

# Remote Sensing software

... Not just one that 'rules them all' like GIS

- **The big three**
- **Less expensive options**
- **Free download options**

## GIS software

**ArcGIS (1981)**      dominates as the industry standard

**Idrisi (1986)**      alternative for education / research

**QGIS (2002)**      open source - free download

**Others .... (fewer since 1995)**

1994: BC Gov used PAMAP (Victoria) and Terrasoft (Nanaimo)

# Remote Sensing software: the big 3

**Software**

**special strength**

**ERDAS** (Atlanta, USA: 1978)

- vector integration

**PCI** (Toronto, Canada: 1982)

- orthoimages / breadth



**ENVI** (Boulder, USA: 1991)

- hyperspectral

# 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) -> Intergraph -> Hexagon
- Current version: Imagine - filetype: `.img`



# PCI Geomatics, Canada 1982

\$\$

... formed as Perceptron Computing Inc.

➤ Windows and Linux



➤ First versions (FORTRAN) were command line:  
EASI : 'Engineering Analysis and Scientific Interface'

➤ Current version: **Catalyst (2022)** – previously Geomatica / Banff

➤ File type **.pix** (will open in other software)

“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
- Most support for new sensors e.g.

#### Toutin's Model

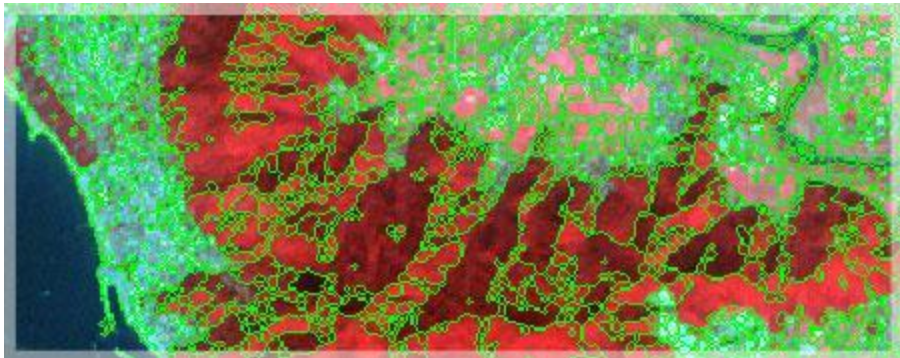
ASTER, AVNIR, CARTOSAT, CBERS, DEIMOS, DMC, DUBAISAT, EOC, EROS, FORMOSAT, GEOEYE, GF, GOKTURK, GOSAT, HJ, IKONOS, IRS, KAZEOSAT, KOMPSAT, LANDSAT, MERIS, ORBVIEW, PLEIADES, PRISM, QUICKBIRD, RAPIDEYE, RASAT, SJ9, SPOT, SSOT, TH, THAICHOTE, WORLDVIEW, YG, ZY

# ENVI: Boulder, CO 1991

\$\$

"ENvironment for Visualizing Images" (with specialty for hyperspectral)

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



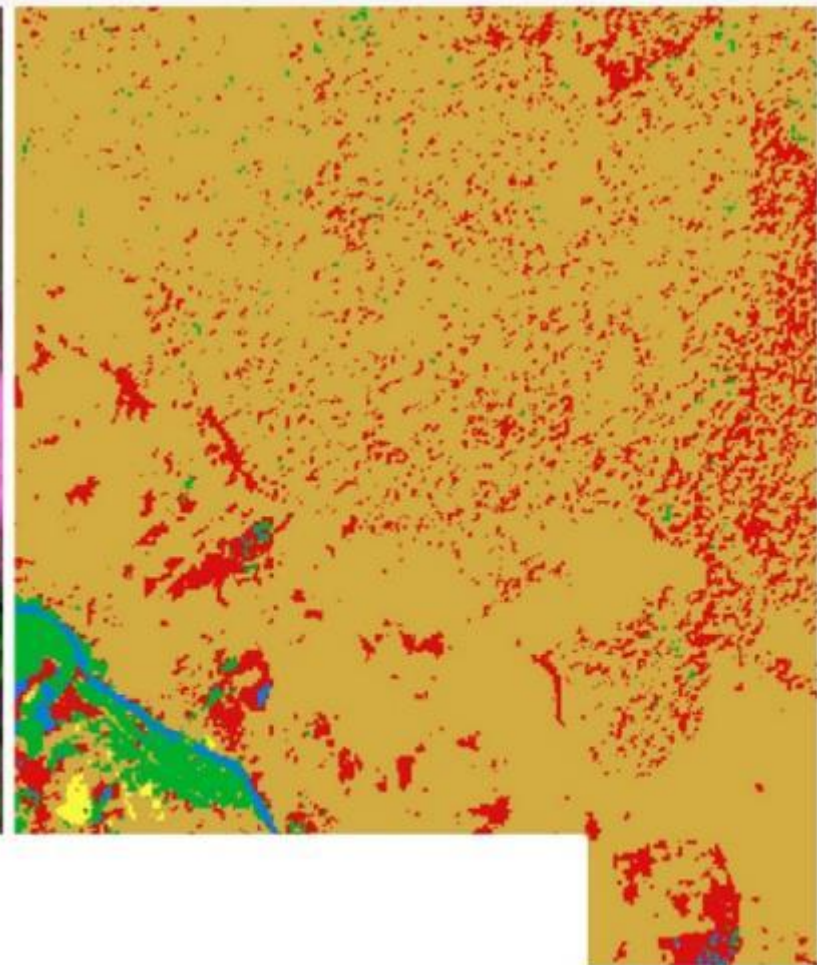
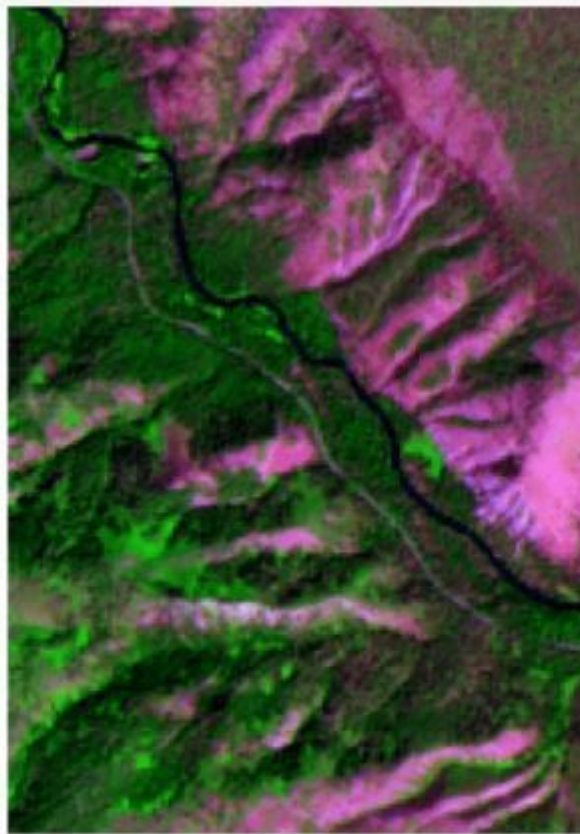
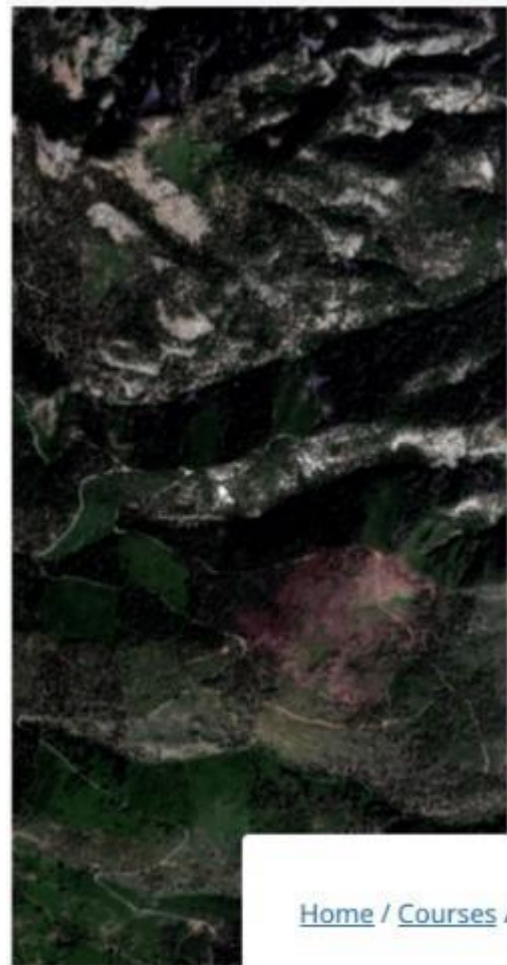
Find and extract specific objects with the ENVI Feature Extraction Module (ENVI FX). User-friendly tools to extract features from geospatial imagery based on the object's spatial, spectral, and texture characteristics and identify them as objects like vehicles, buildings, roads, coastlines, rivers, lakes, and fields.

