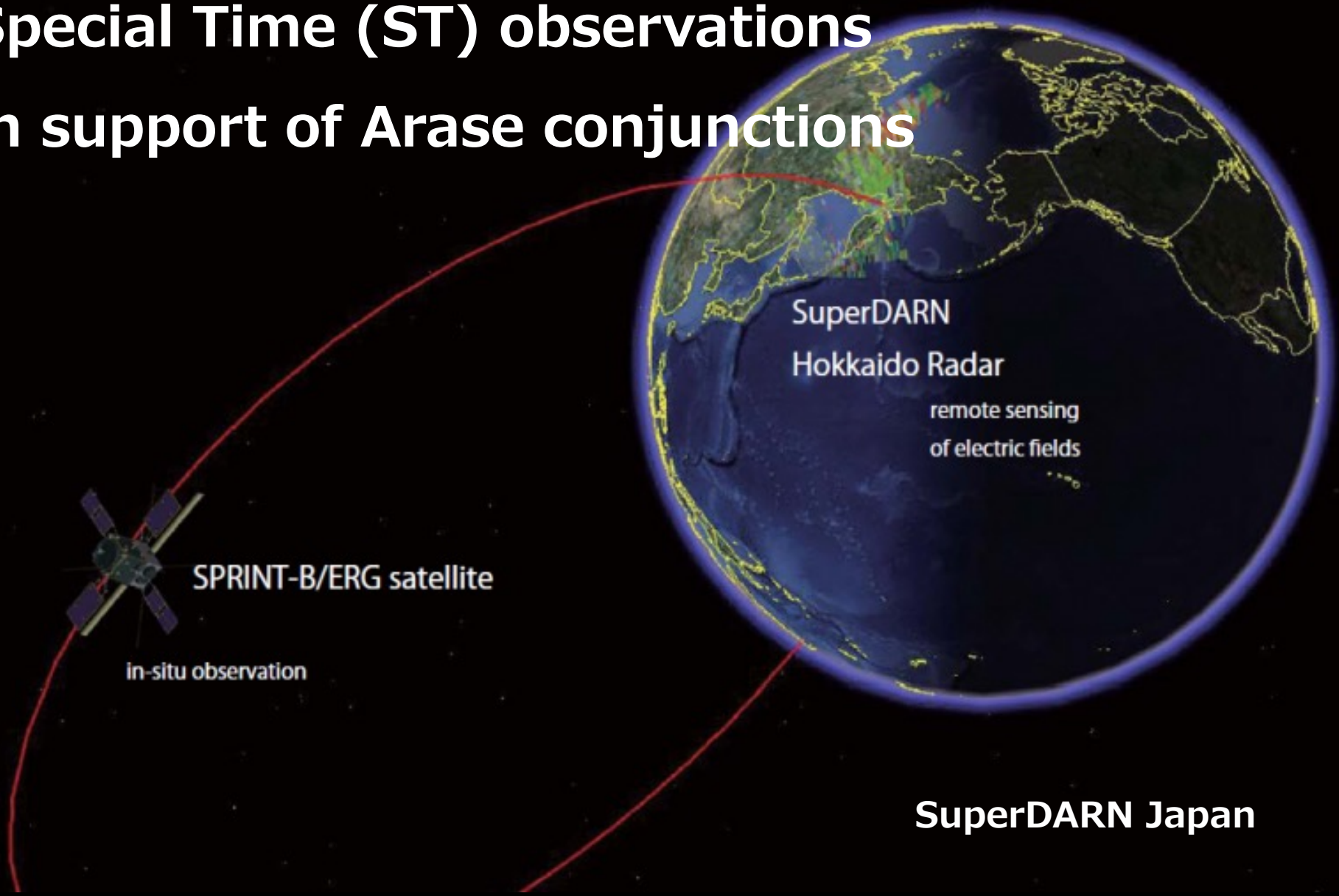
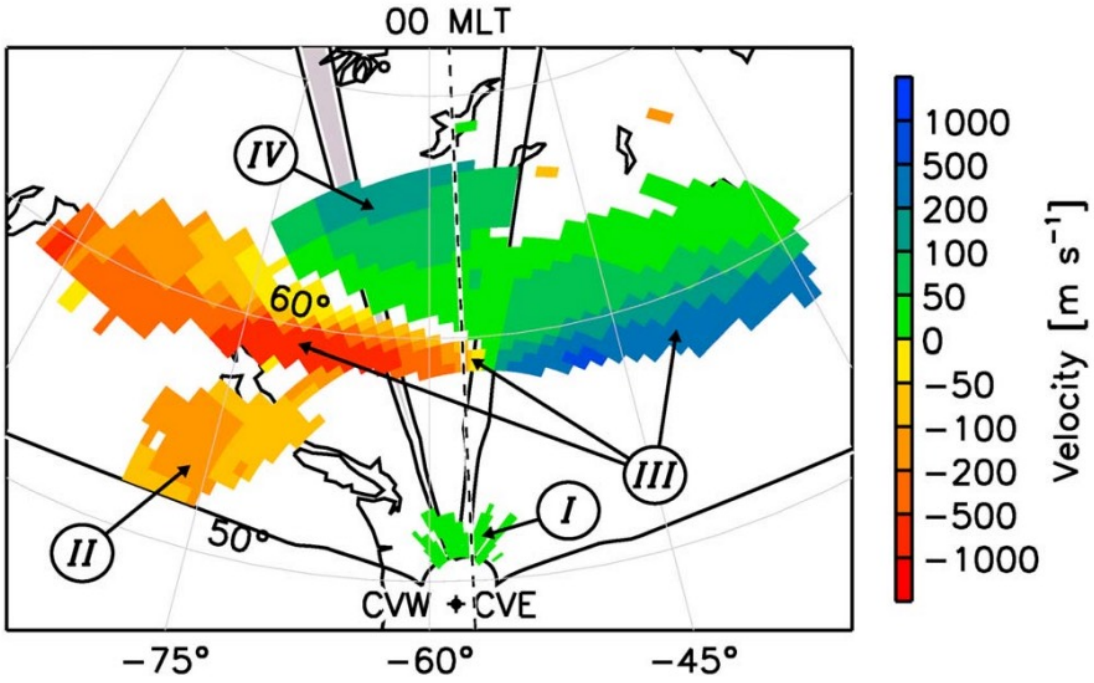
Preliminary results of Special Time (ST) observations in support of Arase conjunctions



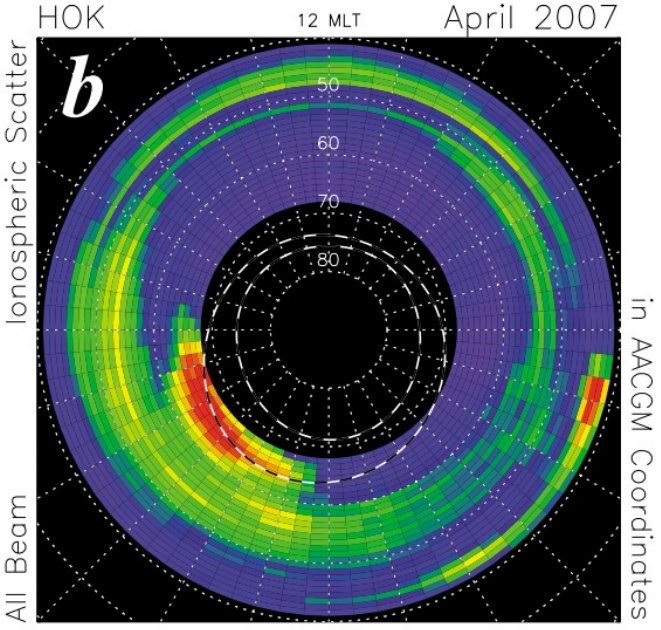
SuperDARN Japan

Possible targets of ST observations

- Subauroral Polarization Stream (SAPS)
  = Subauroral Ion Drift (SAID)
- ULF waves in the auroral / subauroral latitudes
- Plasma irregularities in the mid-latitude trough



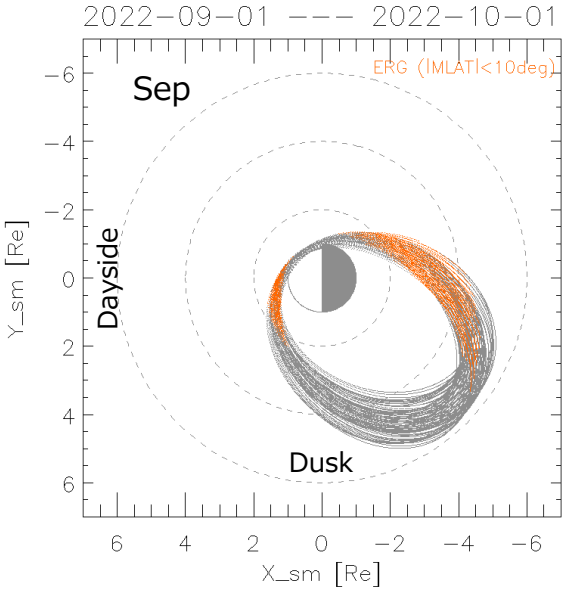
Clausen et al. (2012)

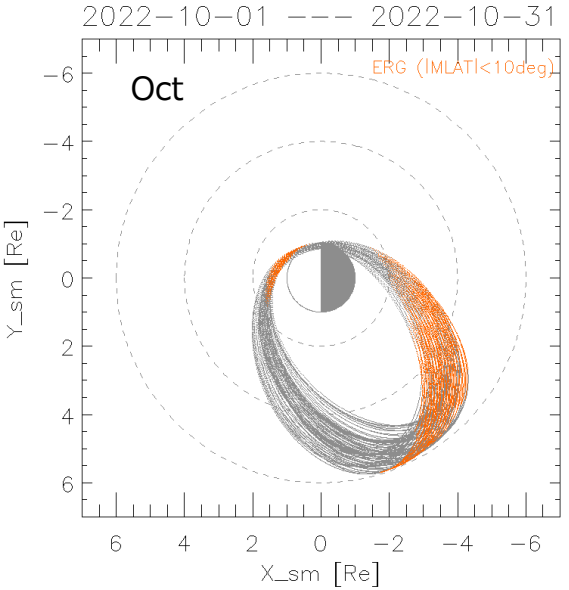


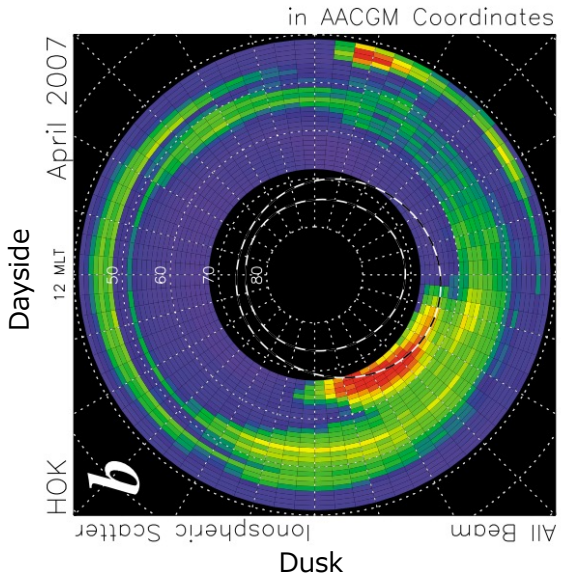
Hosokawa and Nishitani (2010)

