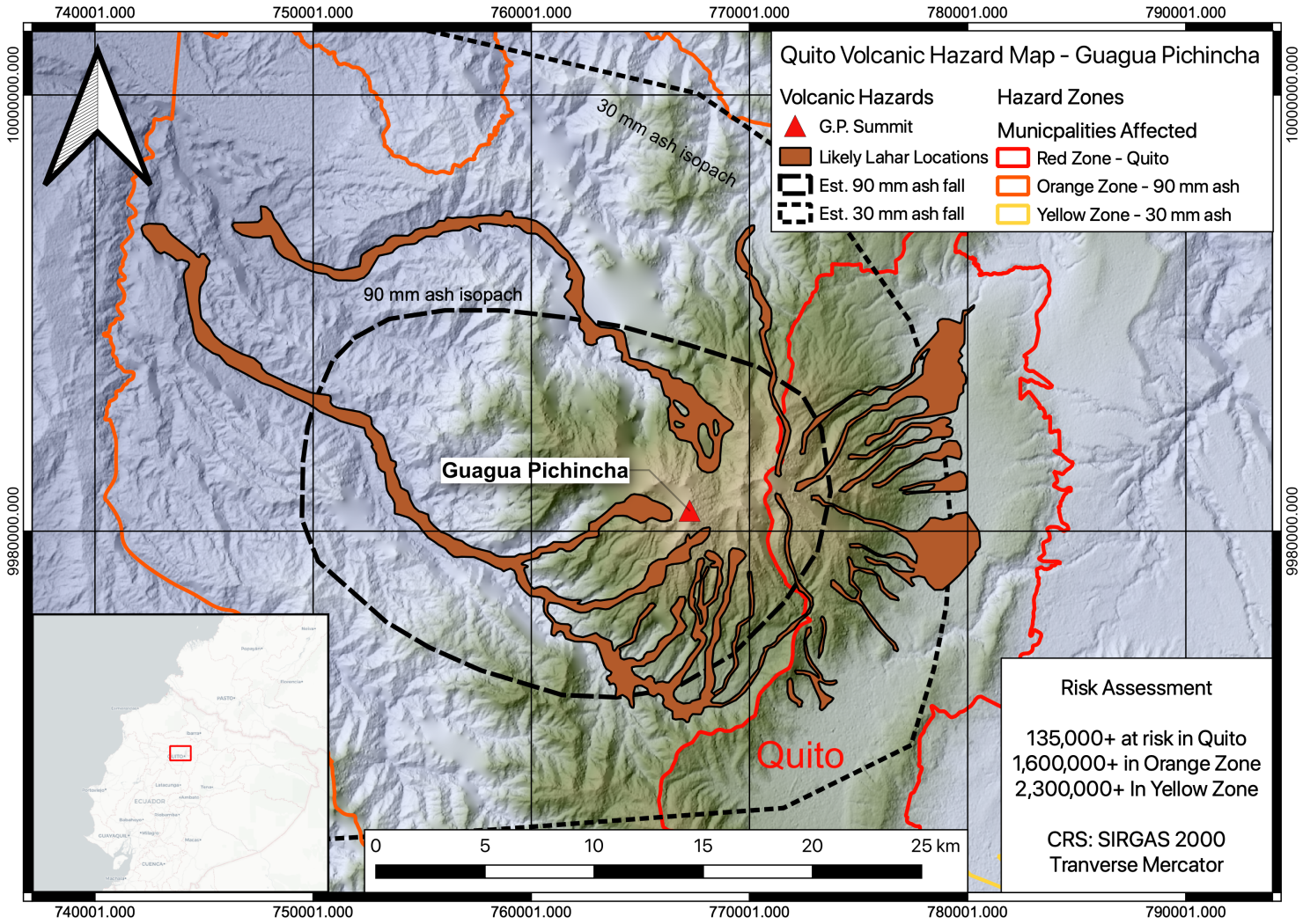


# GIS For Dummies Session 2: Live Demo

Presented by Nicholas Barber, 2nd Year PhD Student at the University of Cambridge, U.K.
ndb38@cam.ac.uk | www.volcannick.com | https://github.com/ndb38 | Twitter @volcannick

