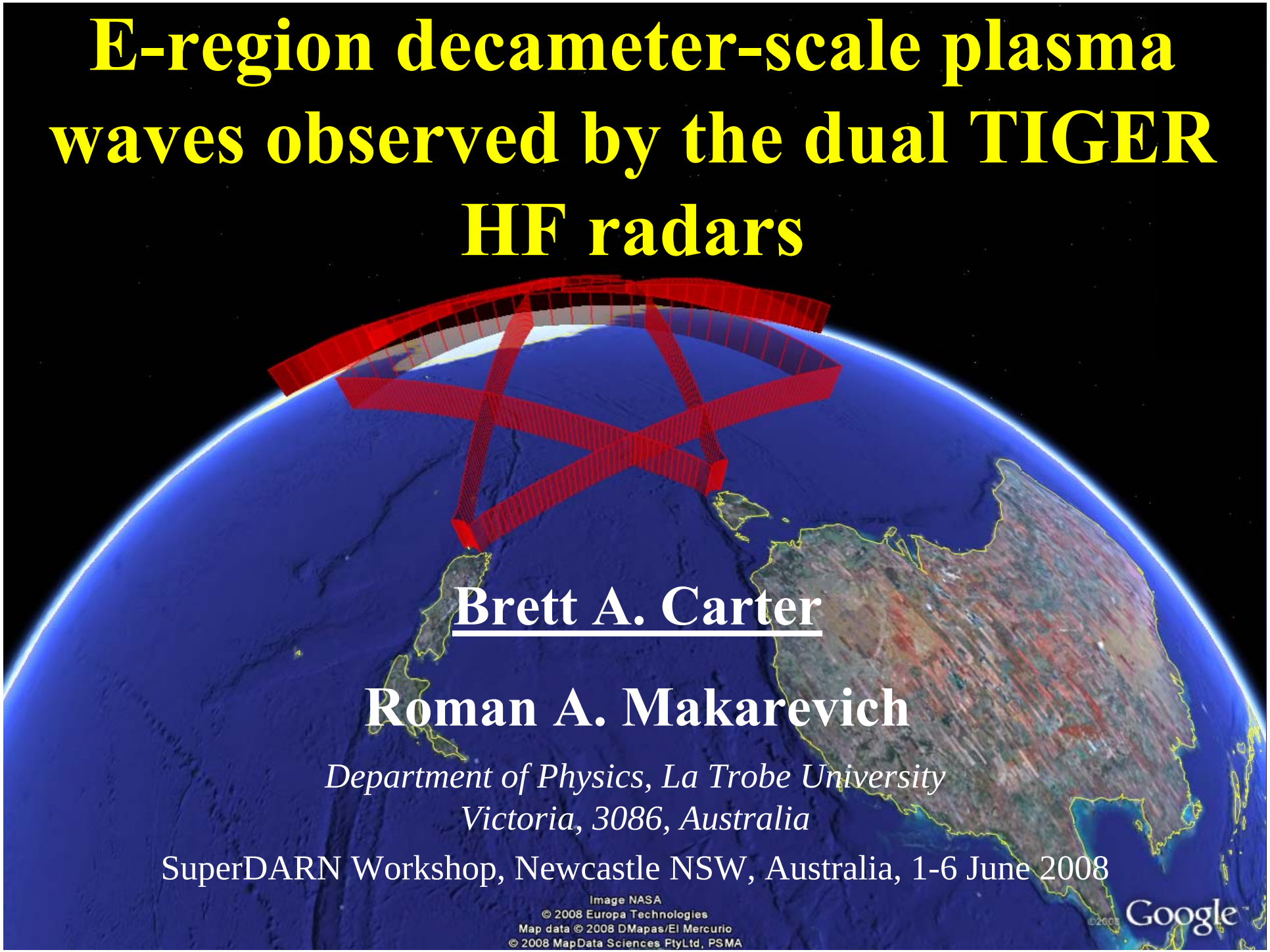
# E-region decameter-scale plasma waves observed by the dual TIGER HF radars

