Unusual Observation of Chorus at L=2.6

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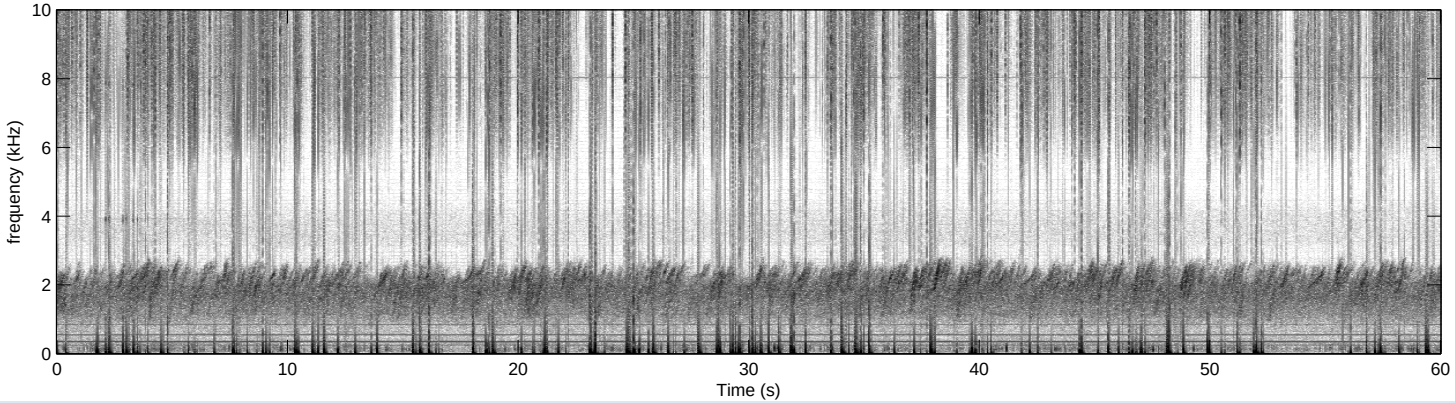
URSI 2011

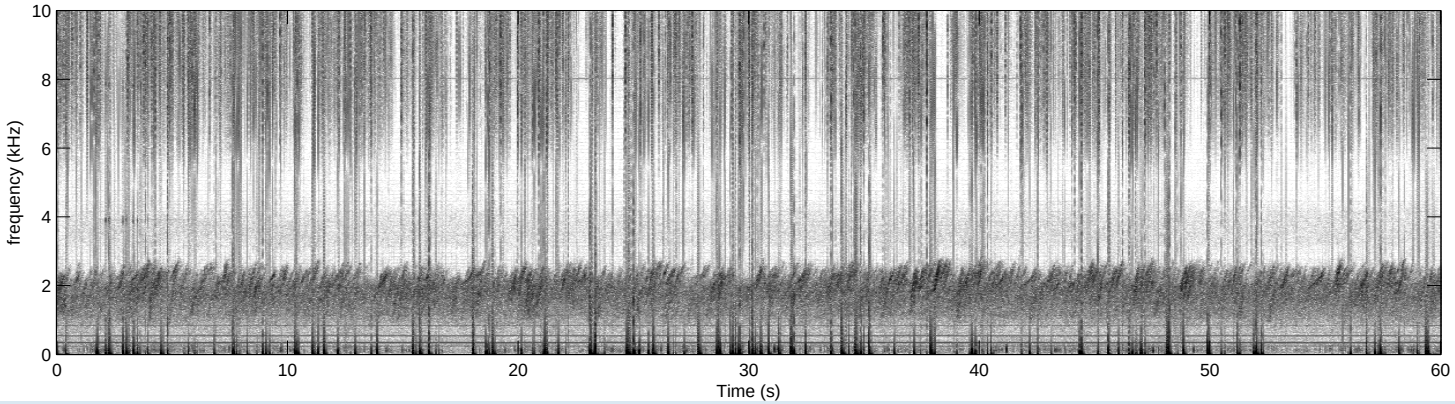
Chorus and (Plasmaspheric) Hiss

Outside the Plasmapause:

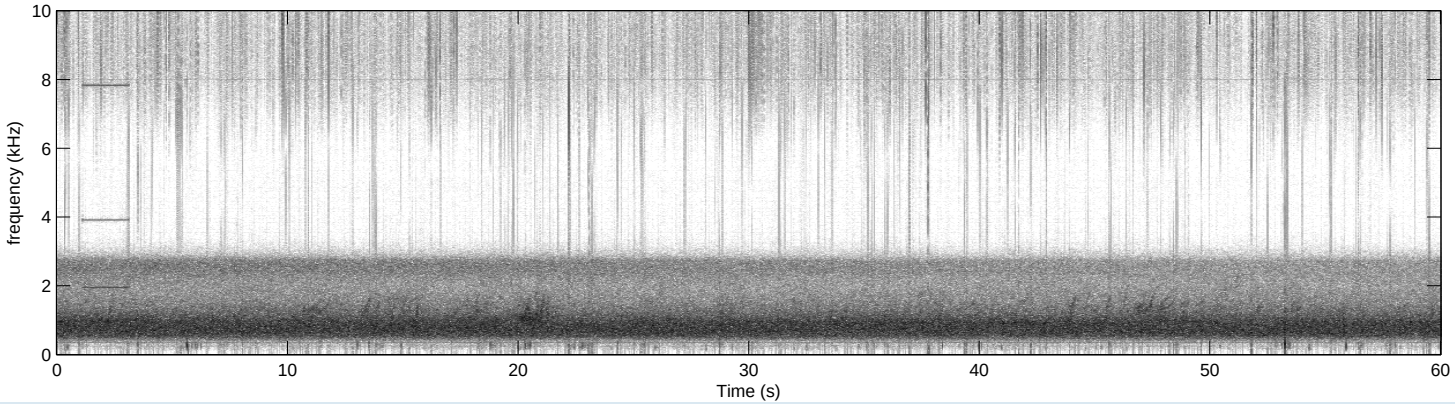


Chorus and (Plasmaspheric) Hiss

Outside the Plasmapause:



Inside the Plasmapause:



Previous Observation

Palmer Station, 2003

The haloween storms of 2003 resulted in a chorus observation at Palmer Station ($L = 2.4$).

