Geospatial Software Evolution, Usability, Implications

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https://www.esri.com/education

My Pathway and Approach for Today

Why discuss these issues?

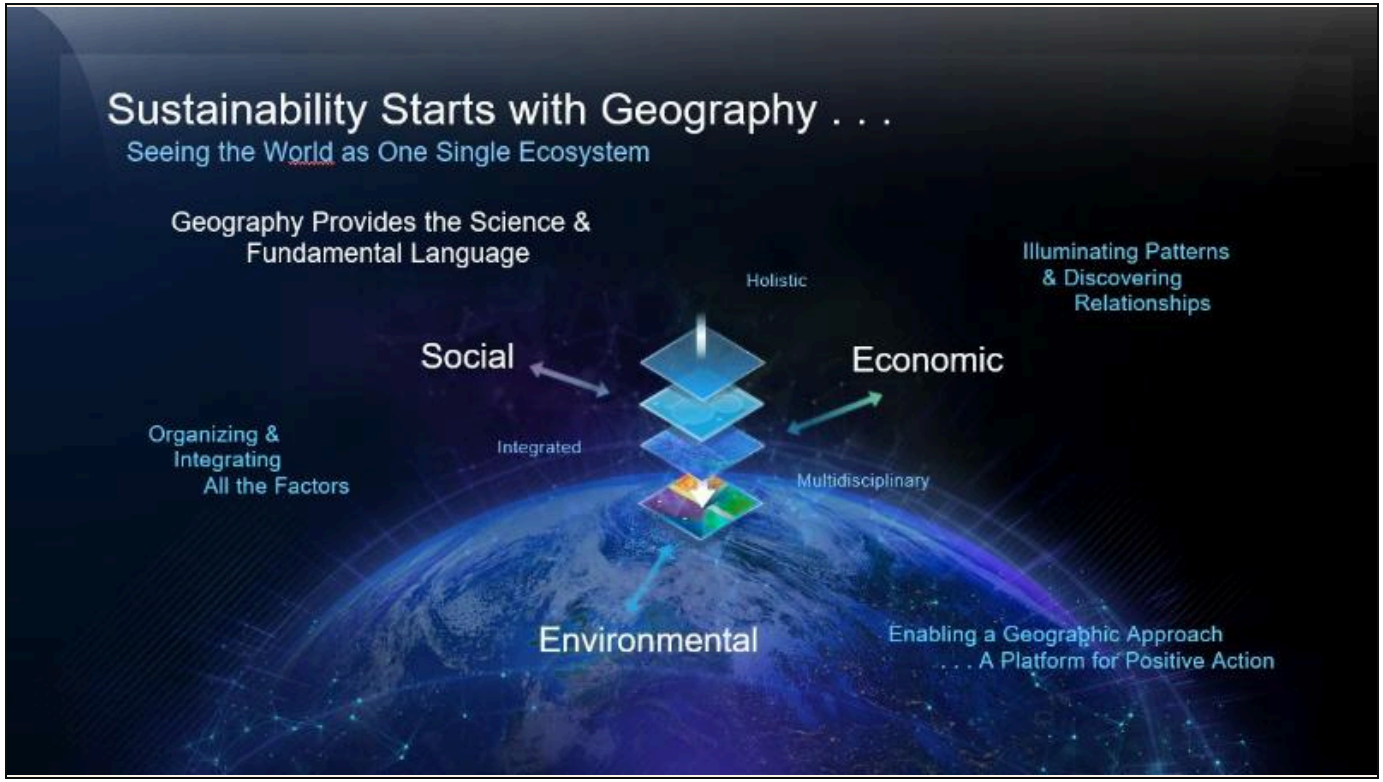
- We believe that understanding is enhanced with the use of geospatial technologies and spatial thinking; hence, we use them in our research.
- We believe that teaching is enriched and students are engaged and empowered when using geospatial technologies and spatial thinking.
- We believe that research and teaching with GIS promotes the inclusive, critical, and open nature of our practice.
- As users of GIS, we must understand its evolution, usability, and implications.
- We are not simply users of geotechnologies, we are the leaders in GIScience and have influence on how it should be developed in the future.

Today's Presentation and Discussion

- Trends in the evolution of GIS.
- Societal forces influencing the evolution of GIS.
- The implications of GIS development on teaching, learning, and research with GIS and on geography.


Our World
Is Now Being Challenged by Human Activities
Extreme Heat
Ocean Warming
Water Crises
Severe Droughts
Overpopulation
Food Shortages
Human-Induced Climate Changes
Steep Decline in Biodiversity
Loss of Nature
Ecological Instability
Natural Disasters
Wildfires
Social Conflict
Pollution
Unconstrained Development
CO_2 Levels
Humans Are Living Recklessly . . .
Beyond Our Means . . .
. . . Unsustainably

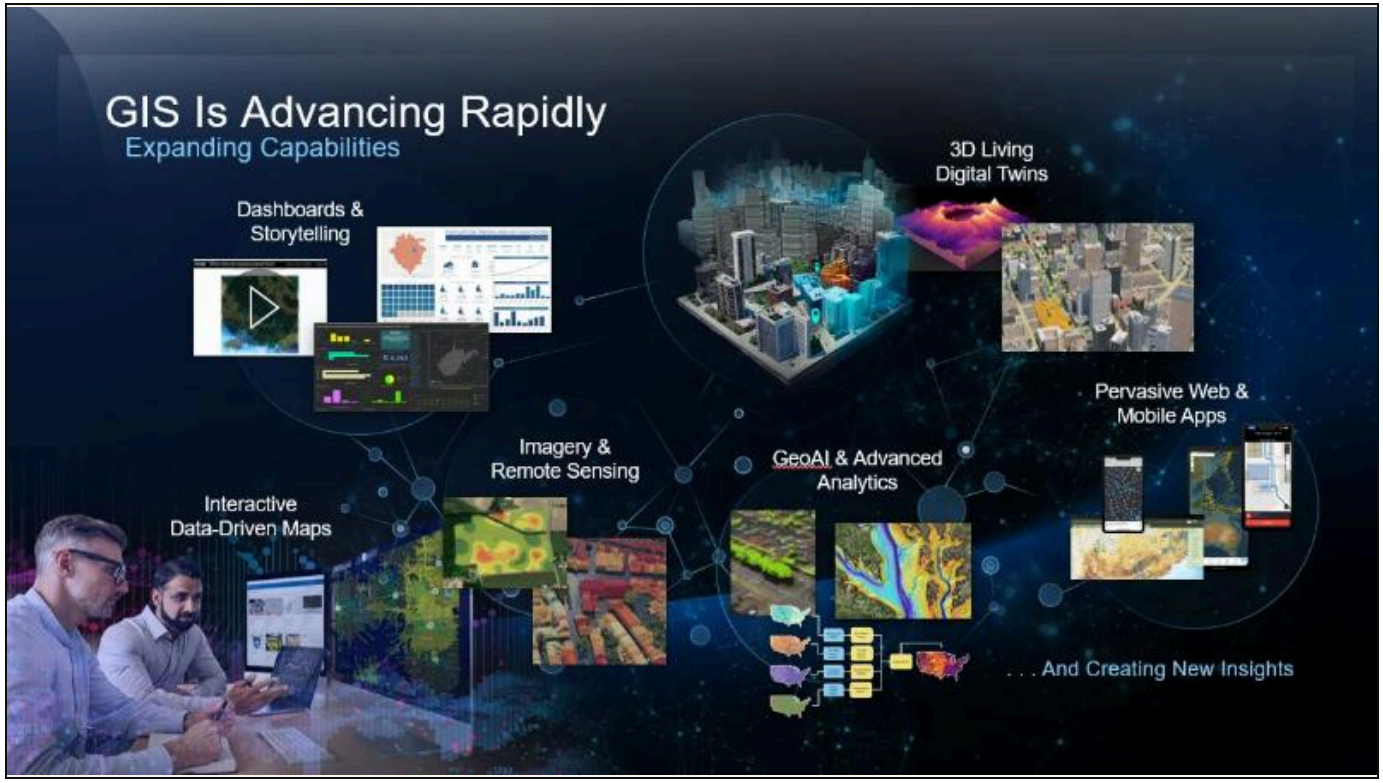

Sustainability Starts with Geography . . .
Seeing the World as One Single Ecosystem


Sustainability Starts with Geography . . .
Seeing the World as One Single Ecosystem
Geography Provides the Science & Fundamental Language
Holistic
Illuminating Patterns & Discovering Relationships
Social
Economic
Organizing & Integrating All the Factors
Integrated
Multidisciplinary
Environmental
Enabling a Geographic Approach . . . A Platform for Positive Action


GIS
Enables The Geographic Approach
A Powerful Platform for . . .
Creating Understanding . . .
Exploring Alternatives . . .
Finding Solutions . . .
Explaining . . .
. . . and Taking Action
Data Collection
Visualization & Mapping
Analysis & Modeling
Planning & Geodesign
Decision-Making
Action
Providing a Foundation for Understanding . . . And Collaboration

5 Forces Bringing us to a key time to reassess what we are doing with GIS

GIS evolution: The long and winding road? Not.


GIS Is Advancing Rapidly
Expanding Capabilities
Dashboards & Storytelling
3D Living Digital Twins
Pervasive Web & Mobile Apps
Imagery & Remote Sensing
GeoAI & Advanced Analytics
Interactive Data-Driven Maps
. . . And Creating New Insights

Implications for Teaching and Learning

- Who needs to know which GIS tools and approaches?
- What content should we teach?
- In which courses and programs should we teach it?
- Do we need to provide step-by-step instructions in our lessons/labs/curriculum?
- How do we assess student achievement?
- Web mapping applications open many new avenues for assessment. Emphasis on communication with maps also necessitates change in what and how we assess.

Dependability of GIS tools

- Despite gloomy forecasts about the demise of GIS, GIS remains a set of tools, an approach, a methodology, and a community.
- Concerns: Advancement of app types vs. the viewability and archival of those apps going forward; such as classic story maps.

Stability and Trust

--The Whys of Where will always be important.

--GIS has not only endured computing and societal paradigm shifts, it has **thrived** through them.

--Esri: 1969.

--ArcGIS platform - the interface has remained largely stable.

--Esri Trust site: Privacy, security, service and system reliability: https://trust.arcgis.com/en/

--Our work with the K-12 community.

Desktop-Connected and Online SaaS GIS

- Which platform is most suitable for which courses and programs?
- The development in each platform: Current and future.

ArcGIS Online

60 million items, 14 million feature layers, millions of users.


GIS Apps Are Becoming Pervasive
Opening Access to GIS
. . . And Dramatically Expanding Its Reach
Work Management
Field Maps
Quick Data Capture
Earth
Survey123
Data Collection
Mapping
StoryMaps
Dashboards
Infographics
Atlas
3D Viewer
Briefing
Instant Apps
Chart Viewer
Mobile Apps
Web Apps
Geospatial Infrastructure


Instant Apps
Templates That Transform Web Maps into Apps
Easy to Configure and Use
Templates
Coming

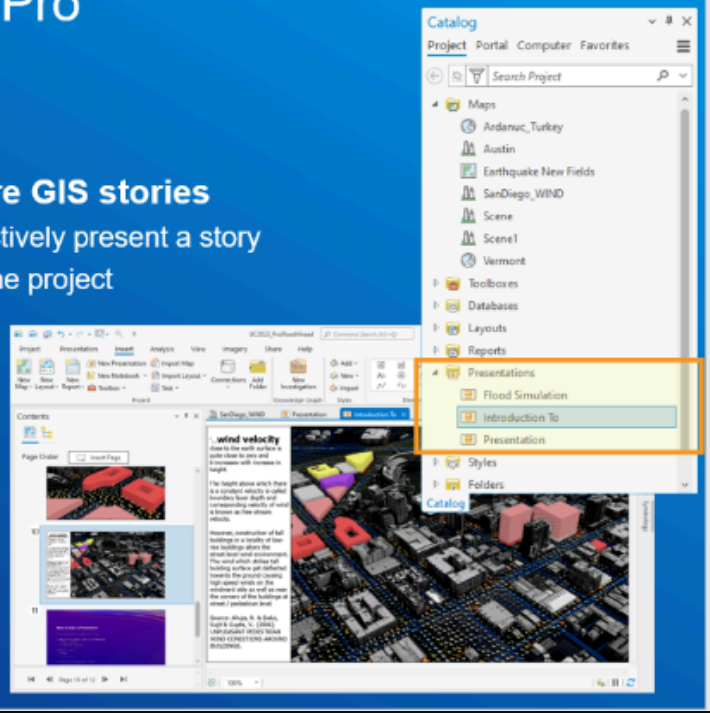

Storytelling with Maps
Communicating Geographic Knowledge Widely
Common Uses
ArcGIS StoryMaps
New & Improved
Growing Rapidly
Millions of Stories Published


Dashboards Dynamic Visual Reporting
• Easy to Configure
• Ready-to-Use
• Interactive
• Highly Scalable
• Embeddable
Visualize Trends
Monitor Status
Manage Performance
New & Improved
• 3D Content
• Mobile Support
• Living Atlas Layers
• Selection Enhancements
• Accessibility
Coming
• Splash Screen
• Attribute Editing
• Time Zone Support
• Improved Map Tools
• Multi-Language
• Better Accessibility
Providing Relevant & Timely Information at a Glance

