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# SVN $Id: documentation.txt 156 2016-07-22 17:58:07Z kauff $
# SVN $URL: https://svn-iam-thesis.cgd.ucar.edu/urban_properties/trunk/doc/documentation.txt $
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Urban Properties Tool

(1) Creates urban thermal properties for use in CLM (CESM's Community Land Model component)

In general, this tool is required to create the urban properties data required as input to CESM's Community Land Model (CLM) Component. CLM requires urban properties for four city types in each of 33 regions. The properties include data such as the percentage of area covered by buildings, building height, roof and wall thermal conductivity, and the emissivity and albedo of roofs, walls, and roads.

(2) General description

This tool works by referencing a file containing the thermal properties of individual materials (eg. the thermal conductivity, heat capacity, emissivity, and albedo of air, concrete, and wood), and then referencing files specifying how such materials are combined to construct walls, roofs, and roads are constructed, from which the thermal properties of various types of roofs, walls, and roads is computed. Finally the code references files that describes, for four city types in each of 33 regions, the geometric shape of buildings and the types of roofs, walls, and roads used.

(3). Specific features

(3.1) Code description

This tool consists of four NCAR Command Language (NCL) scripts that are run in sequence. A command line tcsh driver script is used to run the four NCL scripts in proper order, although a user could run the the four NCL scripts individually on the command line -- this could be useful for, eg., manually altering input/output data to get material properties for use by CLM that are not based on the normal physics equations at play.

The four ncl scripts are:

- (*) gen_lam.ncl - which computes the physical properties of laminates (eg. a wall made up of layers of wood, insulation, and drywall)
- (*) gen_surf.ncl - which computes the physical properties of more complex surfaces (eg. a wall with windows).
- (*) gen_city.ncl - which computes the physical properties of various city types
- (*) gen_region.ncl - which selects city types for use in each of the 33 regions used within CLM

The tcsh driver script is urban_prop.csh -- this script will run the four ncl scripts in proper order. It requires no input on the command line -- the ncl scripts do require input files, files that are included with the source code via SVN checkout (see below).

(3.2) Inputs and Outputs

Note:

- o all input and output files are human-readable comma separated value (csv) text files.
- o all output files created have a unique time-stamp (yymmdd) as part of the file name

(3.2.1) gen_lam.ncl - create properties of simple laminates (roofs, walls)

input: mat_prop.csv (comes with SVN checkout)
input: lam_spec.csv (comes with SVN checkout)
output: lam_prop.yymmdd.csv

(3.2.2a) gen_surf.ncl - create properties of combined glass and window frames

input: lam_prop.yymmdd.csv (created by running previous .ncl script)
input: surf_spec_fw.csv (comes with SVN checkout)
output: surf_prop_fw.yymmdd.csv

(3.2.2b) gen_surf.ncl - create properties of walls with windows

input: surf_prop_fw.yymmdd.csv (created by running previous .ncl script)
input: surf_spec_ww.csv (comes with SVN checkout)
output: surf_prop_ww.yymmdd.csv

(3.2.3) gen_city.ncl - create properties for various city types

input: surf_prop_ww.yymmdd.csv (created by running previous .ncl script)
input: city_spec.csv (comes with SVN checkout)
output: city_prop.yymmdd.csv

(3.2.4) gen_region.ncl - assign city types to the 33 CLM regions

input: city_prop.yymmdd.csv (created by running previous .ncl script)
input: region_spec.csv (comes with SVN checkout)
output: region_prop.yymmdd.csv

(3.4) Running the tool

Use Subversion (SVN) to check out a version of the code from the THESIS SVN repository:

https://svn-iam-thesis-release.cgd.ucar.edu/urban_properties/

The code requires that tcsh and NCL are available. All required input data files are available along with the source code as part of the SVN checkout.

The code is executed by running the driver script, urban_prop.csh, on the command line. Alternately the user can run the ncl scripts manually on the command line -- looking into the urban_prop.csh shell script illustrates how to do this.

Running this code "out-of-the-box" (i.e. an SVN checkout without modification) creates the standard urban properties data that is typically used in CESM (circa 2016). The user can modify the mat_prop.csv file or any of the *_spec_*.csv file to create non-standard urban properties data for use in non-standard CESM experiments. Modifying a file used in one step can alter the output of all subsequent steps. Here are some examples:

(example 1) in mat_prop.csv (which specifies basic material properties), one could change the thermal conductivity of insulated wool, which then would cause a change in the properties of any roof or wall that contains insulated wool, and also cause a change the properties of any city type that uses buildings made of roofs or walls that contain insulated wool.

(example 2) the file city_spec.csv (which defines a city-type), could be edited to introduce/define/specify a new city type. This change alone would not change the end result, unless the file region_spec.csv (which assigns city types to regions) was also edited to specify that some world region actually used the new city type.