



Seeing the Solar Surface:

Advancing Automated Solar Image Processing

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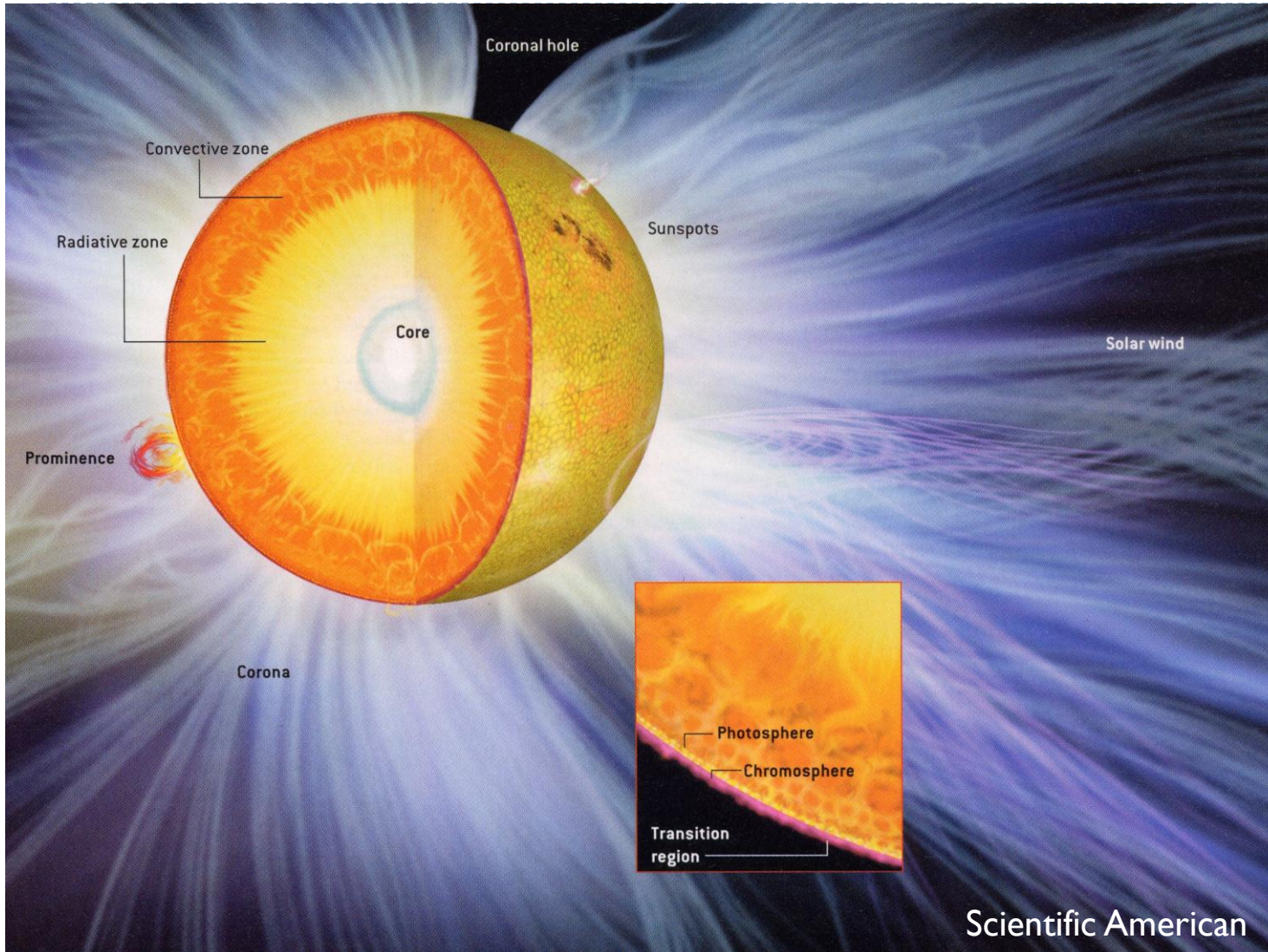
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New Mexico State University

NMSGC Presentation



Anatomy of the Sun from the inside out.



