



# Working with Elevation Services

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ESRI USER CONFERENCE

# Outline

- **ArcGIS Online World Elevation & 3D Elevation Cache for Pro**
- **What is included?**
  - **Data and Tools**
- **How can I use it?**
  - **Modes of use**
  - **Client Applications**
- **What are the details?**
  - **Technical and Legal**

# ArcGIS Online World Elevation & “Terrain 3D” for 3D Visualization

- **ArcGIS Online World Elevation**
  - Supports analysis & visualization
  - Accessed using REST calls defined by REST API (2D AOI, polyline, or points...)
- **Terrain 3D cached elevation service**
  - Optimized to quickly generate an oblique 3D perspective view (multiresolution)
  - Not intended for analysis
  - Automatically connected into ArcGIS Pro

# Data sources

ArcGIS Online World Elevation a.k.a. *“Terrain”* in *Living Atlas*

# World Elevation Services - Data Sources

Public domain elevation data – 2+ TB

1 km Bathymetry (GEBCO)

250m GMTED

90 m SRTM & EarthEnv-DEM90

30 m SRTM (most of world)

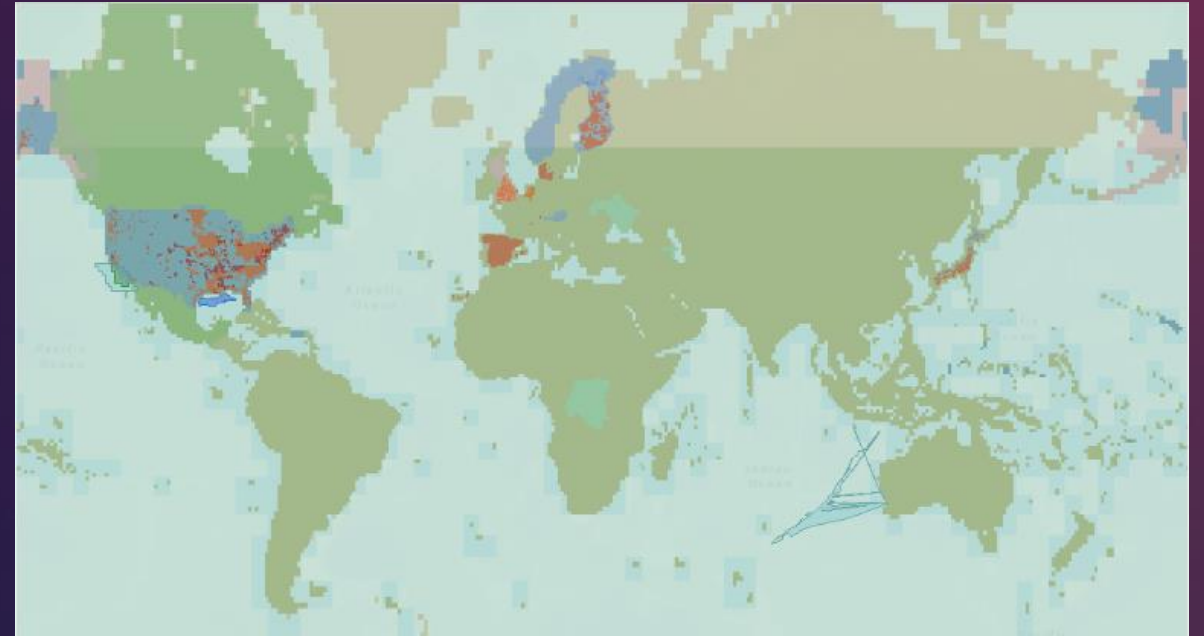
30 m NED (North America)

**12m Airbus (global)**

10 m (USA, Norway, Austria)

Many datasets < 10m

- USA, Denmark, Finland, Spain,
  - UK, Netherlands, Austria
- ...more coming each year



ArcGIS Features Plans Gallery Map Scene Help

## Elevation Coverage Map



This map shows the extents of the various datasets comprising the World Elevation services. Individual dataset boundaries are included as feature layers which may be symbolized and queried.

