GEOG457/657 Advanced Remote Sensing

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Lectures: 5-154 Monday/Friday 12.30-13.20

Labs: Wednesdays 16.00-18.50 Matt.McLean@unbc.ca

– start next week in GIS Lab 8-125

Class of 2022:

9 (4+5) took GEOG357 in fall 2020 or 2021

1 Sir Sandford Fleming, 1 Graduate student (657)

Geography/Anthropology, Forest ecology+management, Computer Science

Course syllabus and notes: http://gis.unbc.ca

Overall evaluation

- 40% Lab exercises / assignments
- 10% Class participation – presentations

  High resolution (Jan 28) / MODIS (Feb 7)

- 30% Exams (Feb 18 and Mar 28)
- 20% Project (due Apr 8)

Classes at UNBC: Winter 2022 (GEOG457)
What's happening next week / after ?

Labs face to face in 8-125 (BYO mask)

Lectures: next week still virtual

rest of January: unsure, maybe hybrid ?

rest of semester: unsure, stay tuned

It's a great time to study remote sensing

-> Impact of humanity and warming

-> size of Canada – can only be seen with RS

-> Growth in geospatial technologies (inc. GIS)

-> Launch of many new satellites

e.g. Landsats, Sentinels, DSCOVR, JEDI ……..

-> RS data mostly more current and 'border-free' ….

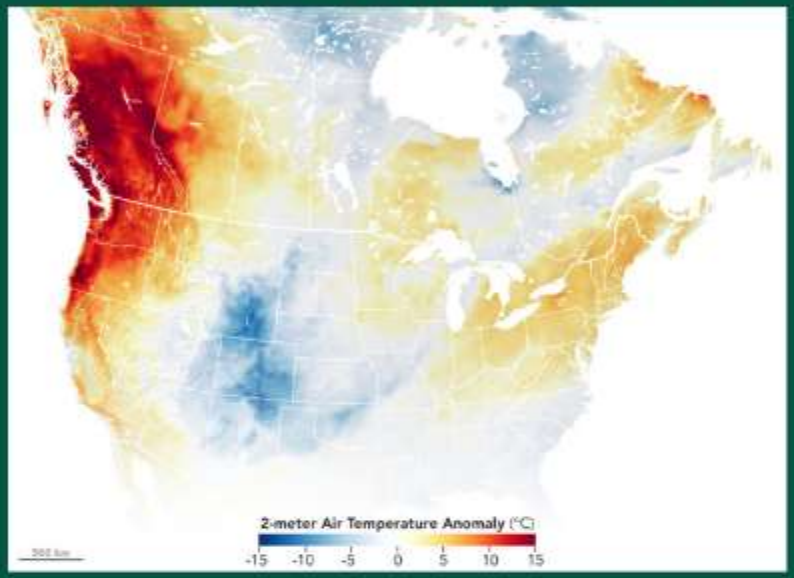
-> Data processing -> -> information e.g. http://sparkgeo.com
https://earthnow.usgs.gov/observer/

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

Geography, Earth & Environmental Sciences

Winter 2022

GEOG 457-3 / 657-3
Advanced Remote Sensing



Lectures: Monday / Friday
12:30 - 1:20 pm
Lab: Tuesday 4:00 - 6:50 pm

Instructor: Dr. Roger Wheate
email: Roger.Wheate@unbc.ca

Remote sensing / télédétection

... "the science of gathering data of a planetary surface area from a distance (including the atmosphere), *e.g. with aerial photography, radar or infrared imagery etc..*

The term was first introduced in the 1960s (Evelyn Pruitt)

New millennium development examples:
Rapideye (2008) and the Red Edge band (5 metre resolution)

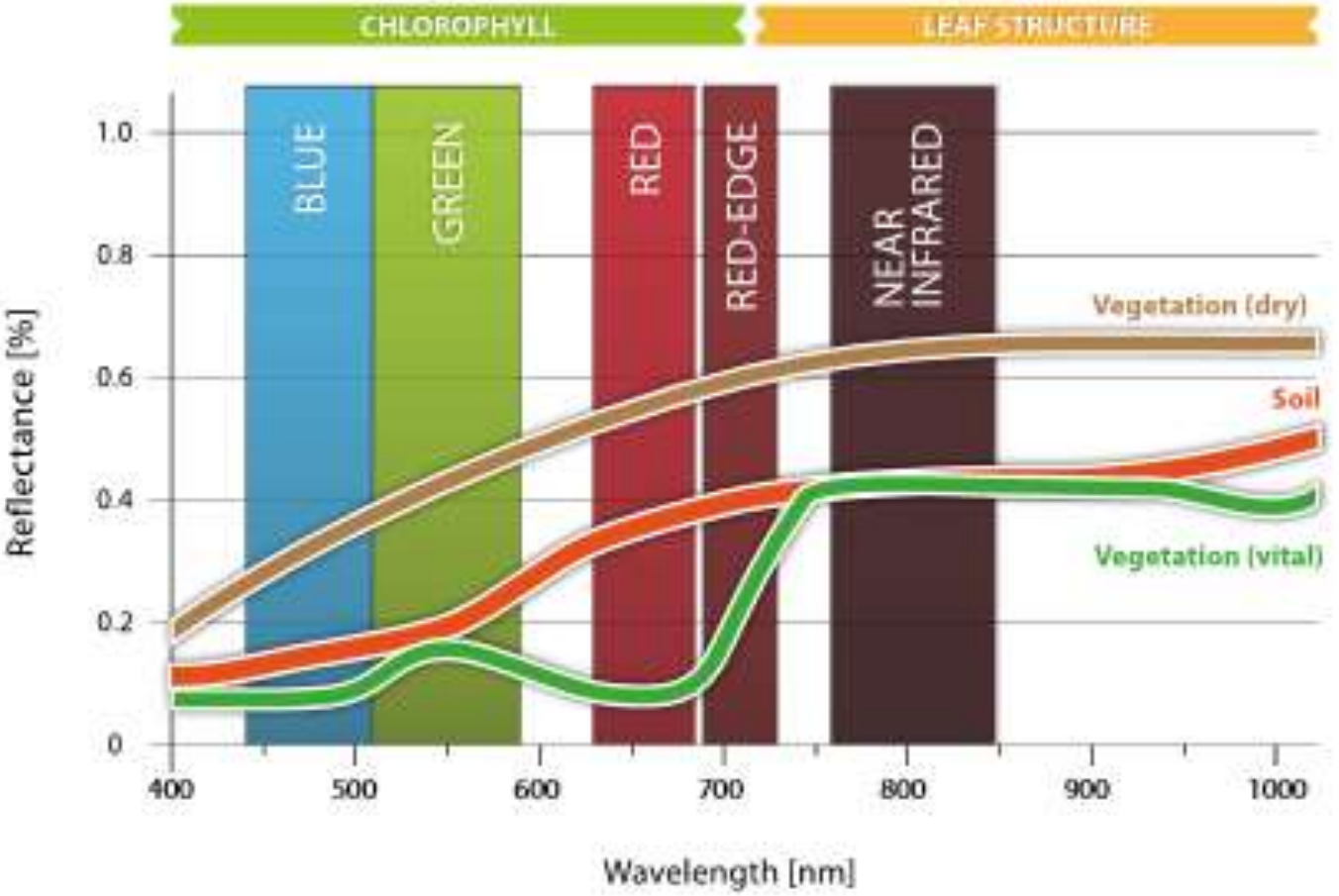


Figure 1: Typical spectral reflectance curves of selected surfaces in relation to the RapidEye spectral bands

