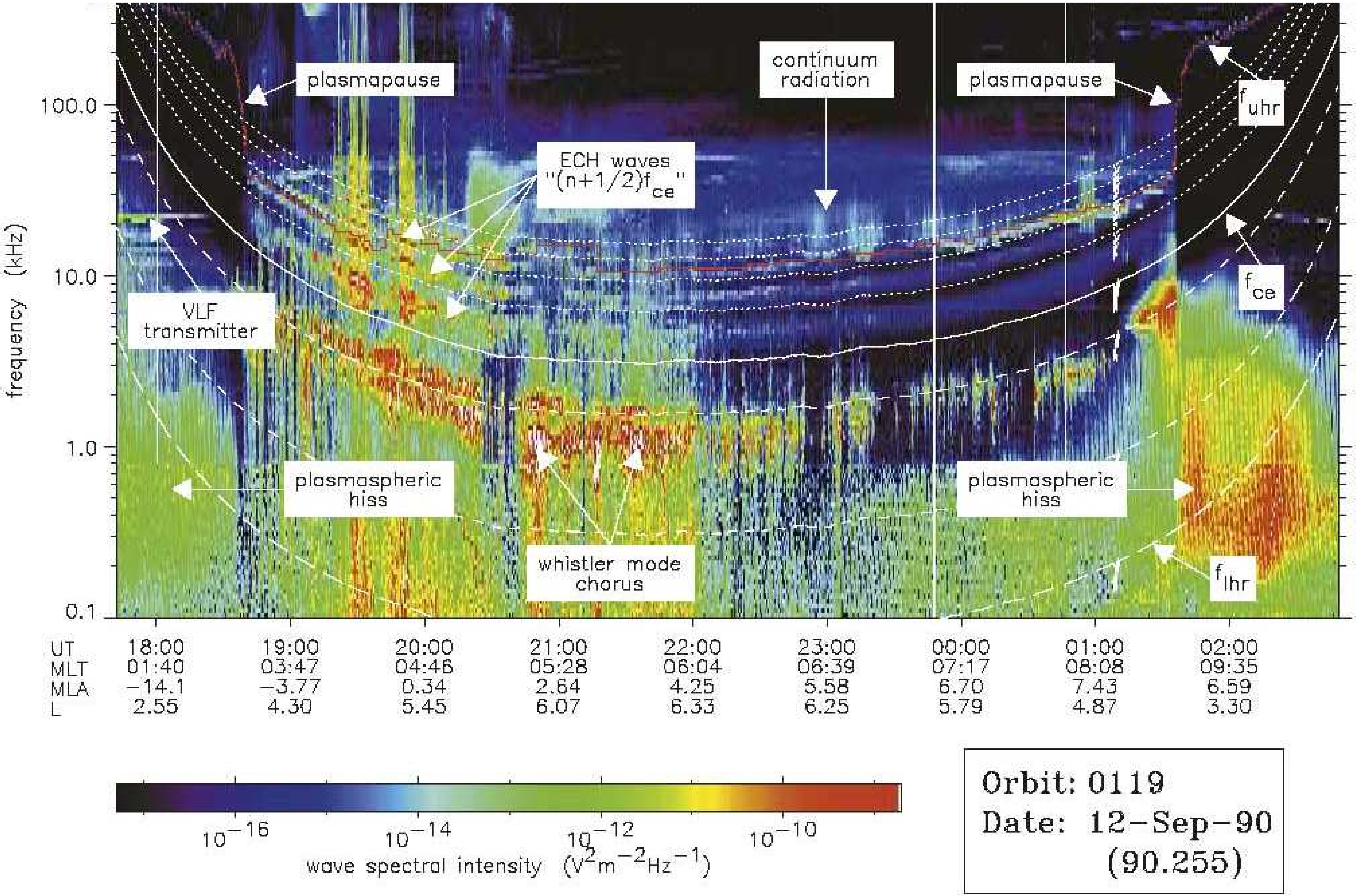
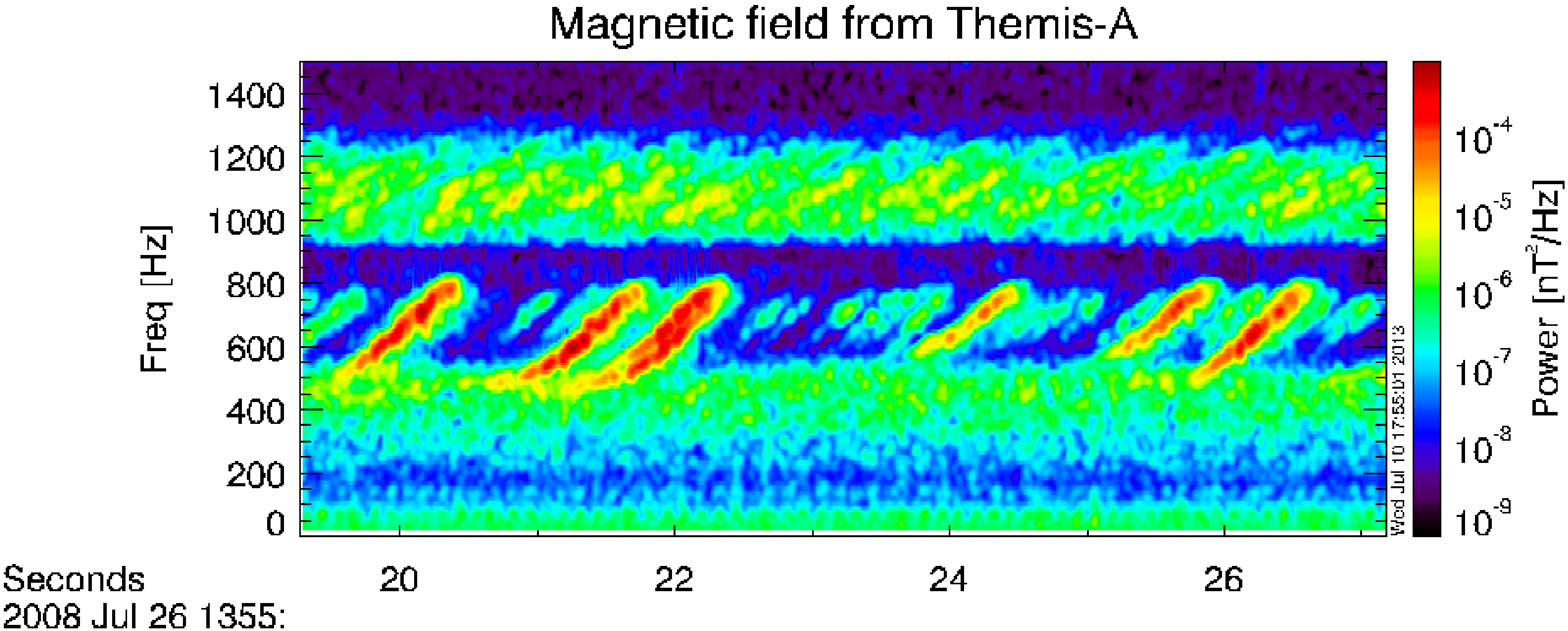


http://onlinelibrary.wiley.com/doi/10.1029/2004JA010387/epdf

Ultra Low Frequency Waves (2–100 mHz) are excited at the magnetopause boundary in response to velocity shear or solar wind pressure fluctuations. These ULF waves cause radial diffusion transport and associated energy change in the trapped particle population. The rate of radial transport is dependent on the power spectral density of the waves and tends to be much faster in the outer magnetosphere.

