

UC



# Working with Scientific Data in ArcGIS Platform

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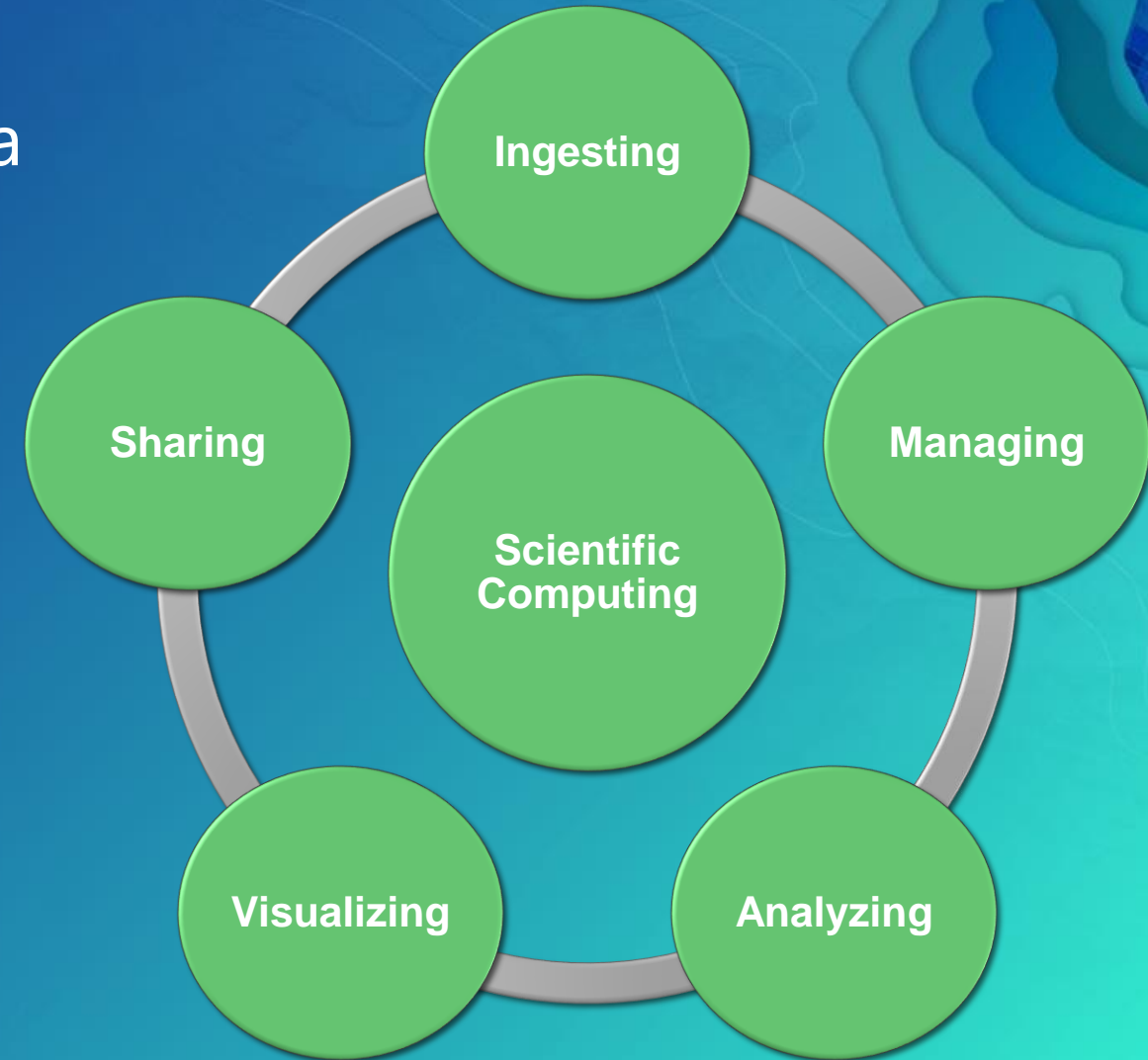
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*Esri User Conference, San Diego, CA. July 11, 2017*

# What we will cover today

- Scientific Multidimensional data
- Using Scientific Data in ArcGIS
  - Ingesting and Managing
  - Visualizing and Analyzing
  - Disseminating and Consuming
- ArcGIS is an Open Platform
- Application(s) and Use case





# Scientific Multidimensional Data

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# Diverse Scientific Multidimensional Data



## Oceanographic

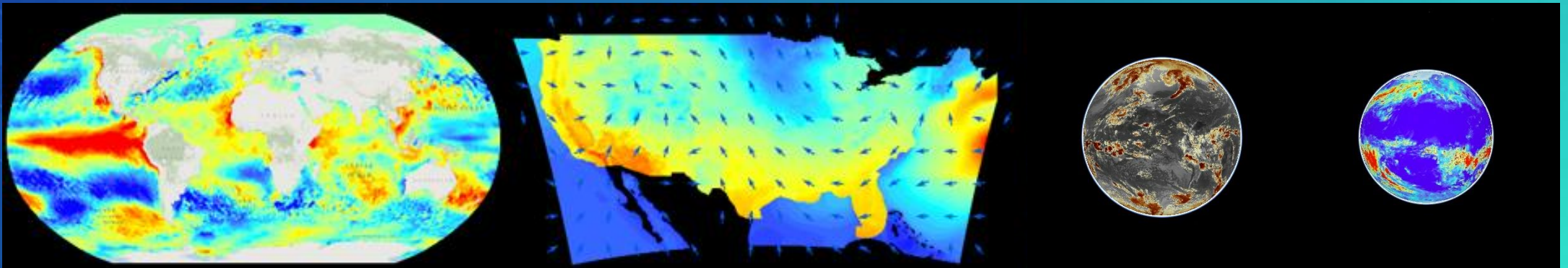
- Salinity
- Sea Temperature
- Ocean current

## Meteorological

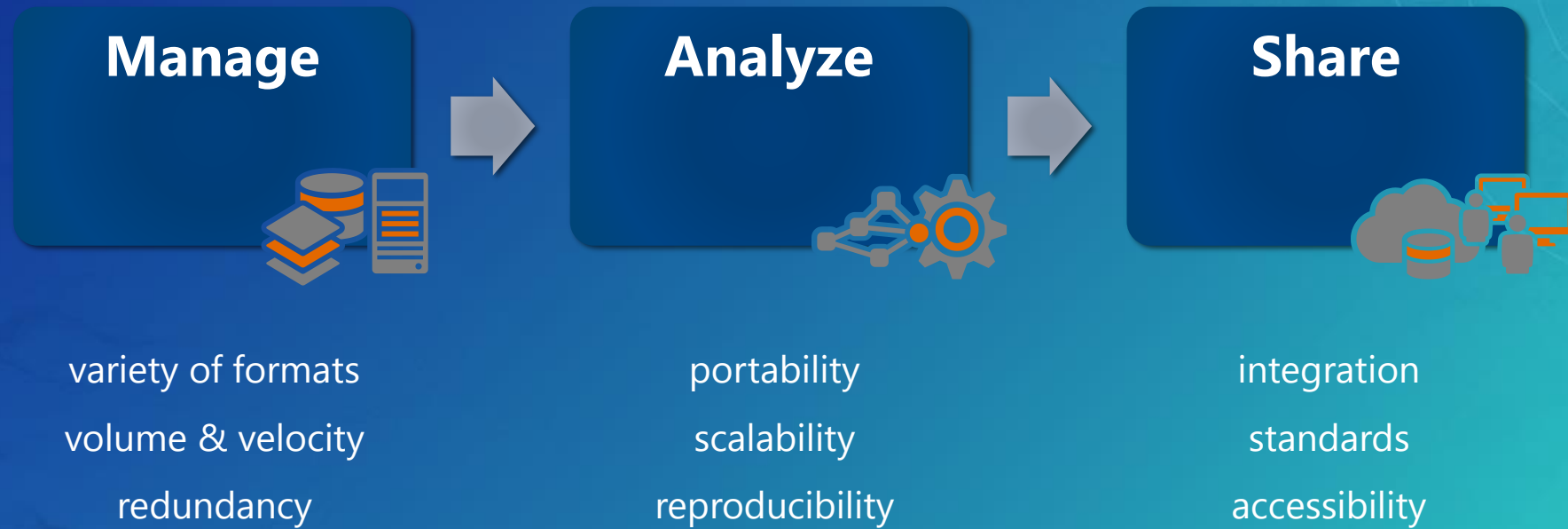
- Temperature
- Water Vapor/Precipitation
- Wind speed/direction

