University of Leicester

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

MARIE CURIE ACTIONS

Remote sensing of vegetation structure

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Aims and objectives

This training day aims to familiarise the participants with imaging and profiling LIDAR and RADAR remote sensing approaches for the purpose of mapping 3D vegetation structure, particularly forest canopy height. The practical provides experience in analysing airborne SAR and LIDAR data.

The objectives are:

1. To introduce the principles of forest canopy modelling using L-systems
2. To introduce the principles of LIDAR and RADAR remote sensing
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 analysing digital canopy height data derived from airborne LIDAR and SAR

Intended learning outcomes

After the session successful students will be able to:

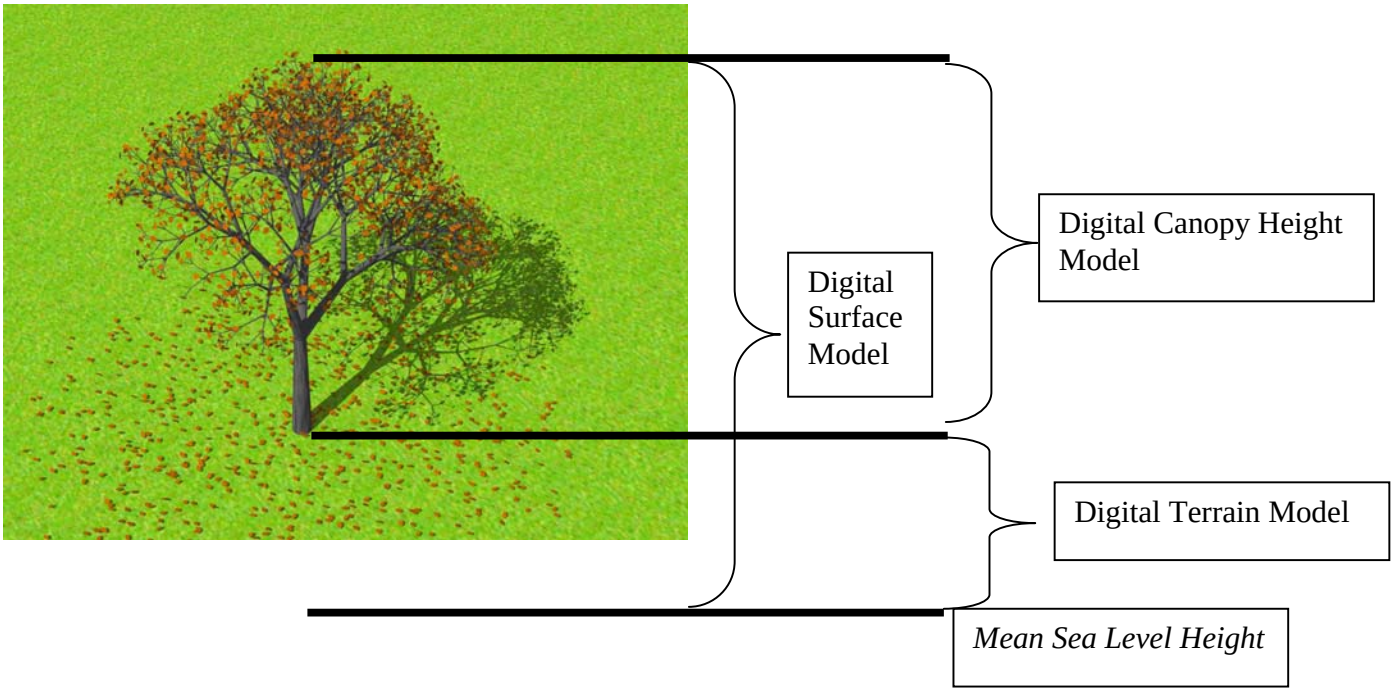
1. Explain how 3D vegetation structure can be modelled
2. Identify a variety of approaches for remote sensing of forest canopy height
3. Discuss the principles of imaging and profiling LIDAR and RADAR remote sensing methods
4. Get independent access to ICESAT-GLAS satellite LIDAR data
5. Visualise and interpret canopy height and terrain elevation data derived from InSAR and LIDAR