Chorus Emissions (0.1–0.7 fce) are discrete coherent whistler mode waves, which occur in two distinct bands above and below one-half the electron cyclotron frequency fce. Chorus is important because it plays a dual role in both the loss and local acceleration of radiation belt electrons and is the dominant scattering process leading to diffuse auroral precipitation.

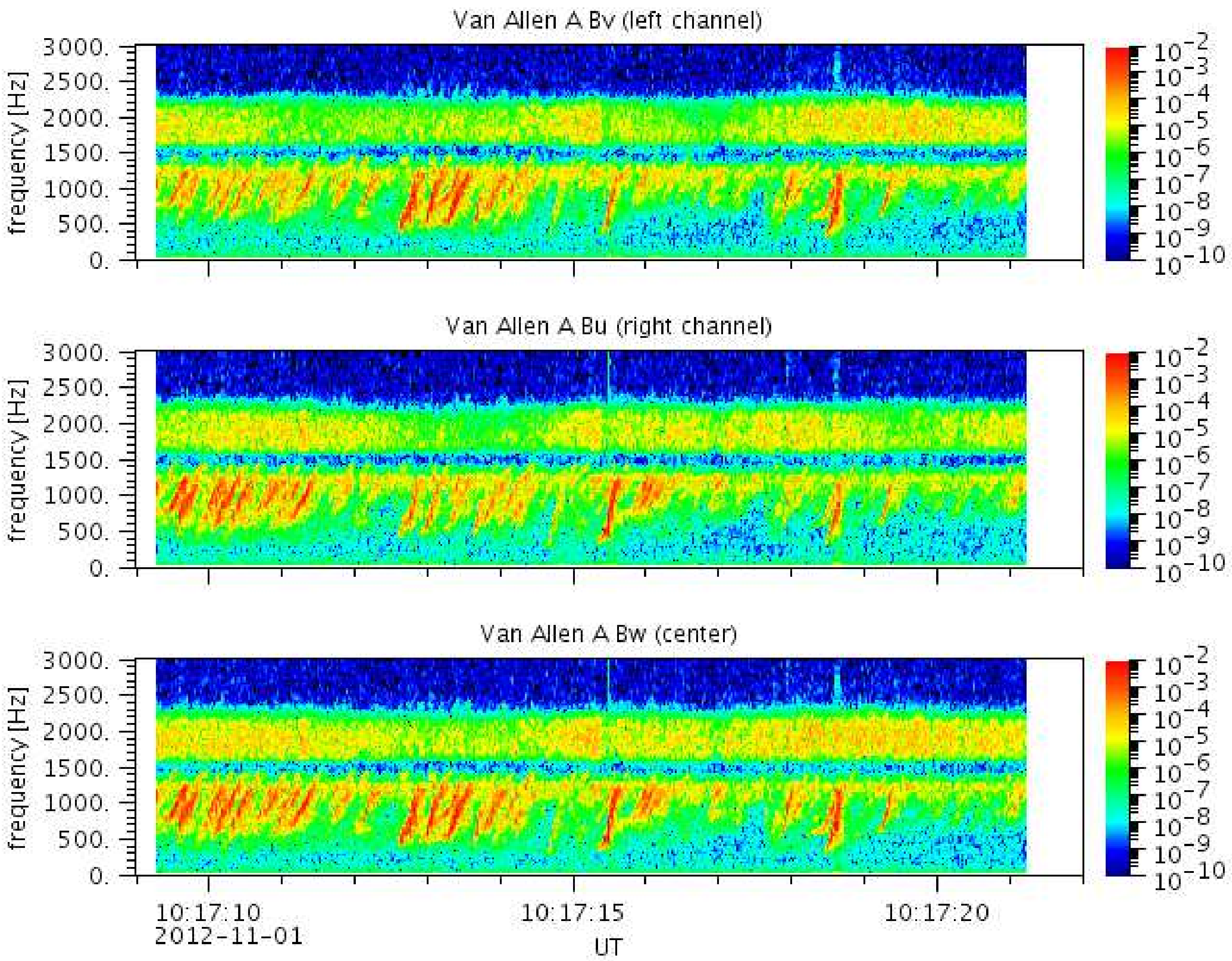
Plasmaspheric Hiss (100 Hz–(~2) kHz) is an incoherent whistler-mode emission mostly confined within the dense plasmasphere and within dayside plasmaspheric plumes, which is mainly responsible for the formation of the quiet time electron slot between the inner and outer radiation belt. Hiss is also observed in plasmaspheric plumes during a storm, and such waves are sufficiently intense to contribute significantly to the scattering loss of outer zone electrons.



