

# Геопространственные данные и программное обеспечение Open Source: источники и особенности использования

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- Open source программное обеспечение
- QGIS

Ссылки

# Геопространственные данные: определение

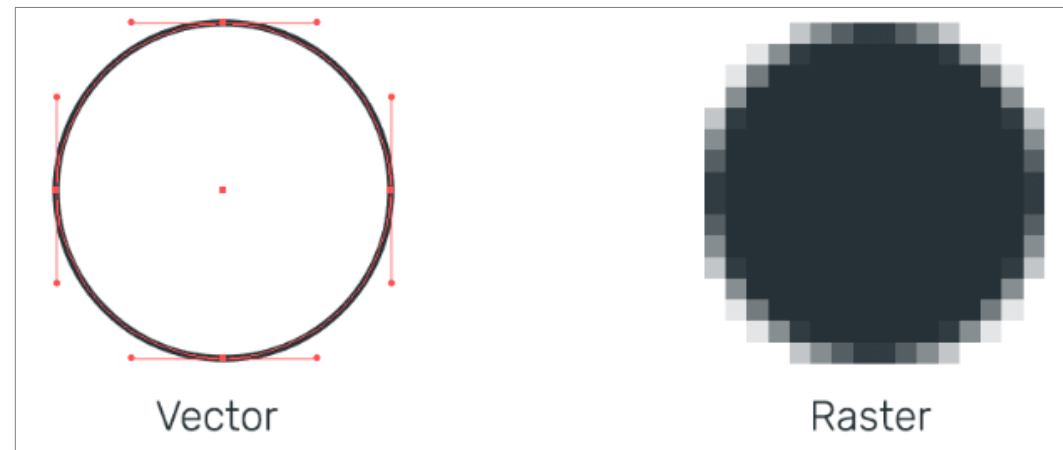
- *Geospatial data* или *geographic information* - данные или информация, которые определяют географическое положение объектов на поверхности Земли, таких как природные или антропогенные объекты
- Пространственные данные обычно хранятся в виде координат и топологии, которые могут быть отображены в картографической форме
- Пространственные данные отображаются и анализируются средствами ГИС

- [https://www.webopedia.com/TERM/S/spatial\\_data.html](https://www.webopedia.com/TERM/S/spatial_data.html)
- <https://gisgeography.com/what-is-geodata-geospatial-data/>
- <https://www.safe.com/what-is/spatial-data/>
- <https://study.com/academy/lesson/geospatial-data-definition-example.html>

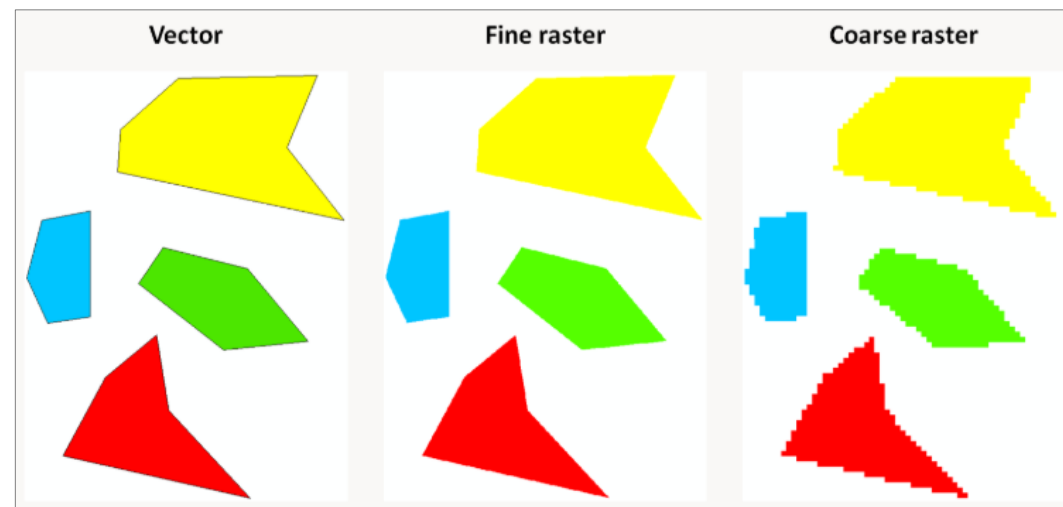
# Типы геоданных: векторы и растры

**Растры:** Растровые данные представляются набором пикселей. Каждый пиксел растра имеет свое значение, которое может быть цветом или единицей измерения (мм, см, км). Качество растровых данных зависит от разрешения (пространственное, временное, например)

