

VISION

A Geospatial Platform
for Official Statistics

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Public Sector & Advanced
Analytics Lead | MEA

Esri

Integration of Statistical and Geospatial Data

Global
Statistical
Geospatial
Framework
(GSGF)

Usable

Interoperable

Common Geographies

Geocoded Units

Fundamental Geospatial Infrastructure



Statistical Process Model (GSBPM)

Planning/
Pre Enumeration

Enumeration

Post Enumeration/
Dissemination

Specify
Needs

Design

Build

Collect

Process

Analyze

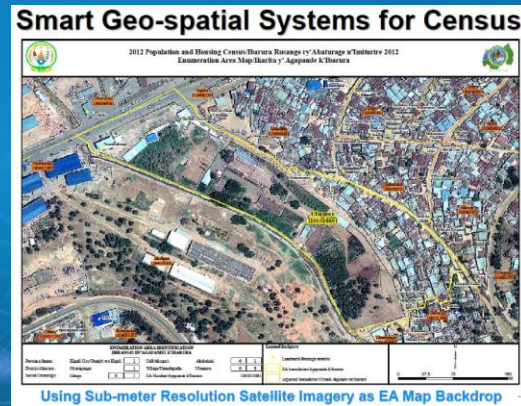
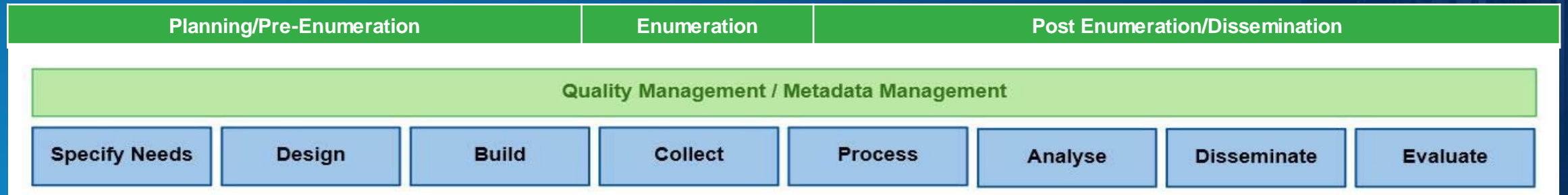
Disseminate

Evaluate

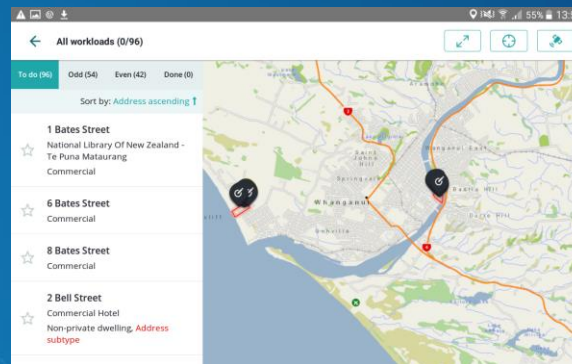
Quality / Metadata Management

Role of GIS in Official Statistics

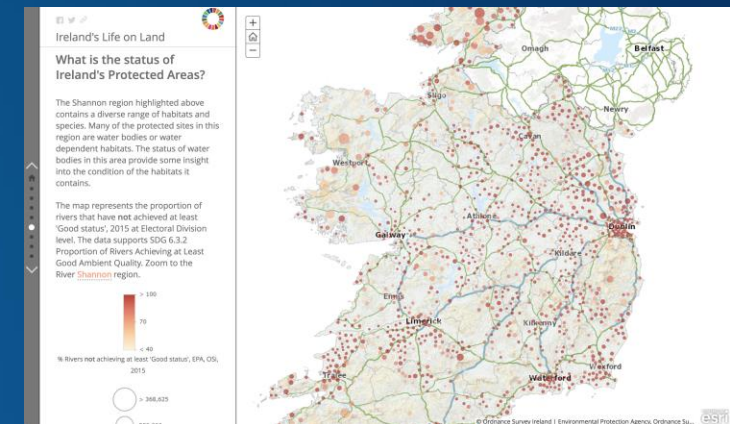
Generic Statistical Business Process Model (GSBPM)



Design and production of enumeration areas



Data collection using Mobile devices, tablets and laptops

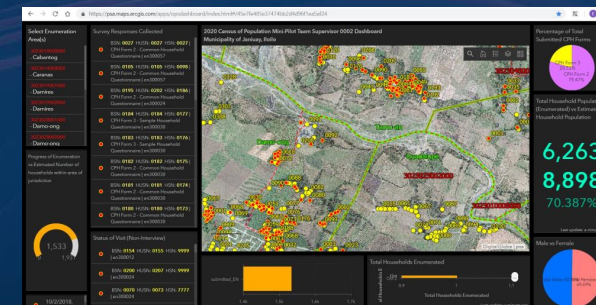
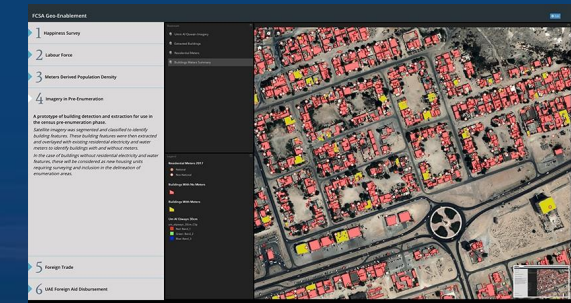
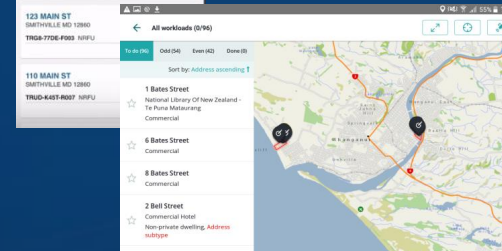
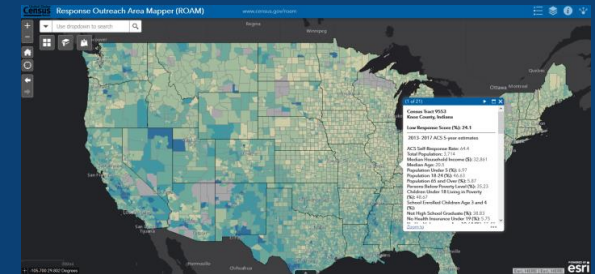
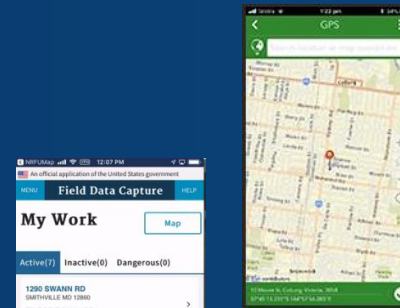


Census dissemination Online thematic maps Story Maps and more

Use of GIS in Census Operations

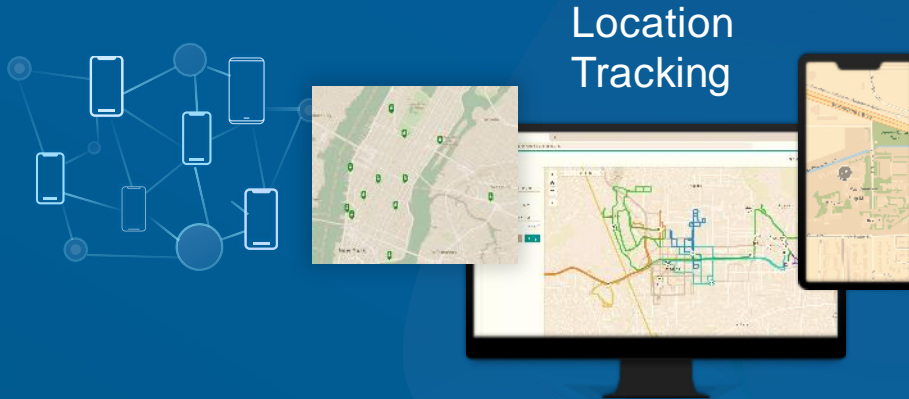
Begins in planning and extends throughout GSBPM cycle

