Problems in interpreting mesospheric green line FPI measurements to infer MLT winds and temperatures.

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Why Green line FPI measurements are difficult to interpret in regard to any science?

- The green line 557.7 emission of [O] is the strongest atomic nightglow emission so why is it so rarely used? Very few publications but one just recently appeared in Annales Geophysique
- So, a detailed explanation is in order.
- Short-answer: results may be of high quality (small error bars) but completely impossible to interpret due to strong shear in horizontal winds existing within the OI volume emission profile
- These high-speed winds are averaged out by the sampling of the MLT dynamics by the line-of-sight integration through the 557.7 nm nightglow layer.

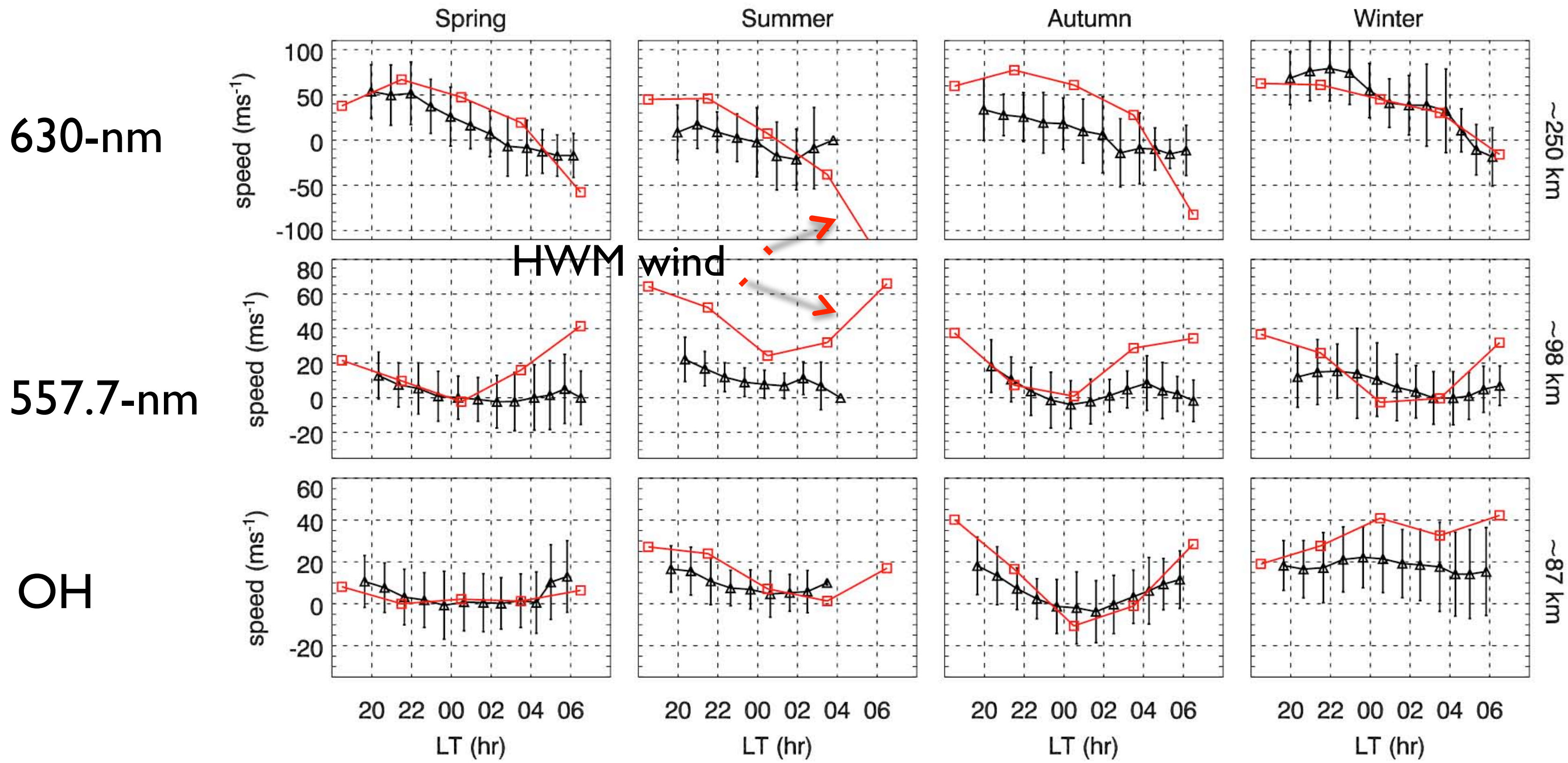


Fig. 6. Seasonally averaged nighttime zonal (eastward positive) wind from FPI (black triangle) and HWM07 (red square) in spring (first column), summer (second column), autumn (third column), and winter (fourth column) at the altitudes of ∼ 250 km (first row), ∼ 98 km (second row), and ∼ 87 km (third row). The error bars are calculated from the standard deviation of the data points used for the seasonal average.

Yuan et al., 2013, Annales Geophysique

Results such as those by Yuan et al. [2013] suggest rather weak winds for the MLT region:

Is this really the case?

But this is not so!

Ignores the results regarding horizontal wind shear obtained by chemical releases and STARFIRE/Mauri observations.

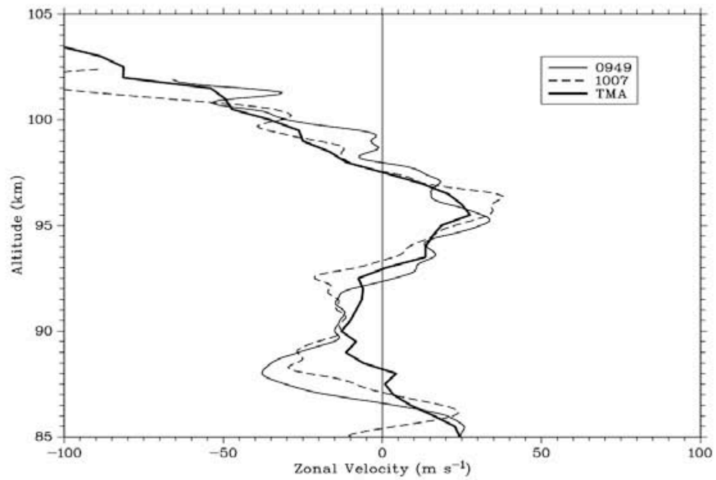


Figure 2. Comparison of the zonal wind component derived from the upleg TMA trail with the zonal wind component derived from the lidar radial Doppler velocity measurements in beams 1 and 2. The heavy line is the chemical tracer wind profile. The two lighter lines show the lidar winds for periods of ten minutes before and after the rocket launch.

