



Introduction to GIS

Suchith Anand

Introduction

What is GIS ?

Spatial Data Models

Fundamental GIS

- Map generalization

Applied GIS

Future Study links

What is a Map?

A **map** is a visual representation of an area (can be for any space not just geographical)

More importantly, Maps helps us make sense of the world

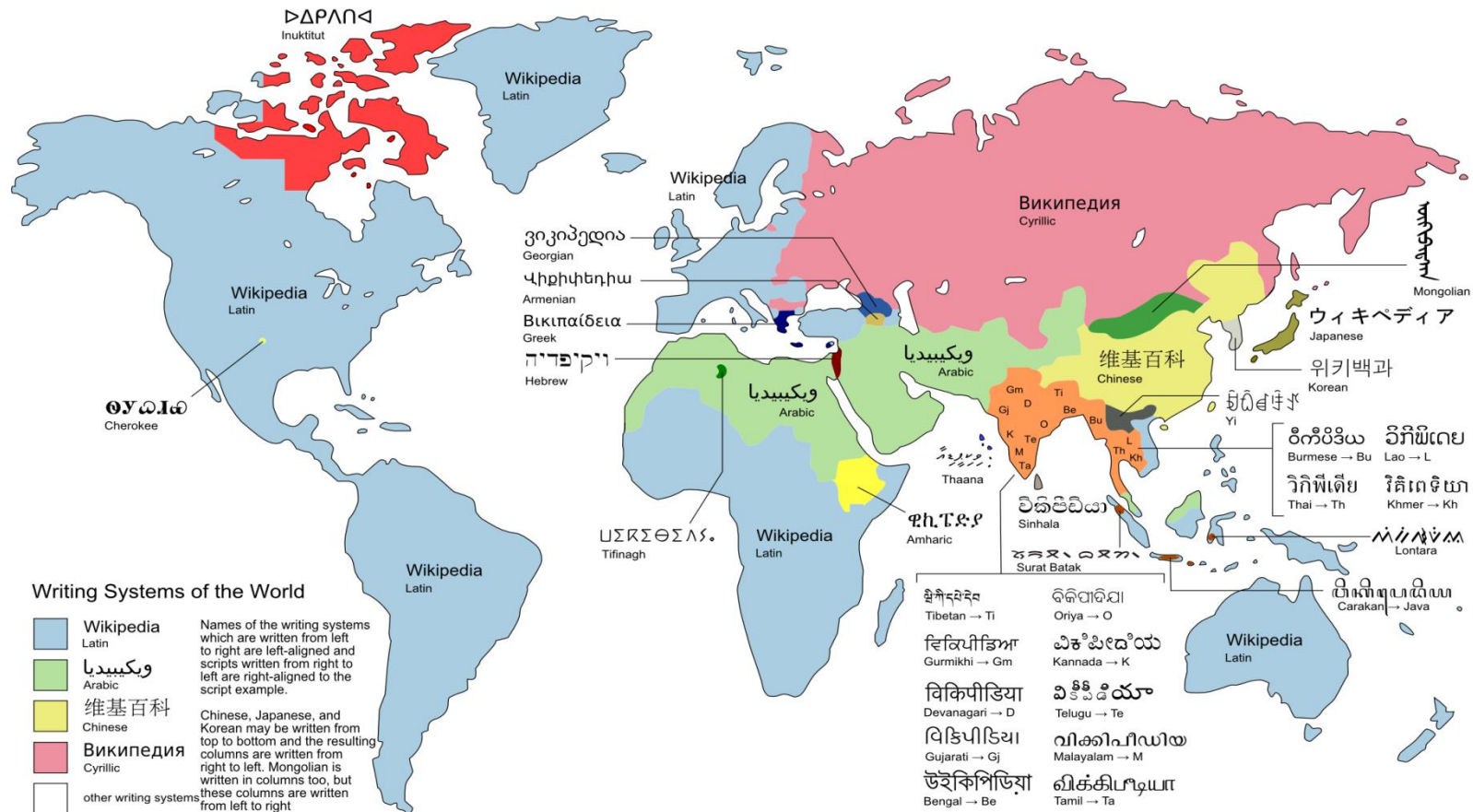
World Map of Vegetation on Earth



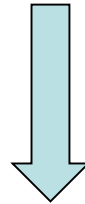
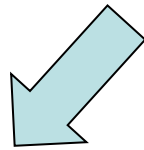
World map of vegetation data collected by the Suomi NPP satellite (National Polar-orbiting Partnership) in a partnership between NASA and the National Oceanic and Atmospheric Administration (NOAA). Image Credit: NASA/NOAA

Herbal Earth: Spectacular Vegetation Views of Our Home Planet and the Natural World of Living Green Life by Ken Kremer

World Map of the Different Writing Systems



What is GIS



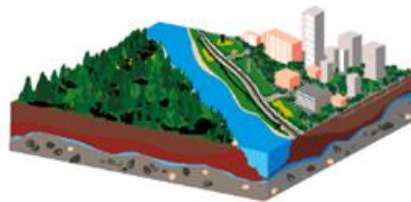
Science

System

Services

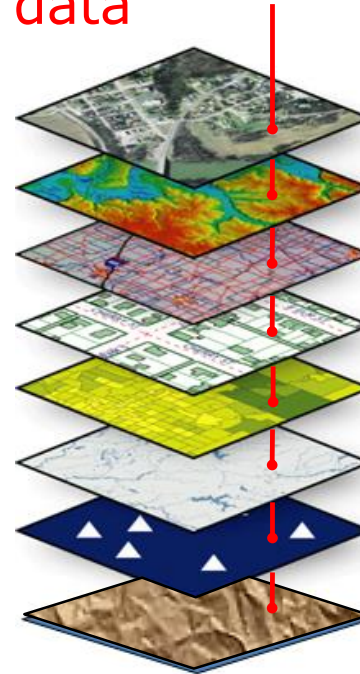
GIS is multidisciplinary (Engineering, Computer Science, Statistics, Mathematics, Geography, Psychology, Philosophy...)

Layered (usually digital) information linked to location, usually visualised as a map.