## Terrestrial

- Soil moisture
- NDVI
- Land cover



# Challenges



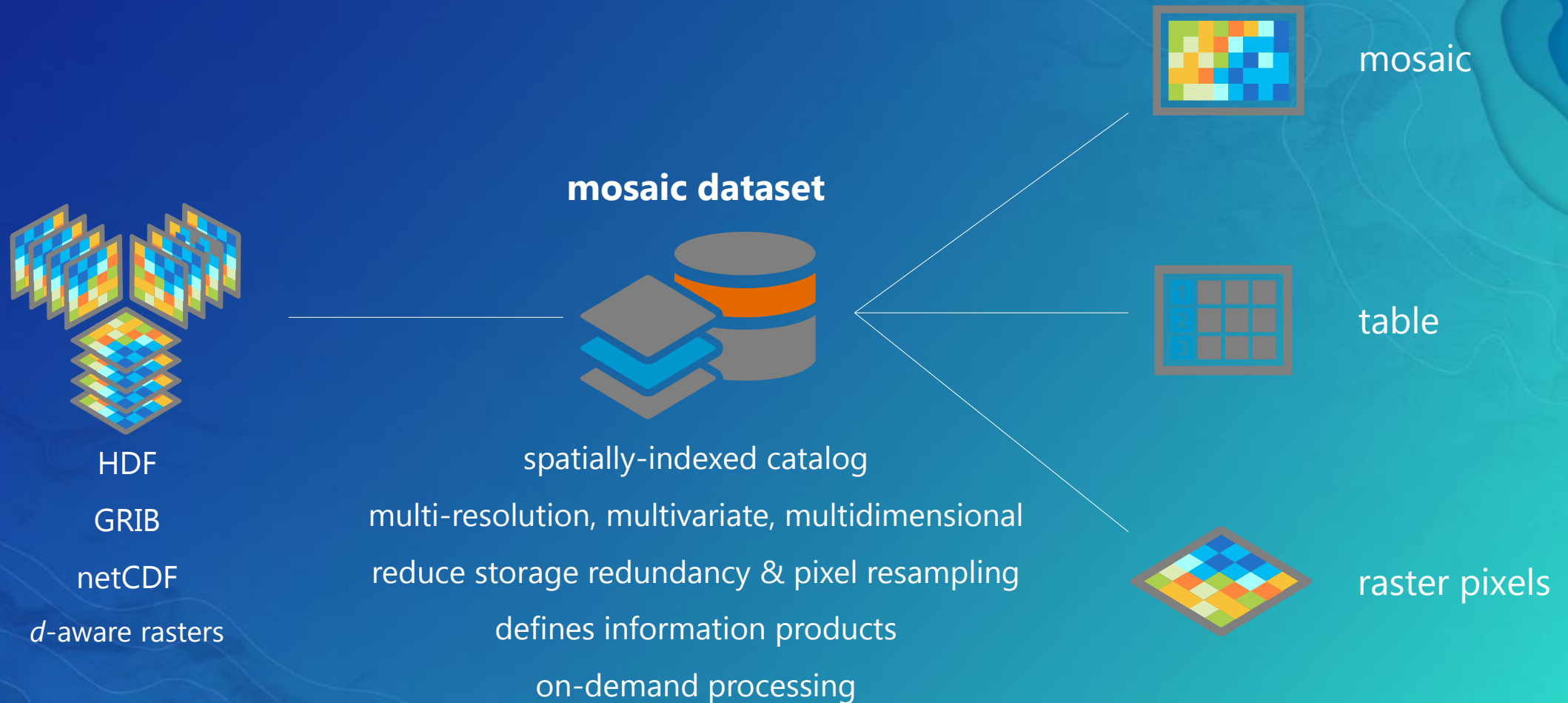


# Ingesting and Managing Data

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# Multidimensional Mosaic Dataset

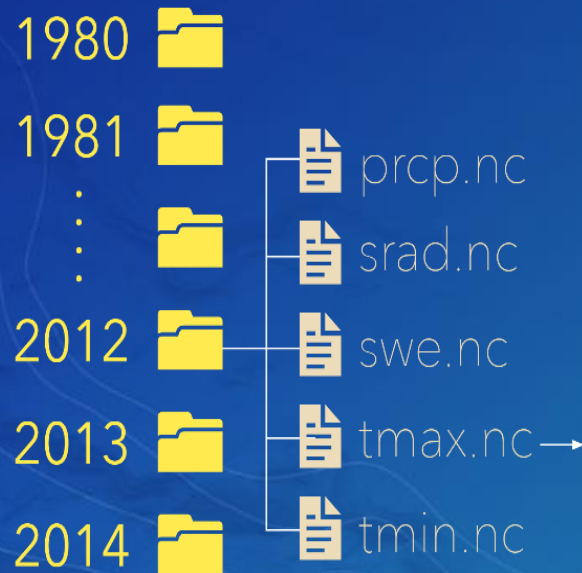


*Representing multivariate collection of multidimensional rasters in ArcGIS*

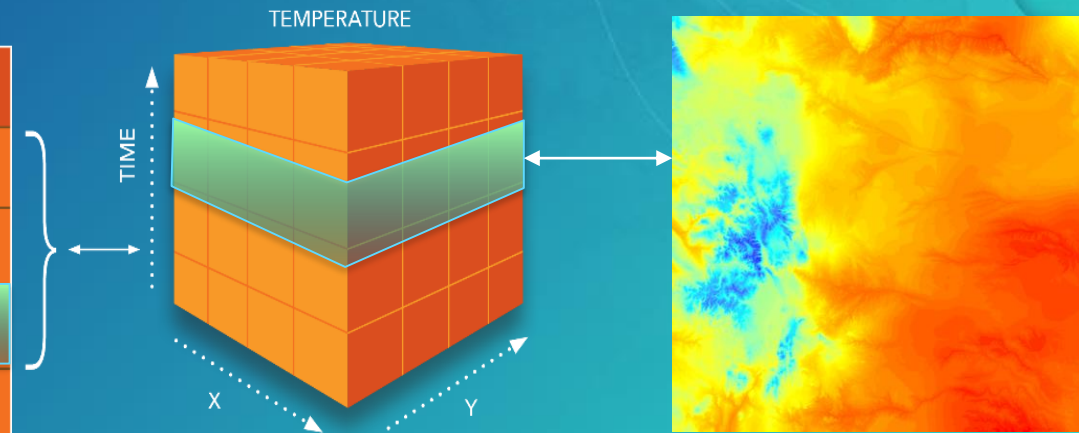
# ArcGIS Multidimensional Data Model

## *Multidimensional Mosaic Dataset in Geodatabase*

- Ingest variables from netCDF, HDF & GRIB using raster types
  - Aggregate multiple variables, multiple files
- Support on-the-fly processing

