Multi-Dimensional Analysis of Regional Development

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Methodology

The goal of the multidimensional analysis of regional development is to review and analyze the common socio-economic development of Bulgarian districts in the 2008-2011 period, using a wide variety of indicators, grouped in seven categories: economy, infrastructure, demographics, education, healthcare, environment, social environment.

In order to be able to assess the development of the districts on the basis of these 7 categories (each of which contains a different number of primary indicators), a complex indicator has been developed for each of them.

Thus it is possible to assess the complex socio-economic development on the basis of a wide variety of indicators, which allow for a most comprehensive analysis of development. The method chosen to achieve this is neural networks – Cohonen Self-Organizing Maps (SOM), to be precise.

Two "fake regions" have been established for the purpose of this analysis. One is a "perfect" region, which scores best (has the highest marks) on all indicators at the same time (i.e., it has the highest complex values of all complex indicators for all four years). The other one is a "worst" region, which scores worst (has the lowest marks). These "fake regions" are used as reference points and benchmarks for assessing the development of the 28 regions during this period. The current state and development of all 28 regions is assessed as positive or negative in comparison to these benchmarks.

One should note that on the maps of the different categories the best-developed territory does not necessarily coincide with the "perfect region", neither the worst-developed territory coincides with the "worst region". This happens because the "best" and the "worst" region are defined as such on the basis of all categories at the same time and are therefore fake and do not really exist. Empirical data shows that some regions score high in some categories and low in others.

After the analysis, the districts have been grouped into clusters, formed by Cohonen's self-organizing maps. The results are represented by two separate methods:

1. The clusters are presented through the so-called "unified distance matrix" (U-matrix). The dark zones represent the borders of the clusters, the light ones – the clusters themselves. The darker the border between the clusters, the more they differ from each other and vice versa.

2. Each zone on the Cohonen map is characterized by a certain level of development, achieved during the period (low or high) based on the different categories – from economy to social environment. The rankings in the different categories are also represented visually on the different maps, with the more saturated color representing high ranking, while a less saturated – low ranking.

