Quantifying fuelwood biomass in savanna woodlands of southern Africa

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1. Presentation Outline

- ❖ Bioenergy in low-income communities
- ❖ Rationale for quantifying fuelwood
- ❖ Spatial data for biomass estimation
  - ❖ Terrestrial
  - ❖ Remotely sensed
- ❖ Implications for African savanna woodlands
- ❖ Concluding Remarks

Bioenergy in low-income communities

Rural domestic energy demands

2 km from village   1 km from village

Bioenergy in low-income communities

## Urban biomass energy demands

Rationale for quantifying fuelwood

❖ Domestic energy demand and supply
  ❖ Current power shortages in the SADC region
  ❖ Modern energy supply to low-income communities is usually second priority
  ❖ Pressure on woodland resources - both rural and peri-urban

❖ Millennium Development Goals
  ❖ Sustainable environmental management

❖ Quantitative data on standing biofuel stocks
  ❖ **Selective exploitation** of fuelwood resources
  ❖ Move from qualitative to quantitative data
  ❖ Improve decision-making processes

❖ Improvement of biomass assessment methodologies

Spatial data for biomass estimation

Terrestrial data

- ❖ Field surveys
- ❖ GPS data
  - ❖ Reference frameworks

Viergever *et al*, 2006
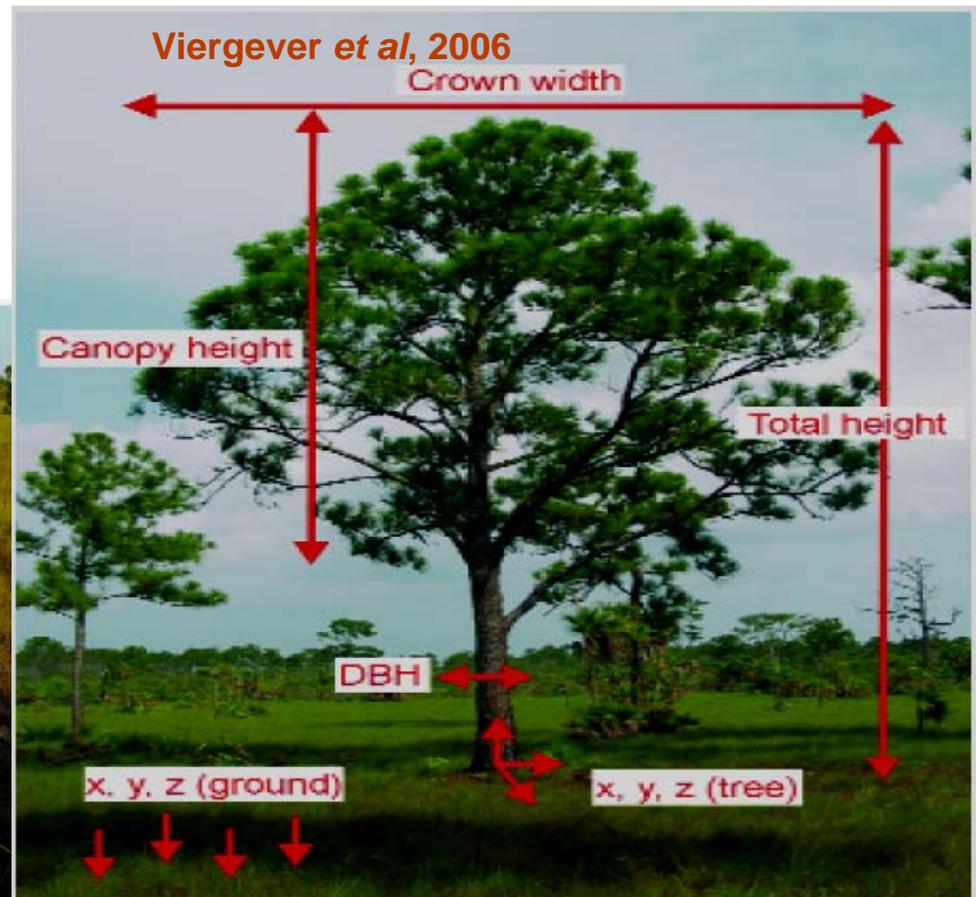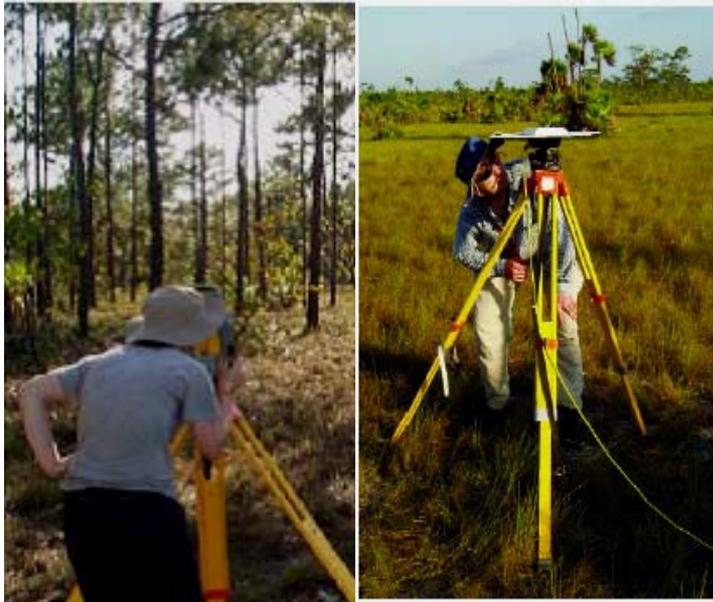
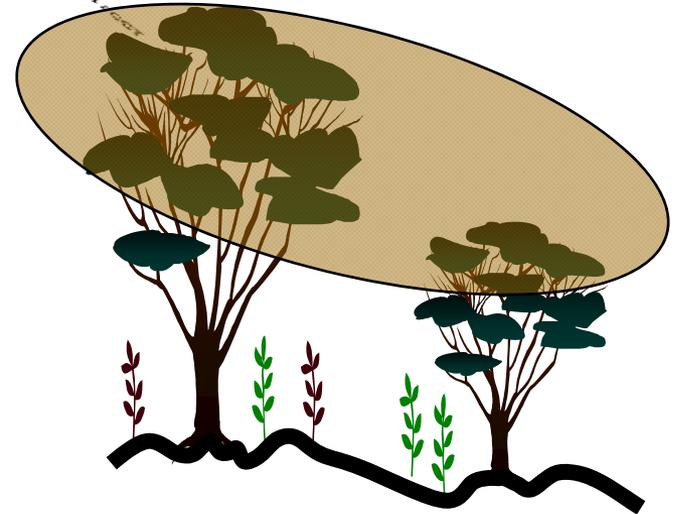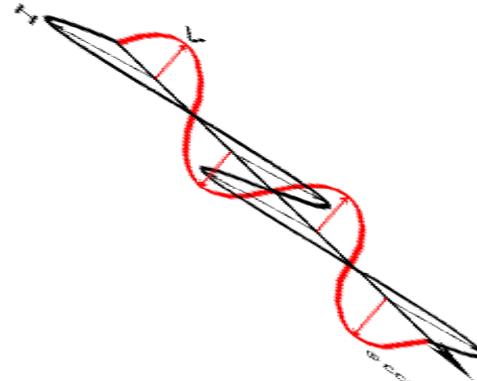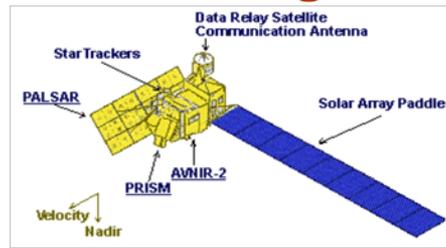# Spaceborne optical data for biomass estimation