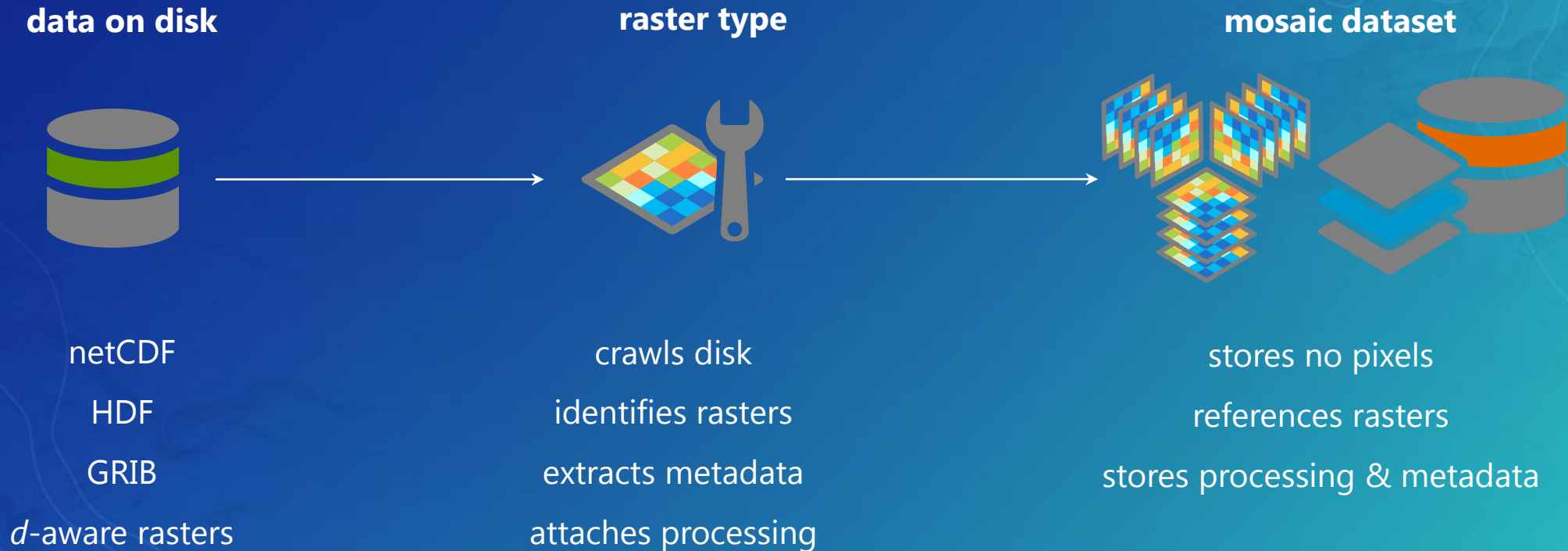


| ID | RASTER   | PRODUCT | VARIABLE    | TIME | Z  | ... |
|----|----------|---------|-------------|------|----|-----|
| 1  | <raster> | netCDF  | temperature | T1   | 10 |     |
| 2  | <raster> | netCDF  | temperature | T2   | 10 |     |
| 3  | <raster> | netCDF  | temperature | T3   | 10 |     |
| 4  | <raster> | netCDF  | temperature | T1   | 20 |     |
| 5  | <raster> | netCDF  | temperature | T2   | 20 |     |
| 6  | <raster> | netCDF  | temperature | T3   | 20 |     |





# Raster Types for Multidimensional data



*Format-agnostic direct ingestion of rasters into a mosaic dataset*

# Creating a Multidimensional Mosaic Dataset



## Using Geoprocessing Tools

- Create a empty mosaic dataset
- Add select variables

Geoprocessing

← Create Mosaic Dataset

Parameters | Environments

Output Location  
Demo\_IS.gdb

Mosaic Dataset Name  
ncom

Coordinate System  
GCS\_WGS\_1984

Product Definition  
None

> Product Properties  
> Pixel Properties

Run

Geoprocessing

← Add Rasters To Mosaic Dataset

Parameters | Environments

Mosaic Dataset  
ncom

Raster Type  
NetCDF

Input Data  
Folder  
D:\Data\Scientific\CFSR\sea-ice

Run

Raster Type Properties

General  
Processing  
Variables

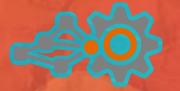
| <input type="checkbox"/>            | Name       | Type | Description                           |
|-------------------------------------|------------|------|---------------------------------------|
| <input type="checkbox"/>            | salinity   |      | Salinity (depth=40, time=25)          |
| <input type="checkbox"/>            | surf_el    |      | Water Surface Elevation (time=25)     |
| <input checked="" type="checkbox"/> | water_temp |      | Water Temperature (depth=40, tim...   |
| <input type="checkbox"/>            | water_u    |      | Eastward Water Velocity (depth=40,... |
| <input type="checkbox"/>            | water_v    |      | Northward Water Velocity (depth=4...  |

> Angle Reference System  
> Interpolate irregular data  
☐ Copy original dimension values

OK Cancel

# Visualizing and Analyzing

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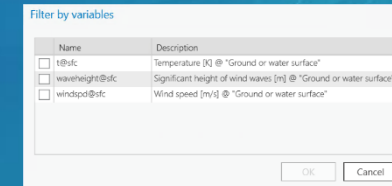
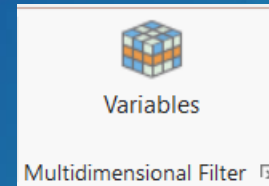