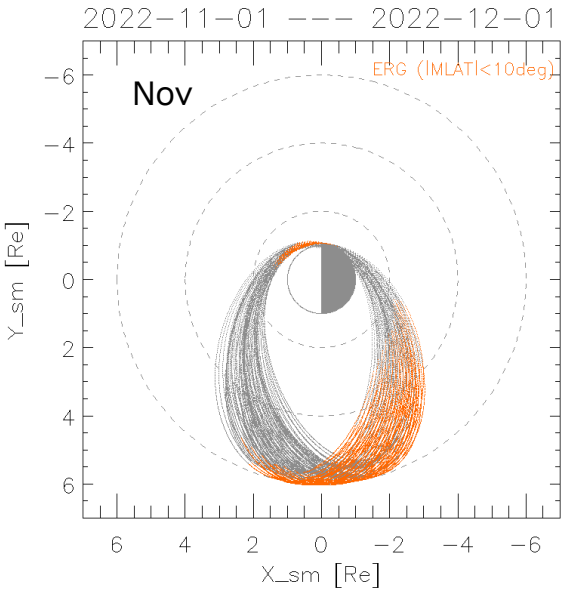
Orbit of Arase in Autumn 2022

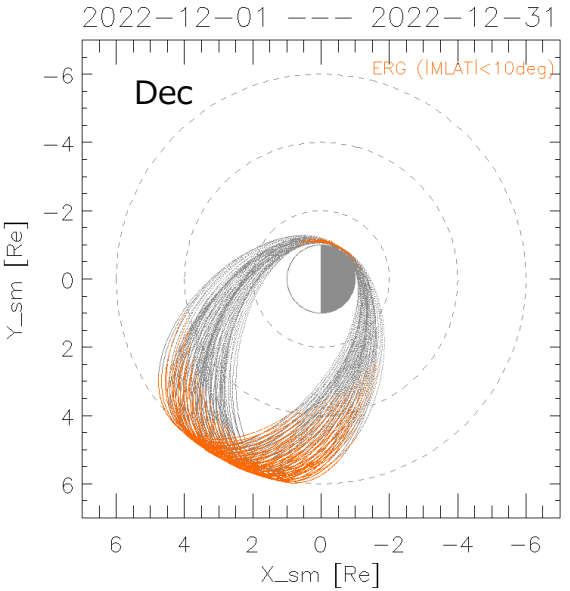
- Covered the auroral/ subauroral region on the dusk side which is a hot spot of irregularities (= echo targets)







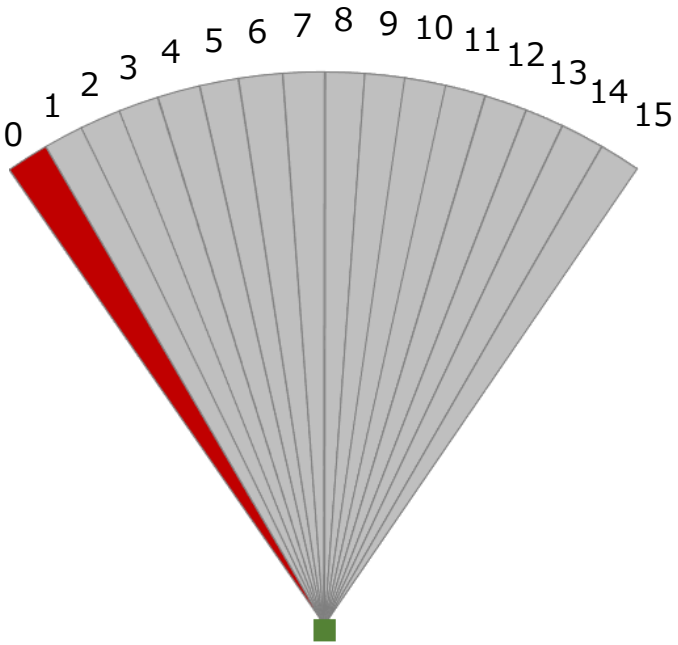




Interleaved normal scan

- Normal beam steering of SD is like:
  0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15
- Interleaved normal scan is composed of four “mini-scans”
  0,4,8,12,1,5,9,13,2,6,10,14,3,7,11,15
- Able to track phenomena faster than the normal beam steering
- Requested ST operations in Sep, Oct, Nov and Dec
- Requests were approved for ~5 days a month during new moon periods when optical instruments are operative

Interleaved normal scan
(so-called Arase mode)



Schedule in Sep and Oct

September 2022

01:00	10:00	Discretionary Time
10:00	16:00	Common Time (1-min) (no switching)
16:00	16:12	Special Time (interleavescan) [ALL] (see Note A)
16:12	18:00	Common Time (1-min)
18:00	18:12	Special Time (interleavescan) [ALL] (see Note A)
18:12	19:00	Common Time (1-min) (no switching)
19:00	19:12	Special Time (interleavescan) [ALL] (see Note A)
19:12	20:00	Common Time (1-min)
20:00	21:12	Special Time (interleavescan) [ALL] (see Note A)
21:12	23:00	Common Time (1-min)
23:00	23:12	Special Time (interleavescan) [ALL] (see Note A)
23:12	25:00	Common Time (1-min)
25:00	25:12	Special Time (interleavescan) [ALL] (see Note A)
25:12	27:00	Common Time (1-min)
27:00	27:12	Special Time (interleavescan) [ALL] (see Note A)
27:12	29:00	Common Time (1-min)
29:00	29:12	Special Time (interleavescan) [ALL] (see Note A)
29:12	30:24	Common Time (1-min) (no switching)

Total Common Time (1-min): 16d 0h
Total Discretionary Time: 9d 0h
Total Special Time: 5d 0h

Notes:

Note A: This is a spacecraft working group request to support the ARASE/ERG mission. All radars should run interleaved_normalscan (a full scan of at least 16 beams with a non-sequential manner that interleaves the beam number, with a scan time of 1-min)

October 2022

01:00	03:00	Common Time (1-min) (no switching)
03:00	06:00	Discretionary Time
06:00	10:00	Common Time (1-min) (no switching)
10:00	13:00	Discretionary Time
13:00	17:00	Common Time (1-min)
17:00	20:00	Discretionary Time
20:00	21:00	Common Time (1-min)
21:00	21:12	Special Time (interleavescan) [ALL] (see Note A)
21:12	22:00	Common Time (1-min)
22:00	22:12	Special Time (interleavescan) [ALL] (see Note A)
22:12	23:00	Common Time (1-min)
23:00	23:12	Special Time (interleavescan) [ALL] (see Note A)
23:12	24:00	Common Time (1-min)
24:00	24:12	Special Time (interleavescan) [ALL] (see Note A)
24:12	25:00	Common Time (1-min)
25:00	26:12	Special Time (interleavescan) [ALL] (see Note A)
26:12	27:00	Common Time (1-min)
27:00	27:12	Special Time (interleavescan) [ALL] (see Note A)
27:12	28:00	Common Time (1-min)
28:00	29:12	Special Time (interleavescan) [ALL] (see Note A)
29:12	31:24	Common Time (1-min) (no switching)

Total Common Time (1-min): 16d 12h
Total Discretionary Time: 9d 0h
Total Special Time: 5d 12h

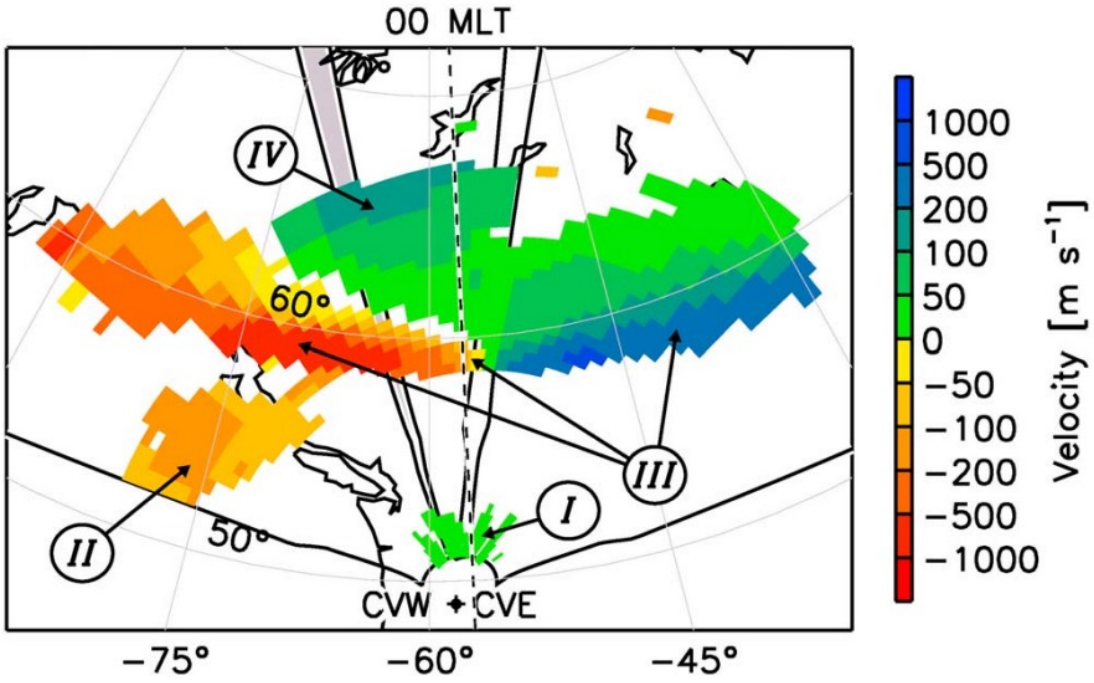
Operation of Arase during ST

- High-sampling observations at *L* > 3:
  - EFD/MGF: high sampling at 256 Hz
  - Electron density observation: 1 sec sampling
  - May resume the high-sampling at high *L* region (L = 5 or 6)
- LEP-i, MEP-i : normal mode operation (i.e., no TOF)
  in order to obtain the 3D distribution function for estimating P_{perp}, P_{para} of the ring current ions

