

Long-time MHD data/model comparison

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Motivation

- The GEM dB/dt challenge involved comparison of predictions of several MHD models and several statistical models.
- Gives a good picture of current state of predictability and was a good starting point.
- More in-depth and long-time-interval analysis is needed to understand:
 - The effect of the addition of various physical processes to the model. Typically only a small interval of time is considered.
 - When the model is best/worst (local time, disturbance amplitude, solar wind conditions, etc.)
 - How changes to models affect various performance metrics - some changes may cause improvement in one metric at the expense of another metric.
- Examples of exploratory analysis are given here and several features are noted

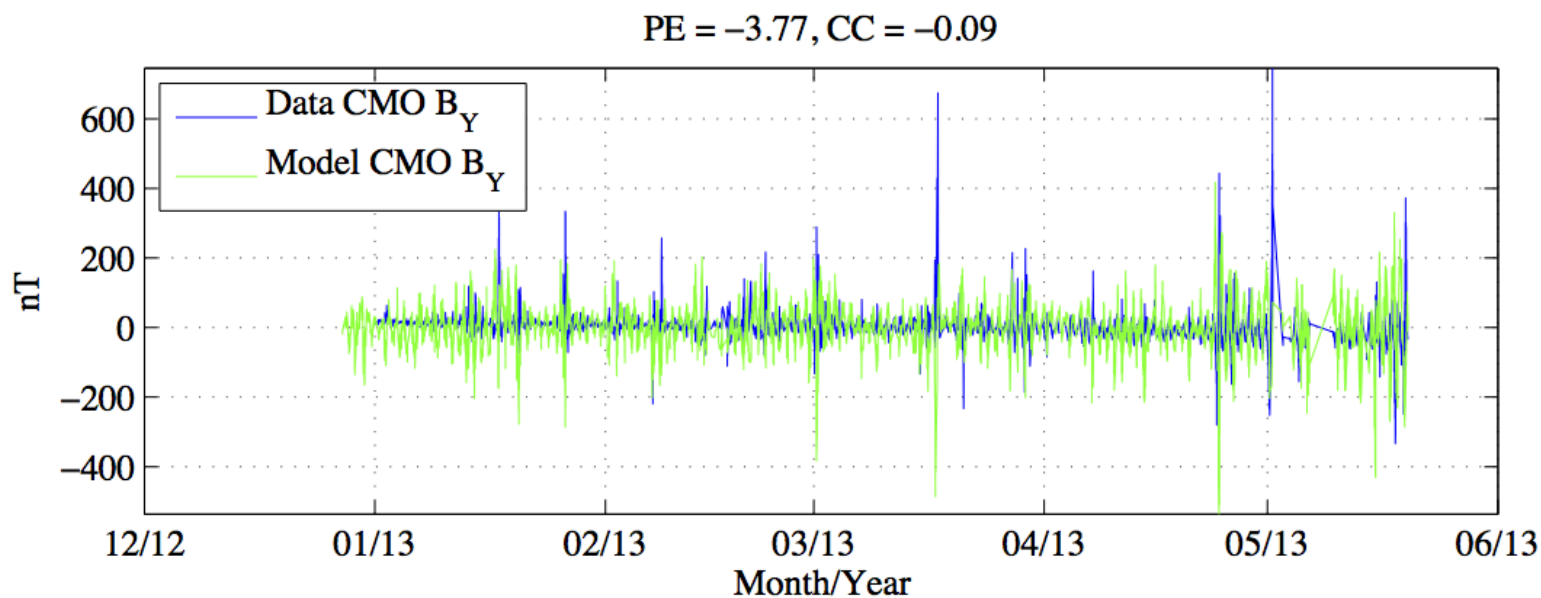
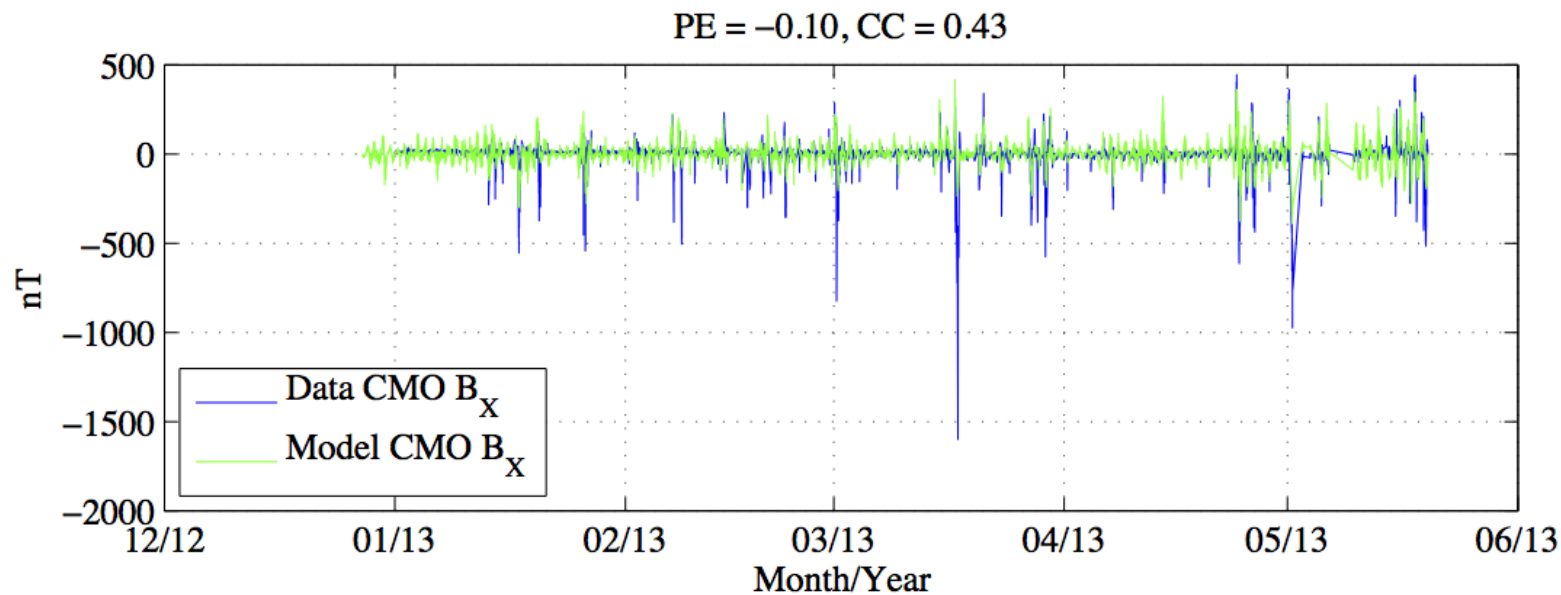
Summary

