What quality requirements should you set for digital image data?

TerraNor has adapted a Canadian system for automatic forest mapping based on digital data from aircraft and satellite to Nordic forestry. The system can provide significantly better quality and more efficient forest mapping provided good digital image data.

The comments are based on the production line Lantmäteriet had in 2005/2006. It may have changed today (2021). The comments are still valid and explain what TerraNor thinks is important.

In 2006 and 2007, Terranor carried out projects for Bergvik skog / Stora Enso, Sveaskog and Statens Fastighetsverk with mapping of forest damage (Gremeniella), measures in young forests and general forest data based on digital image data from Lantmäteriet (LM). LM's data is a standard product developed for use as an orthophoto in GIS. Such standard data are unsuitable for our analysis. In a good collaboration with LM, we gained access to original data and processed data ourselves. The article addresses the points that were critical to our needs.

Dataformat

Data from LM's DMC 30 camera detects radiation in the channels black / white (Pan), Red, Green, Blue and Infrared (RGB + IR) with 12 bit data format. LM automatically converts all data to 8bit, which is preferred for use in GIS.
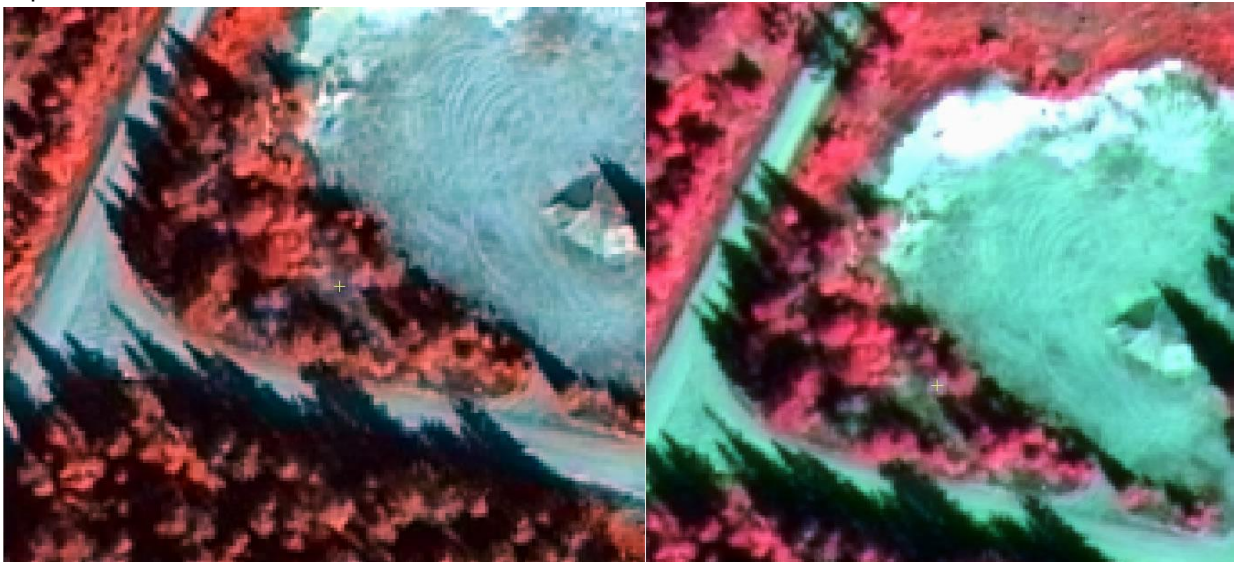
The image on the left has 12 bit data with significantly more details than the 8 bit image on the right. By changing data from 12 bit to 8 bit, the amount of information is reduced 16 times pr channel and makes it impossible to separate all types of wood from each other. Just about any analysis will require 12 bits of data.

Central projection and overlap between images

In the middle of an aerial photo, the trees point straight up. Towards the edges they lean more and more. In the direction of flight, there is a 60% overlap between the images which reduces the problem. Between the airstrips, there is only 20% overlap that gives leaning trees. By increasing to 30% overlap between the stripes, the problem can be reduced a lot. The leaning trees give different colours in the picture, in the north we see the sunny side and in the south the shady side of the trees. This is of great economic importance since we must have more test fields when the colours vary. Satellite images cover large areas and see everything from one direction and do not have this problem.
LM adjusts the colours in the image in its orthophoto production to remove the difference from north to south. This is undesirable in our analyzes.

Orthorectification
By orthorectification, the images are adapted to the map by resampling the pixels. LM uses different processes for resampling the images than what we wanted. We performed the orthorectification ourselves.

