Forest Monitoring

Topic:

In this tutorial we will use data acquired by the ALOS PALSAR sensor operated by the Japan Aerospace Exploration Agency (JAXA) in the years 2007 and 2010 in order to see man-made changes to a forested area.

ALOS PALSAR data are acquired in L-band at a wavelength of 27 cm. This is a much longer wavelength compared to Sentinel-1 C-band data acquired at 5.5 cm. Therefore ALOS PALSAR

Input Data:

- 4 files = 2 ALOS PALSAR HH-HV pairs acquired at L-band from 2007 and one pair from 2010
  - 2007:
    - S06W056_07_sl_HH_db.tif
    - S06W056_07_sl_HV_db.tif
  - 2010
    - S06W056_10_sl_HH_db.tif
    - S06W056_10_sl_HV_db.tif
- SAR data part of the freely available data set “Global PALSAR-2/PALSAR/JERS-1 Mosaics and Forest/Non-Forest Maps”
- Spatial resolution: 0.8 arc seconds (approx. 25 m at the Equator)

ALOS

- ALOS stands for Advanced Land Observing Satellite
- Operated by JAXA (Japan Aerospace Exploration Agency)

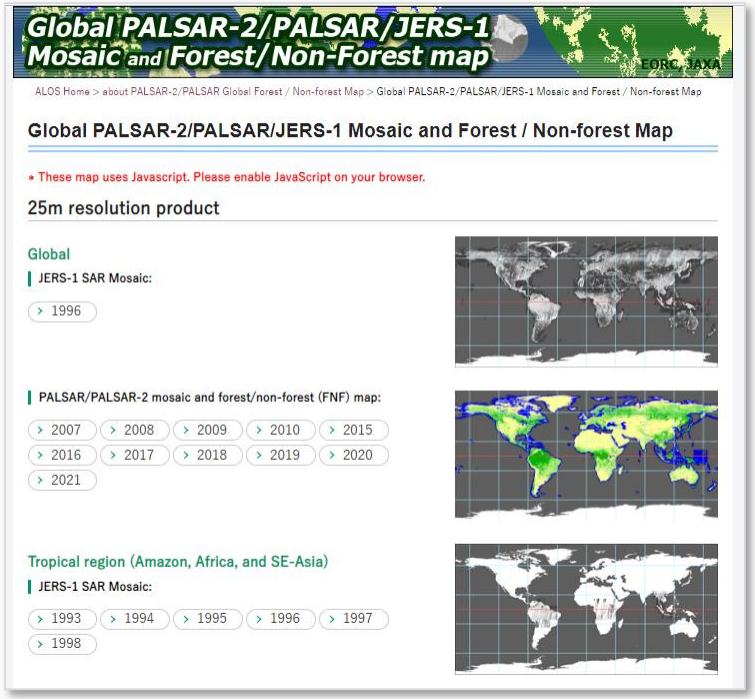
ALOS 1

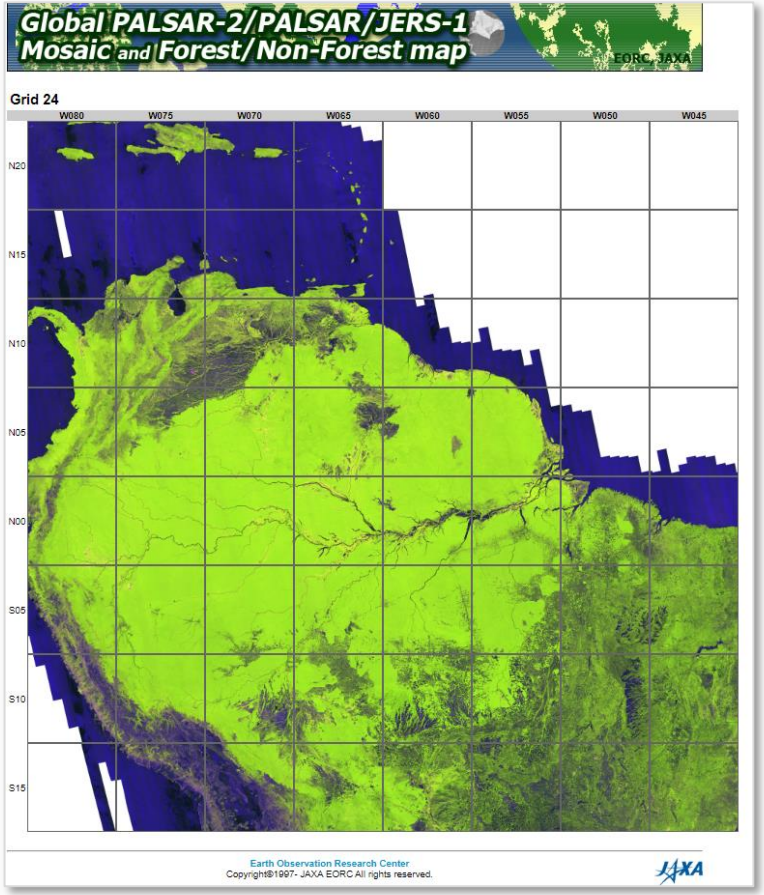
- launch: 24.01.2006
- end of mission: 12.05.2011 (after a malfuntion on 22.04.2011)
- SAR-Sensor PalSAR, operated at L-band (wavelength f 23.62 cm)
- https://www.eorc.jaxa.jp/ALOS/en/alos/a1_about_e.htm

Global PALSAR-2/PALSAR/JERS-1 Mosaics and Forest/Non-Forest Maps are available at:

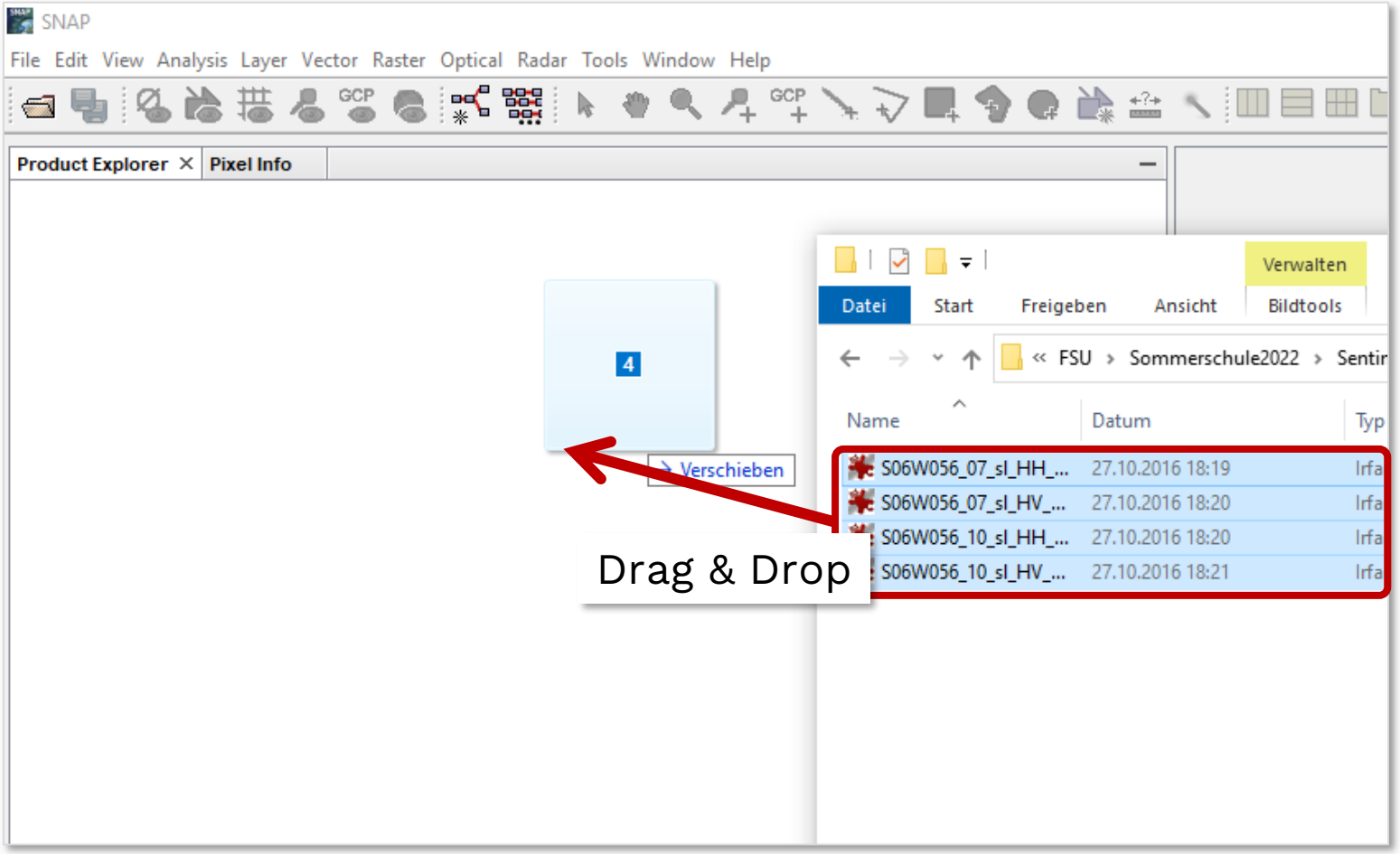
https://www.eorc.jaxa.jp/ALOS/en/dataset/fnf_e.htm

(free registration required)





Load data

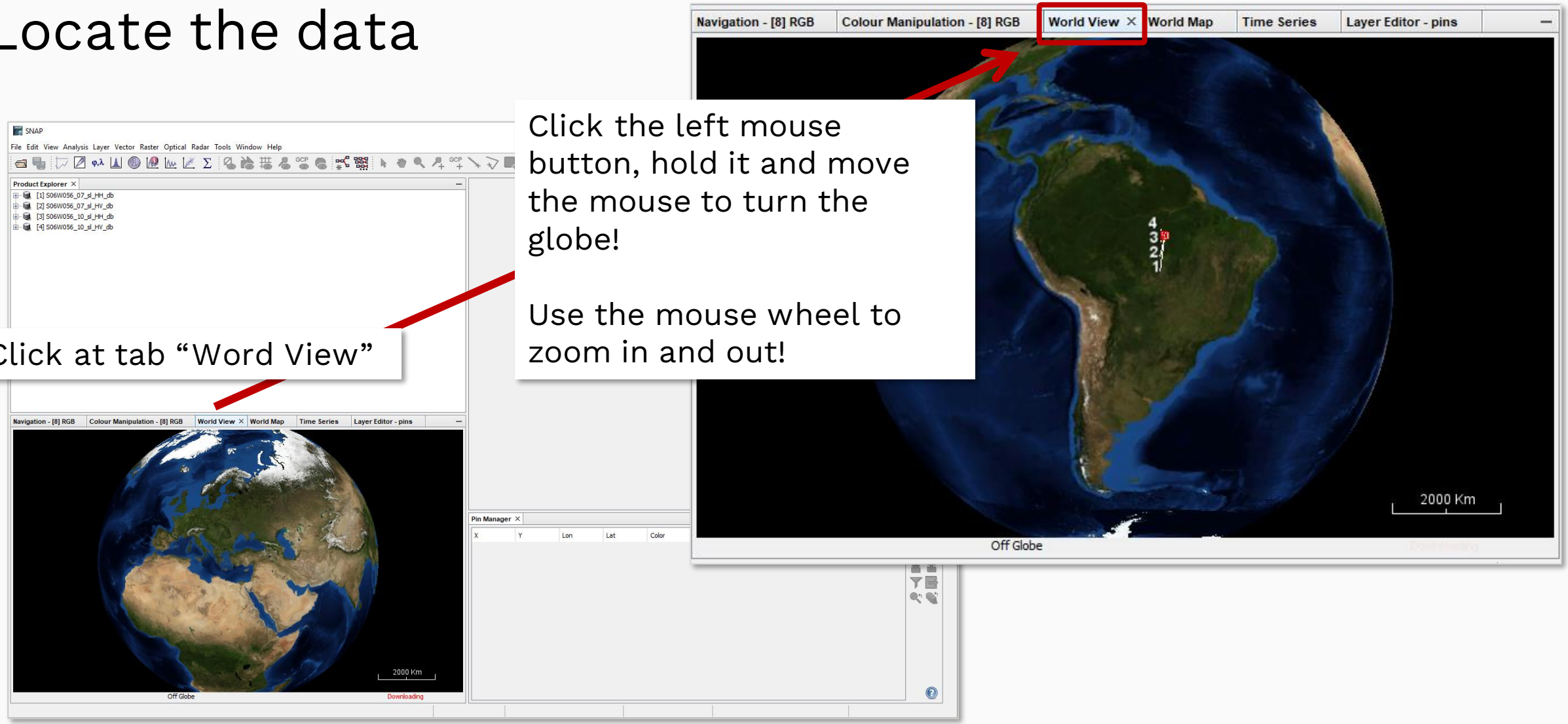

SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
4
Verschieben
Drag & Drop
Verwalten
Datei Start Freigeben Ansicht Bildtools
FSU › Sommerschule2022 › Sentir
Name Datum Typ
S06W056_07_sl_HH_... 27.10.2016 18:19 Irfa
S06W056_07_sl_HV_... 27.10.2016 18:20 Irfa
S06W056_10_sl_HH_... 27.10.2016 18:20 Irfa
S06W056_10_sl_HV_... 27.10.2016 18:21 Irfa

Locate the data

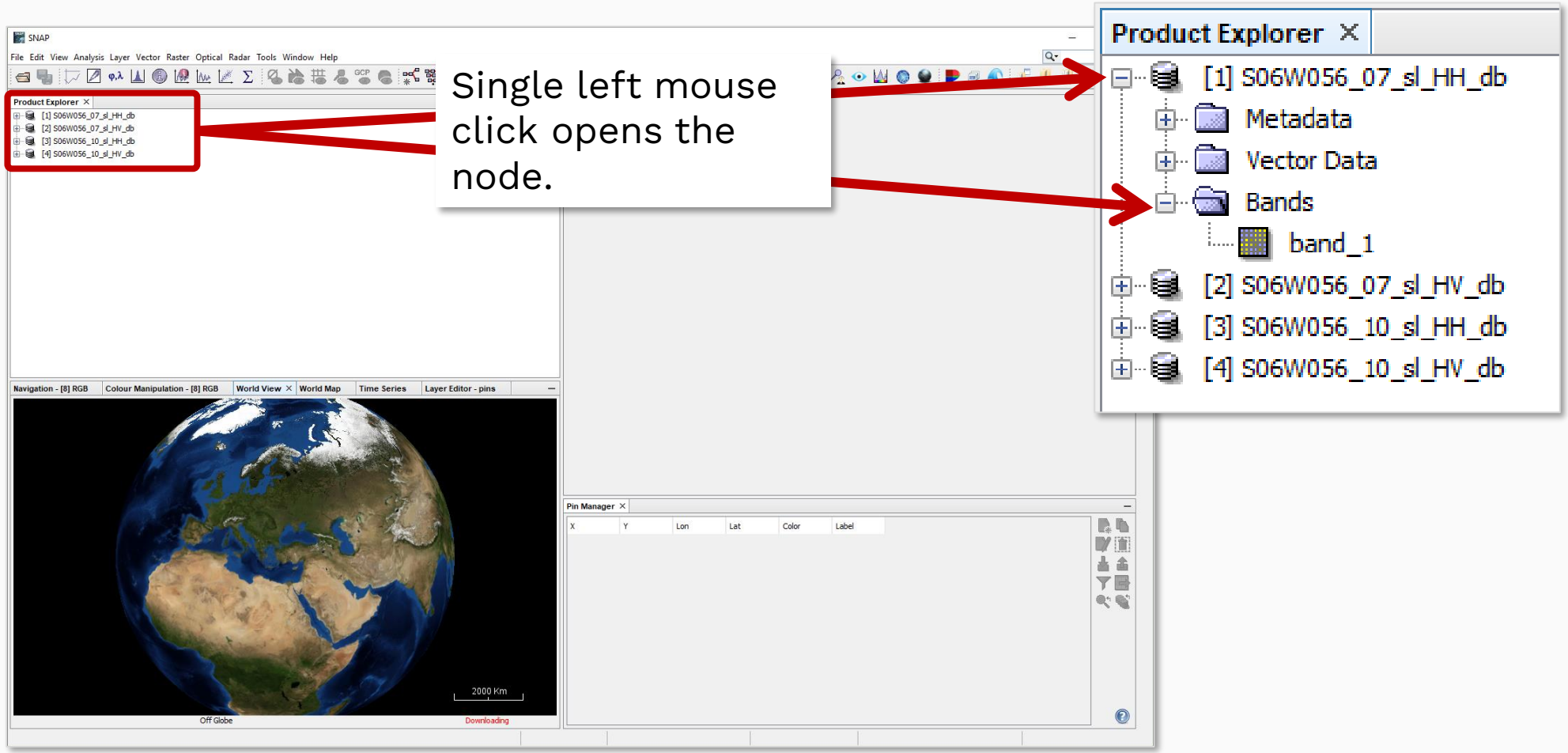
Click at tab “Word View”

Click the left mouse button, hold it and move the mouse to turn the globe!

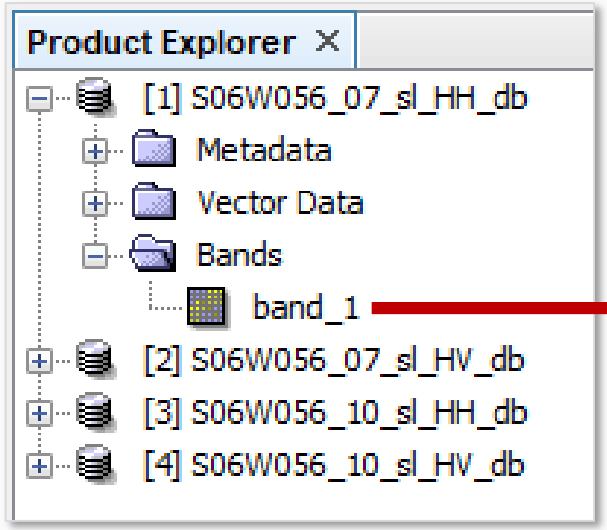
Use the mouse wheel to zoom in and out!



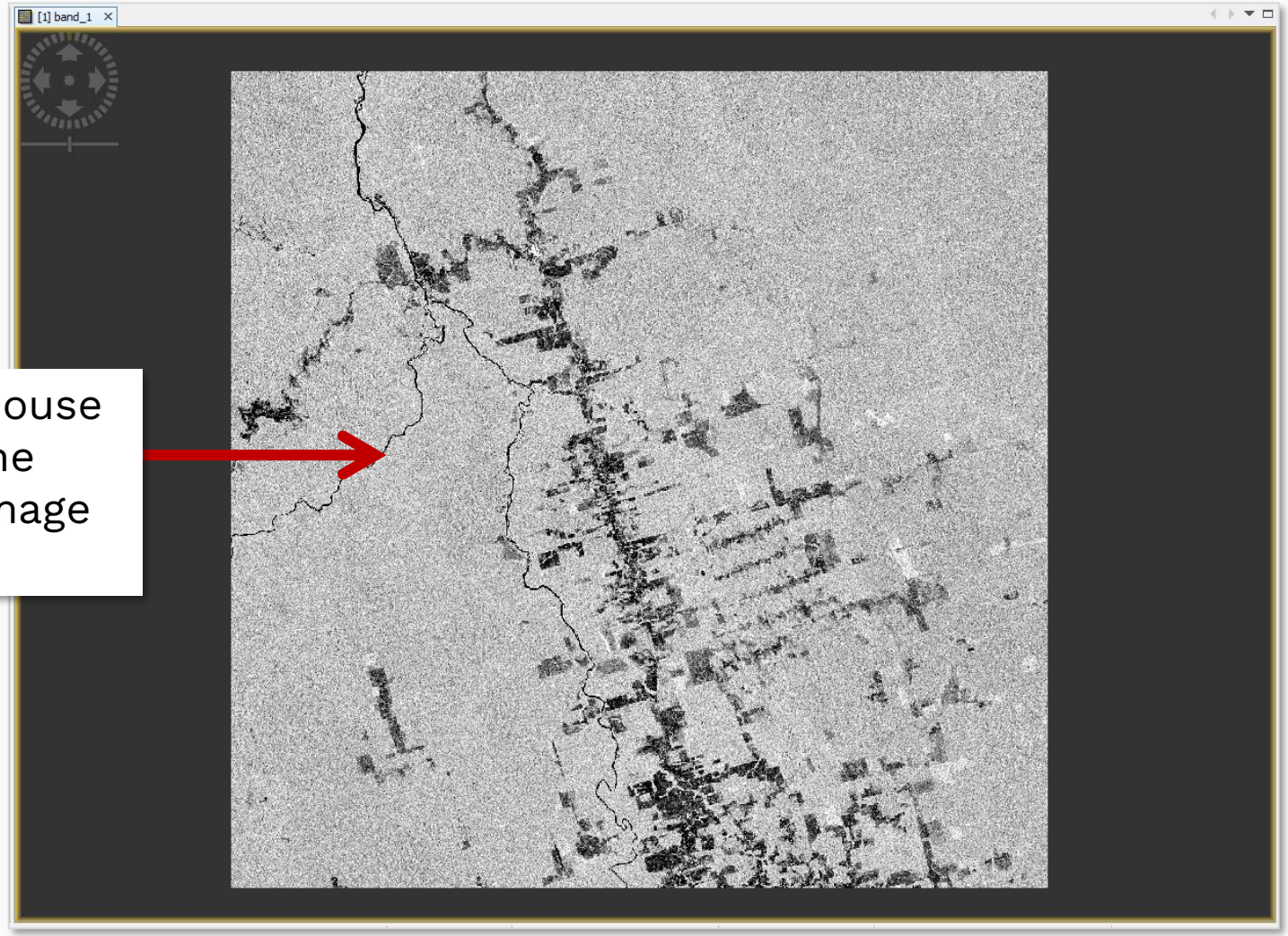
View image bands



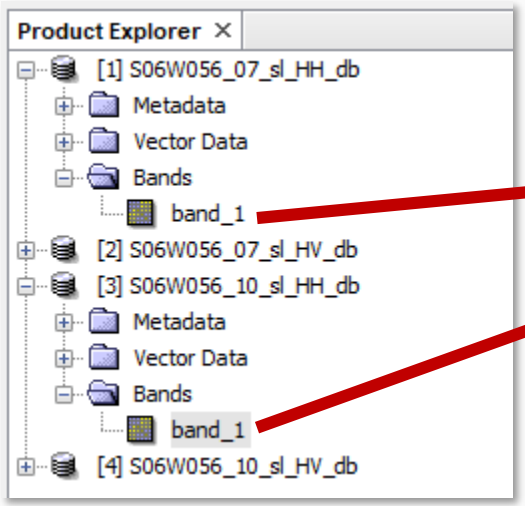
View image bands



Double left mouse click opens the band in the image viewer.