- Creation of GeoDatabase
- In office address canvassing
- Creating efficient enumeration areas (EAs)
- Response outreach
- Optimizing site placement of field offices
- Optimizing capital and asset distribution
- Optimizing workforce and routes
- Integration of administrative and big data
- Operational dashboards
- Mobile map packages

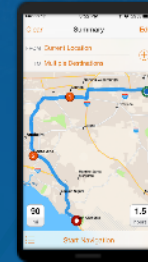


GIS in Field Operations Location-Enabling All Aspects of Field Work

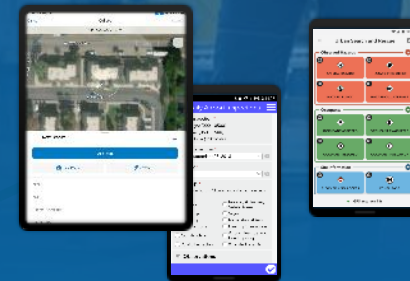
- Tracking
- Offline Workflows
- Preplanned Routes



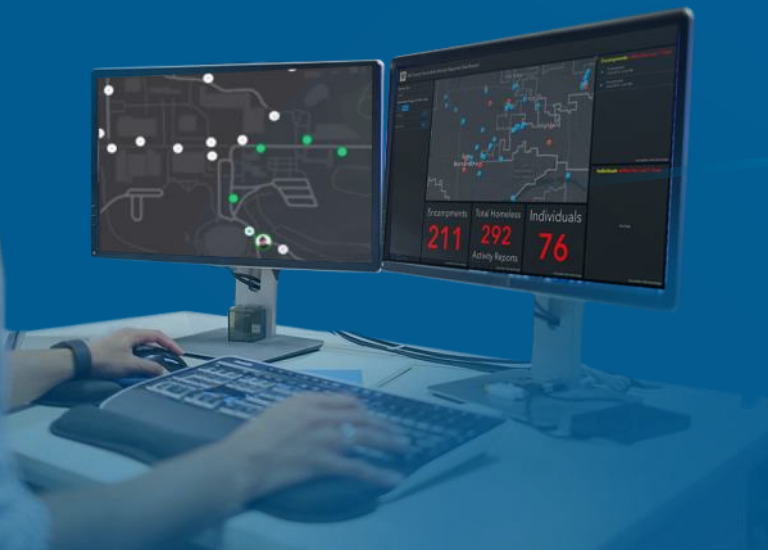
Navigation



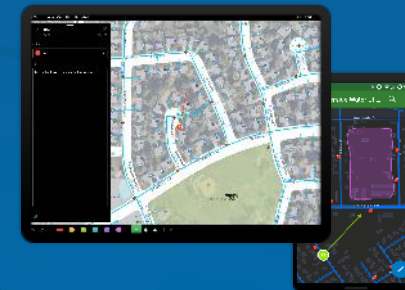
Data Capture



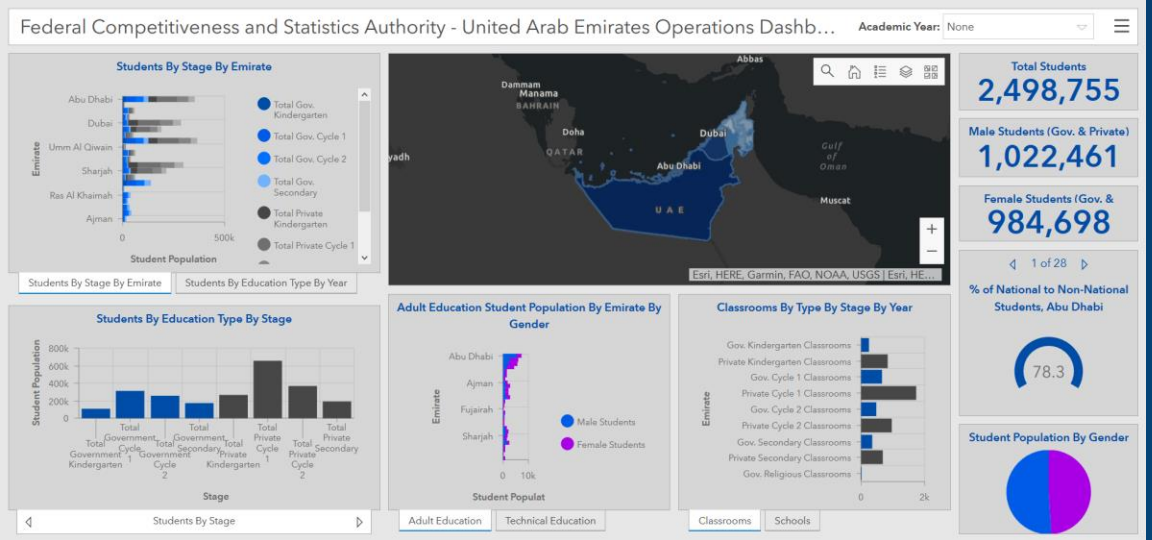
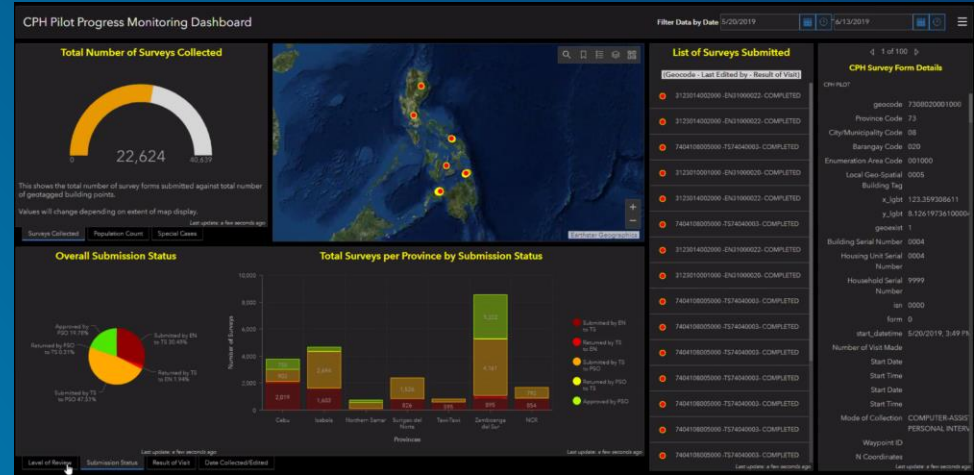
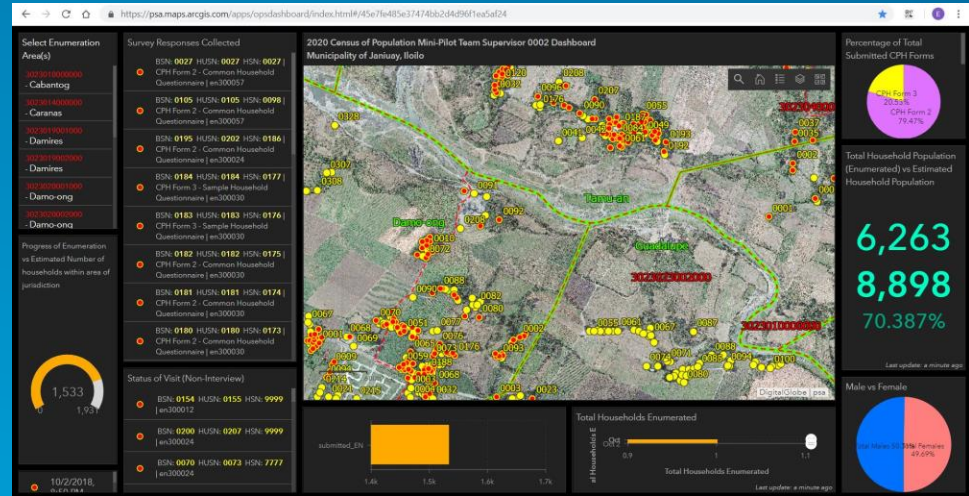
Planning and Management



