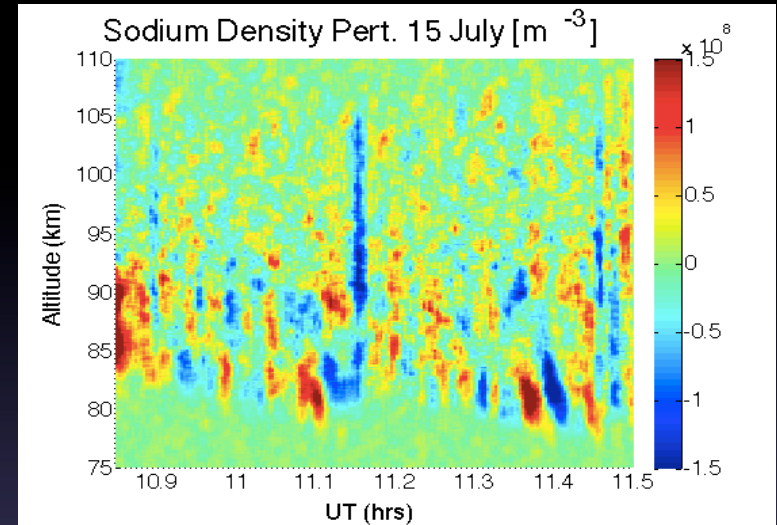
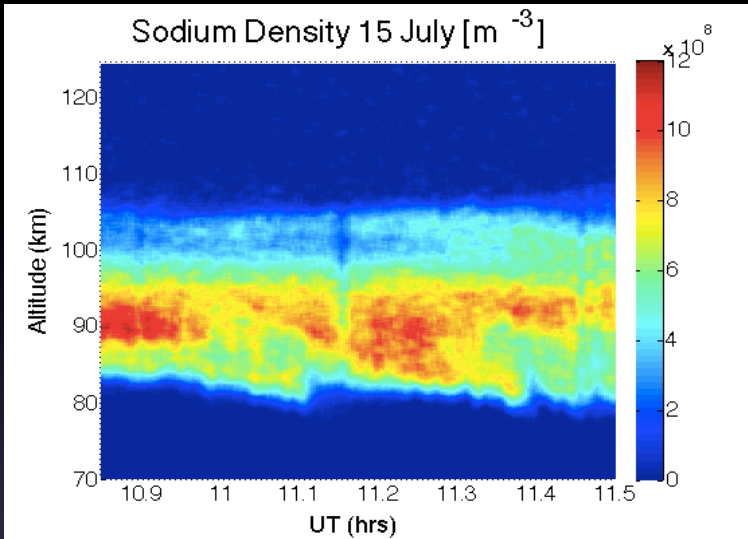


Wave Interactions Using Lidar and AMTM measurements

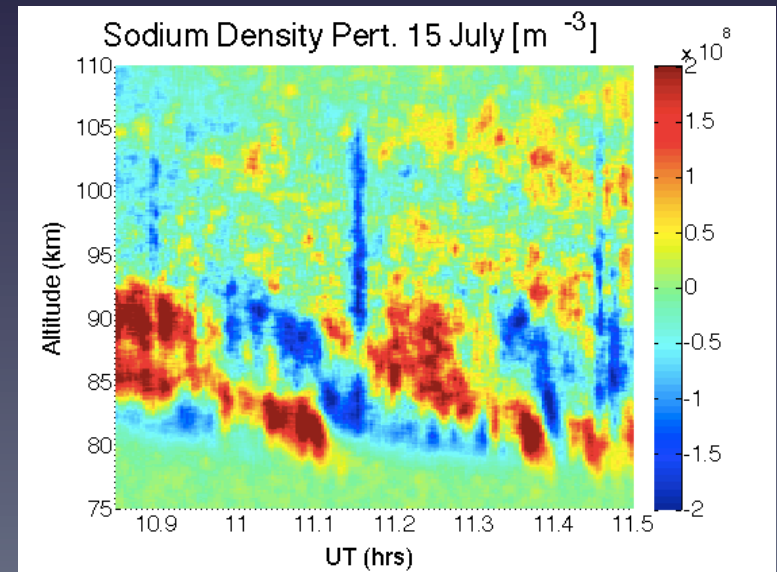
DEEPWAVE

15 July (RF 24)



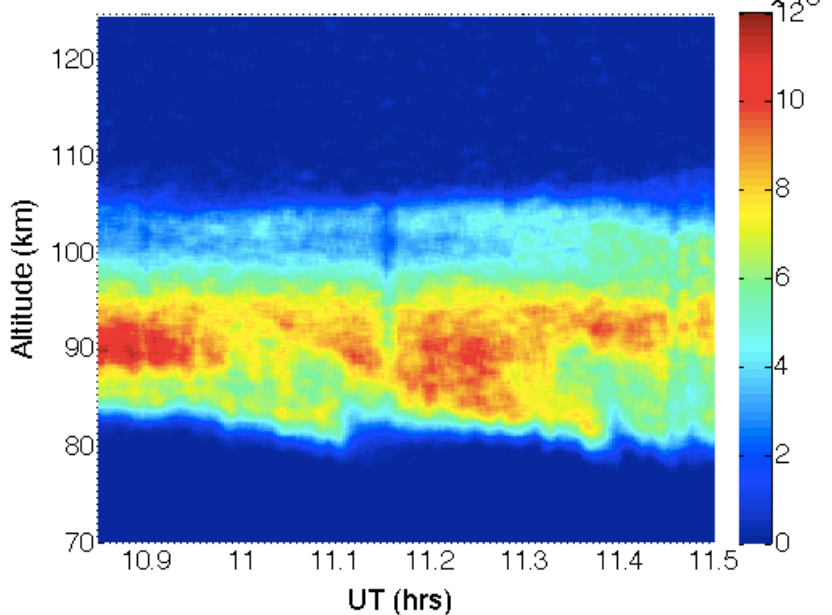
- Multiple waves observed in the sodium density
- Longer period wave (~ 15 minutes) has shorter vertical wavelength (10-15km)
- Shorter period wave (< 5 minutes) has long vertical wavelength

