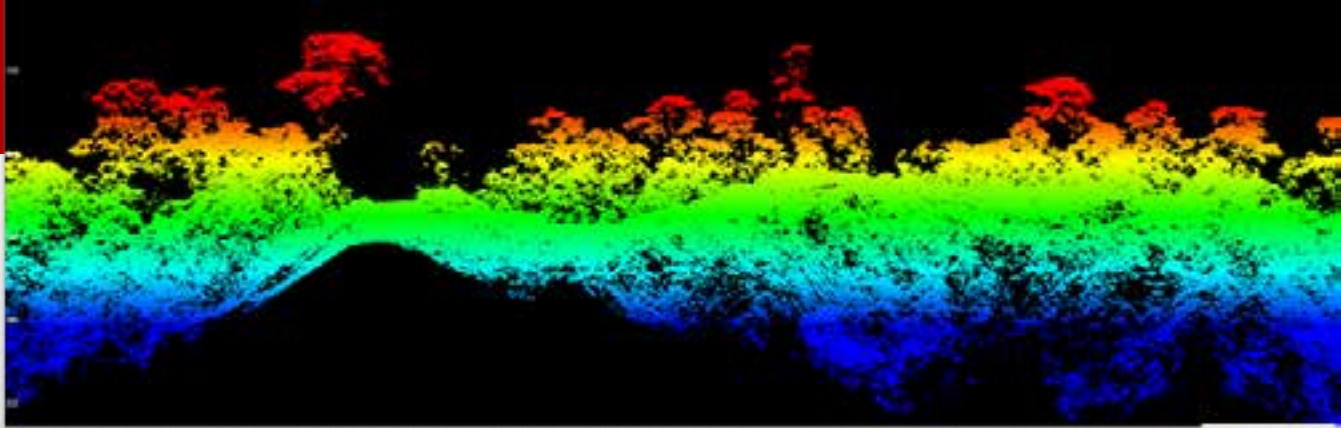


Airborne LiDAR Technology

A 3D Puzzle

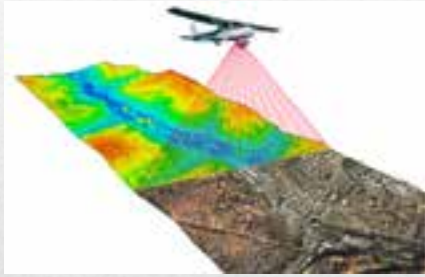


May 2012

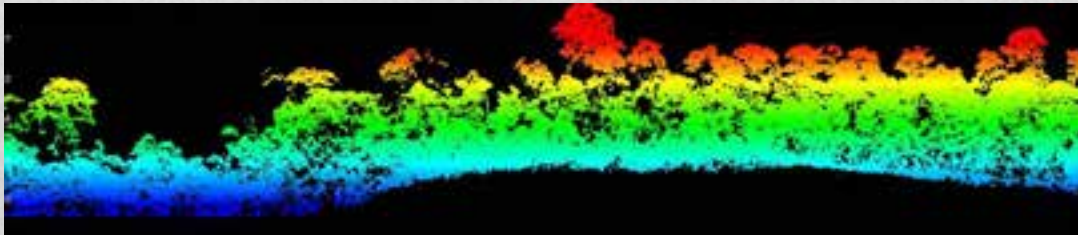


LiDAR Data & Forestry

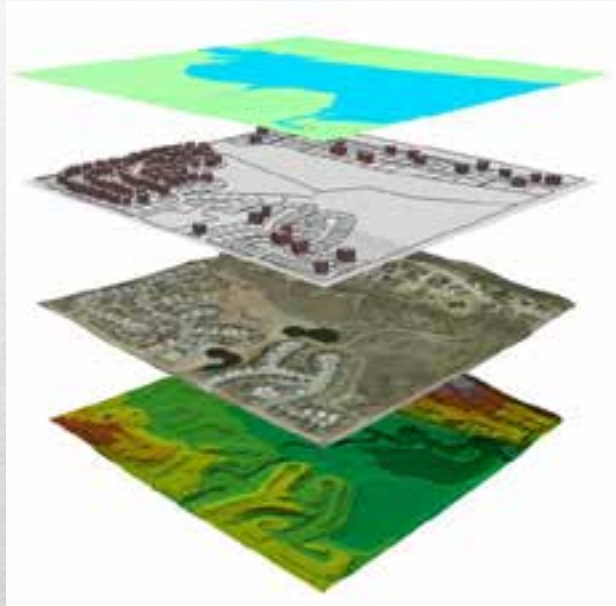
A Rich Source of GIS Information



- Flown with fixed wing or rotary aircraft
- Able to map reasonably large areas efficiently
- Highly accurate: vertical +/- 15 cm
- Fast compared with other surveying technologies



