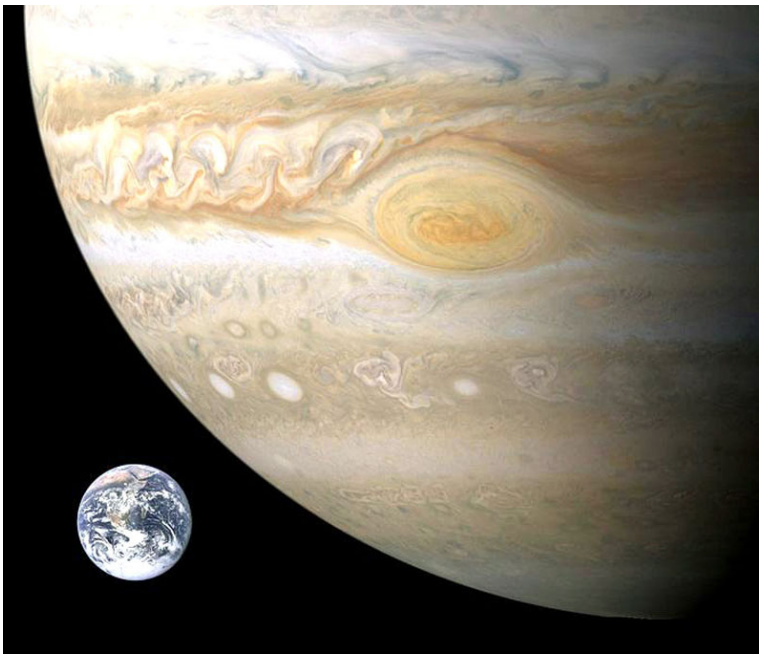
Comparing Storms on Jupiter to Storms on Earth

We will use images from *Voyager 1* to determine the rotation period and wind speeds for the Great Red Spot on Jupiter. We will then compare these values to storms on Earth.

Use the image below to estimate the semi-major and semi-minor axes of the Red Spot by using the Earth as a reference scale; Dobson Chapter 4 $\rightarrow D_{\text{Earth}} = 12,742$ km.



Semi-major axis a:_____
Semi-minor axis b:_____
Circumference C:_____

Provided $a < 3b$, the circumference C of an ellipse can be estimated to $\sim$5% accuracy via $C \approx 2\pi\sqrt{\frac{a^2+b^2}{2}}$.

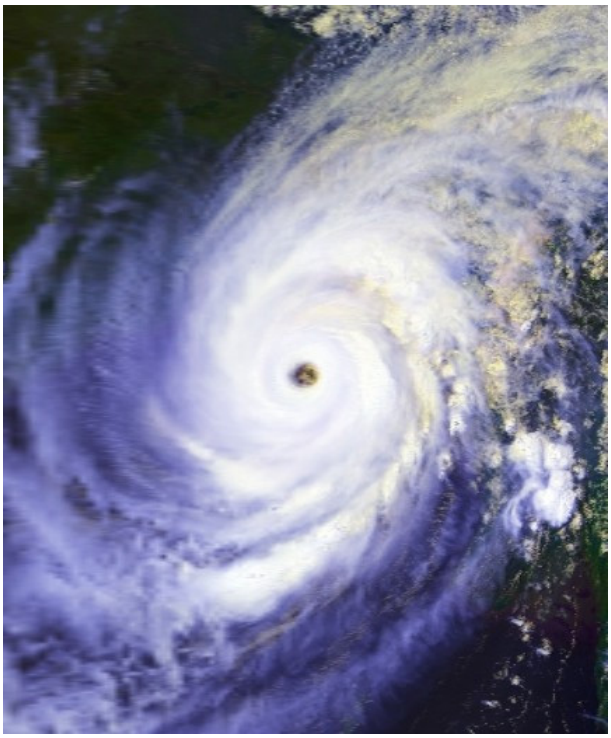
To find the wind speeds, use the following series of images taken by *Voyager 1* in 1979 as it approached Jupiter. Sixty images were taken at a constant cadence between 06 January and 03 February; each frame was taken at the same Jupiter local time, so the spot does not appear to move. The figure provided on the last page shows 12 of the 60 images taken over this period—how many hours does this photo montage cover?