** note: periods dependent on aircraft speed.

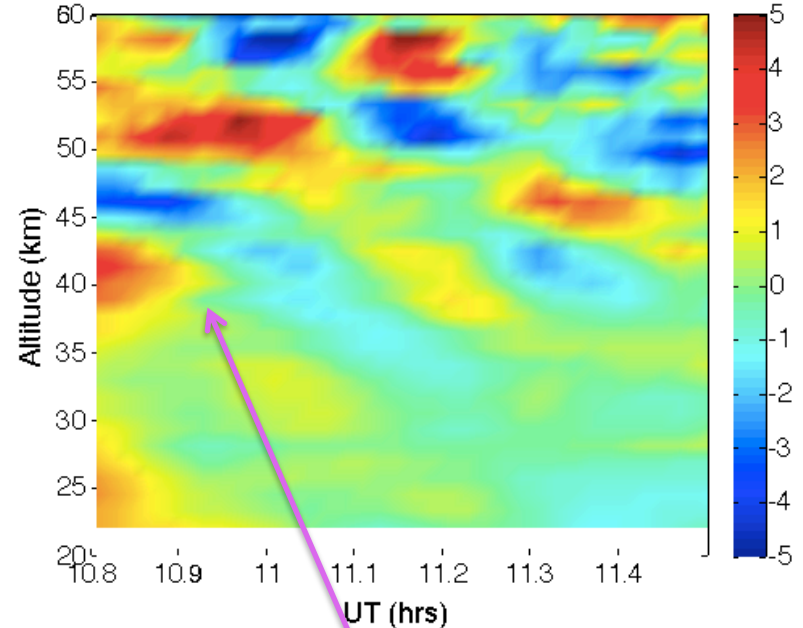


Relation to waves in MLT to Stratosphere?

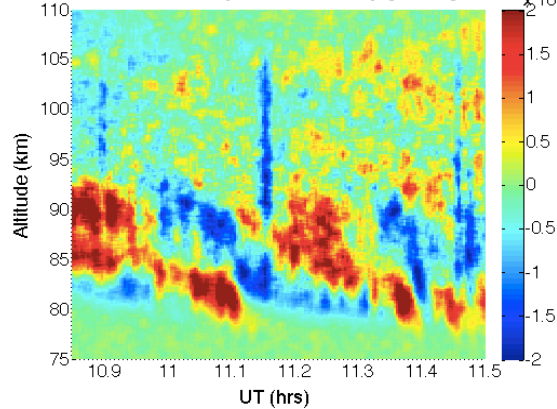
Sodium Density 15 July [m^{-3}]



Temperature Perturbation RF24



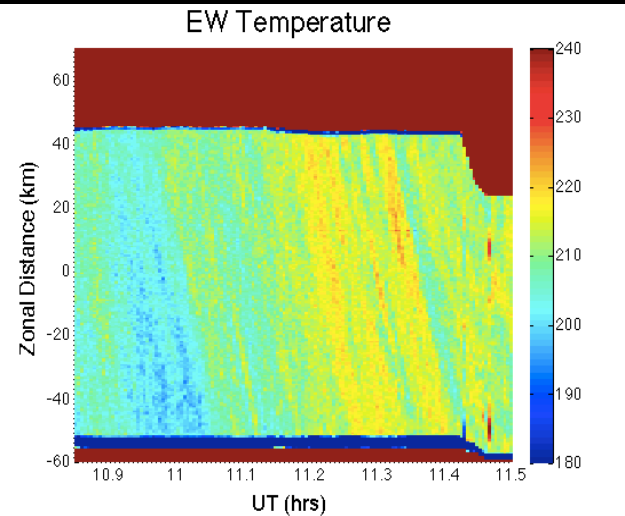
Sodium Density Pert. 15 July [m^{-3}]



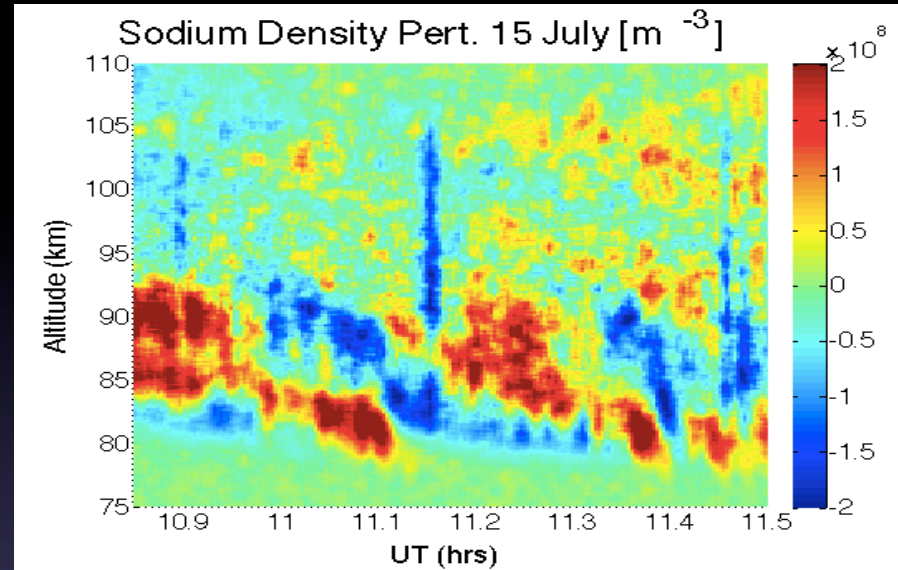
Rayleigh lidar shows multiple scales of waves at lower altitudes.

Larger scale wave observed in UV lidar. Similar period to wave in sodium density.

