REMOTE SENSING RESEARCH FOR SPATIAL ASSESSMENT OF WOODY STRUCTURE IN AFRICAN SAVANNAHS & WOODLANDS – PAST, ON-GOING, AND FUTURE WORK BY THE CSIR

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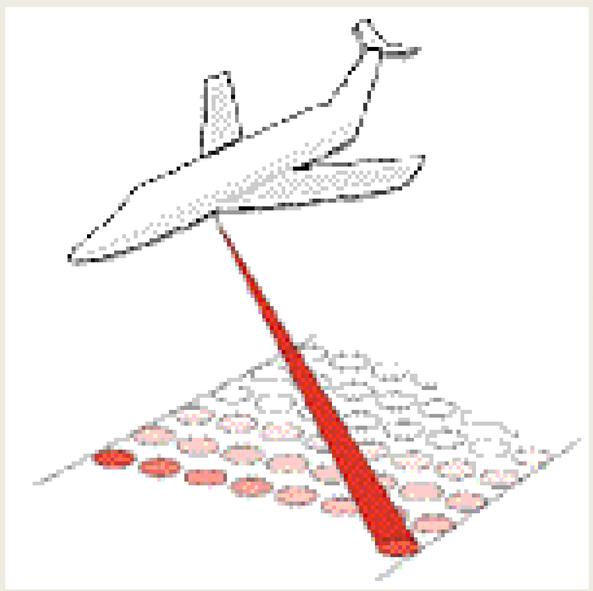
Introduction:

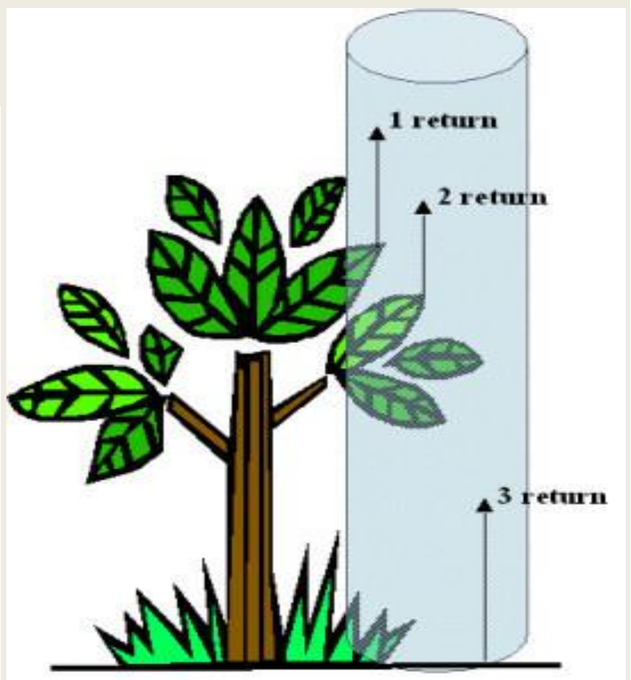
- Appropriate techniques are needed to monitor woody vegetation cover, biomass and carbon stocks
- Important for energy security of rural communities in Africa, climate change & REDD+ program, & ecosystem processes
- Light Detection and Ranging (**LiDAR**) & Synthetic Aperture Radar (**SAR)** interact with vegetation morphology and structure
- Aim: To assess and demonstrate the available remote sensing techniques, implemented in recent CSIR research, which can be utilized to map vegetation structural parameters at various scales

Box 1: LiDAR (Laser altimeter)

- Emits highly repeating laser pulse of given size or footprint and time resolution (discrete vs waveform)

- Based on laser returns detailed structural information can be attained on vegetation structure:
  - Tree height (from Digital Surface & Ground Models)
  - Canopy shape & architecture
  - Woody cover
  - Vertical tree profiles (from pseudo-voxel analysis) (*Asner et al, 2007*)
  - Biomass models

