

D region observations by VHF and HF radars during the PMWE rocket campaign at Andøya

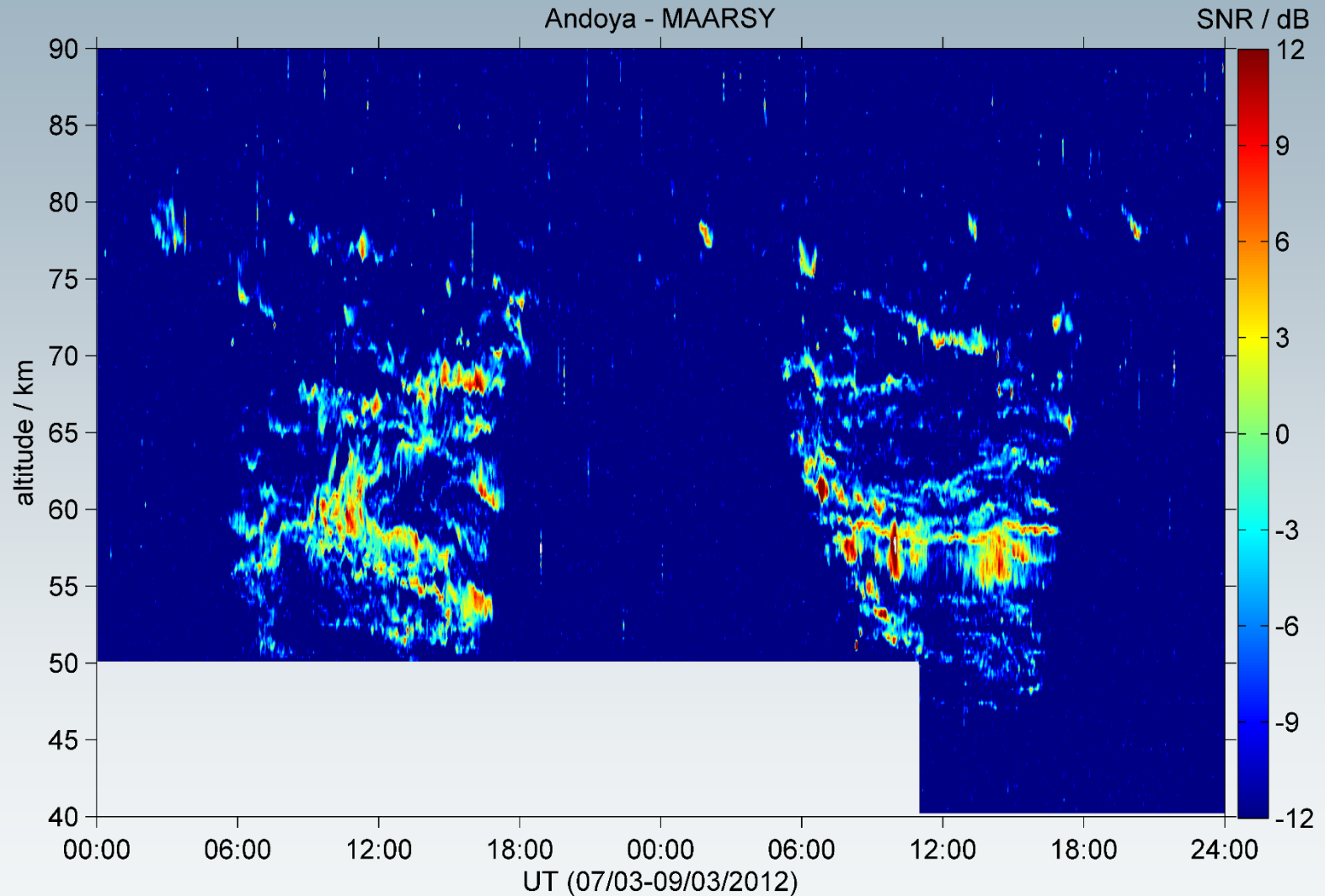
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Schloss-Str. 6, 18225 Kühlungsborn, Germany

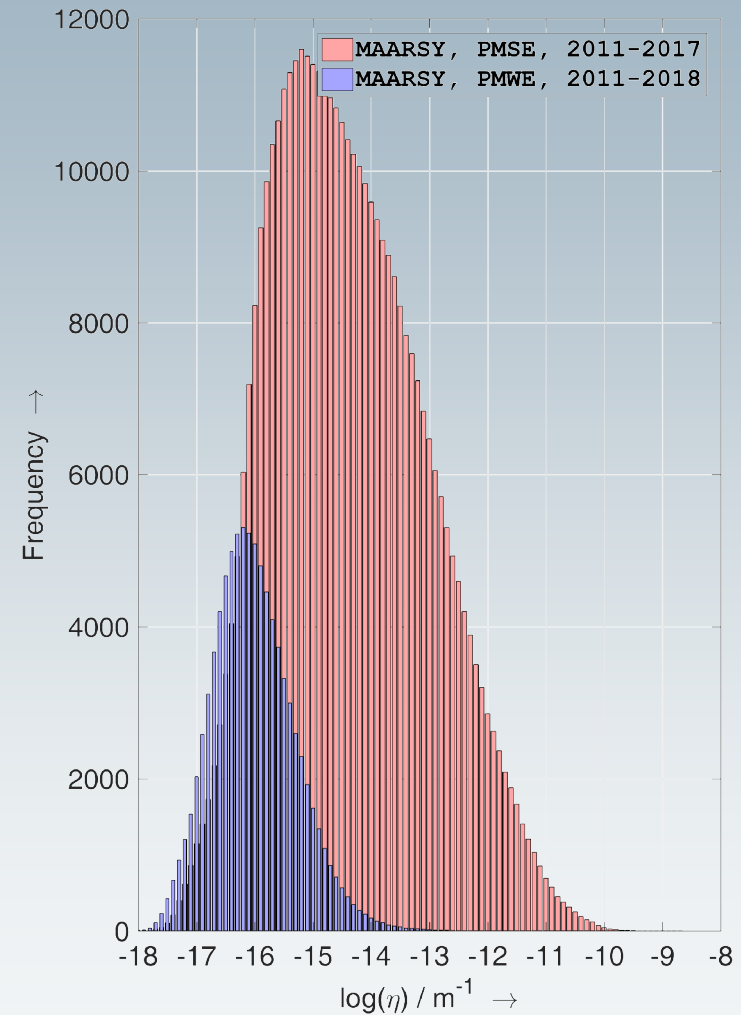
²Hochschule Wismar, University of Applied Sciences Technology, Business and Design,
Philipp-Müller-Straße 14, 23966 Wismar, Germany

Polar Mesosphere Winter Echoes

PMWE after SPE in March 2012

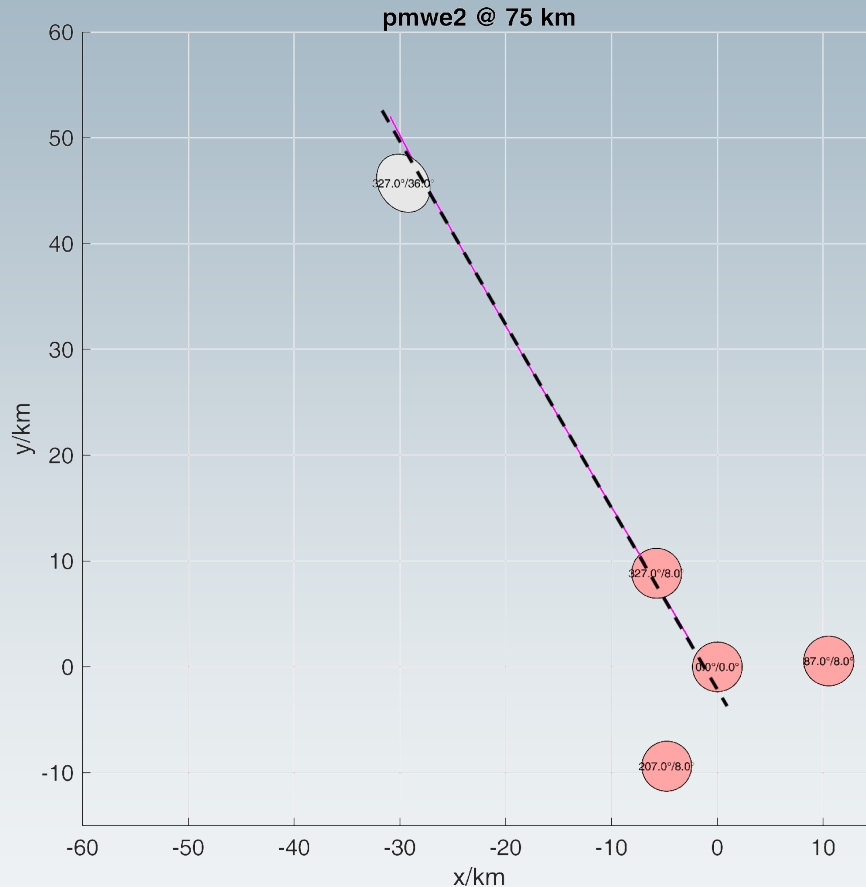


Distributions of PMWE and PMSE volume reflectivity obtained with MAARSY, Andøya (69°N)



