sALR Model Pipeline Operation

Zach Vanderbosch, Physical Scientist, NPS Natural Sounds & Night Skies Division

sALR Github Repository: https://github.com/zvanderbosch/sALR

ArcGIS Pro: Creating the VIIRS TIFF File

The first step is creating the input data that is needed to run the sALR model. The input data is the VIIRS upward radiance data provided by the Earth Observation Group (EOG), cropped to cover just the contiguous United States (CONUS). We typically use only the annual, median filtered, composite data, an example file from EOG looking like VNL_npp_2023_global_vcmslcfg_v2_c202402081600.median.dat.tif. This file covers a huge portion of the world, however, which is why we need to first crop it to the area of interest, and also do some simple data manipulation like setting low-valued pixels to zero.

If Starting From Scratch:

1. Create a new Map project in ArcGIS Pro
   - By default, this project will contain the "World Topographic Map" and "World Hillshade" map layers.
2. Load a CONUS (continental US) state boundary feature layer. You can find one used in a previous project (e.g. CONUS_states from Sharolyn's sALRpipeline project), or can just download a reliable layer from the web (such as Contiguous US State Boundaries). Just google search CONUS ArcGIS layer and several options should show up.
3. Create a **500 km** buffer layer around the CONUS state boundaries.
   - Go to **analysis** tab, click **Tools**, and type "buffer" in the search bar in right panel to find the **Buffer (Analysis Tools)** tool.
   - Select the CONUS state boundary layer as the input, set distance/unit to desired values, and select "Dissolve all output features into a single feature". Side type can stay full, and method can stay planar.
   - Click "Run" to create buffer feature.
4. Create a bounding box for the buffer layer.
   - Go to **analysis** tab, click **Tools**, and type "minimum bounding geometry" in the search bar in right panel to find the **Minimum Bounding Geometry (Data Management Tools)** tool.
   - Select the buffer feature as the input, and set geometry type to **Envelope**. Leave group option as none.
   - Click "Run" to create the bounding box.
5. Download VIIRS data from the Earth Observation Group (EOG)
   - Before downloading data, you'll need to create an EOG account.
   - Scroll down to most recent version of Annual VNL (V2 is most recent as of May 2025)
   - Click "Go to Download" for most recent version (V2.2 is most recent as of May 2025)

- Select folder for year of interest
- Select file ending in "median.dat.tif.gz". Should be about a 9 GB file.

6. Load the VIIRS data layer from EOG into ArcGIS Pro.
7. Clip VIIRS data to bounding box and replace values <0.5 with 0.
   - Go to **analysis** tab, click **Tools**, and type "con" in the search bar in right panel to find the **Con (Spatial Analyst)** tool. If this tool shows up as unlicensed, you'll need to enable it by going to **Project -> Licensing -> Configure your licensing options**. Wait a bit for options to load, then scroll down and check the box next to **Spatial Analyst**.
   - In the **Parameters** window:
     i. Set input raster to EOG VIIRS TIFF layer.
     ii. Add a condition where **VALUE is less than 0.5**
     iii. Set input true value to 0 and input false value the the EOG VIIRS layer.
     iv. Set output raster to CONUS_YYYY_viirs, replacing YYYY with year (e.g. 2024).
   - In the **Environments** window:
     i. Set output coordinate system to **USA Contiguous Albers Equal Area Conic USGS**, which can be found by clicking on the Globe icon and then looking under **Projected Coordinate System -> Continental -> North America**
     ii. Set the XY Extent by clicking the layer dropdown menu and selecting the bounding box layer.
     iii. Set cell size to 500m (meters should already be default unit).
   - Click "Run" to process the VIIRS layer
8. Export CONUS_YYYY_viirs layer to a TIFF file
   - Right click on layer and go to **Data -> Export Raster**
   - No settings should have to be changed, make sure pixel type is 32 bit float.
   - Click "Export" to save layer to TIFF file.

If Only Updating the VIIRS Layer

If the bounding box has already been created and the only goal is to update the VIIRS TIFF file for a new year, then one could open a saved project containing the bounding box layer and replace/remove all EOG VIIRS layers with updated versions, basically starting from step 5 above.

Running the sALR Model Pipeline

Activating and Using the arcgispro-py3 Environment

To run the Python script that generates the sALR model (annulus40_np_CONUS.py), you'll need to be using a Python environment that can access arcpy commands. When you install ArcGIS Pro on your computer, it also installs a python environment called **arcgispro-py3** that can be used to run python scripts with arcpy commands. On Windows this python environment is located at:

```
"C:\Program Files\ArcGIS\Pro\bin\Python\envs"
```

There are several options available for using this environment to run python scripts:

1. **Add path to environment to conda configuration file (my preferred method)**
   a. This method assumes you already have conda installed on your machine, which comes with any Anaconda, Miniconda, or Miniforge installation. On current government machines, Miniforge (v24.9.0.0) can be installed from the Software Center.
   b. Open a Windows Terminal or Powershell
   c. Add path to arcgispro-py3 to .condarc configuration file. This only needs to be done once and will be saved for any future use of conda on your machine.
      i. `conda config --add envs_dirs "C:\Program Files\ArcGIS\Pro\bin\Python\envs"`
   d. Activate the arcgispro-py3 environment
      i. `conda activate arcgispro-py3`
   e. Example of how to execute a python script
      i. `python script.py`
2. **Activate the arcgispro-py3 environment using proenv.bat**
   a. This method does not require any independent installation of conda but rather relies on conda that is also installed with ArcGIS Pro.
   b. Open a Windows Terminal or Powershell
   c. Execute the proenv.bat script to activate the environment
      i. `& 'C:\Program Files\ArcGIS\Pro\bin\Python\Scripts\proenv.bat'`
   d. Example of how to execute a python script
      i. `python script.py`
3. **Execute a script directly using propy.bat**
   a. This method does not require any independent installation of conda but rather relies on conda that is also installed with ArcGIS Pro. This method wraps up both the activation of the arcgispro-py3 environment and execution of a python script into one command.
   b. Open a Windows Terminal or Powershell
   c. Example of how to execute a python script using propy.bat
      i. `& 'C:\Program Files\ArcGIS\Pro\bin\Python\Scripts\propy.bat' script.py`

Running the sALR Model Pipeline Python Script

1. Check for inputs:
    a. A **CONUS_YYYY_viirs.tif** file in the **sALR_inputs** folder where YYYY is the year you wish to process.
    b. **ring_params.json** file in the base folder, with metadata defining each ring.
2. Check for output directories:
    a. **wksp** (a workspace directory for ArcGIS to store temporary files)
    b. **sALR_outputs** (where the resulting model will be stored
3. Open the annulus40_np_CONUS.py python script and modify the following parameters as needed:
    a. **salrBase** (defines the path to the base sALR directory on your machine)
    b. **year** (The year you wish to process, same as YYYY in the CONUS_YYYY_viirs.tif file)
4. Open a Windows Terminal or Powershell and use one of the methods above to run the annulus40_np_CONUS.py script within the arcgispro-py3 environment, e.g.:
    a. `conda activate arcgispro-py3`
    b. `cd path\to\sALR`
    c. `python annulus40_np_CONUS.py`