# Slicing your data

- Slicing

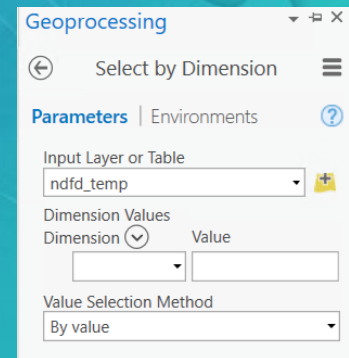
- By variable, using variable selector



- By dimension using Select by Dimension Geoprocessing tool

- Visualizing

- Time slider
- Range slider
- Vector field renderer



# Raster Analysis

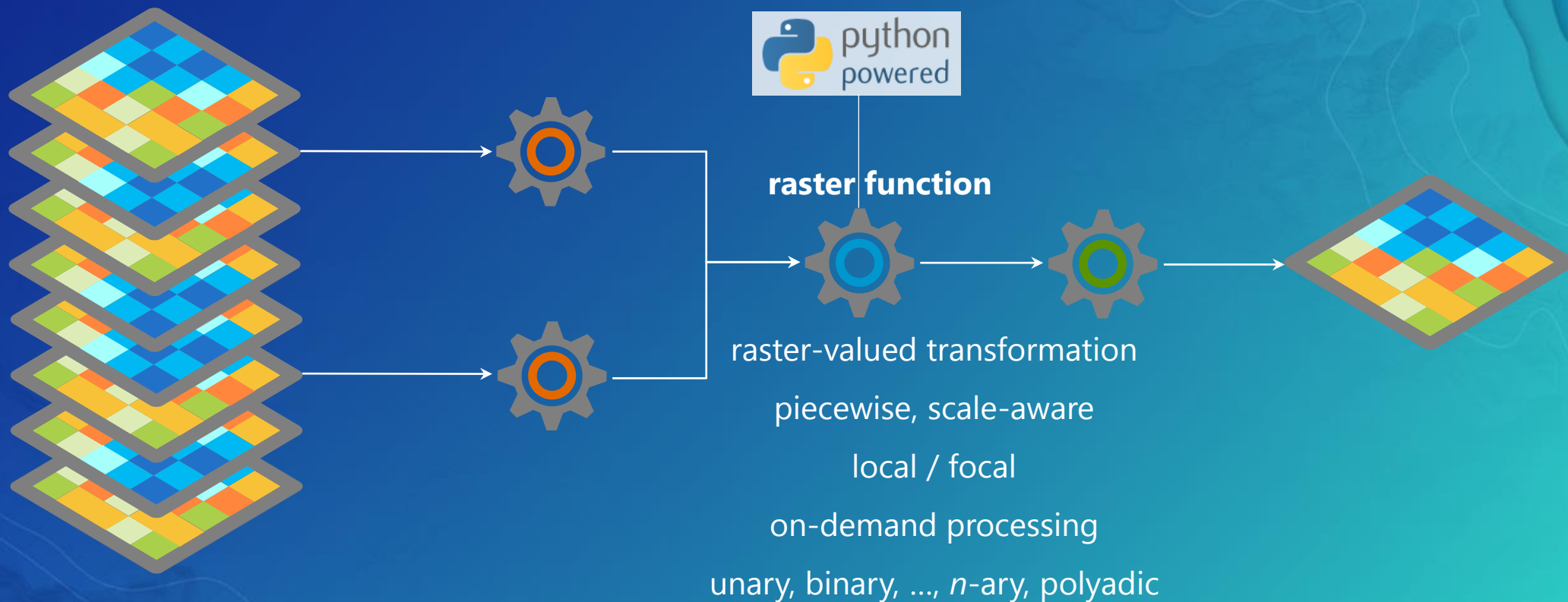
## Geoprocessing Tools (GP)

- Tons of GP tools
- GP tools, Python scripting and ModelBuilder → perfect automation of data management and analysis.

## Dynamic On-the-Fly Processing using Raster Functions

- Manage and analyze large collection of rasters on the fly as the data is accessed and viewed
- Quick and save time by not required to write the processed product to disk
- Functions can be applied to various rasters (images) including:
  - Raster dataset layers
  - Mosaic datasets
  - Image service layers

# Raster Function: Transforming Raster Data



Learn more at: [github.com/Esri/raster-functions](https://github.com/Esri/raster-functions)

*Choose from dozens of built-in functions or implement your own algorithm using Python*

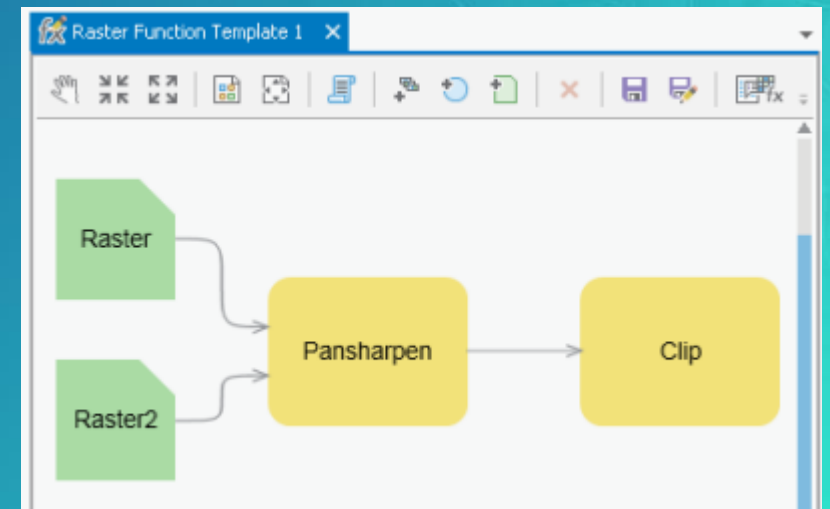
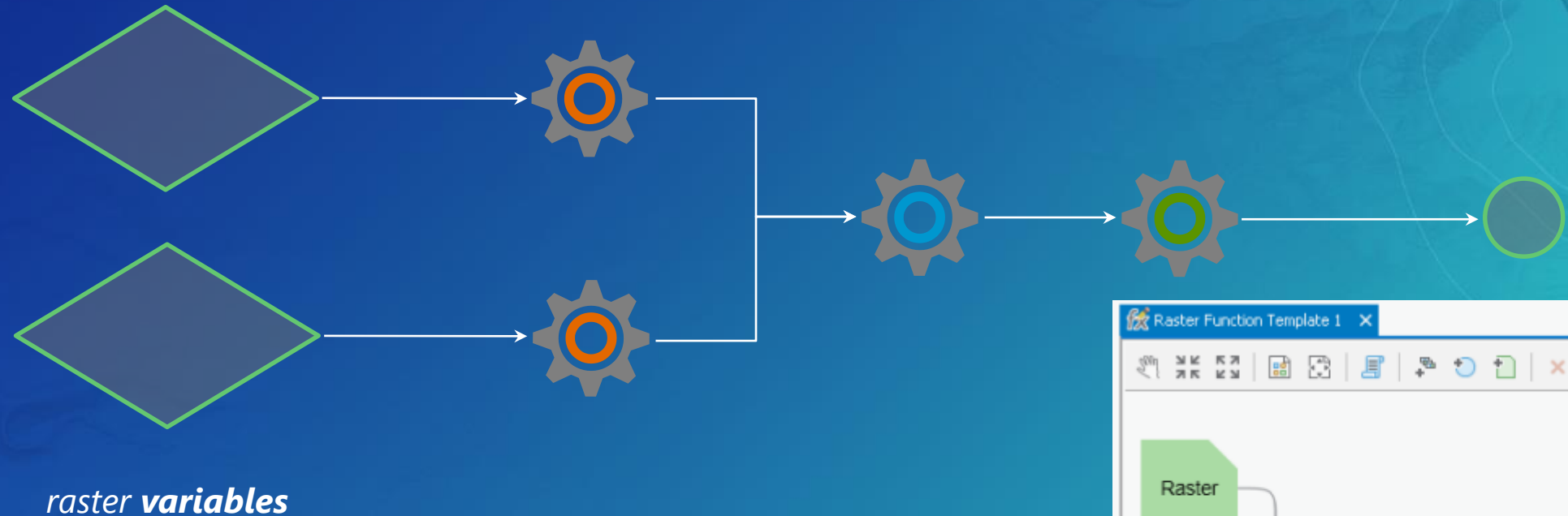


