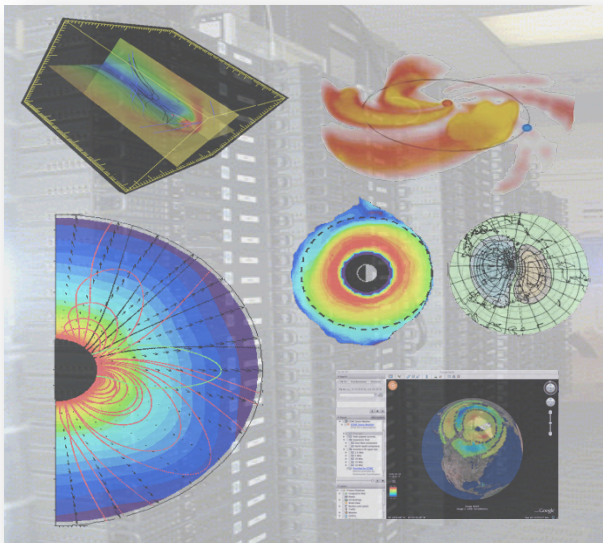
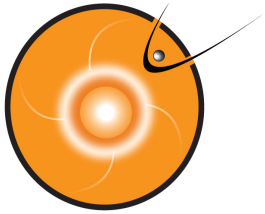


dB/dt metrics analyses and results

A. Pulkkinen, L. Rastaetter, M. Kuznetsova, A. Chulaki

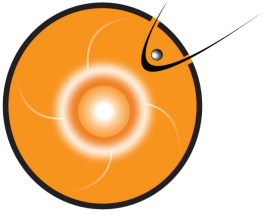
***In collaboration with H. Singer
(NOAA SWPC)***





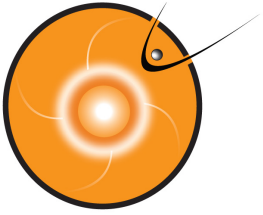
Contents

- Selected storm events.
 - Stations used in the analysis.
 - Metrics used in the analysis.
 - Probability of detection (POD).
 - Probability of false detection (PODF).
 - Heidke Skill Score (HSS)
 - Results:
 - Sample plots of timelines.
 - POD, PODF, HSS.
-



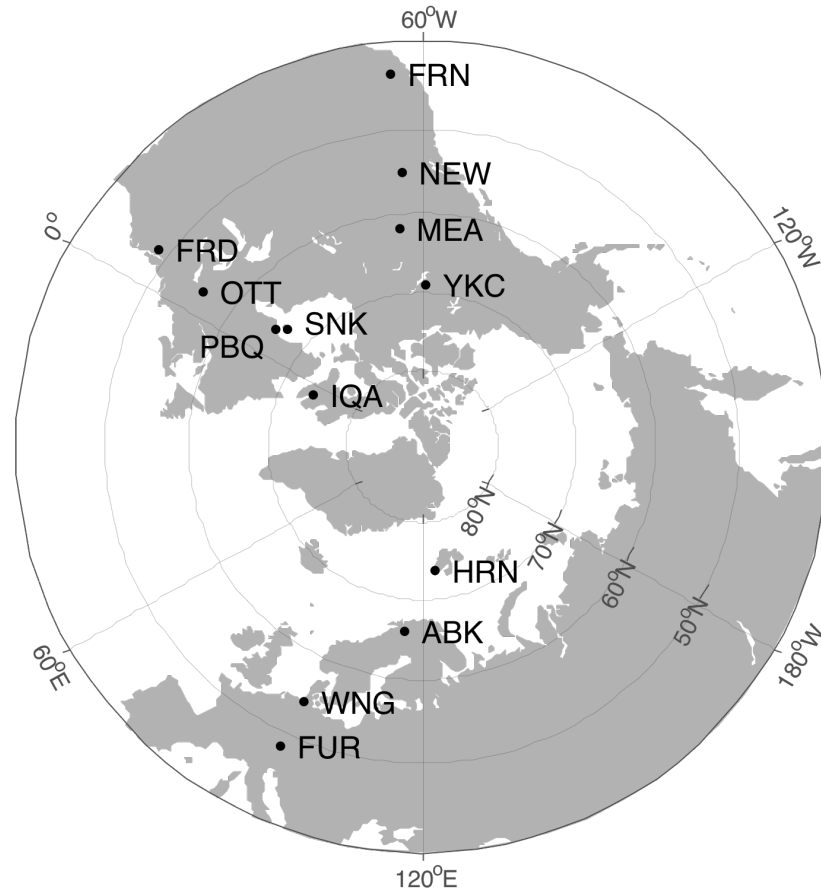
Selected events

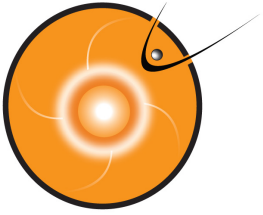
- October 29th, 2003 06:00 UT - October 30th, 06:00 UT
 - December 14, 2006 12:00 UT - December 16, 00:00 UT
 - August 31, 2001 00:00 UT - September 1, 00:00 UT
 - August 31, 2005 10:00 UT - September 1, 12:00 UT
 - April 5, 2010 00:00 UT - April 6, 2010, 00:00 UT
 - August 5, 2011 09:00 UT - August 6, 2011, 09:00 UT
-



