LDT Parameter Testcase

Step-1

In this presentation ...

- You will learn how to run LDT
- Perform parameter processing for the Noah-3.6 land surface model (LSM)
- Generate an actual Noah-3.6 parameter input file to be used later by LIS (and LVT).

Running LDT: Our Testcase Overview

- A simple testcase using LDT to generate model parameters for a LIS model run.
- This test case will be used with each of the testcases available on the LIS website, building off of each section within this LISF tutorial.
- The design of the testcase is to familiarize end-users with a full end-to-end demonstration of the LIS framework, and how each software component plays a role in this framework.
- The end-to-end test case includes:
  - *The Noah land surface model (LSM), version 3.6, and*
  - *SMAP soil moisture (SM) data assimilation (DA)*

Steps to running LDT …

1) Check out the LIS Framework (LISF) software from our new GitHub Repository
2) Set up and compile required libraries (e.g., netCDF, HDF5)
3) Configure and compile LDT to generate the ***LDT*** executable
4) Set up your *ldt.config* file and select options and entries
5) Check that directory paths and filenames are correct prior to running
6) Run the ***LDT*** executable with your *ldt.config* file:

   ./LDT *ldt.config*

Common files that get generated from an LDT parameter processing run …

1) `lis_input.d01.nc` ⇒ The NetCDF-formatted model parameter file, which is read into LIS at runtime.
"d01" -- the indexed domain, typically used as "nests" for NASA-Unified WRF simulations.

1) `lislog.0000` ⇒ This is the output diagnostic log file that provides runtime messages, including warnings and errors messages.

1) `MaskParamFill.log` ⇒ This diagnostic file informs of any disagreements between an LSM-based parameter and the landmask, and whether any parameter gridcells were "filled" to bring agreement with the landmask.

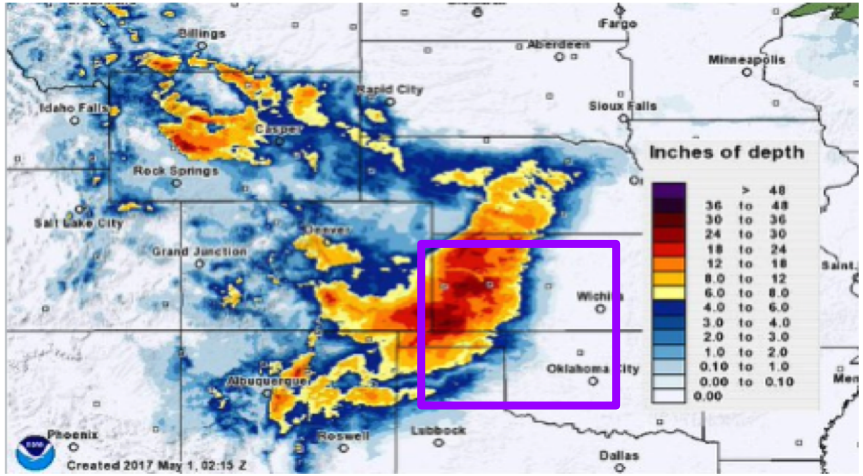
The Testcase Domain: Southern Great Plains (SGP)

- ***Focus region***: Southern Great Plains (SGP) area, spanning most of Oklahoma and Southern Kansas (based somewhat on https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=789610&tag=1)

#LIS domain

Map projection of the LIS domain:	latlon
Run domain lower left lat:	34.375
Run domain lower left lon:	-102.875
Run domain upper right lat:	39.625
Run domain upper right lon:	-96.125
Run domain resolution (dx):	0.25
Run domain resolution (dy):	0.25

- A late April of 2017, major snow storm event occurred across the Southern Great Plains and Rocky Mountains. Purple box in the map, on the right, highlights the test case study domain.



Interpolated Observed Snowfall Analysis, 72-hour preceding May 1, 2017.

Download necessary files to run this step …

1) Download the "*Step 1*" tarred-gzipped file from the LIS testcases webpage ("*testcase1_ldt_parms.tgz*").

2) Unpack the above testcase files into a common working directory (which we will refer to as `$WORKING_DIR`, for all the testcases").

