

Characterising upflows in coronal holes and the quiet Sun

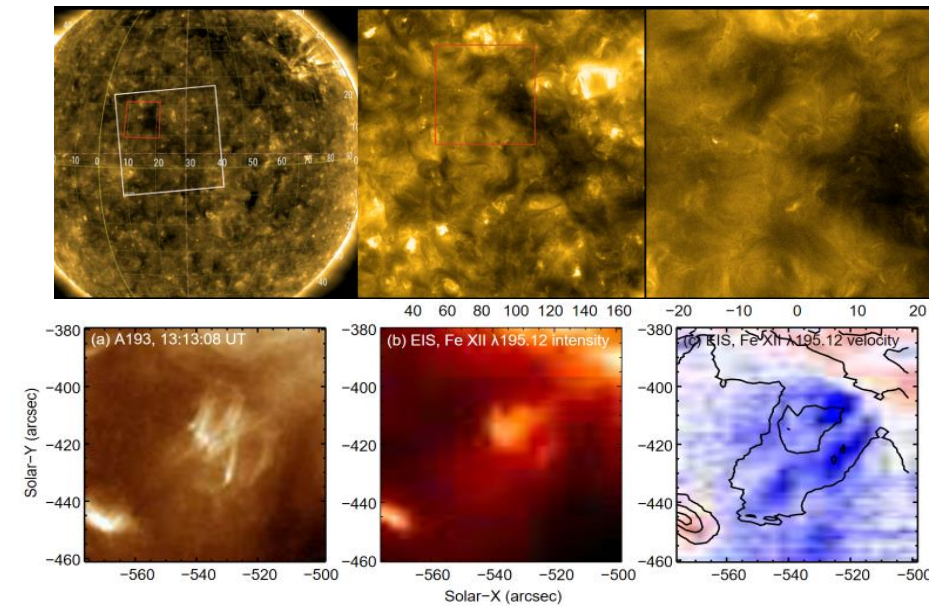
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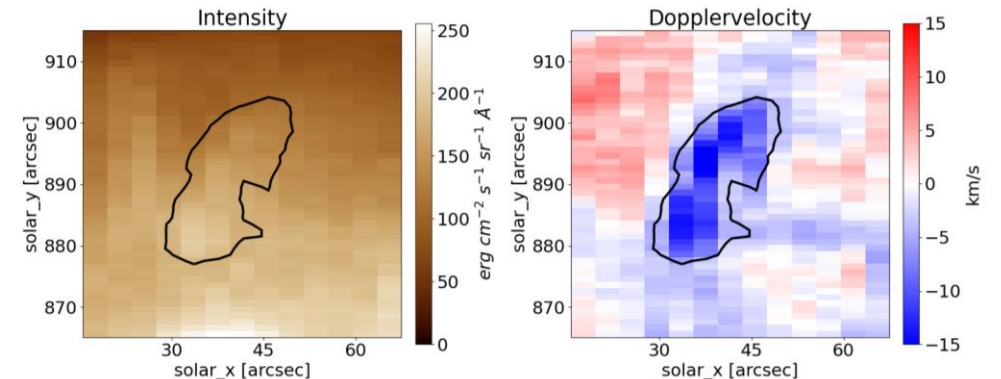
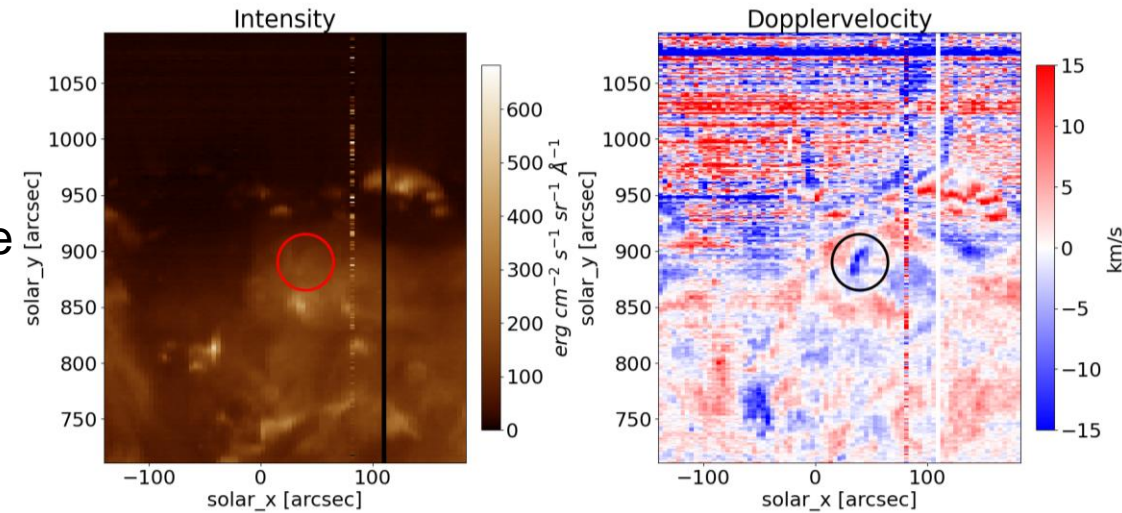
Motivation & idea