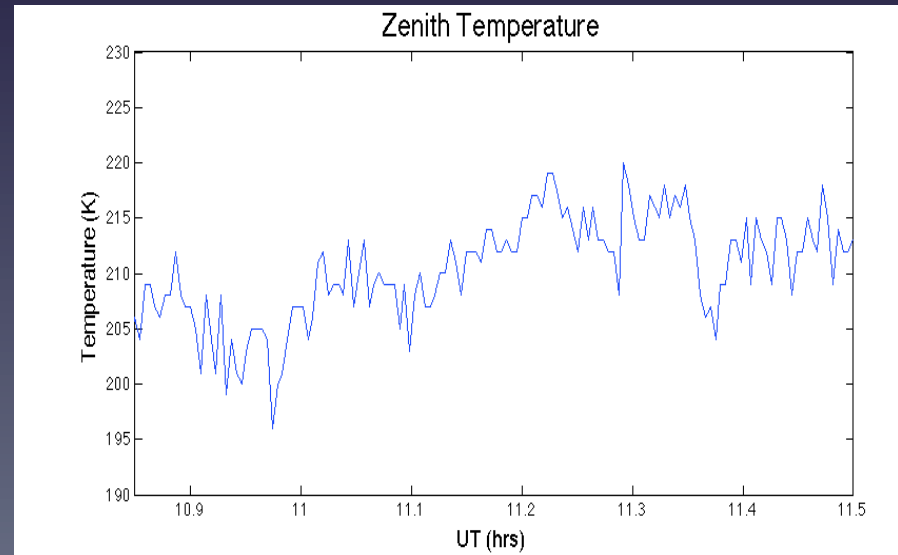
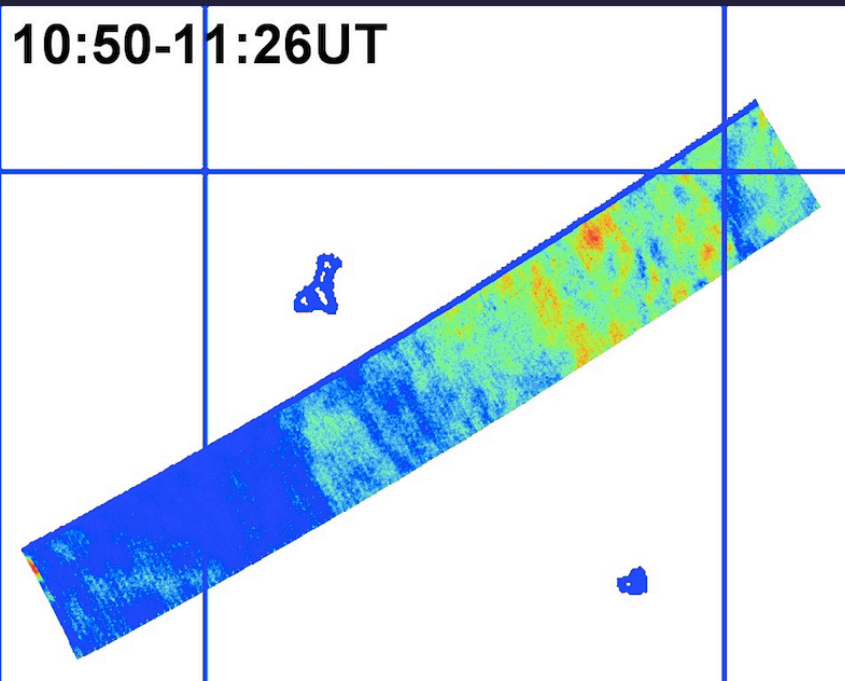
AMTM Measurements



Multiple scales of temperature perturbations observed in AMTM similar to sodium density observations.

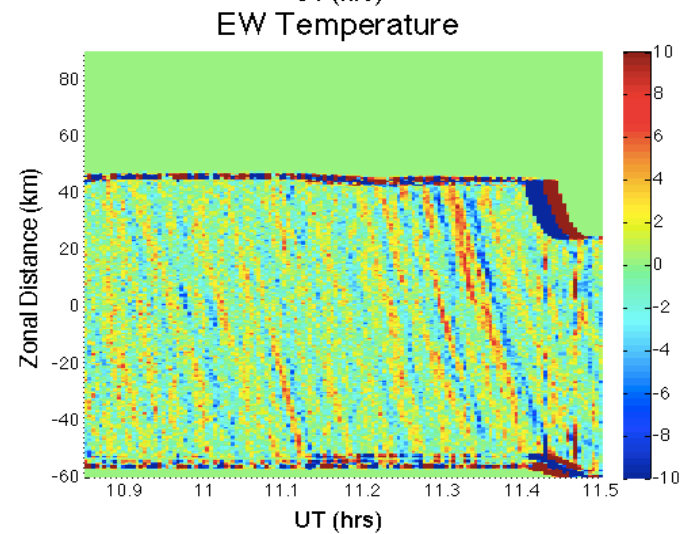
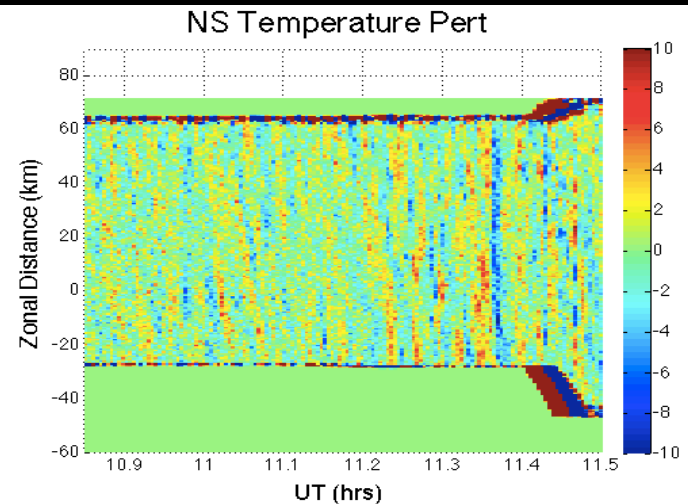
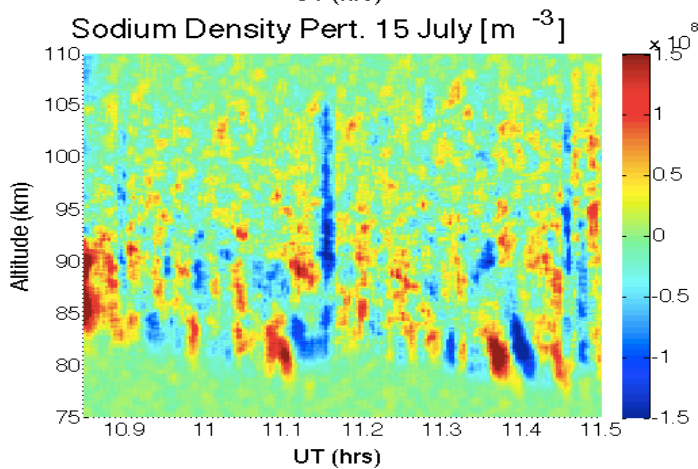
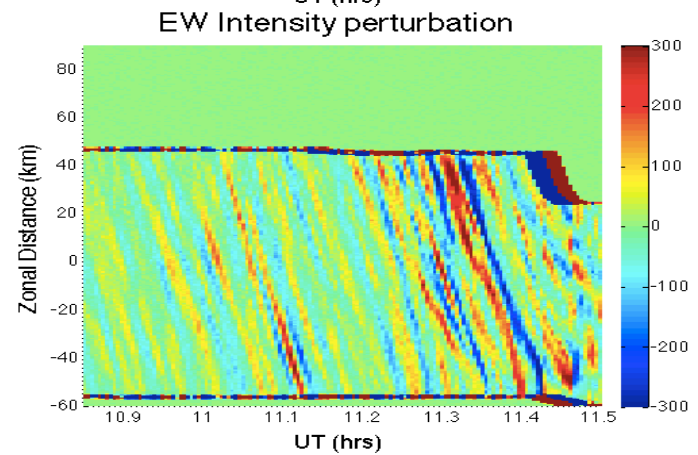
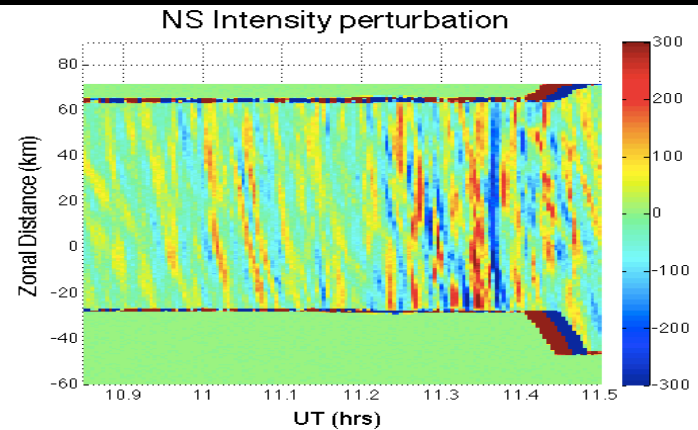


