



Center for Space Environment Modeling
College of Engineering
University of Michigan

Department of Aerospace Engineering
Department of Atmospheric, Oceanic & Space Sciences
Department of Electrical Engineering & Computer Science

BATSRUS - RCM Coupling Update

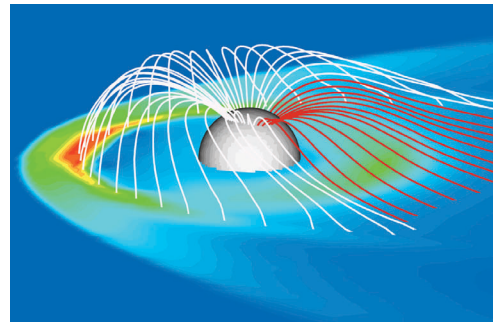
Darren De Zeeuw

April 2002

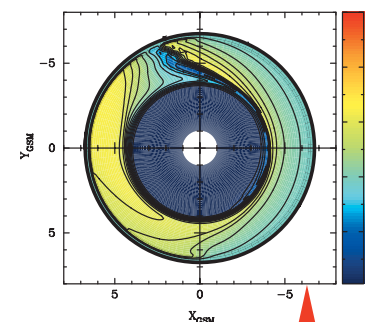


MHD-RCM Coupling

Global Magnetosphere-Ionosphere Model (MHD)



Inner Magnetosphere Model (RCM)



ρ , \mathbf{u} , \mathbf{B} , p at cell centers
Ionospheric potential, Φ distribution

Pressure of superthermal particles

Map RCM superthermal pressure to magnetosphere grid (assuming that pressure is constant along magnetic field lines)

Calculate

Field line volume : $V = \int \frac{ds}{B}$
Field line mass : $M = \int \frac{\rho_{MHD} ds}{B}$
Field line pressure : $P = \int \frac{p_{MHD} ds}{B}$

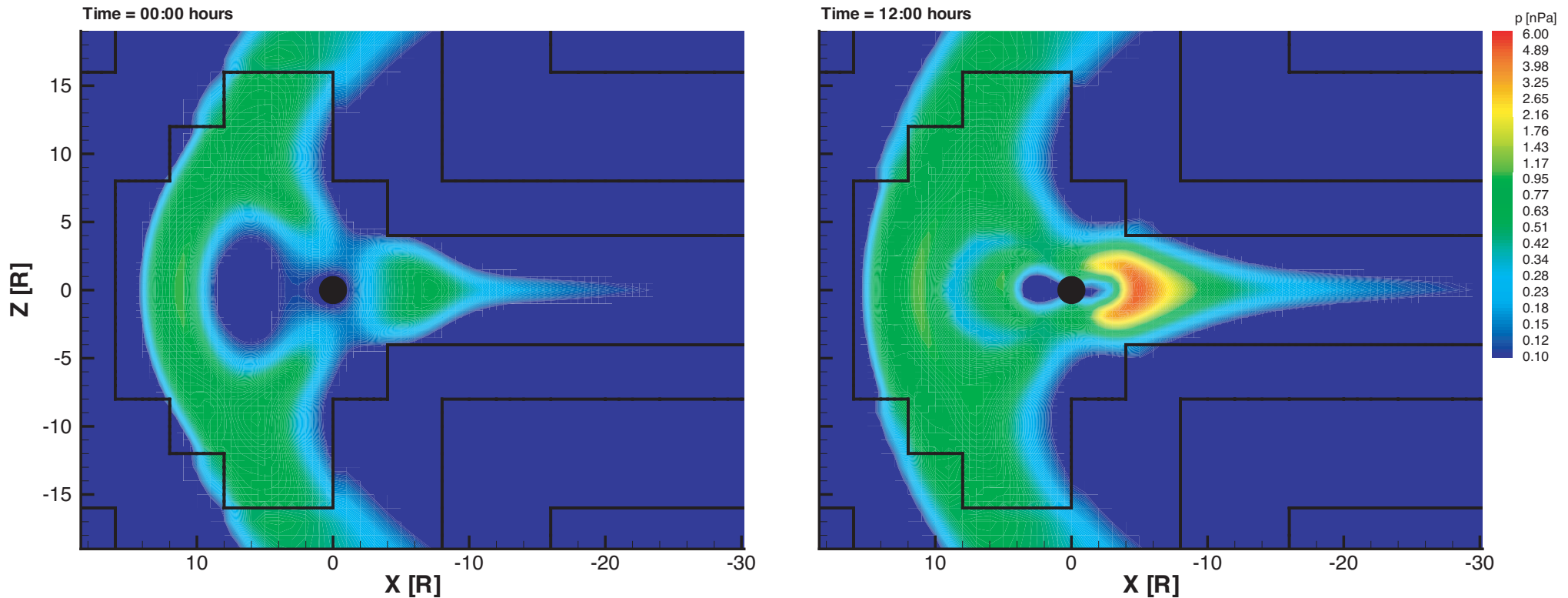
Calculate equatorial crossing of magnetic field lines originating from RCM ionospheric grid points

