Geo372
Vertiefung GIScience

GIS and the internet

Herbstsemester

Ross Purves

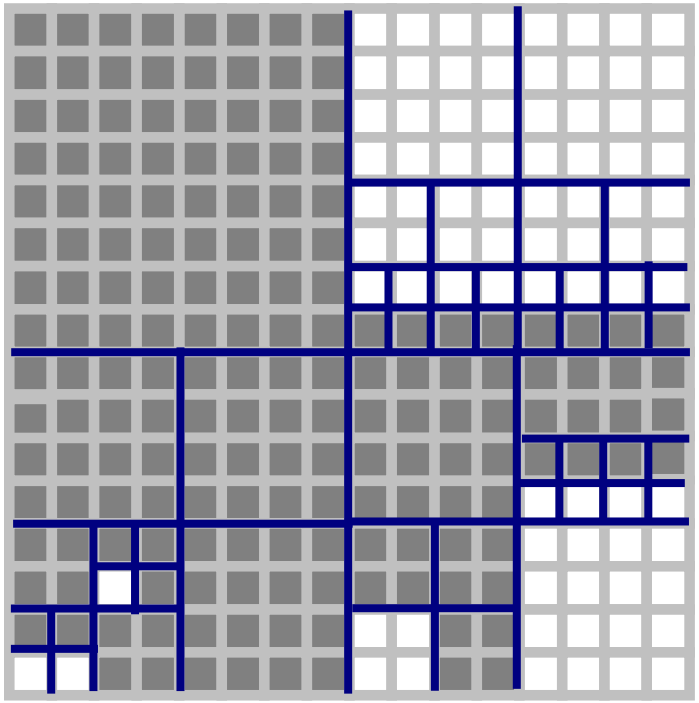
Last week

- First we looked at the basic element of a database – the **database table** and some related definitions and properties
- We explored some **typical database applications** and their **requirements**
- We looked at how we could **index data** to make access faster
- We explored the basics of **spatial databases** and ways of **indexing spatial data**
- **DBMS lie behind most web GIS implementations**

Last week's questions…

Indexed data

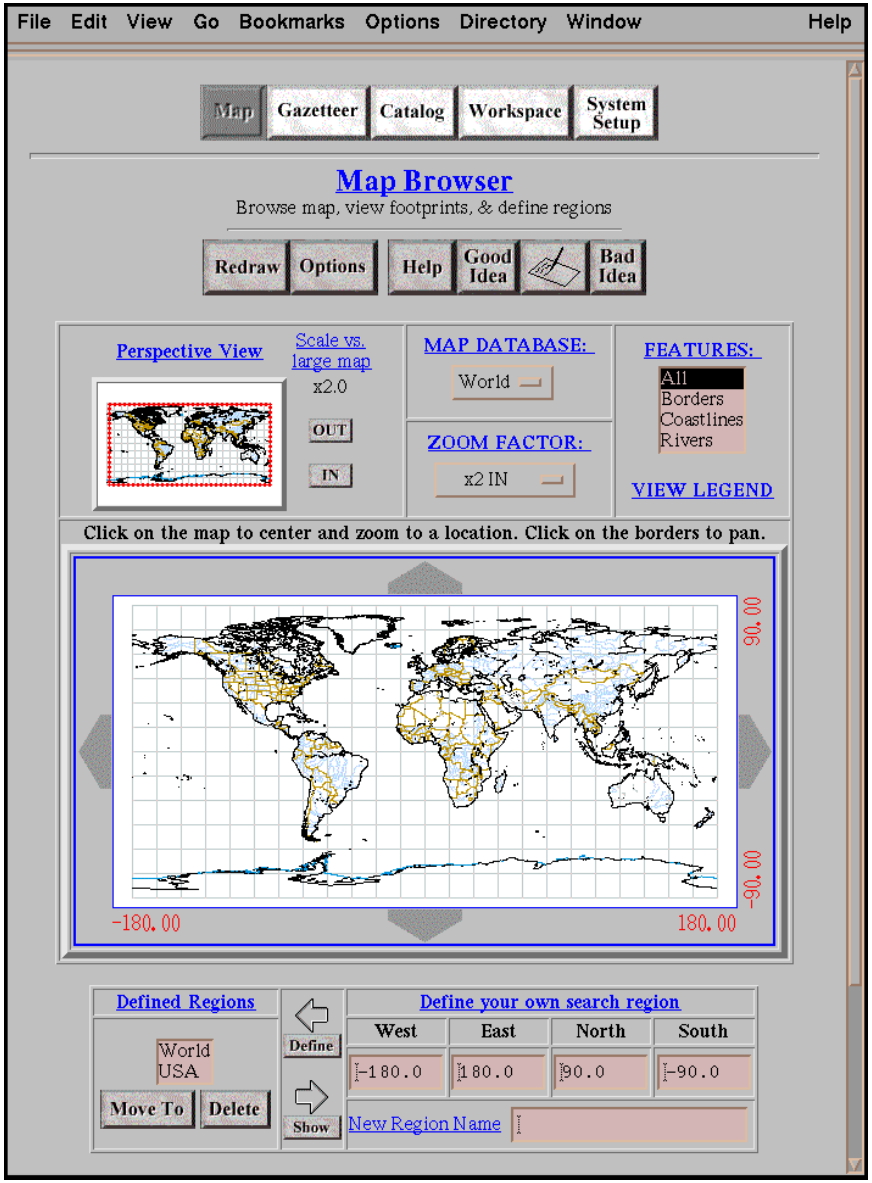
Level 1	Level 2	Level 3
17	10	-20
		3
		10,10
	17	14
		17
	32	21
		23
		32
		70
		72
		100



Learning objectives

- You can give **examples** of the use of **GIS on the web** and relate them to **issues of data quality**
- You can illustrate a **simple web architecture**, and explain how (and why) **presentation** can be **separated** from **data**
- You can define the terms **interface** and **interoperable** in the **context of web services**
- You know what a mashup is, can give examples of how **data** can be **combined to produce a mashup,** and can list some **potential problems with mashups**

Outline



From here (~1993)…

…to here (2016)

Outline

Source:
http://www.news.wisc.edu/newsphotos/images/VAX_computer_system99_1.jpg

Structured spatial data

From here (~1993)…

Source:
http://www.theverge.com/2016/5/20/11719244/hyper-reality-augmented-short-film

Unstructured and structured data from multiple sources combined in Augmented Reality

…to here (20??)

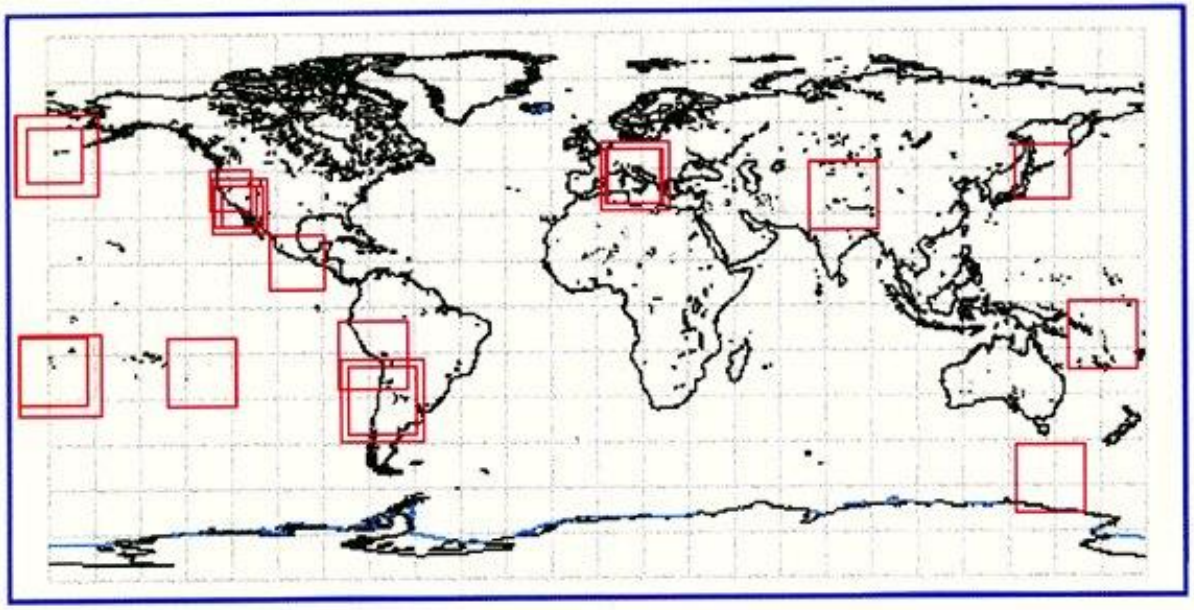
A little history

- The very **first** WWW (world wide web) conference in 1994 had a paper about a **web map server** -> the Xerox Parc Map Server
- The server was hosted in the US, and allowed **integration of other data sets** -> for example Edinburgh University implemented a server which **mapped earthquakes**
- This is a very early example of a **mashup** – but no-one called it that then (we will return to mashups in the second half of the lecture)

Global Earthquake Map

The earthquakes are shown on this world map as red squares, with the size of the square proportional to the magnitude of the earthquake.

You may click on any location on this map to zoom in much closer. Once you zoom, you will have access to the standard Xerox PARC Map Viewer with its full set of functions.