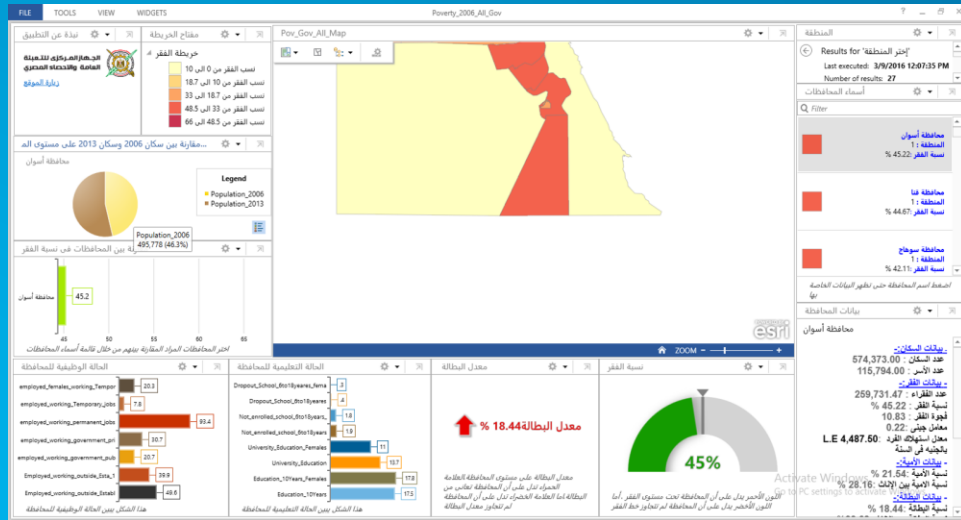
Maps & Mark Up



Dashboards



Dashboards can be used in operations or dissemination



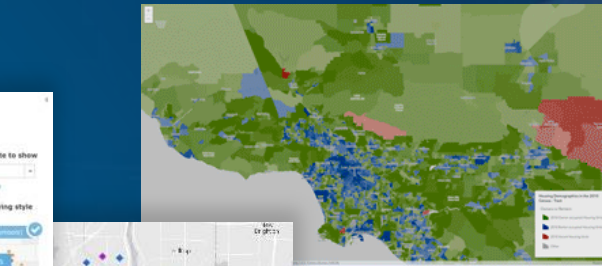
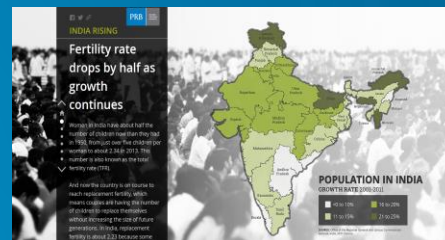
GIS and Dissemination

Dynamic and Data-driven Smart Maps

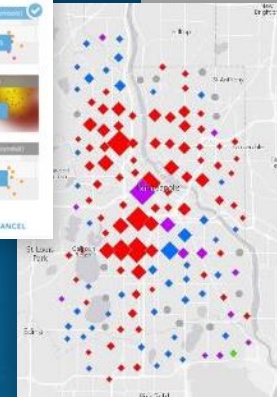
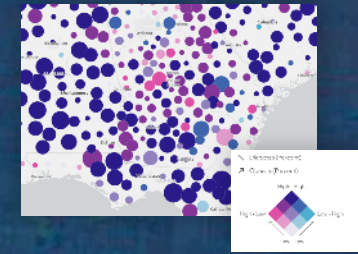
- Geographic aggregation of data
- Information products including maps, reports, atlases, and interactive websites
- Marketing of geographic census products
- Outreach and education
- SDGs – measure, monitor and report



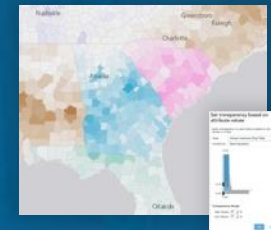
Story Maps



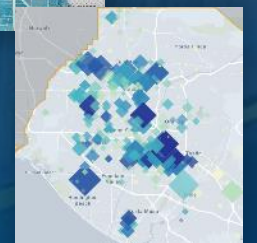
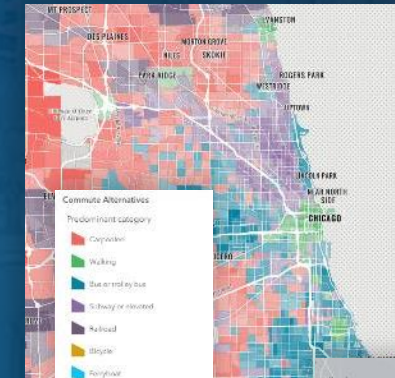
Multivariate