Photosphere

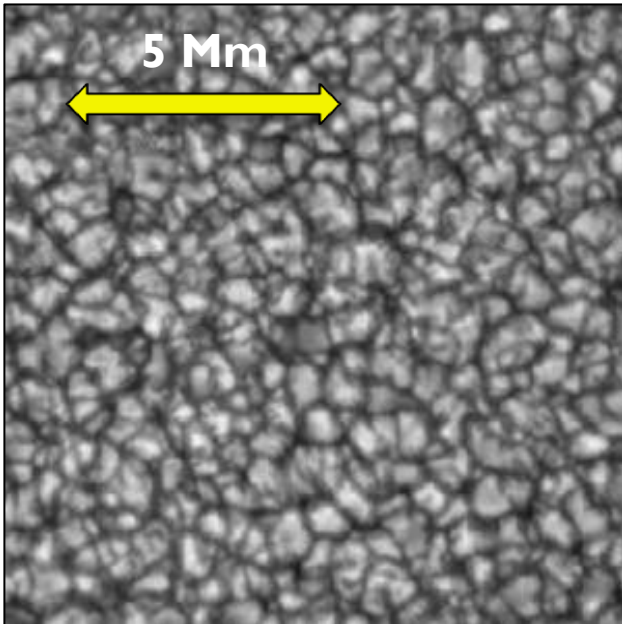
Chromosphere

Corona

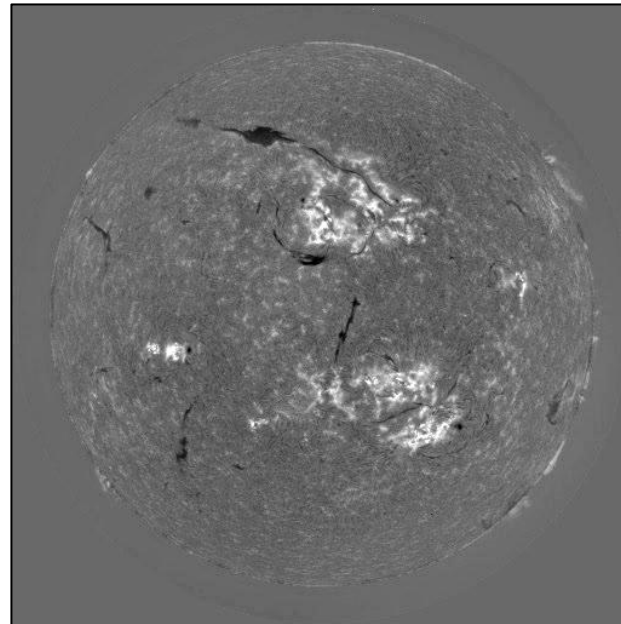
Scientific American



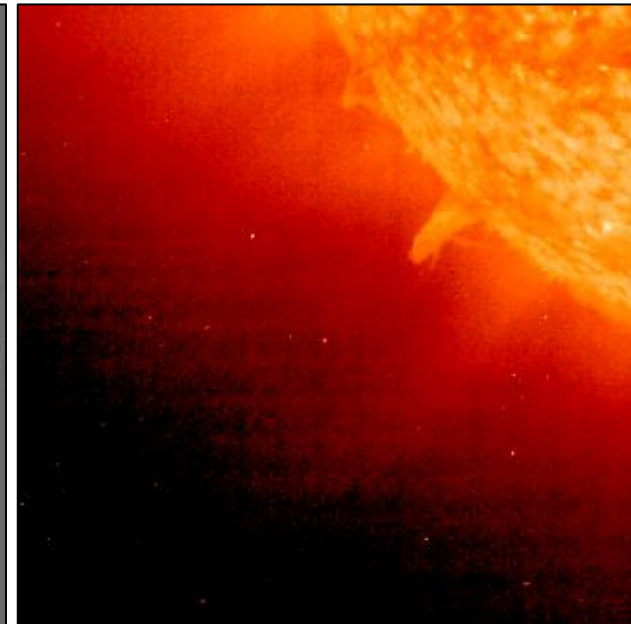
A dynamic body:



Photospheric Granulation:
Composed of dark lanes and bright upwelling due to the convective motion below.



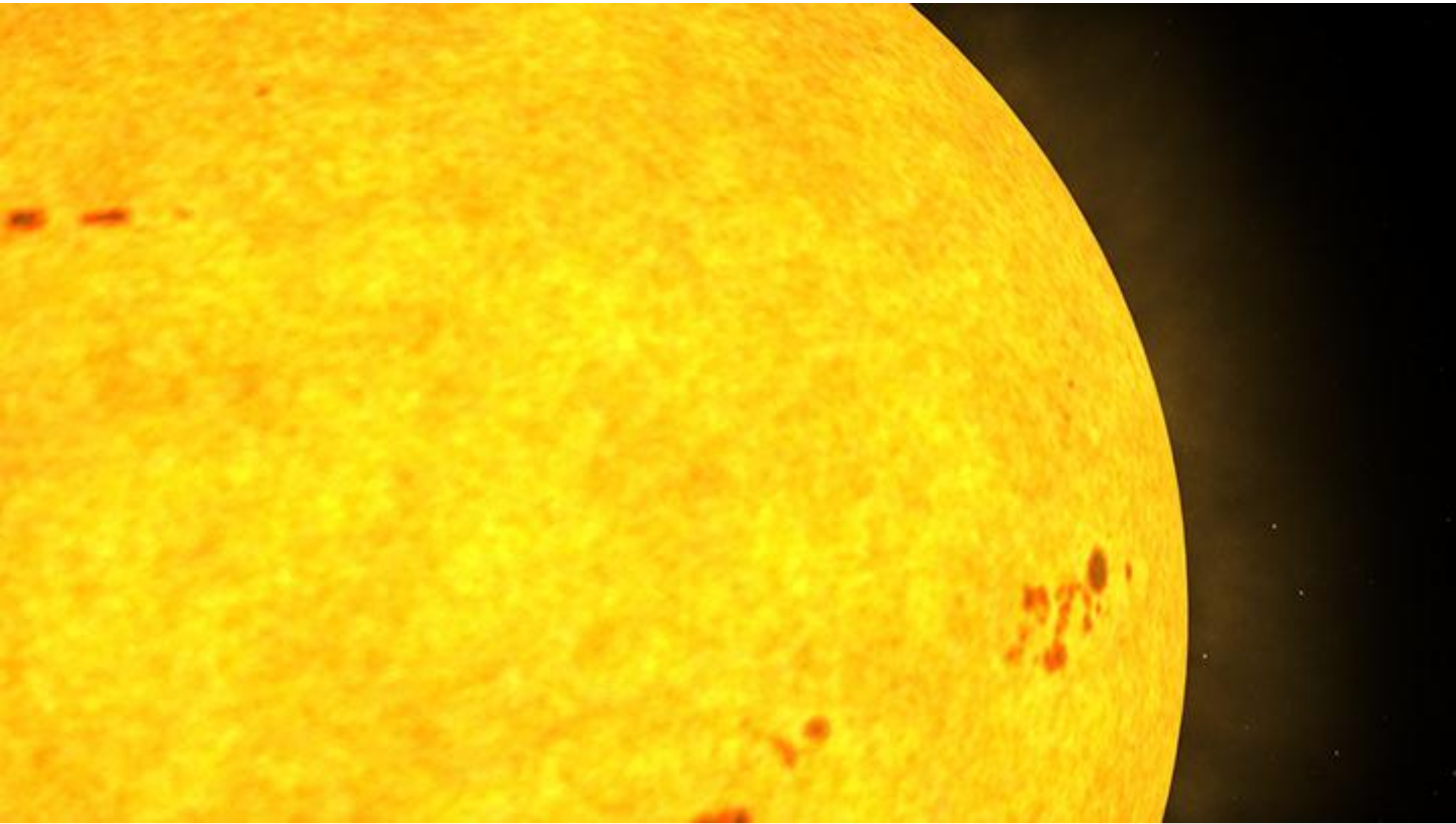
Chromospheric Flare:
Impulsive brightening where material is heated to many millions of degrees.



