Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA
(RUDN University)

Institute of Environmental Engineering

COURSE SYLLABUS

GEOINFORMATICS FOR ENTERPRISE CARBON NEUTRALITY

Recommended by the Didactic Council for the Education Field of:
05.04.06 "Ecology and Nature Management"

The course instruction is implemented within the professional education programme of higher education:
Climate Projects Management

2025

1. COURSE GOAL(s)

The course is designed to provide knowledge on the application of basic GIS technologies to assess the environmental impacts of climate change.

To Know:

theoretical foundations of GIS technologies and geoinformatics; mechanisms and principles of obtaining remote sensing images, basic techniques for interpreting Earth remote sensing images;

Be able to:

- use methods of deciphering aerial and space images to solve practical climate problems; use GIS programs to solve practical problems;
- use spectral indices to solve practical problems;
- use spatial analysis of the territory to solve practical problems;

Own:

- skills in working with design and construction documentation;
- skills in working with regulatory documents

2. REQUIREMENTS FOR LEARNING OUTCOMES

The process of studying the discipline is aimed at the formation of the following competencies:

Competence code	Competence descriptor	Competence formation indicators
PC-6	Able to develop projects based on existing methods for solving geoinformation problems, use modern cloud services and analytical tools to update climate data	**PC-6.1** is able to perform GIS analysis to analyze and predict regional climate changes
		PC-6.2 has the skills to assess ecosystem services for climate regulation using remote sensing

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Course **Geoinformatics for Enterprise Carbon Neutrality** refers to the **Variable component** of the block 1 the curriculum.

Within the higher education programme students also master other disciplines (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course.

Table 3.1

The list of the higher education programme components that contribute to the achievement of the expected learning outcomes

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
PC-6	Able to develop projects based on existing methods for solving geoinformation problems, use modern cloud services and analytical tools to update climate data	No	Low-carbon Economy Ecosystem Services for Climate Change Mitigation Master's Thesis Defence

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the Course is **5** credit units.

Table 4.1. Types of academic activities during the period of the HE program(me) mastering

Types of academic activities		**Total hours**	**Semester(s)**			
			1	**2**	**3**	**4**
Contact academic hours						
Lectures		18		18		
Lab works						
Seminars (workshops/tutorials)		18		18		
Self-study		*117*		*117*		
Evaluation and assessment (exam; pass/fail grading)		*27*		*27*		
The total course workload	hours	**180**		**180**		
	credits	**5**		**5**		

5. COURSE CONTENT

Table 5.1. The content of the discipline (module) by type of educational work

Title of Course Modules	**Content**	**Types of academic activities**
Module 1. Introduction	Topic 1.1. Geoinformatics as a science. What is GIS. Classification of GIS.	L, S
	Topic 1.2. QuantumGIS interface, loading raster data, vector layers creation	L, S
	Topic 1.3. Raster operations. Vector operations	L, S
	Topic 1.4. Openstreetmaps, satellite images, georeferencing	L, S
Module 2. Basic principles of photointerpretation	Topic 2.1. Photointerpretation. photointerpretation signs. Features of recognition of artificial and natural objects	L, S
	Topic 2.2. Semi-automatic classification.	L, S
Module 3. Spectral indices	Topic 3.1. Data analysis with QGIS: variety of indices, their significance and practical application, NDVI calculation, Introduction to the QGIS raster calculator	L, S
	Topic 3.2. Landscape indices. Building index	L, S
Module 4 Enterprise Carbon Neutrality analysis methods	Topic 4.1. Vector analysis tools: random points layer creation, buffer zones.	L, S
	Topic 4.2. Vector analysis tools: spatial analysis, overlaying operations	L, S
	Topic 4.3. Raster analysis tools: interpolations. Classifications, complex methods.	L, S
	Topic 4.4. Cases: typical projects	L, S

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Classroom for Academic Activity Type	Classroom equipment	Specialized educational / laboratory equipment, software and materials for mastering the course (if necessary)
Lecture	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless Internet connection. Software: Microsoft Windows, MS Office / Office 365, MS Teams, Chrome (latest stable release), Skype. Microsoft Windows 7 corporate. License No. 5190227, date of issue March 16, 2010 MS Office 2007 Prof , License # 6842818, date of issue 09/07/2009
Seminars	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless	
For Self-Study	Classroom for self-study (can be used for seminars and consultations), equipped with a set of devices includes laptop, stable wireless.	No

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main reading:

1. Martin Wegmann, Jakob Schwalb-Willmann, Stefan Dech An Introduction to Spatial Data Analysis: Remote Sensing and GIS with Open Source Software (Data in the Wild) 1st Edition, Kindle Pelagic Publishing, 2020
2. E.O. Wilson, Dawn J. Wright, Christian Harder GIS for Science, Volume 3: Maps for Saving the Planet. Esri Press, 2021
3. Jindong Li Satellite Remote Sensing Technologies Springer, Singapore, Space Science and Technologies, 2021
4. Remote Sensing and Image Interpretation, 7th Edition, Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman
5. Ujaval Gandhi End-to-End Google Earth Engine (Full Course Material) A hands-on introduction to applied remote sensing using Google Earth Engine. https://courses.spatialthoughts.com/end-to-¶endgee.html

Additional reading:

1. Systems, ¶Publisher: Saylor Foundation https://open.umn.edu/opentextbooks/formats/24

Internet-based sources

1. ELS of RUDN University and third-party ELS, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System - RUDN EBS http://lib.rudn.ru/MegaPro/Web
- ELS "University Library Online" http://www.biblioclub.ru
- EBS Yurayt http://www.biblio-online.ru
- ELS "Student Consultant" www.studentlibrary.ru
- EBS "Lan" http://e.lanbook.com/
- EBS "Trinity Bridge"

2. Databases and search engines:

- electronic fund of legal and normative-technical documentation http://docs.cntd.ru/
- Yandex search engine https:// www .yandex.ru/
- Google search engine https://www.google.ru/
- abstract database SCOPUS http:// www .elsevierscience.ru/ products / scopus /

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL UPON COURSE COMPLETION

The assessment toolkit and the grading system to evaluate the level of competences (competences in part) formation as results of mastering the discipline are specified in the Appendix to the syllabus.

DEVELOPER:

Associate Professor of the EM Department		**Kapralova D.O.**
Position	Signature	Name, Surname

HEAD OF DEPARTMENT:

Director of the EM Department		**Kucher D.E.**
Position	Signature	Name, Surname

HEAD OF PROGRAMME:

Director of ES&PQM Department		**Savenkova E.V.**
Position	Signature	Name, Surname

Federal State Autonomous Educational Institution for Higher Education PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA (RUDN UNIVERSITY)

Institute of Environmental Engineering

ASSESSMENT TOOLKIT

Geoinformatics for Enterprise Carbon Neutrality

Recommended by the Didactic Council for the Education Field of:
05.04.06 "Ecology and nature management"

The course instruction is implemented within the professional education programme of higher education:

Climate Project Management

2025

Passport to Assessment Toolkit for Course Geoinformatics for Enterprise Carbon Neutrality

Education Field / Speciality 05.04.06 "Ecology and nature management"/ «Climate Project Management»
Course: Geoinformatics for Enterprise Carbon Neutrality

Competences (competences in part) under assessment	Course module under assessment	Course topic under assessment	Tools to assess higher education programme mastering level						Points for topic	Points for module
			Class work				Selfstudies	Exam/Pass-fail assessment		
			Oral/written survey	Test	Lab work topic	Lab work	Report			
PC-6	Introduction	Geoinformatics as a science. What is GIS. Classification of GIS.	0.5	1	QGIS interface	5		1	7.5	29,5
		QuantumGIS interface, loading raster data, vector layers creation	0.5	1	Working with raster images	5		2	8.5	
		Raster operations. Vector operations.	0.5	1	Working with vector images	5		1	6.5	
		Openstreetmaps, satellite images, georeferencing	1	1	Thematic maps	5		1	6.5	
PC-6	Basic principles of photointerpretation	Photointerpretation. photointerpretation signs. Features of recognition of artificial and natural objects	2	1	Recognizon natutal objects from artificial	5		2	10	10

PC-6	Spectral indices	Data analysis with QGIS: variety of indices, their significance and practical application, NDVI	1	1	Vegetation indices, water indices.	5		2	9	17
		calculation, Introduction to the QGIS raster calculator			NDVI computing and interpretation					
		Landscape indices. Building index	1	1	Building index, oil spill index	5		1	8	
PC-6	Enterprise Carbon Neutrality analysis methods	Vector analysis tools: random points layer creation, buffer zones.	0.5	1	Industry Ecological footprint assessment with GIS	10		1	12.5	44.5
		Vector analysis tools: spatial analysis, overlaying operations,	1	1	Intersection, difference	5		2	9	
		Raster analysis tools: interpolations. Classifications, complex methods.	1	1	Cluster analysis, water flow maps	5		2	9	
		Cases: typical projects	1		Land surface temperature assessment Network analysis	10		1	14	
			10	**10**		**65**		**15**		**100**

Course Geoinformatics for Enterprise Carbon Neutrality

QUESTION CARD No 1

QUESTION 1. Building index, oil spill index
QUESTION 2. Land surface temperature assessment
3 * …….

Developer_____(Kapralova Daria)
signature

Head of Educational Department_____(Kutcher Dmitryi)
signature

_____
day, month, year

Note * Practice case/task inclusion is subject to the teacher's discretion.

The set of exam question cards is complemented by the assessment criteria developed by the teacher and approved at the department meeting.

Assessment criteria:
(*in compliance with the legal regulations in force*)

EXAM QUESTIONS

1. QGIS interface
2. Working with raster images
3. Working with vector images
4. Thematic maps
5. Recognizon natutal objects from artificial
6. Vegetation indices, water indices. NDVI computing and interpretation
7. Building index, oil spill index
8. Industry Ecological footprint assessment with GIS
9. Intersection, difference
10. Cluster analysis, water flow maps
11. Land surface temperature assessment
12. Network analysis
13. What is Geoinformatics? What is GIS
14. Types of GIS
15. Raster and vector data in GIS
16. Data for GIS. Types of errors in GIS
17. Spatial analysis in GIS
18. Temporal analysis in GIS
19. GIS for climate change analysis
20. What are the main advantages of using remote sensing
21. Describe the main stages in the development of remote sensing technology. Name the main trends in the development of remote sensing technology.
22. Describe the steps involved in remote sensing and data analysis.
23. What are the transparency windows of the earth's atmosphere?
24. What are the main characteristics of remote sensing data?
25. How is computer interpretation of images made?
26. Describe the steps for interpretation of images.

