Observational characteristics of AR 12192

Xin Huang, Huaning Wang

National Astronomical Observatories,
Chinese Academy of Sciences

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- Forecasting

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→ What can we learn from this event &

 What can we do in the future work

Background

- Preliminary Analysis of Latest Events

  →Selected events for detailed analysis

  →Large active region without CMEs: Activities of NOAA/AR12192

  →"NOAA/AR12192 had area larger than that of AR10486 at the moment of the Halloween event in October, 2003 and produced many M-class and X-class flares. However, solar energetic particle events and geomagnetic storms were not produced by activity of AR12192."

- AR12192 is the largest sunspot group in 24 years. It produces 6 GOES X-class flares (Sun et al 2015)

- We have developed a solar events forecasting model

Event Analysis

- ## Confined flare or eruptive flare
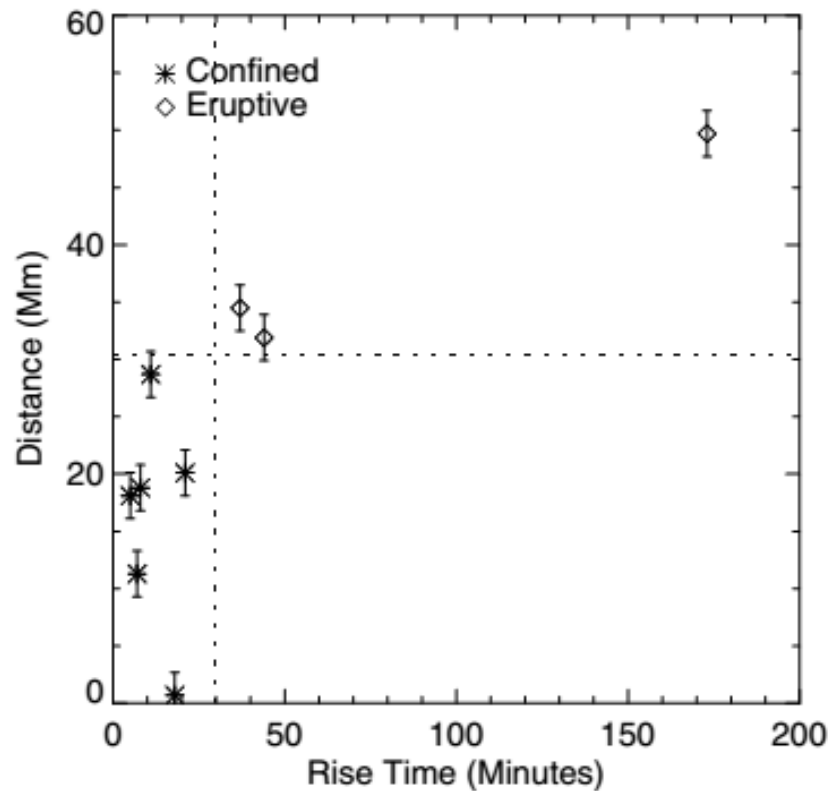 ## (Wang & Zhang 2007 ApJ)