# Chaining Raster Functions



*... to compose a complex analytic model*

# Raster Function Templates

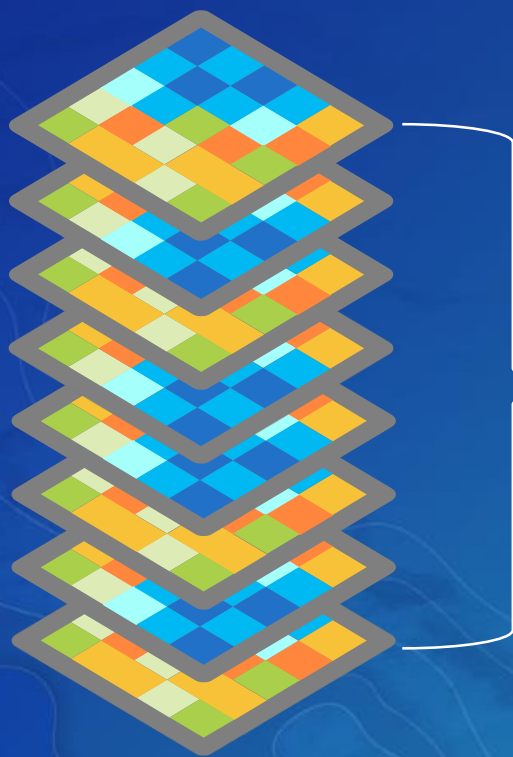


*A portable & reusable chain of raster functions*

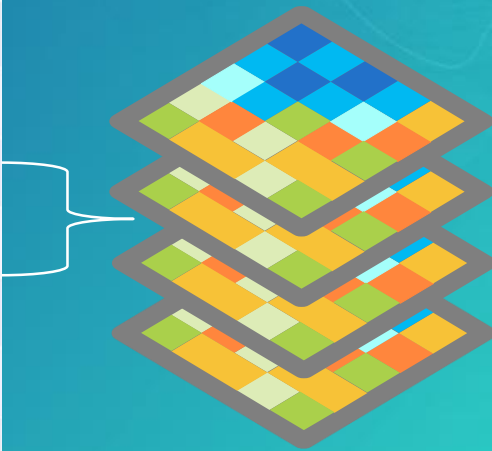
# Raster Function Template and MD: GroupName and Tag

## Mosaic Data must contain:

- Field stored with variable names (tag)
- Field defines groups(GroupName)

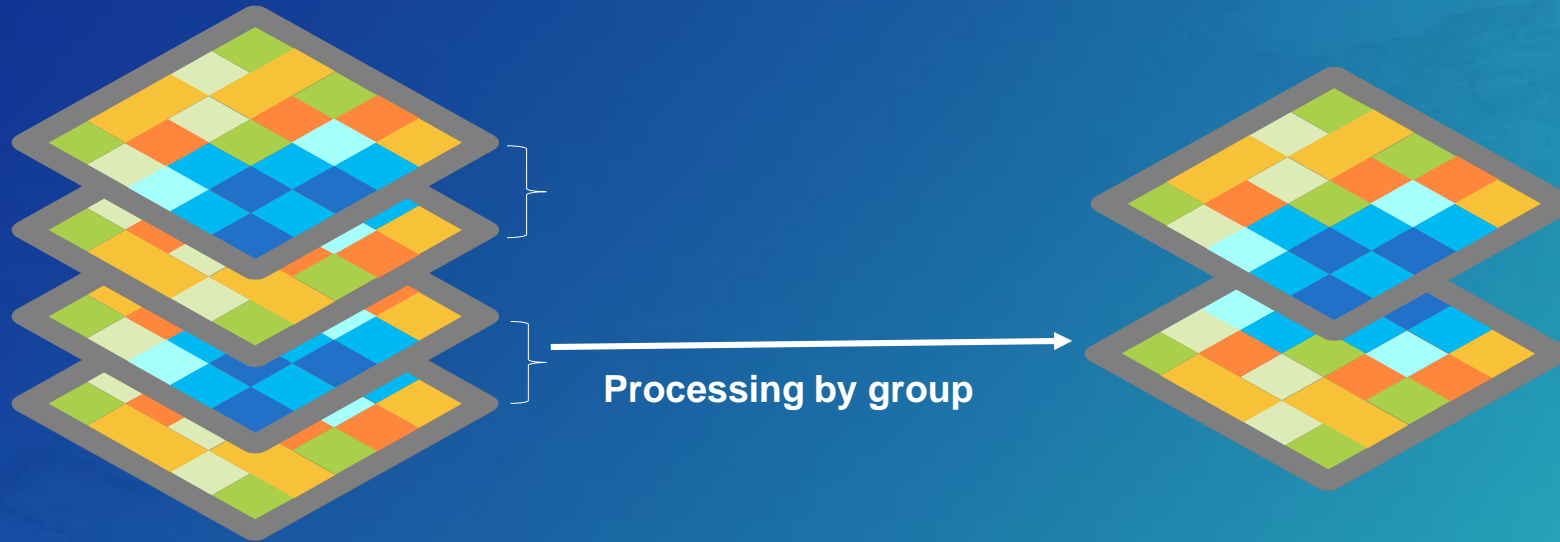


| Raster | Tag         | StdTime   | GroupName |
|--------|-------------|-----------|-----------|
| ...    | Temperature | t1        | 1         |
| ...    | mean        | t1        | 1         |
| ...    | Temperature | <b>t2</b> | <b>2</b>  |
| ...    | mean        | t2        | 2         |
| ...    | Temperature | <b>t3</b> | <b>3</b>  |
| ...    | mean        | t3        | 3         |
| ...    | Temperature | t4        | 4         |
| ...    | mean        | t4        | 4         |





# Applying a Raster Function Template to Mosaic Dataset



Apply RFT to Mosaic Dataset:

