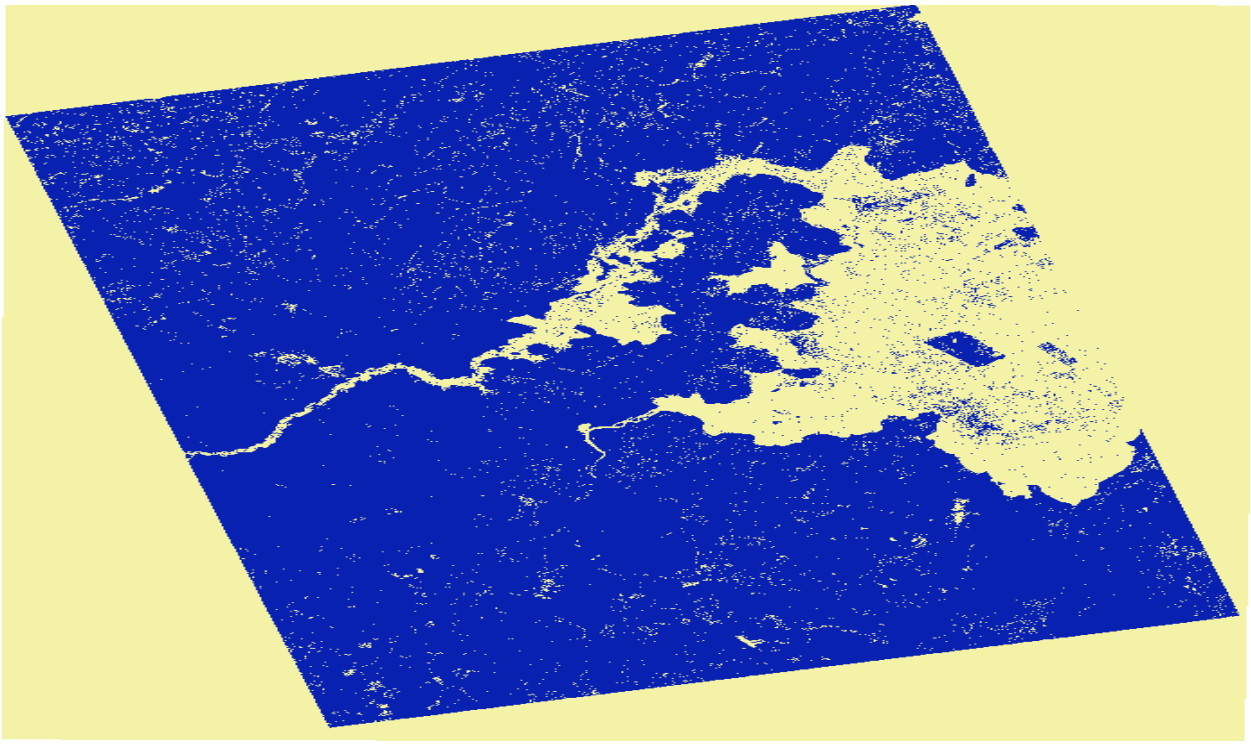
GMAT9600 Lab – Radar Application

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

Method to identify SAR intensity and the principle of the method *[/2 marks]*
Answer:
In the SAR intensity images, we assume that value greater than 180 is more like flowing water area, and the value between 0-80 is the still water area, and the value between the 80-180 is like the land area. A single SAR image acquired during an event could provide a flood map: its capability to detect inundations is based on the low backscatter response from smooth water covering the terrain, which allows to efficiently separate flooded areas from rougher nonflooded terrain that, instead, scatters the impinging signal in many different directions and produces a higher backscattering coefficient (σ0).

Method to identify SAR coherence and the principle of the method *[/2 marks]*
Answer:
We can see the image below, 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.

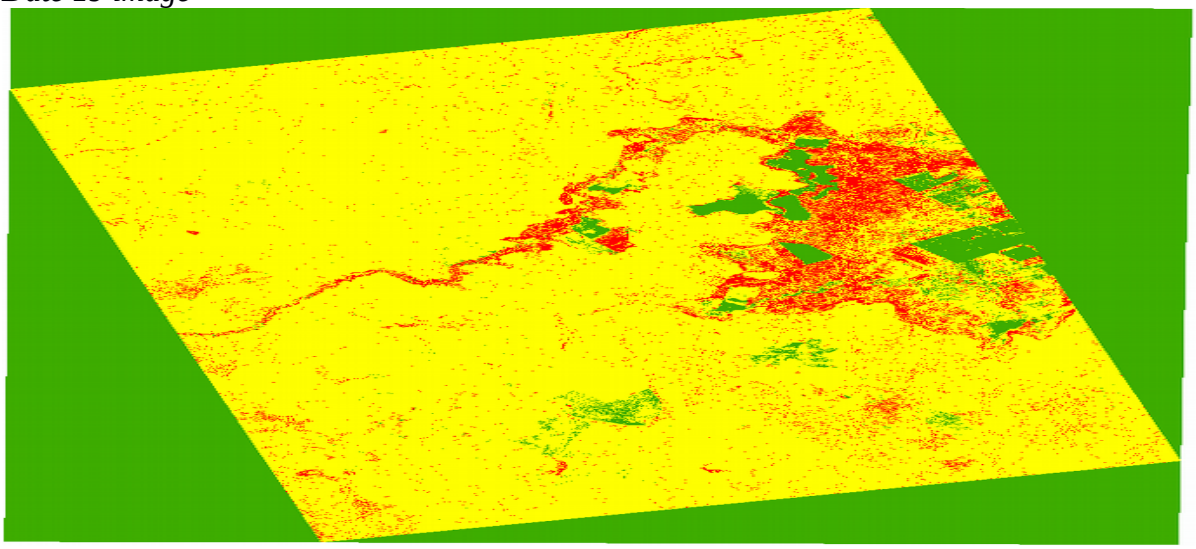


B. Compare the SAR intensity images and the SAR intensity difference image. What do the negative intensity difference and positive intensity difference represent? What can you tell about the flood extent from the two SAR intensity images? [Please include the SAR intensity difference image to answer this question] [/6 marks]

