Update on McMAC & Falcon Ground Magnetometers

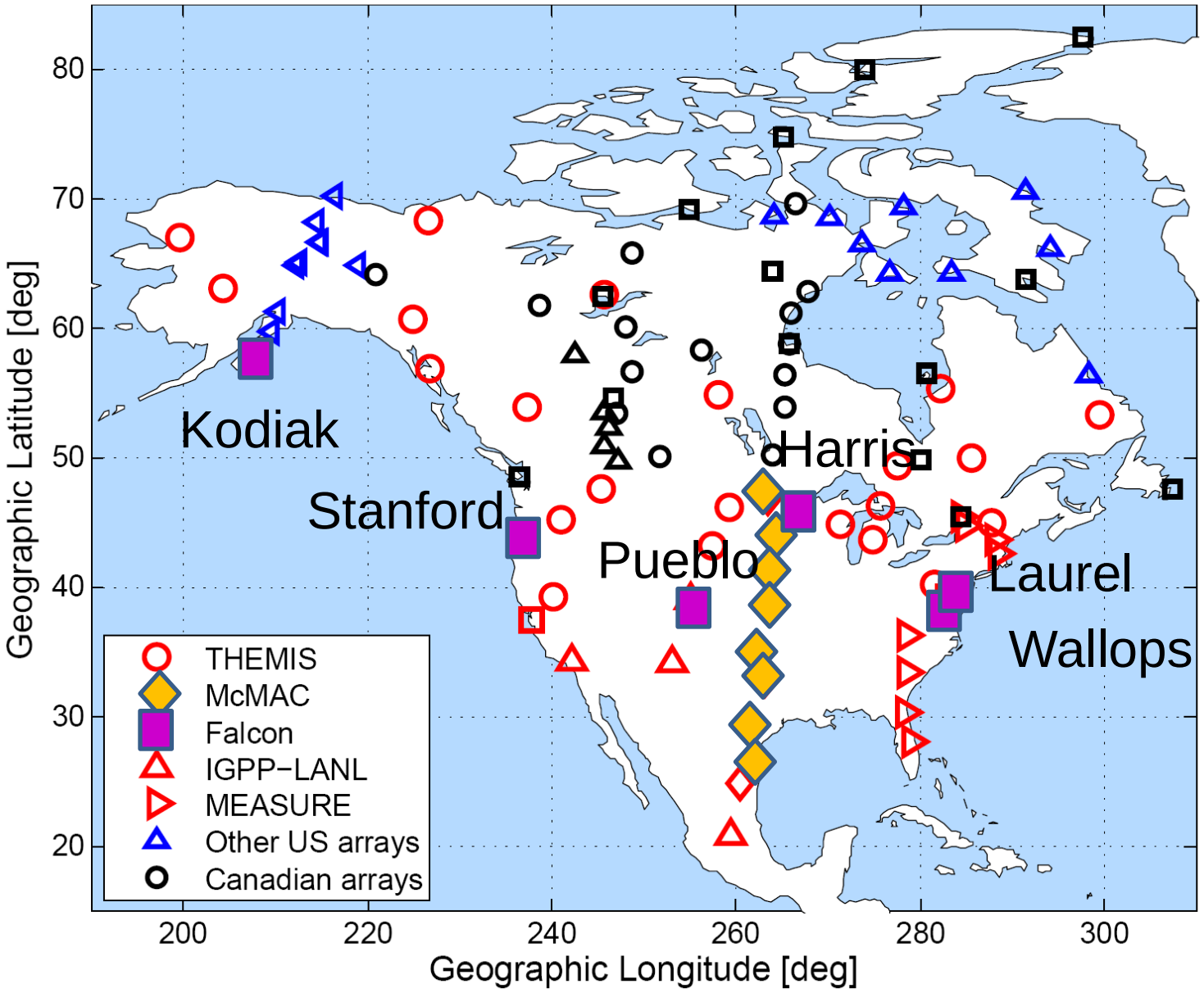
Peter Chi, The McMAC Team, and The Falcon Team

UCLA Institute of Geophysics and Planetary Physics

Joint GEM-ULTIMA Forum on Ground Magnetometers

December 4, 2011, San Francisco, California

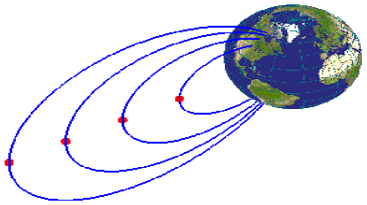
McMAC, Falcon w.r.t. other arrays in North America

