

# Ion injection triggered EMIC wave activity and its association with enhanced convection periods

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# MOTIVATION

Major drivers of magnetospheric EMIC waves:

- Compression of the dayside magnetospheric plasma by solar wind pressure pulses or shocks
- Geomagnetic storms

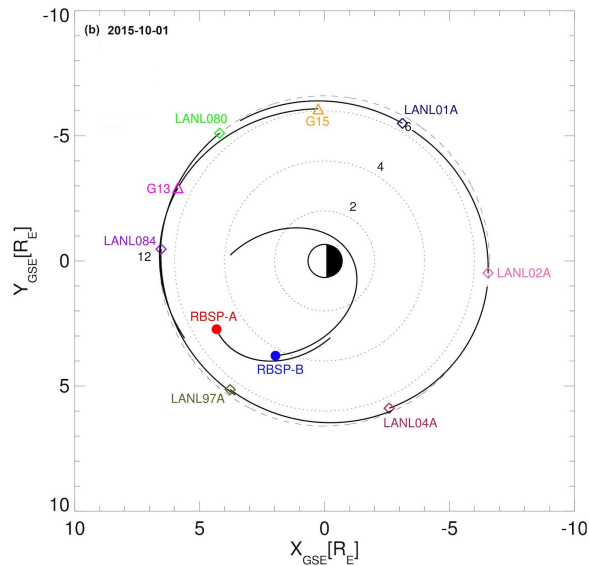
However, EMIC waves occur even in the absence of these two drivers!

- These non-storm time and non-pressure pulse EMIC events are found to be very well associated with individual nightside injections/substorms.
- Nevertheless, not all injections elicit wave activity.

Which injections/substorms favor EMIC wave growth?

# Event analysis: 01 October 2015

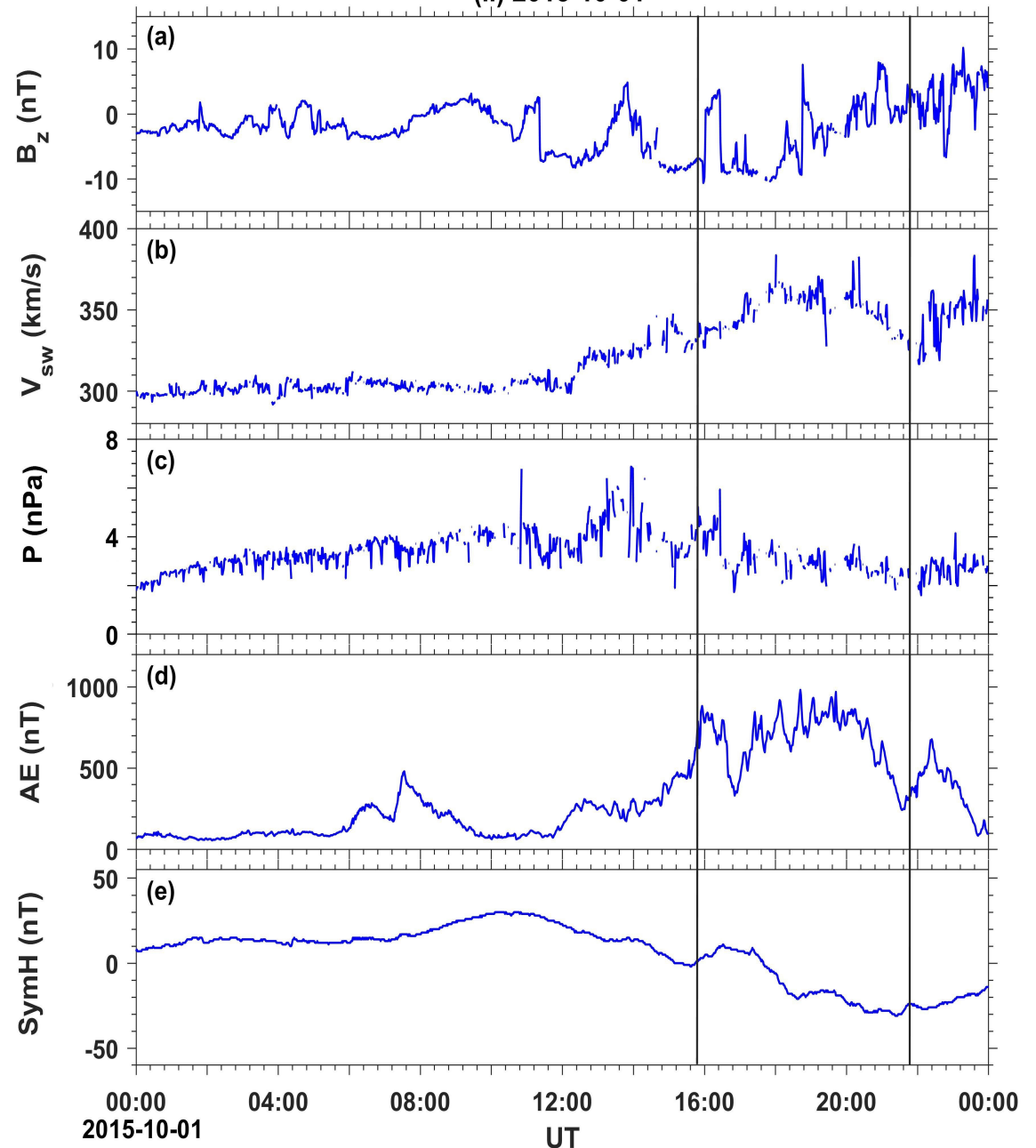
Orbits of LANL, and Van Allen Probes:  
1500-1900 UT

