Max Millennium Program of Solar Flare Research: Evaluation of Cycle 23 Major Flare Watches

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Hinode 4 Science Meeting

October 14, 2010

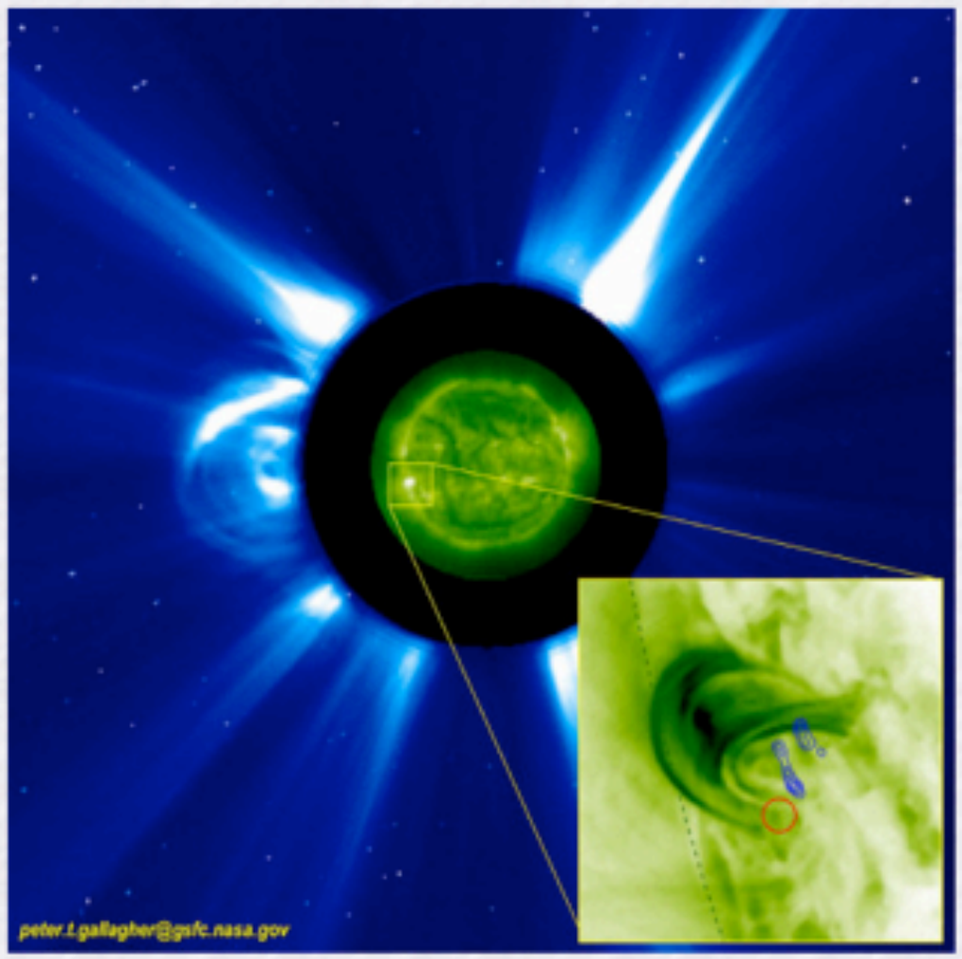
MAX MILLENNIUM PROGRAM

OF SOLAR FLARE RESEARCH

The following Observing Plans are open for possible use today:

"OP 003. Regions Likely to Produce Major Flares"

Contact | Data Archives | Education & Outreach | E-Print Archive | Ground Based Observatories | Home | Mail Lists and Archives | MMMOTD Mail Archive | MMScience Mail Archive | Observing Plans | Press | RHESSI Data Analysis Mail Archive | RHESSI Data Analysis Projects | RHESSI Science Nuggets | Space Based Observatories | Sun Today



The primary goal of the Max Millennium Program is to understand particle acceleration and explosive energy release in solar flares. Elements of the program are coordinated observations, data analysis, and theory. Through electronic mail and the WWW, we work closely with the NASA RHESSI mission and the solar research community. World-wide participation, guided by the Max Millennium Steering Committee and the Max Millennium Chief Observer, is essential to successful achievement of our goals.

Solar Physics E-Print Archive

There are 1947 abstracts currently viewable.

