

Climatology of Thermospheric Neutral Winds over Millstone Hill

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Introduction

Background

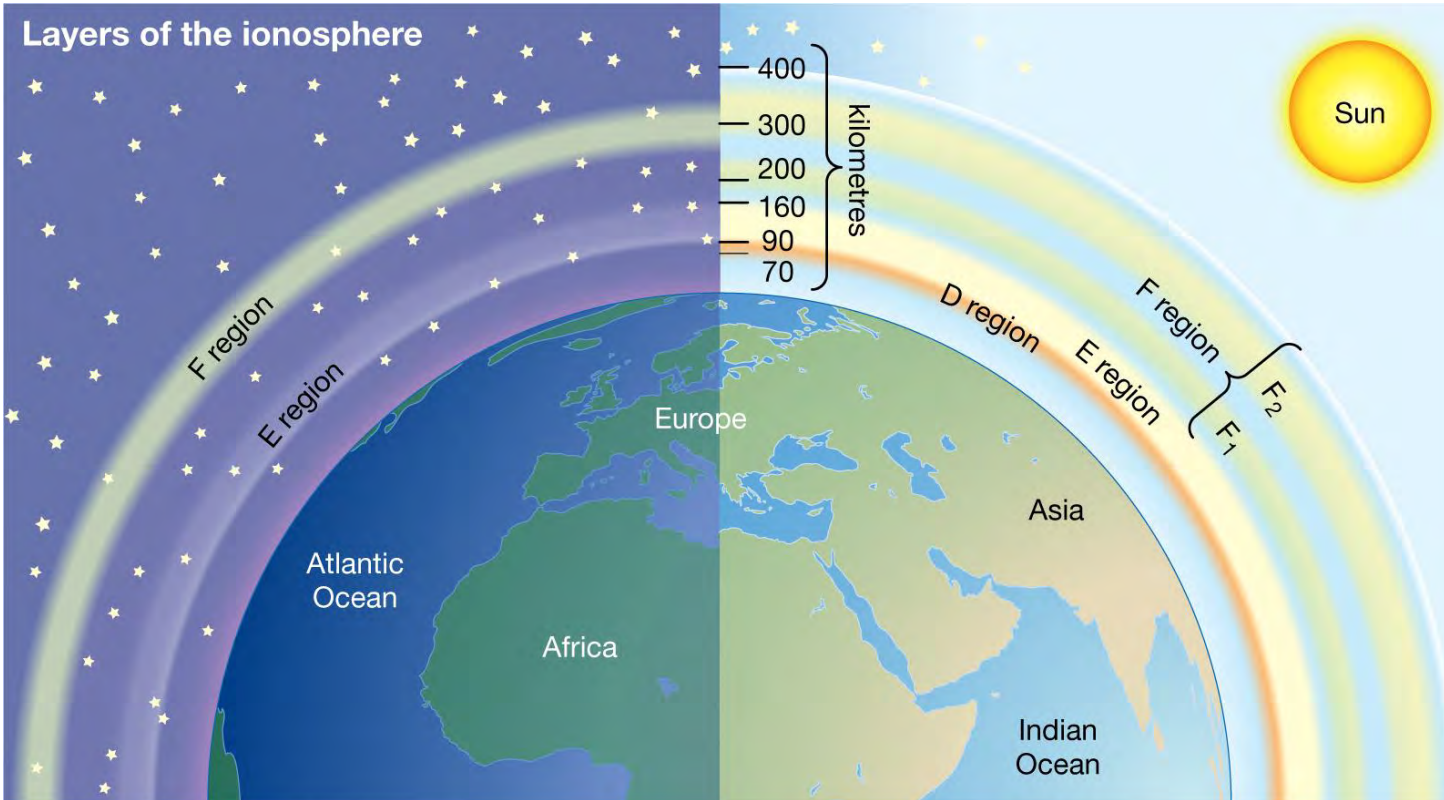
- Uses Fabry-Perot Interferometer (FPI) measurements
- Uses Millstone Hill incoherent scatter radar (MHISR) database
- Investigates thermospheric zonal and meridional neutral wind response to geomagnetic storms and subauroral polarization stream



