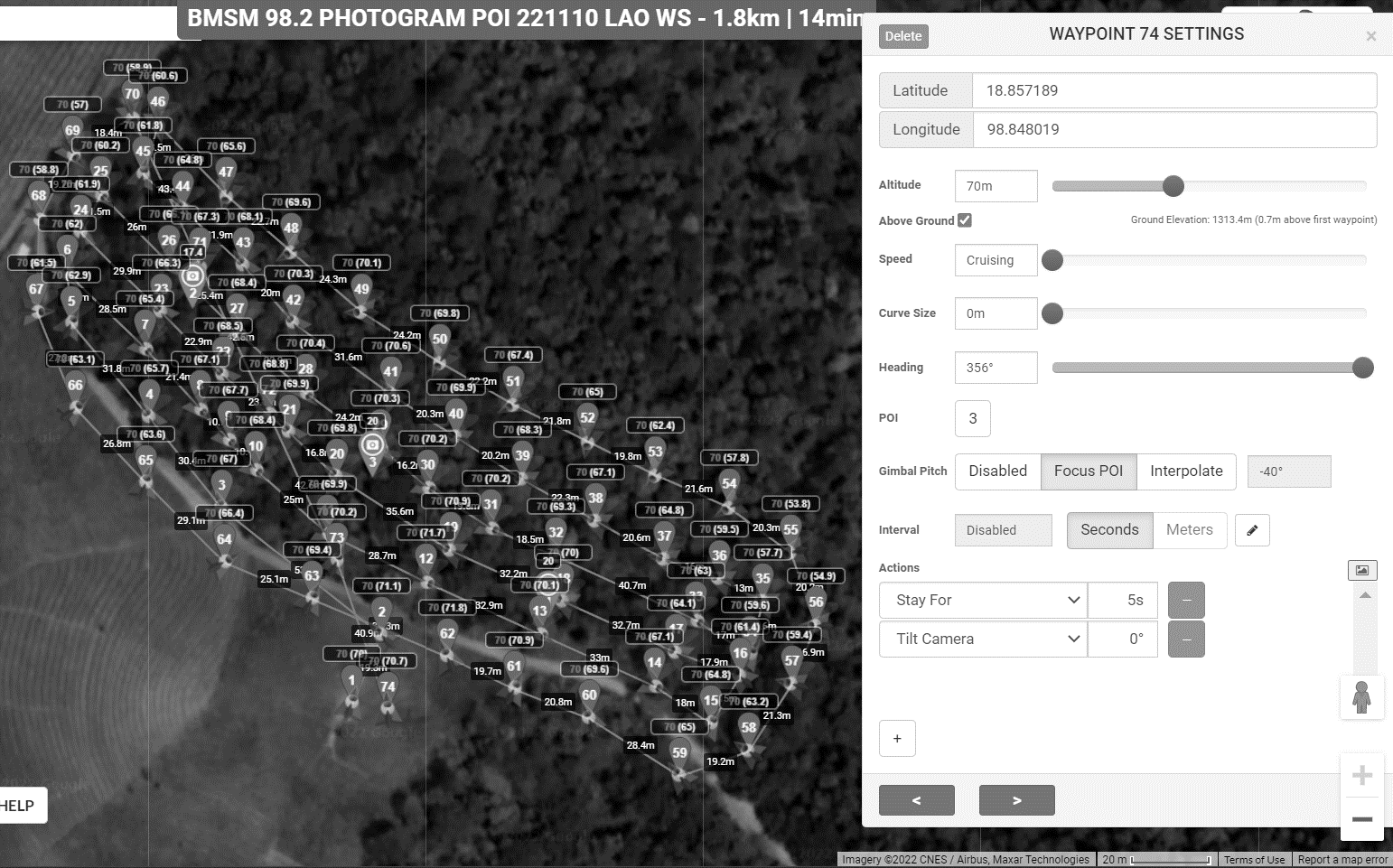
**Monitoring Restoration by Drone**

Images captured by drones and processed by photogrammetry software allow several aspects of restoration to be monitored without the need for boots on the ground. 3D forest models are constructed from 80%+ overlapping photos. Within such models, tree height can be measured and converted to biomass and carbon, forest structure can be visualized and it may soon become possible to identify tree species and calculate species diversity.

