GRASS GIS Is FAIR: Its Evolution Towards Open Science

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GRASS GIS is a powerful open-source cross-platform Geographic Information System (GIS). It has long been a cornerstone of open-source geospatial software, embodying principles that align closely with Open Science and the FAIR data principles – Findable, Accessible, Interoperable, and Reusable. The software's more than 40 years' journey reflects a commitment to transparency, reproducibility, and community-driven development.

I. Open Source Ecosystem

GRASS GIS is driven by the open-source geospatial community. Its open-source ecosystem thrives on **collaboration**, transparency, and **innovation**, enabling a diverse range of users—from academics to government agencies and private sector professionals—to harness the **power of geospatial analysis** without proprietary constraints.

- **Collaborative Development**: GRASS GIS is developed and maintained by an international community of contributors, including developers, researchers, and users. Its open-source nature ensures that anyone can contribute to its codebase, propose new features, or report and fix bugs. This collaborative environment accelerates innovation and ensures the software evolves to meet the community's needs.

- **Vibrant Community Support**: The GRASS GIS ecosystem thrives on its active community of users and developers. Community forums, mailing lists, and events such as FOSS4G (Free and Open Source Software for Geospatial) conferences facilitate knowledge exchange and foster collaboration.

II. Extensible Architecture

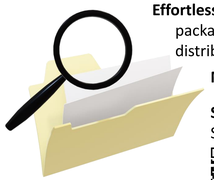
GRASS GIS's **modular design** allows users to develop and share custom extensions. This extensibility has resulted in a rich library of addons for specialized tasks, from hydrological modeling to landscape ecology, expanding the software's utility.

Core Repository

Addons Repository

III. FAIR Principles

By embracing the FAIR principles, GRASS GIS not only serves as a robust GIS tool but also aligns with the ethos of Open Science, empowering users to create, share, and build upon geospatial knowledge in a transparent and sustainable manner.



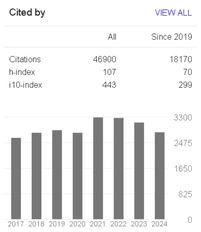
Effortless access to the software through its official website and widely used package managers (OSGeo4W, MacPorts, Docker, and various Linux distributions)

Metadata management incorporates embedded command histories

Searchable references available in documentation and on Google Scholar for scientific research

IV. Findable

GRASS GIS emphasizes data discoverability through robust metadata management. It integrates with repositories and standards like OGC (Open Geospatial Consortium) to ensure datasets can be easily located and utilized.



V. Accessible

As an **open-source** platform, GRASS GIS provides free access to its codebase, documentation, and resources. It supports various data formats, ensuring users from diverse disciplines can access geospatial data without barriers.

Transparent and open licensing under the GNU General Public License **(GPL) v2 and above**, ensuring that its software remains free and open for anyone to use, modify, and share

Native cross-platform support through modernization of the build system

Easier deployment from an extensive package ecosystem

QGIS Provides a **user-friendly** graphical interface for GRASS functionalities

GDAL Enables the processing of a wide variety of geospatial **data formats**

Supports scripting and automation, allowing users to build **custom geospatial workflows**

VI. Interoperable

GRASS GIS offers compatibility with multiple programming languages, including Python and R, and integrates seamlessly with other geospatial tools like QGIS and GDAL. This interoperability fosters collaboration and simplifies workflows across scientific communities.

Reproducible manipulations of raster and vector data with precision and flexibility

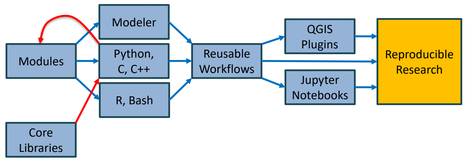
r.mapcalc – A powerful raster algebra tool featuring unique neighborhood modifiers for advanced spatial analysis

v.edit – A robust, scriptable vector editor designed for efficient and precise vector data manipulation

VII. Reusable

By adopting open standards and offering extensive documentation, GRASS GIS ensures that both software and data outputs can be reused and adapted for future research. The system's modular design also allows for customization to meet specific project needs.

Workflow reusability through scriptability and automation



Extensibility with addons and **standardized parameterization**

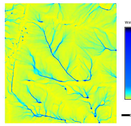
VIII. Commitment to Open Science

GRASS GIS **enables scientists** to conduct reproducible research by providing tools to process, analyze, and visualize geospatial data in a fully transparent environment. Its alignment with FAIR principles strengthens its position as a critical tool in fields such as environmental monitoring, urban planning, and climate change research.

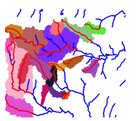
Through its evolution, GRASS GIS not only serves as **a powerful geospatial tool** but also as a model of how software can embody the ideals of FAIR principles and **Open Science**, fostering innovation and collaboration in the global scientific community.

IX. Applications

Hydrologic Modeling



Watershed Analysis



Flood Simulation

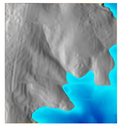
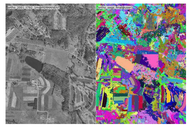
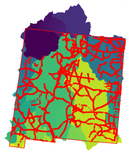


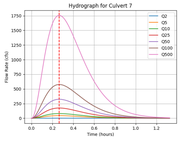
Image Segmentation



Pan Sharpening

State-Scale Hydrologic Analysis





X. Acknowledgment

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XI. Disclaimer

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