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

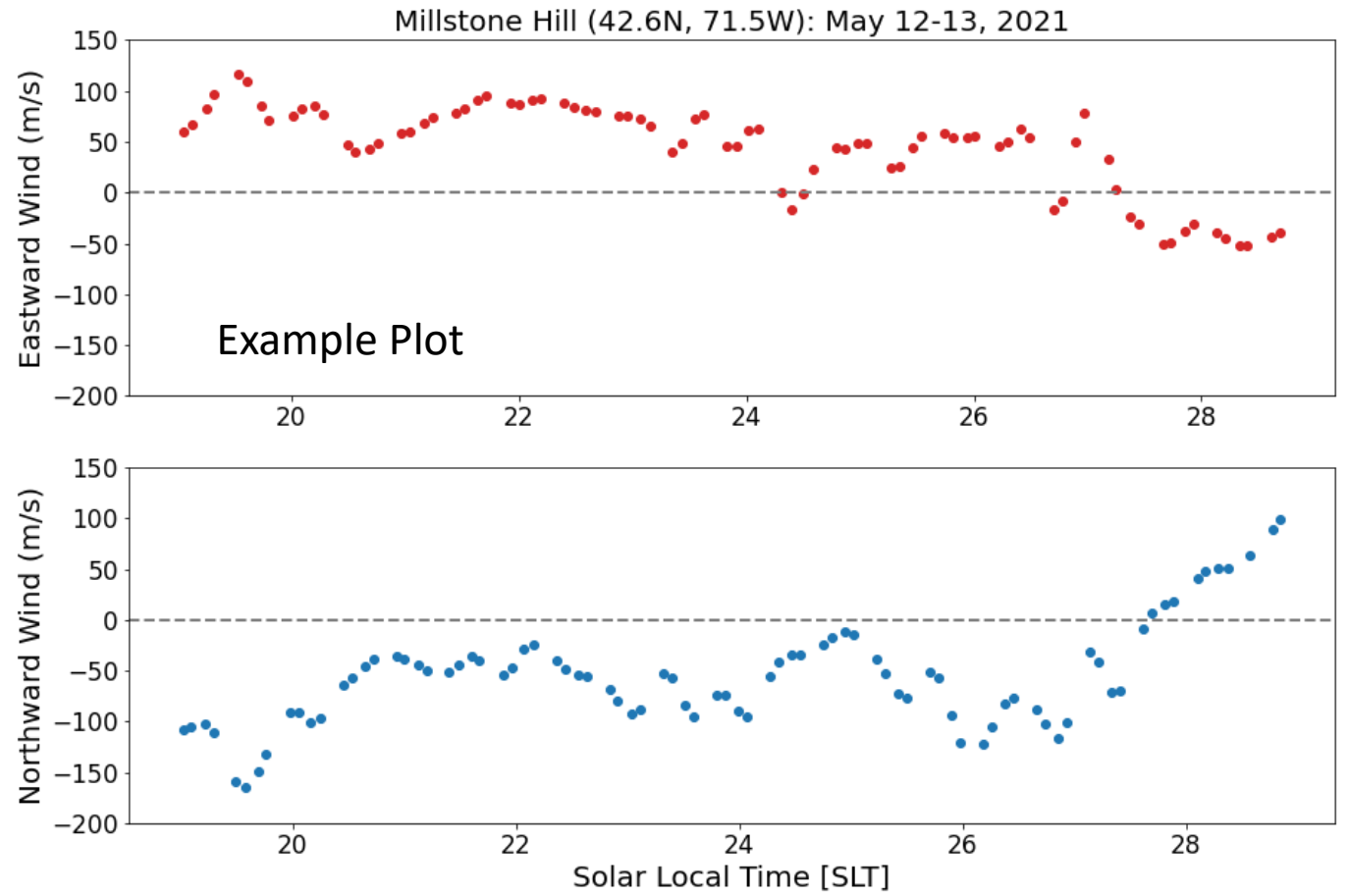


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Instruments & Data

Fabry-Perot Interferometer

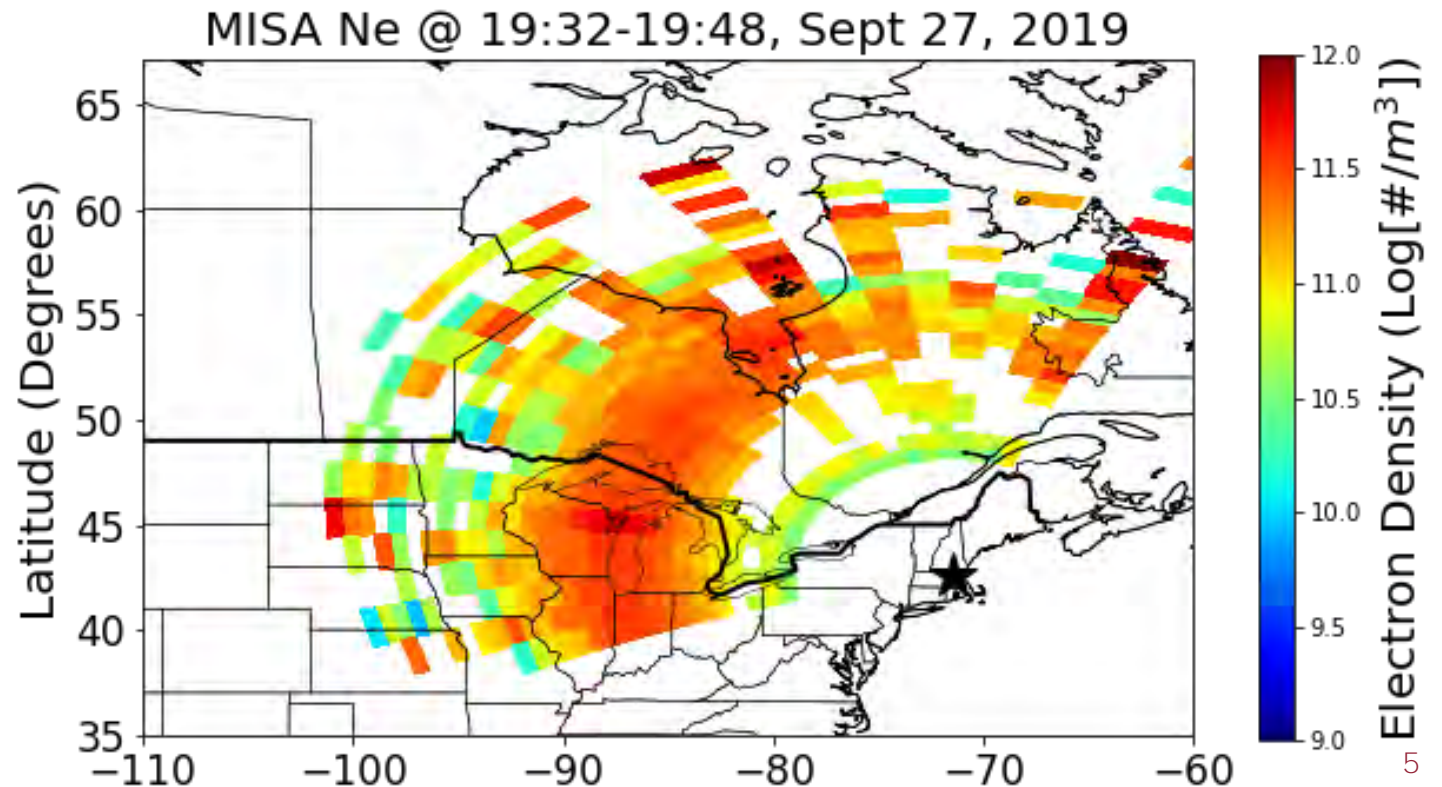
- Measures 630.0-nm nightglow emission at ~250km
 - Faint atmospheric coloring due to oxygen
- Historical Database (1989-2002) used extensively
- New Database (2009 – Present) needs further exploration