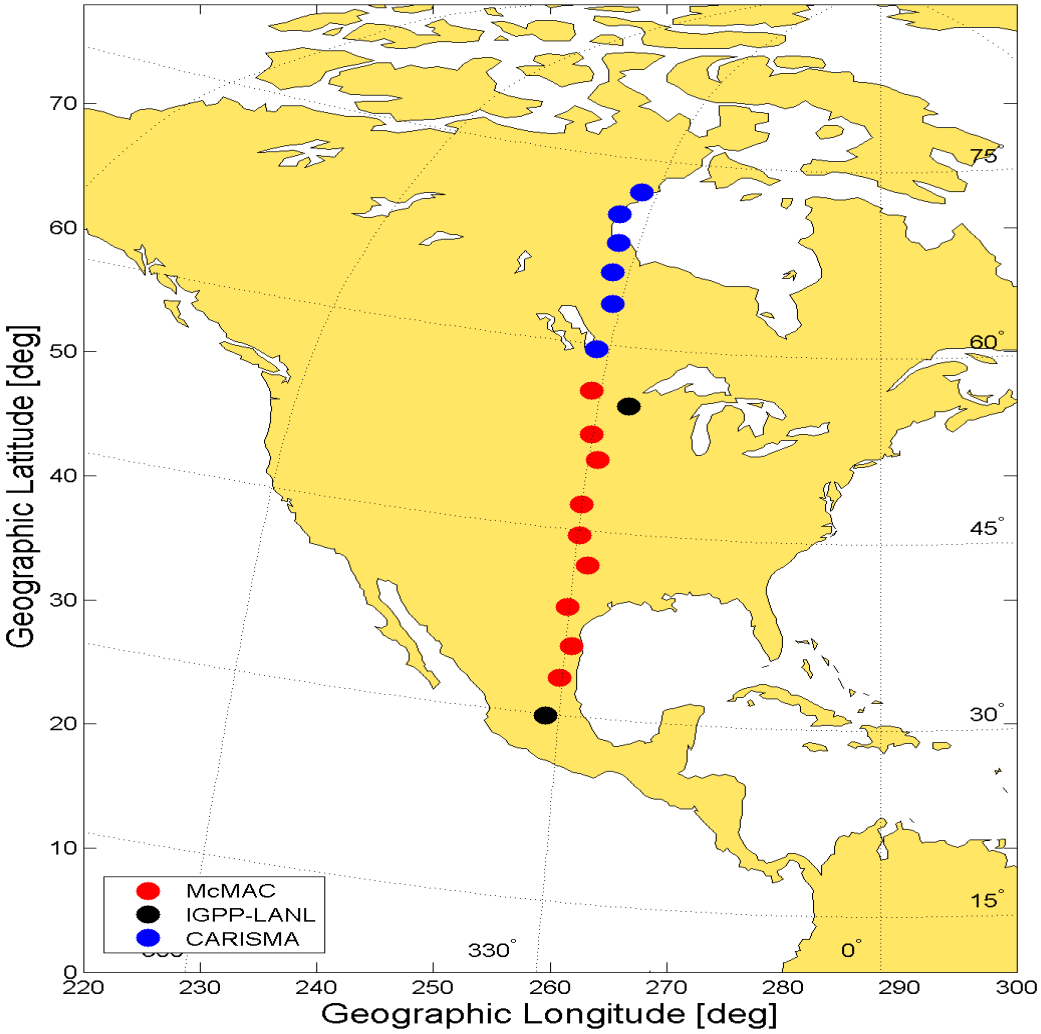


Updates on McMAC and Falcon Stations

- **McMAC**:
  - **Richardson** station (UT Dallas) has stopped operation in April 2011 due to the construction of a new football field. The plan is to move the magnetometer to a nearby location hosted by Polatomic.
  - We have discontinued the monitoring at the **Linares** station (in Mexico) due to the difficulty in operation and the lack of field line resonance signatures picked up from Linares.
- **Falcon**:
  - The **Wallops Island** (Virginia) magnetometer is set up in June 2011. The Wallops station and the Laurel station can form a pair for FLR observations.
  - The **Laurel** station now has Internet but is experiencing problems with GPS reception.