**Векторы:** Векторные данные графически описывают реальный мир с наибольшей точностью, по сравнению с растрами. Существует три типа векторных данных: точка, линия и полигон



<https://mangomap.com/gis-data>



<https://gis.stackexchange.com/questions/57142/what-is-the-difference-between-vector-and-raster-data-models>

<https://support.esri.com/en/other-resources/gis-dictionary/search/>

Растрезация и векторизация: Как конвертировать форматы данных

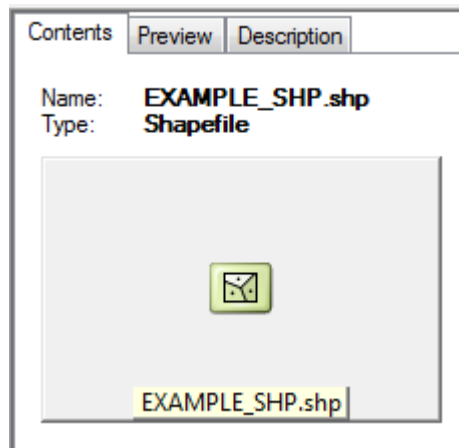
<https://gisgeography.com/rasterization-vectorization/>

# Форматы векторных геоданных (1 – 2)

**SHP**: самый распространённый формат в ГИС, читаемый большинством приложений

Определяется набором файлов, минимальное количество которых должно включать .SHP, .DBF, .PRJ и .SHX

Вид файла в ArcCatalog (ArcGIS, ESRI)



Вид файла в Windows: пример SHP состоит из 7 файлов

Name	Date modified	Type	Size
EXAMPLE_SHP.prj	7/26/2017 5:59 PM	PRJ File	1 KB
EXAMPLE_SHP.dbf	7/26/2017 5:59 PM	DBF File	475 KB
EXAMPLE_SHP.shp	7/26/2017 5:59 PM	SHP File	39,308 KB
EXAMPLE_SHP.shp.xml	7/26/2017 5:59 PM	XML Document	15 KB
EXAMPLE_SHP.shx	7/26/2017 5:59 PM	SHX File	67 KB
EXAMPLE_SHP.sbn	7/26/2017 5:59 PM	SBN File	86 KB
EXAMPLE_SHP.sbx	7/26/2017 5:59 PM	SBX File	4 KB

Каждый SHP файл может хранить геометрию только одного типа (точка, линия и или полигон)

<https://gisgeography.com/gis-formats/>

<https://mangomap.com/gis-data>

<https://gisgeography.com/arcgis-shapefile-files-types-extensions/>

# Форматы векторных геоданных (2 – 2)

<p><b>Geographic JavaScript Object Notation (GeoJSON)</b></p>	<p>.GEOJSON .JSON</p>	<p>The GeoJSON format coordinates as text in vector points, lines and polygons. GeoJSON store object overhead (compared to binary formats) can modify in any text Webmaps browsers use common web format. Fortunately, JavaScript</p>	<p><b>GPS eXchange Format (GPX)</b></p>	<p>.GPX</p>	<p>GPS Exchange format is an XML routes captured from a GPS receiver can openly transfer GPS data description properties.</p> <p>The minimum requirement for GPX files is elevation and geoid height as</p>	<p><b>Digital Line Graph (DLG)</b></p>	<p>.DLG</p>	<p>Digital Line Graph (DLG) files are vector in nature that were generated on traditional paper topographic maps. For example, this includes township &amp; ranges, contour lines, rivers, lakes, roads, railroads and towns.</p> <p>Much of the U.S. Bureau of Census Topologically Integrated Geographic Encoding and Referencing (TIGER) data were generated using the standard DLG format.</p>
<p><b>Geography Markup Language (GML)</b></p>	<p>.GML</p>	<p>GML allows for the use of eXtensible Markup Language readable. GML stores geographic information as GeoJSON, GML can be used for properties, geometry (reference system).</p> <p>There is generally more data because GML results</p>	<p><b>IDRISI Vector</b></p>	<p>.VCT .VDC</p>	<p>IDRISI vector data files have a documentation file with a VDC file. VCT format are limited to point creation of an IDRISI vector file for building metadata.</p> <p>Attributes are stored directly in independent data tables and</p>	<p><b>Geographic Base File-Dual Independent Mask Encoding (GBF-DIME)</b></p>		<p>The GBF-DIME file format was developed by the US Census Bureau in the late 1960s as one of the first GIS data formats to exist. It was used to store the US road network for major urban areas, which is a key factor in census information.</p> <p>GBF-DIME supports choropleth mapping and also assisted in removing error for digitizing features. DIME was a key component to the current TIGER (Topologically Integrated Geographic Encoding and Referencing) system, which was produced by the US Census Bureau.</p>
<p><b>Google Keyhole Markup Language (KML/KMZ)</b></p>	<p>.KML .KMZ</p>	<p>KML stands for Keyhole Markup Language is primarily used for Google Earth was later acquired by Google. KMZ (KML-Zipped) is a compressed format because it is a binary international standard. The longitude, latitude and altitude are measured in meters from the WGS84 EGM96 Geoid vertical datum.</p>	<p><b>MapInfo TAB</b></p>	<p>.TAB .DAT .ID .MAP .IND</p>	<p>MapInfo TAB files are a proprietary format. Similar to shapefile: geographic information and a metadata file.</p> <ul style="list-style-type: none"> <li>TAB files are ASCII files</li> <li>DAT files contain the attribute data</li> <li>ID files are index files</li> <li>MAP files are the map objects that store geographic information.</li> <li>IND files are index files for the tabular data.</li> </ul>	<p><b>ArcInfo Coverage</b></p>		<p>ArcInfo Coverages are a set of folders containing points, arcs, polygons or annotation. Tics are geographic control points and help define the extent of the coverage.</p> <p>Attributes are stored in the ADF or INFO tables. Each feature is identified with a unique number. These feature numbers are a way to link attribute data with each spatial feature.</p> <p>Coverages were the standard format during the floppy disk era. But over time, this GIS format has become obsolete and mostly unsupported in GIS software.</p>

