

SAMBA Magnetometer Array

Some material ~~stolen~~ borrowed from Eftyhia Zesta

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USA

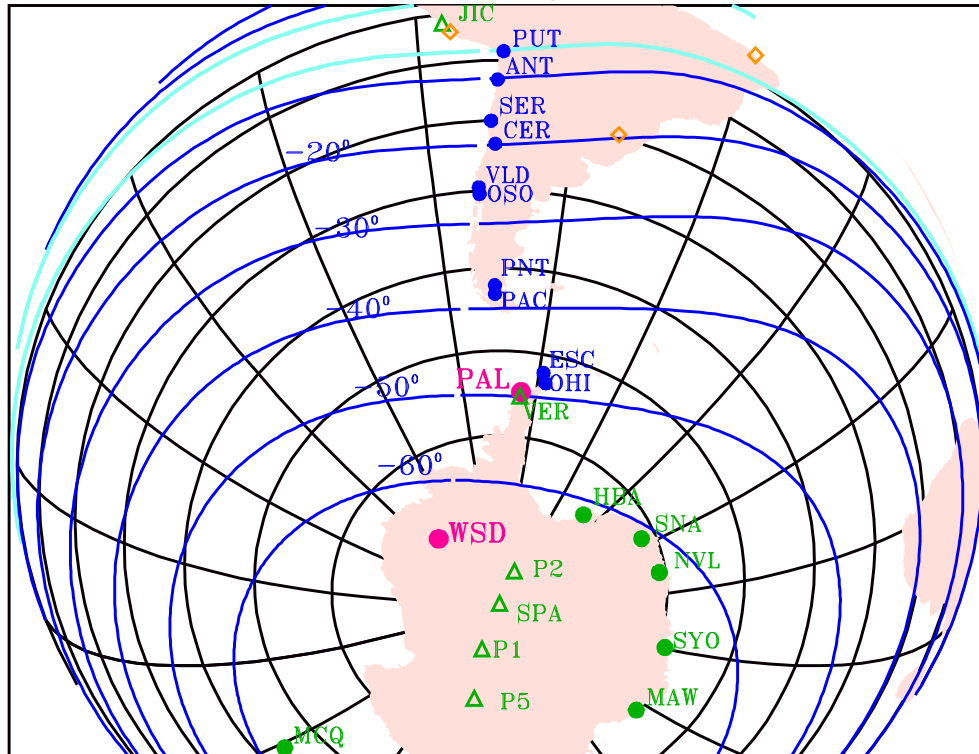
Outline

- The SAMBA magnetometer array
- Field-Line Resonance
- Solving the Resonance Equations
- FLIP model comparisons
- Conclusions

The SAMBA magnetometer array

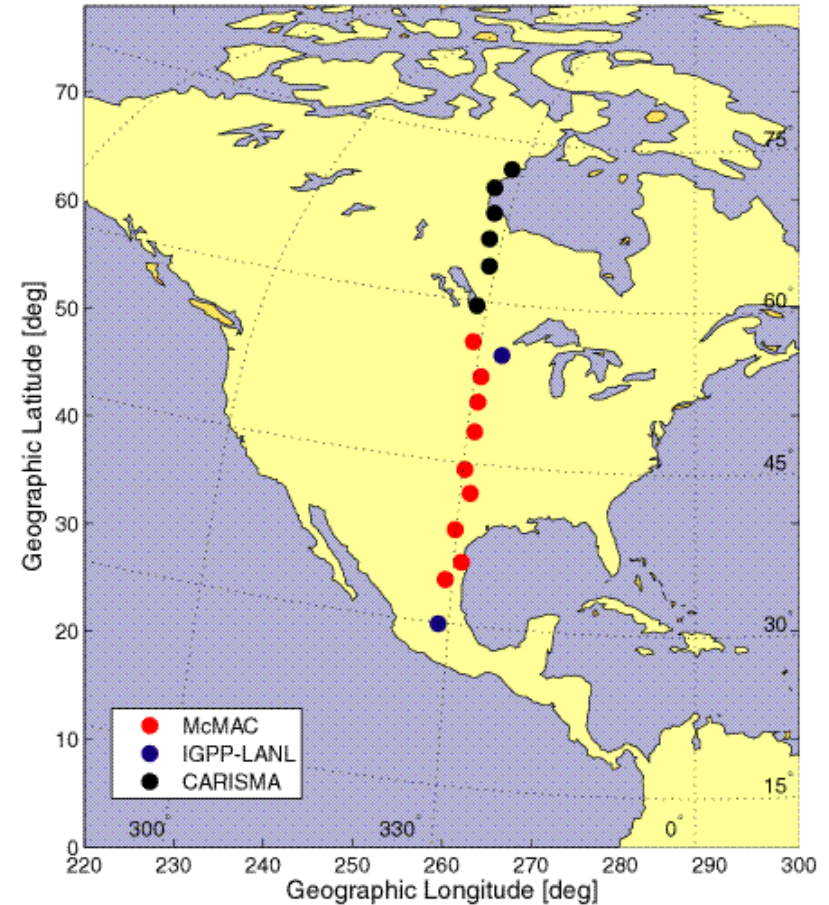
SAMBA

Map of SAMBA magnetometers



**PI: E. Zesta, U.S. Air
Force Research
Laboratory**

McMac and CARISMA



**PI: P. Chi, University
of California, Los
Angeles**

Field-Line Resonance

Fourier FLR plots, 4 July 2006 (day 185)

