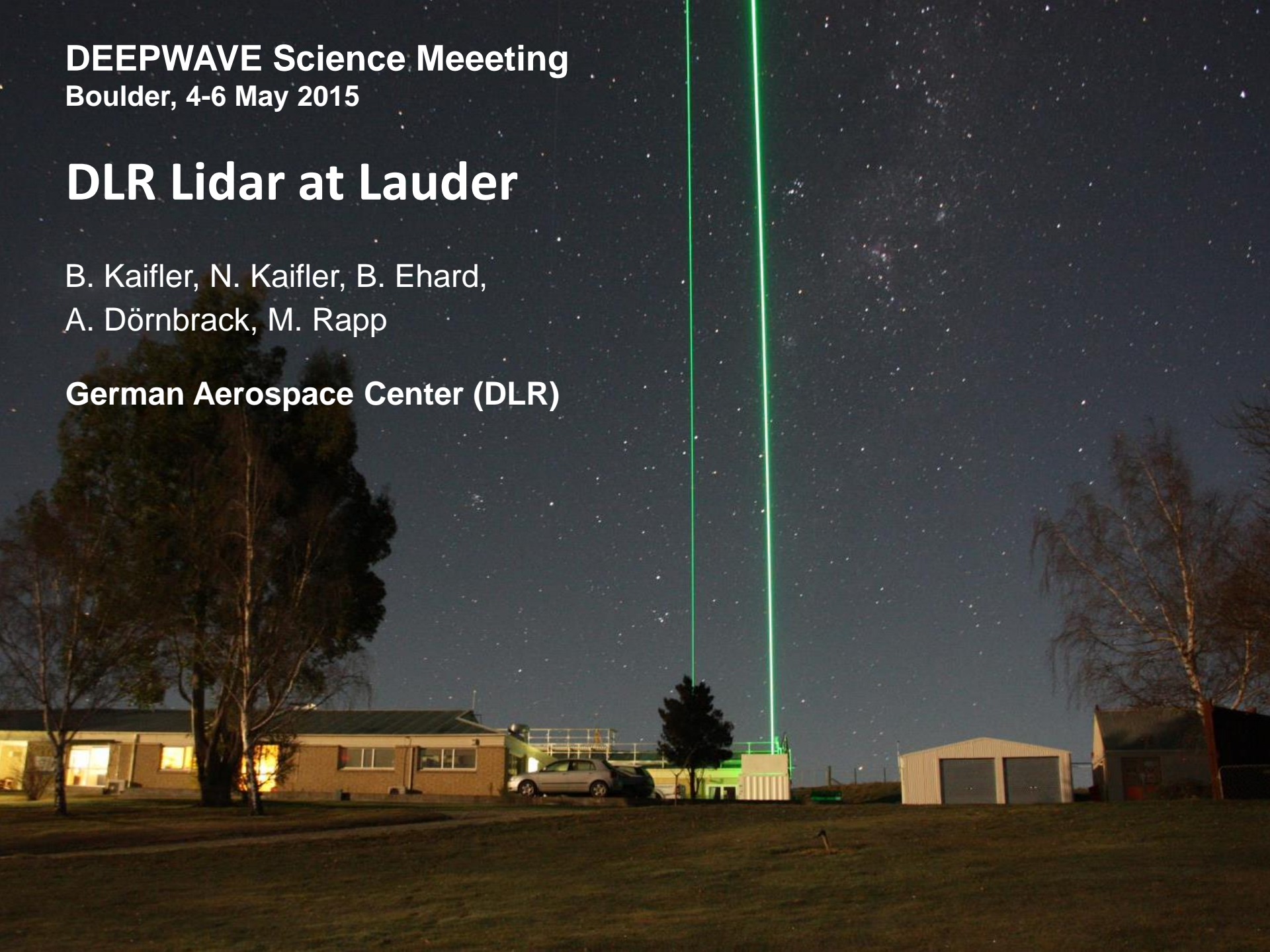


**DEEPWAVE Science Meeting**  
**Boulder, 4-6 May 2015**

# **DLR Lidar at Lauder**

B. Kaifler, N. Kaifler, B. Ehard,  
A. Dörnbrack, M. Rapp

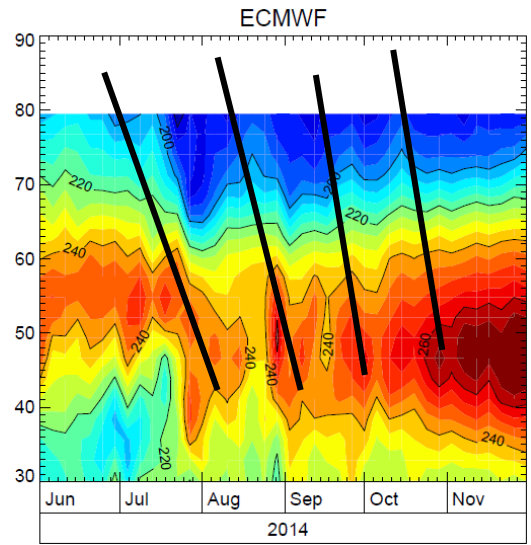
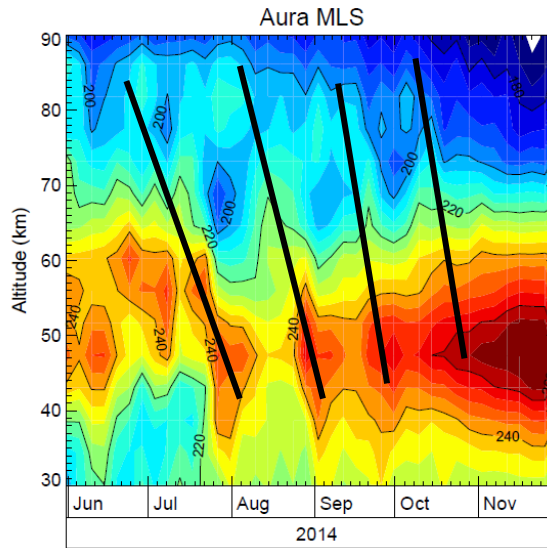
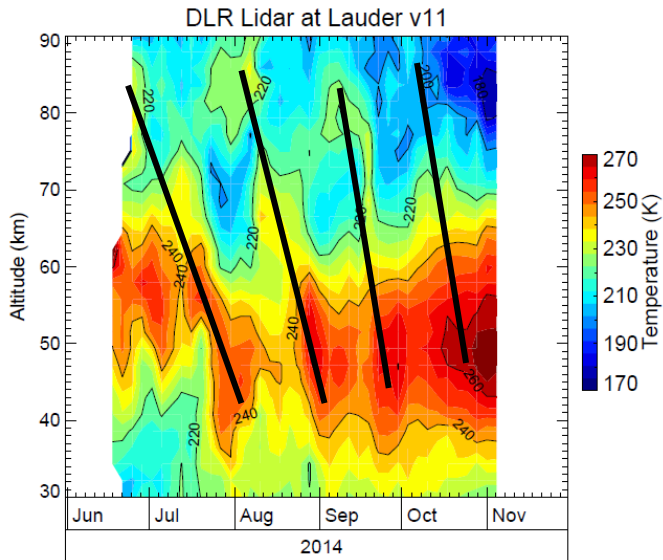
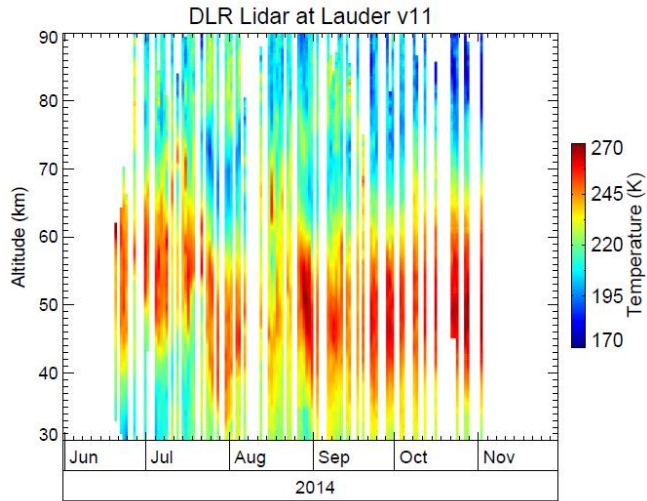
**German Aerospace Center (DLR)**



