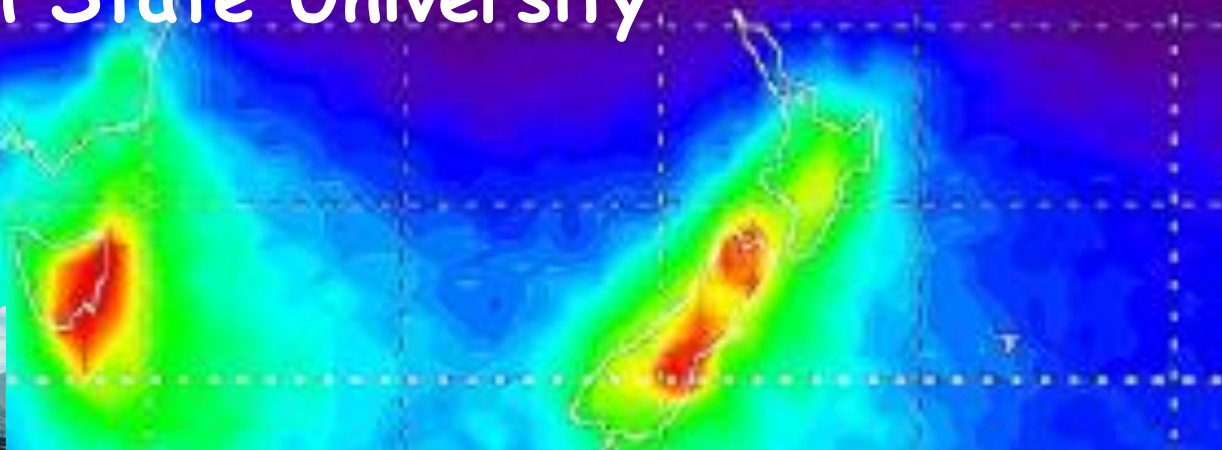


Contributions to the "DEEPWAVE" Mission - Mesospheric Gravity Waves and Temperature Mapping

Mike Taylor, Dominique Pautet, Neal Criddle
Utah State University



What?
How?
Why?

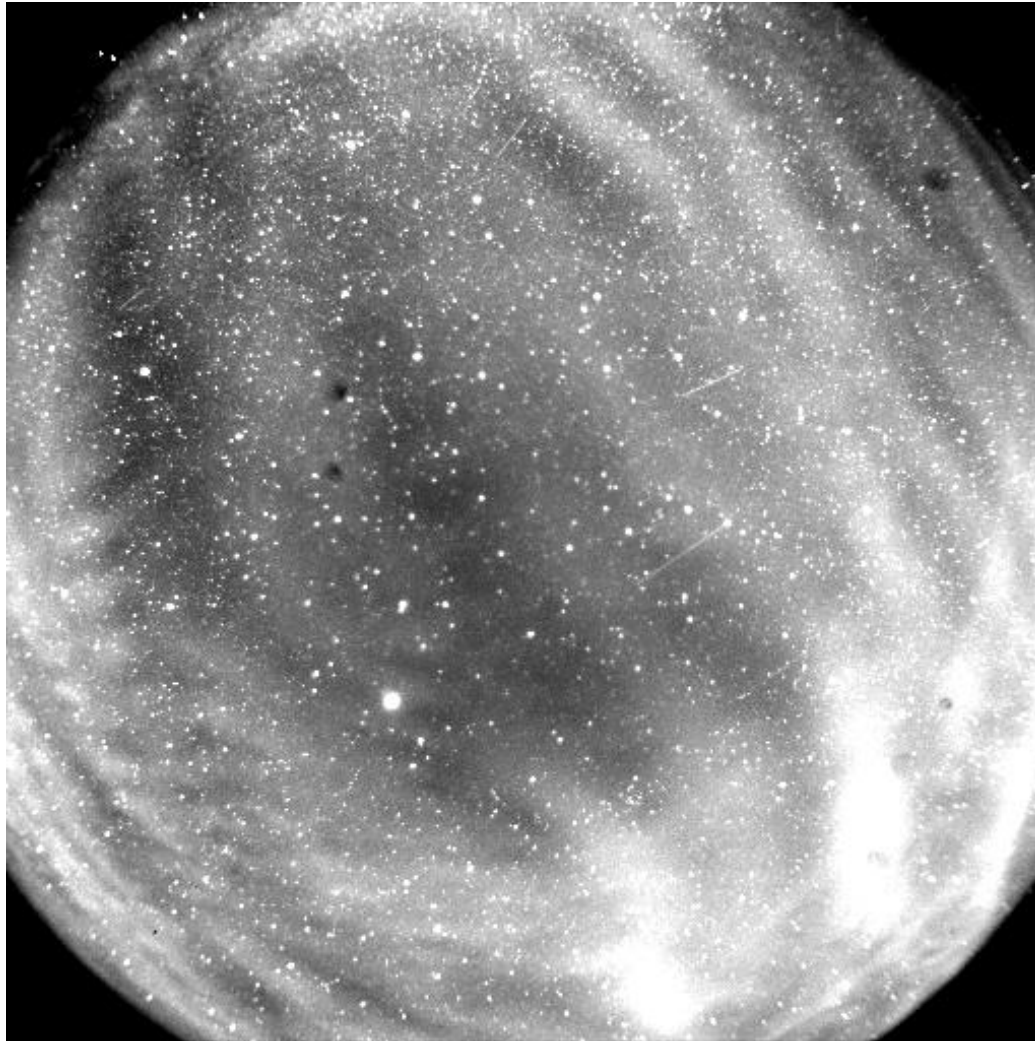


NSF/NCAR GV
Aircraft

160E

Airglow from the International Space Station

Gravity Waves Imaged in the NIR OH Airglow emission (~87 km)

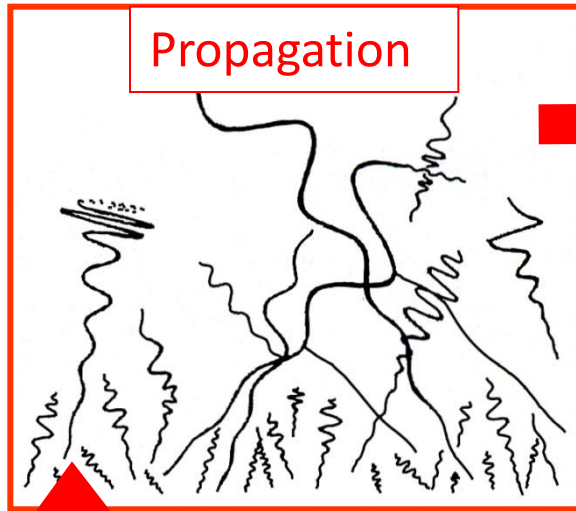


Movie: 3.6 hr

$\lambda = 45 \text{ km}$
 $V = 45 \text{ m/s}$
 $\tau = 15 \text{ min}$

Bear Lake Observatory, UT (41.6 °N, 111.6 °W), June 4-5, 2002
OH emission, altitude ~87 km