Dynamic Clustering



Predominance Mapping



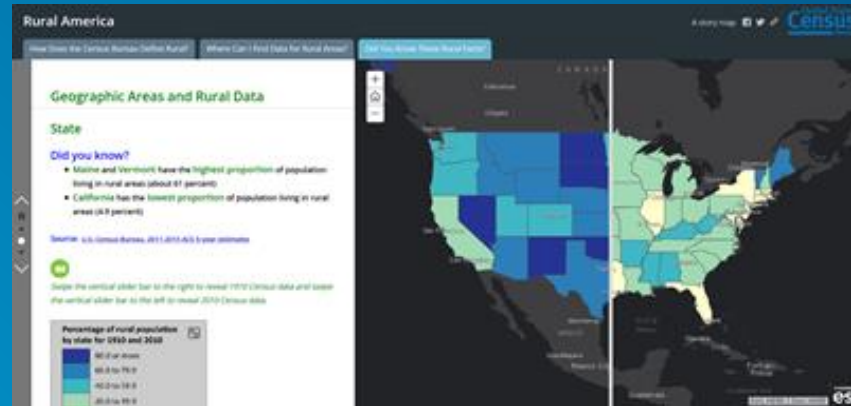
Graduated Symbols

Dissemination of data is fundamental part of mission

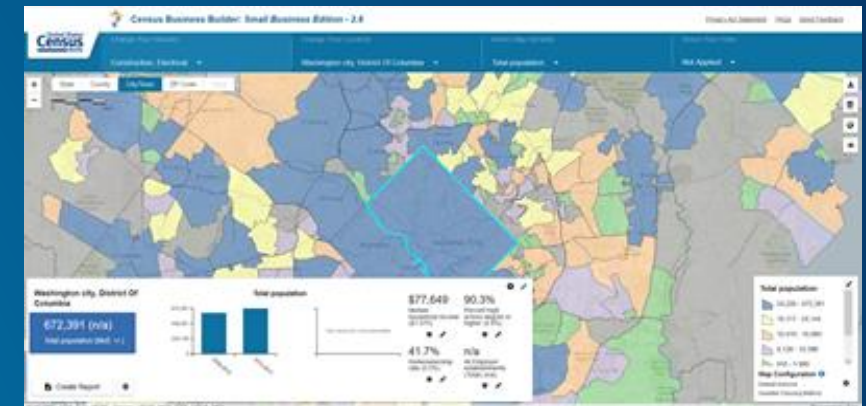
Statistical Yearbook



Applications



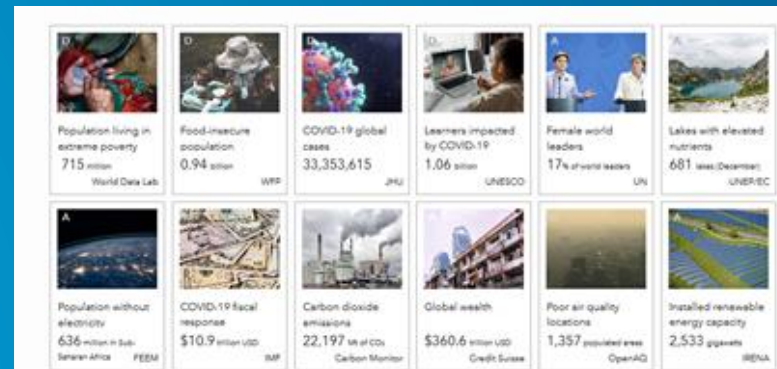
Applications



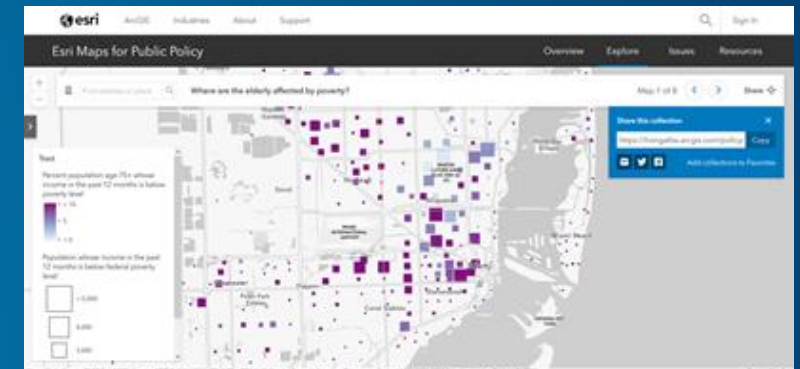
SDG Reporting



SDG Reporting



Maps for Public Policy



SPATIAL

Analysis

Analytical Methods and
Spatial Algorithms

Data Science

Identify Patterns, Trends,
and Anomalies

Artificial Intelligence

Solve Complex Problems,
Using ML and DL Techniques

Applying GIS, the Science and the Technology

One Analytics Platform

Data

Formats / Storage

Engines

Functions / Processes

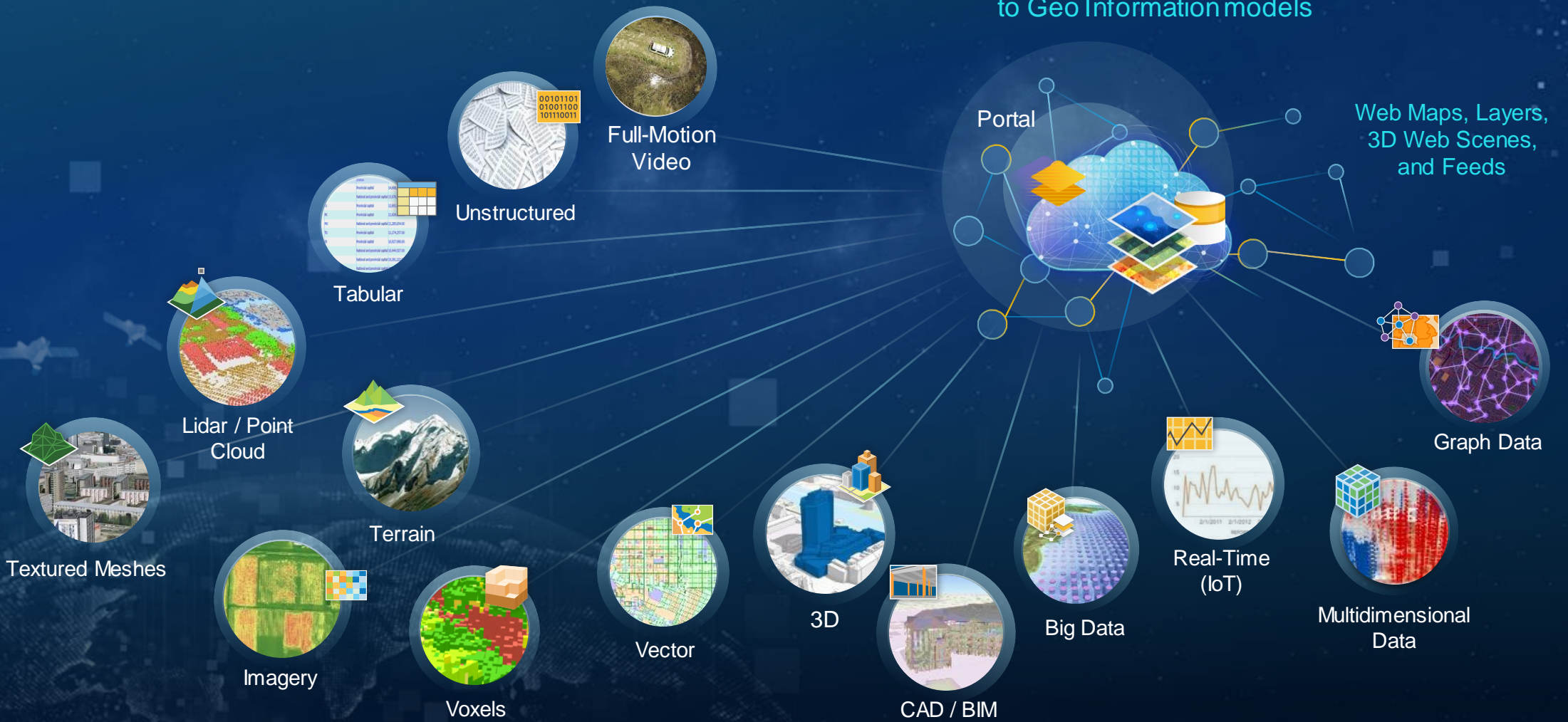
Experiences

User Personas / Workflows

Data

Access All Your Data, to Derive Knowledge, Understanding, and Decisions

Going from Data Models
to Geo Information models



Data

ArcGIS Has the Right Tools and Frameworks for Your Enterprise Data Workflows



Collect



Model



Store



Maintain /
Prepare



Access



Share



Visualize



Analyze



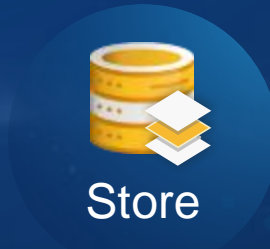
Geospatial
Infrastructure

Data

Connect to Your Enterprise Data, Located Anywhere

Cloud Data Lakes

- Apache HDFS
- Apache Hive
- Amazon S3
- Google Cloud Storage
- Microsoft Azure Blob
- Microsoft Azure Data Lake
- Alibaba Cloud Storage
- ...



File Based Data



SQL Databases



- Amazon Aurora PostgreSQL
- Amazon RDS PostgreSQL
- Amazon RDS SQL Server
- Azure SQL DB
- Azure DB PostgreSQL
- Oracle Autonomous Database
- SAP HANA Cloud



- Db2
- Informix
- Oracle
- PostgreSQL
- SAP HANA
- SQL Server
- SQLite
- Dameng*
- Teradata*

*Database and query layer support only

Cloud Data Warehouses

Amazon Redshift



Google BigQuery



Snowflake



Engines

Purpose-Built Analytics

AI, Machine Learning, Deep Learning

Raster Analysis, Deep Learning

Big Vector and Tabular Data Analysis

Portal

Spatial Analysis and Geoprocessing Tools

Real-Time Analysis

Standard Vector & Tabular Analysis

Network and Routing Analysis

Graph Analysis

NEW

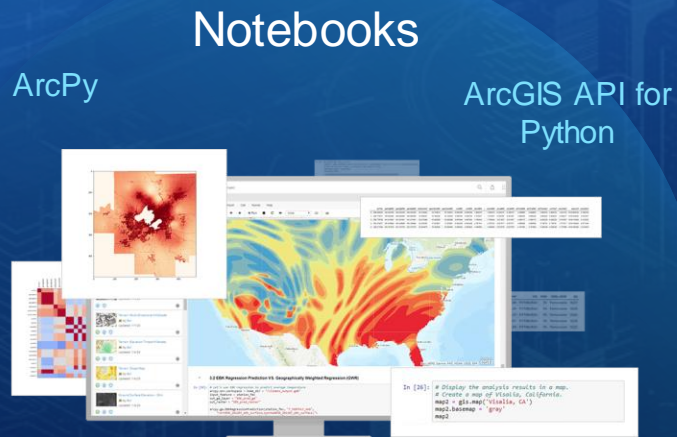
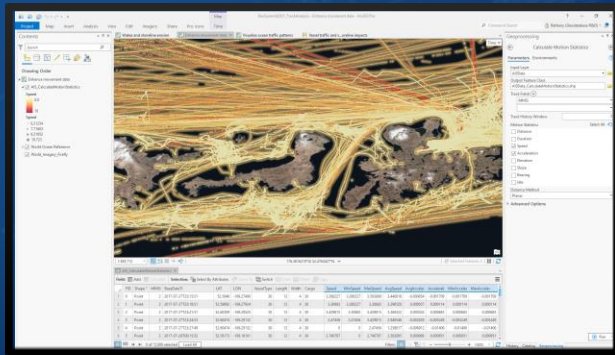
Comprehensive Set of Analytical Methods and Spatial Algorithms for Batch, Interactive, Real-Time, and Scripted Processing

