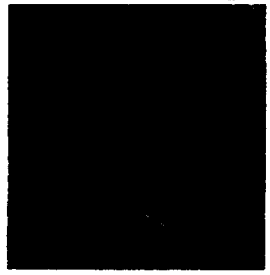
Analysis of Interferometric Radar Data in a Queensland, Australia Tropical Rain Forest



by

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Elaine Chapin, and Arnon Accad

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Presented at PIERS 99

March 23, 1999

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NASA/JPL AIRSAR RADAR

- NASA/JPL operates a multi-frequency fully polarimetric mapping radar onboard a DC-8 aircraft.
- Typically the radar flies at 8000 m (24000 ft) above the ground and collects data in swath about 10 km wide. The radar simultaneously collects data from multiple frequencies and is capable of making interferometric radar measurements.

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TOPSAR/AIRSAR Data Collected

- 3 pairs of flight lines were collected near Tully in northern Queensland over the same site with headings of 11° and 191°.
- Data was collected using C-band and L-band Ping-Pong TOPSAR modes and the polarimetric P-band mode.
- Multiple flight lines at P-band collected for repeat pass interferometry and classification studies.

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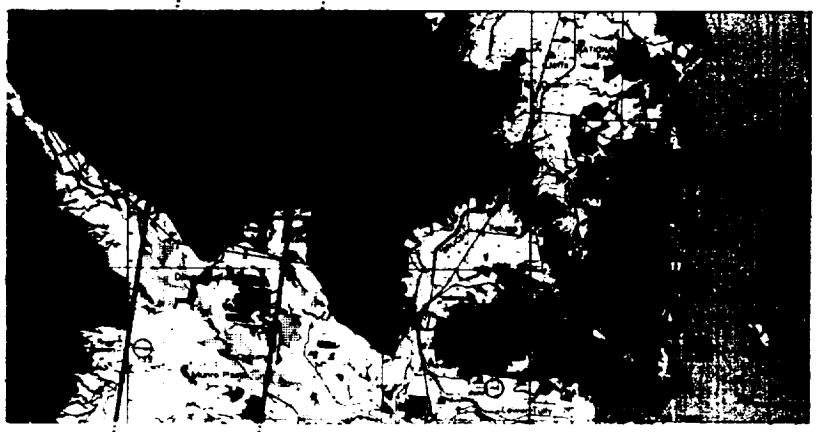
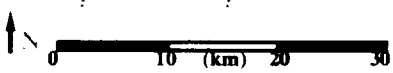
Tully Region





Region Mapped by Radar

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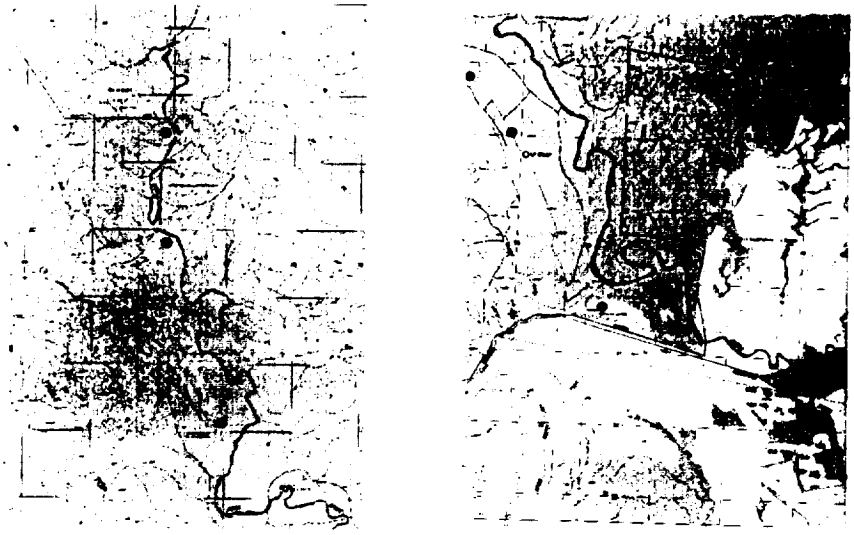
Tone Generator Locations