Stations used in the analysis

- Mid latitude stations:
 - WNG 54.12 95.0
 - NEW 54.85 304.68
 - OTT 55.63 355.31
- High latitude stations:
 - PBQ 65.46 351.81 /
SNK 66.40 356.10
 - ABK 66.06 114.66
 - YKC 68.93 299.36



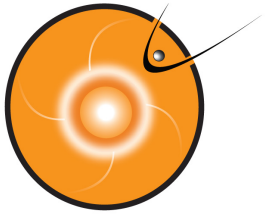


Event-based analysis of dB/dt

- The parameter used for the analysis is dB/dt at each station:

$$dB / dt = \sqrt{\left(\frac{dB_x}{dt}\right)^2 + \left(\frac{dB_y}{dt}\right)^2}$$

- Events, or crossings of thresholds, detected using 20 min analysis window length. We use thresholds 0.3, 0.7, 1.1 and 1.5 nT/s.
-



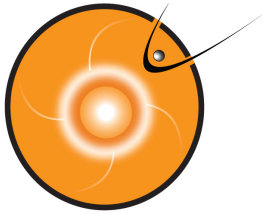
Event-based analysis of dB/dt

- Information about observed vs predicted events collected into contingency tables:

Table 1. Standard Contingency Table for Dichotomous Forecasts

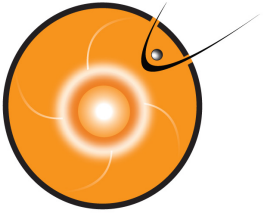
Forecast/Observations	Yes	No	Total
Yes	H	F	FY
No	M	N	FN
Total	OY	ON	T

Lopez et al. (Space Weather, 2007)



Metrics selected for the analysis

- The selection of metrics builds on lessons learned from our earlier GEM community activity: *Pulkkinen et al.* (2010), *Pulkkinen et al.* (2011) and *Rastaetter et al.* (2011).

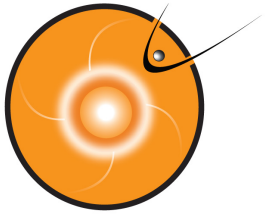


Metrics selected for the analysis

- Probability of Detection (POD). Measures the fraction of observed Yes events which were correctly forecast. It ranges from 0 to 1 with 1 being a perfect score. POD should be used together with POFD.

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



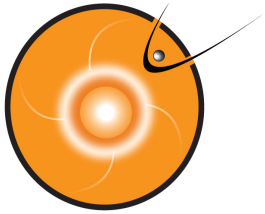


Metrics selected for the analysis

- Probability of False Detection (POFD). Measures the fraction of No events that were incorrectly forecast as Yes events. POFD should be used together with POD.