PMWE1 rocket campaign

MAARSY multi-beam operation using 5 beams



10 Apr 2018 08:00:24 UT

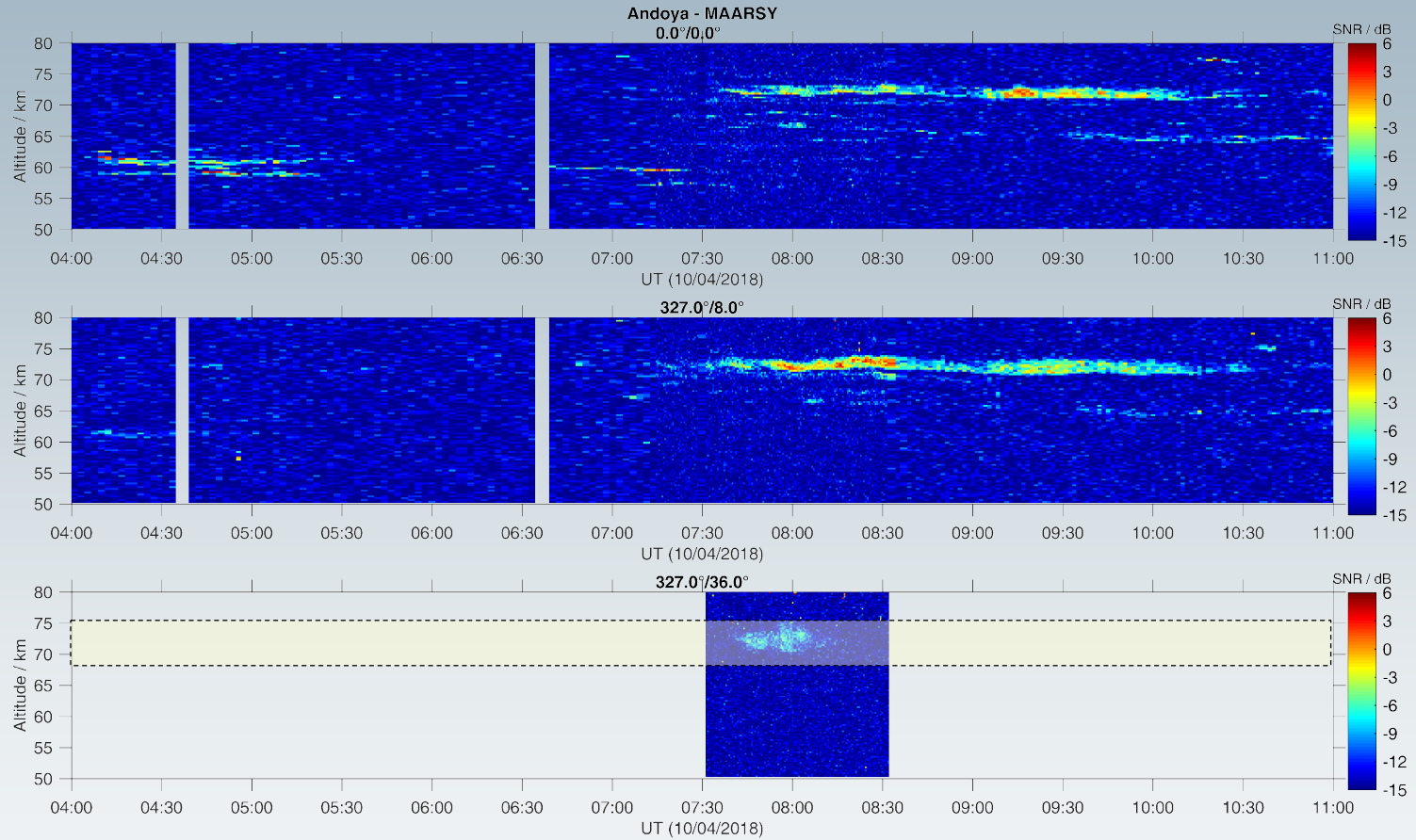
Experiment tag	pmwe2
PRF	1.25 kHz
Pulse length	2000 ns
Pulse code	16 bit complementary
No. CI	2
No. beams	5
HPFW	3.6°
Range	50.1 – 114.0 km
Range resolution	300 m
No. receiving channels	16
No. data points	2048 per beam dir.
Δt	16.0 ms
f_{Ny}	31.25 Hz \equiv 87.6 m/s

Altitude / km (Y-axis for table: 50 to 80)

Horizontal distance / km (X-axis for table: -15 to 6)

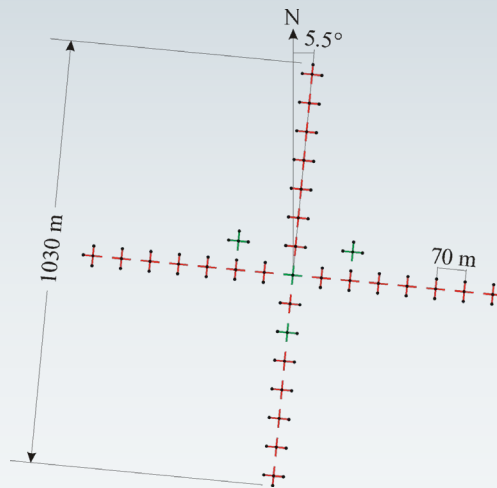
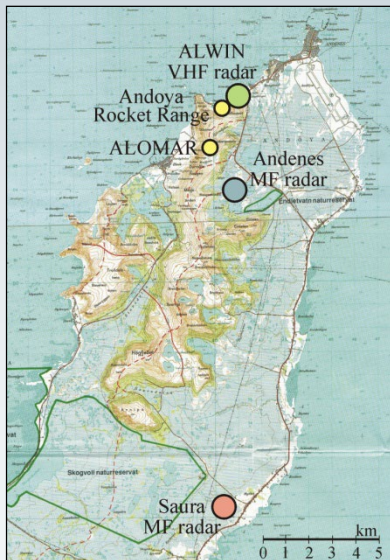
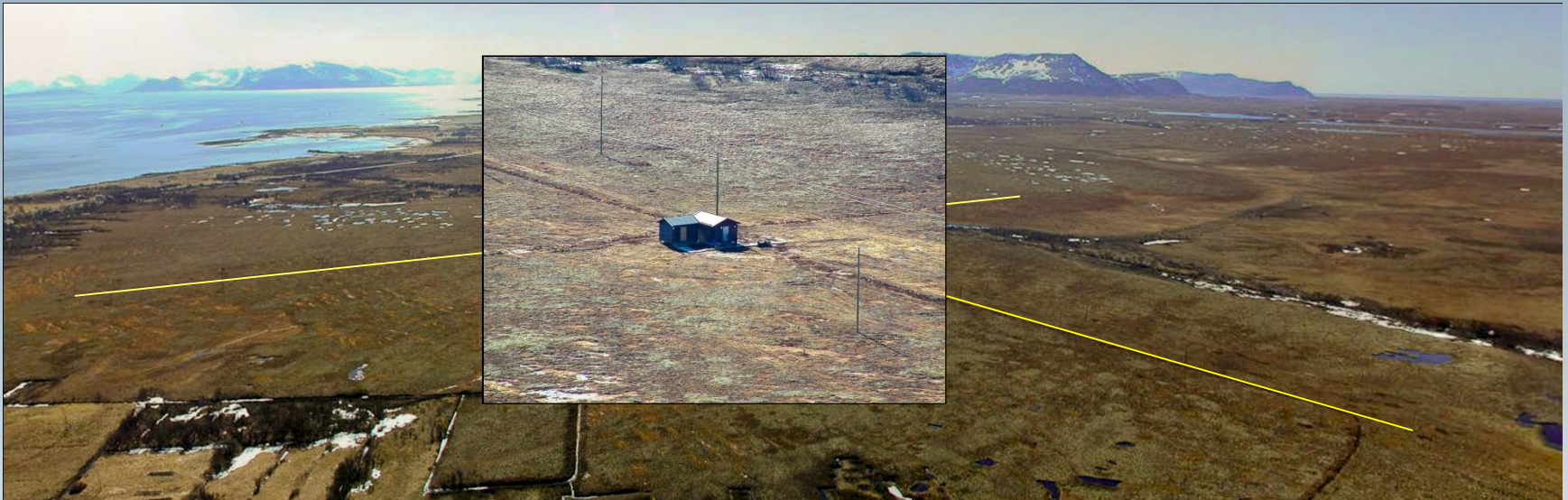
PMWE1 rocket campaign

PMWE observation on April 10, 2018



Saura MF Radar

horizontal wind profiles and electron densities every 4 minutes



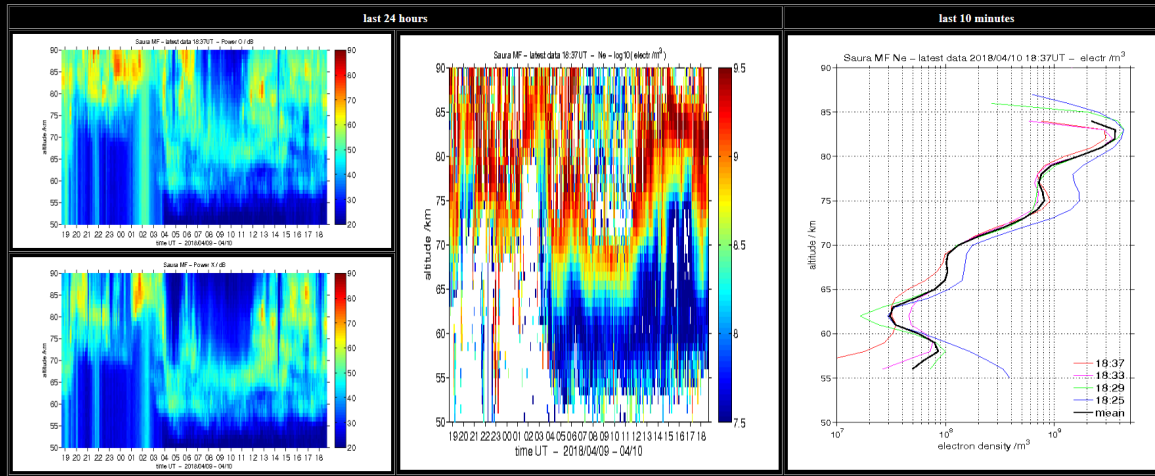
Basic Parameters

Location	69.14°N; 16.02°E
Radar frequency	3.17 MHz
Peak power	116 kW
Pulse form	Gauss
Pulse width	> 7 μ s
Range resolution	1000m
Antenna	29 crossed dipoles
Half power beam width	6.4°
Beam directions	Vertical, 8 off-zenith