Interpolate ionospheric potential to RCM grid

Map open-closed field line boundary to RCM grid

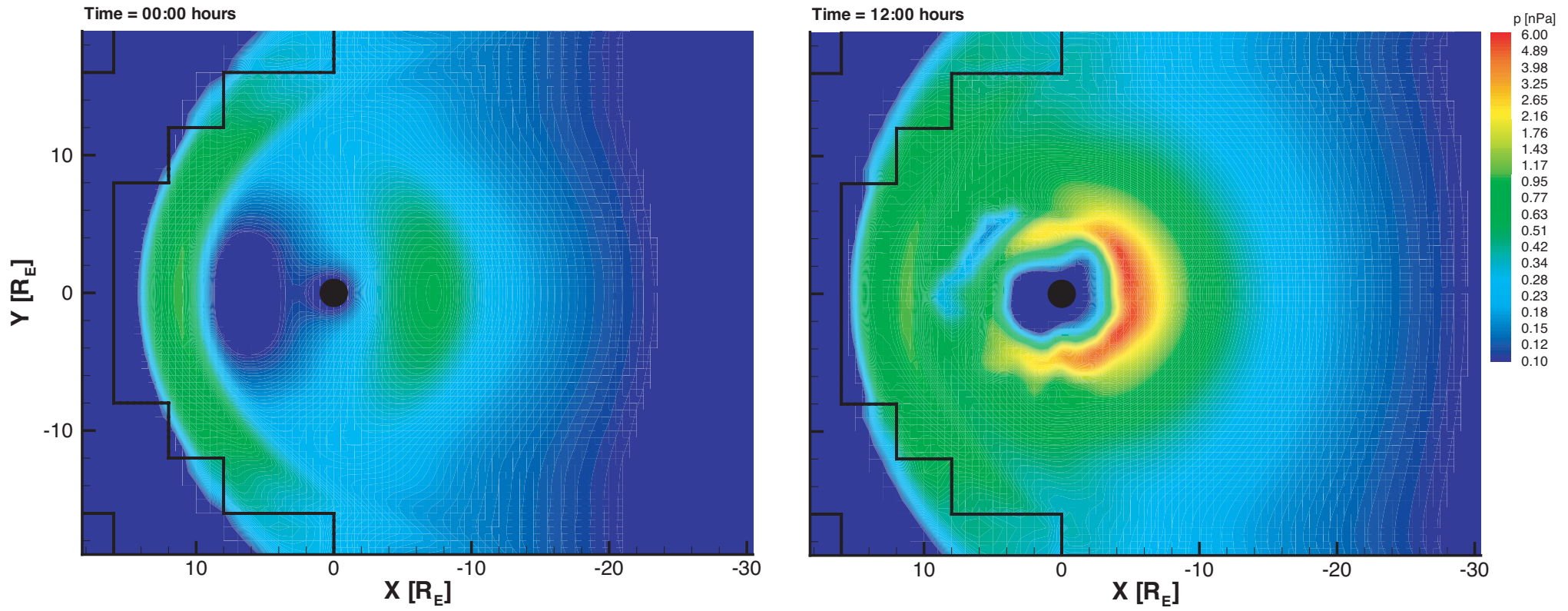


MHD-RCM Coupling: $Y=0$ Plane





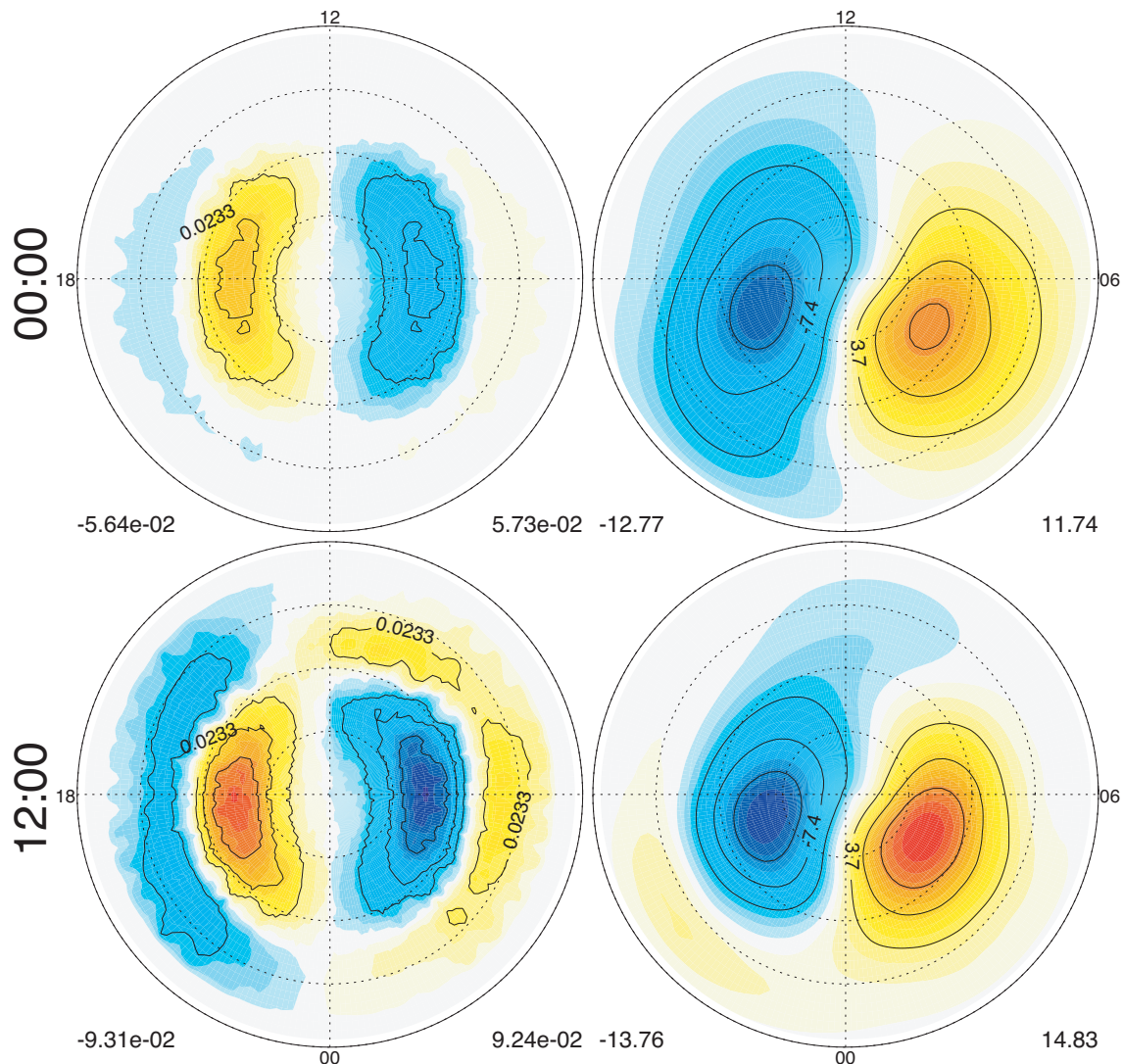
MHD-RCM Coupling: $Z=0$ Plane





MHD-RCM Coupling: Ionosphere

Northern Hemisphere



Data Dictionary (Draft Version 1)

GM (Global Magnetosphere – MHD)

IM (Inner Magnetosphere – RCM)