Atmospheric Gravity Wave Coupling

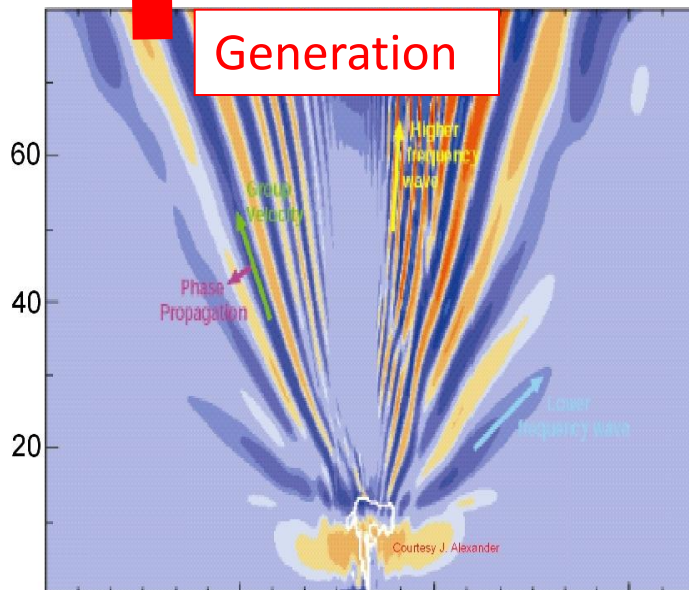


Propagation



Dissipation

Hines, 1960



Generation

- Generated mainly by weather disturbances in the troposphere
- Amplitudes grow as energy propagates upwards through the middle atmosphere
- Short-period waves (<1 hour) break at high altitudes depositing large amounts of energy and momentum globally.
- Profound influence on the regional, seasonal and global mesospheric dynamics.

Courtesy J. Alexander

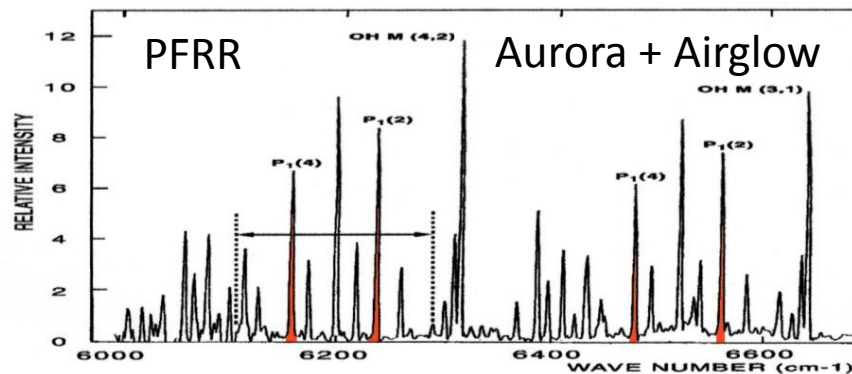
Advanced Mesospheric Temperature Mapper



- New High-resolution mesospheric gravity wave intensity and temperature mapping capability.
- IR imager ($\sim 1.55\mu\text{m}$) OH (3,1) band at ~ 87 km.
- Large format (120° FOV) fast (f/1) telecentric optics. Precision ~ 1 K in < 30 sec.
- **New GV AMTM** ($80^\circ \times 60^\circ$) or 120 km \times 80 km FOV. Operates at very high **4 sec** cadence, **12 sec** for temperature map, **precision 1-2 K**.

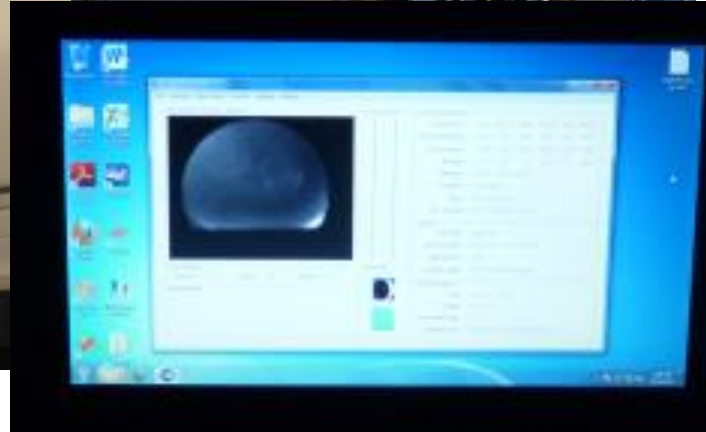
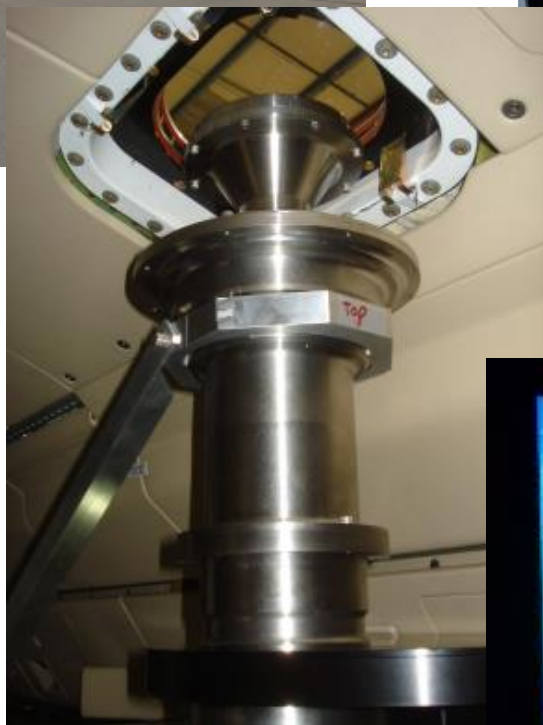


Data since 2011 (3 winters each site)

