Deliverable D2.10

Final version of metadata per country of all national gridded datasets created within module 2

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INTRODUCTION

The grids show different meteorological variables across the interest area in the form of two-dimensional array data. The data are based on daily records and covers the 50-year period 1961-2010. All input station's data underwent a high degree of quality control before analysis per country according to the accepted deliverable D2.5 using common software MASH (D 1.7, D 1.8, Szentimrey 1999, 2008, 2011). The gridding (spatial interpolation) was made on national level as detailed in deliverable D2.7, implemented by common software MISH (D 2.3, Szentimrey, Bihari 2006, 2007, 2007b), and then compiled at the CARPATCLIM region level, except 2 m mean daily temperature, daily surface vapour pressure, daily snow depth and snow water equivalent. Between the neighboring countries the near border station data series were exchanged according to deliverable D2.5 in order to cross-border harmonize the spatial interpolation.

1. GENERAL INFORMATION OF GRIDS

The following information is valid for all countries, as they all have a common grid system for every meteorological parameter.

1.1 Time interval

Daily gridded data series for the period 1961-2010 (18262 days).

1.2 Area of interest and spatial resolution

Area: between latitudes 44°N and 50°N, and longitudes 17°E and 27°E, except Bosnia.
Grid cell resolution: $0.1^\circ \mathrm{x}\, 0.1^\circ \; (\approx 10\mathrm{x}10\ \mathrm{km})$
WGS 1984 Reference system
Number of grids points: 5895 = 6161 (whole area) – 266 (Bosnia)
Stored data format: ASCII grid-point

1.3 The countries

The homogenization, data quality control, data completion and gridding were implemented per countries using common software MASH and MISH.
The predictor countries (in anti-clockwise direction starting with Hungary and Croatia, ending with the Czech Republic) are Hungary and Croatia (1), Serbia (2), Romania (3), Ukraine (4), Slovakia (5), Poland (6), Czech Republic (7). The countries with the grids and the region are presented on Figure 1.

