Working with Raster Content within the ArcGIS Living Atlas

Curated content for visualization and analysis

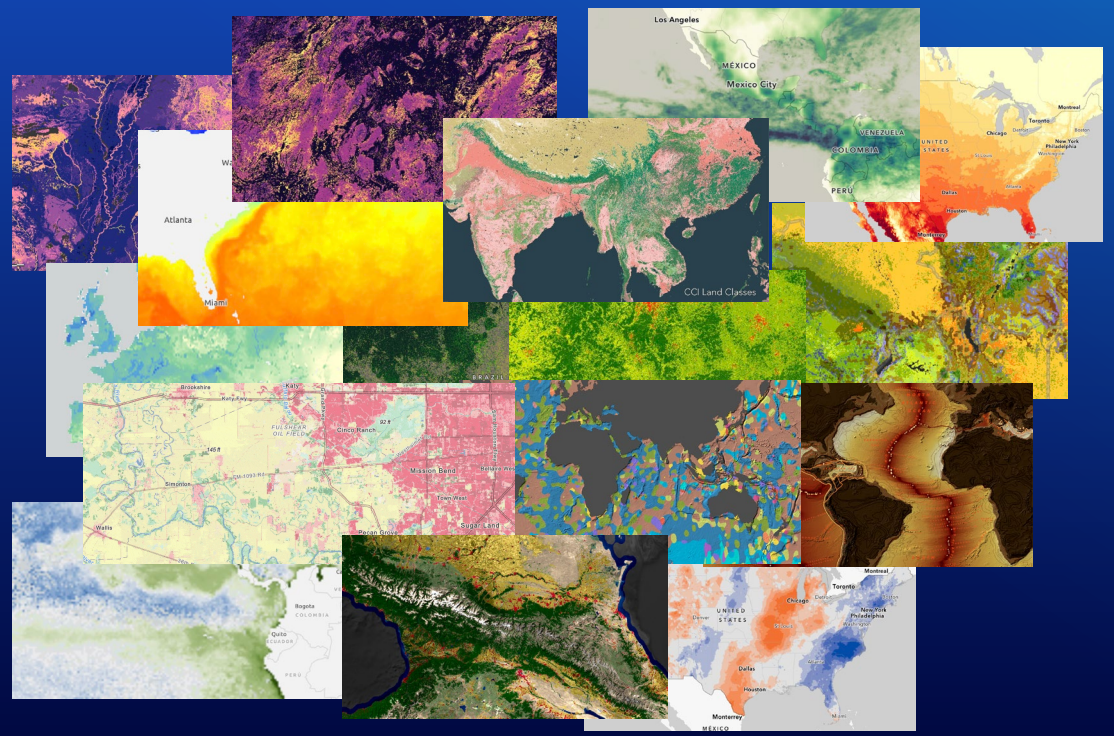
Peter Becker

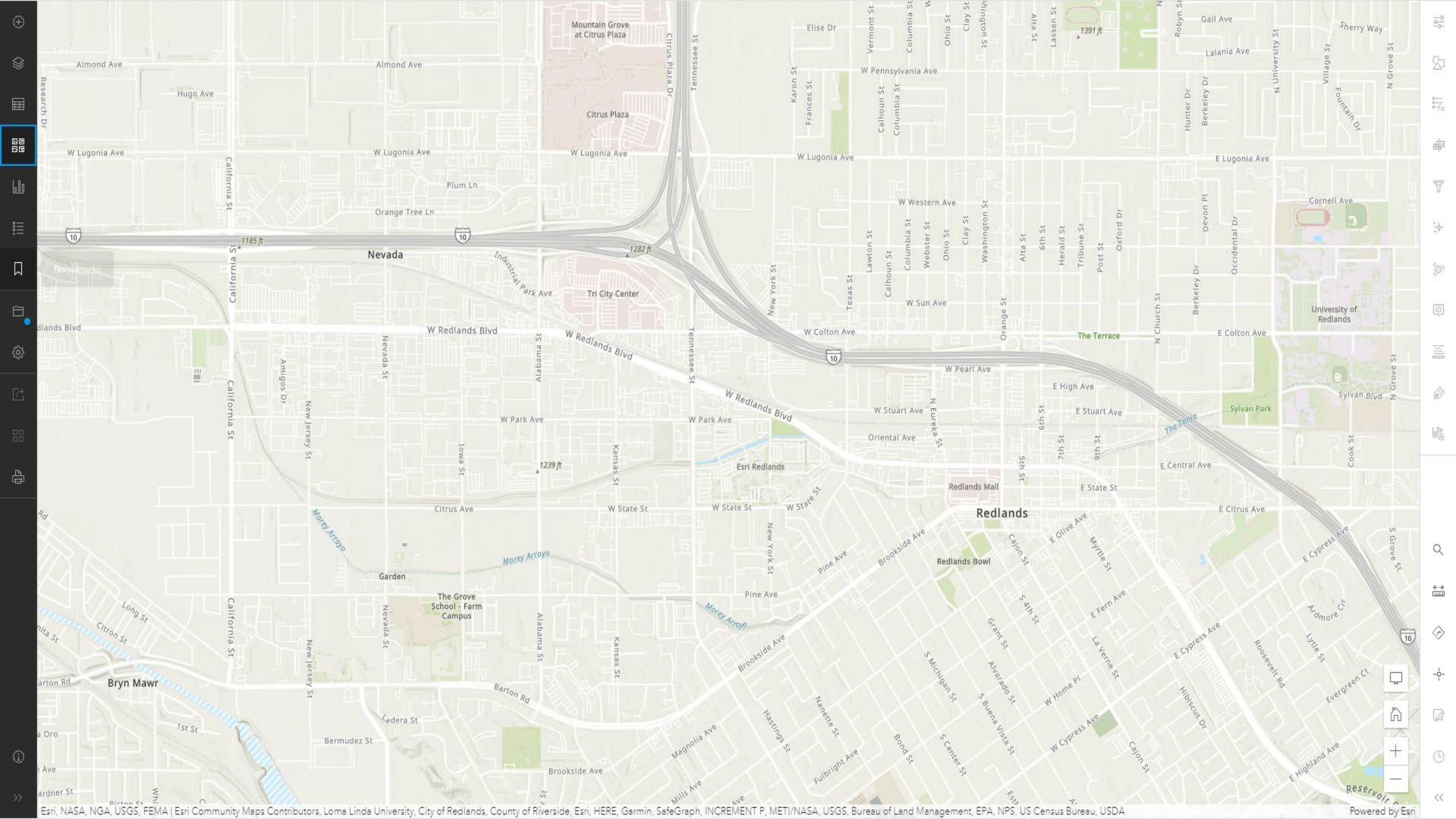
2021 ESRI
IMAGERY SUMMIT

ArcGIS Living Atlas of the World

The foremost collection of geographic information, including maps, apps, and data layers, from around the globe.

- Accessing
- Imagery Layers
- Deeper dive: Esri 10-Meter Land Cover 2020
- Environment Layers
- Types of Analysis and Scaling
- ArcGIS Image Dedicated
- Xtract

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Citrus Plaza
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W Redlands Blvd
W Park Ave
Esri Redlands
Citrus Ave
W State St
Morey Arroyo
Garden
The Grove School - Farm Campus
Bryn Mawr
Barton Rd
Brookside Ave
Pine Ave
Redlands
Redlands Mall
Redlands Bowl
Sylvan Park
University of Redlands
The Terrace
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E State St
E Citrus Ave
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E Highland Ave
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E Lugonia Ave
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1185 ft
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10
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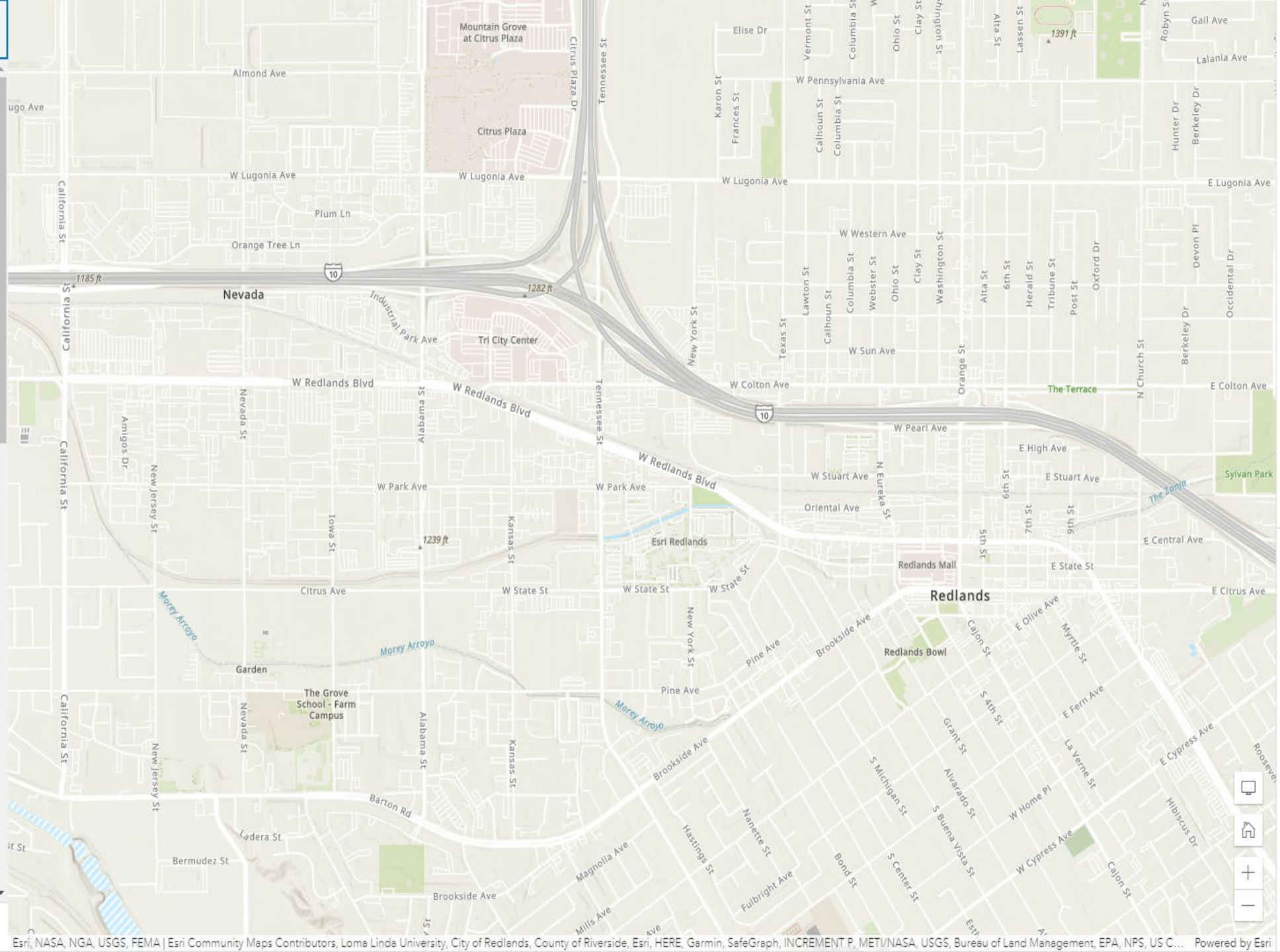
Basemap

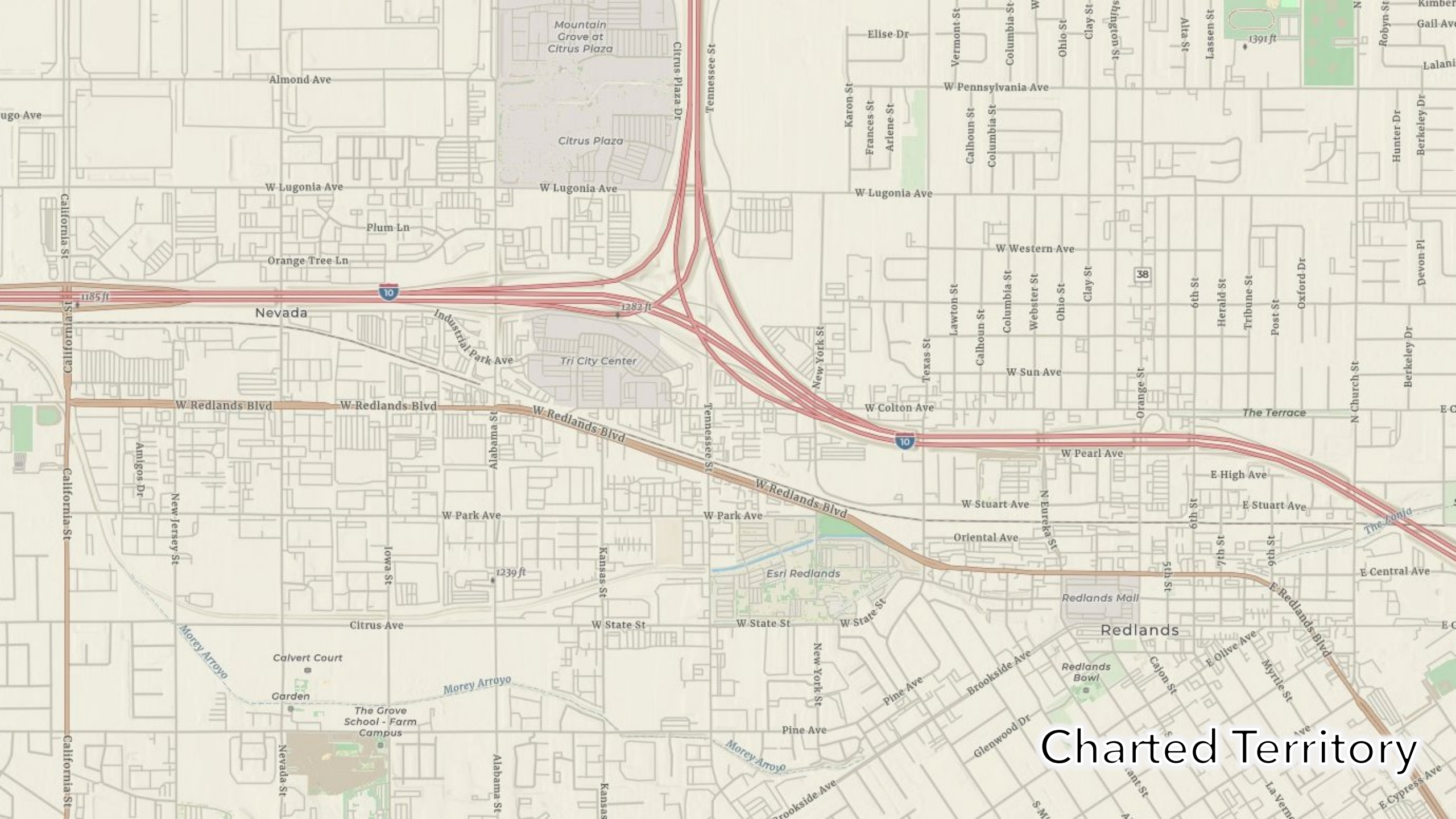
Current basemap

Topographic

- Imagery
- Imagery Hybrid
- Streets
- Topographic
- Navigation
- Streets (Night)
- Terrain with Labels
- Light Gray Canvas
- Dark Gray Canvas
- Oceans

Change background color

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Orange Tree Ln
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1185 ft
1282 ft
Nevada
Industrial Park Ave
Tri City Center
W Redlands Blvd
Alabama St
New York St
W Western Ave
W Sun Ave
W Colton Ave
W Pearl Ave
The Terrace
E High Ave
E Stuart Ave
W Stuart Ave
Oriental Ave
W Park Ave
Amigos Dr
New Jersey St
Iowa St
Kansas St
1239 ft
Esri Redlands
Redlands Mall
E Central Ave
E Redlands Blvd
Citrus Ave
W State St
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Garden
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Nevada St
Pine Ave
Brookside Ave
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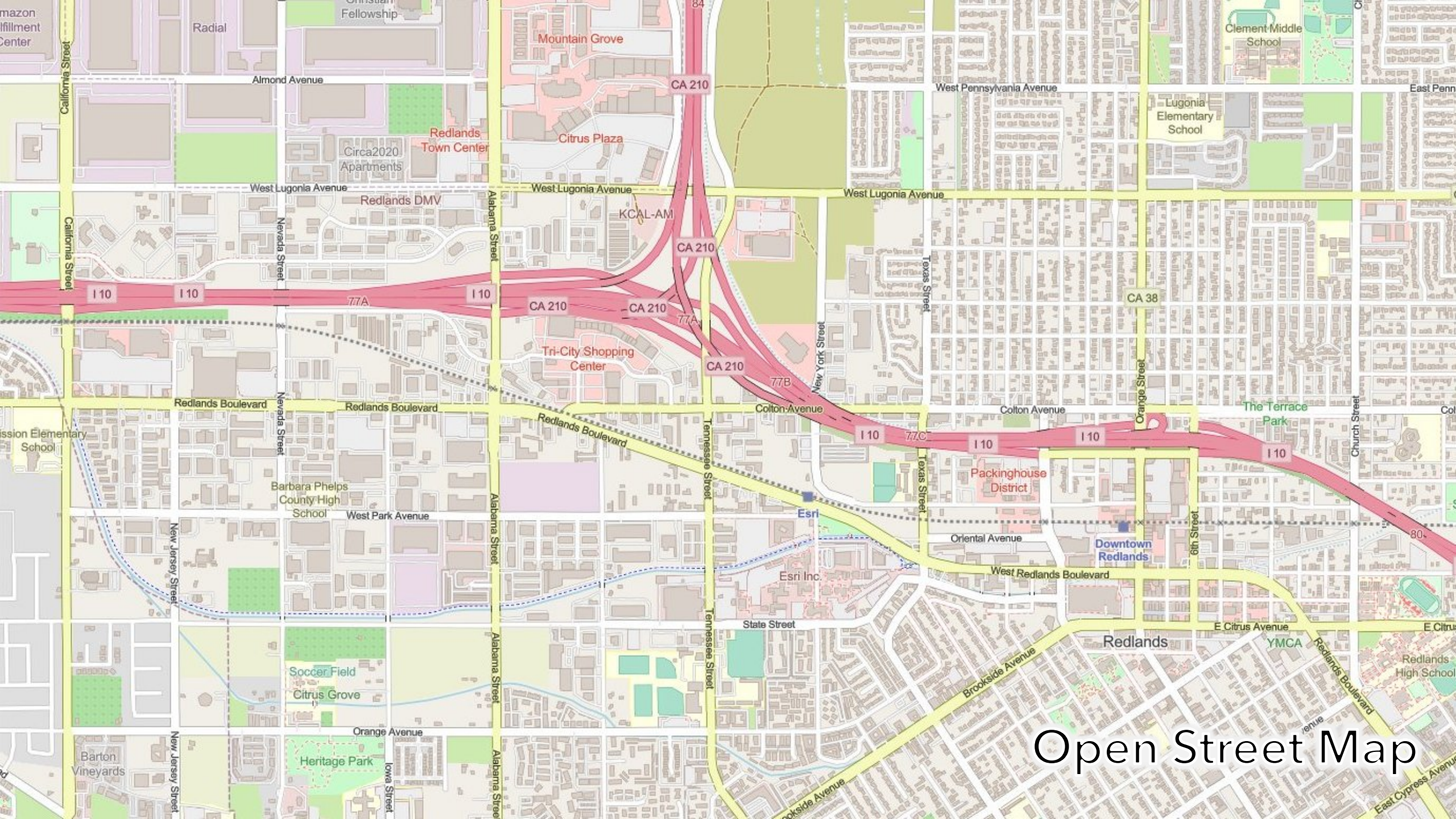
Glenwood Dr
Redlands
Charted Territory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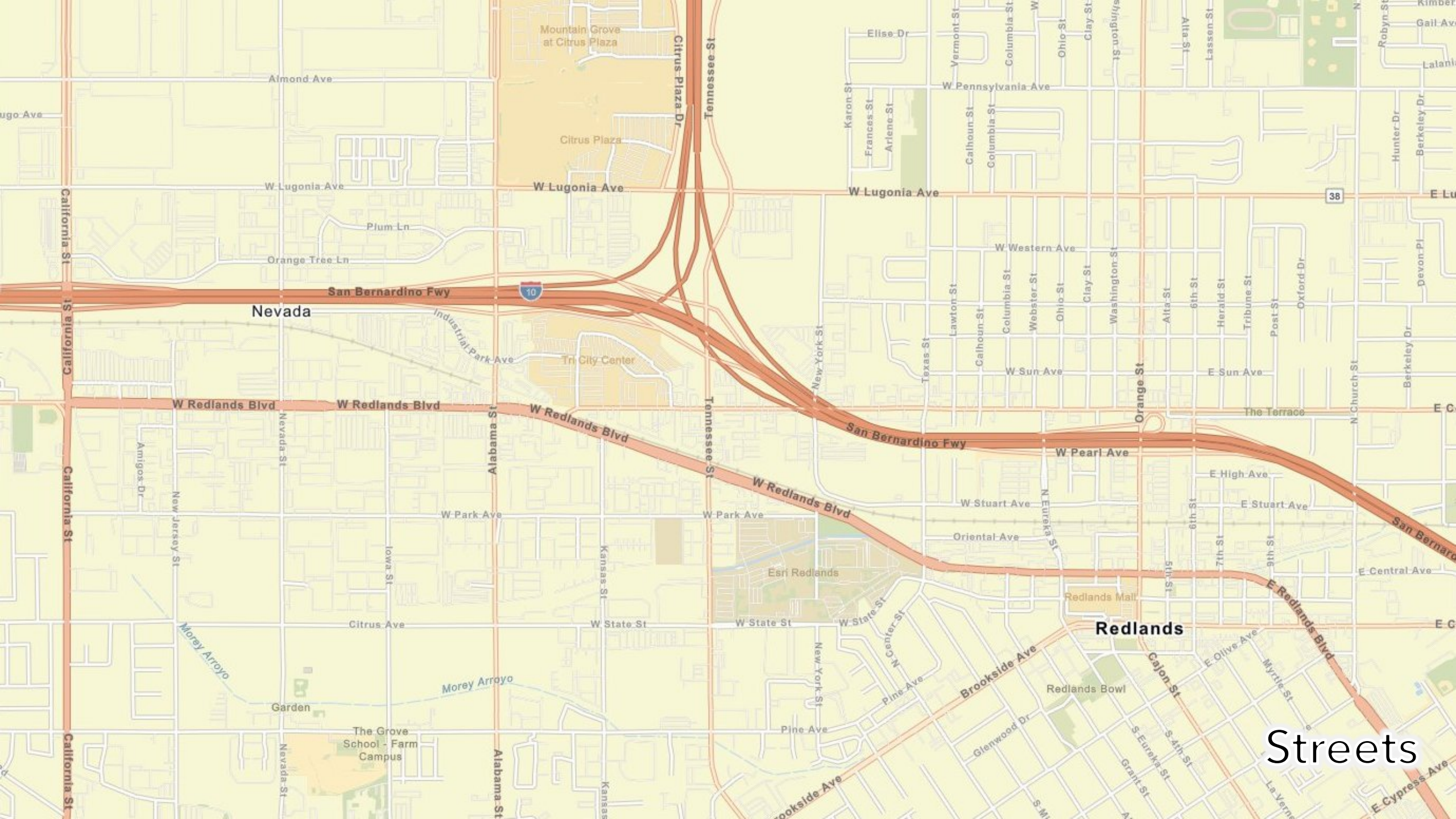
Brookside Avenue
East Cypress Avenue
California Street
Nevada Street
Alabama Street
Tennessee Street
New York Street
Texas Street
Orange Street
Church Street
6th Street
New Jersey Street
Iowa Street
I 10
CA 210
CA 38
77A
77B
77C
Redlands
Esri
Esri Inc.
Downtown Redlands
Packinghouse District
Tri-City Shopping Center
Redlands Town Center
Citrus Plaza
Mountain Grove
Redlands DMV
KCAL-AM
Circa2020 Apartments
Barbara Phelps County High School
Soccer Field
Citrus Grove
Heritage Park
Barton Vineyards
Lugonia Elementary School
Clement Middle School
The Terrace Park
YMCA
Redlands High School
Radial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Orange Tree Ln
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Tri City Center
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The Terrace
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Redlands
Morey Arroyo
Morey Arroyo
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Pine Ave
The Grove School - Farm Campus
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Brookside Ave
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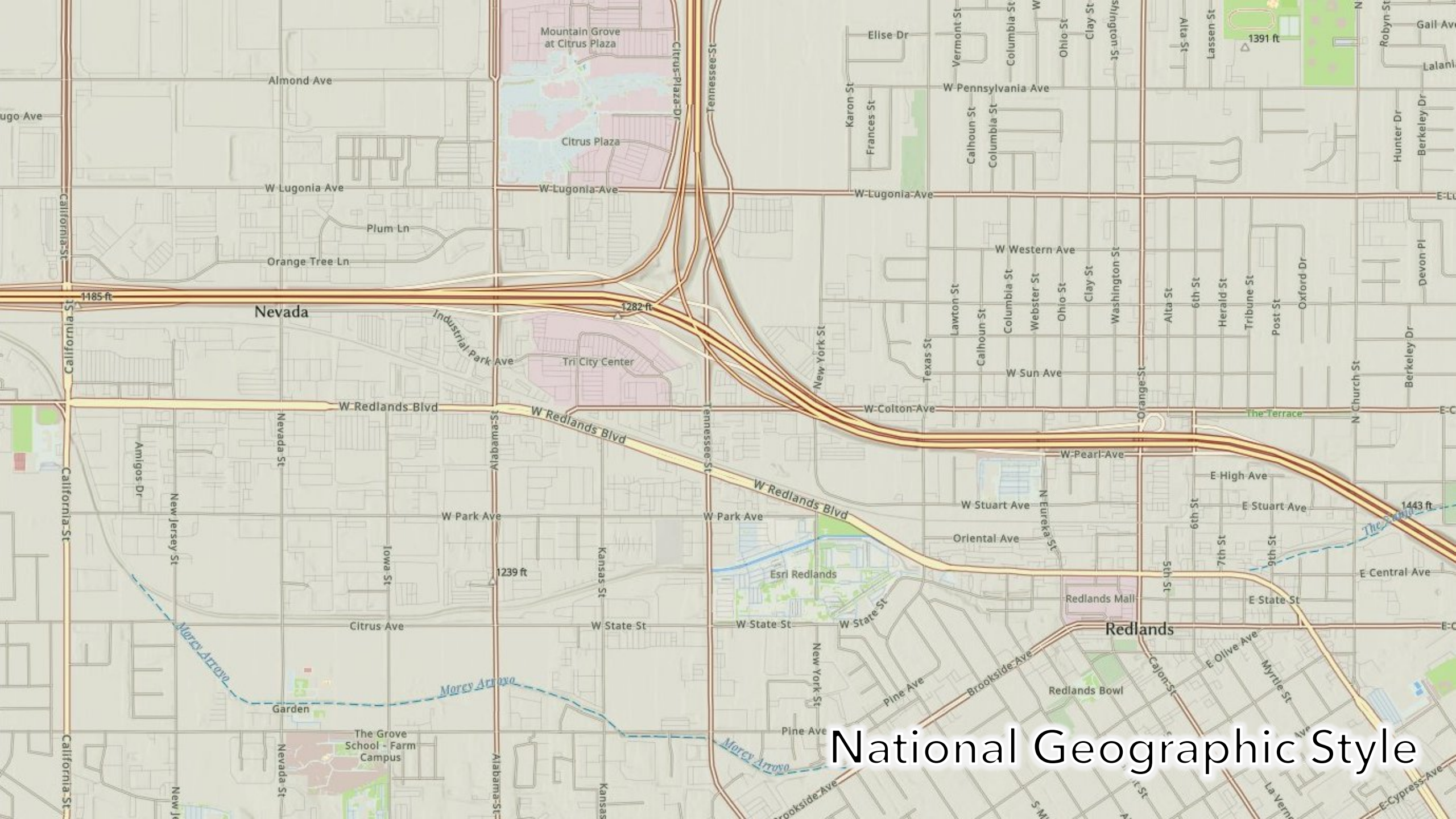
Streets