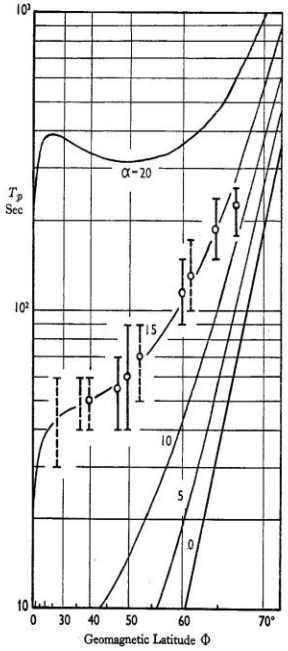
Mid-continent MAgnetoseismic Chain (McMAC)





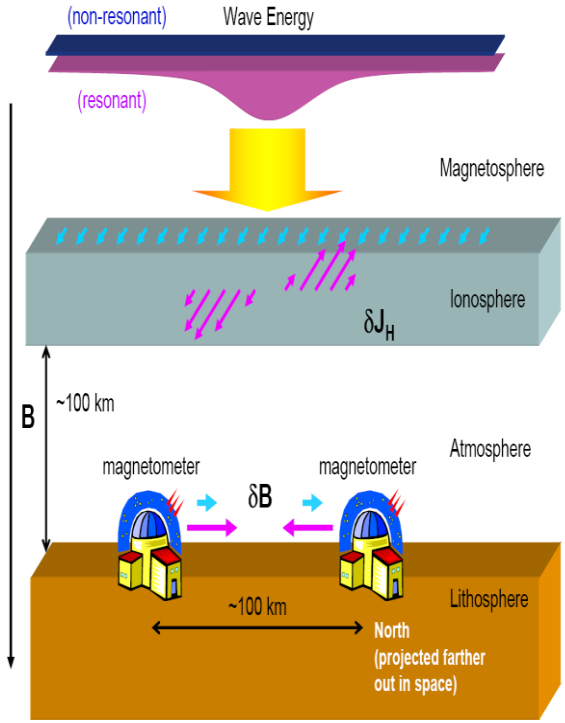
- The mean north-south separation between two adjacent McMAC stations is 275 Km.
- Joint operation with CANOPUS Churchill Line (Canada), IGPP-LANL (U.S.) and MAGDAS (Japan) provides the magnetic field data **from *L* = 1.2 to 11^{+} at one local time.**

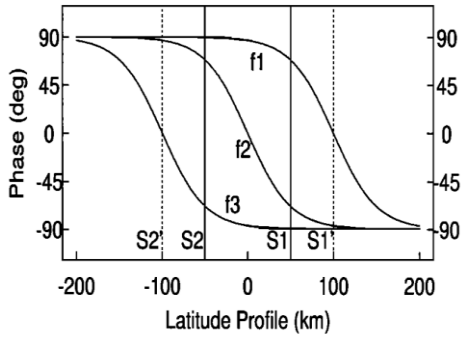
Field Line Resonance Sounding of the Magnetosphere by Ground Observations

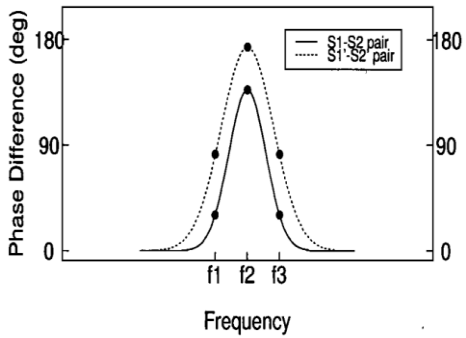


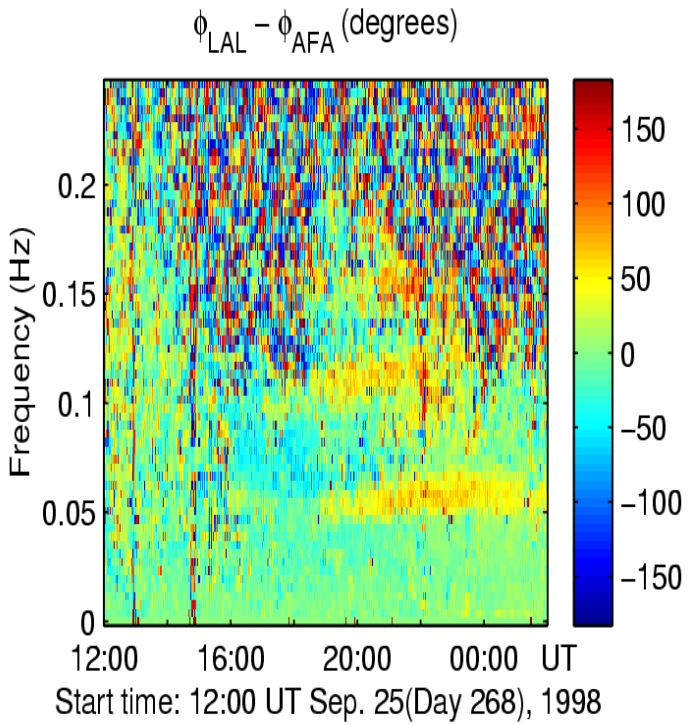
Obayashi &Jacobs [1958]