**Real
World**

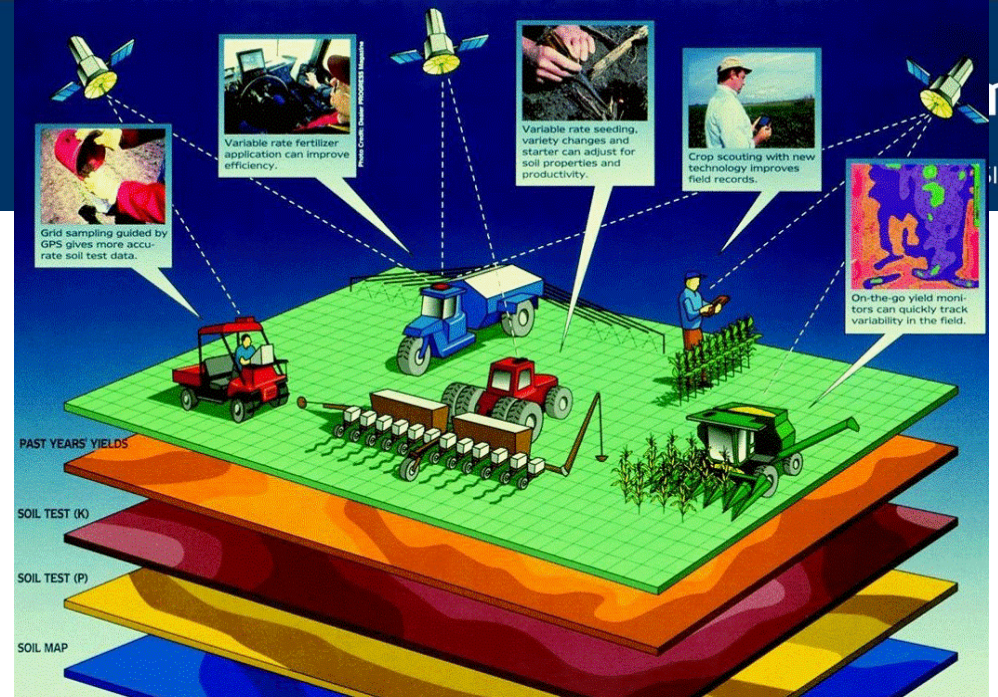
Coordinated layers of
data



**GIS World
Model**

- ◀ Imagery
- ◀ Elevation
- ◀ Transportation
- ◀ Addresses
- ◀ Boundaries
- ◀ Water features
- ◀ Survey Control
- ◀ Your data

- Map
- Satellite imagery
- Photographs, links to reports
- Digital Terrain Model
- Soil data
- Seeding
- Crop data
- Dressings and interventions and auditing
- Historical data
- etc....



Geographic Information Systems

Refers to the specialized set of information technologies that handle georeferenced data

Data acquisition

- Aerial imaging
- GNSS
- Remote sensing
- Land surveying

Data analysis

- Statistical analysis
- modeling

Data storage & manipulation

- image processing
- DBMS

Data visualization

- Geovisualization
- imaging

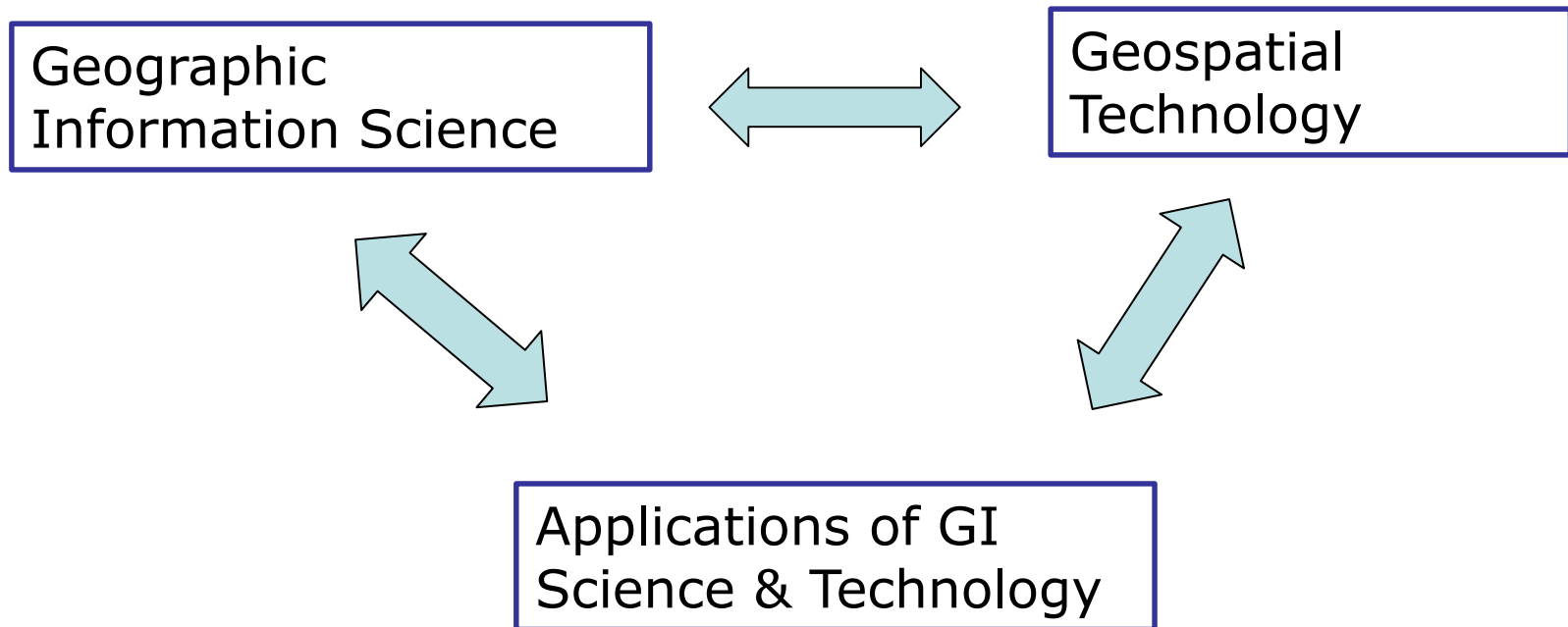
UCGIS GI S&T Body of Knowledge

10 knowledge areas

73 units

329 topics

1,600 formal educational objectives



GIS is composed of

Software
Hardware
Data
Methods
People
Network

Exercise – give examples of each

Past – 20 years back

Present

Future – 10 years from now

- A record of what you have done in the past
- A way of assessing what you are doing now
- A tool to plan for the future
- It connects and can be used to interpret different types of data
- It supports informed decision making

Exercise

Examples of GIS in use in different domains

Spatial Data Models

Vector

Raster

Triangulated Irregular Networks (TIN)

Vector Data Model

Used for defining Discrete objects (attributes and coordinates)

Three basic types

- Point
- Line
- Polygon

Exercise – give examples where this model is used? What are the advantages and disadvantages

Raster Data Model

Represents continuous objects (temperature or elevation)

Regular set of cells or pixels in case of imagery ; grid pattern (matrix)

Exercise – give examples where this model is used? What are the advantages and disadvantages

Applied GIS examples

Network of European Regions Using Space Technologies

The NEREUS video "The voice of regions for Space" regional examples of space based services (EO/GMES, GNSS, Telecommunication etc.) for the benefits of regions and their citizens.

