ULF wave modeling, effects and applications (UMEA)

GEM Focus Group 2016-2020

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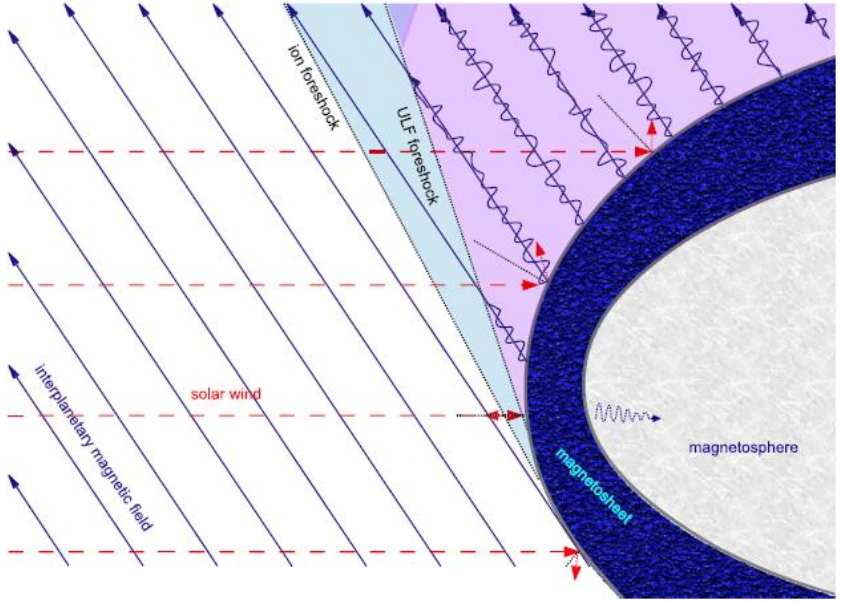
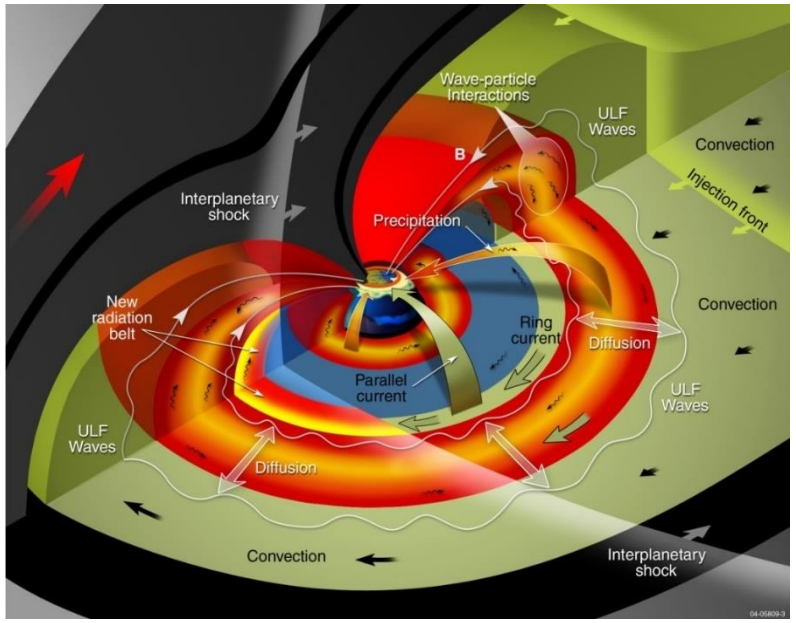
Introducing the UMEA focus group: ULF wave modeling, effects, and applications