Capabilities

- ❖ High to coarse resolution data available commercially e.g. Quickbird, MODIS, AVHRR
- ❖ Vegetation change detection (NDVI for biomass estimates when tree densities are known)
- ❖ High resolution digital elevation models
- ❖ Possibility of data fusion with different spatial resolutions

Limitations

- ❖ Cloud cover and atmospheric conditions
- ❖ Spectral resolution problems to discriminate and classify mixed vegetation
- ❖ Charcoal makers and fuelwood collectors target certain trees for their calorific values
- ❖ Cannot detect under-storey vegetation

Observing standing biomass using radar sensor
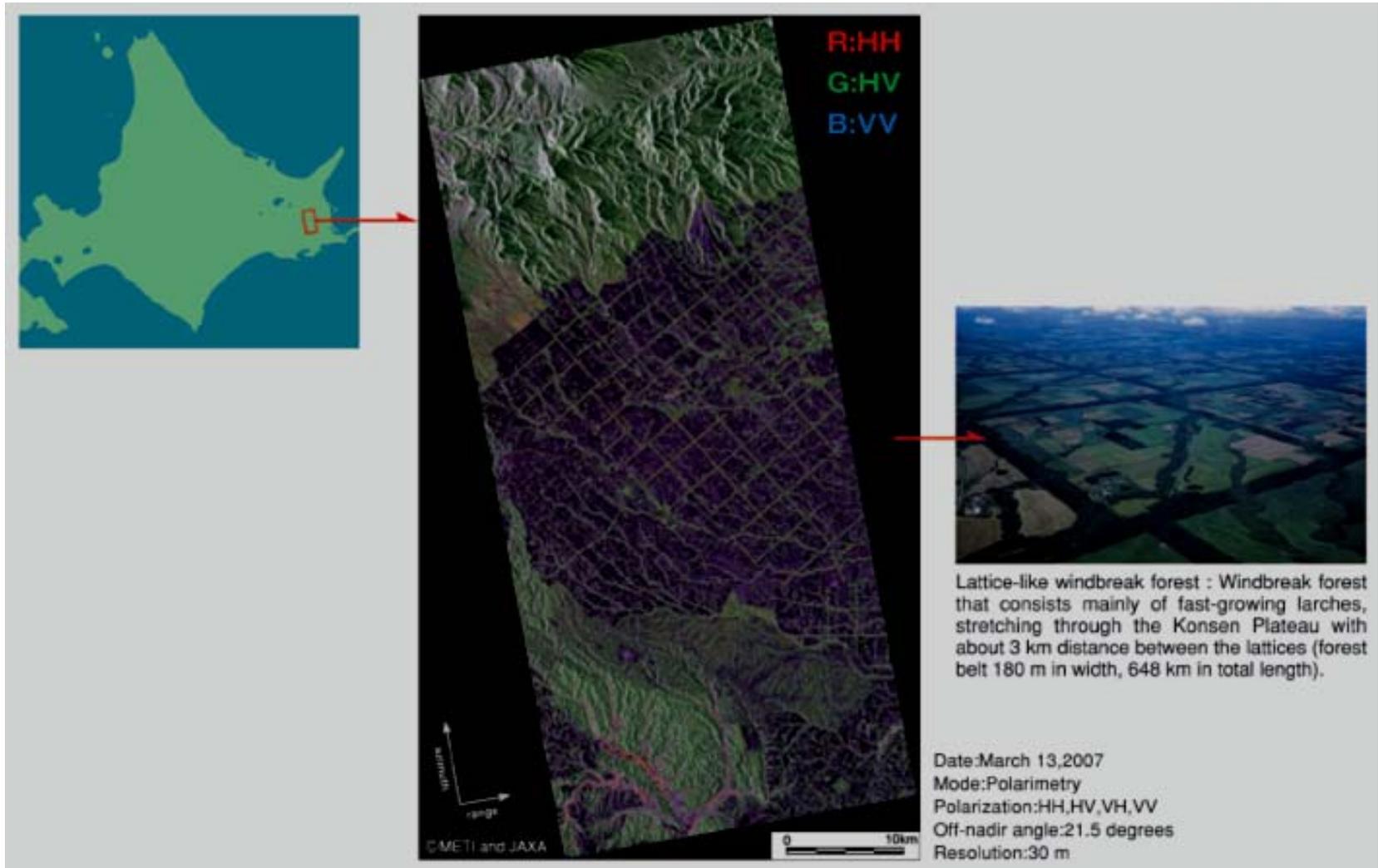
Spaceborne radar data for biomass estimation

Capabilities

❖ Polarimetry and Interferometry
  ❖ Tree heights and canopy densities

❖ Polarization signatures

❖ Radar platforms commercially available e.g. ALOS PALSAR, TerraSAR-X

❖ Biomass saturation levels of over 200 t ha $^{-1}$ well above savanna levels of 70 t ha $^{-1}$

