Don’t forget the fundamentals: Adapting the geospatial professional to an evolving geospatial world

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Who is the geospatial professional?

1. A continually evolving geospatial world
   - Increasing data sources and volumes
   - Integrated applications of data capture and analysis
2. What does the geospatial professional of today (and tomorrow) need to be successful?
3. The fundamentals of spatial science—and are they still relevant?

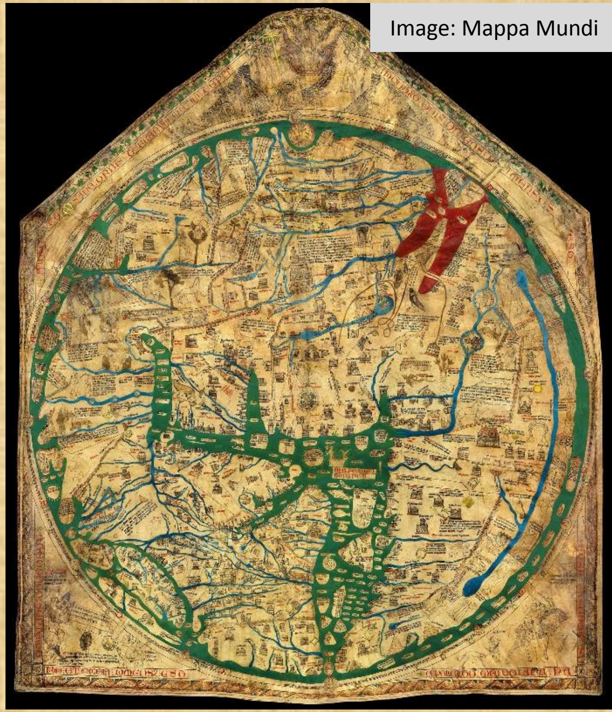


Image: Mappa Mundi

Image: Getty Images/LA Times


Image: listverse.com

Data are all around us

- From underground up into the sky, from outside to inside = many locations and many attributes are measurable
- Little data, big data
- We are getting more efficient at collecting them
- Locational component showing up in traditionally non-spatial data
  - Expanded research and business opportunities