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# Outline

**Introduction:**

- TIGER experimental setup
- Echo type predictions

**Spatial occurrence:**

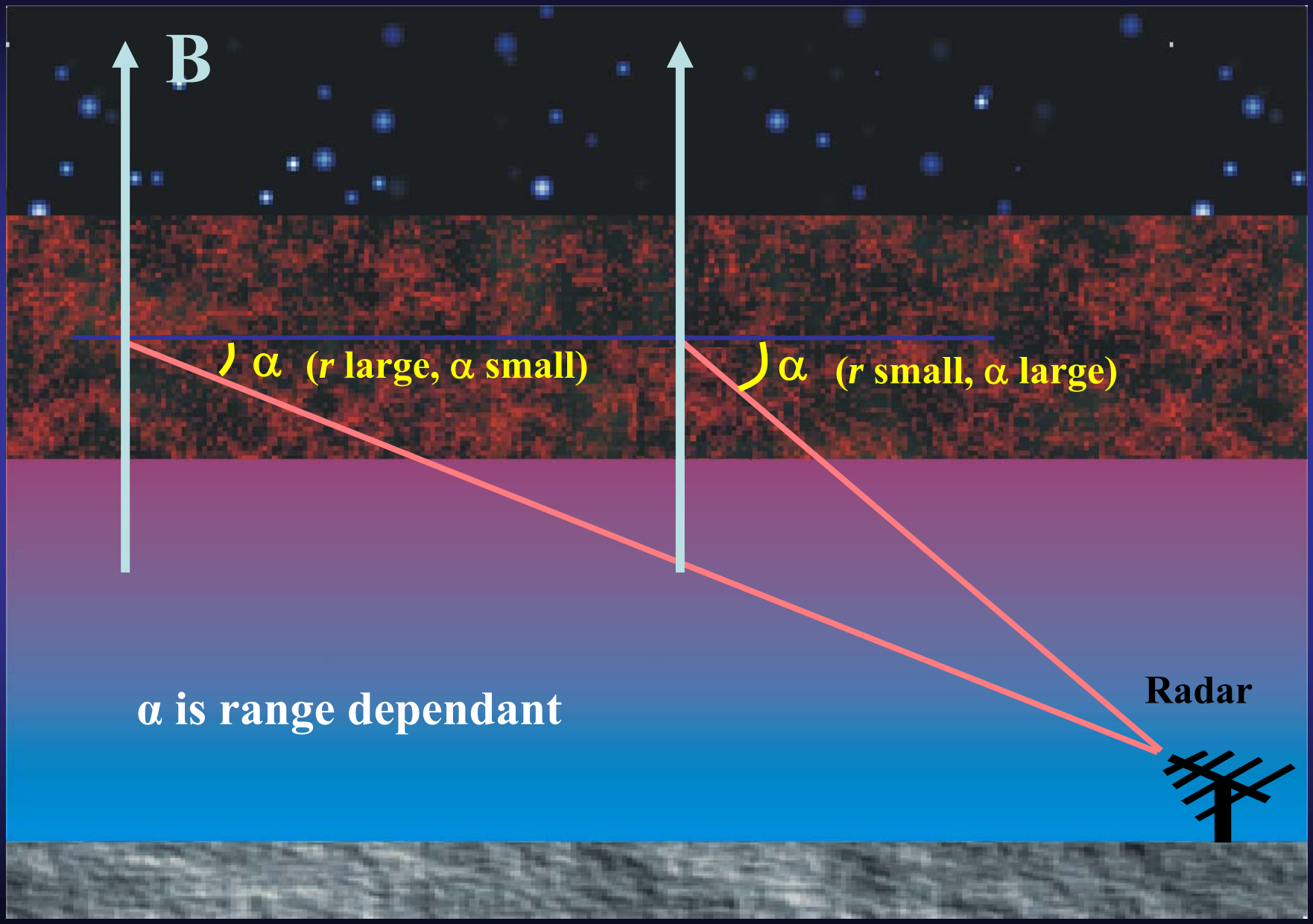
- Morning-evening comparison