Limitations
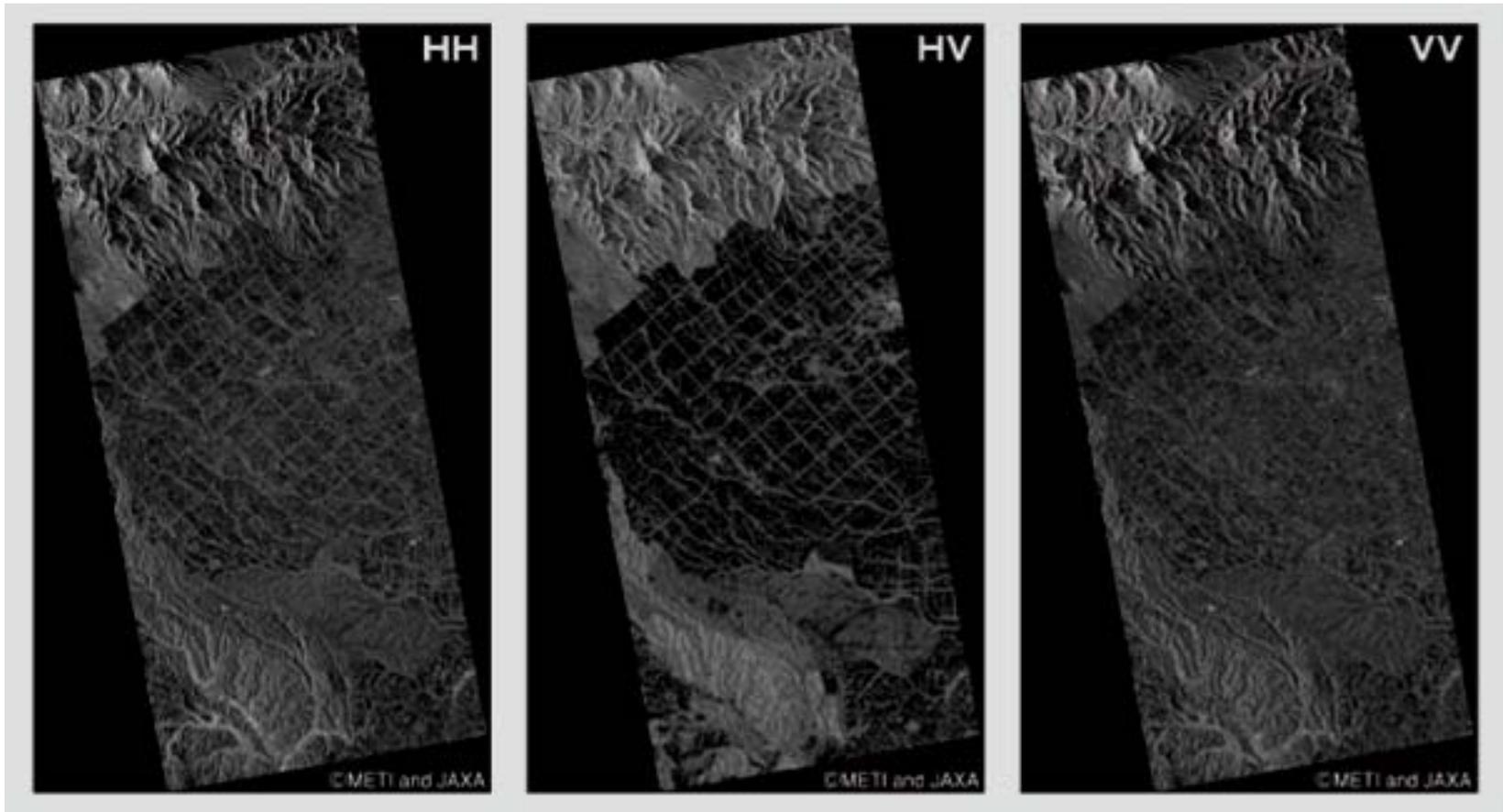
❖ Emerging discipline – steep learning curves

❖ Radar images are characteristically different from optical images

❖ Require corner reflectors for accurate georeferencing

❖ different wavelengths interact with different parts of the trees structures

R:HH
G:HV
B:VV

Lattice-like windbreak forest : Windbreak forest that consists mainly of fast-growing larches, stretching through the Konsen Plateau with about 3 km distance between the lattices (forest belt 180 m in width, 648 km in total length).

Date:March 13,2007
Mode:Polarimetry
Polarization:HH,HV,VH,VV
Off-nadir angle:21.5 degrees
Resolution:30 m