27. What is the purpose of interpretation of images?

28. What are interpretation signs? What kind of signs do you know?
29. What equipment is used for interpretation?
30. What are the automated interpretation methods?
31. What is image correction and restoration used for?
32. What is the difference between improving the visual perception of pictures and image conversion? What are they used for?
33. Direct photointerpretation signs.
34. Factors affecting the tone (brightness) of the image.
35. Calculating the size of an object from its shadow.
36. Ways to determine the scale of the image.
37. Types of object shape.
38. Classification of objects by image contrast.
39. The concept of the structure of the image. Structure types.
40. The concept of image texture. Image texture types.
41. Generalization during decryption.
42. Application of Earth remote sensing data for climate change assessment 43. Name the groups of decryption features.
44. On identifying what patterns is the use of indirect decoding signs based?
45. What is the object of landscape mapping?
46. The concept of remote sensing.
47. Satellites for remote sensing.
48. Active remote sensing
49. Passive remote sensing.
50. Spectral, spatial, radiometric resolution.
51. Vegetation indices.
52. Landscape indices.
53. The main technical factors influencing the information content of satellite images are 54. LST what is it
55. In what areas can remote sensing data be used?
56. How is the area under crops can be estimated?
57. How can remote sensing data be used to study urban growth?
58. How can remote sensing data be used to study landfills and illegal dumps?
59. How remote sensing can be used to prevent and combat consequences of emergencies?
60. In what main areas are remote sensing data used in solving problems of assessing natural resources and the environment?
61. Name the applied tasks that can be attributed to the tasks of detection and control of emergency situations.
62. What are the requirements for software solutions in the field of remote sensing of the Earth?
63. What is cluster analysis? How it can be computed with GIS?

Tentative list of assessment tools

No	Assessment tool	Brief features	Assessment tool representation in the kit
		Class work	
1	Survey/Quiz	A tool of control, organised as a special conversation between a teacher and students on topics related to the course under study, and designed to clarify the amount of students' knowledge in a particular section, topic, problem, etc.	Questions on the course topics /modules
2	Test	A system of standardized tasks that allows the teacher to automate the procedure for measuring the student's level of knowledge and skills	Tests bank
3	Control work	A tool of control organized as a classroom lesson, at which students need to independently demonstrate the acquisition and mastering of the educational material of the course topic, section, or sections.	Questions on the course topics /modules
4	Round table, discussion, polemic, dispute, debate, (class work)	Evaluation tools that allow the teacher to engage students in the process of discussing controversial issues, problems and assess their ability to argue their own point of view.	List of themes for round tables, discussions, polemics, disputes, debates.
5	Business game and/or role play	Joint activities of a student group under the teacher's control to solve educational and professionally oriented tasks through the simulation of a real-world problem; this activity allows the teacher to assess the students' ability to analyze and solve typical professional challenges.	Topic (problem), concept, roles and expected results for each game
6.	Presentation (defense) of project/report/ Library research paper /briefs *	A tool for monitoring the students' ability to present the work results to the audience.	Themes for projects/reports/ Library research paper/ briefs
7	Pass/Fail assessment	A tool for checking the quality of students' performance of laboratory work, acquisition and mastering of the practice training and seminar educational material, successful completion of the advanced field internship and pre-graduate internship and fulfillment of all training assignments in the course of these internships in accordance with the approved programme.	Tasks examples

8	Exam	The evaluation of the student's work during the semester (year, the entire period of study, etc.); it is designed to identify the level, soundness and systematic nature of theoretical and practical knowledge gained by the student, formation of independent work skills, development of creative thinking, ability to synthesize the acquired knowledge and apply it to solve practice tasks.	Examples of tasks/questions/exam question cards

9	Case	A problem-solving task in which the student is asked to comprehend the real work-related (occupational) situation necessary to solve the problem.	Assignments to solve the case
10	Multi-level tasks and assignments with varying difficulty	The tasks and assignments differ in terms of the following levels: a) reproductive level allows the teacher to evaluate and diagnose the students' knowledge of factual material (basic concepts, algorithms, facts) and the students' ability to correctly use special terms and concepts, recognize objects of study within a certain section of the discipline, b) reconstructive level allows the teacher to evaluate and diagnose the students' abilities to synthesise, analyse, generalise factual and theoretical material and formulate specific conclusions, establish cause-and-effect relationships, c) creative level allows to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view.	Set of multi-level tasks and assignments with varying difficulty
Self- studies			
1	Calculation and graphic work	A tool for checking students' skills in applying the acquired knowledge according to a predetermined methodology in task solving or fulfilling assignments for a module or discipline as a whole.	Set of tasks for calculation and graphic work
2	Course work/project	A type of independent written work aimed at the creative development of general professional and specialised professional disciplines (modules) and the development of relevant professional competences	Course assignment themes
3	Project	The final "product" that results from planning and performance of educational and research tasks set; it allows the teacher to assess the students' ability to independently shape their knowledge in the course of solving practice tasks and problems, navigate in the information environment and the students' level of analytical, research skills, skills of practical and creative thinking; it can be implemented individually or by a group of students.	Themes for team-based or individual projects

4	Reports, briefs	The product of the student's independent work, which is a public performance on the presentation of the results of solving a specific educational, practical, research or scientific topic.	Themes for reports, briefs
5	Standard calculations	A tool to test skills in applying the acquired knowledge, according to a predetermined methodology, solving tasks or fulfilling assignments for a module or discipline as a whole.	Set of tasks for standard calculations

6	Homework	The tasks and assignments differ in terms of the following levels: a) reproductive level allows the teacher to evaluate and diagnose the students' knowledge of factual material (basic concepts, algorithms, facts) and the students' ability to correctly use special terms and concepts, recognize objects of study within a certain section of the discipline, b) reconstructive level allows the teacher to evaluate and diagnose the students' abilities to synthesize, analyze, generalize factual and theoretical material and formulate specific conclusions, establish cause-and-effect relationships, c) creative level allows the teacher to evaluate and diagnose students' skills to integrate knowledge of various fields, argue their own point of view.	Set of multi-level tasks and assignments with varying difficulty

Department of Environmental Management

Set of assignments for control work

for the course Geoinformatics for Enterprise Carbon Neutrality

Three basic functions that natural capital performs;

1) ecosystem, aesthetic, informational
2) ecosystem, stimulating, controlling
3) resource, ecosystem, aesthetic d. resource, ecosystem, stimulating

The main technical factors affecting the information content of satellite images are

1) Composition of the atmosphere
2) Used equipment
3) Origin of satellite
4) Orbit type (or flight altitude)
5) Presence of clouds
6) Shooting season

Spectral indices

1) - They are selected empirically.
2) - They are calculated based on the characteristics of vegetation 3) - Table values

Supervised classification is

1) Operator training
2) Classify objects within the image
3) Select training samples and classify your image based on your chosen samples

Photointerpretation is:

1) Measuring objects in an image
2) Studying a Snapshot
3) Image interpretation
4) Image recognition using special equipment

Atmospheric windows are

1) Parts of the electromagnetic spectrum that are not absorbed by the atmosphere
2) Parts of the electromagnetic spectrum that are absorbed by the atmosphere
3) Parts of the electromagnetic spectrum that the atmosphere reflects
4) Territories of countries over where satellites can shoot

Assessment criteria:

(in compliance with the legal regulations in force)

Department of Environmental Management

Set of tasks for calculation and graphic work, simulator training

for the course Geoinformatics for Enterprise Carbon Neutrality

Task (assignment) 1 QGIS interface
Task (assignment) 2 Working with raster images
Task (assignment) 3 Working with vector images
Task (assignment) 4 Thematic maps
Task (assignment) 5 Recognizon natutal objects from artificial
Task (assignment) 6 Vegetation indices, water indices. NDVI computing and interpretation
Task (assignment 7) Building index, oil spill index
Task (assignment 8) Industry Ecological footprint assessment with GIS
Task (assignment 9) Intersection, difference
Task (assignment 10) Cluster analysis, water flow maps
Task (assignment 11) Land surface temperature assessment
Task (assignment 12) Network analysis

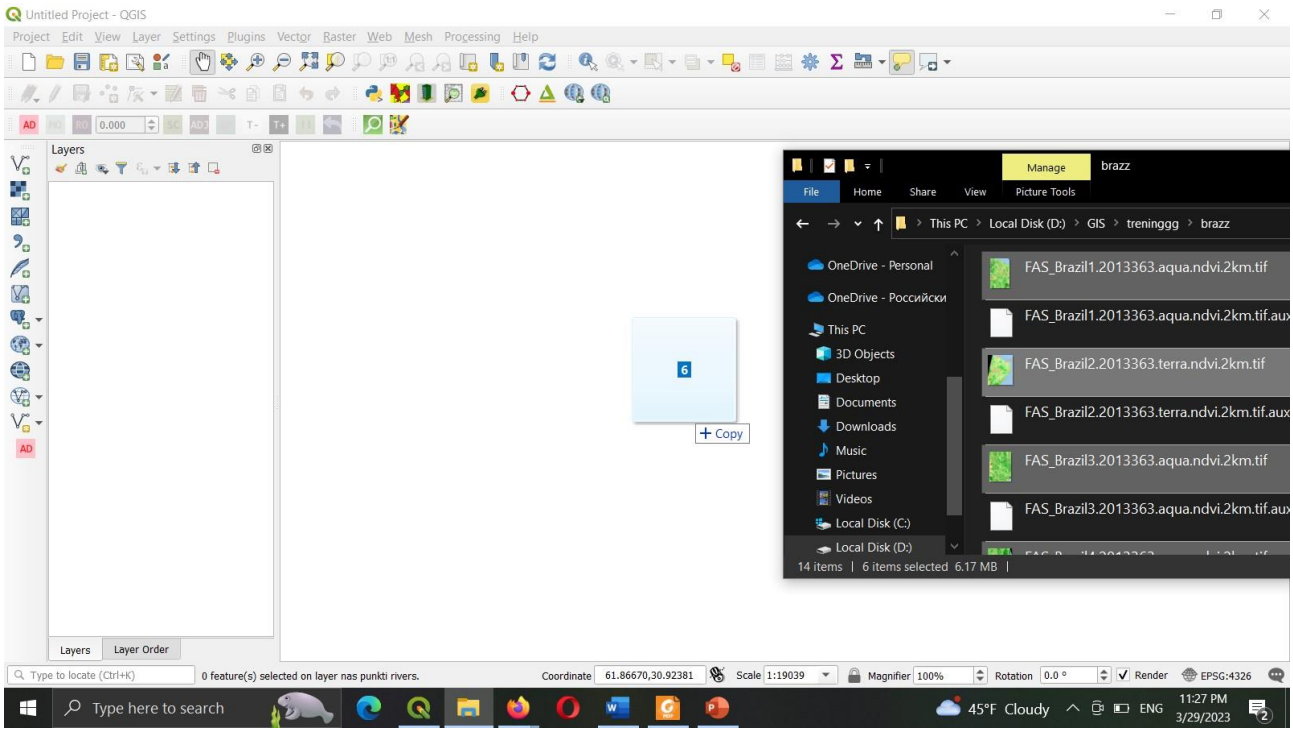
Assessment criteria:
(in compliance with the legal regulations in force)

