Climatology of Thermospheric Neutral Winds over Millstone Hill

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Background

• Uses Fabry-Perot Interferometer (FPI) measurements
• Uses Millstone Hill incoherent scatter radar (MHISR) database
• Investigates thermospheric zonal and meridional neutral wind response to geomagnetic storms and subauroral polarization stream

https://depositphotos.com/vector-images/thermosphere.html
Introduction

Why We Care

• Thermospheric winds have an important role in the dynamics of the F-region ionosphere

• Equatorward neutral wind and the movement of plasma
  • Leads to reduced recombination and an increase in F-region density (in some cases)

• Can cause issues with space vehicle re-entry, modern technology, etc
Fabry-Perot Interferometer

- Measures 630.0-nm nightglow emission at ~250km
  - Faint atmospheric coloring due to oxygen
- Historical Database (1989-2002) used extensively
- New Database (2009 – Present) needs further exploration
**Instruments & Data**

**Incoherent Scatter Radar**
- **ISR**
  - Ground based radar technique for observing the ionosphere
  - Measures density, temperature, velocity
- **MISA**
  - 46m, fully steerable
  - Wide lat/lon coverage
- **Zenith**
  - 68m, vertical beam

![MISA Example Plot](image-url)
Results & Discussion: Quiet-time Neutral Wind Climatology

- Methodology
- Seasonal Definitions
- Variables
Results & Discussion: Quiet-time Neutral Wind Climatology

• Results
  • Agreement with previous climatological and seasonal variance studies
  • Spring vs. Autumn
    • Slight differences, but enough to be non-negligable
Results & Discussion: Active/Storm Time Neutral Wind Climatology

- Active time
  - Kp >= 3
    - Measures geomagnetic activity
- Disturbance Wind
  - Difference between quiet-time and active time
  - Overall more westward and equatorward
  - Summer has most intense equatorward winds
  - Spring has less intense changes in meridional wind and more intense changes in zonal wind than Autumn
Results & Discussion: Wind Variation During SAPS Interval

17 March 2015 (Intense Storm)
MISA Plasma Drift Plot (21:45 – 22:05)

27 September 2019 (Minor Storm)
MISA Plasma Drift Plot (19:32 – 19:48)
Results & Discussion: Wind Variation During SAPS Interval

17 March 2015 (Intense Storm)
FPI Neutral Wind Result

27 September 2019 (Minor Storm)
FPI Neutral Wind Result
Summary & Future Work

• Current work in general agreement with previous climatological studies
• Spring vs Autumn had slight differences, but non-negligible

• More exploration into Spring and Autumn variances
• Connect with geomagnetic storms and magnetic reconnection
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