

MODELLING OF TANDEM-X MEASURED FOREST HEIGHT FROM SMALL FOOTPRINT LIDAR DATA

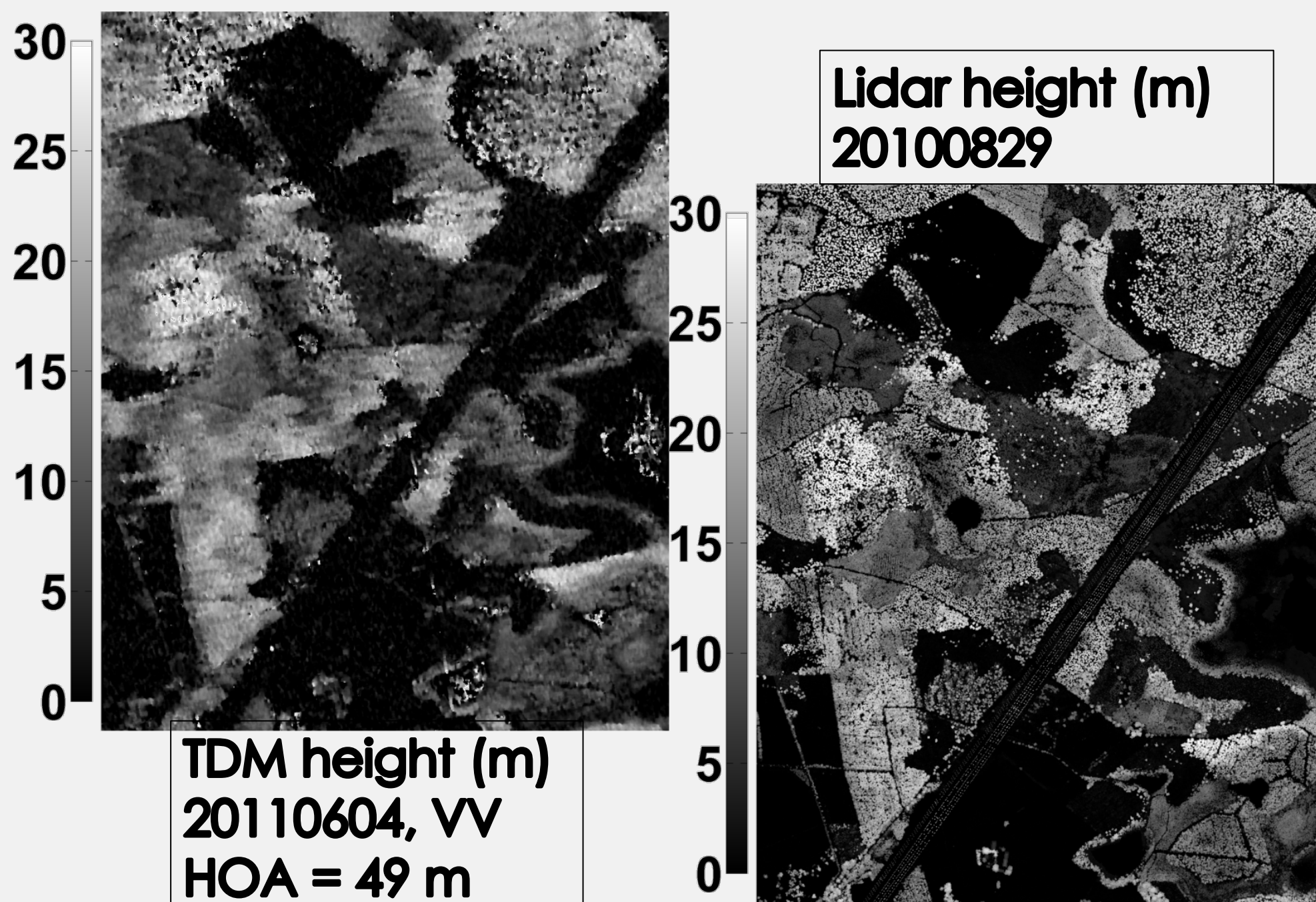


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