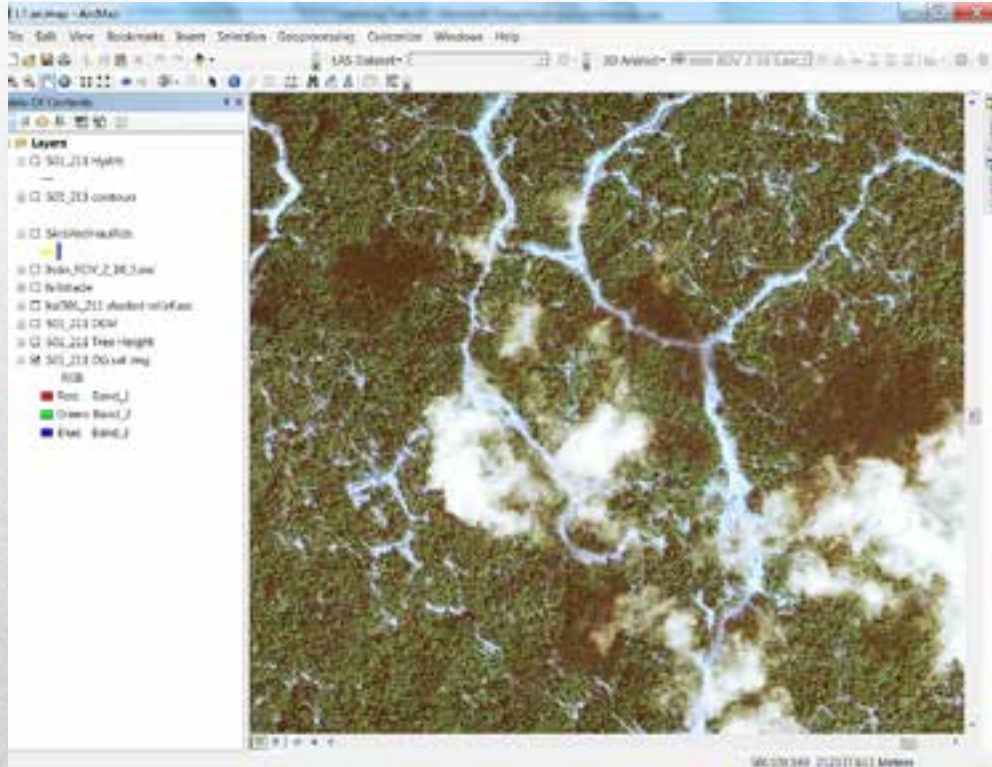
Many GIS Data Layers Just One Collection



- **LiDAR commonly captured with imagery**
- **Many derivative products possible**
- **Plays well with ArcGIS 10.1**



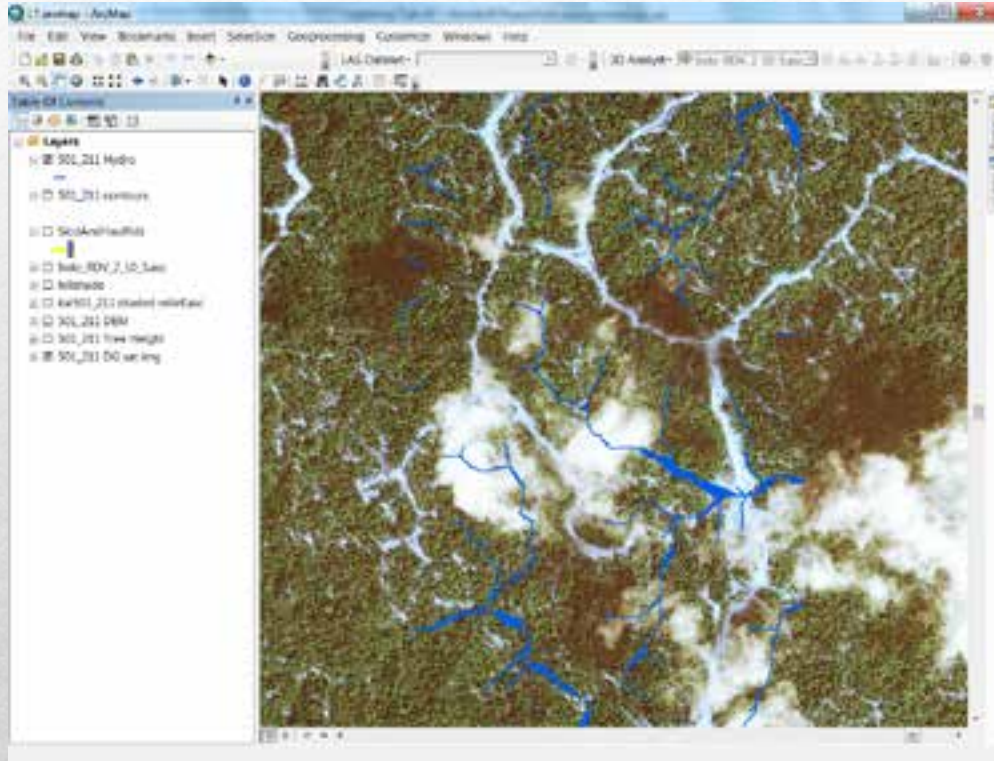
Add Imagery



- Little additional expense to fire a digital camera along with the LIDAR
- Color & color infrared possible
- Colorize LiDAR points