RETURN TO INTRO PAGE

Thanks to Bruce Gittings of Edinburgh University

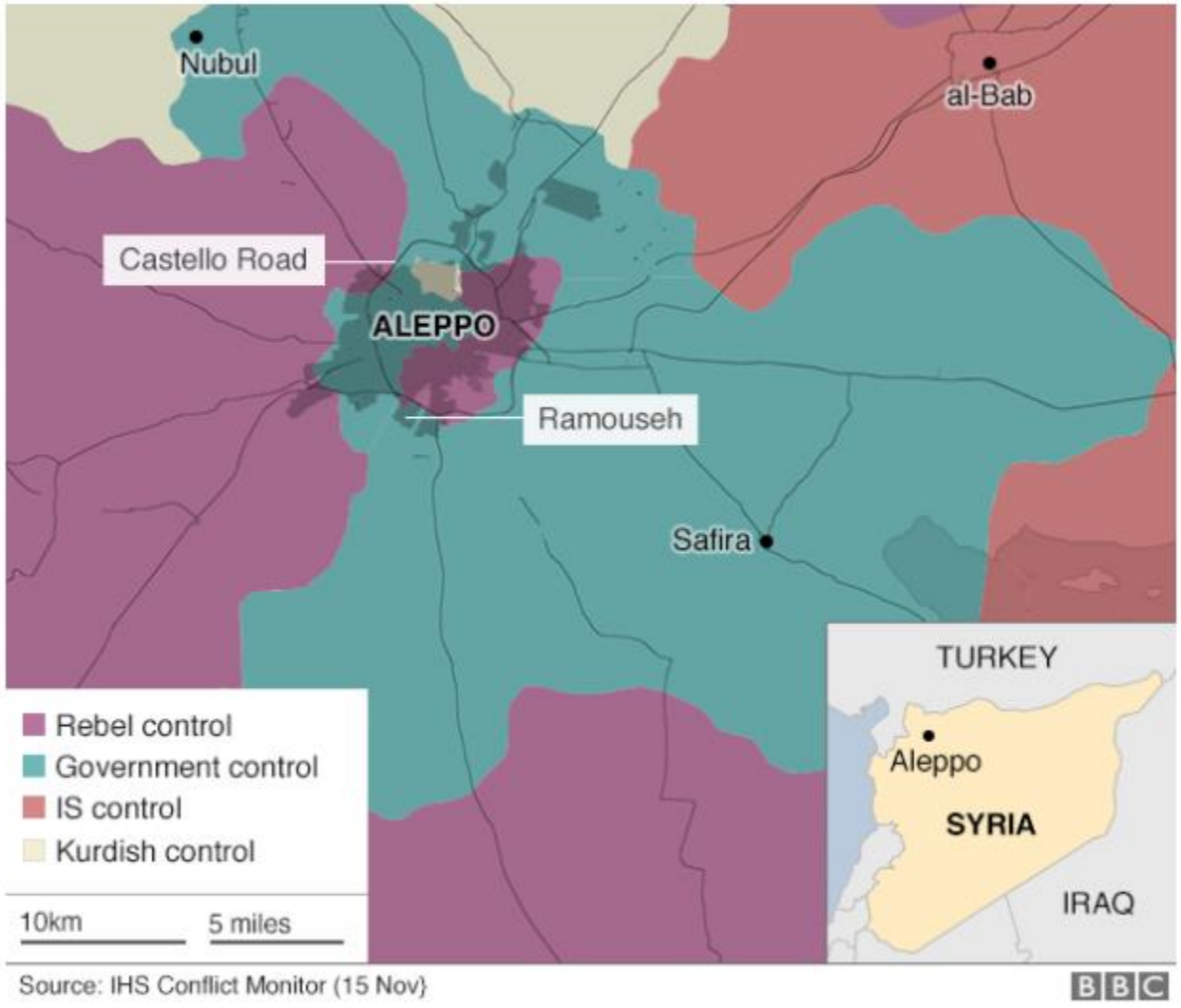
Web mapping

- The most basic web maps are simply **static images**– these are generally produced by a GIS inhouse and simply displayed online as an image
- **Usual cartographic rules** should apply to such maps
- The most **basic** level of **interactivity** is provided by an image map – the user can click on the map and something happens

- Most web mapping systems allow users to **pan** and **zoom**
- Some allow users to change **layers** displayed or **background themes**
- **Similar data** underlies all these services – **national or international seamless topographic data** (e.g. OSM, TeleAtlas), imagery (e.g. LandSat and in some cases a DEM (e.g. SRTM) – note that today I won't talk about the distinction between **administrative data** and **user-generated content/ VGI**

Tuesday, following a three week moratorium. Thirteen - including nine children - have died in the government-controlled west.

Syria Civil Defence, a volunteer rescue service also known as the White Helmets, said there were 180 air strikes on east Aleppo on Saturday alone.



Both the White Helmets and the Observatory said the assault had continued into Sunday, with barrel bombs dropped on the al-Sakhour district.

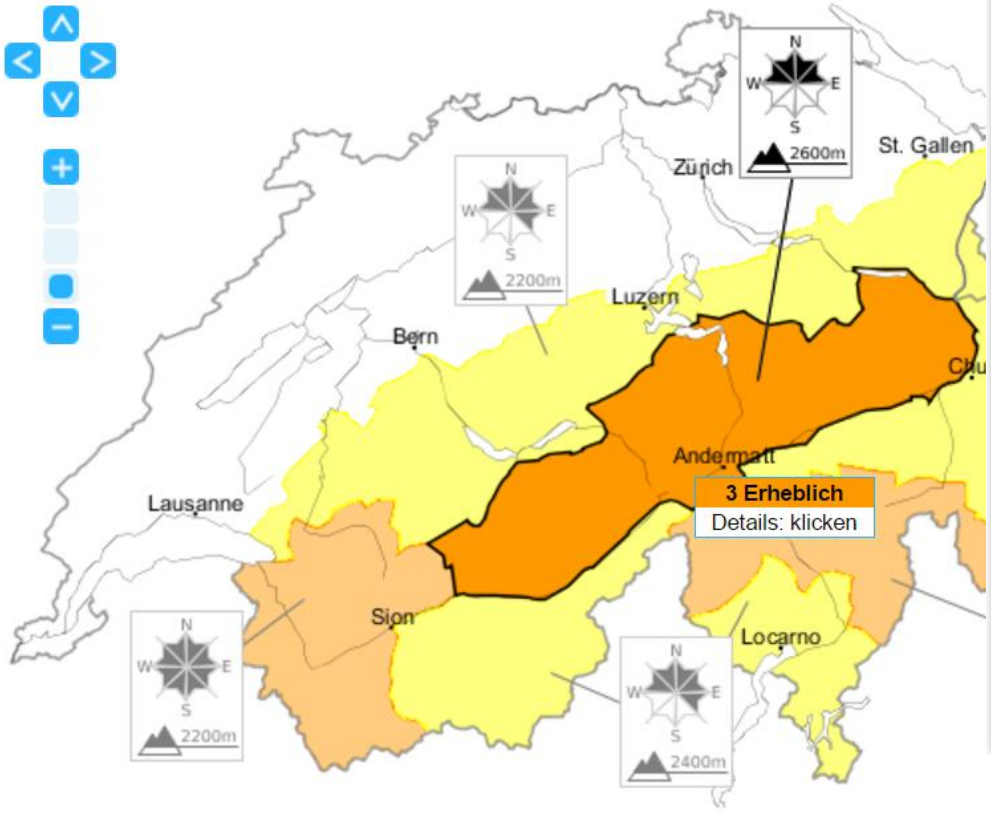
Source: http://www.bbc.com/news/world-middle-east-38043157

Lawinenbulletin bis Sonntag, 20. November 2016

Verbreitet erhebliche Lawinengefahr

Ausgabe: 19.11., 17:00 Nächster Update: 20.11., 17:00 Gültigkeit

Lawinengefahr | Schneedecke und Wetter | Beobachtung melden



Prognose der Lawinengefahr

Erheblich, Stufe 3

Triebschnee, Altschnee

Gefahrenstellen

Vor allem an den Expositionen West über Nord bis Ost oberhalb von rund 2600m.

Gefahrenbeschrieb

Die Triebschneeansammlungen sind störanfällig. Einzelne Wintersportler können Lawinen auslösen. Zudem können teilweise Lawinen in tiefen Schichten anreissen, vor allem an Schattenhängen oberhalb von rund 2800 m. Touren und Variantenabfahrten erfordern Erfahrung in der Beurteilung der Lawinengefahr.

Gleitschneelawinen

Alpennordhang und Wallis: Unterhalb von rund 2500 m sind Gleitschneelawinen zu erwarten. Zonen mit Gleitschneerissen sollten gemieden werden.

Infos zu Schneedecke und Wetter

Messwerte

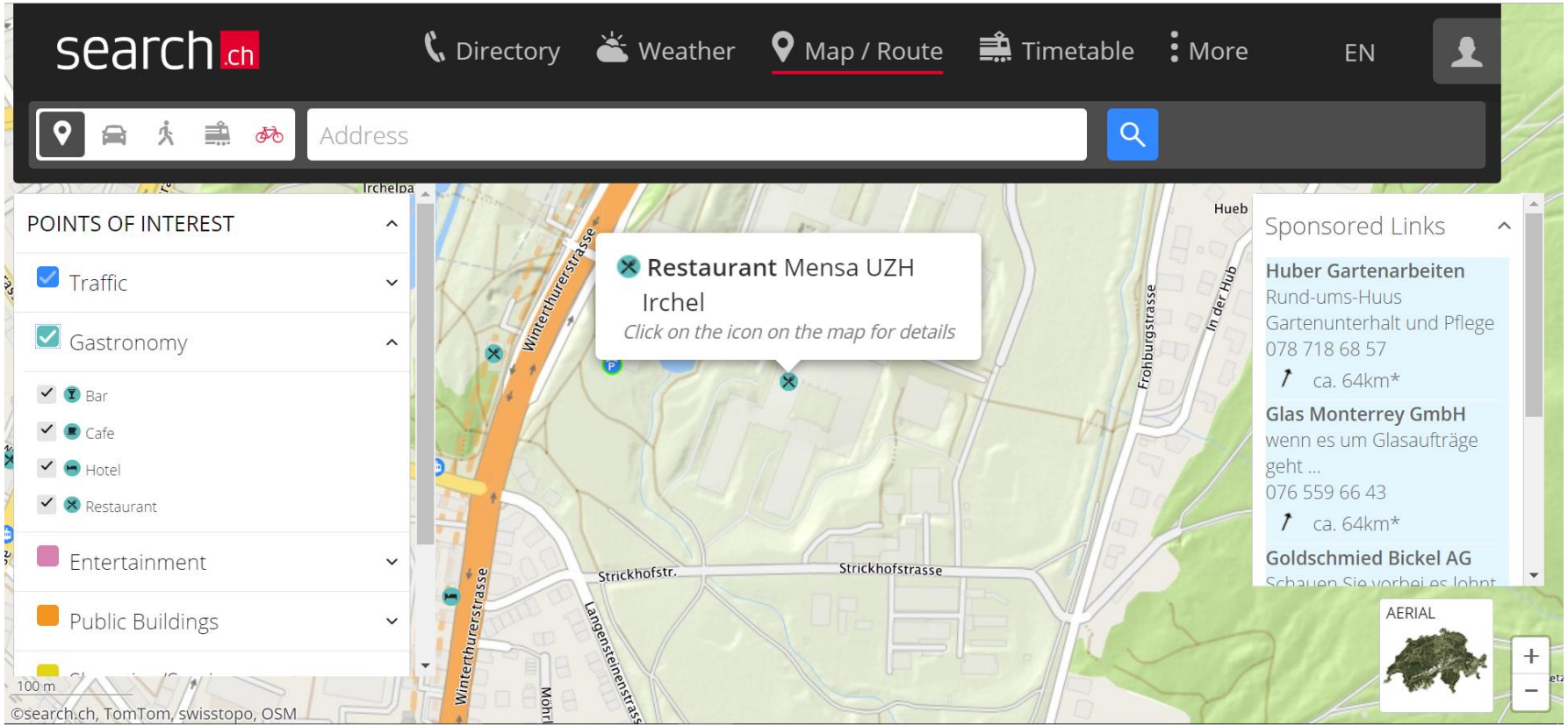
Schnee / Wind und Temperatur

Erklärungen

Interpretationshilfe

Gefahrenstufen 1 gering | 2 mässig | 3 erheblich | 4 gross | 5 sehr gross

http://www.slf.ch



http://search.ch

Facilitating access to archive material online

- Many national libraries hold **historic documents** which have great value (monetary and cultural)
- Among the most fascinating of these (for geographers at least) are **historic maps**
- Before the advent of the internet, **access** to such maps was **difficult** and **generally restricted** to experts
- Some important collections have now been scanned and made **openly available online**