- Obayashi and Jacobs [1958] made the first known study using FLR to estimate plasma density in the exosphere.
- Baransky et al. [1985] developed the gradient method.
- FLR sounding studies by the Newcastle group in the early 1990s motivated other groups in the world to follow.







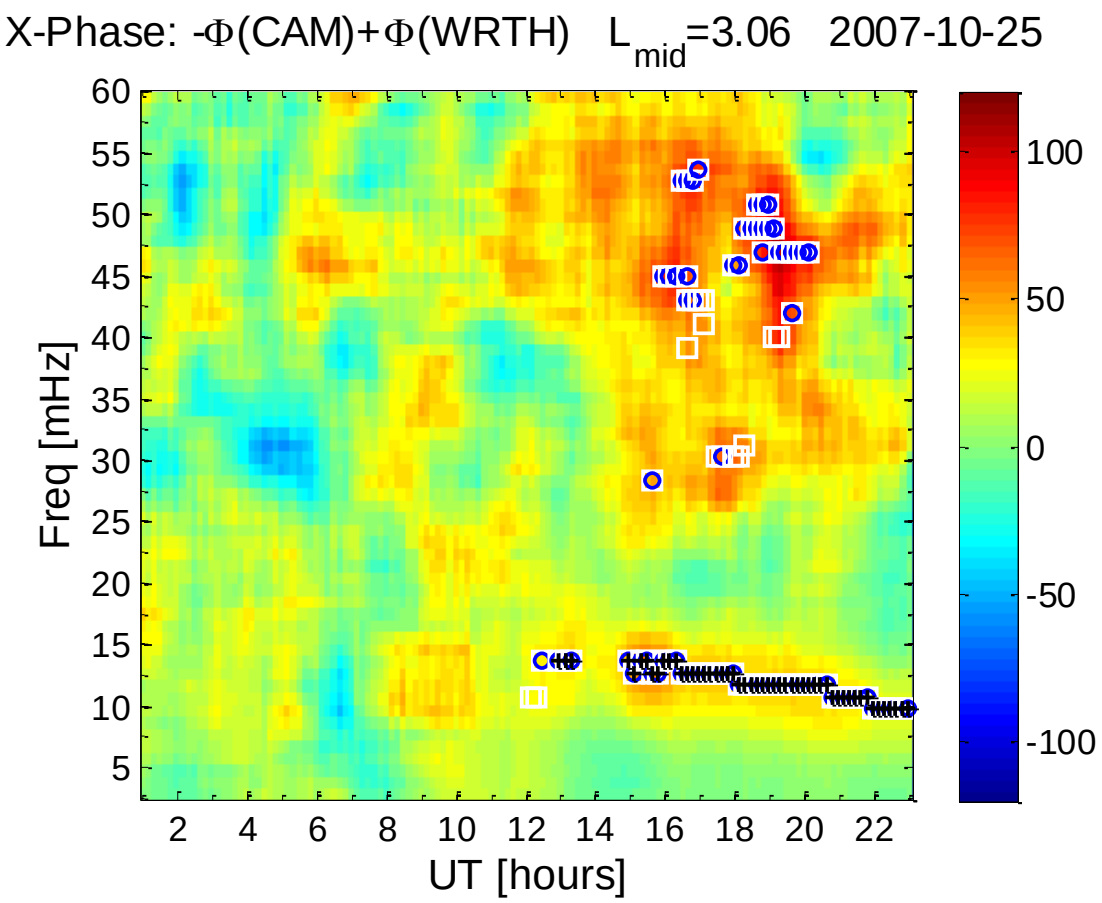


Background

- FLR sounding using the gradient technique (cross-phase and cross-power) has become a popular and important use of ground magnetometer data.
- It has been found that the gradient technique can work for low-latitude data for 80-90% of daytime [see, for example, Waters et al., 1994].
- An often asked question when planning coordinate studies with spacecraft data is the success rate of the gradient technique for different LT hours and latitudes.
- More studies are needed to answer this question.