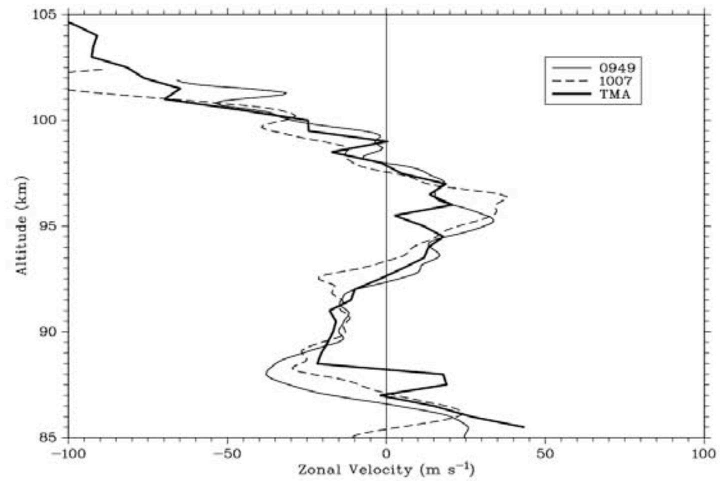


Figure 4. Comparison of the zonal wind component from the downleg TMA trail with the zonal wind from the lidar.

the largest uncertainties are in the height ranges with the largest vertical shear.

Zonal winds observed by the Starfire resonance lidar and by analysis of the TMA chemical release trail

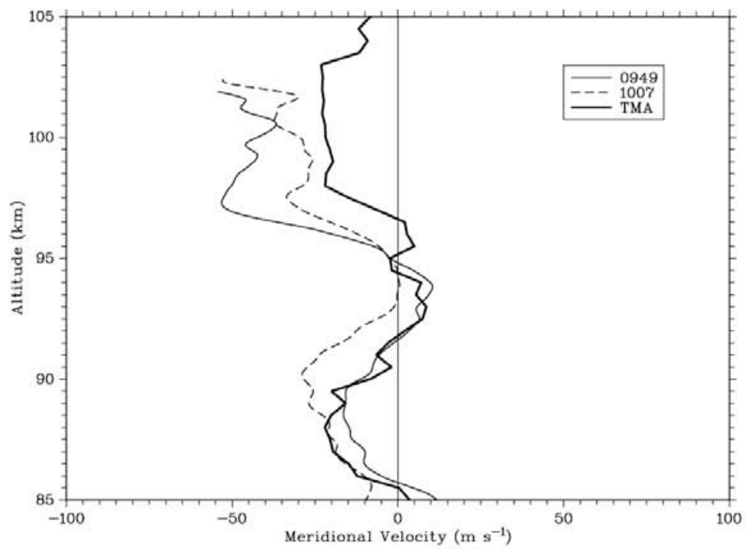


Figure 3. Comparison of the meridional wind component from the upleg TMA trail with the meridional wind from the lidar.

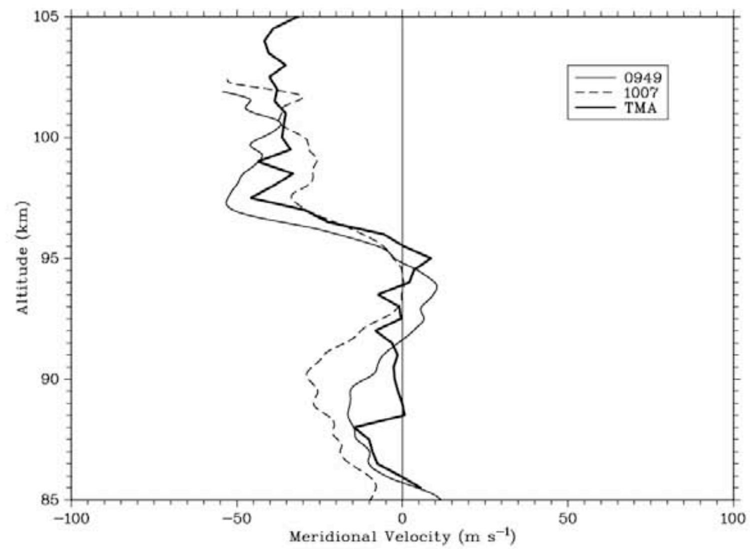
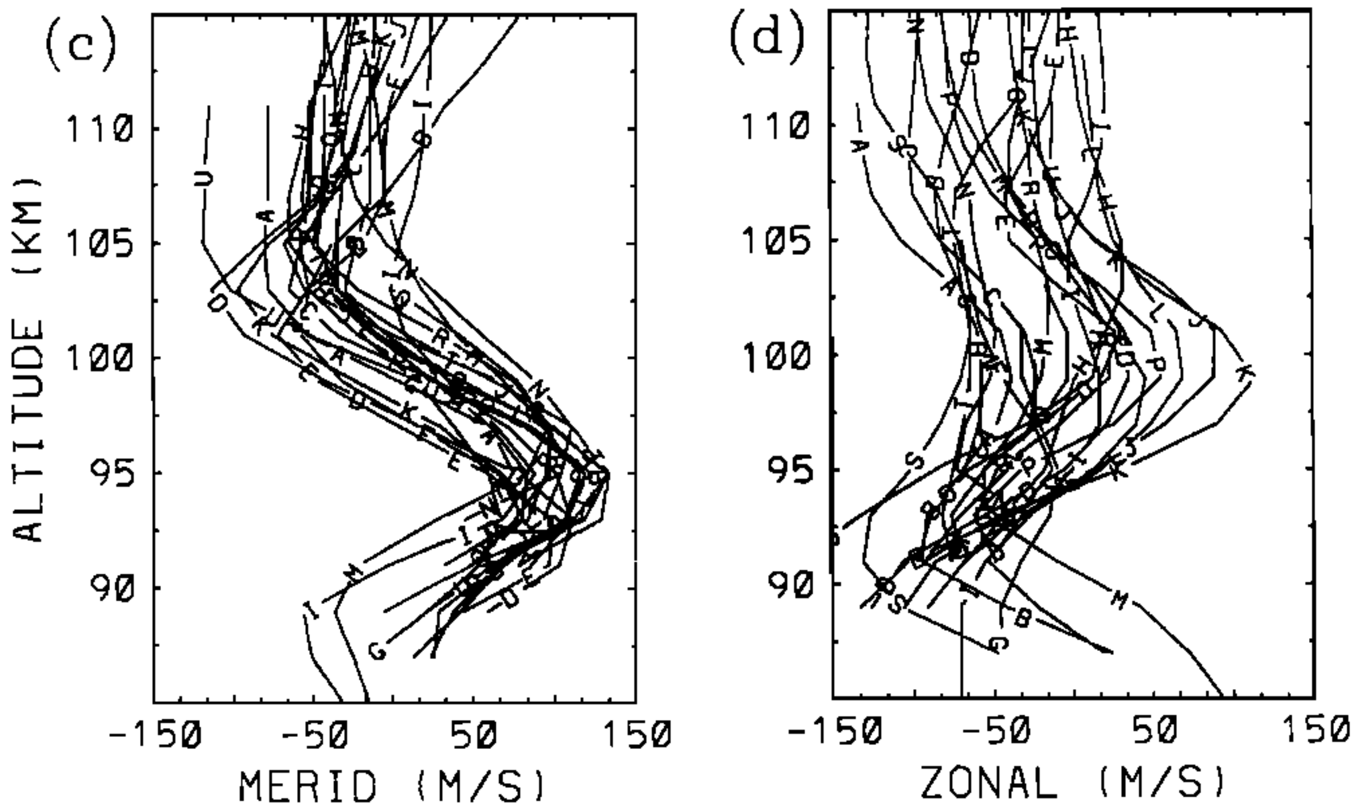


