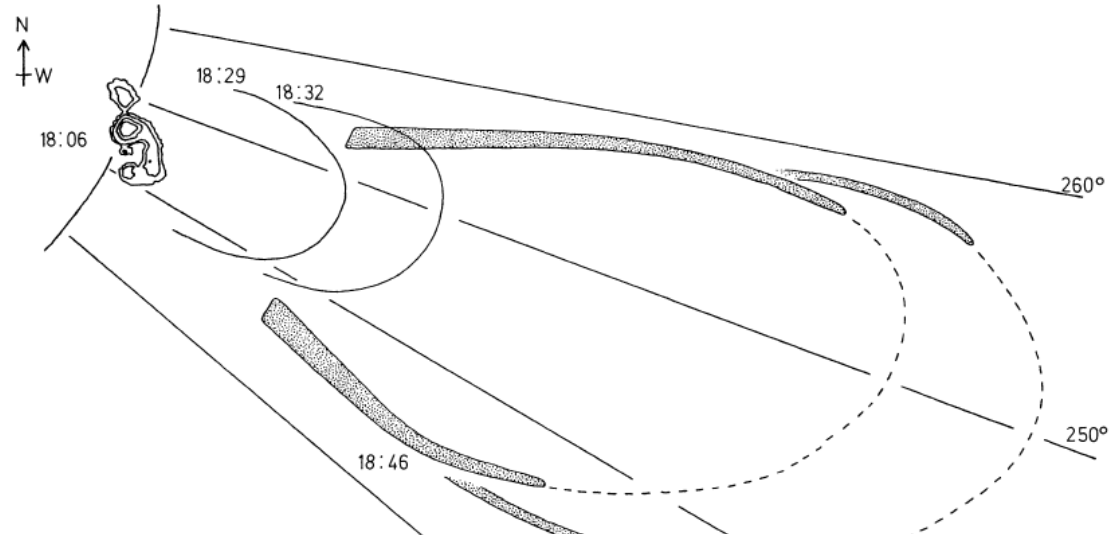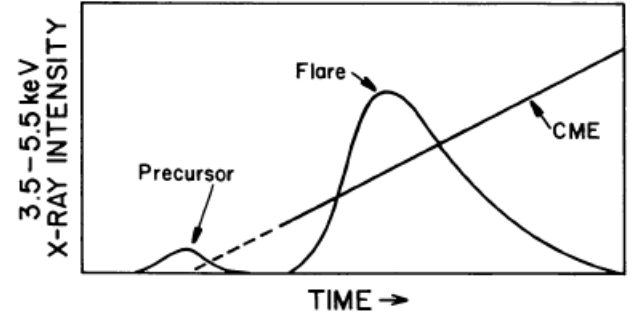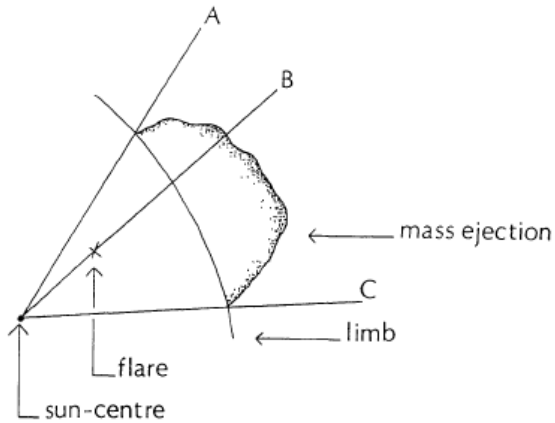# Event Associations in CME Onset Studies from SMM, SOHO & STEREO: A personal view

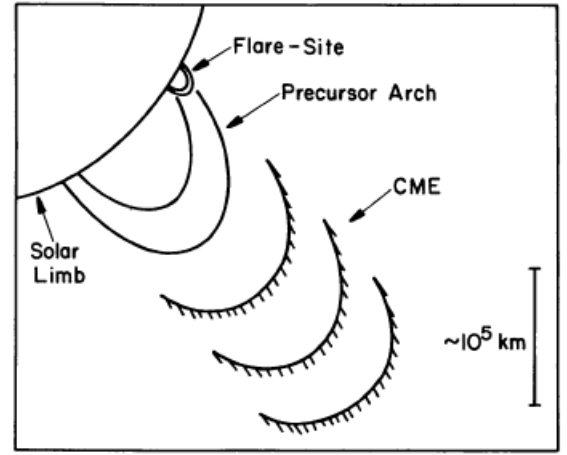## Richard Harrison

Rutherford Appleton Laboratory

- Common practice to project back, to see what occurred in the solar atmosphere in association with the CME onset

- But how do you know when the CME onset occurred? What windows (space, time) do we consider?