# Workshop Structure

- Today: Session 1 – Principles and Motivation for GIS in the Geosciences
  - Why GIS?
  - Principles of GIS
  - Getting acquainted with Quantum GIS?
- **Wednesday June 17th: Session 2 – Tutorial + Guagua Pichincha Exercise**
  - Tour of Interface
  - Tutorial
- Monday June 29th: Session 3 (GIS for the Intrepid) - Advanced GIS
  - Frontiers of GIS
    - Geostatistics
    - Python
    - Data Management
    - Advanced formatting
- Wednesday July 1st: Scheduled "TA Hours" for 1-on-1 project advice

# Refresher on Interface

Queuing up plugins we'll need, refamiliarizing ourselves with the interface

# Textbook Info to Come

# Outline of today's demonstration

- Planning a project
- Finding Data
- Defining CRS/PCS
- Initial Import + Projection
- Georeferencing Images
- Tracing Basemaps
- Analysis: Geoprocessing, Statistics, Attributes
- Visualization and Symbology
- Layout Design

# Making a Plan

# Planning a QGIS Project

- Need to think critically about where GIS fits in to your workflow
- A few questions to ask yourself:
  - What stage of my project am I in? And what value would GIS analyses add at different stages?
    - E.g., in the planning stage, you might want a map and some prospect sites for outcrops. But in the analysis stage, you might want some specific spatial information about your study site
  - What question am I trying to answer?
  - Can this question be answered through other means?
  - Is there data available for this? (short answer: YES)
    - More important question: Where is the data I need??
  - What steps do I need to take to answer this question?
  - What coordinate/projection system should I use?
  - How am I going to organize my data?

# Our Exercise Today

- Focusing on **Guagua Pichincha (GP)**, an active volcano adjacent to Ecuador's capitol, Quito in the Andes
- Our question: <u>How many people are at risk of exposure to the different eruptive products of Guagua Pichincha Quito?</u>
  - This question encompasses two hazards: 1) lahars (volcanic mudflows) and 2) ash fall
- I selected this question for a few reasons:
  - Require datasets that are readily accessibly
  - Results verifiable based on previous research
  - Analyses straightforward, but encompass the crucial "GIS Toolkit" you'll get out of this course

# Our Exercise Today

- Structure today:
  - Live Demo will showcase tools and parameters needed to answer this question
  - Will be accompanied by discussions with these slides
  - IN DEVELOPMENT: By the end of the four-part workshop, I'll create detailed guides in PDF format, describing this exercise workflow step by step.
- Skills you will get out of this exercise: project design, data sourcing, projecting vector and raster data, importing data, setting up interface, file management, basic vector analysis, attribute table calculations, spatial statistics, georeferencing, creating new features, symbology + visualization, layout management.
- Next time we will use G.P. and this region of Ecuador for some more advanced statistical and analytical procedures
- WILL ASK CAT TO SOLICIT FEEDBACK AFTER THIS WEEK

# Finding Data

# Where in the world do I find data?

- Think in detail about our question: what do we need to have?
  - Information on volcano
    - Geology
    - Estimated hazards
      - Location
      - Severity
    - Geochemistry/Geophysics?
  - Information on surrounding population
    - Infrastructure?
    - Hydrology
    - Municipal boundaries
    - Location of Major population centers
    - Population #
      - Demography?
  - Information on topography

