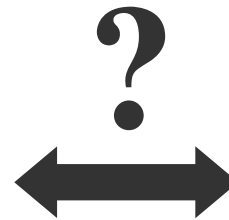
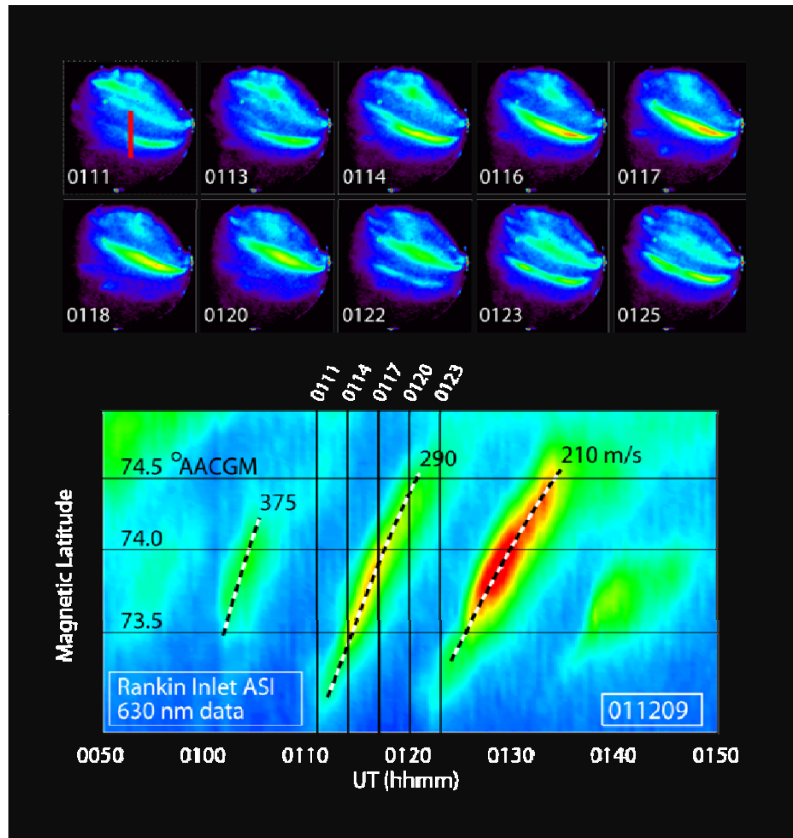


