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EOCap4Africa

5 Introduction to R and QGIS

a) General Introduction to Spatial Software



INES Ruhengeri
Institute of Applied Sciences





Learning objectives

Understand the role of spatial software in geospatial analysis

Identify key features of QGIS and R for spatial data processing

Know when to use GIS software, cloud-based solutions, or programming for spatial analysis

Install and configure QGIS, R, and RStudio on their computers

Set up essential plugins and packages for geospatial workflows

What is spatial software?



Definition:

- Spatial software allows users to analyze, visualize, and manipulate geographic data

Why is it important?

- Helps in mapping, geostatistical analysis, and data visualization
- Used in agriculture, urban planning, environmental monitoring, disaster management, and more



(Geospatial World 2013)



Types of spatial software?

GIS desktop software

- **QGIS** (Open-source) - Versatile, powerful, widely used
- **ArcGIS** (Commercial, "ESRI-Products") - Industry standard, extensive functionality

Cloud-based GIS & remote sensing platforms

- **Google Earth Engine (GEE)** - Satellite imagery processing at scale
- **Copernicus Data Space Ecosystem** - Cloud access to Sentinel data

Programming-based geospatial analysis

- **R** (with sf, terra, raster) – Statistical & spatial analysis
- **Python** (with geopandas, rasterio, folium) – Automation & machine learning
- **PostGIS** (PostgreSQL extension) – Spatial databases



When should you use which spatial software?

Scenario	Best Choice	Why?
Quick visual exploration of spatial data	QGIS / ArcGIS	Easy-to-use GUI with map interaction
Large-scale satellite image processing	Google Earth Engine	Cloud-based, handles petabytes of data
Automating repetitive spatial analysis tasks	Python (GeoPandas) / R	Scripts can run large batch processes
Storing and querying large geospatial datasets	PostGIS / SQL	Optimized for large-scale spatial queries
Machine learning on geospatial data	Python (scikit-learn, TensorFlow)	Full control over data modeling
Collaborative mapping & real-time web GIS	Google Earth, ArcGIS Online	Shareable, cloud-based maps



When should you use which spatial software?

Key takeaways:

- Use GIS desktop software for traditional spatial analysis
- Use cloud-based tools for large-scale remote sensing and fast processing
- Use programming when automation, machine learning, or advanced customization is needed

QGIS



What is QGIS?

- A free, open-source GIS software for visualizing, analyzing, and processing spatial data
- Supports vector and raster data, spatial databases
- <https://qgis.org/>

Key features:

- Data visualisation: Load and edit shapefiles, raster images, GPS data
- Geoprocessing tools: Buffering, clipping, merging, and spatial statistics
- Mapping & cartography: Create professional-quality maps
- Plugins: Expand functionality with GRASS GIS, OpenStreetMap, and Python scripting





Task - Installing QGIS

1. Visit: <https://qgis.org/download/>
2. Choose the offline long-term version

Download QGIS for your platform

The current version is QGIS 3.40.3 'Bratislava' and was released on 2025-01-17.

The long-term builds currently provide 3.34.15 'Prizren'. Long Term Release (LTR) builds are intended for those who value stability over having the latest features. If you are unsure which version is best for you, download the LTR.

QGIS is available on Windows, macOS, Linux, Android and iOS.

We are currently in feature freeze preceding the release of QGIS 3.42. **Please consider testing the prereleases.** See [road map](#).

Online (OSGeo4W) installer:

OSGeo4W Network Installer

This installer is the best way to keep QGIS up to date, run multiple versions on your system and keep the load on our download servers to a minimum. [Learn more](#).

Offline (Standalone) installers:

Long Term Version for Windows (3.34 LTR)

Latest Version for Windows (3.40)

Latest Version for Windows (3.40) with Qt6 (experimental)



Task - Installing QGIS

1. The Download will start automatically
2. Follow the instructions by the program
3. Finish the installation

Downloading QGIS may take some time, as it is a large file

R



What is R?

- A statistical computing language with powerful spatial analysis libraries
- <https://www.r-project.org/>

Why Use R for geospatial analysis?

- Handles large datasets and advanced spatial modeling
- Open-source and integrates with QGIS and other GIS tools





Task - Installing R

1. Visit: <https://mirrors.cicku.me/cran/>
2. Choose the Version suitable for your system

Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- [Download R for Linux](#) ([Debian](#), [Fedora/Redhat](#), [Ubuntu](#))
- [Download R for macOS](#)
- [Download R for Windows](#)

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

Task - Installing RStudio

1. Visit: <https://posit.co/download/rstudio-desktop/>
2. Choose the Version suitable for your system

1: Install R

RStudio requires R 3.6.0+. Choose a version of R that matches your computer's operating system.

R is not a Posit product. By clicking on the link below to download and install R, you are leaving the Posit website. Posit disclaims any obligations and all liability with respect to R and the R website.

DOWNLOAD AND INSTALL R

2: Install RStudio

DOWNLOAD RSTUDIO DESKTOP FOR WINDOWS

Size: 287.98 MB | [SHA-256: BCA050AD](#) | Version: 2025.09.1+401
| Released: 2025-10-01



Task - Installing RStudio

1. Follow the links fitting your system and preferences
2. The download will start automatically
3. Follow the instructions by the program
4. Finish the installation



Summary & key takeaways

QGIS is a **powerful open-source GIS** tool for visualization and geospatial analysis

R is excellent for **spatial statistics, raster processing, and modeling**

Other important spatial software includes **ArcGIS, Google Earth Engine, PostGIS, and cloud-based** tools

Choosing the right tool depends on whether you need a GIS, cloud-based solution, or programming approach

Sources



Geospatial World. (2023, July 13). *Know about geospatial*. Retrieved February 10, 2025, from <https://geospatialworld.net/prime/know-about-geospatial/>

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Thank you for your attention!

Dr. Insa Otte, Hanna Schulten
 (on behalf of the EOCap4Africa Team)
 and colleagues

insa.otte@uni-wuerzburg.de



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 Institute of Applied Sciences

