The control of dayside high-latitude thermospheric winds

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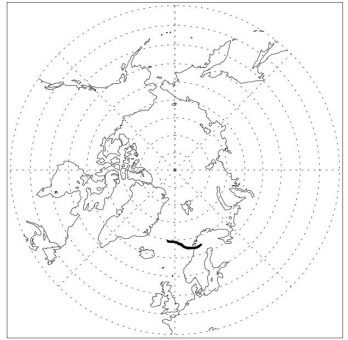
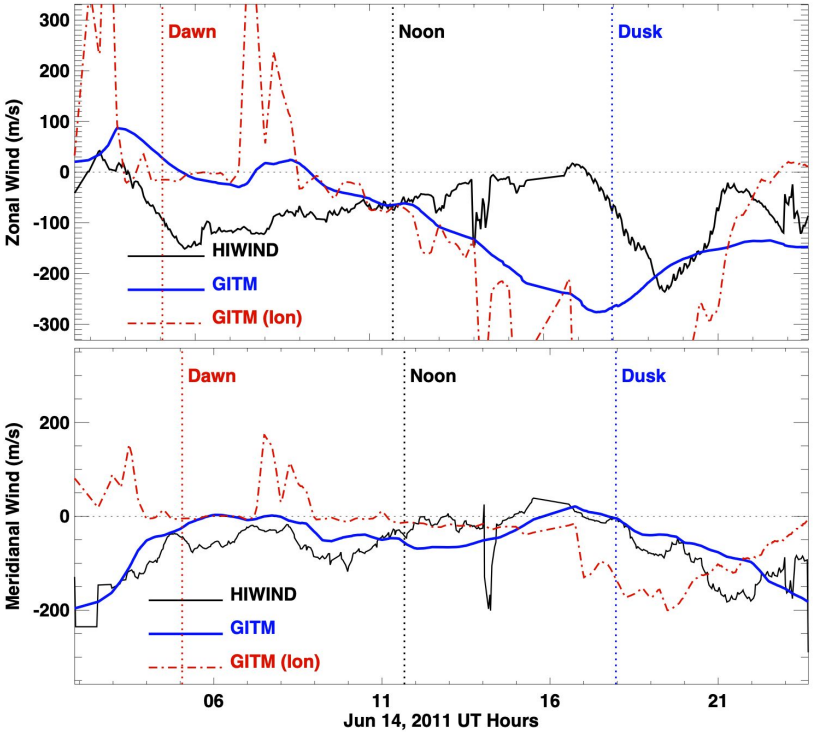
(Feat. Qian Wu and Dan Brandt)

HIWIND June 14, 2011

- Balloon-based FPI
- Data provided by Qian Wu (NCAR)
  - Qian hasn't seen these comparisons yet...
- Comparison to GITM:
  - Zonal winds are not great at all
  - Meridional winds are great
- Zonal winds in GITM:
  - Strongly influenced by the ion drifts
  - Ion drifts by Weimer [2005] - bad???
    - Need to compare to data
- Meridional winds in GITM:
  - Less controlled by ion drifts
  - Probably by gradient in pressure





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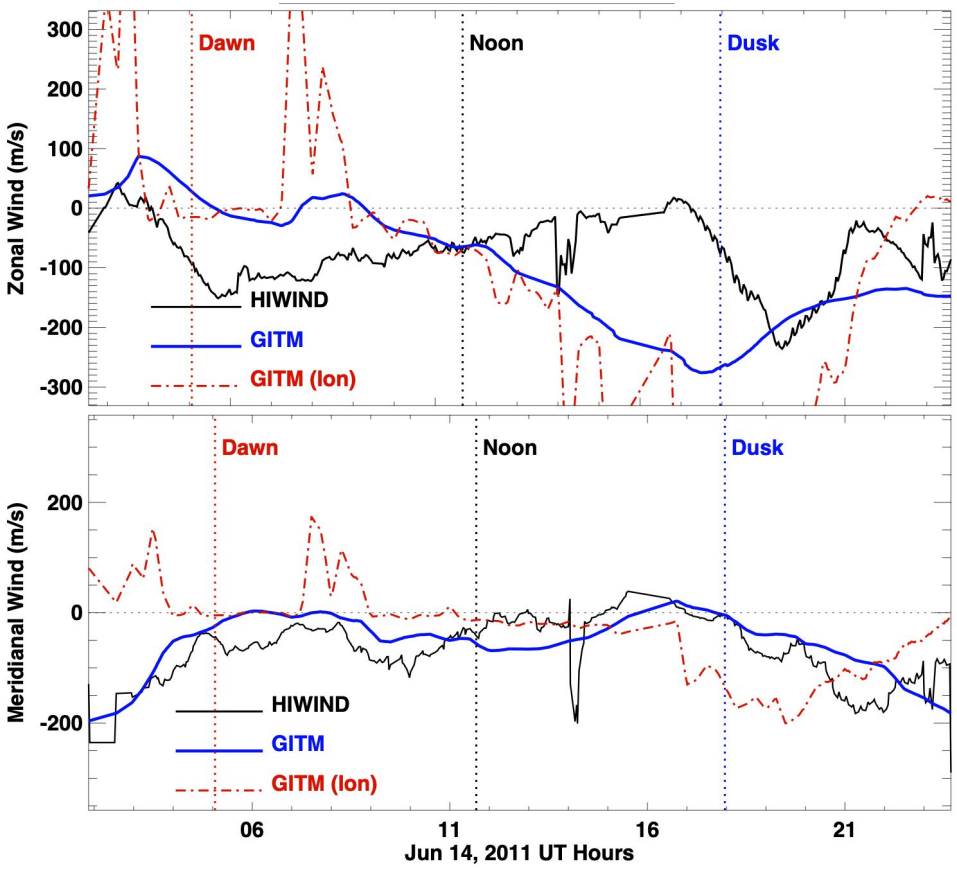

