The g.citation Module for GRASS GIS: Establishing fine granular software citation as a community best-practice for FAIR and Open Science.

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We report on the advances of the new GRASS GIS add-on module g.citation, which is based on the earlier g.cite effort. The module implements a workflow to create citations for individual GRASS GIS modules on demand. This is a crucial step to establish a practice of research code citation for OSGeo software projects.

The Open Source OSGeo foundation is a global umbrella organization for currently over 50 open source software and open data projects. OSGeo became in 2018 a signatory of the Enabling FAIR Data project, committing itself to promote open and Finadable, Accessible, Interoperable, and Reusable (FAIR) data principles (http://www.copdess.org/enabling-fair-data-project/commitment-to-enabling-fair-data-in-the-earth-space-and-environmental-sciences/signatories/).

This commitment includes the promotion of FAIR credit by software citation according to the state-of-the-art best-practices defined by the FORCE11 software citation working group (https://www.force11.org/software-citation-principles).

GRASS GIS (grass.osgeo.org) is a community-driven geospatial software project with a record of being used in scientific publications and research projects over three decades, starting in 1982.

The project is a founding member and strong driver of the OSGeo foundation of geospatial software projects since its establishment in 2006. This makes GRASS GIS a prime candidate to set up a reference implementation for fine granular software citation capabilities.

When using and citing GRASS GIS as part of scientific publications, authors could previously only opt for citing either the entire software package, citing the most recent review publication associated with GRASS GIS, or citing a publication associated with a specific module.

We present a new GRASS GIS add-on module g.citation with the aim to provide a convenient, concise, and standardized way of citing GRASS GIS and its range of over 500 individual modules for scientific users. The module is available in the GRASS GIS Addons repository.

The current version of g.citation extracts the relevant information from a respective manual page of any given GRASS GIS module and derives a proper citation in a variety of styles and formats, including machine-readable formats such as Citation File Format (CFF) and Citation Style Language (CSL).

The implementation of g.citation has led to an analysis of the quality and completeness of the semi-structured manual pages for GRASS GIS modules: Of the currently 504 GRASS GIS core modules, the manual pages of 143 modules (28,65%) require content improvements to ensure fine granular citation. Based on the details of the analysis, recommendations for future improvements and the inclusion of machine-actionable metadata are being derived, to create a OSGeo reference case to comply with the FAIR requirements for scientific software citation.