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TanDEM-X AO VEGE0330

Analysis of TanDEM-X InSAR Data and LiDAR Data Aimed at the Characterisation of Open Forest Vertical Structure: A Case Study in Injune, Queensland (Australia)

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Aim and Objective

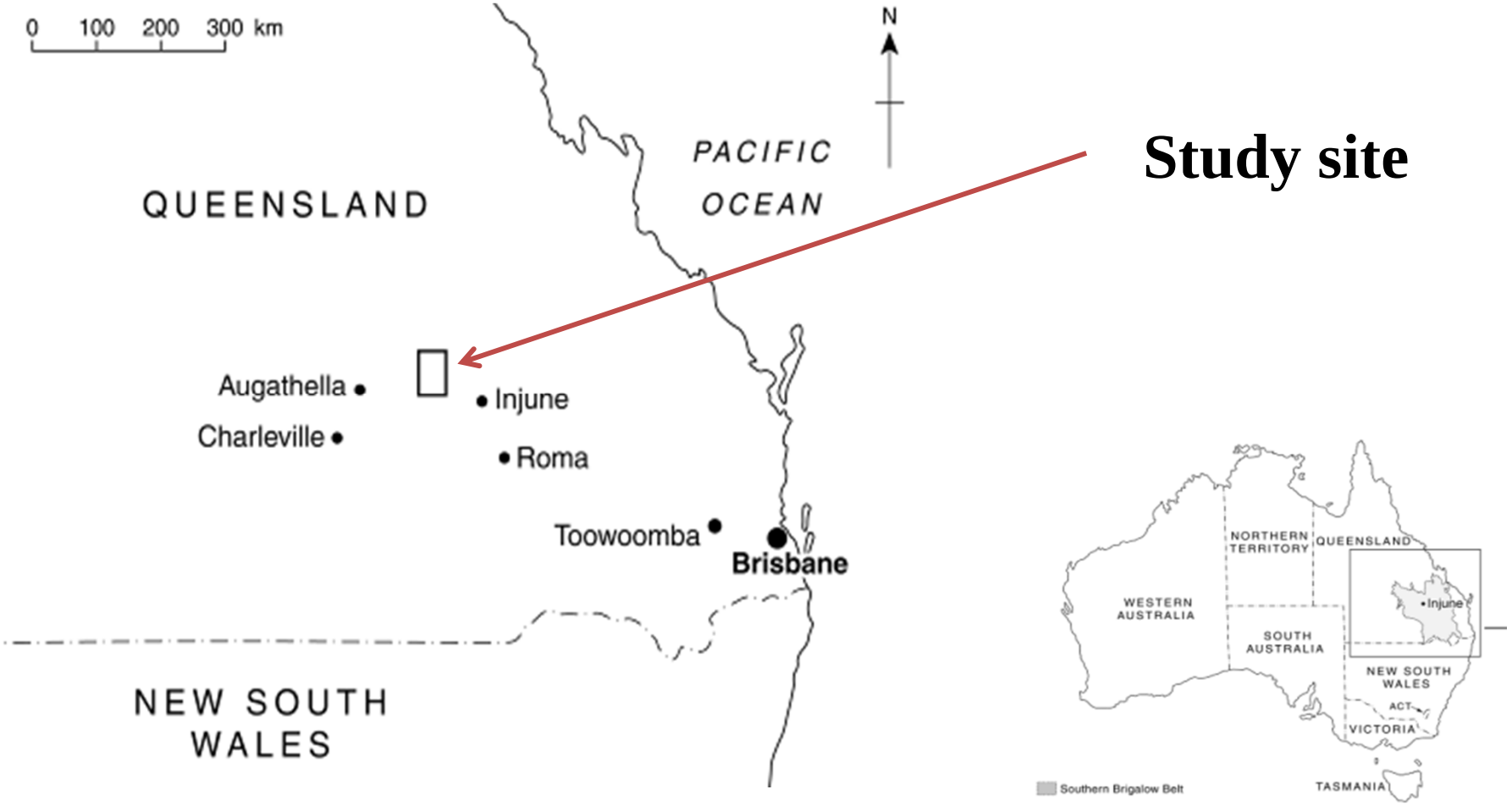
AIM

- Investigation of novel orbital InSAR observations and evaluation of the suitability for the quantitative characterisation of the vertical structure of sub-tropical open forests and woodlands.

OBJECTIVE

- Characterisation of forest biomass and vertical structure by means of TanDEM-X interferometric coherence and phase information.

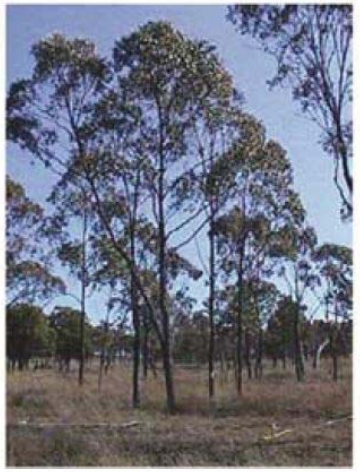
Injune Study Site Location



Injune Vegetation

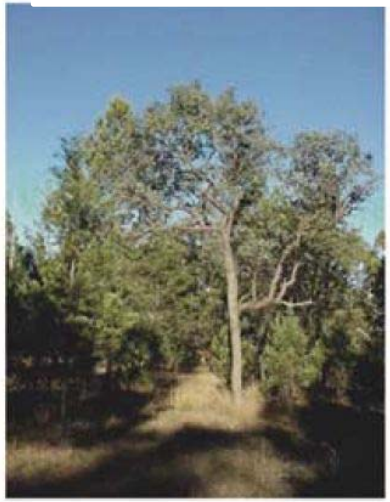
Poplar box
(*E. populnea)*

Brigalow regrowth
(*Acacia harpophylla*)