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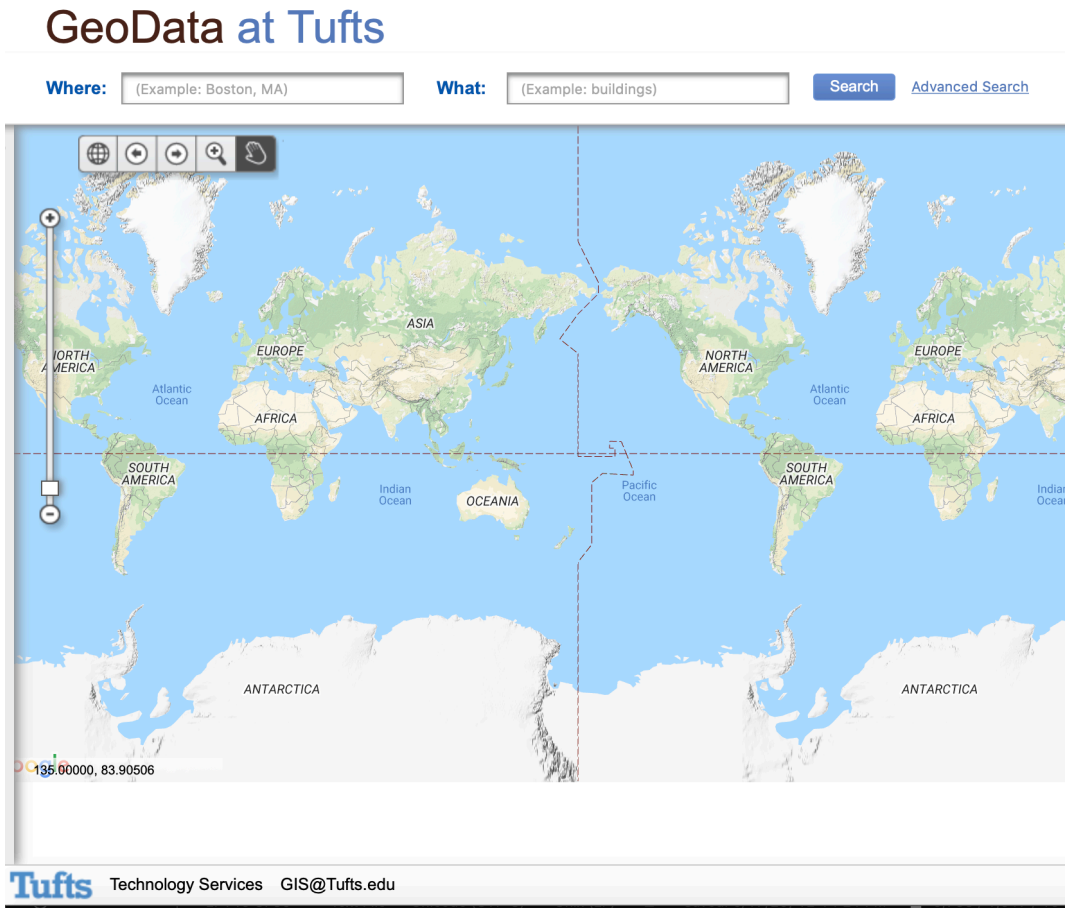
# Generic Datasets (Example): https://geodata.tufts.edu



# Other Data Sources

- Economic Geology: https://mrdata.usgs.gov/general/map-global.html
- Similar generic info: http://hgl.harvard.edu:8080/opengeoportal/
- Humanitarian/land use data: https://geoportal.landportal.org/?gclid=CjwKCAjw_qb3BRAVEiwAvwq6Vgusj8dZX1TuJTa3ipj7r6hEaFvMbdN-ZZJ2ekZ8iNdt-FZZJnmMHhoCAWUQAvD_BwE
- USGS Earth Explorer: https://earthexplorer.usgs.gov
- ESRI Hub: https://hub.arcgis.com/search
- Natural Earth: http://www.naturalearthdata.com/downloads/
- NASA Socioeconomic data: https://sedac.ciesin.columbia.edu
- LIDAR Data: https://opentopography.org
- UN Data: http://geodata.grid.unep.ch
- Pop and Enviro Data: https://terra.ipums.org

# Deciding on Coordinates and Projections

# Importing + Reprojecting Data

# We want something that's accurate for our study area

- Datum itself isn't that important – one of the most common is GRS80
- We want a Latin American projection system, localized in Ecuador

query by filter | retrieve by code

Name:
Type: Click to choose
Area: Search on description: Ecuador
Search on geometry: BBOX | Show Map
North Latitude | West Longitude | South Latitude | East Longitude
Search | Reset ?