Automatic Detection of FLR Frequencies

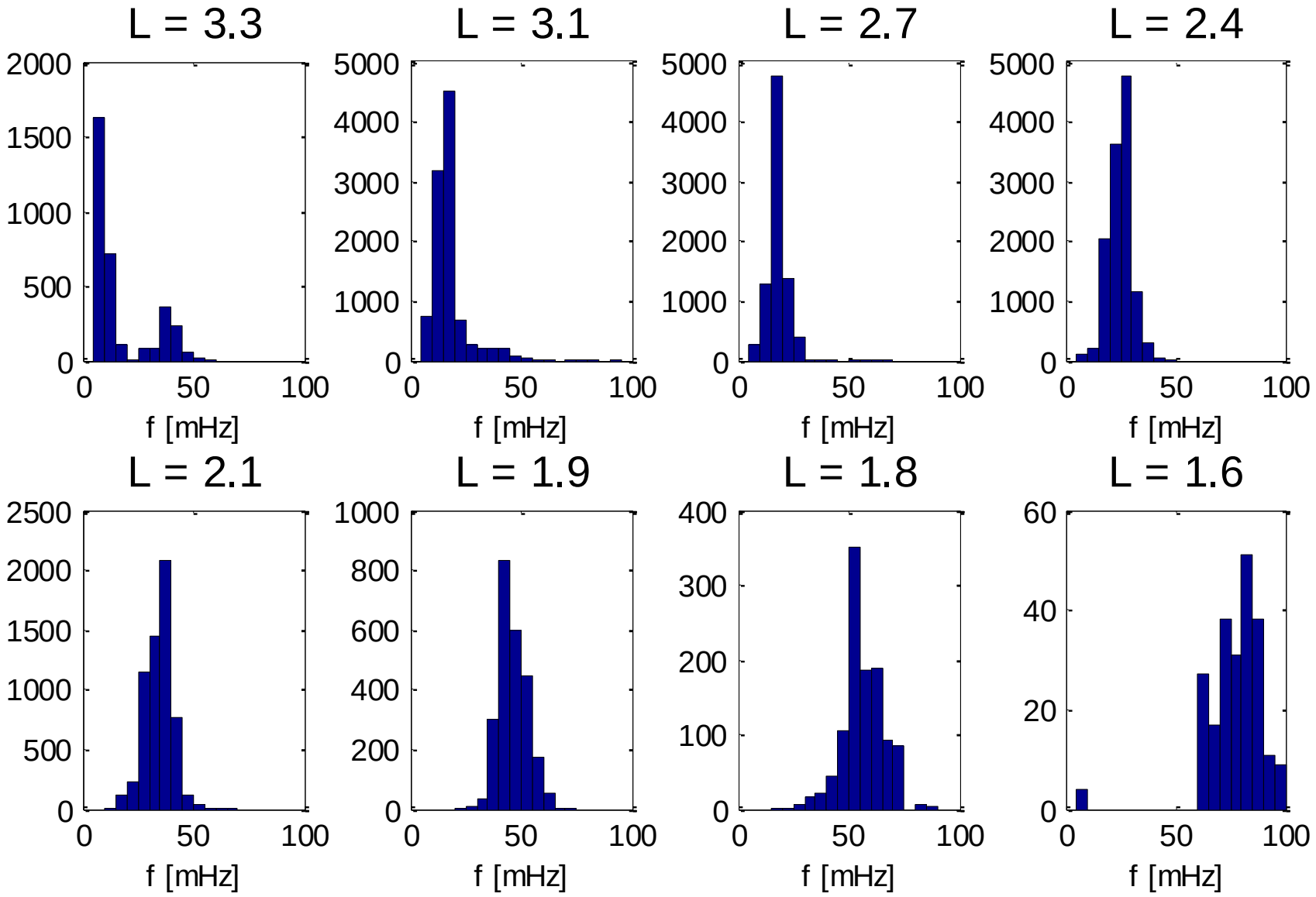
- In North America there are potentially more than 100 pairs of stations useful for gradient analysis (e.g. cross-phase); Picking FLR frequencies by visual inspection is too time-consuming
- Selection criteria:
  1. Peaks in cross phase
  2. Coherence
  3. *t*-statistic
  4. Positive slope in power ratio
  5. Remove isolated selections