- Storm-time echo occurrence patterns

**Echo types at HF:**

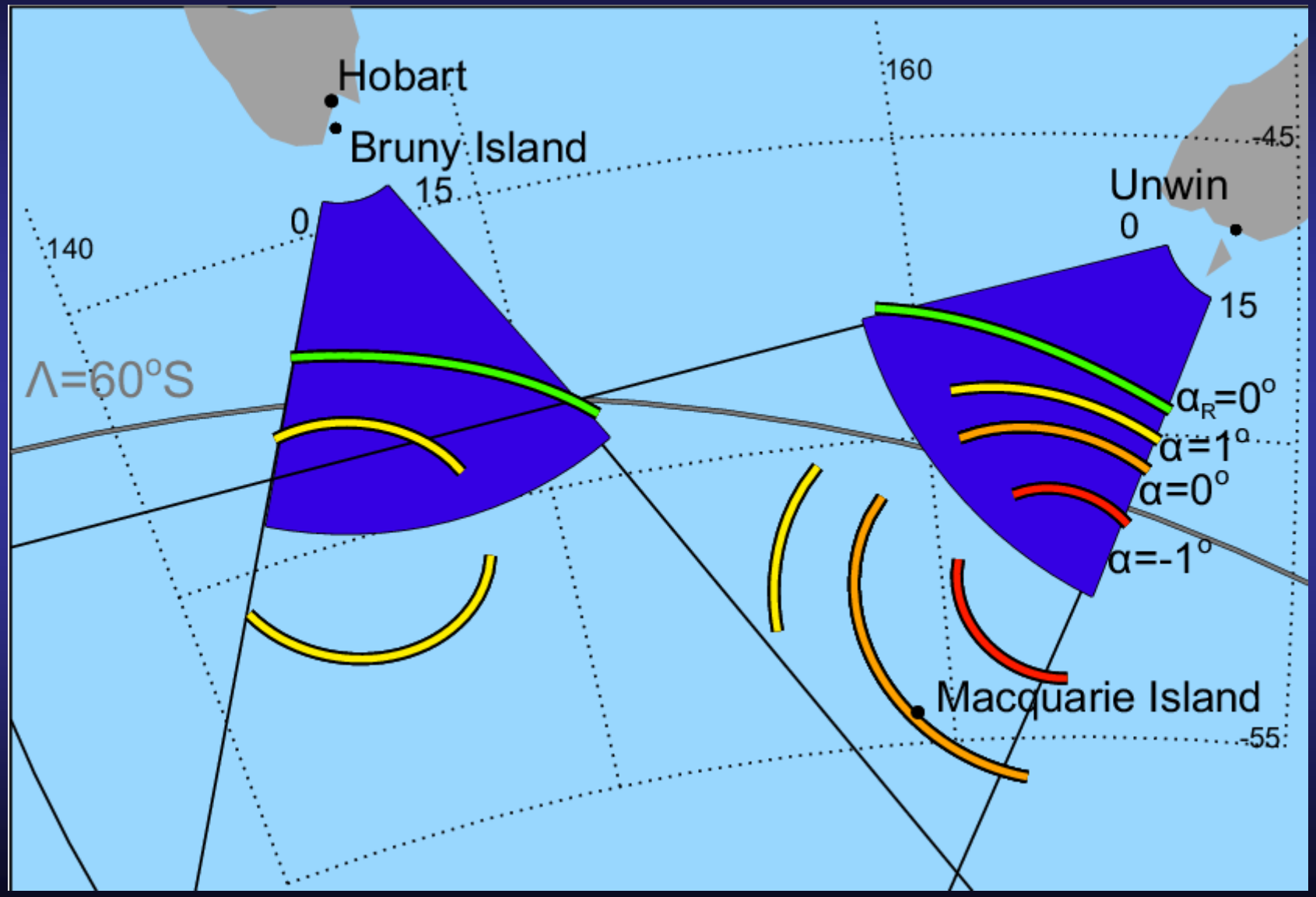
- Spectral width versus velocity plots
- Dependence on geomagnetic activity
- Storm-time echo population