# ArcGIS spatial analyst (formerly GRID) – increased raster options



- Spatial Analyst functional reference
- Color Model (Spatial Analyst)
- Conditional (Spatial Analyst)
- Conversion (Spatial Analyst)
- Density (Spatial Analyst)
- Distance (Spatial Analyst)
- Extraction (Spatial Analyst)
- Generalization (Spatial Analyst)
- Groundwater (Spatial Analyst)
- Hydrology (Spatial Analyst)
- Interpolation (Spatial Analyst)
- Local (Spatial Analyst)
- Map Algebra (Spatial Analyst)
- Math General (Spatial Analyst)
- Math Bitwise (Spatial Analyst)
- Math Logical (Spatial Analyst)
- Math Trigonometric (Spatial Analyst)
- Multivariate (Spatial Analyst)
- Neighborhood (Spatial Analyst)
- Overlay (Spatial Analyst)
- Raster Creation (Spatial Analyst)
- Raster Management (Spatial Analyst)
- Reclass (Spatial Analyst)
- Solar Radiation (Spatial Analyst)
- Surface (Spatial Analyst)
- Zonal (Spatial Analyst)

- Multivariate (Spatial Analyst)**
- An overview of the Multivariate tools
- Band Collection Statistics
- Class Probability
- ClassProb
- Create Signatures
- ClassSig
- Dendrogram
- Edit Signatures
- EditSig
- Iso Cluster
- Maximum Likelihood Classification
- MLClassify
- Principal Components
- PrinComp
- StackStats



[Home](#) / [Courses](#) / Remote Sensing with QGIS

# Remote Sensing with QGIS

QGIS Python Plugins Repository

Semi-Automatic Classification Plugin



# SAGA

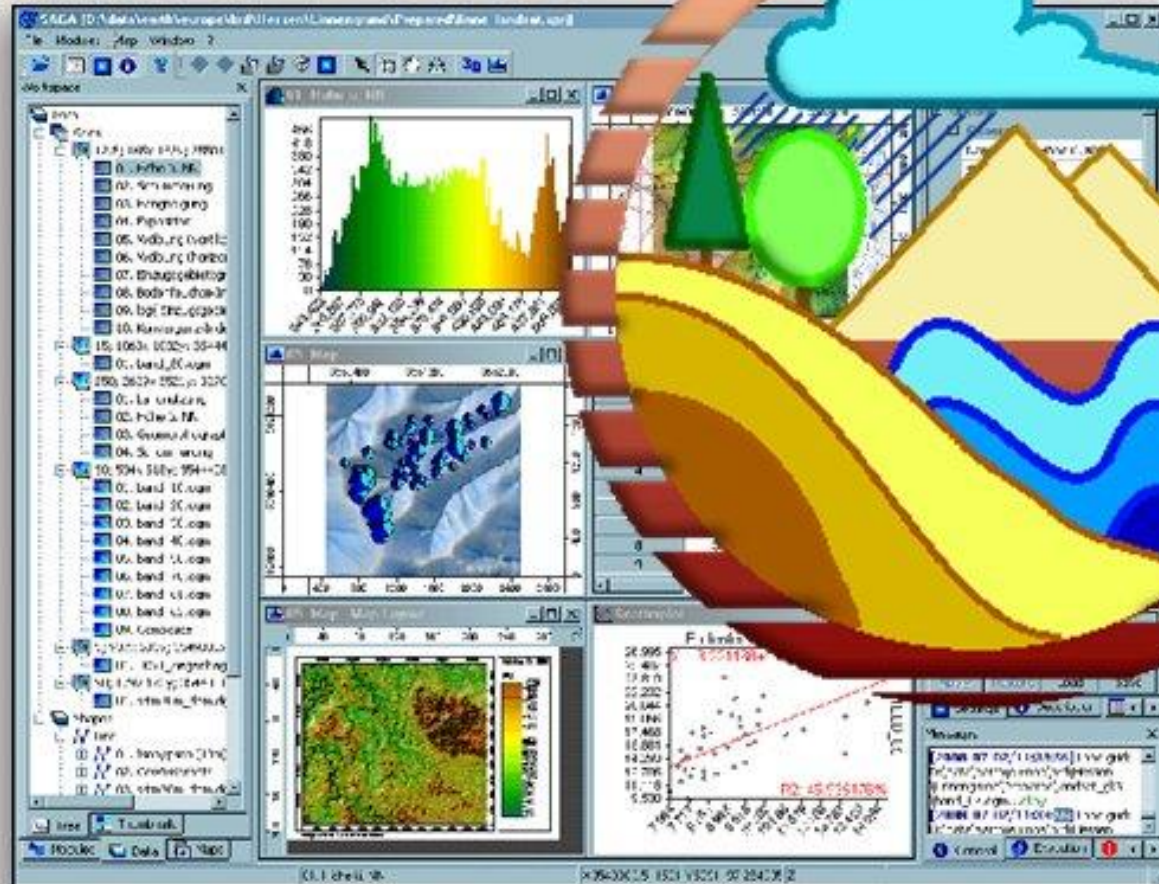
System for Automated Geoscientific Analyses

