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FINNISH METEOROLOGICAL INSTITUTE
GEOPHYSICAL RESEARCH

La Trobe University

The relationship between Auroral Westward Flow Channels (AWFCs) observed by TIGER and magnetospheric substorms

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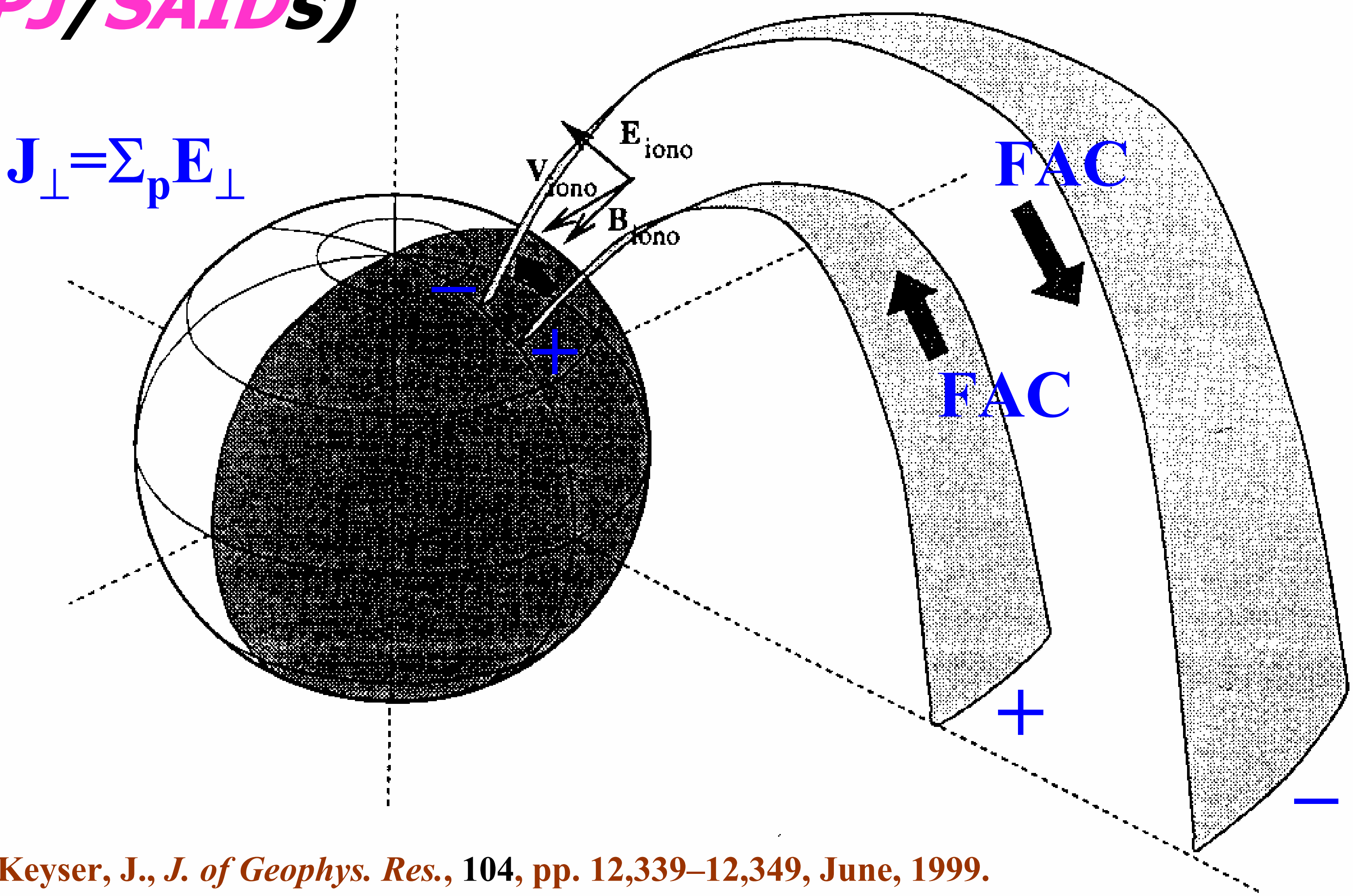
Polarisation Jets or Sub-Auroral Ion Drifts (PJ/SAIDs)



De Keyser, J., *J. of Geophys. Res.*, **104**, pp. 12,339–12,349, June, 1999.

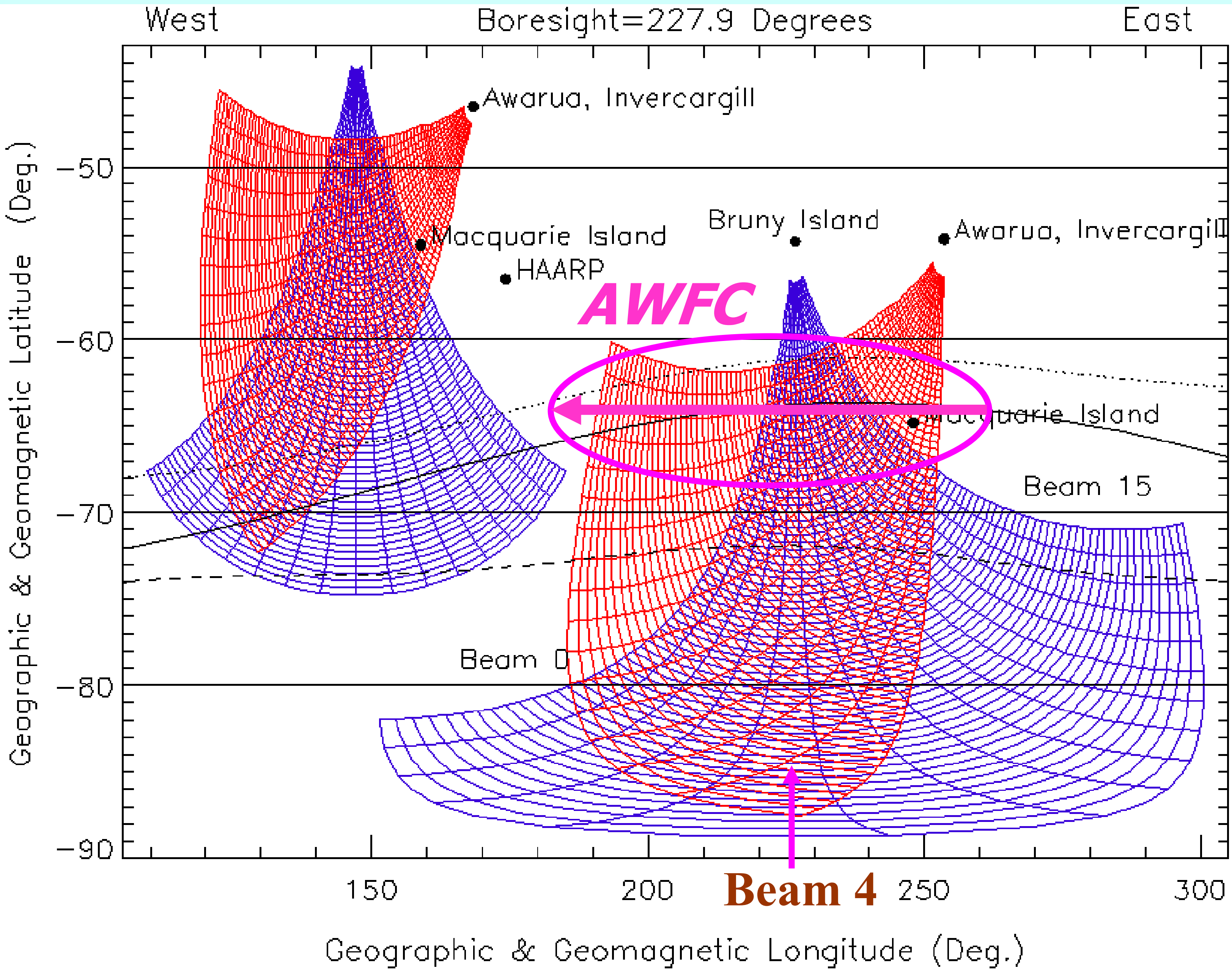
Figure 1. Schematic view of the current sheet connecting the nightside ionosphere where a PJ/SAID is observed to the magnetosphere. The ionospheric magnetic field $\mathbf{B}_{iono}$ points down, the ionospheric drift $\mathbf{V}_{iono}$ is westward, and the electric field $\mathbf{E}_{iono}$ is directed poleward. The arrows indicate the direction of the field-aligned and ionospheric currents.