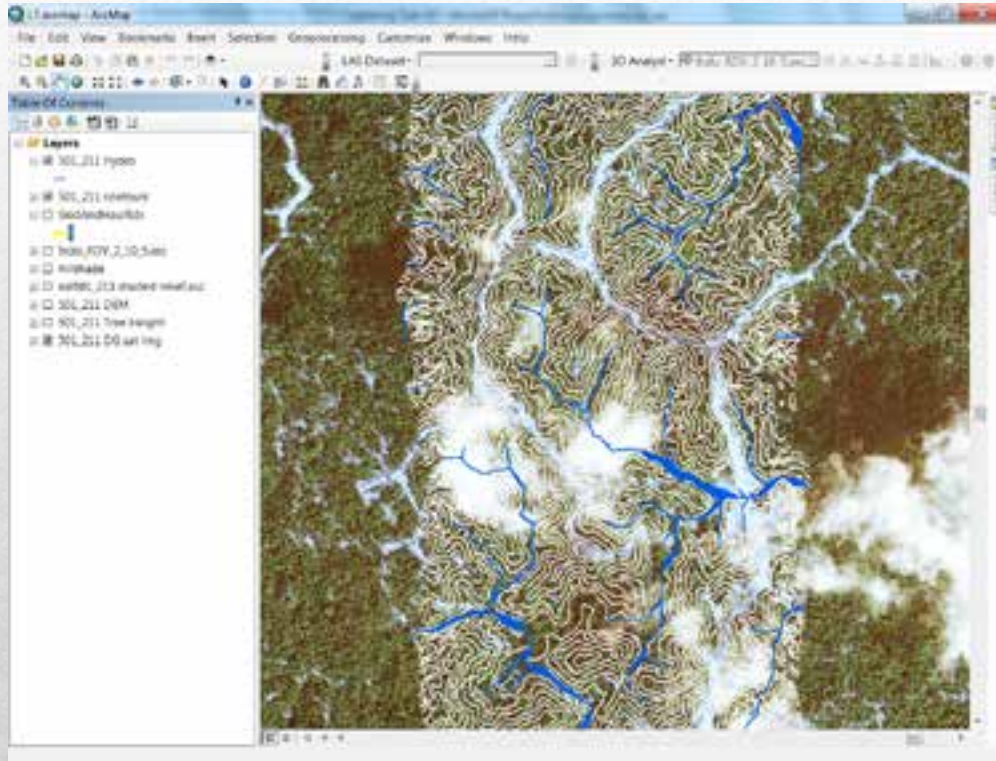
Hydro



- **Extract rivers & streams**
- **Create them in 3D to calculate stream slope**



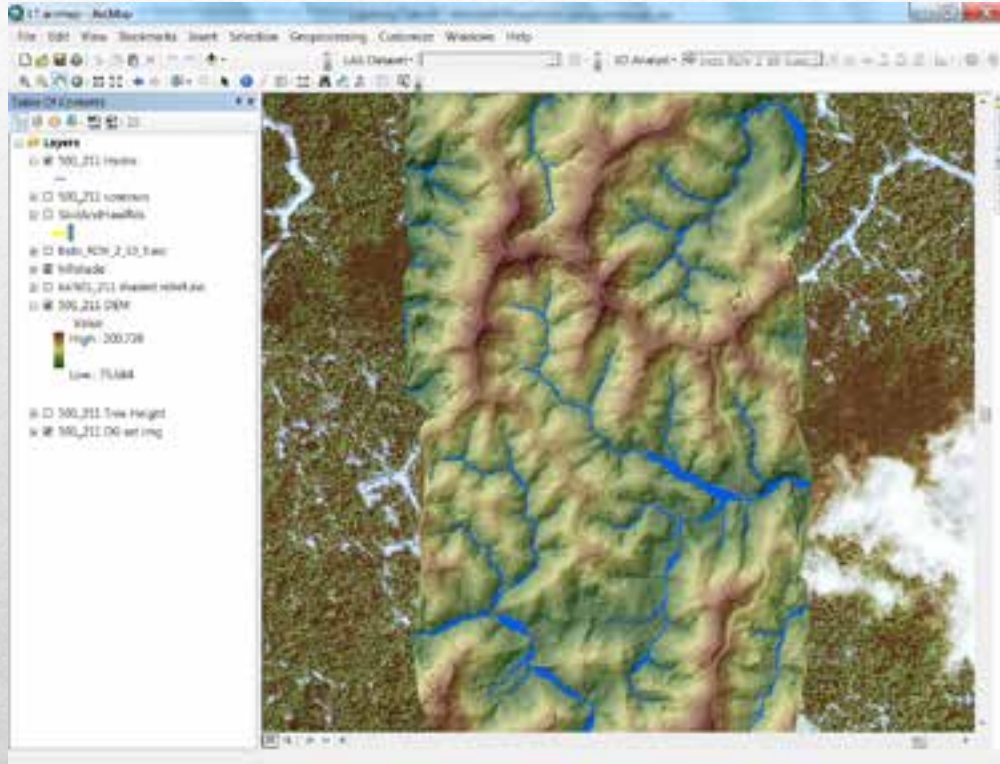
Terrain - Contours



- Quickly and easily created from the LiDAR “bare earth” data