Historical maps

home | welcome to the Pont maps web site | search

the maps | the texts | biographies | history | subjects | further reading | enquiries

National Library of Scotland

BACK TO LIST

the maps
general | specialist

Ben Nevis

Pont's illustration does full justice to Britain's highest mountain (1344 metres), apparently dwarfing all surrounding hills. The old fort of Inverlochy (*Inner-Lochy*), by which grew the town of Fort William in following centuries, can be seen above the mountain, as can the (still) wooded valley of Glen Nevis running down to Loch Linnhe.

Detail from Pont Map 13

Pont maps were drawn by a priest in the 1580s and 1590s

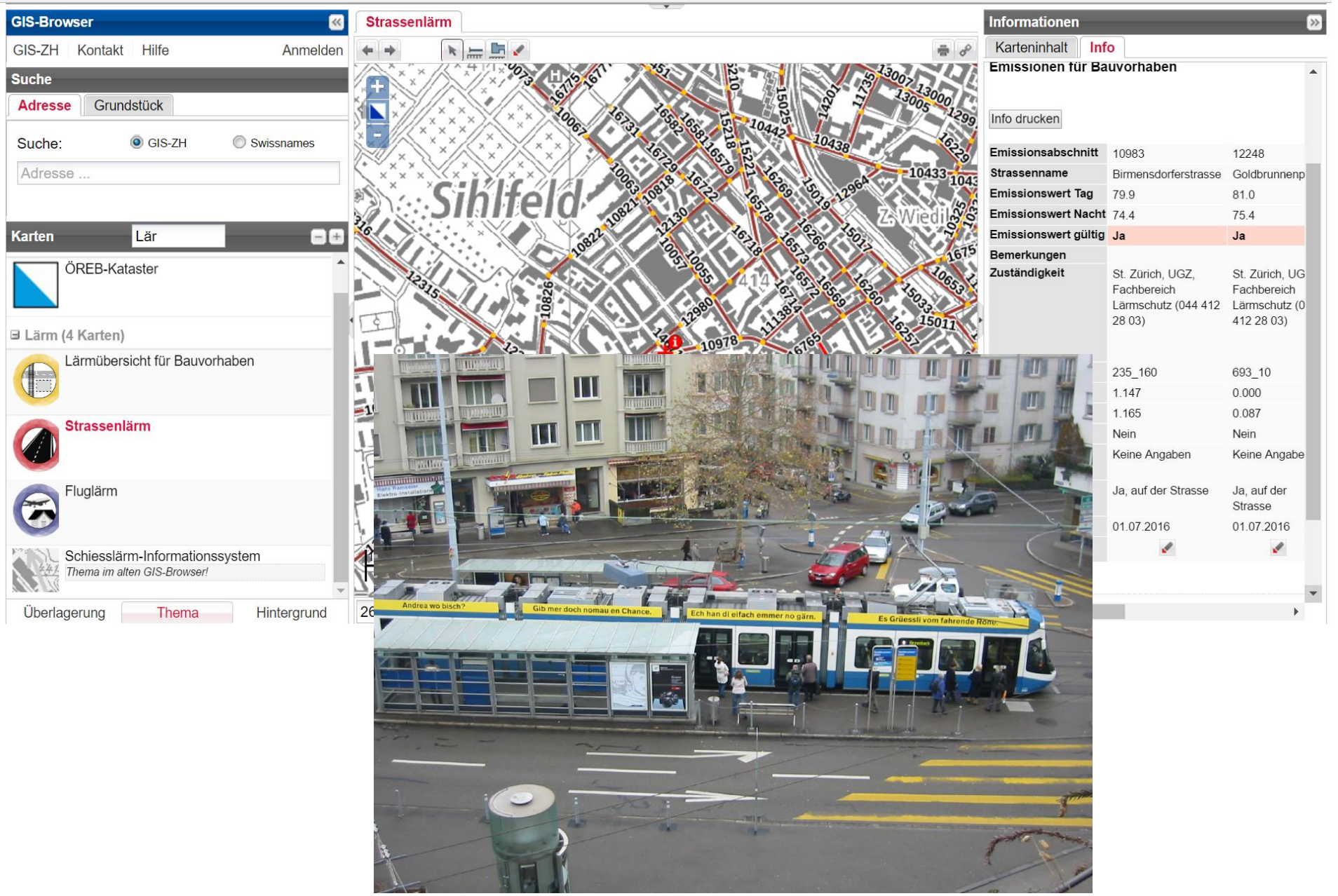
http://www.nls.uk/pont/

Querying and visualising geographic information online

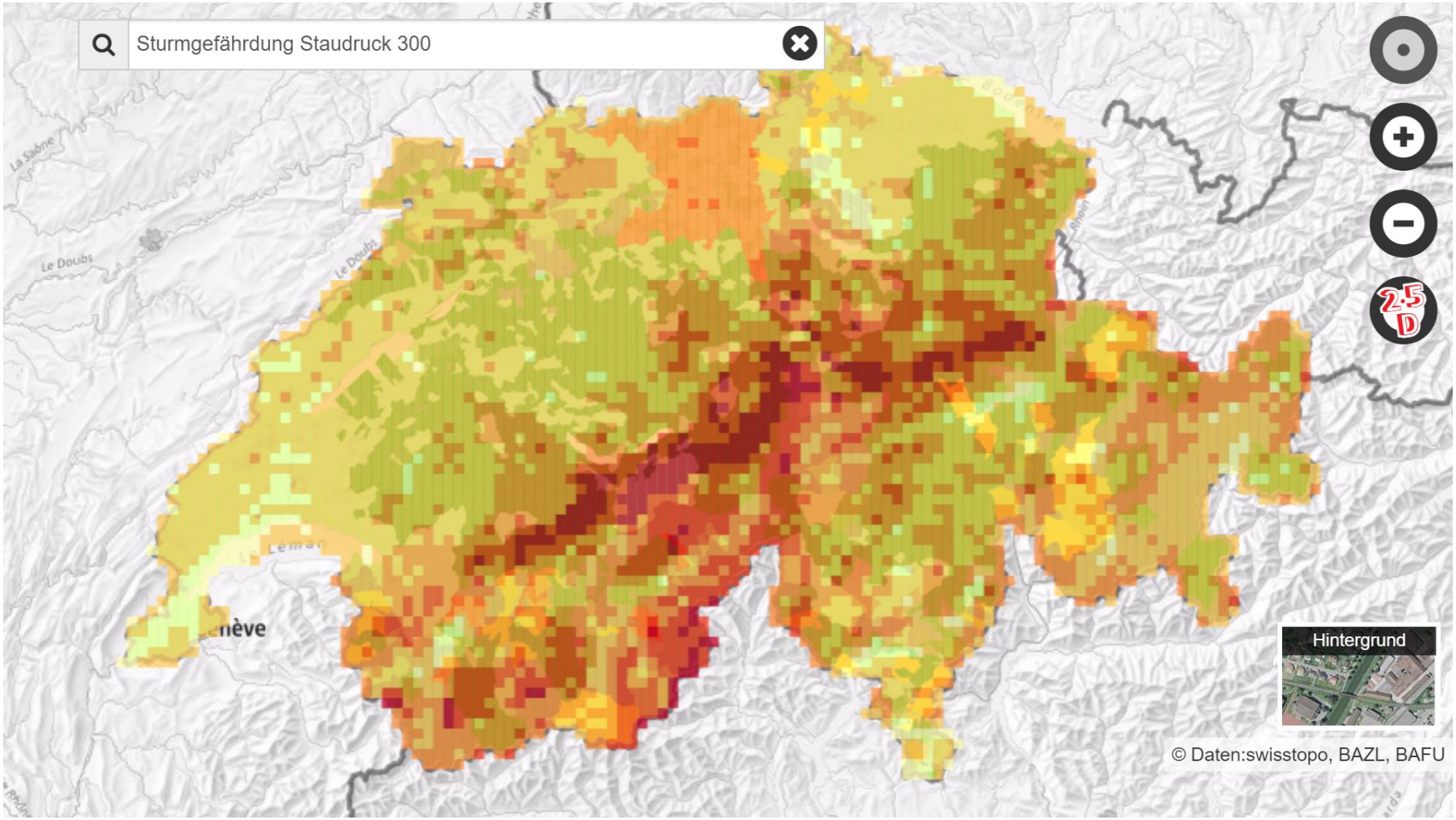
- GIS is used in a wide **variety of organisations** (e.g. local government, utility companies, environmental monitoring, marketing, healthcare, police)
- Web GIS allows such organisations to
  - Fulfil duty to give **public access** to data (mainly government organisations)
  - Provide **basic GIS functionality** to employees through Intranet
- Generally such applications allow **querying** and **visualisation** of data

Source: http://www.scotlandscensus.gov.uk/ods-web/datavis.jsp?theme=Households_September_2013

