Polar cap patches detection algorithm

K. Beser, G. Perry

Is there any combination of parameters measured by SuperDARN that makes patches ‘unique’?

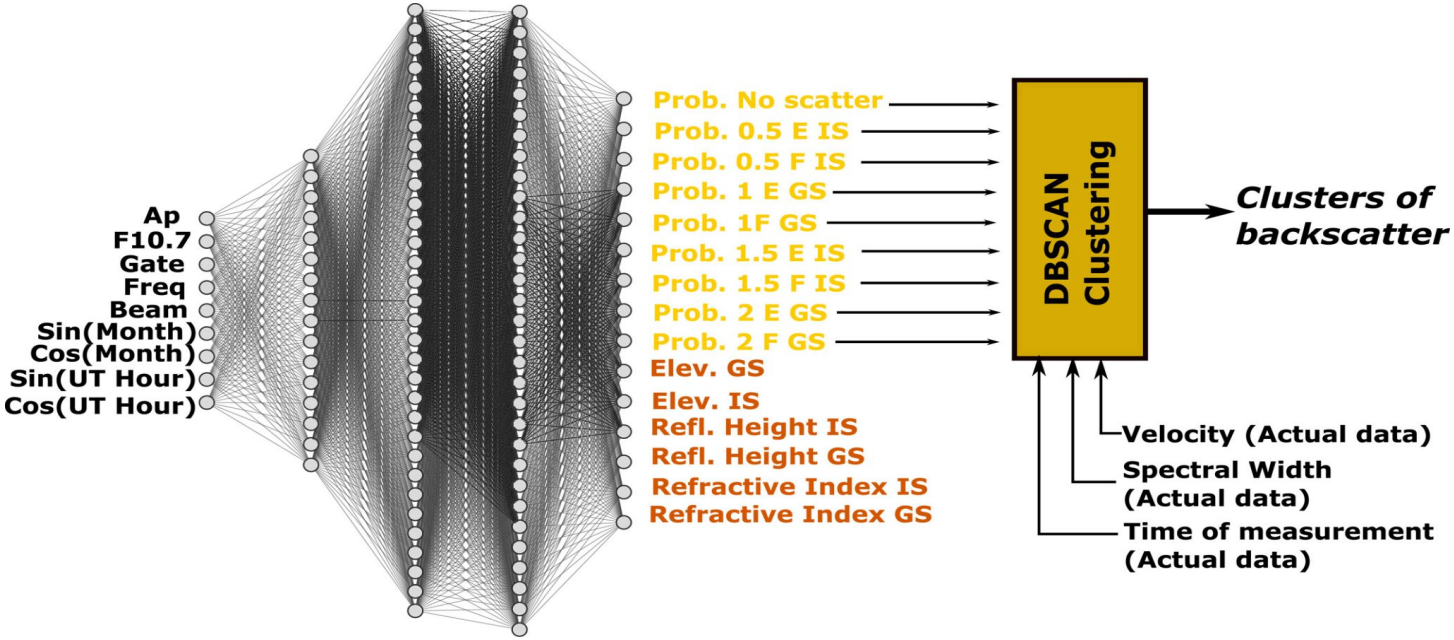
- Main requirements: decameter scale irregularities aligned with the geomagnetic field; transmitted EM wave has to reach the geomagnetic field line perpendicularly