Mountain Grove at Citrus Plaza
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W State St
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Columbia St
Webster St
Ohio St
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Hunter Dr
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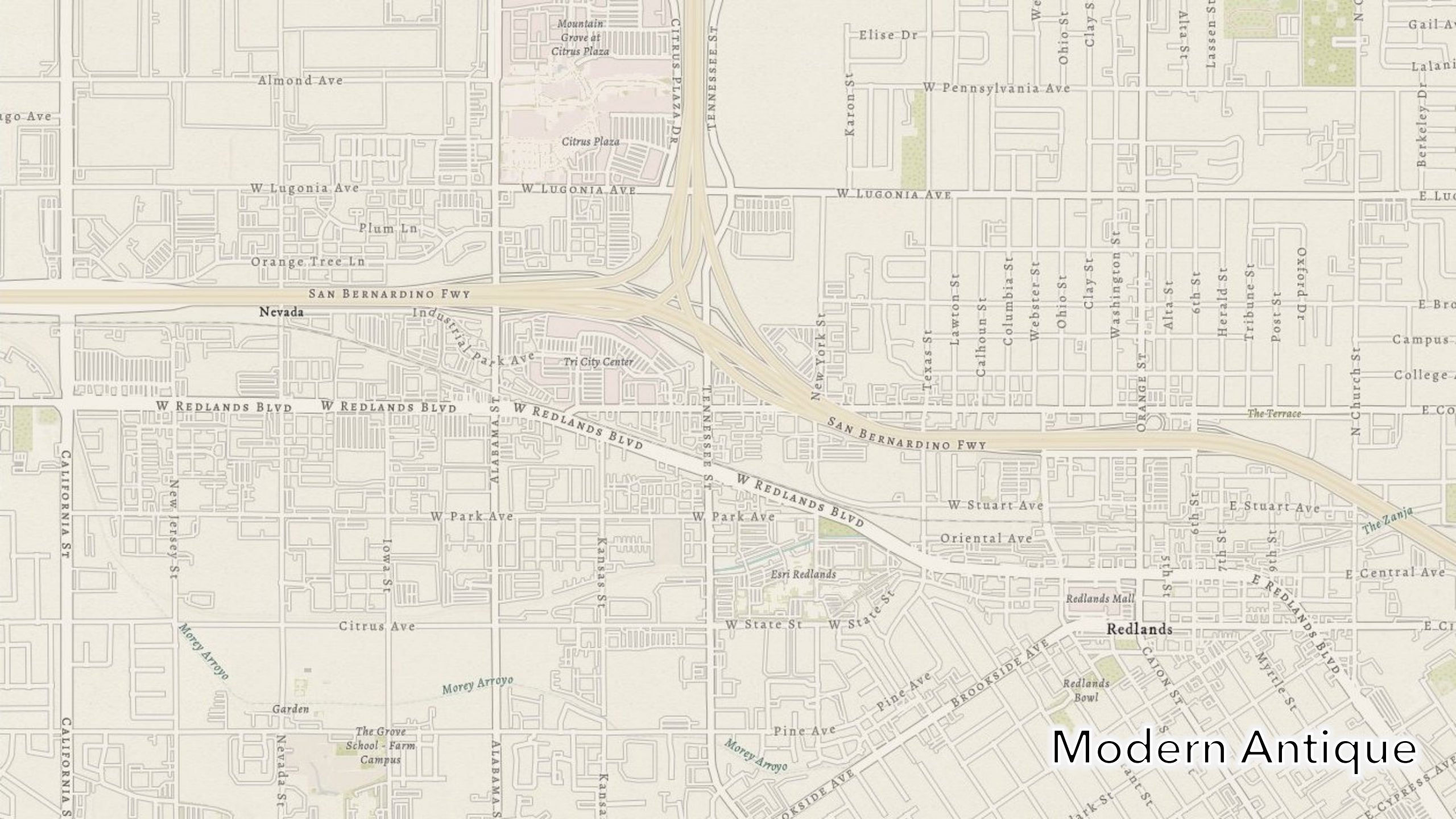
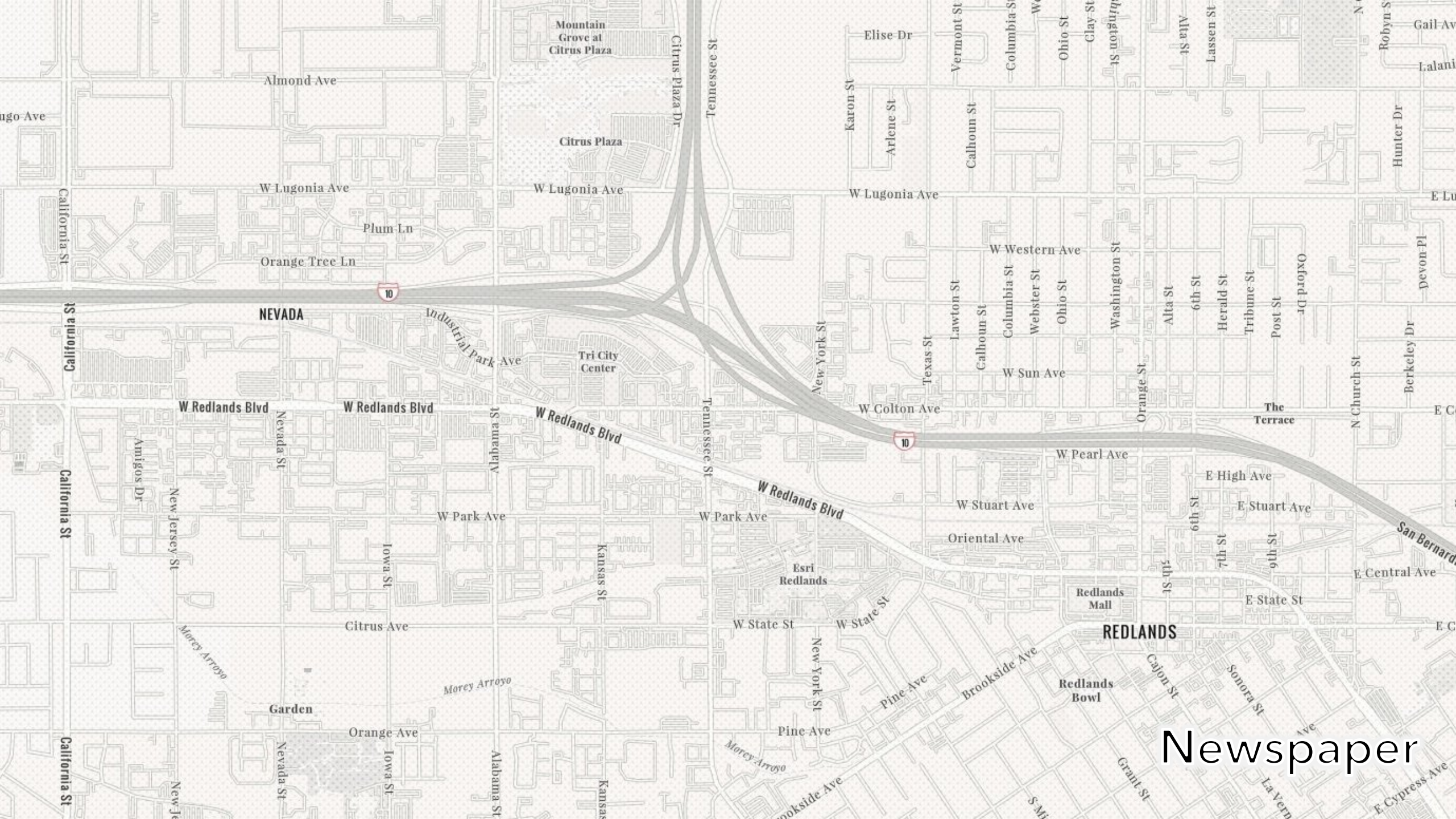
National Geographic Style



Modern Antique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Iowa St
Kansas St
Esri Redlands
5th St
7th St
9th St
E Central Ave
Redlands Mall
E State St
Citrus Ave
W State St
REDLANDS
Morey Arroyo
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Sonora St
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Pine Ave
Garden
Orange Ave
Grant St
E Cypress Ave
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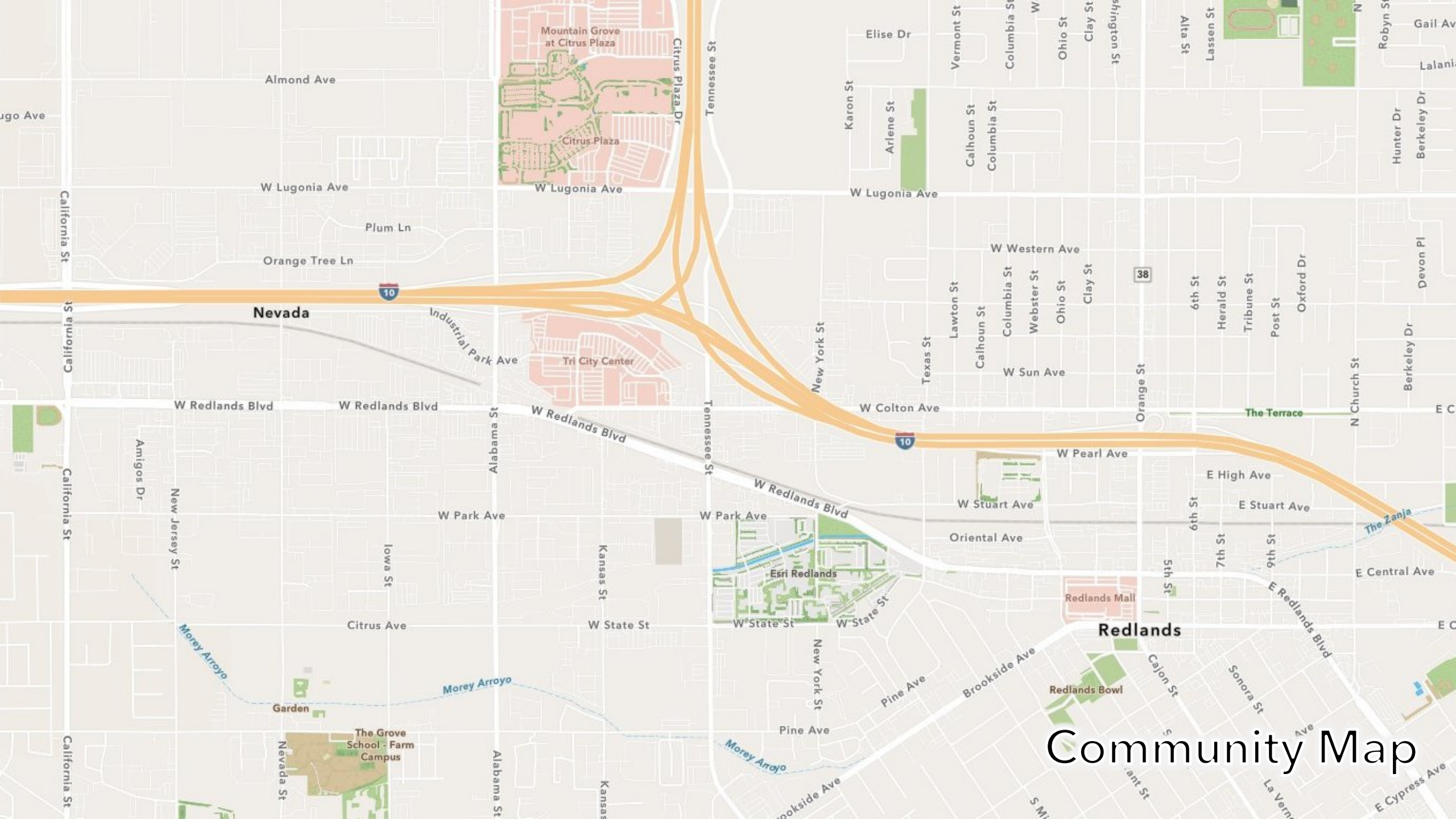
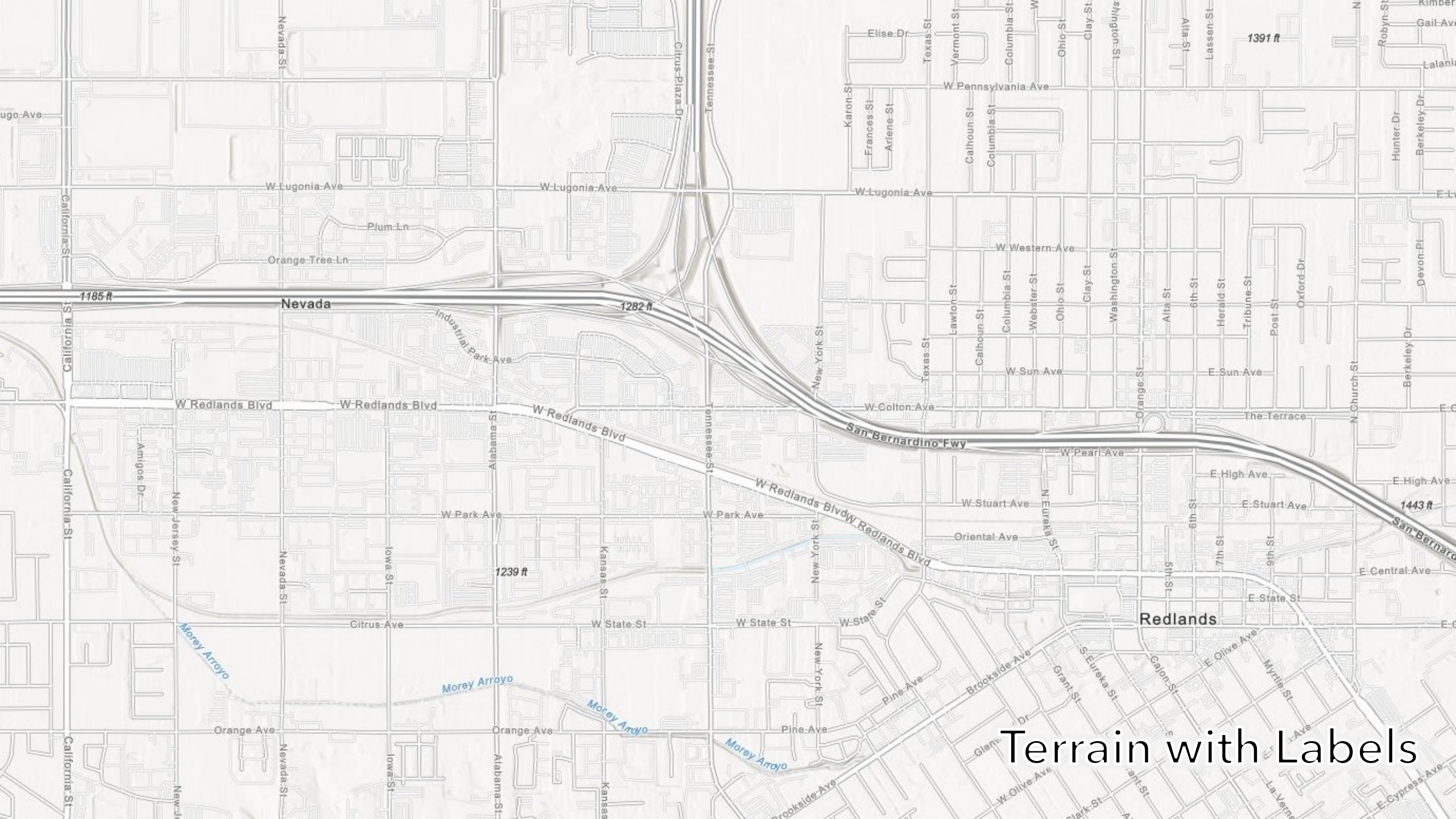
Newspaper



