Large scale structures in the Plasmasphere

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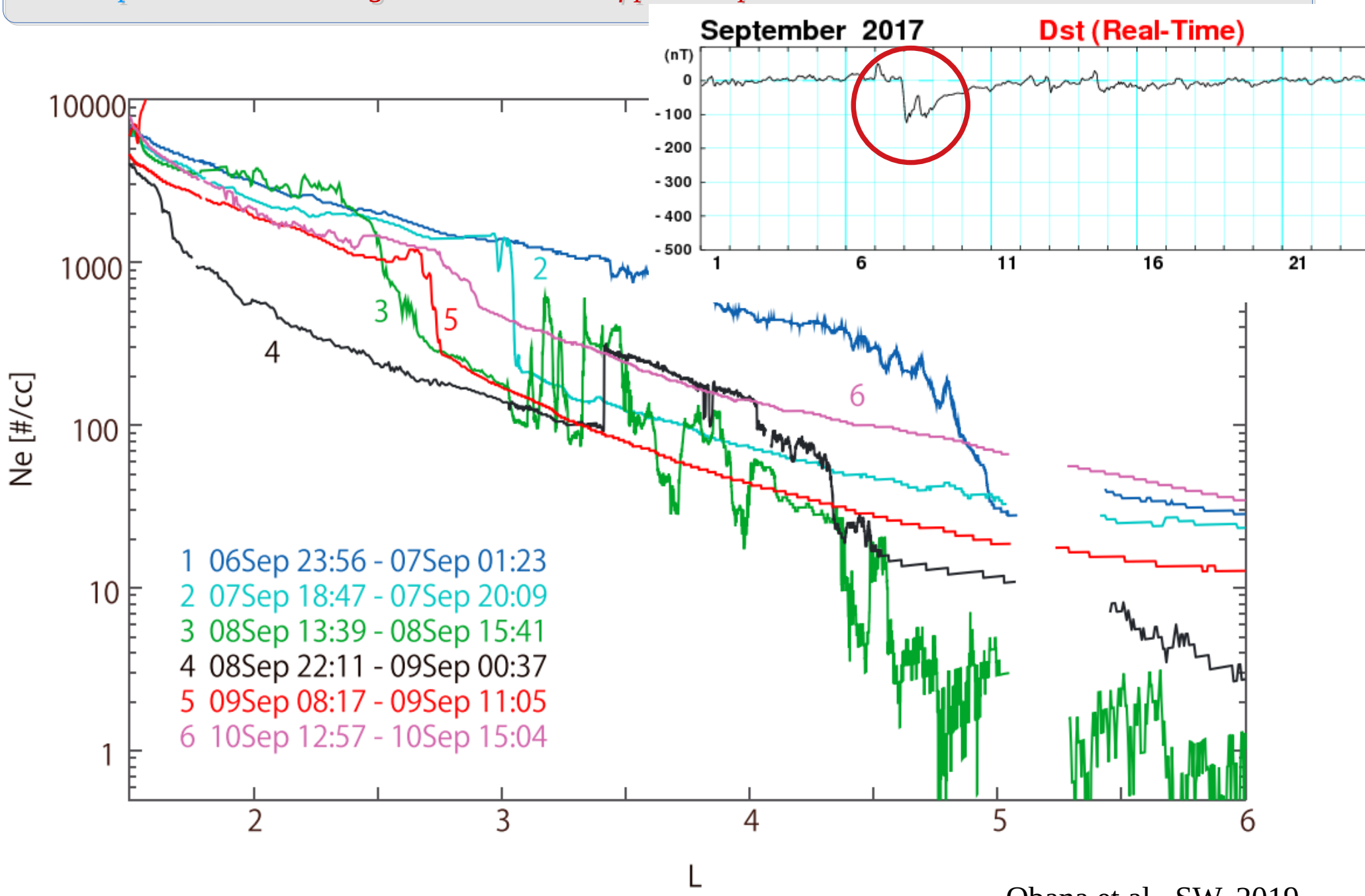
Outline

Large scale structures in the plasmasphere – are they ***»global«***?

1. The 8-9 September 2017 event – *disturbed period*
2. The 14 June 2013 event – *quiet period*

Ducted whistlers outside of the plasmapause or choruses inside the plasmapause ?

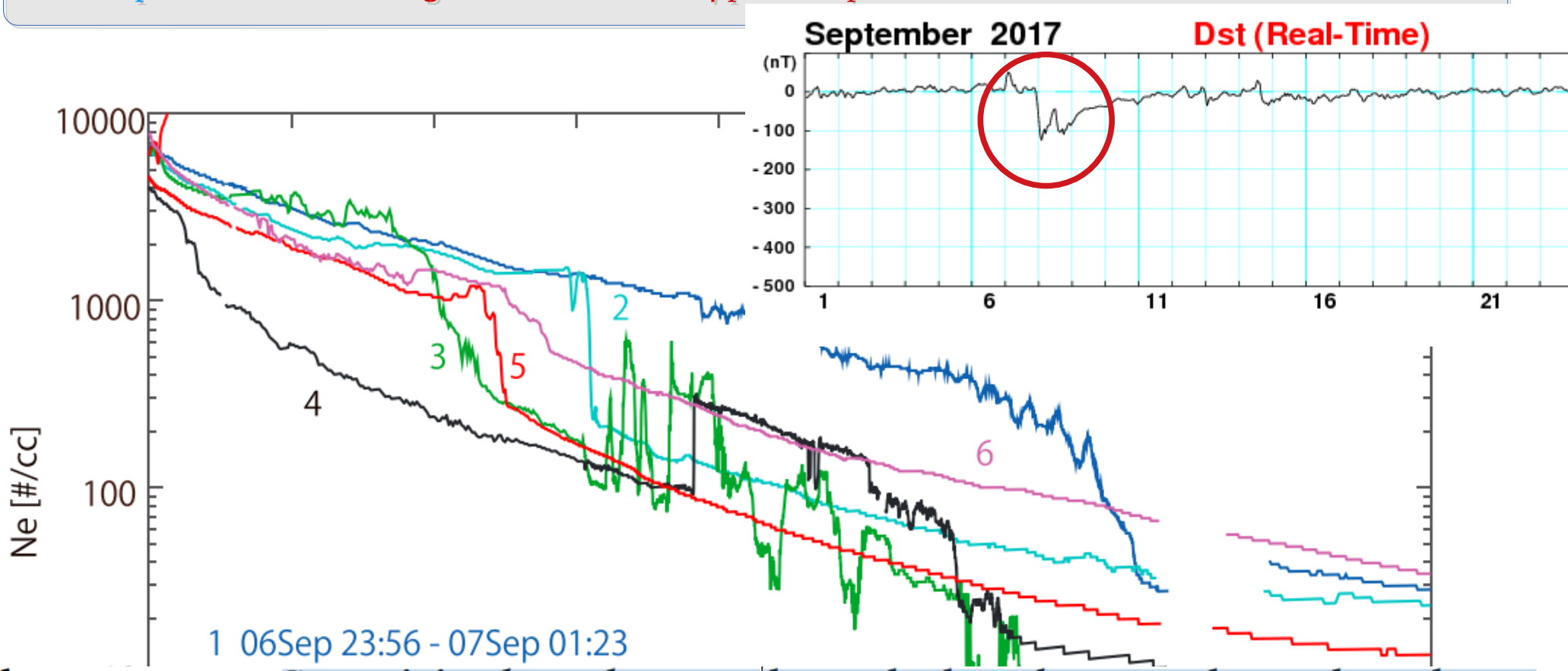
8-9 September 2017 – *large scale structure of plasmasphere*



Obana et al., SW, 2019

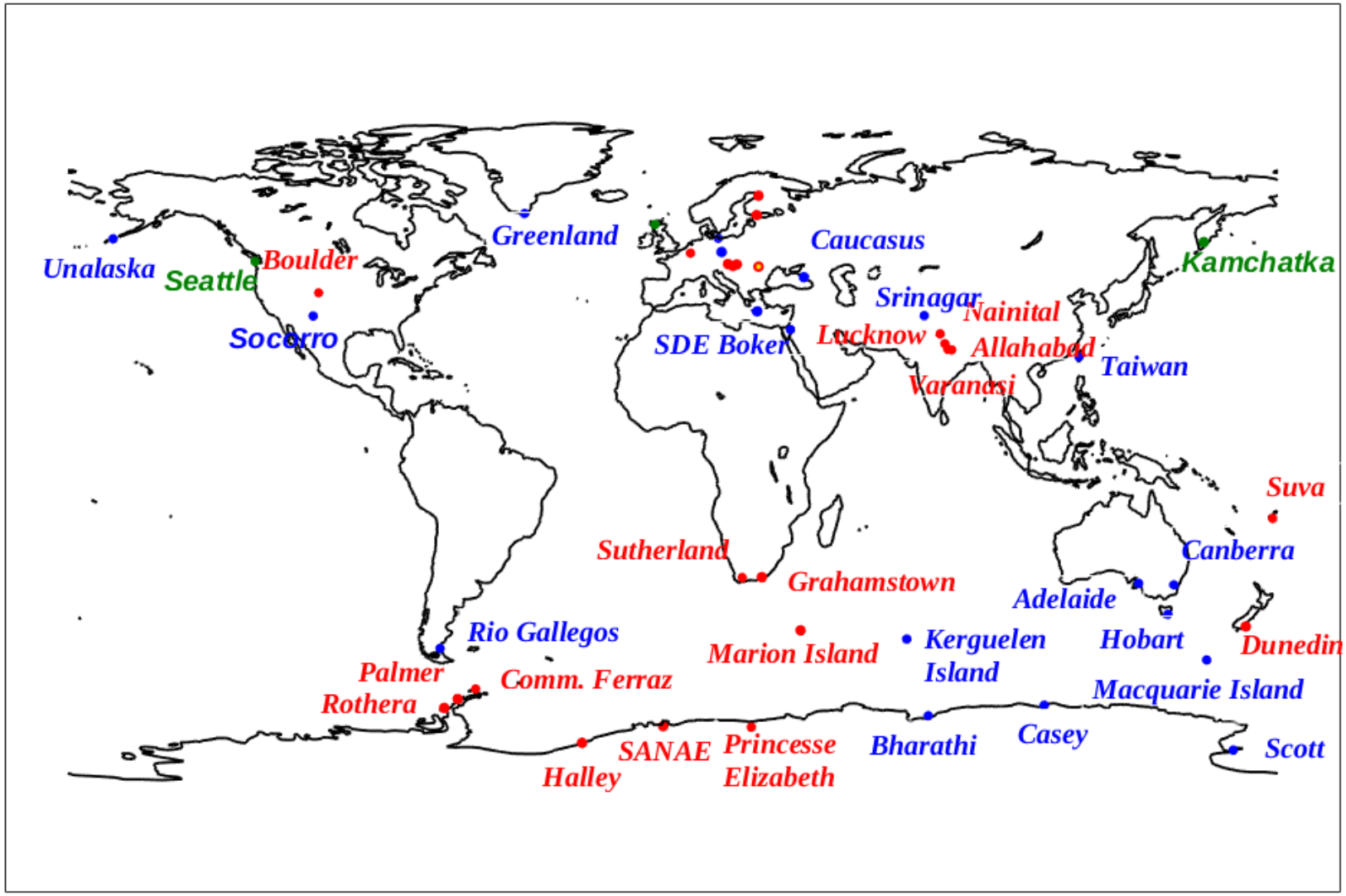
Figure 3. Arase observations of cold electron density profiles as a function

