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GRASS GIS: a peer-reviewed scientific platform and future research repository

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Geographical Information System (GIS) is known for its capacity to spatially enhance the management of natural resources. While being often used as an analytical tool, it also represents a collaborative scientific platform to develop new algorithms. Thus, it is critical that GIS software as well as the algorithms are open and accessible to anybody [18]. We present how GRASS GIS, a free and open source GIS, is used by many scientists to implement and perform geoprocessing tasks. We will show how integrating scientific algorithms into GRASS GIS helps to preserve reproducibility of scientific results over time [15]. Moreover, subsequent improvements are tracked in the source code version control system and are immediately available to the public. GRASS GIS therefore acts as a repository of scientific peer-reviewed code, algorithm library, and knowledge hub for future generation of scientists.

In the field of hydrology, with the various types of actual evapotranspiration (ET) models being developed in the last 20 years, it becomes necessary to inter-compare methods. Most of already published ETa models comparisons address few number of models, and small to medium areas [3, 6, 7, 22, 23]. With the large amount of remote sensing data covering the Earth, and the daily information available for the past ten years (i.e. Aqua/Terra-MODIS) for each pixel location, it becomes paramount to have a more complete comparison, in space and time.

To address this new experimental requirement, a distributed computing framework was designed, and created [3, 4]. The design architecture was built from original satellite datasets to various levels of processing until reaching the requirement of various ETa models input dataset. Each input product is computed once and reused in all ETa models requiring such input. This permits standardization of inputs as much as possible to zero-in variations of models to the models internals/specificities. All of the ET models are available in the new GRASS GIS version 7 as imagery modules and replicability is complete for future research.

A set of modules for multiscale analysis of landscape structure was added in 1992 by [1], who developed the r.le model similar to FRAGSTATS ([10]). The modules were gradually improved to become r.li in 2006. Further development continued, with a significant speed up [9] and new interactive user interface.

The development of spatial interpolation module v.surf.rst started in 1988 [11] and continued by introduction of new interpolation methods and finally full integration into GRASS GIS version 4 [13]. Since then it was improved several times [8]. The module is an important part of GRASS GIS and is taught at geospatial modeling courses, for example at North Carolina State University [14].

GRASS GIS entails several modules that constitute the result of active research on natural hazard. The r.sim.water simulation model [12] for overland flow under rainfall excess conditions was integrated into the Emergency Routing Decision Planning system as a WPS [17]. It was also utilized by [16] and is now part of Tangible Landscape, a tangible GIS system, which also incorporated the r.damflood, a dam break inundation simulation [2]. The wildfire simulation toolset, originally developed by [24], implementing Rothermel's model [21], available through the GRASS GIS modules r.ros and r.spread, is object of active research. It has been extensively tested and recently adapted to European fuel types ([5, 19, 20]).

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