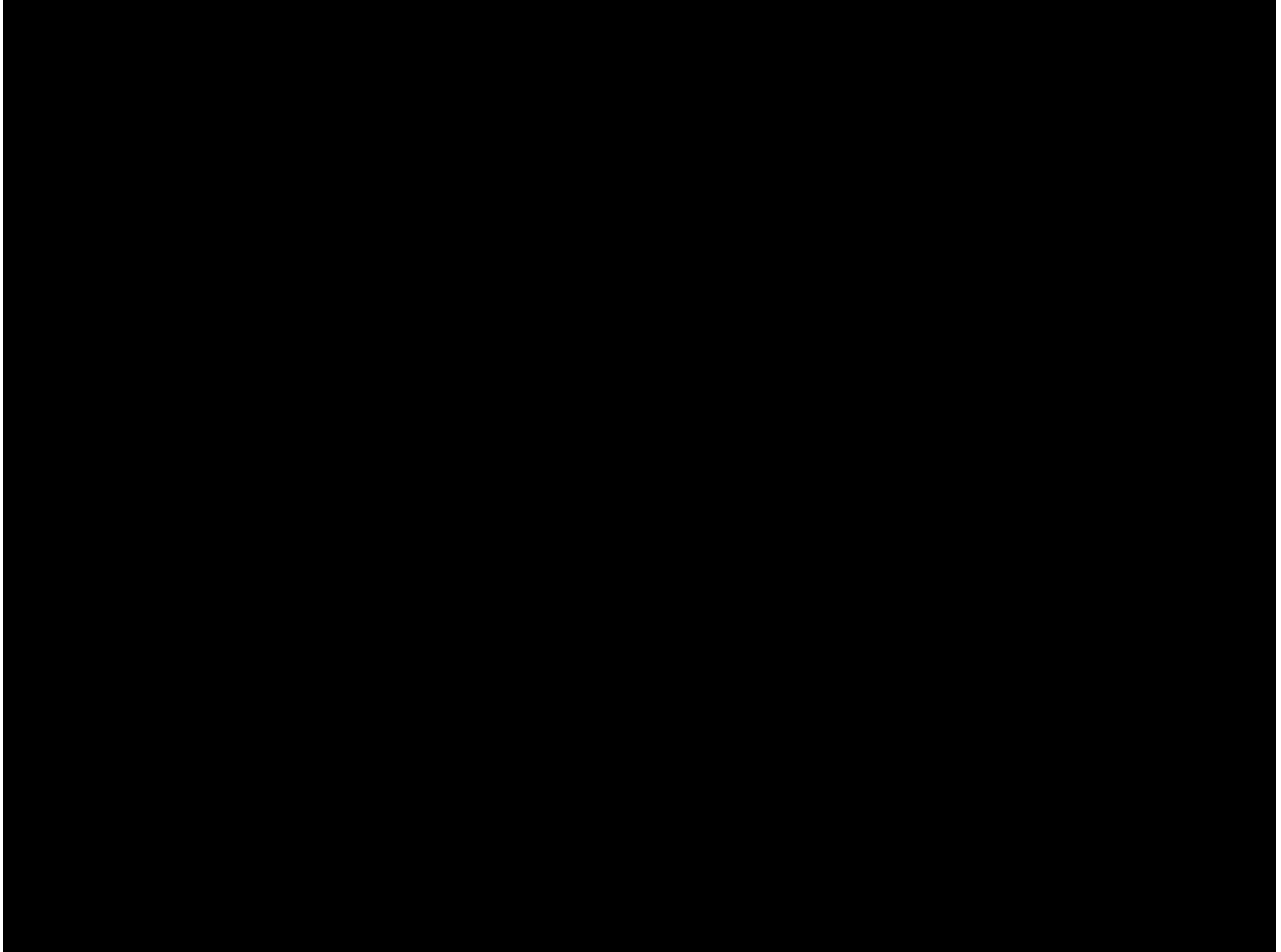


Temperature: ratio of P₁(2) and P₁(4) lines

DEEPWAVE Test Flights - Broomfield CO, 2013

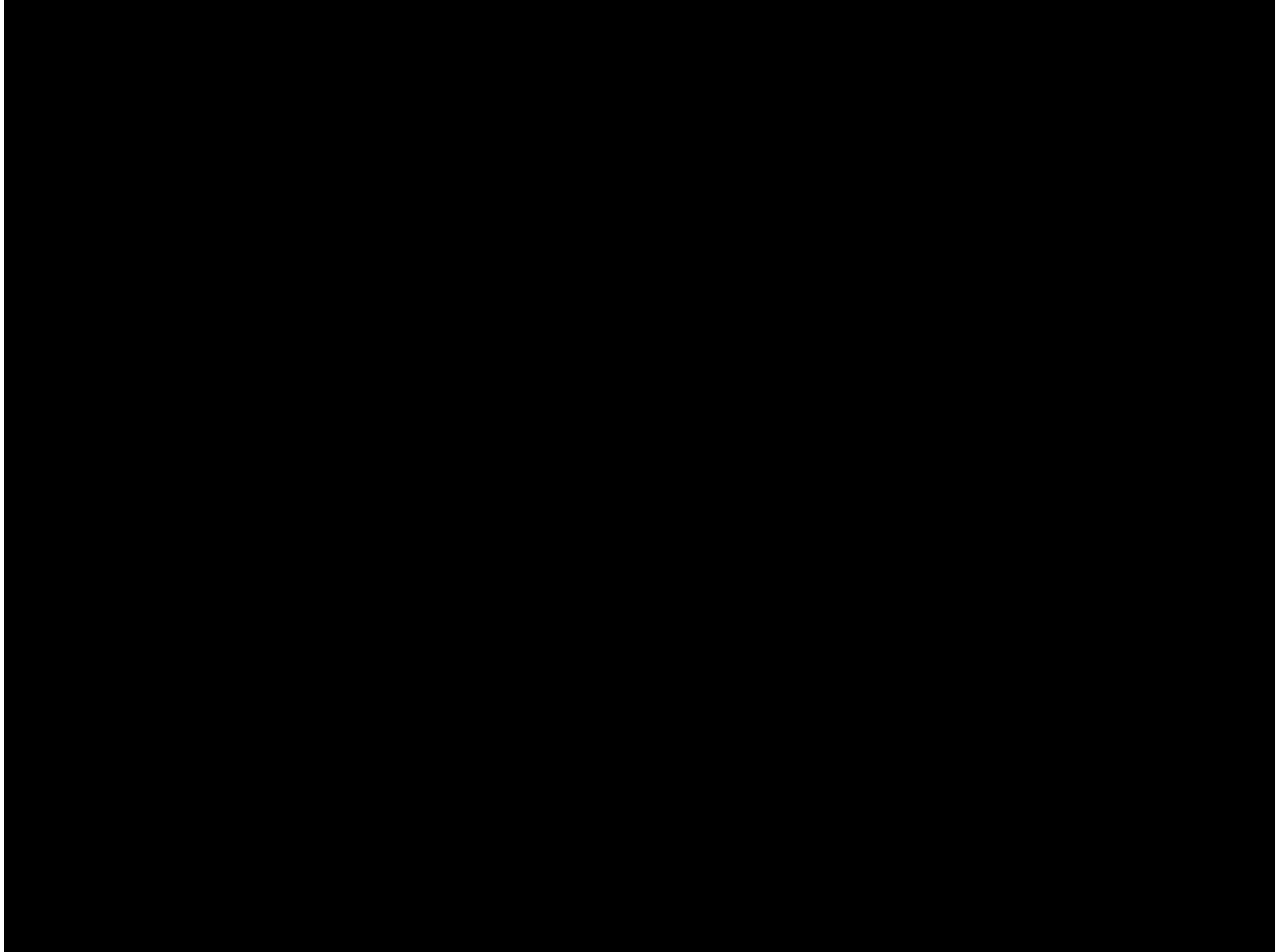


Summary AMTM Movie
RF-01 (6/7 June) South Island