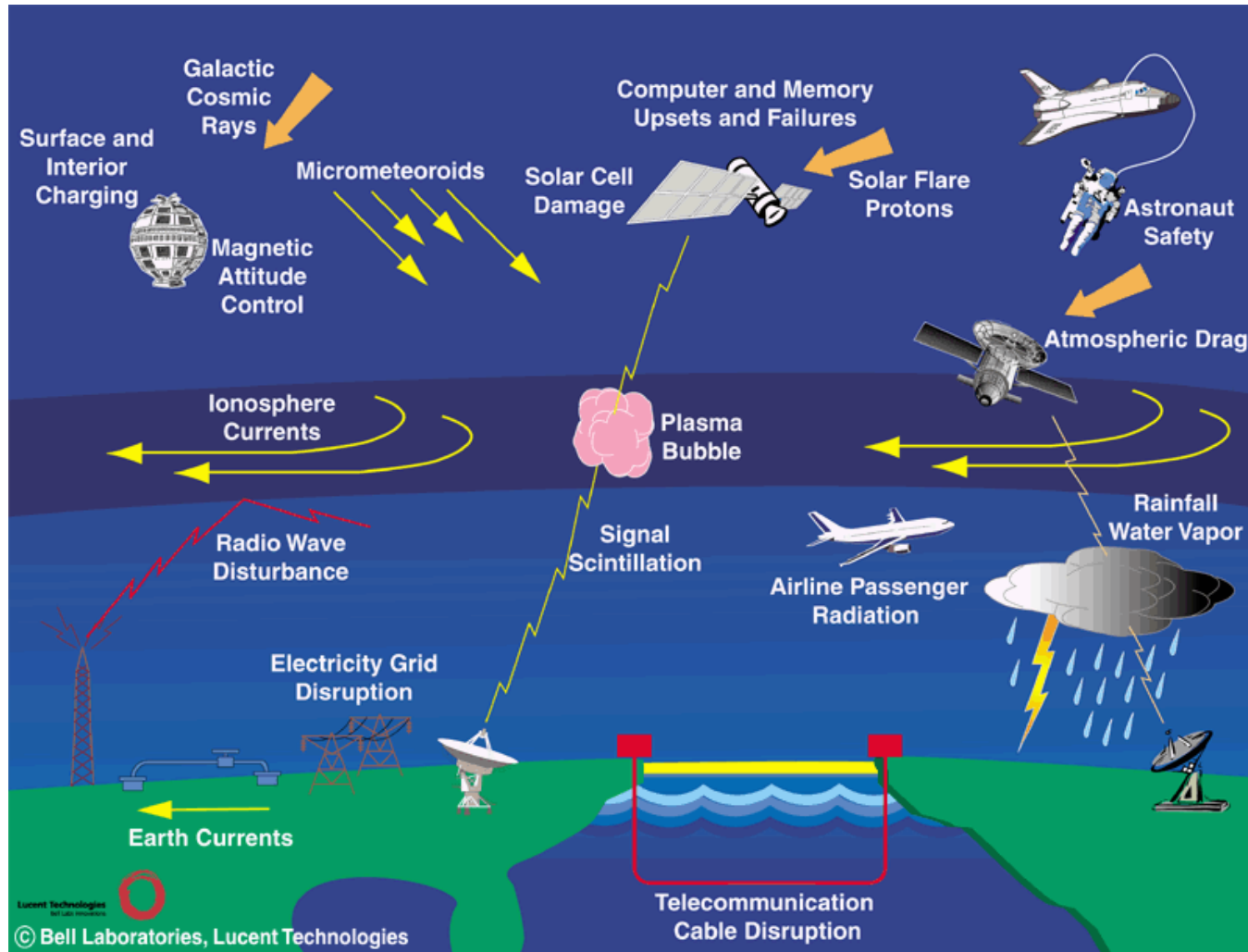
Coronal Prominence Eruption: loops of heated plasma tracing magnetic closed field lines

The Sun is anything but static wherever you look.

