Land Model Diagnostics Package
lnd_diag v4.2

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DISCLAIMER: NCAR support for the Land Model Diagnostics Package is limited to documentation found in this webpage. Land model analysis requires an expert level of understanding of general circulation models, which we cannot provide. These pages are intended to guide expert users only by illustrating methods that have been successfully employed to further the science of the Land Model Working Group.

1. Introduction: Lnd_diag v4.2

Background:
Lnd_diag4.2 was redesigned from earlier land diagnostic packages (v2 and v3). Version 4 enables paleo-climate reconstructions for all analyses. Version 4 produces bit-for-bit consistency with v2 and v3 and the resulting analyses are identical. However, lnd_diag v4 run scripts are not backward compatible with earlier versions.

1.a. Pre-processing Changes:

- We recommend that you pre-stage all the clm monthly history files before running the LMWG diagnostics package. If your files are on the hpss, you can use the script "get_hpss_files.csh" in code/shared (note this script uses "listo" also in code/shared). If your files are on spinning disk you can link to them or copy them (see sections 1 and 6b).

1.b. Download lnd_diag4.2:

- http://www.ccsm.ucar.edu/models/ccsm4.0/model_diagnostics/

OR

- If you have access to the NWSC computers, simply copy lnd_template4.2.XX.csh to your directory. The template script points to the diagnostics version at /glade/p/cesm/lmwg/diag/lnd_diag4.2.

1.c. Revision history:

- Version 4.2 addition of levgrnd, with backward compatibility with levsoi.
- Continuous 'sliding window' pre-processing is no longer available
- RTM is now separated from CLM4 history files
- Added FLUXNET latent heat obs to sets 2, 3, 9
- Added FLUXNET GPP obs to sets 2, 3, 9
- obs_data is now an external
- New set_2 plots and option to run with Swift
- Use swift to multitask set_2 and add non-swift regrid support for SE to FV

- Improvements to all sets and bug fixes
- Integrate CLAMP package
- Add swift regridding support and fix non-swift regrid bugs
- Regridding upgrades and separate script for downloading hpss files
- Add plotObs flag for set_2
- Regridding support for ne120
- Multi-instance capability

1.d. Required and recommended software:

Software	Description
NCL	The NCAR Command Language (NCL), a product of the Computational & Information Systems Laboratory at the National Center for Atmospheric Research (NCAR) and sponsored by the National Science Foundation, is a free interpreted language designed specifically for scientific data processing and visualization.
NCO	The netCDF Operators, or NCO, are a suite of programs known as **operators**. Each operator is a standalone, command line program which is executed at the UNIX shell-level. The operators take netCDF files as input, then perform a set of operations (e.g., deriving new data, averaging, hyperslabbing, or metadata manipulation) and produce a netCDF file as output. The operators are primarily designed to aid manipulation and analysis of gridded scientific data.
ImageMagick	ImageMagick software is used to convert postscript output files to GIF formatted images.
ncview (optional)	Ncview is a visual browser for netCDF format files. Ncview is not an analysis package; its purpose in life is to quickly and easily view simple plots of data stored in netCDF format.
Swift (optional)	Swift is a scripting language for composing application programs into parallel applications that can be executed on multicore processors, clusters, grids, clouds, and supercomputers.

2. Run Script Documentation

NOTE: If you wish to stop (i.e., kill) an analysis run during the pre-processing phase where the summary files are being created you will need to first put the process into the background:

1. **Interrupt the script by typing: cntrl^Z**
2. **Put the process into the background by typing: 'bg'**
3. **Get the process ID by typing: 'jobs'**
4. **Kill the process by typing: ' kill -9 %<process_id>'**

Run Script Template:

Version	Run script template	Code source
lnd_diag4.2	lnd_template4.*.csh	CISL: /glade/p/cesm/lmwg/diag/lnd_diag4.2 CGD: /project/tss/diag/lnd_diag4.2

Section 1: Data Path

Environment Variable	Default Setting	Description
PTMPDIR	CISL: /glade/scratch/$LOGNAME CGD: /scratch/$LOGNAME	Working directory
SOURCE_1	CISL: /glade/scratch/$LOGNAME CGD: /scratch/$LOGNAME	File source 1
SOURCE_2	CISL: /glade/scratch/$LOGNAME CGD: /scratch/$LOGNAME	File source 2
LOCAL_FLAG_1	0	look for history files in LOCAL_1
LOCAL_FLAG_2	0	look for history files in LOCAL_2
LOCAL_FLAG_atm_1	0	look for history files in LOCAL_1
LOCAL_FLAG_atm_2	0	look for history files in LOCAL_2
LOCAL_FLAG_rtm_1	0	look for history files in LOCAL_1
LOCAL_FLAG_rtm_2	0	look for history files in LOCAL_2
LOCAL_LN	1	1=create soft link; 0=copy files

Section 2a, 2b: Source Path

NCAR users should not need to change DIAG_HOME unless you wish to point to a local version of the land diagnostics package (e.g., to make code modifications). Note that even if DIAG_HOME points to your personal sandbox, OBS_HOME can still point to the default OBS_HOME directory to save file space (the OBS_HOME directory is large).