# Форматы растровых геоданных

File type comparison of PNG, JPEG, GIF, and TIFF			
	Use	Example Uses	Don't Use
<b>PNG</b>	Graphics, small images that maintain original quality, transparency	Charts, diagrams, logos, photos	Sharing high-resolution photos on the web
<b>JPEG</b>	Photos on the web	Photos in a slide deck, blog, or social media	Editing images, line graphics, or print
<b>GIF</b>	Small, simple graphics with limited color	Ad banners, simple charts, buttons, animation	Photographs, detailed imagery
<b>TIFF</b>	Editing and storage	Storing photos that will be edited, print	Images on the web

## GeoTIFF

- Самый распространённый двоичный несжатый формат растров
- Формат имеет спецификацию [GeoTIFF Specification (Revision 1.0)], которая включает набор тегов
- Теги необходимы для описания всей картографической информации, связанной с форматом TIFF,
- Существуют примеры геопривязанных TIFF, в описании которых хранятся данные о картографической проекции и системе координат

<https://www.widen.com/blog/whats-the-difference-between-png-jpeg-gif-and-tiff>

<https://mangomap.com/gis-data>

<https://ru.wikipedia.org/wiki/TIFF>

<https://www.geospatialworld.net/article/geotiff-a-standard-image-file-format-for-gis-applications/>

<http://www.ga.gov.au/scientific-topics/earth-obs/accessing-satellite-imagery/technical-information/file-formats/geotiff-format-specifications>

<http://docs.opengeospatial.org/DRAFTS/YY-nnnrx.html>

# Open Data: определение и примеры

Open Data использует принципы свободных и открытых геопространственных данных, позволяющих сотрудничать разным группам при создании геоинформационных продуктов

OSGeo (Open Source Geospatial Foundation) - некоммерческий фонд, курирующий развитие открытого ПО для геоинформационных систем (ГИС)

Геопространственные сообщества, работающие с открытыми данными:

- [openstreetmap.org](http://openstreetmap.org)
- [naturalearthdata.com](http://naturalearthdata.com)

Natural Earth is a public domain map dataset available at 1:10m, 1:50m, and 1:110 million scales. Featuring tightly integrated vector and raster data, with Natural Earth you can make a variety of visually pleasing, well-crafted maps with cartography or GIS software.

Natural Earth was built through a collaboration of many **volunteers** and is supported by **NACIS** (North American Cartographic Information Society), and is free for use in any type of project (see our **Terms of Use** page for more information).

Get the Data

Natural Earth Vector comes in **ESRI shapefile format**, the de facto standard for vector geodata. Character encoding is **UTF-8**.

Natural Earth Raster comes in **TIFF format** with a **TFW world file**.