Presentations in ArcGIS Pro

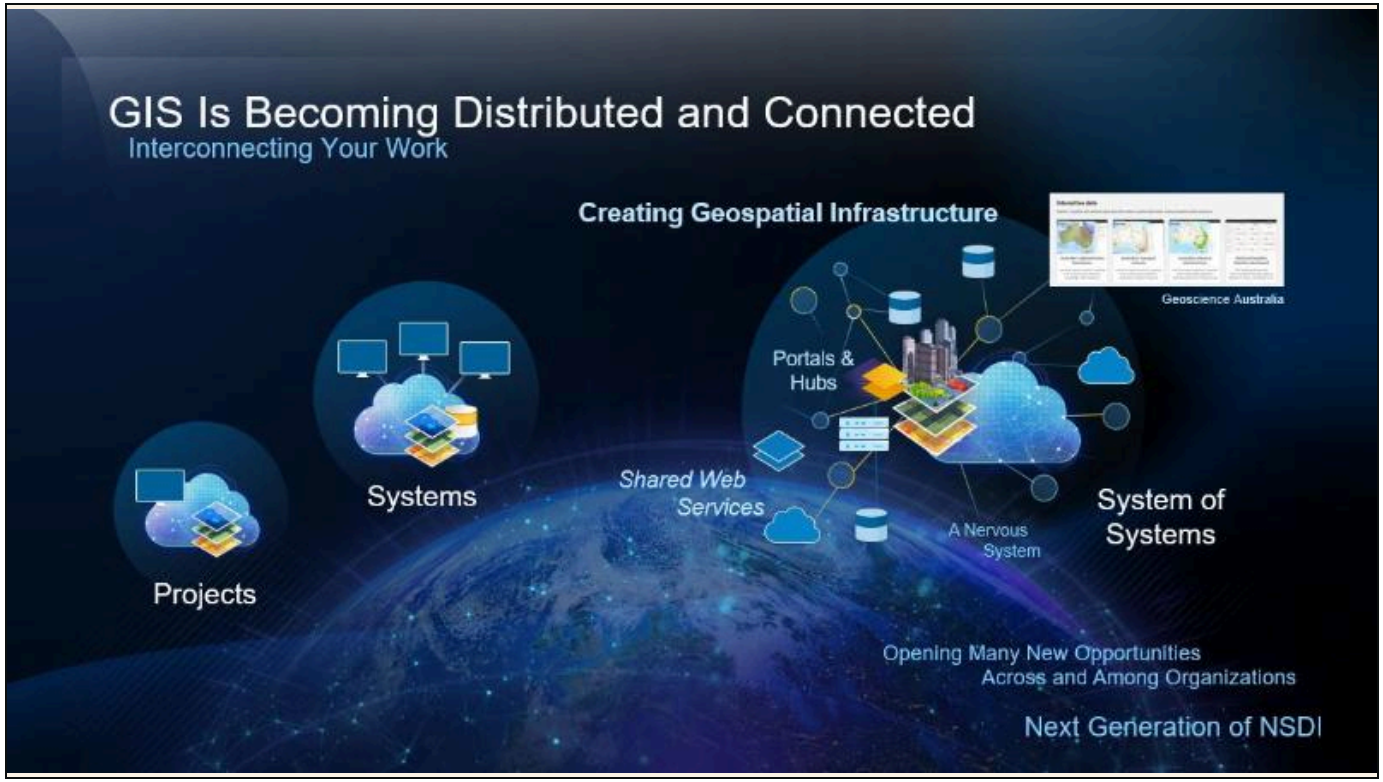
Overview

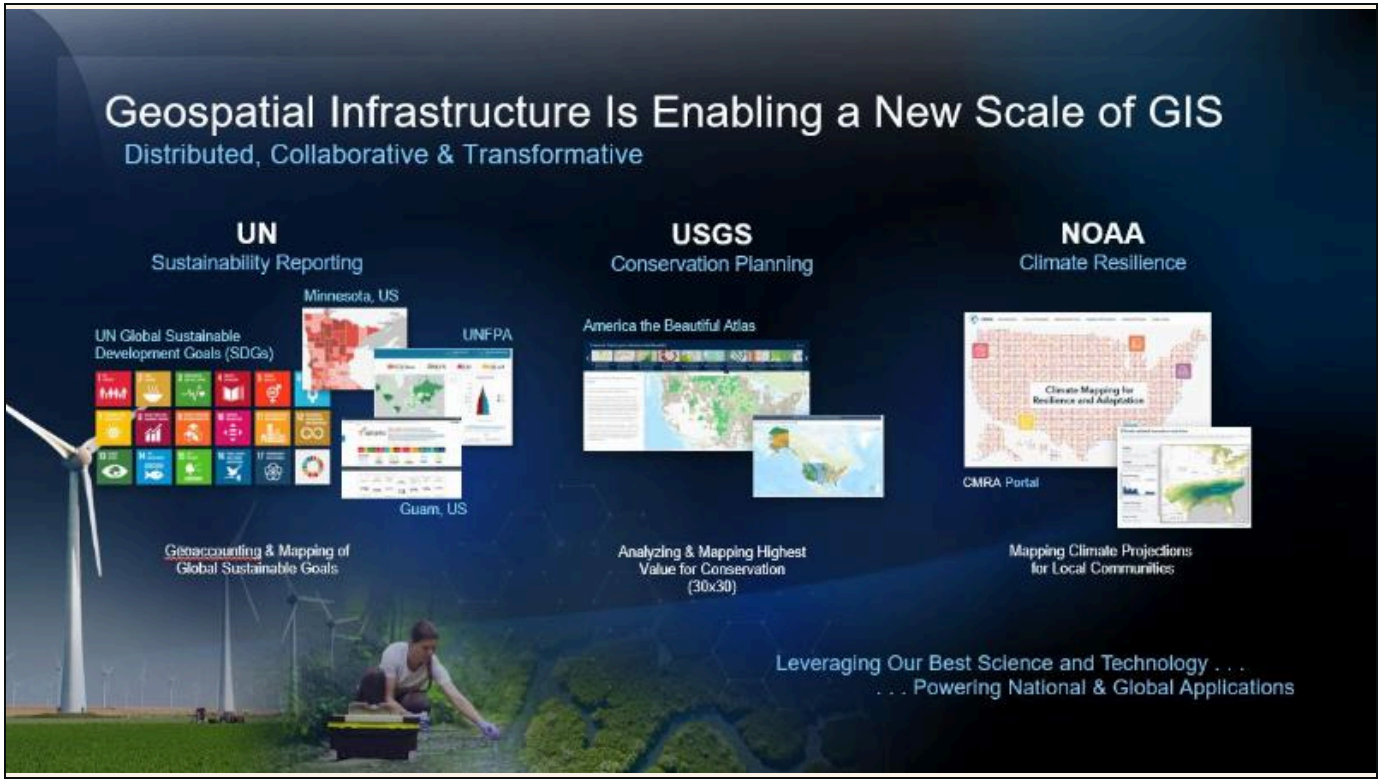
- Ability to **author, present, and share GIS stories**
  - Use maps, scenes, and videos to interactively present a story
  - Managed as a **new document type** in the project
  - Show GIS content in **full-screen mode**
  - Augment pages with images and text
- Examples
  - Show a proposed urban development
  - Present ongoing investigations
  - Summarize an analytical process
  - *Anything* with a strong GIS component



Implications of GIS apps

--Spreading spatial thinking and use of GIS to other disciplines
--Increasing the audience for research results
--Expanding communications options for F2F and web based instruction
--Providing additional assessment options for faculty
--Providing pertinent content for students' professional portfolios
--Providing content for professors and administrators to highlight work from students and faculty.


GIS Is Becoming Distributed and Connected
Interconnecting Your Work
Creating Geospatial Infrastructure
Geoscience Australia
Portals & Hubs
Systems
Shared Web Services
A Nervous System
System of Systems
Projects
Opening Many New Opportunities Across and Among Organizations
Next Generation of NSDI


Geospatial Infrastructure Is Enabling a New Scale of GIS
Distributed, Collaborative & Transformative
UN
Sustainability Reporting
UN Global Sustainable Development Goals (SDGs)
Minnesota, US
UNFPA
Guam, US
Geoaccounting & Mapping of Global Sustainable Goals
USGS
Conservation Planning
America the Beautiful Atlas
Analyzing & Mapping Highest Value for Conservation (30x30)
NOAA
Climate Resilience
CMRA Portal
Mapping Climate Projections for Local Communities
Leveraging Our Best Science and Technology . . .
. . . Powering National & Global Applications

The geographic approach is spreading to additional disciplines: 2 focus areas

(1) **Deepening** the notion of GIS as a platform.

+ Do we teach coding? Enterprise?

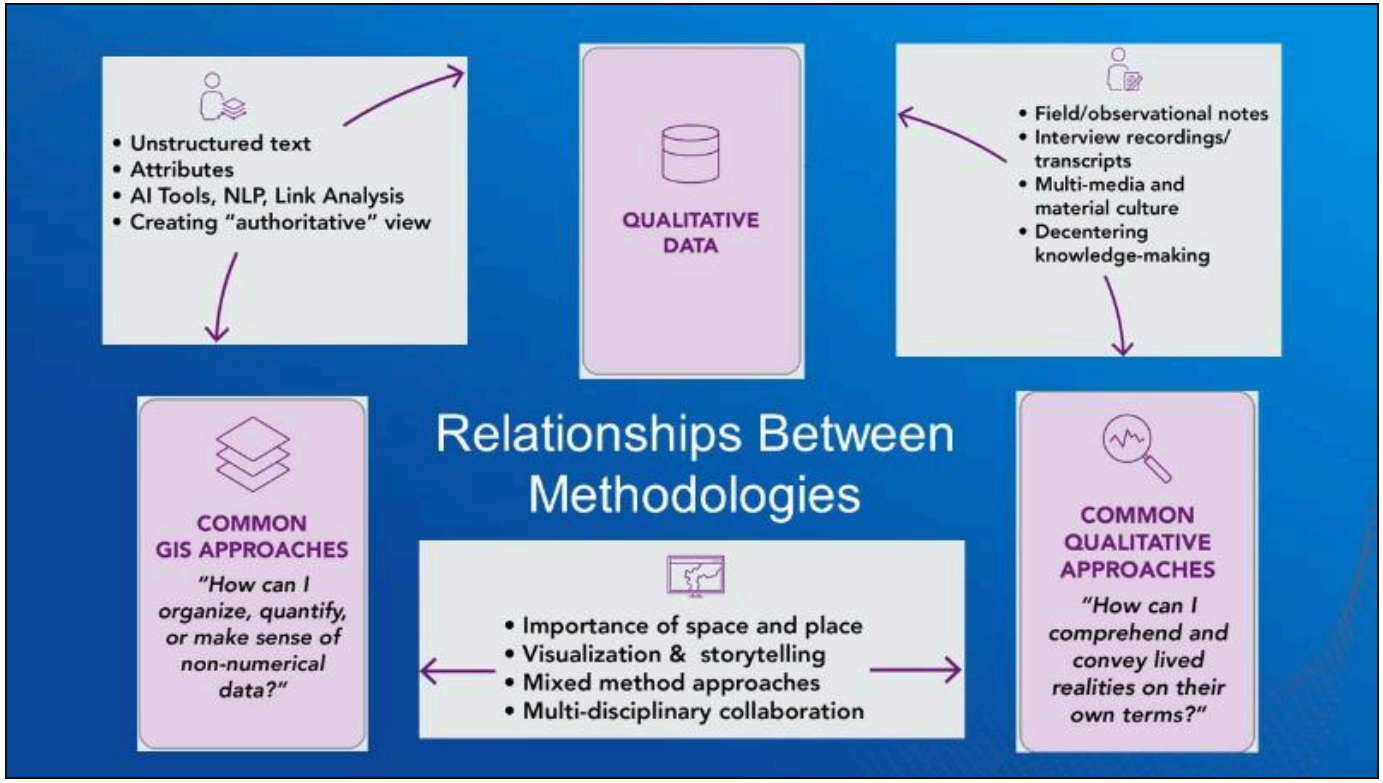
+ Do we need to develop all curricular resources ourselves?

(2) **Widening** the notion of GIS and the geographic approach beyond its core disciplines.

+ In those disciplines, what do they need to know about GIS?

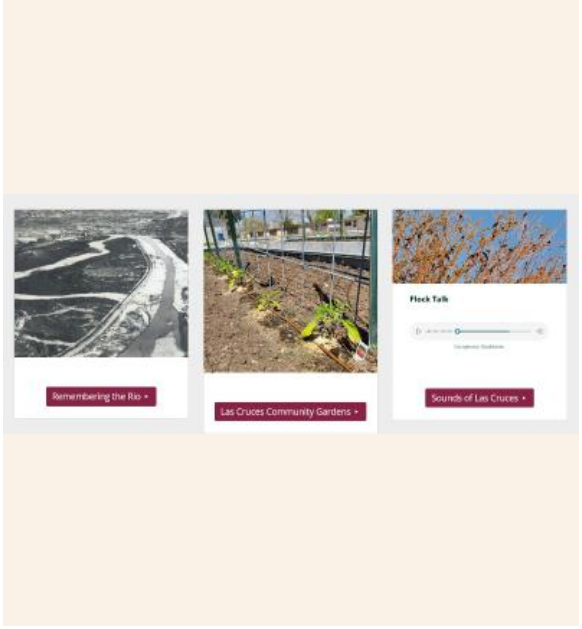
+ An opportunity for the geography and GISc community to provide leadership to other disciplines.


#EsriSocSci
"Enhancing social science with GIS strengthens how qualitative and quantitative data and methods work together. It supports this interplay by providing an organizing context that makes the information more accessible and usable—insights for hard problems like racial equity, climate-driven migration and other impacts, global health challenges and more."
--Esri Social Science Collaborative


• Unstructured text
• Attributes
• AI Tools, NLP, Link Analysis
• Creating "authoritative" view
QUALITATIVE DATA
• Field/observational notes
• Interview recordings/ transcripts
• Multi-media and material culture
• Decentering knowledge-making
Relationships Between Methodologies
COMMON GIS APPROACHES
"How can I organize, quantify, or make sense of non-numerical data?"
• Importance of space and place
• Visualization & storytelling
• Mixed method approaches
• Multi-disciplinary collaboration
COMMON QUALITATIVE APPROACHES
"How can I comprehend and convey lived realities on their own terms?"

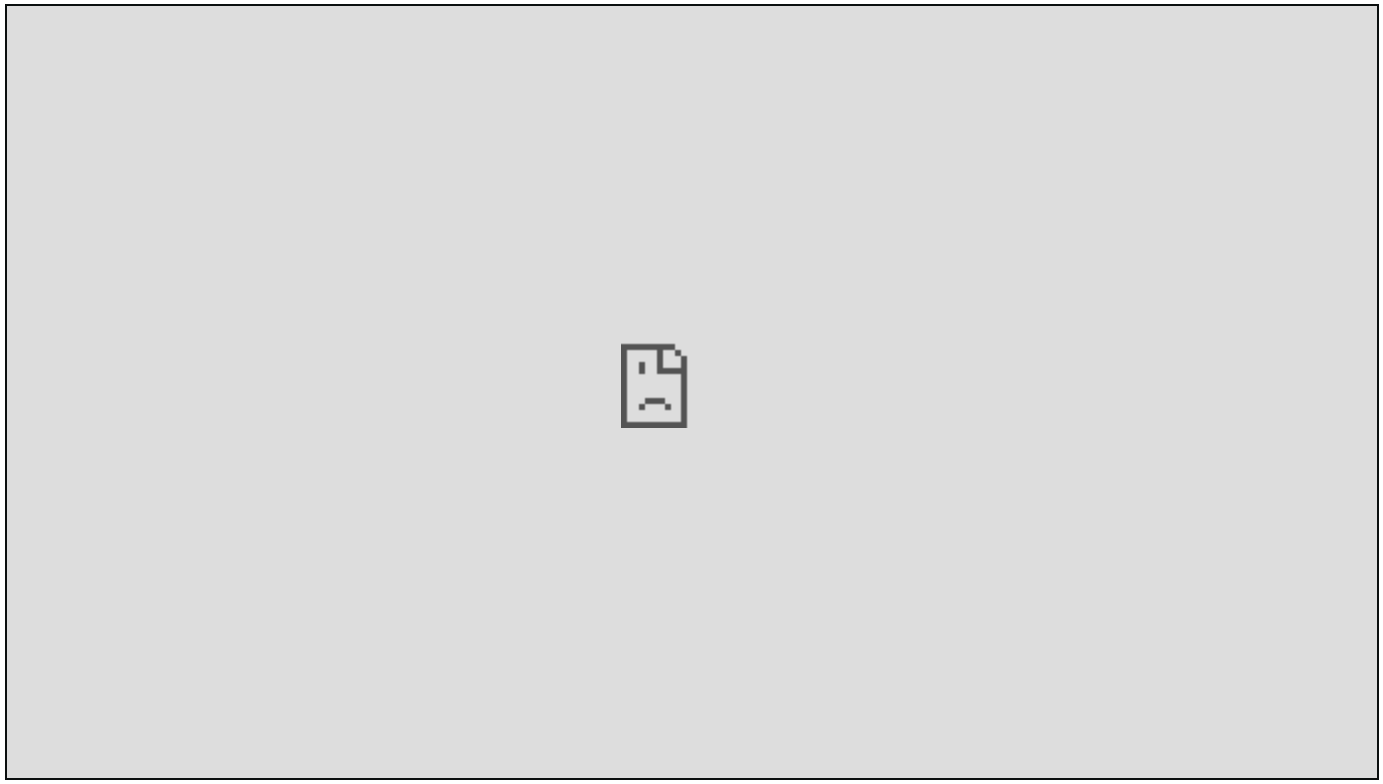
GIS use outside of GIScience and geography is expanding

Innovative Critical Approaches to Place: Teaching Narrative Mapping in Southern New Mexico Brings GIS to an Expanded Array of Disciplines



Through Narrative, Qualitative Data is Supported and Told

Understanding the Night Sky



The impact of freeways on urban neighborhoods (Kerski)

Examining the social, environmental, and economic impact: Article here.