Broad Research Objective:

To investigate and understand substorm, *AWFC* (*PJ/SAID*), and main ionospheric trough dynamics using experimental data recorded with the following suite of coincident instruments:

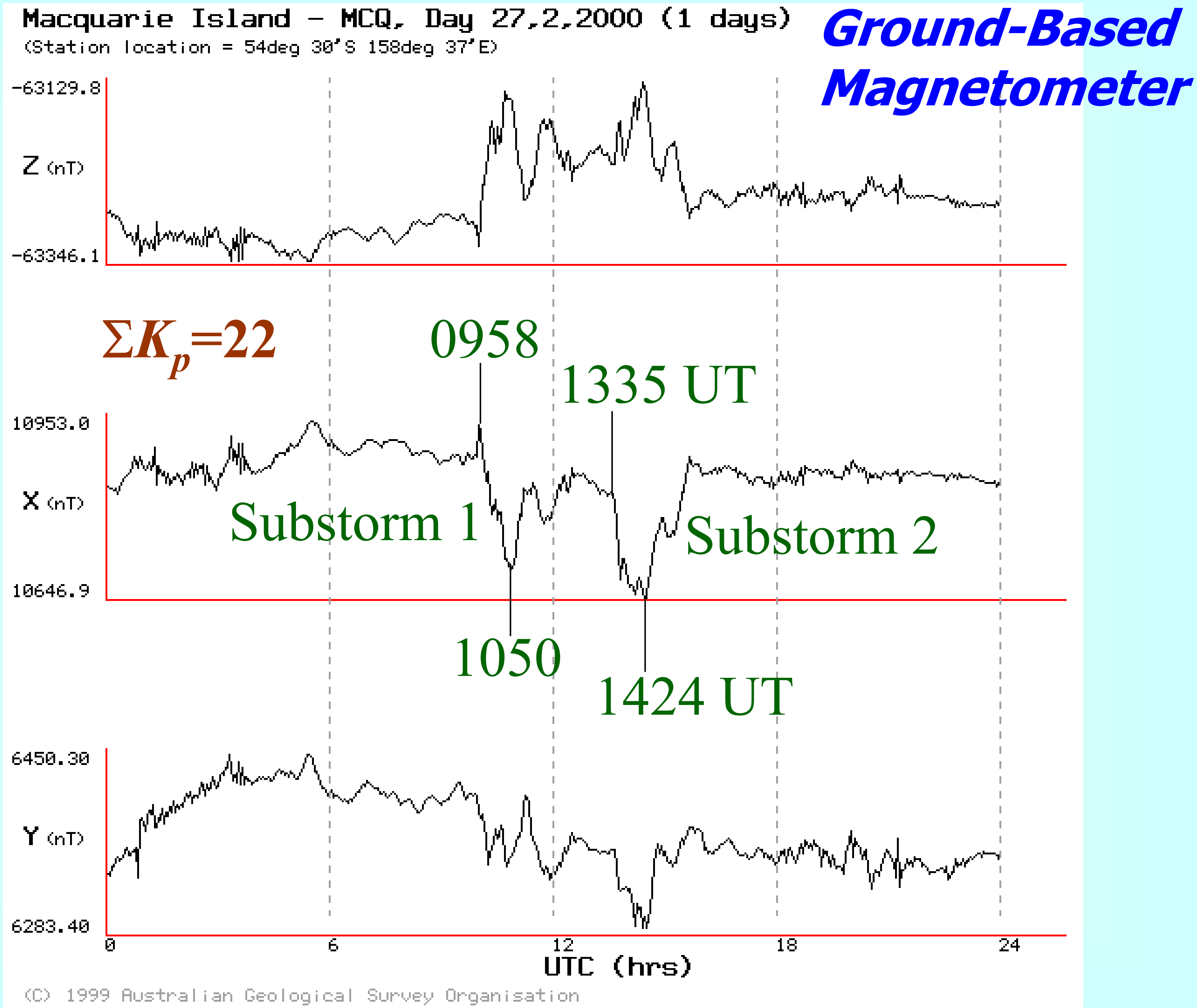
- **The Tasman International Geospace Environment Radar (TIGER) located on Bruny Island, Tasmania (43.4°S, 147.2°E; –54.5°Λ).**
- **The TIGER radar to be located at Awarua, New Zealand (46.5°S, 168.4°E, -54.2 °Λ).**
- **The magnetically conjugate, Communications Research Laboratory (CRL) radar located at King Salmon, Alaska (58.7°S, 156.7°E; 57.4°Λ).**
- **The suite of ground-based instruments include fluxgate and induction coil magnetometers, a CADI, and optical instruments located on Macquarie Island (54.5°S, 158.9°E; –64.3°Λ).**
- **Supporting space-based instruments including Defense Meteorology Satellite Program (DMSP) SS J/4 particle detectors.**

TIGER I & II Field of Views:



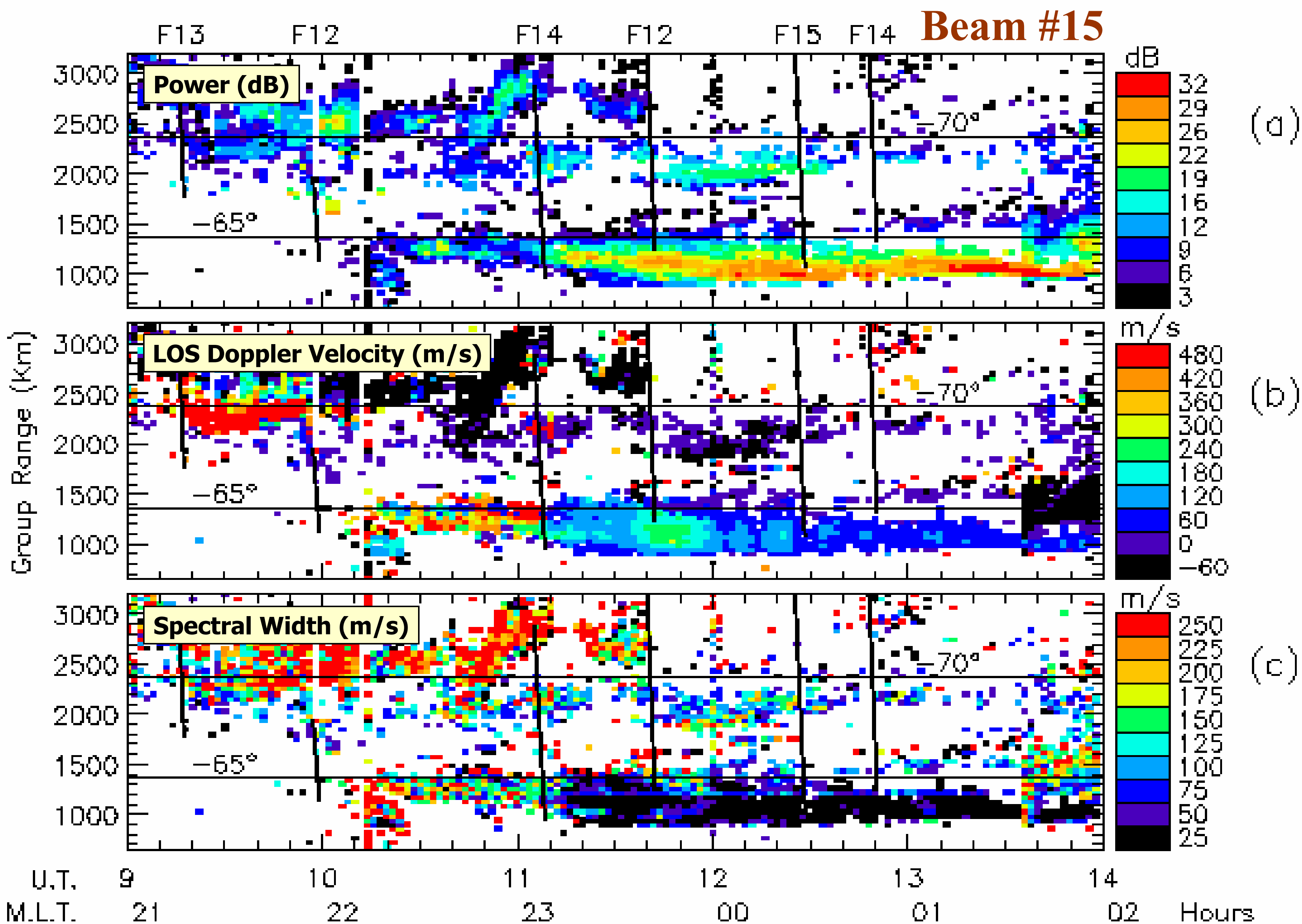
Specific Research Tasks:

- To understand the role of *AWFCs* in substorm evolution, including whether they commence before, during, or after substorm onset.
- To understand any distinction between *AWFCs*, *PJ/SAIDs*, *SAEFs*, *SARASs*, flux depletion regions (FDRs), and the sub-auroral polarisation stream (SAPS).
- To compile occurrence statistics for *AWFCs*, including their location and extent in MLT, their lifetimes, latitudinal widths, maximum drift speeds, etc.
- To identify what fraction of substorms are accompanied by *AWFCs*, and under what conditions.
- To classify and understand the diversity of *AWFC* morphology, including changes in the main FITACF parameters (power, LOS Doppler velocity, and spectral width).
- To understand the detailed instability processes occurring within *AWFCs*, including their relationship to auroral magnetometer and optical phenomena.

