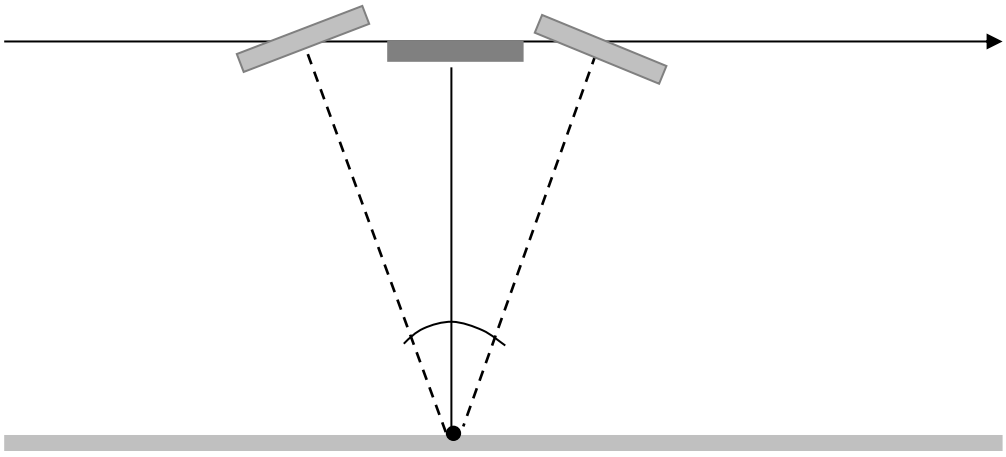
HOMEWORK 7 – Synthetic Aperture Radar

1) What is the illumination pattern for an aperture with a sign reversal at its center? What is $P(0)$? Is the function real or imaginary? Is the function symmetric or asymmetric? The aperture is

$$A(y) = \begin{cases} 0 & |y| > \frac{L}{2} \\ 1 & 0 < y \le \frac{L}{2} \\ -1 & -\frac{L}{2} \le y < 0 \end{cases}$$

2) What is the theoretical azimuth resolution of a spotlight-mode SAR that can illuminate the target over a 10˚ angle as shown in the diagram below.