Source: http://maps.zh.ch/?topic=TBAStrassenlaermZH



Source: https://map.geo.admin.ch/



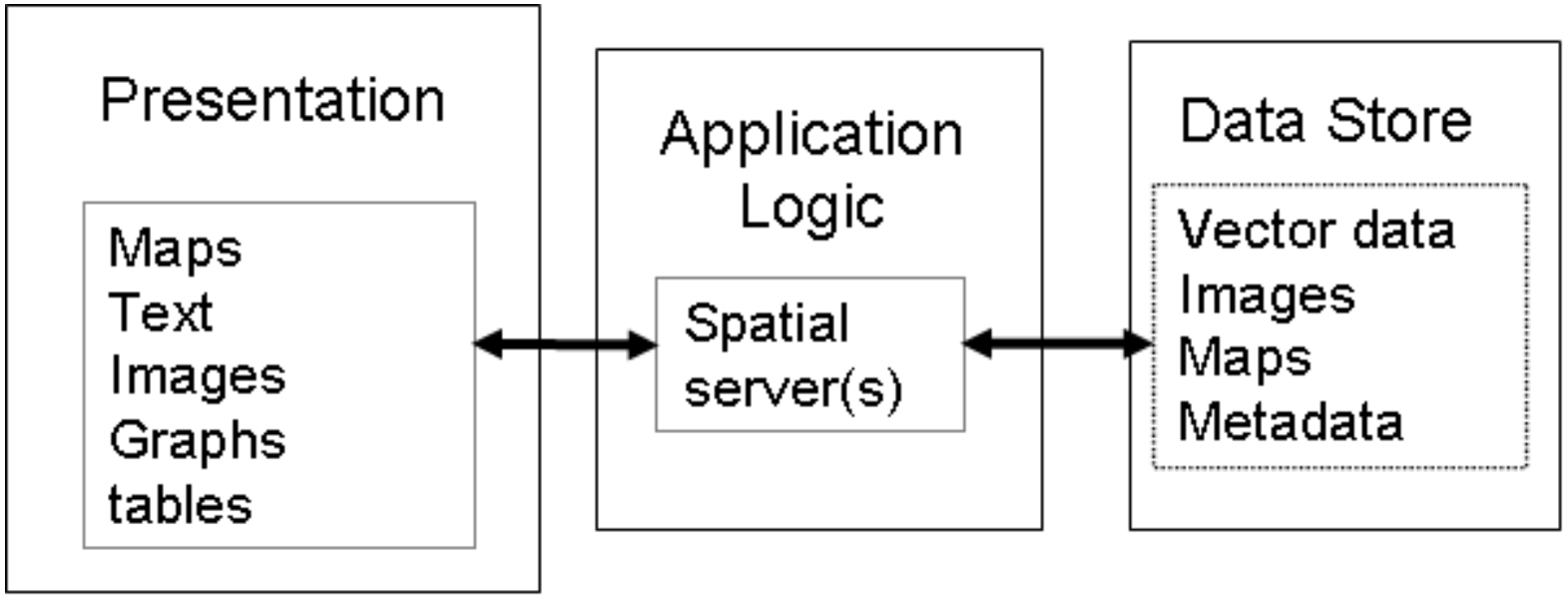
Some comments…

- The census data allow us to **easily visualise basic patterns** of, e.g. population density
- The Kanton Zurich GIS is **very powerful** – but the data presented are **very technical**
- **map.geo.admin.ch** provides access to a very wide range of data: again some are highly complex
- All of these services focus on allowing access to **views on data –** using **prepared maps**

Implementing web-based GIS

- There are a wide range of implementations of web-based GIS
- Systems may be **static** or **dynamic**, and the client may be **thick** or **thin**
- In general, static thin clients **guarantee** that the service will **work** for the widest possible user base, whilst dynamic thick clients offer the **richest interactivity**
- **AJAX** (Asynchronous JavaScript and XML) radically changed the way that interactivity could be delivered (used in Google maps to allow seemingly seamless panning)

Typical basic architecture



Separating presentation from application logic allows bespoke interfaces to be developed for different purposes

Often a **proprietary GIS** such as ArcGIS or Intergraph provides the application logic

Typically a **DBMS** though may be a file-store or prepared maps saved as images

ArcGIS Online – an informal view

Source: https://gisinsider.wordpress.com/category/arcgis-online/

The Open Geospatial Consortium (OGC)

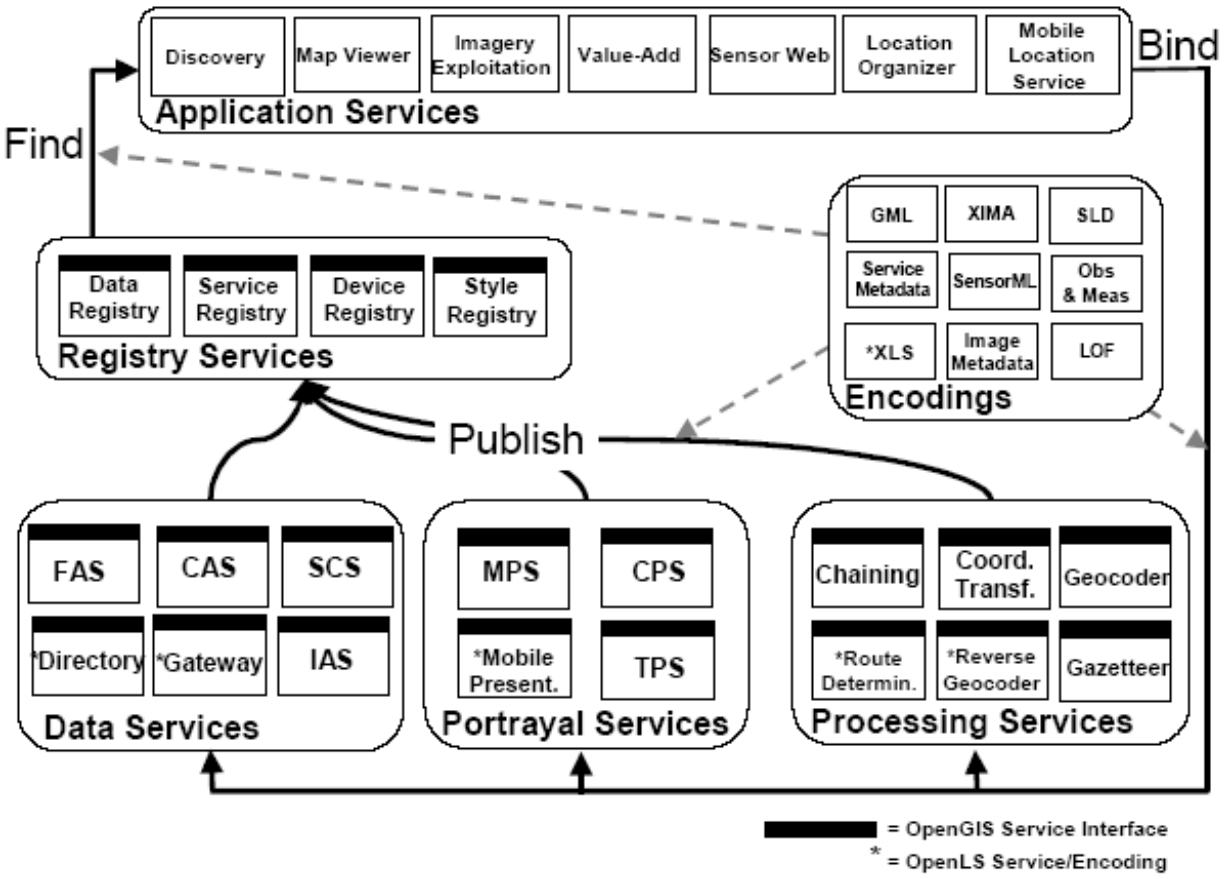
- The Open Geospatial Consortium is an **international industry consortium** of companies, government agencies and universities participating in a **consensus process** to develop **publicly available interface specifications**
- OpenGIS Specifications support **interoperable solutions** that "geo-enable" the Web, wireless and location-based services, and mainstream IT
- The specifications **empower technology developers** to make **complex spatial information** and services accessible and useful with all kinds of applications

This text is directly from OGC web-site (www.opengeospatial.org)

What does this mean?

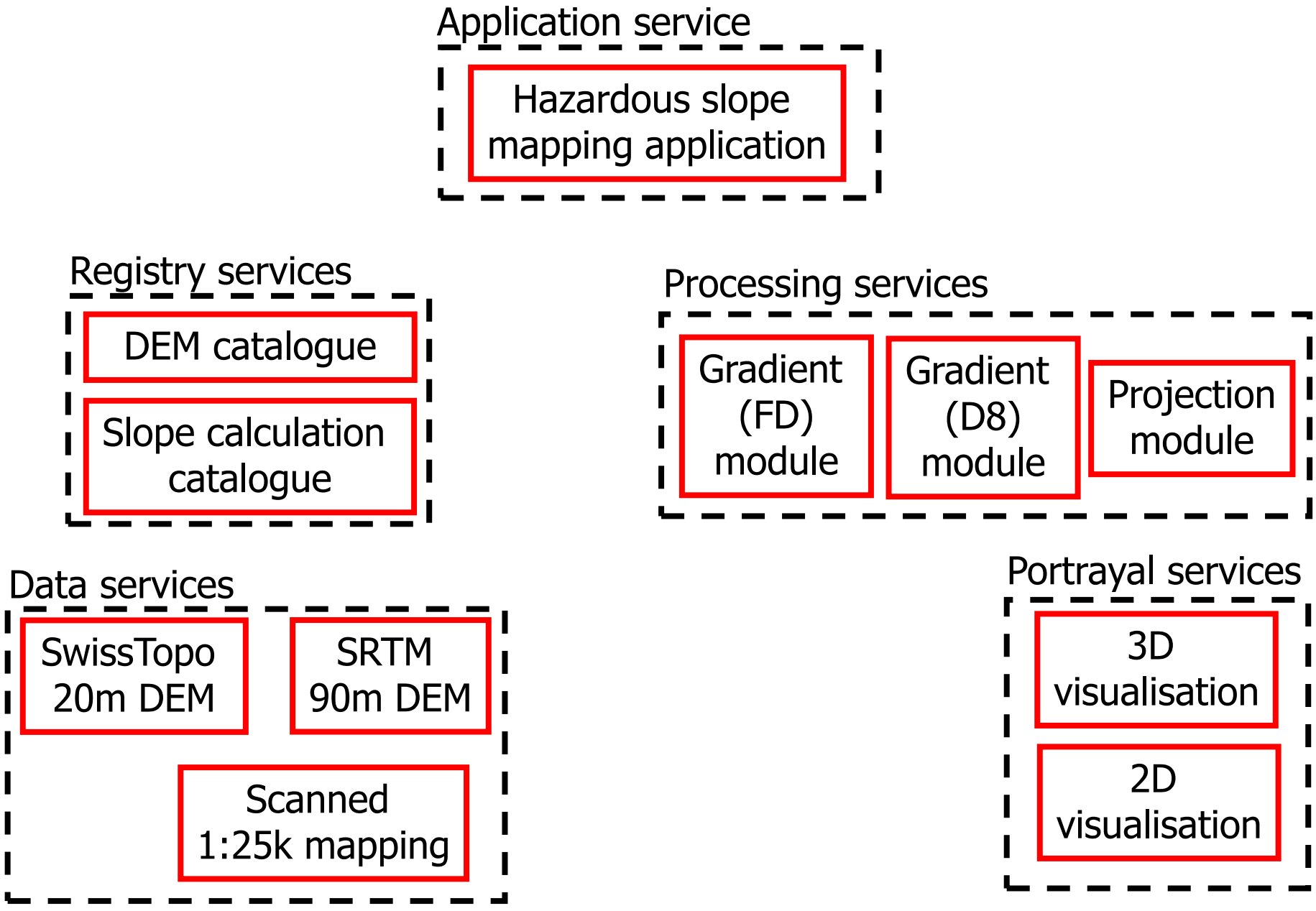
- Interface specifications describe the **inputs**, **outputs** and **functionalities** that software should provide – by using standards we know what to expect
- **Interoperable** means that we can build a **chain of services** and **swap services** as long as they follow our interfaces
- **In principle** such standards make it easier for different software packages to share data - at national and international levels this is the domain of **Spatial Data Infrastructures** (e.g. **Interlis** is part of Switzerland's strategy)

