

Scaling up globally: 30 years of FOSS4G development

Keynote

Markus Neteler

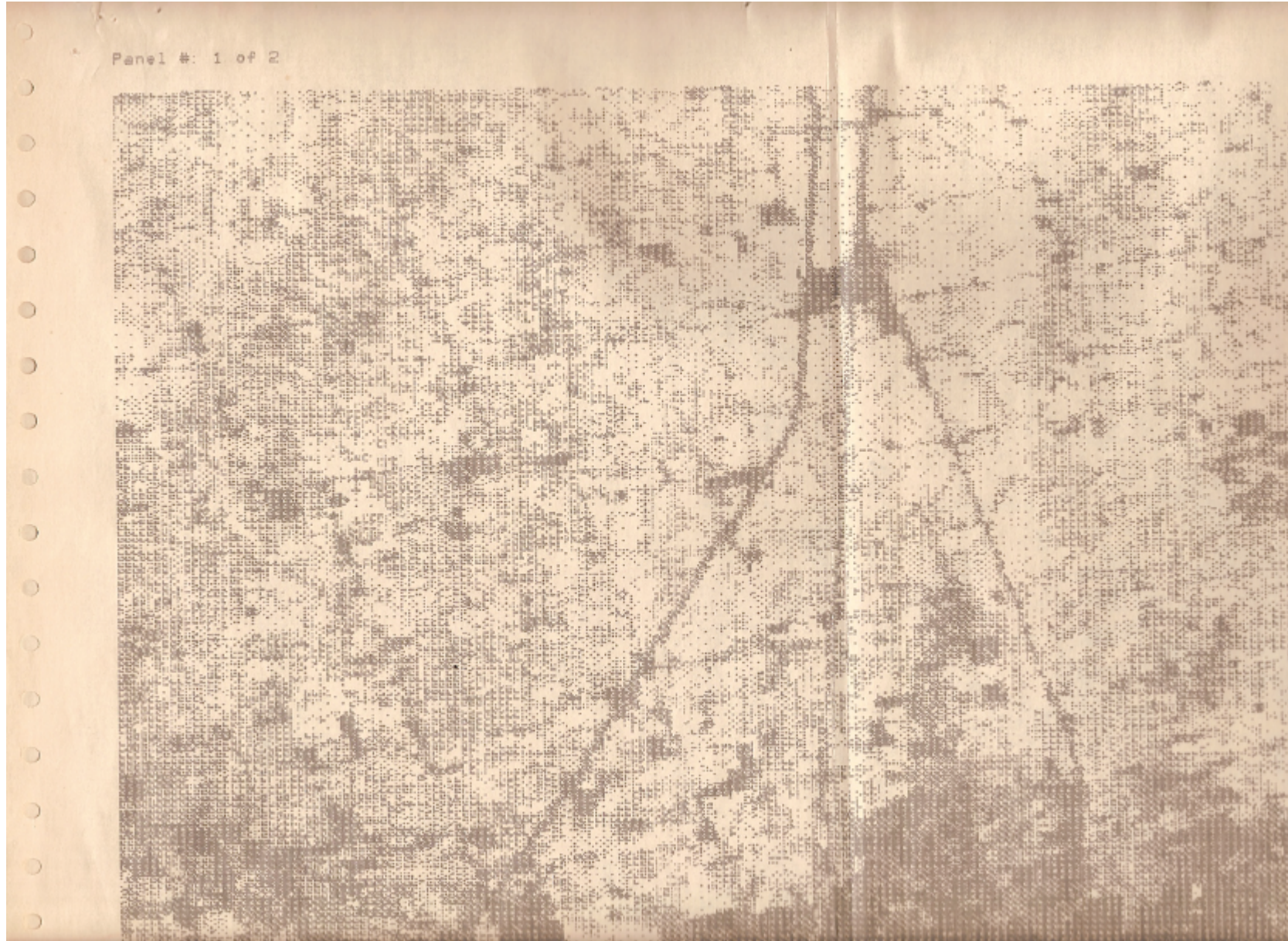
Fondazione Edmund Mach
Research and Innovation Centre
Department of Biodiversity and Molecular Ecology
GIS and Remote Sensing Unit

FOSS4G Central and Eastern Europe 2013

16th - 20th June, National Library of Romania
Bucharest, Romania



THE 80's ... the beginning



*Img. courtesy: J Westervelt 2006:
Early GRASS Community Views on FOSS*

THE 80's ...

1980 – LAGRID – J. Westervelt master's thesis:
GIS software, developed on a mainframe computer,
then ported to Cromemco Z-80. FORTRAN

1982 – FHIS (Fort Hood Information System)
Vax 11/780 minicomputer, UNIX, C language.
Programmer: [L. Van Warren](#)

1983 – "GIS Version 1 Reference Manual"
by J. Westervelt and M. O'Shea, **29 July 1983**

Included GIS programs:

arctogrip	griptocell
area_stats	layer_info (r.info)
cell_stats	list (g.list)
cellmod (grid editor)	over (d.rast, but for b/w monitor)
coin (r.coin)	reclass (r.reclass)
combine (boolean combination)	sho_over (display images created by over)
distance (r.buffer)	table (stats associated with over)
dotmap (graphics on a dot-matrix printer)	whats_here (r.info with a mask)
erase (d.erase)	window (g.region)

1983 – PROJ4 library development started by Gerald I. Evenden



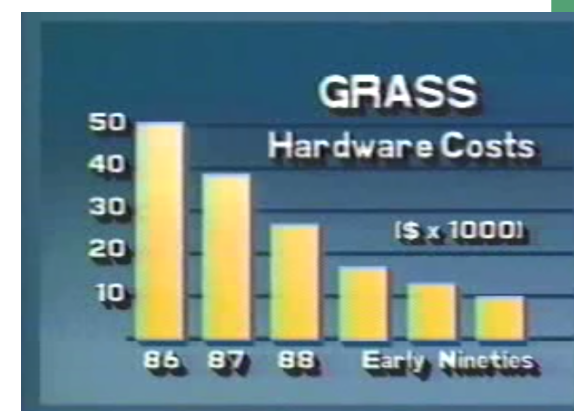
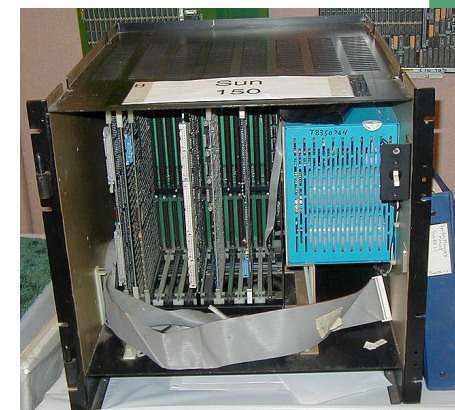
THE 80's ...

August, 1983 – U. S. Army Corps of Engineers' Construction Engineering Research Laboratory (USA/CERL) in Champaign, Illinois

Purchase of first Sun-150 computers (2) – specs:

- \$8.900 16 bit, 10Mhz, 256Kb memory, 10Mbps Ethernet, 17" b/w monitor (100*800)
- \$3.400 1Mbyte extra memory
- \$2.000 3/4M Fast Sun Memory
- \$1.590 Barko color monitor
- \$6.540 80Mbyte hard disk
- \$1.900 Disk controller board
- \$5.500 Dot Matrix printer
- \$1.500 Vanilla UNIX software -or-
- \$2.000 4.2BSD plus library of graphics software

... 33k USD



1983/1984 New analysis capabilities added in GRASS GIS:

Boolean combination - gridcell and polygon
Weighted overlay - gridcell and polygon (reworked later into r.mapcalc)
Distance-from (now r.buffer)
Isoline generation (grid to poly - now r.contour)
Coincident tabulation (now r.coin)
Mathematical combination (reworked later into r.mapcalc)

Source:

<http://lists.osgeo.org/pipermail/grass-psc/2012-December/000985.html>

THE 80's ...

1984 – GRASS running on SUN-1 and Masscomp

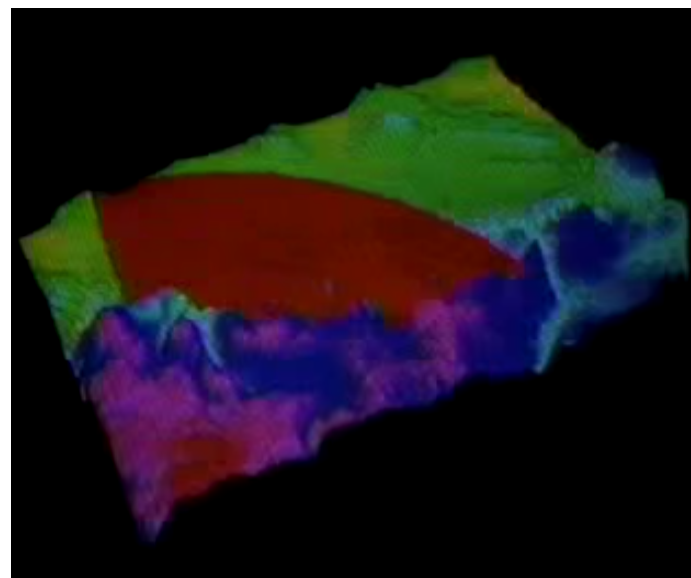
1985 – GRASS 1.0, GRASSnet established
(pre-mailing list)



*15 March 1985: **first** commercial Internet domain name registered*

1985 – Richard Stallman publishes the **GNU Manifesto**

1987 – GRASS 2.0; first issue of *GRASSClippings* Newsletter
GRASS video narrated by William Shatner (Captain Kirk of Star Trek)



1988 – GRASS 3.0; Army R&D Achievement Award (Webster, Goran, Shapiro, Westervelt)

THE 80's ...

1989 – GRASS 3.1

First release available on **Internet**
(uxc.cso.uiuc.edu)



But how was software developed? Locally!

While Revision Control System (RCS) was available and sometimes used, yet no server based system like “CVS” (CVS 1.0 in 1990 – today: SVN, git, ...)

TCP/IP goes global (1989–2010)

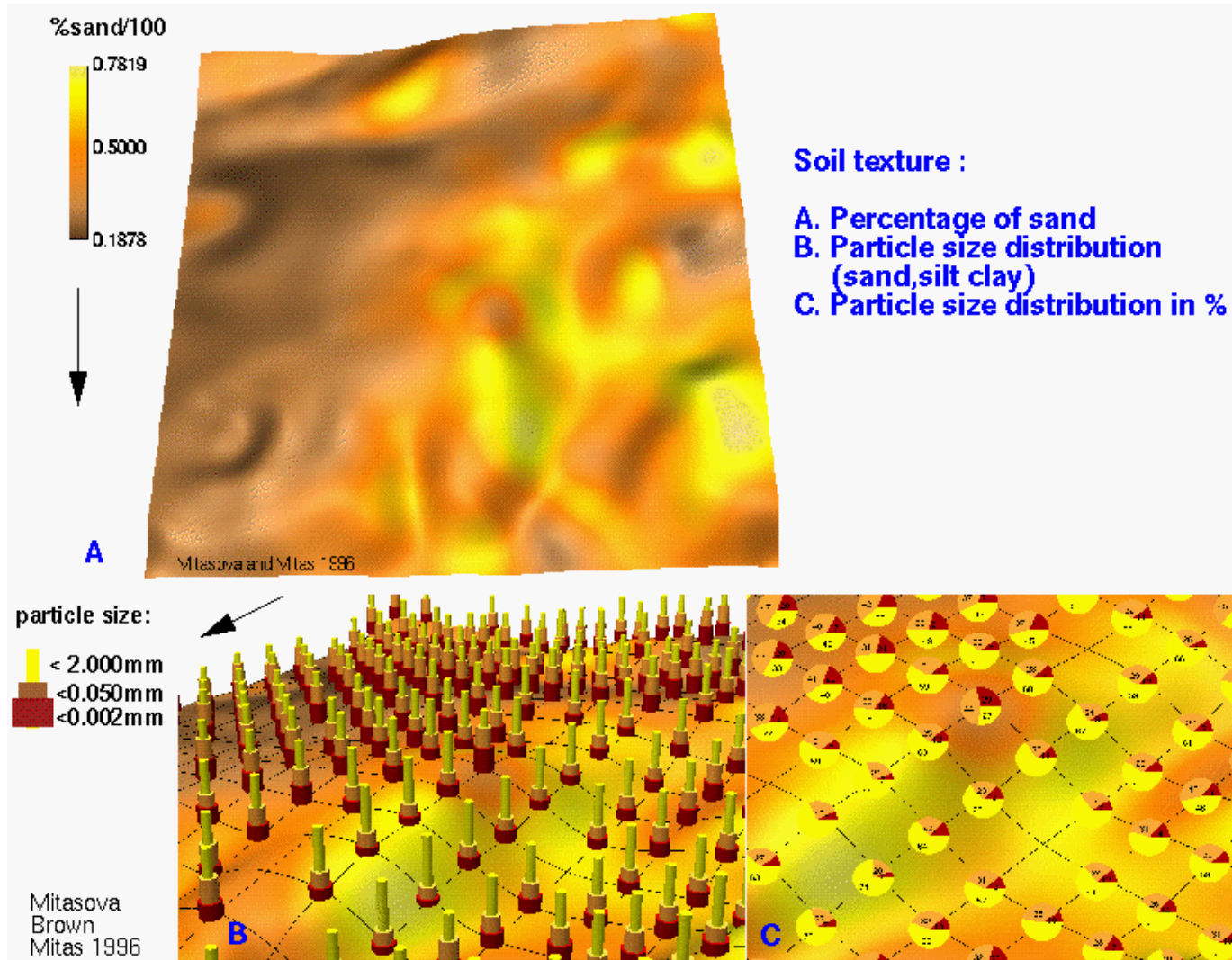
However:

*By 1992, still **less than 15,000** .com domains registered...*

See also:

- <http://grass.osgeo.org/home/history/>
- http://wiki.osgeo.org/wiki/Open_Source_GIS_History
- http://grass.osgeo.org/uploads/grass/history_docs/westervelt2004_GRASS_roots.pdf

THE 90's ... visualization and analysis



Source: Helena Mitasova

<http://skagit.meas.ncsu.edu/~helena/gmslab/gsoils/vizrep2.html>

THE 90's ...

1990 – GRASS 4.0

Letter-dot format adopted for commands (e.g. d.rast and g.region)

1991 – First mailing lists

lists.osgeo.org/pipermail/grass-user/1991-December/013383.html

Opening night

Rob Knauerhase [rob at zorro.cecer.army.mil](mailto:rob@zorro.cecer.army.mil)

Mon Dec 16 19:10:33 EST 1991

- Next message: [Opening night](#)
- Messages sorted by: [\[date \]](#) [\[thread \]](#) [\[subject \]](#) [\[author \]](#)

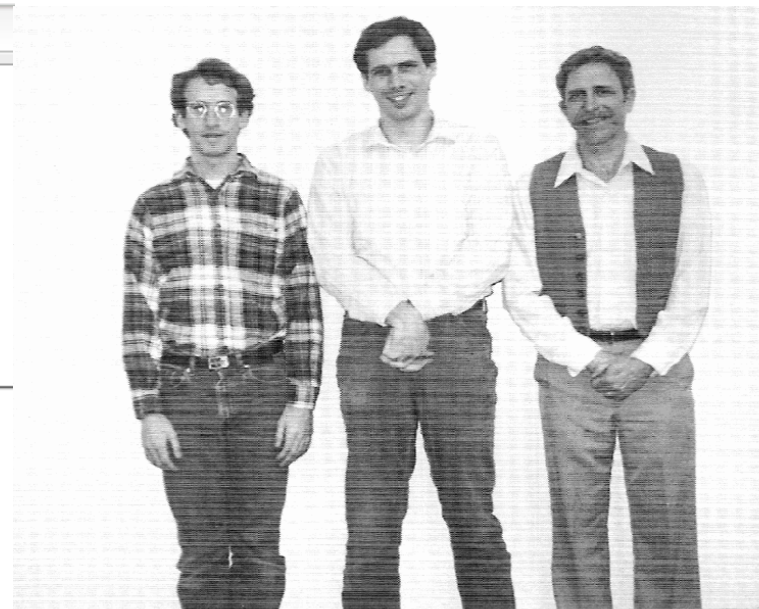
To everyone who has beta-tested the list:

This is the last dry-run before releasing it to the world. There are no more bugs, right? :-)

Rob

- Next message: [Opening night](#)
- Messages sorted by: [\[date \]](#) [\[thread \]](#) [\[subject \]](#) [\[author \]](#)

[More information about the grass-user mailing list](#)

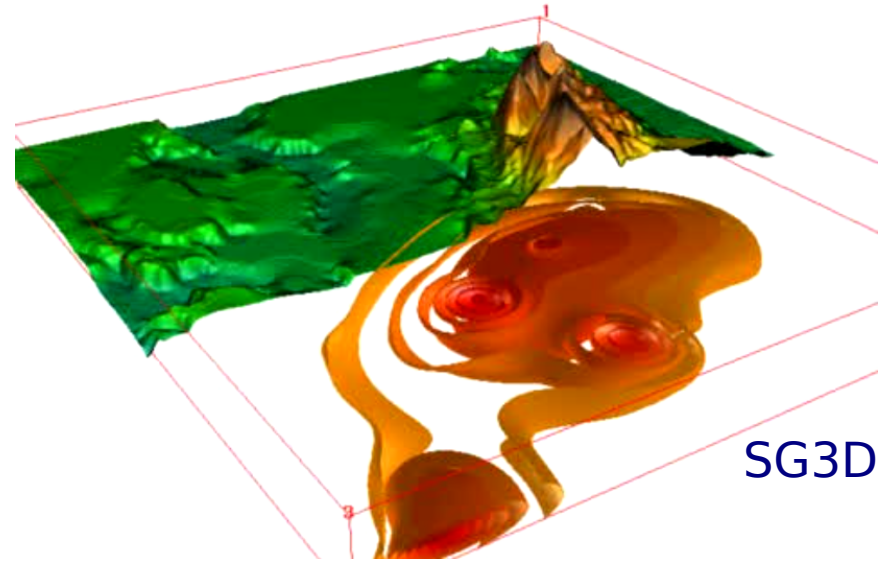
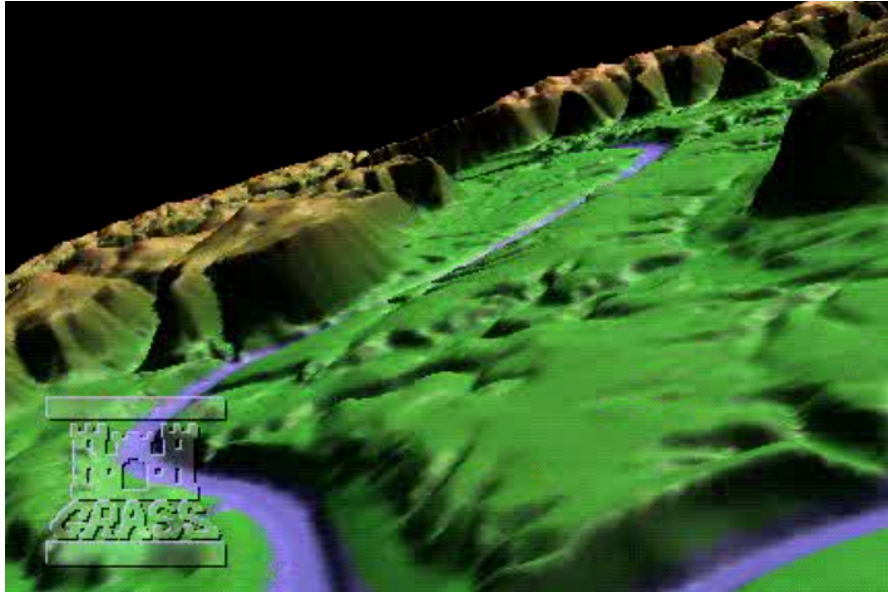


CERL's Michael Shapiro, Jim Westervelt, and Bill Goran, recipients of the 1st GAIA Award (photo by Brenda Johnson, USACERL, 3/90).

November 1992:	[Thread] [Subject] [Author] [Date]
October 1992:	[Thread] [Subject] [Author] [Date]
September 1992:	[Thread] [Subject] [Author] [Date]
August 1992:	[Thread] [Subject] [Author] [Date]
July 1992:	[Thread] [Subject] [Author] [Date]
June 1992:	[Thread] [Subject] [Author] [Date]
May 1992:	[Thread] [Subject] [Author] [Date]
April 1992:	[Thread] [Subject] [Author] [Date]
March 1992:	[Thread] [Subject] [Author] [Date]
February 1992:	[Thread] [Subject] [Author] [Date]
January 1992:	[Thread] [Subject] [Author] [Date]
December 1991:	[Thread] [Subject] [Author] [Date]

THE 90's ...

1992 – New graphics technology became available: **openGL**



**Software distribution:
"Moon" FTP server of CERL**

(note: still 2 years to wait for WWW!)



SGI Indigo

THE 90's ...

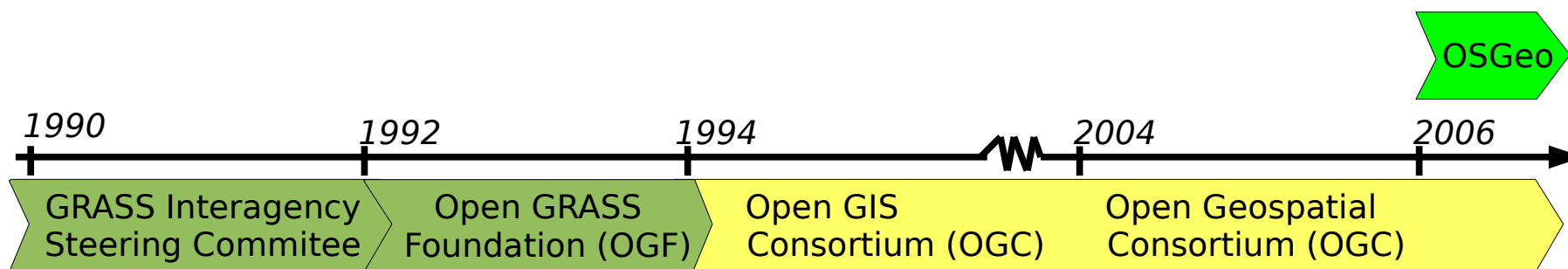
ORGANIZATIONS

1992

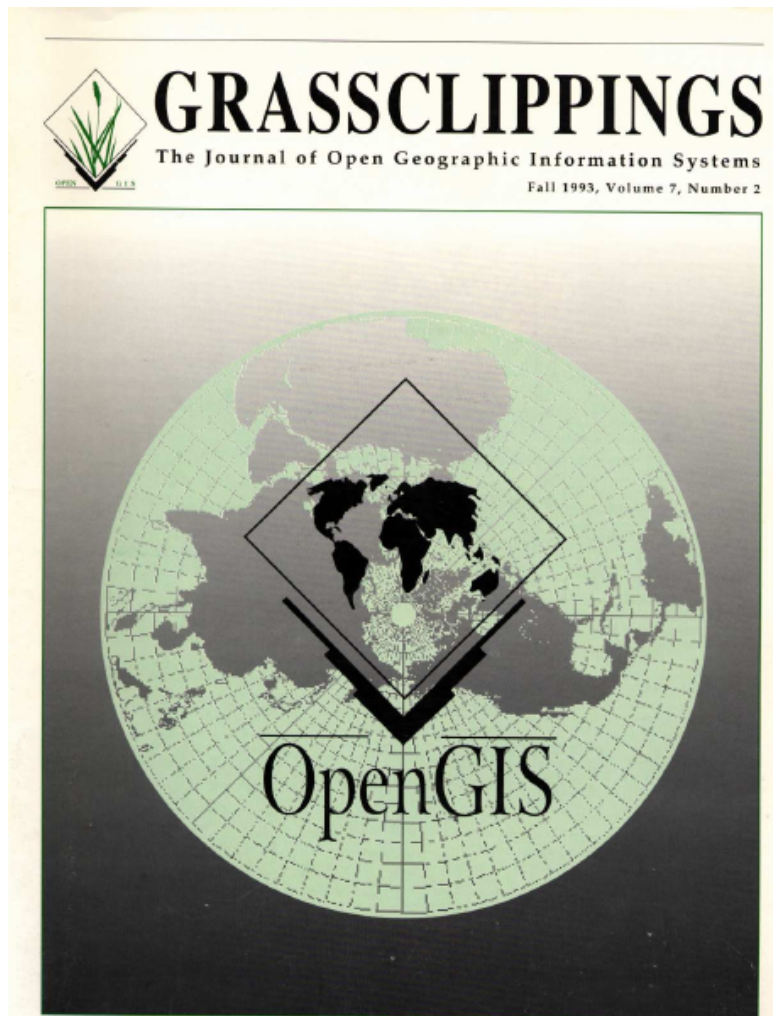
GRASS Inter-Agency Coordinating Committee
→ Open GRASS Foundation (OGF)
→ OpenGIS Consortium (OGC)

1994 – Tim Berners-Lee decided to constitute the
World Wide Web Consortium (W3C)

1994 – Open Geospatial Consortium
(OGC) founded



THE 90's ...



GRASSCLIPPINGS
The Journal of Open Geographical Information Systems
Fall 1993, Volume 7, Number 2

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"GRASSCLIPPINGS" is a periodic publication of the Open GIS Foundation, a not-for-profit corporation. The purpose of this journal is to provide information about the Geographical Resource Analysis Support System (GRASS) software and to provide a forum for the promotion of open geographic information systems (Open GIS) in general. Although GRASS is developed at the U.S. Army Construction Engineering Research Laboratory (USACERL), opinions expressed and advertisements placed herein are not to be considered an official expression or endorsement by USACERL. Reproduction of its contents is prohibited without express written consent from the editor. Copyright 1993, The Open GIS Foundation. Articles, advertisements, inquiries, and comments are welcome and should be addressed to: GRASSCLIPPINGS Editor, c/o The Open GIS Foundation, 1 Kendall Square, Building 20, Suite 2200, Cambridge, MA, 02139.

This issue was produced on a Macintosh™ with QuarkXPress™.

ISSN 0899-7903

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Course Printing and Mailing, Champaign, Illinois, has been printing GRASSCLIPPINGS since 1989. OGF's Executive Director and Board of Directors wish to thank Shirley and David Groves and their employees for their unfailing support, advice, and patience, and for the dependable high quality of their work.

2 GRASSCLIPPINGS The Journal of Open GIS Fall 1993

<http://grass.osgeo.org/home/history/documents/>

The Open GIS Foundation

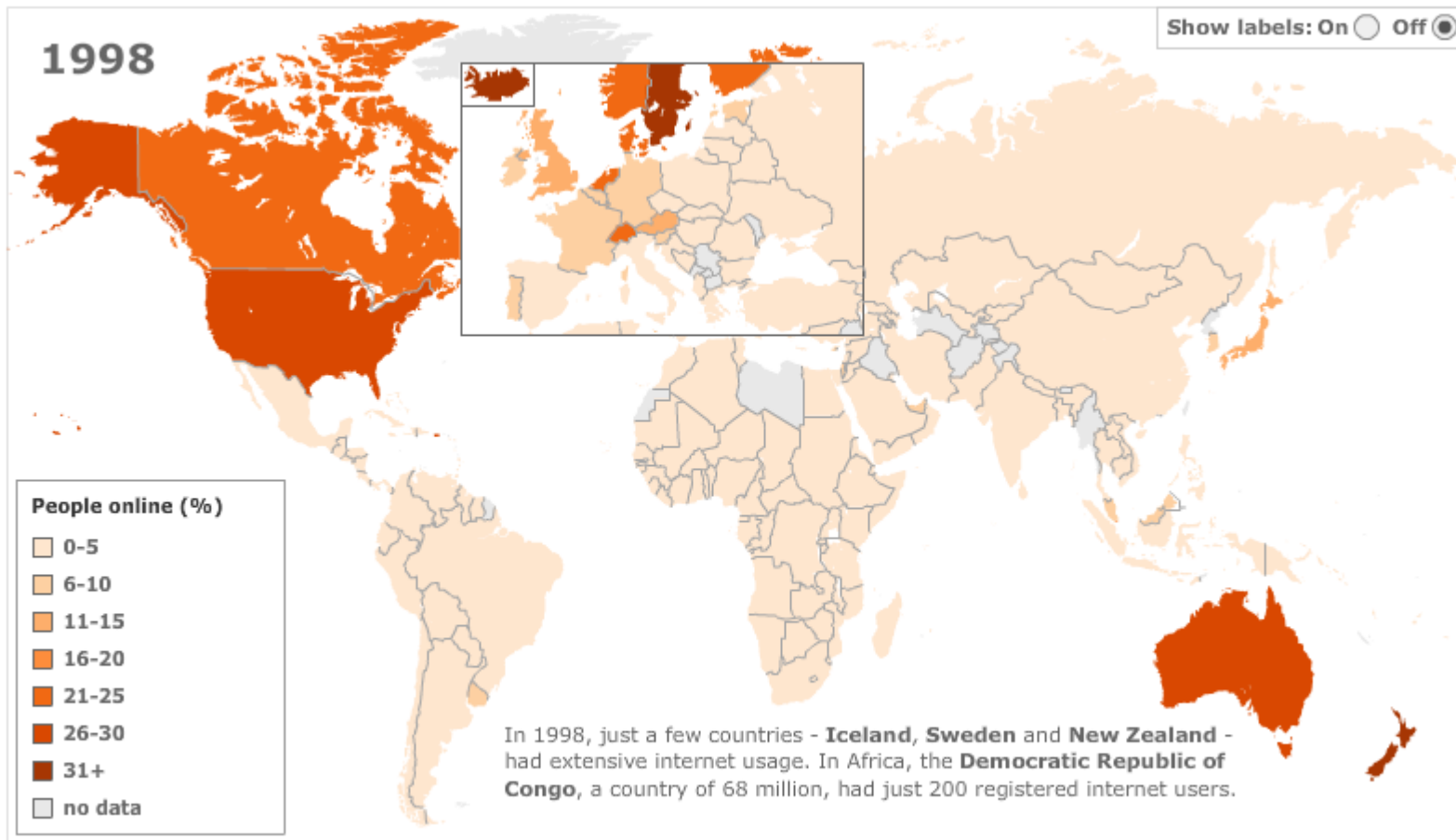
A Forum for the Promotion of Open Geographic Information Systems

The Open GRASS Foundation has changed its name to The Open GIS Foundation to reflect a broader focus and to express the organization's desire to emphasize GRASS in the context of the larger concerns of "Open GIS" and "interoperability."

industries; and, that organizations participating in the geoprocessing industry — government, academic and commercial — must work together to evolve a common data sharing architecture to best meet the needs of the nation, which

THE 90's ...

Internet growth as a crucial precursor to FOSS4G development



Source:
<http://news.bbc.co.uk/2/hi/technology/8552410.stm>

THE 90's ...

First Web Applications come up, finally!

1993 – Xerox PARC Map Viewer

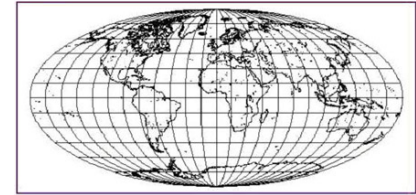
1994 – GNU/Linux 1.0 released

1995 – First GRASS 4.1.5 port to Linux
(Andreas Holz, Greifswald, Germany)

1995 – UMN MapServer project started

1995 –
Well, and also the first **spam** email in the
GRASS mailing list

Xerox PARC Map Viewer: world 0.00N 0.00E (1.0X)



Select a point on the map to zoom in (by 2), or select an option below. Please read [About the Map Viewer](#), [FAQ](#) and [Details](#). To find a U.S. location by name, see the [Geographic Name Server](#).

Options:

- Zoom In: (2), (3), (4), (5); Zoom Out: (1/2), (1/3), (1/4), (1/5)
- Features: Default: All; borders: [show](#)
- Display: color; Projection: [elliptical](#), [rectangular](#), [sinusoidal](#); [Narrow](#), [Square](#)
- Change Release to [USA only \(more detail\)](#)
- [Hide Map Image](#), [Retrieve Map Image Only](#), [No Zoom on Select](#),
- [Place mark at \(0.00N 0.00E\)](#), [Reset All Options](#)



Do you remember:
*30 slackware disks downloaded,
but unfortunately in FTP **ASCII**
mode (7 bit, not 8)??*

lists.osgeo.org/pipermail/grass-user/1995-November/011522.html

"Electroacupuncture" for smoking cessation in Raleigh, NC

cpub.duke.edu cpub.duke.edu

Mon Nov 6 07:00:00 EST 1995

- Previous message: [Scanning maps and GRASS](#)
- Next message: [ARC to GRASS](#)
- Messages sorted by: [\[date \]](#) [\[thread \]](#) [\[subject \]](#) [\[author \]](#)

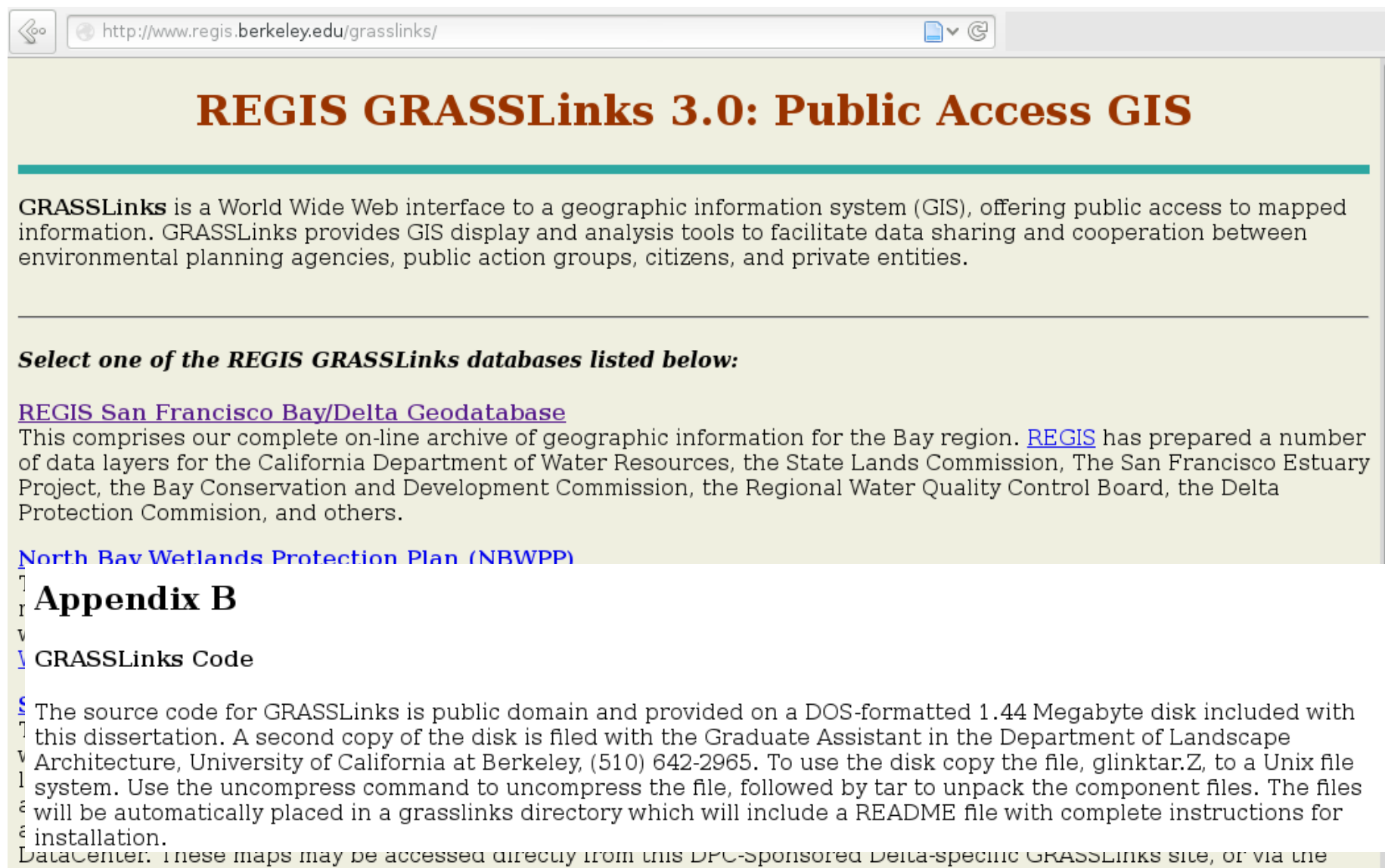
edu>#1/1
approved: Usenet_at_ux1.cso.uiuc.edu
content-type: TEXT/PLAIN; charset=US-ASCII
organization: Duke University, Durham, NC, USA
mime-version: 1.0
newsgroups: info.grass.user
originator: daemon_at_ux1.cso.uiuc.edu

DO YOU WANT TO STOP SMOKING?
We would like to invite you to participate in a SMOKING CESSATION program

THE 90's ...

An interactive GIS via WWW, perhaps the first “Web Processing” service...

1994-1998 – Susan M. Huse's GRASSLinks (PhD thesis at Berkeley)



The screenshot shows a web browser window with the address bar containing the URL <http://www.regis.berkeley.edu/grasslinks/>. The page title is "REGIS GRASSLinks 3.0: Public Access GIS". The main content area has a light green background and contains the following text:

REGIS GRASSLinks 3.0: Public Access GIS

GRASSLinks is a World Wide Web interface to a geographic information system (GIS), offering public access to mapped information. GRASSLinks provides GIS display and analysis tools to facilitate data sharing and cooperation between environmental planning agencies, public action groups, citizens, and private entities.

Select one of the REGIS GRASSLinks databases listed below:

[REGIS San Francisco Bay/Delta Geodatabase](#)
This comprises our complete on-line archive of geographic information for the Bay region. REGIS has prepared a number of data layers for the California Department of Water Resources, the State Lands Commission, The San Francisco Estuary Project, the Bay Conservation and Development Commission, the Regional Water Quality Control Board, the Delta Protection Commission, and others.

[North Bay Wetlands Protection Plan \(NBWPP\)](#)

Appendix B

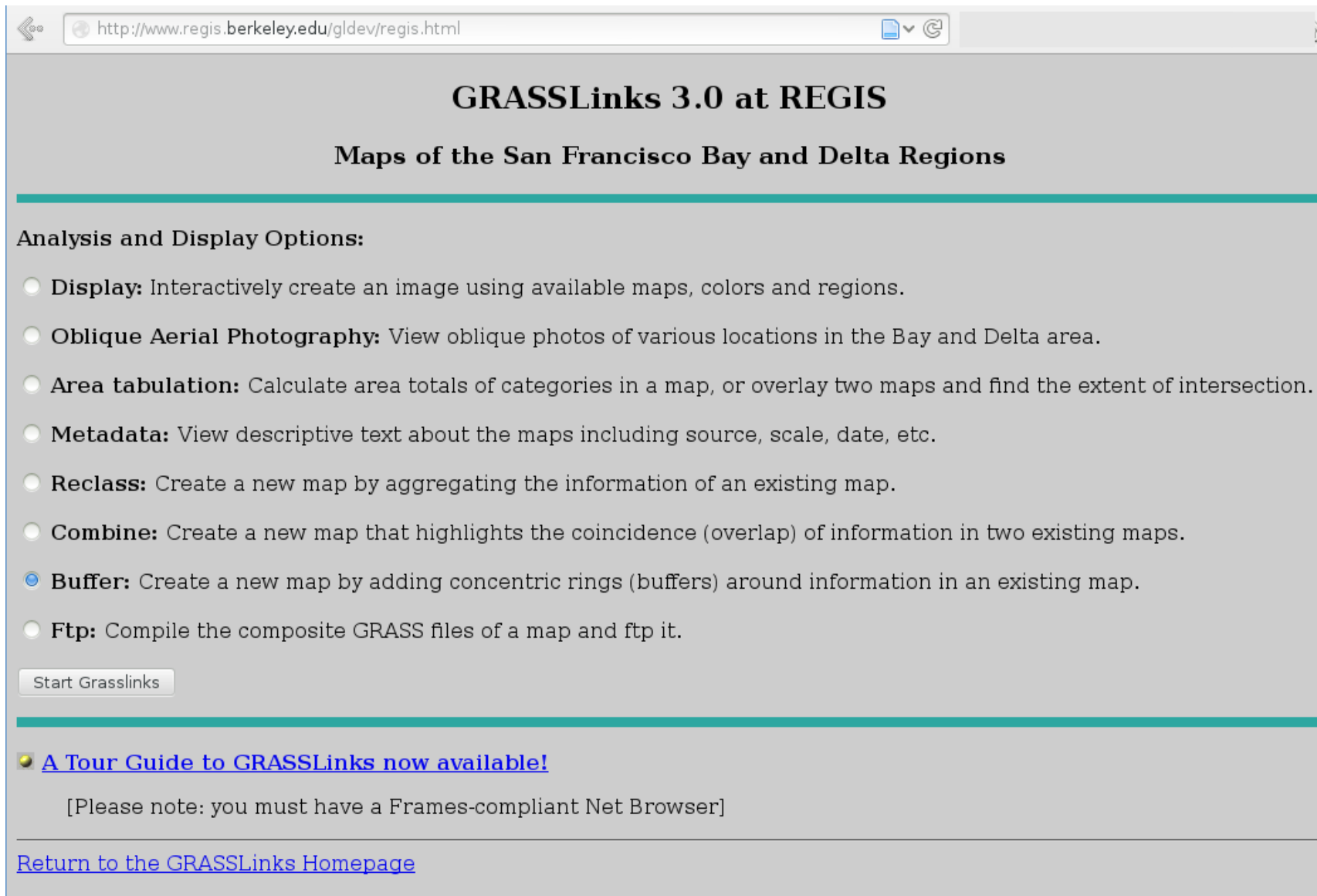
[GRASSLinks Code](#)

§ The source code for GRASSLinks is public domain and provided on a DOS-formatted 1.44 Megabyte disk included with this dissertation. A second copy of the disk is filed with the Graduate Assistant in the Department of Landscape Architecture, University of California at Berkeley, (510) 642-2965. To use the disk copy the file, glinktar.Z, to a Unix file system. Use the uncompress command to uncompress the file, followed by tar to unpack the component files. The files will be automatically placed in a grasslinks directory which will include a README file with complete instructions for installation.

DataCenter. These maps may be accessed directly from this DPC-sponsored Delta-specific GRASSLinks site, or via the

THE 90's ...

GRASSLinks



The screenshot shows a web browser window with the address bar containing <http://www.regis.berkeley.edu/gldev/regis.html>. The page title is "GRASSLinks 3.0 at REGIS" and the subtitle is "Maps of the San Francisco Bay and Delta Regions". Below the subtitle is a horizontal teal line. The main content area is titled "Analysis and Display Options:" and contains a list of nine options, each with a radio button. The "Buffer" option is selected. Below the list is a button labeled "Start Grasslinks". Another horizontal teal line is below the button. At the bottom, there is a link "A Tour Guide to GRASSLinks now available!" with a small globe icon, followed by a note in brackets: "[Please note: you must have a Frames-compliant Net Browser]". At the very bottom is a link "Return to the GRASSLinks Homepage".

http://www.regis.berkeley.edu/gldev/regis.html

GRASSLinks 3.0 at REGIS

Maps of the San Francisco Bay and Delta Regions

Analysis and Display Options:

- Display:** Interactively create an image using available maps, colors and regions.
- Oblique Aerial Photography:** View oblique photos of various locations in the Bay and Delta area.
- Area tabulation:** Calculate area totals of categories in a map, or overlay two maps and find the extent of intersection.
- Metadata:** View descriptive text about the maps including source, scale, date, etc.
- Reclass:** Create a new map by aggregating the information of an existing map.
- Combine:** Create a new map that highlights the coincidence (overlap) of information in two existing maps.
- Buffer:** Create a new map by adding concentric rings (buffers) around information in an existing map.
- Ftp:** Compile the composite GRASS files of a map and ftp it.

Start Grasslinks

[A Tour Guide to GRASSLinks now available!](#)

[Please note: you must have a Frames-compliant Net Browser]

[Return to the GRASSLinks Homepage](#)

THE 90's ...

Internet, its tools and geeks spreading!

1996 – **GeoTools** project started

1998 – **deegree** (originally JaGo) development started with an OGC Simple Features implementation

1998 – **GDAL/OGR** development started

1998 – First European GRASS GIS server at ILN, Uni Hannover, Germany

1999 – GRASS GIS source code moved from manual management to CVS, precisely on 29 Dec. 1999 :-)

 lists.osgeo.org/pipermail/grass-user/1998-April/001148.html

The BIG Spring '98 functionality check of GRASS 4.2.1

Markus Neteler [neteler at geog.uni-hannover.de](mailto:neteler@geog.uni-hannover.de)

Wed Apr 8 09:36:19 EDT 1998

- Previous message: [ERDAS to GRASS](#)
- Next message: [ERDAS to GRASS](#)
- Messages sorted by: [\[date \]](#) [\[thread \]](#) [\[subject \]](#) [\[author \]](#)

Dear GRASS community,
spring time is cleaning time!

So I invite you to the

The BIG Spring '98 functionality check of GRASS 4.2.1
.....

This is the invitation to YOU to make a better GRASS! Due to some
errors which are still in GRASS 4.2.1 I suggest to get through

Since 2000... May the FOSS be with you



Free/Libre and Open Source Software (FOSS)
Copyleft Mayuri 2004

Since 2000... growing communities

2001 – OSSIM initial revision in CVS

PostGIS started

GeoNetwork opensource started

GeoServer started

Thanks to CVS,
SVN and git

2002 – Quantum GIS initial revision in CVS

GEOS initial revision in CVS

2003 – Community MapBuilder started. End of life in 2008

Release of Mapbender under the GNU GPL license

gvSIG was started

2004 – uDig was started

2005 – MapGuide Open Source

2006 – Mapbender gets first bits in CVS

OpenLayers Started

2006: OSGeo!



2007 – GeoMoose was open sourced (started 2005)

2009 – rasdaman was open sourced (started 1995)

http://wiki.osgeo.org/wiki/Open_Source_GIS_History

Since 2000...growing communities



Chulalongkorn University,
Bangkok 2004:

FOSS4G is born!

Jim Westervelt



Special thanks to
Venkatesh Raghavan,
Osaka City University



Since 2000...growing communities



Mapbender
code sprint 2007

FOSS4G Conferences:
Lausanne, Denver,
Victoria, Cape Town, Sydney,
Barcelona, Denver, ...



QGIS Hackfest Pisa 2010

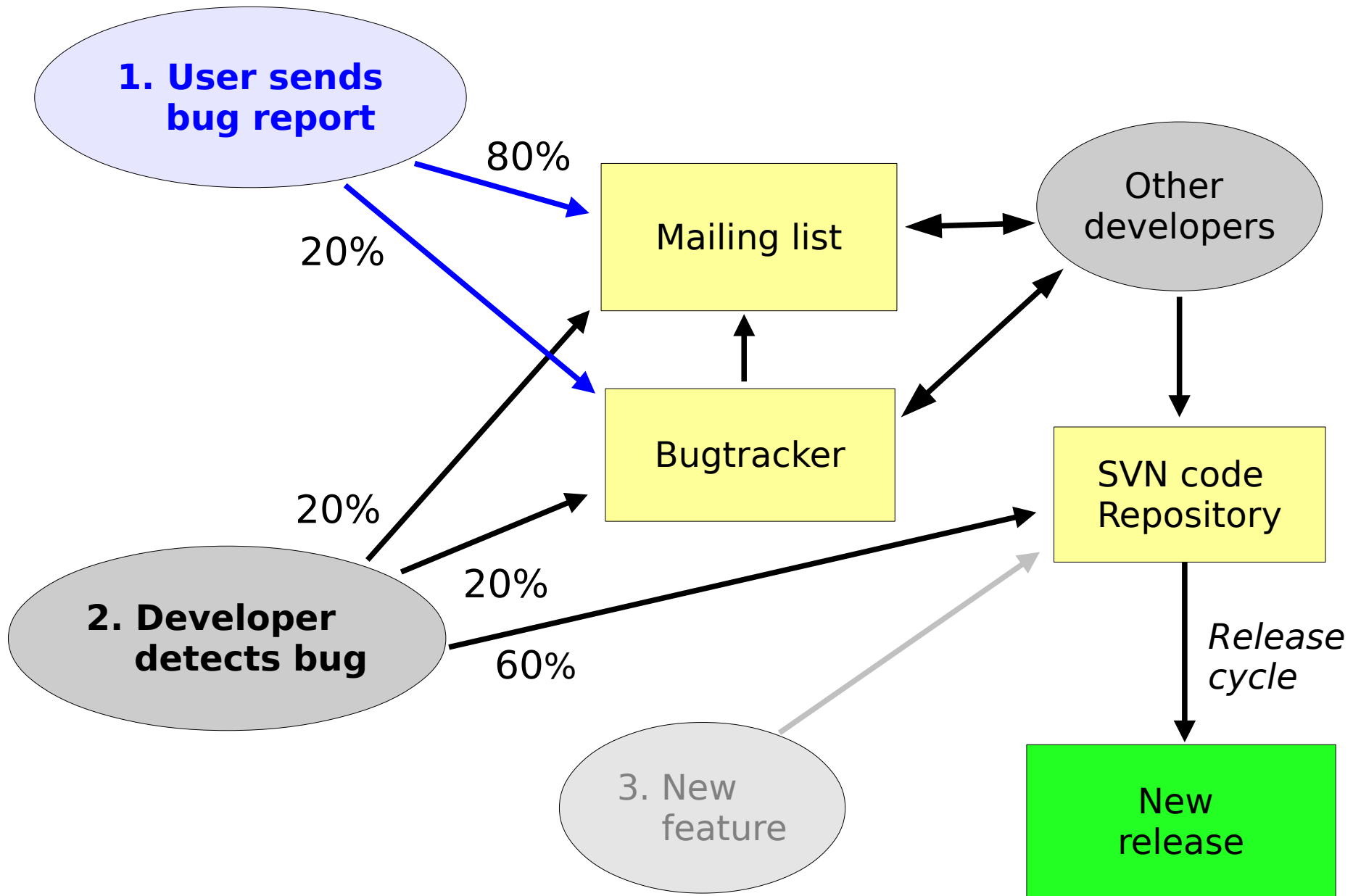
Community sprints, even more...

GRASS-GIS Community Sprint 2012, Prague, Czech Republic



Communication

Flow of bug reporting and solution:



(Percentages are estimated)

Organization of distributed source code management: “Code habitats”

Two main types of developers may be identified:

- generalist
- specialist (the majority)

It appears that many developer assign themselves to “code habitats”, i.e. their area of expertise (e.g., in GRASS GIS a selection of libraries or topics which they maintain)

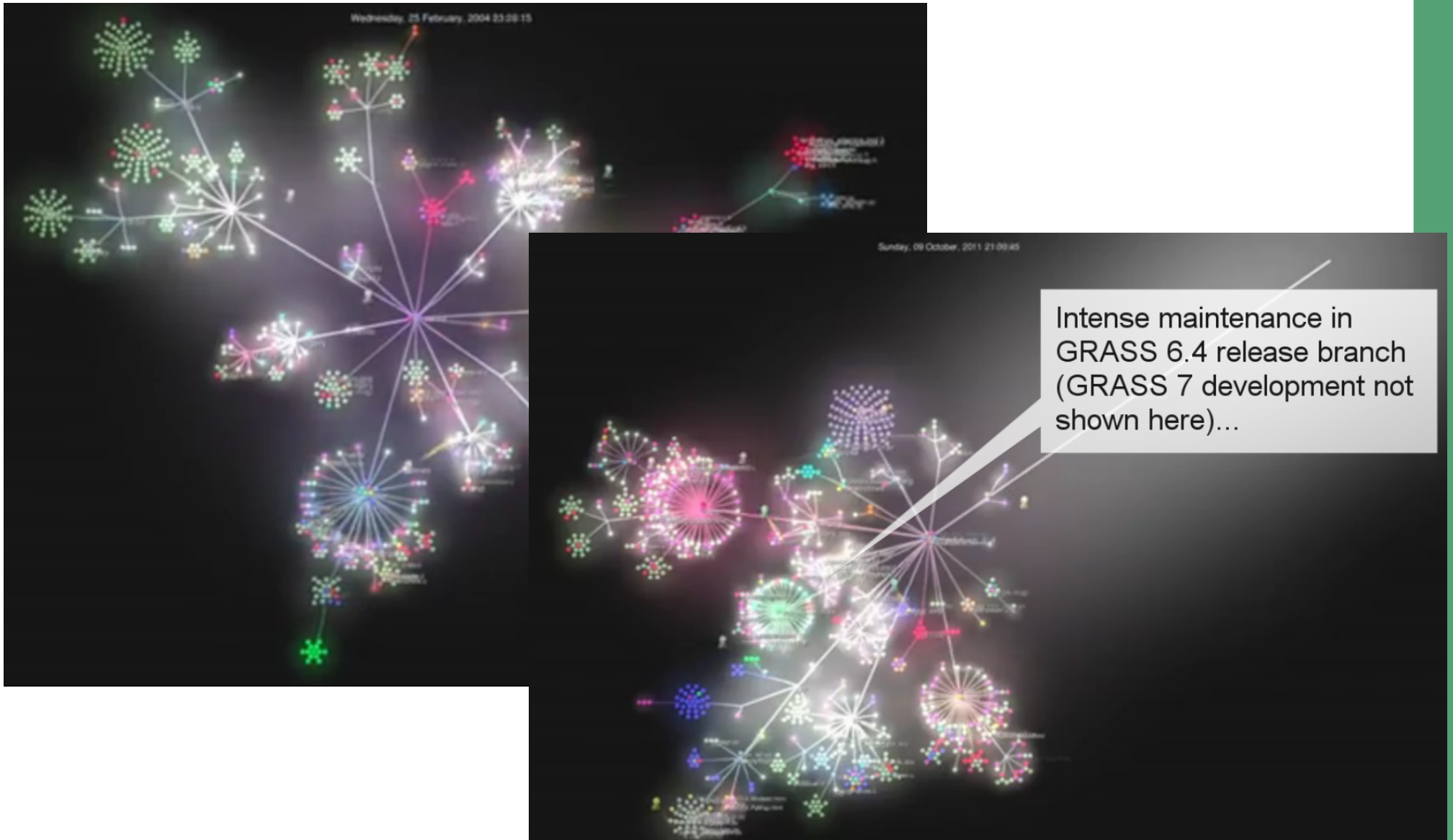
These “code habitats” remain often stable over years

There are also partially abandoned code areas (~ 10% of the code?) which are functional but aren't really getting improved

A few “garbage collectors” (generalists) fix lots of *odds 'n ends*

Organization of distributed source code management: “Code habitats”

<http://www.youtube.com/watch?v=suyDqmGXoWk>



GRASS GIS 6.4 development visualization from 1999 to 2011 with Gource

Code vetting

Legal aspects

License compliance (e.g., GPL)

No code copying from books like “Numerical Recipes in C”

Ensure that 3rd party contributions are clean

Employers must agree that work time is spent

Full transparency and peer review help to minimize the risk.

Apache or OSGeo Foundation

Incubation phase

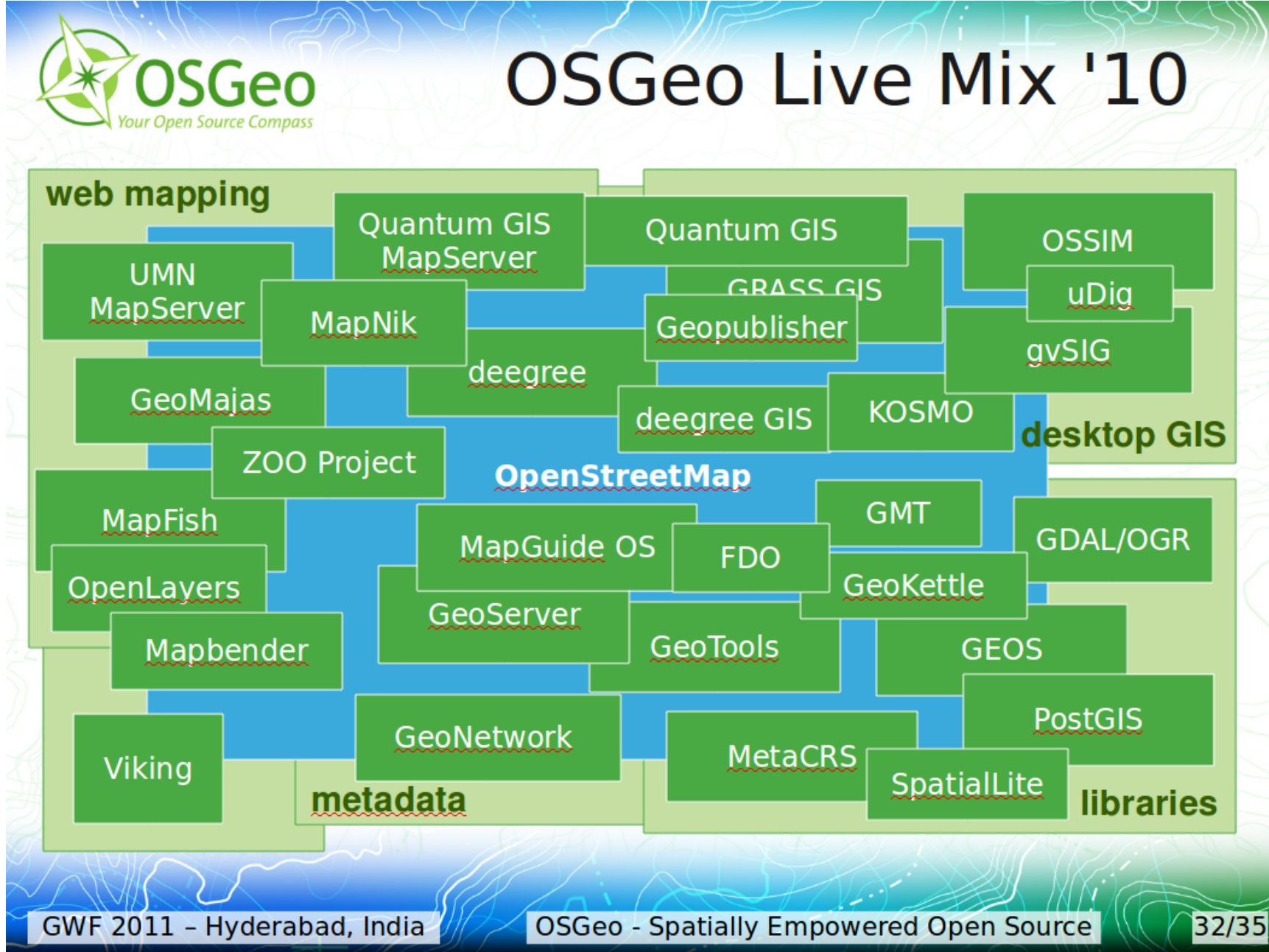
Graduation

<http://incubator.apache.org/>

<http://www.osgeo.org/incubator>



Since 2010...



The diagram illustrates the OSGeo Live Mix '10 software stack, organized into several functional layers:

- web mapping**: UMN MapServer, Quantum GIS MapServer, MapNik, deegree, GeoMajas, ZOO Project, MapFish, OpenLayers, Mapbender, Viking, GeoNetwork, metadata.
- desktop GIS**: Quantum GIS, GRASS GIS, OSSIM, uDig, Geopublisher, gvSIG, deegree GIS, KOSMO, OpenStreetMap, MapGuide OS, FDO, GMT, GDAL/OGR, GeoServer, GeoTools, GeoKettle, GEOS, PostGIS, MetaCRS, SpatialLite, libraries.

OSGeo Logo: Your Open Source Compass

OSGeo Live Mix '10

GWF 2011 - Hyderabad, India | OSGeo - Spatially Empowered Open Source | 32/35

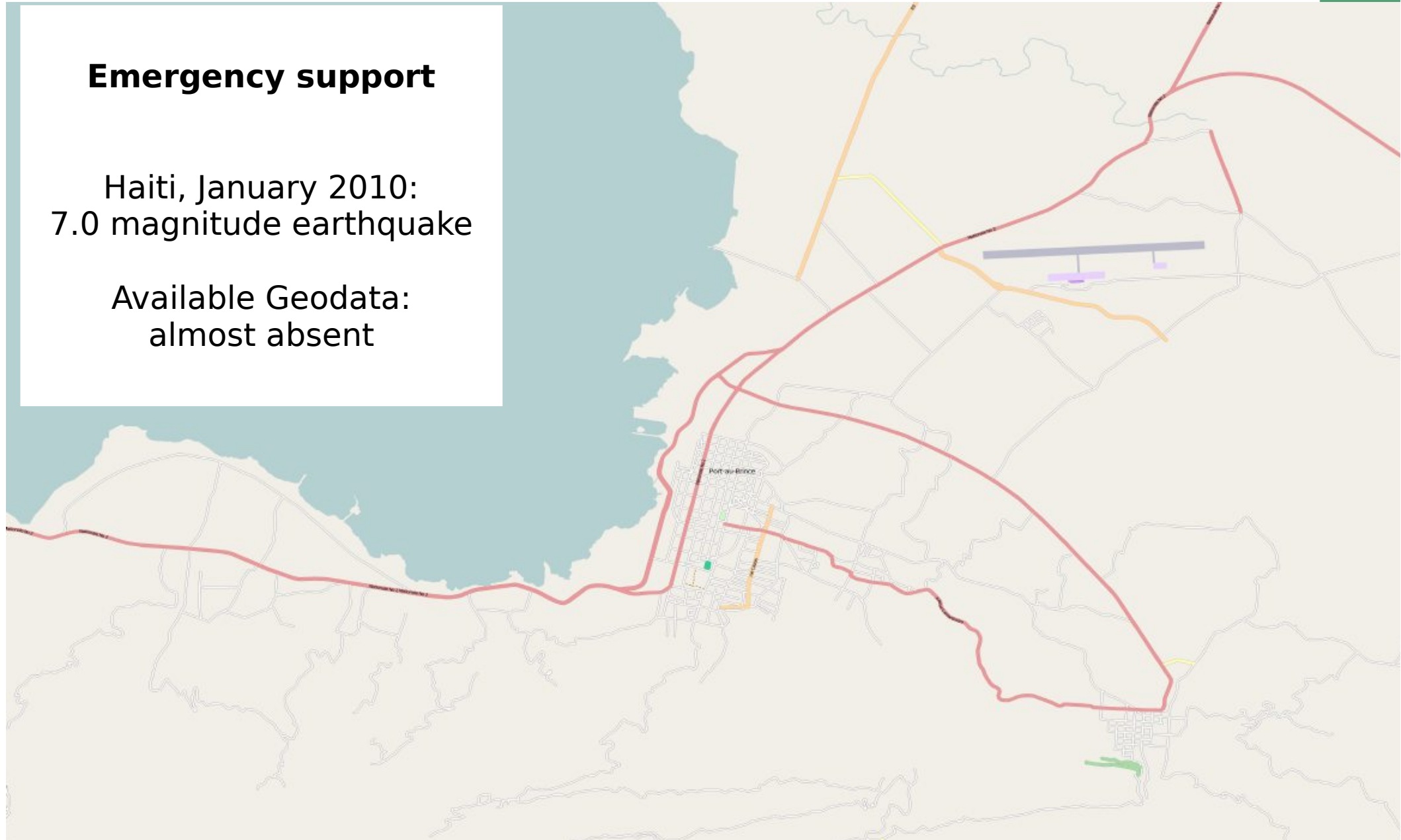
Source: [Blog of Arnulf Christl](#)

Open Data: OpenStreetMap.org

Emergency support

Haiti, January 2010:
7.0 magnitude earthquake

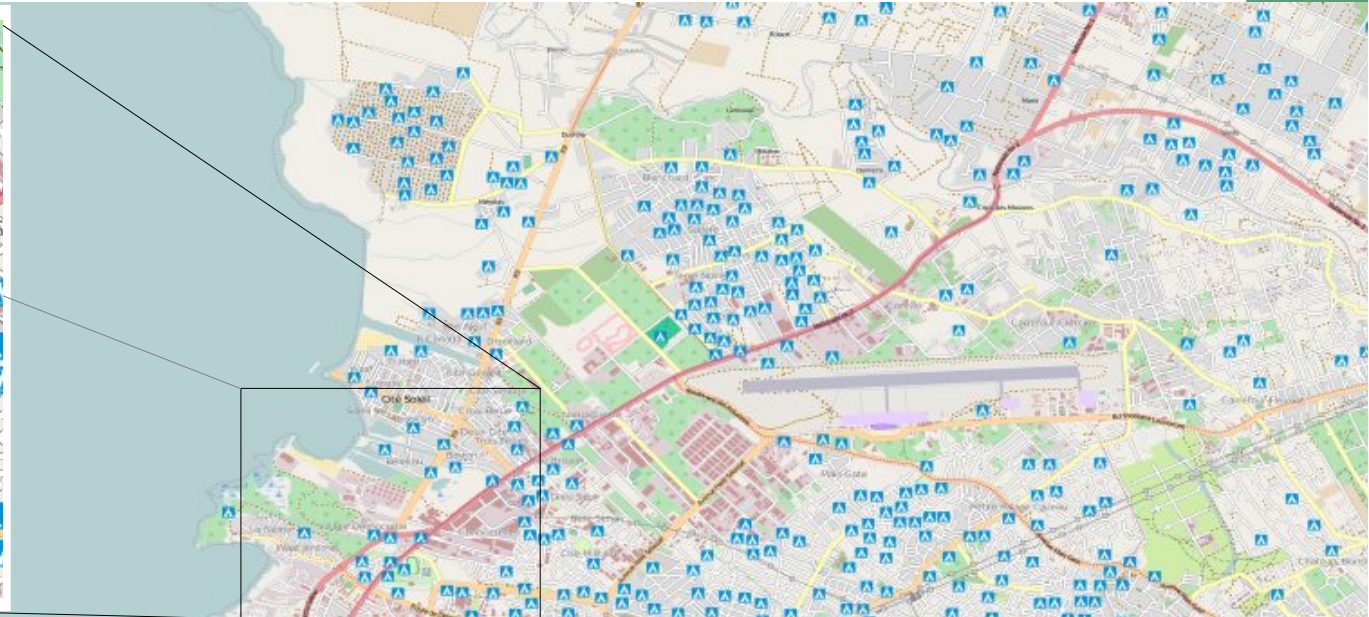
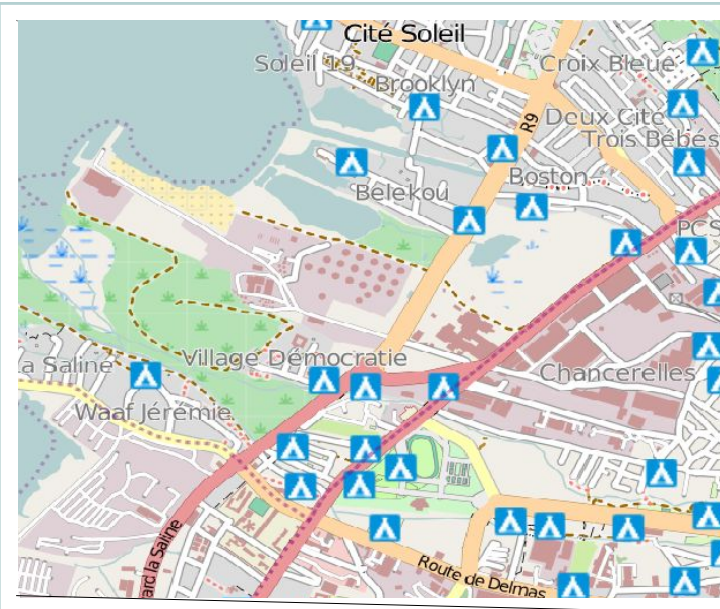
Available Geodata:
almost absent



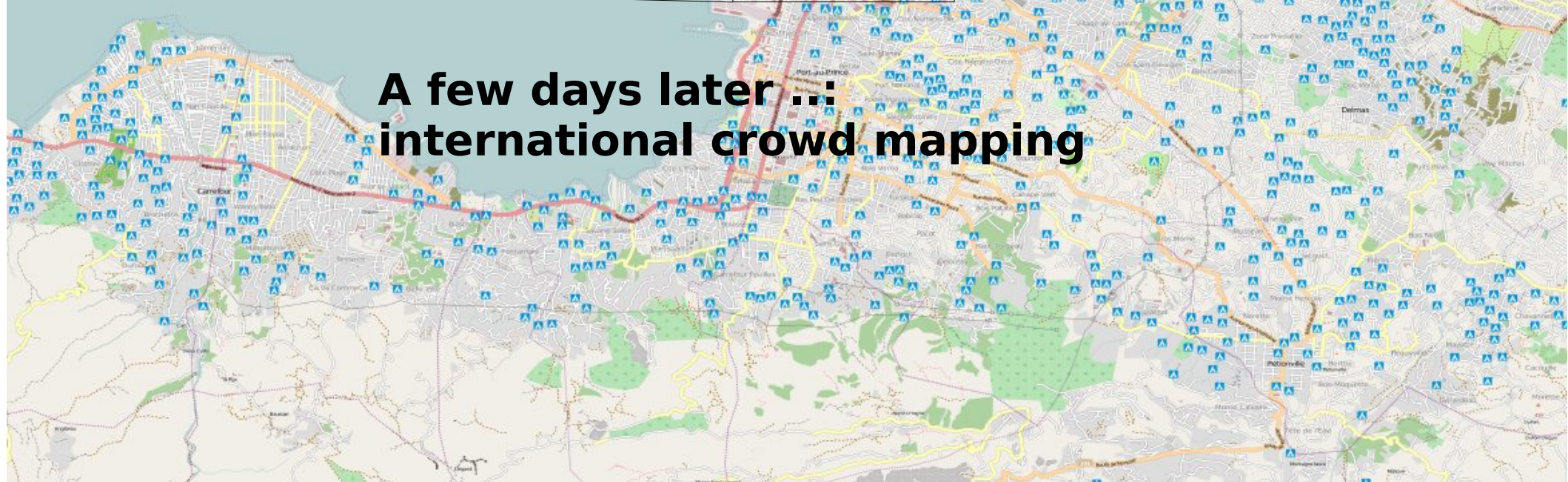
See also:
<http://hot.openstreetmap.org/projects/haiti-2>

Haiti Dec 2009

Open Data: OpenStreetMap.org



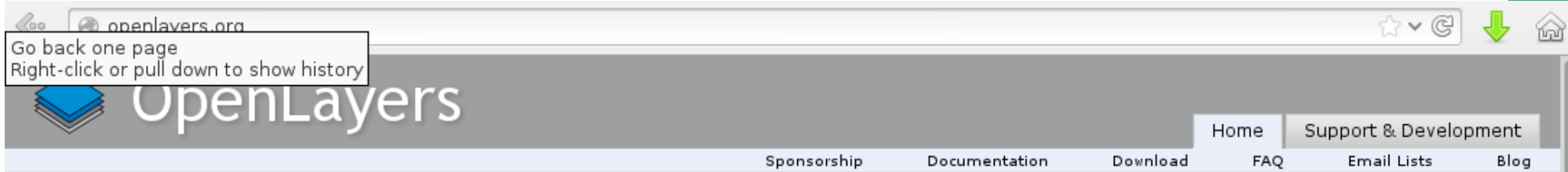
**A few days later ...:
international crowd mapping**