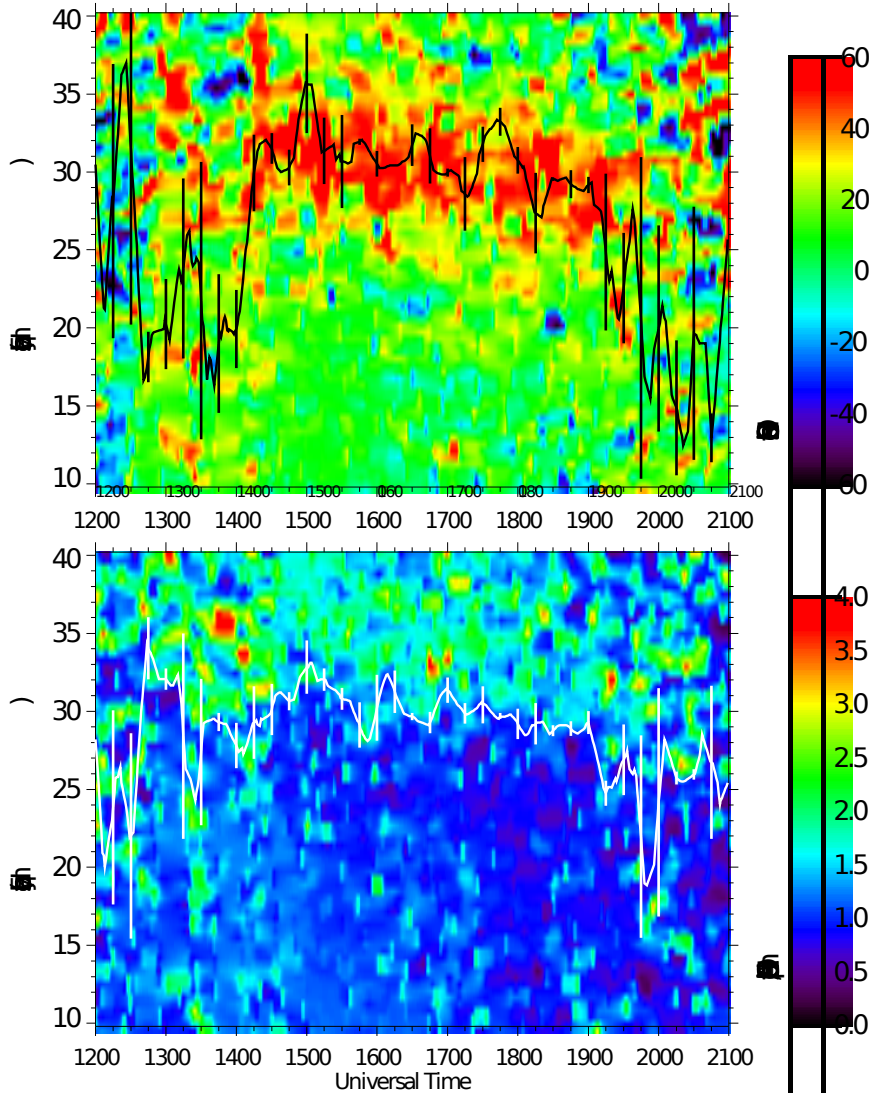
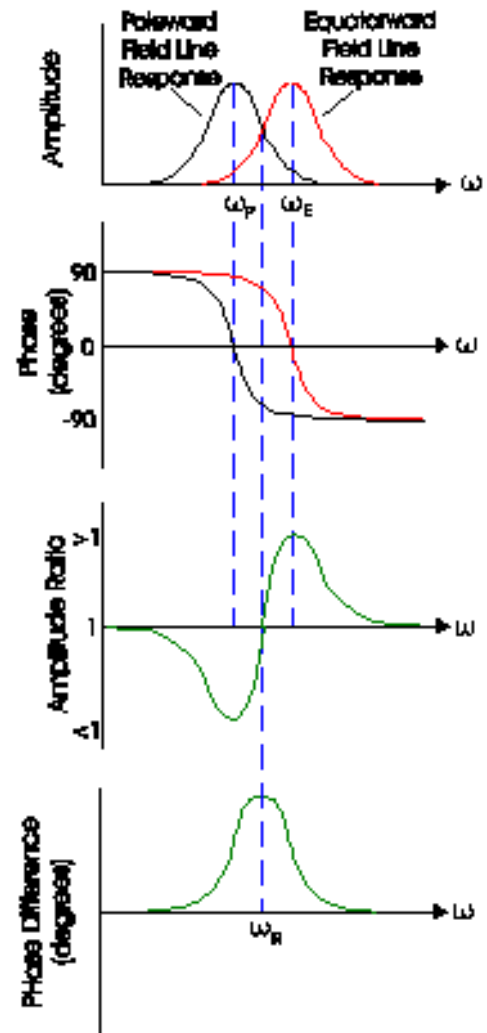
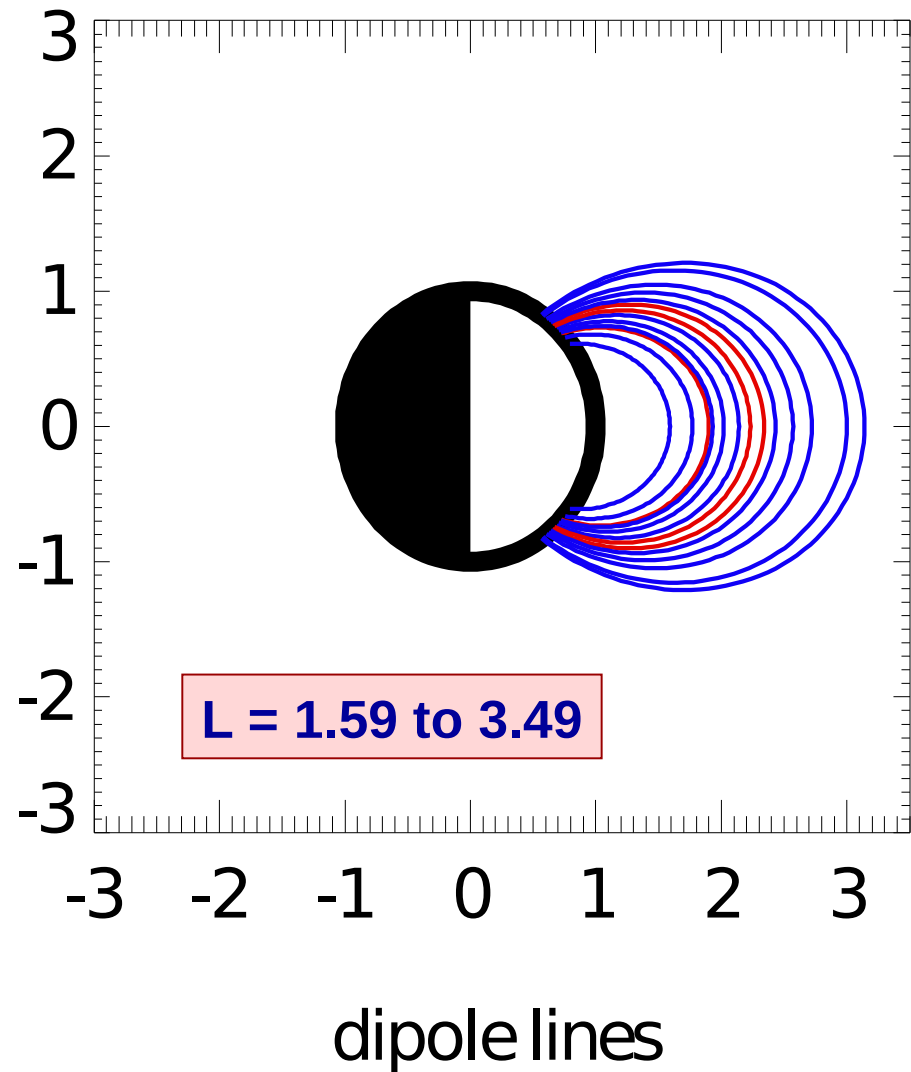


