FOSS4G software in university geomatics education

A case study integrating teaching and research

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OSGeo
Your Open Source Compass

Carleton
UNIVERSITY

FOSS4G in academia

- advantages
  - case study
- challenges
- responses

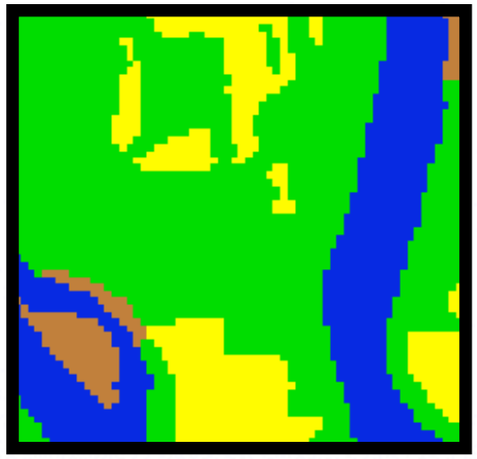
Advantages

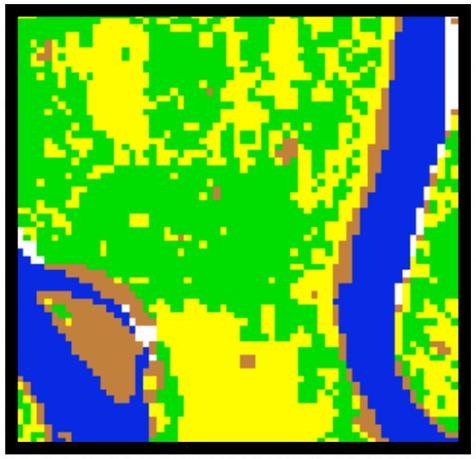
- the usual suspects?
  - transparency (Open Source)
    - others, yours
  - portability, feasibility*
  - support (speed)*

Example: map comparison

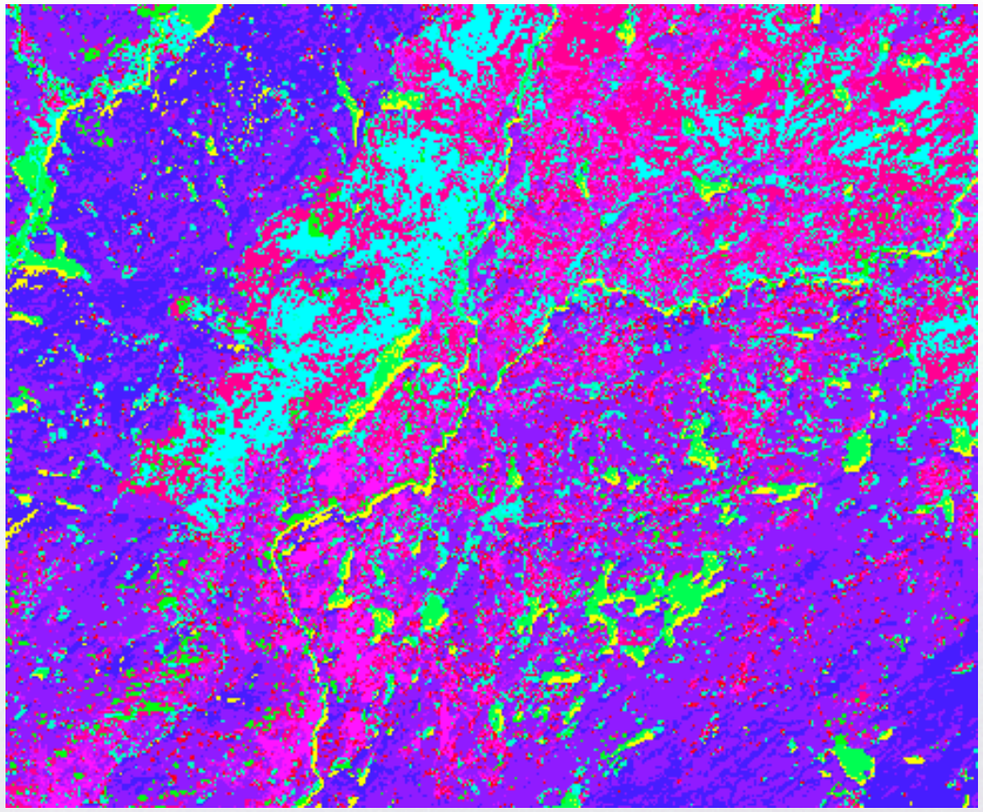
- Research project investigating correspondence between alternative forest cover databases
  - initial contract with Canadian Forest Service, papers
  - 3 undergraduate thesis projects
  - contribute back a GRASS module

Land use / land cover maps





- Important in many applications
- often created using per-pixel image classification
  - convenient
  - standardized methods
  - data availability



Where do the maps come from?

