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DEVELOPMENT OF AN OPEN SOURCE TOOLBOX FOR THE ANALYSIS AND VISUALIZATION OF REMOTELY SENSED TIME SERIES

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- ✓ How to reduce …
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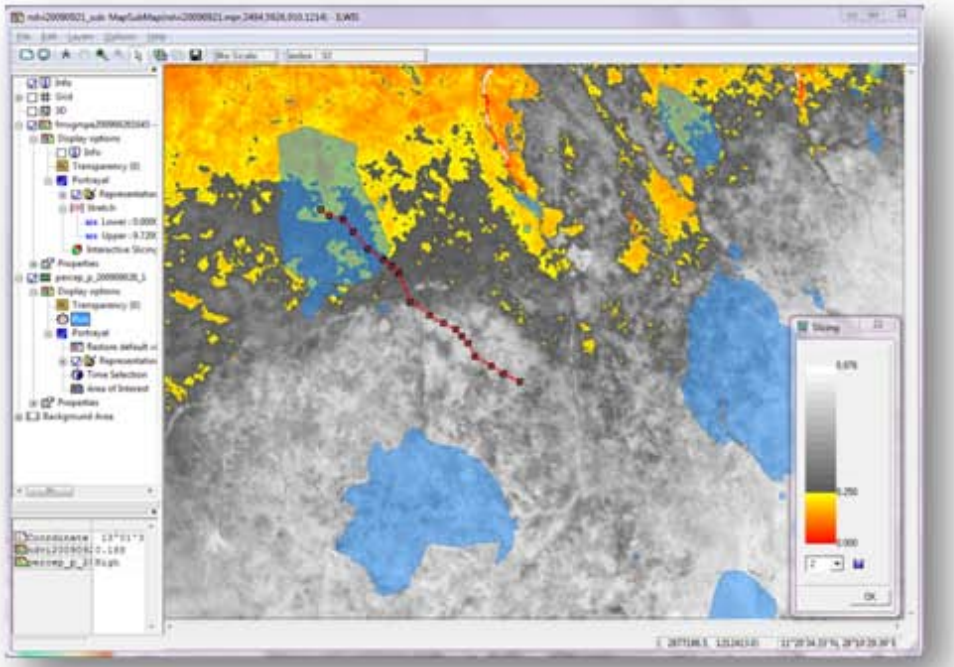
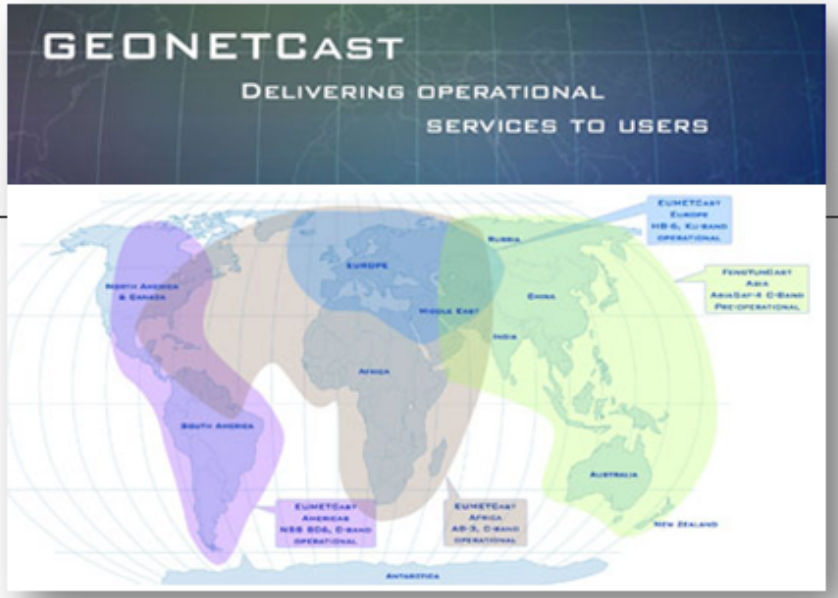


