M-class Flare Forecast Verification

M Flare forecasts are daily probabilistic forecasts, ranging from 1% (0.01) to 99% (0.99), of the likelihood of an M class X-ray flare occurring within the specified 24-hour day. The M1 X-ray flare threshold is 10^{-5} Watts / m^2 X-ray flux in the 0.1 to 0.8 nm passband as measured by the NOAA GOES spacecraft. Forecast lead times range from one to three days. Verification results are provided on forecasts from July 1986 (the beginning of solar cycle 22) through December 2013.

M-class Flare Forecast Statistics Table

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# Prepared by the U.S. Dept. of Commerce, NOAA, Space Weather Prediction
Center.
# Please send comments and suggestions to SWPC.Webmaster@noaa.gov
#
# Annual Verification Statistics for Daily M Flare Probability Forecasts
#
# Lead Time:       Forecast lead time
# Total Records:   Total number of daily forecast/observation records used to
generate statistic
# Event Days:      Total number of days in the sample on which at least one M
class flare occurred
# Mean (f):        Mean forecast
# Mean (x):        Mean observation
# Median (f):      Median forecast
# Std Dev (f):     Standard deviation of forecasts
# Std Dev (x):     Standard deviation of observations
# Std Dev (f-x):   Standard deviation of forecasts minus observations
# Mean (f|x=1):    Mean forecast given the occurrence of an event
# Mean (f|x=0):    Mean forecast given the non-occurrence of an event
# Median (f|x=1):  Median forecast given the occurrence of an event
# Median (f|x=0):  Median forecast given the non-occurrence of an event
# Std Dev (f|x=1): Standard deviation of forecasts given the occurrence of an
event
# Std Dev (f|x=0): Standard deviation of forecasts given the non-occurrence
of an event
# Discrimination:  The difference between [Mean (f|x=1)] and [Mean (f|x=0)]
# ME:              Mean error
# MAE:             Mean absolute error
# MSE:             Mean square error
# RMSE:            Root mean square error
# Linear Assoc:    Linear correlation between forecasts and observations
# Skill:           Forecast skill with respect to observed climatology (same
as prediction efficiency)
#
# Missing data:          -99999
#

Forecast Type:  Likelihood (probability) of the occurrence of an M class
flare
Year:                      2013
Start:                   1/1/13
End:                    12/31/13
Lead Time:               Day 1          Day 2          Day 3
Total Records:             365            365            365
Events:                     63             63             63
Mean (f):                0.230          0.223          0.215
Mean (x):                0.173          0.173          0.173
Median (f):              0.150          0.150          0.150
Std Dev (f):             0.192          0.193          0.193
Std Dev (x):             0.378          0.378          0.378
Std Dev (f-x):           0.348          0.360          0.368
Mean (f|x=1):            0.400          0.370          0.345
Mean (f|x=0):            0.194          0.192          0.188
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Median (f|x=1):	0.400	0.400	0.300
Median (f|x=0):	0.150	0.100	0.100
Std Dev (f|x=1):	0.191	0.198	0.200
Std Dev (f|x=0):	0.172	0.178	0.180
Discrimination:	0.206	0.178	0.156
ME:	0.057	0.050	0.043
MAE:	0.264	0.268	0.269
MSE:	0.124	0.132	0.137
RMSE:	0.352	0.363	0.370
Linear Assoc:	0.406	0.349	0.307
Skill:	0.132	0.077	0.040

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2012		
Start:	1/1/12		
End:	12/31/12		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	366	366	366
Event Days:	75	75	75
Mean (f):	0.227	0.223	0.220
Mean (x):	0.205	0.205	0.205
Median (f):	0.150	0.150	0.150
Std Dev (f):	0.224	0.225	0.226
Std Dev (x):	0.404	0.404	0.404
Std Dev (f-x):	0.392	0.412	0.424
Mean (f|x=1):	0.374	0.332	0.304
Mean (f|x=0):	0.189	0.195	0.199
Median (f|x=1):	0.300	0.250	0.200
Median (f|x=0):	0.100	0.100	0.100
Std Dev (f|x=1):	0.263	0.263	0.265
Std Dev (f|x=0):	0.197	0.205	0.209
Discrimination:	0.185	0.137	0.106
ME:	0.022	0.018	0.015
MAE:	0.279	0.292	0.300
MSE:	0.153	0.169	0.180
RMSE:	0.392	0.411	0.424
Linear Assoc:	0.333	0.245	0.189
Skill:	0.058	-0.039	-0.102

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2011		
Start:	1/1/11		
End:	12/31/11		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	63	63	63
Mean (f):	0.223	0.215	0.207
Mean (x):	0.173	0.173	0.173
Median (f):	0.100	0.100	0.100
Std Dev (f):	0.225	0.220	0.217
Std Dev (x):	0.378	0.378	0.378
Std Dev (f-x):	0.346	0.364	0.374
Mean (f|x=1):	0.436	0.387	0.352
Mean (f|x=0):	0.178	0.179	0.177
Median (f|x=1):	0.450	0.400	0.400

Median (f|x=0):	0.100	0.100	0.100
Std Dev (f|x=1):	0.233	0.239	0.230
Std Dev (f|x=0):	0.196	0.198	0.202
Discrimination:	0.258	0.207	0.175
ME:	0.050	0.042	0.035
MAE:	0.245	0.254	0.258
MSE:	0.122	0.134	0.141
RMSE:	0.350	0.366	0.376
Linear Assoc:	0.433	0.357	0.305
Skill:	0.144	0.064	0.012