http://www.nereus-regions.eu/NEREUS_videopage

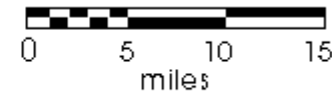
Fundamental GIS example

Map generalization is one of the fundamental research areas of GI Science

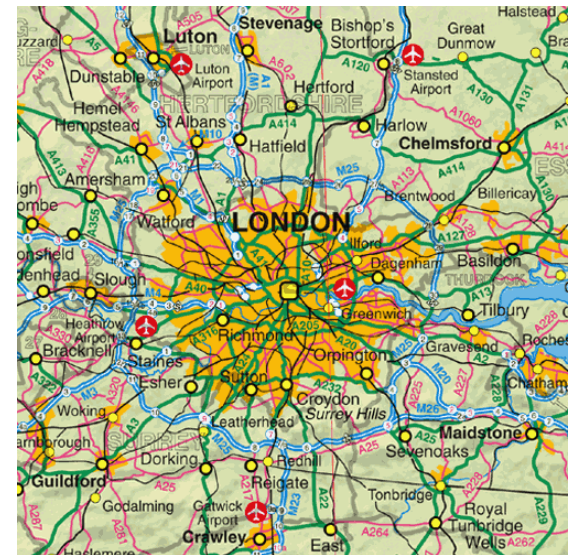
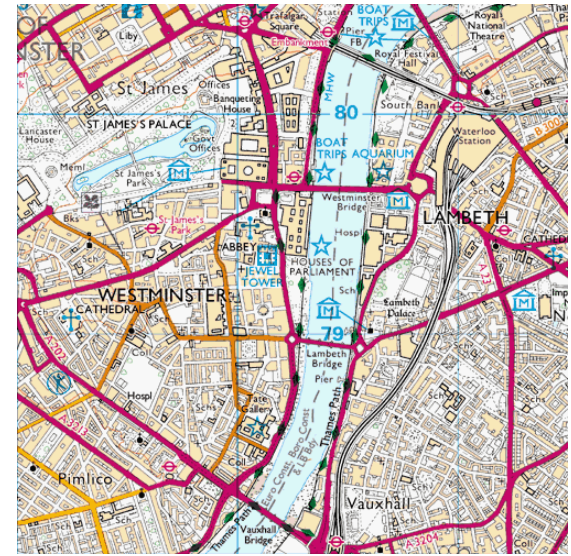
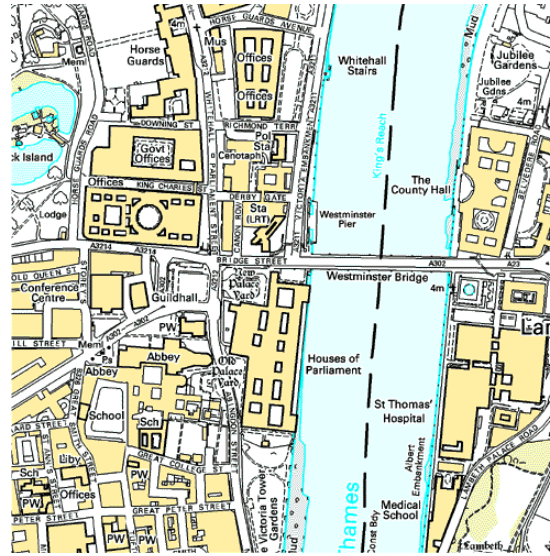
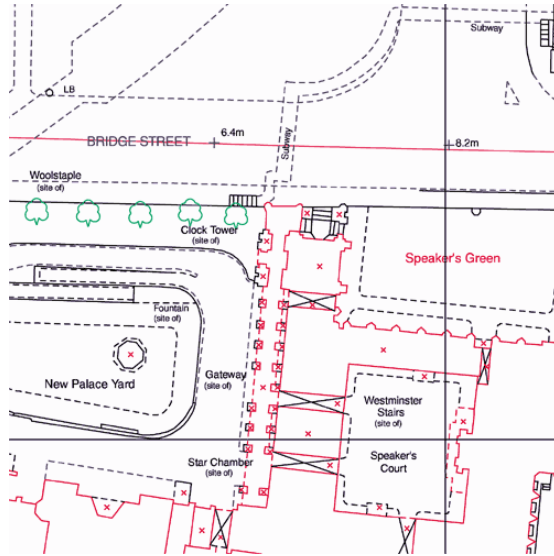
Verbal, numeric, and graphic means
of representing scale



1 inch equals 1 mile

1:63,500




SLC 4/96



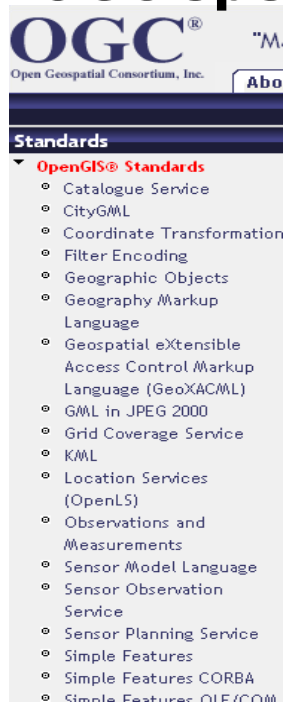
sci-ence  [sahy-uhns]  [Show IPA](#)

noun

1. a branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws: *the mathematical sciences*.
2. systematic knowledge of the physical or material world gained through observation and experimentation.
3. any of the branches of natural or physical science.
4. systematized knowledge in general.
5. knowledge, as of facts or principles; knowledge gained by systematic study.



Geospatial Standards (for ex. OGC spec.)



Open Data

data.gov.uk ^{BETA}
Opening up government



Ability for showing the
operation of general laws
is fundamental for
scientific research

Maturity of open source software (for ex. OSGeo stack)