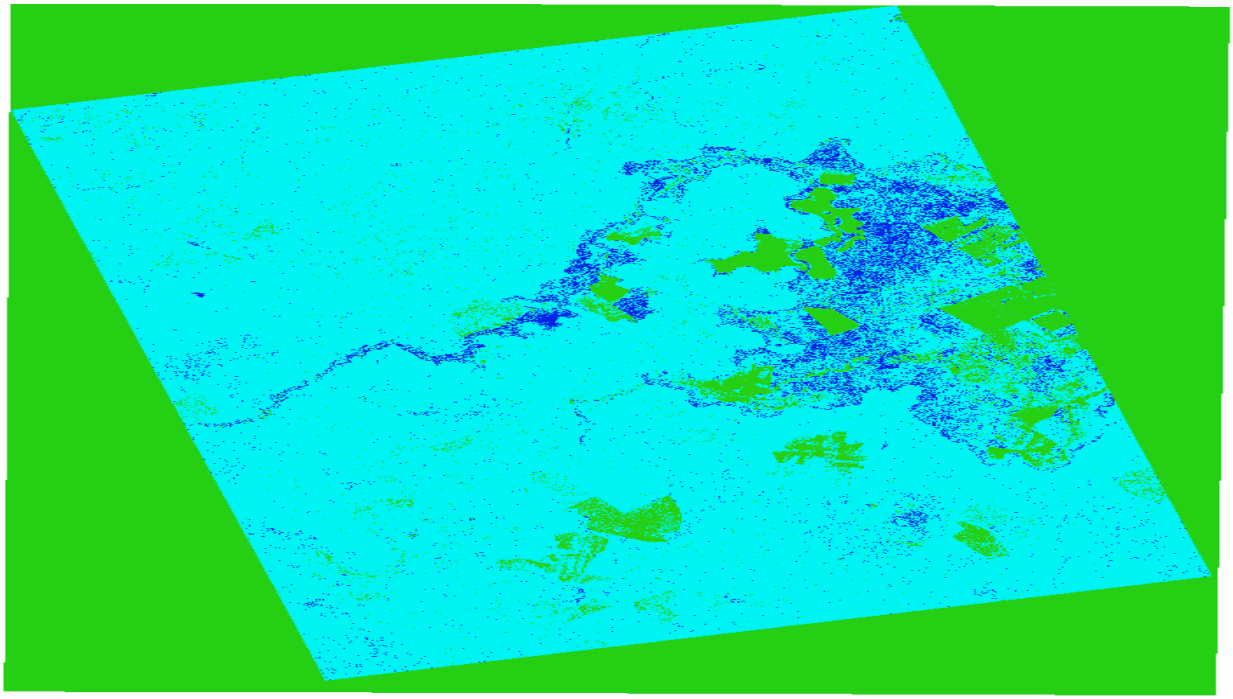
Discuss about positive and negative intensity difference [/2 marks]
Discussion about the flood extent of the 2 SAR images [/2 marks]
Include SAR intensity difference image [/2 marks]

Answer:
According to the images *Date 20 - Date 19 image* below, 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.