**Summary and Conclusions**

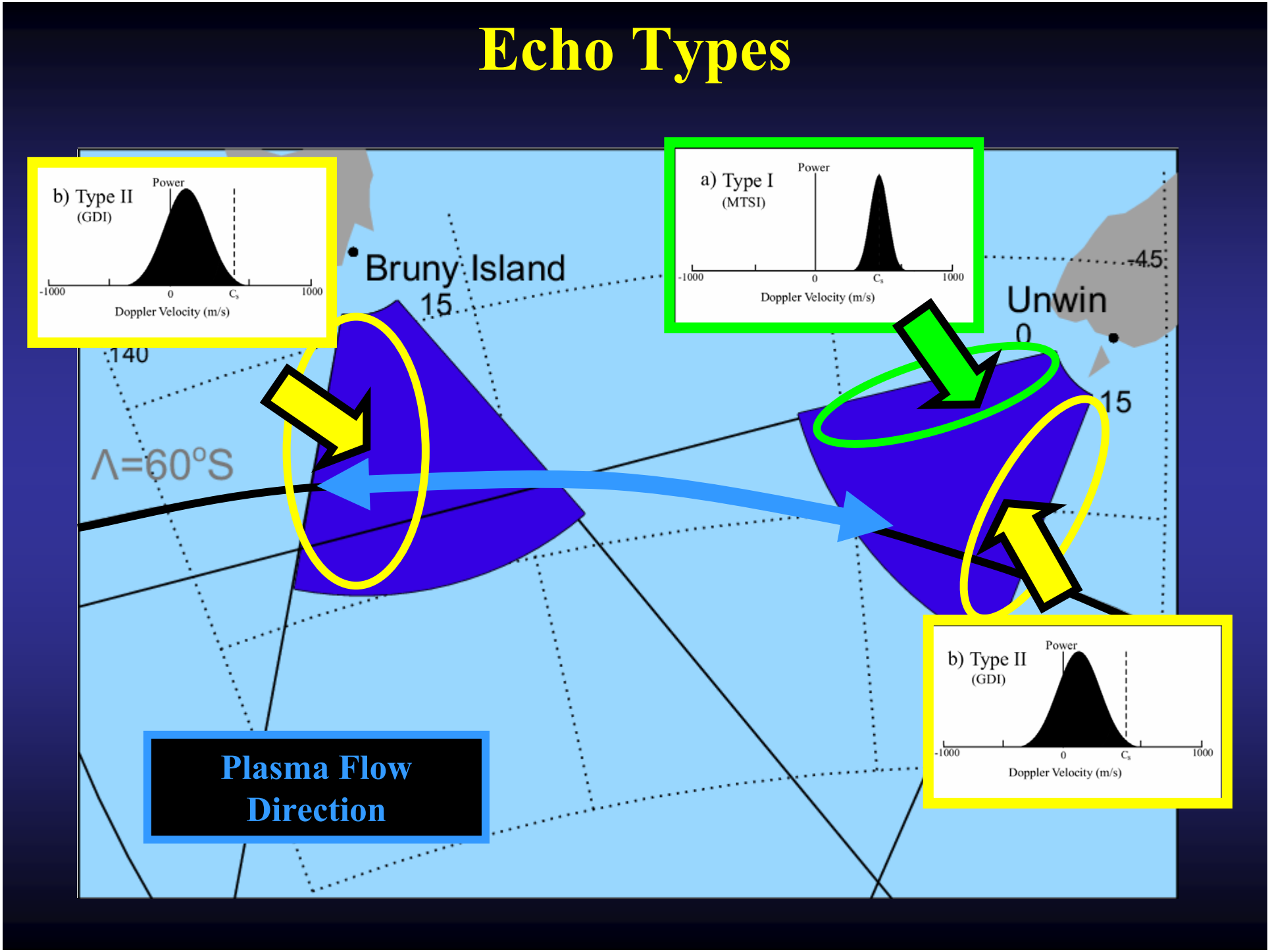
# Aspect Angle



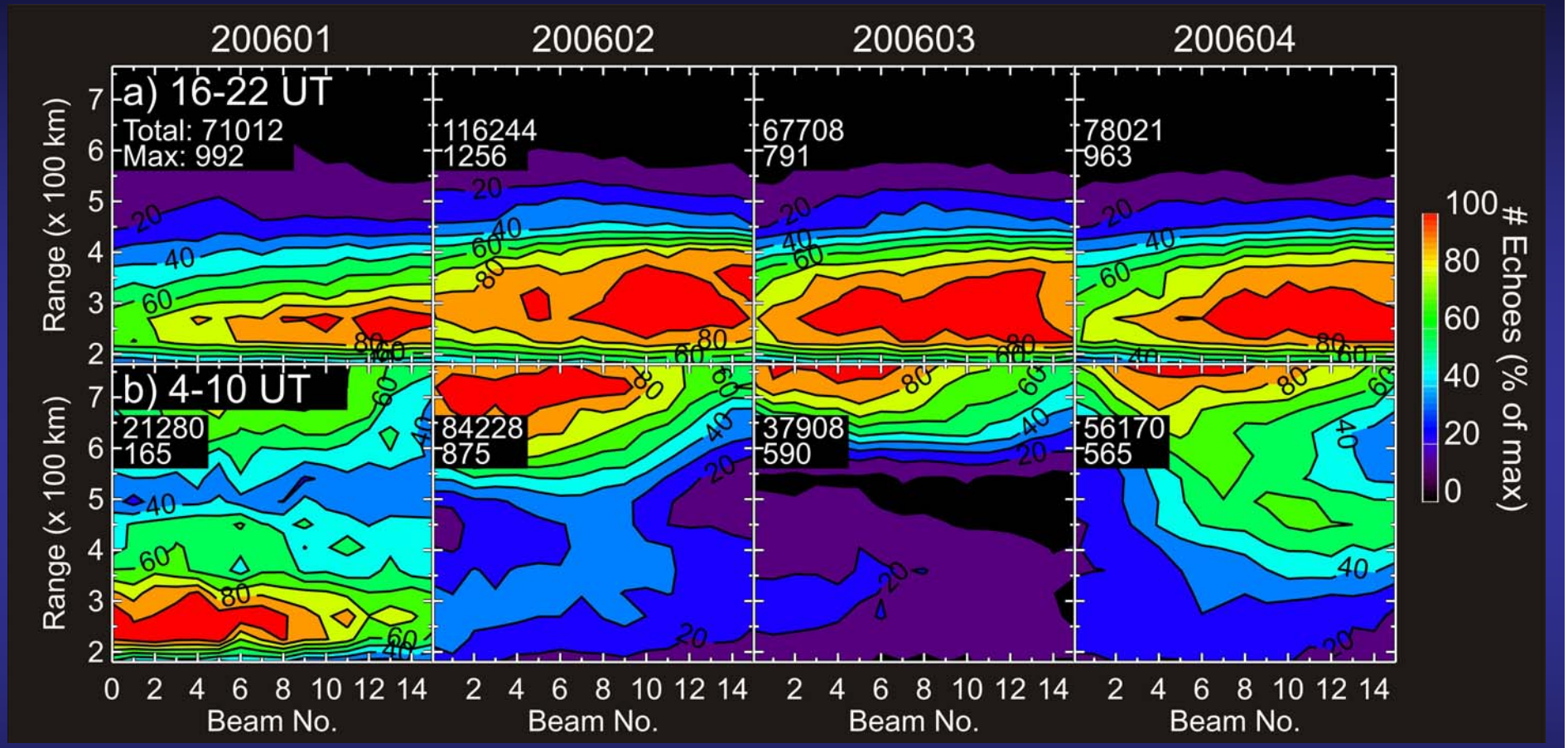
# Experimental setup



# Echo Types

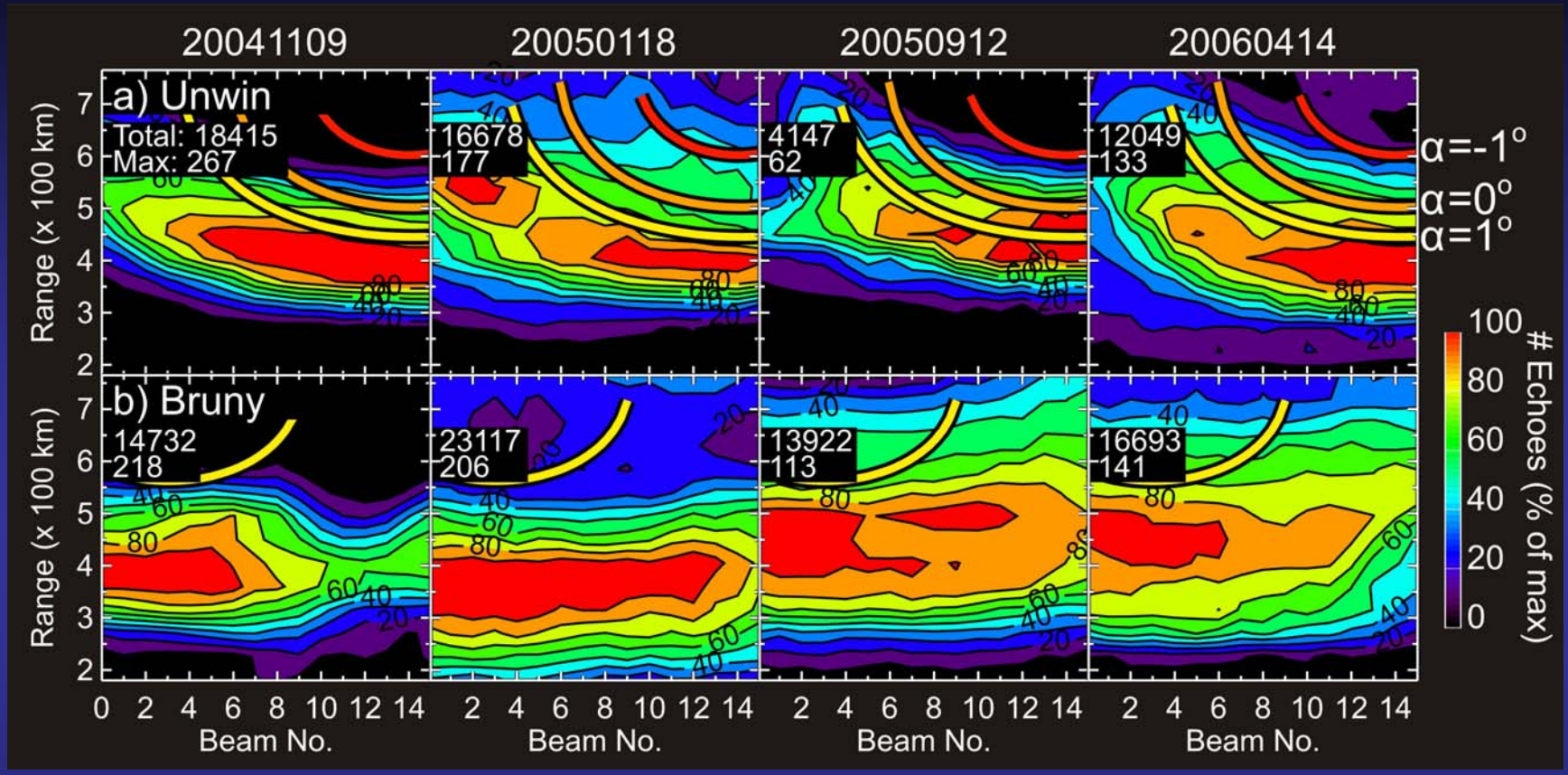

b) Type II
(GDI)
Power
-1000
0
$C_s$
1000
Doppler Velocity (m/s)
a) Type I
(MTSI)
Power
-1000
0
$C_s$
1000
Doppler Velocity (m/s)
Bruny Island
15
140
Unwin
0
15
45
Λ=60°S
Plasma Flow Direction
b) Type II
(GDI)
Power
-1000
0
$C_s$
1000
Doppler Velocity (m/s)

