Overview of tools, data and approaches IIASA

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The ESM Tool Cluster

- Agriculture (GEPIC)
- Economic Modeling (GLOBIOM)
- Forestry (G4M)
- Engineering Models
- System Dynamics Models
- Globally consistent National/Sector Models
- Geographic allocation or downscaling
- Uncertainty & risk assessment

Policy Interaction

REDD\textsuperscript{pac}
### Parameters exchanged between the different models of the modeling framework

<table>
<thead>
<tr>
<th>Model linkage</th>
<th>Parameters exchanged</th>
</tr>
</thead>
</table>
| EPIC $\rightarrow$ GLOBIOM [14, 15]       | For 20 crops (>75 per cent of harvested area) and 4 management systems (high input, low input, irrigated, subsistence)  
- crop yields  
- water balance (including irrigation water)  
- carbon, nitrogen and phosphorus balance |
| G4M $\rightarrow$ GLOBIOM [16, 17]         | - Mean annual increment  
- Share of biomass suitable for sawnwood  
- Harvesting cost  
- Carbon stock in forests                |
| POLES (or other energy model) $\rightarrow$ GLOBIOM + G4M [19] | - Population projections  
- GDP projections                           |
| POLES (or other energy model) $\rightarrow$ GLOBIOM [19] | - Bioenergy demand (fuel wood, biomass for energy industry, biofuels) |
| GLOBIOM $\rightarrow$ G4M [12, 13]         | - Wood price projections  
- Land price projections  
- Agricultural commodity price projections  
- Demand for forest biomass by type         |
Bio-physical impacts of agricultural land use management systems (EU25) on:
- Crop Selection
- Crop Management
- Crop Yields
- Soil Organic Carbon
- 'Direct' N2O-N emissions
- 'Indirect' N2O-N emissions
- CO2 Emissions/Sequestr.
- biomass production (e.g. miscanthus and poplar coppice)
2) Environmental Policy Integrated Climate Model (EPIC)

Objective: To improve site data/information (i.e. weather, soil, topography and land use management) for China for bio-physical impact analysis of alternative land use and cropping systems. Following information can help.

1. Daily weather data (Tmin, Tmax, Rainfall, Solar Radiation, Wind speed, relative humidity) from weather stations across the country
2. Current land use map
3. Current soil map (soil information on: by soil horizons: soil texture, pH, orgC, bulk density, cation exchange capacity, CaCO3 content, etc.)
4. Digital elevation map
5. Crop management information i.e. crop rotations, timing and amount of fertilizations, timing and amount of irrigation, tillage, expected crop yields, etc.
Motivation – Yield Changes

Relative Difference in Means (2050/2100) in Wheat Yields
[Data: Tyndall, Afi Scenario, simulation model: EPIC]
Motivation – Uncertainty in Yields

Relative Difference in Variances (2050/2100) in Wheat Yields
[Data: Tyndall, Afi Scenario, simulation model: EPIC]
Global Forest Model G4M

- NPP
- Forest Cover
- Temperature
- Precipitation
- Soil
- Estimated NPP
1) Global Forest Model (G4M)

Objective: To improve the estimates of biomass production and carbon storage the following information can help.

1. Current forest cover (Share of forest, species, age, biomass) – as map or for inventory points
2. Yield level (potential long time increment) and current increment - as map or for inventory points
3. Yield tables of the major species
REDD – Avoiding Deforestation

Forest Area Development A2r
1. GLOBIOM

Global Biosphere Management Model

Basic resolution: 28 regions
I. GLOBIOM: Supply chains

- **Unmanaged Forest**
  - **Wood Processing**
    - **Energy products:**
      - Ethanol (1st gen.)
      - Biodiesel (1st gen.)
      - Ethanol (2nd gen)
      - Methanol
      - Heat ...
    - **Forest products:**
      - Sawnwood
      - Woodpulp

- **Managed Forest**
  - **Bioenergy Processing**
    - **Energy products:**
      - Ethanol (1st gen.)
      - Biodiesel (1st gen.)
      - Ethanol (2nd gen)
      - Methanol
      - Heat ...
    - **Crops:**
      - Barley
      - Corn
      - Cotton ...