Open Web Service framework

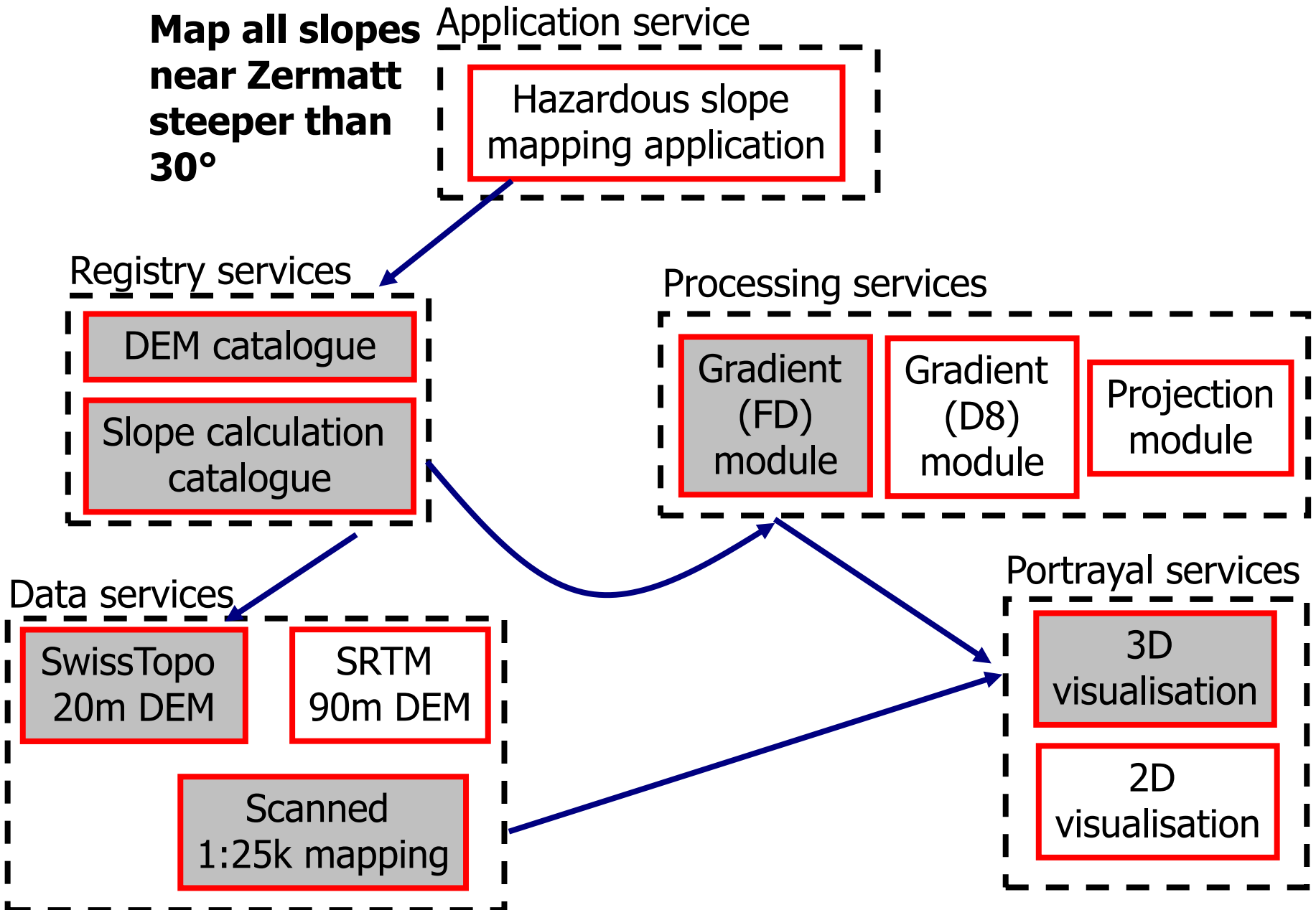


- **Registry services** store metadata – they help us find data and services
- **Data services** provide access to spatial data
- **Processing services** manipulate data in some way (e.g. reproject data)
- **Portrayal services** allow us to visualise data
- **Application services** can chain other services together to build useful services

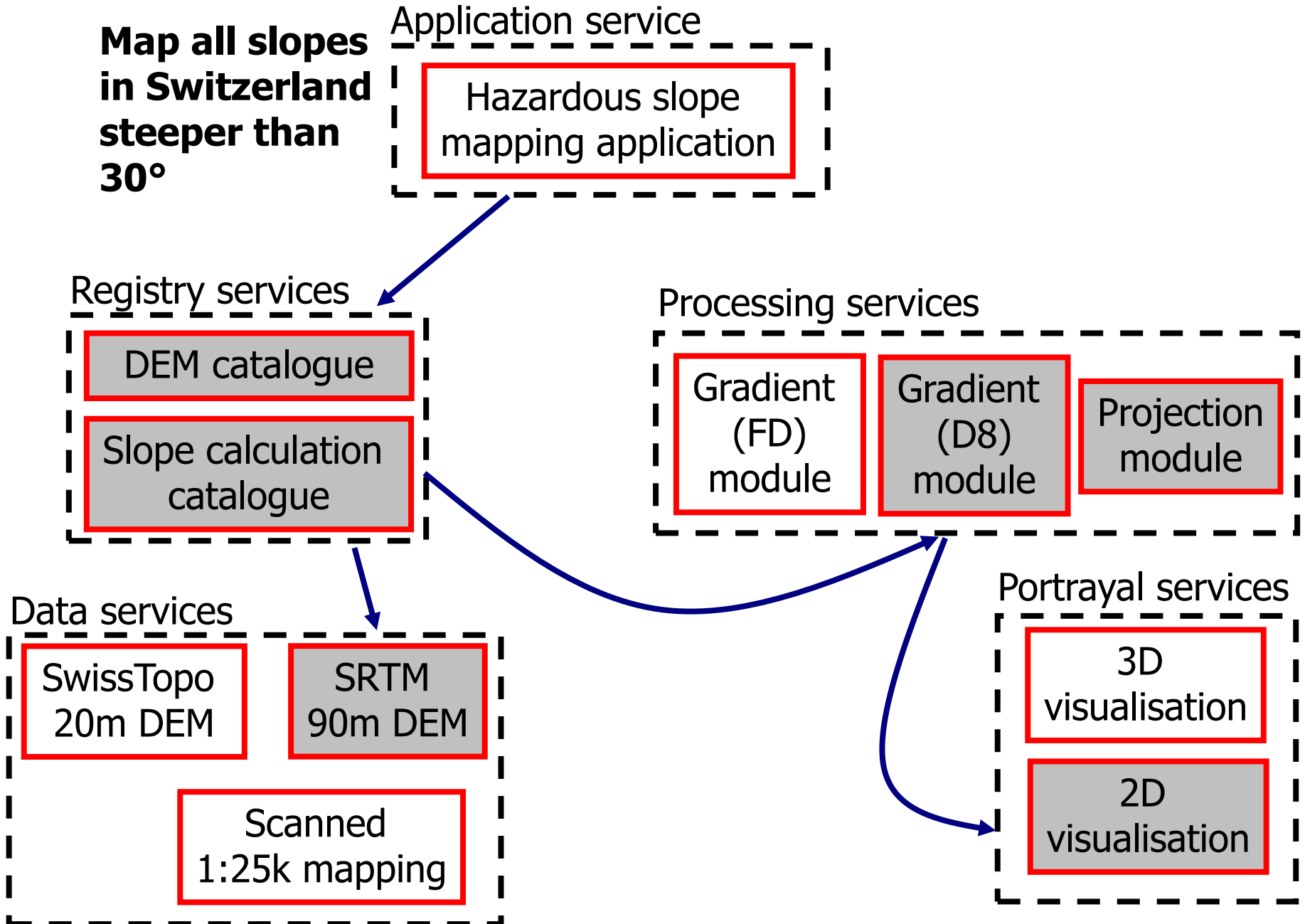
Hypothetical process chain



Hypothetical process chain



Hypothetical process chain



How successful is the OGC?

