Elevate research projects with Quarto

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1 Outline

- Introduction (2)
- Motivation (3)
- Tools (4)
- Conclusion (5)
- Future improvements (6)
- Resources (7)

```
1  https://vhgauto.github.io/seminario2-gulich/
```

2 Introduction

> **Research project**
>
> To estimate water quality indicators in Paraná River middle basin for algorithm development using satellite remote sensing techniques

Collaborative website with automatic running, interactive and open source.

2.1 Front page

- Authors
- Affiliation
- Last modified date
- Keywords
- More resources links

2.2 Table of content

- Sections and subsections
- Ease website navigation
- Variable content according to the development

Contenido

1 Introducción
2 Área de estudio
3 Materiales y métodos
4 Muestreos
5 Resultados
6 Firmas espectrales
7 Discusión
8 Objetivos
9 Ejecución
10 Algoritmos
11 Contacto

2.3 Notebooks

- Source code description
- Processing data justification
- Calculus methodology explanation to promote reproducibility

Notebooks
- Lectura de datos
- Extracción de reflectancia
- Caracterización de las muestras
- Ejecución automática
- Article Notebook

2.4 **References**

- Formatted references according to desired style (`.csl`)

- Reference preview on citation hover

Referencias

[1] United Nations General Assembly, «Work of the Statistical Commission Pertaining to the 2030 Agenda for Sustainable Development», 2017.

[2] M. Bonansea *et al.*, «Evaluating the feasibility of using Sentinel-2 imagery for water clarity assessment in a reservoir», *Journal of South American Earth Sciences*, vol. 95, nov. 2019, doi: 10.1016/j.jsames.2019.102265.

[3] M. H. Gholizadeh, A. M. Melesse, y L. Reddi, «A Comprehensive Review on Water Quality Parameters Estimation Using Remote Sensing Techniques», *Sensors (Switzerland)*, vol. 16, n.º 8, 2016, doi: 10.3390/s16081298.

[4] A. Ferral *et al.*, «In-Situ and Satellite Monitoring of Water Quality of an Eutrophic Lake with an Artificial Air Diffusion System», *IEEE Latin America Transactions*, vol. 16, pp. 627-633, 2018, doi: 10.1109/TLA.2018.8327422.