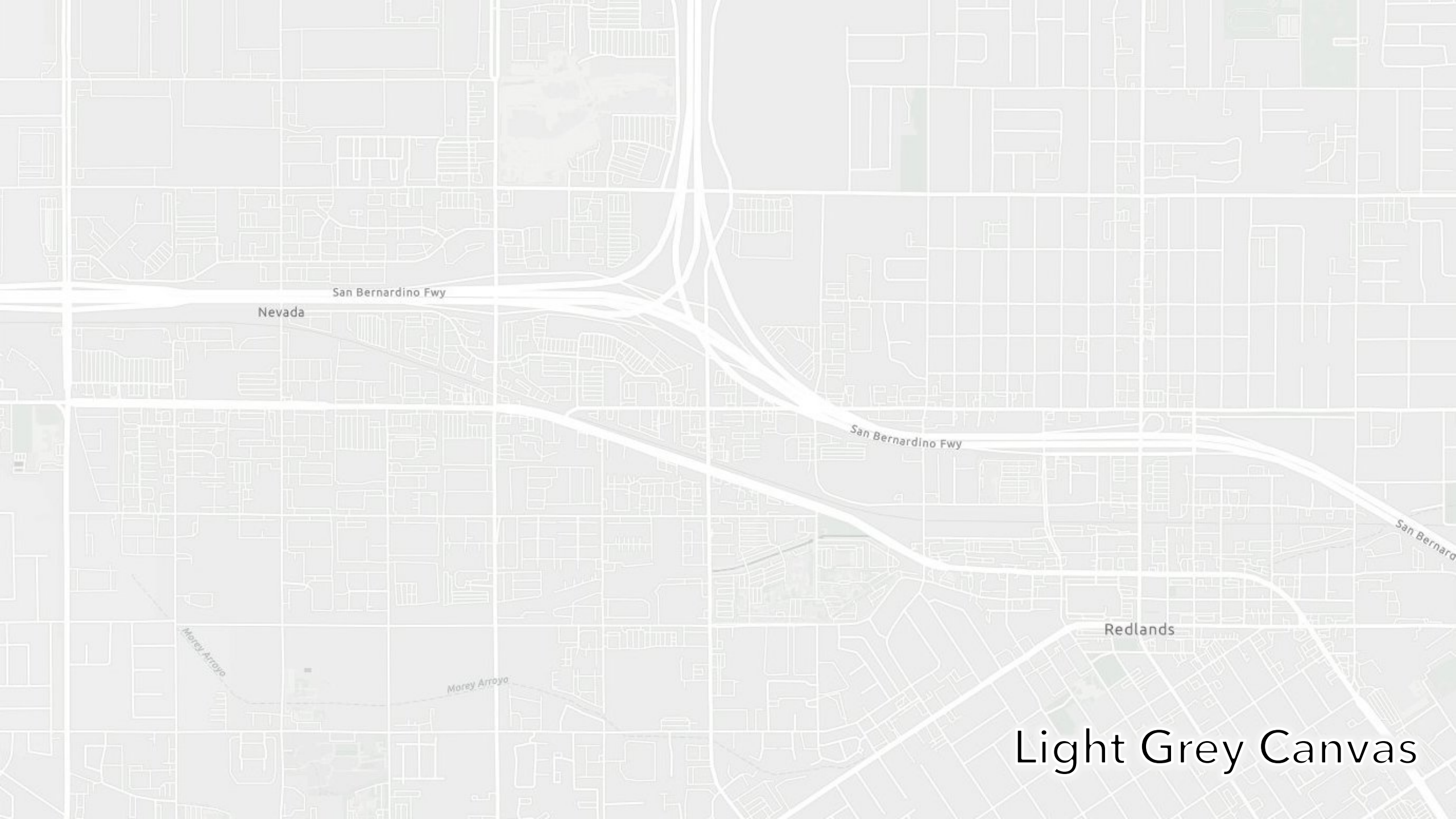
Community Map



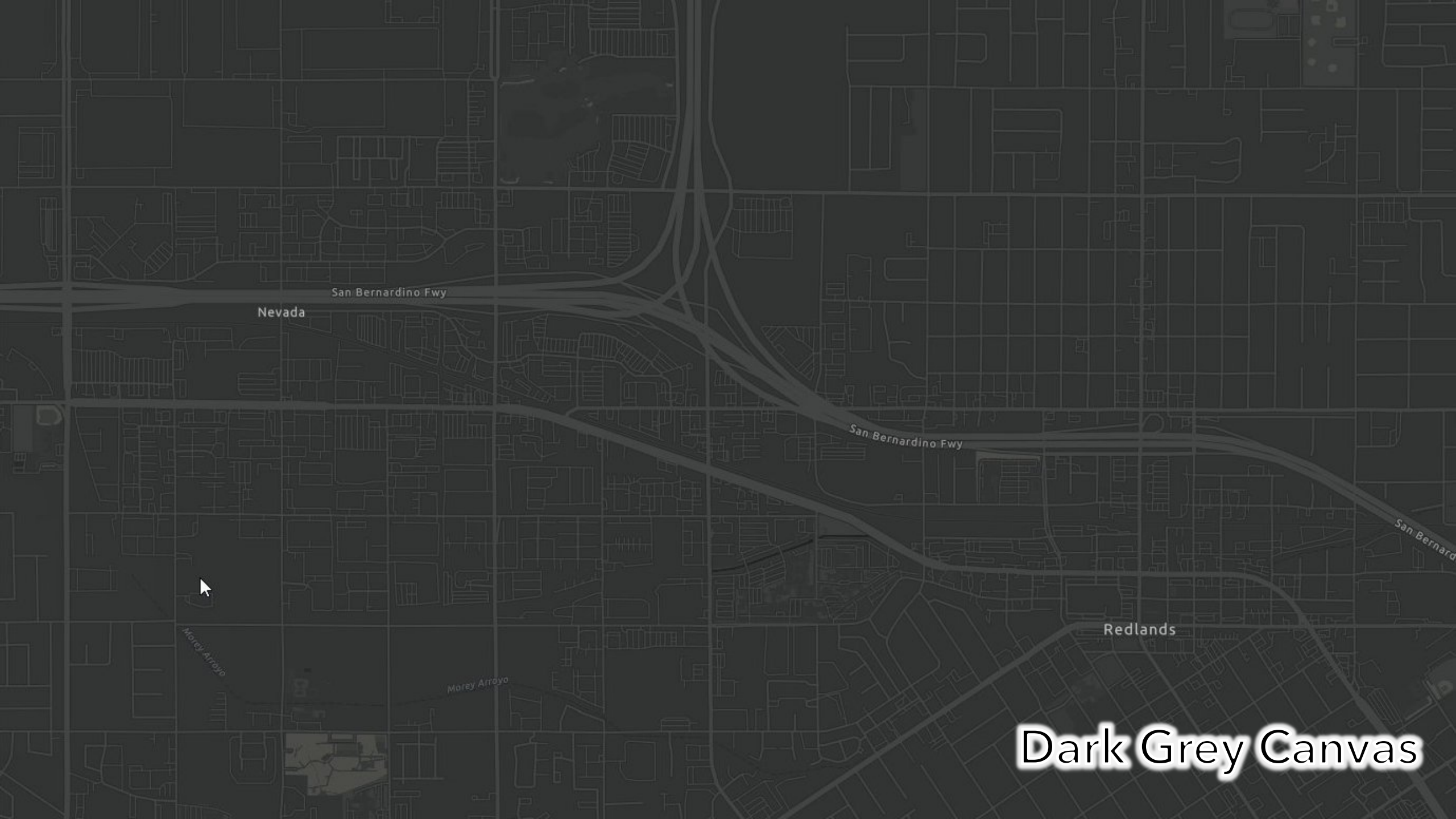
Terrain with Labels



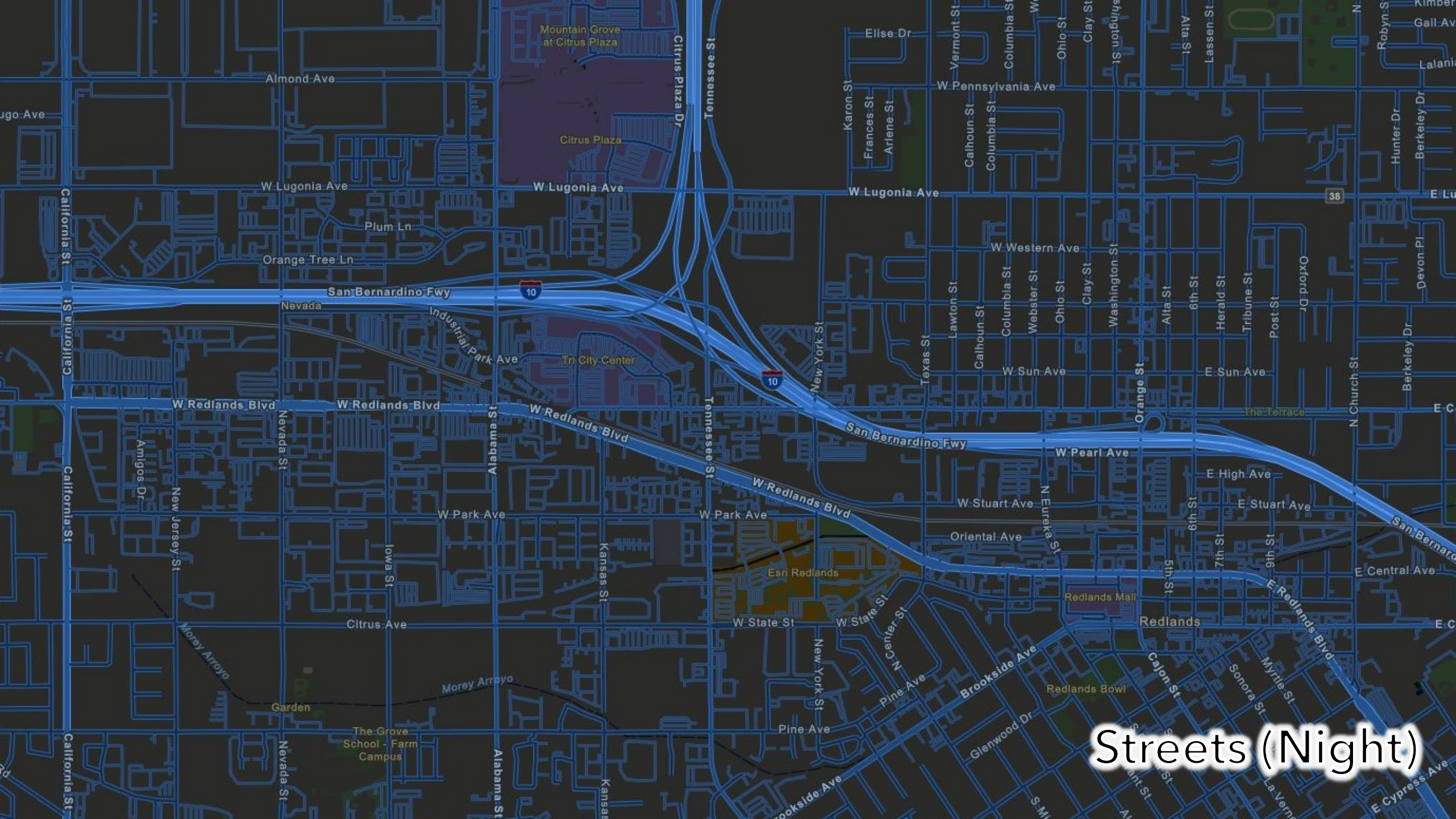
Human Geography



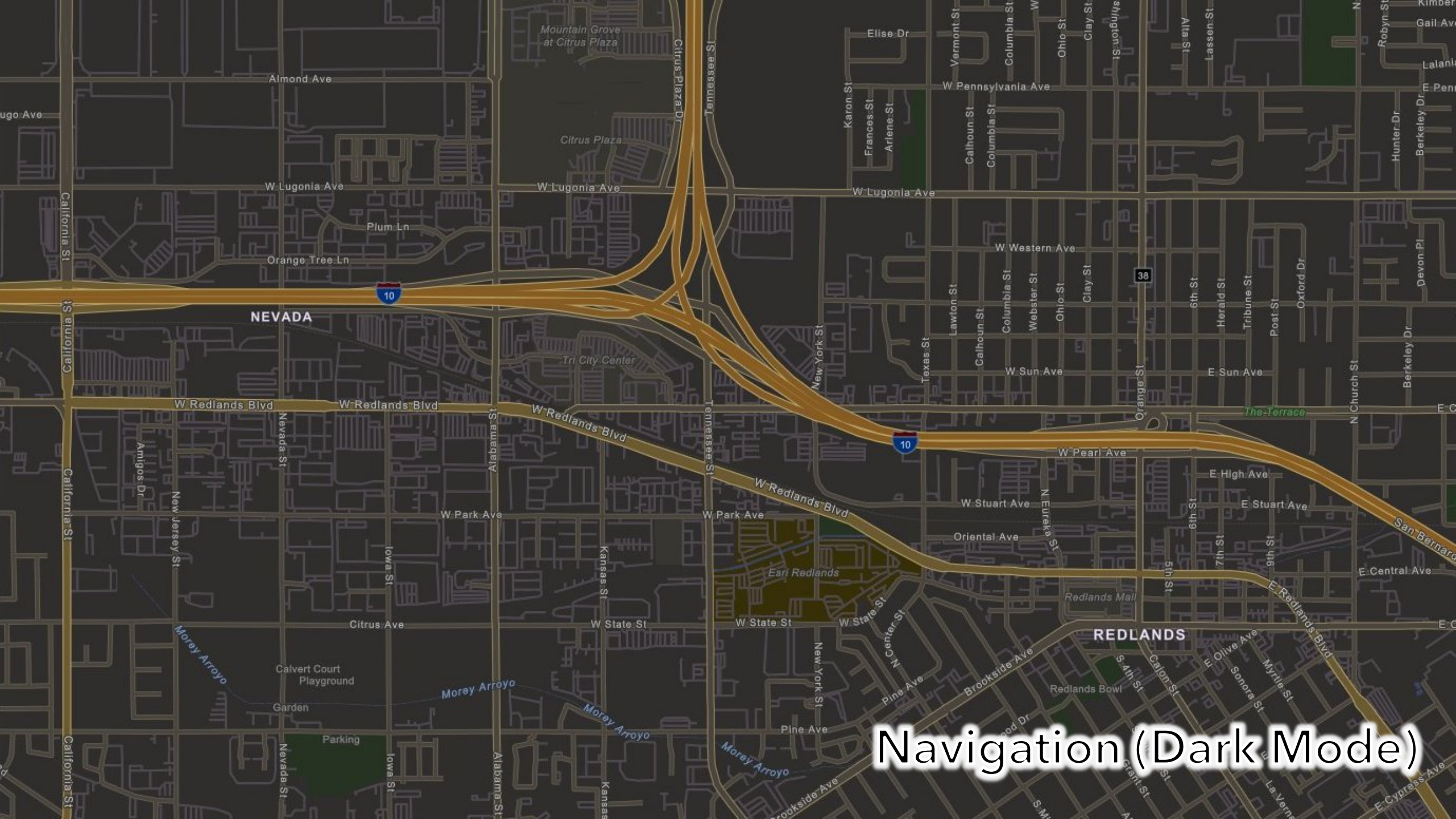
Light Grey Canvas


San Bernardino Fwy
Nevada
San Bernardino Fwy
Redlands
Morey Arroyo
Morey Arroyo
Dark Grey Canvas


MOUNTAIN GROVE AT CITRUS PLAZA
CITRUS PLAZA
Nevada
TRI CITY CENTER
San Bernardino Fwy
THE TERRACE
ESRI REDLANDS
REDLANDS MALL
Redlands
HERITAGE PARK
Human Geography Dark



Streets (Night)


Navigation (Dark Mode)
Mountain Grove at Citrus Plaza
Citrus Plaza
Almond Ave
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Tennessee St
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Vermont St
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Clay St
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Berkeley Dr
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Webster St
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Oriental Ave
Iowa St
Kansas St
Esri Redlands
E Central Ave
Redlands Mail
E Redlands Blvd
San Bernardino
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N Center St
REDLANDS
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Calvert Court Playground
Garden
Parking
Brookside Ave
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Cajon St
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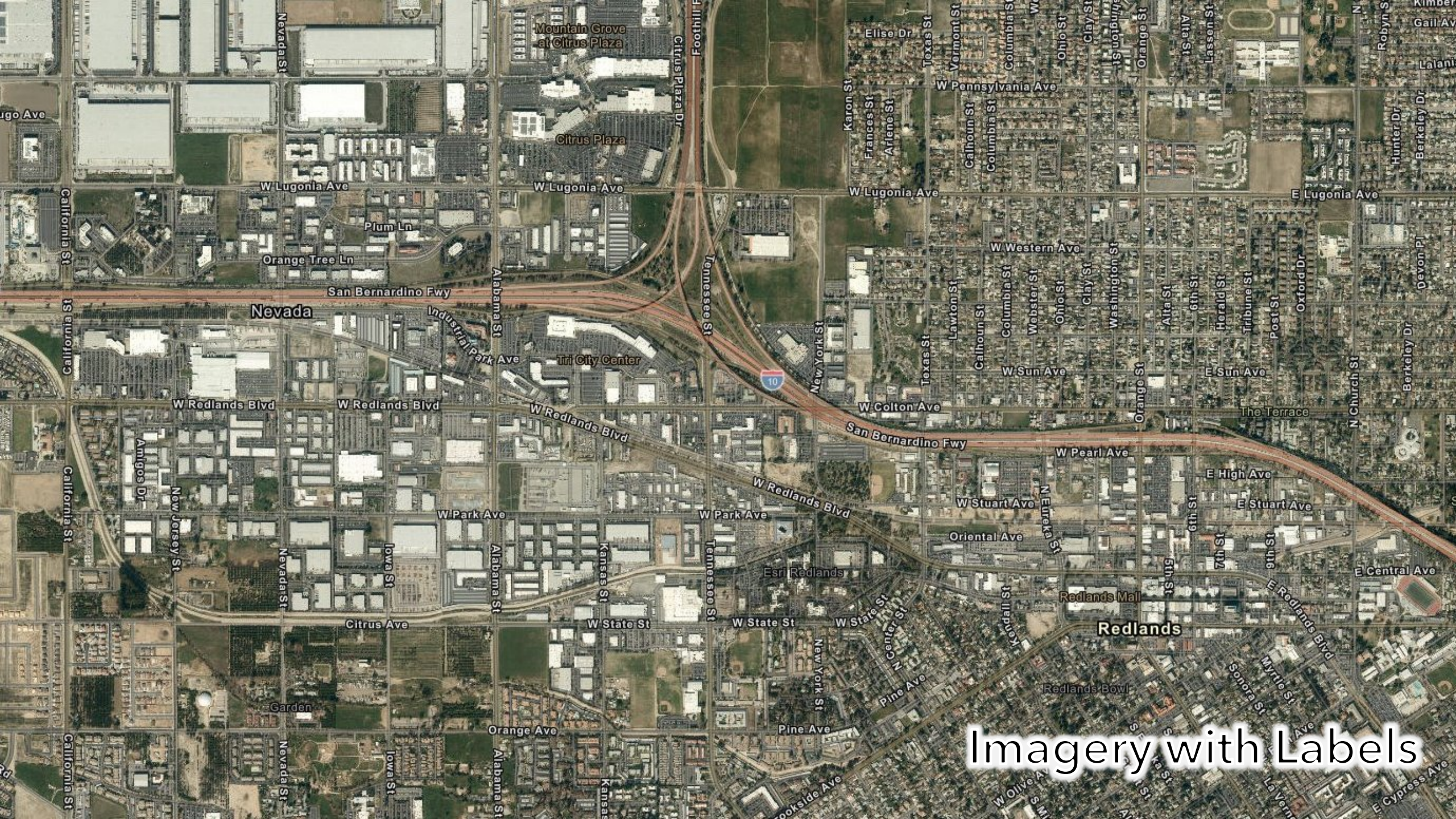
La Verne
E Cypress Ave


Imagery


Mountain Grove at Citrus Plaza
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Myrtle St
Garden
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Pine Ave
Nevada St
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Kansas St
Brookside Ave
W Olive Ave
E Cypress Ave
Imagery with Labels

Layers

Layers

No layers

Add layers to your map and they will appear here.

+ Add layer



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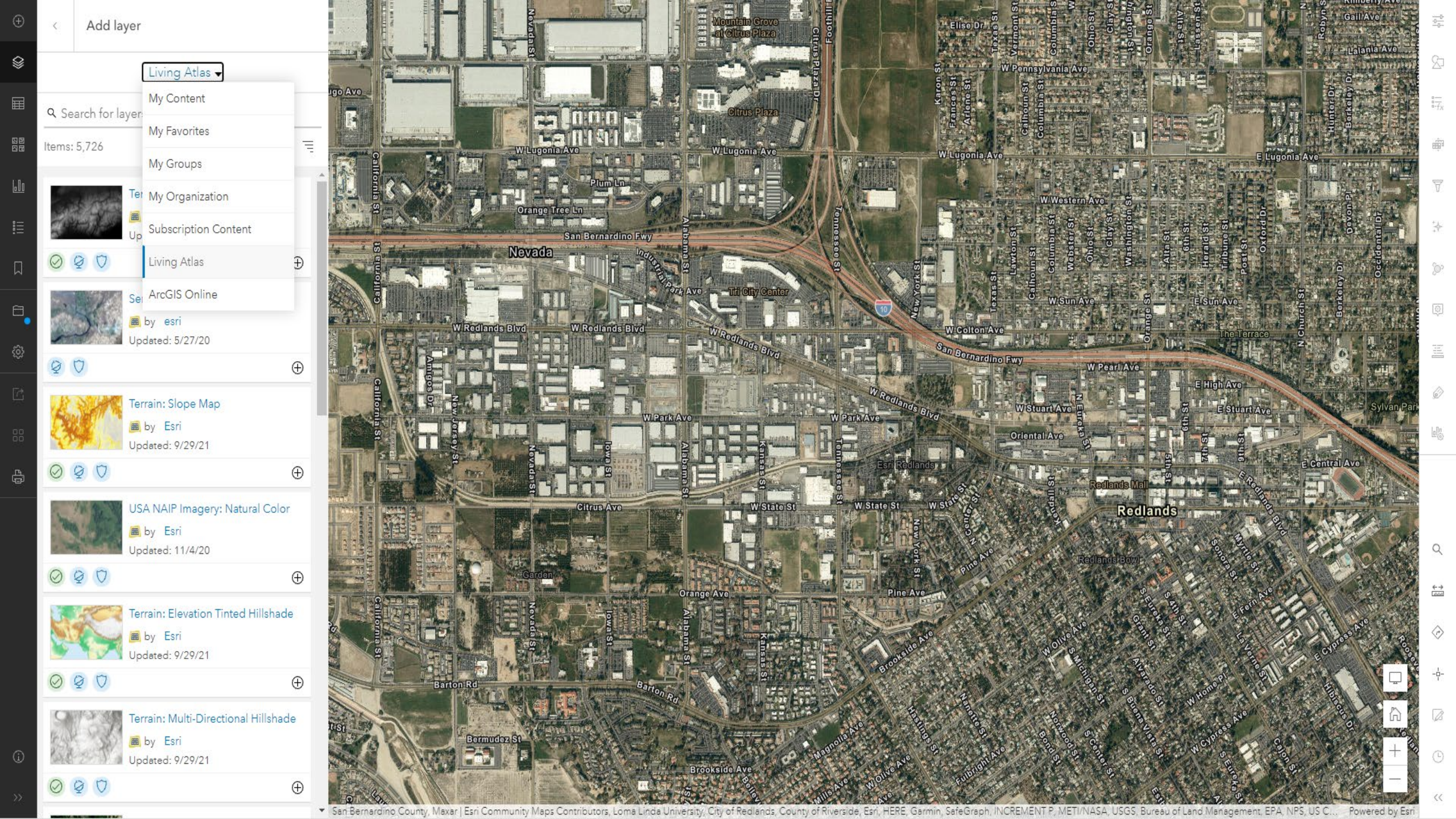
Add layer
Living Atlas
My Content
My Favorites
My Groups
My Organization
Subscription Content
Living Atlas
ArcGIS Online
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by esri
Updated: 5/27/20
Terrain: Slope Map
by Esri
Updated: 9/29/21
USA NAIP Imagery: Natural Color
by Esri
Updated: 11/4/20
Terrain: Elevation Tinted Hillshade
by Esri
Updated: 9/29/21
Terrain: Multi-Directional Hillshade
by Esri
Updated: 9/29/21
Nevada
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W State St
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Mountain Grove at Citrus Plaza
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Redlands Mall
Redlands Bowl
Garden
San Bernardino County, Maxar | Esri Community Maps Contributors, Loma Linda University, City of Redlands, County of Riverside, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US C...
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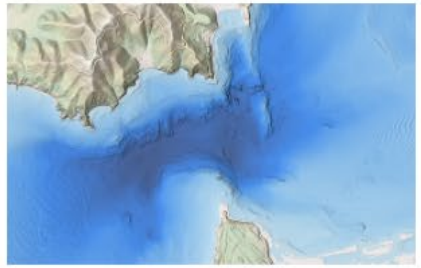
What's new

Explore items recently added to ArcGIS Living Atlas of the World, learn about GIS events, and discover ways to use content.

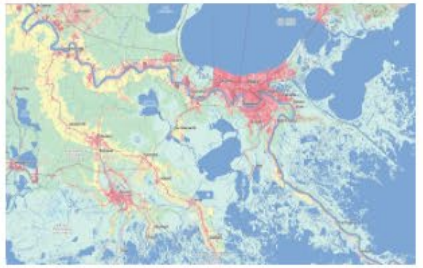


Basemaps and imagery updated with community content

Communities worldwide continue to share their basemap layers and imagery with Esri's Community Maps Program. ArcGIS Living Atlas basemaps and imagery were recently updated with over 65 new and updated communities throughout Europe and North America.







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All Trending Basemaps Imagery Boundaries People Infrastructure Environment

All content types All time All regions Esri-only content Authoritative-only content Sort by: Relevance

10000 Results



Active Hurricanes, Cyclones and Typhoons

Feature Layer By esri_livefeeds2

This layer describes the observed path, forecast track, and intensity of tropical cyclone activity (hurricanes, typhoons, cyclones) from the National Hurricane Center (NHC) and Joint Typhoon Warning Center (JTWC).

Authoritative



Sentinel-2 Views

Imagery Layer By esri

Sentinel-2, 10m Multispectral, Multitemporal, 13-band images with visual renderings and indices. This Imagery Layer is sourced from the Sentinel-2 on AWS collections and is updated daily with new imagery. This layer is in beta release.

Subscriber



World Imagery

Tile Layer By esri

This layer presents low-resolution satellite imagery for the world and high-resolution satellite and aerial imagery, typically within 3-5 years of currency, for most of the world.

Authoritative



USA Current Wildfires

Feature Layer By esri_livefeeds2

This layer shows wildfires that have been updated within the past 7 days in the United States from IRWIN and NIFC information.

Authoritative

esri ArcGIS Industries About Support

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All content types | All time | All regions | Esri-only content | Authoritative-only content | Sort by: Relevance

- All content types
- Maps (2557)
- Layers (5790)
- Scenes (79)
- Apps/Story Maps (1541)
- Tools (32)

10000 Results

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Authoritative

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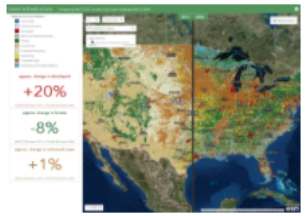
landcover

Search Examples

All Trending Basemaps Imagery Boundaries People Infrastructure Environment

Apps/Story Maps | All time | All regions | Esri-only content | Authoritative-only content | Sort by: Relevance

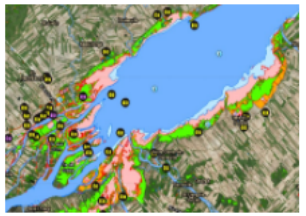
31 Results



Landcover Change App

Web Mapping Application By Esri_GI

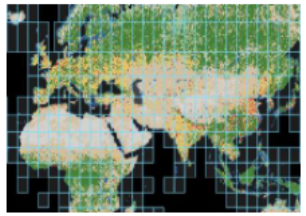
This application compares changes between aggregated 2011 National Land Cover Database land cover categories with similarly aggregated land cover categories from The Clark Labs 2050 Conterminous US Land Cover Prediction.



