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EFFECTS OF GLOBAL WARMING ON THE SIZING OF DRAINAGE NETWORKS

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Abstract: *Global warming has therefore change by increasing the intensity of heavy rainfall. For correct operation of urban drainage networks they will need to undergo dramatic changes to adapt to increased rainfall intensity. By decreasing the total amount of rainfall, stormwater will be managed so that using them can be saved effectively as large volumes of water. Drainage systems should be integrated in the urban utility systems that are integral, first with water systems for maintenance of fire and water for urban areas of interest.*

Key words: *global warming, climate change, rainfall .*

1. Climate Change and Territorial Effects on Regions

Territorial development is generally considered as very important for dealing with climate change.

For instance, territorial development is regarded to be responsible for and capable of reducing regional vulnerability to climate change and developing climate mitigation and adaptation capacities against the impacts of climate change [6], [5].

Also, the World Bank Report „The Global Monitoring Report 2008“ which deals with climate change and the Millennium Development Goals concludes that the development of adaptive urban development strategies is a fundamental field of action for dealing with the challenges of climate change [7].

The EU White Paper „Adapting to climate change: Towards a European framework for action”[3] explicitly relates to spatial planning and territorial development, respectively: „A more strategic and long-term approach to spatial planning will be necessary, both on land and on marine areas, including in transport, regional development, industry, tourism and energy policies.”

The patterns on the projected changes of the annual mean number of summer days show almost the inverse picture compared to the change in annual mean number of frost days (see Figure 1).

Here, increases between less than 10 and more than 50 days per year in average have been calculated by the model.

The comparatively slightest increases are predicted for the North of Europe including Scandinavia, Finland, the Baltic States as well as parts of Denmark, United Kingdom and Ireland while predominantly France, Spain and Portugal exhibit increases of more and 40 days per year on average.

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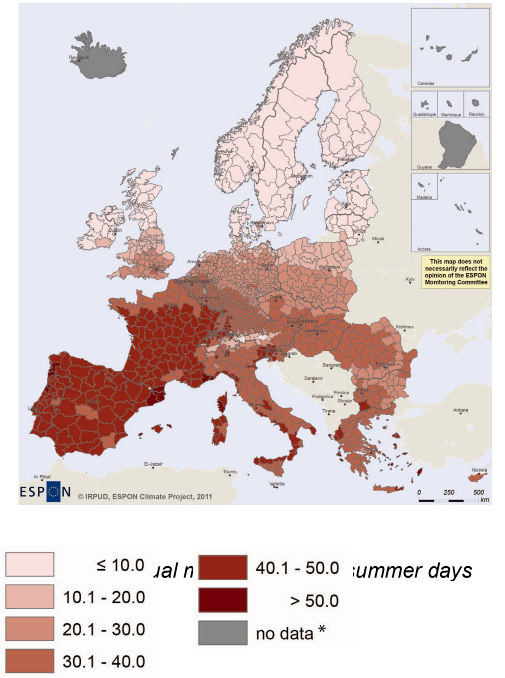

Figure. 1. *Change in annual mean number of summer days*

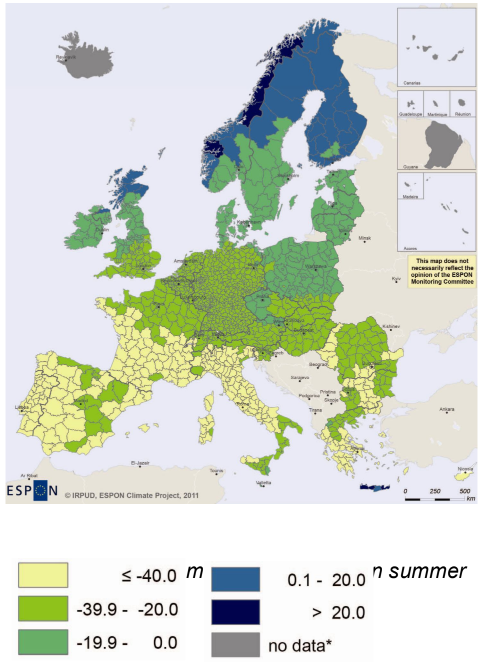

Figure. 2. *Relative change in annual mean precipitation in summer months*

The Regional Climate Model outputs on precipitation in summer month again are twofold considering the changes within the European territory (see Figure 2). While parts of Scandinavia and Finland as well as Northern United Kingdom will experience increases up to 40 % most of the ESPON space will experience decrease in summer precipitation up to 40 % and more. For parts of Scandinavia, the Baltic states, Poland, parts of the Czech Republic, Denmark, Ireland and parts of the United Kingdom those decreases are projected to range up to 20 % while the rest of Europe and here particularly France, Portugal, Spain, Italy, Greece are projected to experience the strongest relative decreases in annual summer precipitation considering the overall patterns for the European territory [4].