OSGeo Projects

Web Mapping

deegree 
Mapbender
MapBuilder
MapGuide Open Source
MapServer
OpenLayers

Desktop Applications

GRASS GIS
OSSIM
Quantum GIS
gvSIG 

Geospatial Libraries

FDO
GDAL/OGR
GEOS 
GeoTools
MetaCRS 

Metadata Catalog

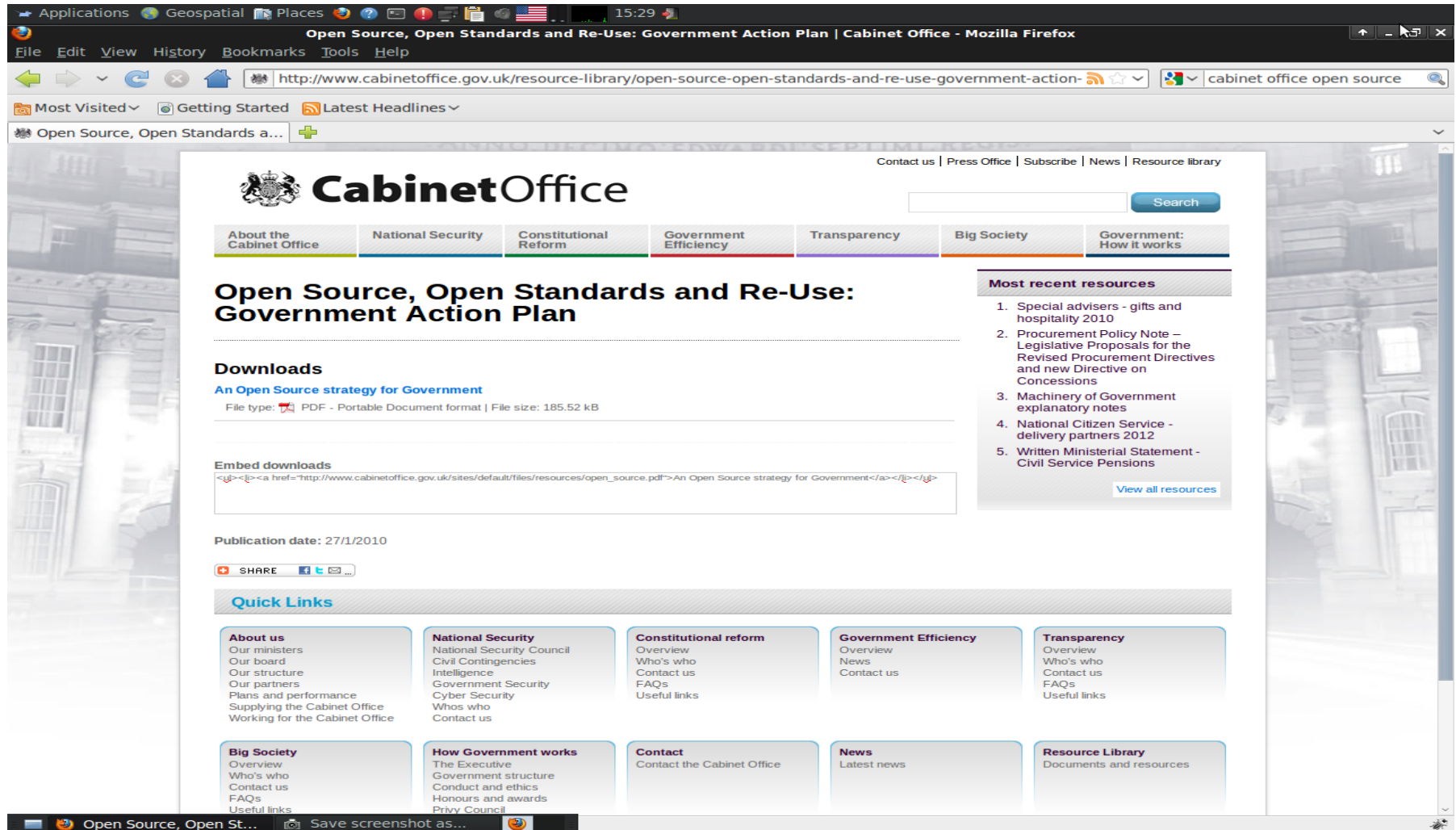
GeoNetwork

Other Projects

Public Geospatial Data
Education and Curriculum

 Project in incubation

Open Standards – Key for interoperability and lower costs



The screenshot shows a Mozilla Firefox browser window displaying the Cabinet Office website. The address bar shows the URL: <http://www.cabinetoffice.gov.uk/resource-library/open-source-open-standards-and-re-use-government-action-plan>. The page title is "Open Source, Open Standards and Re-Use: Government Action Plan | Cabinet Office - Mozilla Firefox".

The website header includes the Cabinet Office logo and navigation links: Contact us | Press Office | Subscribe | News | Resource library. A search bar is also present.

The main content area features a navigation menu with the following categories: About the Cabinet Office, National Security, Constitutional Reform, Government Efficiency, Transparency, Big Society, and Government: How it works.

Open Source, Open Standards and Re-Use: Government Action Plan

Downloads
[An Open Source strategy for Government](#)
File type: PDF - Portable Document format | File size: 185.52 kB

Embed downloads
`An Open Source strategy for Government</code>`

Publication date: 27/1/2010

SHARE [Facebook icon] [Twitter icon] [Email icon]

Quick Links

- About us**
Our ministers
Our board
Our structure
Our partners
Plans and performance
Supplying the Cabinet Office
Working for the Cabinet Office
- National Security**
National Security Council
Civil Contingencies
Intelligence
Government Security
Cyber Security
Whos who
Contact us
- Constitutional reform**
Overview
Who's who
Contact us
FAQs
Useful links
- Government Efficiency**
Overview
News
Contact us
- Transparency**
Overview
Who's who
Contact us
FAQs
Useful links
- Big Society**
Overview
Who's who
Contact us
FAQs
Useful links
- How Government works**
The Executive
Government structure
Conduct and ethics
Honours and awards
Privy Council
- Contact**
Contact the Cabinet Office
- News**
Latest news
- Resource Library**
Documents and resources

Most recent resources

1. Special advisers - gifts and hospitality 2010
2. Procurement Policy Note – Legislative Proposals for the Revised Procurement Directives and new Directive on Concessions
3. Machinery of Government explanatory notes
4. National Citizen Service - delivery partners 2012
5. Written Ministerial Statement - Civil Service Pensions

[View all resources](#)

Open Data – key for innovation and transparency

data.gov.uk^{BETA}
Opening up government

[↑](#) [Data](#) [Apps](#) [Consultation](#) [Forum](#) [Blogs](#) [Ideas](#) [Linked Data](#) [Resources](#) [About](#)



Apps



Numberhood



UK Pharmacy



UK Crime Stats



London Cycle Hire



UK Pharmacy
Find your nearest pharmacy quickly and easily on your iPhone





Search Apps

Share this



What are apps? | [View all apps](#)

This wide range of apps can provide you with information on everything from local services information, to managing finance, and even environmental issues to name but a few. Search the apps list to find out more.

