Comparing Ion Velocities on July 21st, 2021 to Previous Measurements

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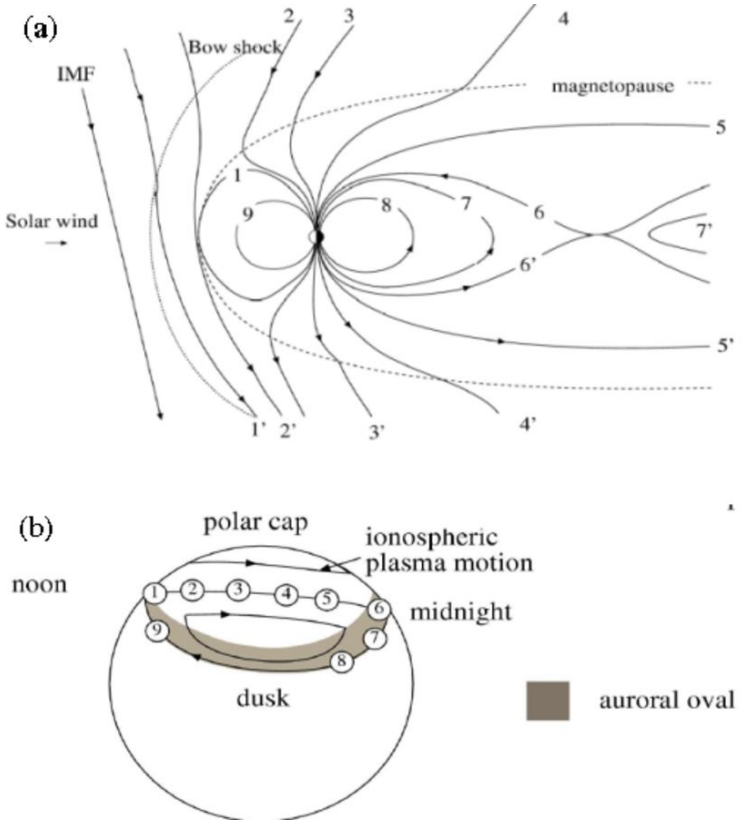
Outline

- Background to ionospheric convection.
- Experimental design and radar parameters.
- Our measured data and solar activity.
- Four comparison events and discussion.
- Summary.

Background

- IMF and Earth's magnetosphere create plasma convection.
- Ionospheric convection is confined to higher latitudes.
- Magnitude is highly dependent upon solar activity.
- F-region plasma flows anti-sunward over polar caps.



Credit: [High-latitude plasma convection (gfz-potsdam.de)]

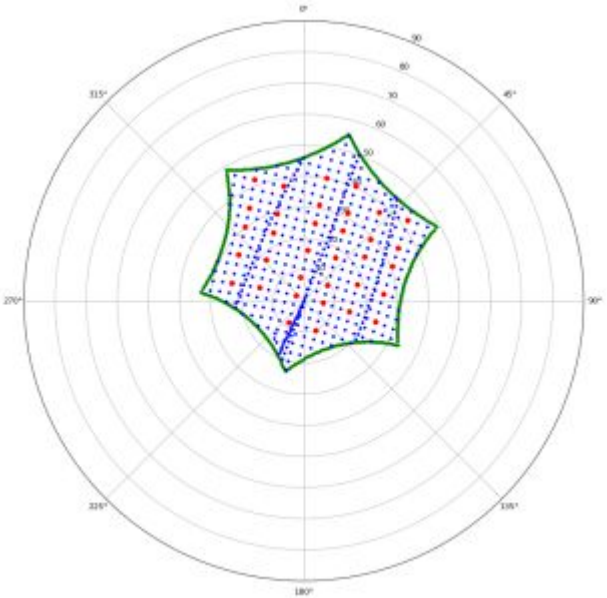
Experimental Outline

- Goal: Measure F-region ion velocity and compare across seasons and geomagnetic activity level.
- Other events include high and low activity.
- Find correlation between ion velocity and geomagnetic activity.

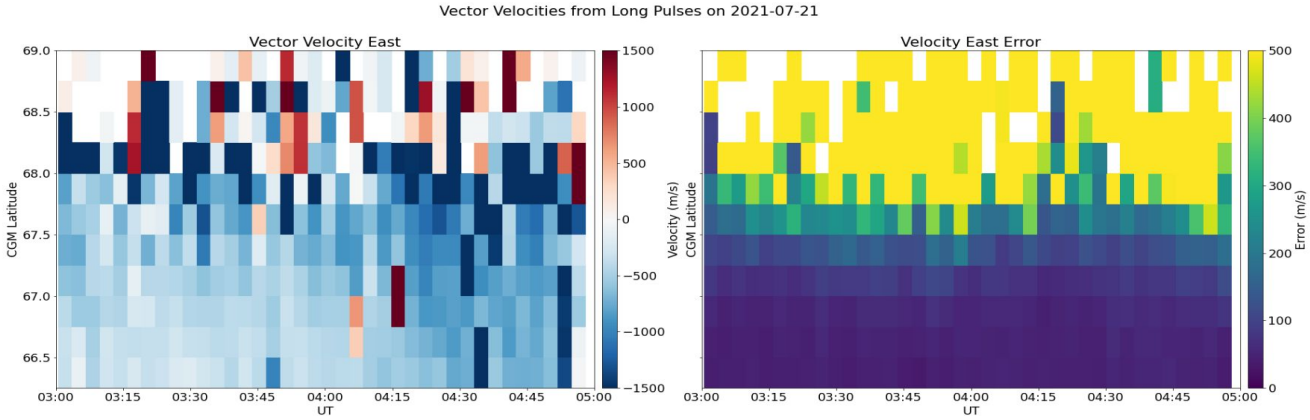
Comparison Event	Date
High activity, summer	June 29th, 2013
High activity, winter	November 14th, 2012
Low activity, summer	June 20th, 2020
Low activity, winter	February 21st, 2015