As the previous precipitation-related indicators also the change in annual number of days with heavy rainfall reveals As the previous precipitation-related indicators also the change in annual number of days with heavy rainfall reveals a twofold pattern over the whole of Europe. Roughly a North-South divide with a division at alpine latitudes becomes evident (see Figure 3). Most of the territory at lower latitudes is projected to experience average decreases in annual heavy rainfall of up to 5 days and more whereas for the territory north of this division line is projected to gain in average number of days with heavy rainfall. For most of these regions increases will amount up to 3 % but along the coastline of Norway as well as Western United Kingdom and Ireland and some parts of the Atlantic coast of France increases between 4 and 13 days have been calculated by model for climate simulations named COSMO-CLM [4].

This is particularly troublesome in an international policy context like the European Union, when it needs to be

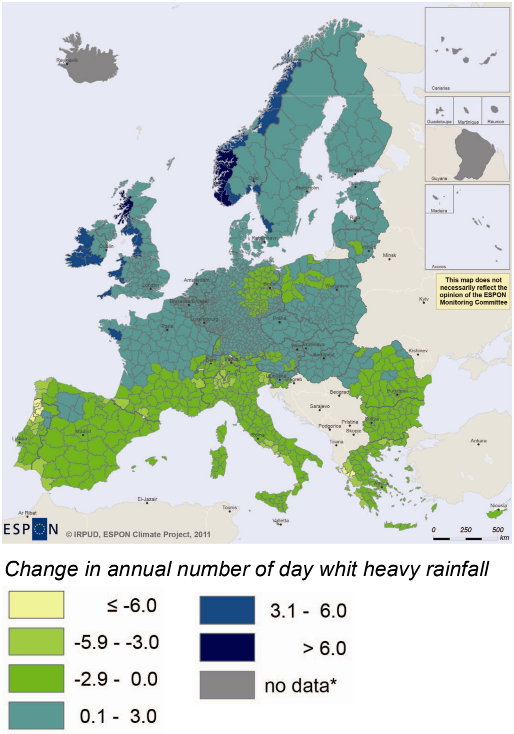

Figure. 3. *Change in annual mean number of days with heavy rainfall*

determined, what are the consequences of climate change on the competiveness of Europe as a whole or the territorial cohesion of European regions.

2. Effects of climate change in Romania

Statistical downscaling models, calibrated observations during 1961-1990 were applied to changes in the set of predictors for the .period 2001-2030 to the current period 1961-1990, calculated from simulations of three global climate models mentioned for air temperature and we calculated the average of all these projections.
The results obtained are shown in Table 1, the values marked with a high certainty, that the projections of results of the models have the same signal Change (increase or decrease).

With A1B emissions scenario for the period 2001 to 2030, projecting a decline in monthly amounts of precipitation to the current period 1961-1990, especially in the

Changes in the monthly amount of precipitation (%) for the period 2001 to 2030 to the current period 1961-1990, obtained by averaging the projections made by statistical downscaling model applied to three global climate models (BCM2, INGV, FUB). Are marked in bold where three projects resulting from global climate models have the same sign.

Tabel. 1.