Environment Variable	Default Setting	Description
DIAG_HOME	CISL: /glade/p/cesm/lmwg/diag/lnd_diag4.2 CGD: /project/tss/diag/lnd_diag4.2	maintained by LMWG maintained by LMWG
OBS_HOME	CISL: /glade/p/cesm/lmwg/diag/lnd_diag4.2	maintained by LMWG maintained by LMWG

	CGD: /project/tss/diag/lnd_diag4.2	

Section 2c: plotObs flag for set_2

Environment Variable	Default Setting	Description
plotObs	1	set_2 compare to present-day observations

Section 3: Variable Lists

Do not change INPUT_HOME unless you wish to copy the contents of this directory to a personal workspace to create non-standard variable lists for sets 1, 2 5, or 8. Note that changing the variables analyzed in sets 3, 4, 6, and 7 requires considerable code revision.

To create non-standard variable lists for sets 1, 2, 5, and 8:

- copy all variable lists from $INPUT_HOME/inputFiles
- modify variable lists (original format is required – Appendix A)
- Change INPUT_HOME to point to new variable lists.

Environment Variable	Default Setting	Description
INPUT_HOME	/${DIAG_HOME}/lnd_diag4.2/code	Source lists maintained by LMWG
var_master_cn	Variable_master4.3.ncl	Current master variable list

Section 4: Type of Model Analysis

Environment Variable	Default Setting	Description
OBS	0	Model1 (vs Obs where avail)
ModelVsModel	1	Model1 vs Model 2 (vs Obs where avail)

Section 5: Run Identification

Environment Variable	Default Setting	Description (0=ON;1=OFF)
prefix_1	clm3_6_14_newfrc_1995-2005	Name of output directory where analysis is performed. The prefix name differentiates a particular diagnostic from others within a series with the same case name. Convention uses the analysis years to distinguish the run (e.g.,

		clm3_6_14_newfrc_1948-2004)
caseid_1	clm3_6_14_newfrc	History file name (case1).
commonName_1	test	Descriptive name for plotting (optional)
UseCommonName_1	0	Use commonName for plots instead of caseid (optional).
prefix_2	clm4_1995-2005	Output file and directory name (case2)
caseid_2	clm4	History file name (case2)
commonName_1	control	Descriptive name for plotting (optional) (case2)
UseCommonName_2	0	Use commonName for plots instead of caseid (optional).

Section 6a: MSS Paths (Note: DEPRECATED. Use the script get_hpss_files.csh in $DIAG_HOME/code/shared to get history files before running diagnostics package)

Environment Variable	**Default Setting**	**Description**
MSS_tarfile_1	0	1=MSS annual tar files. 0=MSS monthly history files.
MSS_tarfile_2	0	1=MSS annual tar files. 0=MSS monthly history files.
MSS_path_1	/home/${USER}/csm/${caseid_1}/lnd/hist	Mass Storage System Path
MSS_path_2	/home/${USER}/csm/${caseid_2}/lnd/hist	Mass Storage System Path
MSS_path_atm_1	/home/${USER}/csm/${caseid_1}/atm/hist	Mass Storage System Path
MSS_path_atm_2	/home/${USER}/csm/${caseid_2}/atm/hist	Mass Storage System Path
MSS_path_rtm_1	/home/${USER}/csm/${caseid_1}/rof/hist	Mass Storage System Path
MSS_path_rtm_2	/home/${USER}/csm/${caseid_2}/rof/hist	Mass Storage System Path

Section 6b: Local Path

Environment Variable	**Default Setting**	**Description (0=ON;**

		1=OFF)
LOCAL_1	/glade/scratch/${USER}/${caseid_1}/lnd/hist.rename	Local file Path
LOCAL_2	/glade/scratch/${USER}/${caseid_2}/lnd/hist.rename	Local file Path
LOCAL_atm_1	/glade/scratch /${USER}/${caseid_1}/atm/hist	Local file Path
LOCAL_atm_2	/glade/scratch /${USER}/${caseid_2}/atm/hist	Local file Path
LOCAL_rtm_1	/glade/scratch /${USER}/${caseid_1}/rof/hist	Local file Path
LOCAL_rtm_2	/glade/scratch /${USER}/${caseid_2}/rof/hist	Local file Path

Section 6c: MSS storage path (Note: DEPRECATED)

Environment Variable	Default Setting	Description
MSS_write	0	Write tar and summary files to MSS
MSS_pe	365	Retention period
MSS_proj	00000000	Project charged for MSS storage
Write2MSS_Only	0	Write MSS files ONLY (assumes processing is complete)
MSS_path_out1	/${UPPERCASE_USER}/csm/${caseid_1}/lnd/diag	MSS storage location for output
MSS_path_out2	/${UPPERCASE_USER}/csm/${caseid_2}/lnd/diag	MSS storage location for output

Section 7a: Summary File Processing

Post-process history files into summary files. This section activates the post-processing of CESM history files into the summary files required by the diagnostics package. The diagnostics package will fail if these files do not exist. Note that there is a significant efficiency penalty for recreating the summary files if they already exist. See Appendix for description of summary file requirements.