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2010		
Start:	1/1/10		
End:	12/31/10		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	14	14	14
Mean (f):	0.065	0.064	0.062
Mean (x):	0.038	0.038	0.038
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.128	0.126	0.125
Std Dev (x):	0.192	0.192	0.192
Std Dev (f-x):	0.204	0.227	0.230
Mean (f|x=1):	0.216	0.084	0.062
Mean (f|x=0):	0.059	0.063	0.062
Median (f|x=1):	0.150	0.050	0.050
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.231	0.093	0.066
Std Dev (f|x=0):	0.119	0.127	0.127
Discrimination:	0.157	0.021	0.000
ME:	0.027	0.025	0.024
MAE:	0.087	0.096	0.095
MSE:	0.042	0.052	0.053
RMSE:	0.206	0.228	0.230
Linear Assoc :	0.237	0.032	0.000
Skill :	-0.147	-0.405	-0.439

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2009		
Start:	1/1/09		
End:	12/31/09		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	0	0	0
Mean (f):	0.013	0.013	0.012
Mean (x):	0.000	0.000	0.000
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.015	0.013	0.011
Std Dev (x):	0.000	0.000	0.000
Std Dev (f-x):	0.015	0.013	0.011
Mean (f|x=1):	-99999	-99999	-99999
Mean (f|x=0):	0.013	0.013	0.012
Median (f|x=1):	-99999	-99999	-99999
Median (f|x=0):	0.010	0.010	0.010

Std Dev (f|x=1):	-99999	-99999	-99999
Std Dev (f|x=0):	0.015	0.013	0.011
Discrimination:	-99999	-99999	-99999
ME:	0.013	0.013	0.012
MAE:	0.013	0.013	0.012
MSE:	0	0	0
RMSE:	0.020	0.018	0.016
Linear Assoc :	-99999	-99999	-99999
Skill :	-99999	-99999	-99999

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2008		
Start:	1/1/08		
End:	12/31/08		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	366	366	366
Event Days:	1	1	1
Mean (f):	0.015	0.015	0.015
Mean (x):	0.003	0.003	0.003
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.039	0.039	0.039
Std Dev (x):	0.052	0.052	0.052
Std Dev (f-x):	0.064	0.065	0.065
Mean (f|x=1):	0.050	0.010	0.010
Mean (f|x=0):	0.015	0.015	0.015
Median (f|x=1):	-99999	-99999	-99999
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	-99999	-99999	-99999
Std Dev (f|x=0):	0.039	0.039	0.039
Discrimination:	0.035	-0.005	-0.005
ME:	0.012	0.012	0.012
MAE:	0.017	0.017	0.017
MSE:	0.004	0.004	0.004
RMSE:	0.065	0.066	0.066
Linear Assoc:	0.048	-0.006	-0.006
Skill:	-0.535	-0.617	-0.617

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2007		
Start:	1/1/07		
End:	12/31/07		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	5	5	5
Mean (f):	0.039	0.040	0.039
Mean (x):	0.014	0.014	0.014
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.090	0.091	0.091
Std Dev (x):	0.116	0.116	0.116
Std Dev (f-x):	0.101	0.117	0.127
Mean (f|x=1):	0.460	0.340	0.242
Mean (f|x=0):	0.034	0.036	0.037
Median (f|x=1):	0.600	0.300	0.100
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.251	0.251	0.249

Std Dev (f|x=0):	0.071	0.080	0.084
Discrimination:	0.426	0.304	0.205
ME:	0.026	0.026	0.026
MAE:	0.040	0.044	0.047
MSE:	0.011	0.014	0.017
RMSE:	0.104	0.119	0.130
Linear Assoc:	0.549	0.388	0.263
Skill:	0.200	-0.056	-0.247

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2006		
Start:	1/1/06		
End:	12/31/06		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	7	7	7
Mean (f):	0.058	0.056	0.055
Mean (x):	0.019	0.019	0.019
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.110	0.107	0.107
Std Dev (x):	0.137	0.137	0.137
Std Dev (f-x):	0.143	0.158	0.171
Mean (f|x=1):	0.336	0.200	0.086
Mean (f|x=0):	0.053	0.053	0.054
Median (f|x=1):	0.200	0.100	0.050
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.308	0.231	0.056
Std Dev (f|x=0):	0.096	0.102	0.108
Discrimination:	0.283	0.147	0.031
ME:	0.039	0.037	0.036
MAE:	0.064	0.068	0.071
MSE:	0.022	0.026	0.030
RMSE:	0.148	0.162	0.174
Linear Assoc:	0.353	0.187	0.040
Skill:	-0.157	-0.392	-0.612

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2005		
Start:	1/1/05		
End:	12/31/05		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	56	56	56
Mean (f):	0.190	0.188	0.182
Mean (x):	0.153	0.153	0.153
Median (f):	0.100	0.100	0.100
Std Dev (f):	0.231	0.227	0.224
Std Dev (x):	0.361	0.361	0.361
Std Dev (f-x):	0.295	0.311	0.327
Mean (f|x=1):	0.505	0.464	0.420
Mean (f|x=0):	0.133	0.138	0.139
Median (f|x=1):	0.500	0.500	0.400
Median (f|x=0):	0.050	0.050	0.050
Std Dev (f|x=1):	0.286	0.297	0.308
Std Dev (f|x=0):	0.165	0.169	0.174

Discrimination:	0.371	0.326	0.281
ME:	0.037	0.035	0.029
MAE:	0.189	0.199	0.207
MSE:	0.088	0.098	0.108
RMSE:	0.297	0.313	0.328
Linear Assoc:	0.580	0.518	0.453
Skill:	0.322	0.248	0.170