Raster GIS, Germany, 2004

FREE

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

integrated  
into QGIS



# GRASS raster GIS (1982)

Now part of QGIS

<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

# TNTmips \$



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Datum Workstation  
Download

## Datum Workstation *Advanced Software for Geospatial Analysis*

Price quotes were sent in mid December to all current and recent TNTgis customers about the new release of Datum Workstation. If you did not receive one, please contact us.

Datum Workstation provides advanced GIS, image processing, and geospatial analysis at an affordable price. Includes scripting language to automate geospatial processing using local and network computing resources. Formerly called TNTgis, it is used in over 120 countries around the world and translated into 24 languages. We stand behind Datum Workstation with responsive free support.

TNTgis 2022  
Previous Release  
New Feature List  
Download

**Datum Workstation** Complete professional package integrating GIS, image processing, terrain analysis and surface modeling, LIDAR visualization/processing, geodatabase management, desktop cartography, and web map publishing.

Top Links  
Purchase

**Datum GeoView** View and interpret any type of geospatial data (image, vector, CAD, shape, LIDAR, TIN). View data in 2D, stereo, and 3D perspective, and view/edit associated relational databases.

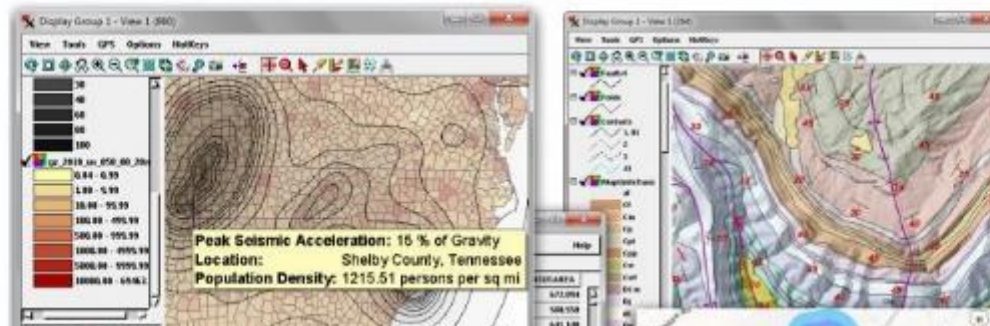
News — Jan 2023  
Datum Workstation  
Official Release

Datum Workstation runs on both Windows and MacOS.

### Uses

- Viewing Geodata
- Editing Geodata
- Georeference / Rectify
- Geodata Formats
- Map Design
- Publishing Geodata
- Mix Local & Web Data
- Publish Web Maps
- Image Processing
- Image Classification
- Feature Mapping

### GIS, Spatial Analysis, and Desktop Cartography



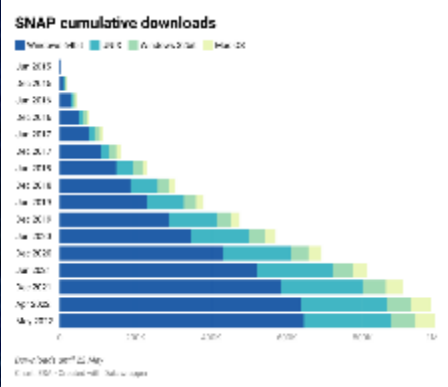
Datum Workstation is an advanced Geographic Information System that integrates display and processing of map data, imagery, and terrain data along with the creation and management of associated relational databases. Datum Workstation provides all the tools needed to create, edit, georeference, interpret, and publish any type of geospatial data. Geospatial analysis processes are provided for geometric (vector, CAD, shape) map data as well as for imagery and terrain