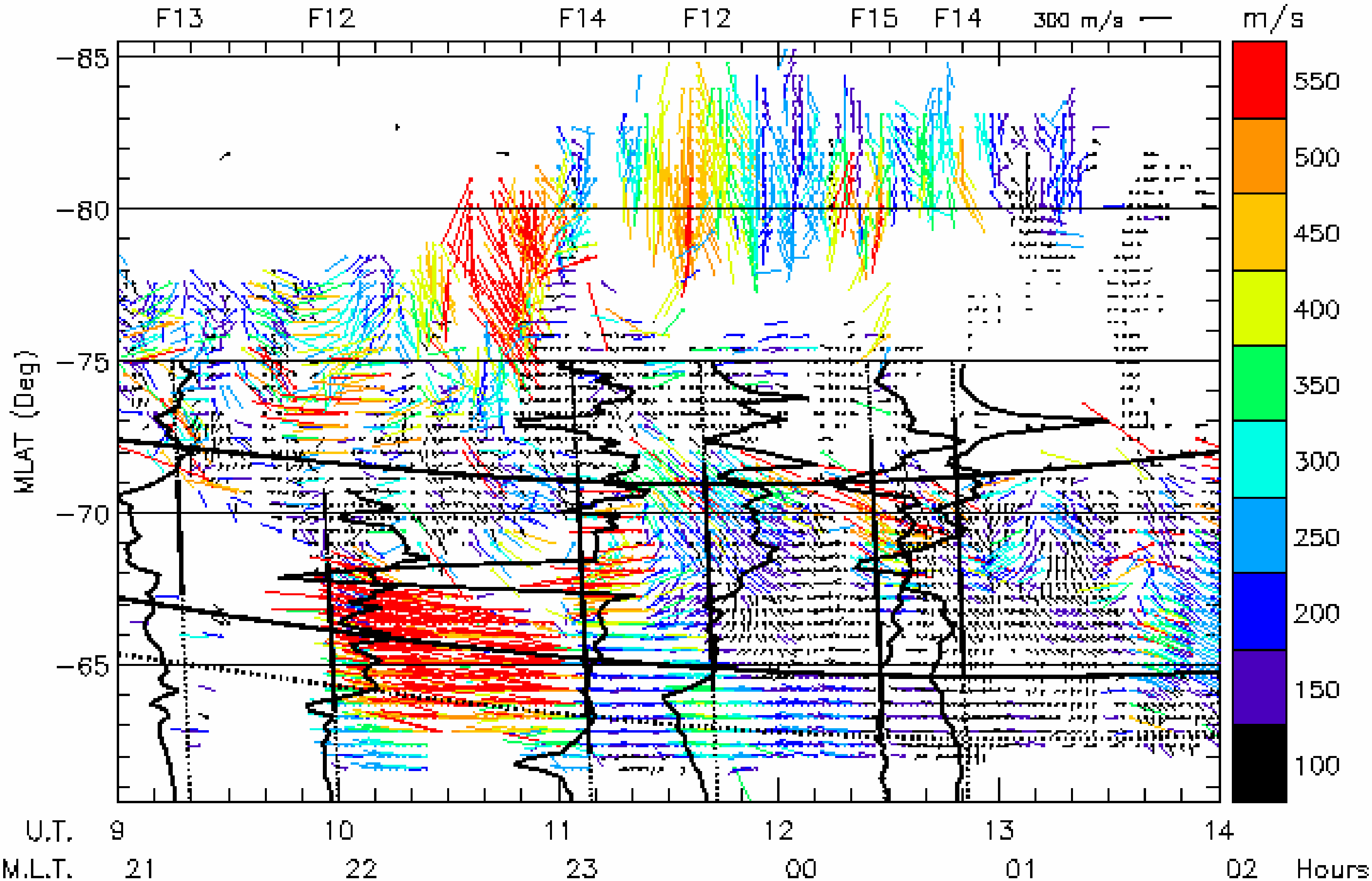


Macquarie Island - MCQ, Day 27,2,2000 (1 days)
(Station location = 54deg 30'S 158deg 37'E)
Ground-Based Magnetometer
-63129.8
Z (nT)
-63346.1
ΣKp=22
0958
1335 UT
10953.0
X (nT)
Substorm 1
Substorm 2
10646.9
1050
1424 UT
6450.30
Y (nT)
6283.40
0
6
12
18
24
UTC (hrs)
(C) 1999 Australian Geological Survey Organisation