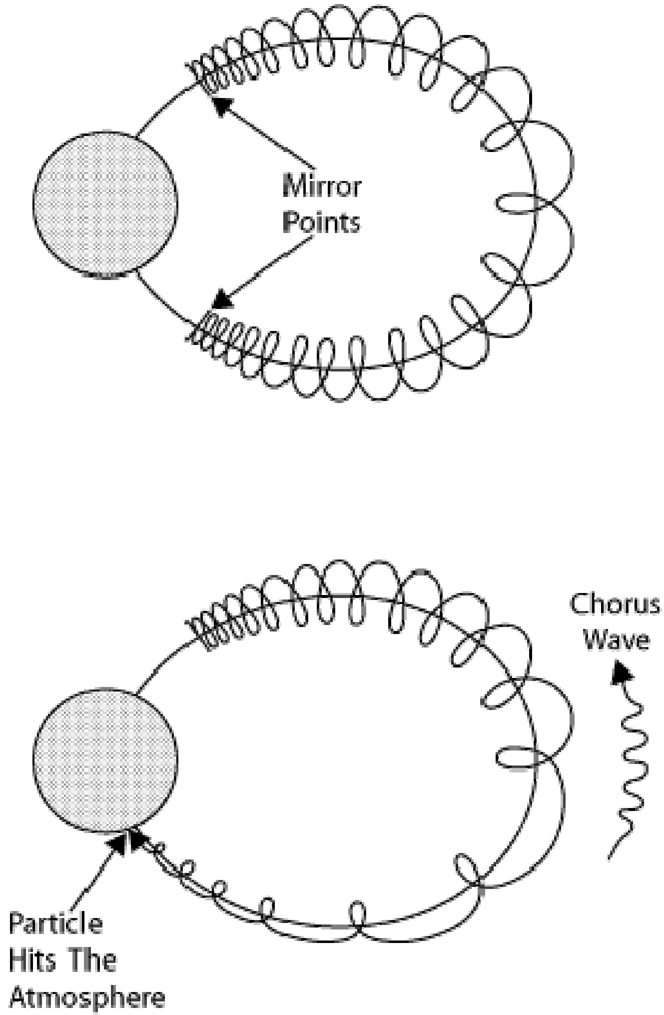
Whistler-mode Chorus is often with a rising or falling tone. Note the intense rising-tone chirps from ~400-800 Hz. These are "lower-band" chorus: chorus emissions below 0.5 fce (at this time, fce~1800 Hz). The weaker rising-tone features from ~900-1200 Hz are "upper-band" chorus (between 0.5 fce and fce). There is a gap in the emissions at 0.5 fce (i.e. 900 Hz), which is very common. The chorus waves are in the ELF/VLF (Extremely/Very Low Frequency) range, which is within the frequency range of human hearing, and can be heard without any demodulation.

