Summer 2019
GIS Introduction

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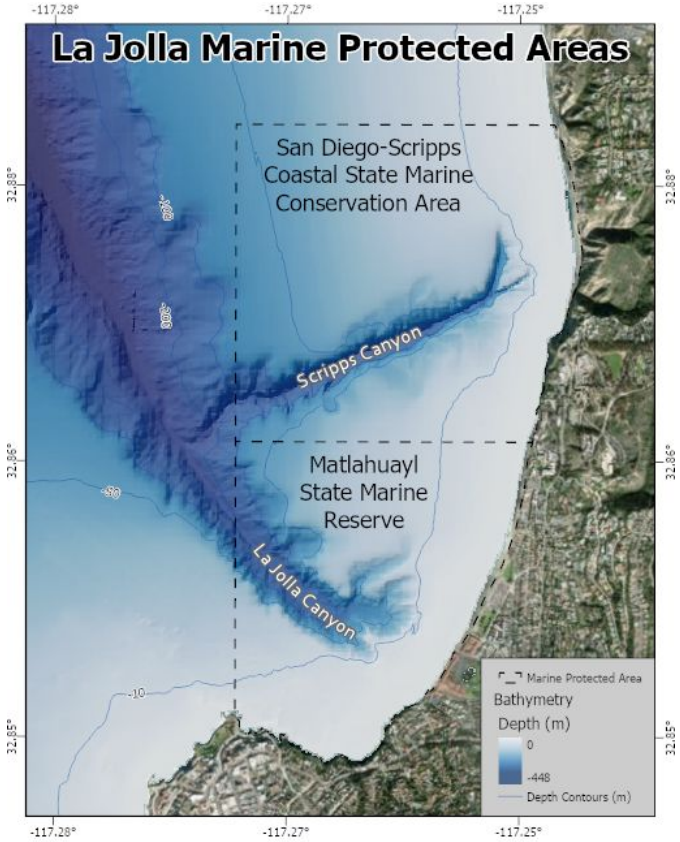
Welcome to UC San Diego!

Instructor: Randy Bucciarelli

- Employment:
  - Programmer/Analyst at Scripps Institution of Oceanography
  - GIS Instructor at UCSD Extension
- Research interests:
  - Waves, beaches, and big data
- Hobbies:
  - Surfing, hiking, and traveling

Outline: GIS Introduction

- Course overview
- What is GIS?
- GIS layers
- GIS software
- The Power of Maps
- Demonstration
- Lab: ArcGIS Pro

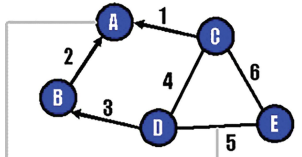


Class Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
08/05/19 **Introduction to Geographical Information Systems** 10:45 am–12:15 am	08/06/19 **Cartography and Spatial Data Display** 8:30am – 11:00pm	08/07/19 **Querying Data for Spatial & Attribute Selections** 8:30am – 11:00pm	08/08/19 **Data Formats and Open-Source GIS** 8:30am – 11:00pm	08/09/19 **Map Projections and Coordinate Systems** 8:30am – 11:00pm
08/12/19 **Spatial Analysis Tool** 8:30am – 11:00pm	08/13/19 **Raster and Terrain Analysis** 8:30 am – 10:00 am **Scripps Institution of Oceanography** 1:00pm – 4:00pm	08/14/19 **Image Analysis** 8:30am – 11:00pm	08/15/19 **Editing Spatial Data and Geocoding** 8:30am – 11:00pm	08/16/19 **Web Mapping/ Wrap up** 8:30am – 11:30am

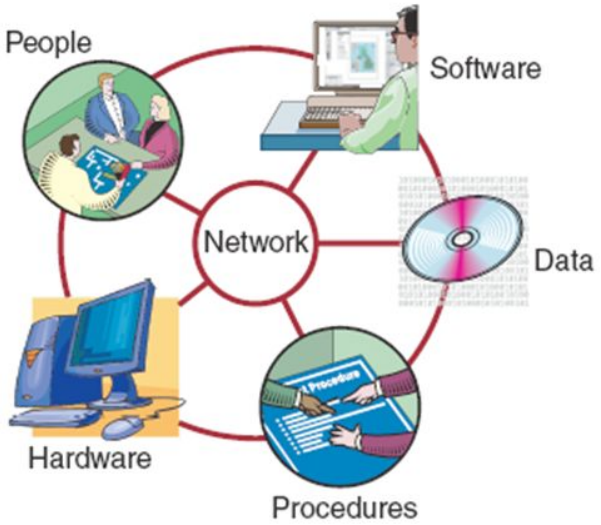
What is GIS?

