LTR at CCMC
LFM-MIX-TIEGCM -RCM

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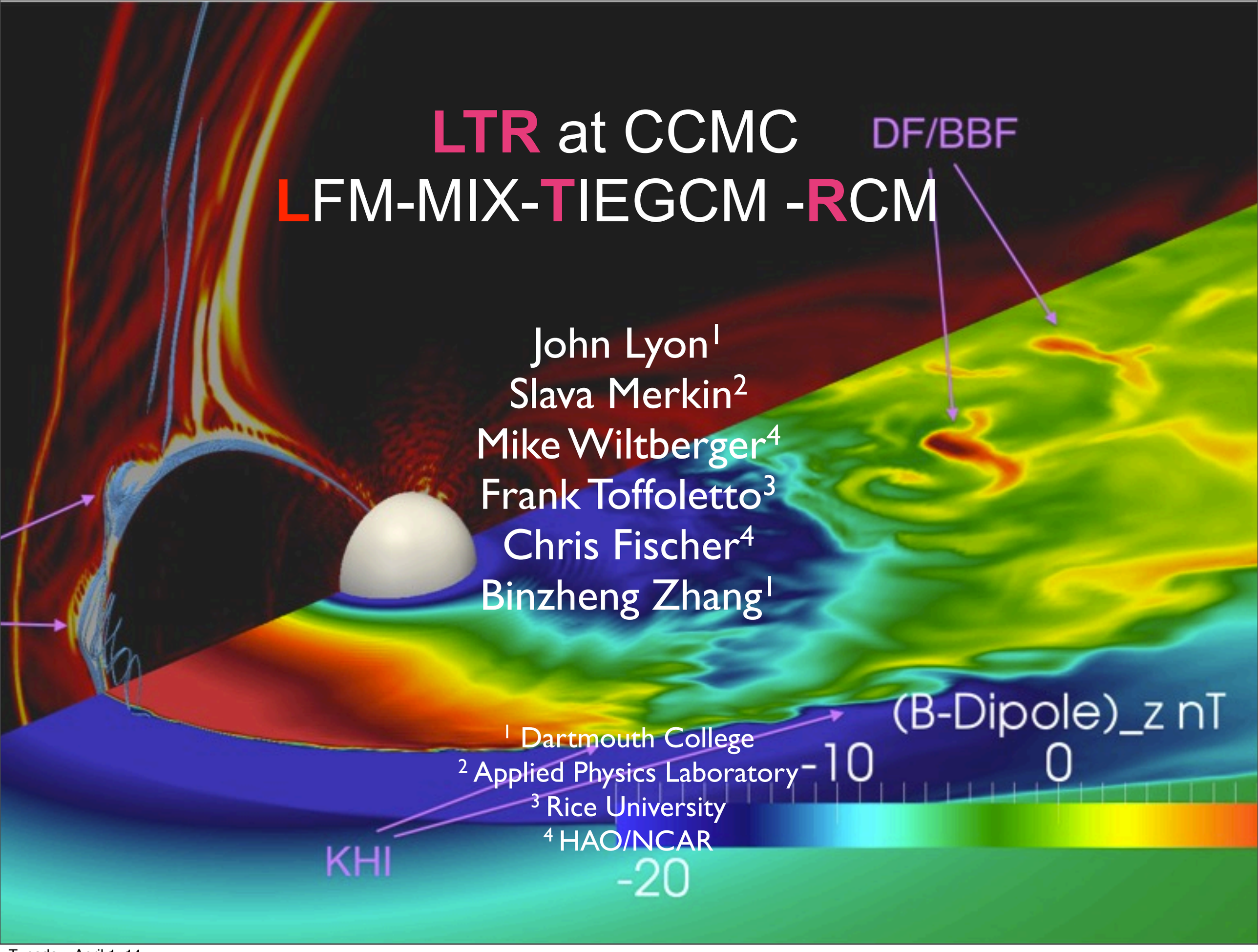
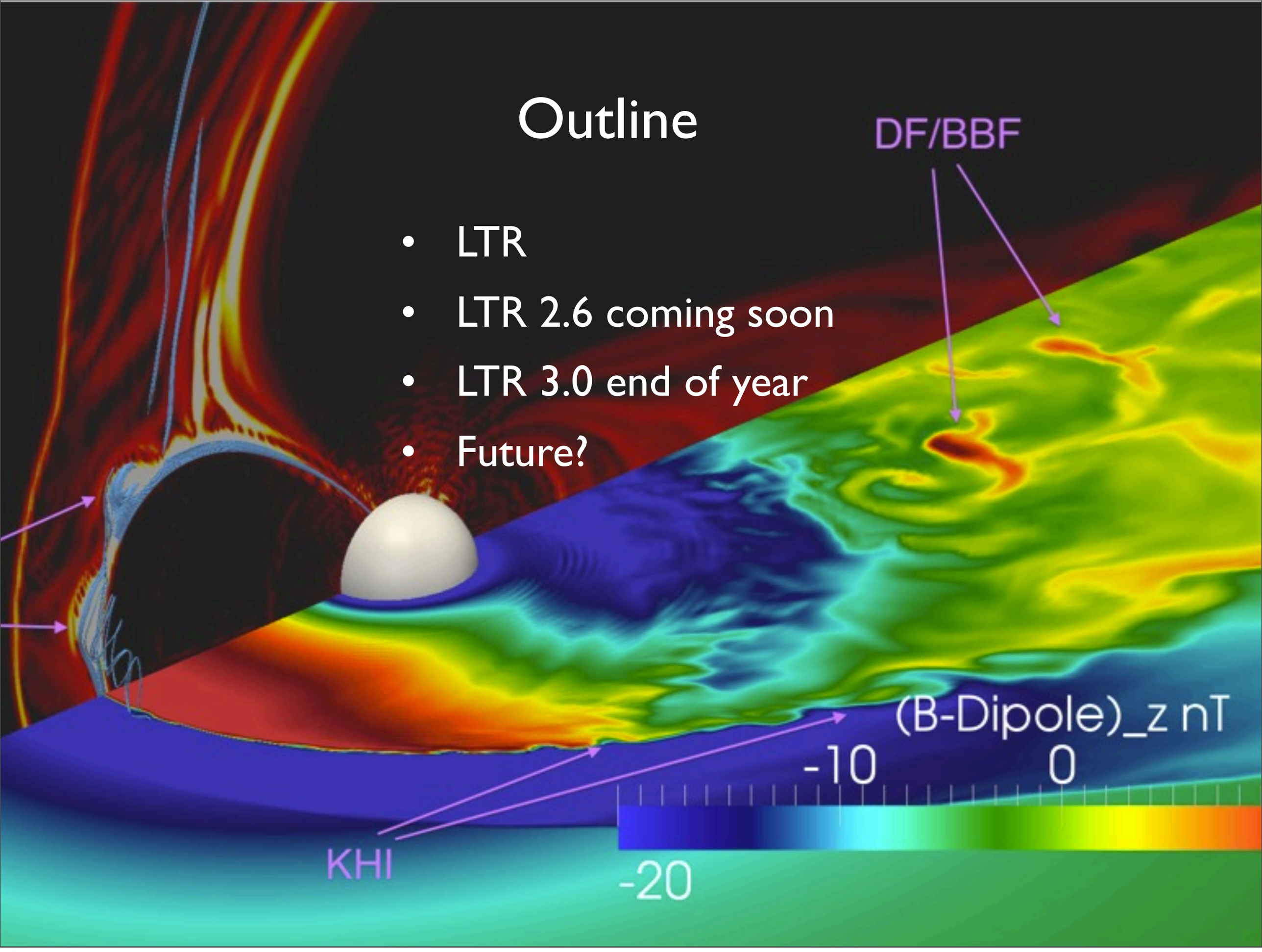


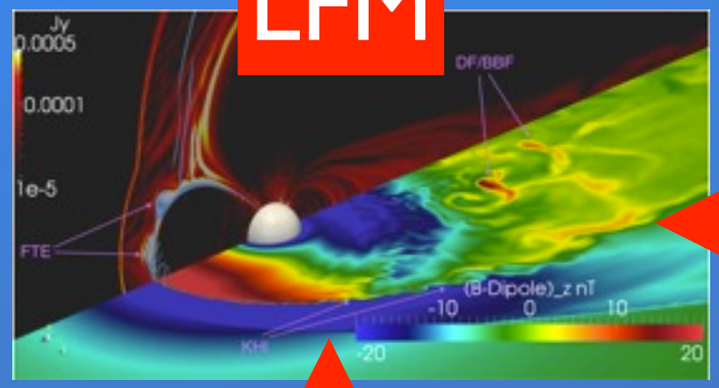
Outline

- LTR
- LTR 2.6 coming soon
- LTR 3.0 end of year
- Future?