Carte interactive des milieux humides - sud du Québec (appli...

Web Mapping Application By Canardslllimites

Cartographie détaillée des milieux humides pour les secteurs habités du sud du Québec.



Esri 2020 Land Cover Downloader

Web Mapping Application By esri_landscape2

This application provides access to individual GeoTIFF scenes files from the Esri 2020 Land Cover.



Unser Park - Johannapark und Clara-Zetkin-Park (Leipzig, Ger...

Web Mapping Application By Stadt.Leipzig

Flächennutzung im Clara-Zetkin-Park und Johannapark im Rahmen der Bürgerbeteiligung "Unser Park - Miteinander fairbunden." Stand: 2017

Landcover Change App

Overview



☆ Add to Favorites

This application compares changes between aggregated 2011 National Land Cover Database land cover categories with similarly aggregated land cover categories from The Clark Labs 2050 Conterminous US Land Cover Prediction.

Web Mapping Application by Esri_GI

Created: Jun 15, 2016 Updated: Apr 27, 2018 View Count: 1,436

Living Atlas

View Application

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Description

This application compares changes between aggregated 2011 National Land Cover Database land cover categories with similarly aggregated land cover categories from The Clark Labs 2050 Conterminous US Land Cover Prediction. It also provides a few summary statistics about possible changes in developed, forest and agricultural land cover. Look for the soon to be released Clark Labs American Land Change Explorer application, which provides exhaustive analysis and summaries of potential transitions from each of the NLCD categories to each of the projected 2050 categories.

The Clark Labs 2050 Conterminous US Land Cover Prediction
© 2016 Clark Labs

Introduction
The Clark Labs' conterminous US land cover prediction for 2050 was produced as part of the development of the Land Change Explorer – a web application to illustrate the potential of predictive land change modeling and to introduce potential users to the Land Change Modeler – a cloud-based software service for land change modeling to be offered in the ArcGIS Marketplace.

Procedure
The prediction is based on an empirical modeling of the relationship between land cover change from 2001 to 2011 and a series of explanatory variables. The land cover data were at a 30 meter resolution from the National Land Cover Database (NLCD). The explanatory variables(1) were:

- Elevation
- Slope
- Proximity to primary roads
- Proximity to secondary roads

Details

Size: 0 KB
API: JavaScript
Purpose: Ready To Use

Share

Edit

Owner

Esri_GI

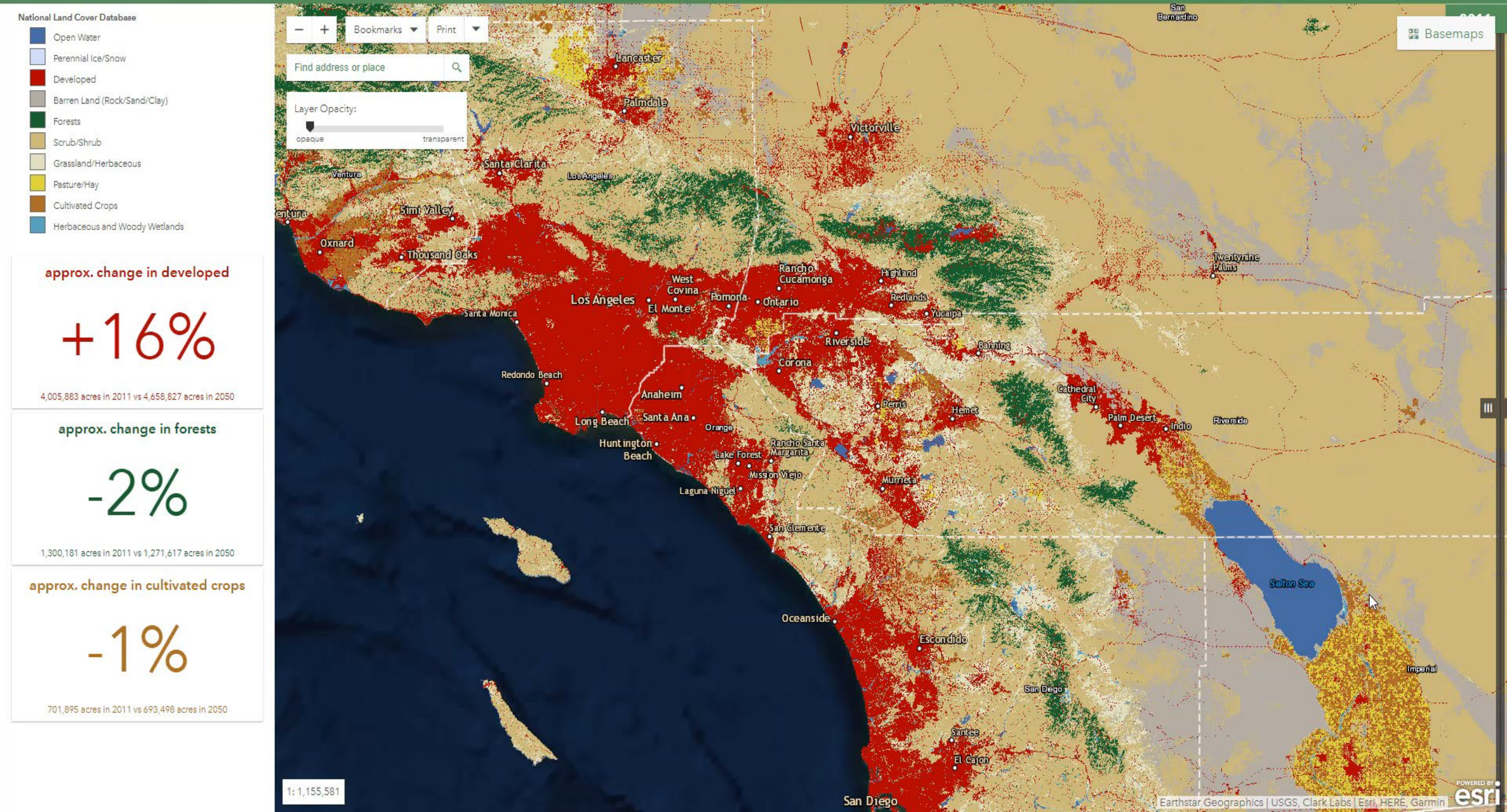
Tags

green, infrastructure, land, cover, landcover, landscape, ecology

Credits (Attribution)

Green Infrastructure

Comparing NLCD 2011 to the Clark Labs' Predicted NLCD 2050



approx. change in developed

+16%

4,005,883 acres in 2011 vs 4,658,827 acres in 2050

approx. change in forests

-2%

1,300,181 acres in 2011 vs 1,271,617 acres in 2050

approx. change in cultivated crops

-1%

701,895 acres in 2011 vs 693,498 acres in 2050

Search Living Atlas for maps, apps, and more

Search Examples

All Trending Basemaps Imagery Boundaries People Infrastructure Environment

Layers All time All regions Esri-only content Authoritative-only content Sort by: Relevance

130 Results



Sentinel-2 Views

Imagery Layer By esri

Sentinel-2, 10m Multispectral, Multitemporal, 13-band images with visual renderings and indices. This Imagery Layer is sourced from the Sentinel-2 on AWS collections and is updated daily with new imagery. This layer is in beta release.

Subscriber

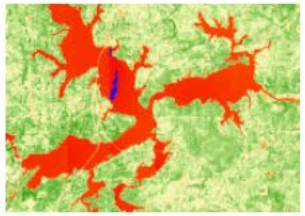


USA NAIP Imagery: Natural Color

Imagery Layer By esri

This Natural Color imagery layer features recent high-resolution (1m or better) aerial imagery for the continental United States, made available by the USDA Farm Services Agency.

Subscriber Authoritative

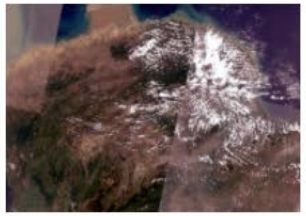


USA NAIP Imagery: NDVI

Imagery Layer By esri

This NDVI imagery layer features recent high-resolution (1m or better) aerial imagery for the continental United States, made available by the USDA Farm Services Agency.

Subscriber Authoritative



Pansharpened Landsat

Imagery Layer By esri

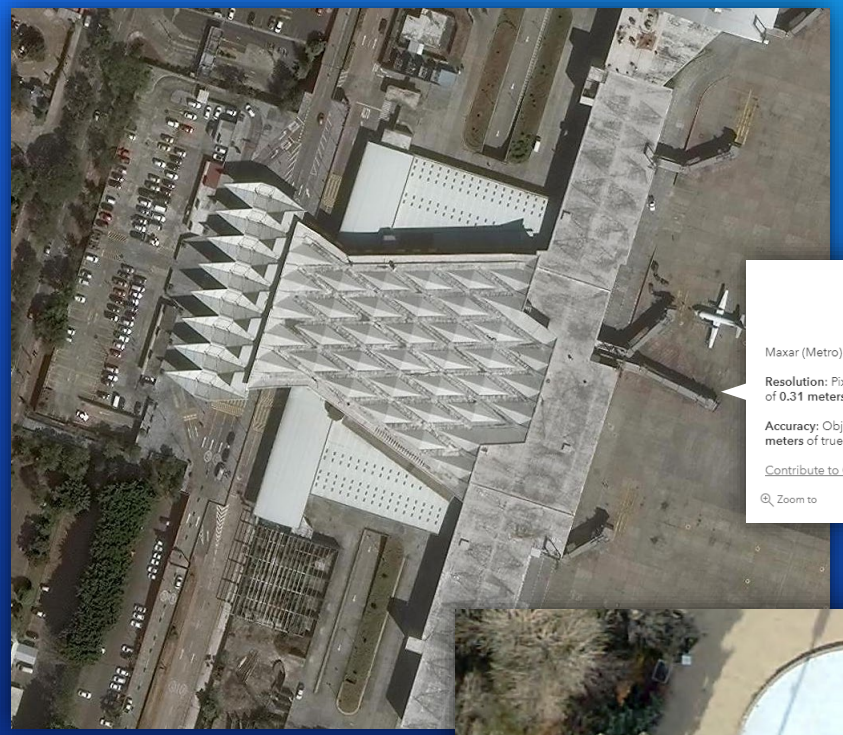
Landsat pansharpened and multitemporal 15m imagery rendered on-the-fly as Natural Color with DRA for visualization and analysis. It is updated daily with new imagery directly sourced from the USGS Landsat collection on AWS.

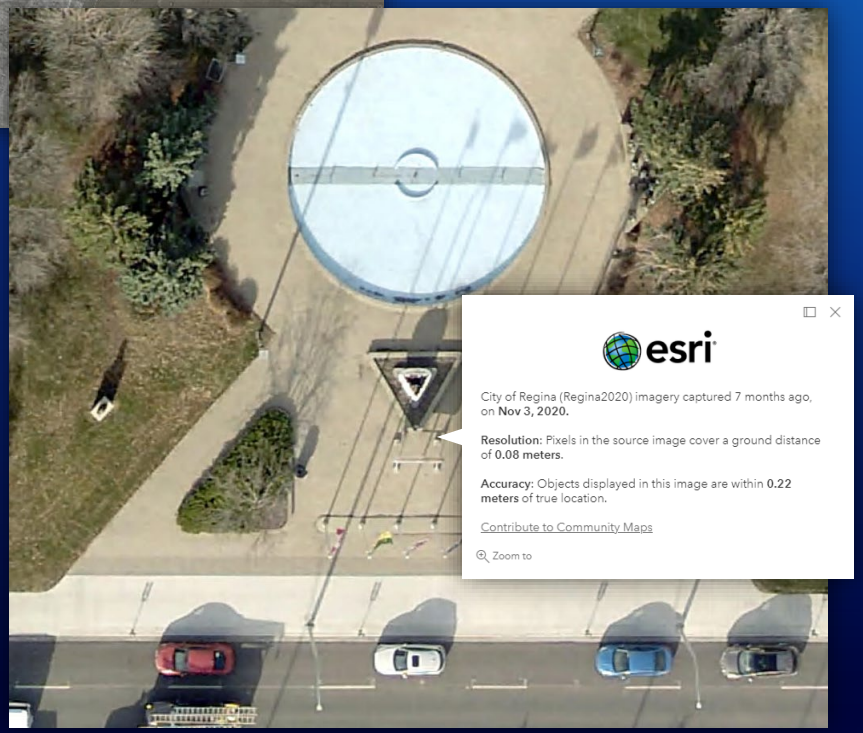
Authoritative

World Imagery

From Multiple Sources

- **Maxar** - High resolution satellite imagery
  - Vivid Standard:
    - Global imagery mosaic, 50 cm to 1.2 m
  - Vivid Advanced:
    - 1,000+ metropolitan areas, 30 cm
  - In the past year:
    - >100 million sq. km. updated
    - Including ~1,200 30cm metros
- **GIS User Community** - High resolution aerial photography
  - Variable coverage and update cycles
    - Average spatial resolution 15cm
  - Notable contributions in the past year
    - Country wide coverage for Switzerland, Austria, Slovenia, and Slovakia.
    - Significant coverage in Germany, Spain, Canada, and United States





World Imagery Publication Summary

Maxar Metropolitan Imagery | Maxar Global Imagery | GIS Community Imagery

About

The GIS User Community, including mapping agencies around the world, enhance the ArcGIS World Imagery map by contributing recent, submeter-resolution aerial imagery through the Community Maps Program.

This map is configured to provide a summary of Community updates published to World Imagery over the past year, as well as any updates currently pending publication. Updates published more than12 months ago are not included.

Publication summary results can be refined with the provided filters.

Filter

Filters

Country Name(s)

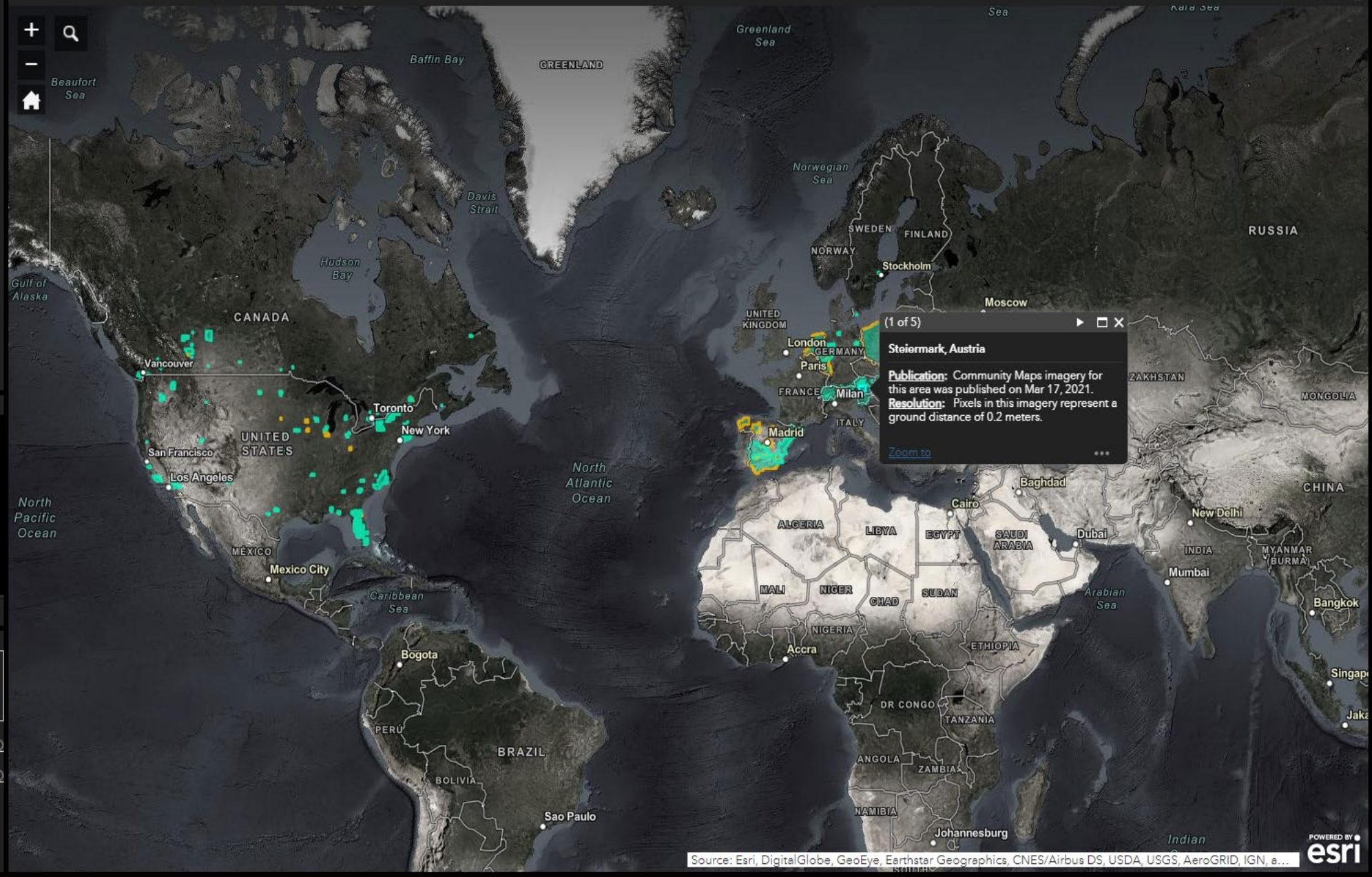
0 selected

Publication Date Range

and

Publication Summary

Community Area Count	245
Published	226
Pending	19

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2016
2018
2020
Wayback 2015-04-30
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2021-07-21
2020-10-14
2020-03-23
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2018-01-08
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2015-04-30
2014-02-20
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reference label overlay
Pole Line Rd
Skye Village Rd
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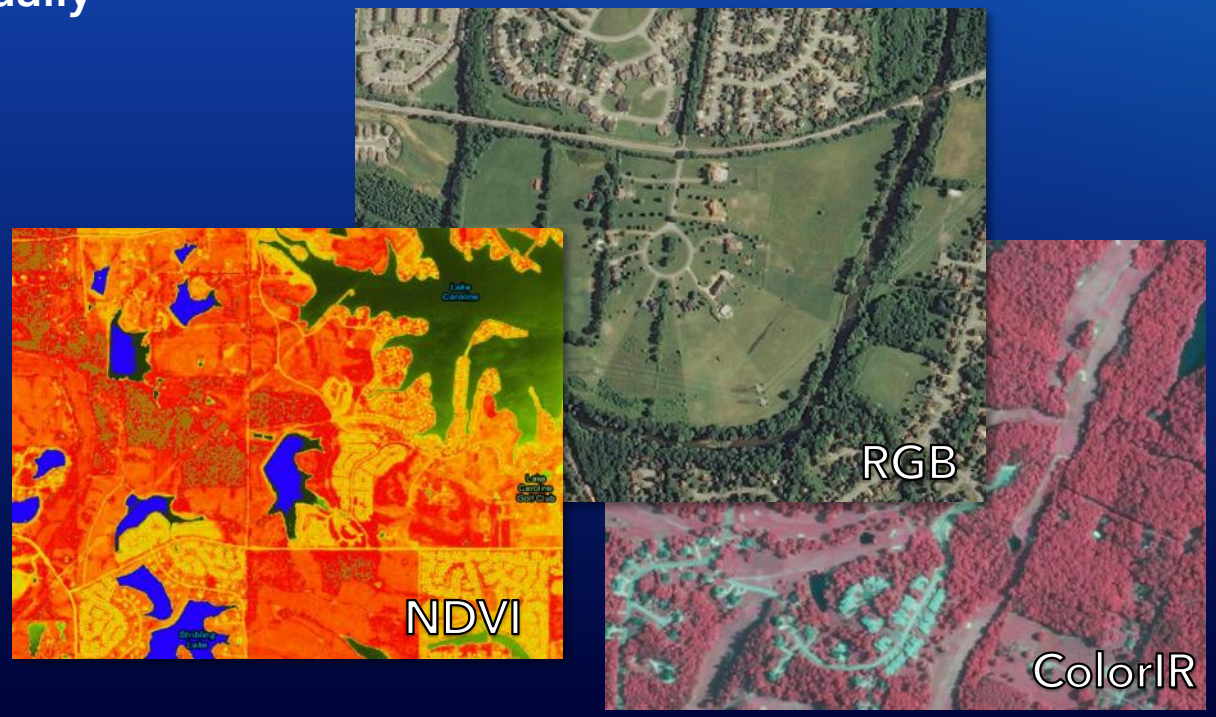
World Imagery Wayback

NAIP – Dynamic Image Services

- **Dynamic Imagery for regional analysis**
- **Geographic Coverage: Continental United States**
- **Source data – Original pixels, No lossy compression/resampling**
  - **Approximately half of the US is updated annually**
  - **2020 coming soon**

From USDA
4 Bands, 0.60cm & 1.0
Multiple UTM Zones
2010 to2019
2 year revisit cycle