Rise time   <13minute
Decay time >9 minute
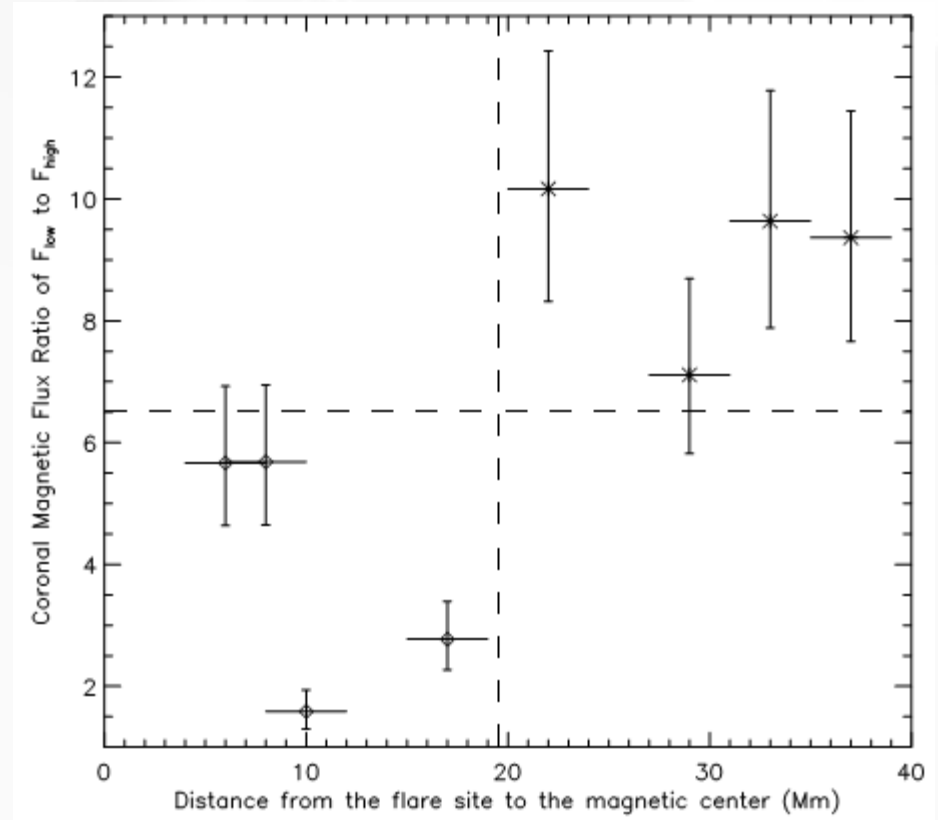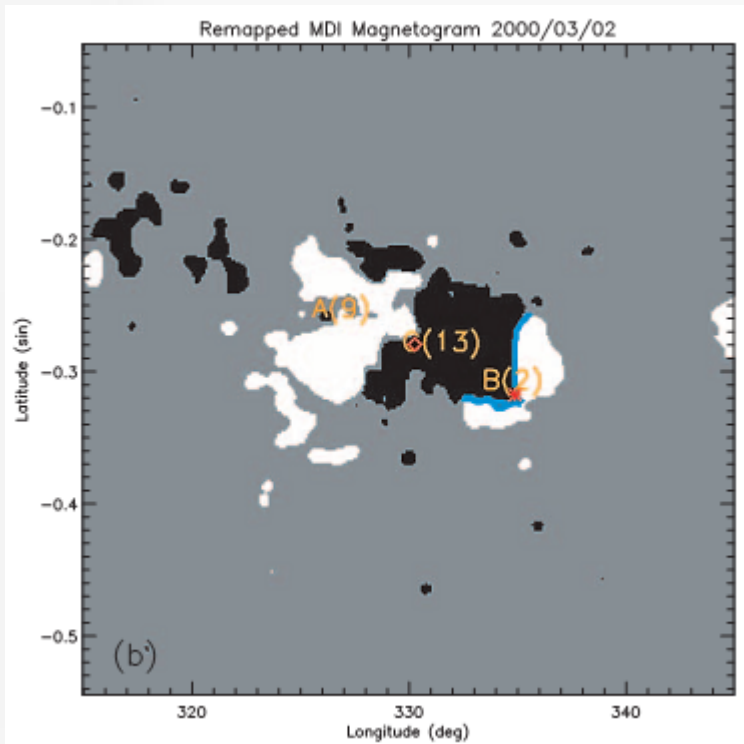
Event Analysis

