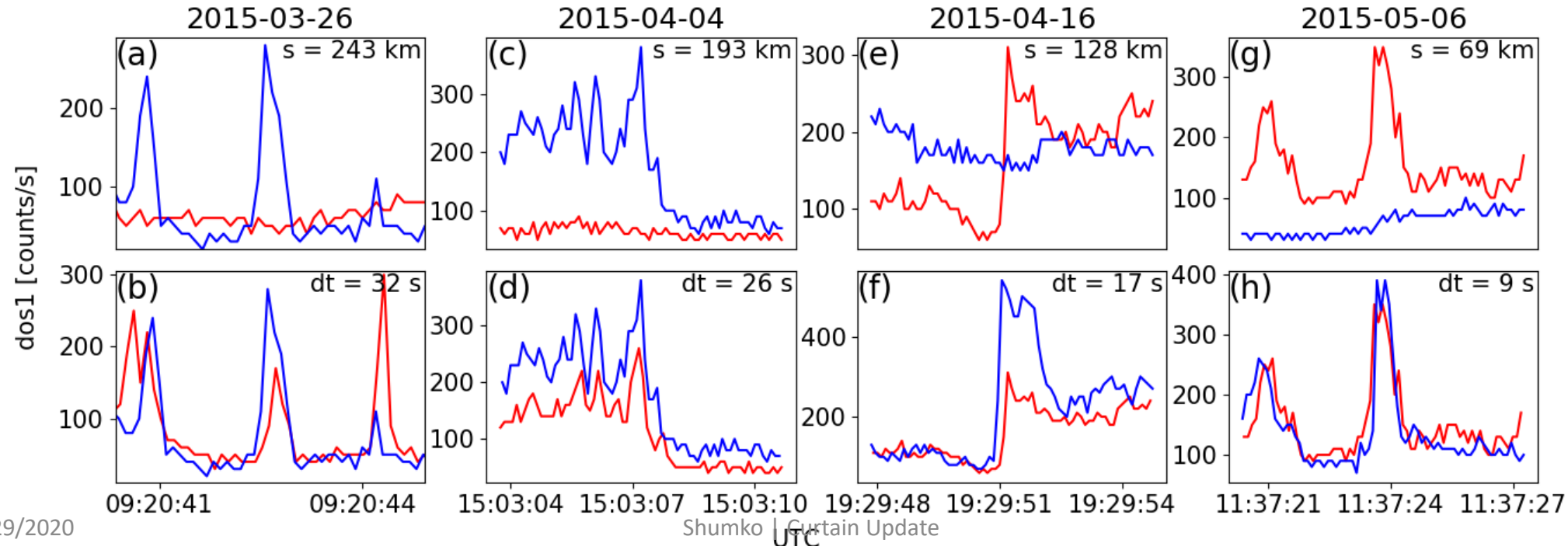
Curtains Statistics Update

29 January 2020

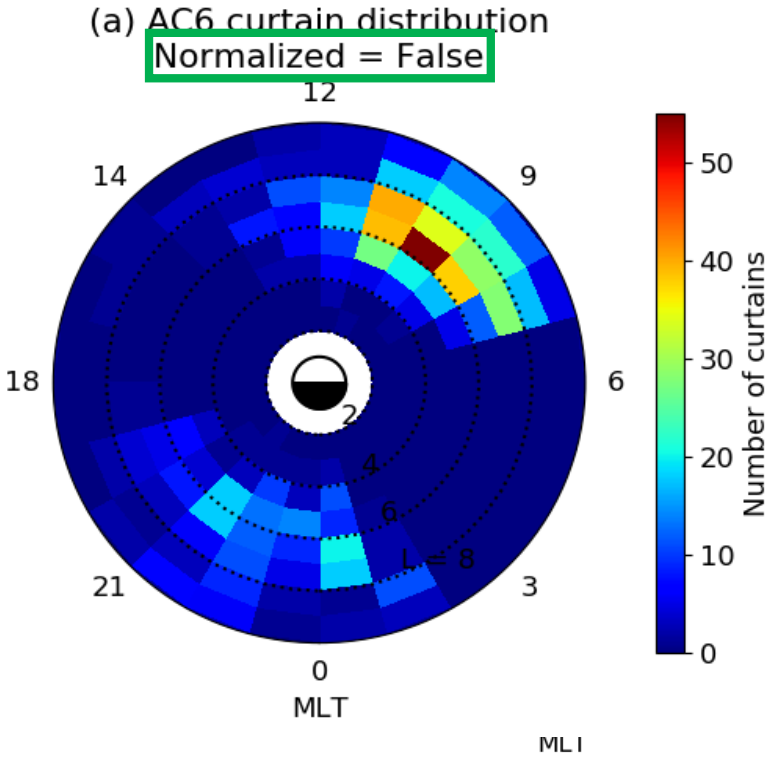
Mykhaylo Shumko

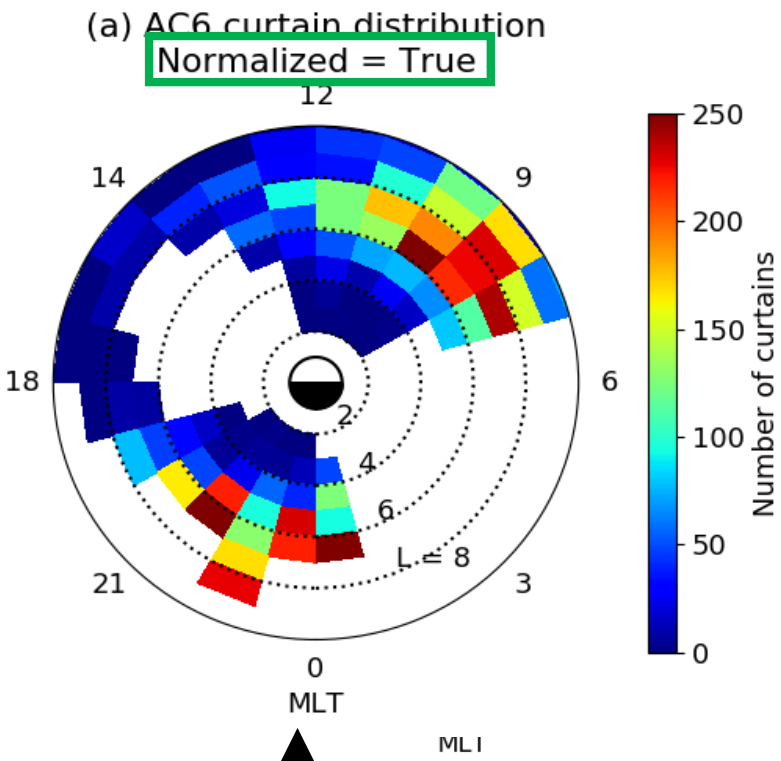
Curtain detections

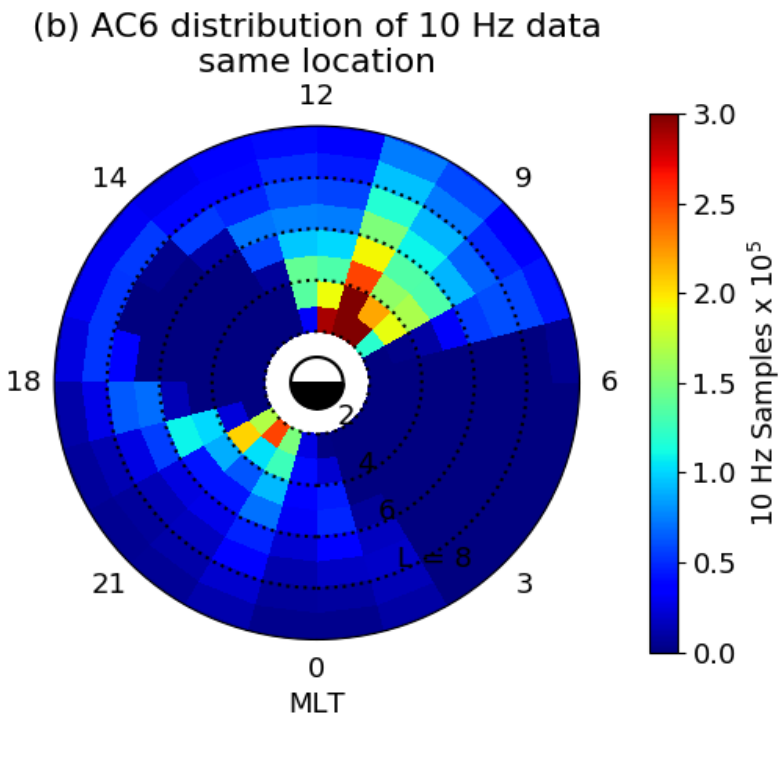
- Used Paul's burst parameter to identify microburst-like spikes in the AC6 data
- Cross-correlated spikes observed at the same time and position
- Looked through events that had a high (> 0.8) correlation at the same position
- Identified and confirmed 933 curtains



