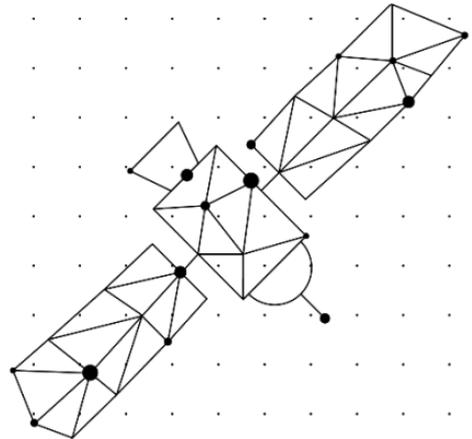# TERRASIGNA™

Learning Earth Observation Image Processing with LEOWorks 4.3

Adrian Stoica

United Nations/Romania International Conference on Space Solutions for Sustainable Agriculture and Precision Farming

Cluj-Napoca, 06-10 May 2019

Contents

ESA EDUSPACE

⌃ LEOWorks is a software product designed and developed for use in educational activities. It is the main tool for demonstrating Earth Observation techniques within the European Earth Observation Web Site for Secondary Schools - EDUSPACE, belonging to the European Space Agency (ESA)

⌃ More info Resources section on
http://www.esa.int/SPECIALS/Eduspace_EN/SEMHA60P0WF_0.html
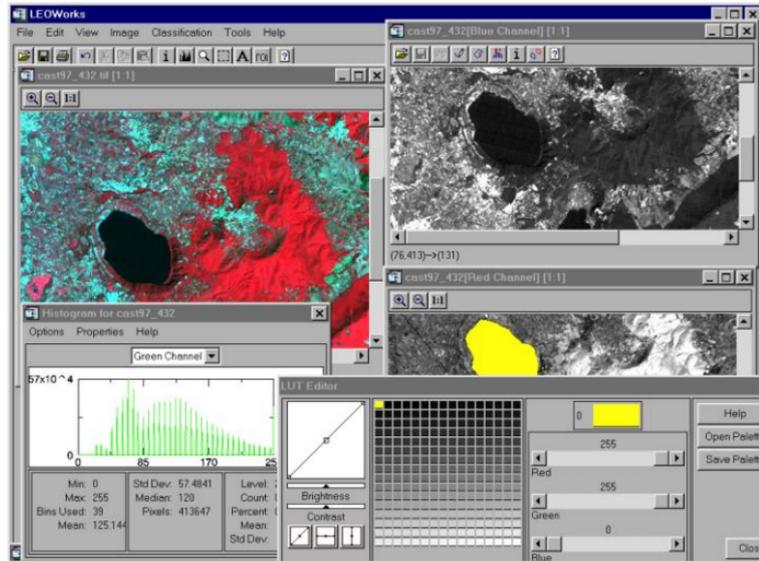
LEOWorks 3.0

⌃LEOWorks 3.0: IDL-based software

⌃Extensive tutorial

⌃Several modules for image manipulation

⌃GIS functionality: possibility to create GIS layers

⌃Developed by Florin Serban and Sorin Andrei (ROSA)

⌃Still available for download on

ESA EDUSPACE website: http://www.esa.int/SPECIALS/Eduspace_EN/SEMHA60P0WF_0.html

LEOWorks 4.3

⌃ LEOWorks 4.3 – to continue ESA's educational
  project developing LEOWorks, main tool for
  demonstrating Earth Observation techniques
  inside Eduspace

⌃ Make use of advanced geospatial libraries to
  develop an independent platform and user
  friendly software application

⌃ Open source, Java based, use of BEAM, NEST
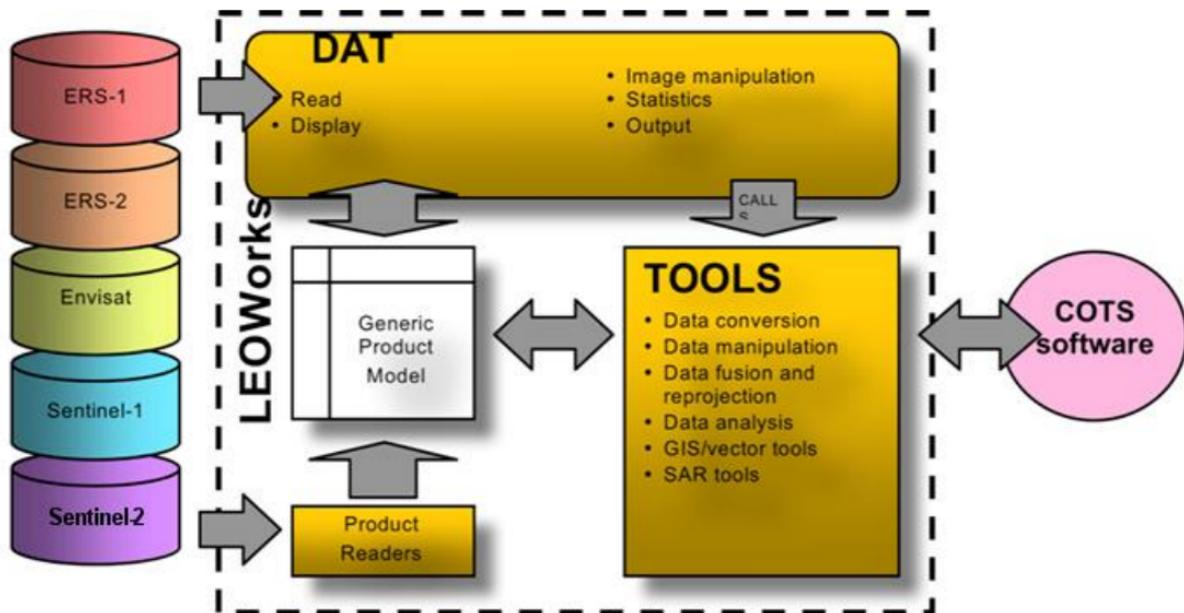 platform and libraries

