

→ 8th ADVANCED TRAINING COURSE ON LAND REMOTE SENSING 10-14 September 2018 | University of Leicester | United Kingdom

# INTRODUCTION TO SNAP TOOLBOX

## **EXERCISE 1 (Exploring S2 data)**

Data: Sentinel-2A Level 1C:

- S2A\_MSIL1C\_20180303T170201\_N0206\_R069\_T14QNG\_20180303T221319.SAFE
- 1. Open file
  - 1.1. 'File' / 'Open Product'
  - 1.2. Browse to: /Ex\_1/S2A\_MSIL1C\_20180303T170201\_N0206\_R069\_T14QNG\_20180303T221319.SAFE 1.3. Select the 'MTD\_MSIL1C.xml' and click 'Open'
- 2. <u>View metadata</u>
  - 2.1. Select plus icons [MAC = triangle icons] by filenames in "Product Explorer", expand "Metadata / Level-1C\_User\_Product / General\_Info" folder and double click on "Product\_Info". Here you can see the basic product information such as acquisition date, processing level and processing baseline (indicates quality of preprocessing)
  - 2.2. Double click on "Product\_Image\_Characteristics". Here you can see the solar irradiance per band and correction factors necessary to convert from Top of Atmosphere Reflectance to Top of Atmosphere Radiance.
- 3. View world map
  - 3.1. Select: 'View' / 'Tool Windows' / 'World Map'
  - 3.2. Select magnifying glass icon to zoom to image footprint
  - 3.3. Use mouse wheel and left click to zoom and pan respectively
- 4. View image single bands

4.1. Select "Bands" folder in "Product Explorer" window and view each band by double clicking on band name.

## 5. <u>View multiple viewers</u>

- 5.1. Close metadata views, leaving only viewers with bands
- 5.2. Synchronise views by selecting the relevant icons in the "Navigation" tab
- 5.3. Select: 'Window' / 'Tile Horizontally'

## 6. View RGB image view

- 6.1. Close all viewers
- 6.2. Select image name in "Product Explorer" window
- 6.3. Select: 'Window' / 'Open RGB Image Window'
- 6.4. Leave default natural colour combination and click OK

## 7. Resampling at 10m

- 7.1. Select image name in "Product Explorer" window
- 7.2. Select: 'Raster' / 'Geometric Operation' / 'Resampling'
- 7.3. In the pop-up window set up the parameters as shown in the Figure below



🔚 Resampling 🛛 🕹	Resampling		×
File Help	File Help		
I/O Parameters Resampling Parameters	I/O Parameters Resampling Parameters		
Source Product Name:	Define size of resampled product		
[1] S2A_MSIL1C_20180303T170201_N0206_R069_T14QNG_20180303T221319 v	O By reference band from source product:	B1 Resulting target width:	1830
Target Product		Resulting target height	: 1830
Name:	O By target width and height:	Target width:	10,980 🗘
S2A_MSIL1C_201803031170201_N0206_R069_T14QNG_201803031221319_resampled		Target height: Width / height ratio:	10,980 -
Directory:	By pixel resolution (in m):		10 🜩
C:\Users\S2Toolbox		Resulting target width: Resulting target height	10980 : 10980
	Upsampling method:	Nearest	~
	Downsampling method:	First	~
	Flag downsampling method:	First	~
	Resample on pyramid levels (for faster ima	ging)	
Run glose			<u>R</u> un <u>C</u> lose

## 7.4. Click 'Run'

8. <u>Open the newly created product</u>

8.1. Repeat step "6" selecting the new image

## 9. <u>Crop</u>

- 9.1. Zoom into Popocatépetl Volcano
- 9.2. Select: 'Raster' / 'Subset...'
- 9.3. Specify: 'Spatial Subset' parameters (as shown in Figure below)
  - Scene start X: 2500
  - Scene start Y: 6501
  - Scene end X: 7500
  - Scene end Y: 10500

Sparuar Subset Band Subset M	etadata Subset	
and the	Pixel Coordinates Geo Co	ordinates
A A CARLEN	Scene start X:	2501 🖨
and the second second	Scene start Y:	6501 🖨
	Scene end X:	7500 🖨
New Come State	Scene end Y:	10500 🚖
	Scene step X:	1
	Scene step Y:	1
	Subset scene width: Subset scene height:	5000. 4000.
	Source scene width: Source scene height:	1098 1098
	Use Pre <u>v</u> jew	Fix full <u>wi</u> dth
	~	
		Estimated, raw storage size: 696
		OV Craniel Mate