Auroral Westward Flow Channel (AWFC), 27 Feb. 2000

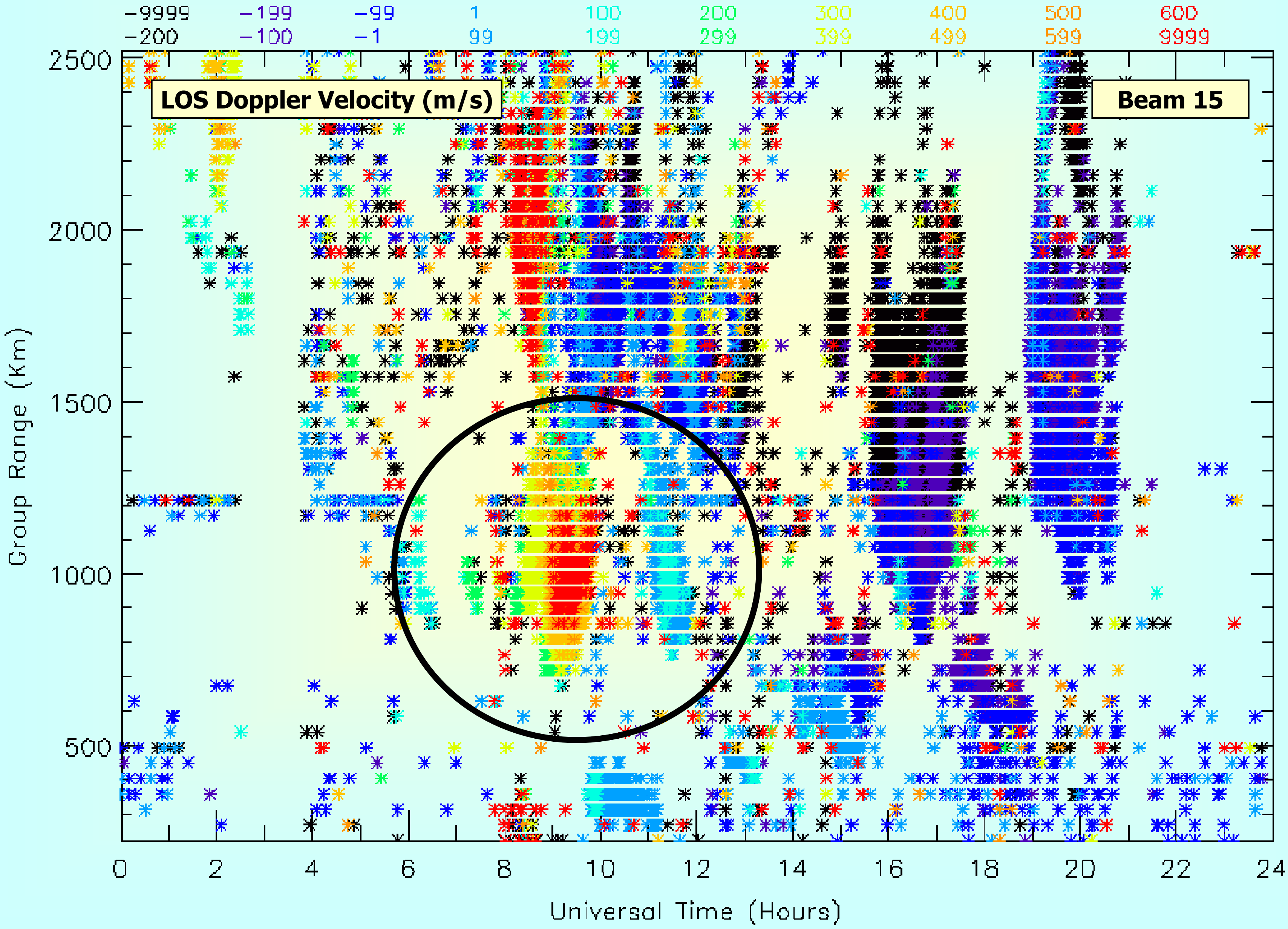


2-D Beam-Swinging Velocities, 27 February, 2000

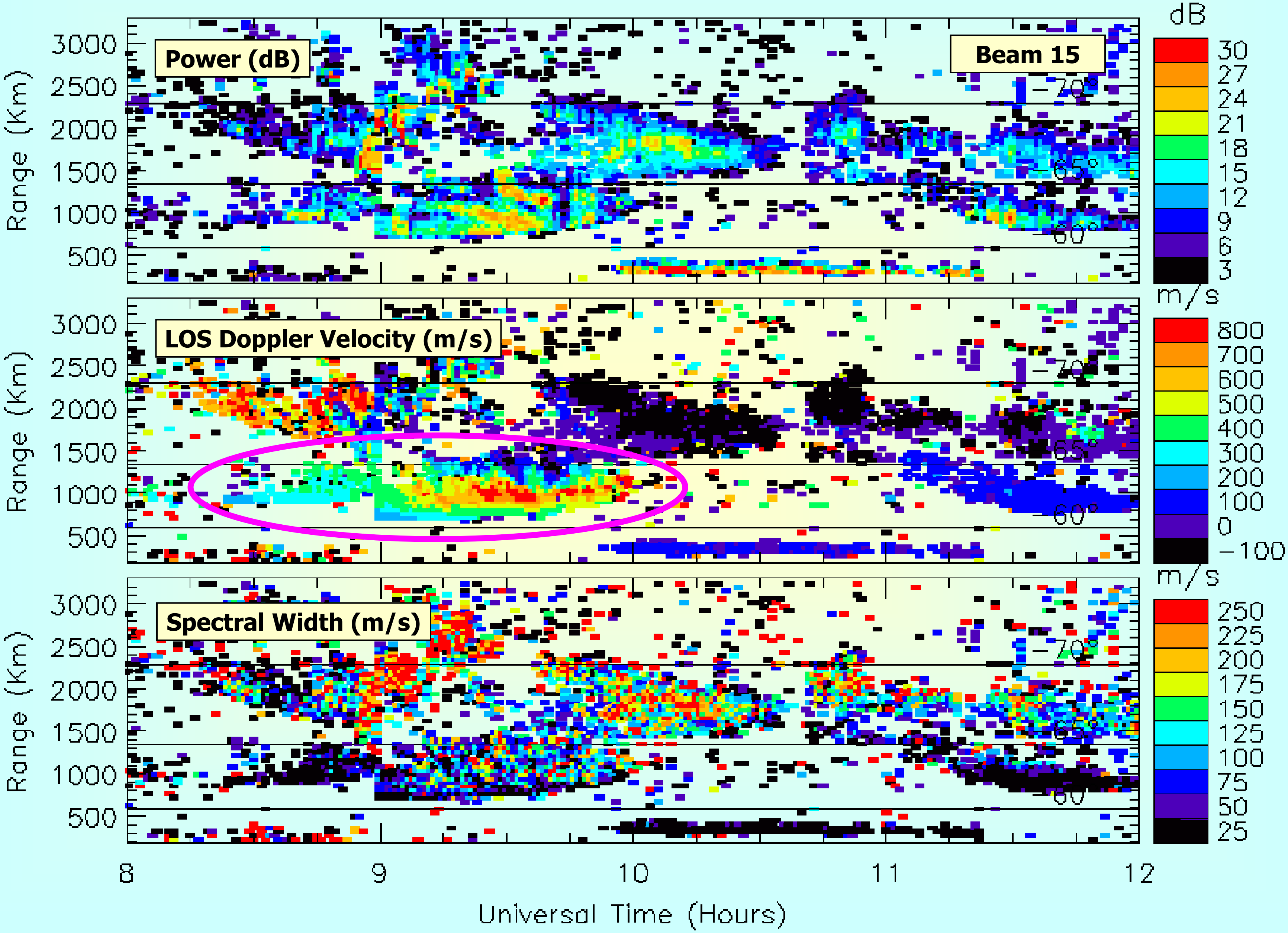


Parkinson et al., *Annales Geophysicae*, In Press, 2003

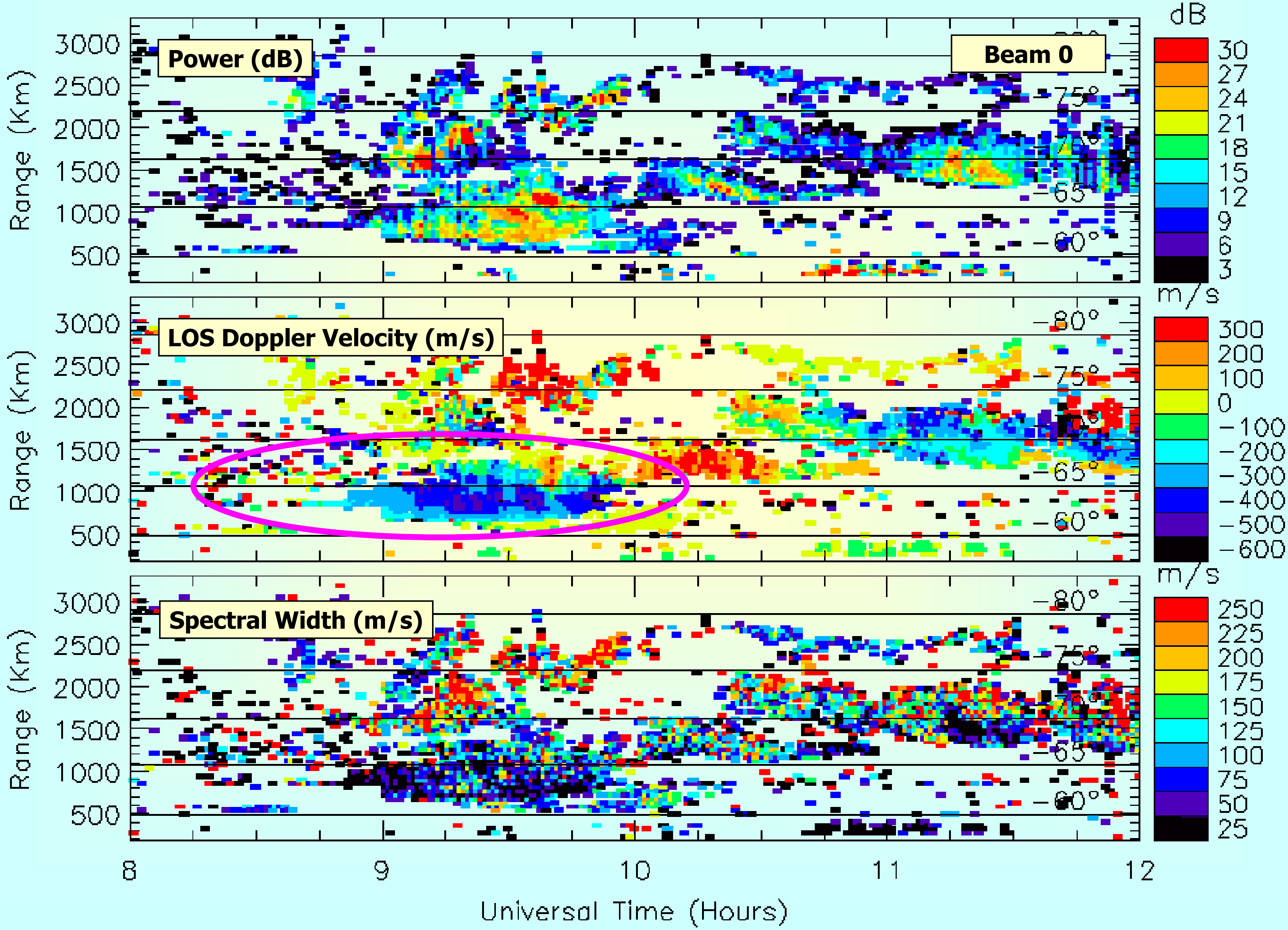
Rapid Identification of AWFC, 7 February 2000