Statia	XII	I	II	III	IV	V	VI	VII	VIII	IX	IX	XI
1. Campina	**-22.7**	-0.7	**-27.2**	**-8.9**	-4.7	1.4	0.37	1.43	0.17	-4.0	**14.8**	5.5
2. Calarasi	**-19.7**	-0.6	**-24.0**	-7.3	-5.1	-3.5	**-8.40**	-9.97	-11.60	13.9	**11.9**	0.8
3. Fundata	**-14.4**	0.9	**-19.2**	-2.5	-1.3	0.9	**6.33**	5.93	**8.23**	-8.2	**12.1**	-4.8
4. Fundulea	**-21.8**	-4.2	**-27.0**	-3.4	0.9	7.6	**-6.67**	-6.73	-8.13	11.4	7.0	-1.5
5. Giurgiu	**-17.8**	-3.1	**-21.8**	**-9.7**	-6.5	-6.0	**3.43**	4.93	2.97	8.6	**10.4**	-11.1
6. Grivita	**-21.7**	-4.3	**-28.7**	-8.6	-4.4	1.8	**-11.43**	-12.53	-12.33	4.4	11.4	-2.4
7. Int. Buzaului	**-15.9**	-0.8	**-20.0**	3.8	**5.0**	11.1	**2.47**	1.50	**5.77**	6.9	**10.7**	-4.6
8. Pitesti	**-18.9**	0.2	**-22.6**	**-10.4**	-6.5	-2.7	**-4.30**	-5.67	-7.47	-0.3	**15.2**	-3.4
9. Ploiesti	**-22.7**	-1.5	**-27.4**	**-10.4**	-6.0	0.4	0.80	3.07	-0.23	5.8	**10.7**	5.7
10. Predeal	**-17.0**	0.3	**-20.4**	-3.9	-1.4	4.3	**5.17**	4.53	**6.57**	0.9	**12.2**	-6.4
11. Rm. Sarat	**-19.0**	-1.2	**-23.9**	**-11.6**	-7.9	-4.5	**-12.20**	-14.43	-15.03	16.0	**15.7**	10.9
12.Sinaia	**-16.2**	3.6	**-19.4**	-6.3	-2.0	6.8	**5.50**	5.43	**5.80**	-2.6	**15.5**	4.6
13. Targoviste	**-19.3**	-0.3	**-23.2**	**-7.8**	-2.0	4.4	**-7.23**	-7.00	-11.87	-1.3	**14.3**	-0.4
14. Tr. Magurele	**-18.4**	-4.5	**-22.5**	**-4.5**	0.2	3.7	**-9.07**	-11.53	-18.03	-7.0	7.7	-16.8
15. Urziceni	**-15.8**	-4.6	**-24.7**	-6.8	-1.6	5.7	**-7.03**	-7.13	-8.23	3.6	6.6	-3.1
16. Vf. Omu	**-11.1**	0.0	**-14.6**	-8.2	**-10.5**	-9.7	**2.80**	1.70	-0.57	**-24.6**	-0.2	**-14.0**

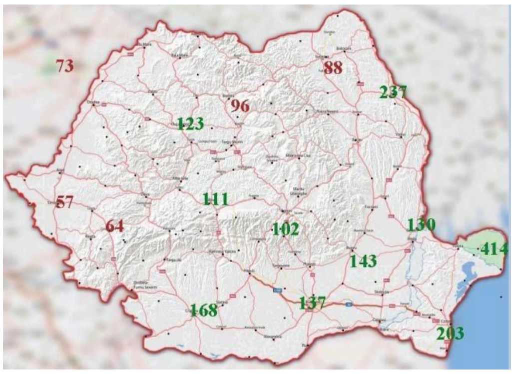

Figure. 4. *Month of* June *2013, annual average rainfall, [%], (sursa Ogimet)*

winter months (December through February), an increase in October and in June projecting a slight increase and decrease in mountain stations hill stations and plain.

For the other months there is greater uncertainty and changes are not significant. Ensemble average changes calculated directly from the grid point values simulated three global climate models, averaged over Romania, compared with similar value calculated from the results of the statistical model projections show similar signals for most months, but less intense for December and February [2].

In June were mainly convective rainfall, with large spatial variations, but mostly surplus. In Romania the average temperatures for the period 1961-1990 were overcome with 0...1 ºC in isolated western Banat and Oltenia, and more than 2 ºC Northern Moldavia, Transylvania and local northeast southeast. The moon was high in convective phenomena, number of days with Thunderstorm was generally between 6 and 18. Monthly amount of precipitation anomaly was negative in the southwest, with a deficit of 45...55%, and only 0...30% in Northern Transylvania and Moldavia. The rest of the country rainfall excess values were highest in Moldavian Plateau and southern Dobrogea, reaching the highest positive deviation in the eastern half of the Danube Delta (Sulina 120 mm compared to an average of 29 mm) [1].

In July the thermal deviation remained positive, ranging between 0.1 and 2 ºC, locally more than 2 ºC, but weather look has changed significantly from the previous month. This change is observed and rainfall deviation values. With the exception of the southeastern half of Dobrogea, the Danube Delta and local East Muntenia quantities of water accumulating multi remained below average, sometimes exceeding 75% deficit. [1]