⌃ New evolution based on ESA SNAP toolboxes.

LEOWorks 4.3

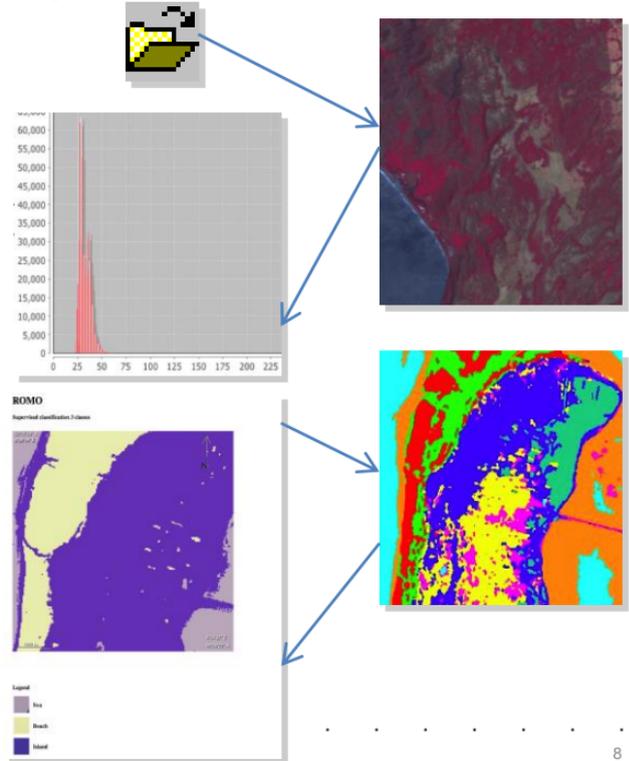⌂ LEOWorks 4.3 – Evolution from NEST and BEAM to SNAP platform.

# LEOWorks 4.3 - Architecture

LEOWorks 4.3 - Concepts

△ Open files: readers provided for
   most common EO data products

△ Display data: gray scale, RGB,
   color-indexed

△ Inspect & analyze

△ Image enhancement and
   information extraction

△ Present results – simple maps
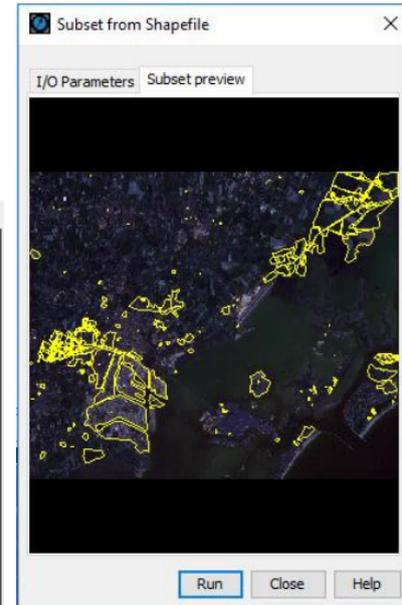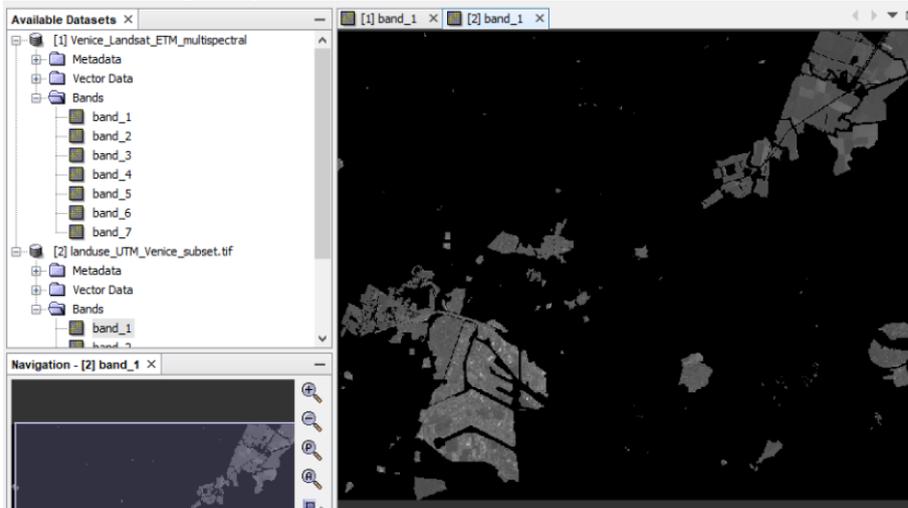

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LEOWorks 4.3 – Access to data

△ Opening files in LEOWorks is a very

flexible operation. It is possible to open:

- △ one single file as a single dataset;
- △ many single files as a single datasets;
- △ many files as a single dataset;
- △ reopen a previously open file.

