Opportunities for CCMC support of GEM Focus Groups

M. Wiltberger
NCAR/HAO
GEM Steering Committee Chair
Outline

• Background on GEM
  – Research Goals
  – Focus Groups

• Previous Experiences with Challenges
  – Reconnection Challenge
  – Storm/Substorm Challenge
  – GEM/CEDAR Challenge

• Future Plans
Geospace Environment Modeling Program

• Initiated in 1991 as NSF targeted research program with the goal
  – to understand the solar-terrestrial system well enough to be able to formulate a mathematical framework that can predict the deterministic properties of geospace (‘weather in space’) and the statistical characteristics of its stochastic properties (‘climate in space’).

• 2013 White Paper updated the vision and mission
  – Vision - Accurate prediction of the geospace environment
  – Mission - Develop physical understanding of the large-scale organization and dynamics of the geospace environment from observations, theory and increasingly realistic models
GEM Goals

• Develop an integrated physical understanding of the geospace dynamical system;
• Develop the scientific understanding of geospace processes required for accurate prediction;
• Advance modeling capabilities, including metrics and validation of first-principles and empirical models, and promote the broader use of models;
• Advance innovative observational capabilities, especially synoptic measurements including ground-based measurements, to improve scientific understanding, facilitate data assimilation and test key elements of models;
• Promote a vibrant community of geospace scientists to accomplish program goals; and
• Prepare and develop the next generation of geospace researchers
GEM Focus Groups I

• Tail-Inner Magnetosphere Interactions (2012-2016)
  – V. Angelopoulos, P. Brandt, J. Lyon, & F. Toffoletto
• Transient Phenomena at the Magnetopause and Bow Shock and Their Ground Signatures (2012 – 2016);
  – H. Zhang, Q.-G. Zong, M. Ruohoniemi, & D. Murr
  – P. Cassak, A. Runov, Y. Liu, and B. Walsh
• Storm-Time Inner Magnetosphere-Ionosphere Convection (2013 – 2017)
  – J. Baker, M. Ruohoniemi, S. Sazykin, P. Chi, and M. Engebretson
  – J. Borovsky, W. Lotko, V. Uritsky, & Juan Valdivia
• Inner Magnetosphere Cross-Energy/Population Interactions (2014 – 2018)
  – Y. Yu, C. Lemon, M. Liemohn, and J. Zhang; RA
• Quantitative Assessment of Radiation Belt Modeling (2014 – 2018)
  – J. Albert, W. Li, S. Morley, and W. Tu
GEM Focus Groups II

  - T. Nishimura, K. Murphy, E. Spanswick, and J. Yang
• Tail Environment and Dynamics at Lunar Distances (2015 – 2019);
  - C. P. Wang, A. Runov, D. Sibeck, V. Merkin, and Y. Lin
• Merged Modeling & Measurement of Injection Ionospheric Plasma into the Magnetosphere (M³I²) and Its Effects -- Plasma Sheet, Ring Current, Substorm Dynamics (2016 – 2020)
  - V. Eccles, S. Zou, and B. Giles
• ULF Wave Modeling, Effects, and Applications (2016 – 2020)
  - M. Hartinger, K. Takahashi, and B. Kress
• Modeling Methods and Validation (2016 – 2020)
  - K. Garcia-Sage, M. Liemohn, L. Rastaetter, and R. Redmon
• Dayside Kinetic Processes in Global Solar Wind-Magnetosphere Interaction (2016 – 2020)
  - H. Hietala, X. Blanco-Cano, G. Toth, and A. Dimmock
First GEM Challenge

• GEM Magnetic Reconnection Challenge
  – One GEM’s most highly cited papers (632)
  – Showed the utility of having different models solve the same problem
Metrics and Validation Challenges
Recent and Current Challenges I

- **Magnetopause Modeling Challenge**
  - Compared simulation results with predictions of MP position from Shue et al. 1998 MP Model
  - Extended to comparison with satellite crossings
  - Sponsored by Metrics and Validation FG

- **ULF Wave Modeling Challenge**
  - Can global models reproduce ULF waves in MS?
  - Can those waves drive radiation belt response during March 2013
  - Sponsored by the M&V and RB & Wave Modeling FG
Recent and Current Challenges I

- **GEM-CEDAR Modeling Challenge**
  - Selected a series of storm intervals for inter-model comparison
  - Focuses included NmF2, HmF2, neutral winds, TEC, and temperatures
  - Supported by both GEM and CEDAR communities
Future Collaborations

• New FG – Modeling, Methods, and Validations
  – Under leadership of K. Garcia-Sage, M. Liemohn, L. Rastaetter, and R. Redmon
  – Key topics for future validation studies include
    • Plasma validation making use of MMS, RBSP, and THEMIS plasma data for increasing model reliability and our understanding of the physical processes leading to certain types of plasma structures and velocity space distributions
    • Magnetopause validation for both reconnection physics and magnetopause shadowing in energetic particle transport
    • Ionospheric conductance carrying out validation of precipitation and conductance models and assessing global effects
Conclusions

• GEM has a long history of using challenge type events to advance its goal enabling better prediction of the magnetosphere

• CCMC has contributed significantly to several recent metric and validation challenges

• We look forward to continued collaboration with CCMC on challenges that address the key topics identified by the new MMV FG