Illustration of the Amplitude Ratio & Phase Difference



SAMBA coverage

- Dense sampling of the inner magnetosphere
- Core of the plasmasphere



Field-Line Resonance

- Standing Alfvén wave on magnetic field line

$$\frac{\partial^2 \mathbf{E}}{\partial t^2} = \mathbf{A} \times \mathbf{A} \times \nabla \times \nabla \times \mathbf{E}$$

- Alfvén speed depends on mass density

$$\mathbf{A} = \frac{\mathbf{B}}{\sqrt{\mu_0 \rho}}$$

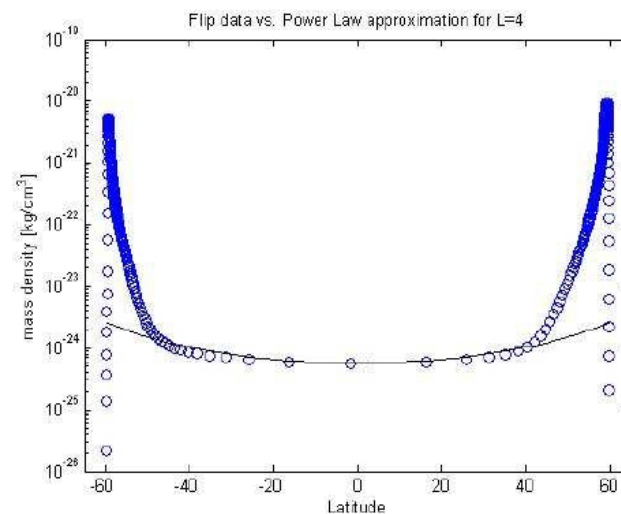
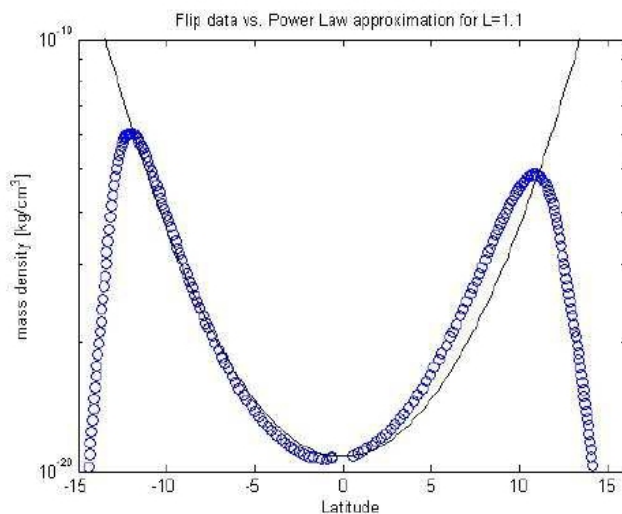
$$\frac{d^2 T_n}{dx^2} + \omega_\nu^2 \left(1 - x^2\right)^6 N(x, \lambda) T_n = 0$$

Schulz (1996) versus reality

- (nearly) Analytical relationship between mass density and frequency for power law mass density distribution along field line

$$\frac{\partial^2 \mathbf{E}}{\partial t^2} = \mathbf{A} \times \mathbf{A} \times \nabla \times \nabla \times \mathbf{E}$$

- But the assumption is only valid for $L > 3.5$, so only sometimes useful in practice (N. McCarthy, 2010)