New millennium development examples:

Unmanned aerial vehicles – UAVs (drones)

Remotely Piloted Aircraft Systems (RPAS)

http://www.drmattnolan.org/photography/2014/uav/

Milestones in the History of Remote Sensing

19th century

1839 Invention of photography

- use of balloons and kites
- pigeons
- oblique photos (mountain peaks)
- Stereo photography – e.g. http://www.londonstereo.com

20th century

1910s First use of aerial photography from planes
(World War I: photo interpretation)

1920s Development of photogrammetry for mapping

1940 Military use of radar (World War II)

1945-> Main aerial photo programs in Canada

1950s Use of colour photography and infra-red

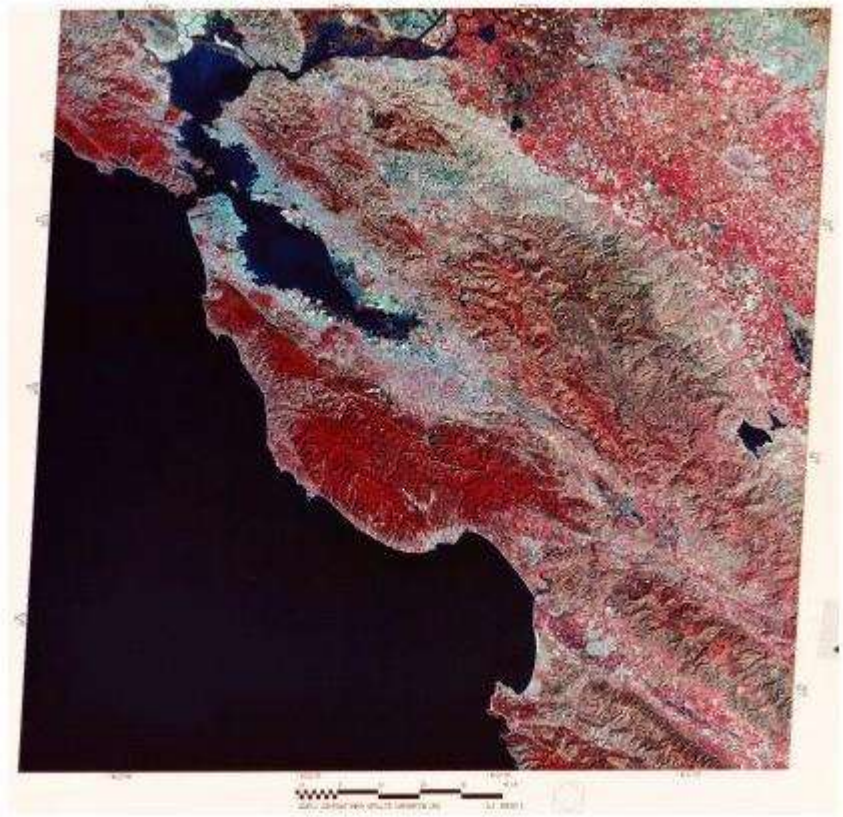
1960 First reconnaissance satellites: e.g. Corona

1961 First weather satellites: Tiros (1960); Nimbus (1964)
(and first digital data transfer)

1960s Term 'remote sensing' first appeared (Evelyn Pruit)

Multispectral image processing: The Landsat Era
This changed everything !

1972 Launch of Landsat 1 satellite and the 80metre MultiSpectral Sensor (MSS)



- Little known about image processing except contrast stretch / rectification

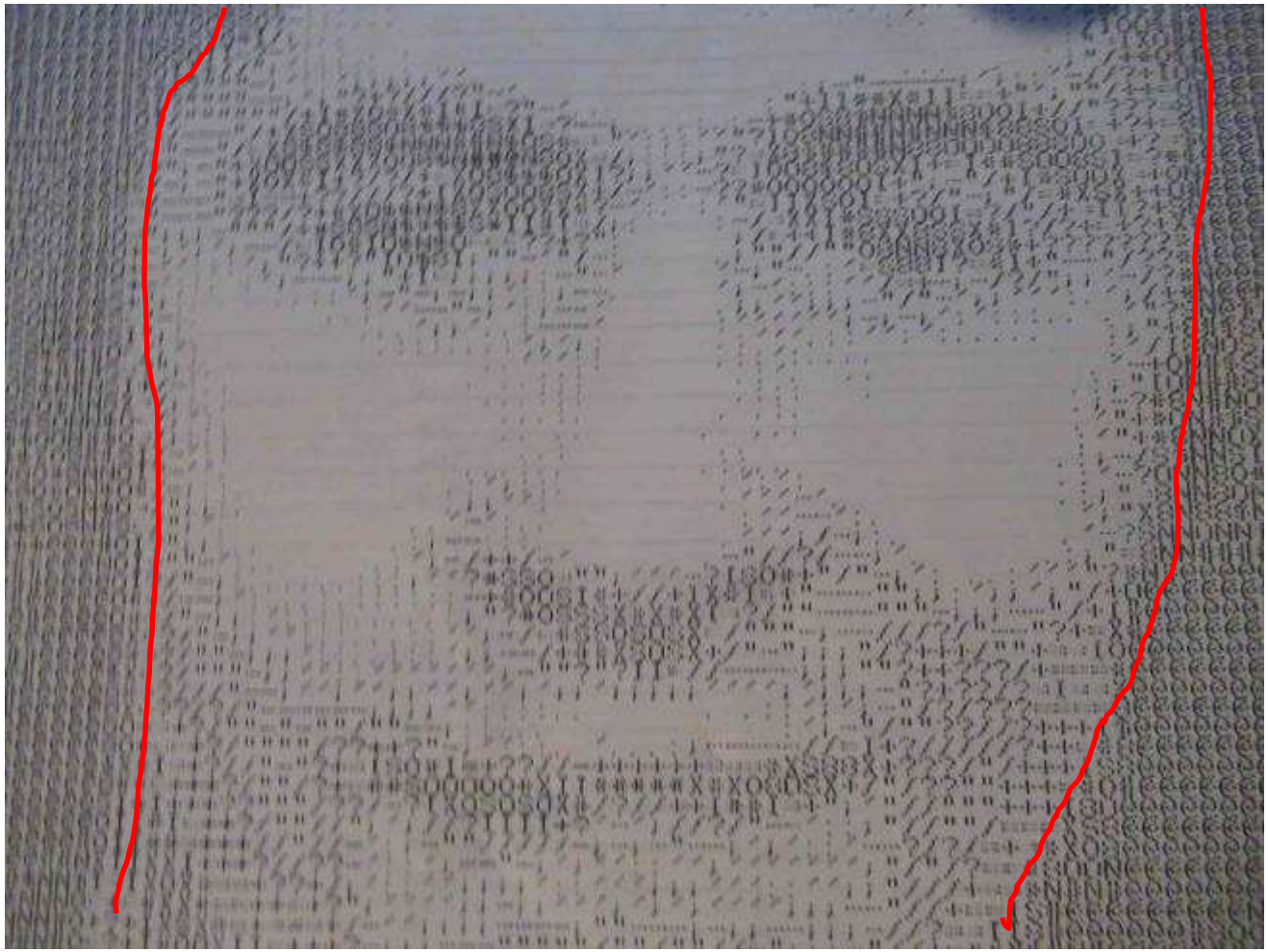
1975: Roger W. comes to Canada (Queen's U.)