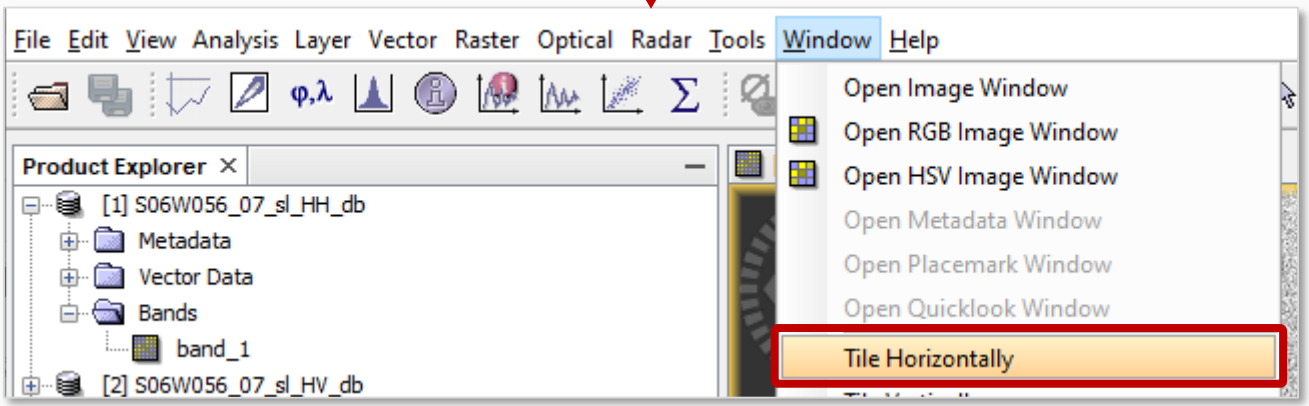


View image bands

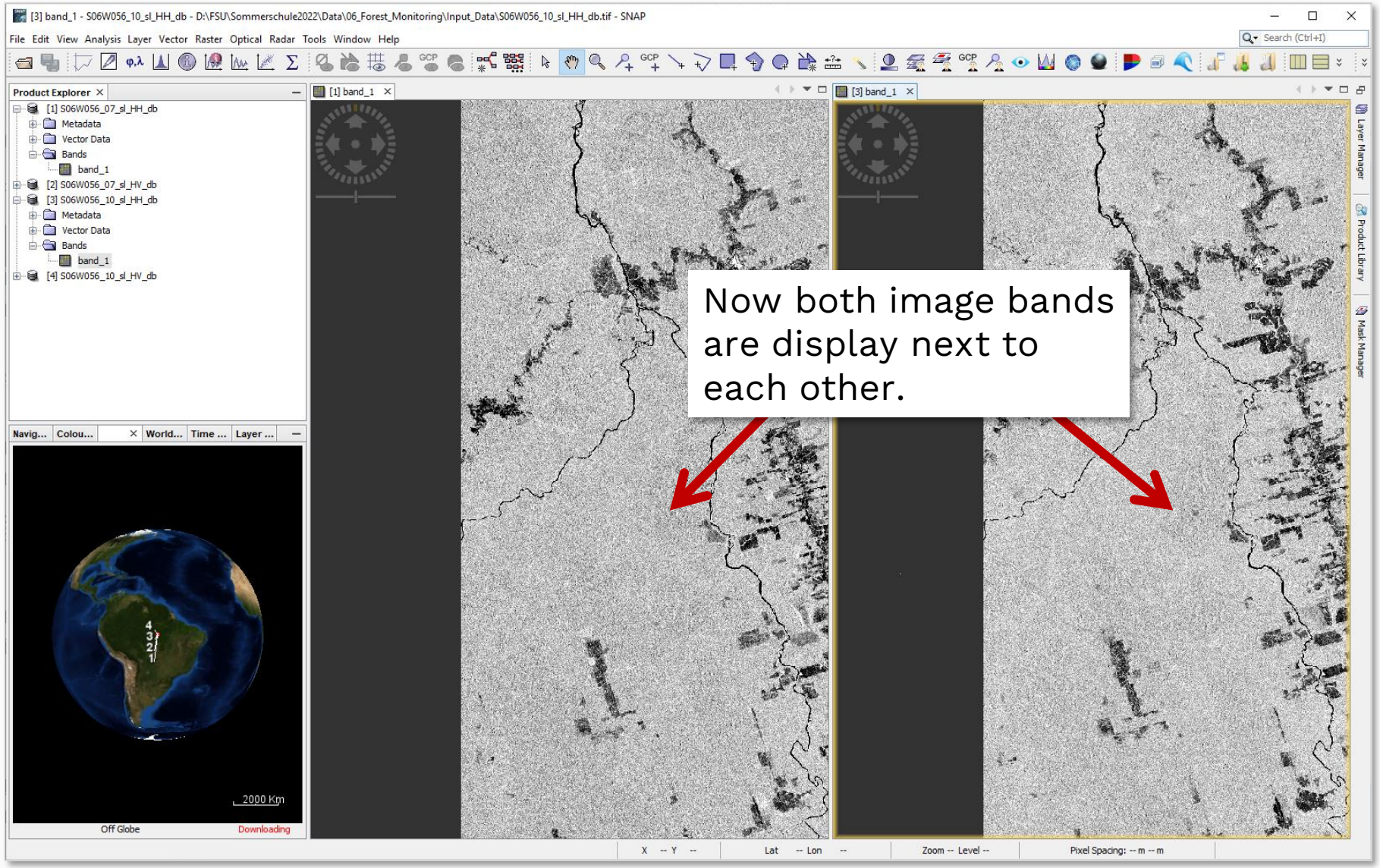


Double left mouse click opens the band in the image viewer. Do this for the HH data from 2007 and 2010!

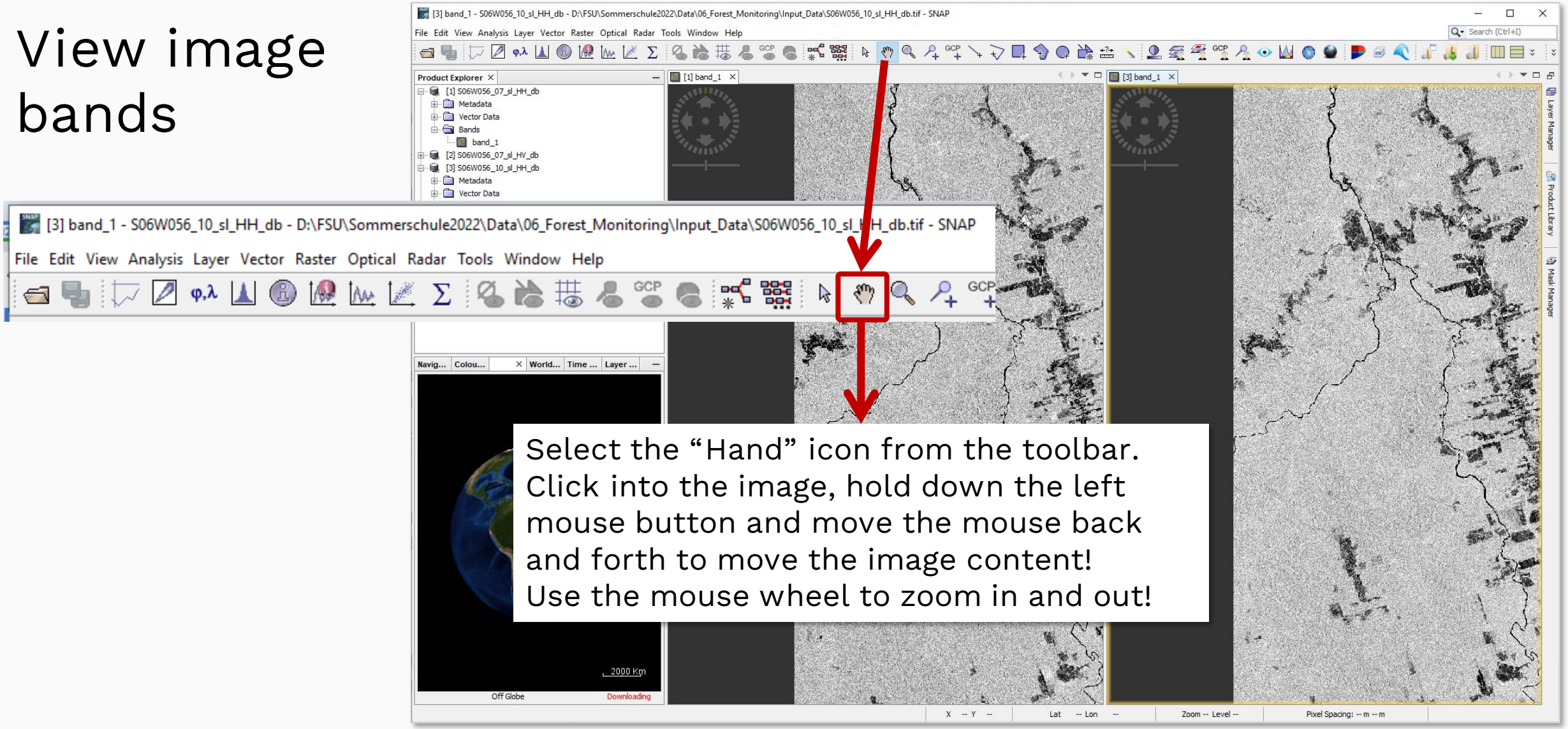
From the menu, select “Window” -> “Tile Horizontally”!



View image bands



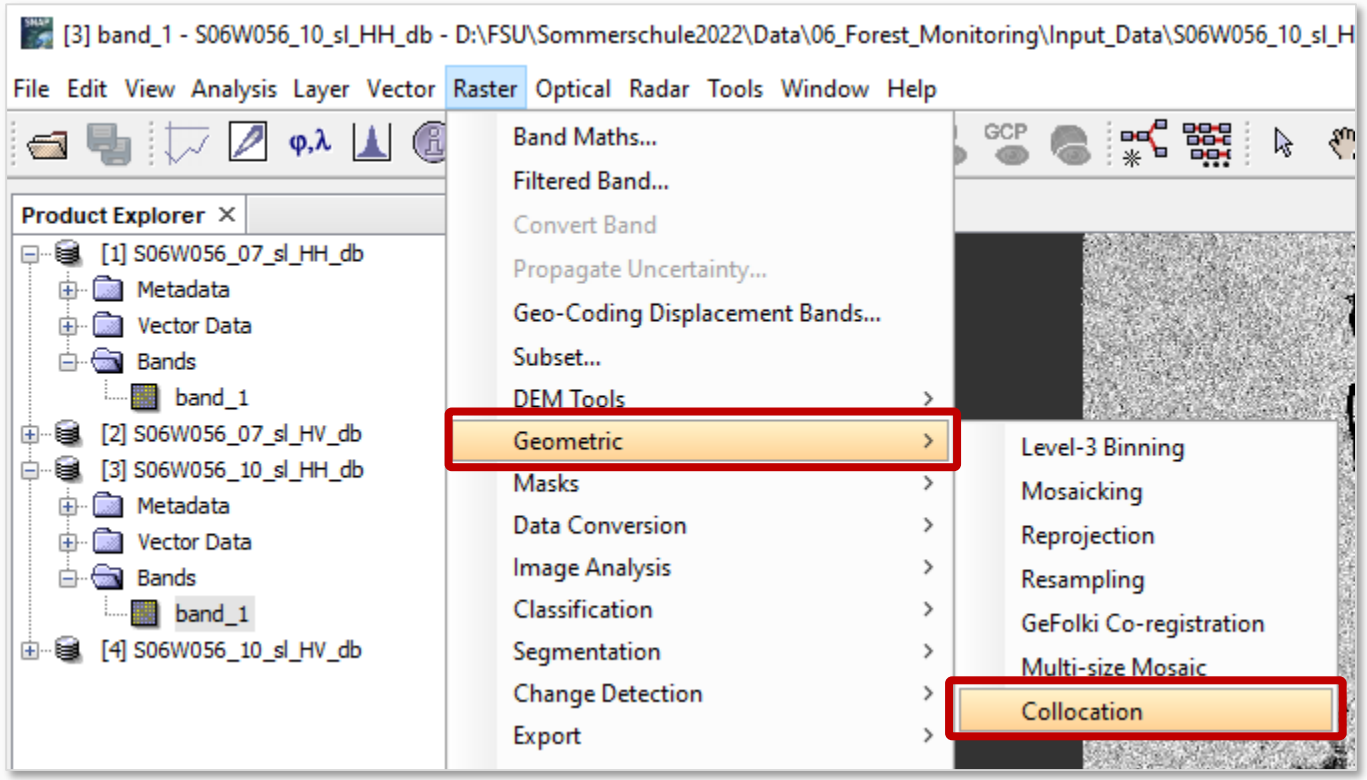
View image bands



Select the “Hand” icon from the toolbar.
Click into the image, hold down the left mouse button and move the mouse back and forth to move the image content!
Use the mouse wheel to zoom in and out!

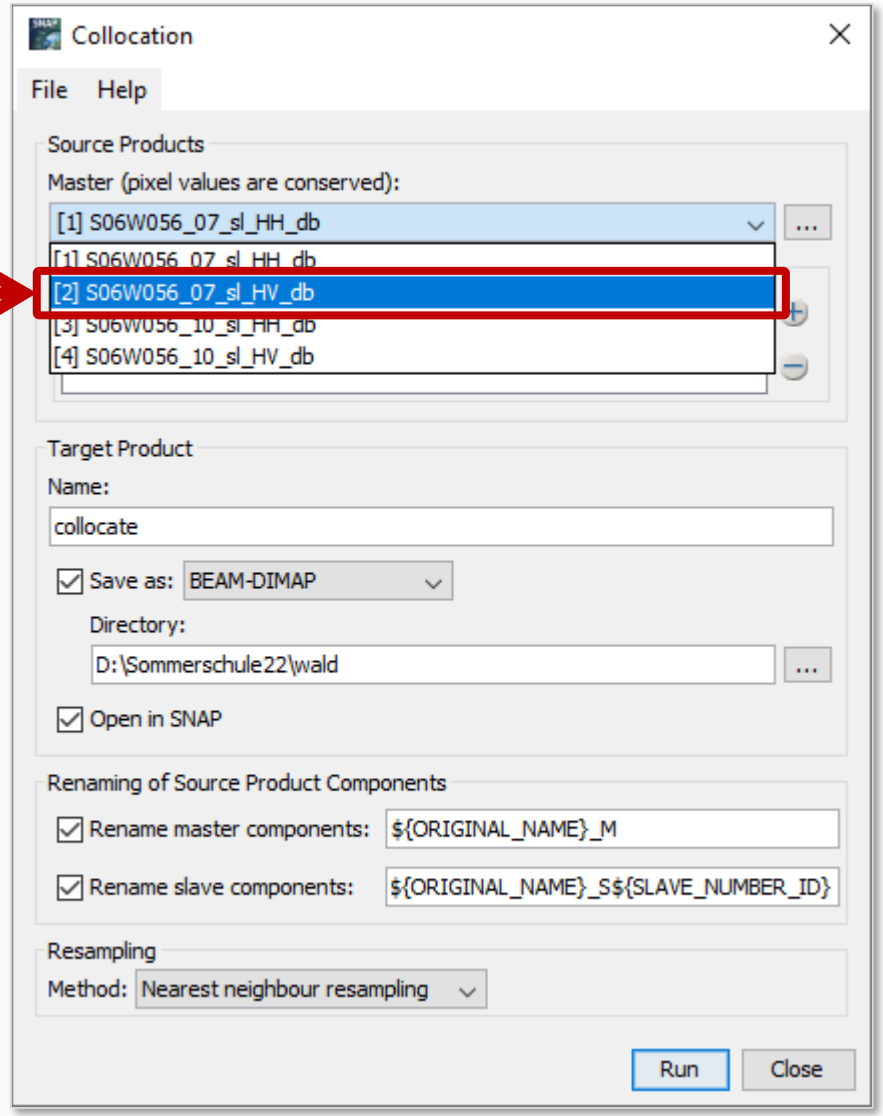
Create Layer Stack

From the menu, select “Raster” -> “Geometric” -> “Collocation”!

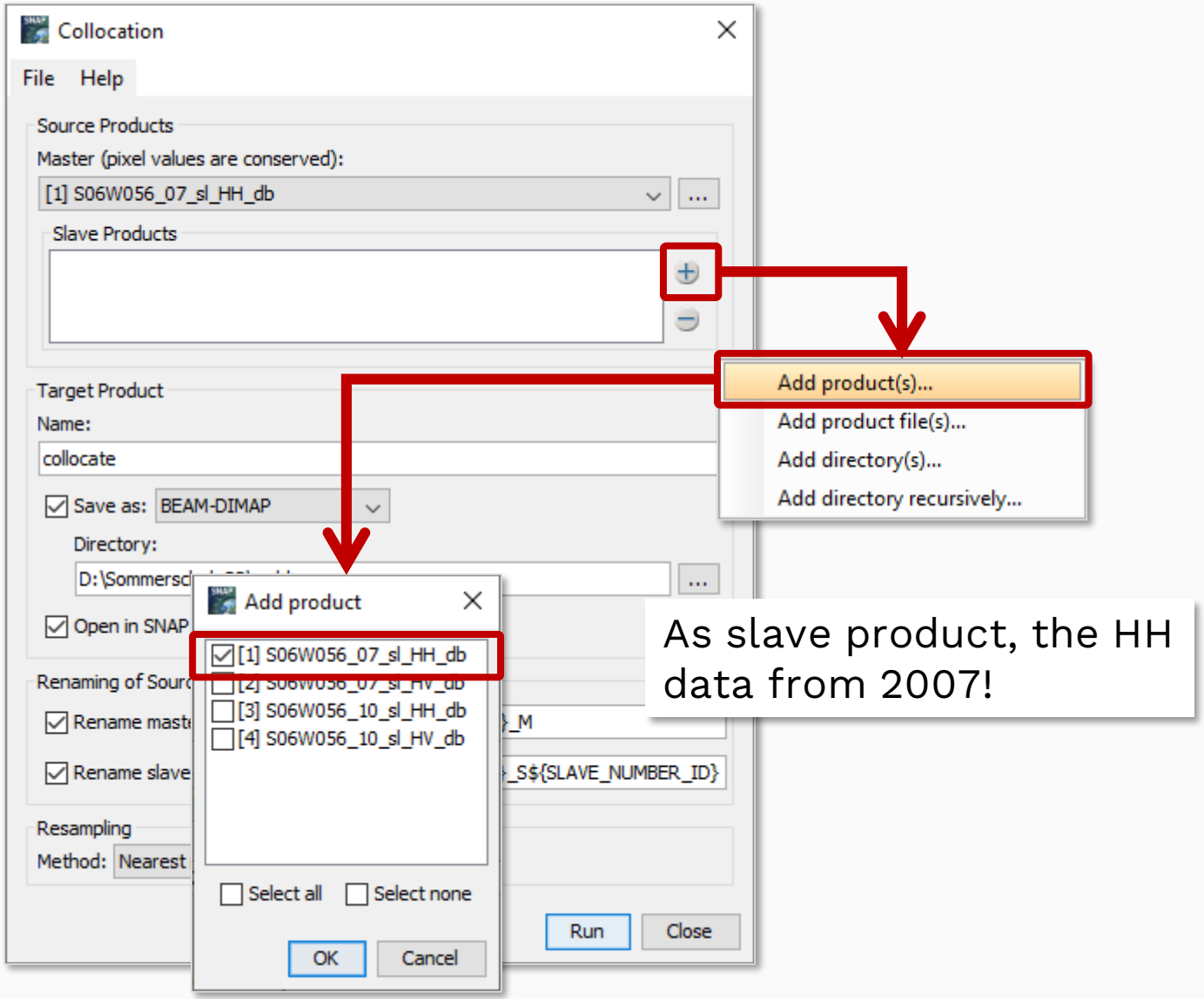


Create Layer Stack

In the drop down menu, select the HV data from 2007!



Create Layer Stack



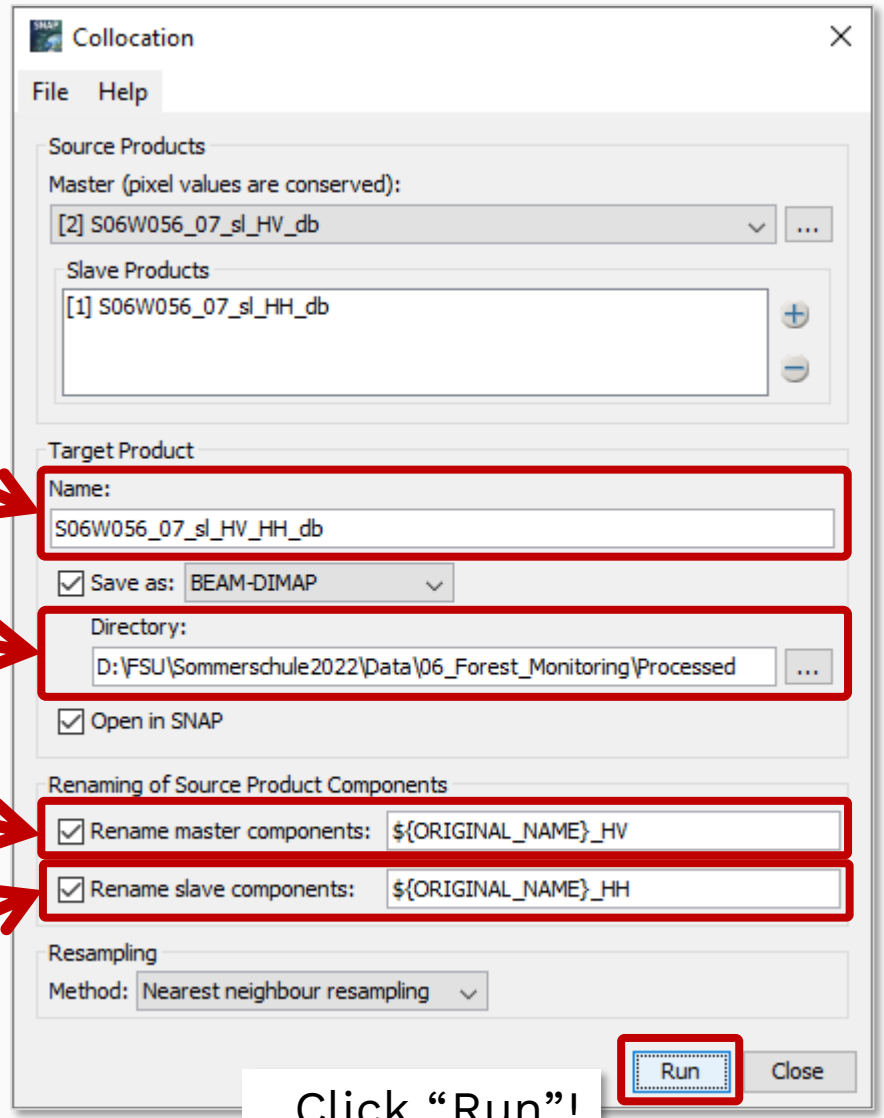
Create Layer Stack

Specify the output name as “S06W056_07_sl_HV_HH_db”!