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2004		
Start:	1/1/04		
End:	12/31/04		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	366	366	366
Event Days:	65	65	65
Mean (f):	0.237	0.228	0.219
Mean (x):	0.178	0.178	0.178
Median (f):	0.150	0.150	0.150
Std Dev (f):	0.218	0.215	0.210
Std Dev (x):	0.383	0.383	0.383
Std Dev (f-x):	0.347	0.363	0.371
Mean (f|x=1):	0.444	0.399	0.368
Mean (f|x=0):	0.192	0.191	0.187
Median (f|x=1):	0.500	0.300	0.300
Median (f|x=0):	0.150	0.100	0.100
Std Dev (f|x=1):	0.252	0.254	0.250
Std Dev (f|x=0):	0.182	0.187	0.186
Discrimination:	0.252	0.208	0.181
ME:	0.059	0.050	0.042
MAE:	0.256	0.264	0.266
MSE:	0.123	0.134	0.139
RMSE:	0.351	0.366	0.373
Linear Assoc:	0.443	0.370	0.329
Skill:	0.156	0.082	0.048

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2003		
Start:	1/1/03		
End:	12/31/03		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	79	79	79
Mean (f):	0.298	0.289	0.279
Mean (x):	0.216	0.216	0.216
Median (f):	0.250	0.250	0.250
Std Dev (f):	0.228	0.221	0.215
Std Dev (x):	0.412	0.412	0.412
Std Dev (f-x):	0.365	0.387	0.400
Mean (f|x=1):	0.503	0.448	0.407
Mean (f|x=0):	0.242	0.245	0.243
Median (f|x=1):	0.500	0.400	0.350
Median (f|x=0):	0.200	0.200	0.200
Std Dev (f|x=1):	0.275	0.276	0.264
Std Dev (f|x=0):	0.175	0.181	0.184
Discrimination:	0.261	0.204	0.164

ME:	0.082	0.072	0.062
MAE:	0.297	0.311	0.319
MSE:	0.140	0.155	0.164
RMSE:	0.374	0.393	0.405
Linear Assoc:	0.472	0.379	0.315
Skill:	0.177	0.088	0.034

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2002		
Start:	1/1/02		
End:	12/31/02		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	136	136	136
Mean (f):	0.478	0.470	0.466
Mean (x):	0.373	0.373	0.373
Median (f):	0.500	0.500	0.500
Std Dev (f):	0.169	0.164	0.162
Std Dev (x):	0.484	0.484	0.484
Std Dev (f-x):	0.465	0.469	0.482
Mean (f|x=1):	0.542	0.525	0.505
Mean (f|x=0):	0.441	0.438	0.443
Median (f|x=1):	0.500	0.500	0.500
Median (f|x=0):	0.400	0.400	0.450
Std Dev (f|x=1):	0.161	0.164	0.167
Std Dev (f|x=0):	0.164	0.156	0.156
Discrimination:	0.101	0.087	0.062
ME:	0.106	0.098	0.094
MAE:	0.447	0.452	0.463
MSE:	0.226	0.229	0.240
RMSE:	0.476	0.479	0.490
Linear Assoc:	0.288	0.258	0.183
Skill:	0.032	0.019	-0.027

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2001		
Start:	1/1/01		
End:	12/31/01		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	149	149	149
Mean (f):	0.491	0.485	0.477
Mean (x):	0.408	0.408	0.408
Median (f):	0.450	0.400	0.400
Std Dev (f):	0.248	0.244	0.241
Std Dev (x):	0.492	0.492	0.492
Std Dev (f-x):	0.428	0.439	0.444
Mean (f|x=1):	0.638	0.618	0.602
Mean (f|x=0):	0.390	0.393	0.390
Median (f|x=1):	0.750	0.750	0.700
Median (f|x=0):	0.350	0.350	0.300
Std Dev (f|x=1):	0.209	0.218	0.219
Std Dev (f|x=0):	0.220	0.218	0.216
Discrimination:	0.248	0.225	0.213
ME:	0.083	0.076	0.068

MAE:	0.378	0.388	0.393
MSE:	0.190	0.198	0.201
RMSE:	0.435	0.445	0.449
Linear Assoc:	0.494	0.454	0.435
Skill:	0.215	0.181	0.166

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	2000		
Start:	1/1/00		
End:	12/31/00		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	366	366	366
Event Days:	130	130	130
Mean (f):	0.411	0.406	0.399
Mean (x):	0.355	0.355	0.355
Median (f):	0.400	0.400	0.400
Std Dev (f):	0.207	0.204	0.200
Std Dev (x):	0.479	0.479	0.479
Std Dev (f-x):	0.463	0.470	0.476
Mean (f|x=1):	0.493	0.476	0.459
Mean (f|x=0):	0.366	0.367	0.366
Median (f|x=1):	0.500	0.500	0.500
Median (f|x=0):	0.300	0.300	0.350
Std Dev (f|x=1):	0.213	0.208	0.215
Std Dev (f|x=0):	0.189	0.191	0.184
Discrimination:	0.126	0.110	0.093
ME:	0.056	0.050	0.044
MAE:	0.416	0.422	0.428
MSE:	0.217	0.223	0.228
RMSE:	0.466	0.472	0.478
Linear Assoc:	0.293	0.258	0.223
Skill:	0.053	0.028	0.003

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1999		
Start:	1/1/99		
End:	12/31/99		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	101	101	101
Mean (f):	0.346	0.338	0.330
Mean (x):	0.277	0.277	0.277
Median (f):	0.300	0.300	0.300
Std Dev (f):	0.243	0.240	0.239
Std Dev (x):	0.448	0.448	0.448
Std Dev (f-x):	0.416	0.432	0.435
Mean (f|x=1):	0.502	0.466	0.453
Mean (f|x=0):	0.287	0.289	0.283
Median (f|x=1):	0.500	0.500	0.500
Median (f|x=0):	0.250	0.200	0.200
Std Dev (f|x=1):	0.241	0.250	0.257
Std Dev (f|x=0):	0.216	0.217	0.215
Discrimination:	0.215	0.177	0.170
ME:	0.070	0.061	0.053
MAE:	0.345	0.357	0.356

MSE:	0.178	0.190	0.192
RMSE:	0.422	0.436	0.438
Linear Assoc:	0.397	0.331	0.319
Skill:	0.112	0.049	0.041