- **Geographic**
  - The spatial location of the real world (coordinate system)
- **Information**
  - The database
- **Systems**
  - The hardware, software, and people



Nodes		
ID	Long	Lat
A	40.42345	-75.1245
B	40.31021	-75.2510
C	40.41882	-74.9124
D	40.25908	-75.0031
E	40.28990	-74.7893

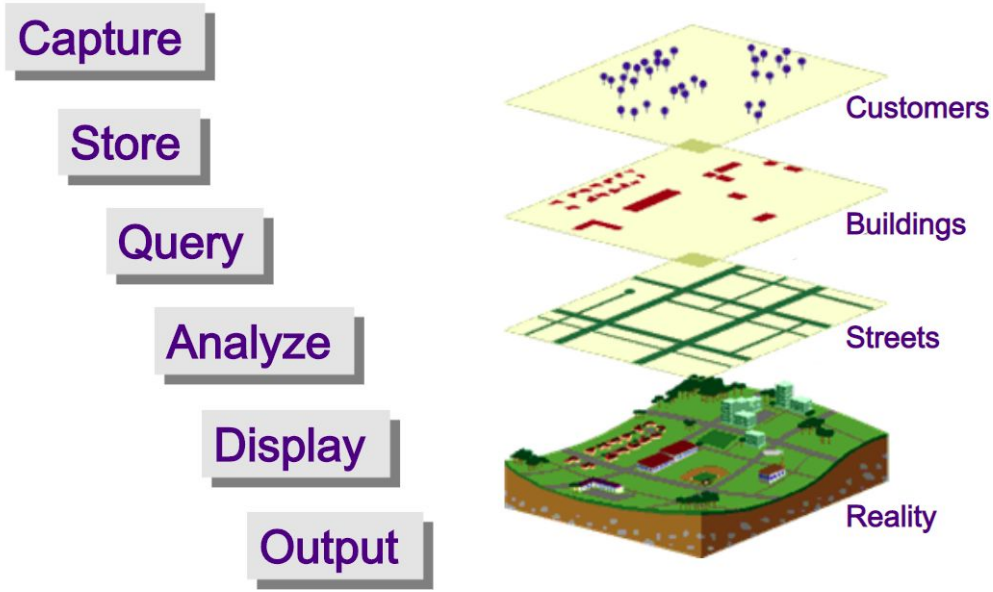
Links			
ID	From	To	One_Way
1	C	A	Yes
2	B	A	Yes
3	D	B	Yes
4	D	C	No
5	D	E	No
6	C	E	No



What can a GIS do?

Fundamental operations:

- Capture data
- Store data
- Query data
- Analyze data
- Display data
- Present data



GIS provides a framework

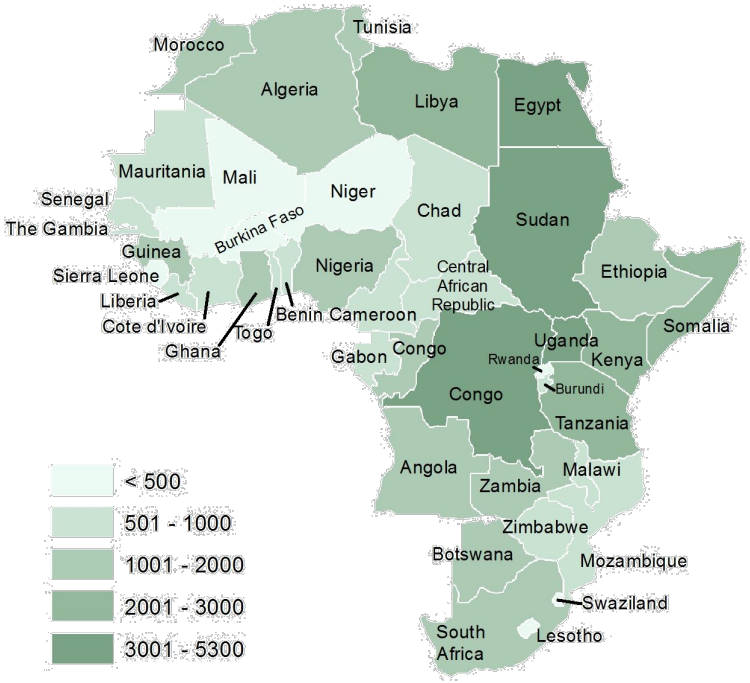
Source: The ArcGIS Book (ESRI, 2017)

When Do We Need GIS?

Table 1.1: Index of total African conflict for the 1966-78 period (Anselin and O'Loughlin 1992).

Country	Conflicts	Country	Conflicts
EGYPT	5246	LIBERIA	980
SUDAN	4751	SENEGAL	933
UGANDA	3134	CHAD	895
ZAIRE	3087	TOGO	848
TANZANIA	2881	GABON	824
LIBYA	2355	MAURITANIA	811
KENYA	2273	ZIMBABWE	795
SOMALIA	2122	MOZAMBIQUE	792
ETHIOPIA	1878	IVORY COAST	758
SOUTH AFRICA	1875	MALAWI	629
MOROCCO	1861	CENTRAL AFRICAN REPUBLIC	618
ZAMBIA	1554	CAMEROON	604
ANGOLA	1528	BURUNDI	604
ALGERIA	1421	RWANDA	487
TUNISIA	1363	SIERRA LEONE	423
BOTSWANA	1266	LESOTHO	363
CONGO	1142	NIGER	358
NIGERIA	1130	BURKINA FASO	347
GHANA	1090	MALI	299
GUINEA	1015	THE GAMBIA	241
BENIN	998	SWAZILAND	147