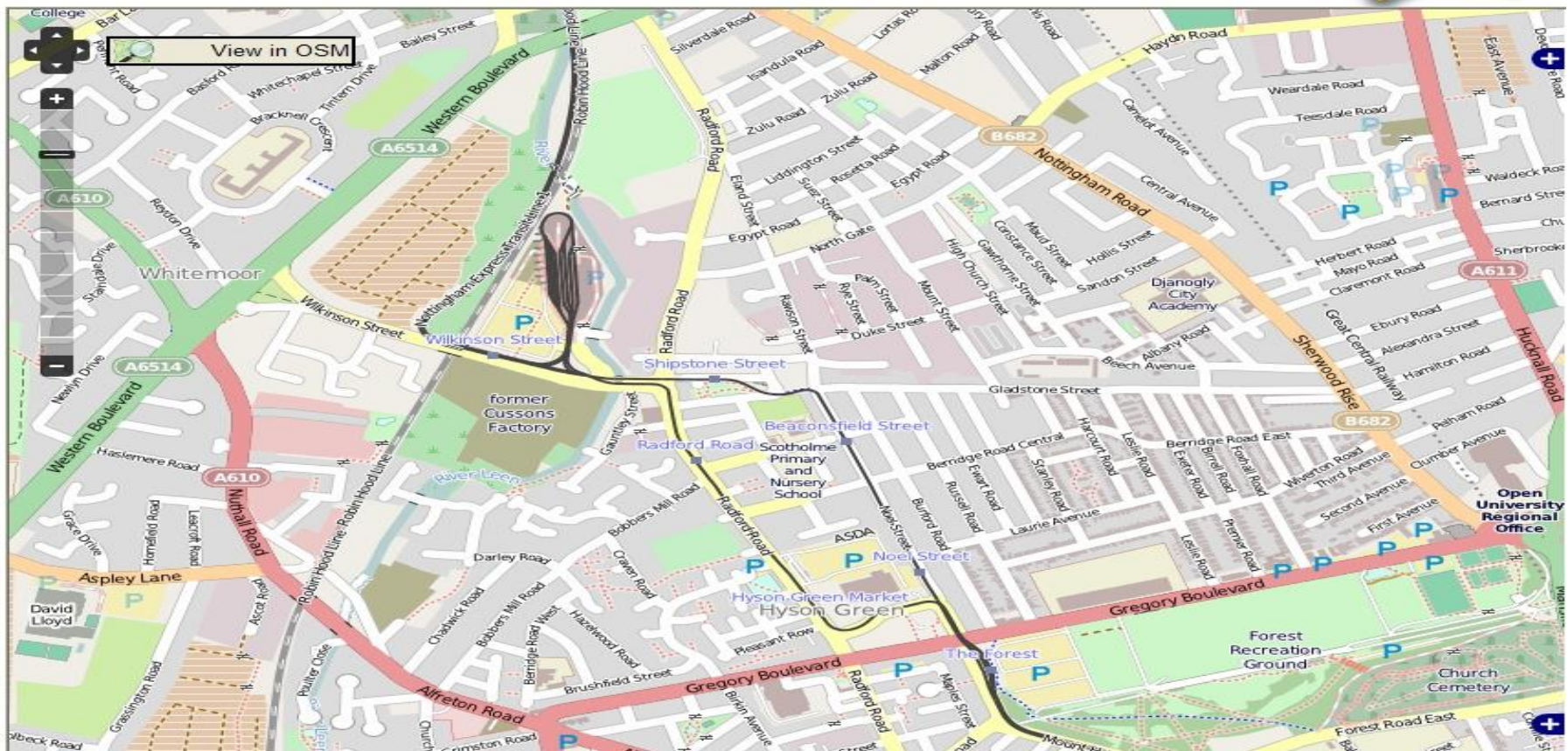
Popular tags

[View all tags](#)

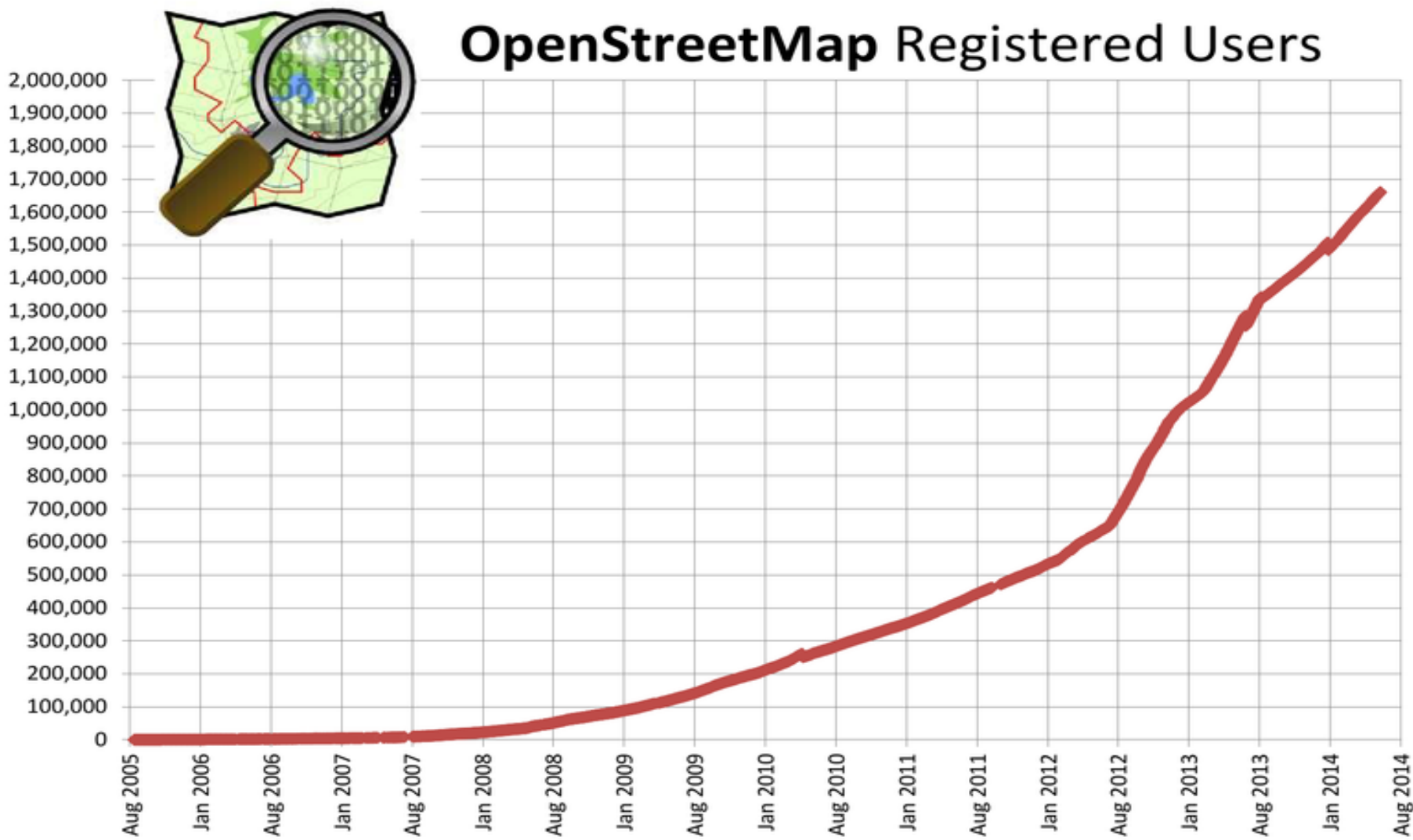
[map \(21\)](#) [crime \(18\)](#) [uk \(17\)](#) [maps \(13\)](#) [local authority \(13\)](#) [london \(12\)](#) [transport \(11\)](#) [schools \(10\)](#) [mapping \(10\)](#)
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The Free Wiki World Map

The world's largest collaborative geospatial database made by the volunteers



Registered users



<http://wiki.openstreetmap.org/wiki/Stats>

Milestones in Open Source GIS

1982 - GRASS (Geographical Resources Analysis Support System)

1992 - Open GRASS Foundation (OGF)

1994 - OGF was re-structured as the Open Geospatial Consortium (OGC)

2006 - Open Source Geospatial Foundation established



OSGeo Foundation

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[IRC](#)
[Service Providers](#)
[Journal](#)
[Sol Katz Award](#)
[Local Chapters](#)
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[Gallery](#)
[Live DVD](#)

Language

- English
- Български
- 简体中文
- Deutsch
- Français
- Indonesian
- Italiano
- 日本語
- 한국어
- Nederlands
- Polski

The Open Source Geospatial Foundation...

Created to support and build the highest-quality open source geospatial software. Our goal is to encourage the use and collaborative development of community-led projects. Join us by signing up to our [mailing lists](#) or check out the [Getting Started](#) page to become more involved.