Specify the output directory!

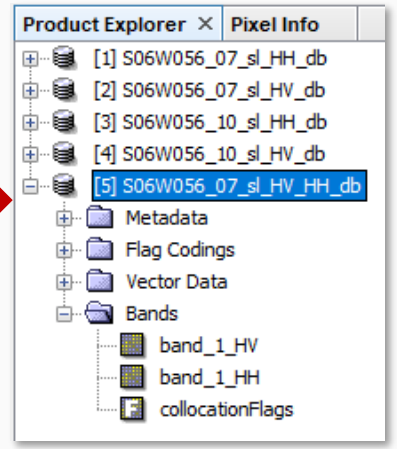
Specify the master components name as “${ORIGINAL_NAME}_HV”!

Specify the master components name as “${ORIGINAL_NAME}_HV”!



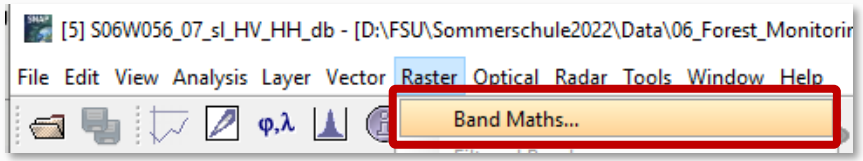
Click “Run”!

Result: Layer Stack with two layers:

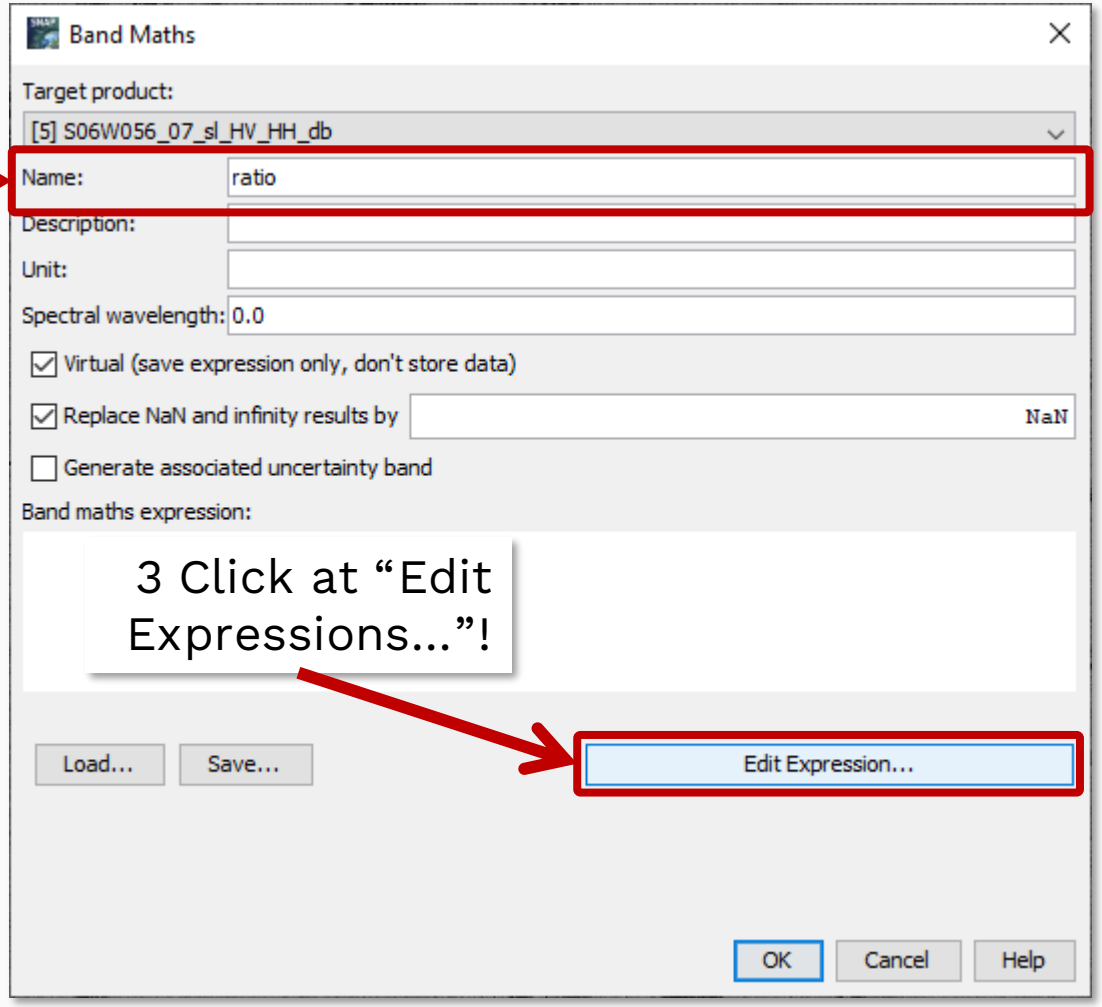


Calculate Polarization Ratio

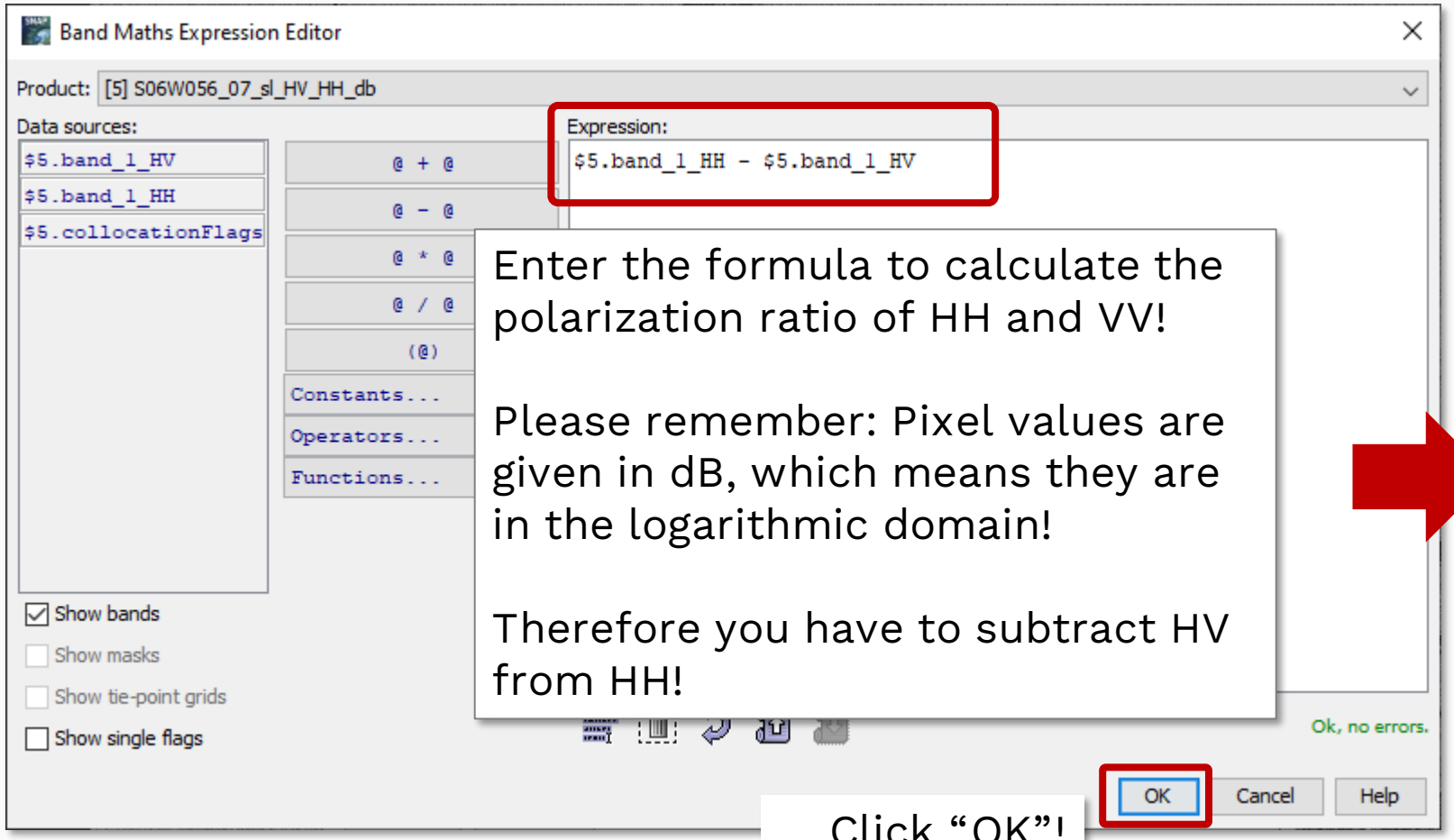
1) From the menu, select “Raster” -> “Band Maths…”!



2) Specify the output name as “ratio”!



Calculate Polarization Ratio



Enter the formula to calculate the polarization ratio of HH and VV!

Please remember: Pixel values are given in dB, which means they are in the logarithmic domain!

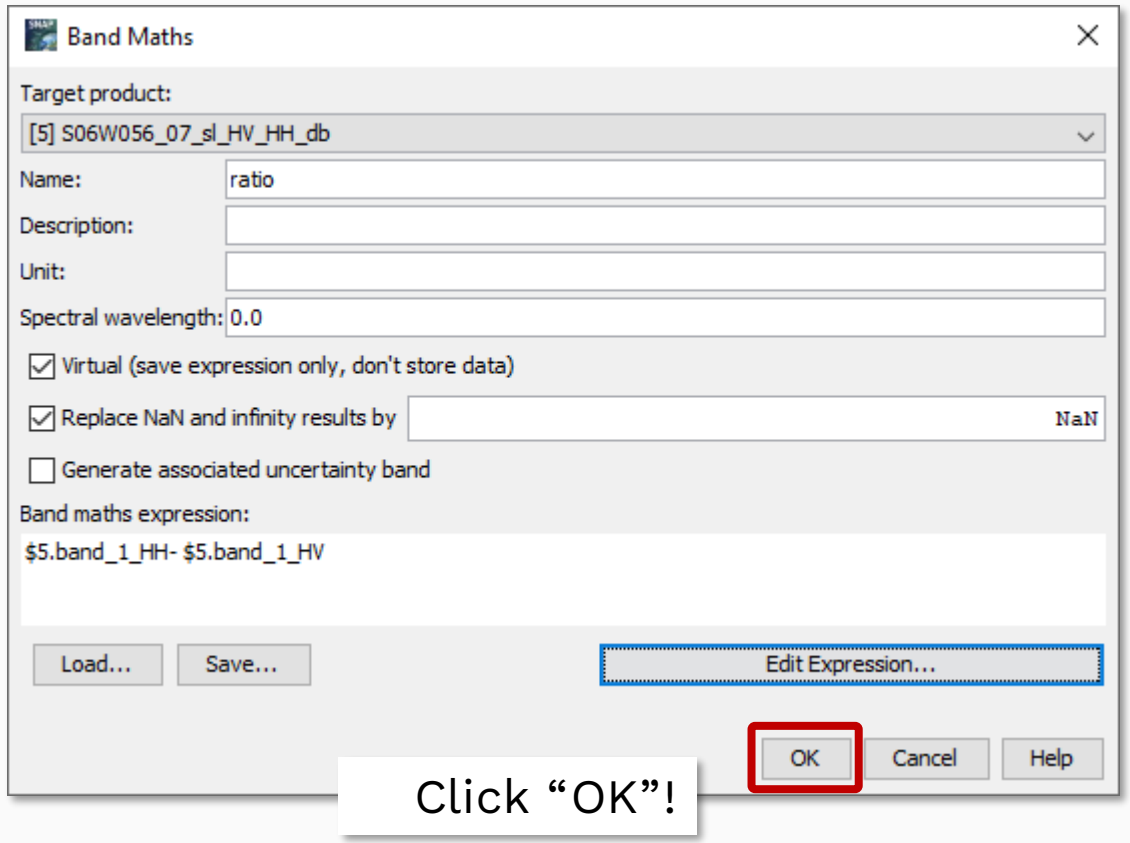
Therefore you have to subtract HV from HH!

Click “OK”!

Attention! Remember the calculation rules for logarithmic values!

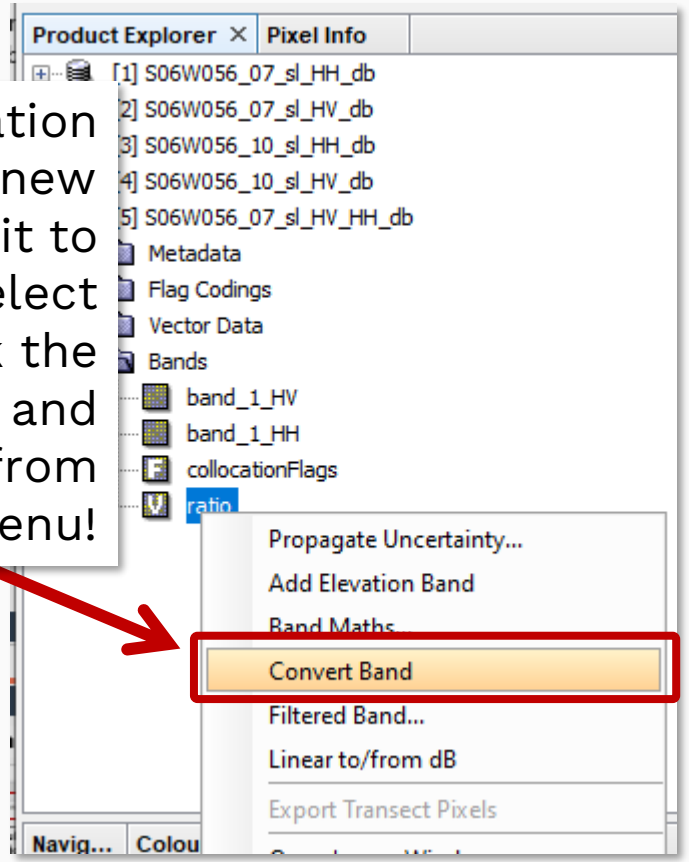
Linear Values		Logarithmic Values
multiplication $log_a(u \cdot v)$	→	addition $log_a u + log_a v$
division $log_a \frac{u}{v}$	→	subtraction $log_a u - log_a v$
exponentiation $log_a u^r$	→	multiplication $r \cdot log_a u$
root extraction $log_a \sqrt[r]{u}$	→	division $\frac{1}{r} log_a u$

Calculate Polarization Ratio



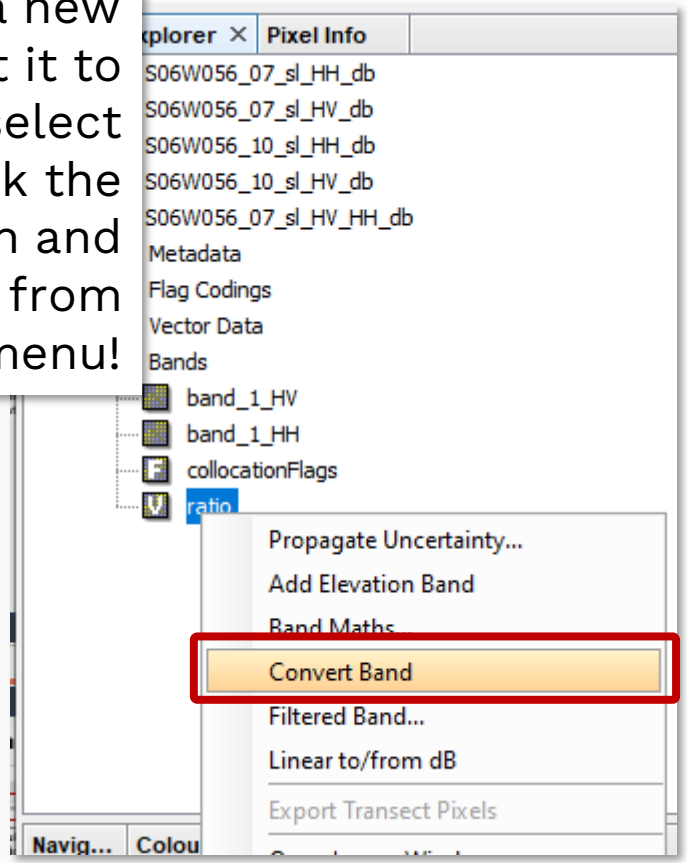
Click “OK”!

The result of the calculation will be added as a new virtual band. To convert it to a permanent band, select the band “ratio”, click the right mouse button and select “Convert Band” from the context menu!

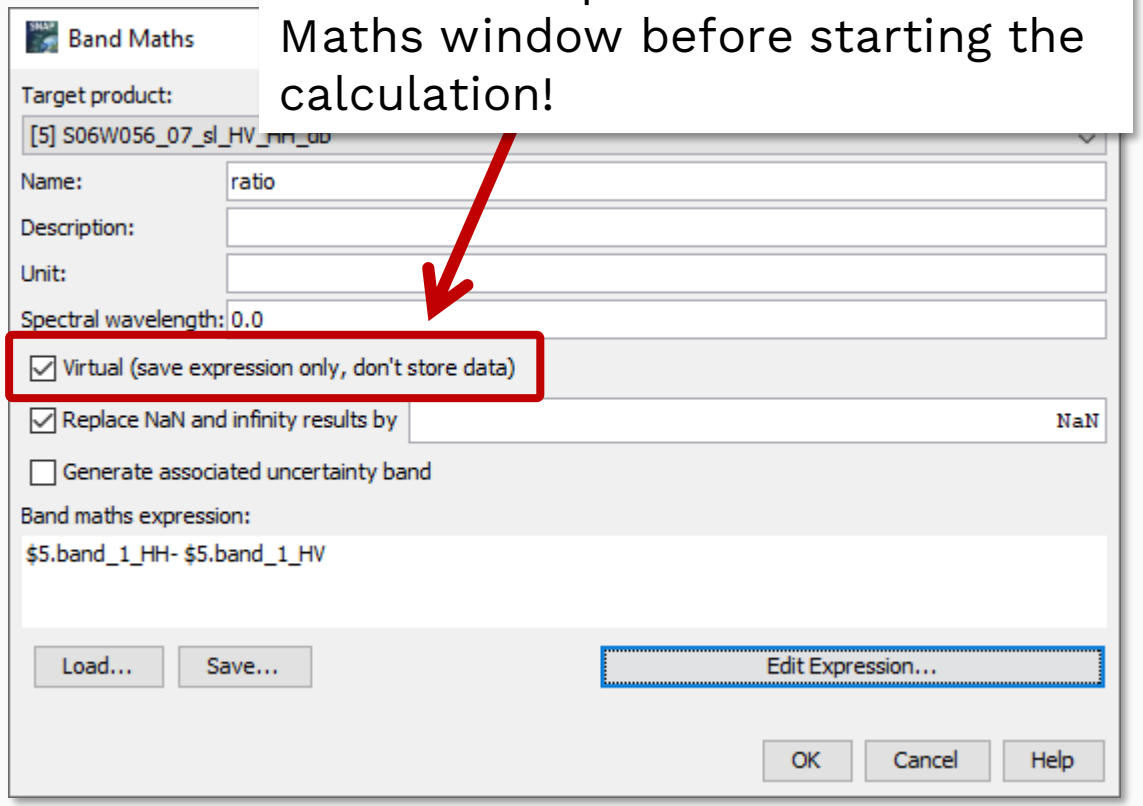


Calculate Polarization Ratio

The result of the calculation will be added as a new virtual band. To convert it to a permanent band, select the band “ratio”, click the right mouse button and select “Convert Band” from the context menu!

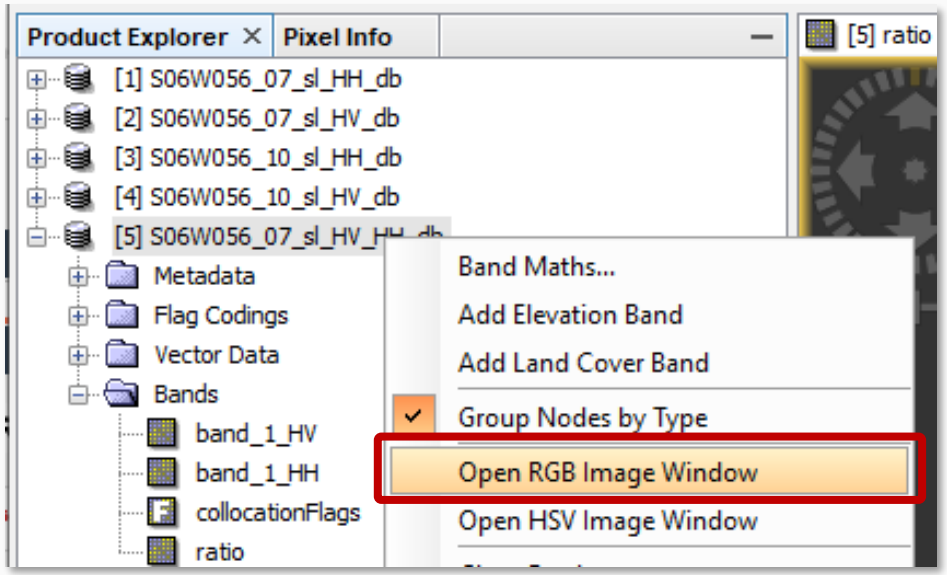


Alternative:
Untick this option in the Band Maths window before starting the calculation!