***Eric Donovan, Elizabeth MacDonald, and Robyn Millan***

*Mapping is over-utilized and understudied.*

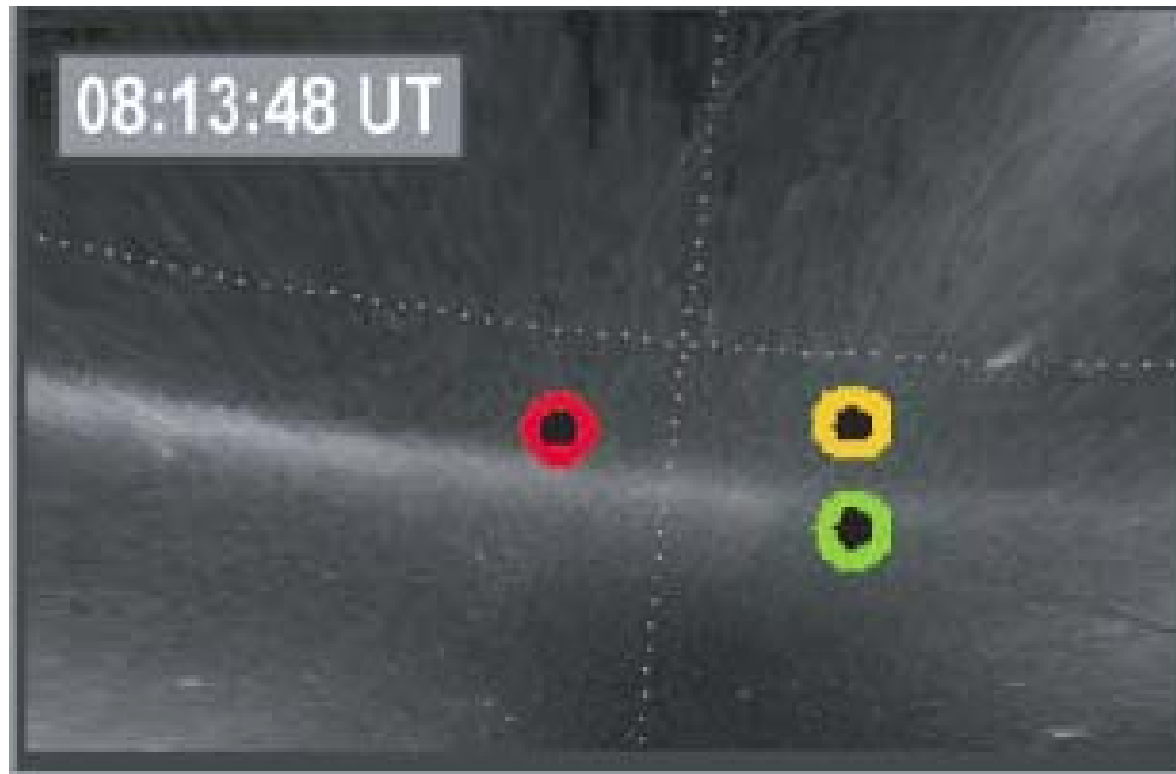
*Understanding of the issues limiting mapping and the various  
techniques for mapping is lacking.*