All Natural Earth data use the **Geographic coordinate system (projection)**, **WGS84 datum**

## Large scale data, 1:10m



Cultural Physical Raster

The most detailed. Suitable for making zoomed-in maps of countries and regions. Show the world on a large wall poster.

1:10,000,000  
1" = 158 miles  
1 cm = 100 km

## Medium scale data, 1:50m

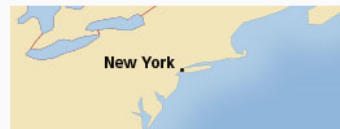


Cultural Physical Raster

Suitable for making zoomed-out maps of countries and regions. Show the world on a tabloid size page.

1:50,000,000  
1" = 790 miles  
1 cm = 500 km

## Small scale data, 1:110m



Cultural Physical

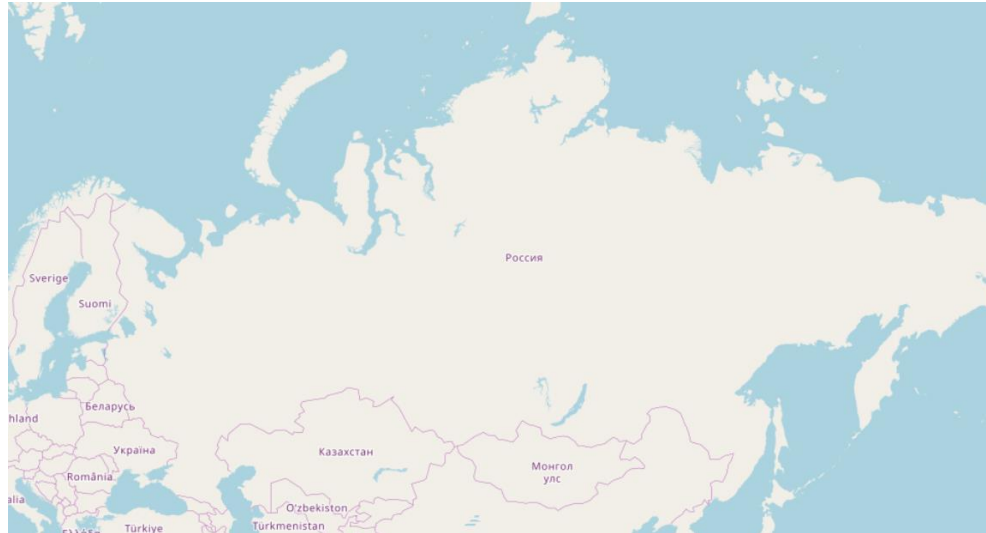
Suitable for schematic maps of the world on a postcard or as a small locator globe.

1:110,000,000  
1" = 1,736 miles  
1 cm = 1,100 km

<https://www.osgeo.org/about/what-is-open-data/>  
<https://www.naturalearthdata.com/>  
<https://freegisdata.rtwilson.com/#>  
<http://dsilakov.ru/papers/osgeo.pdf>