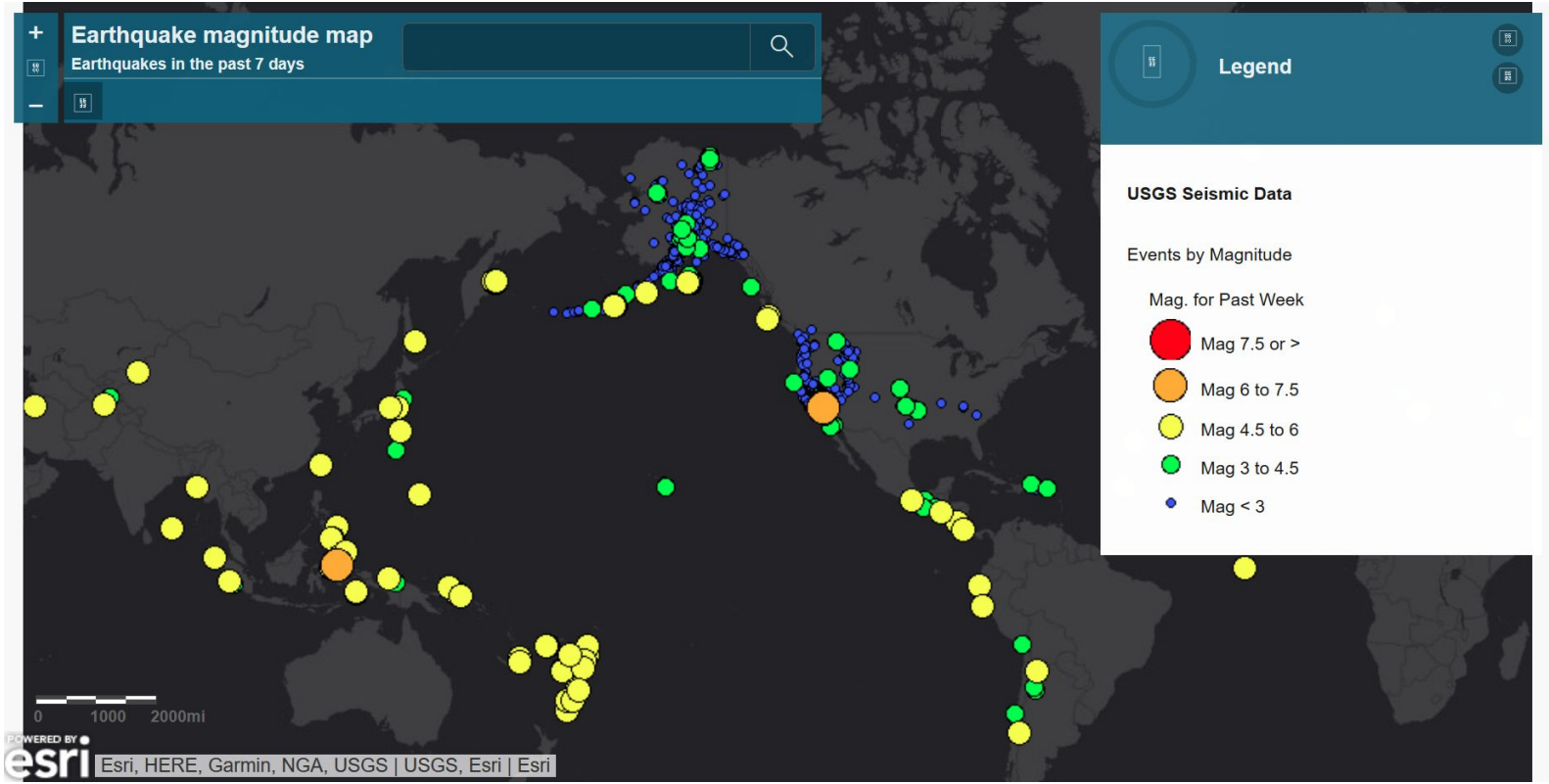
Data source: Anselin, L. and John O'Loughlin. 1992. Geography of international conflict and cooperation: spatial dependence and regional context in Africa. In The New Geopolitics, ed. M. Ward, pp. 39-75.