- Open to bias – e.g. the flare-CME relationship?
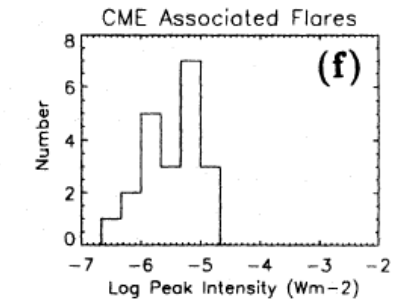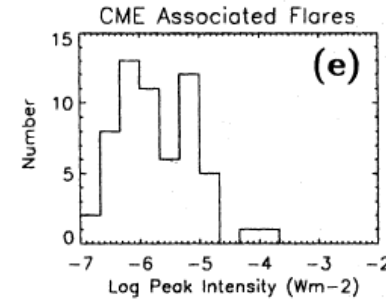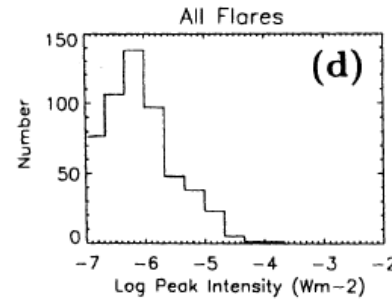
- Can we suggest standards for the future?

Harrison, 1986, A&A 162, 283

- Asymmetry?
- Timing?
- No strict windows
- Few events – but still relevant!

All Flares (a) — Duration (Hours); CME Associated Flares (b) — Duration (Hours); CME Associated Flares (c) — Duration (Hours); All Flares (d) — Log Peak Intensity (Wm−2); CME Associated Flares (e) — Log Peak Intensity (Wm−2); CME Associated Flares (f) — Log Peak Intensity (Wm−2)
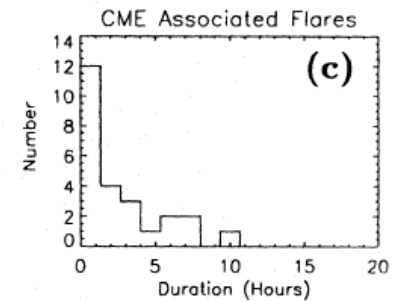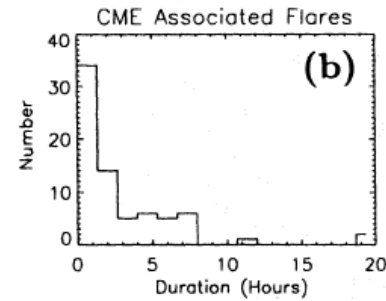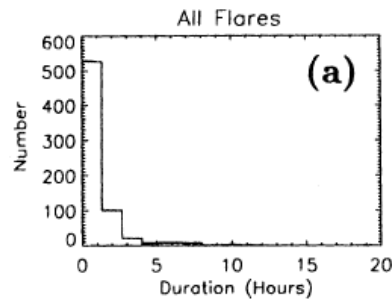
Harrison, 1995 A&A 304, 585

- 674 X-ray flares, 72 in CME 'windows'
- 151 CMEs, 61 with flares
- Duration?
- Intensity?
- Asymmetry?
- Timing?
- Window?

(a) — Tcme (h=0) − Tflare
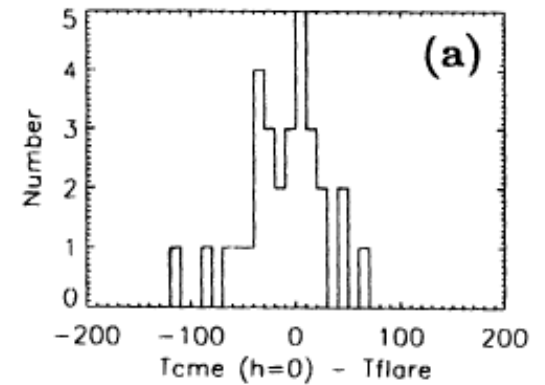
The 'Temporal Window'