Teaching Mathematics using Interactive Maps

Book from Taylor & Francis, Arlinghaus, Kerski, Arlinghaus

Using these perspectives in a GIS activity

Locating an Art-o-Mat in a neighborhood

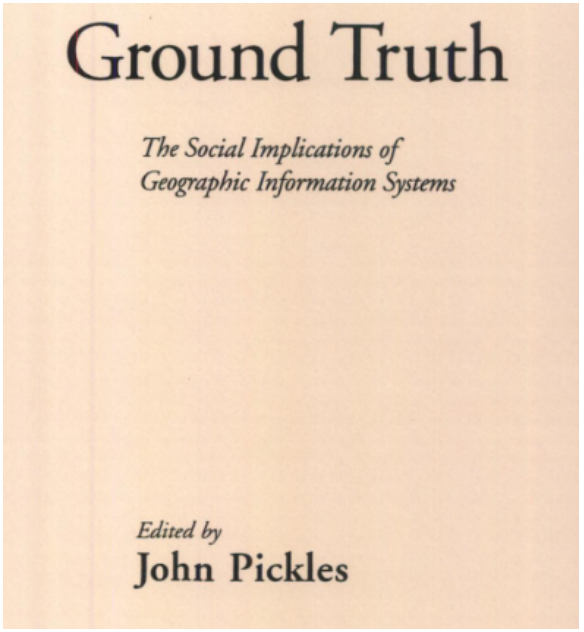
https://www.esri.com/en-us/industries/higher-education/roles/business-education

Criteria: In the past 12 months:

1. Ordered from Etsy website.
2. Went to museum.
3. Went to art gallery.
4. Did any painting or drawing.

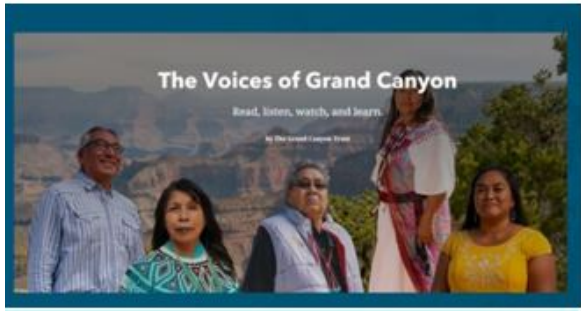
The Social Implications of GIS

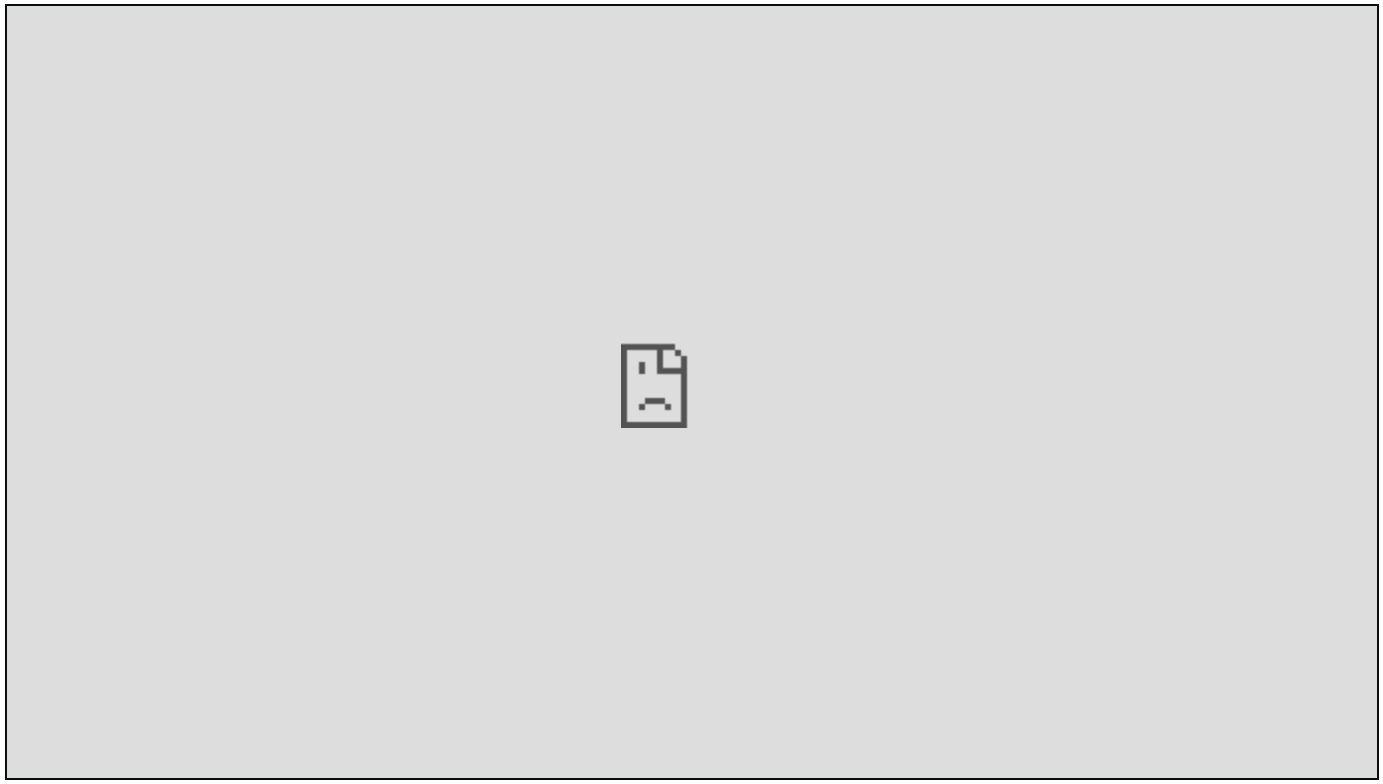
Ground Truth, John Pickles, 1995



2 social science examples

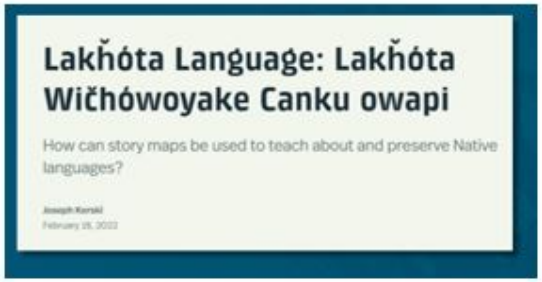
Voices of the Grand Canyon
and
Attitudes and experiences with Electric Vehicles

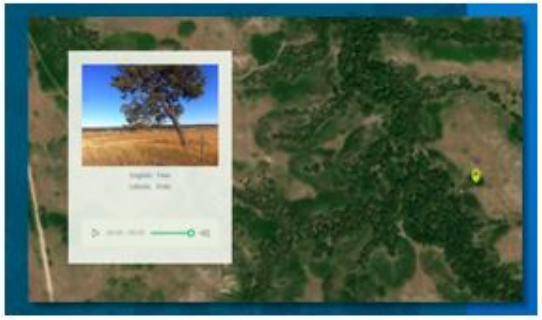




There is usually a higher goal in using GIS in research and instruction

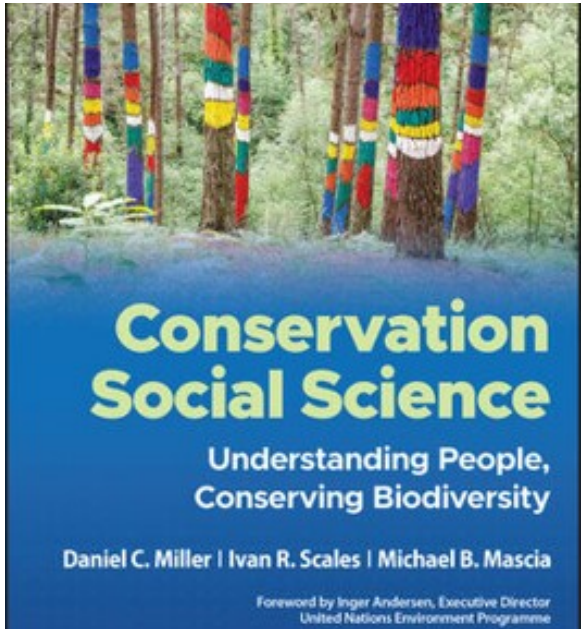
The Lakota Language Story Map





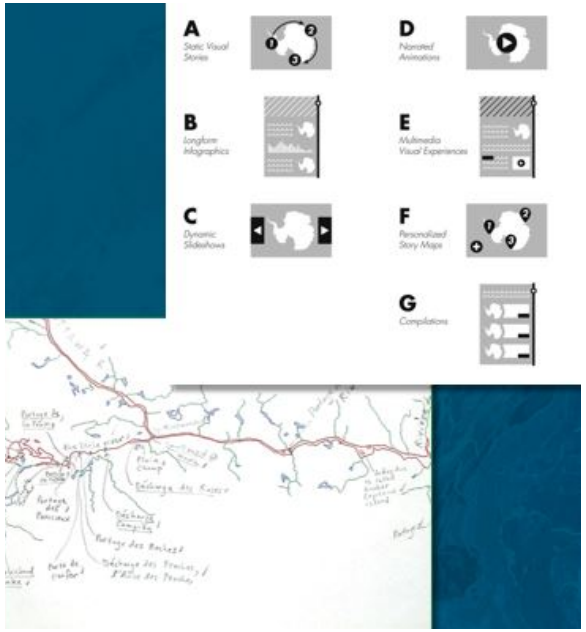
Social Science perspectives are increasingly integral in "standard texts"

Conservation Social Science: Understanding People, Conserving Biodiversity



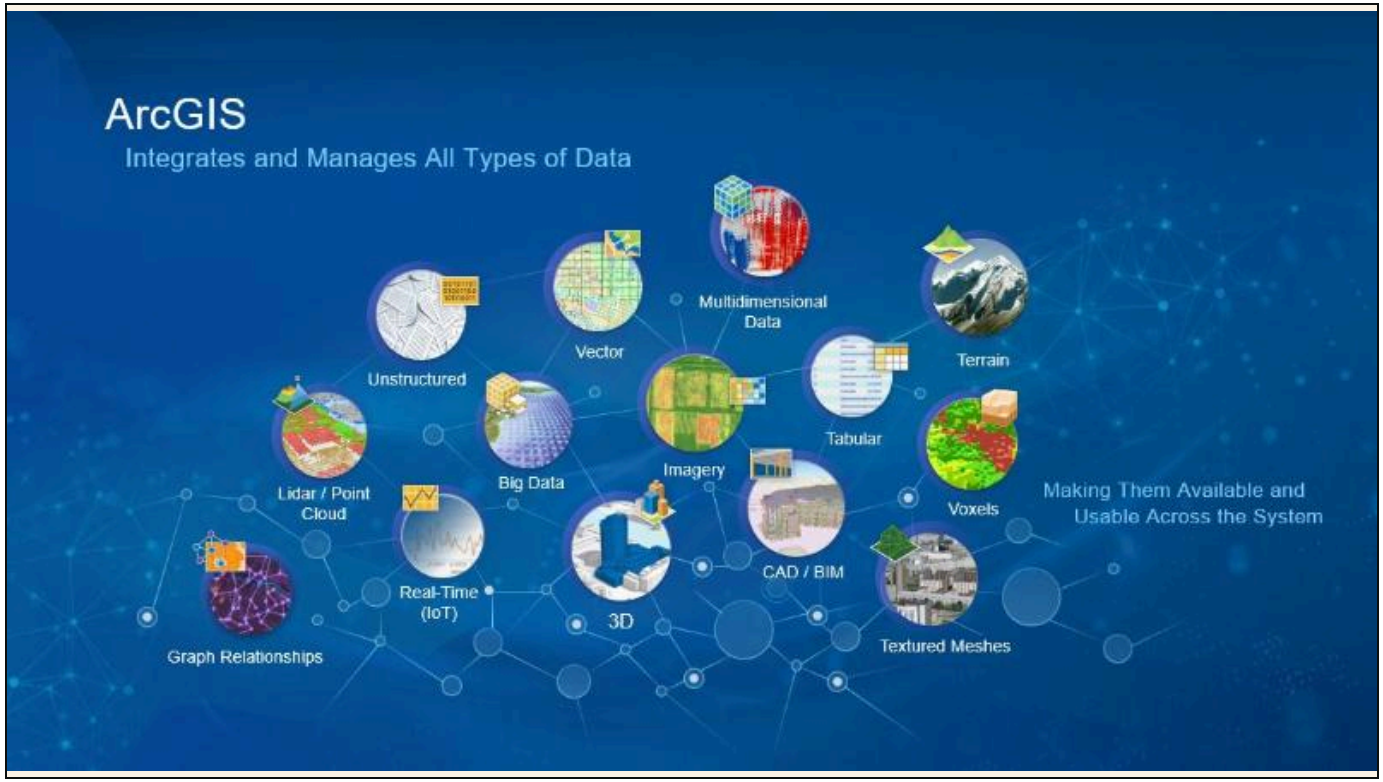
Visual Storytelling research and methods

Cartographic Design as Visual Storytelling: Synthesis and Review of Map-Based Narratives, Genres, and Tropes
and
Framing the Days: Place and Narrative in Geography – Margaret Wickens Pearce, Cartography and GIScience and Sensory Maps

