GEM Workshop 2015

Real-time SWMF Geospace: Magnetopause comparisons

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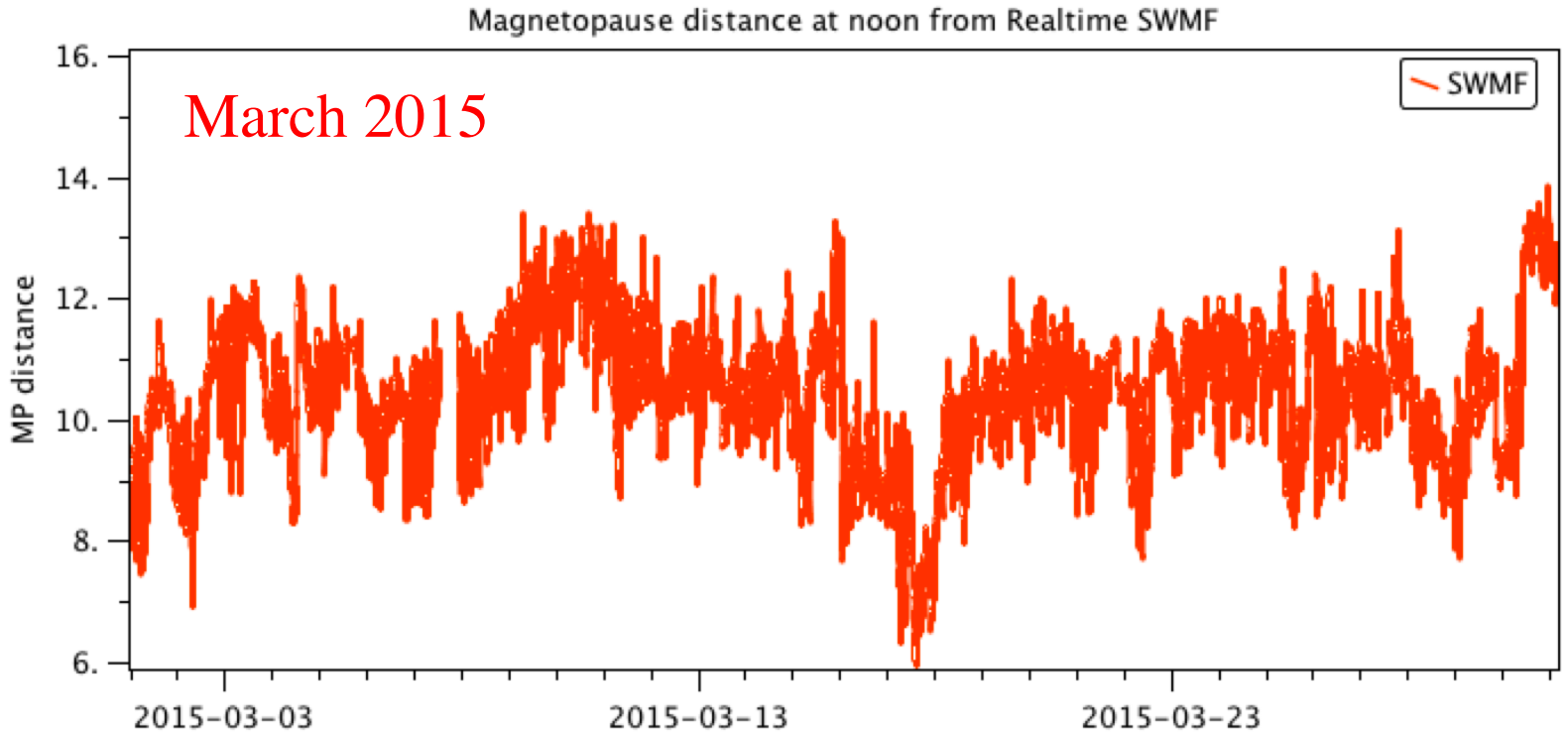
Real-time SWMF

- CCMC has been running a geospace configuration of SWMF in real time since 2007
  - Just the GM and IE physics modules
    - So, only BATS-R-US and the Ridley Ionosphere Model
    - Fairly low grid resolution (<1 M cells) for MHD code
- New version running since 2011
  - Three physics modules: GM, IE, and IM
  - So, now with the Rice Convection Model for near-Earth keV plasma solution
  - Better grid in MHD code and some other improvements