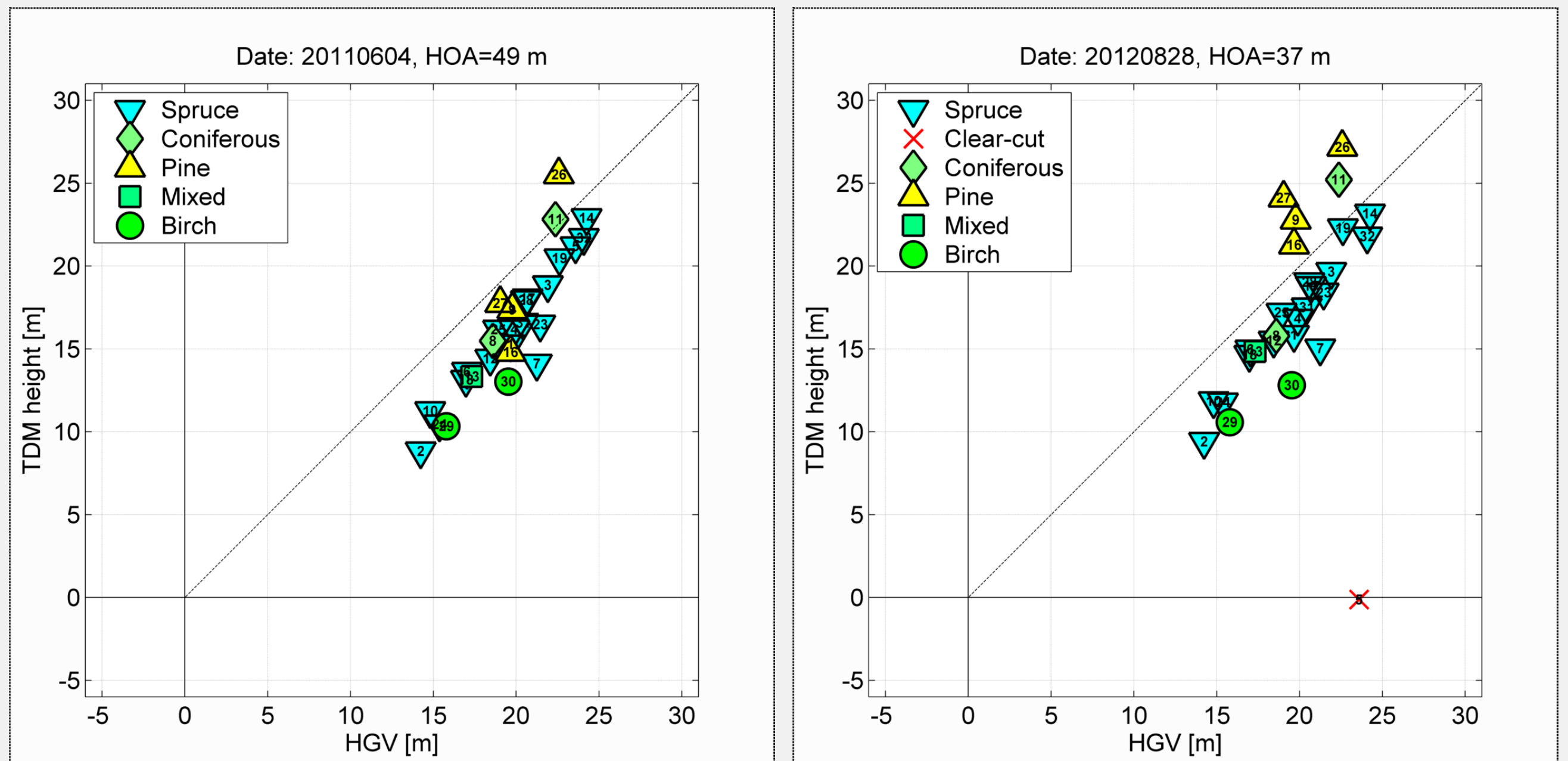
**TanDEM-X (TDM) forest height map =
TanDEM-X DEM – HiRes* DTM**
*grid: 2 m x 2 m, mean error < 0.5 m



