SUPPLEMENTAL MATERIALS

Data Considerations for Estimating Outdoor Heat Exposure for Environmental Epidemiological Studies

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eTable 1: Gridded climate datasets

Dataset	Type of model	Source	Spatial Resolution & Domain	Temporal Resolution & Domain	Relevant Variables Included	Data Notes
APHRODITE	Statistical	RIHN & Kyoto University [1]	0.05°, 0.25°, 0.5°; Asia	Daily; 1961 - 2015	Precipitation, Temperature	Temporal domain ends in 2015; limited real-time utility. Station observation bases good at capturing extremes, may be less reliable in areas with less coverage. Spatial coverage in Asia. Access: https://www.chikyu.ac.jp/precip/english/index.html
Daymet V4	Statistical	NASA [2]	1km; CONUS, Hawaii, Puerto Rico	Daily; 1980–present	Temperature, Precipitation, Shortwave Radiation, Vapor Pressure	High resolution by modeling ground observations and topography. Coverage limited to CONUS, Puerto Rico, and Hawaii. Suitable for air temperature and heat index only. Access: https://daymet.ornl.gov/ R software package for data access: daymetr
E-OBS	Statistical	European Climate Assessment & Dataset [3]	0.1° (~12km) or 0.25° (~25 km); Europe	Daily; 1950–2025	Temperature (mean, min, max), precipitation (sum), pressure, wind speed, relative humidity, radiation	Common for European extent. Temporally high resolution and long extent. Based on station data so poorer reliability in less covered areas, also for precipitation. Access: https://www.ecad.eu/download/ensembles/download.php
ERA5-HRES	Dynamic	European Centre for Medium-Range Weather Forecasts [4]	~31km; Global	Hourly; 1940–present	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	High temporal resolution and high spatial and temporal extent. There is a 9km downscaled version that covers land areas that is more useful for health studies. Access: https://data.europa.eu/data/datasets/oai-zenodo-org-3269270?locale=en
ERA5-LAND	Dynamic	European Centre for Medium-Range Weather Forecasts [5]	~9km (1/10th degree); Global	Hourly; 1950-Present	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	One of the few datasets available globally with rich available variables and a long historical extent. 9km spatial extent is appropriate for health studies. Large data volume can make download and data storage complicated. Access: https://cds.climate.copernicus.eu/datasets/reanalysis-era5-land?tab=overview R software package for data access: ecmwfr
gridMET	Hybrid	Abatzoglou et al. [6]	~4km; CONUS	Daily; 1979–present	Temperature, Precipitation, shortwave radiation, wind, humidity (relative and specific)	Combines PRISM (for temperature) and NLDAS reanalysis (for humidity, wind, etc.). Coverage limited to CONUS Access: https://www.climatologylab.org/gridmet.html R software package for data access: amadeus
GDAS	Dynamic	Environmental Modeling Center, NCEP, NWS, NOAA, U.S.	~28km (1/4th degree); Global	3-hourly (00, 06, 12, 18); 2000–present	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	Sub-hourly temporal resolution. Coarse spatial resolution. More appropriate for climate research than health research. Access: https://www.ncei.noaa.gov/products/weather-climate-models/global-data-assimilation