List of Abstracts, No: 1 to 20

Submitter	Title	Authors	Date
Paulett Liewer	Stereoscopic Analysis of STEREO/SECCHI Data for CME Trajectory Determination	P. C. Liewer, J. R. Hall, R. A. Howard, E. M. De Jong, W. T. Thompson, A. Thernisien	2010-10-06
Markus J. Aschwanden	The State of Self-Organized Criticality of the Sun During the Last Three Solar Cycles. II. Theoretical Model	Markus J. Aschwanden	2010-10-05
Valery Nakariakov	Oscillatory processes in solar flares	Authors: V.M. Nakariakov, A.R. Inglis, I.V. Zimovets, C. Foullon, E. Verwichte, R. Sych, I. N. Myagkova	2010-10-05
Spiros Patsourakos	Evidence for a current sheet forming in the wake of a Coronal Mass Ejection from multi-viewpoint coronagraph observations	S. Patsourakos, A. Vourlidas	2010-10-05
Thomas Wiegelmann	Magnetic loops in the quiet Sun	Thomas Wiegelmann, Sami K Solanki, Juan Borrero, Valentin Martinez Pillet, J. C. del Toro Iniesta, Vicente Domingo, J. A. Bonet Navarro, Peter Barthol, Achim Gandorfer, Michael Knoelker, Wolfgang Schmidt, Alan M. Title	2010-10-04
Shane Maloney	Solar Wind Drag and the Kinematics of Interplanetary Coronal Mass Ejections	Shane, A. Maloney, Peter, T. Gallagher	2010-10-03
Nat Gopalswamy	Long-duration Low-frequency Type III Bursts and Solar Energetic Particle Events	N. Gopalswamy and P. Makela	2010-10-03
Stathis Ilonidis	Determining Absorption, Emissivity Reduction, and Local Suppression Coefficients inside Sunspots	Stathis Ilonidis and Junwei Zhao	2010-10-02
Petr Jelinek	Impulsively Generated Wave Trains in a Solar Coronal Loop	Petr Jelinek and Marian Karlicky	2010-09-30
Pawel Rudawy	Search for Rapid Changes in the Visible-Light Corona during the 21~June 2001 Total Solar Eclipse	P. Rudawy, K.J.H. Phillips, A. Buczylko, D.R. Williams, F.P. Keenan	2010-09-28
Guillaume Aulanier	A single picture for solar coronal outflows and radio noise storms	Del Zanna, G., Aulanier, G., Klein, K.-L., Torok, T.	2010-09-28
Rui Liu	A Reconnecting Current Sheet Imaged in A Solar Flare	Rui Liu, Jeongwoo Lee, Tongjiang Wang, Guillermo Stenborg, Chang Liu, Haimin Wang	2010-09-27
Anastasios Anastasiadis	Universality in solar flare, magnetic storm and earthquake dynamics using Tsallis statistical mechanics	G. Balasis, I. A. Daglis, A. Anastasiadis, C. Papadimitriou, M. Mandea, K. Eftaxias	2010-09-27

Notes

Click on submitter name to send email to submitter.

Click on title to display the full abstract.

Older Entries

MAX MILLENNIUM MAILING LISTS AND ARCHIVES

There are three Max Millennium mailing lists and corresponding archives, with the following addresses:

- **MMscience at solar.physics.montana.edu**: a general-purpose list for messages about campaign plans, observations, meetings, workshops, new databases and facilitites, etc; a moderated list that anyone may use for the benefit of solar flare science.
- **MMmotd at solar.physics.montana.edu**: a special-purpose list for transmission of the "message of the day" identifying the chosen Max Millennium program target, campaign, or observing program of the day; only campaign leaders and the Max Millennium Chief Observers are able to post to this list.
- **RHESSI_Data_Analysis at solar.physics.montana.edu**: a special-purpose list for sharing any and all information relevant to the analysis of RHESSI data, e.g. instrument performance, calibration, software; a moderated list that anyone may use for the benefit of RHESSI data analysis.

MMscience	MMmotd	RHESSI_Data_Analysis
Enter e-mail address to subscribe: Enter	Enter e-mail address to subscribe: Enter	Enter e-mail address to subscribe: Enter
View List	View List	View list
Go to archive	Go to archive	Go to archive

To remove your name from any list, or to change your address, simply e-mail canfield at physics.montana.edu or use majordomo at mithra.physics.montana.edu to do so yourself. An e-mail message to this majordomo address with only the word help in the body of the message will provide guidance.