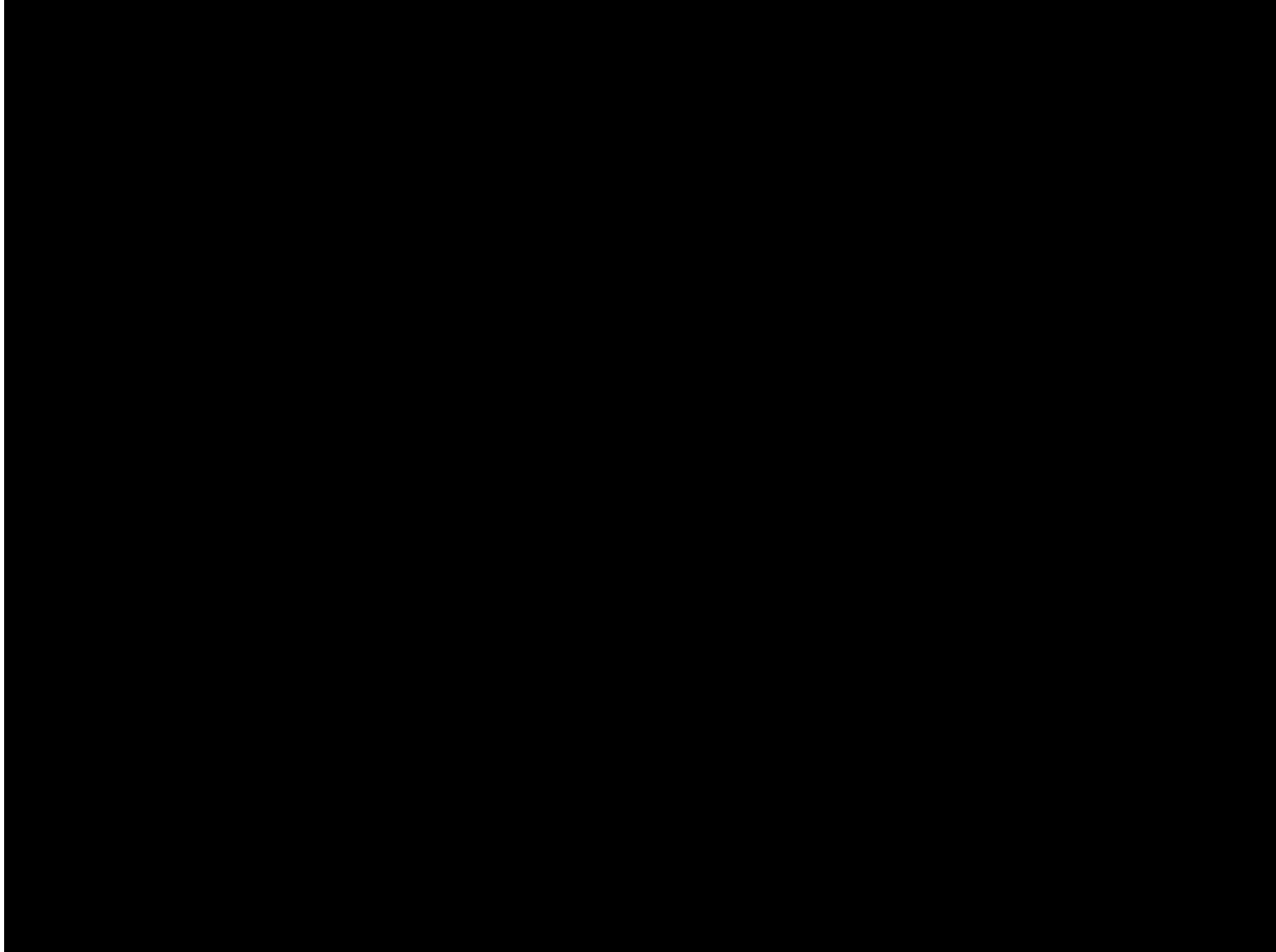


Summary AMTM Movie

RF-01 (6/7 June) South Island

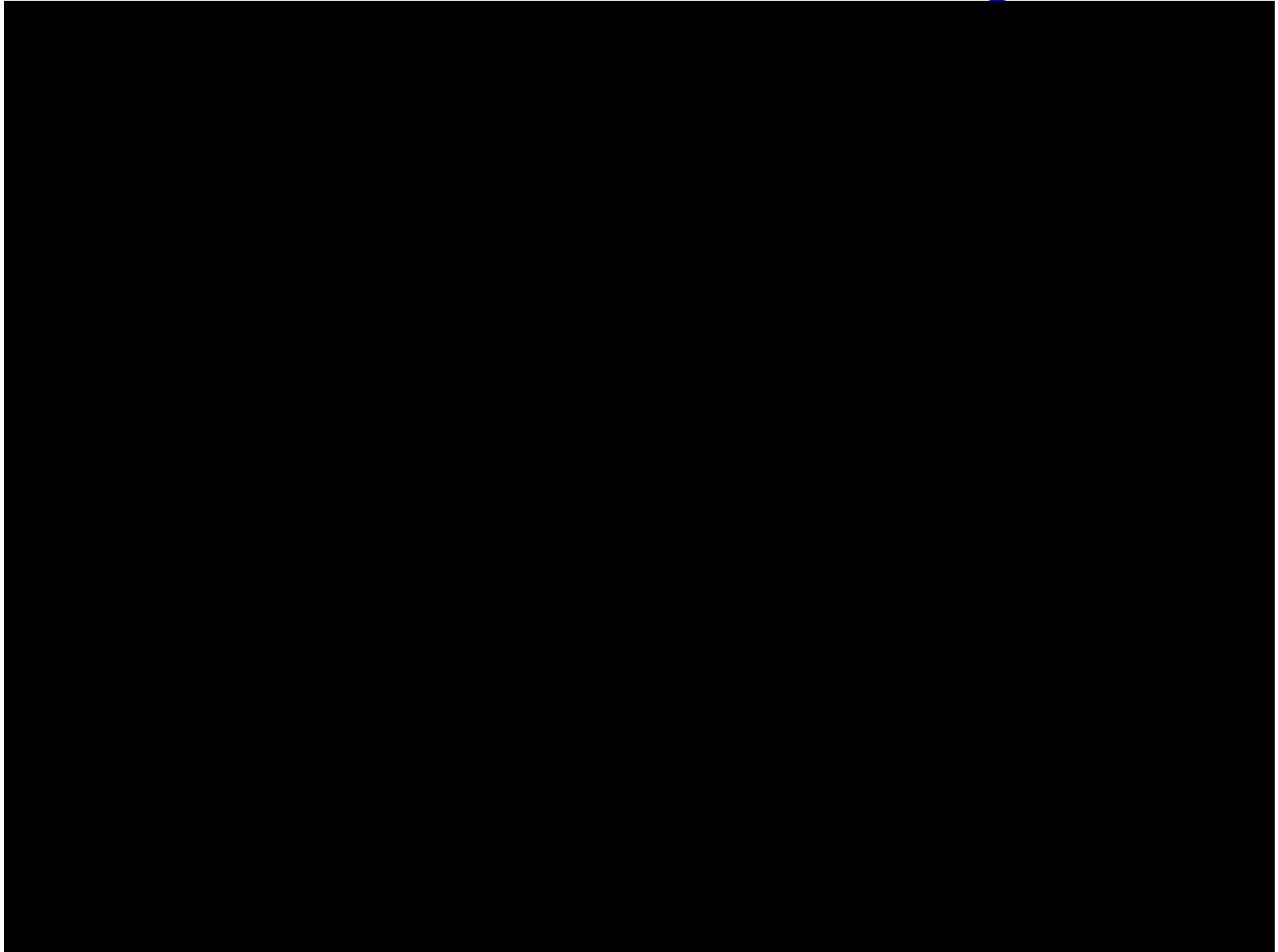


Summary AMTM Temperature Movie
RF-01 South Island (range 195-225K)