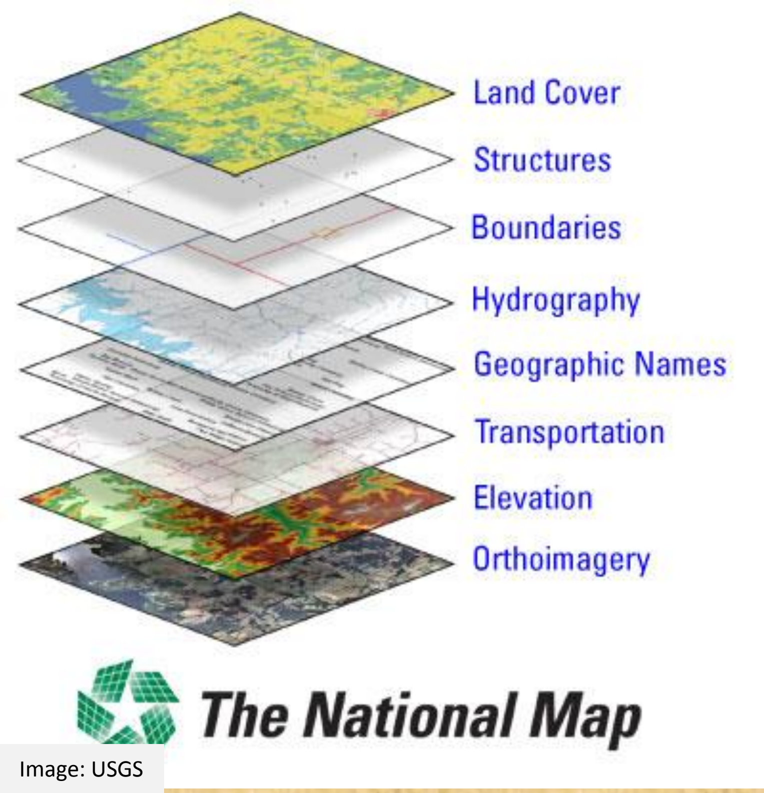


Image: USGS

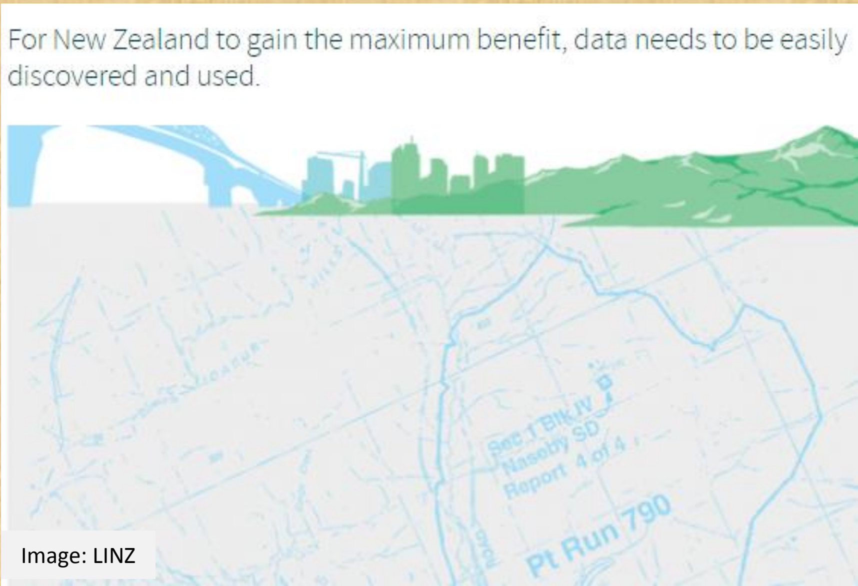


Image: LINZ

The world is a pretty busy place

- We are getting better at measuring phenomenon ***y*** at location ***x***
- We are getting better at modelling the relationship between many ***y****s* and many ***x****s*
- Data are getting cheaper
- THIS IS EXCITING!
- And challenging
- And noisy

