Precision forestry – why geospatial data is vital and affordable

Forestry SAT – Reforestation

What is precision forestry?

It's been around for a while, but precision forestry is a term that has been steadily gathering momentum in recent years. But what does it actually mean? For most of us, it conjures images of robotics: drones applying pesticide, harvester telemetry or automated nursery systems. And precision forestry is all of these things, but more broadly, it's the use of any technology to make more granular management prescriptions and achieve tighter operational control.

With this definition in mind, it is not surprising that most of the existing forestry technologies are focused on the start and the end of the rotation. After all, this is where most management prescriptions are made, operational expenditure is concentrated, and significant cost savings are possible. This is really important because precision forestry technologies don't just need to work: they need to make economic sense. In the forestry world it's also vital that they work at scale and are suitable for remote areas. Few emerging technologies we see in forestry satisfy these requirements.

This is why satellite data should form part of any precision forestry strategy in 2023. The scalability of satellite data capture is truly unrivalled, the cost – in relative terms – is low, and when fused with geospatial AI, the insights that are unlocked have genuine value.

It's not all about drones

Rezatec's Reforestation product uses a time series of multi-spectral satellite data, combined with geospatial AI, to monitor conifer establishment progress across vast forest portfolios.

The product also differentiates between crop, and non-crop vegetation, providing foresters with quantitative metrics for competition intensity, at 10m resolution. In other words, for every 1/100th hectare of young plantations in your care, it tells you how your planted trees are performing, and whether or not any silvicultural interventions are required.

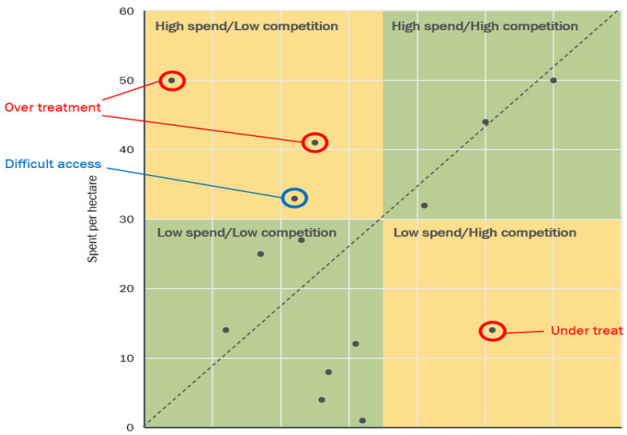
One Rezatec customer estimates that, at block level, using our Reforestation product has reduced their net herbicide treatment by 15%, which has resulted in huge cost savings. In addition, they're identifying additional areas that require treatment, which were previously being missed. So, at a time when labor supply is tight and costs are increasing, this allows them to do more with less. They're making more granular management prescriptions and saving operational costs, while de-risking their portfolio from patchy or failed establishment. And, as an added bonus, they're keeping stakeholders happy by reducing their volume of herbicide application.

This is precision forestry in its purest form, yet it's robustly affordable when compared with other emerging solutions, and there are unique capabilities unlocked by this consistent method of monitoring. With satellite and geospatial AI solutions, every site is analyzed in the same way. The effects of seasonal and weather variation are minimal when compared with drone-based solutions and the possibilities are endless when it comes to the macro-scale data you can interrogate. Here are just three examples of metrics you can start to track.

1. Weeding spend vs competition intensity

We should all be tracking expenditure at block level; you want to be able to answer the question "how much has it cost me to establish this site?" Now, if you can do this, you can also start to combine those data with Rezatec's competition intensity data in really interesting ways.

Excepting a few legitimate outliers – perhaps you have a wildlife constraint preventing treatment in summer months ('high competition/low spend'), or you have a site which is unusually expensive to treat due to access ('low competition/ high spend') – you would reasonably expect most of your sites to fall into the 'high competition/high spend' or 'low competition/low spend' categories. Anything else is likely to have been over or under treated.



This analysis gives you an instant impression of how your sites are performing in terms of over treatment and under treatment, but also gives you a quantitative metric to measure against. Next time a client queries a large weeding invoice, or an auditor asks about your approach to integrated pest management, you can demonstrate that across your sites, your activity (and therefore spend) has been proportional to what has been required. When it comes to internal audits, you can target more sites in the 'high/low' and 'low/high' categories and identify more legitimate quality issues as a result.

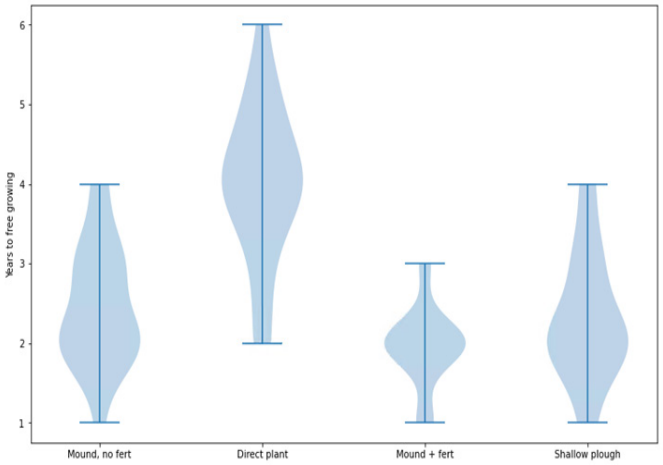
2. Years to 'free growing'

Metric number two is 'years to free growing', or in other words, within each block, for how many seasons are the trees vulnerable to weed competition, herbivory, insect damage, and at what age can the trees, for the most part, look after themselves?

