**Supplementary data files**

(update Nov 30, 2022)

**Fig1EDFig9\_obs\_wet.csv, Fig1EDFig9\_obs\_inter.csv, Fig1EDFig9\_obs\_dry.csv**

Data used to generate Figure 1a,c and ED Figure 9a,c

Data format is csv

Observed summer daytime and nighttime urban wet-bulb island intensity, and its UHI & UDI components

Data grouped into dry, intermediate, wet region

Data sorted in increasing order of wet-bulb island value

Variable definition:

City: city name

DeltaTw: observed wet-bulb island (deg C)

UHI Com: observed UHI component (deg C)

UDI Com: observed UDI component (deg C)

DN: day or night designation

Number of Pairs: number of station pairs in a city

**Fig1EDFig9\_model\_wet.csv, Fig1EDFig9\_model\_inter.csv, Fig1EDFig9\_model\_dry.csv**

Data used to generate Figure 1b,d and ED Figure 9b,d

Data format is csv

Modelled summer daytime and nighttime urban wet-bulb island intensity, and its UHI & UDI components

Data grouped into dry, intermediate, wet region

Data sorted in increasing order of wet-bulb island value

Variable definition:

ModelDeltaTw: modelled urban wet-bulb island (deg C)

ModelUHICom: modelled UHI component (deg C)

ModelUDICom: modelled UDI component (deg C)

DN: day or night designation

**StaionList.docx**

Meta data on weather station observations

Format is standard words document

Column name:

Country: country name

Data source: network/institution that operates the site

Station: station name

Type: urban or rural designation

Lat: site latitude

Lon: site longitude

B: built-up fraction in site buffer (1 km radius for urban and 3 km radius for rural)

Obs. period: observation period (years)

**SiteMetaData.csv**

Meta data on weather station observations

Used to generate Extended Data Figure 1

Data format is csv

Column name:

Source: data source

StationID: station id

StationName: station name

Type: urban or rural

Latitude: site latitude

Longitude: site longitude

Elevation: site elevation

Timezone: site time zone

YearStart: start year of observation

YearEnd: end year of observation

Climate: climate zone designation (wet, intermediate, dry)

**ModelUHIUDIComponents\_Figure4EDFigure2.nc**

Data used to generate Figure 4 and Extended Data Figure 2

Data format is netcdf

Variable definition:

DaytimeUDICom: modelled daytime UDI component (deg C)

DaytimeUHICom: modelled daytime UHI component (deg C)

NighttimeUDICom: modelled nighttime UDI component (deg C)

NighttimeUHICom: modelled nighttime UHI component (deg C)

area: grid cell area (km2)

lat: latitude coordinate

lon: longitude coordinate

**DangerousDaysNights\_Figure5.nc**

Data used to generate Figure 5

Data format is netcdf

Variable definition:

Coastal grids: grid type (coastal grid = 99; interior grid = 0)

DangerousDays\_R: number of rural dangerous days (Tw > 27 deg C) per summer

DangerousDays\_U: number of urban dangerous days (Tw > 27 deg C) per summer

DangerousNights\_R: number of rural dangerous nights (Tw > 27 deg C) per summer

DangerousNights\_U: number of urban dangerous nights (Tw > 27 deg C) per summer

area: grid cell area (km2)

lat: latitude coordinate

lon: longitude coordinate

**PartitionTerms.nc**

Data used to generate Figure 2, Figure 3, ED Figure 2, ED Figure 3, ED Figure 4, and ED Figure 5

Data from diagnostic analysis of model outputs

Data format is netcdf

Variable definition:

DaytimeDeltaTw: daytime urban wet-bulb island calculated by the model (deg C)

DaytimeConvectionTerm: daytime convection term from diagnostic analysis (deg C)

DaytimeAnthropogenicHeatTerm: daytime anthro. heat term from diagnostic analysis (deg C)

DaytimeHeatStorageTerm: daytime heat storage term from diagnostic analysis (deg C)

DaytimeSolarAbsorptionTerm: daytime solar absorp. term from diagnostic analysis (deg C)

DaytimeLongwaveRadTerm: daytime LW radiation term from diagnostic analysis (deg C)

NighttimeDeltaTw: nighttime urban wet-bulb island calculated by the model (deg C)

NighttimeConvectionTerm: nighttime convection term from diagnostic analysis (deg C)

NighttimeAnthropogenicHeatTerm: nighttime anthro. heat term from diagnostic analysis (deg C)

NighttimeHeatStorageTerm: nighttime heat storage term from diagnostic analysis (deg C)

NighttimeSolarAbsorptionTerm: nighttime solar absorp. term from diagnostic analysis (deg C)