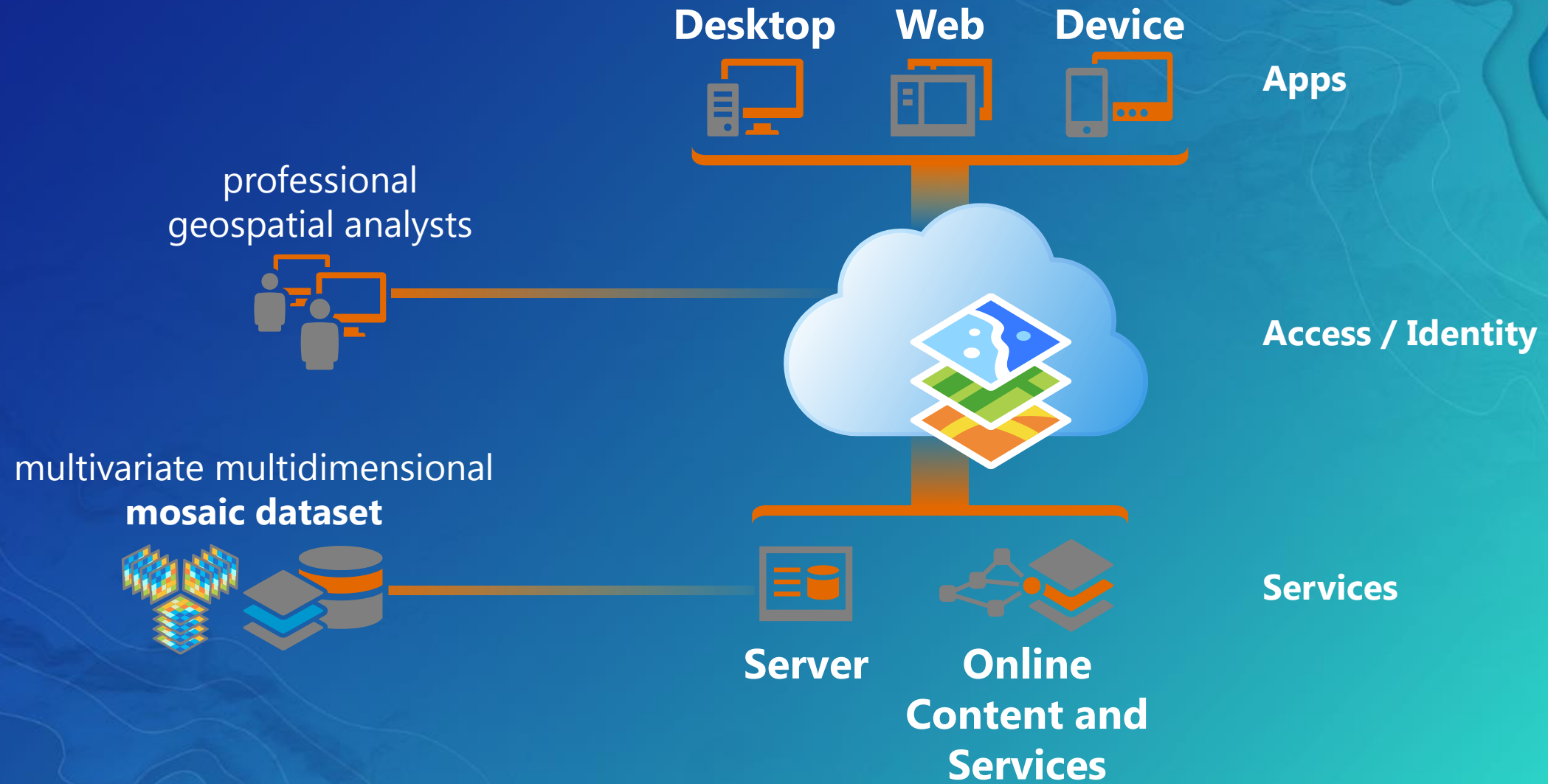
Process each row  
Process each group

# Disseminating and Consuming

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# Disseminating





# Serving Multidimensional Data

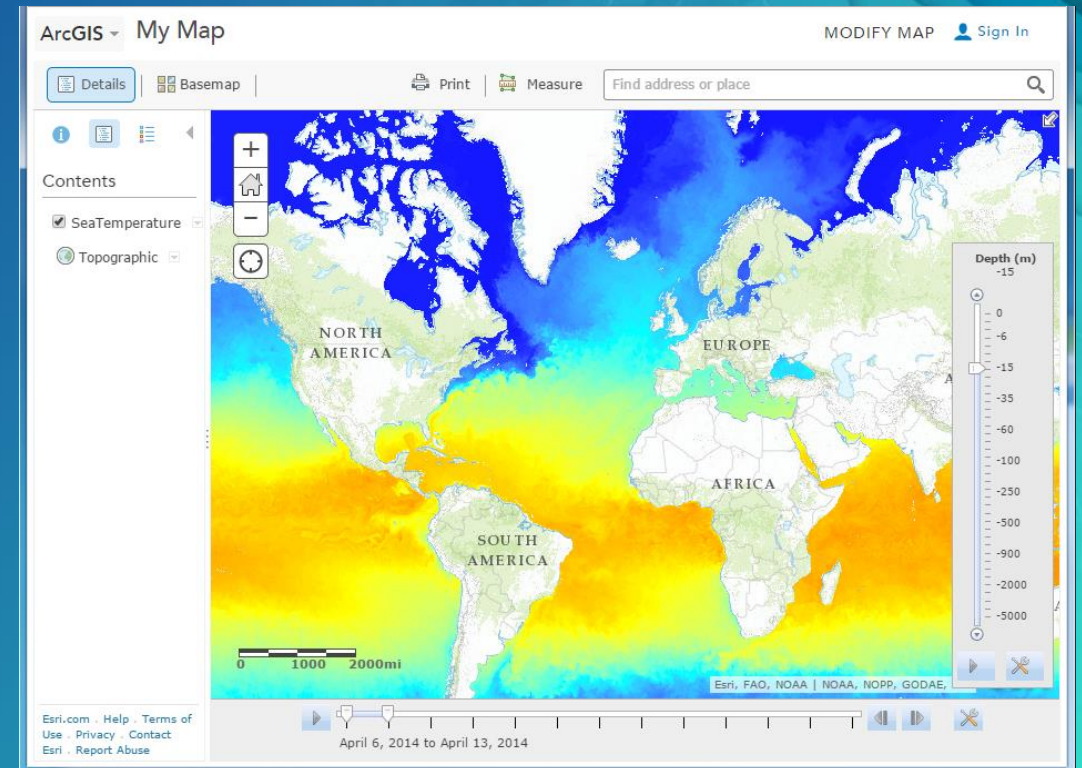
## Multidimensional Image Services

### Serve data (not a picture)

- LERC compression to maintain data quality
- Perform analysis and analysis through the web

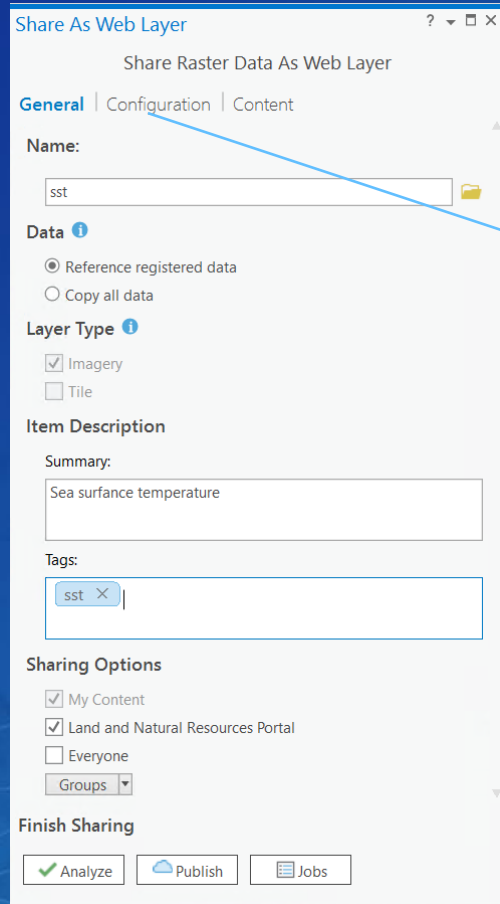
### Multiple clients:

- Desktop clients
- Web Map Viewers
- JavaScript etc.
- WMS/WCS
  - Time=t1&Elevation=z1
  - DIM\_Time=t1&DIM\_depth



