Operational suite for observational gridded data in Belgium

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ABSTRACT
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. An operational automated suite of gridded data covering Belgium at a spatial resolution of 5 km has been developed at the Royal Meteorological Institute of Belgium (RMI).

Main specifications

Parameters

TN,TX	min/max air temperature
RR	precipitation quantity
G	global solar radiation
D	direct solar radiation
SD	sunshine duration
FF	10-m wind speed
RH	relative humidity

Developed in R
with gstat and rgdal

Resolution
- 5km x 5km grid + 589 municipality mean values
- daily, monthly, seasonal, annual values

Processing
- near-realtime processing (next day)
- reprocessing for archiving (after fine data quality control)

Benefits
- climate information for any location and period since 1961
- computation of areal averages

Observations
from climatological, synoptic and hydrological networks
+ Meteosat Second Generation/MSG (for G, D, and SD)

Pre-processing
filtering of raw data (outliers detection, removal of unreliable climatological stations, etc.)

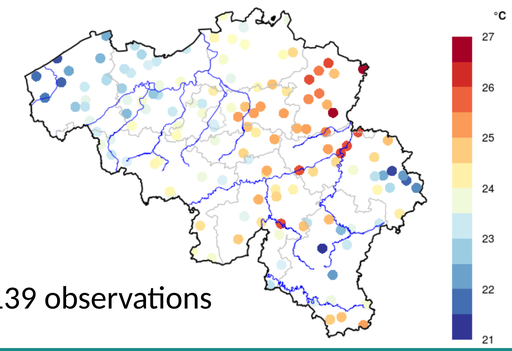
Spatial interpolation
Spatial interpolation on a grid 1km x 1km
External drift kriging with pertinent covariates
→ terrain elevation for TX, TN and RR
→ solar radiation estimates from MSG for G, D and SD
Ordinary kriging otherwise

Post-processing
Averaging on 5km x 5km pixels
Computation of municipality values (polygon averages)

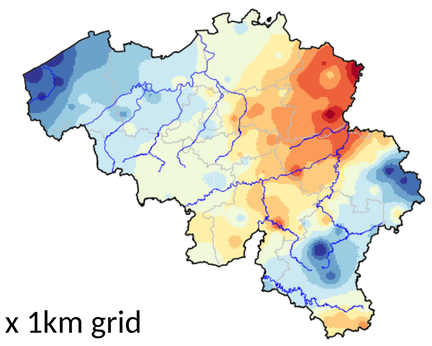
Near-realtime grids
Next day morning
Based on filtered raw data

Archiving (1961 - 2017)
Reprocessing with validated data and pertinent covariates (when available)