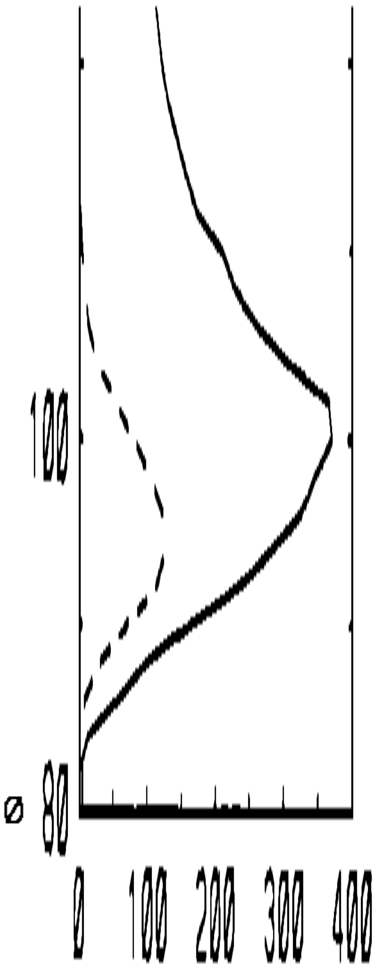
Figure 5. Comparison of the meridional wind component from the downleg TMA trail with the meridional wind from the lidar.

Meridional wind comparison



Individual WINDI profiles in the 5° latitude interval centered at 20 N for March 26, 1993: (left) meridional and (right) zonal winds;

Also shown is the volume emission profile for the 557 emissions (solid, day; dashed, night); from McLandress et al. (1996)



Vol. emission observed by WINDII

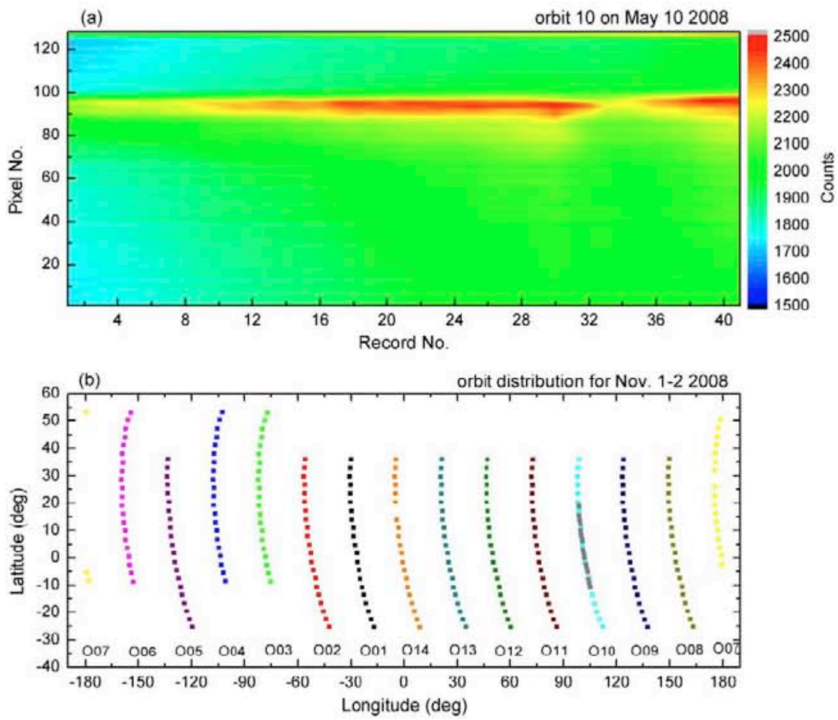


Fig. 1. **(a)** An image of a layer of O(^{1}S) airglow measured on 10 May 2008. **(b)** The latitudes and longitudes of ISUAL orbits. For 12 November 2008, one point in the figure represents one picture of the OI558 nm airglow emission was taken there.