We measure this by using the establishment progress outputs from our Reforestation product, which provide a consistent monitoring method across your full program, and are therefore directly comparable data.

Using some ground-truth data, we set a threshold for what a free growing site looks like for your forest types in our outputs, and then record the number of growing seasons before this threshold is met.

For those who are certified, this is hugely useful for targeting outlying sites for audit, and for practical foresters it allows us to perform all sorts of interesting analyses. For example, the figure above is showing years to free growing for four different site prep prescriptions: mounding, direct planting, mounding + fert, and shallow ploughing. By recording this data for each of our sites, which are defined and monitored in a consistent way, we start drawing meaningful comparisons. This ground prep illustration is just one example of many. You can start to confirm your anecdotal experiences, or more enticingly, begin to challenge them.

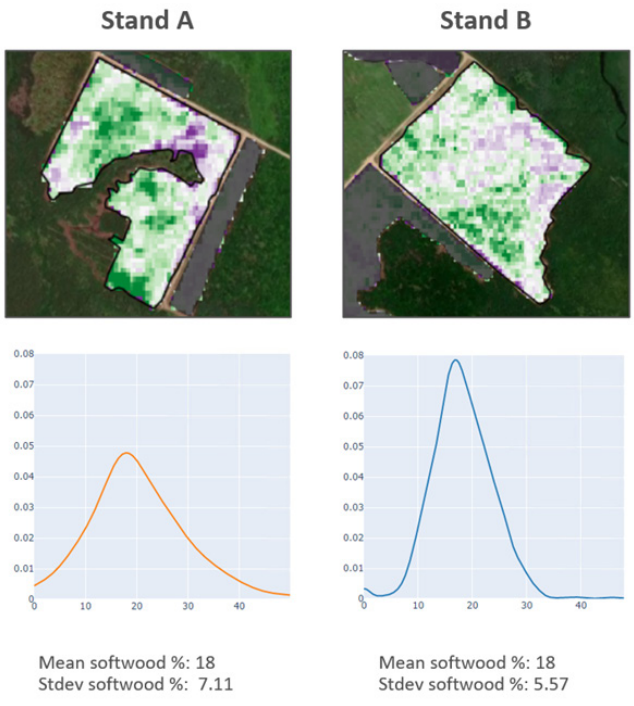


3. Establishment variability
The third metric is relatively simple: establishment variability. In other words, in a given block, how variable is your establishment?

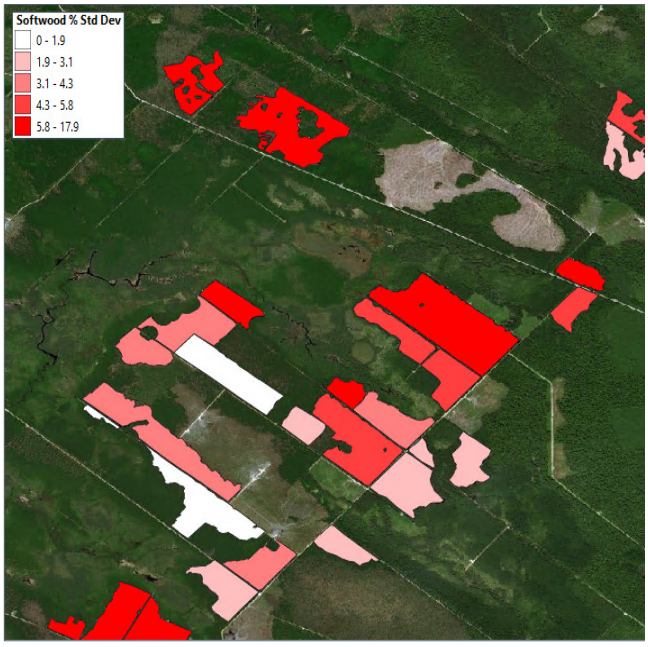
We approach this by taking the raw outputs from Rezatec's establishment progress outputs, which provide an establishment progress figure for each 10m pixel. By calculating the variance and/or standard deviation of these pixel values within each block, we get a picture of how consistent your crop is within these defined polygons.

A high standard deviation tells us that your crop is variable, so perhaps you have patchy establishment, perhaps some areas are performing unusually well. Whatever the underlying cause, if you're going to visit a site for a stocking survey or just a walkover, it tells you that you need to sample it more intensively to get a representative impression.

In the figure below, there are two example sites which have the same average softwood percentage from our outputs. Superficially, we look at the data and say that these sites are performing equivalently. But when we look at the raw, underlying data, or crucially, the standard deviation, we can see that stand A is more variable than stand B, and likely deserves more attention.



Crop variability is also a great metric to interrogate at portfolio scale, for the planning of stocking surveys and prioritization of sites for audit. It gives you an instant impression of where crop condition is consistent throughout a stand, and where you might need to make a more thorough inspection. Sites with low variability likely qualify for a quick transect survey, whereas on those deep red coloured sites, with high variability, it could be worth investing in a more intensive survey.



No technical barrier, robust affordability
There is no doubt that the concepts of precision forestry, when applied appropriately, can help all of us to do more with less, as we deal with the many challenges facing the industry. However, precision forestry is not all robotics and drones. Embracing the scalability of satellite data and taking an analytical approach to establishment monitoring falls into this same category, yet there is no technical barrier to implementation and there is a robustly affordable unit price.