Source: https://mgimond.github.io/Spatial/introGIS.html

Video - GIS: The Science of Where

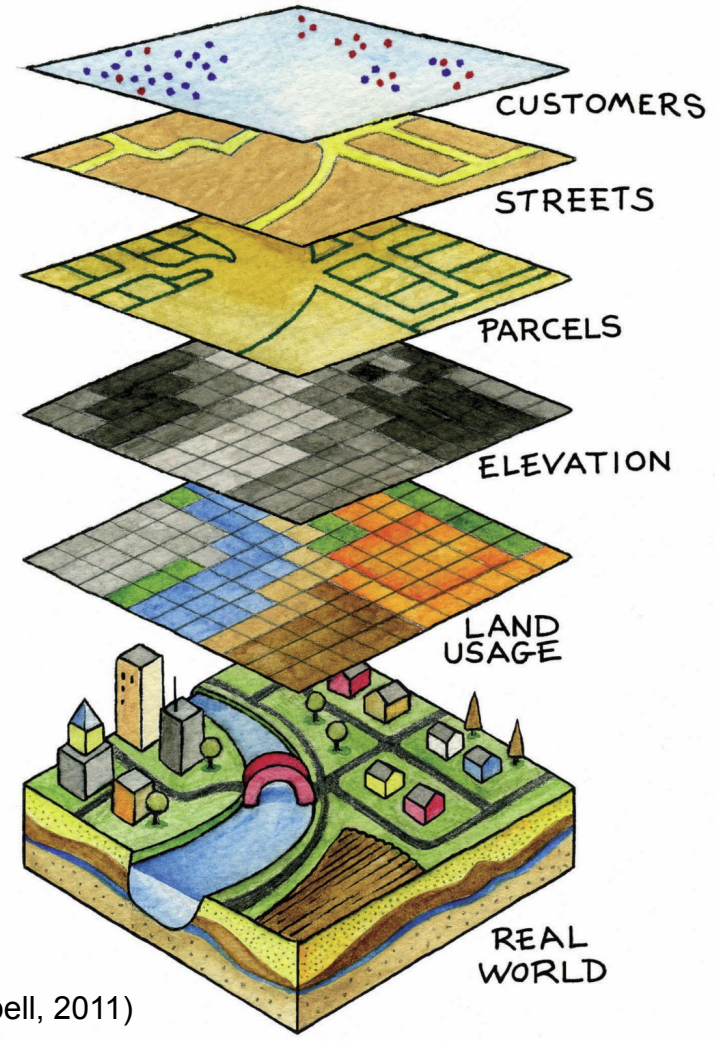
It all begins with a map



Source: [Earthquake magnitude map]

GIS as a layered cake

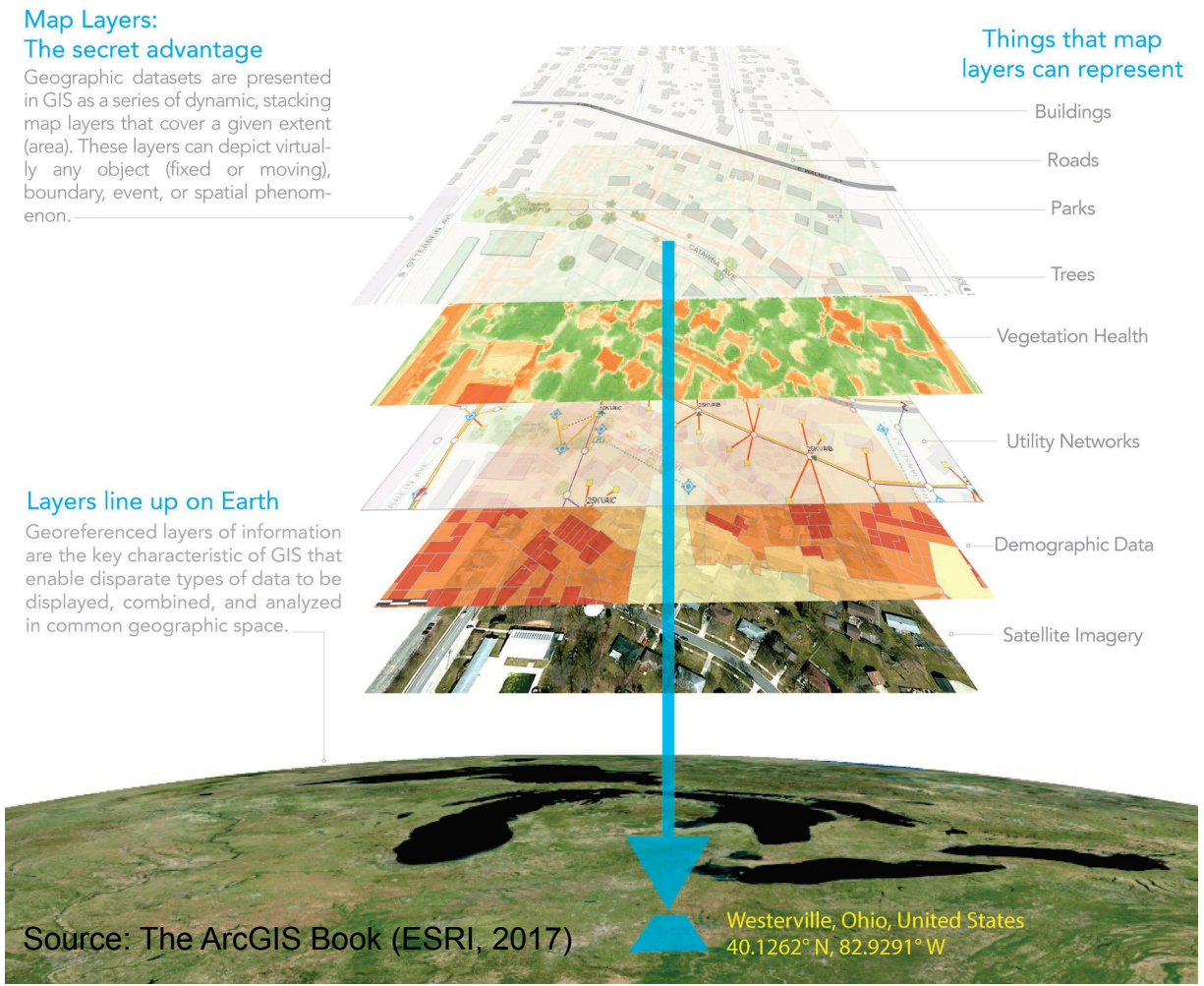
- Spatial data as layers
  - Locations
  - Attributes
- Layers are stacked on top of each other
  - Aligned together (georeferenced)
  - Each one a different theme