PanSharpening
The colour channels (RGB + IR) in LM's data have a resolution of 2.4 m while Pan has a resolution of 0.48 m. With special Pansharpening techniques, one can manipulate and produce colour data with a resolution of 0.48 m. A good pansharpening software will maintain the quality of colours for analysis.

Data resolution
LM flies its sensor at 4800 m altitude which gives 0.48 m and 2.4 m resolution, about the same as for data from the QuickBird satellite (0.61 m and 2.4 m). Normally when mapping forests, you fly so low that you get 0.2 m Pan and 1-1.2 m Multispectral resolution. Lower flight altitude gives greater resolution and you get more details and better quality of the analysis.

Økonomiske konsekvenser:

| Data type	Laser data combination	RGB scanned	FCIR scanned	DMC Intergraph	ADS-40 2nd Leica	Quickbird Digitalglobe
Cost pr ha	+ 0,50 €/ha	4,25 €/ha	3,00 €	3,00 €	2,75 €	1,50 €
Number of classes that can be registered with good precision> 80%		4 classes	6 classes	8 classes	8 classes	8 classes

The table shows costs for analysis of different types of data. Picture costs are not included. We have included scanned data from film for comparison (good old days). Satellite data provides the same or better quality and lower costs than aerial photos. Orthophoto from Quickbird will be very good.

Summary
Buy best data format, ie 16 bit (12 bit content). 8 bits can be produced when needed.
Purchase original unprocessed data. You can run orthorectification, mosaic and pan sharpening yourself easily for the production of orthophotos.
If you do not need to map details, buy standard data. If better quality is needed, book your own flight and agree on a resolution of data that is sufficient.
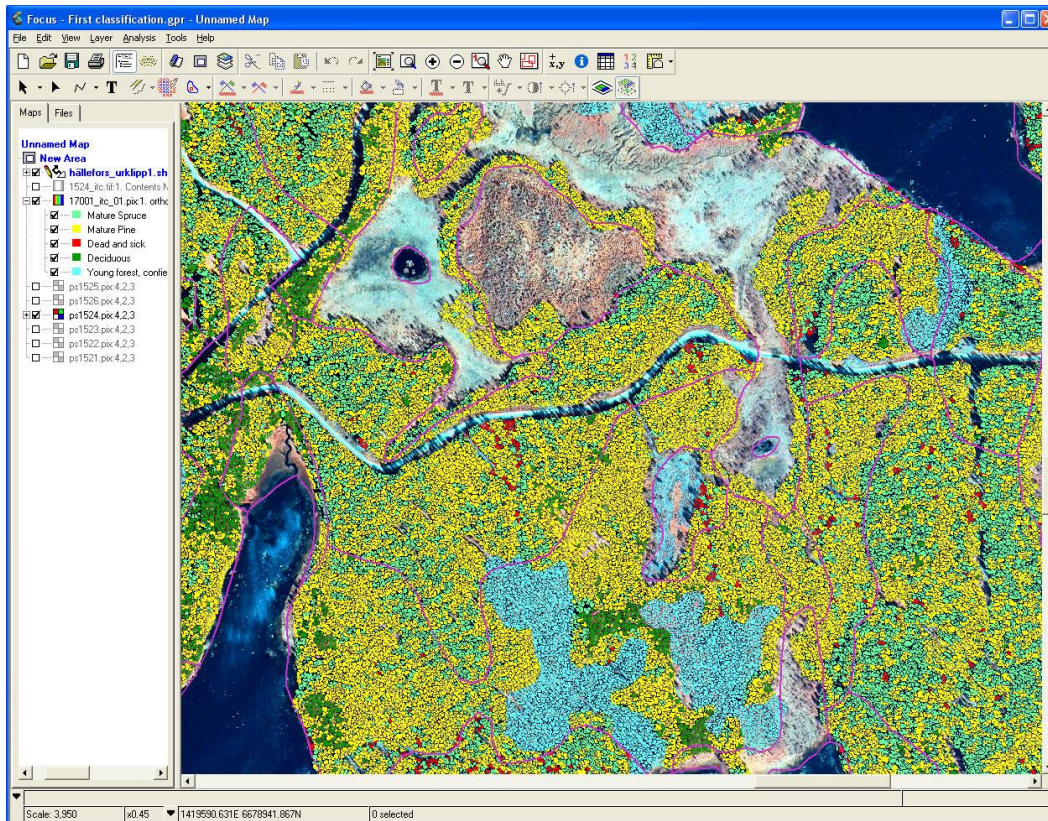
The result of analysis for trees died of gremeniella. DMC 30 data from LM processed correctly gives good results.
Software used in our projects: PCI Geomatica and Trimble eCognition Developer.