  Different instruments detect different processes, not overlapping

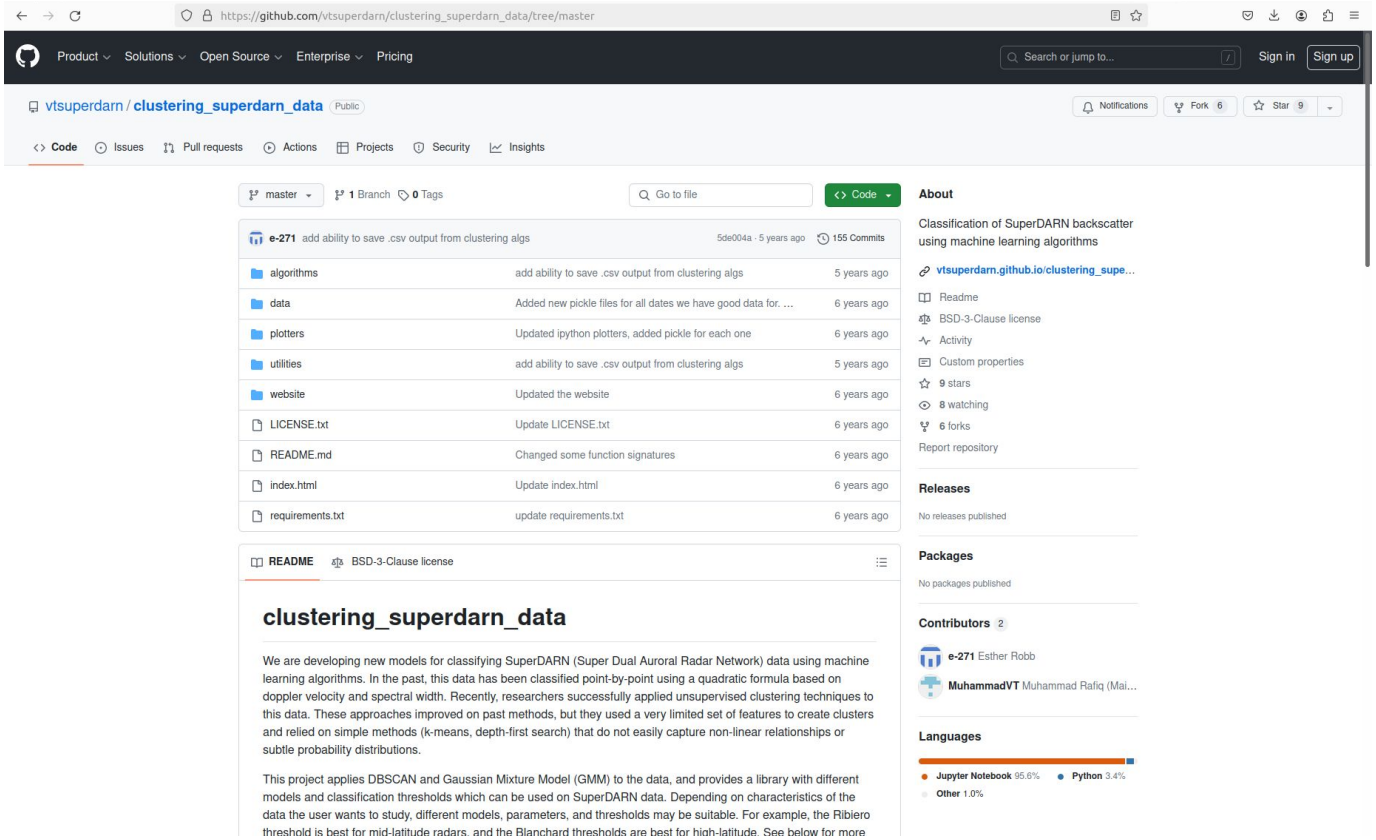
  Within SuperDARN backscatter, we need to distinguish between different source regions - first step

Kunduri et al, 2022: **An Examination of SuperDARN Backscatter Modes Using Machine Learning Guided by Ray-Tracing**

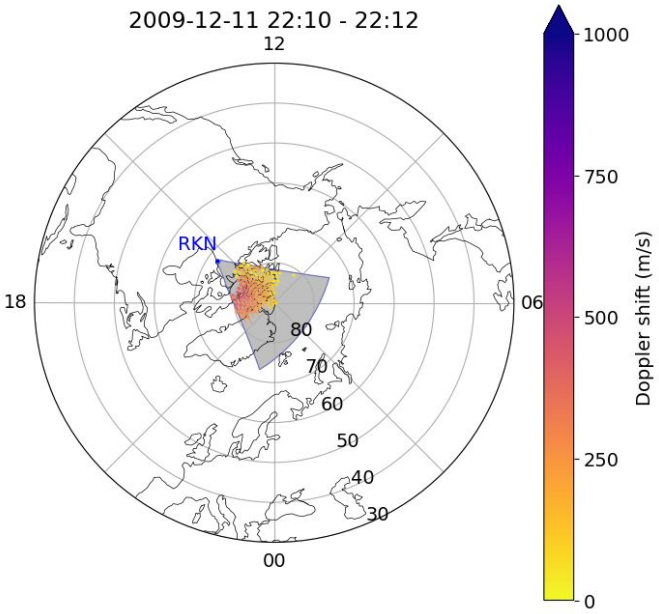
- Algorithm applied to mid-latitudes, to distinguish between ionospheric backscatter, groundscatter and meteor trails echo
- Includes predictions from ray-tracing (trained neural network), which are then combined with SuperDARN signal and clustered