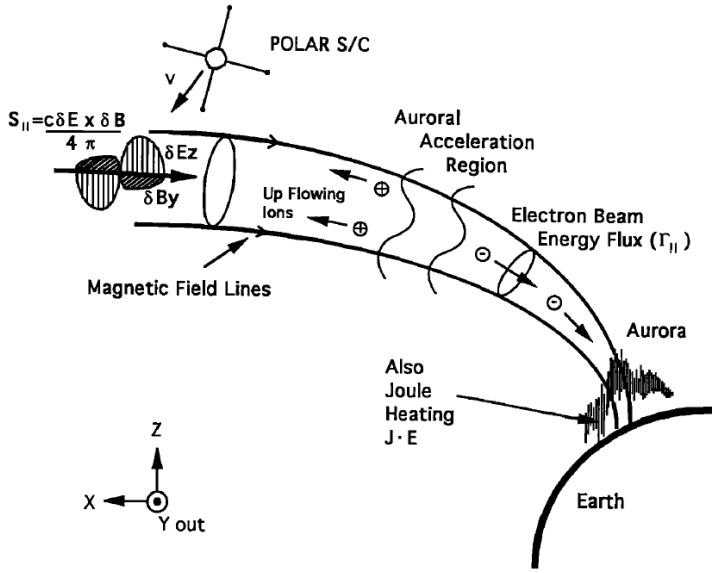
- ULF wave research spans many different research areas and focus groups



[Nakariakov et al., 2016]



[Mauk et al., 2012]



[Wygant et al., 2000]

Introducing the UMEA focus group: ULF wave modeling, effects, and applications

- ULF wave research spans many different research areas and focus groups
- UMEA aims to bring researchers in different areas together to address these questions:
  - What excites ULF waves?
  - How do ULF waves couple to the plasmasphere/ring current/radiation belts?
  - What is the role of ULF waves in magnetosphere-ionosphere coupling?
- This is an ideal time for such an effort: unprecedented availability of multi-point in situ and ground-based observations, high quality measurements of electric/magnetic fields and particles, and improved modeling capabilities

2016 GEM meeting overview

Four sessions:

- Introducing UMEA
- Magnetospheric Signatures of Dayside Transients: Joint session with Dayside Transients and Dayside Kinetics:
- ULF wave modeling: Joint session with Modeling Methods and Validation
- ULF waves and nonlocal transport: Joint session with QARBM

Full UMEA report from GEM available at UMEA GEM wiki: http://aten.igpp.ucla.edu/gemwiki/index.php/FG:_ULF_Wave_Modeling%2C_Effects%2C_and_Applications

