The on-line catalog of Wind/EPACT proton events

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Outline

I. Aim

II. Technical part (data analysis and catalog status)

III. Scientific part (selected preliminary results)

IV. Future plans (release, updates & support)

⇨ *focus on the catalog contents*

Solar energetic proton catalogs

- GOES list (p > 10 MeV) **http://umbra.nascom.nasa.gov/SEP/**

+: events list since 1976; solar origin proposed; onset, max time and peak intensity reported; regularly updated (last SEP in Jan 2016)
–: high threshold >10 pfu (weak events not reported); erroneous onsets/peaks (due to local acceleration at IP shocks)

- SEPServer list (p ~ 68 MeV) **http://server.sepserver.eu**

+: onset time and intensity; overview plots; addition p & e channels
–: no peak time; no solar origin given; not regularly updated (by end 2014)

- SEPEM list (p ~ 10 MeV) **http://dev.sepem.oma.be/help/event_ref.html**

+: start, end times, fluences and peak flux; events > 1973
–: no solar origin given; not regularly updated (by March 2013)

- 'static' SEP lists (publications)

e.g., ~25 MeV Cane et al. (2010)

Wind/EPACT catalog

+s
all events reported (no threshold); 2 energy channels;
correction for near-Earth shock signatures;
overview plots; link to the data

–s
only first version on-line: catalog release is coming soon...

Aim:
1) To compile comprehensive proton event list in solar cycles 23 & 24
2) To provide proton event list suitable for scientific purposes
3) To have regular updates

Wind/EPACT catalog

Instrument:
Energetic Particles: Acceleration, Composition and Transport (*EPACT*) aboard *Wind* spacecraft
von Rosenvinge et al. (1995); http://epact2.gsfc.nasa.gov/

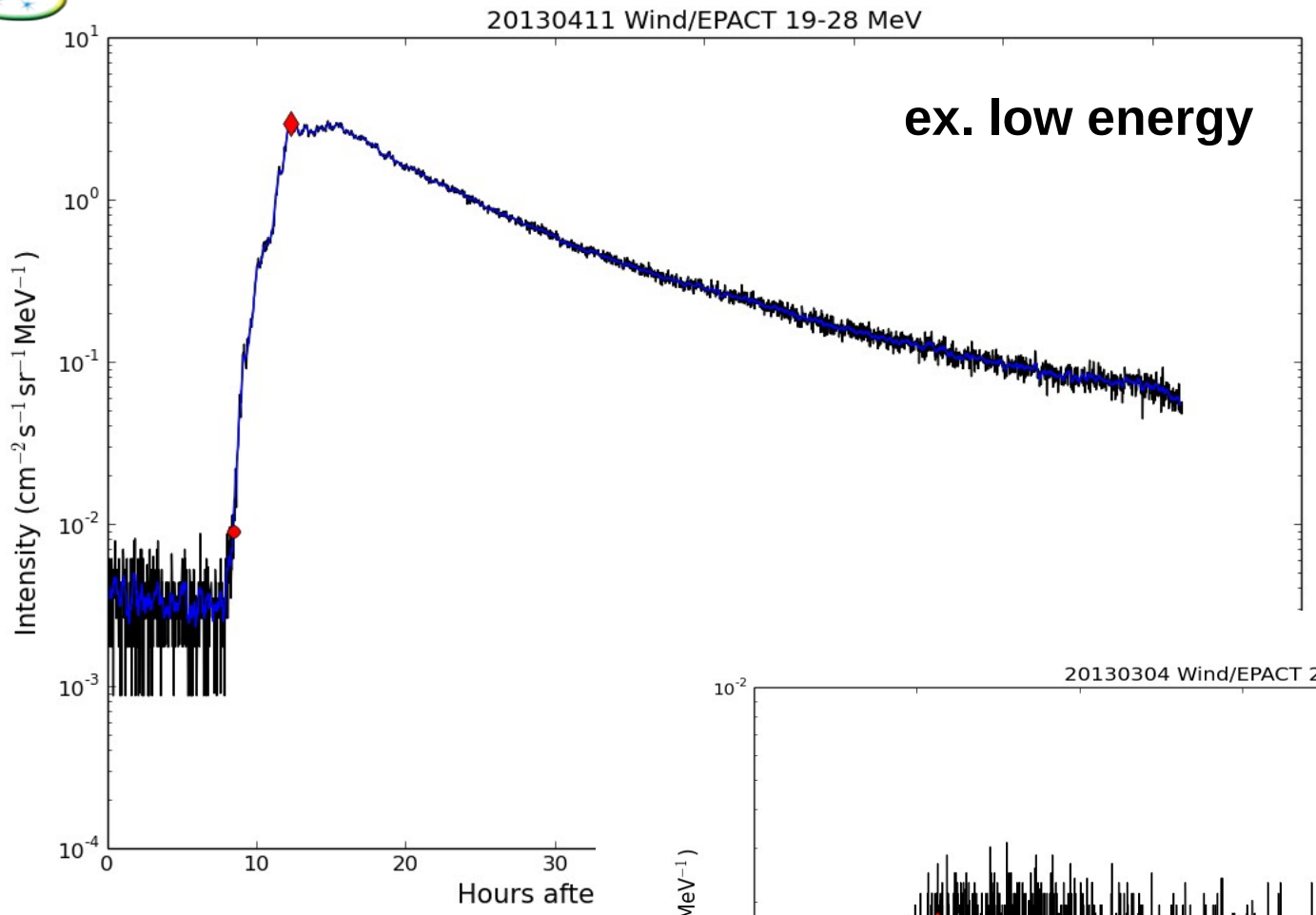
Data source: http://cdaweb.gsfc.nasa.gov