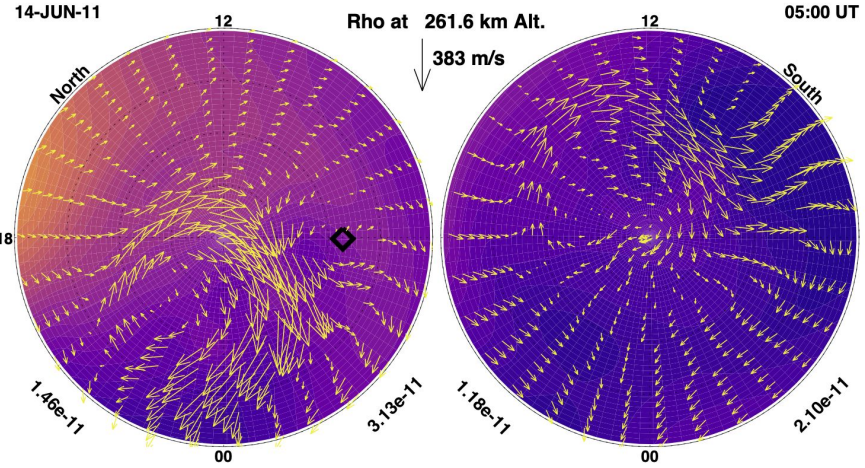

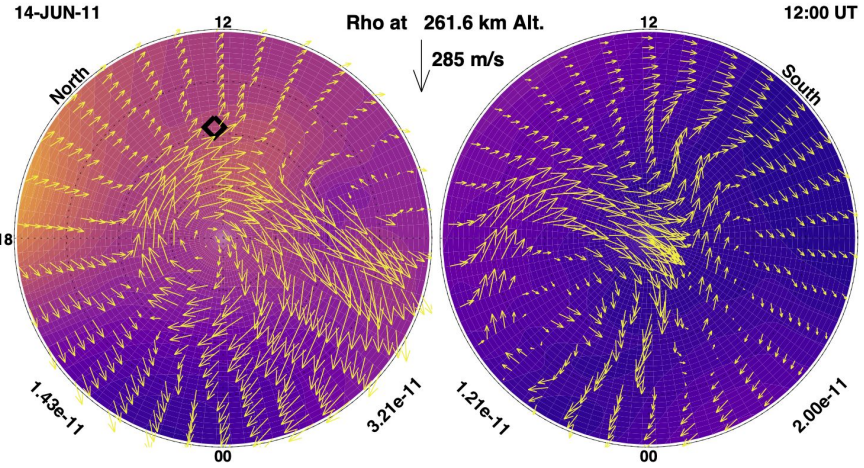

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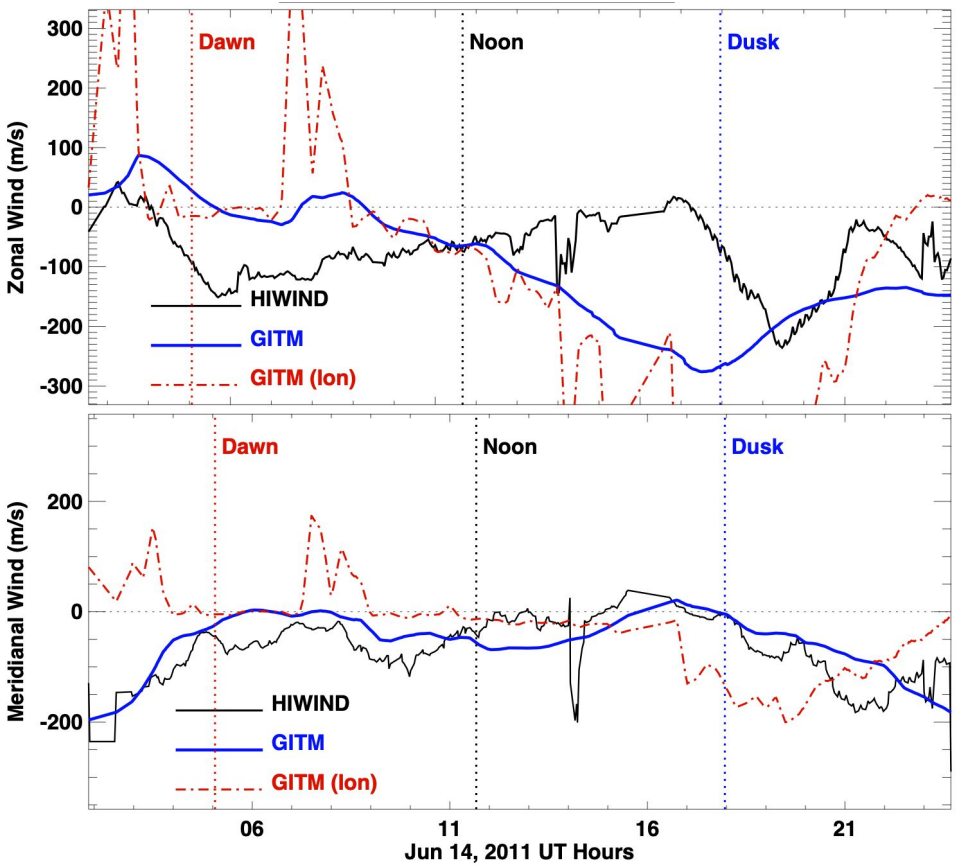