<http://esriurl.com/ElevationCoverageMap>

## More elevation data - Arctic DEMs

- Different data source, different image service
- Details later in presentation

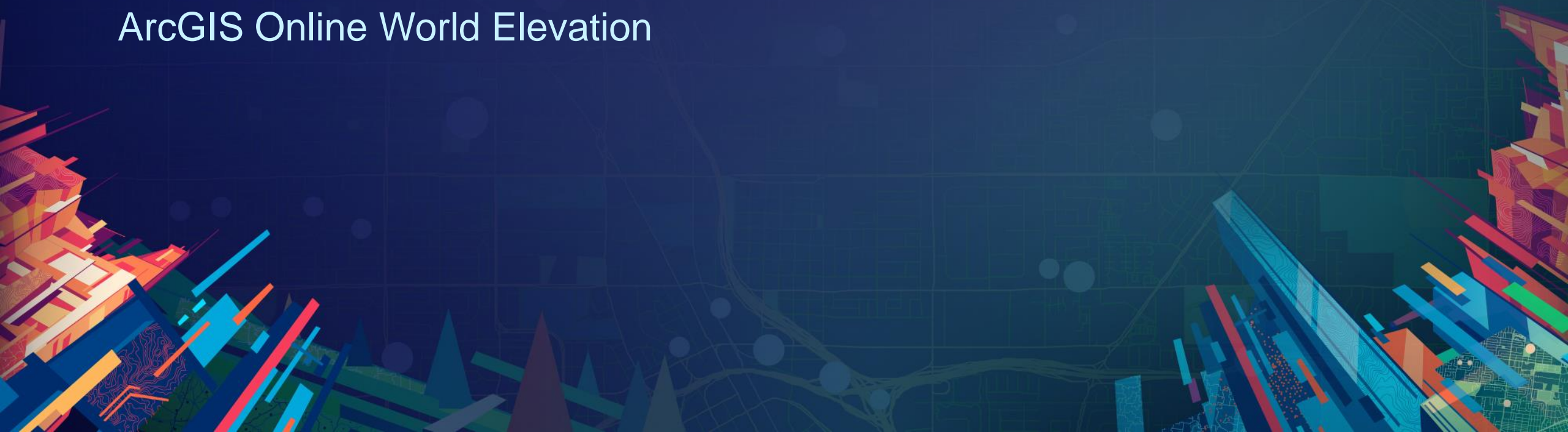


# “How can I use these services?”

- **Usage Modes**
  - Visualization
  - Data Values
  - Geoprocessing
- **Client Applications**
  - ArcMap, ArcGIS Pro, ArcGIS Online, Custom web apps
- **End Users vs. Developers**

# Modes of Use

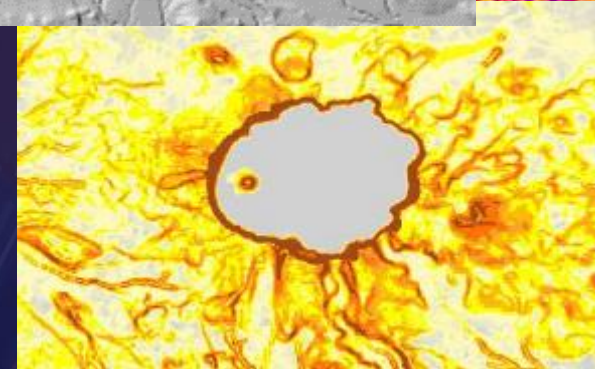
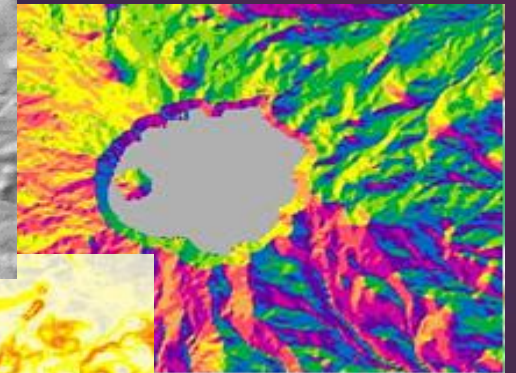
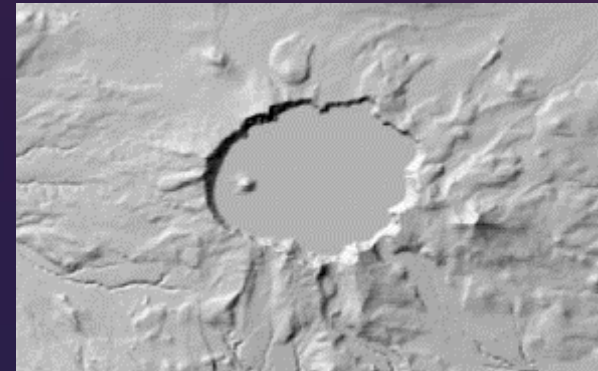
ArcGIS Online World Elevation