- The outer radiation belts were depleted.
- A minimum *Dst* of $-350\mathrm{nT}$ was experienced.
- A direct observation by IMAGE showed that the plasmapause was pushed beyond Palmer.

Marion Island, 2010

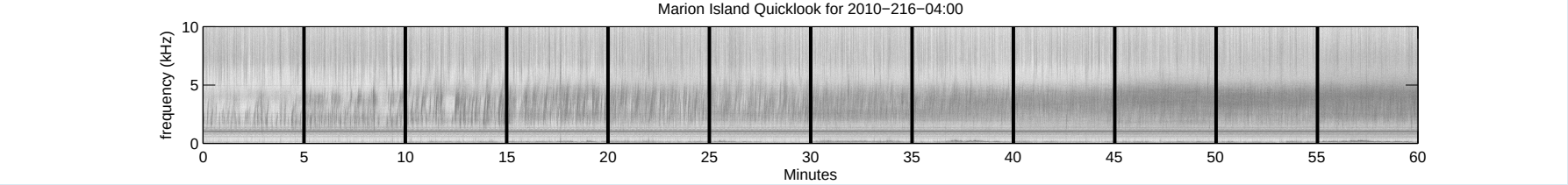
On 4th August 2010, a moderate geomagnetic storm occurred.

- A minimum *Dst* of $-65\mathrm{nT}$ was experienced.
- K_p peaked at $7-$.
- Chorus was observed at Marion Island, L=2.6

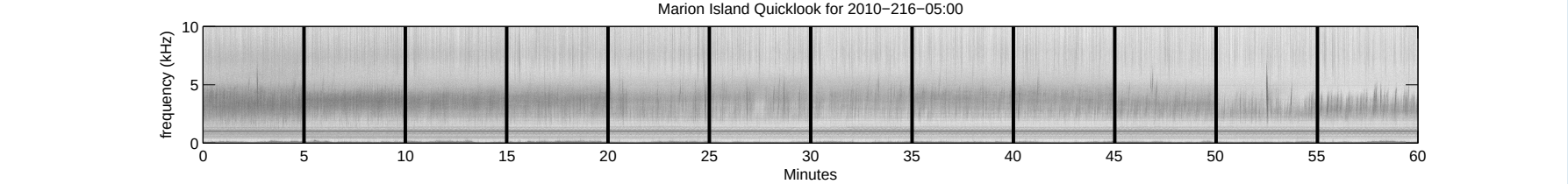
Marion Island Event

Chorus observation from 03:00 - 07:00 UT (06:00 - 10:00 LT).