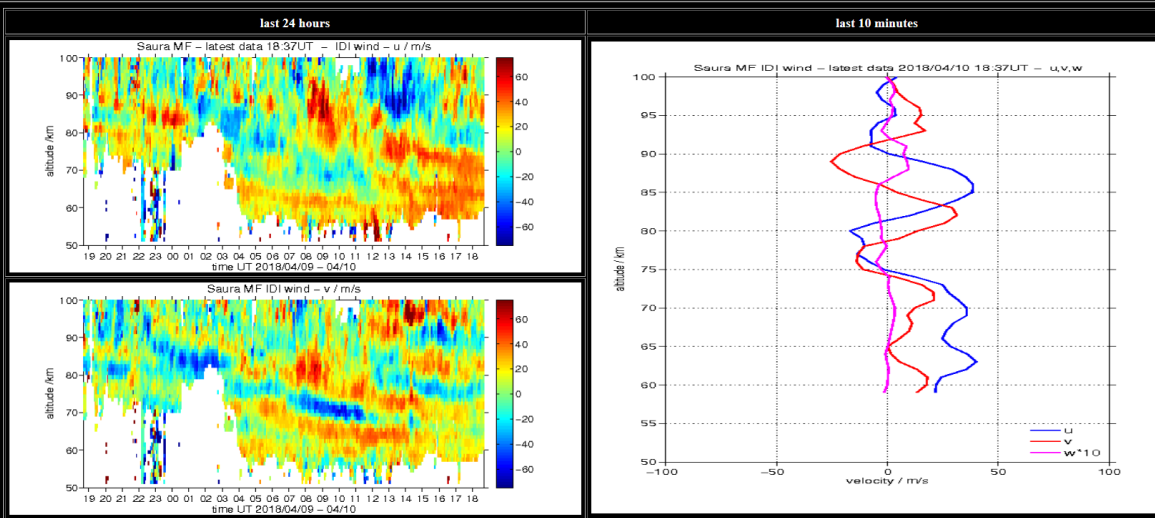
PMWE1 rocket campaign

electron density and horizontal wind estimation from Saura MF radar

Saura MF radar - latest Ne results

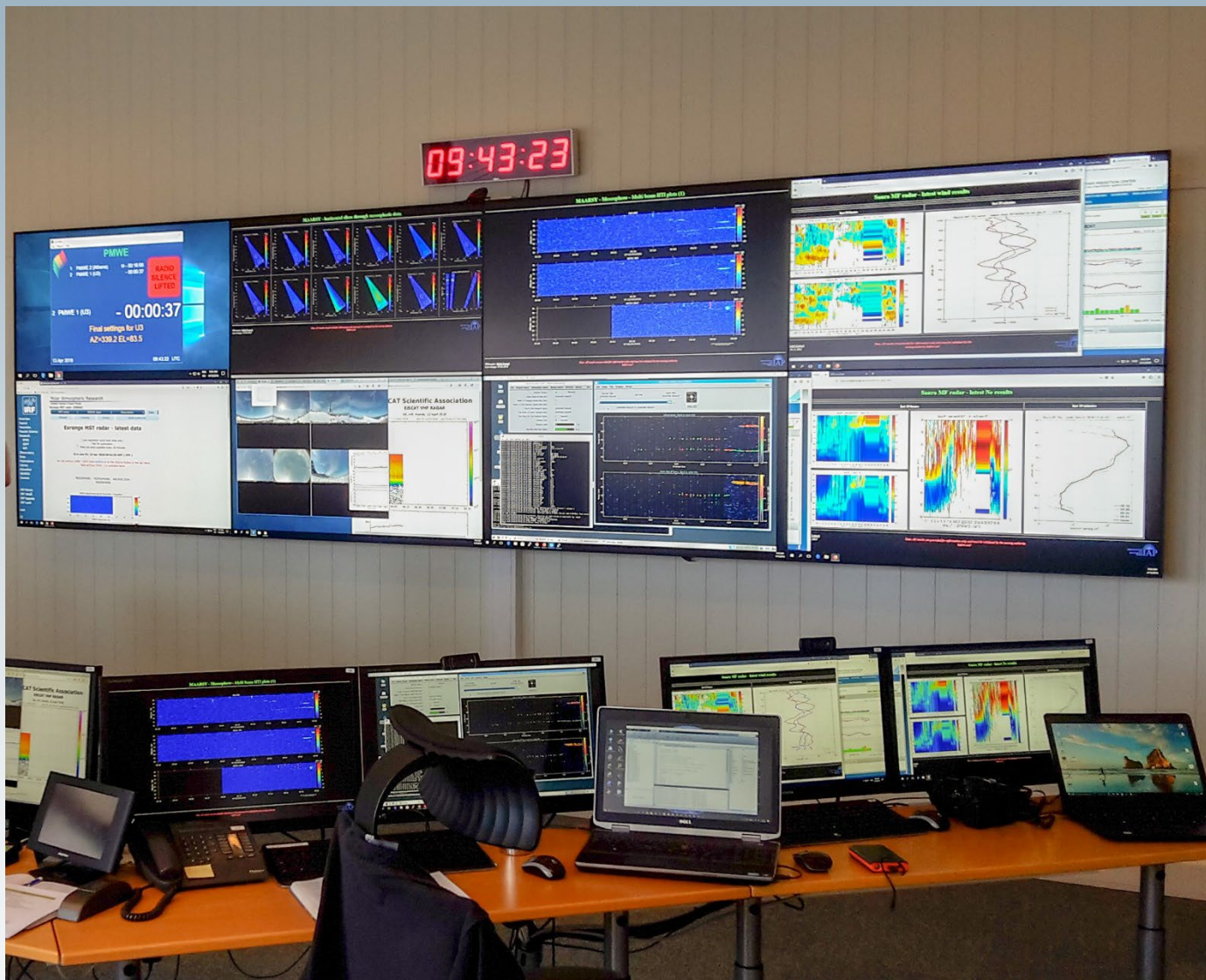


Saura MF radar - latest wind results



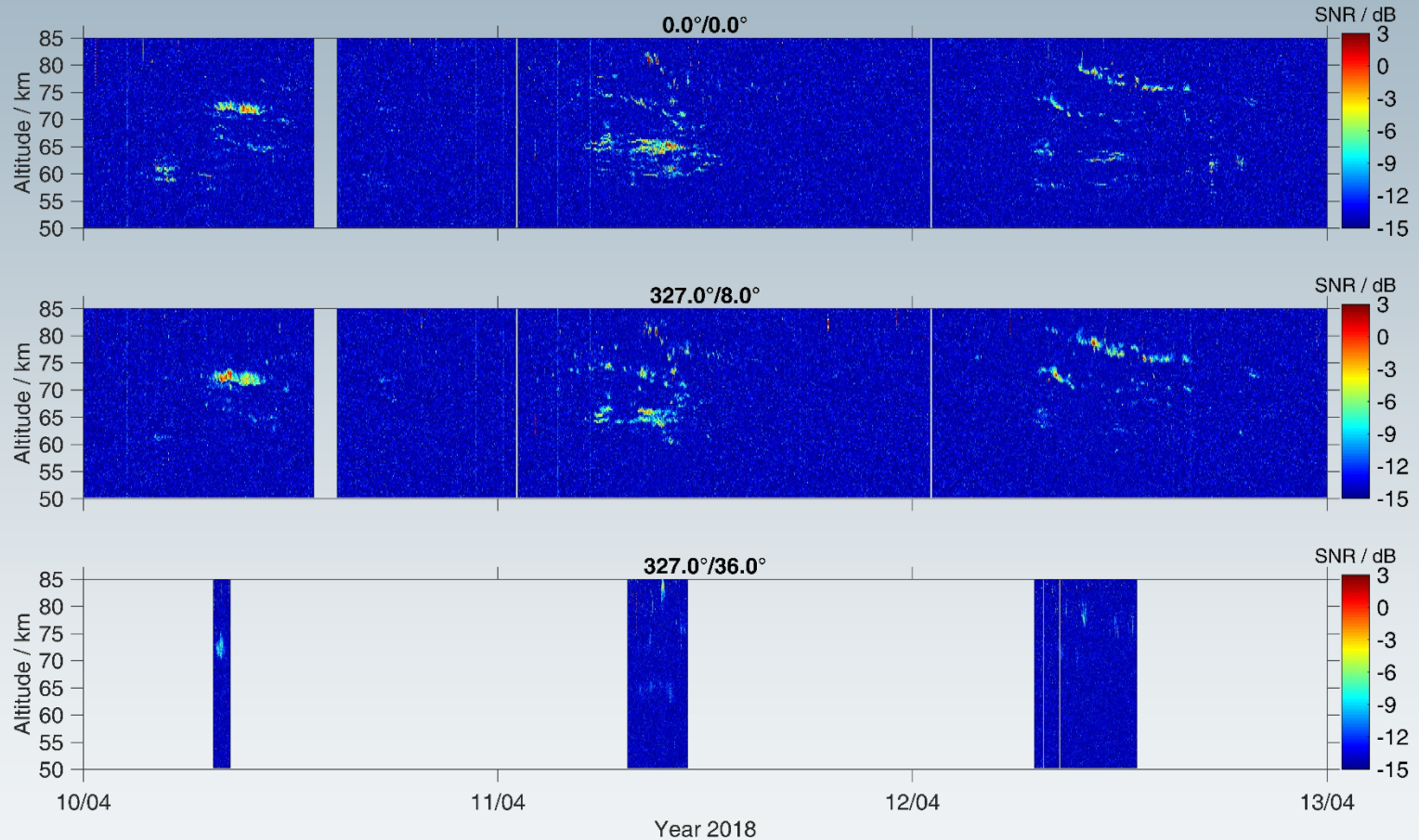
PMWE1 rocket campaign

real time resentation of atmospheric conditions at USOC



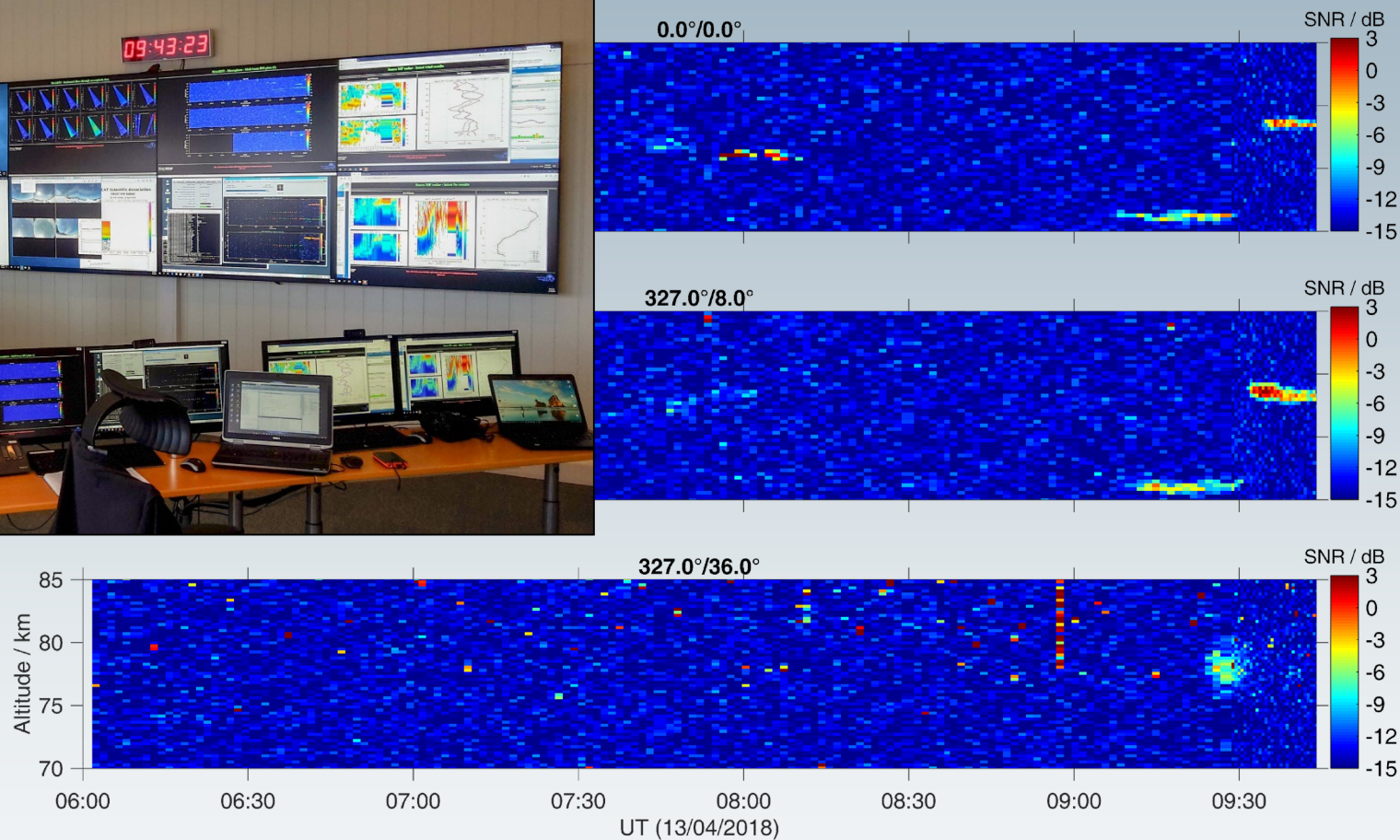
PMWE1 rocket campaign

MAARSY multi-beam operation during the first three days of the campaign



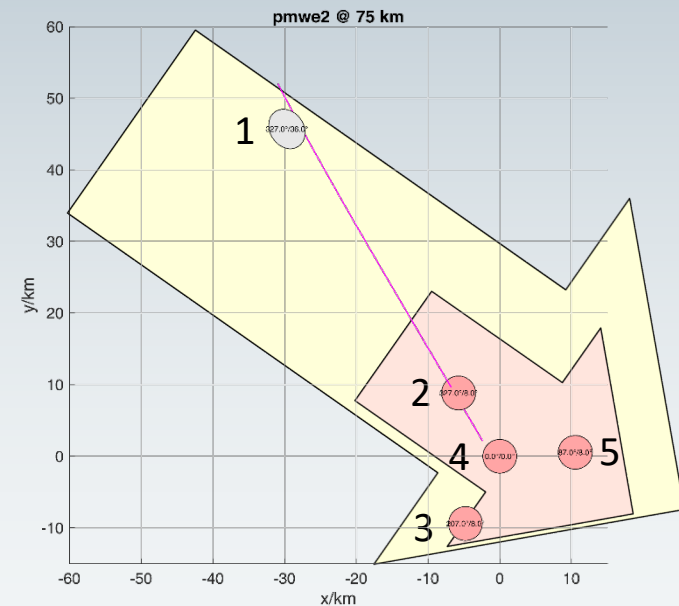
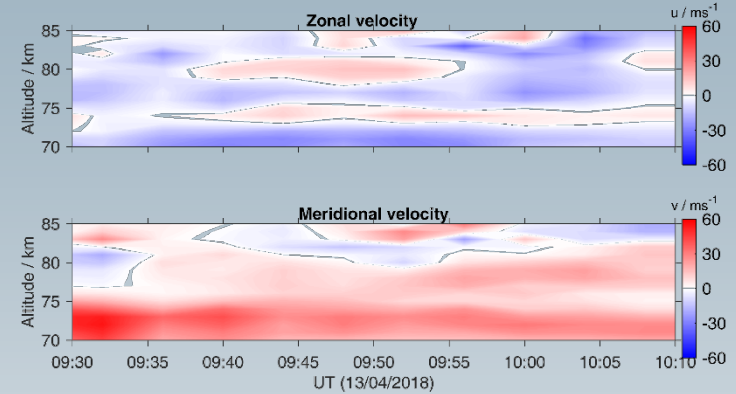
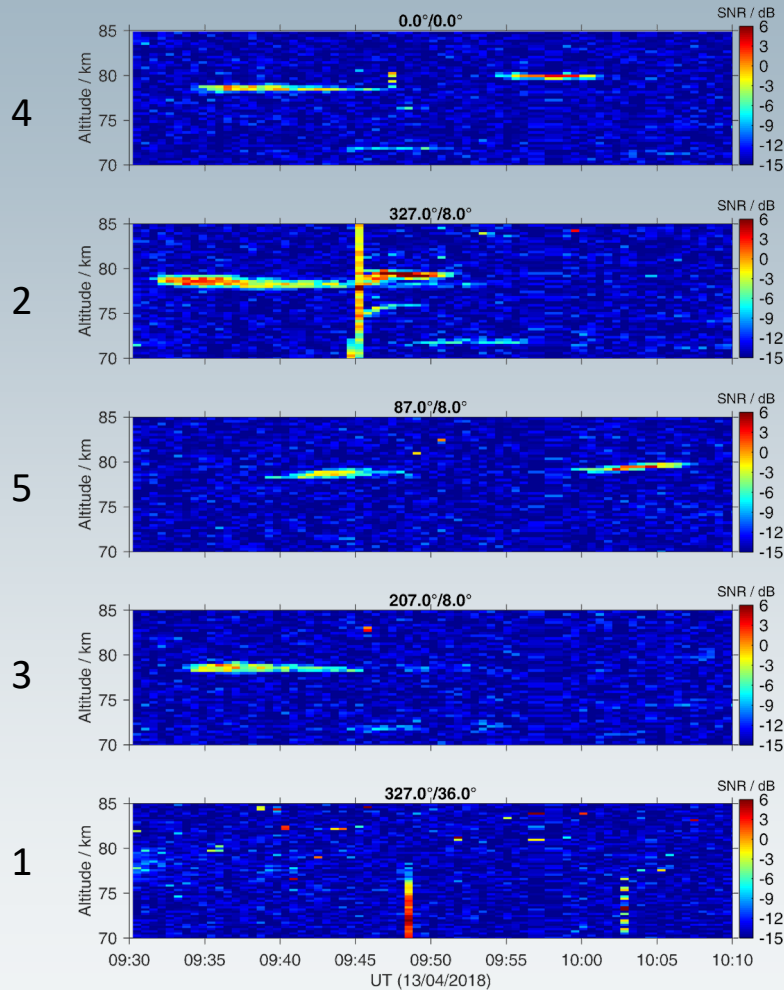
PMWE1 rocket campaign