- The OGC has produced **many standards** in cooperation with its partners
- Many commercial and most OpenSource GIS have **implemented** OGC interfaces
- However, most commercial GIS also provide their own (non-OpenGIS) solutions
- Lots of people (including me) would argue that OGC standards are **often too complex** for **simple applications**
- However, for **web mapping services**, involving **simple overlay**, specifications are very successful

Simpler specifications: GeoJSON

- GeoJson is a simple format based on JavaScript Object Notation
- It encodes the following types of geometry (based on the OGC Specification we saw last week): Point, LineString, Polygon, MultiPoint, MultiLineString, and MultiPolygon.

```
{
  "type": "Feature",
  "geometry": {
    "type": "Point",
    "coordinates": [125.6, 10.1]
  },
  "properties": {
    "name": "Dinagat Islands"
  }
}
```

Source: http://geojson.org/

…and then suddenly there was…

…Google Earth (and Google Maps)

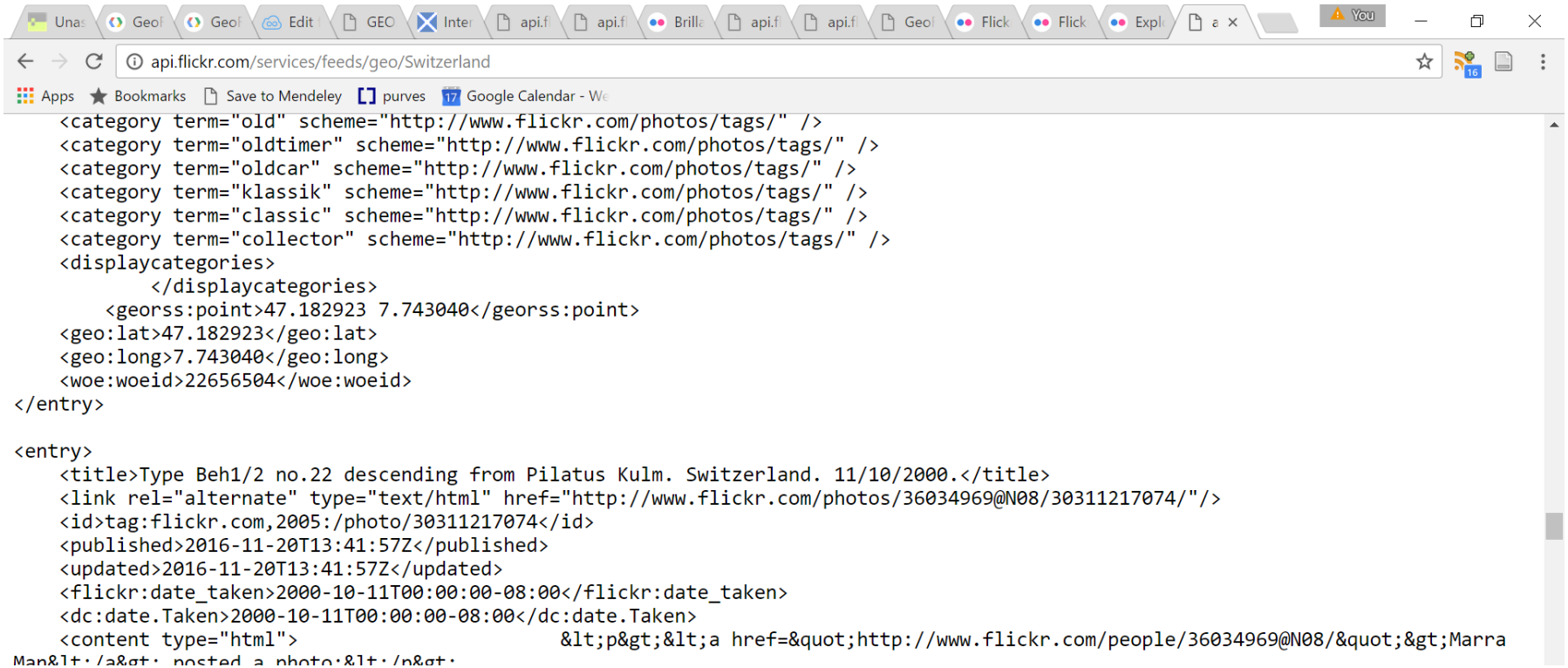
- **Google Maps** and **Google Earth** were both released in 2005 (though Google Earth was bought from another company)
- They **revolutionised** the use of **spatial data** on the web
- Google Maps offered **APIs** (Application Programming Interfaces) which made it easy to add data
- Google Earth (and now Google Maps) use **KML** which allows users to overlay data in 3D
- Much of the OGC's interoperable vision is now happening through Google's (and other similar products) – which **were not standards compliant**…
- …but the **standards changed** to embrace these

Mashups

- Mashups **integrate data** from **multiple sources** to produce **new, useful applications**
- They are a way of **fulfilling the OGC's aim** to "empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications"
- To allow creation of mashups **data** and **service providers** need to **provide interfaces** to their data so that it can be **passed along** a **service chain**
- Mashups allow the **interactive mapping** of **realtime data** -> this is not possible with paper maps (e.g. where is my train **NOW**)

Simple mashup

- I created this in 30 minutes
  - Flickr provides a feed outputting recent images
    (http://api.flickr.com/services/feeds/geo/Switzerland&lang=en-us&format=feed-georss)
  - The Google Maps API can take this input and add it to a map
    - To do so I need an API key (Google can monitor how much I use their service and what I do)
  - The feed is converted to Google's own format (KML)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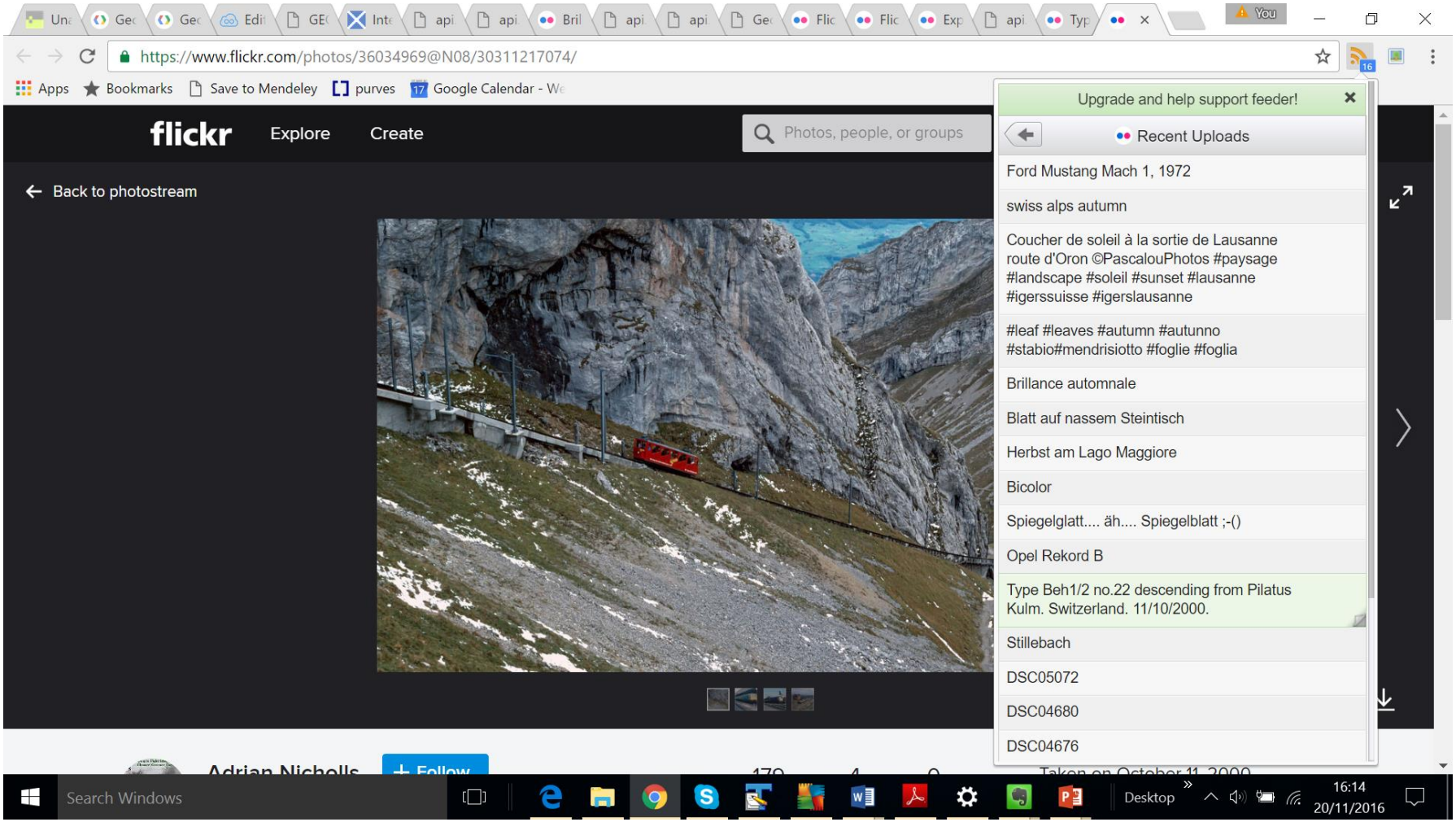
https://www.flickr.com/photos/36034969@N08/30311217074/
Apps
Bookmarks
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Google Calendar - We
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Explore
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Photos, people, or groups
Back to photostream
Upgrade and help support feeder!
Recent Uploads
Ford Mustang Mach 1, 1972
swiss alps autumn
Coucher de soleil à la sortie de Lausanne route d'Oron ©PascalouPhotos #paysage #landscape #soleil #sunset #lausanne #igerssuisse #igerslausanne
#leaf #leaves #autumn #autunno #stabio#mendrisiotto #foglie #foglia
Brillance automnale
Blatt auf nassem Steintisch
Herbst am Lago Maggiore
Bicolor
Spiegelglatt.... äh.... Spiegelblatt ;-()
Opel Rekord B
Type Beh1/2 no.22 descending from Pilatus Kulm. Switzerland. 11/10/2000.
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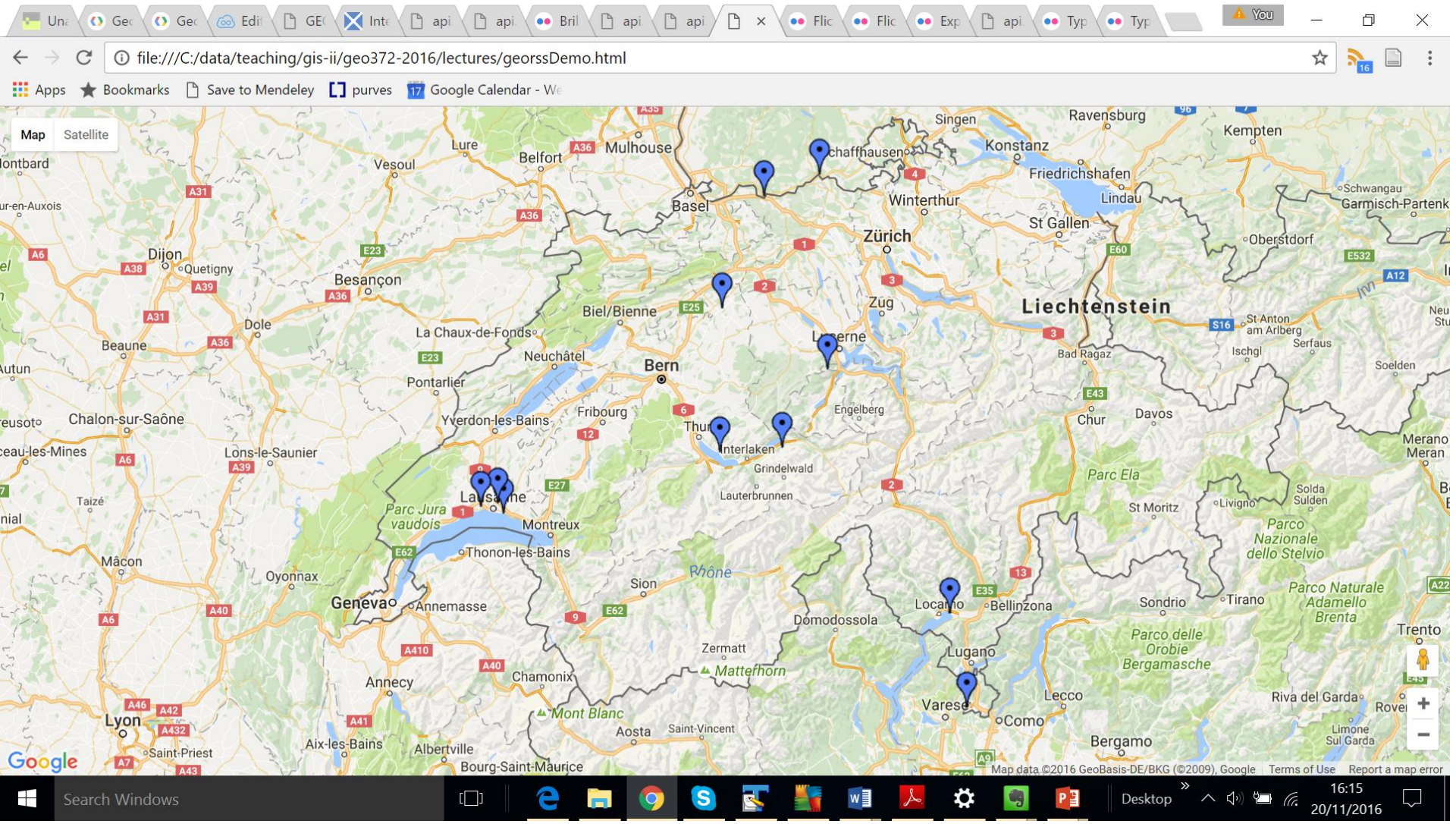
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Geneva
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Interlaken
Grindelwald
Lauterbrunnen
Engelberg
Montreux
Thonon-les-Bains
Annemasse
Chamonix
Mont Blanc
Zermatt
Matterhorn
Locarno
Bellinzona
Lugano
Varese
Como
Domodossola
Sion
Rhône
Liechtenstein
Konstanz
Friedrichshafen
Winterthur
St Gallen
Lindau
Zug
Davos
Chur
Bad Ragaz
Parc Jura vaudois
Parc Ela
Parco Nazionale dello Stelvio
Parco Naturale Adamello Brenta
Parco delle Orobie Bergamasche
Map data ©2016 GeoBasis-DE/BKG (©2009), Google
Terms of Use
Report a map error
Search Windows
Desktop
16:15
20/11/2016