Experiences

To Suit Your Preferences and Needs



Desktop



Pro



Enterprise

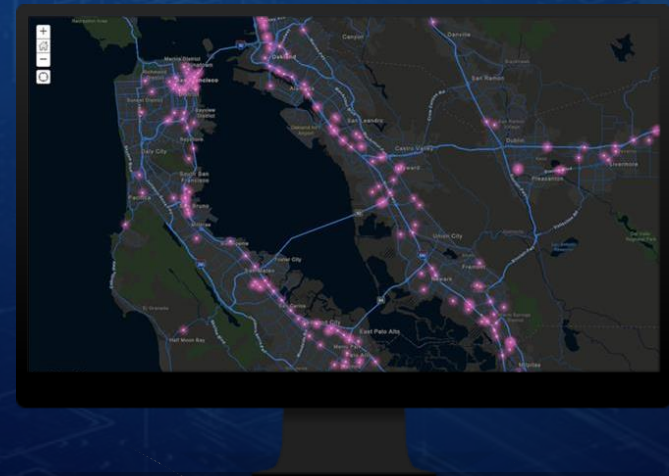


Online

Insights



Web



For Interactive and Scripted Workflows

Experiences

Open and Integrated for Scientific Communities



Advancing Spatial Science

Data
Engineering



Visualization
& Exploration



Spatial
Analysis



Machine Learning
& AI



Big Data
Analytics



Modeling
& Scripting



Sharing &
Collaboration



Advancing Spatial Science

Data
Engineering



Visualization
& Exploration



Modeling
& Scripting



Sharing &
Collaboration

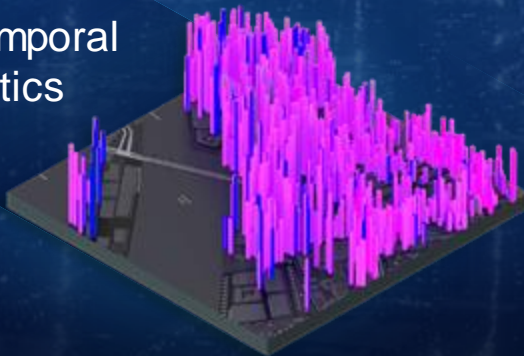


Geographic Approach

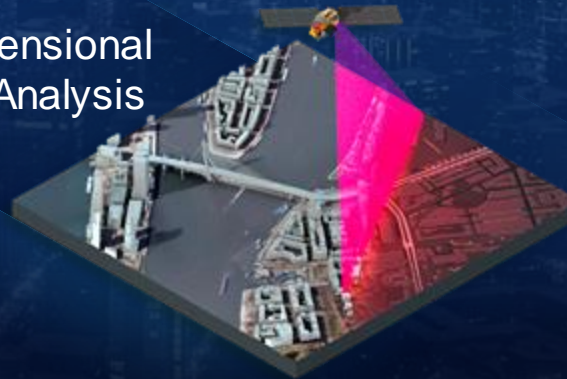
Advancing Spatial Science



Spatiotemporal
Statistics



Multidimensional
Raster Analysis



Geospatial AI



Machine Learning & ArcGIS

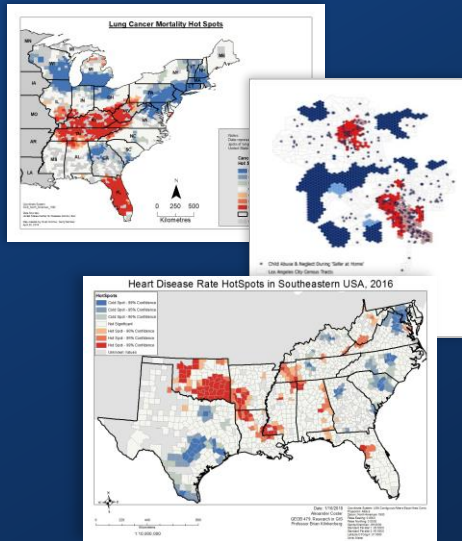
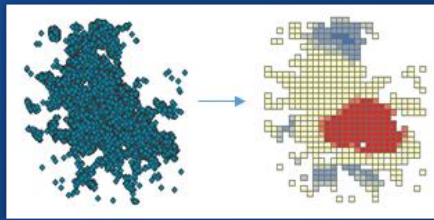
- ArcGIS API for Python
- ArcGIS Velocity
- ArcGIS Notebooks
- ArcGIS Pro
- ArcGIS Online
- ArcGIS Enterprise
- ArcGIS Hub – Citizen Data Science
- ArcGIS QuickCapture – Edge AI (in R&D)
- ArcGIS Insights
- ArcGIS Pro for Intelligence

Where we offer machine learning integration.

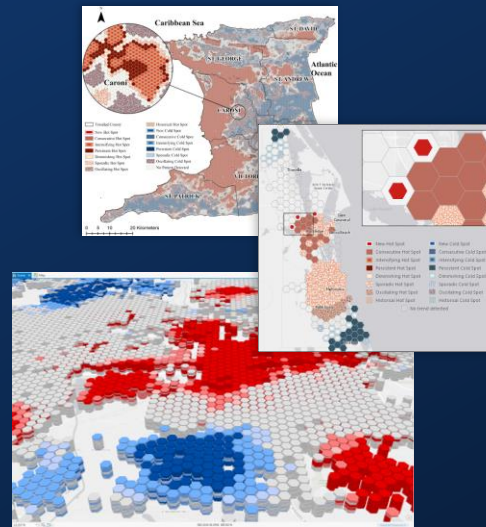
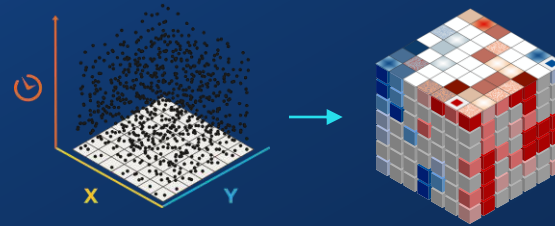


Spatial Statistics and Spatial Machine Learning

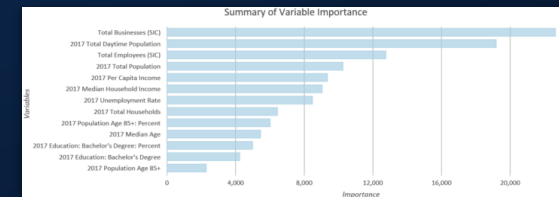
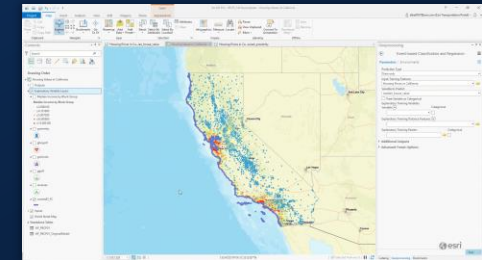
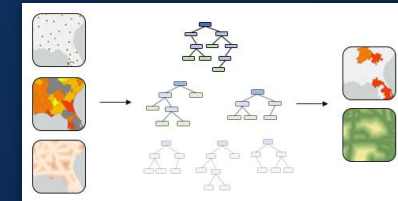
Hot Spot Analysis



Space Time Pattern Mining



Forest-based Classification & Regression



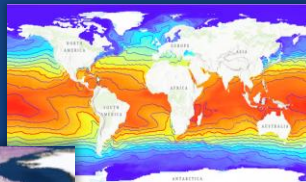
Multidimensional Raster Analysis Capabilities