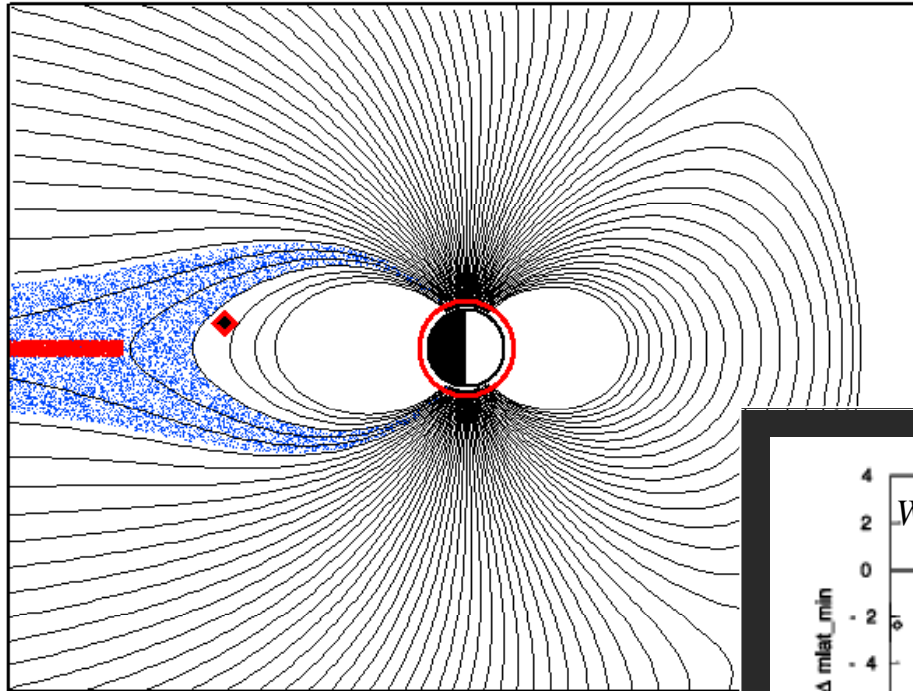
*This is not just field line tracing.*



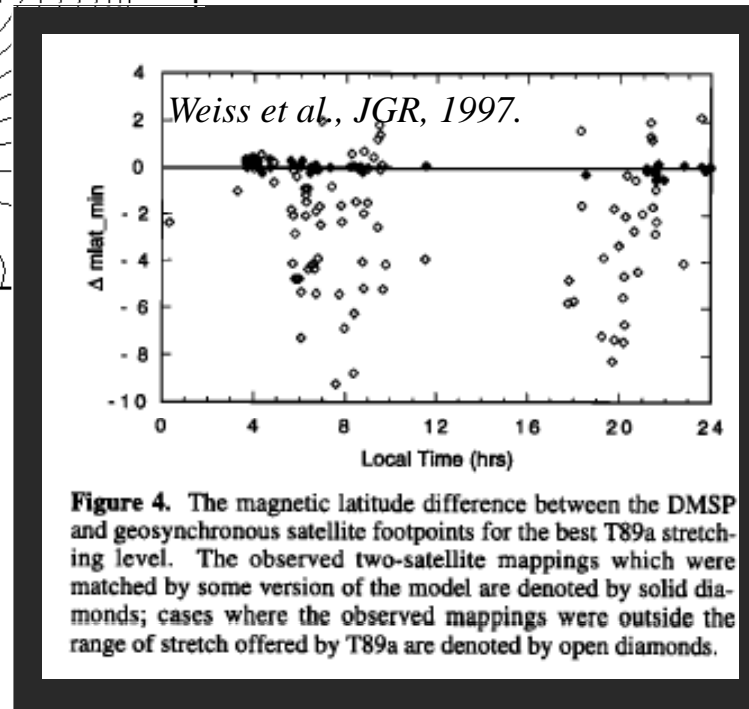
Within the GEM community, ionospheric observations are often used to specify something about the state/physics of the magnetosphere, to track magnetospheric dynamics, and/or to assess consequences of MI coupling.

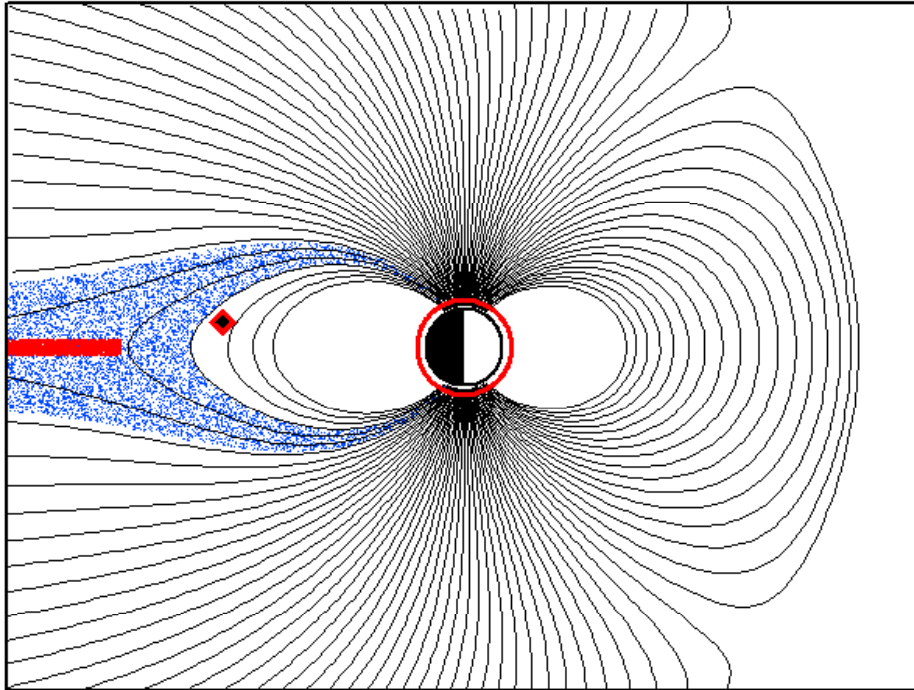
Closure of many of our questions demands understanding the relationship between ionospheric and magnetospheric phenomena, so in general “mapping” is a significant issue for GEM.