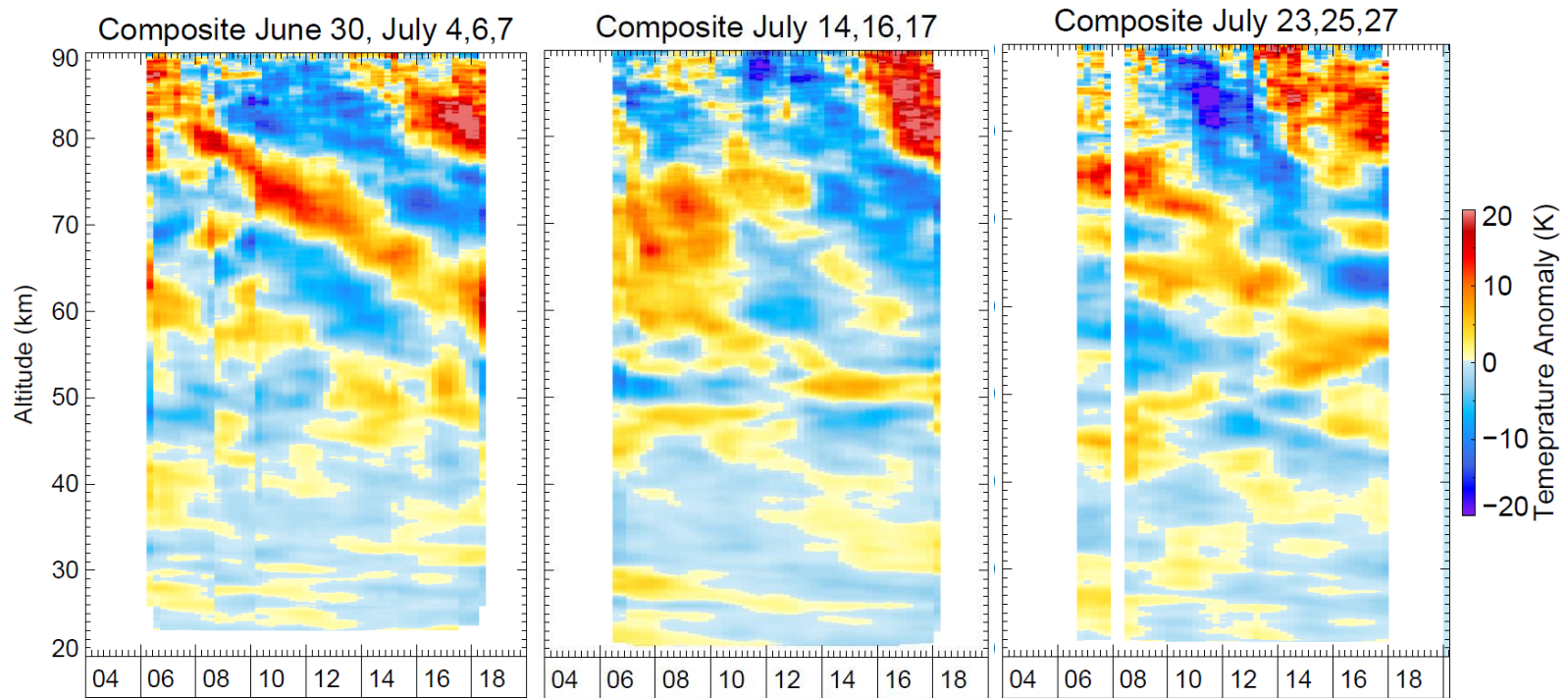
# Mean Temperature

- 94 observations
- 500 hours

Planetary waves?



# Tides

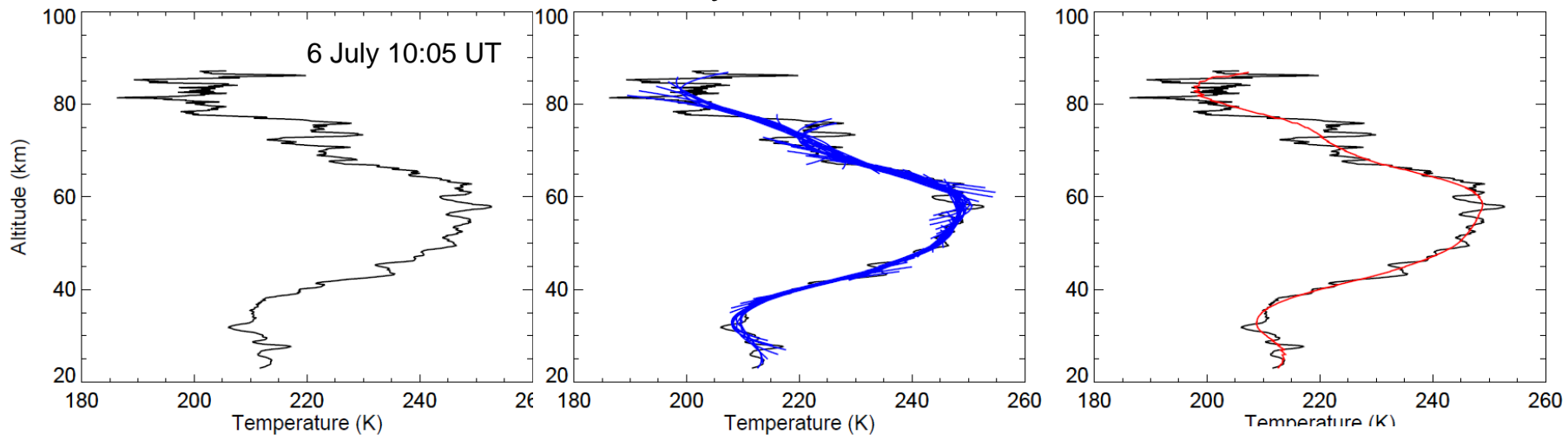


- Up to 20 K in amplitude at 80 km
- Phase of semi-diurnal tide variable, vertical wavelength 25-35 km

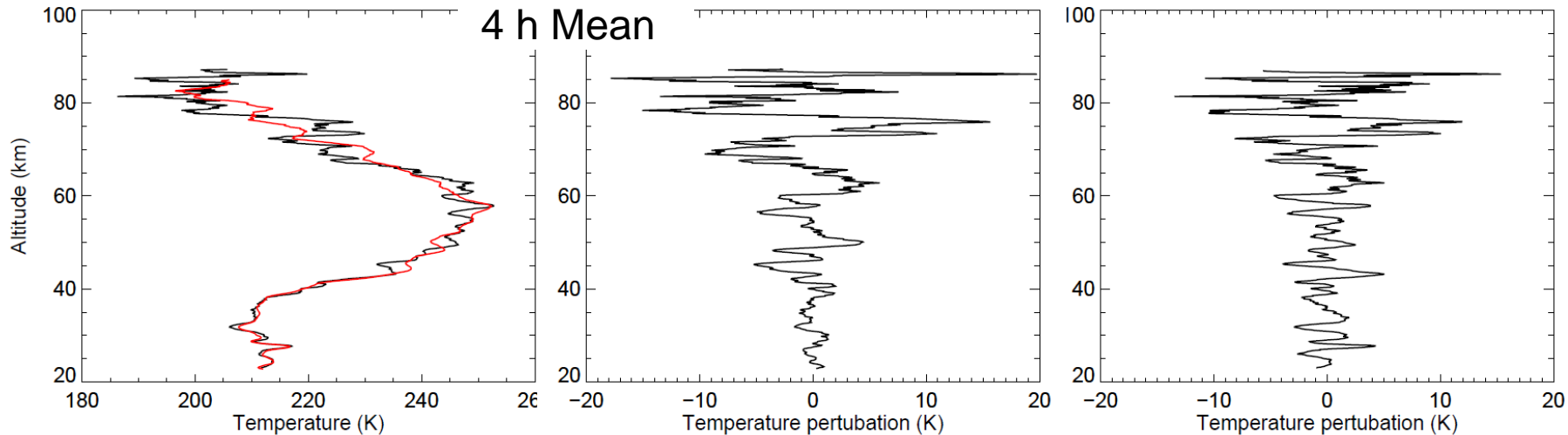


# GW Extraction

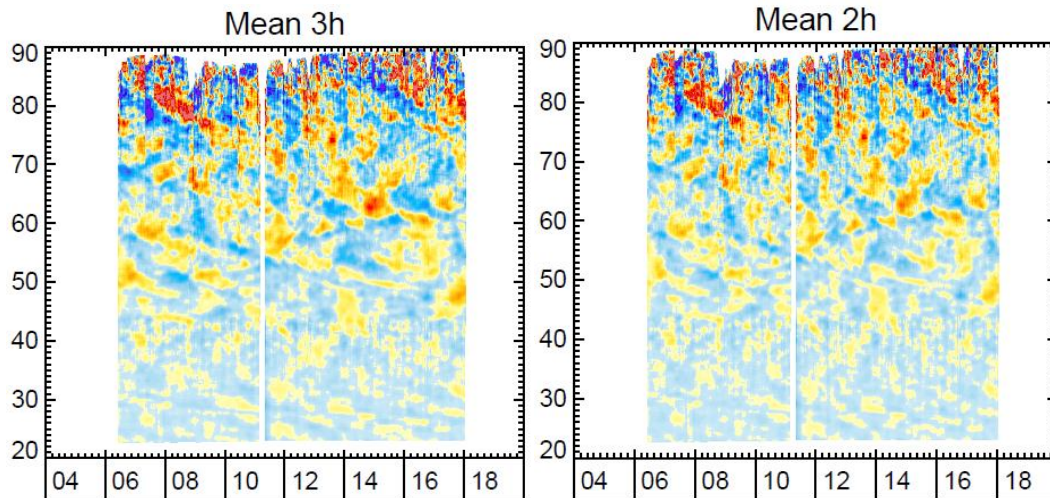
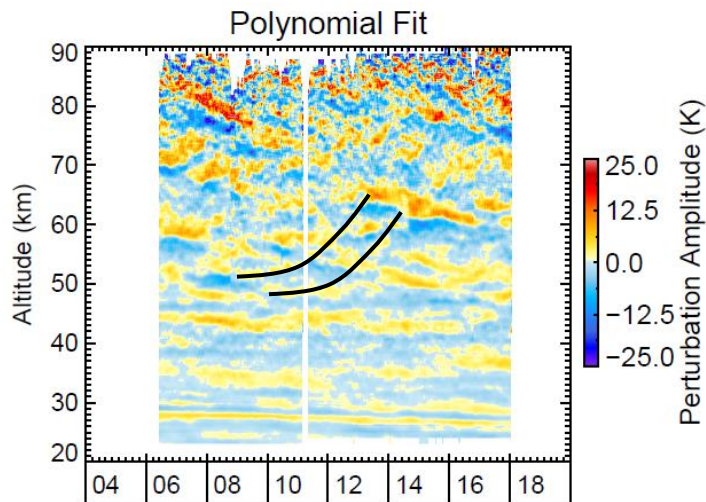
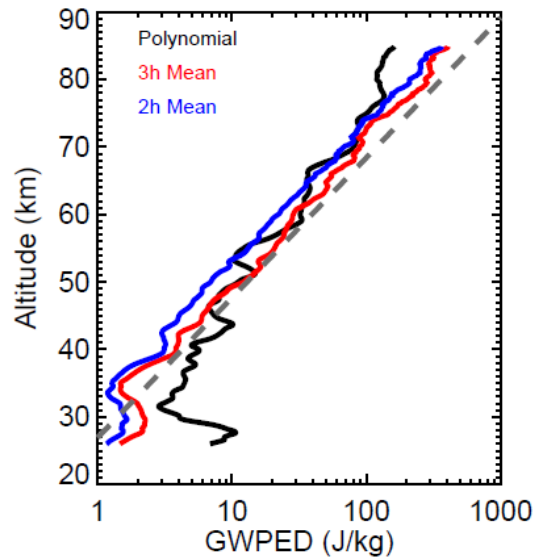
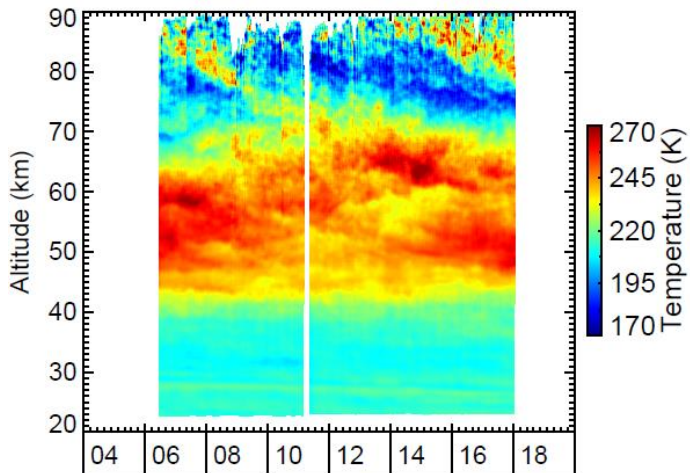
## Polynomial Fit