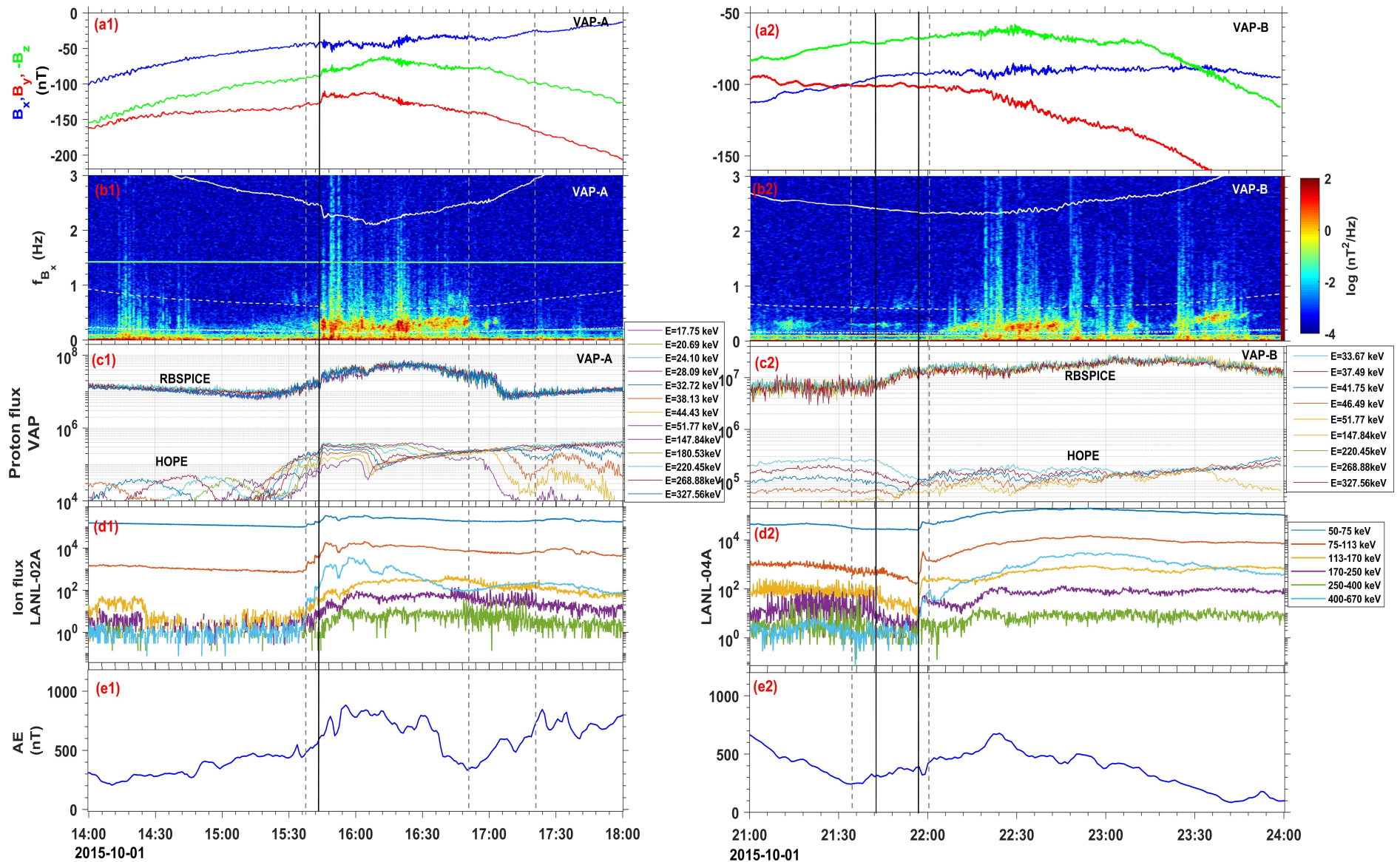


- IMF  $B_z$  southward for >2hrs, turning northward during the event.
- Gradually increasing solar wind speed.
- No drastic change in solar wind dynamic pressure ( $\leq 4$  nPa).
- Enhanced AE (>800 nT) and non-storm time SYM-H (-10 to -30 nT).