- Centred on projected onset or time of first observation
- Assumptions: zero acceleration, zero altitude, limb, zero height
- Acceleration or disc events would favour an earlier onset
- CME source height would favour a later onset
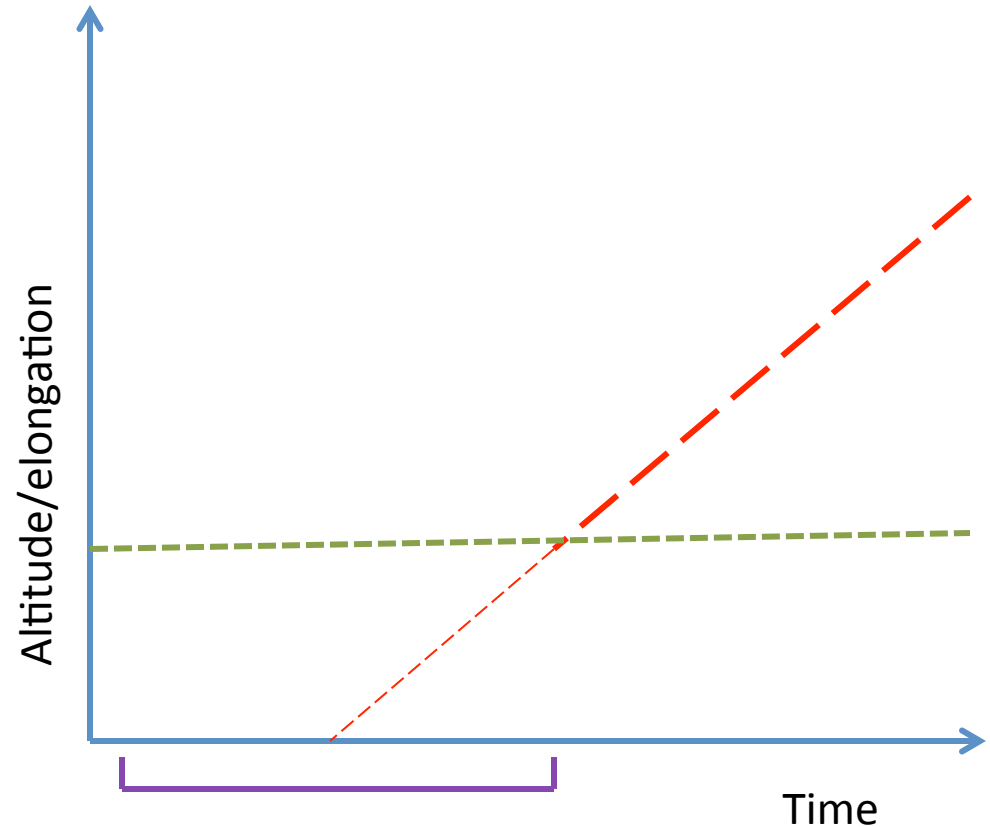- +/- 2 hour window chosen to cater for slowest speeds
- Argued that in statistical study, this must catch most if not all associations.
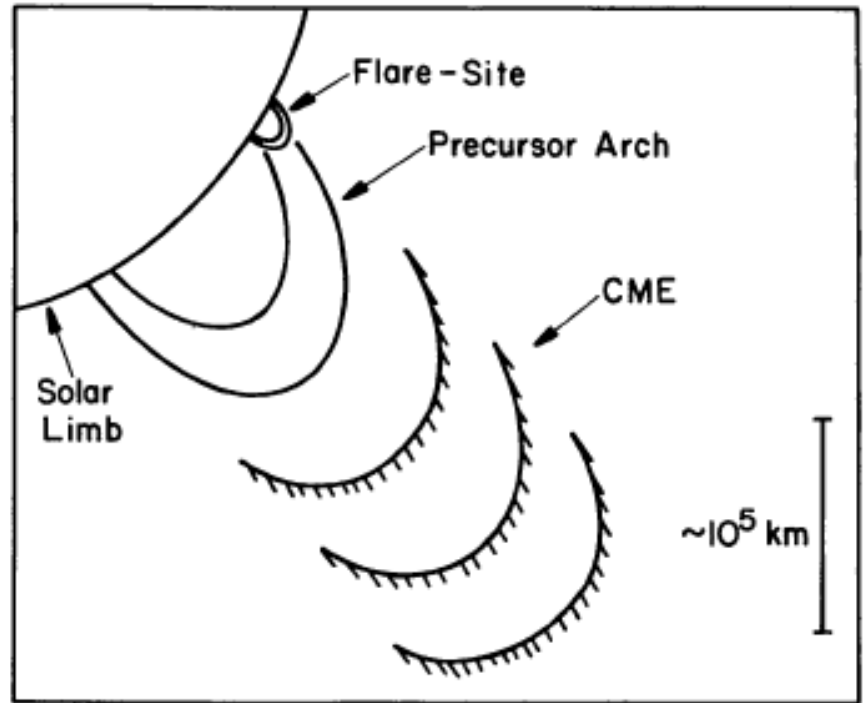
Altitude/elongation

Time

Basic principle = NO BIAS
We do not 'fix' the window to fit in a flare!
TOO MANY HORROR STORIES!