# Open Street Map (OSM): примеры векторных данных



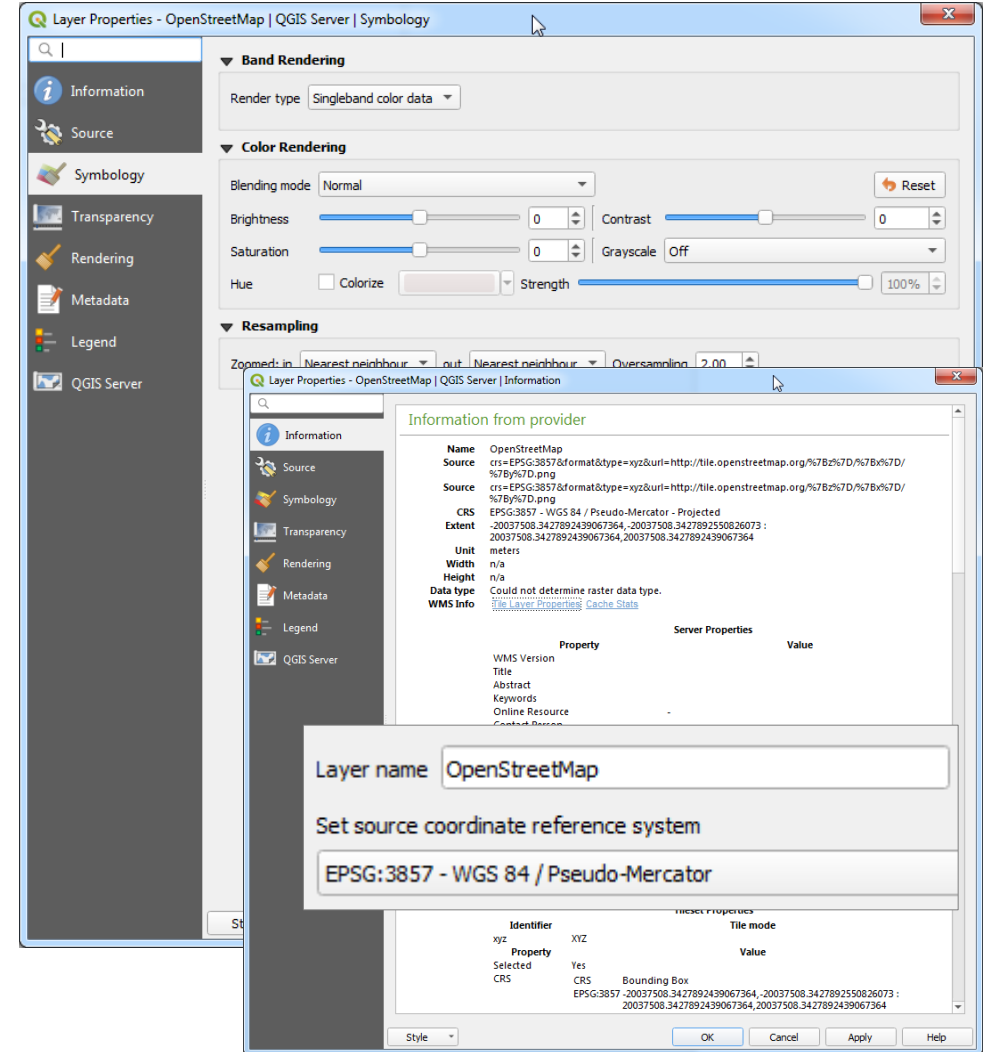
## OpenStreetMap OSM XML

.OSM

OSM files are the native file for OpenStreetMap which had become the largest crowdsourcing GIS data project in the world. These files are a collection of vector features from crowd-sourced contributions from the open community.

The GIS format OSM is OpenStreetMap's XML-based file format. The more efficient, smaller PBF Format ("Protocolbuffer Binary Format") is an alternative to the XML-based format.

The data interoperability in QGIS can load native OSM files. The OpenStreetMap plugin can convert PBF to OSM, which then can be used in QGIS.



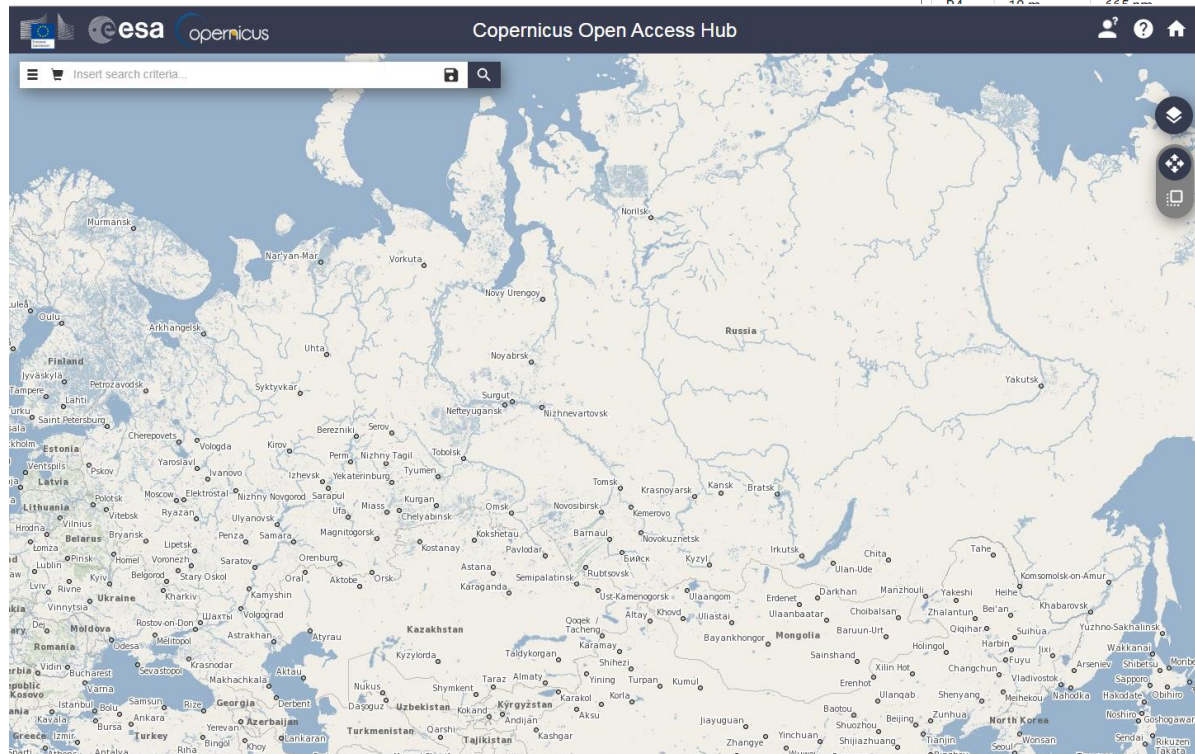
<https://gisgeography.com/openstreetmap-download-osm-data/>