<https://www.microimages.com/products/tntmips.htm>

# FREE – ESA (Sentinel)



## SNAP SeNtinel Applications



<https://gisgeography.com/best-remote-sensing-software/>

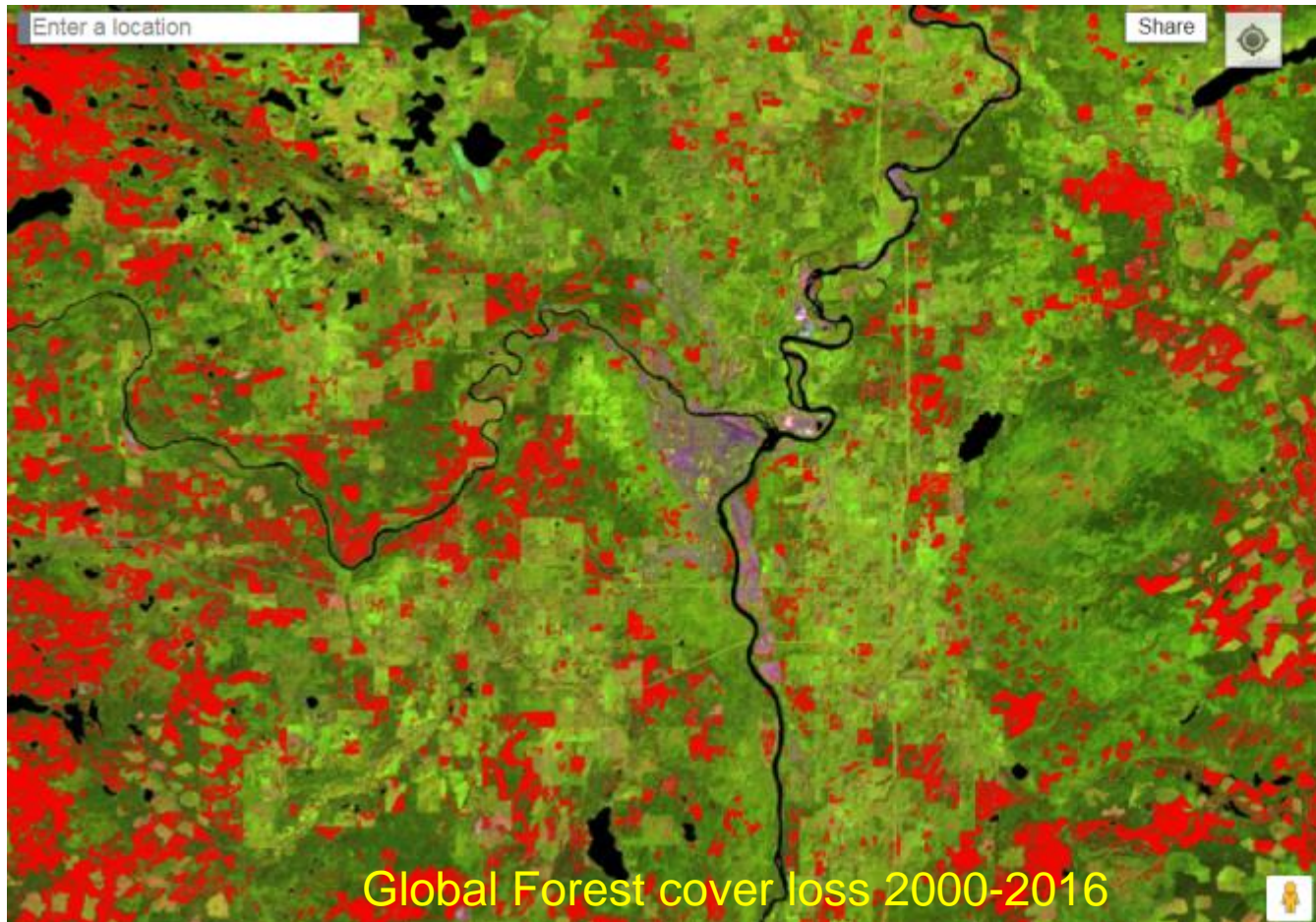
Also Cloud-based imagery and Scripting e.g. using R, Python, GDAL

See GEOG457

**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>

Updated site: <https://glad.earthengine.app/view/global-forest-change>



### Global Forest Change

Published by Hansen, Potapov, Moore, Hancher et al. 2013, in a paper about forest change globally within the period 2000–2012. 'Forest Loss Year' is a disaggregation of total 'Forest Loss' to annual time scales.

Reference 2000 and 2014 imagery are median observations from a set of quality assessment-passed growing season observations.

[Download the data.](#)

[Reset to default view](#)

Data Products

Forest Cover Loss 2000–2014 (Transparent)



