University of Leicester

METIER:
Marie Curie Series of Events "METhods in Interdisciplinary Environmental Research"

MARIE CURIE ACTIONS

Remote sensing of fire

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Aims and objectives

This training day aims to give an overview of remote sensing approaches to the characterisation of fires, and provide hands-on experience in fire mapping using satellite data.

The objectives are:

1. To introduce the importance of fires in the Earth system
2. To provide an overview of satellite remote sensing approaches to fire characterisation
3. To critically discuss the strengths and weaknesses of these approaches
4. To enable students to get access to remote sensing data
5. To provide practical image analysis experience by creating a sample burned area map from satellite data

Intended learning outcomes

After the session successful students will be able to:

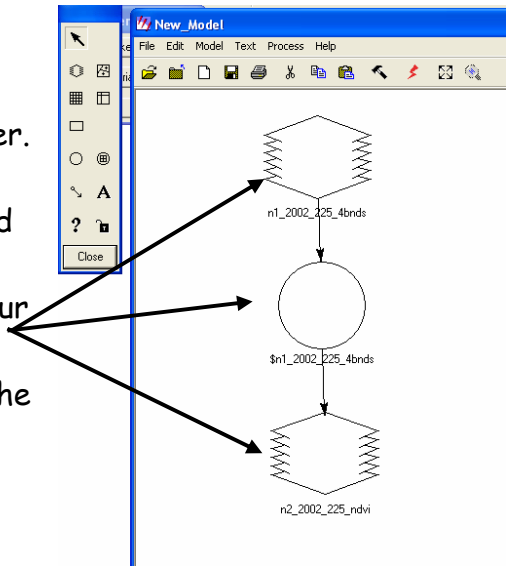
1. Explain why fires are important in the Earth system
2. Identify a variety of approaches for remote sensing of fire
3. Provide a critical appraisal of the advantages and downsides of these approaches
4. Get independent access to MODIS satellite data
5. Create a burned area map from MODIS data

PRACTICAL: Burned area mapping

EXERCISE: BURNED AREA MAPPING FROM THE NORMALISED DIFFERENCE VEGETATION INDEX (NDVI)

Task: You will get NDVI and NDSWIR images from 2002 and 2003 of an area in Siberia. Based on the two images you will create a map of the changes in NDVI (and then for NDSWIR) which is mainly related to fire disturbance. At the end of the practical you will have created your own fire scar map(s) and derived burned area statistics. You can overlay the CEH fire scar map and heat emission data from active fires on top of your map to check the results.

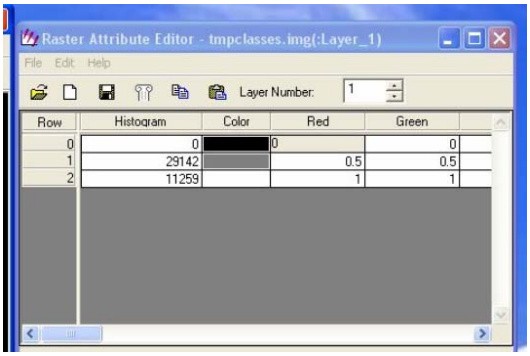
1. In Windows Explorer go to "Tools – Map Network Drive". Type in the path "\\splint\metier". Copy the subdirectory "practical_fire" with all files into your own workspace on Z:
2. Start ERDAS IMAGINE (from Start menu – All Programs – CFS Software – Imagine – ERDAS Imagine)
3. Open a classic viewer. From the viewer menu, go to File - Open – Raster Layer and select the file "2002_225_4bnds.img". This image shows an area of Siberia imaged on August 13th 2002.
4. Open a second viewer, go to File - Open – Raster Layer and select the file "2003_225_4bnds.img". This image shows the same area imaged exactly one year later.
5. Click on Modeler, then Model maker.
6. Drag and drop two raster layer symbols and a circle across. Link them with arrows.
7. Double-click on each symbol to link it to your input and output files.
8. Calculate NDVI from bands 1 and 2 using the modeller. Make sure to select "Declare as float" in all cases.