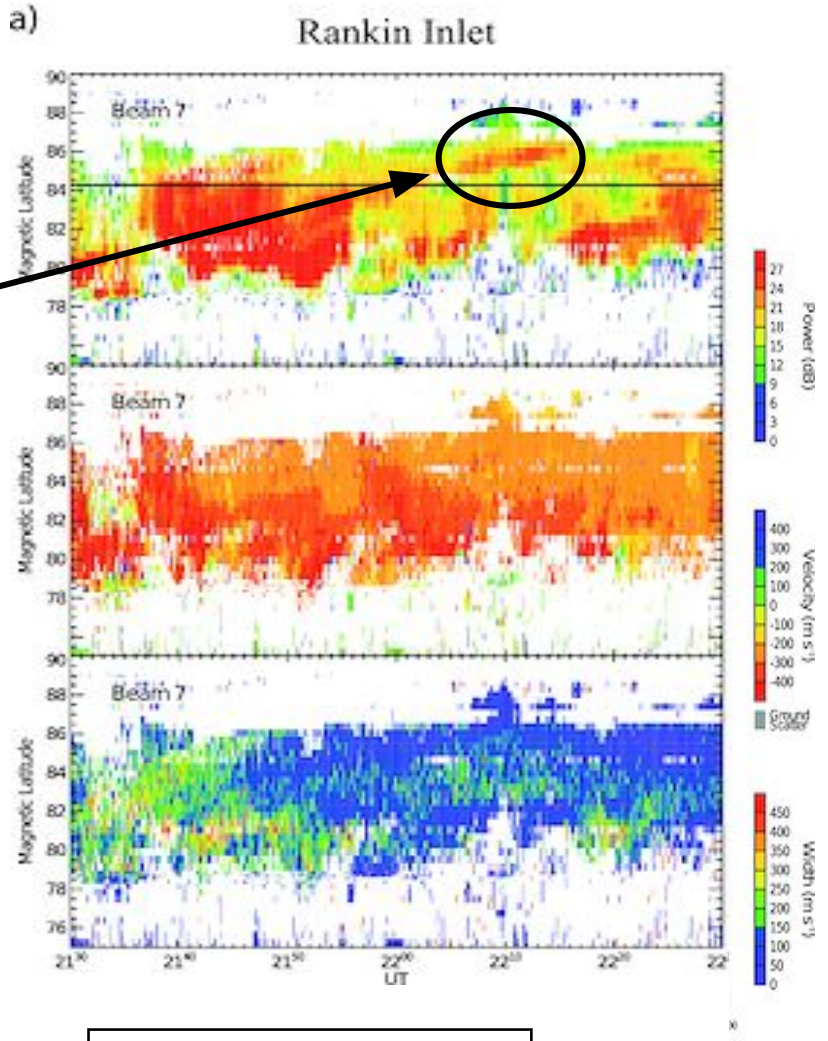


Distinguishing between different source regions of the signal

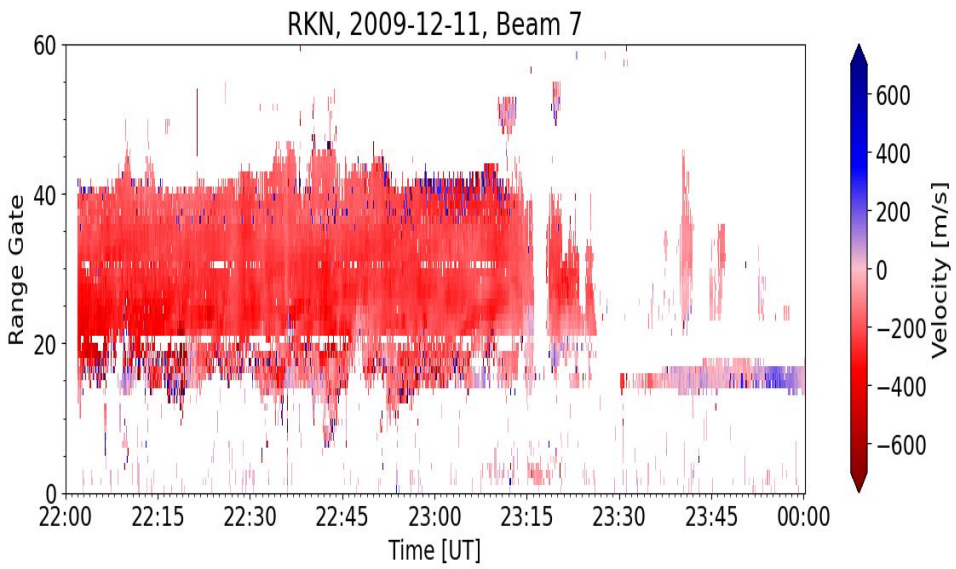


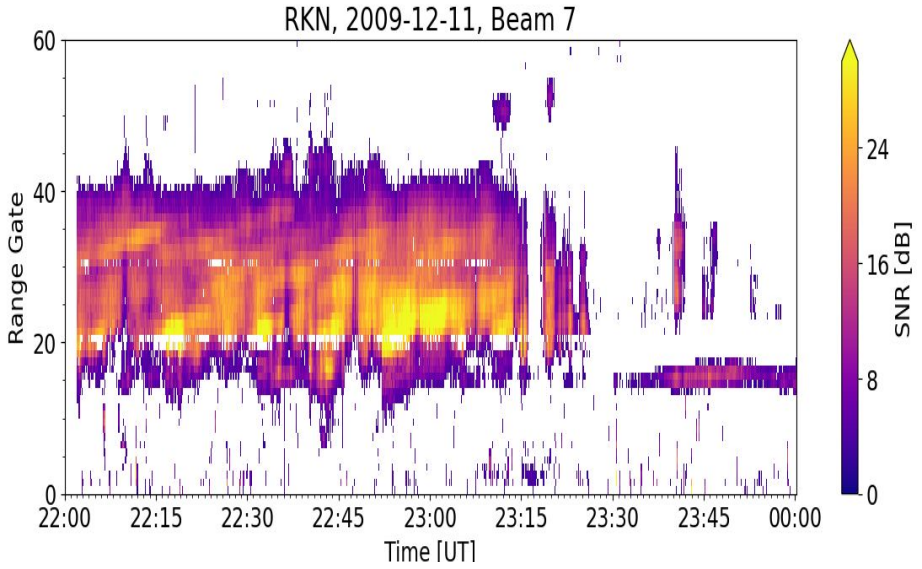
- Since SuperDARN does not provide plasma density measurements, which other parameters are important for the polar cap detection?
- We use the same dataset as Dahlgren et al., (2012) – a patch is identified at around 22:13 UT