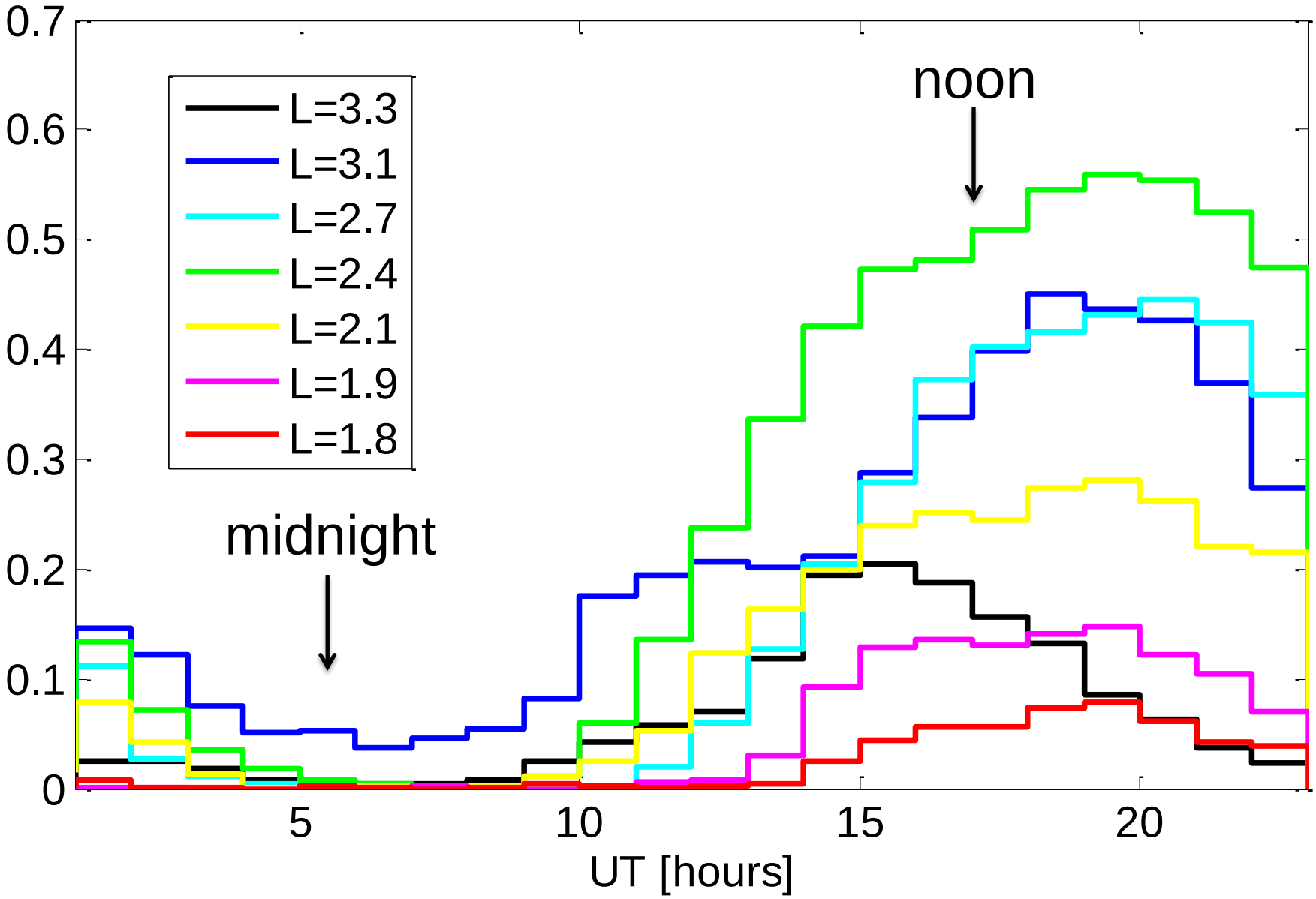
Data Set

- 4-s data (down-sampled from the 0.5-s data) from 10 McMAC stations (L = 1.3 – 3.4)
- July 2006 – June 2007