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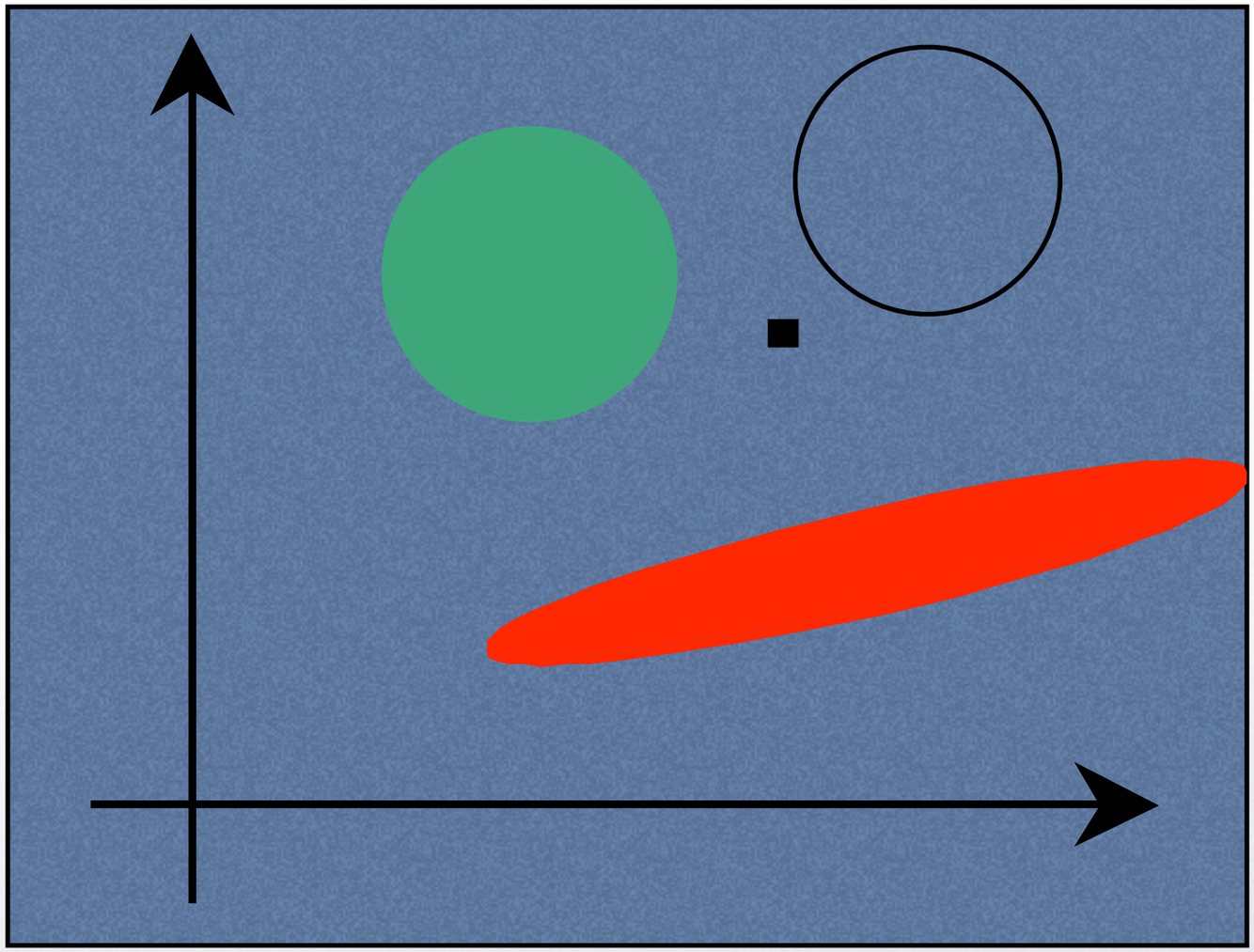
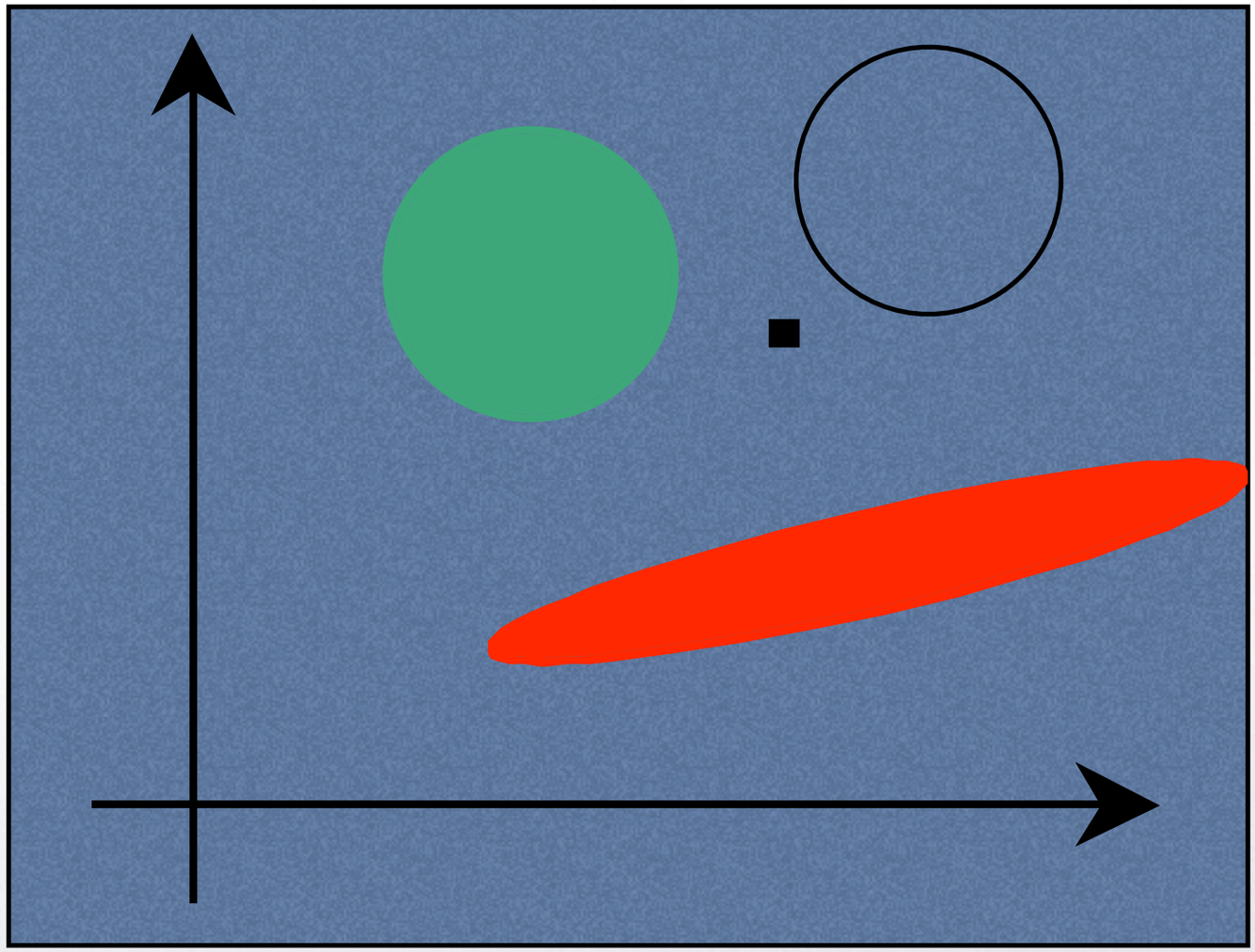
- some classification scheme which identifies clusters in n-D space
- normally only the final assignment to one class is used
- assessments typically global; useless for judging how reliable a prediction is at a particular point
- for each pixel, there are likelihoods of belonging to all possible classes based on distance away from the clusters