MM Chief Observers (MM_CO)
MM Message of the Day (MOTD)

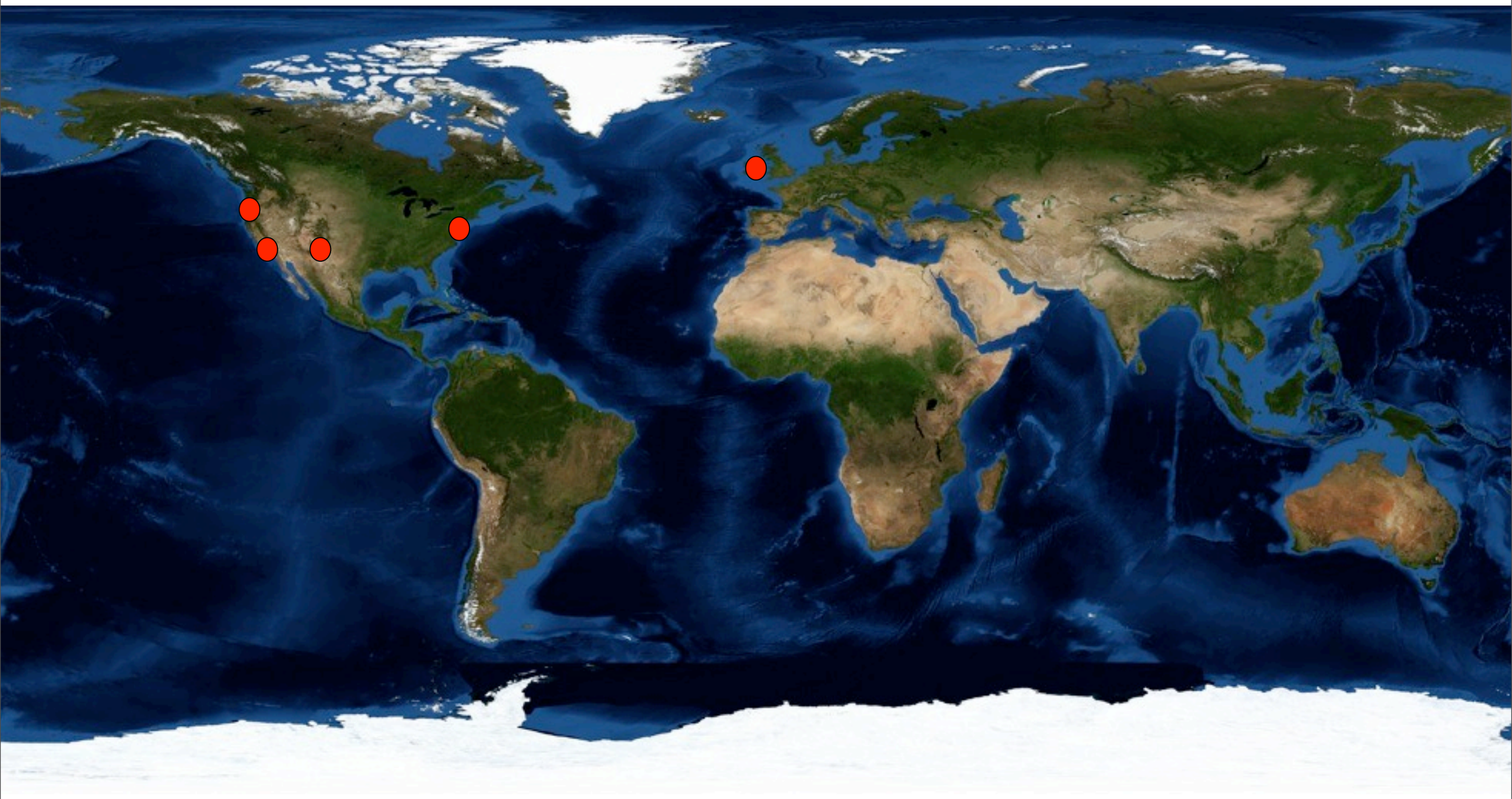
The MM_COs keep abreast of solar activity.