- High variations in the solar wind detected by Parker Solar Probe [e.g. Bourouaine et al., 2020]
- Small scale brightenings in EUV detected by Solar Orbiter „campfires“ [Berghmans et al., 2021]
- *Dark jets in solar coronal holes* (Peter R. Young, 2015)
- observation of new features only visible in spectroscopic data
- Standard approach: search for strong transients in imaging data
- Our approach: search for strong blueshifts in spectroscopic data

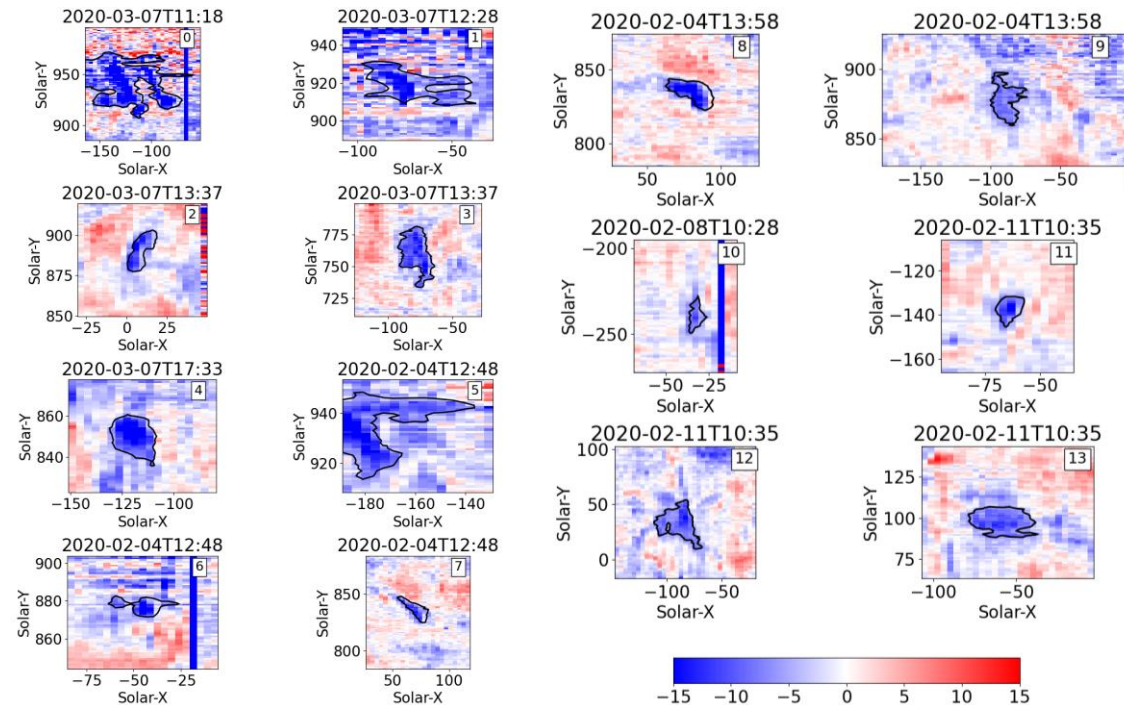


Data analysis

- 12 Hinode/EIS rasters from coronal hole studies
- Analyse Fe XII line: determine Doppler velocities by single Gaussian fits
- Determine blueshift features stronger than -6km/s
- Compare to EUV data from SDO/AIA, magnetic data from SDO/HMI and X-ray data from Hinode/XRT
- Find sources of blueshift