9.4. Specify: 'Band Subset' parameters selecting B2, B3, B4, B8, B11 and B12 (as shown in Figure below)



Specify Product Subs	set	
ipatal Subset Band Subs	set Metadata Subset	
- e1	Reflectence in band B1	
	Reflectance in band 82	
E 83	Reflectance in band 63	
1 B4	Reflectance in band 84	
D na	Reflectance in band 05	
0.00	Reflectance in band DS	
0 97	Reflectance in band 87	
es	Reflectence in band BB	
E BBA	Reflectance in band BBA	
E9	Reflectance in band 83	
B10	Reflectance in band E10	
P.811	Reflectance in band (111	
1 anz	Reflectance in band U12	
View_zanith_mean	Viewing incidence zenith angle	
Chies szinuth mean	Viewmo incidence azimuth anore	
Select @ Select	tgone	
		Estimated, ray storage size: 57
		OK Cannel Hein

9.5. Click 'OK'

#### 10. Save the newly created subset image

- 10.1. Select product in "Product Explorer"
- 10.2. Select: 'File' / 'Save Product As...'
- 10.3. Select "Yes" to convert to BEAM DIMAP format (SNAP native file format)
- 10.4. Select an output filename and location, and click "Save"
- 10.5. In order to view the saved file with the filename you specified, close the cropped image and reopen it

### 11. Open the newly created product

- 11.1. Close all viewers
- 11.2. Select image name in "Product Explorer" window
- 11.3. Select: 'Window' / 'Open RGB Image Window'
  - 11.3.1. Leave default natural colour combination and click 'OK'
  - 11.3.2.Select B12 for Red, B11 for Green and B4 for Blue and click 'OK'
- 11.4. Synchronise views by selecting the relevant icons in the "Navigation" tab
- 11.5. Select: 'Window' / 'Tile Horizontally' and compare the images

#### 12. Create New Mask (based on a logical band maths expression)

- 12.1. Select image name in "Product Explorer" window
- 12.2. Select 'View' / 'Tool Windows' / 'Mask Manager'
- 12.3. Select 'f(x)' and edit the expression: '(B12 > 1.0) and (B11 > 0.3)'

🕌 New Logical Band I	Maths Expression		×
Data sources:  B2 B3 B4 B4 B8 B11 B12  ✓ Show bands Show masks	8 and 8           8 or 8           not 8           (8)           Constants            Operators            Functions	Expression: (B12 > 1.0) and (B11 > 0.25)	
Show tie-point grids Show single flags		📑 📋 🖉 🔟 💹 Ok, no e	errors.
		QK <u>C</u> ancel <u>H</u> e	lp

- 12.4. Click 'OK'
- 12.5. This simple mask highlights the hot surface (e.g. volcano craters, active fires, gas flares, ... )

#### 13. Change Projection

- 13.1. Select 'Raster' / 'Geometric Operations' / 'Reprojection'
- 13.2. In "Reprojection Parameters" leave default projection 'Geographic Lat/Lon (WGS84)' as shown in Figure



-					
層 Reprojectio	on				
ile Help					
I/O Parameters	; Reproj	ection Parar	neters		
Coordinate Re	eference :	System (CR:	5)		
Custom C	IRS				
Geodetic	: datum:	World Geod	letic System 1984		~
Projectio	on:	Geographic	Lat/Lon (WGS 84)		~
	L			Projection Para	meters
	ed CRS				Select
O Use CRS	of	[2] Subset_'	52A_M5IL1C_20170316T	094021_N0204	~
	gs		_		
Preserve	resolution	n	Reproject tie-point	: grids	
Outpu	it Parame	ters	No-data value: N	JaN	
Outpu	ut Parame 3 lat/lon b	ters ands	No-data value: N Resampling method: N	laN Nearest	~
Outpu Add delta	it Parame 3 lat/lon b nation	ters	No-data value: N Resampling method: N	laN Jearest	~
Outpu Add delta Output Inform Scene width:	ut Parame a lat/lon b nation 1860 pi>	ters ands cel	No-data value: N Resampling method: M Center longitude:	laN Jearest 15°01'37" E	~
Output Add delta Output Inform Scene width: Scene height:	It Parame a lat/lon b nation 1860 pix 1486 pix	ters ands cel cel	No-data value: N Resampling method: N Center longitude: Center latitude:	JaN Jearest 15°01'37" E 37°45'05" N	~
Output Add delta Output Inform Scene width: Scene height: CRS:	It Parame a lat/lon b nation 1860 pix 1486 pix WG584(	ters ands :el :el DD)	No-data value: N Resampling method: M Center longitude: Center latitude:	JaN Jearest 15°01'37" E 37°45'05" N Show	~ WKT
Output Add delta Output Inform Scene width: Scene height: CRS:	it Parame a lat/lon b nation 1860 pix 1486 pix WG584(	ters ands cel cel DD)	No-data value: N Resampling method: C Center longitude: Center latitude:	JaN Jearest 15°01'37" E 37°45'05" N Show	~ WKT