△ Open files are displayed in Available data
window.
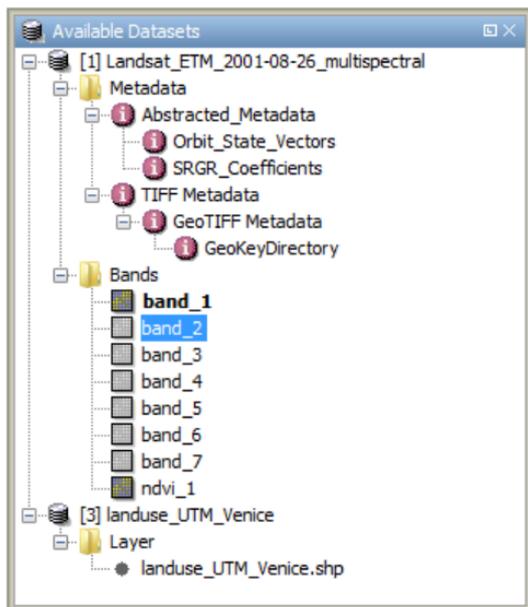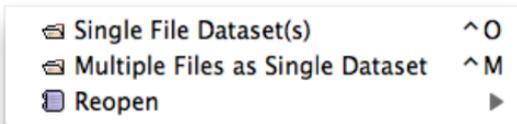
LEOWorks 4.3 – Access to data

⌃ When opening files, either Raster data or
  GIS vector data, it is possible to subset
  and or resize the content in a selected file
  or in a group of files;

LEOWorks 4.3 – Data display

⌃ Once a file is displayed in the Available Data window it is possible to display the data it contains as gray scale or color images.

⌃ GIS vector data can be displayed by double clicking the name of the feature layer of a vector dataset (under the Feature node).

⌃ By default, any vector data is displayed using a random symbol. It is always possible to change the way a vector layer is displayed by clicking the Style editor button.

⌃ All data is displayed in one or more viewer as layers; overlaying data with different CRS is possible; order and visibility is controlled using the Layer Manager.

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LEOWorks 4.3 – Inspecting data

⌃ Data inspection tools are available under the Inspect menu

⌃ Each tool is activated when clicking on data items in the Available Data window

⌃ Feature info and feature attribute table - available for GIS vector data

LEOWorks 4.3 – Image processing

⬦ Radiometric and geometric image processing

⬦ Contrast manipulation

⬦ Image filtering

⬦ Geometric transformation: scale, rotate, translate
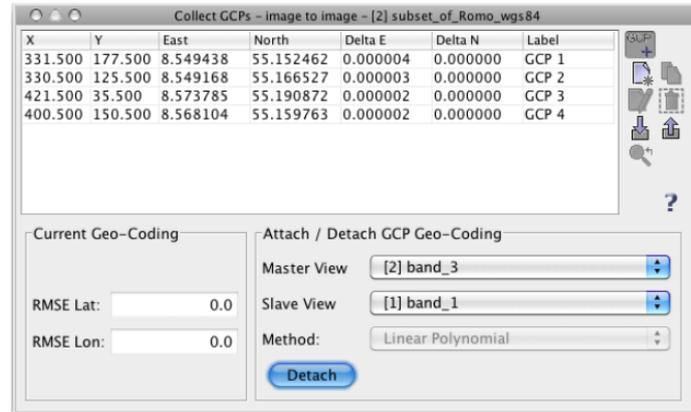
⬦ Pan-sharpening based on RGB-HIS transform
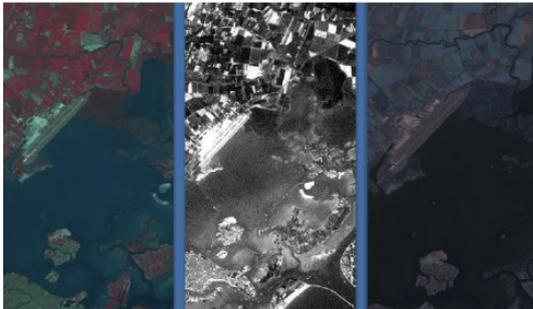
LEOWorks 4.3 – Image arithmetic