http://www.ucalgary.ca/above/science/chorus

Van Allen Probes EMFISIS Waves
Chorus from 2012-01-01

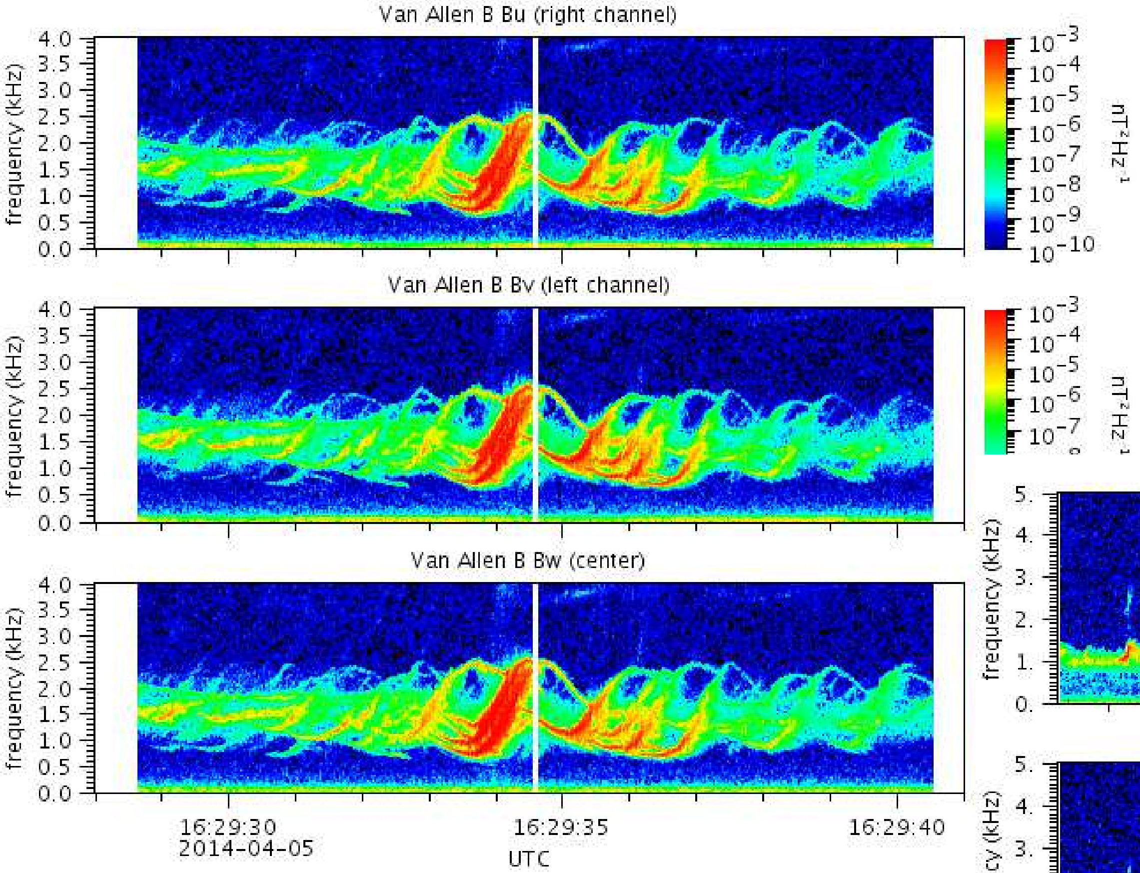


Chorus Generation

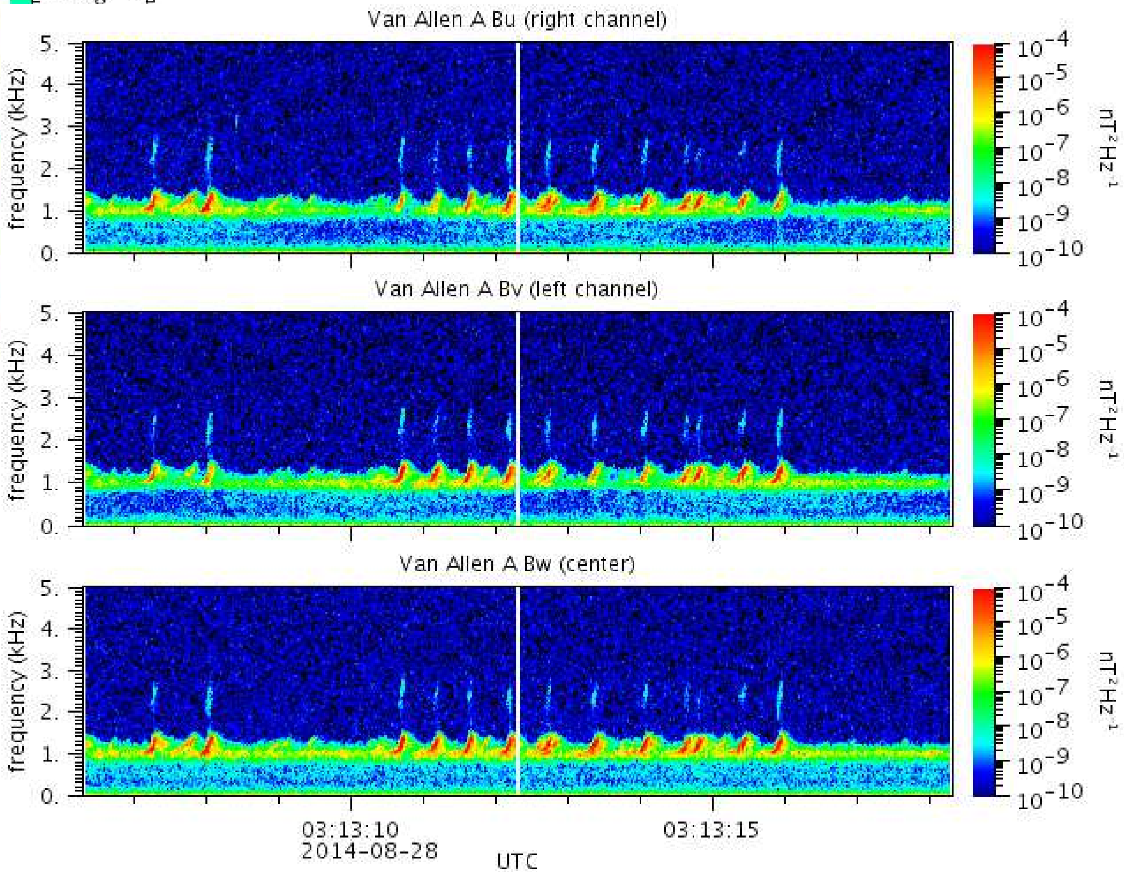


http://www-pw.physics.uiowa.edu/rbsp/audio/201211/VanABvBuBw_20121101_1017.html

Twisted Chorus 2014-04-05



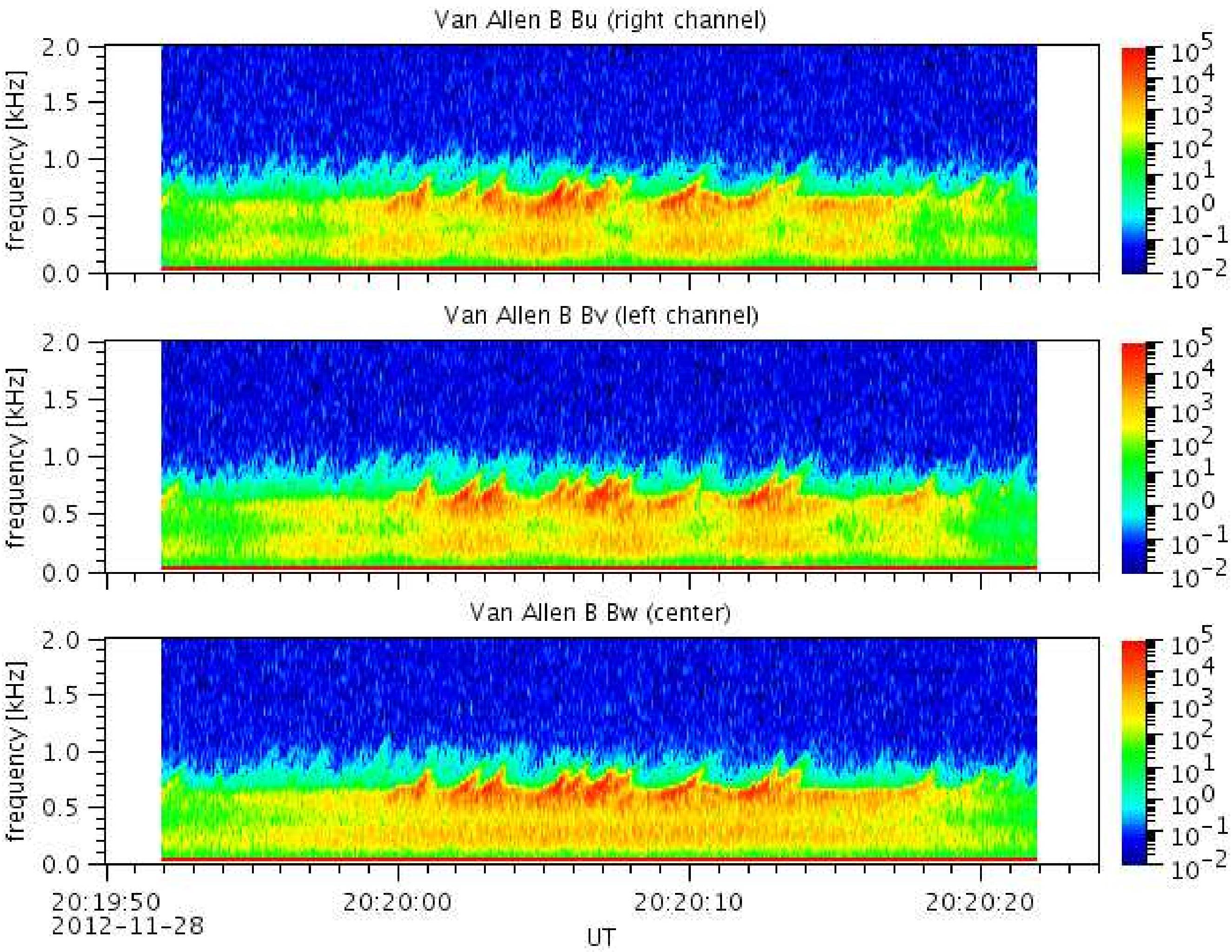
Birthday Chorus 2014-08-28

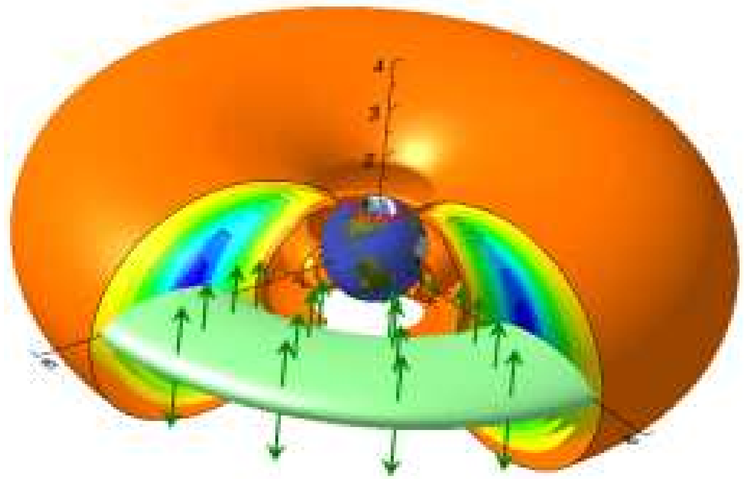


http://www-pw.physics.uiowa.edu/rbsp/audio/201404/VanB-2014-04-05_162928-162941.html