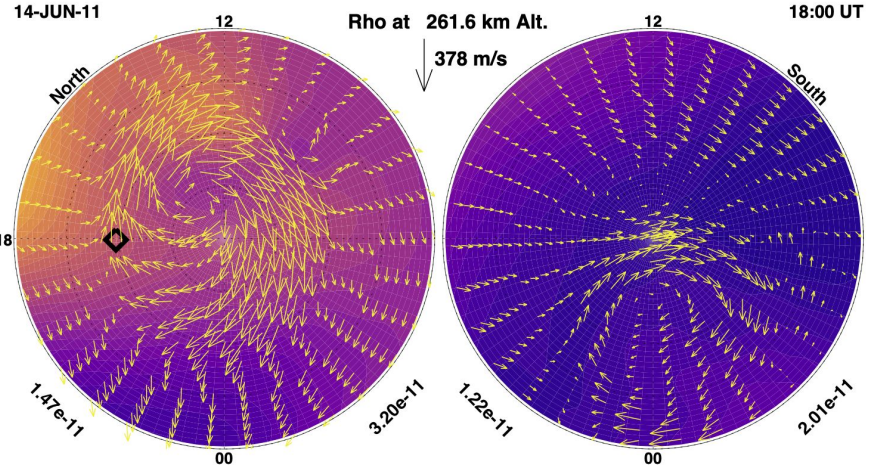

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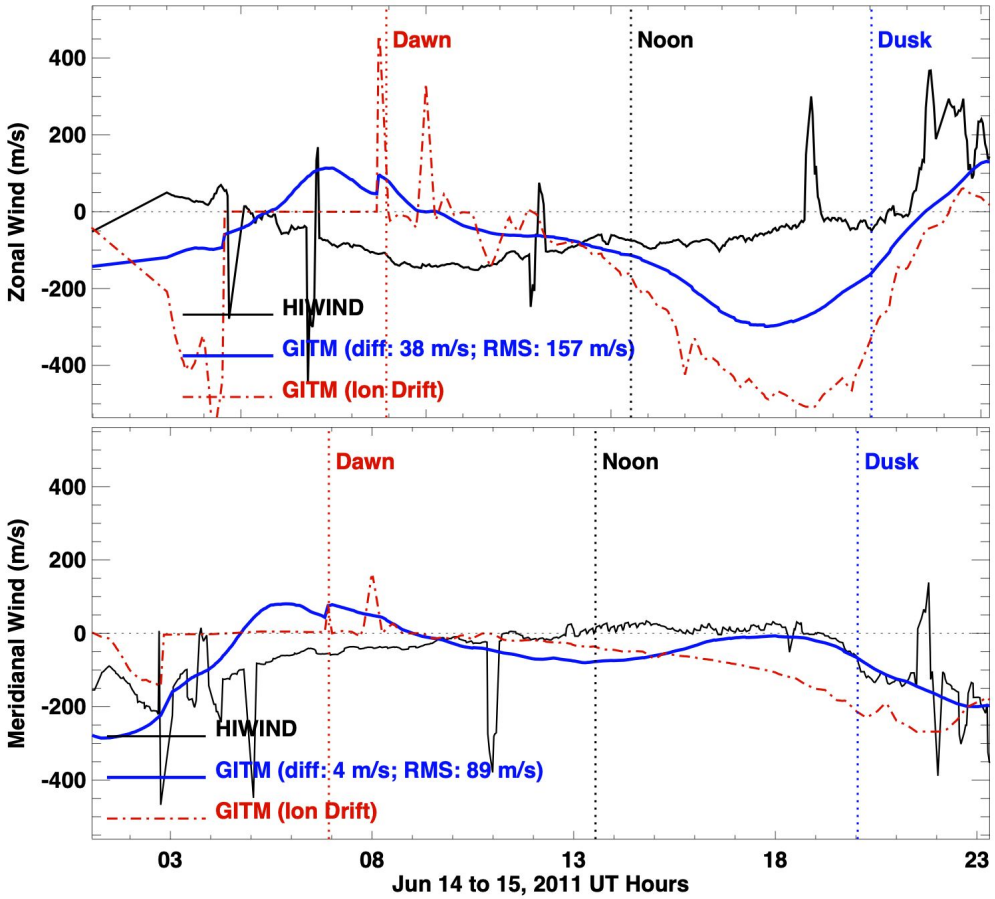

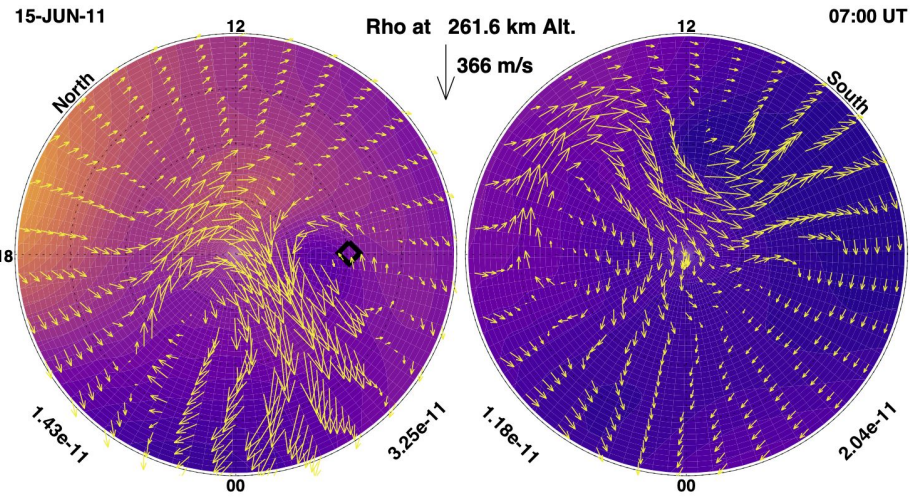

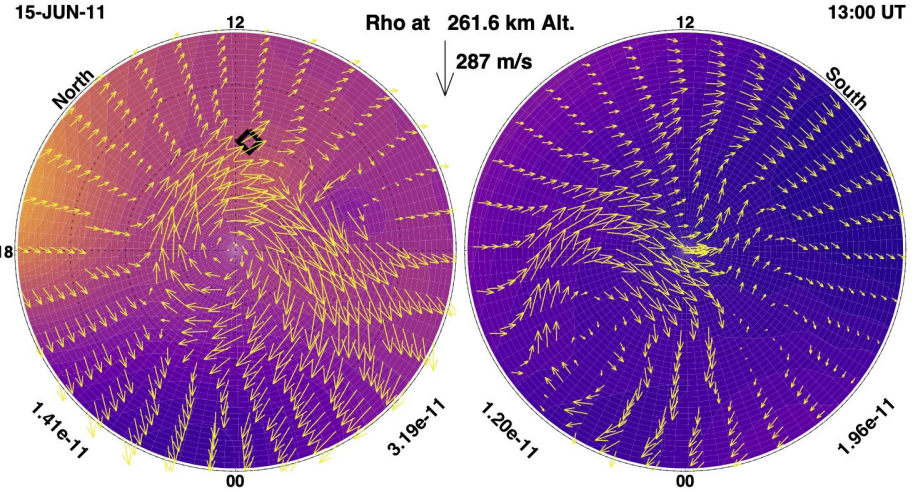

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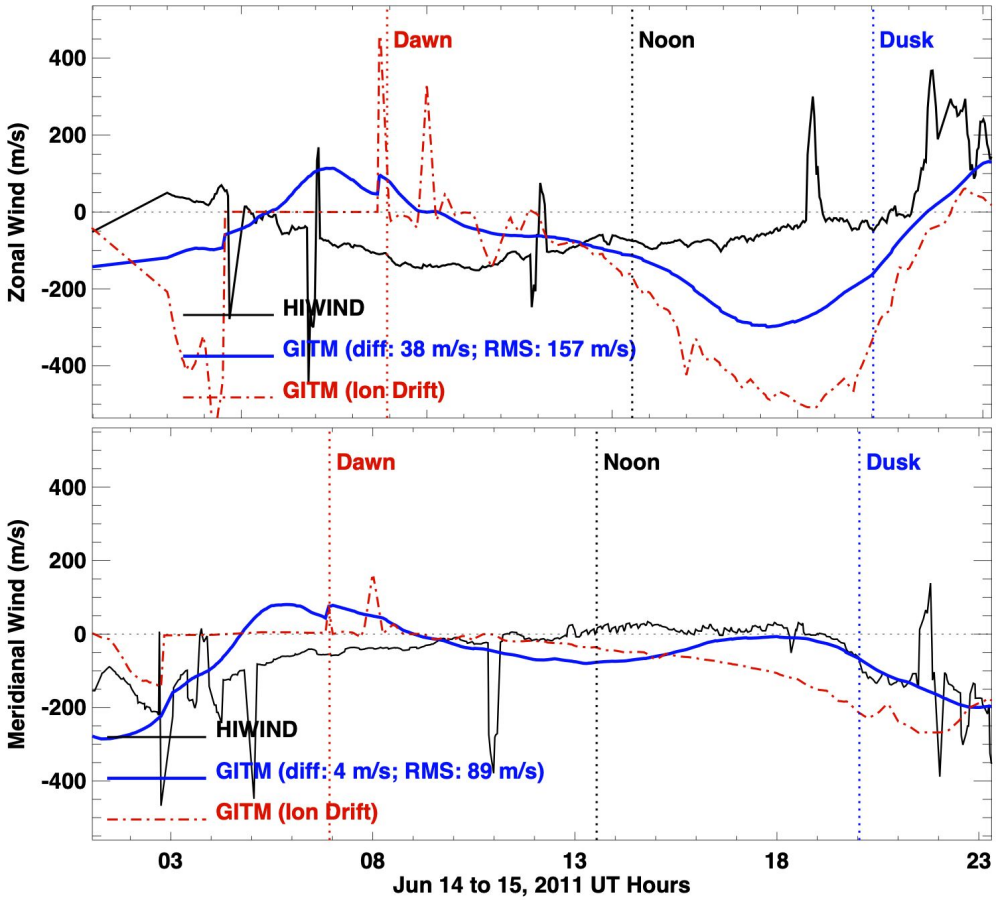