## 13.3. Click 'Run'

## 14. Export to Google Earth

14.1. Open the reprojected S2 image subset in false colours (B12=Red, B11=Green, B4=Blue)

- 14.2. Select 'File' / 'Export' / 'Other' / 'View as Google Earth KMZ'
- 14.3. Double click on the newly created KMZ file to open it in Google Earth



# **EXERCISE 2 (Radiometric Indices)**

Radiometric indices are quantitative measures of features that are obtained by combining several spectral bands, features that are not otherwise obvious if using only one band.

The indices provided with Sentinel-2 Toolbox, detailed below, are grouped into three categories:

- Vegetation indices
- Soil indices
- Water indices

Data: Sentinel-2A Level-2A pre-processed:

## Subset\_S2A\_MSIL2A\_20170809T100031\_N0205\_R122\_T33TUF\_20170809T100028\_10m

The data have been resampled at 10m, cropped spatially and spectrally (B2, B3, B4, B5, B6, B7, B8, B11, B12) and exported in BEAM-DIMAP (SNAP native file format).

1. Open files

1.1. 'File' / 'Open Product'

1.2. Browse to:

/Ex\_2/Subset\_S2A\_MSIL2A\_20170809T100031\_N0205\_R122\_T33TUF\_20170809T100028\_10m 1.3. Click 'Open'

2. <u>View RGB image view</u>

2.1. Select image name in "Product Explorer" window

- 2.2. Select: 'Window' / 'Open RGB Image Window'
- 2.3. Leave default natural colour combination and click OK
- 3. Normalized Difference Vegetation Index (NDVI)

The NDVI composes a measurement for the photosynthetic activity and is strongly in correlation with density and vitality of the vegetation. The normalizing reduces topographic and atmospheric effects and enables the simultaneous examination of a wide area.

$$NDVI = \frac{(NIR_{factor} * NIR_{band}) - (Red_{factor} * Red_{band})}{(NIR_{factor} * NIR_{band}) + (Red_{factor} * Red_{band})}$$

3.1. Select: 'Optical' / 'Thematic Land Processing' / 'Vegetation Radiometric Indices' / 'NDVI Processor'

3.2. Set up the I/O and the processing parameters as shown in the Figure below

NDVI ×	X NDVI
File Help	File Help
I/O Parameters Processing Parameters	I/O Parameters Processing Parameters
Source Product	Red factor: 1.0 NR factor: 1.0
[1] 20086C_259T_M20154_5011/00041100021_M0502_K155T_12210A_5011/00041100050_1000 <	Red source band: B4 V
Target Product Name: Subset: 524_MSI 24_20120809T100031_N0205_P122_T3STUF_20120809T100028_10m_pdv4	NIR source band:  B8
Save as:     BEAM-DIMAP       Directory:     C:       C:     Users       Users	
El Open in SIVAP	Bun Qose

- 3.3. Obtaining the following result.
- 3.4. [Min: Blue]; [Mean: White]; [Max: Red]





4. Brightness Index (BI)

The Brightness Index algorithm is representing the average of the brightness of a satellite image. This index is sensitive to the brightness of soils which is highly correlated with the humidity and the presence of salts in surface (Escadafal, 1989).

$$BI = \sqrt{\frac{\left(Red_{factor} * Red_{band}\right) + \left(Green_{factor} * Green_{band}\right)}{2}}$$