04:00 - 05:00 UT

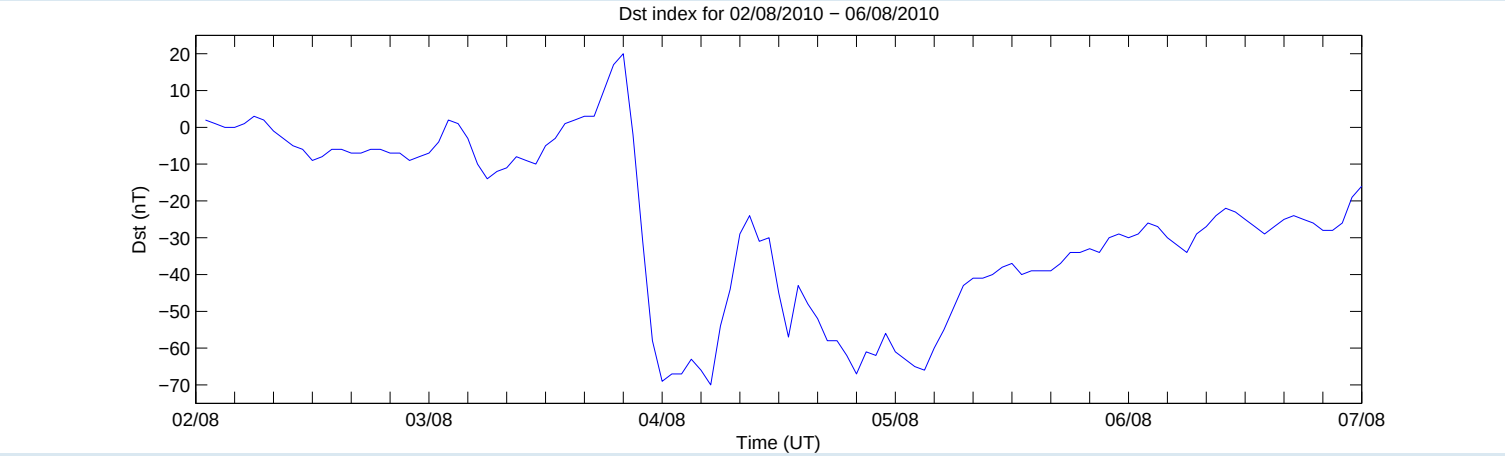


05:00 - 06:00 UT

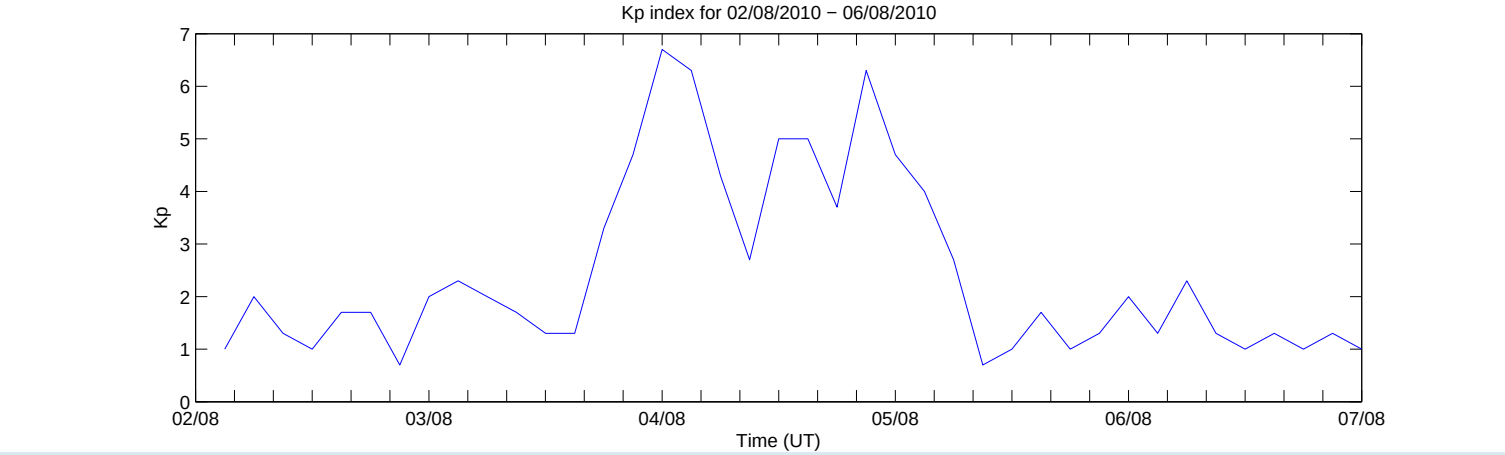


Geomagnetic Indices

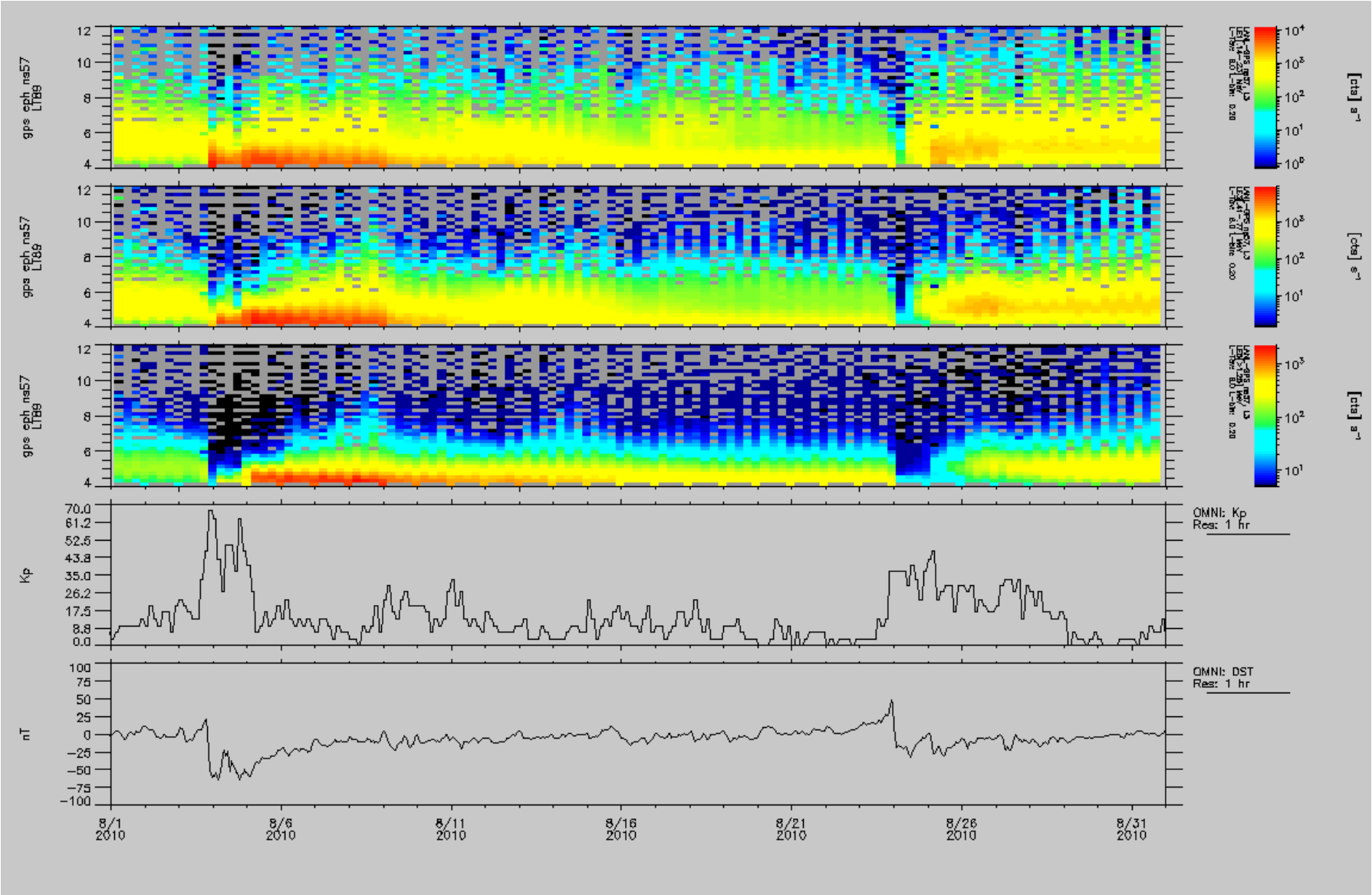
Dst



Kp



Depletion of Radiation Belts



Plasmapause Compression