What happens to Earth?



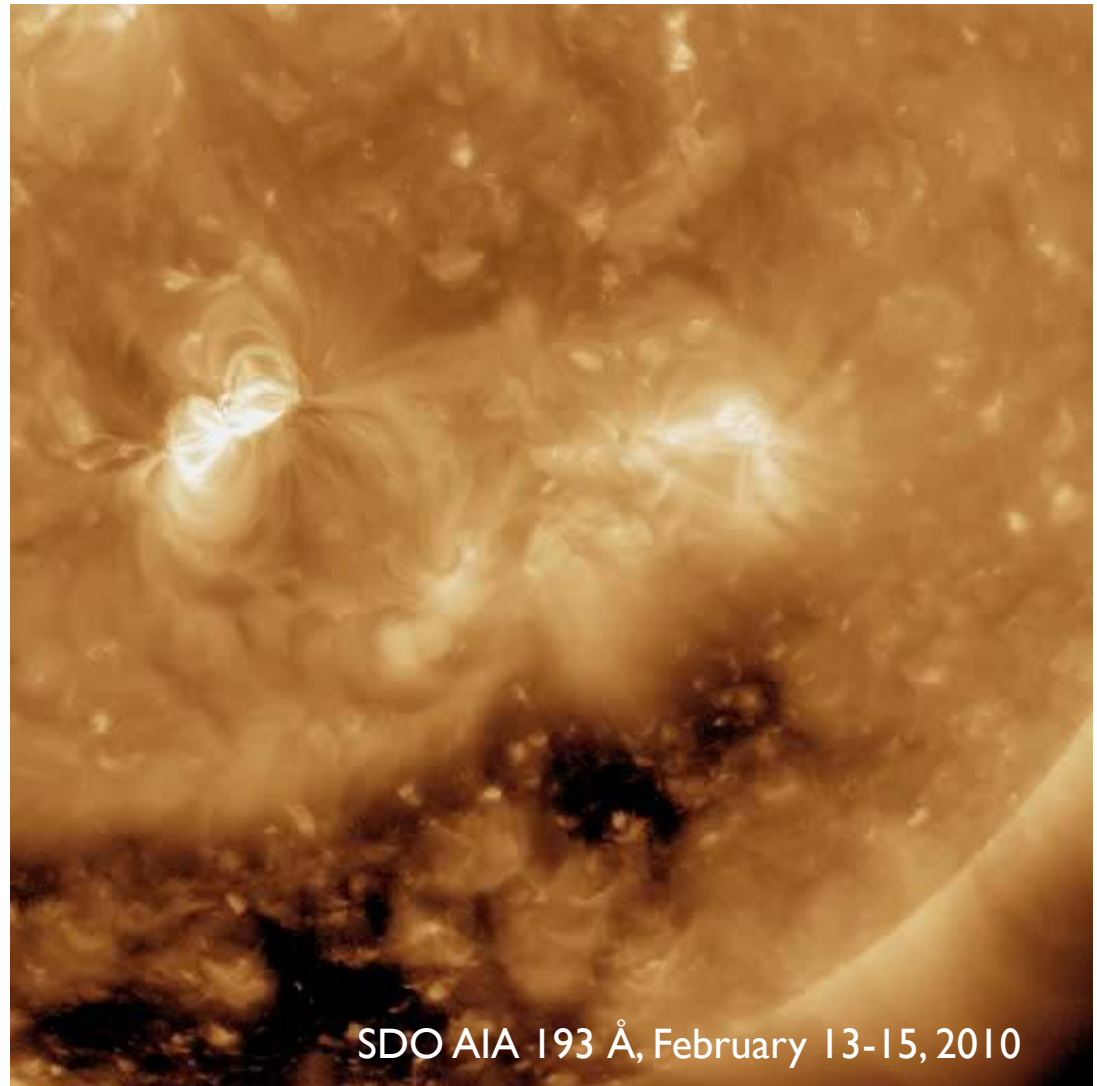
The effects of space weather.