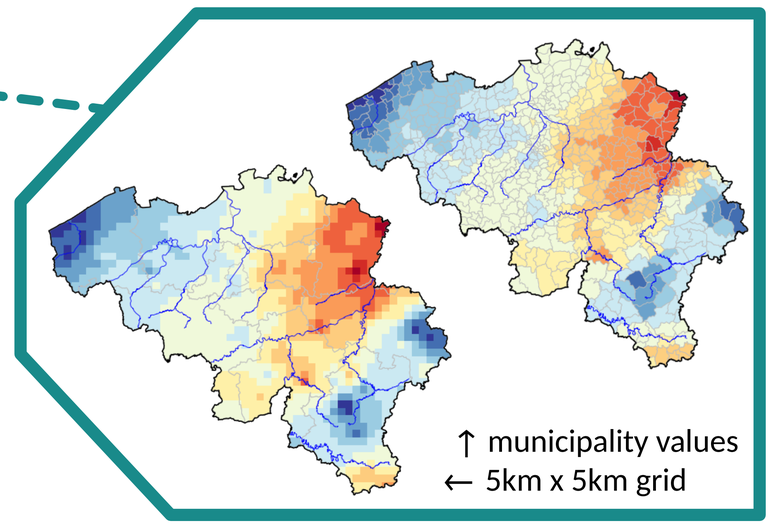
Example. TX on 30/07/2017



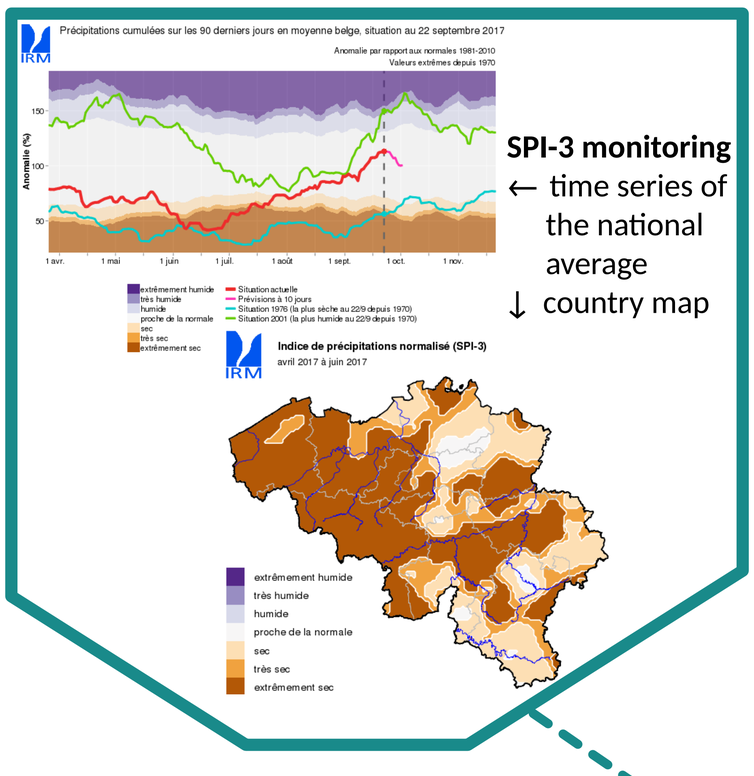
139 observations



1km x 1km grid



↑ municipality values
← 5km x 5km grid



SPI-3 monitoring
← time series of the national average
↓ country map

Climate monitoring products
Monthly climate summaries
Dryness (SPI-3)
Extreme events monitoring

Climate statistics
Climate atlas
Return period estimation of climate events

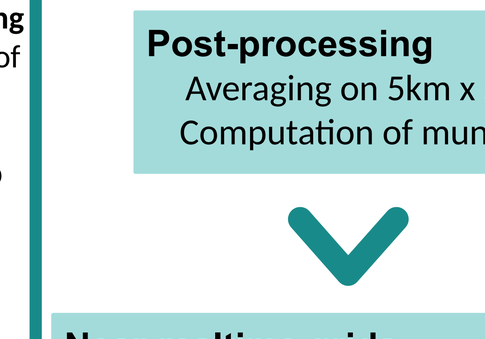
Monthly anomaly maps

E.g. Monthly precipitation anomaly (vs. 1981-2010), July 2017

Precipitation, temperature and sunshine duration maps released monthly in the climate summaries.

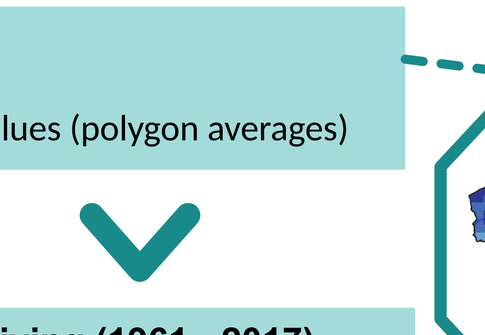
Extreme events maps

E.g. Large daily precipitation total on May 30, 2016



30-years climate maps

E.g. Summer global solar radiation, average 1984-2013



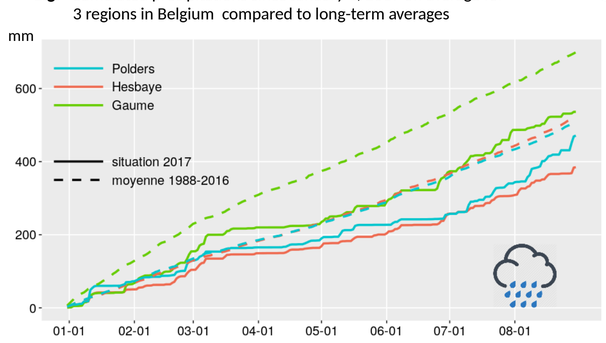
RMI climate atlas
www.meteo.be/climatlas

Return period maps

E.g. Low precipitations from August 2016 to June 2017
Areas where the return period exceeds 15 and 20 years

Areal information

E.g. Cumulated precipitations since January 1, 2017 on average for 3 regions in Belgium compared to long-term averages



Grid resolution sensitivity analysis

A sensitivity study has been conducted to determine the most meaningful grid resolution for air temperature.

i.e. Given the stations' density, is a fine grid resolution of 1 km more informative than a coarser grid resolution of 5 km or even 10 km?

Experimental setup
- Data from 124 temperature stations from 2012 to 2016
- Evaluation of daily grids with a resolution from 1km to 20km by leave-one-out cross-validation
- Comparison of grid estimates against actual observations by several indices: MBE, RMSE, 1st and 99th percentiles of the error distribution (P01 and P99).

Main results
- Low impact of the resolution for most stations:
  → RMSE varies by less than 0.2°C for grid resolutions from 1 km to 20 km for 83% of the stations
  → P01 and P99 vary by less than 0.2°C for grid resolutions from 1 km to 10 km for 73%
- A grid resolution refinement from 5km to 1 km or 2 km improves P01/P99 for 2 stations. No improvement for RMSE. MBE improved by min. 0.2°C for 10 stations but degraded for 14 other stations.
- A grid resolution degradation from 5km to 10 km or 20 km improves RMSE for 2 stations and P01/P99 for 21 stations.
  → Some nearby stations are not representative for each other (impact of station's environment and local topography)