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
HIWIND June 26, 2018

Dawn
Noon
Dusk

Zonal Wind (m/s)

HIWIND
GITM (diff: 28 m/s; RMS: 175 m/s)
GITM (Ion Drift)

Meridional Wind (m/s)

HIWIND
GITM (diff: 29 m/s; RMS: 131 m/s)
GITM (Ion Drift)
HIWIND June 26, 2018

Graph showing zonal and meridional wind profiles for Dawn, Noon, and Dusk. The graphs compare measurements from HIWIND with GITM simulations, including differences and RMS values.
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 it 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 oscillatory, and random magnitudes, we look at standard deviation of V
A couple of individual comparisons
Magnitudes of vertical winds

- Capture how many orbits in which $V_z$ 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

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<th>$V_z$: Northern Hemisphere</th>
<th>$V_z$: Southern Hemisphere</th>
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<td>AE $\leq$ 250</td>
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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