● Tone Generator Deployment

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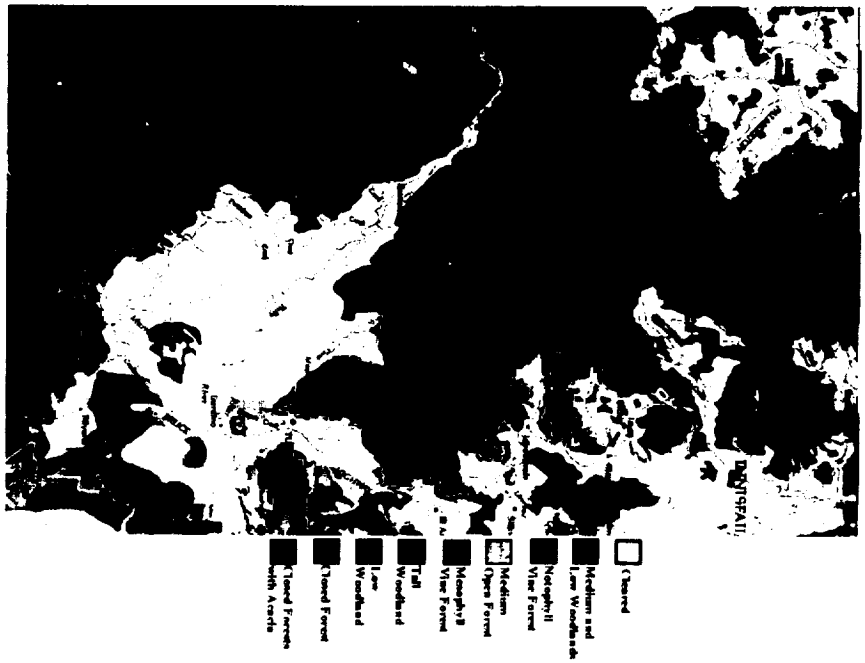

Wet Tropics Classification Map

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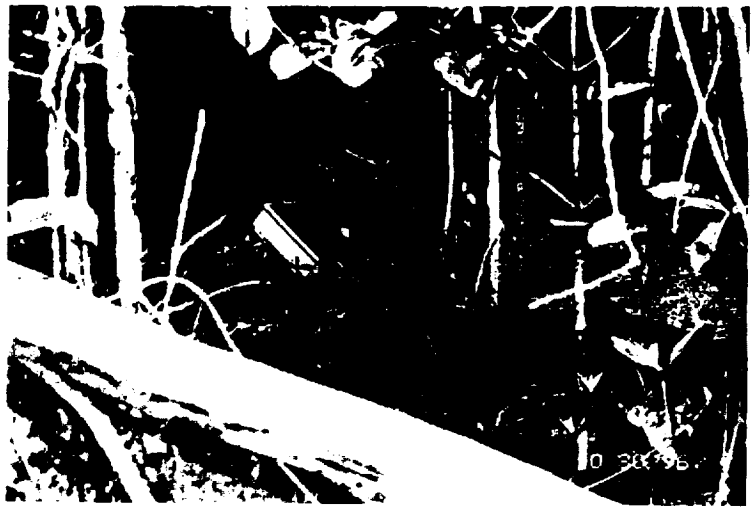
Typical Tone Generator Deployment



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Earles Court

- Trees varied from 15 - 25 m surrounding clearing in forest at Earles Court.

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Medium Density Canopy

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Ground and Crown of Low Density Canopy

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Thick Canopy

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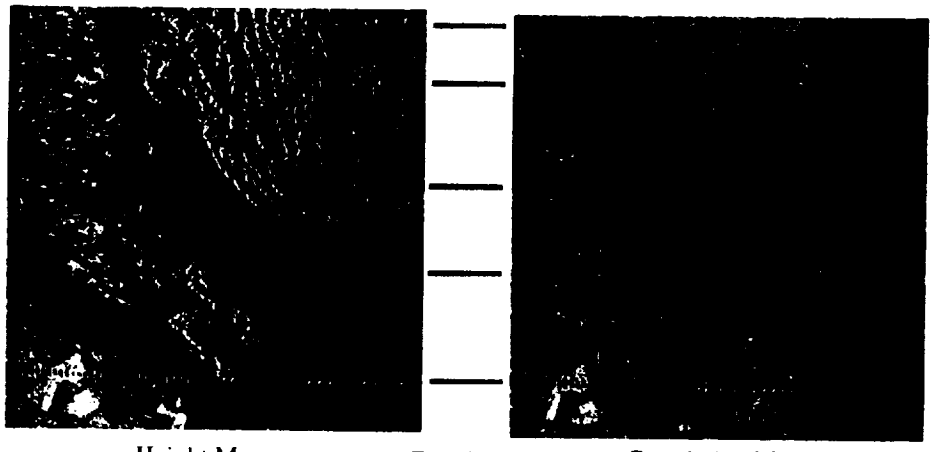
C-band Tone Generator Detection



Height Map — Tone Generator — Correlation Map

- Five C-band Tone Generators were deployed and all five were detected even in locations with 80% canopy closure.