How bad can it be (mapping down)?





How bad can it be (mapping up)?

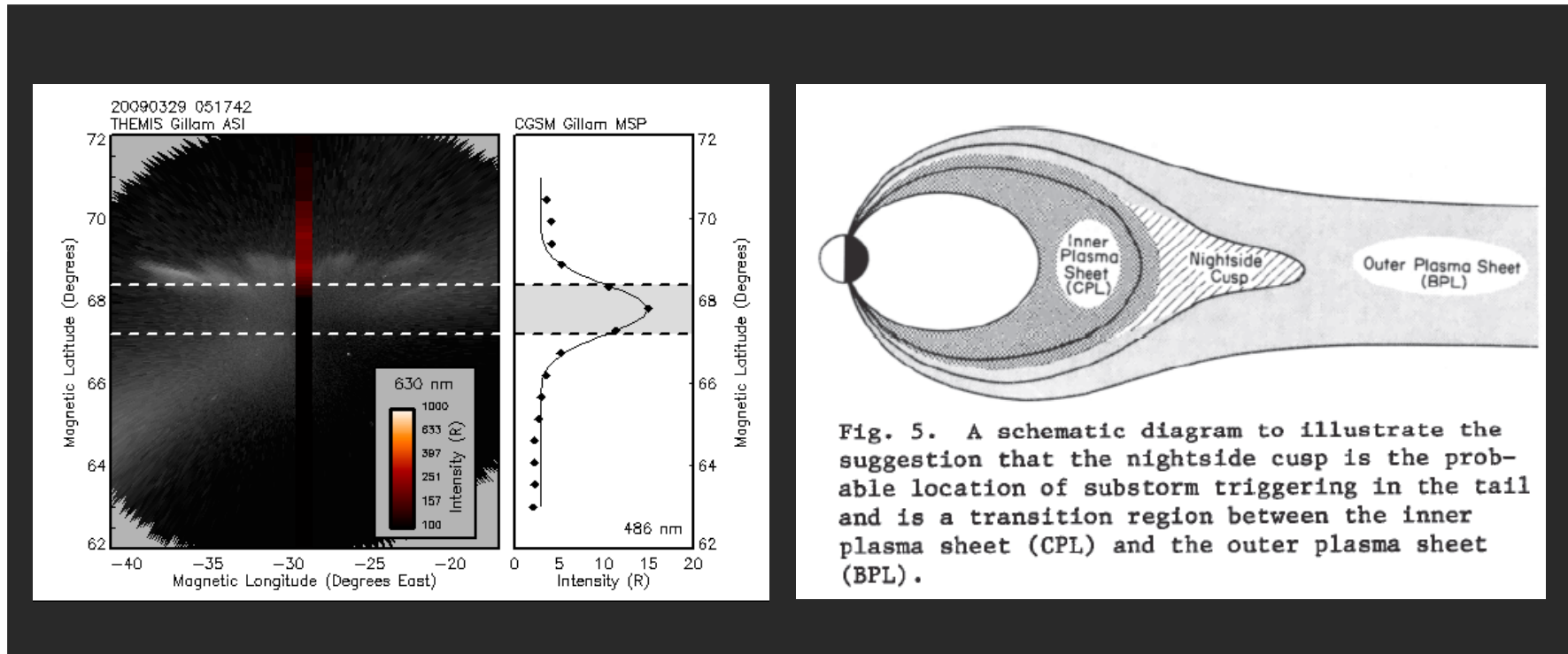
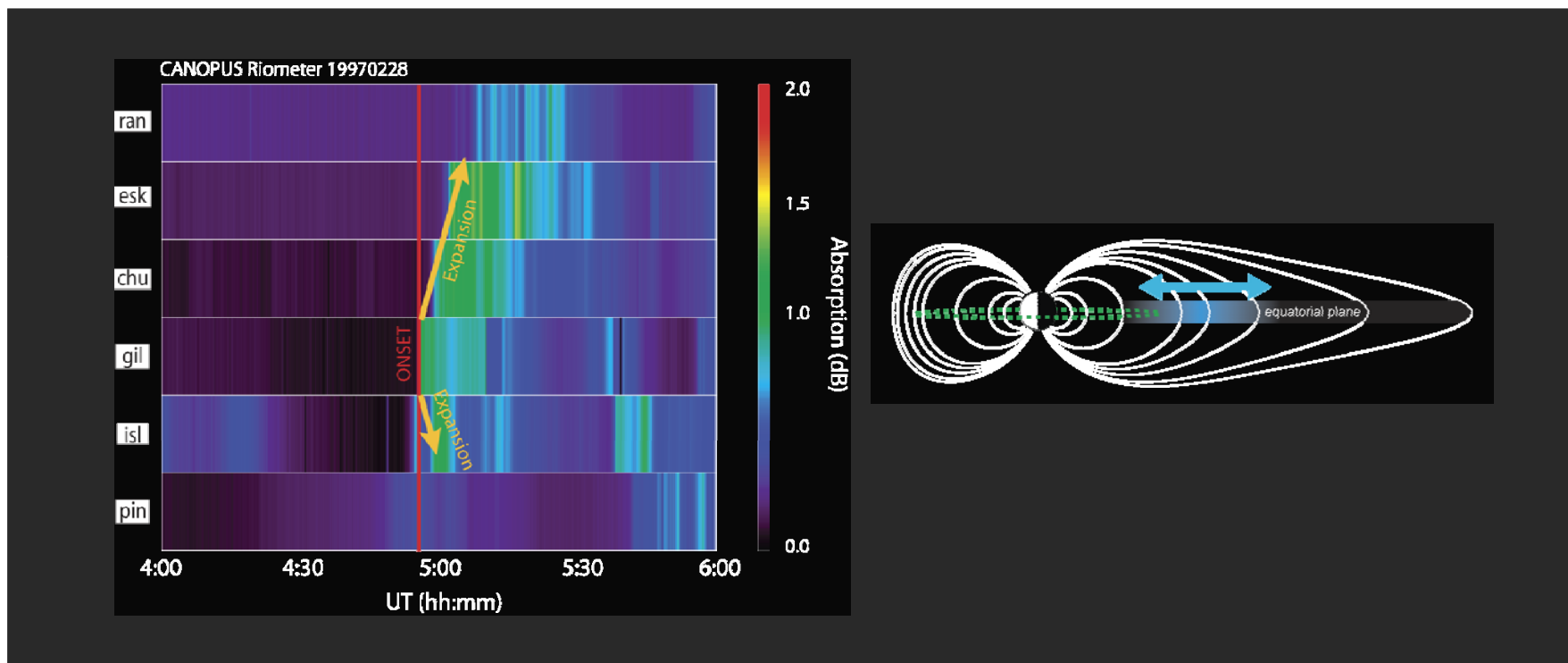