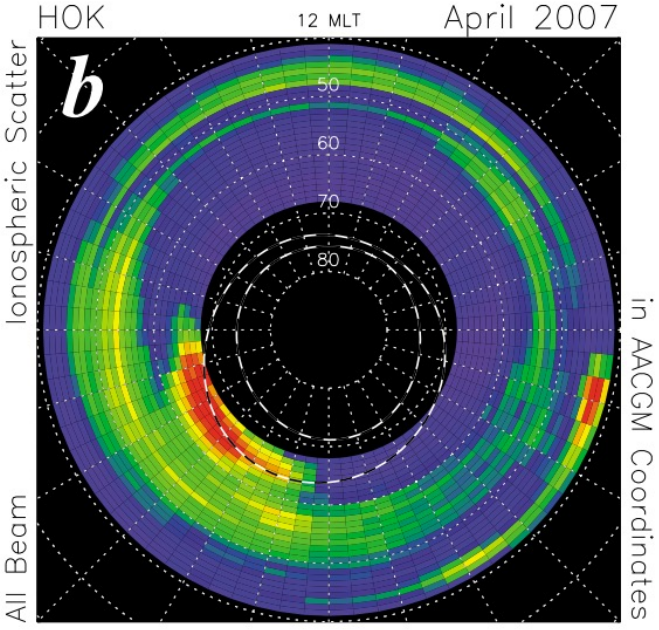
09/18 00:00-09/18 12:00	LEPi/MEPi NML: PWE EFD/MGF 256 Hz
09/19 00:00-09/19 12:00	LEPi/MEPi NML: PWE EFD/MGF 64 Hz
09/20 00:00-09/20 24:00	LEPi/MEPi NML: PWE EFD/MGF 256 Hz (00:00-12:00)
	LEPi/MEPi NML: PWE EFD/MGF 64 Hz (12:00-24:00)
09/21 00:00-09/21 12:00	LEPi/MEPi NML: PWE EFD/MGF 64 Hz
09/23 00:00-09/23 12:00	LEPi/MEPi NML: PWE EFD/MGF 256 Hz

Possible targets of ST observations

- Subauroral Polarization Stream (SAPS)
  = Subauroral Ion Drift (SAID)
- ULF waves in the auroral / subauroral latitudes
- Plasma irregularities in the mid-latitude trough



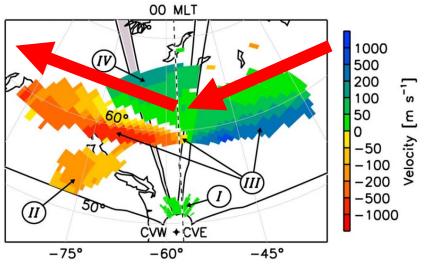
Clausen et al. (2012)

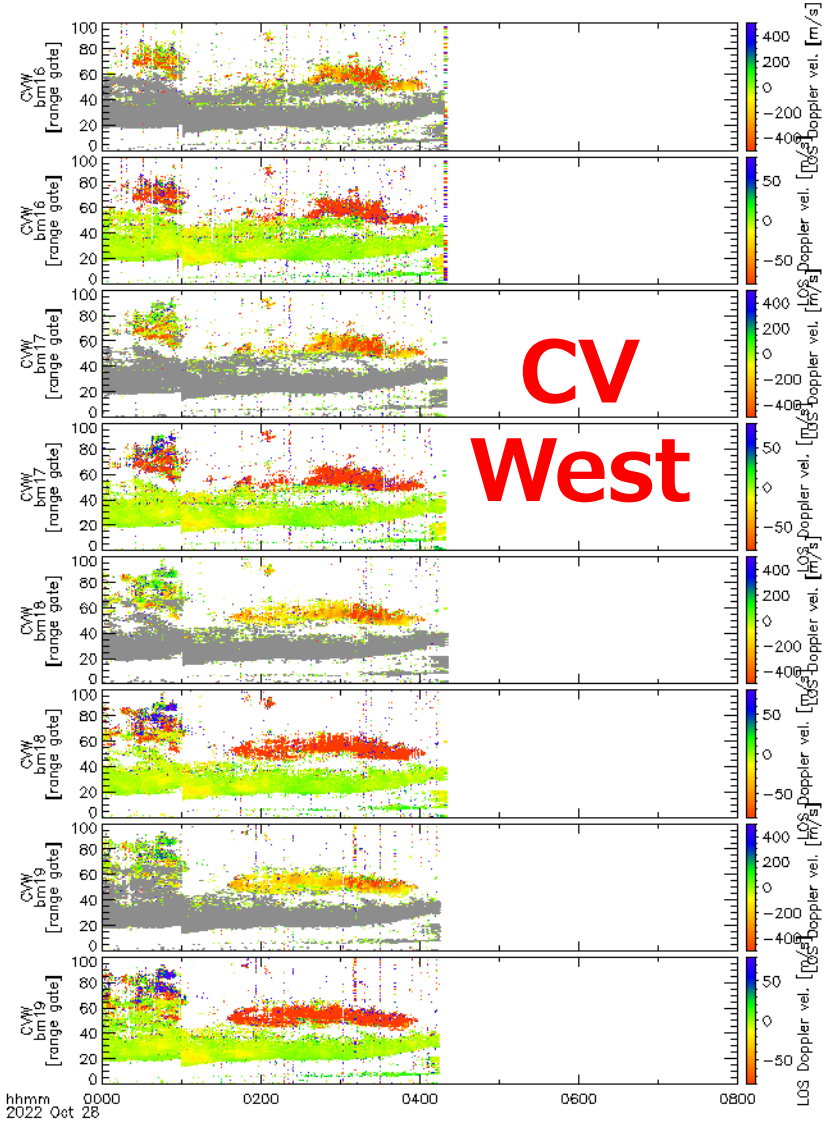


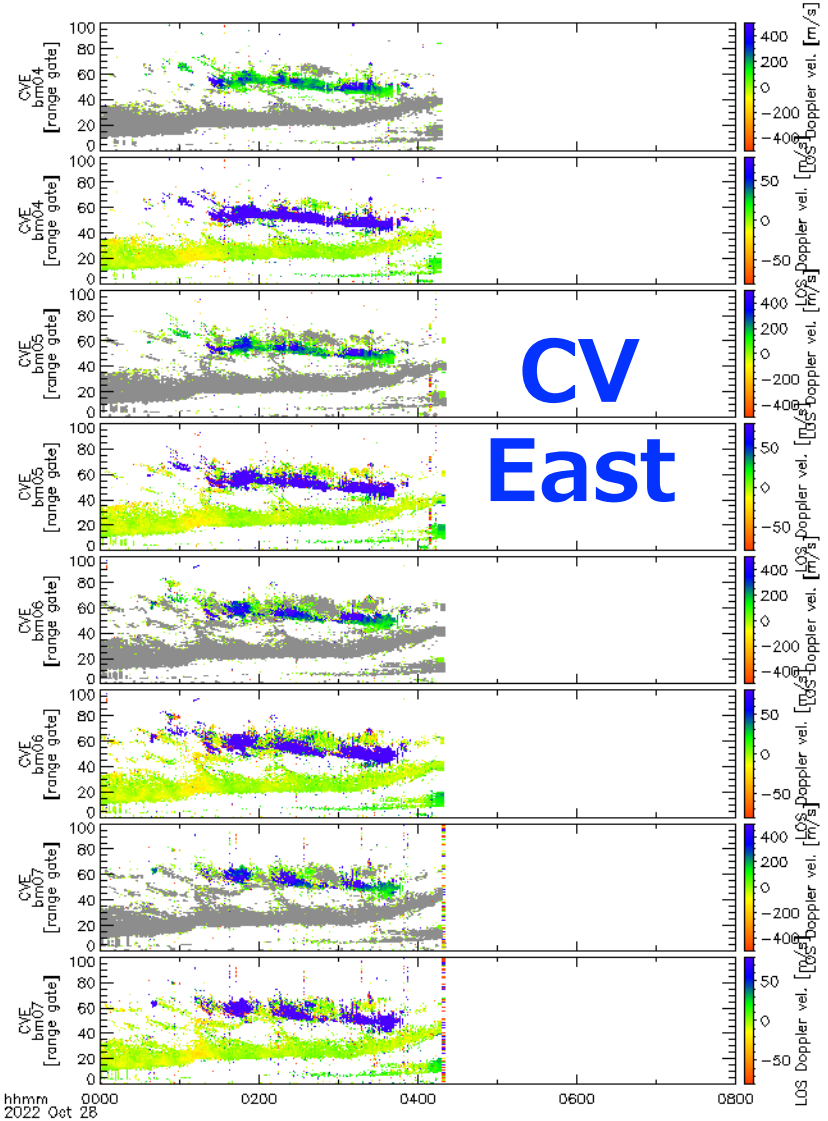
Hosokawa and Nishitani (2010)