3) Once unpacked, you will see the following directories and files:

- `INPUT` ➔ Contains parameter files and input files for subsequent test cases
- `ldt.config.noah36_parms` ➔ The ldt.config file for this testcase
- `target_lis_input.nldas.noah36.d01.nc` ➔ The "target" (already generated) LDT generated netcdf file;
- `target_ldtlog.0000` ➔ The "target" (already generated) LDT log file;
- `target_MaskParamFill.log` ➔ The "target" mask-parameter log file;

The LDT configuration file: `ldt.config.noah36_parms`

- The ldt.config file used in this part of the testcase, includes:
  - The LSM of interest (e.g., "**Noah.3.6**")
  - The name of NetCDF-formatted parameter file, which will be used by LIS: e.g., **lis_input.nldas.noah36.d01.nc**
  - You can provide the name of the LDT diagnostic file: e.g., **ldtlog**
  - The grid projection, domain extents, and spatial resolution to be used by LIS (and LVT)
  - Selecting the parameter data sources and features of interest
  - Other features, e.g., irrigation or elevation datasets, can be selected and read in
- The grid domain that you select in an **ldt.config** file will be placed in your NetCDF-formatted parameter file, and LIS will read that information automatically at the LIS run-time.

LDT.config file: Setting up and checking entries

- First, review the LDT configuration file for our LDT-based Noah3.6 parameter test case:

  ldt.config.noah36_params

- Make sure desired options are selected for the Noah-3.6 model
- Settings within the given ldt.config file for this step should match the parameter filepaths in the "***INPUT***" directory.
- ***For additional information, please see LDT User's Guides, found here:***

  https://modelingguru.nasa.gov/docs/DOC-2635

The Noah Land Surface Model: Parameters

- **The Noah land surface model (LSM), version 3.6 (NOAA/NCAR)**
- *Landcover*: MODIS-based IGBP landcover map (~ 1 km, NOAA)
- *Soil texture*: FAO+STATSGOv1 combined soil texture map (~ 1 km, NOAA)
- *Greenness fraction:* AVHRR-based monthly climatology (1.0 deg, NOAA)
- *Snow-free albedo:* Monthly climatology dataset (1.0 deg, NOAA)
- *Maximum snow albedo:* MODIS-based maximum snow albedo (0.05 deg; Mike Barlage, NCAR)
- *Bottom of soil column temperature:* ISLSCP-1 climatology dataset (1.0 deg)

Running LDT - The Parameter Processing Step

- Run the ***LDT*** executable with the Noah-3.6 model parameter ldt.config file:

  ./LDT ldt.config.noah36_params

- Should take a couple of minutes to run …
- Was the run successful?
  - **Yes** ⇒ *Great job!*
  - **No** ⇒ *Let's check for any run-time error messages or files …*
- Let's check our *`ldtlog.0000`* file to confirm how our run ended.
- Next, let's check the Noah-3.6 parameter NetCDF file that was produced …

Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

- LDT generated the final processed parameter file for Noah-3.6:

  `lis_input.nldas.noah36.d01.nc`

- This is the parameter file that will be read into LIS at runtime.
- Since it is in the NetCDF-4 format, we can view with NCView:

  `ncview lis_input.nldas.noah36.d01.nc`

- Viewing window will pop-up with a variety of Noah parameter options to view for our domain.