- 4.1. Select: 'Optical' / 'Thematic Land Processing' / 'Soil Radiometric Indices' / 'BI Processor'
- 4.2. Set up the I/O and the processing parameters as shown in the Figure below

📓 BI X	BI	×
File Help	File Help	
I/O Parameters Processing Parameters	I/O Parameters Processing Parameters	
Source Product	Resample Type: None	~
[1] Subset_S2A_MSIL2A_20170809T100031_N0205_R122_T33TUF_20170809T100028_10m v	Upsampling Method: Nearest	$\sim$
	Downsampling Method: First	~
Target Product	Red factor:	1.0
Name:	Green factor:	1.0
Subset_S2A_MSIL2A_20170809T100031_N0205_R122_T33TUF_20170809T100028_10m_bi	Red source band: B4	~
Save as: BEAM-DIMAP	Green source band: B3	~
Directory:		
C:\Users\S2Toolbox		
Open in SNAP		
<u>B</u> un <u>C</u> lose		<u>R</u> un <u>C</u> lose

- 4.3. Obtaining the following result.
- 4.4. [Min: Blue]; [Mean: White]; [Max: Red]





5. <u>Second Normalized Difference Water Index (NDWI2)</u>

The second Normalized Difference Water Index algorithm was developed by McFeeters (1996) to detect surface waters in wetland environments and to allow for the measurement of surface water extent.

$$NDW12 = \frac{(Green_{factor} * Green_{band}) - (NIR_{factor} * NIR_{band})}{(Green_{factor} * Green_{band}) + (NIR_{factor} * NIR_{band})}$$

5.1. Select: 'Optical' / 'Thematic Land Processing' / 'Water Radiometric Indices' / 'NDWI2 Processor' 5.2. Set up the I/O and the processing parameters as shown in the Figure below

MDWI2 ×	MDWI2
File Help	File Help
I/O Parameters Processing Parameters	I/O Parameters Processing Parameters
Source Product source: [1] Subset_SSA_MSIL2A_201708097100031_N0205_R122_T33TUF_201708097100028_10m v	Resample Type:         None           Upsampling Method:         Nearest
Turnhoudud	Downsampling Method: First
Name:	NIR factor: 1.0
Subset_S2A_MSIL2A_20170809T100031_N0205_R122_T33TUF_20170809T100028_10m_ndwi2	Green source band: B3 ~
Save as: BEAM-DIMAP Directory: C:\Users\S2Toolbox	NIR source band: B8 ~~
<u>R</u> un <u>C</u> lose	

- 5.3. Obtaining the following result.
- 5.4. [Min: Blue]; [Mean: White]; [Max: Red]





Zooming in the gulf of Gaeta (right part of the image), thank you to the NDWI2 index, it is visible an aquaculture system as shown below.



## 6. Graph Builder

- 6.1. Select the product in "Product Explorer" window
- 6.2. Select: 'Tools' / 'GraphBuilder' or the icon
- 6.3. In the GraphBuilder window we can start to build our graph clicking the right button of the mouse and add all the SNAP modules that we need.
- 6.4. Brightest Index Operator: 'Add' / 'Optical' / 'Thematic Land Processing' / 'Soil Radiometric Indices' / 'BiOp'
- 6.5. NDWI2 Operator: 'Add' / 'Optical' / 'Thematic Land Processing' / 'Soil Radiometric Indices' / 'Ndwi2Op'
- 6.6. NDVI: 'Add' / 'Raster' / 'BandMaths' editing the equation (B8-B4)/(B8+B4)



## 6.7. Bands Merge Module: 'Add' / 'Raster' / 'BandMerge'

🗱 Graph Builder	×
File Graphs	
BiOp Ndwi2Op Read BandMerge Write	•
BandMaths	*
Read Write BiOp Ndwi2Op BandMaths BandMerge	
Source Product Name:	
[1] Subset_S2A_MSIL2A_20170809T100031_N0205_R122_T33TUF_20170809T100028_10m	~
Data Format V	
Load Save 🏷 Clear 🕜 Note 🔞 Help. 🕞 Run	





Figure 1: Natural Colour



Figure 2: Brightest Index output





Figure 3: NDVI output



Figure 4: NDWI-2 output

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