Image: The Economist

Near-

time t … cities

… sensors

New

s

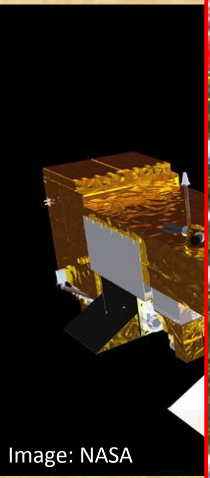


Image: NASA


Image: Trimble


Image: Libelium

We need geospatial professionals to cut through the noise

Working with a data stew

Image: Shutterstock


Image: BBC


Image: Food Hacks Daily

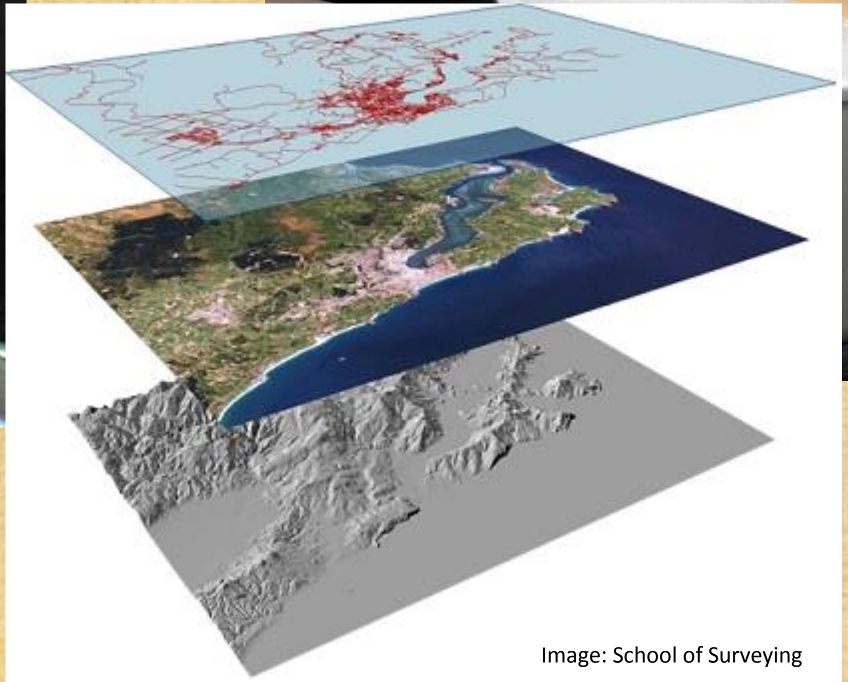


Image: School of Surveying

We can’t train our geospatial professionals to know everything about everything

***After all, Number One, we're only mortal*.**

Image: Wikipedia

- BUT we can train them to ask the right questions at the right time to find the right answer
- It may be appealing to want someone trained in the newest technologies or languages
  - BUT that training may come at the expense of experience with (unique) foundational geospatial science concepts
- *What balance of theory and practice make the most adaptable, resilient geospatial professionals?*

An outside example

- What makes a good GP?
  - Experience
    - Formal training
    - Good grasp of scientific principles
    - Patients with typical ailments
    - Patients with atypical ailments
  - Resources
    - Ability to acquire additional pertinent information (blood tests, x-ray)
    - Access to emerging research journals and databases, colleagues, the internet
  - Curiosity and creativity

= A balance between formal theory and applied practice

Image: The Guardian/Phovoir/Alamy

An adaptable geospatial professional

Spatial science fundamentals

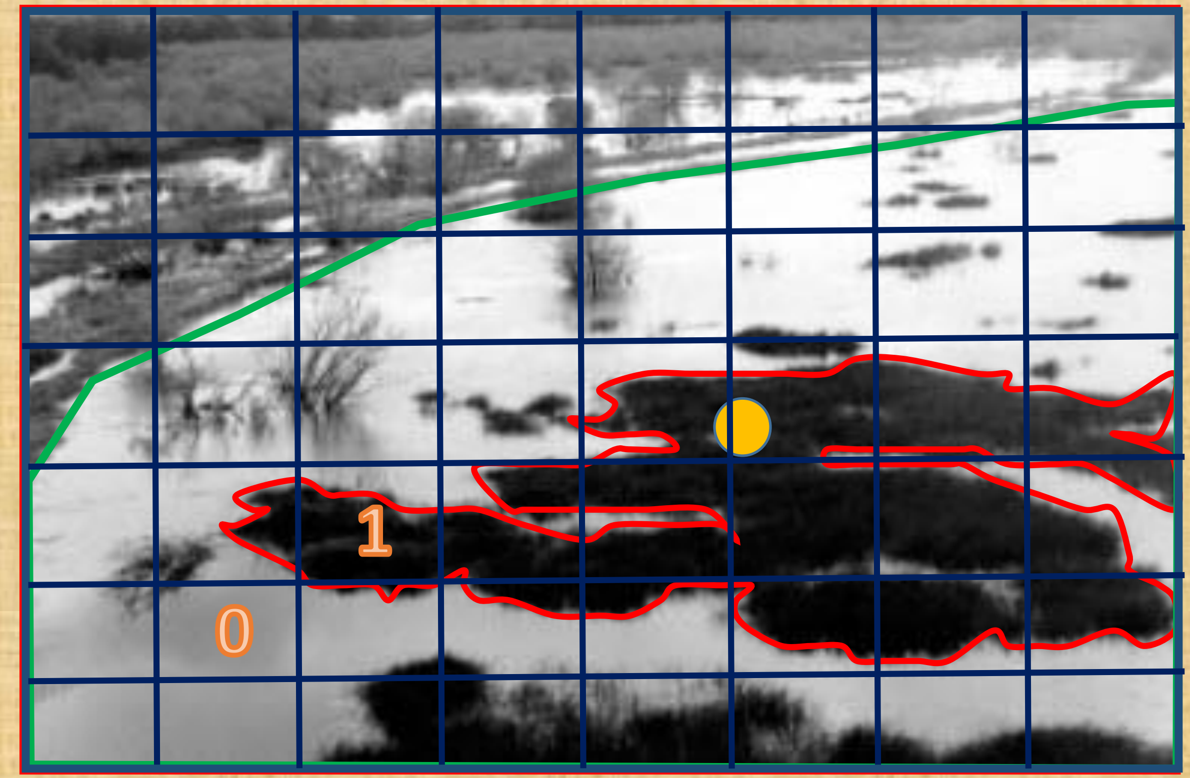
I. Spatial data structures
II. Data organisation and management
III. Data manipulation
IV. Computational language exposure (and proficiency)
V. Measurement and interpretation of error
VI. Good communication skills, good math skills, good attitude, good at making coffee, etc, etc…

