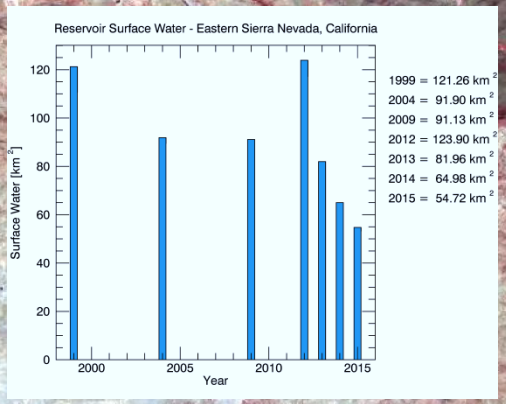
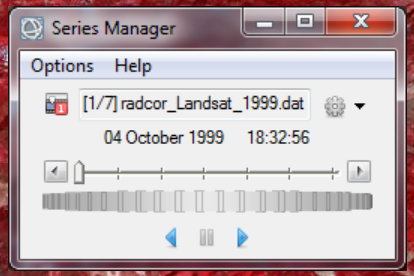




From Data to Information

Spatio-temporal analysis of historic and recent Landsat acquisitions with ENVI 5.3

Thomas Bahr

Arbeitskreis Fernerkundung
Geozentrum Universität Bonn, 24./25. September 2015

Agenda

Spatio-Temporal Analysis with ENVI 5.3

- Live-presentation exemplified by Landsat acquisitions

What‘s New in ENVI 5.3

What‘s New in SARscape 5.2

Agenda

Spatio-Temporal Analysis with ENVI 5.3

- Live-presentation exemplified by Landsat acquisitions

What's New in ENVI 5.3

What's New in SARscape 5.2

Spatio-Temporal Analysis

Ability to construct a stack of time-enabled raster images.

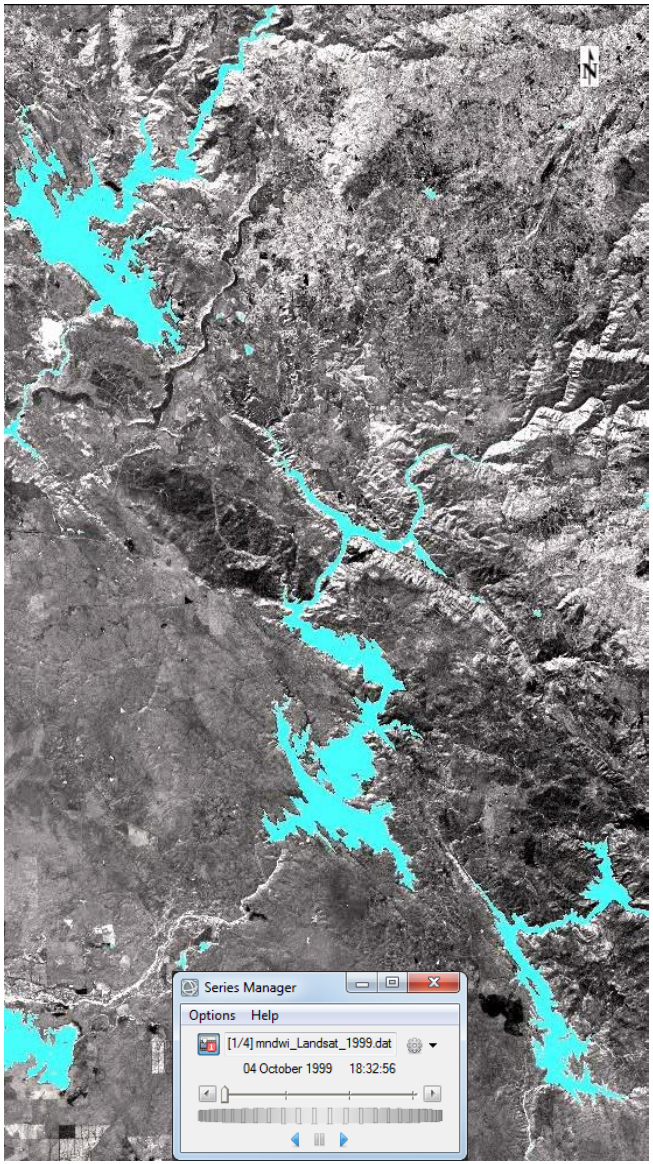
- Normalize a stack of rasters to a common spatial grid with automatic reprojection & resampling.
- Option to order the raster series sequentially according to time metadata.

Automatic ingest of "acquisition time" metadata for raster datasets from a wide variety of sensor data sources.

View and animate a spatio-temporal series.

Raster animation (intra-file band & inter-file series/time).

Animation export to common video formats (.avi, .flv, .mp4, .webm, etc.).



ENVI 5 API

ENVITask System

- Modern object-oriented programming interface for processing.
- Helping you bridge the gap from Desktop application to Enterprise solutions.