News

2011-09-27 [OSGeo and the International Cartographic Association \(ICA\) sign MoU](#)

2011-09-07 [OSGeo-Live 5.0 Released](#)

2011-08-22 [OSGeo Board Election Results](#)

2011-07-29 [OSGeo Board Election 2011](#) [more](#)

[Submit News](#)

Upcoming events

2011-11-02 [Jornadas SASIG 4, Guimarães, Portugal](#)

2012-06-23 [Bolsena Hacking Event 2012](#) [more](#)

[Submit Upcoming Events](#)

Community Blogs

Dylan Beaudette: Experimental S4 Classes and Methods added to AQP (Algorithms for Quantitative Pedology) Package

OSGeo News: OSGeo and the International Cartographic Association (ICA) sign MoU

Jackie Ng: A screenshot to tide you over

Arnulf Christl: Two busy weeks touring Asia

Darren Cope: QGIS Topological Editing

SEXTANTE Team: Out of office

SEXTANTE Team: R

Stefano Costa: SVG Pottery: the documentation is now available

BALIZ-Media.com: Géomatique 2011: quelques faits saillants de cette semaine Géo au Québec

Jody Garnett: Nothing to see here

Andreas Schmitz: Setting up eclipse using maven

Matt Sheehan: Offline Mobile GIS

Matt Sheehan: Q&A – Mobile App Development Planning

Sandro Santilli: PostGIS topology ISO SQL/MM complete

[more](#)

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- Get involved by subscribing to our [discussion e-mail list](#).
- Start contributing by following the instructions on the [Getting Started](#) page.



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OSGeo Projects

Web Mapping

[deegree](#)
[geomajas](#)
[GeoServer](#) ♦
[Mapbender](#)
[MapBuilder](#)
[MapFish](#)
[MapGuide Open Source](#)
[MapServer](#)
[OpenLayers](#)

Desktop Applications

[GRASS GIS](#)
[Quantum GIS](#)
[gvSIG](#) ♦

Geospatial Libraries

[FDO](#)
[GDAL/OGR](#)

The Projects



Welcome to OSGeo-Live 10.0

[OSGeo-Live](#) is a self-contained bootable DVD, USB thumb drive or Virtual Machine based on [Lubuntu](#), that allows you to try a wide variety of open source geospatial software without installing anything. It is composed entirely of free software, allowing it to be freely distributed, duplicated and passed around.

It provides pre-configured applications for a range of geospatial use cases, including storage, publishing, viewing, analysis and manipulation of data. It also contains sample datasets and documentation.

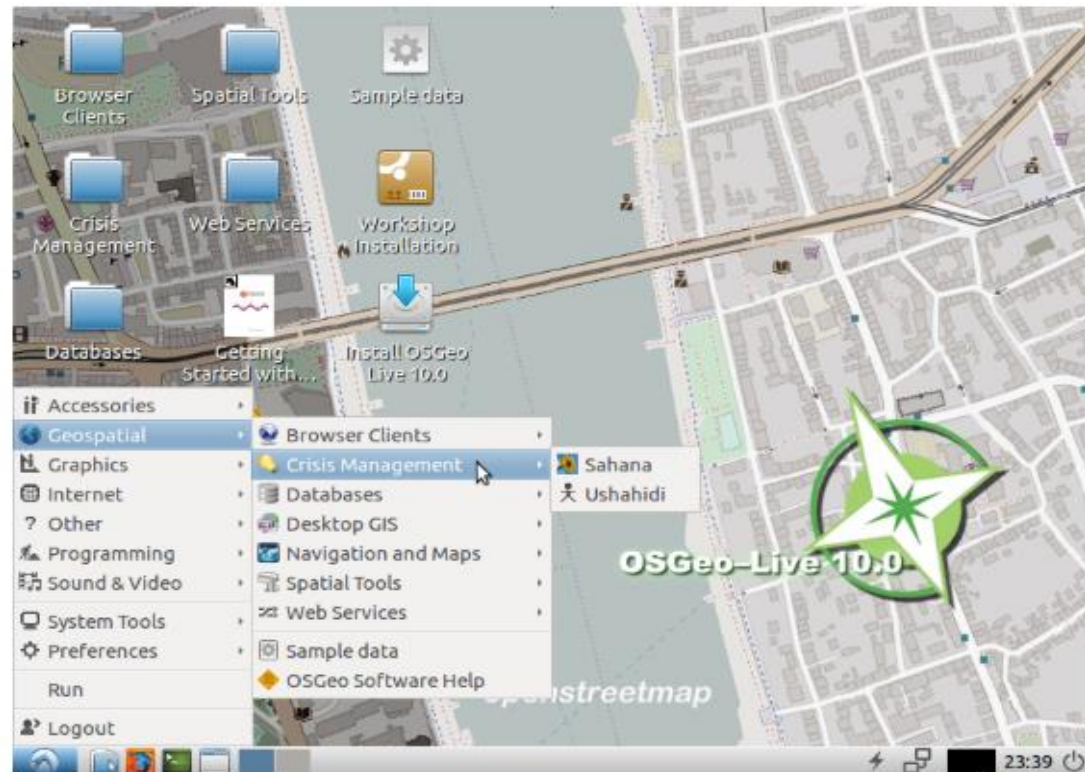
To try out the applications, simply:

1. Insert DVD or USB thumb drive in computer or virtual machine.
2. Reboot computer. (verify boot device order if necessary)
3. Press "Enter" to startup & login.
4. Select and run applications from the "Geospatial" menu.

OSGeo-Live is an [OSGeo Foundation](#) project. The OSGeo Foundation is a not-for-profit supporting Geospatial Open Source Software development, promotion and [education](#).