I. Spatial data structures

- What about it?
  - Vector data
    - Discrete phenomena. Points, lines and areas. Features that can be counted on the landscape, e.g. roads, trees
  - Raster data
    - Continuous phenomena. Coverages. Occurring everywhere on the landscape, e.g. temperature, elevation
- Why does it matter?
  - We decide how we represent the world. Foundational to any analysis. How are data arranged and what kind of analysis is possible? Are conversions necessary? How do datasets talk to one another? *Fit for purpose*

I. Spatial data structures

- An example
  - A surveyor or GIS analyst is asked to delineate a wetland area for new development proposal
  - Someone needs to decide what data structure is most appropriate—it matters downstream



II. Data organisation and management

- What about them?
  - Database management
    - What goes where? Interoperability
  - Metadata and organisational standards
    - By discipline, by national standard. Quality requirements
    - Internal (and external) discoverability, use limitations and security, IP, client needs
  - Documentation
    - Repeatability, auditing, good science
- Why do they matter?
  - Geospatial data are special—usually involving multiple dimensions, increasing the need for good data management and discoverability. Volumes continue to increase exponentially. Sloppy data management has been allowed to persist, even if costly. Forming good habits early pays off!

II. Data organisation and management

- An example
  - The process flow diagram
    - More than a frustrating experience with Powerpoint; a way of thinking geospatially
    - Repeatable, referenceable, with self-checks and heuristics