Mahalanobis Distance

$$P(X|c) = \log(\det|V_c|) + (X-m_c)T*V_c - 1*(X-m_c)$$

- $P(X|c)$ = likelihood of a pixel belonging to class
- V_c = variance-covariance matrix
- $X-m_c$ = distance between the pixels and the cluster centroids
- classification provides m_c and v_c

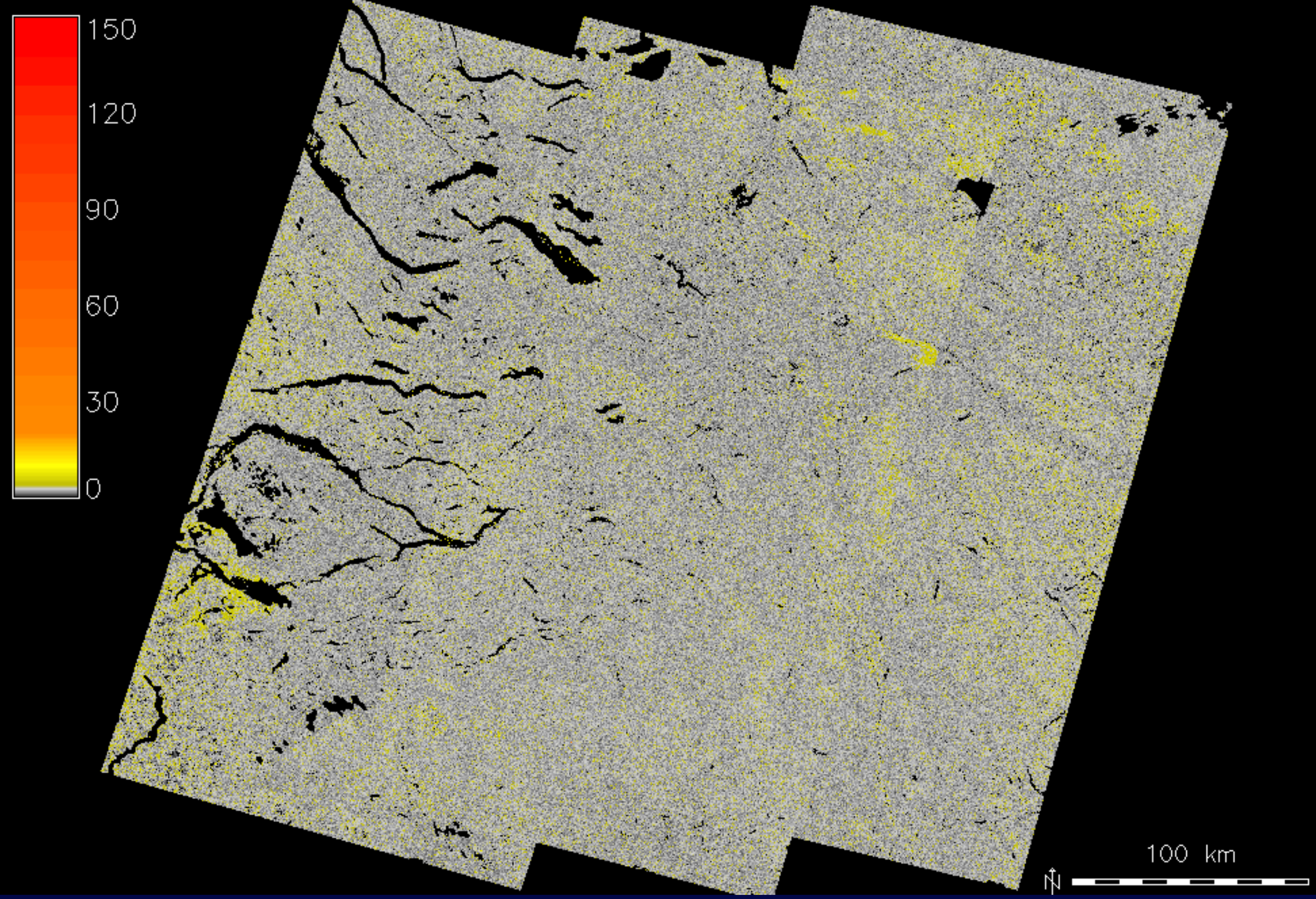


Standardized distance ($X-m_c$)

How far to the closest cluster?