# Sharing data & information products

- Mosaic Dataset > **Share As Web Layer**



Share As Web Layer

Share Raster Data As Web Layer

General | Configuration | Content

Name:  
sst

Data ⓘ  
☒ Reference registered data  
☐ Copy all data

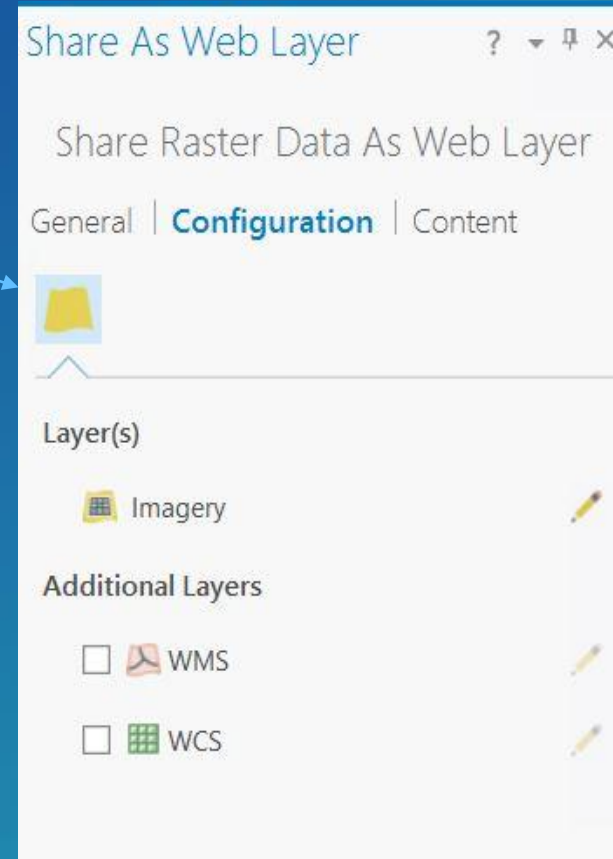
Layer Type ⓘ  
☒ Imagery  
☐ Tile

Item Description  
Summary:  
Sea surface temperature

Tags:  
sst

Sharing Options  
☒ My Content  
☒ Land and Natural Resources Portal  
☐ Everyone  
Groups

Finish Sharing  
 Analyze  Publish  Jobs



Share As Web Layer

Share Raster Data As Web Layer



General | Configuration | Content

Layer(s)  
Imagery

Additional Layers  
☐ WMS  
☐ WCS

*Enable access to a dynamic representation of your information product as an image service*

# Consuming your services

- In any ArcGIS application or any WMS client
- In a web map 
  - Identify web services driven by maps or datasets
  - Bring service layers into a web map
- In a map-based application 
  - Configurable apps
  - Story Maps
  - Web AppBuilder
  - Custom web apps using ArcGIS API for JavaScript



# Demo

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Scientific data support in ArcGIS