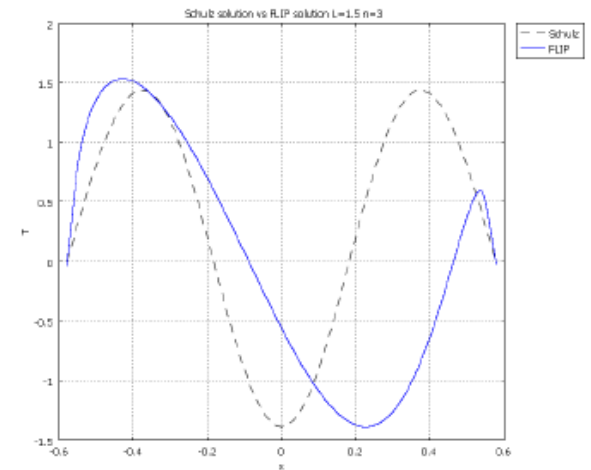
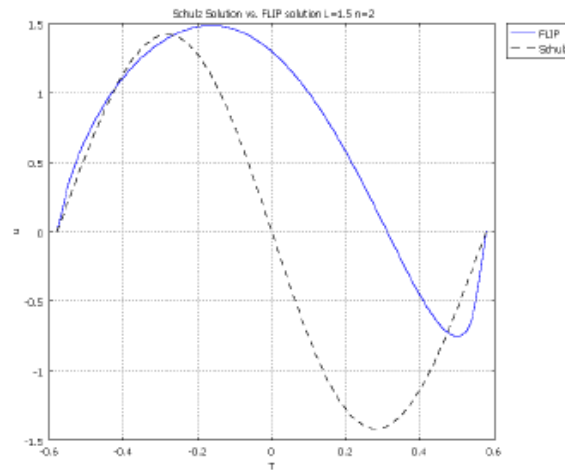
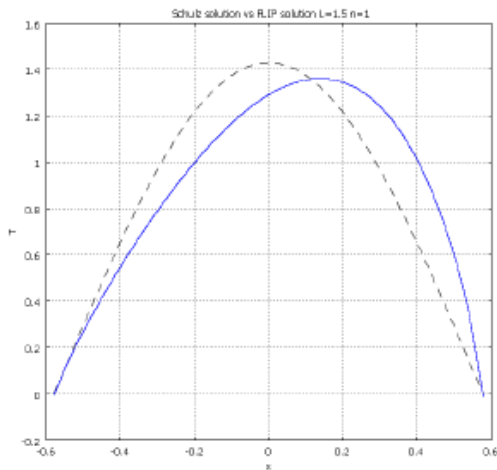
Field Line
Interhemispheric
Plasma Model
(FLIP)

- Phil Richards

Solving Standing Wave Equation

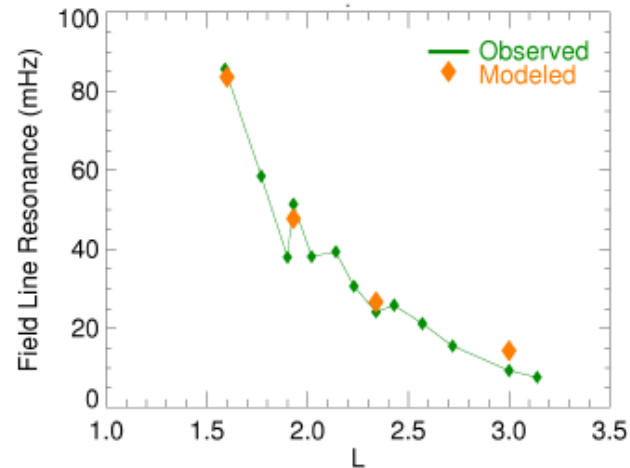
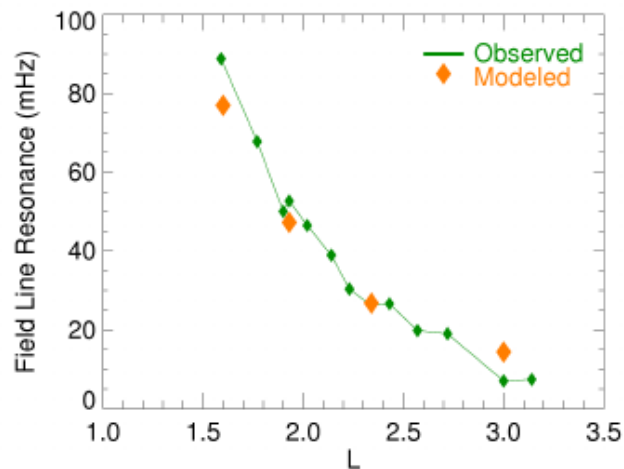
- Within the context of the FLIP model

$$\frac{d^2 T_n}{dx^2} + \omega_\nu^2 \left(1 - x^2\right)^6 N(x, \lambda) T_n = 0$$



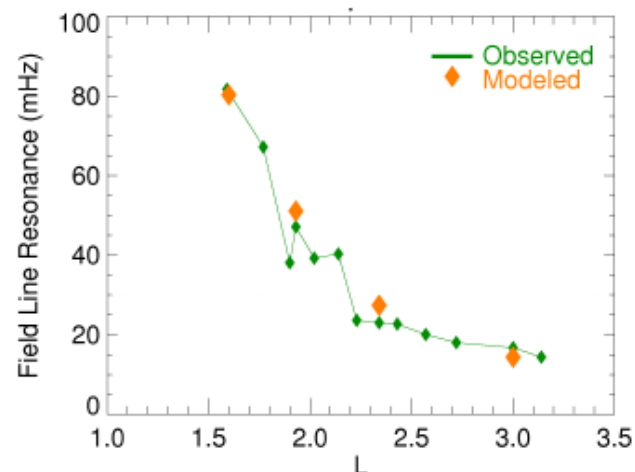
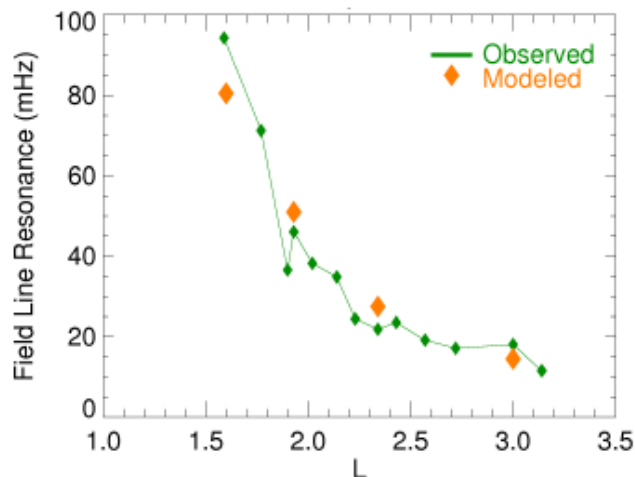
FLIP/SAMBA comparison – quiet time