Source: Essentials of GIS (Campbell, 2011)

How GIS works

- GIS is both:
  - Technology
  - Science
- Organize data:
  - Discrete layers
  - Aligned to each other



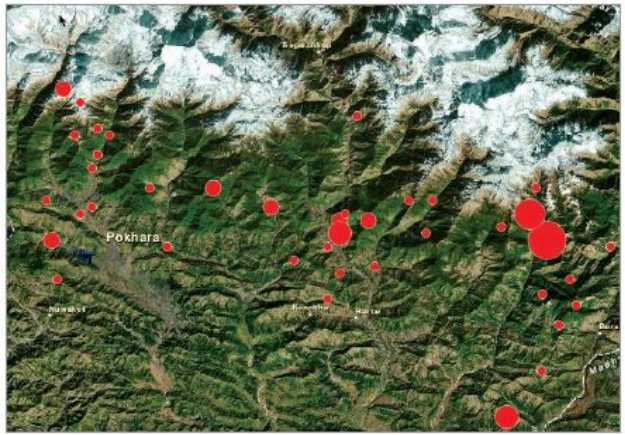
Source: The ArcGIS Book (ESRI, 2017)

GIS Layers

- Layers are how geographic data are:
  - Organized and combined to create maps
  - Basis for geographic analysis
- Layers can represent:
  - Geographic features (points, lines, polygons)
  - Imagery
  - Surface elevations and models
  - Data feeds (weather, traffic, security cameras, etc)
  - And much more!

GIS Layer Examples

Nepal earthquake epicenters

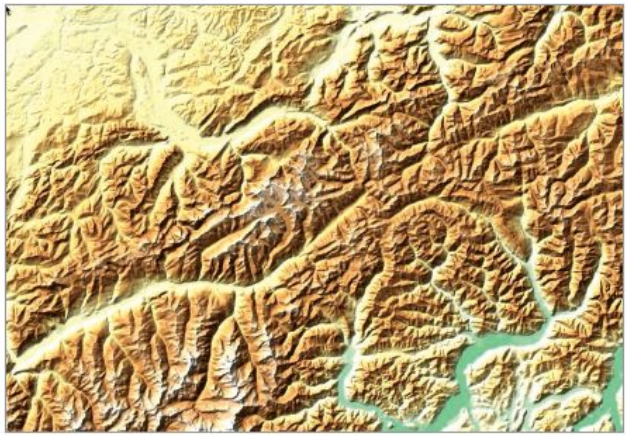


Feature point data from in-ground data sensors.

Toronto traffic

Road segments showing future vehicle speeds forecast using historical sensor data.

Terrain of the Swiss Alps



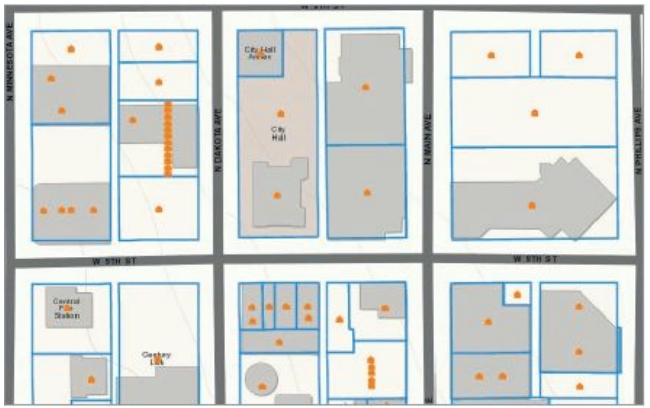
Tinted hillshade is a cell-based raster derived from an elevation surface.