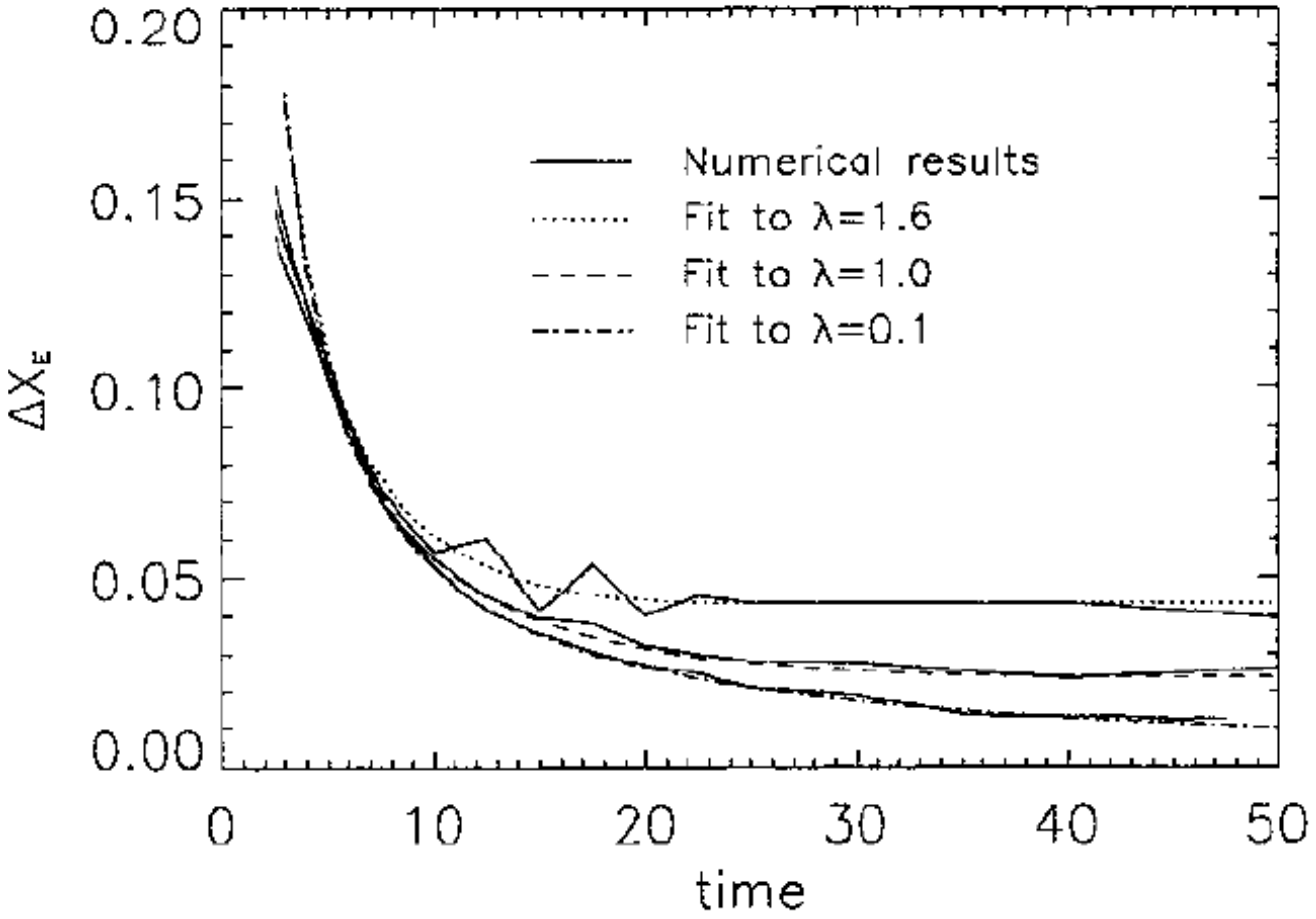
Planning based on 2016 GEM meeting

- Continue CCMC ULF wave modeling challenge for global MHD simulations: ionospheric conductivity, conductivity variations, plasmasphere, inner boundary
- Incorporate other ULF wave models: non-MHD effects, wave-particle interactions, ULF modulation of other wave modes, localized magnetopause disturbance
- Coordinate ground-based and in situ observations of ULF waves: conjunctions, instrument modes relevant to ULF waves, campaigns
- Compare observations to models/simulations: event studies, statistical analysis

Current UMEA/MMV initiative: CCMC ULF wave modeling challenge

- Work with MMV FG and CCMC to continue ULF wave modeling challenge (Lutz Rastaetter presents overview in this session)
- Next step: use same ionospheric conductivity profiles in each simulation code
- Potential future steps: effect of including plasmasphere, inner BC, event studies relevant to UMEA and other FG,…