July 4, 2006 1600 UT and 1700 UT



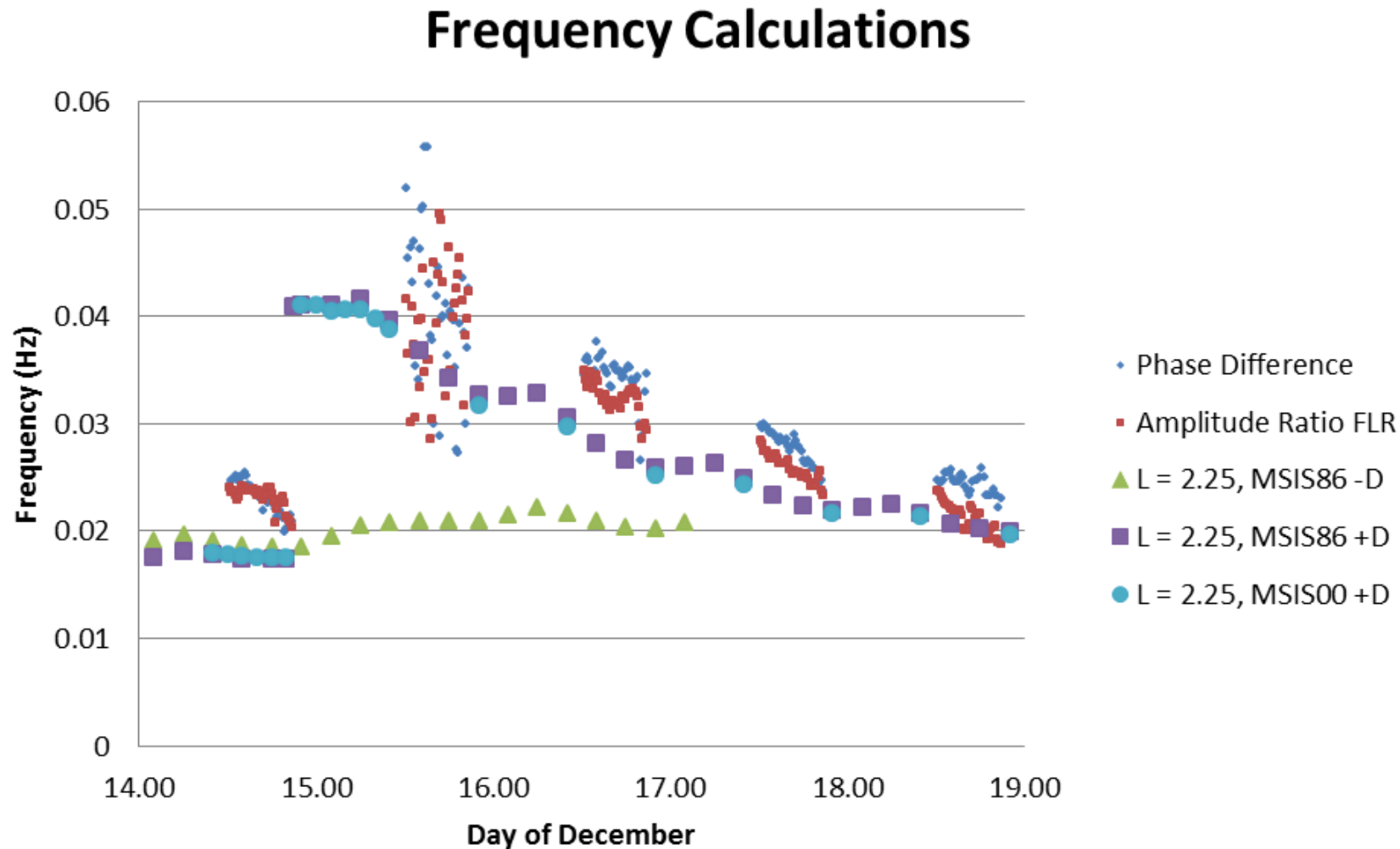
N. McCarthy (2010)
And
E. Zesta (2010)

