Introduction

An important step towards developing a comprehensive model of the Sun-Earth environment is the coupling of the Lyon-Fedder Moby (LFM) global MHD model with the Rice Convection Model (RCM) drift physics code. In this poster, we present some initial results from the coupled model. It is expected that the coupled LFM-RCM model will provide a more realistic and physically consistent model of the inner magnetosphere than either model alone and is expected to address several important and outstanding science questions such as:

- The role of a self-consistent magnetic field and the plasma sheet on ring current formation.
- The effects on the inner magnetospheric electric field.
- Insight on the role of the inner magnetosphere on the global magnetospheric structure and dynamics.

Methodology

The codes are run asynchronously, exchanging data and coordinating their timings through files. Future versions will use the INTERCOMM software package, the transition to is expected to be straightforward.

- The RCM modeling region is confined to an ellipse in the equatorial plane (-10<z<8 R_E, |y|<8 R_E).
- Over a specified time interval (1 minute) the LFM interpolates time averaged MHD magnetic field, pressure and density onto a rectilinear grid.
- The rectilinear grid allows for relatively fast field line integration.
- The LFM specifies the data exchange time-interval.
- Time averaging smoothes out some temporal structure.
- LFM also supplies high latitude potential and the conductivity as input for the RCM.
- RCM-computed values of the sound speed (s) and density (ρ) are gently returned into the LFM.

\[ s^\text{LM} = s^\text{CM} + (s^\text{RCM} - s^\text{CM}) \frac{\Delta t}{T} \]

This is essentially a source-temp coupling scheme, where T is the exchange coupling time (1 minute) and \( \Delta t \) is the LFM timestep.

Test Runs

For a set of tests, 4 runs were performed. For the LFM, the solar wind was held steady with a velocity of 400 km/s and particle density of 5 particles/cc. The IMF direction was flipped from \( B_z = +5 \) nT to -5 nT at t=4 hours when the RCM was turned on. The 4 runs consisted of:

1. LFM-only, constant pederson conductance of 5 s.
2. LFM-RCM, constant pederson conductance of 5 s.
3. LFM-only, constant pederson conductance of 8 s.
4. LFM-RCM, constant pederson conductance of 8 s.

The hall conductance was set to zero in all the runs. Periodic oscillations also show up in the RCM as flow-jets that inject plasma into the inner magnetosphere that causes the LFM to release plasma down the tail.

Summary

1. LFM-RCM code produces a ring current that consists of a region of trapped plasma near the inner boundary of the LFM.
2. The values of \( \Delta B_z \) in the LFM-RCM shows a substantial reduction in the inner region as compared to the LFM-only run.
3. Periodic behavior in the coupled code appears to be as result of the buildup of the inner magnetosphere that causes the LFM to release plasma down the tail.
4. Periodic oscillations also show up in the RCM as flow-jets that inject plasma into the inner magnetosphere.
5. The x-line location (as measured by the line of \( B_z = 0 \)) is more dynamic and moves further out in the LFM-RCM run.
6. RCM results show a lack of shielding in the inner magnetosphere, that results from a hot, tenuous plasma distribution entering the RCM from the LFM’s plasmasheet. This hot plasma comes from an x-line in the LFM that is reconnecting lobe field lines.