- Display at various resolutions



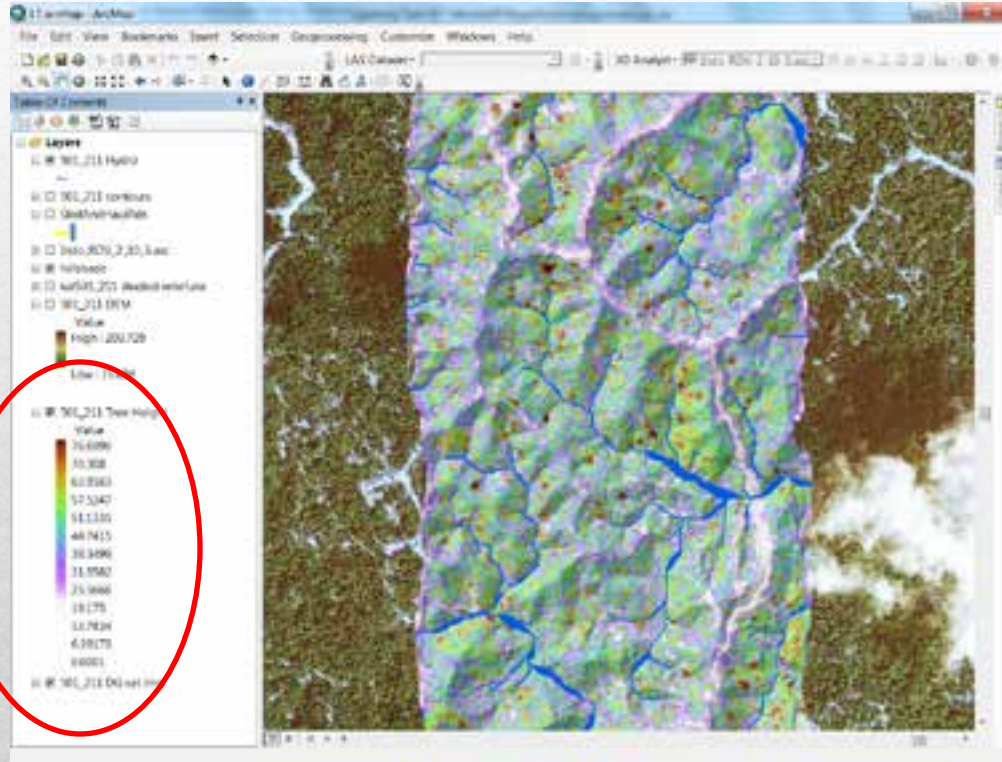
Terrain - DEM



- **Topographical information can be displayed and colored by height**
- **And easily viewed in 3D**