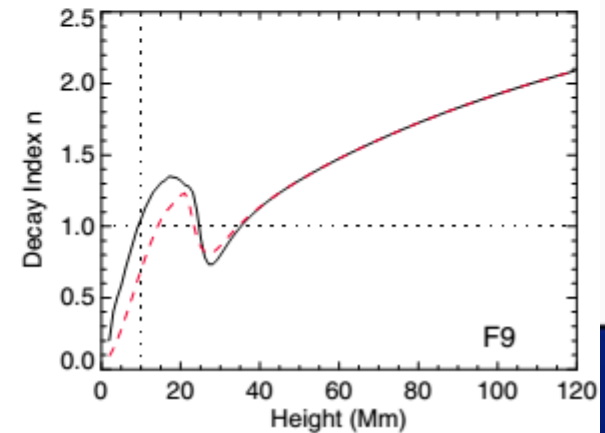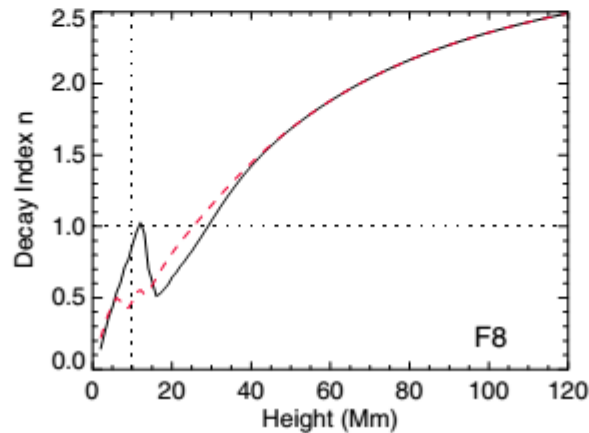- Confined flare or erupted flare (Cheng et al 2011 ApJ)

