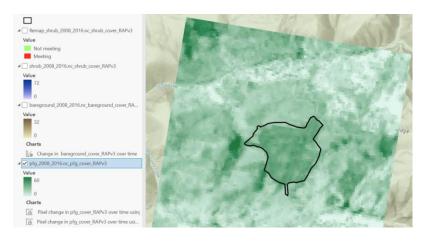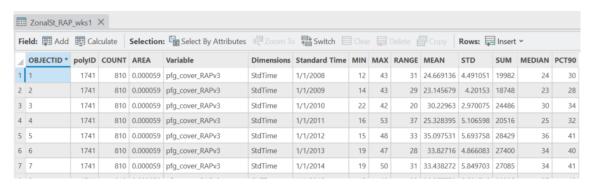## SRM 2025: RAP workshop - Accessing RAP data with ArcGIS

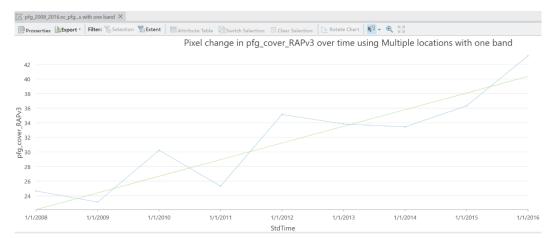### Intro: options for RAP data in ArcGIS

- We are working towards having RAP data available in the ArcGIS Living Atlas.
- In the meantime, there are a few options for how to view and work with RAP data in ArcGIS:
  - Cover and yearly production layers can be added as a web map tile service (WMTS) (https://rangelands.app/support/19-view-rap-data-in-your-gis). These layers are only able to be used for visualization – no analysis functionality, and users have relatively little control over display.
  - The CONUS rasters can be downloaded from here (cover, production). These are very large files.
    - In a command line prompt, you could gather these data using *wget* and clip to a region of interest using *gdal.*
    - In QGIS, you can add the full raster layers using these links
  - If you have RAP rasters downloaded, you can import them as a data layer in ArcGIS.
- For this workshop, I extracted RAP cover (shrubs, bare ground, perennial forbs and grasses) within and near our treatment of interest from 2008-2016. I exported as a NetCDF file (file extension .nc so we can work through Multidimensional Raster.
  - This is a common file format for raster data with repeat observations with different 'slices' (i.e., time, depth).
  - These files are available in the github repository in folder "RAP_NetCDF_forArcGIS"
  - R Script I used to gather RAP data

1) Import the multidimensional rasters and the treatment boundaries
- Open a new map in ArcGIS Pro
- Add treatment boundary: Map > add data > navigate to treatment shapefile.
- Add multidimensional rasters for each functional group: Map > add data > Multidimensional Raster Layer… > Navigate to NetCDF file (i.e. pfg_2008_2016.nc in the RAP_NetCDF_forArcGIS folder) > check box to select variables > select OK.
  - Repeat for two other functional groups
  - You can view the name of the variable being displayed in Layer Properties
    - Right click on layer > Properties > Source > Multidimensional Info
- Update symbology as you see fit.
- Note that this is just one way to create a multidimensional raster, you could also build from a collection of individual rasters or multiple NetCDF files. Tutorial on other options.

2) View cover before and after treatment
- When you have one of the cover files selected, you will have a "Multidimensional" tab activated.
- You can view cover per year under Multidimensional > Current Display Slice. Hit the play button next to "StdTime" to view cover per year.
- You can also use the slider bar.

3) Summary statistics within treatment
- Summary Stats as a table
    a. Multidimensional tab > summary statistics > Zonal Statistics as Table
        i. Input Raster or Feature zone: ROI
        ii. Input value for Raster: pfg_2008….
        iii. Statistics Type: all
        iv. Check box for process as multidimensional
    b. This will create a table with summary statistics (min, max, mean, std, etc.) for each year within the treatment polygon
    c. Can be exported by right clicking on Standalone Table > Data > export table

ZonalSt_RAP_wks1

OBJECTID *	polyID	COUNT	AREA	Variable	Dimensions	Standard Time	MIN	MAX	RANGE	MEAN	STD	SUM	MEDIAN	PCT90
1	1741	810	0.000059	pfg_cover_RAPv3	StdTime	1/1/2008	12	43	31	24.669136	4.491051	19982	24	30
2	1741	810	0.000059	pfg_cover_RAPv3	StdTime	1/1/2009	14	43	29	23.145679	4.20153	18748	23	28
3	1741	810	0.000059	pfg_cover_RAPv3	StdTime	1/1/2010	22	42	20	30.22963	2.970075	24486	30	34
4	1741	810	0.000059	pfg_cover_RAPv3	StdTime	1/1/2011	16	53	37	25.328395	5.106598	20516	25	32
5	1741	810	0.000059	pfg_cover_RAPv3	StdTime	1/1/2012	15	48	33	35.097531	5.693758	28429	36	41
6	1741	810	0.000059	pfg_cover_RAPv3	StdTime	1/1/2013	19	47	28	33.82716	4.866083	27400	34	40
7	1741	810	0.000059	pfg_cover_RAPv3	StdTime	1/1/2014	19	50	31	33.438272	5.849703	27085	34	41

- Summary stats as a figure:
    a. Select one of the plant functional group layers
    b. In Multidimensional Tab > Temporal Profile > Pixel Time Series Change Explorer
        i. Change detection method: LandTrendr
        ii. Define a pixel location: select the polygon for treatment
        iii. Can adjust data and axis labels and aesthetics as you see fit

Pixel change in pfg_cover_RAPv3 over time using Multiple locations with one band

4) Trend:
- Multidimensional tab > analysis > Trend
    a. *Image analysis extension required*
- Resources: https://pro.arcgis.com/en/pro-app/latest/help/analysis/image-analyst/multidimensional-analysis-in-arcgis-pro.htm

5) Segmentation
- You can use many of the [Raster Functions](#) to perform summaries on the multidimensional rasters (i.e., hot spot analysis, anomaly analysis)
  a. This analysis will run on every 'slice' of the raster
- For example, if we wanted to reclassify cover based on a threshold value
  a. Analysis tab > Raster Functions > Reclass > Remap
  b. For shrub cover: reclassify values 0-10 as a 0 and 20-100 as 1
  c. Select "create new layer"
- Update symbology:
  a. Right click on remapped layer > Symbology
  b. Primary Symbology: Unique values
  c. Pop up warning – compute unique values? Select Yes.
- View reclassified layer Using the play button in Multidimensional tab
- Repeat for bare ground using a threshold of 10%

Raster Functions   ? ∨ ⚲ ✕

⬅   Remap Properties

General **Parameters**

Raster

| shrub_2008_2016.nc_shrub_cover_RAP\ ∨ | 📁 |

Remap Definition Type

| List | ∨ |

	Minimum	Maximum	Output	NoData
1	0	20	0	☐
2	20	100	1	☐
*				☐

☐ Change Unmatched Values to NoData

Replacement Value

| |

6) Exporting multidimensional raster as cloud raster format (ESRI native multidimensional raster format)
- Open "Copy Raster" tool, select input multidimensional raster.
- The output will automatically be in .crf file
- Select "Process as Multidimensional"
- More information about sharing Multidimensional rasters https://pro.arcgis.com/en/pro-app/latest/help/data/imagery/share-multidimensional-raster-data.htm