Some stats : L-MLT distribution

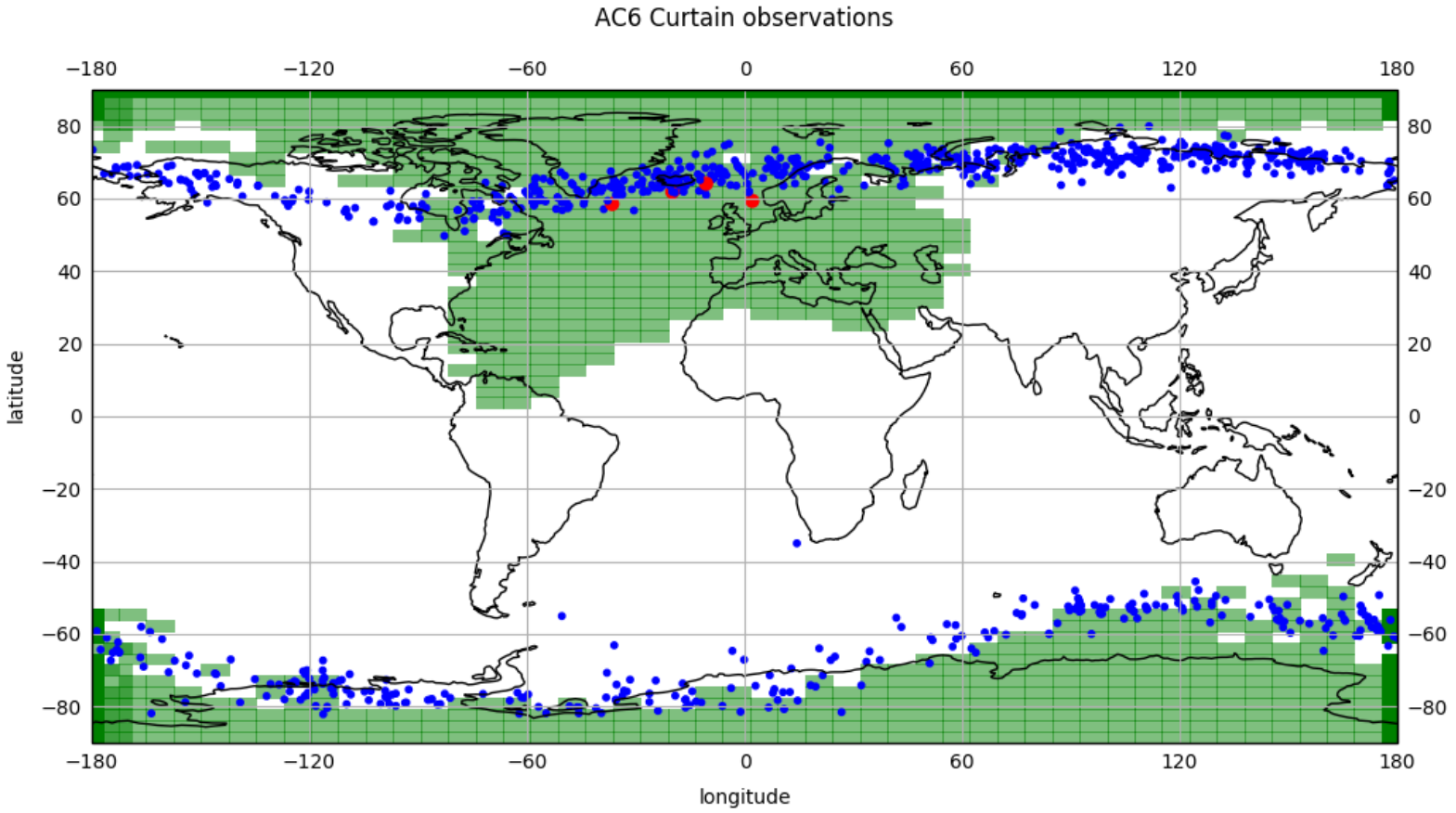




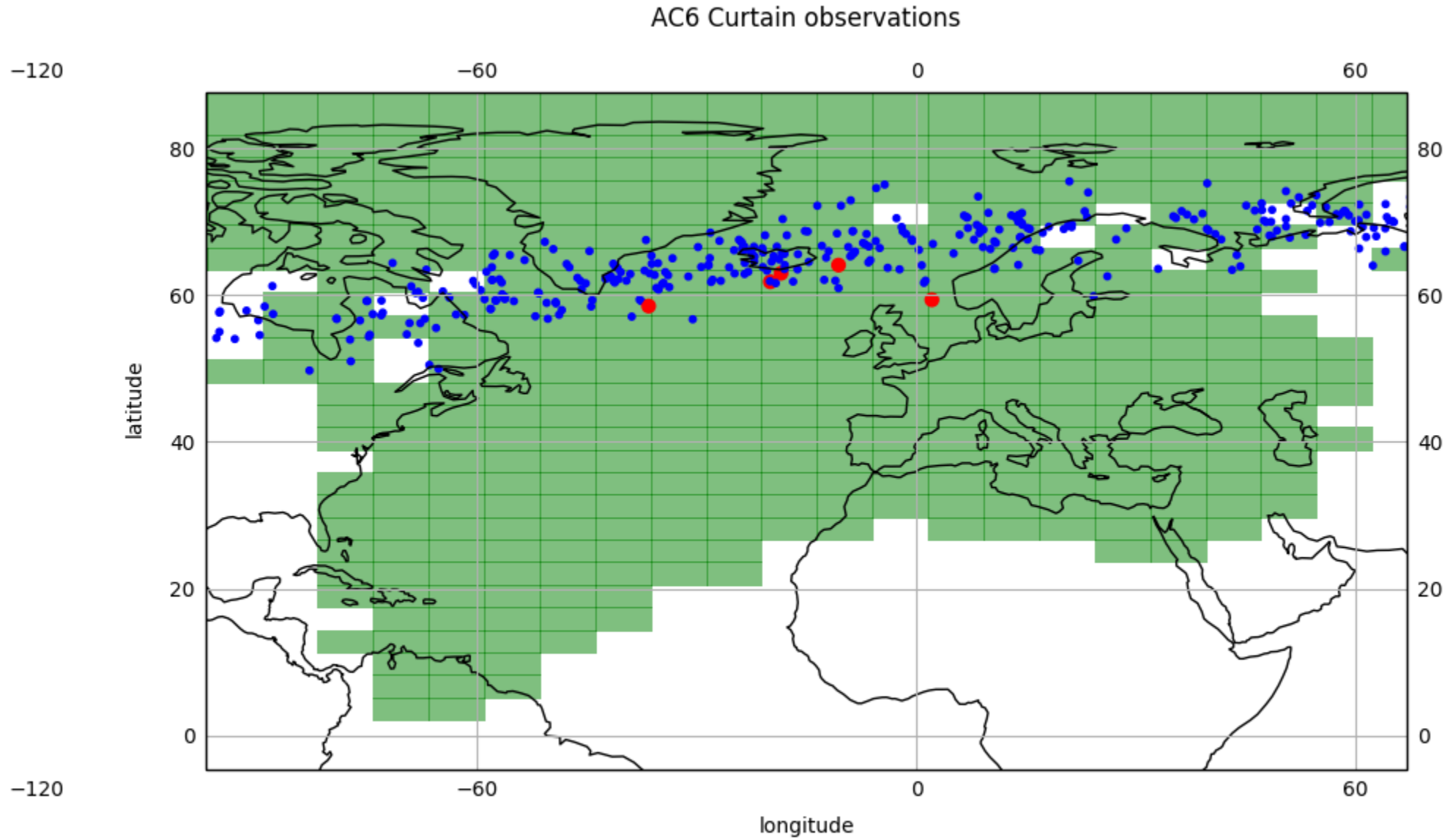


In the normalized case the white L-MLT bins had less than 20k good 10 