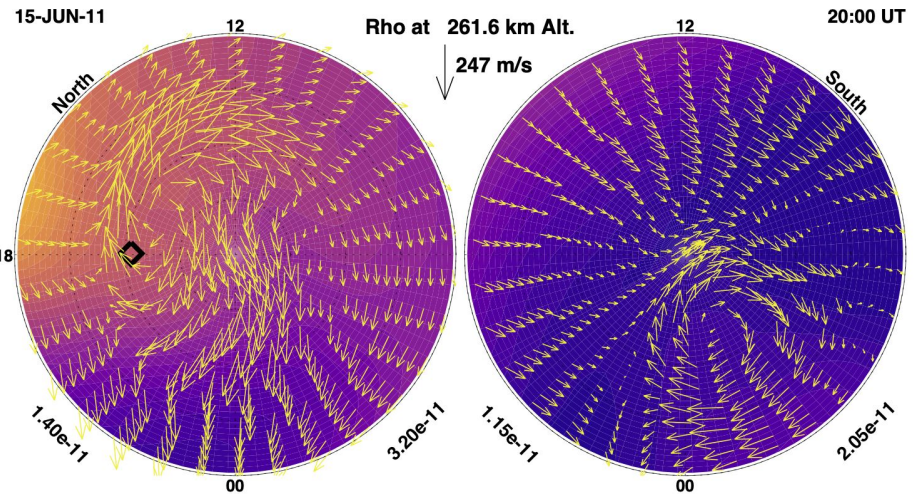

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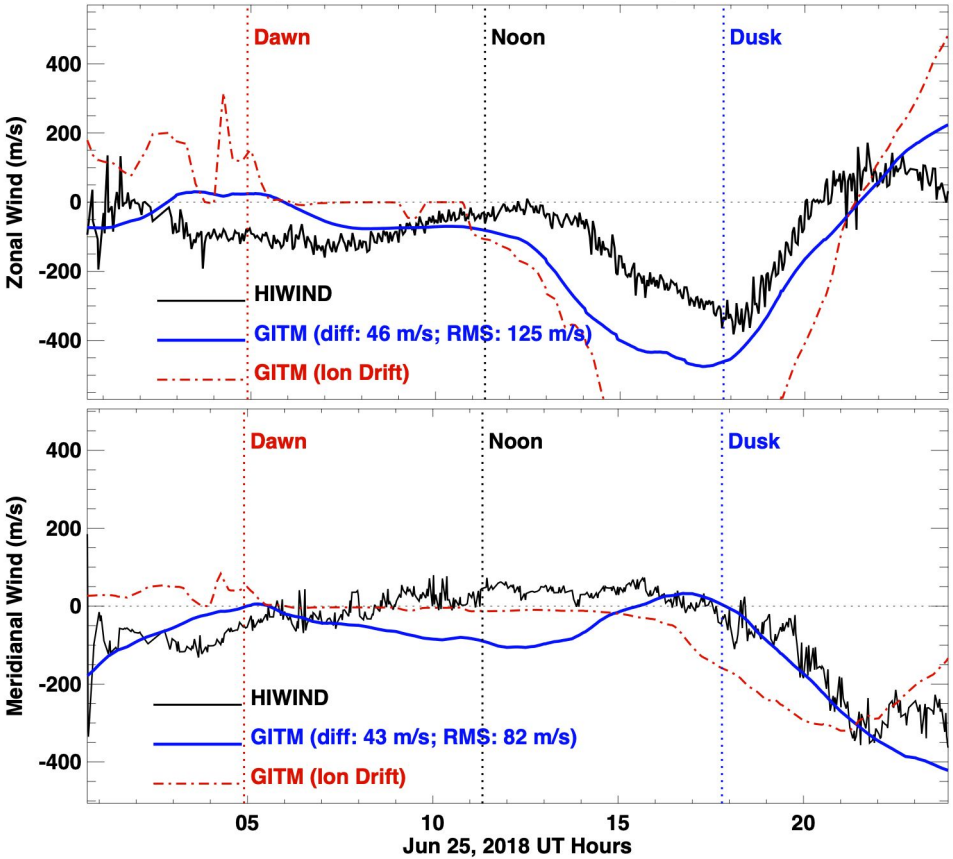

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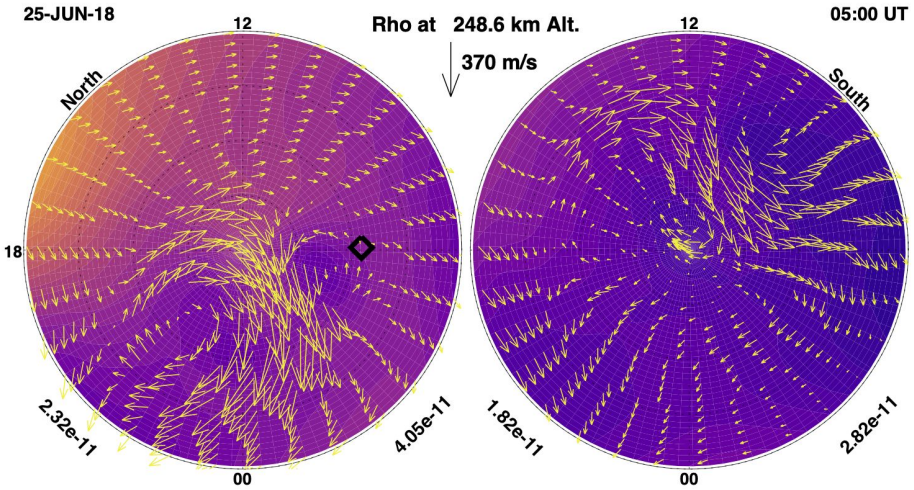