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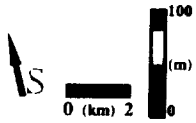
Height Maps - Before and After RFI Removal
Innisfail L-Band Ping-Pong Data

Before RFI (Tone Generators) Removal

After RFI (Tone Generators) Removal



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Cleared Region Amplitude Images

C-band Amplitude Image

L-band Amplitude Image

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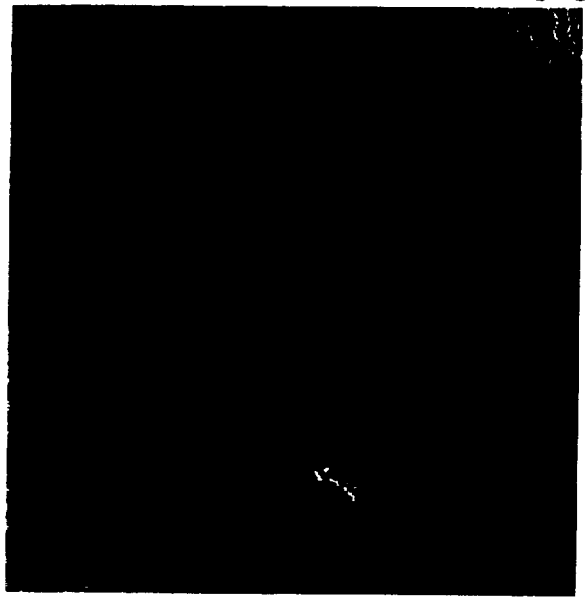
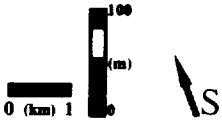
Cleared Region C-band Topographic Map



Very flat agricultural area with readily discernible elevation differences due to vegetation along drainages and in some cultivated areas.



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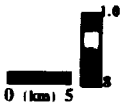
Cleared Region Correlation Maps

C-band Ping-Pong Correlation

C-band TOPSAR Correlation

L-band Ping-Pong Correlation

- Correlation maps used to derive penetration estimates. Note the correlation is strongly linked the vegetation in the scene.



L-Band - C-Band TOPSAR Heights in Cleared Region

- Height difference of L-band Ping-Pong with C-band Ping-Pong heights in area south of Tully site.
- Vegetation is this area is mostly agricultural (sugar cane) with sporadic tree growth.
- Mean height difference in vegetated region is approximately 0 m except in vegetated areas.

"Tree Height" Estimated from Correlation For Cleared Region

- Tree height is scaled standard deviation from correlation estimates to give rough vegetation height estimate.
- Vegetation is this area is mostly agricultural (sugar cane) with sporadic tree growth.
- Mean vegetation height in vegetated areas is approximately 5 m.

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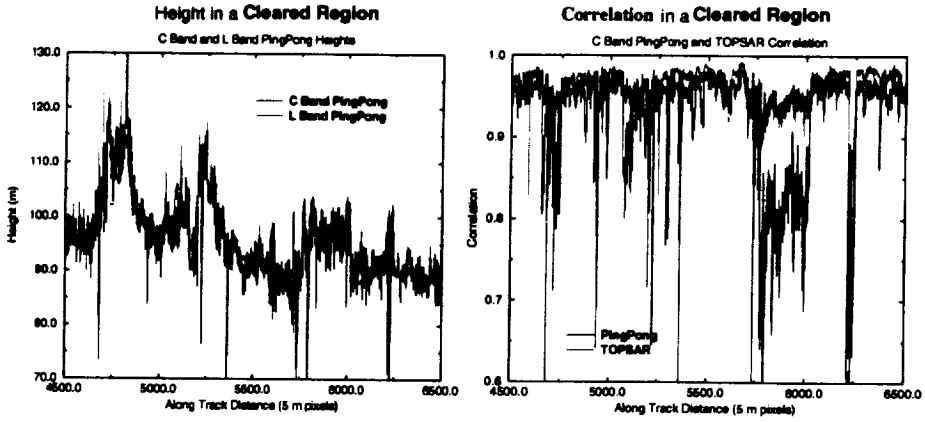
Height and Correlation Comparisons for Cleared Region