Tree Heights

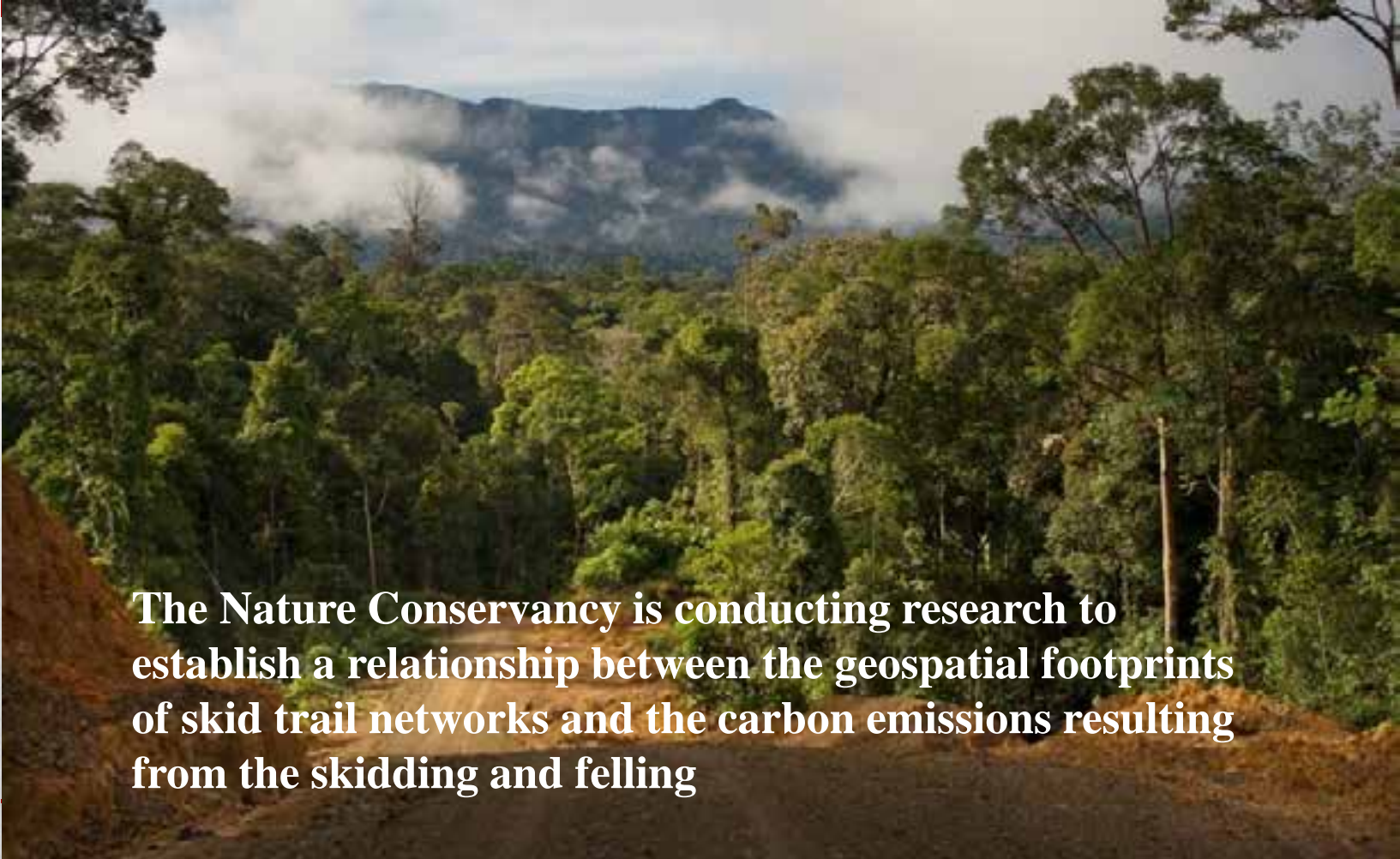


By subtracting the elevation of the ground (DTM or bare earth) from the top of the canopy (DSM or 1st return) tree heights can be automatically calculated



- **The Nature Conservancy**
- **East Kalimantan, Indonesia, July 2010**
- **Evaluation of LiDAR as a tool to scale up field-based direct measurements of carbon emissions of logging concessions**



