

SENTINEL-2 PROCESSING IN SNAP

EXERCISE 1 (exploring S2 data)

Data: Sentinel-2A Level 1C:

• S2A_MSIL1C_20170316T094021_N0204_R036_T33SVB_20170316T094506.SAFE

1. Open file

- 1.1. 'File' / 'Open Product'
- 1.2. Browse to: /ETNA/S2A_MSIL1C_20170316T094021_N0204_R036_T33SVB_20170316T094506.SAFE/MTD_MSIL1C.xml
- 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. <u>View image single bands</u>
 - 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 F	File Help		
I/O Parameters Resampling Parameters	I/O Parameters Resampling Parameters		
Source Product	Define size of resampled product		
Name: [1] S2A_M5IL1C_20170316T094021_N0204_R036_T335VB_20170316T094506	O By reference band from source product:	B1	~
Target Product		Resulting target width: Resulting target height:	1830
Name:	O By target width and height:	Target width:	10,980 🔺
S2A_MSIL1C_20170316T094021_N0204_R036_T335VB_20170316T094506_resampled		Target height:	10,980 💂
Save as: BEAM-DIMAP		Width / height ratio:	1.00000
Directory:	By pixel resolution (in m):		þo 🖨
D:\OA\H		Resulting target width:	10980
Open in SNAP		Resulting target height:	10980
	Upsampling method:	Nearest	~
	Downsampling method:	First	~
	Flag downsampling method:	First	~
	Resample on pyramid levels (for faster ima	ging)	
Run Close			<u>R</u> un <u>C</u> lose

- 7.4. Click 'Run'
- 8. Open the newly created product
 - 8.1. Repeat step "6" selecting the new image

9. <u>Crop</u>

- 9.1. Zoom into Etna Volcano
- 9.2. Select: 'Raster' / 'Subset...'
- 9.3. Specify: 'Spatial Subset' parameters (as shown in Figure below)
 - Scene start X: 9504
 - Scene start Y: 1435
 - Scene end X: 10979
 - Scene end Y: 2919



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



Specify Product Subs	et	×
Spatial Subset Band Subs	et Metadata Subset	
B1	Reflectance in band B1	^
✓ 82	Reflectance in band B2	
🗹 ВЗ	Reflectance in band B3	
🗹 в4	Reflectance in band B4	
B5	Reflectance in band 85	
B6	Reflectance in band B6	
B7	Reflectance in band B7	
☑ 88	Reflectance in band B8	
B8A	Reflectance in band BSA	
B9	Reflectance in band 89	
B10	Reflectance in band B10	
🗹 B11	Reflectance in band B11	
☑ 912	Reflectance in band B12	
view_zenith_mean	Viewing incidence zenith angle	
view_azimuth_mean	Viewing incidence azimuth angle	
	Solar zenith angle	
sun_azimuth	Solar azimuth angle	
view_zenith_B1	Viewing incidence zenith angle	
view_azimuth_B1	Viewing incidence azimuth angle	~
Select all Select	Done	
		Estimated, raw storage size: 6.3
		QK <u>C</u> ancel <u>H</u> elp

- 9.5. Click 'OK'
- 10. <u>Save the newly created subset image</u>
 - 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: '(*B*12 > 1.0) and (*B*11 > 0.3)'

🕌 New Logical Band	Maths Expression		×
Data sources:]	Expression:	
B4 ^	0 and 0	(B12 > 1.0) and $(B11 > 0.3)$	
B5	0 or 0		
B6			
B7	not U		
B8	(0)		
BSA	Constants v		
B11	Operators V		
B12 🗸	-		
Show bands	Functions V		
Show masks			
Show tie-point grids			
Show single flags		📺 🖓 🗃 🖉 🛛 Ok, no err	ors.
		<u>O</u> K <u>C</u> ancel <u>H</u> elp)

12.4. Click 'OK'



12.5. This simple mask highlights the hot surface (lava flow and volcano craters)

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

le Help		
/O Parameters Repro	ojection Parameters	
Coordinate Reference	System (CRS)	
Custom CRS		
Geodetic datum:	World Geodetic System 1984	~
Projection:	Geographic Lat/Lon (WGS 84) ~
		Projection Parameters
O Predefined CRS		Select
O Use CRS of	[2] Subset_S2A_MSIL1C_201	
Output Settings		
🗹 Preserve resoluti	on 🗹 Reproject	tie-point grids
Output Param	eters No-data value:	NaN
Add delta lat/lon	bands Resampling me	thod: Nearest \sim
Output Information		
Scene width: 1860 p	ixel Center Ion	gitude: 15°01'37" E
Scene height: 1486 p	ixel Center latil	(ude: 37°45'05" N
	(00)	Chain UKT