C:METI and JAXA

0   10km
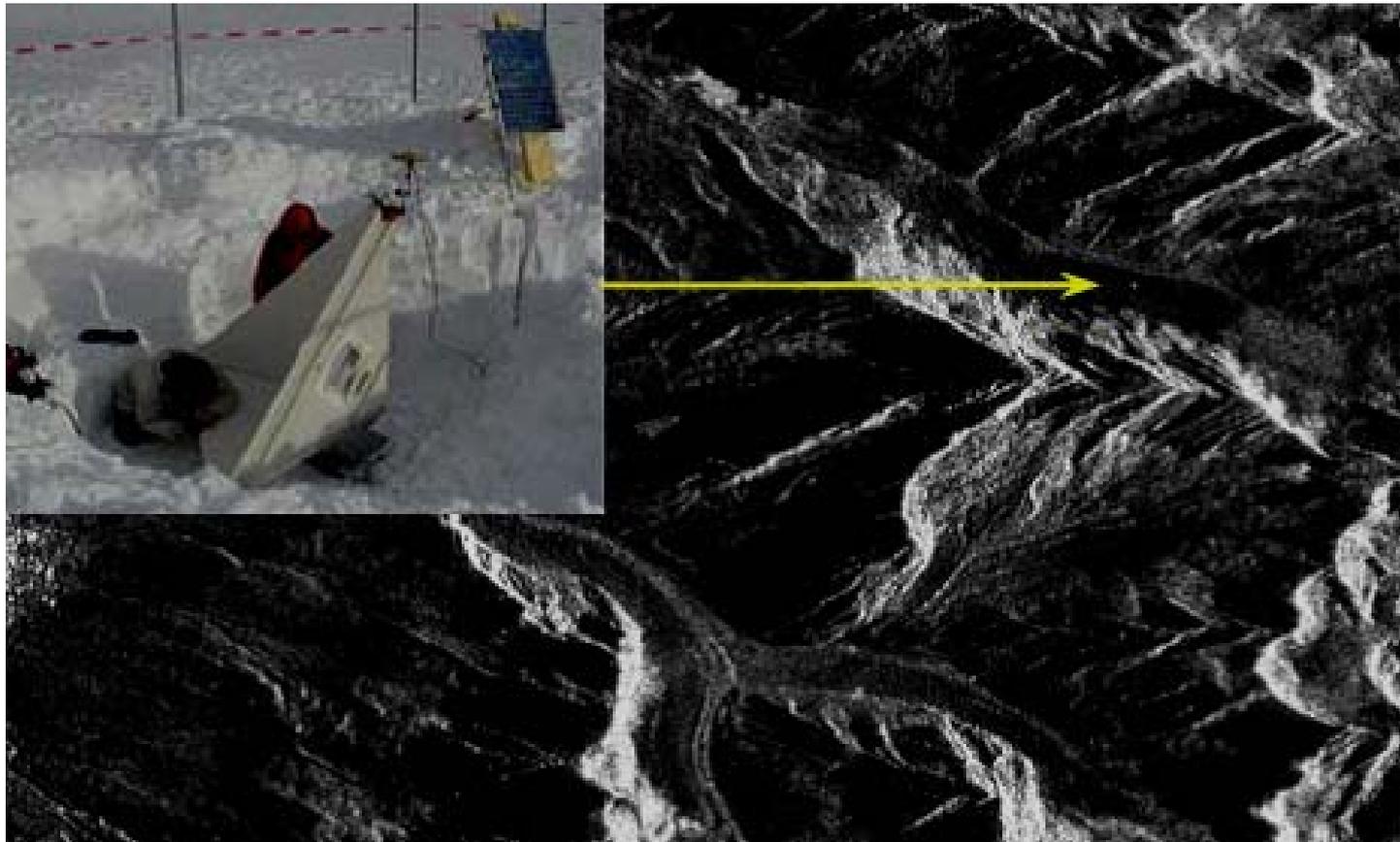
ERCDAC 2007
PALSAR Finebeam Mode