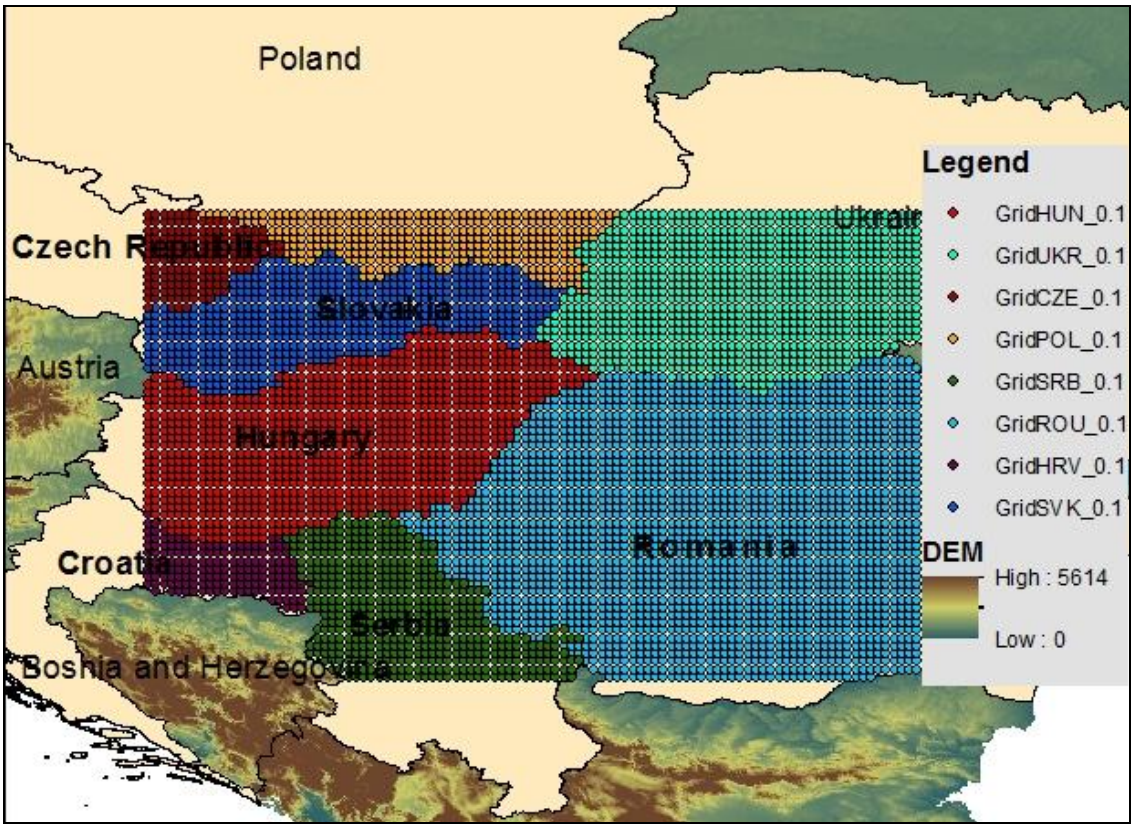

Figure 1. The area of interest and the CARPATCLIM countries

We have the same structure that was used at the deliverables D1.12, D2.5, D2.8 where the tables were given for the above seven predictor areas of the countries, including the predictor station systems.

1.3.1 Remark

As regards the expression ‘per country’, it is necessary to make a nice distinction between the concept of predictor and predictand countries. The procedures of homogenization and gridding were performed at seven areas of countries, where Croatia and Hungary were together. These are the predictor areas. However we have eleven predictand countries altogether since there are some gridded series also for Austria, Bulgaria and Moldova according to the contract. On Figure 2 we present all the predictand area coloured by predictor countries.

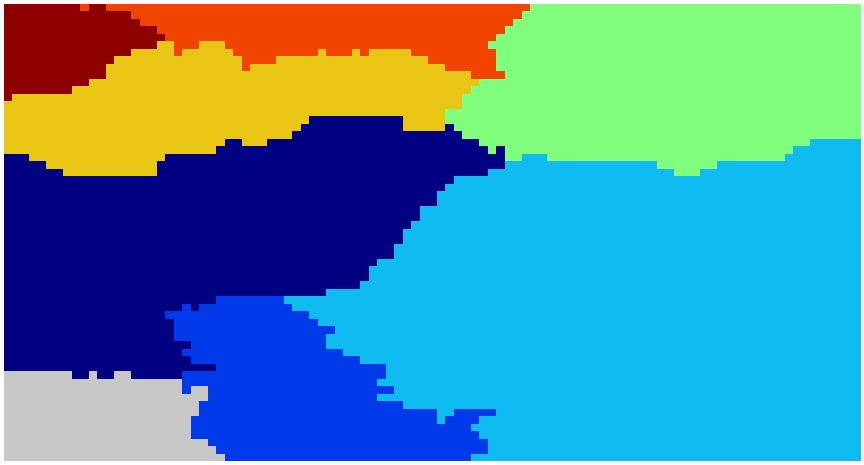

Figure 2. The area of interest and the grids per predictor countries (except Bosnia)

Table 2. Number of grids per countries

Hungary and Croatia (1)	1214
Serbia (2)	507
Romania (3)	2192
Ukraine (4)	912
Slovakia (5)	599
Poland (6)	303
Czech Republic (7)	168

2. GENERAL DATA OF GRIDDED METEOROLOGICAL PARAMETERS

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2.1 The variables

2.1.1 Origin of data and units of variables for all countries

	measured/calculated	units
Daily mean temperature	computed	°C
Minimum air temperature	measured	°C
Maximum air temperature	measured	°C
Daily precipitation	measured	mm
10 m wind direction	measured	degrees (0-360°)
10 m horizontal wind speed	measured	m/s
Sunshine duration	measured/calculated	hours
Cloud cover	measured	tenth
Global radiation	measured/calculated	J/cm^2
Relative humidity	measured	%
Surface vapour pressure	computed	hPa
Surface air pressure	measured	hPa
Snow depth	computed	cm

2.1.2. Method of computation

2.1.2.1 Daily mean temperature

The homogenized t_{mean} is calculated as the arithmetic mean of homogenized t_{min} and t_{max} .

