Strategy for tool integration

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São José dos Campos, 2012
Integration between TerraLib and IIASA tools

SciSoft

G4M  GLOBIOM  EPIC  GeoWiki

TerraLib
Software: Open source GIS

**TerraLib 4 ➔ TerraLib 5**

- very large databases
- different data sources
- heterogeneous formats
- spatiotemporal data
TerraLib Family – implemented in version 4
conn = openConn(u="art", dbms="mysql")
db = openDb(conn, "dbname")

thpoints = openTheme(db, "themepts")

thcontour = openTheme(db, "thcontr")
points = getPoints(thpoints)
contour = getPolygons(thcontour)
data = getData(thpoints)
raster = krigge(points, contour, data)
l = createLayer(db, "lraster")

addRaster(l, raster)

thraster = createTheme(l, "thrstr")
Intersection area

Average:

\[ f(C') = \sum_{I = P \cap C \neq \emptyset} f(P) \frac{a(I)}{a(C')} \]

Sum:

\[ f(C') = \sum_{I = P \cap C \neq \emptyset} f(P) \frac{a(I)}{a(P)} \]
Sum (population)
Average (income per capita)
### Database

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Type</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFOR_2002</td>
<td>Percentage of new clear-cut deforestation in 2002</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
</tr>
<tr>
<td>DEFOR_2003</td>
<td>Percentage of new clear-cut deforestation in 2003</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
</tr>
<tr>
<td>DEFOR_2004</td>
<td>Percentage of new clear-cut deforestation in 2004</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
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<tr>
<td>DEFOR_2005</td>
<td>Percentage of new clear-cut deforestation in 2005</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
</tr>
<tr>
<td>DEFOR_2006</td>
<td>Percentage of new clear-cut deforestation in 2006</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
</tr>
<tr>
<td>DEFOR_2007</td>
<td>Percentage of new clear-cut deforestation in 2007</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
</tr>
<tr>
<td>DEFOR_2008</td>
<td>Percentage of new clear-cut deforestation in 2008</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
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<tr>
<td>ACUM_1997</td>
<td>Percentage of accumulated clear-cut deforestation until 1997</td>
<td>Land Use</td>
<td>PRODES Raster 90m</td>
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<td>CENSO96_PASTAGEM</td>
<td>Percentage of estimated pasture in 1996, from CENSUS data spatialized using PRODES data</td>
<td>Land Use</td>
<td>IBGE CENSUS Municipality, PRODES Raster 90m</td>
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<td>CENSO96_TEMPORARIA</td>
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<td>CENSO96_FLORESTA</td>
<td>Percentage of estimated planted forest in 1996, from CENSUS data spatialized using PRODES data</td>
<td>Land Use</td>
<td>IBGE CENSUS Municipality, PRODES Raster 90m</td>
</tr>
<tr>
<td>CENSO96_NUSADO</td>
<td>Percentage of estimated non-used areas in 1996, from CENSUS data spatialized using PRODES data</td>
<td>Land Use</td>
<td>IBGE CENSUS Municipality, PRODES Raster 90m</td>
</tr>
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<td>CENSO06_PASTAGEM</td>
<td>Percentage of estimated pasture in 2006, from CENSUS data spatialized using PRODES data</td>
<td>Land Use</td>
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Strategy for integration

- First Step: generate the data for IIASA (1st January 2013)
- Second Step: develop TerraLib drivers to allow visualizing IIASA databases
- Third Step: improve TerraLib drivers to allow writing IIASA databases
Data for GeoWiki

- Biomass
- Land cover 2008/TerraClass (Forest/Pasture/Agriculture)
G4M is a model to assess afforestation-deforestation-forest management decisions
G4M

- Annual increment of biomass, CO2 emissions, harvesting cost
- Spatial resolution: 30 arcmin (259200 cells)
- Temporal resolution: 1 year
- C++, with Postgre without spatial extension
- Table with: x (real), y (real), country id and other attributes

(-89.5) (-180) (-179.5)
(-90) (-89.75; -179.75)
Data for G4M

- Percentage of accumulated deforestation until 2008
- Percentage of planted forest in 1996 and 2006
- Euclidean distance to the nearest paved road, nearest non-paved road, nearest mineral deposit, and nearest road in 2006
- Price of wood land in 2002
- Percentage of integral protection conservation units in 2006
- GDP in 2002
- Value of rural credit in 1996 and 2006
- Percentage of conservation units in 2002
- Priority municipalities in control of deforestation in 2007
- Percentage of total area of settlements in 1996 and 2006
- Density of population in 1996 and 2006
- Strength of connections to ports, to Sao Paulo, Rio de Janeiro, nearest capital in the Legal Amazonia, and Recife through roads network in 2006
- PVM GDD0 and GDD5 Indexes, as well as seasonal and humidity index
- Total urban and rural populations in 1996 and 2006
- Percentage of indigenous land areas in 1996 and 2006
G4M

**Diagram:**
- **G4M**
  - Data flow to **PostgreSQL**
  - Import original data (shape and tiff)
  - Export TerraView
  - Amazonia (TerraLib)

**Details:**
- Import data
- 2013 data
- Original data (shape and tiff)
- Export 1st Jan
EPIC

- Environment Policy Integrated Climate (EPIC) Model
- Developed by Texas AgriLife Research & Extension Center
- Written in FORTRAN
- No spatial scale
- Temporal scale: 1 day
Figure 1: EPIC0509 File Structure