MAARSY multi-beam operation on April 13, 2018



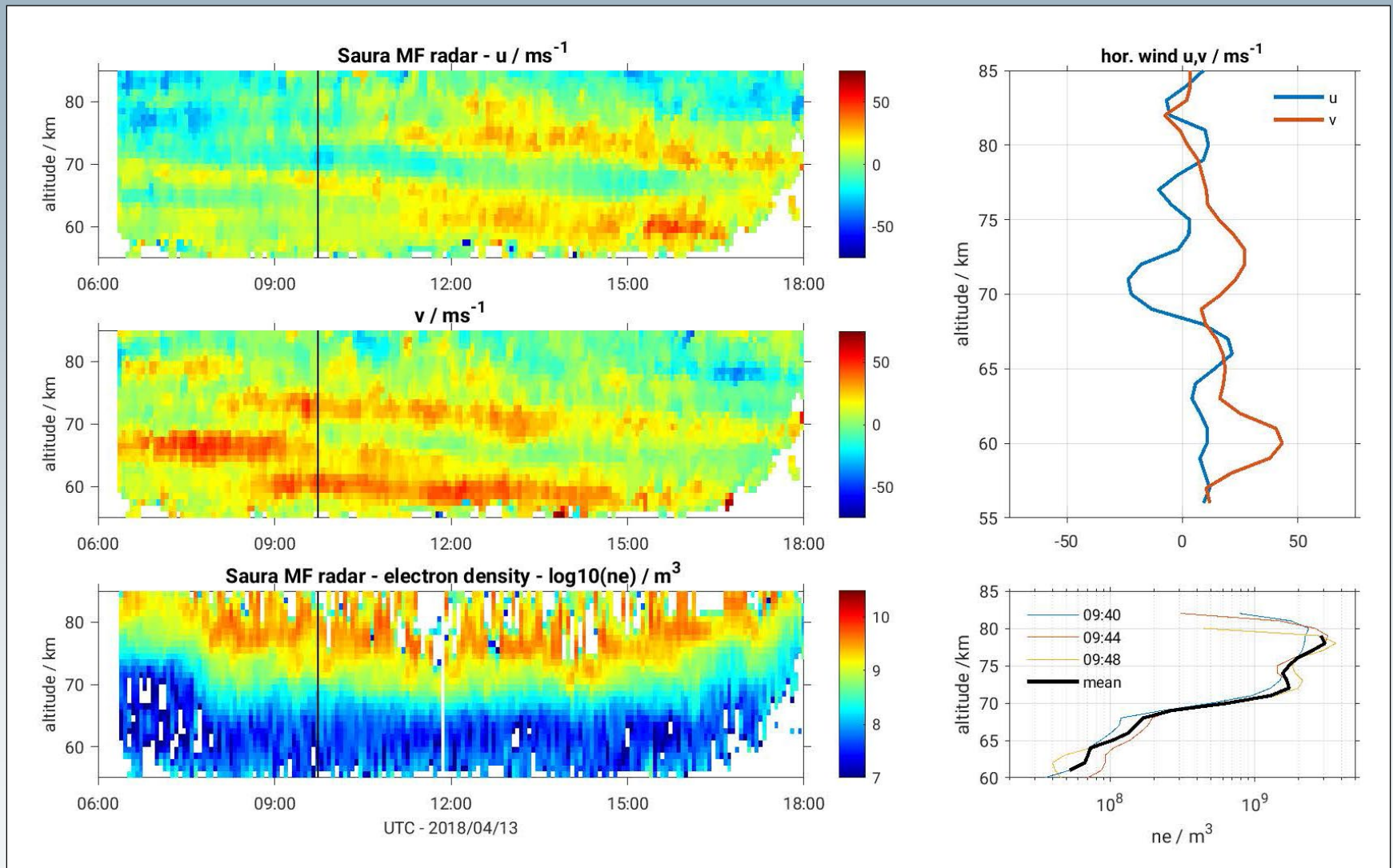
PMWE1 rocket campaign: FIONA

SNR from MAARSY multi-beam operation and horizontal wind



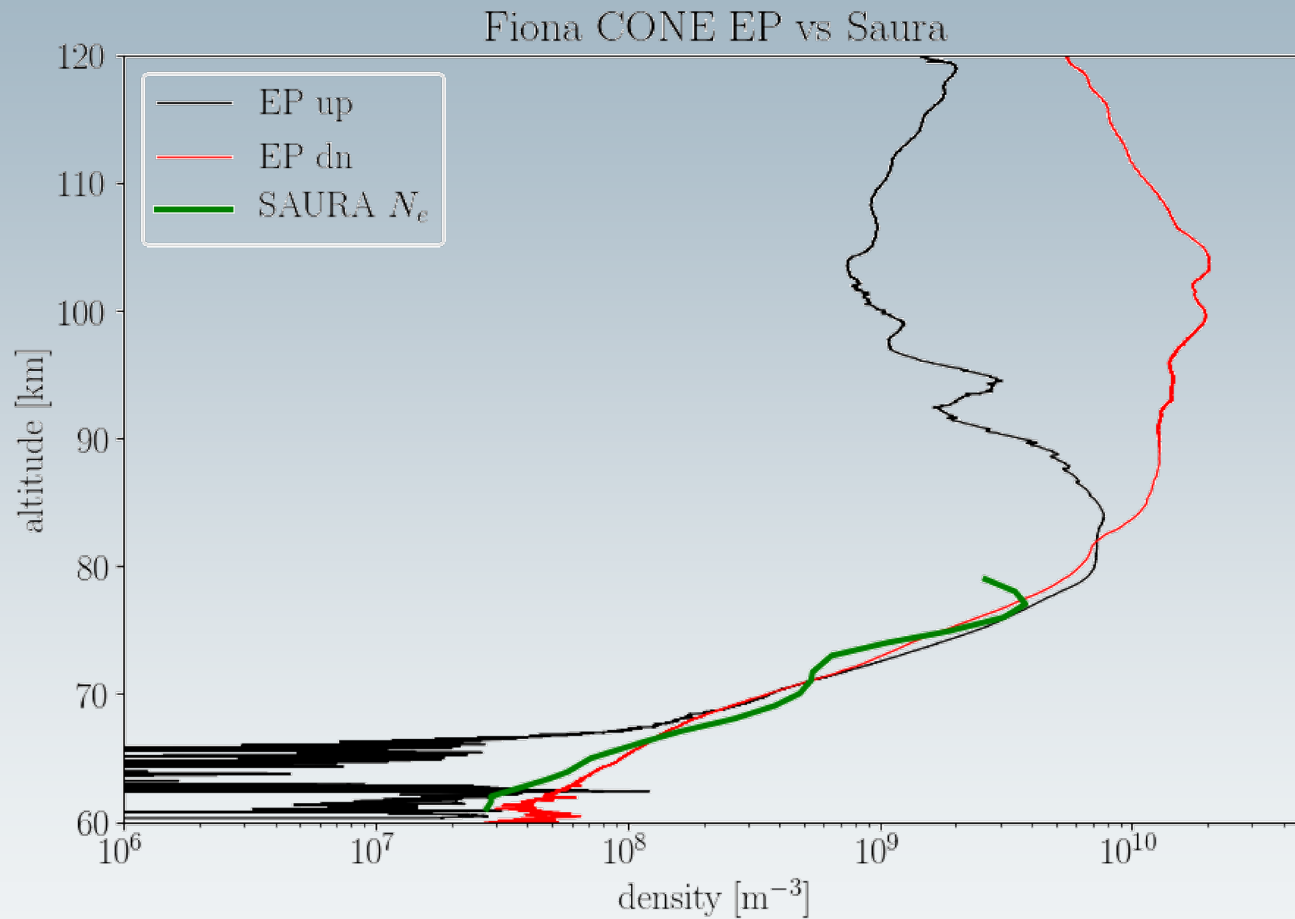
PMWE1 rocket campaign

horizontal wind and Ne from Saura MF radar on April 13, 2018