Time resolution: 92-sec

Energy coverage: 19–28 (**~25**) and 28–72 (**~50**) MeV

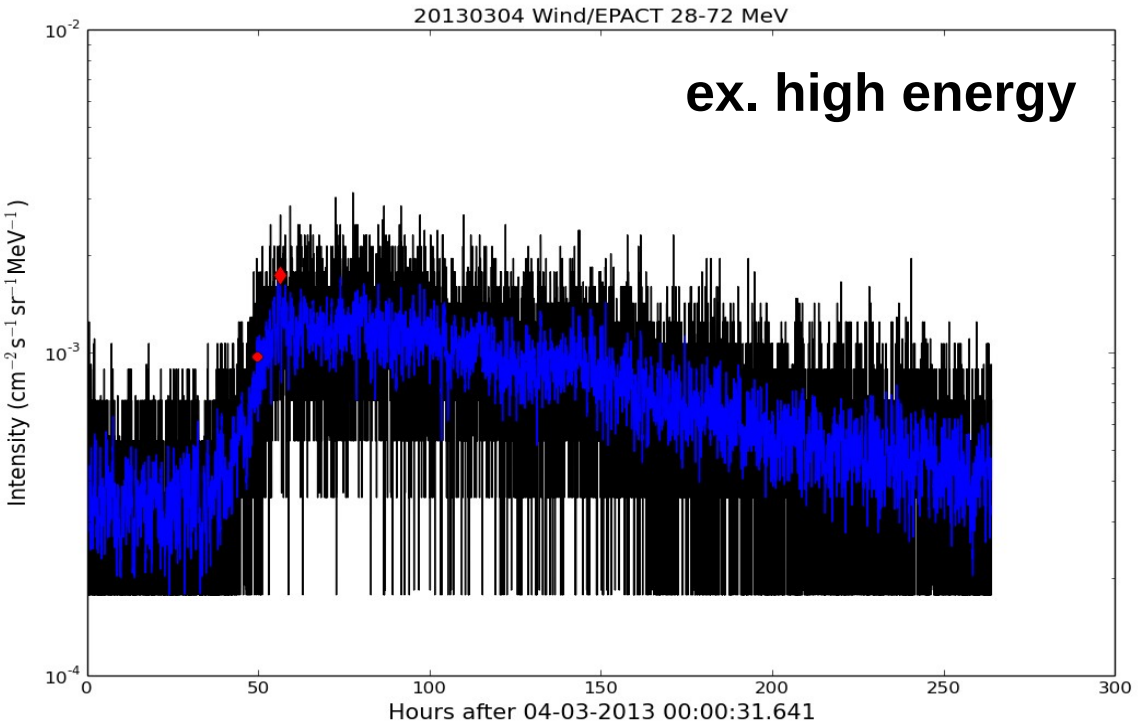
Identification: visual scanning of **proton** enhancements: **1996–2015**

Data analysis: onset time; peak time;
peak intensity in protons/(cm^2 s sr MeV)



