

Rapid flips between hot and cold in a warming world

1-01: This code is used to process ERA5, Berkeley Earth, and NCEP datasets.

We use daily mean temperature at 2 m height above the surface over the historical period (1961–2023) from three different datasets, they are, ERA5, Berkeley Earth, and NCEP datasets, and this code is used to process these datasets. The ERA5 dataset is available via the Copernicus Climate Data Store (CDS) at <https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-complete?tab=form>. The Berkeley Earth surface air temperature dataset is available at <http://berkeleyearth.org/>. The NCEP-NCAR reanalysis dataset is available at <https://psl.noaa.gov/data/gridded/data.ncep.reanalysis.html>.

1-02: This code is used to process CMIP6 datasets.

The projected changes in the characteristics of temperature flips during 1961–2100 are examined using daily temperature outputs from the simulations of 17 climate models participating in the ScenarioMIP within the CMIP6 project. The temperature output over 1961–2014 utilizes the historical simulations, whereas the 2015–2100 period uses the future climate projection under various emission and socioeconomic scenarios represented by four Tier 1 experiments based on SSP-RCP scenarios, which are SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5. The outputs of daily near-surface air temperature from multi-model climate simulations are from the CMIP6 portal at <https://esgf-node.llnl.gov/projects/cmip6/>.

2-01: Detect temperature flips (including hot-to-cold flip and cold-to-hot flip) by using ERA5, Berkeley Earth, and NCEP datasets.

2-02: Detect temperature flips (including hot-to-cold flip and cold-to-hot flip) by using CMIP6 dataset.

3-01 and 3-02: Calculate seasonal mean temperature flips, i.e., we can obtain the yearly mean and different seasonal mean values of temperature flip frequency, transition duration, and intensity.

4-01: Global patterns of rapid temperature flip occurrences

This code is used to draw Figure-1.

5-01: Observed historical changes of temperature flips.

This code is used to draw Figure-2.

6-01: Projected future changes of temperature flip.

This code is used to draw Figure-3.

7-01: Escalating threats of rapid temperature flips.

This code is used to draw Figure-4.