HELCATS
Connecting Coronal Mass Ejections to their Solar Active Region Sources

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STEREO spacecraft

Definitive catalogue of CMEs imaged by STEREO/SECCHI Heliospheric Imagers.
STEREO/SECCHI Coronagraphs
SECCHI Heliospheric Imagers

Wide-angle visible-light imaging system for the detection of CME events in interplanetary space and, in particular, of events directed towards the Earth.
Tracking interplanetary CMEs
Heliophysics Cataloguing, Analysis, and Techniques Service

STEREO-A/SECCHI
2012-03-06 00:00UT

1901 events from 2007 -2014
Tracking interplanetary CMEs
Heliophysics Cataloguing, Analysis, and Techniques Service

1901 events from 2007 - 2014
Automatic CME source identification

Ballistic propagation model constrained by

- Max and minimum speed
- Time search window

\[ \tau_f \pm \Delta \tau_f = \tau_i - \frac{R_i - R_f}{v_{cme} \pm \Delta v_{cme}} \]

\[
R_i = 12 \, R_\odot \\
R_f = 2 \, R_\odot \\
v_{cme} = 150 - 1500 \, \text{kms}^{-1}
\]

Yurchyshyn et al, 2005
Automatic CME source identification

Ballistic propagation model constrained by

- Max and minimum speed
  - Time search window
- CME position angle
Automatic CME source identification

Ballistic propagation model constrained by

- Max and minimum speed
  - Time search window
- CME position angle
- CME vs flow
Automatic CME source identification

HI → COR2 → FLARE → SOURCE

HI Position Angle [°] vs. COR2 Position Angle [°]
Automatic CME source identification

Ballistic propagation model constrained by

- Maximum/minimum speed
- Time search window

\[
\tau_f \pm \Delta \tau_f = \tau_i - \frac{R_i - R_f}{v_{cme} \pm \Delta v_{cme}}
\]

\[
R_i = 2 \enspace R_\odot \\
R_f = 0.5 \enspace R_\odot \\
v_{cme} = 200 - 800 \text{ kms}^{-1}
\]

Yurchyshyn et al, 2005
Automatic CME source identification

Ballistic propagation model constrained by

- Maximum/minimum speed
- Time search window
- Hemisphere location
Automatic CME source identification

Ballistic propagation model constrained by

- Maximum/minimum speed
  - Time search window
- Hemisphere location
- Optional database searching
Automatic CME source identification

Ballistic propagation model constrained by

- Maximum/minimum speed
  - Time search window
- Hemisphere location
- Optional database searching
- Quality of detection
Automatic CME source identification

HI → COR2 → FLARE → SOURCE

Legend:
- 2014-09-26
- 2011-01-21
- 2007-05-15
Automatic CME source identification

Match flare peak position to active region.

- Constrained by location (latitude and longitude range).

**SOLAR REGION SUMMARY**

- NOAA No.
- Location
- Area
- Longitudinal extent
- No. Spots
- Hale class
- McIntosh class
Automatic CME source identification

HI ▸ COR2 ▸ FLARE ▸ SOURCE

Match flare peak position to active region.

• Constrained by location (latitude and longitude range).

Solar Monitor Active Region Tracker [Higgins et al]
Automatic CME source identification

HI → COR2 → FLARE → SOURCE

GOES flux [Wm$^2$] vs Total area [Mm$^2$]

- $\alpha$
- $\beta$
- $\beta\gamma$
- $\beta\delta$
- $\beta\delta\gamma$
Automatic CME source identification

HI $\rightarrow$ COR2 $\rightarrow$ FLARE $\rightarrow$ SOURCE

![Graph showing median velocity vs. SMART Total Flux (Mx)](image)
Conclusions

• Further testing needed but automatic method working well
  • Properties correlating as expected
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• More detailed analysis to follow once code fully completed
  • Comparison between CME kinematics and active region properties using FLARECAST database.
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