EPICCONT.DAT
Control File, setting parameters that are constant for entire study or group of runs. “UTILITY”

EPICFILE.DAT
(associates 15*.dat file names)
Internal File Reference
File Name to be used “UTILITY”

EPIC0509. exe
“EPIC0509”

Site2110.dat (default)
List of Sites (Number and Filename.sit) “UTILITY SITELIST”

Filename.sit (one file per site) “UTILITY SITE”

Site2110.dat (default)
List of Operated
Schedules (Number and Filename.ops) “UTILITY OPSCLIST”

FILENAME. ops (one file per operation schedule) “UTILITY OPSC”

OpSC2110.dat (default)
List of Soils (Number and Filename.sol) “UTILITY SOILLIST”

Filename.sol (one file per soil) “UTILITY SOIL”

SoIL2110.dat (default)
List of Wind Weather Stations (number and Filename.wnd) “UTILITY WINDLIST”

FILENAME. wnd (one file per Wind Weather Station) “UTILITY WIND”

WindMO.dat (default)
List of Weather Stations (number and Filename.wp1) “UTILITY WPMLIST”

FILENAME. wp1 (one file per Weather Station) “UTILITY WPM”

Output files (28 per run)
Runname.out standard output
Runname.acm annual cropman
Runname. ave annual summary
Runname.dhy daily hydrology
Runname.dps daily pesticide
Runname.mfs monthly flipm
Runname.mps monthly pesticide
Runname.mcm monthly cropman
Runname. dcs daily crop stress
Runname. sco summary operation cost
Runname. abr annual biomass C&N table
Runname. csn daily soil organic C&N table
Runname. scn summary soil organic C&N table
Runname. dgn daily general output
Runname. dtw daily soil water
Runname. ace annual crop yield
Runname. aco annual cost
Runname. dsl daily soil table
Runname. msw monthly water N cycle
Runname. abr annual biomass root weight
Runname. atg annual tree growth
Runname. swm monthly output to SWAT
Runname. aps Annual pesticide
Runname. dwc daily water cycle
(where xxxx is Run #)
Simulation Units

PX30

HRU

Country

HRU & PX30 zone

- real pixel area (ha)
- geographical position of SimU delineation
- reference to climate data
- mean altitude
- representative slope
- dominant STU (reference to analytical data)

SimU delineation

geo-spatial database

non-geo-spatial database

SimU delineation

Land cover class

- Cropland
- Other agricultural land
- Grassland
- Forest
- Wetland

Cropland LU

- High input
- Low input
- Irrigated (high)

= SimU (for cropland)

crop share

- Wheat
- Barley

= SimU (for other LC than cropland)
Data to EPIC

Spatially explicit
- Pasture, agriculture, forest, forest plantation (TerraClass)
- Total area of sugarcane 2002-2007
- Percentage of degraded forest in 2007
- Humidity index
- Regional climate data (daily weather, solar radiation, precipitation, humidity, ...) - grided

By municipalities (shapefile)
- Average summer/winter/autumn/spring precipitation
- Average summer/winter/autumn/spring temperature
- Percentage of high/low/very low fertility soils – other soil maps?
- Minimum temperature
- Fertilizers
EPIC

EPIC files

EPIC infrastructure

simU and shapefiles (original data)

TerraView

Amazonia (TerraLib)

1\textsuperscript{st}/Jan

simU shapefiles
- land use competition between the major land-based production sectors
- 18 crops, pasture, forest
Data to GLOBIOM

Data related to years 2000, 2005, and 2010 (data will be adapted for such years when data is not available, such as TerraClass for 2008):

- Pasture, agriculture, forest, forest plantation, selective logging (permanent/ temporal agriculture could also be used for the Brazilian model)
- Density of population
- Transportation costs from the center of the SimU to the nearest port, to the nearest capital, and to São Paulo (time and distance)
- Percentage of protected (integral protection and sustainable use)/indigenous/legal reserve areas (remove the protected areas and compute a percentage according to the bioma)
Data to GLOBIOM

Data related to years 2000, 2005, and 2010 (data will be adapted for such years when data is not available, such as TerraClass for 2008):

- Prices of cattle/soybean/sugarcane
- Number and value of fines
- Price of land (clean land and forest)
- Number/area of small/medium/large properties
- Technological factors (Number of tractors, ...)
- Number of cattle
- GDP
- Municipalities on the black list
- Rural and urban population
- sidra.ibge.gov.br for productivity, price, and land use of each of almost 18 uses (take a look)
GLOBIOM Integration

- **GLOBIOM**
  - import GeoTiff, CSV
  - GMS files
  - export TerraView
  - GDX files
  - simU shapefiles
  - 2013 data

- **TerraView**
  - import GeoTiff, CSV
  - export 1st/Jan

- **Amazonia (TerraLib)**
GLOBIOM Integration

- GLOBIOM
  - data
  - GMS files
  - import
  - GMS directly?

- GMS files
  - 2013 data
  - export
  - 1st/Jan

- TerraView
  - Amazonia (TerraLib)

- GDX files
  - simU shapefiles
Final Remarks and future steps

1. Computational environment ready to generate the data at chronos.dpi.inpe.br
2. Review the attribute list to generate a final version.
3. Compare generated land use/cover from different sources to investigate the agreement between them:
   1. spatialized census data for 1996/2006
   2. TerraClass for 2008
   3. MMA/Funcate 2002
   4. IBGE 2009
   5. GLC (200)