10:50-11:26UT



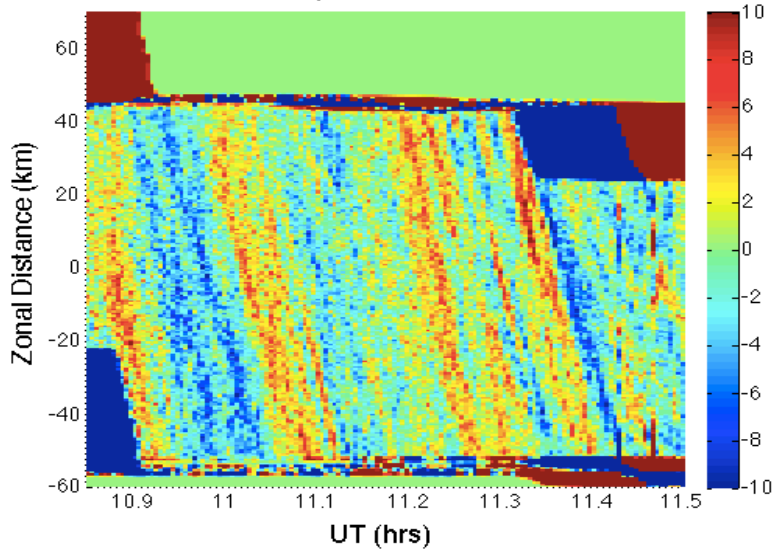
Filtered AMTM Data

Small scale waves observed in both AMTM and sodium data. Wavelengths on the order of 10's of km.

