Geospace model validation and transition: Challenge process & lessons learned from the CCMC perspective

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Validation process

- Systematic multi-model validations do not happen overnight:
  - We got started 2008 as a part of the GEM metrics & validation focus group. (*Pulkkinen et al*., 2010)
  - "Final" Challenge paper was published 2016. (*Glocer et al*., 2016)
- We had very close interaction between CCMC, modelers and NOAA SWPC:
  - Selection of parameter of end-user interest (*dB/dt*).
  - Selection of metrics.
  - Selection of events (including surprise events).

Results

Table 3. Models Analyzed in the Validation Effort[a]

Identifier	(Model Version) Model	Grid (No. of Cells, Min. Res.)
2_LFM-MIX	(LTR-2.1.1) LFM coupled with ionospheric electrodynamics	163,000, 0.4 R_E
3_WEIGEL	empirical model	N/A
4_OPENGGCM	(OpenGGCM 4.0) global MHD coupled with CTIM	3.9 million, 0.25 R_E
5_WEIMER	empirical model	N/A
9_SWMF	(SWMF 2011-01-31) BATS-R-US coupled with RIM and RCM	1 million, 0.25 R_E

[a]Each model is assigned a unique model identifier given by the leftmost column of the table. The table indicates the model setting, and if applicable, the number of cells and the minimum spatial resolution used in the global MHD part of the mode. See text in section 4 for details.

Pulkkinen et al., (2013)

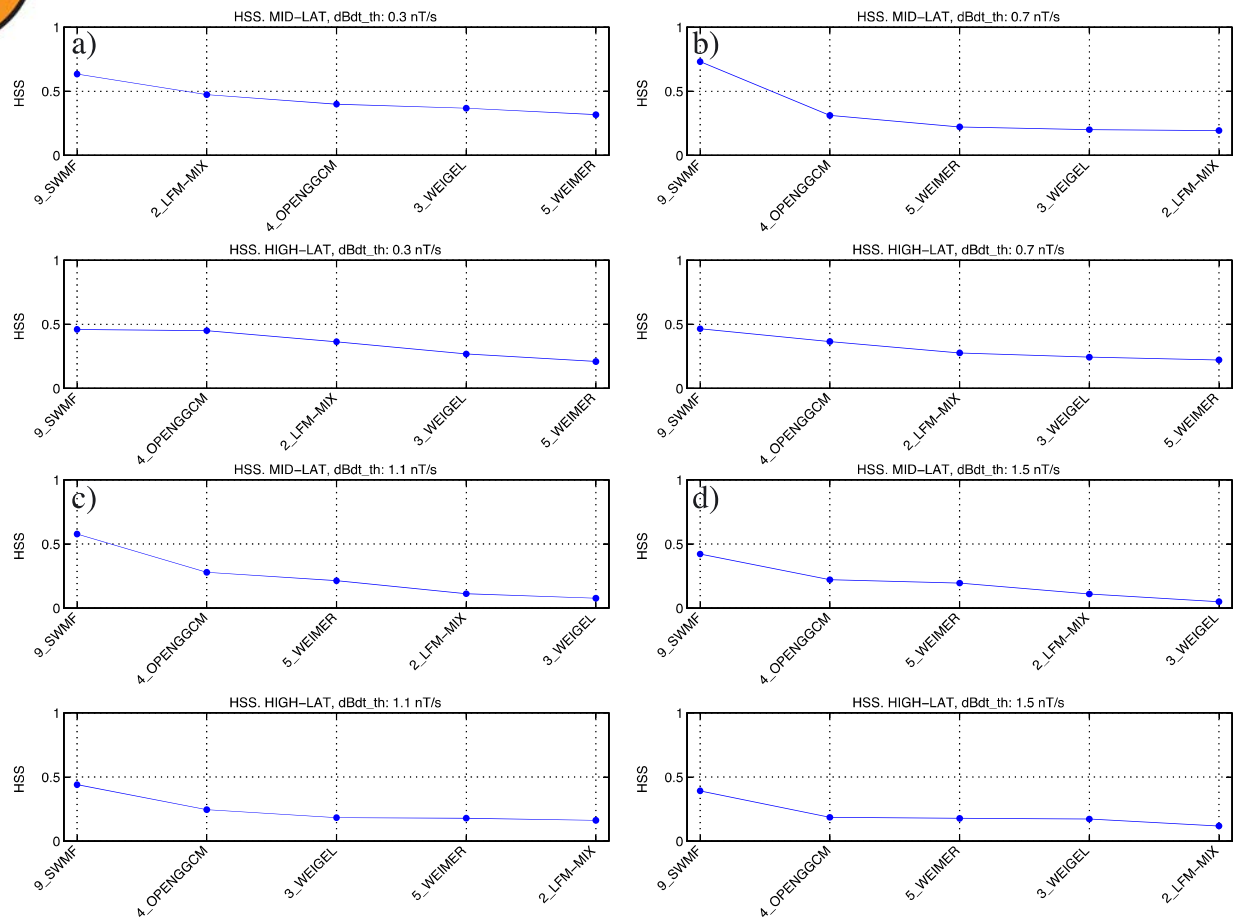

Figure 6. Heidke Skill Score (HSS) defined in section 3 for the dB/dt thresholds (a) 0.3 nT/s, (b) 0.7 nT/s, (c) 1.1 nT/s, and (d) 1.5 nT/s. In Figures 6a–6d, the top panel shows HSS obtained by integrating over the three mid-latitude stations, and the bottom panel shows HSS obtained by integrating over the three high-latitude stations. The models (see Table 3) are ordered according to their HSS. The model with the largest HSS is the leftmost in all panels.

Pulkkinen et al., (2013)

Results

- The published results informed NOAA SWPC about the models' capabilities.
- CCMC also provided a separate report detailing, for example computational aspects pertaining to different models, to NOAA SWPC.

(some) Lessons learned

- Extensive testing and validation of collections of models is not easy or fast – lessons learned will help accelerate the process.
- Trust built over time between CCMC, model developers and NOAA SWPC was critically important for our success.
- CCMC acted as an independent & trusted "bond" between research, applications and operations communities.

Path forward

- Geospace Challenge results are publicly available and allow further validation and model testing:
  - Re-evaluation of the Challenge results. (*Welling et al.*, 2016)
  - Validation against AMPERE data. (*Anderson et al.*, 2016)
- CCMC personnel are working with U. Michigan and the community to modify the operational version of the SWMF code:
  - Tests for settings that can cope with extreme solar wind conditions. (NOAA SWPC request)
  - Improved ionospheric conductance models. (latest scientific research development)
- Modified versions will be tested for the Challenge events to quantify possible improvements.

References

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