Fig. 5. A schematic diagram to illustrate the suggestion that the nightside cusp is the probable location of substorm triggering in the tail and is a transition region between the inner plasma sheet (CPL) and the outer plasma sheet (BPL).

Reasonable researchers using reasonable data and models argue that the field lines threading the onset arc cross the neutral sheet in the “nightside cusp” in the transition between more and less stretched *or* somewhat further out (~12 Re) in a region of thin current sheet and high.

What are some of the difficulties that arise?

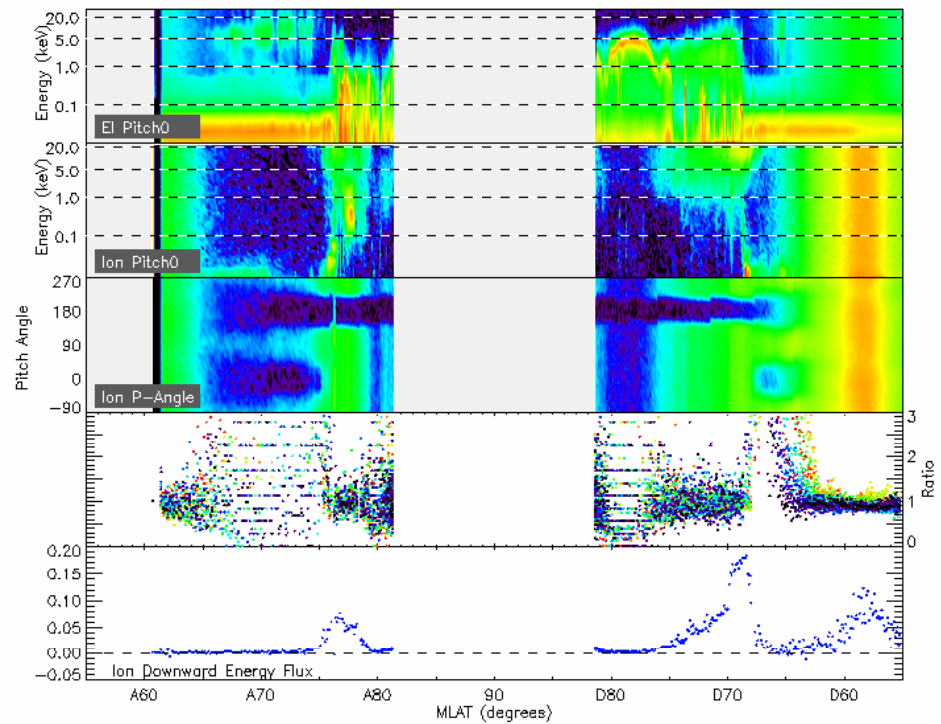
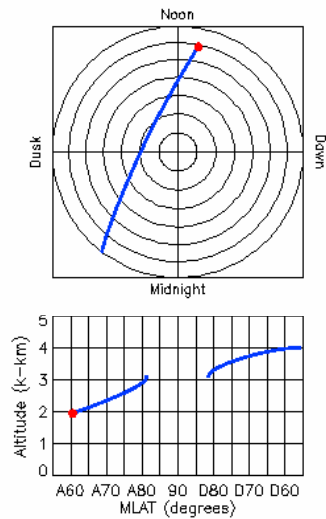
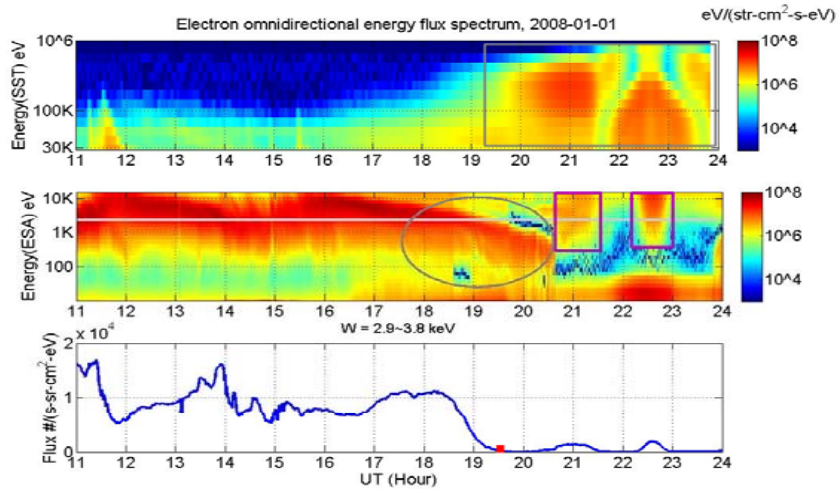


Propagation/evolution of an ionospheric signature of a time evolving magnetospheric process is difficult to interpret because of the evolution of the mapping. A simple example is that poleward propagation might mean tailward evolution, but might not.