SAPS / SAID signatures

- Christmas Valley West / East on Oct 28, 2022

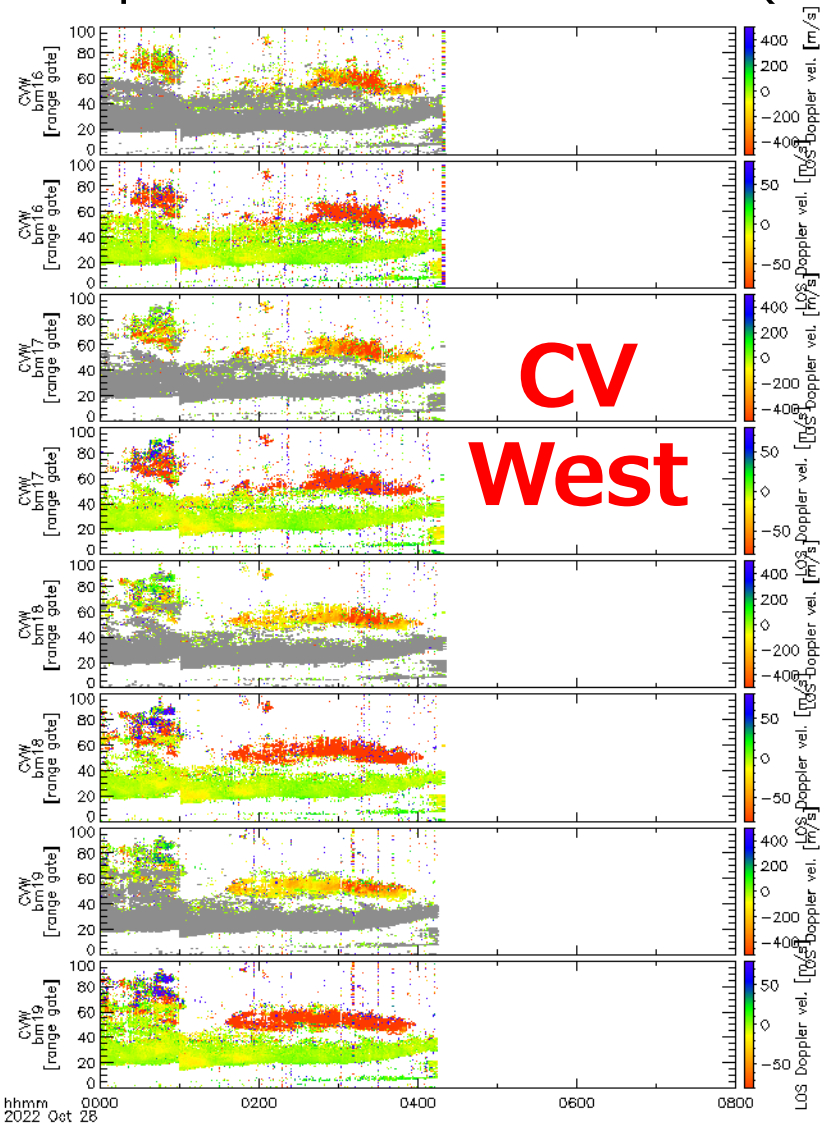


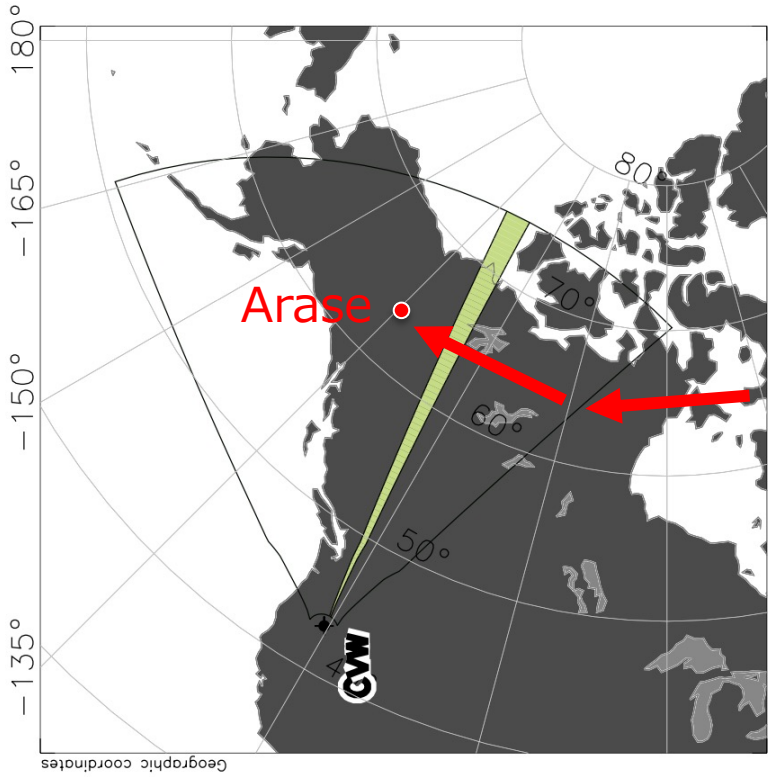




SAPS / SAID signatures

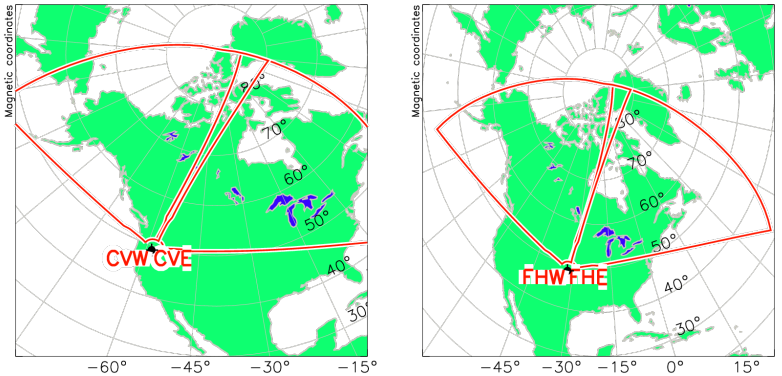
- Footprint of Arase was close (though it may not be “pin-point”)

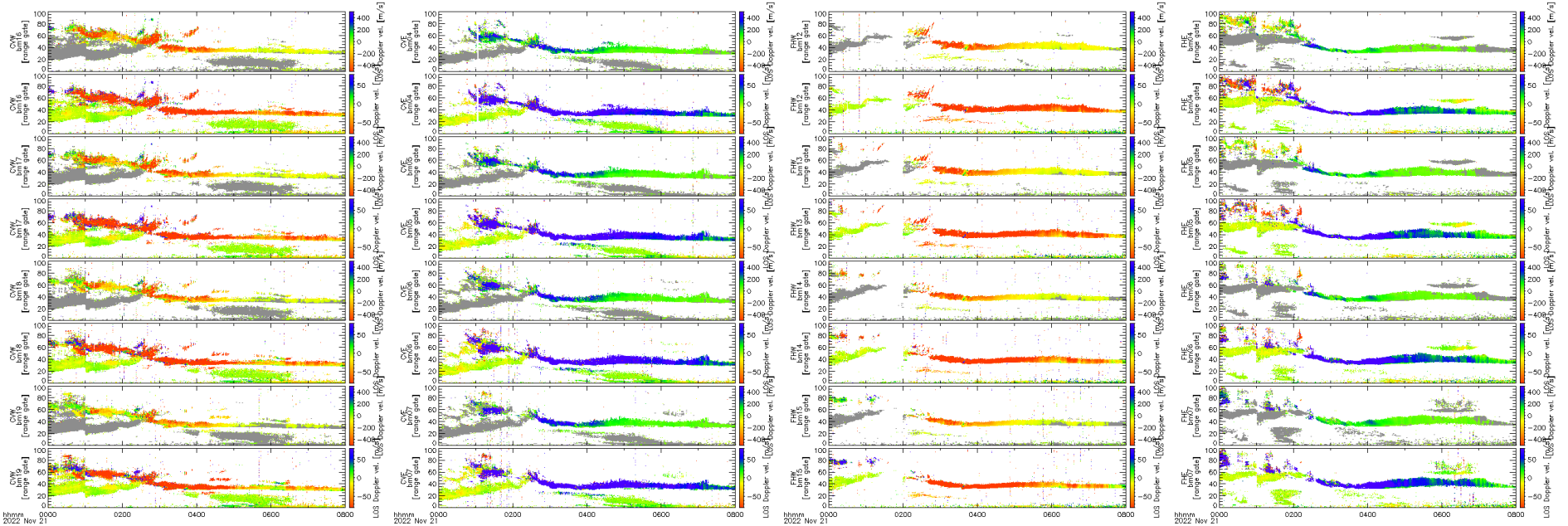




SAPS / SAID signatures

- Mid-latitude radars in North America on Nov 21, 2022 Christmas Valley West / East + Fort Hays West / East
- Long lasting possible SAPS/SAID during a relatively quiet period
- Trace of plasmapause?
- Arase was over Alaska for ~6 h





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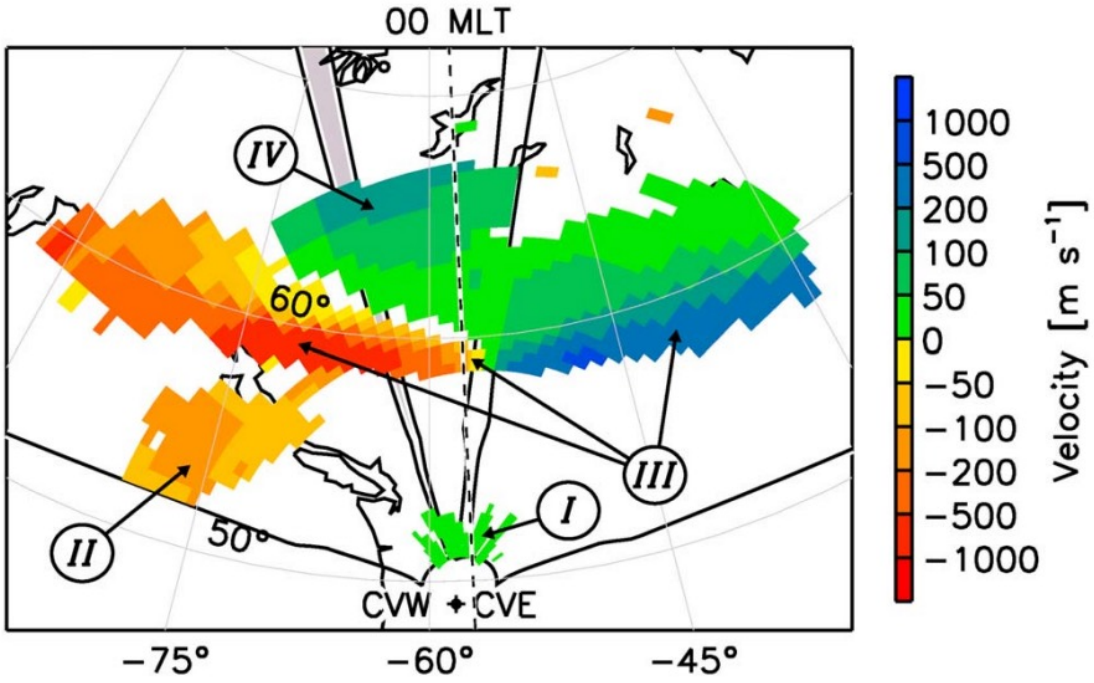
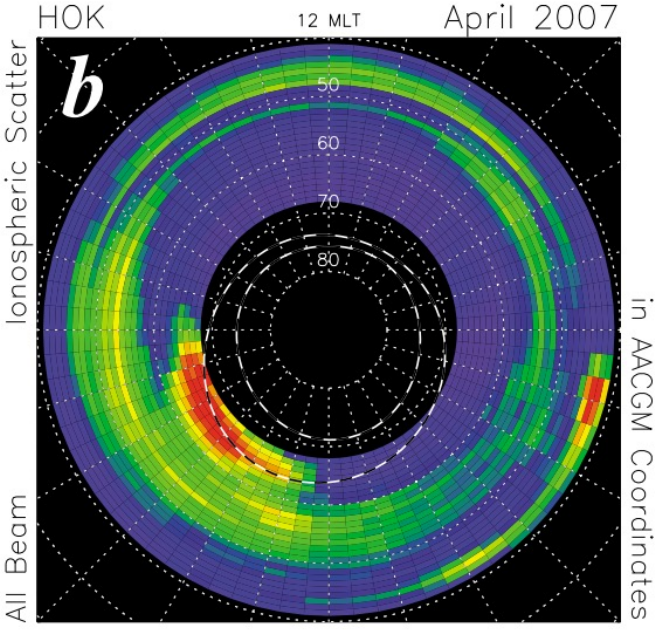
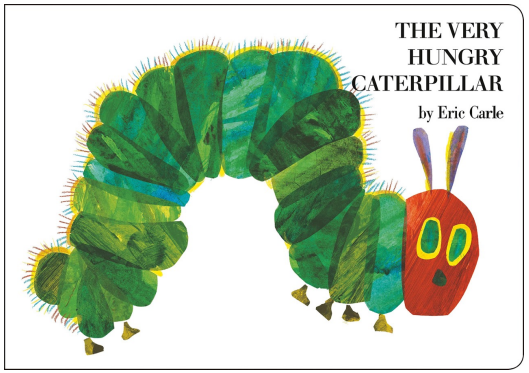


