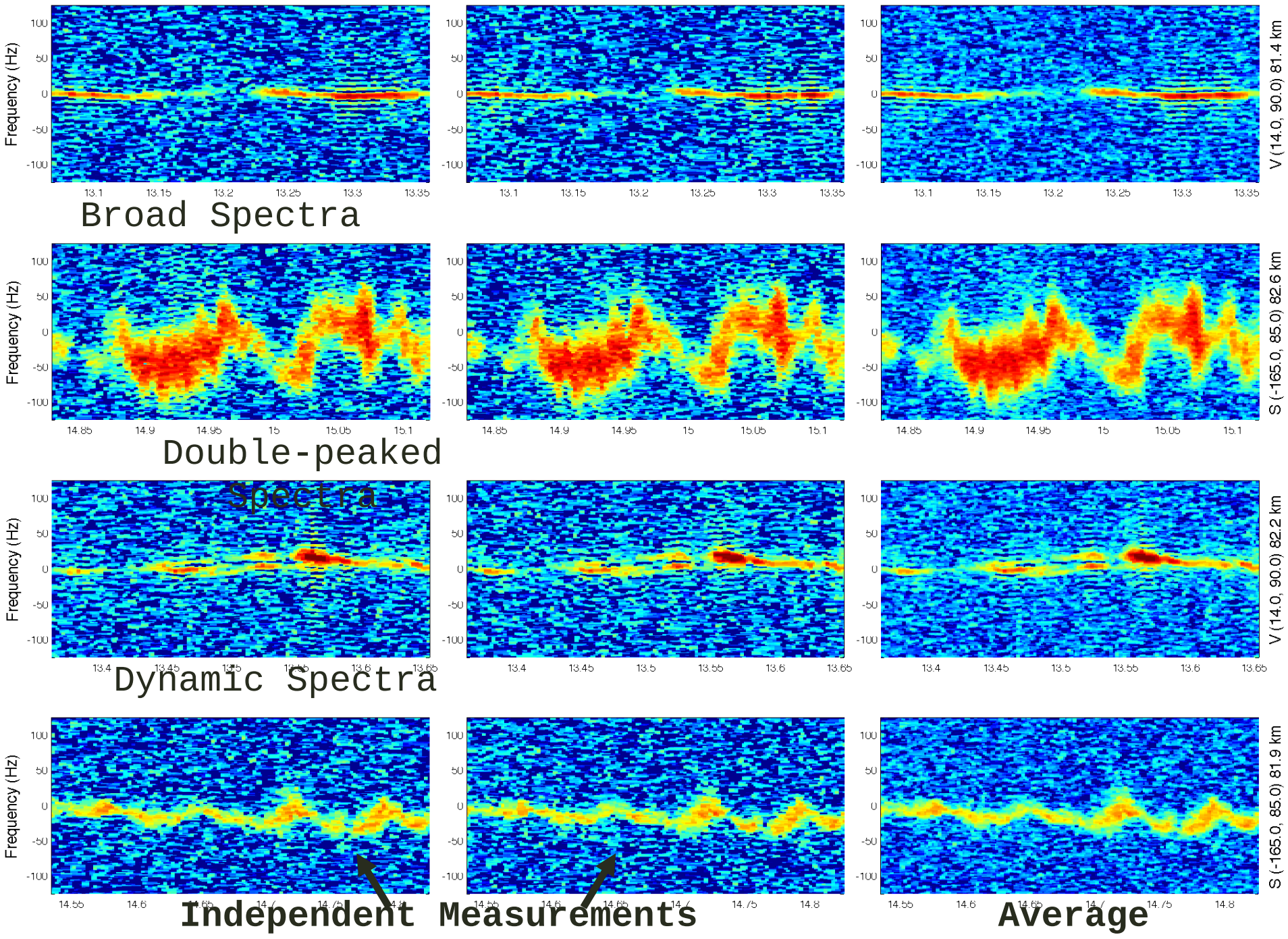






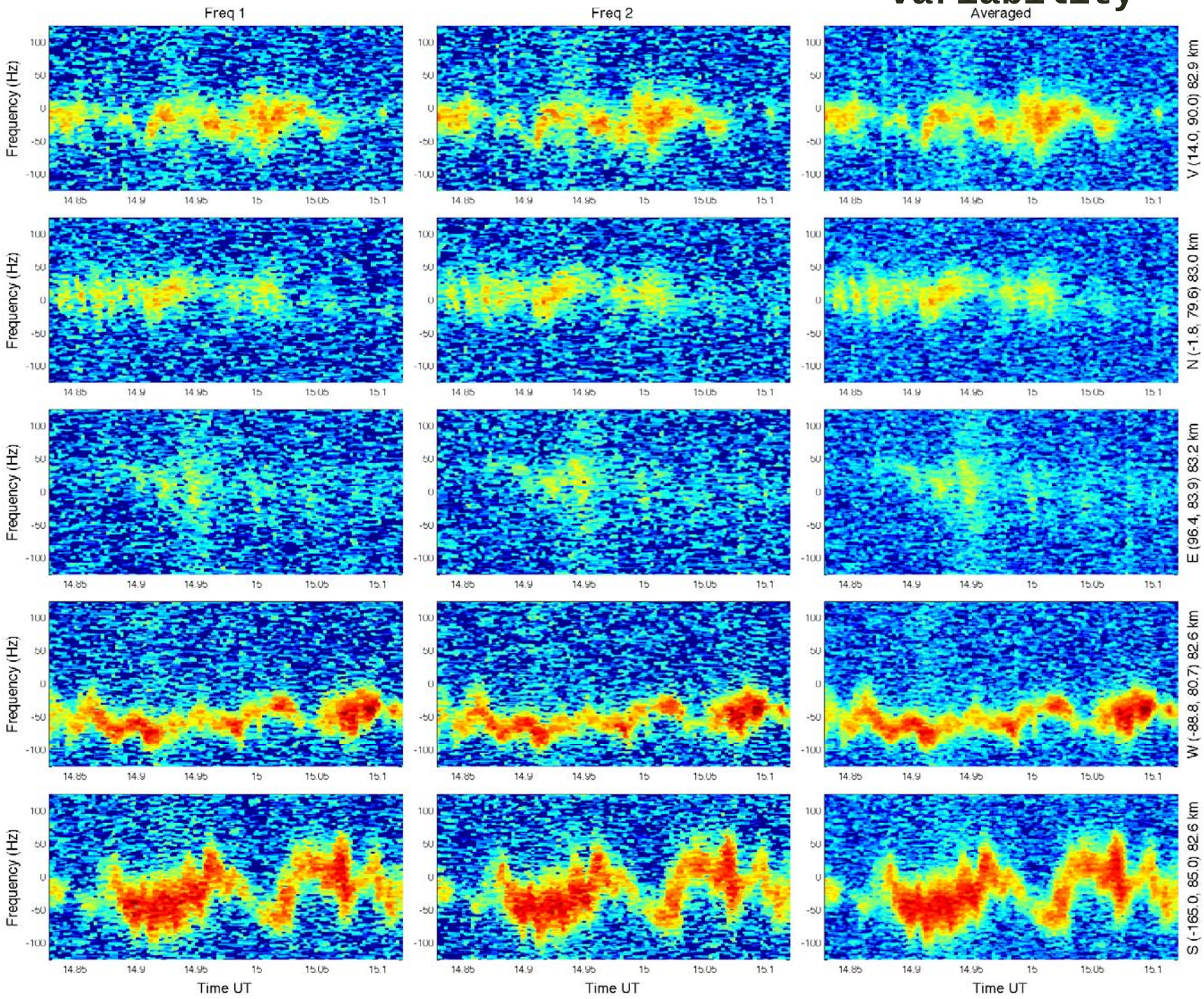
Spectral Observation

~20 minutes windows, ~15 second integrations



Spectral Observations

Significant beam-to-beam variability



Vert.

North

East

West

South

Summary and Future Work

- Observed reflectivities are in line with expectations of turbulence theories
- Schmidt numbers to explain even narrowest spectral widths can be obtained given typical particle radii and charge numbers in mesopause region
- Diffusion times are somewhat worrisome - "narrow" echoes persist much longer than tens of seconds - may be some physics missing here - calculations are extremely sensitive to background parameters
- Need common volume UHF/VHF measurements - VHF systems likely probe edges of turbulent structures, UHF are likely more direct measure of turbulent region

IPY Operatio