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Global Biomass Information System


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MIDLANDS POSTGRADUATE
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Outline

- Biomass Background
- Biomass Monitoring Challenges
- Allometry
- Biomass Mapping
- Rationale of the Research
- Objective of the Research
- General Concept

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Biomass Background

- Definition: organic dried mass, usually expressed in terms of a given area and time
- Forest accumulates carbon primarily in the form of living above-ground biomass (AGB) of trees
- World's total forest area is estimated at 3.69 billion hectares, 30% of the total land area ¹⁾
- Global forests store 45% of terrestrial carbon, and sequester large amounts of carbon per year ²⁾
- International mechanisms aim the protection and enhancement of forest carbon stocks through economic incentives (CDM, REDD+)

1) FAO, 2011: Global forest land-use change from 1990 to 2005. Initial results from a global remote sensing survey, released on 30th November 2011 side-event to the 17th Conference of Parties of the UN Framework Convention on Climate Change in Durban (S. Africa)

2) Bonan, G.B., 2008: Forests and Climate Change: Forcings, Feedbacks, and the Climate Benefits of Forests. *Science*, 320, 1444-1449.

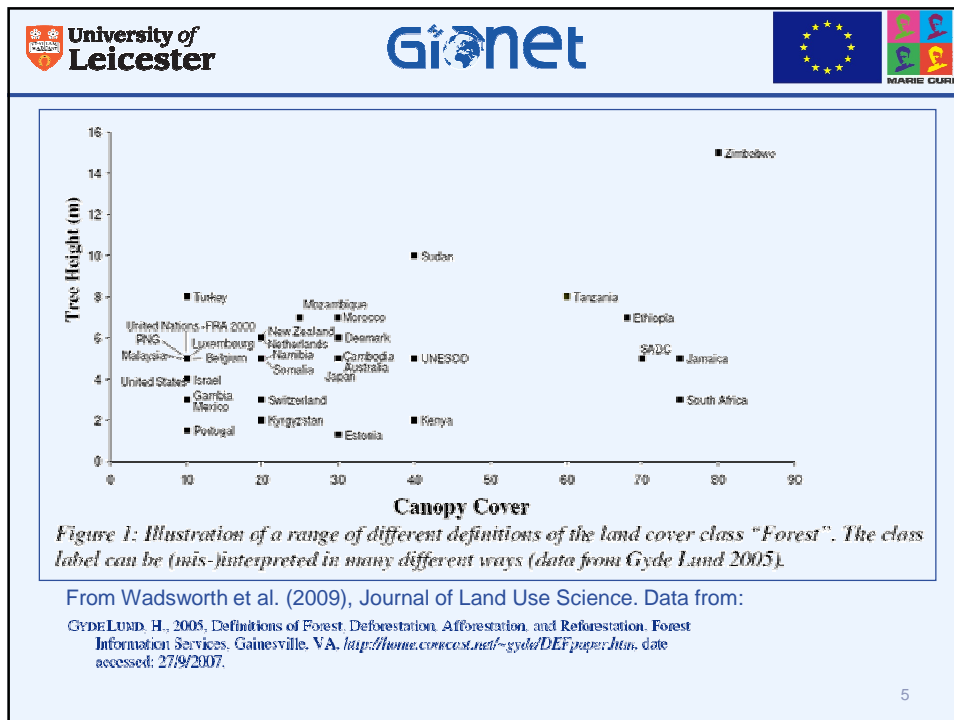
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Monitoring Challenges

- Definition of Forest
- Data needs:
 - Biomass Measurements
 - Forest/Non-Forest Cover
 - Forest Degradation (Natural or Anthropogenic)
- AGB Estimation
 - Destructive sampling methods (in situ)
 - Non-Destructive sampling methods (in situ)
 - Direct or Indirect inference from Remote Sensing
 - Models

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Monitoring Challenges

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Allometry

- Derivation of allometric relationships is based on the allometry of living organisms. Allometry is the condition of geometric similitude which results when geometry and shape are conserved among organisms differing in size
- Allometric biomass regressions are developed by measuring biomass of entire trees or their components and regressing these data against some more easily measured variables ³⁾

$$AGB = b_0 \cdot D^{b_1}$$

3) Pastor, J., Aber, J.D., and Melillo, J.M., 1984: Biomass prediction using generalized allometric regressions for some northeast tree species. *Forest Ecology and Management*, 7, 265-274.