Clausen et al. (2012)

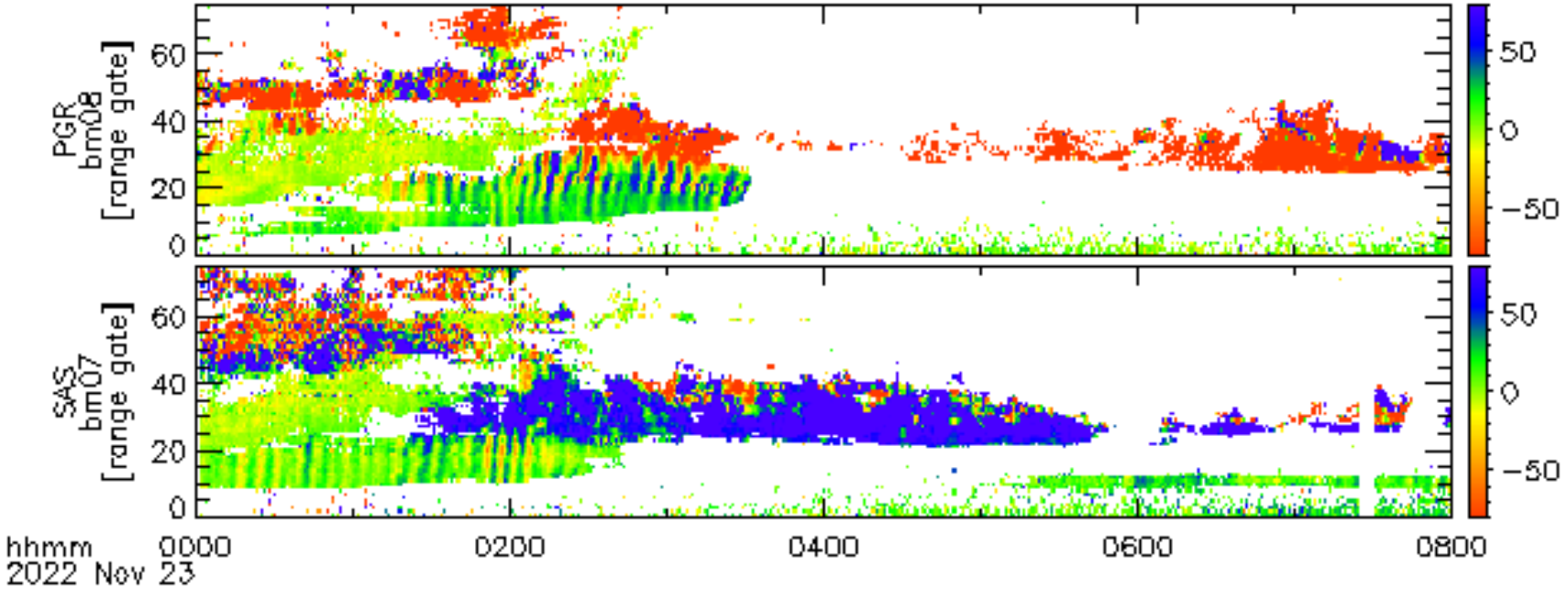


Hosokawa and Nishitani (2010)

Hungry caterpillar ULF



- ULF signatures possibly embedded with the dusk scatter echoes – looks like the very hungry caterpillar by Eric Carle



Hungry caterpillar ULF

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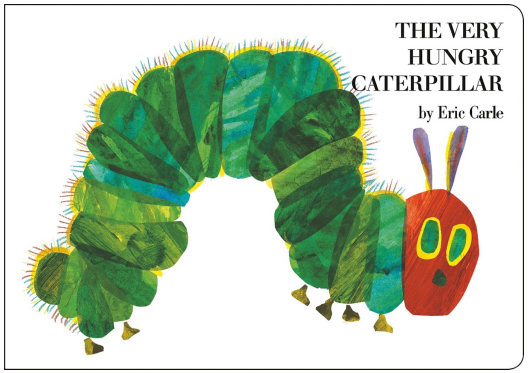