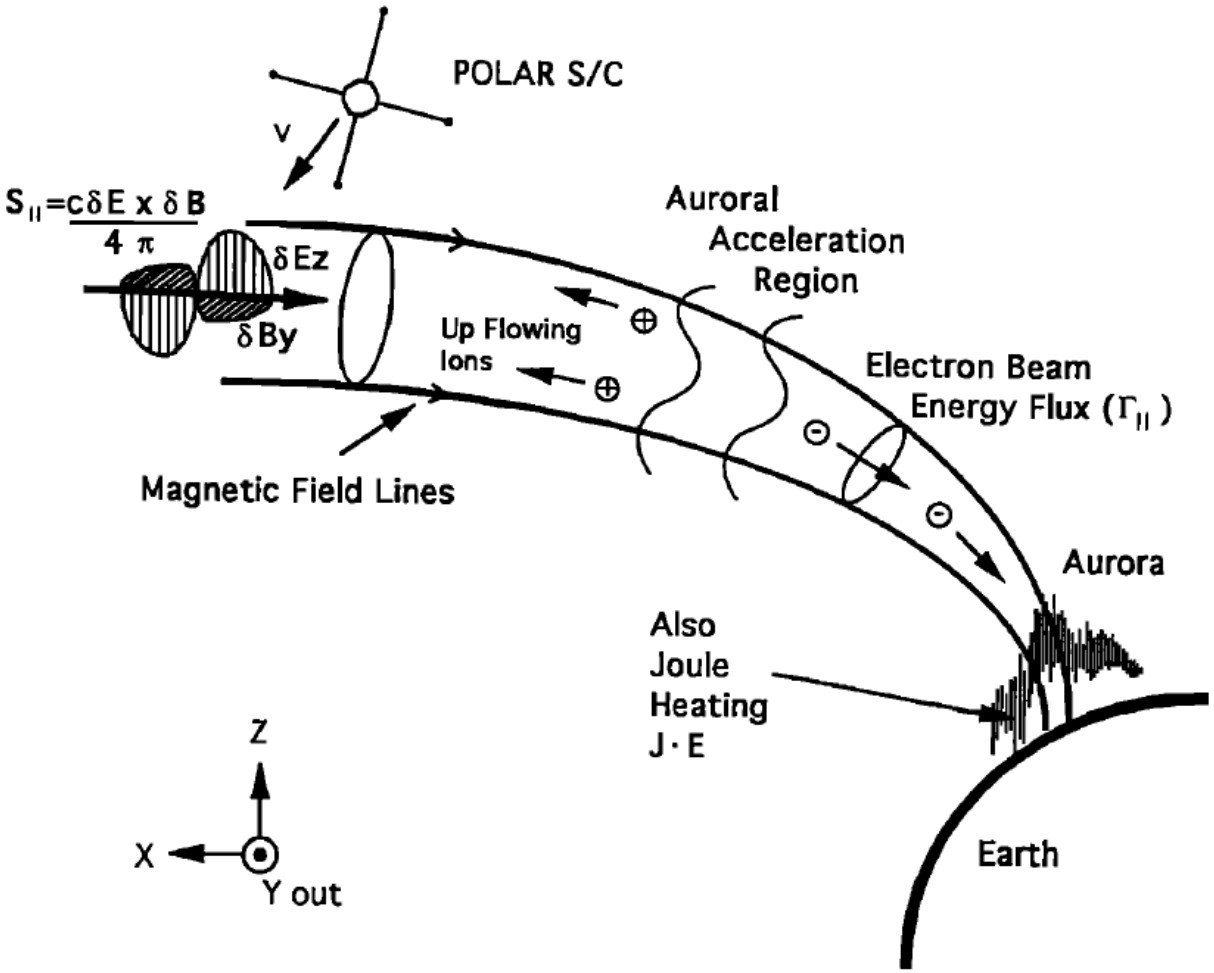
Future UMEA initiatives: Inner Boundary Conditions



[Mann et al., 1995]

- Examine effect of inner boundary conditions using global MHD codes, other simulations [e.g., Lysak et al., 2015], and analytic calculations
- How do “gap region” assumptions affect damping rates, resonance width, and other wave properties
- Natural extension of ULF wave modeling challenge with MMV