Environment Variable	Default Setting	Description
overWriteTrend	0	overwrite pre-existing trend files (ANN_ALL.nc)
overWriteClimo	0	overwrite pre-existing climo files (DJF_climo.nc etc.)
weightAnnAvg	1	ON: Ann=(Jan*31+Feb*28+…+Dec*31)/365 OFF: Ann=(Jan +Feb +…+Dec)/12
CASE 1		
trends_1	1	construct long-term trends for case 1

climo_1	1	construct climatological means for case 1
trends_atm_1	0	construct long-term atmospheric trends for case 1
climo_atm_1	0	construct climatological atmospheric means for case 1
rtm_1	1	set to 1 if case 1 RTM files are on separate history files
trends_rtm_1	0	always set to 0 (no trends for RTM)
climo_rtm_1	1	construct climatological RTM means for case 1
CASE 2		
trends_2	1	construct long-term trends for case 2
climo_2	1	construct climatological means for case 2
trends_atm_2	0	construct long-term atmospheric trends for case 2
climo_atm_2	0	construct climatological atmospheric means for case 2
rtm_2	1	set to 1 if case 2 RTM files are on separate history files
trends_rtm_2	0	always set to 0 (no trends for RTM)
climo_rtm_2	1	construct climatological RTM means for case 2

Section 7b: Seasonal Means Processing

Create seasonal means which are used for T-Test in set 2.

Environment Variable	Default Setting	Description
meansFlag	1	for OBS runs
meansFlag	1	Required for set 2 T-Test for ModelVsModel runs.

Section 8: Monthly, Seasonal and Annual Climatology.

Specify first year and number of years to be analyzed for long-term climatologies. The ending year is calculated from clim_first_yr + clim_num_yrs. Model1 vs Model2 climatologies can compare different time periods, but for consistency they should be averaged over the same number of years.

Setting	Description
clim_first_yr_1 clim_first_yr_2	First model year for calculating model climatology.
clim_num_yrs_1 clim_num_yrs_2	Number of years to be included in climatology.

Example:

Environment Variable	Settings
clim_first_yr_1	1995
clim_num_yrs_1	11
clim_first_yr_2	1995
clim_num_yrs_1	11

Section 9: Annual trends.

User-specified first year and number of years to be analyzed for long-term trends. The ending year is calculated from trends_first_yr + trends_num_yrs. Model1 vs Model2 trends can compare different time periods, and be of different lengths. For comparisons between runs of different lengths and/or time periods, use Section 10 to indicate the first year of overlap for each case.

Setting	Description
trends_first_yr_1 trends_first_yr_2	First model year for calculating annual trends
trends_num_yrs_1 trends_num_yrs_2	Number of years to be included in annual trend analysis

Example:

Environment Variable	Settings
trends_first_yr_1	1995
trends_num_yrs_1	11
trends_first_yr_2	1995
trends_num_yrs_1	11

Section 10: Set Comparison Years (Optional)

Use this section to specify the first year of overlap between cases 1 and 2 if the length and/or time periods differ between cases.

Environment Variable	Default Setting	Description
trends_match_Flag	0	1=Turn on overlapping time periods
trends_match_yr_1	1975	Identify first year of overlap for case 1
trends_match_yr_2	1995	Identify first year of overlap for case 2

Examples:

1) 100-179 vs 400-479

```
trends_match_Flag      1
 trends_match_yr_1   100
trends_match_yr_2   400
```

Result: overlaps the two 80 yr periods

2) 100-179 vs 400-479
   trends_match_Flag 1
   trends_match_yr_1 170
   trends_match_yr_2 400
   Result: overlaps the last ten years of case 1 with the first 10 yrs of case 2.
3) 100-179 vs 100-179
   trends_match_Flag 1
   trends_match_yr_1 170
   trends_match_yr_2 100
   Result: overlaps the last ten years of case 1 with the first 10 yrs of case 2.
4) 100-179 vs 100-179
   trends_match_Flag 1
   trends_match_yr_1 170
   trends_match_yr_2 150
   Result: overlaps the last ten years of case 1 with the last 30 yrs of case 2.

Section 11: Optional Exit (Note: DEPRECATED. Use the script get_hpss_files.csh in code/shared to get history files before running diagnostics package.

Exit after reading MSS files and estimating trends and climatologies.

Environment Variable	Default Setting	Description
Exit_after_MSS	0	Exit after downloading history files and calculating trends and climotologies.

Section 12a: Carbon Models

Environment Variable	Default Setting	Description
CN	0	CN carbon model active
C13	0	C13 Isotopes active (DEPRECATED)
CLAMP	0	CLAMP terminology (DEPRECATED)
CASA	0	CASA terminology (DEPRECATED)

Section 12b: Hydrology Variables

Environment Variable	Default Setting	Description
HYDRO	1	Hydrology plots active

Section 13: NaN Screening (Optional)

Pre-screen for NaNs in CCSM history files. Script examines all variables in ANN_ALL.nc file for NaNs. User specifies whether script allows NaNs and continues processing, or exits fatally if NaNs are found. If BLOCK_NAN is set to 0 (thereby allowing the diagnostic package to continue processing) all NaNs are set to missing in every set. The goal of this step is to avoid potential problems by bring NaNs to the users immediate attention, therefore the default/recommended settings enable both set_0 and BLOCK_NAN.