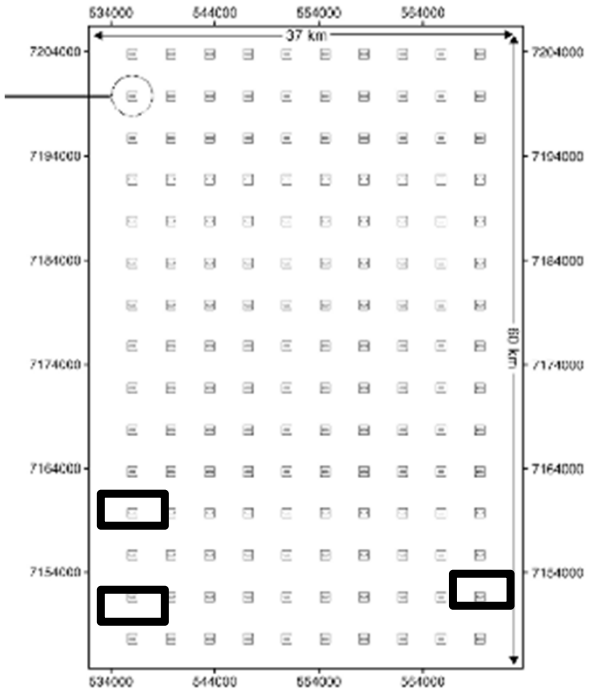
Cypess pine
(*C. glaucophylla*)

Smoothed barked apple
(Angophora leiocarpa)



Silver-leaved ironbark
(*E. melanaphloia*)

Sampling Strategy

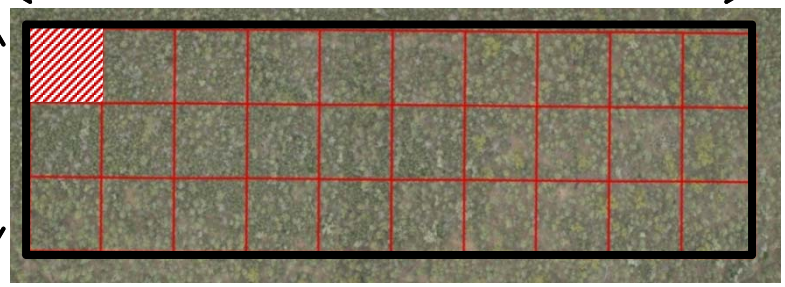


PSU

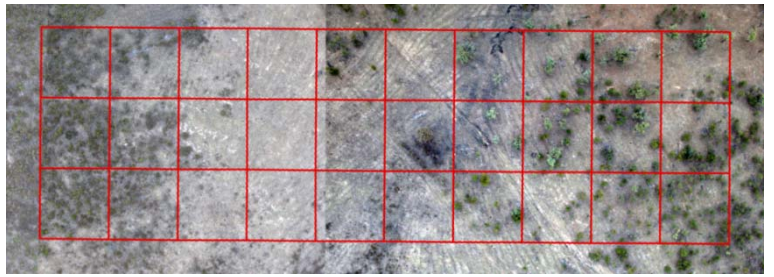
SSU

500 m

150 m



111



131

138

PSU	Dominant Specie	$\bar{x}$ Vegetation Height (m)	$\bar{x}$ FPC (%)	$\bar{x}$ Biomass (Mg/ha)
111	CP-SLI	10.26	48.4	110.34
131	BGL	3.64	5.9	8.55
138	SLI-CP	8.22	27.9	76.27

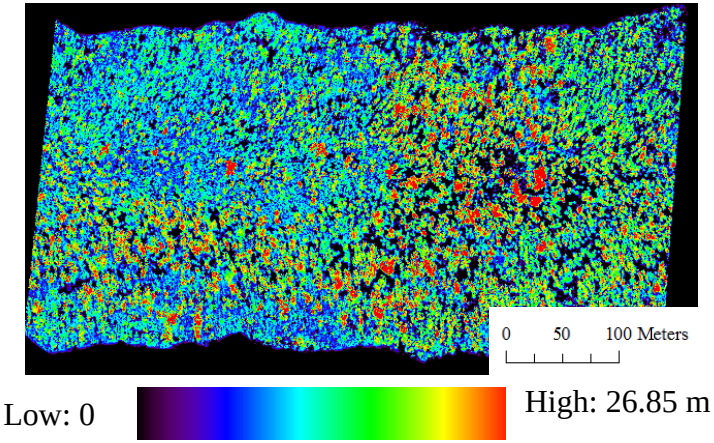
***From a combination of LiDAR and Large Scale Photography.**

AP (2009)

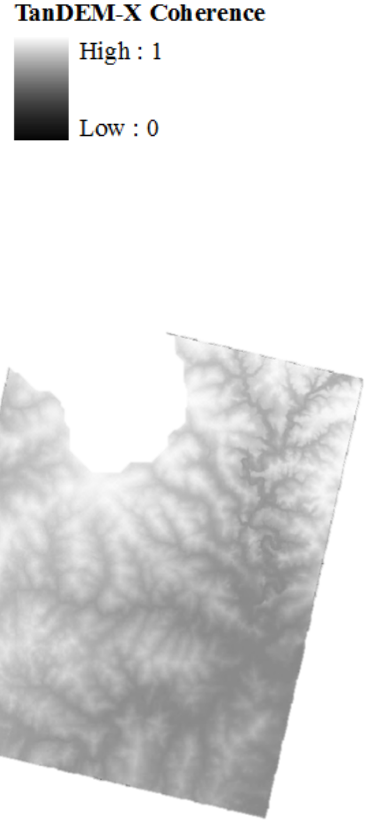
Datasets

Source	Sampling	Purpose
TanDEM-X (2011)**	5 m (coherence and DSM)	AGB-coherence regression Vegetation height estimates
LiDAR (2009)*	1 m	DTM and CHM for validation
LiDAR (2002)*	1 m	AGB
Ground Truth (2000)*	SSU level (50 x 50 m)	UTA model parameterization