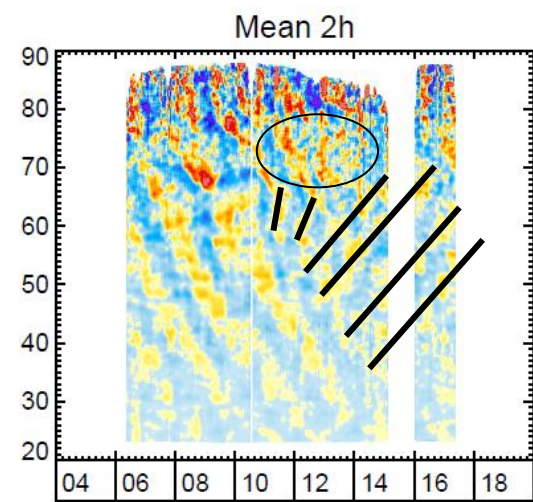
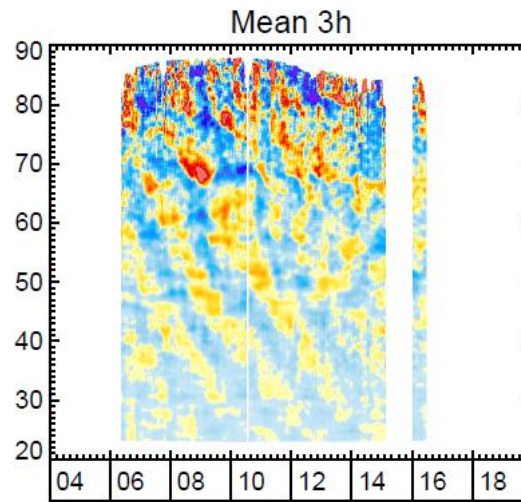
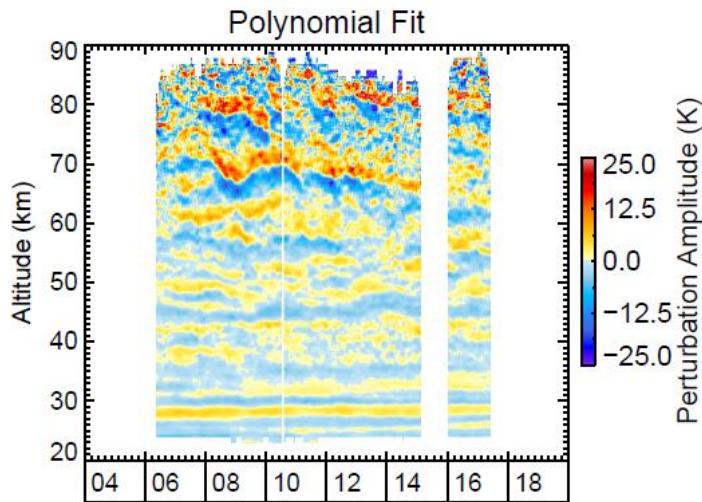
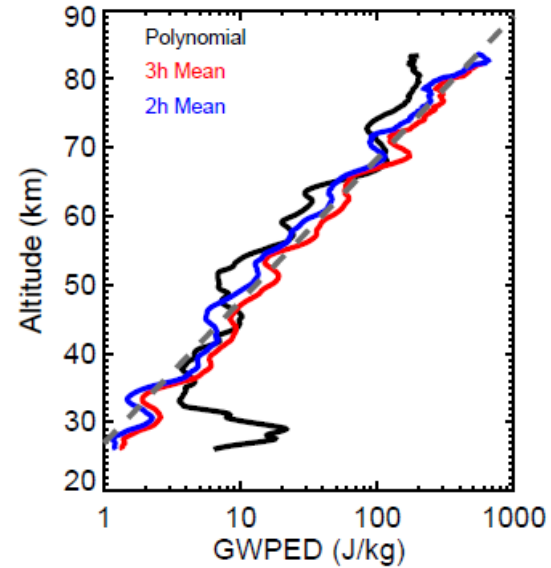
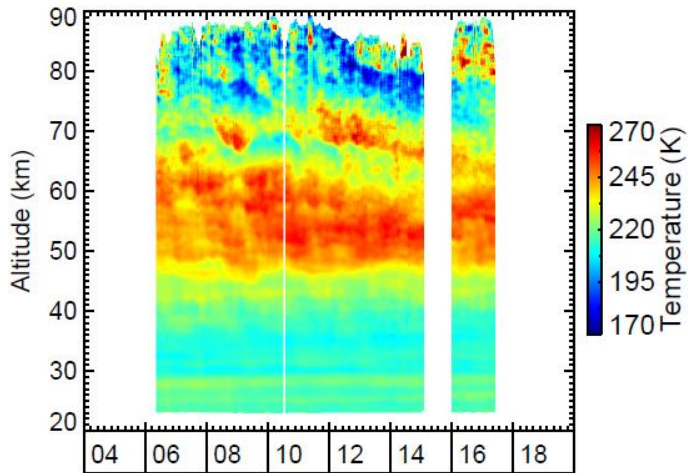
## 4 h Mean



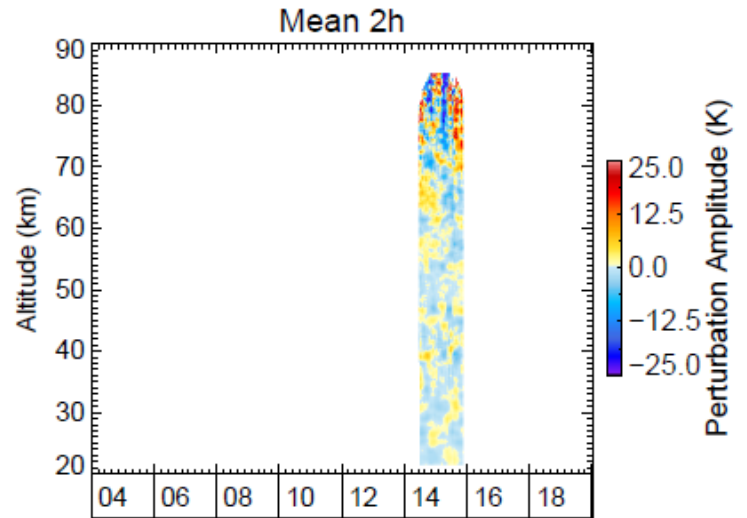
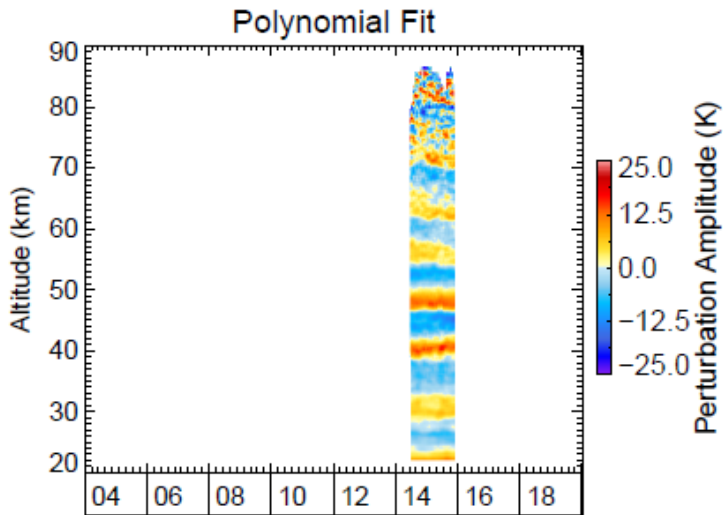
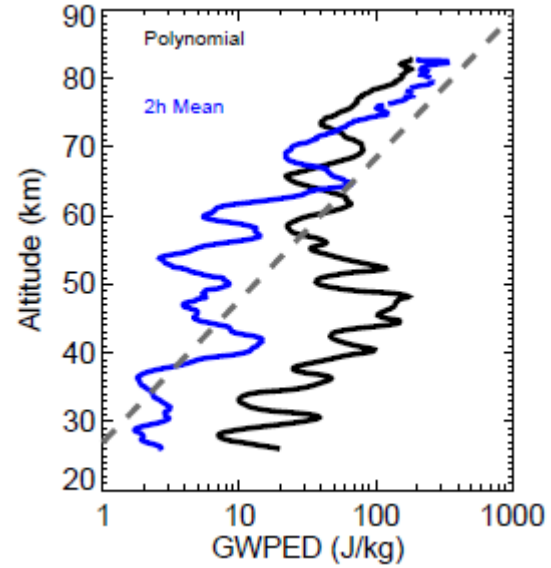
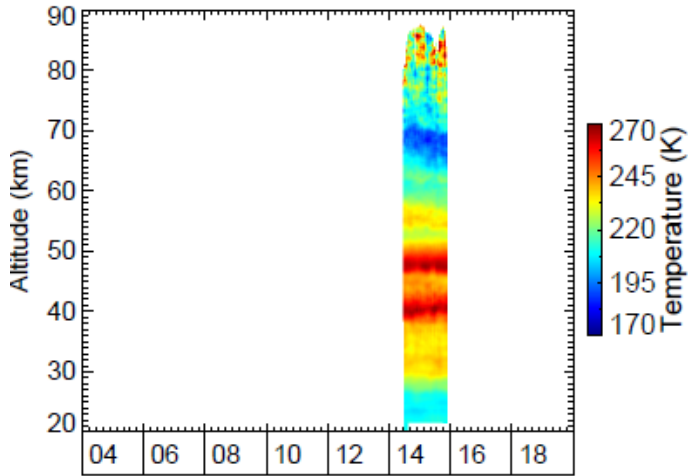
# 6 July