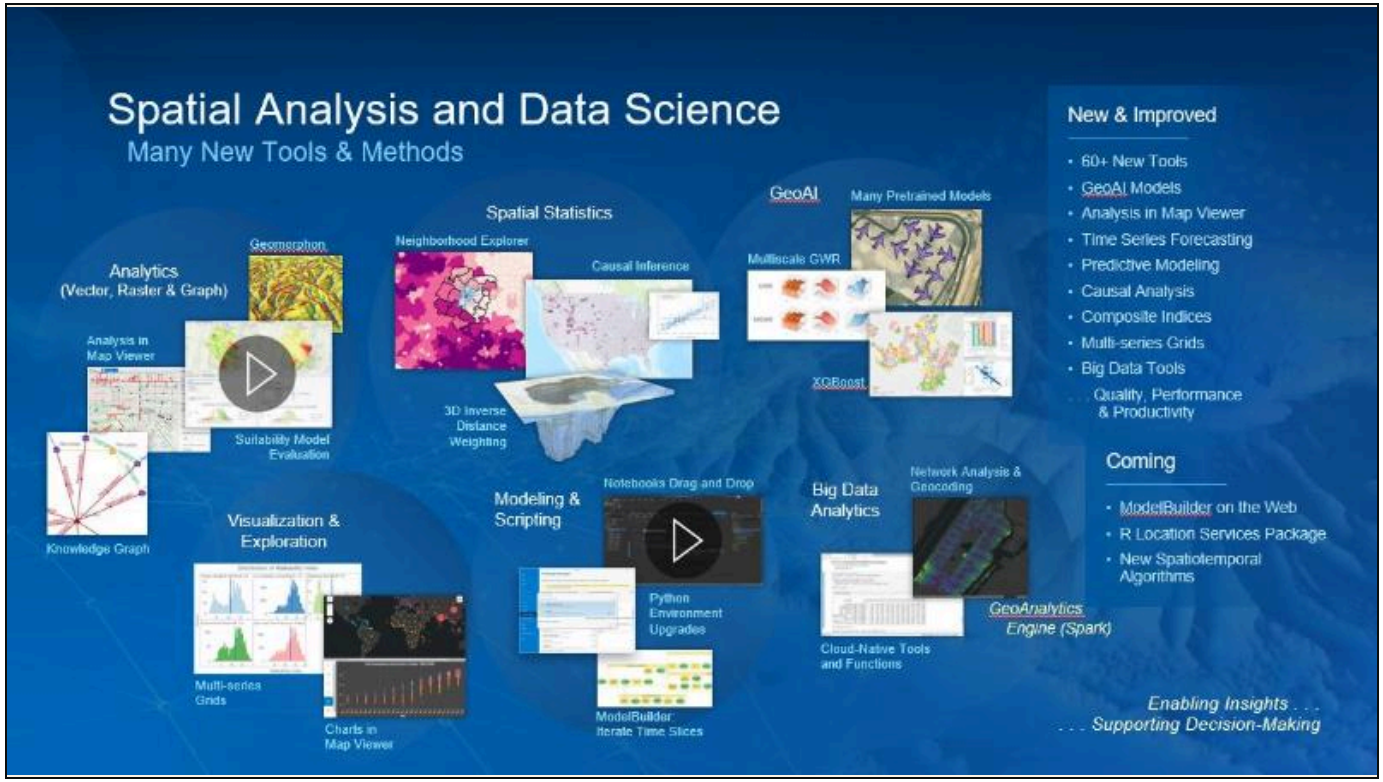


Geospatial Data

--Volume, Variety, Scales, Formats, Portal Types--all increasing


ArcGIS
Integrates and Manages All Types of Data
Multidimensional Data
Vector
Unstructured
Terrain
Tabular
Lidar / Point Cloud
Big Data
Imagery
Voxels
Making Them Available and Usable Across the System
CAD / BIM
Real-Time (IoT)
3D
Textured Meshes
Graph Relationships


ArcGIS Creates & Manages Geospatial Data
Integrating with Leading Data Technologies
Cloud Storage & Cloud Data Warehouses
ArcGIS
Database Services (DBaaS)
NoSQL
RDBMS
Modern Industry Models (Services Based)
Utility & Telco Networks
Transportation
Parcels
Hydrology
Editing Enhancements
Nonversioned Editing
3D Features & Meshes
COGO & Alignment Tools
Linear Referencing
QA / QC Tools
Web Editing App (Coming)
Web Data Import (Data Pipelines)
new
ArcGIS Online
Extracts Data from Cloud Sources
Processes, Enriches and Cleans Data
Creates Hosted Feature Layer
Geodatabase Advancements
Mobile Geodatabases
64-Bit Identifiers
New Date / Time Fields
Schema Reporting
Major Focus on Performance, Scalability and Quality


Spatial Analysis and Data Science
Many New Tools & Methods
Analytics
(Vector, Raster & Graph)
Geomorphon
Analysis in
Map Viewer
Suitability Model
Evaluation
Knowledge Graph
Spatial Statistics
Neighborhood Explorer
Causal Inference
3D Inverse
Distance
Weighting
GeoAI
Many Pretrained Models
Multiscale GWR
XGBoost
Visualization &
Exploration
Multi-series
Grids
Charts in
Map Viewer
Modeling &
Scripting
Notebooks Drag and Drop
Python
Environment
Upgrades
ModelBuilder
Iterate Time Slices
Big Data
Analytics
Network Analysis &
Geocoding
GeoAnalytics
Engine (Spark)
Cloud-Native Tools
and Functions
New & Improved
60+ New Tools
GeoAI Models
Analysis in Map Viewer
Time Series Forecasting
Predictive Modeling
Causal Analysis
Composite Indices
Multi-series Grids
Big Data Tools
Quality, Performance
& Productivity
Coming
ModelBuilder on the Web
R Location Services Package
New Spatiotemporal
Algorithms
Enabling Insights . . .
. . . Supporting Decision-Making


ArcGIS Includes the Living Atlas of the World
Ready-to-Use Basemaps & Layers
Massive (10,000 items) . . .
Rapidly Growing . . .
Curated . . .
Authoritative
Demographics
Habitats Landscape
Basemaps Land Cover
Environment Transportation
Infrastructure Hydro Movement
Traffic Business
Imagery
Biodiversity
POI Boundaries Elevation
Weather Oceans
Soils Hazards
NGDA Layers
3D Basemap
new
Global
3D Basemaps & Layers
Land Use (2017–2021)
Places (POIs) Layers
OpenStreetMap Layers
Analysis-Ready Imagery
Climate Layers
World Pop. 2000–2020
Air Quality
Premium Location Services
US
Hydrology (NHDPlus)
Census ACS (2017–2021)
DOT National Addresses
FCC Broadband Data
NAIP Imagery (2021)
iNaturalist (Coming)
Built from Best Available Commercial and Community Sources

Connection to Ethics

Instruction and Research considerations: Choice of symbology, projection, classification. Location Privacy. Copyright. Data Quality. Metadata (and lack of it).
The Spatial Reserves book and long-running blog.

A Data, GIS, and Society course

Readings, activities, discussions, final project, and quizzes.

https://community.esri.com/t5/education-blog/a-new-complete-course-in-data-gis-and-society/ba-p/1402213

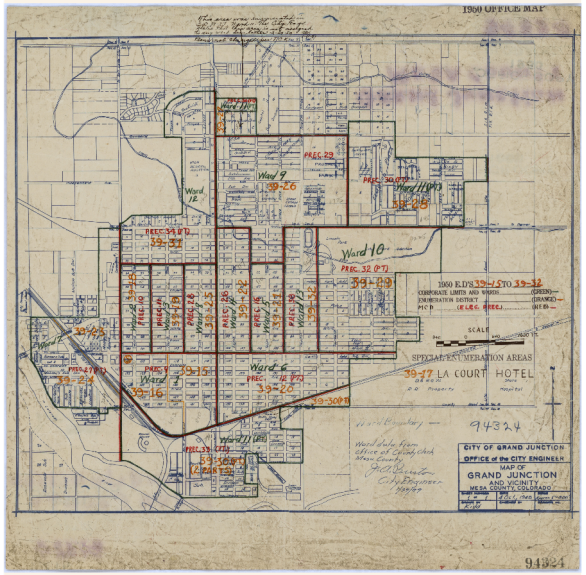
Modern Strategies for Finding Geospatial Data

1980-2010: Where can I find data ? > > > (Today): I have so much data; how can I filter to just what I need, what format(s) are best for me to use; how can I know whether I can trust the data; what are the ethical considerations with Data Set A vs Data Set B?

https://spatialreserves.wordpress.com/2024/01/22/modern-strategies-for-finding-geospatial-data-updated/

Plus, now I can generate my own data if none already exists: Field tools, surveys, feature extraction, geo-registration, and other methods.


ArcGIS Blog
Overview
Topics
ArcGIS Online
Announcing Media Layers for adding images to web maps
Mapping
Media Layers are a new kind of layer in web maps that allow anyone to quickly overlay scanned paper maps or images so they visually line up with other layers. Paper maps are everywhere and bringing them into our web maps can be tricky. Perhaps you have a great scanned 19th century survey of your hometown, or a cell phone photo of a cute tourist brochure map.


1900 OFFICE MAP
Ward 10
Ward 9
Ward 6
LA COURT HOTEL
94324
CITY OF GRAND JUNCTION
OFFICE of the CITY ENGINEER
MAP OF
GRAND JUNCTION
AND VICINITY
MESA COUNTY, COLORADO

Haven't all the maps been made?

No!

1. People want to map things that have never before been mapped: Mars, the Human Brain, chemistry of the Marianas Trench, etc.
2. People want to map things at higher resolution than before: The invasive plant species in a specific field, changes in human behavior by neighborhood over time; etc.
3. People increasingly want data as close to NOW as possible: near-real time and real-time feeds; updating feature services and dashboards.
4. People want to embed maps in an expanding array of tools (SalesForce, R), and an expanding array of multimedia.


Real-Time Visualization and Analytics
Integrating Sensors & IoT with ArcGIS
Analysis
Visualization
Alerting
& Actuation
Integration
& Ingestion
Data
Management
47
16.8 mi
39.2 mi
2 tons
13
GeoEvent
Server
Integration
Configurability
Performance
Velocity
(SaaS)
Visualization
Analytic Authoring
IoT Ingestion
Supporting Operations &
Improving Decision-Making

GIS has always been data science!

- How to use data.
- How to turn data into *actionable information*.
- How to filter, classify, generalize data to *make sense of it*.
- The societal implications of using geospatial data.
- How to find, use, and consider the implications of geospatial data book and blog: https://spatialreserves.wordpress.com
- Data fluency: Understanding the digital generation, book: https://www.amazon.com/Understanding-Digital-Generation-Teaching-Landscape/dp/1412938449
- Approach for selected disciplines: GIS as a component of data science, location analytics, location intelligence, etc.

The users of GIS will continue to have a key role!

Understanding the situation, explaining it to others, determining what is needed and wanted, choosing which tools to use and where to apply them, creating holistic solutions, collaborating and sharing, maintaining public trust...

The Research Cycle

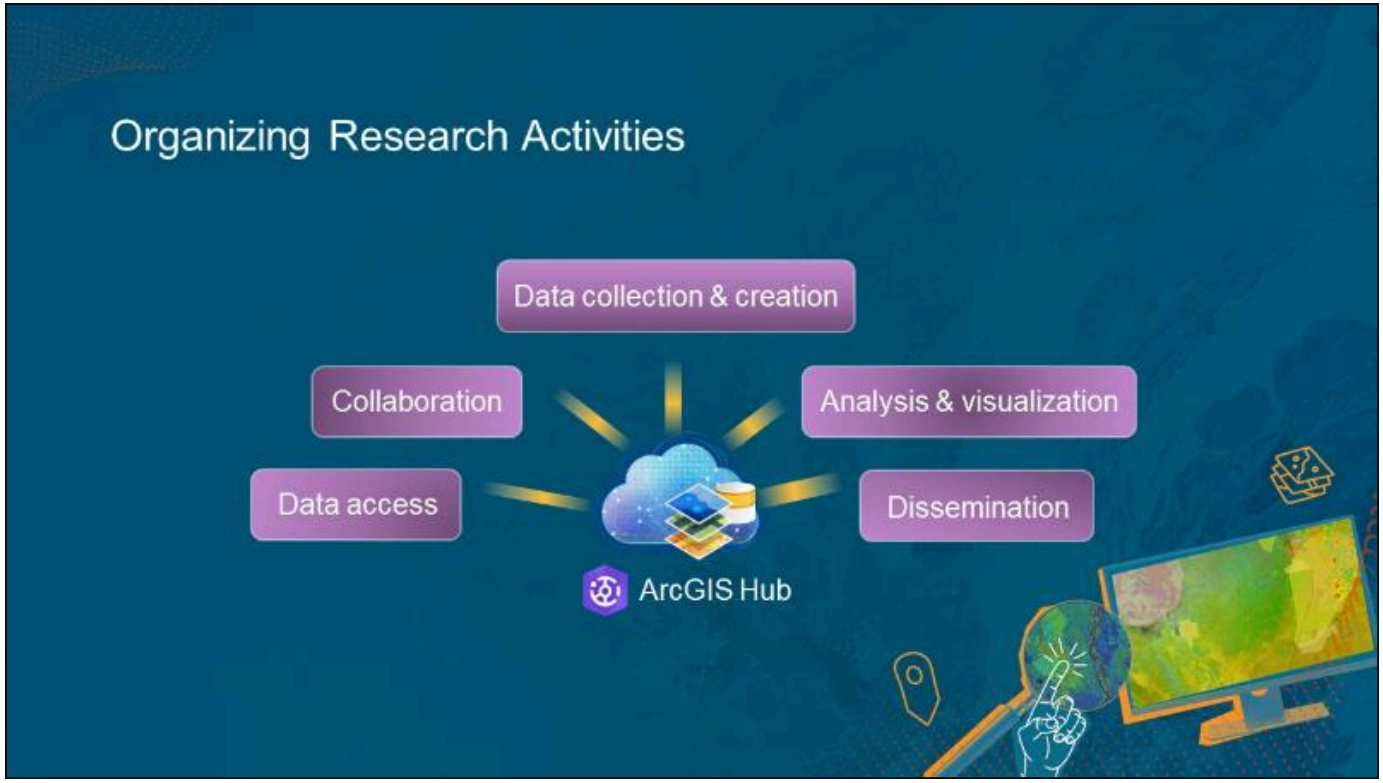
Formulating Questions | Gathering Data | Conducting analysis | Mapping | Synthesis | Communicating Results

Rodin's The Thinker.

Source: Jean-David & Anne-Laure via Wikimedia Commons

Tools supporting research steps I

Tools supporting research steps II


Organizing Research Activities
Data collection & creation
Collaboration
Analysis & visualization
Data access
Dissemination
ArcGIS Hub

Usability I

While many things in GIS are vastly easier than X years ago, there is still, and more so than ever, a mountain of tools and ArcGIS <product> many other tools as well outside of Pro, that is daunting to many users.