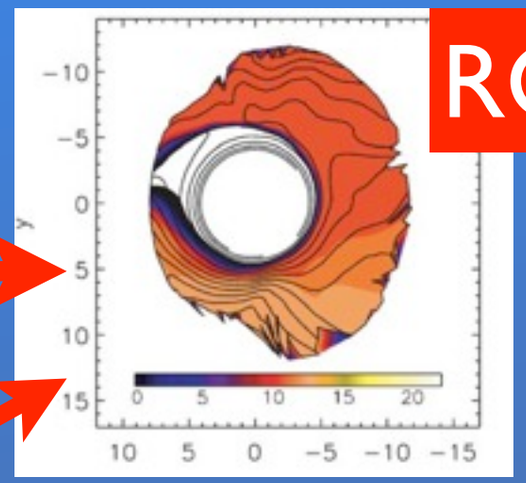


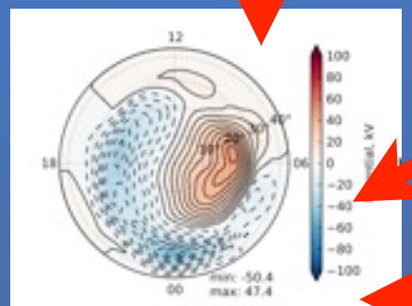
LTR

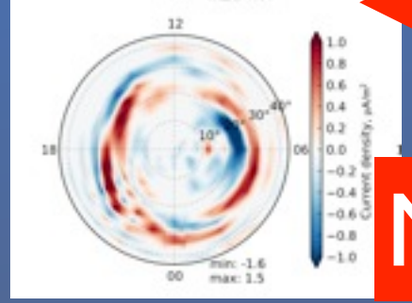
LFM



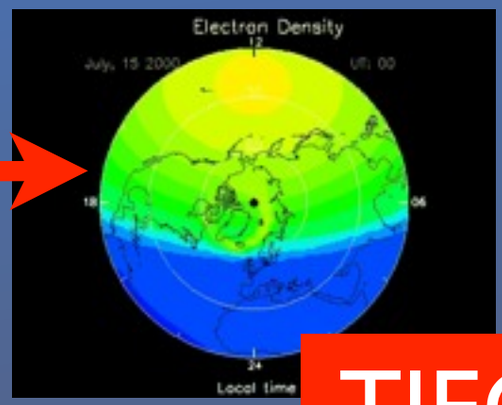
RCM





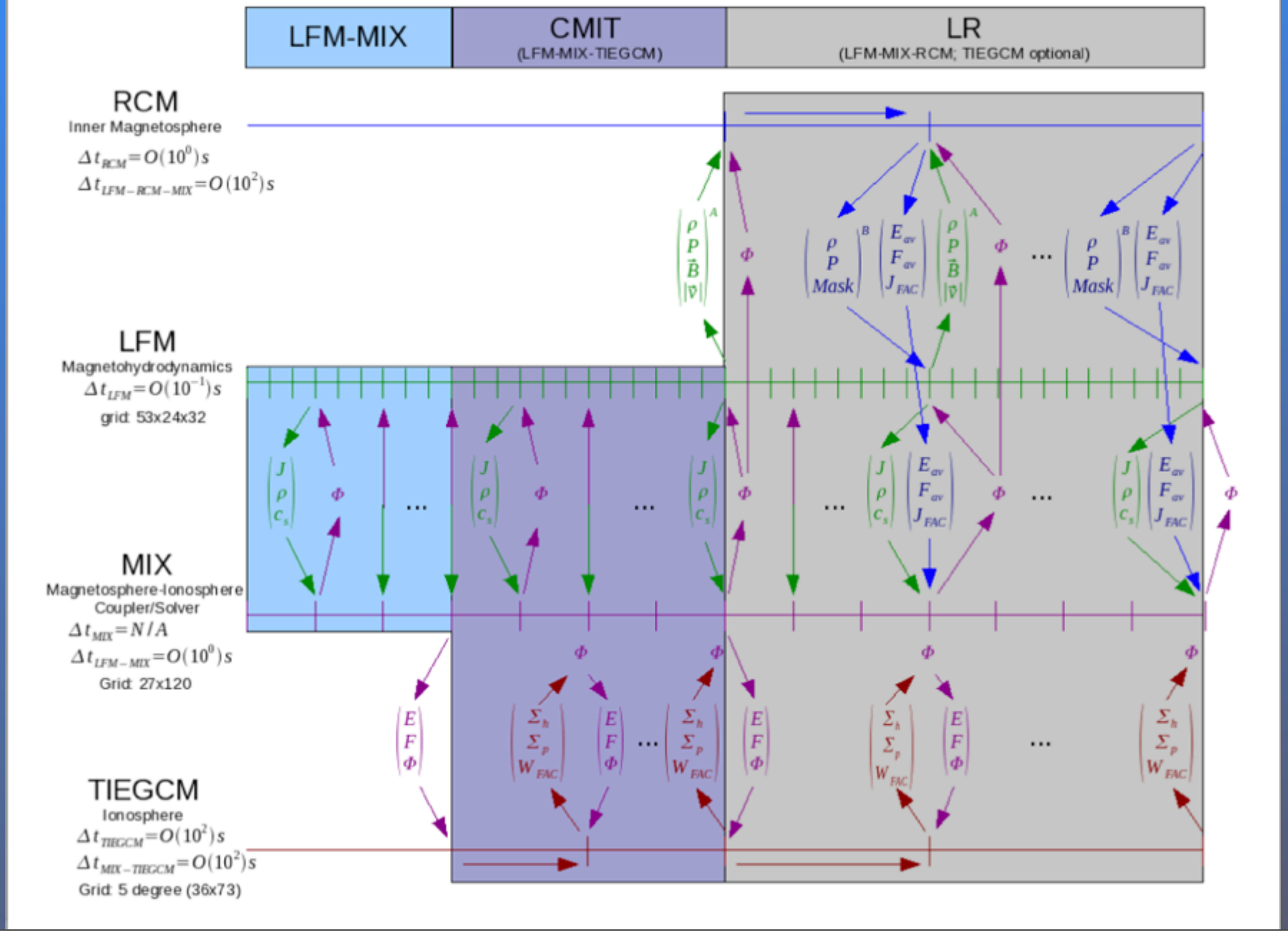


MIX



TIEGCM

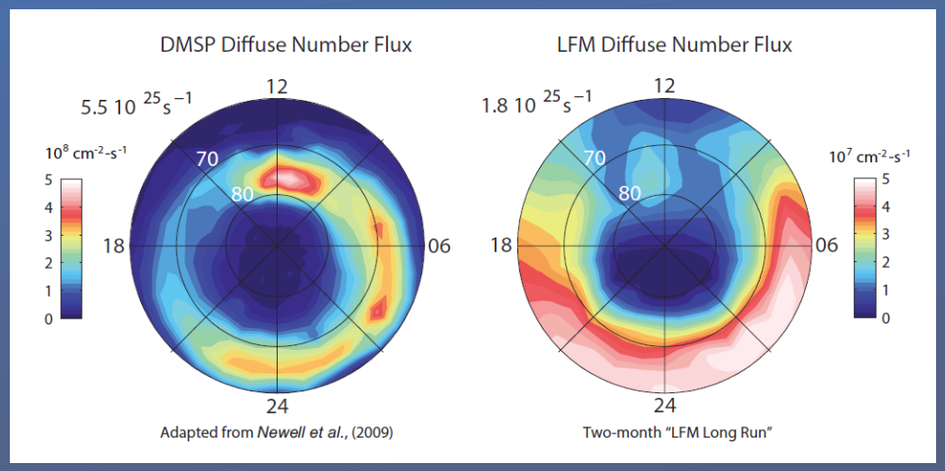
LTR


LFM-MIX
CMIT
(LFM-MIX-TIEGCM)
LR
(LFM-MIX-RCM; TIEGCM optional)
RCM
Inner Magnetosphere
$\Delta t_{RCM}=O(10^0)s$
$\Delta t_{LFM-RCM-MIX}=O(10^2)s$
LFM
Magnetohydrodynamics
$\Delta t_{LFM}=O(10^{-1})s$
grid: 53x24x32
MIX
Magnetosphere-Ionosphere
Coupler/Solver
$\Delta t_{MIX}=N/A$
$\Delta t_{LFM-MIX}=O(10^0)s$
Grid: 27x120
TIEGCM
Ionosphere
$\Delta t_{TIEGCM}=O(10^2)s$
$\Delta t_{MIX-TIEGCM}=O(10^2)s$
Grid: 5 degree (36x73)

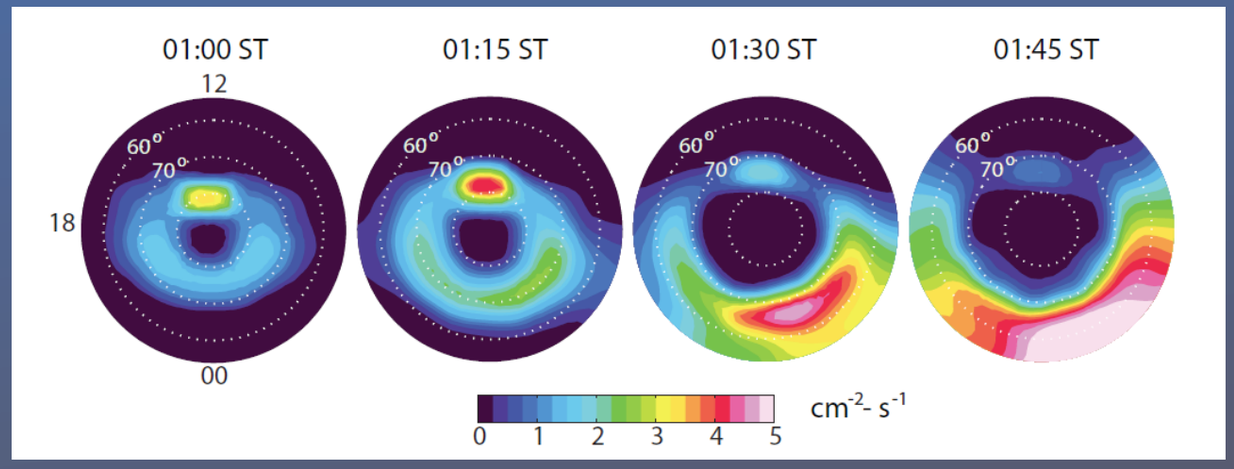
LTR 2.6

- Major change is new ionospheric conductance model in MIX
- Current model is somewhat improved version of Joel Fedder's model from the 90's
- Problems at low latitude and over time with thie model
  - partially due to low resolution/diffusion at inner boundary
  - partially to assumption of filled loss cone