- 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 (Burned area detection)

Data: Sentinel-2A pre-processed:

PedrogaoGrande_S2A_MSIL1C_20170614T112111_N0205_R037_T29TNE_20170614T112422_10m.data PedrogaoGrande_S2A_MSIL1C_20170704T112111_N0205_R037_T29TNE_20170704T112431_10m.data 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: /PT/PedrogaoGrande S2A_MSU1C_2017

/PT/PedrogaoGrande_S2A_MSIL1C_20170614T112111_N0205_R037_T29TNE_20170614T112422_10m /PT/PedrogaoGrande_S2A_MSIL1C_20170704T112111_N0205_R037_T29TNE_20170704T112431_10m 1.3. Click 'Open'

- 2. View RGB image view
 - 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
 - 2.4. Repeat for both of the products
- 3. View multiple viewers
 - 3.1. Synchronise views by selecting the relevant icons in the "Navigation" tab
 - 3.2. Select: 'Window' / 'Tile Horizontally'

4. NDVI (Normalised Difference Vegetation Index)

- 4.1. By Radiometric Indices
 - 4.1.1. Select: 'Optical'/ 'Thematic Land Processing' / 'Vegetation Radiometric Indices' / 'NDVI processor'
 - 4.1.2. Set up the I/O and the processing parameters as shown in the Figure below

NDVI ×	NDVI ×
File Help	File Help
I/O Parameters Processing Parameters	I/O Parameters Processing Parameters
Source Product source:	Red factor: 1.0
[2] PedrogaoGrande_S2A_M5IL1C_2017061.4T112111_N0205_R037_T29TNE_2017061.4T112422_10m v	NIR factor: 1.0 Red source band: B4
Target Product Name:	NIR source band: B8
PedrogaoGande_S2A_MSLIC_20170614T112111_M0205_R037_T29TNE_20170614T112422_10m_ndvl Directory: Dire	
Bun Qose	Run Close

4.1.3. Click 'Run'

4.1.4. A new product will be created containing the NDVI band

4.2. By Band Maths

- 4.2.1. Select: 'Raster' / 'Band Maths...'
- 4.2.2. Set up the I/O and the processing parameters as shown in the Figure below
- 4.2.3. Change the output name in 'NDVI'
- 4.2.4. Deselect "Virtual"
- 4.2.5. Select "Edit Expression ... "
- 4.2.6. Type in the following expression in the 'Expression' field: "(B8 B4)/(B8 + B4)"



🛃 Band Maths	,	<	🛃 Band Maths Expres	ssion Editor	>	<
Target product: [2] PedrogaoGrand Name: Description:	e_S2A_M5IL1C_20170614T112111_N0205_R037_T29TNE_20170614T112422_10m		Product: [2] PedrogaoGr Data sources: \$2.B2 \$2.B3	ende_S2A_MSILIC_20170614T1	12111_N0205_B037_T29TNE_20170614T112422_10m Expression: (\$2.B8 - \$2.B4) / (\$2.B8 + \$2.B4)	,
Spectral wavelength Uirtual (save ex Replace NaN ar Generate assoc Band maths express	0.0 dinfinity results by Na ated uncertainty band	N	\$2.84 \$2.85 \$2.86 \$2.87 \$2.88 \$2.811 \$2.811 \$2.811 \$2.811	8 * 8 0 / 8 (0) Constants V Operators V Functions		
Load	Edit Expression		Show tie-point grids		Ok, no error OK Cancel Help	rs.

- 4.2.7. Click 'OK' and 'OK'
- 4.2.8. The newly created NDVI band is added as band of the input product
- 5. View NDVI band
 - 5.1. Select NDVI band name in "Product Explorer" window and double click
 - 5.2. Repeat for both of the NDVI bands
 - 5.3. Synchronise views by selecting the relevant icons in the "Navigation" tab
 - 5.4. Select: 'Window' / 'Tile Horizontally'

6. <u>Colour Manipulation</u>

- 6.1. Select NDVI image displayed
- 6.2. Select: "Colour Manipulation" tab
- 6.3. Change the values and colour setting as shown in figure below
- 6.4. [Min: 0.0, Blue]; [Mean: 0.5, Orange]; [Max: 1.0, Green]



6.5. Repeat for both of the NDVI obtaining the following result





- 6.6.
- 6.7. The NDVI before and after the wild fire in Pedrógão Grande (Portugal)