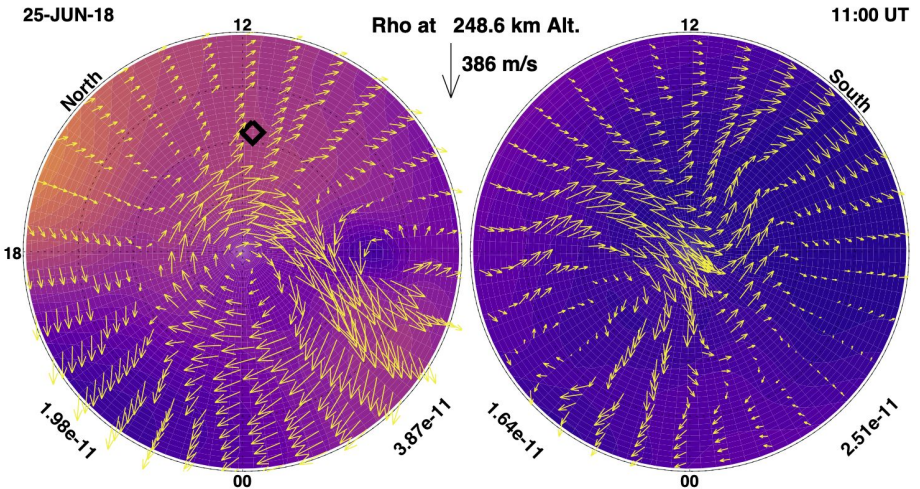

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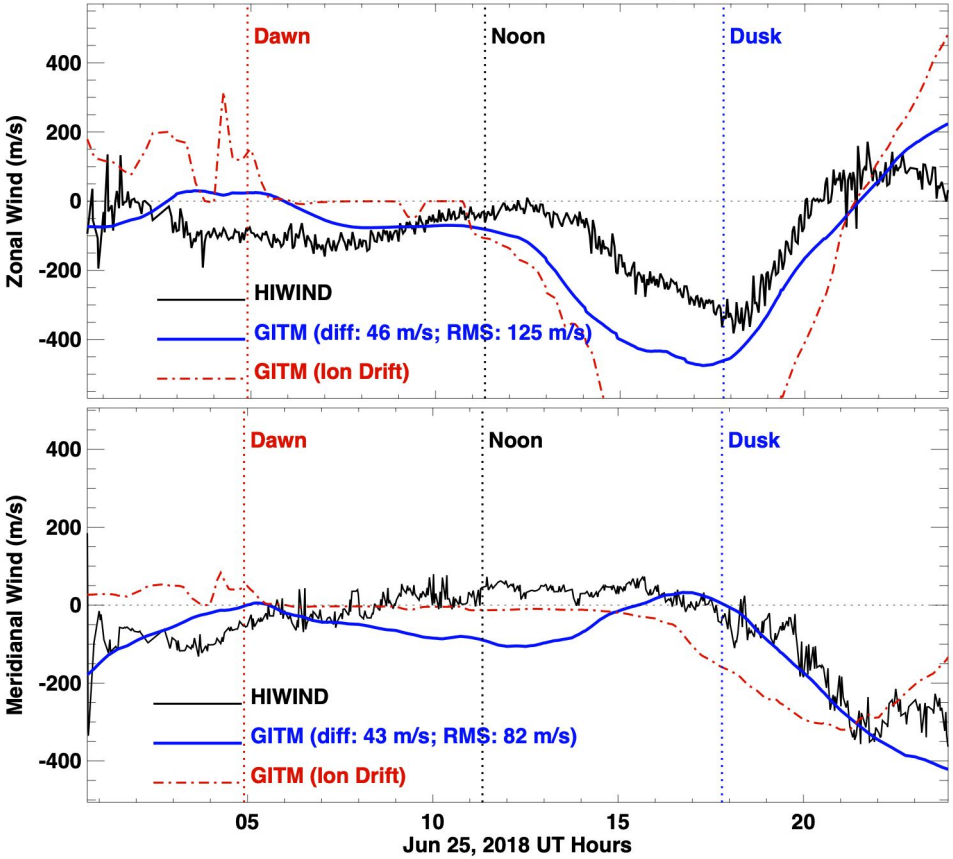