ERCDAC 2007, ScanSAR Mode

©METI and JAXA

Corner Reflector

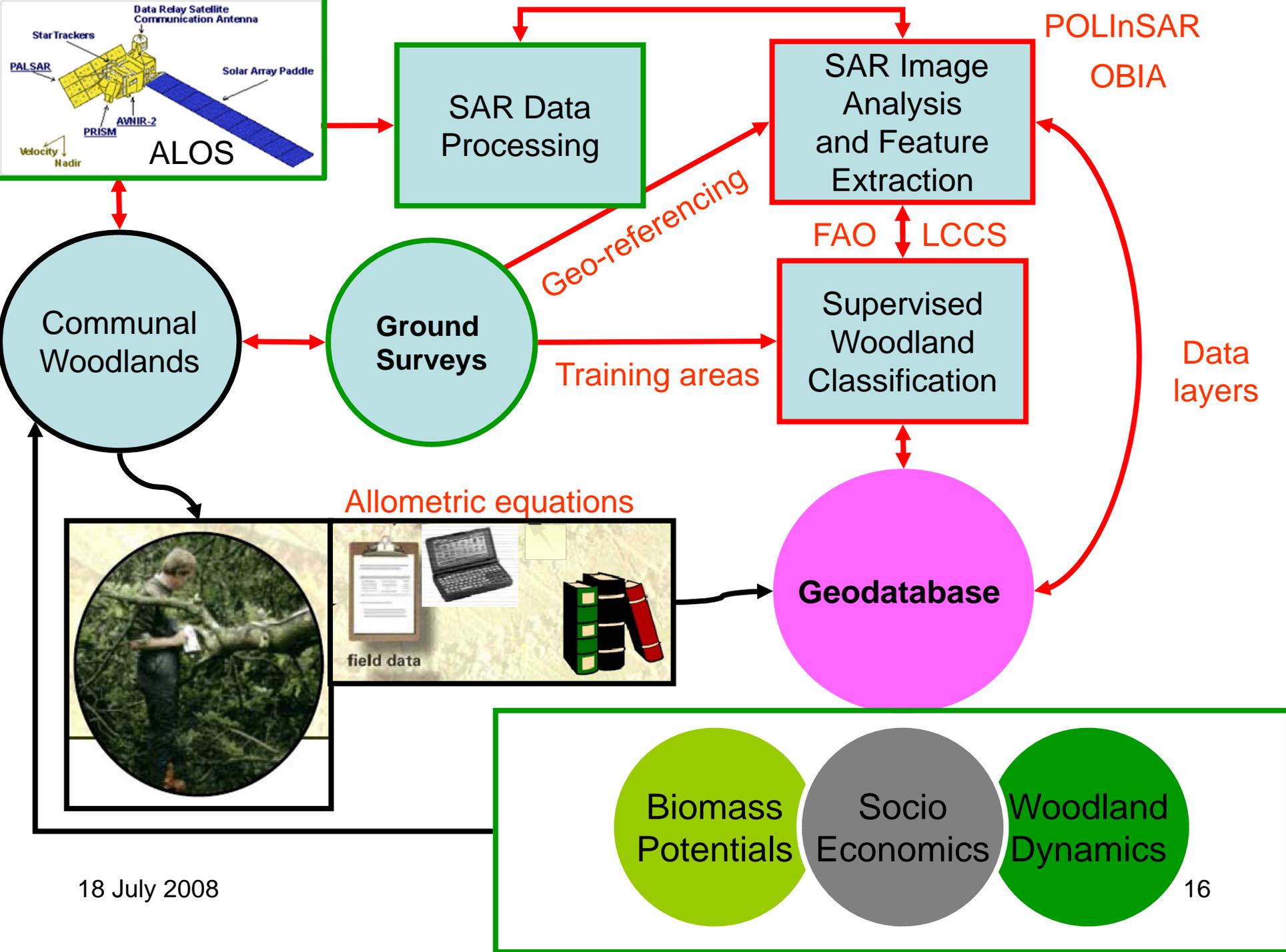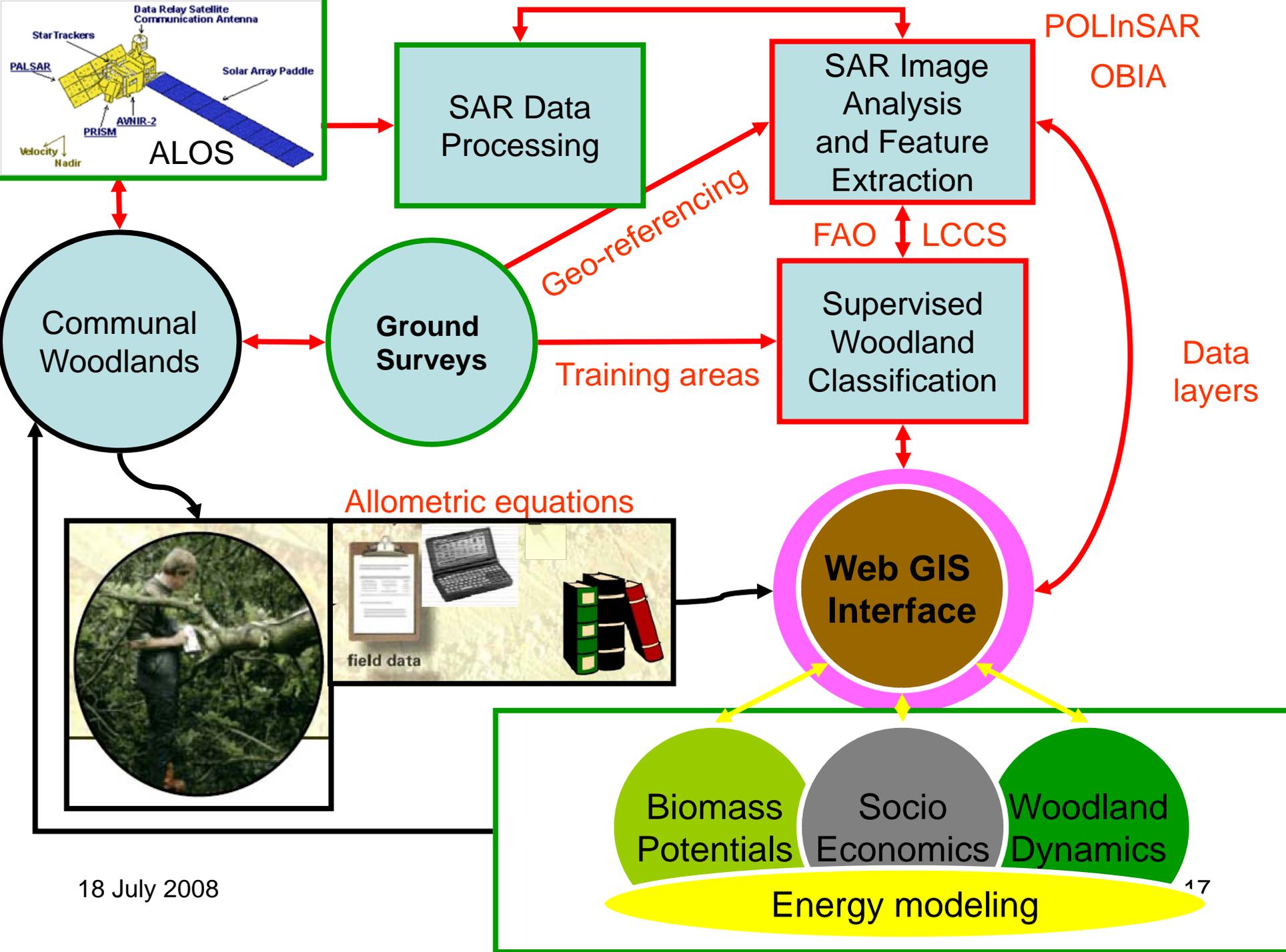Bolon *et al.* 2007