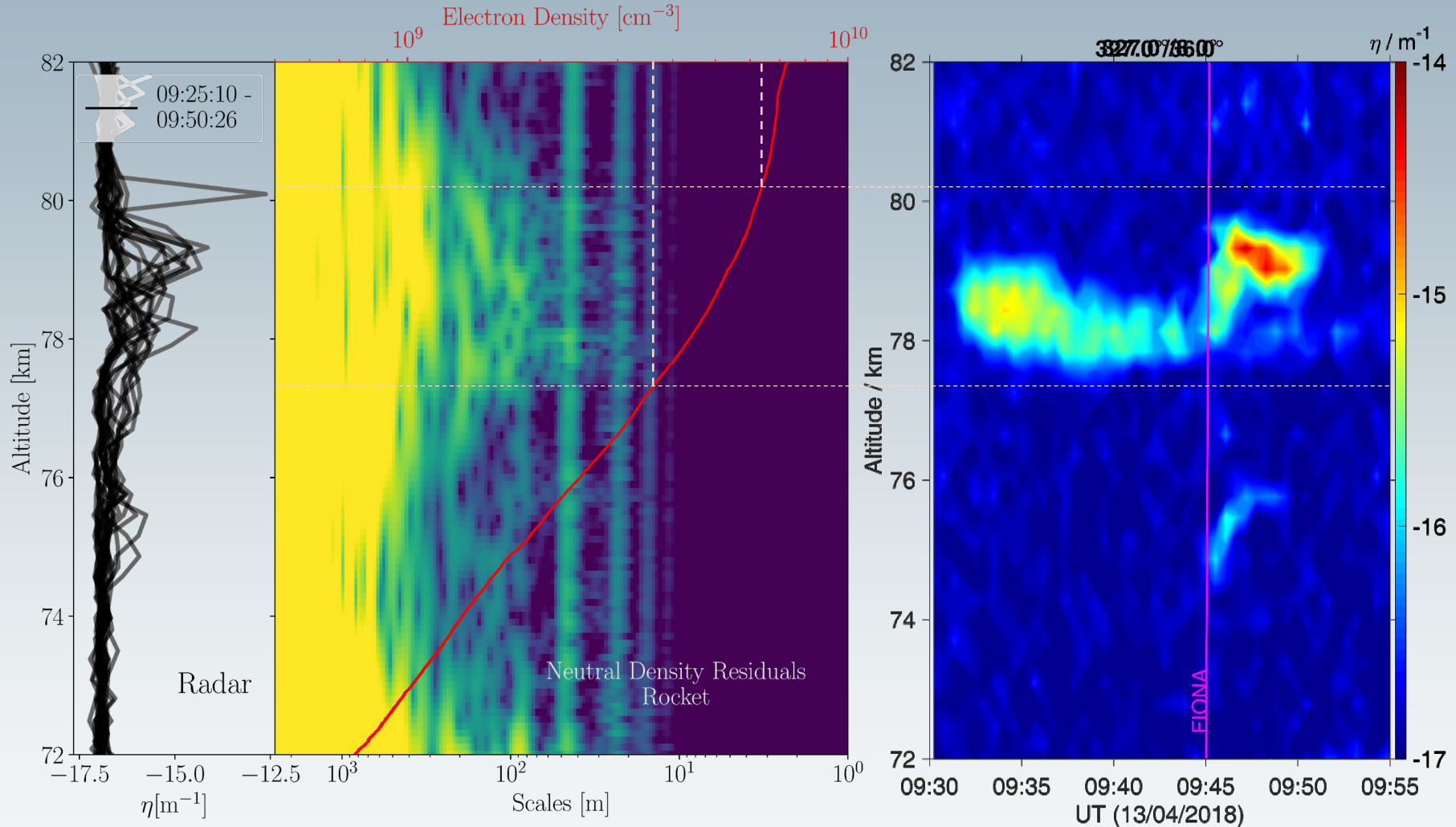
PMWE1 rocket campaign: FIONA

Ne from CONE and Saura MF radar



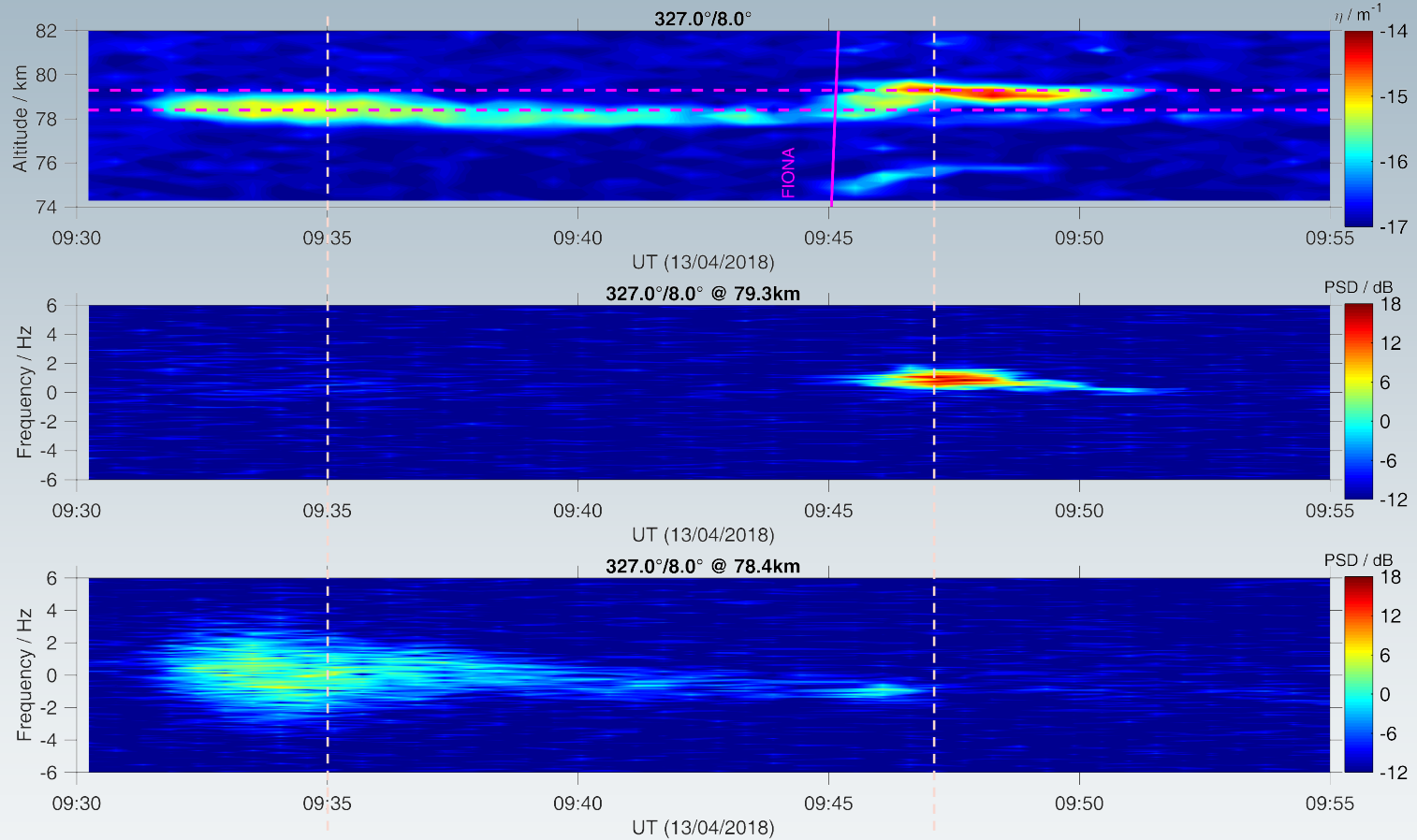
PMWE1 rocket campaign: FIONA

neutral density residuals, Ne and PMWE reflectivity



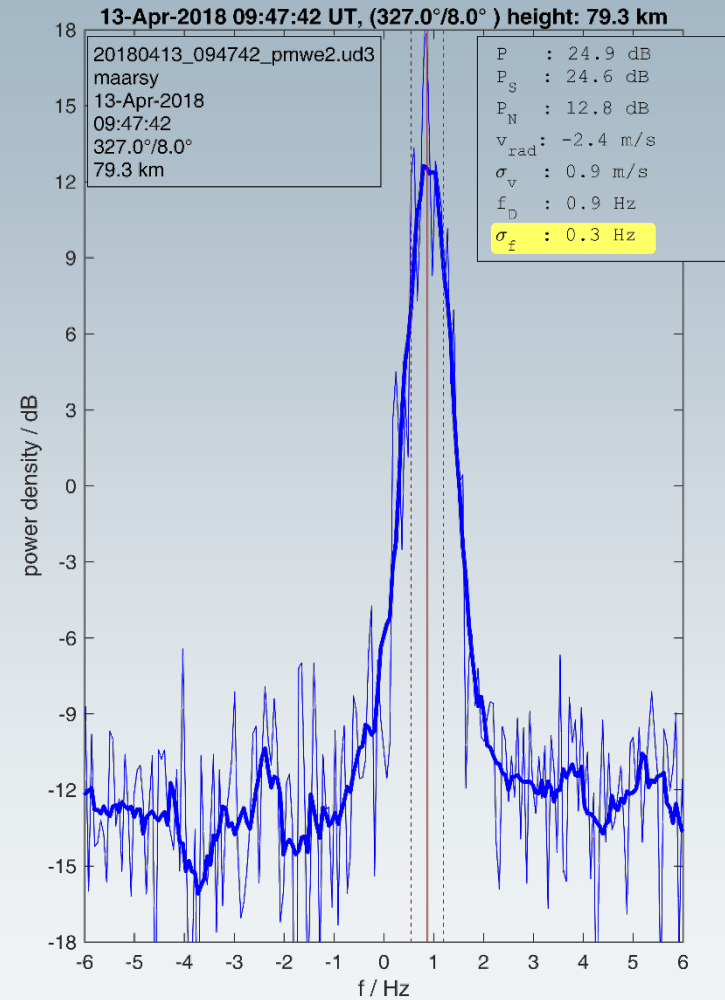
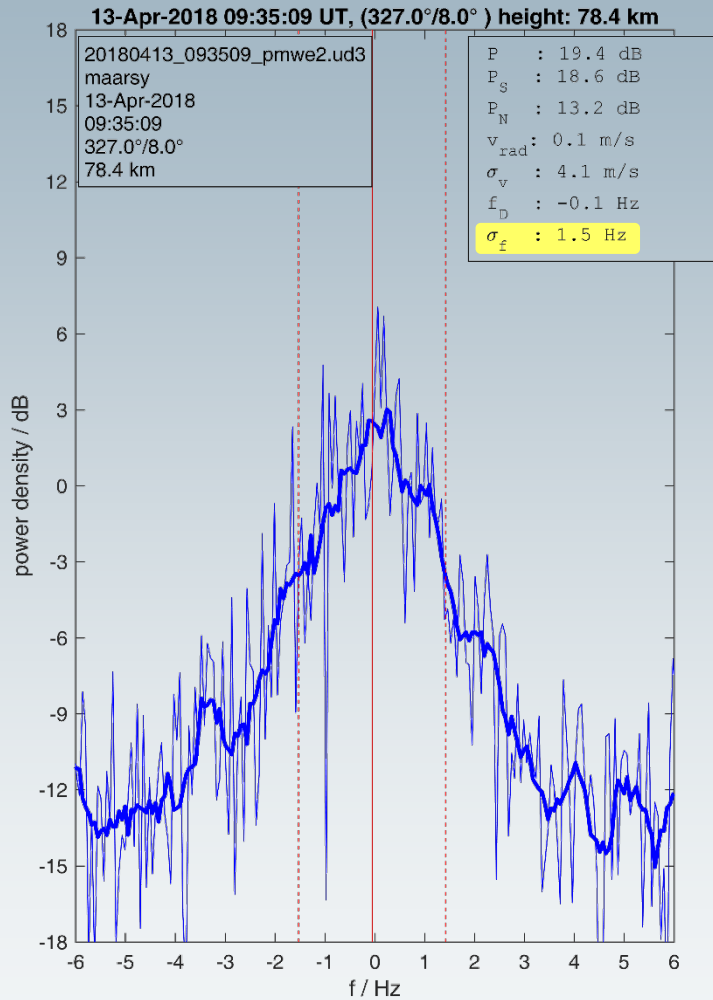
PMWE1 rocket campaign: FIONA