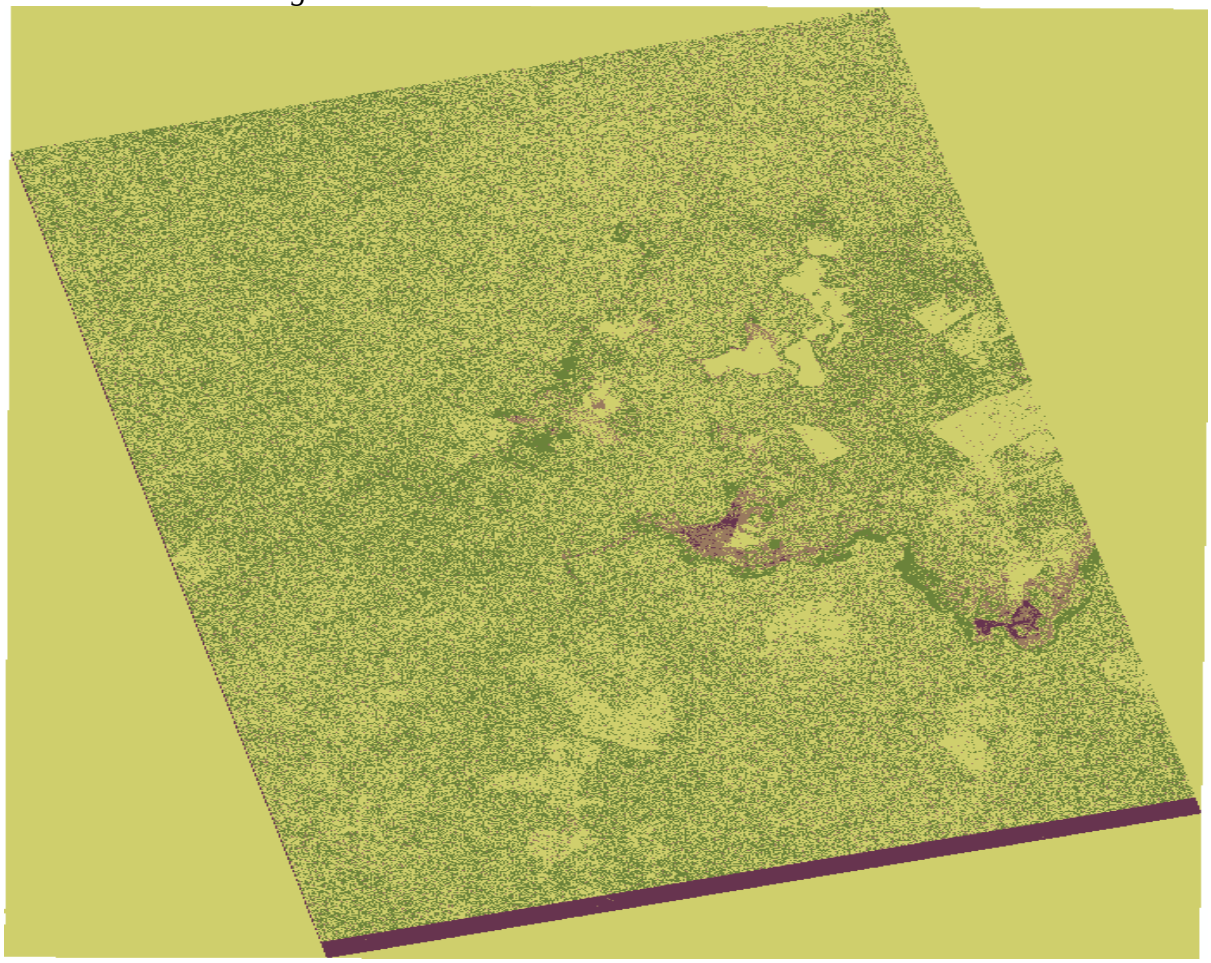
Date 19 image



Date 20 image



Date 20 - Date 19 image

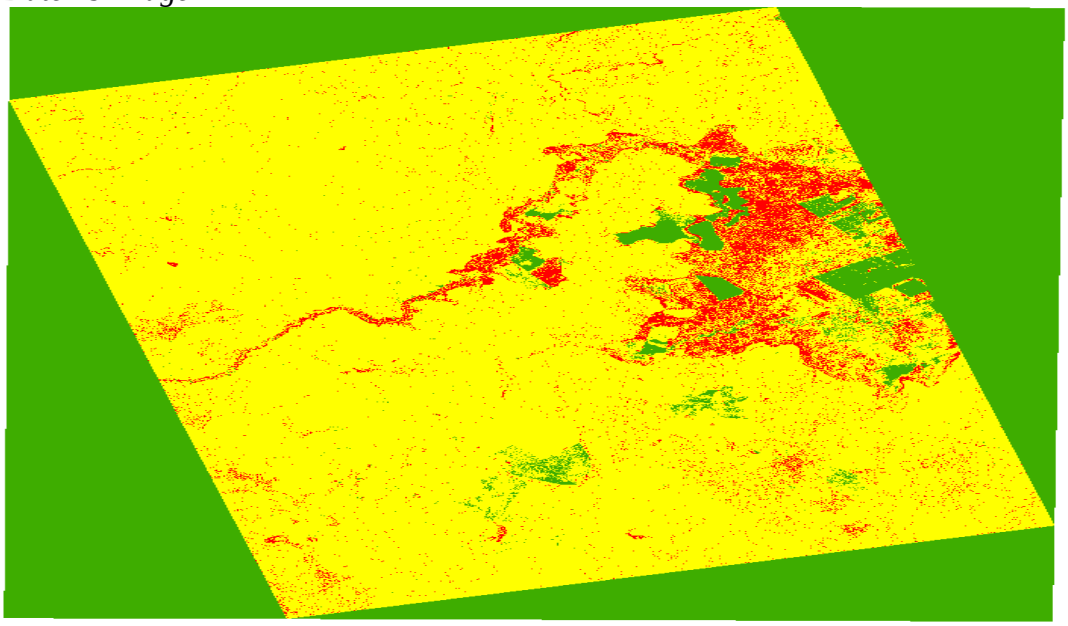


C. Compare the SAR intensity analysis and coherence analysis. Discuss the pros and cons of both methods with a table. [/6 marks]

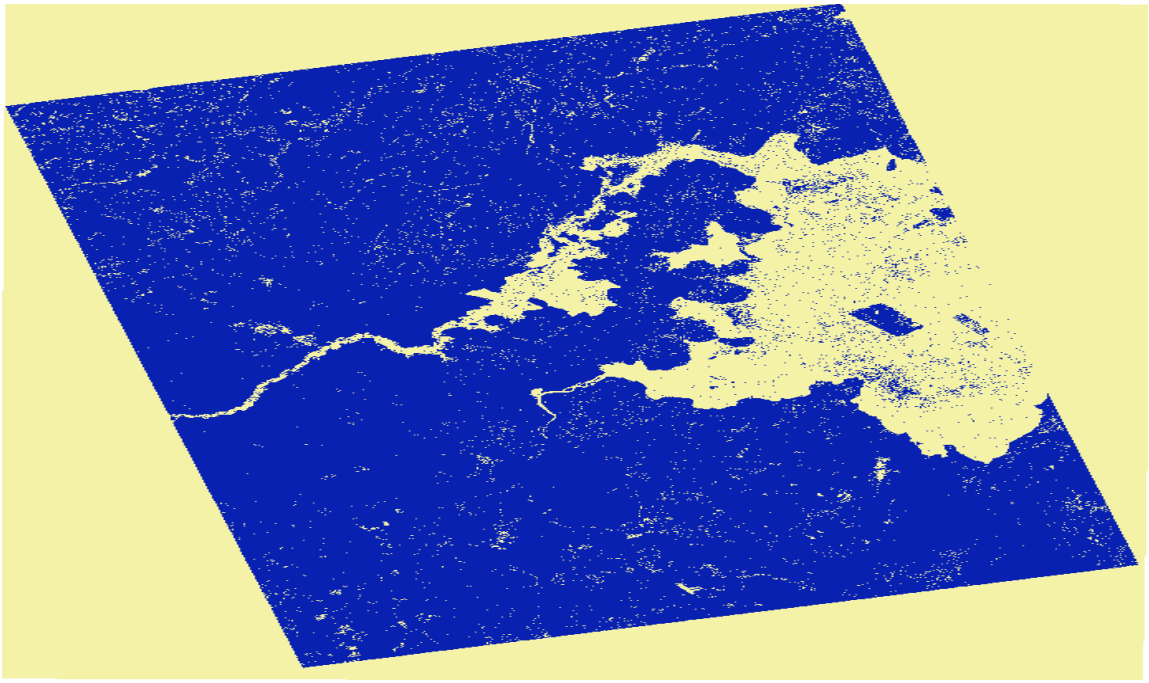
A table including:
Pros and Cons for SAR intensity analysis [/2 marks]
Pros and Cons for SAR intensity analysis [/2 marks]
With images to back up the answers [/2 marks]

