Estimating Forest Biomass Potentials with Biomass Maps and GIS Analysis

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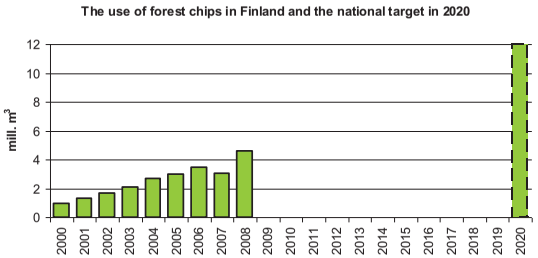
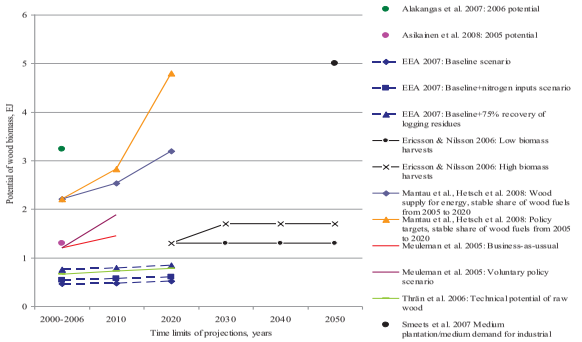
Background

- Use of forest biomass for energy is increasing
- Reliable estimates of available biomass potentials needed for both policy and industry



Background

- However, estimates still differ largely



Rettenmaier et al. 2008

Biomass Energy Europe

- *Objective:* To contribute to an increase of the accuracy and reliability of biomass resource assessments
- *With focus* on:
  - All biomass categories
  - Both national & European scope
  - All methodological approaches
  - All types of potentials
- Coordinated by University of Freiburg, Department FELIS (Dr. Matthias Dees)
- http://www.eu-bee.net/

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Biomass Energy Europe

Technical Potential

- Constraints usually spatial
  - slope
  - site type
  - buffer zones

-> Difficult to consider when using only statistical data

Removals of wood products 1990-2005

Country/area	1990	2000	2005			
	Total	Total	Total	Industrial roundwood	Wood fuel	% of growing stock
	1000 m³ o.b.	1000 m³ o.b.	1000 m³ o.b.	1000 m³ o.b.	1000 m³ o.b.	
South Africa	15,521	17,000	17,741	17,491	250	2.8

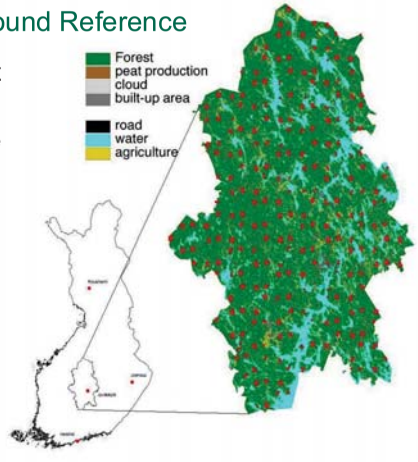
FAO 2006

Advanced Spatially Explicit Method

- Method for estimating technical potentials of forest biomass with biomass maps and GIS analysis
- Case study in Central Finland

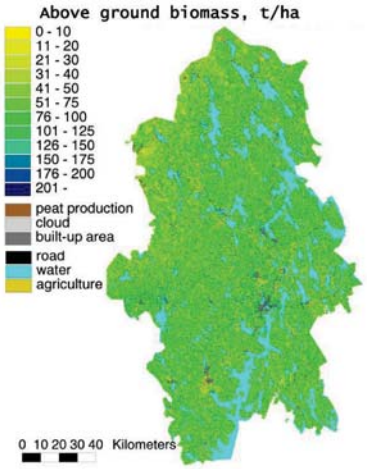
Study Area & Ground Reference

- 1.4 mill. ha forest land
- 1645 NFI sample plots as ground reference



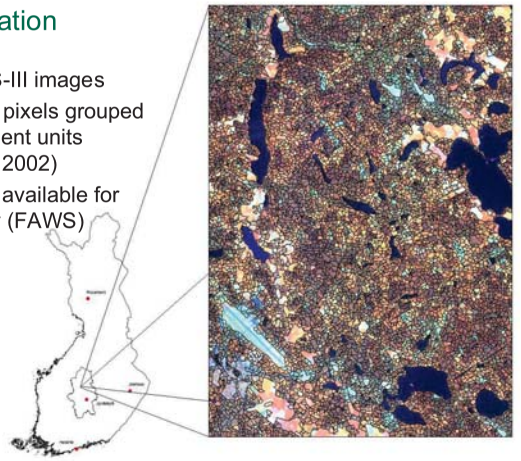
Thematic Maps

- Sample plot attributes generalized by using auxiliary information (Tomppo et al. 2009, Tuominen et al. 2010)
  - satellite images
  - basic maps
  - soil maps
  - digital elevation models
- Attributes
  - stem volume
  - basal area
  - mean height
  - site type
  - development class
  - biomass