8-9 September 2017 – *large scale structure of plasmasphere*



phase starts. Surprisingly, almost the whole plasmasphere has been eroded and only a slightly dense area remains in the narrow region of $L \leq 1.7$. The decrease in density, which seems to correspond to the plasmapause, begins at $L = 1.6$ and ends at 1.7 around 13.2 MLT. The smooth shape of this black curve between $L = 1.7$ and 3.4 looks like the density profile of the saturated plasmasphere. However, we will note that the density level is very low. For example, Carpenter and Anderson

Automatic Whistler Detector and Analyzer Network
AWDANet



8-9 September 2017 – *large scale structure of plasmasphere*

Plasmasphere/plasmapause/plasmatrough and whistlers

- ***whistlers recorded on the ground are propagating in the plasmasphere in density ducts*** *(or at the plasmapause → knee whistlers)*

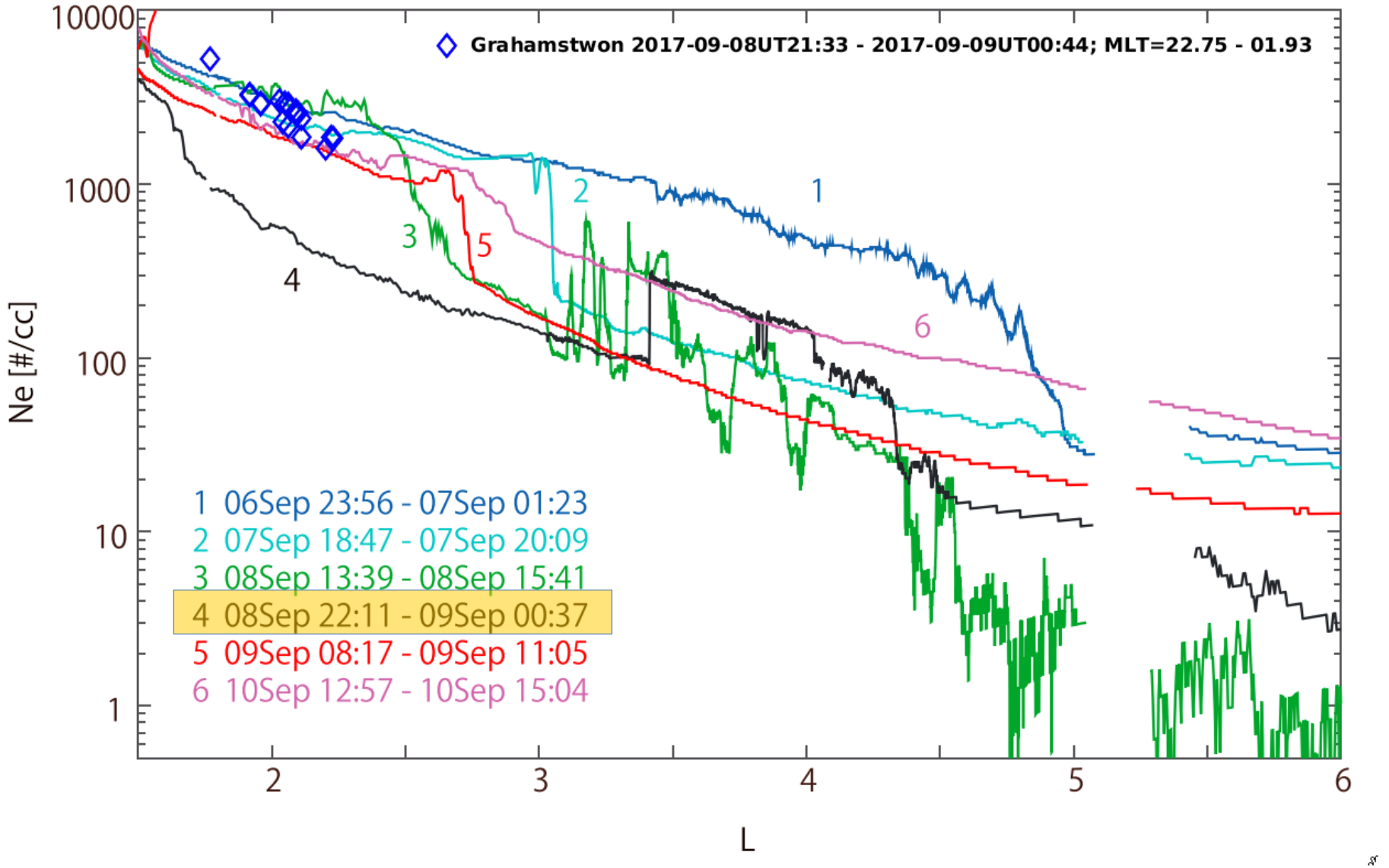
- **8811** whistlers were recorded at Rothera, Antarctica (**L=2.71**) between 21:00UT and 02:00UT on 8-9 September 2017

- **1258** whistlers were recorded at Grahamstown, South Africa (**L=1.81**)between 21:00UT and 02:00UT on 8-9 September 2017

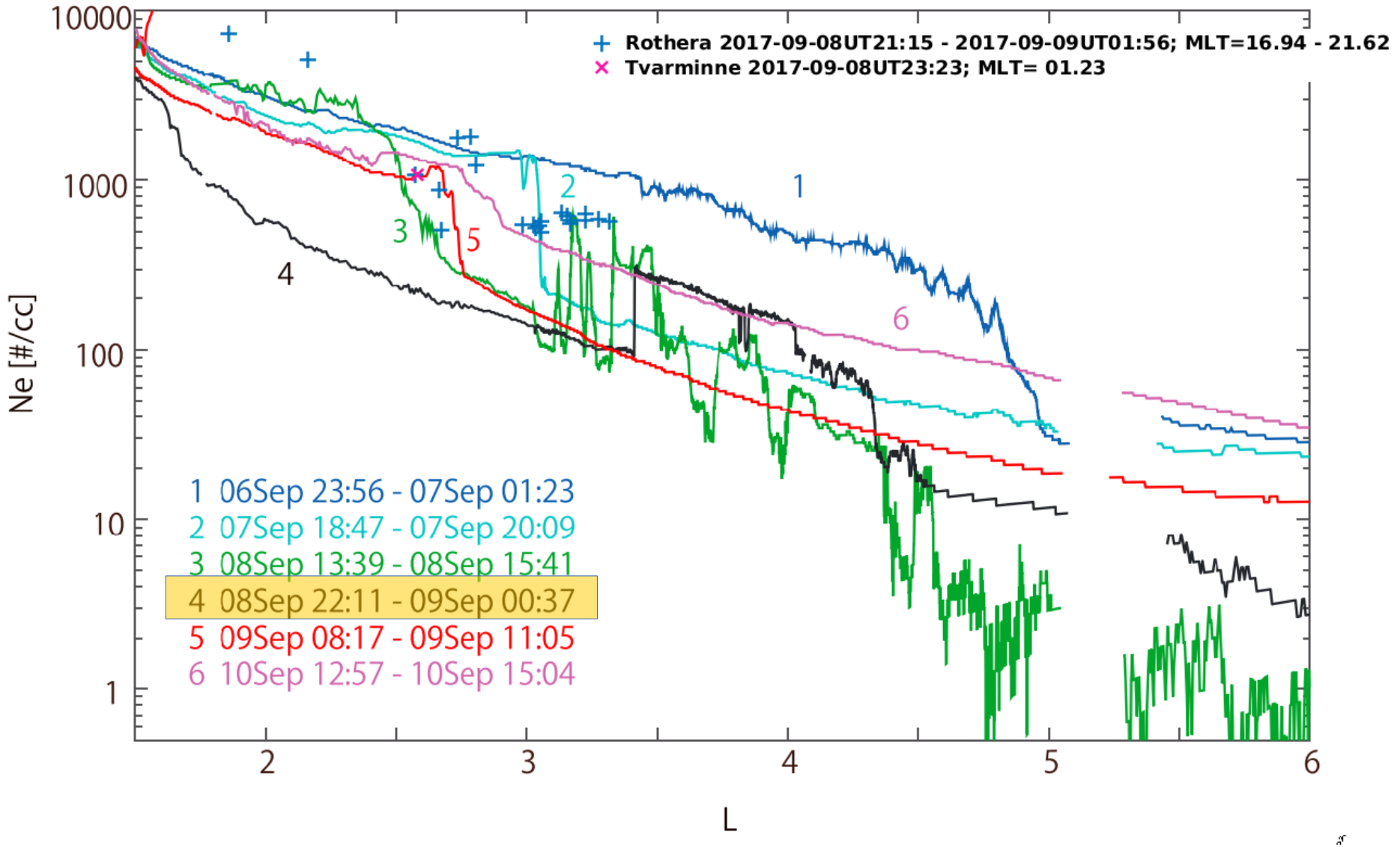
- **55** whistlers were recorded at Karymshina, Kamchatka (**L=2.13**)between 21:00UT and 02:00UT on 8-9 September 2017 *(it is on the Northern Hemisphere)*

These 3 receivers were surely inside the plasmasphere!