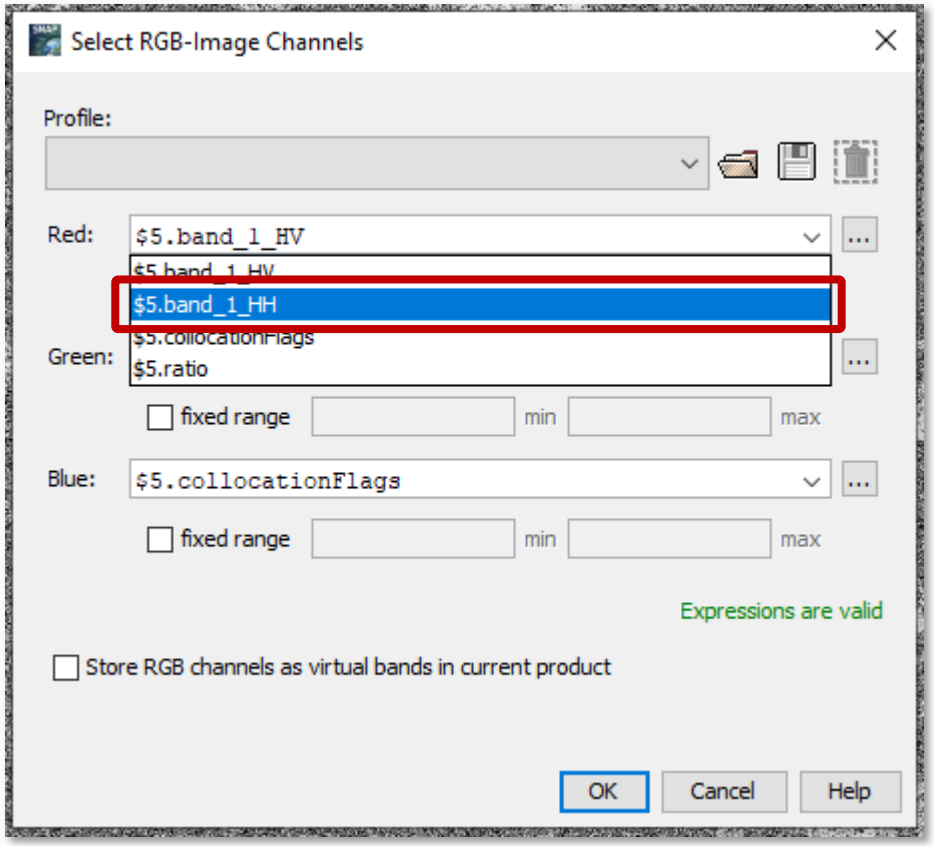
Create RGB-View

In the Product Explorer, select the Layer Stack product name and click the right mouse button!
From the context menu select “Open RGB Image Window”!



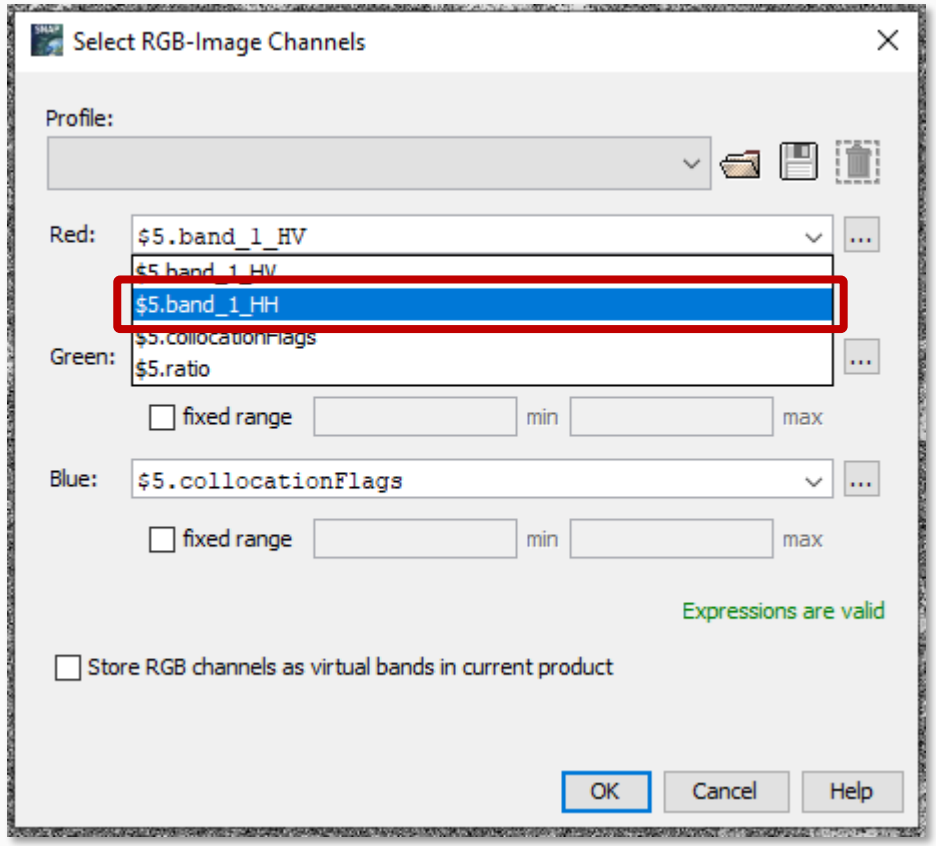
Create RGB-View

To select image bands for the three RGB-Image-Channels, use the drop down menus and select a band from the list!



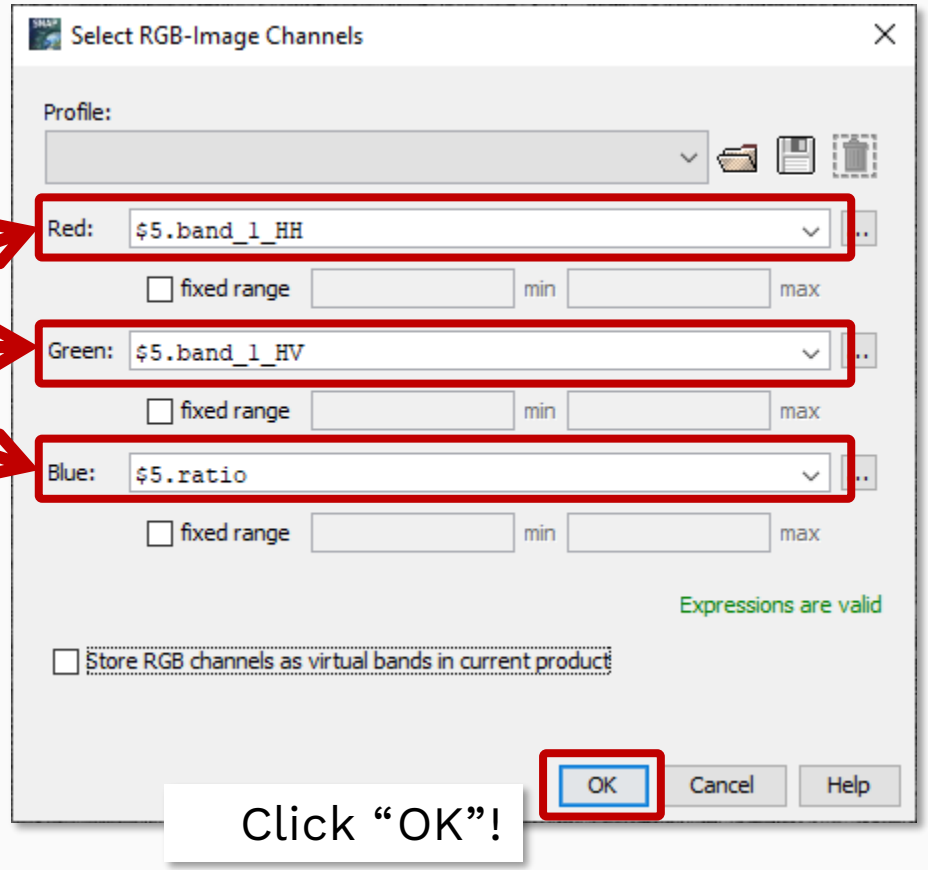
Create RGB-View

To select image bands for the three RGB-Image-Channels, use the drop down menus and select a band from the list!



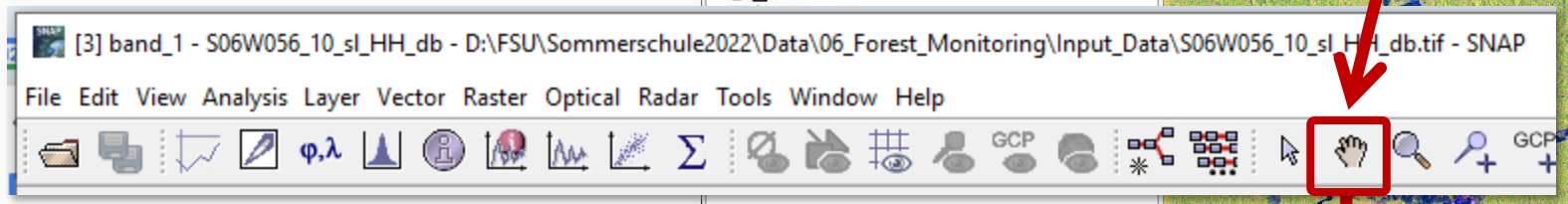
Create RGB-View

For our exercise, select
Red: HH band
Green: HV band
Blue: ratio



Click “OK”!

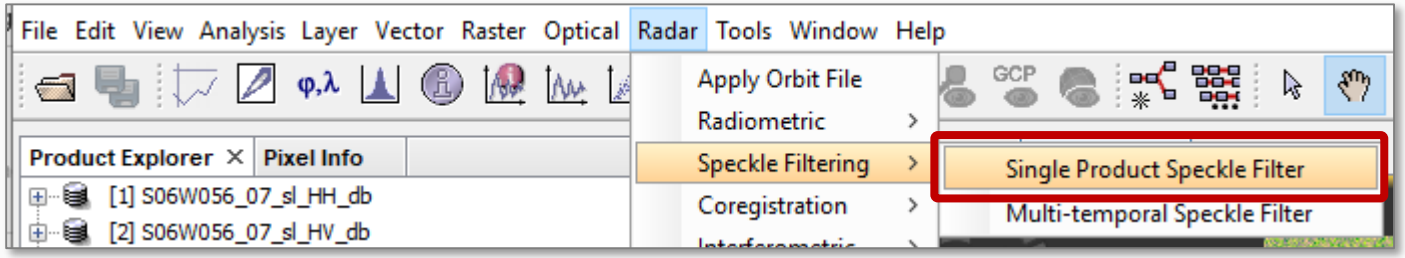
Create RGB-View



Select the “Hand” icon from the toolbar.
Click into the image, hold down the left mouse button and move the mouse back and forth to move the image content!
Use the mouse wheel to zoom in and out!

Speckle-Filtering

From the menu select “Radar” -> “Speckle Filtering” -> “Single Product Speckle Filter”!



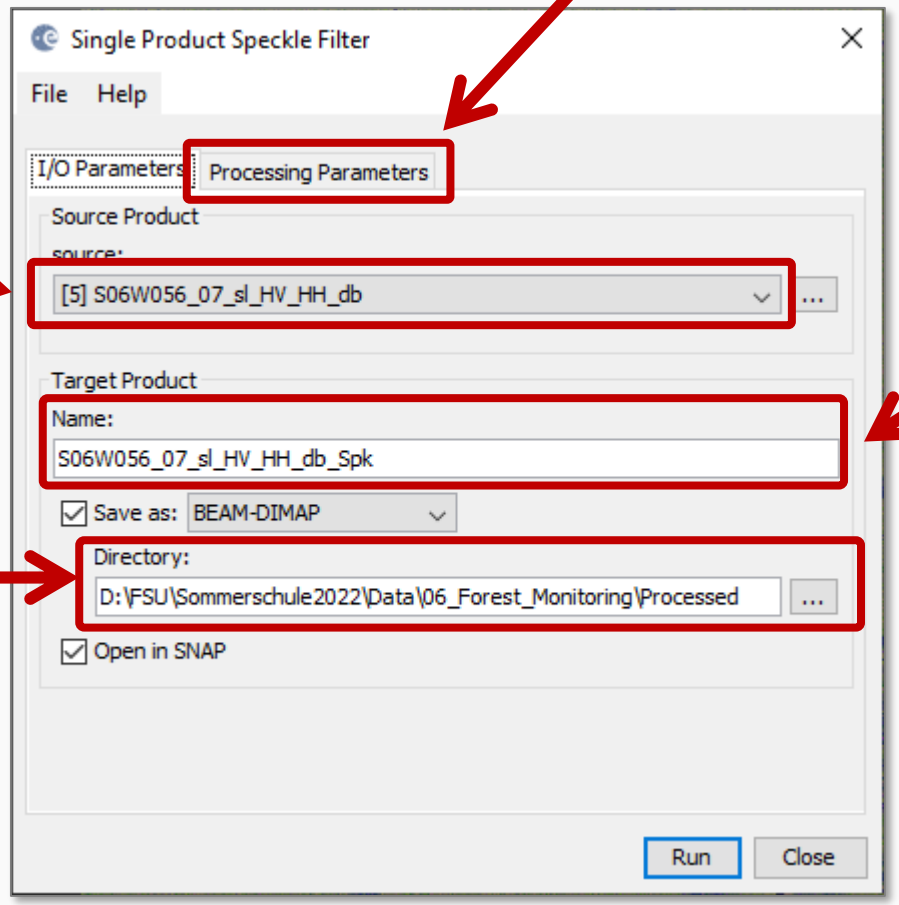
Speckle-Filtering

4) Click the tab “Processing Parameters”!

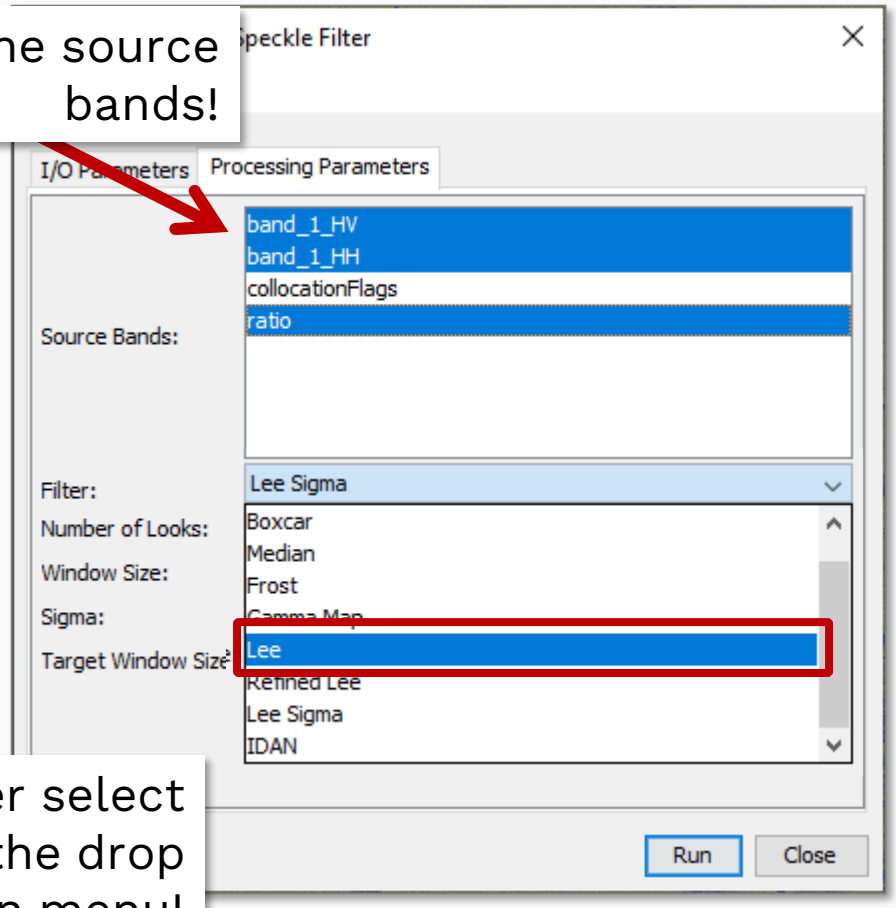
1) The Layer Stack is our source product.

2) SNAP automatically adds “_Spk” at the end of the file name to create the output name

3) Specify your output directory!

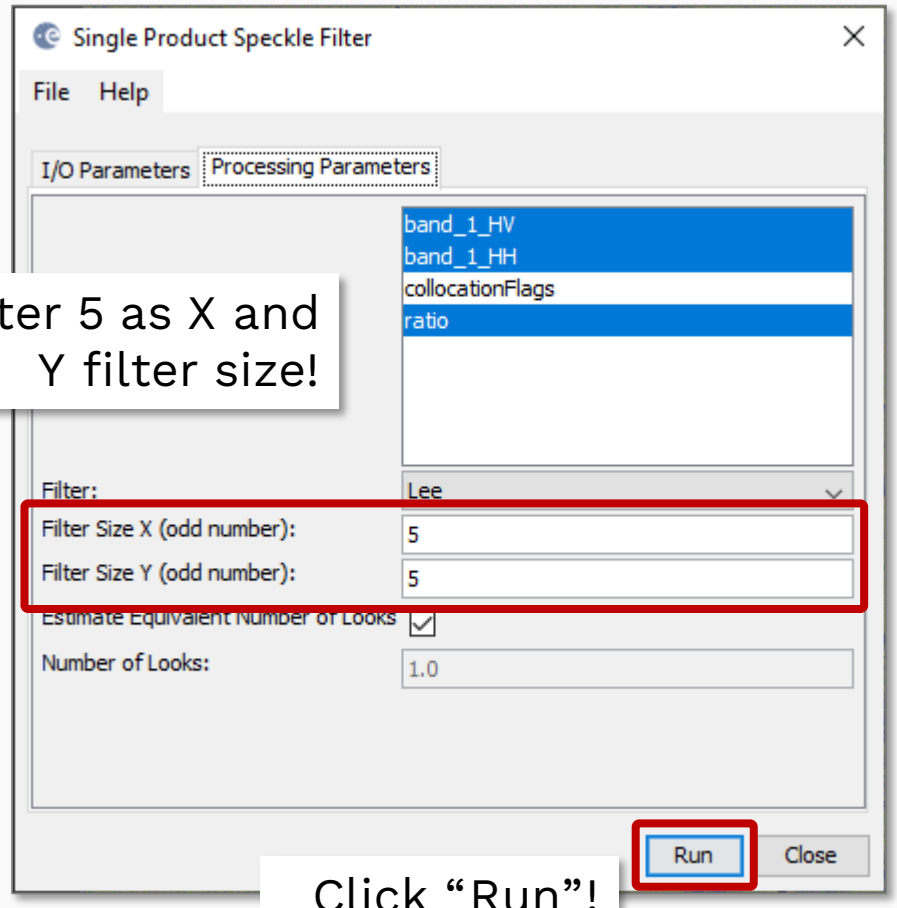


1) Select the source bands!



2) As filter select “Lee” from the drop down menu!

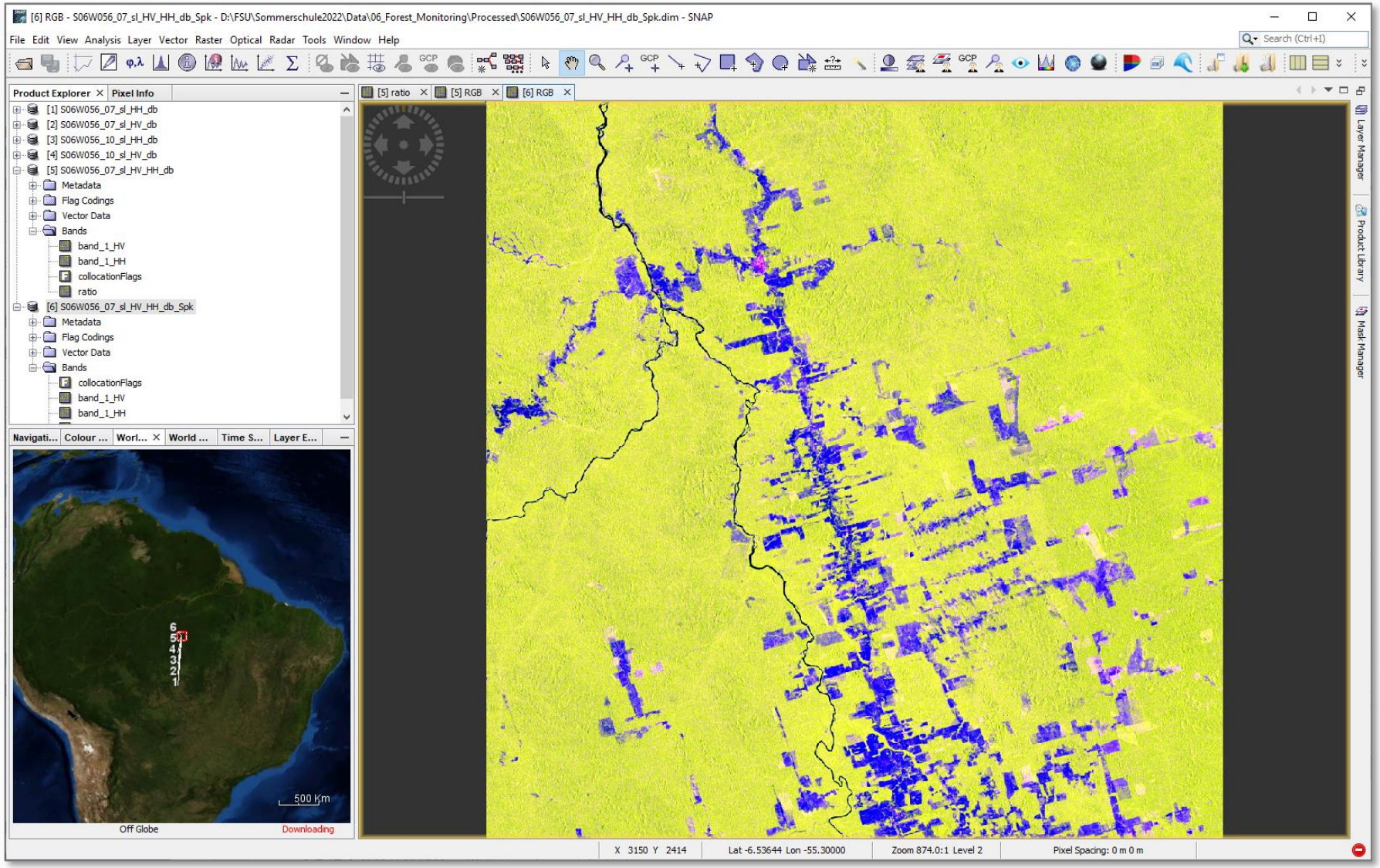
3) Enter 5 as X and Y filter size!