DMSP – LFM comparison

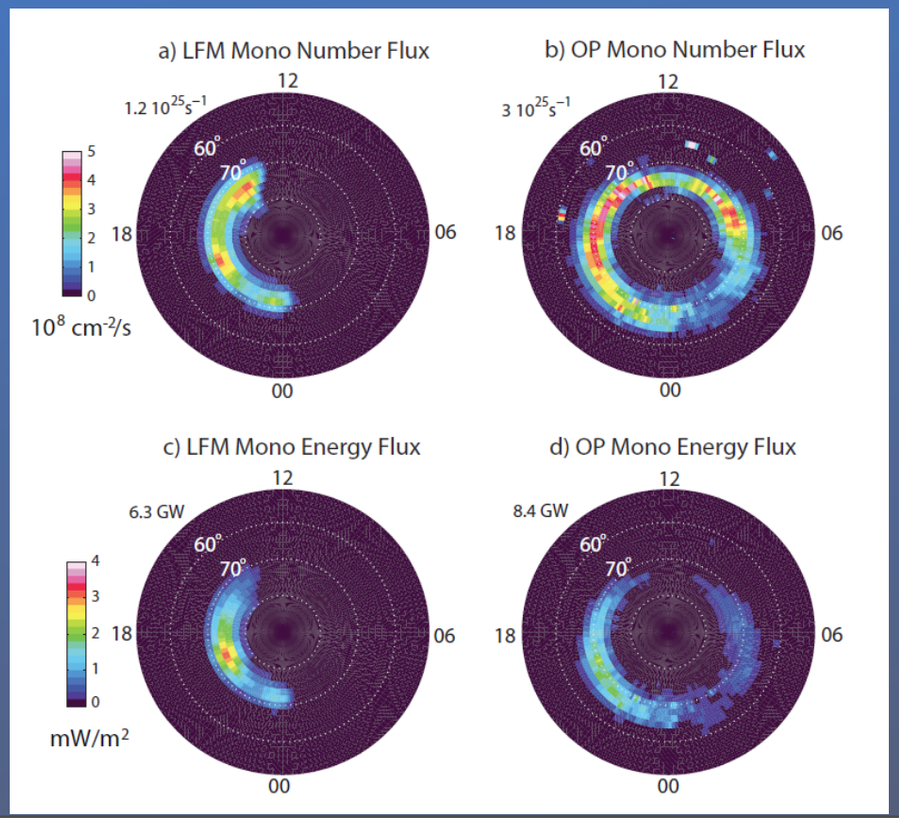


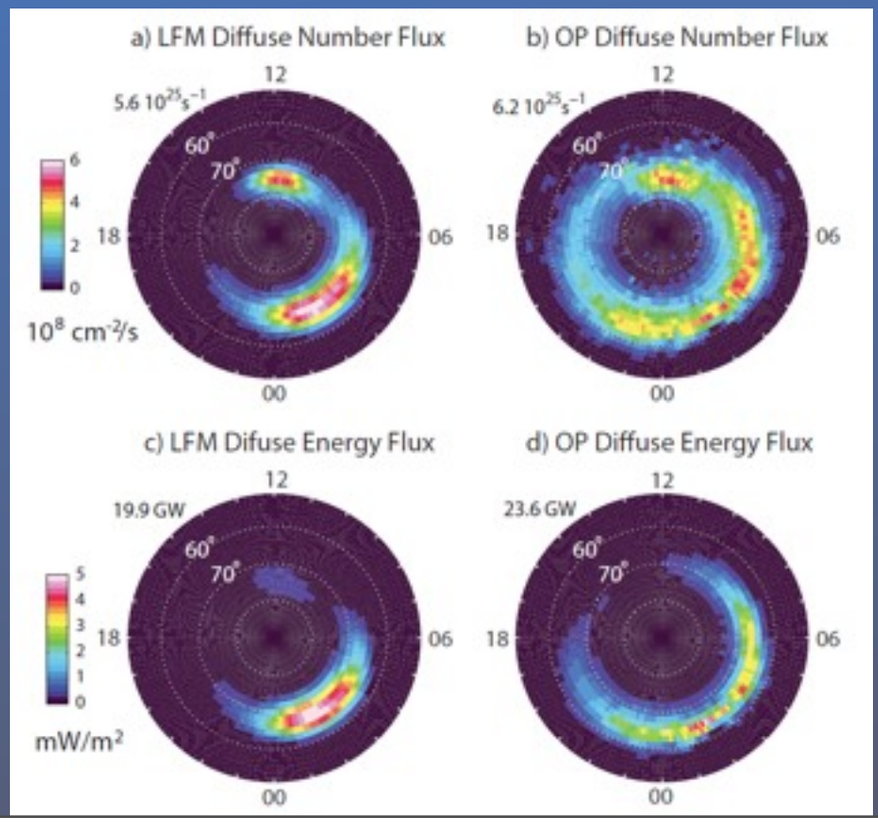
LFM Test Simulation – time evolution



New Model

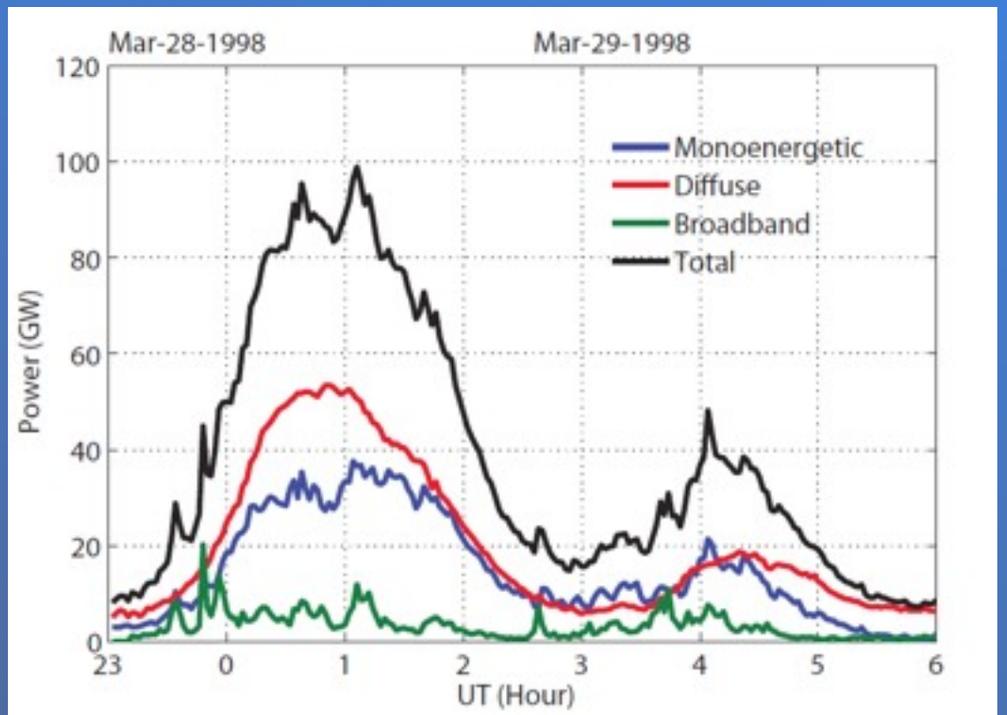
- Developed by BinZheng Zhang
- Includes:
  - **Monoenergetic –** Use a new current-voltage relation in stead of the Knight Relation to model ***V***
