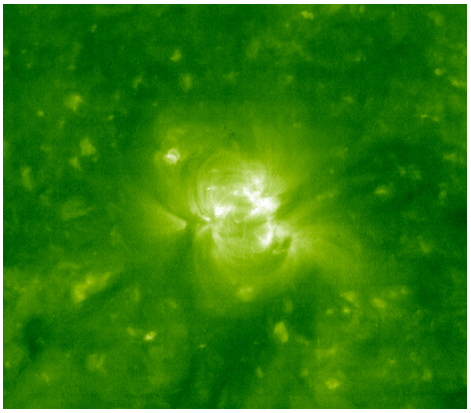
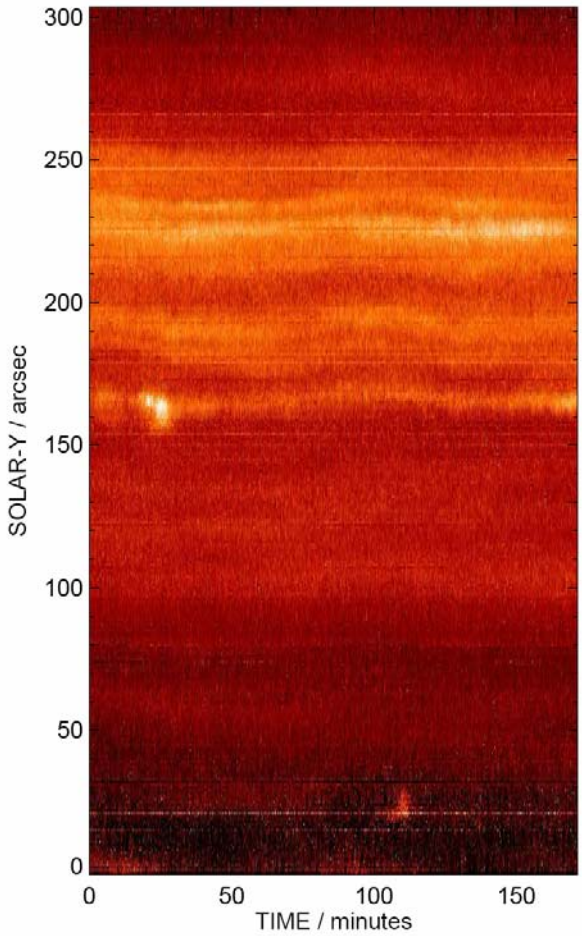
Plasma Speeds in Active Regions



The Hinode EIS instrument can study a single slice of an active region and detect subtle changes in position over time. The image above shows an active region near a sunspot, and reveals its 'bar magnet' magnetic field loops.

The strip plot to the right shows the motion of the plasma sliced vertically along the center line of the active region, over a span of about 200 minutes. The vertical axis gives the location of the plasma in units of arcseconds, where one arcsecond equals a physical distance of 725 kilometers on the solar surface.



Individual features in the upper image appear as bands on the strip plot. The slope of the band is a measure of the speed of motion of the gas.

Problem 1 - Select the bright feature near Y=160. What is the change in the Y-position during the period from A) 0-50 minutes? B) 50 - 100 minutes? C) 100-150 minutes?

Problem 2 - From your answer to Problem 1, what is the average speed of this feature during each 50-minute period from A to C in kilometers per second?

Problem 3 - How soon after the start of the data did a flare occur in this feature? How long did it last?

Answer Key:

Problem 1 - Select the bright feature near Y=160. What is the change in the Y-position during the period from A) 0-50 minutes? B) 50 - 100 minutes? C) 100-150 minutes?

Answer: Students need to use a millimeter ruler and determine the Y-axis scale of the plot. The total height represents 300 arcseconds or a physical length of 300 x 725 km = 217,500 kilometers. The vertical length of the figure is 116 millimeters, so the scale is 1,875 km/mm

A) The change in the Y-axis location between the beginning and end of this segment is about 1 millimeter or 1,875 kilometers.

B) The change in the Y-axis location between the beginning and end of this segment is about 3 millimeters or 5,625 kilometers.

C) The change in the Y-axis location between the beginning and end of this segment is about 2 millimeter or 3,750 kilometers.

Problem 2 - From your answer to Problem 1, what is the average speed of this feature during each 50-minute period from A to C?

Answer: Each segment is 50 minutes long or 3000 seconds. Dividing the distances in Problem 1 by 3000 seconds you get A) 0.625 kilometers/sec; B) 1.87 kilometers/sec and C) 1.25 kilometers/sec.

Problem 3 - How soon after the start of the data did a flare occur in this feature? How long did it last?

Answer: The flare event is located in the strip plot between Y = 160 and 170 arcseconds. 50 minutes equals 18 millimeters so the scale is 2.8 minutes/mm. The flare occurred about 7 mm or 19.6 minutes after the start of the data, and lasted 3 mm or 8.4 minutes.