Effect of forest sparseness at low HOA*

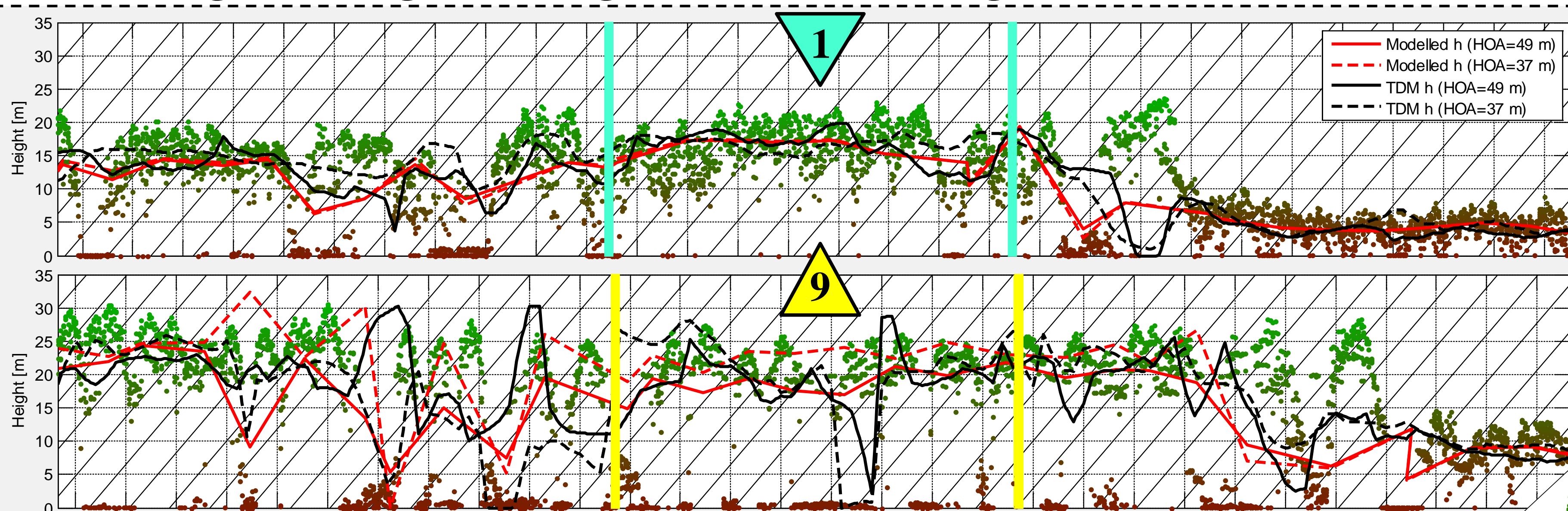
*HOA = height of ambiguity

$$HOA = \frac{2\pi}{k_z} = \frac{\pi R \sin \theta}{B_{\perp}}$$



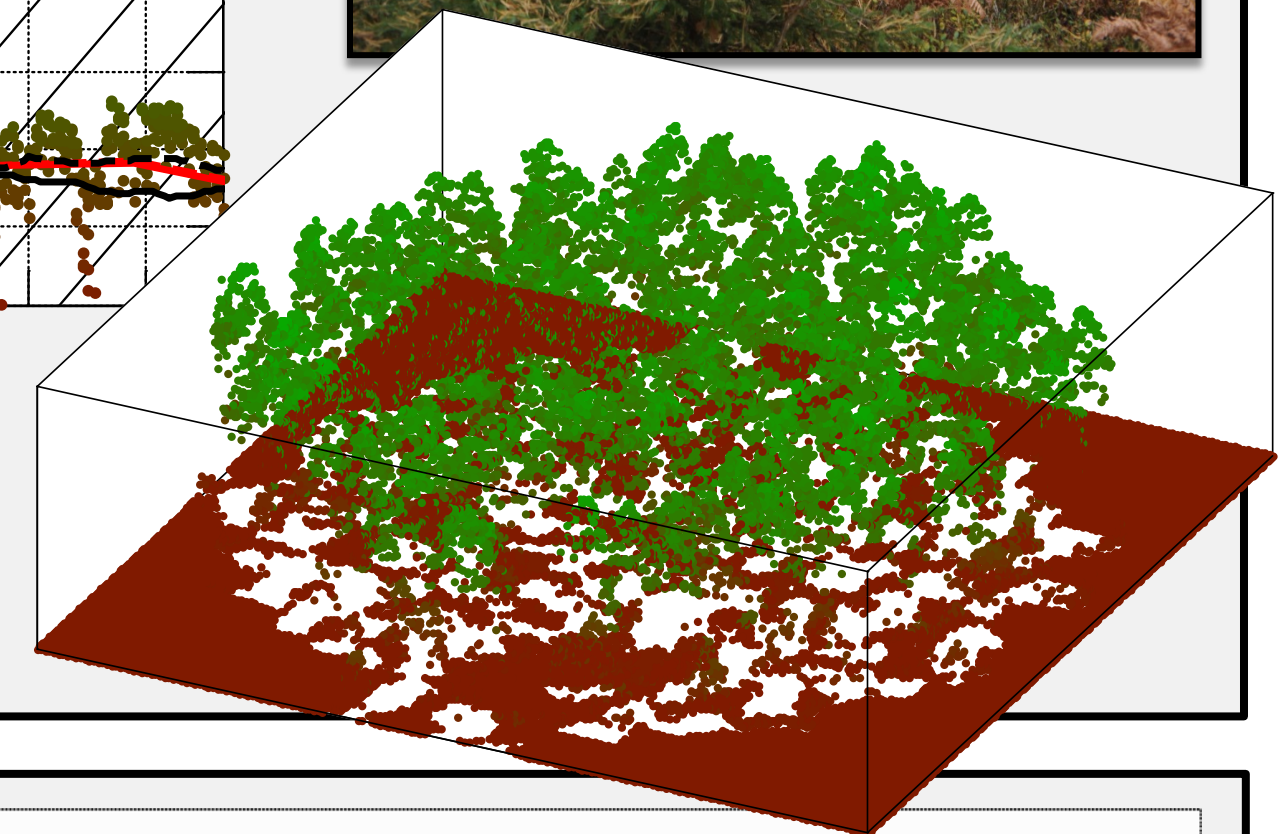
- Overestimation of height and very low coherence of sparse pine plots (40-metre diameter) with a second vegetation layer

