In Praise of Open Source GIS Software

Cortney Cameron, YP-0359

It's something of a running joke at my job that I'm obsessed with R, an open source programming language popular for statistical computing and graphics. What takes 25 columns of formulae in Excel or 25 steps (with nuisance intermediate shapefiles) in ArcMap can typically be reduced to a few simple – and importantly, reproducible – lines of code in R. As a user-friendly language with powerful and versatile data analysis options (hundreds of useful packages are a search query away), R's potential is hard to overstate. Some months ago, however, I needed to delineate a watershed using a drainage point and a DEM. Watershed delineation is one of those rare items that (to my knowledge)

has yet to feature in an R package, so I decided to use ArcMap. After all, I had previously done this work in ArcMap and didn't want to waste time on another approach that might not work.

As this was for a personal project, I loaded up my ArcMap .mxd file on my personal laptop and got to work – or I would have, except that ArcMap continually crashed while trying to run just the first step. Granting that my laptop was aged, I moved the project to my more powerful desktop computer, only to encounter the same slowness. I spent an hour optimizing ArcMap using the usual canned tricks before giving up in frustration. Some weeks later, I attempted once more, only to be greeted by a licensing error that mocked my perfectly valid and unexpired license. Annoyed by this erroneous claim and unable to quickly resolve it, I decided to jump ship to an open source alternative. If the alternative was slow, so is ArcMap, and at least it wouldn't nag about expensive licenses!

Fortunately, thanks to an unrelated project involving unsupervised classification of satellite imagery, I already had QGIS with GRASS installed on my laptop. QGIS is an open source GIS software, and GRASS is a powerful programming toolbox that easily links into the program. A quick search revealed that this combination gave me the ability to delineate watersheds, so I opened QGIS and dragged in my DEM and drainage point. A few fast button-clicks later, I had a lovely and accurate watershed. I was blown away by how fast and easy the process was – and it was completely free.

Compared to R, I admit that ArcMap holds appeal for certain tasks – such as conveniently scrolling through projected geospatial data or easily creating professional maps with drag-and-drop capabilities, for example. Plus, some users prefer not to deal with code. However, after my QGIS experience, I'm astounded at its low market penetration compared to ArcMap. With a decent GUI and a robust feature set, QGIS (especially with GRASS) can deliver almost anything the user demands – quickly and for free. Price aside, ArcMap has seemingly grown bloated and slow over time – the inevitable consequence of its unparalleled market share (I confess I've yet to try ArcGIS for Desktop, so maybe that platform has addressed performance complaints). Fig.1 is an example of a simple map made quickly using R.

That said, I acknowledge that ArcMap revolutionized GIS software and continues to offer key features; some of its tools (Network Analyst comes to mind) and third-party extensions probably haven't been fully replicated elsewhere.
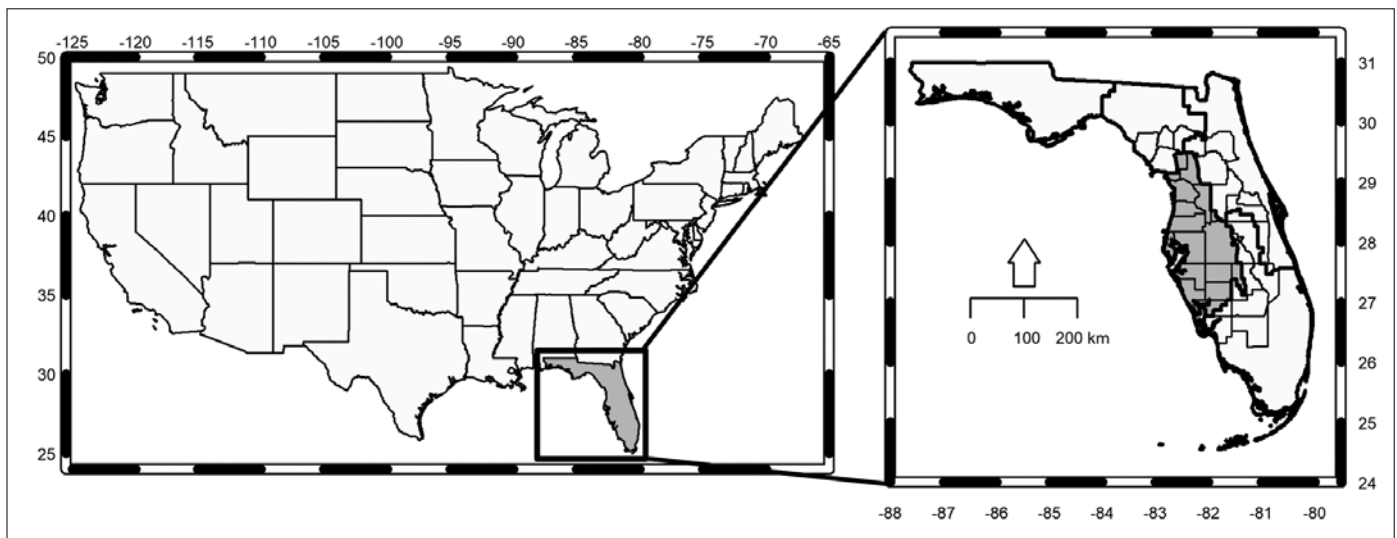