Radar Parameters

Experimental Parameter	Parameter Type
Pulse Type	Uncoded long pulse
Number of Frequencies	Tri-frequency
Number of Samples	330 μs pulse, 20 μs samples
Beam Setup	34 beam measurements
Date and Time	07/21/2021, 3:00-5:00 UT

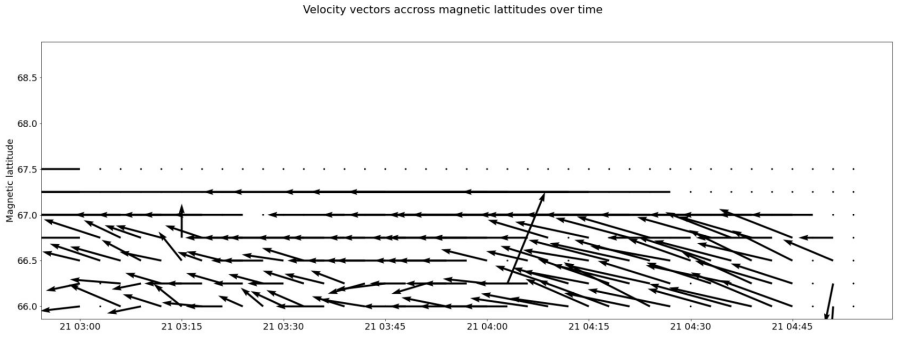


Data from July 21st, 2021

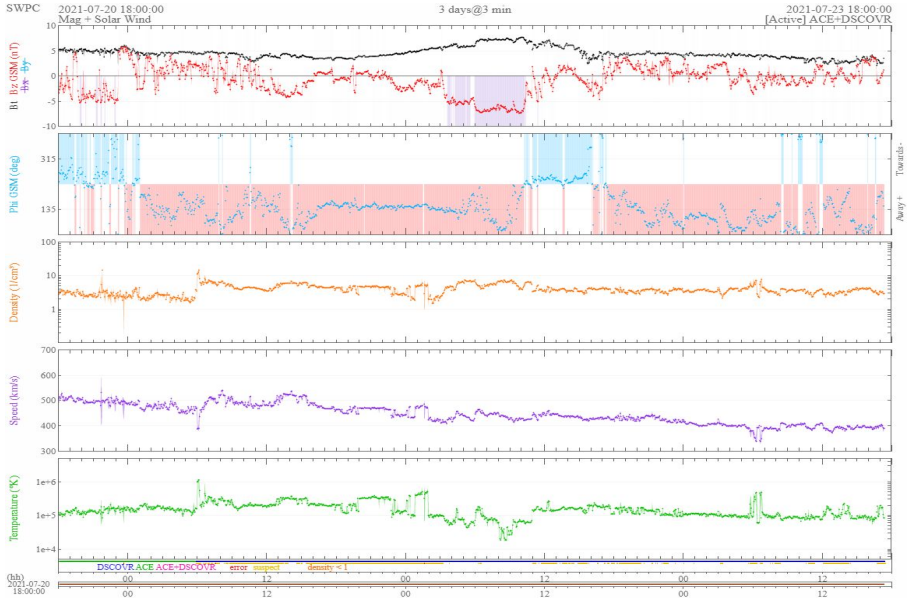


F region convection measurements made with the aforementioned custom beam pattern

Overall trend of westward velocities, made clearer when plotting the velocity vectors over magnetic latitude



Geomagnetic Conditions on July 21st, 2021



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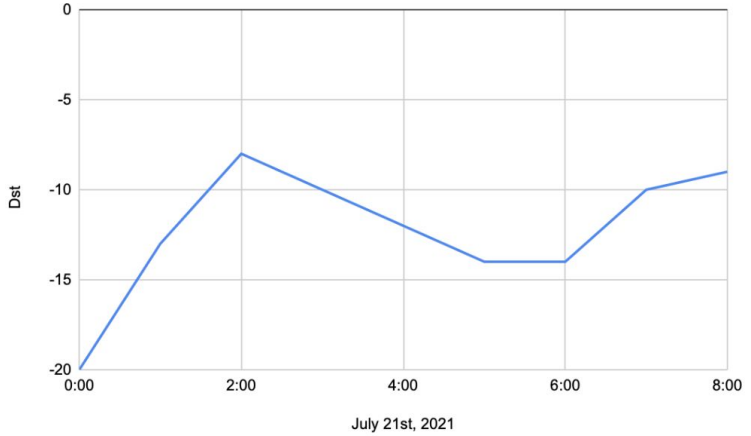
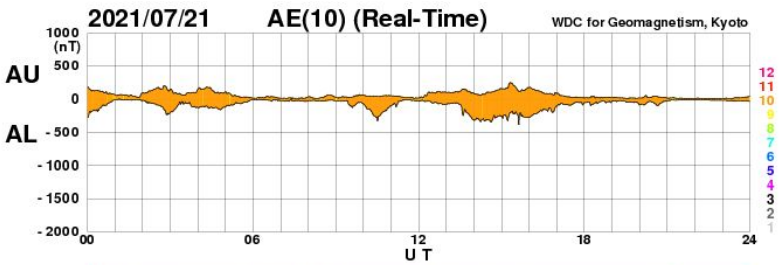
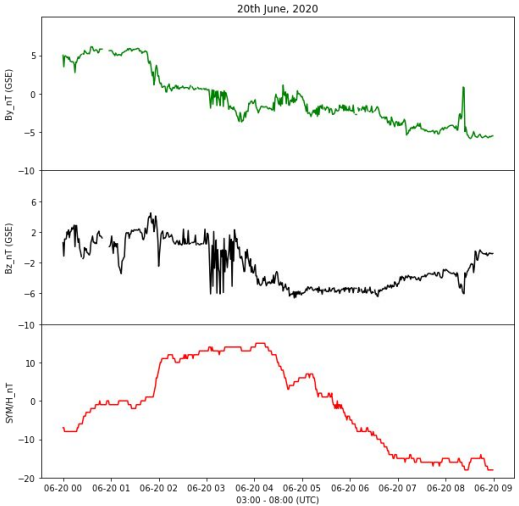
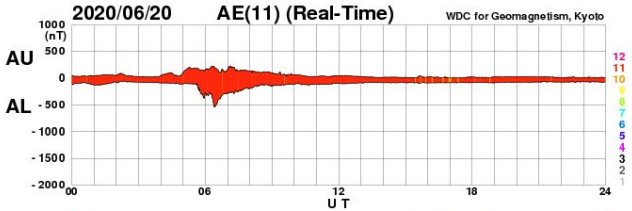