2.5 Maps, tables & interactive plots

- Results visualization
- Correlation between parameters exploration
- Spectral properties description
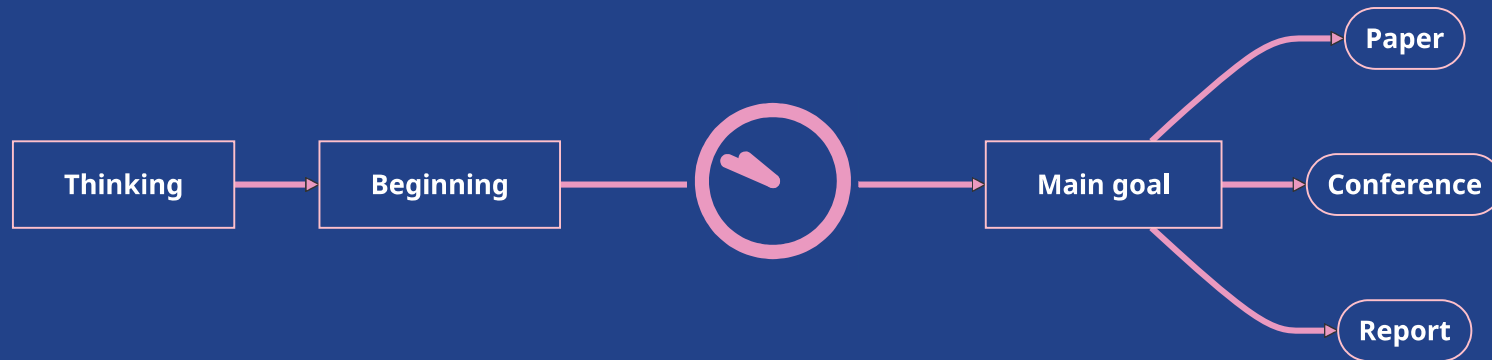- Sample site location
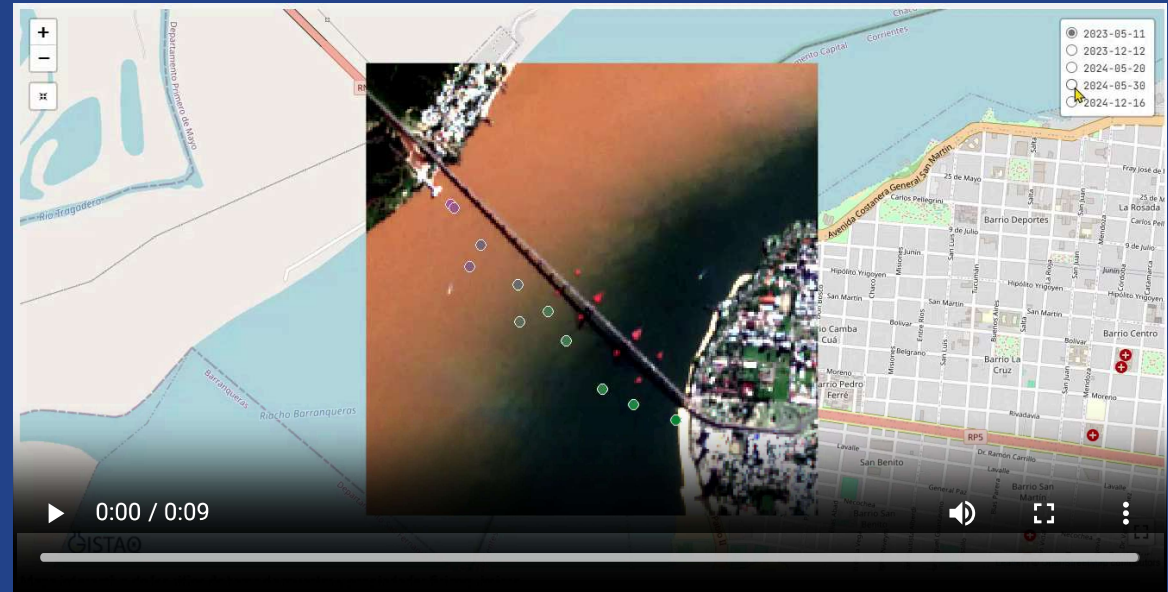
Web site

```
1  https://vhgauto.quarto.pub/gistaq-parana/
```

3 Motivation

Research project typical life journey.

- Water sampling
- Physicochemical test
- Partial results analyses
- Reference reading
- Other tasks

3.1 During the project development

- Dynamic document, that adapts to the current project state.
- Easy access site to check the latest results.
- Unified reference search.
- Script code execution and results reproducibility.
- All project members can work seamless and without problems and no fear of disarranging the document.
- Consultation resource and to admire all the effort done.
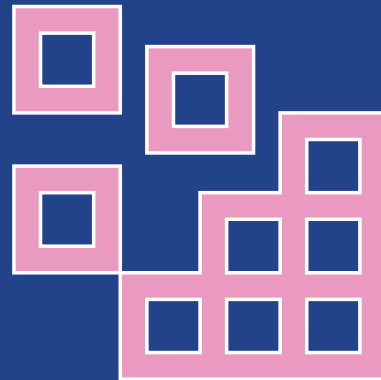
4 Tools

- R y Python: reading and data collection; processing and results storage; plots, tables and maps generation.

- Git y GitHub: version control management and project members collaboration.

- Quarto: to content compilation and website publishing.