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1998		
Start:	1/1/98		
End:	12/31/98		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	364	363	362
Event Days:	74	74	74
Mean (f):	0.232	0.221	0.210
Mean (x):	0.203	0.204	0.204
Median (f):	0.200	0.200	0.200
Std Dev (f):	0.204	0.195	0.187
Std Dev (x):	0.403	0.403	0.404
Std Dev (f-x):	0.374	0.391	0.408
Mean (f|x=1):	0.388	0.338	0.288
Mean (f|x=0):	0.192	0.191	0.190
Median (f|x=1):	0.350	0.300	0.250
Median (f|x=0):	0.150	0.150	0.150
Std Dev (f|x=1):	0.236	0.224	0.211
Std Dev (f|x=0):	0.174	0.175	0.175
Discrimination:	0.196	0.147	0.097
ME:	0.028	0.017	0.006
MAE:	0.277	0.287	0.297
MSE:	0.141	0.153	0.166
RMSE:	0.375	0.391	0.407
Linear Assoc:	0.388	0.304	0.210
Skill:	0.132	0.058	-0.020

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1997		
Start:	1/1/97		
End:	12/31/97		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	14	14	14
Mean (f):	0.068	0.067	0.064
Mean (x):	0.038	0.038	0.038
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.133	0.132	0.132
Std Dev (x):	0.192	0.192	0.192
Std Dev (f-x):	0.203	0.213	0.220
Mean (f|x=1):	0.244	0.186	0.141
Mean (f|x=0):	0.061	0.062	0.061
Median (f|x=1):	0.150	0.150	0.100
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.263	0.168	0.139
Std Dev (f|x=0):	0.121	0.129	0.131
Discrimination:	0.183	0.124	0.080
ME:	0.030	0.029	0.026
MAE:	0.088	0.091	0.092
MSE:	0.042	0.046	0.049

RMSE:	0.205	0.215	0.221
Linear Assoc:	0.265	0.180	0.116
Skill:	-0.136	-0.248	-0.330

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1996		
Start:	1/1/96		
End:	12/31/96		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	366	366	366
Event Days:	4	4	4
Mean (f):	0.023	0.021	0.018
Mean (x):	0.011	0.011	0.011
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.057	0.047	0.040
Std Dev (x):	0.104	0.104	0.104
Std Dev (f-x):	0.099	0.107	0.107
Mean (f|x=1):	0.215	0.093	0.058
Mean (f|x=0):	0.021	0.020	0.018
Median (f|x=1):	0.200	0.150	0.010
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.206	0.097	0.095
Std Dev (f|x=0):	0.050	0.046	0.039
Discrimination:	0.194	0.073	0.039
ME:	0.012	0.010	0.008
MAE:	0.029	0.030	0.028
MSE:	0.010	0.012	0.012
RMSE:	0.100	0.108	0.108
Linear Assoc:	0.357	0.160	0.104
Skill:	0.079	-0.071	-0.071

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1995		
Start:	1/1/95		
End:	12/31/95		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	9	9	9
Mean (f):	0.027	0.025	0.024
Mean (x):	0.025	0.025	0.025
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.042	0.038	0.037
Std Dev (x):	0.155	0.155	0.155
Std Dev (f-x):	0.153	0.155	0.158
Mean (f|x=1):	0.080	0.053	0.033
Mean (f|x=0):	0.025	0.024	0.023
Median (f|x=1):	0.050	0.050	0.010
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.064	0.039	0.032
Std Dev (f|x=0):	0.041	0.038	0.037
Discrimination:	0.055	0.029	0.010
ME:	0.002	0.000	-0.001
MAE:	0.047	0.047	0.047
MSE:	0.023	0.024	0.025
RMSE:	0.152	0.155	0.158

Linear Assoc:	0.201	0.121	0.042
Skill:	0.035	-0.001	-0.037

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1994		
Start:	1/1/94		
End:	12/31/94		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	21	21	21
Mean (f):	0.063	0.062	0.061
Mean (x):	0.063	0.063	0.063
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.109	0.108	0.110
Std Dev (x):	0.265	0.265	0.265
Std Dev (f-x):	0.240	0.257	0.268
Mean (f|x=1):	0.247	0.199	0.149
Mean (f|x=0):	0.052	0.053	0.056
Median (f|x=1):	0.250	0.200	0.050
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.176	0.167	0.151
Std Dev (f|x=0):	0.093	0.098	0.105
Discrimination:	0.195	0.146	0.094
ME:	0.000	-0.001	-0.002
MAE:	0.098	0.102	0.107
MSE:	0.057	0.066	0.071
RMSE:	0.239	0.257	0.267
Linear Assoc:	0.426	0.275	0.183
Skill:	0.181	0.057	-0.021

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1993		
Start:	1/1/93		
End:	12/31/93		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	56	56	56
Mean (f):	0.190	0.187	0.181
Mean (x):	0.153	0.153	0.153
Median (f):	0.100	0.100	0.100
Std Dev (f):	0.202	0.201	0.199
Std Dev (x):	0.361	0.361	0.361
Std Dev (f-x):	0.350	0.366	0.375
Mean (f|x=1):	0.348	0.307	0.276
Mean (f|x=0):	0.161	0.165	0.163
Median (f|x=1):	0.300	0.250	0.200
Median (f|x=0):	0.100	0.100	0.100
Std Dev (f|x=1):	0.209	0.215	0.220
Std Dev (f|x=0):	0.187	0.191	0.190
Discrimination:	0.187	0.142	0.113
ME:	0.037	0.033	0.027
MAE:	0.237	0.246	0.249
MSE:	0.123	0.135	0.141
RMSE:	0.351	0.367	0.375
Linear Assoc:	0.334	0.254	0.205