NighttimeLongwaveRadTerm: nighttime LW radiation term from diagnostic analysis (deg C)

area: grid cell area (km2)

lat: latitude coordinate

lon: longitude coordinate

**SummerPrecipitation.nc**

Data used to generate Figure 2, Figure 3, Figure 4, Figure 5, ED Figure 1, ED Figure 4, and ED Figure 5

Data format is netcdf

Variable definition:

Precip: Summer precipitation (mm)

lat: latitude coordinate

lon: longitude coordinate

**EDFigure6\_Berlin.csv, EDFigure6\_Phoenix.csv**

Data used to generate ED Figure 6

Data format is csv

Diurnal composites of observed and modelled wet-bulb temperature, urban wet-bulb island, and its UHI and UDI components.

Data for Berlin, Germany (4 possible combinations of site pairing) and Phoenix, USA (6 possible combinations of site pairing)

Variable definition:

LocalTime: local time

ModelTw\_U: modelled urban wet-bulb temperature (deg C)

ModelTw\_R: modelled rural wet-bulb temperature (deg C)

ModelUHICom: modelled UHI component (deg C)

ModelUDICom: modelled UDI component (deg C)

ObsTw\_U: observed urban wet-bulb temperature (deg C)

ObsTw\_R: observed rural wet-bulb temperature (deg C)

ObsDeltaTw: observed wet-bulb island (deg C)

ObsDeltaTw\_std: standard deviation of observed wet-bulb island (deg C)

ObsUHICom: observed UHI component (deg C)

ObsUHICom\_std: standard deviation of observed UHI component (deg C)

ObsUDICom: observed UDI component (deg C)

ObsUDICom\_std: standard deviation of observed UDI component (deg C)

**EDFigure7\_WetObs.csv**

Data used to generate ED Figure 7

Data format is csv

Diurnal composites of observed wet-bulb temperature, urban wet-bulb island, and its UHI and UDI components.

Data for 11 site pairs in the wet climate region with observations at 2:00, 8:00, 14:00 and 20:00 local time.

Variable definition:

LocalTime: local time

ObsTw\_U: observed urban wet-bulb temperature (deg C)

ObsTw\_R: observed rural wet-bulb temperature (deg C)

ObsDeltaTw\_std: standard deviation of observed wet-bulb island (deg C)

ObsUHICom: observed UHI component (deg C)

ObsUHICom\_std: standard deviation of observed UHI component (deg C)

ObsUDICom: observed UDI component (deg C)

ObsUDICom\_std: standard deviation of observed UDI component (deg C)

**EDFigure7\_WetModel.csv**

Data used to generate ED Figure 7

Data format is csv

Diurnal composites of modelled wet-bulb temperature, urban wet-bulb island, and its UHI and UDI components.

Data for 11 model grids corresponding to 11 site pairs in EDFigure7\_WetObs.csv

Variable definition:

LocalTime: local time

ModelTw\_U: modelled urban wet-bulb temperature (deg C)

ModelTw\_R: modelled rural wet-bulb temperature (deg C)

ModelDeltaTw\_std: standard deviation of modelled wet-bulb island (deg C)

ModelUHICom: modelled UHI component (deg C)

ModelUHICom\_std: standard deviation of modelled UHI component (deg C)

ModelUDICom: modelled UDI component (deg C)

ModelUDICom\_std: standard deviation of modelled UDI component (deg C)

**EDFigure8\_obs\_wet.csv, EDFigure8\_obs\_inter.csv, EDFigure8\_obs\_dry.csv**

Data used to generate ED Figure 8a

Data format is csv

Observed urban wet-bulb island intensity, and its UHI & UDI components, calculated from the daily maximum wet-bulb temperatures of urban and rural land

Data grouped into dry, intermediate, wet region

Data sorted in increasing order of wet-bulb island value

Variable definition:

City: city name

DeltaTw: observed wet-bulb island (deg C)

UHI Com: observed UHI component (deg C)

UDI Com: observed UDI component (deg C)

Number of Pairs: number of station pairs in a city

**EDFigure8\_model\_wet.csv, EDFigure8\_model\_inter.csv, EDFigure8\_model\_dry.csv**

Data used to generate ED Figure 8b

Data format is csv

Modelled urban wet-bulb island intensity, and its UHI & UDI components, calculated from the daily maximum wet-bulb temperatures of urban and rural land

Data grouped into dry, intermediate, wet region

Data sorted in increasing order of wet-bulb island value

Variable definition:

ModelDeltaTw: modelled urban wet-bulb island (deg C)

ModelUHICom: modelled UHI component (deg C)

ModelUDICom: modelled UDI component (deg C)