Stored in Cloud as COG
Managed by Esri



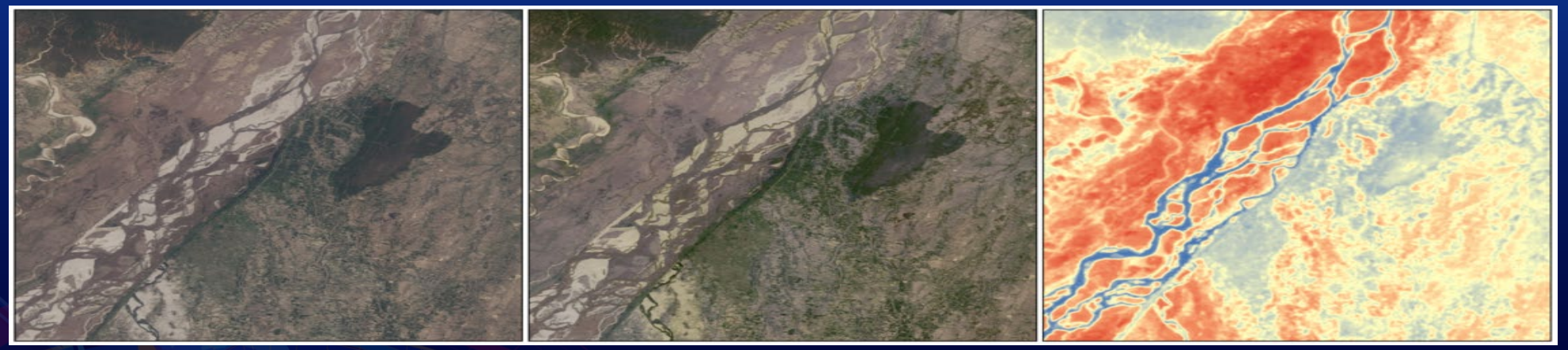
Landsat – Dynamic Image Services

Global Earth Observation

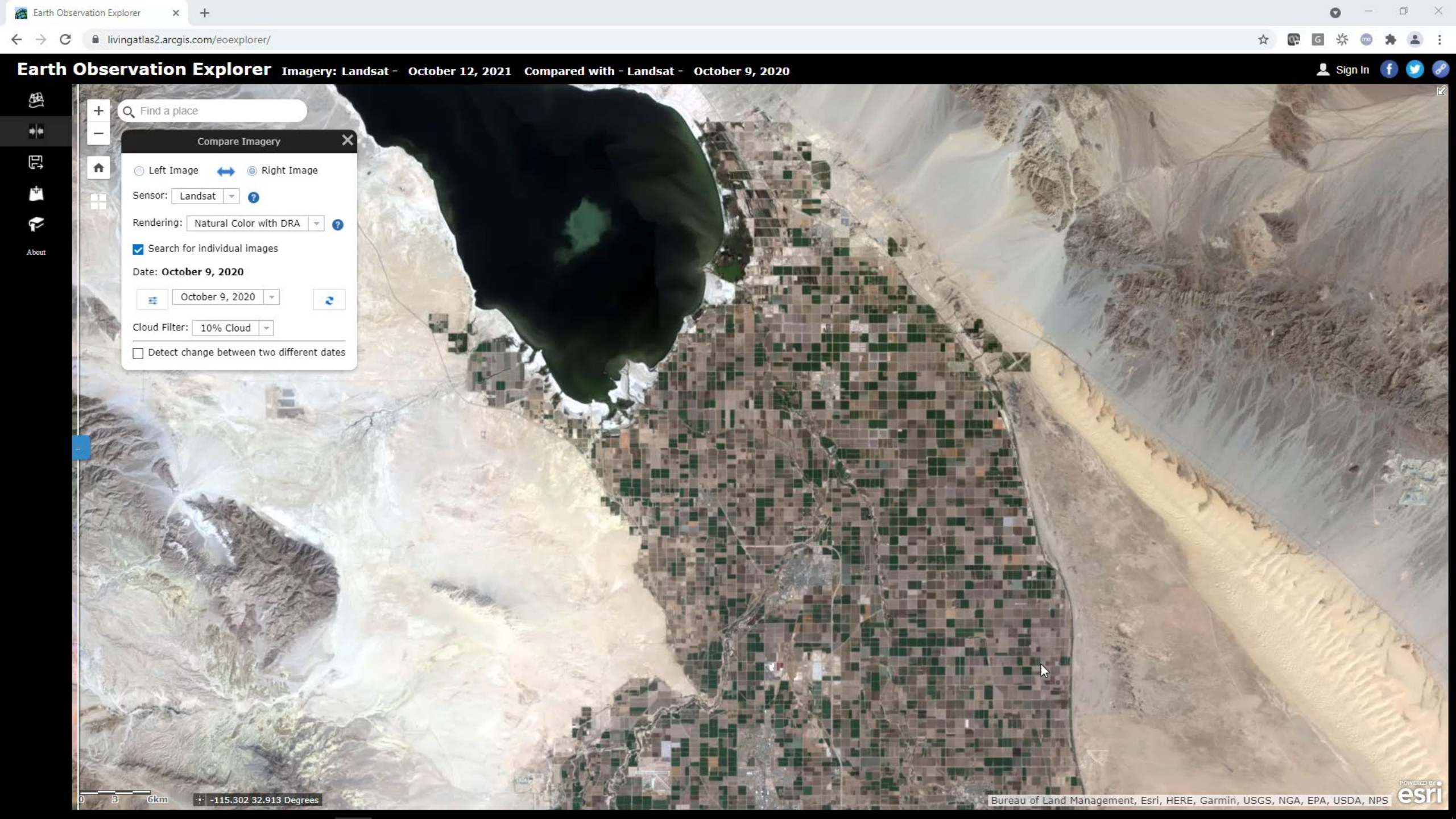
- **Landsat-8 Collection2 - Level 1**
  - **Top of Atmosphere Reflectance**
  - **Upgraded from Collection 1 to Collection 2**
  - **Improved geometric and radiometric accuracy**
- **Landsat-8 Collection2 - Level 2**
  - **Surface Reflectance**
  - **Analysis Ready**

From USGS
11Bands
1 Pan Band x15m
8 MS Bands x 30m
2 Thermal Bands x 100m
2013 to present
16 day revisit cycle
Updated Daily

Hosted on Microsoft Planetary Computer
Stored as COG
Download and Managed by Esri



Level-1 top-of-atmosphere | Level-2 surface reflectance | Level 2 - surface temperature


Earth Observation Explorer
livingatlas2.arcgis.com/eoexplorer/
Earth Observation Explorer
Imagery: Landsat - October 12, 2021
Compared with - Landsat - October 9, 2020
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Left Image
Right Image
Sensor: Landsat
Rendering: Natural Color with DRA
Search for individual images
Date: October 9, 2020
October 9, 2020
Cloud Filter: 10% Cloud
Detect change between two different dates
0 3 6km
-115.302 32.913 Degrees
Bureau of Land Management, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS
esri

Sentinel-2 – Dynamic Image Services

Global Earth Observation

- **Sentinel 2 - Level 1C**
  - **Top of Atmosphere Reflectance**

- **Sentinel 2 - Level 2A**
  - **Surface Reflectance**
  - **Analysis Ready**

From ESA
15Bands:
4 Bands x10m
6 Band x20m
3 Bands x60m
3 AOTMAp,WVPMap,SCL
2015 to present
5 day revisit cycle
Updated Daily

Level 2A - Hosted on Microsoft Planetary Computer in West Europe Region
Stored as COG
Processed and Managed by Esri



Sentinel 2 Level-1C



Sentinel2 Level-2A



On-The-Fly Raster Functions

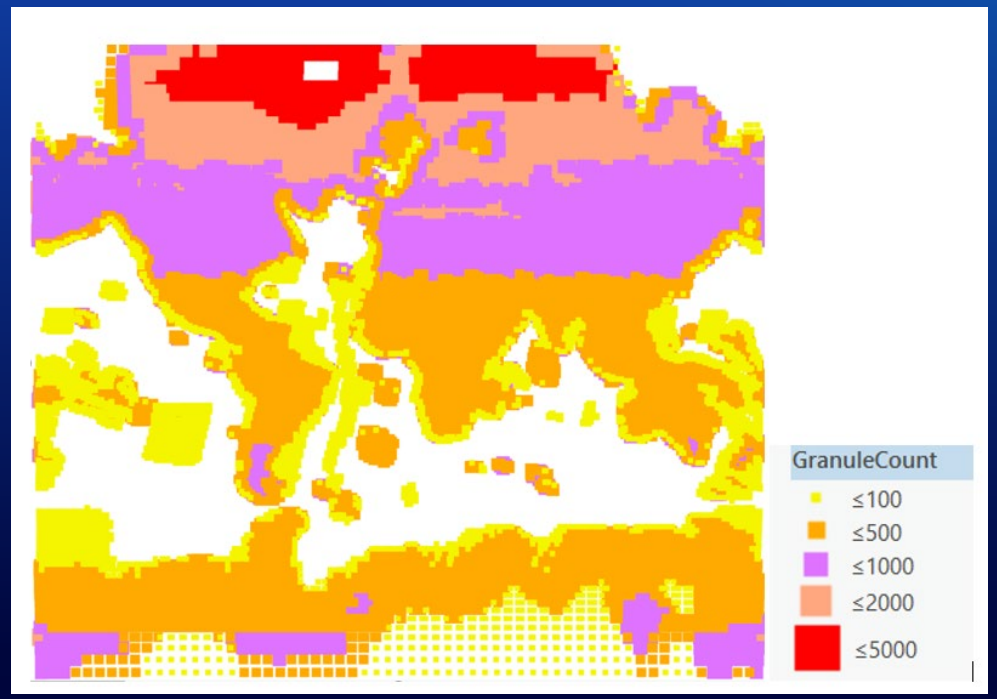
Sentinel 2 – Level 2A Processing

- Processed by Esri for Microsoft
- ESA SNAP (approx. 40min CPU/Granule)
- Using Azure Compute

- 18 Million granules
- 14 PB of imagery
- 12 Million Hrs of compute
  (primarily 40,000 cores for 10days)

- Stored as COG on Microsoft Planetary Computer
- Served as Dynamic Image Services
- Input for Analytics

- Every Day:
  - Approx. 9000 granules
  - Downloaded and processed
  - 9600 CPU hr/day (50 instances x 8CPU x 24hr)





AI-powered planetary insights for our changing world

Steve Brumby CEO steve@impactobservatory.com

Impact Observatory - Proprietary and Confidential

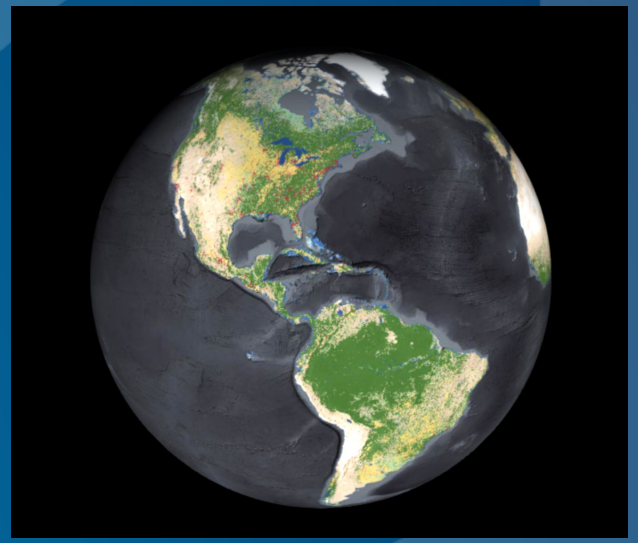
June 2021 - Esri, Impact Observatory, and Microsoft launch revolutionary AI-powered global maps to monitor the world at previously unobtainable speed and scale



Billions of human labeled training pixels



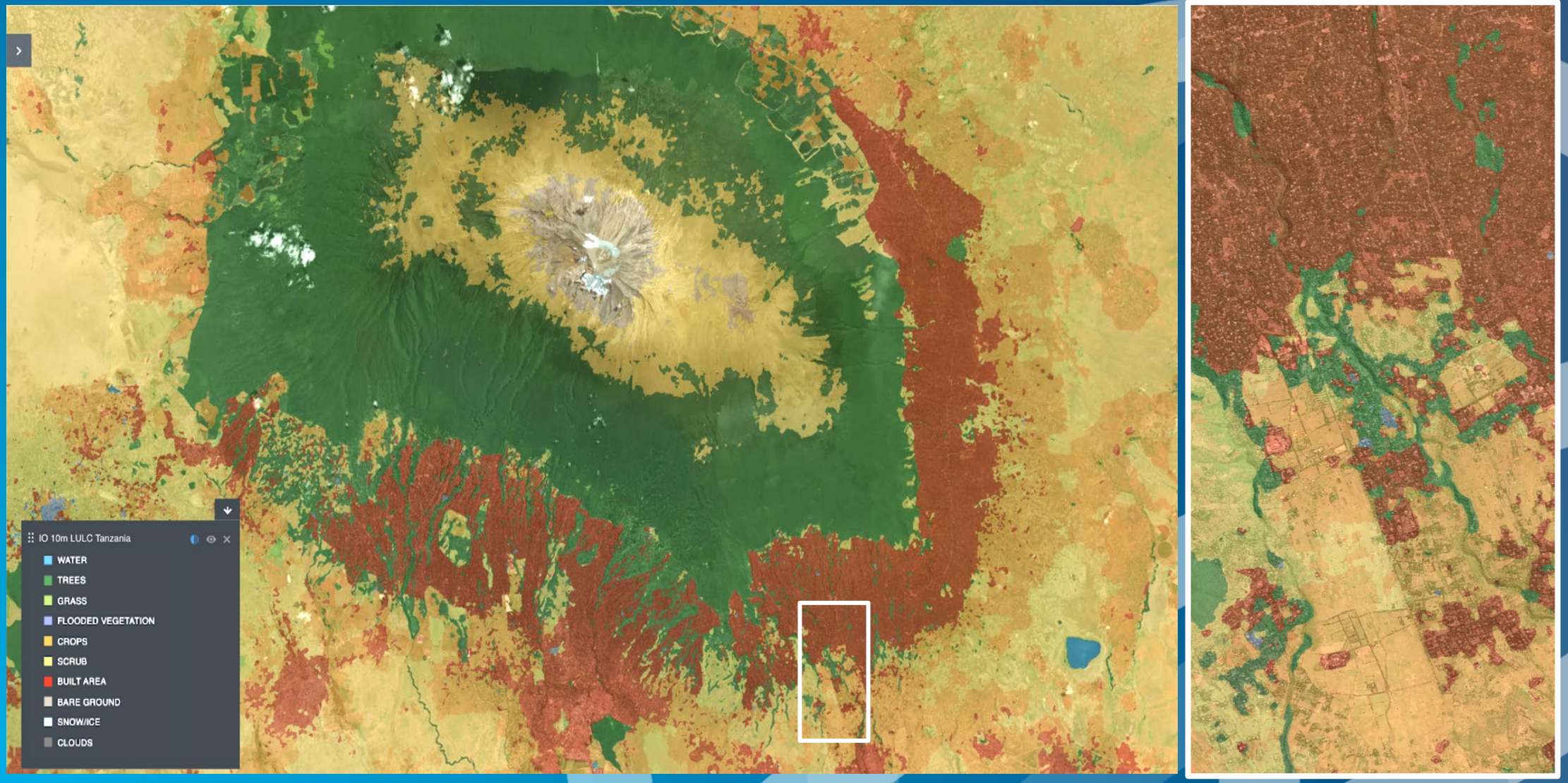
Deep learning model on thousands of cloud cores and 600TB of public satellite imagery



Global mapping at unprecedented speed, scale, and accuracy

Impact Observatory

livingatlas.arcgis.com & planetarycomputer.microsoft.com



Mount Kilimanjaro, Tanzania

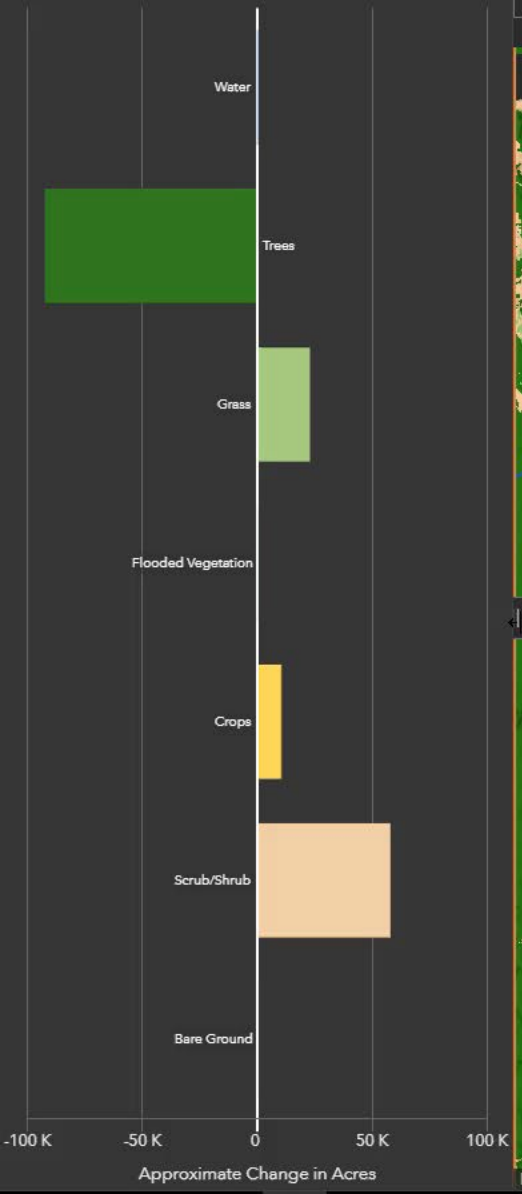
K. Karra, C. Kontgis, Z. Statman-Weil, J. C. Mazzariello, M. Mathis and S. P. Brumby, "Global land use / land cover with Sentinel 2 and deep learning", 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS, 2021, pp. 4704-4707, doi: 10.1109/IGARSS47720.2021.9553499.


Land Cover 2020 3D
Earthstar Geographics | Source: USGS, NGA, NASA, CGIAR, GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community
Powered by Esri

Compare Land Cover Change between 2018, 1019, and 2020

Peter (Imagery Samples)