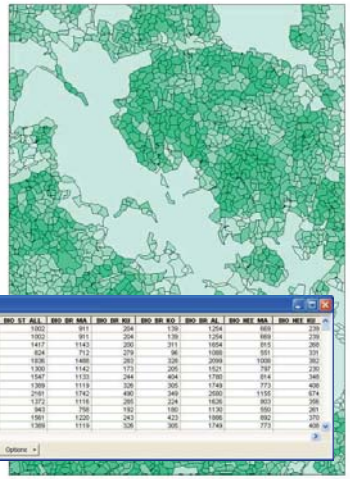
Segmentation

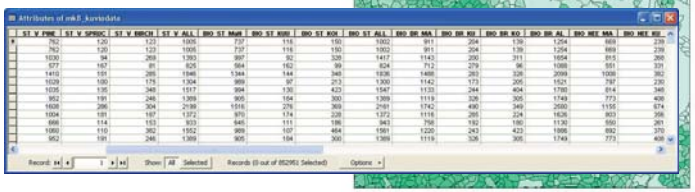
- IRS-P6 LISS-III images
- Neighboring pixels grouped to management units (Pekkarinen 2002)
- Only forests available for wood supply (FAWS) included



Attributes to Segments

- Segments overlaid on thematic maps
- Stand attributes as averages of maps' cell values





Environmental Constraints

Biomass potential limited by

- national guidelines for roundwood harvesting
- FAWS
- maintaining site productivity
- maximum recovery rate
- recovery limited on poor soils
- slope
- soil compaction risk / soil bearing capacity
- riparian zones

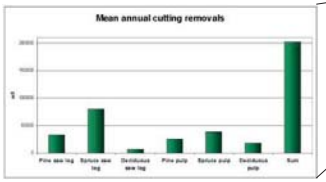
Technical and Economical Constraints

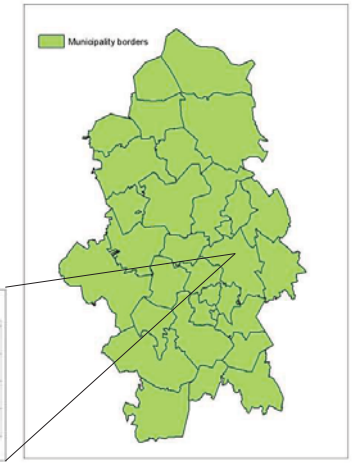
Biomass potential further limited by

- accessibility by roads
- maximum forwarding distance
- minimum biomass removal
- maximum technical recovery rate

Timber Production Estimates

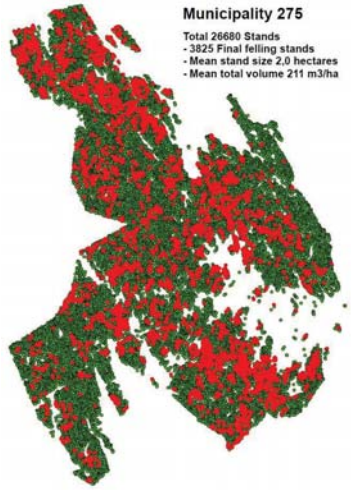
- Availability of residues depends on harvesting of industrial roundwood
- Timber production estimates for municipalities, e.g.
  - maximum sustainable
  - business as usual





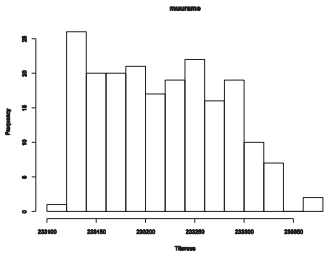
Technical Biomass Potential

- For logging residues and stumps, select all segments marked as final felling stands
- For biomass from precommercial or commercial thinnings, select all segments marked as advanced seedling stands or young thinning stands



Technical Biomass Potential

- For logging residues as follows:
  - repeat *n* times
    - repeat until Σ(segment's stem volume) = timber production estimate in a municipality
      - select segments randomly
    - apply constraints to segments
    - sum up segment's logging residues
  - technical potential from the distribution
- For stumps correspondingly
- For thinning material, thinning models applied after constraints



Results

- To be calculated...

References

- FAO 2006. Global forest resources assessment 2005 - Progress towards sustainable forest management. FAO Forestry Paper 147. 320 p. Available from: http://www.fao.org/forestry/site/fra/en/.
- Pekkarinen, A. 2002. Image segment-based spectral features in the estimation of timber volume. Remote Sensing of Environment 82 (2-3): 349–359.
- Rettenmaier, N., et al. 2008. Status of Biomass Resource Assessments. Version 1. Report of project Biomass Energy Europe. 19 Dec 2008. Available from: http://www.eu-bee.net/_ACC/_Components/ATLANTIS-DigiStore/Download.asp?fileID=132813&basketID=837.
- Tomppo, E., Haakana, M., Katila, M., Mäkisara, K. & Peräsaari, J. 2009. The Multi-source National Forest Inventory of Finland – methods and results 2005. Working Papers of the Finnish Forest Research Institute 111. 277 p. Available from: http://www.metla.fi/julkaisut/workingpapers/2009/mwp111.htm.
- Tuominen, S., et al. 2010. Mapping of biomass variables with multi-source forest inventory technique, Manuscript.