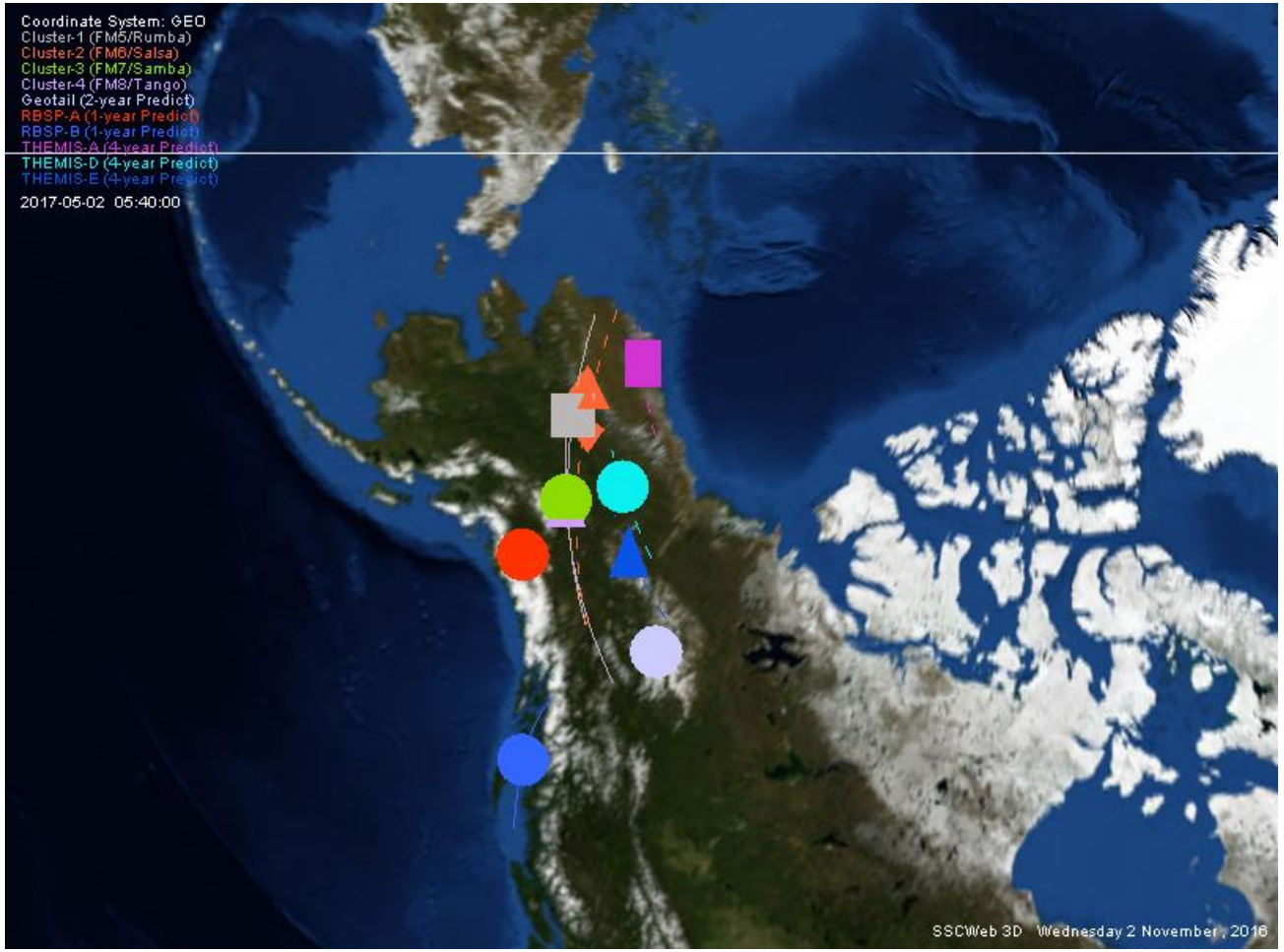
Future UMEA initiatives: ULF wave growth and dissipation



[Wygant et al., 2000]

- Data-model comparisons: both statistical and event studies
- Need multiple models, including those that examine non-MHD effects (e.g., parallel electric fields, kinetic Alfven waves, wave-particle interactions such as drift-bounce resonance)