The 'x' on these images tracks a white feature as it makes one complete revolution around the storm. What is the implied speed of this feature?

Current measurements of the speed of the outer parts of the Great Red Spot are 430–680 km/hr. Quantitatively compare your results from the 1979 data to the current range of speeds and comment.

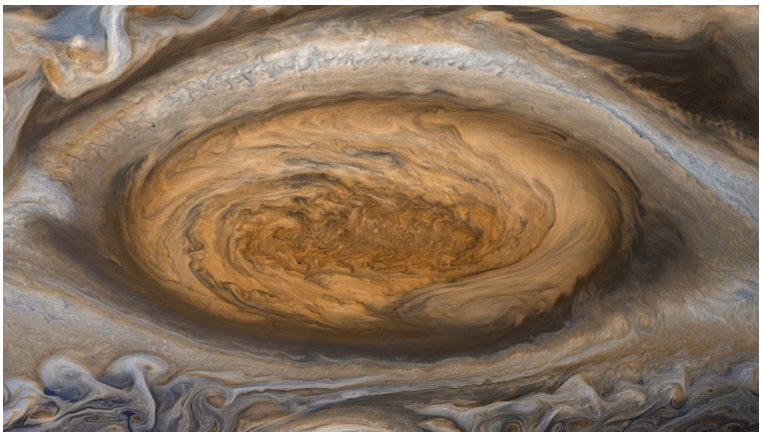
What do you think are the largest sources of error in your measurement?

The below figure shows a cyclone that developed from a tropical depression on 22 April 1991 in the Bay of Bengal. Before reaching landfall it had wind speeds of 160 mph (258 km/hr), the equivalent of a Category 5 hurricane. After making landfall near Chittagong, Bangladesh, the storm weakened and dissipated by 30 April, a total lifetime of just over a week.



Quantitatively compare the maximum speed of the cyclone to your value for the Great Red Spot. Comment on the comparison.

From Space.com: https://www.space.com/39764-jupiter-great-red-spot-could-disappear.html
Jupiter's Great Red Spot Could Disappear Within 20 Years



An enhanced image of Jupiter's Great Red Spot, as seen by Voyager 2 on 7 July 1979.

The iconic Great Red Spot of Jupiter may disappear in the next 20 years, according to a researcher at NASA's Jet Propulsion Laboratory (JPL) in California.

The massive storm—larger than Earth itself—was first spotted in 1830, and observations from the 1600s also revealed a giant spot on Jupiter's surface that may have been the same storm system. This suggests Jupiter's Great Red Spot (GRS) has been raging for centuries.