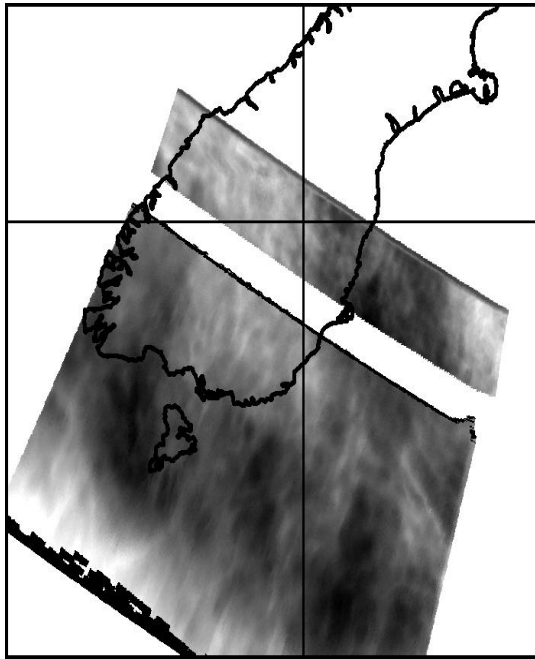


Summary "Wing Camera" Movie

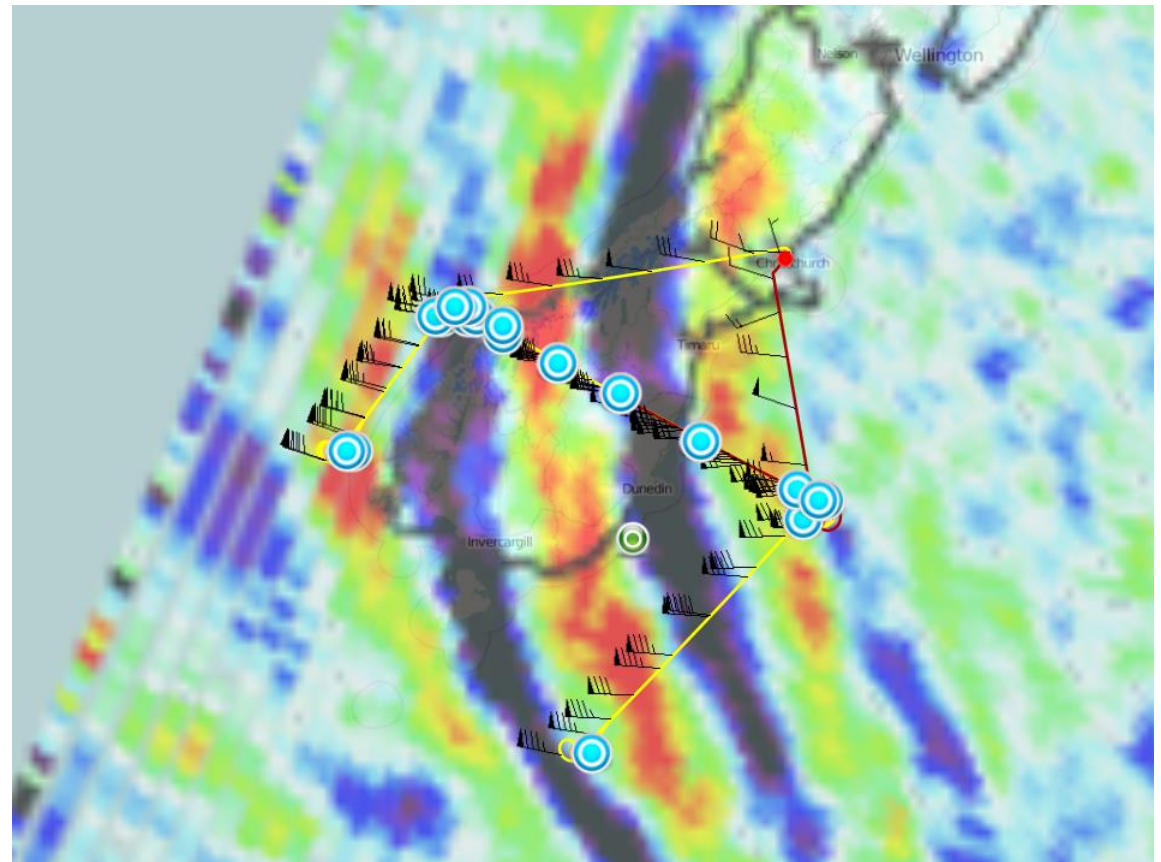
RF-02 Tasmania Over-flight



RF-05 South Island (14/15 June) OH