PRACTICAL: Vegetation structure

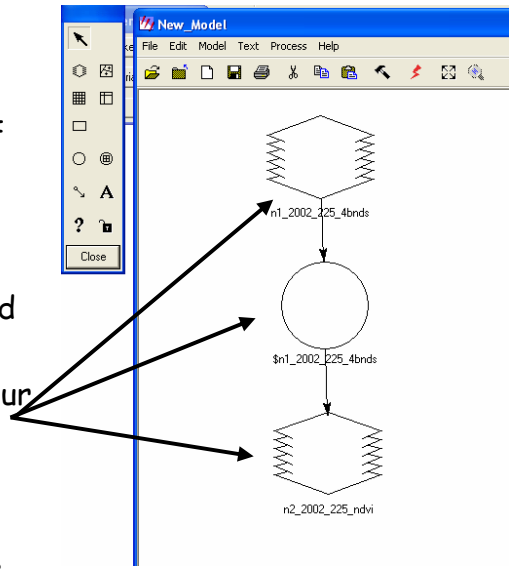
EXERCISE: ANALYSING FOREST CANOPY AND TERRAIN HEIGHT AT MONKS WOOD NATIONAL NATURE RESERVE, UK

Task: You will investigate the differences between airborne imaging LIDAR data and Digital Elevation Data derived from interferometric SAR (Synthetic Aperture Radar) at 2 wavelengths and different polarisations.

1. In Windows Explorer go to "Tools – Map Network Drive". Type in the path "\\splint\metier". Copy the subdirectory "practical_vegstructure" 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 "lidar_dsm.img". This image shows a Digital Surface Model of Monks Wood. It consists of the sum of terrain height and canopy height. It was derived from the first return data.



4. Open a second viewer, go to File - Open – Raster Layer and select the file "lidar_dtm.img". This image shows the terrain elevation underneath the canopy of the same area. It was derived from an extrapolation of the last return data.
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. To derive canopy height, calculate the difference between the Digital Surface Model and the Digital Terrain Model. Make sure to select the option "Declare as float" in all cases.
9. Save your output to a new file "my_lidar_chm.img".
10. Open a new viewer and load the file "lidar_chm.img". It shows a canopy height model done earlier. Does it correspond to your own results?