AR 10720

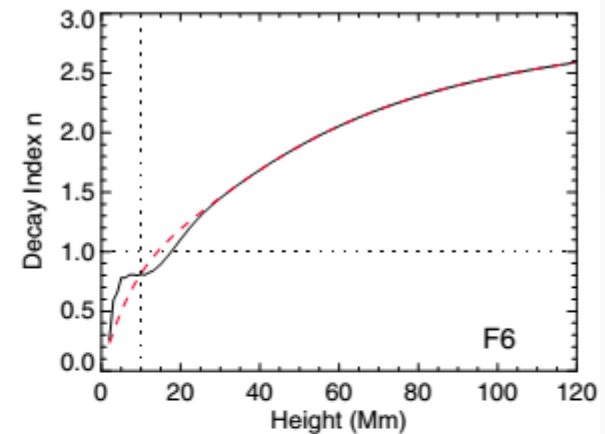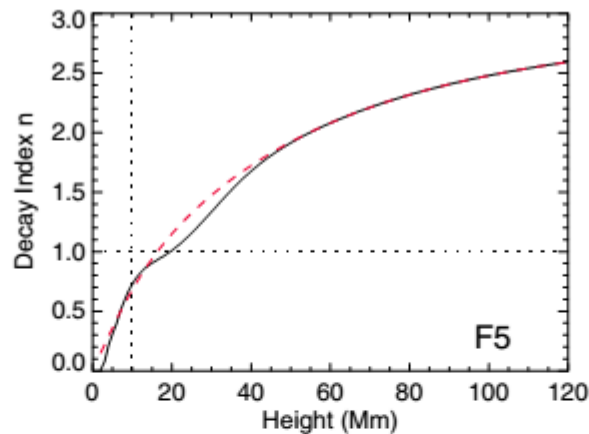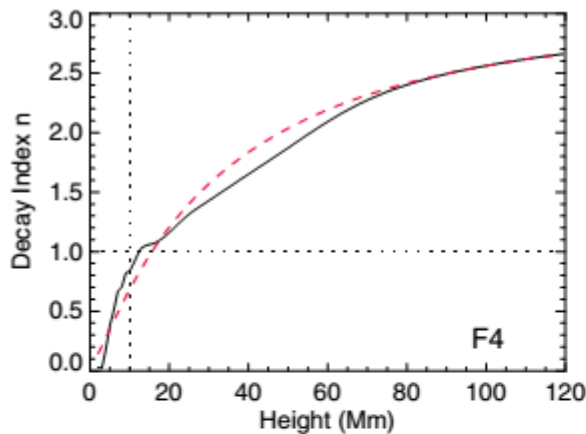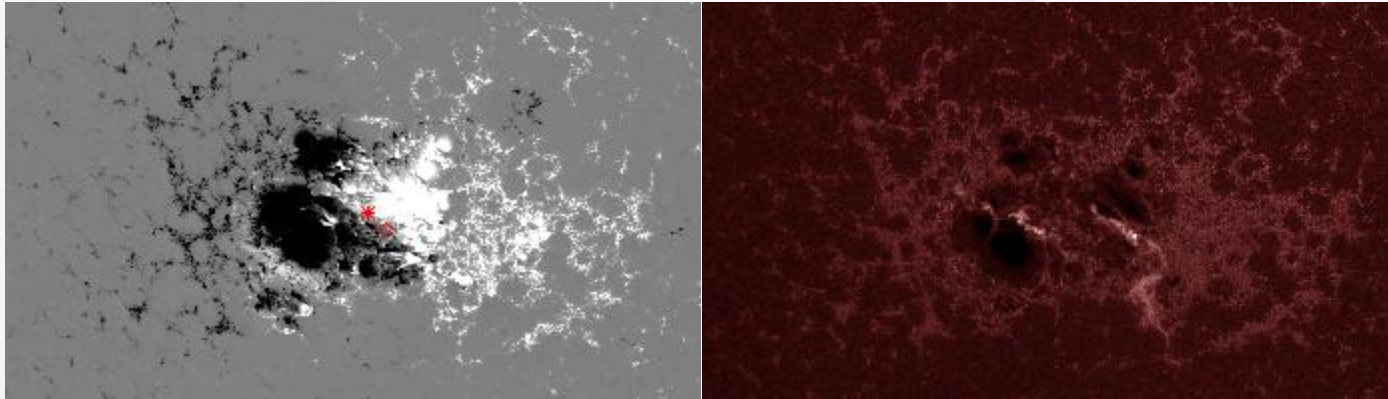- Confined flare or erupted flare (Cheng et al 2011 ApJ)