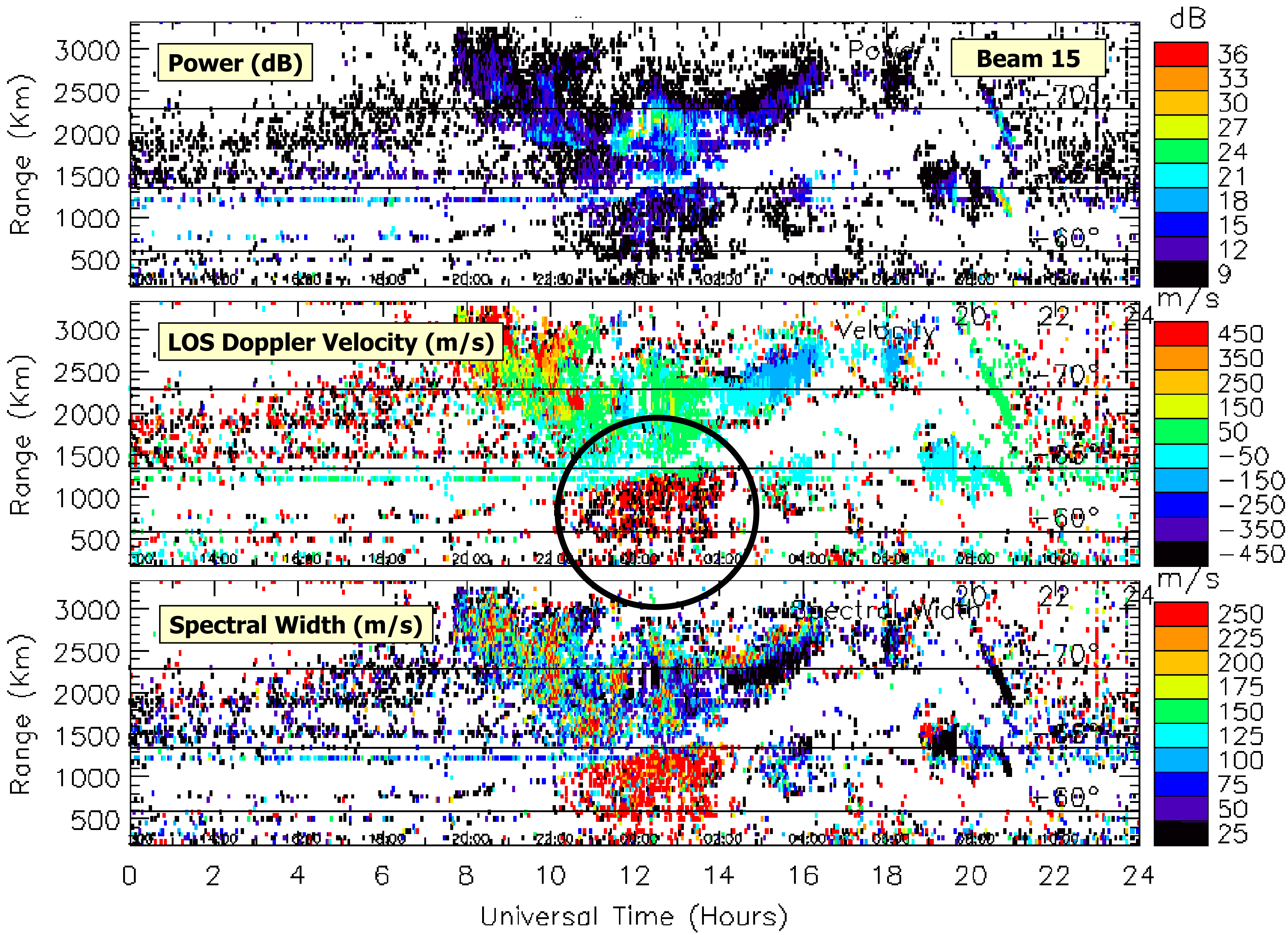
Rapid Identification of AWFC, 7 February 2000



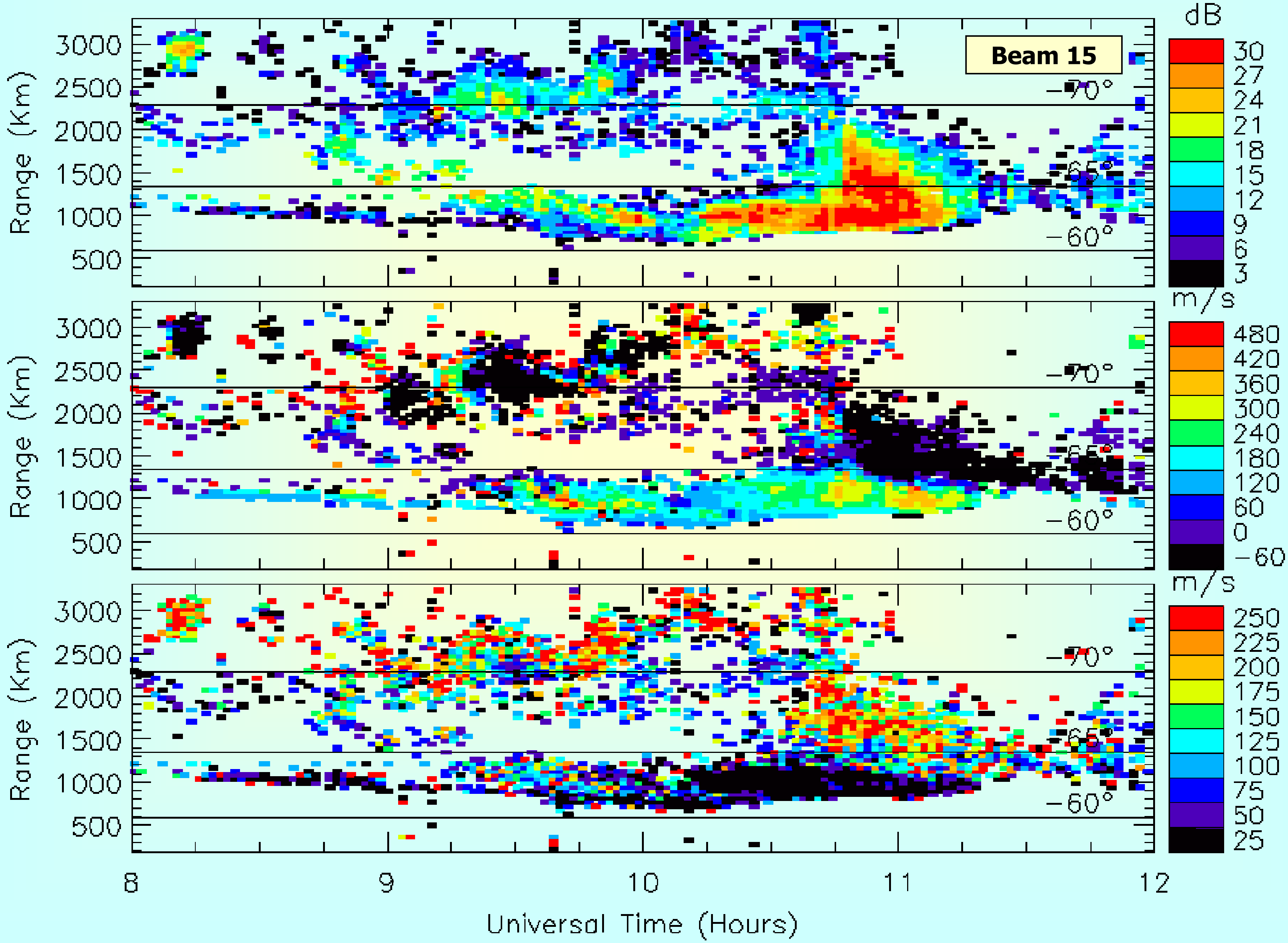
Rapid Identification of AWFC, 7 February 2000