Instruments & Data

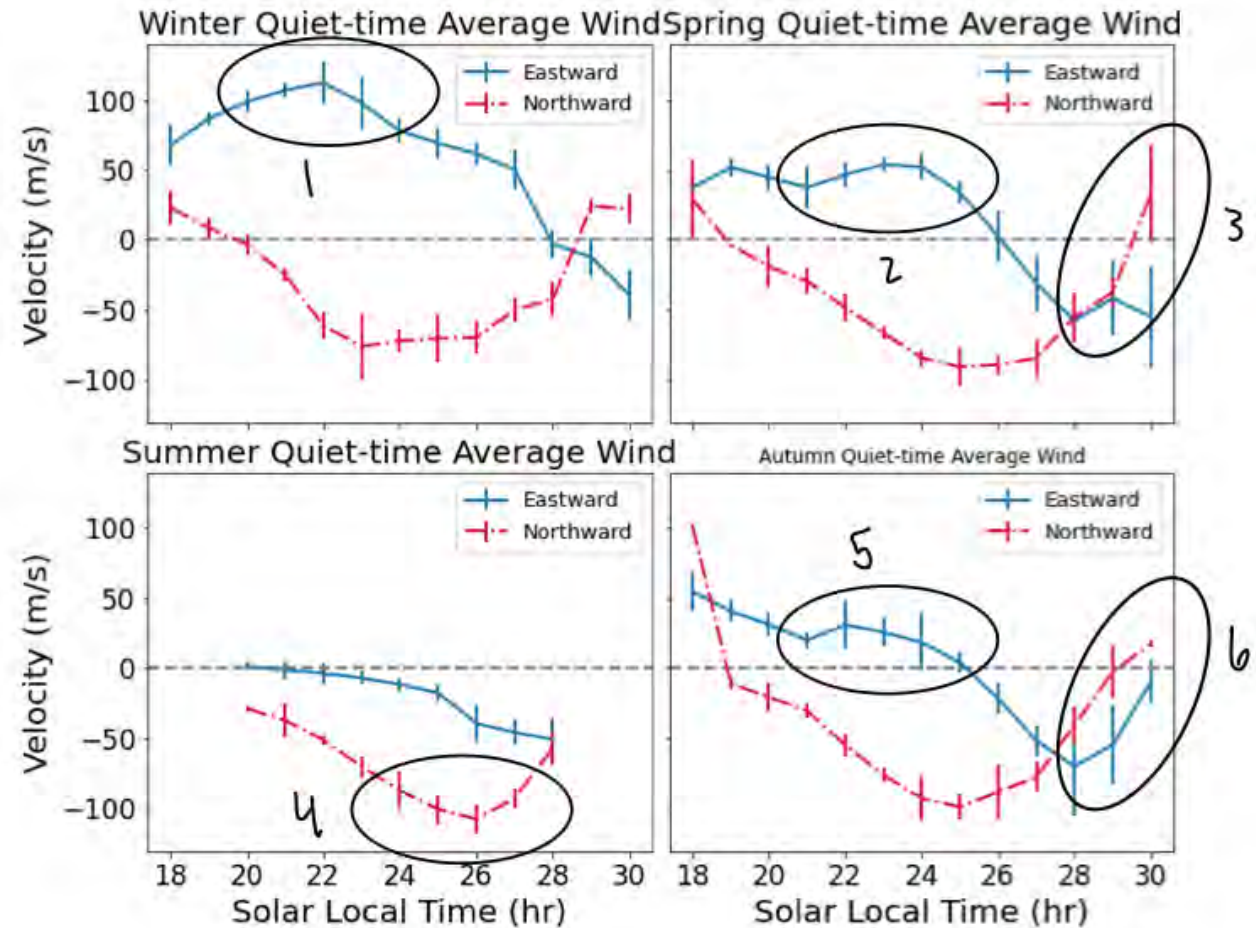
Incoherent Scatter Radar

- 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



