Workflow

1. In ArgGIS Pro define study areas,
   1. Import,
      1. ESRI Living Atlas ‘World Hillshade’ DEM
      2. My organization’s ‘Afghan Provinces Map’
      3. Any one of the Landsat Geotiffs in the correct row and path
   2. Clip the hillshade to Afghanistan, Herat Provence, and the Landsat extent (3 clips), save each and remove the world hillshade
   3. Use the ‘Aspect (3d analysis)’ tool on the Afghanistan Dem
   4. Clip the Aspect image to Herat and to the imagery extent
   5. Create the Elevation part of what will be the ENVI ROI (Mask)
      1. Raster to Point either the Afghan-extent or the Herat-extent elevation (note: the Afghan-extent will crash most computers a few tools from now; my PC took 10 min)
         1. Value field
         2. Label feature
      2. Create fishnet for whatever extent chose
         1. Cell size was found in the hillshade metadata (1020 x 1020)
         2. Output as polyline
      3. Feature to polygon (this will take some time)
         1. Input is fishnet
         2. Label feature is output from the to point tool
      4. Definition query the output of iii and select only cases that are 2500 or more AND 3600 or Less
   6. Create the aspect part of what will be the ENVI ROI (Mask)
      1. Use the Int tool on the aspect layer
      2. Reclassify the output with direction degrees as your classes
         1. Use the original aspect label to reclassify. There should be 10 total, -1 is flat, north will have 2 ranges, include NODATA)
      3. I created a new attribute field at this point named ‘Directions’ to make the data more meaningful
      4. Raster to point
         1. I used direction for the output
         2. Label feature
      5. Feature to polygon using the same fishnet as the elevation part of the workflow
         1. Make sure the aspect points are used
      6. Definition query the output and select only cases that = Southwest OR =South OR =SouthEast
   7. Create the Study area mask
      1. Use intersect for the aspect and elevation layers
      2. Clip this to the imagery extent
      3. Save it in a way that you can find it later
2. In ArgGIS Pro, Optional: begin some spatial analysis in ArgGIS Pro
   * 1. Create a new feature class from the study area mask layer and the province map to determine the ephedra habitat for the various provinces
     2. Create 3 new attributes in the table of the resulting layer/geodatabase,
        1. PopulationZ, HabitatZ, CompositeZ (all are floats)
        2. PopulationZ is the z score of each provence’s population
        3. Habitat Z is the z score of each provence’s south-facing slopes at the correct altitude
        4. CompositZ is PopulationZ and HabitatZ added together
3. In ArcGIS, Export the Study Area mask as a file type that ENVI can use for its ROI
   1. The imagery extent included the row and path mask but the polygons outside of the actual image are few enough to remove manually by selecting them, switching the selection in the attribute table and making a new layer from the selection…
   2. Use Feature Class to Shapefile tool
      1. Input Data is the study area feature class
      2. Save and close
4. In ENVI, Preprocess the imagery
   1. Open all the unzipped landsat with metadata files (7 in this case)
   2. Radiometric calibration for radiance at sensor
      1. Use the Multispectral file for each respective layer
      2. Apply FLAASH Settings
   3. Atmospheric Correction with FLAASH
      1. Input = the respective .dat files from the sensor calibration (use single scale factor)
      2. Sensor = Landsat-8 OLI, Acquisition time should be automatically uploaded, elevation = 2km, Atmospheric Model = Mid-Lat Summer, Aerosol Model = Rural
      3. Multispectral Settings: (Filter function = landsat8\_oli\_sli), 2BandK-T tab: standard overland retrieval
   4. Rescale FLAASH Surface reflectance data to range (0-1) with Band Math
      1. Equation: (B1 le 0)\*0+(B1 ge 10000)\*1+(B1 ge 0 and B1 lt 10000)\*float(B1)/10000
      2. B1 = the FLAASH output
   5. Do this for each layer
      1. At least 2013 and 2019
5. In ENVI, import the mask
   1. Open the study area shape file in the 2013 ROI menu using Import
      1. Import the whole file as one single ROI
6. Use the NDVI tool with each of the processed bands
   1. Apply the mask by selecting ‘Spatial Subset’, selecting ‘ROI/EVF’, and selecting the imported .shp file
7. ‘Compute band statistics’ for the annual NDVI
   1. Use the ‘compute band statistics’ tool for each NDVI band without any mask applied
      1. Log the mean and sigma
   2. Use ‘compute band statistics’ again but this time select ‘mask options’, ‘build mask’, ‘options’, ‘import roi’, and select the mask you imported
   3. Log the totals
   4. The band statistics will be different because the ‘Spatial Subset’ option in the calculate NDVI step will be a contiguous polygon that encompasses all the area of the mask, and the Mask will apply the ROI pixel by pixel
8. Visualize the logged data in excel
9. Visualize the annual NDVI maps as a .gif
10. Write it all up