Implications for African savanna woodlands

❖ Increasing need for **quantitative** data on bioenergy resources

❖ Previous studies concentrated on vegetation change detection using optical datasets

❖ Long revisit periods may impact negatively on interferometric analysis of SAR data e.g. PALSAR has a revisit period of 46 days

❖Low levels of expertise in both academia, public and private sector institutions

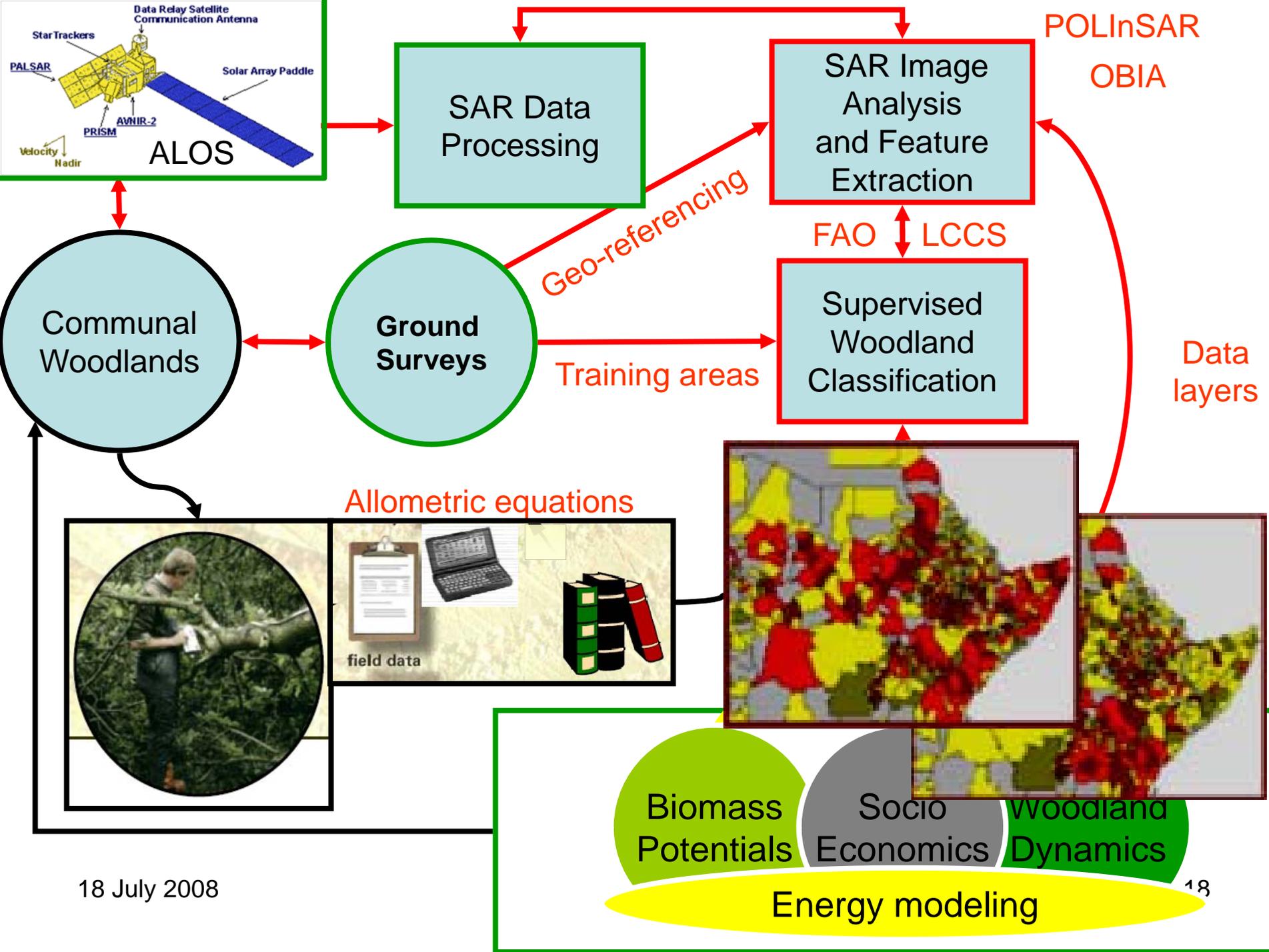❖ High capital investment in technical, institutional and human resources