Other Data Layers

Tropical Hinterland Forests ▾

Background Imagery

Year 2000 Bands 5/4/3 ▾

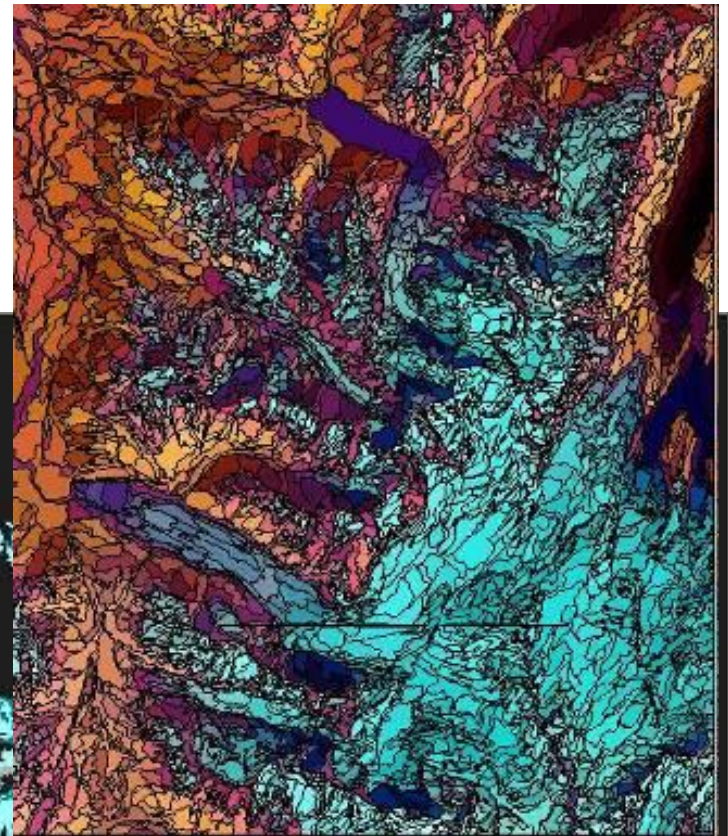
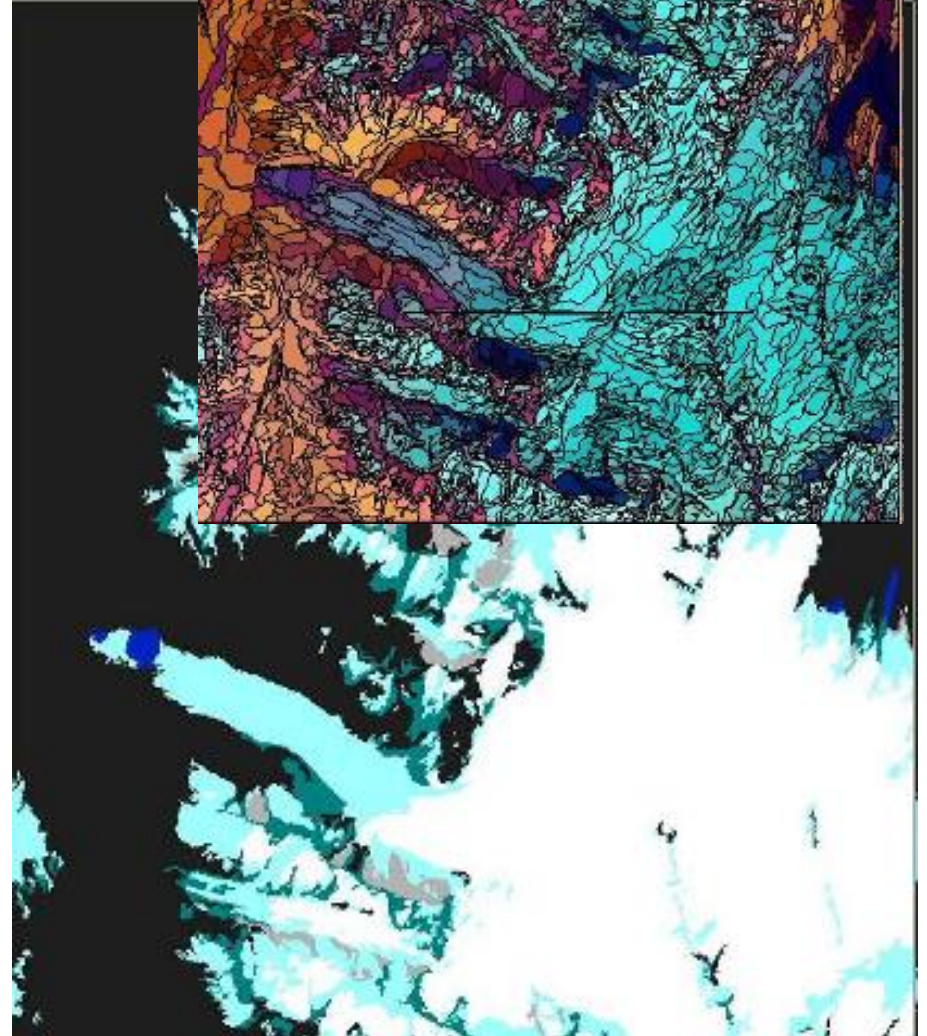
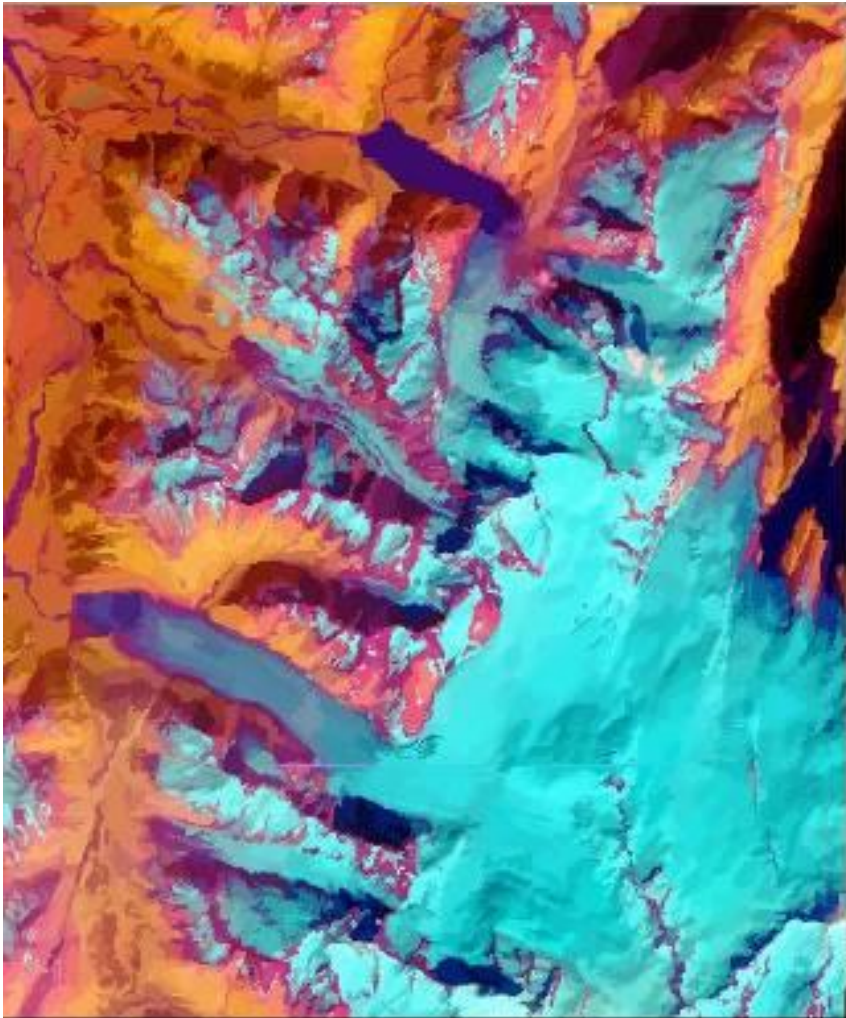
Example Locations

Forestry and Tornado in Alabama ▾

[Zoom to area](#)

# eCognition, Germany 2000

- Object-oriented classifier
- Feature based not per-pixel
- ... the most significant change in RS for 25 years ?



# IDRISI Worcester (Boston)



<http://www.clarklabs.org>

Idrisi Canada: <http://www.idrisi.ca>

Raster based GIS and remote sensing since 1986

## What's New

**IDRISI Taiga Now Shipping! Includes Innovative Earth Trends Modeler Application Segment-based Classification!**

[Learn More >](#)

**Focus Paper on Segmentation & Segment-Based Classification Now Available!**

[Download >](#)

[See all Focus Papers >](#)



Feature / segment classification (instead of per pixel) is now part of GIS/RS software:  
or .... Object-based image analysis (OBIA) .. See Advanced RS (GEOG457)

## Object oriented (segmented) classification OBIA

Object-oriented classification starts by segmenting the image into meaning objects. The segmentation algorithm is a bottom-up region-merging technique. It begins by considering each pixel as a separate object. Subsequently, adjacent pairs of image objects are merged to form bigger segments.