In the perfect case – If a region ranks "best" in each of the categories – from economy to social environment, it should match the "perfect" one or be very close to it. In reality, none such exists, so the regions are located all over the map. The reasons for their location can be seen in the analysis of the different categories.
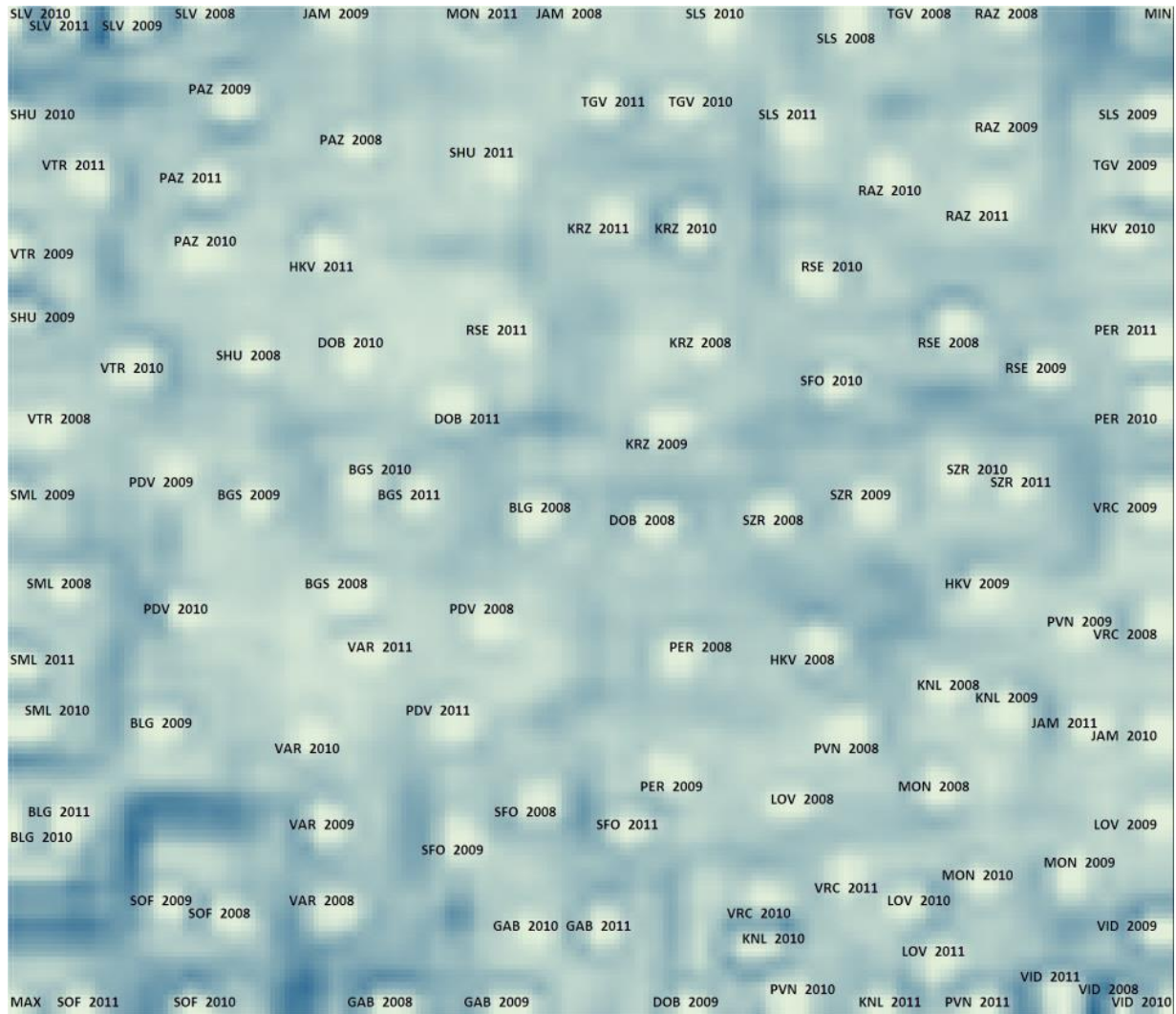
The results thus represented in the Cohonen maps allow us to study the development of all regions for the entire period at the same time, visualizing:

- Difference levels – how much do certain regions differ from the others during one or all years of the period;

- Development directions – whether the development of the regions shows a positive or a negative trend;
- Speed of development – what is the pace of growth or decline;

Results

This graphic shows the visual clusters according to the complex socio-economic development and state of the regions during the period. Every region has the year of its development attached to it. The lower left corner of the map shows the fake "perfect region", the lower right one – the "worst region".

SLV 2010 SLV 2011 SLV 2009 SLV 2008 JAM 2009 MON 2011 JAM 2008 SLS 2010 TGV 2008 RAZ 2008 MIN
SLS 2008
PAZ 2009 TGV 2011 TGV 2010 SLS 2011
SHU 2010 RAZ 2009 SLS 2009
PAZ 2008 SHU 2011
VTR 2011 PAZ 2011 TGV 2009
RAZ 2010
PAZ 2010 KRZ 2011 KRZ 2010 RAZ 2011 HKV 2010
VTR 2009 HKV 2011 RSE 2010
SHU 2009 PER 2011
DOB 2010 RSE 2011 KRZ 2008 RSE 2008
SHU 2008 RSE 2009
VTR 2010 SFO 2010
VTR 2008 DOB 2011 PER 2010
KRZ 2009
BGS 2010 SZR 2010 SZR 2011
SML 2009 PDV 2009 BGS 2009 BGS 2011 SZR 2009
BLG 2008 VRC 2009
DOB 2008 SZR 2008
SML 2008 BGS 2008 HKV 2009
PDV 2010 PDV 2008 PVN 2009 VRC 2008
VAR 2011 PER 2008 HKV 2008
SML 2011 KNL 2008 KNL 2009
SML 2010 PDV 2011 JAM 2011 JAM 2010
BLG 2009 PVN 2008
VAR 2010 PER 2009 LOV 2008 MON 2008
BLG 2011 SFO 2008 LOV 2009
BLG 2010 VAR 2009 SFO 2011
SFO 2009 MON 2010 MON 2009
VRC 2011 LOV 2010 VID 2009
SOF 2009 VAR 2008 VRC 2010
SOF 2008 GAB 2010 GAB 2011 KNL 2010 LOV 2011
VID 2011 VID 2008
MAX SOF 2011 SOF 2010 GAB 2008 GAB 2009 DOB 2009 PVN 2010 KNL 2011 PVN 2011 VID 2010