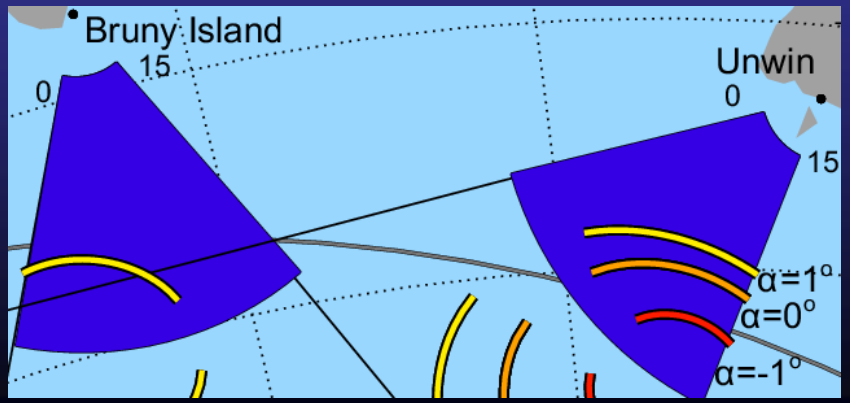
# Morning-evening comparison




*Carter and Makarevich*, submitted to Ann. Geophys. 2008

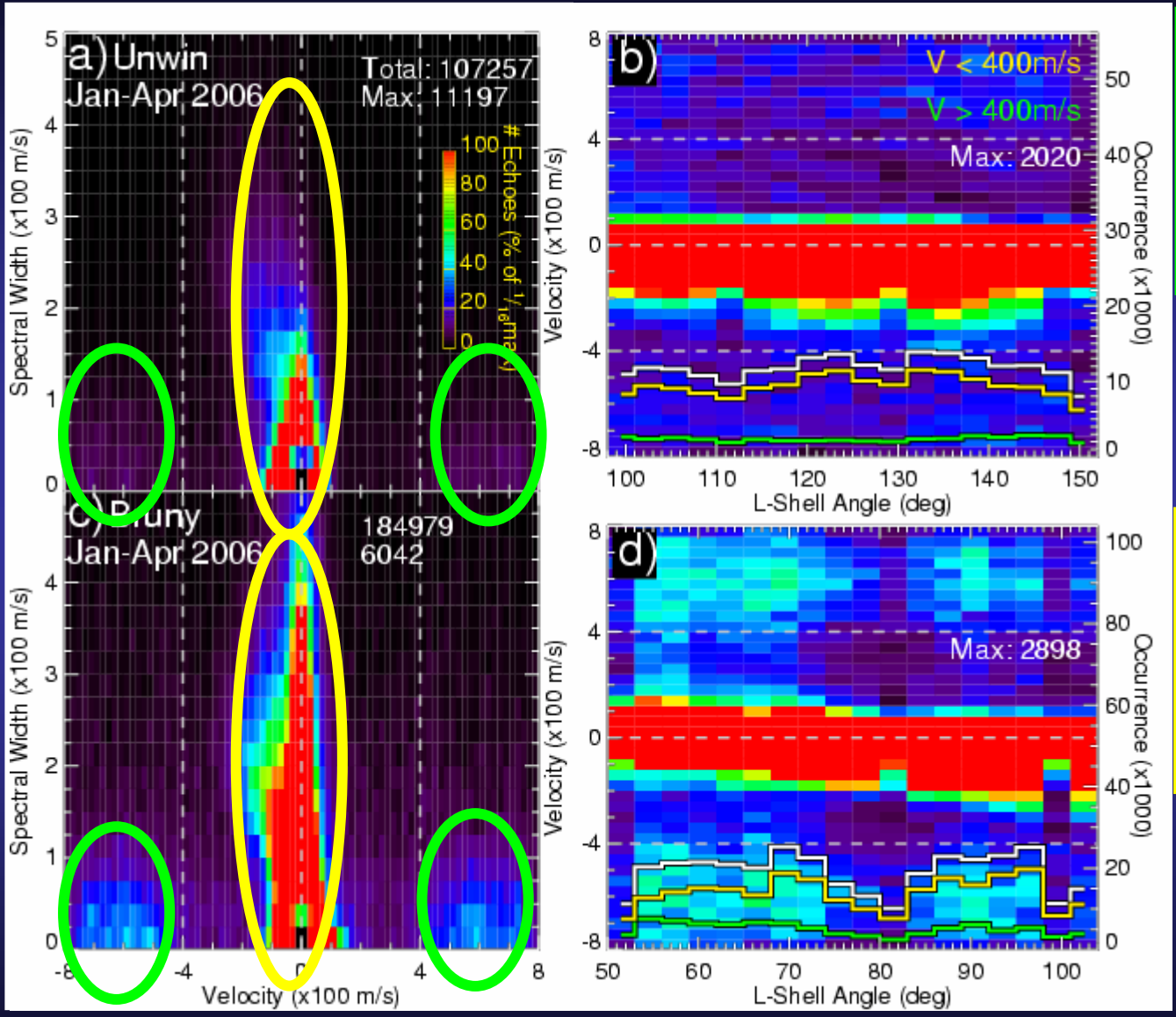
# Storm-time patterns

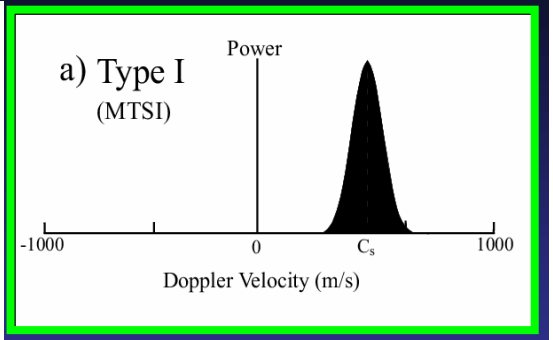


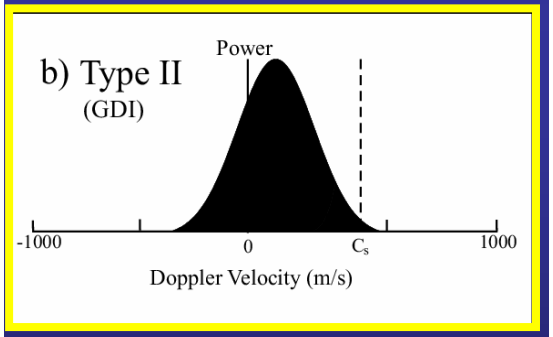

**Ionosonde measurements confirmed that the curved feature is present during storms when there is a plasma density depletion (negative storm phase)**