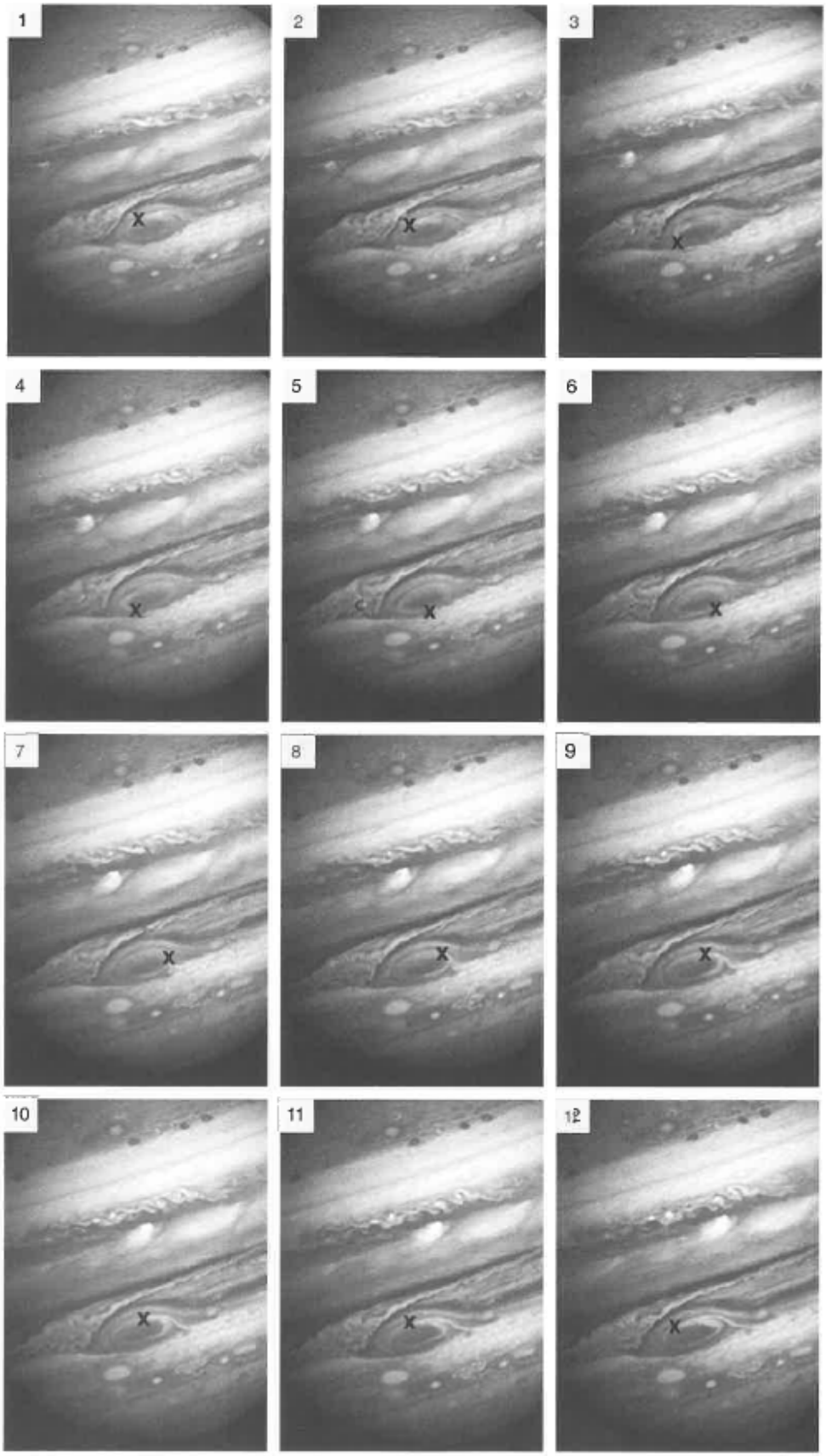
In a recent story, Business Insider spoke with Glenn Orton, a lead Juno mission team member and planetary scientist at JPL, about the giant storm's fate.

According to Orton, the storm's vortex has maintained strength because of Jupiter's 300-400 mph (483-640 km/hr) jetstreams, but like any storm, it won't go on forever. "In truth, the GRS has been shrinking for a long time," Orton told Business Insider.

"The GRS will in a decade or two become the GRC (Great Red Circle)," Orton said. "Maybe sometime after that the GRM," by which he means the Great Red Memory.

In the late 1800s, the storm was perhaps as wide as 30 degrees longitude, Orton said. That works out to more than 35,000 miles—four times the diameter of Earth. When the nuclear-powered spacecraft Voyager 2 flew by Jupiter in 1979, however, the storm had shrunk to a bit more than twice the width of our own planet.

Data on Jupiter's crimson-colored spot reveals that this shrinking is still occurring. As of April 3, 2017, the GRS spanned the width of 10,159 miles (16,350 km), less than 1.3 times Earth's diameter.The longest storm on Earth lasted 31 days, but Jupiter can sustain longer storms because the gas planet has tens of thousands of miles of atmosphere, and spins much faster than Earth.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