### Application of Machine Learning, Deep Learning, AI, Neural networks

built-in contextual rules to identify and define objects and assess probabilities of features  
- to replicate human interpretation methods

Examples often use recognizing cats v dogs



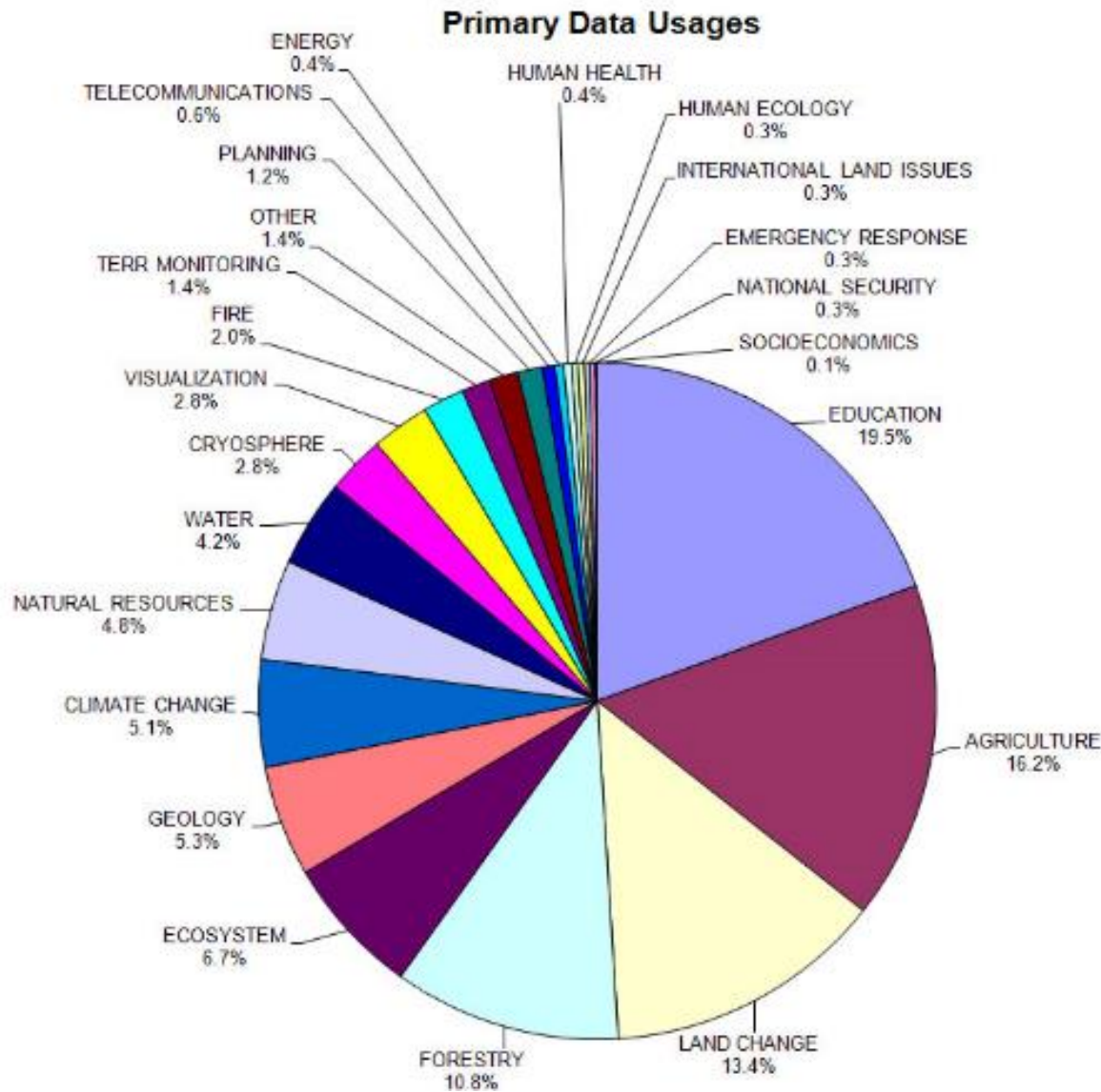
Chihuahuas or muffin?





## Landsat Free Archive - How Landsat Data are Being Used

Statistics as of August 31, 2009



Since 2008

Impact of free data on applications and use including open source analysis.



# HOW HEAVY IS A SATELLITE?



## LARGE SATELLITE



>1000 kg



## MEDIUM SATELLITE



500-1000 kg



## MINI SATELLITE



100-350 kg



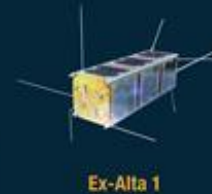
## MICRO SATELLITE



10-100 kg



## NANO SATELLITE including CUBESAT



1-10 kg  
1 kg per unit



Note: These weights are approximations.

Canada

CATEGORY	WEIGHT	SIMILAR IN SIZE TO A ...
LARGE	More than 1,000 kg	
MEDIUM	500-1,000 kg	
MINI	100-500 kg	
MICRO	10-100 kg	
NANO	1-10 kg	

# Major trends in remote sensing 2024 ->

More and more satellites especially nano and cubesat

More airborne platforms – planes and drones

Data clouds – online processing and more and more data

Scripting data options: GDAL, Google Earth Engine, Python

## Object Based Image Analysis

PCI Catalyst: Object Analyst - option below Analysis-> Supervised Classification

ArcGIS: Feature Analyst

QGIS: OBIA (with plug-Ins)

= possible GEOG 499 Independent Study in 2025 ? (May be our last year with PCI ? )

GEOG 457 runs in January 2026

- Either / both could count towards GIS Minor, especially if you missed GEOG413 (runs in fall 2026)