Raster Functions and Tools

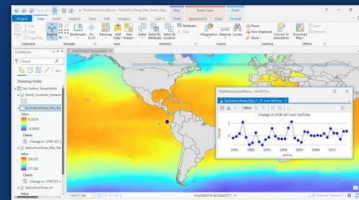
Trend & Predictive Analysis



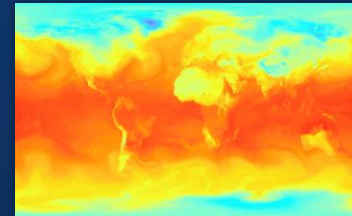
Data Aggregation



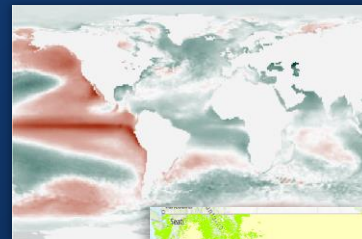
Anomaly Detection



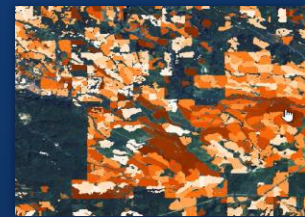
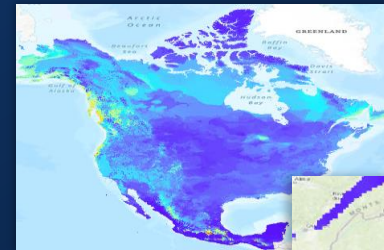
Dimensional Outlier Removal



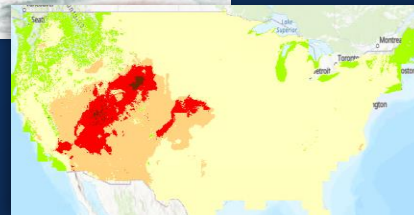
PCA Pattern Identification



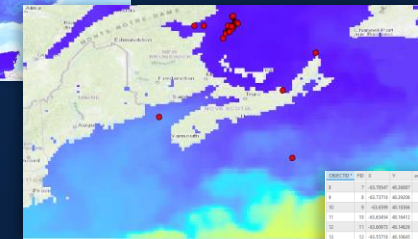
Find When and Where



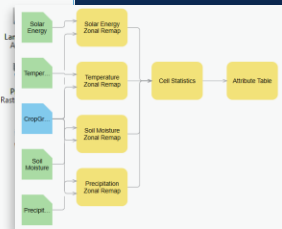
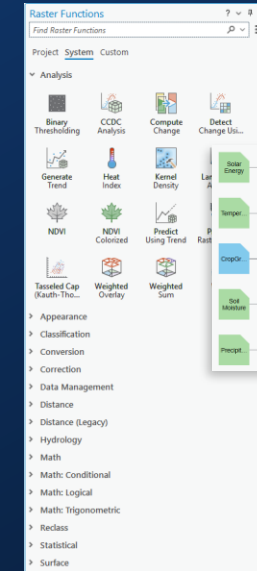
Change Detection



Suitability Analysis



Data Enrichment

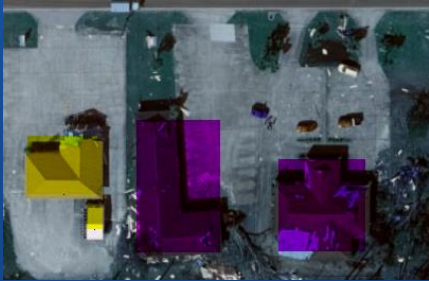


Raster Functions

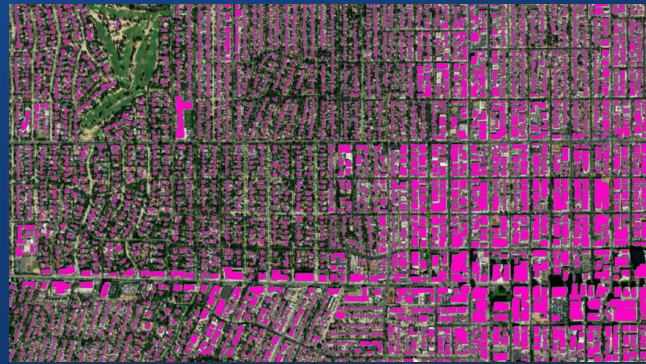
How can ArcGIS Imagery AI Capabilities help you

Object Detection, Instance Segmentation, Land Cover, Change Detection..

Damaged Structures



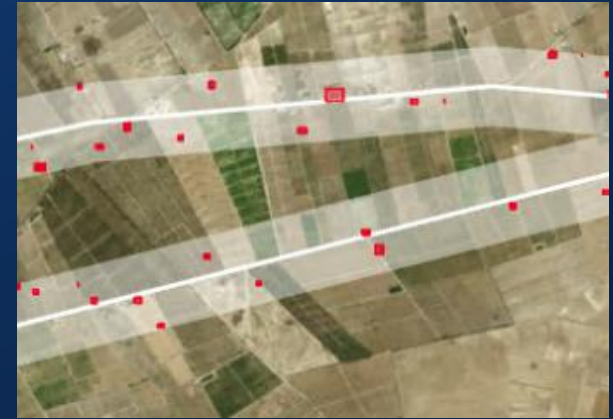
Building Footprints



Land Cover



Pipeline Encroachment



Roads



Oil Pads



Road Cracks



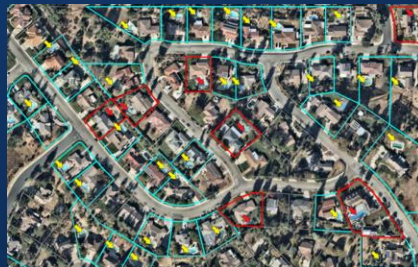
Cars



Palm Trees



Swimming Pools



Beyond Detections

End to End GeoAI Lifecycle enabled by ArcGIS Imagery AI Capabilities



**Imagery
Access**



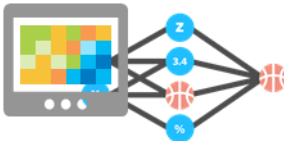
**Imagery
Prep**



**Data
Labelling**



**Deploy
Models to
Production**



**Train &
Consume
Models**



**Run Inference
at SCALE**

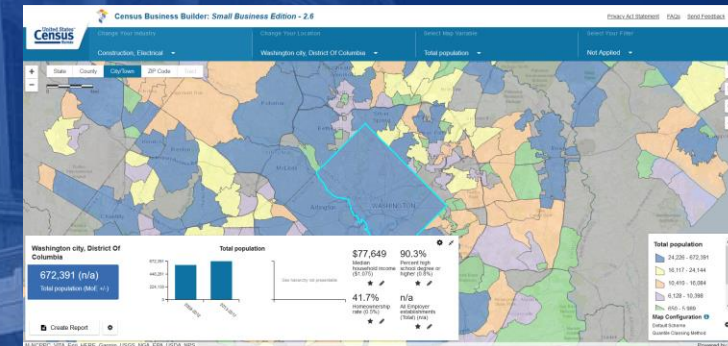
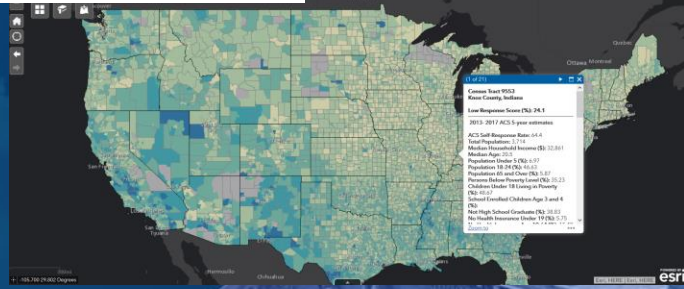
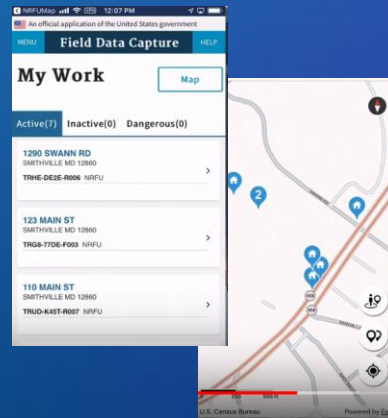
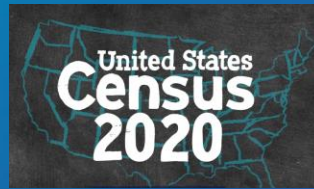
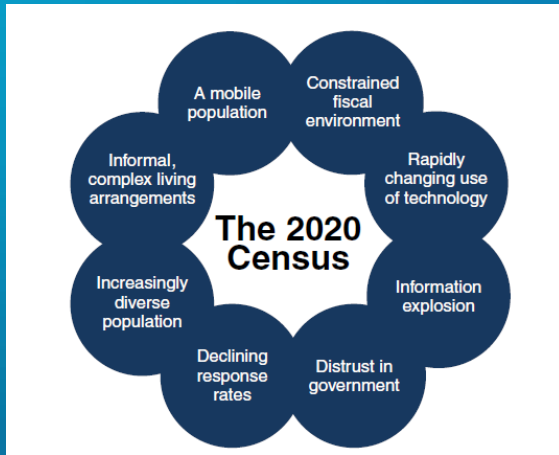