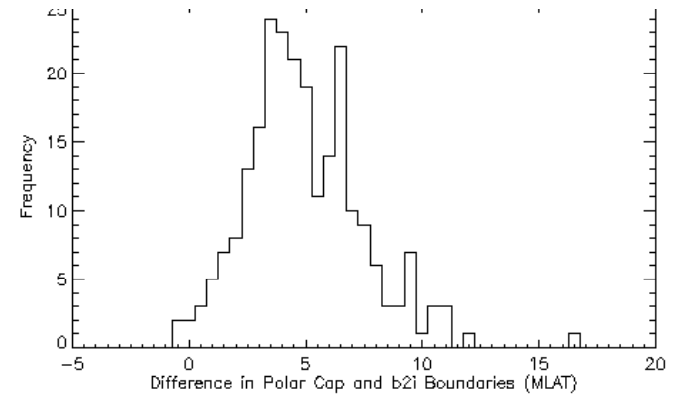
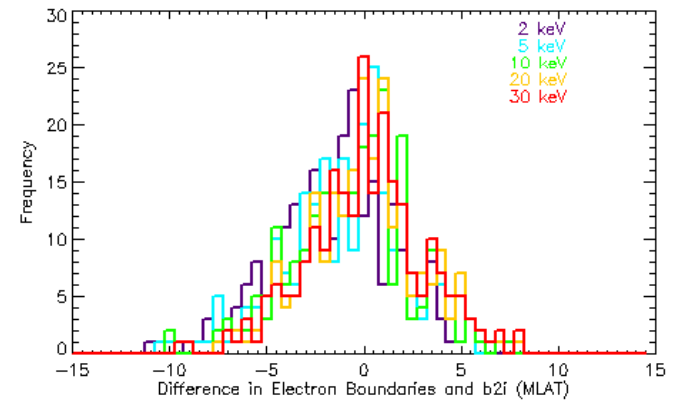
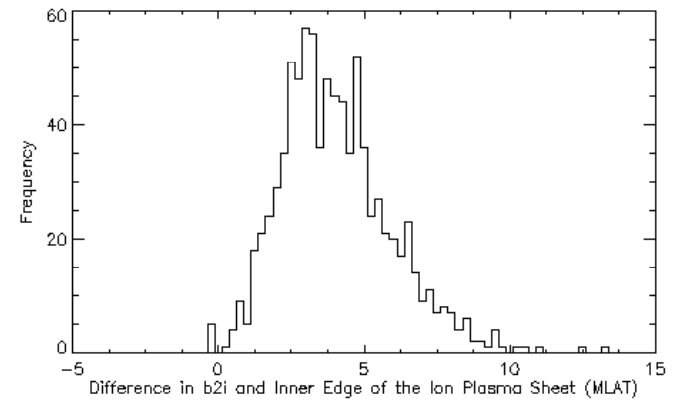
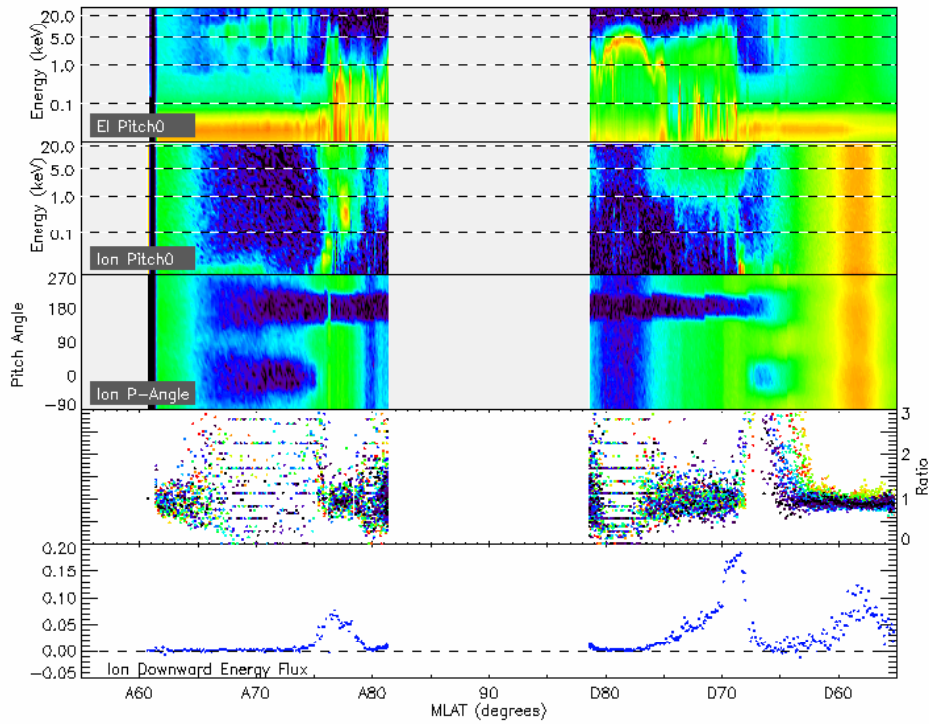