MAARSY spectral width from $327.0^\circ/8.0^\circ$ beam pointing along upleg

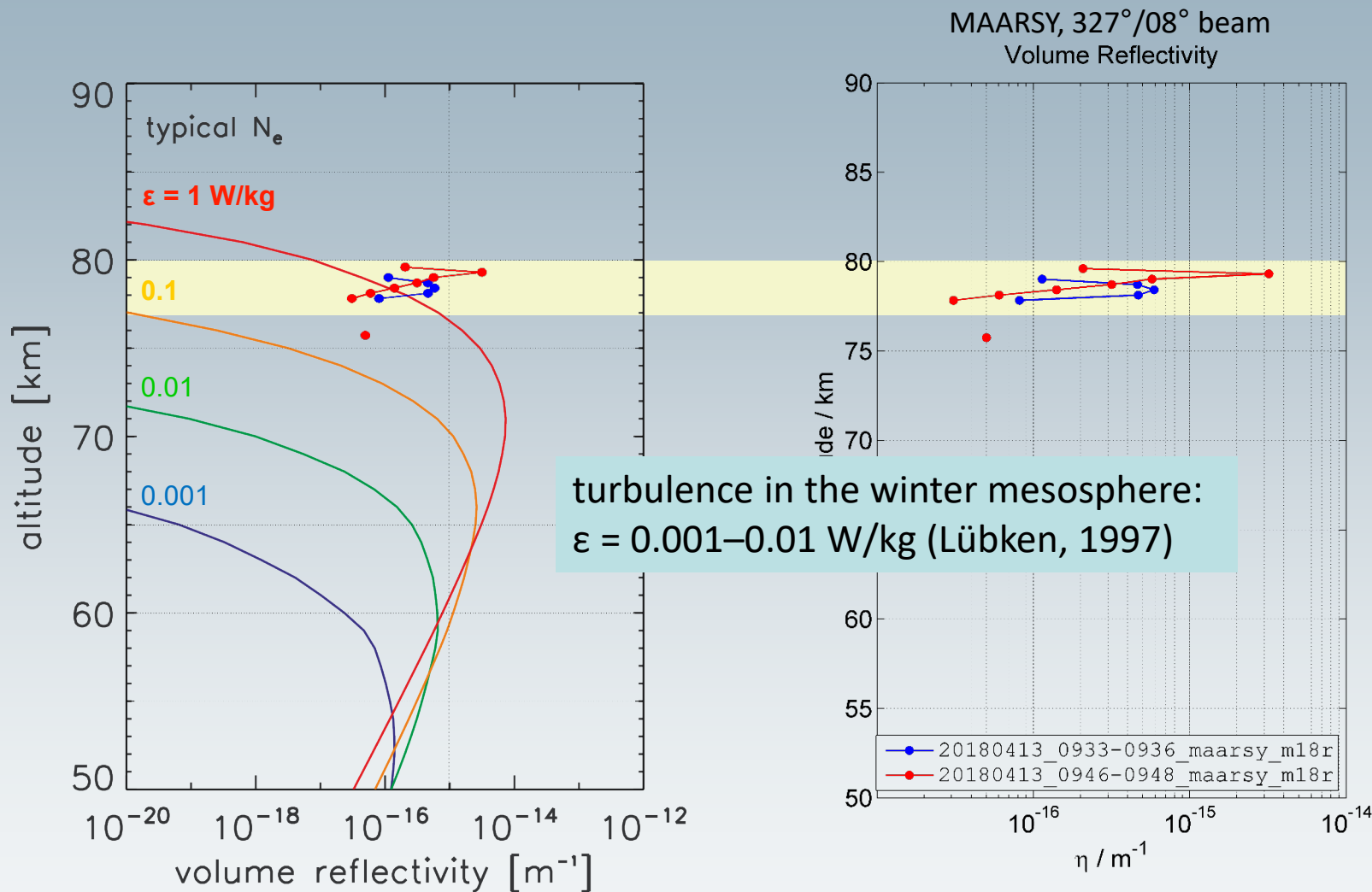


PMWE1 rocket campaign: FIONA

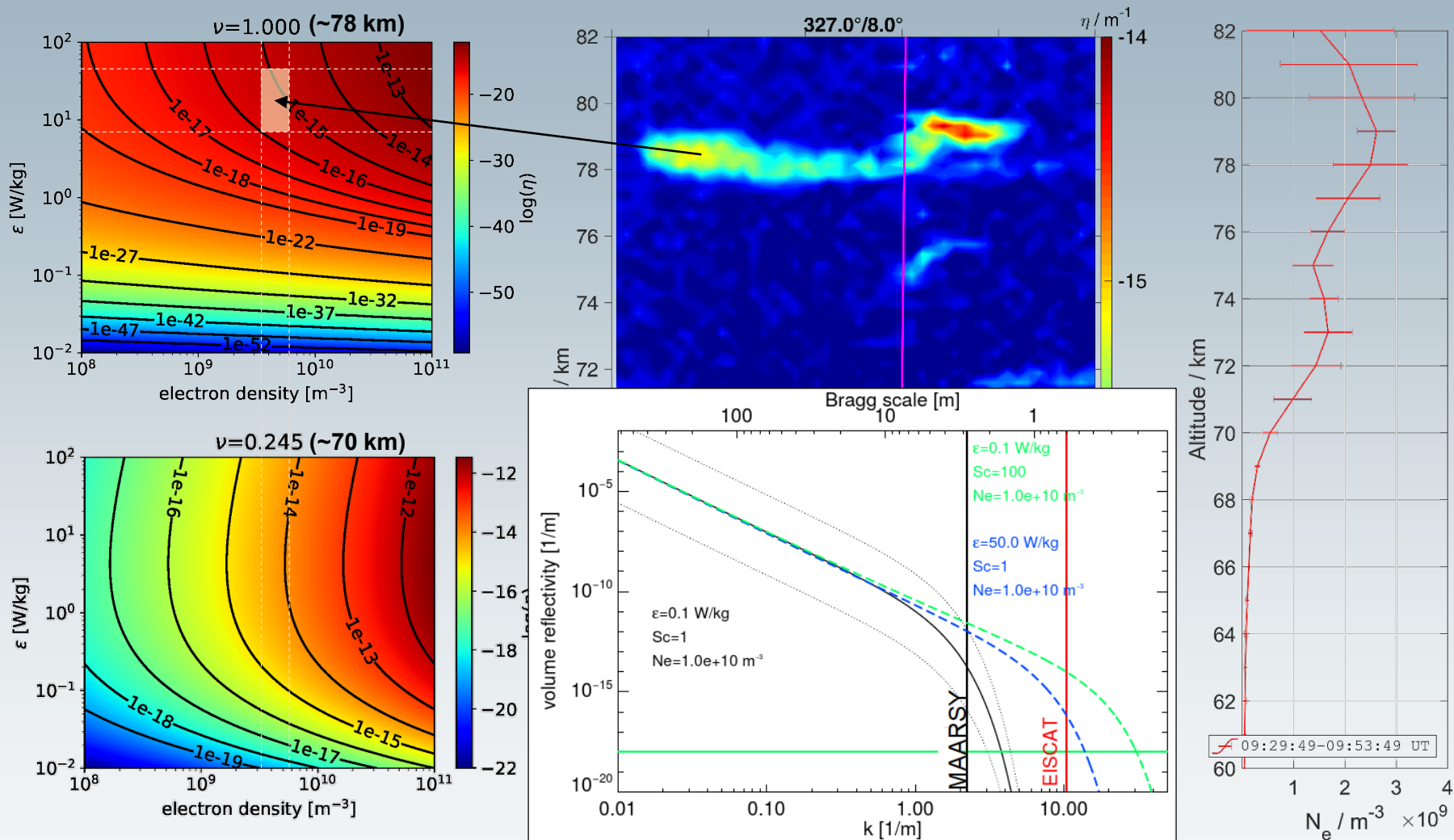
MAARSY (327°/8°) before and after passing of rocket