http://www-pw.physics.uiowa.edu/rbsp/audio/201408/VanA-2014-08-28_0313.html

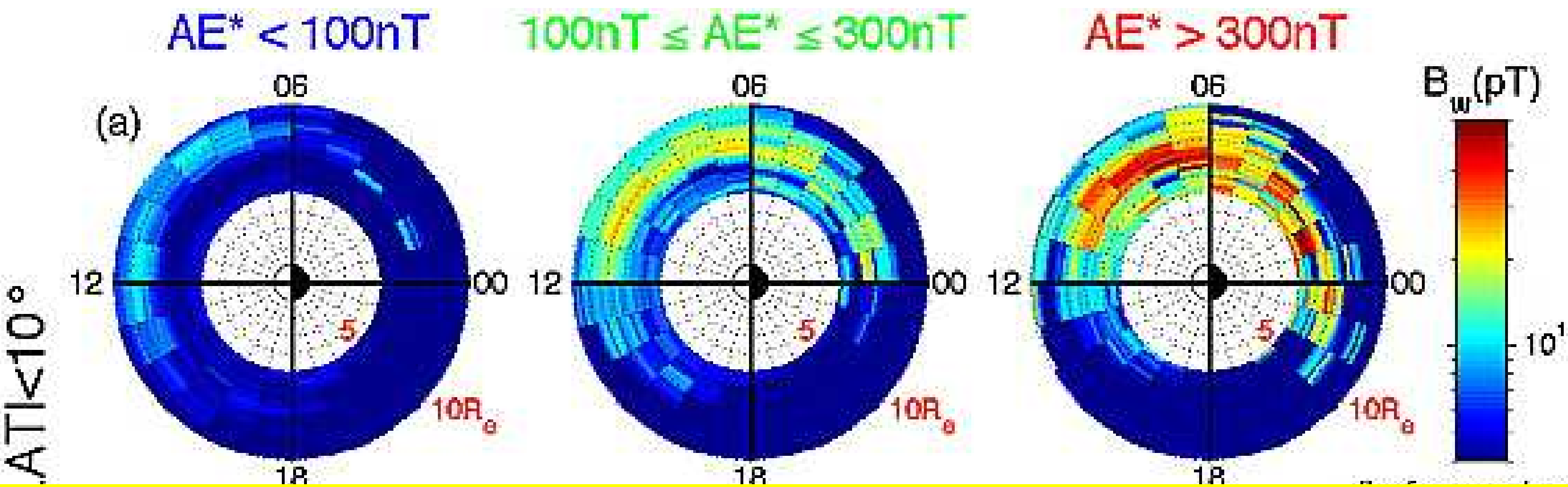
Van Allen Probes EMFISIS Waves
Chorus from 2012-11-28



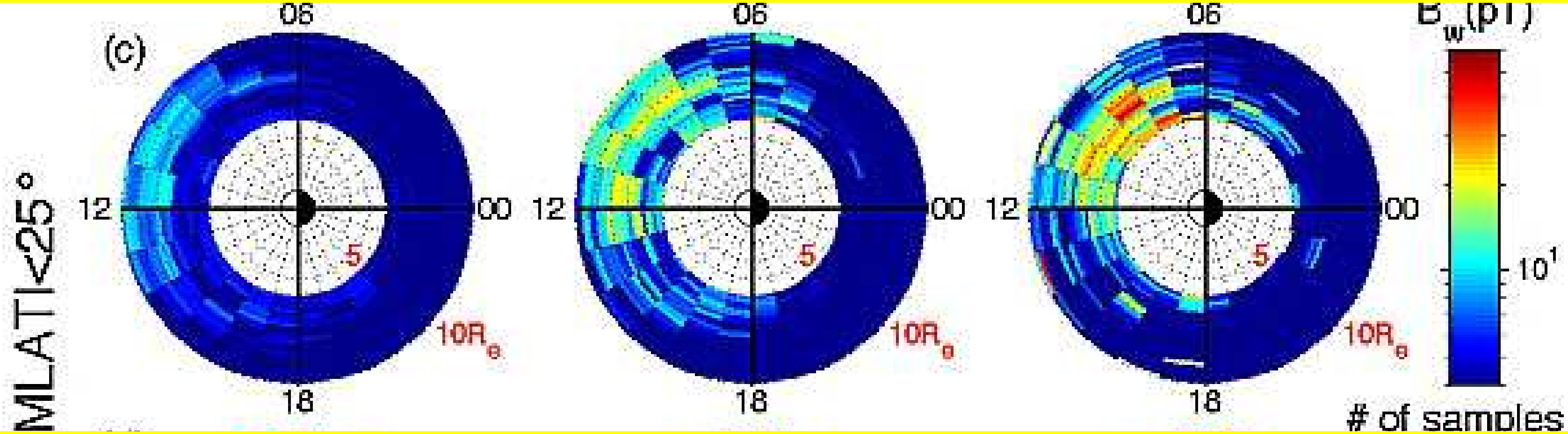


The Van Allen Probe B is ~16 degrees south of Earth's magnetic equator during this time, hence, the chorus has propagated quite some distance from its source at the equator. These chorus are at a relatively low frequency, partly because of the high latitude of the spacecraft. Also, the chrous have longer durations and do not drift in frequency as rapidly as they typically do. This may be due to the long distance from their source.