Hz samples so the normalized number of curtains is not shown

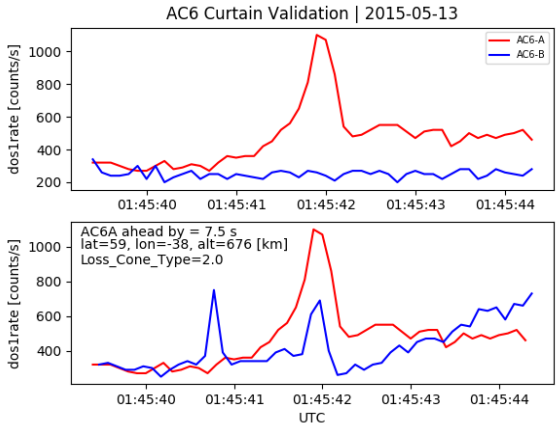
Some stats : lat-lon distribution

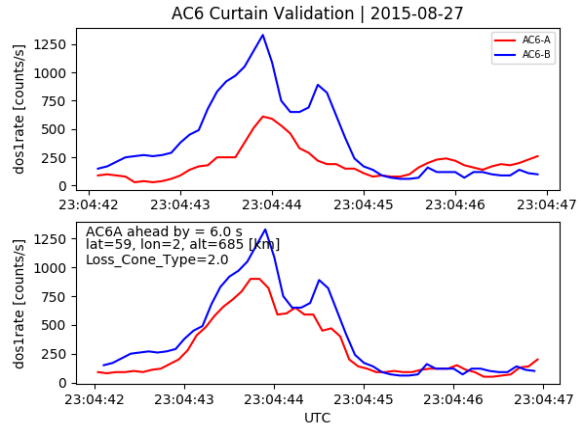


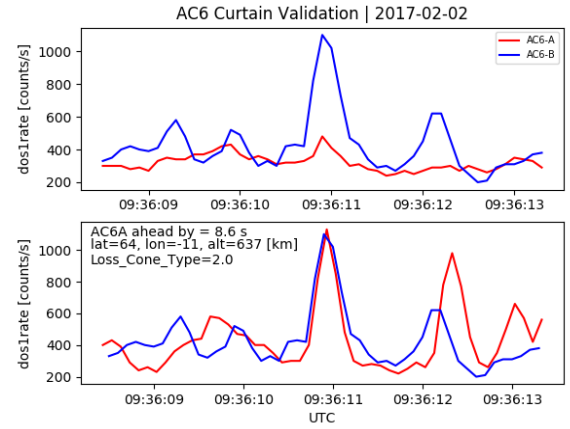
- Blue dots = curtain detections
- Green area shows the BLC/open field lines assuming the OPQ77 field model.
- Curtains are observed inside the BLC region