Environment Variable	Default Setting	Description
set_0	1	Pre-screen for NaNs in derived files.
BLOCK_NAN	0	Exit script if NaNs are found.

Section 14: Analysis Sets

The diagnostics package performs a series of analyses that are divided into sets for convenience. Setting the set to 1 activates that analysis. Setting the set to 0 makes it inactive. See Appendix for detailed description.

Environment Variable	Default Setting	Description
set_1	1	Annual global trends.
set_2	1	Global contour plots.
set_3	1	Regional monthly plots of selected variables.
set_4	0	Vertical profiles (Atmospheric climatologies required)
set_5	1	Tables of annual means.
set_6	1	Annual regional and global trends of selected variables.
set_7	1	River flow and discharge (RTM required)
set_8	0	Ocean-atmosphere tracers (Atmospheric climatologies required)
set_8_lnd	0	Land-atmosphere tracers
set_9	1	Validation statistics for model vs OBS (T, P, Albedo, Latent Heat, GPP)

Section 15: Restart

This option is useful for runs that fail after pre-processing, during the set analysis. For example: Sets 1, 2, and 3 completed, but set 4 fails for an arbitrary external reason (e.g., the machine goes down unexpectedly or you run out of space on your working directory). To restart the run at set 4 and avoid re-running sets 1-3, set the 'restart_set_flag' to 1, and set 'restart_set' to 4. Leave sets 1-3 turned on (1) so they are visible on the webpages where only active sets are listed. This will not work with swift on.

Environment Variable	Default Setting	Description
setRestart_flag	0	Turn on to restart analysis at 'setRestart_set'.
setRestart_set	2	Valid options: 2,3,4,5,6,7,8,9

Section 16: User Preferences

Recommendation: New users should run a short test run (e.g., 5 yrs) with these flags turned off to be sure the diagnostics packages will run with their history files. Then turn the rmMonFiles* flags on to remove history files and save file space for longer runs. If you plan to extend this run by adding years or branching from the original diagnostics (e.g., extending an initial analysis of years 1-40 to years 1-100), be sure that deleteProcDir is turned off.

Environment Variable	Default Setting	Description
projection	0	1=Cylindrical Equidistant, 0=Robinson
colormap	1	1=use Blue-Yellow-Red, 0=use original colormaps
density	144	Controls density of output *.gif images
rmMonFilesTrend	0	Remove monthly history files after trends are created
rmMonFilesClimo	0	Remove monthly history files after climo files are created
raster	1	Raster mode for set 2 plots
expContours	0	All contours are user defined for set2 plots. To set explicit contours when expContours=0, change 0 to 1 in $INPUT_HOME/set2_*.txt.
deleteProcDir	1	Delete processing directory

Section 17a: Web Pages

Environment Variable	Default setting	Description
web_pages	1	Create web page.

Section 17b: Processing directives

Environment Variable	Default Setting	Description
delete_ps	1	Delete postscript files when analysis is complete.
delete_webdir	1	Delete web directory after tar file is created.
cleanup_Only	0	Cleanup directories after tar file is created (debug option)
webpage_Only	0	Skip to webpage creation (debug option)
ps2gif_Only	0	Skip to ps2gif conversion (debug option)
convert	1	Convert from ps to gif (debug option)

Section 18: File Transfer

Send notification and scp tar file to local machine where you would like to view results in a browser.

Environment Variable	Default Setting	Description (1=ON; 0=OFF)
remote	1	Send email to user account
scpFile	0	Send tarfile to machine (requires interactive password)
Remote_system	'mymachine'	Machine where you would like to post results.
Remote_dir	/web/web-date/tss/	Local directory where you would like to store results.
Email_address	'**myEmail@myaddress**'	Your email address.

Section 19: Swift

For more details on using swift as part of the land diagnostics package, see lnd_diag_swift4.2.XXXXXX.pdf in the top-level directory (additional settings required). Currently the swift version is supported only on the NWSC Geyser cluster.