Wave Activity and AIRS Structures

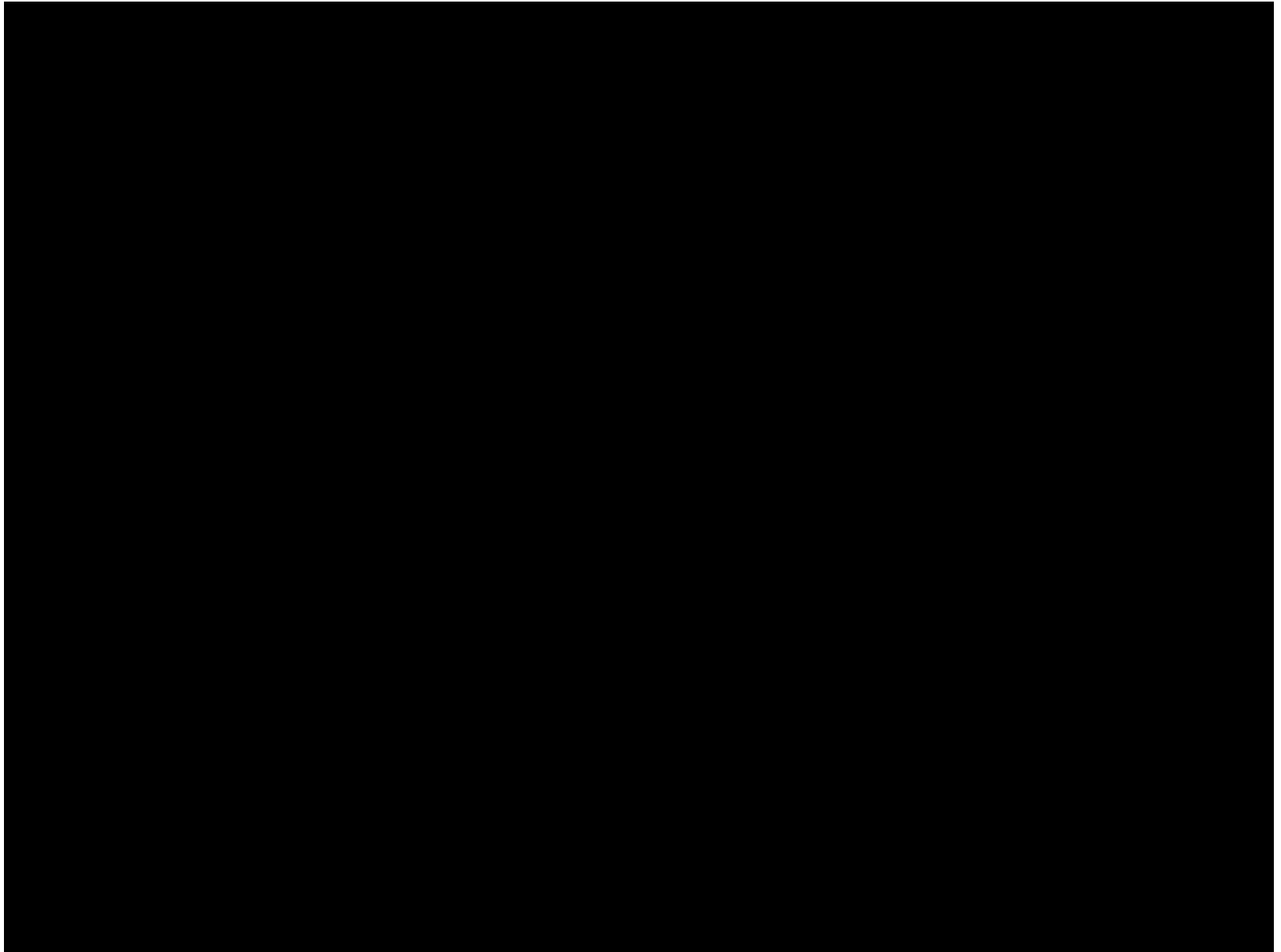


OH Waves (~87 km)

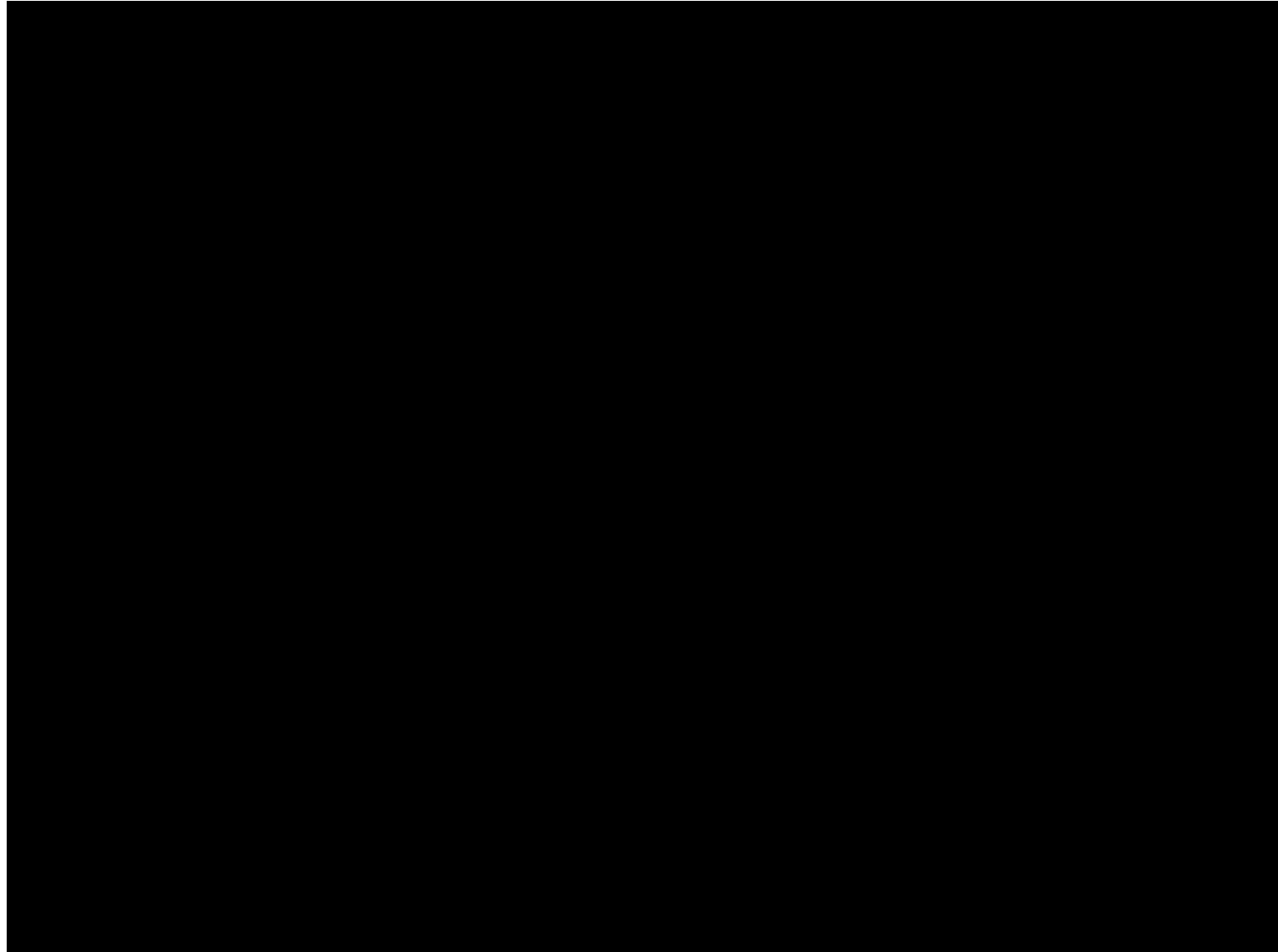


AIRS Waves (~ 40 km altitude)