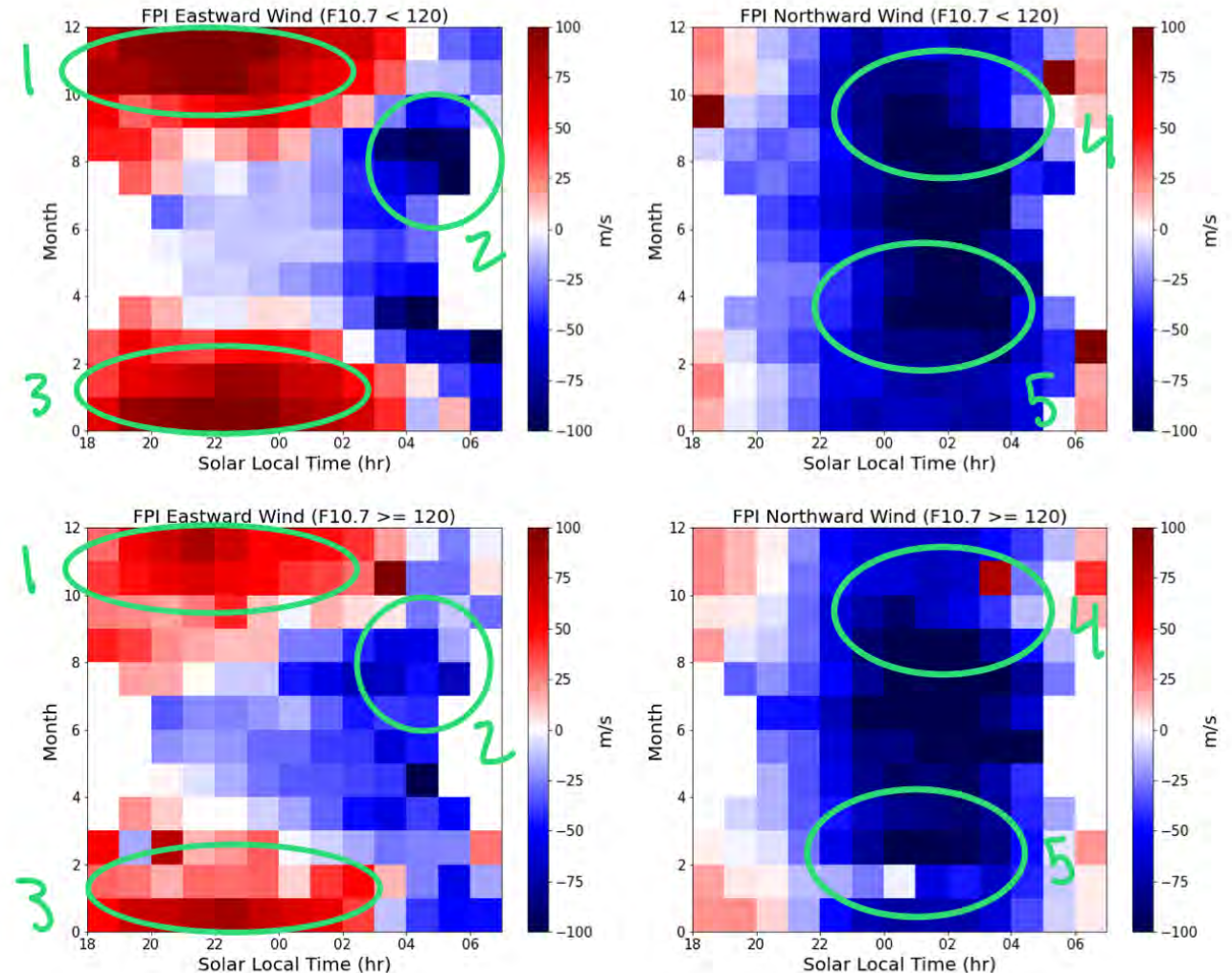
Results & Discussion: Quiet-time Neutral Wind Climatology