Environment Variable	Default Setting	Description (1=ON; 0=OFF)
use_swift	0	Use swift
swift_scratch_dir	/glade/scratch/$USER/swift_scratch	Scratch directory for swift output files
RUNDIR	/$HOME/lnd_diag/run	Swift run directory

Section 20: Regrid data

Regrid spectral element output to finite volume (required if output is spectral element).
Currently only regrids NE30 to FV_192x288 and NE120 to FV_768x1152.
Some notes on regrid_file_type:
HISTORY = regrid all history files used in the comparison
-- Must be set to HISTORY if the C-LAMP package is set to true.
-- BUT the NE30/NE120 history files must already be staged in the case directory(ies). You can either do this by linking to the files if they exist at another location or getting them from the hpss using code/shared/get_hpss_files.csh.
The automated linking method specified by LOCAL_FLAG above will only work seamlessly when regrid_file_type is set to CLIMO.
CLIMO = regrid only the climo files

Environment	Default	Description

Variable	Setting	
regrid_file_type	CLIMO	Files to regrid
regrid_1	0	Regrid model 1
method_1	conserve	Type of regrid model 1
old_res_1	SE_NE30	Spectral element resolution model 1
new_res_1	FV_192x288	Finite volume resolution model 1
wgt_dir_1	/glade/p/cesm/lmwg/diag/lnd_diag4.2/regriddingFiles/ne30/	Regrid weights directory model 1
wgt_file_1	$old_res_1”_to_”$new_res_1”.”$method_1”.nc”	Regrid weights model 1
area_dir_1	/glade/p/cesm/lmwg/diag/lnd_diag4.2/regriddingFiles/	FV area variable directory model 1
area_file_1	$new_res_1"_area.nc"	FV area variable file model 1
regrid_2	0	Regrid model 2
method_2	conserve	Type of regrid model 2
old_res_2	SE_NE120	Spectral element resolution model 2
new_res_2	FV_768x1152	Finite volume resolution model 2
wgt_dir_2	/glade/p/cesm/lmwg/diag/lnd_diag4.2/regriddingFiles/ne120/	Regrid weights directory model 2
wgt_file_2	$old_res_2”_to_”$new_res_2”.”$method_2”.nc”	Regrid weights model 2
area_dir_2	/glade/p/cesm/lmwg/diag/lnd_diag4.2/regriddingFiles/	FV area variable directory model 2
area_file_2	$new_res_2"_area.nc"	FV area variable file model 2

Section 21: Multi-instance mode

Supports the multi-instance capability that the CSU CMMAP project has developed. Only works with swift. Set num_instance to 1, 16, or 32. If you only want to diagnose one of the instances (instead of the average of all of the instances), then set num_instance to 1 and id_instance to the id of the land instance to diagnose.

Environment Variable	Default Setting	Description (1=ON; 0=OFF)
multi_instance1	0	Model 1
num_instance1	32	Number of model 1 instances
id_instance1	_0003	If num_instance1 is 1, then this is id of land instance to diagnose
multi_instance2	0	Model 2
num_instance2	32	Number of model 2 instances
id_instance2	_0003	If num_instance2 is 1, then this is id of land instance to diagnose

END: GENERAL USER MODIFIED SECTION

BEGIN: ADVANCED USER MODIFIED SECTION

Section 22: Significance testing

Significance level.

Environment Variable	Default setting	Description
sig_lvl	0.10	Significance level for set 2 T-Test

Section 23: Sub-Regions (DEPRECATED)

Environment Variable	Default setting	Description
reg_contour	0	Sub-regions active
min_lat	30.	Southern boundary in degrees North
max_lat	80.	Northern boundary in degrees North
min_lon	-130.	Western boundary in degrees East

max_lon	-50.	Eastern boundary in degrees East
OBS_RES	T42	Observation resolution

Section 24: Time Stamp (DEPRECATED)

Turn on time stamp at bottom of plots.

Environment Variable	Default setting	Description
time_stamp	0	time stamp at bottom of plot

Section 25: Image Format

Environment Variable	Default setting	Description **(PS is the only tested option)**
p_type	ps	Postscript plots

Section 26: Paleo-specific run directives.

Environment Variable	Default Setting	Description
paleo	0	1=use or create coastlines
land_mask1	0	Define value for land in test case (DEPRECATED)
land_mask2	0	Define value for land in standard case (DEPRECATED)
paleo_diff_plots	0	Create difference plots for different continental outlines.

Section 27: CLAMP Diagnostic Package.

Environment Variable	Default Setting	Description
CLAMP_DIAG	0	1=run the CLAMP diagnostic package
CLAMP_SCRIPT	/$DIAG_HOME/clamp/run_2-model.csh	Choose run_1-model.csh for model vs obs and run_2-model.csh for model vs model
MODEL_vs_MODEL	clm3_6_14_newfrc_vs_clm4	User defined directory name to hold Model1 vs Model2 web table
MODEL_TYPE1	"old"	"new" if NEE, NETRAD,

		LATENT, FSH are present in history file, "old" otherwise
MODEL_TYPE2	"old"	"new" if NEE, NETRAD, LATENT, FSH are present in history file, "old" otherwise
GRID_1	0.5	Model grid: 0.5, 0.9, 1.9, T31, or T42
GRID_2	0.5	Model grid: 0.5, 0.9, 1.9, T31, or T42
nlat_1	360	Number of latitudes on model1 grid
nlon_1	720	Number of longitudes on model1 grid
nlat_2	360	Number of latitudes on model2 grid
nlon_2	720	Number of longitudes on model2 grid

END Users Guide

Appendix

A1. Directory Tree – CCSM History Files

The directory tree is created automatically by the land model diagnostics package (lnd_systems.csh). It includes the case directory, the model run directory (working directory), and subdirectories: model-obs or model1-model2.