Landsat print on the lab wall
No commercial software available

Canada Centre for Remote Sensing (CCRS) was the first to acquire the Image100 system developed by General Electric - $1million
Display 512 x 512 pixels

1970s-early 80s

No commercial software, only in-house code
‘Classification’ without screen display
Dot matrix printer character display – colour pencil around similar areas



Facsimile image (me)

1980s: Commercial Image processing software

1. Earth Resources Data Analysis System (ERDAS)

The first version of ERDAS was launched in 1978 on Cromemco microcomputers running the CDOS - OS.

- Unix / Windows / Mac
- Live link raster-vector 1988
- Partnered with ESRI 2000
- Owned by Leica (2001) then Intergraph
- Current version: Imagine (filetype: .img)

2. PCI Geomatics, Canada 1982

… formed as Perceptron Computing Inc.
(NOT MANY PEOPLE KNOW THIS)

- Windows and Linux

- First versions (FORTRAN) were command line:
  EASI/PACE Engineering Analysis and Scientific Interface /PACE

- Tutorials: http://www.pcigeomatics.com/support/tutorials/

- Current version: Catalyst (2021)
  Formerly know as Geomatica (2016)
  File format: .pix

“PCI Geomatics, is the world leader in geo-imaging products and solutions. PCI Geomatics offers customized solutions to the geomatics community in over 135 countries.”

- Recognised as the most extensive RS software system
- Modules written by leading Canadian researchers
- Best for orthorectification .. Orthoengine
- Weakest link ? … vector options and integration
- Most support for new sensors

1980s Landsat 4/5 : Thematic Mapper (TM)
'next generation' 30m sensor': addition of mid-IR bands

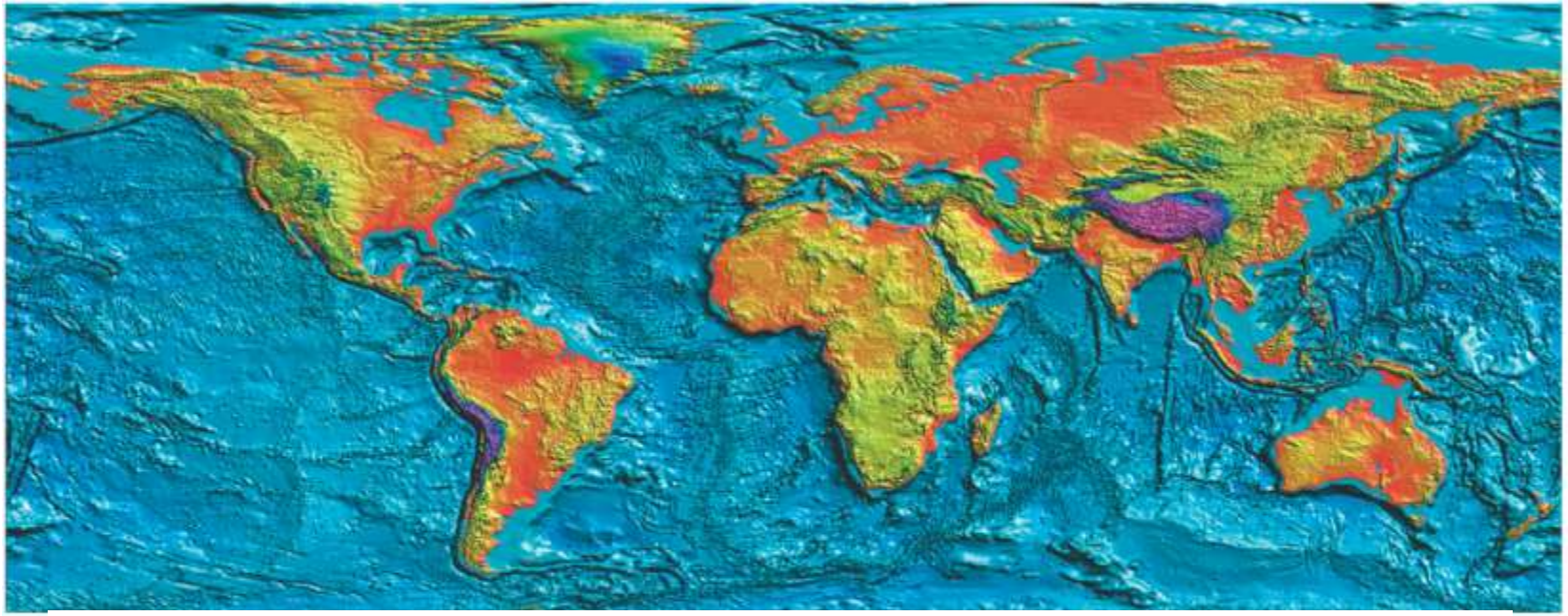
1981: European Space Agency formed

1981: Alberta Government has image processing workstation

OVAAC 8 by Dick Economy (formerly GE),
on VAX system, … sold to PCI in 1985

University of Calgary (Survey Engineering) – in-house code
TM data on 3 magnetic tapes, mounted, read, unmounted
One image cost $8000 and needed geo-rectification
1989: One Landsat scene fits on one CD

1990s software: ER Mapper,Perth, Australia 1990



"As a master's student , I interviewed with ER Mapper in 1991. I was very impressed with the software. I was somewhat concerned when they stated ER Mapper would be larger than ERDAS within 2-years. They hired Jill rather than me. I accepted a technical sales position at ERDAS.