⌃ Dedicated function for computing NDVI and applying a predefined color palette

⌃ Advanced Band Arithmetic tool allows editing complex formula
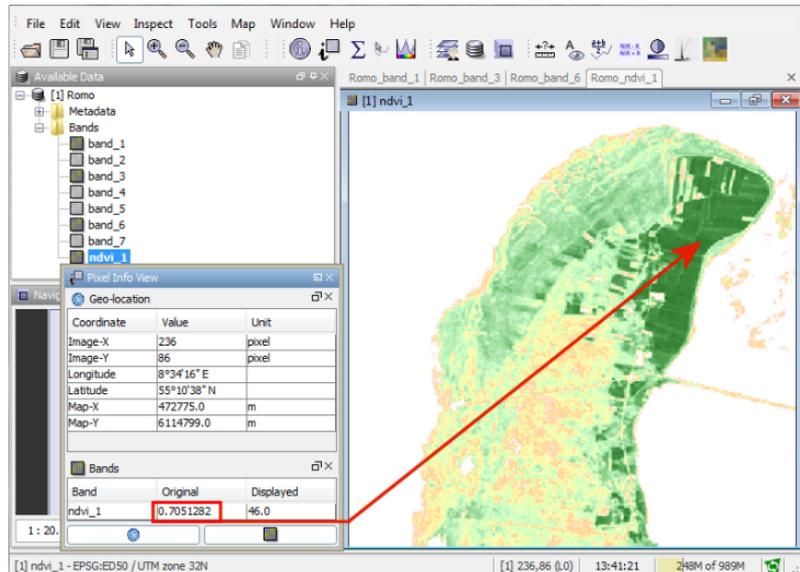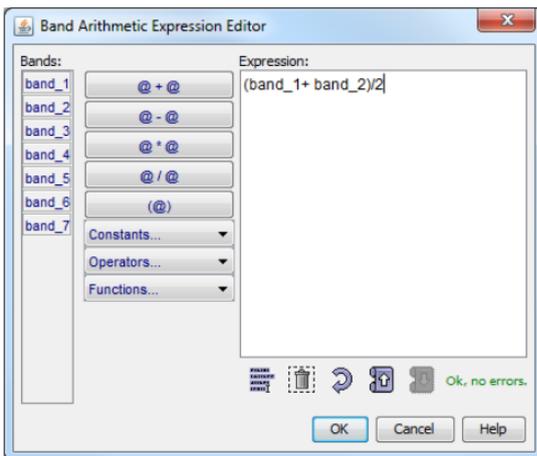
LEOWorks 4.3 – Attach coordinates to pixels

⌃ The registration procedures implemented in LEOWorks allows you to compute and attach geographic coordinates to every pixel in a satellite image

  ⌃ In Image to Map registration, the GCPs are selected exclusively by inspecting the image and choosing features that are also visible on a map in such a way their geographic or map coordinates can be accurately indicated

  ⌃ In Image to Image registration, the GCPs needed to compute the geocoding for a non-geocoded image are defined based on a geocoded image

⌃ Re-projection is possible for both vector and raster data

Collect GCPs – image to image – [2] subset_of_Romo_wgs84

X	Y	East	North	Delta E	Delta N	Label
331.500	177.500	8.549438	55.152462	0.000004	0.000000	GCP 1
330.500	125.500	8.549168	55.166527	0.000003	0.000000	GCP 2
421.500	35.500	8.573785	55.190872	0.000002	0.000000	GCP 3
400.500	150.500	8.568104	55.159763	0.000002	0.000000	GCP 4

Current Geo-Coding

RMSE Lat: 0.0

RMSE Lon: 0.0

Attach / Detach GCP Geo-Coding

Master View: [2] band_3

Slave View: [1] band_1

Method: Linear Polynomial

Detach

LEOWorks 4.3 – Radiometric calibration

⌄ The calibration window gives you access to the tools allowing you to radiometrically calibrate a band of an image by selecting points for which filed values are known.
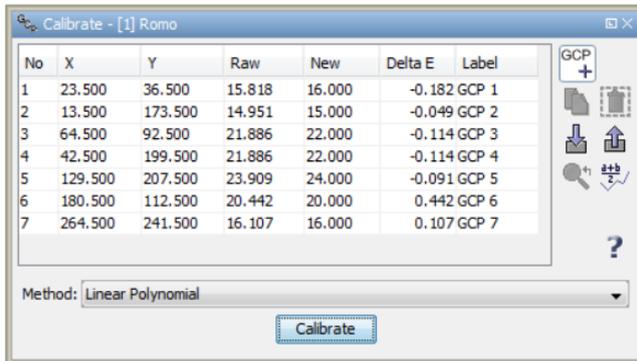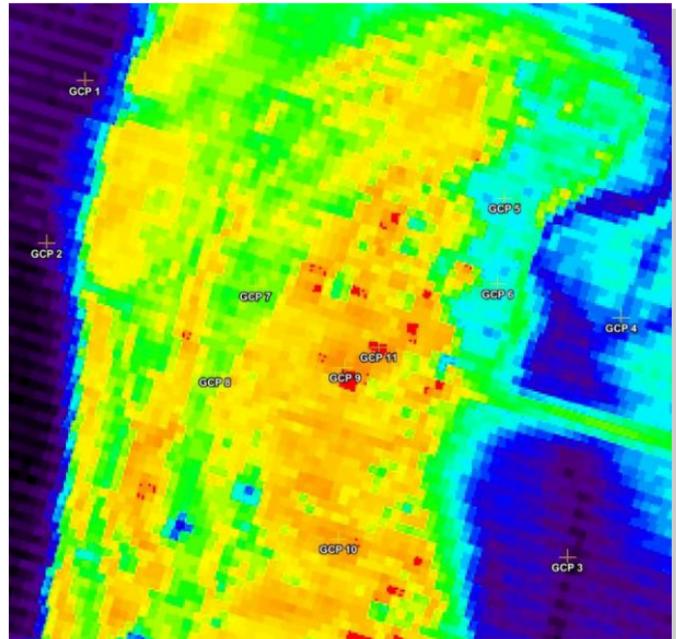

