Mapping and Assessment of Ecosystems and their Services (MAES)

Thematic Pilot 3 on forest – Part 2

José I. Barredo (EC – Joint Research Centre)

Cristina Marta Pedroso (Polytechnic Institute of Bragança, PT)
Henrique Pereira (German Centre for Integrative Biodiversity Research)
Jan Bengtsson (Swedish University of Agricultural Sciences)
Törd Snall (Swedish University of Agricultural Sciences)
Jon Moen (Umeå University, Sweden)
Hannah Östergård (Swedish Environmental Protection Agency)

7th meeting of the MAES WG, DG-ENV – 06 March 2014
Pilot 3 on forest: recap from 2013

MAES Working Group meeting, DG-ENV
18 September 2013

Pilot 3 - Next steps
- Reporting in coordination with MAES Pilots (12/2013)
  - Content/Structure of reporting TBD
- Proposed pan-European indicators and country level indicators

- Is there a live after 2013 for Pilot 3?
Pilot 3 support to Member States

Collaborative mapping and assessment of selected forest ecosystem services based on:

- Outcomes of thematic pilots (2nd MAES report)
- Conclusions of the JRC-MESEU mapping workshop
- JRC work programme 2014
Pilot 3: Structure and organisation

- To be decided...
- Pilot co-leaders: coordination, voluntaries...
- Thematic workshops: where, content, output [tbd]
- Dissemination: CIRCABC...
- Output format: reports, maps, publications, web, conferences, etc.
Pilot 3: Forest services (indicators)

- Biomass stock and supply (increment)
  - Fuel wood, timber, C stock, biomass stock

- Other services agreed and proposed by MS (tbd):
  - Recreational value of forest
  - Forest biodiversity
  - Forest habitat provision
  - Etc...
Indicator: Above ground forest biomass increment (AGBi)


Method:
- Estimation of AGBi from MODIS data
- Correction of MODIS GPP
- Country Validation against MCPFE data
- Regional Validation against NFI data
Indicator: Above ground forest biomass increment (AGBi)

Objective

- To develop a pan-European wall-to-wall map of above ground woody forest biomass increment ($AGBi_w$) using Primary Production (NPP/GPP) estimates derived from MODIS satellite imagery and other ancillary spatial datasets, and using National Forest Inventory (NFI) data for validation.

- To compute a spatially disaggregated estimation of forest biomass increment (timber and energy potential) at the 1 km grid size.
**Estimation of $AGBi_w$ from MODIS data**

**Input MODIS Data preprocessing**

**Computation of $AGBi_w$**

\[
AGBi_w = \frac{NPP_w}{CF_{LC}} = \frac{0.589 \cdot GPP_w}{CF_{LC}} = \frac{0.589 \cdot (c_1 \cdot GPP + c_2) \cdot GPP}{CF_{LC}}
\]

**Woody GPP to Woody NPP ratio**

Assumed constant

**Woody GPP to total GPP ratio**

More GPP is allocated to wood in “older” forests

**Carbon Fraction**

Carbon Fraction in total above ground dry matter for the land cover class of pixel $i$ (LC) – derived from IPCC 2006 report.

<table>
<thead>
<tr>
<th>LC</th>
<th>Climatic Domain</th>
<th>CF</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENF, EBF</td>
<td>Temperate and Boreal</td>
<td>0.51</td>
</tr>
<tr>
<td>DNF, DBF</td>
<td>Temperate and Boreal</td>
<td>0.48</td>
</tr>
<tr>
<td>All</td>
<td>Mediterranean</td>
<td>0.47</td>
</tr>
</tbody>
</table>

**MODIS GPP Map**
Estimation of $AGBi$ from MODIS NPP data

Results: validated spatially-explicit dataset
Other indicators, data and maps

Above ground forest carbon stock

BIOMASAR datasets
Thank you
Estimation of $AGBi_W$ from MODIS data

Input MODIS Data preprocessing

<table>
<thead>
<tr>
<th>Code</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENF</td>
<td>Evergreen Needleleaf Forest</td>
</tr>
<tr>
<td>EBF</td>
<td>Evergreen Broadleaf Forest</td>
</tr>
<tr>
<td>DNF</td>
<td>Deciduous Needleleaf Forest</td>
</tr>
<tr>
<td>DBF</td>
<td>Deciduous Broadleaf Forest</td>
</tr>
<tr>
<td>MF</td>
<td>Mixed Forest</td>
</tr>
</tbody>
</table>

MODIS UMD Land Cover Map
Sweden: Tree species biodiversity (plot level – Swedish NFI)

From: Gamfeldt L. et al.: Higher levels of multiple ecosystem services are found in forests with more tree species, Nat Commun, 4, 1340, 2013.
Estimation of $AGBi_w$ from MODIS data

Correction of the estimates using MTE ENSEMBLE data set

- Preliminary analysis showed overestimation in particular in Mediterranean areas

- The MODIS GPP map was then compared with GPP estimates at 0.5° resolution for the 2000-2010 period derived by Jung et al. (2011) from upscaling of FLUXNET CO2 and H20 fluxes observations using the Model Tree Ensemble (MTE) technique. (Jung et al., 2011. Global patterns of land-atmosphere fluxes of carbon dioxide, latent heat, and sensible heat derived from eddy covariance, satellite, and meteorological observations)

- This comparison highlighted a significant tendency of MODIS GPP towards overestimation in SubTropical (Mediterranean) areas. This tendency was particularly evident for the “Evergreen Broadleaves” and “Mixed Forests” Land Cover classes
Estimation of $AGBi_W$ from MODIS data

Correction of the estimates using MTE ENSEMBLE data set

- MODIS GPP data was adjusted using the MTE GPP. Forest-type specific correction factors for MODIS GPP were derived from the ratios between MODIS GPP and MTE GPP observed on the 0.5°grid-cells, spatialised using a spline interpolation and applied to the original MODIS GPP map.
Defining forest ecosystem

**Forests are:**

Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ.

**Other wooded land (OWL) is:**

Land not classified as “Forest”, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5–10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent.

**Source:**

Eurostat; FAO Global Forest Resources Assessment (2010); MCPFE; EU Forest Action Plan → Main sources of forest information, data and indictors
Issues to be addressed through the pilot

- **Defining forest ecosystem**
  - At pan-European level should be in line with data and indicators sources: EFDAC, FOREST EUROPE (MCPFE, UNECE, FAO), Eurostat
  - At MS level → to be discussed → In line with NFI [?]

- **Defining forest ecosystem types**
  - At pan-European level to be decided on the basis of available forest data and indicators (bottom-up)
  - At MS level → to be discussed → In line with NFI [?]
Forest types classification (pan-European)

EEA:
European forest types – Categories and types for sustainable forest management reporting and policy (EEA Technical report No 9/2006) → Bio-climatic approach

Input to reporting:
MCPFE, UNECE, FAO-FRA, Eurostat

**European forest types — category level**
1. Boreal forest
2. Hemiboreal forest and nemoral coniferous and mixed broadleaved-coniferous forest
3. Alpine coniferous forest
4. Acidophyloous oakwood and oak-birch forest
5. Mesophytic deciduous forest
6. Lowland to submountainous beech forest
7. Mountainous beech forest
8. Thermophilous deciduous forest
9. Broadleaved evergreen forest
10. Coniferous forests of the Mediterranean, Anatolian and Macaronesian regions
11. Mire and swamp forest
12. Floodplain forest
13. Non-riverine alder, birch or aspen forest
14. Plantations and self-sown exotic forest
Forest Management Approach

Hengeveld et al. (2012): A Forest Management Map of European Forests → Management approach