Brief introduction to GRASS GIS Temporal Framework

GRASS GIS Temporal Workshop

September, 2013
Motivation

How to handle big data in GIS?

- different sources – satellites, lidar, results from models and simulations
- different temporal and spatial resolution

Example: Reconstructed MODIS Land Surface Temperature Dataset (4 maps per day since 2000, 250 m resolution)\(^1\)

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GRASS GIS Temporal Framework (TGRASS)

- fully integrated in GRASS GIS 7
- main author Sören Gebbert

Functionality available through

- t.* modules
- Python API for power users and developers
Time concepts

interval vs. instant

- not always so easy to decide which to use
- precipitation as interval vs. current temperature as instant
- generally, when both make sense, use interval
- interval defined with start time and end time: \([\text{start}, \text{end})\)

absolute vs. relative

- again, not always so easy to decide which to use
- absolute date time format: 2013-10-15 13:00:00
- relative: 4 years, - 90 days
Approach

We do not work with individual map layers but with *space-time datasets*. Dataset is a collection of individual map layers with assigned time stamps.

- strds – space-time raster dataset
- stvds – space-time vector dataset
- str3ds – space-time 3D raster dataset

Note that raster, vector and 3D raster data is still stored in standard GRASS database, and temporal framework manages the temporal metadata in separate temporal database.
Advanced concepts
Temporal granularity

Granularity is a characteristic of a spatio-temporal dataset similar to resolution.

Temporal granularity is the greatest common divisor of the temporal extents (and possible gaps) of all maps of the dataset.
### Temporal topology

Temporal topology analyzes temporal relations between time intervals.

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Y</td>
<td>before/after</td>
</tr>
<tr>
<td>X</td>
<td>Y</td>
<td>precedes/follows</td>
</tr>
<tr>
<td>X</td>
<td>Y</td>
<td>overlapped/overlaps</td>
</tr>
<tr>
<td>X</td>
<td>Y</td>
<td>starts/started</td>
</tr>
<tr>
<td>X</td>
<td>Y</td>
<td>during/contains</td>
</tr>
<tr>
<td>X</td>
<td>Y</td>
<td>finishes/finished</td>
</tr>
<tr>
<td>X</td>
<td>Y</td>
<td>equals</td>
</tr>
</tbody>
</table>
Temporal sampling

Temporal sampling is used to determine the state of one process during a second process.

Sampled dataset

| \(X_1\) | \(X_2\) | \(X_3\) | \(X_4\) |

Sample dataset

| \(Y_1\) | \(Y_2\) | \(Y_3\) |

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| \(Y_1\) | — | — | \(X_1\) | — | — | — | — |
| \(Y_2\) | \(X_2, X_3\) | \(X_2, X_3\) | — | \(X_1\) | — | \(X_4\) | — |
| \(Y_3\) | \(X_4\) | — | — | — | \(X_4\) | — | \(X_3\) |


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\(\text{time}\)
GRASS GIS 7  Free download for MS Windows, Mac OSX, Linux and source code: http://grass.osgeo.org/download/

Addons (user contributed extensions):  
http://grasswiki.osgeo.org/wiki/GRASS_AddOns

Sample data  Rich data set of North Carolina (NC) available as GRASS GIS location and in common GIS formats:  
http://grass.osgeo.org/download/sample-data/

User Help  Mailing lists (in different languages):  
http://grass.osgeo.org/support/

Wiki including FAQ:  
http://grasswiki.osgeo.org/wiki/

Manuals:  
http://grass.osgeo.org/documentation/manuals/