- Interval: 2013-01-01 through 2013-05-29
- Comparison Data: <http://magweb.cr.usgs.gov/data/magnetometer/CMO/OneMinute/>
- Model Data: ftp://virbo.org/users/rastaetter/dB_20121227-20130529/
- Summary plots: ftp://virbo.org/users/rastaetter/dB_summary/
- Model:
 - Runs generated by Lutz Rastaetter
 - CCMC run: SWMF_RealTimeRun; CCMC model: BATSRUS
 - Shielding angle [deg.]: -90.0000
 - North, East and vertical components of magnetic field computed from magnetosphere currents and field-aligned currents in gap region between ionosphere and magnetosphere and ionospheric height-integrated currents
- Notes:
 - Only one station (57 total) has been compared at this time.
 - Very preliminary results.

Results

X = Geographic North

Y = Geographic East

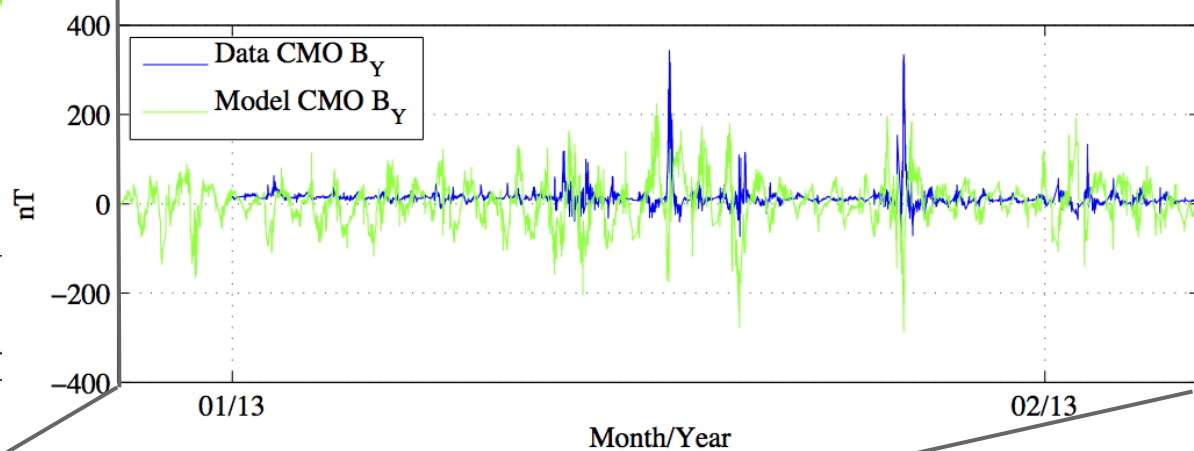
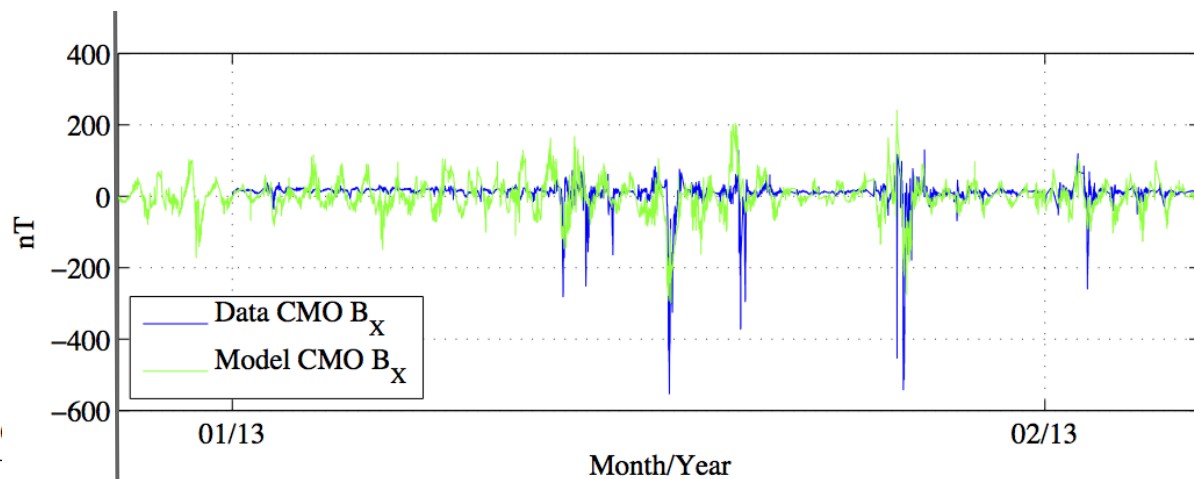
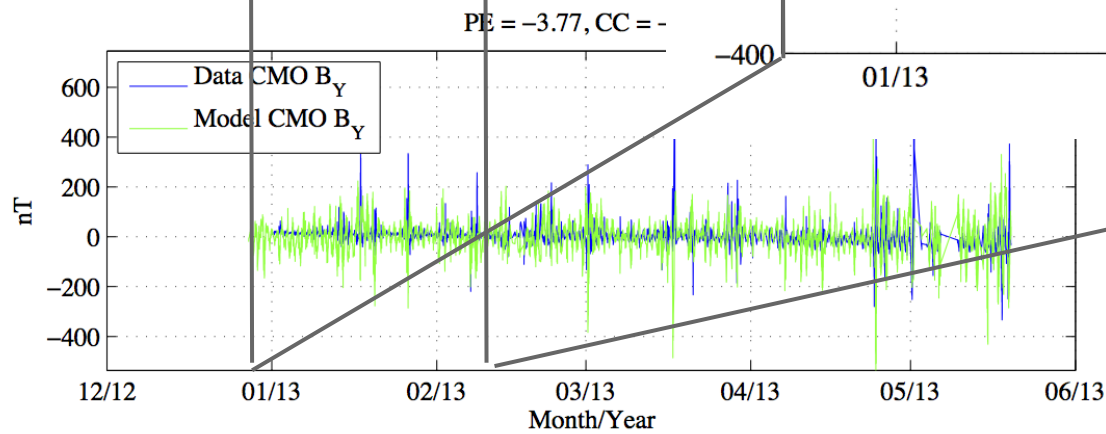
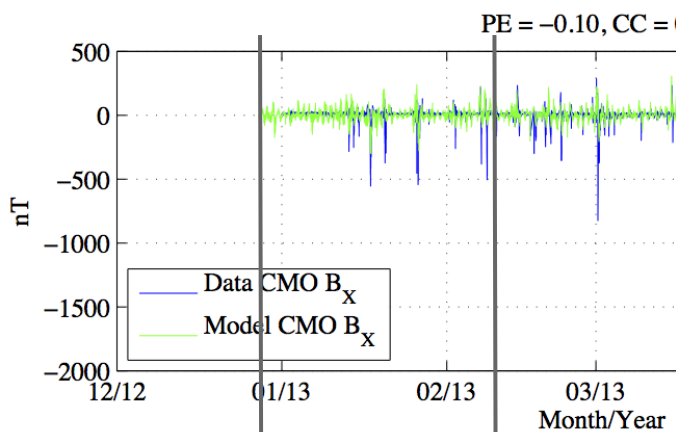


Results

Model has much higher amplitudes (T=24h) when measured amplitude is low.