In May 2007, ERDAS announced the purchase of ER Mapper Ltd

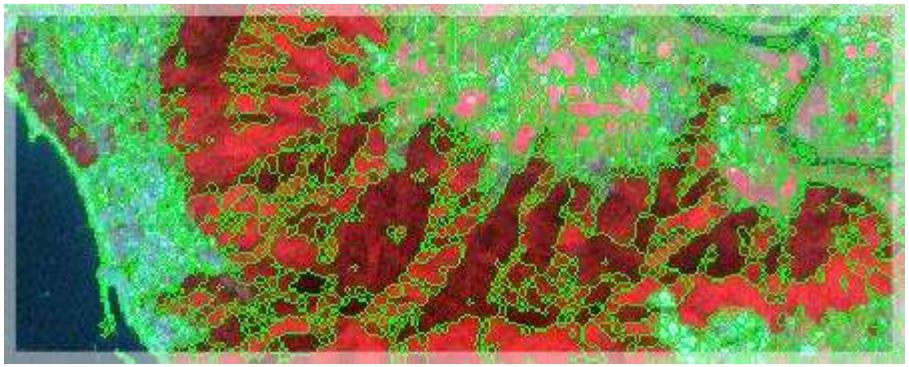
Main strength: data storage, compression and serving (.ecw format) web-serving

FREE download http://erdas-er-mapper.software.informer.com/7.2/

ENVI: Boulder, CO 1991

"ENvironment for Visualizing Images"

http://www.exelisvis.com/ProductsServices/ENVIProducts.aspx



Extract specific objects with the ENVI Feature Extraction Module (ENVI FX), based on the object's spatial, spectral, and texture characteristics and identify them as objects like vehicles, buildings, roads, coastlines, rivers, lakes, and fields.

IDRISI Raster GIS - Worcester (Boston) 1986 $

http://www.clarklabs.org Idrisi Canada: http://www.idrisi.ca

Affordable GIS option for education, research and development

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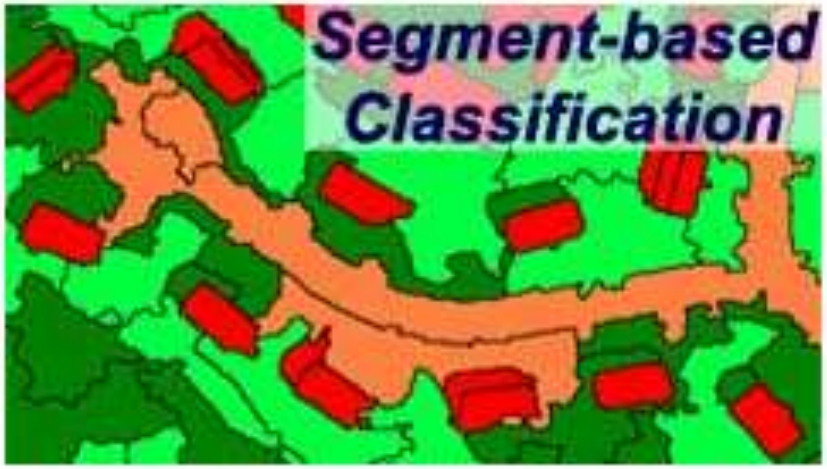
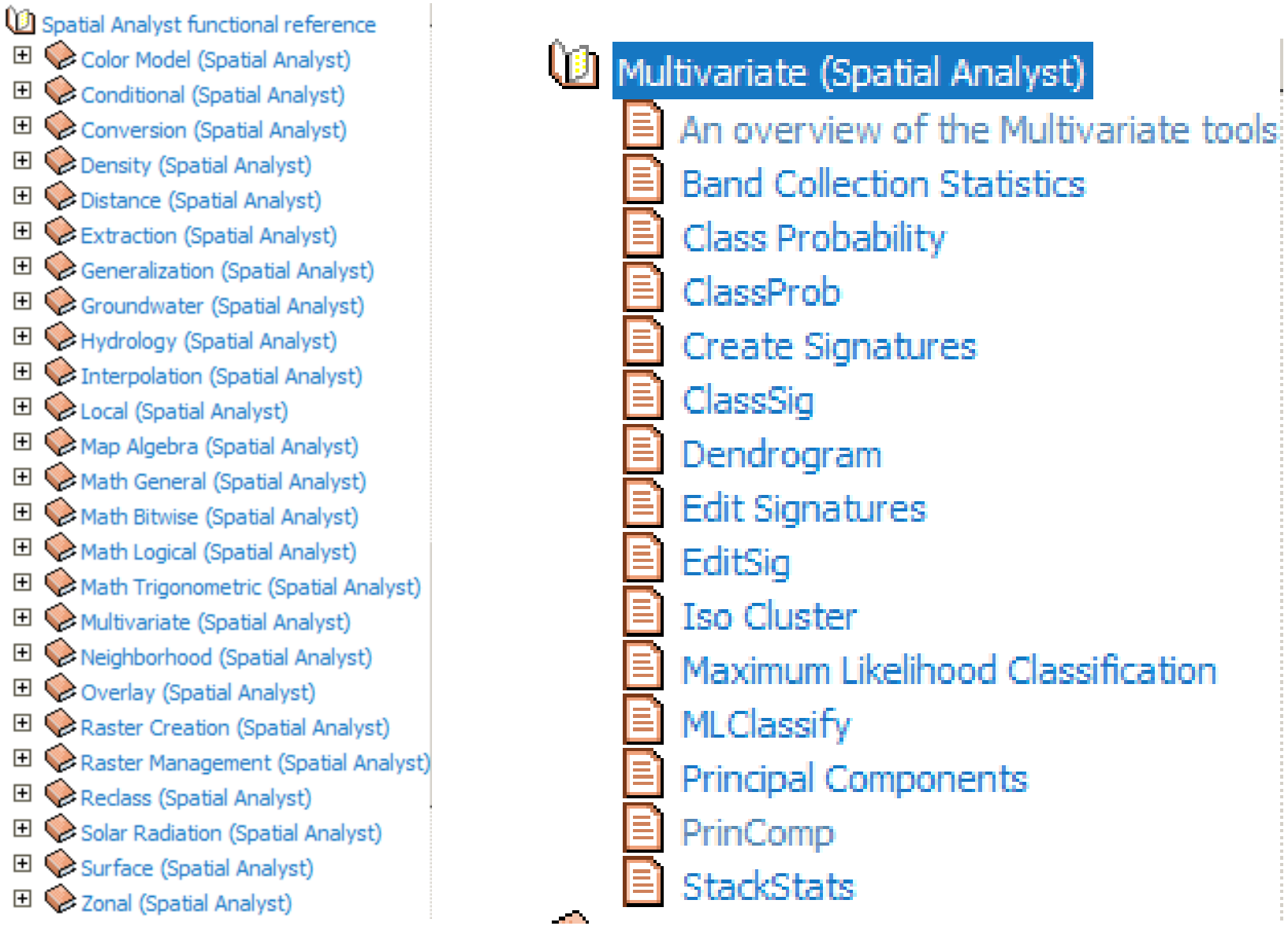


