Observational gridded data

Observational gridded data provides an estimate of the spatial distribution of a meteorological variable based on observations. While instrumental measurements are taken at irregularly distributed stations, gridded data represents the meteorological variable on a predefined regular grid. Gridded observational data is of strong benefit in disciplines applying distributed quantitative models to examine the influence of weather and climate. Gridded data are also very convenient to provide estimations for any specific location of interest for the user. The Royal Meteorological Institute of Belgium (RMI) provides gridded data for several climate variables at a 5–km spatial resolution over Belgium. The present document provides an overview of the current processing of these grids.

1 Main features

- The gridded data results from the spatial interpolation of stations' observations. When possible, the spatial interpolation is augmented by ancillary data (e.g., terrain elevation, remote sensing data or outputs of weather prediction models).
- Gridded data are currently generated for the following variables:
  - min., max. and average air temperature
  - precipitation quantity
  - global solar radiation
  - direct solar radiation
  - sunshine duration
  - 10-m wind speed
  - relative humidity
- The grids are available at several temporal resolutions: daily, monthly, seasonal, annual values as well as 30–years climate averages.
- The interpolation results are provided in two forms: regular grid of 5km x 5km, and mean values for the 598 belgian municipalities.
- The archive of gridded data starts in 1961 for most variables and is updated each day with the available observations of the previous day. The grids are then updated for archiving as soon as the data quality control is completed.

2 Data processing chain

2.1 Overview

As the spatial coverage of the stations' observations as well as the availability of pertinent covariates differ between the considered variables, the interpolation method is adapted to each variable. However the following data processing steps are shared by all variables.

Preliminary grids are first generated each day based on the observations of the previous day:

1. extraction of the available stations' data from the data base.
2. automatic filtering of the data to eliminate gross errors

3. spatial interpolation by kriging methods with the exploitation of pertinent covariates, when available. For most variables, the interpolation is computed on a regular grid of 1-km resolution which is then degrated to a 5–km resolution grid. This way of preceeding derives block estimates instead of point estimates (in same the spirit as the block kriging methods). The municipality values are computed as the average of the 1–km grid points located on the municipality territory.

These preliminary grids are latter updated for archiving as soon as all input data has been validated by our data quality control staff.

2.2 Precipitation quantities

Input data.

- daily observations from the manual rain gauges of the climatological network (24-hours totals from 8:00 to 8:00 (+1 day) local time).
- observations from the automatic rain gauges from the RMI network of automatic weather stations (AWS).
- observations from the automatic rain gauges from SPW/DGO–2 network.

Interpolation method.

1. Spatial interpolation of the available observations on a grid on 1kmx1km. If the correlation with the orography is sufficient, the interpolation is performed by kriging with external drift (KED) and otherwise by ordinary kriging (OK).
2. Degradation of the 1kmx1km grid to 5kmx5km by averages on 5x5 pixels.

No radar data is used. Radar products combining observations from various radars with rain gauges are available but processed separately.

2.3 Min./max./average air temperature

Input data.

- daily observations from the climatological network (daily extreme observations recorded at 08:00 local time.).
- observations from the RMI network of automatic weather stations (AWS).

Interpolation method.

1. Spatial interpolation (kriging) of available observations. If the correlation with the orography is sufficient, the interpolation is performed by kriging with external drift (KED) and otherwise by ordinary kriging (OK).
2. Degradation of the 1kmx1km grid to 5kmx5km by averages on 5x5 pixels.

The daily average temperature is approximated by the average of the daily extreme temperatures.

2.4 Solar radiation and sunshine duration

Input data.

- observations from pyranometers and sunshine duration sensors in the RMI network of automatic weather stations (AWS).
- observations from Meteosat satellites (since 1983)

Interpolation method.

1.a From January 1st, 2006: Spatial interpolation (Kriging with external drift, KED) of pyranometers/sunshine duration sensors measurements based on an estimation of the global solar radiation from Meteosat Second Generation (MSG) satellites. Processing on the Meteosat grid (approx. 4km (E-W) x 6km (N-S))

1.b From January 1st, 1983 to December 31, 2005: Spatial interpolation (Kriging with external drift, KED) of pyranometers/heliographs measurements based on an estimation of the global solar radiation from Meteosat First Generation (MFG) satellites.

1.c From January 1st, 1961 to December 31, 1982: Spatial interpolation (ordinary Kriging, OK) of pyranometers/heliographs measurements at a resolution of 1km.

2. Reprojection on the 5kmx5km grid.

2.5 Wind speed and relative humidity

Input data.

- observations from the Belgian synoptic stations (operated by RMI, Belgocontrol and Wing Meteo)
- output from the ALARO numerical weather prediction (NWP) model

Interpolation method.

- From June 1st, 2013: stations observations and NWP results are combined by the INCA nowcasting system which provides 1kmx1km hourly analysis in real-time. These INCA analysis are averaged to daily 5kmx5km averages.
- Before June 1st, 2013: Spatial interpolation by ordinary kriging of synoptic observations on a grid on 1kmx1km. Degradation of the 1kmx1km grid to 5kmx5km by averages on 5x5 pixels.

3 Forthcoming developments

The processing of observation gridded data is continuously improved. The following developments are planned in the near future:

- New variables: atmospheric pressure and reference evapotranspiration (ET0).
- Inclusion of neighboring foreign stations data to better map the border area. In particular, RMI receives in real-time AWS data from several stations operated by KNMI (Netherlands).
- Improved interpolation of the air temperature by using the INCA analysis as a covariate.