Asa Hayes GEOG-361-502 Due 11 Apr. 2019

Lab07: Interpreting Radar Images

Question 1. What band does the Radarsat-1 use to acquire the SAR image radarsat_img? What is the corresponding wavelength for this band? Hint: you can use the internet.
Radarsat-1 uses the C-Band for its SAR imaging, which has a wavelength of 5.6cm (though Band-C's total range is 3.75-7.5cm).

Question 2. What is the look direction (from the bottom, left, top, or right side of the image)? Print out a screen capture of the entire image and label the near-range and far-range on the image.

Question 3. Why can Radarsat-1 obtain this sharp image even during the long winter night of Antarctica when there is no reflected solar energy?
As radar is an active sensor, it sends its own signal to be reflected. In this case, that would be the projected microwaves, which bounce directly back and can give clear readings regardless of light level.

Question 4. What geomorphologic features (e.g. mountains, coastlines, etc.) can you observe from this SAR image?
The coastline comes from around the top-left corner to the bottom right corner, with land being on the right. There appear to be glaciers flowing from partway on land into the sea, going top-right to bottom-left in center of image.

Question 5. First, define the following four terms: (a) slant range format, (b) ground range format, (c) near range, and (d) far range.
Slant-range format is measuring the distance between the sensor and the centerline of the image, or exactly between the near and far range angle. Ground-range is when the image is formatted in a way that preserves the actual shape of the terrain, not having the side-looking range issue. Near-range is the line edge closest to the sensor and its associated angle of depression, and far-range is the same but for the far edge of the image.

Question 6. Now compare the image chips range1.jpg and range2.jpg. Determine which image is a slant range image and which one is a ground range image and justify your selection.
Range1 is a slant-range image because there is visible distortion on the left and right sides of the image, indicating perspective issues that would be fixed in the ground range image. Range2 fits as the ground-range format as the fields are roughly proportional.

Question 7. What is the look direction in these images (from the bottom, left, top or right)? For help, I suggest consulting Figure 6.14 in your Lillesand textbook.
The look direction for these two images is from right to left, indicated by the shadowing prevalent on the left side.

Question 8. Compared with the ground range image, the fields, roads and rivers on the left side of the slant range image are greatly compressed. Explain why this is the case.
Due to the perspective being slanted and foreshortening being an issue, the whole image becomes more compressed as the sensor gets closer to the far range. The signal sent is covering a larger area despite the same transmitting angle, so the proportion is erroneously kept. This is what a ground-range format image is supposed to rectify.

Question 9. Why do you expect urban built-up areas to appear brighter in the SAR image than the surrounding rural areas?
Built up urban areas have tall buildings with glass and other reflective surfaces, so more of the signal is sent back to the sensor.

Question 10. Why do the two SAR images look so different from different look directions?
Radar tends to highly emphasize objects closer to the sensor, moreso than most other types of sensing due to the angling of the signal. So, from two entirely different directions, different elements of the same area will be more prevalent/emphasized.

Question 11. What does the term multi-look mean?
Multi-look entails using several sub-signals concurrently over the same area. This creates several images/"looks" over the same area, which can be average to reduce image interference like speckling.

Question 12. Which image has a more serious problem with speckle noise?
sarlook_a has the greater problem with speckling. There is an area in sarlook_b that is clearly defined (irregular shape to left of square field) that has heavy speckling on sarlook_a.

Question 13. Why do radar images often have speckle noise? What can be done to reduce speckle in radar images?
Due to the relatively low spatial resolution of radar sensors, there may be multiple areas within one cell that have wildly different reflectance. As the levels are averaged within one cell, this causes wrong shades of grey to appear in spots. This is sue is fixed with multi-look processing as seen earlier, as well as filtering algorithms to reduce the bad averaging issue.

Question 14. Which image, the Airborne Radar or Landsat, shows the most pronounced topographic effect? Why is this so?
The radar makes the differences in topography much more visible due to the contrast and shaping of the radar shadow. Unfortunately, this sacrifices other details that are more visible in the landsat image.

Question 15. Given the depression angle, what is the minimum slope of the terrain surface in the radar shadows of the image whitemountains_radar.jpg?
The minimum slope of terrain for the radar shadows is 17 degrees, as anything less would not be in the shadows.

Question 16. Which image shows more serious foreshortening distortions? Explain why this is the case.
The ERS image has a much more severe foreshortening distortion that the JERS image. In the ERS image, the white reflectance areas are both smaller and more clearly separated from the darker grey slope areas in comparison to the JERS image, which is much more uniform in shape and shading.

Question 17. What is the look direction of the SAR image saint_helens_sar.jpg? What types of geometric distortions can you observe from saint_helens_sar.jpg? How is the geometric distortion pattern in this SAR image different from the relief displacement in a vertical aerial photograph?
The look direction is from the right. Geometric distortion is highly visible in this image is foreshortening, which shows in a much more severe extent than the previous question's images. This image's distortion pattern appears to be an exaggerated form of the relief displacement, but skewed very heavily to the left.

Question 18. What band did the SIR-A used to acquire the SAR image? Why can the SIR-A radar image detect the buried drainage pattern that does not appear in the Landsat image? (The longer the microwave length, the greater the penetration for radar energy. Landsat image reflects solar radiance.)
The SIR-A used the L-band for this image, which has the longest wavelength of any radar band (15-30cm). This gives it the penetration capability to go through the sand and see the drainage features underneath.

Question 19. What are the possible weather conditions during the flooding? Why can the ERS-1 satellite obtain a sharp radar image showing the flooded area whereas it might be difficult to use a multispectral image to delineate the flooded area?
In a multispectral image, the saturation of the water of the area in general is a large issue as land saturation becomes hard to separate from higher water saturation at a certain point. With radar, it is much easier to tell between what is saturated land and what is flooded, as water is much better at absorbing (or refracting/dampening/other interference to prevent sensor from hearing back) the microwaves emitted than the land, which reflects back in the same manner regardless of saturation.