Skill:	0.051	-0.036	-0.083

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1992		
Start:	1/1/92		
End:	12/31/92		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	366	366	366
Event Days:	97	97	97
Mean (f):	0.327	0.320	0.312
Mean (x):	0.265	0.265	0.265
Median (f):	0.300	0.300	0.300
Std Dev (f):	0.217	0.210	0.204
Std Dev (x):	0.442	0.442	0.442
Std Dev (f-x):	0.417	0.418	0.426
Mean (f|x=1):	0.457	0.441	0.417
Mean (f|x=0):	0.280	0.276	0.274
Median (f|x=1):	0.400	0.400	0.350
Median (f|x=0):	0.250	0.250	0.250
Std Dev (f|x=1):	0.238	0.239	0.238
Std Dev (f|x=0):	0.189	0.180	0.175
Discrimination:	0.177	0.165	0.143
ME:	0.062	0.055	0.047
MAE:	0.350	0.351	0.356
MSE:	0.177	0.178	0.183
RMSE:	0.421	0.421	0.428
Linear Assoc:	0.359	0.347	0.309
Skill:	0.092	0.088	0.061

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1991		
Start:	1/1/91		
End:	12/31/91		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	218	218	218
Mean (f):	0.578	0.561	0.549
Mean (x):	0.597	0.597	0.597
Median (f):	0.600	0.600	0.500
Std Dev (f):	0.248	0.246	0.244
Std Dev (x):	0.491	0.491	0.491
Std Dev (f-x):	0.439	0.467	0.480
Mean (f|x=1):	0.670	0.631	0.607
Mean (f|x=0):	0.441	0.457	0.462
Median (f|x=1):	0.700	0.700	0.650
Median (f|x=0):	0.400	0.400	0.400
Std Dev (f|x=1):	0.222	0.234	0.237
Std Dev (f|x=0):	0.221	0.228	0.230
Discrimination:	0.229	0.174	0.146
ME:	-0.019	-0.036	-0.049
MAE:	0.375	0.405	0.420
MSE:	0.192	0.219	0.232
RMSE:	0.439	0.468	0.482
Linear Assoc:	0.452	0.346	0.293
Skill:	0.200	0.091	0.034

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1990		
Start:	1/1/90		
End:	12/31/90		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	171	171	171
Mean (f):	0.468	0.460	0.455
Mean (x):	0.468	0.468	0.468
Median (f):	0.500	0.450	0.450
Std Dev (f):	0.222	0.220	0.220
Std Dev (x):	0.500	0.500	0.500
Std Dev (f-x):	0.478	0.489	0.496
Mean (f|x=1):	0.544	0.523	0.511
Mean (f|x=0):	0.402	0.405	0.406
Median (f|x=1):	0.600	0.500	0.500
Median (f|x=0):	0.400	0.400	0.400
Std Dev (f|x=1):	0.220	0.222	0.224
Std Dev (f|x=0):	0.203	0.202	0.205
Discrimination:	0.142	0.118	0.105
ME:	0.000	-0.008	-0.013
MAE:	0.427	0.439	0.445
MSE:	0.228	0.239	0.245
RMSE:	0.477	0.488	0.495
Linear Assoc:	0.319	0.268	0.238
Skill:	0.086	0.042	0.015

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

Year:	1989		
Start:	1/1/89		
End:	12/31/89		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	237	237	237
Mean (f):	0.641	0.632	0.621
Mean (x):	0.649	0.649	0.649
Median (f):	0.700	0.650	0.650
Std Dev (f):	0.252	0.252	0.255
Std Dev (x):	0.478	0.478	0.478
Std Dev (f-x):	0.436	0.450	0.458
Mean (f|x=1):	0.719	0.701	0.685
Mean (f|x=0):	0.497	0.506	0.502
Median (f|x=1):	0.800	0.800	0.750
Median (f|x=0):	0.500	0.500	0.500
Std Dev (f|x=1):	0.233	0.241	0.248
Std Dev (f|x=0):	0.219	0.222	0.225
Discrimination:	0.222	0.195	0.183
ME:	-0.008	-0.017	-0.028
MAE:	0.357	0.372	0.380
MSE:	0.190	0.202	0.210
RMSE:	0.436	0.450	0.458
Linear Assoc:	0.422	0.370	0.344
Skill:	0.167	0.111	0.078