  - **Diffuse –** Introduce the diffuse precipitation boundary (DPB) to model the loss cone filling factor
  - **Cusp –** Identify the cusp region
  - **Broadband –** Use AC Poynting flux and empirical relations derived from observations

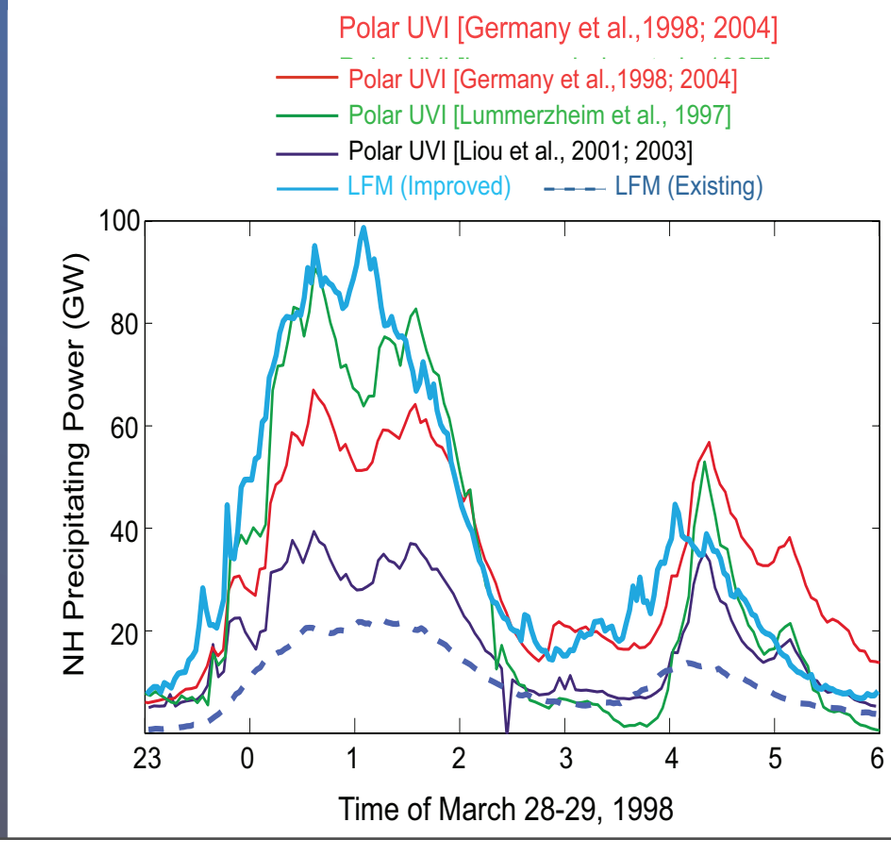




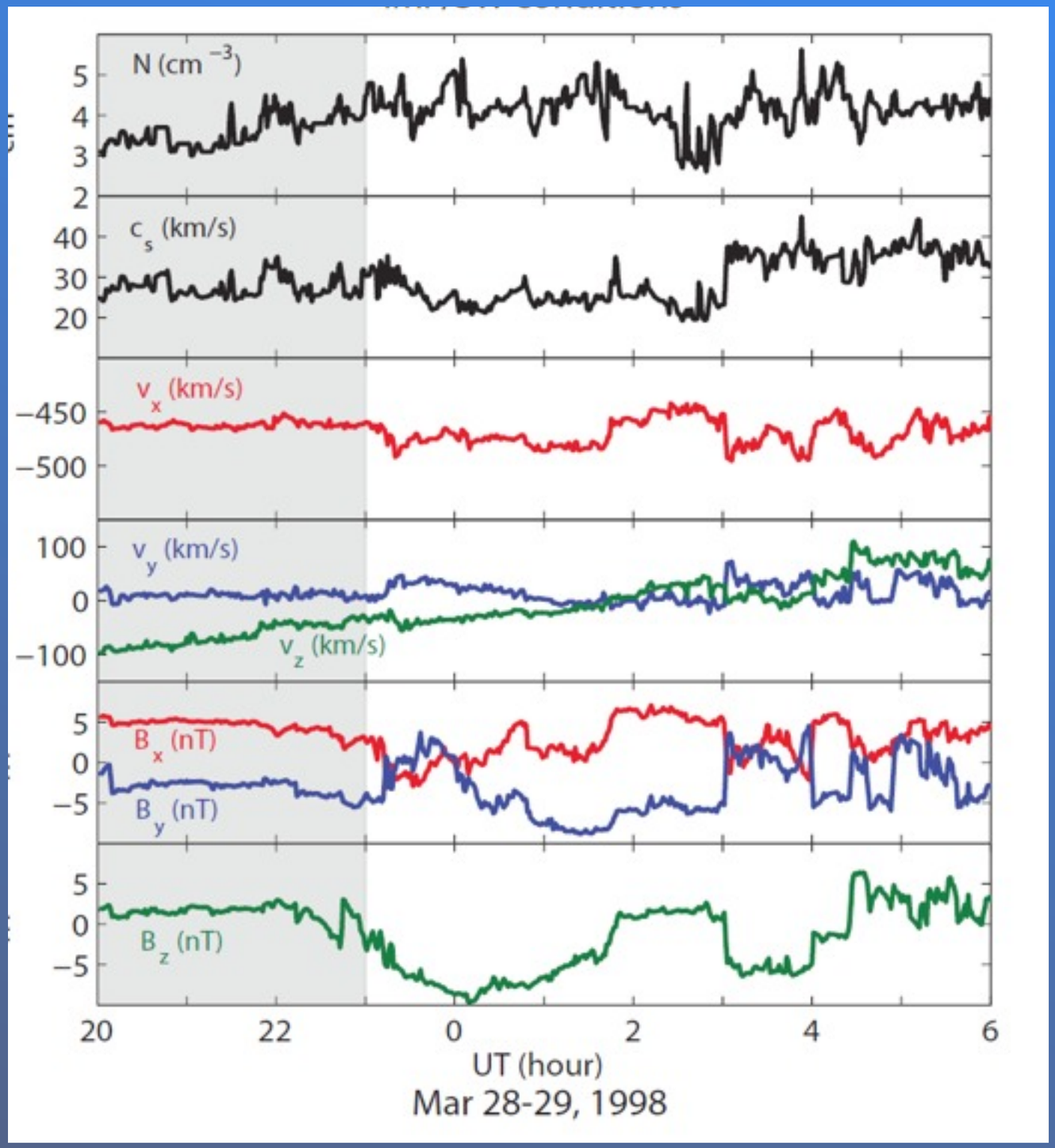
Comparison with Observations (28-29 Mar 1998 Event)