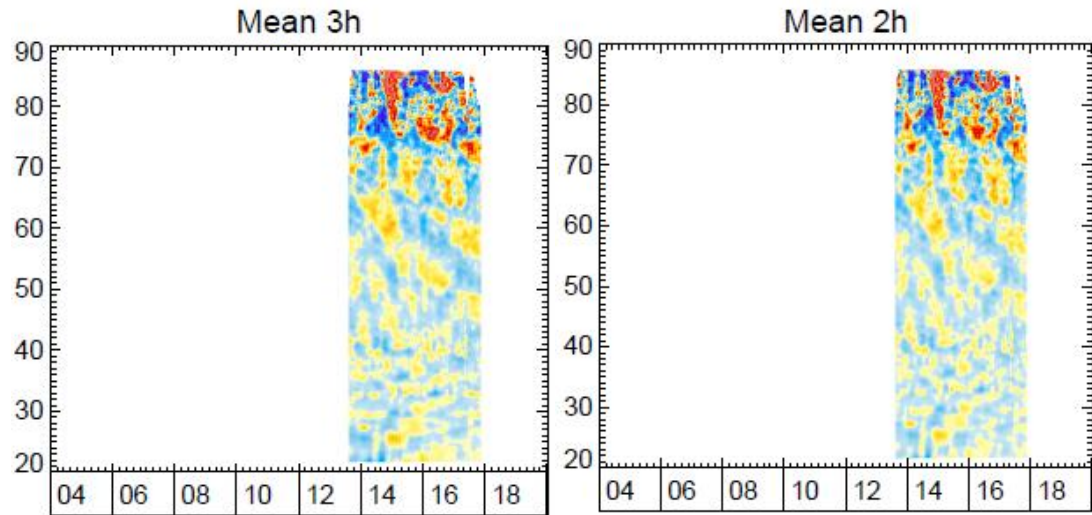
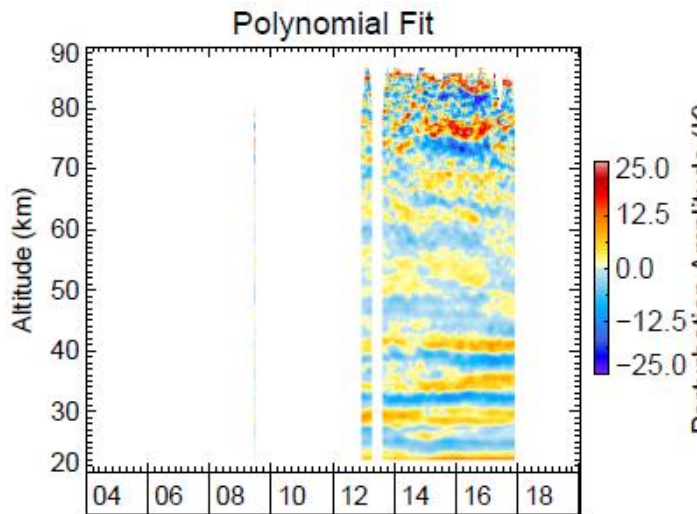
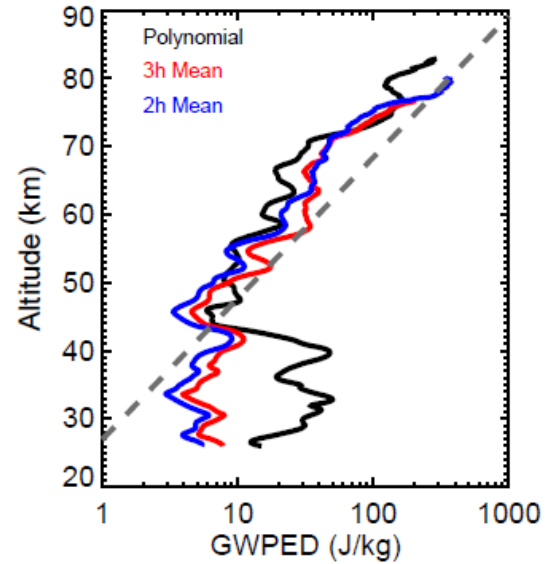
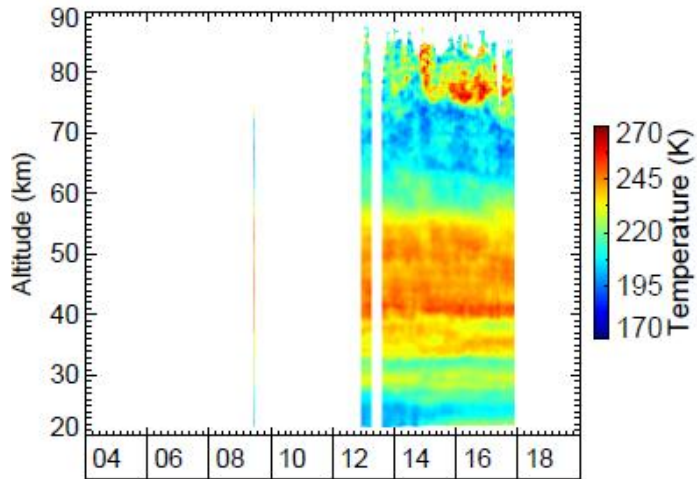
# 7 July (IOP 12, RF 18)



# 29 July (GB 21)



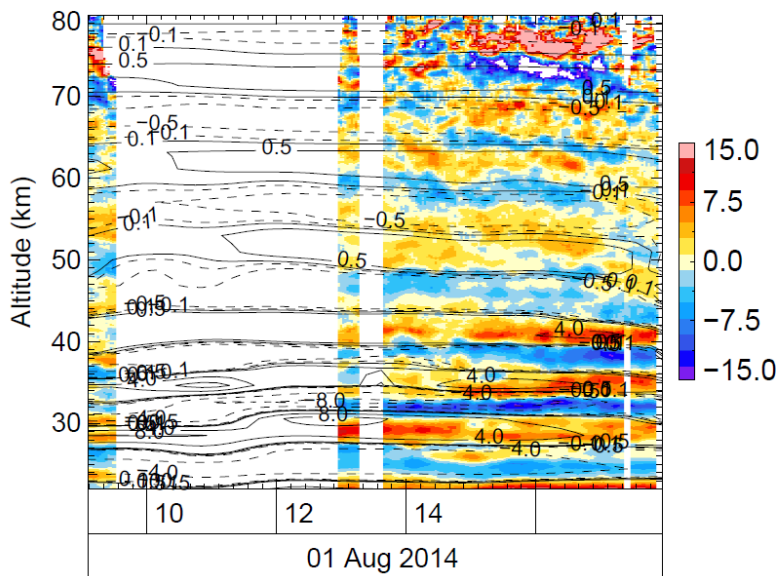
# 1 August (GB 21)