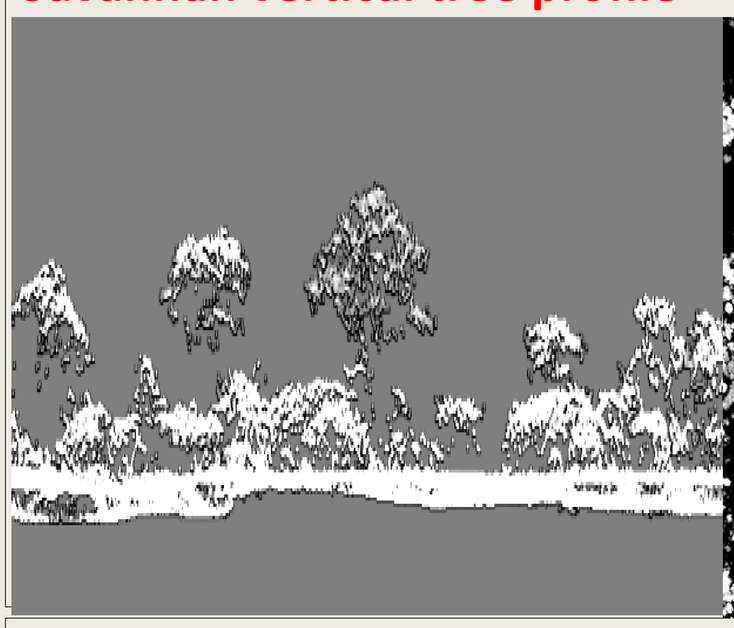




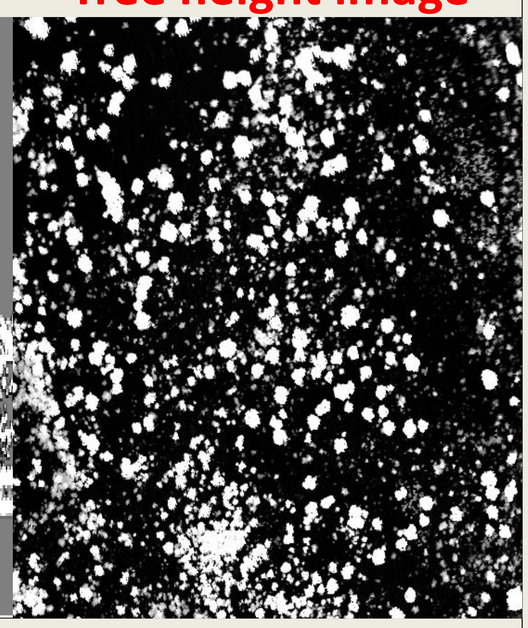
Box 2: LiDAR Studies and Examples

- The change in vegetation structure resulting from rural resource extraction was investigated by *Fisher et al (2009)* and *Wessels et al (2009)*