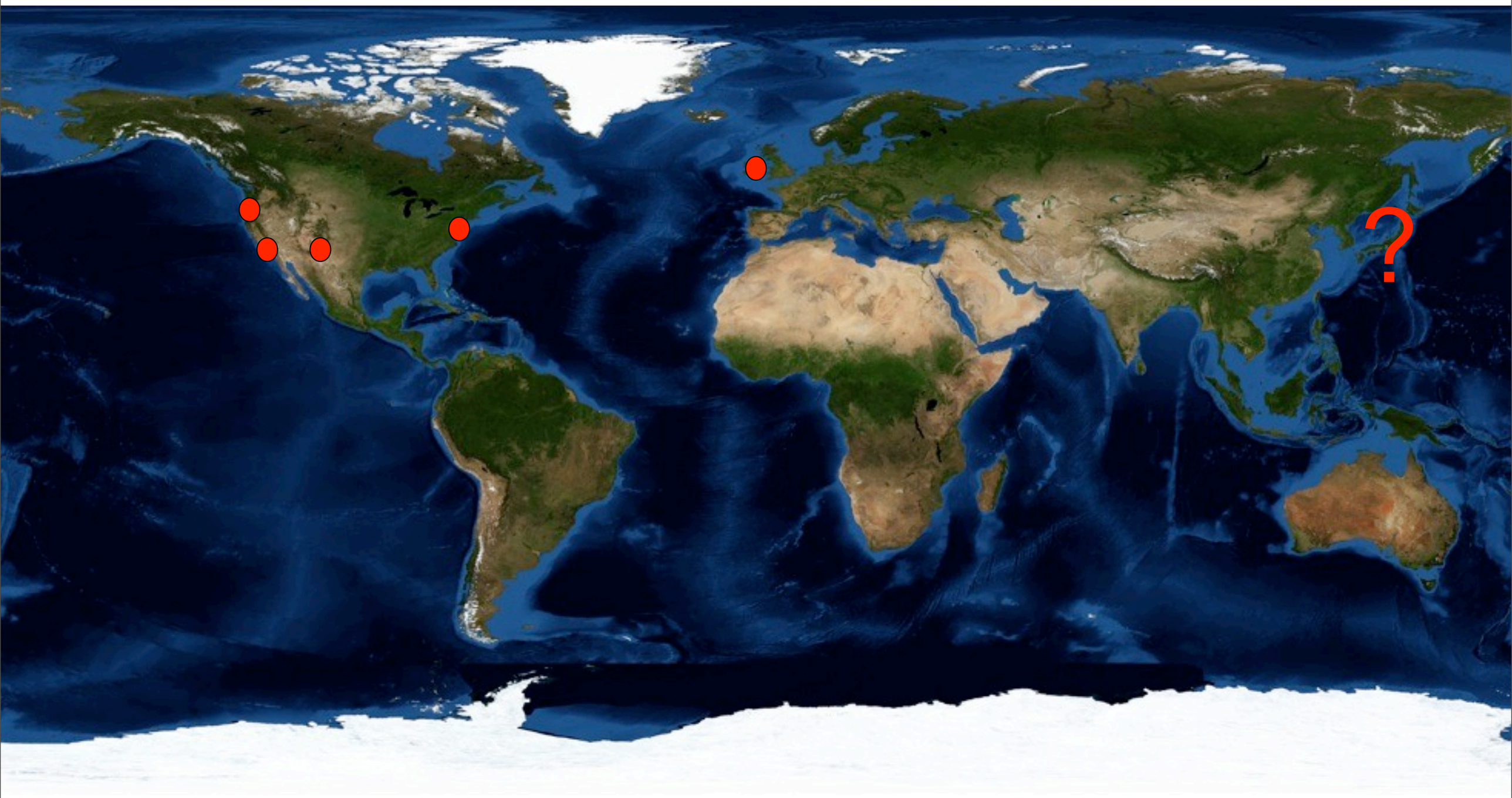
Each day, the MM_CO who is on duty selects the most appropriate Active Region and Observing Plan (if no pre-chosen plan is in place) using all available on-line data and their expertise at solar activity forecasting.

The MM_CO sends out the MOTD to over 200 solar scientists, planners, and observers worldwide via the self-subscribing MOTD e-mail system on a daily (or more frequent) basis.

The following team serves as MM_CO on a rotating basis:

- Shaun Bloomfield — Trinity College Dublin
- William Marquette — Helio Research
- James McAteer — New Mexico State University
- Ryan Milligan — Goddard Space Flight Center
- Clare Raftery — Space Science Laboratory, Berkeley





Typical Major Flare Watch MOTD

Date: Thu, 19 Jun 2003 08:57:04 -0700 (PDT)
From: Max Millennium Chief Observer <mm_co@bbso.njit.edu>
Subject: Major Flare Watch

Dear RHESSI collaborators,

Target region, NOAA 0386, was quiescent yesterday, but it continues to maintain its reversed polarity beta-gamma-delta magnetic configuration. As long as 0386 remains magnetically complex, it has the potential to produce another major flare.