Modelling TDM height from high resolution lidar height data (0.5 m x 0.5 m)



- Spruce forest (↑↑transect through plot 1) shows similar heights at different HOA
- Pine forest (↑transect through plot 9) shows different heights due to sparser canopy
- Model with all points within resolution cell + extinction coefficient α

Correlation: $\tilde{\gamma} = \frac{\sum \exp((\alpha + ik_z)h)}{\sum \exp(\alpha h)}$
Extinction: $\alpha = 0.01$
Height: $h = \frac{\arg(\tilde{\gamma})}{k_z}$

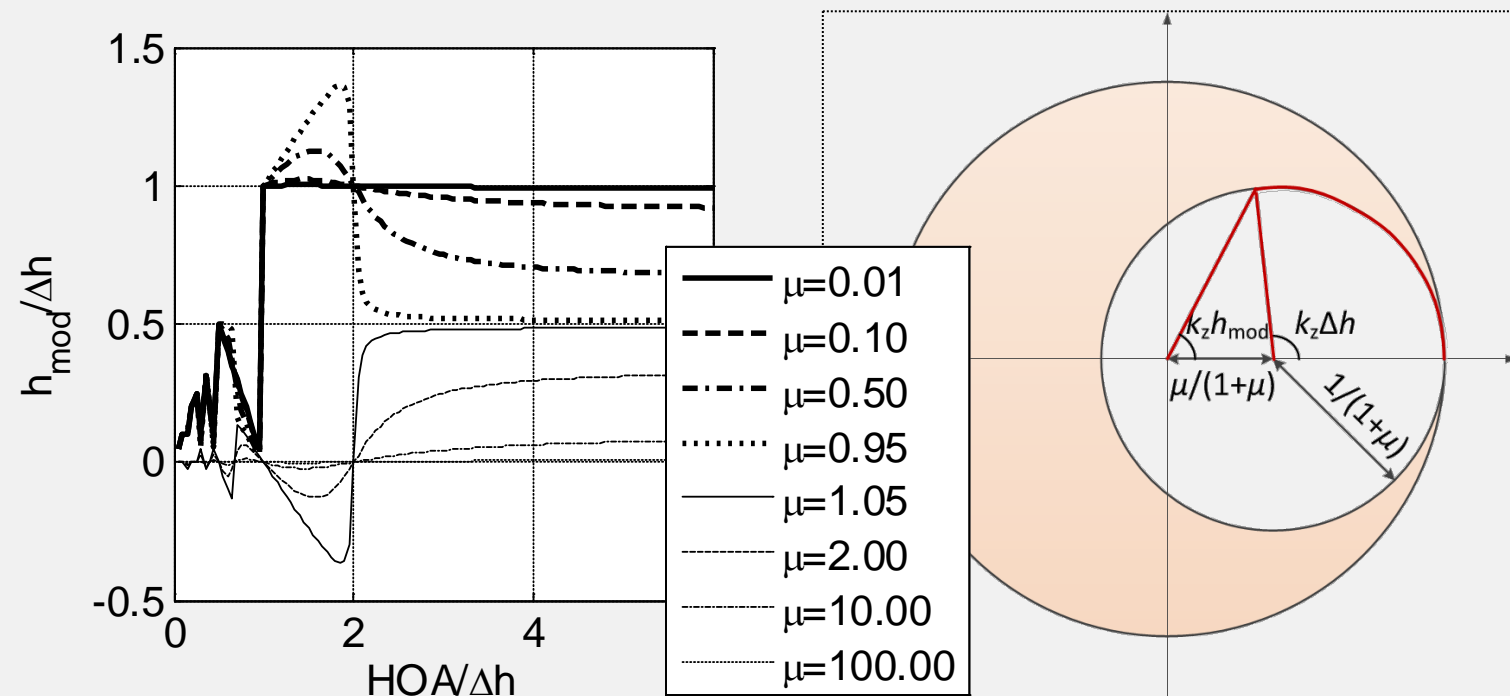


Two-layer model

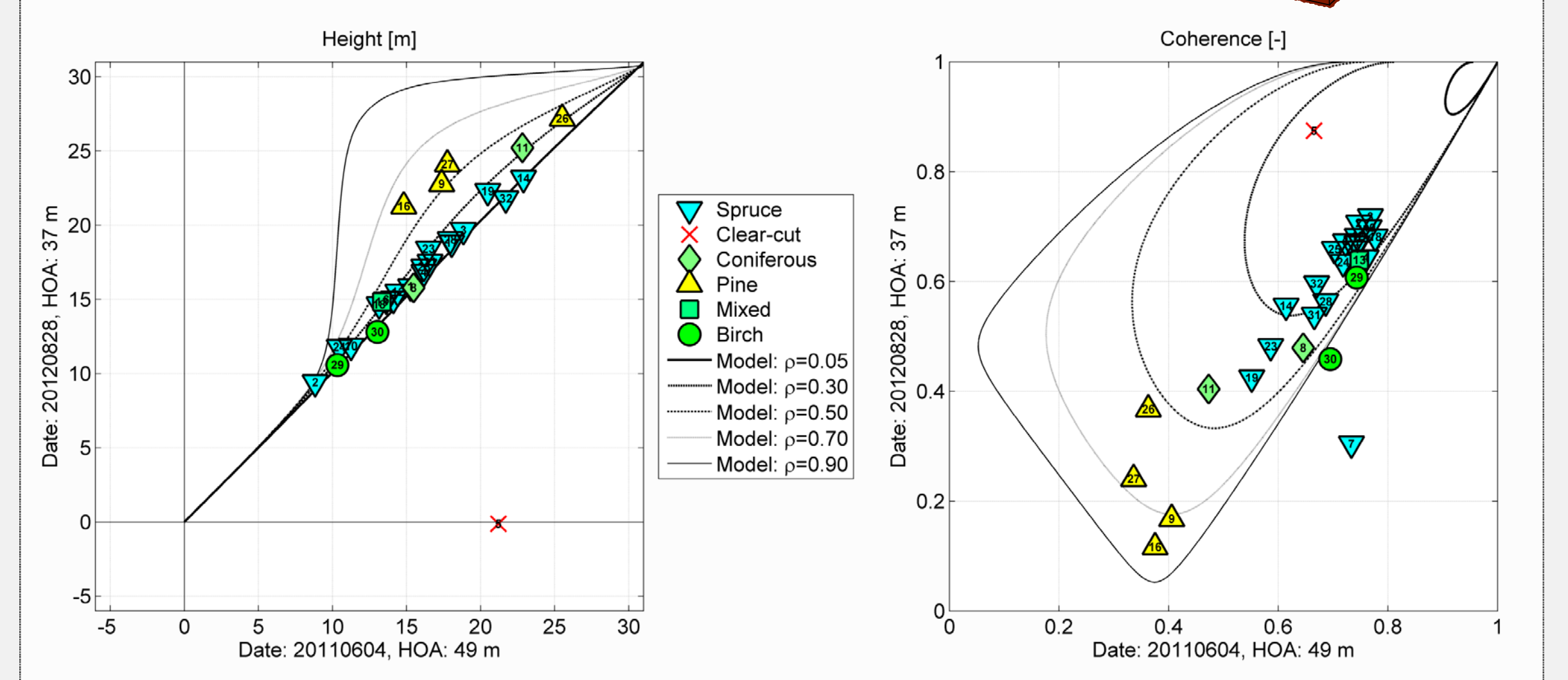
Correlation:

$$\tilde{\gamma} = [\exp(ik_z \Delta h) + \mu] / (1 + \mu)$$

Height: $\frac{h_{mod}}{HOA} = \tan^{-1} \left[\frac{\sin(\frac{2\pi \Delta h}{HOA})}{\mu + \cos(\frac{2\pi \Delta h}{HOA})} \right] / 2\pi$



← Ratio μ close to 1 and low HOA: height strongly dependent on HOA
← Bias occurs due to angle measurement reference offset
→ Comparison across acquisitions + model for constant μ and varying Δh



CONCLUSIONS:

- Overestimation observed in sparse pine forest with second layer of vegetation
- Explanation with two-layer model: interference effect occurring when $HOA < 2\Delta h$ and $\mu \approx 1$

ACKNOWLEDGEMENTS

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