The analysis of the cluster map has a few different aspects:

1. The ranking of each region (for a certain year) on the map shows its overall socio-economic state for the year in question. The regions which are close to the "perfect" have the best socio-economic state, those closest to the upper right corner – the worst one. For instance, Sofia (capital) is obviously the most developed region, since it is the one closest to the "perfect region".

2. Varna, and Blagoevgrad regions are also close to the lower left corner; however, they are further away from the "perfect region". Moreover, despite their relatively good state in

comparison to the rest of the regions, they stil differ significantly from Sofia (capital). This is illustrated by the color of the boundary between the Sofia (capital) cluster and those of the neighbouring regions – highly saturated color, demonstrating big differences.

3. The "motion" of the regions on the map during the four-year period shows their development trend – either negative or positive. Ideally, if a region has a positive development trend, between 2008 and 2011 it should have moved towards the lower left corner. And, if the trends are negative, its motion should be directed to the upper right corner. The motion of Sofia (capital) is really specific – its state in 2011 is closest to the "perfect" region. The trend's direction is toward improvement of the basic socio-economic state. Such is also the case for Blagoevgrad, that demonstrates significant improvement for 2008-2011 – in 2008 it is located on the middle of the map, and in 2010 and 2011 stays really close to Sofia (capital). In contrast to them Varna and Gabrovo are heading in exactly the opposite direction – worsening of the socio-economic state. Both regions are moving away from the "ideal" region during the entire period.

4. Negative or positive development trends can also be assessed on the basis of similarity or dissimilarity. For instance, if we take Sliven, the borders of the clusters for the last four years are saturated dark. This shows an intensive pace of development, since the degree of difference is high. The maps of the different categories clearly show that the development is intensive but in negative trend.

5. The change of direction demonstrates the presence or lack of sustainable development. For instance, Smolyan has unsustainable development trends.

Economy

This map shows the state and development of the economy of the regions during the four-year period. The saturated color in the lower left corner, where Sofia (capital) is located, shows that it is the most developed region in this respect. The difference of the saturation of the colors is huge compared to all the other districts – even for the closest Varna and Blagoevgrad.

The worst-developed regions when it comes to the economy are Silistra, Razgrad, and Vidin, since the color of the map is the least saturated in their zone.