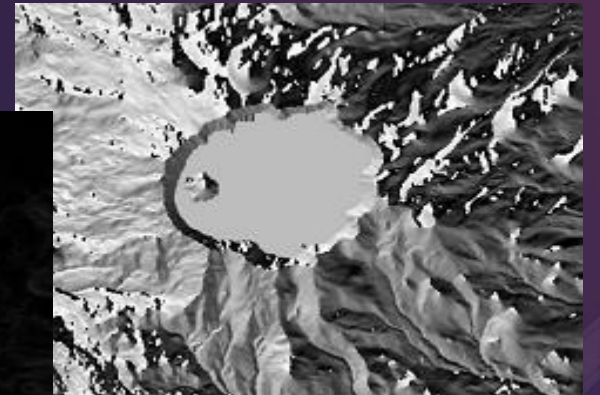
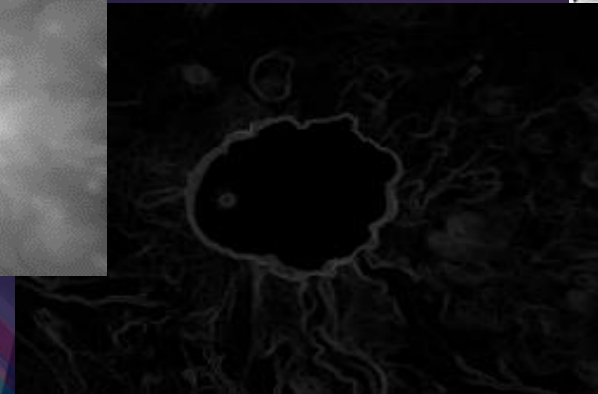
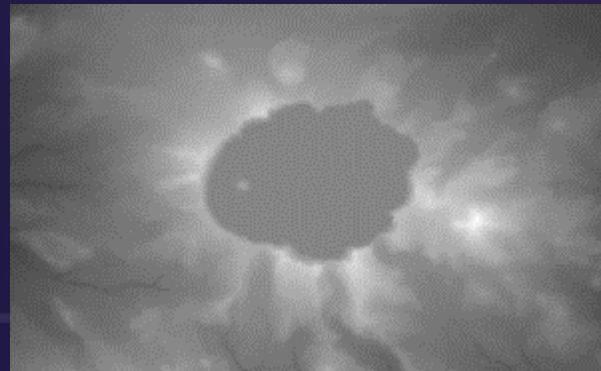
# Usage Modes

- **Visualization**
  - **Hillshade (Grayscale, Elevation Tinted)**
  - **Slope Map & Aspect Map**



# Usage Modes

- **Visualization**
  - Hillshade (Grayscale, Elevation Tinted)
  - Slope Map & Aspect Map
- **Data Values**
  - Orthometric & Ellipsoidal Height - for Orthorectification, Local Analysis...
  - Slope & Aspect



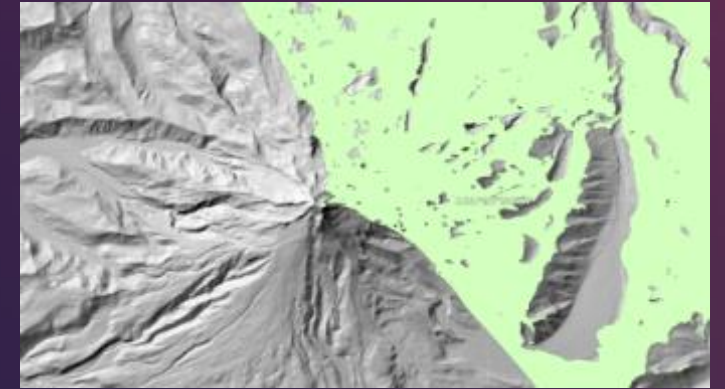
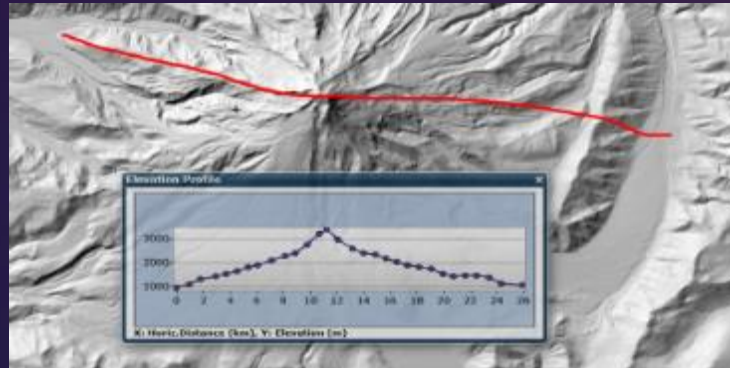
# Usage Modes