8-9 September 2017 – *large scale structure of plasmasphere*

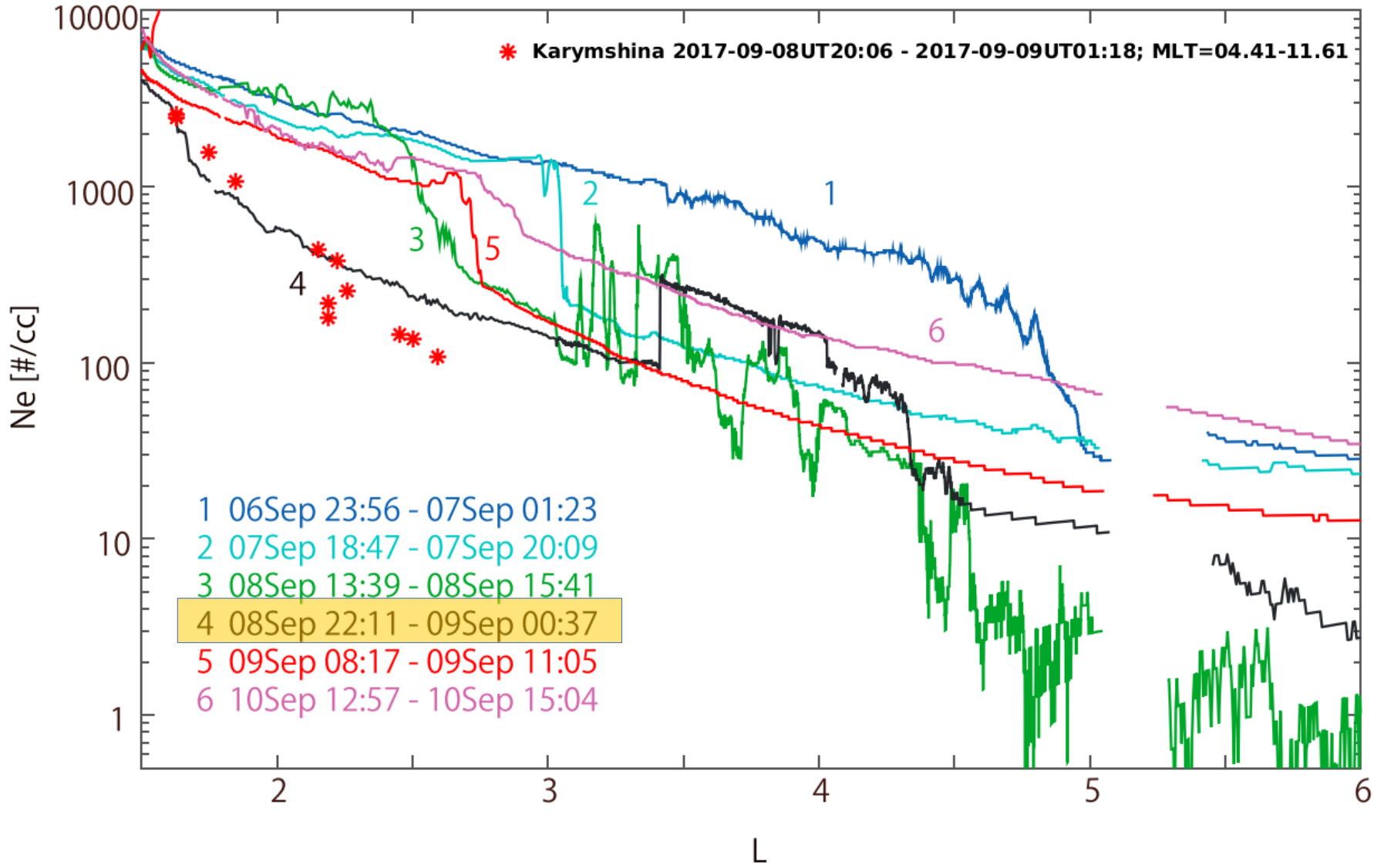


8-9 September 2017 – *large scale structure of plasmasphere*



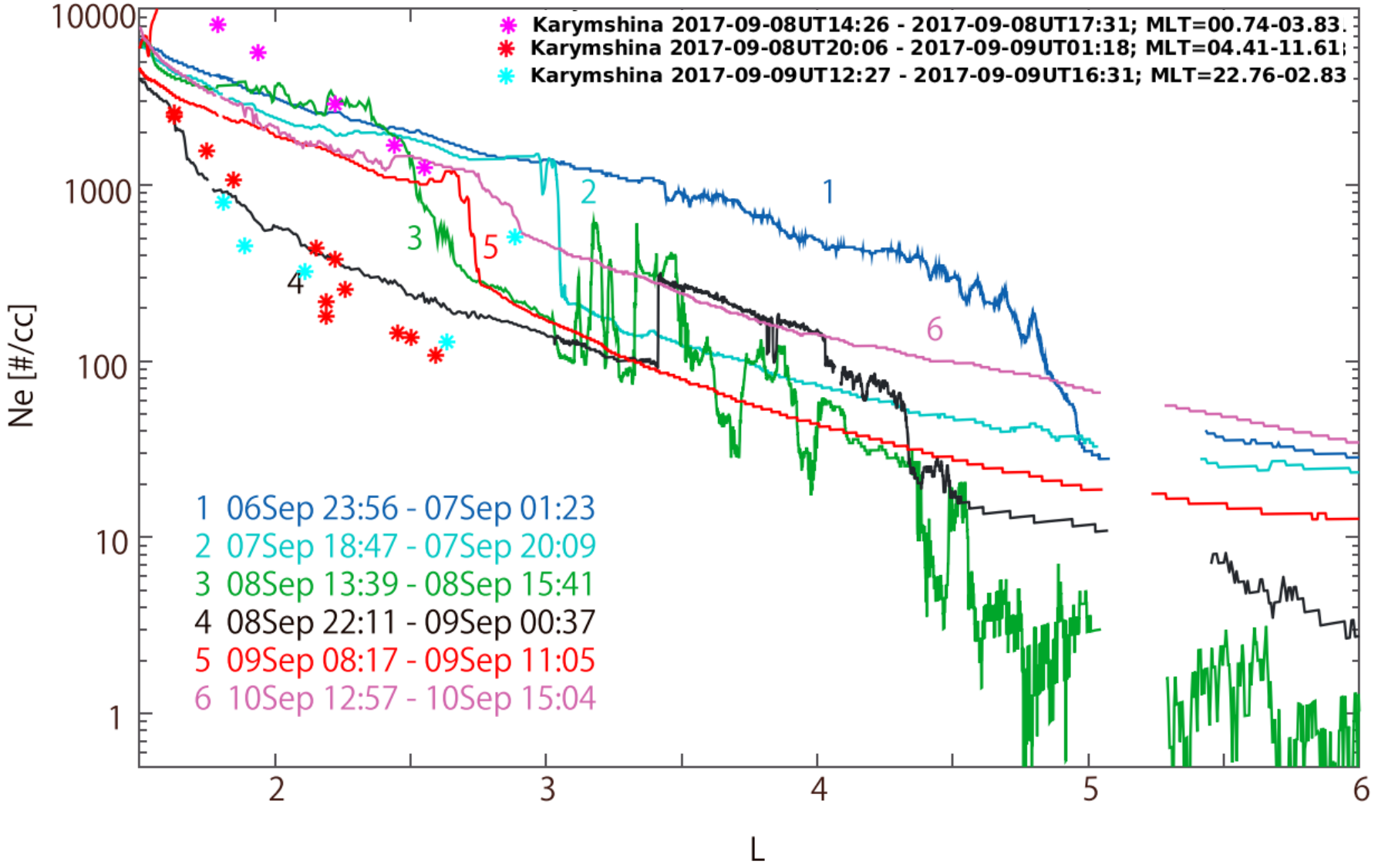
Is something wrong with ARASE density measurements?