During the entire four-year-period, Vidin shows weak rate of development which is evident from the lack of difference in colour saturation between it's position in 2008, 2009, 2010, and 2011.
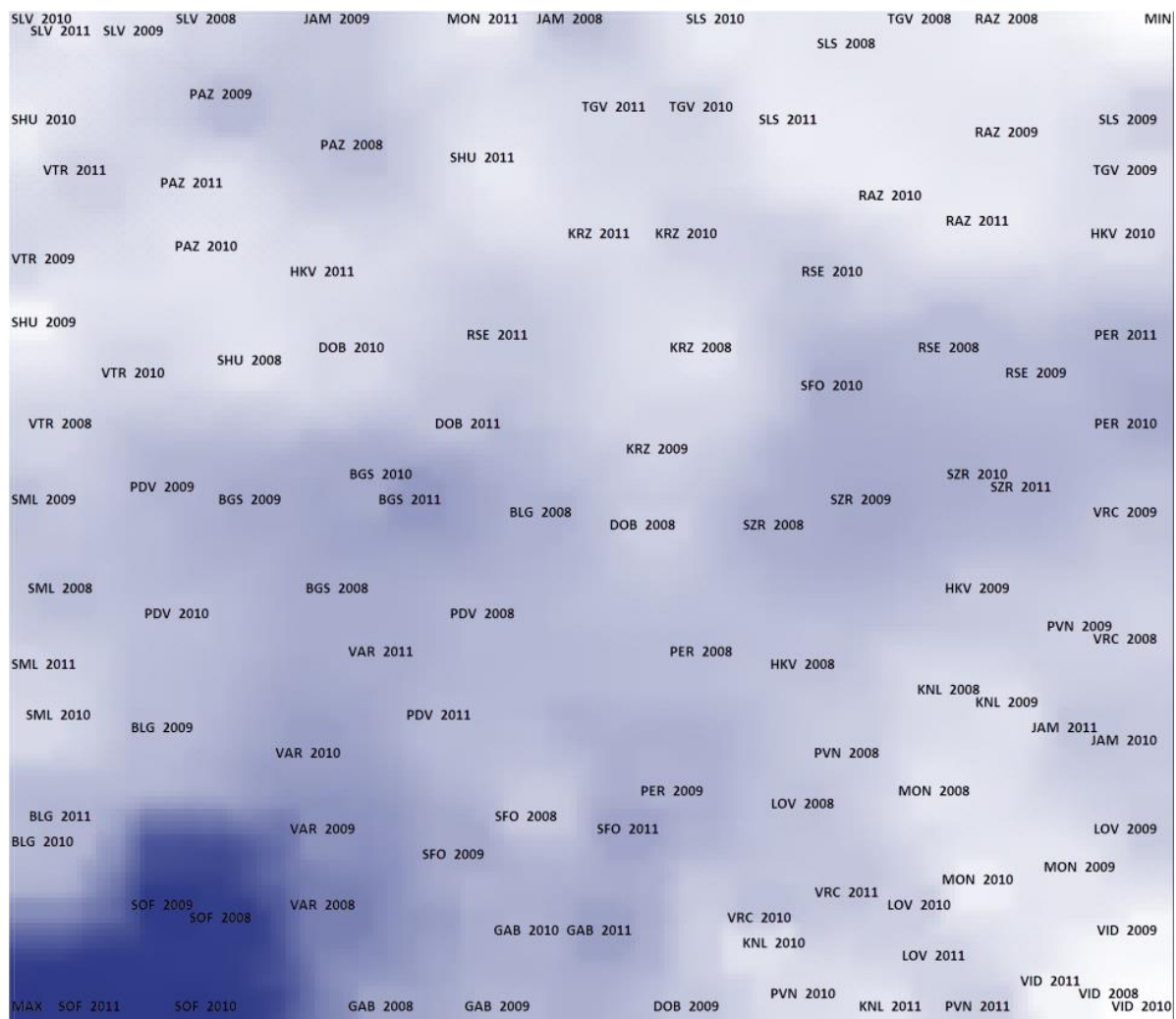
Infrastructure

This map shows the state and development of the infrastructure of the regions during the four-year period. The saturated color in the lower left corner shows that Sofia (capital) is the most developed region when it comes to infrastructure. Ruse (in 2008 and 2009) and Stara Zagora (2010 and 2011) also score high in this category.