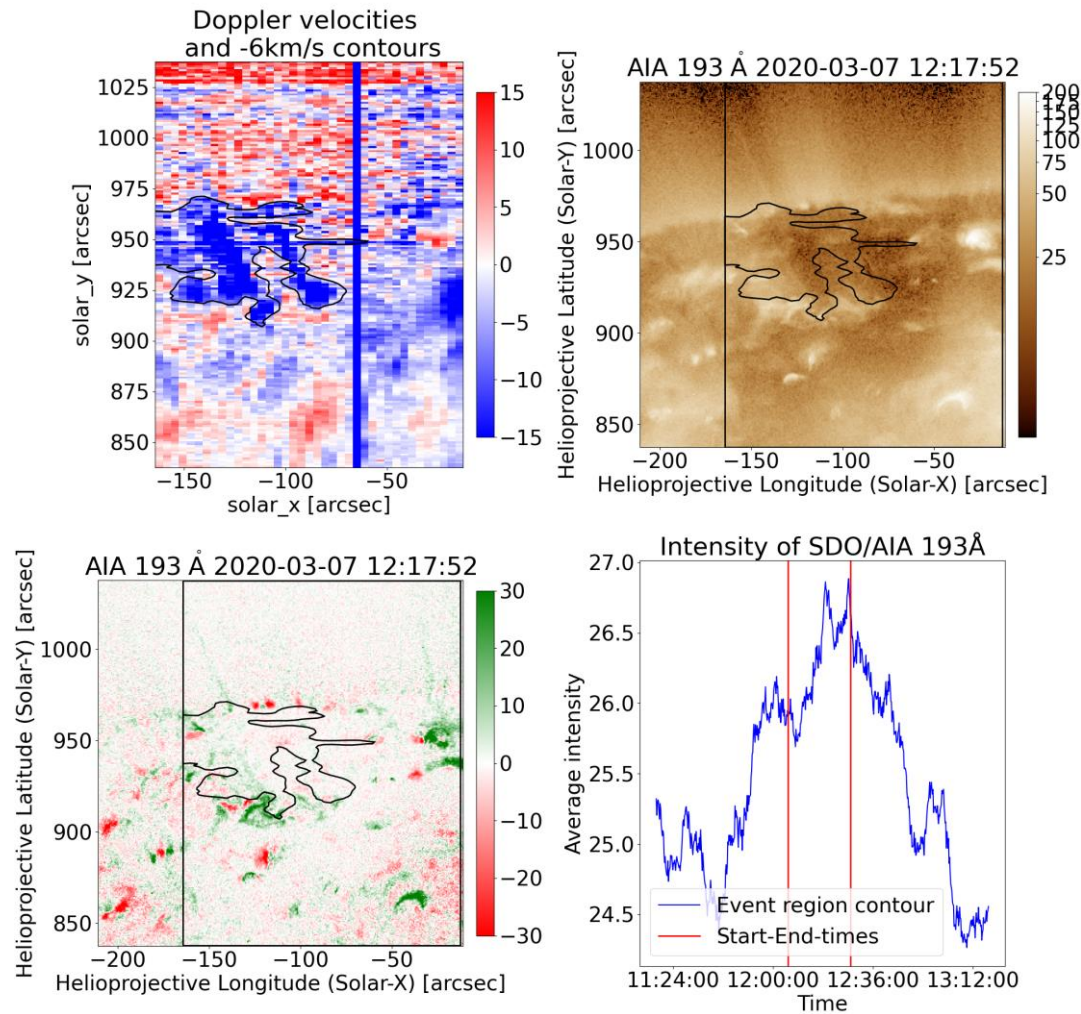
Results: Blue-shifts



- 14 blue-shift events
- shapes: circular till elongated
- location: coronal holes, coronal hole boundaries, quiet Sun
- size: 100-8000 arcsec²