Tip:
NDVI = (NIR-red)/(NIR+red)
Use the equation:
MODIS NDVI = (band2 - band1)/(band2+band1)

9. Save your output to a new file 2002_ndvi.img

10. Calculate NDVI from the bands 1 and 2 of the 2003 image, using the same procedure and save your output to a new file 2003_ndvi.img
11. Calculate the difference between the 2003 and 2002 NDVI images and save them as a new file ndvi_diff.img
12. Open a new viewer and look at the NDVI difference image. Where do you expect to find burned areas?
13. In the viewer menu, click on "File – Open – Vector layer", choose the type "shapefile" and select "hotspot_03.shp". This file shows the locations of active fire detections from MODIS in 2003.
14. Change the colour of the vectors to red.
15. Classify the image to distinguish burned area from healthy forest. To do this, go to "Classifier" in the main icon toolbar, select "Unsupervised classification", and define your input file, output image file, and signature file. Use the default options if in doubt.
16. Look at your classified fire scar image in a viewer.
17. In the viewer menu, click on "Raster - Attributes". The class frequency table appears in a new window. Write down the total burned area in units of number of pixels in the Table at the end of this section.

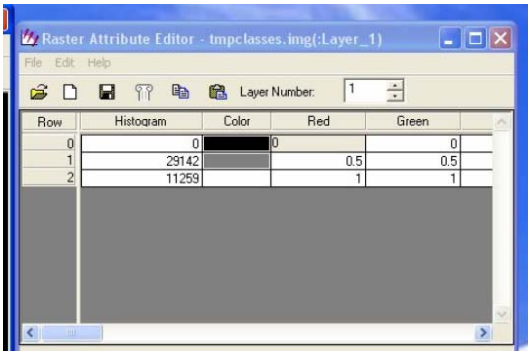


NOW MOVE ON TO THE NDSWIR INDEX.

18. Open a new viewer, go to File - Open – Raster Layer and select ndswir_2003_composite.img This file contains the NDSWIR index from bands 2 (NIR) and 6 (SWIR).
19. Click on File – Open – Vector layer, choose the type shapefile and select hotspot_03.shp.
20. Click on Vectors – Viewing Properties. Change the colour of the vectors to red. The points show hotspots from the MODIS active fire detection in 2003.
21. Assess which NDSWIR values are probably due to fires in the year 2003 and which ones might be other disturbances (logging, insect damage, windfall).
22. Classify the image to distinguish burned area from healthy forest.

COMPARISON

23. Compare the NDVI and NDSWIR difference classifications visually.
24. In the viewer menu, click on "Raster - Attributes". The class frequency table



appears in a new window. Write down the total burned area in pixels from your burned area maps in the table.

RESULTS:

Method	Burned area (in pixels)
NDVI	
NDSWIR	

25. Overlay the shapefile disturb92_03.shp. This is the CEH fire scar map showing all disturbed areas between 1992 and 2003 derived from an NDSWIR segmentation algorithm. Compare it to your own classifications.
26. Please show me your results.

Acknowledgement: A big thank you goes to my former colleague Dr Clare Rowland (CEH) who prepared the data and first version of these instructions.

RASTER DATA SETS

Raw MODIS NBAR* 16-day composite data

MODIS channels

Band	Bandwidth
Band 1	620-670 (Red)
Band 2	841-876 (NIR)
Band 3	459-479 (Blue)
Band 4	545-565 (Green)

* NBAR = Normalised BRDF adjusted reflectance (BRDF is the bidirectional reflectance function)

Not provided is Band 6, the SWIR which is required for the NDSWIR index.

1. 2002_225_4bnds.img - bands 1-4 of the MODIS NBAR image for the compositing period starting on Julian day 225 of 2002.
2. 2003_225_4bnds.img - as above for 2003.

Data sets derived from MODIS NBAR 16-day data

Image channel	**Julian day**	**Calendar date**
ch1	65	March 6th
ch2	81	March 22nd
ch3	97	April 7th
ch4	113	April 23rd
ch5	129	May 9th
ch6	145	May 25th
ch7	161	June 10th
ch8	177	June 26th
ch9	193	July 12th
ch10	209	July 28th
ch11	225	August 13th

1. ndswir_2003_composite.img - 1 band image which is a composite of NDSWIR values from the height of the growing season.
2. ndvi_difference_02_03_209.img - 1 band image with difference between NDVI for 2002 and 2003 for the Julian day 209 composite.
3. ndvi_difference_02_03_225.img - 1 band image with difference between NDVI for 2002 and 2003 for the Julian day 225 composite.
4. ndvi_2003.img - 11 band image, where each channel is the NDVI for a different date through the year.