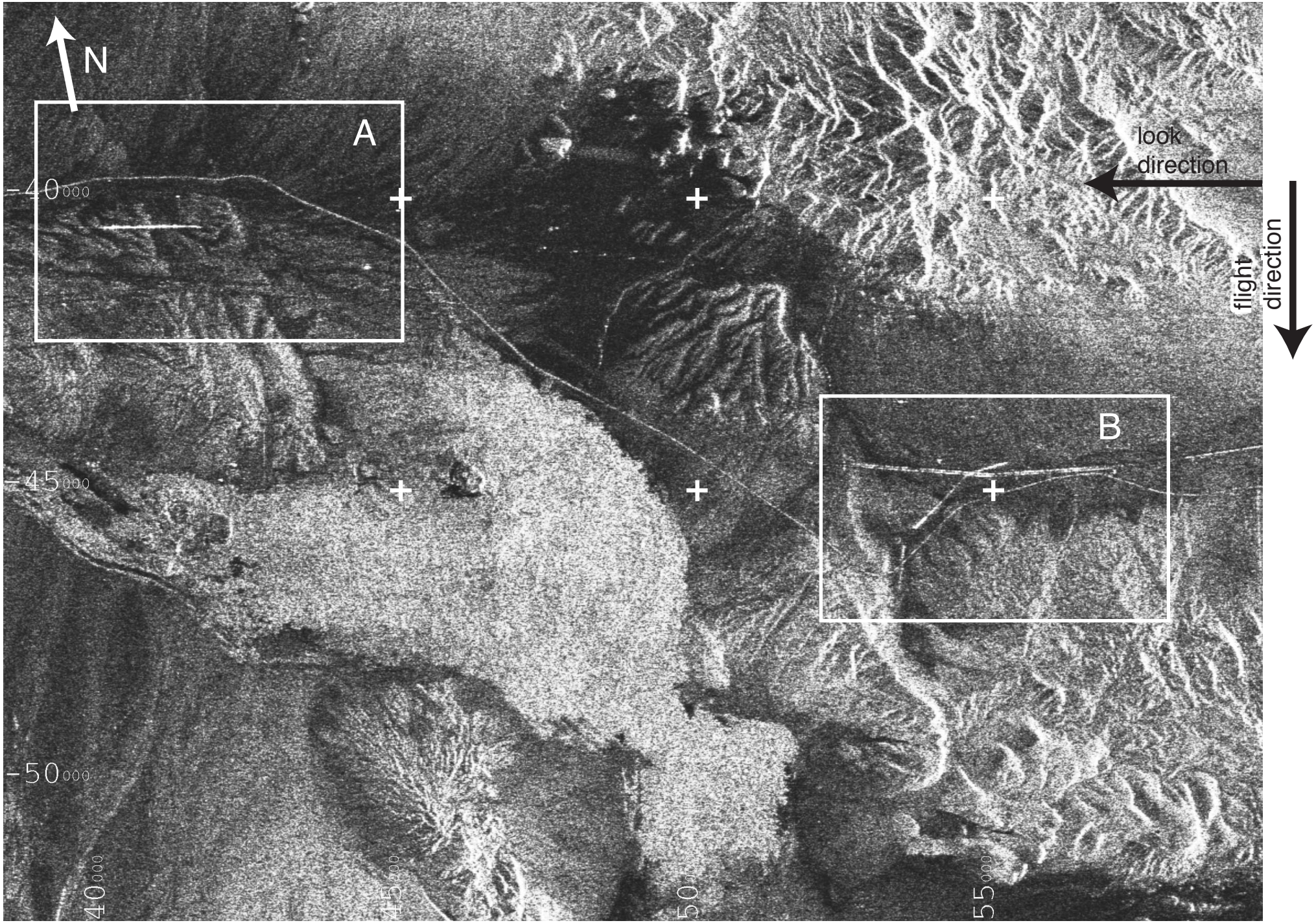
3) What is the ground-range resolution of side-looking radar with a pulse length of 6×10^{-8} s and a look angle of 45˚?

4) (a) What is the period for a satellite in a circular orbit about the moon where the radius of the orbit is 1.9×10^6 m? The mass of the moon is 7.34×10^{22} kg.

(b) You are developing a SAR mission for the moon. The length of your SAR antenna is 10 m. What minimum pulse repetition frequency is needed to form a complete aperture? The circumference of the moon is 1.1×10^7m. You will need the orbital period from problem (a)

5) IMAGE INTERPRETATION (20 points)

Synthetic aperture radar image of the I-40 corridor east of Barstow CA (following page). The image was collected on a north-to-south satellite pass and the radar looks to the right (tic interval is 5 km). What is the line going through the image and why is it bright relative to roads in the area? Areas A and B are shown in detail on the following figures. The image was acquired on day 93 of 1996 at 10:25 AM Pacific time. You will need some additional information. The altitude of the ERS-1 spacecraft is 800 km and the look angle is 23 degrees so the offset of the image from the satellite track is 340 km. The wavelength of the radar is 58 mm. The kml file for Google Earth will help in the interpretation.