**Flight plan**

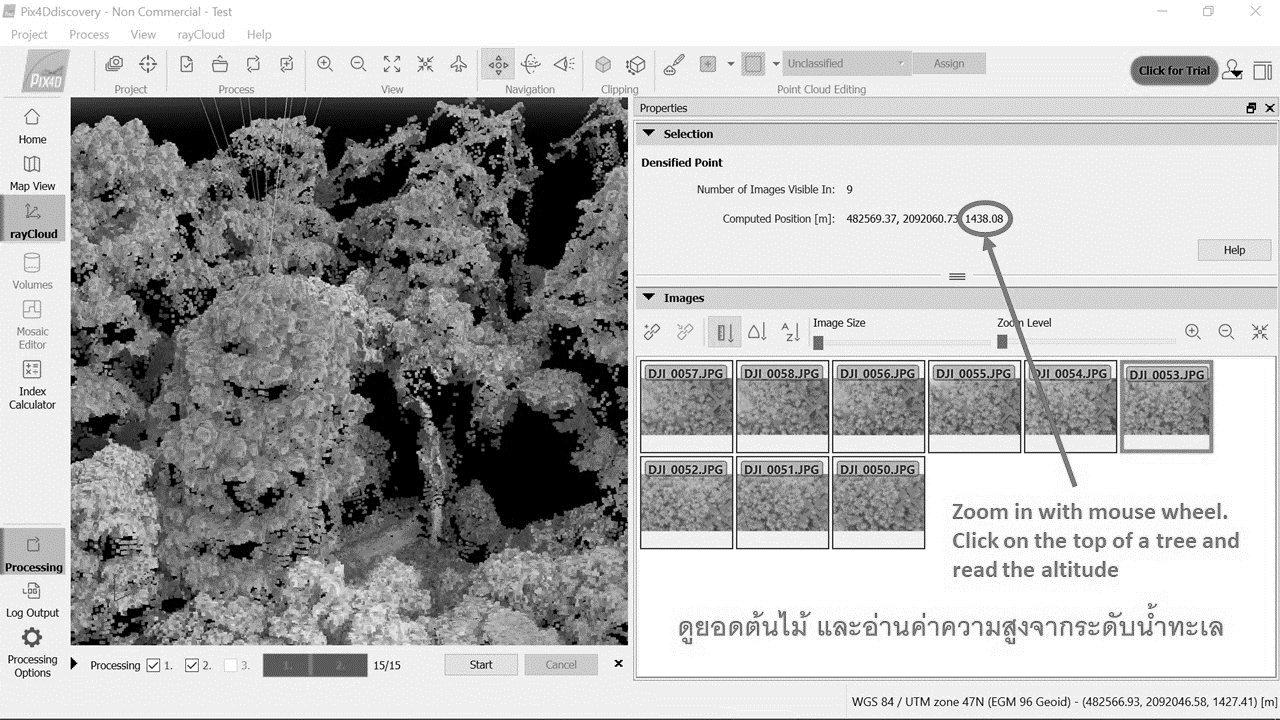
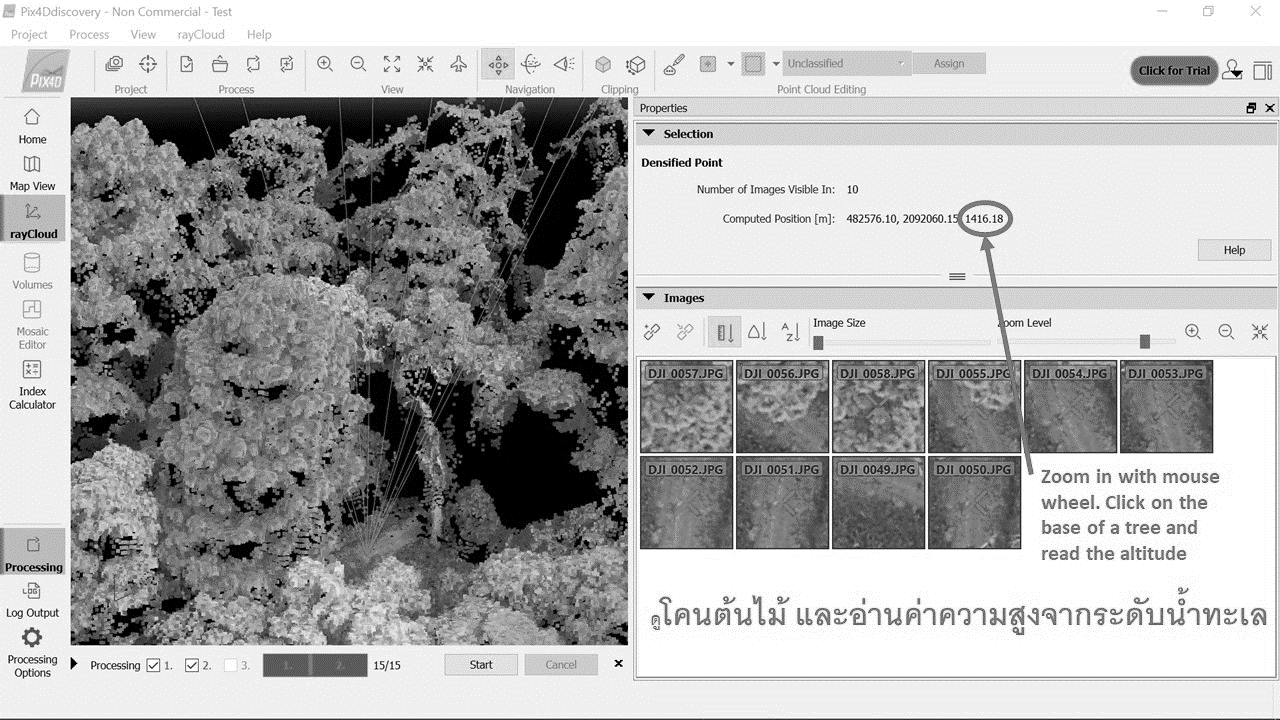
Litchi software is first used to construct a flight plan to program the drone to fly in a grid pattern, taking photos every 3 seconds or so, resulting in 80-85% overlap between adjacent photos. This is typically done by flying 70 m above the ground at about 10-12 km/h, with grid lines about 20 m apart.



**3D Forest Model**

The images are then fed into photogrammetry software. We use PIX4D but there are now many options. The software uses parallax (difference in position of the same point between 2 or more photos) to calculate the distance of every point from the drone. Combined with the known x, y co-ordinates from the drone’s GPS, this enables the software to construct a 3D forest model and an orthorectified flat map. The map can be used with other software to assess in tree cover and the 3D model can be used to measure individual trees.

See 3D model virtual fly thru here: **- https://youtu.be/ilP63ZyxHRI**

**Measuring Trees in 3D models – ground up method**

Tree top altitude 1,438.08 m above sea level. Ground 1,416.18.

Therefore, tree height is 1438.08 – 1,416.18 = 21.90 m tall.

More information on how drones can assist with forest restoration is here: <https://www.forru.org/advice/automated-forest-restoration>

Or join our FRAME workshop on Forestry Drones 6-9/2/23 for intensive training.