Click “Run”!

Create RGB-Views

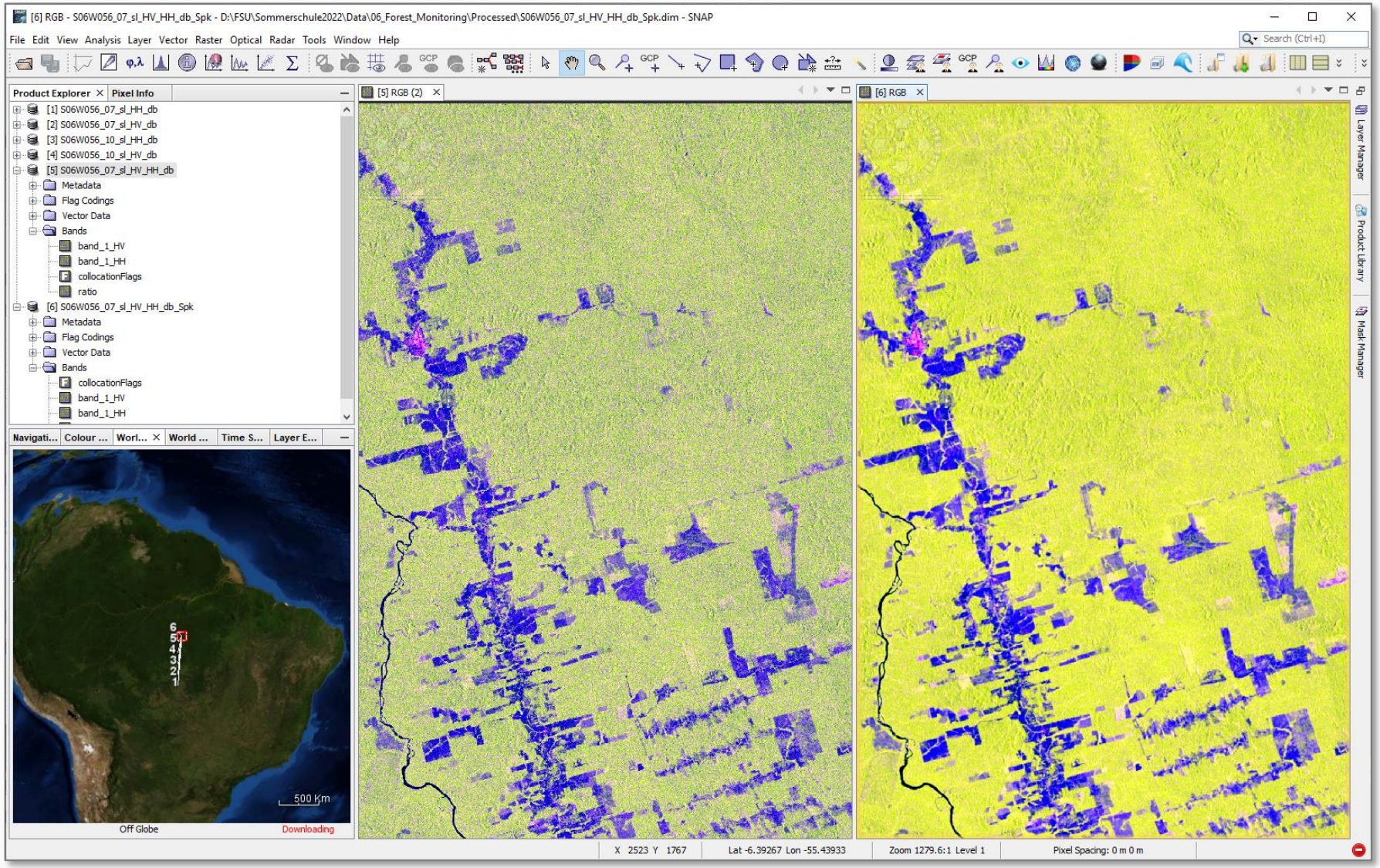
Use the speckle filtered product to create an RGB-View!
See slides 21 – 25.



Compare RGB-Views

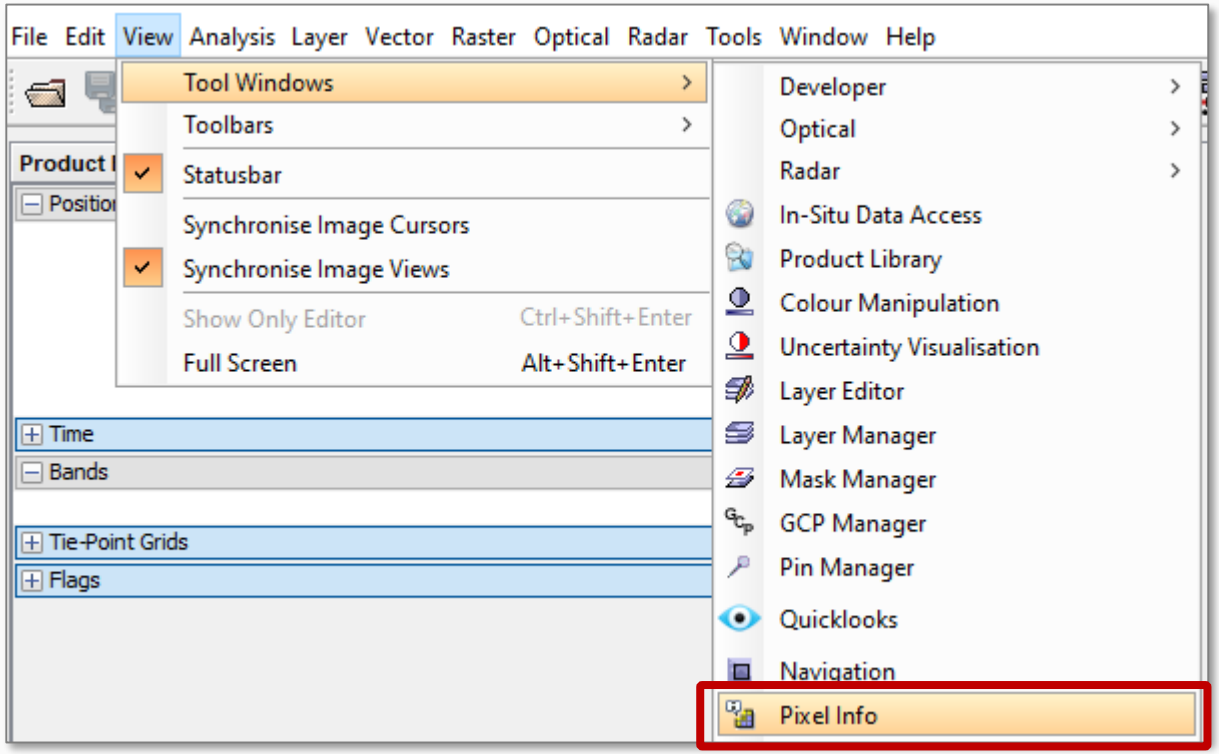
Compare the unfiltered and the filtered RGB-Views using horizontal tiling!

See slides 10 - 12!



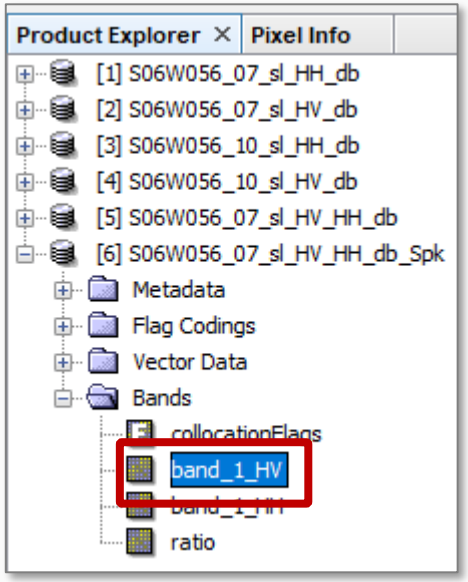
View pixel values

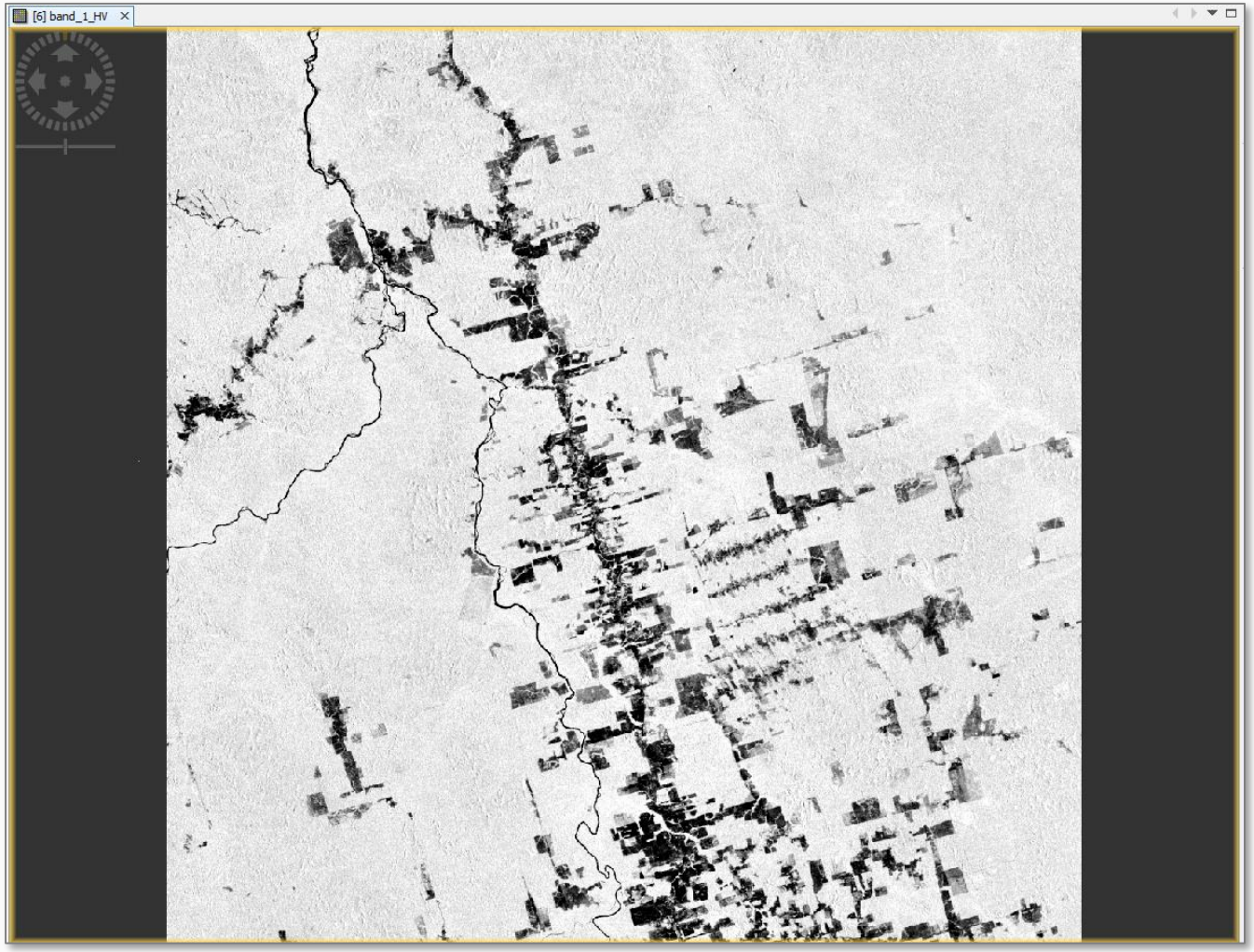
From the menu select “View” -> “Tool Windows” -> “Pixel Info”!



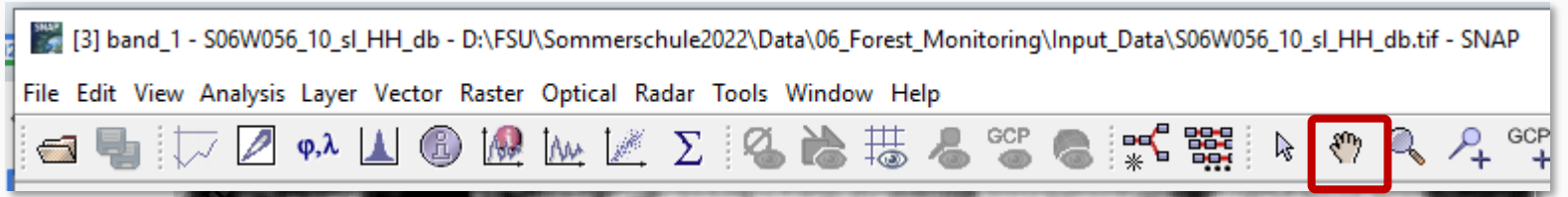
View pixel values

Please open speckle filtered HV data by double-clicking the image band!





View pixel values



Product Explorer | Pixel Info

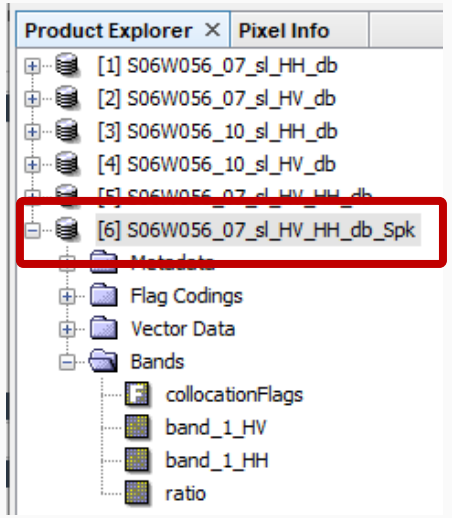
Position		
Image-X	878	pixel
Image-Y	2290	pixel
Longitude	55°48'17" W	degree
Latitude	6°30'32" S	degree
Map-X	-55.80477777777778	°
Map-Y	-6.509	°
Time		
Bands		
band_1_HV	-11.31035	amplitude
Tie-Point Grids		
Flags		

When you have selected the hand tool and you move the mouse pointer over the image, you can see the pixel information in the Pixel View tool window, e.g. the value of the band_1_HV amplitude.

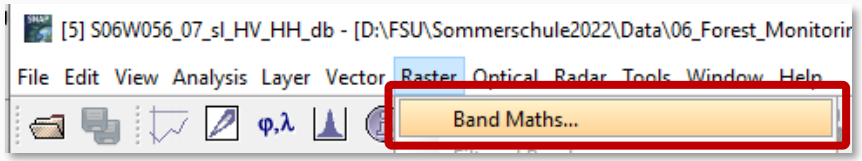
Observe the pixel values of the forested areas (white to light grey areas) and the non-forested areas (dark regions)!
You will notice that the backscatter values for the forested areas will range between -10 and -12 dB, whereas the non-forested areas show much lower backscatter values in the range from -19 to -22 dB.

Mask area covered by forest

1) Select the speckle-filtered Layer Stack!

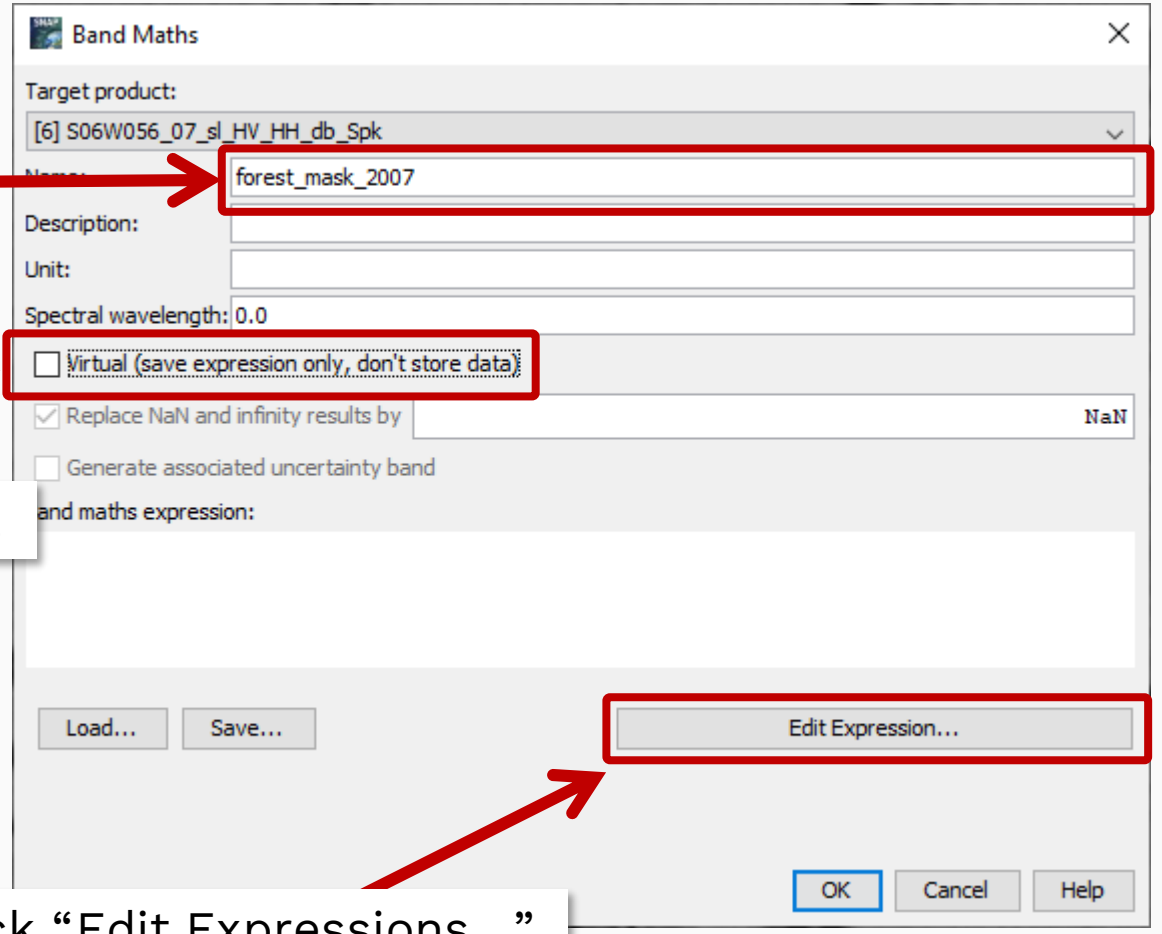


2) Open the “Band Maths...“ tool



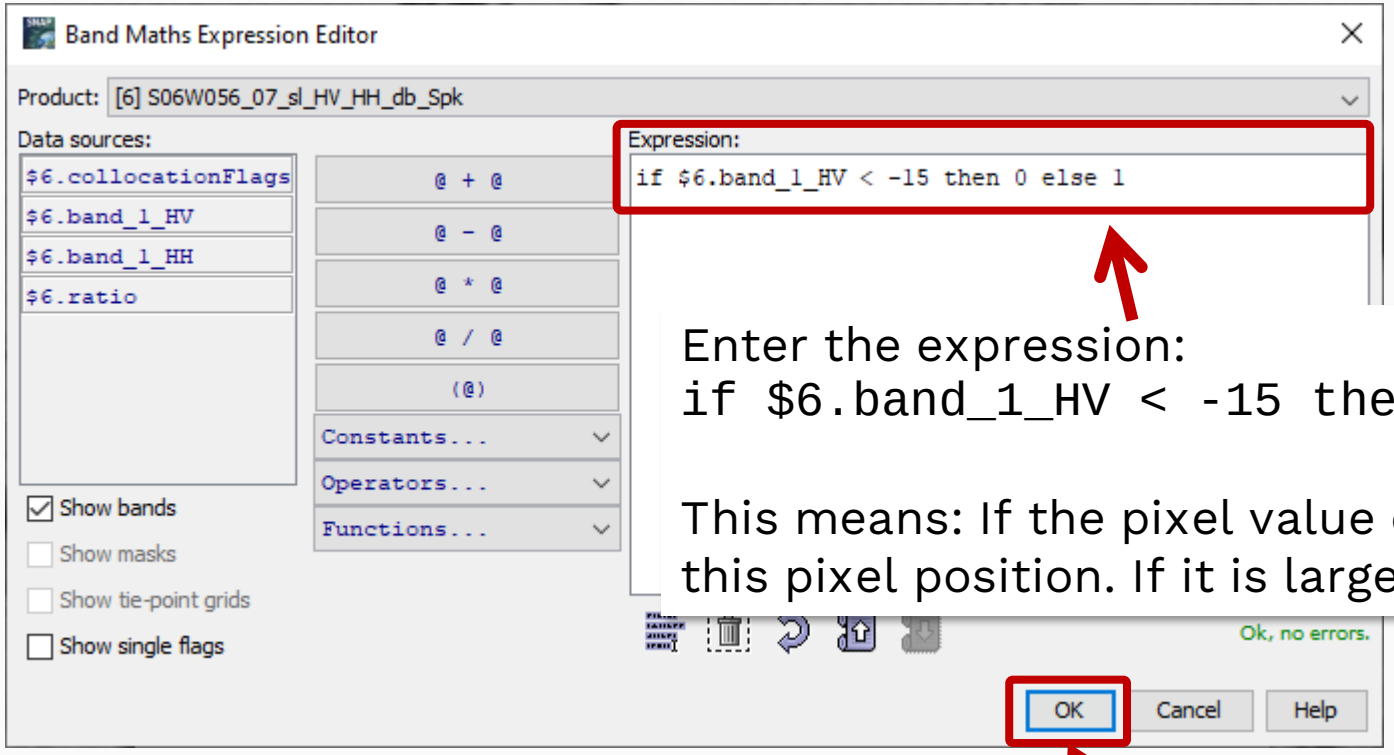
3) Specify the output name as “ratio”!

4) Untick this option!



5) Click “Edit Expressions...”