- **Visualization**

- Hillshade (Grayscale, Elevation Tinted)
- Slope Map & Aspect Map

- **Data Values**

- Height
- Slope & Aspect

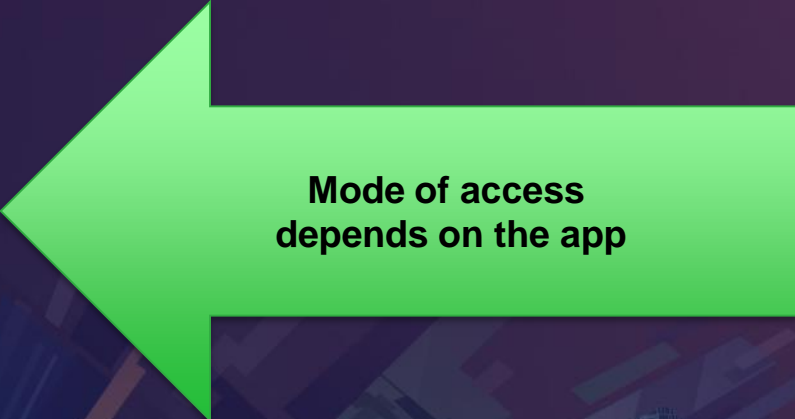


- **Server-side Geoprocessing Services**

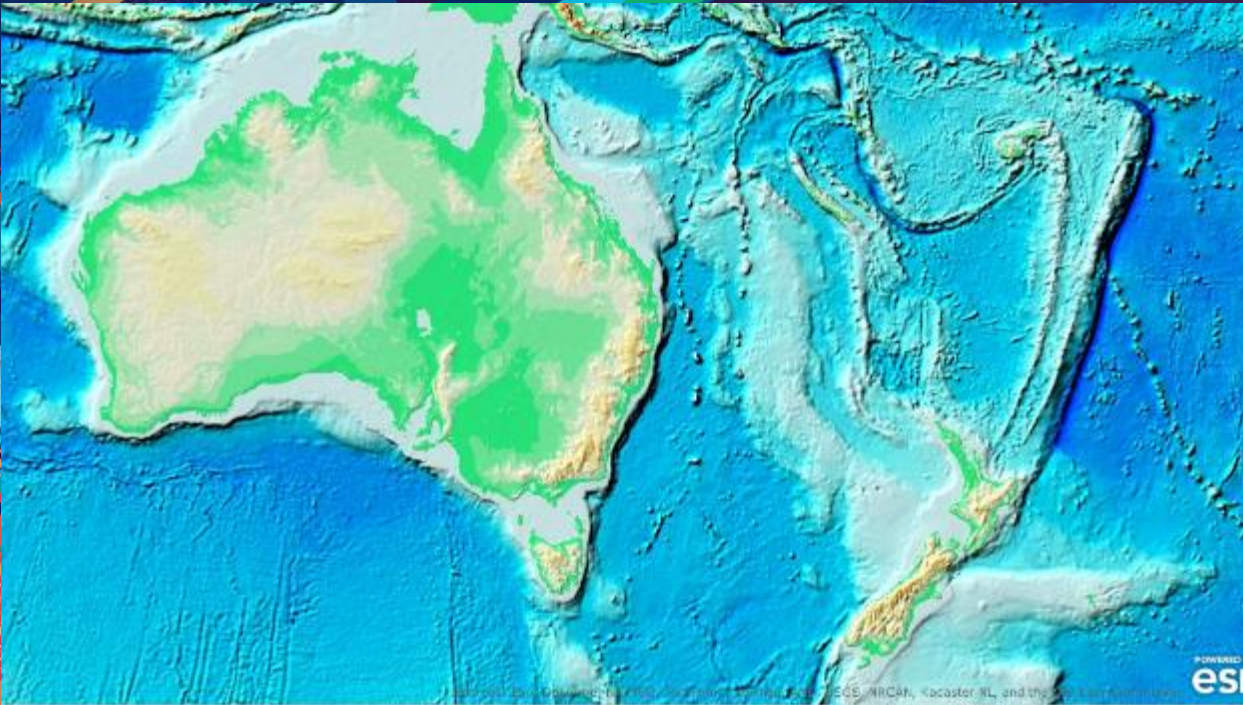
- Viewshed, Profile, Statistics, Watershed, Trace Downstream

# Services

- **Image services: elevation values & derived products**
  - Terrain
  - TopoBathy
  - Dedicated NED 30m (USA)
- **Server-side Geoprocessing (GP) services**
  - Profile
  - Summary Statistics
  - Viewshed
  - Watershed (Hydro)
  - Trace Downstream (Hydro)