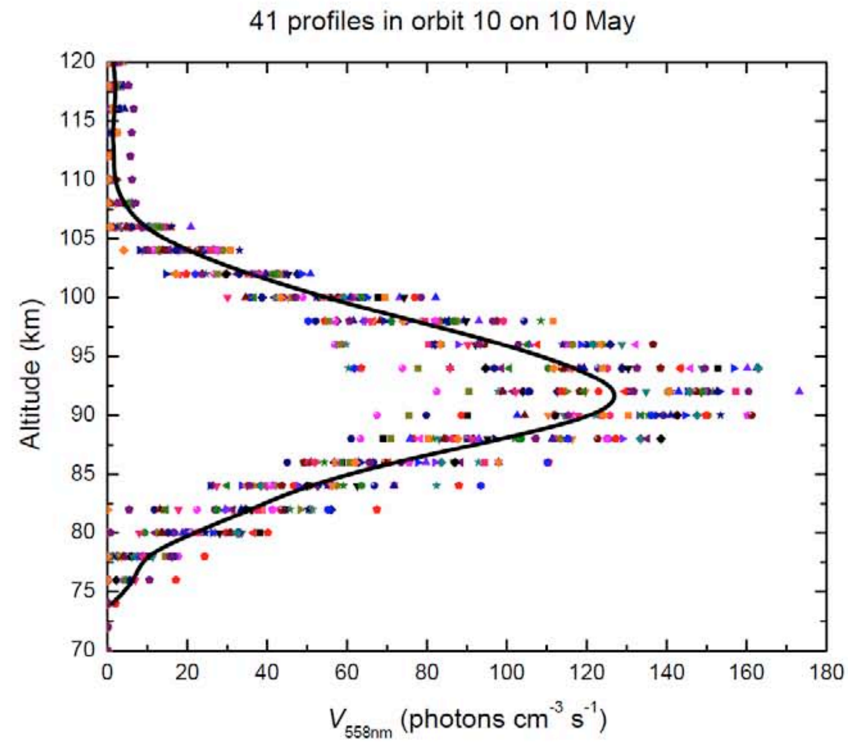
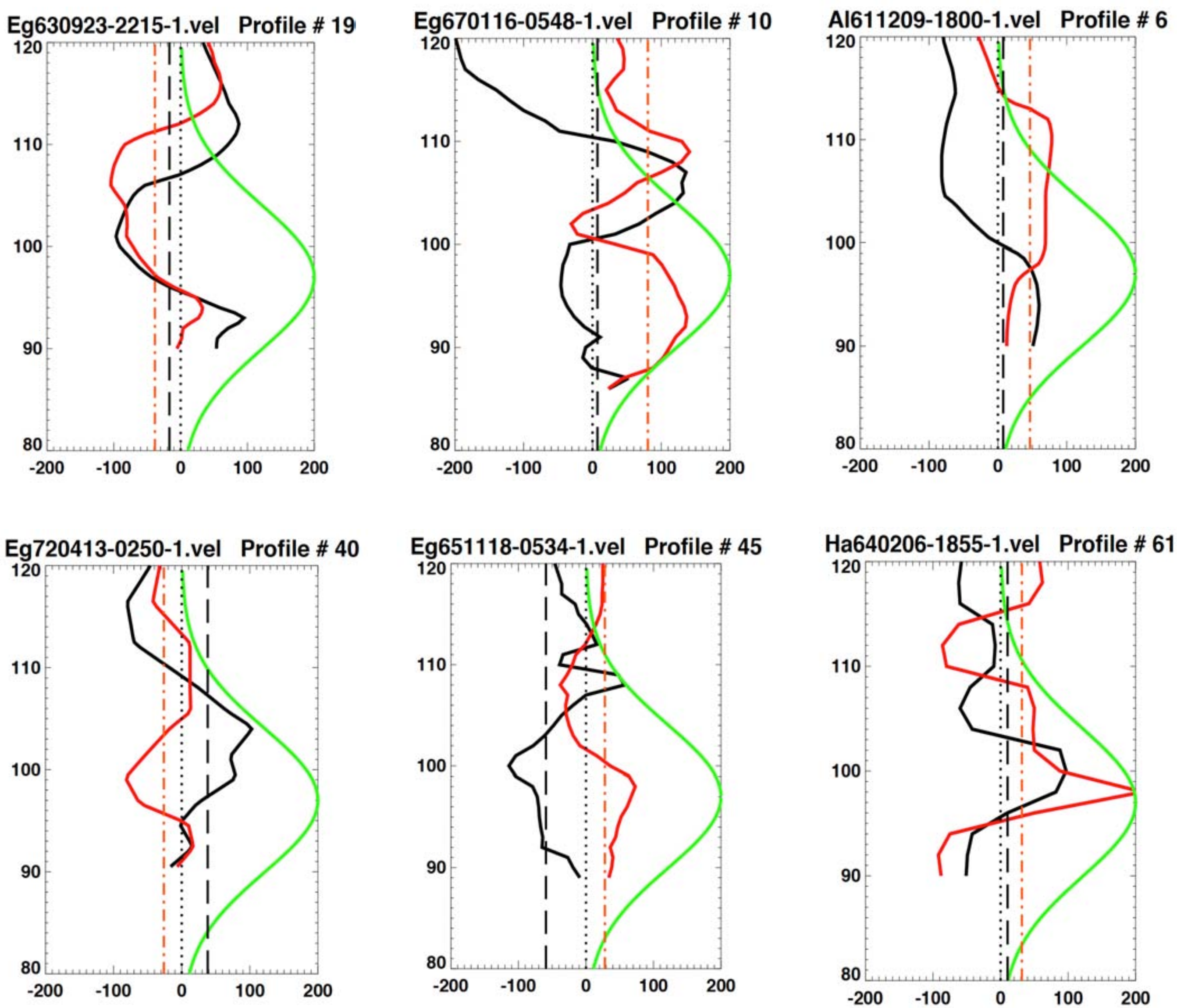


Fig. 2. Forty one scattered profiles of OI558 nm volume emission rate retrieved from images taken from orbit 10 on 10 May 2008. The 41 data are marked by different colors and symbols with the average profile in black solid line.

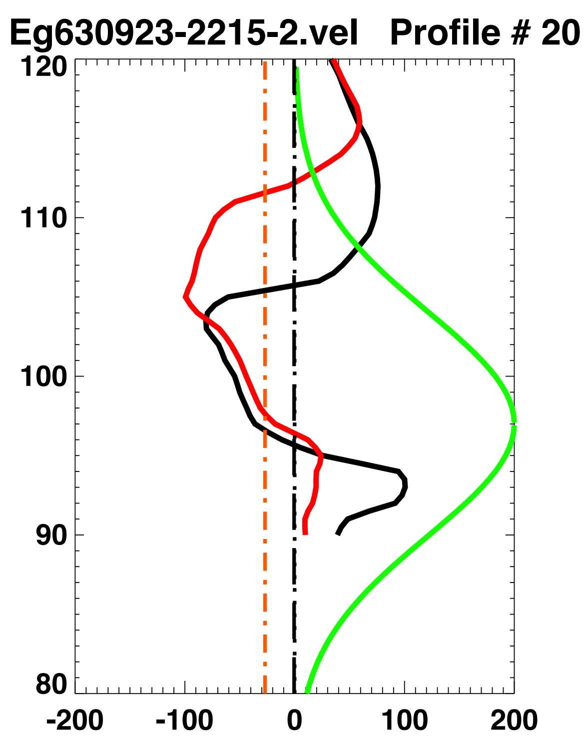
Recent limb-scanning measurements suggest that the green line profiles peak at 90 to 95 km rather than the nominal 97-98 km generally accepted as the peak atitude.