	Pros	*Cons*
SAR 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.	*SAR intensity cannot show the boundaries of the flood. And only use the pure colour.*
SAR coherence	*SAR coherence can show the flooding area clearly*	*SAR coherence cannot show the changes of flooding. And only use the pure colour.*

Date 19 image



Coherence image



D. Compare the SAR intensity/coherence analysis with optical imagery. Discuss the pros and cons of SAR for flood mapping in a table. [/4 marks]

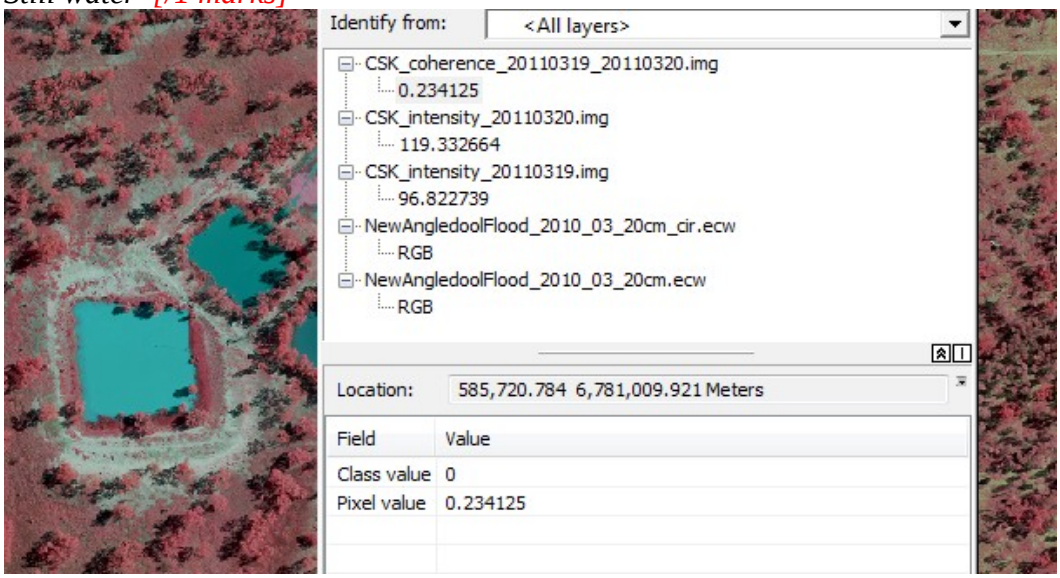
A table including:
Pros and Cons for SAR intensity results and Optical data [/4 marks]

	Pros	*Cons*
SAR intensity	Are NOT affected by cloud coverage Acquire during day and night time Can achieve a very high resolution (1m) Capability to acquire data everywhere in the world, covering a wide area in a very short time frame. Capability to acquire data under every weather condition and during night time.	1. *Flood detection capability in urban and vegetated areas(Due to resolution and active sensor limitations).* 2. *Flood detection capability in case of material presence.*

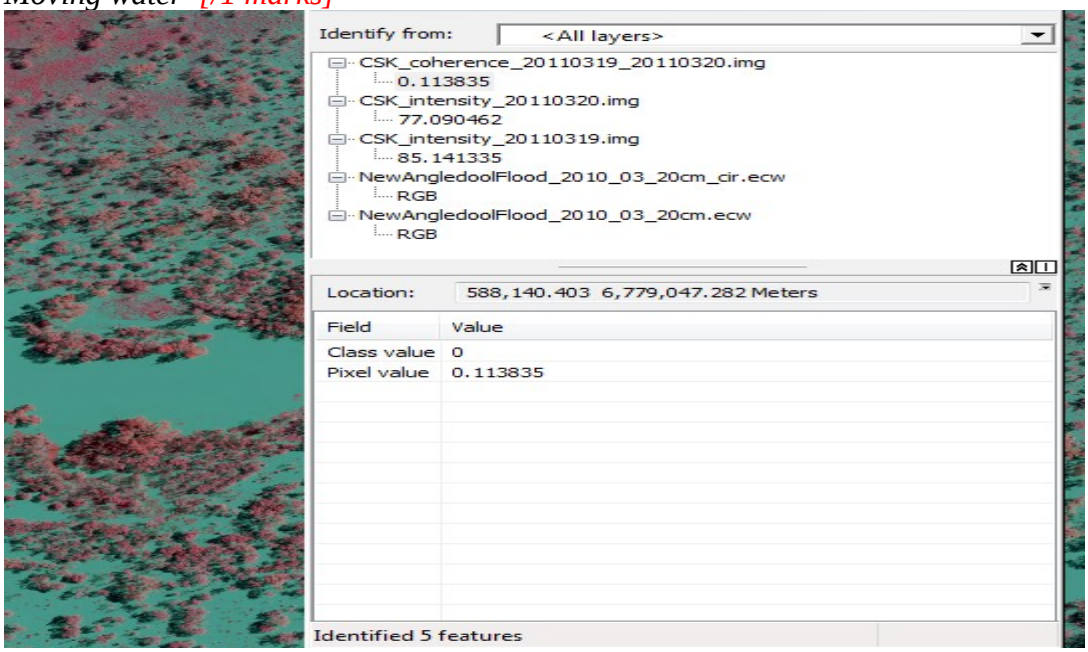
Optical data	Can achieve a very high resolution (< 1m) Capability to monitor the evolution of water retreat during the days/weeks following the event' with daily updates	Flood detection capability in forested areas*(Due to passive sensor limitations).*

