CME Arrival Time & Impact Working Team

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Team goals

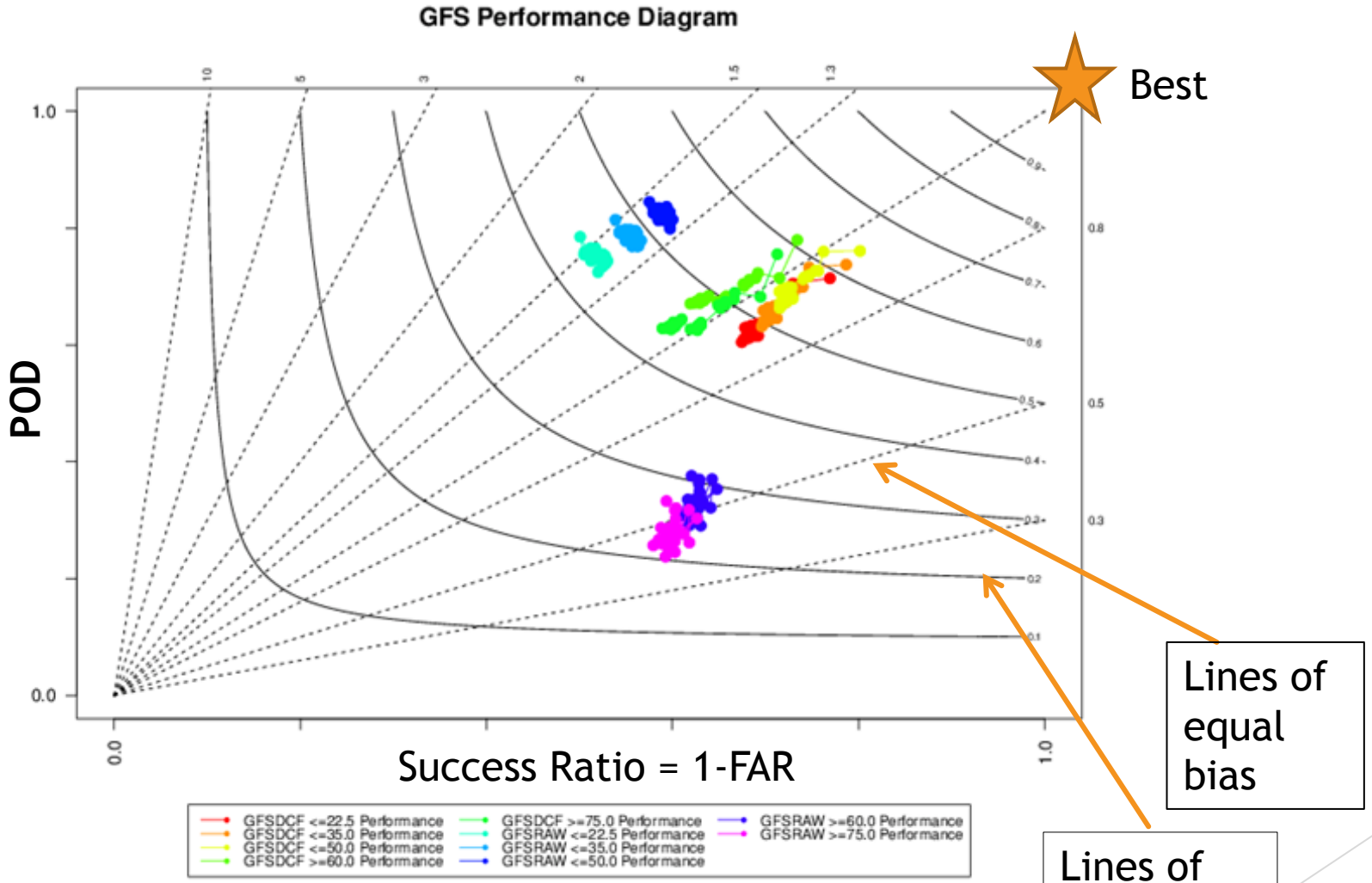
- Establish **community-agreed metrics and events** regarding CME arrival time and impact taking into account both **user and science** needs
- Provide **a benchmark** against which future models can be assessed
- Evaluate where we stand with **CME arrival time and impact prediction**
- Complimentary to CME Scoreboard

Community-agreed metrics for CME arrival time: Contingency table

	Observed Arrival	No Observed Arrival
Predicted Arrival	Hit (H)	False Alarm (FA)
No Predicted Arrival	Miss (M)	Correct Rejection (CR)

- What is a hit? – Different time intervals!
- Still under discussion which derived skill scores from contingency table will be used e.g. success ratio
- Performance diagram

Contingency table: Performance diagram



Best

Lines of equal bias

Lines of equal CSI

After Roebber (2009), slide adapted from T. Jensen

Community-agreed metrics for CME arrival time: Basic metrics

- Mean Error
- Mean Absolute Error
- Root Mean Square Error
  - Each error reflects on a different aspect
  - More will be added

- For CME impact: still under discussion

Solar background wind: effect?