Mode of access  
depends on the app



# Using World Elevation

ArcGIS Pro 2.2

# Client Applications

- ArcGIS Online web map

# Client Applications

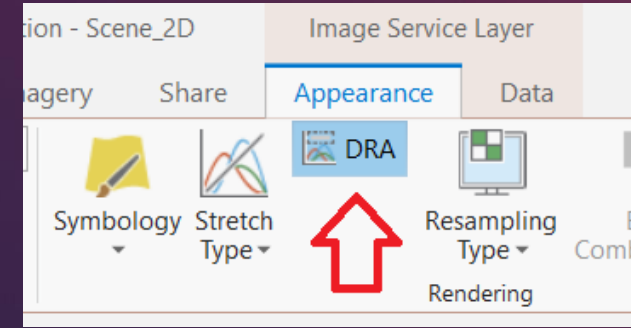
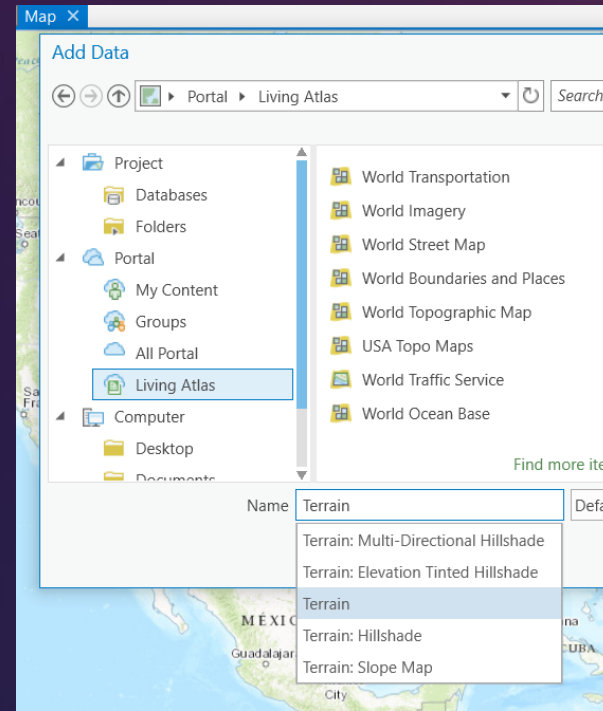
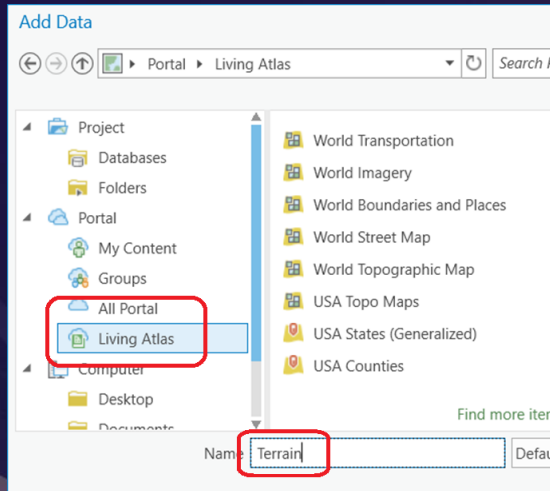
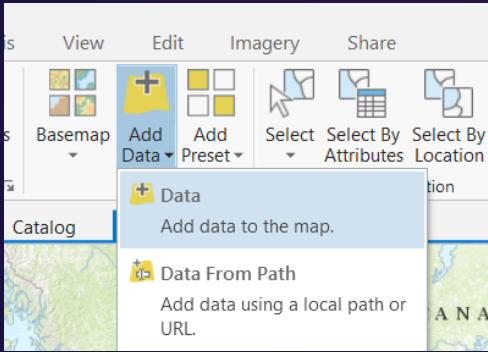
- ArcGIS Online web map
- ArcGIS Pro, ArcMap (10.1.1 or later)

# Client Applications

- ArcGIS Online web map
- ArcGIS Pro, ArcMap (10.1.1 or later)
- Custom web applications
  - Cartography
  - Data for elevation analysis
  - Custom geoprocessing
  - ArcGIS API's vs. OGC (WMS, WCS – limited functionality)
  - Web AppBuilder
    - See additional widgets specifically for imagery <http://esriurl.com/WABIS>



# Connecting and Using – ArcGIS Pro

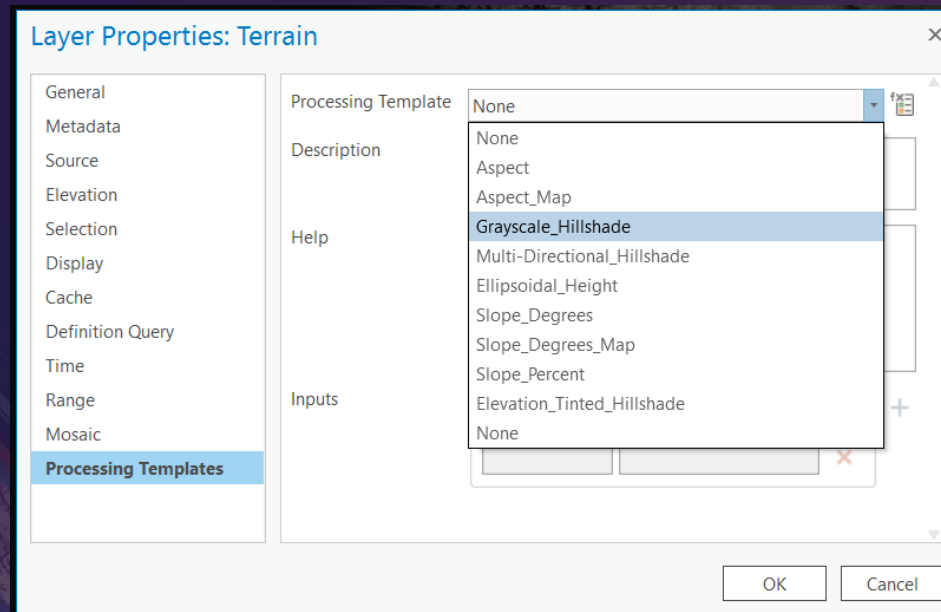
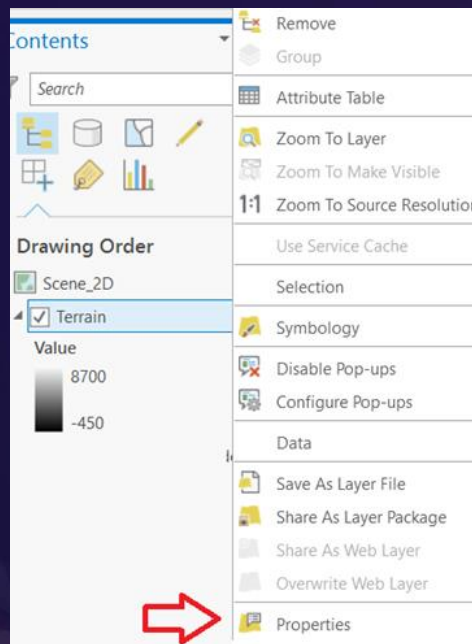