LiDAR CHM (1 m)



Low: 0 High: 26.85 m



* Provided by R. Lucas and P. Bunting

**InSAR processing by SARMap ©

TanDEM-X Processing

Interferogram generation

↓

Adaptive Filter and Coherence Generation

↓

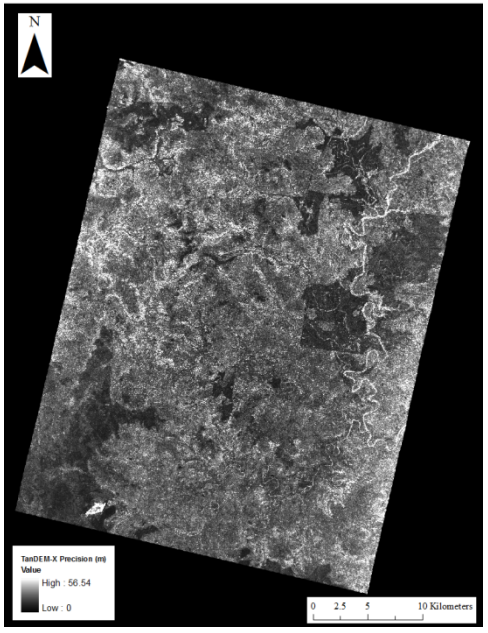
Phase Unwrapping

↓

Refinement and Reflattening

↓

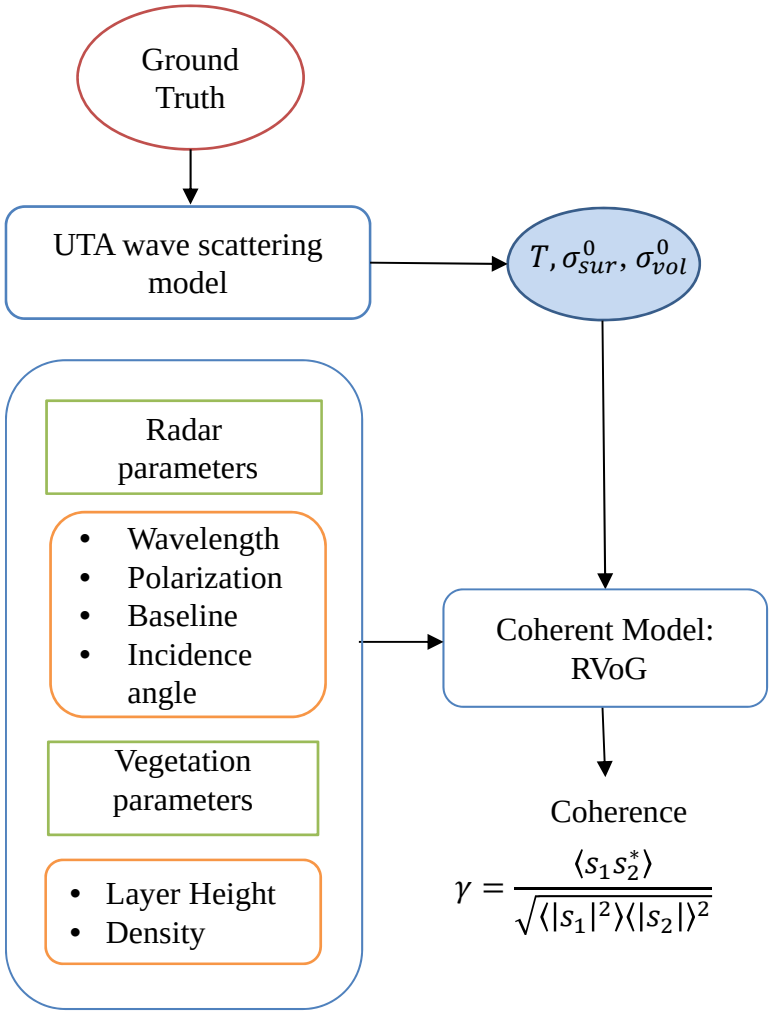
Phase to Height Conversion



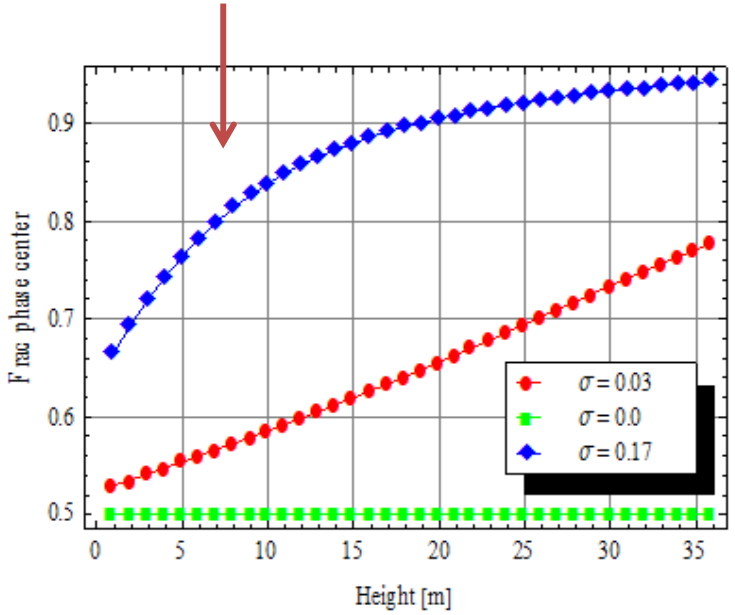
TanDEM-X DSM SE (Precision)