http://www-pw.physics.uiowa.edu/rbsp/audio/201211/VanB_BuBvBw_20121128_2020.html

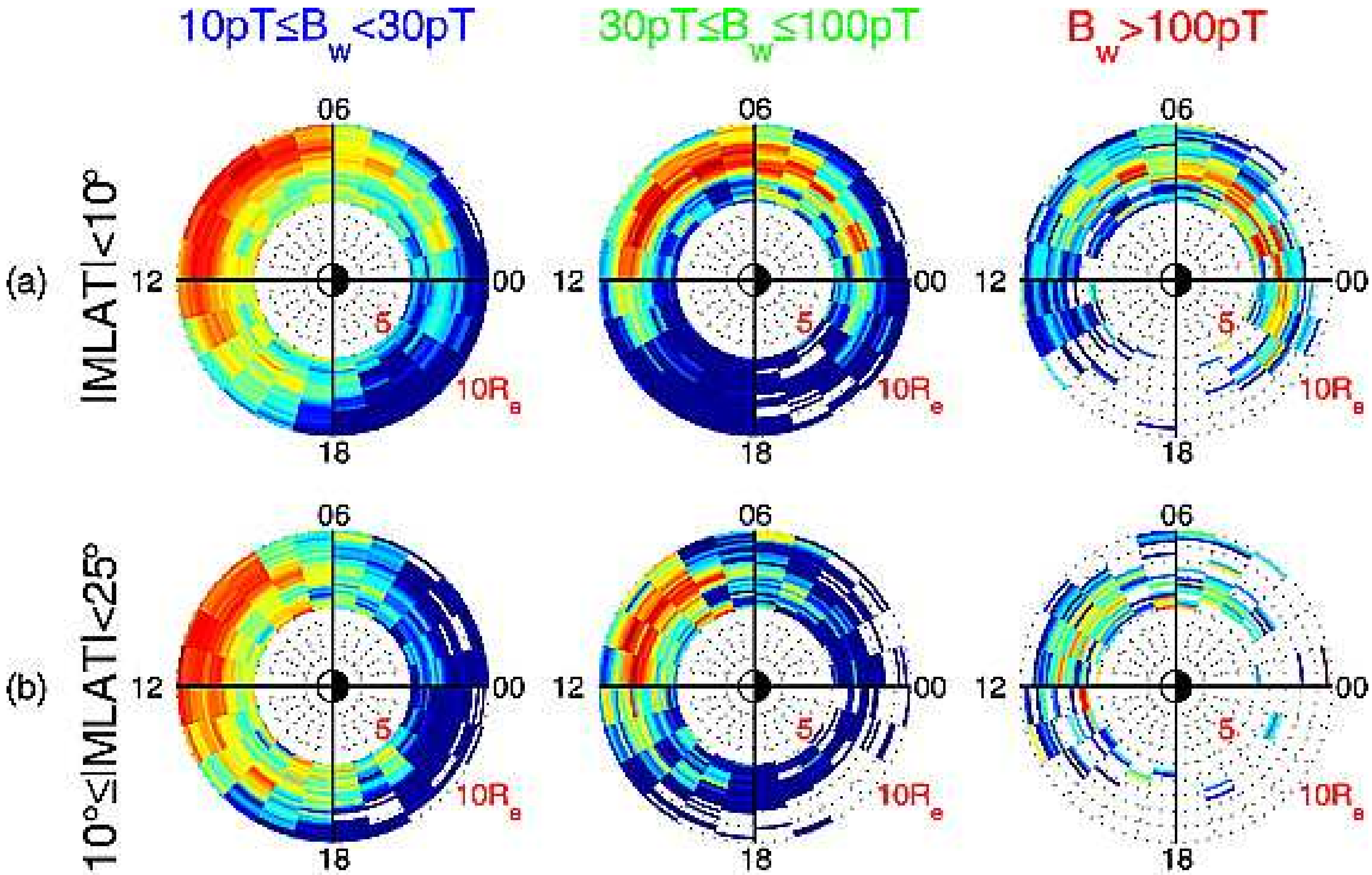


In the near-equatorial region, chorus intensity on the nightside (up to $L \sim 8$) depends strongly on AE* with much stronger intensity during higher geomagnetic activity. However, around noon, wave intensity is less dependent on AE* and moderate chorus is present even during quiet times (AE* < 100 nT). Strong nightside chorus is confined to $L \leq 8$, while strong dayside chorus can extend to higher L-shells.



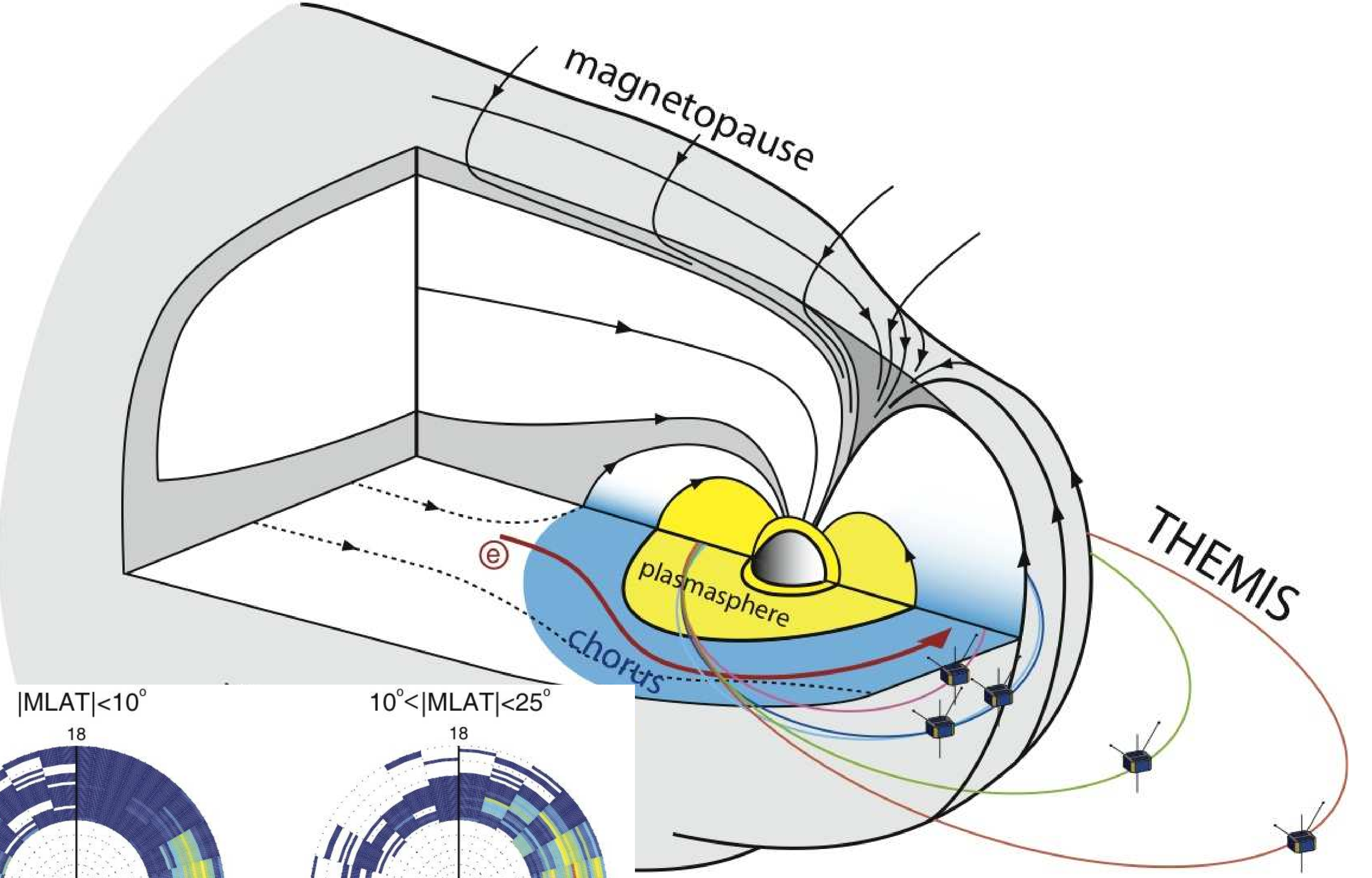
In the mid-latitude region, nightside chorus is very weak even during strong magnetic activity (AE* > 300 nT), while strong dayside chorus can be present up to at least $L \sim 10$, peaking around $L \sim 8$

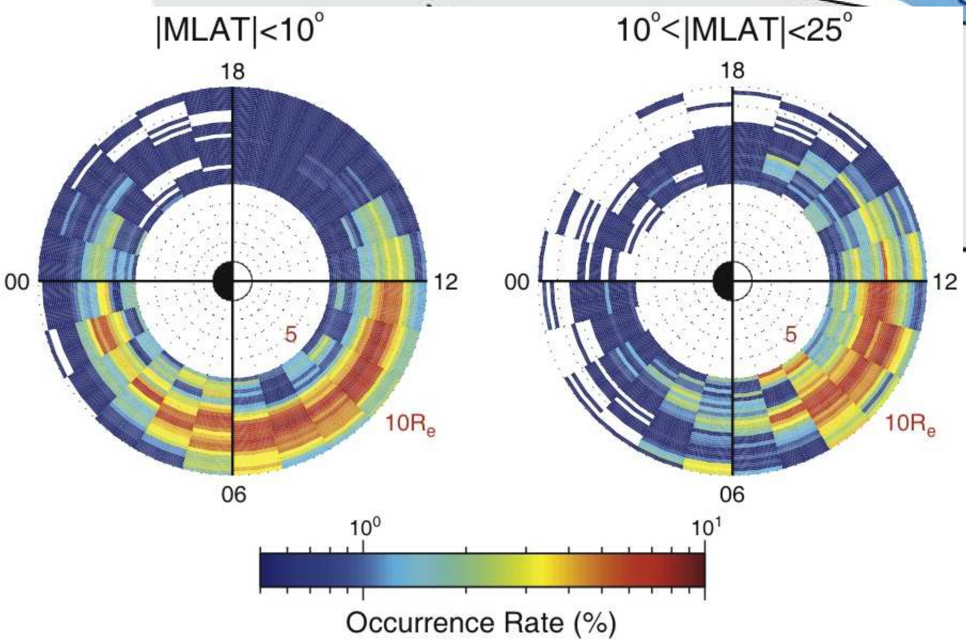
http://onlinelibrary.wiley.com/doi/10.1029/2009GL037595/full



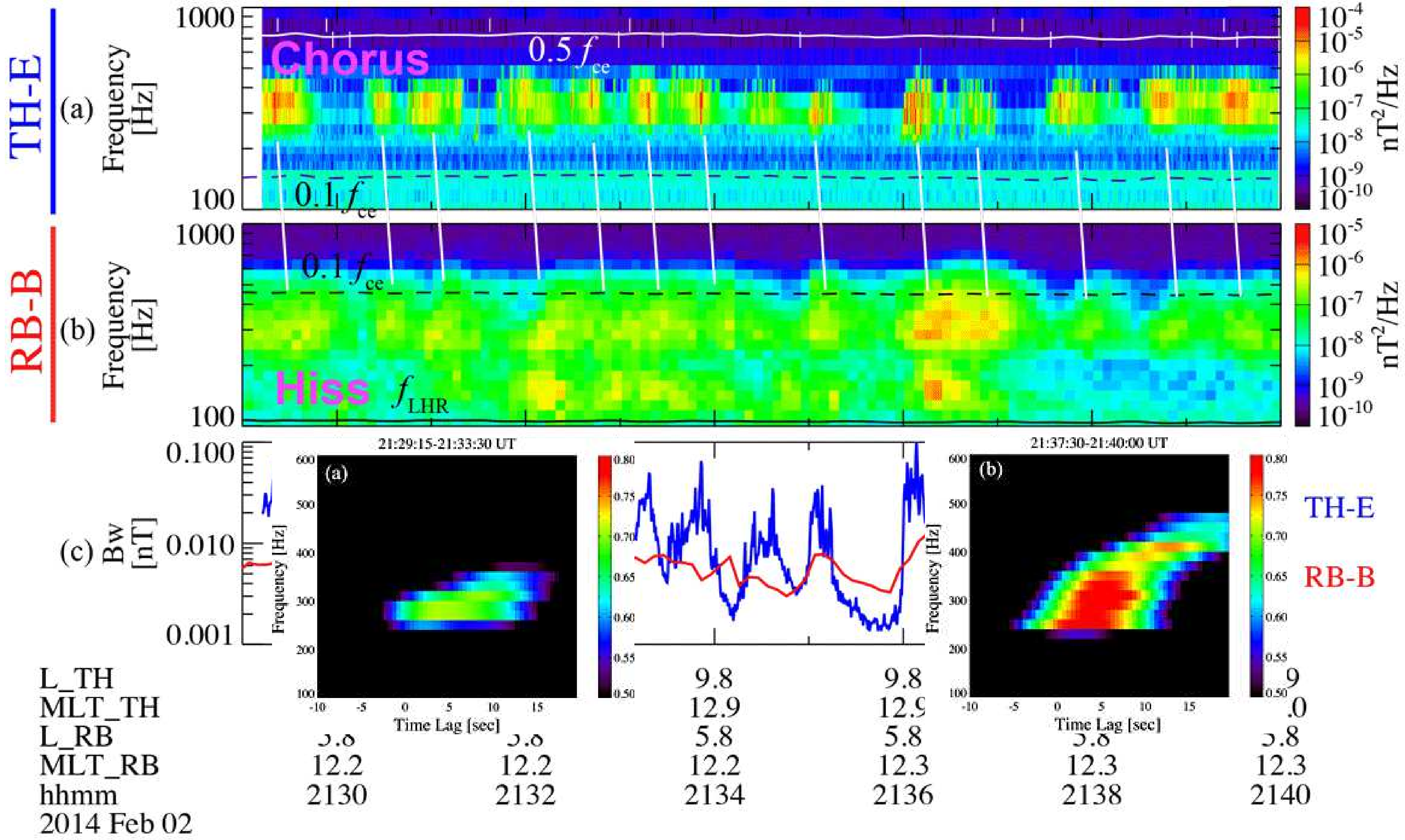
In the near-equatorial region, the occurrence rate of both moderate and strong chorus is larger on the dayside than that on the nightside, and this MLT asymmetry is most apparent at larger *L*-shells. However, for the extremely strong chorus, which can lead to non-linear scattering, the occurrence rate tends to be larger in the region between the nightside and the dawnside. In the mid-latitude region, the asymmetry of the occurrence rate of moderate and strong chorus on the dayside and nightside is even more pronounced, with differences of almost an order of magnitude.

http://onlinelibrary.wiley.com/doi/10.1029/2009GL037595/full





http://www.igpp.ucla.edu/public/THEMIS/SCI/Pubs/Nuggets/
2009_nuggets/wenli/grl_09/figure1.jpg



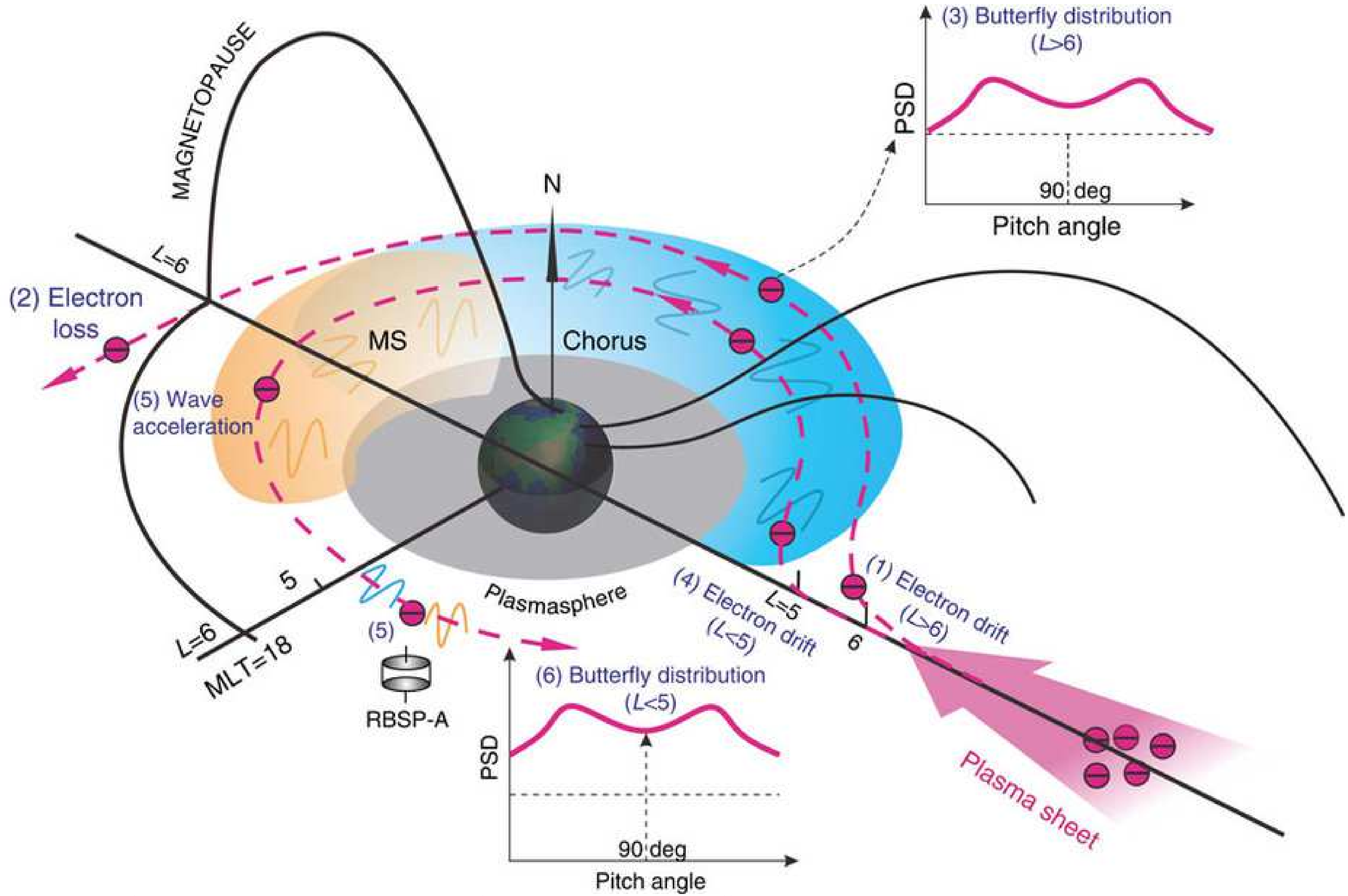
TH-E located at ~9.8 R_E and observed chorus waves well outside the plasmapause, while RB-B observed hiss inside the plasmasphere at ~5.5–6 R_E both near the noon sector. The wave intensity of chorus and hiss at ~300 Hz exhibits the highest correlation with a time delay of ~5–8 s. This provides quantitative support that chorus from large *L* shells, where it was previously considered unable to propagate into the plasmasphere, can be the source of hiss.

http://onlinelibrary.wiley.com/wol1/doi/10.1002/2014GL062832/full

Equatorial Magnetosonic Waves (<flh) are highly oblique whistler-mode emissions excited within a few degrees of the equatorial plane at frequencies between the proton cyclotron frequency and the lower. The waves are observed both inside and outside the plasmapause and are excited by a cyclotron resonant instability with a ring distribution of injected ring current ions. MS waves also undergo a Landau resonance with radiation belt (100 keV to a few MeV) electrons, and the timescale for energy diffusion (~day) can be comparable to that due to chorus scattering.

Electron Cyclotron Harmonic (ECH, fce(n + 1/2)) waves are electrostatic emissions, which occur in harmonic bands between multiples of the electron cyclotron frequency. These waves are excited by the loss cone instability of injected plasma sheet electrons. The analyses of the global distribution of ECH emission intensity and its dependence on geomagnetic activity show that these waves are similar to that of chorus. Although ECH emissions contribute to the scattering loss of plasma sheet electrons below a few keV at larger L (L>8), ECH waves play little role in energetic (>30 keV) radiation belt dynamics.

http://link.springer.com/article/10.1007/s11214-013-9993-6



Relativistic electrons originating from the plasma sheet azimuthally drift eastward around Earth. (1) Higher pitch angle electrons at L>6 drift to larger radial distance beyond the dayside magnetopause and are consequently lost due to the day-night magnetic field asymmetry (2), yielding the regular butterfly distribution (3). (4) Electrons at L<5 drift inside the magnetosphere without loss to the dayside magnetopause because of a very small day-night magnetic field asymmetry, continuously resonating with chorus and MS waves. (5) Wave acceleration can enhance electron PSD primarily within the medium pitch angles, leading to the formation of the unusual butterfly distribution (6).

http://www.nature.com/articles/ncomms9590