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

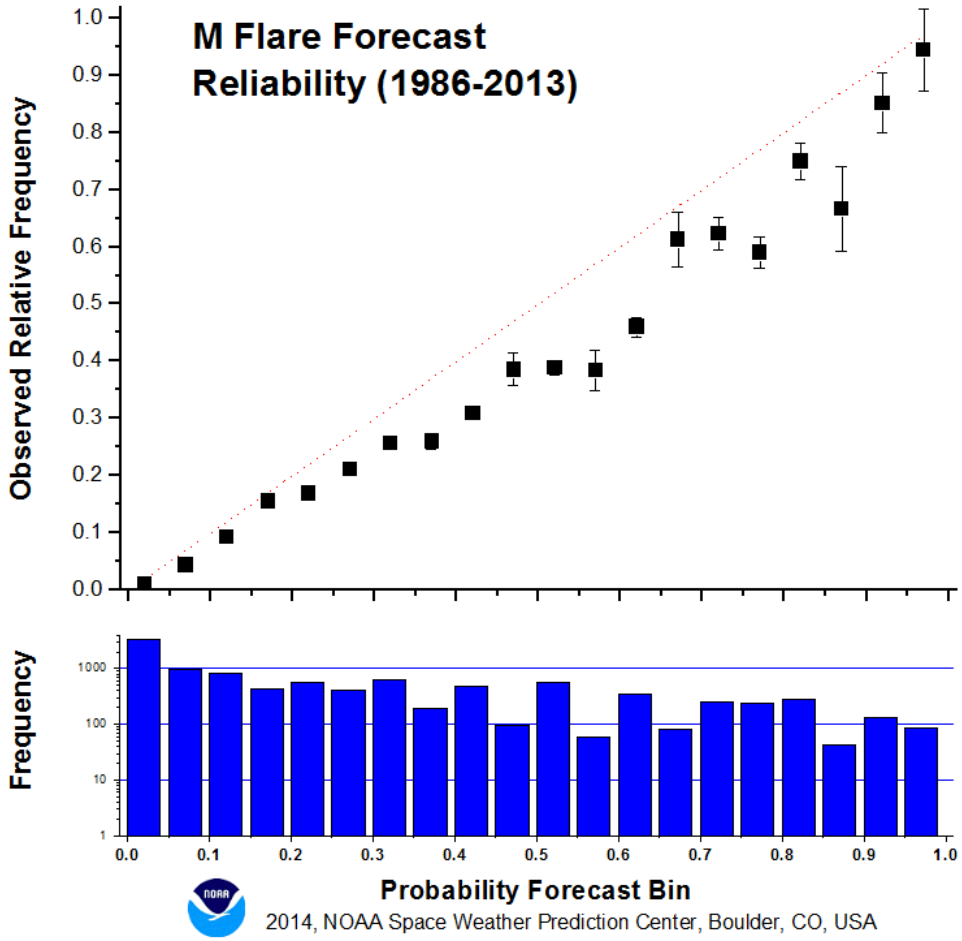
Year:	1988		
Start:	1/1/88		
End:	12/31/88		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	366	366	366
Event Days:	107	107	107
Mean (f):	0.348	0.338	0.326
Mean (x):	0.292	0.292	0.292
Median (f):	0.300	0.300	0.250
Std Dev (f):	0.254	0.253	0.251
Std Dev (x):	0.455	0.455	0.455
Std Dev (f-x):	0.412	0.417	0.419
Mean (f|x=1):	0.523	0.504	0.488
Mean (f|x=0):	0.276	0.269	0.259
Median (f|x=1):	0.500	0.500	0.500
Median (f|x=0):	0.200	0.200	0.200
Std Dev (f|x=1):	0.249	0.242	0.244
Std Dev (f|x=0):	0.219	0.224	0.221
Discrimination:	0.247	0.235	0.229
ME:	0.056	0.046	0.034
MAE:	0.335	0.336	0.333
MSE:	0.172	0.176	0.176
RMSE:	0.415	0.419	0.420
Linear Assoc:	0.442	0.423	0.416
Skill:	0.167	0.151	0.149

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

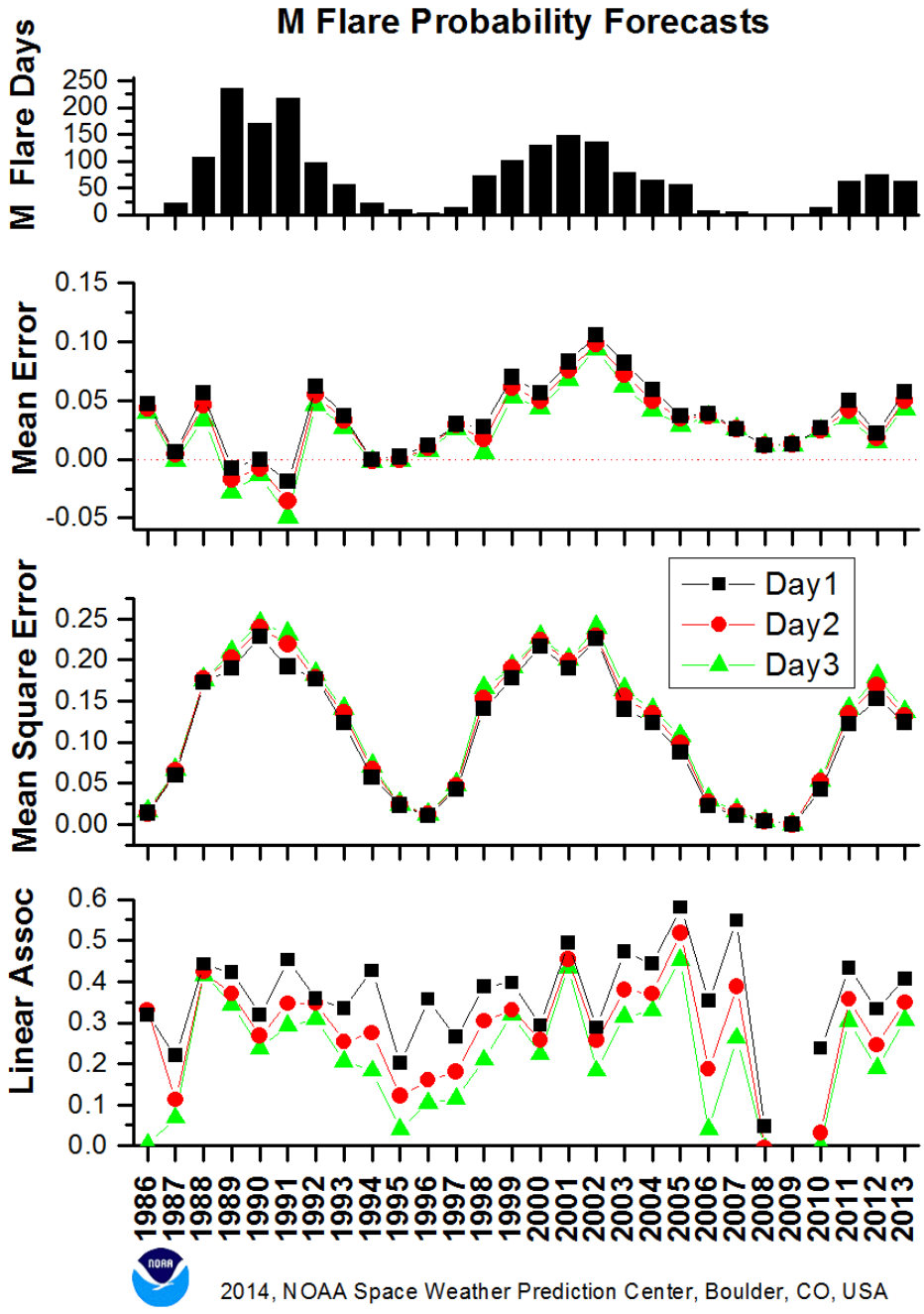
Year:	1987		
Start:	1/1/87		
End:	12/31/87		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	365	365	365
Event Days:	23	23	23
Mean (f):	0.069	0.067	0.062
Mean (x):	0.063	0.063	0.063
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.111	0.112	0.107
Std Dev (x):	0.243	0.243	0.243
Std Dev (f-x):	0.244	0.256	0.259
Mean (f|x=1):	0.163	0.116	0.090
Mean (f|x=0):	0.063	0.064	0.060
Median (f|x=1):	0.150	0.150	0.050
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	0.133	0.091	0.081
Std Dev (f|x=0):	0.107	0.112	0.109
Discrimination:	0.101	0.052	0.030
ME:	0.006	0.004	-0.001
MAE:	0.112	0.115	0.114
MSE:	0.060	0.065	0.067
RMSE:	0.244	0.256	0.259
Linear Assoc:	0.220	0.113	0.069
Skill:	-0.008	-0.107	-0.133