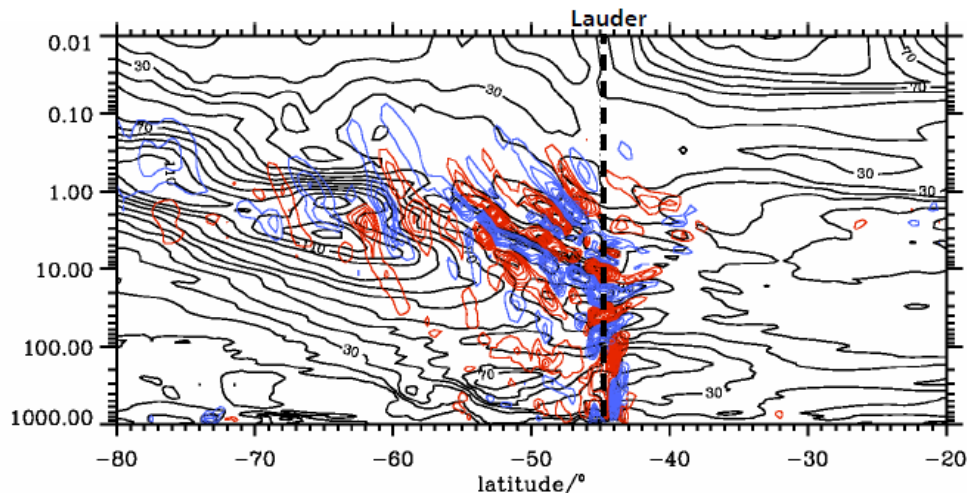


# 1 August (GB 21)

Contour lines: ECMWF  
Color: Lidar

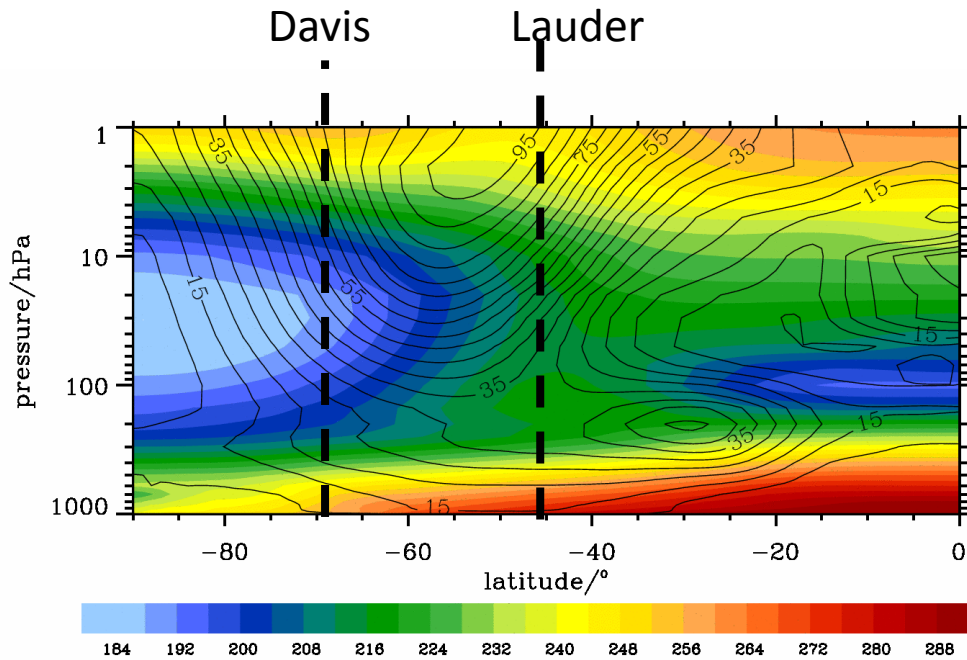


ECMWF horizontal (black) and vertical wind (red/blue) at 170 °E, 12 UTC

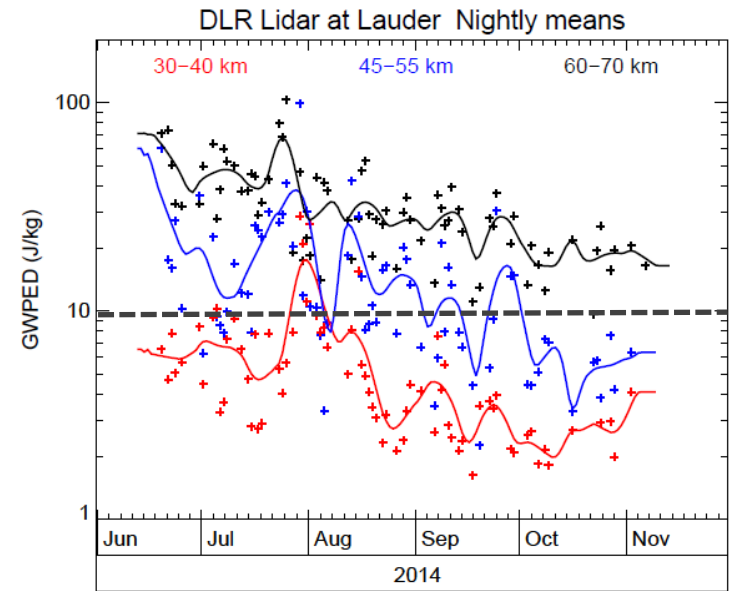


# Position relative to polar vortex

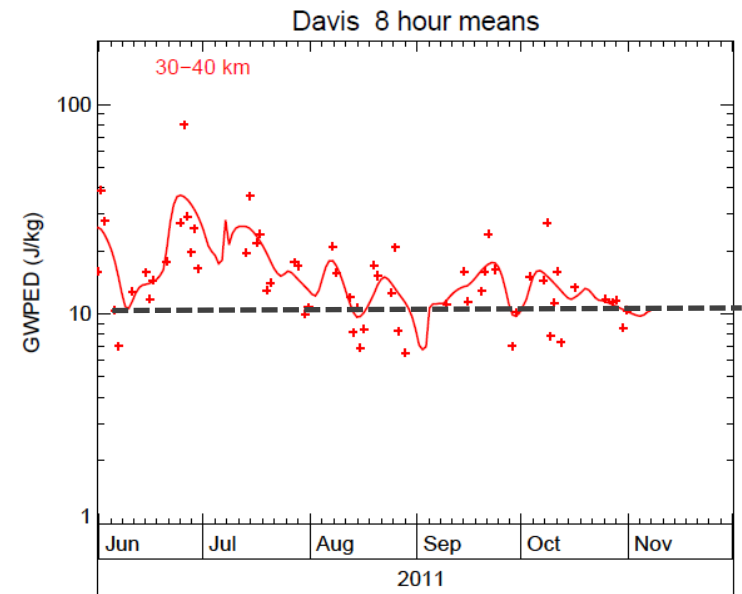
- Lauder outside southern polar vortex
- Different propagation conditions for GW



Zonal mean temperature (K) and horizontal wind (m/s) from ECMWF (July 2014)