Simulated Electron Precipitation Fluxes





SW/IMF Conditions



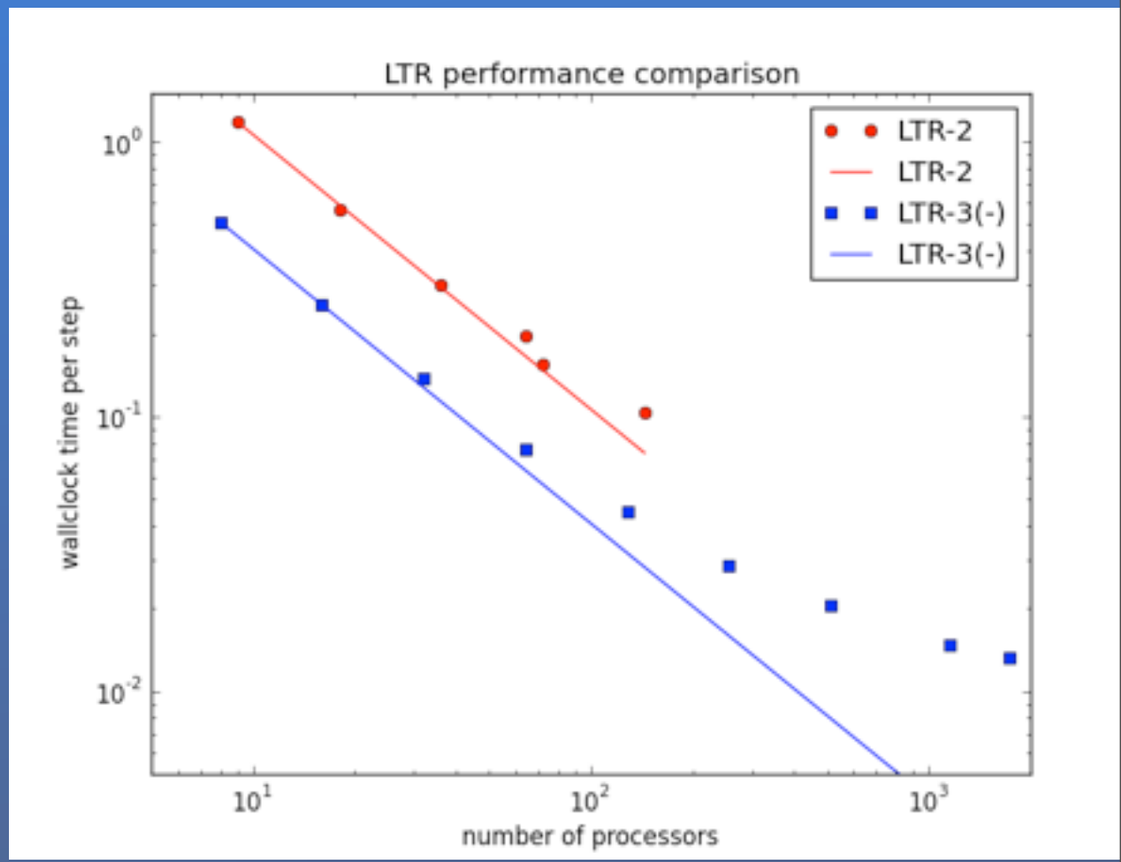
LTR 3.0

- Algorithmic Improvements
- RCM ready for use
- TIEGCM at improved resolution - 2.5°