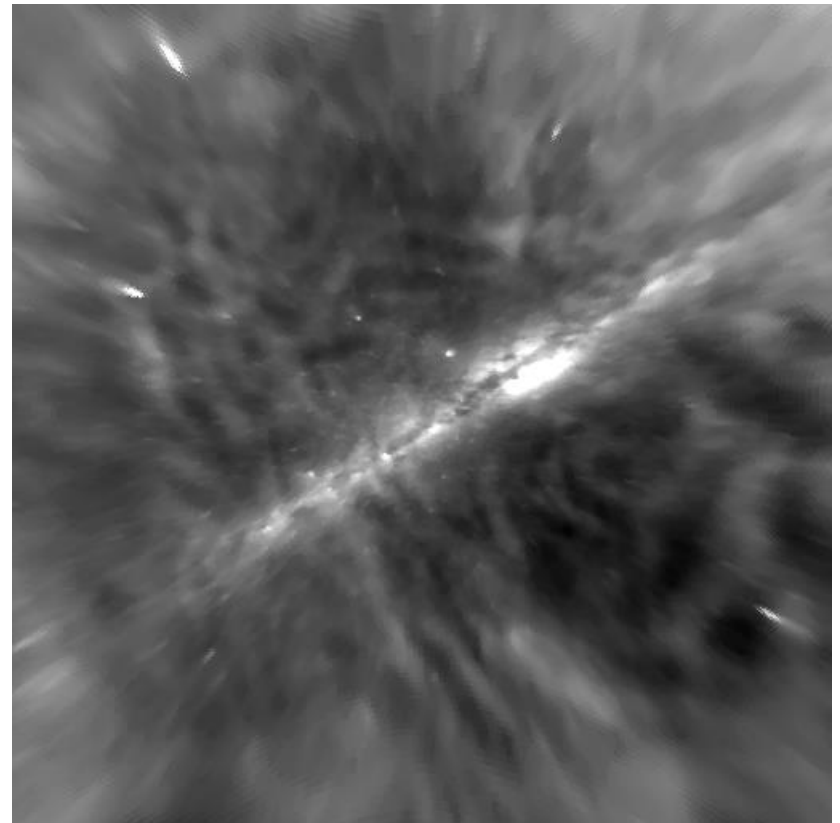
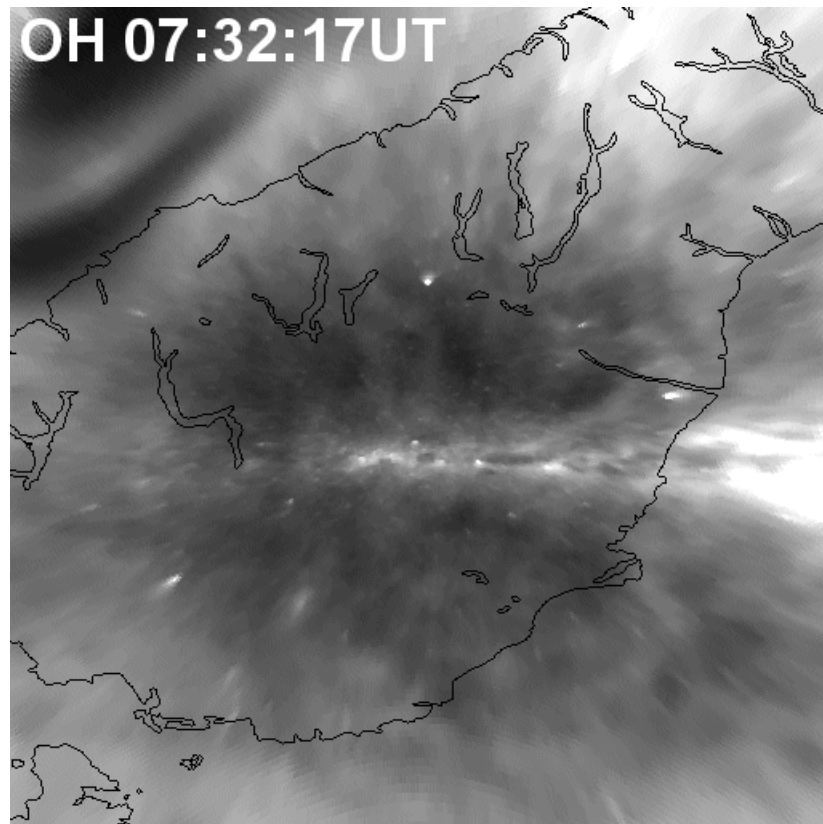
Lauder AMTM Movie 30-31 May (13 hrs)



Lauder Movie During RF-06 (Tasmania) Mountain Waves and Chaos!



RF-07 (19/20 June) Steve Smith, Example of Lauder OH Data

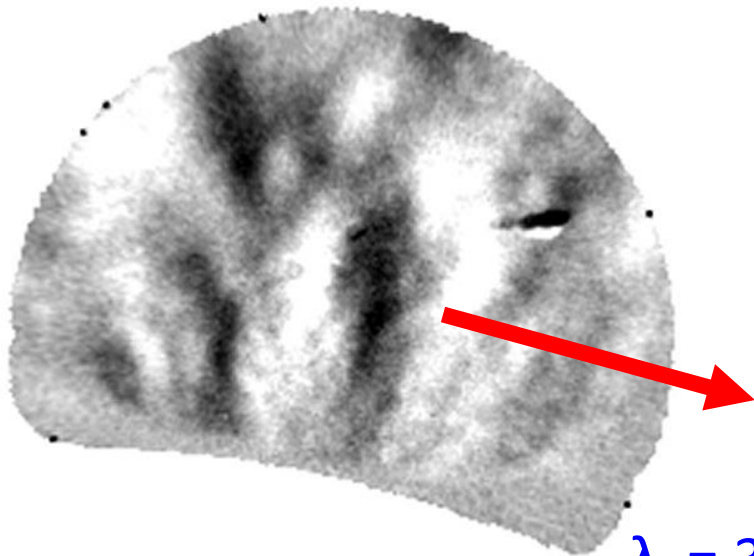


Summary (to date)

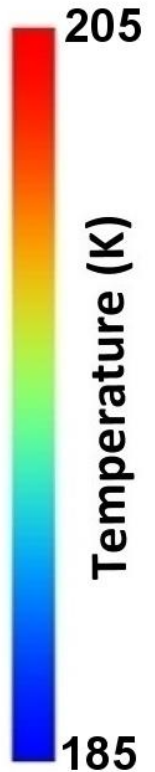
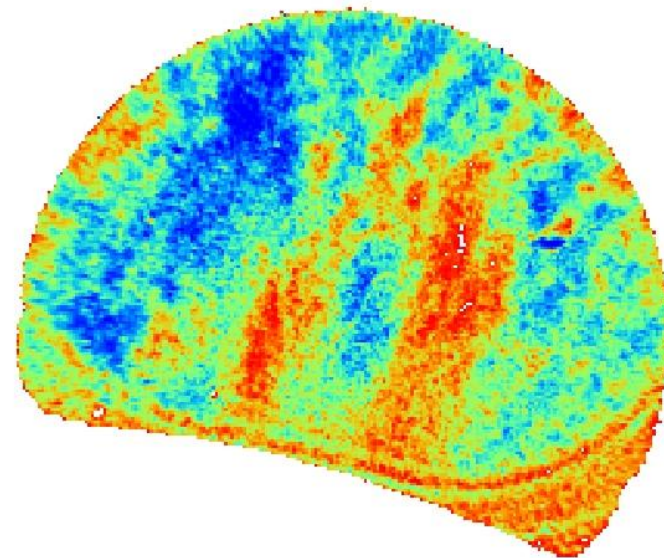
- T-Mapper instrument suite working well. Enables detailed measurements of the characteristics and dynamics of GW from the GV (lateral spatial coverage ~1000 km).
- Airborne mesospheric GW measurements starting to show correlations with the stratospheric AIRS wave maps.
- Possible evidence for more wave activity over land than over Oceans?
- Coordinated measurements at Lauder indicate Mountain Wave activity on at least **5 nights** so far (May 30th to date)..not during strong forcing?
- **Overall:** Wave data are very, very interesting but not yet exceptional in amplitude or spatial/temporal characteristics..waiting for stronger forcing conditions!