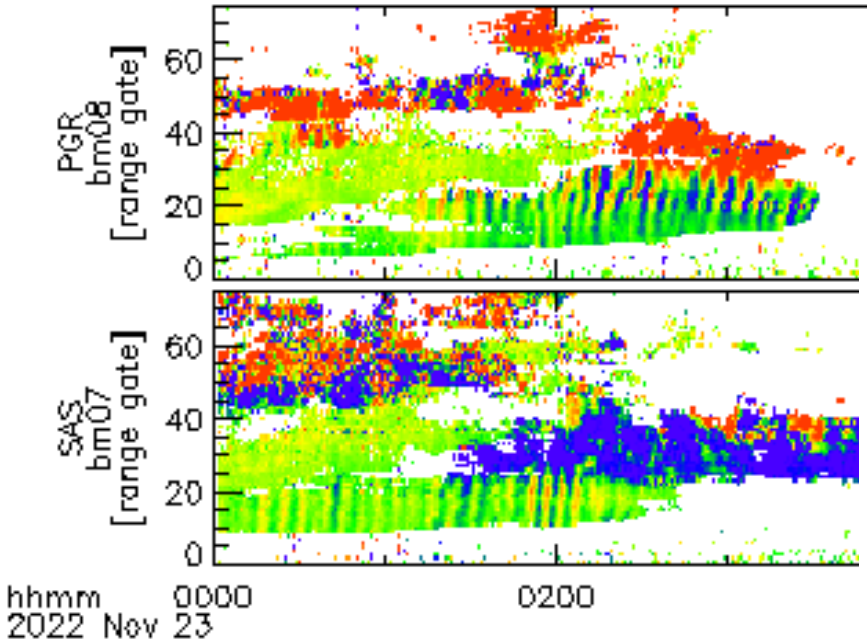

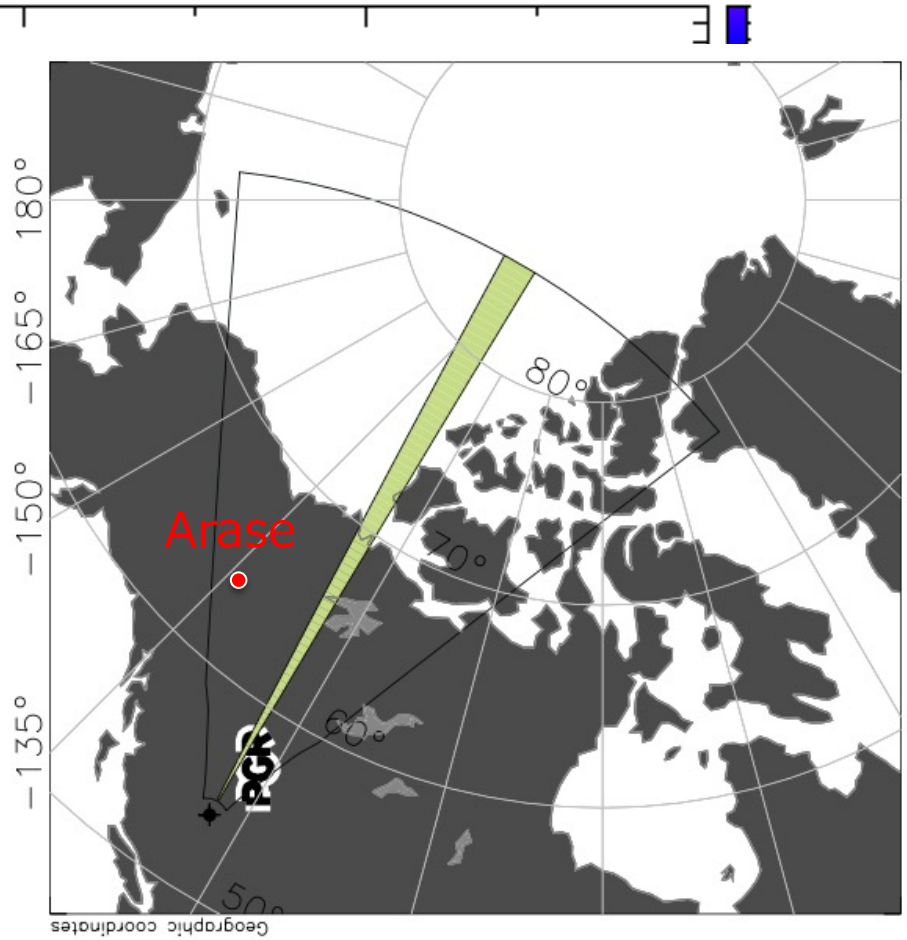

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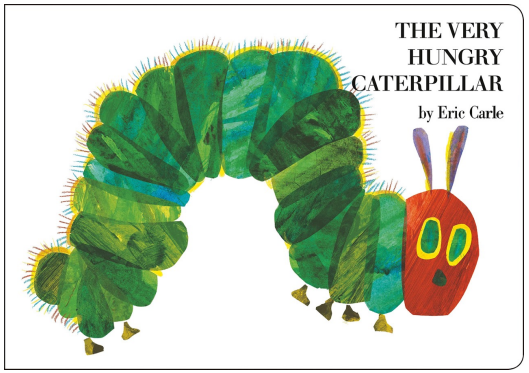
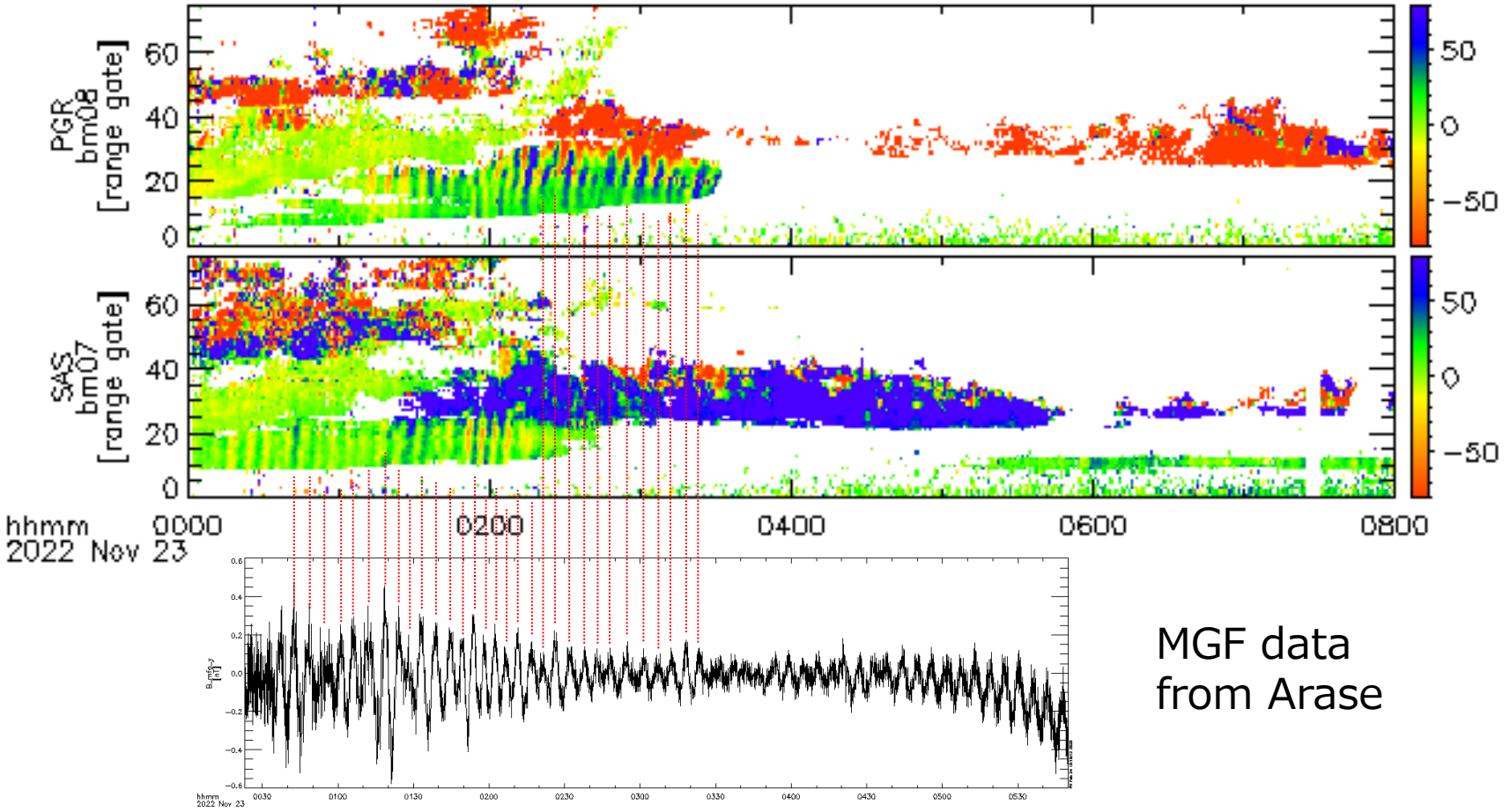
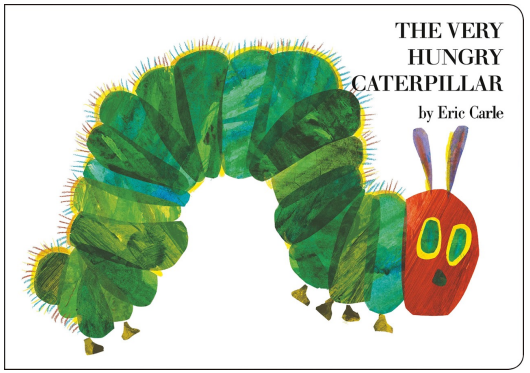


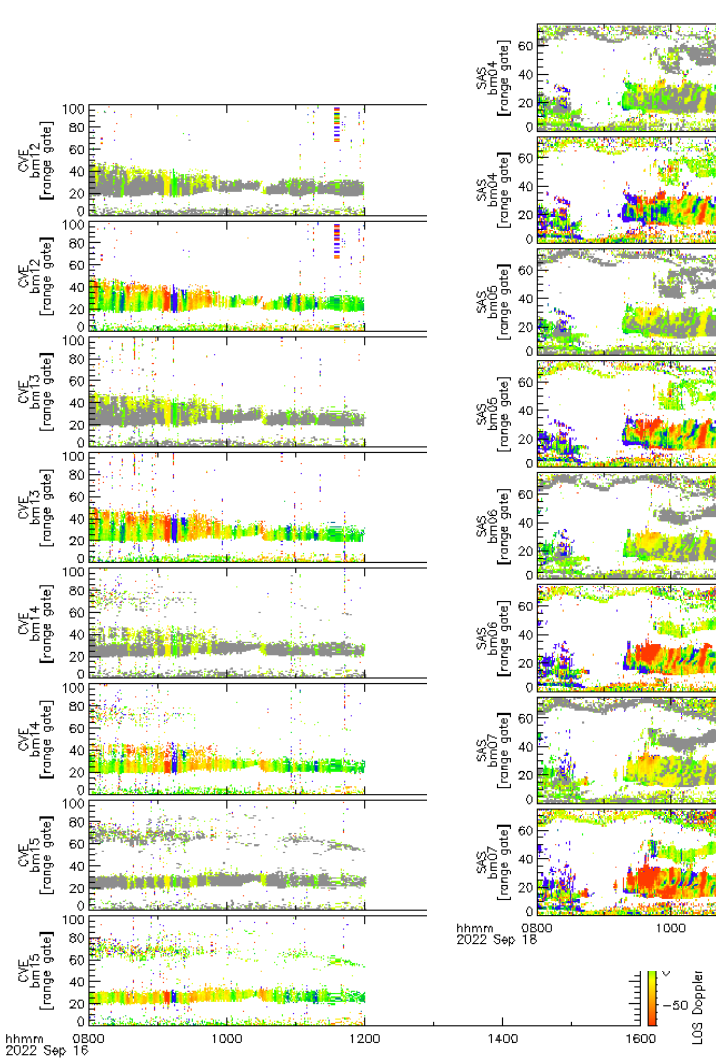


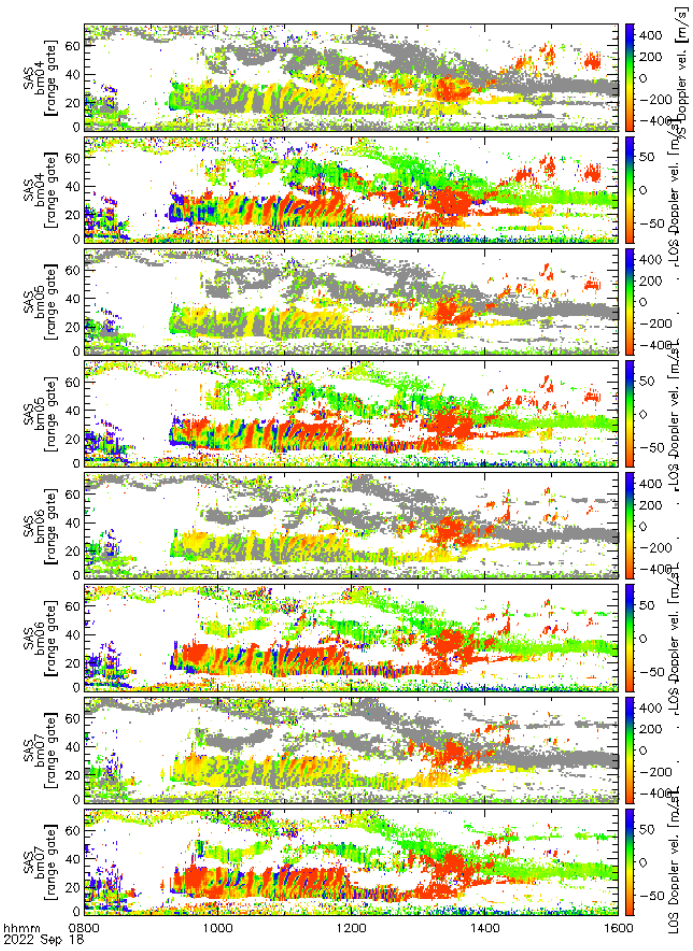
MGF data
from Arase

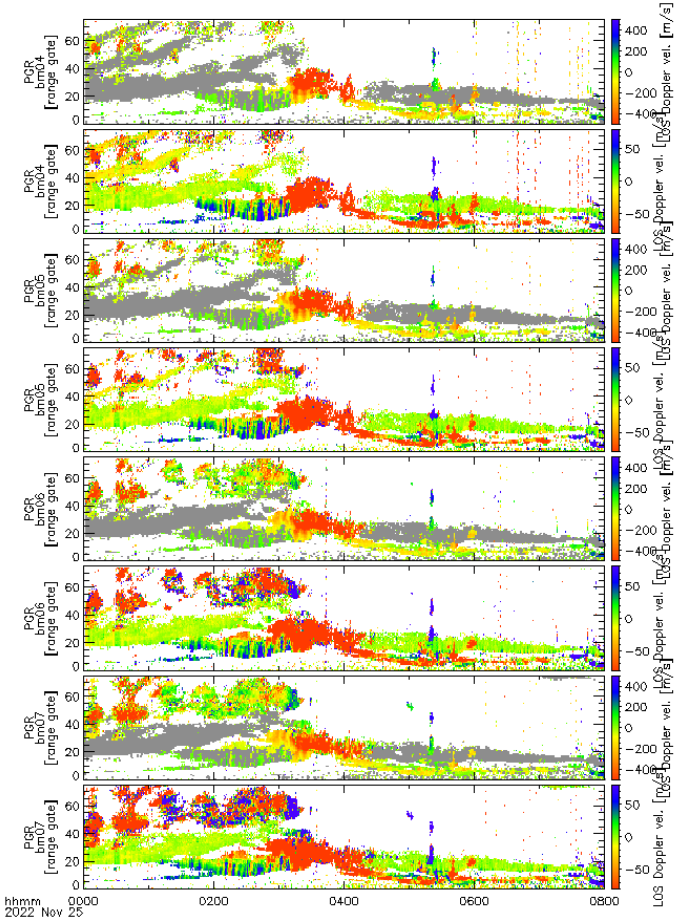
More caterpillars ...