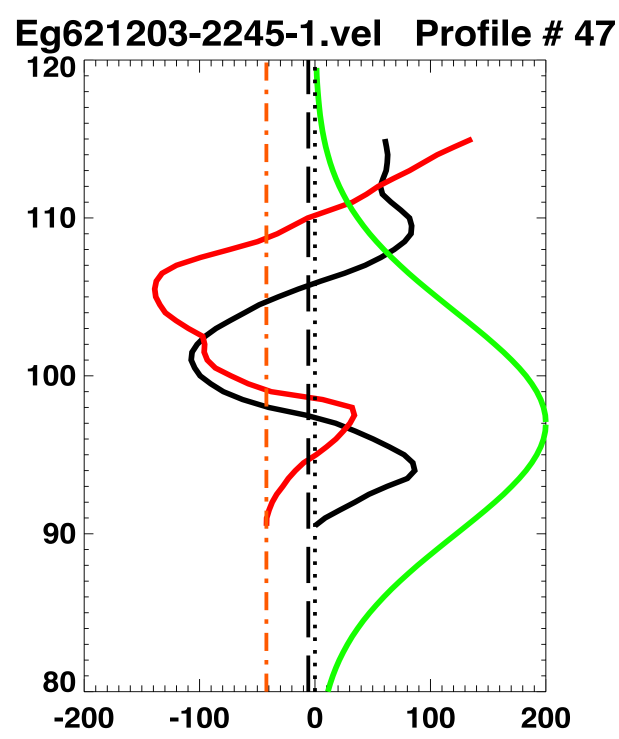


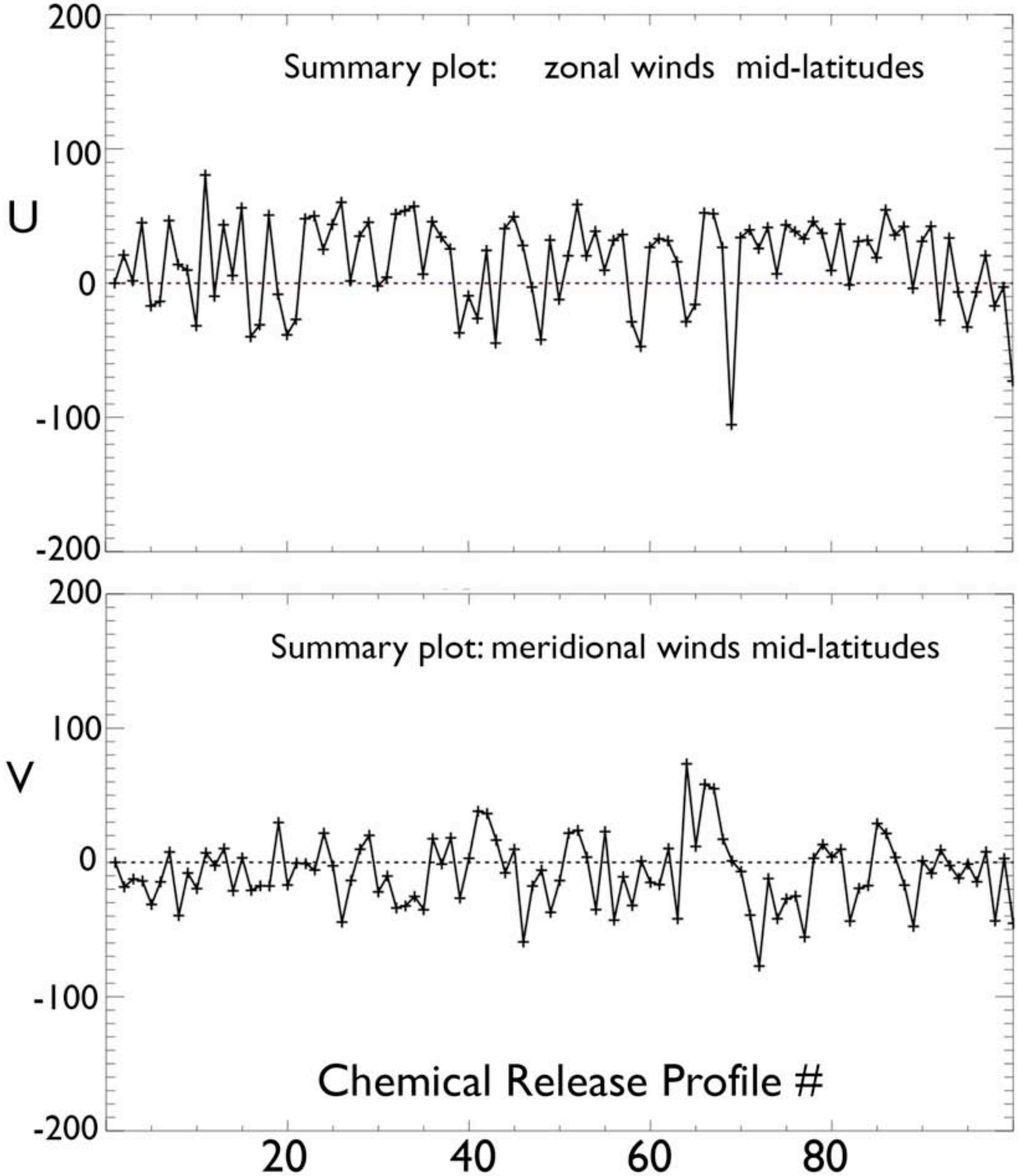
Examples of chemical release profiles of u and v.