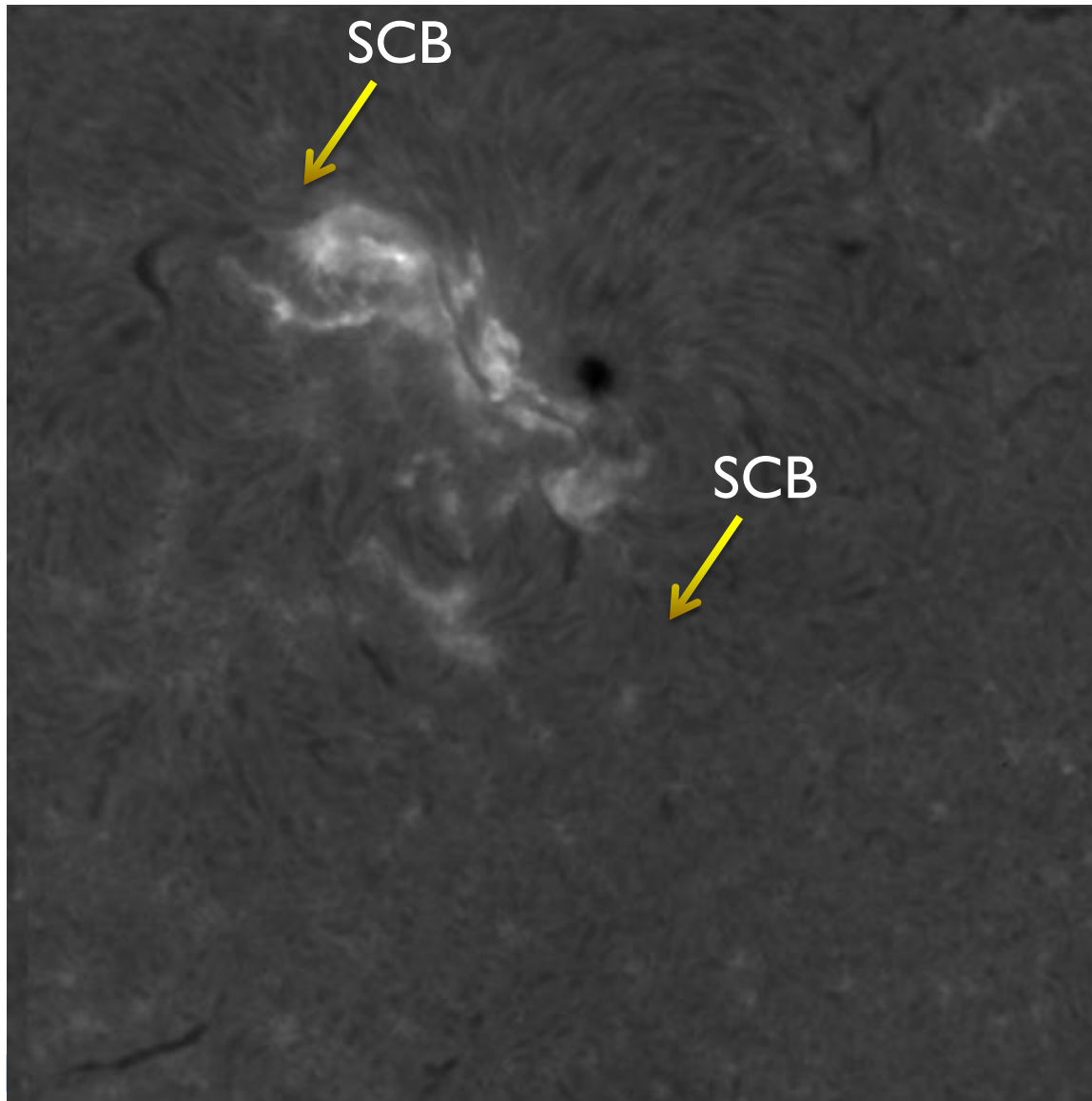
- Space weather is the environment outside Earth and is dominated by the solar wind.
- It can effect the way we communicate and power our world.
- One large event can destroy satellites and interrupt electric grids.

Solar flares.

“... a solar flare is a process associated with a rapid temporary release of energy in the solar corona triggered by an instability of the underlying magnetic field configuration that evolves into a more stable state by changing and reconnecting the magnetic topology. As a result of this process non-thermal particles are accelerated and the coronal/chromospheric plasma is heated”
(Aschwanden, 2006)



Sequential Chromospheric Brightenings:



→ First documented in 2005 in H α images by Balasubramanium et al.

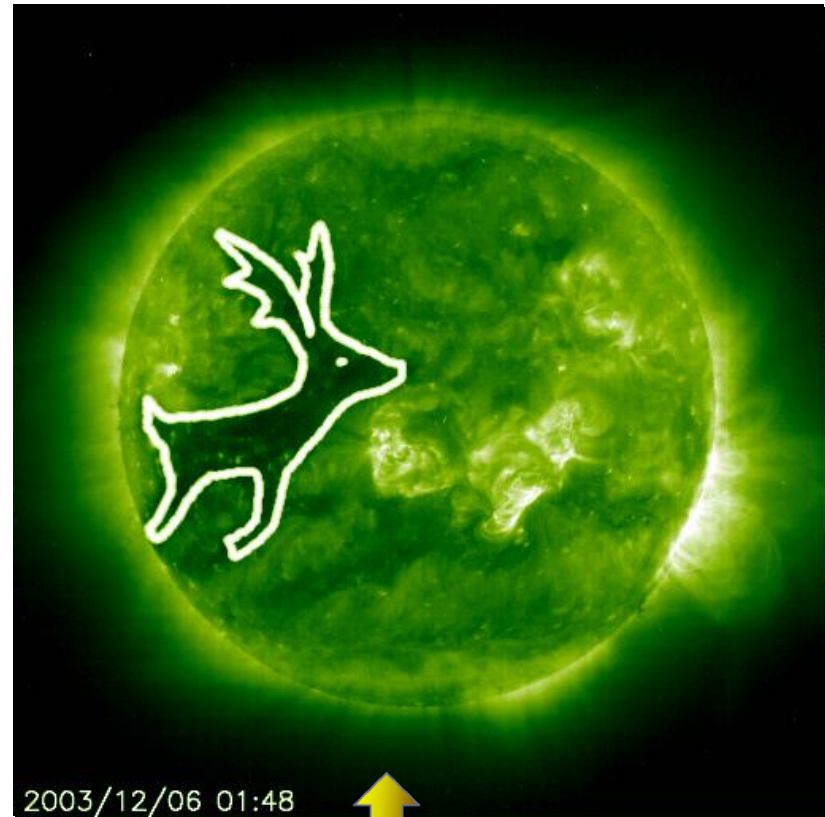
→ Observed in conjunction with prominence eruptions and coronal mass ejections