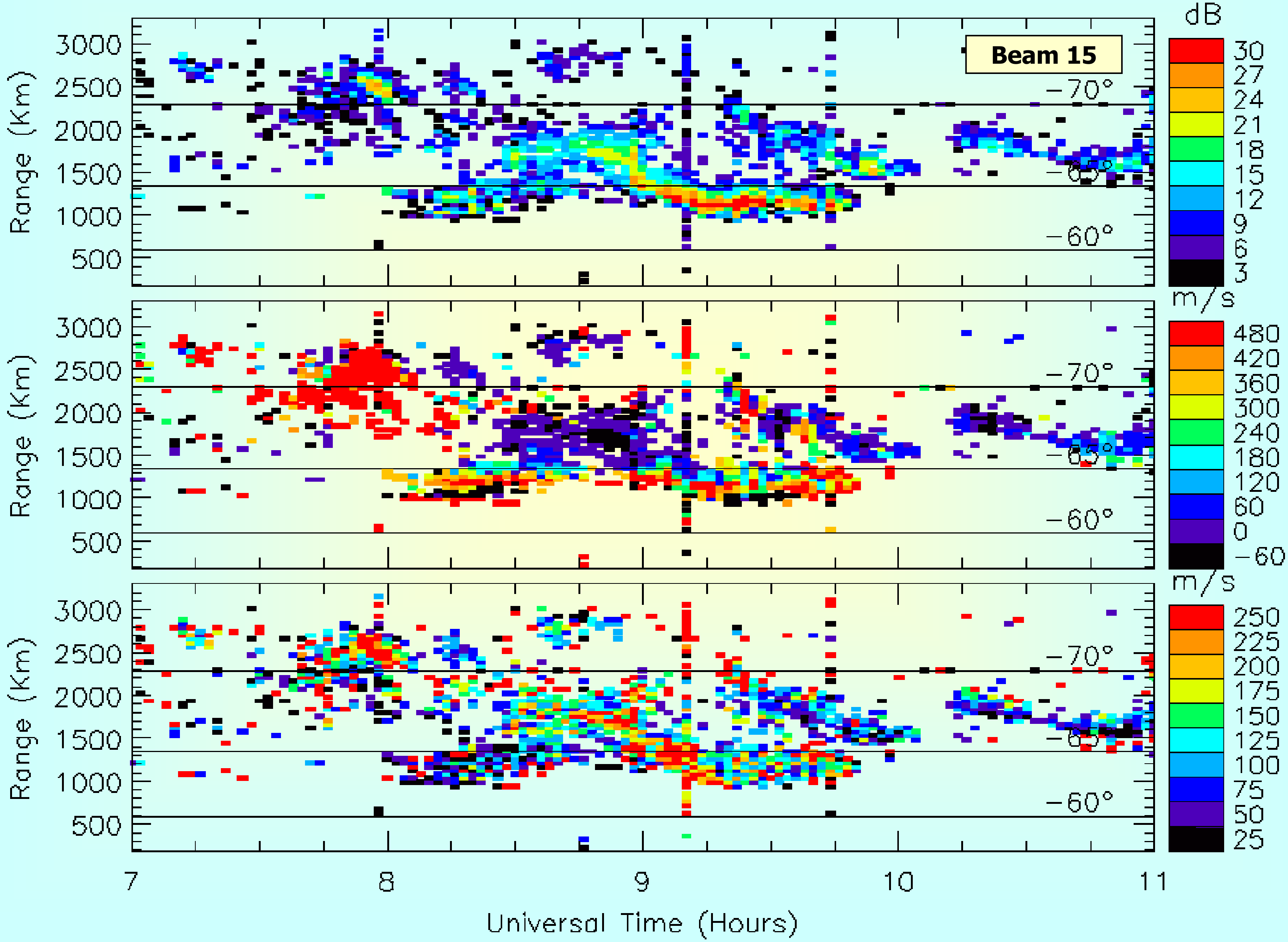
Echoes with Extreme Spectral Width, 15 April 2000



