Monthly Heating and Cooling Degree Days

Introduction

Heating Degree Day (HDD) is a weather-based technical index designed to estimate the heating energy requirement of buildings. HDD is derived from meteorological measurements of air temperature.

Cooling Degree Day (CDD) is a climatological index describing the amount of energy required for indoor cooling (air-conditioning).

Methodology

The calculation of HDD relies on the base temperature, defined as the lowest daily mean air temperature not leading to indoor heating. The value of the base temperature depends in principle on several factors associated with the building and the surrounding environment. By using a general climatological approach, the base temperature is set to a constant value of 18°C in the HDD calculation:

$$\textbf{If } T^i_{mean} \leq 15°C \textbf{ then } HDD = \sum_i \left(18 - T^i_{mean}\right) \textbf{ else } HDD = 0$$

where T^i_{mean} is the daily mean air temperature of the ith day.

Only days with a daily mean air temperature equal or below 15°C are considered for this calculation.

CDD are calculated in analogy to HDD. The base temperature for CDD is set to 21°C. CDD is derived by using the following equation:

$$\textbf{If } T^i_{mean} \geq 24°C \textbf{ then } CDD = \sum_i \left(T^i_{mean} - 21\right) \textbf{ else } CDD = 0$$

where T^i_{mean} is the daily mean air temperature of the ith day.

Only days with a daily mean air temperature equal or above 24°C are considered for this calculation.

The **long-term average (LTA) of the HDD** data, as published in the AGRI4CAST portal, is calculated from the long-term average daily air temperature:

$$\textbf{If } T^i_{LTA} \leq 15°C \textbf{ then } HDD = \sum_i \left(18 - T^i_{LTA}\right) \textbf{ else } HDD = 0$$

where T^i_{LTA} is the long-term average daily mean air temperature of the ith day.

The **long-term average (LTA) of the CDD** data is correspondingly calculated from the long-term average daily air temperature:

$$If\ T_{LTA}^i \geq 24°C\ then\ CDD = \sum_i \left(T_{LTA}^i - 21\right)\ else\ CDD = 0$$

where T_{LTA}^i is the long-term average daily mean air temperature of the ith day.

Aggregation of HDD/CDD

Temporal aggregation

The **monthly** HDD and CDD data provided in the AGRI4CAST portal are monthly sums of the daily calculated HDD and CDD values.

Spatial aggregation

HDD and CDD are calculated from the Daily Gridded Agro-meteorological Data in Europe available on the AGRI4CAST Resource portal. The underlying spatial JRC MARS grid has a resolution of 25km.

HDD and CDD data aggregated to administrative units (NUTS version 2021 – Eurostat Nomenclature of Territorial Units for Statistics, https://ec.europa.eu/eurostat/web/nuts/nuts-maps). The monthly sums of HDD and CDD have been weighted using the intersection area between the JRC MARS grid and the administrative levels using NUTS polygons:

$$HDD_{NUTS} = \frac{\sum_i (HDD_{grid\ i} * area_{grid\ i})}{\sum_i area_{grid\ i}}$$

with:

HDD_{NUTS} = aggregated value of th Heating Degree Day index for the given NUTS region

HDD _{grid i} = Heating Degree Day index value of grid cell i

area_{grid i} = area of grid cell i within the given NUTS region

i = number of grid cells within the given NUTS region

For each administrative level NUTS 3 to NUTS 0, HDD and CDD aggregates are calculated. In addition, there is available an aggregate for the European Union.