Quiet Summer Event - June 20th 2020





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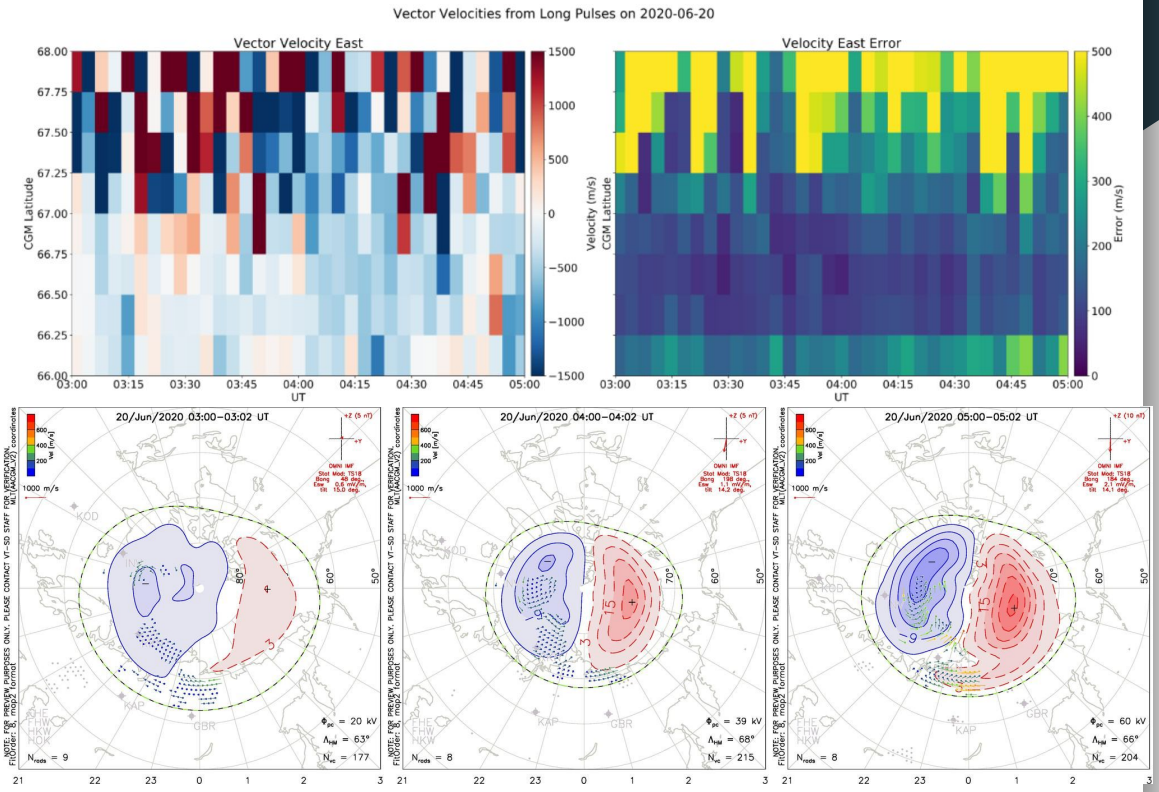
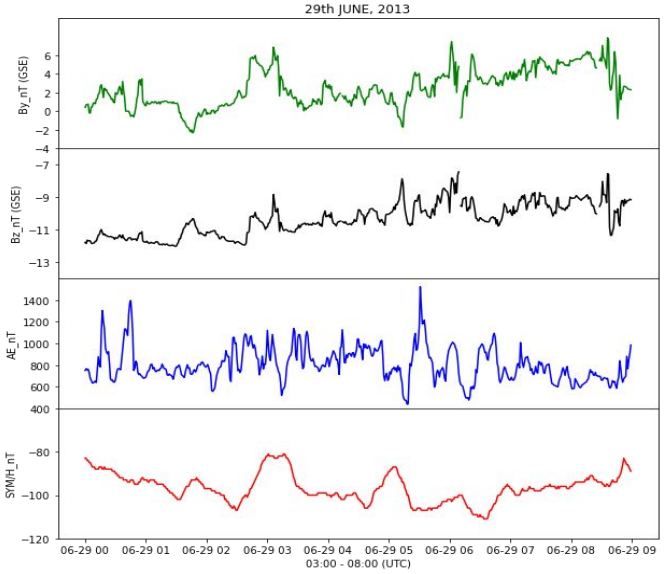