GV Sample Data, Feb 22-23, 2012

OH P₁₂ (3,1) line

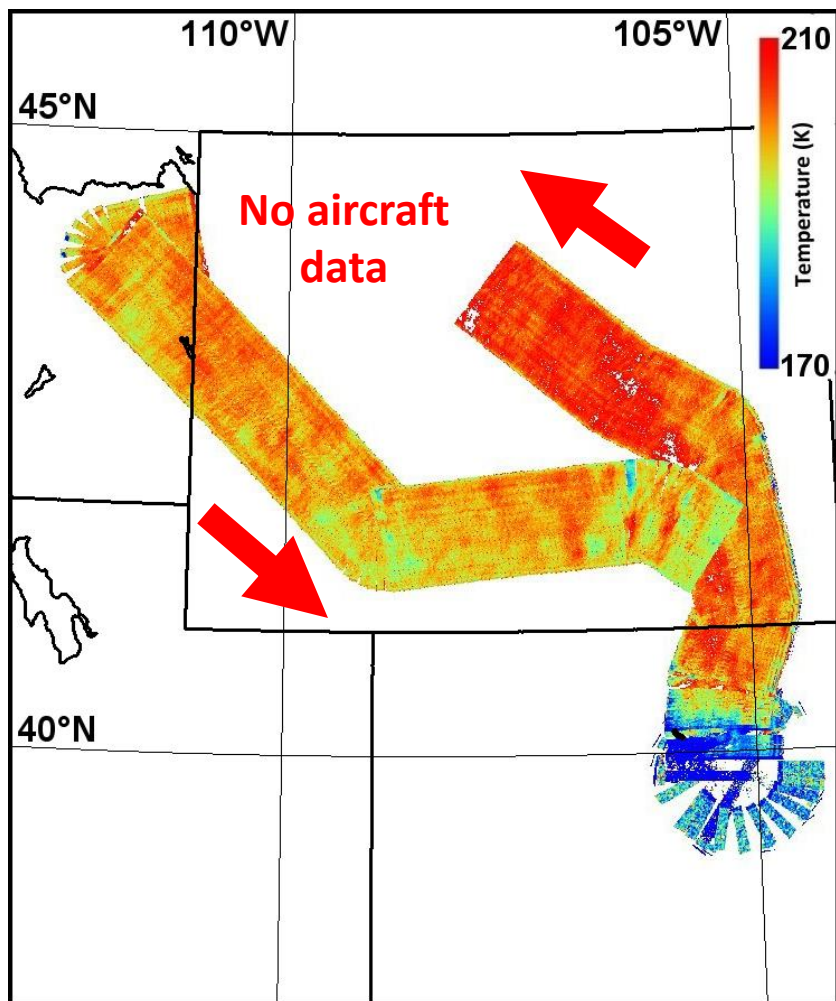


OH (3,1) rotational temperature



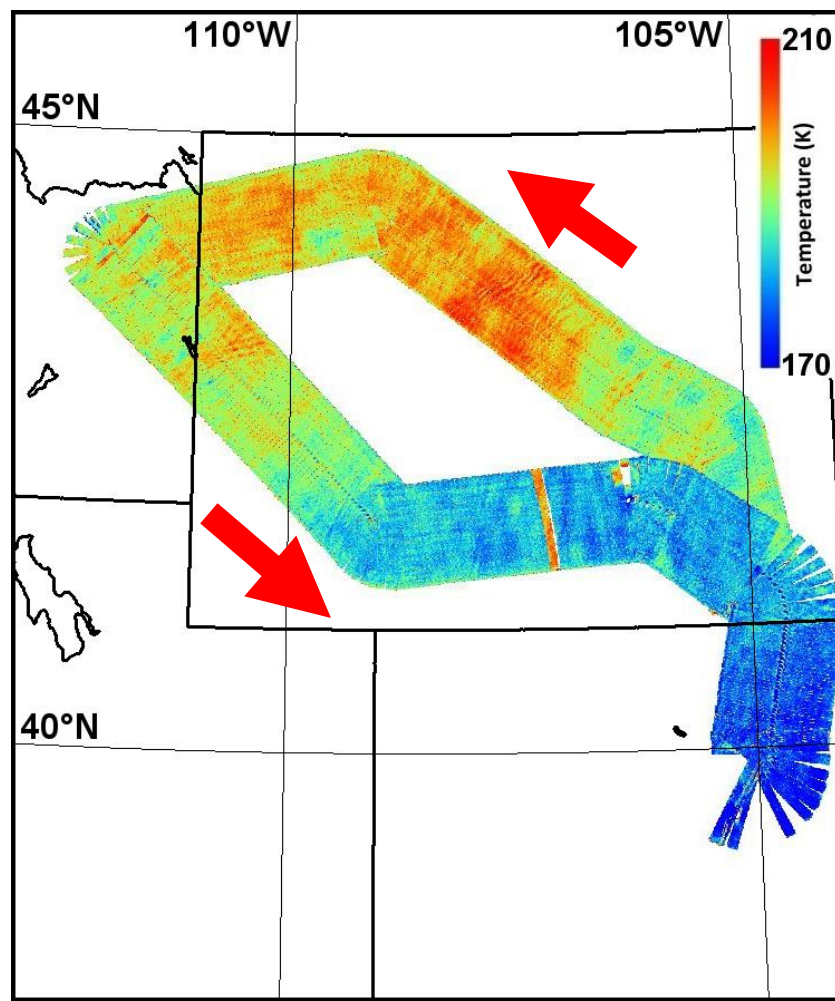
$\lambda_z = 30$ km
 $V \sim 44$ m/s
 $T = 11.4$ min
Direction = 114°

OH (3,1) Temperature Keogram - Feb22-23



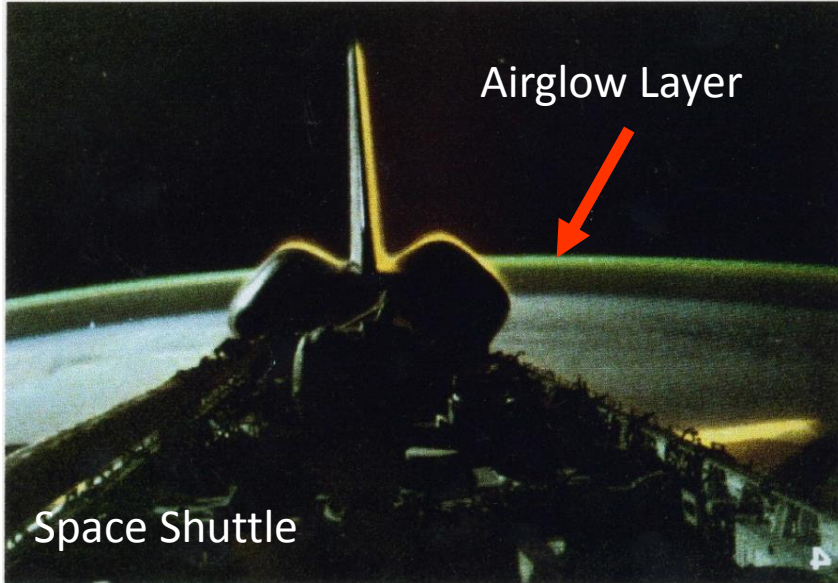
1st loop

6 hr duration



2nd loop

Imaging Mesospheric Emissions



Airglow Emission Chemistry