Large SEP

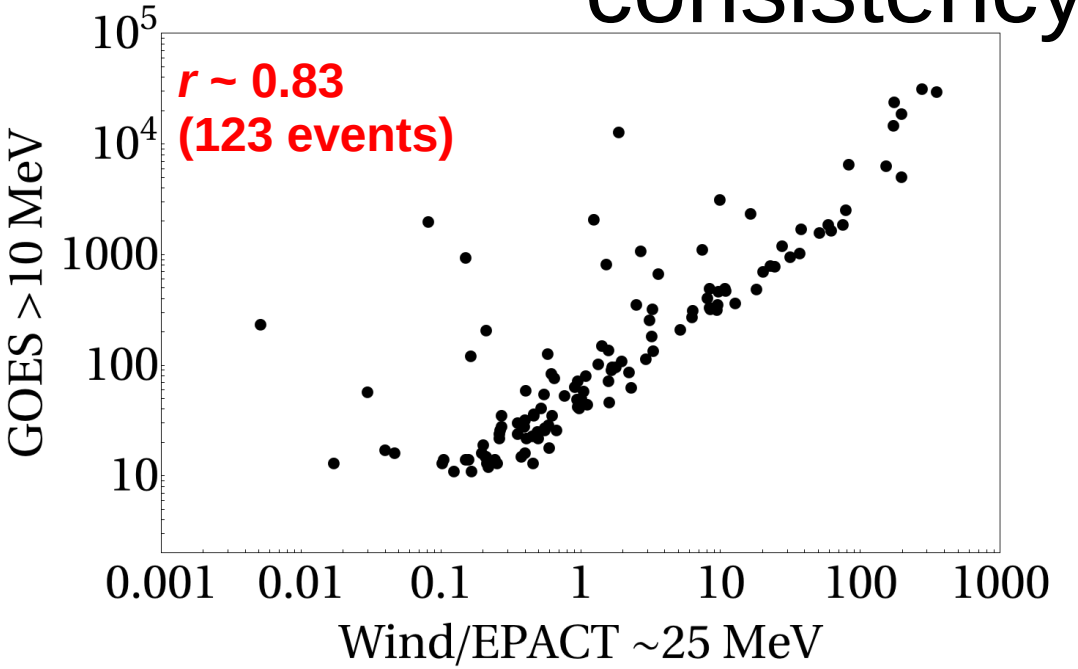
Minor SEP

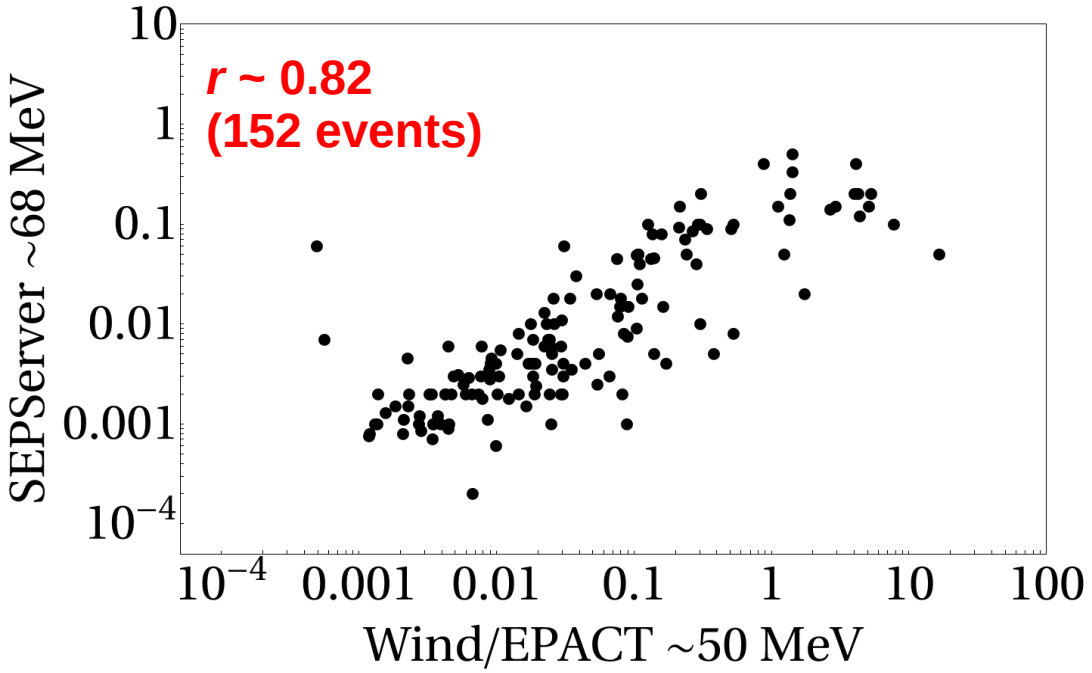


● **Onset**
(3-σ above bg-level)
♦ **Peak**
5-point smoothing

Wind/EPACT catalog

consistency check





Catalog of solar energetic particles

from Wind/EPACT instrument

first version:
newserver.stil.bas.bg/SEPcatalog/index.html

Solar cycle 23: 1996-2008 Solar cycle 24: 2009-present

Event date	19-28 MeV			28-72 MeV	Flare	CME	Comment
yyyy-mm-dd	onset time (UT)	peak time (UT)	J_p $(cm^2\ s\ sr\ MeV)^{-1}$	J_p $(cm^2\ s\ sr\ MeV)^{-1}$	class/time /location	time/speed /width	
2009	-	-	-	-	-	-	no SEP events
2010-06-12	04:04	08:39	0.0123	plot			
2010-08-03	15:13	18:25	0.0478	plot			
2010-08-07	22:45	01:43nd	0.0111	plot	TBA	TBA	
2010-08-07	u	11:22nd	0.0074	plot			
2010-08-14	11:15	13:05	0.158	plot			
2010-08-18	08:01	12:18	0.0486	plot			
2010-09-09	03:02	04:25	0.0071	plot			
2011-01-28	02:32	05:13	plot	plot			
2011-01-28	11:31	13:37	plot	plot			
2011-02-15	05:04	10:24	plot	plot			
2011-03-07	22:33	10:03nd	plot	plot			