Mask area covered by forest



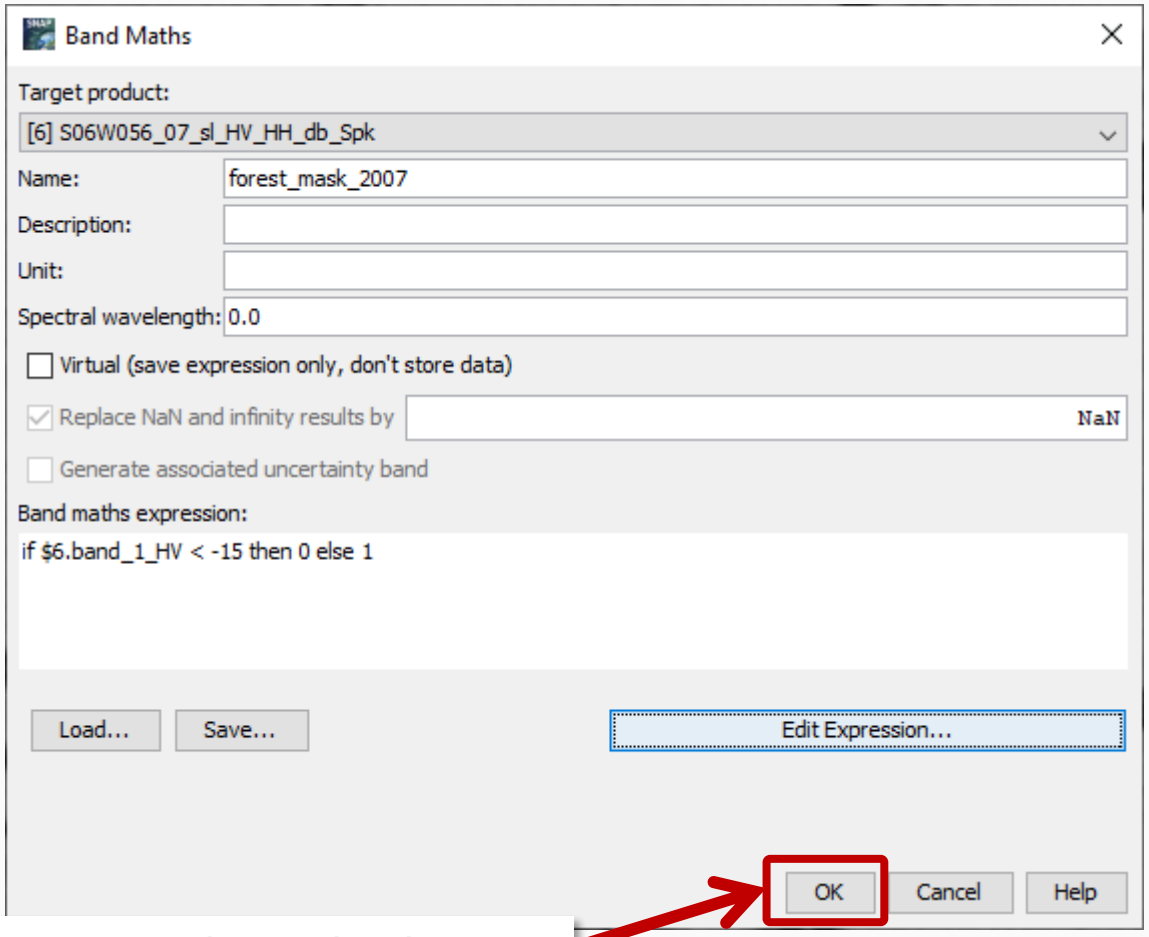
Enter the expression:

```
if $6.band_1_HV < -15 then 0 else 1
```

This means: If the pixel value of band_1_HV is lower then 15, save a “0” at this pixel position. If it is larger, then save a “1” at the pixel position.

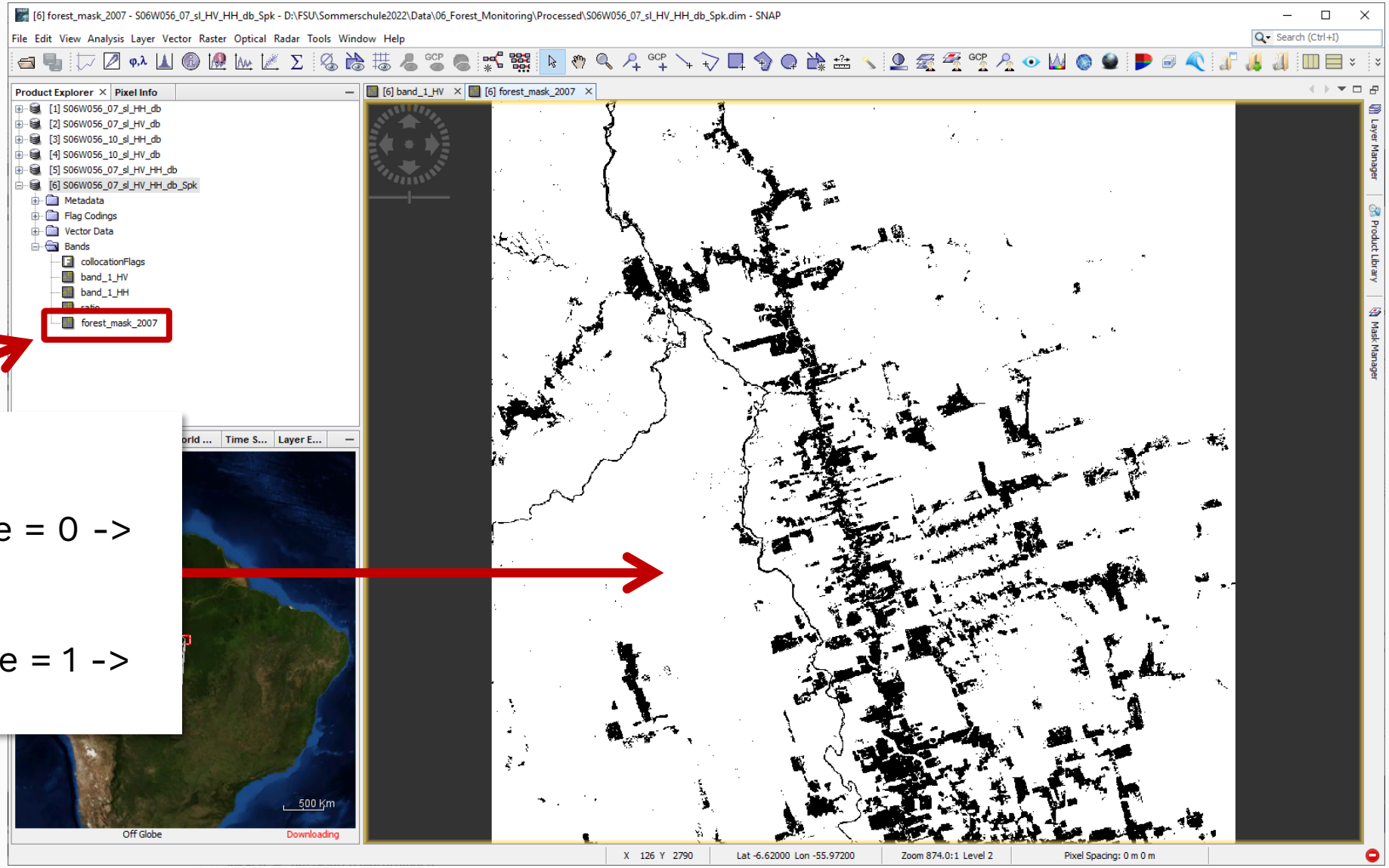
Click “OK” to close the window!

Mask area covered by forest



Click “OK” to start the calculation!

Mask area covered by forest



Result:

Black pixels -> Pixel value = 0 -> non-forested area

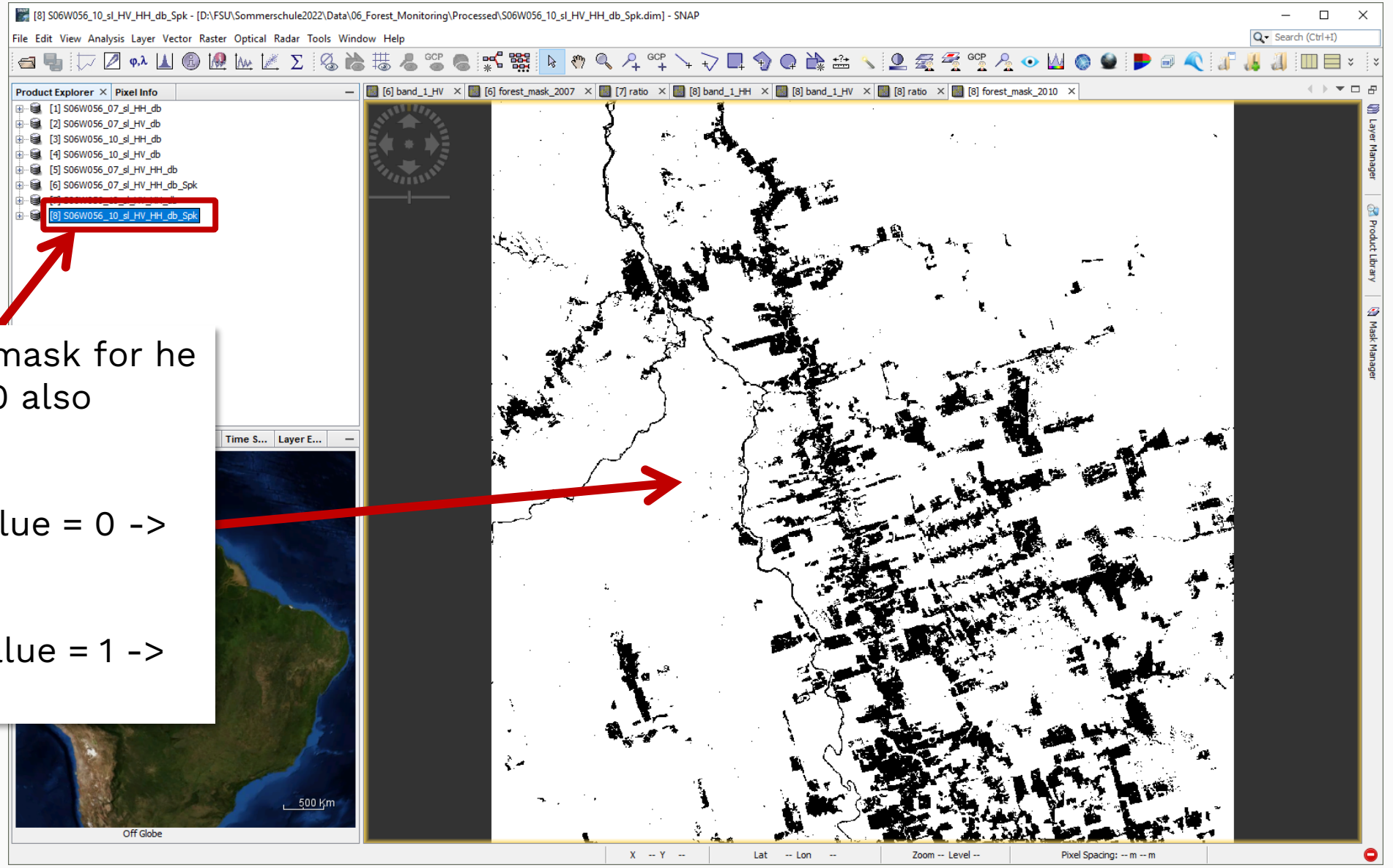
White pixels -> Pixel value = 1 -> forest area

Repeat these steps for the data set from the year 2010!

The forest-non-forest mask for he data from the year 2010 also contain:

Black pixels -> Pixel value = 0 -> non-forested area

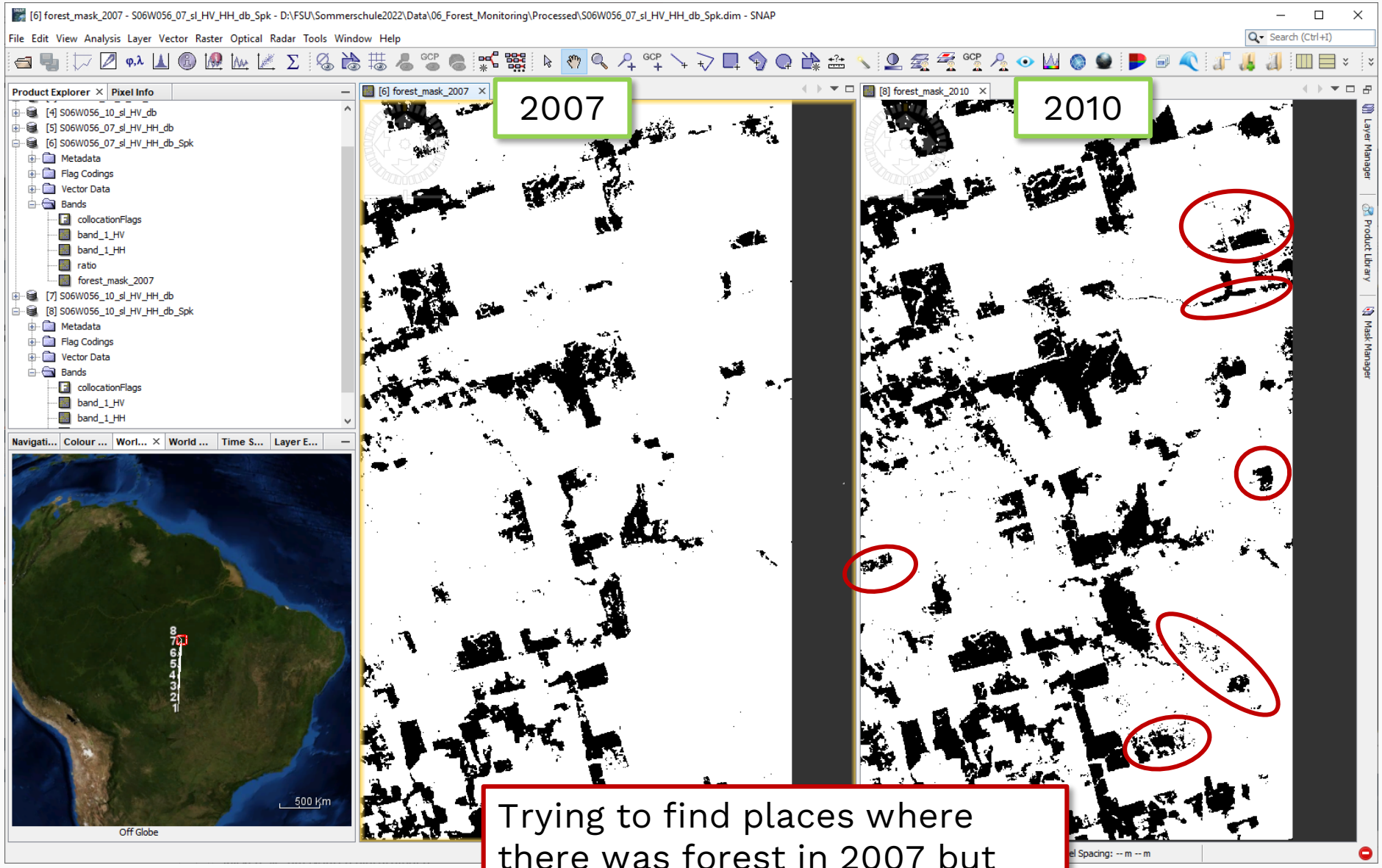
White pixels -> Pixel value = 1 -> forest area



Compare masks

Compare the masks from 2007 and 2010 using horizontal tiling!

See slides 10 - 12!

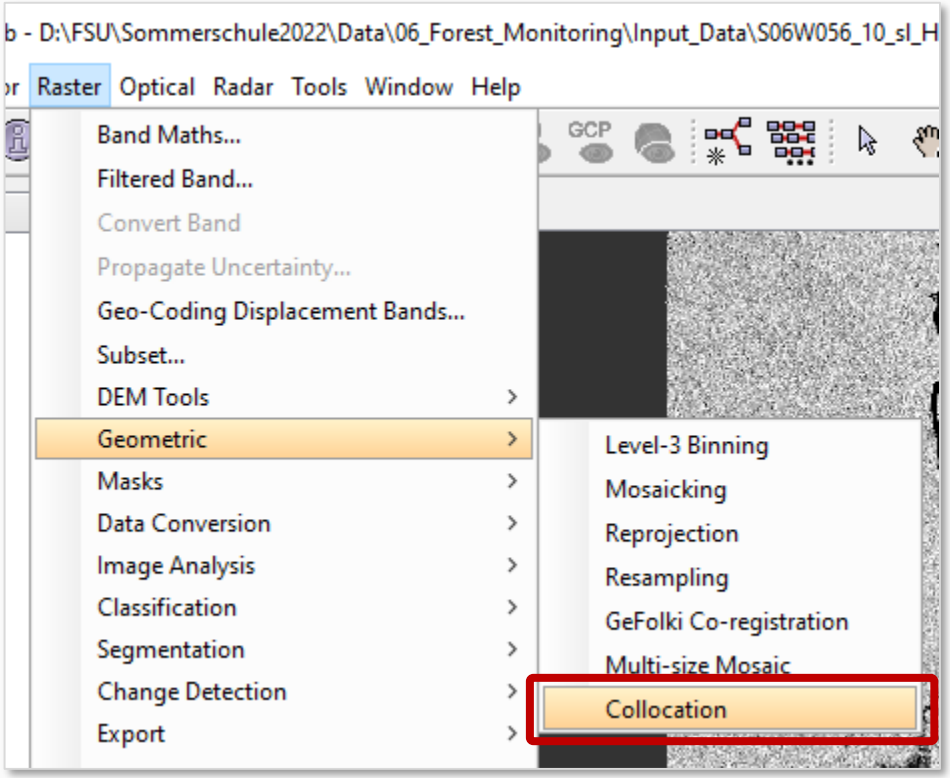


Trying to find places where there was forest in 2007 but not in 2010.

Create Layer Stack

To combine both speckle-filtered products with the forest-non-forest mask in one layer stack, we use the Collocation tool again.

From the menu, select “Raster” -> “Geometric” -> “Collocation”!



Create Layer Stack

1) As Source Product (Master), select speckle-filtered product containing data and mask for the year 2007!

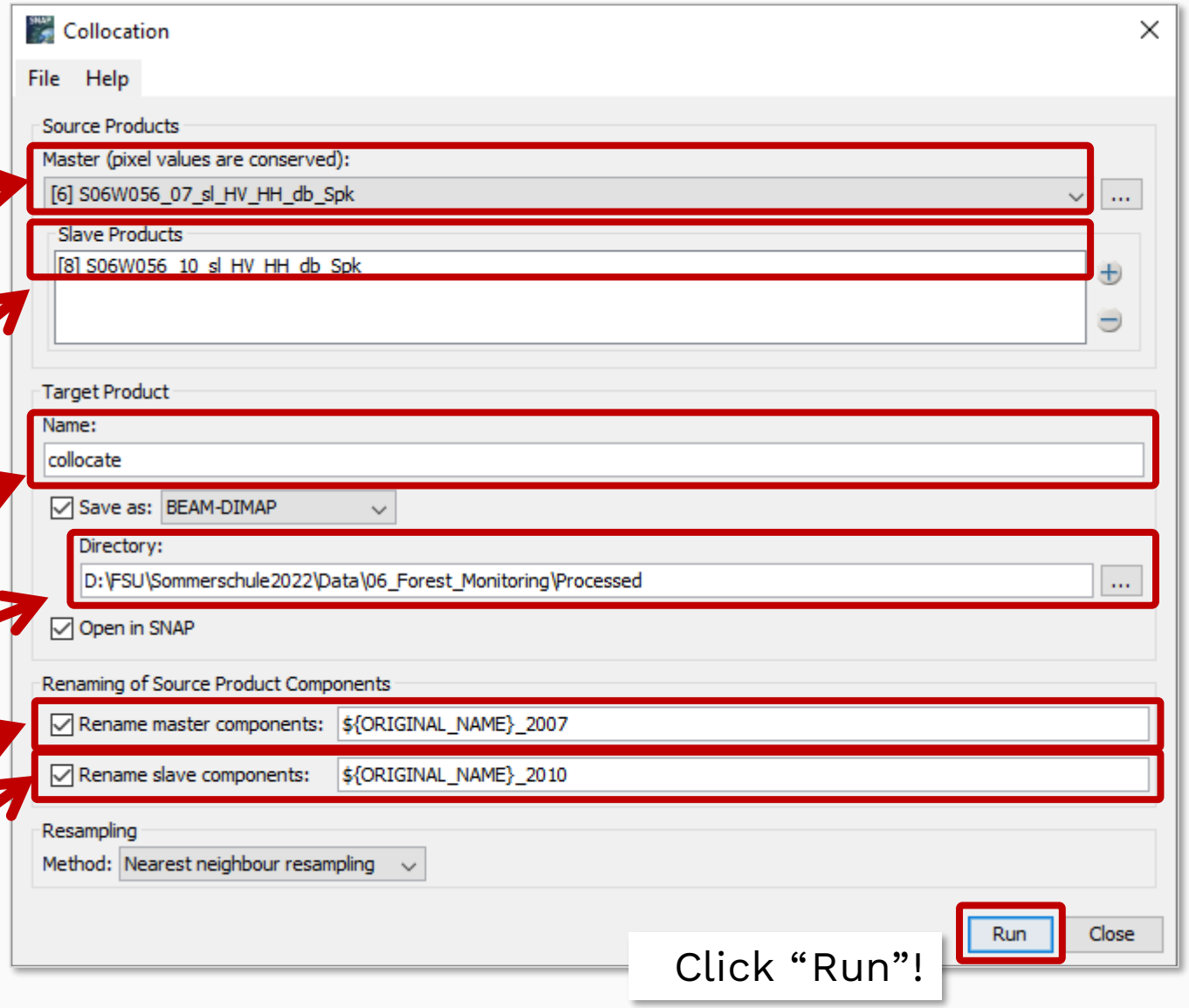
2) As Slave Product, select speckle-filtered product containing data and mask for the year 2010!

3) Specify the output name, e.g. “collocate”!