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

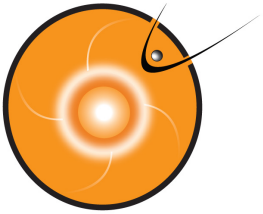




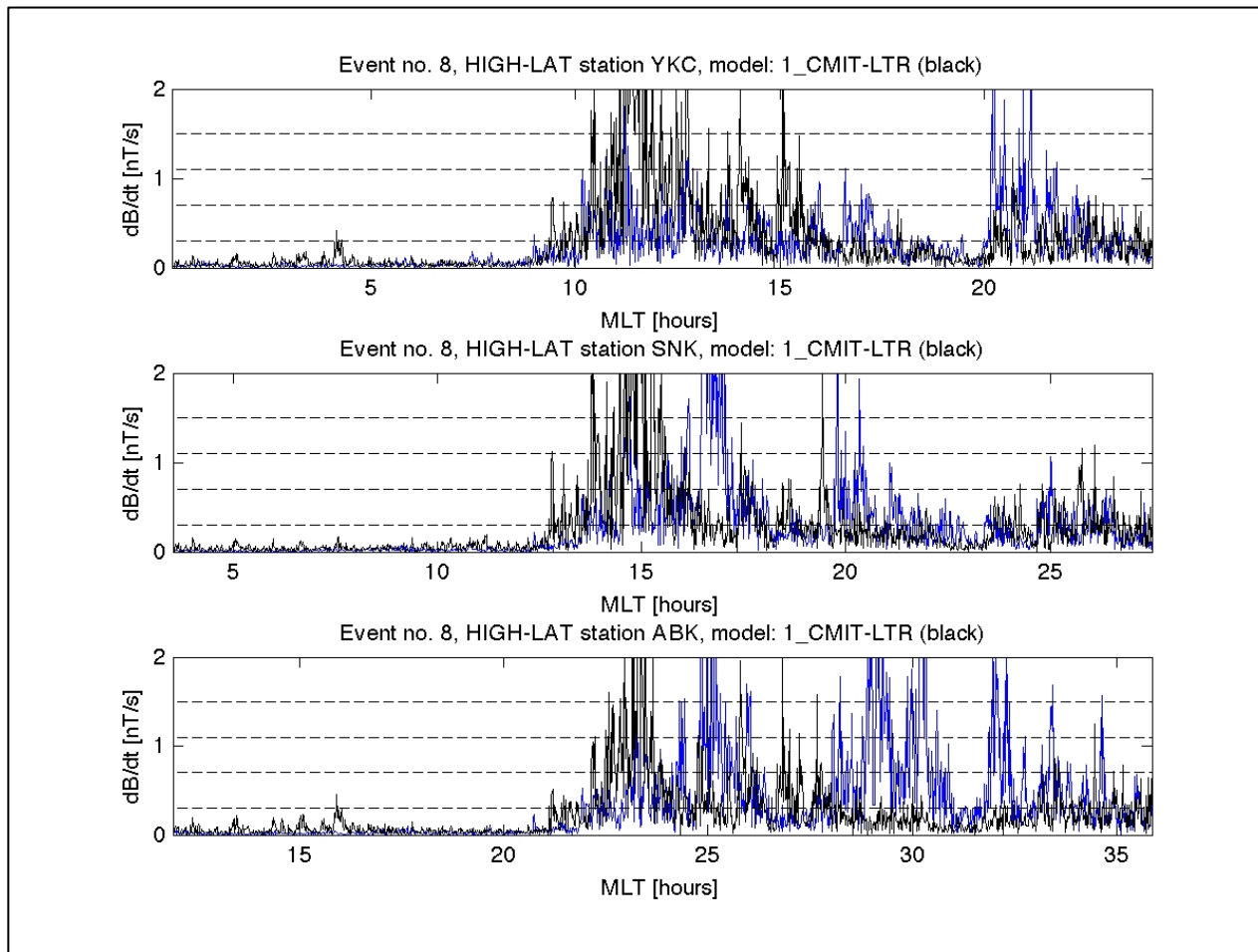
Metrics selected for the analysis

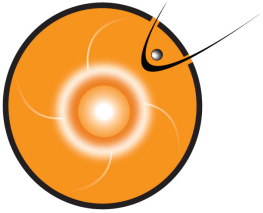
- Heidke Skill Score (HSS). Measures the fraction of correct forecasts after eliminating those forecasts that would be correct purely by random chance. It ranges from negative infinity to 1. Negative values indicate that random forecast is better, 0 indicating no skill (as good as random) and 1 being a perfect score.