2.1.2.2 Daily mean wind speed and direction (VV, DD)

The following algorithm was developed for calculation of daily mean wind speed and wind vector direction:

Hourly wind vectors: $\mathbf{v}(t,k)=[u(t,k),v(t,k)]^{\mathrm{T}}\quad (t=1,..,n;\ k=1,...,K)$ (*t*: day, *k*: hour)

$u(t,k)$: component towards east,

$v(t,k)$: component towards north.

The components can be expressed by the wind speed $z(t,k)=|\mathbf{v}(t,k)|$ (m/s) and meteorological wind direction $\phi_{MET}(t,k)$ in degree:

$$u(t,k)=-z(t,k)\cdot\sin\left[\frac{\pi}{180}\cdot\phi_{MET}(t,k)\right],\quad v(t,k)=-z(t,k)\cdot\cos\left[\frac{\pi}{180}\cdot\phi_{MET}(t,k)\right]$$

Then, the daily mean wind speed: $z(t)=\frac{1}{K}\sum_{k=1}^{K}z(t,k)$

Daily mean wind vector: $\mathbf{v}(t)=\frac{1}{K}\sum_{k=1}^{K}\mathbf{v}(t,k)=[u(t),v(t)]^{\mathrm{T}}$,

where $u(t)=\frac{1}{K}\sum_{k=1}^{K}u(t,k)$, $v(t)=\frac{1}{K}\sum_{k=1}^{K}v(t,k)$.

The daily "vectorial mean" meteorological wind direction in degree:

$$\phi_{MET}(t)=\frac{180}{\pi}\cdot\operatorname{atan2}[-u(t),-v(t)]\qquad (\text{if } \mathbf{v}(t)\neq\mathbf{0})$$

Remark: atan2 is a variation of the arctangent function.

2.1.2.3 Sunshine duration/ Global radiation

While data gaps in these two variables were different in the examined period in this case not the grids but the station data were calculated from the other element (Šťastný, P. and Nejedlík, P., Allen, R. G. et al).

$$R_s=\left(0.25+0.50\frac{n}{N}\right)R_a$$

where

R_s – global radiation

n – sunshine duration

N – maximal possible sunshine duration, function of latitude, solar declination

R_a – global radiation intensity at the upper level of the atmosphere, function of latitude, solar declination, relative distance from globe to sun

2.1.2.4 Surface water vapour pressure

Daily grids of relative humidity [%] interpolated from the station records and daily max and min temperature [°C] grids were used to compute the surface water vapour pressure using the following formula (Allen 1998):

$$e(t) = \frac{RH(t)}{100} e_w(t)$$

where

$e(t)$: vapour pressure (hPa)

$RH(t)$: relative humidity (%)

$e_w(t)$: saturation vapour pressure (hPa) estimated as,

$$e_w(t) = \frac{6.112}{2}\left(\exp^{17.62\,T_{\min}(t)(243.12+T_{\min}(t))} + \exp^{17.62\,T_{\max}(t)(243.12+T_{\max}(t))}\right)$$

2.1.2.6 Daily snow depth

The gridding of the two variables concerning the snow cover, snow depth and snow water equivalent (SWE), features substantial differences compared to the interpolation of the other climate variables: firstly, not direct interpolation of station observation applying the MISH software was performed, but a process-related snow cover model based on pre-finished CARPATCLIM grids was applied. Secondly, the application of the snow cover model was not divided among the project members according to their national domains, but collectively by the project associate member ZAMG (D2.9). Pre-finished CARPATCLIM daily grids of mean air temperature [°C], precipitation sum [mm] and relative humidity [%] were used as input.