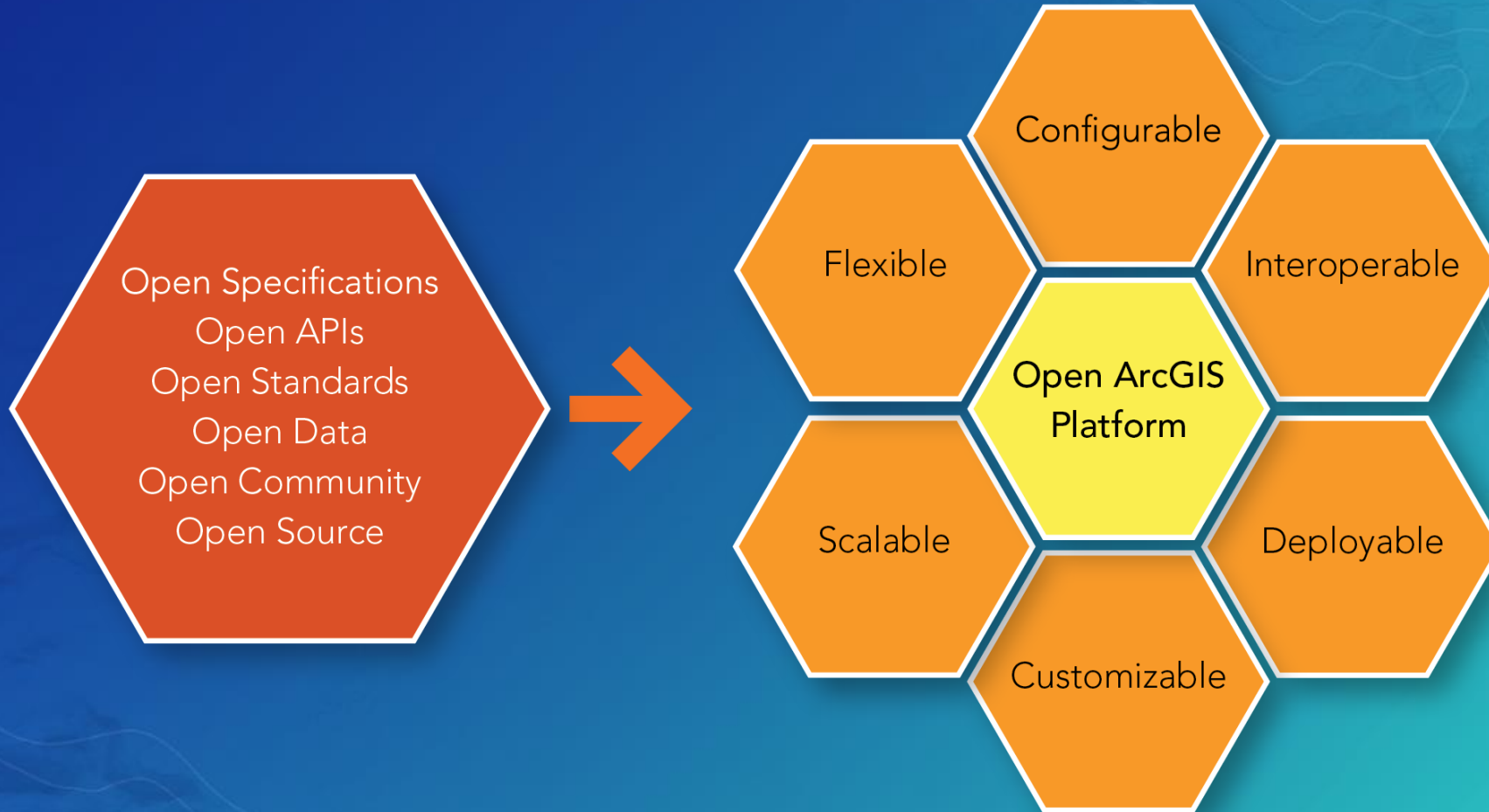
# ArcGIS: An Open Platform

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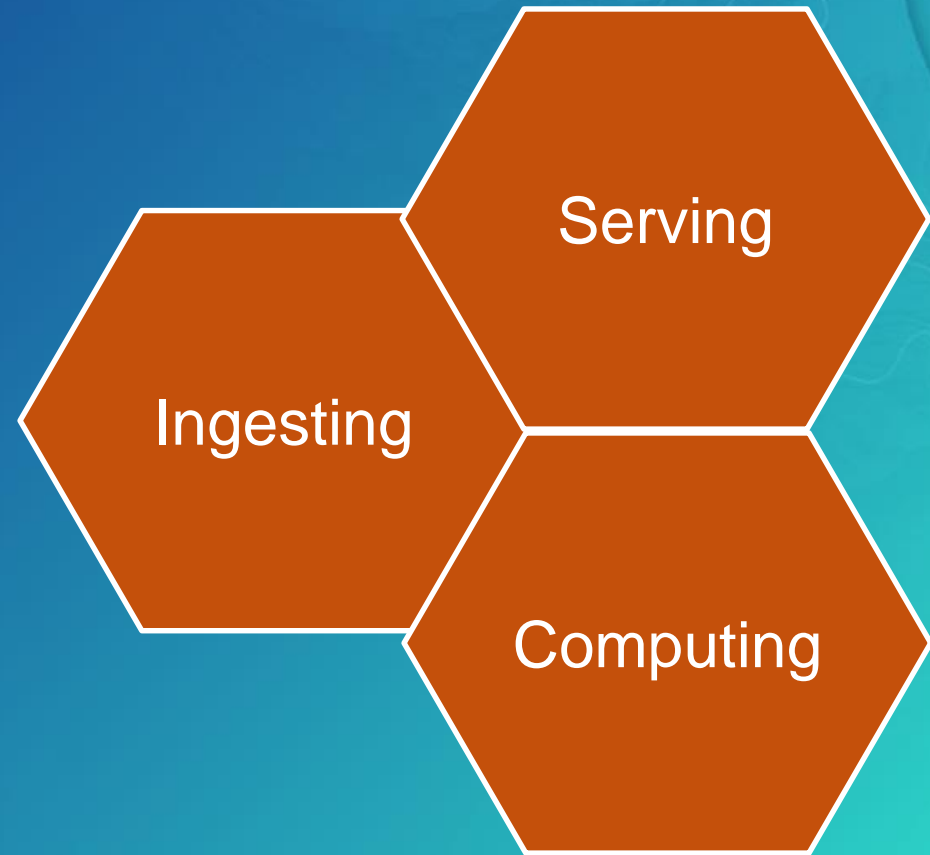
# ArcGIS is an Open Platform





# Scientific Data Interoperability in ArcGIS

- Ingesting many scientific data formats
- Supporting common scripting language in scientific computing
- Support OGC specifications in serving scientific data through web



# Scientific Data Formats

- Support multidimensional raster formats
  - NetCDF
  - GRIB 1 and GRIB 2
  - HDF 4 and HDF 5
- Use Open Source GDAL
- Extendable by developing custom format driver

# Scientific Data Formats - HDF

- HDF4
  - Support HDFEOS4
- HDF5
  - Support HDFEOS5 (for HDF5)
  - Support some custom CF style HDF5
    - SMAP
  - Will provide generic support for CF style HDF5



# Scientific Computing

- Perform scientific computing using Geoprocessing tool
  - Extendable by creating a custom Geoprocessing tool
- Performing scientific computing using Raster Function
  - Extendable by developing a custom python raster function
- Support Python Scripting
  - NumPy
  - SciPy

# Serving Scientific Data

- Serve gridded raster data as image service with OGC capabilities
  - WCS
  - WMS
  - Dimensional query of Time and Depth

# Few Take Away

1. Mosaic Dataset is a robust data model that allows you to manage your large collections of scientific multidimensional data
2. Raster function(s) can help with your efficient on the fly computing that saves Time and Resources
3. Mosaic Dataset is a quick way to build the live web service
4. Make your scientific data and research output usable with repeatable workflow to your larger community
5. ArcGIS is an open platform that provides opportunity to expand the capabilities to collaborate and support your work



## Want to learn more....please join these sessions:

Scientific and Multidimensional Raster Support in ArcGIS (SDCC Room 17A)

When: July 12, 2017 8:00-10:00 AM.

Raster Analytics-Envision Center Presentation (SDCC: Envision Center 1)

When: July 12, 2017 2:00-3.30 PM

Image Management using Mosaic Datasets and Image Services (Room 3).

When: July 13, 2017 8:30-9:45 AM

Session 2084: Weather, Forecasting, and Radar Site-selection (Room 29 A/B)

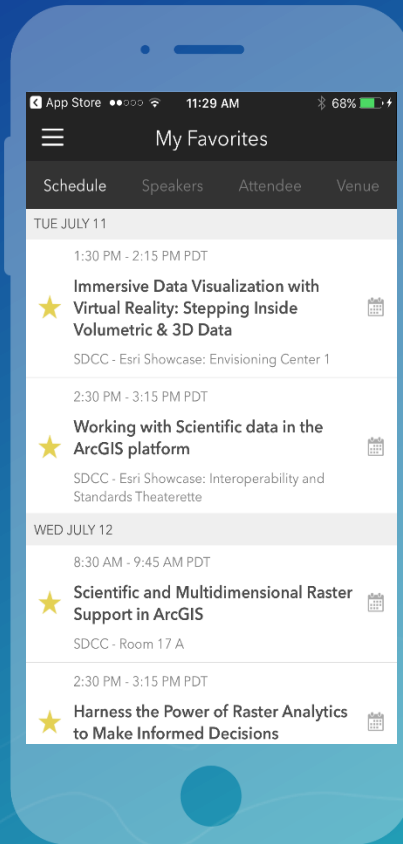
When: July 13, 2017 10:00AM-12PM.

# Please Take Our Survey on the Esri Events App!

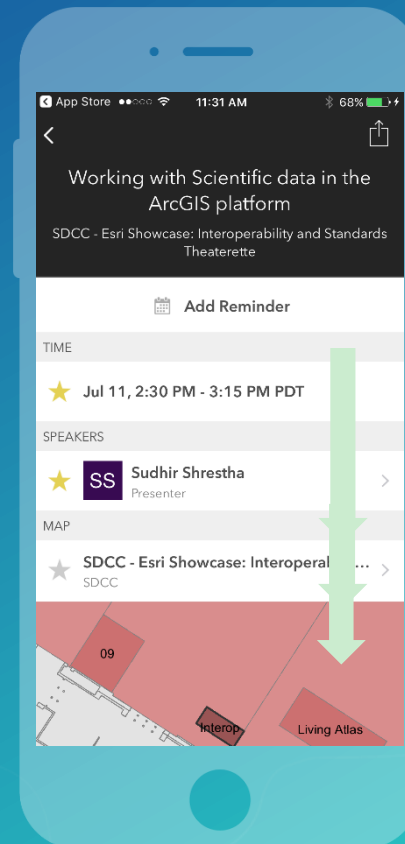
**Download the Esri Events app and find your event**



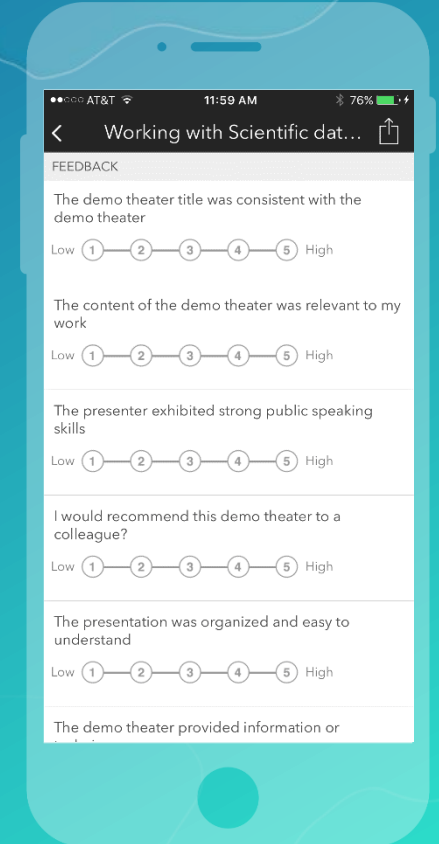
**Select the session you attended**



**Scroll down to find the survey**



**Complete Answers and Select "Submit"**







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THE  
SCIENCE  
OF  
WHERE