# GEM

## Magnetic Mapping Focus Group







The ability to map between the ionosphere and magnetosphere is fundamentally important to the GEM “mission”. *We need to develop metrics for assessing how correct mappings are.*

Empirical (e.g. T19XX, T20XX) and event-specific (e.g. Kubishkina) models cannot resolve the mapping issue. *Future mapping advances will come from other avenues that we need to take stock of, including....*

auroral boundaries

auroral characteristics

radar echo boundaries

radar echo characteristics

magneto-seismology

global physics-based models

“toy” models

under/over-flights

active experiments

correlation between ionospheric and magnetospheric time series

other?

There has been a lot of progress on many of these fronts over the last decades. However, all of these utilize “rules of thumb” that are based on specific physical assumptions that may or may not be true (or may be wrong). *We need to assess these rules of thumb.*

*We need to explore how mapping is relevant to GEM.*

## **Objectives**

Survey of Mapping Techniques

Assessment and Development of Techniques

Relevant Science Questions: .....

Applications of Results to GGCM and GEM and Vice-Versa

## **Deliverables**

A review of existing mapping techniques.

New metrics for assessing the validity of different techniques.

Quantifiable improvements of existing techniques.

Understanding of how auroral distribution relates to magnetospheric plasma populations.

Demonstration of how those improvements will benefit GEM.

**Relation to other Focus Groups:** GGCM groups, Substorm Expansion Onset, Radiation Belts, Near-Earth Magnetosphere, and Plasmasphere-Magnetosphere Interactions. Natural follow on to Diffuse Auroral Precipitation.

## **Expected Activities**

(1) **survey current mapping techniques and relevant problems.** It will involve at least one session where the community will provide input on the different mapping techniques; (2) **further develop the techniques for mapping and advance metrics to evaluate these techniques.** For example, how reliable are empirical or event-based models? We envision challenges, for example challenging theorists and modelers to map a specific boundary or type of event and then comparing to observations (comparing physics-based mappings with those inferred from empirical models or simulations). This will involve sessions at the GEM summer and min-workshops; (3) **identify, and apply advanced tools to solving, science questions.** This will involve GEM community input through sessions during at least three successive summer workshops.

These (1-3) focused activities are expected to advance our knowledge of mapping problems and solutions within the community.

**By end year two,** we will have identified focused activities that would enable mapping to contribute significantly to GGCM and GEM as a whole.

**In years 3-5** our activities will shift from the details of mapping to its application in system-level geospace science, and to the use of system-level tools to improve the utility of various mapping techniques. Overall, we anticipate 3-4 GEM summer workshop sessions, during each of the five years of the focus group, as well as one session during each GEM mini workshop.