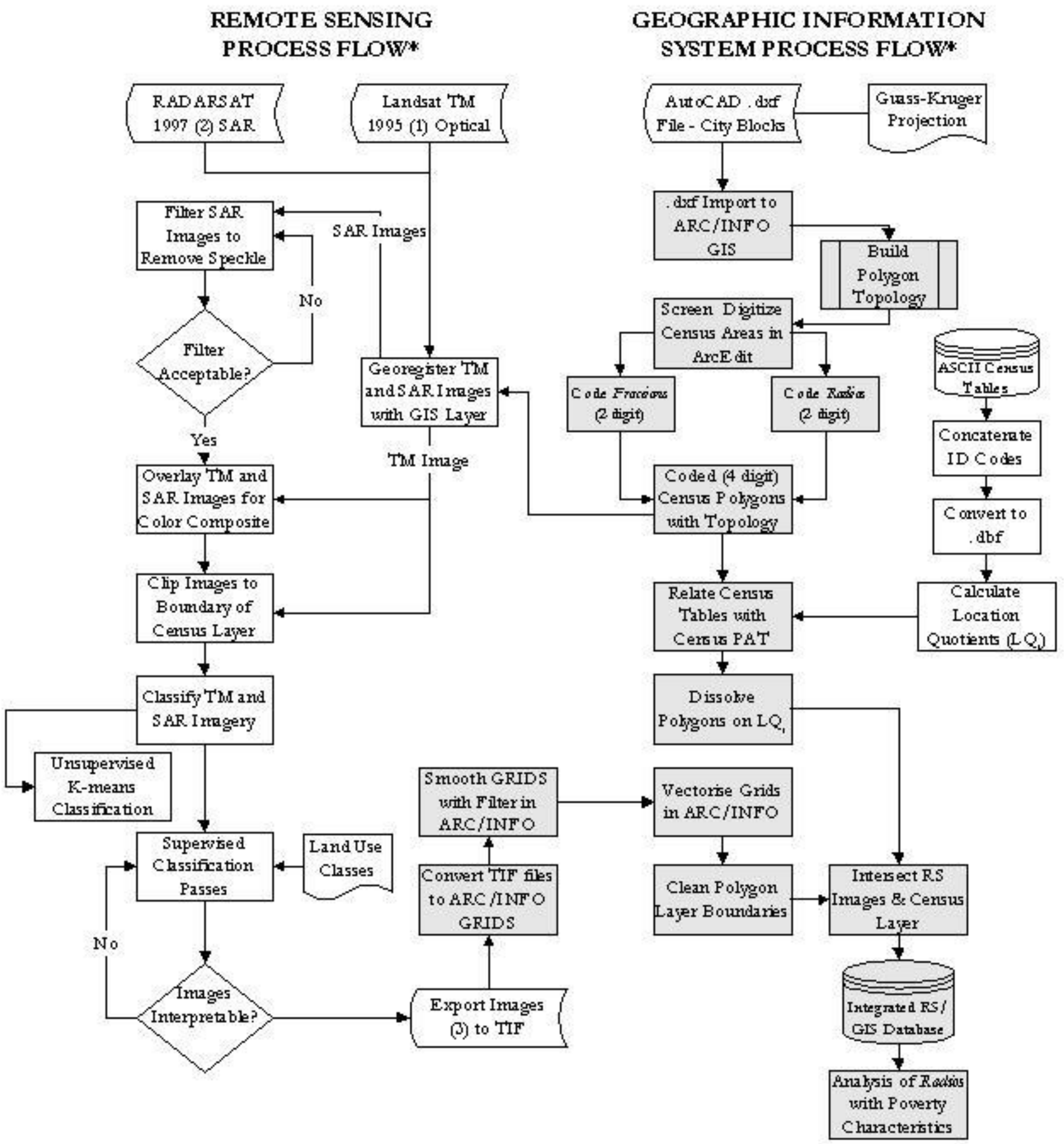


Figure 2 - Process Flow Model of RS/GIS Data Integration

* Note: All RS analysis in PCI EASI/PACE 6.3; GIS analysis in Arc/Info 7.2.1

Processing and Analysis in GIS   Processing and Analysis in RS

Image: Hall et al. 1999

III. Data manipulation

- What about it?
  - Data conversion
    - Interoperability, analysis needs, storage needs, visualisation, deliverables, engagement
  - Data analysis
    - Transformations (buffers, overlays) → 4D modelling