The world is complex, and GIS to understand the world is also understandably complex.

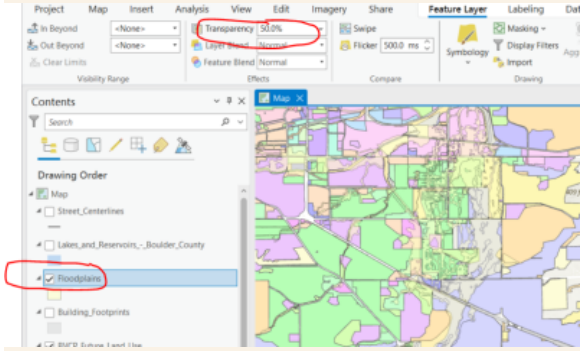
Computer Graphics: GIS Geographic Information System (database, mapping, ARCinfo, ARCview) 1988

Usability II

Consider the many things you have to do with data as just 1 example to get it into a usable format: Rename fields, join fields, project data, etc.

I'm grateful to choices AND for modern GIS where a person doesn't have to learn ALL of GIS to accomplish something; they can use "pieces" – but for them to determine which pieces they need is sometimes daunting too.

Does GenAI have the potential for us to get past some of the need to assemble knowledge about using a set of specific tools to accomplish a job? Some 'solutions templates' meet some of this need – i.e. wastewater - but we still need a paradigm shift in accomplishing the day-to-day GIS work so we can get to the analysis point more quickly.



UX practices that inform product design and usability at Esri

1. Esri has a dedicated UX research team embedded within design teams for Pro, Online and other products. UX research helps understand user problem spaces via conference interviews, surveys, and other means. Usability studies are conducted to ensure the user experience matches needs. https://www.esri.com/en-us/user-research-testing/experience-research
2. The research team identifies key capabilities used and core workflows to benchmark usability within and across these products so that we can measure the user experience ***over time.***
3. We have greatly expanded the number of product designers adding dedicated usability and design support to Dashboards, Survey123, Business Analyst, SiteScan, Drone2Map and others.

Mobile GIS

GIS developers need to develop everything to be mobile ready. Example: Dashboards - add a view if person opens on phone. Hub does this too. Story Maps auto-configure for tablet and phone: https://www.esri.com/arcgis-blog/products/ops-dashboard/decision-support/getting-started-with-dashboard-mobile-views/

But not Experience Builder: Choice is good, but...

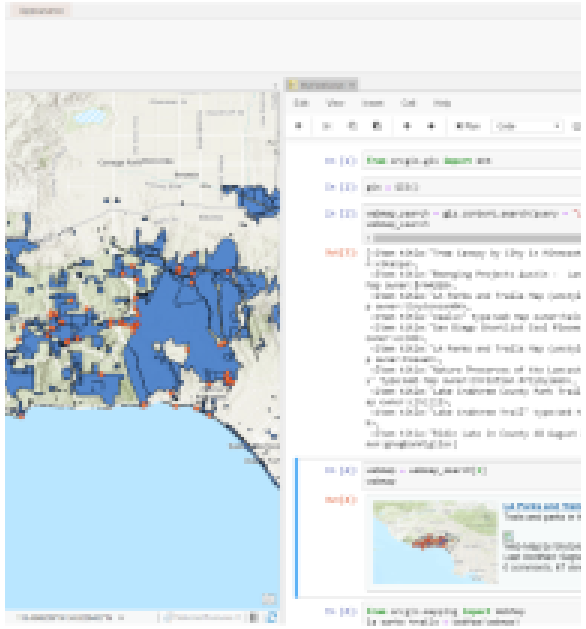
ArcGIS Ideas and User Experience Improvement Program

ArcGIS Ideas:

https://community.esri.com/t5/custom/page/page-id/arcgis-ideas

User Experience Program:

https://pro.arcgis.com/en/pro-app/latest/get-started/the-esri-user-experience-program-euei-.htm



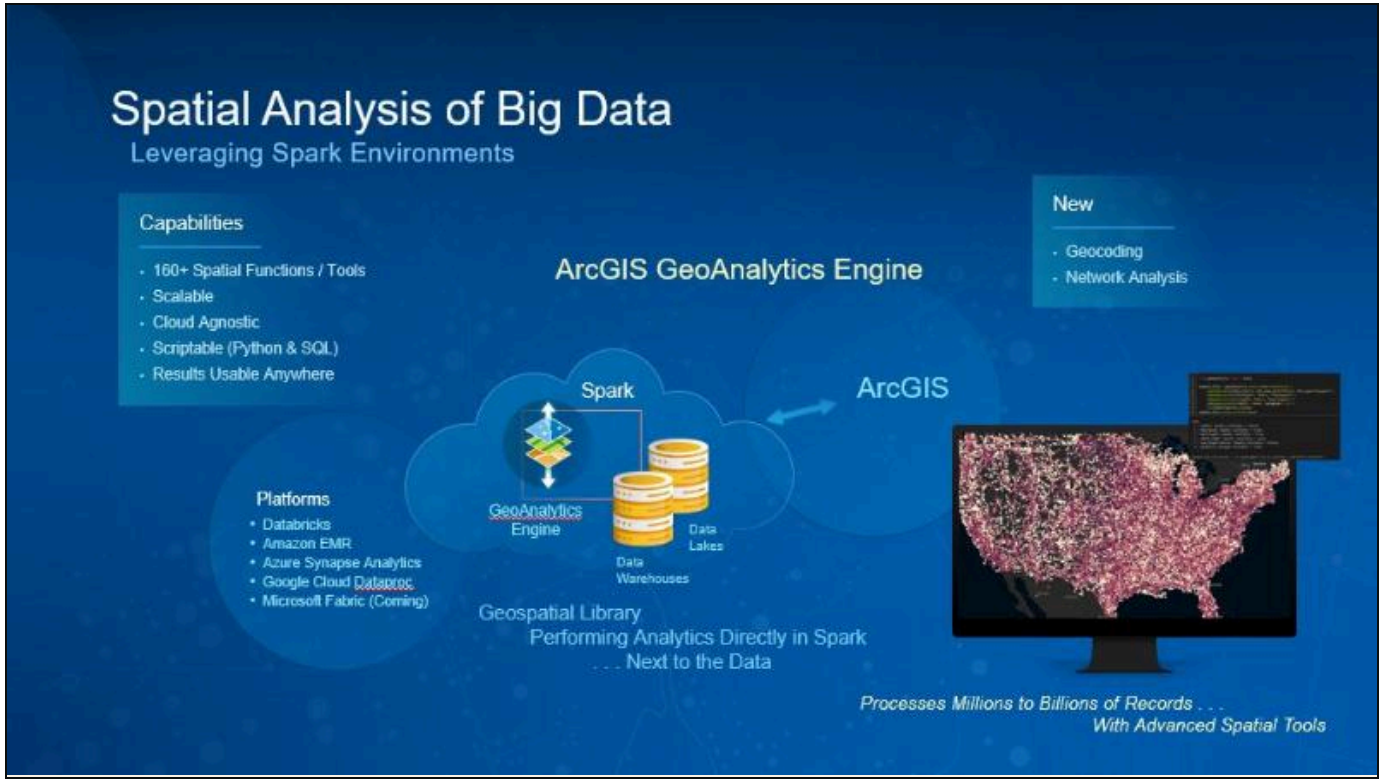
Language

Support for other languages is accelerating. 1 example: Multilingual surveys:

https://community.esri.com/t5/arcgis-survey123-blog/survey123-tricks-of-the-trade-introducing/ba-p/894919

Beyond my workstation or server environment

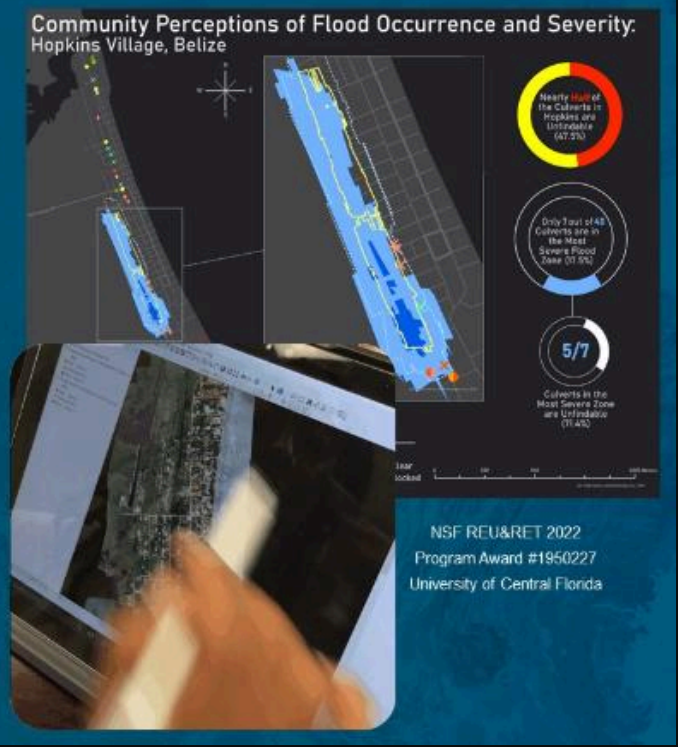
- Leveraging big data
- Leveraging big computing power
- Spatial Analytics in Planetary Computer and Microsoft Fabric: https://spatialreserves.wordpress.com/2024/02/19/rethinking-how-gis-users-work-with-data-spatial-analytics-in-microsoft-fabric/


Spatial Analysis of Big Data
Leveraging Spark Environments
Capabilities
160+ Spatial Functions / Tools
Scalable
Cloud Agnostic
Scriptable (Python & SQL)
Results Usable Anywhere
ArcGIS GeoAnalytics Engine
New
Geocoding
Network Analysis
Spark
GeoAnalytics Engine
Data Lakes
Data Warehouses
ArcGIS
Platforms
Databricks
Amazon EMR
Azure Synapse Analytics
Google Cloud Dataproc
Microsoft Fabric (Coming)
Geospatial Library
Performing Analytics Directly in Spark
. . . Next to the Data
Processes Millions to Billions of Records . . .
With Advanced Spatial Tools

5 Key trends in GIS (Kerski).

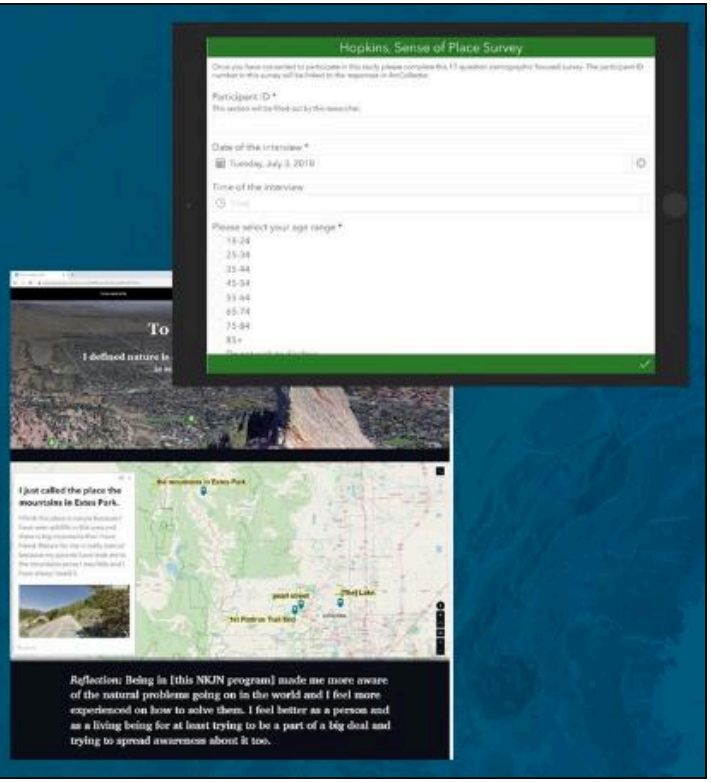
Data collection & creation I

- Using ***ArcGIS Field Maps*** mobile app to record spatial data, fieldnote jottings, and photos during ***participant-observation*** and ***go-along interviews*** (Singer, 2020; see also Kamstra et al, 2019)
- Engaging participants to use ***ArcGIS Field Maps*** to record everyday experiences of place in cities (Wee et al, forthcoming)
- Longitudinal participatory study combining ***drone imagery and manual mapping/digitization*** (e.g., ***Site Scan for ArcGIS***) with ***digital sketch mapping*** and ***interviewing*** with ***ArcGIS Pro*** (formerly ArcMap) (Brandt et al, 2019)



Data collection & creation II

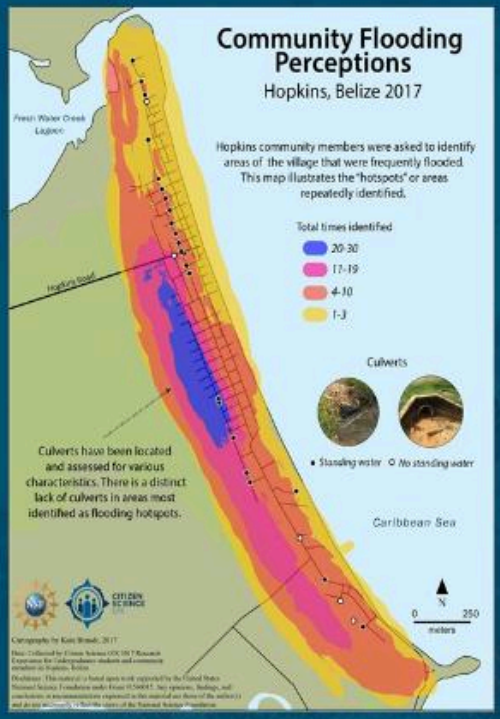
- Creating a public ***questionnaire*** with ***ArcGIS Survey123*** to collect locational and qualitative data (Chivite, 2016)
- ***Map elicitation*** – using digital maps (e.g., ***ArcGIS Online***) or other GIS outputs as an interviewing tool to prompt discussion and reflection (Moore-Cherry et al, 2014, Coleman (Tate), 2018)
- Engaging participants to use ***ArcGIS Survey123*** and ***ArcGIS StoryMaps*** to document ***narratives*** and support ***interviews*** about relationships with place (Martz et al, 2020) and nature (Martz et al, 2022)



Analysis & visualization

3 main approaches to integrating geospatial and qualitative analysis identified by Jung and Elwood (2010):

- Attaching or hyperlinking qualitative data within a GIS, such as including a quote, photo, or video within a point or area on a map (e.g., Szukalski, 2019)
- Geovisualizing qualitative data through classification, symbolization, or other manual cartographic processes, such as extracting placenames and movement patterns from interview transcripts (Orford and Webb, 2017) or delimiting areas of concern from sketch maps (Curtis et al, 2014)



Don't stop at mapping: Spatial Analysis

This hazards analysis includes an enrichment activity that considers population (total, age, and those living in group quarters).