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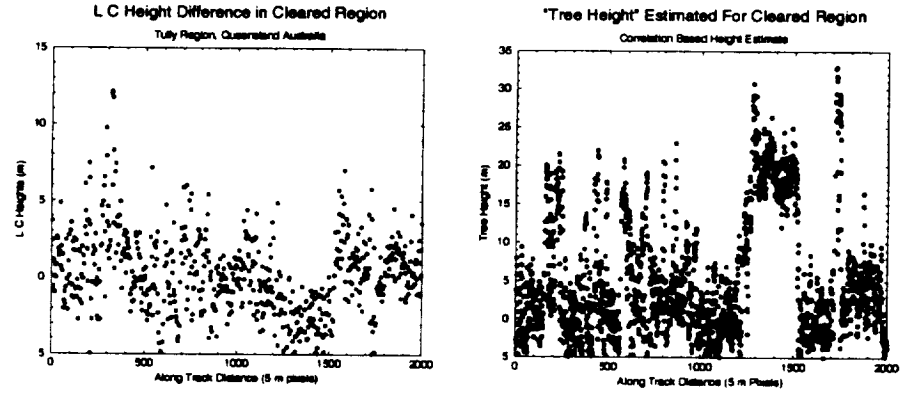
Penetration and Tree Height Estimates for Cleared Region



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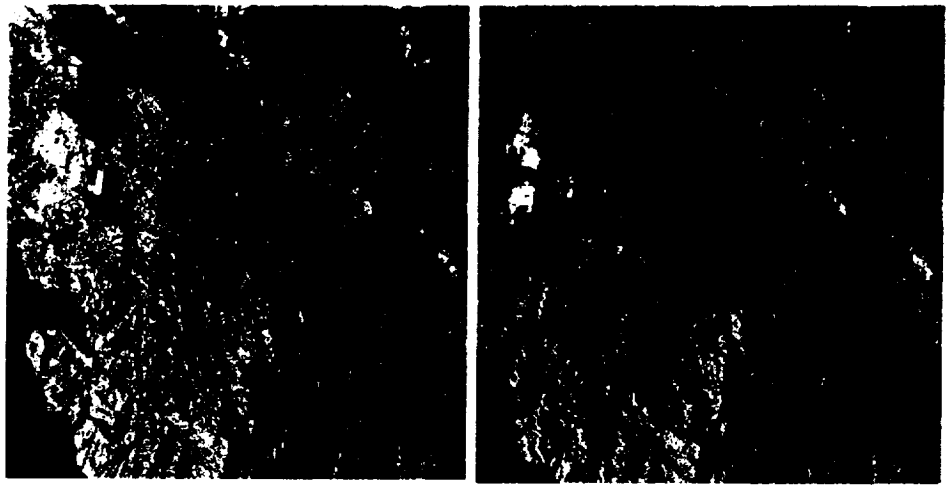
Tropical Forest Amplitude Images



C-band Amplitude Image

L-band Amplitude Image

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Tropical Region C-band Topographic Map

Dense tropical forest with relatively flat area along Jarra Creek between the Table Top and Walter Hill Ranges. Although these ranges are of modest elevation the average slope is quite large in some areas.

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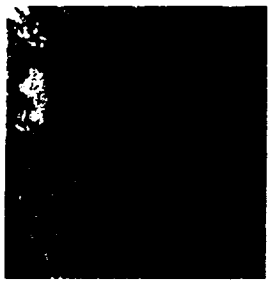
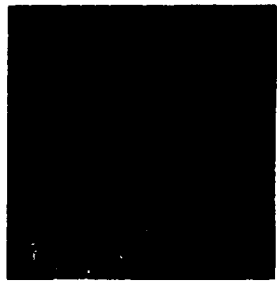
Tropical Forest Correlation Maps



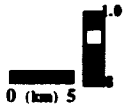
C-band Ping-Pong Correlation

C-band TOPSAR Correlation



L-band Ping-Pong Correlation

- Correlation maps used to derive penetration estimates. Note the correlation is strongly linked the vegetation in the scene.