<https://gisgeography.com/qis-formats/>

# Спутниковые данные: примеры растров

## Sentinels Scientific Data Hub (Sentinel-1 и Sentinel-2A)

<https://scihub.copernicus.eu/dhus/#/home>



### What are the Spectral Bands of Sentinel 2A and 2B?

We've listed below, the spectral and spatial resolution of Sentinel 2A. There are 13 bands in total. Four spectral bands have a 10 meter resolution. Six bands have a 20 meter resolution. And the remaining 3 have a spatial resolution of 60 meters.

Here are the spectral band details for Sentinel 2A:

Band	Resolution	Central Wavelength	Description
B1	60 m	443 nm	Ultra blue (Coastal and Aerosol)
B2	10 m	490 nm	Blue
B3	10 m	560 nm	Green
B4	10 m	665 nm	Red
B5	20 m	675 nm	Visible and Near Infrared (VNIR)
B6	20 m	720 nm	Visible and Near Infrared (VNIR)
B7	20 m	755 nm	Visible and Near Infrared (VNIR)
B8	10 m	842 nm	Visible and Near Infrared (VNIR)
B9	20 m	865 nm	Visible and Near Infrared (VNIR)
B10	20 m	940 nm	Short Wave Infrared (SWIR)
B11	20 m	1240 nm	Short Wave Infrared (SWIR)
B12	20 m	1640 nm	Short Wave Infrared (SWIR)

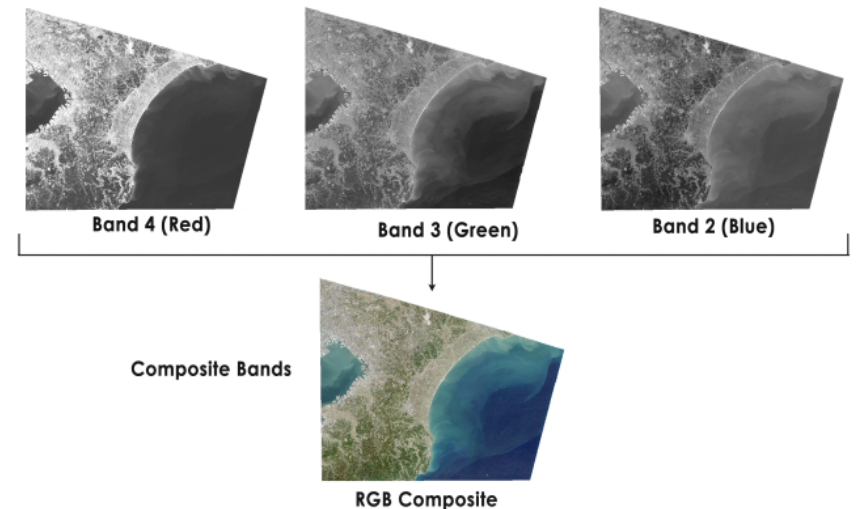
Here are the RGB bands for Sentinel 2A data,

Band 2: Blue (490 nm)

Band 3: Green (560 nm)

Band 4: Red (665 nm)

Each band is a separate image file with a resolution of 10 meters. Add each image (band) to ArcMap. As shown in the image below, these three bands will be combined from single images into a multi-band raster.