May want to use DRA  
(Dynamic Range Adjustment)  
if viewing Terrain values

Default is Terrain (orthometric height, 32 bit float)

# Elevation products on demand via Processing Templates

- 9 Raster Functions to create on-the-fly products



# Connecting and Using (other apps)

## 1. Start in ArcGIS Online Group: “Elevation Layers”

- Base image service is “Terrain”
- Or choose layer preconfigured with Raster Function

**Elevation Layers**

**Terrain**  
A multi-resolution layer providing access to elevation values for use in analysis with functions for slope, aspect, and hillshade.  
Imagery Layer by esri  
Last Modified: April 13, 2016  
Subscriber Content  
(18 ratings, 22 comments, 122,519 views)

Open ▾ Details  
Add layer to map  
Add layer to new map  
Open in ArcGIS for Desktop

**Terrain: Elevation Tinted Hillshade**  
This layer provides access to a tinted hillshade for use as a base map or in other visualization.  
Imagery Layer by esri  
Last Modified: April 16, 2015  
Subscriber Content  
★★★★★ (5 ratings, 9 comments, 136,842 views)

# Connecting and Using (other apps)

## 1. Start in ArcGIS Online Group: “Elevation Layers”

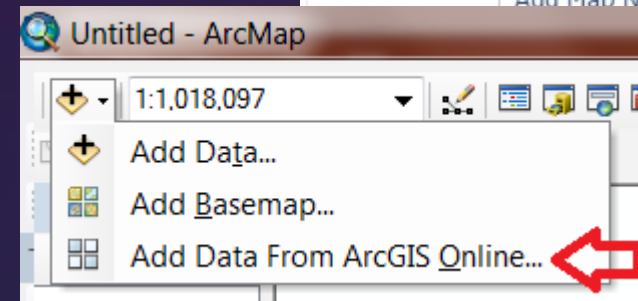
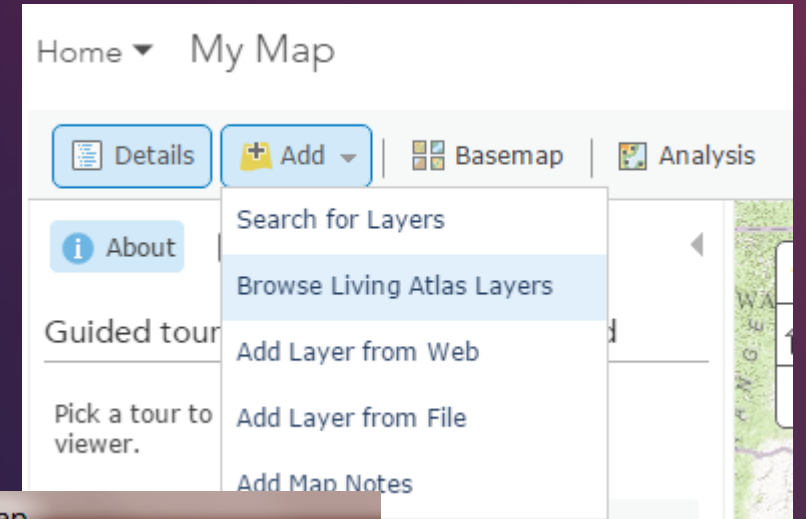
- Base image service is “Terrain”
- Or choose layer preconfigured with Raster Function

## 2. Start in ArcGIS Online Web Map

- “Add” from Living Atlas, “Terrain”

## 3. OR Start in ArcMap

- “Add Data” from ArcGIS Online, “Terrain”