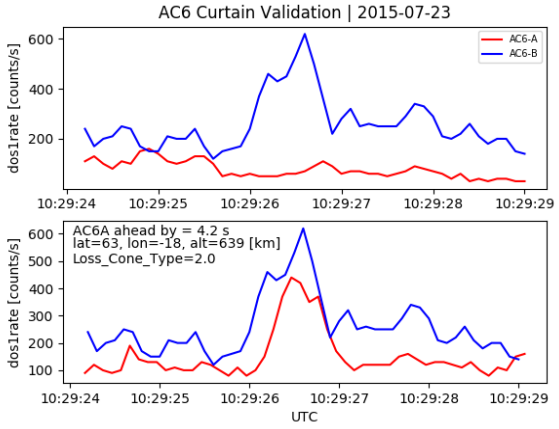

AC6 Curtain observations
−120
−60
0
60
80
60
40
20
0
latitude
longitude

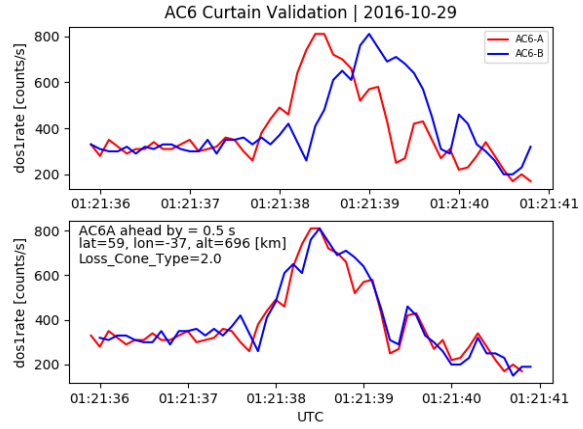
Examples of curtains observed in the BLC

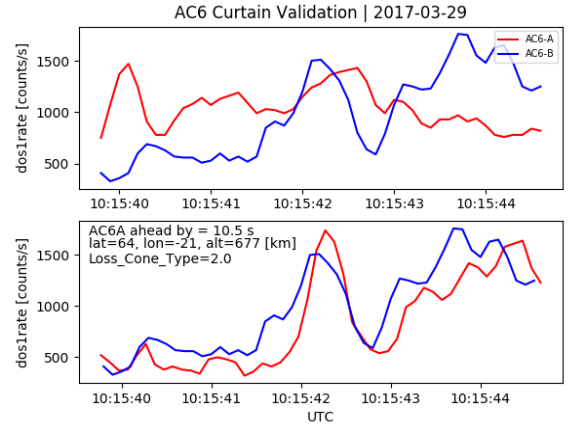

AC6 Curtain Validation | 2015-05-13
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 7.5 s
lat=59, lon=-38, alt=676 [km]
Loss_Cone_Type=2.0
UTC

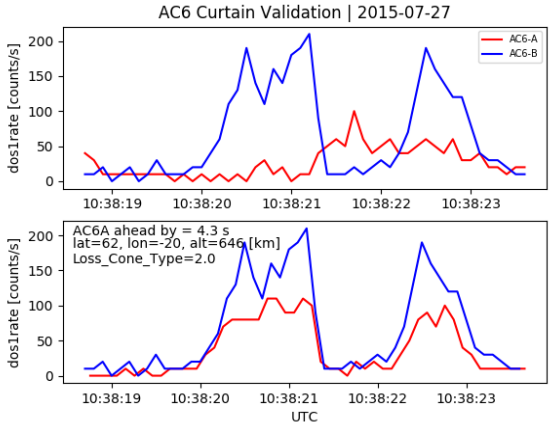

AC6 Curtain Validation | 2015-08-27
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 6.0 s
lat=59, lon=2, alt=685 [km]
Loss_Cone_Type=2.0
UTC