# Spectral plots



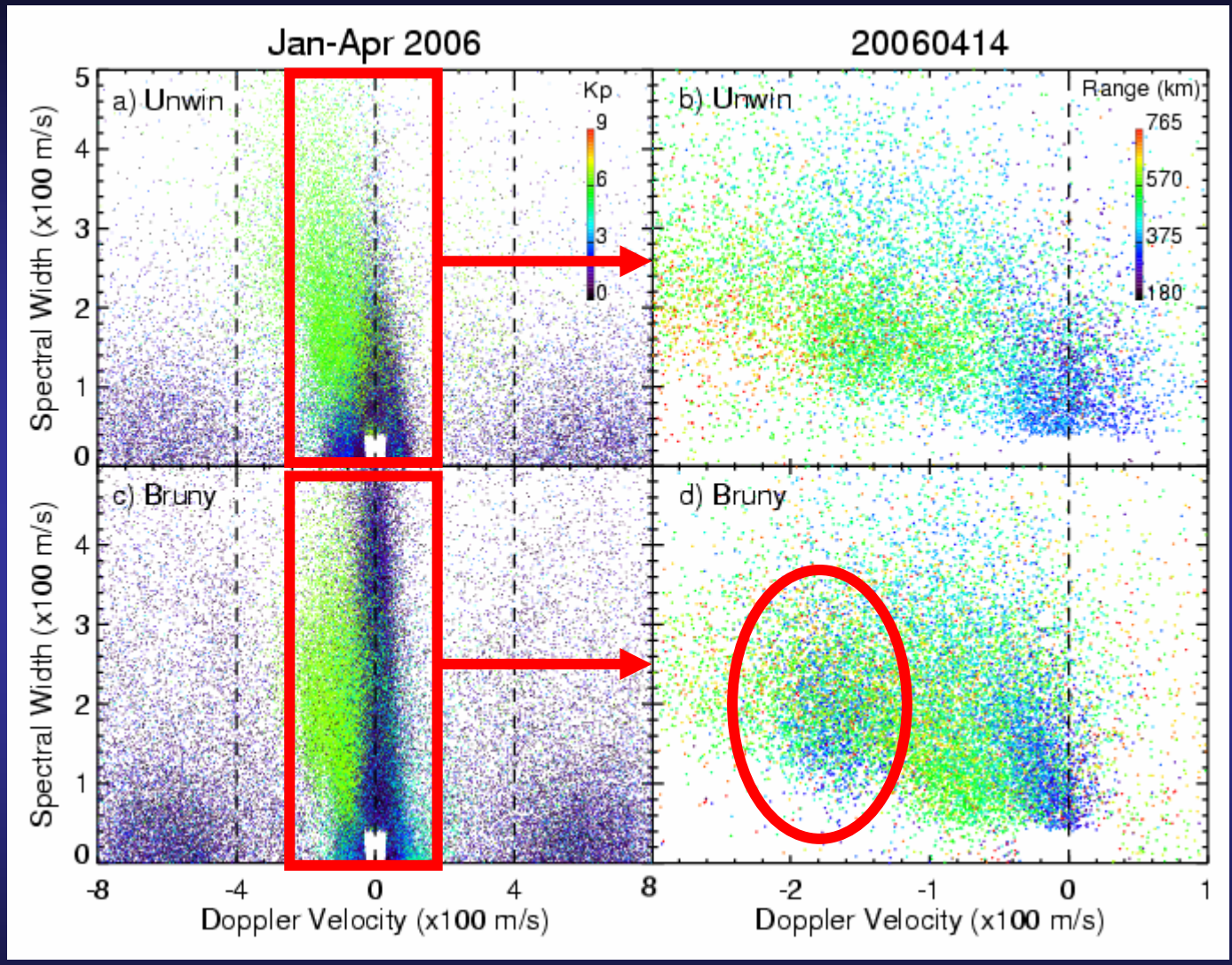

Observed along flow




Observed at all/large flow angles

Type 1-like echoes do not have preferred direction, maybe an indication of secondary generation…?