Magnetopause values from the runs

- As of today, Rmp is only available from the SWMF2007 configuration

March 2015



Comparing with something

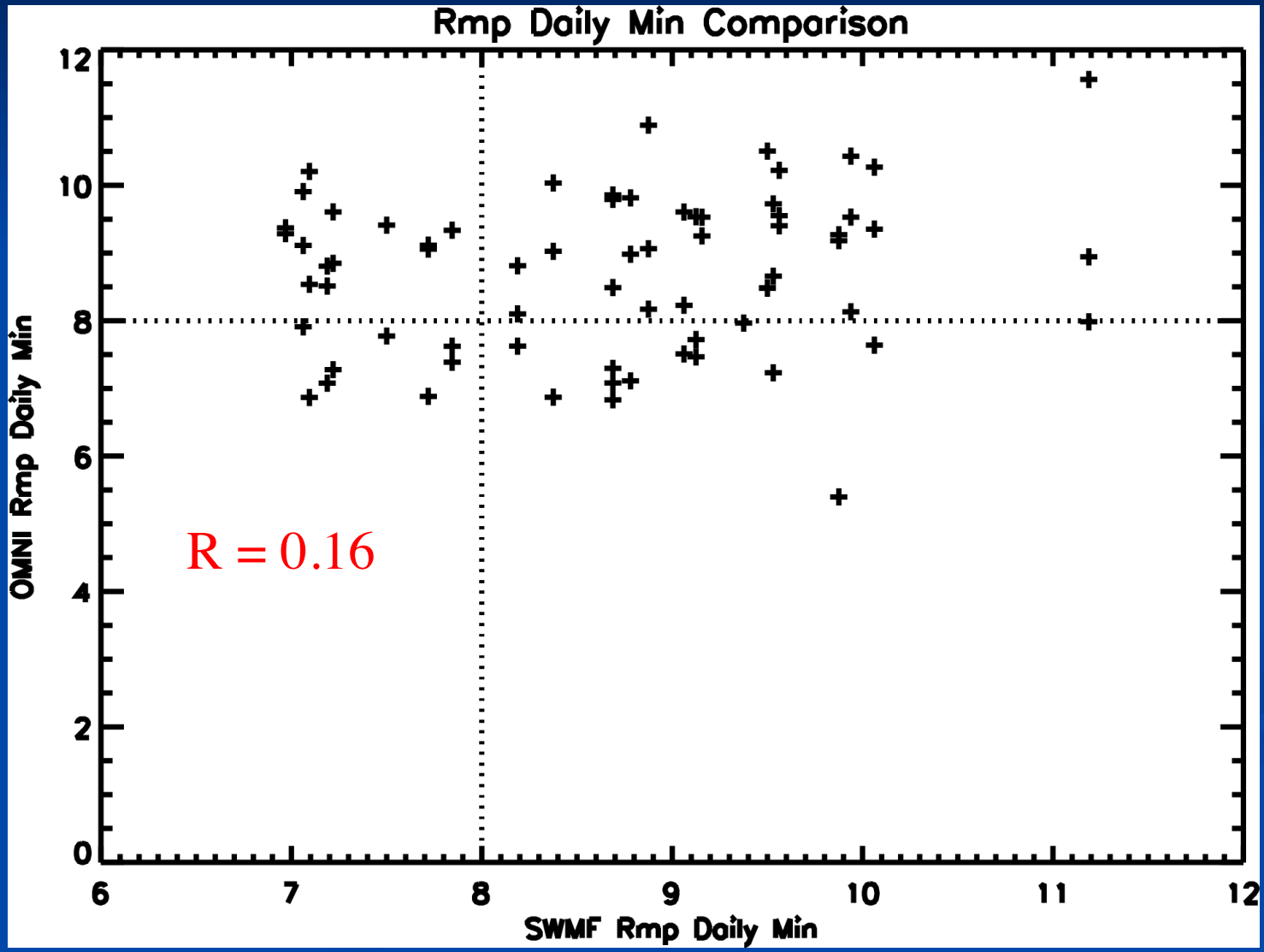
- Shue et al. magnetopause model:

$$r_{MP} = \left\{10.22 + 1.29\tanh\left[0.184\left(Bz + 8.14\right)\right]\right\}\left(\frac{1}{p_{SW}}\right)^{\frac{1}{6.6}}$$