Savannah vertical tree profile

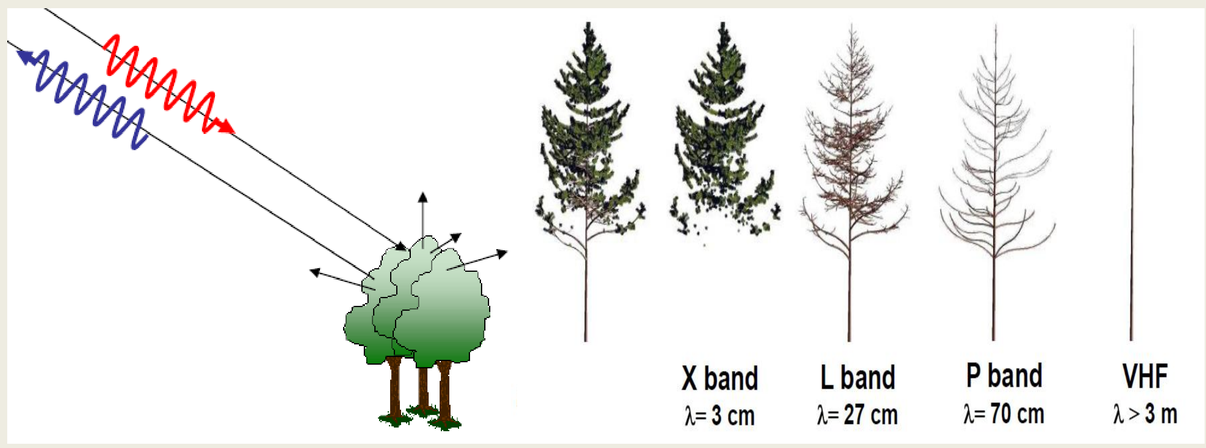


Tree height image



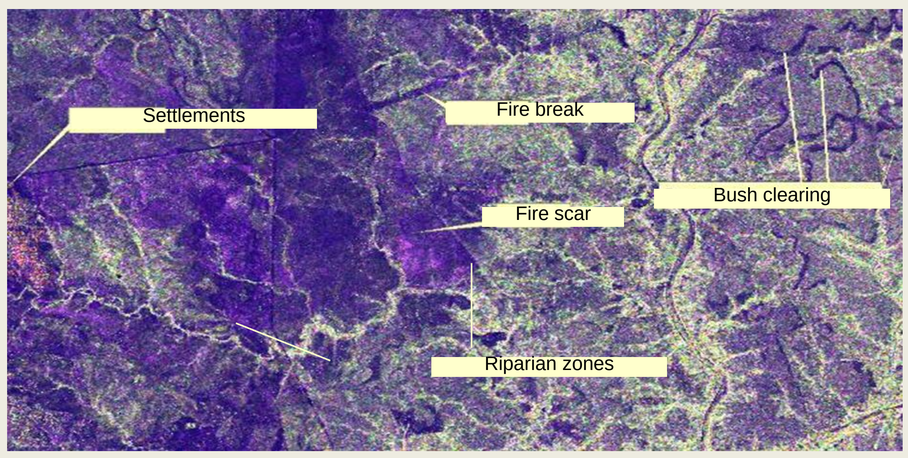
Box 3: SAR, Products & Studies

- E.g. of spaceborne satellites: RADARSAT 1-2; ENVISAT-ASAR; ALOS-POLSAR & TerraSAR-X



- Permits the usage of various analytical techniques:
  1) Interferometry (allows accurate measure of distance in the landscape e.g. tree height)
  2) Multi-frequency polarimetry (allows investigation of vegetation structure e.g. biomass) *Le Toan (2007)*

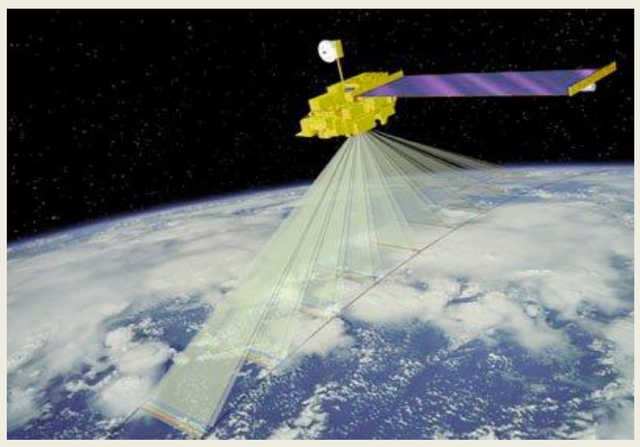
Multi-polarized RADARSAT-2 C-Band Image



- *Mathieu et al (2010)* assessed the potential of polarimetric C-band RADARSAT-2 data to map woody features in South African savannas across different seasons

Box 4: Multi-angle optical technique

- E.g. Coarse scale Multi-Angle Imaging Spectro-radiometer
- Use Bidirectional Reflectance Distribution Function principles and multi-angle view points of several cameras on board of satellite (forward, nadir, backward) to extract structure



Conclusions:

- Appropriate technology and guidelines still need to be researched to move one step closer towards the development of woody structure products for effective savanna & woodland management
- This research is on-going and is a key area of interest for the CSIR Ecosystems Earth Observation unit

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