- Lots of other caterpillars indeed...









Possible targets of ST observations

- Subauroral Polarization Stream (SAPS)
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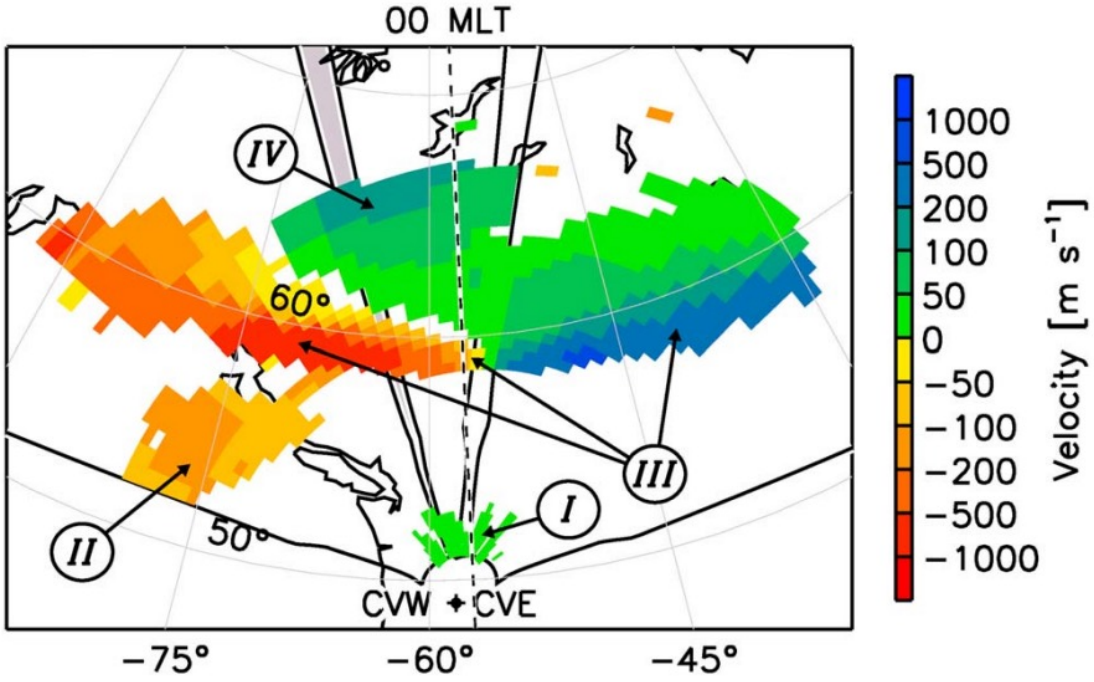
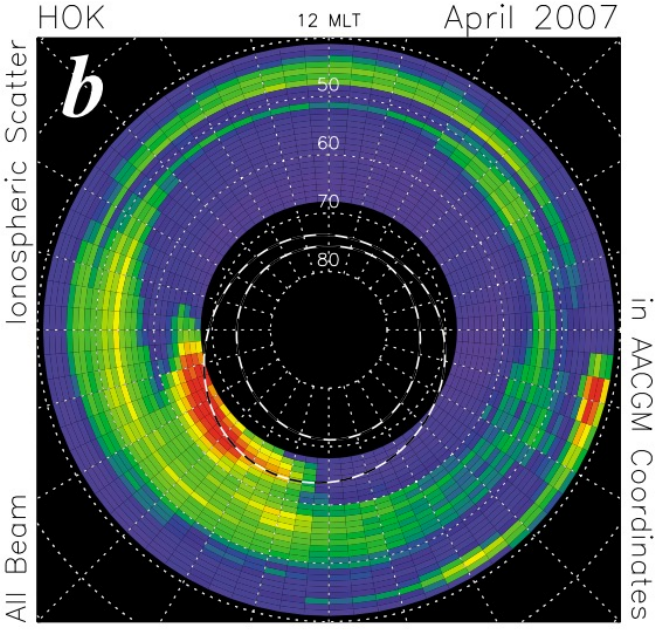


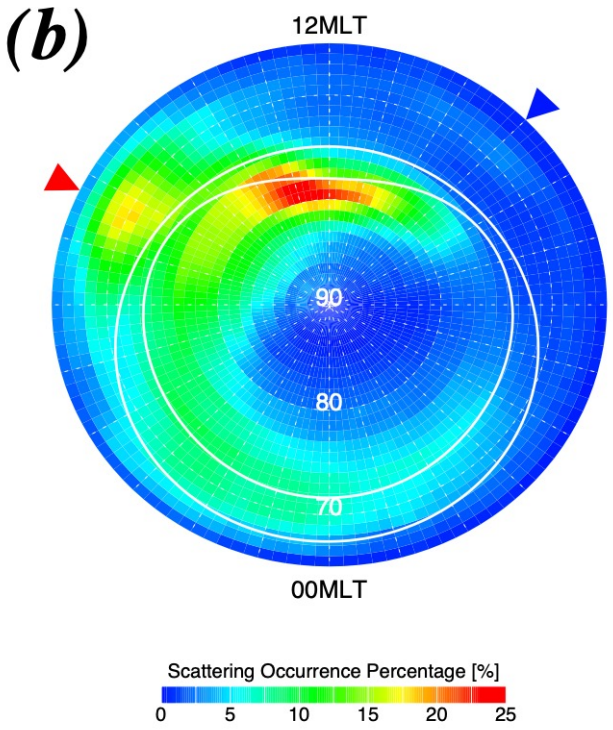
Clausen et al. (2012)



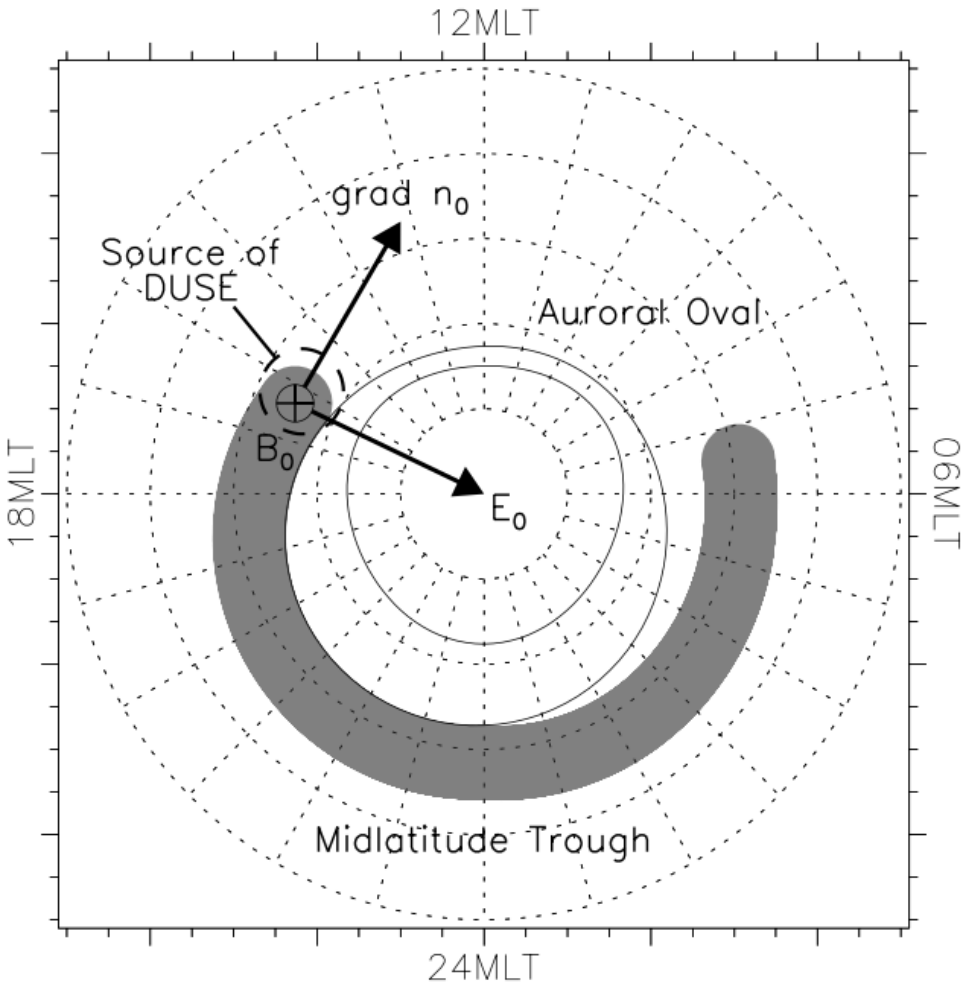
Hosokawa and Nishitani (2010)

Dusk scatter events

- Hot spot of ionospheric irregularities in the subauroral region
- Suggested to coincide with the sunward edge of the trough