Examples of the task for calculation and graphic work, simulator training

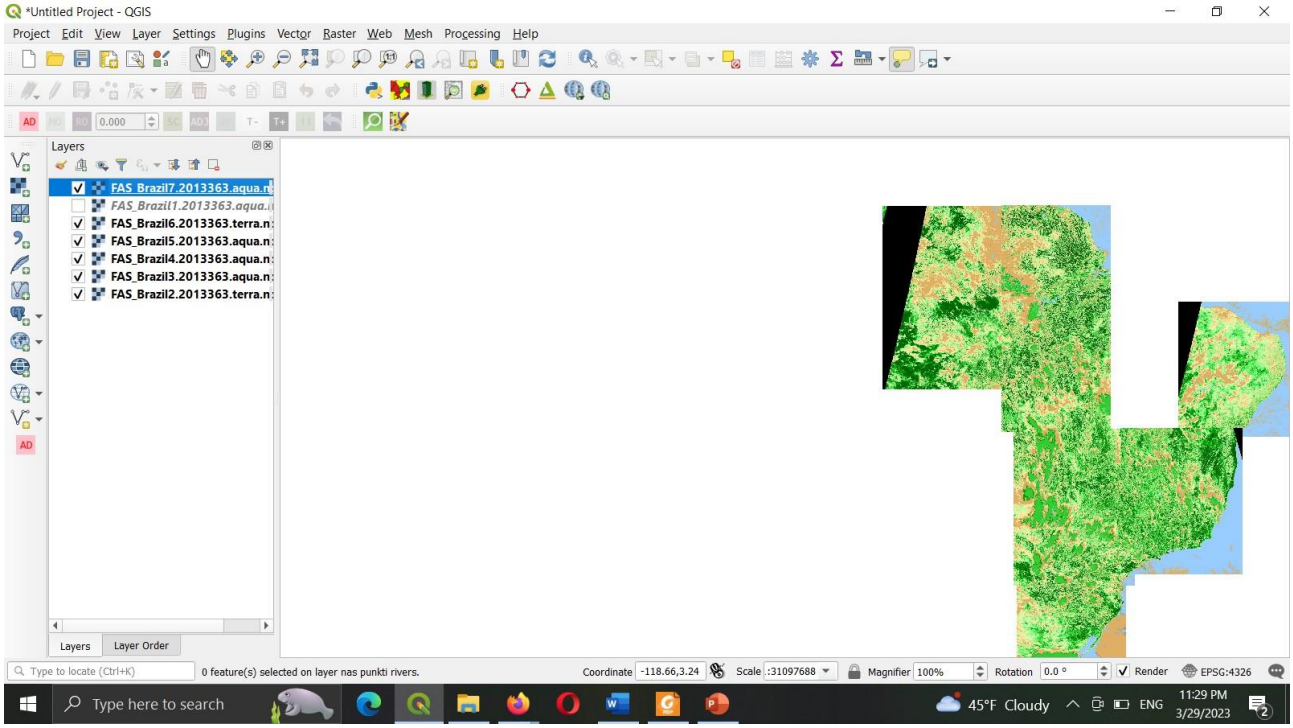
Task (assignment) 2 Working with raster images

Simple Raster operations

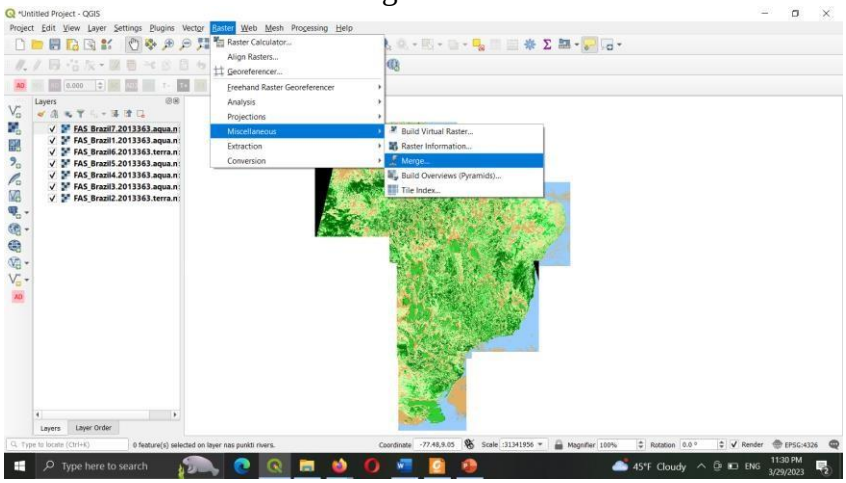
Download the 7 raster files

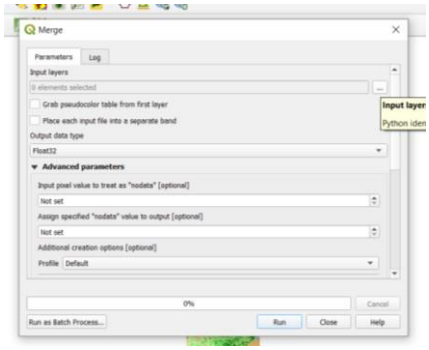


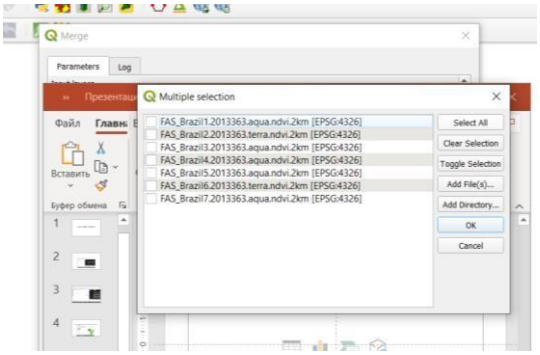
7 files create the picture of the country. But they are separate. You may switch off them one by one