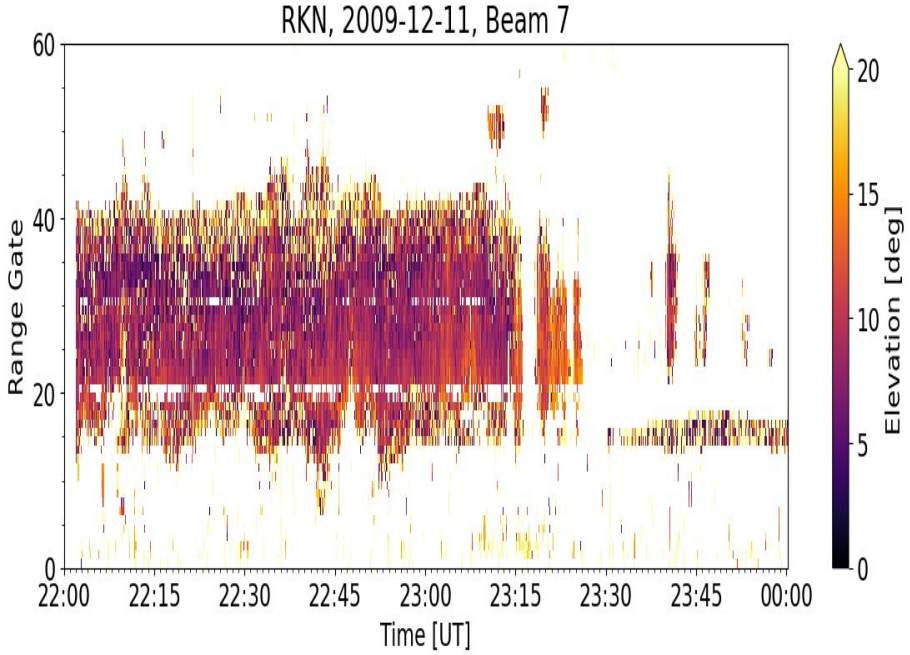


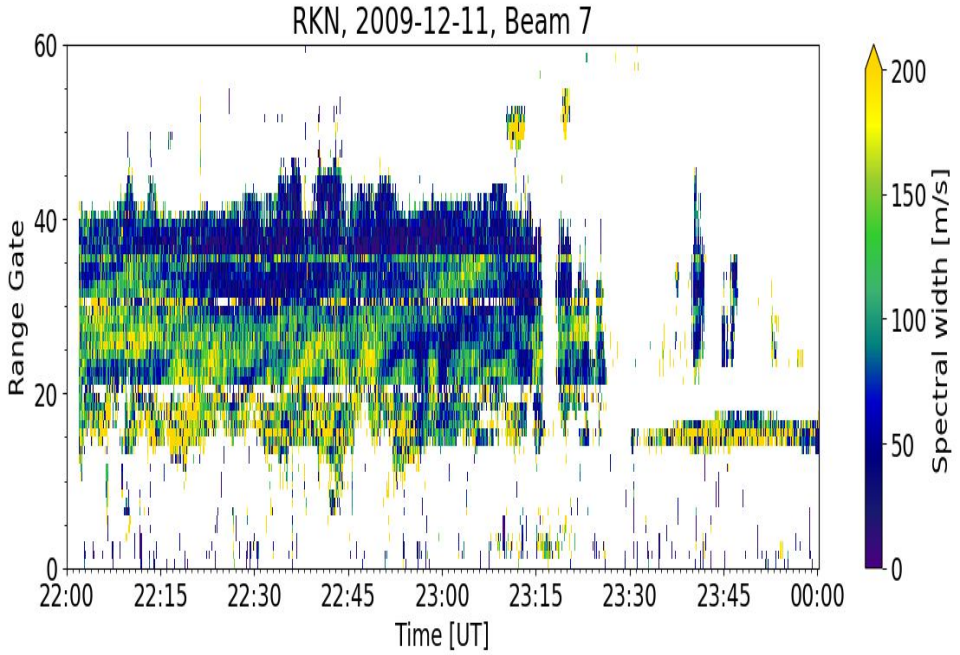


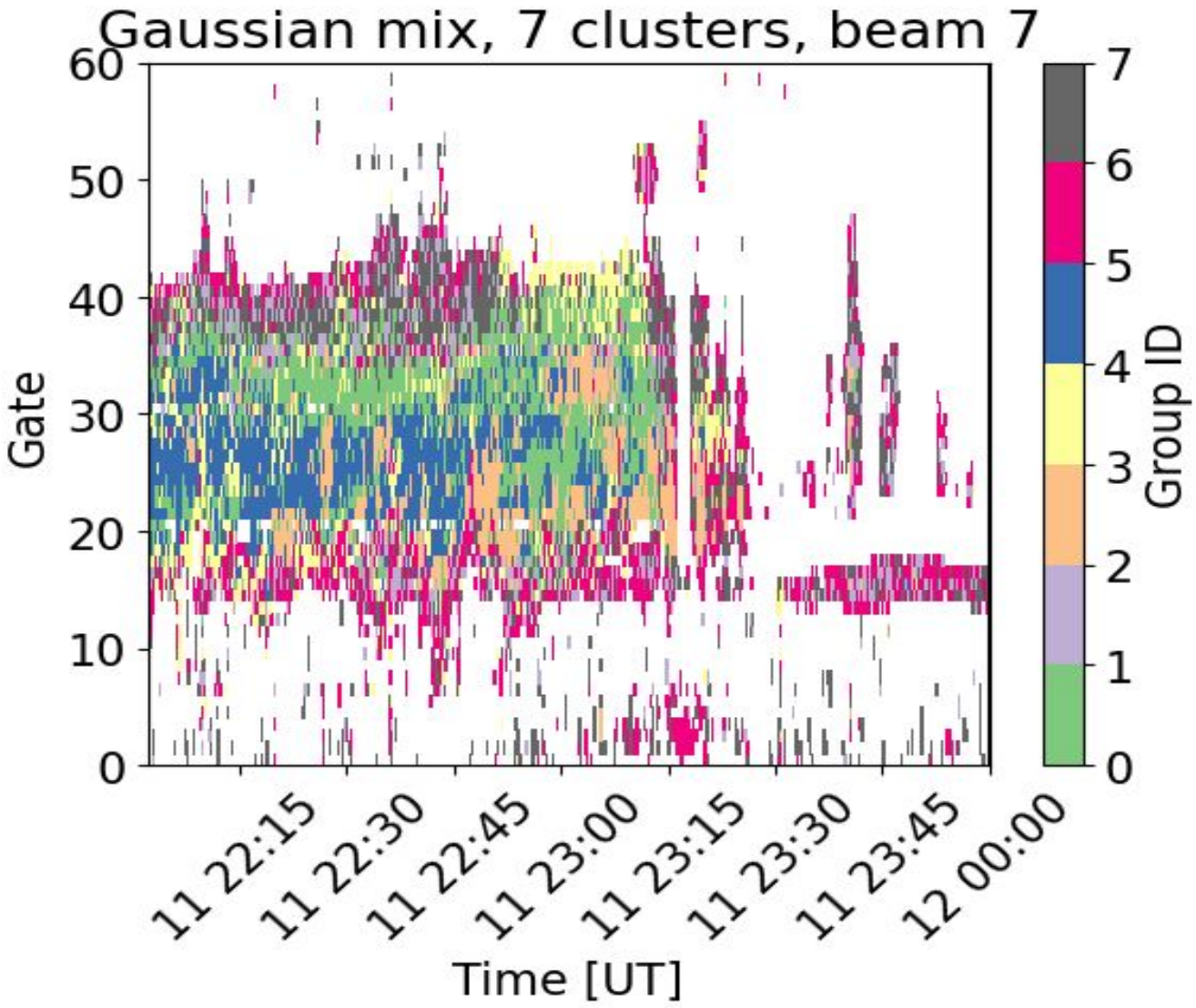
(Dahlgren et al., 2012)


RKN, 2009-12-11, Beam 7
Range Gate
Time [UT]
Velocity [m/s]
600
400
200
0
−200
−400
−600
22:00
22:15
22:30
22:45
23:00
23:15
23:30
23:45
00:00