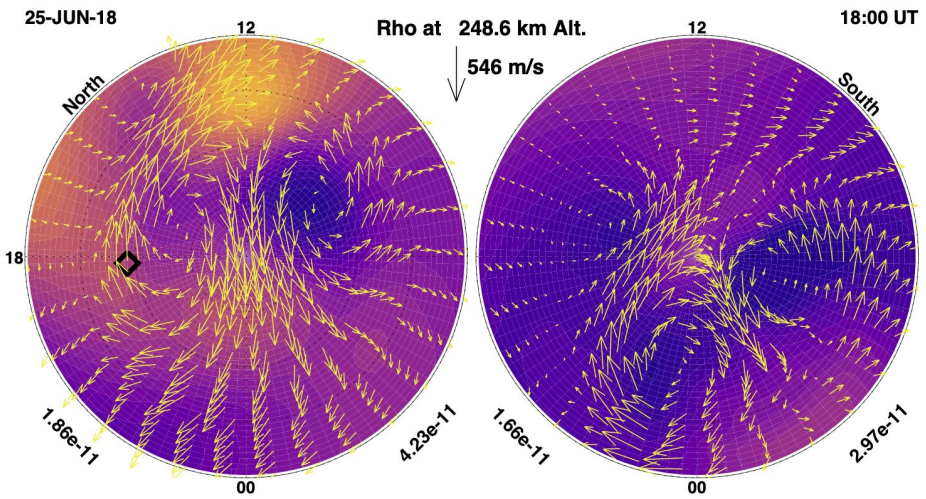

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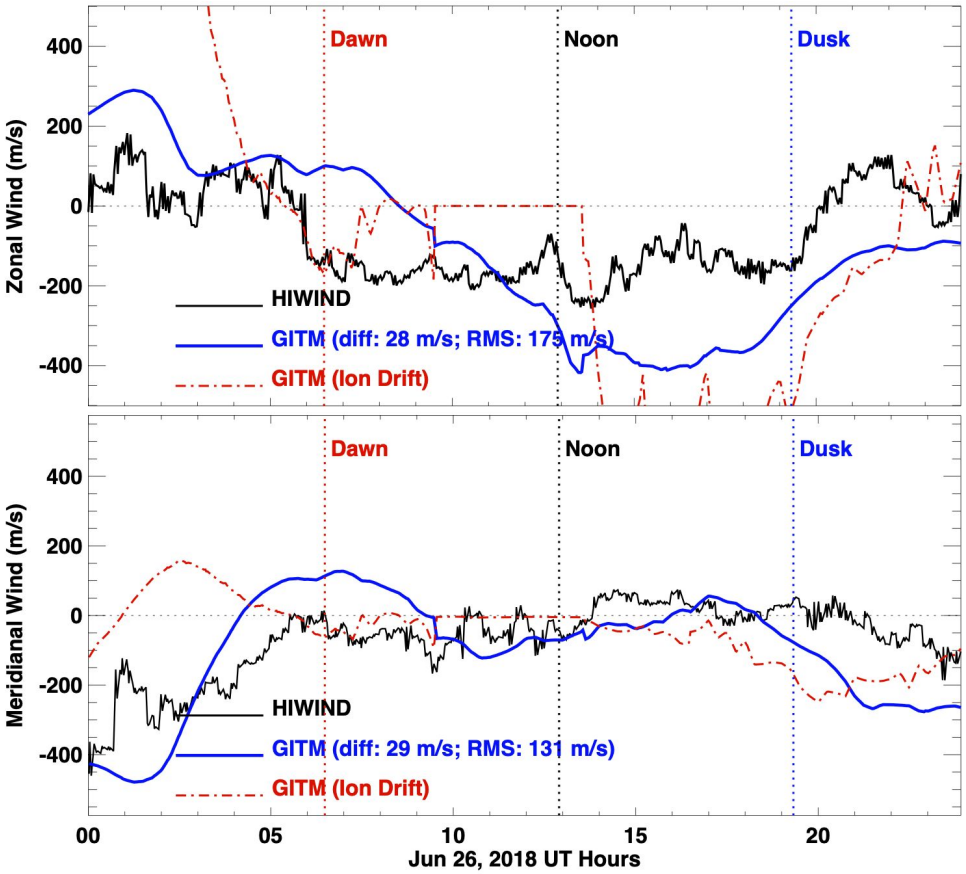
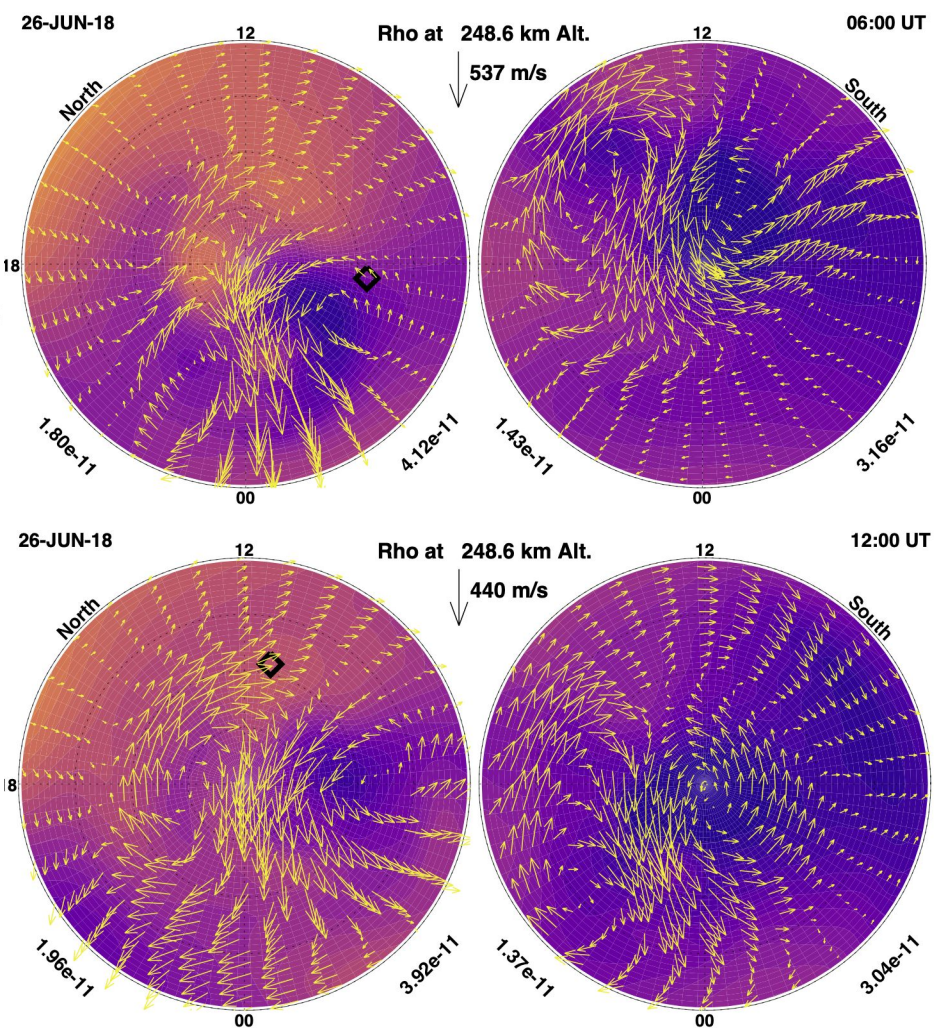
HIWIND June 26, 2018