The position of NOAA 0386 on June 19 at 15:00 UT:
S07E35 (Solar X = -539", Solar Y = -135")

See www.bbso.njit.edu/arm/latest/, www.lmsal.com/solarsoft/last_events and www.bbso.njit.edu/cgi-bin/LatestImages for images and additional information and for a description of the current Max Millennium Observing Plan go to solar.physics.montana.edu/max_millennium/ops/observing.shtml.

Regards,
Bill Marquette
BBSO/NJIT

MAX MILLENNIUM OBSERVING PLANS

Observing plans in *italics* do not have a fixed schedule -- they are used in response to solar circumstances [Target of Opportunity].

OP 001. 3-D Structure of Flaring Active Regions
OP 002. *Eruptive Flares Associated with Sigmoids during WSM3*
OP 003. *Region Likely to Produce Major Flares*
OP 004. Flare Genesis Flight in Antarctica
OP 005. The Triggering and Evolution of Solar Flares
OP 006. H-alpha Linear Polarization in Flares
OP 007. Doppler Shifts in X-Ray Jets
OP 008. Moreton/EIT Observing Campaign
OP 009. *Default RHESSI Collaboration*
OP 010. Flare Loop Oscillations
OP 011. *Eruptive Flares Associated with Sigmoids*
OP 012. Type I Noise Storms and Related Activity
OP 013. Helium Abundance in Flares from the Chromosphere to the Solar Wind
OP 014. High Cadence Imaging
OP 015. VLA-RHESSI-TRACE Observations of Flare Buildup and Impulsive Energy Release in Active Regions
OP 016. RHESSI-TRACE Micro-Events

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Major Flare Watch Scientific Goals

The scientific goal of this program is to understand energy release, particle acceleration, and particle and energy transport in the largest flares, which afford unique opportunities for observations of gamma-ray lines.

Key questions are:

1. What is the partition of energy between ions and electrons?
2. Where are ions accelerated, and what are the physical conditions (temperature, density, velocity and magnetic fields) there?
3. What are the abundances of accelerated particles and the ambient atmosphere at the Sun?
4. What mechanisms accelerate both electrons and ions to high energies so rapidly and efficiently?
5. What mechanisms transport high-energy ions away from the acceleration site?
6. What are the characteristic signatures of flares that have potentially hazardous radiation effects?
7. What is the relationship between ion acceleration and CMEs?

Coordinated observations between space- and ground based instruments are crucial for answering these questions

Current Criteria for Calling an MFW (Zirin & Marquette, 1990; BEARALERTS)

- A major flare has occurred (if a region produced one big flare, it will probably produce at least one more)
- Large island delta - opposite polarity umbrae within 2 heliographic degrees within a common penumbra (delta configuration) and, in addition, the delta surrounded by opposite polarity flux - even better if the region is reversed polarity. Bright H-alpha will be present.
- Large delta configuration with bright H-alpha plage and better still if reversed polarity. Bright H-alpha along the neutral line is needed.
- Elongated umbrae in pairs of opposite polarity even if the umbrae are not a delta configuration. Transverse magnetograms will reveal strong shear.
- EFR within an existing active region, if the leader spots of the EFR are adjacent to the existing region's trailing spots or vice-versa.
- Rapidly moving sunspots - sunspot(s) moving towards and/or into an opposite polarity spot.