  - **Manuscript** allows website creation with an emphasis in reproducibility and targeted to scientific and academic documents.
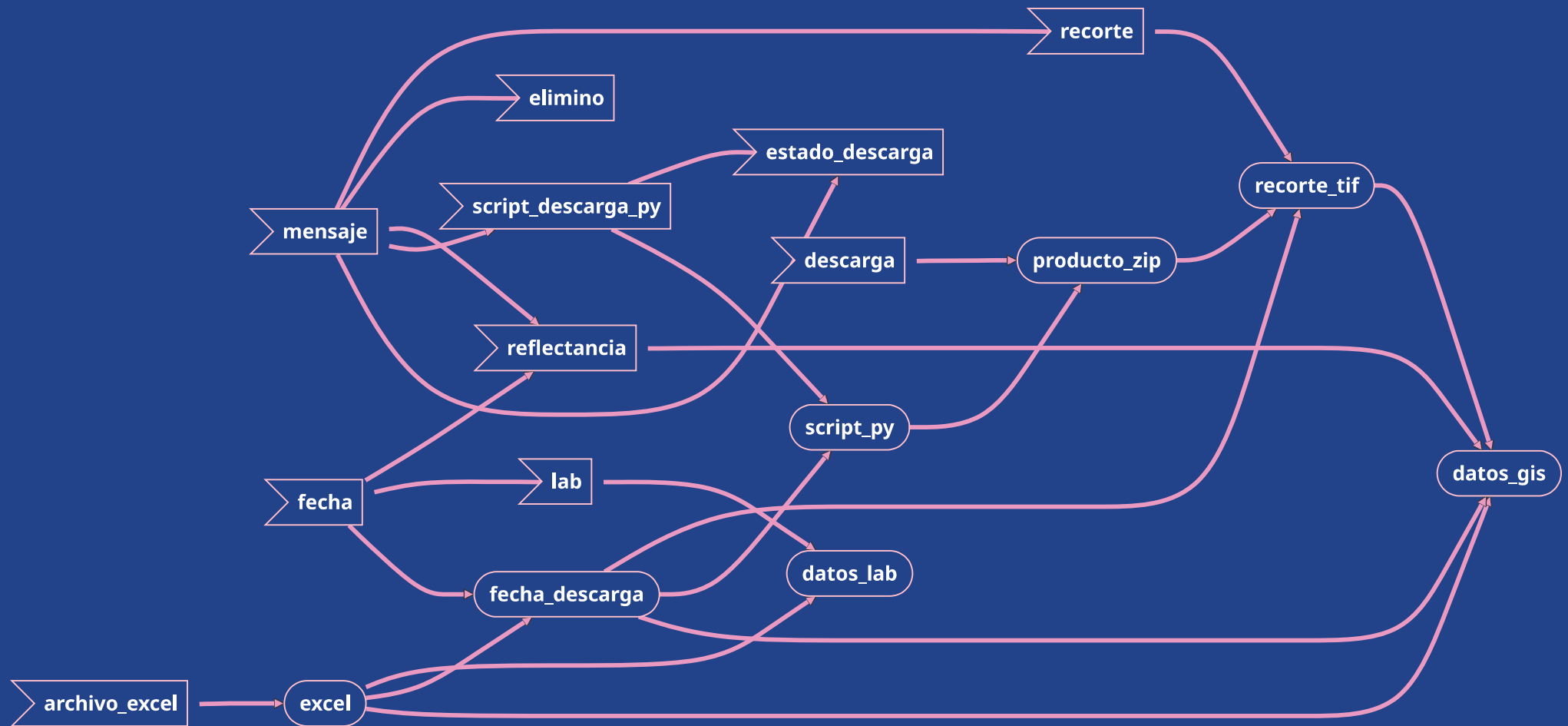
4.1 R

targets allows automatic functions execution and dependencies management between them.

Check current workflow state and execute only outdated targets.

File monitoring and code re-execution when change detection.

4.2 R

recorte

elimino

estado_descarga

script_descarga_py

mensaje

descarga

producto_zip

recorte_tif

reflectancia

script_py

fecha

lab

datos_gis
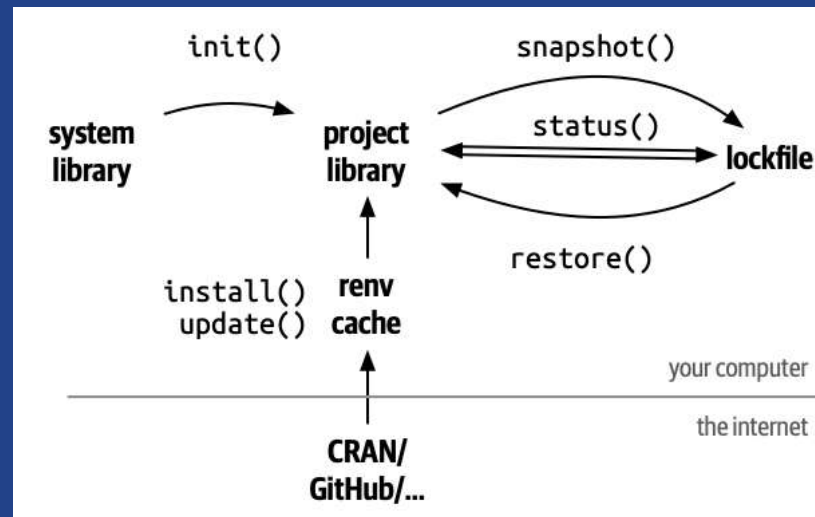
fecha_descarga

datos_lab

archivo_excel

excel

4.3 R

renv execution environment management, package version and its dependencies.