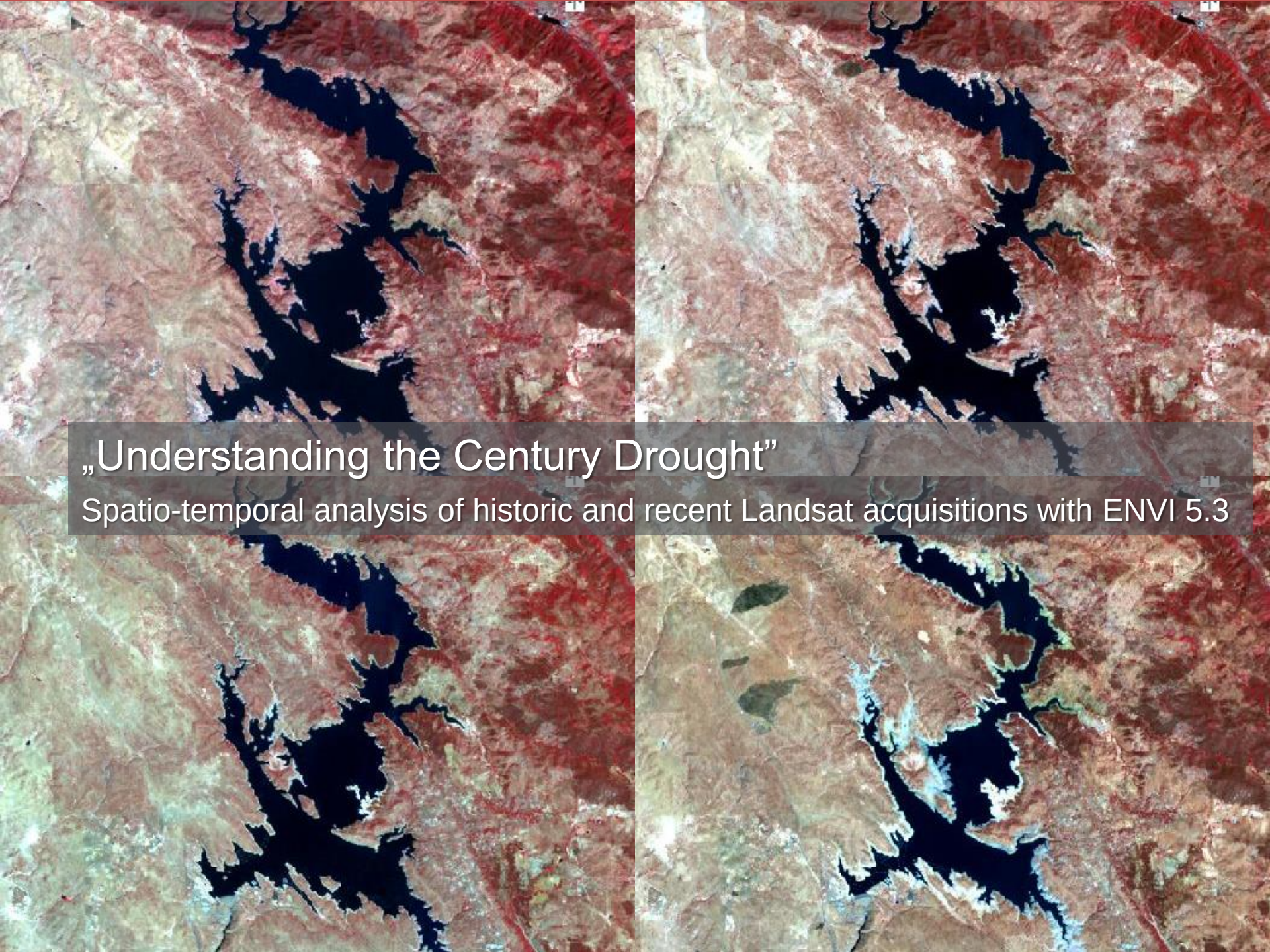
AutoChangeThresholdClassification
BuildBandStack
BuildRasterSeries
BuildTimeSeries
ChangeThresholdClassification
ClassificationAggregation
ClassificationSmoothing
ClassificationToShapefile
ColorSliceClassification
DarkSubtractionCorrection
DimensionsResampleRaster
EqualizationStretchRaster
FXSegmentation
ForwardICATransform
ForwardMNFTransform
ForwardPCATransform
GaussianStretchRaster
GramSchmidtPanSharpening
ISODATAClassification
ImageBandDifference
ImageIntersection
ImageThresholdToROI
LinearPercentStretchRaster
LinearRangeStretchRaster
LogStretchRaster
MahalanobisDistanceClassification
MappingResampleRaster
MaximumLikelihoodClassification
MinimumDistanceClassification
NNDiffusePanSharpening
OptimizedLinearStretchRaster
PCPanSharpening
PercentThresholdClassification
PixelScaleResampleRaster
QUAC
QuerySpectralIndices
ROIToClassification
RPCOrthorectification
RXAnomalyDetection
RadiometricCalibration
RadiometricNormalization
RasterStatistics
RasterViewshed
RegridRaster
RegridRasterSeriesByIndex
RegridRasterSeriesByIntersection
RegridRasterSeriesByUnion
ReprojectGLT
RootStretchRaster
SpectralAngleMapperClassification
SpectralIndex
SpectralIndices
ThematicChange
TrainingClassificationStatistics
VectorAttributeToROIs
VectorRecordsToROI
VegetationSuppression
VideoToRasterSeries

138 Tasks in ENVI 5.3

ENVI 5 API – Example

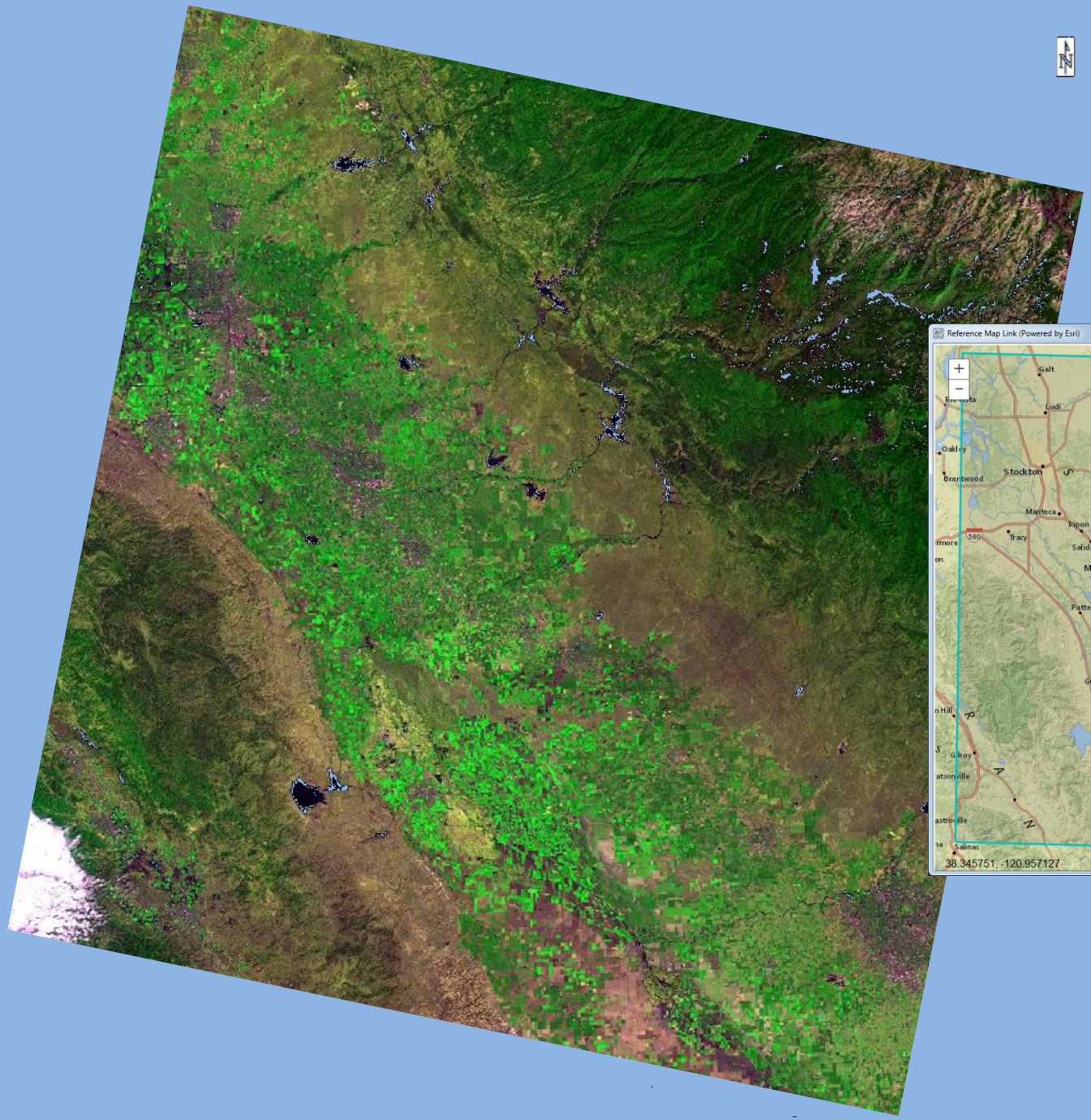
- File search (batch)
- ENVITask Radiometric Calibration
- ENVITask QUAC (Atmospheric correction)
- ENVITask Spectral Index (NDVI)