- How do we **disentangle** wrong arrival due to wrong solar wind or due to wrong CME inputs/model limitations?
- Still under discussion: different options
  - Tag and model single CME events and their solar wind conditions
  - Do parametric model runs

Provide benchmark

- Database of events
- Metadata collection
- Agree on observations/inputs/outputs

Provide benchmark: Database events

- Model entire period, not selected set of events
  - Contingency table: accurate representation
- Core set as test events

CME scoreboard

CME: 2017-09-06T12:24:00-CME-001

Actual Shock Arrival Time: 2017-09-07T22:30Z

Observed Geomagnetic Storm Parameters:
Max Kp: 8.0
Dst min. in nT: -142
Dst min. time: 2017-09-08T02:00Z
CME Note: Associated with X9.3 flare from AR 12673.

Predicted Shock Arrival Time	Difference (hrs)	Confidence (%)	Submitted On	Lead Time (hrs)	Predicted Geomagnetic Storm Parameter(s)	Method
2017-09-08T06:00Z (-3.0h, +3.0h)	7.50	80.0	2017-09-07T05:00Z	17.50	Max Kp Range: 5.0 - 8.0	WSA-ENLIL + Cone (Met Office)
2017-09-08T06:00Z (-2.0h, +2.0h)	7.50	----	2017-09-07T16:30Z	6.00	----	Ooty IPS
2017-09-08T07:32Z (-5.0h, +6.0h)	9.03	----	2017-09-07T08:33Z	13.95	----	DBM
2017-09-08T08:00Z (-3.0h, +3.0h)	9.50	70.0	2017-09-07T05:40Z	16.83	----	DBM + ESWF
2017-09-08T10:16Z (-4.0h, +4.0h)	11.77	----	2017-09-07T09:00Z	13.50	----	EAM (Effective Acceleration Model)
2017-09-08T10:25Z	11.92	----	2017-09-07T02:13Z	20.28	----	SARM
2017-09-08T10:42Z	12.20	----	2017-09-07T15:55Z	6.58	----	SPM
2017-09-08T12:46Z	14.27	84.0	---	---	Max Kp Range: 4.33333 - 6.5	Average of all Methods
2017-09-08T13:00Z (-7.0h, +7.0h)	14.50	90.0	2017-09-07T08:25Z	14.08	Max Kp Range: 5.0 - 7.0	Other
2017-09-08T13:52Z	15.37	----	2017-09-07T15:46Z	6.73	----	SPM2
2017-09-08T15:48Z (-9.0h, +10.0h)	17.30	100.0	2017-09-07T14:53Z	7.62	Max Kp Range: 4.0 - 6.0	Ensemble WSA-ENLIL + Cone (GSFC SWRC)
2017-09-08T16:00Z	17.50	----	2017-09-09T12:59Z	-38.48	----	WSA-ENLIL + Cone (BoM)
2017-09-08T16:30Z (+14.0h)	18.00	----	2017-09-07T12:32Z	9.97	----	ElEvo
2017-09-08T17:00Z (-12.0h, +12.0h)	18.50	80.0	2017-09-06T22:40Z	23.83	Max Kp Range: 4.0 - 6.0	Other (SIDC)
2017-09-08T18:27Z (-7.0h, +7.0h)	19.95	----	2017-09-06T17:23Z	29.12	Max Kp Range: 3.0 - 5.0	WSA-ENLIL + Cone (GSFC SWRC)
2017-09-08T22:00Z	23.50	----	2017-09-06T23:24Z	23.10	Max Kp Range: 5.0 - 7.0	WSA-ENLIL + Cone (NOAA/SWPC)

- Use lessons learned for working team
  - Standardize inputs, metadata collection
  - Access to data
  - Use statistically significant set
  - Keep training and validation separate

Provide benchmarks: Metadata & Inputs/Observations/Outputs

- Collection of metadata for each model started
  - What parameters are variable and which stay fixed throughout different runs?
  - Will enable reproducibility of results and transparency in results
- CME input parameters from observations?
  - Catalog will be provided
  - Data can be modified in a consistent way
  - Can models use their own CME input parameters?
    - YES but:
      - Must run the provided data set as well
      - Add their measurements to the database

Upcoming plans

- End collection of metadata
- Set-up database
  - Implementation of the metadata for the models
  - CME measurements and metadata on model fitting
  - Link to CME arrivals at Earth