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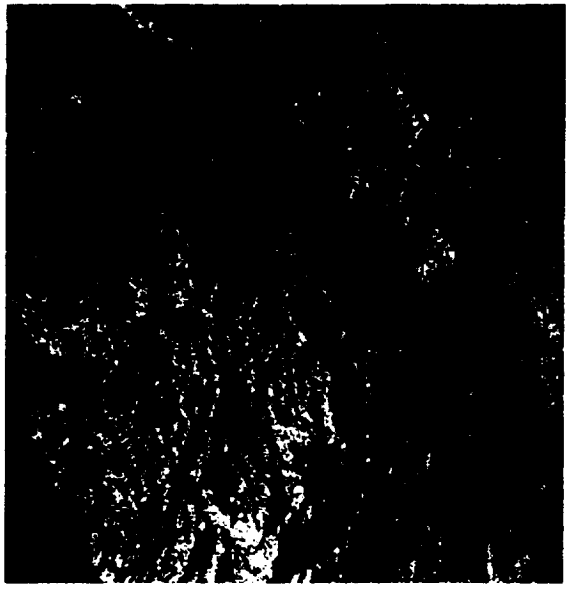
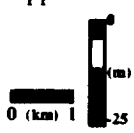
L-Band - C-Band TOPSAR Heights in Tropical Forest



- Height difference of L-band Ping-Pong with C-band Ping-Pong heights at the Tully site.
- Vegetation height in this area varies from 25-35 m.
- Area covered by multi-layered dense tropical forest.
- Mean height difference in vegetated region is approximately 3 m.



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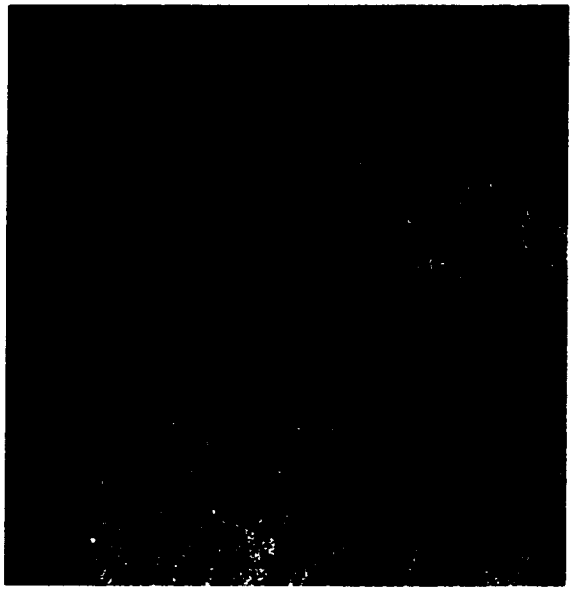
"Tree Height" Estimated from Correlation For Tropical Forest



- Tree height is scaled standard deviation from correlation estimates to give rough vegetation height estimate.
- Vegetation is this area is tropical rain forest where tree heights range from 25-35 m.
- Mean vegetation height in vegetated areas is approximately 20 m.

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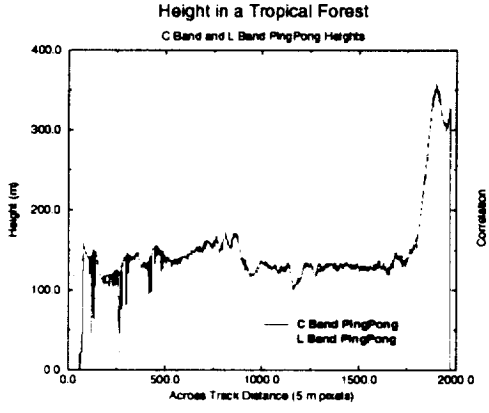
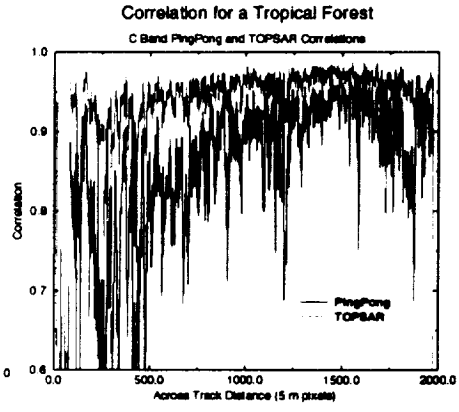
Height and Correlation Comparisons for Tropical Forest





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Penetration and Tree Height Estimates for Tropical Forest