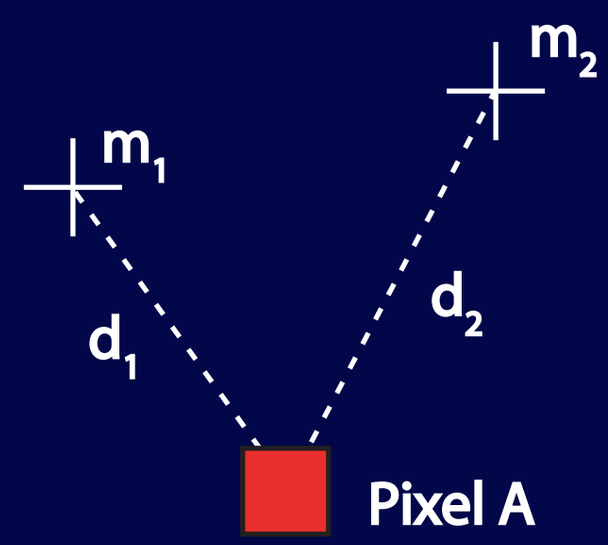
$$Dist = \sqrt{\left(\frac{X - m_1}{v_1}\right)^2 + \ldots + \left(\frac{X - m_n}{v_n}\right)^2} \quad n = \#classes$$

```
r.mapcalc clststddist = sqrt(
     exp((tm1 - cluster.tm1avg) / cluster.tm1stddev, 2)
   + exp((tm2 - cluster.tm2avg) / cluster.tm2stddev, 2)
   + exp((tm3 - cluster.tm3avg) / cluster.tm3stddev, 2)
   + exp((tm4 - cluster.tm4avg) / cluster.tm4stddev, 2)
   + exp((tm5 - cluster.tm5avg) / cluster.tm5stddev, 2)
   + exp((tm7 - cluster.tm7avg) / cluster.tm7stddev, 2)
   + exp((texture - cluster.textureavg) / cluster.texturestddev, 2))
```



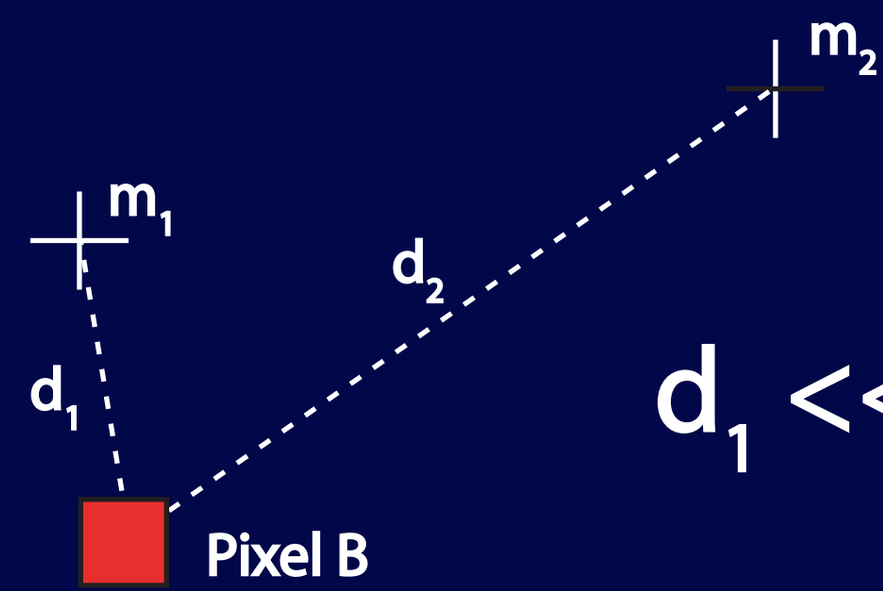
Misclassifications in areas with larger distances

Next cluster?



$d_1 < d_2$

- GRASS/R links
- 80x80 regions chosen in GRASS, read in to R
- determine ratio between first and second cluster distances