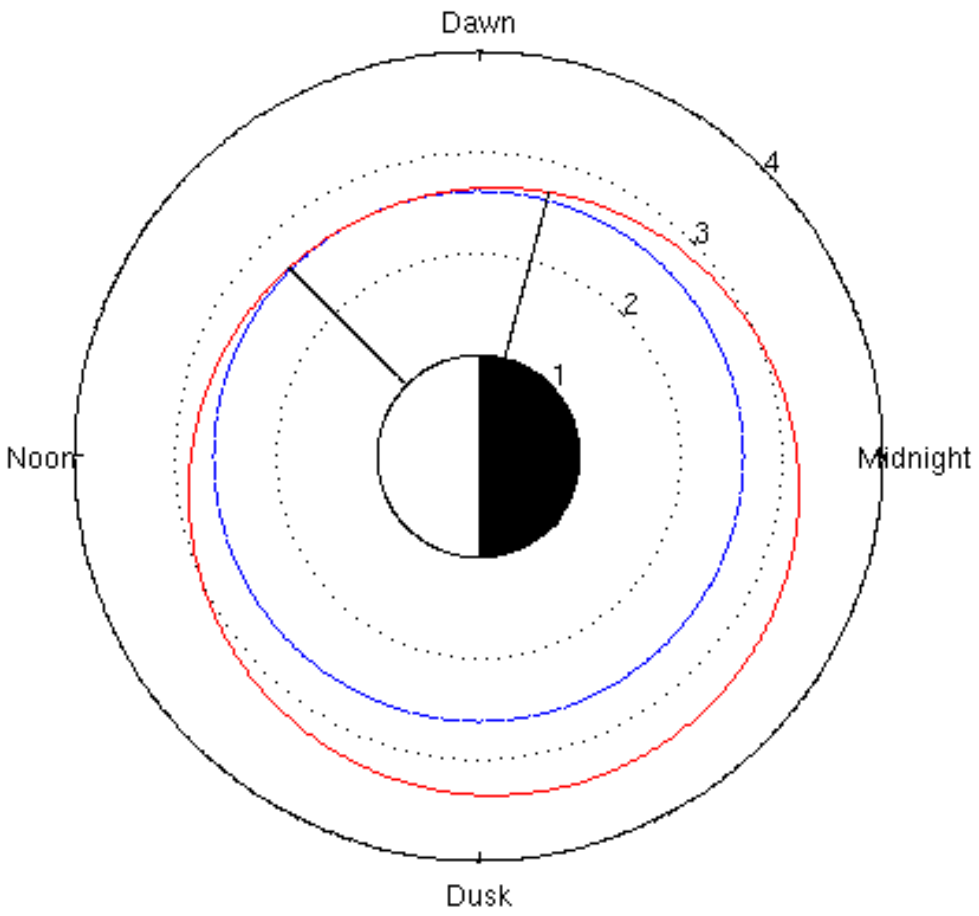
Carpenter 1967

$Lpp = 5.7 - 0.47Kp_{max}$

Plasmapause Compression

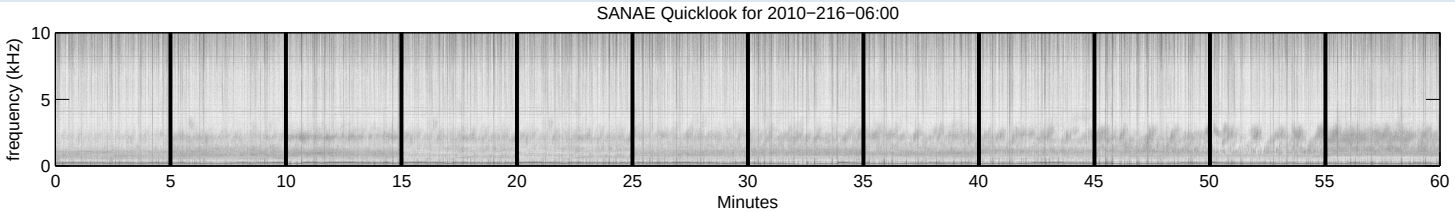
Moldwin 2002

$$L_{pp} = -0.39(1 - (0.34)\cos(\phi - 4.34))K_{pmax} + 5.6(1 + 0.12\cos(\phi - 0.7854))$$