- Methodology
 - Seasonal Definitions
 - Variables

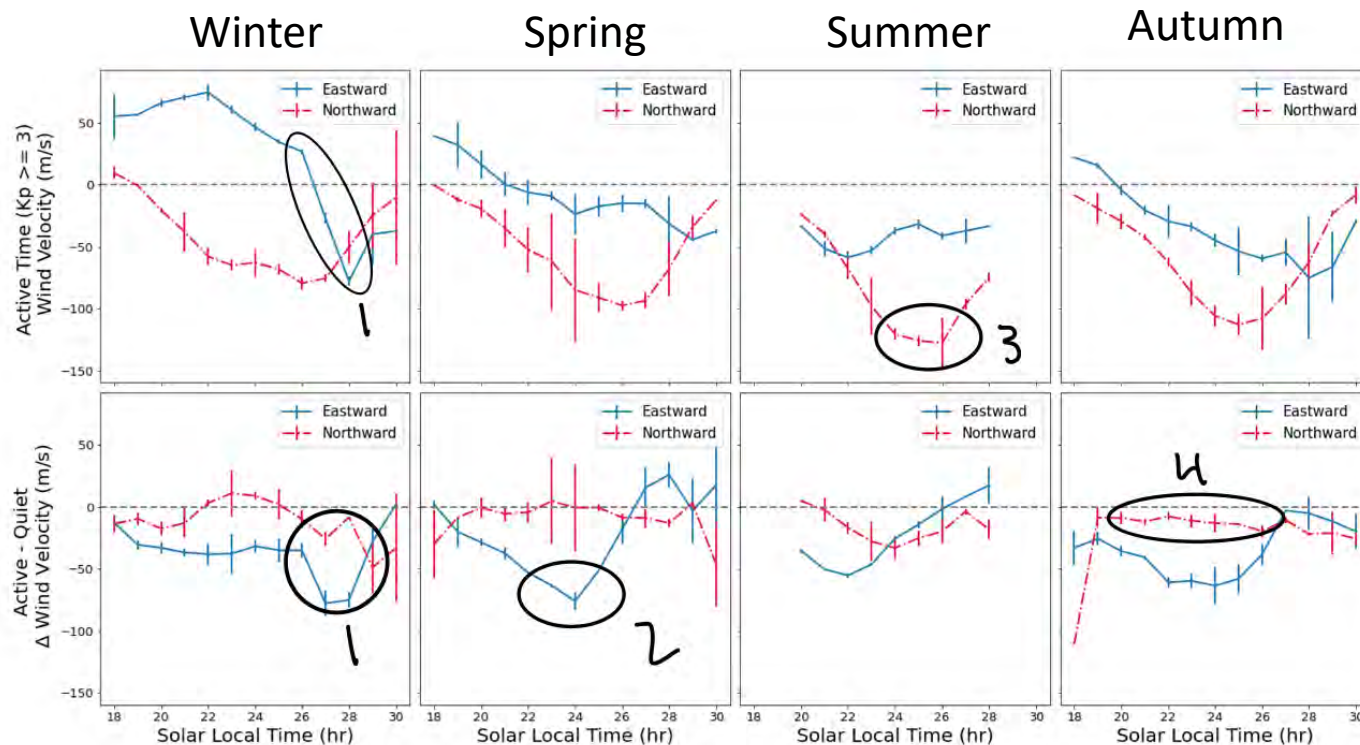


Results & Discussion: Quiet-time Neutral Wind Climatology

- Results
 - Agreement with previous climatological and seasonal variance studies
 - Spring vs. Autumn
 - Slight differences, but enough to be non-negligible



Results & Discussion: Active/Storm Time Neutral Wind Climatology



- Active time
 - $K_p \geq 3$
 - 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