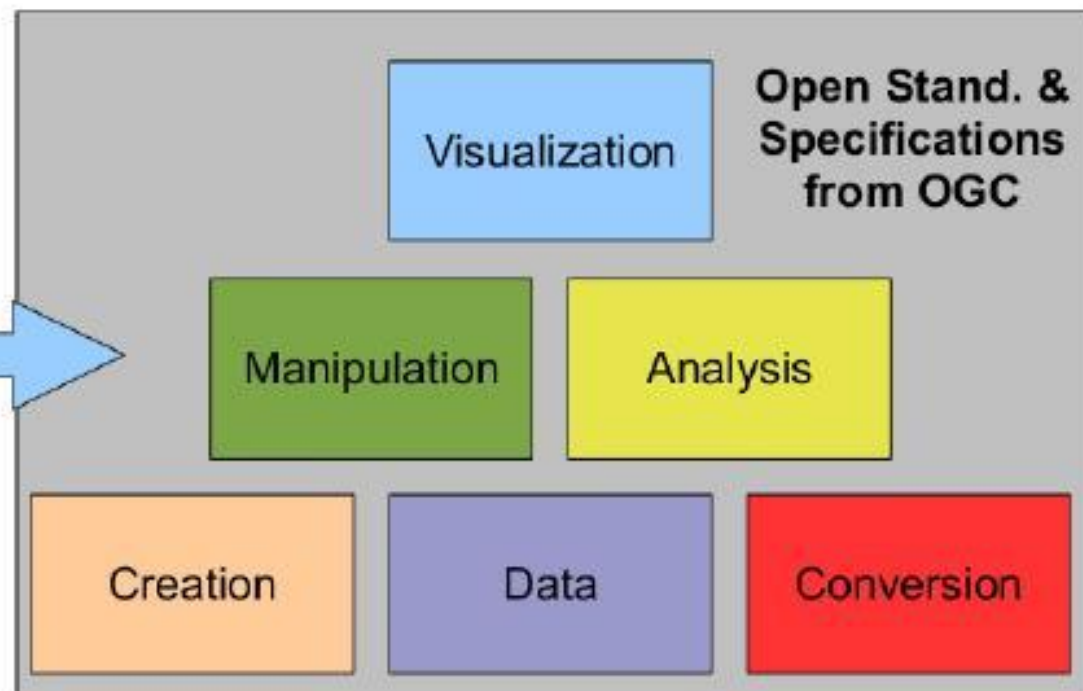
Quick Starts

- [Getting started with the OSGeo-Live DVD](#)



Today's Toolkit

**Monolithic
Black Box**



What is the economic impact of GEO SERVICES

Oxera

Geo services are:



Satellite receivers and manufacturing



Electronic maps



Satellite navigation



Location-based search



Satellite imagery

Geo services global revenues are \$150–\$270 billion per year

Video games industry
\$25 billion

Geo services
\$150–\$270 billion

Airline industry
\$594 billion

Geo services global added value is around \$100 billion per year



Geo services save:



Geo services facilitate competition, leading to savings from reduced prices among infrequently bought goods and services of up to:



Geo services can improve agricultural irrigation, helping to achieve global cost savings per year of:



Source: Oxera (2013), 'What is the economic impact of Geo?', January.



Geo services aid faster emergency response; for example, in England Geo services may have helped to save at least 152 lives per year



Students educated using Geo services can expect

3%

higher average wages five years after graduation than those who weren't



Sustainable Development Goals



TRANSFORMING OUR
WORLD:
THE 2030 AGENDA FOR
SUSTAINABLE
DEVELOPMENT

1 NO
POVERTY



2 ZERO
HUNGER



3 GOOD HEALTH
AND WELL-BEING



4 QUALITY
EDUCATION



5 GENDER
EQUALITY



6 CLEAN WATER
AND SANITATION



7 AFFORDABLE AND
CLEAN ENERGY



8 DECENT WORK AND
ECONOMIC GROWTH



9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



10 REDUCED
INEQUALITIES



11 SUSTAINABLE CITIES
AND COMMUNITIES



12 RESPONSIBLE
CONSUMPTION
AND PRODUCTION



13 CLIMATE
ACTION



14 LIFE
BELOW WATER



15 LIFE
ON LAND



16 PEACE, JUSTICE
AND STRONG
INSTITUTIONS



17 PARTNERSHIPS
FOR THE GOALS



Why ?

◇GLOBAL URBAN PROBLEMS: access to water, sanitation, traffic congestions, economic sustainability, citizens' health, impact on environment ...

◇Mapping is a critical component to help understand and develop solutions for urban growth problems

◇Proprietary software tools are very expensive (hence unavailable) for economically poor countries and communities worldwide



Kibera , Kenya

<http://www.flickr.com/photos/8485582@N07/7365580810>



Dharavi, Mumbai

<http://www.flickr.com/photos/56685562@N00/2340042701>

GIS tools play a key role in helping find solutions to global societal challenges

- Open source software.
- Open data.
- Open standards.
- Open access to research publications.
- Open education resources

Geo4All is fundamentally it is based on Open Principles

[About the
Cabinet Office](#)[National Security](#)[Constitutional
Reform](#)[Government
Efficiency](#)[Transparency](#)[Big Society](#)[Government:
How it works](#)

Government bodies must comply with Open Standards Principles

1 November 2012

From today all government bodies must comply with [Open Standards Principles](#), an agreed set of standards to make our IT more open, cheaper and better connected, Minister for Cabinet Office, Francis Maude said today.

The Open Standards Principles have been developed following the public consultation 'Open Standards: Open Opportunities – flexibility and efficiency in Government IT' which took place from February to June this year. The principles will help Government to deliver more innovative IT services and further drive savings and encourage more competition for government contracts.



There has been overwhelming support from the public and the IT community for setting an open standards policy for software interoperability, data and document formats:

- nearly 70 per cent of respondents believe the principles would improve innovation, competition and choice in the provision of government services; and
- over 70 per cent agree that they would help improve value for money.

Francis Maude said:

"We know that there are more real savings to be made in Government IT contracts – in the first half of this year, we have already saved £409 million on ICT services."

"Government must be better connected to the people it serves and partners who can work with it - especially small businesses, voluntary and community organisations. Having open information and software that can be used across government departments will result in lower licensing costs in government IT, and reduce the cost of lock-in to suppliers and products.

"It is only right that we are encouraging competition and creating a level playing field for all companies to ensure we

Related links

[Francis Maude speech at an event for IT professionals](#)

Related News and Media

[Liam Maxwell engaged by Efficiency and Reform Group](#)

[ICT Strategy Strategic Implementation Plan to deliver savings of over a billion pounds](#)

[New government Chief Information Officer announced](#)

[CloudStore opens for business](#)

[Cabinet Office and Oracle sign deal to save £75 million for taxpayers](#)

[View all news](#)

Most recent resources

1. Taking account of bidders' past performance
2. List of strategic suppliers
3. Open Standards Consultation responses
4. Open Standards Consultation documents
5. Charitable Incorporated Organisation (CIO) – Secondary Legislation before Parliament

Open agenda is now implemented by the UK Government and delivering huge cost savings for government

£409 million in the first half of this year

<http://www.cabinetoffice.gov.uk/news/government-bodies-must-comply-open-standards-principles>

Economic impact of FLOSS on innovation and competitiveness of the EU ICT sector

Study on the:

Economic impact of open source software
on innovation and the competitiveness of the
Information and Communication Technologies
(ICT) sector in the EU

Final report

Prepared on November 20, 2006

Lead contractor: UNU-MERIT, the Netherlands

Subcontractors:

Universidad Rey Juan Carlos, Spain

University of Limerick, Ireland

Society for Public Information Spaces, France

Business Innovation Centre of Alto Adige-Südtirol, Italy

Prepared by: Rishab Aiyer Ghosh, MERIT


Disclaimer

*The opinions expressed in this Study are those of the authors and do not necessarily reflect
the views of the European Commission. Contract ENTR/04/112.*

Internet backbone is powered by
OSS

Since April 1996 Apache has been
the most popular HTTP server
software in use. As of May 2011
Apache was estimated to serve
63% of all websites and 66% of
the million busiest

"May 2011 Web Server Survey". Netcraft. May 17, 2011

**NATIONAL AERONAUTICS
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NASA Open Source Software

NASA conducts research and development in software and software technology as an essential response to the needs of NASA missions. Under the NASA Software Release policy, NASA has several options for the release of NASA developed software technologies. These options now include Open Source software release. This option is under the NASA Open Source Agreement "NOSA".