PTMPDIR	case_1_dir	caseid_1_annT_YEAR.nc caseid_1.clm2.h0.YEAR-MO.nc	caseid_2_annT_YEAR.nc caseid_2.clm2.h0.YEAR-MO.nc
PTMPDIR	case_1_atm_dir	caseid_1_annT_atm_YEAR.nc caseid_1.cam2.h0.YEAR_MO.nc	caseid_2_annT_atm_YEAR.nc caseid_2.cam2.h0.YEAR-MO.nc
PTMPDIR	case_1_rtm_dir	caseid_1_annT_rtm_YEAR.nc caseid_1.rtm.h0.YEAR_MO.nc	caseid_2_annT_rtm_YEAR.nc caseid_2.rtm.h0.YEAR-MO.nc

A2. Directory Tree – Trend Files

PTMPDIR	prefix_1_dir prefix_2_dir	prefix_1_ANN_ALL.nc prefix_1_ANN_means.nc	prefix_2_ANN_ALL.nc prefix_2_ANN_means.nc
PTMPDIR	prefix_1_atm_dir prefix_2_atm_dir	prefix_1_ANN_ALL_atm.nc prefix_1_ANN_means_atm.nc	prefix_2_ANN_ALL_atm.nc prefix_2_ANN_means_atm.nc
PTMPDIR	prefix_1_rtm_dir prefix_2_rtm_dir	prefix_1_ANN_means_rtm.nc	prefix_2_ANN_means_rtm.nc

A3: Directory Tree – Climatology Files

PTMPDIR	prefix_1_dir prefix_2_dir	prefix_1_DJF_climo.nc prefix_1_MAM_climo.nc prefix_1_JJA_climo.nc prefix_1_SON_climo.nc prefix_1_MONS_climo.nc prefix_1_ANN_climo.nc	prefix_2_DJF_climo.nc prefix_2_MAM_climo.nc prefix_2_JJA_climo.nc prefix_2_SON_climo.nc prefix_2_MONS_climo.nc prefix_2_ANN_climo.nc
PTMPDIR	prefix_1_dir prefix_2_dir	prefix_1_DJF_means.nc prefix_1_MAM_means.nc prefix_1_JJA_means.nc prefix_1_SON_means.nc prefix_1_ANN_climo.nc prefix_1_ANN_means.nc	prefix_2_DJF_means.nc prefix_2_MAM_means.nc prefix_2_JJA_means.nc prefix_2_SON_means.nc prefix_2_ANN_climo.nc prefix_2_ANN_means.nc
PTMPDIR	prefix_1_atm_dir prefix_2_atm_dir	prefix_1_DJF_climo_atm.nc prefix_1_MAM_climo_atm.nc prefix_1_JJA_climo_atm.nc prefix_1_SON_climo_atm.nc prefix_1_MONS_climo_atm.nc prefix_1_ANN_climo_atm.nc	prefix_2_DJF_climo_atm.nc prefix_2_MAM_climo_atm.nc prefix_2_JJA_climo_atm.nc prefix_2_SON_climo_atm.nc prefix_2_MONS_climo_atm.nc prefix_2_ANN_climo_atm.nc
PTMPDIR	prefix_1_atm_dir prefix_2_atm_dir	prefix_1_DJF_means_atm.nc prefix_1_MAM_means_atm.nc prefix_1_JJA_means_atm.nc prefix_1_SON_means_atm.nc	prefix_2_DJF_means_atm.nc prefix_2_MAM_means_atm.nc prefix_2_JJA_means_atm.nc prefix_2_SON_means_atm.nc
PTMPDIR	prefix_1_rtm_dir prefix_2_rtm_dir	prefix_1_DJF_climo_rtm.nc prefix_1_MAM_climo_rtm.nc prefix_1_JJA_climo_rtm.nc prefix_1_SON_climo_rtm.nc prefix_1_MONS_climo_rtm.nc prefix_1_ANN_climo_rtm.nc	prefix_2_DJF_climo_rtm.nc prefix_2_MAM_climo_rtm.nc prefix_2_JJA_climo_rtm.nc prefix_2_SON_climo_rtm.nc prefix_2_MONS_climo_rtm.nc prefix_2_ANN_climo_rtm.nc
PTMPDIR	prefix_1_rtm_dir prefix_2_rtm_dir	prefix_1_DJF_means_rtm.nc prefix_1_MAM_means_rtm.nc prefix_1_JJA_means_rtm.nc prefix_1_SON_means_rtm.nc	prefix_2_DJF_means_rtm.nc prefix_2_MAM_means_rtm.nc prefix_2_JJA_means_rtm.nc prefix_2_SON_means_rtm.nc

