ESA TRAINING COURSE ON RADAR AND OPTICAL REMOTE SENSING

Cesis (Latvia) : 5 – 9 September 2016

SENTINEL-2 PROCESSING IN SNAP – LATVIA

Data: Sentinel-2A Level 1C:

- S2A_OPER_MTD_SAFL1C_PDMC_20151216T142740_R036_V20151003T094959_20151003T094959

1. **Open the file (resampled to 10m)**
   1.1. File / Open Product
   1.2. Browse to S2A_OPER_MTD_SAFL1C_PDMC_20151216T142740_R036_V20151003T094959_20151003T094959.xml
   1.3. Select "Resampled at 10m resolution"

2. **View metadata**
   2.1. Select plus 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 (that indicates quality of pre-processing)
   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. 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. **View multiple viewers**
   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 Vertically

6. **Display a RGB composite**
   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 (Red, Blue, Green) combination[1] and select OK
   6.5. Display also a false colour (NIR, Red, Green) combination image
   6.6. Compare the two images by using the multiple viewers tool explained above (Tile Vertically).
   6.7. Discover the Pixel Info View (in View / Pixel Info View)

[1] See the Annex about the Sentinel-2 spectral bands displayed on the EM spectrum.

7. Crop

7.1. Zoom into the South-East part of the image, which includes Riga and its surroundings.
7.2. Raster / Subset… and select OK

8. Save the newly created subset image

8.1. Select image in "Product Explorer"
8.2. Select: File / Save Product As…
8.3. Select "Yes" to convert to BEAM DIMAP format (SNAP native file format)
8.4. Select an output filename and location, and select "Save"
8.5. In order to view the saved file with the filename you specified, close the cropped image and reopen it

9. Spectral analysis

9.1. Open a false colour RGB of the cropped image
9.2. View / Tool Windows / Pin Manager
9.3. Select the "Pin Placing Tool" (icon on top toolbar)
9.4. Click to place a pin on an area of water in the image
9.5. In the "Pin Manager" window, double click in the "Label" field to rename the pin "Water"
9.6. Click in the colour field to change the colour to blue
9.7. Repeat the steps above to create 3 other pins, one each over an area of vegetation (shown as red on false colour image), buildings (shown as cyan) and cloud (shown as white), giving each a unique colour and label.
9.8. Select the Filter icon and select bands 1 to 12
9.9. Export the pins to both XML and TXT using the relevant icons in the "Pin Manager" window
9.10. Select: Optical / Spectrum View
9.11. View spectral signature of all pins
9.12. Deselect "Show spectra for all pins" and select "Show spectrum at cursor position"
9.13. Move the mouse over image to view spectra of different pixels.
9.14. Now close the Spectrum View and delete all pins in Pin Manager window: select pins, then select "remove selected pin" icon. Then close also the Pin Manager window.

10. NDVI (Normalised Difference Vegetation Index)

For this purpose, we create a new band by using Band Maths.

10.1. Raster / Band Maths
10.2. Change name to NDVI
10.3. Deselect "Virtual"
10.4. Select "Edit Expression…"
10.5. Type in the following expression in the "Expression" field: "$(B7 - B4)/(B7 + B4)^2$" then select OK and OK
10.6. View the newly created NDVI band
10.7. One can also try another expression that some research papers have said to be more optimal for Sentinel-2 than the classic one above: "(B5-B4)/(B5+B4)". This is sometimes referred as *NDI45*.

11. Colour manipulation

11.1. Open the *Colour Manipulation* tab, in View / Tool Windows
11.2. In Editor, choose first Basic. Choose a colour ramp to display NDVI in a different way than a black and white ramp. NB: there is vegetation index colour ramp called "derived from meris_veg_index". This is the most common way to display NDVI.
11.3. Click back to Sliders and play with the different sliders defined by the predefined colour ramp.
11.4. Do the same process for both NDVI products and compare them.
11.5. Find five suitable thresholds to delineate vegetation areas (classified in 1. High vegetation / 2. Medium vegetation / 3. Low vegetation), 4. Urban areas and 5. waters areas.

12. Create a vegetation mask

12.1. Click on Mask Manager (in View / Tool Window).

[2] Rouse et al. (1973)

12.2. Click on the icon “Create a new mask based on a value range”.
12.3. In the window, for each of the five NDVI classes defined above, change the raster band to NDVI, insert the thresholds framing it, and click OK. For each mask created, rename it and assign it a colour.
12.4. Visualize the mask on the NDVI band by clicking on Layer Manager (in View / Tool Window). Uncheck the NDVI layer to only leave the masks.

13. Change Projection

13.1. Raster / Geometric Operations / Reprojection
13.2. In “Reprojection Parameters” leave default projection “Geographic Lat/Lon (WGS84)” and select “Run”

14. Export to Google Earth

14.1. Open the NDVI band of the reprojected S2 image subset.
14.2. File / Export / Other / View as Google Earth KMZ
14.3. Double click on the newly created KMZ file to open it in Google Earth

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ANNEX: Sentinel-2 spectral bands

THE SPATIAL RESOLUTION OF SENTINEL-2 IS DEPENDENT ON THE PARTICULAR SPECTRAL BAND

A. 10 metre spatial resolution:

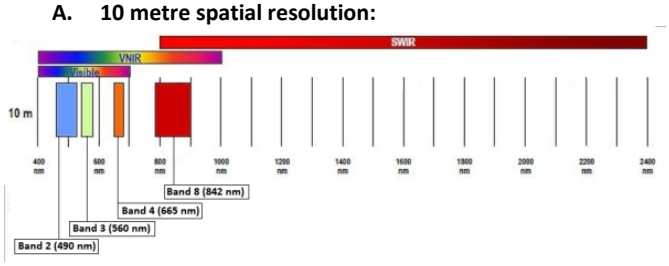

Figure 1: SENTINEL-2 10 m spatial resolution bands: B2 (490 nm), B3 (560 nm), B4 (665 nm) and B8 (842 nm)

B. 20 metre spatial resolution:

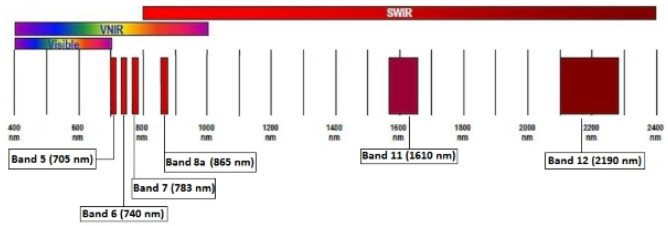

Figure 2: SENTINEL-2 20 m spatial resolution bands: B5 (705 nm), B6 (740 nm), B7 (783 nm), B8a (865 nm), B11 (1610 nm) and B12 (2190 nm)

C. 60 metre spatial resolution:

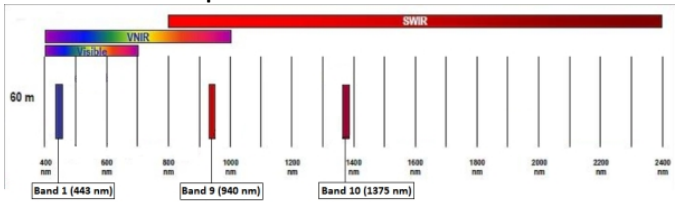

Figure 3: SENTINEL-2 60 m spatial resolution bands: B1 (443 nm), B9 (940 nm) and B10 (1375 nm)