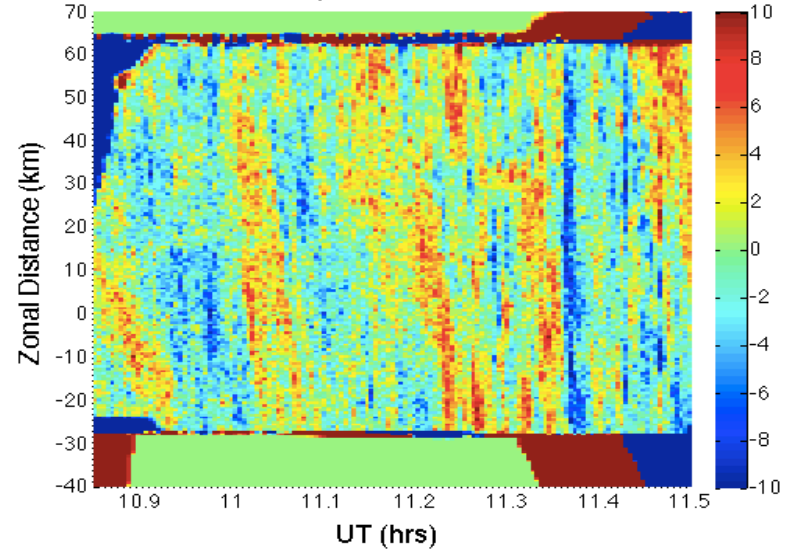


Filtered AMTM data

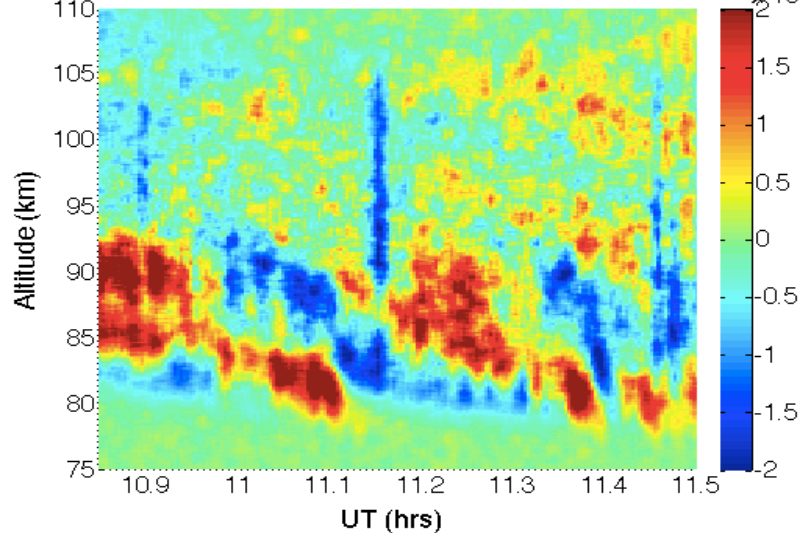
EW Temperature Filtered



NS Temperature Filtered

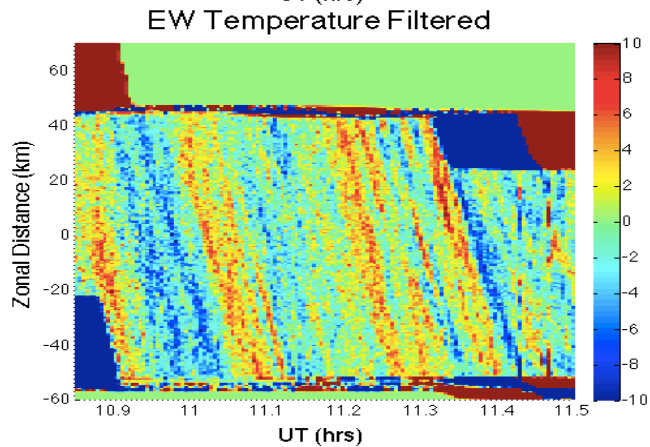
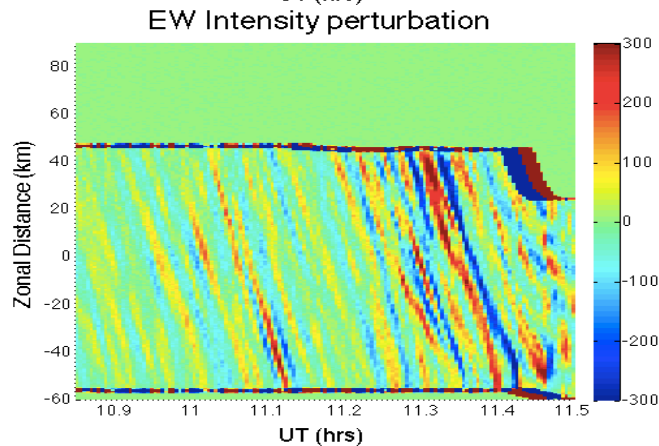
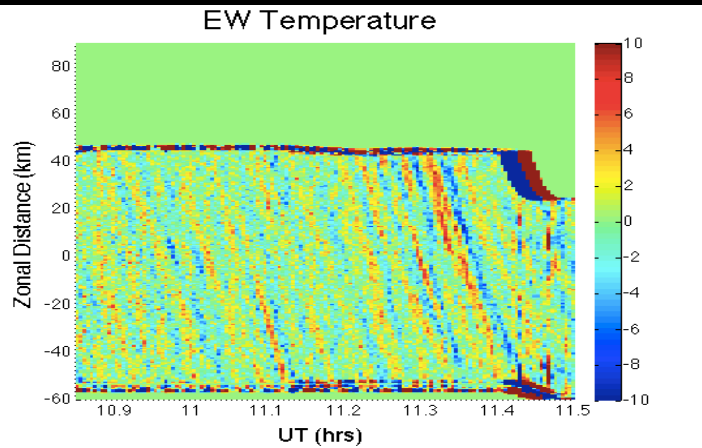


Sodium Density Pert. 15 July [m^{-3}]



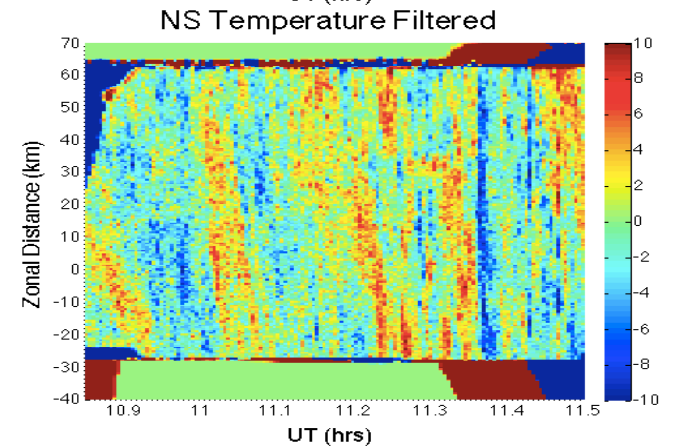
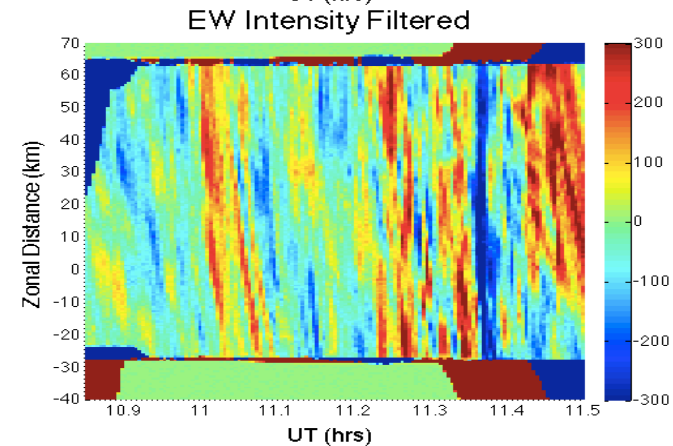
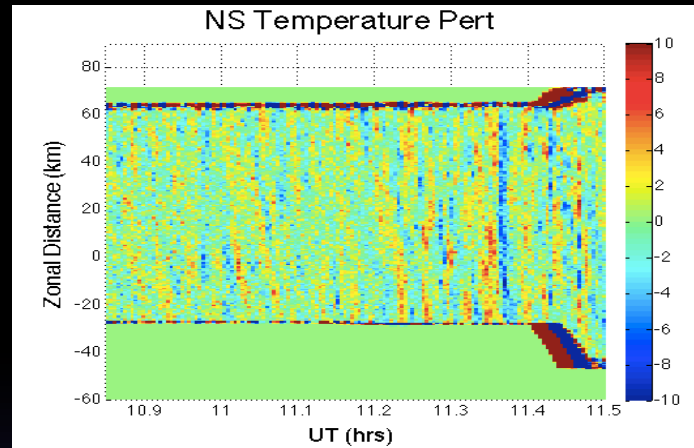
- Larger scale waves visible in both data sets as well.
- Larger scale waves may be between 100-300km