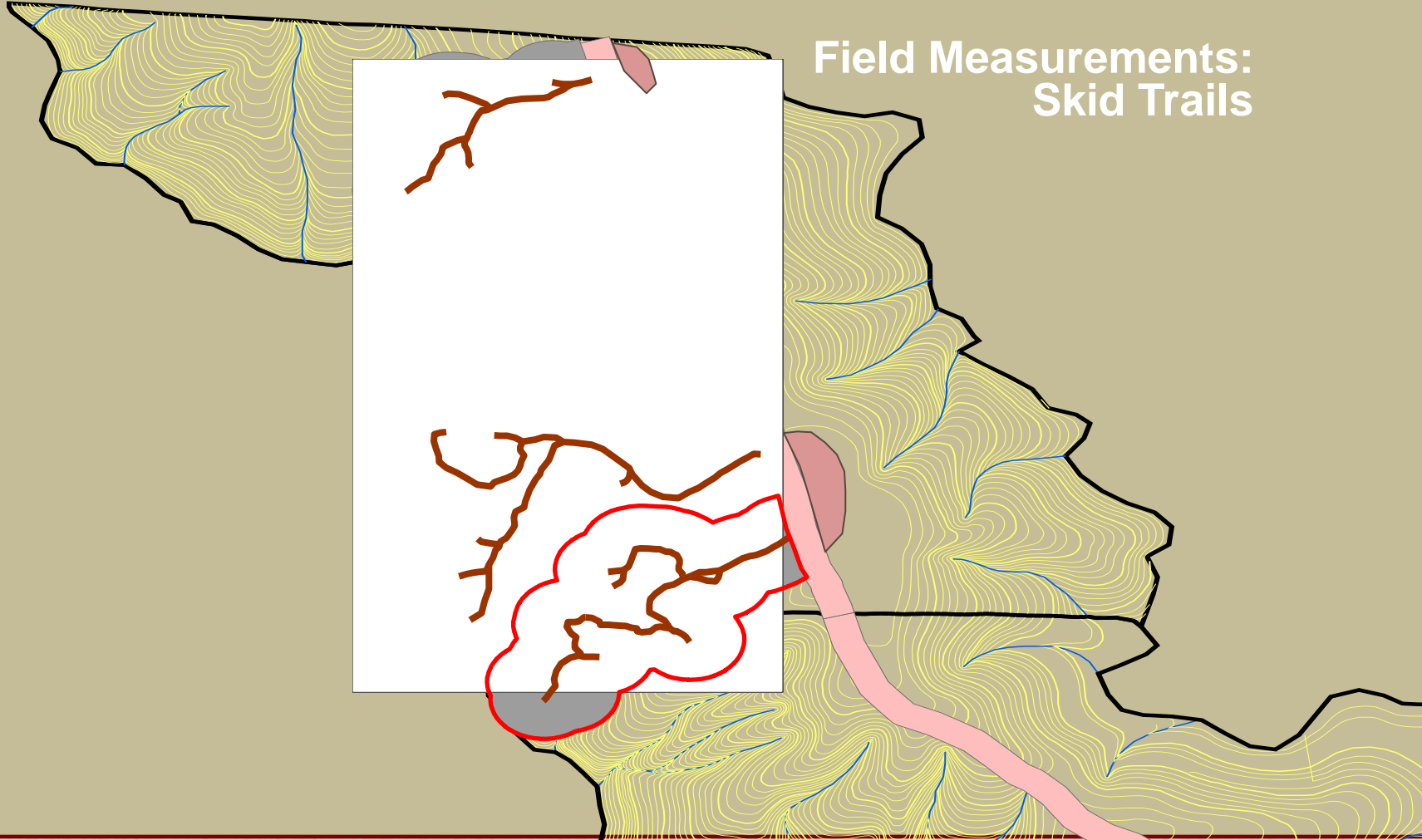
A photograph of a dense forest with a dirt road in the foreground and misty mountains in the background. The forest is lush green, and the mountains in the distance are partially obscured by white mist or low clouds. The sky is overcast. The text is overlaid on the lower portion of the image.

The Nature Conservancy is conducting research to establish a relationship between the geospatial footprints of skid trail networks and the carbon emissions resulting from the skidding and felling