Coupling

Name	isize	
Description	Number of cells in latitude in RCM grid.	
Producer	IM: Inner Magnetosphere	Consumer(s)
Range	Positive integer	Resolution
Storage Type	Single value	Data Type
Units	None	Default
		GM: Global Magnetosphere
		Integer
		78

Name	jsize	
Description	Number of cells in longitude in RCM grid.	
Producer	IM: Inner Magnetosphere	Consumer(s)
Range	Positive integer	Resolution
Storage Type	Single value	Data Type
Units	None	Default
		GM: Global Magnetosphere
		Integer
		48

Name	RCM_lat	
Description	Latitude value for each isize grid point.	
Producer	IM: Inner Magnetosphere	Consumer(s)
Range	0 to 90	Resolution
Storage Type	Array [isize]	Data Type
Units	Degrees	Default
		GM: Global Magnetosphere
		Real
		~1

Name	RCM_lon	
Description	Longitude value for each jsize grid point.	
Producer	IM: Inner Magnetosphere	Consumer(s)
Range	0 to 360	Resolution
Storage Type	Array [jsize]	Data Type
Units	Degrees	Default
		GM: Global Magnetosphere
		Real
		7.5

Name	RCM_p	
Description	Pressure from RCM	
Producer	IM: Inner Magnetosphere	Consumer(s)
Range	1.E-10 to 20	Resolution
Storage Type	Array [isize,jsize]	Data Type
Units	nPa	Default
		GM: Global Magnetosphere
		See RCM_lat, RCM_lon
		Real
		-1 (tagged to indicate no RCM p)

Name	MHD_vol	
Description	Fieldline volume from MHD	
Producer	GM: Global Magnetosphere	Consumer(s)
Range		Resolution
Storage Type	Array [isize,jsize]	Data Type
Units	$nT^{*}*(-2/3)$	Default
		IM: Inner Magnetosphere
		See RCM_lat, RCM_lon
		Real
		-1 (tagged to indicate open field)

Data Dictionary (Draft Version 1) continued

Name	MHD_xmin
Description	X coordinate of fieldline intersection with equatorial plane.
Producer	GM: Global Magnetosphere
Range	-10 to 10
Storage Type	Array [isize,jsize]
Units	Re
	Consumer(s)
	IM: Inner Magnetosphere
	Resolution
	See RCM_lat, RCM_Ion
	Data Type
	Real
	Default
	0

Name	MHD_ymin
Description	Y coordinate of fieldline intersection with equatorial plane.
Producer	GM: Global Magnetosphere
Range	-10 to 10
Storage Type	Array [isize,jsize]
Units	Re
	Consumer(s)
	IM: Inner Magnetosphere
	Resolution
	See RCM_lat, RCM_Ion
	Data Type
	Real
	Default
	0

Name	MHD_Bmin
Description	Magnitude of B for fieldline intersection with equatorial plane.
Producer	GM: Global Magnetosphere
Range	
Storage Type	Array [isize,jsize]
Units	nT
	Consumer(s)
	IM: Inner Magnetosphere
	Resolution
	See RCM_lat, RCM_Ion
	Data Type
	Real
	Default

Name	MHD_rho
Description	Average density along fieldline
Producer	GM: Global Magnetosphere
Range	
Storage Type	Array [isize,jsize]
Units	n/cc
	Consumer(s)
	IM: Inner Magnetosphere
	Resolution
	See RCM_lat, RCM_Ion
	Data Type
	Real
	Default
	0

Name	MHD_p
Description	Average pressure along fieldline
Producer	GM: Global Magnetosphere
Range	
Storage Type	Array [isize,jsize]
Units	nPa
	Consumer(s)
	IM: Inner Magnetosphere
	Resolution
	See RCM_lat, RCM_Ion
	Data Type
	Real
	Default
	0

Name	MHD_v
Description	Ionospheric potential
Producer	IE: Ionosphere
Range	
Storage Type	Array [isize,jsize]
Units	kV
	Consumer(s)
	IM: Inner Magnetosphere
	Resolution
	Data Type
	Real
	Default

Name	MHD_j
Description	Ionospheric current
Producer	IE: Ionosphere
Range	
Storage Type	Array [isize,jsize]
Units	uA/m**2
	Consumer(s)
	IM: Inner Magnetosphere
	Resolution
	Data Type
	Real
	Default