**EPSG Geodetic Parameter Registry** *Version: 9.8.12*
Welcome guest! | (login or register) | help

International Association of Oil & Gas Producers

**Search Results (1 - 10 of 32 possible results)**
Report all results ? | WKT for all results ? | Entities per page: 10

<<first <prev | page 1 of 4 | next> last>>

| Report | Name | Code | Type | Status | Area Description | Remarks / Description | |
|---|---|---|---|---|---|---|---|
| | IGb14 | EPSG::9378 | GeodeticCRS (geocentric) | Valid | World: Afghanistan, Albania, Algeria, American Samoa, Andorra, Angola, Anguilla, Antarctica, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Banglades... | Used for products from the International GNSS Service (IGS) from 2020-05-17. Replaces IGS14 (code 8227). For most practical purposes IGb14 is equivalent to ITRF2014. | view |
| | ITRF2014 | EPSG::7789 | GeodeticCRS (geocentric) | Valid | World: Afghanistan, Albania, Algeria, American Samoa, Andorra, Angola, Anguilla, Antarctica, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Banglades... | Replaces ITRF2008 (CRS code 5332). | view |
| | PSAD56 | EPSG::4248 | GeodeticCRS (geographic 2D) | Valid | Aruba - onshore; Bolivia; Bonaire - onshore; Brazil - offshore - Amazon Cone shelf; Chile - onshore north of 43°30'S; Curacao - onshore; Ecuador - mainland onshore; Guyana - onshore; Peru - onshore; V... | Incorporates La Canoa (CRS code 4247) and within Venezuela (but not beyond) the names La Canoa and PSAD56 are synonymous. | view |
| | PSAD56 / UTM zone 17N | EPSG::24817 | ProjectedCRS | Valid | South America (Ecuador) between 84°W and 78°W, northern hemisphere, onshore. | | view |
| | PSAD56 / UTM zone 17S | EPSG::24877 | ProjectedCRS | Valid | South America (Ecuador and Peru) between 84°W and 78°W, southern hemisphere, onshore. | | view |
| | PSAD56 / UTM zone 18N | EPSG::24818 | ProjectedCRS | Valid | South America (Ecuador; Venezuela) between 78°W and 72°W, northern hemisphere, onshore. | In Venezuela also known as La Canoa / UTM zone 18N. | view |
| | PSAD56 / UTM zone 18S | EPSG::24878 | ProjectedCRS | Valid | South America (Chile - north of 45°S; Ecuador; Peru) between 78°W and 72°W, southern hemisphere, onshore. | | view |

Back to IOGP's Geomatics area

# Importing Data

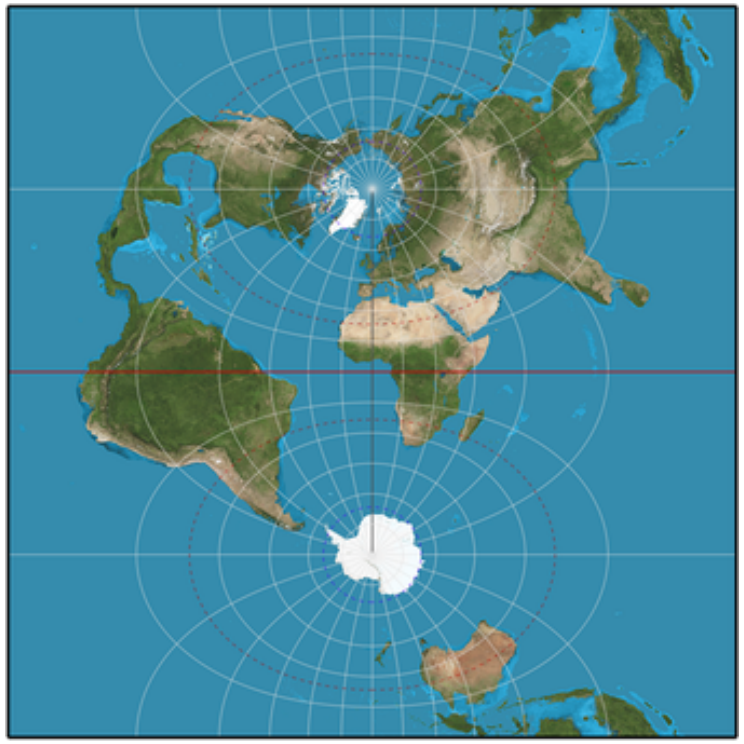
- Format: SHP, GPKG, GeoTiff
- Which layers to keep?
- Renaming and resaving
- Data specific tasks:
  - Vector Data: Metadata
  - Elevation data: Close Gaps + Hillshade
  - CSV: Import
- Reprojection

# SIRGAS 2000/UTM Zone 17S

- We are just in bounds of 1.0m accuracy SIRGAS 2000/17S
  - EPSG 31977
- Note: not the only choice we could make! There are many possibly options
  - Decision based on locality (always better to fit with a projection suited to your part of the geoid) and widespread use – SIRGAS 2000 a standard CRS for South America

# SIRGAS 2000

- “The projection is reasonably accurate near the central meridian. Scale at an angular distance of 5° (in longitude) away from the central meridian is less than 0.4% greater than scale at the central meridian, and is about 1.54% at an angular distance of 10°.”