$$HSS = \frac{2(HN - MF)}{(H + M)(M + N) + (H + F)(F + N)}$$

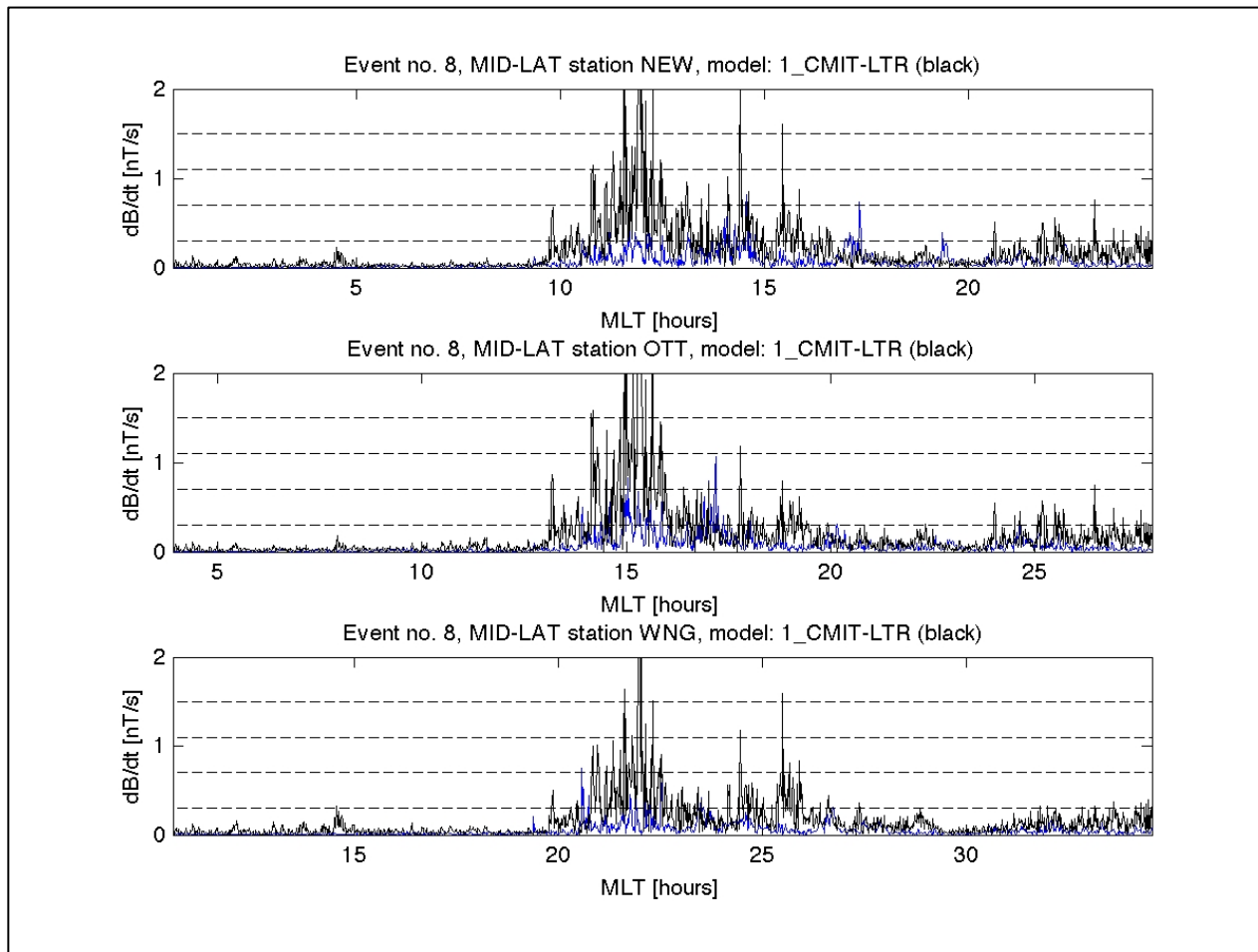


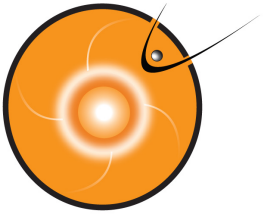
Results