The motivations for NASA to distribute software codes Open Source are:


- To increase NASA software quality via community peer review

Search
Intelligent Systems Division



FIRSTGov
Your First Click to the U.S. Government

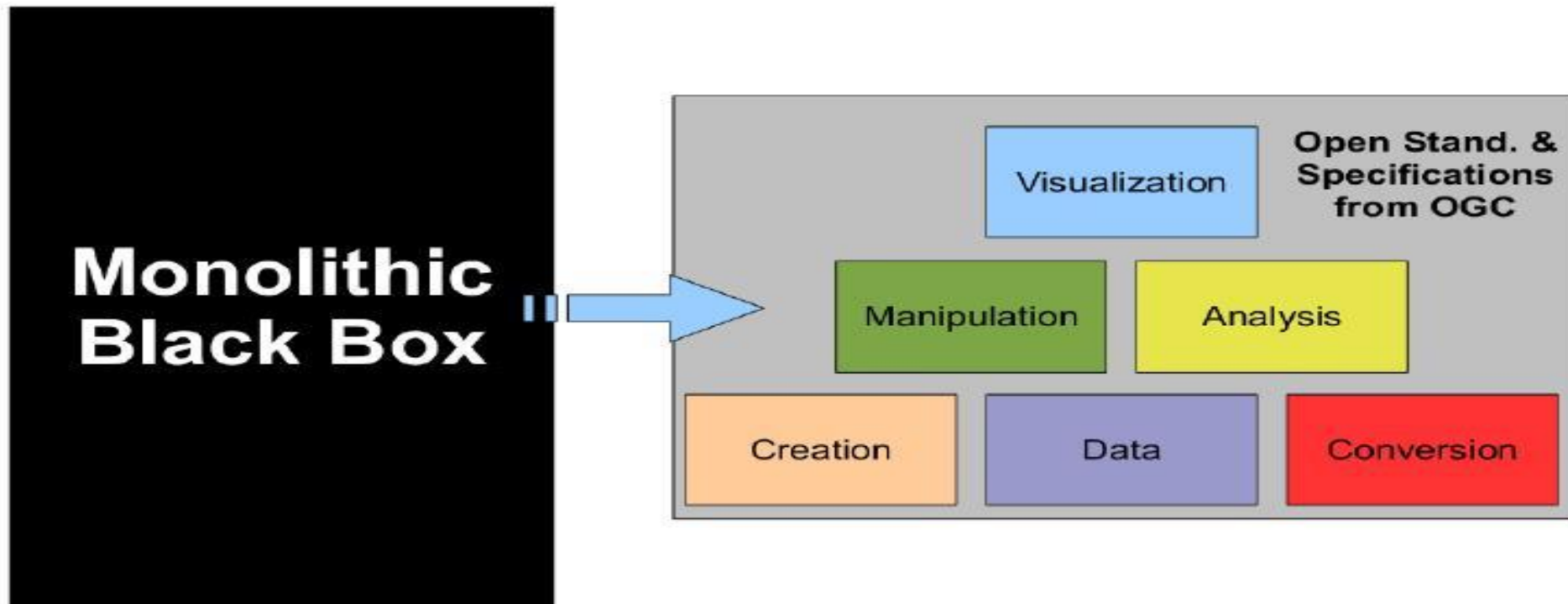
[+ Freedom of Information Act](#)
[+ The President's Management Agenda](#)
[+ NASA Privacy Statement, Disclaimer, and Accessibility
Certification](#)



NASA Official: Dave Korsmeyer
Curator: ASANI Solutions

Science is NOT a Black Box

Today's Toolkit



GRASP - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://grasp.nottingham.ac.uk/

Most Visited Getting Started Latest Headlines

Edit Post to Blog

GRASP

GRASP
Geospatial Resource for Agricultural Species Pests

HOME DATABASE DOCS TEAM ABOUT

Genotype1 Genotype2 Genotype3 Genotype4
Trait1 Trait2 Trait3 Trait4
Product knowledge
Market knowledge
Indigenous/farmer knowledge

Agro-ecological matching

GRASP1

Climate change scenarios

Trait hypothesis construction

new trait variation for breeding for Food Security

More screenshots

GRASP Overview (CPiB, 2011).

Fully build on Open Source

Summary

Advantages for open source, open standards, open data geospatial research and teaching



Represents the
individual content
creator on the World
Wide Web

Key advantages

- High quality and impact for research
 - Scalable
 - Interoperability
 - Low costs
- Benefits wider community
- Equips students with key knowledge needed for employability.

Acknowledgements

Stephen Fuller, University of Nottingham
SIGTE, University of Girona
GIS Summer School Staff
GeoAcademy, USA
GeoForAll colleagues
Dr Mark Ware, University of Glamorgan

FOSS4G GEOACADEMY CURRICULUM

Thirty-five (35) FOSS4G University-level **lectures and labs** are maintained and made available for download from the Spatial {Query} Lab on behalf of the [GeoAcademy](#). The lectures focus on a vendor-agnostic set of theories and principles. The labs focus on the use of [QGIS](#), [GRASS](#), and [Inkscape](#).

These lectures and labs are freely available for you to use and are released under the [Creative Commons Attribution 3.0 Unported license](#). The lectures and labs are aligned to the [Geospatial Technology Competency Model](#) and all labs focus on the use of Free and Open Source GIS Software (FOSS4G).

The components of the lectures and labs are listed on this page to make it easy to download and use. All of the labs are also available on [GitHub](#).

Note: The lectures are currently only viewable on line as HTML. Downloadable source files are coming soon.

GST 101 – Introduction to Geospatial Technology (QGIS) – Updated to QGIS 2.8 – **Now with lectures!**

GST 102 – Spatial Analysis (QGIS) – Updated to QGIS 2.8 – **Now with lectures!**

GST 103 – Data Acquisition and Management (QGIS) – Updated to QGIS 2.8 – **Now with lectures!**

GST 104 – Cartographic Design (QGIS and Inkscape) – Updated to QGIS 2.8 and Inkscape 0.91 – **Now with lectures!**

GST 105 – Introduction to Remote Sensing (QGIS and GRASS) – Updated to QGIS 2.8 and GRASS 6.4.3

ATTRIBUTION FOR DEVELOPMENT

The development of the original documents was funded by the Department of Labor (DOL) Trade Adjustment Assistance Community College and Career Training (TAACCCT) Grant No. TC-22525-11-60-A-48; The National Information Security, Geospatial Technologies Consortium (NISGTC) is an entity of Collin College of Texas, Bellevue College of Washington, Bunker Hill Community College of Massachusetts, Del Mar College of Texas, Moraine Valley Community College of Illinois, Rio Salado College of Arizona, and Salt Lake Community College of Utah. This work is licensed under the Creative Commons Attribution 3.0 Unported License. To view a copy of this

<http://spatialquerylab.com/foss4g-academy-curriculum/>