A. How can you identify the flood water extent from SAR intensity/ coherence images? What is the principle of the methods? [/4 marks]

*Method and principle to identify SAR intensity*

SAR intensity method needs to SAR images in the same area which are taken before

and immediately after the flood. the reflection of dry land is a diffuse reflection before

the flood and will be changed to specular reflection after flooding. The detail shows in

figure 1. Because of this change, the water zones can be detected by comparing these

two images.

*Method and principle to identify SAR coherence*

In the SAR coherence images since when the value

is more close to 1, it means this part is more similar, so we set the value is 0.3.

So the value between 0-0.3 is the water area. And the value between 0.3-

0.914589703 is more like the land area.

B. Produce SAR intensity images and SAR intensity difference image. Compare the SAR intensity images and the SAR intensity difference image. What do the negative intensity difference and positive intensity difference represent? [Please include the SAR intensity difference image to answer this question] [/6 marks]

*Discuss about positive and negative intensity difference*

According to the images Date 20 - Date 19 image, the negative intensity difference represent the Light green area and the positive intensity difference represent the lavender area.

We can find the red area in the Date 19 image and the blue area in the Date 20 image to find out the flood extend.

C. Compare the SAR intensity analysis and SAR coherence analysis. Discuss the pros and cons of these methods in a table. [/6 marks]

|  |  |  |
| --- | --- | --- |
|  | Pros | Cons |
| Intensity analysis | - Intensity can reflect the surface condition by absolute value of intensity.  - SAR intensity can show the  whole flooding area and the  density of flood.What’s more, it can show the positive and  negative changes in the images. | - Not sensitive to variations when the absolute value is low.  - SAR intensity cannot show the  boundaries of the flood. And only use  the pure colour. |
| Coherence analysis | - Good at indicating temporal changes.  - SAR coherence can show the  flooding area clearly | - Cannot represent the property of positive and negative of water extent.  - SAR coherence cannot show the  changes of flooding. And only use the  pure colour. |

D. Compare the SAR images and optical images. What are the radar intensity and coherence values for the pixels over different surfaces, such as still water, flooded forest, bare soil, farm land, forest and buildings? Are these values reasonable? [/6 marks]

Values of selected features in SAR intensity images and Coherence images

SAR intensity images SAR coherence images

Still water 26-77.6 0-0.31

Flood forest 154-242 0.06-0.31

Bare soil 77-131 0.58-0.67

Farm land 102-193 0.06-0.65

Non-flooded forest 111-183 0.06-0.63

buildings 193-227 0.31-0.51

According to the results shown on table, the values may not be reasonable. It may

caused by SAR images as value overlap, which leads to difficulty of objects

identification. Meanwhile SAR images do not have good visualisation with true

colour.

E. Try different threshold values for mapping flood water extent from the SAR intensity and coherence images [i.e. m*odify the value in the colour table*]. What are the best threshold values for the generation of water extent map from the SAR intensity and coherence images? [Please include water extent maps generated from the SAR intensity/coherence images to answer this question] [/6 marks]

*Reasonable threshold values for SAR intensity image 1 and water extent map*

Both water and flooded forest should be identified by the result, combining the intensity value obtained in question D with the histogram, 80 is chosen to be the lower limit and 180 is chosen as the upper limit.

*Reasonable threshold values for SAR intensity image 2 and water extent map*

The overall intensity level of image 2 is higher than the previous one, so a higher high threshold is chosen. The resulting thresholds are 80 and 180.

*Reasonable threshold values for SAR coherence image and water extent map*

The threshold should fall between 0.2 and 0.4. 0.3 is a good threshold that shows the water extent well.

G. Compare the SAR images, the optical images and the flood extent map from SES (State Emergency Service). Discuss the pros and cons of these methods with illustrations. [/6 marks]

Discuss about the accessibility [/1 marks]

SAR system is not limited by weather but highly rely on an applicable satellite

revisiting time. However, optical images are highly influenced by weather because it

is produced by airborne. SES can do both air observation and land observation, which

is a fast mapping method.

Discuss about the cost [/1 marks]

Compared with the SAR system, the operating costs on the aerial platform and SES

are high.

Discuss about the spatial extent [/1 marks]

SAR images are the largest spatial extent in this three method as the high monitoring

level. Optical images system may be in the second, which depends on the aerial

platform. However, due to the SES is depended on both air platform and land-based

techniques, the spatial extent is critical, so, it hard to decide which one is larger. In

this case, SES seems larger than the optical images. Detail is shown on figure 15.

Discuss about the temporal extent [/1 marks]

The temporal extent of optical images and the SES may be the same if weather

allowed.

Discuss about the resolution [/1 marks]

optical images are the best in resolution, and second is SAR images. SES has lowest

resolution because it is only able to show flood boundaries but not to show the nonflood

area.

Discuss about the accuracy [/1 marks]

The SAR images show the flood extents accurately. The optical images show the

floodwater extent correctly but cannot show the flood underneath vegetation. The SES

only shows the flood boundaries but cannot show the non-flooded areas in between.

**End of lab exercise.**