Calibrate - [1] Romo

No	X	Y	Raw	New	Delta E	Label
1	23.500	36.500	15.818	16.000	-0.182	GCP 1
2	13.500	173.500	14.951	15.000	-0.049	GCP 2
3	64.500	92.500	21.886	22.000	-0.114	GCP 3
4	42.500	199.500	21.886	22.000	-0.114	GCP 4
5	129.500	207.500	23.909	24.000	-0.091	GCP 5
6	180.500	112.500	20.442	20.000	0.442	GCP 6
7	264.500	241.500	16.107	16.000	0.107	GCP 7

Method: Linear Polynomial

Calibrate

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LEOWorks 4.3 – Image classification

- Unsupervised (k-means) and supervised methods available (Min Distance, Parallelepiped, Max Likelihood).

- Complete set of tools for defining, inspecting and refining training fields.

- Legend editing and classified image statistics are available.

LEOWorks 4.3 – Image classification

⌃ Supervised Classification - Complete set of tools for defining, inspecting and refining training fields.

LEOWorks 4.3 – GIS tool

GIS tools allowing to:

- Edit existing data (geometry and attributes)
- Create new data
- Select and export features
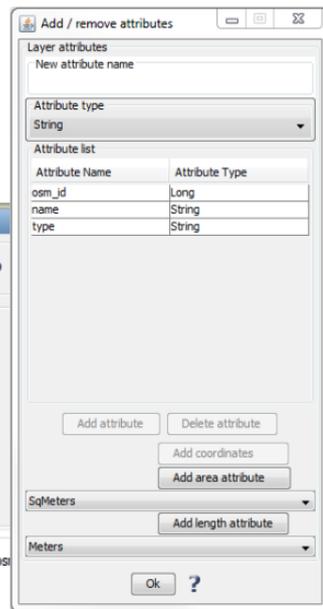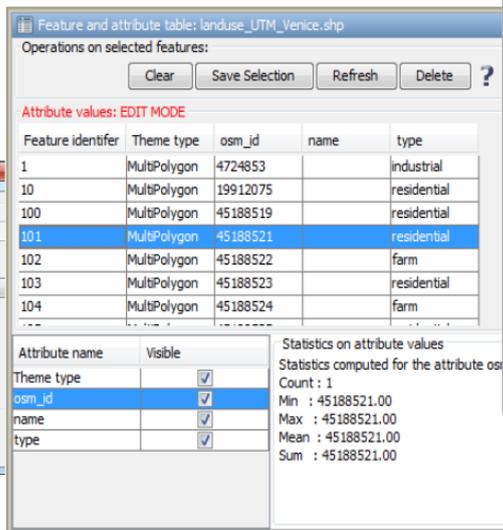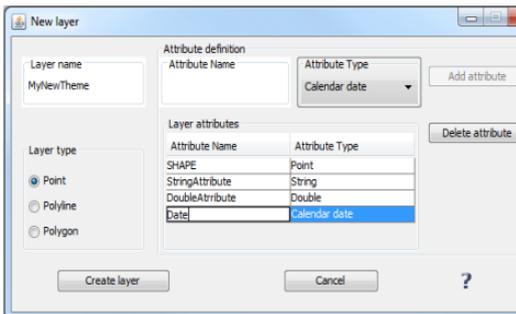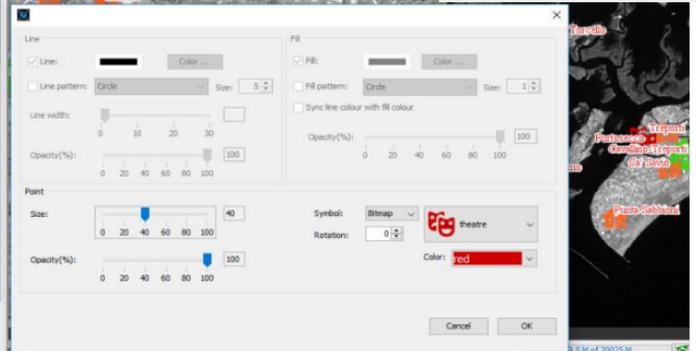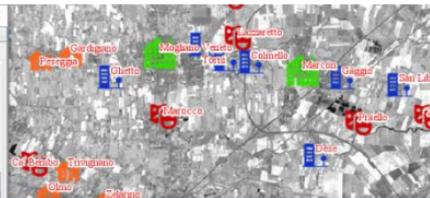
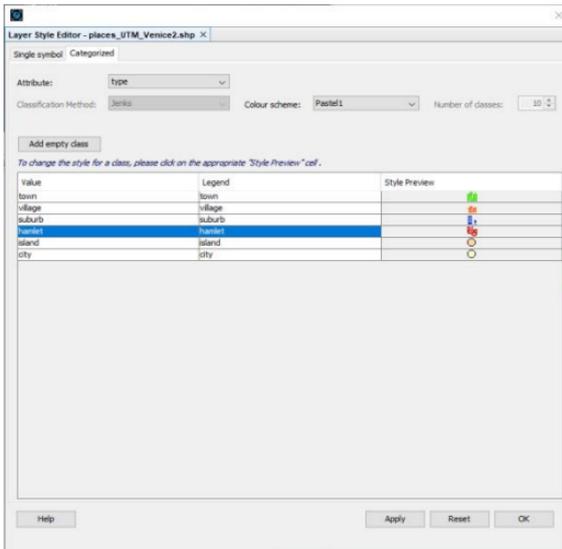# LEOWorks 4.3 – GIS tool