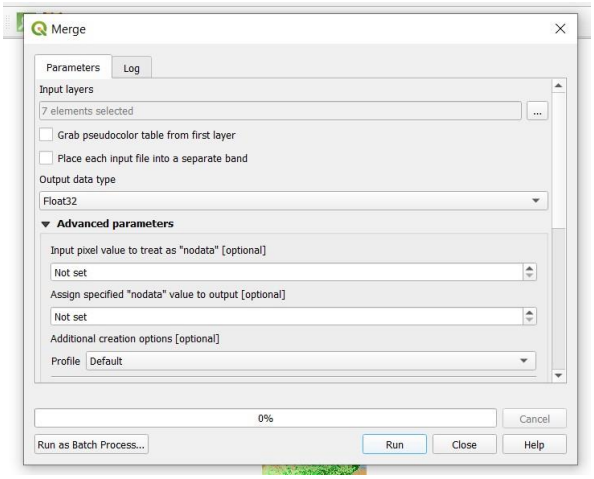


We will make one united image

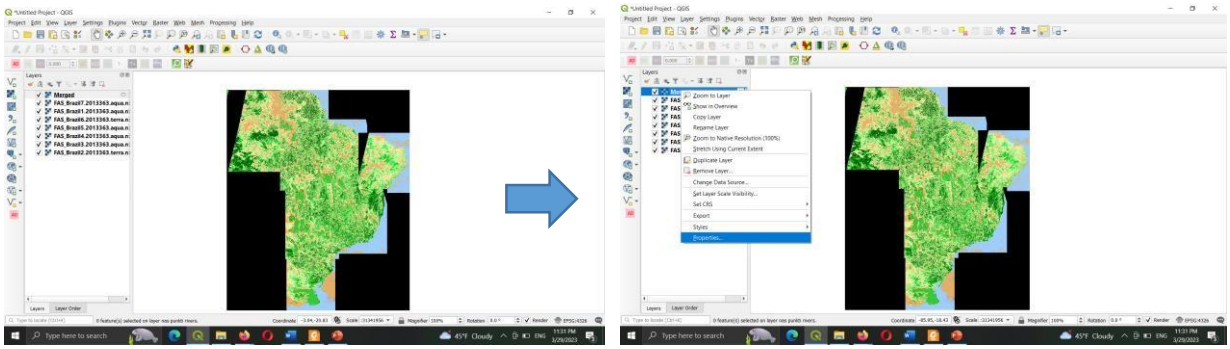


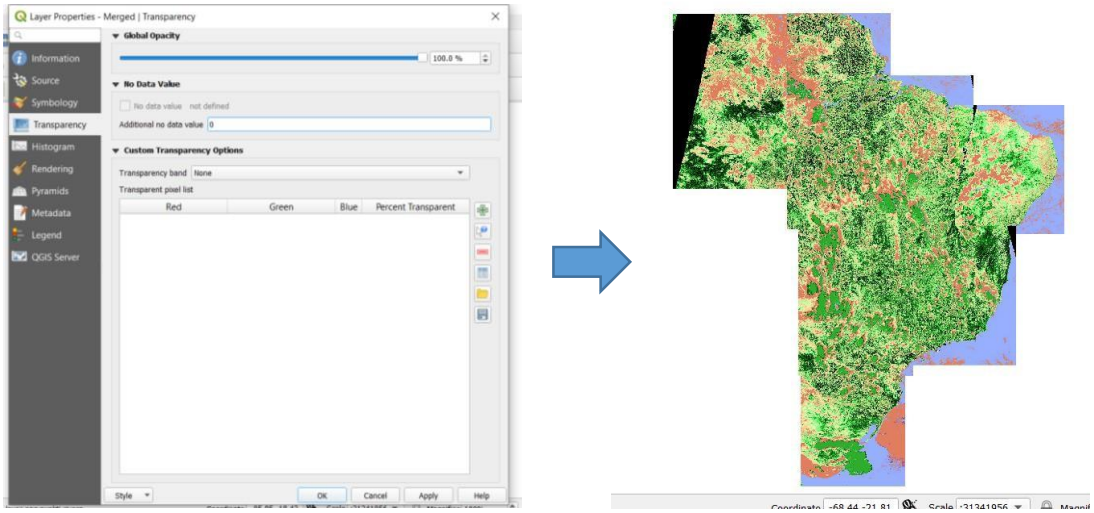




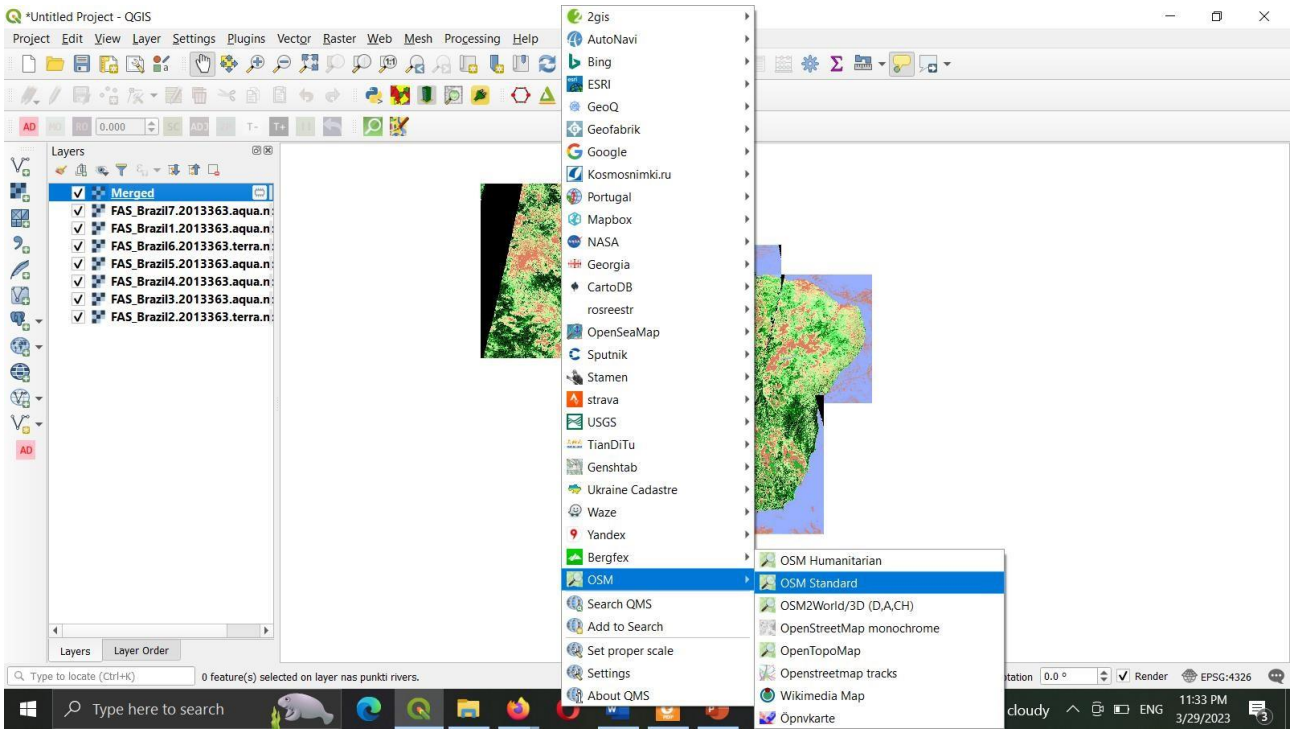


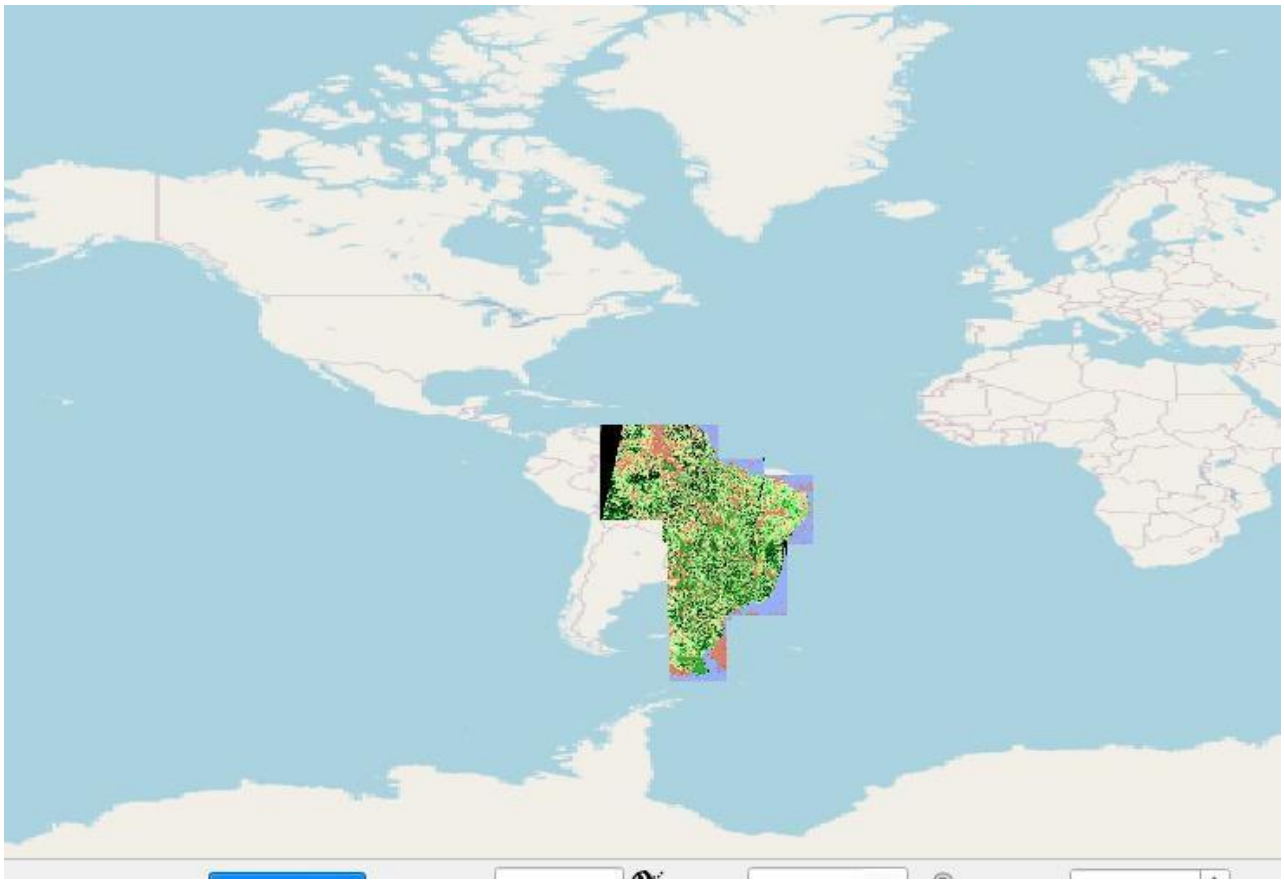
The result will have black background. To change it we will need to adjust the transparency:



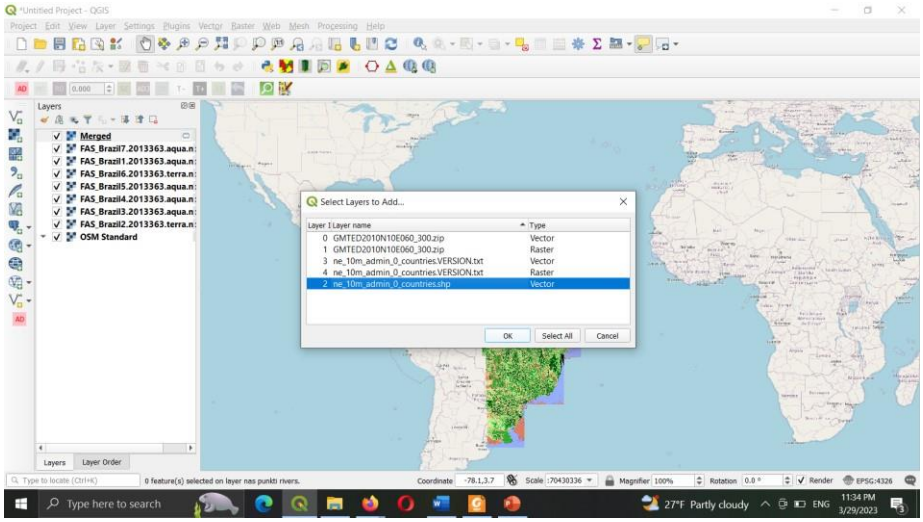


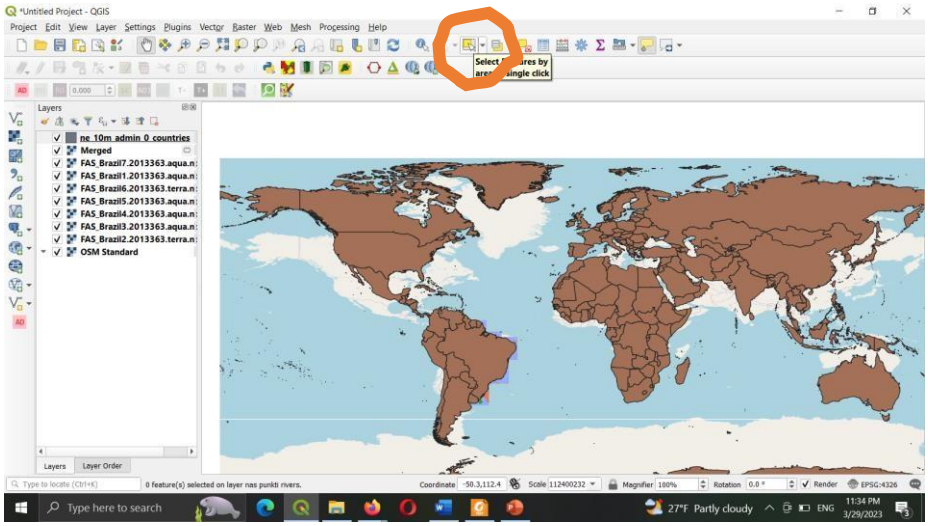
Then we will add the interactive map as the background