8-9 September 2017 – *large scale structure of plasmasphere*

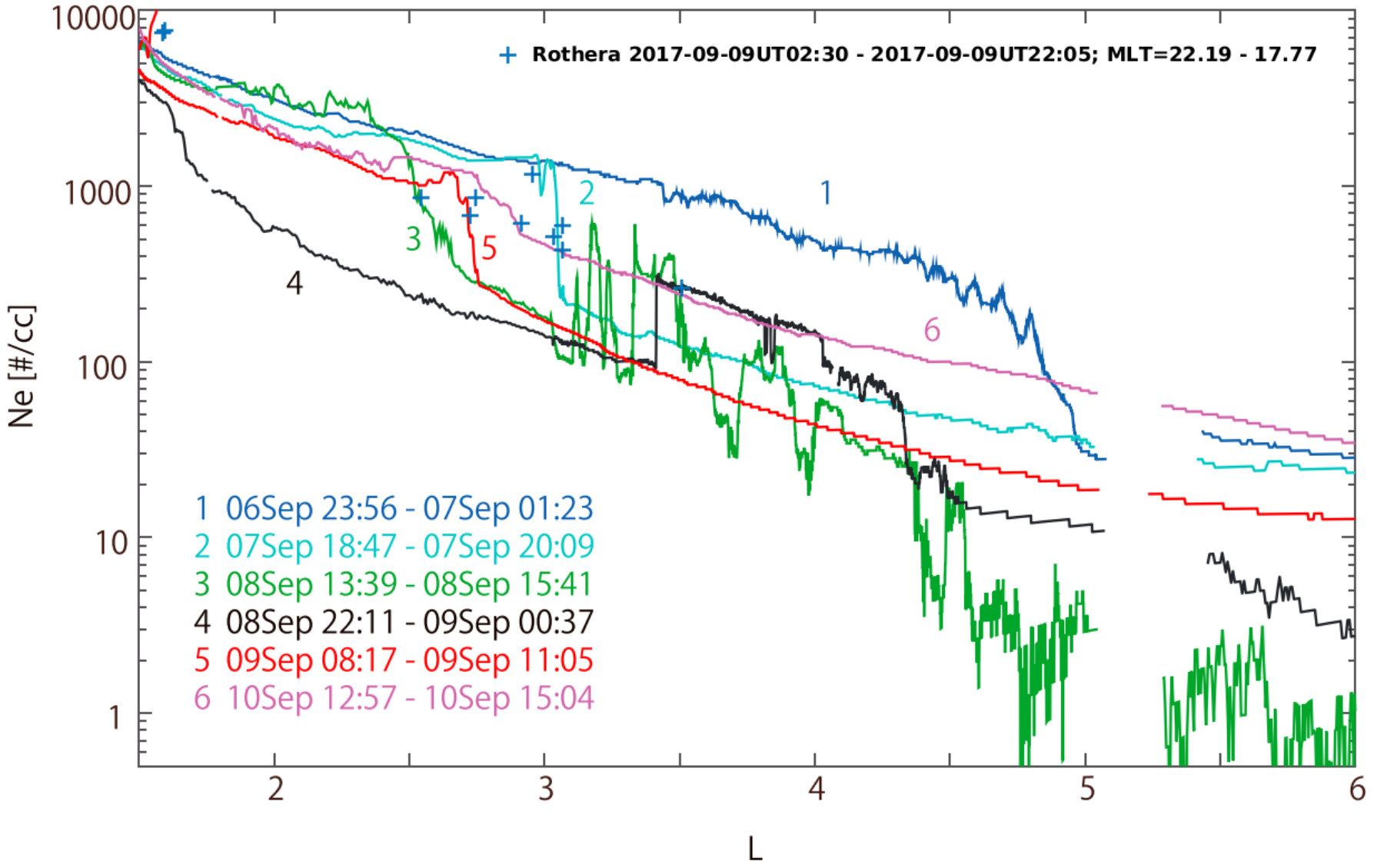


Is something wrong with ARASE density measurements? **NO!**

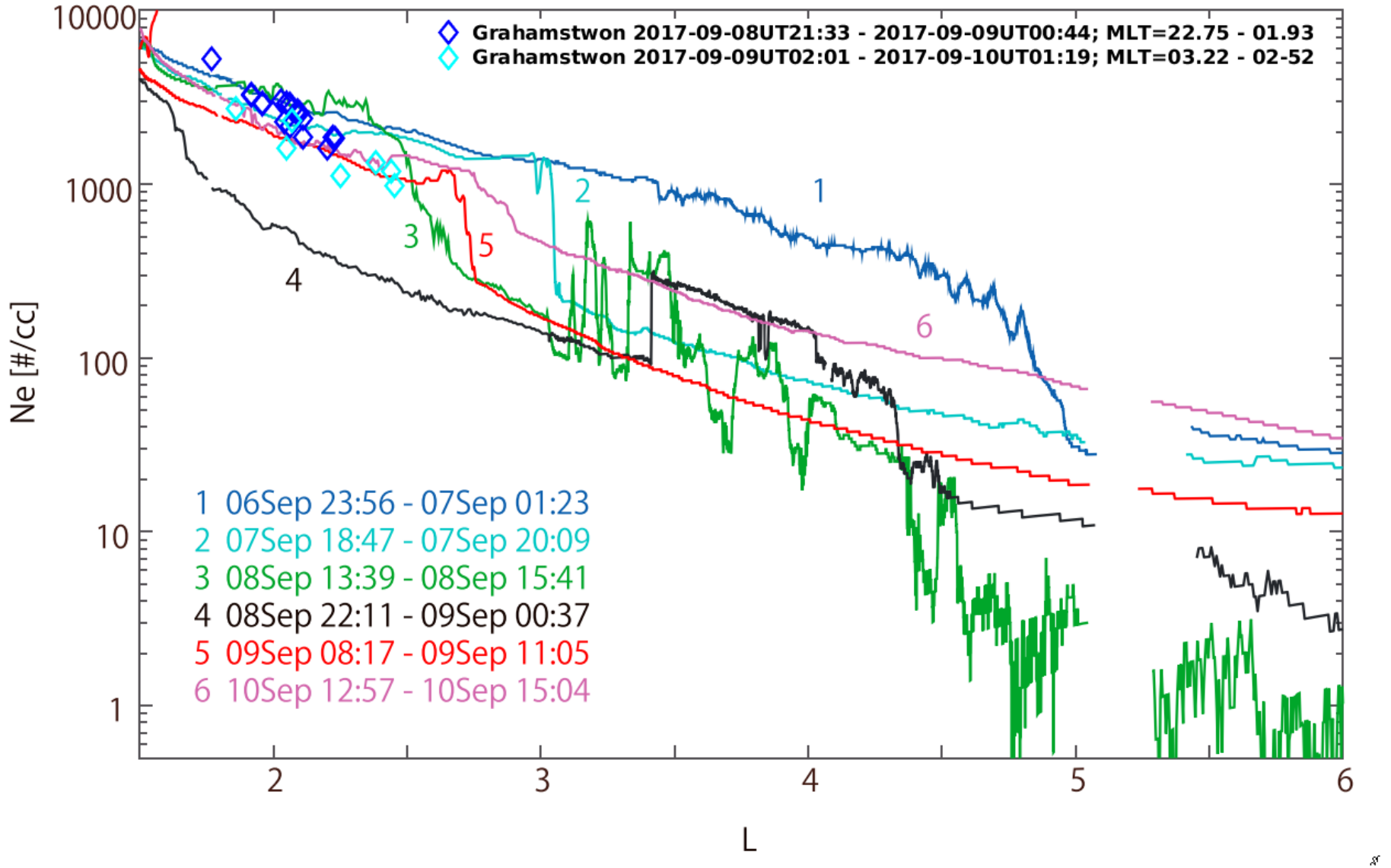
8-9 September 2017 – *large scale structure of plasmasphere*