The black vertical lines are the start time of the injections observed either at LANL or RBSP.

(ii) 2015-10-01





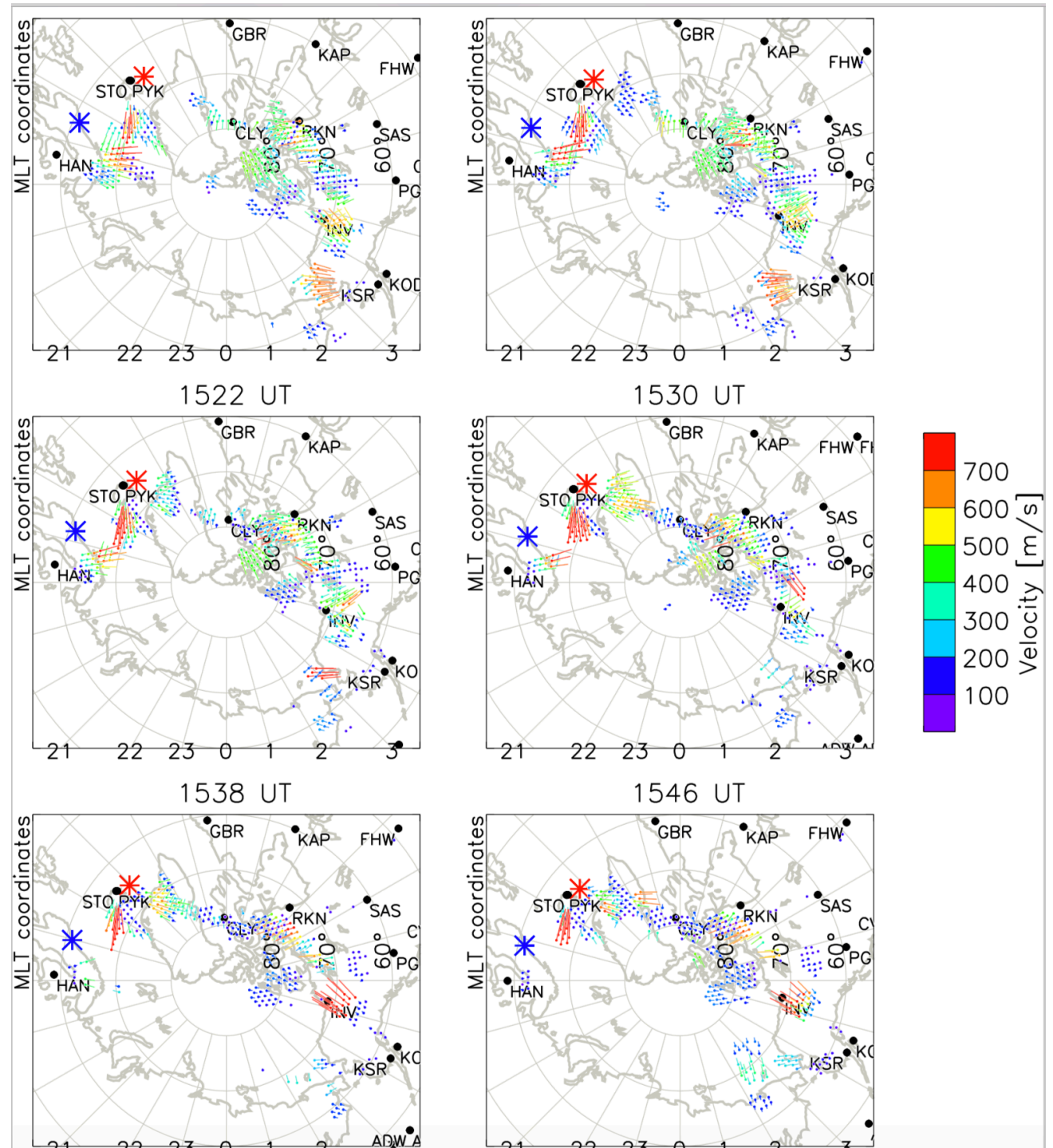


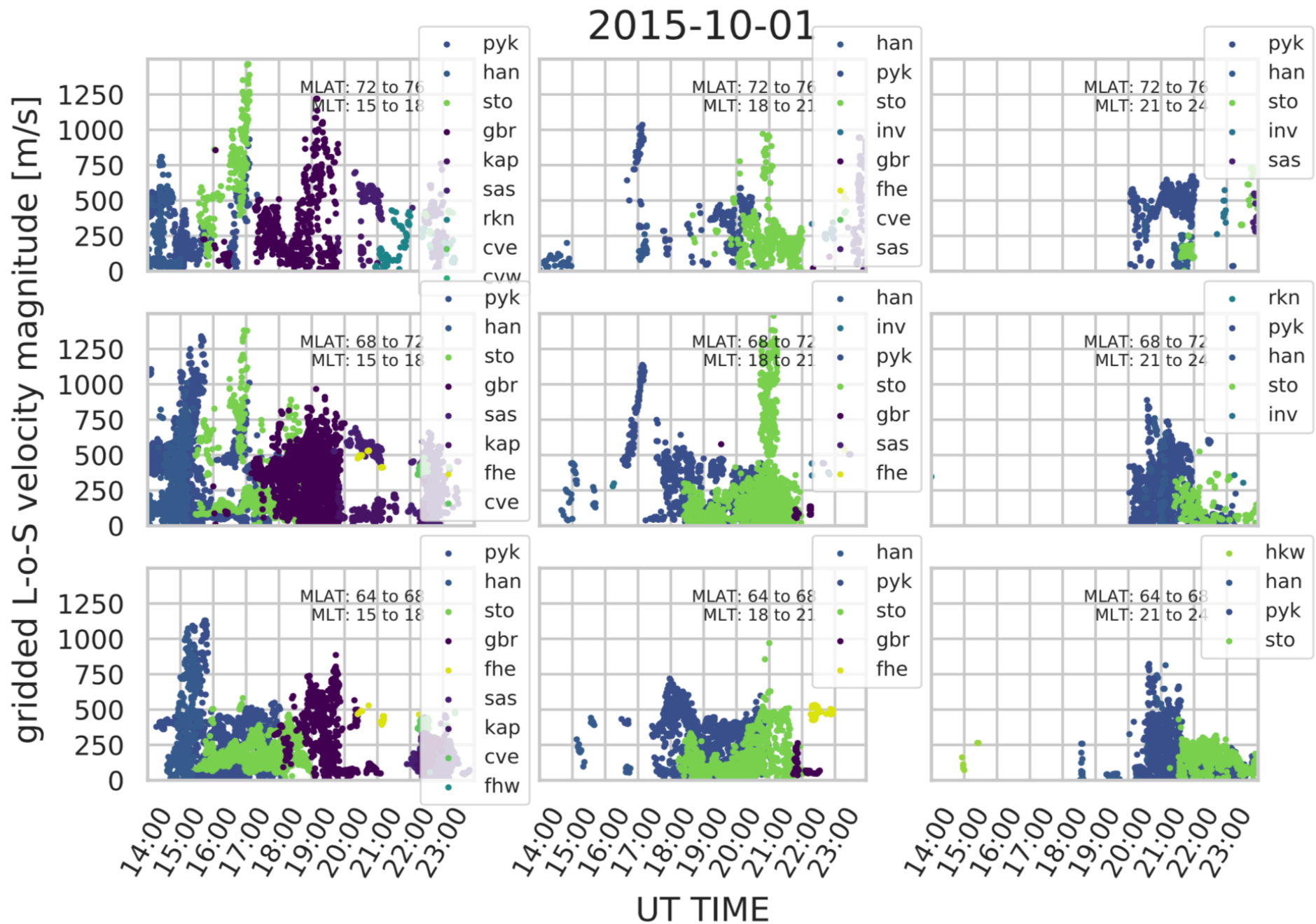
# Event description:

- Panels b1 and b2 shows strong helium band EMIC waves.
- Flux variations from VAP and LANL (located close to midnight) shown in panels c and d, respectively, indicate sudden rise in ion fluxes corresponding to the EMIC wave onsets at VAPs.
- Panels e1 and e2 show disturbed geomagnetic conditions during the event with AE index  $>650$  nT during both events.
- Substorm onset times from SuperMAG database are marked as grey dashed vertical lines which are well associated with the flux rise and corresponding EMIC wave onset times during the events.

Maps showing gridded line-of-sight velocity vectors derived from the northern hemisphere SuperDARN radars, between 15:00 - 16:00 UT on 01 October 2015. The velocities are color coded according to the scale on the right.