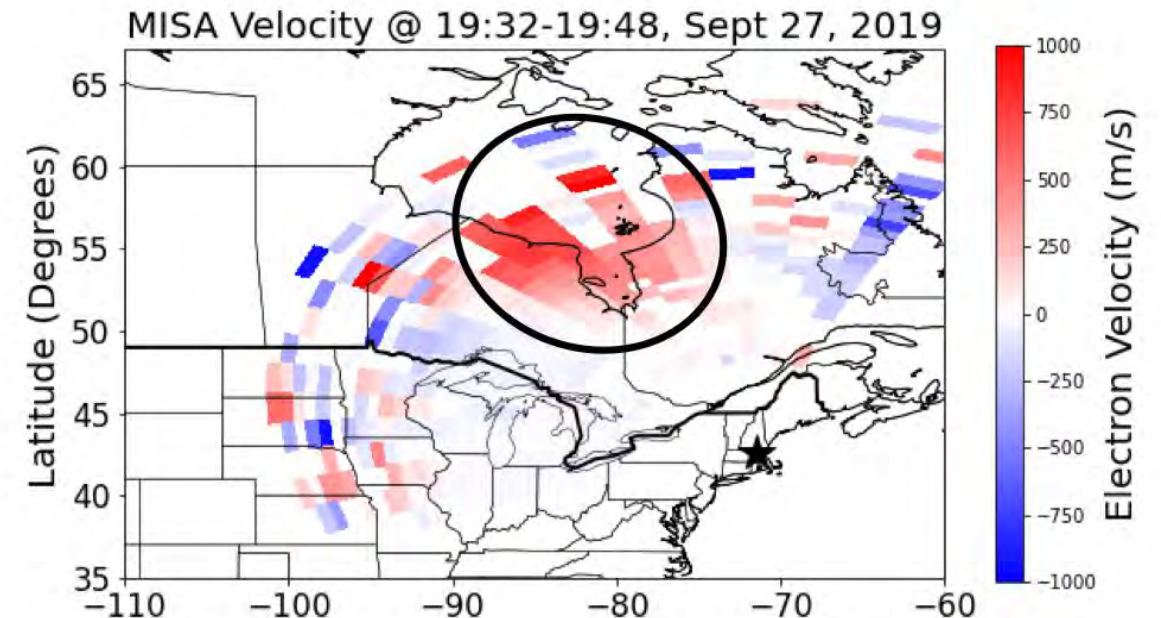
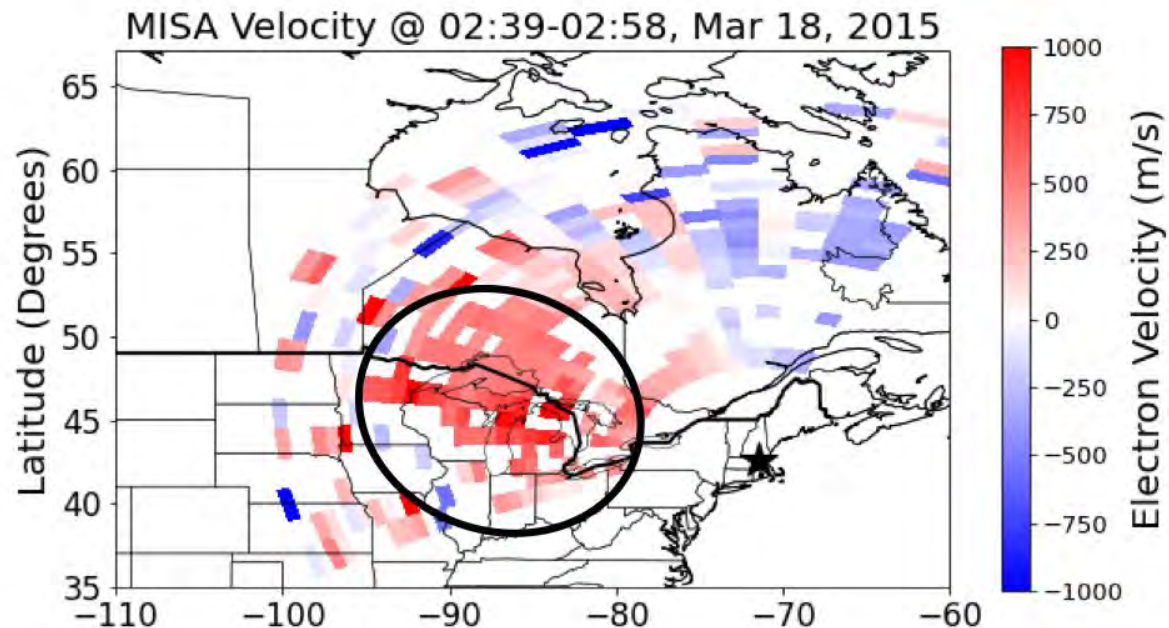
Results & Discussion: Wind Variation During SAPS Interval

17 March 2015 (Intense Storm)

MISA Plasma Drift Plot (21:45 – 22:05)