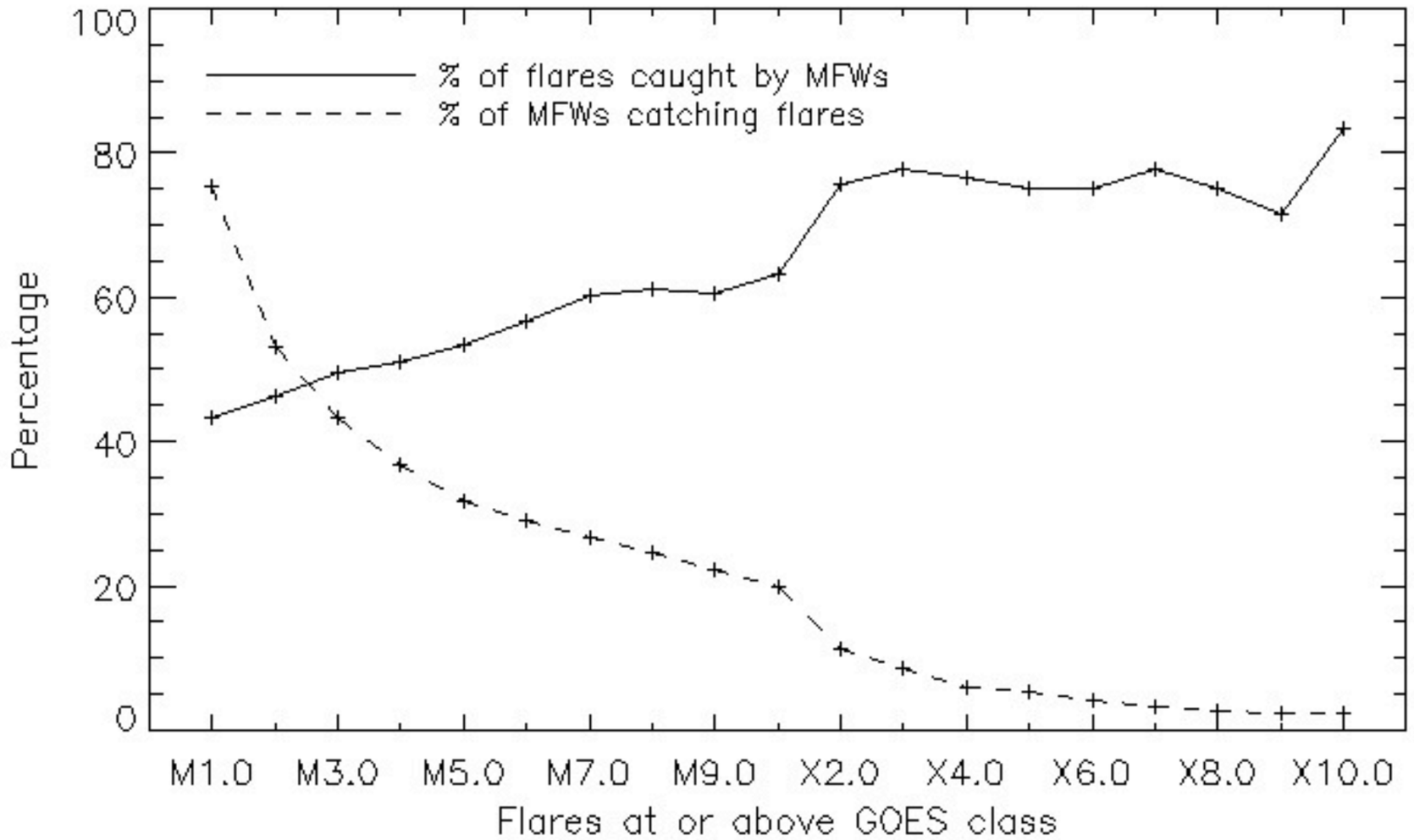
Statistics for Daily MFW Messages

Number of flares at or above a chosen GOES class within 24 hours of the Major Flare Watch UTC message issue times (24-hour MFW periods, MFWs below) during the period 26-Mar-2001 to 17-May-2010

Flare GOES class	Flares in all MFWs	Total flares	% flares in MFW	MFWs with flares	MFWs without flares	% MFWs with flares
M1.0	430	992	43	166	54	75
M2.0	216	466	46	117	103	53
M3.0	153	308	50	95	125	43
M4.0	119	233	51	81	139	37
M5.0	100	187	53	70	150	32
M6.0	86	152	57	64	156	29
M7.0	77	128	60	59	161	27
M8.0	69	113	61	54	166	25
M9.0	61	101	60	49	171	22
X1.0	55	87	63	44	176	20
X2.0	28	37	76	25	195	11
X3.0	21	27	78	19	201	9
X4.0	13	17	76	13	207	6
X5.0	12	16	75	12	208	5
X6.0	9	12	75	9	211	4
X7.0	7	9	78	7	213	3
X8.0	6	8	75	6	214	3
X9.0	5	7	71	5	215	2
X10.0	5	6	83	5	215	2

Major Flares Caught by MFWs

Percentage of flares at or above a chosen GOES class within 24 hours of the Major Flare Watch UTC message issue times (24-hour MFW periods, aka MFWs) for 26-Mar-2001 to 17-May-2010



Summary of MFW Effectiveness for Gamma-Ray Flares

Gamma-ray flares are a high-value target.

For reasons evident in the previous plot, let's identify them with GOES class > X2 (~ Shih 2009).

A criticism sometimes heard in the past has been that too many Major Flare Watches were called.