## **Course summary / review**

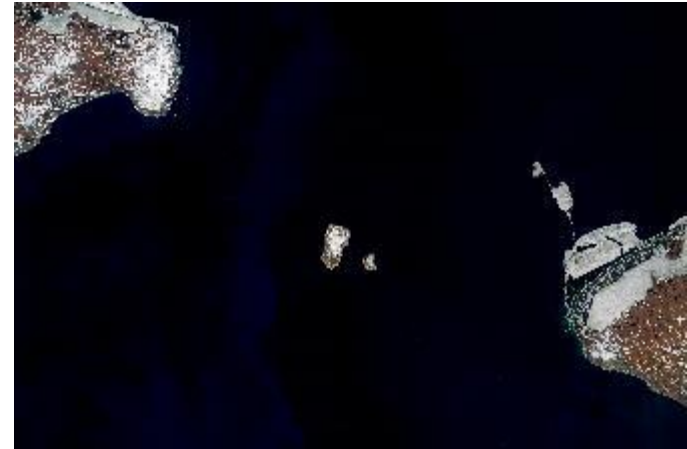
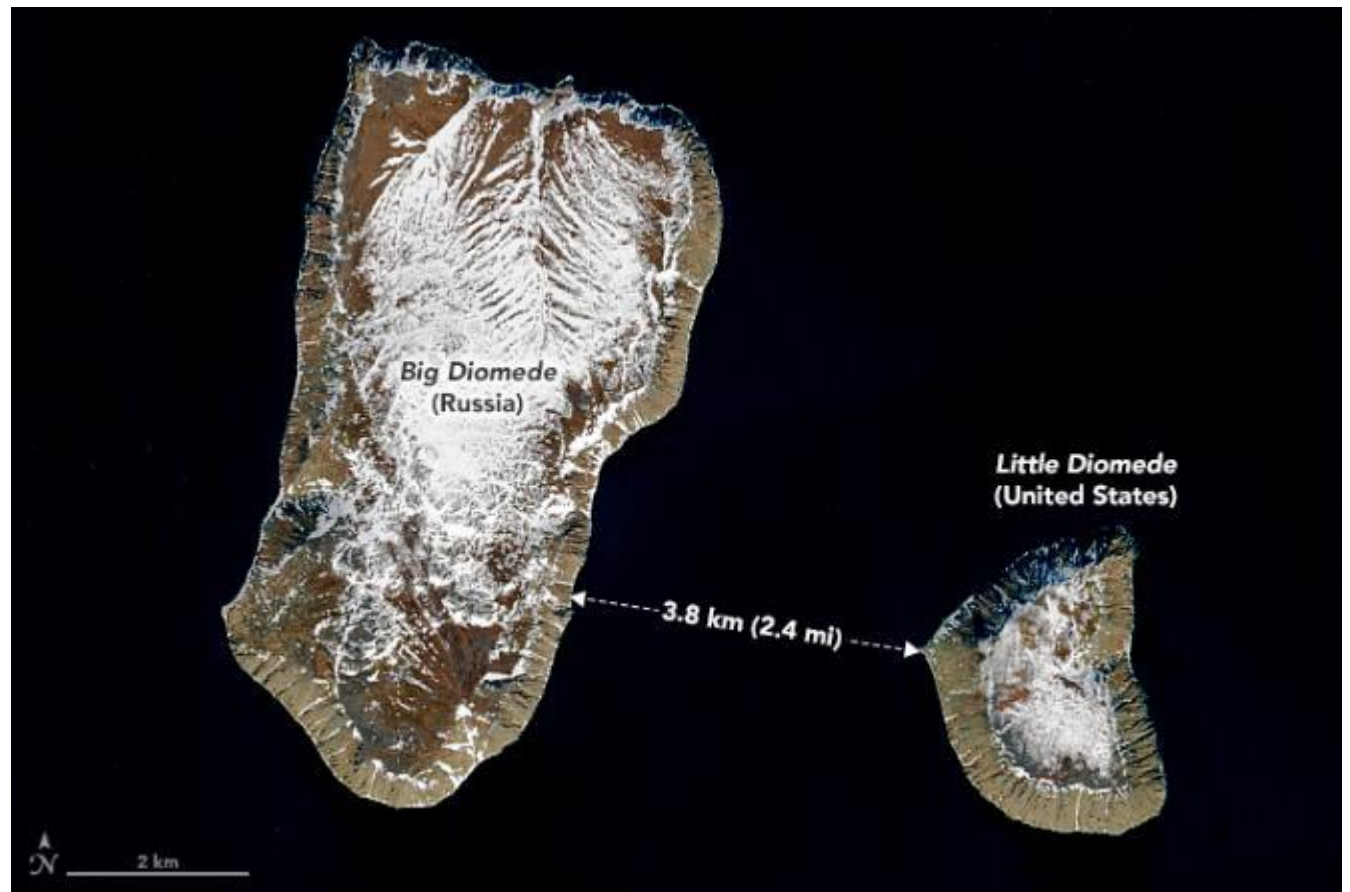
**In this course, you should have gained a sense of:**

- Understanding of imagery and wavelengths
- Potential of digital imaging to extract features
- The potential power of multispectral sensing
- Contribution of remote sensing to Geomatics / GIS
- Data availability – purchase and online
- Many applications - agriculture, forestry, land cover, glaciers etc..