Dissemination with ArcGIS Hub

1. Provide 1-stop—shop for research participants to access everything they need to participate in a study.

2. Include community accounts for researchers to provide research participants with access to ArcGIS tools to generate data.

3. Organize participants and configure Hub in ways that protects the privacy of participants and the data they share.

University of Denver campus-city partnership.

and Connect Ocean.

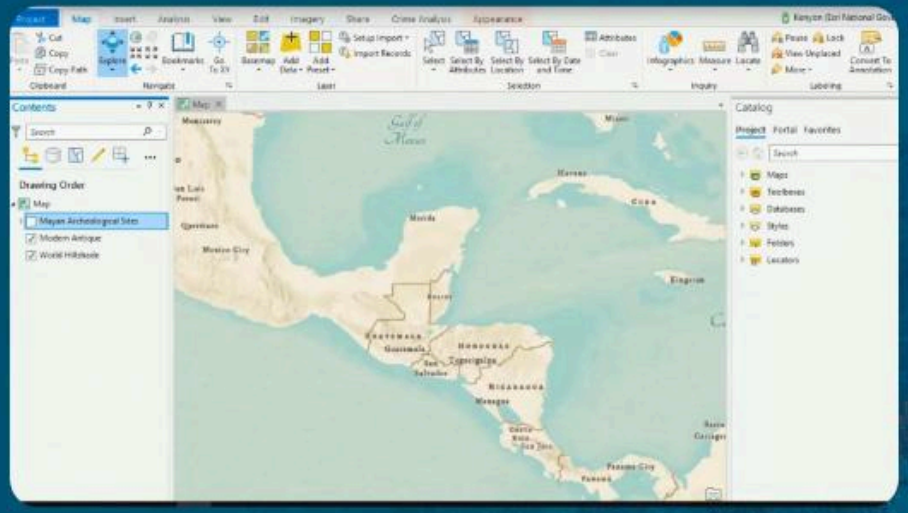

ArcGIS
Supports Enterprise Field Operations
Data Collection
Situational Awareness
Enterprise Data Access
Survey123
Field Maps
Connected &
Disconnected
Synchronizing
Office & Field Activities
QuickCapture
New & Improved
Location Sharing
AI Assistants
Sensor Support
Security (Smart Cards)
Geofencing / Alerts
Calculations (Arcade)
Windows 11 Support
Oriented Imagery
Dashboards
Plan, Optimize
& Coordinate
Includes Task
Management & Navigation . . .
. . . Transforming Mobile Workflows
Connecting Field to the Enterprise . . .

How walkable is your community?

Links 4 components of the ArcGIS Platform: Survey, map, dashboard, story map.

Analysis & visualization of 'big' qualitative datasets I

- ***Exploratory text analysis*** of large-scale survey data using ***ArcGIS API for Python*** (Majumdar, 2020)
- Perform ***unstructured data analysis*** using ***ArcGIS LocateXT*** to automatically identify, extract, and map locational data from large amounts of unstructured text data (Fotheringham, 2020)



Participatory Field Sketching

Smart sketching in ArcGIS Survey123.

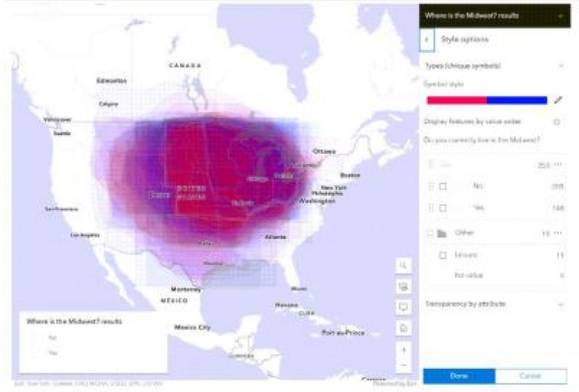
Sample survey: What do you consider to be the wetland area of our campus?
https://arcg.is/1my1Py

Sample survey result in a map:

https://www.arcgis.com/apps/mapviewer/index.html?
webmap=b8fd08391cdc4dcfa47eb65fed92fabf

Visualize, Combine, and Analyze Responses from Participatory Mapping

Where is the Midwest? This uses ArcGIS Survey123, ArcGIS Online (Merge), ArcGIS Pro (count Overlapping Polygons). Extensions: Where is the "rust belt/Steppe regions of the world/where you feel safe on your campus?



Recommendations & considerations:

- For qualitative researchers, GIS can be another tool in your kit.
- For GIS practitioners, qualitative data and methodologies can provide context and grounding.
- Different GIS tools can be used throughout project lifecycle.
- How might you need to adapt your informed consent and data use policies?

Challenges still exist:

- Many kinds of qualitative data are still not well supported in GIS tools.
- Easy to get stuck in tools or lost in the terminology.
- Sometimes a time-consuming manual process.
- Lack of integration between GIS-CAQDAS (computer-aided qualitative data analysis) tools: https://lumivero.com/products/nvivo/ NVIVO qualitative data analysis.

How can you continue moving forward in this area?

Map meaningful places in your community: https://learn.arcgis.com/en/projects/map-meaningful-places-in-your-community/

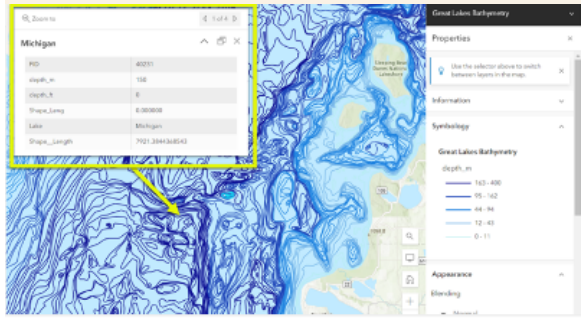
Crowdsource student hangouts: https://learn.arcgis.com/en/projects/crowdsource-student-hangouts/

Integrating Survey123 and StoryMaps - https://arcg.is/1f8byX

Create a layer, add features: https://learn.arcgis.com/en/projects/create-a-layer-and-add-features/

Manage data: Use hosted feature layers to provide relevant data to city employees managing interactions between citizens and wildlife.
- https://learn.arcgis.com/en/projects/manage-data/arcgis-online/

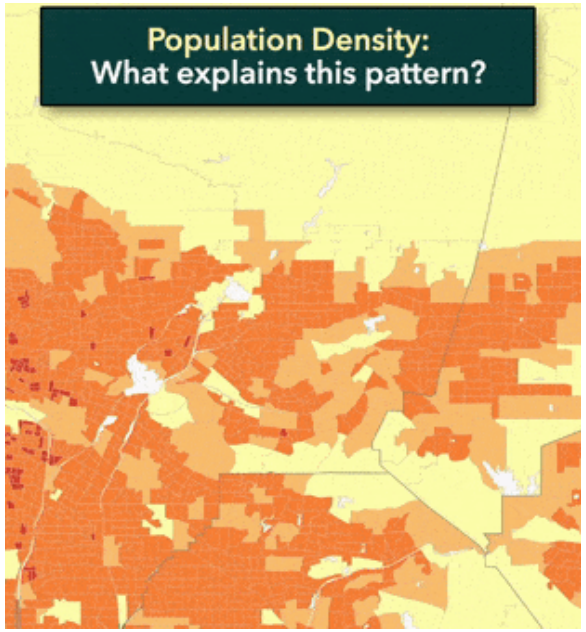
Cartography



Animated Symbols

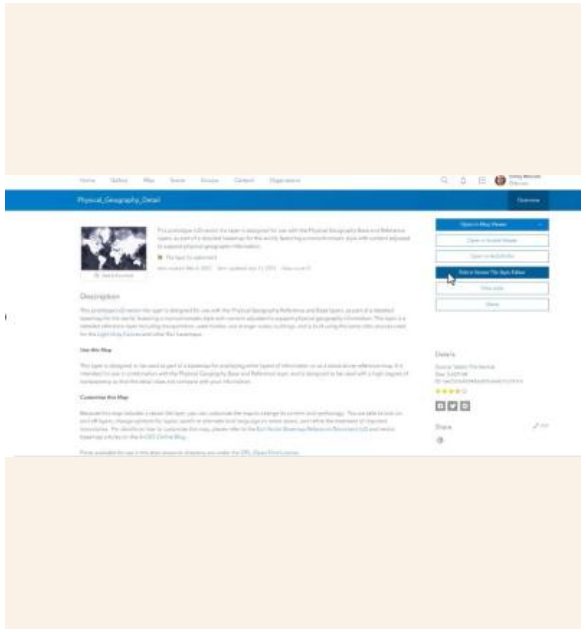
Animation is part of the marker symbol layer of a symbol. NFL animated symbols: https://www.arcgis.com/apps/View/index.html?appid=6028b54ca9e34533ad639ea59a9edaa3

Blending



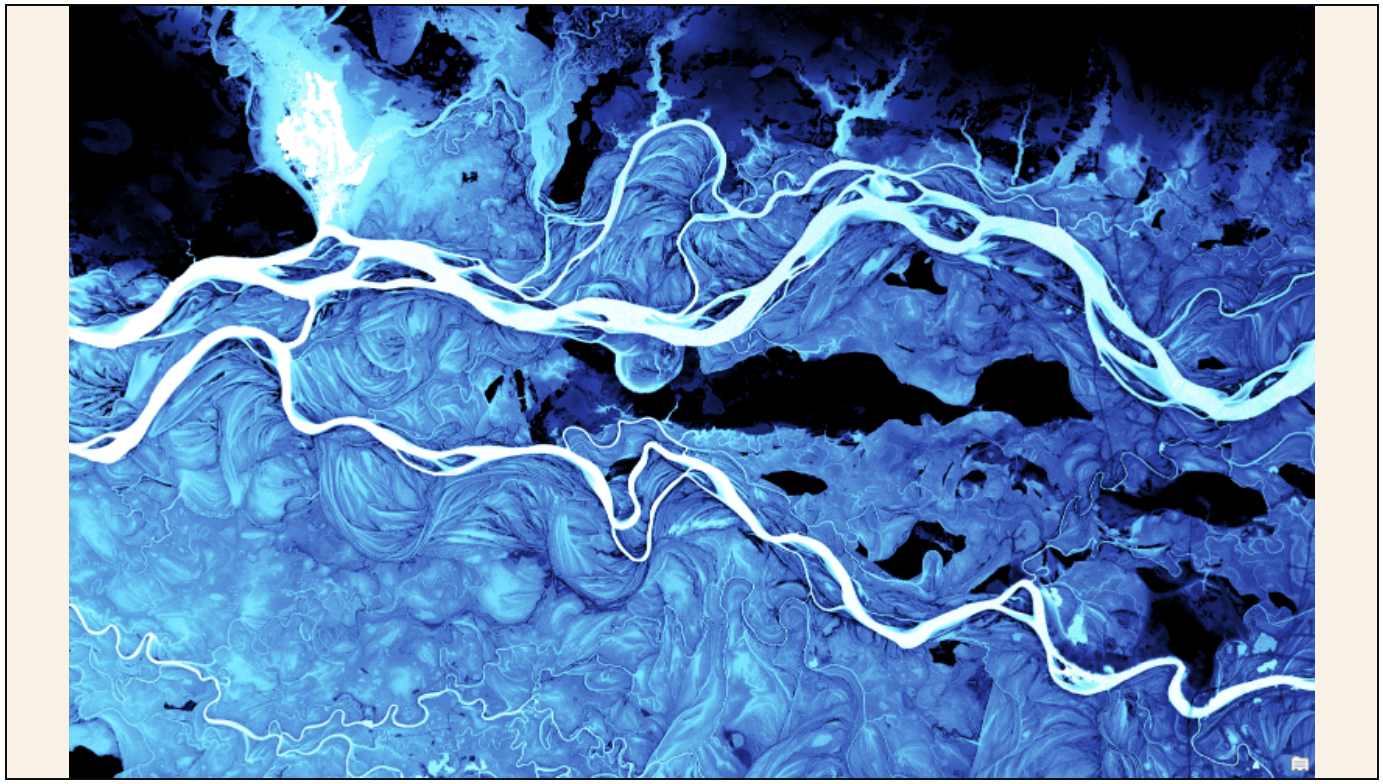
Customizing your own basemaps

Vector Tile Style Editor

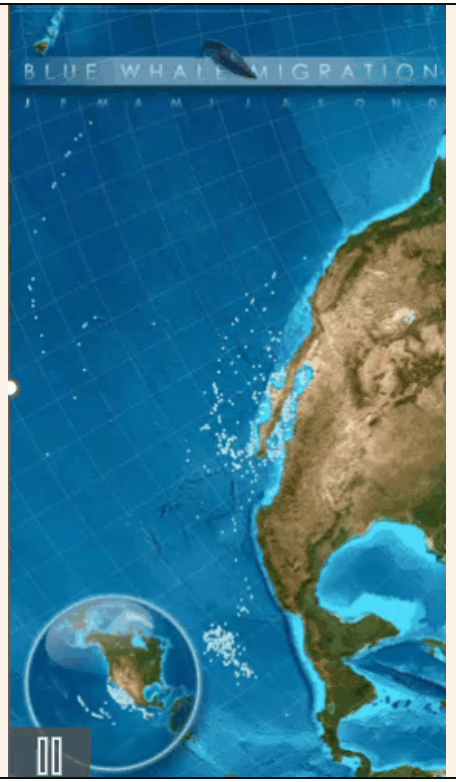


Animated Flow Renderer

How to do this? See: https://www.esri.com/arcgis-blog/products/arcgis-online/mapping/flow-renderer/




67
678
678
678
67
7502 m
1205 m
67
96
67

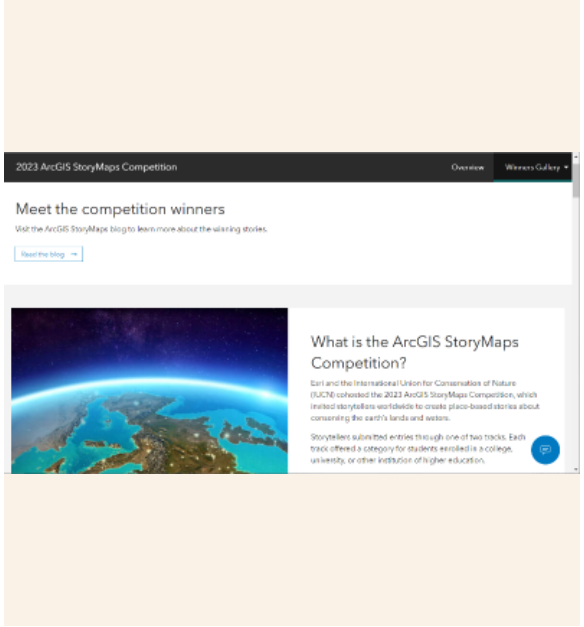

BLUE WHALE MIGRATION

Esri Map Gallery and Annual Map Books

https://www.esri.com/en-us/esri-map-book/maps#/list and https://mapgallery.esri.com/