Explanatory notes:

This catalog lists the proton enhancements in Wind/EPACT 19-28 and 28-72 MeV energy channels.

Proton data: from CDAweb database provided with 92-sec time resolution.
Onset time: identified as the time of 3-sigma intensity value above pre-event level.
Peak time: identified at the maximum of the particle profile (local enhancements are not considered).
J_p: maximum proton intensity after subtraction of the pre-event level.

The reported here onset/peak times and J_p are based on 5-point smoothed data.

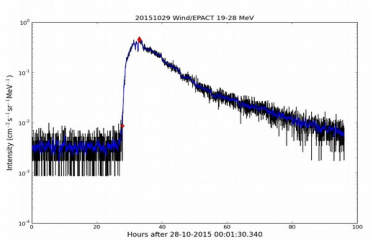
N/A: onset not found and/or it was fully masked by previous ongoing event
nd: next day
pd: previous day
p: peak is poorly defined
u: uncertain

Acknowledgements:
If you use results from this catalog, we would appreciate the following acknowledgement:
'For catalog description and first results see Miteva et al. (Sun & Geosphere, subm.).'

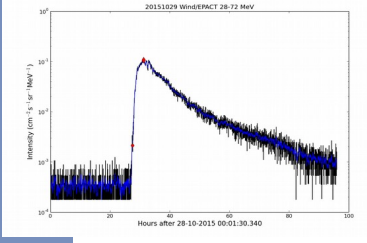
Contact:
R. Miteva

Links:
Space Climate Group Homepage
Space Research and Technology Institute Homepage