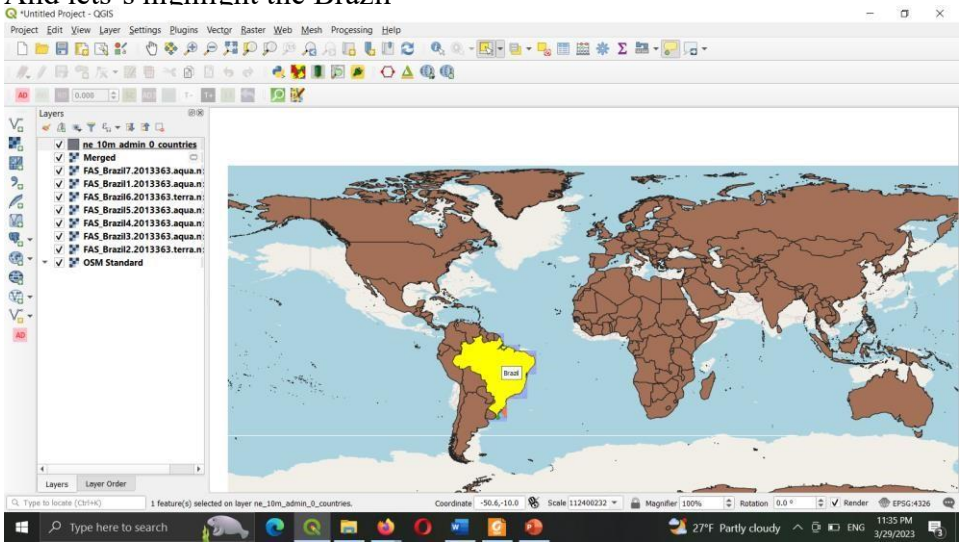


Now we will add the layer with all countries in vector form

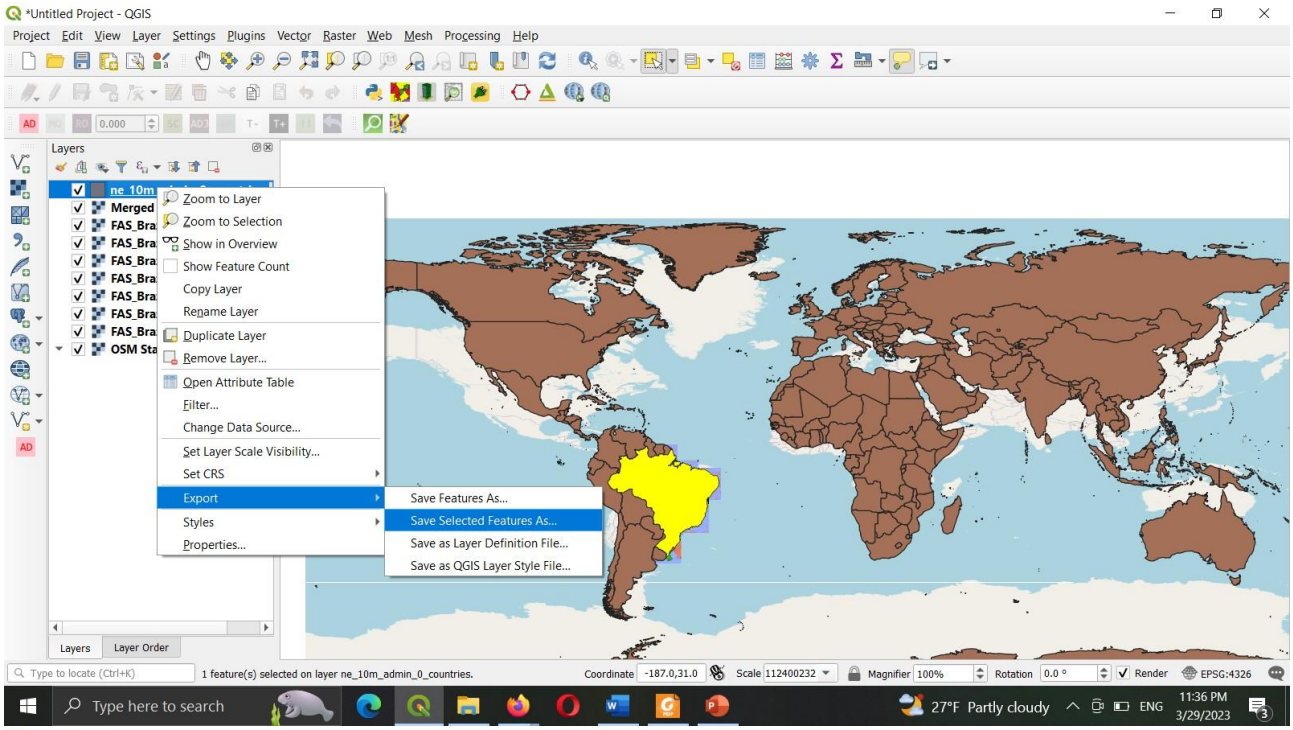


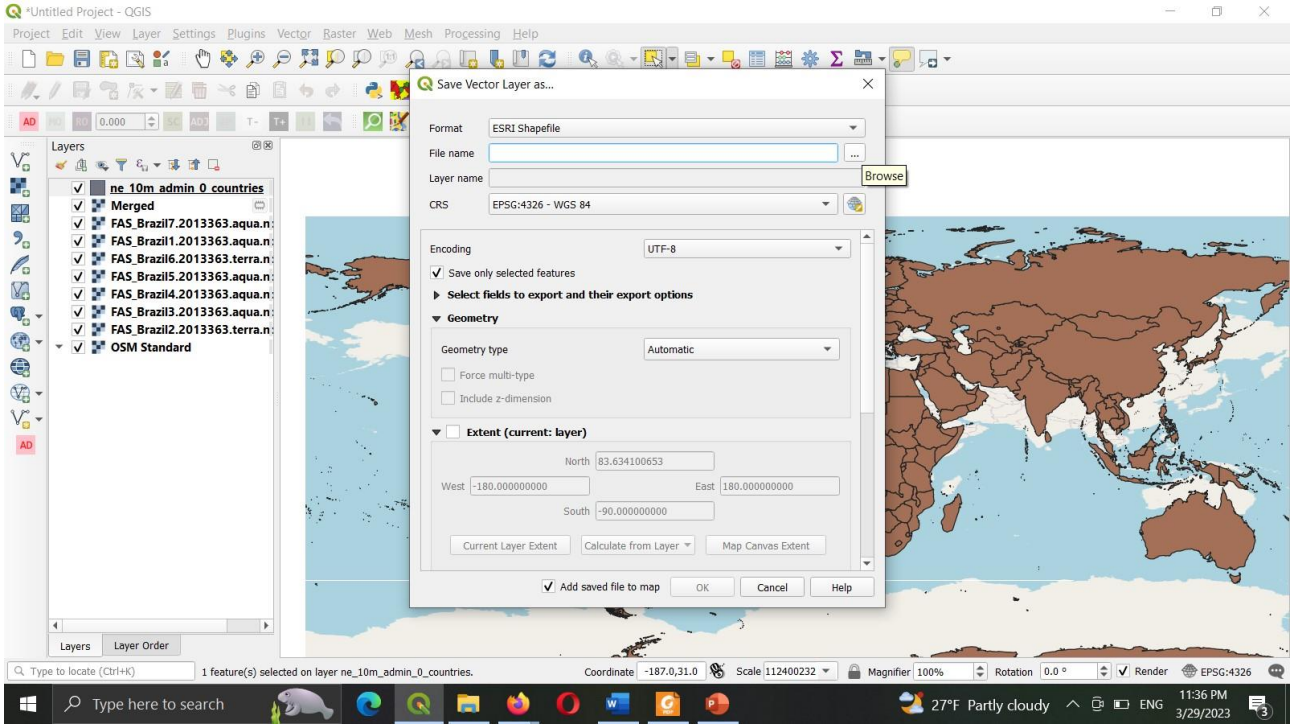


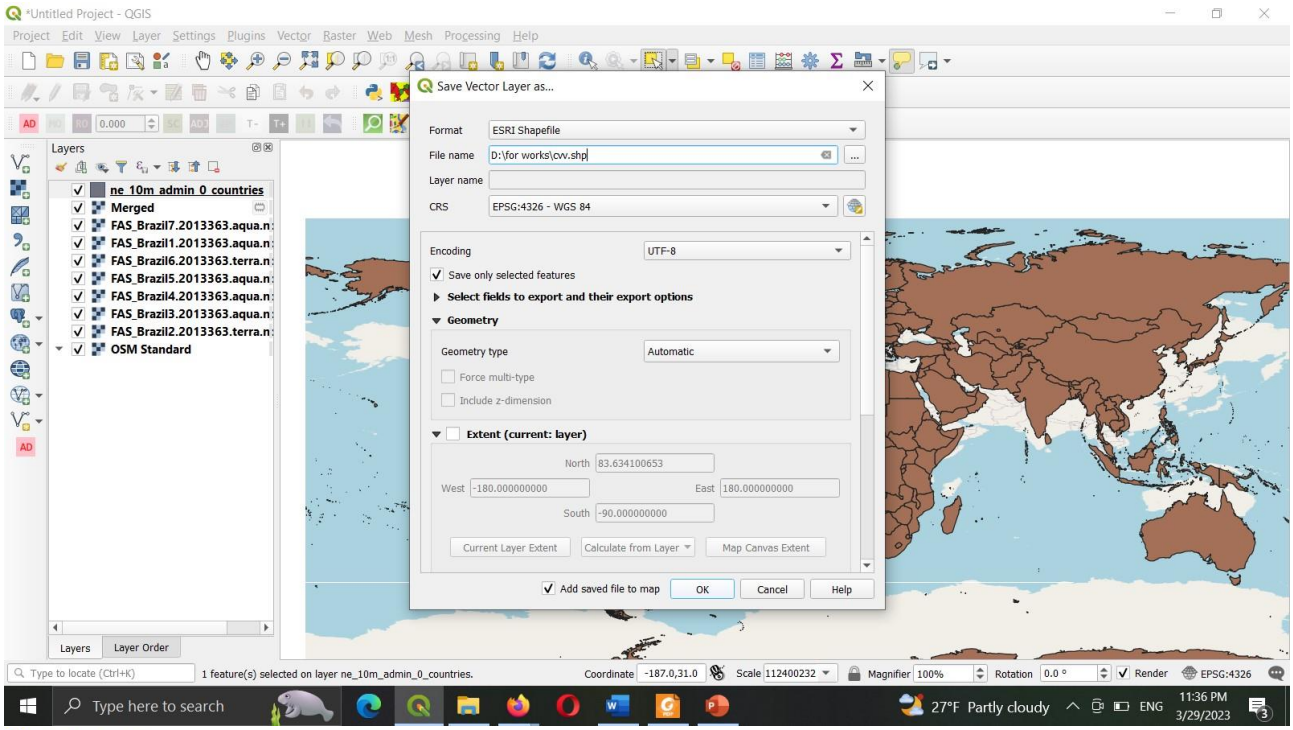