- **Short Rotation Tree Plantations**
  - **Livestock Production**
    - **Livestock:**
      - Cattle meat & milk
      - Sheep & Goat
      - Pork meat
      - Poultry meat & egg

- **Cropland**
- **Grassland**
- **Other Natural Vegetation**
Cumulative land-use change under the BAU scenario

- Cropland
- Managed Forest
- Unmanaged Forest
- Short Rotation Coppice
- Grassland
- Other Natural Vegetation

Area (Mha)

2000  2010  2020  2030  2040  2050
Cumulative loss of area of unmanaged forest 2000-2050 in different regions under the BAU scenario
GHG emissions from total land use 2000-2050 under the different scenarios
The Geo-Wiki Project is a global network of volunteers who wish to help improve the quality of global land cover maps. Since large differences occur between existing global land cover maps, current ecosystem and land-use science lacks crucial accurate data (e.g. to determine the potential of additional agricultural land available to grow crops in Africa). Volunteers are asked to review hotspot maps of global land cover disagreement and determine, based on what they actually see in Google Earth and their local knowledge, if the land cover maps are correct or incorrect. Their input is recorded in a database, along with uploaded photos, to be used in the future for the creation of a new and improved global land cover map.
Geo-wiki makes GEO data easy to visualize and analyze.
Volunteers from around the globe can input their agreement/disagreement with the existing data.
GEOSS in action: Geo-Wiki registered on the Geo-Portal.
A bunch of projects: landcover, agriculture, biomass, urban, regional, etc.
Onboard biomass datasets

**Above Ground Live Biomass**
- Global Forest, 2005, res.30' [details](#)
- European Forest (JRC) [details](#)
- European Forest (Corine) [details](#)
- European Forest (GLC2000) [details](#)
- European Forest (GlobCover) [details](#)
- Russia, 2009, res.1km [details](#)
- USA, 2000, res.30m [details](#)

**Load Biomass DB**

**Forest Woody Biomass**
- Africa, 2003, res.1km [details](#)
- Europe, 2000, res.500m [details](#)
- Sweden, 2005, res.0.01deg [details](#)
- Russia, 2009, res.1km [details](#)
- Siberia, 2005, res.0.01deg [details](#)
- Mexico, 2008, res.0.01deg [details](#)
- Quebec, 2005, res.0.01deg [details](#)
## Onboard biomass datasets

### Above Ground Live Biomass

<table>
<thead>
<tr>
<th>Region</th>
<th>Base year</th>
<th>Resolution</th>
<th>Provider</th>
<th>Object, units</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>2005</td>
<td>30 min</td>
<td>IIASA</td>
<td>Forest, Mg dm/ha</td>
<td>FAO data downscaling by RS</td>
</tr>
<tr>
<td>Europe</td>
<td>2005</td>
<td>1 km</td>
<td>IIASA</td>
<td>Forest, Mg dm/ha</td>
<td>FAO data downscaling by RS and forest maps</td>
</tr>
<tr>
<td>Russia</td>
<td>2009</td>
<td>1 km</td>
<td>IIASA</td>
<td>Vegetation, Mg dm/ha</td>
<td>National forest &amp; land statistics downscaling by RS</td>
</tr>
<tr>
<td>USA</td>
<td>2000</td>
<td>30 m</td>
<td>WHRC</td>
<td>Vegetation, Mg dm/ha</td>
<td>Landsat + Forest Inventory</td>
</tr>
</tbody>
</table>

### Forest Woody Biomass

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<th>Provider</th>
<th>Object, units</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical Africa</td>
<td>2003</td>
<td>1 km</td>
<td>WHRC</td>
<td>Woody biomass, Mg dm/ha</td>
<td>MODIS + field measurements</td>
</tr>
<tr>
<td>Europe</td>
<td>2000</td>
<td>500 m</td>
<td>Joanneum Research</td>
<td>Growing Stock, m3/ha</td>
<td>MODIS + forest inventory</td>
</tr>
<tr>
<td>Russia</td>
<td>2009</td>
<td>1 km</td>
<td>IIASA</td>
<td>Growing Stock, m3/ha</td>
<td>National forest &amp; land statistics downscaling by RS</td>
</tr>
<tr>
<td>Sweden</td>
<td>2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Siberia</td>
<td>2005</td>
<td>0.01°</td>
<td>Gamma Remote Sensing; Friedrich Schiller Univ. Jena</td>
<td>Growing Stock, m3/ha</td>
<td>ENVISAT ASAR, MODIS VCF</td>
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<tr>
<td>Mexico</td>
<td>2008</td>
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<tr>
<td>Quebec</td>
<td>2005</td>
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</table>

### In Situ Forest Biomass Measurements

<table>
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<th>Region</th>
<th>Base year</th>
<th>Provider</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Eurasia</td>
<td>1952-2007</td>
<td>IIASA</td>
<td>Main tree species, Tree height, Above ground live biomass, Stem biomass, Coarse woody debris</td>
</tr>
</tbody>
</table>
For Questions and comments please contact

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