<https://www.terraserver.com/>

<https://gisgeography.com/free-satellite-imagery-data-list/>

# Обнаружение и определение дальности с помощью света LiDAR

- Лидарные данные представляют собой “облака точек”, густую сеть точек со значениями высоты
- Современные лидарные системы способны моделировать реальный мир с очень высокой плотностью точек, порядка тысяч точек на квадратный метр
- Использование лидарных данных требует специальных методов обработки и ПО

Extension	File Type	Description
<b>ASPRS LiDAR Data Exchange Format</b>	.LAS, .LASD, .LAZ	<p>The LAS file format is a binary file format specifically for the interchange between vendors and customers. Overall, LAS files maintain information specific to LIDAR without the loss of information.</p> <p>LAS files are available for public use, unlike ASCII and other proprietary file formats. The dense networks of coordinate point measurements are so large sometimes that they often need to be split to prevent the file size becoming too large.</p> <p>When you compress a LAS file, the file format specifically for this is LAZ. You can save significant storage space using the LAZ file format. Like most file compression, LAZ has no information loss.</p> <p>Lastly, LAS Datasets (LASD) reference a set of LAS files. The purpose of LASD is to be able to examine 3D point cloud properties from the referenced LAS files. Through LAS datasets, you can visualize triangulated surfaces and perform statistical analysis.</p>
<b>Point Cloud XYZ</b>	.XYZ	<p>XYZ files don't have specifications for storing point cloud data. The first 3 columns generally represent X, Y and Z coordinates. But there's no standard specification so it may include RGB, intensity values and other LiDAR values.</p> <p>They are in the ASCII point cloud group of file formats which includes TXT, ASC and PTS. Non-binary files like XYZ are advantageous because they can be opened and edited in a text editor.</p>