Change in Land Cover Area
2018 to 2020

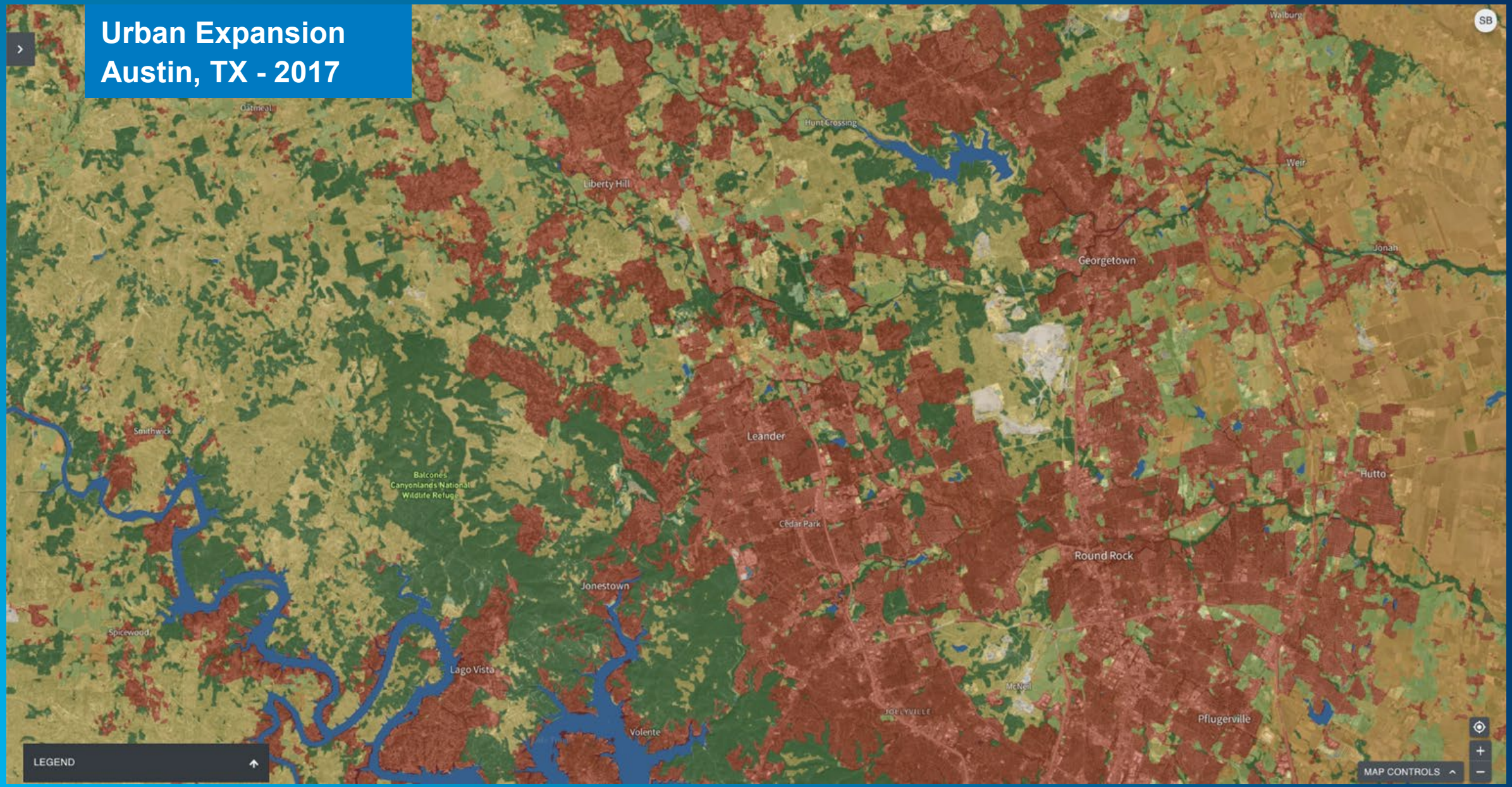


kincaid fire | australian fires | amazon deforestation | grey glacier

2018 2019 2020

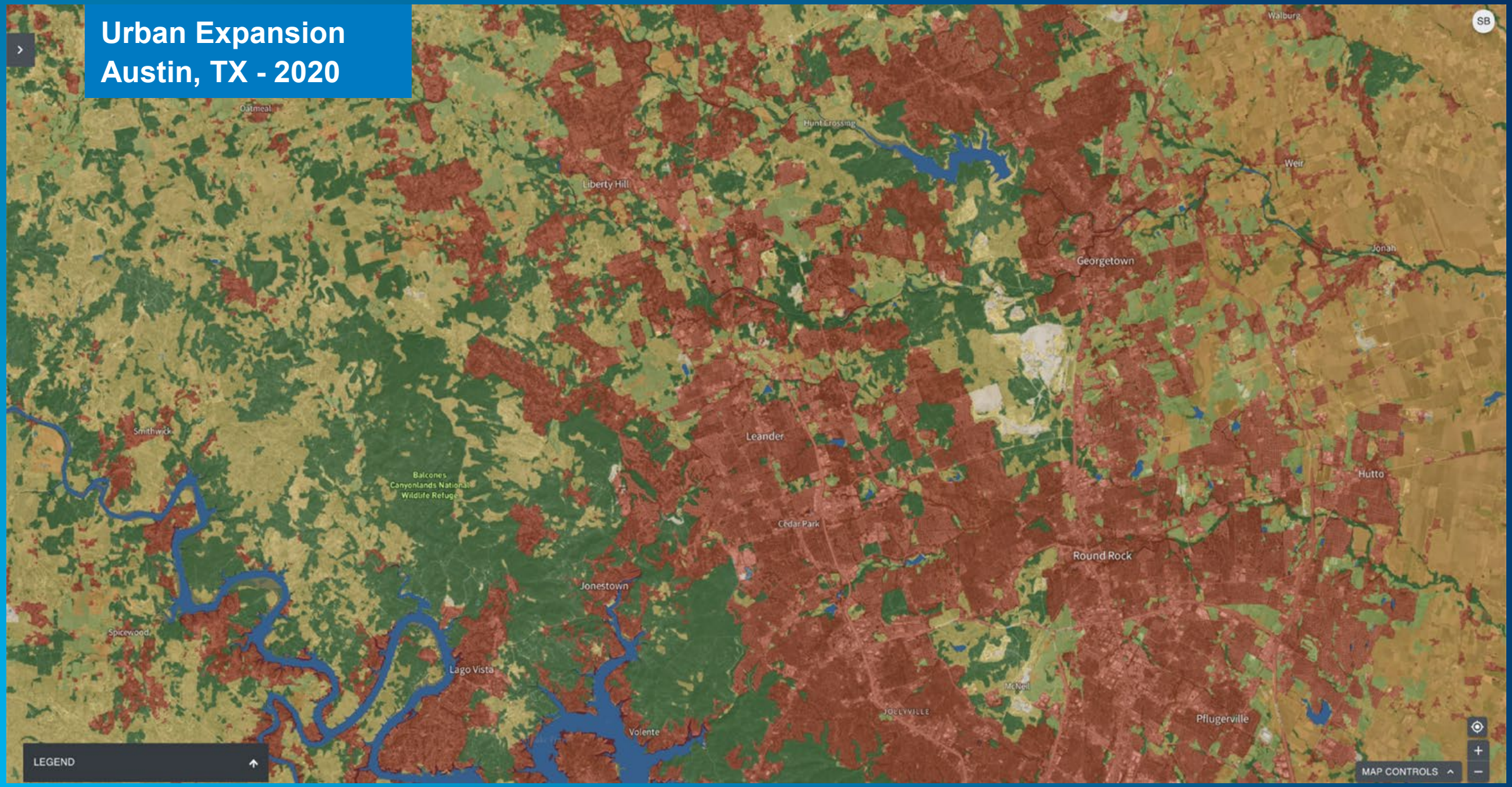


Urban Expansion
Austin, TX - 2017

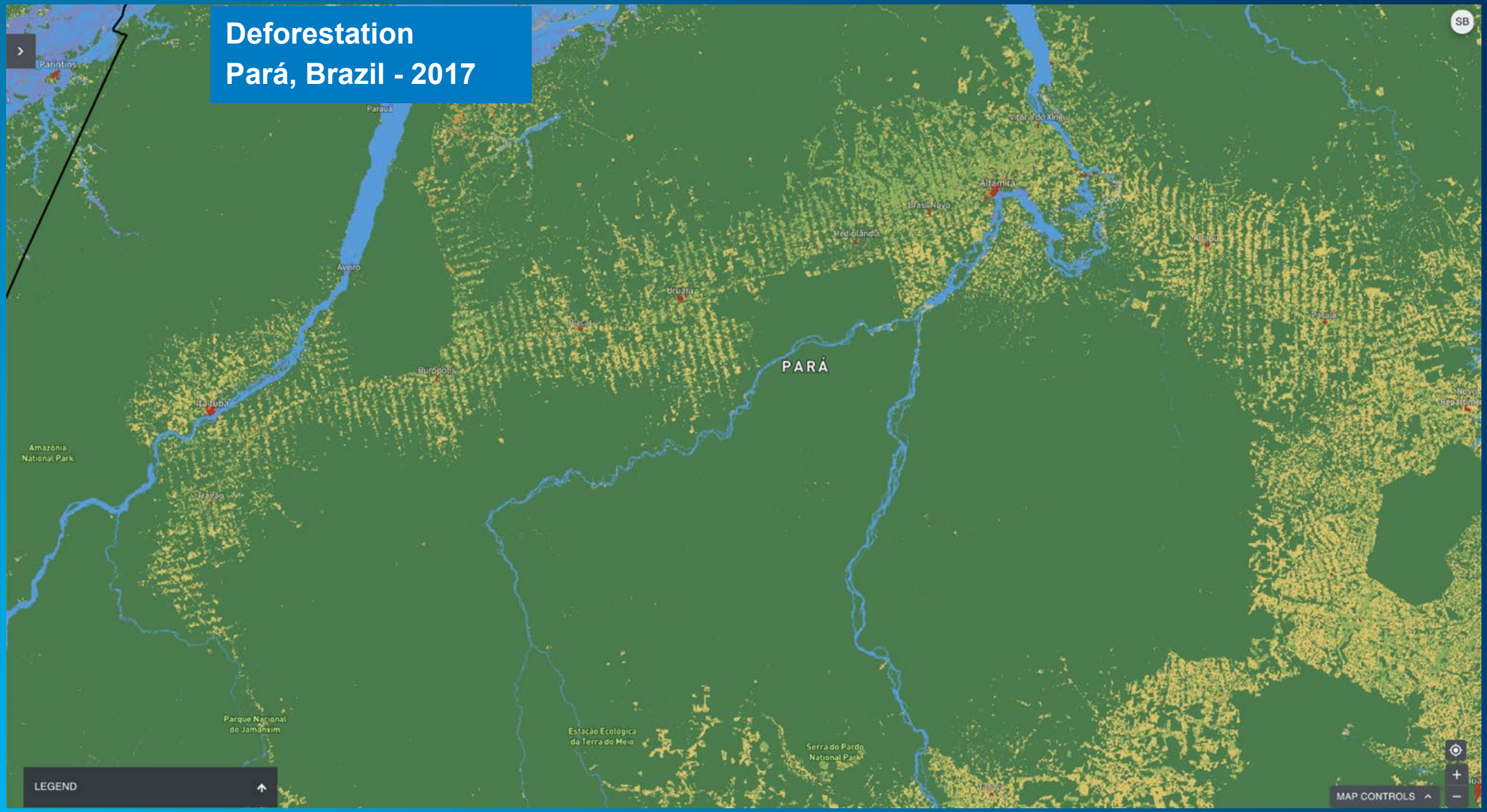


Impact Observatory

Urban Expansion
Austin, TX - 2020



Impact Observatory



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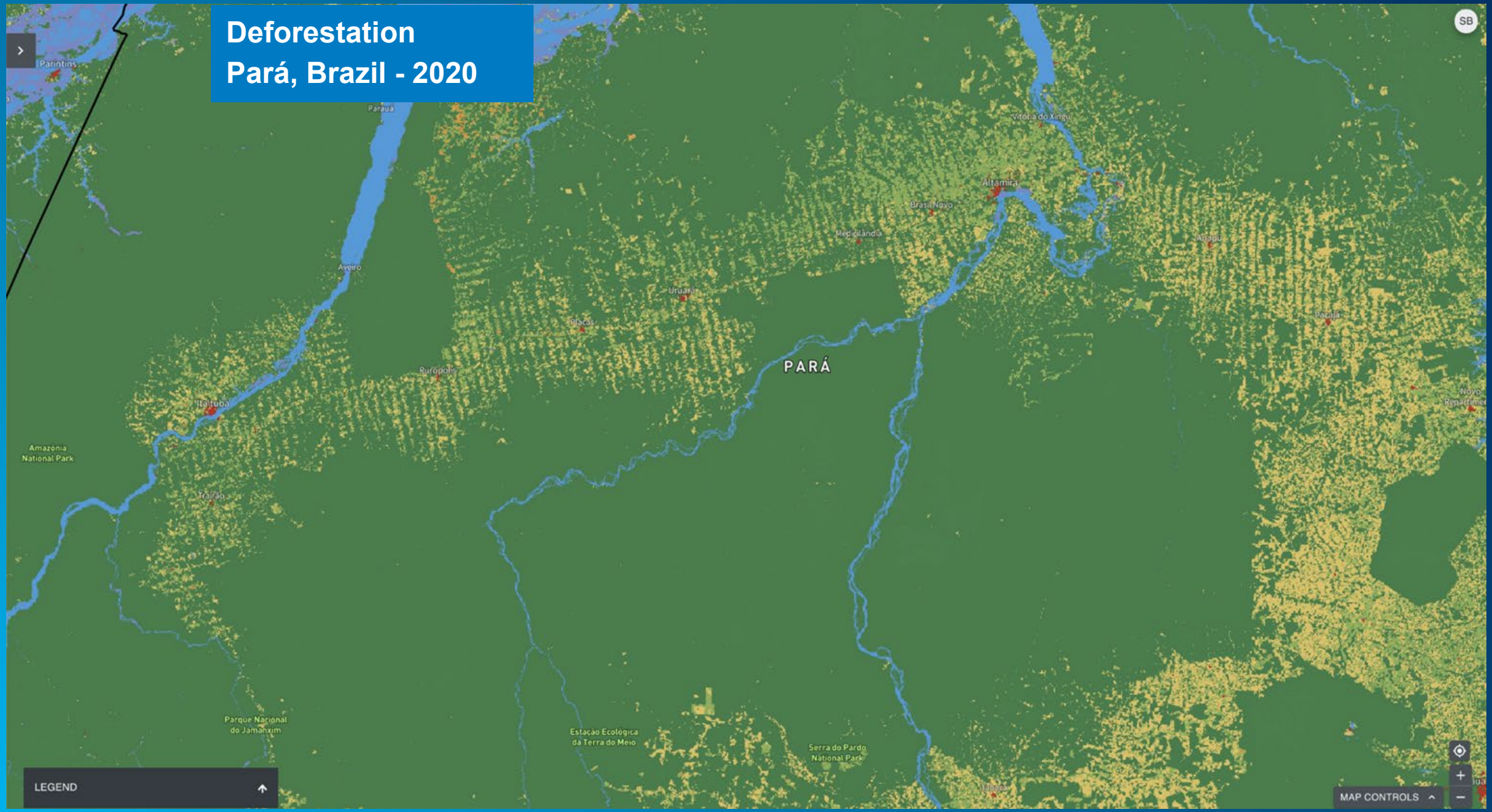

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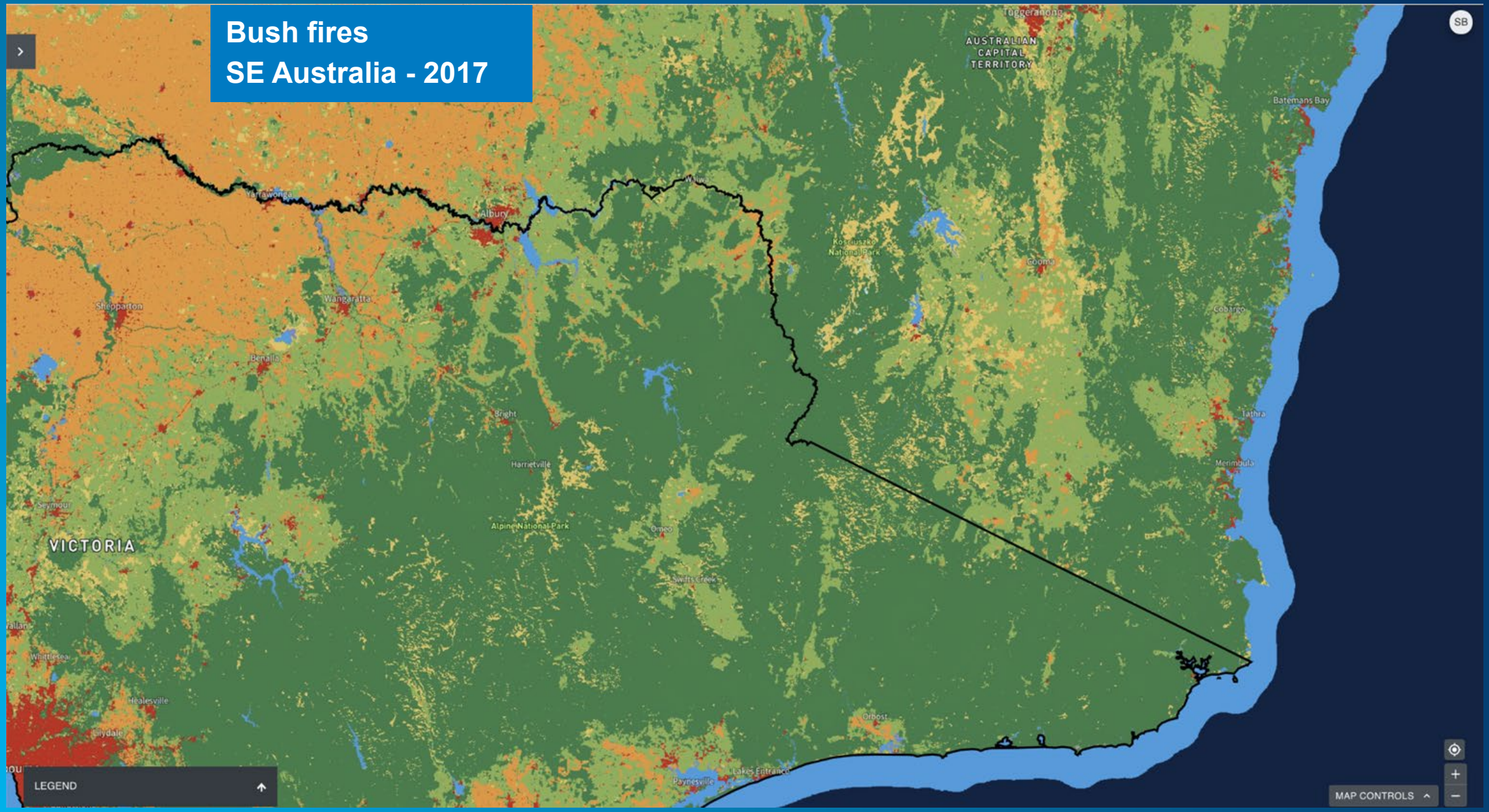
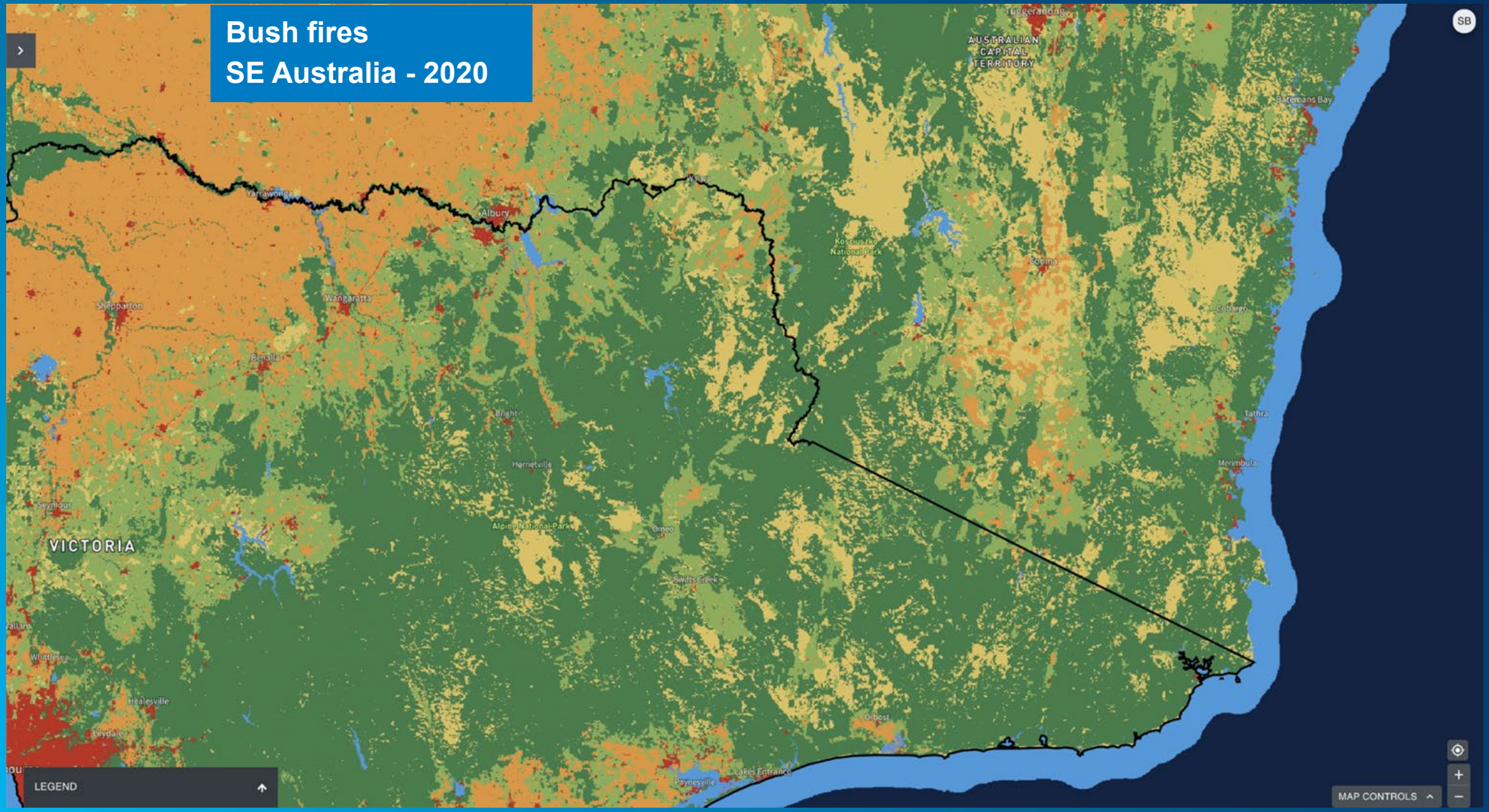


Impact Observatory



Impact Observatory

Oct 2021 - Esri, Impact Observatory announce
AI-powered maps-on-demand limited preview



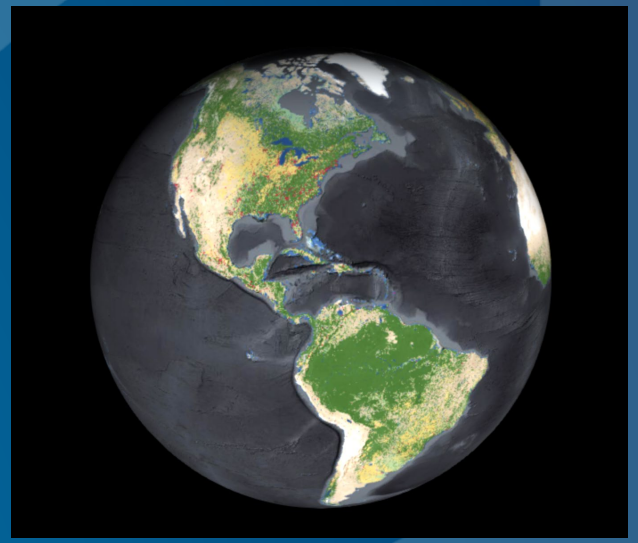
June 2021 - Esri, Impact Observatory, and Microsoft launch revolutionary AI-powered global maps to monitor the world at previously unobtainable speed and scale



Billions of human labeled training pixels



Deep learning model on thousands of cloud cores and 600TB of public satellite imagery



Global mapping at unprecedented speed, scale, and accuracy

Impact Observatory

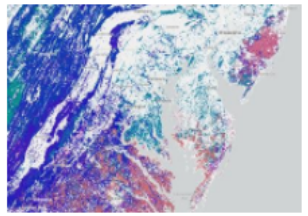
Search Living Atlas for maps, apps, and more

Search Examples

All Trending Basemaps Imagery Boundaries People Infrastructure Environment

Layers All time All regions Esri-only content Authoritative-only content Sort by: Relevance

1265 Results

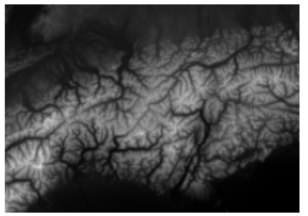


USA Forest Type

Imagery Layer By esri

This layer contains the Forest Type across the contiguous United States and Alaska.

Subscriber Authoritative



Terrain

Imagery Layer By esri

A multi-resolution world elevation layer providing access to elevation values for use in analysis with functions for slope, aspect, and hillshade.

Subscriber Authoritative

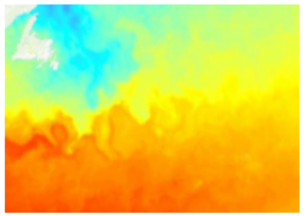


USA SSURGO - Soil Hydrologic Group

Imagery Layer By esri

This layer displays hydrologic soil group in seven classes that describe the rate that the soil absorbs rainfall.

Subscriber Authoritative



Sea Surface Temperature (°C)

Imagery Layer By esri

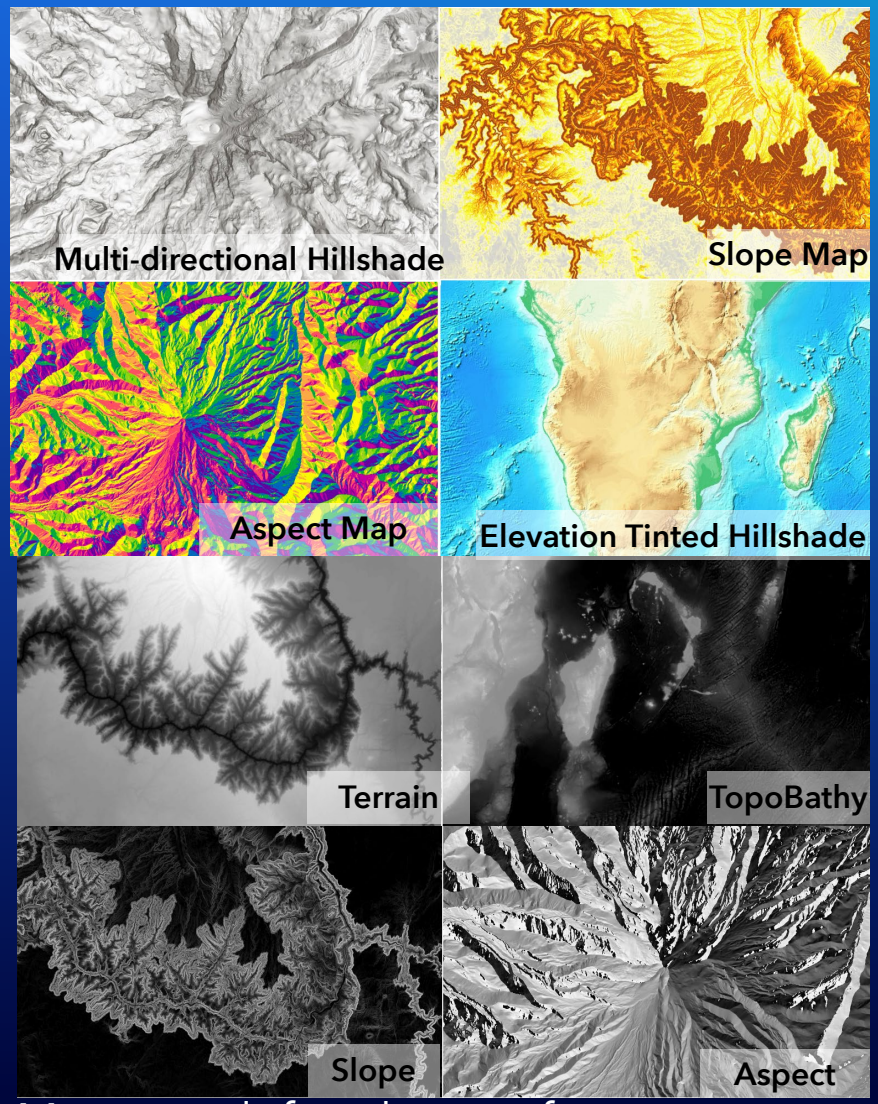
This layer displays daily global sea surface temperature in degrees Celsius (°C) at 10 km resolution.