E. 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, moving water, flooded forest, bare soil, farm land, forest and buildings? [Hint: Utilise the optical images] Justify your answer based on the backscattering nature of radar. [/7 marks]

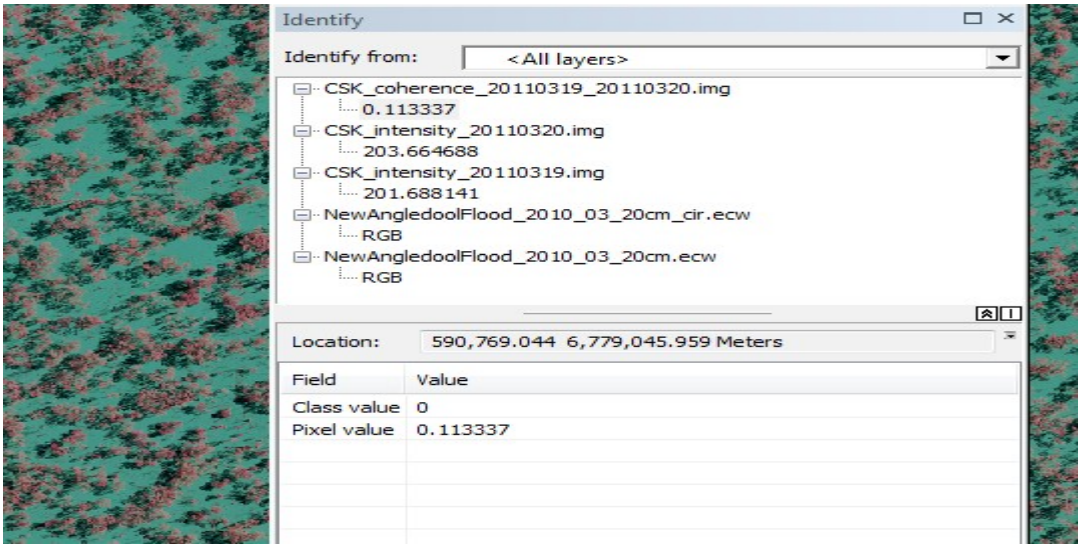
Still water [/1 marks]



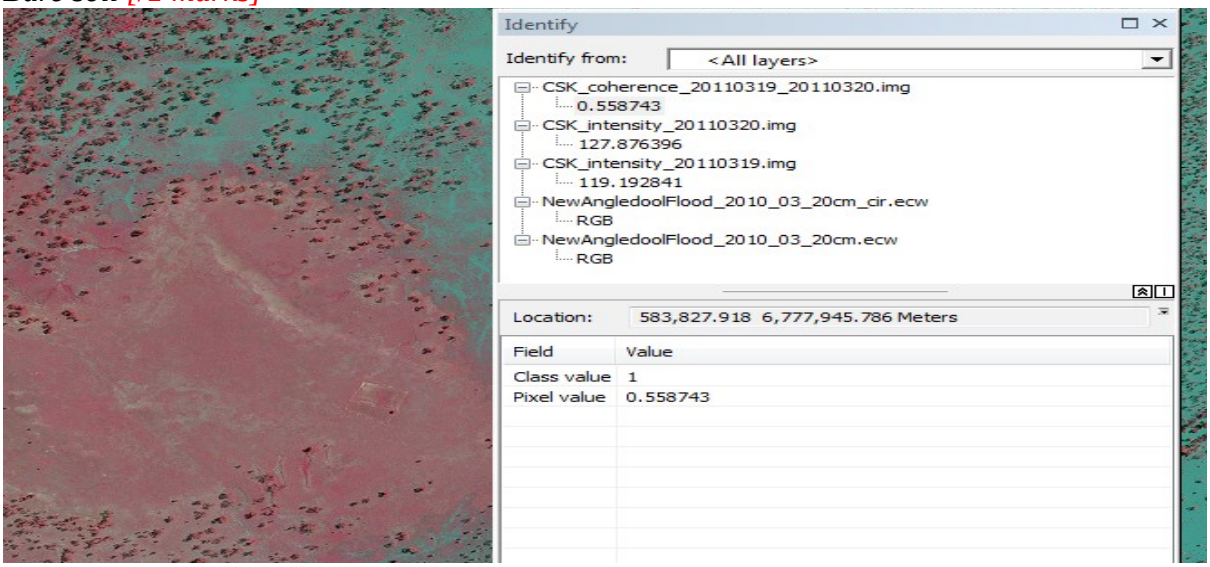
Moving water [/1 marks]