19-28 MeV: overview plot



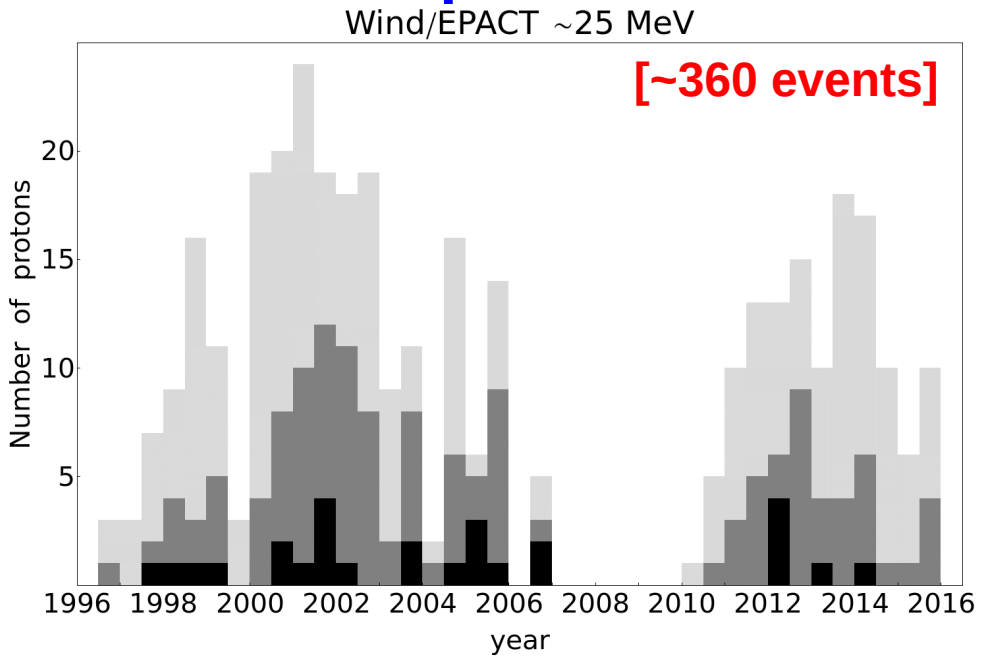
28-72 MeV: overview plot



Preliminary results: SEPs

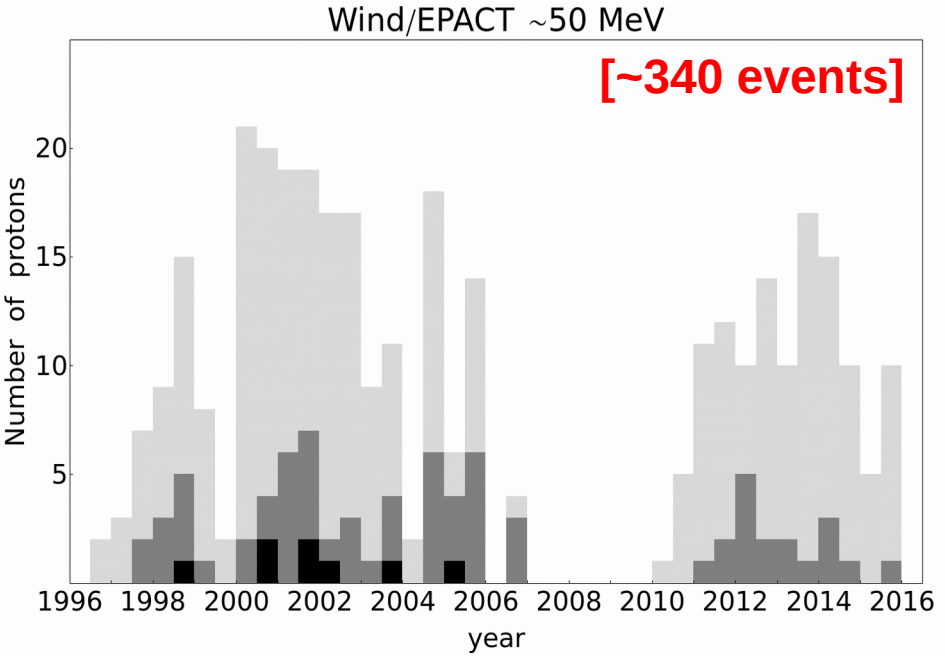
Miteva, Samwel, Costa-Duarte et al. (subm)

Solar cycle dependence: ~25 MeV protons



% change in SC24 wrt SC23	
All	–29±8%
Major (≥1)	–50±25%
Medium	–36±13%
Minor (<0.01)	–24±11%

Solar cycle dependence: ~50 MeV protons



% change in SC24 wrt SC23	
All	–29±8%
Major (black)	–100%
Medium (gray)	–40±18%
Minor (light)	–23±10%

SC comparison is based on 7yr of data in each SC!