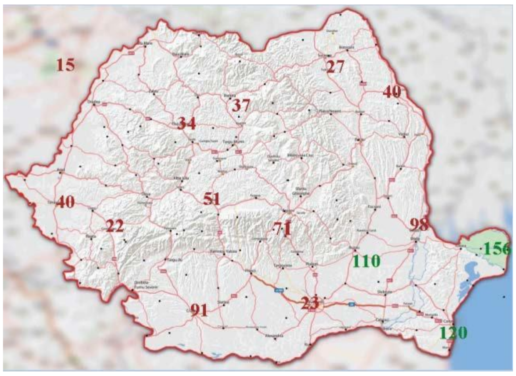

Figure. 5. *Month of July 2013, annual average rainfall, [%], (sursa Ogimet)*

In August 2013 monthly average temperatures exceeded multiannual average 1...1.5 ºC in northern Moldavia and local over 4 ºC in Banat. Although rainfall exceeded the climatological averages on larger areas in the local mountains and lowlands, the number of days with precipitation was low, heavy downpour had predominant character. The Danube Valley and Northeast Dobrogea rainfall deficit exceeded 75%, and in some quantities of water accumulating litres/m^2 not reached 10.[1]

Were performed for the first time in Romania simulations with a regional climate model RegCM3 at fine resolution (10 km) for both the current period 1961-2000 (control simulations) and for 2020 to 2030, under the A1B emissions scenario.

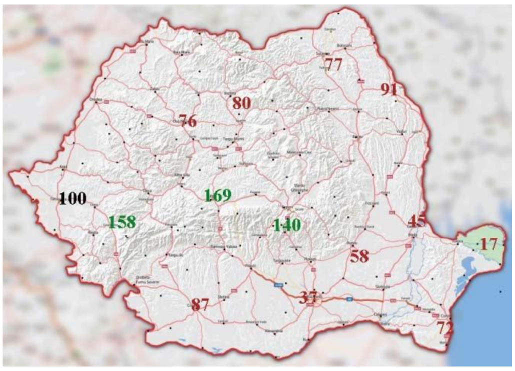

Figure. 5. *Month* of *August 2013, annual average rainfall, [%],(sursa Ogimet)*

The boundary conditions were provided by interworking model simulations performed with regional climate by ICTP (Trieste), but integrated at a resolution of 25 km, taking in turn boundary conditions simulated ECHAM global model developed by Max-Plack Institute for Meteorology (Hamburg). RegCM is a version of mesoscale climate model developed at NCAR 80s (National Center for Atmospheriuc Research) and the University of Pennsylvania, MM4 model. It is a limited-area model has been adapted to improve strength and regional climate simulation of regional scale atmospheric circulation, by altering physical parameterizations, most of the physics of radiative transfer and land surface physics. It is known that numerical climate simulations impose great numerical computation (processing power, data storage, continuous transfer of large volumes of data, the order TB), particularly in terms of integration very fine resolution . For this reason, in this study, is presented as a final analysis of the result, namely the 10-year scenario period 2020-2030 relative to the 1965-1975 reference period. Continuation of these tests will be done in European FP6 project CECILIA (Central and Eastern Europe Climate Change Impact and Vulnerability Assessment). Analysis was performed by experimental sets of calibration and control scenarios.[2]

3. Adapting Drainage Systems

DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework for Community action in the field of water policy and first article says: Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such.

A feature of rainfall during this period of increased trends is rain intensity increasingly higher. The sewerage system usually works well, the rapid increase of the intensity of rain, the flow moves to the water pressure and escapes to the outside.

Therefore, a simple solution is to temporarily store excess water retention basins where the waters will be discharged normally.

Another solution would be to retain hydrocarbons and their desanding and retaining rainwater in tanks for fire fighting or for maintaining cleanliness in urban areas of general interest thus saving drinking water. But this version is quite expensive requiring high investment costs for building huge tanks buried in concrete.

Another option would be to build rainwater channels open or covered for the handling and transport rainwater. Open channels have the advantage of having large dimensions allow easy maintenance and can retrieve their flow peaks. A negative feature is their large gauge hardly afford urban crossing.

Caring for water resources will materialize in the future interconnection facilities for drinking water and fire by monitoring the flow of rainwater vehicle, their quality and the quantities stored.

Will be revised regulations and design standards and regulations for the operation of facilities for integrating rainwater fire in the fire fighting methods.

The current provisions of the regulations very easy to send tanks stinst building fire. Cheapest water storage tanks being the metal supraterame occurred in industrial and commercial areas many reservoirs negative impact of urban point of view and from the point of view of water management. Long unused water fire fighting must be replaced which means huge volumes of wasted water.

Open channels have long tradition in the construction of storm sewer. Since the Roman cities functioned near open sewage canals aqueducts.

In medieval cities went from channel to channel water through open channels closed urban channel. Paris's famous canals are huge modern era. They have square and can be easily integrated functionality today in the conditions created by global warming and its effects on long-term drinking water and the precipitation.

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