Modelling:

A Pre-requisite for the Experimental Analysis

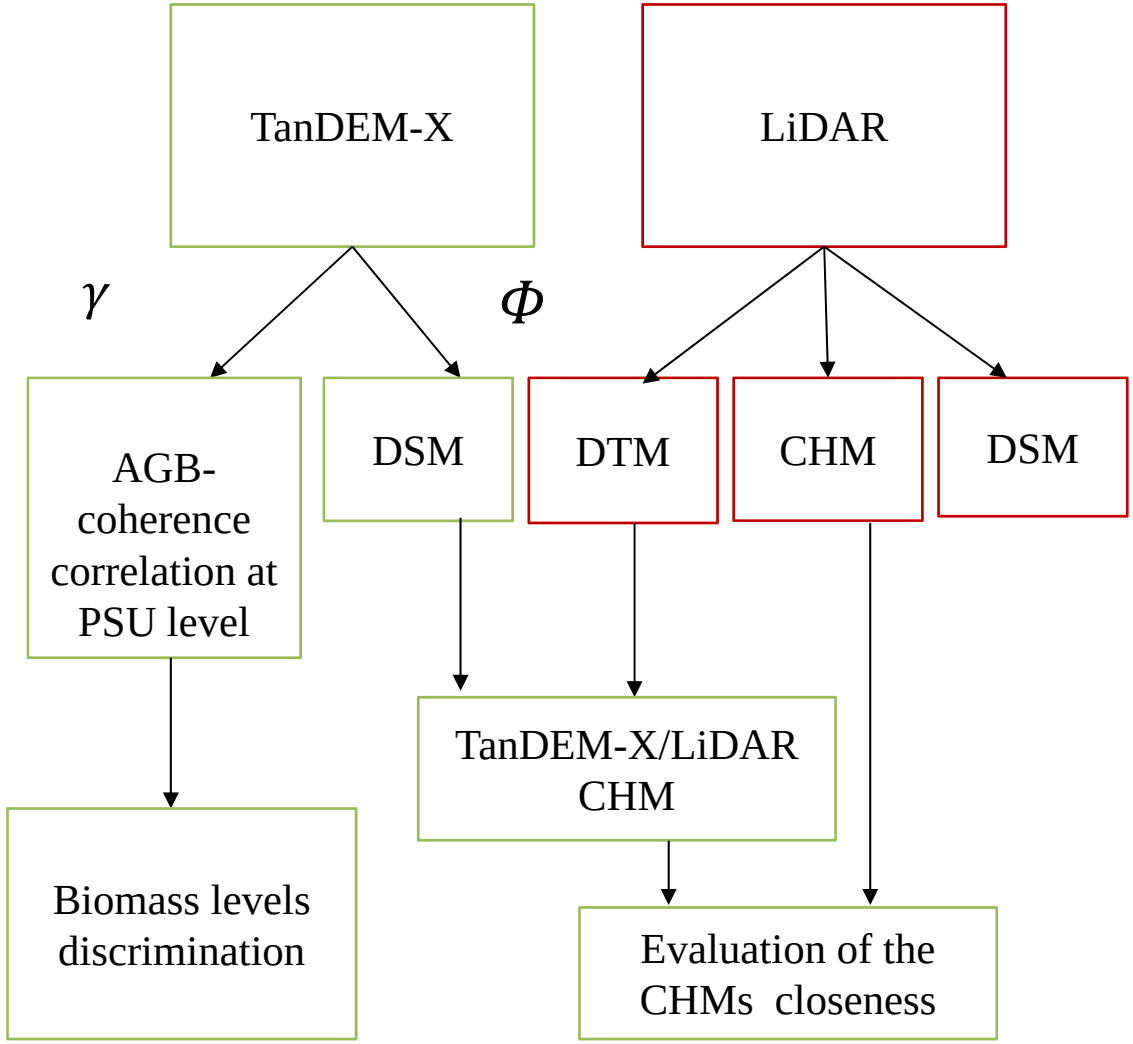


Fractional scattering phase center height



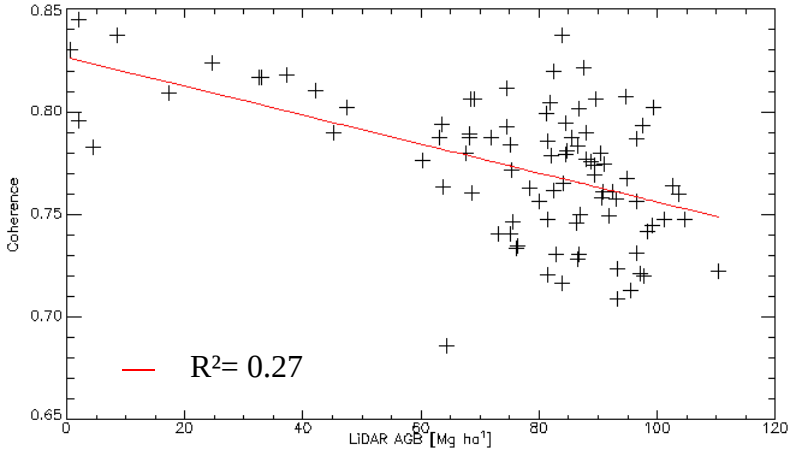
Fractional phase center height as a function of three different extinction factors (dB/m) and layer height (0 to 35 m).