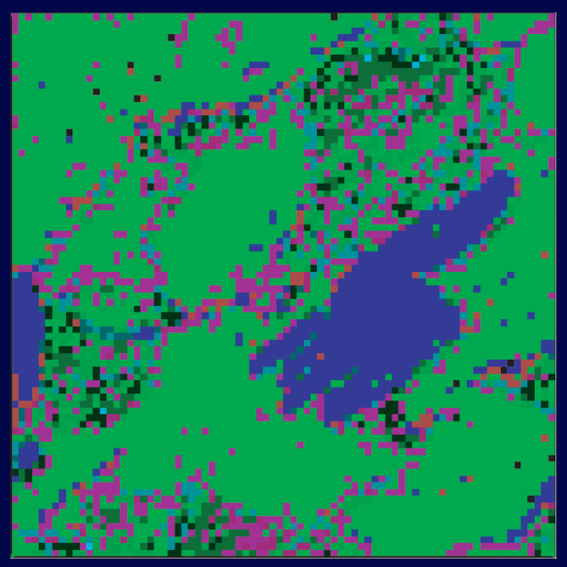


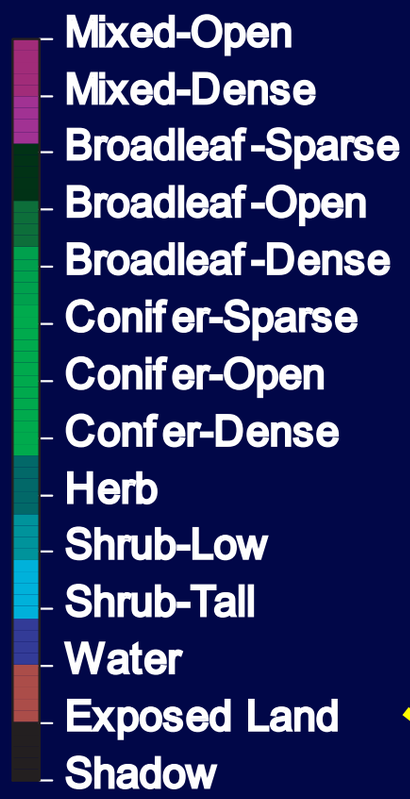
$d_1 << d_2$

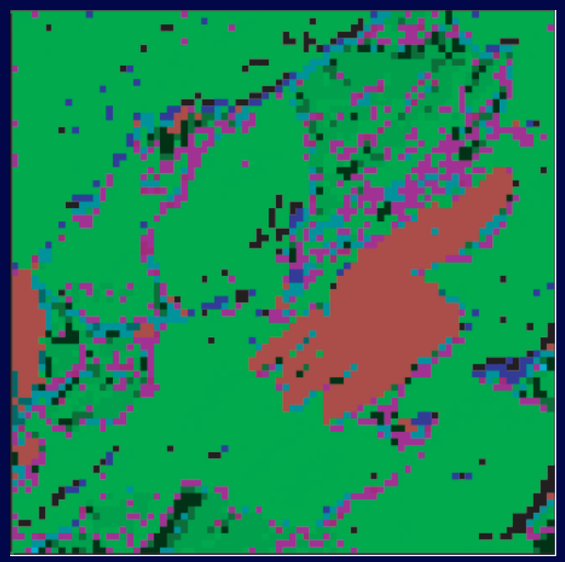
```
args(secondcluster)
function (inputclass = classes$classes, outclass = "secondclass",
    nlayers = 4, clusclas = "clusclastbl", cluscentres = "4822",
    clustermaps = clusters, nclusters = 241, nbands = 7, tmdata = tm4822,
    nrows = 80, ncols = 80, stddist = TRUE, verbose = TRUE)
```

Potentially confused classes

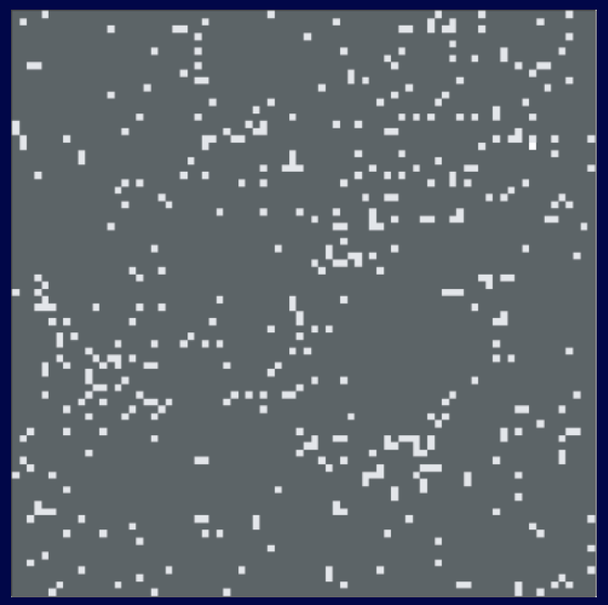
Second Closest







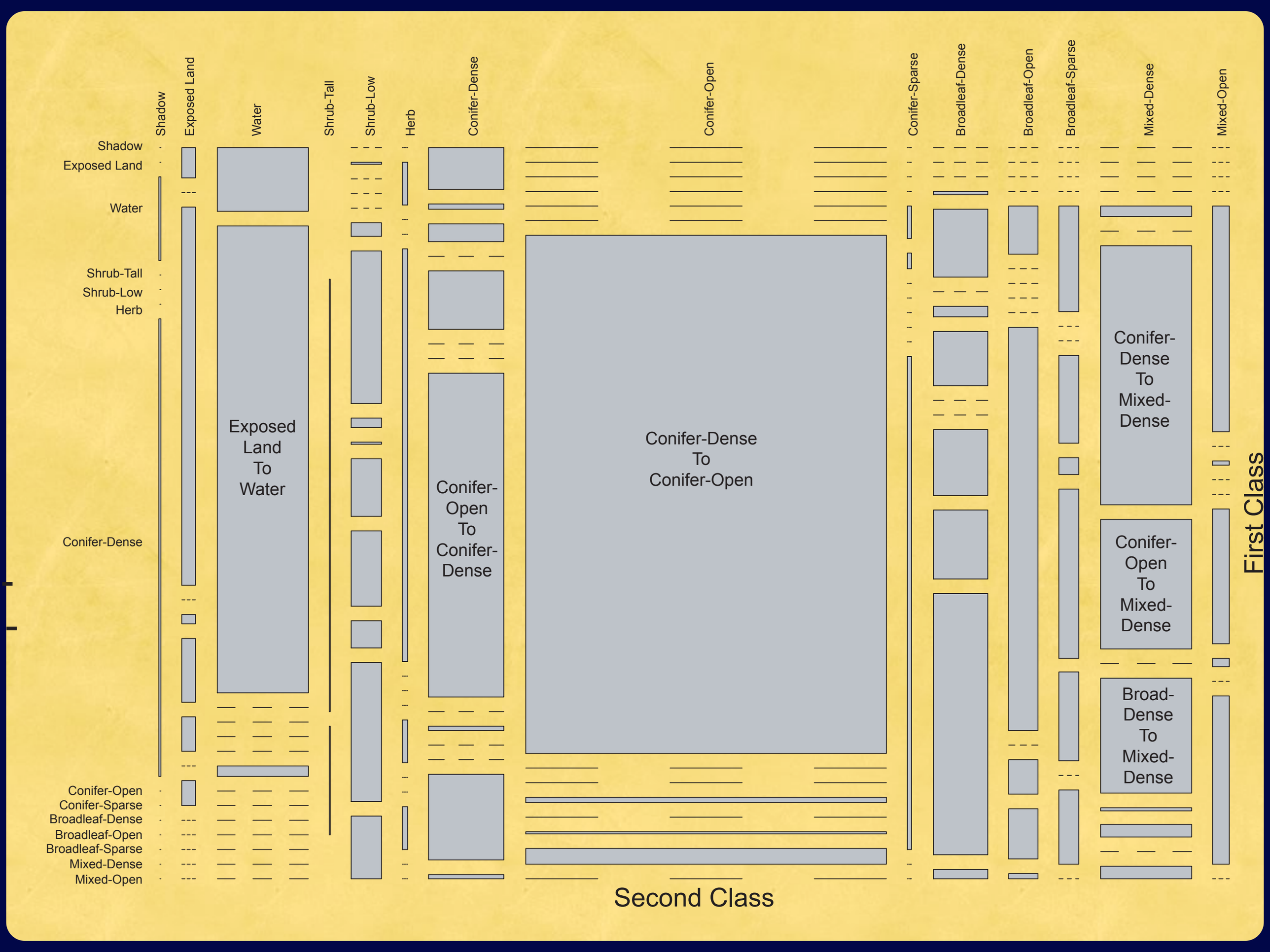
Closest



Non-significant

Significant

Difference Ratio
Z-score significance


Shadow
Exposed Land
Water
Shrub-Tall
Shrub-Low
Herb
Conifer-Dense
Conifer-Open
Conifer-Sparse
Broadleaf-Dense
Broadleaf-Open
Broadleaf-Sparse
Mixed-Dense
Mixed-Open
Exposed Land To Water
Conifer-Open To Conifer-Dense
Conifer-Dense To Conifer-Open
Conifer-Dense To Mixed-Dense
Conifer-Open To Mixed-Dense
Broad-Dense To Mixed-Dense
First Class
Second Class