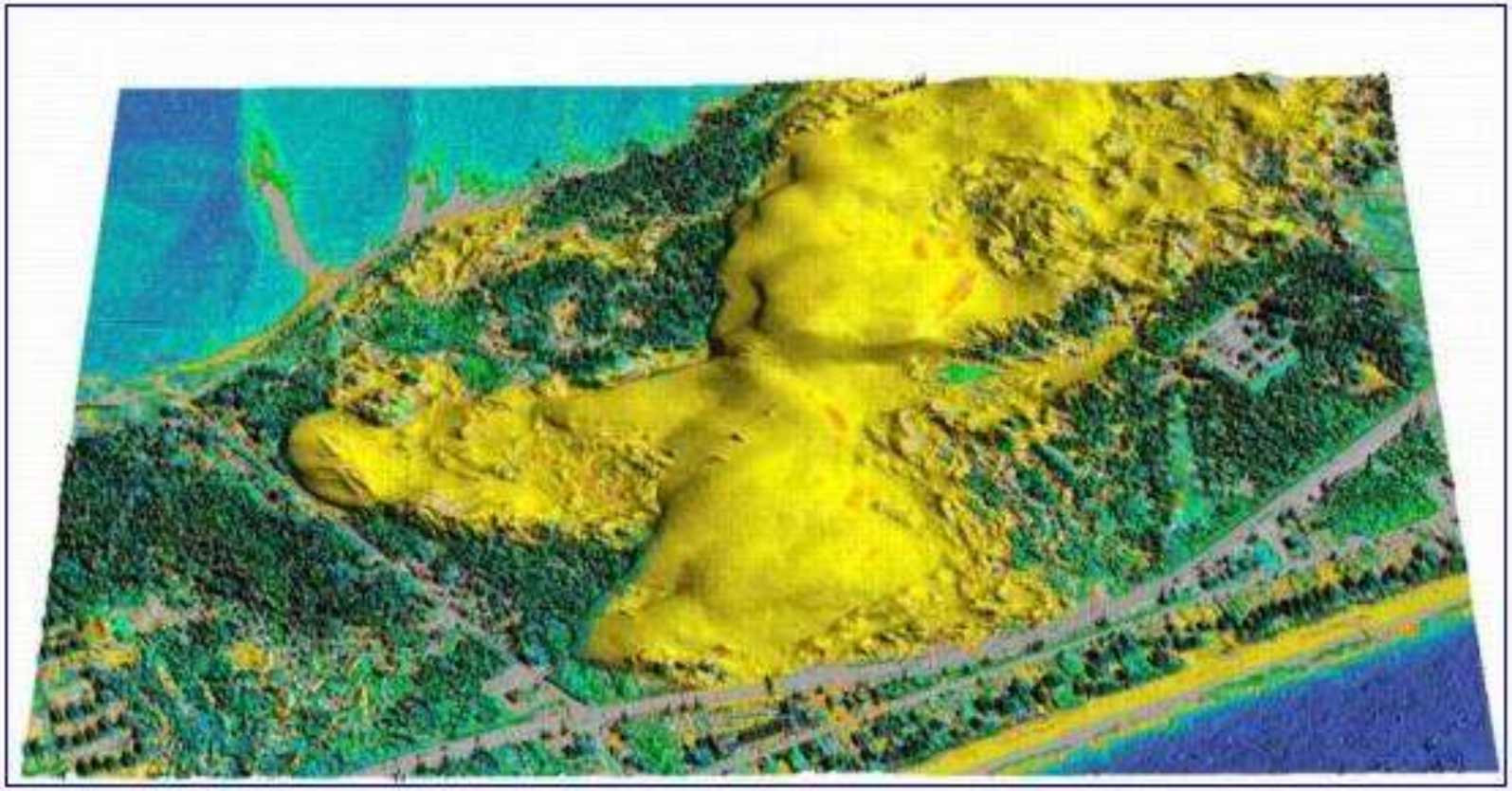
ArcGIS spatial analyst (GRID)



GRASS raster GIS (1982) – now in QGIS

Geographic Resources Analysis Support System https://grass.osgeo.org/

Started in 1982 by U.S. Army - Construction Engineering Research Laboratory (USA-CERL) in Champaign, Illinois. USA-CERL completed its last release of GRASS in 1992. GRASS development was assumed by academia in 1997, and became an OS project – an international team manages the source code. **FREE**



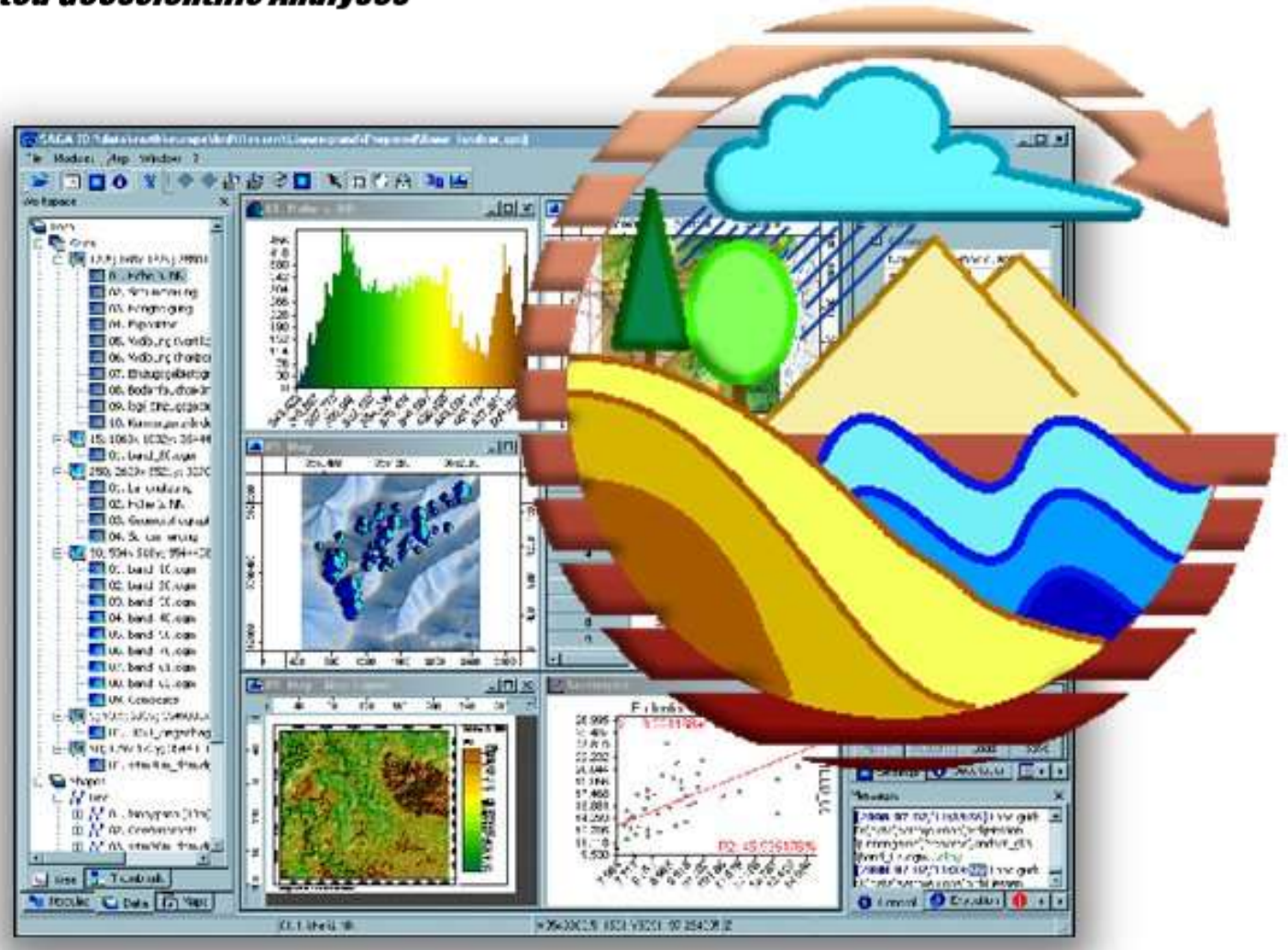
Dune Migration at Jockey's Ridge State Park, North Carolina
Infrared photo draped on USGS LIDAR data