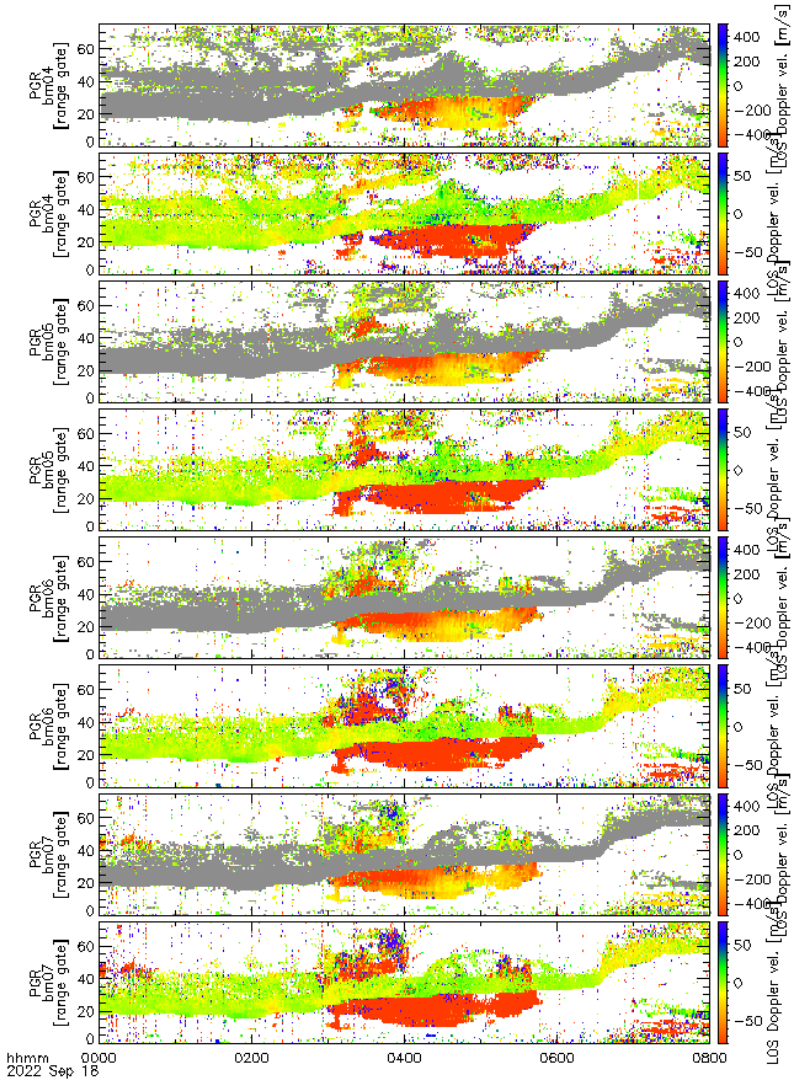


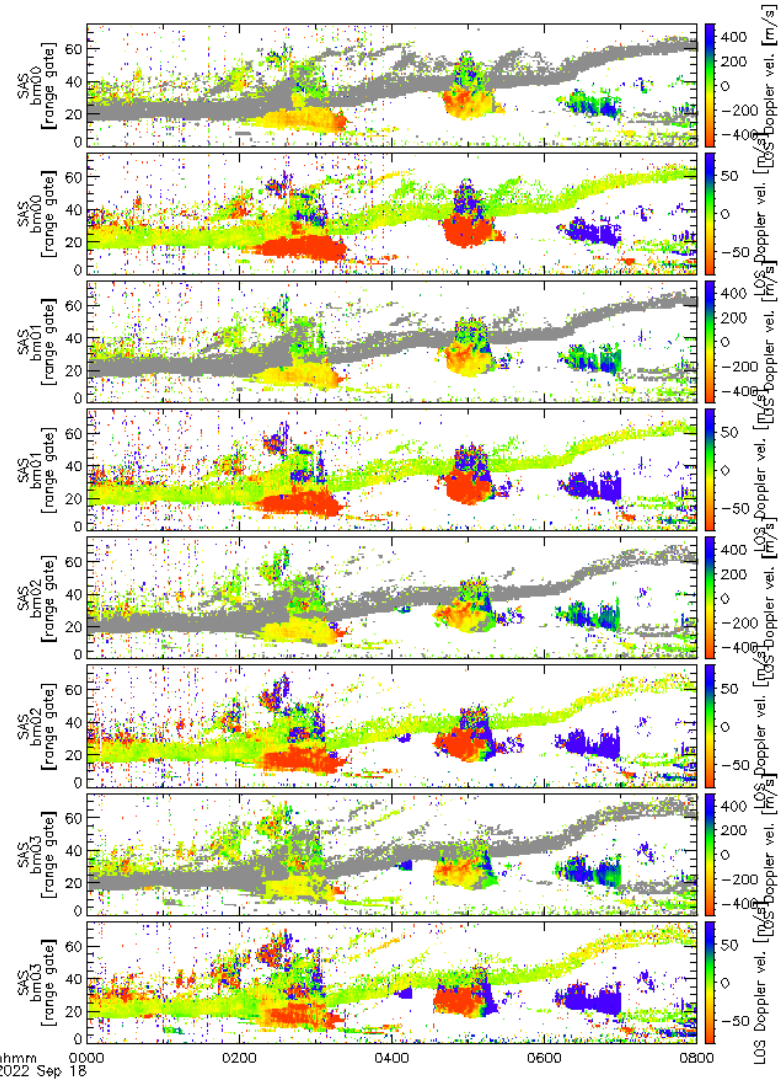
Hosokawa et al. (2001)



Dusk scatter events

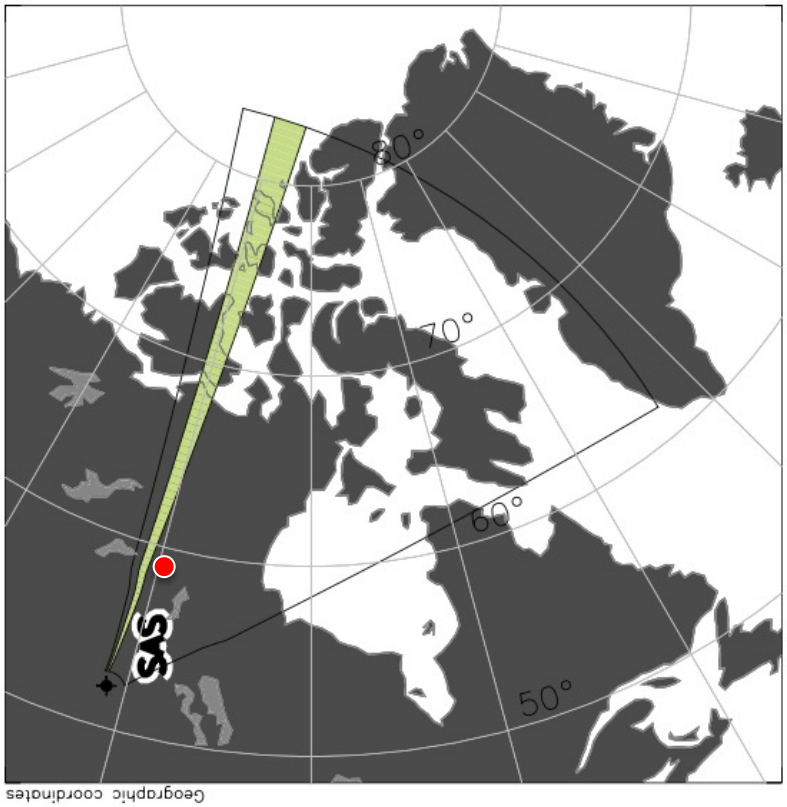
- Prince George and Saskatoon pair on Sep 18, 2022

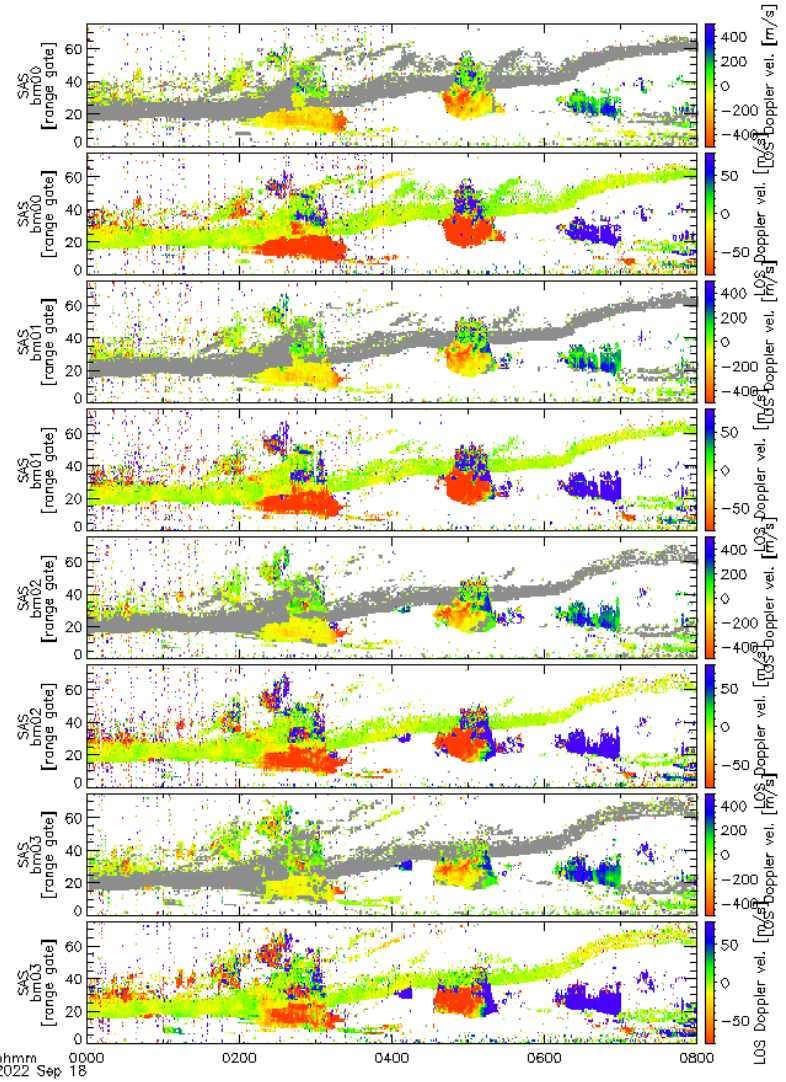




Dusk scatter events

- Prince George and Saskatoon pair on Sep 18, 2022
- Good conjunction with Arase on the Sakatoon side
- Relation to the trough signature





Summary

- Carried of ST observations in Sep, Oct, Nov and Dec, 2022
- Employed interleaved normal scan for the experiment
- Identified some good examples, some of which were observed during the conjunction intervals with Arase

  1) SAPS/SAID on Oct 28 and Nov 21, 2022

  2) Hungry caterpillar ULF events on Nov 23 and many others

  3) Dusk scatter event on Sep 18, 2022
- We have not yet checked all the SD data obtained during the campaign period
- We have not yet checked the corresponding data from Arase at the magnetospheric counterpart