Active Summer Event - June 29th 2013



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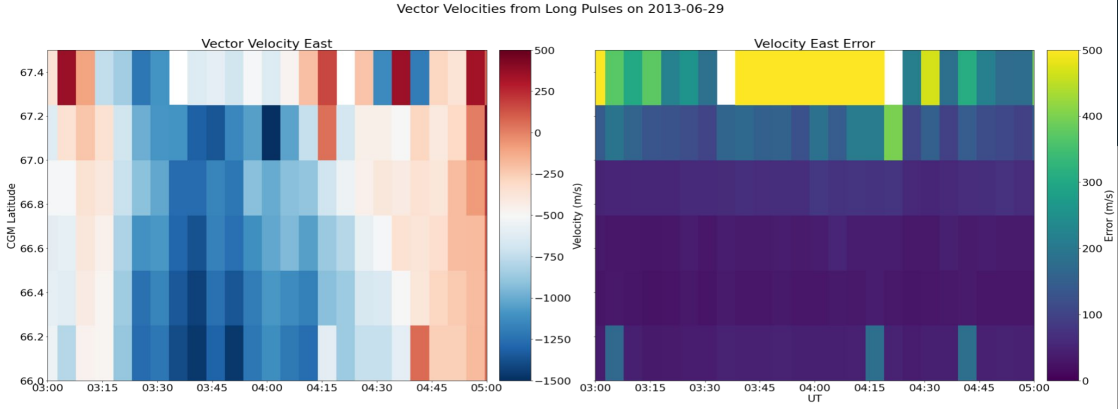
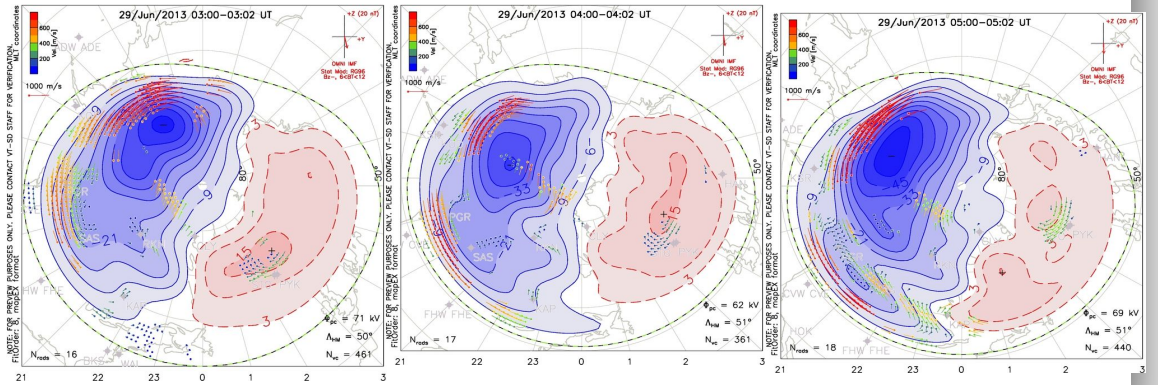
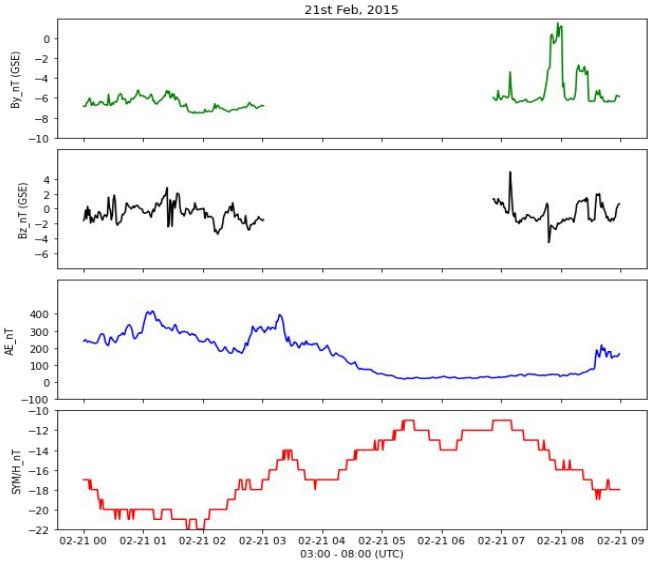




Quiet Winter Event - Feb 21st 2015



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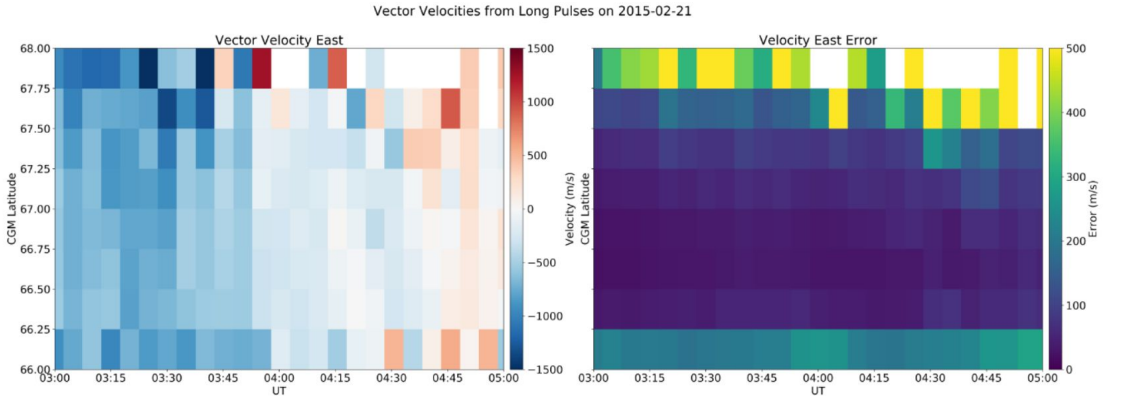
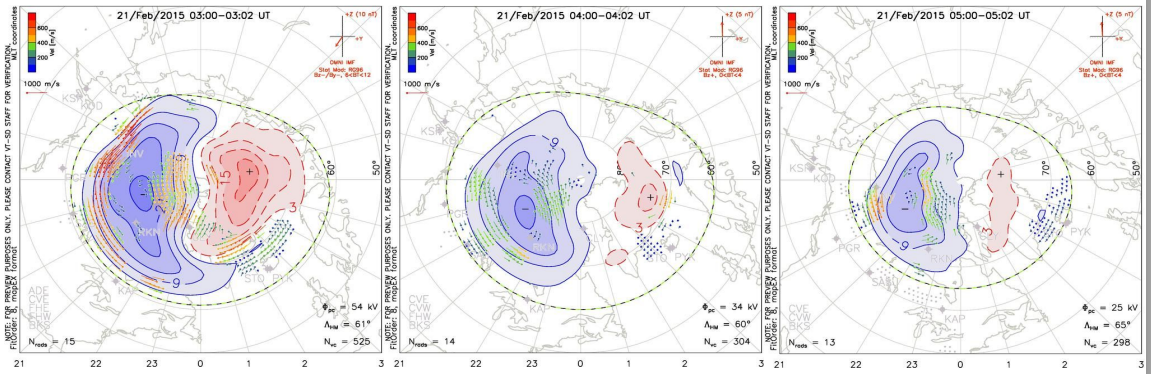
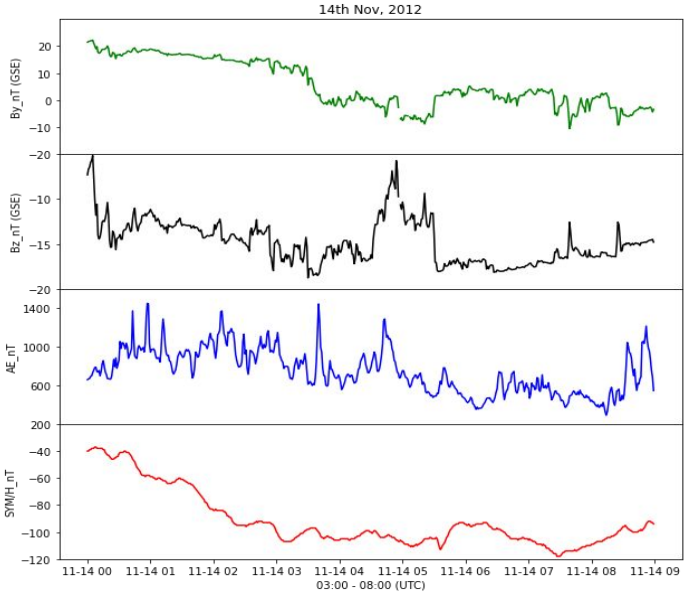