SAGA

System for Automated Geoscientific Analyses

Raster GIS, Germany, 2004 - now in QGIS

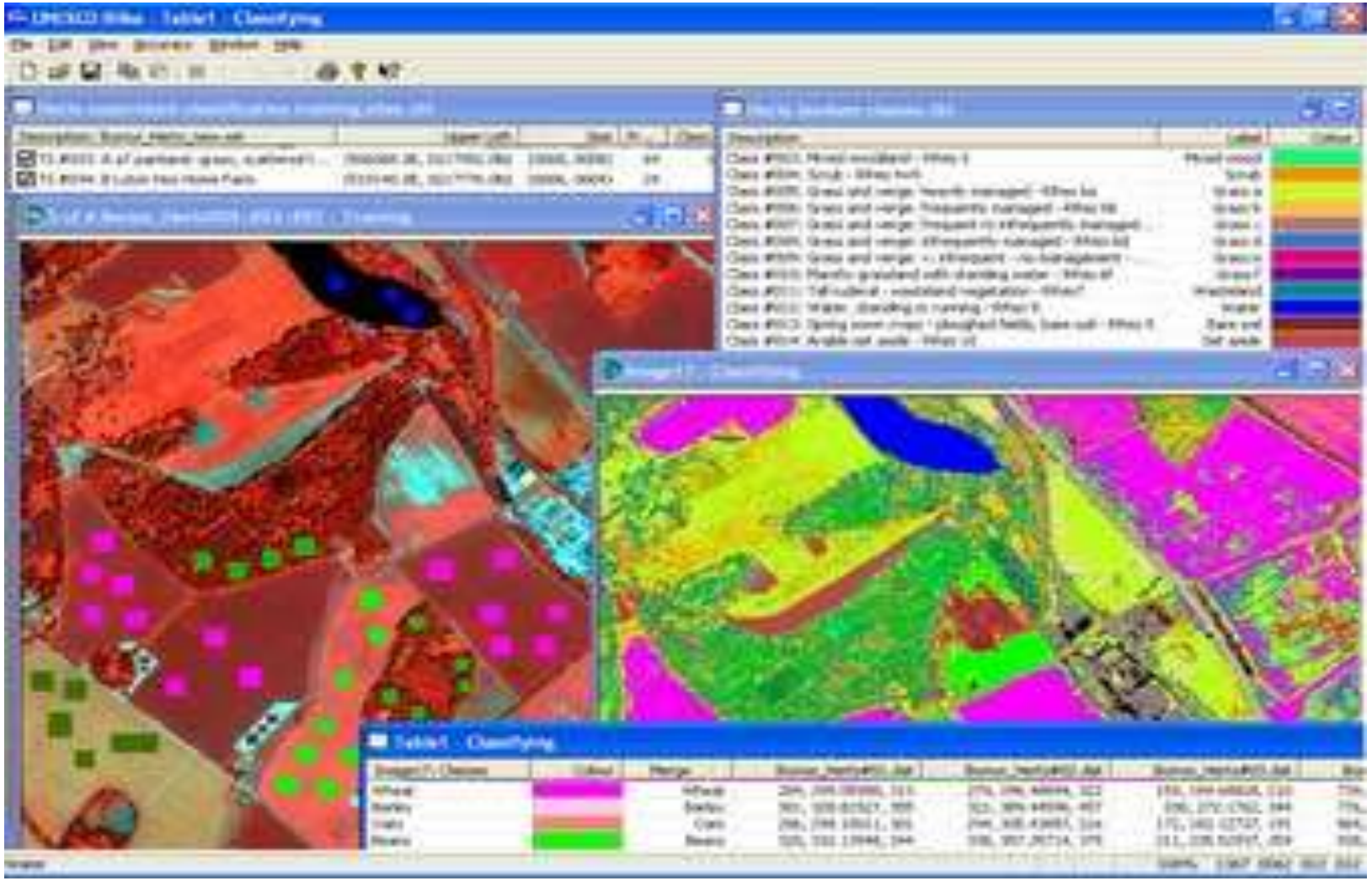
Recently integrated into QGIS



http://www.saga-gis.org/en/index.html

UNESCO- BILKO: (really!) FREE

http://www.noc.soton.ac.uk/bilko/



1990s

1990s Other countries' launch satellites / sensors:
IRS: India (5 metre)
JERS: Japan
ERS: Europe
RESURS: USSR