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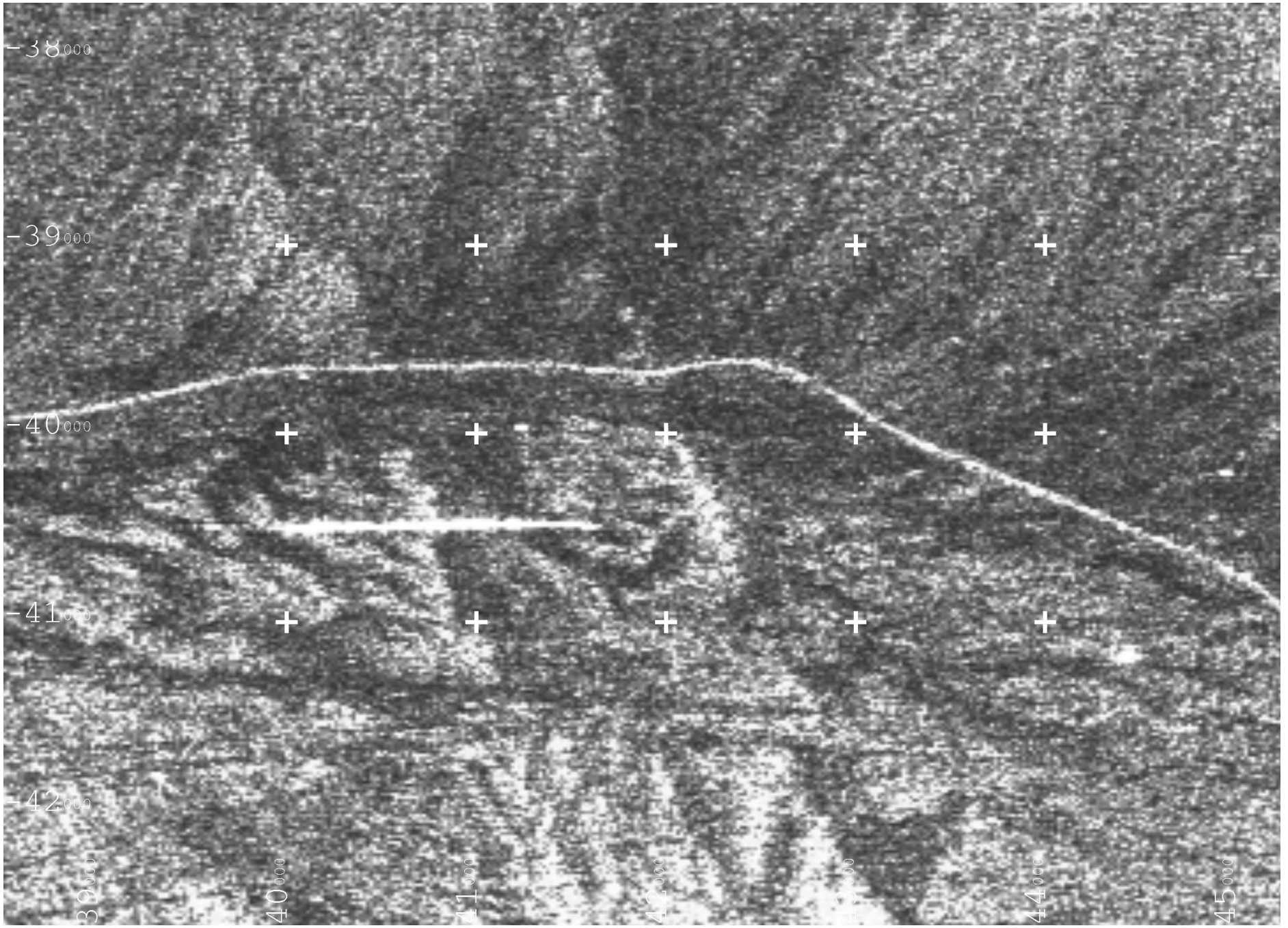
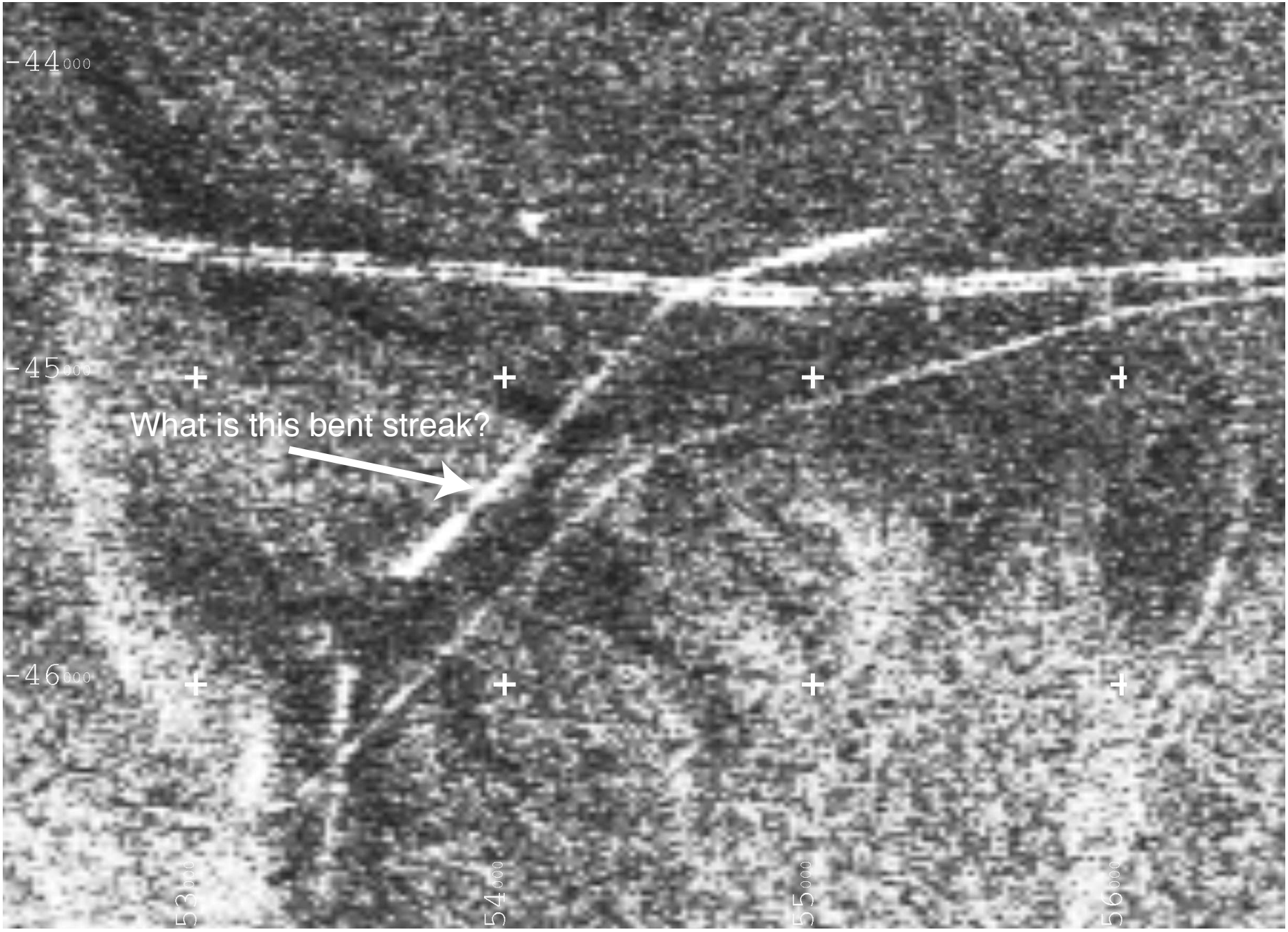


Area A. There is a bright streak across the image below the bright line running along the I-40 corridor. What is this streak? Be as quantitative as possible. The tic marks are spaced at 1 km intervals and the right-looking radar moves from top to bottom at 7000 m/s.



Area B. What is the streak two segment streak? Why is it bent? Be as quantitative as possible. The tic marks are spaced at 1 km intervals and the right-looking radar moves from top to bottom at 7000 m/s.