**Feedback
Loop**



**Take
Action**

US Census Bureau



International Census Examples



ESTABLISH WHERE TO COUNT



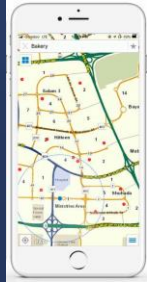
MOTIVATE PEOPLE TO RESPOND



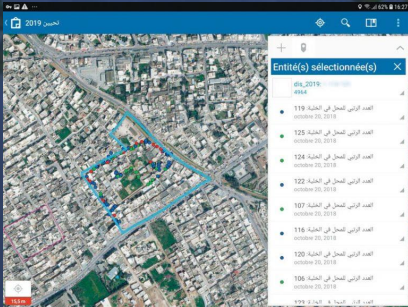
COUNT THE PEOPLE



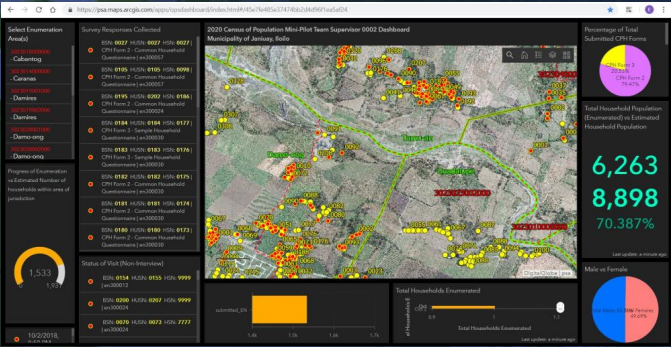
TABULATE DATA AND RELEASE CENSUS RESULTS



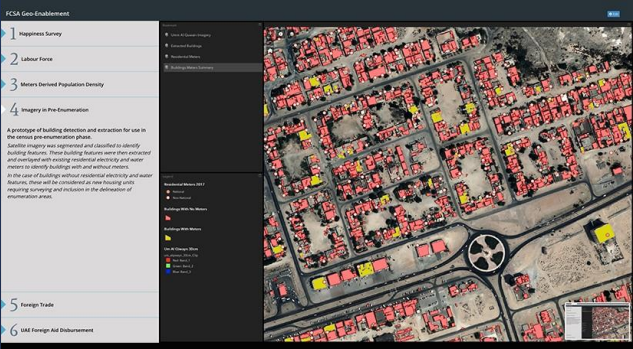
PACI
Kuwait



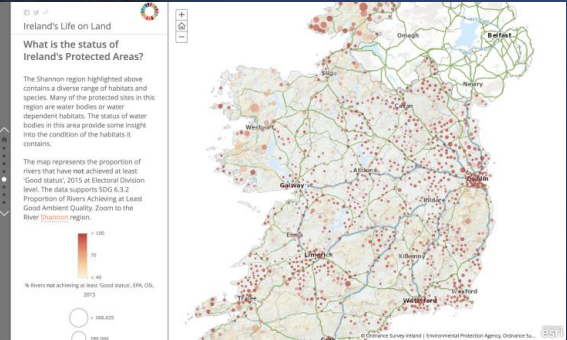
NSI Tunisia



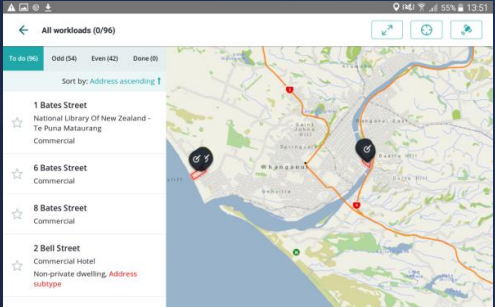
PSA Philippines



FCSA UAE



CSO Ireland



Statistics New Zealand



الهيئة الاتحادية
للتنافسية والإحصاء
FEDERAL COMPETITIVENESS
AND STATISTICS AUTHORITY



United Arab Emirates

البوابة المكانية - الجيو إحصائية
Geo-Statistical Portal



Feature Extraction from Imagery

Object Identification, feature extraction for census pre-enumeration phase

1 Happiness Survey

2 Labour Force

3 Meters Derived Population Density

4 Imagery in Pre-Enumeration

A prototype of building detection and extraction for use in the census pre-enumeration phase.

Satellite imagery was segmented and classified to identify building features. These building features were then extracted and overlaid with existing residential electricity and water meters to identify buildings with and without meters.

In the case of buildings without residential electricity and water features, these will be considered as new housing units requiring surveying and inclusion in the delineation of enumeration areas.

5 Foreign Trade

6 UAE Foreign Aid Disbursement

Bookmark

- Umm Al Quwain Imagery
- Extracted Buildings
- Residential Meters
- Buildings Meters Summary

Legend

- Umm Al Qiwayn 30cm**
 um_alqiwayn_30cm_Clip
- Red: Band_1
 - Green: Band_2
 - Blue: Band_3



1 Happiness Survey

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3 Meters Derived Population Density

4 Imagery in Pre-Enumeration

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Legend

Extracted Buildings

-

Um Al Qiwayn 30cm

- Red: Band_1
- Green: Band_2
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1 Happiness Survey

2 Labour Force

3 Meters Derived Population Density

4 Imagery in Pre-Enumeration

A prototype of building detection and extraction for use in the census pre-enumeration phase.

Satellite imagery was segmented and classified to identify building features. These building features were then extracted and overlaid with existing residential electricity and water meters to identify buildings with and without meters.

In the case of buildings without residential electricity and water features, these will be considered as new housing units requiring surveying and inclusion in the delineation of enumeration areas.

5 Foreign Trade

6 UAE Foreign Aid Disbursement

Bookmark

- Umm Al Quwain Imagery
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- Residential Meters**
- Buildings Meters Summary