PROBLEM



http://www.earthobservations.org/geonetcast.shtml

Long time series of RS data available to study behaviour of dynamic phenomena

Problems if animated with few controls

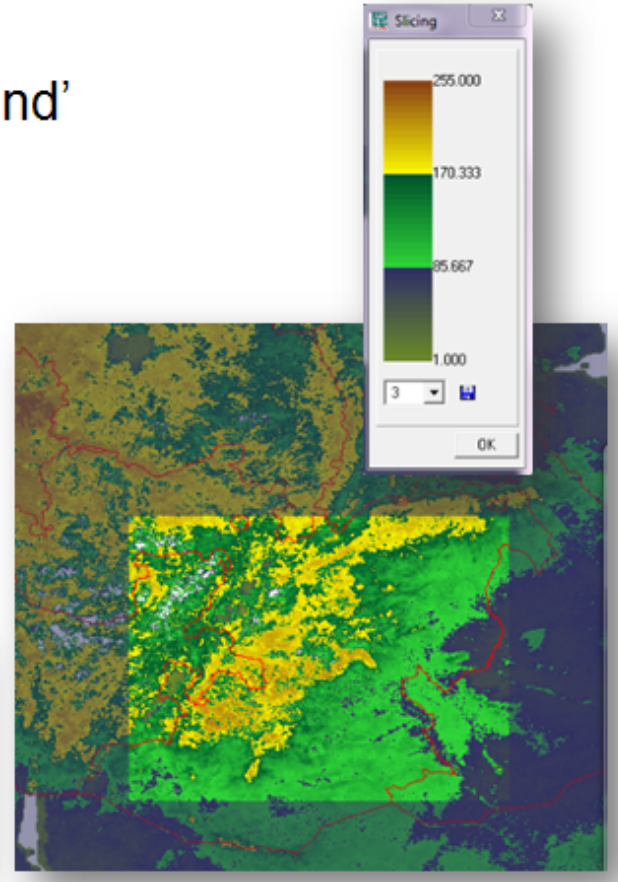
- ✓ extraction of subsets
- ✓ comparisons
- ✓ change blindness → mixture of bottom-up (driven by visual info) and top-down (attention- or task-driven)

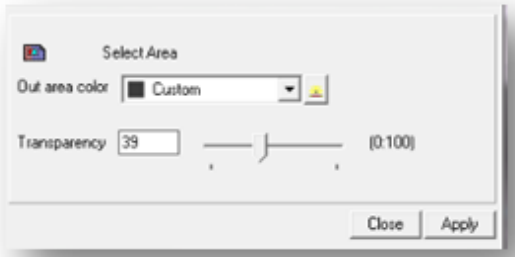
Attention: crucial role in change perception, but limited !

HOW TO REDUCE ...

Our aim is to facilitate
top-down processing through effective (bottom-up) visualization:

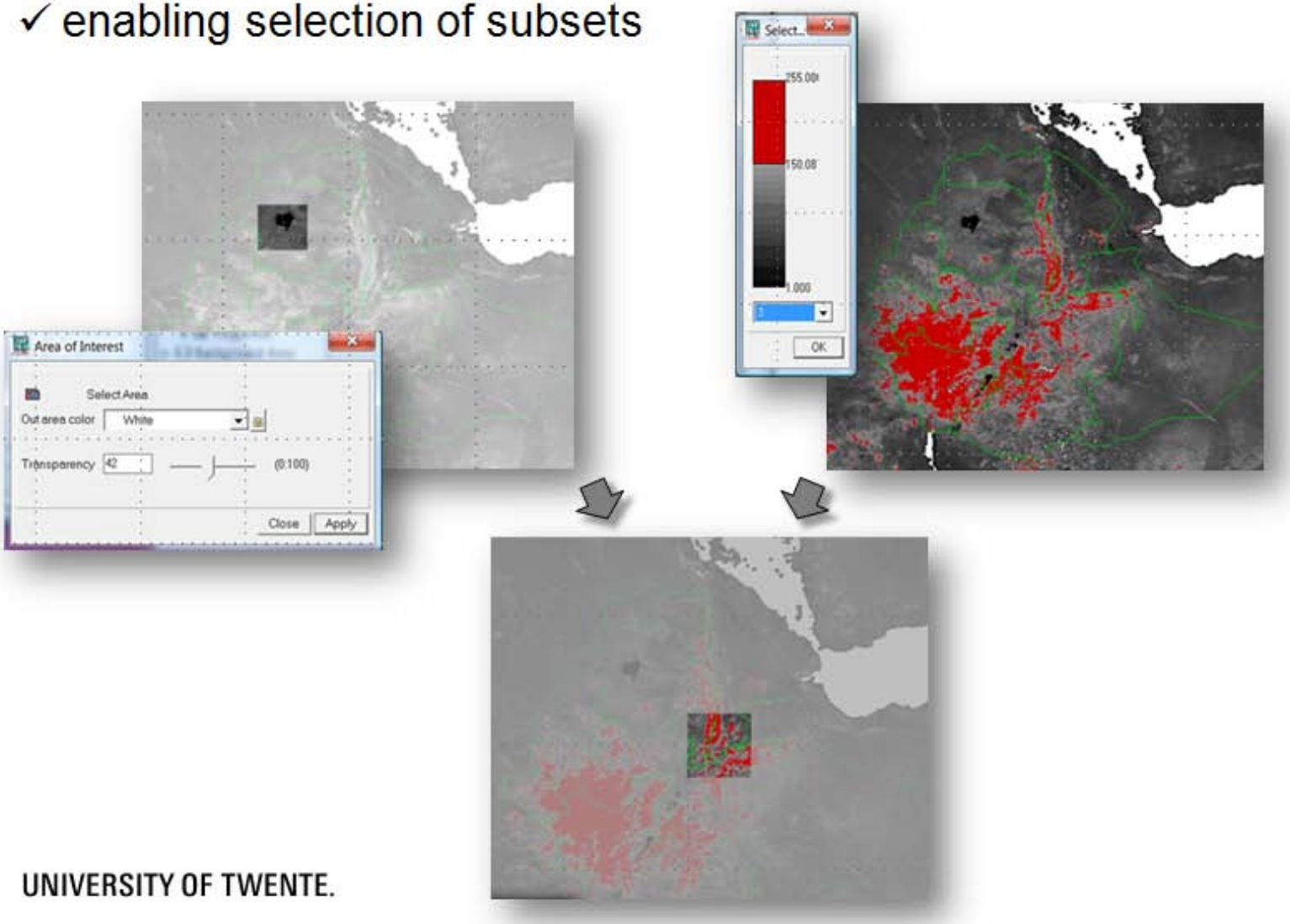
- by letting 'figures' stand out against a 'ground'
  - ✓ tracking of objects → polygons
  - ✓ classification
  - ✓ enabling selection of subsets
  - ✓ option to keep the context ('figure') around a selection visible, but subdued ('ground')





HOW TO REDUCE ...