See also:
<http://hot.openstreetmap.org/projects/haiti-2>

Haiti Jan 2010

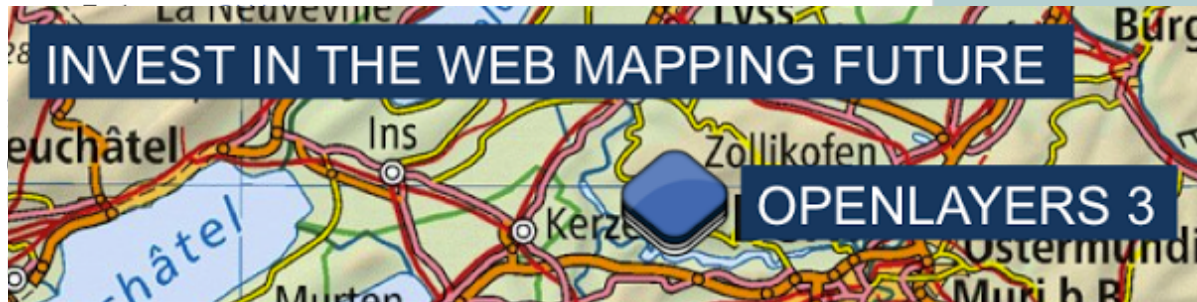
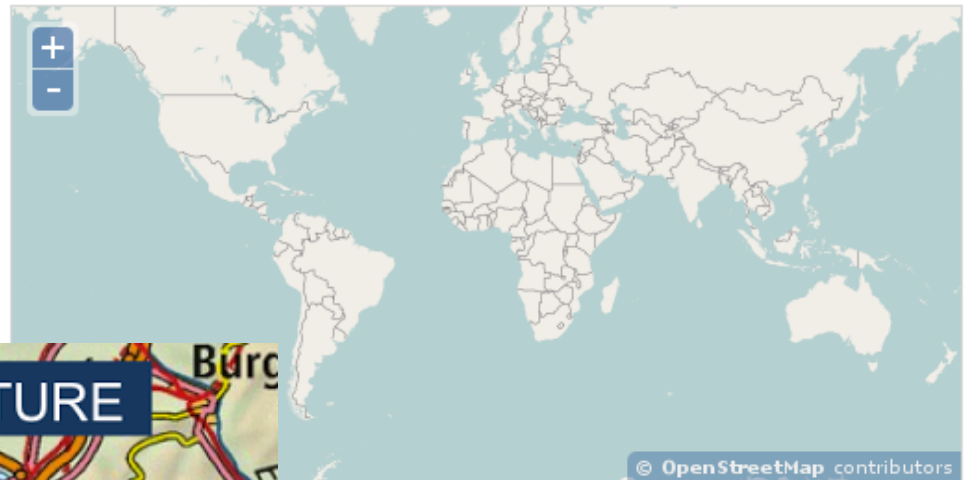
New: Crowdfunding of development



OpenLayers: Free Maps for the Web

Get OpenLayers Now!

- [2.12 \(Stable\): .tar.gz | .zip](#)
- [2.12 Release Notes](#)
- [API Documentation, User documentation](#)
- See examples of OpenLayers Usage: [Release Examples \(2.12\)](#), [Development Examples](#)



an open map widget in any web page!

WHY OPENLAYERS 3?

While OpenLayers is the most complete and capable javascript web mapping library around, it has also started to show its age. While there is great benefit in maintaining full backwards compatibility, the current code base is not designed to take full advantage of a number of the best features of the web, like **WebGL**, **CSS3** and other **HTML5** advances.

The **OpenLayers team** has already started work on a 3.0 version with a number of goals:

- Cleaner, **friendly API** that is more intuitive for modern web developers
- **Small size** (20kb in tests), for faster loading, leveraging Google's **Closure Compiler**
- Nicer default design, and easy designer customizability with **CSS3**
- **WebGL** fully integrated, for **3D maps** and faster **2D performance** on the latest browsers
- **Great documentation** and examples, making the library easier for all to approach and use

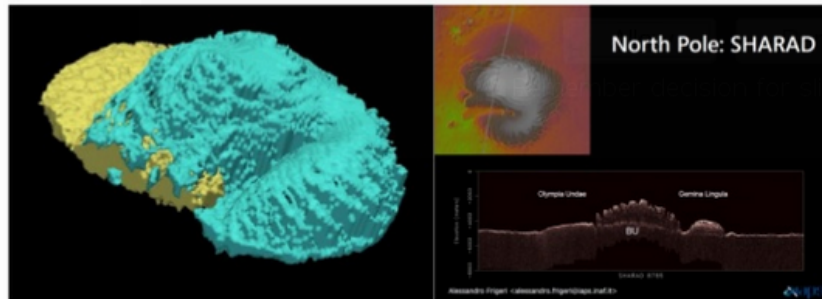


OpenLayers 3 Funding

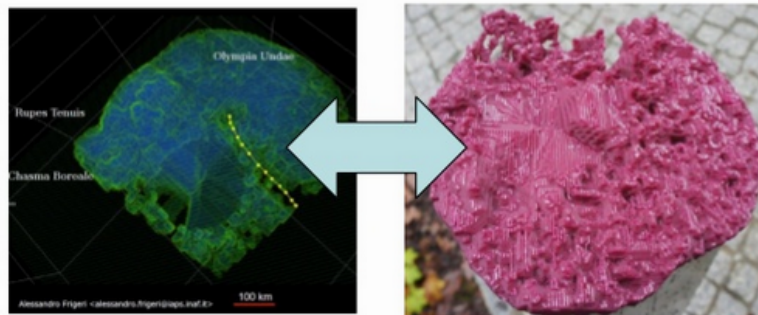
New cool stuff: plotting GIS data

www.slideshare.net/loewe/scientific-3d-printing-gfz-geoinformatics-kollquium-april-2012

3D Volume: Mars North Polar Cap



- Research topics:
 - Buried valleys beneath the polar cap,
 - radar signal attenuation.
- Need: „Handpiece“ for communication among scientists and data quality assessment.
- 3D Print is currently used by INAF for data quality assessment.



From
Radar
to
voxels
to
3D plots



Scientific 3D Printing (GFZ Geoinformatics Kollquium April 2012)

by Peter Loewe on Apr 16, 2013

New cool stuff: massive data processing

- Since 2005 GRASS GIS is running natively on 64bit CPUs
- GRASS GIS 7 also offers Large File Support on 32bit Windows
- Installed on Grids and TOP500 supercomputers (AKKA Umeå, ENEA Frascati, Aurel Bratislava, ...)
- Runs on Linux, AIX, Solaris, freeBSD, netBSD, ...
- Various ways of parallelization



Massive data processing: also for you

GRASS GIS



Doug Newcomb

General - May 31, 2013

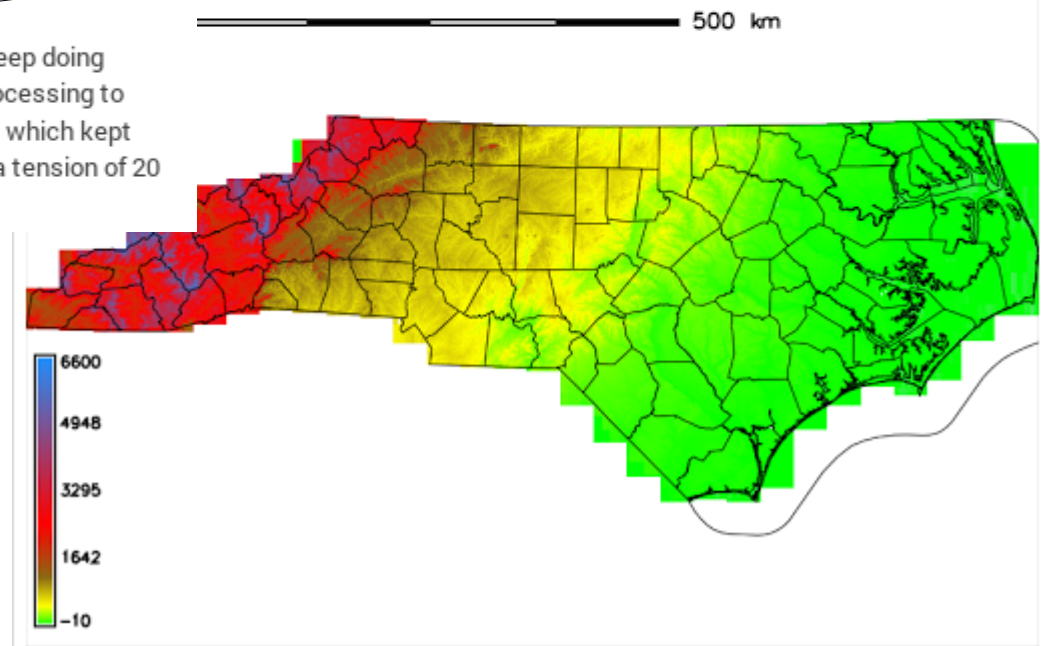
Finally finished recreating the the 20ft elevation grid for North Carolina from all of the bare earth points and verticies of break lines (about 8.5 billion points).

I had all of the points in a single text file , sorted them by X Coordinate, then split them into 30 files in which the coordinates overlapped by 1000 feet in the X direction.

Since the home computer only has 8 GB of RAM (and I wanted to keep doing things like reading email during processing) I limited the extent of processing to about 140,000 feet N-S by 110,000 feet E-W (about 30 million cells) , which kept the memory requirements in the 4-6 GB range. I used v.surf.rst with a tension of 20 and npmin of 100 from the GRASS 7 svn pull from March 2013 .

“8.5 billion points...”

“Since the **home** computer only has 8 GB of RAM...”



+4

↻ 2



<https://plus.google.com/u/0/communities/111147786674687562495>

Concluding remark:



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And more to come...