(Last year's) conclusions

- cluster distances enable method to evaluate per-pixel classification confidence
- for algorithm development, R, GRASS/R & friends provide a good environment to test ideas (especially for those of us with "rusting" C skills)
- some tasks challenge R's interpreted, memory resident; R is not intended to be a GIS (even with spgrass6)
- getting the algorithm right in R allows faster development of a GRASS module (!!)*

r.secondclosest

Second try at a secondclosest module.

Options | Output

- [ ] Quiet
- [ ] standardize distances

Name of input raster map: (input: name, required)

Name of an output layer to hold closest class: (firstclassout: string, required)

Name of an output layer to hold distance to closest class: (firstdistout: string, required)

Name of an output layer to hold second closest class: (secondclassout: string, required)

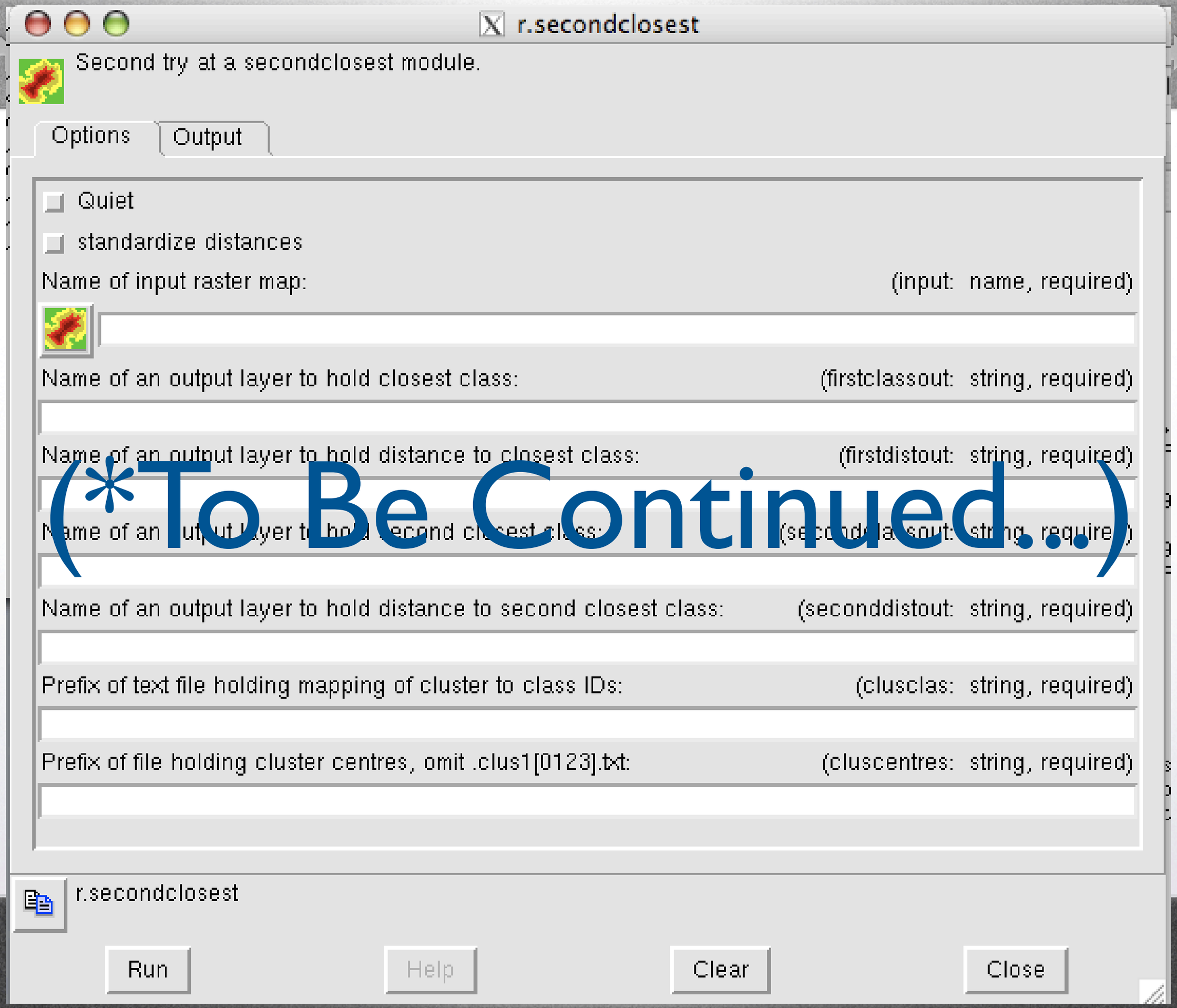
Name of an output layer to hold distance to second closest class: (seconddistout: string, required)

Prefix of text file holding mapping of cluster to class IDs: (clusclas: string, required)