✓ enabling selection of subsets

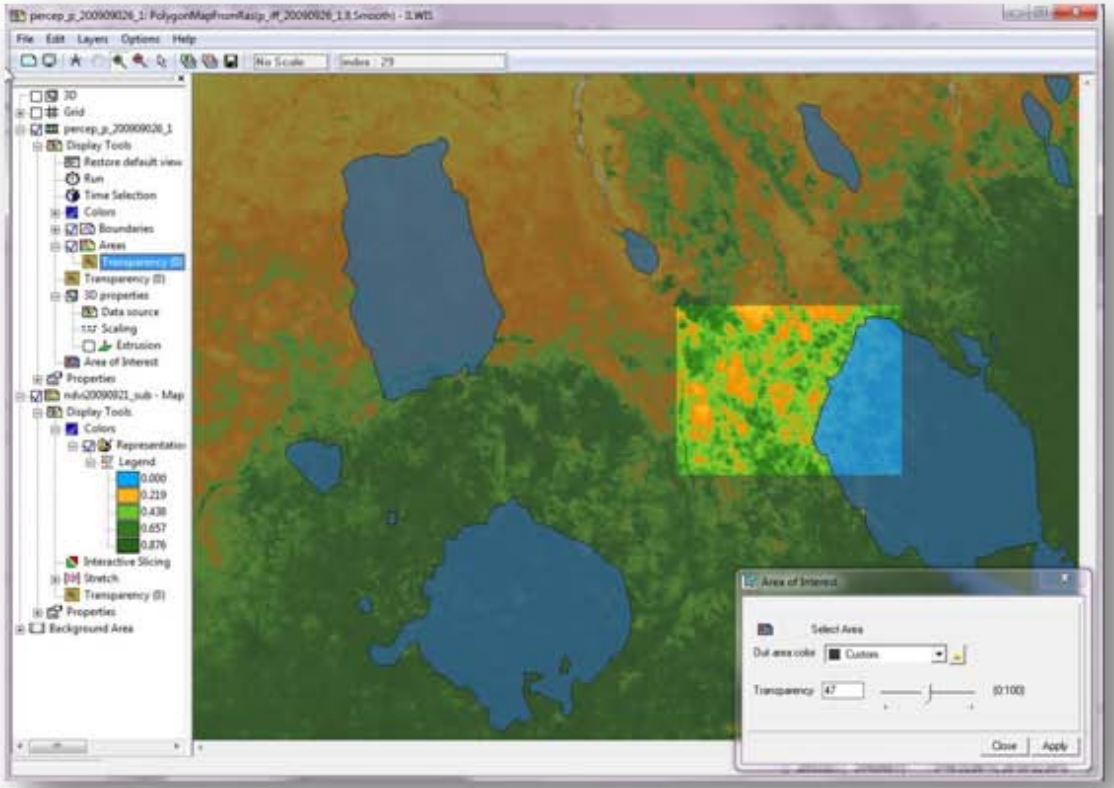


HOW TO REDUCE ...

- by adding other functions
  - ✓ multiple layers
  - ✓ control of display speed

  ....

Implementation:
extension of ILWIS
for visual exploration
of animated time series



ILWIS open 3.7

http://52north.org/

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USE OF THE TOOLBOX

Ethiopean lowlands:

- ✓ serious droughts
- ✓ flash floods

Explore relations vegetation ⟺ precipitation:

- ✓ Spot-5 VEGETATION: NDVI
- ✓ MSG: Multi-Sensor Precipitation Estimates

Algorithm detects precipitating features and binds them into objects

- ✓ polygons
- ✓ paths

1. Fix feature index *I* in previous time step *i-1*
2. For a given feature index *I*, determine feature index k_{MO} in current time step *i* with maximum spatial overlap:

$$k_{MO}(I) = \textbf{\textit{argmax}}\ [Size(F_I^{i-1} \cap F_k^i)]$$

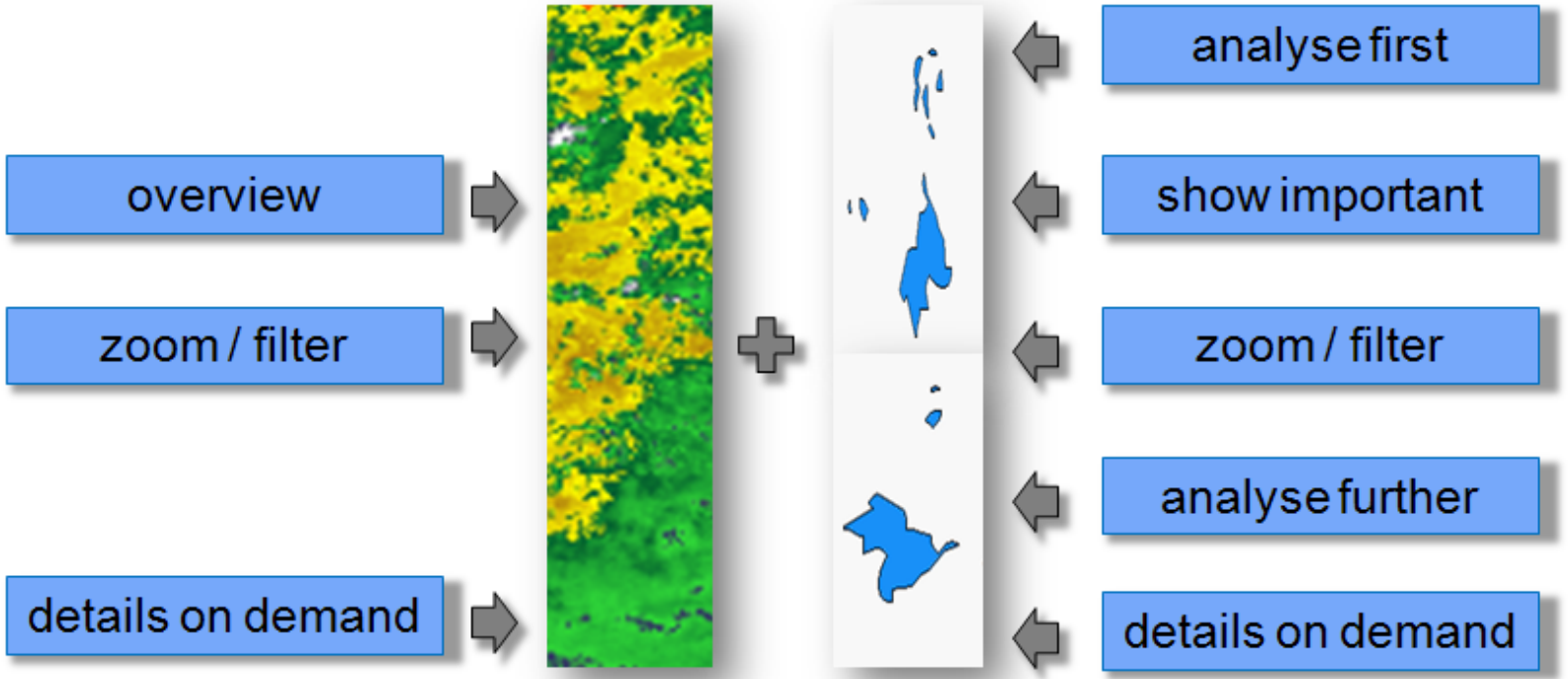
3. For a given feature index k_{MO}, determine feature index l_{MO} in previous time step *i-1* with maximum spatial overlap:

$$l_{MO}(k_{MO}) = \textbf{\textit{argmax}}\ [Size(F_I^{i-1} \cap F_{k_{MO}}^i)]$$

