	krig_DEM	krig_slope	krig_aspect	krig_stdev	RST_DEM	RST_slope	RST_aspect	RST_stdev
Min	71.37	0	-180	0.466	66.55	0	-179.999	0.9144
1st Qu.	430.87	9.491	-112.845	11.545	430.42	10.29	-111.784	13.4169
Median	566.56	15.667	-5.742	17.734	567.06	16.74	-5.602	19.6106
Mean	551.38	15.713	-11.547	18.39	551.38	16.69	-11.034	20.2738
3rd Qu.	690.73	21.495	77.662	24.189	690.65	22.61	78.142	26.0236
Max	1005.2	54.47	179.997	85.725	1005.6	49.58	179.995	71.6148

Table 1: Statistical summary of interpolation products.

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Interview with Michael Barton

Michael Barton is is geoarchaeologist by training. His research interests are on long-term human ecology and human-environmental interaction at regional scales. He is professor & curator of archaeology/ethnology at the Arizona State University, Tempe, USA

Welcome to the first interview series in 2006. Could you start by telling us a bit about yourself, what is your profession, where do you live, which OS, GRASS version are you using etc? How did you first get into contact with GRASS?

Macintosh is my preferred computing platform. When the Mac OS switched to BSD Unix, I was interested in trying *GRASS* which I had heard of for many years. My colleagues and collaborators at the University of Valencia were also interested in *GRASS* at that time and beginning to work with Linux. By 2001, I was increasingly frustrated with *ArcView*, both the functioning of the program and the lack of Mac support. In fact, I wrote a letter to ESRI customer support about the lack of Mac support in particular and lack of support in general which sur-

prised me given that I am at a major US university which has had a campus-wide ESRI license since the late 1990s. I even said that without support for Mac/Unix platforms, I was strongly considering switching all my research and teaching to *GRASS*. ESRI's response was essentially, we are going to follow the commercial market. So I followed through on the threat and here I am.

Figure 1: Michael Barton

Which GIS/RS software did you use first? Any commercial ones, did you drop them in favour of GRASS? And if yes, why?

In my first year of graduate school still at the University of Kansas where I did my undergrad work was working as an RA (Research Assistant - a graduate student position to help a professor with a research project) for an archaeologist, doing spatial analysis of a late glacial archaeological site in Bosnia. We had thousands of artifacts from the excavation plotted in 3D and I had to do repeated back plots and plan views of artifacts. I could see in my mind the 3D artifact distribution, but re-plotting every artifact on graph paper for many views was too laborious to do. I heard that the Kansas Geological Survey was working on a computer mapping program. So I went to talk with the programmers to ask them if it was possible for a computer to take our xyz coordinates and make a contour map of artifact densities. They said not yet, but we're working on it. This was in 1976. I was looking for that kind of program from that point on. KGS (Kansas Geological Survey) eventually came out with *Surface* and *Surface II* that did this though it was far too late to help me in the RA

job.

When I did my PhD thesis in the mid-1980's, I used a version of Atlas Graphics to make one of my maps. It seemed like a good idea, but was very difficult to use. I didn't have access to the Unix workstations that *ArcInfo* and *GRASS* ran on in those days. After I came to ASU in 1987, I started my current long-running field project in eastern Spain. When I was planning for the first field season, I knew I wanted to do digital mapping. I first bought a CAD program with my grant money. We mapped survey areas and traced contour lines. Then *MapInfo* for Windows came out in 1990. I knew that GIS was what I REALLY needed, and moved all the first season's data to that.

MapInfo was my first real experience with GIS. My experience got a number of people interested in GIS here at ASU and some of them still use *MapInfo*. It is a very nice program in many respects. It is very sensible from the user point of view and quite powerful. Its main drawback is it poor support for raster spatial data. As I moved from making maps to spatial analysis, this became an increasing drawback for my research program. I remember following the instructions in Ian Johnson's *MapInfo* for archaeology book on how to do a Local Density Analysis with *MapInfo*. Eventually, I made the switch to *ArcView* 3 in the late 1990's. *ArcView* was pretty worthless before this. But with version 3 and some effort customising the program it was pretty functional. There were still a number of things that were much easier in *MapInfo* (especially database manipulation), but the combination of raster and vector overrode these annoyances.