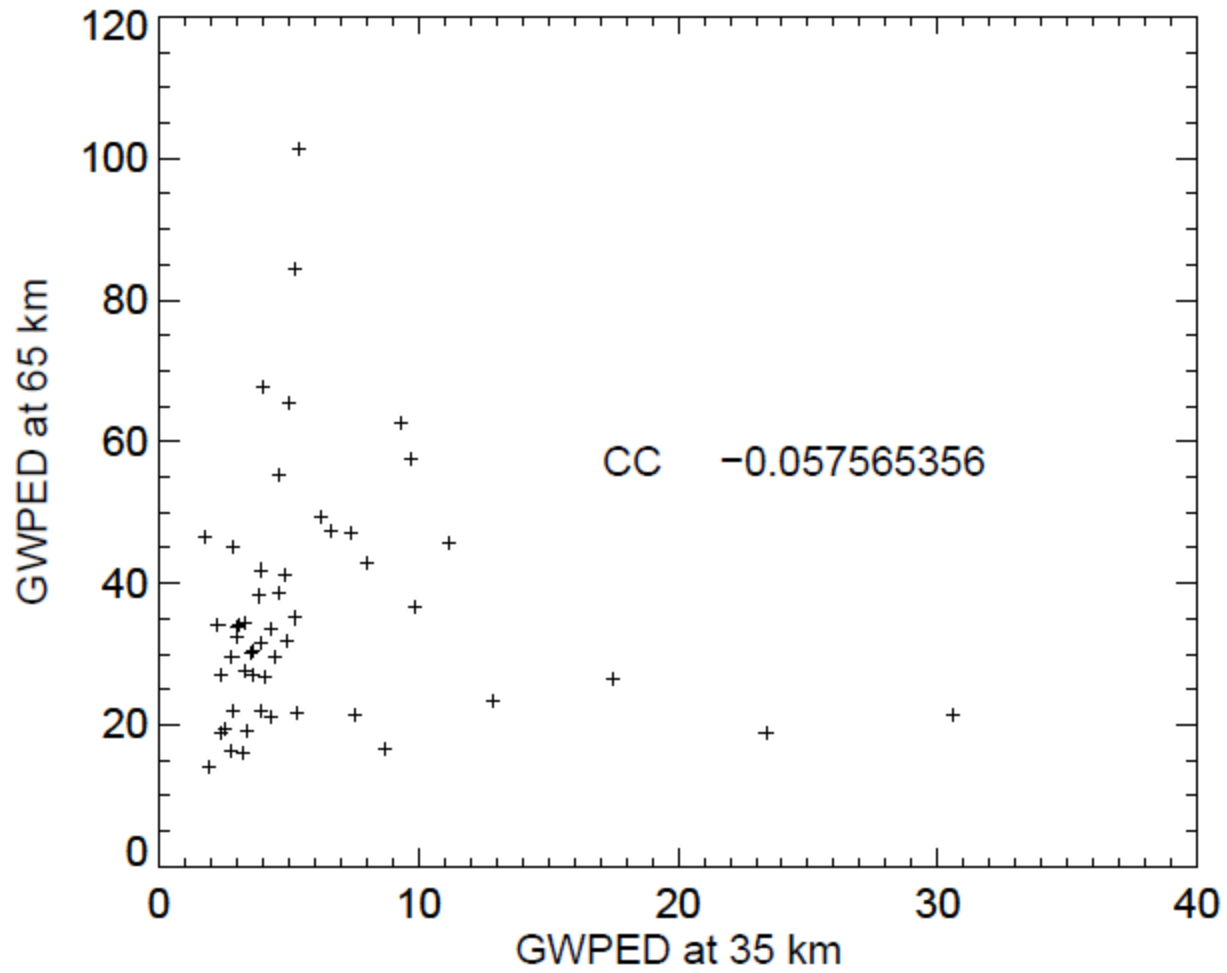


bk Deepave\_V2a 6 November 2014 13:42:55



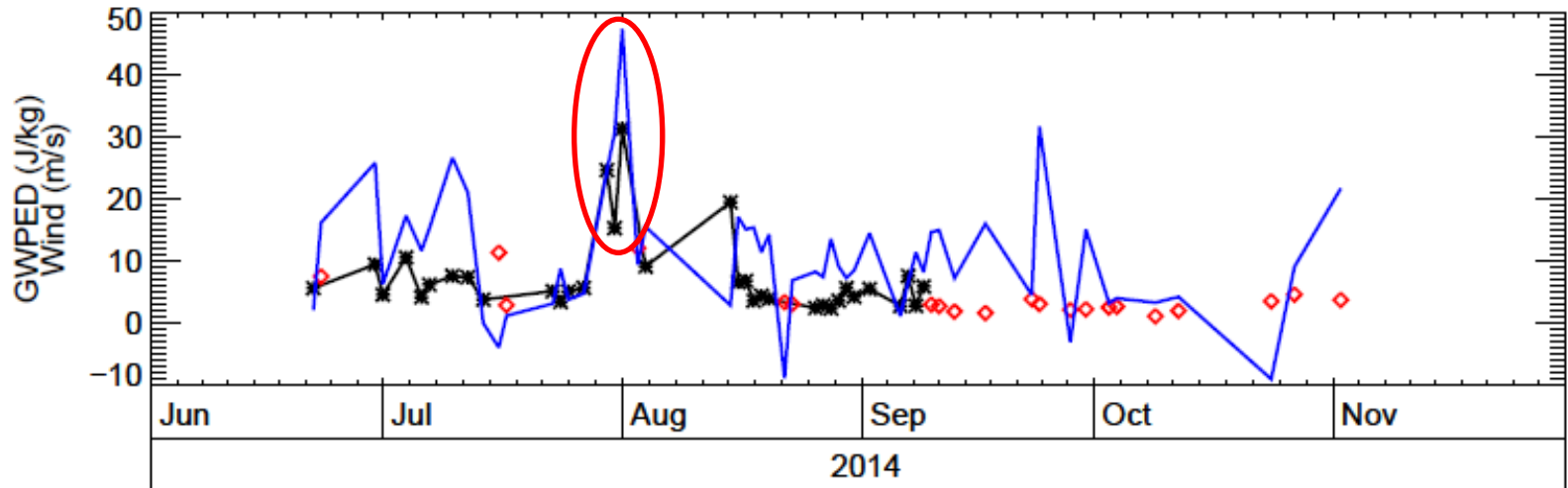
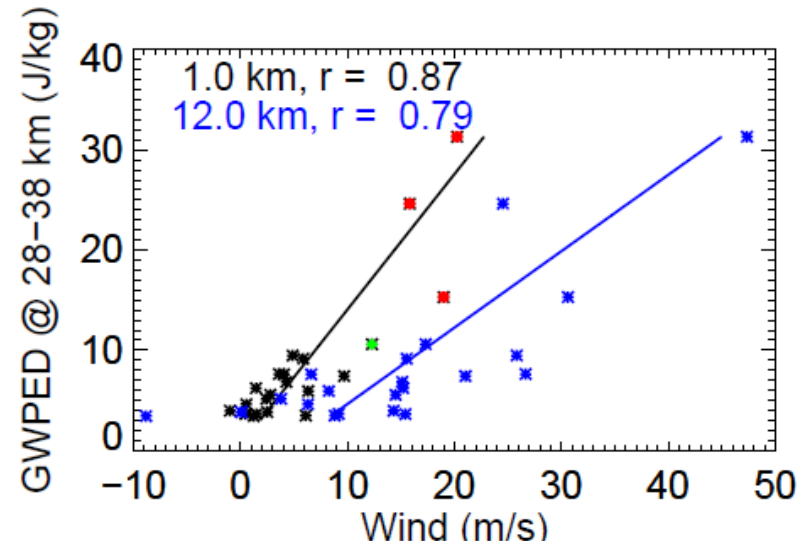
bk Davis v2 23 March 2015 13:52:40



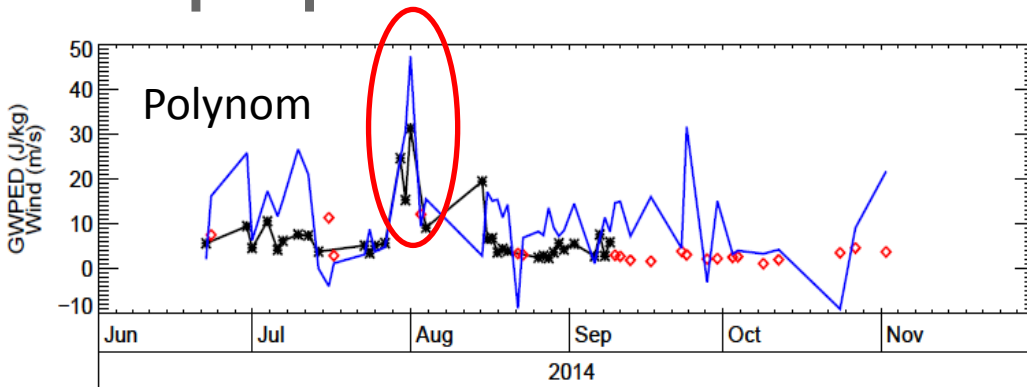


# Correlation of lower stratosphere GWPED with tropospheric wind

- GWPED 28-38 km, polynom method
- days with rotation of wind vector between 1-30 km smaller than 90 deg (GW are not filtered)
- Correlation between ECMWF wind at 1km and 12 km perp. to NZ Alps

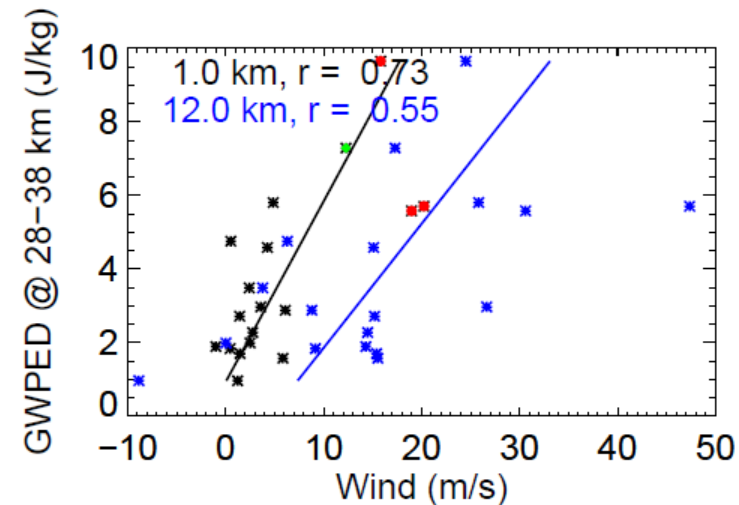
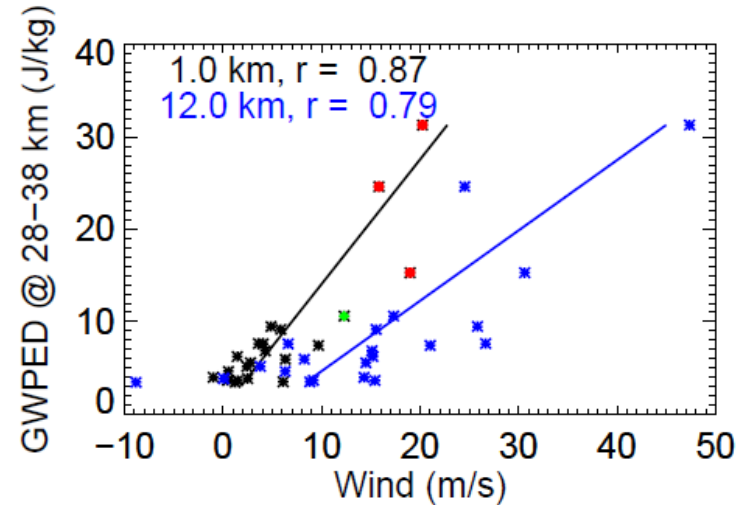
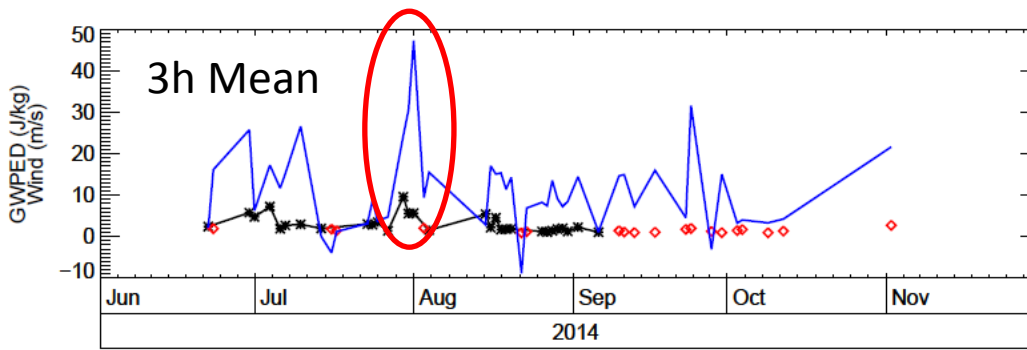