4. Check if feature indices are the same: $l_{MO}=I$

USE OF THE TOOLBOX

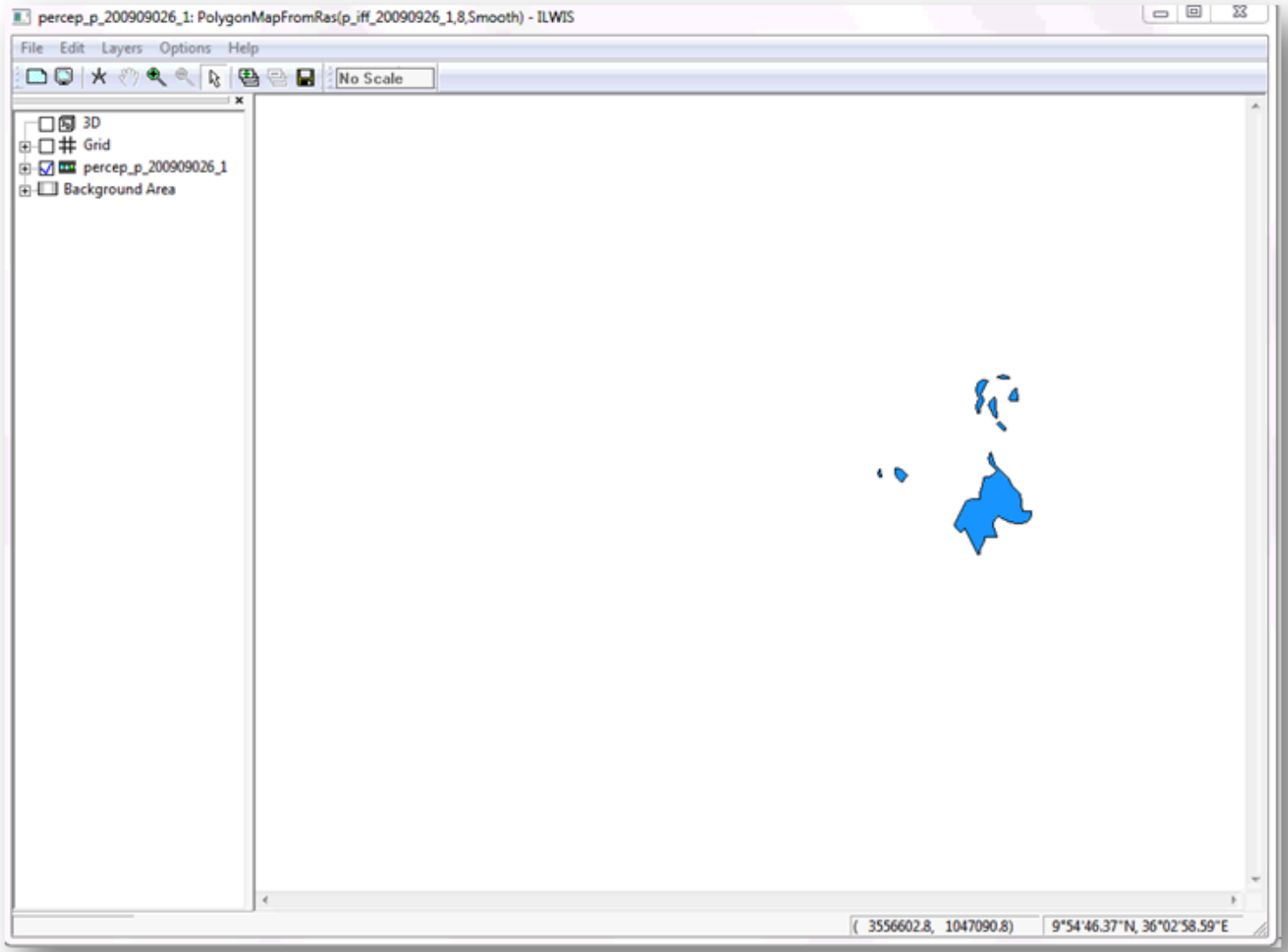
Use strategies



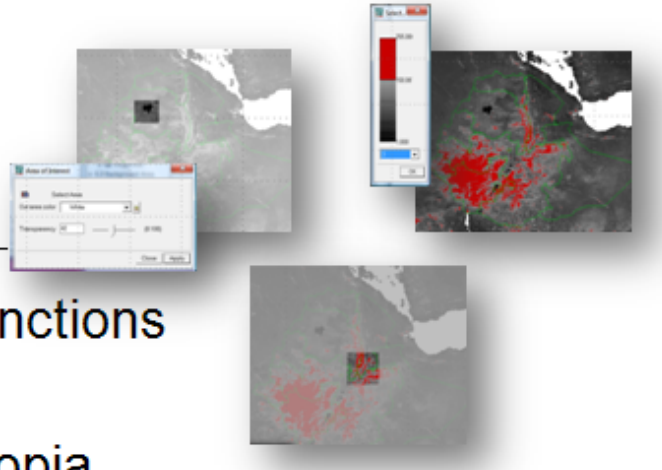
Shneiderman, 1996

Keim et al., 2006

USE OF THE TOOLBOX



USE OF THE TOOLBOX



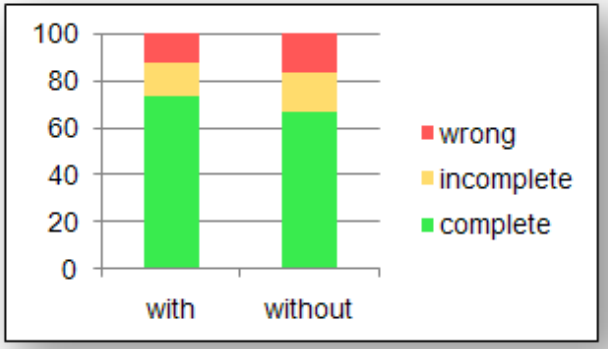
Early evaluation of selected visualization functions