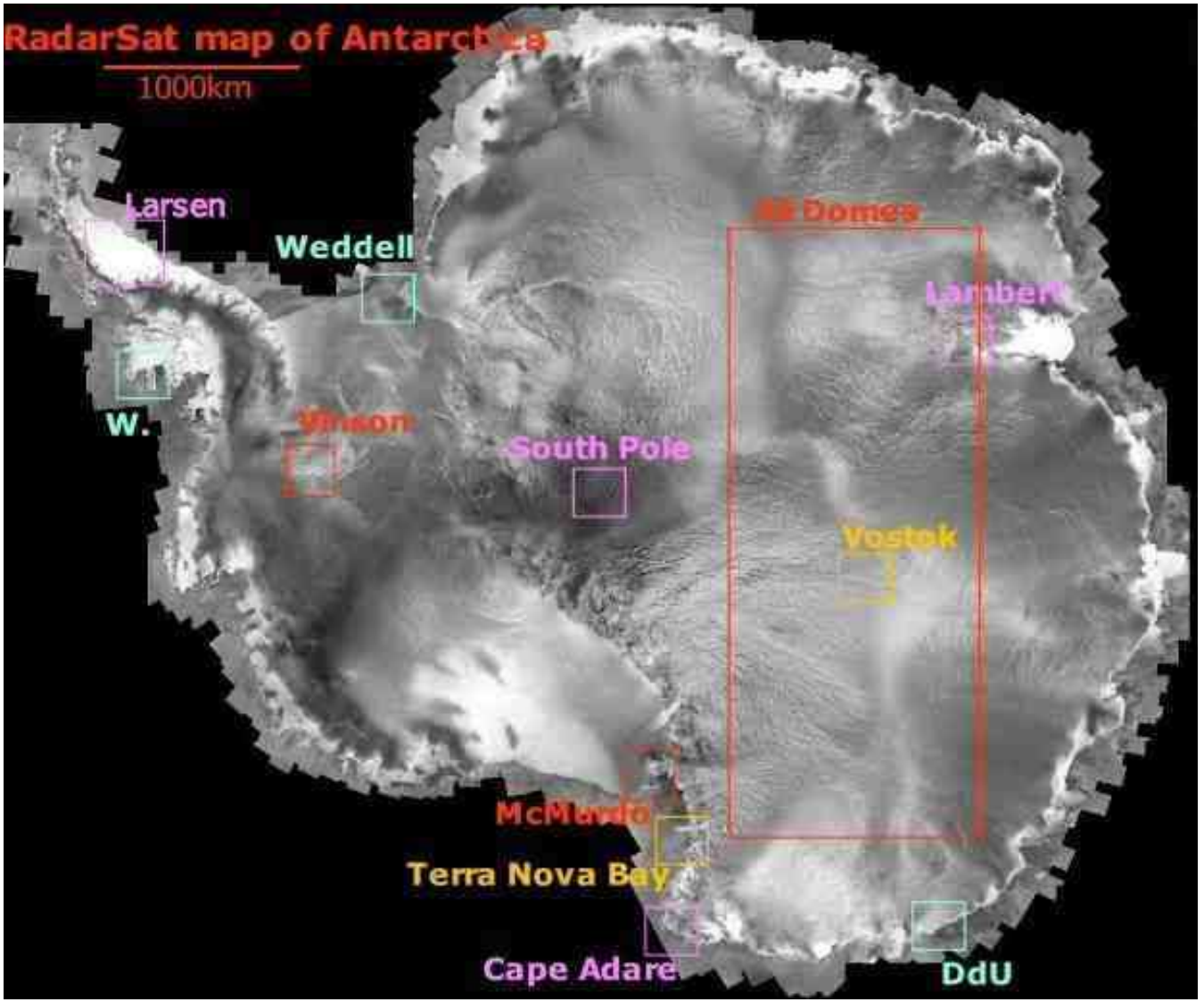
1990 Canadian Space Agency

1995 Radarsat-1 Canada's first remote sensing satellite

2007 Radarsat-2 First complete mapping of Antarctica

MacDonald-Dettwiler, Richmond BC (1969->)
manufactured Radarsat and previously built most of the world's satellite receiving stations

2013: Canada produces the first complete image of Antarctica – we rock RADARSAT launched by NASA in exchange for complete map image



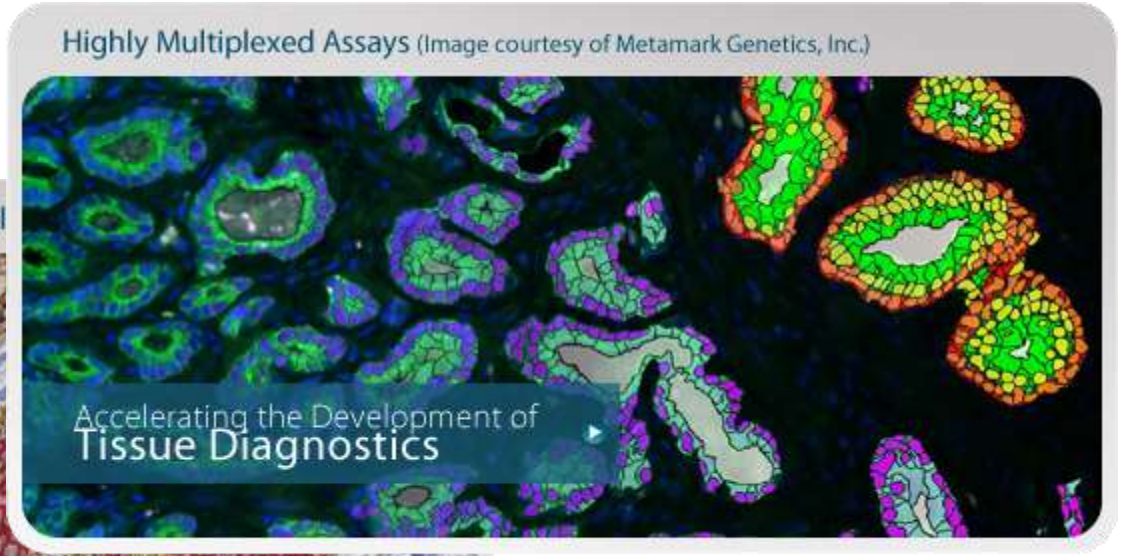
http://ice-glaces.ec.gc.ca/App/WsvPageDsp.cfm?ID=1&Lang=eng

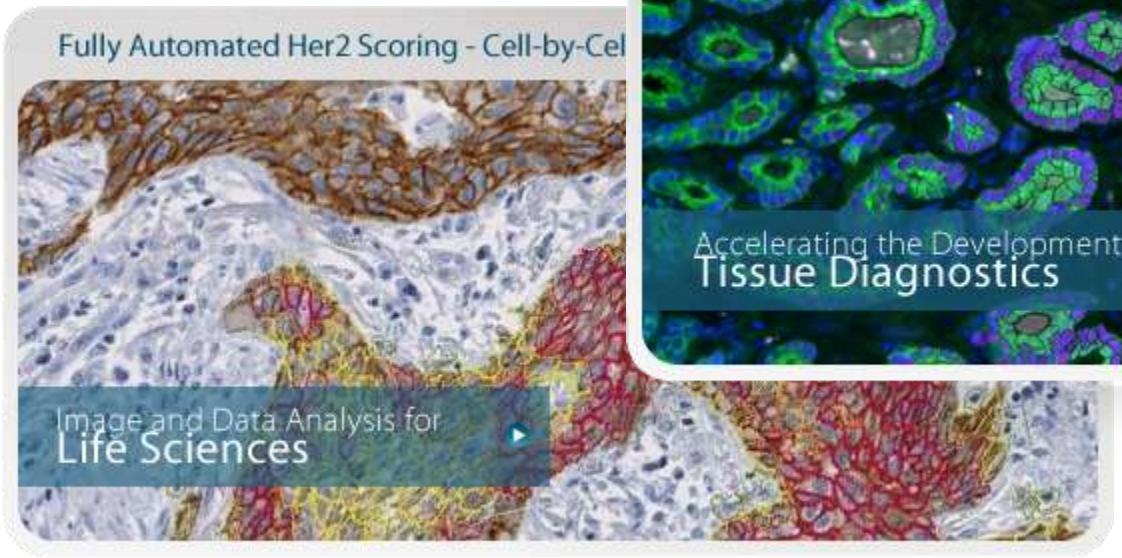
Object-oriented classification
eCognition, Germany, 2000 $$

Object-oriented classifier: Feature based not pixels

[versus per pixel classifiers: Unsupervised/Supervised]