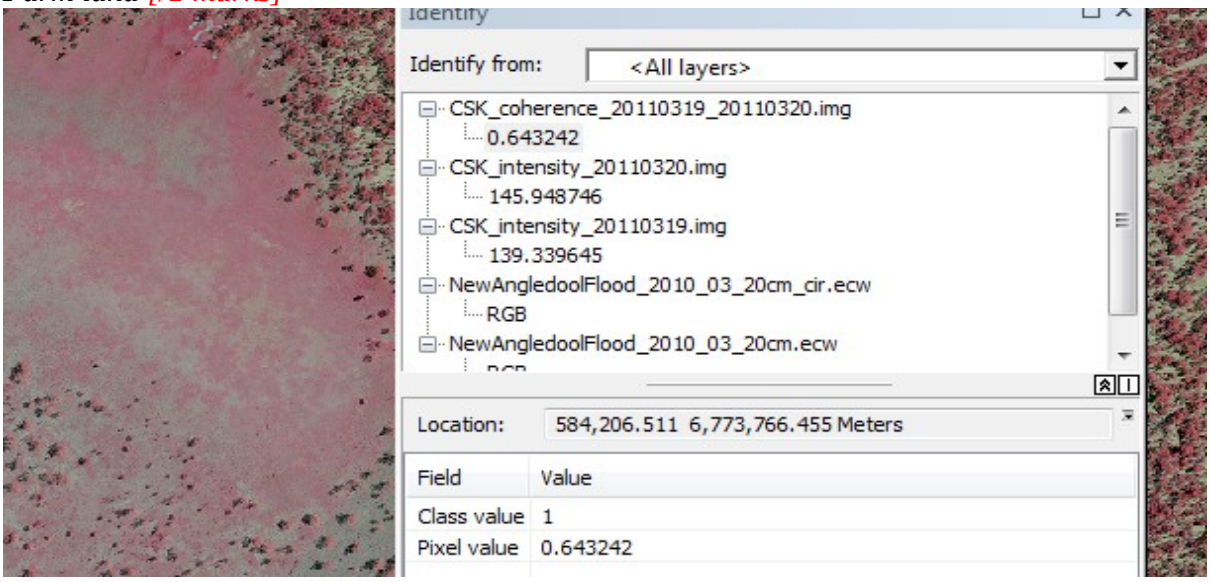
Flooded forest [/1 marks]



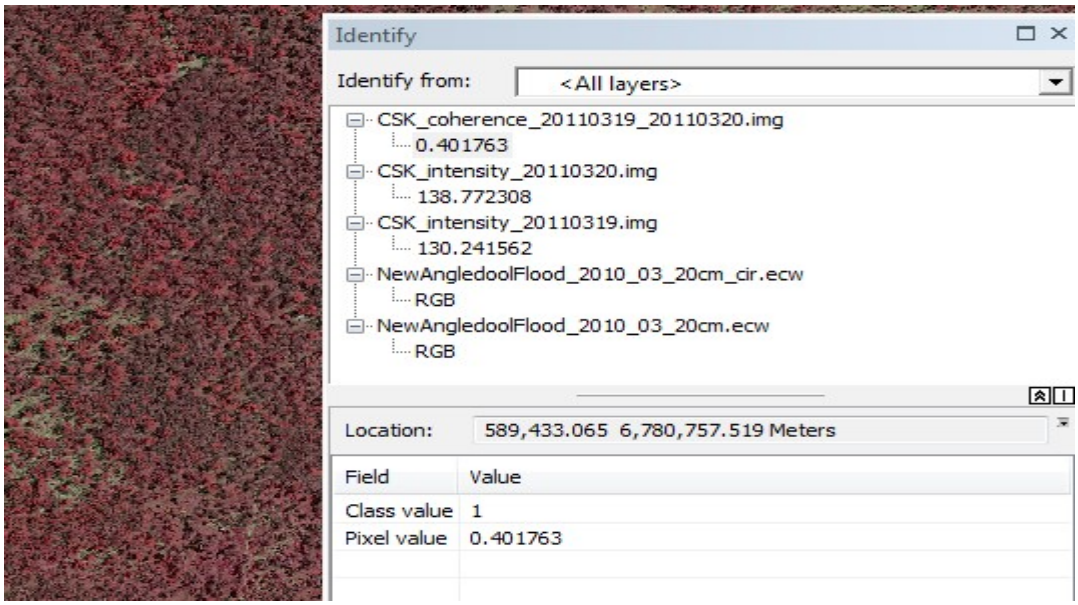
Bare soil [/1 marks]