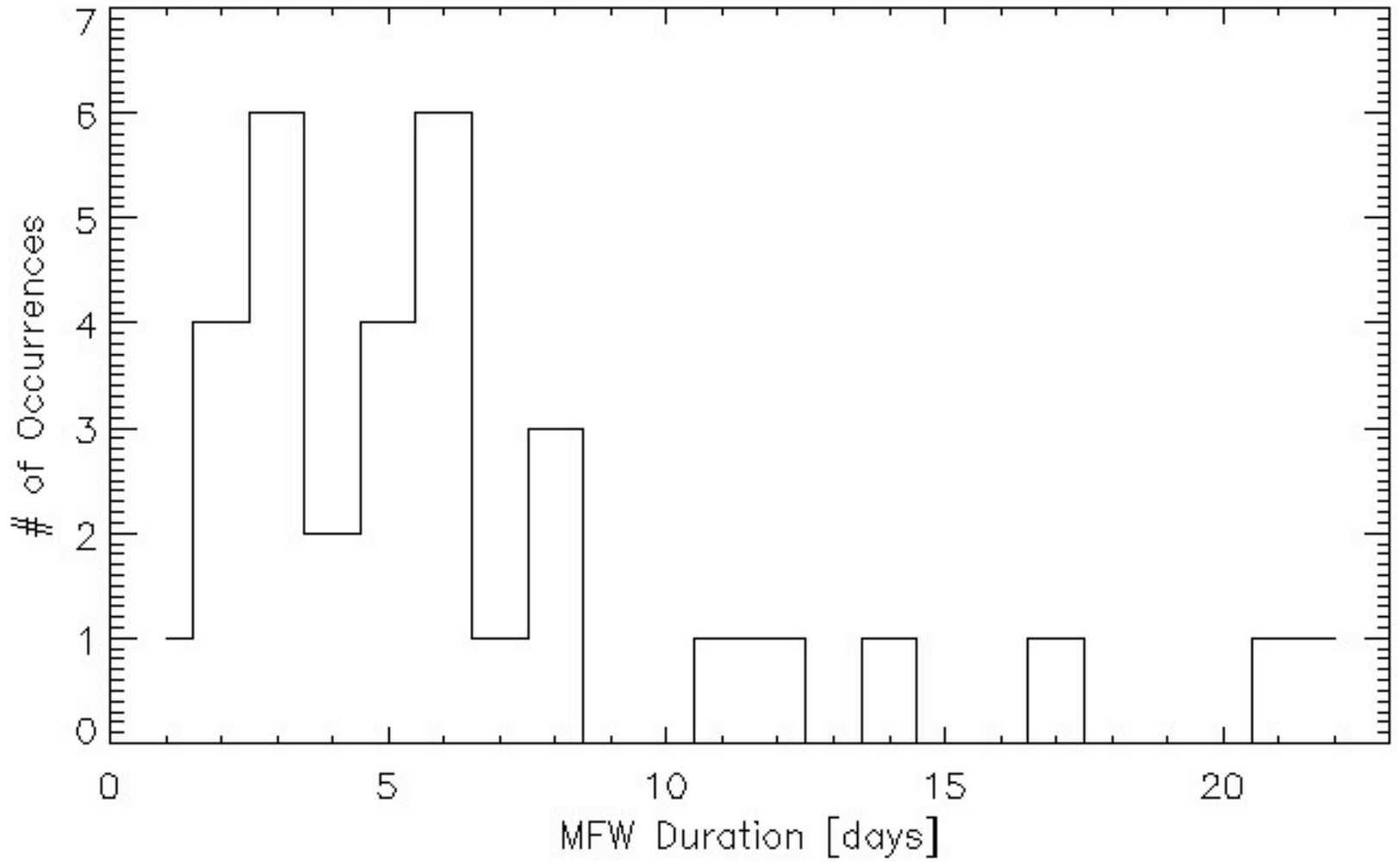
The data show that 220 MFW days were called over 9-plus years.

If we view this (as some do) as a cost that precludes non-flare science, the analysis shows that over 75% of all > X2 flares were caught at the cost of < 7% of all available observing days.

Pretty cost-effective, I'd say!