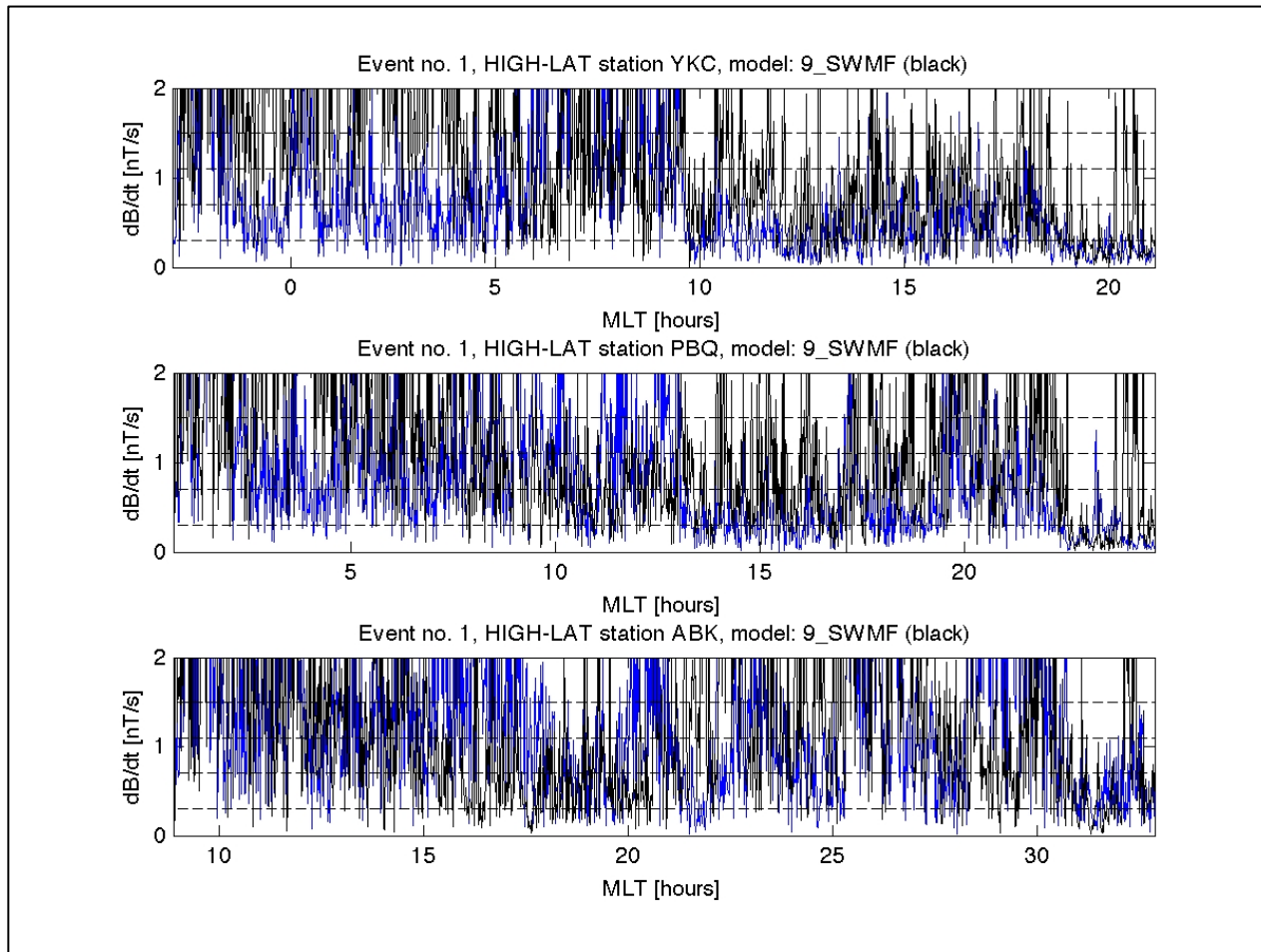


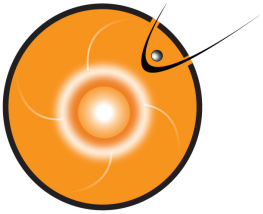
Results



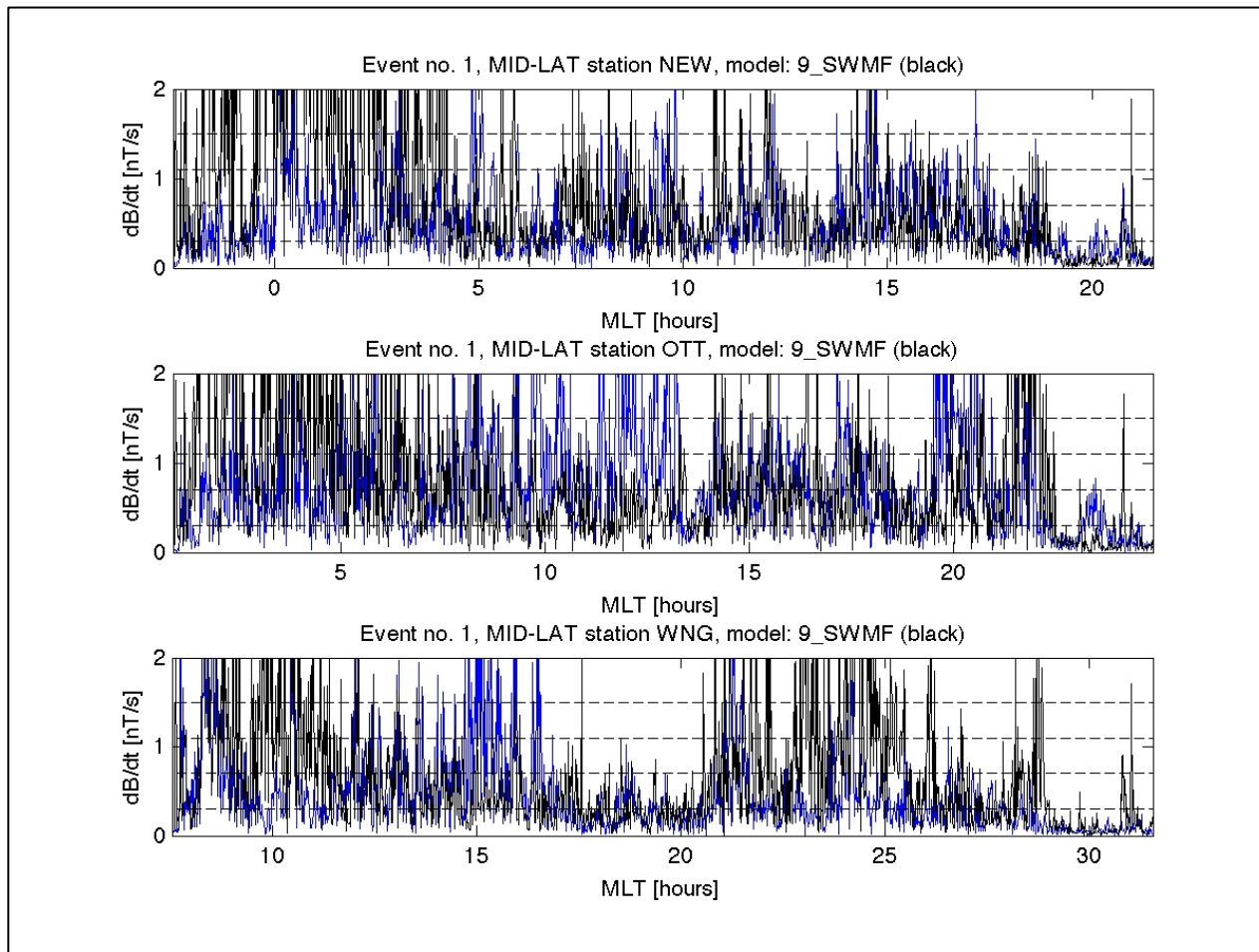


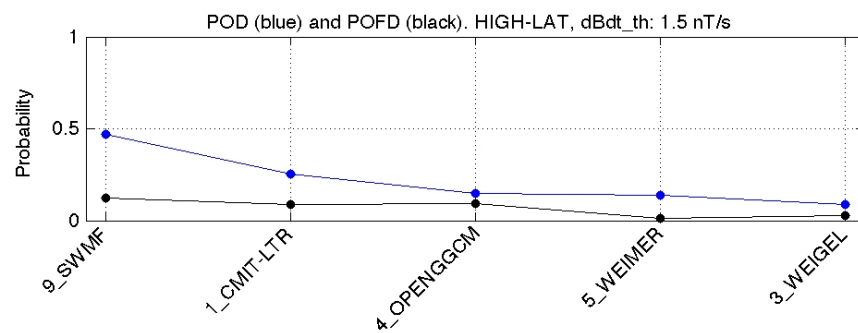