8-9 September 2017 – *large scale structure of plasmasphere*

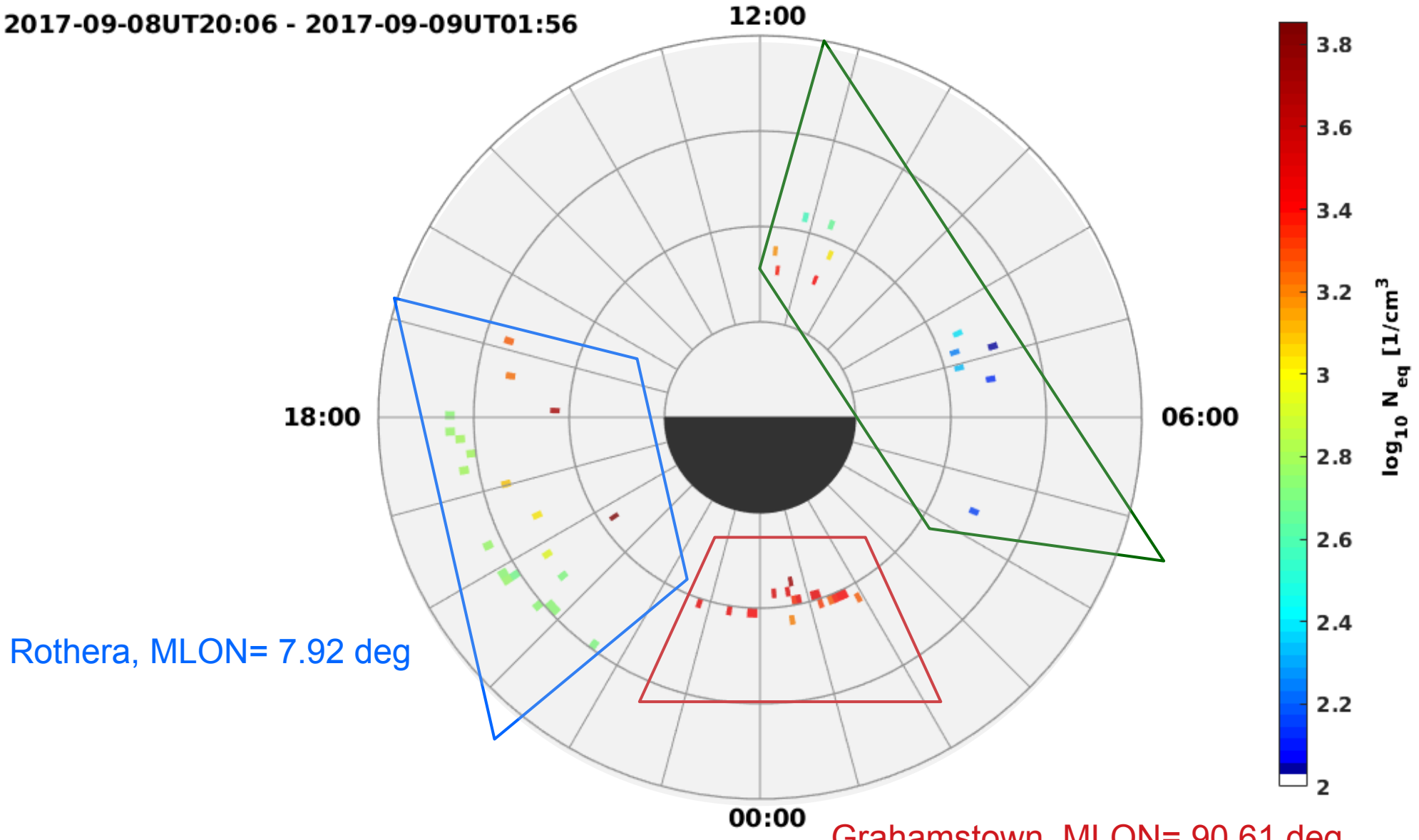


8-9 September 2017 – *large scale structure of plasmasphere*



8-9 September 2017 – *large scale structure of plasmasphere*

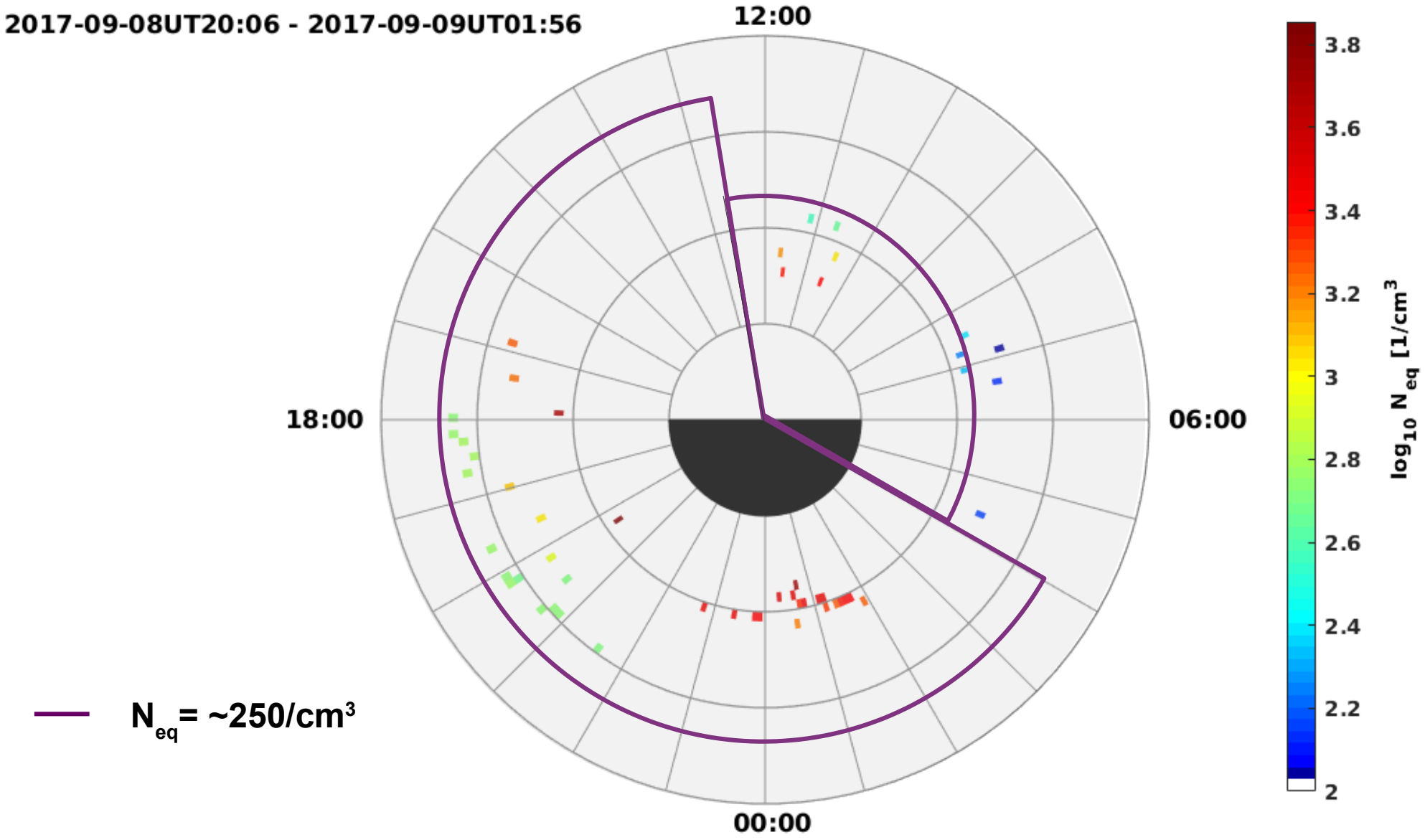
Karymshina, MLON= 227.37 deg



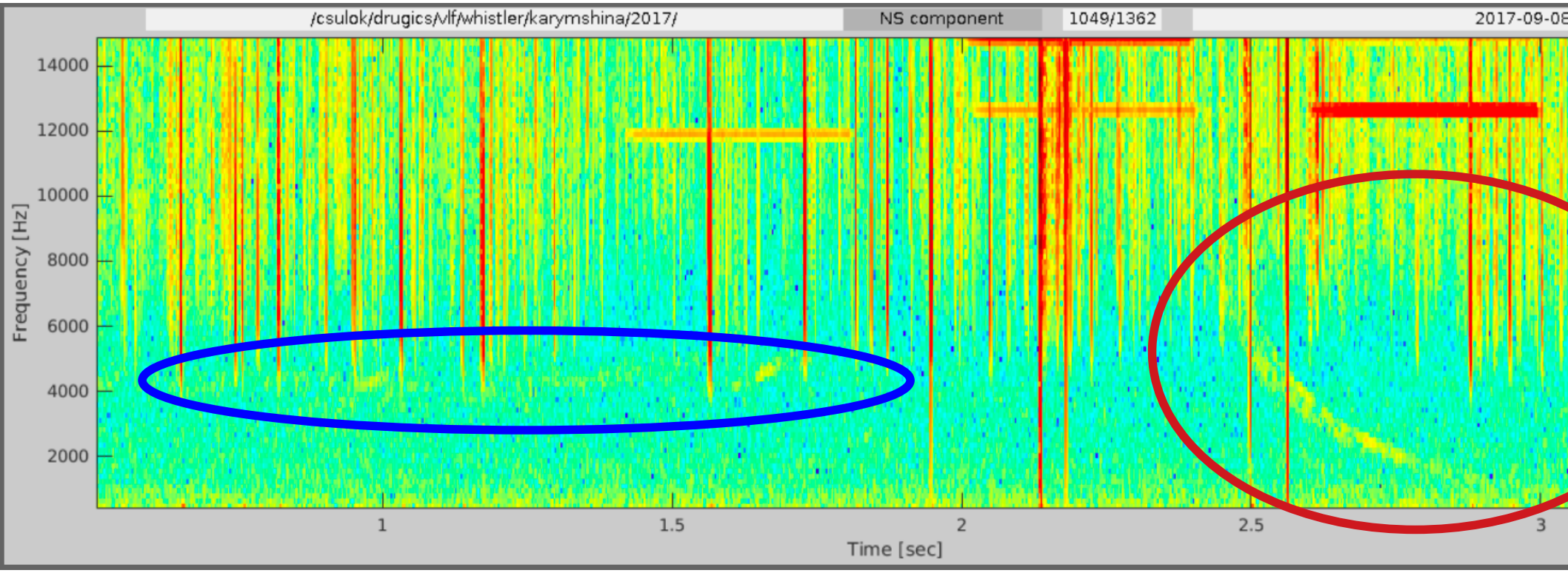
Rothera, MLON= 7.92 deg

Grahamstown, MLON= 90.61 deg

8-9 September 2017 – *large scale structure of plasmasphere*



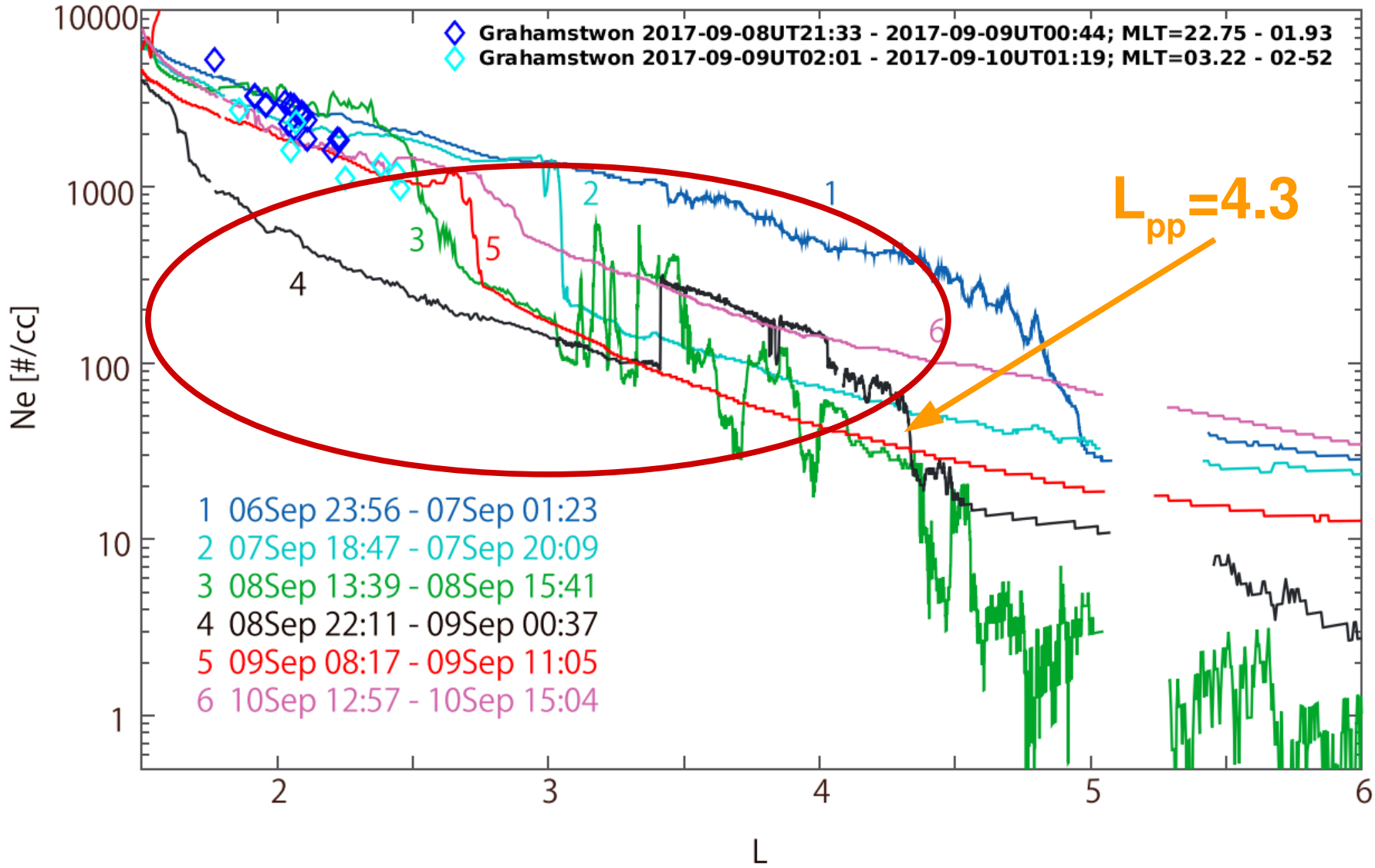
8-9 September 2017 – *large scale structure of plasmasphere* – ***plasmasphere or plasmatrough?***