# Georeferencing

# What is Georeferencing?

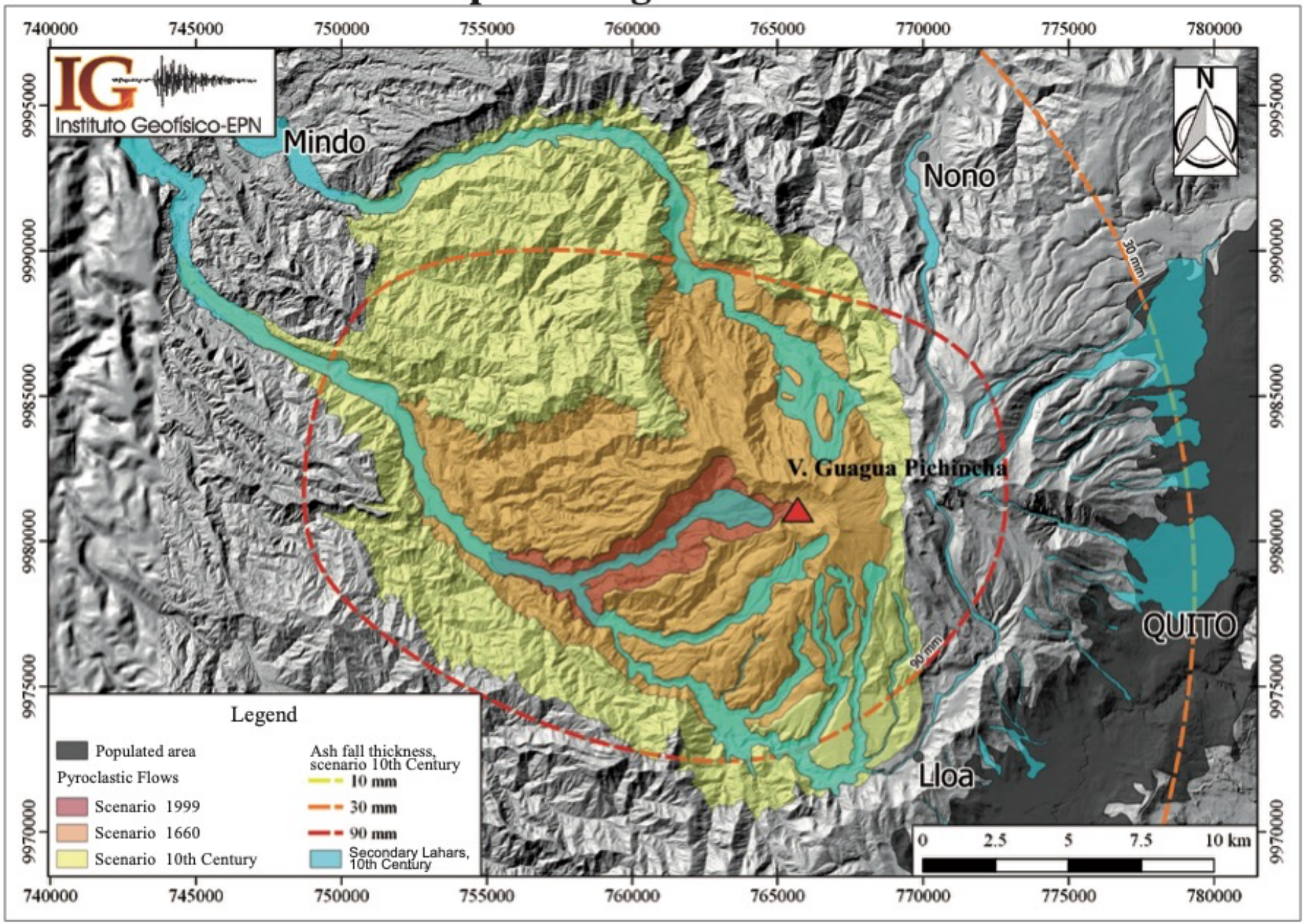
- Assignment of real world coordinates to pixels of an unreferenced raster
  - Deccan Traps example from last time
- Requires manually fixing "control points" between map and real spatial objects
- BEST CONTROL POINTS:
  - Riverheads
  - Clear topographic features (ridge, unique landform, etc.)
  - Intersections of lat/long grid lines
  - Edge of map area
- BAD CONTROL POINTS: Town names
- Choice of transformation….
- Thorough walk through: https://www.qgistutorials.com/en/docs/3/georeferencing_basics.html

illitic map of pyroclastic fall associated to the scenario of 1999, VEI-2 (50% probability).