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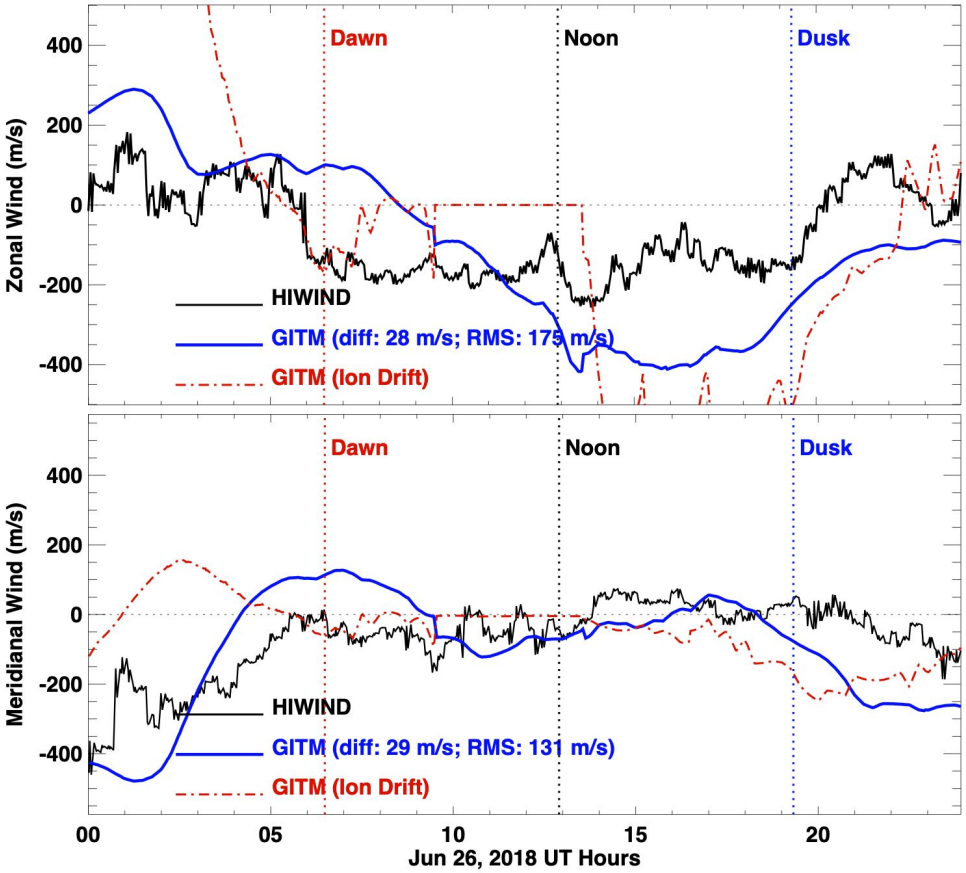
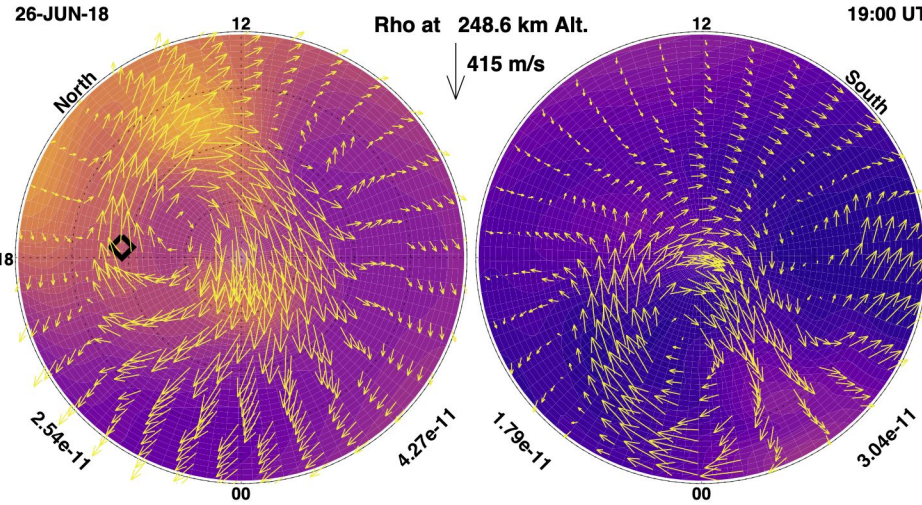
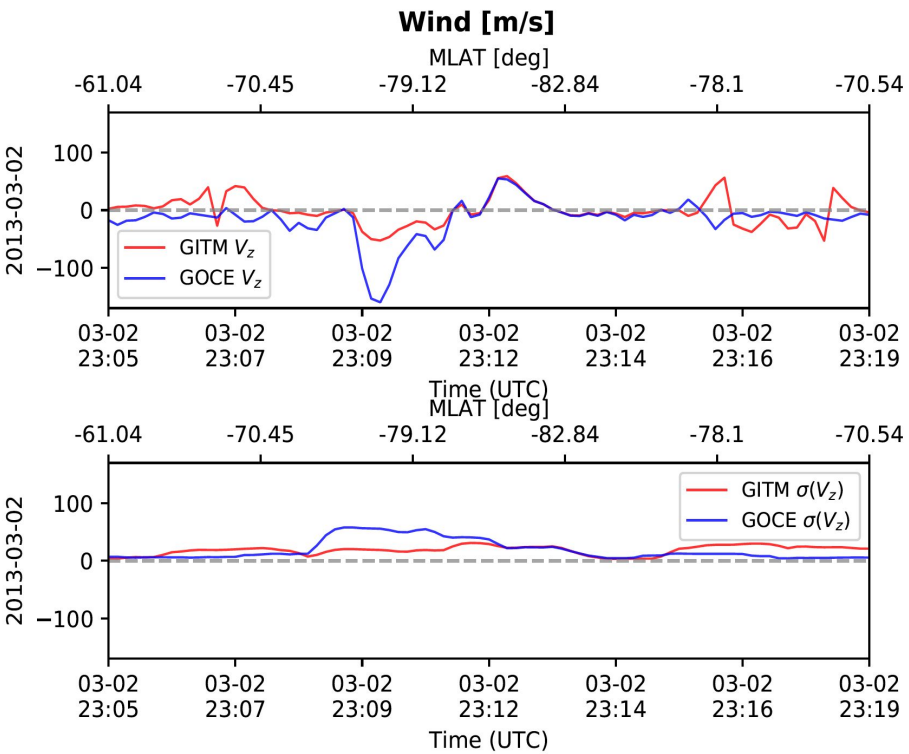