# Correlation of lower stratosphere GWPED with tropospheric wind

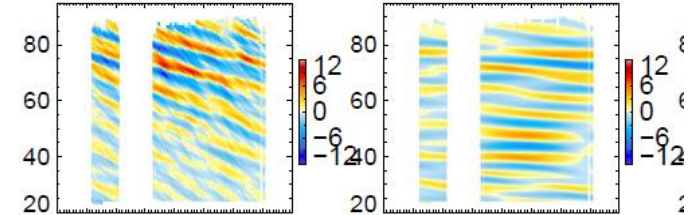
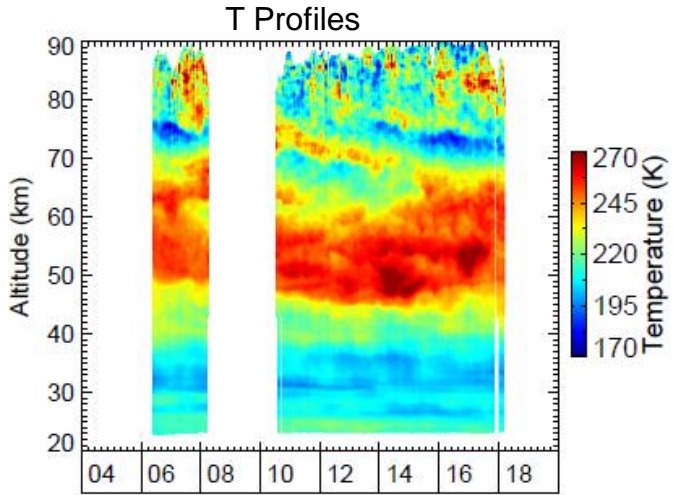


➤ Polynom method gives best correlation with tropospheric wind

➤ Better extraction of GW

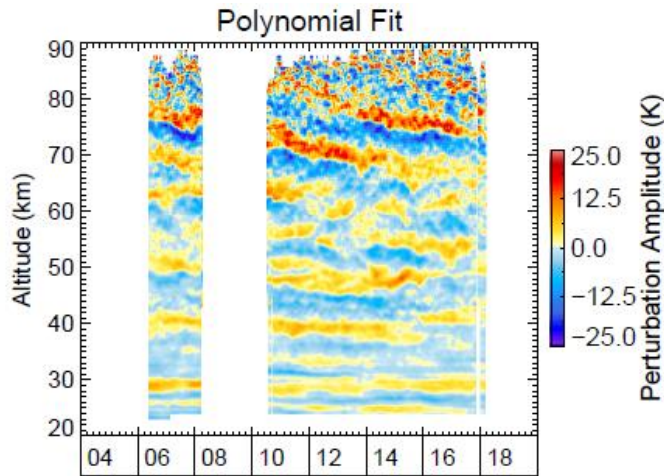


# Case study 4 July

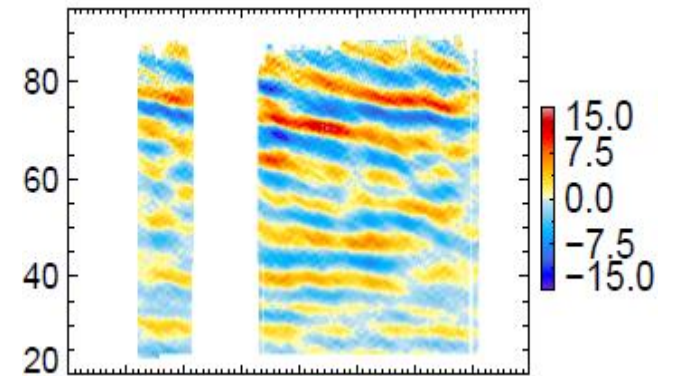


Wave extraction:  
Polynom method,  
3h and 4h means

Windowing  
spectral bands



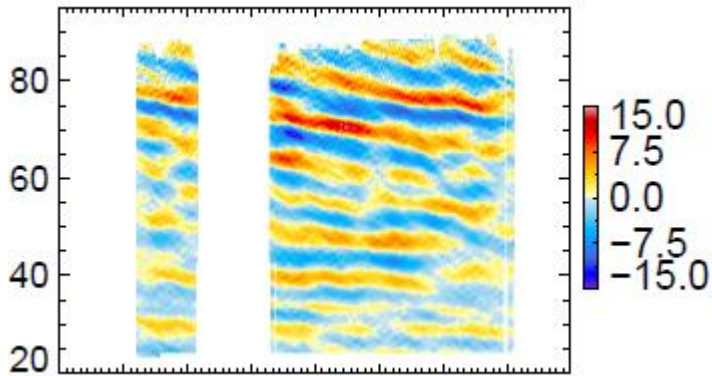
2D FFT  
Reconstruct  
significant waves



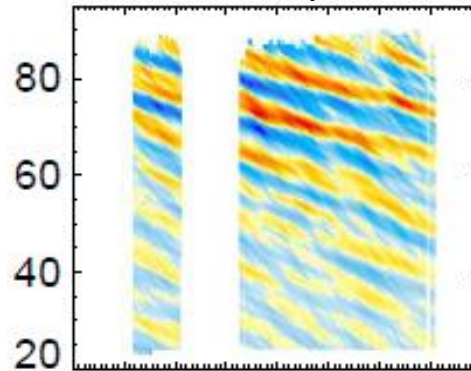
# Case study 4 July: Significant GW

Polynom method

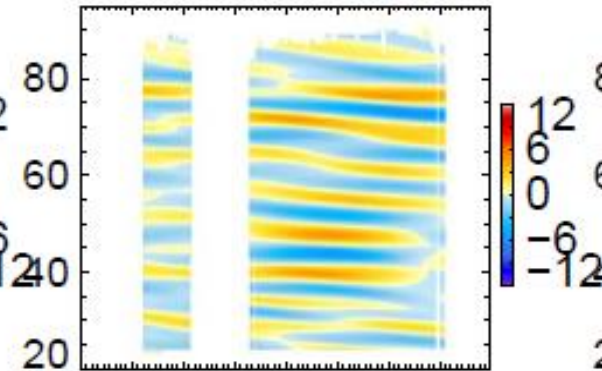
sign., 2.5 K



up, 1.9 K

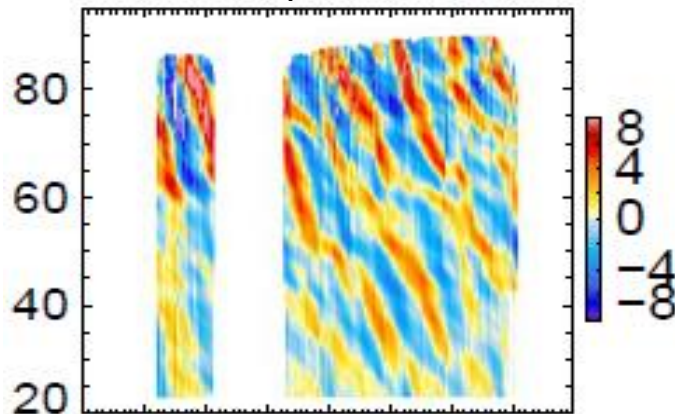


horizontal, 1.5 K



3h Mean

up, < 3 h, 2.1 K

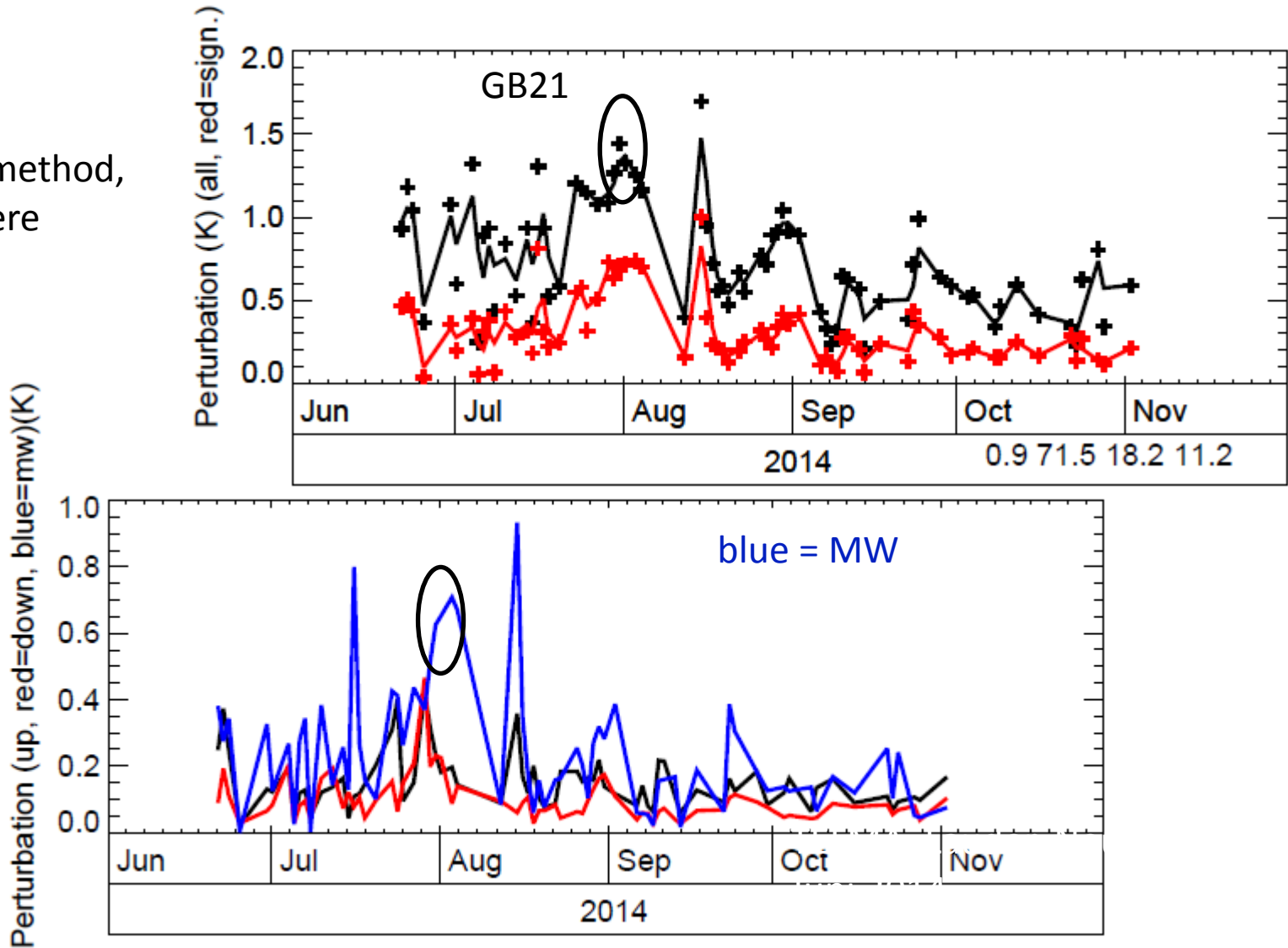


- Contributions from different parts of the GW spectrum
- Observed periods and vertical wavelengths:
  - 2.2 h, ~18 km
  - 6 h, ~8 km
  - > 10 h, ~8 km