Whistler and choruses were recorded simultaneously at Karymshina (Kamchatka) at 22:40UT on 8 September 2017

$L=2.13; L_{pp}=4.3$

8-9 September 2017 – *large scale structure of plasmasphere*



It is rather a large inner trough than heavy erosion of the whole plasmasphere

Large scale structures in the plasmasphere - the 14 June 2013 event

Density cavities/Inner trough (Carpenter et al., 2000)

=> **but are they »global«?**

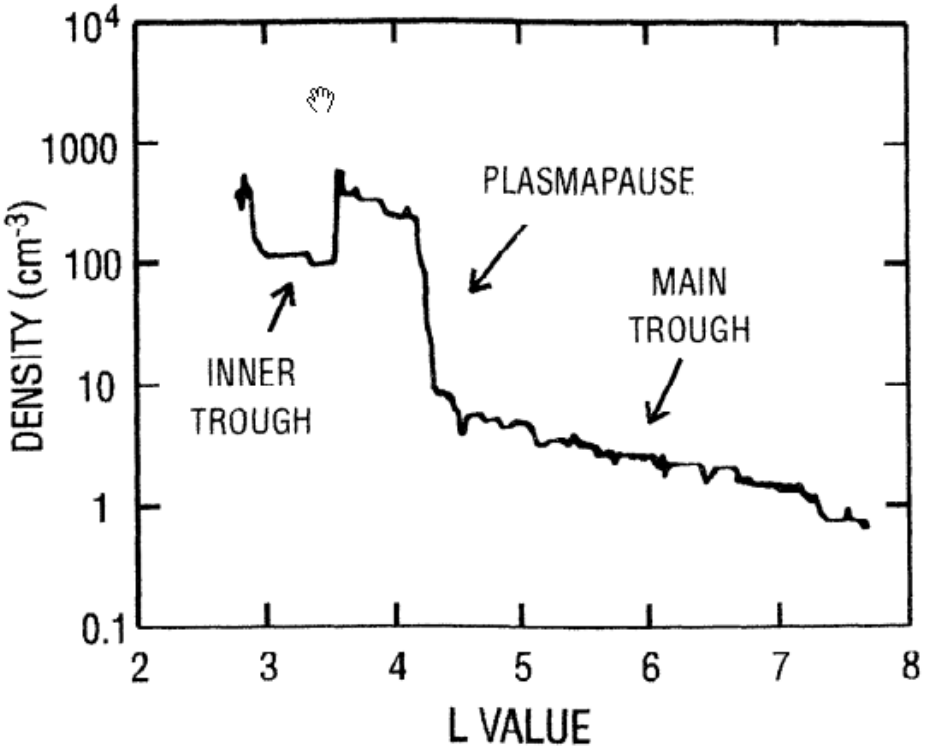
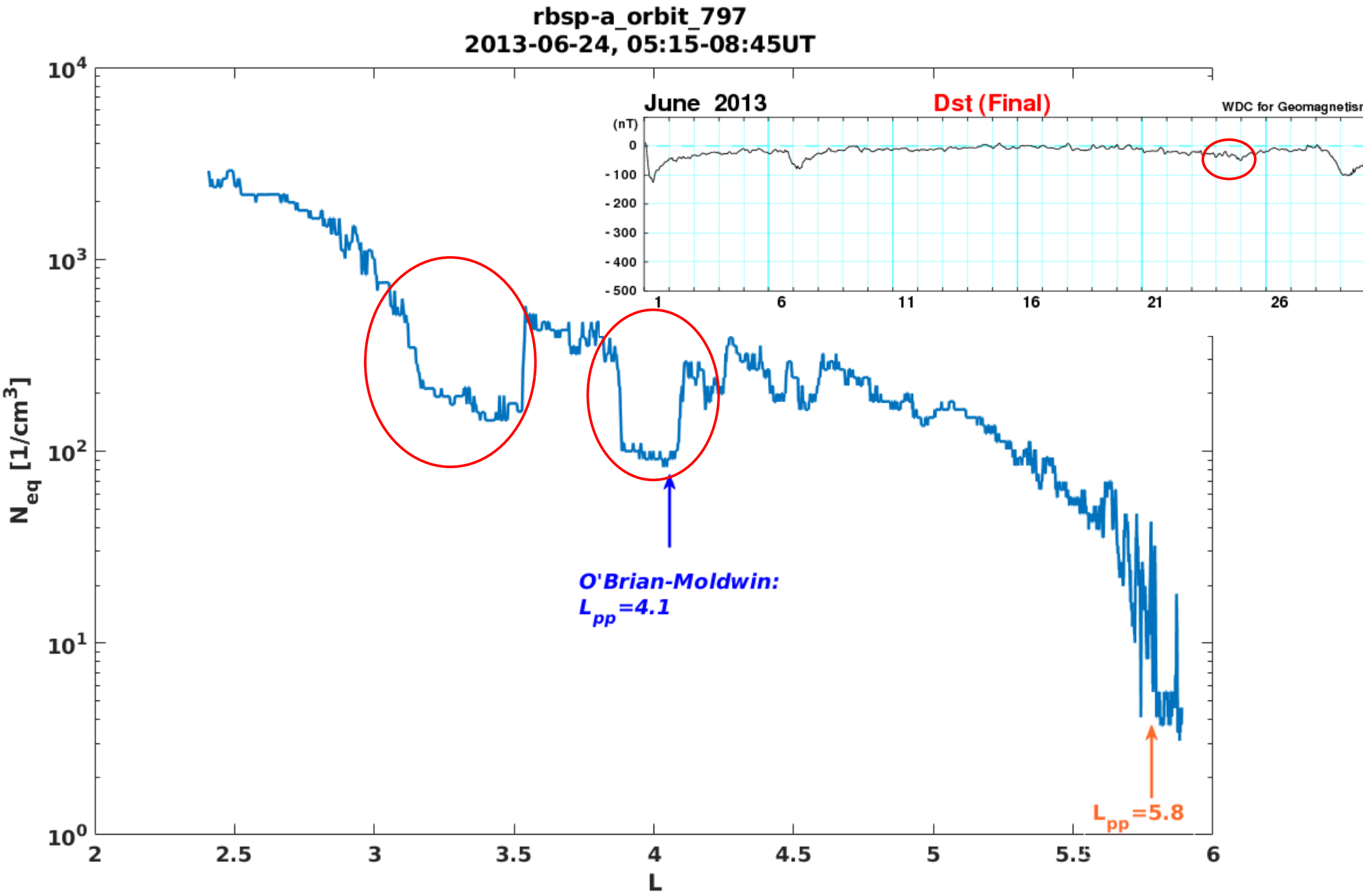
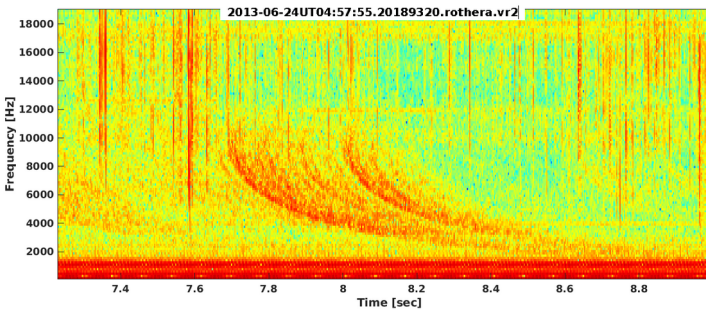


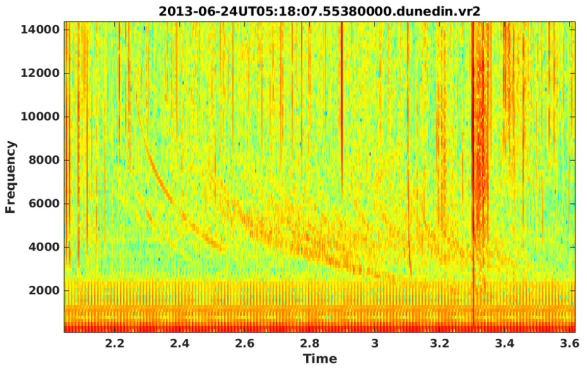
Figure 1. A near-equatorial electron density profile from ISEE 1 showing an example of a plasmaspheric cavity in the dusk sector

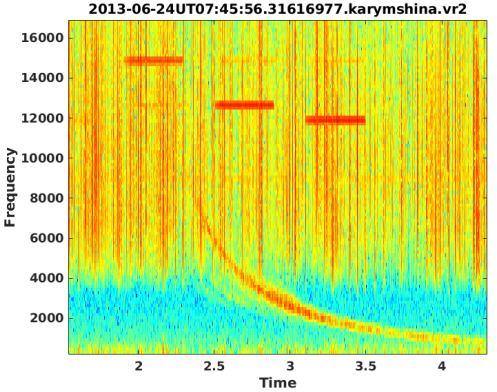
Large scale structures in the plasmasphere - the 14 June 2013 event