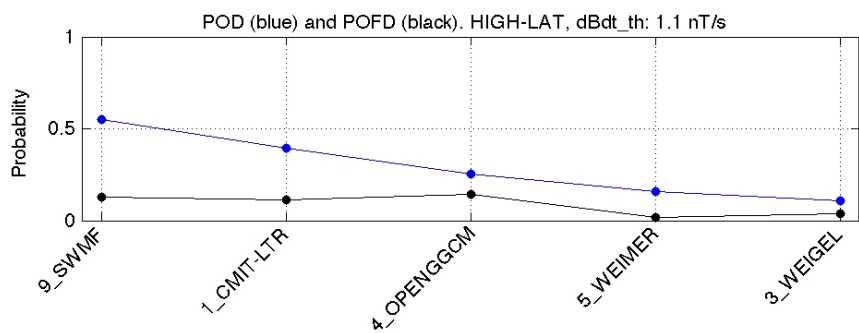
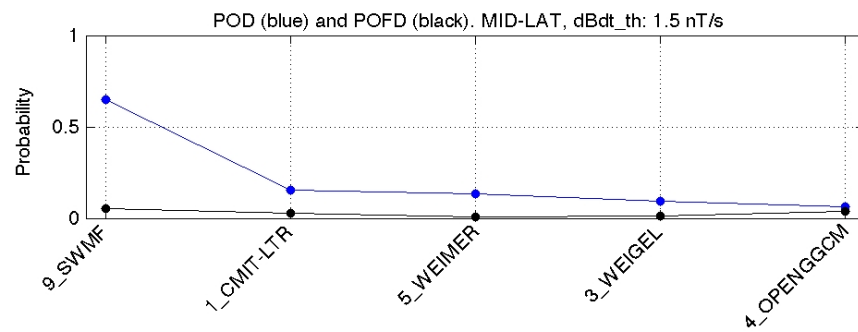
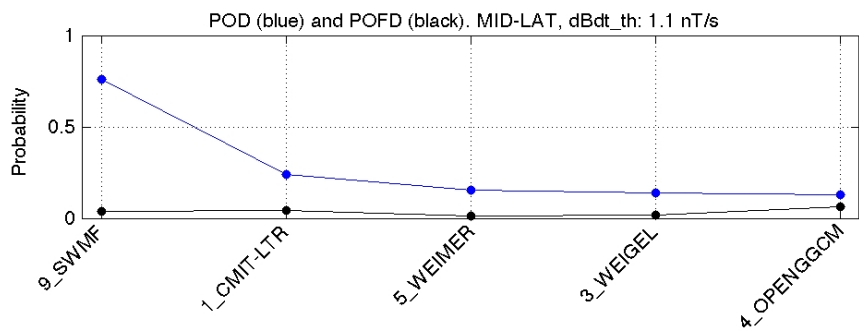