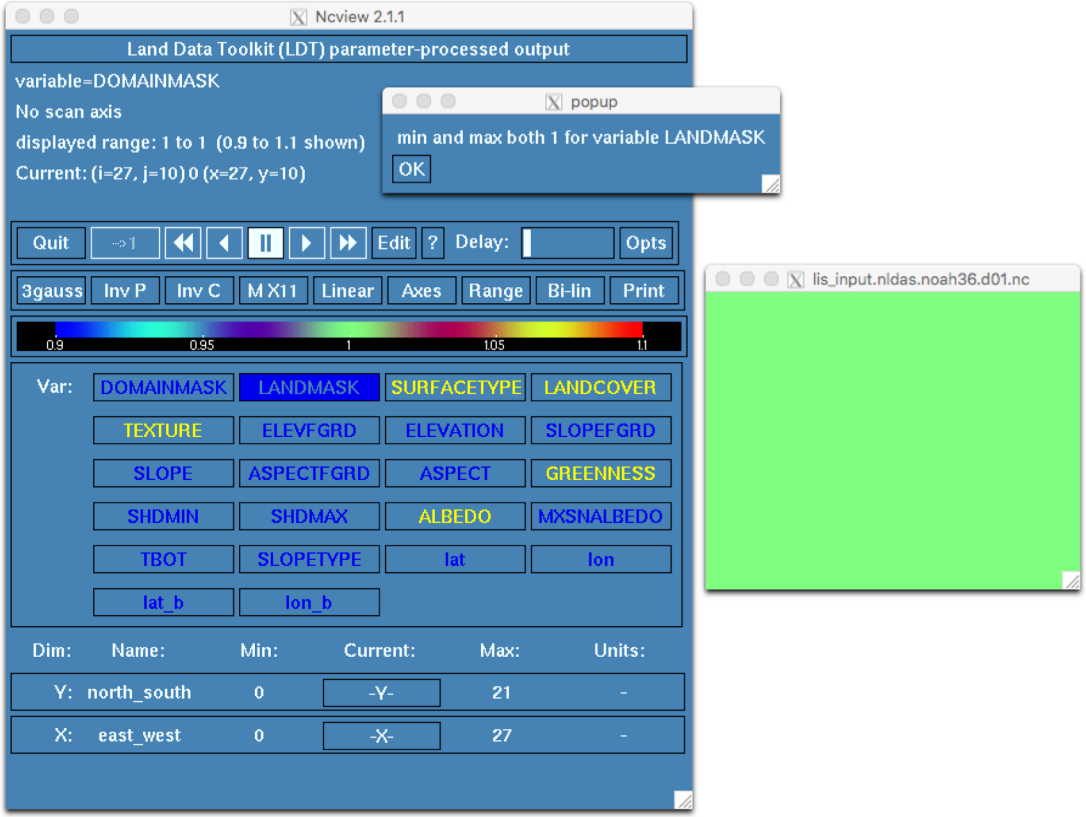
Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

Ncview viewing panel …

- Click on the widget that reads: "**LANDMASK**"
- Next, click on: "**DOMAINMASK**"

⇒ Both masks have a constant value of "1", which indicates all gridcells in our domain are treated as "land" points.

⇒ This means that all parameters in our LIS input file should have "**NO**" undefined values (e.g., -*9999.*)



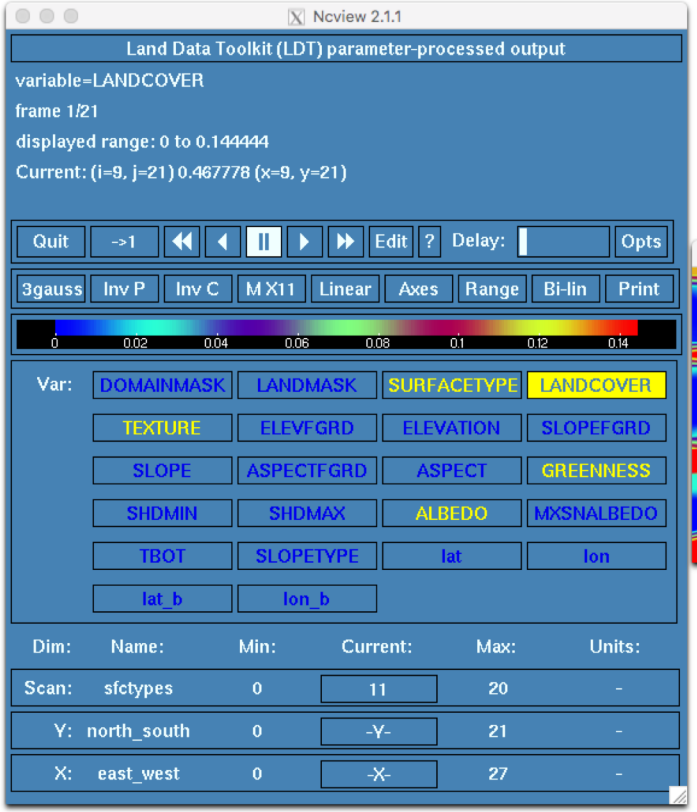
Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

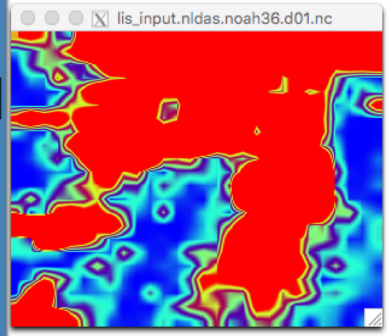
Let's look now at the "LANDCOVER" parameter ...

- Click on:
  "**LANDCOVER**"
- Then, click on the number below "**Current**" in the row named: "**sfctypes**"

⇒ This will allow you to toggle through the 20 different IGBP landcover and use classes. *Crop* class of 12 (11 here via index) is shown on the right.