  see Stan Solomon's talk

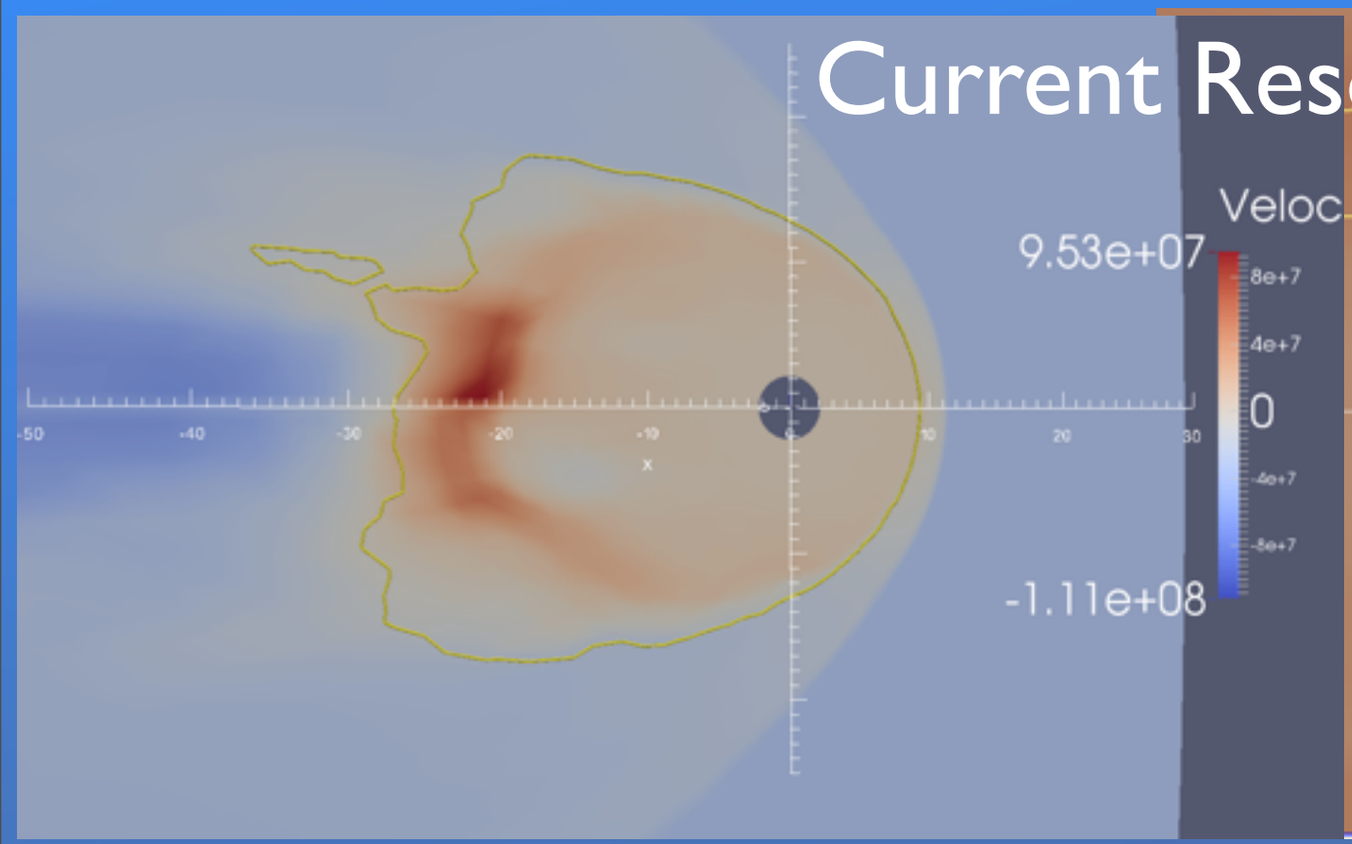
LTR 3.0

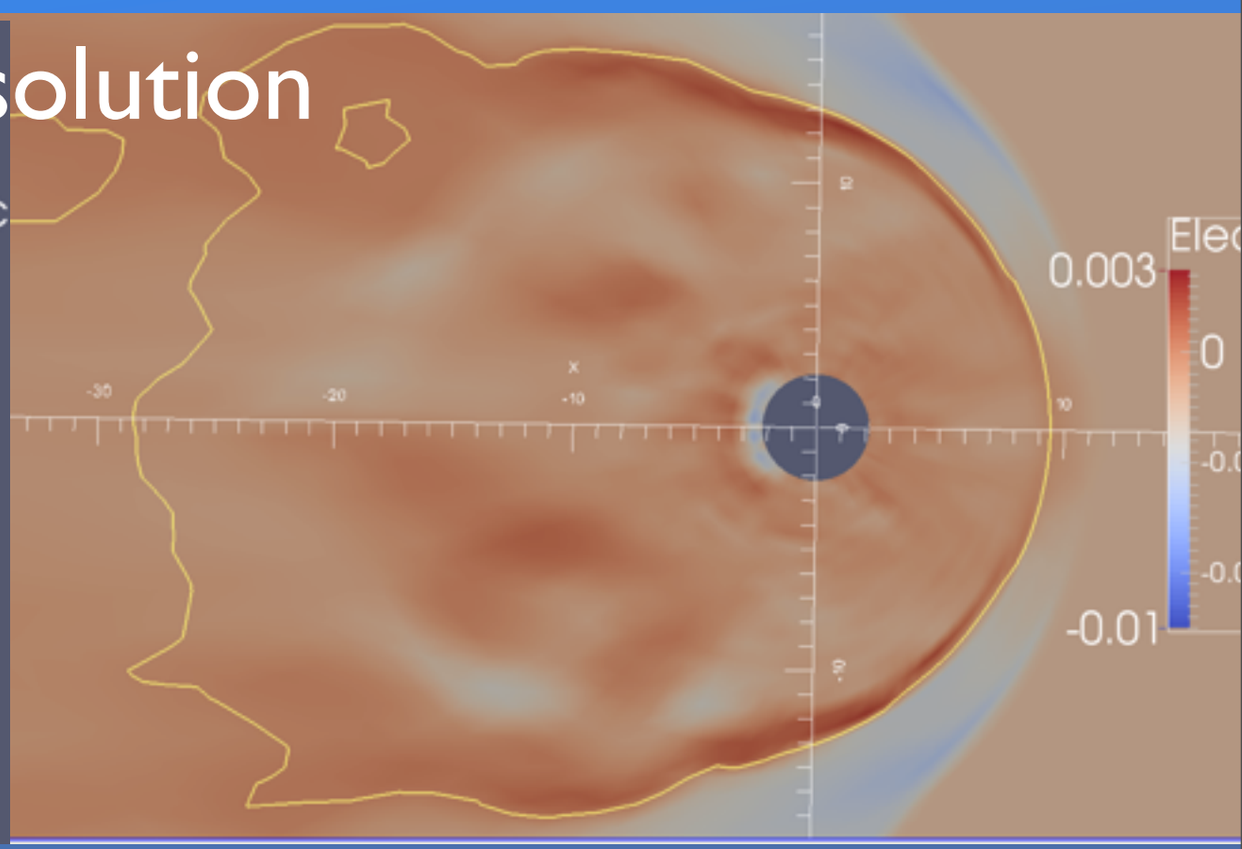
- Algorithmic improvements:
  - Improved computational kernel
    - ➡ 2.5 times faster
  - Processor count and resolution defined at runtime
  - Can work with any computationally hexahedral grid:
    - LFM, LFM-helio, LFMBOX, LFM-dipole
      - ➡ every grid needs specialized boundary routines
  - Communications still an issue



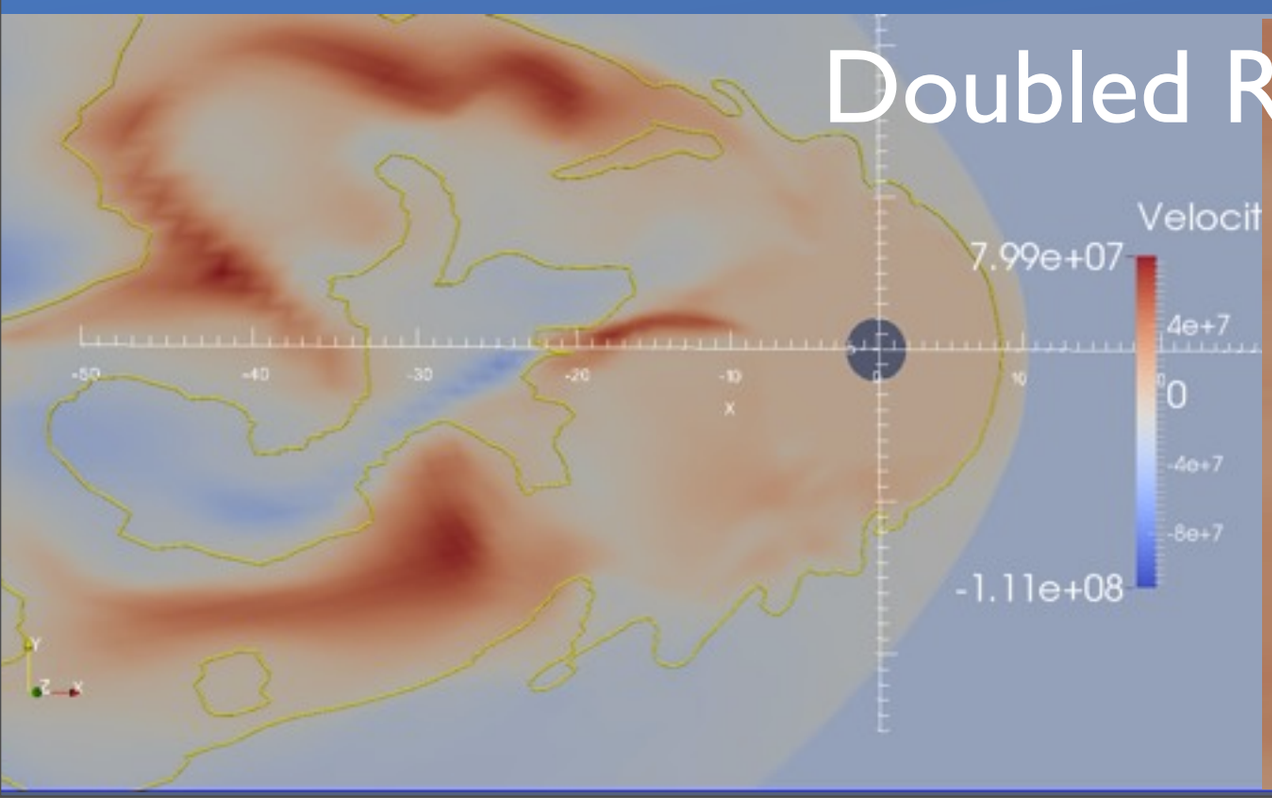
Should allow improved resolution at CCMC