27 September 2019 (Minor Storm)

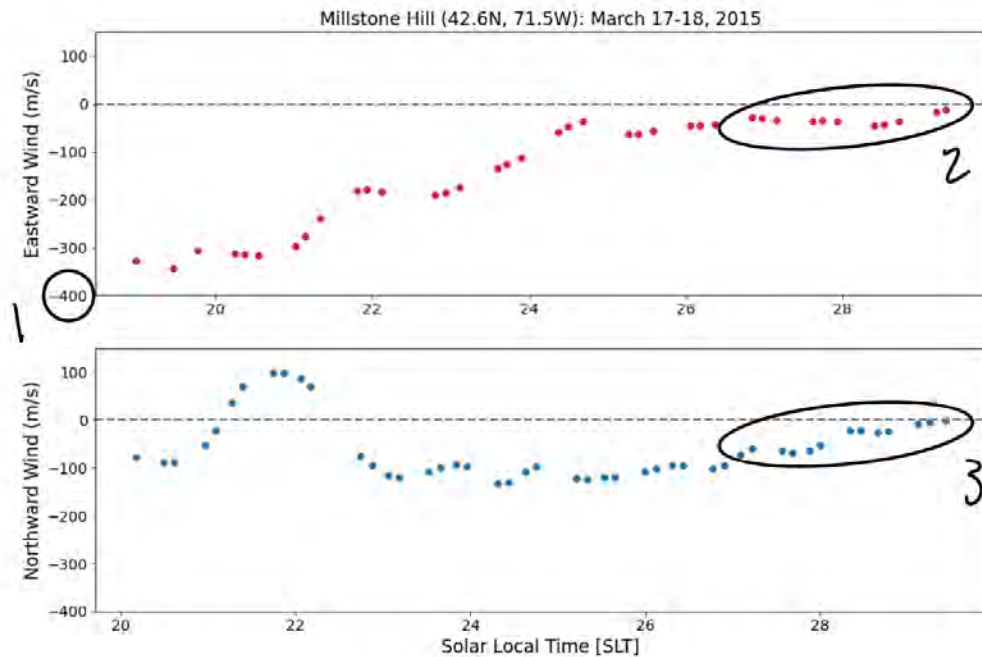
MISA Plasma Drift Plot (19:32 – 19:48)



Results & Discussion: Wind Variation During SAPS Interval

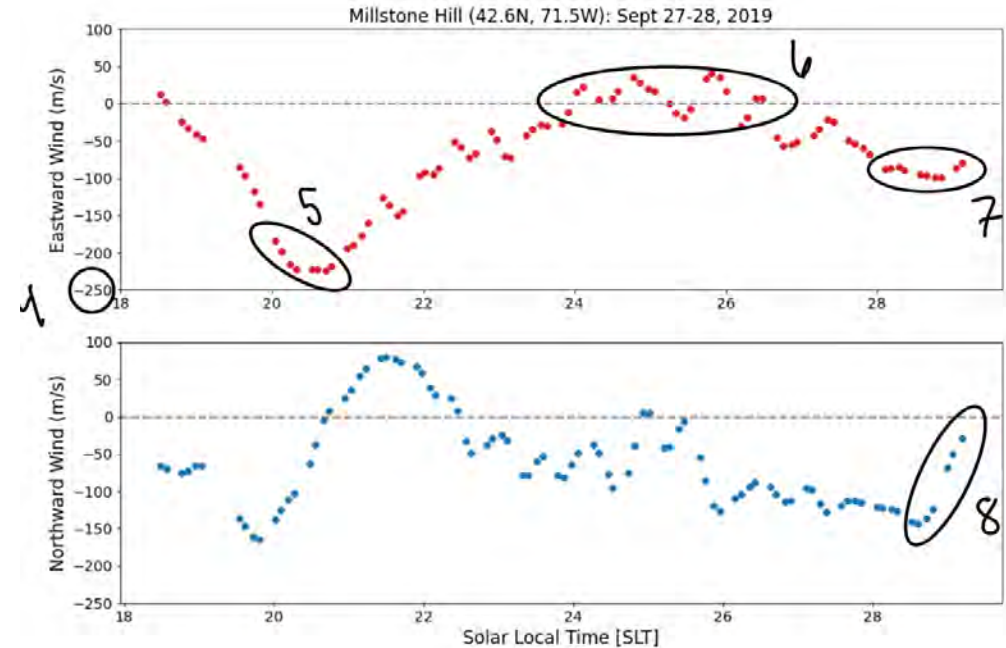
17 March 2015 (Intense Storm)

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

Acknowledgements

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