⌂ GIS tools allowing to:

⌂ Query and query builder
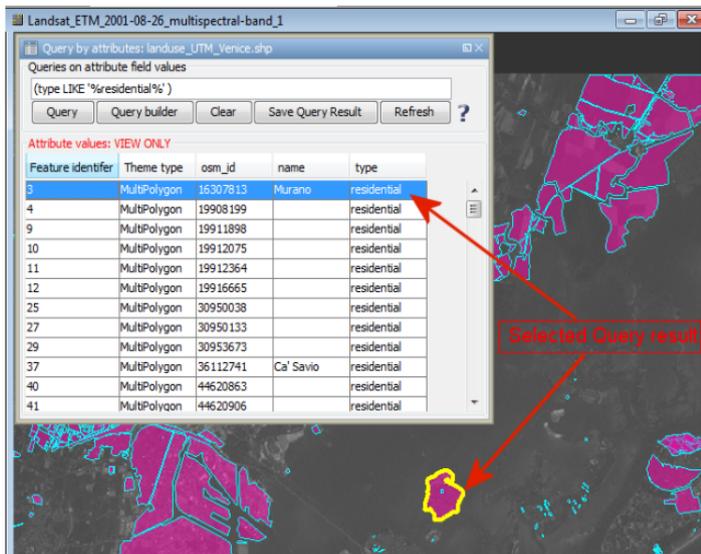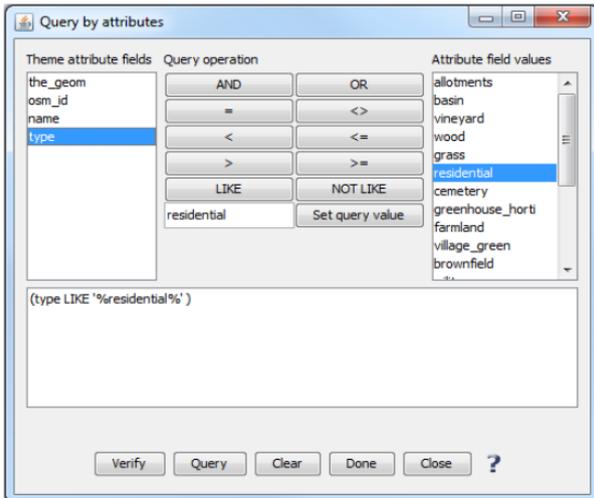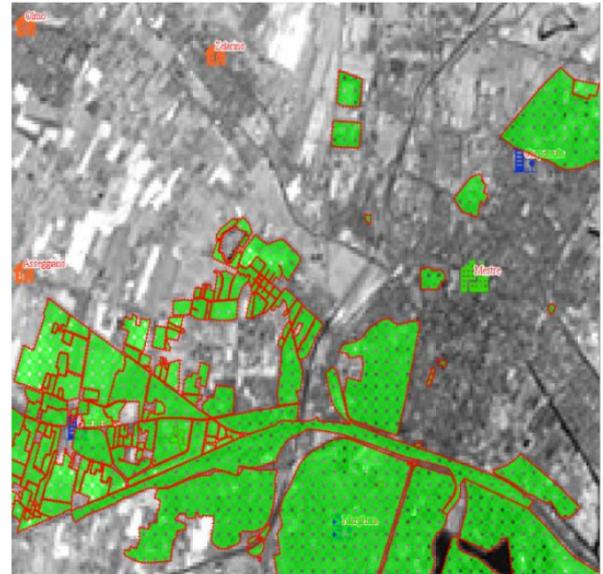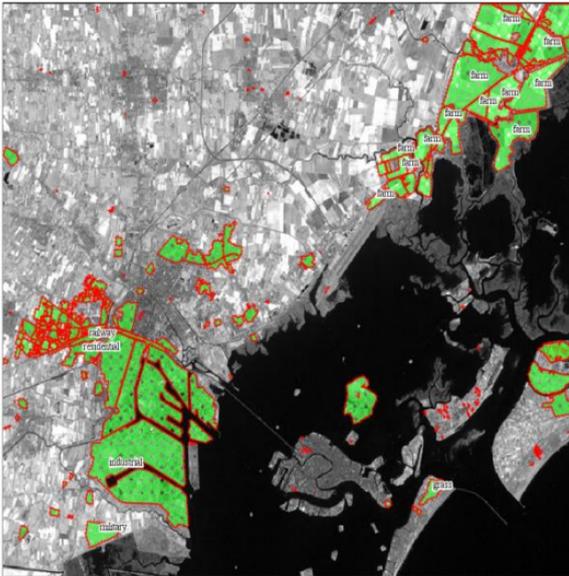
LEOWorks 4.3 – GIS tool