Active Winter Event - Nov 14th 2012



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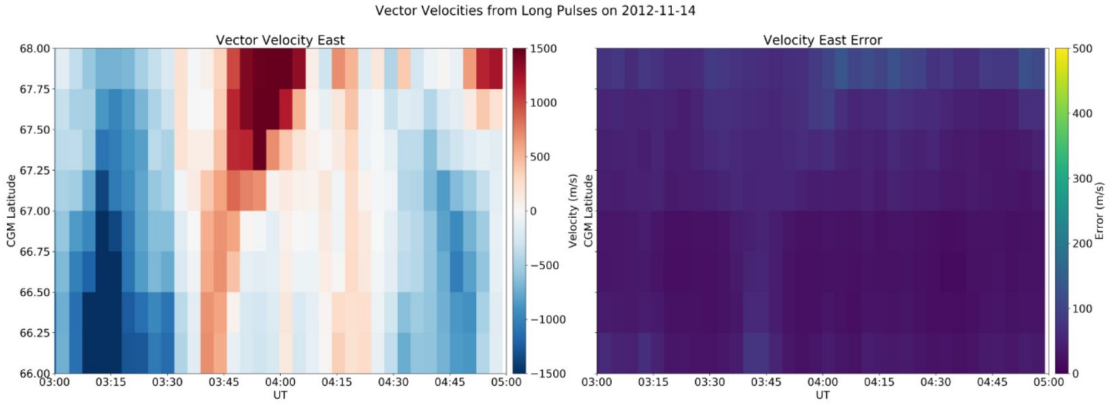
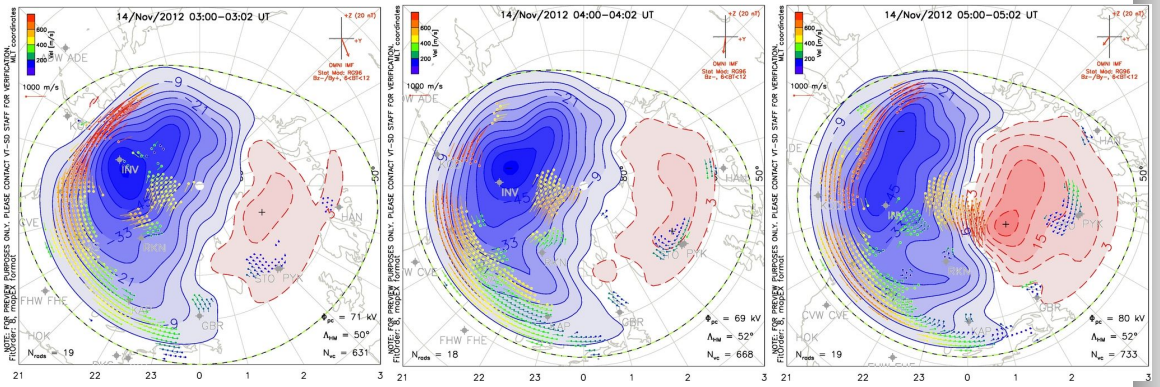
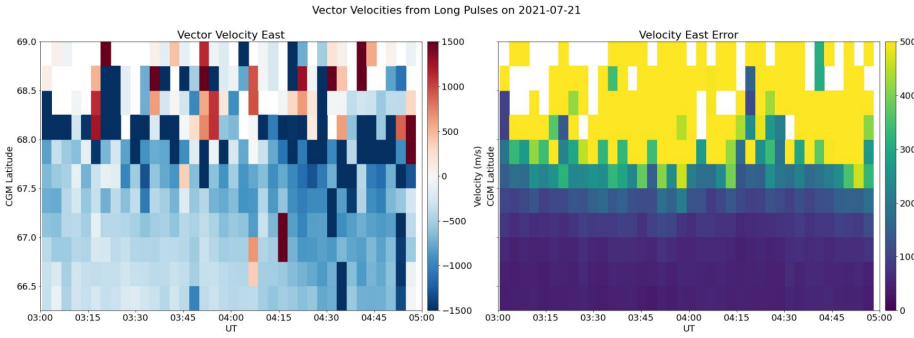
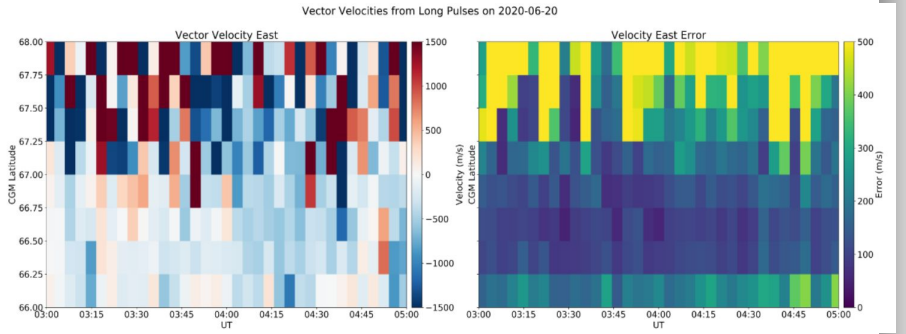