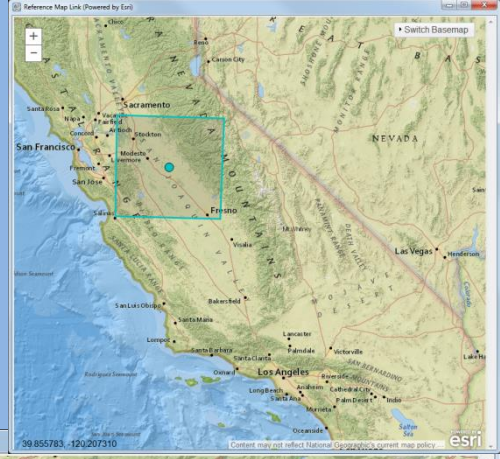
```
pro Pleiades_RadCal_QUac_NDVI_Batch
  compile_opt idl2

  ; Start the application
  e = envi(/CURRENT)
  if e eq !NULL then e = envi()

  ; Create list of files to perform processing
  filelist = File_Search('C:\envidata\AGA\Batch_Processing_Inputs', 'DIM_*MS*.XML')

  ; Get the Radiometric Calibration task from the catalog of ENVITasks.
  Task1 = ENVITask('RadiometricCalibration')

  ; Get the QUAC task from the catalog of ENVITasks.
  Task2 = ENVITask('QUAC')

  ; Get the Spectral Indices task from the catalog of ENVITasks
  Task3 = ENVITask('SpectralIndices')
  Task3.INDEX = ['Normalized Difference Vegetation Index']

  ; Define output raster directories
  out_dir_cal = 'C:\envidata\AGA\enviout\cal'
  out_dir_quac = 'C:\envidata\AGA\enviout\cal_quac'
  out_dir_ndvi = 'C:\envidata\AGA\enviout\ndvi'

  ; Open the rasters and execute the tasks.
  foreach file, filelist do begin

    ; Open an image from the filelist
    raster = e.OpenRaster(file)

    ; Run Radiometric Calibration
    out_file_cal = out_dir_radcal + path_sep() + 'RadCal_' + file_basename(file, '.XML') + '.dat'
    Task1.Input_Raster = raster
    Task1.Output_Raster_URI = out_file_radcal
    Task1.Execute

    ; Run QUAC
    out_file_quac = out_dir_quac + path_sep() + 'QUac_' + file_basename(file, '.XML') + '.dat'
    Task2.Input_Raster = Task1.Output_Raster
    Task2.Output_Raster_URI = out_file_quac
    Task2.Execute

    ; Run Spectral Indices
    out_file_ndvi = out_dir_ndvi + path_sep() + 'NDVI_' + file_basename(file, '.XML') + '.dat'
    Task3.Input_Raster = Task2.Output_Raster
    Task3.Output_Raster_URI = out_file_ndvi
    Task3.Execute

  endforeach

end
```

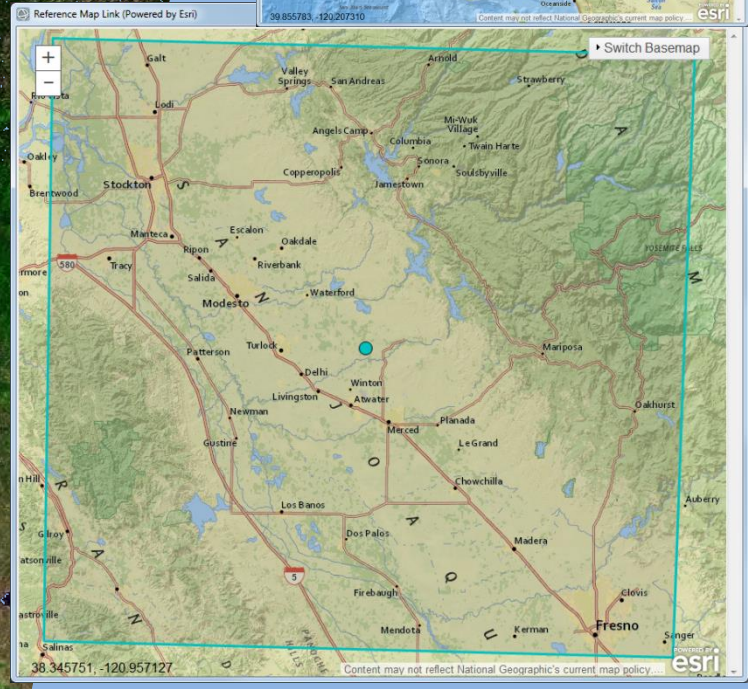


„Understanding the Century Drought”

Spatio-temporal analysis of historic and recent Landsat acquisitions with ENVI 5.3




Reference Map Link (Powered by Esri)
Switch Basemap
Sacramento
San Francisco
Fresno
Las Vegas
Los Angeles
NEVADA
39.855783, -120.207310
esri


