Modelling Ecosystem Services: state of the art and prospects for future development

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Contents

- The SEEA EEA, illustrated for the Netherlands
- Using advanced models for compiling accounts
- Using remote sensing for compiling accounts
- Using open access datasets for compiling accounts
- Conclusions and future prospects
The ecosystem accounts

Core accounts
- Ecosystem extent;
- Condition;
- Ecosystem services supply and use;
- Monetary ecosystem assets

Thematic accounts
- Land
- Water
- Carbon
- Biodiversity

Source figures: UNSD
The extent account for the Netherlands
Dutch Condition account: 15 key indicators
Ecosystem services in NL SEEA account

Provisioning services
- Crop production
- Fodder production
- Timber production
- Other biomass
- Water supply

Regulating services
- Carbon sequestration
- Erosion control
- Air filtration
- Water infiltration
- Pollination
- Pest control

Cultural services
- Nature recreation (hiking)
- Nature tourism

Multiple datasets and models per service
## Timber production

<table>
<thead>
<tr>
<th>Region</th>
<th>Total area</th>
<th>stock</th>
<th>Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groningen</td>
<td>6</td>
<td>1,221</td>
<td>19</td>
</tr>
<tr>
<td>Friesland</td>
<td>14</td>
<td>2,918</td>
<td>40</td>
</tr>
<tr>
<td>Drenthe</td>
<td>31</td>
<td>6,633</td>
<td>129</td>
</tr>
<tr>
<td>Overijssel</td>
<td>34</td>
<td>7,723</td>
<td>106</td>
</tr>
<tr>
<td>Flevoland</td>
<td>14</td>
<td>2,910</td>
<td>73</td>
</tr>
<tr>
<td>Gelderland</td>
<td>88</td>
<td>20,411</td>
<td>308</td>
</tr>
<tr>
<td>Utrecht</td>
<td>17</td>
<td>3,526</td>
<td>53</td>
</tr>
<tr>
<td>Noord-Holland</td>
<td>17</td>
<td>4,478</td>
<td>38</td>
</tr>
<tr>
<td>Zuid-Holland</td>
<td>8</td>
<td>1,420</td>
<td>18</td>
</tr>
<tr>
<td>Zeeland</td>
<td>4</td>
<td>553</td>
<td>11</td>
</tr>
<tr>
<td>Noord-Brabant</td>
<td>65</td>
<td>12,358</td>
<td>215</td>
</tr>
<tr>
<td>Limburg</td>
<td>24</td>
<td>5,147</td>
<td>73</td>
</tr>
<tr>
<td>Zuid-Limburg</td>
<td>5</td>
<td>1,436</td>
<td>13</td>
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<tr>
<td>Netherlands</td>
<td>326</td>
<td>70,726</td>
<td>1,097</td>
</tr>
</tbody>
</table>

Mean increase timber stock

- **5.5 - 6.5**
- **6.5 - 7.5**
- **7.5 - 9.5**
- **9.5 - 11.5**
- **11.5 - 13.5**
- **13.5 - 15.5**
Ecosystem asset account

- Monetary indicators only, based on NPV of expected flow of ecosystem services
- To be finalised December 2018
- Ecosystem services valued based on actual use patterns, corrections made in case of unsustainable use patterns.
The carbon account

- Stocks, emissions and sequestration of CO2
Using machine learning for mapping carbon
- Philippines
- Costa Rica

Biomass maps predicted by random forest, support vector machine, and neural networks
Using remote sensing to compile accounts

- Ecosystem extent / land use
  - Conversion of forest in plantations
  - Smallholders versus plantations
- Condition
  - Fire
  - Water/flooding
- Carbon
  - Stocks and flows
- Supply and use account
  - Rice production
Compiling extent accounts with satellite data

Case study showing expansion of oil palm plantations in Johor, Malaysia 2016-2018

<table>
<thead>
<tr>
<th>Land cover (ha)</th>
<th>Production</th>
<th>(ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>109,000 Timber</td>
<td>981,000</td>
</tr>
<tr>
<td></td>
<td>Carbon sequestration</td>
<td>654,000</td>
</tr>
<tr>
<td>Plantation</td>
<td>91,000 Oilpalm fruit</td>
<td>1,820,000</td>
</tr>
<tr>
<td>Annual crops</td>
<td>85,000 Paddy rice</td>
<td>1,020,000</td>
</tr>
<tr>
<td>Urban</td>
<td>25,000</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>310,000</td>
<td></td>
</tr>
</tbody>
</table>
Mapping estates and smallholder plantations

Land Use

- Oil palm estates plantations
- Oil palm smallholder plantations
- Acacia plantations
- Logged peat swamp forest

Sentinel-1A image classification 2015-16

Mapping smallholders and estates

Sumatra
Indonesia
Mapping burned areas (fire scars), 12 day interval
Condition account: Monitoring and recording flooding

Flood monitoring – Haor region, Bangladesh Sentinel-1 images 02/2017 – 05/2017

Fresh areas flooded in Netrakona

Situation unchanged in Kishoreganj

Our Correspondent, Mymensingh

Flood situation in Netrakona continues to deteriorate as fresh areas of farmland were inundated yesterday, causing immense sufferings to thousands of farmers.

Due to washing away of two more embankments – Gadhikhat and Joypur – embankments in Khalijury upazila, over 60 percent area of the upazila has gone under water, said Mohammed.
From accounts to policy support: flooding frequency
Carbon account: Mapping carbon stocks and flows (above ground vegetation)
In new, European space agency funded project also emissions from peat drainage will be included

Biomass time series over the years 2000-2012
Small section of the East Kalimantan map (50 km wide).
Supply and use account: crop (rice) production

Rice growth stage monitoring, Mekong Delta, Vietnam
Using open-access, ‘big data’ for mapping ES

Mapping recreation

Statistics Netherlands

Using ‘big data’ to produce accounts, cultural services modelling based on strava, flickr, and other apps
Conclusions and look into the future

- Technology for using models, earth observation and open data for informing natural resource management and compiling accounts is developing VERY rapidly.

- Machine learning will replace existing earth system modelling approaches. In five to 10 years?

- Level of detail, in time and in space, and high accuracy already present multiple policy use options.

- Need for further development:
  - Developing new approaches, testing in new areas, scaling up, connecting to users.

- Question: should every individual country develop these models and connect them to accounts and environmental information management system? Or should this be done by global / regional centres? If so which ones? and how to connect to national and sub-national policy makers?