GIS Layer Examples

Montreal, Canada, buildings

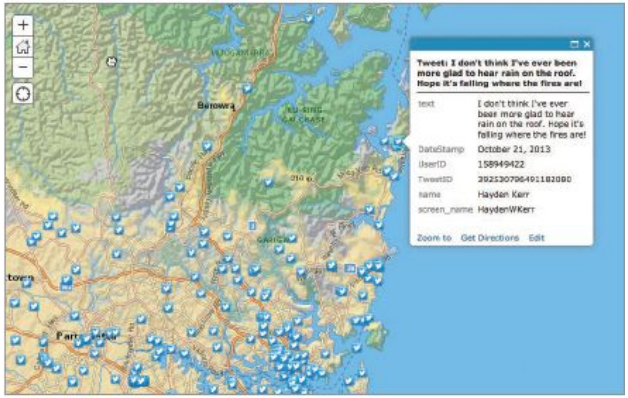
This 3D scene highlights layers for Montreal, Canada

Sioux Falls parcels



Feature polygon data from cadastral surveys.

New South Wales Wildfire tweets

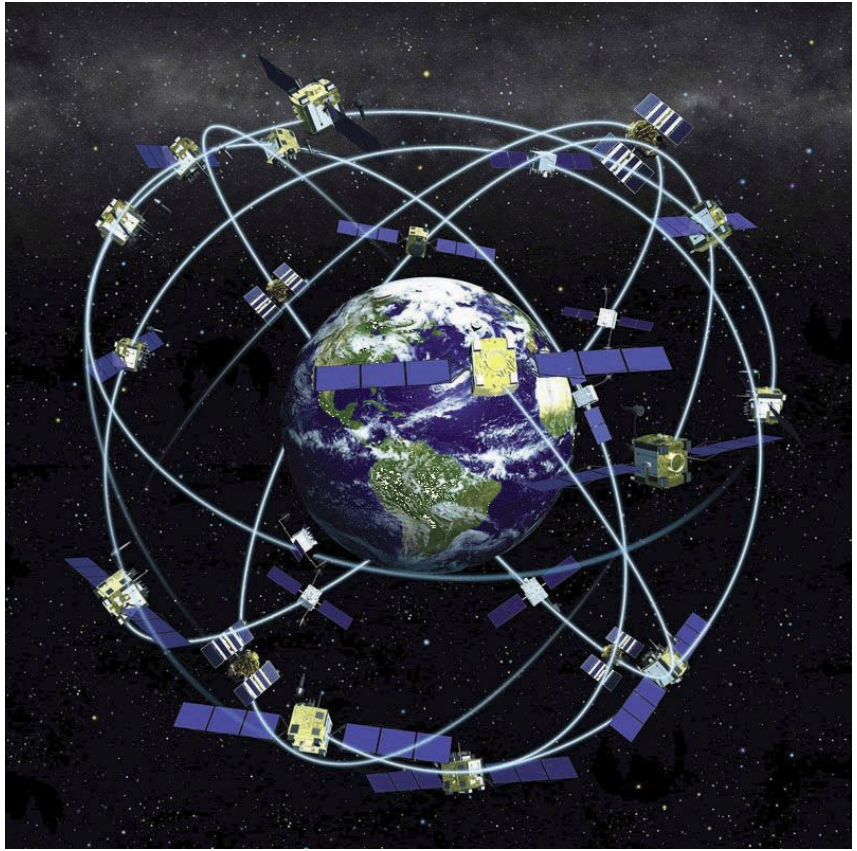


Feature point layer of tweets during 2013 New South Wales fires

Global Positioning Systems (GPS)

- Satellites constantly transmitting signal
- Receiver on Earth triangulates position
- Geographic coordinate system (GCS)
  - Latitude/Longitude

Satellite Map Link



Source: Essentials of GIS (Campbell, 2011)

GIS Software

- Industry standard: ArcGIS by ESRI
- Web mapping: Google Earth, D3
- Open Source: QGIS, GRASS
- Spreadsheets with charting: Excel, Google Sheets
- Scientific software: Matlab, R
- Programming languages: Python, C++