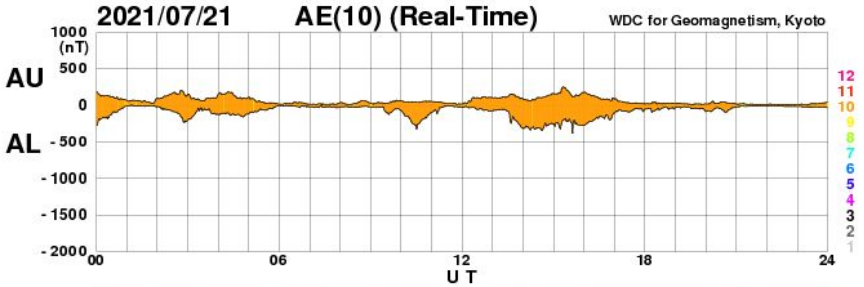


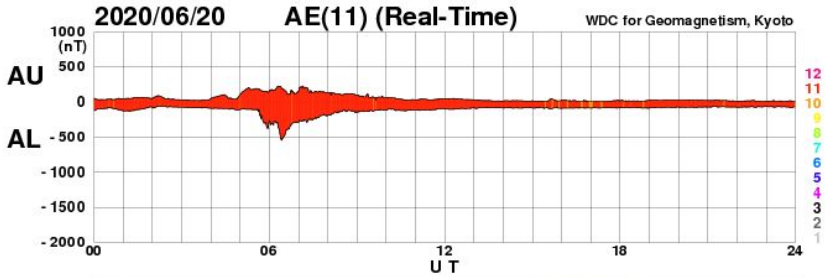
Discussion: Current vs. Quiet Summer

- Our event has slightly higher AE than the June 2020 event
- Our current event is on par with what is expected for this season and geomagnetic conditions