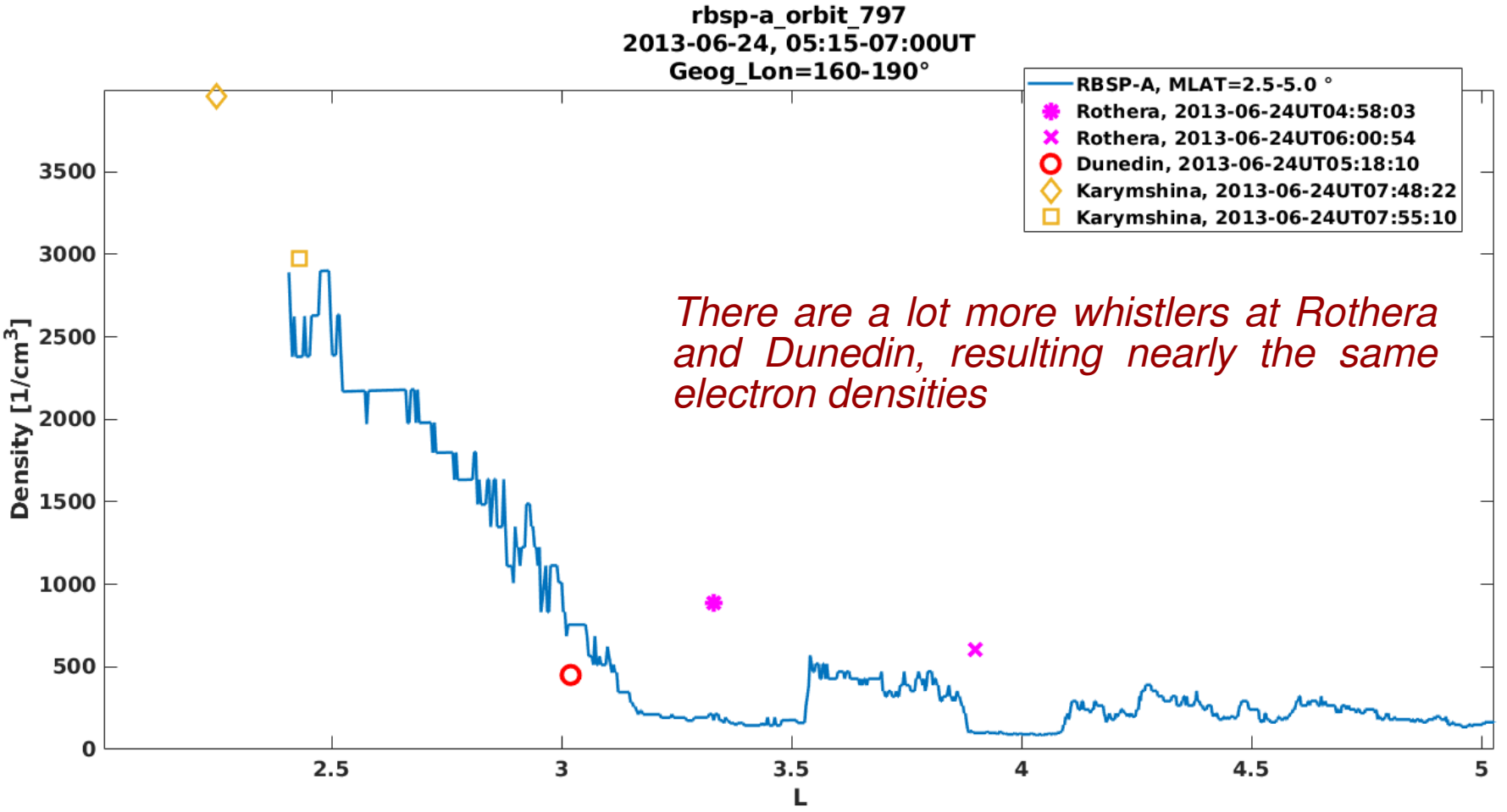


24 June 2013 – *small scale structure in the plasmasphere*

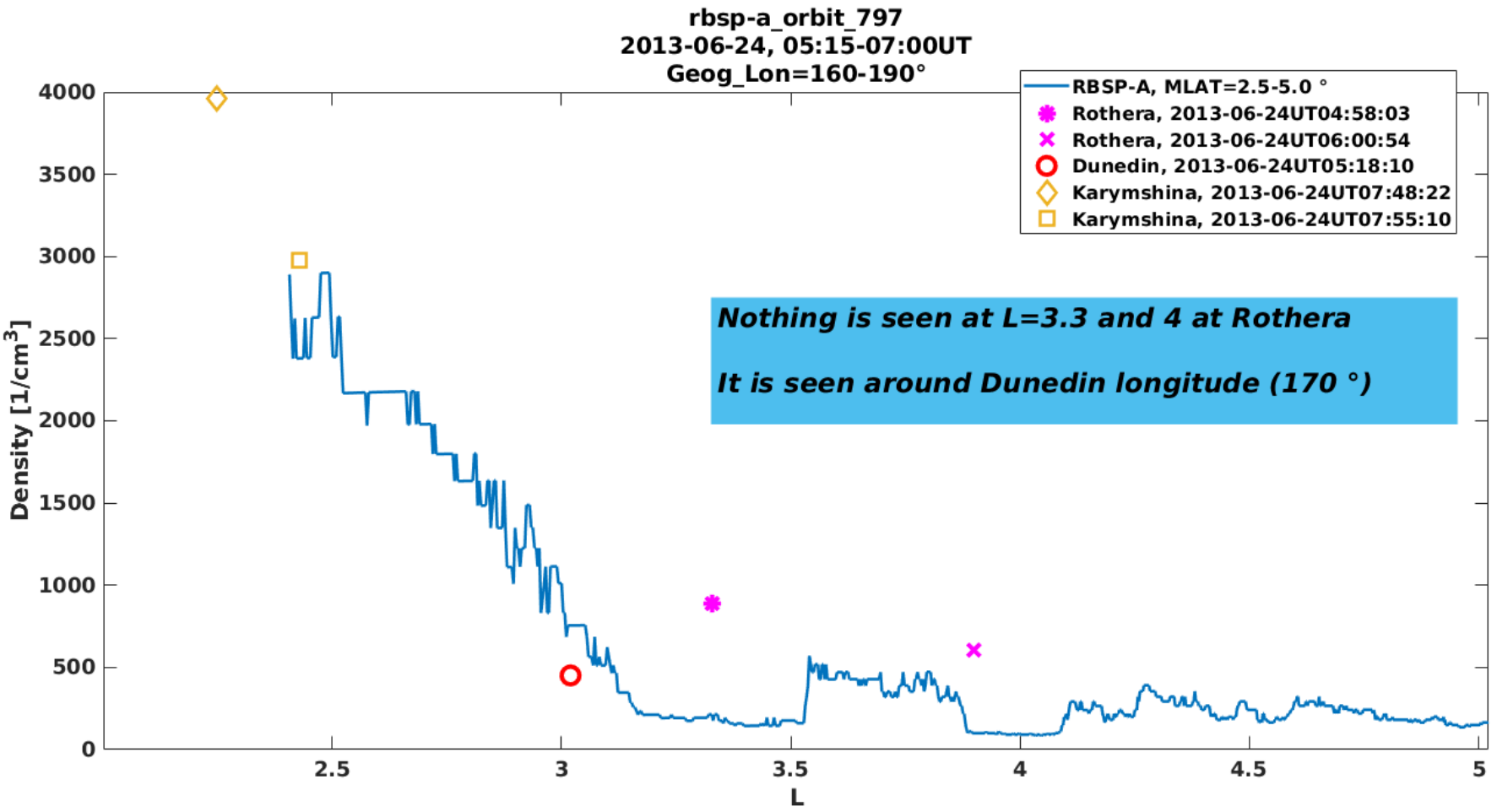




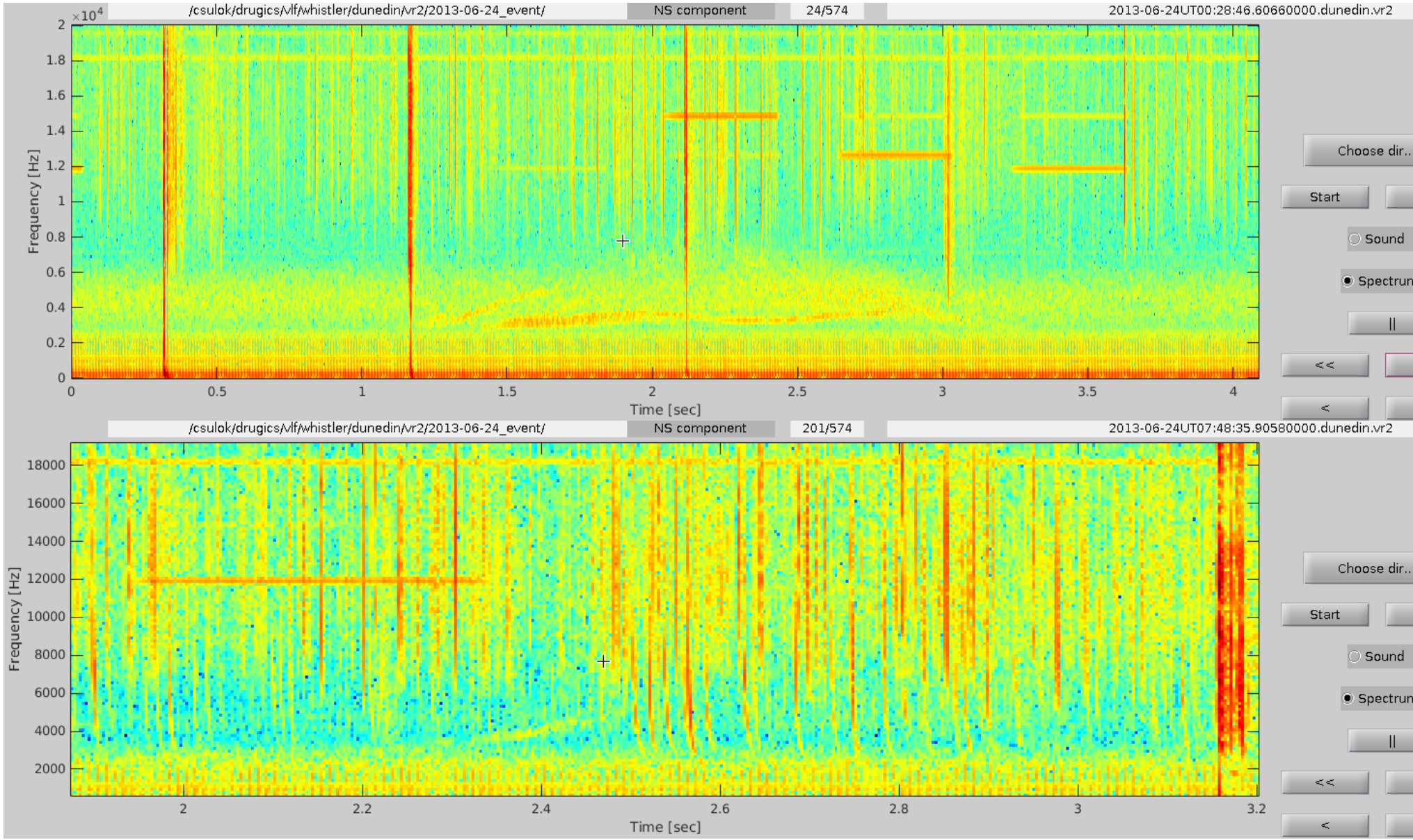




24 June 2013 – *small scale structure in the plasmasphere*



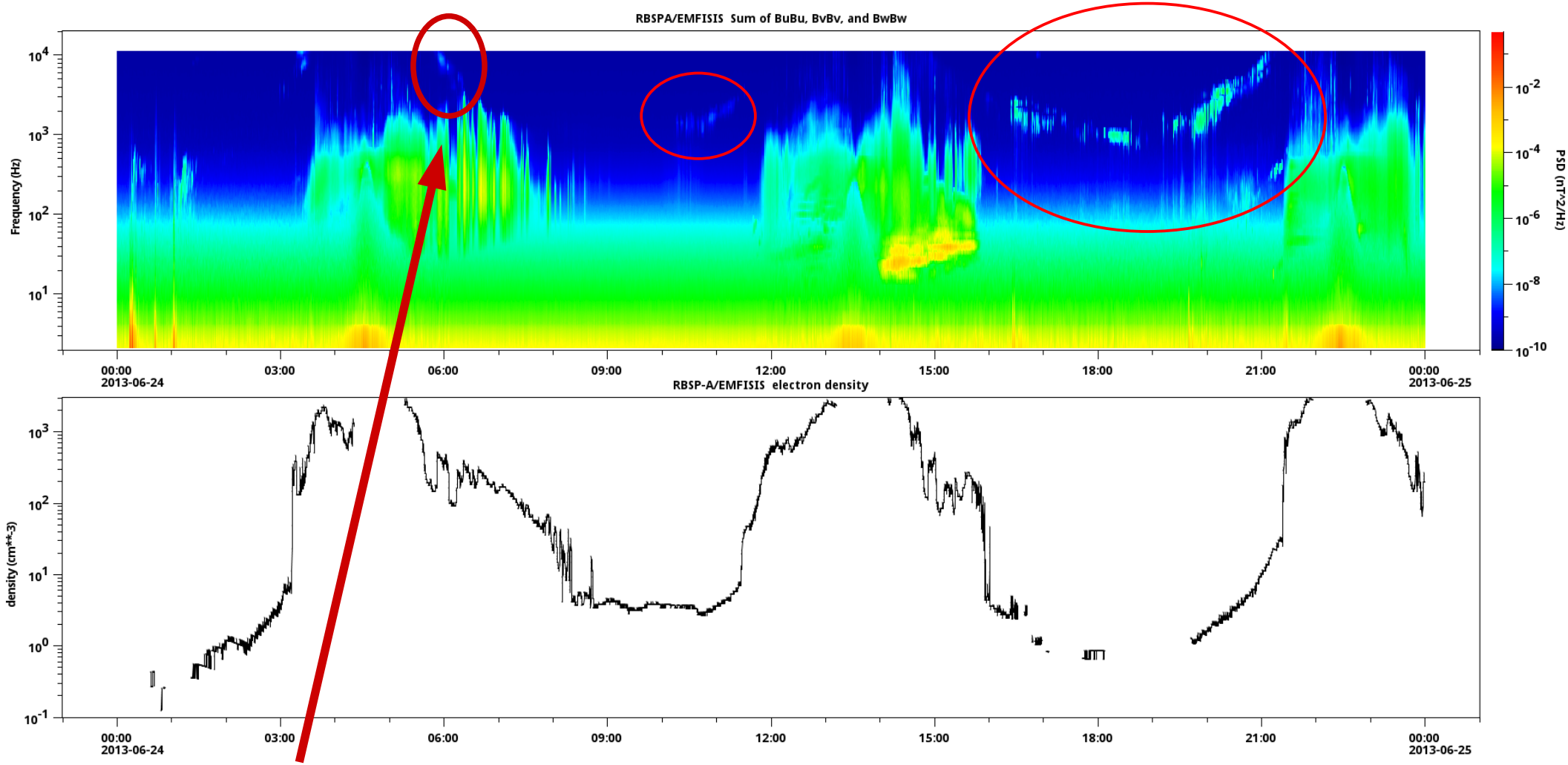
24 June 2013 – *choruses recorded at Dunedin!*



The distance between *Dunedin* and the *plasmapause* is >1400km!

$L=2.74$; $L_{pp}=5.8$

24 June 2013 – *choruses recorded on RBSP-A*

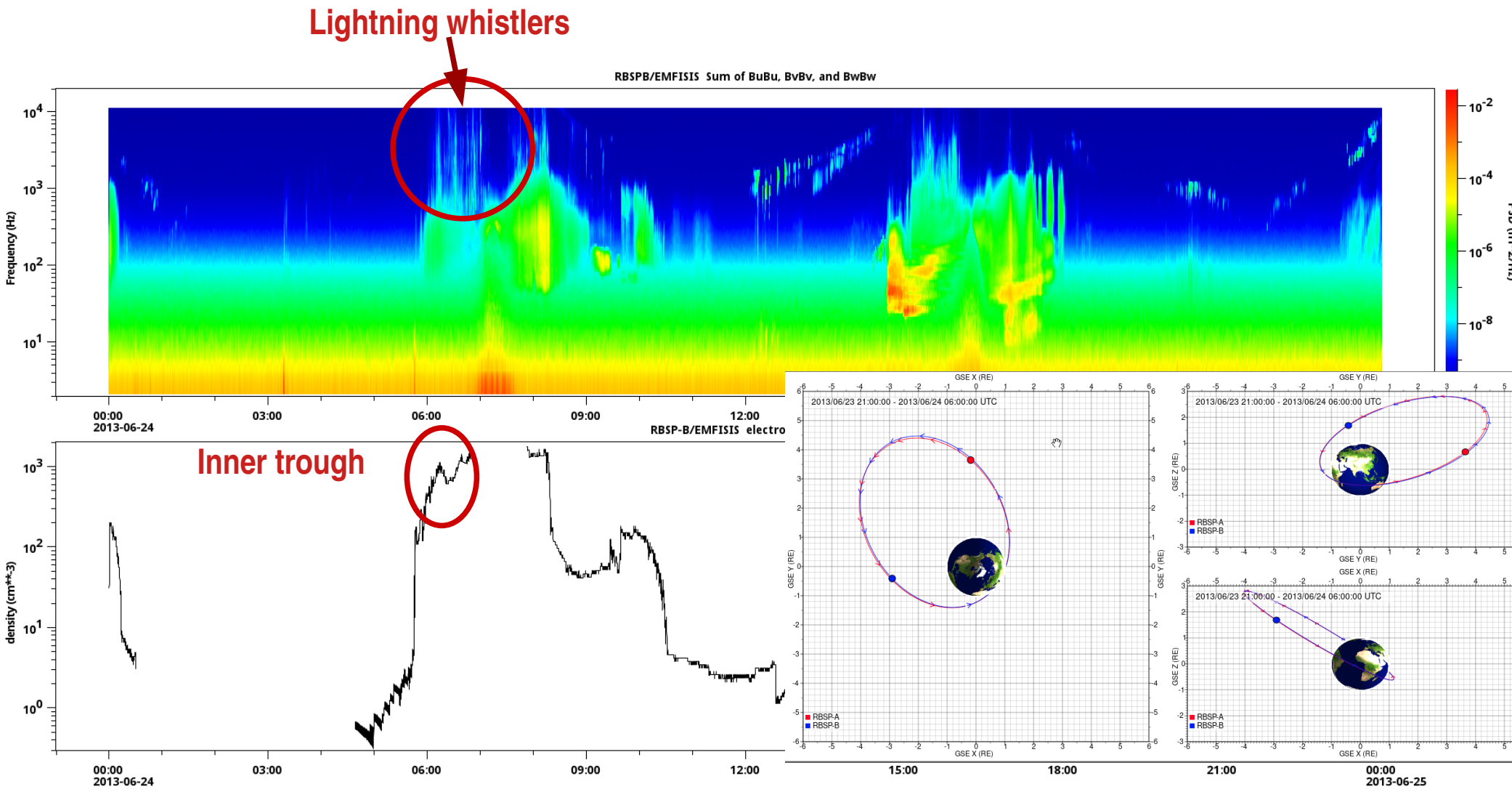


RBSP-A was deep inside the plasmasphere:

L=3-3.5, L_{pp}=5.8(!)

They may not be obliquely propagated waves from outside of the PP - it is too far

24 June 2013 – *waves and density recorded by RBSP-B*



RBSP-B was also deep inside the plasmasphere:

$L=3.8$, $L_{pp}=5.8$

This inner trough is less steep – it may be important

Conclusions

- Plasmasphere is not a smooth region as the models suggest

- There are both *large scale* and *small scale* ***structures*** **inside the plasmasphere,** not only at the plasmapause

- Double-faced behaviour: plasmasphere and plasmatrough may not be separated/ distinguished easily

- The structures can be limited to longitudinal sectors of the plasmasphere (**they are *NOT* »global«)**- this may affect the wave-particle interaction of both the bouncing and the drifting particles in the radiation belts.

- Steeper inner troughs may behave like the real plasmatrough for wave (chorus?) generation

Such events may be seen by simultaneous, global measurements (AWDANet) only