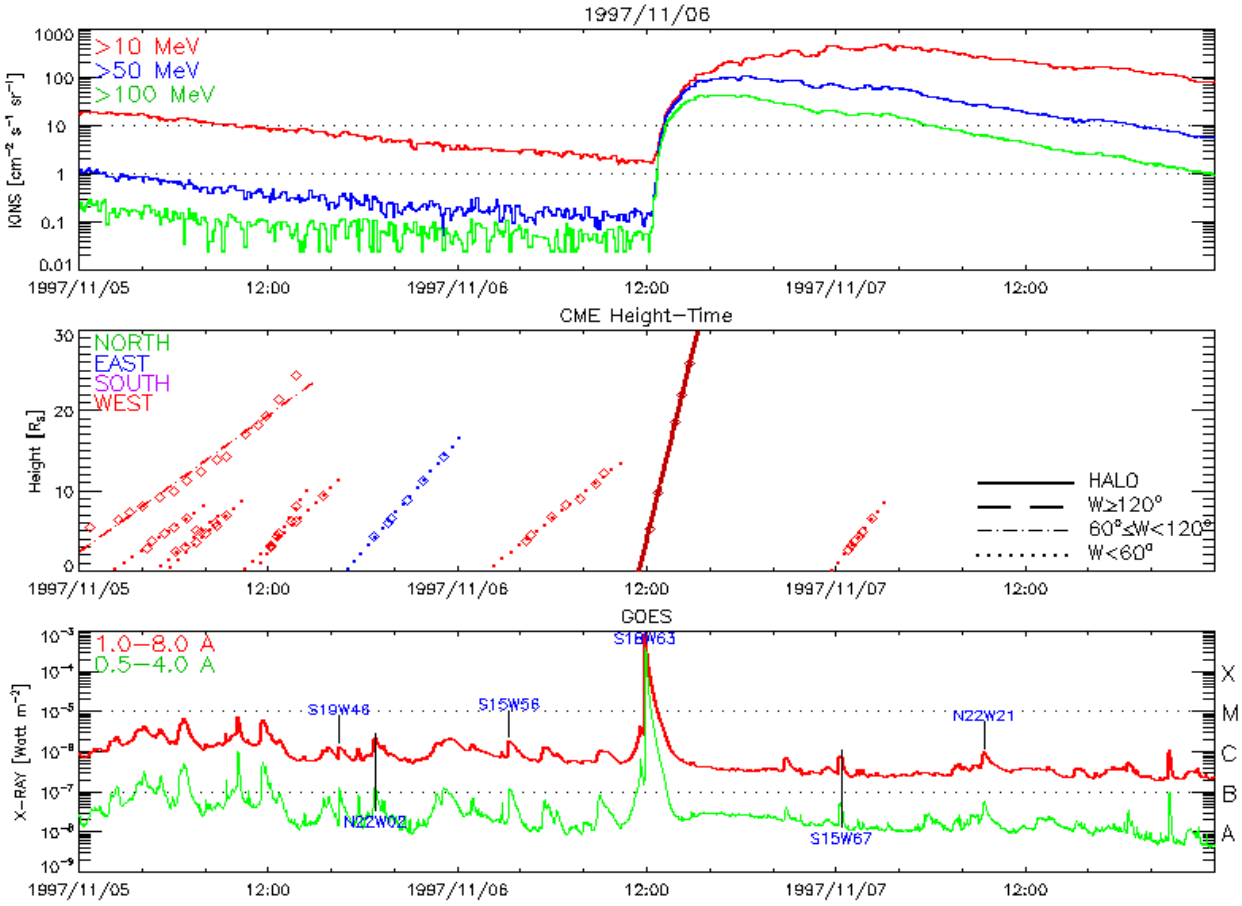
Preliminary results: SEP origin

Miteva, Samwel, Costa-Duarte et al. (subm)

SEP origin: flares and CMEs

Criteria: search for flare/CME in a time window before SEP onset;
preference usually given to *large flare/fast CME* pair & to western origin candidates;
the *SEP-profile* denotes E/W origin; *electron timing* aids to select the solar origin; etc.

Often there is a clear
flare-CME pair,
identified as SEP origin.