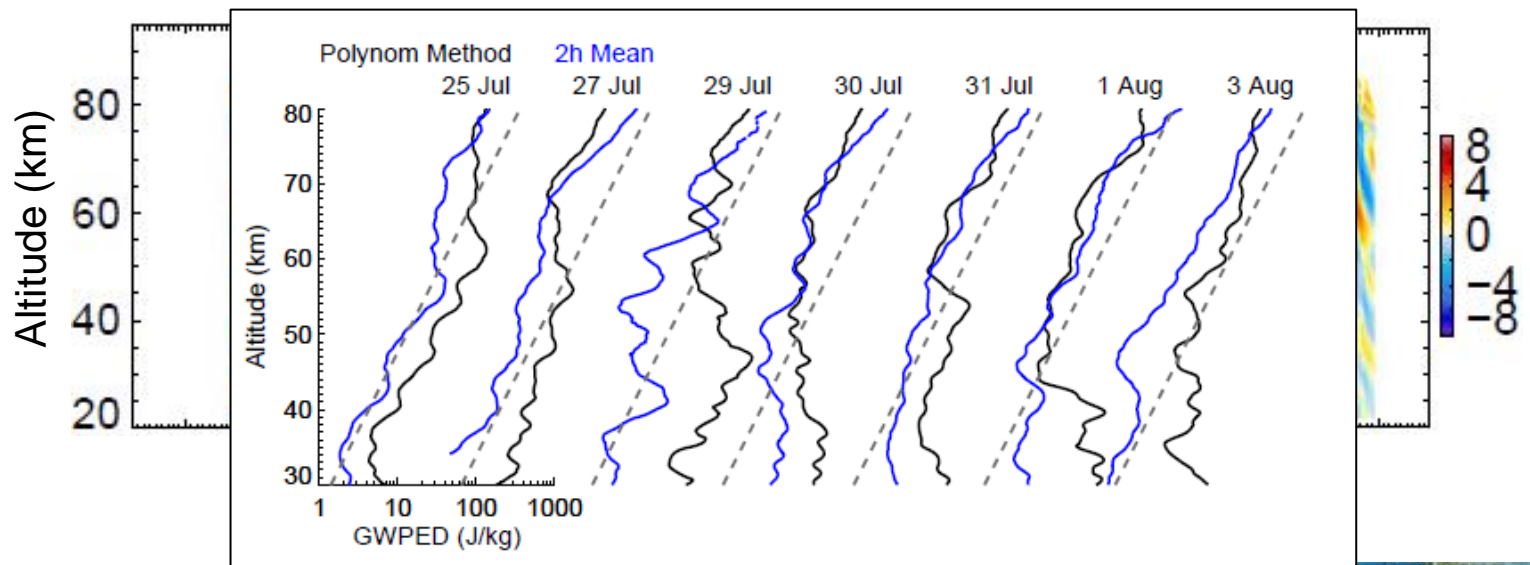
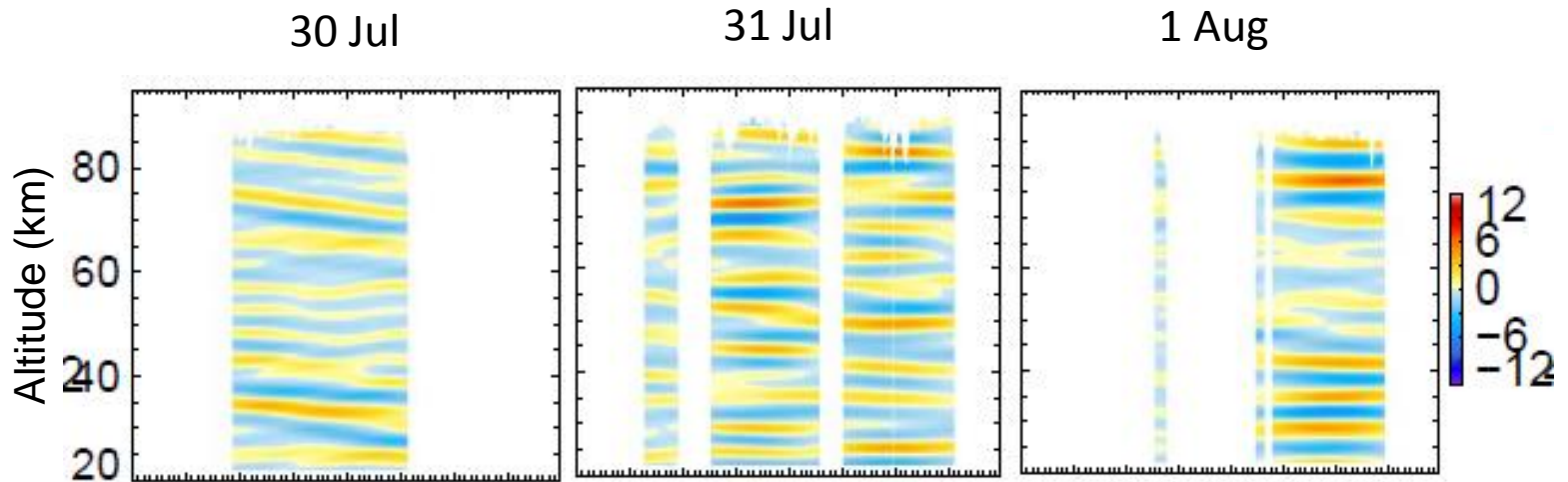
# Strong mountain wave event during GB21

Polynom method,  
stratosphere

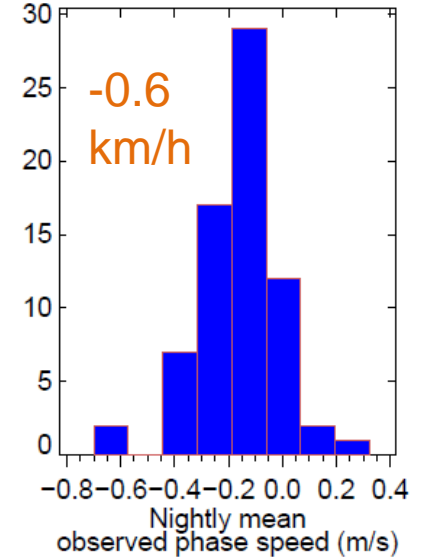
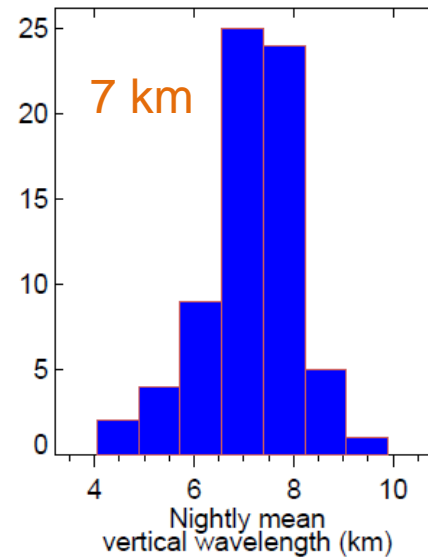
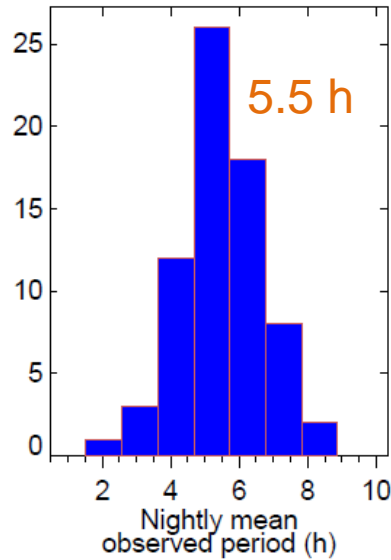
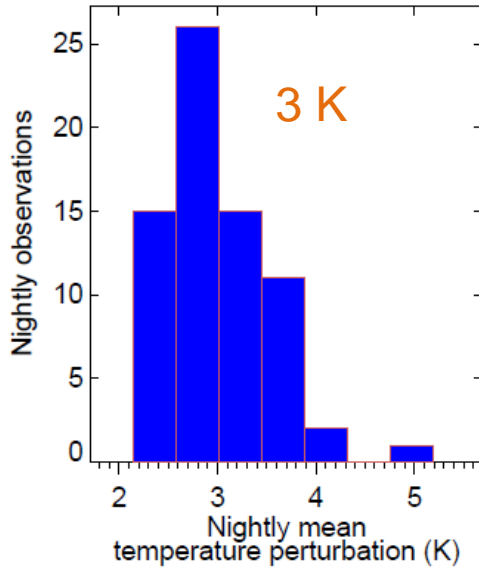




# Strong mountain wave event during GB21



# GW statistics for New Zealand



Parameter	Mesosphere	Stratosphere	Davis stratosphere
Temp. pert.	3 – 5 K	1 – 2.5 K	2 – 3 K
Period	2.5 – 6 h	3 – 9 h Mountain waves	1 – 4 h
Vert. wavelength	5 - 8 km	4 – 8 km	3 - 6 km
Phase speed	-0.8 km/h 70 % upward	-0.3 km/h	