Methods for the Experimental Analysis

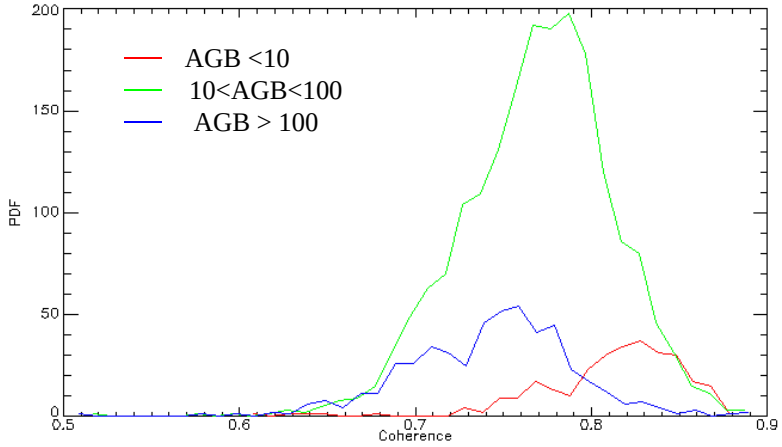


Biomass-Coherence Analysis

AGB-Coherence at PSU level

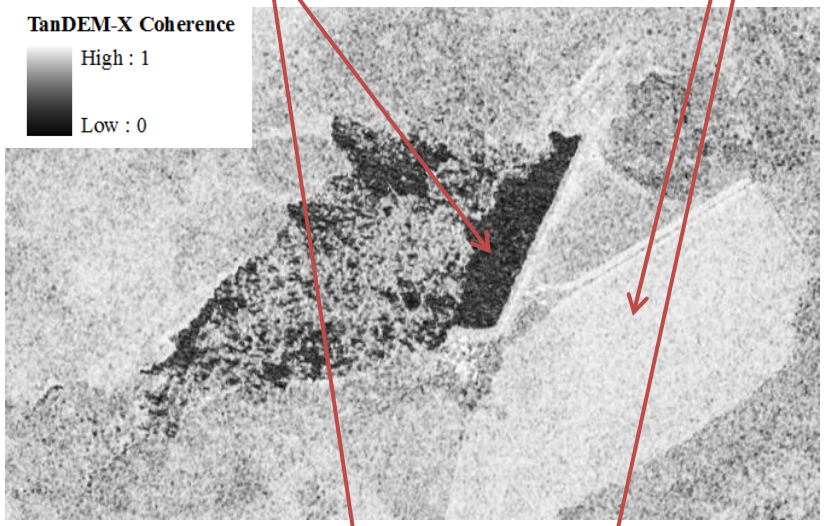


Histograms for three AGB classes (Mg/ha)

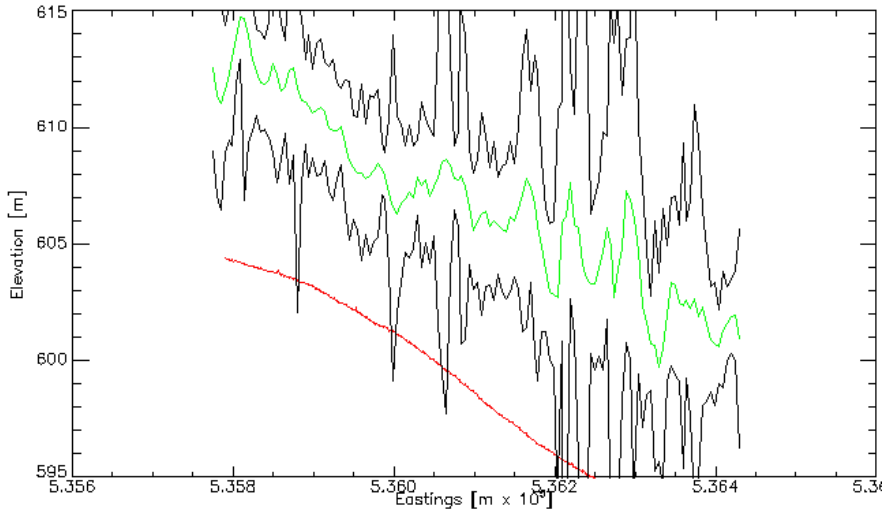


Disturbance
(low coherence)

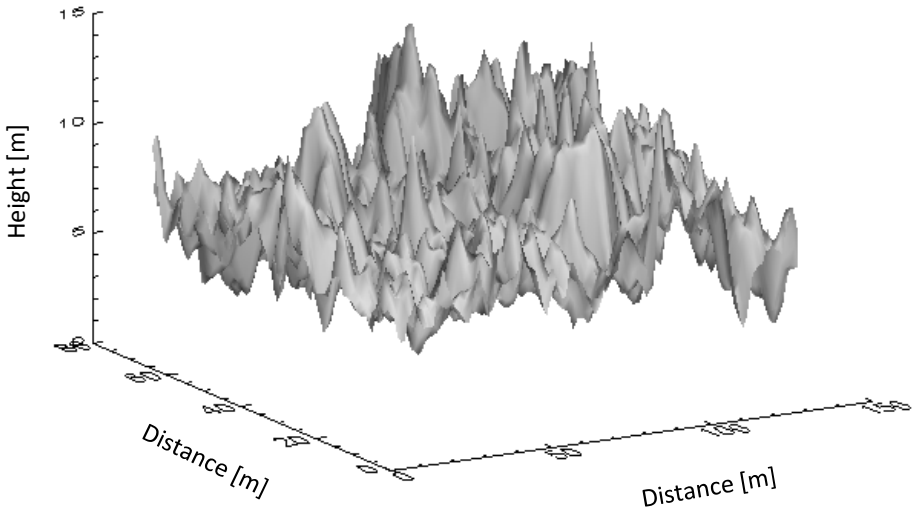
Clear cut
(high coherence)