- Why does it matter?
  - The power of geospatial data is analysis. Change the location and the corresponding value may change. Knowing what to do, in what order, at the right time is not always self-evident. Basic analyses are often still relevant. Should the analysis be done with the raster or vector data model? *What is the right tool for the job?*

III. Data manipulation

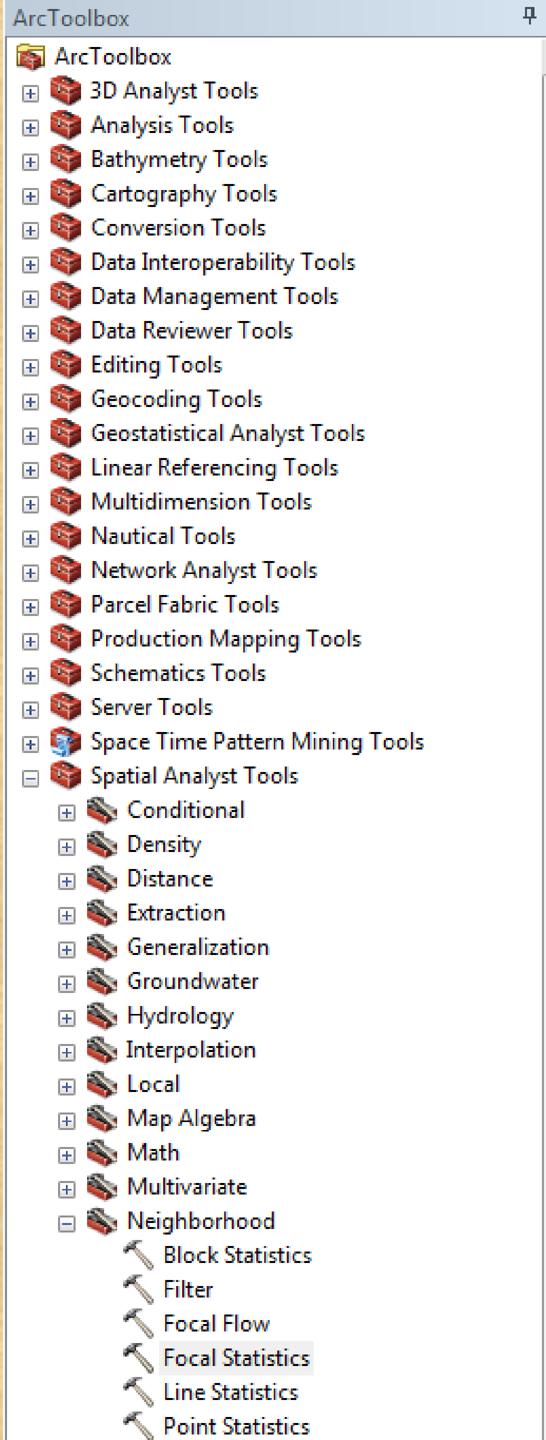
- An example
  - A recent exam question from an Introduction to GIS paper