Reference Map Link (Powered by Esri)
Switch Basemap
Galt
Arnold
Valley Springs
San Andreas
Strawberry
Lodi
Angels Camp
Mi-Wuk Village
Columbia
Twain Harte
Sonora
Soulsbyville
Oakley
Stockton
Copperopolis
Jamestown
Brentwood
Manteca
Escalon
Oakdale
Ripon
Riverbank
Tracy
Salida
Waterford
Modesto
Patterson
Turlock
Mariposa
Delhi
Winton
Livingston
Atwater
Oakhurst
Newman
Merced
Planada
Gustine
LeGrand
Chowchilla
Los Banos
Auberry
Gilroy
Dos Palos
Madera
Firebaugh
Clovis
Mendota
Kerman
Fresno
Salinas
38.345751, -120.957127
Content may not reflect National Geographic's current map policy.
esri

Batch Mode Using the ENVI 5 API

Preprocessing

File search (batch)

- ENVITask Radiometric Calibration
- ENVITask QUAC
  (Atmospheric correction)

ENVITask Build Time Series

Animation of spatiotemporal series (view 1)

Analysis

File selection (interactive)

- ENVITask Spectral Index (MNDWI)
- ENVITask Color Slice Classification
- ENVITask Classification Aggregation
- ENVITask Classification to Shapefile
- ENVIDoit Stretch Doit
- ENVIDoit Classification Overlay

Display shape files (view 1)

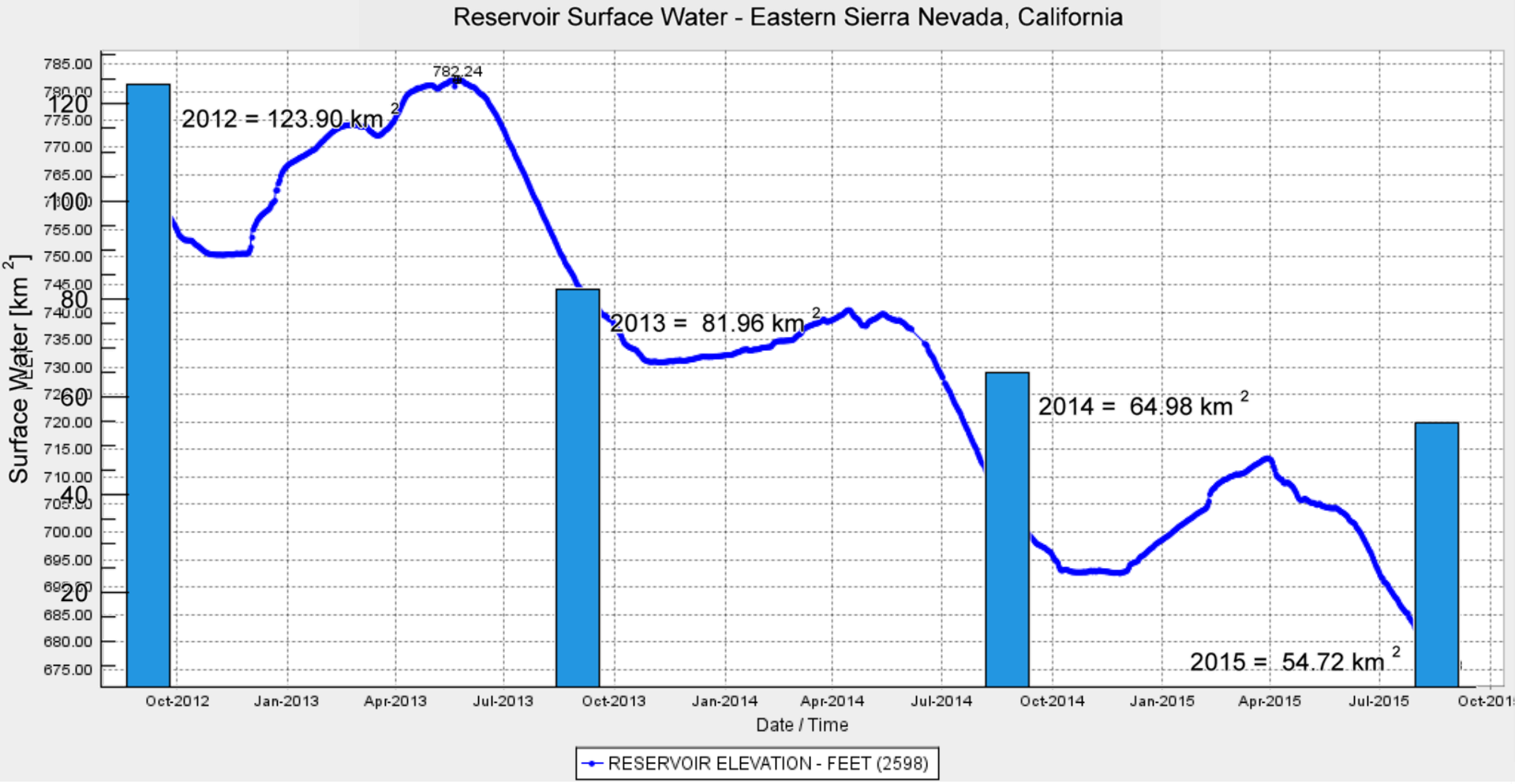
ENVITask Build Time Series

Animation of spatiotemporal series (view 2)

Create video animation

Visualization of results as
IDL-Barplot and export as PDF

Correlation with Reservoir Elevations



Agenda

Spatio-Temporal Analysis with ENVI 5.3

- Live-presentation exemplified by Landsat acquisitions

What‘s New in ENVI 5.3

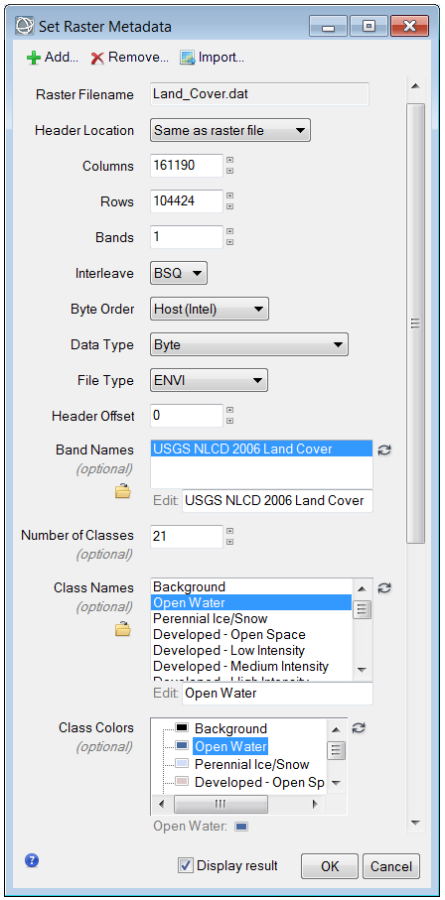
What‘s New in SARscape 5.2

ENVI 5.3 – What's New (1 of 6)