⇒ "**SURFACETYPE**" field is based on landcover types.





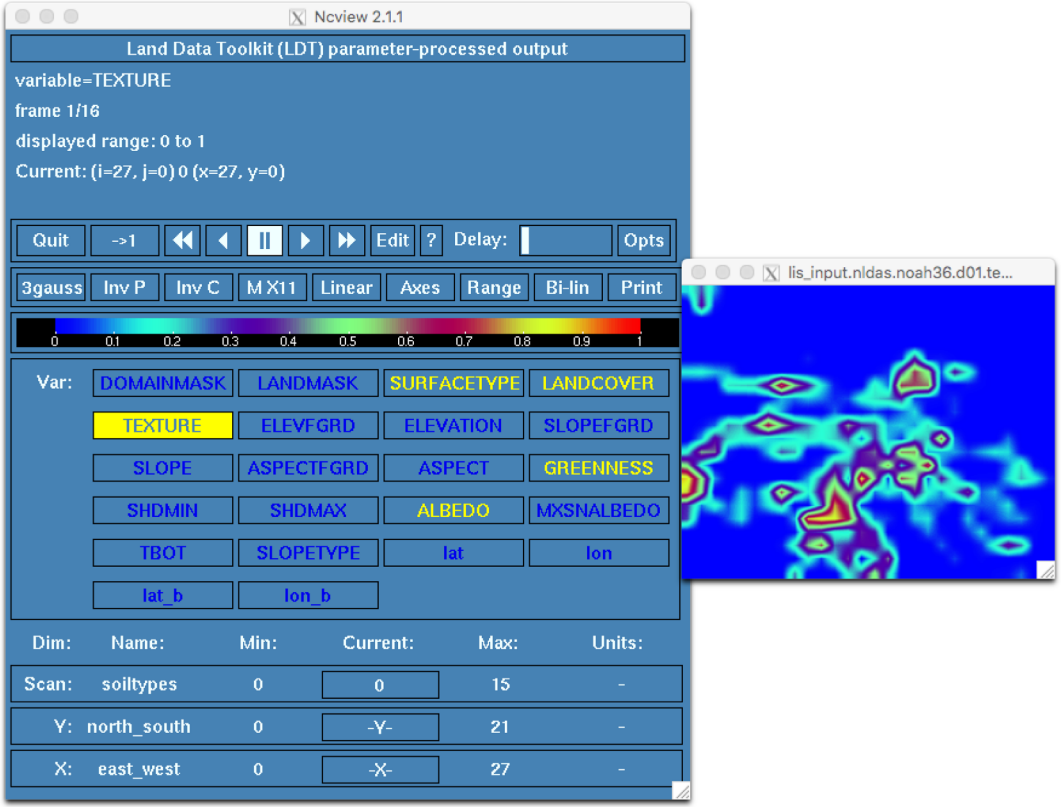
Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

One final parameter to look at ...

- Click on:
  "**TEXTURE**"
- Then, click on the number below "**Current**" in the row named: "**soiltypes**"

⇒ This is the FAO+STATSGO soil texture map, aggregated using the "**tile**" grid transform option.

⇒ You see "frequencies" or the fraction of each soil type within the 0.25 degree gridcell of our domain.



Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

What if we were to rerun our LDT executable and ldt.config file by selecting "mode" for soil texture option … ?

- Go back to our ldt.config file, `ldt.config.noah36_params`

  and change the following entry:

`Soil texture spatial transform:`

  from `tile` ⇒ **`mode`**

- Run the LDT executable again: `./LDT ldt.config.noah36_params`

Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

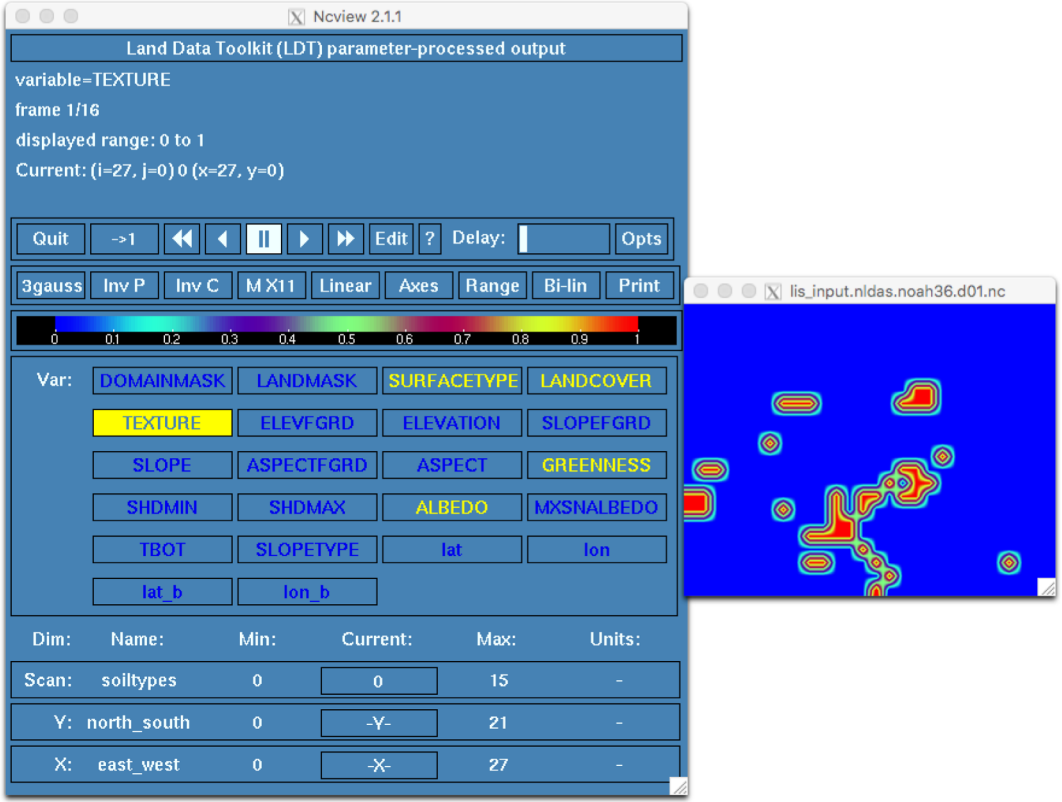
What if we were to rerun our LDT executable and ldt.config file by selecting "mode" for soil texture option … ?

- Click again on:
  "**TEXTURE**"

⇒ You see now "total" values of ***1*** for each soil type within the 0.25 degree gridcell of our domain.

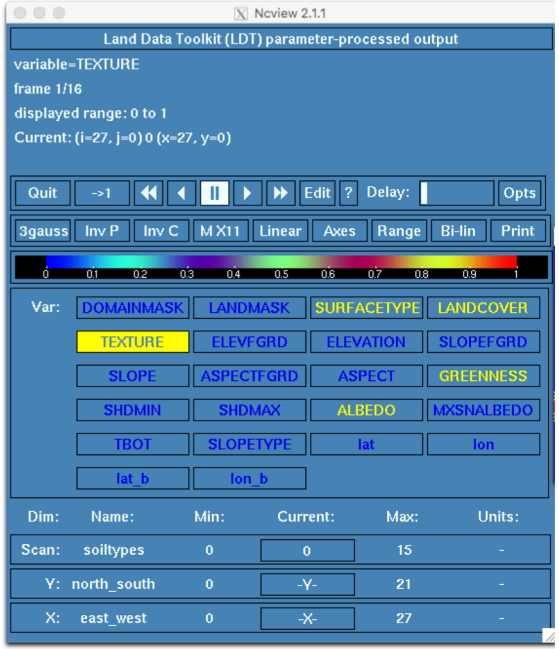
⇒ ***Why?***

Since we are selecting the "dominant" gridcell to be represented for each soil type.