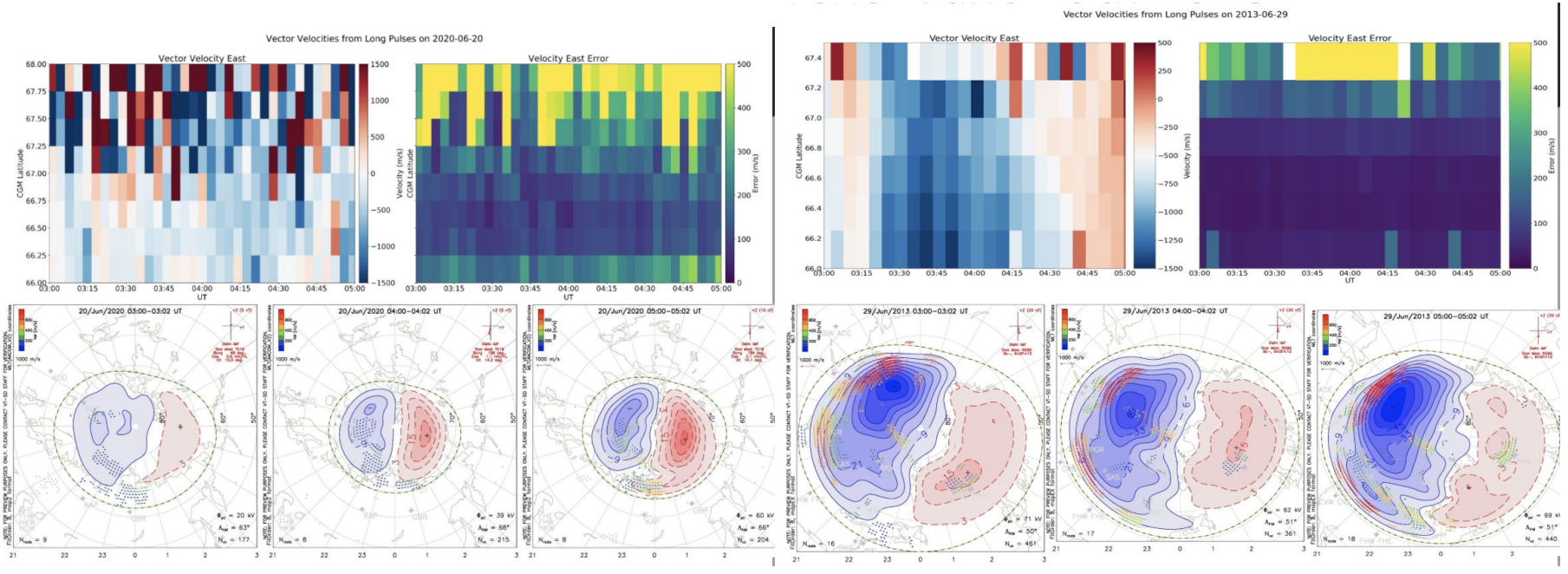






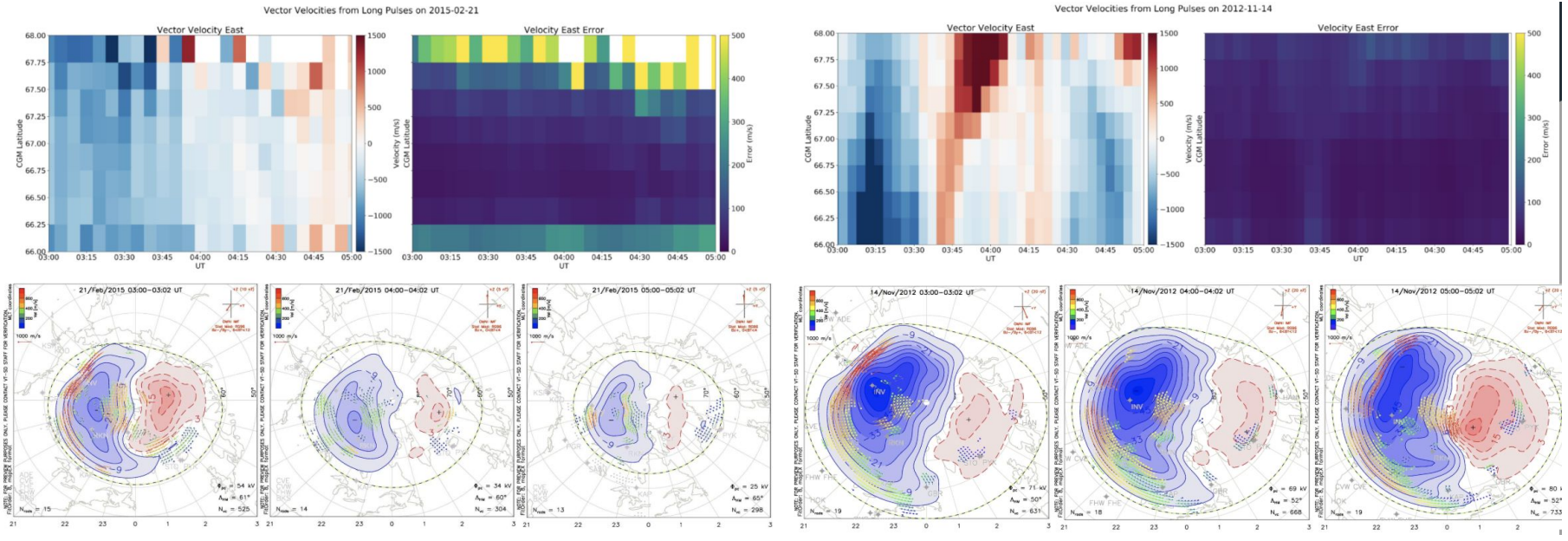
Discussion - Quiet Summer vs. Active Summer

- Convection is stronger during geomagnetically active periods, which results in stronger plasma flow



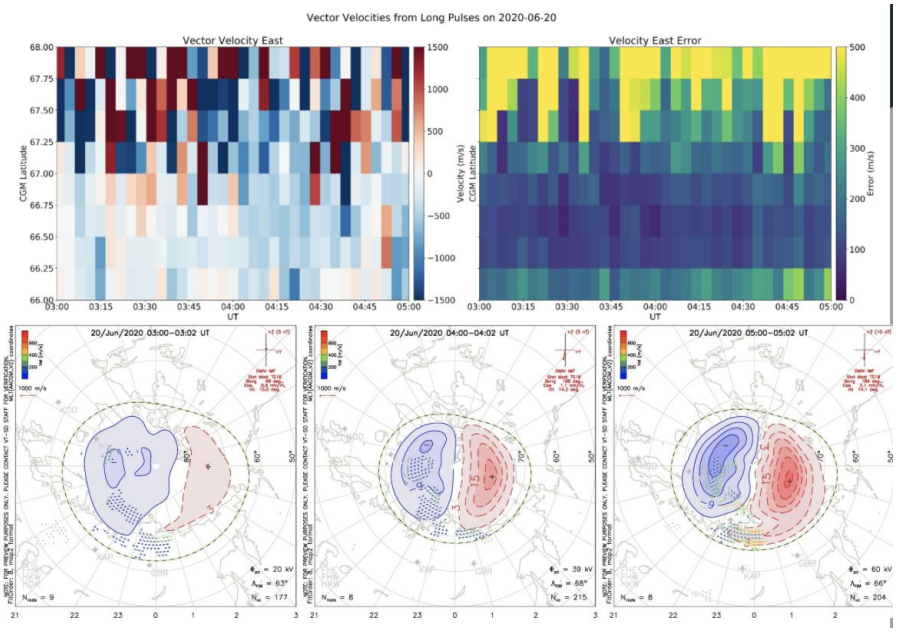
Discussion: Quiet Winter vs. Active Winter