Esri Software: ArcGIS Family

ArcGIS Pro

The next generation desktop GIS

ArcMap and ArcCatalog

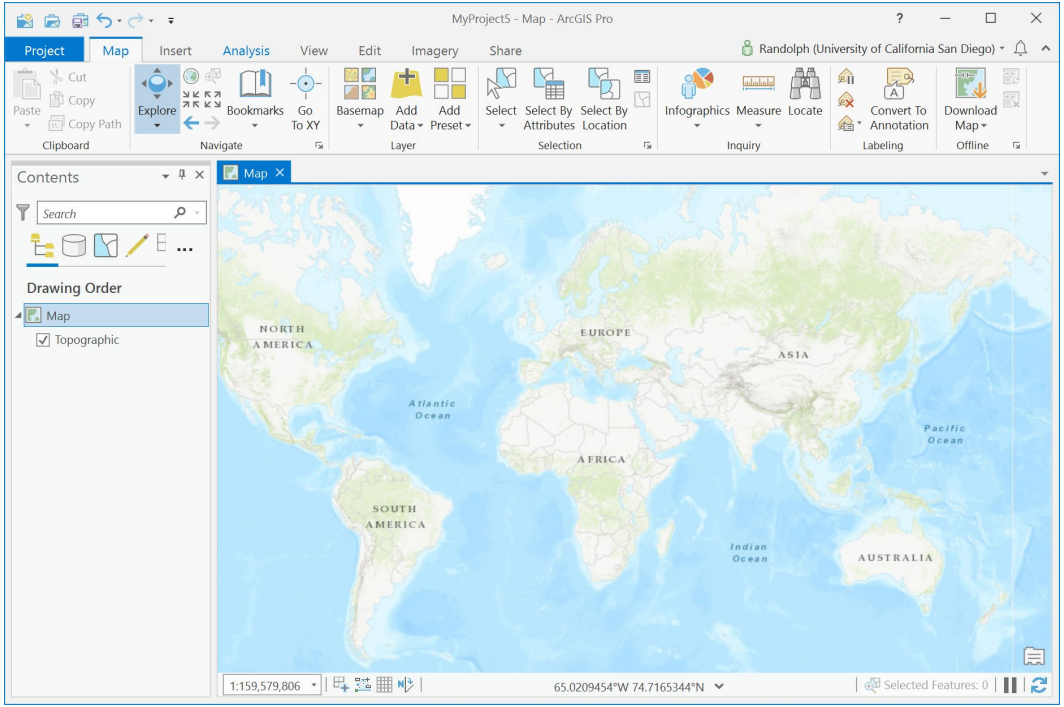
The industry leading “traditional” GIS authoring and editing applications

ArcGIS Online

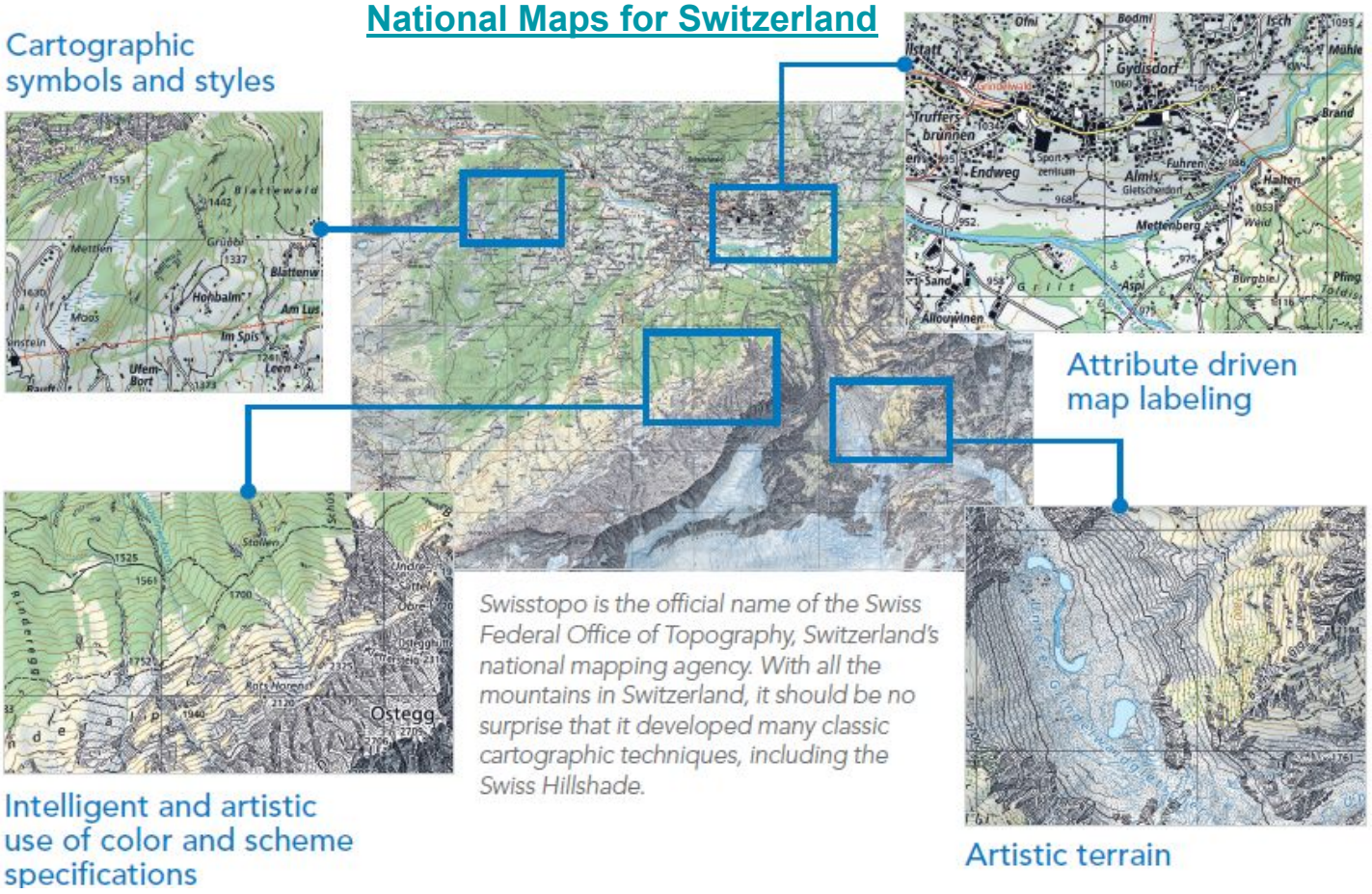
Cloud-based software-as-a s-service (SaaS)