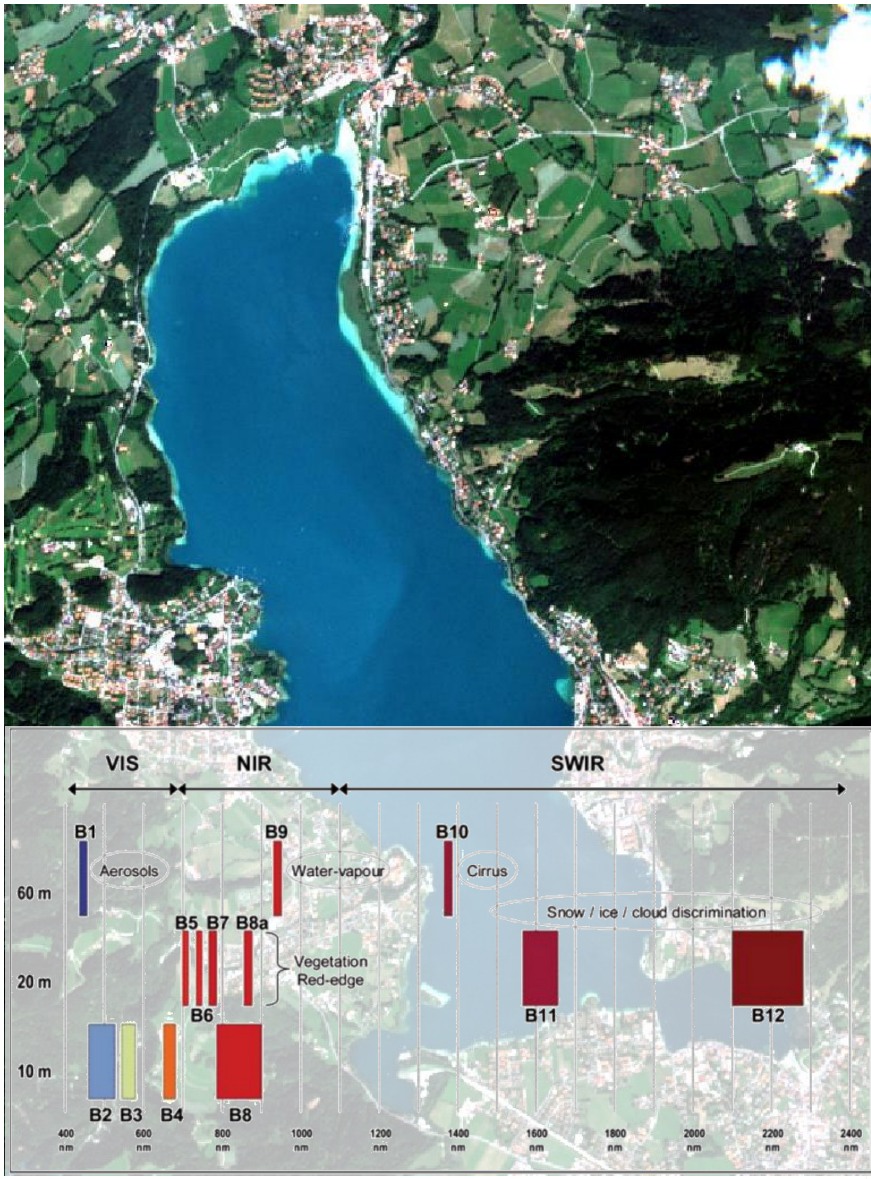
Sensor Product Input

- Sentinel-2A MSI Level 1C

Raster Metadata



- Modern upgrade to „Edit ENVI Header".
- Edit classification image class names & colors.