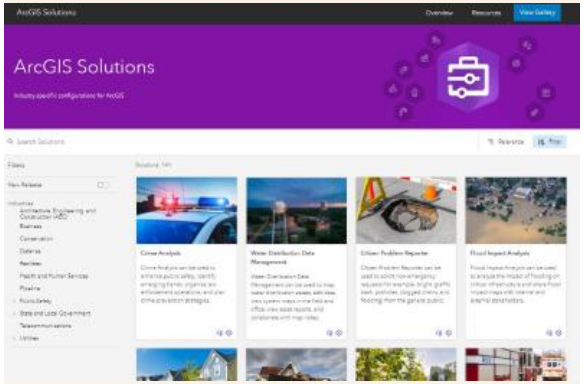
The ArcGIS Story Maps Competition

https://www.esri.com/en-us/arcgis/products/arcgis-storymaps/contest/gallery/archive

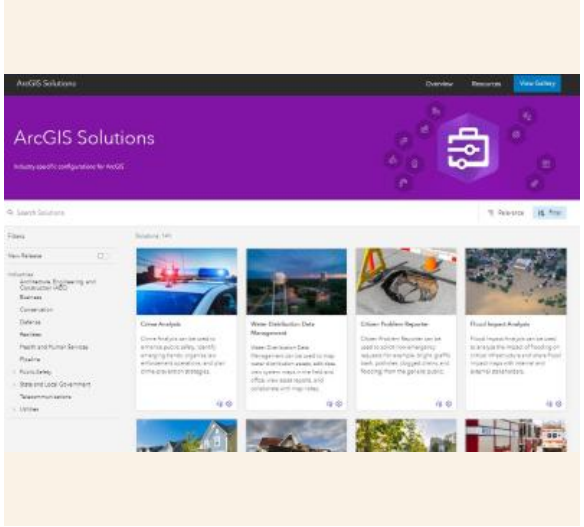


The Developer Community

GIS for specific needs



GIS inside other applications



Maps, Visualizations, Infographics, Dashboards

--A blurring of the lines between these.

--Implications for instruction methods and assessing student work

Flowing Data: https://flowingdata.com/

Andy Woodruff's Maps: https://andywoodruff.com/

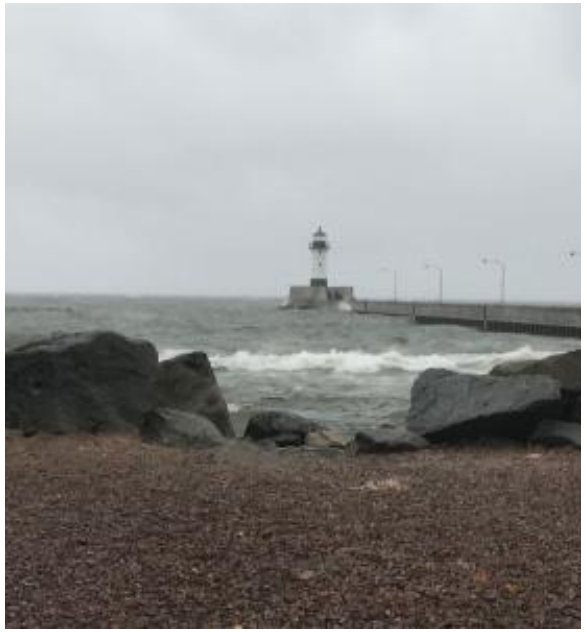

ArcGIS Is Advancing Rapidly
Many New Innovations
Data
Networks
Mobile
Measurement
Technology
Computing
AI
LLM
Cloud
GeoAI (AI / ML)
Reality Mapping
Game Engine Integration
Imagery & Remote Sensing
Data Science
Notebooks
Ready-to-Use Solutions
Spatial Analysis
Data Management
BIM
Enterprise Readiness
Cloud Computing
Link Analysis
Interactive Mapping
Security
3D Visualization & Analytics
Shared Services
Indoor GIS & IPS
Big Data
StoryMaps
Collaboration (Portals & Hubs)
Real-Time
Immersive Experience
Open Data
Standards & Interoperability
Dashboards
Automation
Apps
Mobile
Builders
Ready-to-Use Content
Embedded GIS
Developer Tools
Charts
Infographics
Web Maps
Integrating and Leveraging Leading Science & Technology


Integrating AI Into ArcGIS – GeoAI
Tools & Models for Feature Extraction & Analytics
New & Improved
• 16 New Pretrained Models
• New Model Types
• Foundation Models (SAM, Prithvi)
• AI-Assisted Labeling
• AutoML / AutoDL
• Point Cloud Feature Detection
• Fairness & Multimodal Input in ML
Coming
• Model Explainability
• Visualize & Compare Model Metrics
• Text Prompts for Labelling
• New Models (SuperRes)
• LLM Support for Text Analysis
Point Cloud Classification
Object Classification
Road Extraction
Crop Classification
Imagery & Remote Sensing
Leveraging Open Science Libraries
GeoAI
Time-Series Forecasting
Classification
Regression
Vector & Tabular Data
Prediction
Causal Inference
Text
Text Classification
Text Transformation
Entity Extraction
. . . Automating, Processing & Accelerating . . . Data Analytics

The Rise of AI meets the Golden Age of Geography

Article in Forbes

+ 40% of goods produced in USA are distributed via waterways. US Army Corps monitors 25,000 mi of waterways and 400 ports, using spatial analysis and AI, and save $100M / year by improving the ability to predict water depth: Ask and answer key Qs. Automate tasks, repeat quickly at scale, make predictions based on past patterns using imagery including 3D. Not only where but *where now* and *where in the future*? Where are my assets or operational locations in danger from ___?

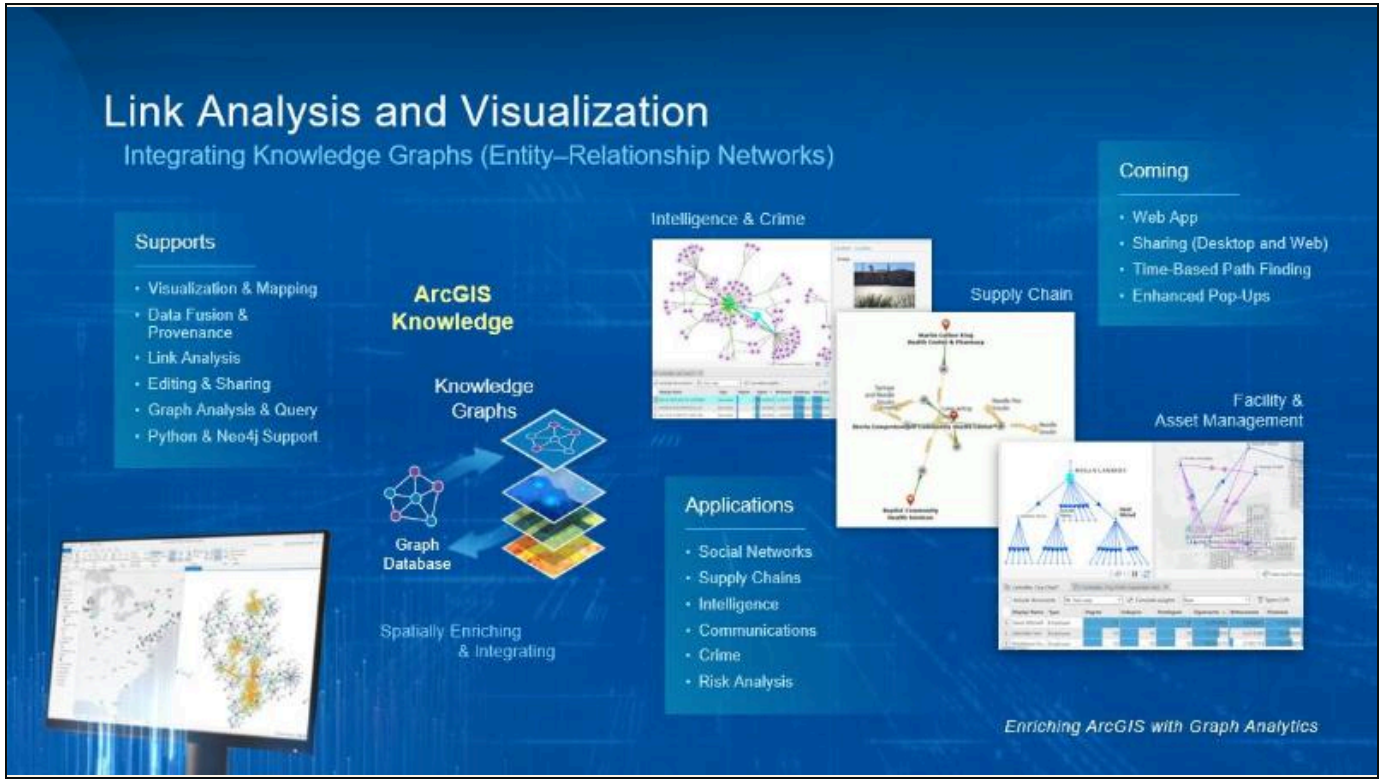



Pretrained GeoAI Models
Included with ArcGIS
Cars
License Plate Blurring
Parking Lots
Parking Spots
Humans
Crowd Counting
Face Blurring
Land Cover
Buildings
Roads
Parcels
Ag Fields
Swimming Pools
Well Pads
Cooling Towers
Power Lines
Pylons
Transmission Towers
Insulator Defects
Wind Turbines
Solar Arrays
Solar Panels
Ships
Shipwrecks
Oil Spills
Oil Tanks
Cloud Masking
Water Bodies
Pavement Cracks
Arctic Seals
Elephants
Seabirds
Mangroves
Palm Trees
Trees
Plant Leaf Disease
Common Object Detection
Optical Character Recognition
Text Parsing from Photo
Object Tracking
Segment Anything Model (SAM)
Prithvi (Crops, Burn Scars, Floods)
... and Many More
State & Local Government
Public Safety
Conservation
Natural Resources
Transportation
Commercial Business
National Security
Insurance
Utilities
Road Extraction (Global)
Elephant Detection
Wind Turbine Detection
Cloud Mask Generation
Building Footprints
Land-Cover Classification
Solar Park Classification
Parking Spot Detection

Generative AI

--"*1001 gen AI assistance in every corner of the ArcGIS ecosystem.*" --In ArcGIS Survey123, ArcGIS Hub, Pro help, Spatial Analysis, and elsewhere.
https://mediaspace.esri.com/media/t/1_opret32t

ArcGIS and Generative AI Assistants


Link Analysis and Visualization
Integrating Knowledge Graphs (Entity–Relationship Networks)
Supports
• Visualization & Mapping
• Data Fusion & Provenance
• Link Analysis
• Editing & Sharing
• Graph Analysis & Query
• Python & Neo4j Support
ArcGIS Knowledge
Knowledge Graphs
Graph Database
Spatially Enriching & Integrating
Intelligence & Crime
Supply Chain
Facility & Asset Management
Applications
• Social Networks
• Supply Chains
• Intelligence
• Communications
• Crime
• Risk Analysis
Coming
• Web App
• Sharing (Desktop and Web)
• Time-Based Path Finding
• Enhanced Pop-Ups
Enriching ArcGIS with Graph Analytics


3D Capabilities Are Advancing Across ArcGIS
Visualization
High-Quality Visual Effects
Global (Earth)
3D Heat Maps
Analysis
Point Cloud Classification (Deep Learning)
Flood Simulation
3D Interpolation (Voxels)
New & Improved
3D Basemap
Animated Symbols
Line of Sight
Visual & Weather Effects
Floor Awareness
GeoJSON Support
Clip & Ship
Voxel Layers on the Web
Game Engines (Maps SDK)
Heat Maps
3D Tiles
Formats & Content
3D Mesh
3D Basemaps
3D Feature Layers
Editing
Updating 3D Models
Authoring Voxel Layers
Immersive Experiences
Game Engine Integration (Unity, Unreal)
AR Scene Viewing
Virtual Reality
Coming
Flood Simulation
Transportation Analysis
Improved Web Editing
A Foundation for Living Digital Twins


Imagery Capability
Reality Mapping
Drone, Aerial & Satellite
True Ortho
DSM & DTM
3D Mesh & Point Cloud
Analysis
GeoAI
Classification
Change Detection
Feature Extraction
Raster Analytics
Visualization
Apps
Image Interpretation
Map & Image Space
Oriented Imagery
Stereo, Video
SOM-Excalibur (App)
Ready-to-Use Imagery Content
Data Management
Tiled and Dynamic Services
Open Standards
120+ Imagery Layers via Living Atlas
Massively Scalable
New & Improved
Geospatial Video
Satellite 3D Mapping
SAR Sensors (ICEYE, RCM)
Radar Processing
Oriented Imagery
STAC
Desktop, Enterprise & SaaS
Transforming Imagery into Useful Information

Implications for Remote Sensing with GIS

--Integrate RS into GIS? --Separate courses/majors/certificates for RS?


Reality Mapping
Creating Accurate 3D Representations
. . . Using Imagery
ArcGIS Reality
• Pro Extension
• Studio App
Drone Mesh – Fort McDowell
Outputs
• 3D Meshes
• True Orthos
• Orthomosaics
• Digital Surface Models
• Point Clouds
Aerial Imagery Mesh - Boston
Satellite Mesh - Barcelona
Fast and Massively Scalable . . .
Modernizing Photogrammetry and Map Production


ArcGIS Is Open and Interoperable
Open Standards
OGC, W3C & ISO
Open Data
Open Science
Open Architecture
Open Source
Open Catalogs
Open APIs
Security
Accessibility
Metadata
Supporting FAIR Data Principles
(Findable, Accessible, Interoperable, Reusable)
Supporting and Leveraging
Multiple Open Initiatives

Interoperability

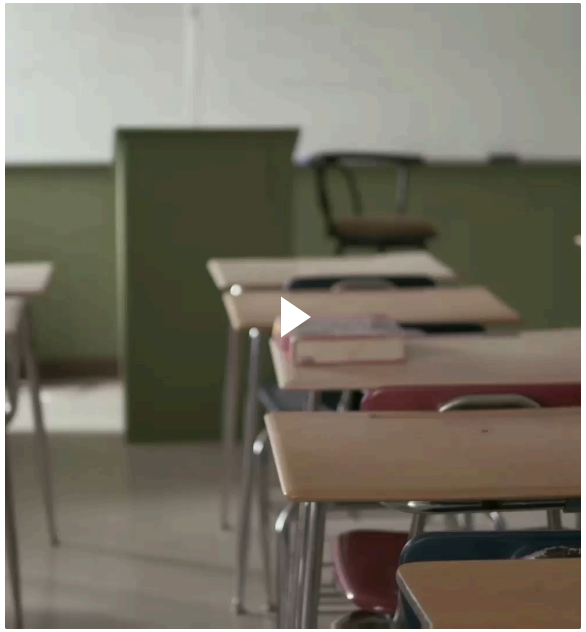
--Implications for society *and* for what and how we teach and conduct research.