Figure 1 - A simple map made almost entirely in R (the callout lines were added in a photo editor).
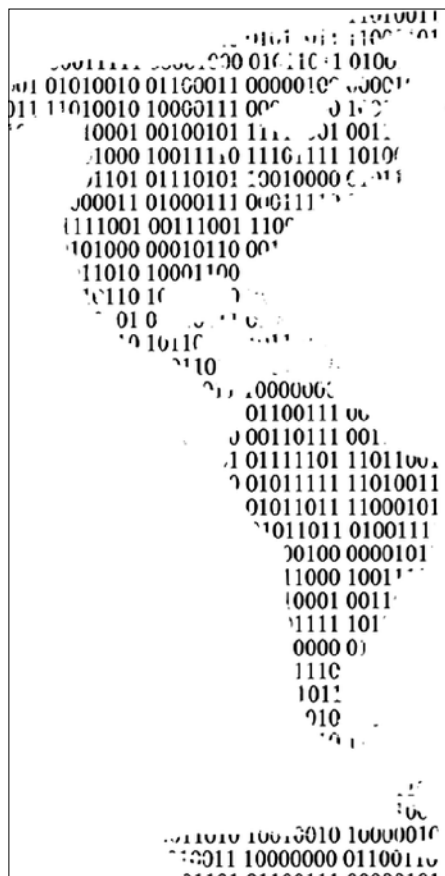
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Second, I hold nothing but praise for ESRI's field data collection apps. Finally, I acknowledge that some level of fees is necessary to underwrite ESRI's enterprise-level support and development. Despite these concessions, however, I echo a long list of academics and industry experts in holding that open source software options like QGIS and R represent the way of the future, for any number of reasons ranging from reproducibility and transparency to cost savings (see Moore and Hutchinson's 2017 piece, "Why Watershed Analysts Should Use R for Data Processing and Analysis," in The Confluence for a recent example).

While the perceived inconvenience of coding precludes R for many users, no such barriers exist for QGIS; I am therefore convinced the main reason QGIS hasn't seen wider adoption is simply inertia. ArcMap pioneered the GIS scene and companies expect proficiency in the software, leading schools to (appropriately, given market forces) focus on ArcMap in many geospatial classes. Unsurprisingly, there is a learning curve involved in going from ArcMap to QGIS, although I would venture that QGIS isn't any less user-friendly than its proprietary cousin: most longtime ArcMap users suffer from an "expert's blind spot" and forget how daunting its interface can be to the uninitiated. However, those able to learn ArcMap have demonstrated that they can learn QGIS (and R, for that matter). Meanwhile, educators interested in introducing students to QGIS – but rightly concerned with meeting market demands for skills in ArcMap – might consider holding class lessons in ArcMap using licensed school computers, while assigning simpler homework projects in QGIS; this would spare students the trouble of licensing their personal laptops, while giving them experience in both platforms.

As with ArcMap, most people will not develop expertise overnight, but basic proficiency can come relatively quickly. While there is some overlap in layout between ArcMap and QGIS, where the two diverge (a frequent occurrence), a simple search engine query on "how to X in QGIS" usually results in a number of helpful articles and posts (more often than not on Stack Overflow). More than once, after I've cast aside the baggage that I inevitably carry from years of ArcMap usage, I've recognized that QGIS's setup was ultimately the more intuitive. As I continue to use it, QGIS has consistently pleased me with its functionality (especially in concert with GRASS, and I should also mention the plugin Serval for easy raster editing).

Due to its combination of key suites of features and market dominance, ArcMap will rightfully continue to play a crucial role in many organization's geospatial operations. However, for those struggling to pay ArcMap fees, or simply hoping to expand their skillsets and capabilities, some combination of QGIS and R (or other open source platforms) can superpower analyses at little monetary expense. Put more simply, I rely on ArcMap and R on my work computer, but favor QGIS and R at home…and these days, I'm finding myself using QGIS more and more even in the former.

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