file:///C:/data/teaching/gis-ii/geo372-2016/lectures/georssDemo.html

Apps Bookmarks Save to Mendeley purves Google Calendar - We

Map Satellite

Type Beh1/2 no.22 descending from Pilatus Kulm. Switzerland. 11/10/2000.

Marra Man posted a photo:

The 800mm gauge Pilatus Bahn is the worlds steepest railway with gradients reaching 48%. Not to be confused with a funicular railway It runs for 4.6km between Alpnachstad and the summit at Pilatus Kulm using 1550v DC overhead power lines. Because the line is so steep it employers the 'Locher' rack system which consists of two horizontal gear pinions either side of a toothed centre rail.

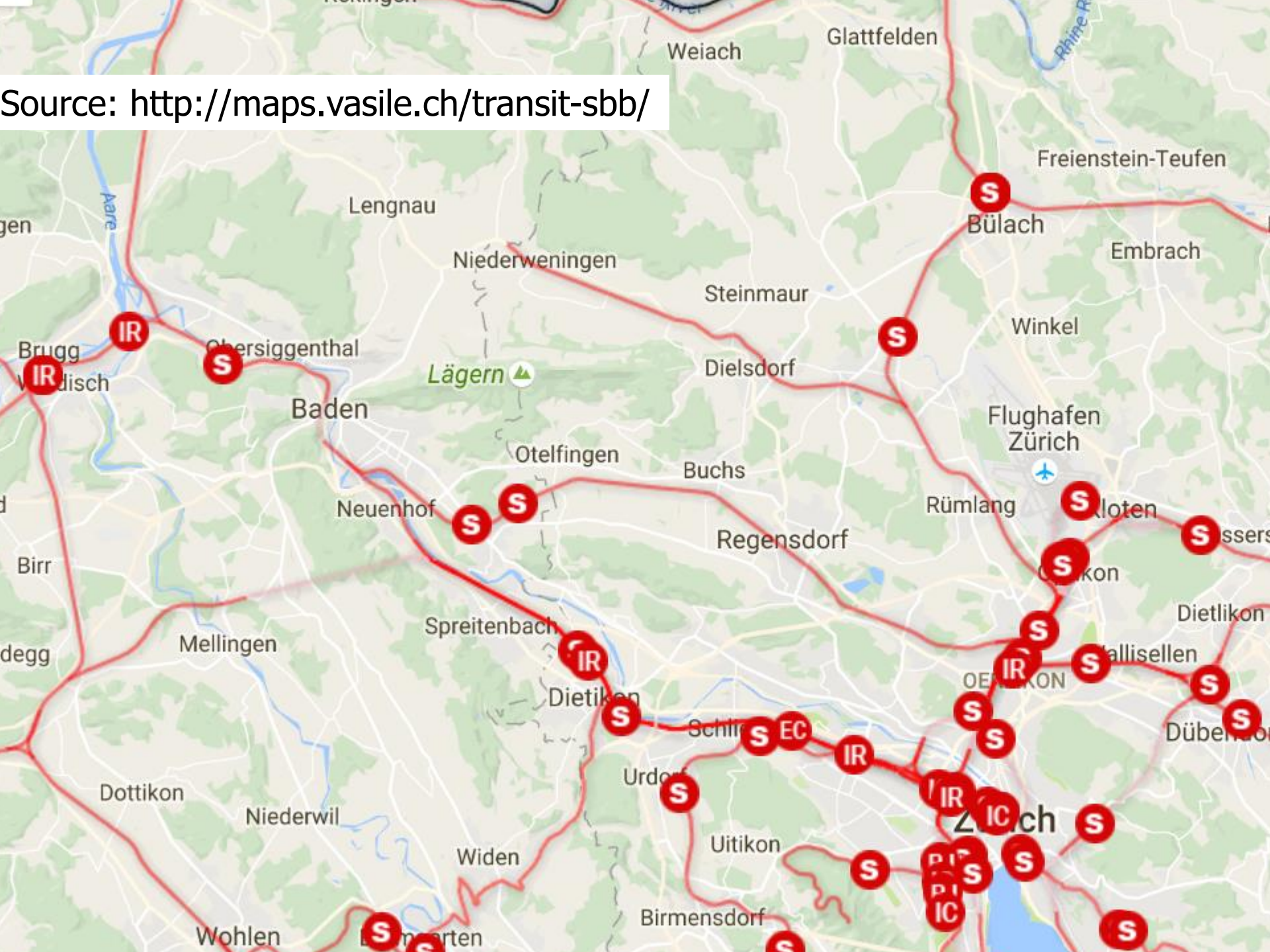
Type Beh1/2 car no.22 built in 1937 by SLM in Winterthur is seen descending from Pilatus Kulm with the 11.25 service to Alpnachstad.

Saint-Avold Karlsruhe Crailsheim Nördlingen Neuburg an der Donau Augsburg Landsberg am Lech Kempten Garmisch-Partenkirchen Oberstdorf St Anton am Arlberg Serfaus Ischgl Bad Ragaz Bern Neuchâtel La Chaux-de-Fonds Beaune Dole Dijon Quetigny Besançon Vesoul Langres Châtillon-sur-Seine Dolancourt Chaumont Neufchâteau Vittel Nancy Saint-Dizier Bar-le-Duc Vitry-le-François -en-Champagne

Google Map data ©2016 GeoBasis-DE/BKG (©2009), Google Terms of Use Report a map er