# Connecting and Using (other apps)

## 1. Start in ArcGIS Online Group: “Elevation Layers”

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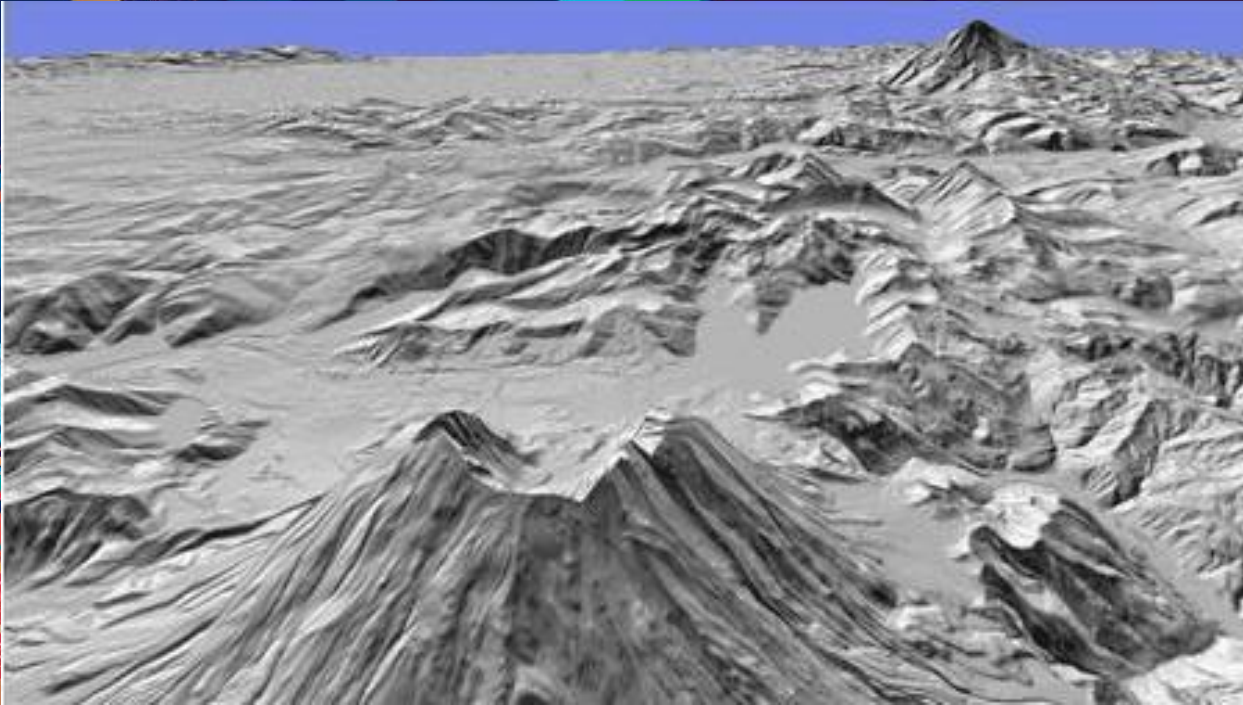
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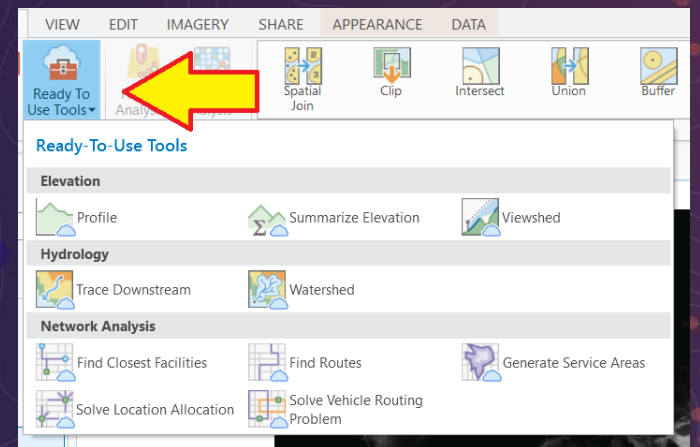
- “Add Data” from ArcGIS Online, “Terrain”

## • Authentication required

- ArcGIS, AGOL map:
  - ArcGIS Online Subscription Account
- Custom REST-based apps
  - Acquire token
  - Pass token in REST request



# Geoprocessing Services



# Arctic elevation

The image features a dark blue background with a faint, light-colored grid pattern. In the bottom-left and bottom-right corners, there are abstract, colorful geometric shapes in shades of red, orange, yellow, and blue, resembling stylized buildings or data visualizations. The text "Arctic elevation" is centered in the upper half of the image in a white, bold, sans-serif font.

# Arctic elevation service and web app

- **Overlapping DSMs generated by the POLAR GEOSPATIAL CENTER (PGC) from Digital Globe WorldView satellite imagery**
  - **Attributed with acquisition date**
  - **Resolutions 2, 5 and 8 meters**
  - **Polar projection WGS\_1984\_EPSG\_Alaska\_Polar\_Stereographic**

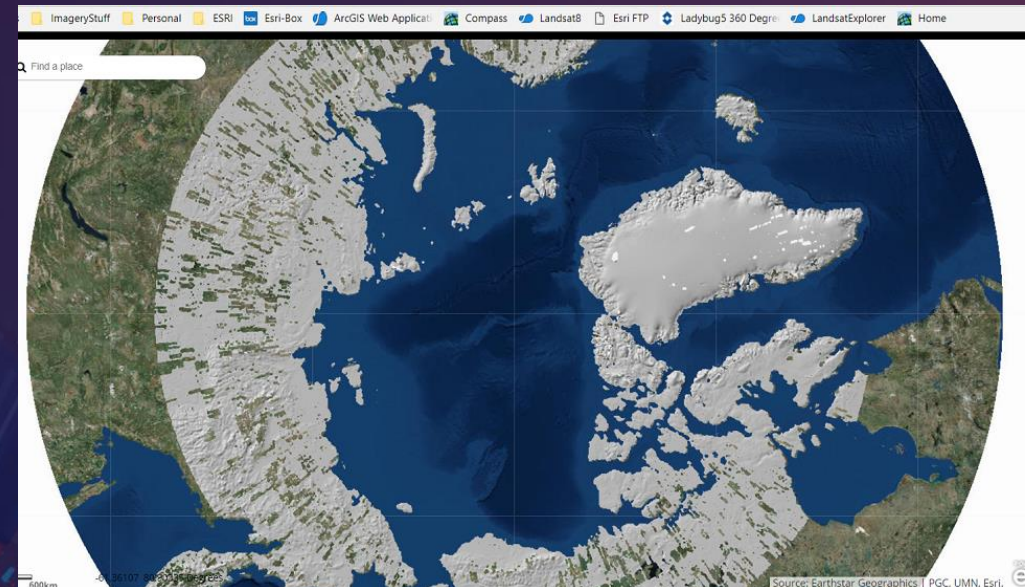
<http://esriurl.com/ArcticElevationServices> (group)