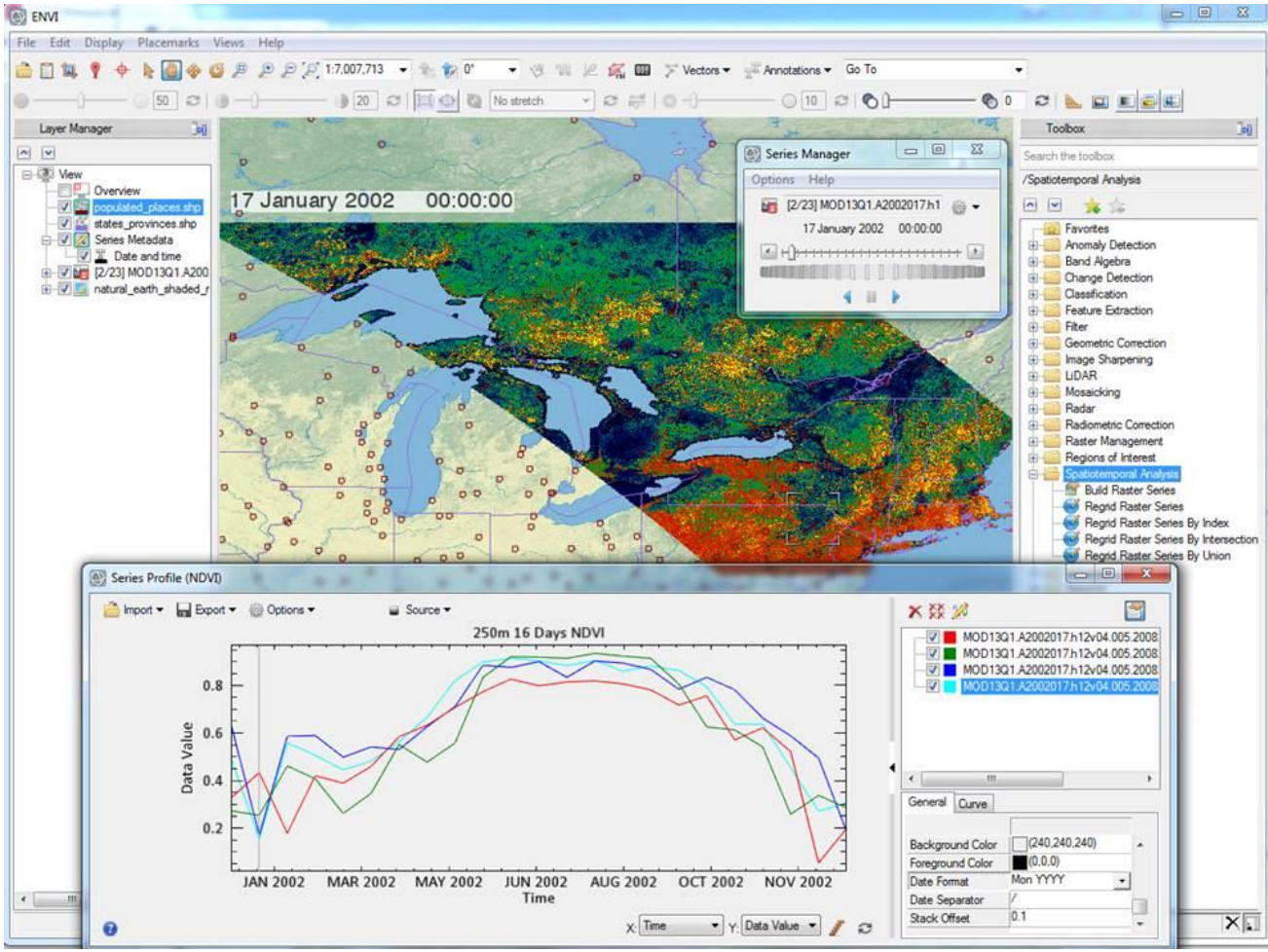


Sentinel-2A image data courtesy of European Space Agency

ENVI 5.3 − What‘s New (2 of 6)

Spatio-Temporal Analysis

- Raster series custom grid definitions.
- Raster series time profile.

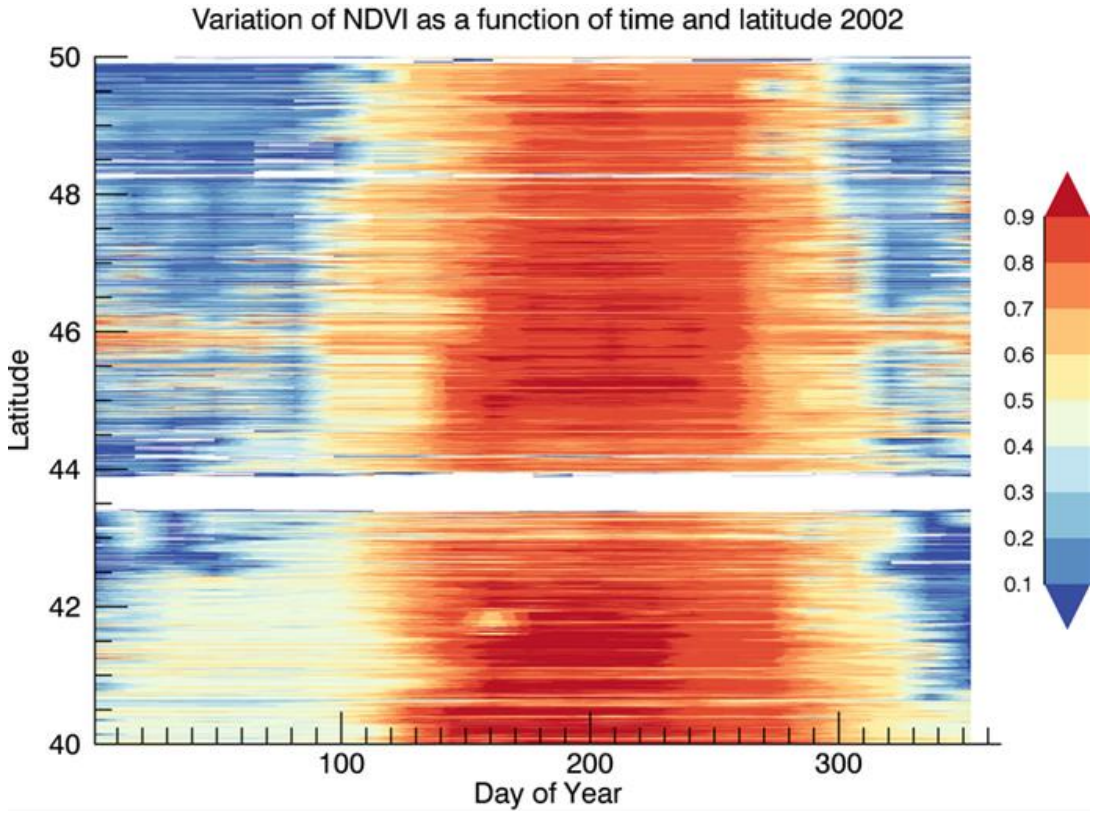


Temporal NDVI analysis using MODIS

ENVI 5.3 − What‘s New (3 of 6)

ENVI/IDL Programmatic API

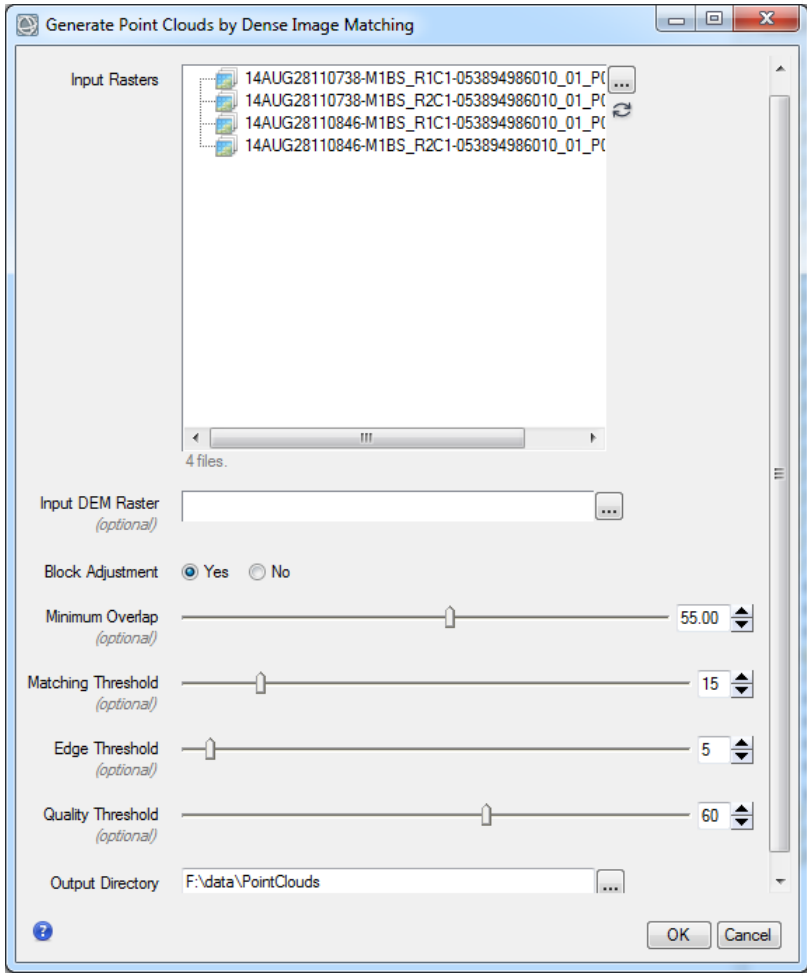
- 54 new ENVITasks, i. a.
  - –“Seamless Mosaic” functionality,
  - –Tasks for working with spectral libraries,
  - –Reproject a raster to any coordinate system.
- Under-defined ENVITasks
- Temporal processing examples
  - –Time-frequency analysis
  - –Space-time visualization