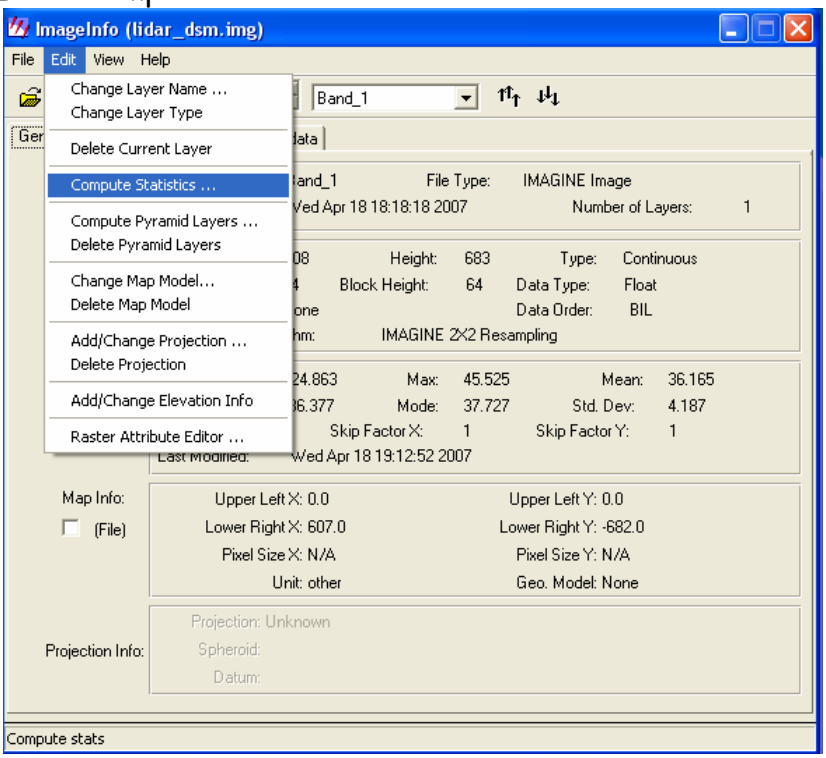
Comparison with Radar

11. We will now move on to RADAR data. Using the same methods as above, now generate the following canopy height models:
    lhh_chm = lhh_dem – lidar_dtm
    lvv_chm = lvv_dem – lidar_dtm
    lhv_chm = lhv_dem – lidar_dtm
    xvv_chm = xvv_dem – lidar_dtm

    In all cases you will use the LIDAR digital terrain model as a model of the unvegetated terrain height. The "canopy height models" derived in this way illustrate the penetration depth into the canopy at different radar wavelengths and polarisations.
12. Now calculate the difference images between the RADAR and LIDAR derived models using the same methods. These files show the deviation of the RADAR-derived height maps from the LIDAR height map. You should create the files:
    xvv_diff = xvv_chm – lidar_chm
    lhh_diff = lhh_chm – lidar_chm
    lvv_diff = lvv_chm – lidar_chm

lhv_diff = lhv_chm – lidar_chm

13. In turn, open each of these files in a viewer. In the Viewer window, click on "AOI – Tool" and draw a square area of interest.
14. Click on "Utility – Layer Info".
15. Click on "Edit – Compute Statistics"



Select "Use AOI", then select the "Viewer" option and click "OK". The image statistics will be calculated for your selected area of interest. Enter the "Mean:" value in the results table below:

RESULTS:

Method	Mean canopy height difference from LIDAR
X-VV	
L-HH	
L-VV	
L-HV	

16. Please show me your results when you have finished.

Acknowledgement: The original E-SAR data are courtesy of DLR, Germany. The LIDAR data are provided by the Environment Agency (UK). This work was supported by NERC.

RASTER DATA SETS

lidar_dsm.img	LIDAR Digital Surface Model (m), pixel spacing 3 m
lidar_dtm.img	LIDAR Digital Terrain Model (m)
lidar_chm.img	LIDAR Digital Canopy Height Model (m)
xvv_dem.img	X-band VV-polarised Digital Elevation (Surface) Model (m) based on single-pass SAR interferometry with the airborne E-SAR system
lhh_dem.img	L-band HH-polarised Digital Elevation (Surface) Model (m) based on repeat-pass SAR interferometry with the airborne E-SAR system
lvv_dem.img	L-band VV-polarised Digital Elevation (Surface) Model (m) based on repeat-pass SAR interferometry with the airborne E-SAR system
lhv_dem.img	L-band HV-polarised Digital Elevation (Surface) Model (m) based on repeat-pass SAR interferometry with the airborne E-SAR system

Monks Wood NNR

County: Cambridgeshire
Area team: East of England Region (Peterborough)
Main habitats: Woodland
Area: 157 Ha

Monks Wood NNR is one of the best examples of ancient ash-oak woodland in the East Midlands.
To download a leaflet describing this reserve, click here.
A wide range of tree and shrub species are found in the reserve, including field maple, aspen, hawthorn, hazel, guelder rose, wayfaring tree, spindle, privet, blackthorn and dogwood. The site is also notable for its population of rare wild service trees.
The reserve's plant life includes species typical of ancient woodlands, such as bluebell and wood anemone. Rarer plants found in the area include the greater butterfly orchid, violet helleborine and crested cow-wheat. The woodland is also a breeding site for birds such as tawny owl, nightingale and woodcock.
Monks Wood is an important site for beetles with over 1,000 species being recorded in the area, many of them associated with decaying wood. The Wood is also known for its butterflies and is home to the rare black hairstreak.
The best time to visit the site is during the spring, for woodland wildflowers.

Location and access
Monks Wood is 10 km north of Huntingdon and 1 km to the east of the A1 (M) between junctions 14 and 15. The reserve is accessed via the B1090 (from the B1043). The nearest village is Woodwalton.

Source: http://www.english-nature.org.uk/special/nnr/nnr_details.asp?NNR_ID=112