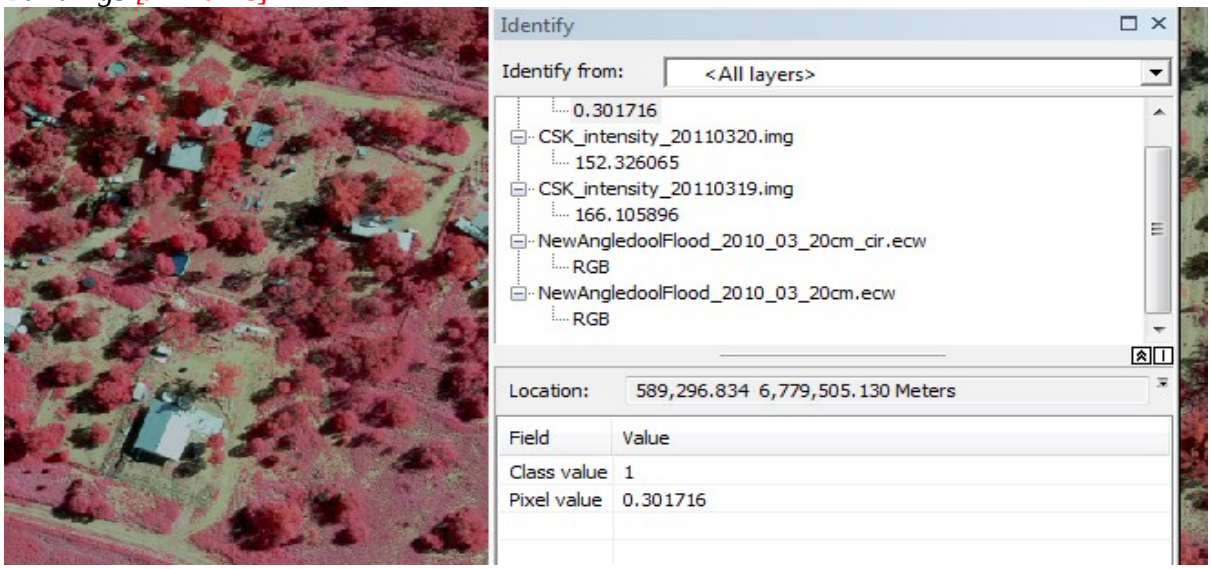
Farm land [/1 marks]



Non-flooded Forest [/1 marks]



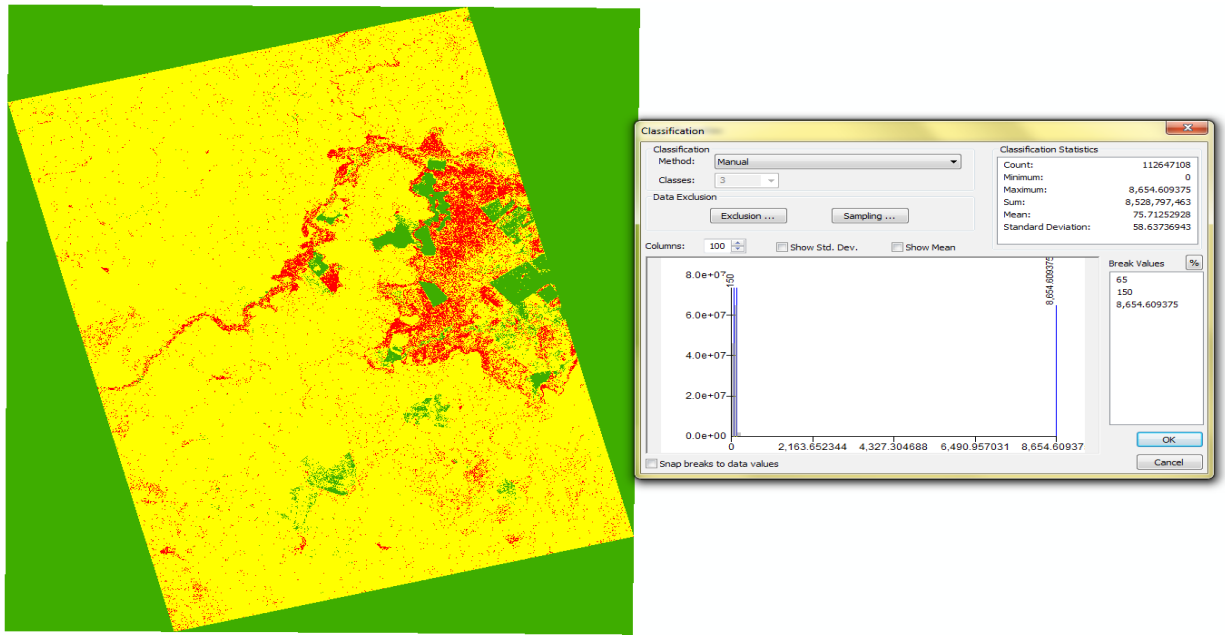
Buildings [/1 marks]



F. Try different threshold values for mapping flood water extent from the SAR intensity and coherence images [i.e. *modify 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? [Include water extent maps generated from the SAR intensity/coherence images to answer this question] [/6 marks]

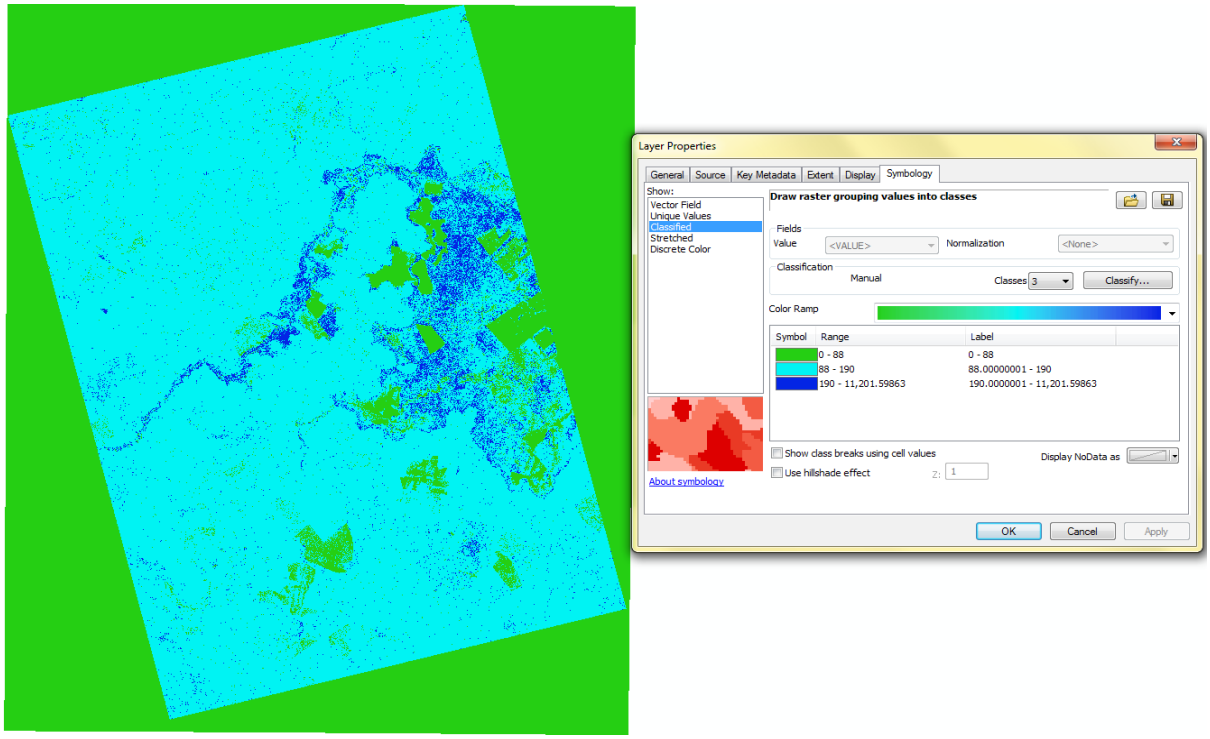
Reasonable threshold values for SAR intensity image 1 and water extent map [/2 marks]