→ Propagate out from the flare several hours before a mass ejection is detected

→ Understanding SCBs are critical to unraveling how flare loops evolve in the chromosphere

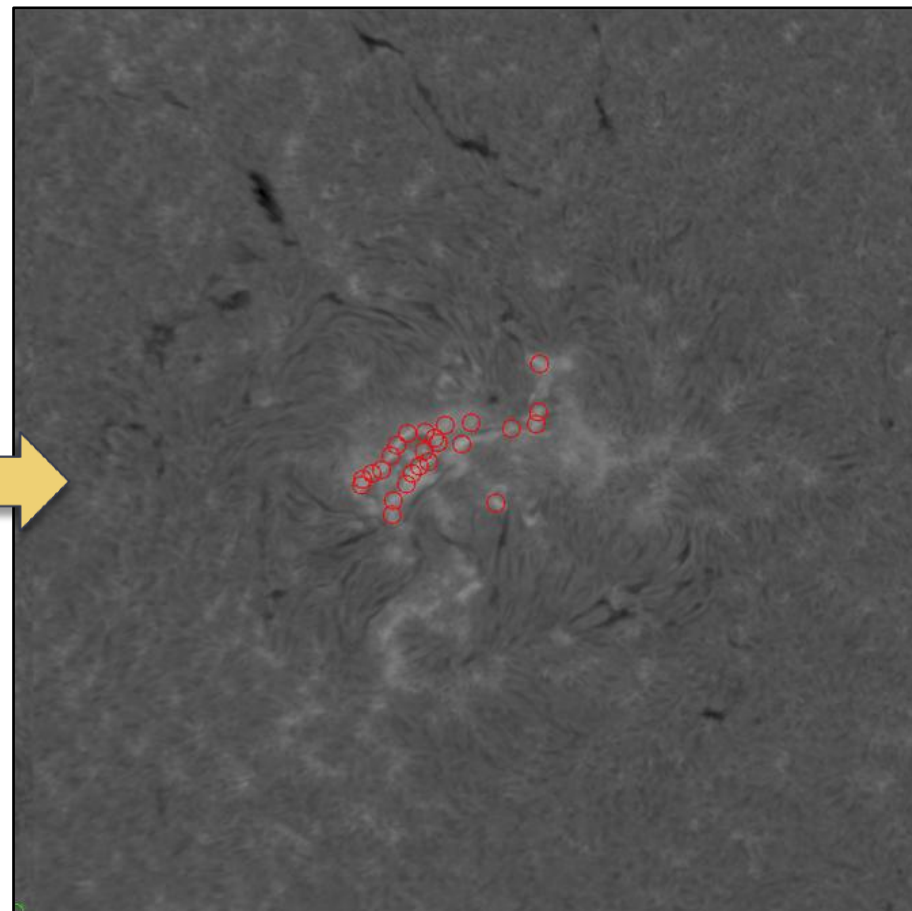
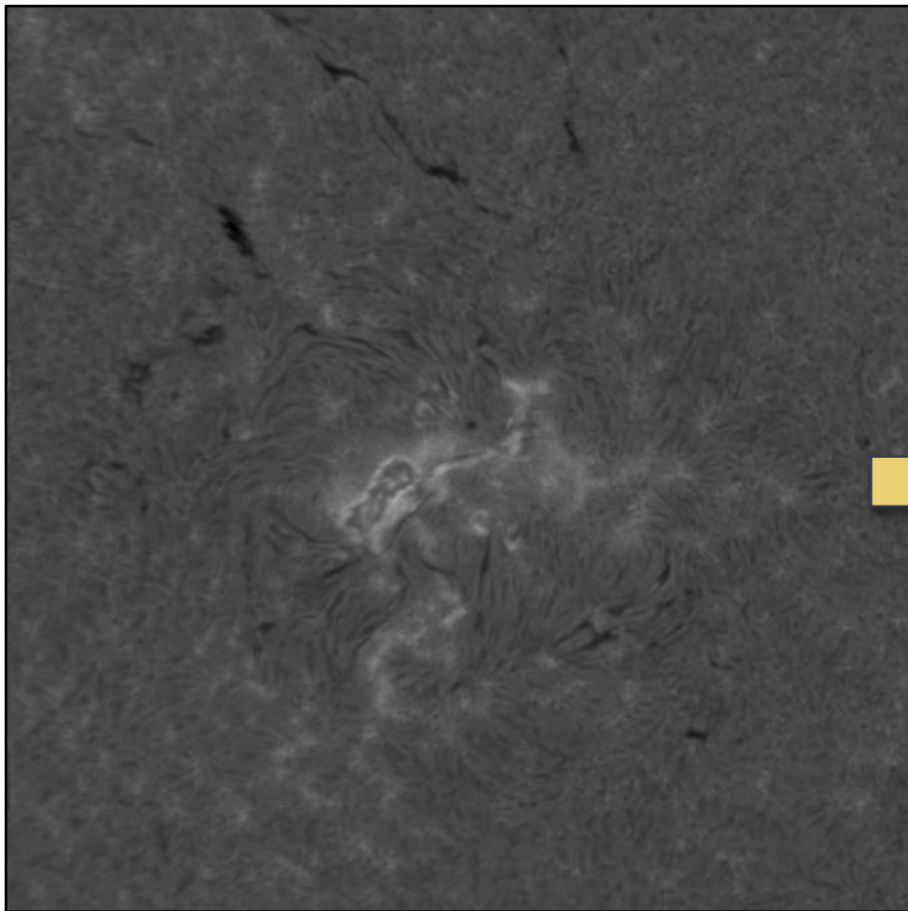
Automated feature recognition:

- ▶ Solar features in the past have been identified visually with a few exceptions
- ▶ Automated techniques aim to have the computer recognize what your eye sees in the image
- ▶ Software is needed for the computer to see what you want it to see



What do you see here?

Detecting bright points.



Flare before detection algorithm

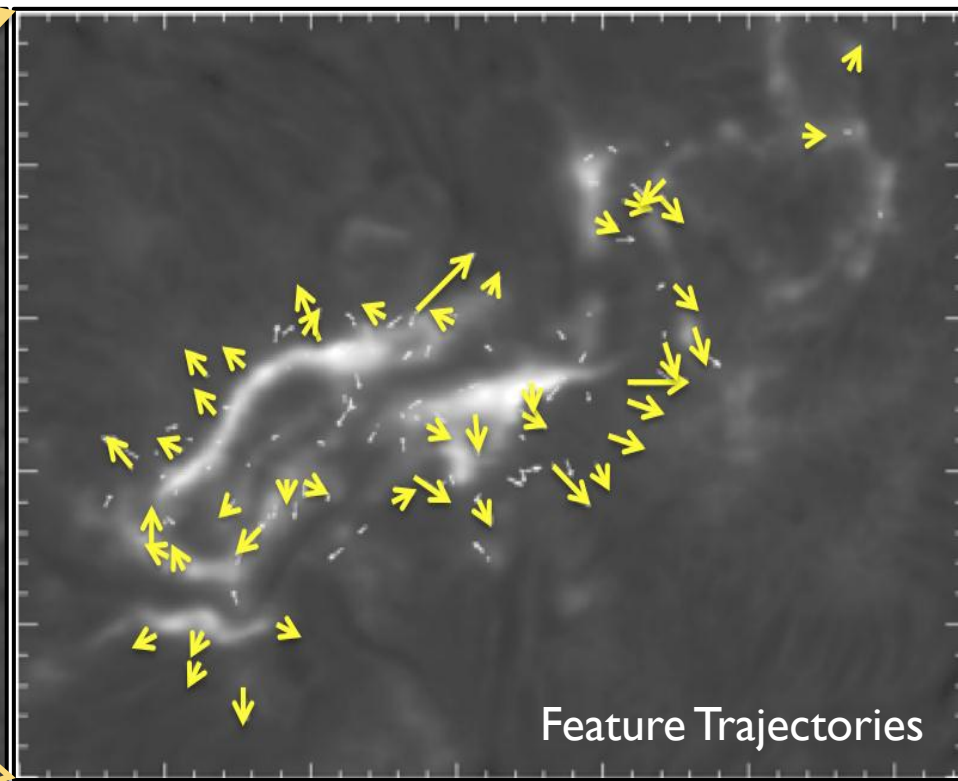
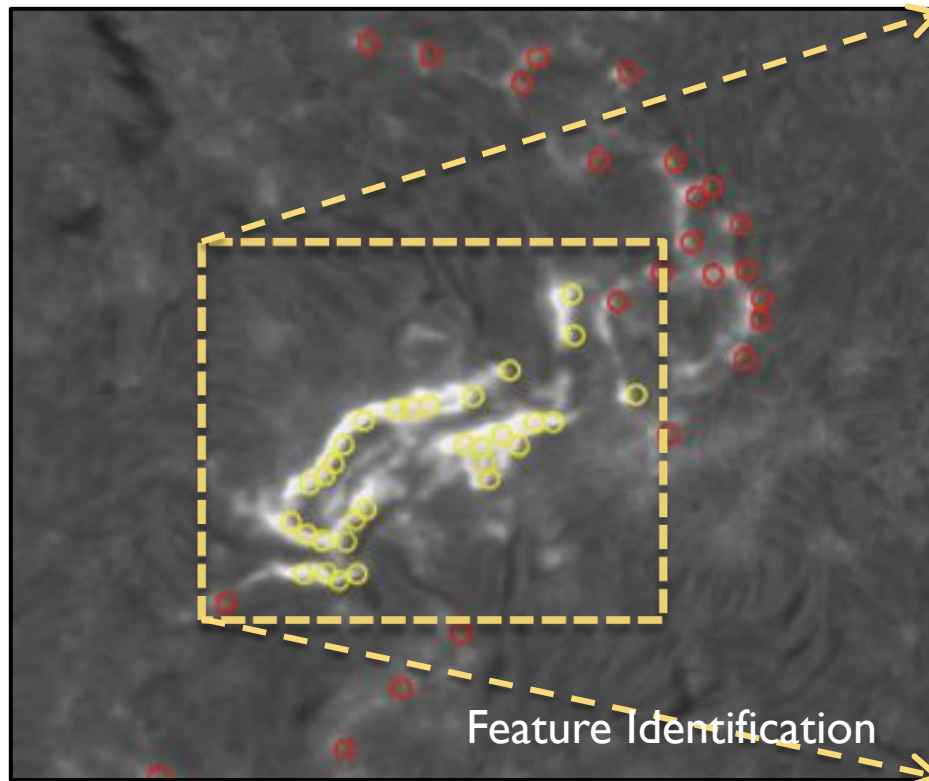
Flare after detection algorithm has been applied