Results: known sources

Event 1

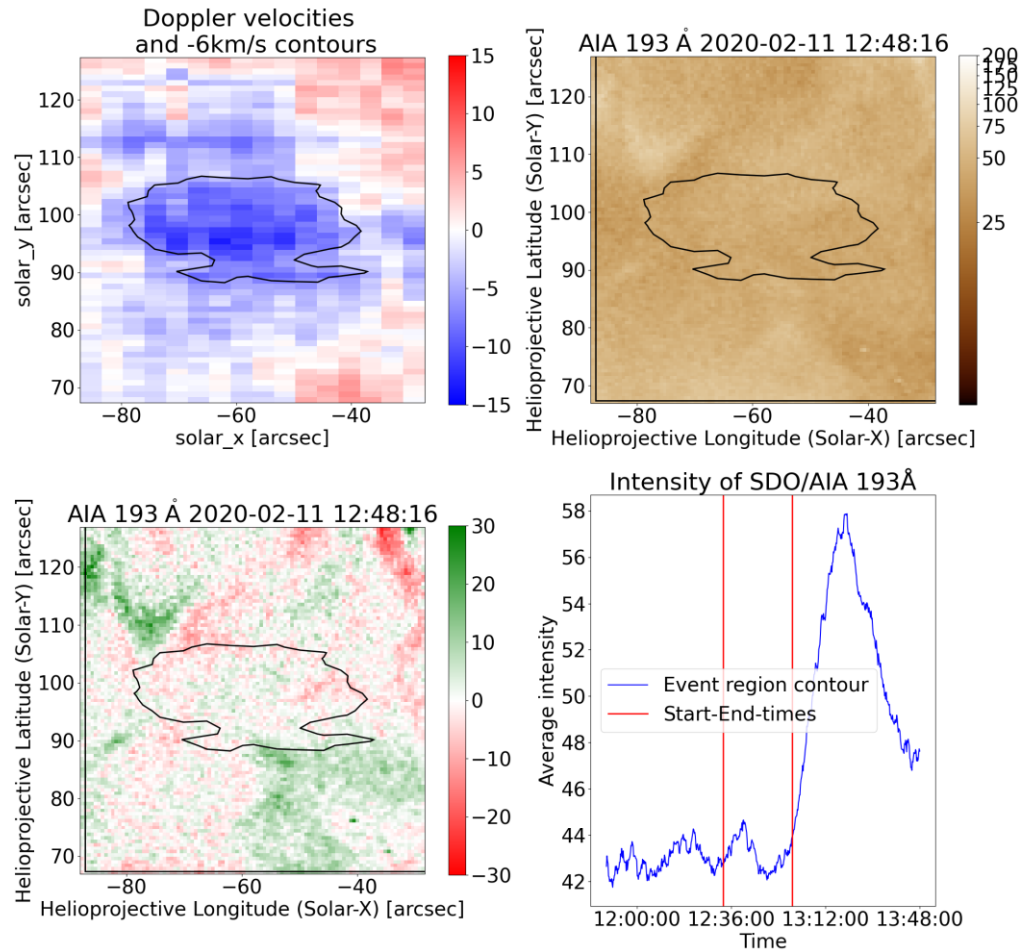


example: classic jets

- upflows related to jets or bright points
- 2 events related to jets
- 4 events related to bright points