EW/NS wave comparison AMTM

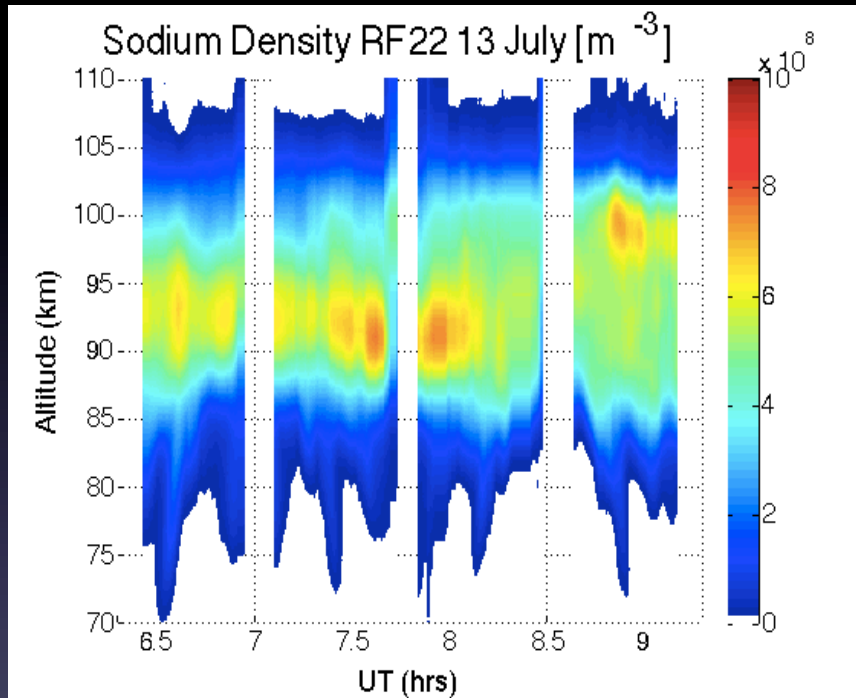


Smaller scale waves appear to follow direction/orientation of larger scale waves in keograms.

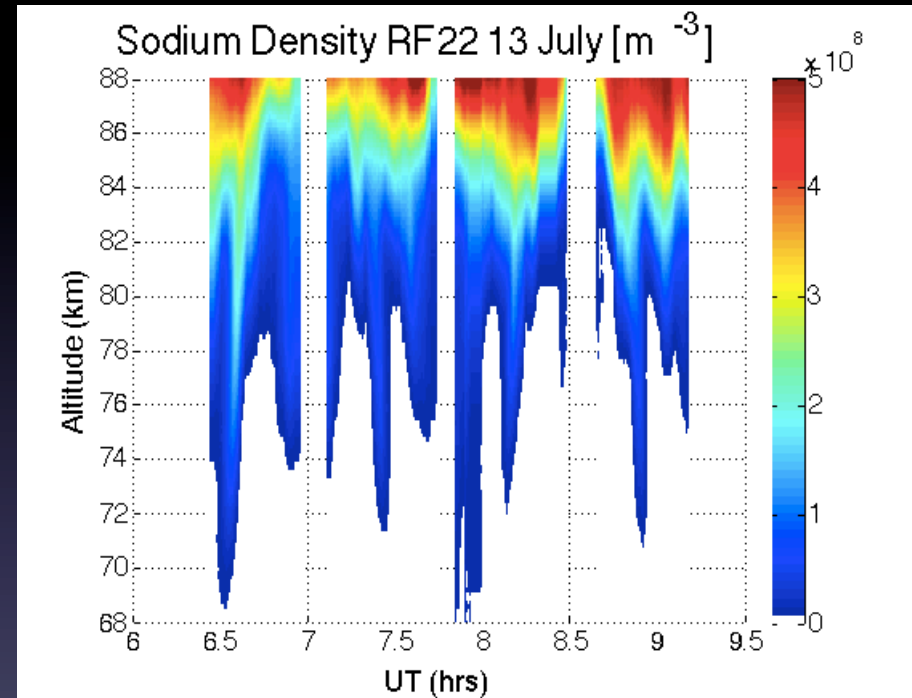
Note from sodium density plots previously shown, the vertical wavelengths are different for the longer and shorter period waves.



Deepwave 13 July (RF 22)



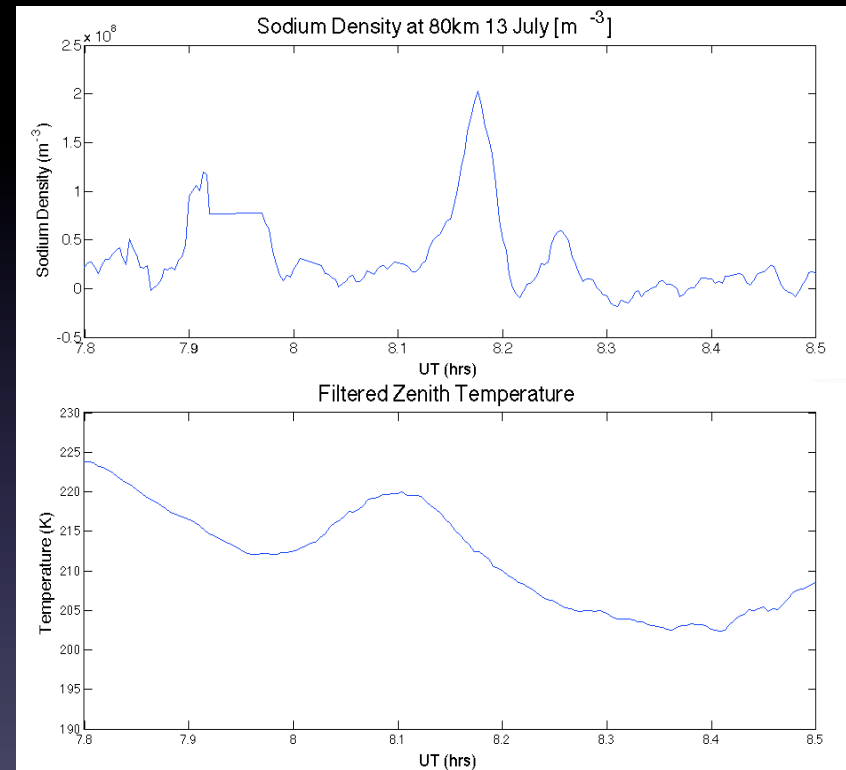
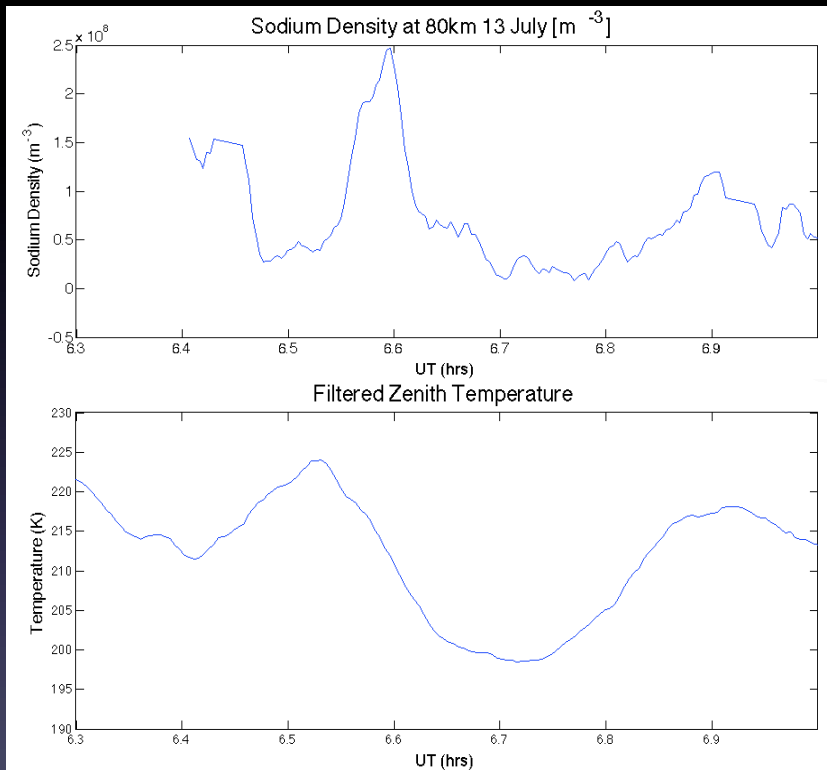
Strong waves observed in sodium density layer.