And lets’s highlight the Brazil

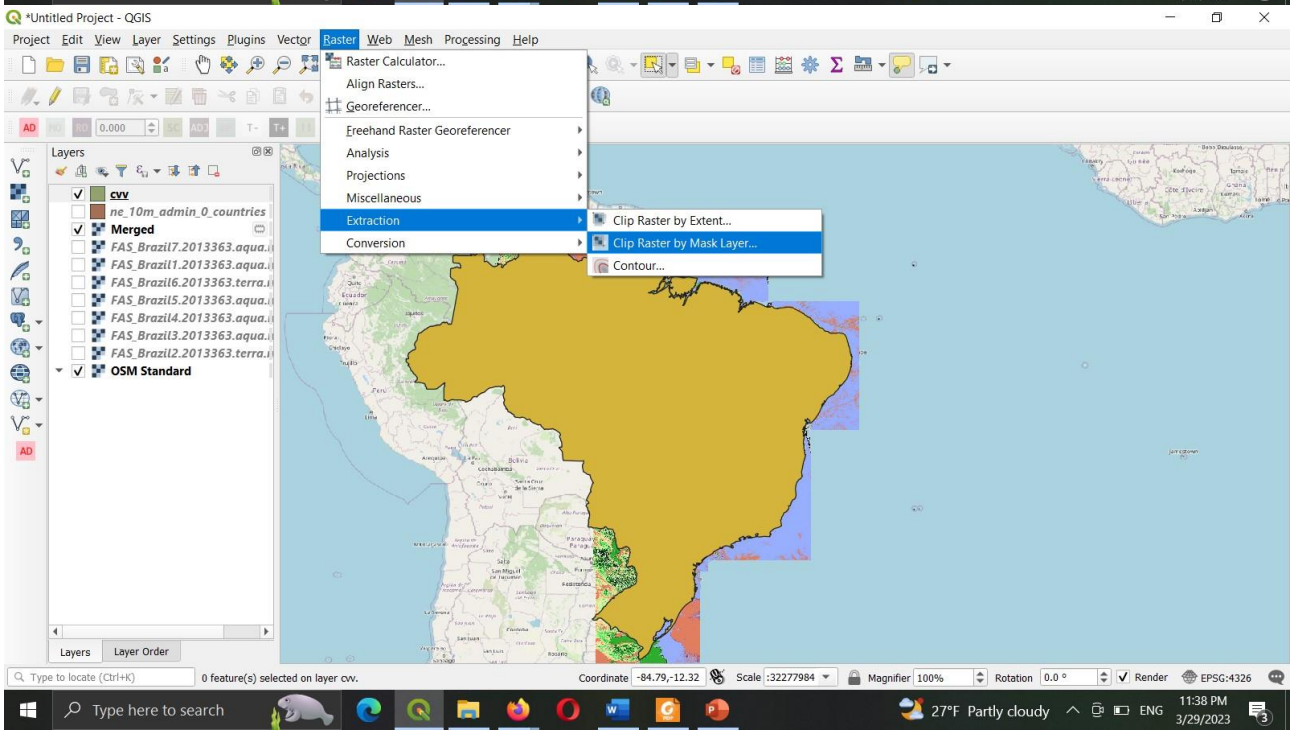


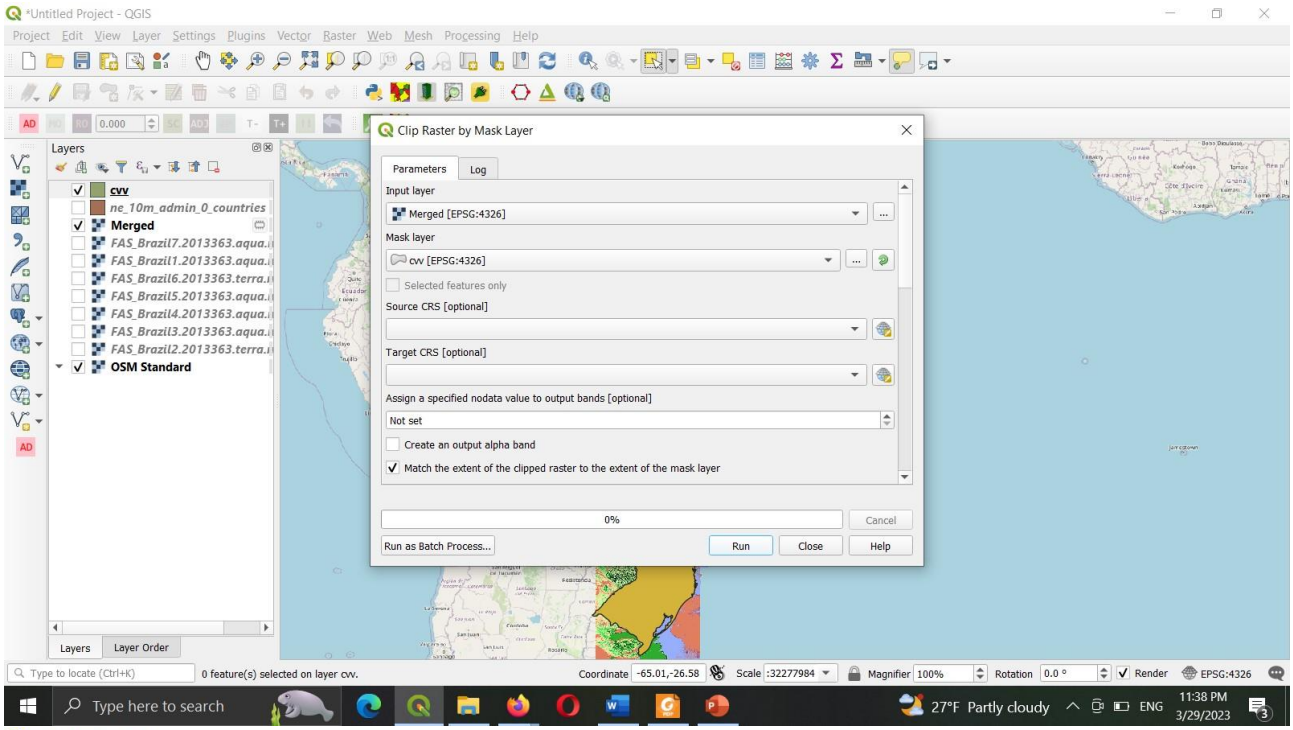
Now we will use the country contour as a mask and lets cut the raster file with this mask