SECTION A: Answer this question. (48 MARKS)

A1. Outline in detail how you would use a GIS to solve the following problem. Your answer should include a discussion of:

a. the data required (spatial and attribute), including format;
b. the GIS data model you would use to address the problem;
c. the analysis operations that must be performed using the data;
d. the information products (output) to be produced.

Your discussion should be supported by a process flow model.

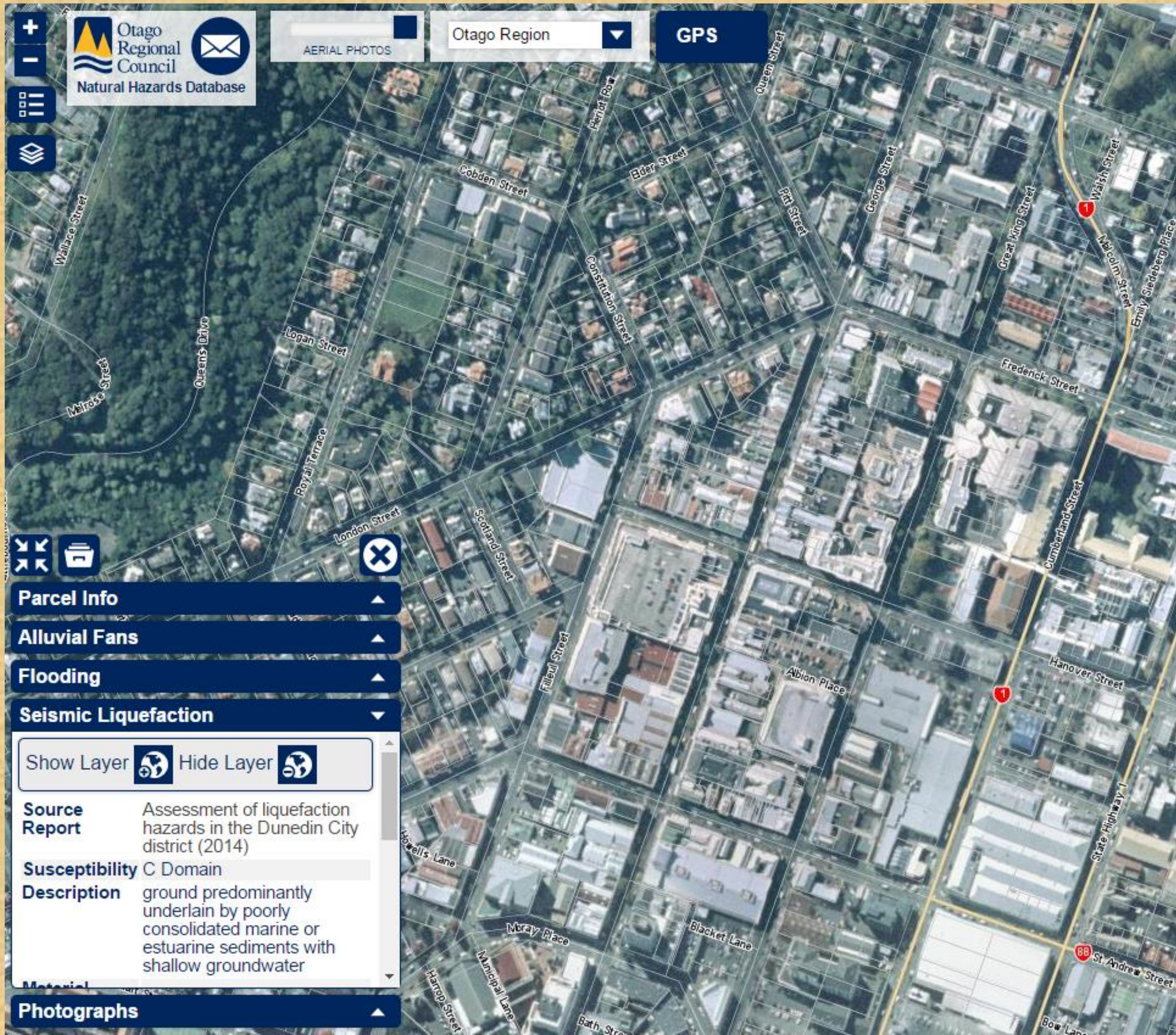


IV. Computational language proficiency

- What about it?
  - Scripting is becoming an essential part of:
    - Data management, analysis, geovisualisation, data accessibility, automation, open data …
  - Some disciplines use it more than others; with web integration demand is increasing
    - When is scripting not useful? What language is appropriate for the task? Java, Python, SQL, C#, Ruby, .NET, R, Logo… … …
- Why does it matter?
  - Most languages share similarities in structure. Understanding the structure of multiple languages—and how to get what you need from a language—may be more important than being an expert in one. Linking computer science to spatial science

IV. Computational language proficiency

- An example
  - ORC Data and web mapping
    - growotago project
    - Natural Hazards Database

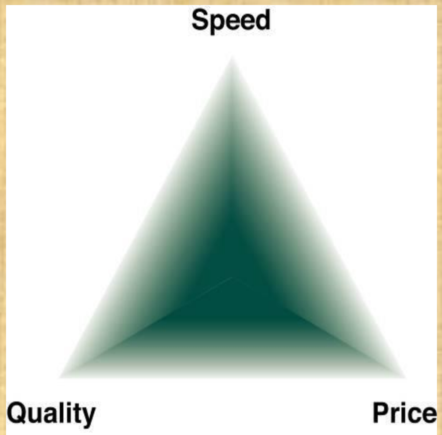


http://growotago.orc.govt.nz/

http://hazards.orc.govt.nz/intramaps/mapcontrols/nhdb/index.html

V. Measuring and interpreting error

- What about it?
  - Error: Uncertainty due to systematic and human limitations
  - From myriad capture and analysis sources; can usually be estimated
  - A measure of data quality, with downstream effects
- Why does it matter?
  - Knowing when to care about it (and how much to care about it) is ultimately a judgement call. Tools to measure error in data capture and analysis may be hard to use or interpret. The geospatial professional should take the sceptical scientist approach



Longley et al. 2015

V. Measuring and interpreting error

- An example
  - The drone age…
  - Have you heard the buzz?
  - Fast to market, fit for purpose

Professionals know that an accurate ortho (or DEM or 3D model) can look identical to an inaccurate one. Both are "pretty" pictures with lots of great detail, but one has more intrinsic value for a greater number of uses than the other because it is more accurate.
– Mike Tully, Aerial Services Inc.

Image: Aerdron

The adaptable and resilient geospatial professional: Conclusions

- If we boil it all down:
    1. Training
        - Theory
        - Scientific, spatial thinking
        - Practical skills with programs/programming
        - Fundamentals of geospatial science
    2. Resources
    3. Curiosity and creativity

= An ability to draw upon fundamentals while exploring emerging technologies and working with spatial data in new ways

Thank you!

Questions?