Reproducibility

--sustainability goals of accessing files, models, and methods.
--licensing and access
--Preservation: 3D/VR in the Academic Library: Emerging Practices and Trends.

--Beyond Data: Reproducibility in Scientific Software and the Role of Digital Preservation, Council on Library and Information Resources.

--Emulation practices for software preservation in libraries, archives, and museums.



Transparency I

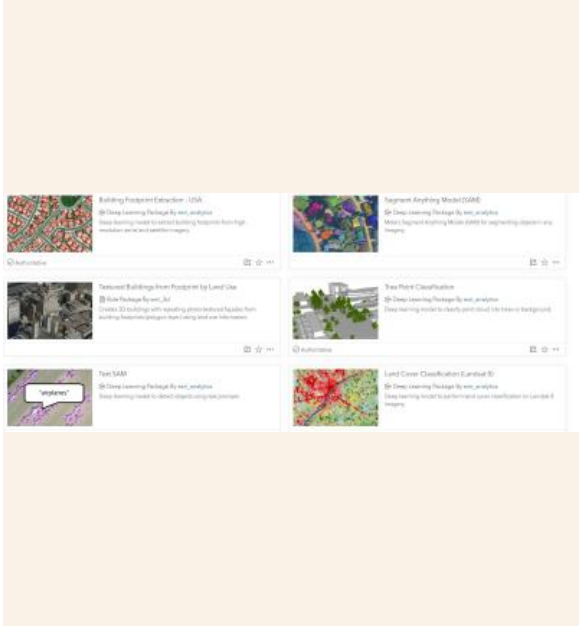
--Of the data and the analysis. 1. Geoprocessing history in ArcGIS Pro *and* ArcGIS Online (2023). 2. At end of Geoprocessing history—ArcGIS Pro | Documentation, > > you can also write those operations out either to a log file or right into the dataset's metadata.

--Esri is exploring and developing Geo blockchain technology (pending patents) that stores all the transactions of a dataset in a sort of wiki-ledger. See The Business Benefits of Blockchain and Geoblockchain Explained at Esri.com.

--Transparency implications of GeoAI?

Transparency II

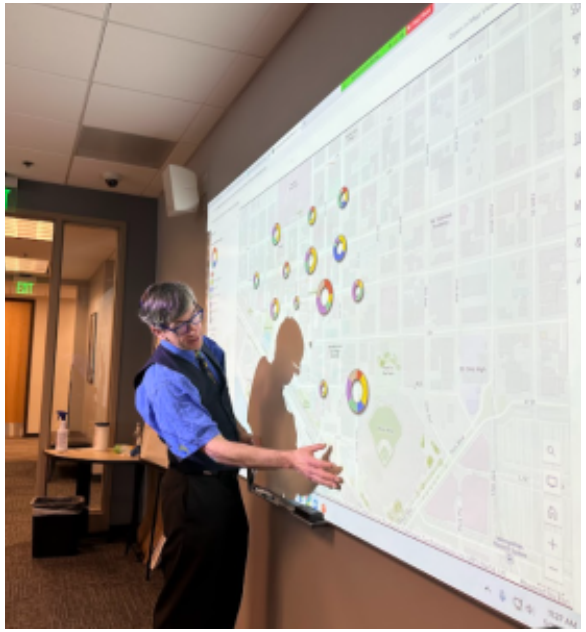
--One ArcGIS Living Atlas of the World's focus areas is developing those apps to make it easier for people to find and use the Living Atlas data. --There are some already-developed tools on the Living Atlas: For example, the deep learning packages: Living Atlas > > Browse > > on left, change Content type to Tools.



Accessibility and Neurodiversity

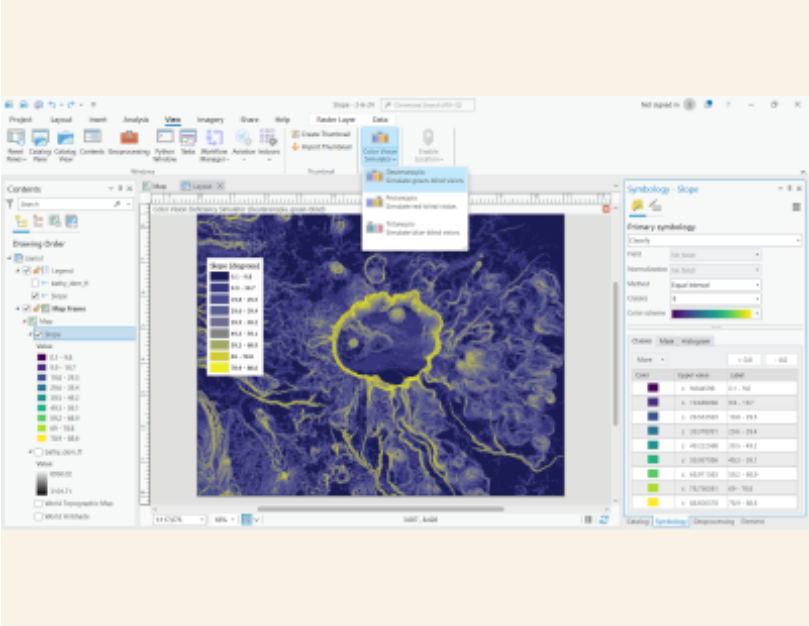
Accessibility - https://www.esri.com/about/newsroom/arcuser/accessibility/

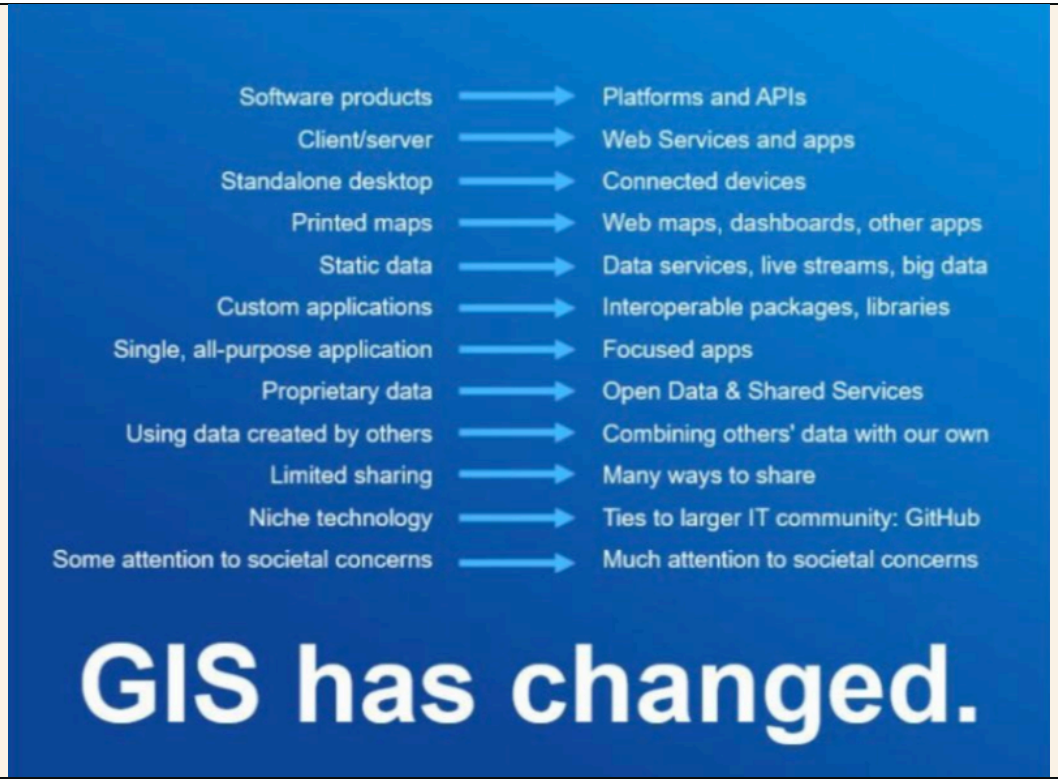
Neurodiversity - https://www.esri.com/about/newsroom/arcnews/neurodiversity-in-the-gis-workplace/



Color Vision

Simulators in ArcGIS Pro.

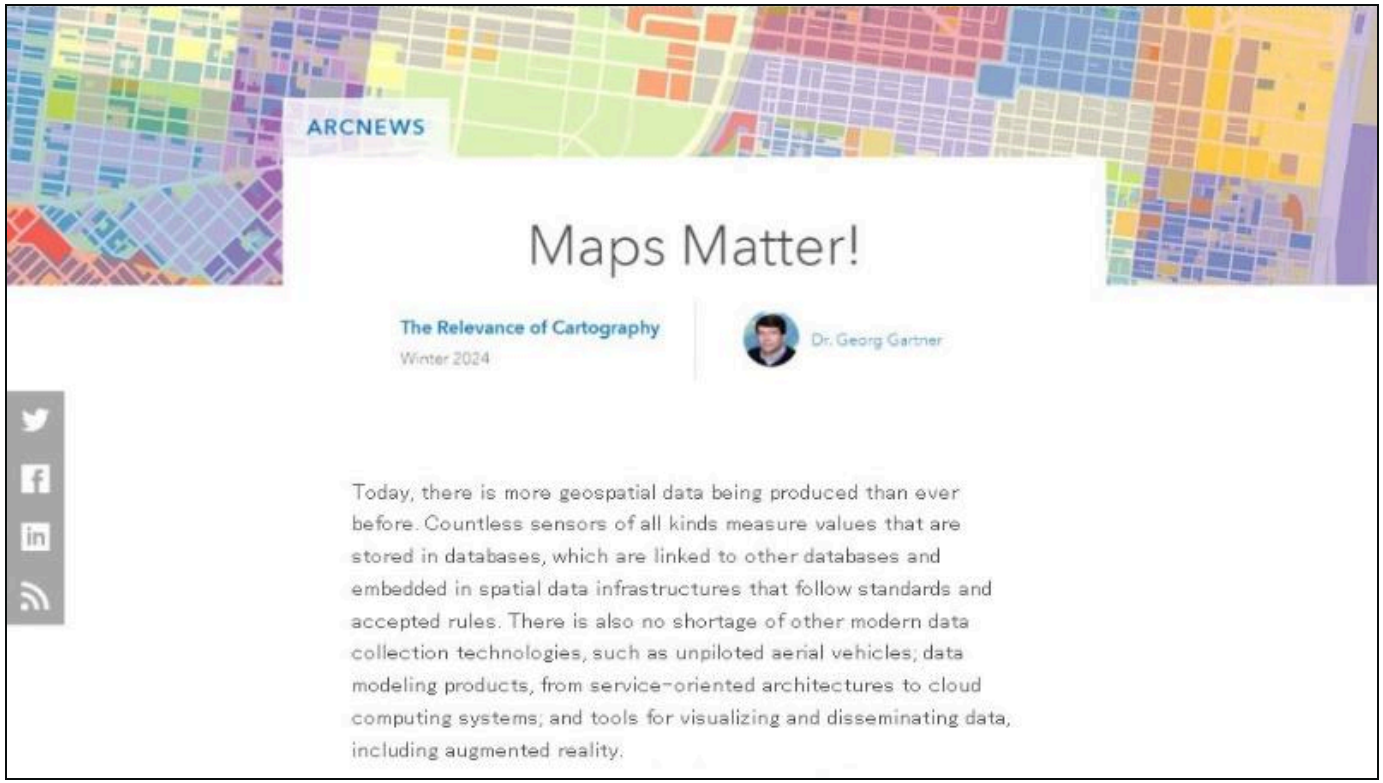



Software products → Platforms and APIs
Client/server → Web Services and apps
Standalone desktop → Connected devices
Printed maps → Web maps, dashboards, other apps
Static data → Data services, live streams, big data
Custom applications → Interoperable packages, libraries
Single, all-purpose application → Focused apps
Proprietary data → Open Data & Shared Services
Using data created by others → Combining others' data with our own
Limited sharing → Many ways to share
Niche technology → Ties to larger IT community: GitHub
Some attention to societal concerns → Much attention to societal concerns
GIS has changed.

What remains the same?

--Maps will continue to be useful tools for decision making.
--Maps are representations of reality.
--Scale, patterns, data quality, all still matter.
--Education, GIS, and society will continue to rapidly simultaneously evolve.
--IT and societal forces will continue to impact GIS, particularly AI.
--GIS can be taught as a discipline and as a tool and perspective for other disciplines.

--This community has a leadership role in charting the future!


ARCNEWS
Maps Matter!
The Relevance of Cartography
Winter 2024
Dr. Georg Gartner
Today, there is more geospatial data being produced than ever before. Countless sensors of all kinds measure values that are stored in databases, which are linked to other databases and embedded in spatial data infrastructures that follow standards and accepted rules. There is also no shortage of other modern data collection technologies, such as unpiloted aerial vehicles; data modeling products, from service-oriented architectures to cloud computing systems; and tools for visualizing and disseminating data, including augmented reality.

Today, any individual who has even modest computing skills can create and use maps anywhere, for almost any purpose. Often, people produce and use maps to address needs that arise instantaneously when they are in a particular location. Think about searching for a restaurant to go to or analyzing, from the field, where a wildfire is headed next. In these instances, cartographic data in its finalized form is usually delivered to users digitally—sometimes even in real time, as the data is collected.

While these and other advances during the past decade have enabled mapmakers to significantly improve how maps are designed, produced, and implemented, many cartographic principles remain unchanged. The most important one is that maps are an abstraction of reality. Visualizing data means that some features of reality are depicted more prominently than others, while many features might not even be depicted at all. Abstracting reality is a necessary part of making powerful maps, as it helps users efficiently understand and interpret complex situations.

Blah, blah, blah…

6 skills important for students as they work with GIS:

1. Be curious! > Tenacity. Ask Good questions! A key part of the Inquiry Process.

2. Be able to work with data and be critical of it! Geospatial data book and blog: **https://spatialreserves.wordpress.com**

3. Know **Geographic and Geotechnical Foundations**: Skills (spatial stats, coding, web, projections, analysis, classification, etc.), + content knowledge + the geographic perspective (scale, systems thinking). Use GTCM to ID gaps and make plans to fill gaps!

4. Be adaptable and flexible. Go int'l; or outside your "disciplinary comfort zone"! Ikigai diagram.

5. READ. Even outside your own discipline.

6. Cultivate your communications skills. Do you have an elevator speech?

Geospatial Software Evolution, Usability, and Implications

16 April 2024 | 323C, 3rd Floor, Hawai'i Convention Center

Joseph Kerski PhD GISP, Education Manager and Geographer, Esri
jkerski@esri.com