ArcGIS Pro:

- Next generation software
- Professional mapping
- GIS tools for:
  - Data compilation
  - Importing data
  - Both 2D and 3D
  - Spatial Analysis



ArcGIS Pro: The cartographer's workhorse



Web GIS: ArcGIS Online

GIS is evolving

- Originally: Only local files on single computer
- Presently: Distributed web services in cloud

Consists of:

- Lightweight browser based clients
- Data layers shared online
- Custom apps and websites

Web Map Examples

Highway Access Web Map

3D Web Map

The Power of Maps

Explore five maps that inspire and engage

I. Maps provide windows to information
II. Maps are data
III. Maps tell stories
IV. Maps can trigger emotional responses
V. Maps provide innovative solutions

I. Maps provide windows of information

Maps are windows for:

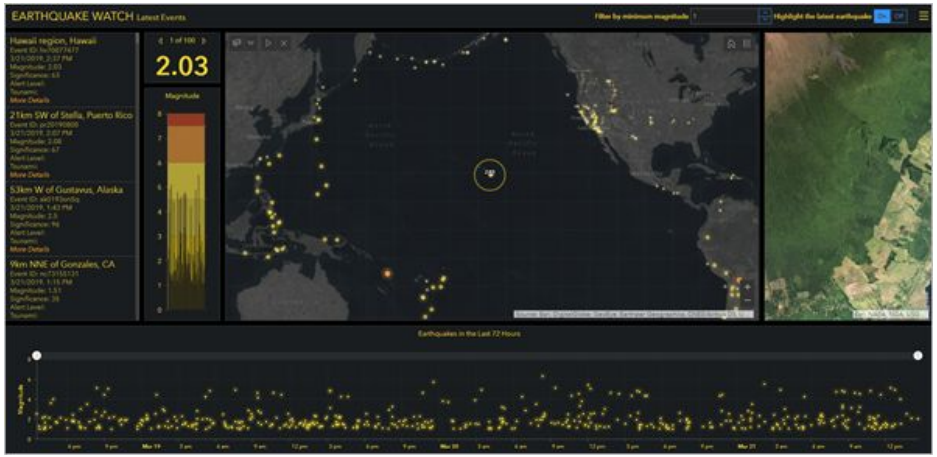
- Exploration and discovery
- Interactive data repositories
- Storytelling medium
- Decision- making tools

Geography Treasure Hunt (World Heritage Sites)

II. Maps are data

Interactive repositories of data:

- World is constantly changing
- Data is widely available
- Dashboard monitors real-time operations



Earthquake Watch Dashboard

III. Maps tell stories

Maps interpret information:

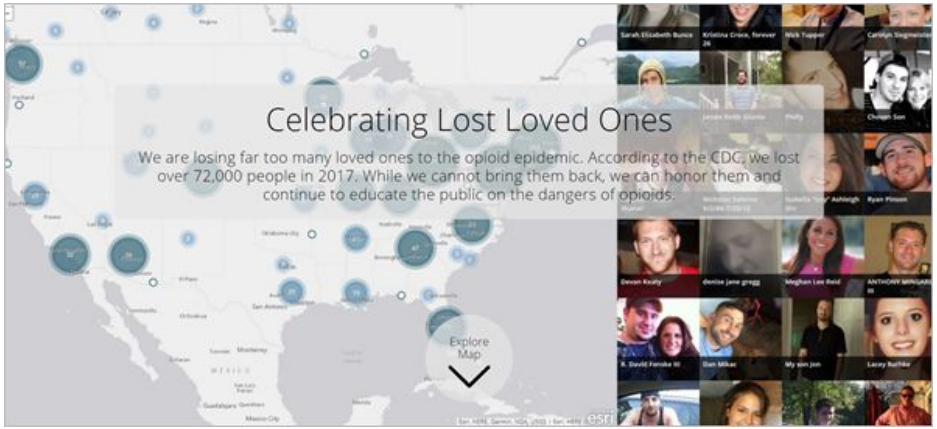
- Tell powerful and engaging stories
- Turn information into:
  - Knowledge
  - Understanding
- Story Maps bring geography to life

Somalia in Crisis Story Map

IV. Maps trigger emotional responses

Maps make us feel:

- Use maps to share our own stories and connect with others
- Community can contribute to and create
- Engage others like us



National Safety Council (NSC) Memorial Site

V. Maps provide innovative solutions

Maps solve problems:

- Perform analysis
- Help improve our communities
- Prepare for emergencies
- Plan for the future

[Safe Streets to Schools]

Demo: San Diego Story Map