ENVI 5.3 – What's New (4 of 6)

ENVI Photogrammetry Module

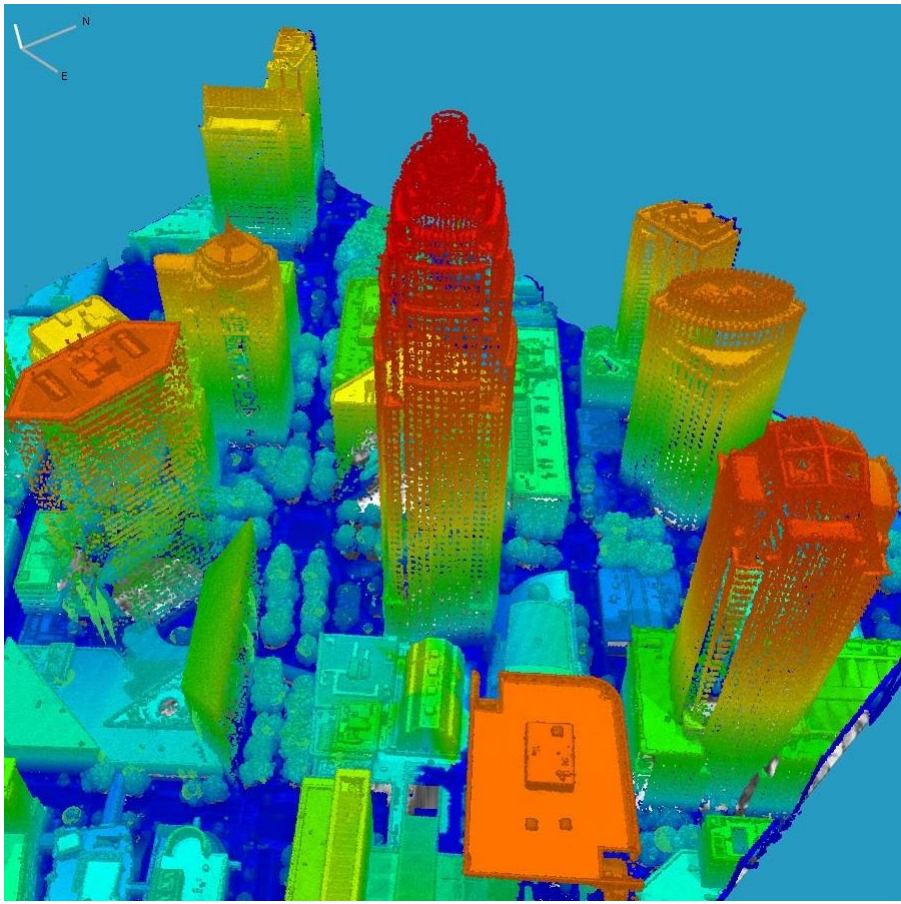
- Photogrammetrically derived 3D point-clouds from spaceborne EO/IR platform stereo imagery via pixel correlation.
- Uses semi-global matching (SGM) algorithm for dense image matching.
- Sensor orientation metadata used to constrain search along epipolar dimension.
- Matches all pixels generating point cloud with one 3D point per pixel.
- Output LAS files encoded with Intensity or RGB from input images used for matching.
- Initial sensor support:
  - ENVI Standard raster format with generic RPC model
  - WorldView-1/2/3
  - GeoEye-1
  - IKONOS
  - QuickBird
  - Pleiades-1 & SPOT-6/7



ENVI 5.3 − What‘s New (5 of 6)

ENVI LiDAR Integration

- ENVI now has significant out-of-the-box point-cloud visualization and analysis:
  - Bare-Earth DEM and DSM generation
  - Orthophoto extraction
  - Contours production
  - Terrain TIN creation (Triangulated Irregular Network)
  - “Viewshed“ line-of-sight analysis
- 3D point-cloud feature extraction (buildings, trees, power lines) now part of the ENVI Feature Extraction Module
  - ENVI Fx module is now 2D + 3D !
- LiDAR API integrated into e=ENVI()
  ⇨ programmatic access is much simpler
  - Custom extension development
  - Headless batch mode execution
  - Enterprise server deployments