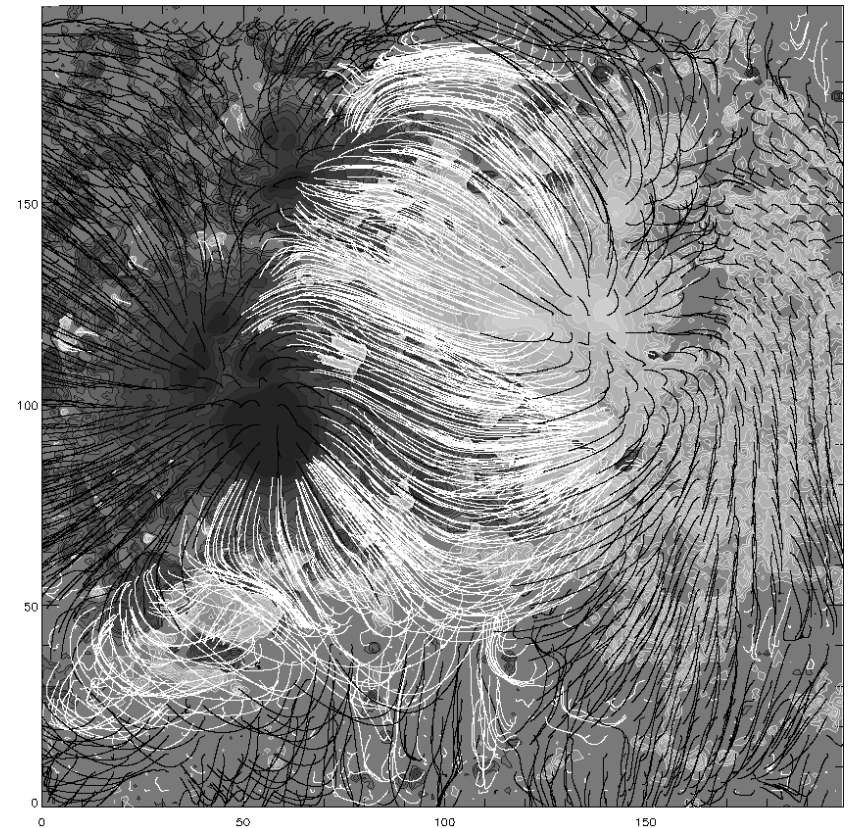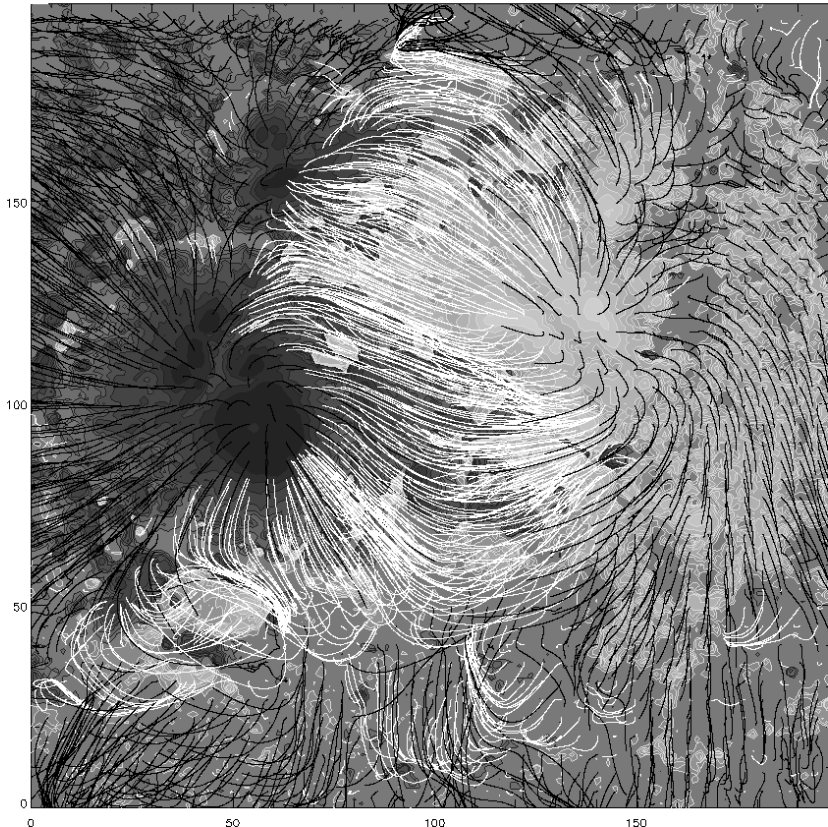
$$n = -\frac{\log B}{\log h}$$
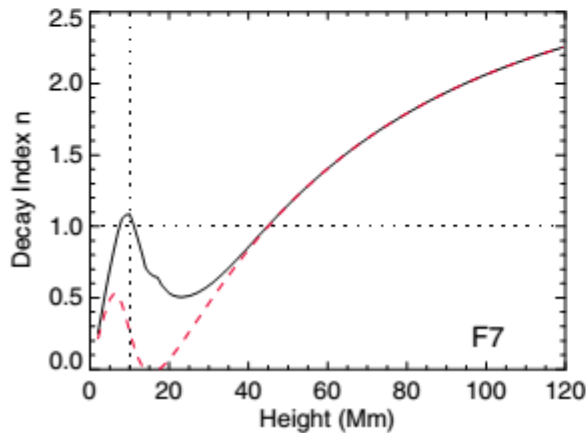
Event Analysis