Probabilitic map of pyroclastic fall associated to the scenario of 1660, VEI-3 (50% probability).

Probabilitic map of pyroclastic fall associated to the scena Century, VEI-4 (50% probability).

# Hazard Map of Guagua Pichincha Volcano

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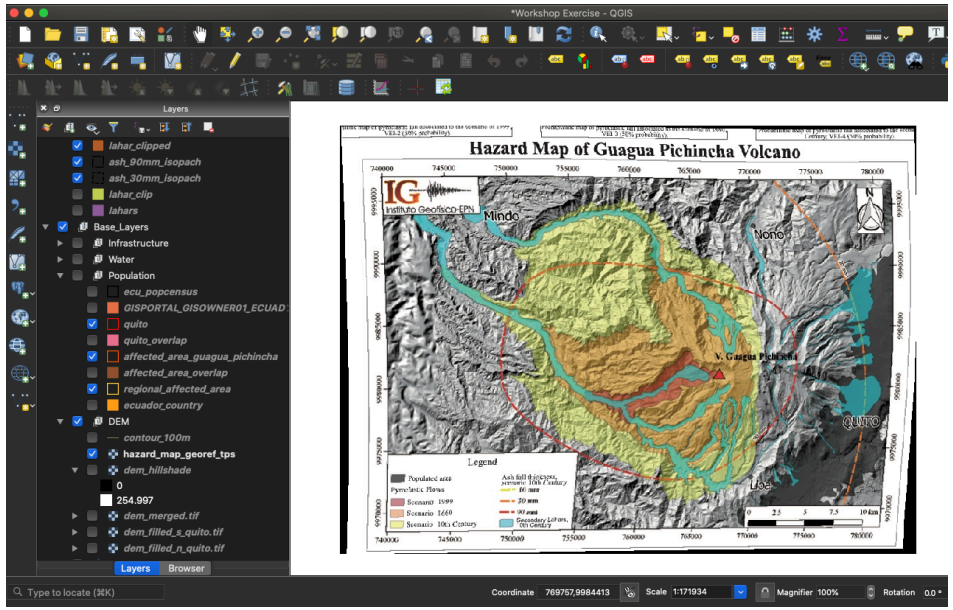
Presented by N.D. Barber (Cambridge) ndb38@cam.ac.uk

# Tracing Basemap

# Creating New Features




- Need to first define layer, then manually add points
  - Note: image processing algorithm can do some of this work
- NEXT account for tracing errors: I fixed my scale of tracing, so I know my error is between 10-50 m (USGS)
  - ALWAYS KEEP SCALE IN MINDS
  - We also have to account for distortion from georeferencing

# Errors

# Error Sources

- Attribute data
  - Unfortunately don't know this at this time – what is the error in a census?
  - Hazard Map doesn't given an indication of error either, but doubtless there is some
- Projection error (usually quite small)
  - Estimated Error of SIRGAS is 1.0m (see EPSG website)
- Georeferencing error: Error report suggests < 1 m
  - However, given we didn't know starting PCS, this is likely an underestimate – we can see some notable distortion
  - Anything derived from basemap carries this georeferencing error forward
- Base map error: USGS defines between 10-50m error in a map drawn between 1:20000-1:100000 scale
  - We drew between these scales, so let's take the high end (50 m)

# Analysis

# Answering our question

How many people are at risk of exposure to the different eruptive products of Guagua Pichincha Quito?

- Attribute Manipulation: How many people live in a canton?
- Define provinces affected by ash and lahars
  - Selection, Dissolving
- Spatial Statistics: How many people in total?
  - Exporting Statistics
- Areal statistics: % Overlap in Lahars and Quito
  - Proportion of population vulnerable to lahars

# Symbolizing

# Making the Data Look Nice

- Do some of this formatting before editing the layout
- Symbology:
  - Making topography data look nice
  - Stylizing vector data
    - Fill
    - Stroke
    - Transparency
- Label Making
  - Easy Custom Labels + Memory

# Layout Management

# Layout

- Elements we want:
  - Main Map
  - Regional Inset Map
  - Legend
  - North Arrow
  - Scale bar
  - Grid
  - Labels for important features
  - Text box summarizing findings
- Thigs to keep in mind:
  - Map Scale
  - Locking of display
  - Legend items
  - Aesthetic value

# Thoughts for next time