7. NDVI Difference

- 7.1. Select: 'Raster' / 'Band Maths...'
- 7.2. Set up the I/O and the processing parameters as shown in the Figure below
- 7.3. Change the output name in 'NDVI-Diff'
- 7.4. Deselect "Virtual"
- 7.5. Select "Edit Expression..."
- 7.6. Type in the following expression in the 'Expression' field: "(\$3.ndvi+1)-(\$4.ndvi+1)"

📕 Band Maths		>	(📕 Band Maths Expression	on Editor						Х
Target product:				Product: [4] PedrogaoGran	nde_52A_MSIL1C_20170704T112	111_NC	0205_R037_T	29TNE_3	20170704	T112431_1	0m_ndvi 🗸
[3] PedrogaoGrand	e_S2A_MSIL1C_20170614T1	12111_N0205_R037_T29TNE_20170614T112422_10m_ndvi 🧠		Data sources:		Expre	ssion:				
Name:	NDVI-Diff			\$4.ndvi	8 + 6	(\$3	ndvi + 1) - (\$	4.ndvi	+ 1)	
Description:				\$4.ndvi_flags		1					
Unit:				\$4.NDVI_ARITHMETIC	8 - 6						
Spectral wavelength	: 0.0			\$4.NDVI_NEGATIVE	0 * 0						
🗌 Virtual (save ex	pression only, don't store da	ta)		\$4.NDVI_SATURATION	0 / 0						
🖂 Replace NaN an	d infinity results by	Nal	I		(@)]					
Generate assoc	iated uncertainty band				Constants v						
Band maths express	ion:			Show bands	Operators 🗸	1					
				Show masks	Functions V]					
Load 9	iave	Edit Expression		Show tie-point grids			1		3	()k, no errors.
		QK <u>C</u> ancel <u>H</u> elp							<u>O</u> K	Cancel	Help

- 7.7. The symbol "\$3." and "\$4." is the link to the different products
- 7.8. Obtaining the following result





7.9. The brightest values represent high difference between the NDVI before and after the wild fire, consequence of vegetation loss



EXERCISE 3 (Water detection)

Data: Sentinel-2A pre-processed:

Kunming_S2A_OPER_MTD_SAFL1C_PDMC_20161118T141436_R061_20161118T034032_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:
 - /CHN/Kunming_S2A_OPER_MTD_SAFL1C_PDMC_20161118T141436_R061_20161118T034032_10m
- 1.3. Click 'Open'

2. View RGB image view

- 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. Automated Water Extraction Index (AWEI-sh)

The main aim of the AWEI is to maximize the separability of water and non-water pixels using band differencing, addition and application of different coefficients.

 $AWEI_{sh} = Blue_{band} + (2.5 * Green_{band}) - 1.5 * (NIR_{band} + SWIR1_{band}) - (0.25 * SWIR2_{band})$

- 3.1. Select: 'Raster' / 'Band Maths...'
- 3.2. Set up the I/O and the processing parameters as shown in the Figure below
- 3.3. Change the output name in 'AWEI-sh'
- 3.4. Deselect "Virtual"
- 3.5. Select "Edit Expression..."
- 3.6. Type the following expression in the 'Expression' field: B2 + (2.5 * B3) - (1.5 * (B8 + B11)) - (0.25 * B12)

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).

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

- 4.1. Select: 'Raster' / 'Band Maths...'
- 4.2. Set up the I/O and the processing parameters as shown in the Figure below
- 4.3. Change the output name in 'BI'
- 4.4. Deselect "Virtual"
- 4.5. Select "Edit Expression..."
- 4.6. Type the following expression in the 'Expression' field: sqrt (((B4 * B4) + (B3 * B3)) / 2)
- 5. <u>View multiple viewers</u>
 - 5.1. Once opened the RGB band combination, AWEI-sh and BI
 - 5.2. Synchronise views by selecting the relevant icons in the "Navigation" tab
 - 5.3. Select: 'Window' / 'Tile Horizontally'





- 6. Create New Mask (based on a logical band maths expression)
 - 6.1. Select image name in "Product Explorer" window
 - 6.2. Select 'View' / 'Tool Windows' / 'Mask Manager'
 - 6.3. Select 'f(x)' and edit the expression: '('AWEI-sh' > 0.08) and (BI < 1.2)'

🕌 New Logical Band N	Maths Expression	>	ĸ
Data sources:	0 and 0	Expression: ('AWEI-sh' > 0.08) and (BI < 0.13)	
B4 B5	@ or @ not @		
B6 B7 B8 B11	(@) Constants ~ Operators ~ Functions ~		
Show bands Show masks Show tie-point grids Show single flags		Ck, no error	rs.
		OK Cancel Help	

6.4. Click OK



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