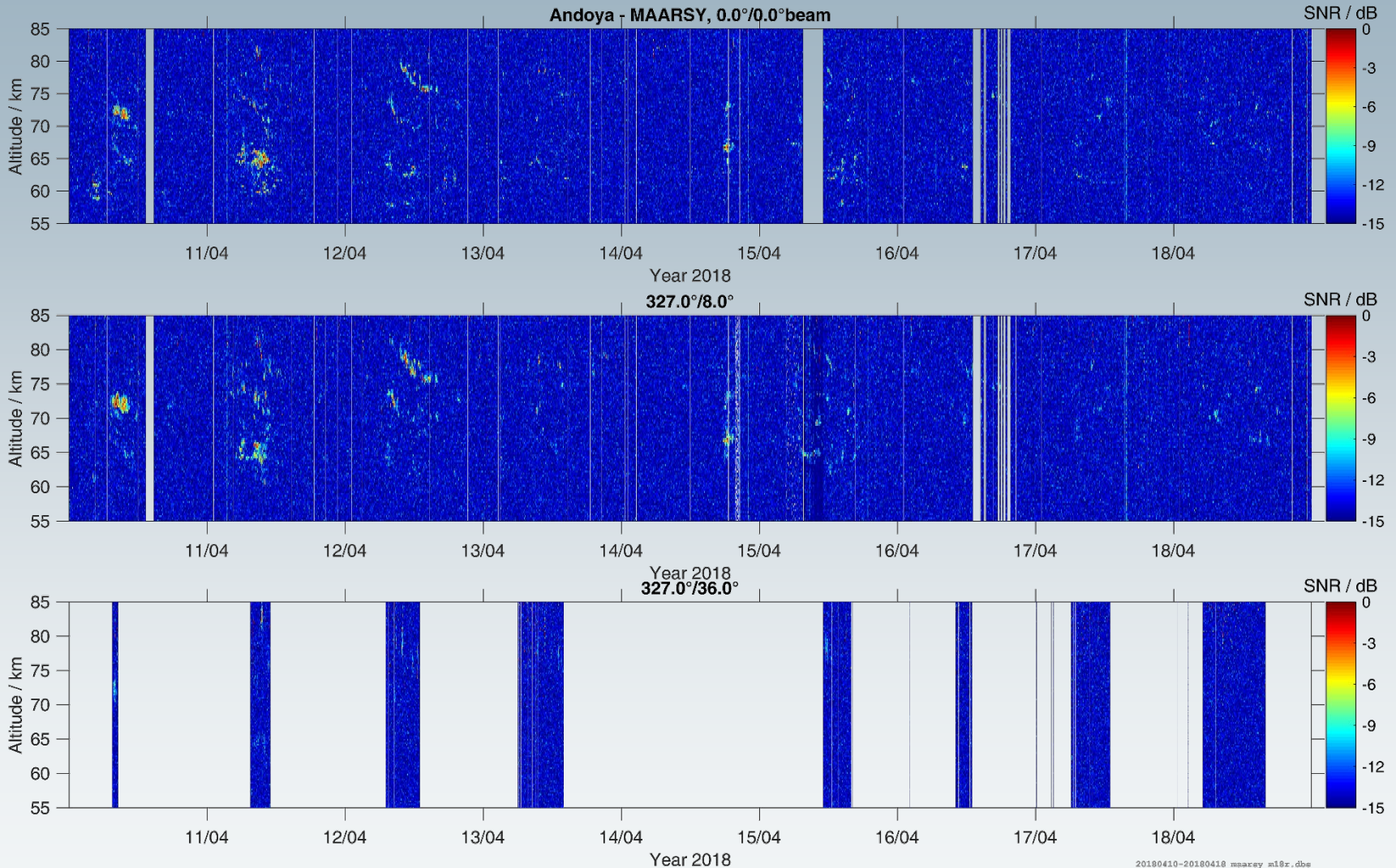
Comparison of radar results with model calculations of coherent radar backscatter from turbulent PMWE (Lübken et al., 2006)



Comparison of radar results with model calculations of coherent radar backscatter from turbulent PMWE (Lübken et al., 2006)