Answer: I set the value 65 and 150 as threshold values



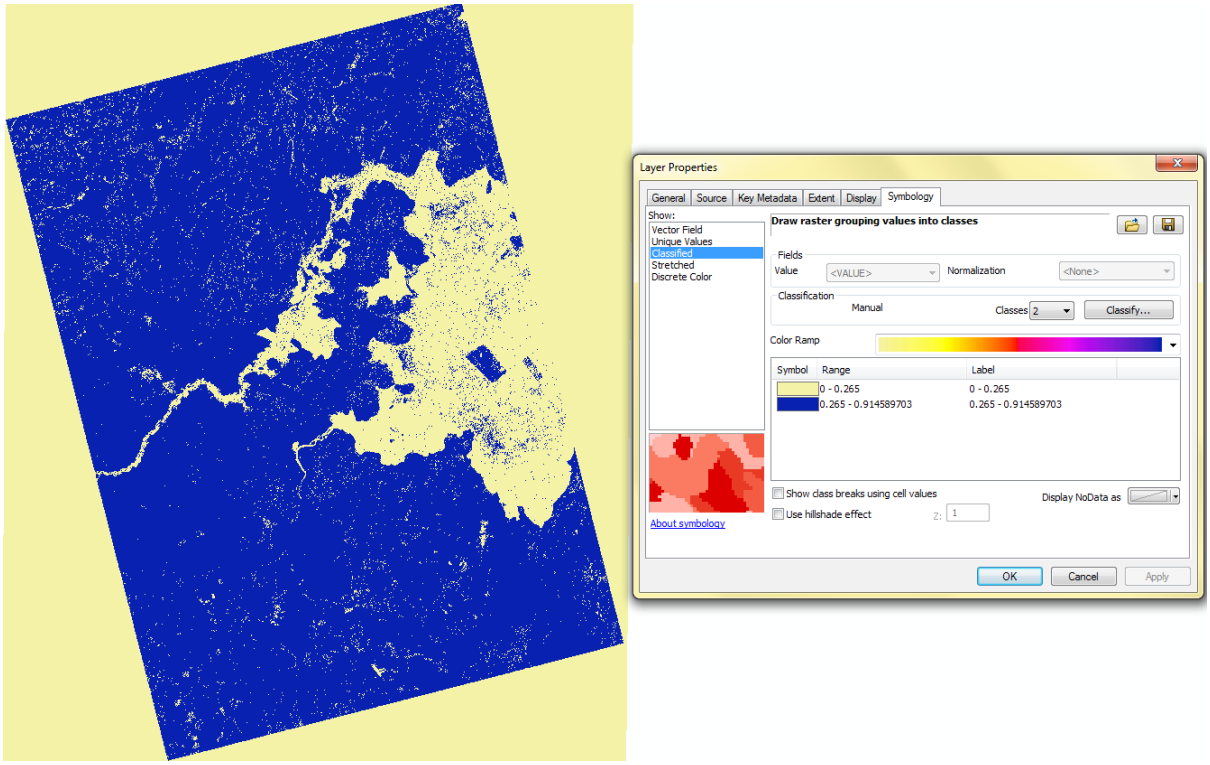
Reasonable threshold values for SAR intensity image 2 and water extent map [/2 marks]

Answer: I set the value 88 and 190 as threshold values



Reasonable threshold values for SAR coherence image and water extent map [/2 marks]

Answer: I set the value 0.265 as threshold value



G. Compare the SAR images and optical images with the flood extent map from SES (State Emergency Service). What can you tell? [/4 marks]

Discuss about the spatial extent [/1 marks]
Discuss about the temporal extent [/1 marks]
Discuss about the resolution [/1 marks]
Discuss about the accuracy [/1 marks]

Answer:

Optical images usually refer to image data obtained by visible and some infrared band sensors. The SAR sensor is basically microwave band, and the wavelength is usually at the centimeter level. What's more, Since the resolution of SAR image is relatively low and the signal noise is low, the amplitude information contained in SAR image can not reach the imaging level of optical image. And Visible images often contain grayscale information of multiple bands for identification of targets and classification extraction. The SAR image only records the echo information of a band, which is recorded in binary plural form.