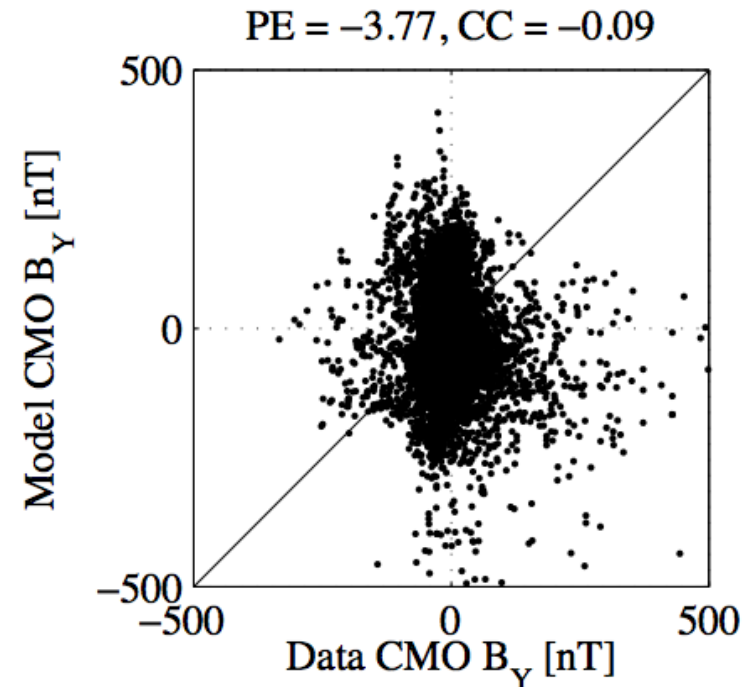
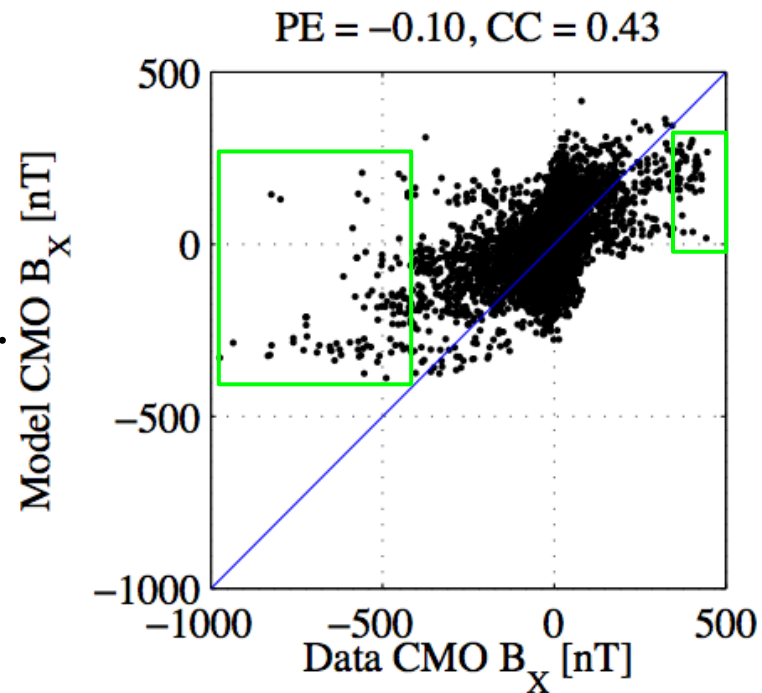
X = Geographic North

Y = Geographic East



Results

- Yellow boxes show regions of consistent under- and over-prediction.
- A moderate CC, but negative PE.
- Scatter in B_y shows asymmetry.
- CC is negative.



Future work/investigation suggestions

- Include all available data (Lutz has computed for 57 locations!)
- Separate out by local times. Some local times are much more predictable; e.g., Weigel et al. 2003 found high PE of
 - up to 0.7 for B_x in EEJ and WEJ regions;
 - as low as 0.0 in transition regions.
- Separate out by large disturbances; compare with GEM challenge results.
- Why is model variation so large during quiet times?
 - Separate out by quiet days.
 - We tend to focus mostly on very disturbed times. On quiet days, interpretation is less complicated as number of active processes is smaller.
- Add comparison to statistical models.
 - How well can a linear prediction filter predict MHD?
 - This could lead to insight into the nonlinear aspects of the magnetospheric response.