Monitoring tasks – NDVI time series of Ethiopia

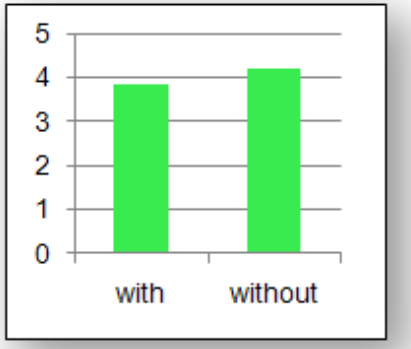
- ✓ 8 participants ('with') : toolbox with the new functions
- ✓ 8 participants ('without') : toolbox without the new functions

Methods used: think aloud, observation, questionnaires, interview

Effectiveness



Efficiency (av. time / task, minutes)



Satisfaction:

comparable (high) rates, but 'with' had more confidence in the tasks

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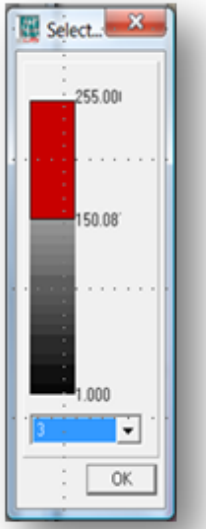
USE OF THE TOOLBOX

Less difference than expected due to bugs / deficiencies



Improvements made in:

- ✓ selection of attribute values
- ✓ display of variations within selected values
- ✓ dynamic link between legend and display area
- ✓ speed control and interface

Main rendering: by the graphics hardware (OpenGL)

Potential bottlenecks:

- ✓ raster : amount of available graphics RAM
- ✓ vector : number of triangles needed to render the polygons

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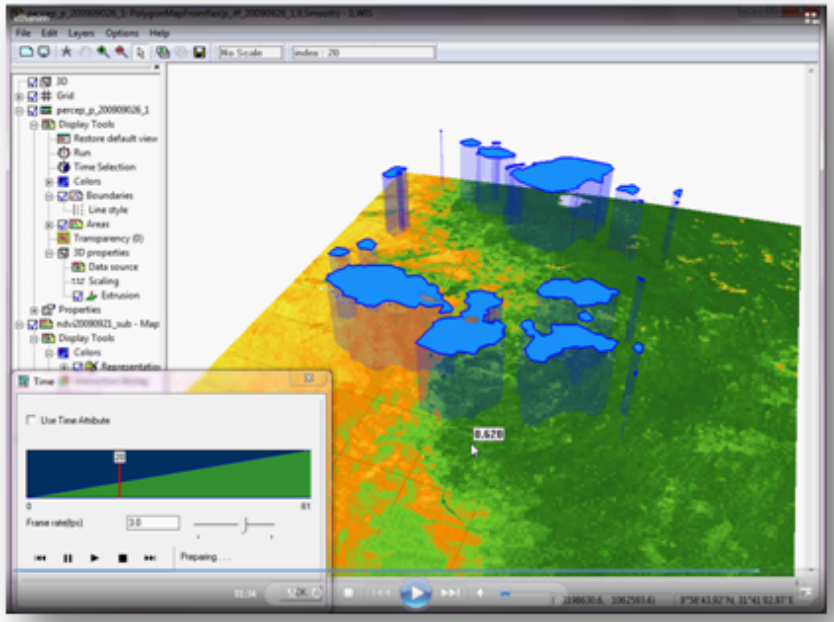
CONCLUSIONS

Single Open Source environment:

- ✓ access to GEONETCast data
- ✓ pre-processing
- ✓ analytical and animation functions

α - version ready

but further work to be done …



FUTURE

Preprocessing of time series:

- ✓ projection / resampling of images
- ✓ filling missing pixels
- ✓ image smoothing

Analytical / visualization functionality:

- ✓ tracking algorithms
- ✓ quantification / visualization of attributes
- ✓ options to compare / synchronize time series
- ✓ optimization of the temporal legend

Evaluation: do the tools reduce change blindness !?

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