Prefix of file holding cluster centres, omit .clus1[0123].txt: (cluscentres: string, required)

r.secondclosest

Run | Help | Clear | Close



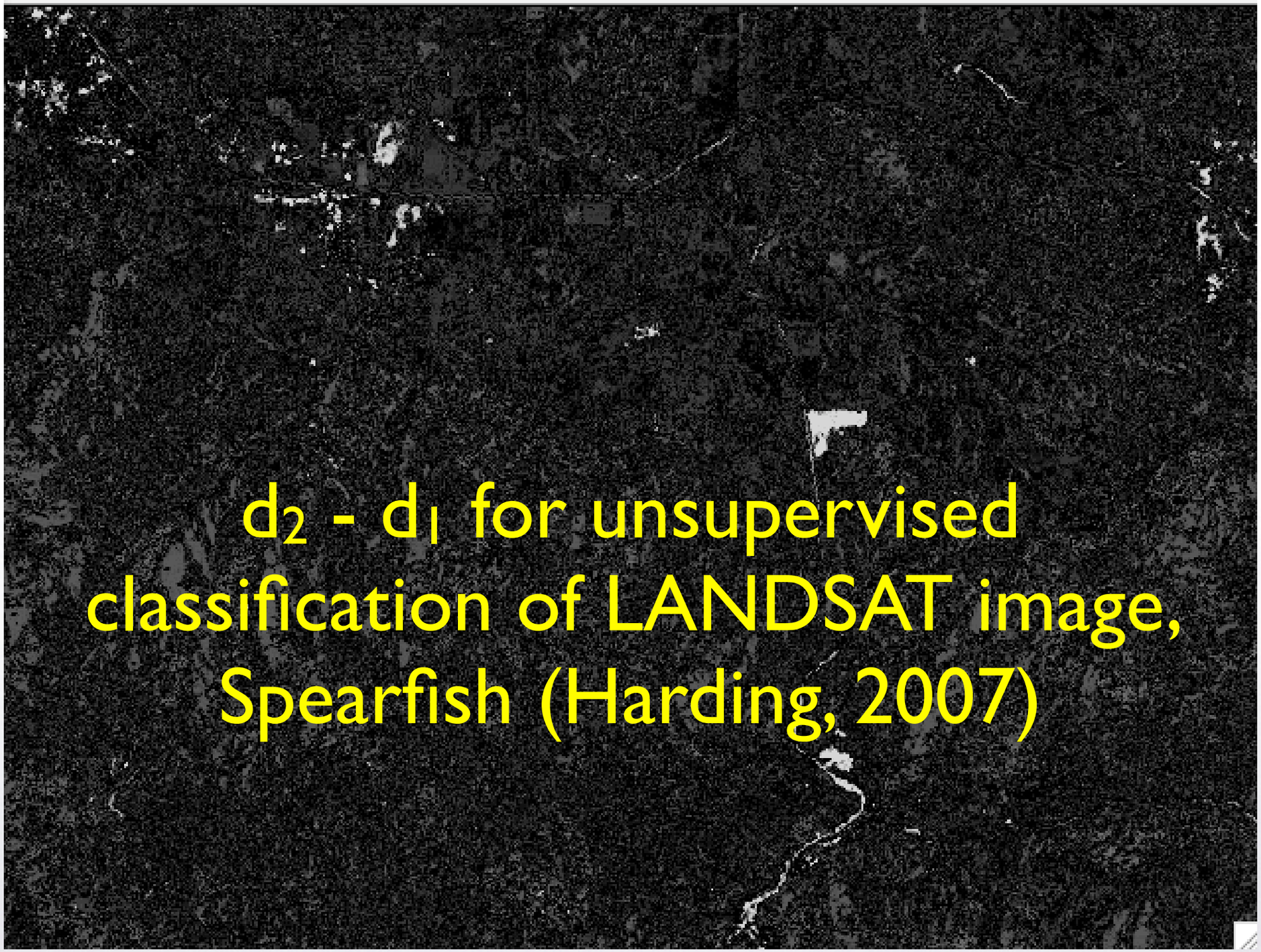
(*To Be Continued..)

On the other hand...

- R implementation - great for (geography) student projects
- even if student doesn't have programming background, can read, understand, modify R code, and can run on any computer

Yes, Spearfish!

d_2 - d_1 for unsupervised classification of LANDSAT image, Spearfish (Harding, 2007)



d_2 - d_1 for unsupervised classification of LANDSAT image, Spearfish (Harding, 2007)

Other “infiltration”

- good existing geomatics program @ Carleton
- how to best bolster curriculum, not replace?
- second year Intro to GIS: brief exposure
- fourth year classes: evolving, expanding

Geomatics

Geomatics at Carleton

Why do it?

Are you interested in: the geographical aspects of environmental and world issues, satellite images, computer graphics and maps, acquiring practical and useful work skills and experience in the environmental field?

What is it?

Geomatics is the acquisition, management, analysis, and display of geographic information. It uses information technology to analyse problems involving the physical, social and economic environment and is built on knowledge from geography, cartography and remote sensing.

Career Opportunities

The ability to work with geographic data and the related technology opens many doors to graduates, with career opportunities in Federal government agencies, local governments and in commercial enterprises. The graduates of our program are employed in:

- Remote sensing and image analysis
- Web-based mapping
- Real estate and market analysis
- Training and education
- Software development
- Impact assessment
- Resource management

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Web Mapping Projects

Carleton Lab 2005

Documentation

Carleton GEOG4008 Chameleon exercise, Winter 2005

backlinks...

history similar comment 1 attachment

This section of the Community Site was developed to help the 4th Year GIS students from Carleton University do their Chameleon project. Their project takes place between Feb 16th and March 23rd, 2005.

GEOG4008 students: this is a dynamic document and may be updated as new information becomes available - make sure you check back here each week.