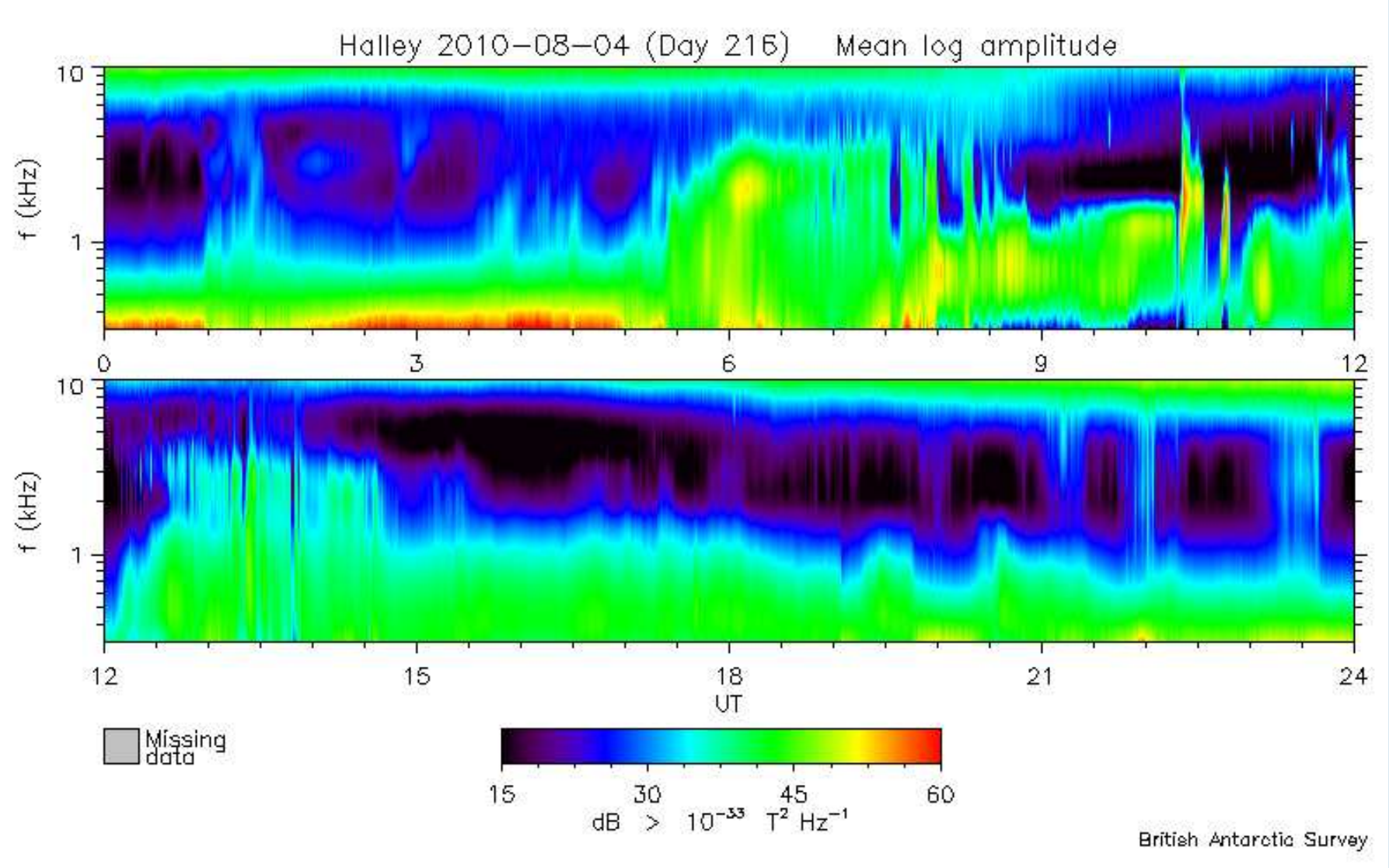
Observation at Other Stations

SANAE IV: 06:00 - 08:00 UT (LT = UT)



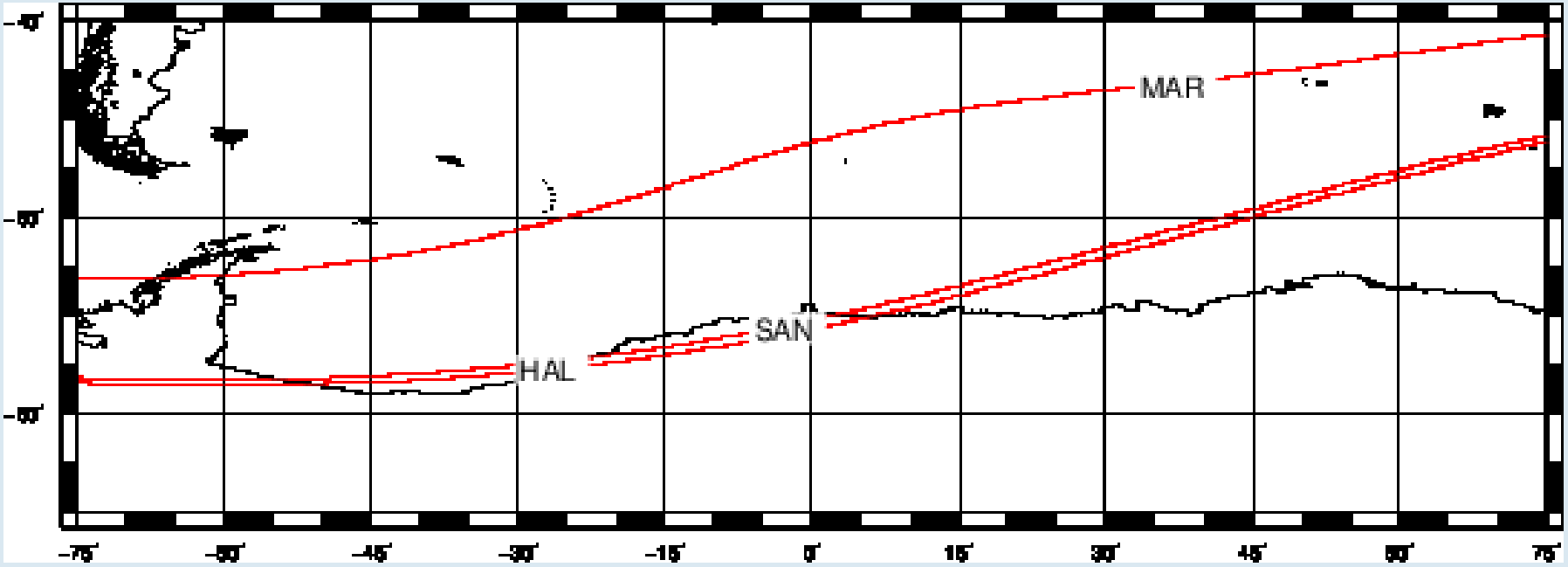
Observation at Other Stations

Halley Bay: 02:00 UT (00:00 LT)