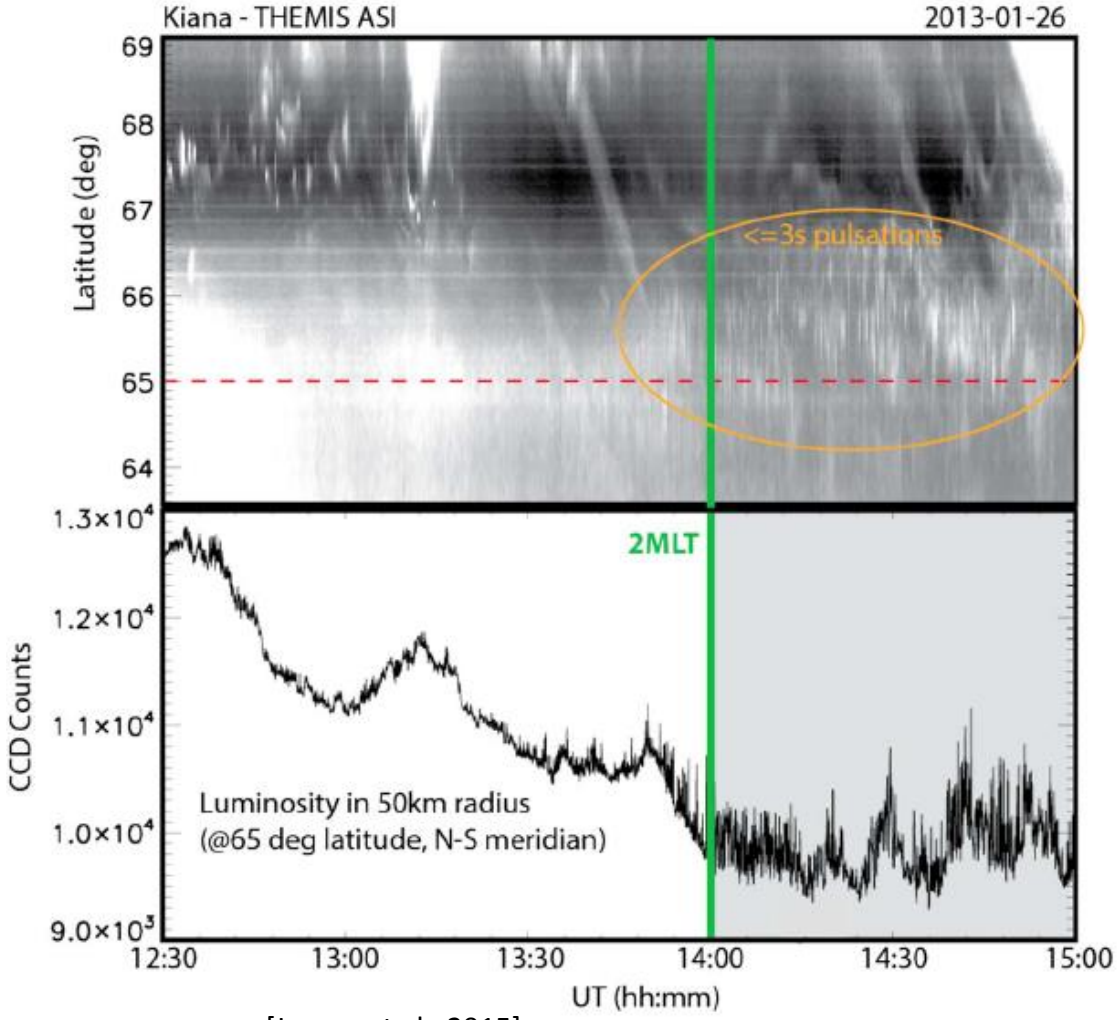
Future UMEA initiatives: ULF wave dissipation



- Data-model comparisons
- Need multiple models, including those that examine non-MHD effects (e.g., parallel electric fields, kinetic Alfven waves, wave-particle interactions)
- Need in situ and ground based measurements
- Potential events? Future ISR world day proposal?