Sodium density perturbations down to 70km!

AMTM comparison

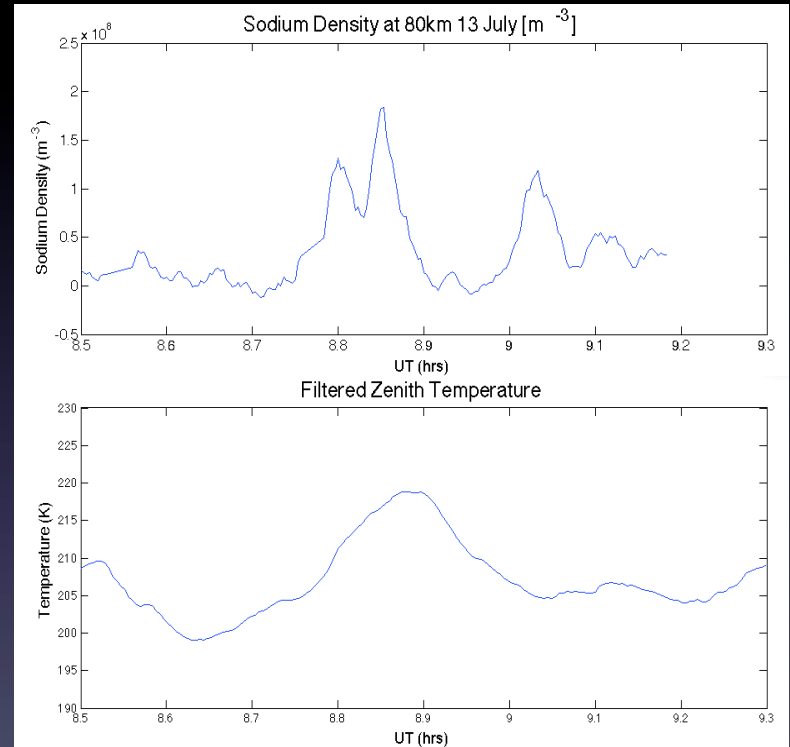
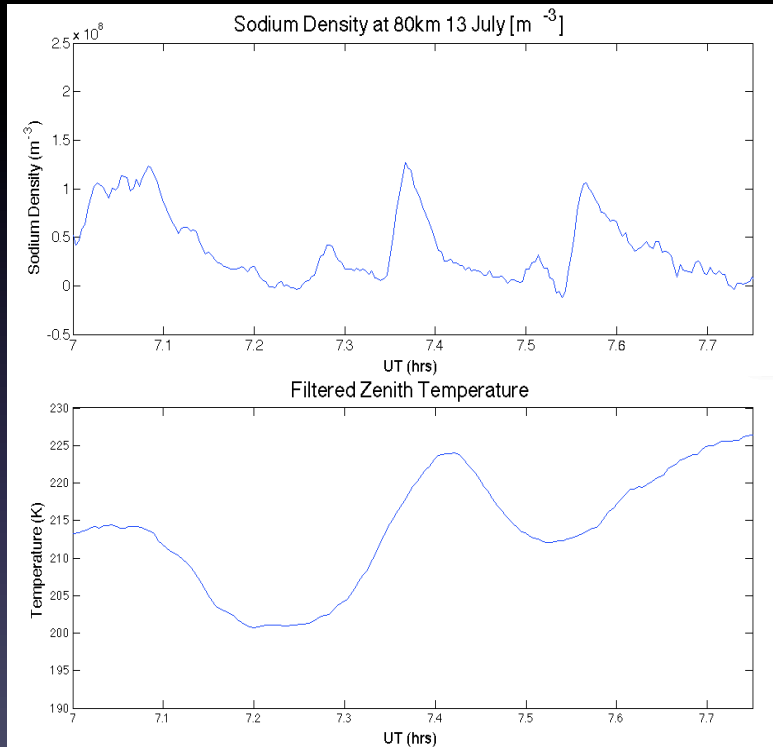
East to West



Comparisons of AMTM and sodium densities show correlations between temperature and large density perturbation observed below 80km.