**Field Measurements:
Skid Trails**

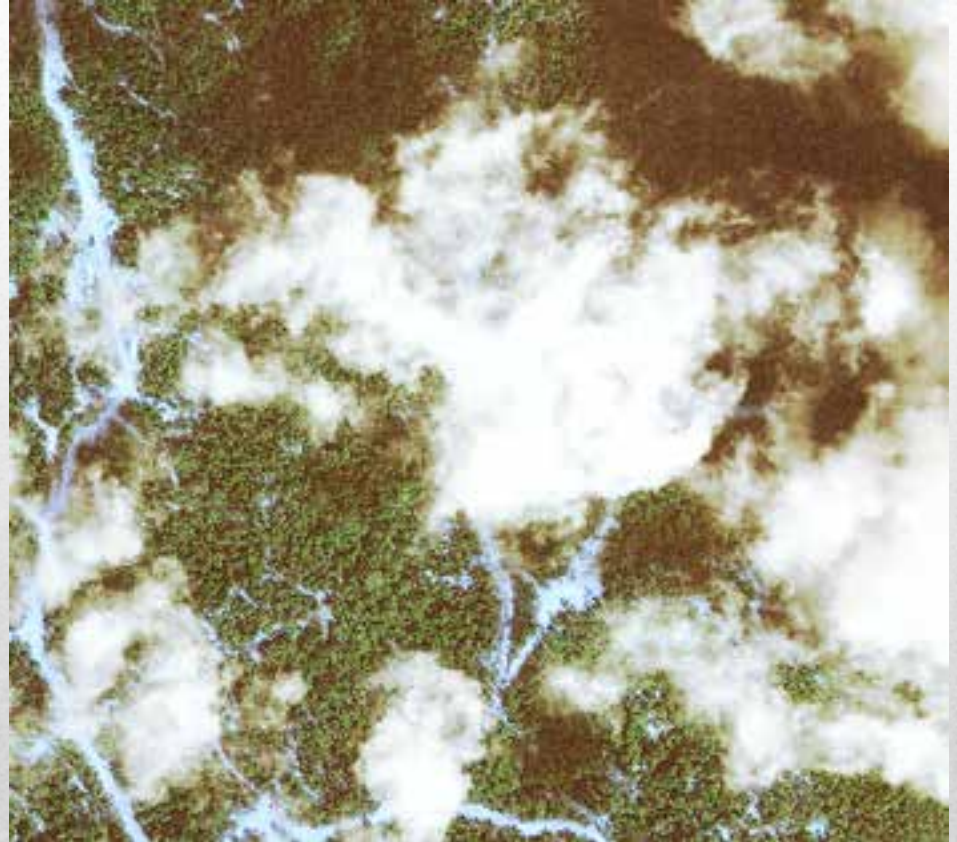


Field Measurements: Skid Trails



The Challenge

- Remotely detecting sub-canopy disturbances associated with logging activities (i.e. skid trails)
- Optical satellite imagery frequently fails because the upper canopy of trees or clouds obscures the sub-canopy.



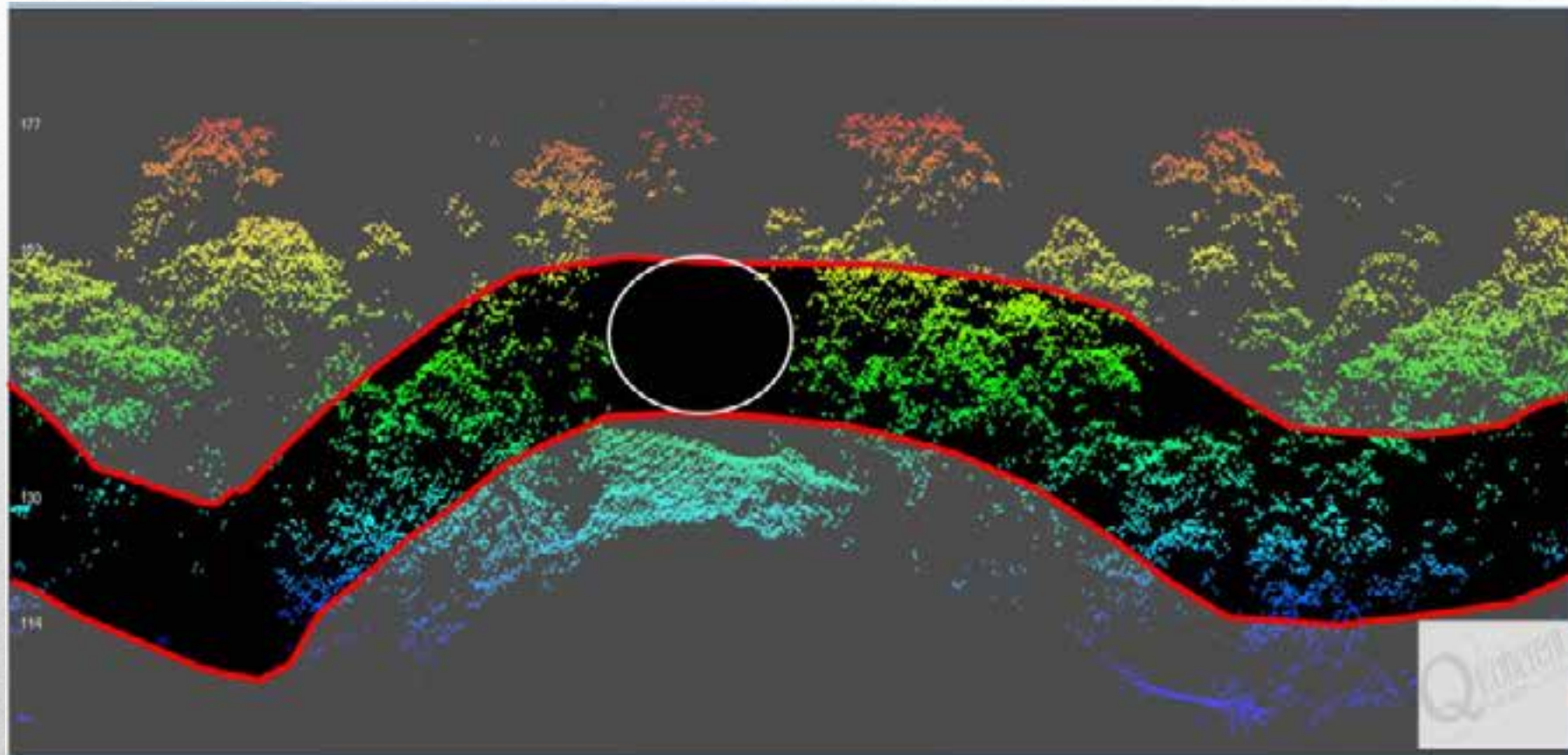
The Solution

- **Filter the 3 dimensional LiDAR point cloud to remove all vegetation above and below a specific height**
 - **Eliminates over head canopy**
 - **Removes any existing undergrowth**
 - **Identifies “tunnels” in the point cloud**
 - **Oliveira et al: Relative Density Model (RDV)**
-