Preliminary results: SEP origin

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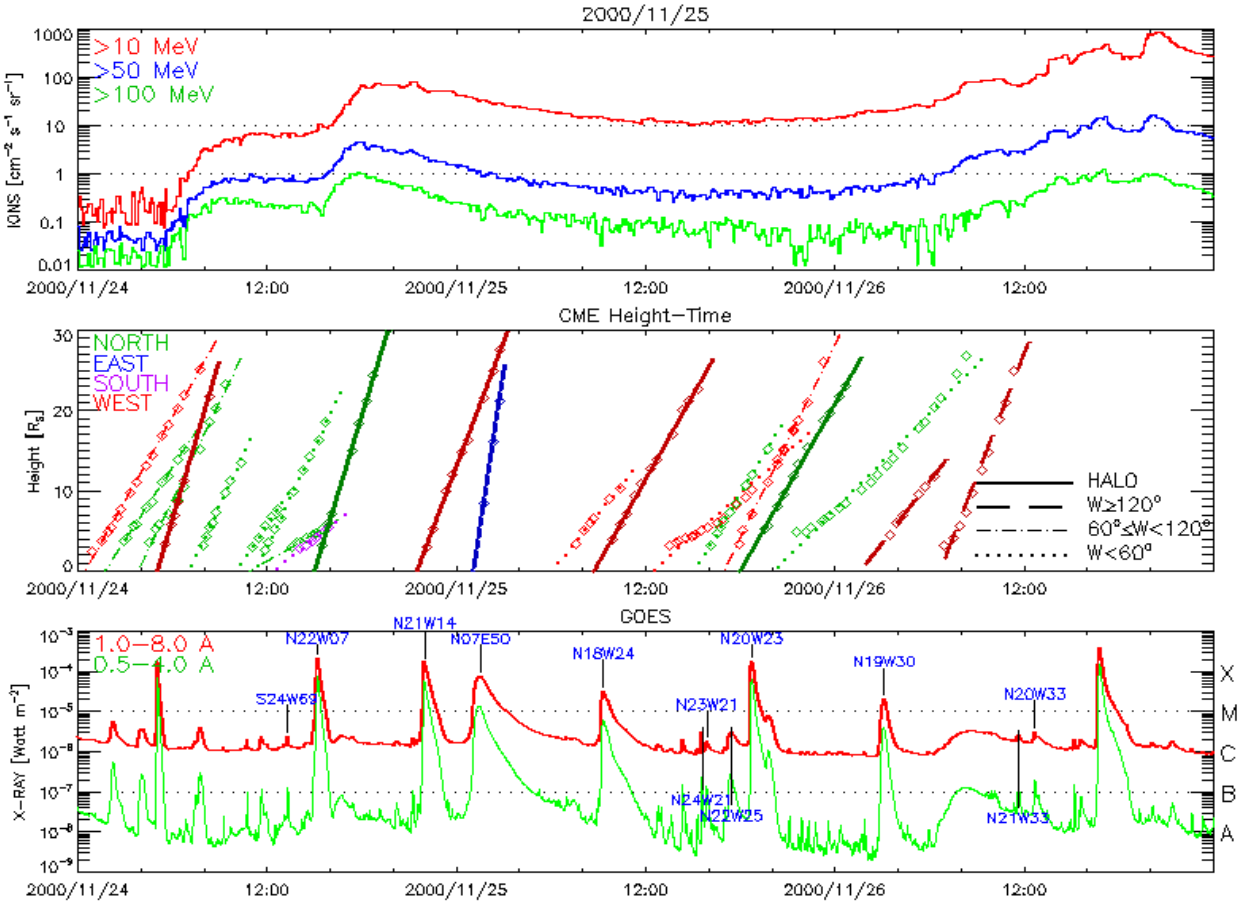
Criteria: search for flare/CME in a time window before SEP onset; preference usually given to *large flare/fast CME* pair & to western origin candidates; the *SEP-profile* denotes E/W origin; *electron timing* aids to select the solar origin; etc.

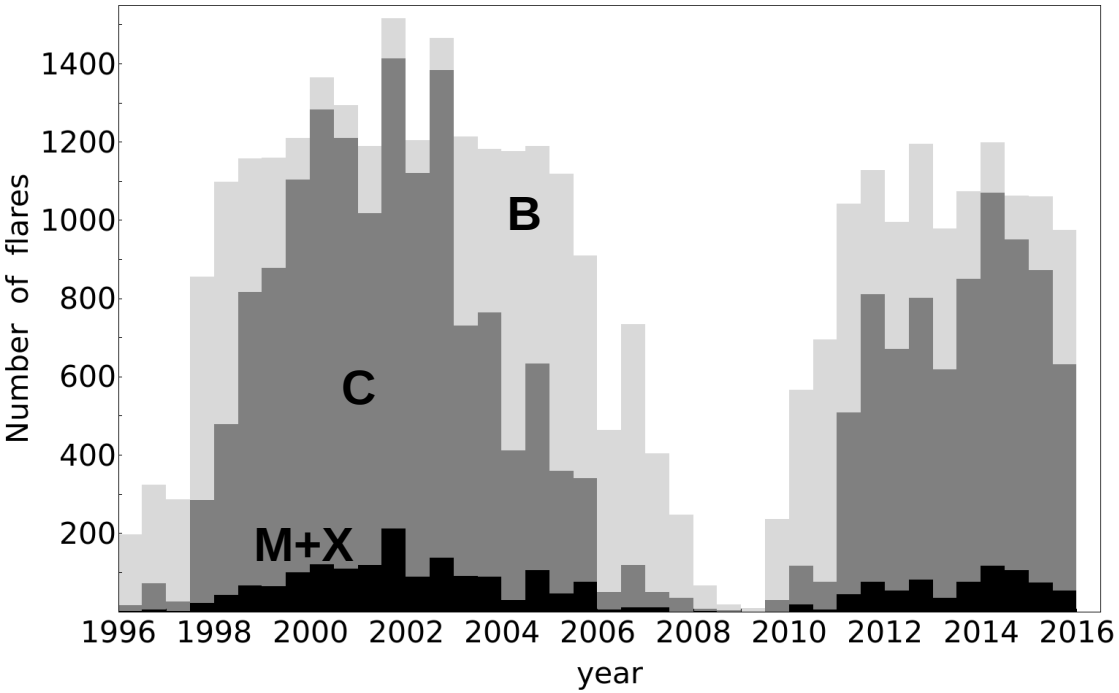
Subjectivity issues: during times of high solar activity there are multiple flare/CME candidates that may contribute to final SEP flux at 1 AU.