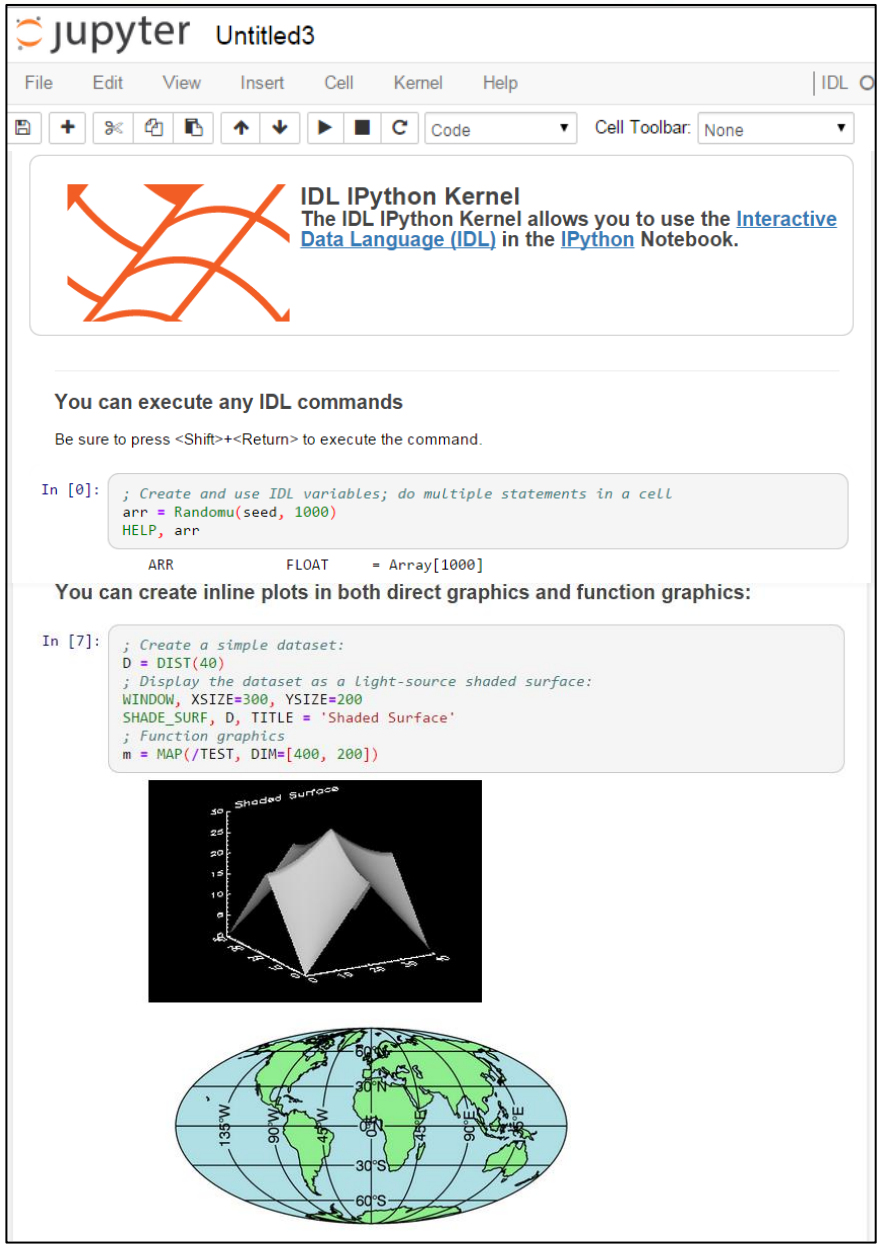


Point-cloud data from Harris IntelliEarth™ Geiger-mode LiDAR sensor

ENVI 5.3 – What's New (6 of 6)

Bi-Directional IDL-Python Bridge

- Access to all IDL routines and Python modules in either language.
- Seamless integration of Python code in ENVI.
- Ability to execute
  ArcGIS ⇨ Python ⇨ IDL ⇨ ENVITask
- Automatic data and syntax conversions.
- IPython Notebook kernel for running IDL
  - Web interface for interactive publication-quality notebooks for exploratory data analysis.
  - Combine code execution, rich text, mathematics, plots and rich media.



Agenda

Spatio-Temporal Analysis with ENVI 5.3

- Live-presentation exemplified by Landsat acquisitions

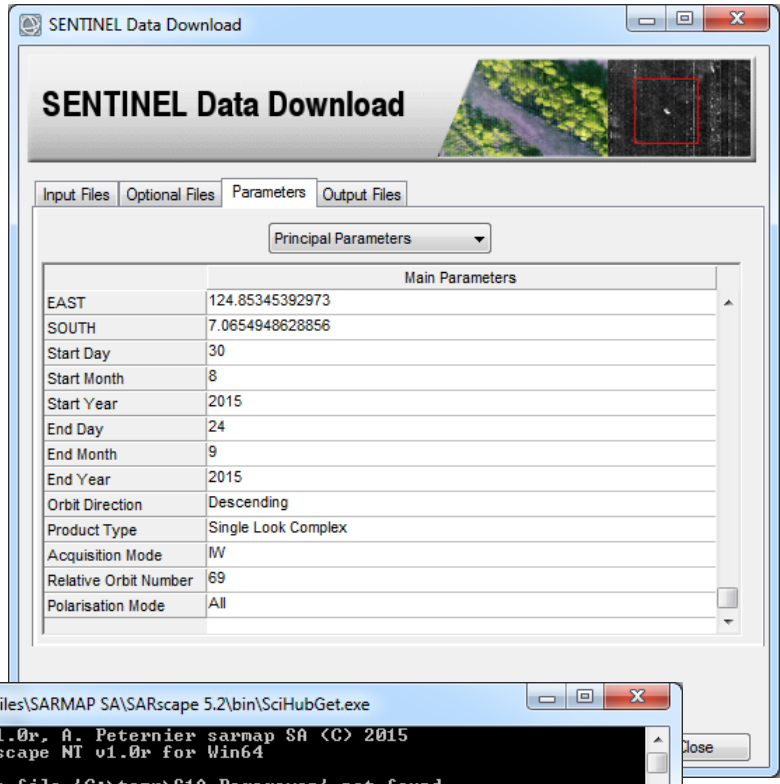
What‘s New in ENVI 5.3

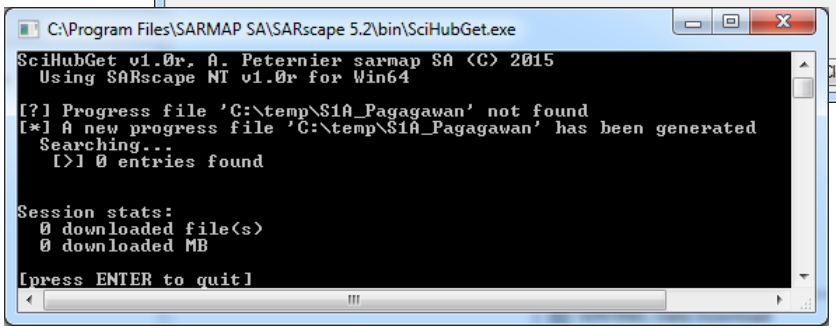
What‘s New in SARscape 5.2

SARscape 5.2 − What's New

Key features among the new enhancements are:

- Sentinel-1 IW (TOPSAR)
  - Full support for Sentinel TOPSAR (and Stripmap) interferometry and interferometric stacking.
  - Includes new, very precise coregistration based on spectral diversity.
- SARscape import tools now contain a Sentinel Data download tool.
- PALSAR-2 ScanSAR Full Aperture interferometry preliminary support.
- Improved parallel computing in interferometric processing.
- Second-generation De Grandi multi-temporal speckle filter.
- IDL API
  - New functions to read and write SARscape .sml ancillary / header files from IDL scripts.
  - New IDL example scripts.





Workshop 2 (14:00 Uhr)

Spatio-temporal analysis of historic and recent Landsat acquisitions with ENVI 5.3

Thomas Bahr

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