Also shown is a model profile of the volume emission profile for the OI 557.7 nm emission

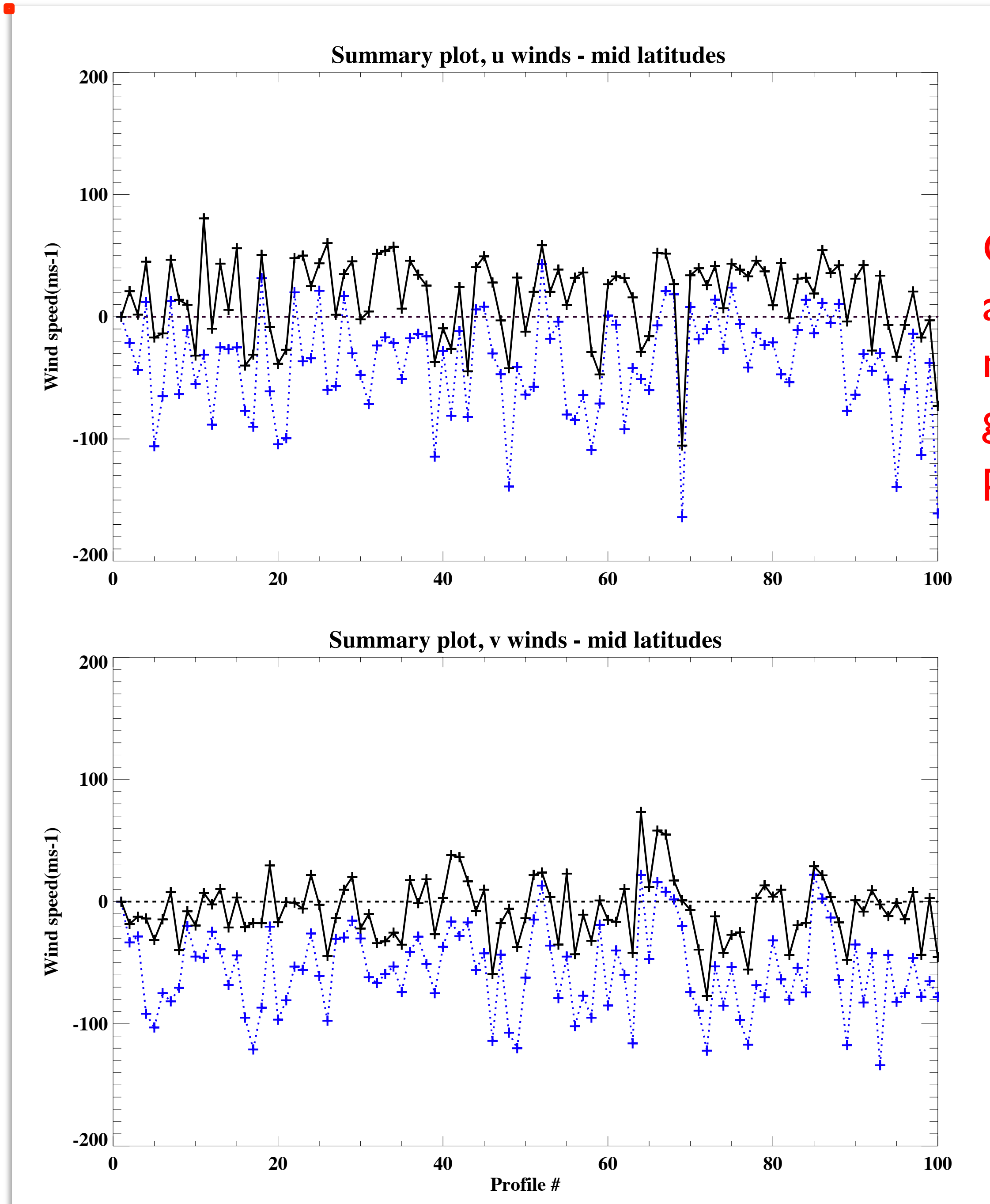
The modeling plan is to simulate FPI green line winds using chemical release profiles of MLT winds and do a weighted average of the u and v winds within the volume emission profile.