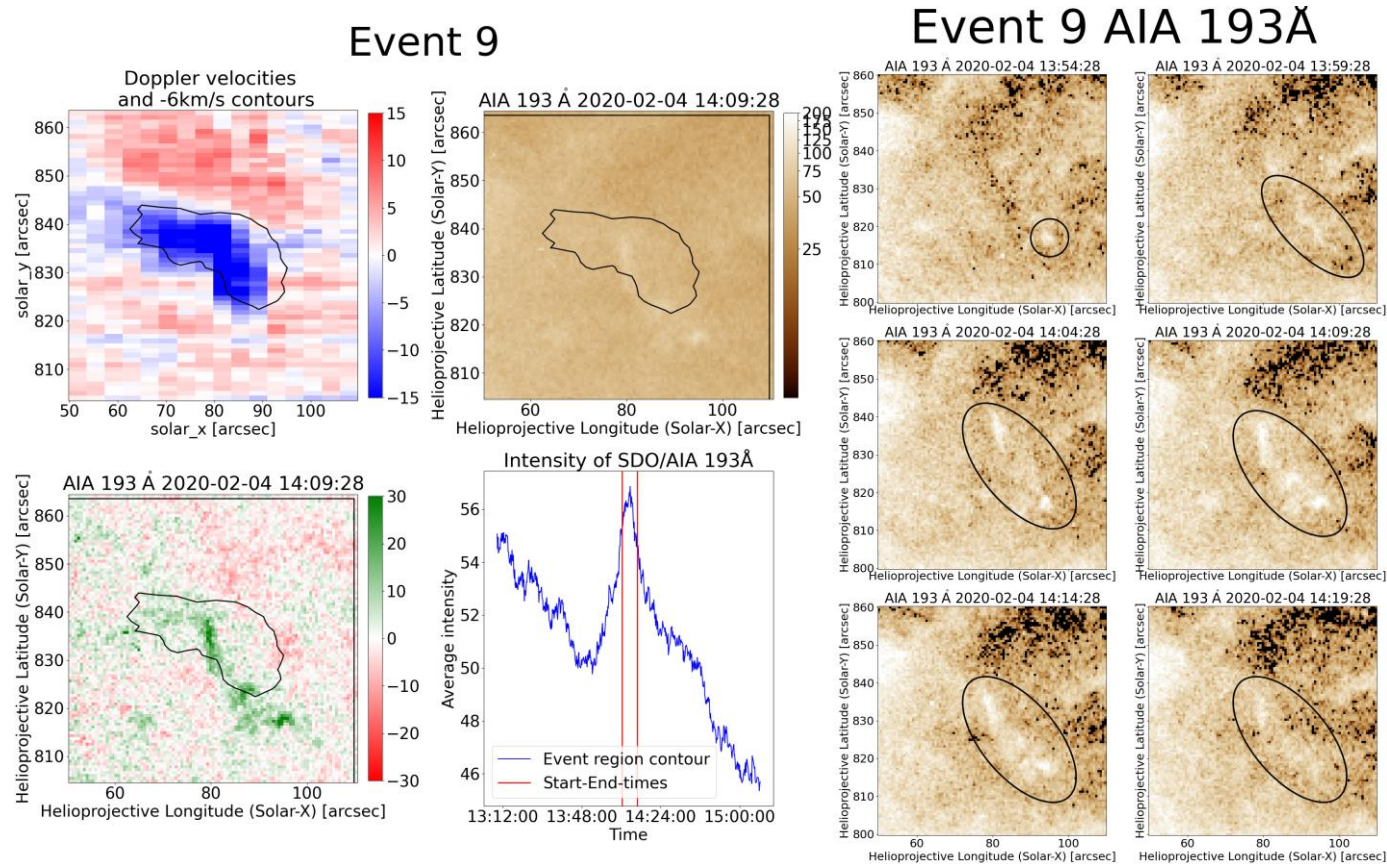
Results: unclear sources

Event 14



- 2 events have no clear source
- no bright point present
- no transient present
- no small-scale structures

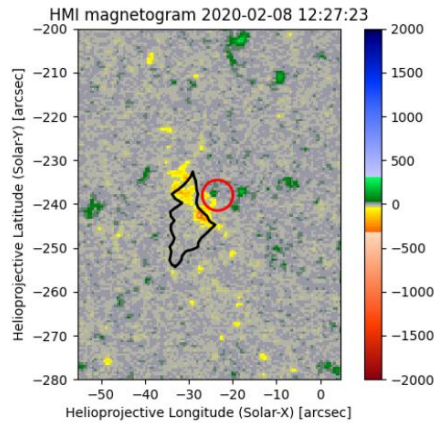
Results: small-scale features



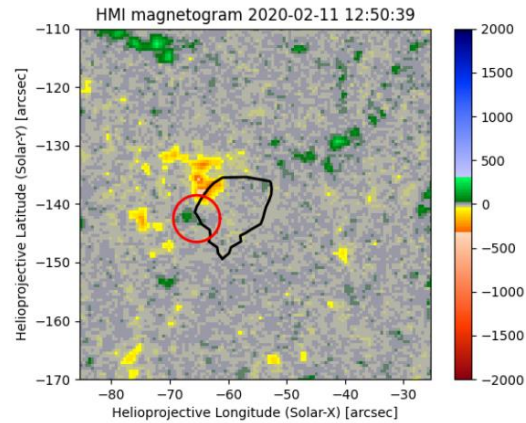
- multiple small features observed
- 3 small-scale brightening
- 4 small faint outflows (example)
- life-times: 10-30 min