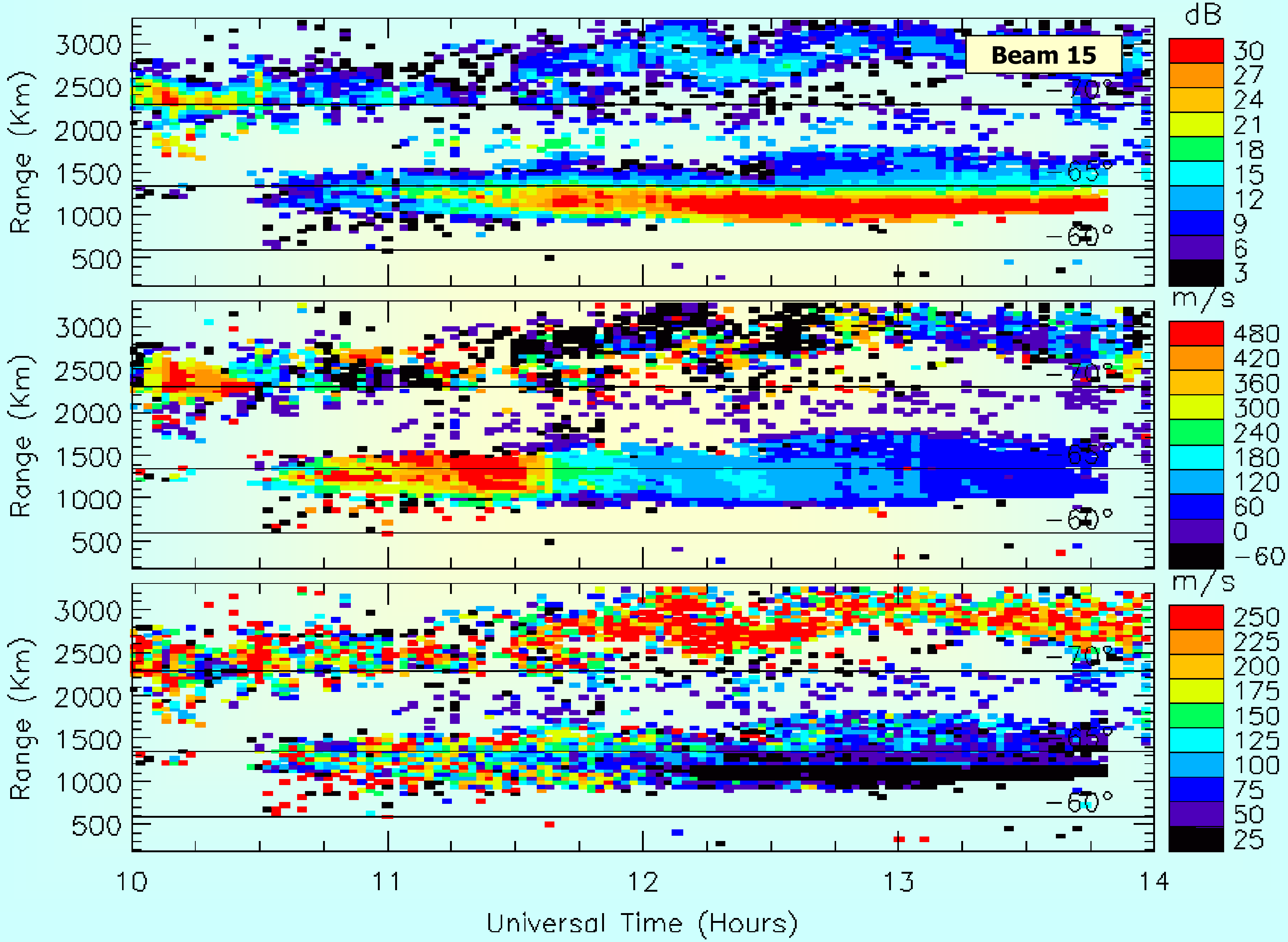
AWFC, 3 April 2000



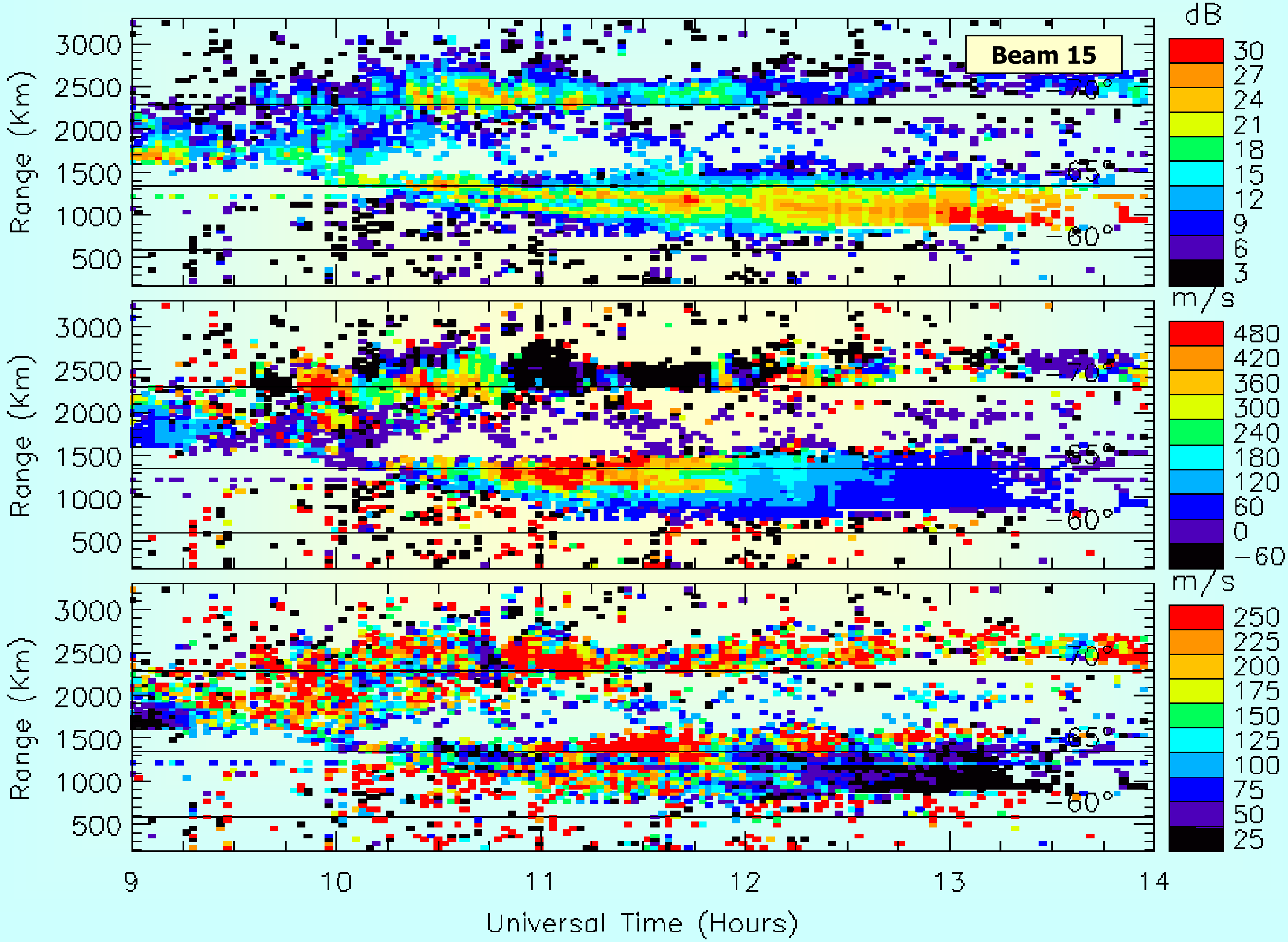
AWFC, 6 April 2000



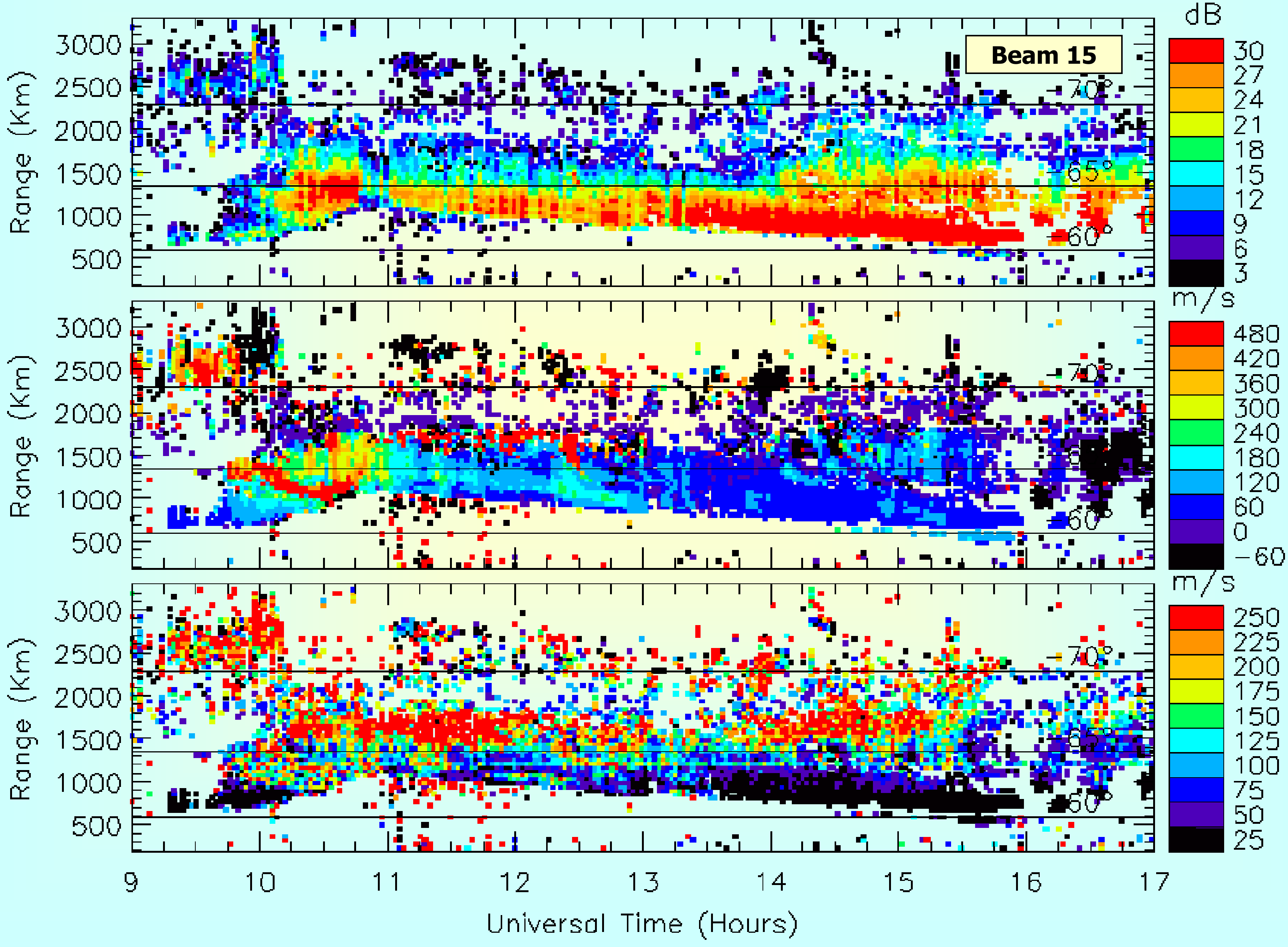
AWFC, 22 April 2000



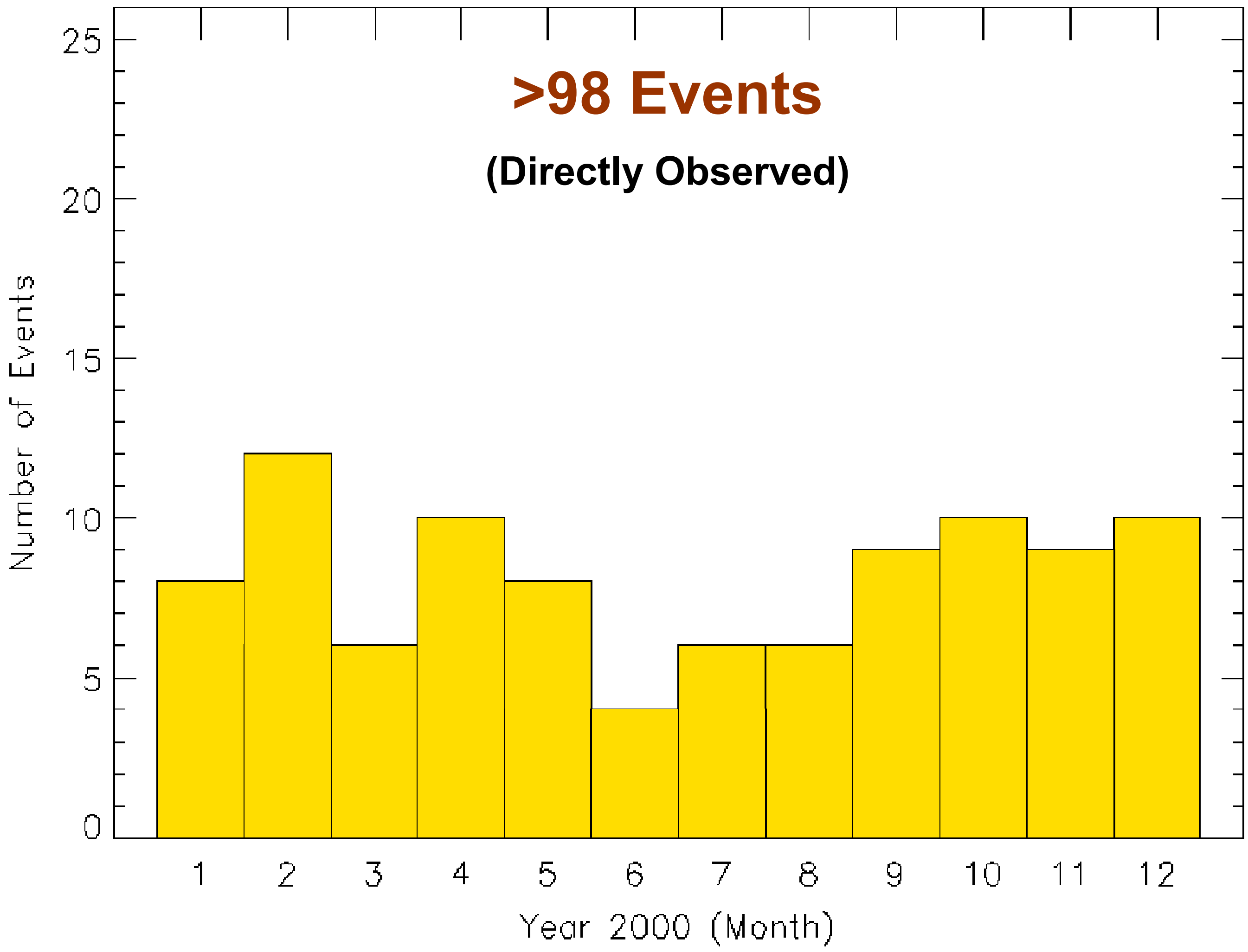
AWFC, 15 August 2000



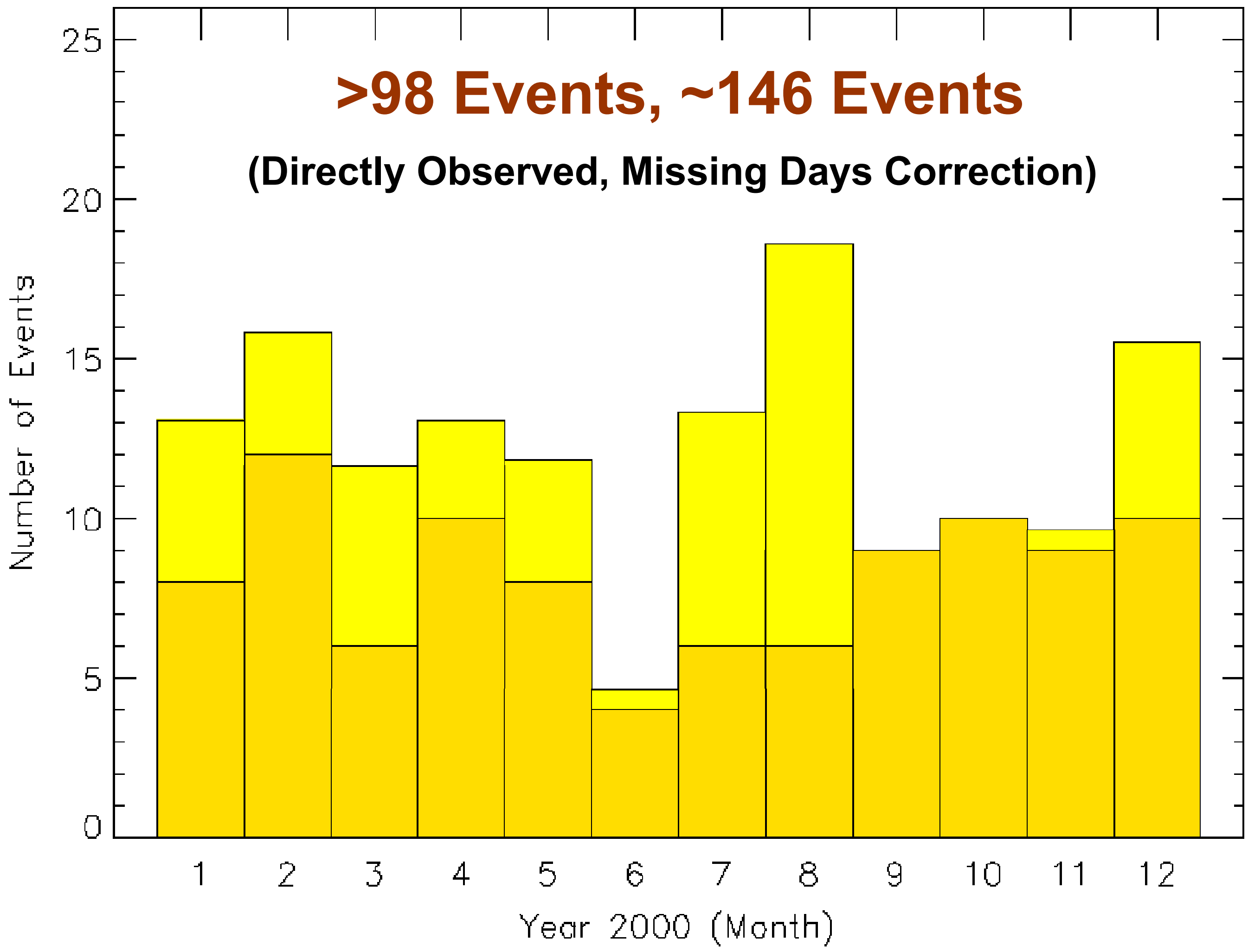
AWFC, 31 August 2000



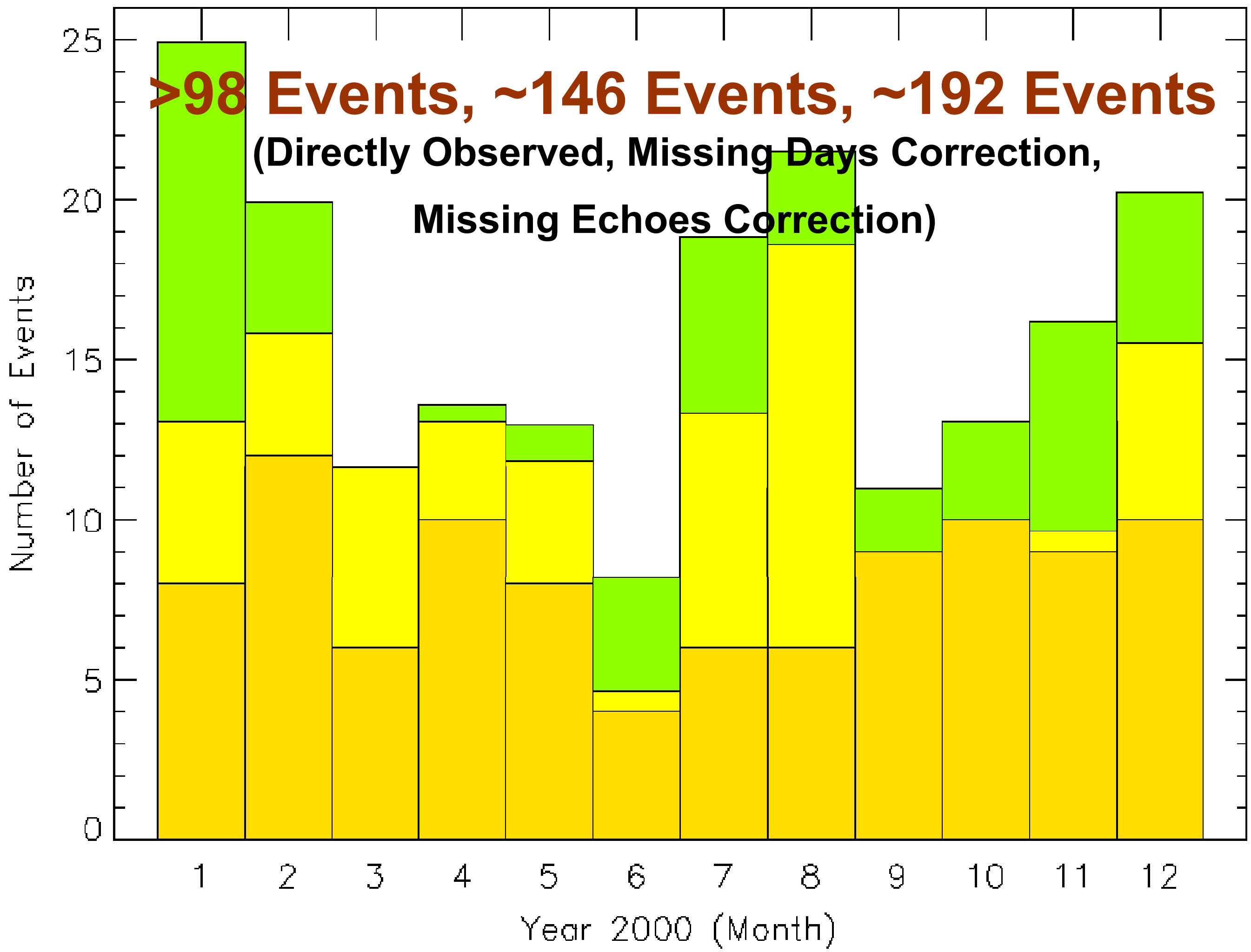
Occurrence of AWFCs in TIGER Observations, 2000 (NB. Not "Absolute Occurrence")



Occurrence of AWFCs in TIGER Observations, 2000 (NB. Not "Absolute Occurrence")



Occurrence of AWFCs in TIGER Observations, 2000 (NB. Not "Absolute Occurrence")



Summary:

- *AWFCs* strongly resemble *PJ/SAIDs*, except they are more closely synchronised with the onset and recovery of substorms.
- *AWFCs* are the dominant electric field signature in the 20 to 24 MLT sector when substorms occur.
- Perhaps every quiet to moderate substorm is accompanied by an *AWFC* in the pre-midnight sector.
- TIGER I has the potential to observe ~150 well-defined *AWFCs* per annum during 8 to 13 UT (~20 to 01 MLT), and –60°Λ to 68°Λ (beam 15 range bins 10 to 38).
- *AWFCs* exhibit a diverse morphology, including narrow, snake-like events, events consisting of bifurcated narrow channels, and very broad intense events spreading in latitude to trough-like ionospheric scatter.

Summary:

- **Usually the backscatter powers and spectral widths are moderate during the *AWFC*, and the subsequent main-trough like scatter has large backscatter power and small spectral widths.**