		Department of Commerce [7]				
GLDAS V2.0	Dynamic	NASA/GSFC [8]	~28km (1/4th degree); Global	3-hourly (00, 06, 12, 18); 1948 - 2015	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	Temporal domain ends in 2015; limited real-time utility. Access: https://ldas.gsfc.nasa.gov/data
GLDAS V2.1	Dynamic	NASA/GSFC [9,10]	~28km (1/4th degree); Global	3-hourly (00, 06, 12, 18); 2000–present	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	Updated version of GLDAS 2.0, available from 2000+. Coarse spatial resolution. Access: https://ldas.gsfc.nasa.gov/data
HRRR-Analysis	Dynamic	NOAA [11,12]	3km; CONUS	Hourly; 2014–present	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	High-resolution real-time dataset, though only recent years available. Coverage limited to CONUS. Planned to be replaced by Rapid Refresh Forecast System (RRFS). Access: https://rapidrefresh.noaa.gov/hrrr/ Data can be accessed via Herbie Python package [13] and Amazon Web Services S3 Open Registry in Zarr format [14]
JRA-55	Dynamic	Japan Meteorological Agency [14,15]	60km, Global	3-Hourly, 6-Hourly, 1958-2022	Temperature, Precipitation	Global extent and long history. Coarse spatial resolution. Less commonly used in health analysis. Access: https://gdex.ucar.edu/datasets/d628001/
Landsat LST	Dynamic	USGS	30m, Global	8-16 days, 1982-present	Temperature	Only includes land surface temperatures – not suitable for health studies. Access: https://www.usgs.gov/landsat-missions/data
MDG625	Statistical	Institute of Atmospheric Physics, CAS [16]	~7km (1/16th degree); Asia	Daily; 1940–2023	Temperature, Surface Pressure, Wind Speed	Limited variable set. Interpolation method may miss extreme or rapid events. Spatial coverage in Asia. Access: https://www.scidb.cn/en/detail?dataSetId=90b393095894433291500f8975ef84ec
MERRA-2	Dynamic	NASA Global Modeling and Assimilation Office [17]	~50km; Global	Hourly; 1980–present	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	Large spatial resolution. Includes additional meteorological variables useful for climate research. Access: https://gmao.gsfc.nasa.gov/gmao-products/merra-2/data-access_merra-2/
MODIS LST	Dynamic	NASA MODIS [18]	1km, Global	Daily, 2000-present	Temperature, Emissivity	Only includes land surface temperatures – not suitable for health studies. Access: https://modis.gsfc.nasa.gov/data/dataprod/mod21.php

NAM-Analysis	Dynamic	NOAA/NCEP [19]	3km or 12km; North America	3-hourly (00, 06, 12, 18); 2004–present	Temperature, Relative Humidity, Wind, Surface Pressure, Solar Radiation	High-resolution real-time dataset, though only available back to 2004. Sub-daily estimates. Access: https://www.ncei.noaa.gov/products/weather-climate-models/north-american-mesoscale
NLDAS-2	Dynamic	NASA [20,20]	12km; CONUS (parts of CAN & MEX)	Hourly; 1979–2024	Temperature, Relative Humidity, Solar Radiation, Wind, Surface Pressure	High-resolution data for North America, limited to CONUS+ parts of Canada and Mexico. Access: https://ldas.gsfc.nasa.gov/nldas/nldas-2-model-data
PRISM	Statistical	PRISM Group at Oregon State University [21]	4km or 800m; CONUS	Monthly (1895–present) or Daily 1981–present	Temperature, Vapor Pressure (Dew Point), Solar Radiation (as monthly normal only)	Daily high-resolution coverage across the US; widely used in public health and climate studies. Coverage limited to CONUS, and no sub-daily estimates. Access: https://prism.oregonstate.edu/ R software package for data access: amadeus
SA-OBS	Statistical	Climate Research Unit & University of Cape Town [22]	0.25°, 0.5°; Southeastern Asia	Daily; 1981-2014	Temperature (mean, min, max), Precipitation (sum)	Temporal domain ends in 2014; limited real-time utility. Spatial coverage in Asia. Access: http://sacad.database.bmkg.go.id
TopoWx	Statistical	Pennsylvania State University [23–25]	800m; CONUS	Daily; 1948–2016	Daily Min/Max Temperature	High resolution data, limited to CONUS. Limited temperature metrics but includes a suite of atmospheric variables more relevant for climate-specific studies. Access: https://www.scrim.psu.edu/resources/topowx/

Abbreviations:

APHRODITE: Asian Precipitation – Highly-Resolved Observational Data Integration Towards Evaluation
CONUS: Continental United States (i.e. lower 48 states, excluding Alaska and Hawaii)
ECMWF: European Centre for Medium-Range Weather Forecasts
GSFC: Goddard Space Flight Center
NASA: National Aeronautics and Space Administration
NCEP: National Centers for Environmental Prediction
NOAA: National Oceanic and Atmospheric Administration
NWS: National Weather Service

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