Subscriber Authoritative

World Elevation (Terrain) layers - Dynamic Image Services

- For visualization, analysis, orthorectification
- Global collection of multi-resolution & multi-source
  - 1000 meters to 0.25 meters
  - ~ 163,000 rasters (~ 6 TB, LERC compressed MRF's)
  - Terrain & TopoBathy

- Requires ArcGIS Online subscription
  - No credits

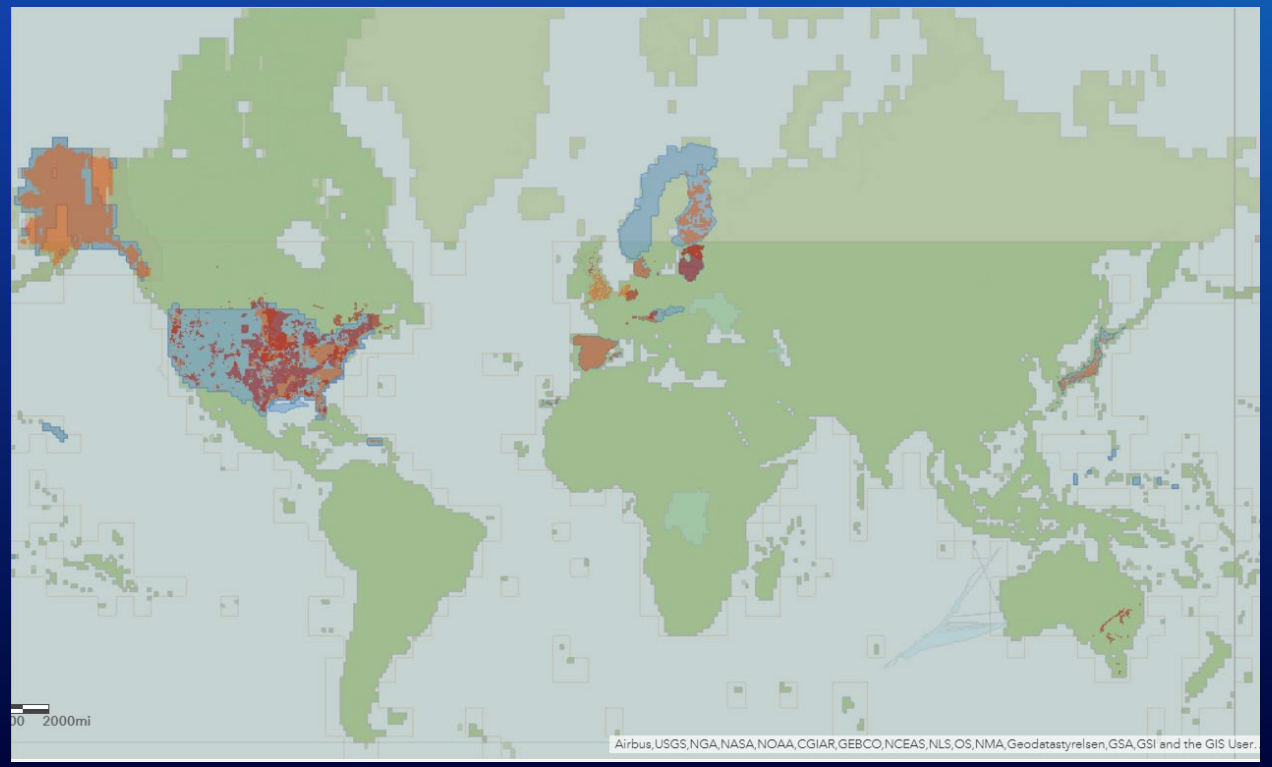


Many predefined raster functions

World Elevation – Coverage and Data Sources

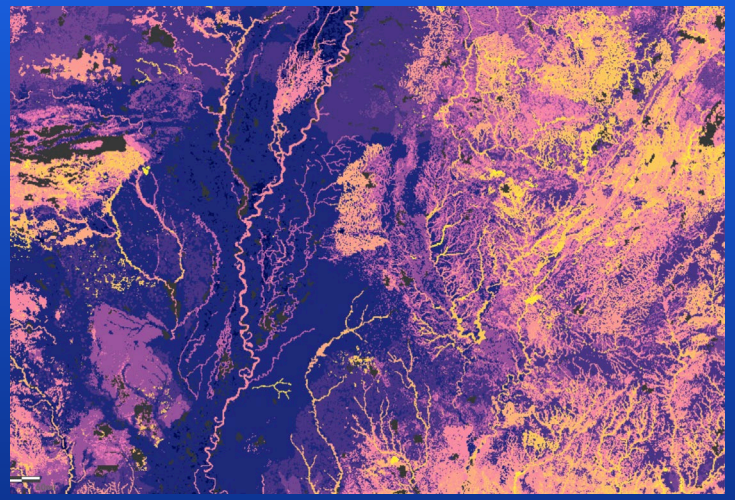
Best public, commercial and community data
USGS, NRCS, NASA, NOAA, CGIAR and many national mapping organizations
Global - Airbus Defence & Space (24m, 4m r.m.s.e)
44 authoritative data providers and growing …

- Recent Additions:
  - Canada HRDEM 1m
  - Latvia 1 m, 10 m, 20 m
  - Lithuania 1 m, 10 m
  - Spain 2m (partial)
  - Slovak Republic 10 m
  - GSA Australia 1 m (partial)
  - Moreton Bay Australia 1m
  - Varnamo (Sweden) 50 cm
  - Salzburg (Austria) 1m
  - USGS 3DEP 1 m (updates)
  - USGS 3DEP 5 m (Alaska)
  - GEBCO 2019 (~ 464 m)

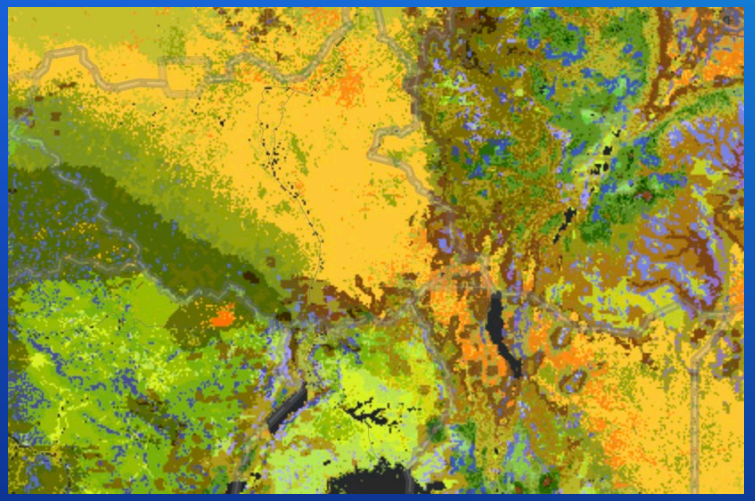


https://www.esriurl.com/ElevationCoverageMap

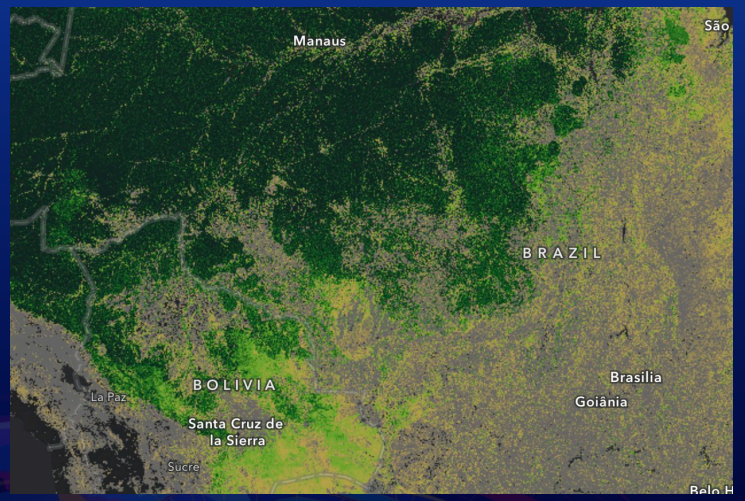
Ecosystem Content



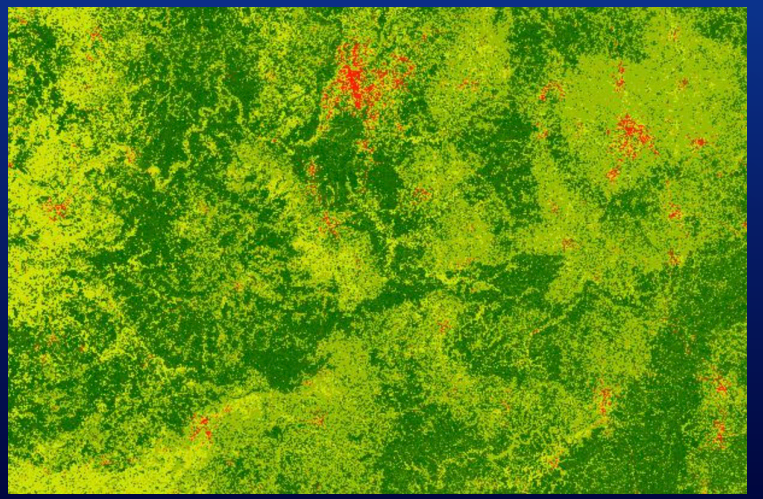
MOBI USA biodiversity



World Ecosystems

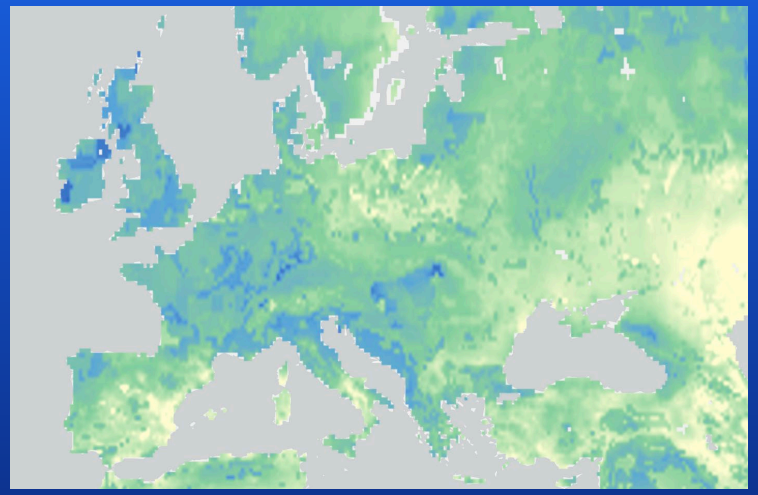


Global Carbon Biomass

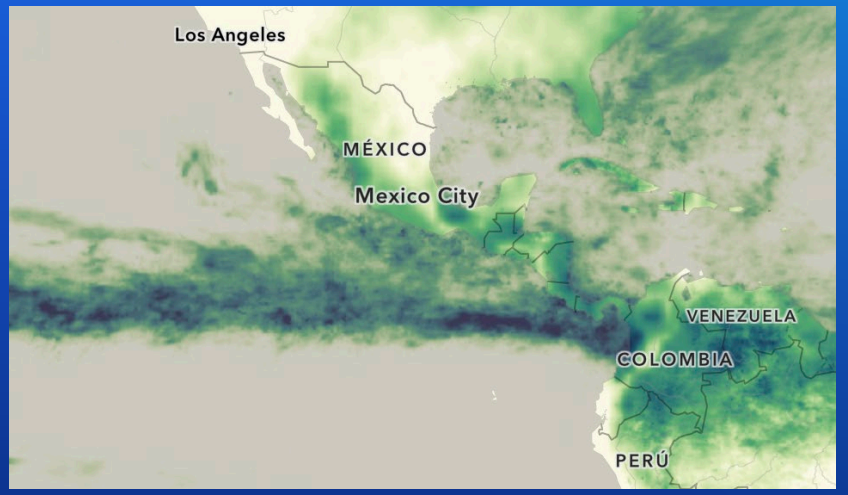


Ecosystem Connectivity

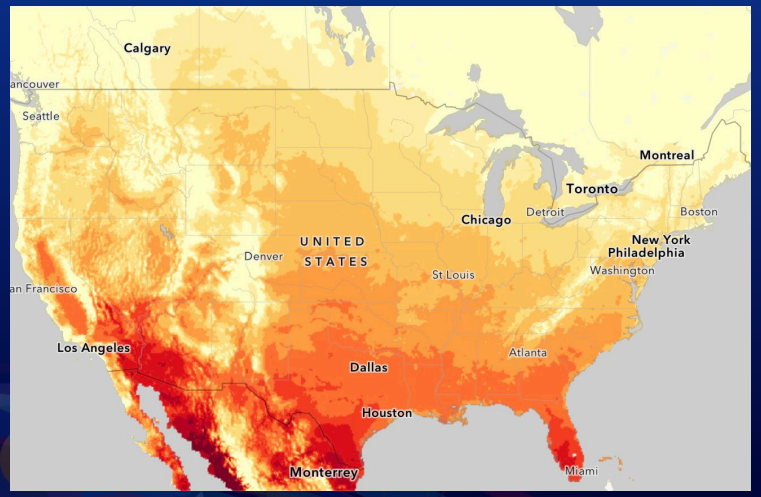
Climate Content



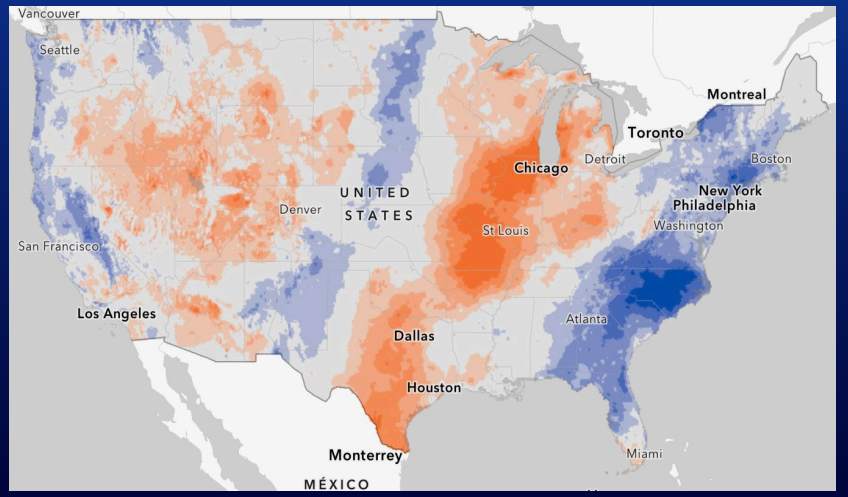
NASA GLDAS hydrology models



IMERG and WorldClim precipitation estimates

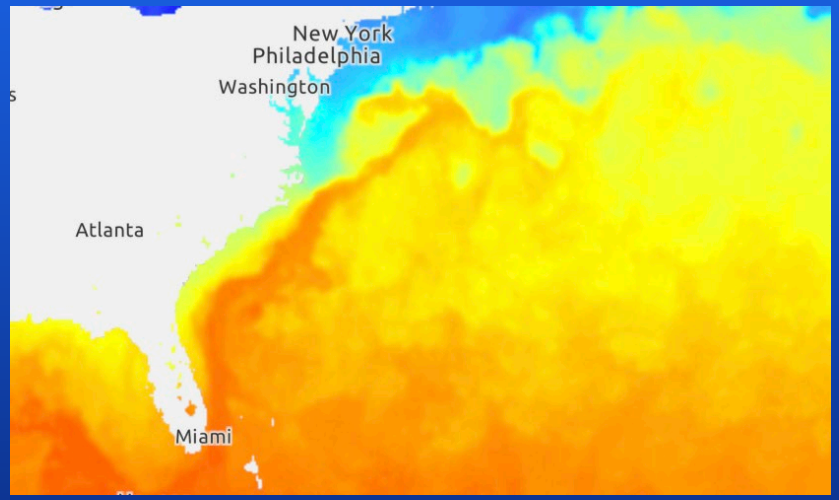


LOCA climate models

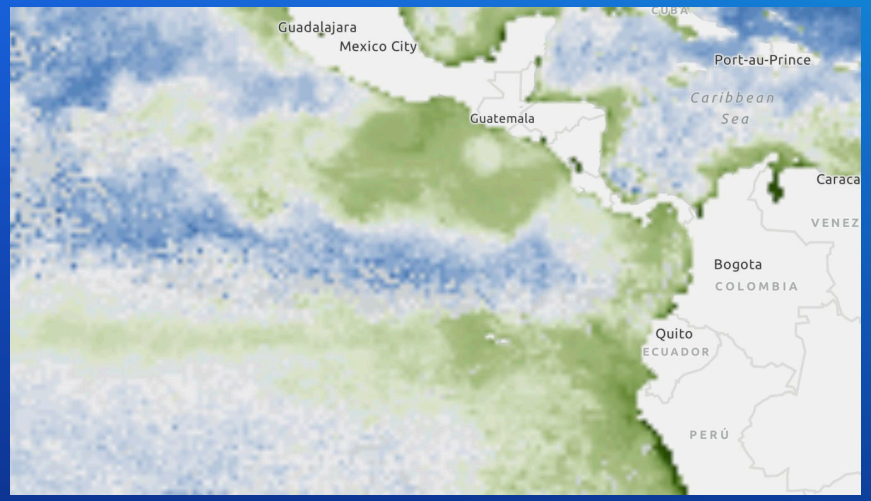


USDA's drought analysis timeseries

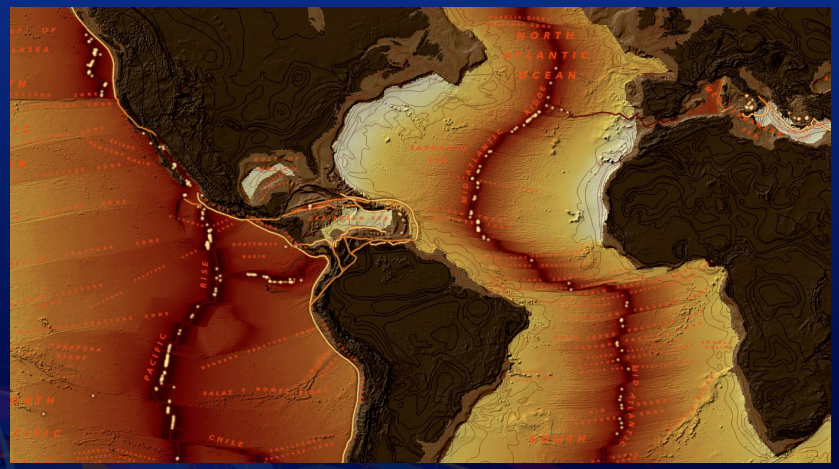
Ocean Content



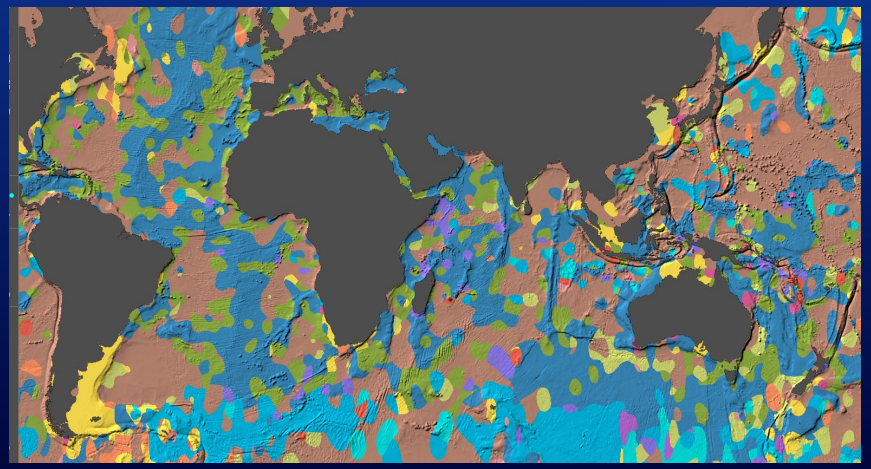
Daily sea surface temperature



Daily chlorophyll concentration

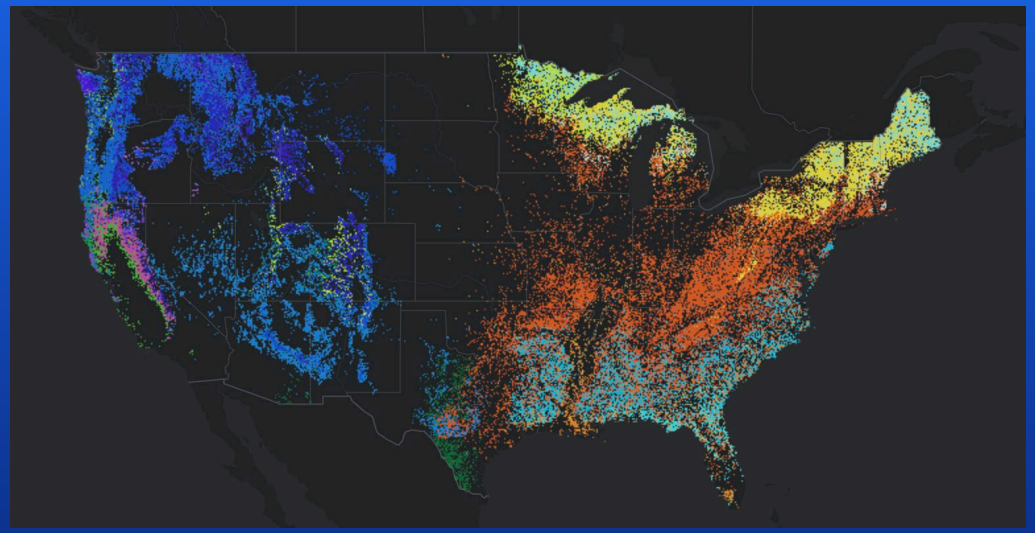


Seafloor age

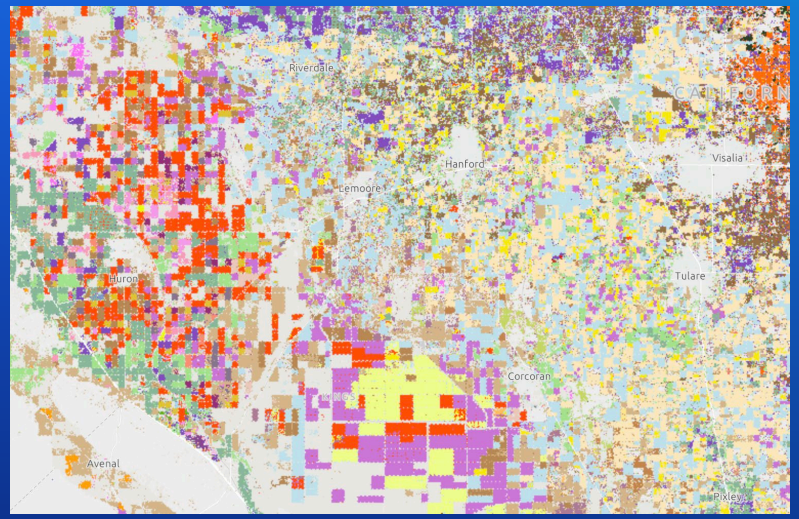


Seabed lithology

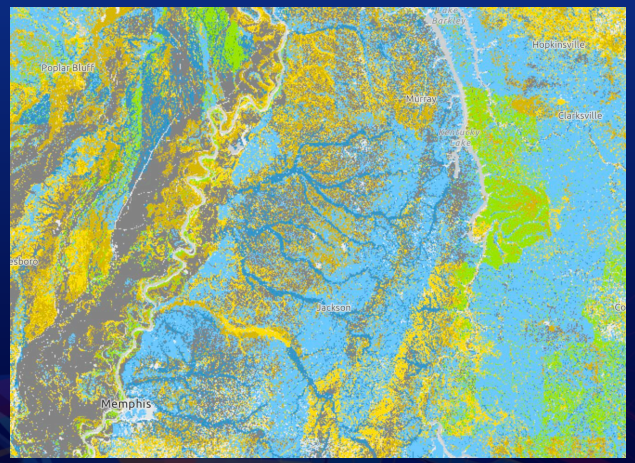
Landscape Content



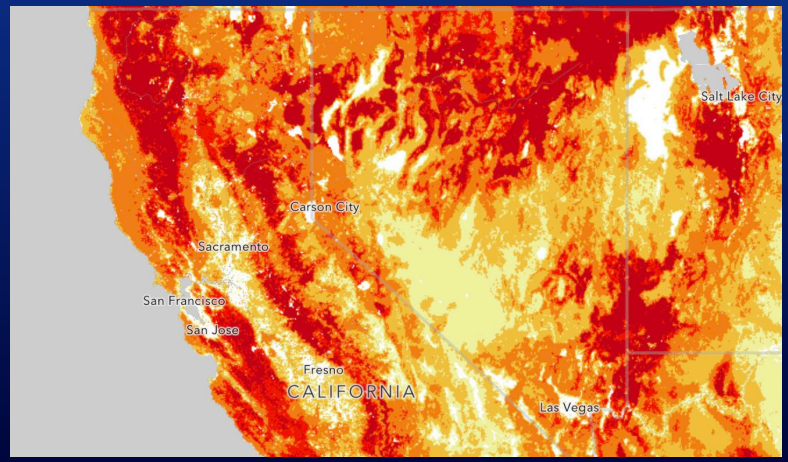
FIA Forest Type Group



USA Cropland timeseries

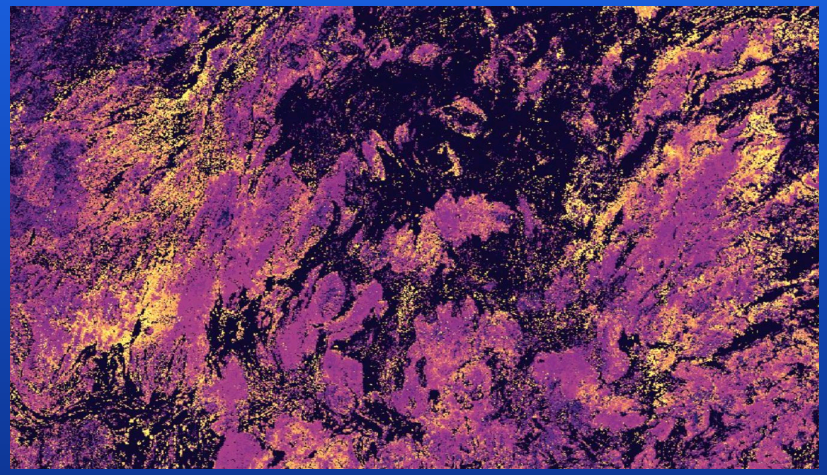


SSURGO USA Soils

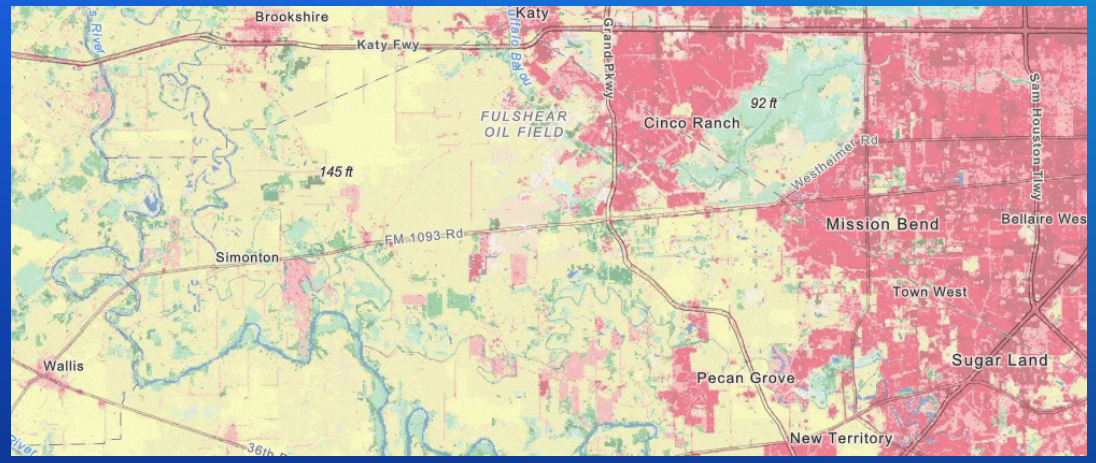


Wildfire risk collection

Land Cover Content



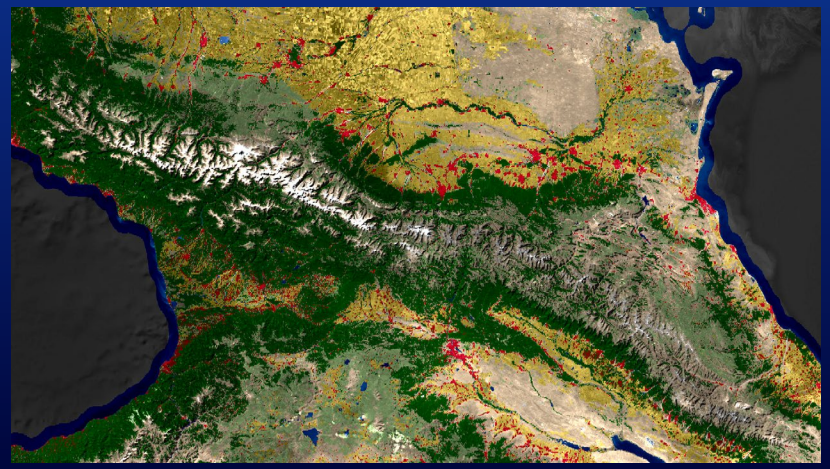
Esri 2050 Land Cover and Vulnerability



NLCD timeseries



ESA 1992-2019 timeseries



Esri 10m Land Cover

Tiled Imagery

- Server Streams Preprocessed tiles
  - Any Bit Depth
  - Any Number of Bands
  - Any Projection
  - Including Multi-dimensional
- Client
  - Makes request for required tiles
- Server
  - Returns Tiles
- Client
  - Performs rendering or processing
- Optimized for Analytics and Serving Pre-generated products
- Output from Analytics