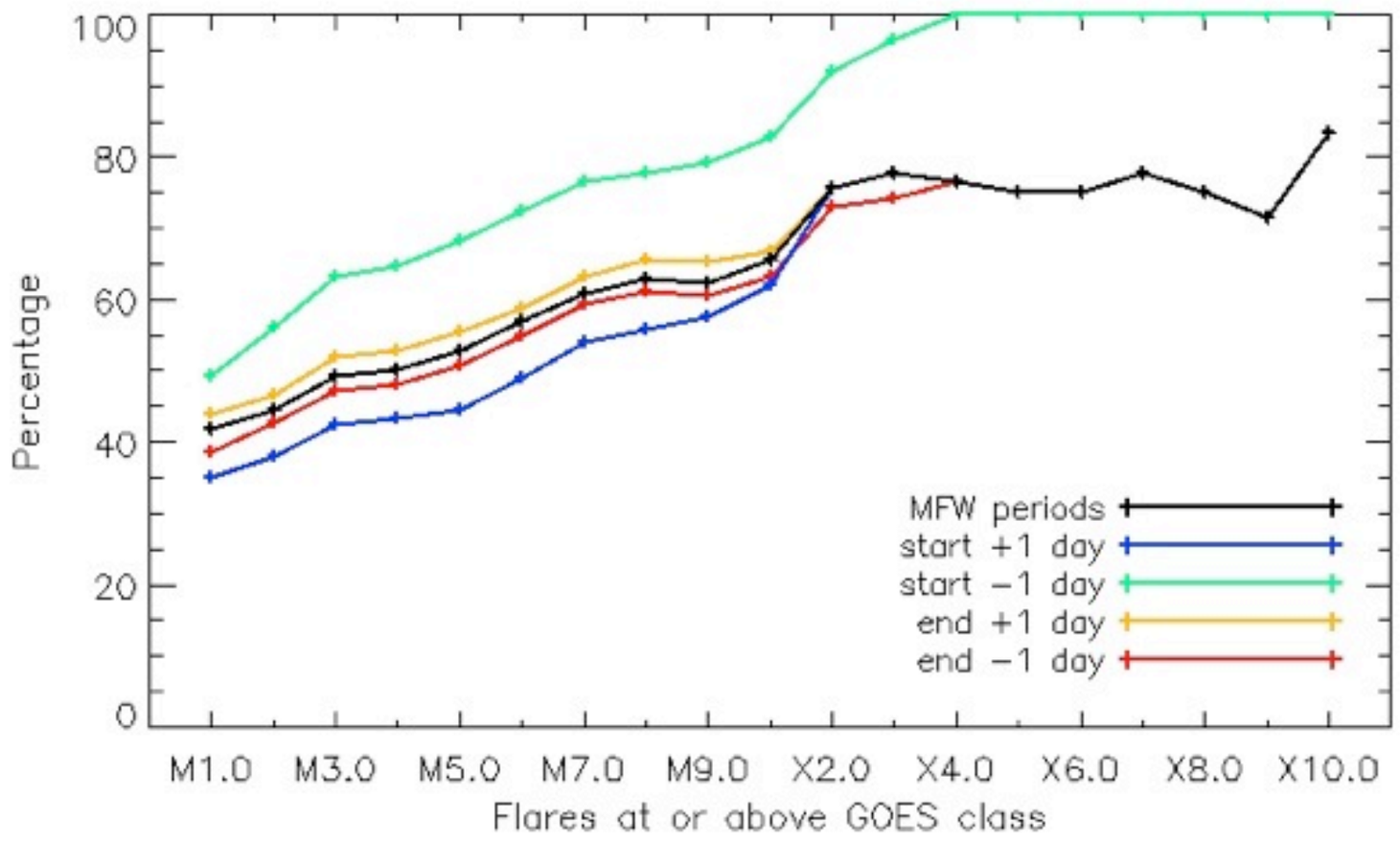
MFW Period Durations

- MFW durations measure periods of contiguous daily MFW messages.
- NB: there were 33 such MFW periods from 1-Feb-2001 to 31-May-2010



MFW “What-if” Study

- What if MFW periods started one day earlier/later or ended one day earlier/ later?
- NB: Success catching > X1 flares is independent of 1-day delays in MFW period start dates



Current Activities/Goals

- Draft “Ideal” Hinode MFW Observing Program for (gamma-ray) flares from RHESSI Point of View (Milligan)
- Recruit new MM_COs based in Europe and Asia
- Revisit Current Criteria for Calling MFWs and develop standardized “guidelines” for MM_COs (McAteer, Marquette)
- Develop RHESSI Nugget(s) on Max Millennium Program, MFWs (Bloomfield, McAteer, Raftery)
- Publish findings of this statistical study into formal paper (Canfield)

mmchiefobserver@gmail.com

solar.physics.montana.edu/max_millennium