December 14, 2006 1500 UT and 1600 UT



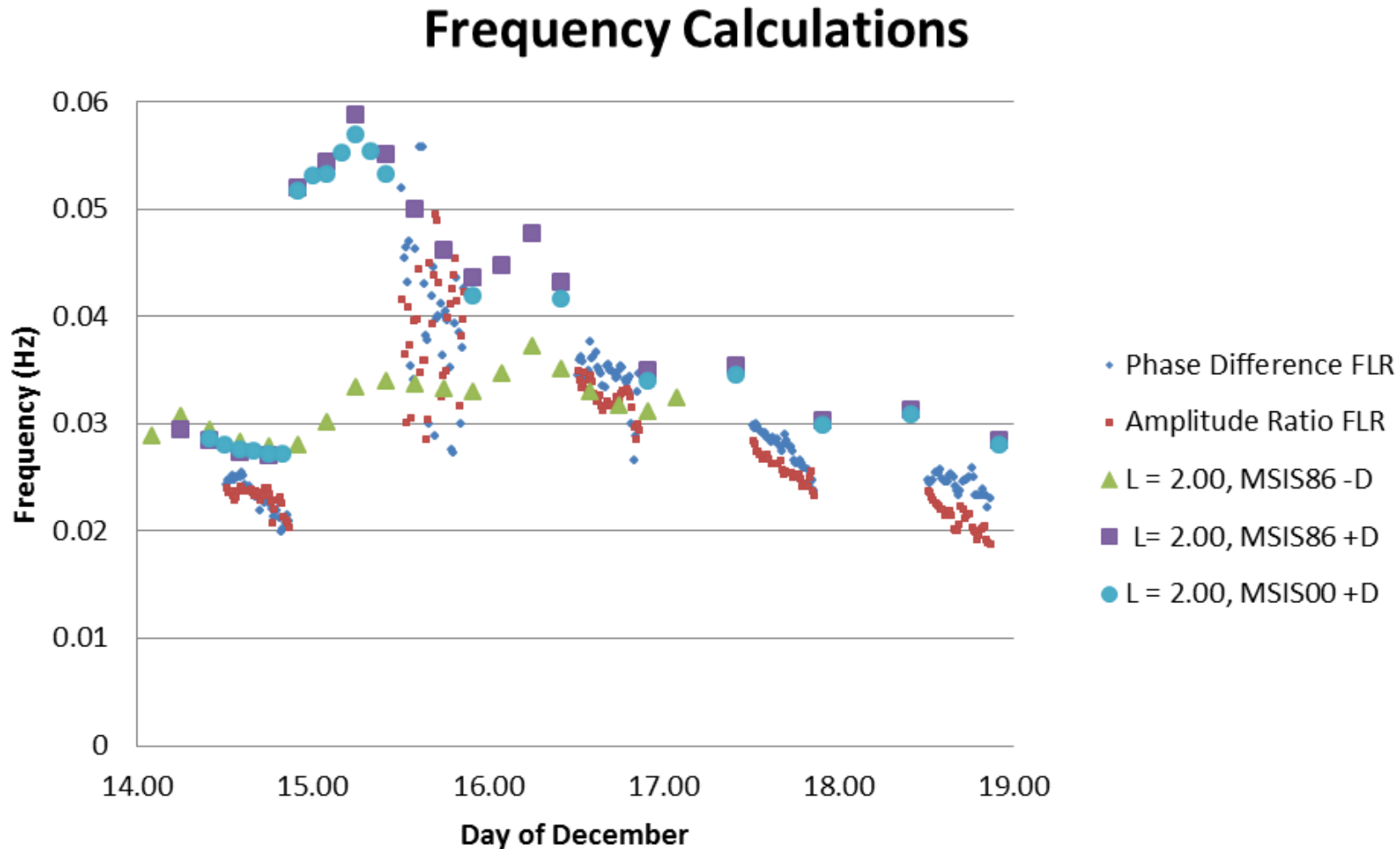
FLIP/SAMBA comparison – storm time

J. Duffy
(2011)



FLIP/SAMBA comparison – storm time

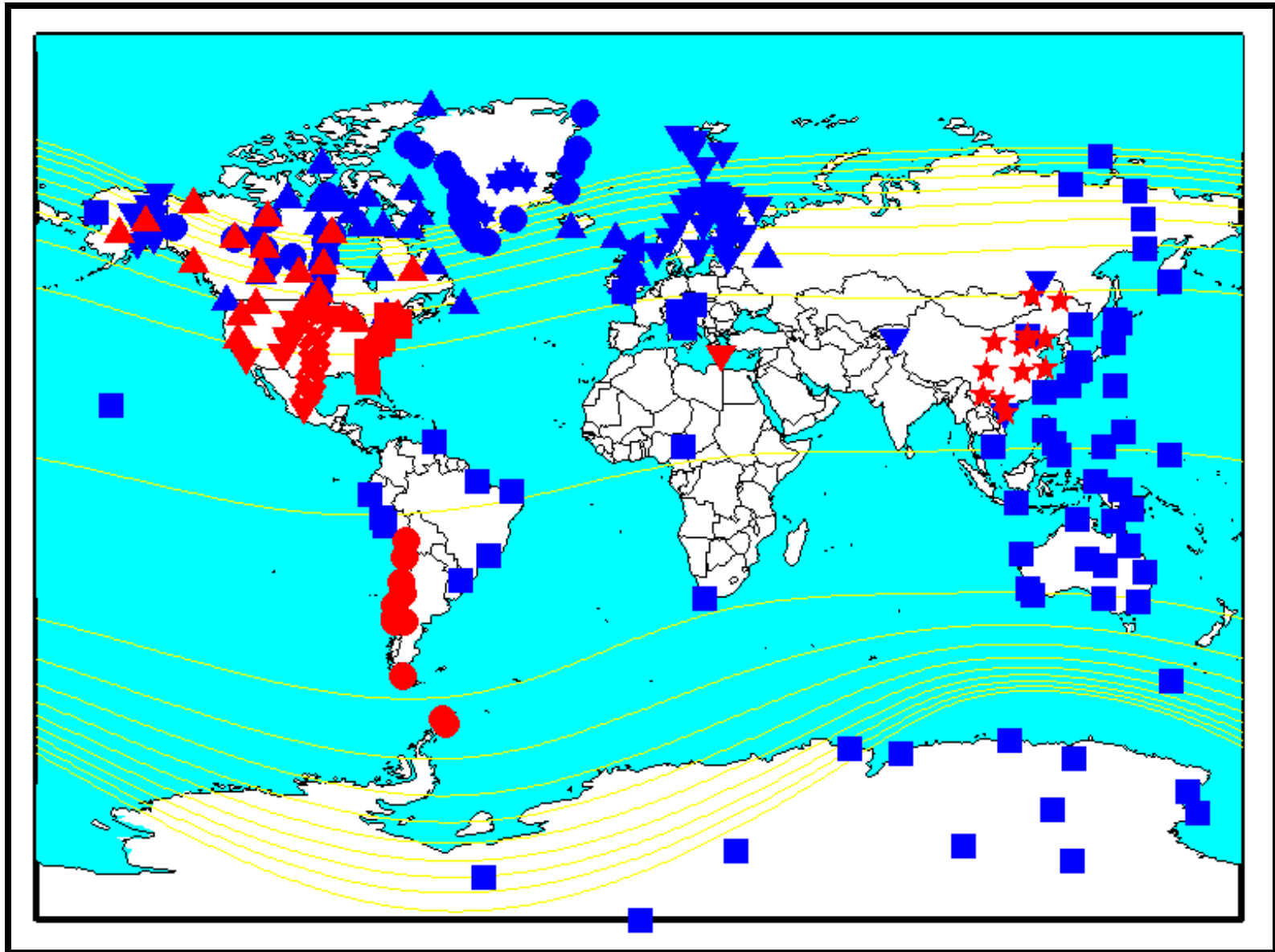
J. Duffy
(2011)



FLR discussion

- We are making progress on understanding the relationship between FLR frequencies and mass densities
- The goal is to be able to use FLRs to “confidently” measure the mass density in the inner plasmasphere upper ionosphere/thermosphere
- Such “confidence” will allow FLRs to be used as inputs to data assimilative models

ULTIMA magnetometer collaboration



What Else can we do with FLRs??