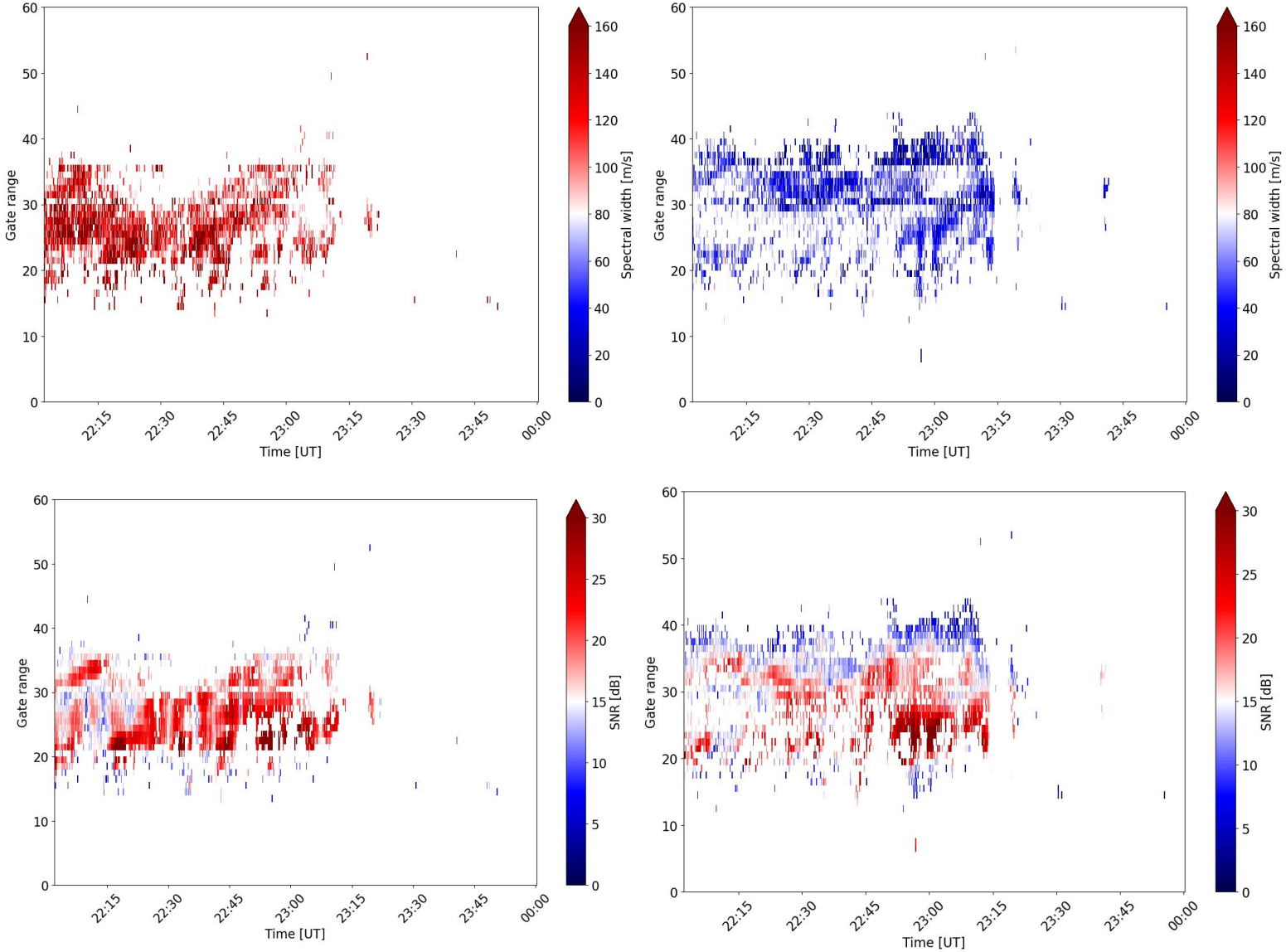

RKN, 2009-12-11, Beam 7
Range Gate
Time [UT]
SNR [dB]
24
16
8
0
22:00
22:15
22:30
22:45
23:00
23:15
23:30
23:45
00:00

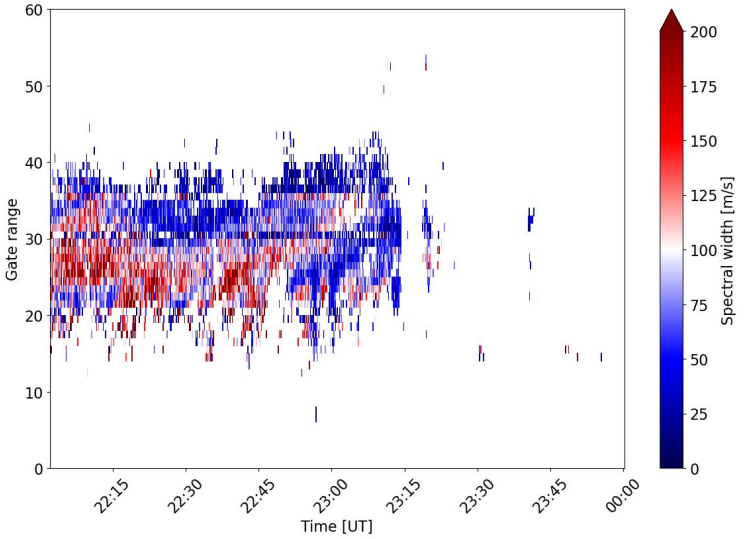

RKN, 2009-12-11, Beam 7
Range Gate
Time [UT]
Elevation [deg]
20
15
10
5
0
22:00
22:15
22:30
22:45
23:00
23:15
23:30
23:45
00:00