TanDEM-X/LiDAR Canopy Height Model



TanDEM-X Digital Surface Model and LiDAR Digital Terrain Model (PSU 111)



TanDEM-X/LiDAR CHM 3-D reppresentation (PSU 111)

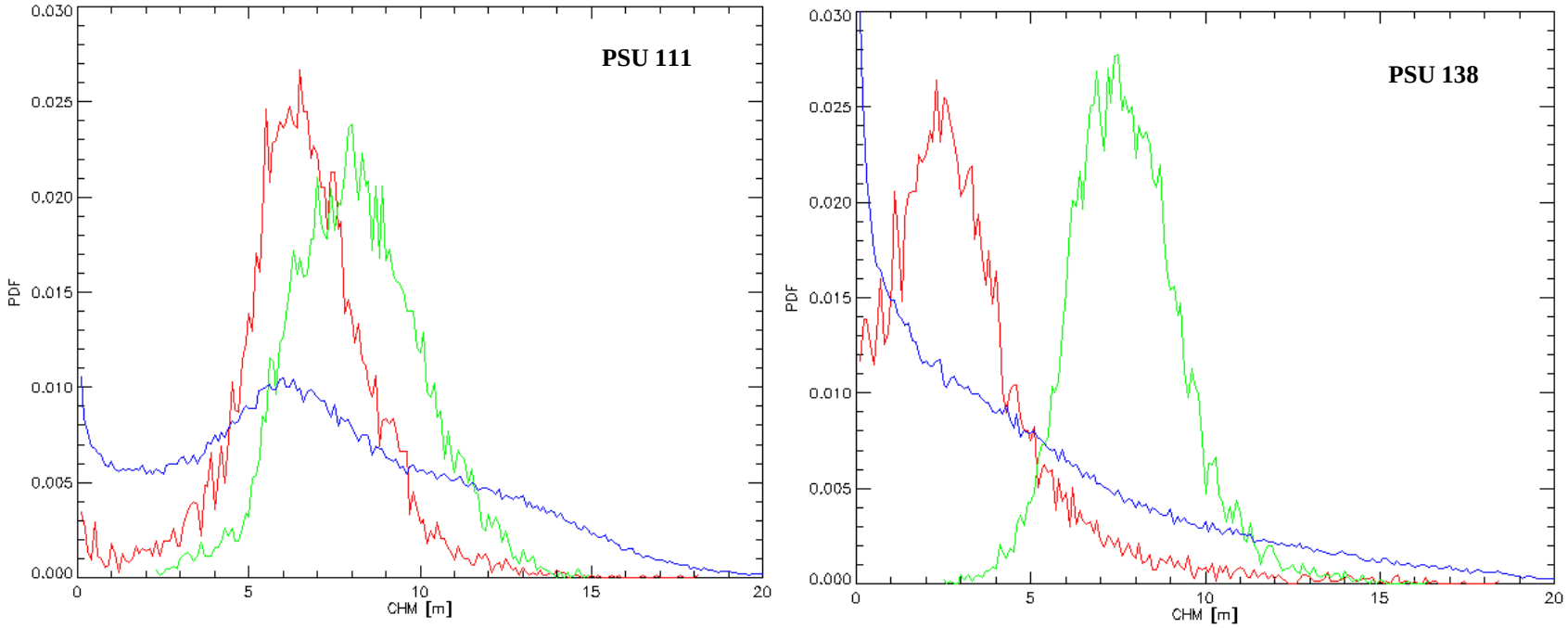
TanDEM-X DSM (5 m)

LiDAR DTM (1 m)

TanDEM-X Standard Error

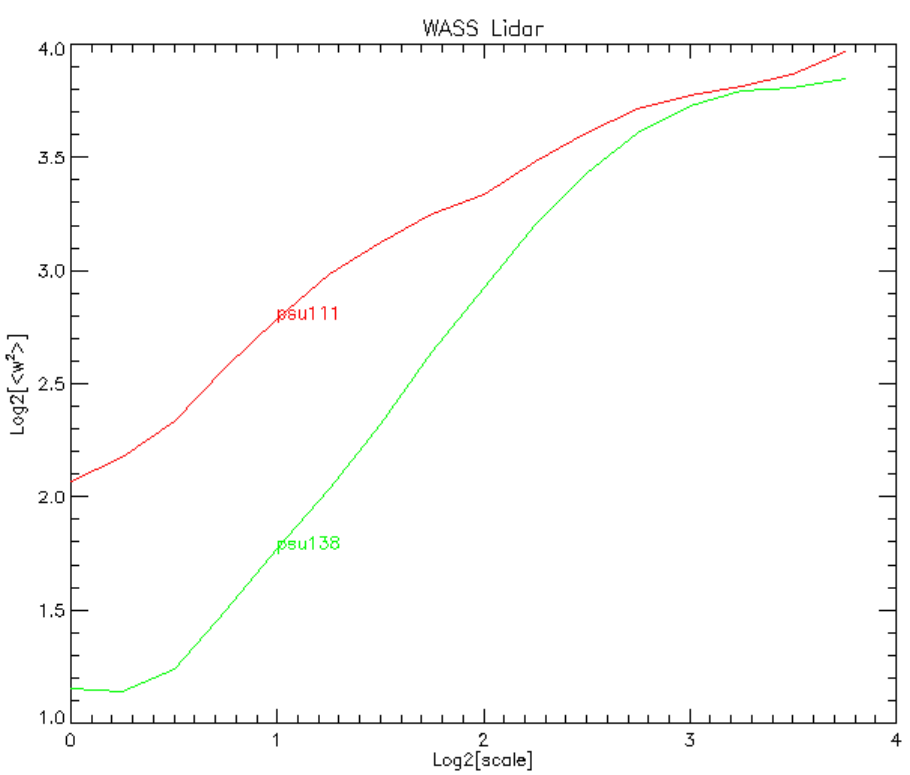
TanDEM-X and LiDAR CHMs Closeness Evaluation:

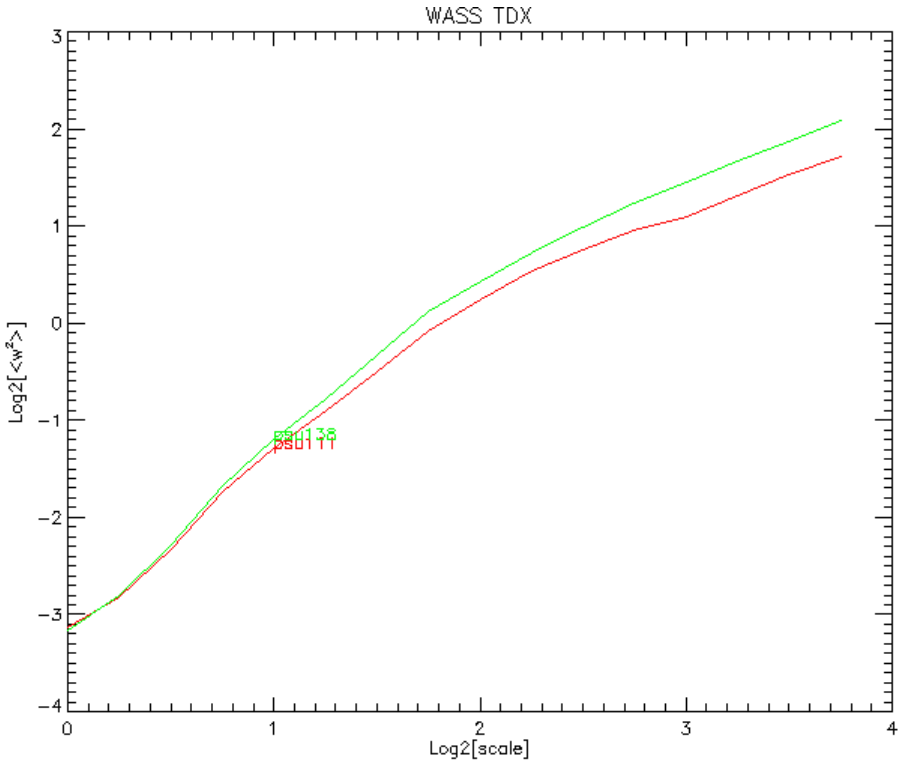
One-point Statistics (Probability Density Function)



TanDEM-X and LiDAR CHMs Closeness Evaluation:

Two-point Statistics (Structure Function)



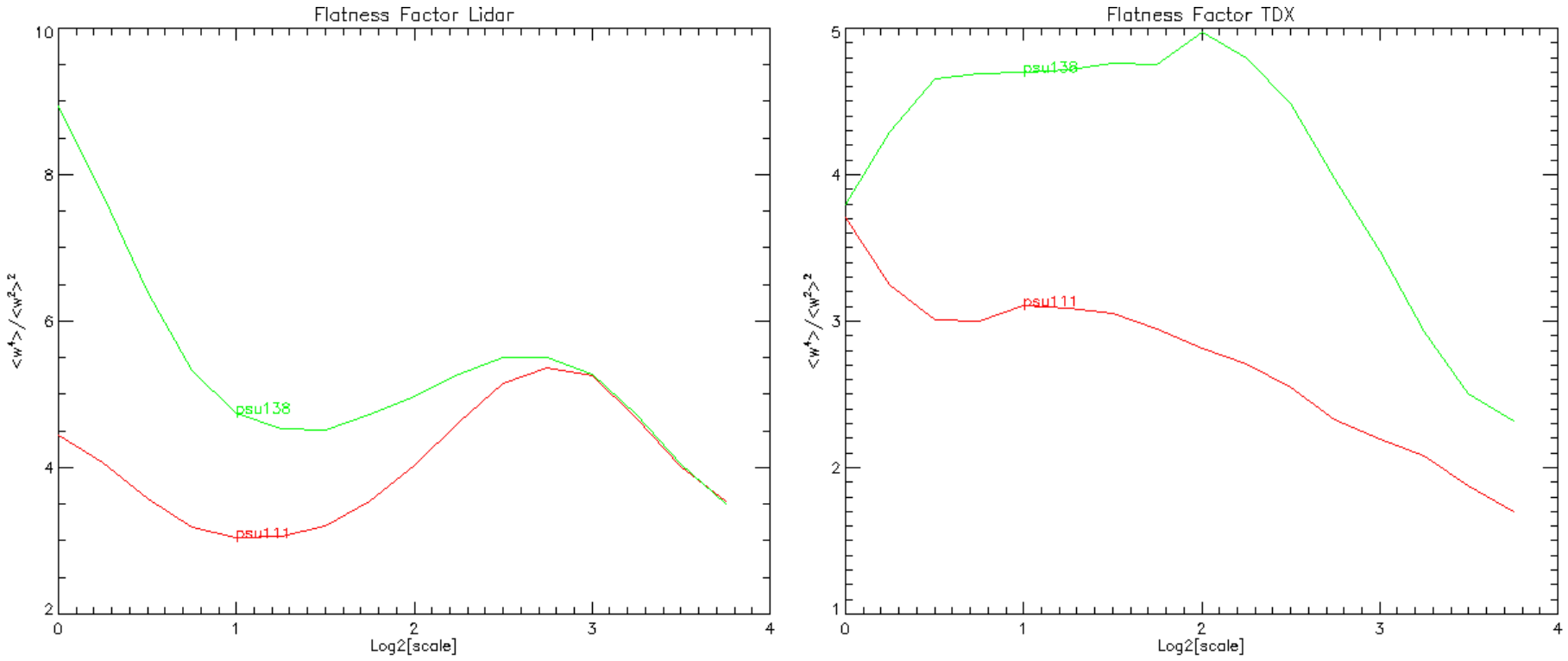


PSU 111

PSU 138

TanDEM-X and LiDAR CHMs Closeness Evaluation:

Two-point Statistics (Wavelet Flatness Factor)

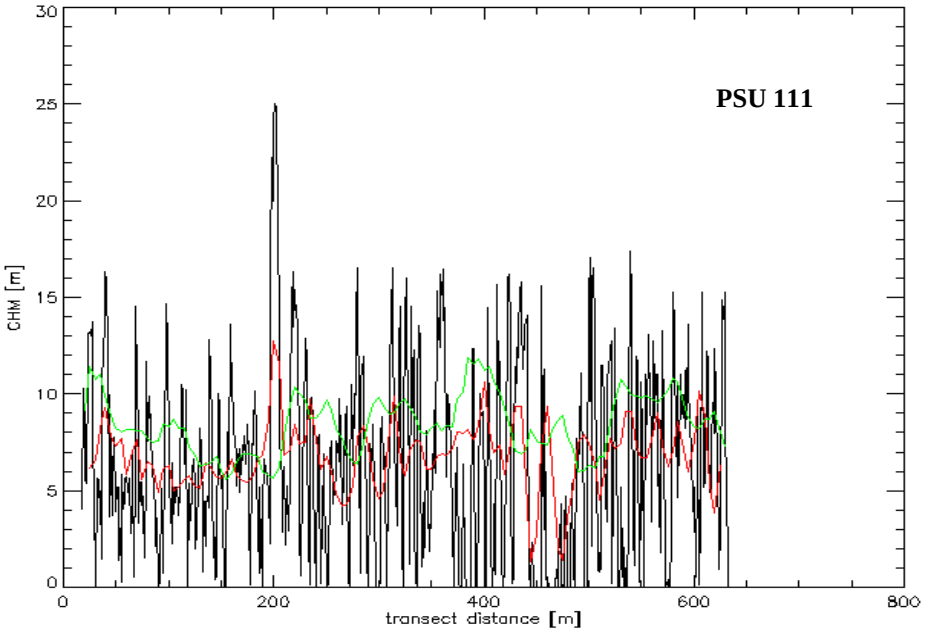


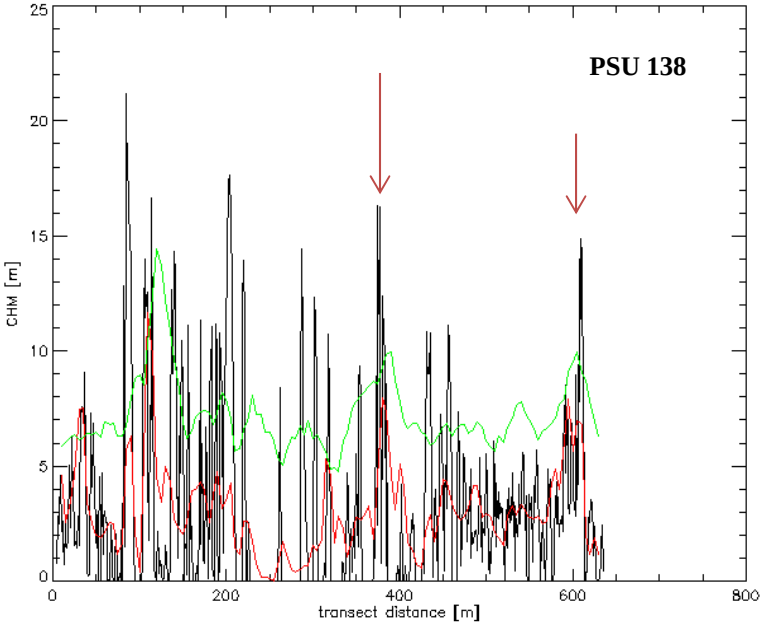
PSU 111

PSU 138

TanDEM-X and LiDAR CHMs Closeness Evaluation:

Profiles





LiDAR CHM (1 m)

TanDEM-X CHM (5 m)

LiDAR CHM (5 m)

Statistical Parameter	PSU 111	PSU 138
SE TDX height	3.6	3.3
LiDAR <height>	6.6	3.2
TDX <height>	8.1	7.8
Pearson Correlation	0.68	0.55
Wavelet Flatness (scale=0)	4.5	9.0
Wavelet Flatness =3 scale	2	16

Conclusions

- Weak correlation between AGB and coherence at PSU level.
- Coherence is not a 1:1 function of AGB being affected by other forest parameters. Coherence at X-band cannot be used to estimate AGB of an open forest.
- Vegetation height estimates at 5 m spatial sampling derived from the combination of TanDEM-X DSM and LiDAR DTM.
- Evaluation of CHMs closeness in statistical sense indicates that the distance between the two processes depends on the forest spatial distribution. This is due to different sensor's resolution and phase centers location.

Acknowledgments

I would like to thank:

- DLR
- TanDEM-X AO VEGE0330 Team
- sarmap SA
- ILCP researchers

Paper subimtted at IGARSS 2013:

“ANALYSIS OF TANDEM-X INSAR DATA AIMED AT THE CHARACTERISATION OF VEGETATION VERTICAL STRUCTURE: A CASE STUDY IN INJUNE (QUEENSLAND, AUSTRALIA)”