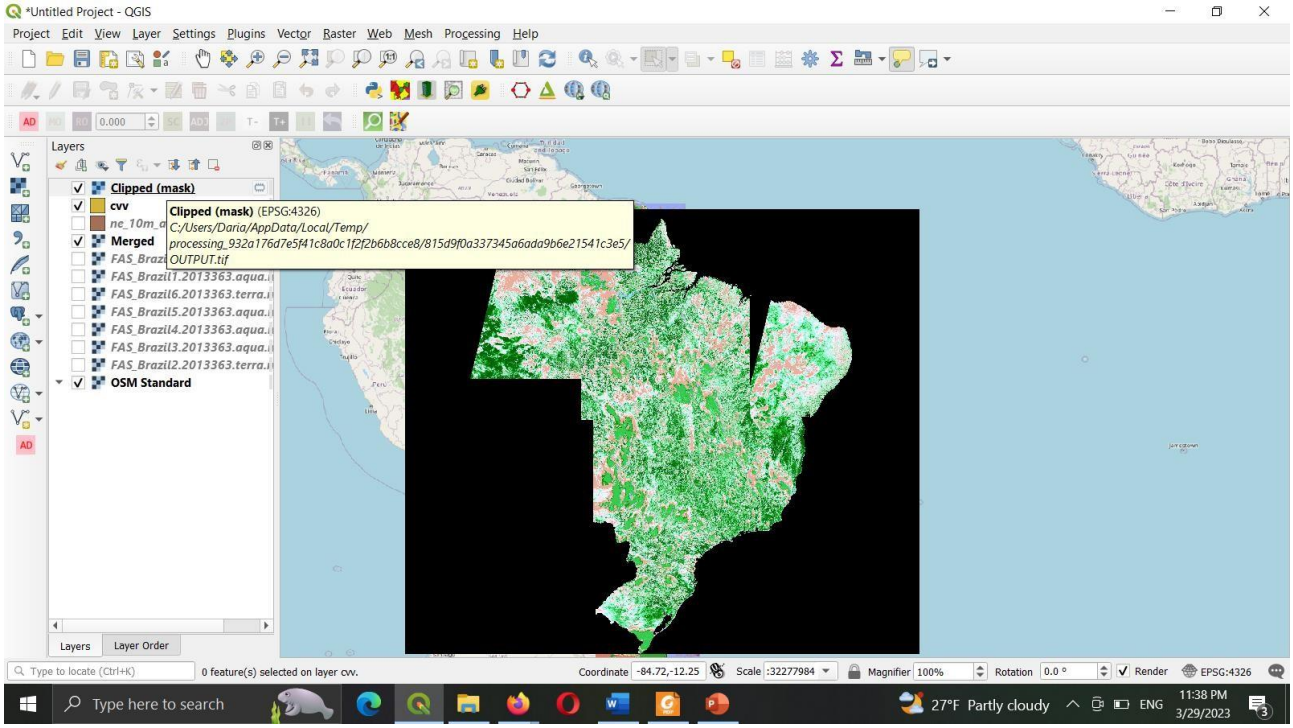

*Untitled Project - QGIS
Project Edit View Layer Settings Plugins Vector Raster Web Mesh Processing Help
Layers
ne_10m
Merged
FAS_Bra
FAS_Bra
FAS_Bra
FAS_Bra
FAS_Bra
FAS_Bra
FAS_Bra
OSM Sta
Zoom to Layer
Zoom to Selection
Show in Overview
Show Feature Count
Copy Layer
Rename Layer
Duplicate Layer
Remove Layer...
Open Attribute Table
Filter...
Change Data Source...
Set Layer Scale Visibility...
Set CRS
Export
Styles
Properties...
Save Features As...
Save Selected Features As...
Save as Layer Definition File...
Save as QGIS Layer Style File...
Layers
Layer Order
Type to locate (Ctrl+K)
1 feature(s) selected on layer ne_10m_admin_0_countries.
Coordinate -187.0,31.0
Scale 112400232
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326
Type here to search
27°F Partly cloudy
ENG
11:36 PM
3/29/2023


*Untitled Project - QGIS
Project Edit View Layer Settings Plugins Vector Raster Web Mesh Processing Help
Layers
ne_10m_admin_0_countries
Merged
FAS_Brazil7.2013363.aqua.n
FAS_Brazil1.2013363.aqua.n
FAS_Brazil6.2013363.terra.n
FAS_Brazil5.2013363.aqua.n
FAS_Brazil4.2013363.aqua.n
FAS_Brazil3.2013363.aqua.n
FAS_Brazil2.2013363.terra.n
OSM Standard
Save Vector Layer as...
Format
ESRI Shapefile
File name
Layer name
CRS
EPSG:4326 - WGS 84
Browse
Encoding
UTF-8
Save only selected features
Select fields to export and their export options
Geometry
Geometry type
Automatic
Force multi-type
Include z-dimension
Extent (current: layer)
North 83.634100653
West -180.000000000
East 180.000000000
South -90.000000000
Current Layer Extent
Calculate from Layer
Map Canvas Extent
Add saved file to map
OK
Cancel
Help
Layers
Layer Order
Type to locate (Ctrl+K)
1 feature(s) selected on layer ne_10m_admin_0_countries.
Coordinate -187.0,31.0
Scale 112400232
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326
Type here to search
27°F Partly cloudy
ENG
11:36 PM
3/29/2023


*Untitled Project - QGIS
Project Edit View Layer Settings Plugins Vector Raster Web Mesh Processing Help
Save Vector Layer as...
Format ESRI Shapefile
File name D:\for works\cvv.shp
Layer name
CRS EPSG:4326 - WGS 84
Encoding UTF-8
Save only selected features
Select fields to export and their export options
Geometry
Geometry type Automatic
Force multi-type
Include z-dimension
Extent (current: layer)
North 83.634100653
West -180.000000000
East 180.000000000
South -90.000000000
Current Layer Extent
Calculate from Layer
Map Canvas Extent
Add saved file to map
OK
Cancel
Help
Layers
ne_10m_admin_0_countries
Merged
FAS_Brazil7.2013363.aqua.n
FAS_Brazil1.2013363.aqua.n
FAS_Brazil6.2013363.terra.n
FAS_Brazil5.2013363.aqua.n
FAS_Brazil4.2013363.aqua.n
FAS_Brazil3.2013363.aqua.n
FAS_Brazil2.2013363.terra.n
OSM Standard
Layer Order
1 feature(s) selected on layer ne_10m_admin_0_countries.
Coordinate -187.0,31.0
Scale 112400232
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326
Type here to search
27°F Partly cloudy
ENG
11:36 PM
3/29/2023


*Untitled Project - QGIS
Project Edit View Layer Settings Plugins Vector Raster Web Mesh Processing Help
Raster Calculator...
Align Rasters...
Georeferencer...
Freehand Raster Georeferencer
Analysis
Projections
Miscellaneous
Extraction
Conversion
Clip Raster by Extent...
Clip Raster by Mask Layer...
Contour...
Layers
cvv
ne_10m_admin_0_countries
Merged
FAS_Brazil7.2013363.aqua.n
FAS_Brazil1.2013363.aqua.n
FAS_Brazil6.2013363.terra.n
FAS_Brazil5.2013363.aqua.n
FAS_Brazil4.2013363.aqua.n
FAS_Brazil3.2013363.aqua.n
FAS_Brazil2.2013363.terra.n
OSM Standard
Layer Order
0 feature(s) selected on layer cvv.
Coordinate -84.79,-12.32
Scale :32277984
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326
Type here to search
27°F Partly cloudy
ENG
11:38 PM
3/29/2023





The result will have the black background again. We know how th adjust it. Repeat the step with transparency.

Task (assignment 7) Building index

Purpose of the work: to master the tools and to study in practice the use of indices allowing to identify changes in the technogenic load.

General description. The VIBI index (vegetation index built-up index) - literally can be translated as the vegetation index, the building index developed in 2012 by a group of researchers (D. Statakis, K. Perakis, I. Yu. Savin Deciphering urban areas using Landsat satellite data // Research Earth from Space. 2012. No. 5. P. 22.).

A method for recognizing urbanized areas (more efficient than existing indices), which is a normalized combination of the well-known NDVI and NDSI (normalized difference soil index) indices - a normalized difference soil index. Approbation of the developed approach on the test site showed its advantage over the existing indices.

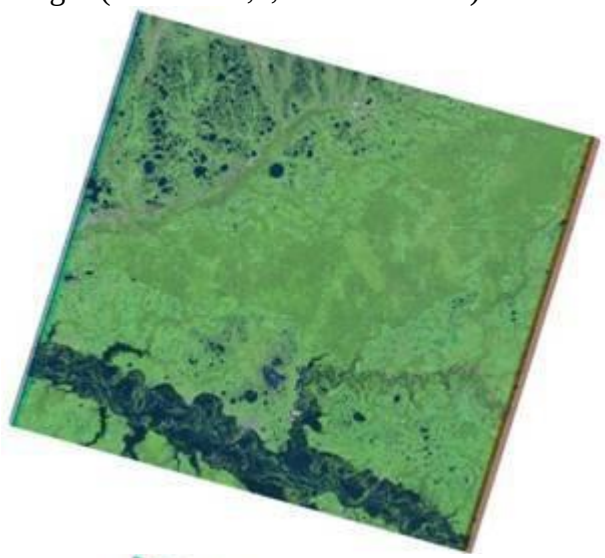
$$VIBI = \frac{NDVI}{NDVI + NDSI} = \frac{\frac{b4 - b3}{b4 + b3}}{\frac{b4 - b3}{b4 + b3} + \frac{b5 - b4}{b5 + b4}},$$

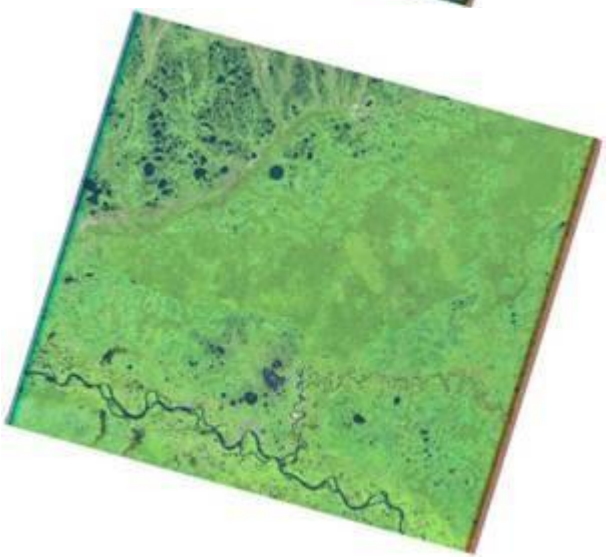
The task for the laboratory work

1. Form a color image from Landsat-5 monochromatic channels (channels 5,4,3 must be used).
2. Calculate VIBI for the provided images.
3. Calculate the difference between the obtained VIBI indices for 2007 and 2011. Determine which pixel values (negative or positive) correspond to the appearance and disappearance of objects in the image. Pixel values of the resulting image in the range from -0.2 to 0.2 will record no changes or minor changes. Large negative or positive pixel values indicate the appearance or disappearance of objects.
4. Based on the VIBI index, identify changes associated with man-made objects.
5. Form the results of the work in the form of a card.

Algorithm

1. Use the composite bands tool. Create a fake color synthesized image for two Landsat images (channels 5,4,3 must be used).





2.