A4: Directory Tree – Source Code

DIAG_HOME	code/shared	find_var_with_alts.ncl functions_contrib.ncl functions_tables.ncl get_hpss_files.csh listo lnd_ann.pm lnd_createTarFile.csh lnd_create_webpage.pl lnd_driver.csh lnd_func.ncl lnd_getFiles.pm lnd_lookupTable.pl lnd_mons.pm lnd_NaNScreen.ncl

		lnd_preProcDriver.pl lnd_ps2gif.pl lnd_regrid.pl lnd_seas_climo.pm lnd_seas_means.pm lnd_statTable.pl lnd_systems.csh lnd_util.pm lnd_varMaster.pl lnd_write2mss.pl mergeall.sh plot_functions.ncl plot_SE_FV.ncl raobs_station.ncl read_obs.ncl regional_values.ncl regrid_history_ncl_wrapper.csh regrid_history_standalone.pl se2fv_esmf.genwgt.ncl se2fv_esmf.regrid2file.ncl se2fv_esmf.regrid2file.testsinglefile.conserve.ncl
DIAG_HOME	code/model-obs	set_1.ncl set_2.ncl set_3.ncl set_4.ncl set_5.ncl set_6.ncl set_7.ncl set_8_DJF-JJA_contour.ncl set_8_ann_cycle.ncl set_8_ann_cycle_lnd.ncl set_8_contour.ncl set_8_trends.ncl set_8_zonal.ncl set_8_zonal_lnd.ncl
DIAG_HOME	code/model1-model2	set_1.ncl set_1DiffPlot.ncl set_2.ncl set_3.ncl set_4.ncl set_5.ncl set_6.ncl set_7.ncl set_8_DJF-JJA_contour.ncl set_8_ann_cycle.ncl set_8_ann_cycle_lnd.ncl set_8_contour.ncl set_8_trends.ncl set_8_zonal.ncl set_8_zonal_lnd.ncl set_9.ncl

A5: Directory Tree – Swift Code

DIAG_HOME	swift/swift_configs/geyser	cf.properties fs.data sites.xml tc.data
DIAG_HOME	swift/swift_utils	complete.csh create_ANN_climo.pl create_ANN_means.pl createAnnualAll.pl createAnnual.pl create_MONS_climo_step2_1.pl create_MONS_climo_step2_2.pl create_MONS_climo_step2_3.pl create_multi_instance_average.pl create_SEAS_climo_step1_1.pl create_SEAS_climo_step1_2.pl create_SEAS_climo_step2.pl create_SEAS_means_step1.pl create_SEAS_means_step2.pl getDecFlag.csh get_fileList.csh lnd_ps2gif_swift.pl lnd_util.pm mergerCompareTable.csh mfiles.csh run_ncl_model_model.csh run_ncl_model_obs.csh run_pre-clamp_ncl.csh run_clamp_ncl.csh run_regridding.csh

A6: Directory Tree – CLAMP Code

DIAG_HOME	clamp/	00.initial.ncl 01.npp.ncl 02.lai.ncl 03.co2.ncl 04.biomass.ncl 06.fluxnet.ncl 07.beta.ncl 08.turnover.ncl 09.carbon_sink.ncl 09x.carbon_sink.ncl 10.fire.ncl 10.write_ameriflux_clm4.5BGC_RUN.ncl 11.ameriflux.ncl 20.write_fire_clm4.5BGC_RUN.ncl 99.final.ncl

		README.old run_1-model.csh run_2-model.csh taylor_diagram.ncl test.csh template_1-model/ template_1-model_noCO2/ template_2-model/ template_2-model_noCO2/

A7: Script Flags for Summary Files

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Environment Variable	**Set**	**Description**
trends_1 trends_2	Set 1 Set 6	Annual Trends
climo_1 climo_2	Set 2 Set 3 Set 5 Set 7	Monthly, annual and seasonal climatology and means
trends_atm_1 trends_atm_2	Set 8	Annual Trends (Atmosphere)
climo_atm_1 climo_atm_2	Set 4 Set 8	Monthly, annual and seasonal climatology and means (Atmosphere)
trends_rtm_1 trends_rtm_2	Set 7	NA
climo_rtm_1 climo_rtm_2	Set 7	Monthly, annual and seasonal climatology and means (RTM)

A8: Set Description and Required Summary Files

Environment Variable	**Description**	**Temporal**	**Spatial**	**Required Summary files**
set_1	Line plots	Annual Trends	Global	ANN_ALL
set_2	Contour Plots	Long-term Climatology	Global	DJF_climo MAM_climo JJA_climo SON_climo DJF_means MAM_ means JJA_ means SON_ means
set_3	Line plots	Monthly Climatology	Regional	region_definitions MONS_climo
set_4	Vertical profiles of atmosphere	Long-term climatology	Global	RAOBS_new ANN_climo_atm MONS_climo_atm

set_5	Summary table by category and variable	Long-term climatology	Global	region_definitions ANN_climo
set_6	Line plots	Annual Trends	Regional	region_definitions ANN_ALL
set_7	River flow and discharge Note: the RTM output (QCHANR and QCHOCNR) is at 0.5 degrees.	Long-term climatology	Regional and global	ANN_climo_rtm MONS_climo_rtm
set_8 + set_8_lnd	Line and contour plots	OCN-ATMOS tracers	Global	DJF_climo_atm MAM_climo_atm JJA_climo_atm SON_climo_atm MONS_climo_atm ANN_ALL_atm DJF_climo MAM_climo JJA_climo SON_climo
set_9	Statistics table + contour plots	Monthly and seasonal climatology	Global	MONS_climo DJF_climo DJF_means MAM_climo MAM_means JJA_climo JJA_means SON_climo SON_means