Log file that allows environment reproducibility.

4.4 R

tidyverse with multiple packages for general purpose data processing and manipulation.

terra for geographic data processing and vector and raster reading.

corrr linear correlation coefficient calculation.

4.5 **R**

ggplot2 for basic plot creation (`.png`).

ggiraph for interactive plot creation (`.html`).

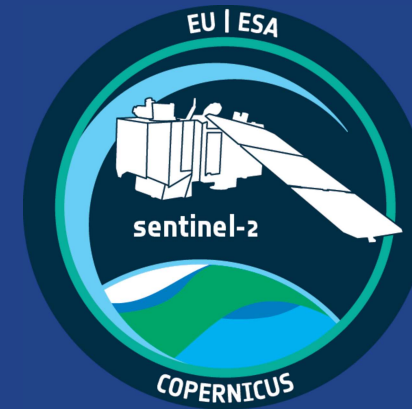leaflet for interactive map creation (`.html`).

4.6 PYTHON

Copernicus Data Space

- Collection
- Processing level
- Region of interest
- Time range
- Credentials

4.7 GIT

Version control management and simultaneous collaboration between project members.

`github` cloud storage service.

`branch` per member, so each one works in a specific section without interfering with the remaining repository.

`pull request` to request adding changes.

`merge` to combine changes once checked and accepted.

4.8 QUARTO

- Combines code execution by programming language and narrative text to create a product in multiple formatted options

- Offers a publishing platform for the output and to access it as a website
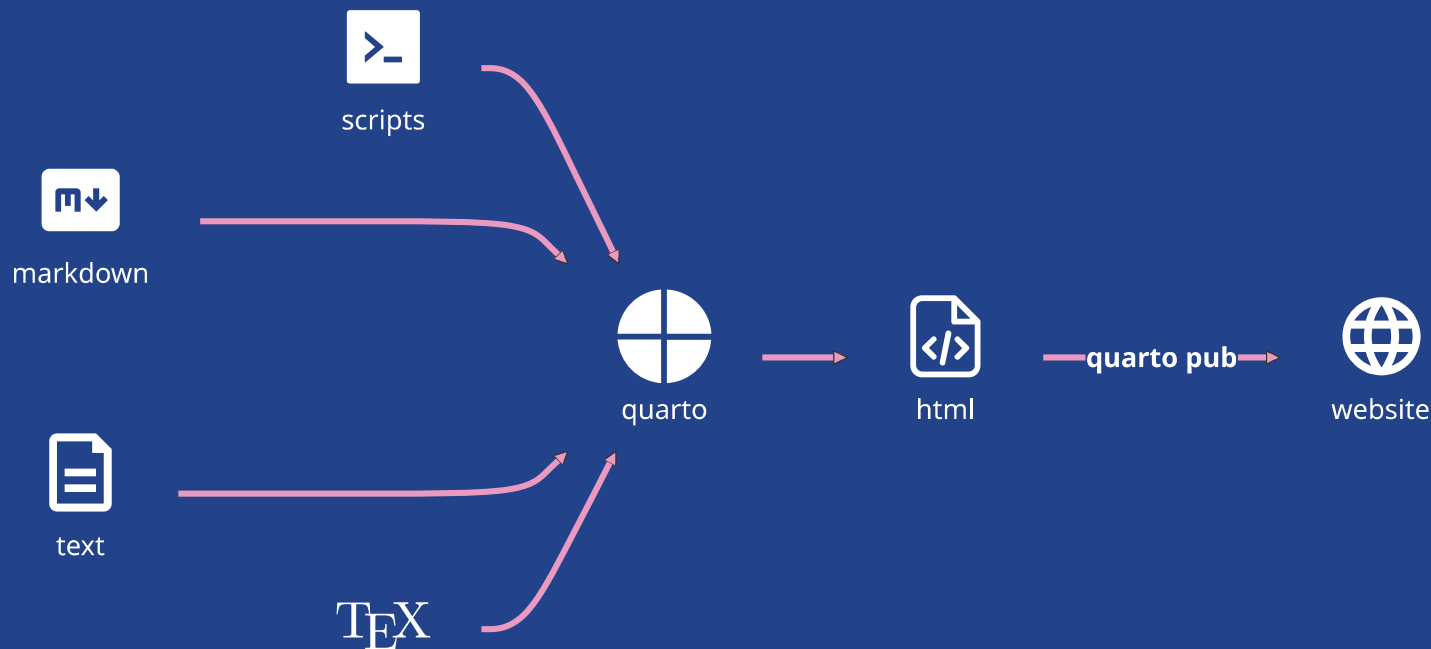
4.9 QUARTO