- Just did this analysis this week:
  - Downloaded OMNI solar wind for March 2015 on
    - They have values until mid-May
  - In this set: 70 days of overlap
- Calculate stats on the minimum Rmp for each day
  - Correlation, contingency table, and other values

The Real-time Rmp Values

- First, let's look at the SWMF and Shue values



The contingency table

- Four-part table of integer values
- The quadrants have names:
  - **Hits:** both model and data are in the state
  - **Misses:** data in state but not the model
  - **False alarms:** model in state but data not in state
  - **Correct negatives:** both data and model not in state

Contingency Table	Model in the state	Model not in state
Data in state	Hits (H)	Misses (M)
Data not in state	False Alarms (F)	Correct Negatives (N)

Derivative Values From the Table

- Probability of Detection:
  - Ranges from 0 to 1
  - Want it high

$$POD = \frac{H}{H + M}$$

- Probability of False Detection:
  - Ranges from 0 to 1
  - Want it low

$$POFD = \frac{F}{F + N}$$

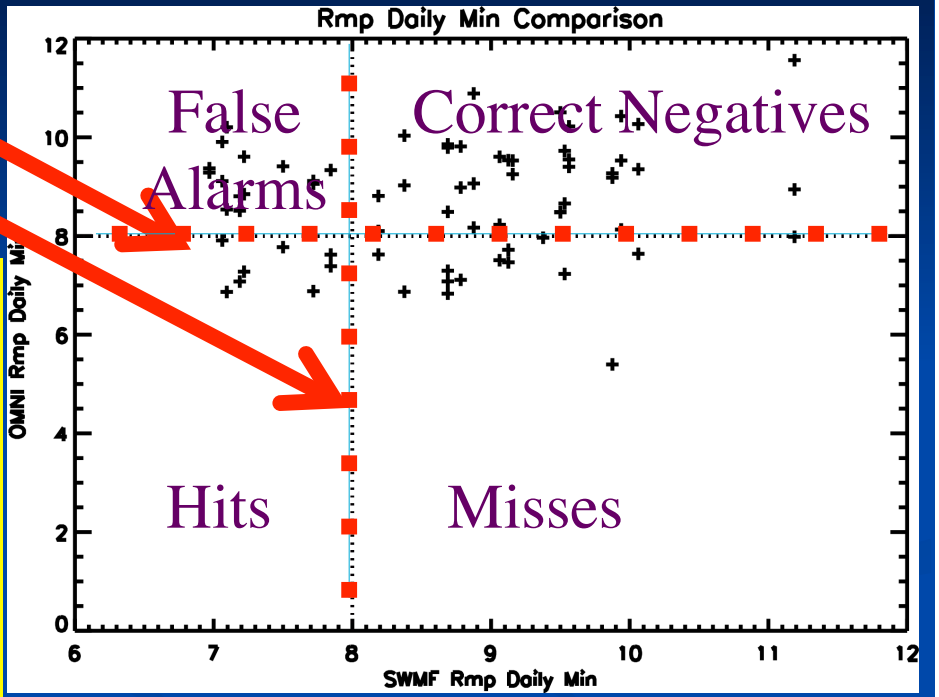
- Heidke Skill Score:
  - Max is 1
  - = 0 is = random
  - < 0 is...well...bad

$$HSS = \frac{2\left[\left(H \cdot N\right) - \left(M \cdot F\right)\right]}{\left(H + M\right)\left(M + N\right) + \left(H + F\right)\left(F + N\right)}$$

Contingency Tables

- Shue cutoff = 8 R_E
- SWMF cutoff = 8 R_E

Contingency Table	$Rmp_M < X_M$	$Rmp_M > X_M$
$Rmp_S < X_S$	H = 8	M = 14
$Rmp_S > X_S$	F = 14	N = 34



POD = 0.36
POFD = 0.29
HSS = 0.072

HSS ~0: random luck

Can we interpret this?

Summary

- Experimental real-time SWMF-Geospace runs exist at CCMC
  - One output: magnetopause values
- For the SWMF-2007 version (GM-IE only):
  - Not very good compared to Shue et al. formula
  - At least not for the 2.5 months I examined
- Things to do:
  - Go back through all 8 years of values
  - Do it with the same solar wind input (i.e., r-t values)
  - Do it for the SWMF-2011 version of the code
  - Do it against other Rmp empirical models