A9: Summary File Creation

Summary file	Contents	Time Dimension	Dimensions	Created by
annT annT_atm annT_rtm	Annual average from monthly history files. (ncra)	1	Time Lat Lon	lnd_util.pm lnd_ann.pm
ANN_ALL ANN_ALL_atm	Annual records for all years specified by trends_num_yrs, starting with trends_first_yr.	nTrendYrs	Time Lat Lon	lnd_util.pm lnd_ann.pm
ANN_climo ANN_climo_atm ANN_climo_rtm	Annual climatology	1	Time Lat Lon	lnd_ann.pm
MONS_climo	Monthly	12	Time	lnd_mons.pm

MONS_climo_atm MONS_climo_rtm	Climatology	months	Lat Lon	
DJF_climo DJF_climo_atm DJF_climo_rtm MAM_climo MAM_climo_atm MAM_climo_rtm JJA_climo JJA_climo_atm JJA_climo_rtm SON_climo SON_climo_atm SON_climo_rtm	Seasonal Climatology	1	Time Lat Lon	lnd_seas_climo.pm
ANN_means ANN_means_atm ANN_means_rtm	Annual means	nClimYrs	Time Lat Lon	lnd_ann.pm
DJF_means DJF_means_atm DJF_means_rtm MAM_ means MAM_means_atm MAM_means_rtm JJA_means JJA_means_atm JJA_means_rtm SON_means SON_means_atm SON_means_rtm	Seasonal means	nClimYrs	Time Lat Lon	lnd_util.pm lnd_seas_means.pm
ANN_globalClimo	Global avg/total	nTrendYrs	time	Created by set_1.ncl from ANN_ALL.nc file

A10. Directory Tree – Input Files

DIAG_HOME	code/inputFiles	set1_c13.txt* set1_clm.txt* set1_cn.txt* set2_c13.txt* set2_clm.txt* set2_cn.txt* set3_cnFlx.txt* set3_fireFlx.txt* set3_landFlx.txt* set3_moistEnergyFlx.txt* set3_radFlx.txt* set3_turbFlx.txt* set4_stationIds.txt* set5_c13.txt*

		set5_clm.txt* set5_cn.txt* set5_hydReg.txt* set6_cnFlx.txt* set6_fireFlx.txt* set6_landFlx.txt* set6_radFlx.txt* set6_turbFlx.txt* set8_ann_cycle.txt* set8_ann_cycle_lnd.txt* set8_contour.txt* set8_contour_DJF-JJA.txt* set8_trends.txt* set8_zonal.txt* set8_zonal_lnd.txt* variable_master4.3.ncl*

A11: Input File Format (Required)

Each set has a separate list of input files. The set listing defines how the variables will be analyzed. For example, global temperature is globally averaged, while annual GPP is represented as a global total. In addition, sets may define the same variable differently depending on the set. For example, set 1 treats NEE as an annual global sum, and as a global daily average for set 2.

Set 2 uses an additional column in the input files to indicate whether the variable should be contoured using dynamic or pre-set contour intervals. Pre-set contour intervals are defined in variable_master4.2.ncl.

The addition of this feature allows the user to define the contour intervals for selected variables without requiring that all variables have either pre-set or dynamic contouring.

This feature is not available for set_8_contour.ncl, therefore all contour levels for this set are dynamic.

A12: Required Input File format: Sets 1, 3, 4, 5, 6, 7, 8, 9

Format:

Column	1-6	7-10	11-13	14-16	17 –
Options	global	Mean Totl	Day Ann Nat	[spaces]	Variable name from CCSM History file

Example:

globalTotlAnn C13_NEE
globalTotlAnn C13_NEP

globalTotlAnn C13_GPP
globalTotlAnn C13_PSNSUN_TO_CPOOL

A13: Required Input File format: Set 2

Column	1-6	7-10	11-13	14	15-16	17 –
Options	global	Mean Totl	Day Ann Nat	0 1	[spaces]	Variable name from CCSM History file

Example: Set 2

globalMeanDay0 NEE
globalMeanDay0 NEP
globalMeanDay0 GPP
globalMeanNat0 TSA

Options:

Columns 11-13:	Units
Ann	Annual units
Day	Daily units
Nat	Native units from history file

Column 14: Dynamic Contour flag (set 2 ONLY)		
0	Dynamic contours	
1	User defined contours	(NOTE: info@cn_Explicit must also be True) User-defined contour levels are set in variable_master.ncl. If you define user-defined contours you must copy the input files and variable_master to your personal workspace and reset INPUT_HOME

Columns 17 - … Variable Name	Variable must either be defined on the history file or derived in lnd_func.ncl
Ann	Annual units
Day	Daily units
Nat	Native units from history file