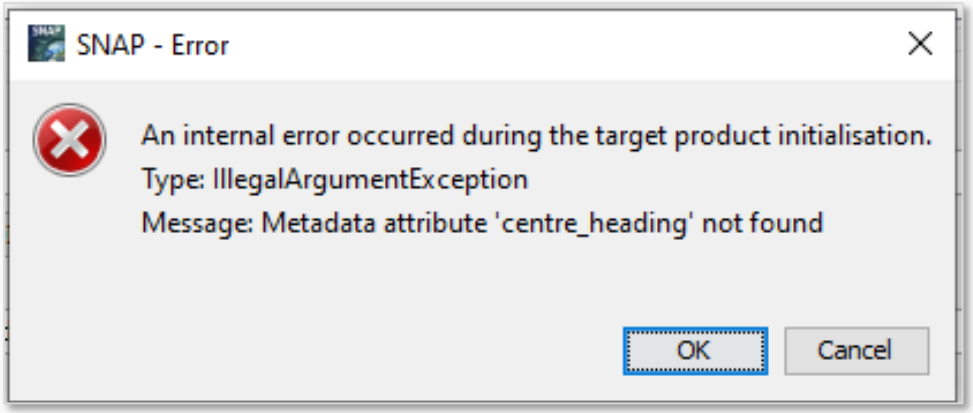
4) Specify the output directory!

5) Specify the master components name as “${ORIGINAL_NAME}_2007”!

6) Specify the master components name as “${ORIGINAL_NAME}_2010”!



Click “Run”!



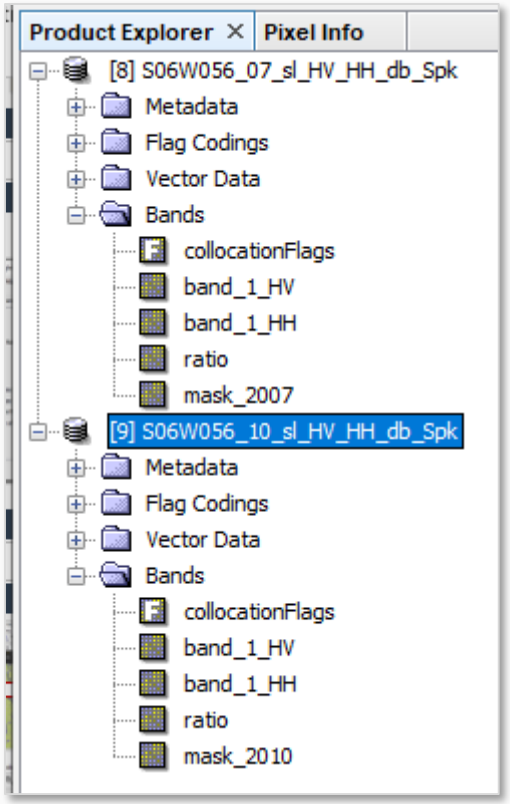
In SNAP 9 an error occurs at this stage of processing!

This was not the case for the last years version of SNAP, version 8. Most probably this will be fixed with on version-9 internal update.

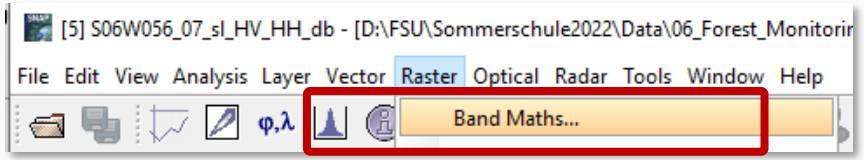
For the moment, we will show you a work-around in the next slides.

Create Layer Stack – Work Around

1) Select the speckle-filtered product with data and mask for the year 2010 in the Product Explorer!



2) Open the “Band Maths...“ tool



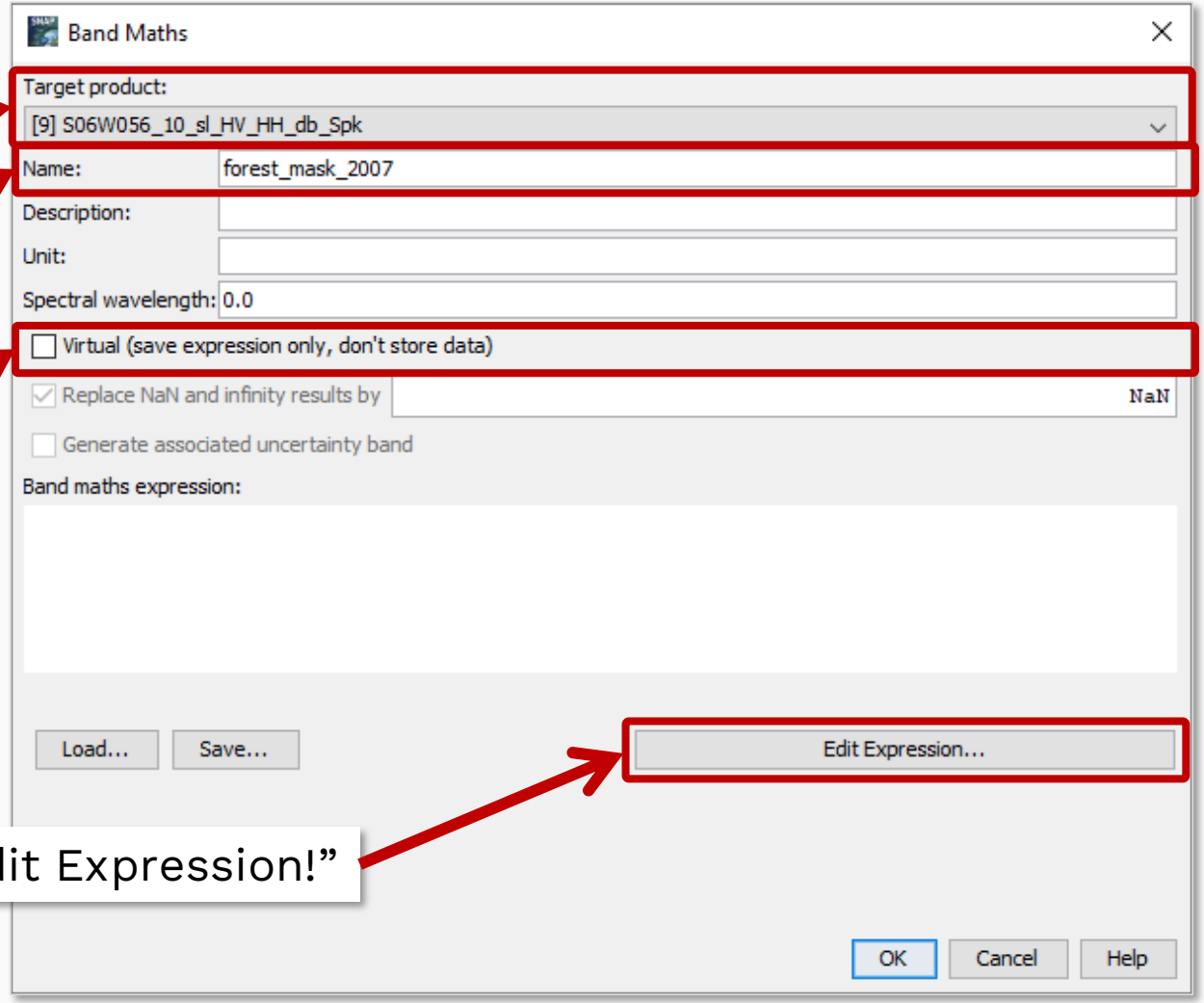
Create Layer Stack – Work Around

1) Target Product is 2010 data set

2) Enter new band name, e.g. “forest_mask_2007”!

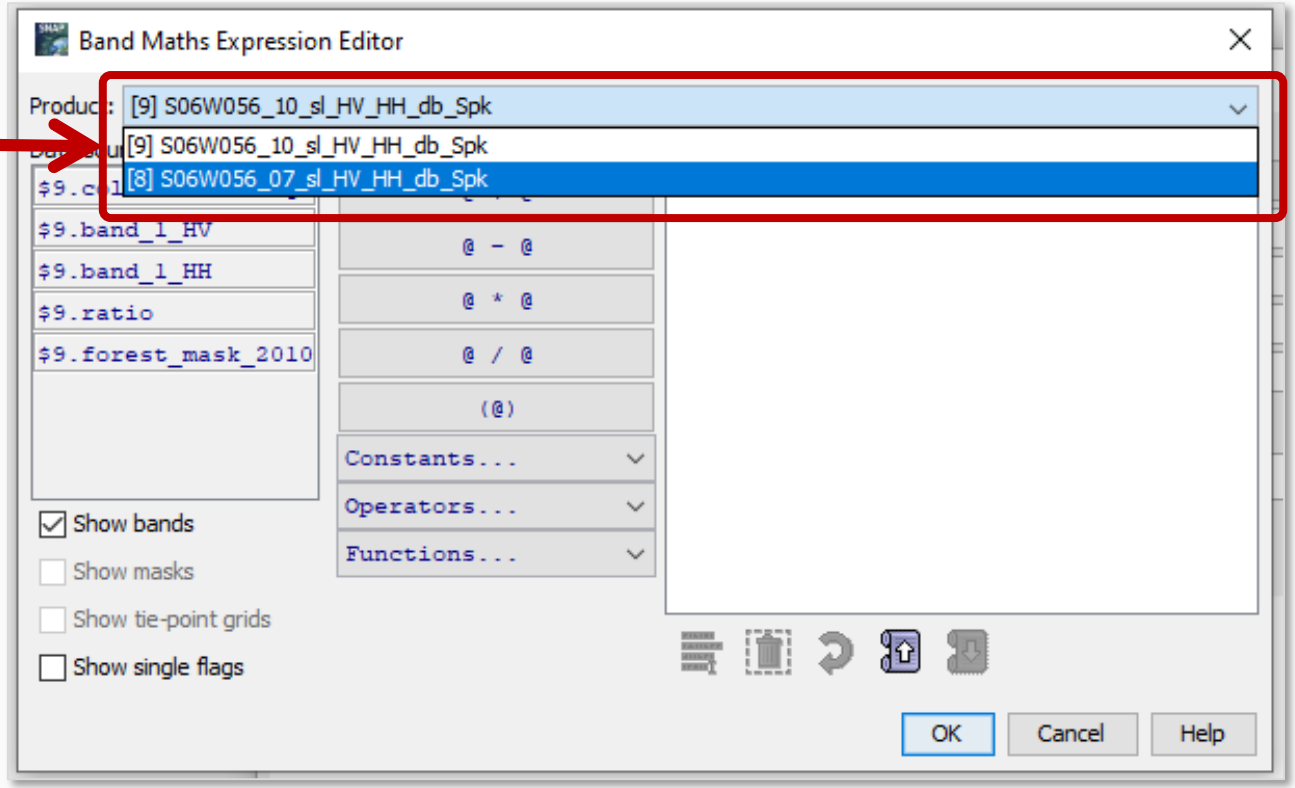
3) Untick this option!

4) Click at “Edit Expression!”



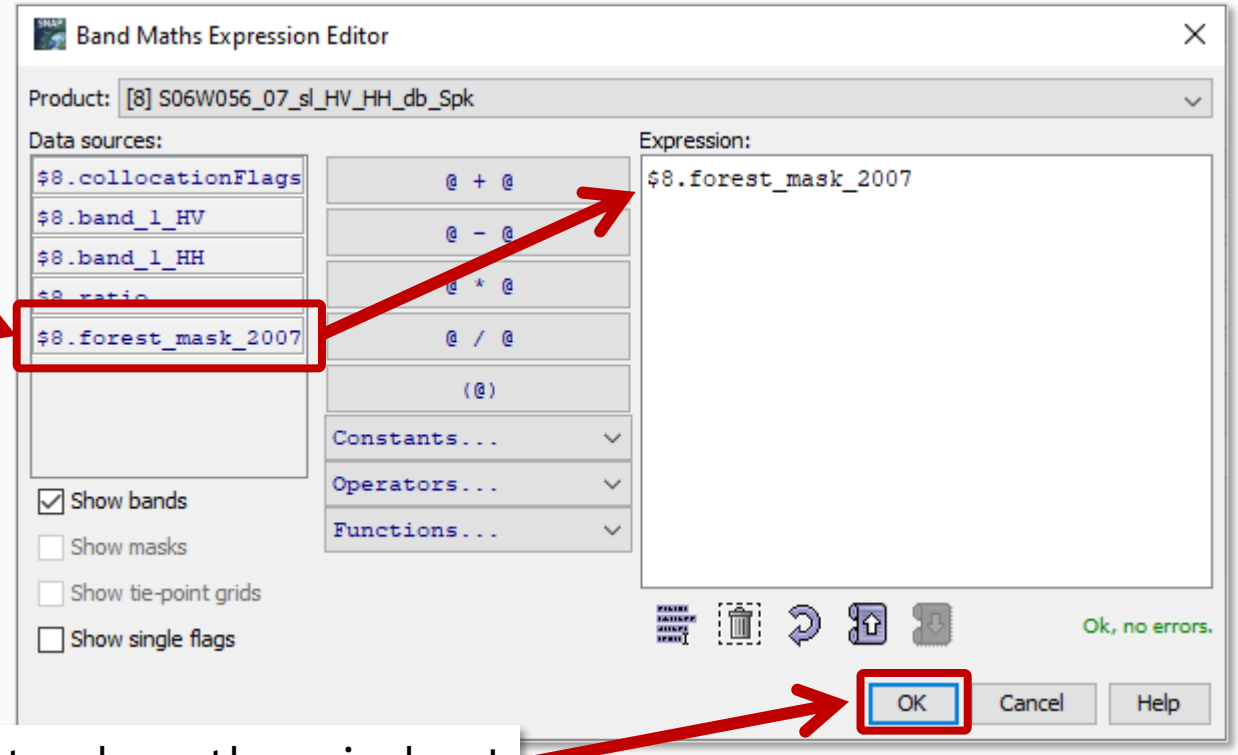
Create Layer Stack – Work Around

1) From the drop down menu, select the 2007 data set!



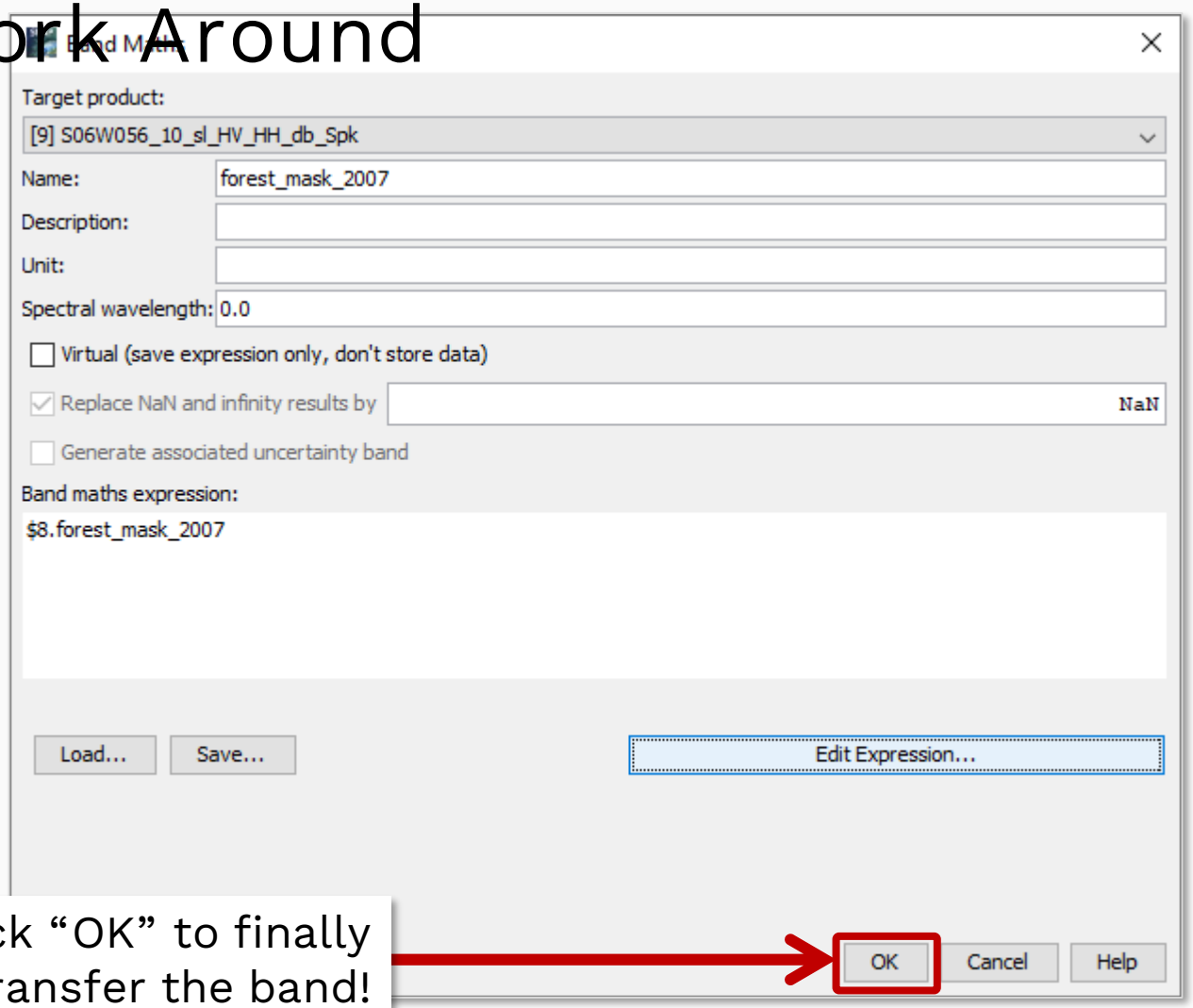
Create Layer Stack – Work Around

1) With a single mouse click at the entry $x.forest_mask_2007, this band is transferred to the Epression entry window.



Click “OK” to close the window!

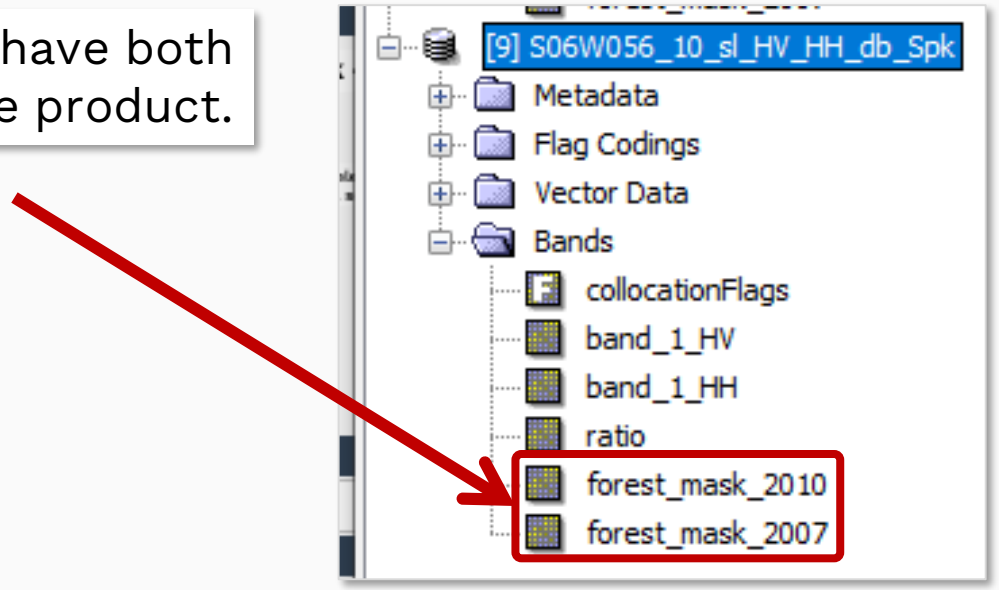
Create Layer Stack – Work Around



Click “OK” to finally transfer the band!

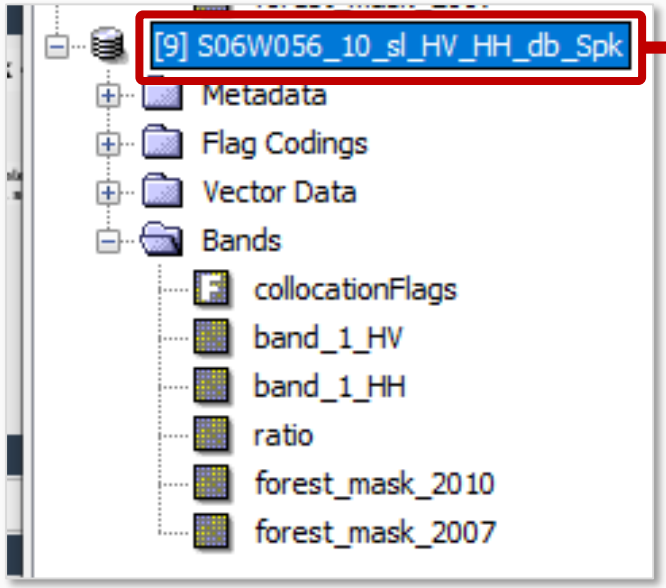
Create Layer Stack – Work Around

As a result, we now have both forest masks in one product.

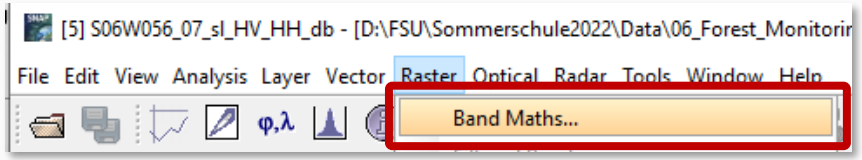


Create Forest Change Product

1) Select the 2010 product containing both forest masks (from the year 2007 and 2010)!