Neat image

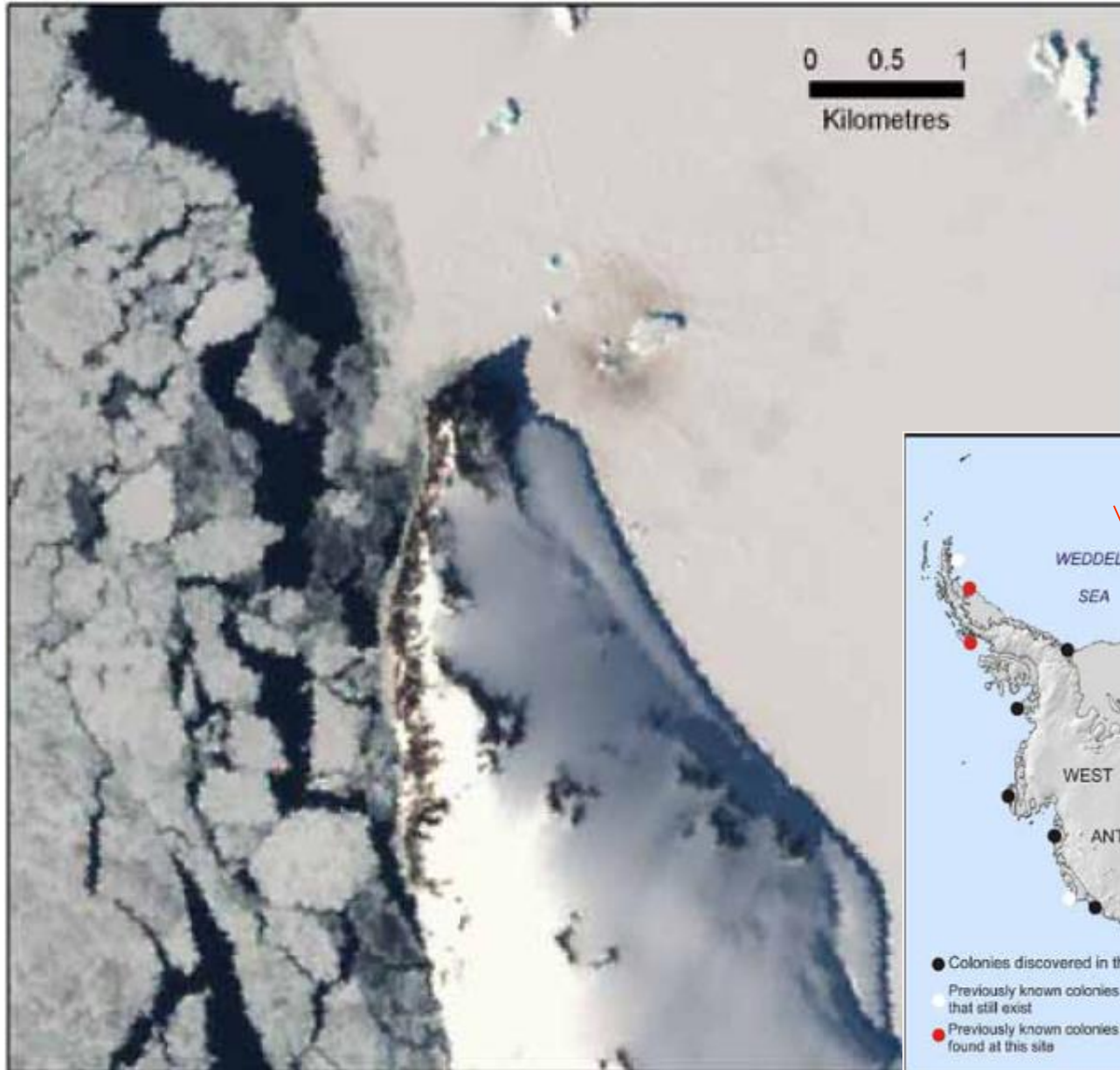
Closest distance  
Russia-USA 3.8km

Landsat 8 OLI

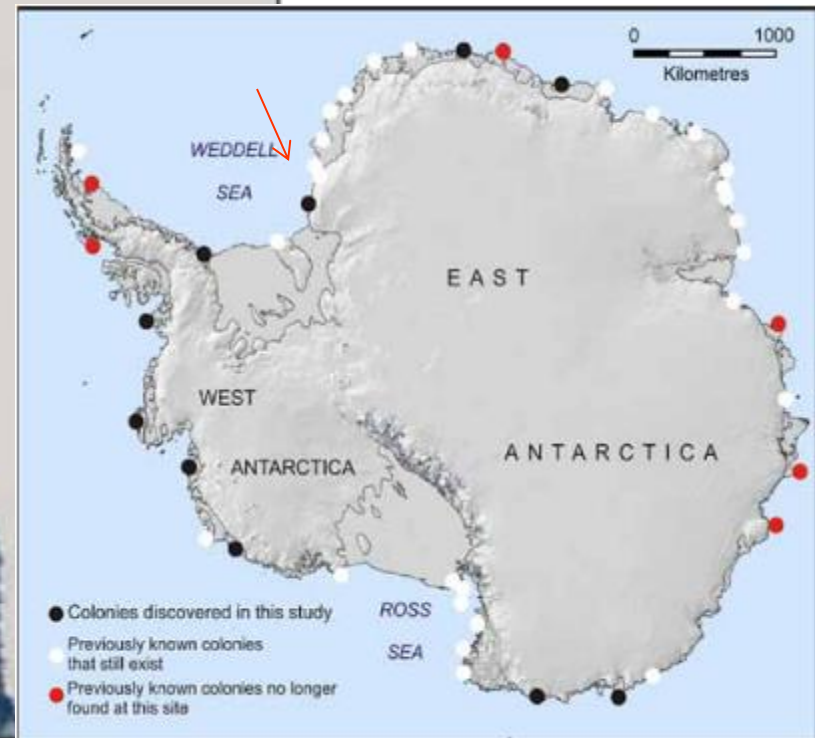


# My favourite satellite image

Mapping Penguins from space – using penguin poop



Landsat TM image showing guano stains of an emperor penguin colony in Halley Bay, Antarctica



# GEOG357 wrap-up

**Tuesday 10.30** (now): RS software and course summary

**Wednesday 15:00:** project data processing -> report ...

**Thursday 10.30:** 2<sup>nd</sup> exam via Moodle – 30 minutes within 10.30-11.30

**Tuesday 10.30:** 'project demos' – a few slides / 3 minutes: e.g.

1: goal – type of application, study area, image data used and year(s)

2: colour composite image(s) of area (clipped) with date(s)

3-4: processing: e.g. classification, ratios, bitmaps, feature vectors etc.

5: summary results - possible extra slide showing any challenging issues

*Please: no first slide with just your name and student ID ☺*

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*Sample exam question: which wavelengths are able to penetrate cloud cover*

*a. Visible    b. Near-IR    c. SWIR    d. Thermal IR    e. Microwave*

## Lecture topics / course since midterm exam

### October

21-25      Glaciers / Change detection

*Lab 7: Glaciers*

28-Nov 1   Projects / Env. Change class demos

*Lab 8: Change detection*

### November

4 – 8      DEMs / Microwave-RADAR

*Lab 9: DEMs*

12-15      Hyperspectral / LiDAR /

*Lab 10: Projects-data*

18-22      High resolution sensors / Planetary RS

*Lab 11: Data processing*

25-29      RS Software-course review / *Exam2 (10%)*

*Lab 12: project write-up*

Dec 2-3    Project demos – 3 minutes each

(course survey ends Dec 3 midnight)

*Dec 5-16 exam period      (no exam in this course)      Project deadline: Dec 6*

### Evaluation      100%

🕒 Exams: Oct 17, Nov 28      25%

🕒 Environmental Change exercise, Oct 25      10%

🕒 Lab exercises 8 x 5%      40%

🕒 Final project, Dec 6      25% (5 + 20)