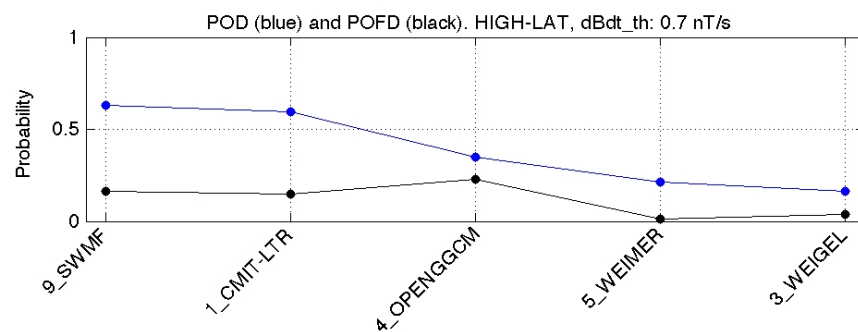
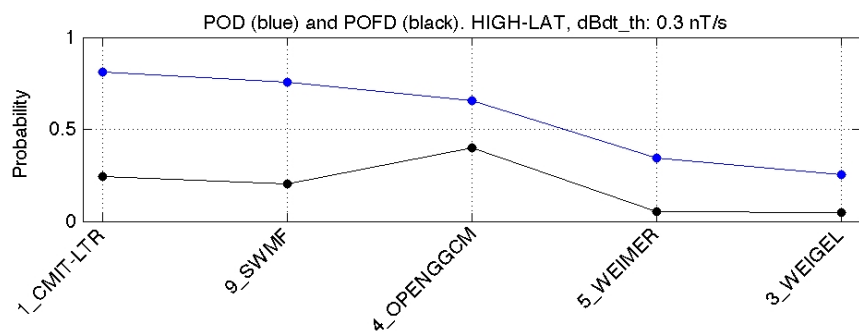
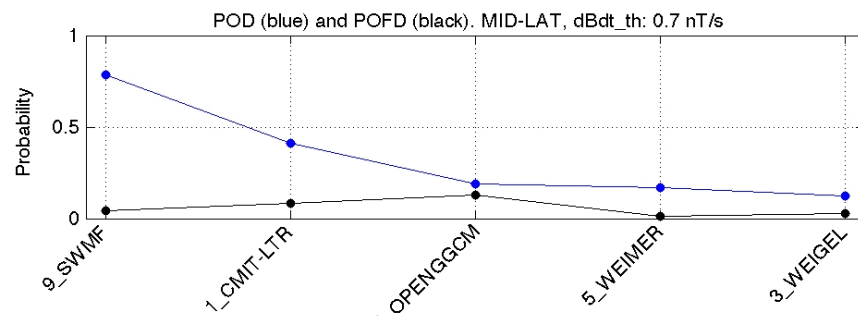
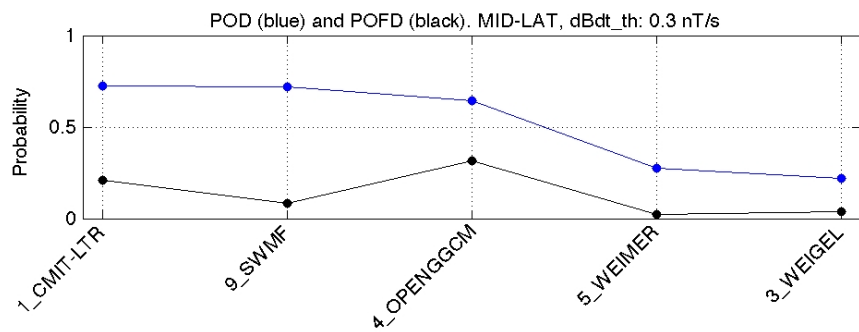
Results