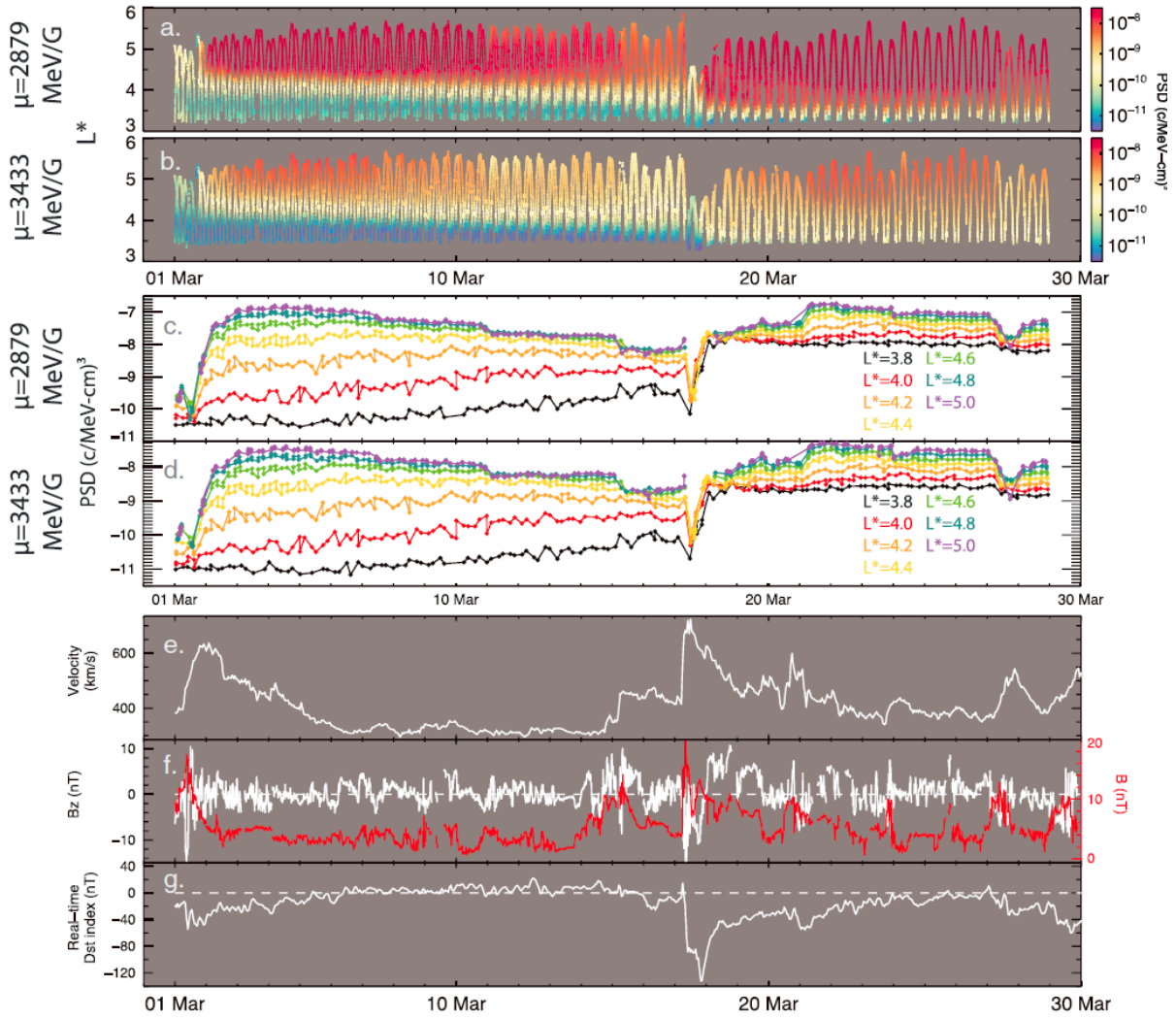
Future UMEA initiatives: Modulation of VLF, EMIC, waves and precipitation

- Pc5 waves modulate a range of VLF, EMIC waves and several types of precipitation
- Need data-model comparisons (e.g., Brito et al., 2015) for each mechanism
- Overlap with QARBM, IMCEPI, and other FG



[Jaynes et al., 2015]