The Data Portal Project -- *Project Overview - "Project Contractual Requirements".*

Chameleon Service Instance Lab — *Lab exercise for March 2nd, 2005.*

- Chameleon Lab: Glossary of Terms -- *Terms used during the Lab/Project.*
- Reference Listing -- *Using the Tiki Directory listing, get important information about related technologies and standards.*
- Chameleon Community Application Gallery -- *To get ideas of different functionality found in Chameleon.*
- Official Chameleon Documentation — Pay special heed to the Application Developers Guide and the "Released Widgets" Documentation.
- OGC WMS List -- *List of Web Mapping Services that can be incorporated into an OGC Context file or MapServer? mapfile.*
- Feb 16th Intro Slides-- *Slides used by Chris Thorne for Feb 16th Intro to Web Mapping. DOWNLOAD (*.zip ~1MB)*

Project Mailing List

nunaliit
Cybercartographic Atlas Framework

HOME | ABOUT | DOWNLOADS | DOCUMENTATION | DEVELOPERS

Welcome to the Nunaliit project

The Nunaliit Cybercartographic Atlas Framework aims to make it easy to tell stories and highlight relationships between many different forms of information from a variety of sources, using maps as a central way to connect and interact with the data.

Currently, nunaliit consists of a schema for documenting the sources and interconnections between data, as well as software to convert that information into a highly interactive web atlas.

Did you know: The word nunaliit means "settlement", "community", or "habitat" in Inuktitut - the name given to the dialects of the **Inuit language** in Canada. Written in Syllabic Inuktitut, it appears at the very top right of this site.

Search This Site

Go!

“Advanced Topics”

- diversify student software experience
- emphasize GIScience, as opposed to software training (read manuals/find help!)
- still have lab exercises, tied to research literature & my projects, leading to class projects
- uncertainty, decision support, interpolation, pattern analysis, data standards and metadata

So what's wrong?

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- institutional support (going it alone)

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  - system administration, security

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- institutional support (going it alone)
  - supporting versus "allowing"/control
  - system administration, security
- pace of change

Mitigation/Solution

- user's groups
- contributions from local firms
- students
- wider support in educational community

Welcome to the Ottawa GRASS (GIS) Users Group — Ottawa GRASS User's Group Portal

http://cemml.carleton.ca:8080/OGUG

upgrading zope

Getting Started | Latest Headlines | CompStuff | News | Home | Teaching | Sustain | Carleton | geoStuff | YOW Weather | PCF login | BabelFish

Plone Upgra... | Welcome to ... | FOSS4G2007 ... | Canadian Ge... | Chameleon.M... | MacDoc.com | Kyng Chaos -...

site map | accessibility | contact

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OGGUG
Ottawa's GRASS GIS Users Group
http://cemml.carleton.ca/OGUG/

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log in | join

you are here: home

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- FOSS4G2006 - Free and Open Source Software for Geomatics Conference Pre-registration
- OGUG server back up - time for change

Welcome to the Ottawa GRASS (GIS) Users Group

by zopeadmin — last modified 2006-09-05 10:38

OGUG - The Ottawa GRASS GIS Users group

We are a group of GIS Practitioners interested in GRASS and associated open source GIS technology, primarily based in the Ottawa area. The Geographic Resource Analysis Support System (GRASS) is one of the oldest and largest open source GIS applications in the GIS Free and Open Source Software (GFOSS) community. GRASS is actively developed and OGUG aims to introduce more people to it.

OGUG was created in Summer 2005, to form a network of GIS practitioners interested in incorporating or replacing their proprietary GIS workflow with Open Source GIS Solutions. OGUG aims to be a central body of knowledge and expertise for the GRASS GIS Community in the Ottawa area. In July, 2006, reflecting exciting developments in the broader Open Source geomatics community, and our interest in all of the geomatics tools that surround the use of GRASS, we met with the Ottawa Mapserver User's group, and any other interested participants, and decided to form a local OSGEO chapter to better serve this interest.

Visit http://cemml.carleton.ca/mailman/listinfo/ogug to see the archives of our original mailing list, but please visit ottawa.osgeo.org for the new mailing list and other resources.

news

- New OSGEO Local Chapter (Ottawa) 2006-09-05
- OGUG server back up - time for change 2006-07-21
- Local OSGEO Ottawa Chapter to form by merger of two GFOSS users groups 2006-07-10
- CCA looking for Geotec volunteers 2006-05-25
- JGrass 2.0 Release

OGGUG
Ottawa's GRASS GIS Users Group
http://cemml.carleton.ca/OGUG/

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Tutorials

Up one level

Series of OGUG Tutorials and workshops

Tutorial 2: Supplemental info concerning GPSMan and v.in.garmin by Dave Sampson — last modified 2006-02-14 12:01

Old school approach to multiple external packages. This is for historical and informational use. The process outlined here does not work. It fails at importing vectors nicely. Interesting tools though

Tutorial 3:Building a GRASS Dataset for Ottawa, Ontario by Dave Sampson — last modified 2006-02-07 19:52

How I learned to Stop Worrying and Love Mining for Free Geospatial Data in Canada

Tutorial 4:Building a National GRASS Framework for Canada by Dave Sampson — last modified 2006-02-07 19:53

How I Continued My Love Affair With Free Geospatial Data in Canada

Tutorial 2: GPS_and_GRASS-v1.4 by Dave Sampson — last modified 2006-02-05 17:12

Introducing v.in.GPSBabel

Tutorial 5 - Raster elevation data in GRASS workshop by Scott Mitchell — last modified 2006-03-25 14:11

This document will structure the workshop being given in Ottawa on March 23, and will

news

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OGUG s
- time for cl

Local OS
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users group

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Geotec volu

JGrass 2
Candidate a

Ottawa Chapter

Contents [hide]

Next Meeting

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Date: October 4th (confirmation?)
Time: 6pm
Location: Fox and Feather Pub (upstairs, small room)
Address: 283 Elgin Street (at Maclaren St)
map


The July meeting turn out (more or less).

Presentation: None as of yet

Business Items:

- TBA
- Eat, Drink, Be Merry

- FOSS4G has been important part of research and research-teaching partnerships

- Ottawa community, evolution of FOSS4G in broader community, have come together to facilitate richer educational experience for students

- focus on individual projects plus multi-purpose tutorials (as opposed to traditional courseware) worked for me; came to hear about and discuss other ideas out there, how we might work together