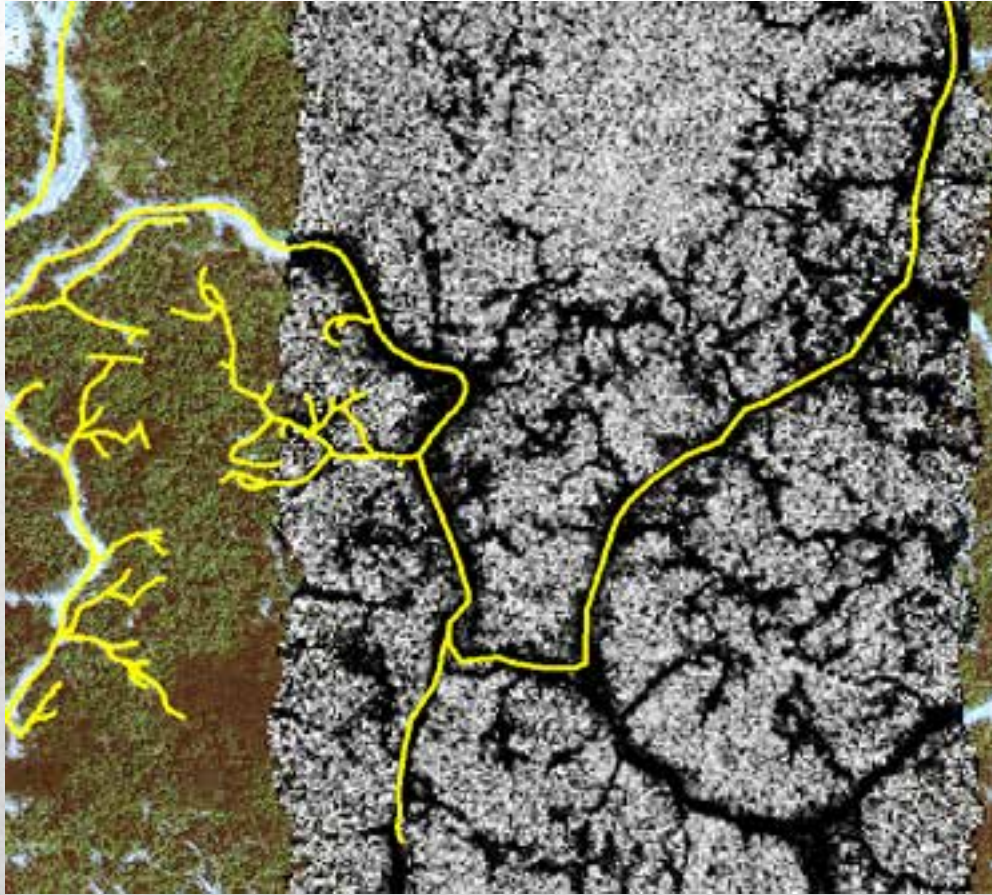
d'Oliveira M.V.N., Reutebuch, S.E., and McGaughey, R.J. 2011. Forest structure and Forest Logging impacts assessment in the Antimary State Forest in Acre State Western Amazon, through the use of cloud-metrics and surface models derived from Lidar data. Unpublished



% cover of the height strata between 2 meters and 10 meters



Oliveria et. al. 2011

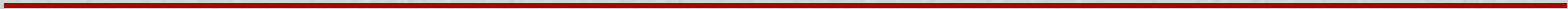


- Results in a raster GIS map
- Dark areas are point cloud “tunnels”
- Similar to skid trail networks as mapped by GPS on the ground



Conclusion

- Airborne LiDAR has historically been used to produce accurate terrain data
- Today we preform point cloud calculations such as canopy height (ArcGIS 10.1)
- Starting to unveil the mysteries of the point cloud
- More to come! Stay tuned!



Credits

Many Thanks To The Following Organizations & Individuals

- **The Nature Conservancy**
 - **Bronson Griscom, Senior Scientist, Forest Carbon Climate Change Team**
 - **Peter Ellis, Forest Carbon Science Analyst**
- **Marco Oliveira, Researcher, Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA).**
- **Credent Technology (ASIA) PTE LTD**
(<http://www.credent-asia.com>)



Thank You!