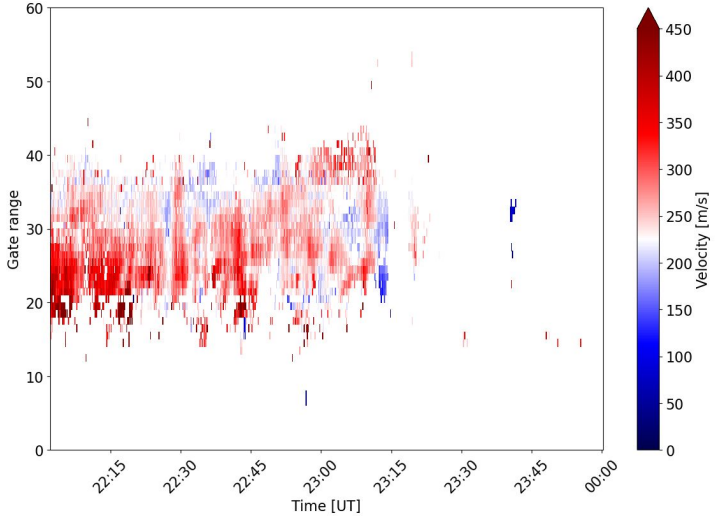

RKN, 2009-12-11, Beam 7
Range Gate
Time [UT]
Spectral width [m/s]
200
150
100
50
0
22:00
22:15
22:30
22:45
23:00
23:15
23:30
23:45
00:00

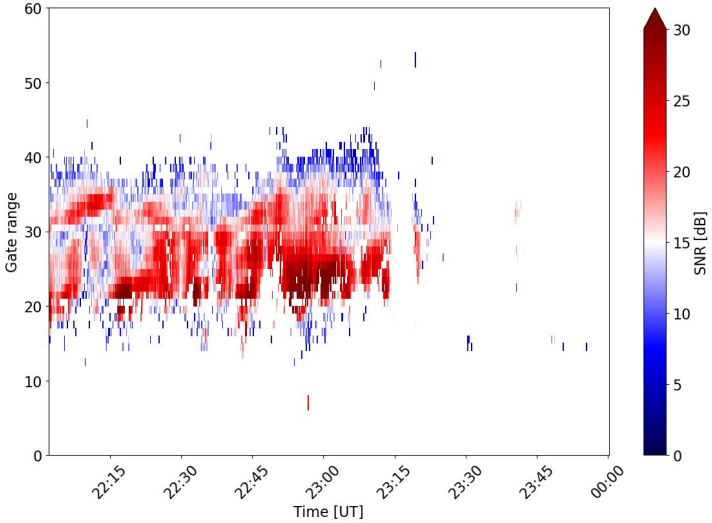


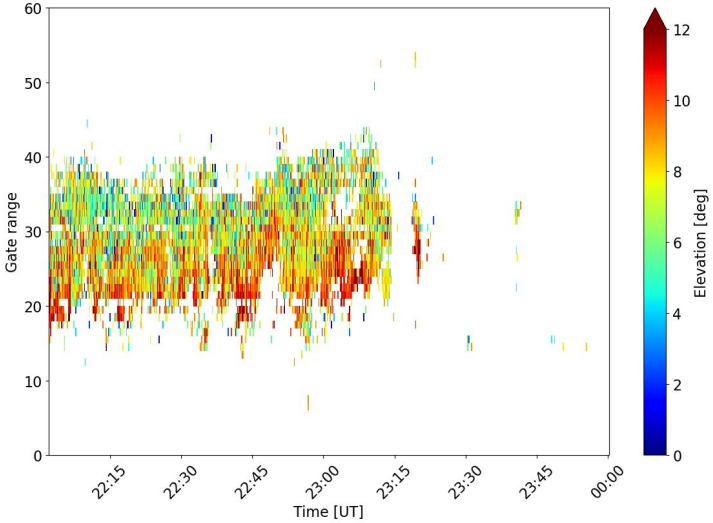
Number of clusters estimated from the BIC score test


Gate range
Time [UT]
Spectral width [m/s]
SNR [dB]
22:15
22:30
22:45
23:00
23:15
23:30
23:45
00:00


Gate range
Time [UT]
Spectral width [m/s]


Gate range
Time [UT]
Velocity [m/s]


Gate range
Time [UT]
SNR [dB]


Gate range
Time [UT]
Elevation [deg]

Conclusions

- Case studies are helpful for constraints used in automatic detections
- Statistical study requires automatic approach
- There are already tools to differentiate between different source regions, but still we need to investigate the properties of patches themselves

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