2.2 Number of stations used to compute the grids for different variables

2.2.1 Hungary and Croatia

	number of all stations	number of stations from neighbouring countries
Daily mean temperature	68	19
Minimum air temperature	68	19
Maximum air temperature	68	19
Daily precipitation	233	33
10 m wind direction	66	17
10 m horizontal wind speed	66	17
Sunshine duration	33	17
Cloud cover	66	19
Global radiation	33	17
Relative humidity	68	19
Surface vapour pressure	68	19
Surface air pressure	41	15

2.2.2 Serbia

	number of all stations	number of stations from neighbouring countries
Daily mean temperature	39	12
Minimum air temperature	39	12
Maximum air temperature	39	12
Daily precipitation	114	16
10 m wind direction	40	11
10 m horizontal wind speed	40	11
Sunshine duration	28	10
Cloud cover	39	12
Global radiation	28	10
Relative humidity	35	12
Surface vapour pressure	35	12
Surface air pressure	26	12

2.2.3 Romania

	number of all stations	number of stations from neighbouring countries
Daily mean temperature	140	16
Minimum air temperature	140	16
Maximum air temperature	140	16
Daily precipitation	182	16
10 m wind direction	119	15
10 m horizontal wind speed	119	15
Sunshine duration	112	12
Cloud cover	110	16
Global radiation	112	12
Relative humidity	140	16
Surface vapour pressure	182	16
Surface air pressure	139	15

2.2.4 Ukraine

	number of all stations	number of stations from neighbouring countries
Daily mean temperature	53	14
Minimum air temperature	53	14
Maximum air temperature	53	14
Daily precipitation	57	18
10 m wind direction	53	14
10 m horizontal wind speed	53	14
Sunshine duration	24	12
Cloud cover	53	14
Global radiation	24	12
Relative humidity	53	14
Surface vapour pressure	53	14
Surface air pressure	49	10

2.2.5 Slovakia

	number of all stations	number of stations from neighbouring countries
Daily mean temperature	59	37
Minimum air temperature	59	37
Maximum air temperature	59	37
Daily precipitation	165	102
10 m wind direction	53	31
10 m horizontal wind speed	53	31
Sunshine duration	27	16
Cloud cover	52	30
Global radiation	29	17
Relative humidity	44	22
Surface vapour pressure	52	30
Surface air pressure	26	18

2.2.6 Poland

	number of all stations	number of stations from neighbouring countries
Daily mean temperature	38	17
Minimum air temperature	38	17
Maximum air temperature	38	17
Daily precipitation	102	48
10 m wind direction	42	21
10 m horizontal wind speed	42	21
Sunshine duration	17	8
Cloud cover	40	19
Global radiation	17	8
Relative humidity	31	19
Surface vapour pressure	40	19
Surface air pressure	26	15

2.2.7 Czech Republic

	number of all stations	number of stations from neighbouring countries
Daily mean temperature	18	12
Minimum air temperature	18	12
Maximum air temperature	18	12
Daily precipitation	51	28
10 m wind direction	17	11
10 m horizontal wind speed	17	11
Sunshine duration	9	5
Cloud cover	17	11
Global radiation	9	5
Relative humidity	17	11
Surface vapour pressure	17	11
Surface air pressure	8	5

3. REFERENCES

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D1.8 Proposal for homogenization methods to be applied to all observational time series, Submitted to JRC.

D1.12 Final report on quality control and data homogenization measures applied per country, including QC protocols and measures to determine the achieved increase in data quality

D2.3 Proposal for the methodology to harmonize observational time series across country borders

D2.5 Report with final results of the data harmonization procedures applied, including all protocols, per country

D2.7 Progress report on the creation of national gridded datasets

D2.8 Final version of gridded datasets of all harmonized and spatially interpolated meteorological parameters, per country

D2.9 Final report on the creation of national gridded datasets, per country

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