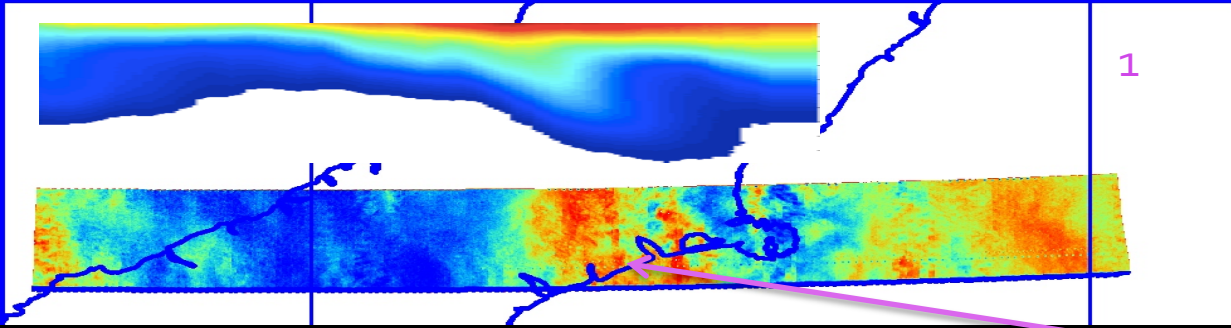
The phase is slightly offset showing evidence of upward propagating wave.

AMTM comparison West to East

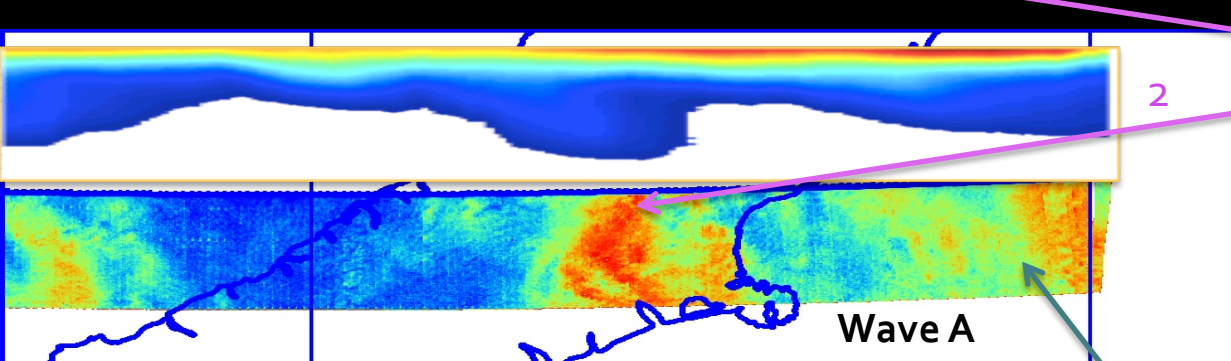


Flight legs in opposite direction show opposite phase lag/lead between sodium density at 80km and AMTM temperature (centered at $\sim 86\text{km}$) giving further evidence of propagating wave.

AMTM Flight legs

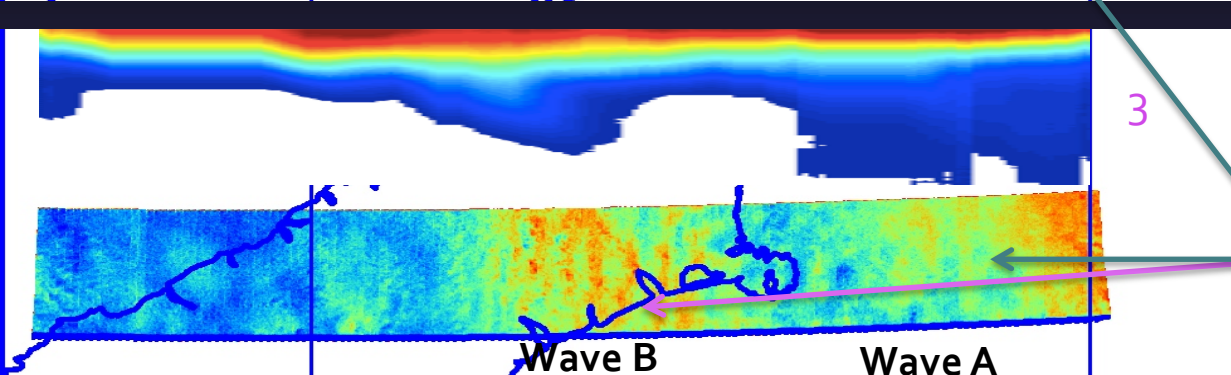


1



2

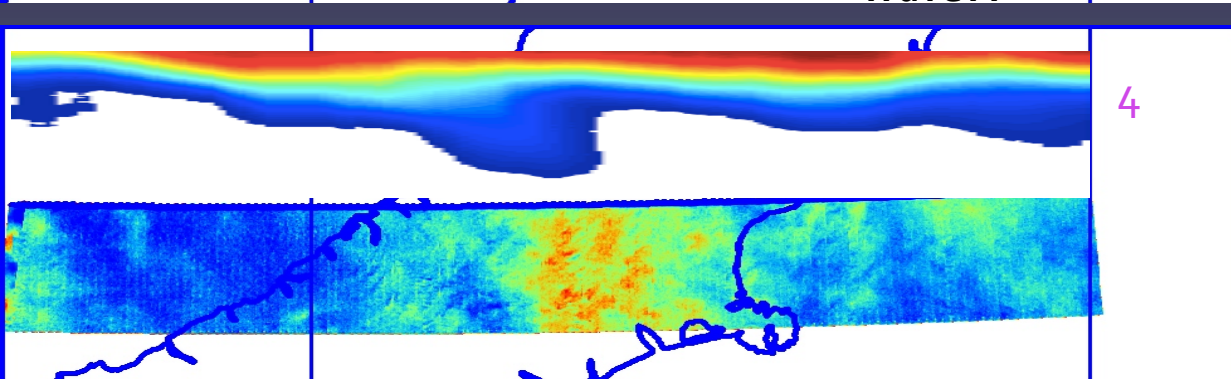
Wave A



3

Wave B

Wave A



4

Warm phase of event observed over NZ, West of Christchurch

On second and third leg of flight, small scale wave features observed in the warm phase.

Wave A and B appear to be different.

- Wave A moving slowly towards west.
- Wave B moving quickly towards the east.

Conclusions

- Multiple scales of waves present in sodium densities
- Similar waves observable in AMTM data
- Potential link between warm phase of wave and smaller scale wave propagation