Results: HMI data

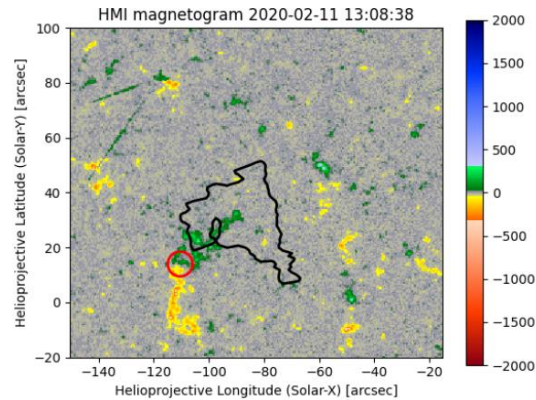
Event 10



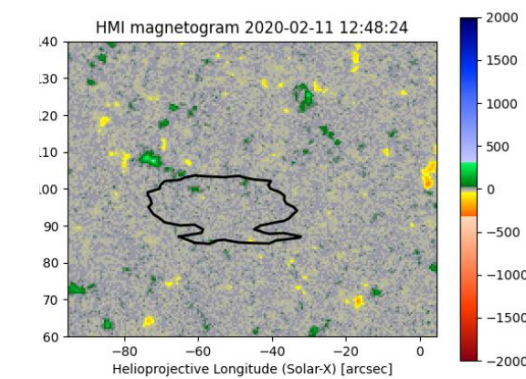
Event 15



Event 16

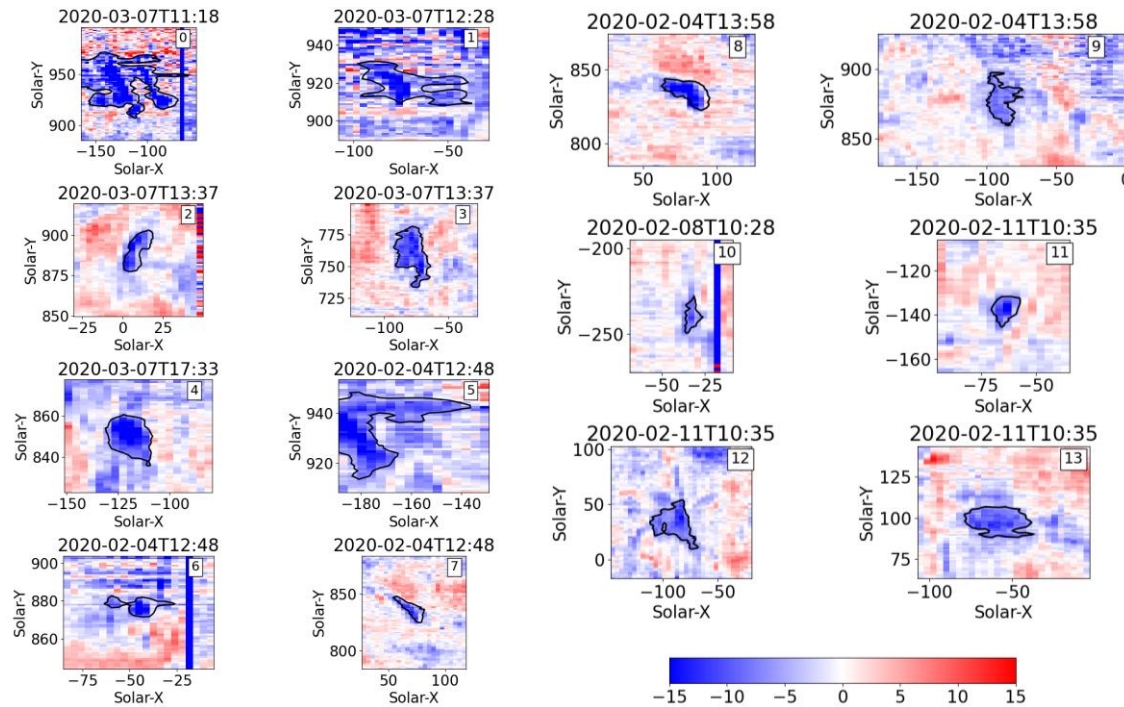


Event 17



- photospheric magnetic field
- 4 events analysed
- 3 events show small magnetic flux cancellations

Results: summary



- Probable sources:
 - jets: 2
 - Bright points: 4
 - unclear: 2
 - small-scale eruption: 4
 - small-scale brightening: 3
- three events are associated to flux cancellation
- Open question:
 - underlying mechanisms
 - connection to campfires
 - contribution to solar wind