Legend

Residential Meters 2017

- National
- Non-National

Umm Al Qiwayn 30cm

- um_alqiwayn_30cm_Clip
- Red: Band_1
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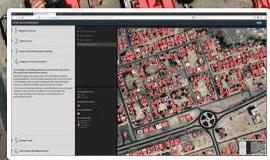
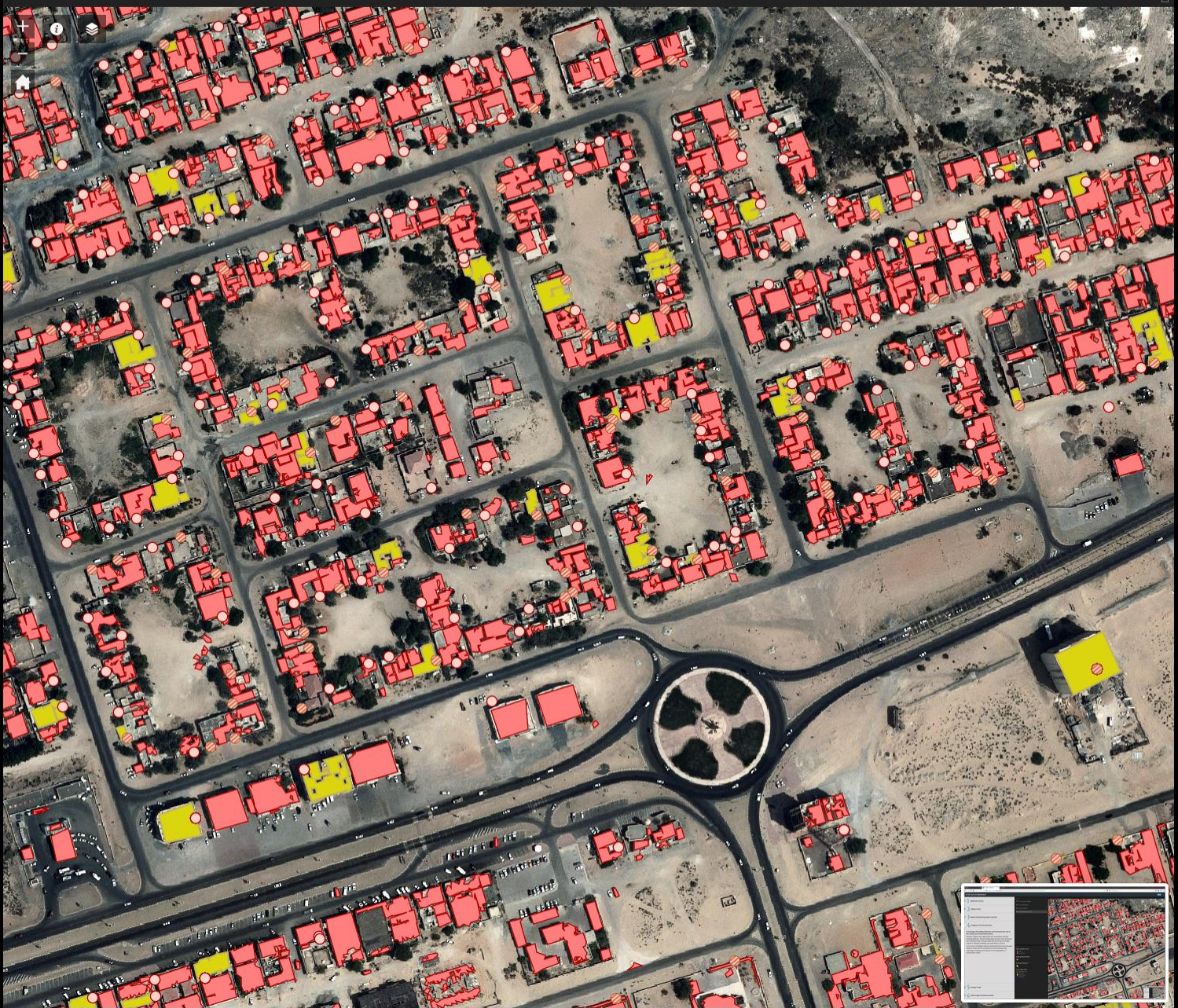
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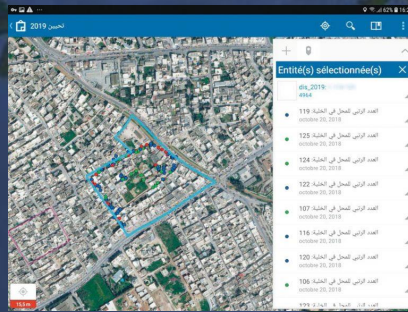
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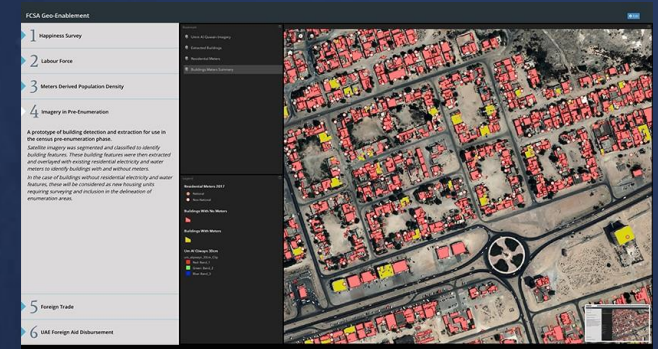
International Census Examples



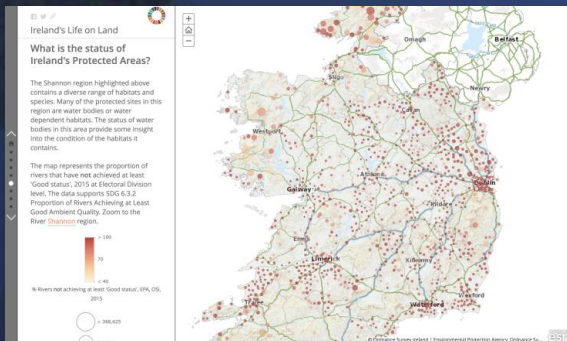
PACI
Kuwait



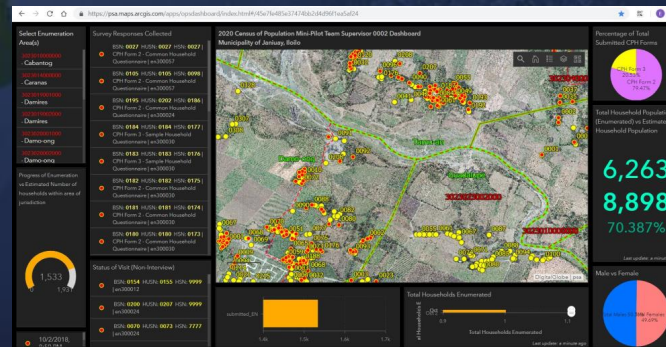
NSI Tunisia



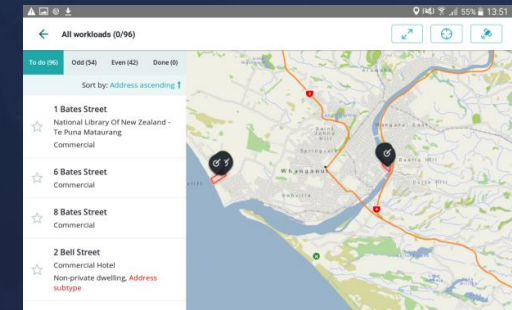
FCSA UAE



CSO Ireland



PSA Philippines



Statistics New Zealand

PACI, Kuwait



Few old buildings still stand in Kuwait City, where construction cranes are a common sight



The algorithm recognizes both roads and buildings.

Building footprints digitized manually on the left compared to the deep learning algorithm outputs on the right.

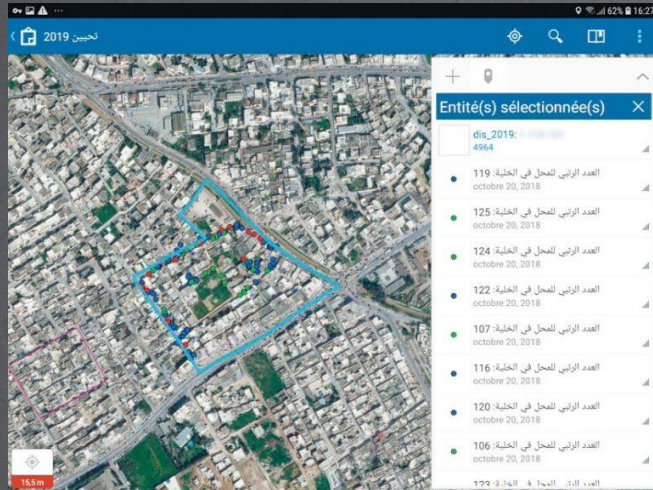


The output from the street level imagery can distinguish between parked cars and trucks.

Deep Learning Helps Kuwait Automate Map Updates to Better Serve Citizens



NSI, Tunisia



The National Statistical Institute's (NSI) field apps are map oriented and customizable.



An interactive, real-time dashboard built with Operations Dashboard for ArcGIS lets NSI staff monitor in-progress surveys.

Tunisia Automates Census Work with Web, Mobile, and Enterprise GIS

Web GIS Is the Modern GIS Architecture

Helping Everyone Do Their Work Better

End Users
and Developers

Communities

Organizations

Departments

Teams

Individuals

Leveraging
Web Services

Sharing and
Collaboration

Distributed
and
Interconnected

Engaging
Everyone



ArcGIS Platform for Official Statistics:



- Geodatabase
- Base map updates
- Map of enumeration areas
- Optimize, edit and validate EAs
- Earth Observation data integration
- Optimize assignments
- Census data model and web apps
- Survey design and testing
- Integration of Admin and Big Data
- Field data collection
- Field editing
- Workforce management
- Operations management
- Project management
- Data dissemination
- Thematic maps
- Online atlas
- Open Data
- Story maps
- Smart maps
- Other map information products
- SDG alignment and reporting



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**THE
SCIENCE
OF
WHERE**