Future UMEA initiatives: ULF waves during QARBM challenge events

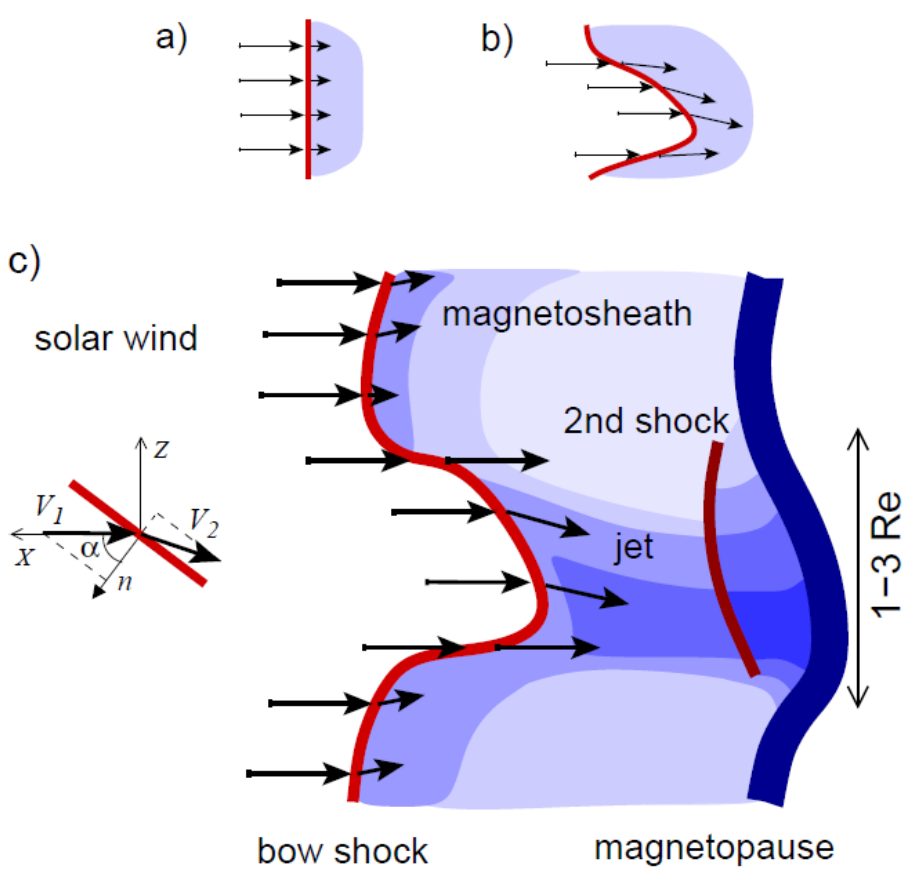


[Baker et al., 2014]

- ULF wave observational and modeling studies during QARBM challenge events
- Do ULF wave properties differ between events?
- What is the nature of ULF wave interactions with radiation belts in each case?
- Natural overlap with QARBM and MMV FGs, potential overlap with System Science (ULF wave indices, global characterization)

Future UMEA initiatives: Localized Magnetopause Disturbances

- Magnetosheath and ion foreshock transients perturb the magnetopause on a variety of spatial scales
- ULF wave properties differ from event to event
- Need models that can account for spatially localized magnetopause displacements with scale lengths and velocities
- Need data-model comparisons (e.g., recent events by Zhang and others) for wave properties and driving mechanisms
- Natural overlap with Dayside Kinetics and MMV



[Hietala et al., 2012]

Future activities

- ULF wave modeling challenge: ionospheric conductivity, plasmasphere, inner BC (MMV)
- ULF wave dissipation (IMCEPI, MMV)
- ULF wave modeling and observation during QARBM events (QARBM, System Science, MMV)
- ULF modulation of VLF waves and/or precipitation (QARBM, IMCEPI)
- ULF waves excited by local magnetopause disturbances (Dayside Kinetics, MMV)
- Coordination of modeling and observation efforts
- **We want your feedback!**