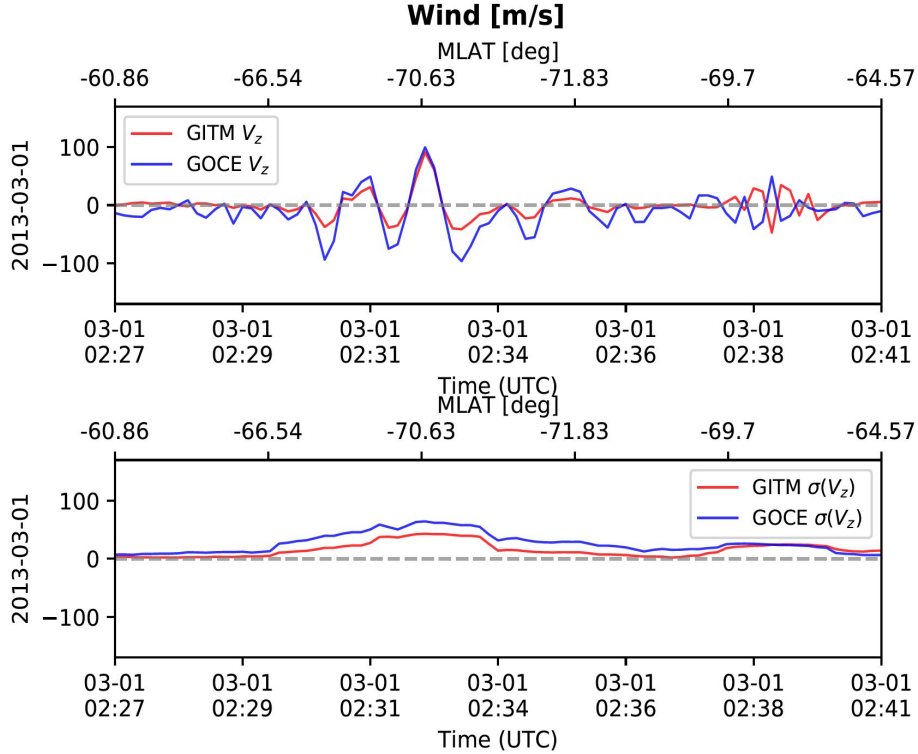


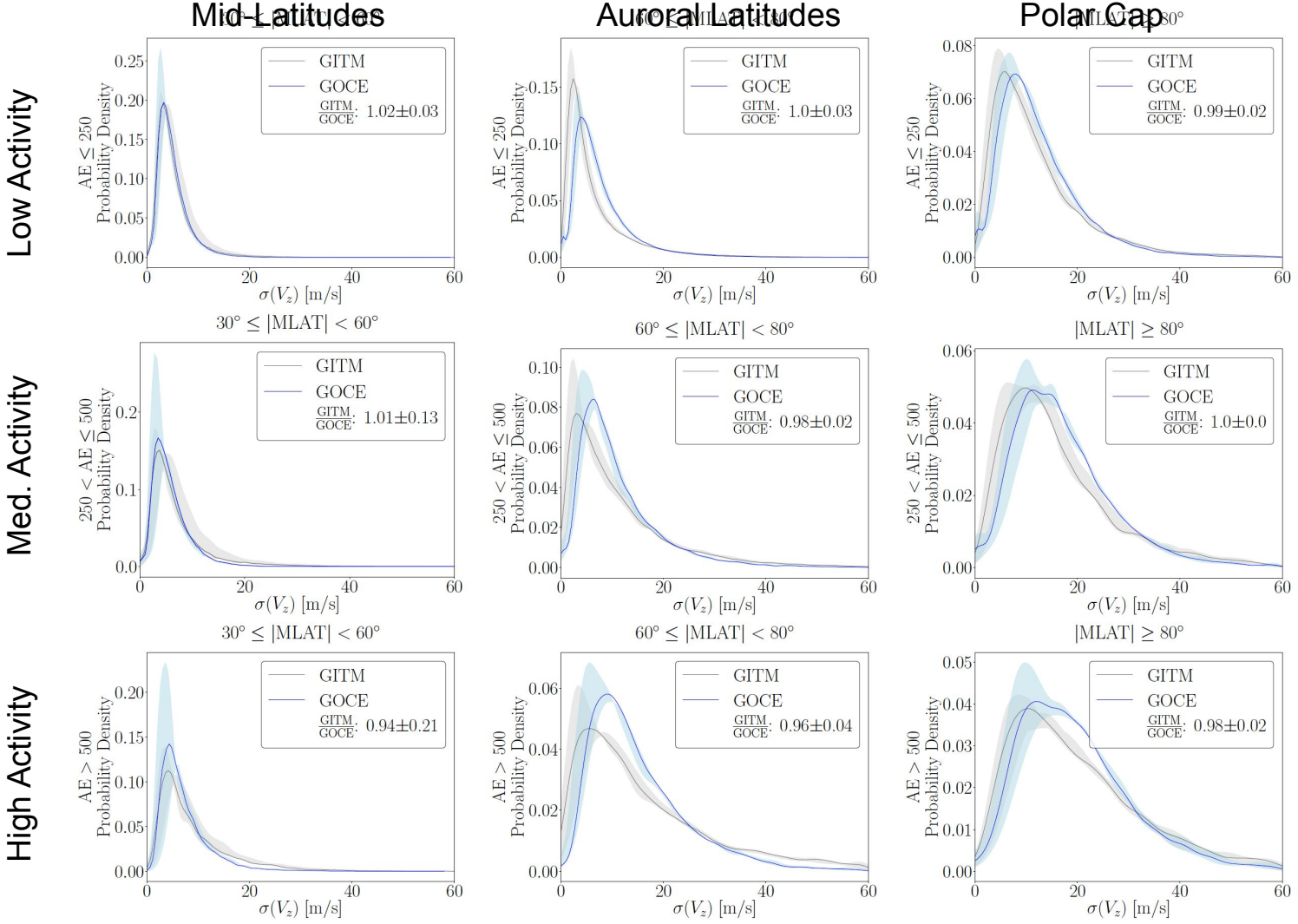
Comparisons to GOCE Vertical Winds

- This work done by Dan Brandt, a grad student at UM
- GOCE had an accelerometer that allowed specification of:
  - Mass density
  - Cross-track winds (both horizontal and vertical)
- GOCE had a thruster that kept is at roughly 250 km altitude from ~2010-2013
- GOCE was in a roughly dawn-dusk orbit at ~98° inclination (reached 82° geographic latitude)
- Recent paper shows distribution of vertical winds
- Wanted to compare to GITM
  - Ran 2013 with GITM
  - Fly GOCE through GITM, extracting data at GOCE location/time
  - Compare results statistically
  - Because Vz is so oscilitory, and random magnitudes, we look at standard deviation of V

A couple of individual comparisons






Mid-Latitudes
Auroral Latitudes
Polar Cap
Low Activity
Med. Activity
High Activity
30° ≤ |MLAT| < 60°
60° ≤ |MLAT| < 80°
|MLAT| ≥ 80°
AE ≤ 250
250 < AE ≤ 500
AE > 500
Probability Density
σ(V_z) [m/s]
GITM
GOCE
GITM/GOCE: 1.02±0.03
GITM/GOCE: 1.0±0.03
GITM/GOCE: 0.99±0.02
GITM/GOCE: 1.01±0.13
GITM/GOCE: 0.98±0.02
GITM/GOCE: 1.0±0.0
GITM/GOCE: 0.94±0.21
GITM/GOCE: 0.96±0.04
GITM/GOCE: 0.98±0.02

Magnitudes of vertical winds

- Capture how many orbits in which Vz exceeded some threshold (25, 50, 75)
- Dependence on activity & hemisphere
- GITM seems to show more passes with strong winds than GOCE
- Working on actual truth tables

V_z: Northern Hemisphere			
AE$\leq$ 250			
Data Source	n_{25}	n_{50}	n_{75}
GOCE	3036	1117	366
GITM	3153	1762	807
250 $<$ AE $\leq$ 500			
GOCE	560	208	105
GITM	591	268	122
AE $\geq$ 500			
GOCE	281	66	20
GITM	314	149	64

V_z: Southern Hemisphere			
AE$\leq$ 250			
Data Source	n_{25}	n_{50}	n_{75}
GOCE	3413	1708	595
GITM	2946	1348	692
250 $<$ AE $\leq$ 500			
GOCE	714	340	143
GITM	653	395	189
AE $\geq$ 500			
GOCE	372	165	67
GITM	349	220	117

Summary

- GITM zonal winds are strongly controlled by ion drifts
  - Ion drifts can have relatively narrow structures, so comparisons may be hard?
  - GITM comparisons to HIWIND are often lacking
- GITM meridional winds seem to be more controlled by gradient in pressure
  - Gradient in pressure is larger-scale, so easier to capture
  - GITM comparisons to HIWIND are pretty good
- GITM vertical winds:
  - Comparisons to GOCE at mid-latitudes and polar latitudes show similar magnitude variations at all activity levels (i.e., histograms are very similar)
  - Comparisons at auroral latitudes show lower vertical wind variations most of the time, but with a longer tail