- AR 12192

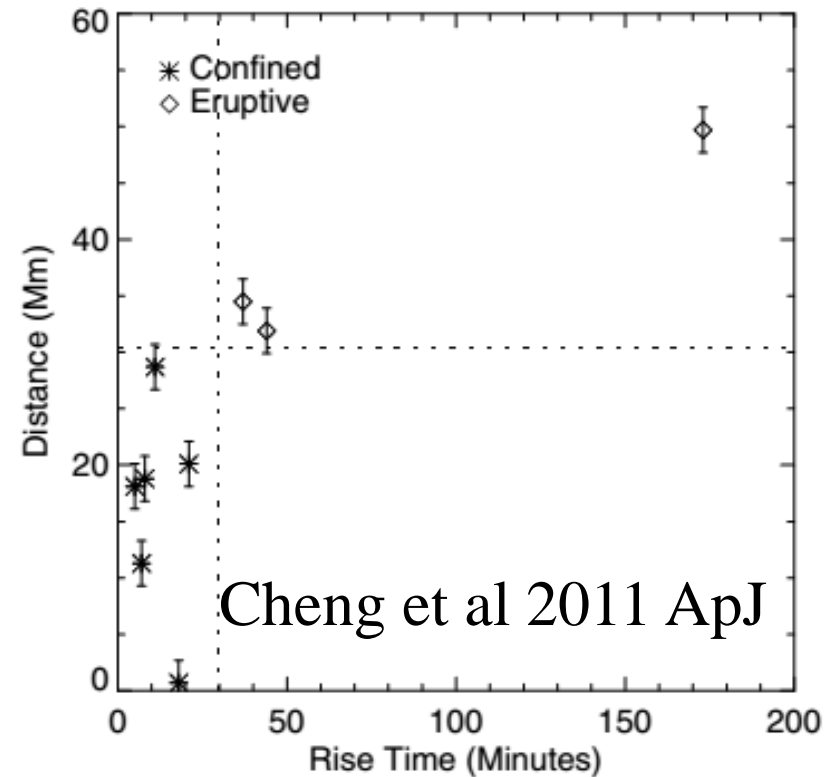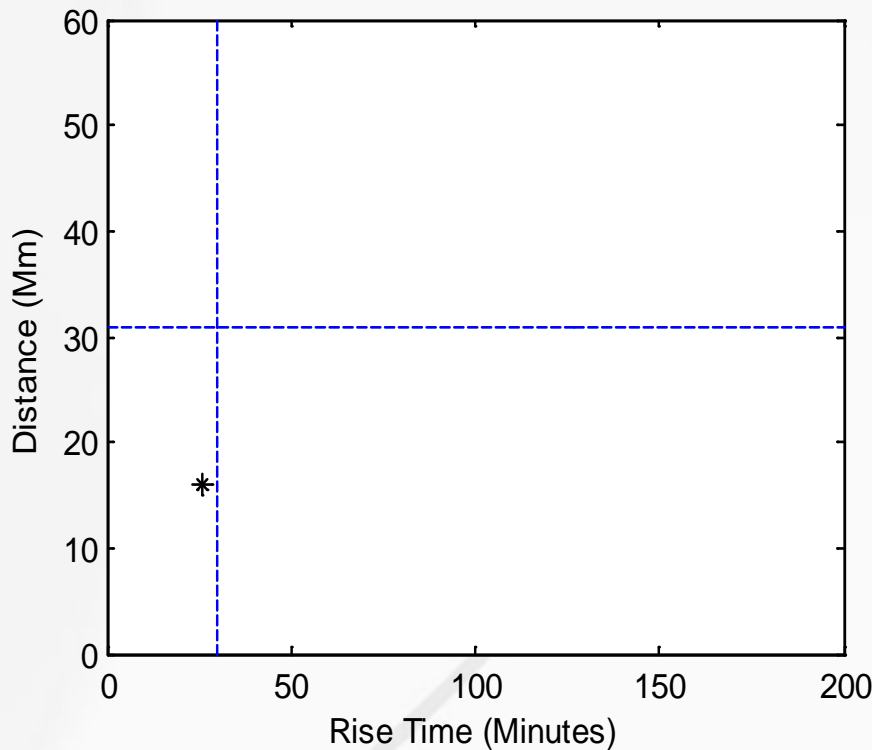- X 16 Flare :2014.10.22 14:02(begin) 14:50(end) 14:28(maximum) S14E13