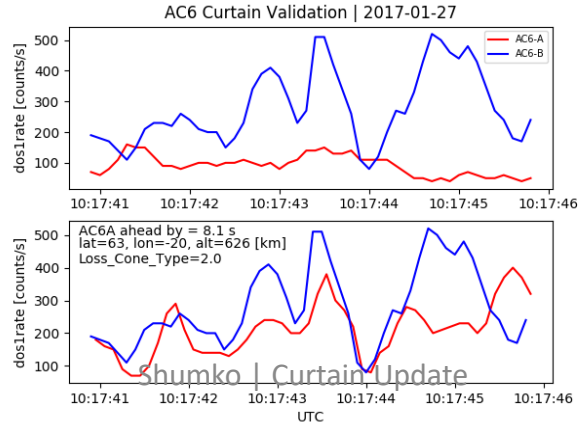

AC6 Curtain Validation | 2017-02-02
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 8.6 s
lat=64, lon=-11, alt=637 [km]
Loss_Cone_Type=2.0
UTC

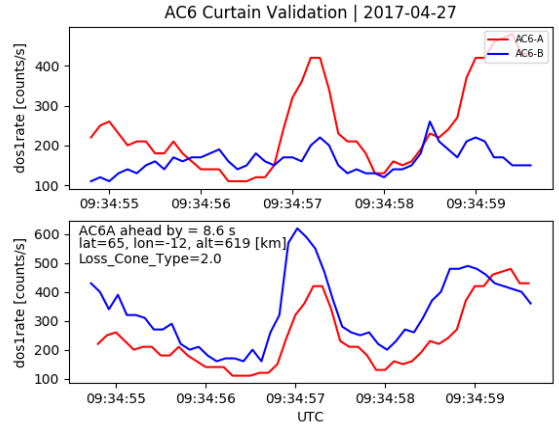

AC6 Curtain Validation | 2015-07-23
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 4.2 s
lat=63, lon=-18, alt=639 [km]
Loss_Cone_Type=2.0
UTC


AC6 Curtain Validation | 2016-10-29
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 0.5 s
lat=59, lon=-37, alt=696 [km]
Loss_Cone_Type=2.0
UTC