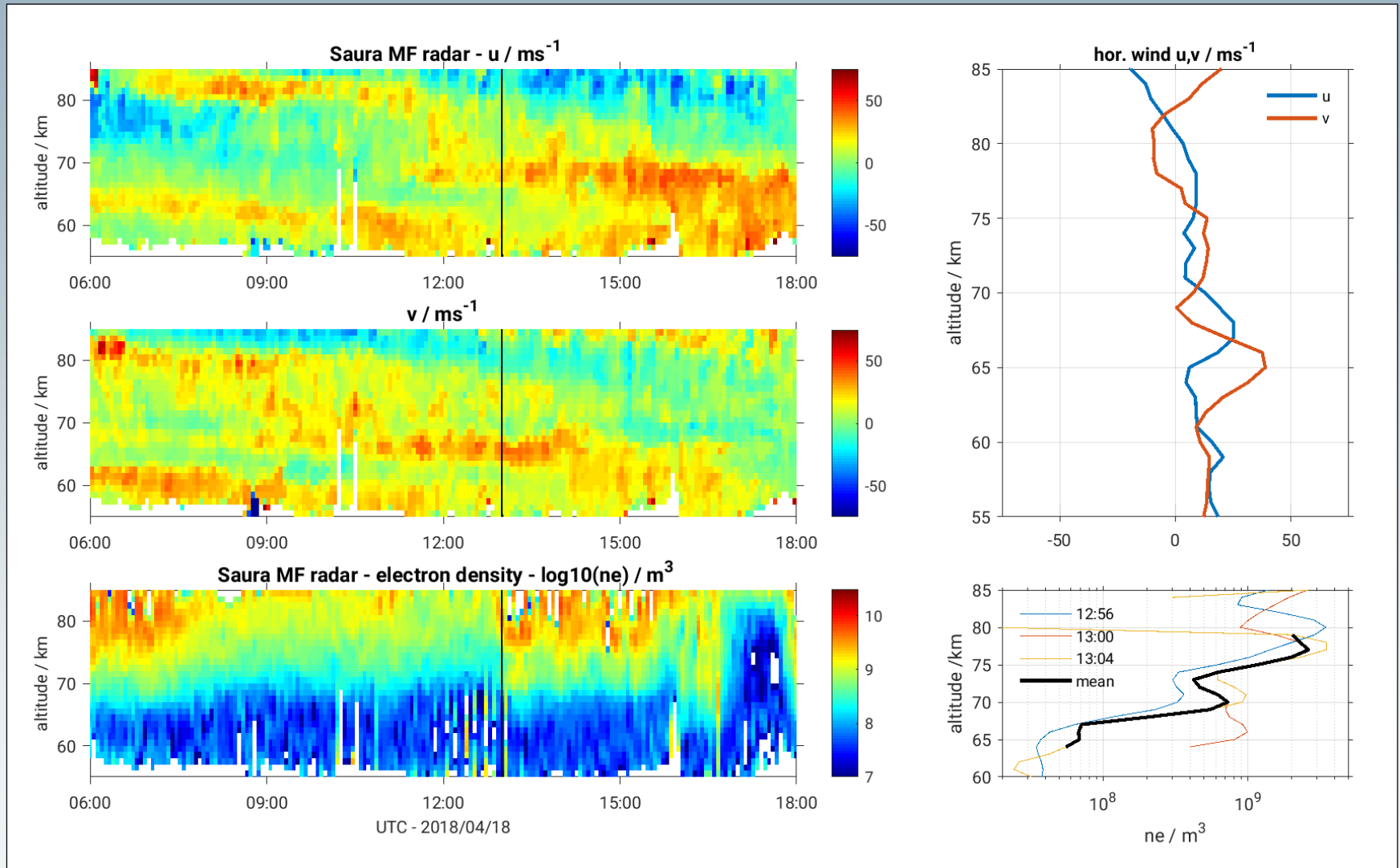


PMWE1 rocket campaign: DUSTIN MAARSY multi-beam operation



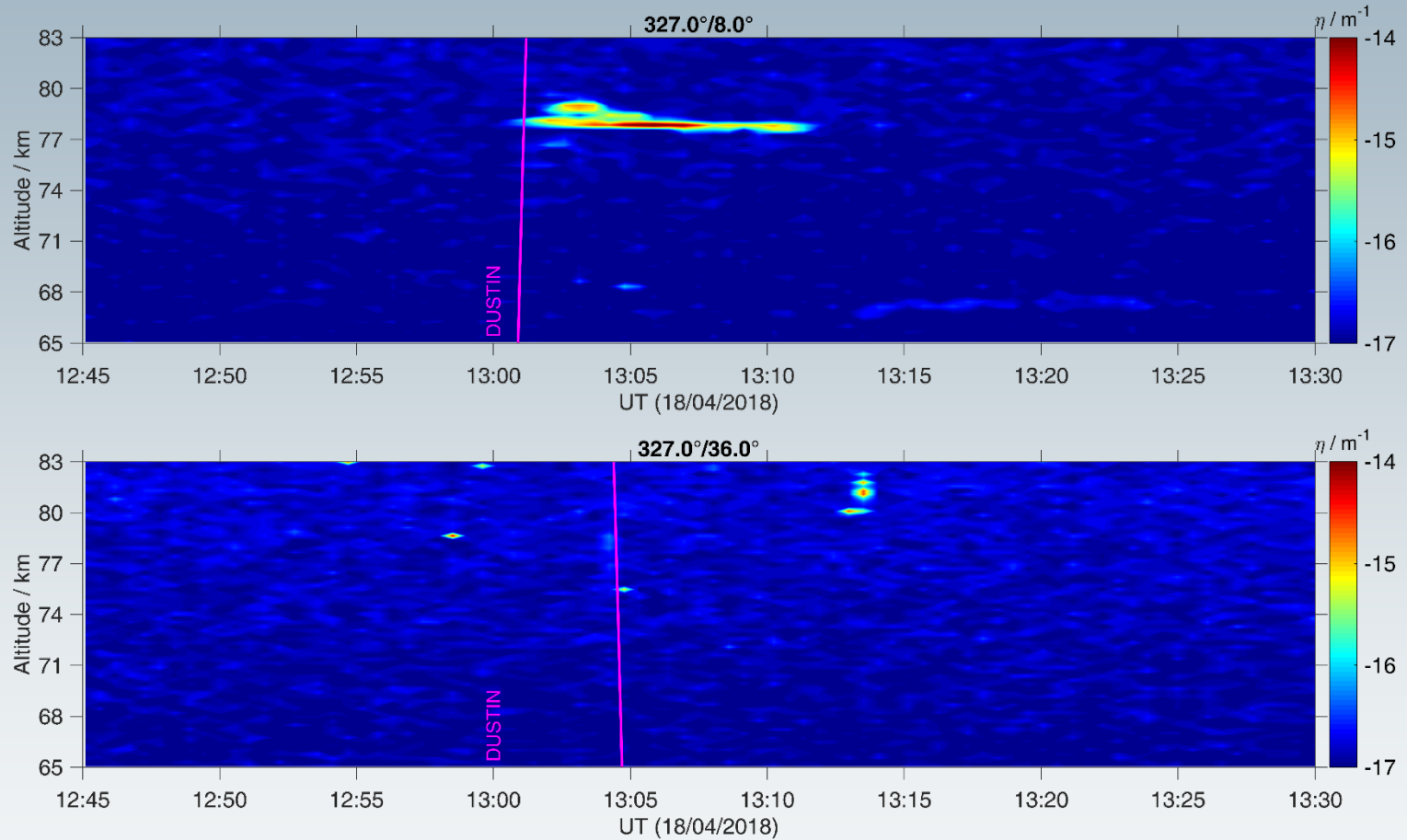
PMWE1 rocket campaign: DUSTIN

horizontal wind and Ne from Saura MF radar on April 18, 2018



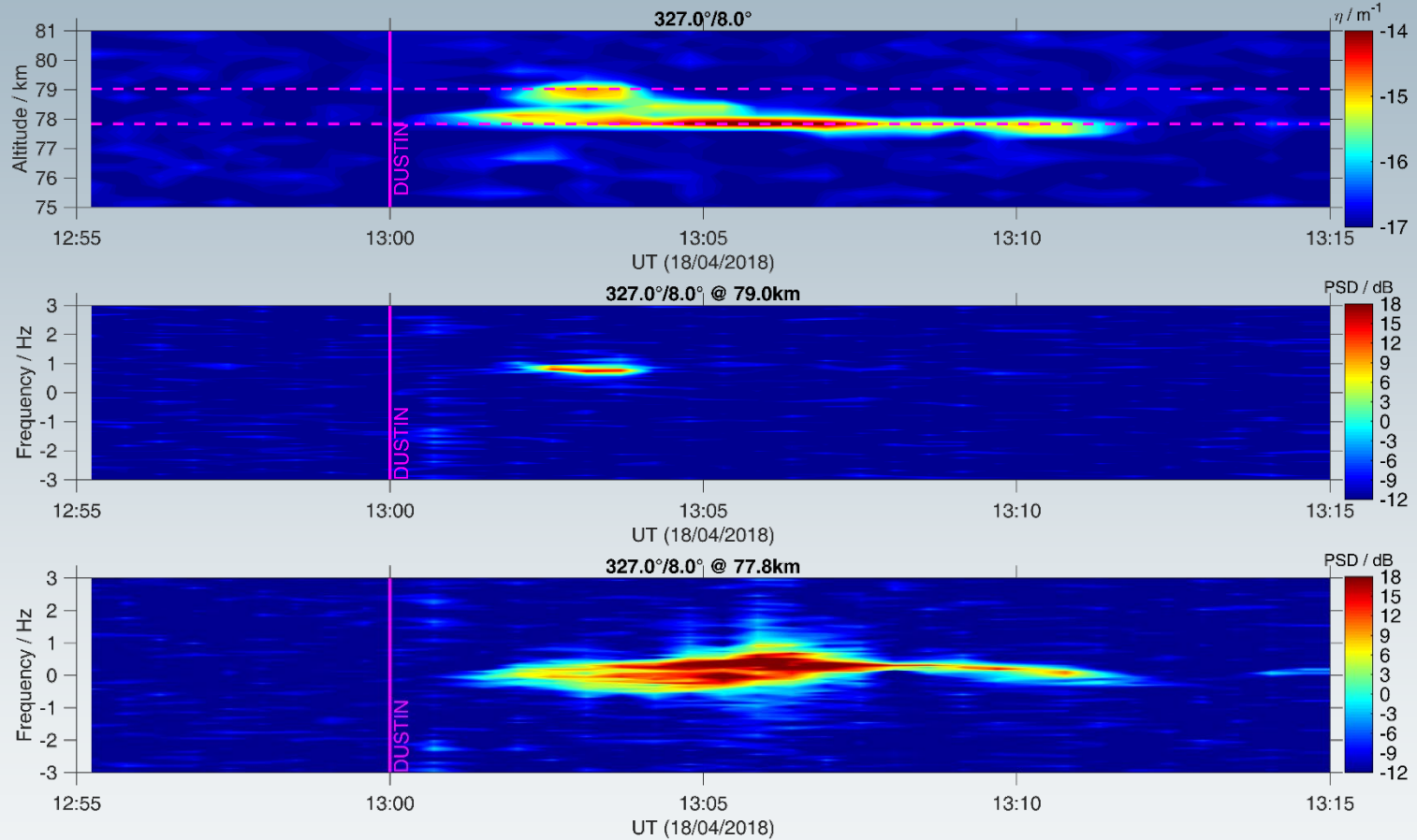
PMWE1 rocket campaign: DUSTIN

MAARSY SNR from 327°/8° and 327°/36° beams

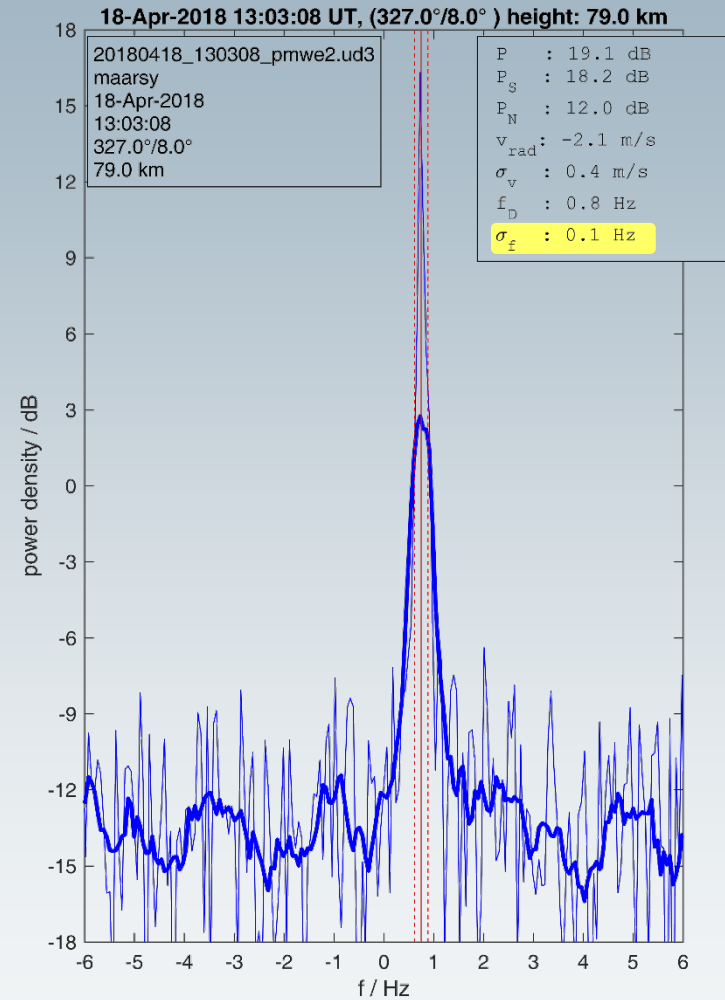
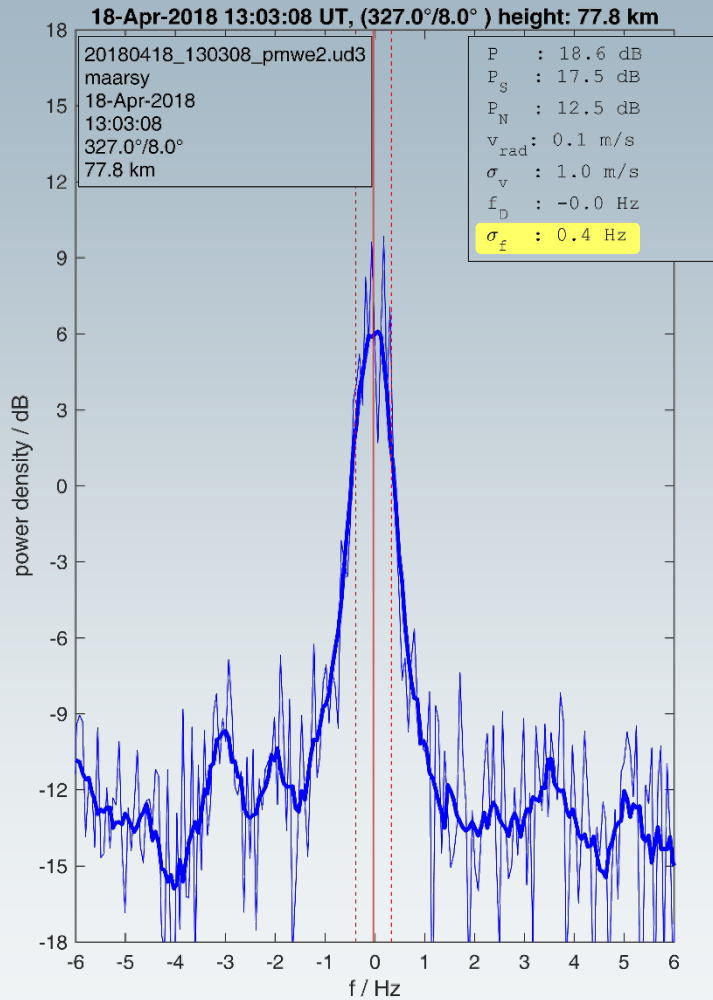


PMWE1 rocket campaign: DUSTIN

MAARSY spectral width from $327^\circ/8^\circ$ beam pointing along upleg

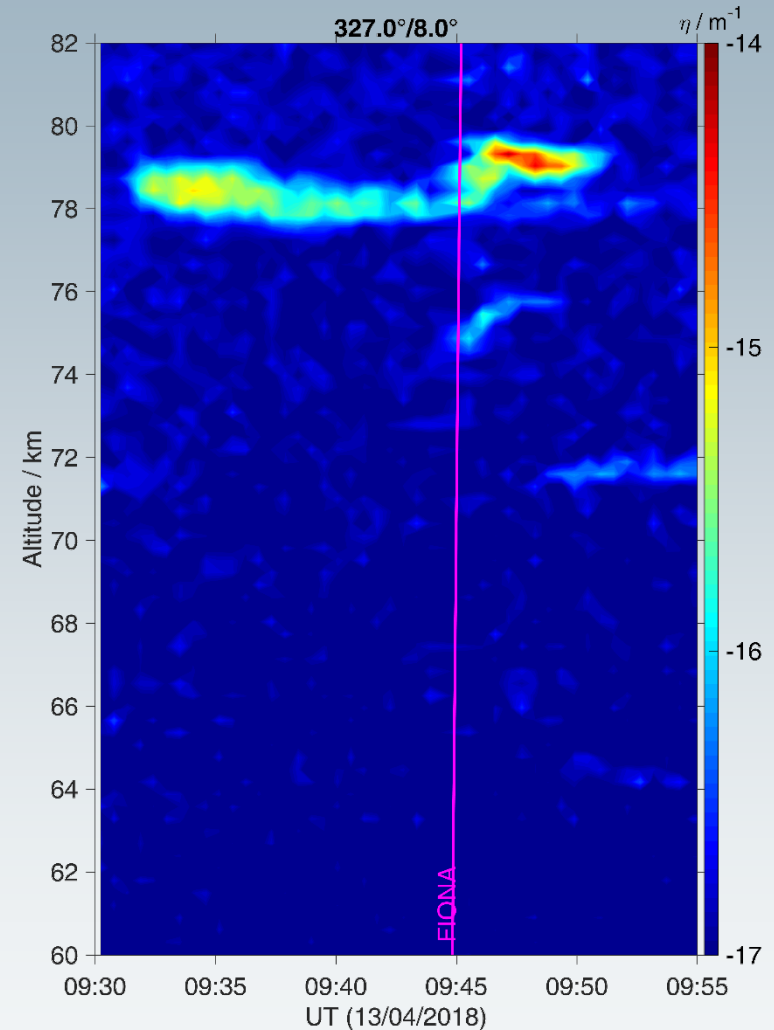


PMWE1 rocket campaign: DUSTIN MAARSY (327°/8°) after passing of DUSTIN



Summary

- PMWE at 78km detected in 4 oblique beams by MAARSY on April 13, 2018:
 - Horizontally broad structure
 - $\eta \approx 10^{-15} \text{m}^{-1}$
 - $\sigma_f \approx 1.5 \text{Hz}$
- Atmospheric conditions detected by Saura MF radar:
 - Wind shear in u and v below 78km
 - $N_e \approx 2 \cdot 10^9 - 5 \cdot 10^9 \text{m}^{-3}$
- Rocket borne instruments probed the PMWE altitude at the decay of the structure
 - Weak PMWE in 8° oblique beams (upleg of rocket payload)
 - No PMWE in 36° oblique beam (downleg of rocket payload)
 - N_e from rocket probes in very good agreement with N_e from Saura MF radar
- Comparison with model indicate that pure turbulence might not be sufficient to create PMWE at $\sim 78 \text{km}$ \rightarrow dust?
- Very strong radar echo $\sim 80 \text{km}$ was detected after passage of rocket \rightarrow ?



Thank you