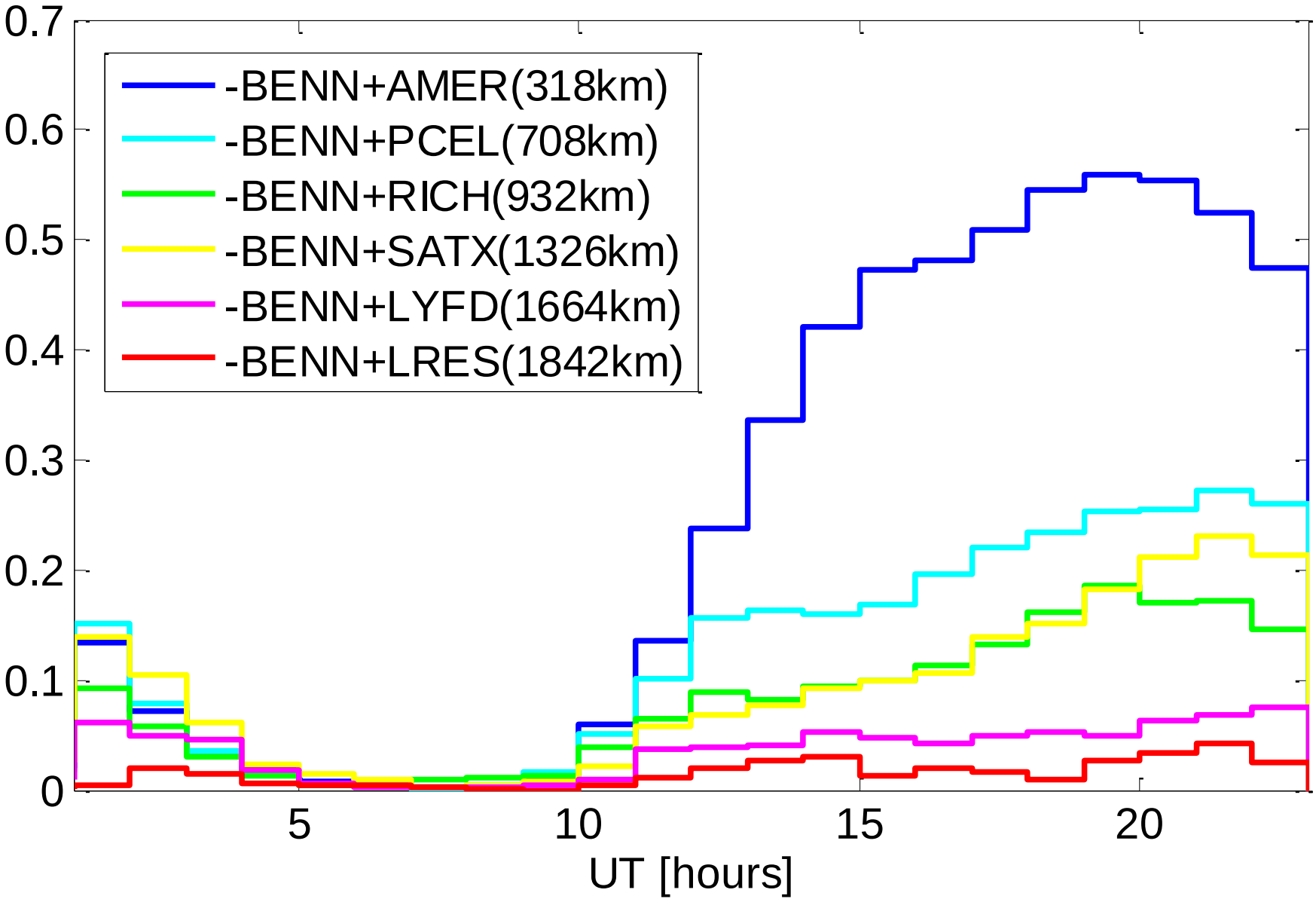
FLR frequency (n=1) vs. L



Occurrence Rate vs. Local Time



Occurrence vs. Separation



Summary

- With the automatic identification of FLR frequencies we can systematically investigate the properties of field line resonance observations.
- We find that the success rate of the gradient technique can exceed 50% near local time for L = 2.4.
- With similar separation between two stations the occurrence rate of FLR drops at both higher and lower latitudes for different reasons.
- We have found FLR signatures picked up by the gradient technique even when the separation between two stations exceeds 1000 km.