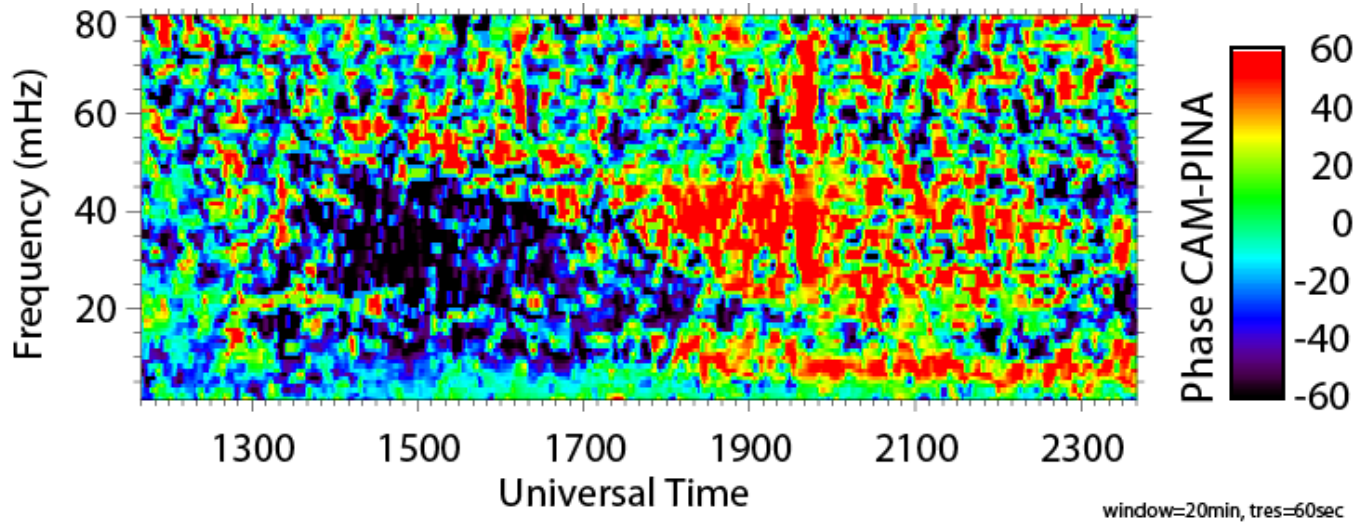
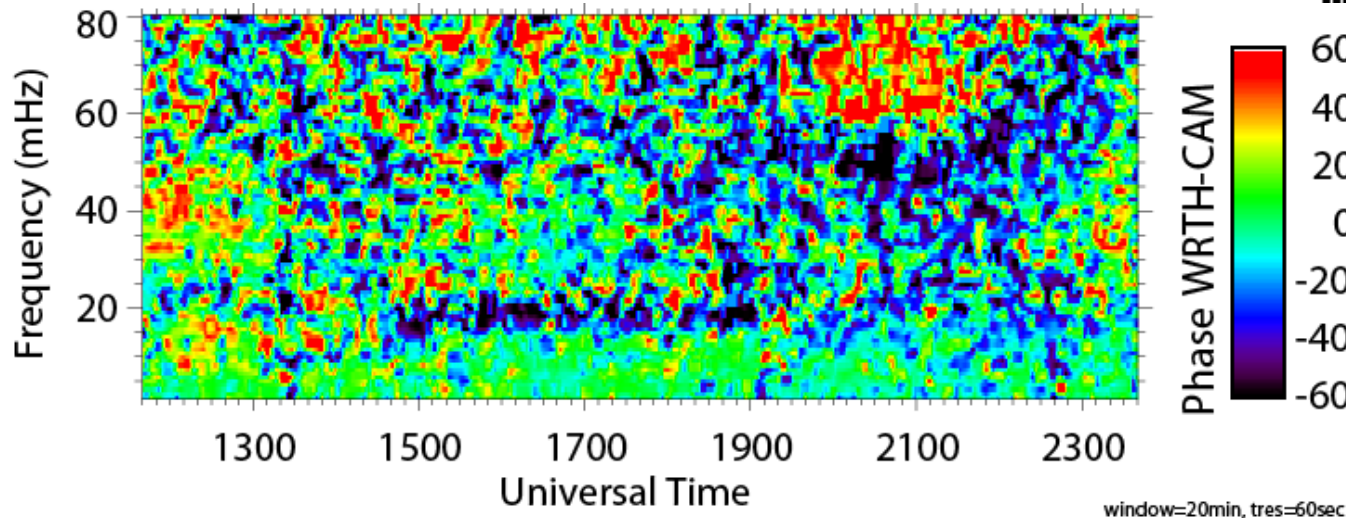
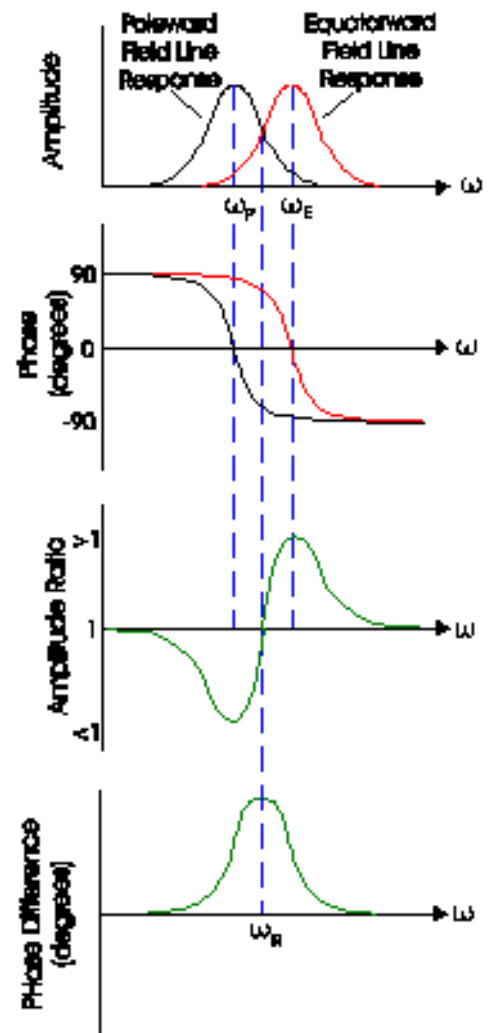
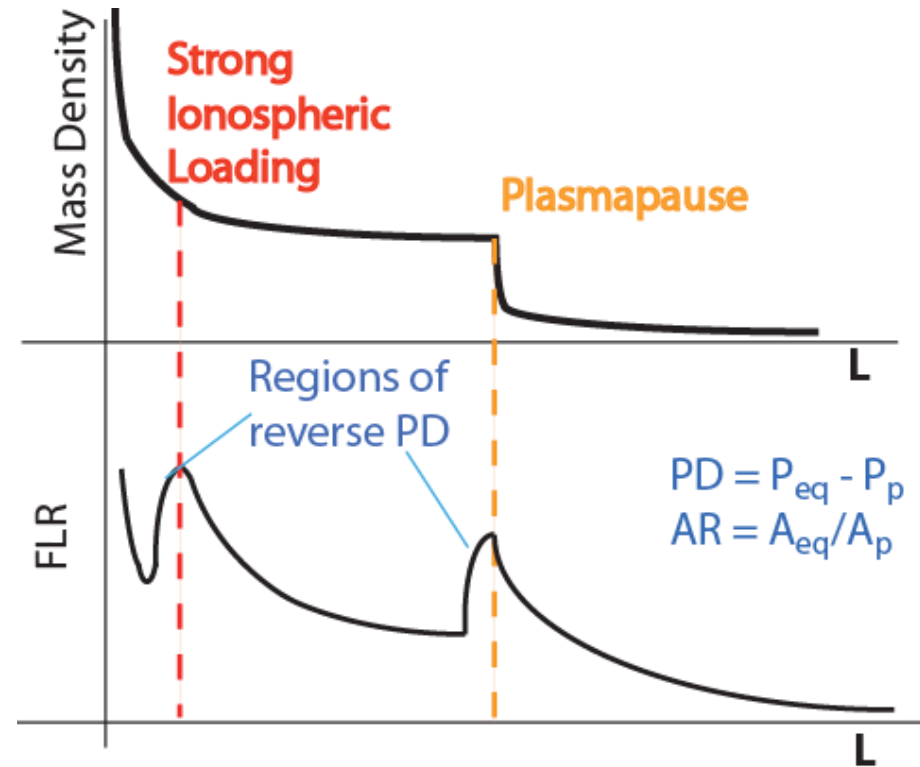
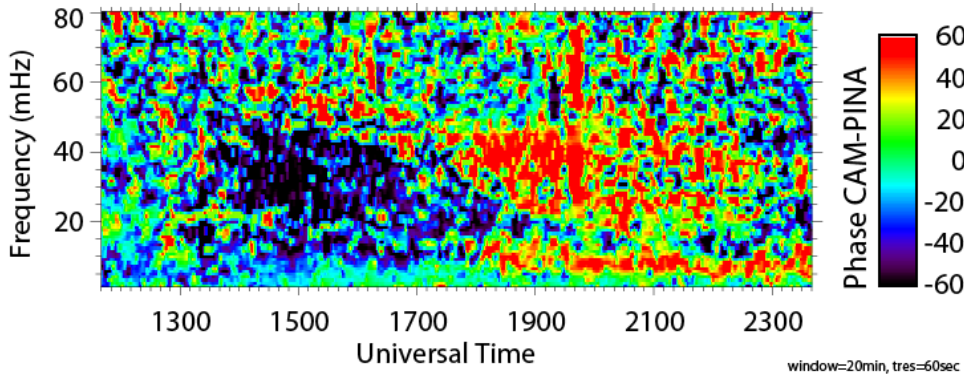
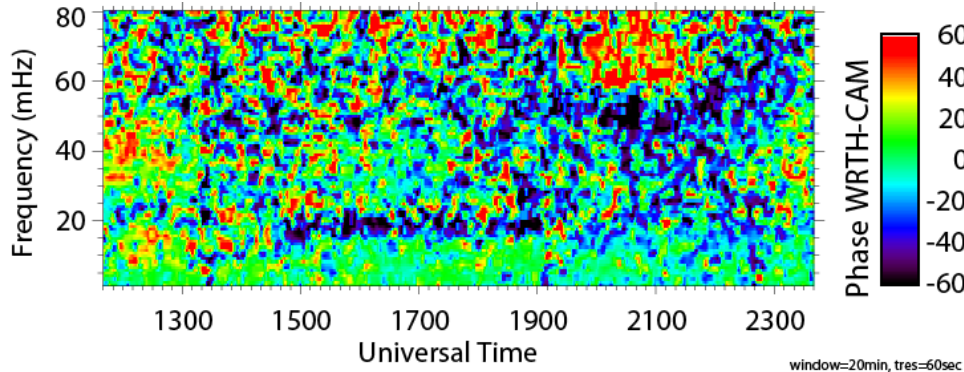


Illustration of the Amplitude Ratio & Phase Difference



What Else can we do with FLRs??



Conclusions

- SAMBA can be used in PLASMON
- We get very good agreement with FLIP model at low latitudes
- There may be more things we can extract from FLRs