⌃ GIS tools allowing to:

  ⌃ Changing the symbols for point layers

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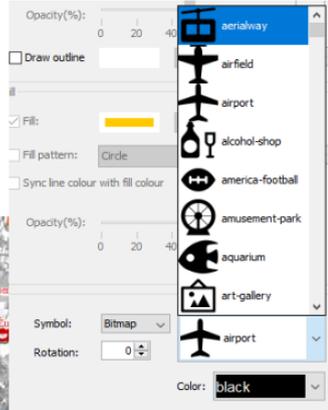
LEOWorks 4.3 – GIS tool
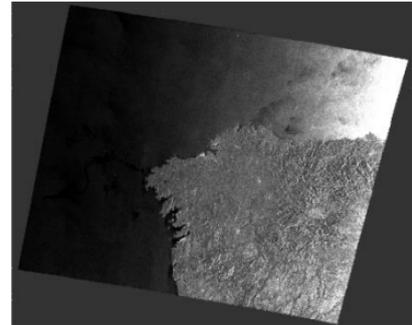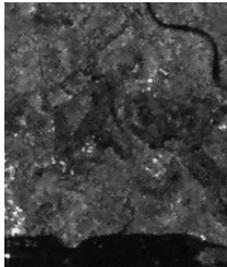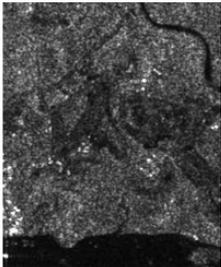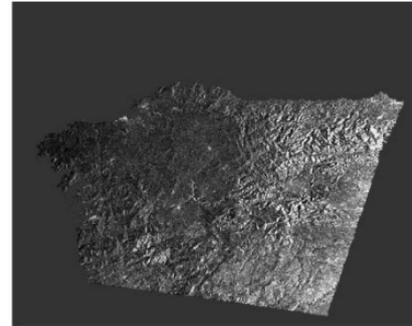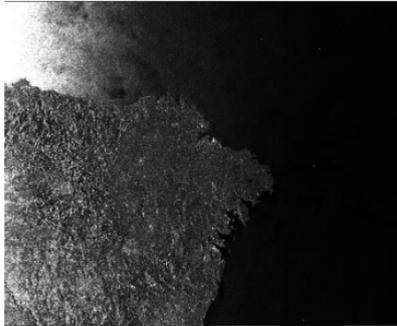
⌄ GIS tools allowing to:

  ⌄ Creating graduated and/or proportional symbols for GIS layers

LEOWorks 4.3 – Radar (SAR) tools
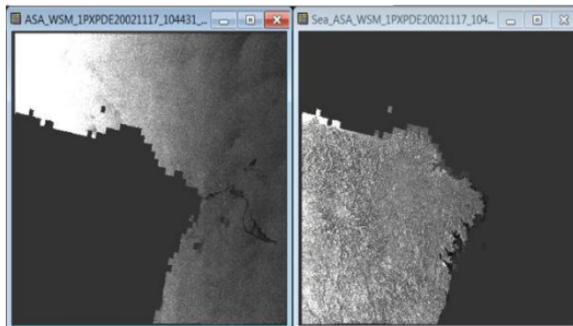
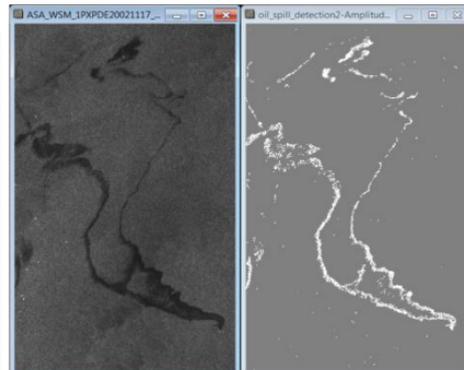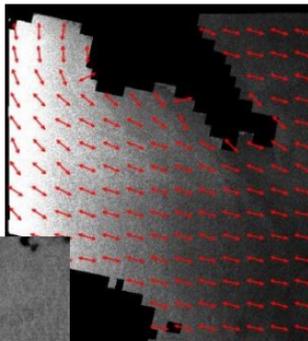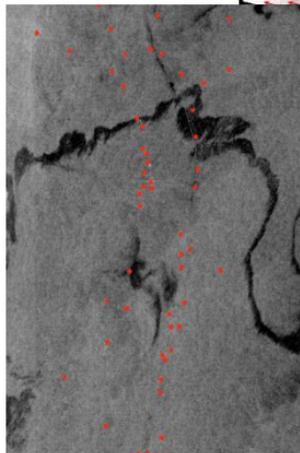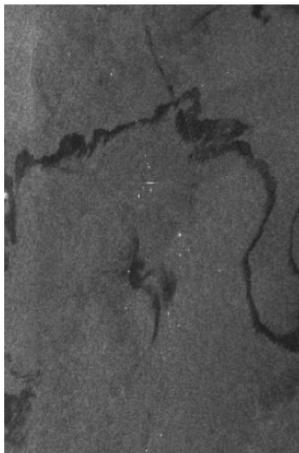⌃ SAR tools allowing to do operations like:

- ⌃ Radiometric calibration
- ⌃ Geometric correction
- ⌃ Speckle filtering
- ⌃ Resampling
- ⌃ Multilooking
- ⌃ Ocean Tools
- ⌃ S1 - deburst

LEOWorks 4.3 – Radar (SAR) tools
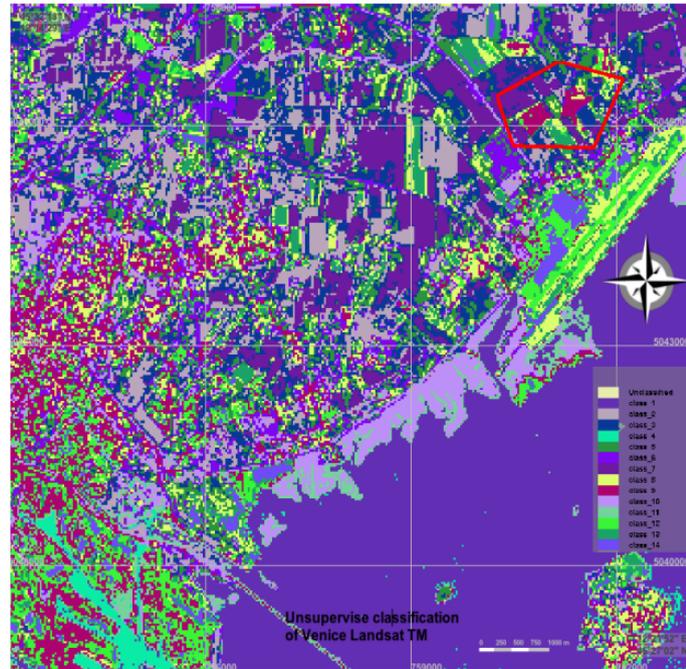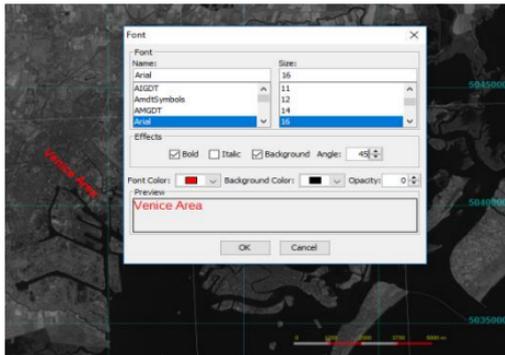
- SAR tools:
 - Ocean Tools

LEOWorks 4.3 – Map tool

- MAP tool allowing to:
  - Create a new map composition
  - Add different types of elements to the map
  - Print or export the map as PDF or JPEG
  - Show or hide the map grid or the map composer ruler

Unsupervise classification of Venice Landsat TM

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LEOWorks 4.3 – Other tools

⌃ Spatial and spectral subset

⌃ Image Stack

⌃ Mosaic

⌃ Data conversion

⌃ Orthorectification

⌃ Reprojection

⌃ Animation

⌃ & more to come

⌃ & more to discover …
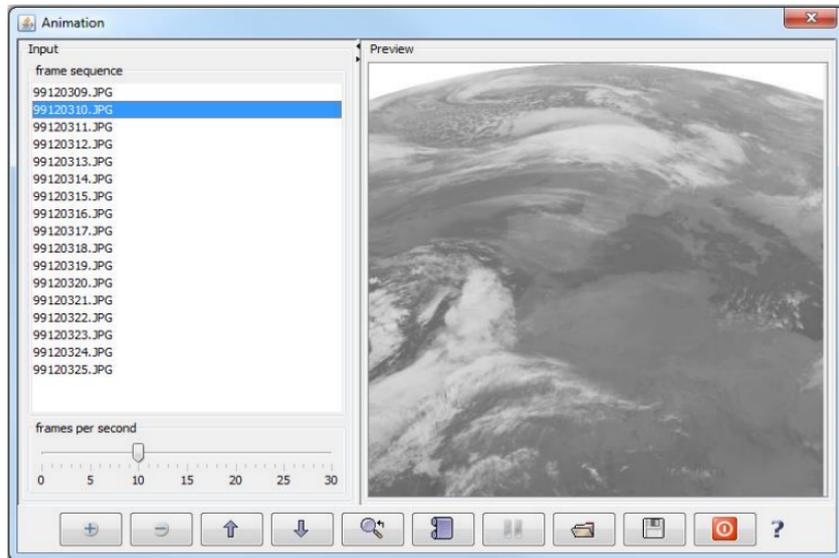
LEOWorks 4.3 – Download and Contacts

⌂ For download: **http://leoworks.terrasigna.com**

⌂ And:
http://www.esa.int/SPECIALS/Eduspace_EN/SEMHA60P0WF_0.html

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Thank you for attention