Panels show strong sunward ionospheric convection at dusk local times (14-18 MLT). The red and blue stars indicate the footpoint locations of Van Allen Probes A and B, respectively.





**Gridded L-o-S velocity magnitude. Each panel shows combined measurements from radars (shown in the legend) whose field of view scans the 4° MLAT and 3-hr MLT bin (top right corner).**

# Summary

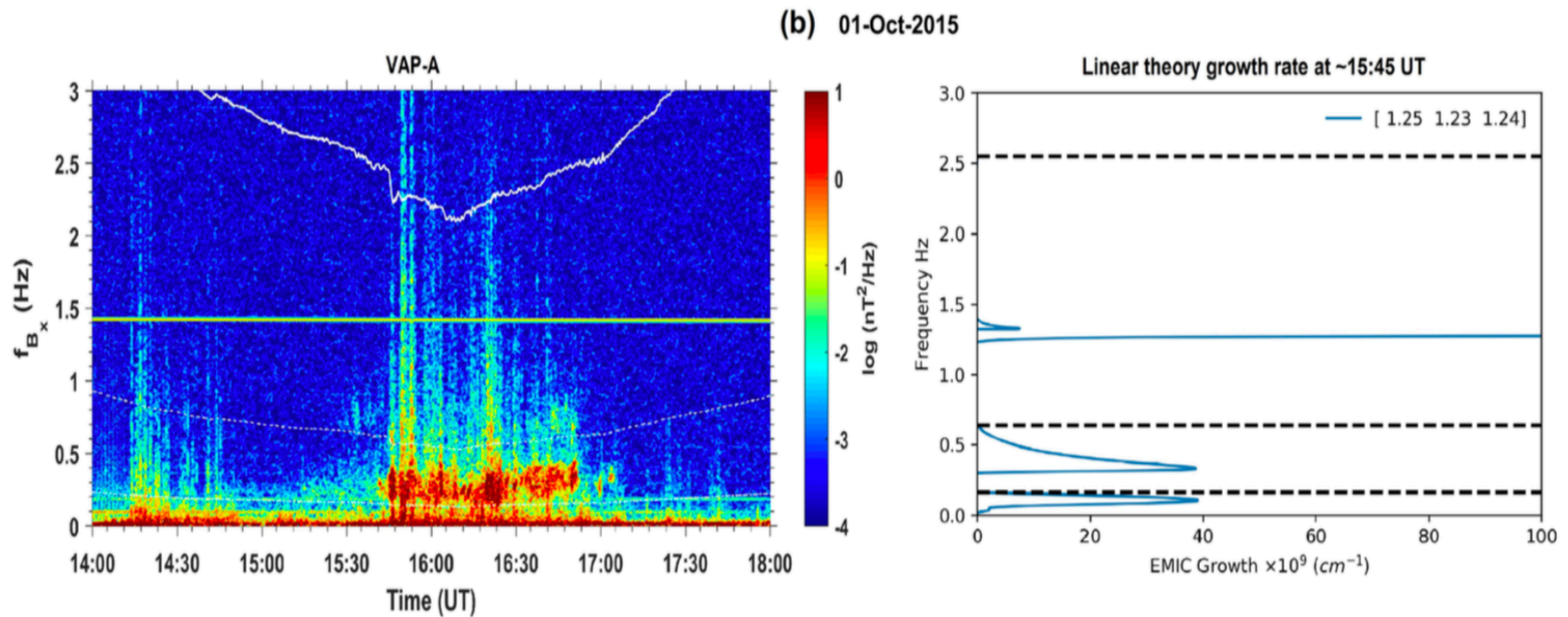
- ❖ Ion injections/substorms are found to favor EMIC wave growth in the absence of the other two major known drivers - geomagnetic storms and solar wind pressure pulses (dayside compressions).
- ❖ Magnetic field and plasma conditions during injections/substorms favor EMIC wave growth in the dusk or pre-midnight sectors (14-22 MLT).
- ❖ An association between EMIC wave enhancements and enhanced convection periods during injections/substorms are reported. Enhanced high-latitude ionospheric plasma flow velocities are strong manifestations of enhanced magnetospheric convection.
- ❖ Strong convection helps push more particles deeper and faster into the magnetosphere leading to unstable ion distributions that possibly favor wave growth.

*Thank you....*

Back up slides



## Linear growth rate calculations



The magnetic field power spectral density for the EMIC waves observed by VAP-A (left-hand panel) and the calculated linear theory convective growth rates (in  $\text{cm}^{-1}$ ) for observed parameters (right-hand panel). The calculated peak EMIC wave power matches well with observed wave frequencies.