Event Analysis

- AR 12192

- Nonlinear force-free coronal magnetic field extrapolation based on the direct boundary integral formulation

  (He &Wang 2008 JGR)

Event Analysis

- AR 12192

- Decay index at height of 10 Mm: 0.4

Cheng et al 2011 ApJ

Forecasting

- ## Predictors

- Length of Neutral Line

- Summation of photospheric magnetic free energy density

- Decay Index at the height of 10 Mm

- Transverse magnetic flux ratio between the summation from 0Mm to 10Mm and the summation from 10Mm to 20Mm

- Distance between the center of longitudinal magnetogram and the center of photospheric magnetic free energy density (Dmf)

- Distance Ratio between Dmf and Dpn (Dpn is the distance between positive magnetic field and negative magnetic field)
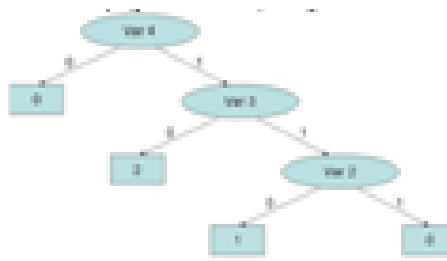
Forecasting

- Model

Parameters	Model	Evaluation
Time Series of Parameters	Decision Tree	Contingency Table

```
a  b  c   <-- classified as
25  4  2 |  a = 0          80%
 4 20  7 |  b = 1          64%
 1  6 24 |  c = 2          77%
```
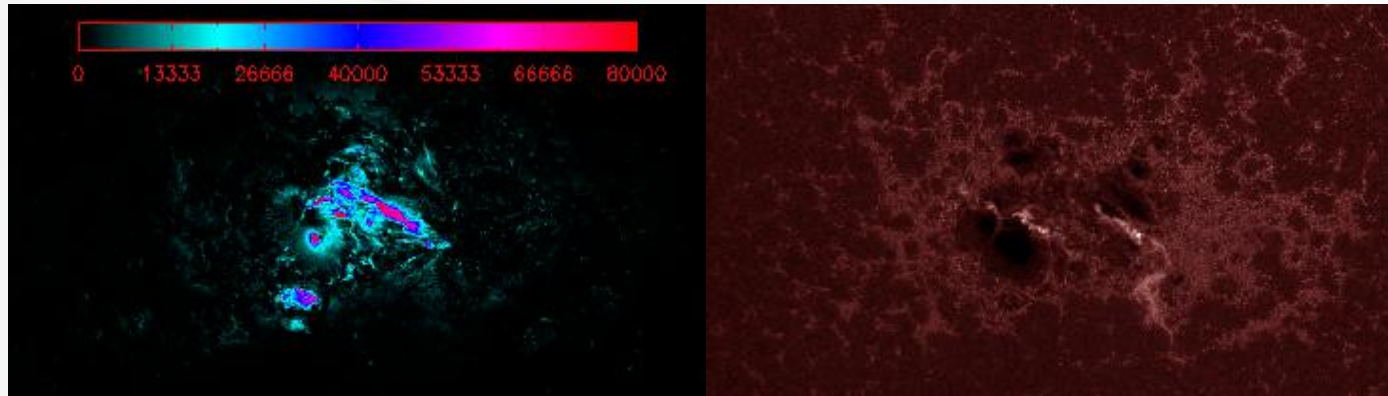
Forecasting

- Test for AR12192


```
a b c   <-- classified as
0 0 0 | a = 0
0 1 0 | b = 1
0 0 0 | c = 2
```

Summary

- AR12192 is similar with other active region with confined flares

- Nonpotential parameters are used to forecast weather or not solar flare happens

- The potential location of solar flare
  & the overlying coronal magnetic field
  are important to determine it is confined or
  eruptive flare

- AR 12192 remind us we need consider solar flares and CMEs together

- The forecasting capability remains probabilistic

Thanks !