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PRODUCT BRIEF

LTPP Climate Tool

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This document provides an overview of the Long-Term Pavement Performance (LTPP) Climate Tool functionality.⁽¹⁾ Details are provided in the LTPP Climate Tool User Guide (FHWA-HRT-17-012).⁽²⁾

Objective

This Product Brief describes the Long-Term Pavement Performance (LTPP) Climate Tool (intended for use by infrastructure engineers) that provides convenient access to the National Aeronautics and Space Administration (NASA) Modern-Era Retrospective Analysis for Research and Applications (MERRA) climatic data.⁽¹⁾

Introduction

The LTPP Climate Tool is an online tool hosted on LTPP InfoPave™ that provides users with access to processed versions of MERRA data using different visual features and interfaces.^(1,3) MERRA is a global climate data reanalysis repository that combines computed model fields with the basic climatic data attributes.^(4,5) The data have been collected globally from

1979 to the present at an hourly temporal resolution and a horizontal spatial resolution of 0.5 degrees latitude by 0.67 degrees longitude (approximately 50 by 65 km at mid-latitudes). Further details regarding the MERRA data can be found in the Federal Highway Administration (FHWA) publication *Evaluation of LTPP Climatic Data for Use in Mechanistic-Empirical Pavement Design Guide (MEPDG) Calibration and Other Pavement Analysis*.⁽⁶⁾

The LTPP Climate Tool offers users convenient access to climate data derived from the MERRA database in an intuitive and easy-to-use format.⁽¹⁾ The MERRA Climate Data for Mechanistic-Empirical Pavement Design Guide (MEPDG) Inputs button under the tools menu of the LTPP InfoPave™ Web site allows users to extract the

MERRA data in a format that is compatible with the American Association of State Highway and Transportation Officials AASHTOWare® Pavement ME Design software.^(3,7,8)

Available Data

The climatic attributes available through the LTPP Climate Tool include temperature, precipitation, humidity, wind, and solar data.⁽¹⁾ The data elements available for each climatic attribute include the following:

- **Temperature:** This element provides access to temperature, soil temperature layers 1–6, soil temperature unsaturated zone, and soil temperature saturated zone.
- **Precipitation:** This element provides access to precipitation, evaporation, infiltration, overland runoff, snow mass, snow melt, snow-covered area fraction, and snowfall.

- **Humidity:** This element provides access to specific humidity, relative humidity, and air pressure.
- **Wind:** This element provides access to north wind, east wind, wind velocity, and air density.
- **Solar:** This element provides access to shortwave surface, shortwave top of atmosphere, cloud cover, percent sunshine, emissivity, and albedo.

The data are available in hourly, daily, monthly, and annual temporal resolutions. Data summaries, including average, maximum, minimum, standard deviation, and count, are provided for various elements.

LTPP Climate Tool Interface

The LTPP Climate Tool is composed of three modules: Location, Country, and Map.⁽¹⁾ These modules are used to select and download the desired data. The location module allows the user to select the desired data geographically, while the country module allows the user to select data based on country and State/Province for any

country in the world.

The map module provides geographic information service (GIS)-based files for all of the MERRA data cells for a selected year.

Location Module

The location module offers users multiple options for selecting geographic data. The single-point selection tool allows the user to select a single location on the map, and the corresponding data cell will be highlighted. The area selection tool allows the user to select an area consisting of multiple locations for which the climatic data can be extracted. The Climate Tool graphical interface is shown in figure 1.⁽¹⁾

The search location bar allows the user to search for and access the required data for the geographic location by name. The user can also highlight one or more LTPP test sections by applying the filters on the left-hand side of the window and then using the single-point or area selection tool to highlight the data cell encompassing the LTPP test section(s).

Country Module

The country module allows users to select and extract data based on country and State/Province for any country in the world as shown in figure 2.

Map Module

The map module allows users to download GIS-based data files for all of the MERRA data cells for a selected data attribute and time frame. Files can be downloaded either in ESRI Shape File (*.shp) or Keyhole Markup Language (*.kml) format.

Data Extraction

The MERRA data selected using the location or country options can be downloaded for a specific time range, climatic attribute (temperature, precipitation, humidity, wind, or solar), and frequency (annual, monthly, daily, or hourly). These data can be obtained in a Microsoft® Excel (.xlsx) format file, a Microsoft® Access database (.mdb) format, or a Microsoft® SQL database (.bak) format.

A complete user guide is available in FHWA publication number FHWA-HRT-17-012.⁽²⁾

Figure 1. LTPP Climate Tool—select data by location.⁽¹⁾

The screenshot shows the LTPP Climate Tool interface. On the left is a sidebar with categories: Find Sections, General (Age, Experiment Type, Study, Monitoring Status, Section, Location, Maintenance and Rehabilitation, Roadway Functional Class), Structure (Surface Type, Base Type, Subgrade Type), Climate (Climatic Region, Freezing Index (Annual), Precipitation (Annual), Temperature (Annual)), Traffic (Avg. Annual Daily Traffic (AADT), Avg. Annual Daily Truck Traffic (AADTT)), and Performance (Deflection (9-kip, wheel path), Fatigue Cracking, Faulting, Longitudinal Cracking, Longitudinal Profile (IRI), Transverse Cracking, Transverse Profile). The main area is titled 'LTPP Climate Tool' and shows 'There are 2548 of 2548 sections currently selected.' Below this are buttons for Location, Country, and Map. A search bar is present with a 'Search' button. Filters include 'Range: Annual', 'Climatic Attribute: Temperature', and 'Date: 1980'. A color scale for 'Air Temperature Average' ranges from -23 °C to 34 °C. A map of North America is displayed with a search location marker.

Figure 2. LTPP Climate Tool—select data by country.⁽¹⁾

The screenshot shows the LTPP Climate Tool interface for selecting data by country. The sidebar on the left includes: Data, Section Summary Reports, State/Province Summary Report, Visual Data Selection & Download, Data Selection and Download, Standard Data Release, Ancillary Data Selection/Download, SQL Export, Table Export, LTPP Climate Tool, and DAOFR Form. The main area is titled 'LTPP Climate Tool' and shows 'There are 23 of 49980 cells currently selected.' Below this are buttons for Location, Country, and Map. A status bar indicates 'Country: United States (3291 cells)' and 'State/Province: South Carolina (23 cells)'. A 'Data' tab is active, showing a search bar and checkboxes for Primary Data Classification, Advanced Data Classification, Primary Data, and Advanced Data. A date range selector is present: 'Please select the Date Range below: From: 12/31/2014 To: 12/31/2015'. A 'Collapse All' button is at the bottom.

Contact Information

For questions about the LTPP Climate Tool, contact LTPP Customer Support Service Center at ltppinfo@dot.gov or submit questions using the customer support feature under the help tab of the menu bar of LTPP InfoPave™^(1,3)

References

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Additional Information

Researchers—This study was performed by iENGINEERING Corporation.

Distribution—This Product Brief is being distributed according to a standard distribution. Direct distribution is being made to the FHWA Divisions and Resource Center.

Availability—The LTPP Climate Tool can be accessed via the LTPP InfoPave™ Web site at <https://infopave.fhwa.dot.gov/> under the data tab.

Key Words—MERRA, MEPDG, pavement performance, climate data, pavement design.

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