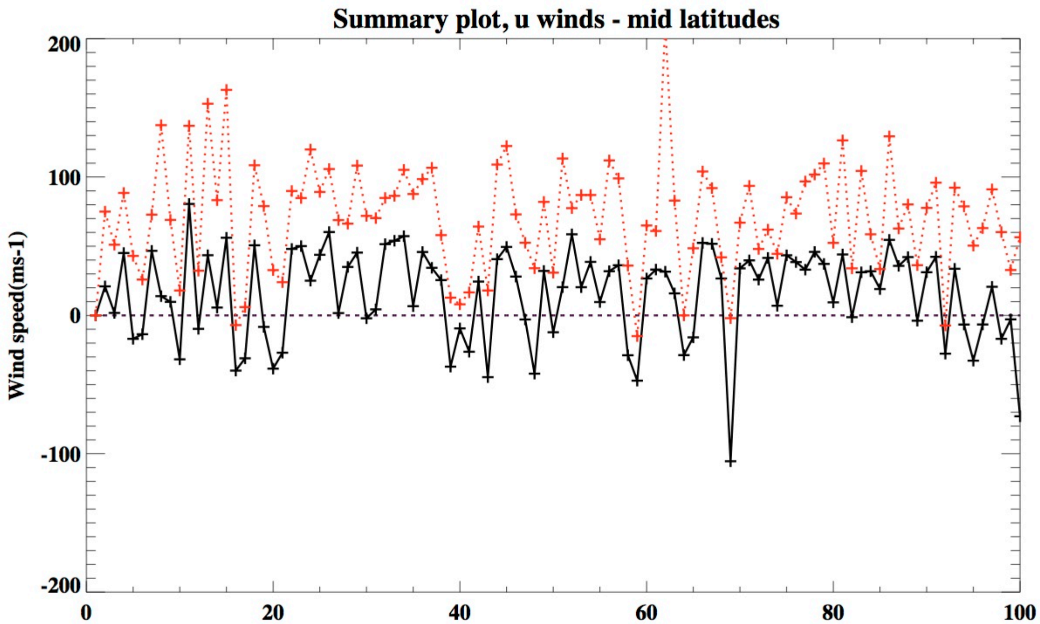




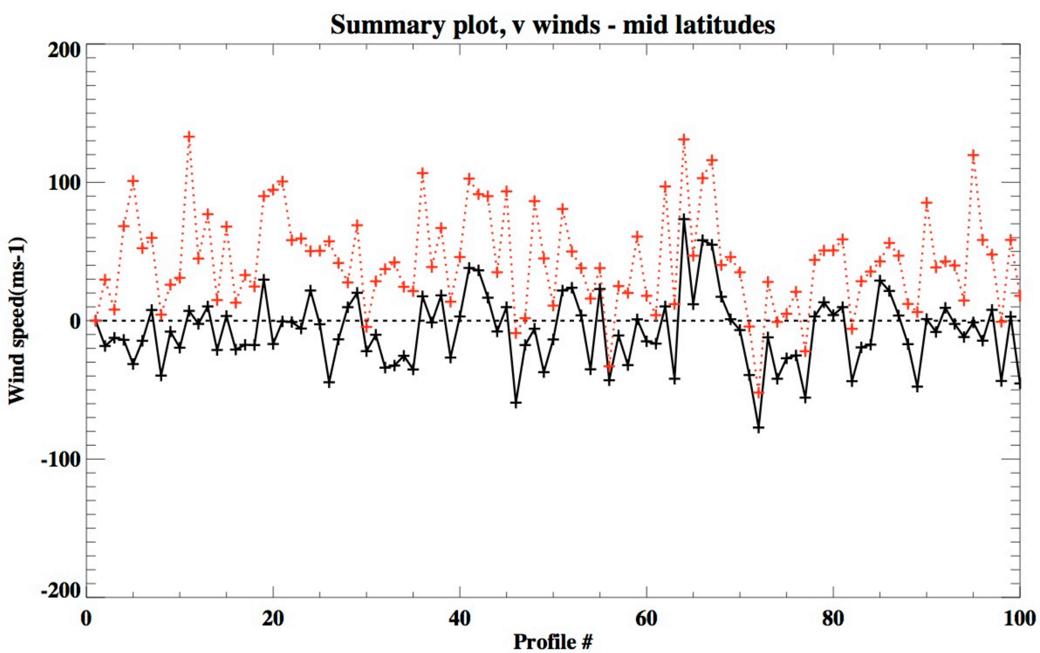
Shown here are the u and v winds averaged over the 557 nm model emission profile

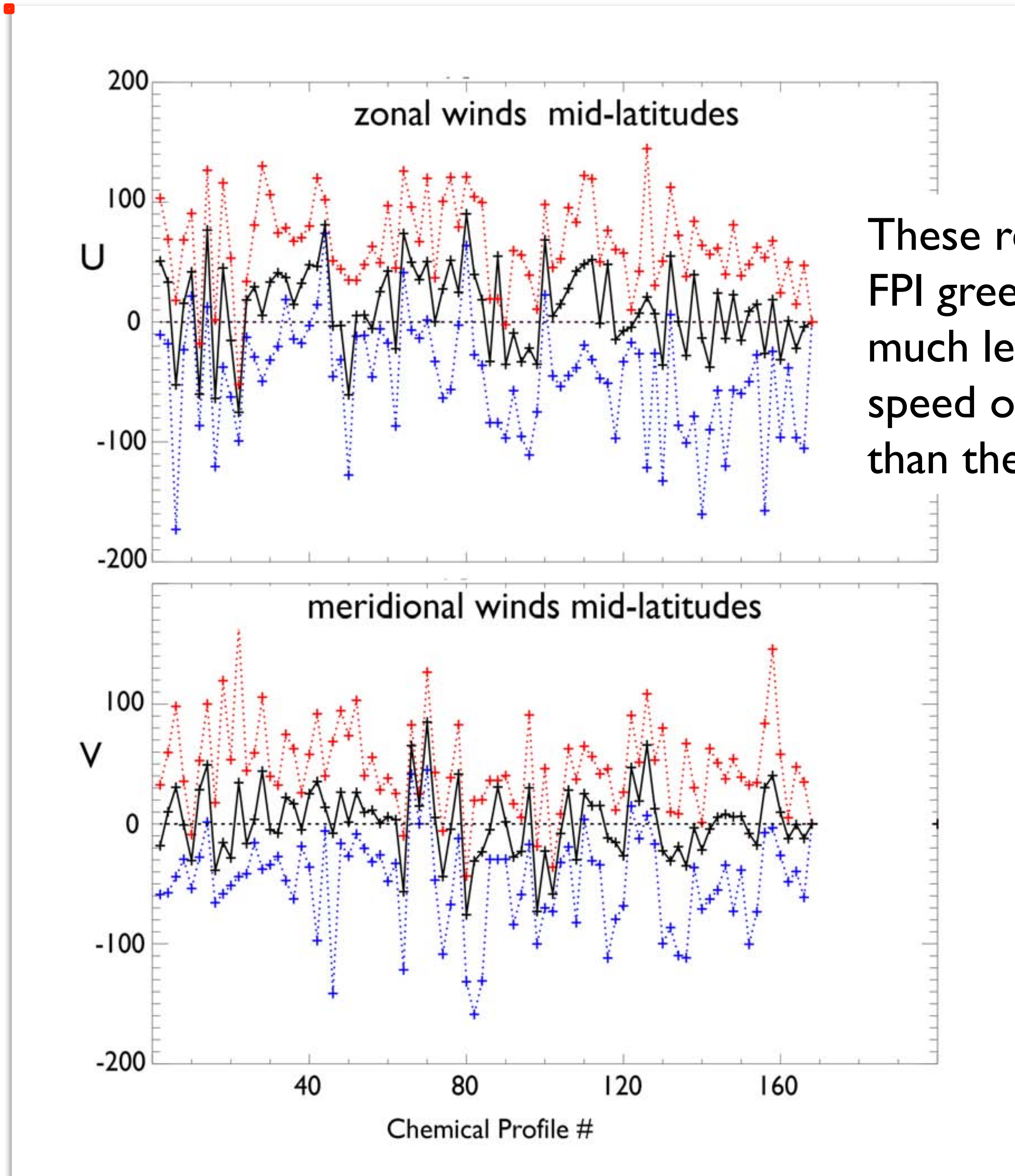


Green line averaged speeds are higher than the minimum speed within the green line volume emission profile.