Forecast Type: Likelihood (probability) of the occurrence of an M class flare

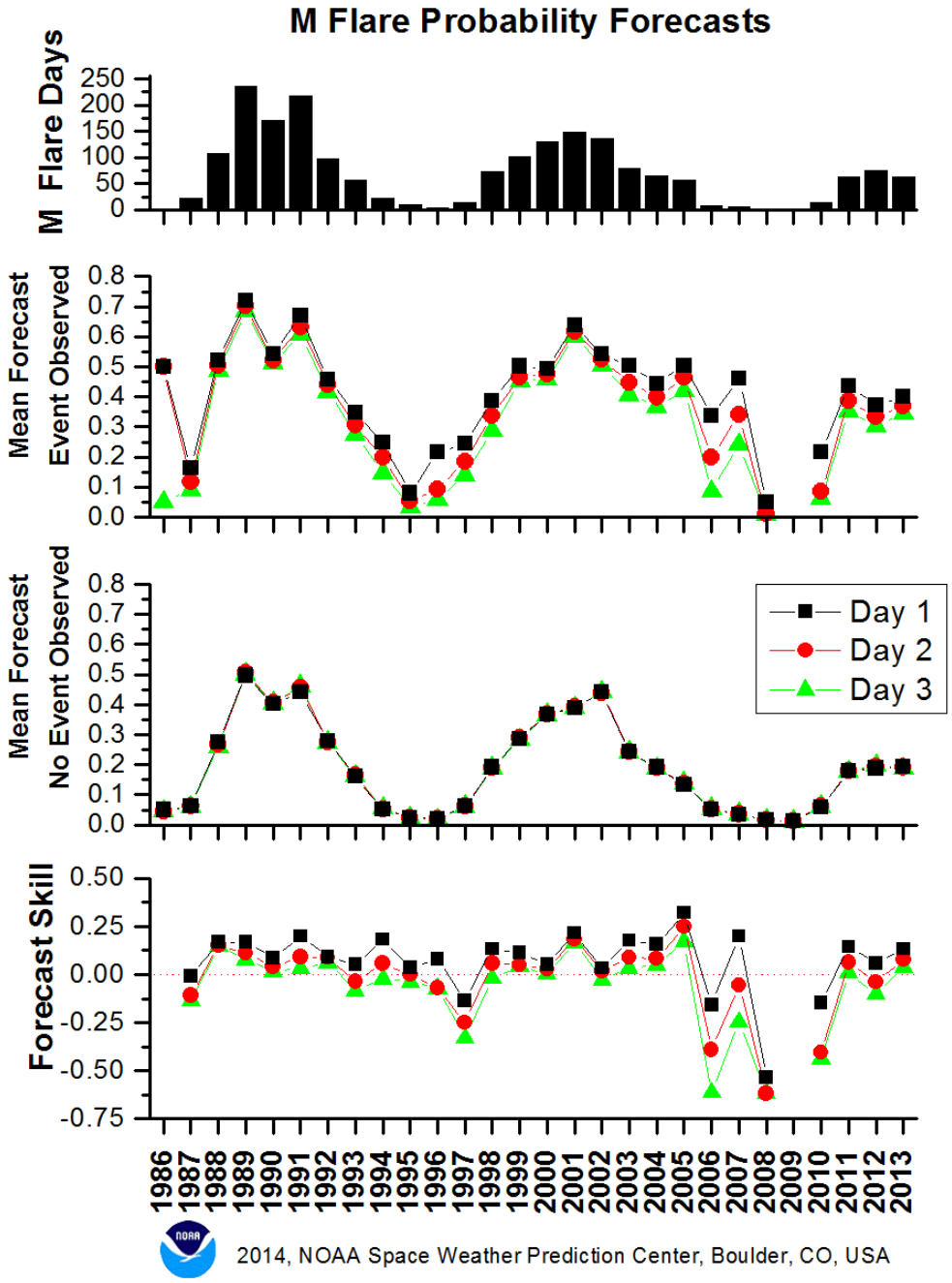
Year:	1986		
Start:	7/1/86		
End:	12/31/86		
Lead Time:	Day 1	Day 2	Day 3
Total Records:	184	184	184
Event Days:	1	1	1
Mean (f):	0.052	0.049	0.045
Mean (x):	0.005	0.005	0.005
Median (f):	0.010	0.010	0.010
Std Dev (f):	0.104	0.101	0.095
Std Dev (x):	0.074	0.074	0.074
Std Dev (f-x):	0.107	0.104	0.120
Mean (f|x=1):	0.500	0.500	0.050
Mean (f|x=0):	0.050	0.046	0.045
Median (f|x=1):	-99999	-99999	-99999
Median (f|x=0):	0.010	0.010	0.010
Std Dev (f|x=1):	-99999	-99999	-99999
Std Dev (f|x=0):	0.099	0.096	0.096
Discrimination:	0.450	0.454	0.005
ME:	0.047	0.043	0.040
MAE:	0.052	0.049	0.050
MSE:	0.014	0.013	0.016
RMSE:	0.116	0.112	0.126
Linear Assoc:	0.318	0.331	0.004
Skill:	-1.505	-1.323	-1.953