Preliminary results: Flares

Miteva, Samwel, Costa-Duarte et al. (subm)

Solar cycle dependence: all flares



% change in SC24 wrt SC23	
All (C-to-X)	–34±1%
X-class	–44±10%
M-class	–38±3%
C-class	–33±1%

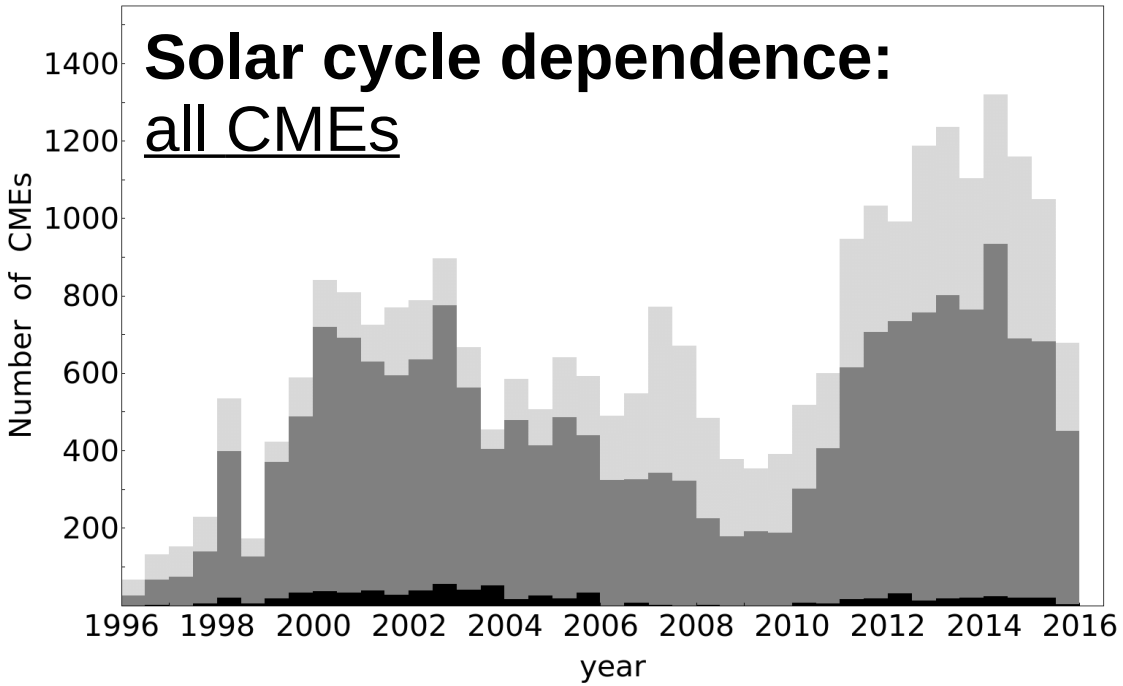
Solar cycle dependence:
25 MeV SEP-productive flares

(overall decreasing trends)

% change in SC24 wrt SC23	
All (C-to-X)	–38±9%
X-class	–50±15%
M-class	–39±12%
C-class	–24±21%

Preliminary results: CMEs

Miteva, Samwel, Costa-Duarte et al. (subm)



% change in SC24 wrt SC23	
All	+61±2%
Fast (black; ≥ 1000 km/s)	–46±5%
Intermediate (gray)	+33±2%
Slow (light-gray; < 250 km/s)	+200±9%

Solar cycle dependence:
25 MeV SEP-productive CMEs

(overall decreasing trends)

% change in SC24 wrt SC23	
All	–22±10%
≥1000 km/s	–26±13%
<1000 km/s	–16±16%
halo*	+18±20%
non-halo* (<360°)	–59±9%
narrow* (<100°)	–90±7%

* no restriction on CME speed

Future plans

Link: http://newserver.stil.bas.bg/SEPcatalog/index.html

Release: end 2016

Planned updates: ~yearly

Additions: information of SEP-related flares/CMEs;
searching/sorting options;
catalog entries organized per year; etc.

Support: Space Climate Group
Space Research and Technology Institute
Bulgarian Academy of Sciences
www.space.bas.bg