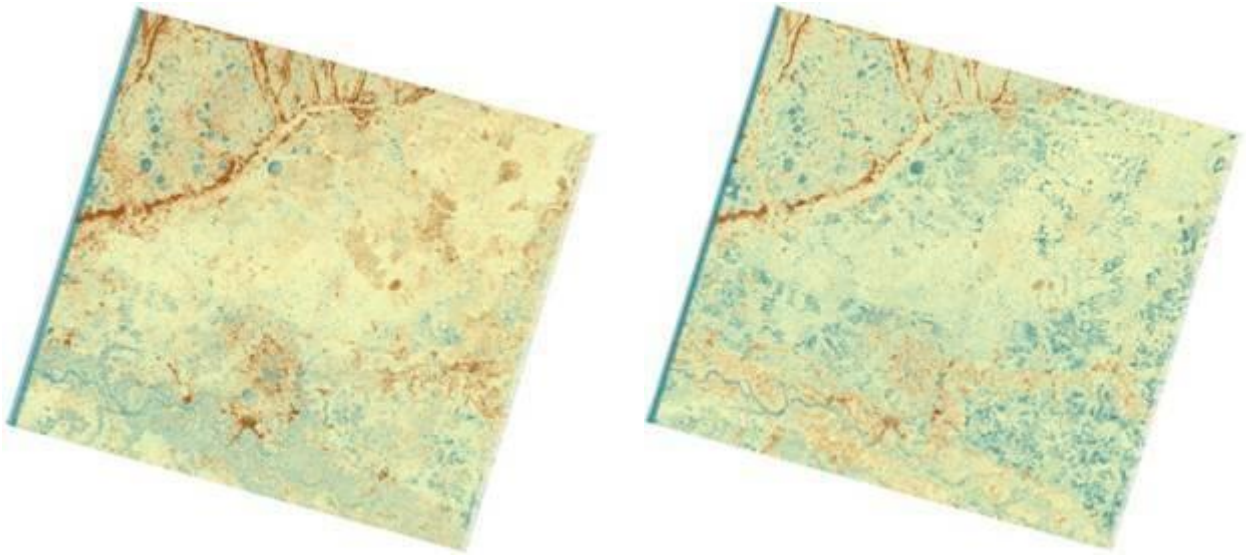
Figure 1 - Color-synthesized image of satellite images obtained by combining channels 5,4,3

2. Use the raster calculator tool. Calculate VIBI index for two original Landsat 5 images using the formula:

$$VIBI = \frac{\frac{b4 - b3}{b4 + b3}}{\frac{b4 - b3}{b4 + b3} + \frac{b5 - b4}{b5 + b4}}$$

In the raster calculator tool, you must use the Float () operator so that the output raster is not an integer, otherwise it will only have three values -1, 0, 1. The Float () operator denotes the value type used to store 32-bit floating point values ... The approximate range is ± 1.5 * 10-45 to ± 3.4 * 10-38, with an accuracy of 7 digits. If you do not use the Float () operator, then the values will be integers (no decimal places), this is not enough to perform correct classification.

(Float(b4 - b3) / Float(b4 + b3)) / (Float(b4 - b3) / Float(b4 + b3)) + (Float(b5 - b4) / Float(b5
+ b4))



а) б)

Figure 2 - Raster images obtained using the VIBI index

3. Use the raster calculator tool. In the raster calculator tool, use the Float () operator. Calculate the difference between the obtained VIBI indices for 2007 and 2011. Determine which pixel values (negative or positive) correspond to the appearance and disappearance of objects in the image. Pixel values of the resulting image in the range from -0.2 to 0.2 will record no changes or minor changes. Large negative or positive pixel values indicate the appearance or disappearance of objects.

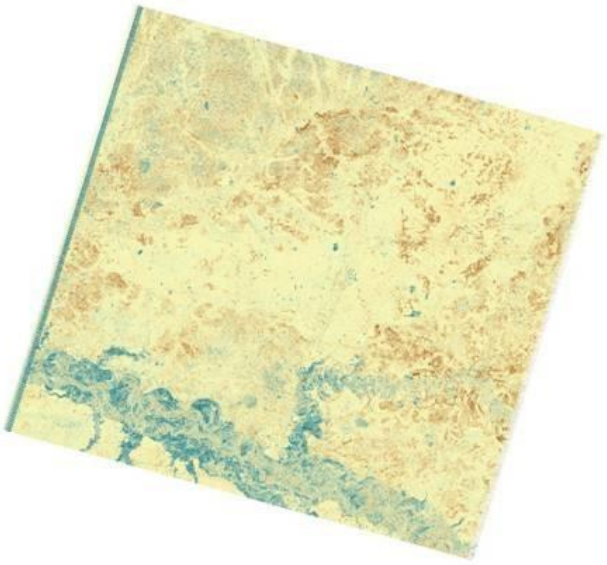


Figure 3 - Raster image obtained as a result of calculating the difference of VIBI indices

4. Use the tools reclassify, raster to polygon and merge. Create a mask of technogenic objects for each image obtained using the VIBI index - filter out pixels with a value less than 0.97. The resulting raster layers are vectorized and combined into one vector file.
5. After completing these steps, you will get a mask of technogenic objects in the images for 2007 and 2011.

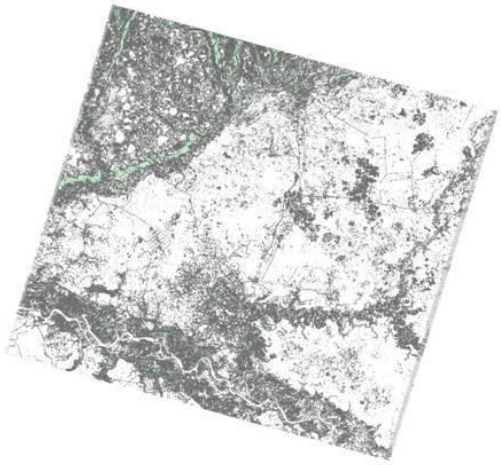


Figure 4 - Vector mask of technogenic objects

5. Use the extract by mask tool. Crop the raster image obtained in step # 3 using the mask (vector layer) obtained in step # 4. This action is necessary to exclude objects that are not technogenic from the raster layer.

6. Use reclassify tools. Reclassify the raster image obtained in point # 5 into

- ranges: from -2 up to -0,2 (appearance OR disappearance) – was defined in clause # 3; from -0,2 up to 0,2 (little or no changes); from 0,2 up to 2 (appearance OR disappearance) – was defined in clause # 3;.

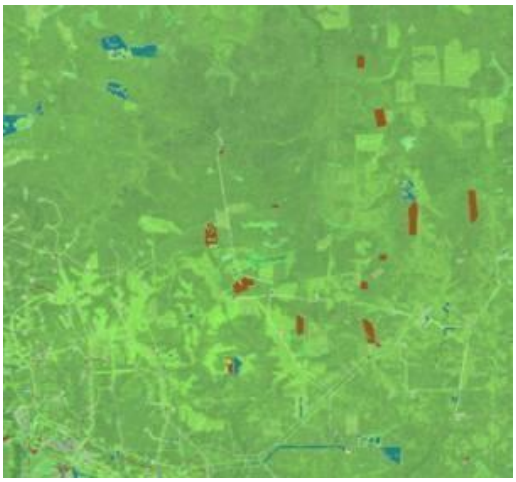


Figure 5 - Fragment of a color-synthesized image with the classification of appeared and disappeared objects

7. The results of the work should be presented in the form of a map.

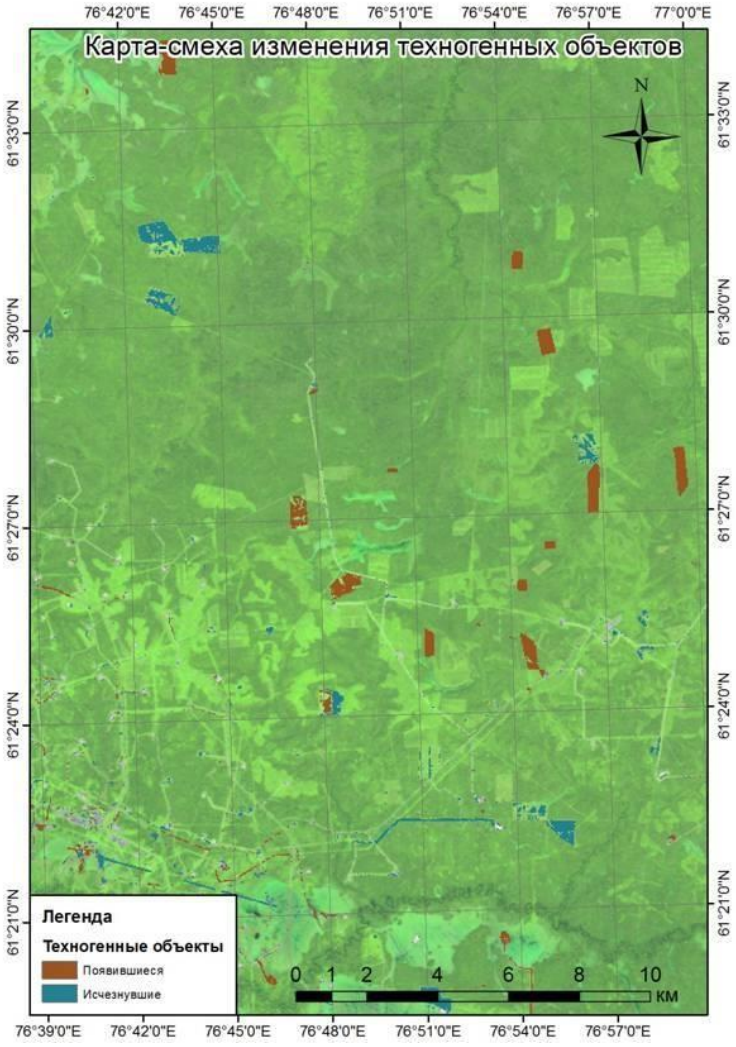


Figure 6 - An example of a card design

DEVELOPER:

Associate Professor of the EM Department		**Kapralova D.O.**
Position	Signature	Name, Surname

HEAD OF DEPARTMENT:

Director of the EM Department		**Kucher D.E.**
Position	Signature	Name, Surname

HEAD OF PROGRAMME:

Director of ES&PQM Department		**Savenkova E.V.**
Position	Signature	Name, Surname