Observation at Other Stations

Halley → Marion → SANAE IV



Using DEMETER Data

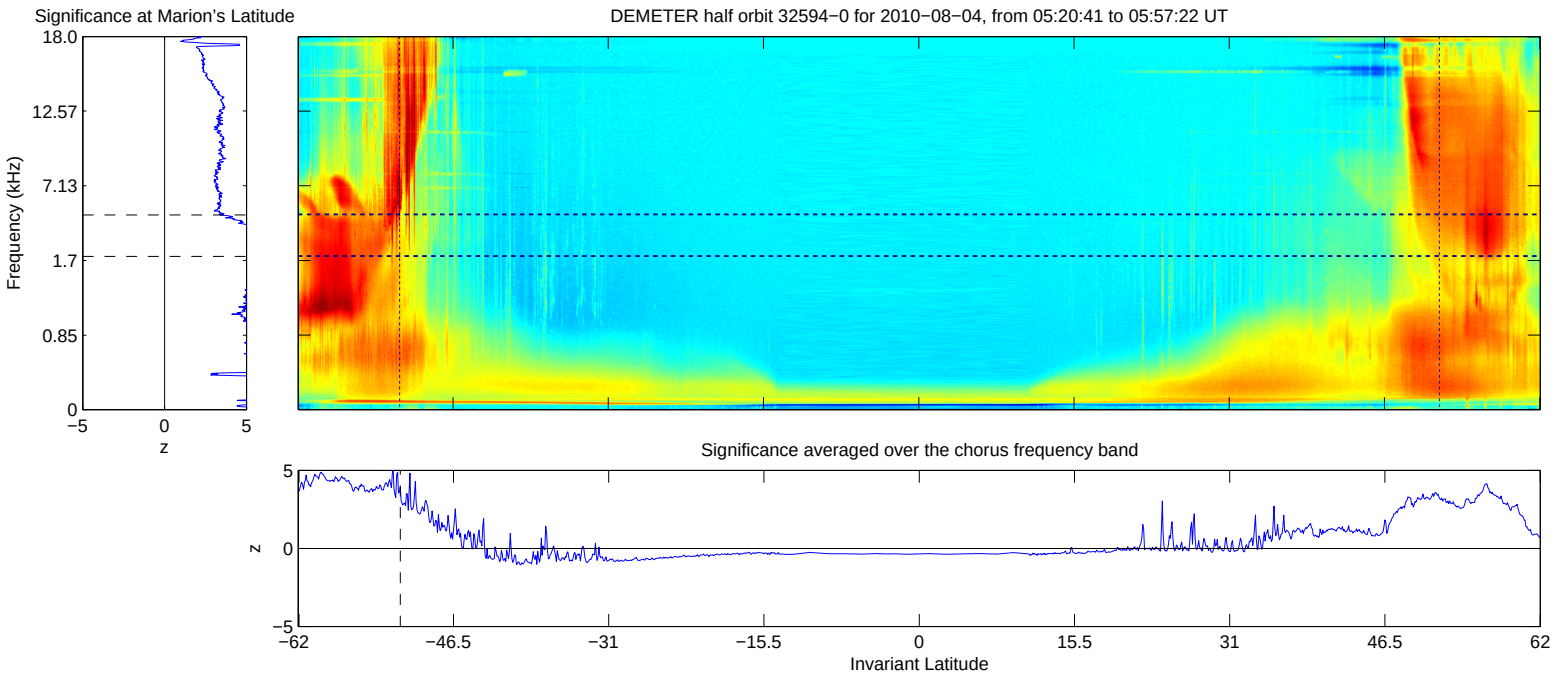
Statistical Significance

- Data from 223 DEMETER half orbits (X_i) are analysed.
- We determine the mean spectrum (μ) and the standard deviation (σ) from the (X_i).
- We determine z from

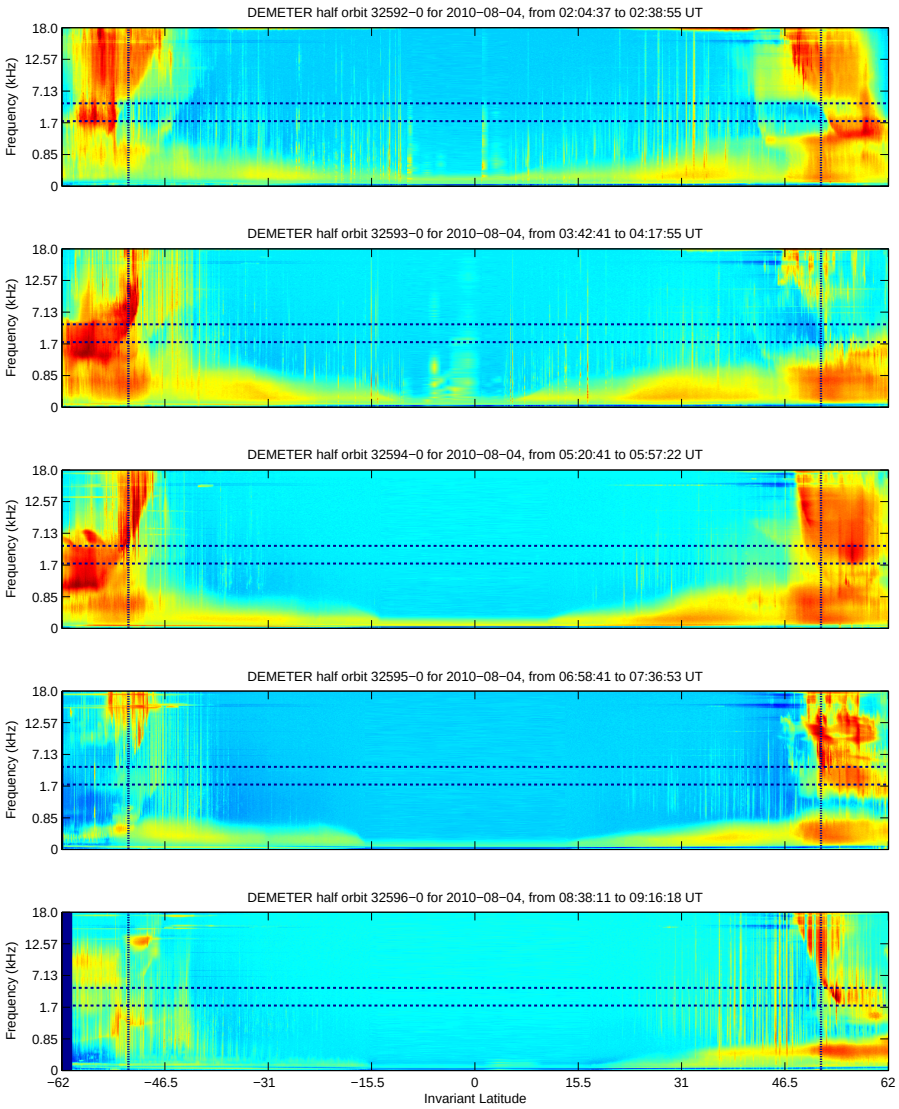
$$z_i = \frac{X_i - \mu}{\sigma} \tag{1}$$

where $|z| \geq 1.65$ implies that the sample is in the 5% confidence interval.

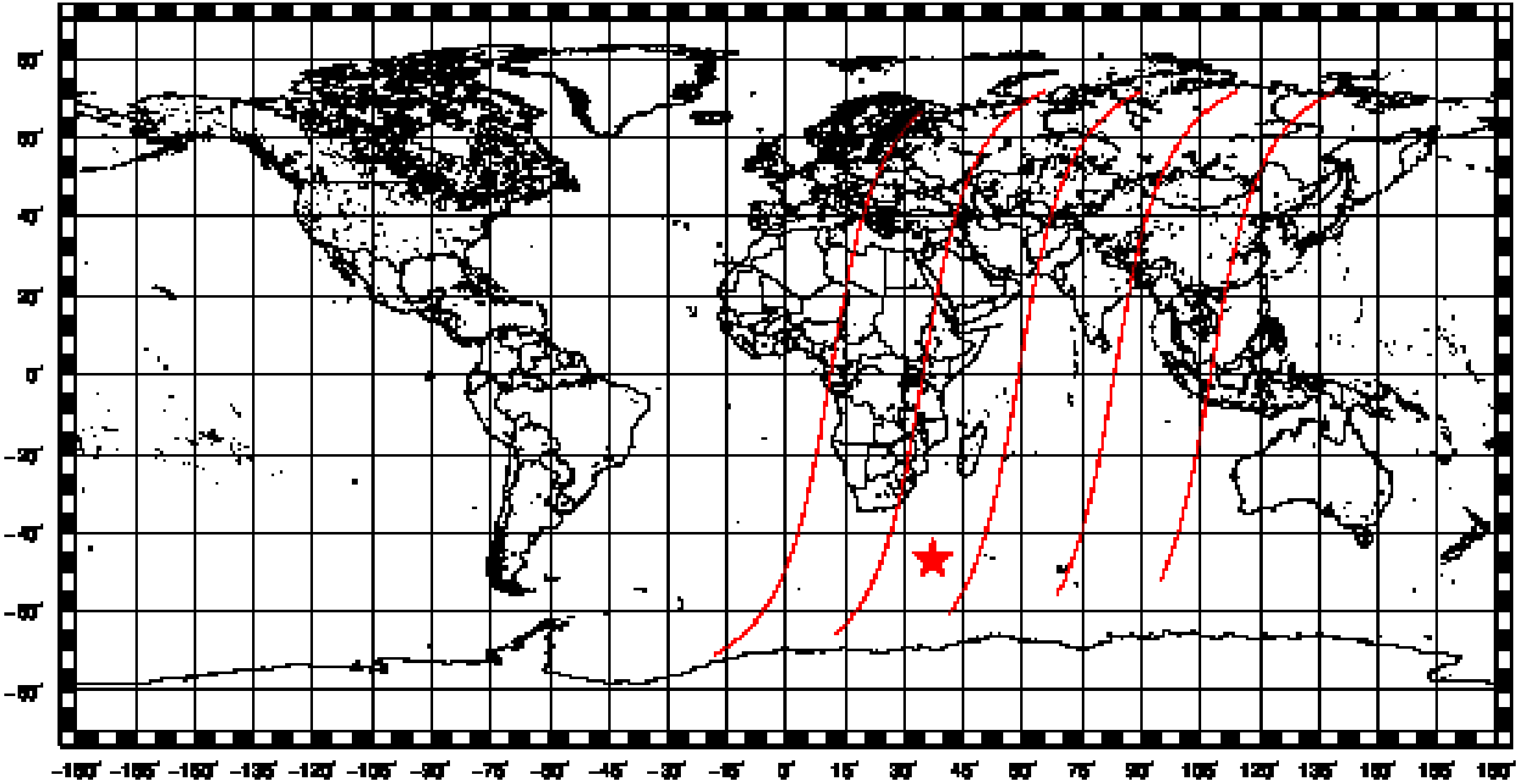
Using DEMETER Data



Extent of the Chorus



Extent of the Chorus



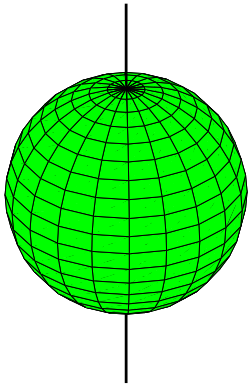
Reasons For Occurrence Asymmetry

- Difference of $\sim$45 minutes between northern and southern hemisphere.
- Half orbit is not along a magnetic meridian.
- Positive asymmetry ($A = \frac{T_\perp}{T_\parallel} - 1$) required for wave growth.

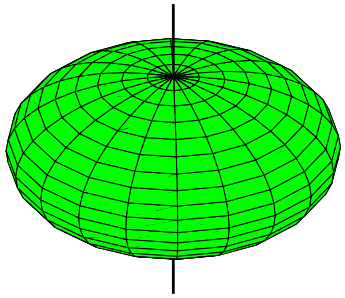
Asymmetry Considerations

$$A = \frac{T_{\perp}}{T_{\parallel}} - 1 \tag{2}$$

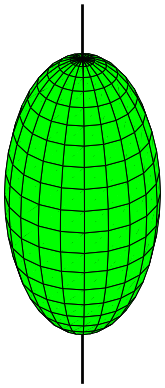
$A = 0$



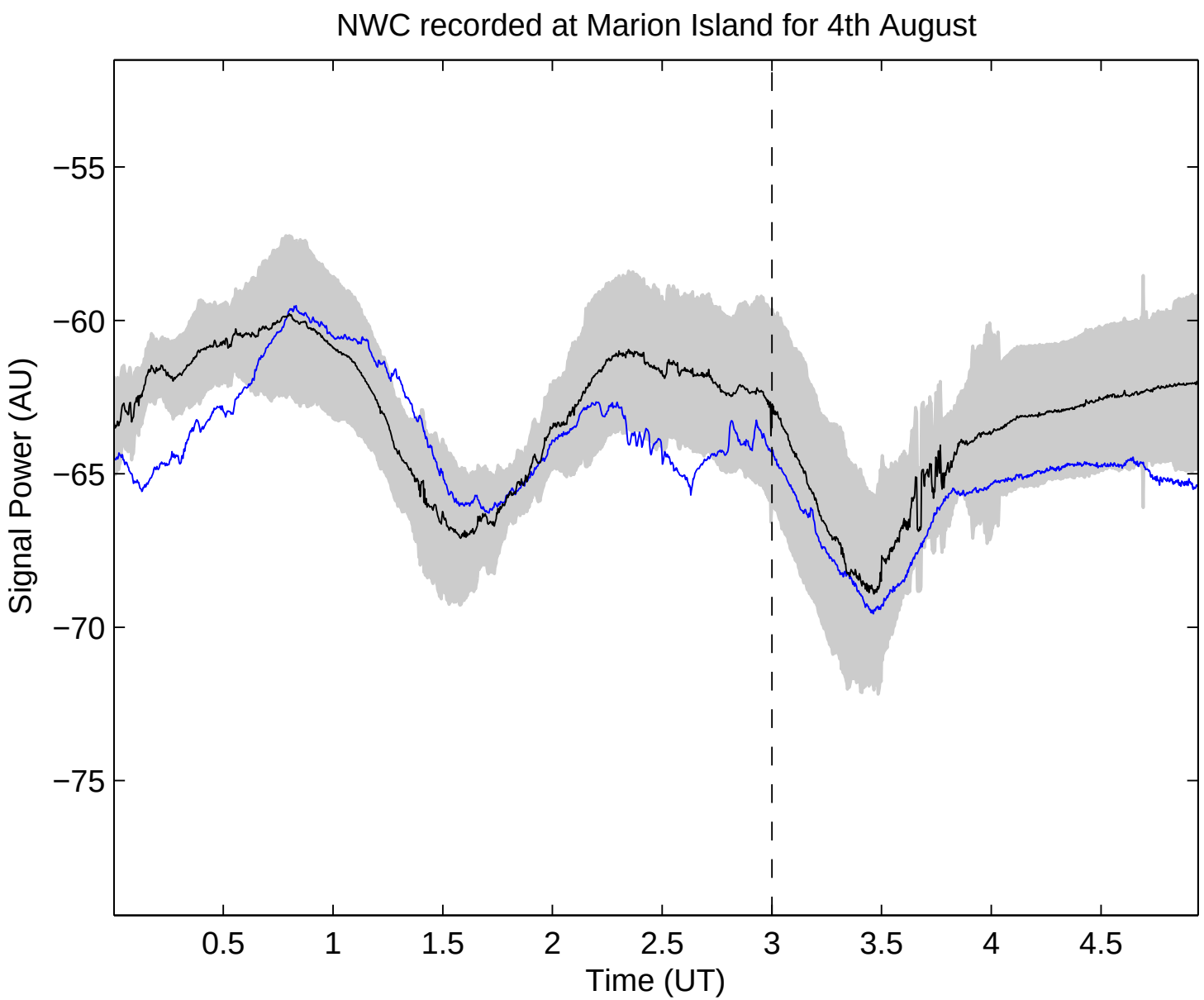
$A > 0$



$A < 0$



Precipitation?



Conclusion

- Extremely rare observation of chorus at Marion Island ($L = 2.6$).
- Simultaneous observation of chorus and plasmaspheric hiss.
- Non-simultaneous onset between hemispheres.

Acknowledgements

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