Dynamic Imagery

- Server Side On-The-Fly
  - Processing
  - Mosaicking
- Client
  - Makes single request
  - Define processing to be performed
- Server
  - Performs processing & rendering
  - Against source data
  - At requested resolution
  - Returns required product
- Can use Tiled Imagery as Input
- Optimal for On-The-Fly Analysis

Available with ArcGIS Image Server, ArcGIS Image for ArcGIS Online, and ArcGIS Image Dedicated

ArcGIS Image for ArcGIS Online

Host imagery

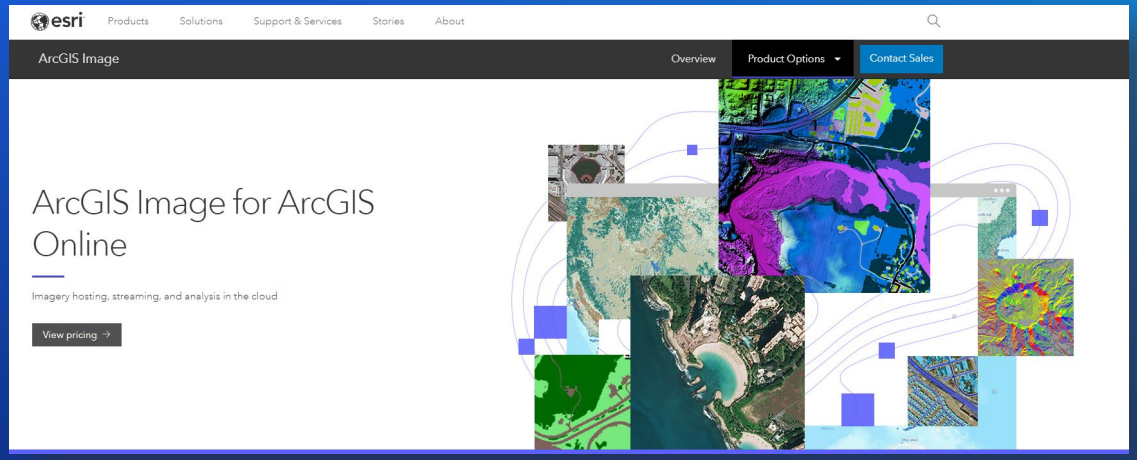
Upload imagery and rasters into ArcGIS Online for secure storage and management.

Stream imagery

Stream intelligent tiled imagery that's performant and analysis ready. Serve dynamic imagery that offers on-the-fly processing and dynamic mosaicking.

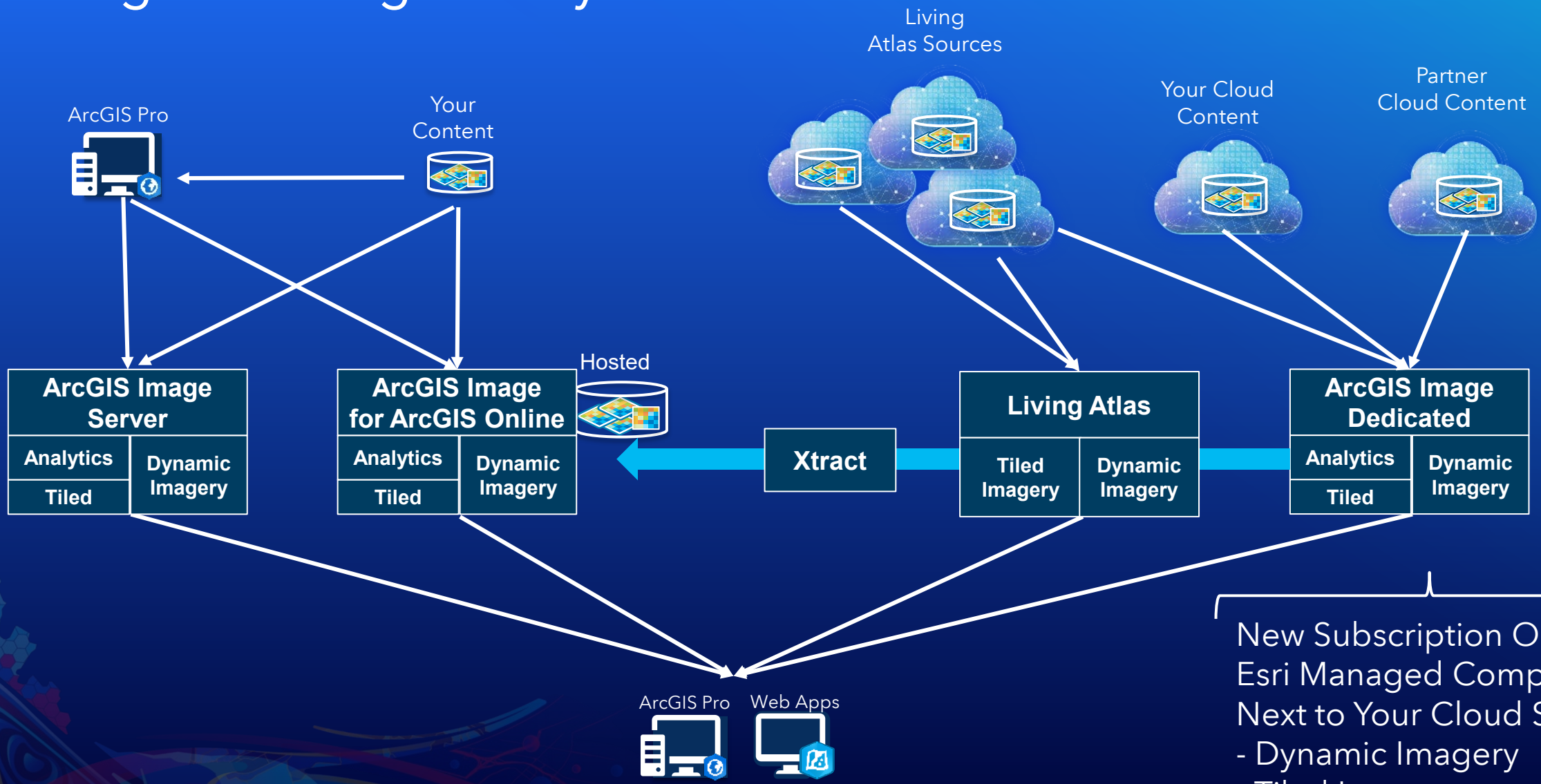
Analyze imagery

Make sense of imagery and raster collections to understand climate change, urban sprawl, agriculture production, and more.



Make imagery accessible | Eliminate infrastructure management | Stay within budget | Simplify image management | Image analysis in the cloud

Scaling Processing & Analytics

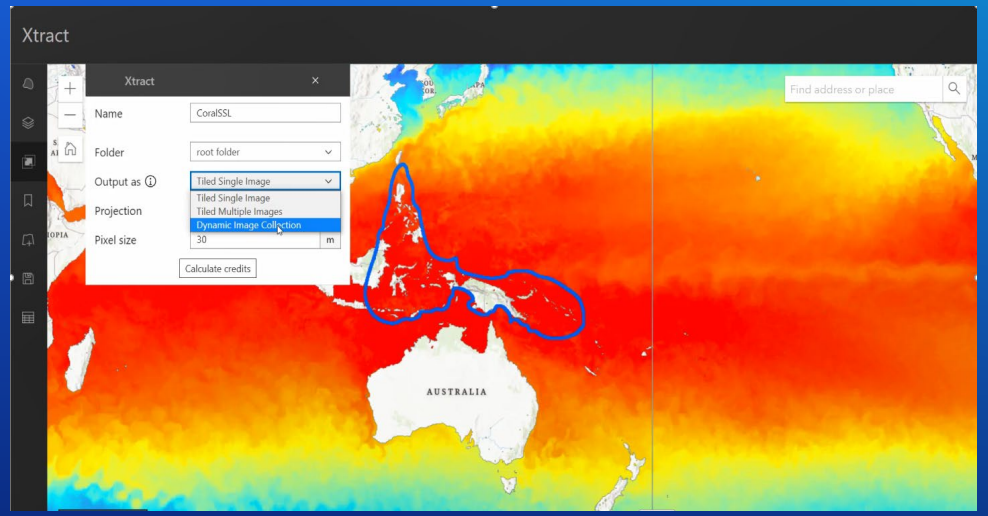


New Subscription Option
Esri Managed Compute
Next to Your Cloud Storage:
- Dynamic Imagery
- Tiled Imagery
- Processing & Analysis

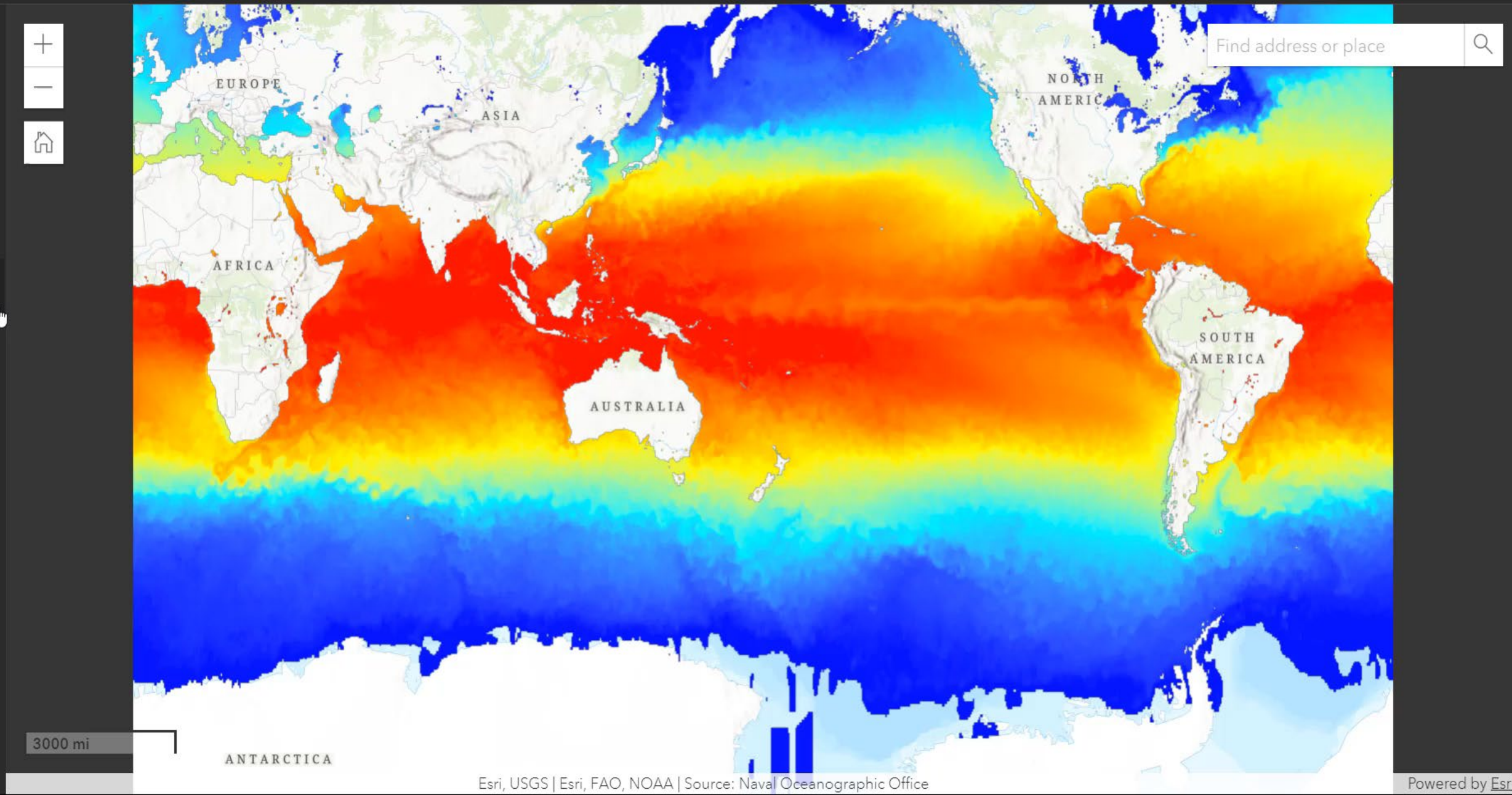
Xtract

Extract subset of the living Atlas to ArcGIS Image for ArcGIS Online

- From Multiple Source
- Define Area of Interest
- Optionally define pre-processing (eg NDVI)
- Multiple Modes
  - Tiled Single – Single Multidimensional Data Cube
  - Tiled Multiple – Extract individual datasets
  - Dynamic Image Collection – Mosaic dataset with source data
- Data remains in source projection, where possible



Xtract


Find address or place
EUROPE
ASIA
NORTH AMERIC
AFRICA
AUSTRALIA
SOUTH AMERICA
ANTARCTICA
3000 mi
Esri, USGS | Esri, FAO, NOAA | Source: Naval Oceanographic Office
Powered by Esri

Home ▾ Coral Triangle Risk Map

Open in new Map Viewer | New Map | Create Presentation

Details | Add ▾ | Basemap | Analysis | Save ▾ | Share | Print ▾ | Directions | Measure | Bookmarks | Find address or place

About | Content | Legend

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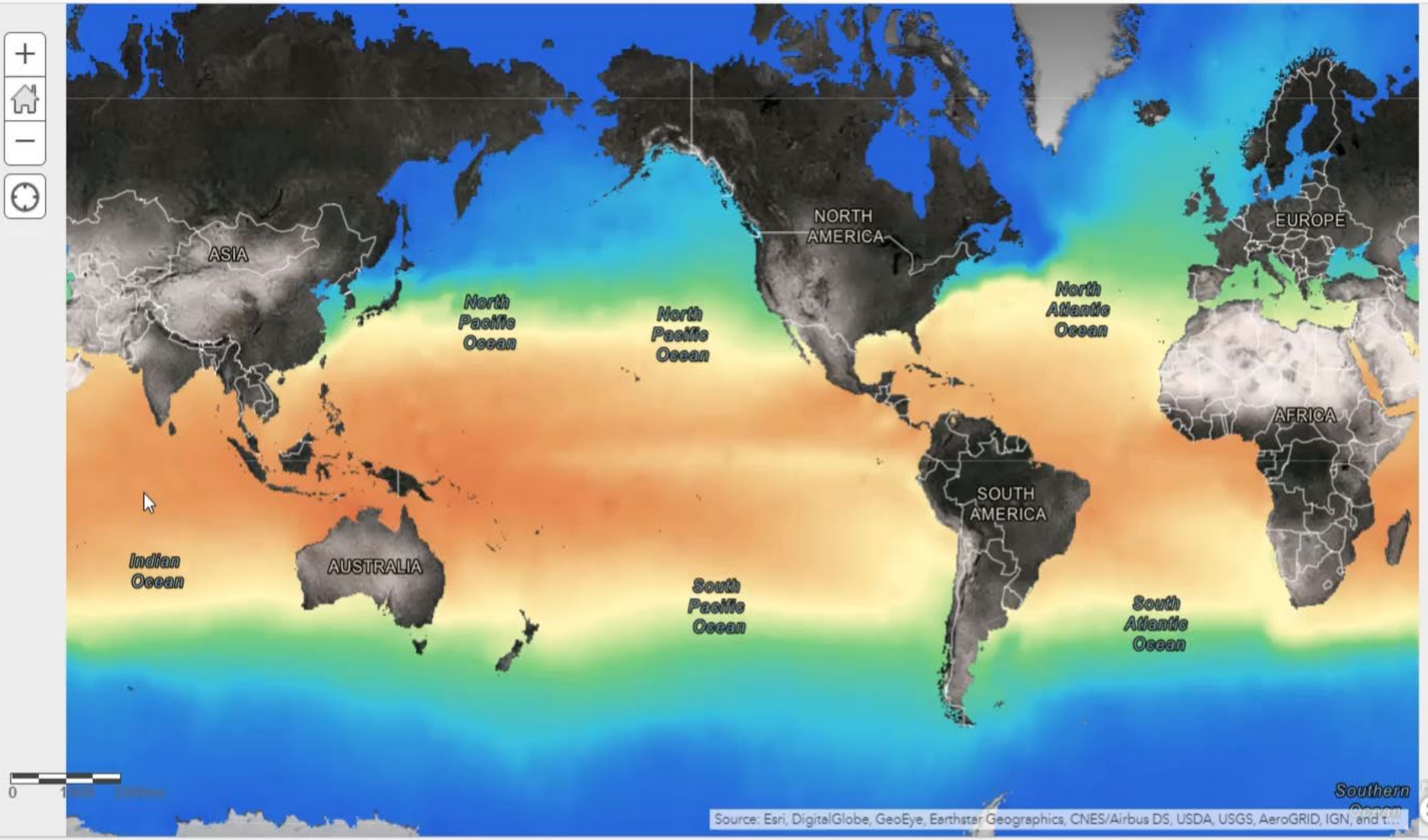
- [ ] CoralReefs-predictedRisk
- [ ] CoralTriangle
- [ ] SST CoralTriangle Trend
- [ ] SST CoralTriangle
- [x] Sea Surface Temperature (SST)
- [ ] SST CoralTriangle Trend Tiled
- [ ] CoralStationPoints symbolized vectorTile
- Firefly Imagery Hybrid

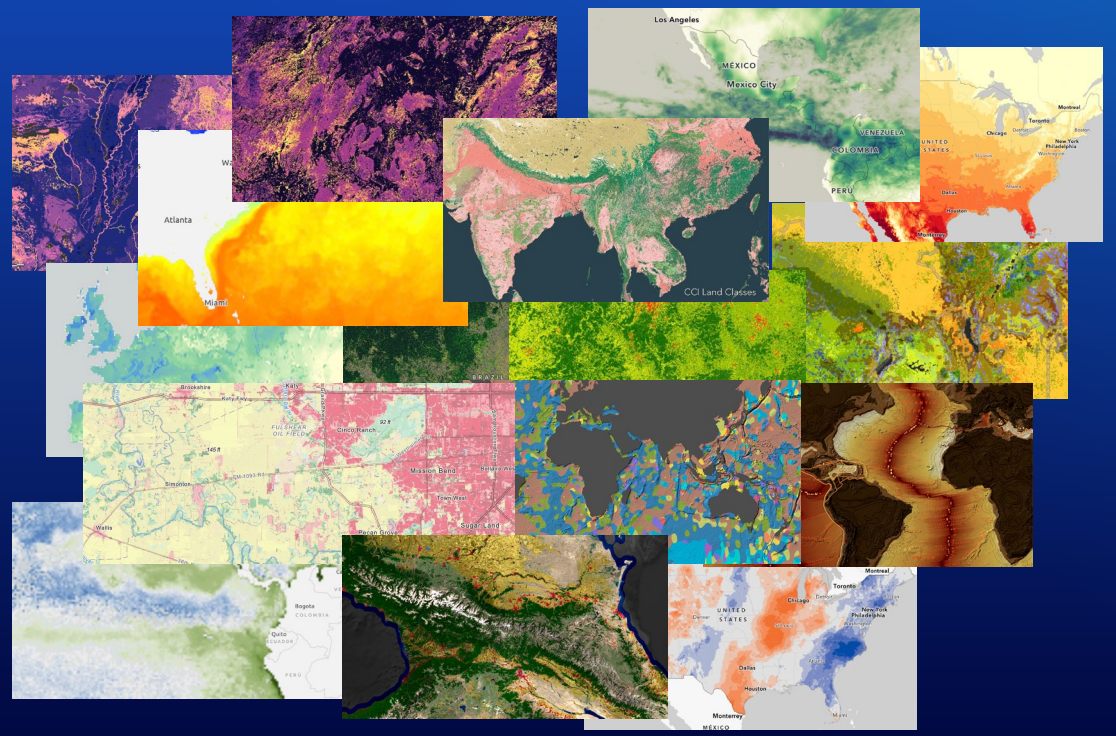


January 1, 1985, 4:00 AM - January 2, 1985, 4:00 AM

Summary

- ArcGIS Living Atlas of the World is the foremost collection of geographic information, including **maps, apps, and data layers**, from around the globe.

- Massive Collection of Imagery and Rasters
- For Visualization and Analysis
- Dynamic Imagery & Tiled Imagery
- Multiple Processing Options
  - Dynamic Imagery from clients
  - ArcGIS Pro as client and analysis
  - ArcGIS Image for ArcGIS Online
  - ArcGIS Image Dedicated
  - Xtract to ArcGIS Image for ArcGIS Online





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