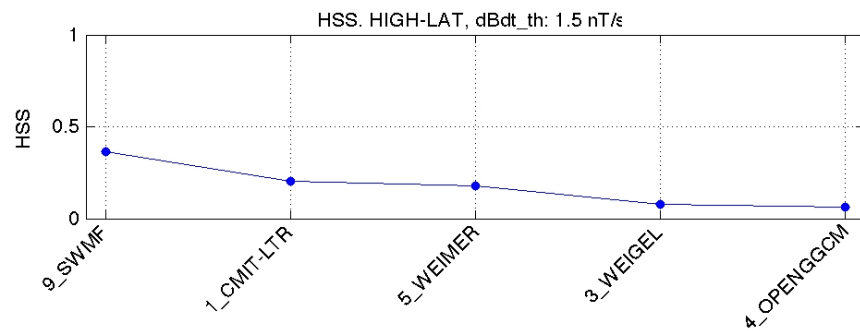
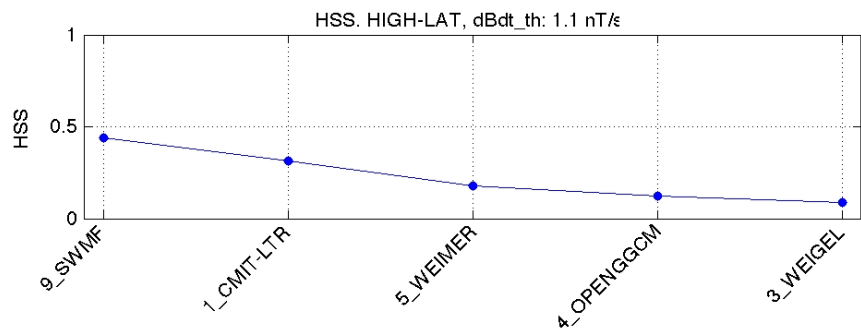
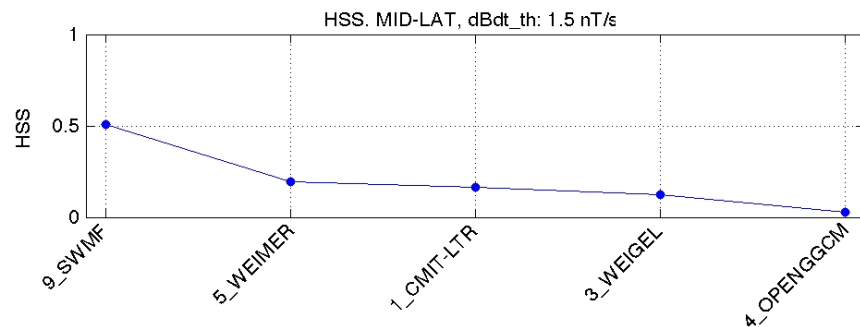
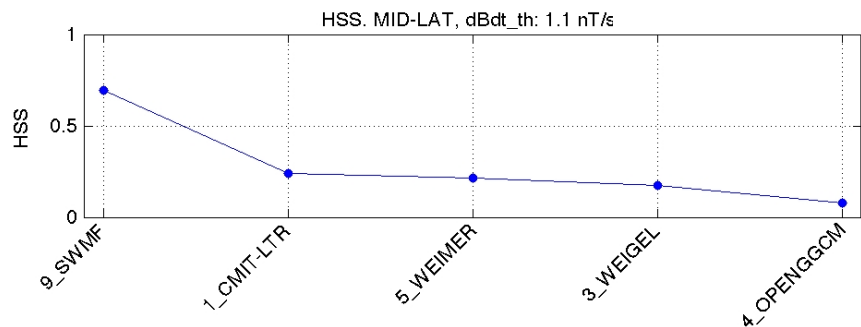
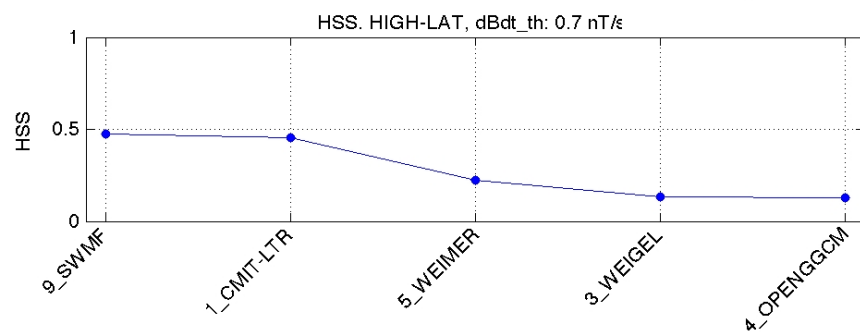
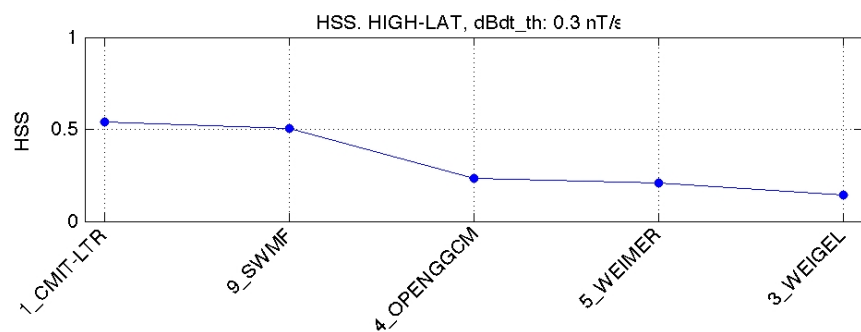
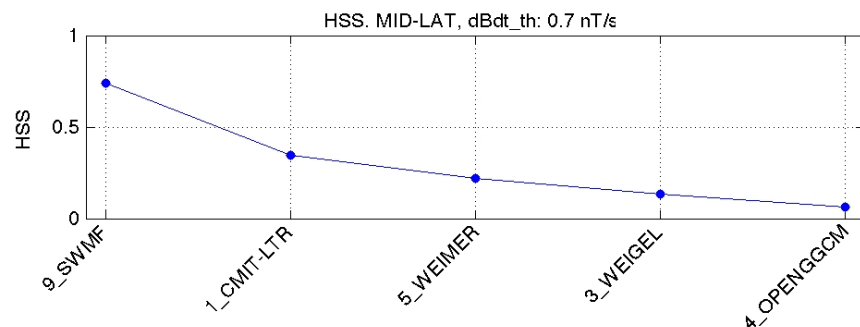
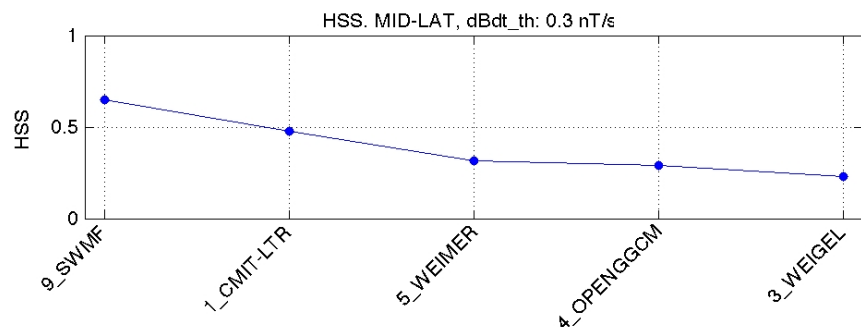


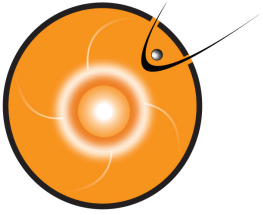


Results









Discussion

- We showed here only results integrated over all events.
 - For example, the Halloween storm event dominates the statistics for large threshold values.
 - Contingency tables for different events available.
 - We will prepare report/manuscript by September 1, 2012. Also our earlier sensitivity analyses will be documented in the report.
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