摘要：An understanding of solar wind-magnetosphere-ionosphere (MI) coupling is a central issue in understanding the near-earth space environment. There is a plethora of complex dynamic processes associated with this coupling that leads to various forms of geomagnetic activity. A difficulty in understanding these processes involves the broad range of spatial and temporal scales involved in the coupling. This presentation will consider two case studies of forefront MI coupling space science research issues: (1) Cross Polar Cap Potential (CPCP) saturation and (2) wave generation associated with Dipolarization Fronts (DFs). These two phenomena span the range of spatial scales from global-scale to micro-scale. Advanced computational methods provide a test laboratory for ultimately interpreting much of the complex physics involved during M-I coupling and computational models will be used to investigate these two phenomena and make progress towards resolving currently unanswered questions. Global Magnetohydrodynamic (MHD) computational models will used to interpret physical mechanisms leading to saturation characteristics of the CPCP during a rare event of northward Interplanetary Magnetic Field (IMF). A key objective is to determine the primary coupling driver for the unusual behavior that is currently poorly understood. Dipolarization Fronts (DFs) are characterized by an enhanced geomagnetic field north-south component and sharp gradients of plasma density and pressure on the scale of the ion inertial length. Broadband wave activity associated with these regions provides substantial information about the physical processes associated with DFs. Electromagnetic Particle-in-Cell (EMPIC) computational models are used to investigate mechanisms that produce these waves in the strongly inhomogeneous space plasma configuration representative of DFs. Comparisons of the computational model results with both space-based and ground-based data will be discussed.