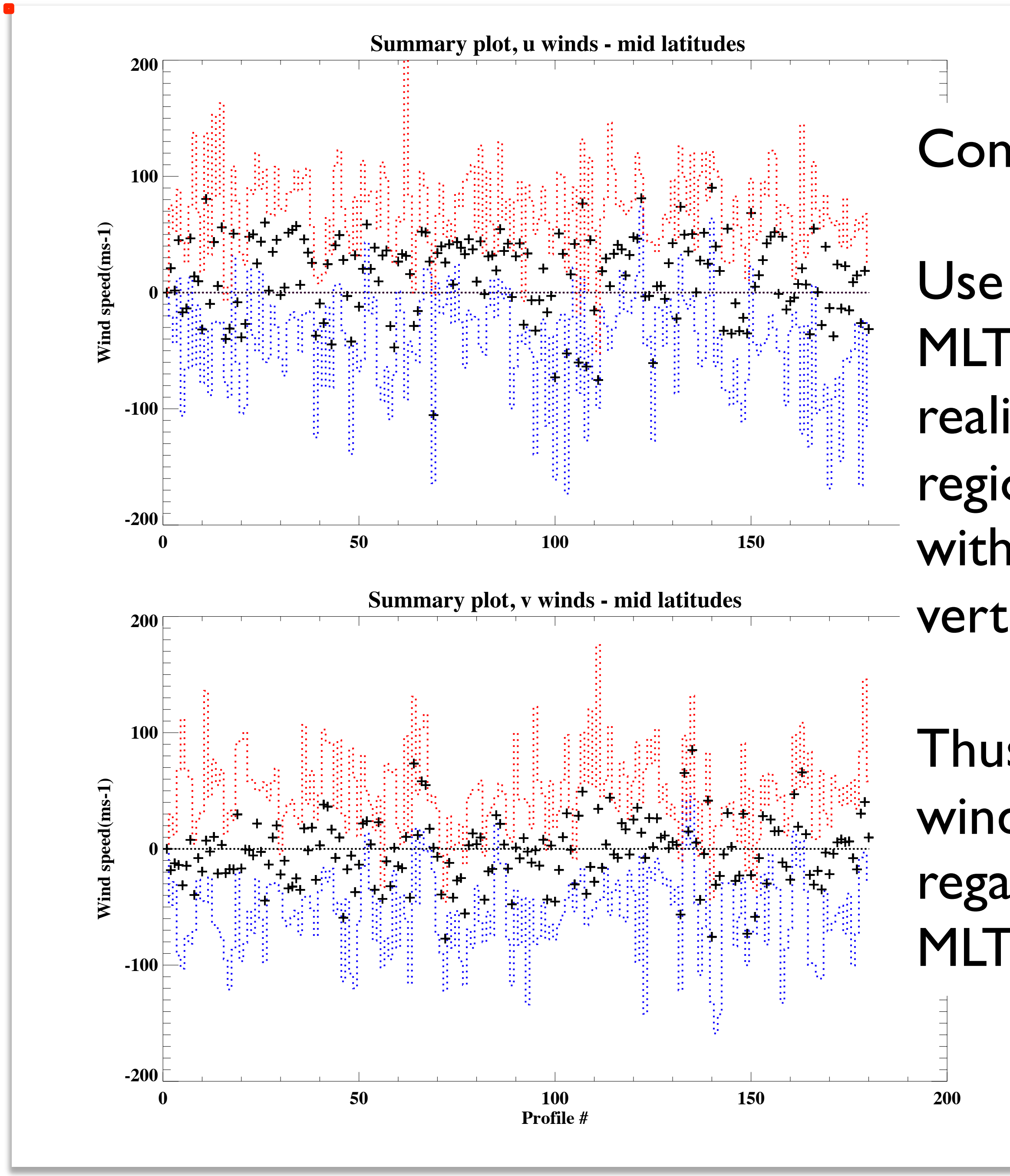


Green line averaged speeds are lower than the maximum speed within the green line volume emission profile.





These results illustrate that the FPI green line speed is always much less than the maximum speed or considerably greater than the minimum speed.



Conclusion:

Use of the FPI to observe MLT winds ignores the reality that there is always a region of turbulent shear within the O 557.7 nm vertical profile.

Thus, the observed FPI winds give little insight regarding the behavior of MLT dynamics.

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Example of how the use of green line winds leads to the wrong conclusion

Comparison of winds measured by MU radar and Fabry–Perot interferometer and effect of OI5577 airglow height variations

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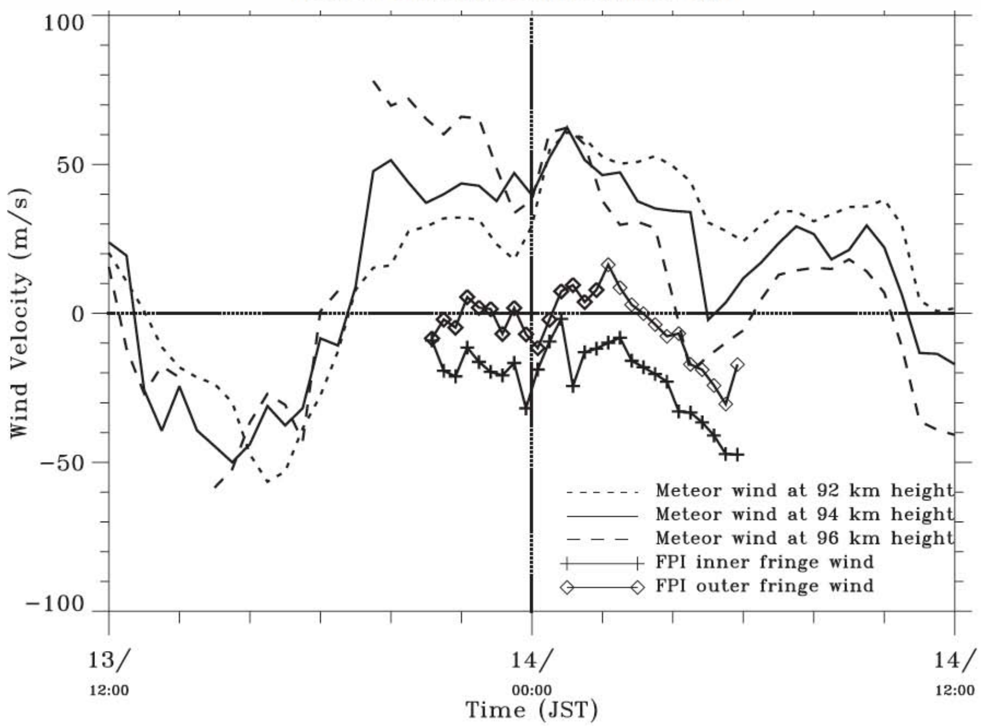

Fig. 3. Time series plot of eastward wind velocities between 1200 LT on November 13 and 1200 LT on November 14.

These authors explained the observed difference between the MU meteor radar winds and FPI winds to be the result of a vertical shift of the green line layer height caused by a 6 hr gravity wave.

A better explanation is that the green line winds are smaller due to the nature of the vertical sampling of the MLT winds represented by the vertical height range of 557.7 emission profile.