Creating VIC model from GIS data inputs

Data materials:

1. Elevation data
2. Land cover data
3. Soil data
4. Annual precipitation climatology data
5. Basin shapefile

Data preprocessing steps:

- The following steps are performed for each raster input from the data materials section

1. Reproject data to same geographic projection (typically WGS84/EPSG:4326)
2. Clip datasets to basin extent
3. Calculate other derived datasets
    a. Slope
    b. Flow Direction
    c. Gauge watershed

VIC Model setup:

1. Open terminal and navigate to the "scripts" folder within the training directory
2. First, we need to make our underlying grid template:
    a. Run the command: `$ python create_aoi_grid.py ../data/input/gis/Nyando_basin.shp ../data/input/gis/Nyando_grid.tif 0.05`
3. Next, we need to align (coregister) all of our input raster data sets to the grid template at the spatial resolution we need for all of the input datasets:
    a. Run commands: `$ python snap_raster.py ../data/input/gis/Nyando_basin_SRTM_filled.tif ../data/input/gis/Nyando_basin_SRTMSnap.tif ../data/input/gis/Nyando_grid.tif True bilinear`
    b. `$ python snap_raster.py ../data/input/gis/Nyando_basin_SRTM_filled.tif ../data/input/gis/Nyando_basin_ElvAvg.tif ../data/input/gis/Nyando_grid.tif False mean`
    c. `$ python snap_raster.py ../data/input/gis/Nyando_basin_Slope.tif ../data/input/gis/Nyando_basin_SlopeAvg.tif ../data/input/gis/Nyando_grid.tif False mean`
    d. `$ python snap_raster.py ../data/input/gis/Nyando_basin_MODISLandCover.tif ../data/input/gis/Nyando_basin_LC_IGBP.tif ../data/input/gis/Nyando_grid.tif True nearest`

e. `$ python snap_raster.py ../data/input/gis/Nyando_basin_HWSD_soils.tif ../data/input/gis/Nyando_basin_SoilsAgg.tif ../data/input/gis/Nyando_grid.tif False mode`

f. `$ python snap_raster.py ../data/input/gis/Nyando_basin_AnnPrecip.tif ../data/input/gis/Nyando_basin_PrecipSnap.tif ../data/input/gis/Nyando_grid.tif False mean`

g. `$ python snap_raster.py ../data/input/gis/Nyando_gauge_watershed.tif ../data/input/gis/Nyando_gauge_fraction.tif ../data/input/gis/Nyando_grid.tif False mean`

4. Now we need to start formatting our input files that the VIC model can read:

    a. Format elevation band file: `$ python format_snow_params.py ../data/input/gis/Nyando_grid.tif ../data/input/gis/Nyando_basin_SRTMSnap.tif ../data/input/snow.param 100`

    b. Format soil parameter file: `$ python format_soil_params.py ../data/input/gis/Nyando_grid.tif ../data/input/gis/Nyando_basin_SoilAgg.tif ../data/input/gis/Nyando_basin_ElvAvg.tif ../data/input/gis/Nyando_basin_PrecipSnap.tif ../data/input/gis/Nyando_basin_SlopeAvg.tif ../data/input/soil.param`

    c. Format vegetation parameter file: `$ python format_veg_params.py ../data/input/gis/Nyando_grid.tif ../data/input/gis/Nyando_basin_LC_IGBP.tif ../data/input/veg.param IGBP`

    d. Setup vegetation library file: `$ python make_veg_lib.py ../data/input/gis/Nyando_basin_LC_IGBP.tif ../data/ancillary/LAI/ ../data/ancillary/ALB/ ../data/input/veg.lib IGBP`

    e. Format meteorological forcing files: `$ python format_meteo_forcing.py ../data/input/gis/Nyando_grid.tif ../data/input/forcing/raw/ ../data/input/forcing/ 2005 2013`

5. We now have all of the input files required to run the VIC model a couple more steps before executing the model…

    a. Update the global parameter file to run the model for 2005 – 2013

    b. Update paths to the input files and output file directory

        i. Use absolute paths or relative paths from the VIC executable file

6. Now the we can run the VIC model:

    a. Navigate to data directory where the VIC executable file is

b. Run the command: `$ ./vicNl –g ./input/global.params`

i. This command assumes the VIC executable file is in the "/home/servir-vic/Documents/vic-training/data" directory

7. If the VIC model has finished running successfully, we can now format the output flux data into a more useable format

a. Navigate back to the scripts folder

b. Run the command: `$ python flux2nc.py ../data/output/fluxes/ ../data/output/`

i. When prompted for input, enter "3" for the runoff variable, then "2005" for the start year, and lastly "2013" for the ending year

c. Run the same command but for the baseflow ("4") parameter

8. Now that we have gridded outputs from the model, we can run the routing model

a. Run the command:
```
$ python rout_vic.py
../data/input/Nyando_UHFile.csv
../data/input/gis/Nyando_gauge_fraction.tif
../data/output/runoff_2005.nc ../data/output/base_2005.nc
../data/output/rout_out.csv 20050101 20131231 False
```

b. Now the routing results can be opened and compared to the observed streamflow

Additional data post-processing

1. We have simulated data for additional variables such as ET and soil moisture, now we can format the data and see how it looks

a. Run the command: `$ python flux2nc.py ../data/output/fluxes/ ../data/output/`

i. When prompted for input, enter "2" for the ET variable, then "2005" for the start year, and lastly "2013" for the ending year

b. Run the command: `$ python format_flux_climo.py ../data/output/evap_2005.nc`

2. Visualize the climatology dataset

a. Run command: `$ /home/servir–vic/Panoply/panoply.sh`

i. This will open the Panoply visualization software

b. Open the "evap_climo.nc" file within Panoply and plot the data