The 'Spatial Window'

- Anywhere under CME span PLUS 20° on either side
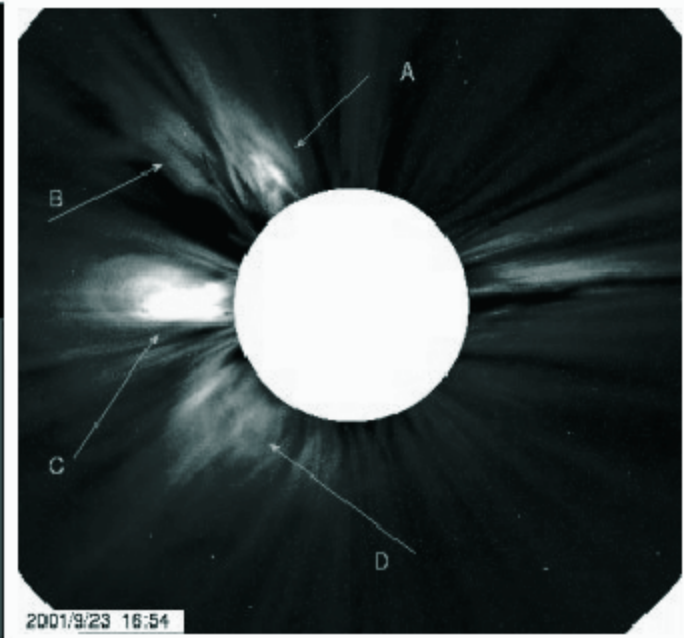- Events/features within 50° of relevant limb

Again:

Basic principle = NO BIAS
We do not 'fix' the window to fit in a flare!
TOO MANY HORROR STORIES!
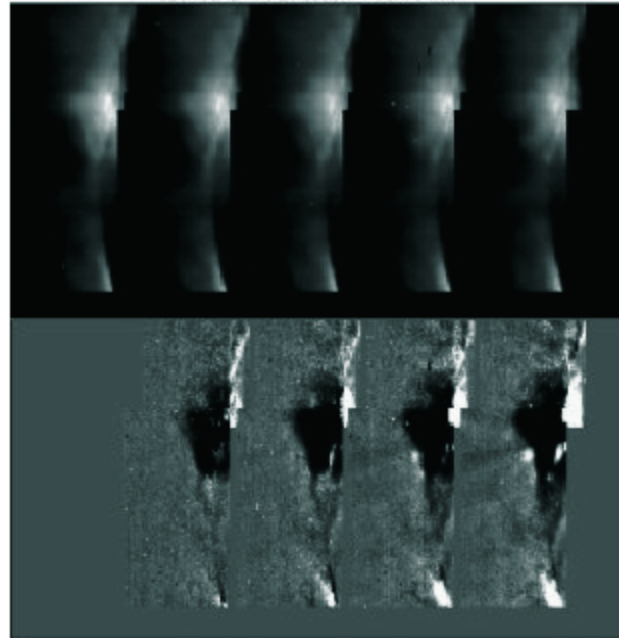
SOHO CDS Mg IX 368 Å & LASCO C2

EUV Dimmings associated with CMEs – Looking for the source regions
[Harrison, 1997, ESA SP-415, 121; Bewsher, Harrison & Brown, 2008, A&A 478, 897]

Association window – Other way round:
- Temporal: Duration of the dimming period plus 1.5 hr on either side;
- Spatial: Spans PA range of dimming extent plus $10°$ on either side.

NO BIAS

- Forget a standard model if it **requires** a flare and a CME and fixes the geometry

- However, we need a model that can cater for a flare and a CME but could include neither

- *"...the flare and CME are both consequences of the same magnetic 'disease'. They do not cause one another but are related. Their characteristics are the results of local conditions, and thus we may witness a spectrum of events without the flare or CME component."*   [Harrison, Solar Phys. 166, 441]

Action for thus meeting?

- We need to suggest some standards for CME onset associations (not just flares); what is a reasonable window in space and time? What is good practice? How do we remove all bias? Historically just too random!

- Can this meeting endorse an approach to making CME onset associations?