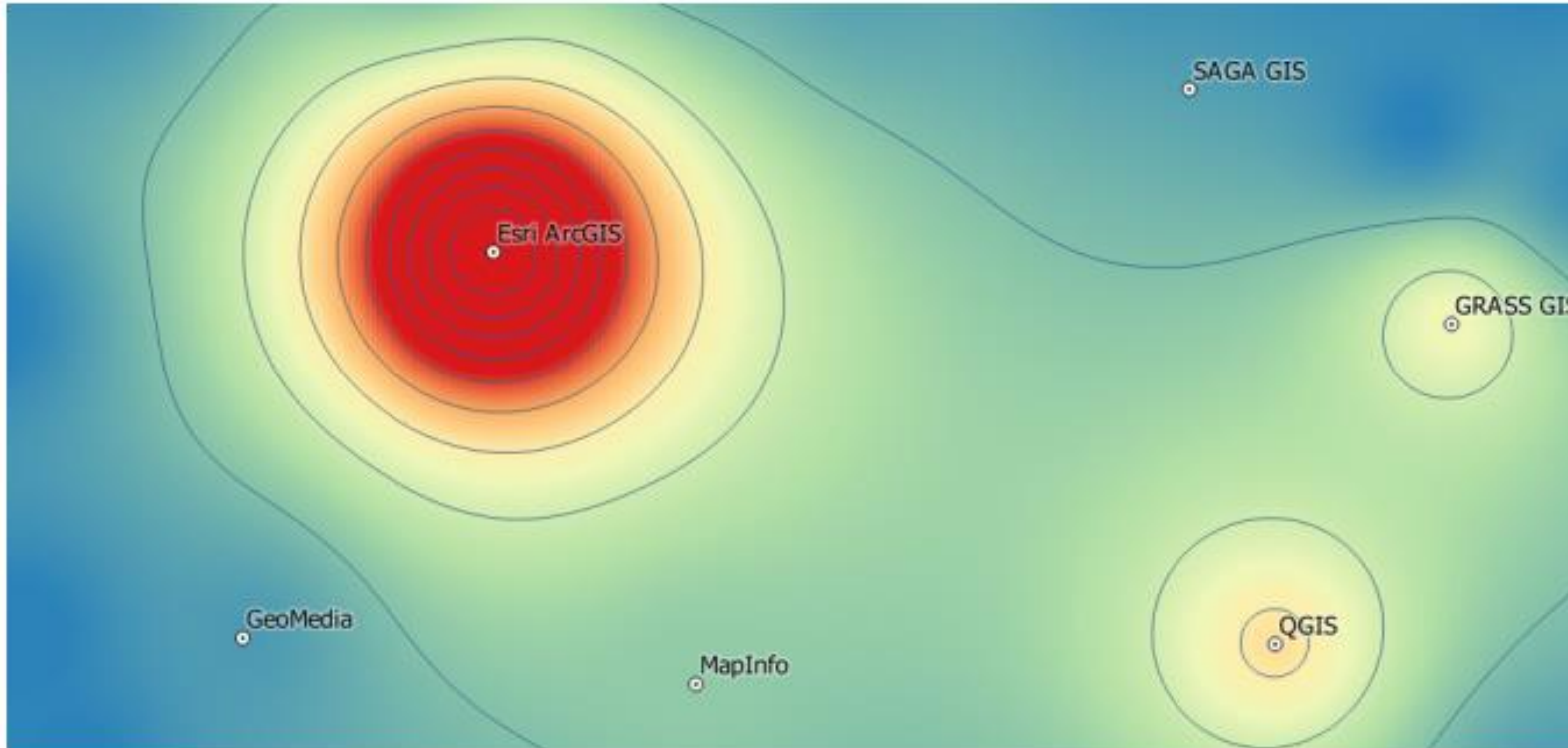
<https://mangomap.com/gis-software>

<https://gisgeography.com/top-6-free-lidar-data-sources/>

<https://www.geospatialworld.net/blogs/did-you-know-the-sources-for-free-lidar-data/>

# Open Source программное обеспечение

## 30 GIS Software Applications [2020 Rankings]



Published on: March 28, 2015 | Last Updated: January 21, 2020

### But how were our rankings compiled?

**40% is based on which GIS software is required by employers in job postings**

So you've graduated college... It's a major milestone. Congratulations. But remember that the career you want to pursue may require knowledge in specific GIS software products. This is why we've relentlessly searched years of job postings data. You get a complete picture of what GIS software employers are requesting in job postings.

**20% is based on which GIS software is being used in research and publications**

So maybe a job isn't your thing just yet. Graduate school it is... not a bad option. You'll probably want to publish a research paper. What are credible sources of GIS software currently being used? We've done the work for you. We've plucked from hundreds of research publications from the last 5 years the GIS software performing the analysis.

**20% is based on which GIS software is being searched for**

How much are GIS professionals speaking about a specific software package? When you have a question about GIS software, Google search is often the way to go. This data has been quantified using [Google Trends](#) for each GIS software package in this list.

**20% is based on which GIS software is being discussed in community forums**

For those who can't find their answer in Google Search, the next place they'll end up is a GIS community forum. But we don't want to skew data by only selecting Esri forums. What are "neutral" GIS discussion forums? We looked at only 2 – [GIS Subreddit](#) and [GIS Stack Exchange](#). When you aggregate the discussion topics from these two communities, this sums up community forum voice.

<https://gisgeography.com/free-gis-software/>  
<https://gisgeography.com/mapping-out-gis-software-landscape/>  
<https://gisgeography.com/qgis-arcgis-differences/>  
<https://gisgeography.com/qvsig-software/>  
<https://mangomap.com/gis-software>



🌐 Open Source   🧑‍🤝‍🧑 Community 100   🎓 Research 17   🏢 Employer 4   📊 Popularity 31.8

QGIS			
QGIS version	3.4.9-Madeira	QGIS code revision	<a href="#">54585165bb</a>
Compiled against Qt	5.11.2	Running against Qt	5.11.2
Compiled against GDAL/OGR	2.4.1	Running against GDAL/OGR	2.4.1
Compiled against GEOS	3.7.2-CAPI-1.11.0	Running against GEOS	3.7.2-CAPI-1.11.0 b55d2125
PostgreSQL Client Version	9.2.4	Spatialite Version	4.3.0
QWT Version	6.1.3	QScintilla2 Version	2.10.8
Compiled against PROJ	520	Running against PROJ	5.2.0

QGIS is licensed under the GNU General Public License  
<http://www.gnu.org/licenses>

## ADVANTAGES

- Extensibility with plugins
- Stunningly beautiful cartography and labeling
- Large user base, online support and thorough documentation
- Interoperability
- Open source and group effort

## DISADVANTAGES

- Organization of plugins and tools

<https://gisgeography.com/mapping-out-gis-software-landscape/>  
<https://qgis.org/en/site/>

# ССЫЛКИ

- <https://freegisdata.rtwilson.com/>
- <http://gis-lab.info/qa/data.html>
- <https://gisgeography.com/top-6-free-lidar-data-sources/>
- <https://gisgeography.com/best-free-gis-data-sources-raster-vector/>
- <https://gisgeography.com/free-satellite-imagery-data-list/>
- <https://gisgeography.com/free-historical-imagery-viewers/>
- <https://data.world/datasets/geodata>
- <https://www.sigterritoires.fr/index.php/en/open-data-en/>
- <https://3d.bk.tudelft.nl/open-gis-software/>