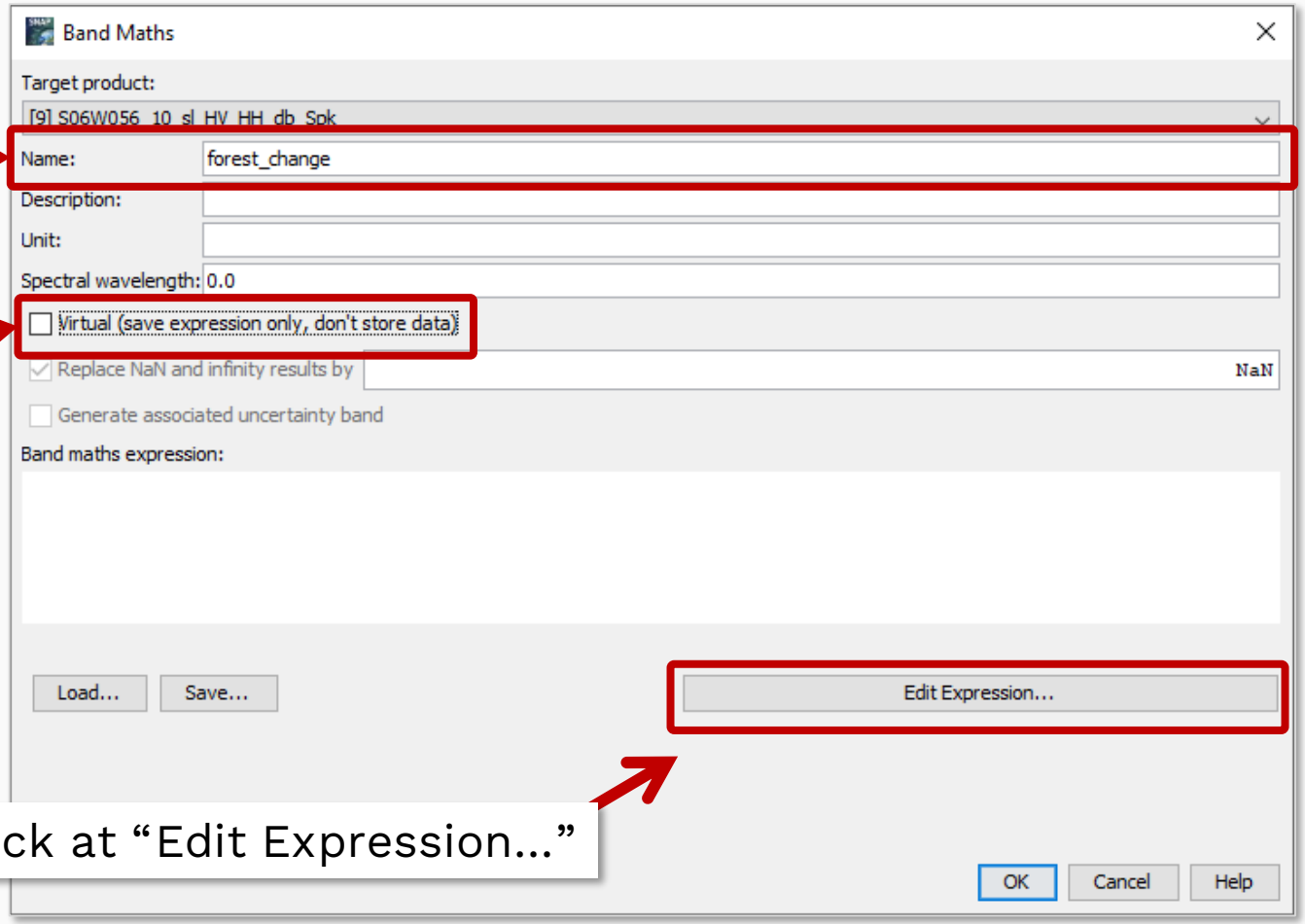
2) Open the “Band Maths...“ tool



Create Forest Change Product

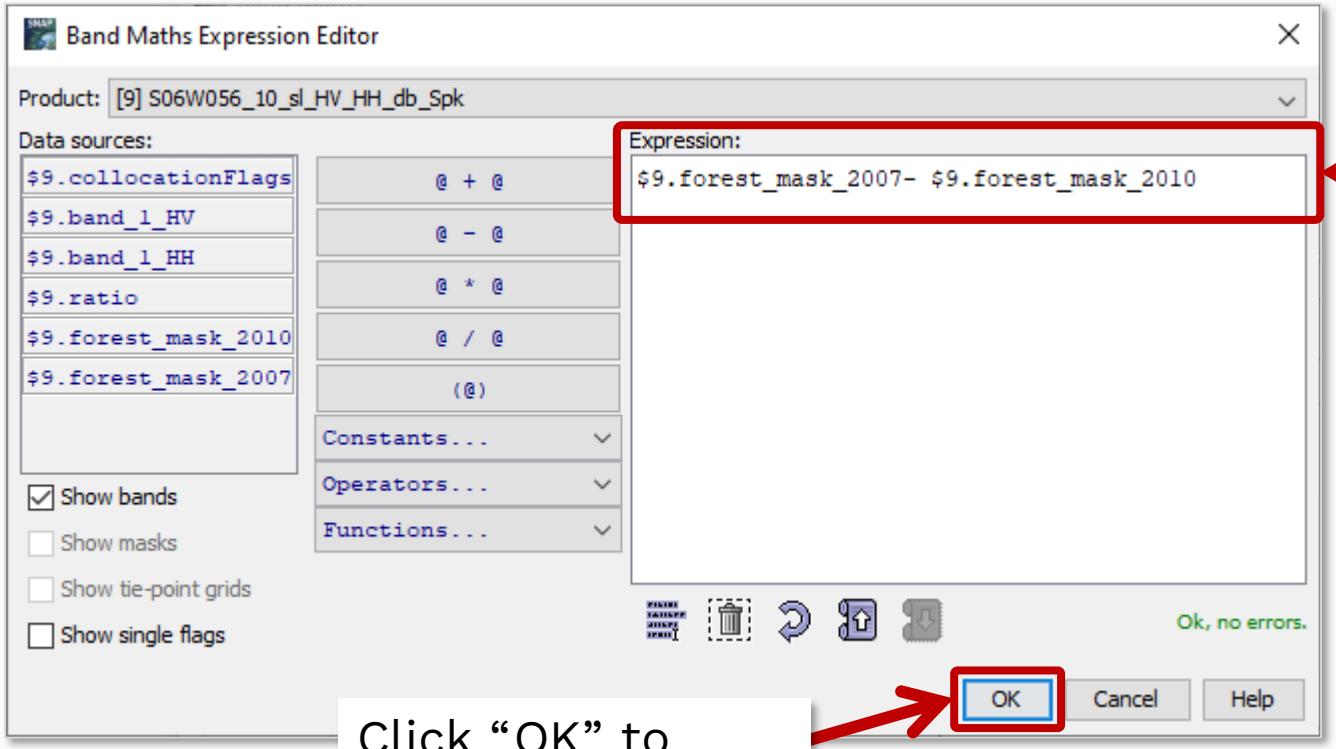
1) Enter name of new band, e.g. “forest_change”!

2) Untick this option!



3) Click at “Edit Expression...”

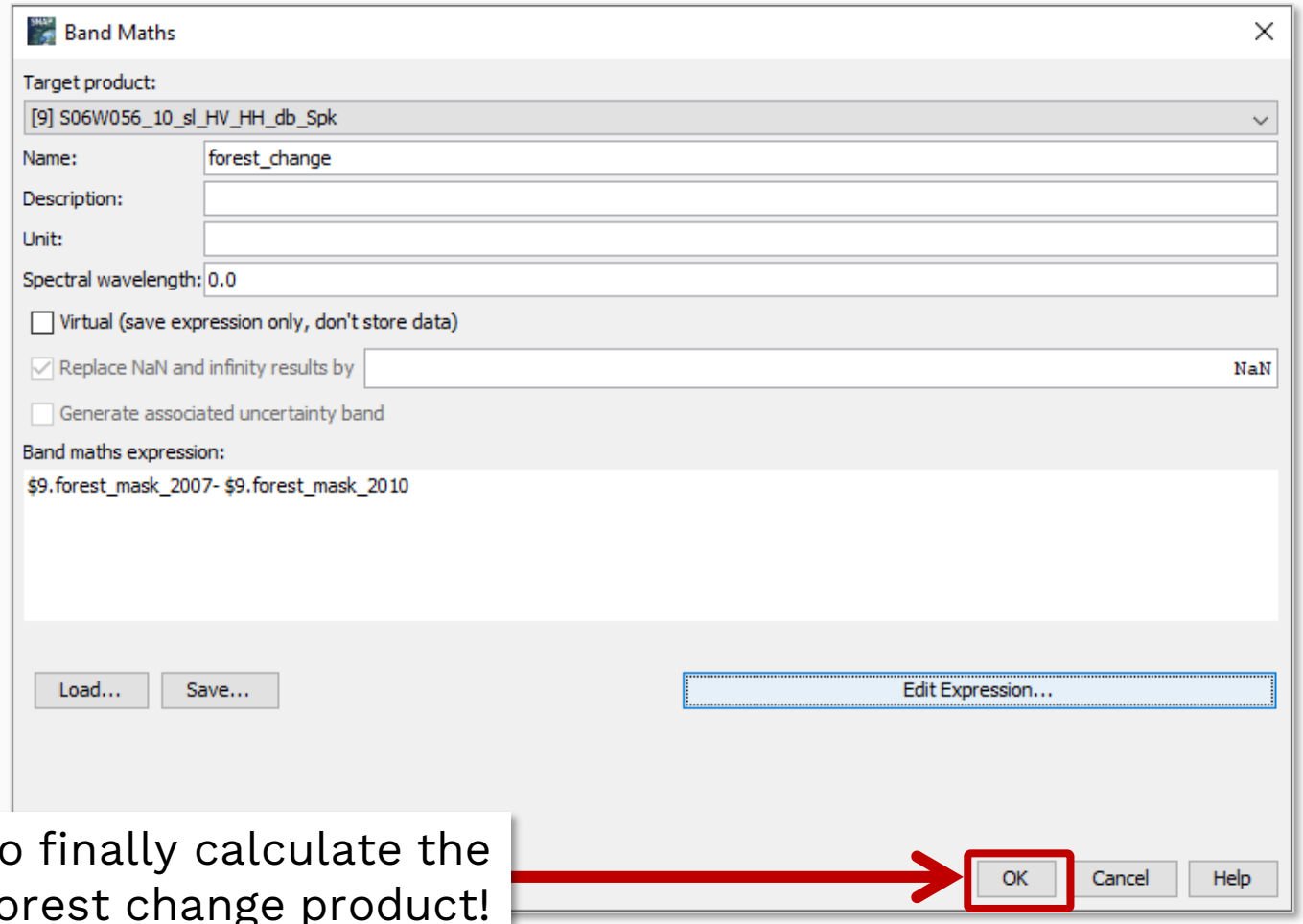
Create Forest Change Product



To calculate the forest change, subtract the 2010 forest-non-forest mask from the 2007 forest-non-forest mask!

Click “OK” to close the window!

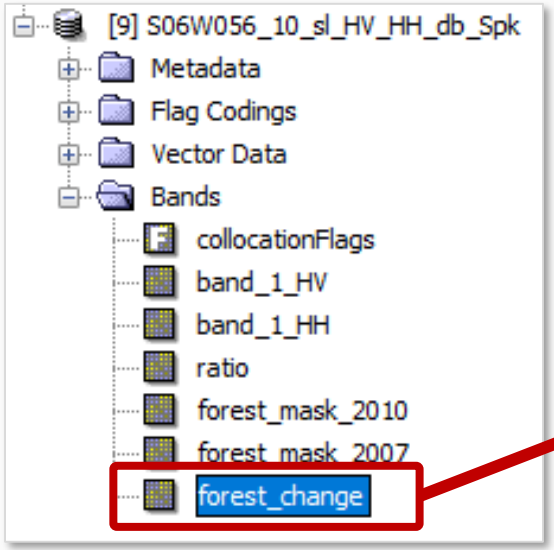
Create Forest Change Product

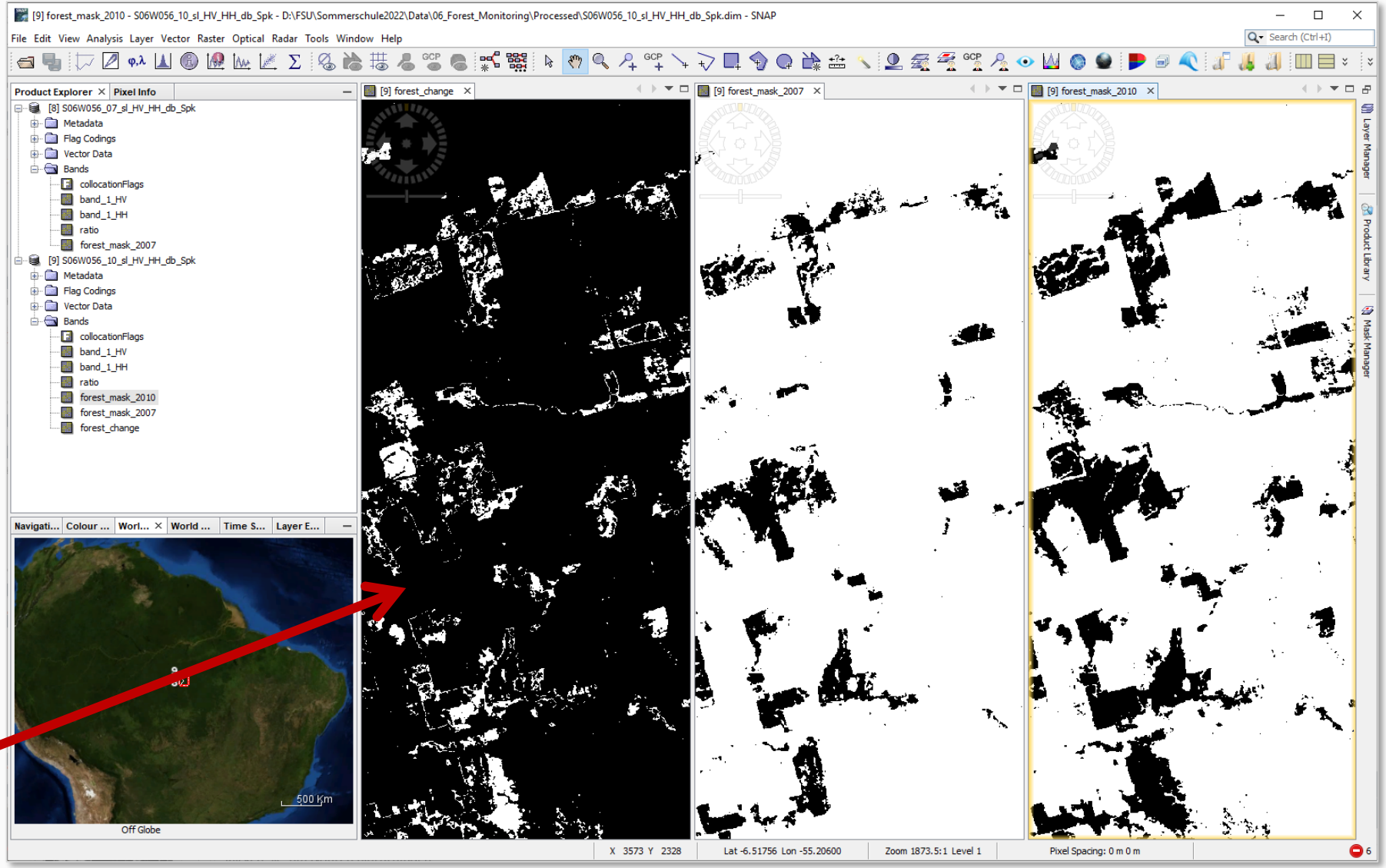


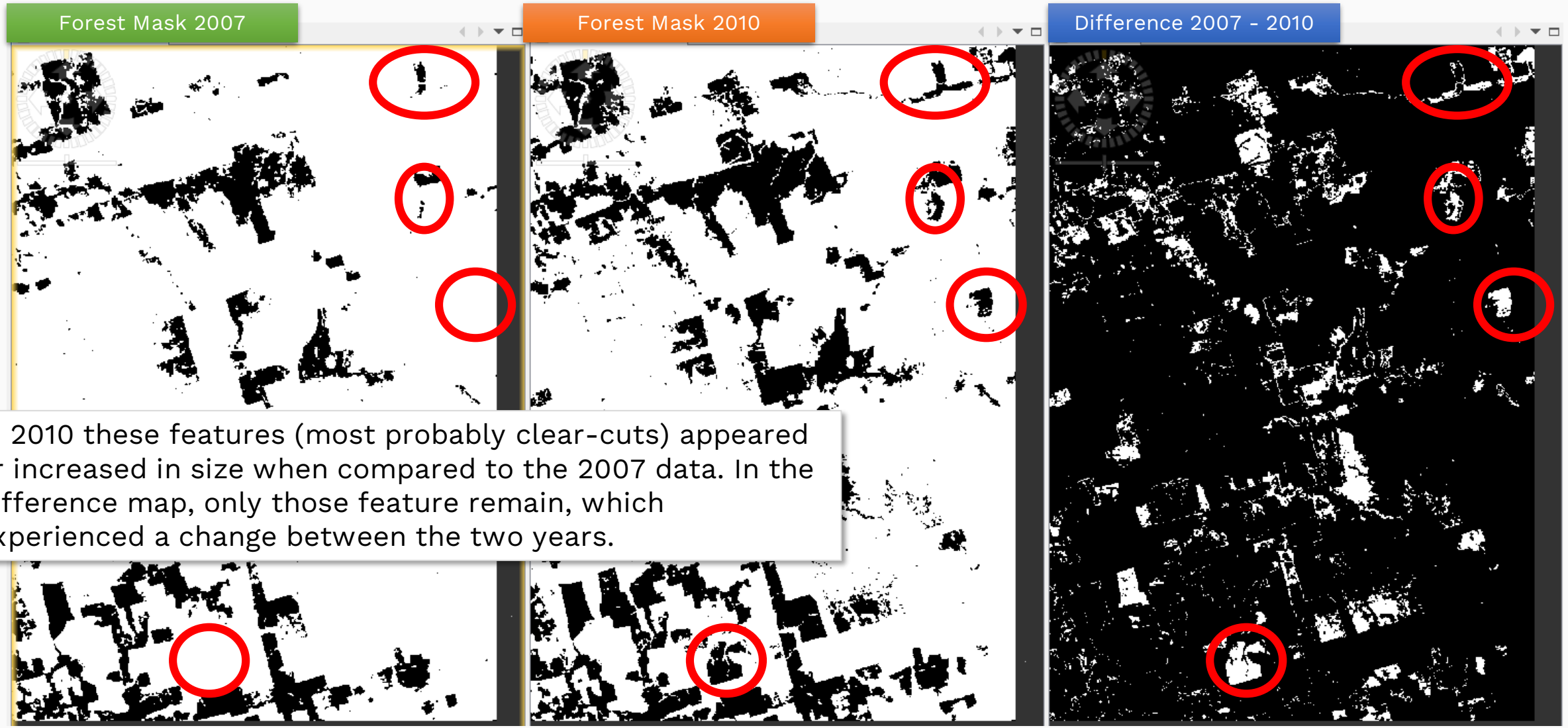
Click “OK” to finally calculate the forest change product!

Create Forest Change Product

As a result, we only get the areas where there was a change between 2007 and 2010.



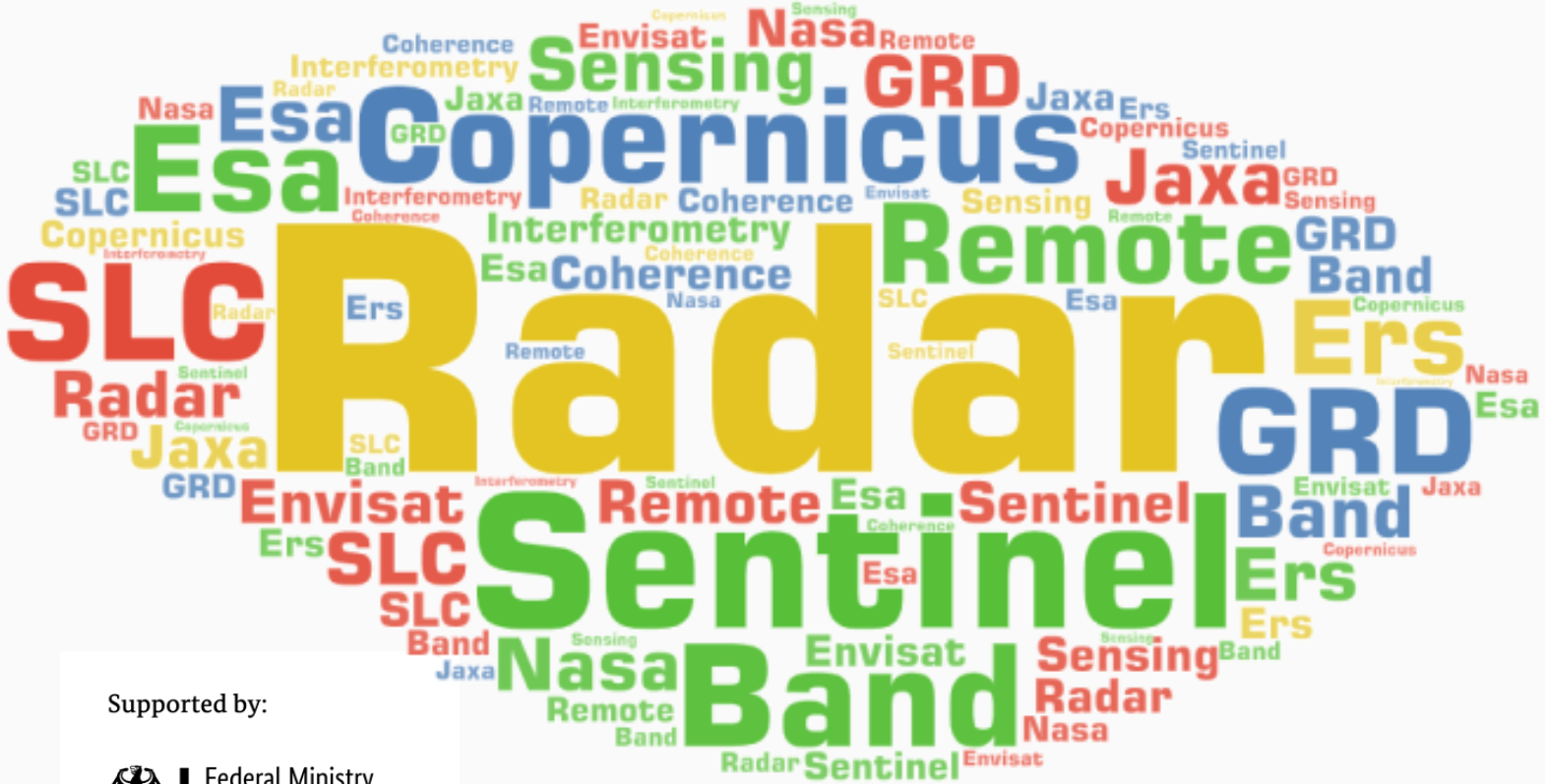




In 2010 these features (most probably clear-cuts) appeared or increased in size when compared to the 2007 data. In the difference map, only those feature remain, which experienced a change between the two years.

FRIEDRICH-SCHILLER-
UNIVERSITÄT
JENA

eo college



Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag