Course title: EOTIST Standard course

Course subject: Computer Science

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LESSON SC1 - EXERCISE
BATCH PROCESSING

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OBJECTIVES

Basic statements of batch processing

Use of loops

Use of command lines of GIS modules

KEY ELEMENTS

Time series, band selection, vegetation index

SOFTWARE

SNAP, GDAL and MiraMon

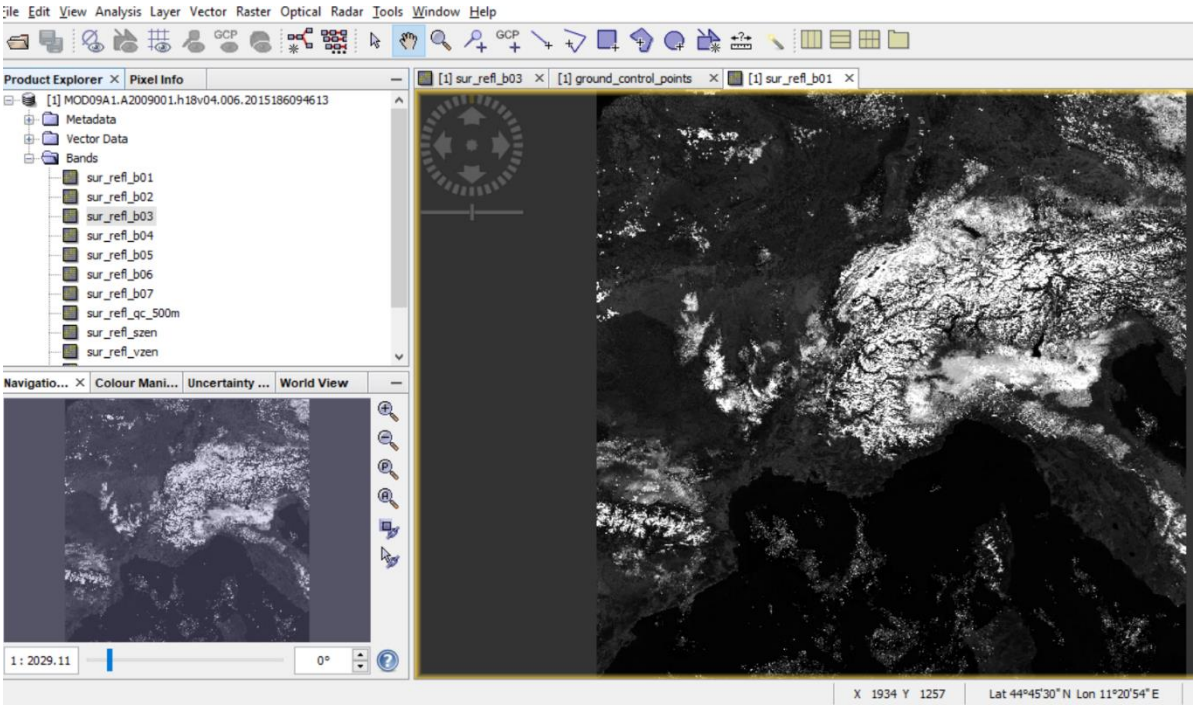
DATA

MODIS MOD09A1 product time series (8-day composite at 2009)

1. EXPLORING THE DATASET

We have downloaded the MOD09A1 8-days composite product at 500 m for the 2009 year at the tile h18_v04 region (part of Europe). This data set is compressed in the **MOD09A1_2009_h18v04.zip**. We decompress the ZIP file in an empty folder, i.e *C:\SC1_Exercise*.

We visualize on of the images, for instance the *MOD09A1.A2009001.h18v04.006.2015186094613.hdf*.



Visualization of one example image using SNAP.

Using a collection of this type of images, we are learning to automatize a RS process, the calculation of EVI index for each image.

2. BASIC BATCH COMMANDS

The first step is the creation of a BATCH file with Notepad (or other plain text editor) and writing a title with the *rem* Operating System (OS) command:

> *rem* command (OS)
>
> It adds a comment. It uses to say what exactly this batch file does or to avoid some command line without deleting it.

We add a command for displaying a text:

echo command (OS)

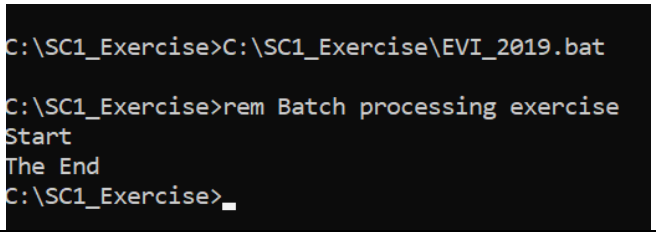
echo <text>: displays the <text>.

@echo off: echo off turns off the display for the whole script; @ apply it to itself

We save the content of the Editor as *EVI_2009.bat.*

We execute this bat in the command line interpreter, ***cmd.exe***

Content of *EVI_2009.bat*	Result of the execution in the *cmd*

`rem Batch processing exercise`
 	
`@echo Start`
 	
`@echo The End`
	

1st version of EVI_2009.bat

We would like to list the HDF files in the working folder in a cleaned window.

cls command (OS)

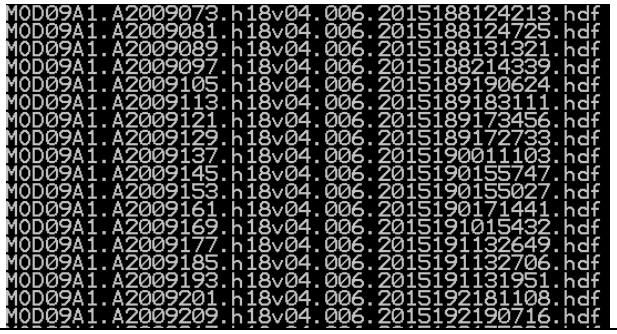
Clears (erases) the screen

dir command (OS)

Displays directory (folder) of files and directories (folders) stored on disk.

dir [u:][path][filename] [/A:(attributes)] [/O:(order)] [/B][/C][/CH][/L][/S][/P][/W]

Content of *EVI_2009.bat*	Result of the execution (partial view) in the cmd

`rem Batch processing exercise`
 	
`cls`
`@echo Start`
`dir C:\SC1_Exercise\*.hdf`
`@echo The End`
	

2nd version of EVI_2009.bat

We introduce the loop statement for repeating instructions.

for statement (OS)

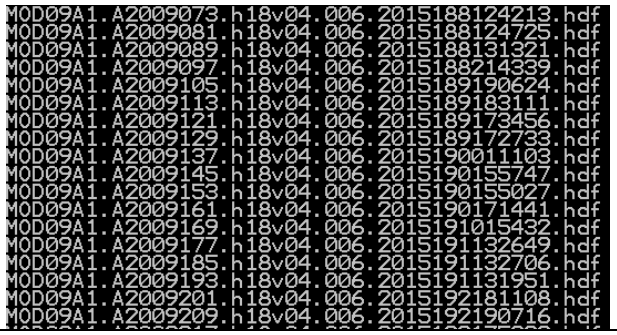
conditionally perform a command several times in a loop.

*for %*variable*% in (*subset*) do* (commands)

for /R - loop through files (recourse subfolders)
for /D - loop through several folders.
for / L - loop through a range of numbers.
for / F - loop through items in a text file.

We obtain the same list of HDF files, but in this case invoking them into a loop.

Content of *EVI_2009.bat*	Result of the execution (partial view) in the cmd

`rem Batch processing exercise`
 	
`cls`
`@echo Start`
`for /R %%i in ("*.hdf") do (`
`dir %%i)`
`@echo The End`
	

Since this step, we used internal command lines of the Operating System. In next steps, we are combining these SO instructions with command lines of tools of particular Remote Sensing software: GDAL and MiraMon.

3. BANDS EXTRACTION AND FORMAT CONVERSIONS

Before, processing to all images, we are to trying with one image as an example. We create the *gdal_test.bat* in orde to understand two instructions: *gdalinfo* and *gdal_translate:*

gdalinfo module (GDAL)

lists various information about a GDAL supported raster dataset.

gdalinfo [--help-general] [-mm] [-stats] [-hist] [-nogcp] [-nomd] [-norat] [-noct] [-nofl] [-checksum] [-proj4] [-listmdd] [-mdd domain|`all`][-sd subdataset] datasetname

gdal_translate module (GDAL)

convert raster data between different formats, potentially performing some operations like subsettings, resampling, and rescaling pixels in the process.

gdal_translate [--help-general] [-if format] [-of format] [-b band]* [-mask band] [-a_scale value] [-a_offset value]… src_dataset dst_dataset*

Content of *gdal_test.bat*

```
rem GDAL test exercise
cls
gdalinfo.exe MOD09A1.A2009001.h18v04.006.2015186094613.hdf
```

Result of the execution (partial view)

```
  SUBDATASET_9_DESC=[2400x2400] sur_refl_szen MOD_Grid_500m_Surface_Reflectance
(16-bit integer)
  SUBDATASET_10_NAME=HDF4_EOS:EOS_GRID:"L:\MODIS\vers_2021\MOD09A1_v6\MOD09A1.A2
009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_
vzen
  SUBDATASET_10_DESC=[2400x2400] sur_refl_vzen MOD_Grid_500m_Surface_Reflectance
 (16-bit integer)
  SUBDATASET_11_NAME=HDF4_EOS:EOS_GRID:"L:\MODIS\vers_2021\MOD09A1_v6\MOD09A1.A2
009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_
raz
  SUBDATASET_11_DESC=[2400x2400] sur_refl_raz MOD_Grid_500m_Surface_Reflectance
(16-bit integer)
  SUBDATASET_12_NAME=HDF4_EOS:EOS_GRID:"L:\MODIS\vers_2021\MOD09A1_v6\MOD09A1.A2
009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_
state_500m
  SUBDATASET_12_DESC=[2400x2400] sur_refl_state_500m MOD_Grid_500m_Surface_Refle
ctance (16-bit unsigned integer)
  SUBDATASET_13_NAME=HDF4_EOS:EOS_GRID:"L:\MODIS\vers_2021\MOD09A1_v6\MOD09A1.A2
009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_
day_of_year
  SUBDATASET_13_DESC=[2400x2400] sur_refl_day_of_year MOD_Grid_500m_Surface_Refl
ectance (16-bit unsigned integer)
Corner Coordinates:
Upper Left  (    0.0,    0.0)
Lower Left  (    0.0,  512.0)
Upper Right (  512.0,    0.0)
Lower Right (  512.0,  512.0)
```

1st version of gdal_test.bat

When the displayed information is too large, we can redirect the display information to a text file

gdalinfo.exe MOD09A1.A2009001.h18v04.006.2015186094613.hdf > metadata_2015186094613.txt

When we open the *metadata_2015186094613.txt* file, we can access to all information in the file text and in particular, de name of datasets:

```
Subdatasets:
  SUBDATASET_1_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_b01
  SUBDATASET_1_DESC=[2400x2400] sur_refl_b01 MOD_Grid_500m_Surface_Reflectance (16-bit integer)
  SUBDATASET_2_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_b02
  SUBDATASET_2_DESC=[2400x2400] sur_refl_b02 MOD_Grid_500m_Surface_Reflectance (16-bit integer)
  SUBDATASET_3_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_b03
  SUBDATASET_3_DESC=[2400x2400] sur_refl_b03 MOD_Grid_500m_Surface_Reflectance (16-bit integer)
  SUBDATASET_4_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_b04
  SUBDATASET_4_DESC=[2400x2400] sur_refl_b04 MOD_Grid_500m_Surface_Reflectance (16-bit integer)
  SUBDATASET_5_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_b05
  SUBDATASET_5_DESC=[2400x2400] sur_refl_b05 MOD_Grid_500m_Surface_Reflectance (16-bit integer)
  SUBDATASET_6_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_b06
  SUBDATASET_6_DESC=[2400x2400] sur_refl_b06 MOD_Grid_500m_Surface_Reflectance (16-bit integer)
  SUBDATASET_7_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_b07
  SUBDATASET_7_DESC=[2400x2400] sur_refl_b07 MOD_Grid_500m_Surface_Reflectance (16-bit integer)
  SUBDATASET_8_NAME=HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_Surface_Reflectance:sur_refl_qc_500m
  SUBDATASET_8_DESC=[2400x2400] sur_refl_qc_500m MOD_Grid_500m_Surface_Reflectance (32-bit unsigned integer)
```

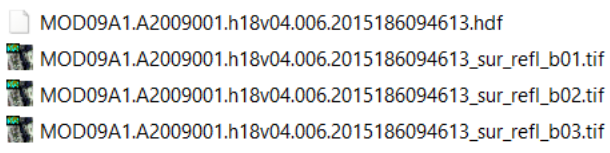
Partial view of the gdalinfo output.

We execute the importation of three bands (information of bands in https://lpdaac.usgs.gov/products/mod09a1v006/) of this selected image. We add a comment statement (*rem*) in order to avoid a re-execution of the *gdalinfo* instruction.

Content of *gdal_test.bat*

```
rem GDAL test exercise

cls

rem gdalinfo.exe MOD09A1.A2009001.h18v04.006.2015186094613.hdf

rem red band
gdal_translate
HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_
Surface_Reflectance:sur_refl_b01
MOD09A1.A2009001.h18v04.006.2015186094613_sur_refl_b01.tif

rem NIR band
gdal_translate
HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_
Surface_Reflectance:sur_refl_b02
MOD09A1.A2009001.h18v04.006.2015186094613_sur_refl_b02.tif

rem blue band
gdal_translate
HDF4_EOS:EOS_GRID:"MOD09A1.A2009001.h18v04.006.2015186094613.hdf":MOD_Grid_500m_
Surface_Reflectance:sur_refl_b03
MOD09A1.A2009001.h18v04.006.2015186094613_sur_refl_b03.tif
```

Result of the execution in the File explorer



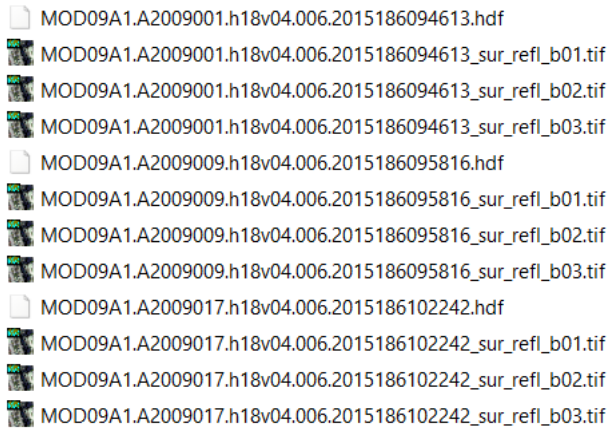
Import of three bands in TIF format from one HDF image

We can use the command line for the previous import example into the loop of *EVI_2009.bat in order to import the three bands of all 2009 images.* We need to explain one parameter option of the *for statement:* ***%%~ni*** that excludes the file extension from the file name **%%i.**

Content of *EVI_2009.bat*

```
rem Batch processing exercise
cls
@echo Start
for /R %%i in ("*.hdf") do (
rem red band
gdal_translate
HDF4_EOS:EOS_GRID:%%i:MOD_Grid_500m_Surface_Reflectance:sur_refl_b01
%%~ni_sur_refl_b01.tif
rem NIR band
gdal_translate
HDF4_EOS:EOS_GRID:%%i:MOD_Grid_500m_Surface_Reflectance:sur_refl_b02
%%~ni_sur_refl_b02.tif
rem blue band
gdal_translate
HDF4_EOS:EOS_GRID:%%i:MOD_Grid_500m_Surface_Reflectance:sur_refl_b03
%%~ni_sur_refl_b03.tif )
@echo The End
```

Result (partial view) of the execution in the File explorer



Import of three bands of the all images in the working folder

4. VEGETATION INDEX CALCULATION

For the calculation of EVI index, we are going to use the *Indexs* MiraMon module.

Indexs module (MiraMon)

allows to calculate a set of predefined vegetation indices.

Indexs option_index input1band input2band … output vegetation_index

The syntax for EVI (option 19) is:

Indexs 19 BandNIR BandRed BandBlue OutputEVI

In the *Indexs* module, the format of these input bands must be IMG, the raster native format of MiraMon software. We need to translate TIF format to IMG with *TIFIMG* module:

TIFIMG module (MiraMon)

Conversion between TIFF and IMG raster formats.

TIFIMG option_index input1file input2file … outputfile1 outfile2…

The option indicates the type of conversion. For TIF to IMG monoband conversion is:

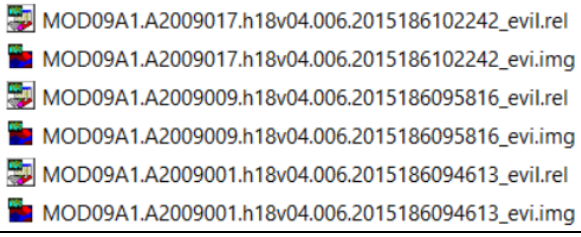
TIFIMG 2 InputTIFFfile OutputIMGfile

Content of *EVI_2009.bat*

```
rem Batch processing exercise
cls
@echo Start
for /R %%i in ("*.hdf") do (
rem red band
gdal_translate
HDF4_EOS:EOS_GRID:%%i:MOD_Grid_500m_Surface_Reflectance:sur_refl_b01
%%~ni_sur_refl_b01.tif
rem NIR band
gdal_translate
HDF4_EOS:EOS_GRID:%%i:MOD_Grid_500m_Surface_Reflectance:sur_refl_b02
%%~ni_sur_refl_b02.tif
rem blue band
gdal_translate
HDF4_EOS:EOS_GRID:%%i:MOD_Grid_500m_Surface_Reflectance:sur_refl_b03
%%~ni_sur_refl_b03.tif )
```

```
for /R %%i in ("*sur_refl_b0?.tif") do (
TIFIMG 2 %%i %%~ni.img /SAC)

rem the next CanviRel command fixes the right Coordinate Reference System

for /R %%i in ("*.img") do (
CanviRel 1 %%~niI.rel SPATIAL_REFERENCE_SYSTEM:HORIZONTAL
HorizontalSystemIdentifier Sinusoidal-V5-MODIS )

for /R %%i in ("*.hdf") do (
Indexs 19 %%~ni_sur_refl_b02.img %%~ni_sur_refl_b01.img %%~ni_sur_refl_b03.img
%%~ni_evi.img )
@echo The End
```

Result (partial view) of the execution in the File explorer



Some final remarks

In case that the program modules are not defined in the *%path%* variable environment of the SO, we must indicate the full path for the modules. It means, you must use *"C:\Program Files\GDAL\gdal_translate*" (or the path where GDAL folder is installed) instead of just *gdal_translate* and "*C:\MiraMon\Indexs*" instead of *Indexs* (same comment for *TIFIMG* and *CanviRel* MiraMon modules; and *gdalinfo* for the GDAL modules).

The provided masks included in the product are not applied, thus the EVI obtained values are not filtered by any quality mask such as cloud pixels. Then, the results contain some values out of the typical range of a vegetation index and the visualization of the result is affected. We recommend to saturate the minimum and maximum of the visualization to a normal range like -1,1 or similar.