Concluding Remarks

❖ Most villages located in regions of low economic potential with little or no conventional and/or GPS control networks

❖ Possibility data fusion – highly accurate field surveys (conventional surveying and GPS), high resolution optical data and SAR data

❖ VW Foundations BioModels project

ALOS

SAR Data Processing

SAR Image Analysis and Feature Extraction

POLInSAR

OBIA

Geo-referencing

FAO   LCCS

Communal Woodlands

Ground Surveys

Supervised Woodland Classification

Training areas

Data layers

Allometric equations

field data

Geodatabase

Biomass Potentials

Socio Economics

Woodland Dynamics

POLInSAR

OBIA

Data layers

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Geo-referencing

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field data

ALOS
- Data Relay Satellite Communication Antenna
- Star Trackers
- PALSAR
- Solar Array Paddle
- PRISM
- AVNIR-2
- Velocity
- Nadir

SAR Data Processing

SAR Image Analysis and Feature Extraction

POLInSAR

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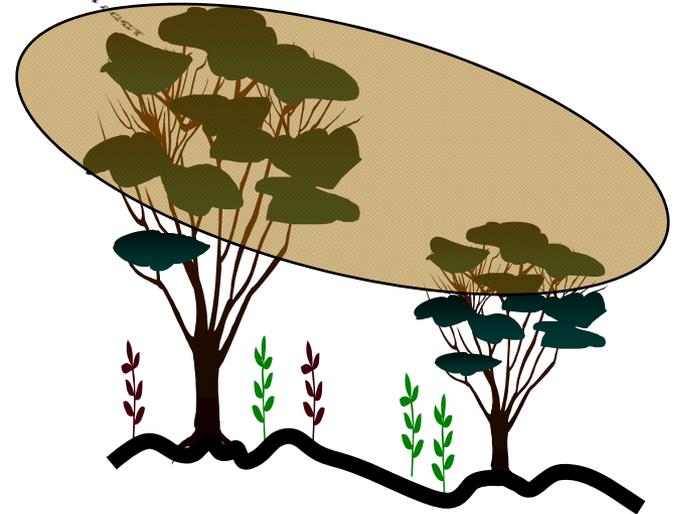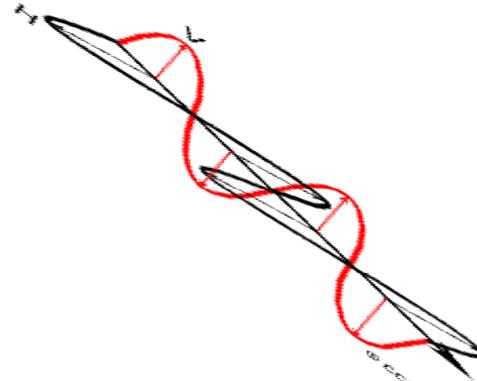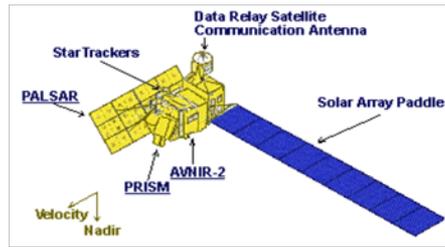
Biomass Potentials

Socio Economics

Woodland Dynamics

Energy modeling

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❖ Midlands State University

Ndinotenda, I Thank You All