# Storm-time dependence

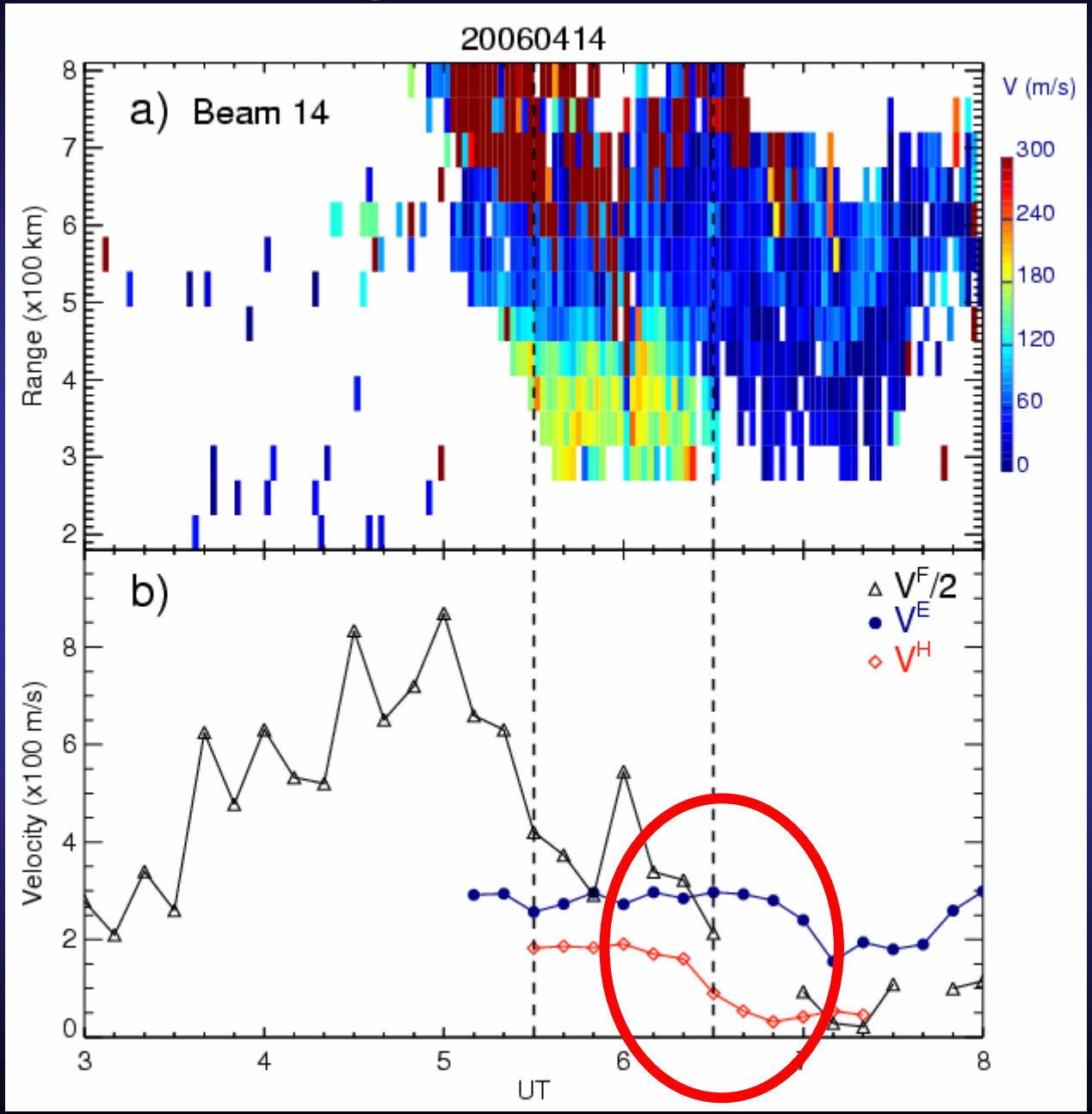



Short-range population first reported at HF by *Milan et al* [2001] and then further investigated experimentally by *Milan et al* [2004]

# Short-range echoes

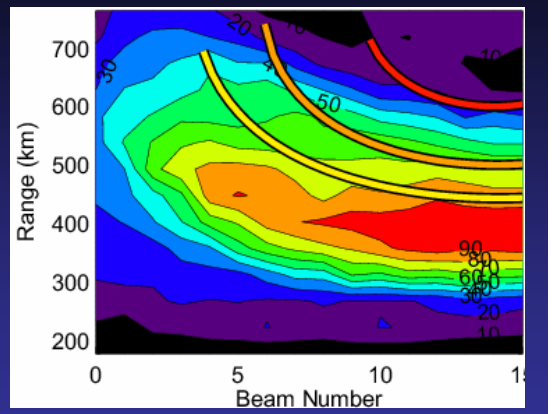
Note the sudden decrease in $V^H$ (disappearance of HAIR echoes) as $V^F$ goes below ~ 600 m/s.

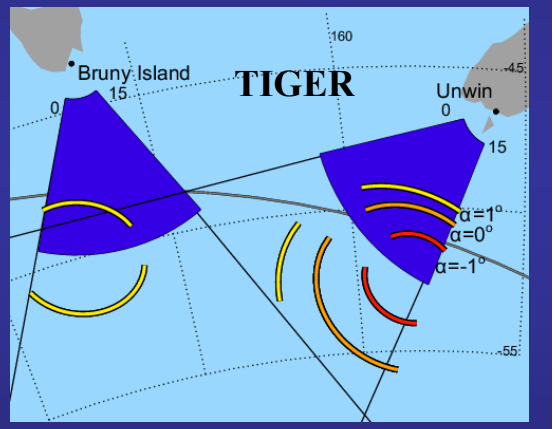
Indication that high E fields are needed to generate irregularities at such high aspect angles

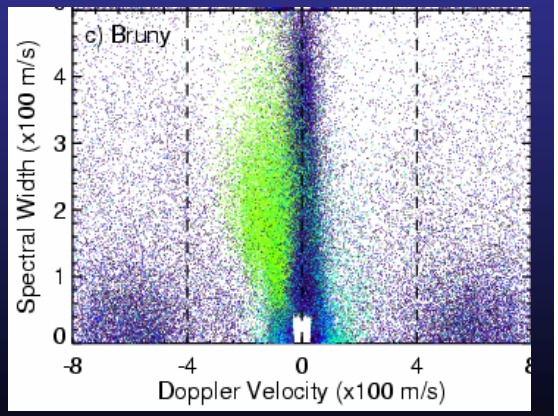


# Summary and Conclusions

1. <u>A curved band of E-region echoes</u> was observed in the evening sector
   - with similar curvature to those of geometric aspect angle lines
   - during storms when plasma density was depleted
2. <u>Two populations of the E-region echoes</u> were identified and associated with Types I and II
   - Unwin observed far less high-velocity echoes (Type-I-like) than Bruny
   - Type-I-like echoes did not have preferential direction of observations; possibly generated via a nonlinear mechanism
3. <u>A separate population of HF echoes was observed during storms</u>
   - including Type-II-like echoes and
   - backscatter at close ranges and constant velocities (similar to HAIR echoes reported previously)
   - HAIR-like echoes are associated with high E fields




THE END
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