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Biomass Mapping





- Ground-based Forest Inventory Data
- Biome-average approach
- Remote Sensing
 - Optical sensors
 - Very high-resolution airborne optical sensors
 - Radar sensors
 - LIDAR sensors

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Goetz, S., Baccini, A., Laporte, N., Johns, T., Walker, W., Kelndorfer, J., Houghton, R., and Sun, M., 2009: Mapping and monitoring carbon stocks with satellite observations: a comparison of methods. *Carbon balance and management*, 4.2. Data from:
 A. Baccini, A., Laporte, N., Goetz, S.J., Sun, M., and Dong, H., 2008: A first map of tropical Africa's above-ground biomass derived from satellite imagery. *Environmental Research Letters*, 3.
 B. Gibbs, H.K., Brown, S., Niles, J.O., and Foley, J.A., 2007: Monitoring and estimating tropical forest carbon stocks: making REDD a reality. *Environmental Research Letters*, 2.
 Gibbs, H., and Brown, S., 2007: Geographical Distribution of Woody Biomass Carbon Stocks in Tropical Africa: An Updated Database for 2000. Carbon Dioxide Information Center, Oak Ridge National Laboratory, Oak Ridge, TN

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Category	Above Ground Biomass (Mg/ha)
1	0 - 25
2	26 - 50
3	51 - 75
4	76 - 100
5	101 - 150
6	151 - 200
7	201 - 250
8	251 - 300
9	301 - 350
10	351 - 400
11	>400

Distribution of forest aboveground biomass (circa 2000). AGB is mapped at 1-km spatial resolution using 4079 inventory plots, 3 million GLAS- footprints (493 calibration plots - allometry), SRTM digital elevation, QSCAT (radar), MODIS NDVI, LAI and VCF products

Saatchi, S.S., Harris, N.L., Brown, S., Lefsky, M., Mitchard, E.T.A., Salas, W., Zutta, B.R., Buermann, W., Lewis, S.L., Hagen, S., Petrova, S., White, L., Silman, M., and Morel, A., 2011: Benchmark map of forest carbon stocks in tropical regions across three continents. *Proceedings of the National Academy of Sciences*, 108, 9899-9904.





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Rationale

- Existing programmes are insufficient
 - FAO Forest Resource Assessment: every 5 years, systematic area frame sampling
 - ALOS Kyoto and Carbon Initiative: ALOS-PALSAR L-band SAR data, global coverage every year, simplified approach, only one sensor, no biomass produce
 - Forest inventories: not available globally, not always trustworthy
 - BIOMASS mission: not decided yet whether to go ahead
 - TREES project, GLOBCOVER, GLC2000 etc.: only forest cover
 - GLAS tree height data
- No global GIS database combines the best available data sources with allometric models and GIS data

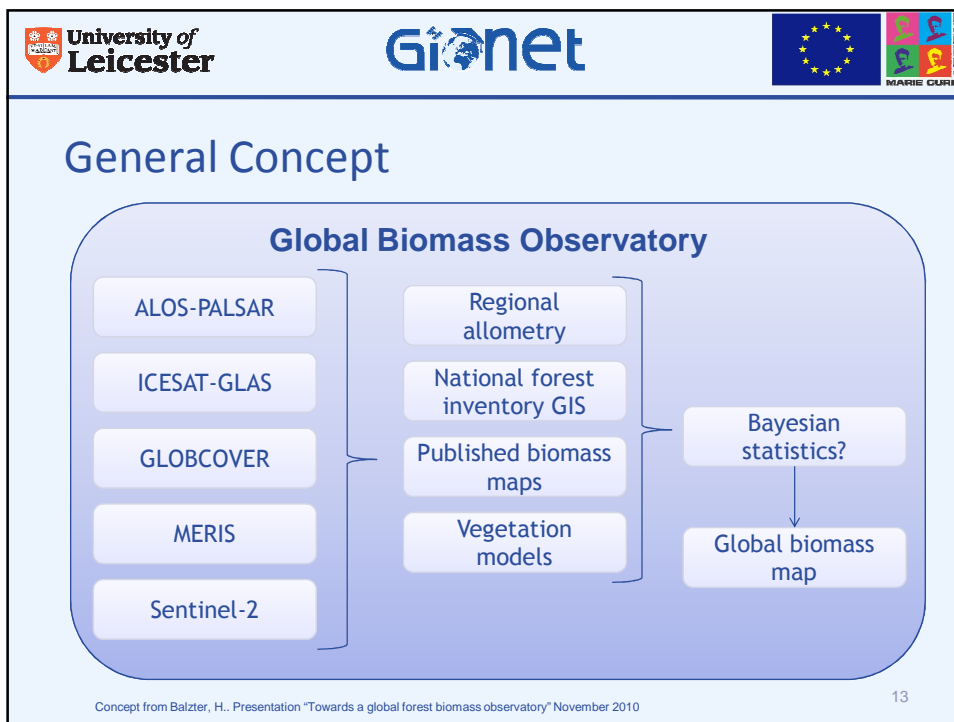
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Objective

- Spatial database on forest aboveground biomass stocks using:
 - Data synergies (SAR, LIDAR, Optical, GIS)
 - Regional forestry expertise (allometric models)
 - Data on forest disturbances and degradation
- The resulting GIS database will be assessed for uncertainties over well established validation sites and compared with the FAO Forest Resource Assessment (if available from FAO)

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