As I said earlier, by 2000 and 2001, however, I had become increasingly frustrated with *ArcView* especially the bugginess and lack of Mac support. By 2001 (when I taught my first spatial technologies course here at ASU) I was running *ArcView* under Virtual PC and it was regularly crashing (it did the same for PC users). This was when I began seriously looking into *GRASS*. I had a sabbatical in Valencia in the fall of 2003, that included teaching an informal GIS seminar. This gave me the opportunity to really look into *GRASS*. I started to become proficient in the program that fall. The following spring (2004) I taught spatial technologies again here at ASU and used *GRASS* along with *ArcView* as a recommended program. This forced me to learn it much better (you HAVE to learn it well to teach it). Along with my colleagues in Valencia, I moved all of my data to *GRASS* that year. Now I'm using it as the primary GIS and spatial modelling tool for a large, 5-year research project in the Mediterranean, funded by the US National Science Foundation. I taught *GRASS* GIS to archaeology doctoral students at Valencia again last summer and am using it in my

remote sensing course at ASU this spring.

Do you recommend people (students, colleagues) to use GRASS instead of other software, and if yes, why?

I highly recommend it for 3 reasons:

1. It is simply an excellent piece of geospatial analysis and visualisation software. It is as or more powerful than any other GIS I've worked with and much easier to accomplish complex spatial analysis tasks in than other software.

2. Because it is open source, it can be modified to suit a given research project. The development team is highly responsive. I never could get a response from ESRI even though I've used it in a number of high-visibility projects. I can honestly tell people that when a bug is reported it is often fixed within 48 hours. That's so amazing that my colleagues generally won't believe me.

3. For students especially it is a great deal. Here is one of the most powerful spatial technologies available and they can keep it legally for their own research.

Unfortunately, because *GRASS* still is rather clunky on Windows and daunting to install in spite of the great installation web site done by Huidae Cho I have to temper my enthusiasm a bit for Windows users. I'm very hopeful about the efforts by Radim Blazek and others to produce a Windows-native *GRASS*. Even though I'm a die-hard Mac user, the majority of computer users here live in the Windows world, of course. I've been recommending QGIS to Windows folks a lot especially if they are relatively new to GIS. I'm getting folks interested in Linux and we'll see how that goes. For Mac users, Lorenzo Moretti's binaries have made it very easy to recommend *GRASS* even for less technical users.

What do you think is great about GRASS and which feature is missing?

The raster tools are great. But NVIZ always blows people away the most. I've been working with the true 3D volumetric tools and NVIZ visualisation and this blows people's socks off.

Good management tools for attribute data is the biggest lack that I can think of. As mentioned before, I'd also like a Windows version and better installation for Windows (they need a simple downloadable exe file installer). I've tried to improve the user interface which is important. If people can't figure out how to use a piece of software, its abilities are wasted.

How long have you been engaged in Open Source/GRASS development?

In late 2003, as I was getting to know the program, I wrote (what I thought was) a tactful email to one of the development team (maybe Markus) about the lamentable state of the tcltkgrass GUI. It was way out of date, not very well organised, missing half of the commands, and had several commands in twice. He tactfully wrote back that if I was concerned about the GUI, I could volunteer to fix it. I didn't write again for awhile. But in early 2004, after returning from sabbatical, I decided I'd take up the challenge and at least try to get all the commands in the GUI. I wanted to do this so I could use *GRASS* for my spatial technologies course. I added about 200 commands to tclckgrass for *GRASS* 5.3 and reorganised the menu to make it (IMHO) easier to navigate. I also wrote my first script. There was no easy way to get a nice *GRASS* display into another program (ps.map is powerful but easy it is NOT). So with considerable help from others, I wrote d.out.png. *GRASS* 5.1-5.7 development was underway at the time, and there was no overall interface to speak of for the new version. So I promised Markus that I'd work on it next. Radim had ported the display manager from 5.3 to 5.7 and Markus got me started on a menu. The first thing I had to do was find out which of the 400+ commands had been ported from 5.3 to 5.7. So I made a little text file of the 5.3 commands, so I could note whether they had or had not been ported to 5.7 and check off when I did the tcltkgrass menu for the command. (This BTW was the origin of the *GRASS* 6 porting list on the WIKI site).

Since early 2004, I've gone from nervously modifying existing TclTk menu files to finally learning enough TclTk to reprogram the entire GUI. This is the fun and challenging part working on an open source project like this. I've also learned enough shell-scripting to go from the first tentative d.out.png to d.vect.thematic that I finished at the beginning of 2005. This gave me the skills to write a very useful script that will compute USPED (Unit Stream Power Erosion/Deposition) for my NSF research project. I started my graduate students working with this and they have now turned this into a full-fledged landscape modeling platform. It's also rewarding to think that I may be helping a broad and diverse group of fellow scientists and GIS users around the world. Finally, I've enjoyed collaborating with *GRASS* pen-pals' around the globe. It's a great group of people to work with.

You have been developing the Tcl/Tk interface for quite a long time now, what are your plans for the future?

I released version 2 of the GIS Manager earlier

this year to help move *GRASS* toward a new user interface. It's becoming clear from the UI discussion last year and continuing into this year, that *GRASS* needs to shed its dependence on x-displays in order for a more sophisticated GUI to be developed. The new GIS Manager is a step in that direction. We are currently planning to replace TclTk with the more powerful wxPython interface toolkit. (Getting a start on learning Python and wxPython was my summer project.) However, in the interim, it is clear that we can get a lot more out of TclTk than we were previously.

Why are you dedicating so much time into GRASS? Philosophy, profession?

It's great and personally rewarding to be able to collaborate with the people on the *GRASS* team, benefit my own research and teaching, AND have fun at the same time. I think open source is a wonderful philosophy for software development and one that fits very well into an academic environment. We here at ASU are strongly encouraged to make meaningful contributions of our expertise to our community. Being a part of the *GRASS* project is one way I can do this.

Over the past couple years, I've had a wonderful opportunity to work with some really bright, dedicated, and diverse people to help produce some of the best geospatial software that money can buy. Then I get to turn around and give it to students and researchers for free. I enjoy that. But there is a more serious, underlying set of motivations that I have. As someone whose research interests centre around the long-term outcomes of our interactions with the environment, it is clear to me that these interactions are fundamentally critical for ensuring that our children have a world worth inhabiting. The past has many lessons of successes and failures in which the way in which people interacted with the world around them had important consequences for their well-being and their social and physical survival. But whereas, in the past a society could succeed or fail and have minimal impact on others, now, due to the our highly connected, global social and information network, such successes and failures have repercussions for all of humanity.

However, socio-environmental interactions are highly complex and even more so in our as they reach global scales–beyond even our extraordinary human abilities to understand complex systems. Yet understand them we must or we put our future at risk. We have become a keystone species in most terrestrial ecosystems, leaving us no choice but to manage these systems for better or for worse.

So what does this all have to do with *GRASS*? New kinds of computer technology and data never before available (from ancient climates to satellite imagery) give us the tools to understand the operation of coupled human-natural systems (I use the term socioecosystems) better than we ever could before. This kind of understanding gives us a better chance to make more intelligent choices about how we manage our interactions with the world. But because the emergent properties of these highly complex systems produce many surprises in spite of the potential for better understanding, we stand a much better chance if we can come up with a high diversity of potential solutions to problems as they arise.

By making complex geospatial analysis and modelling technology as widely available as possible–from undergraduate students in Arizona, to environmental planners in Italy, to ecologists in Sri Lanka, to agronomists in South Africa–we give ourselves a better chance of finding diverse solutions to old and new problems, and so making this a better world for our children. As a citizen of a 'first world' country, I'm very fortunate to have a life that allows me the opportunity to spend time on something like the *GRASS* project. In working on the *GRASS* project, I have an opportunity to give back of my good fortune to others and at the same time help 'hedge our bets' for the future by making tools to better understand our world available to all who need them.

What would be in your opinion a major breakthrough for GRASS?

Seamless 2D-2.5D-3+D GIS and visualisation. *GRASS* is already way ahead of the competition in this direction. Integrating these abilities into a single way of analysing and visualising spatial data would make *GRASS* THE outstanding program in its class by far.

When do you think will this be accomplished? Will it be part of the new UI design? Any timeframe?

I hope soon. Glynn Clements and others on the development team have been working to bring the internal *GRASS* display architecture into the 21st century over the past few months. Recent changes to NVIZ have freed it from needing an xterminal and I'm now working with Bob Covill to update the TclTk side of this module. Hopefully, these changes will make it easier to integrate NVIZ-like displays with the rest of *GRASS* visualisation as the display architecture and GUI evolve. In the new GIS Manager, I've set it so that you can create an NVIZ display (using current NVIZ technology) from the same set of layers that create your 2D display in a map display window. This is not the kind of integration I envision ultimately for *GRASS*. But perhaps it will give some inspiration to move in that direction. One recent development that gives me cause for optimism is the inclusion of *GRASS* as a founding member of

the new Open Source Geospatial Foundation (OS-Geo). This could provide resources, code, and inspiration for *GRASS* development to take place much more rapidly than when it was on its own. This is an exciting development for geospatial technologies in general.

Thanks for the interview and all the best for your GRASS engagement!

The GRASS Development Team announces GRASS GIS 6.2.0

released 31 Oct 2006

We are happy to announce that a new stable version of GRASS GIS has been released today. This release adds hundreds of new features, support for the latest GIS data formats, and includes new translations for many languages. The Geographic Resources Analysis Support System, commonly referred to as GRASS, is a Geographic Information System (GIS) combining powerful raster, vector, and geospatial processing engines into a single integrated software suite. GRASS includes tools for spatial modeling, visualization of raster and vector data, management and analysis of geospatial data, and the processing of satellite and aerial imagery. It also provides the capability to produce sophisticated presentation graphics and hardcopy maps. GRASS is currently used around the world in academic and commercial settings as well as by many governmental agencies and environmental consulting companies. It runs on a variety of popular hardware platforms and is Free open-source software released under the terms of the GNU General Public License. Joining GRASS's well-developed raster engine, the GRASS 6 series introduced a new topological 2D/3D vector engine featuring support for vector network analysis and SQL-based DBMS management of linked attributes. This new release improves the integration and functionality of the raster and vector engines, and greatly enhances 3D raster volume (voxel) support. Additionally, this release debuts a new graphical GIS manager and menu system, while an improved version of the old GUI display manager has been retained for legacy support. The NVIZ visualization tool has been enhanced to display 3D vector data and voxel volumes, and now supports the creation of on-the-fly MPEG animations. Further improvements include substantial message translations (i18n) with support for FreeType fonts, including multi-byte Asian characters, and the inclusion of tools to create new project locations automatically given a georeferenced data file or EPSG code. This is the first release of GRASS as a proposed founding project of the new Open Source Geospatial Foundation. In support of the movement towards consolidation in the open source geospatial software world, GRASS is tightly integrated with the latest GDAL/OGR libraries. This enables access to an extensive range of raster and vector formats, including OGC-conformal Simple Features. GRASS also makes use of the highly regarded PROJ.4 software library with support for most known map projections and the easy definition of new and rare map projections via custom parameterization.

Platforms supported by GRASS

GNU/Linux, Mac OS X/Darwin, Microsoft Windows (native using MinGW or with full UNIX support via Cygwin), Sun Solaris (SPARC/Intel), Silicon Graphics Irix, HP-UX, DEC-Alpha, AIX, BSD, iPAQ/Linux and other UNIX compliant platforms. GRASS runs on both 32 and 64 bit systems with large files (>2GB) supported by many key modules.