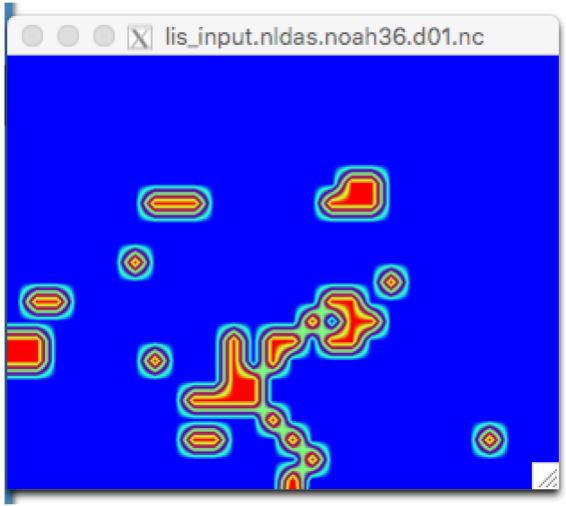


Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

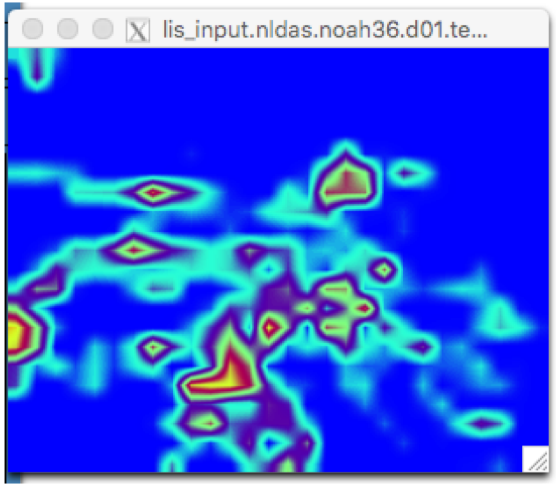
Dominant vs. fractional soil type ...



Mode



Tile



Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

- We can also use other NetCDF tools for viewing the contents of our file:

  `lis_input.nldas.noah36.d01.nc`

  ⇒ Such as ***ncdump*** …

- Using "`ncdump -h`", we can view the dimensions, variable names and attributes of the file.

```
ncdump -h lis_input.nldas.noah36.d01.nc
```

* Note: *(append " | `more`" after the LIS input file name to scroll easier …)*

Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

```
⇒ ncdump -h lis_input.nldas.noah36.d01.nc

netcdf lis_input.nldas.noah36.d01 {
dimensions:
        east_west = 28 ;
        north_south = 22 ;
        east_west_b = 32 ;
        north_south_b = 26 ;
        month = 12 ;
        time = 1 ;
        sfctypes = 21 ;  ⇐ Note: 21 … includes "openwater" surface type
        soiltypes = 16 ;
        elevbins = 1 ;
        slopebins = 1 ;
        aspectbins = 1 ;
```

Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

```
⇒ ncdump -h lis_input.nldas.noah36.d01.nc
variables:
        float time(time) ;
        float DOMAINMASK(north_south, east_west) ;
                DOMAINMASK:standard_name =
"DOMAINMASK" ;
                DOMAINMASK:units = "" ;
                DOMAINMASK:scale_factor = 1.f ;
                DOMAINMASK:add_offset = 0.f ;
                DOMAINMASK:missing_value = -9999.f
;
                DOMAINMASK:vmin = 0.f ;
                DOMAINMASK:vmax = 0.f ;
                DOMAINMASK:num_bins = 1 ;
```

Viewing the LIS input file: lis_input.nldas.noah36.d01.nc

```
// global attributes:
                :MAP_PROJECTION = "EQUIDISTANT CYLINDRICAL" ;
                :SOUTH_WEST_CORNER_LAT = 34.375f ;
                :SOUTH_WEST_CORNER_LON = -102.875f ;
                :DX = 0.25f ;
                :DY = 0.25f ;
                :INC_WATER_PTS = "true" ;
                :LANDCOVER_SCHEME = "IGBPNCEP" ;
                :BARESOILCLASS = 16 ;
                :URBANCLASS = 13 ;
                :SNOWCLASS = 15 ;
                :WATERCLASS = 17 ;
                :WETLANDCLASS = 11 ;
                :GLACIERCLASS = 15 ;
                :NUMVEGTYPES = 17 ;
                :LANDMASK_SOURCE = "MODIS_Native" ;
                :SFCMODELS = "Noah.3.6+Openwater" ;
                :SOILTEXT_SCHEME = "STATSGO" ;
                :GREENNESS_DATA_INTERVAL = "monthly" ;
                :ALBEDO_DATA_INTERVAL = "monthly" ;
```

Wrap-up of the LDT parameter processing step

- You have now generated your parameter input file for LIS-Noah3.6
- You can compare this newly generated file with the "*target*" version, provided with this testcase step.
- The file you generated will be used then in the next step (*Step 2*) of our end-to-end testcase ...

  ⇒ ***Running the Noah-3.6 LSM retrospective (or open-loop) run using LIS!***

- **For more details about some of the options that we went over, plus many other parameter options, please refer to Arsenault et al. (2018) and our LDT User's Guide*:***

  https://modelingguru.nasa.gov/docs/DOC-2635