README

Melt prediction from observed surface melt occurrence and modeled near-surface temperatures

Note: Scripts will be in either shell (tcsh), Python or Jupyter Notebook format. The latter thus require that Python tool. Every effort has been made to provide all required input datasets for the model execution and plotting scripts but it is possible that missing files or other prereqs may exist. Changes will definitely be needed to customize scripts to the user's runtime environment.

All tgz files will expand into a new directory, appropriately named for the files.

1. Input datasets (input_*.tgz)

Model input datasets are derived from WRF postprocessed files. For melt prediction, the 3-hourly data were averaged to daily resolution.

Surface melt occurrence observations are derived from "MEaSUREs Greenland Surface Melt Daily 25km EASE-Grid 2.0, Version 1" (https://nsidc.org/data/NSIDC-0533/versions/1). Data were regridded to the WRF 15-km grid. A small amount of other processing was also done to fit the dataset into project workflow.

An icesheet mask was also derived from the melt occurrence data.

input_gis_erai.tgz
input_gis_cesmle_ historical.tgz
input_gis_cesmle_ rcp85.tgz
input_gis_cesmlw_1pt5degC.tgz
input_Mote_surface_melt.tgz

2. Output datasets (output_*.tgz)

Output files are the product of the melt prediction scripts described below.

output_gis_erai.tgz
output_gis_cesmle_ historical.tgz
output_gis_cesmle_ rcp85.tgz
output_gis_cesmlw_1pt5degC.tgz

3. Preprocessing scripts (scripts_preproc.tgz)

a. Convert WRF tas from 3-hourly to daily

calc_anom
run_calc_anom

b. Adjust CESM for bias between average CESM and average WRF

calc_erai_bias
bias_adjust

c. Create icesheet mask from surface melt occurrence data

make_icesheet_mask
mask_icesheet.nco

4. Melt prediction scripts (scripts_prediction.tgz)

Model temperature-based predictions of melt probability and melt occurrence are developed using distributions of melt occurrence versus temperature (tas). Three temperature ranges are used to make the predictions:

a. lowest: no occurences of melt observations

Melt probability is zero and melt occurrence is “no melt” for all temperatures.

b. highest: no occurences of “no melt” observations

Melt probability is one and melt occurrence is “melt” for all temperatures.

c. transitional: “melt” and “no melt” observations for the same temperature.

Melt probability and melt occurrence in the transitional range are determined through a process of linear interpolation and thresholding. First, the temperature dataset is partitioned into “melt” and “no-melt” by comparing with surface melt occurrence observations. Second, the transitional range is defined by the values of the distributional peaks of “no melt” and “melt” temperature data, with the distributions computed using kernel density estimation (KDE; Python SciPy function scipy.stats.gaussian_kde). Third, the modeled temperature is mapped to an estimate of melt occurrence probability by linear interpolation between the lower and upper temperatures. Last, melt occurrence (zero, one) is derived by applying a threshold value (in the 0-1 range of the interpolation). This threshold minimizes the difference between predicted and observed melt in the transitional range. It is calculated by an iterative process of predicting and testing predictions versus observations.

For example, if the modeled temperature interpolates to 0.7 and the threshold was calculated at 0.78, the probability of melt at this temperature will be recorded as 0.7 and, because 0.7 < 0.78, melt occurrence will be zero (“no melt”). Similarly, for the same threshold, an interpolated temperature of 0.93 would have melt probability 0.93 and melt occurrence one (“melt”).

gis_cesmlx-based predictions use gis_cesmlx-based calibrations (not gis_erai-based calibrations) As noted under preprocessing, the gis_cesmlx data have also been “bias adjusted” to account for differences between average gis_cesmlx results and average gis_erai results.

gis_erai-based scripts:
- melt_erai_wrf_tas_kde_parameters.ipynb (calculate lower/upper temperatures)
- melt_erai_wrf_tas_kde_predict.ipynb (predict from temperatures)
- melt_erai_wrf_tas_kde_test (test predictions versus observations)

gis_cesmle-based scripts:

historical-only
- melt_cesmle_wrf_tas_kde_parameters.ipynb (calculate lower/upper temperatures)
- melt_cesmle_wrf_tas_kde_test (test predictions versus observations)

historical and rcp85
- melt_cesmle_wrf_tas_kde_predict.ipynb (predict from temperatures)

gis_cesmlw-based script:
- melt_cesmlw_wrf_tas_kde_predict.ipynb (1pt5degC-only)

5. Plotting scripts (scripts_plotting.tgz)

Create a range of plots to display and analyze observed and predicted surface melting data.

plot_wrf_tas_newmelt.ipynb
plot_wrf_tas_newmelt_changes.ipynb
plot_wrf_tas_newmelt_diffs.ipynb
plot_wrf_tas_newmelt_diffs_pctile.ipynb
plot_wrf_tas_newmelt_uncertainty.ipynb

Plot temperature distributions for melt and no-melt subsets.

melt_erai_wrf_tas_kde_plot.ipynb
melt_cesmle_wrf_tas_kde_plot.ipynb