<http://esriurl.com/ArcticDEMExplorer> (app)

<http://esriurl.com/ArcticDEMChange> (app)

Data courtesy of <https://www.pgc.umn.edu/> and

<http://www.digitalglobe.com>



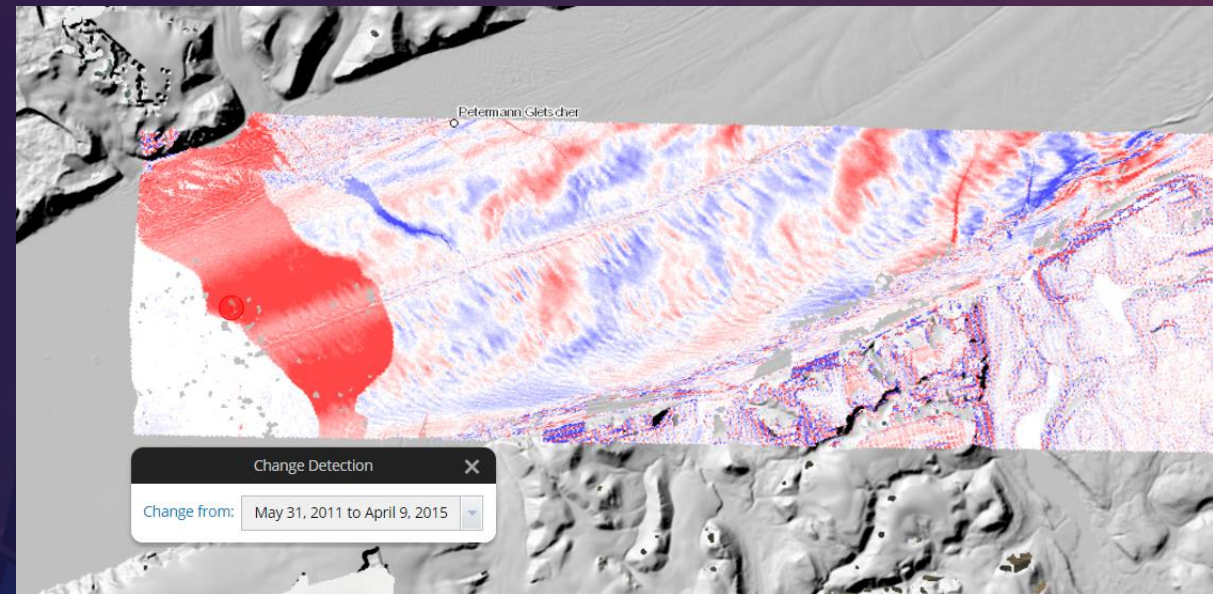


# Arctic DEM Change App



Pick a point to get a height graph through time

“See Change” to compare 2 dates



# ArcGIS Online Terrain service

A few important details



# Terms of Use

- **Must log in with ArcGIS Online Subscription account**
- **Services with no cost in terms of AGOL Credits:**
  - **Image services & functions (elevation, hillshade etc.)**
  - **ElevationSync analysis: Profile** *(max 100 points; 'sync' = synchronous)*
- **Geoprocessing services that will consume Credits:**
  - **Hydrology analysis: Trace Downstream and Watershed**
  - **Elevation analysis: Profile, Summarize Elevation, and Viewshed**  
*(These are asynchronous; Profile max 1000 points)*
- **1 credit per 1000 features!**

## Resources

World Elevation group on ArcGIS Online:

<http://esriurl.com/6548>

FAQs for World Elevation services:

<http://esriurl.com/ElevationFAQ>

Community Elevation Contributions:

<http://esriurl.com/CommunityElevation>

For developers:

AGOL elevation analysis: <https://developers.arcgis.com/rest/elevation/>

Export AOI: <http://esriurl.com/ImageServiceREST>

Image Service Widgets for Web AppBuilder: <http://esriurl.com/WABIS>

Open for  
questions...

cbenkelman@esri.com



Note different APIs



# Adding custom elevation into ArcGIS Pro

*Optional Demo, if time permits*



esri

THE  
SCIENCE  
OF  
WHERE