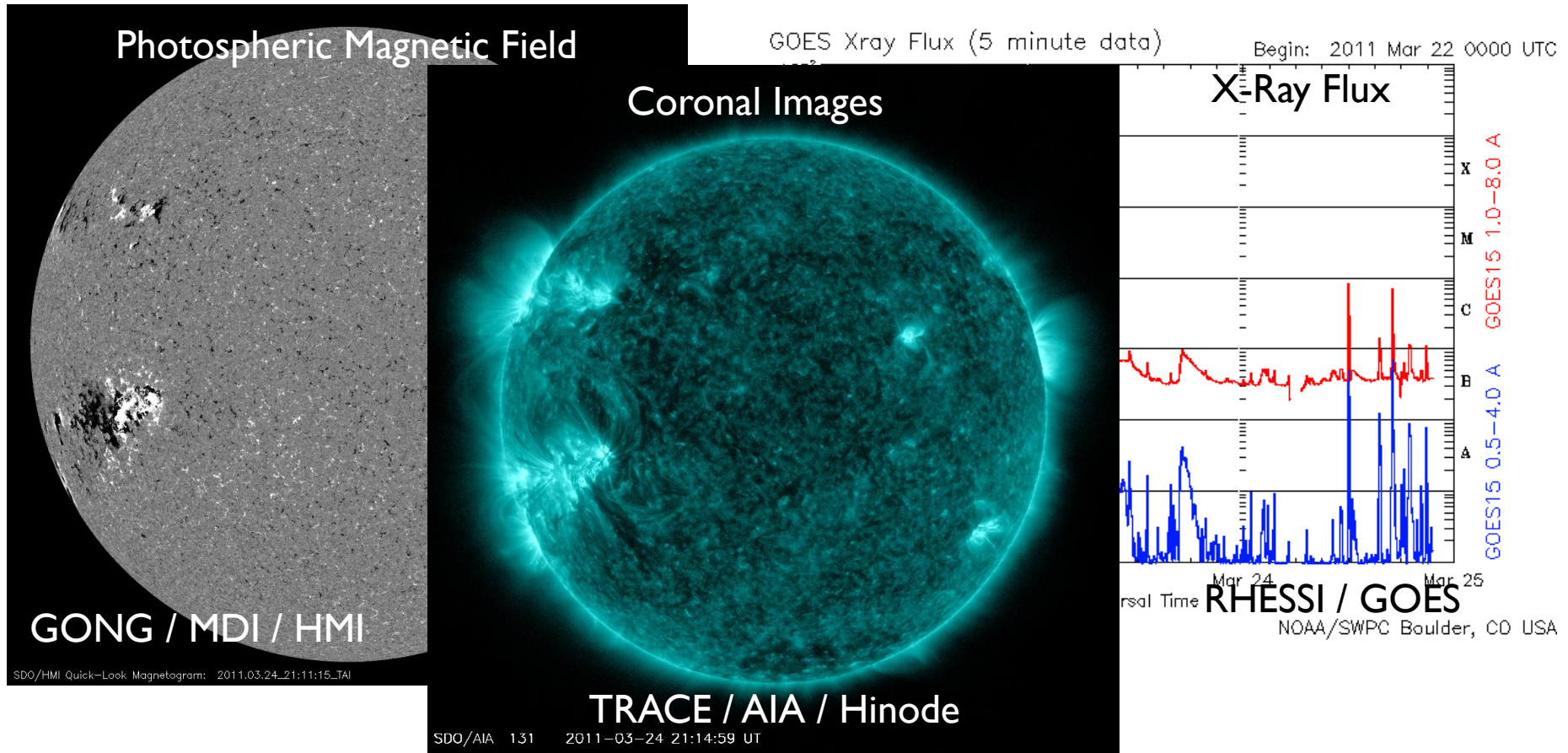
Linking detection into trajectories.

ISOON With Automated Detection Algorithm

ISOON With Feature Tracking Algorithm



Extrapolating kernels to other data.



Several other data sets exist to provide insight into other aspects of the solar atmosphere.

Launch of the Solar Dynamics Observatory in February 2010



Questions?