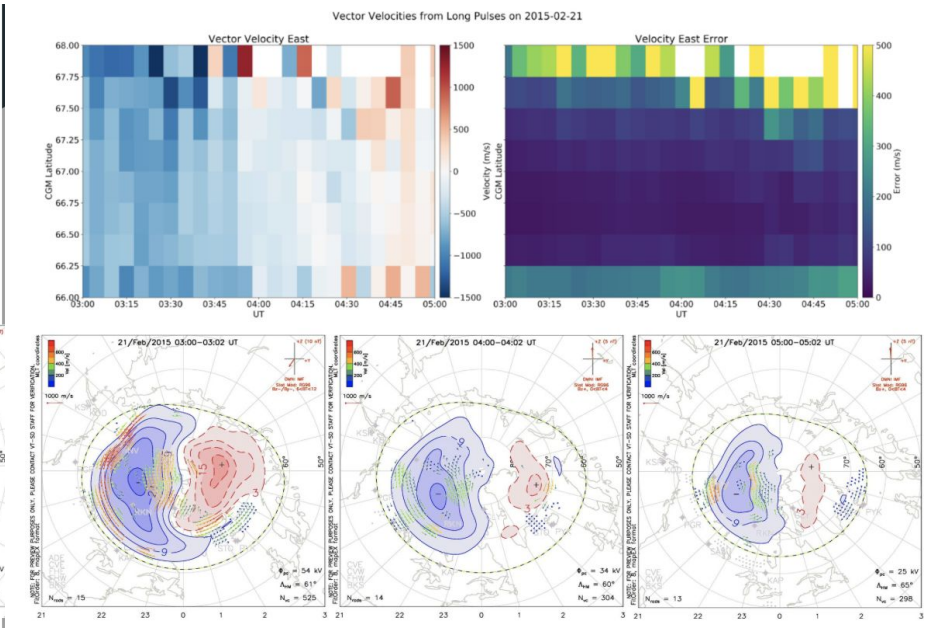
- Again, convection is stronger during the geomagnetically active period, which results in stronger winds



Discussion: Quiet Summer vs Quiet Winter

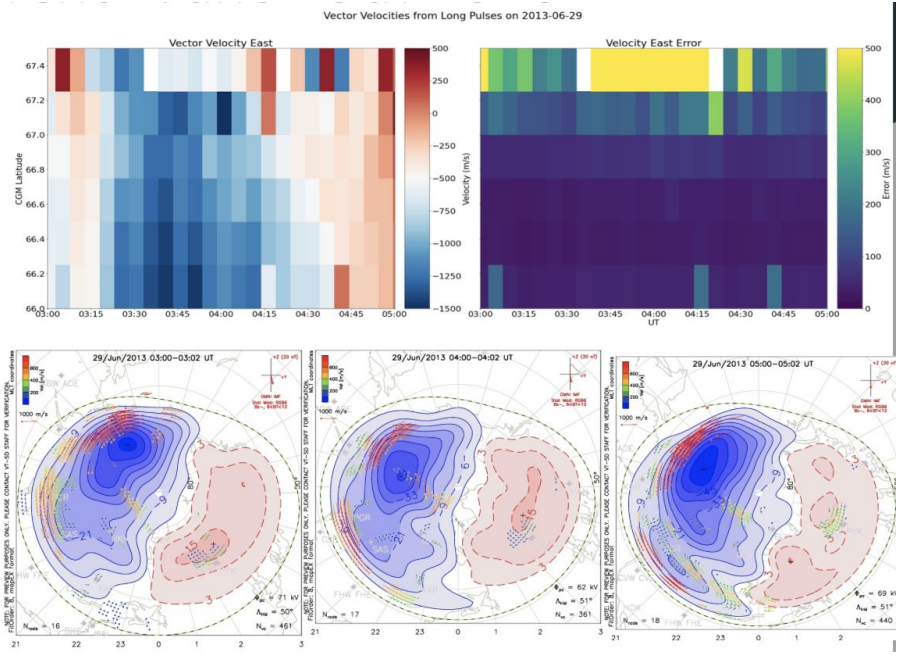
- Winter event actually has substorm with AE ~400nT
- Towards end of substorm (after 0400UT), convection maps look similar

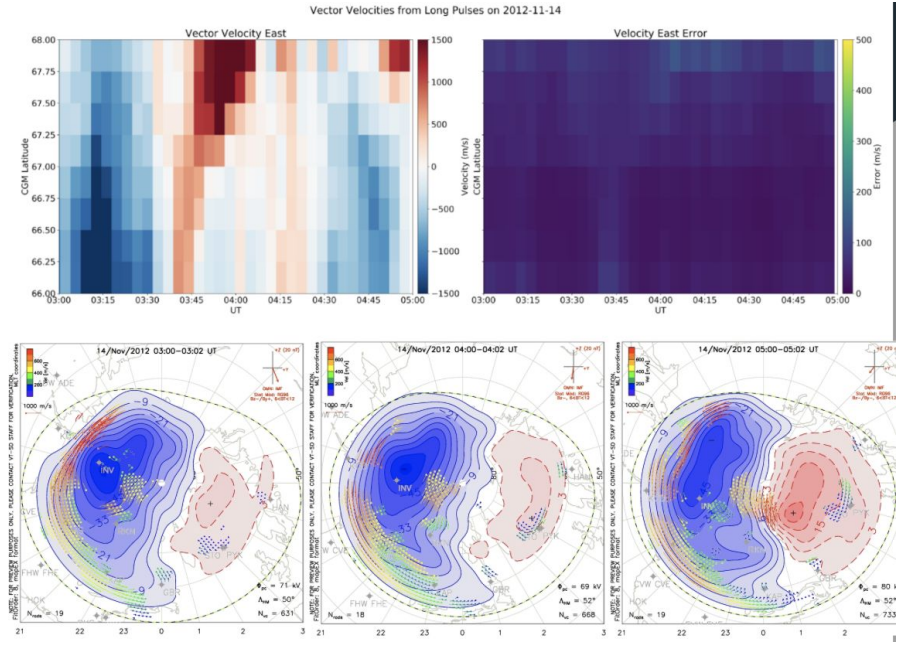




Discussion: Active Summer vs. Active Winter

- AE and SYM-H were similar, but B_z was slightly stronger in the winter event
- Convection and corresponding plasma flow are slightly stronger in the winter event





Summary and Conclusions

- Measured F-region ion velocities using a 34 beam, uncoded long pulse experiment
- Data from July 21st, 2021 showed weak westward winds, as expected for a quiet time event
- Comparison showed that quiet events showed weaker winds than active events
- Further comparison showed that there is not much variation in wind magnitude across seasons, though this conclusion might change with a larger data set
- Our data has proven that the ionospheric convection, and subsequent plasma flow, is heavily dependent upon solar activity

Thank you!
Questions?