4.10 QUARTO

- **Manuscript** is design for scientific document authoring, with emphasis in reproducibility, since it encourages the readers to explore processing scripts (notebooks).

- Offers multiple static outputs that follow an specific template from a magazine.

- It allows to deploy the website in Quarto Pub or GitHub Pages .

- In combination with targets, plots/tables/maps are regenerated with new data input, or script modification, updating the results.

4.11 QUARTO

Files and directory tree.

```
quarto_manuscript
├── bibliography/
│   ├── ieee.csl
│   └── reference.bib
├── data/
│   ├── [CSV] laboratory.csv
│   └── [CSV] reflectance.csv
├── plots/
│   ├── [PNG] boxplot.png
│   └── [PNG] time_series.png
├── notebooks/
│   ├── ⊕ plots.qmd
│   └── ⊕ data_reading.qmd
├── raster/
├── scripts/
│   ├── ® functions.R
│   └── ® support.R
├── vectors/
├── [YML] _publish.yml
├── [YML] _quarto.yml
├── ® _targets.R
└── ⊕ manuscript.qmd
```

4.12 QUARTO

```
manuscript.qmd
1  ---
2  title: Research Project
3  author: Víctor Gauto
4  date: last modified
5  ---
6
7  # Introducción
8
9  **Paraná River** has <i>water</i>.
10
11  ```{r}
12  ggplot(data, aes(x, y)) +
13    geom_point()
14  ```
```

4.13 QUARTO

```yaml
_quarto.yml
1  project:
2    type: manuscript
3
4  manuscript:
5    article: manuscrito.qmd
6    notebooks:
7      - notebooks/data_reading.qmd
8
9  format:
10   html:
11     lang: es
12     include-in-header:
13       - extras/favicon.html
14     theme:
15       - extras/my_style.scss
16     toc: true
17     code-link: true
18     code-copy: true
19     tbl-cap-location: margin
20     fig-cap-location: bottom
21     bibliography: bibliography/reference.bib
22     csl: bibliography/ieee.csl
23     html-math-method: katex
```

4.14 QUARTO

```
_publish.yml
1  - source: project
2    quarto-pub:
3      - id: ff90d76c-20c0-4210-8791-5d868ede4c50
4        url: https://vhgauto.quarto.pub/gistaq-parana
```

5 Conclusion

The **Research Project** development allowed us to learn a new set of tools.

6 Future improvements

- Rewrite functions used by targets.
  - Define arguments clearly.
  - Return descriptive messages during runtime and in case of errors.
  - Incorporate website rendering.
- Optimize satellite data download, avoiding to get the entire product.
  - Google Earth Engine.
  - rsi package.
- Organice website visual features (colors, fonts, styles, margins) in the `.scss` file.
- Use the full potential of **Manuscript**, so the results are created by the notebooks.

Thanks for your time

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/vhgauto

7 **Resources**

Download

This presentation repository

Reproducible Manuscripts with Quarto - posit::conf(2023)

Quarto for Academics | Mine Çetinkaya-Rundel

Quarto | Get started

Quarto Manuscripts

The {targets} R package user manual

Introduction to renv

R for Data Science (2e)

ggiraph-book

Quarto: The Definitive Guide

Website repository

Quarto Extensions

Official repository for Citation Style Language (CSL) citation styles

The End

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