Spatial / earth sciences market applications sold to Trimble, 2010
Partnership with PCI Geomatics (who dropped their own Feature Object Extraction tool 'FOX')



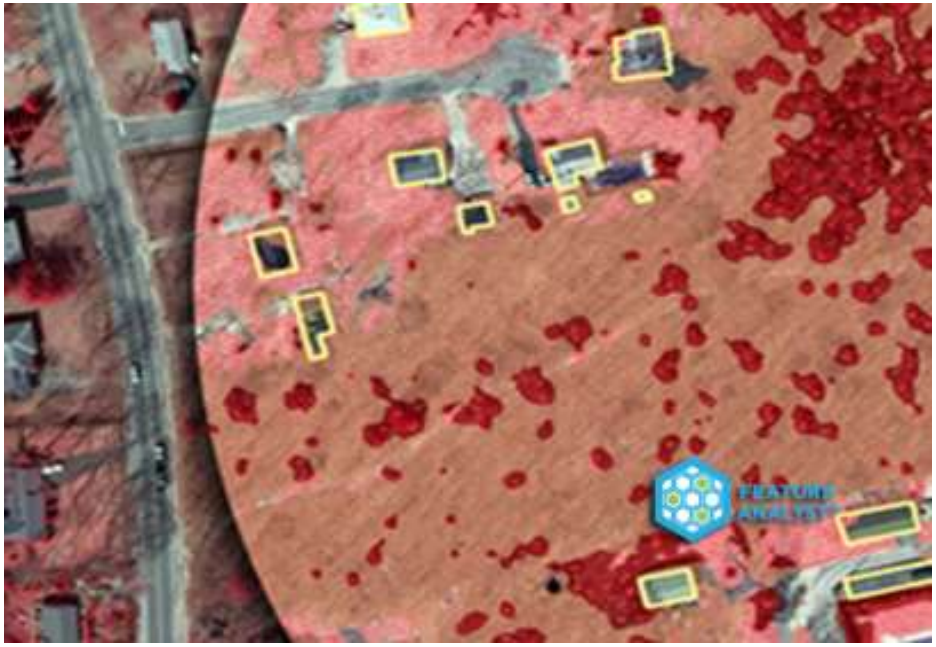


http://www.pcigeomatics.com/software/partner-products/trimble-ecognition

eCognition: htttp://www.definiens.com/

More feature based / segmentation software

Feature Analyst plug-in for ESRI and ERDAS
http://www.textronsystems.com/products/geospatial/feature-analyst



SPRING, Brazil 1995 **FREE**
http://www.dpi.inpe.br/spring/english/

New millennium events

Many new sensors including high resolution

Terra satellite: ASTER / MODIS

High resolution private sector satellites:

LiDAR, RADAR, RPAS,

Large datasets, DEMs

Free image data ….

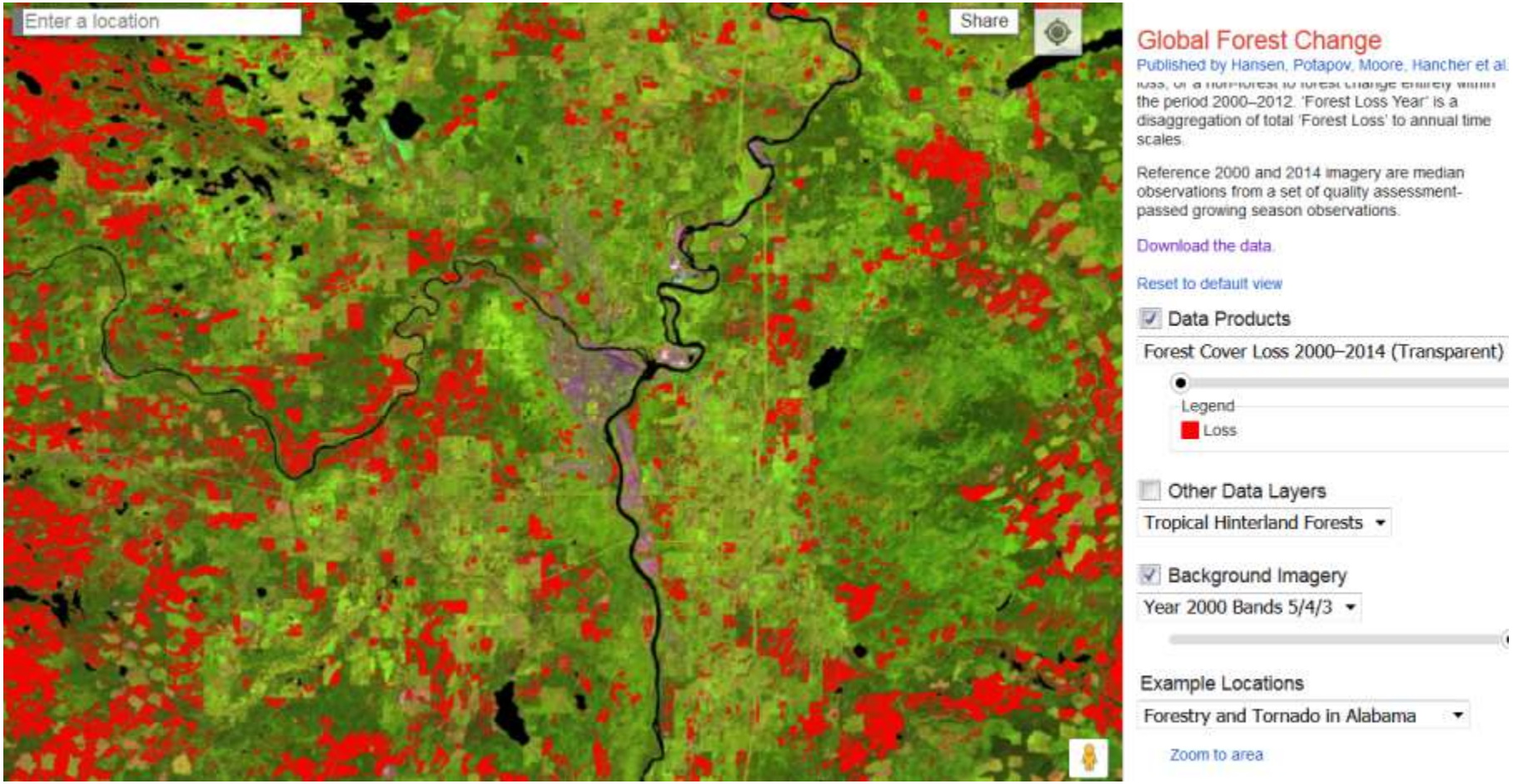
Multi-year time series for environmental monitoring

Online image viewers- e.g. google earth

All topics for this course

Google Earth Engine is a cloud computing platform for processing satellite imagery and other Earth observation data. It provides access to a large warehouse of satellite imagery and the computational power to analyze those images.

https://earthenginepartners.appspot.com/science-2013-global-forest



Global Forest cover loss 2000-2014