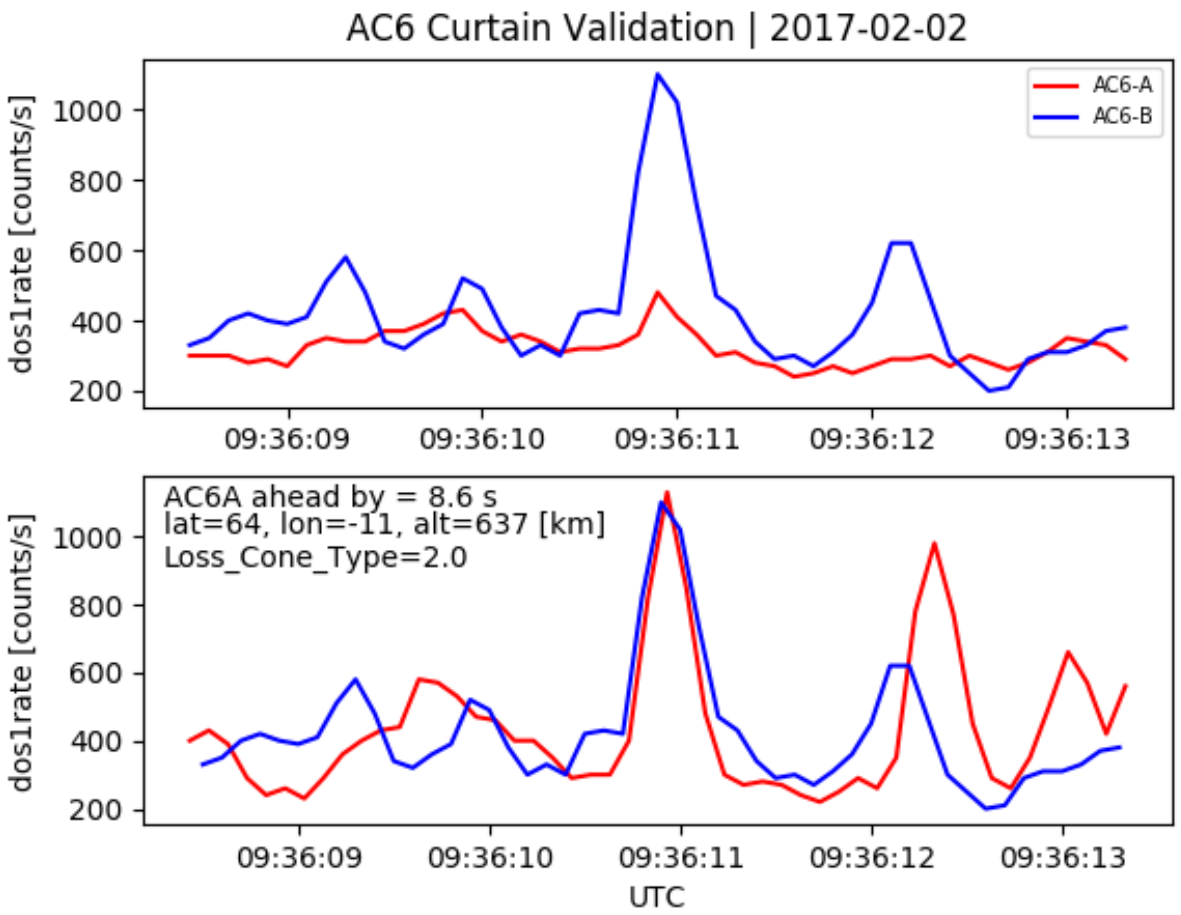

AC6 Curtain Validation | 2017-03-29
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 10.5 s
lat=64, lon=-21, alt=677 [km]
Loss_Cone_Type=2.0
UTC


AC6 Curtain Validation | 2015-07-27
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 4.3 s
lat=62, lon=-20, alt=646 [km]
Loss_Cone_Type=2.0
UTC


AC6 Curtain Validation | 2017-01-27
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 8.1 s
lat=63, lon=-20, alt=626 [km]
Loss_Cone_Type=2.0
UTC


AC6 Curtain Validation | 2017-04-27
dos1rate [counts/s]
AC6-A
AC6-B
AC6A ahead by = 8.6 s
lat=65, lon=-12, alt=619 [km]
Loss_Cone_Type=2.0
UTC

Case study – can choose a nicer example



- Observed when AC6 was separated by 9 s
- Near Iceland
- Lm_OPQ = 5.6
- MLT_OPQ = 10
- AE = 271 nT

Case study - mirror point altitude

- Found that the mirror point of locally mirroring electrons to be 34 km in the SAA
- Electrons must have been lost. Other examples have mirror points below Earth's surface
- Since these electrons are lost, what can be driving this precipitation for at least 9 seconds?
- We need a DC potential to continuously accelerate electrons
- Question – What is the minimum DC potential necessary to lower the mirror point from just trapped (defined as 100 km altitude mirror point in the SAA) to AC6's altitude?

Case study – DC potential

Paul's idea to use adiabatic invariants. Kinetic energy of a prticle at the mirror point is $W = \mu B_0$ with no potential. Then you accelerate the particle with a potential Φ and the particle will keep going until it reaches a new mirror point at $\mu B_1 = \mu B_0 + q\Phi$. Then the potential is just

$$q\Phi = \frac{W}{B_0}(B_1 - B_0),$$

where W is the electron's kinetic energy.

- q*Phi = 1 kV for this example. One other example I looked at had a 4.5 kV potential
- Seems reasonable to be accelerated by an auroral potential
- The mystery continues – are curtains related to microbursts or aurora? We now know at least some can't be related to microbursts.

Paths forward

- Look at the MLT of curtains in the BLC
- Look at auroral imagers when AC6 is overhead in Canada
- What other curtain stats do you want to see?
- More work can be done but maybe this is enough work for a short JRL, followed by a more comprehensive study?