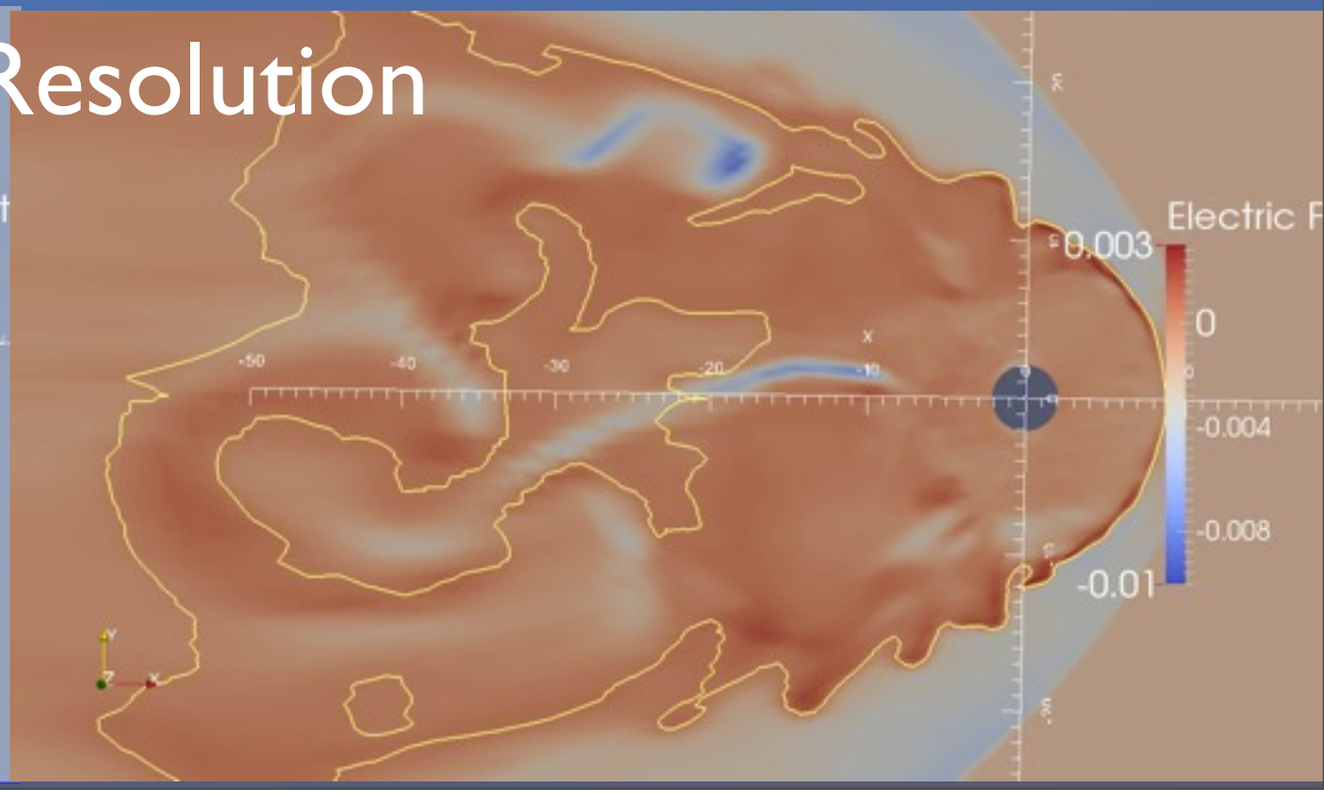
Current Resolution





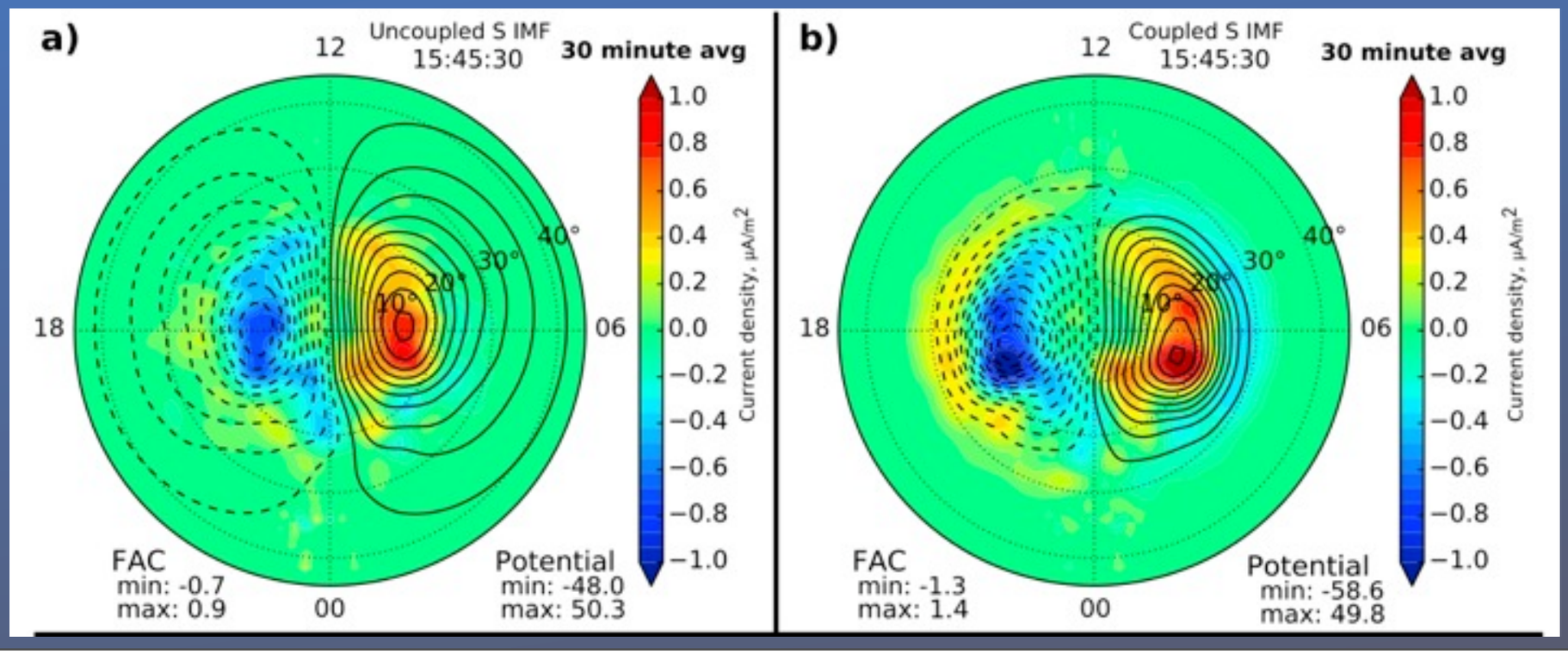
Doubled Resolution

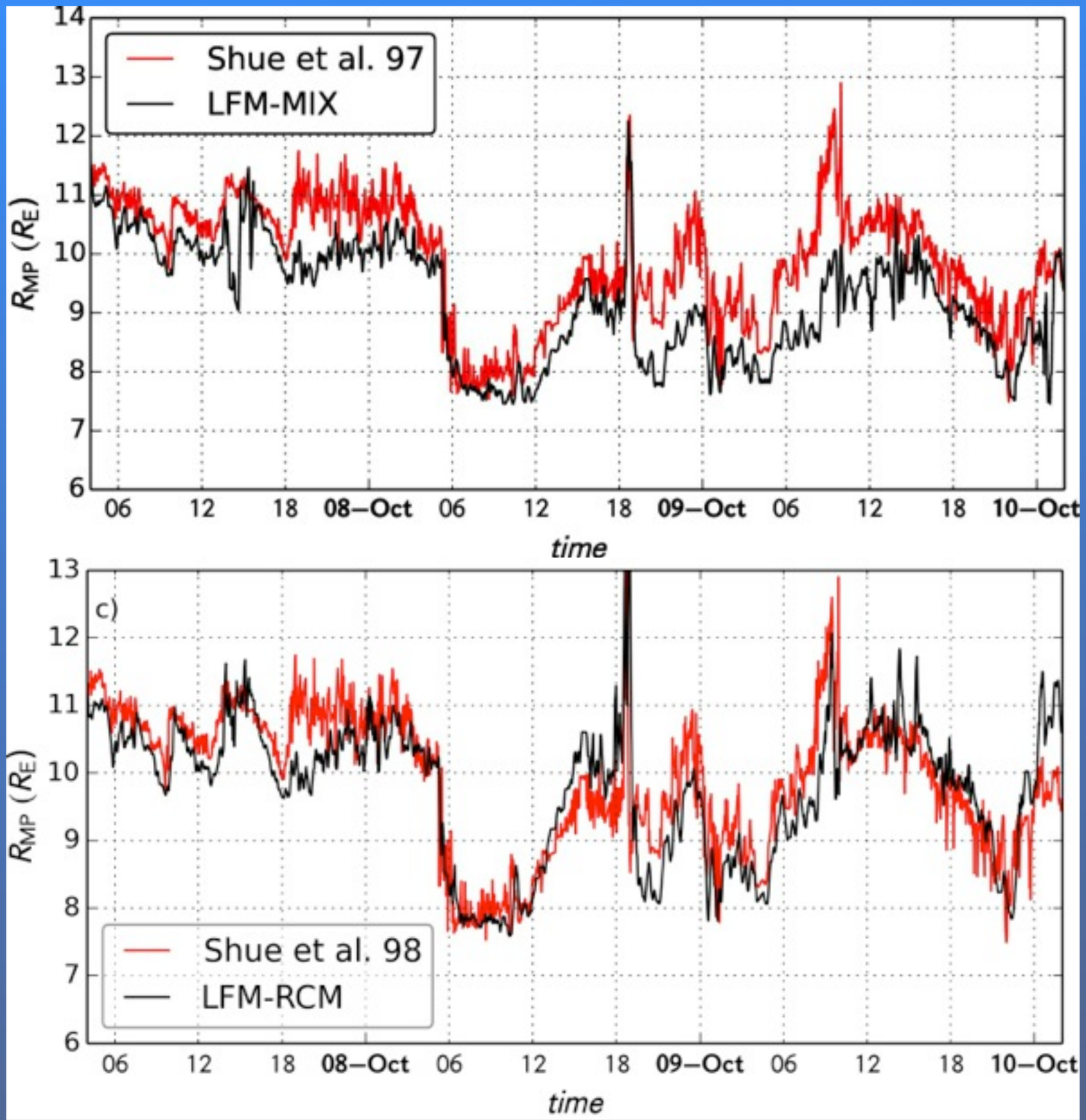




LTR 3

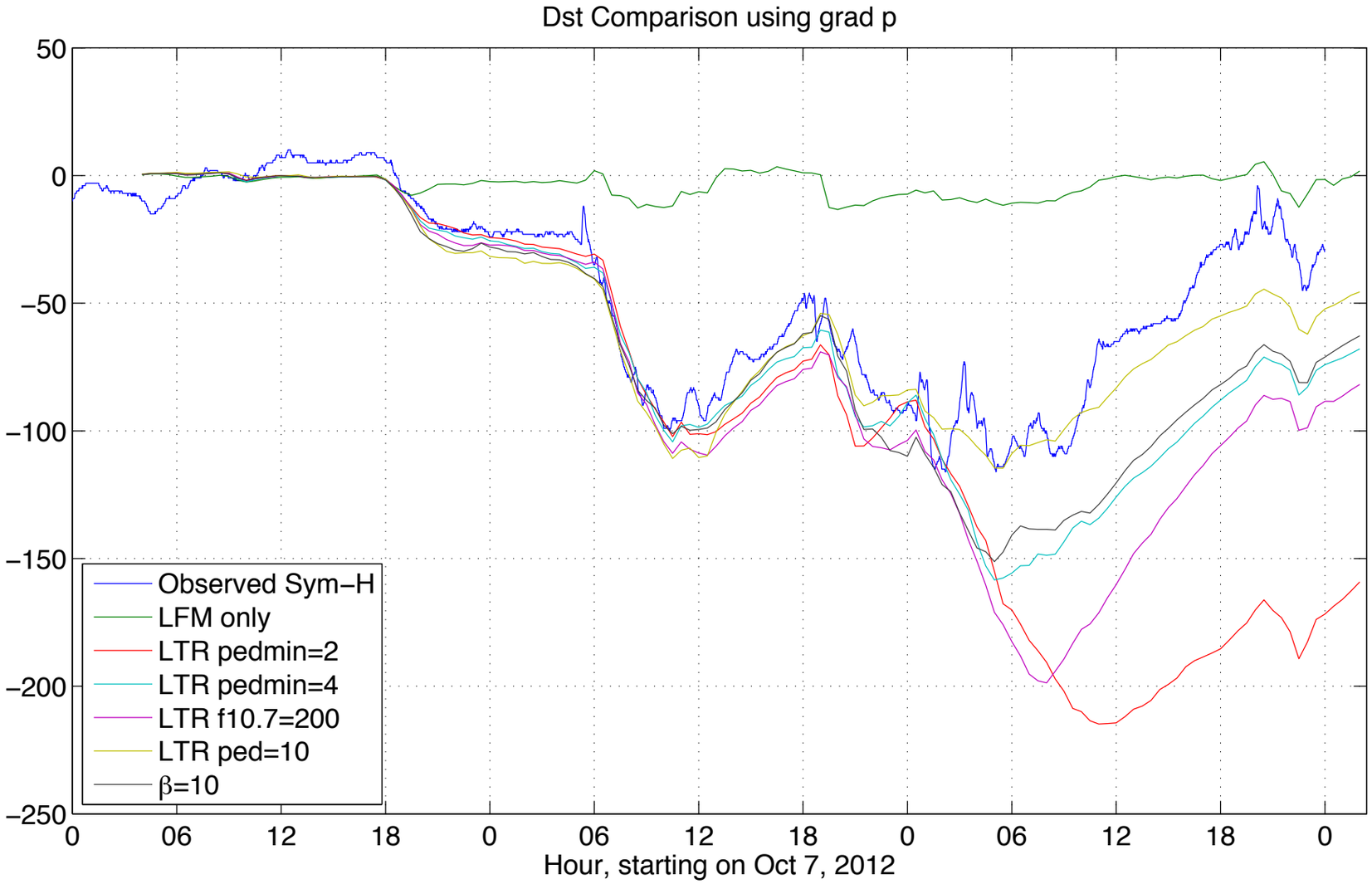
- Rice Convection Model (RCM)
  - Has been included in LTR 2 but not turned on at CCMC
    - Will turn on for LTR 3
  - Can handle dipole tilt, non constant solar wind conditions
  - Currently undergoing resolution testing
  - Greatly improves inner magnetospheric shielding, R2 currents





- greatly improved magnetopause position due to inflation of inner magnetosphere
- much richer and better (?) ULF spectra from presence of plasmasphere

Dst comparison with and without RCM



- Lack of ring current for standalone LFM-MIX
- relatively low resolution calculation, currently testing at higher resolution
- Note dependence on conductance model
  - 10 Siemens constant Pedersen is “special”

Future of LTR at CCMC (LTR 3.X)

- Transition of developments to CCMC will slow
  - lack of resources for general development
    - have a couple of projects ongoing, but lean heavily on infrastructure developed when climate was more favorable (e.g., CISM)
  - lack of resources to specifically transition to CCMC
  - too many knobs - e.g., multi-fluid
- What may show up at CCMC following LTR 3.0 (3.1,2,3, ∞)
  - improved communications
  - realistic plasmasphere (two hydrogen fluids)
  - fully electrodynamic M-I coupling
- Code Development: R2O
  - idea, coding, testing, validation, refinement and hardening
  - research codes rarely get beyond testing and validation, why?
    - there's always a good new idea
    - proposal pressure creates a lot of proof-of-principle calculations that get cast in stone.
    - people time is more important than computer time
      - efficiency and simplicity are not prime concerns:
        - "make it work"
        - "if it aint broke ..."
        - examples: hybrid computation model (OpenMP, MPI), overlapped computation and communication