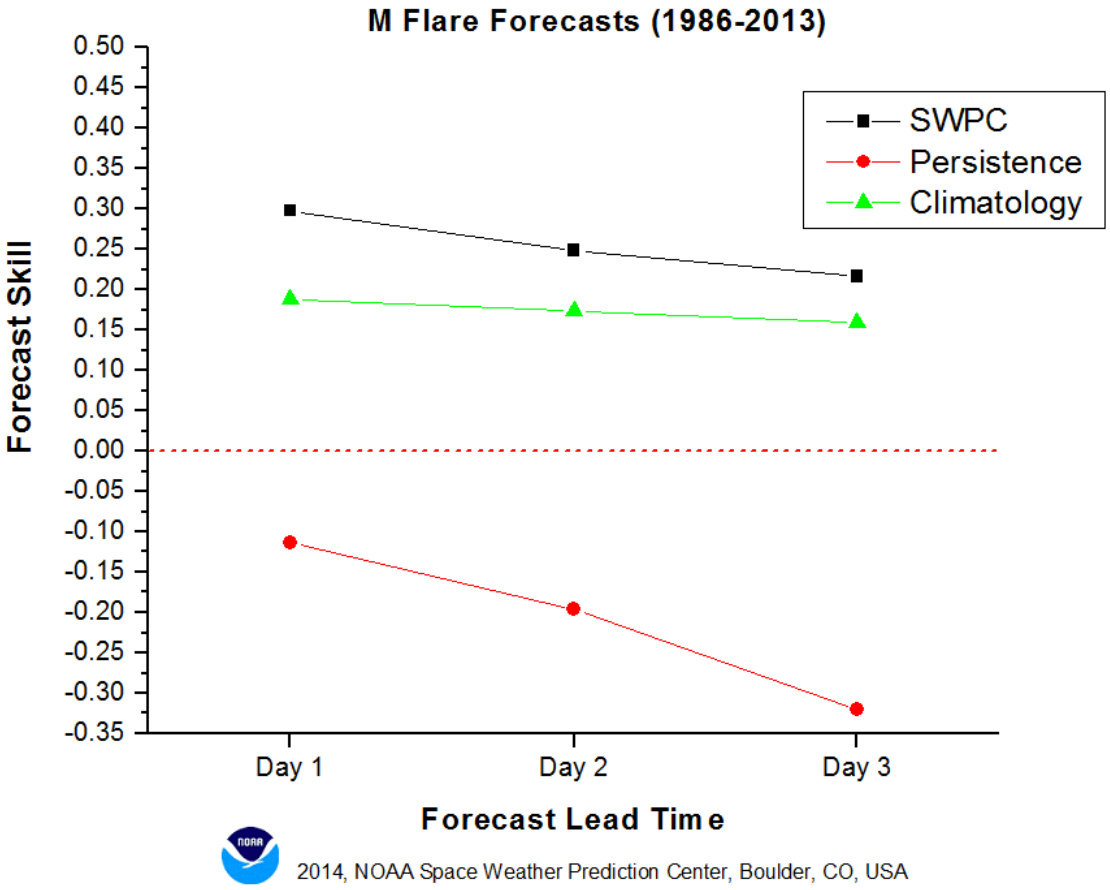
Next-day (1-day lead time) M flare forecast "reliability" during the period 1986 to 2013. The top panel plots the observed relative frequency of M flare days (days on which an M flare occurred) against their corresponding forecasts, grouped in 5% (0.05) bins. The dashed diagonal line represents perfect correspondence. Points falling below the diagonal indicate a tendency of the forecasts within that bin to overpredict the occurrence of M flares while points above the diagonal indicate underprediction. The error bars in the top panel correspond to the standard error associated with the number of forecasts in each bin. The number of forecasts in each bin is plotted in the bottom panel histogram. Note that the histogram Y-axis scale is logarithmic.



These plots show the annual trend, from 1986 to 2013, of various verification metrics for M flare forecasts with lead times of one to three days. The top panel plots the number of days on which an M flare occurred during the year (event climatology), the second panel plots the mean error (or bias) of the forecasts, the third panel shows the mean square error of the forecasts, and the bottom panel displays the linear association (correlation) between the forecasts and observations.



These plots show the annual trend, from 1986 to 2013, of various verification metrics for M flare forecasts with lead times of one to three days. The top panel plots the number of days on which an M flare occurred during the year (event climatology), the second panel plots the mean value of the forecasts associated with days on which an M flare occurred, the third panel plots the mean value of the forecasts associated with days on which an M flare did not occur, and the bottom panel displays annual SWPC forecast skill relative to sample climatology forecasts (prediction efficiency).



Forecast skill as a function of lead-time for M flare probability forecasts during the period 1986 to 2013. The skill of forecasts produced by SWPC is compared to that of forecasts produced by short-term (30-day) climatology and 1-day persistence. This skill metric is based on the relative error of the forecasts with respect to constant forecasts of sample climatology (the mean observation during the period) and is sometimes called the “prediction efficiency.” The upper bound for this metric is "one" and there is no lower bound. Negative values indicate no skill above constant forecasts of sample climatology.