Search Windows Desktop 16:16 20/11/2016

Mashup examples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Otelfingen
Buchs
Flughafen Zürich
Rümlang
Neuenhof
Regensdorf
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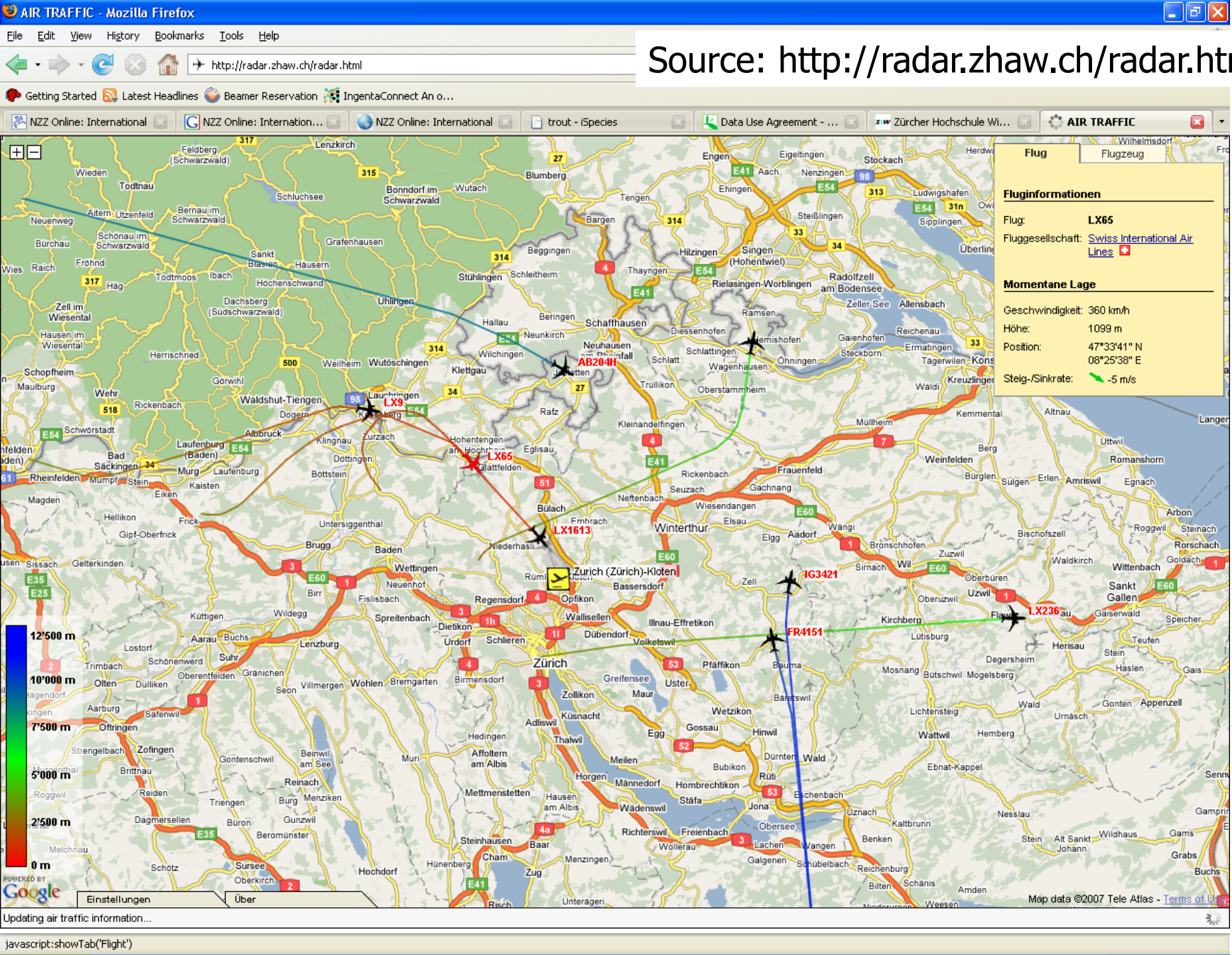
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Flug
Flugzeug
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Flug: LX65
Fluggesellschaft: Swiss International Air Lines
Momentane Lage
Geschwindigkeit: 360 km/h
Höhe: 1099 m
Position: 47°33'41" N 08°25'38" E
Steig-/Sinkrate: -5 m/s
AB204H
LX9
LX65
LX1613
IG3421
FR4151
LX236
Zürich (Zürich)-Kloten
Zürich
Winterthur
12'500 m
10'000 m
7'500 m
5'000 m
2'500 m
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Einstellungen
Über
Map data ©2007 Tele Atlas - Terms of Use
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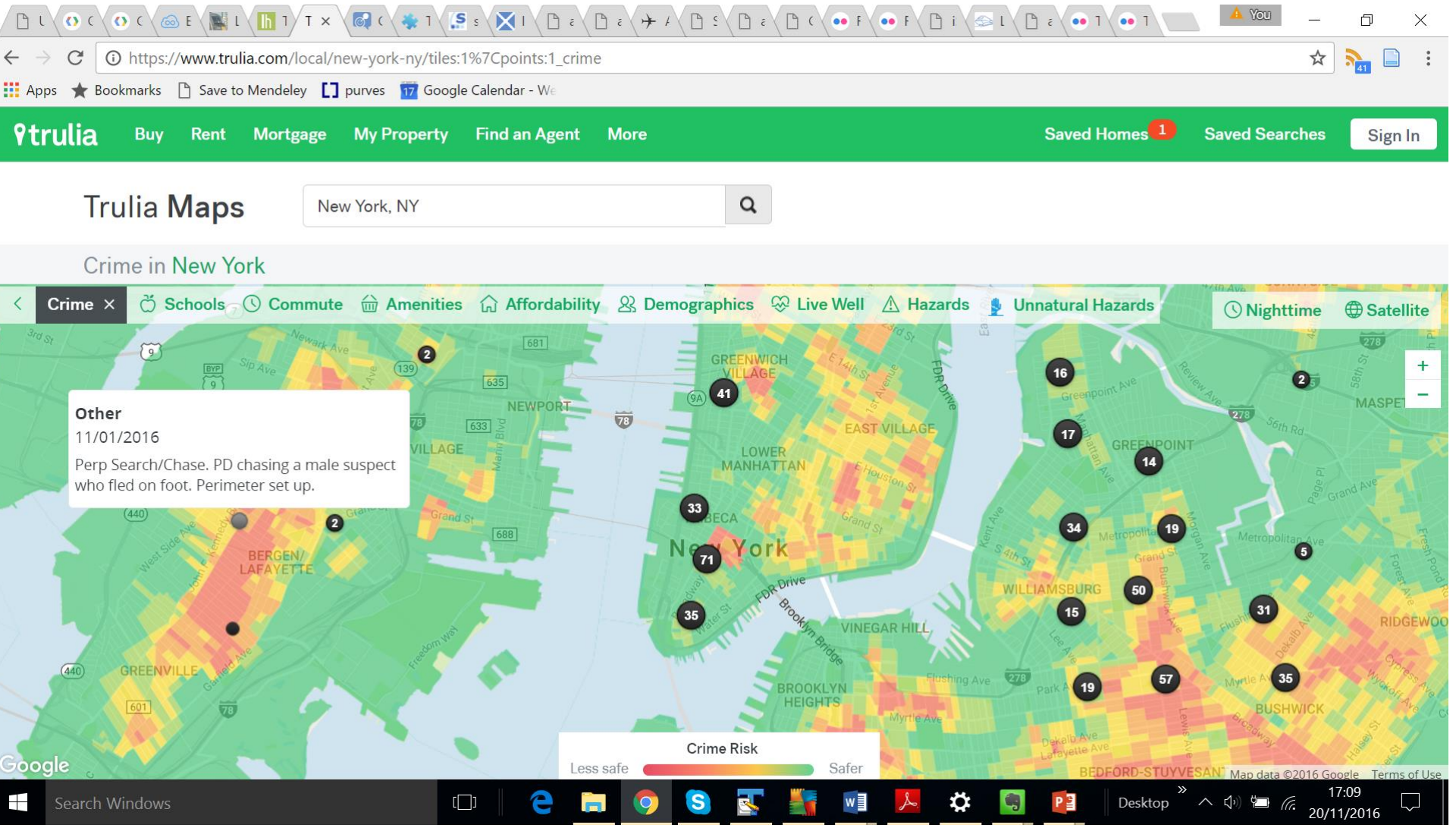
https://www.trulia.com/local/new-york-ny/tiles:1%7Cpoints:1_crime



https://www.data-mashup.org.uk/

See also http://tools.data-mashup.org.uk/medmi/video.html for an example of the tools in action

Mashup examples

- 4 examples
  - **Travel planning** – shows train movements in real(?) time
  - **Fun** – Maps aircraft and related information in real time in the Zurich area
  - **Sinister(?)** – Crime mapping
  - **Scientific** – links multiple data sources to explore relationship between climate and health

Potential challenges for and with mashups

"Creating and Maintaining the Mashup

- Mashup access, governance, and ownership
- Access to and ownership of original data
- Training of personnel and users
- Rapidly changing hardware and software
- Funding and resources (including long term secure data storage and appropriate staffing) to ensure longevity"

Source: Fleming, Lora E. et al. "Data Mashups: Potential Contribution to Decision Support on Climate Change and Health." *International Journal of Environmental Research and Public Health* 11.2 (2014): 1725–1746. *PMC*. Web. 20 Nov. 2016.

List from:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3945564/table/ijerph-11-01725-t002/

Potential challenges for and with mashups

"Data Issues

- Confidentiality of data
- International standardization of data
- Different types of complex data with issues of variable granularity, time spans, "richness", certainty, etc.
- Creation and maintenance of data documentation
- Understanding of the uncertainty of the data"

Source: Fleming, Lora E. et al. "Data Mashups: Potential Contribution to Decision Support on Climate Change and Health." *International Journal of Environmental Research and Public Health* 11.2 (2014): 1725–1746. *PMC*. Web. 20 Nov. 2016.

List from:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3945564/table/ijerph-11-01725-t002/

Potential challenges for and with mashups

"Using the Mashup

- Need for and understanding of new methods of modeling and statistics
- Interpretation of data, analyses and findings
- Interpretation and evaluation of new associations for validity and strength
- Use of real time data to make decisions
- Evaluation of use and effectiveness of the mashup
- Ability to look at big picture without obscuring smaller issues (such as effects on subpopulations)
- Communication of the uncertainty of data and findings
- Interactions with wide variety of stakeholders
- Maintenance of the mashup and its resources over long periods of time"

List from:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3945564/table/ijerph-11-01725-t002/

Source: Fleming, Lora E. et al. "Data Mashups: Potential Contribution to Decision Support on Climate Change and Health." *International Journal of Environmental Research and Public Health* 11.2 (2014): 1725–1746. *PMC*. Web. 20 Nov. 2016.

Exercise

- For two of the previous four examples identify one challenge related to:
  - **Creating and Maintaining the Mashup**
  - **Data issues**
  - **Using the mashup**

Summary

- We have seen a wide variety of applications of web gis ranging from
  - Simple map backdrops
  - Basic web mapping services
  - Interfaces to data allowing users to query and visualise datasets
  - Methods to implement such services, and use OGC standards to make it possible to swap different elements in and out easily
  - The use of mashups to popularise such chains of web services
- The boundary between web GIS and standard GIS is blurred – but key is understanding the issues of integrating data from many different sources

Next week

- We will look at the link between GIS and people through participatory GIS
- Our focus will be on the importance of integrating ways people think about space (and place) in GIS, and including this in the decision making process

References

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- Jones, C.B. and Purves, R.S. 2008. Web-based Geographic Information Systems (In *The Handbook of Geographic Information Systems*)
- Longley et al. 2015. Geographic Information Science and Systems. Chapter 10 (The Geoweb)
- OGC Reference Model (available at www.opengeospatial.org)