Vidin, Lovetch, Montana and Pleven have the least-developed infrastructure for 2011.
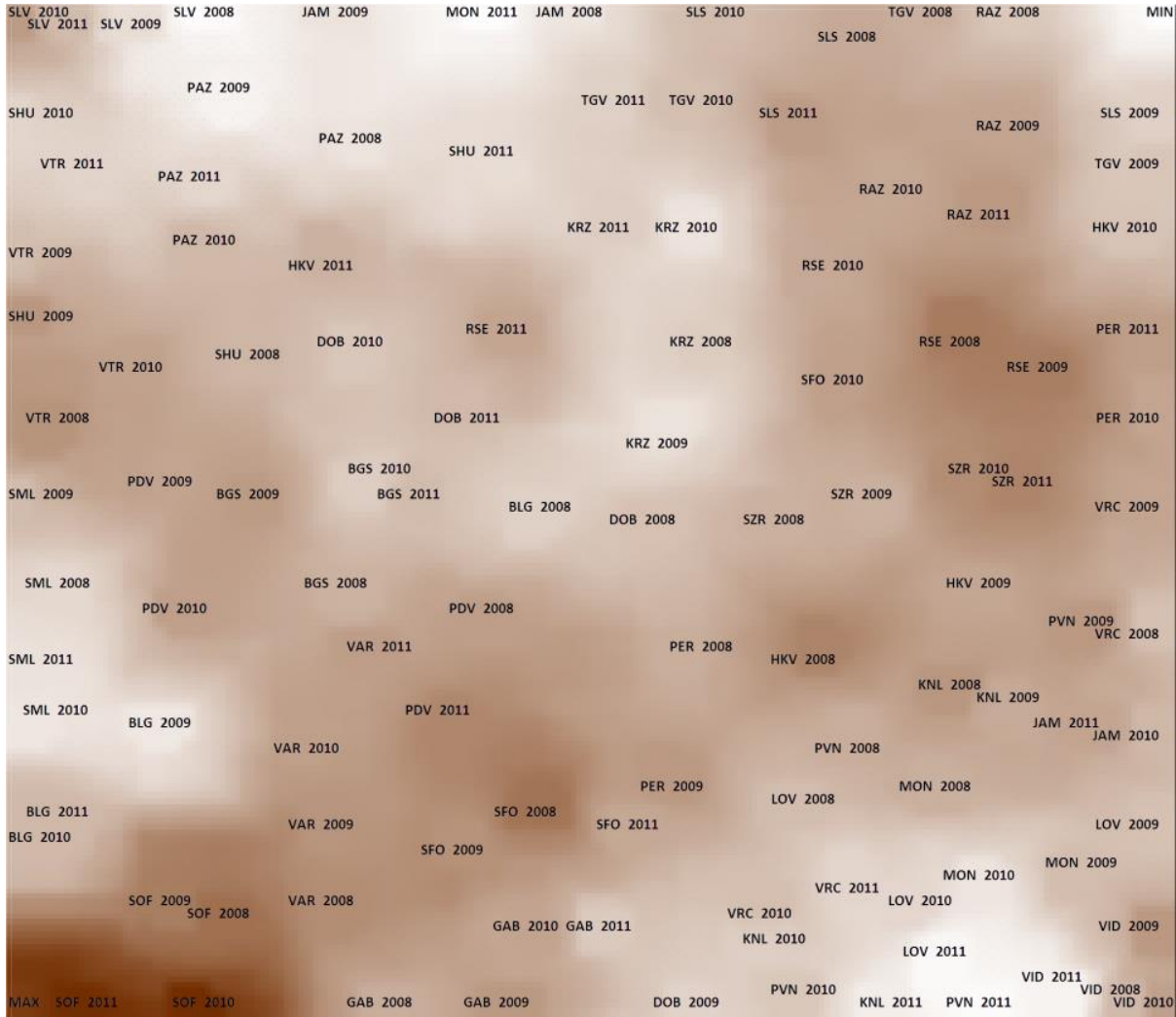
Demographics

This map shows the state and development of the demography of the regions during the four-year period.

Expectedly Sofia (capital) has the best demographic state and dynamics (highly saturated color), followed by Varna, Plovdiv, Blagoevgrad and Burgas.

Sliven has relatively good demographic conditions in comparison with the rest of the regions, but this is due to its specific ethnical structure. Its location, far from the left corner of the map, show that it didn't cause any positive impact on the region's socio economic development.

Vidin, Lovech and Montana have the worst demographic state during the three-year period, and therefore the least-saturated color on the map.

Gabrovo demonstrates pronounced worsening trends during the period in question.
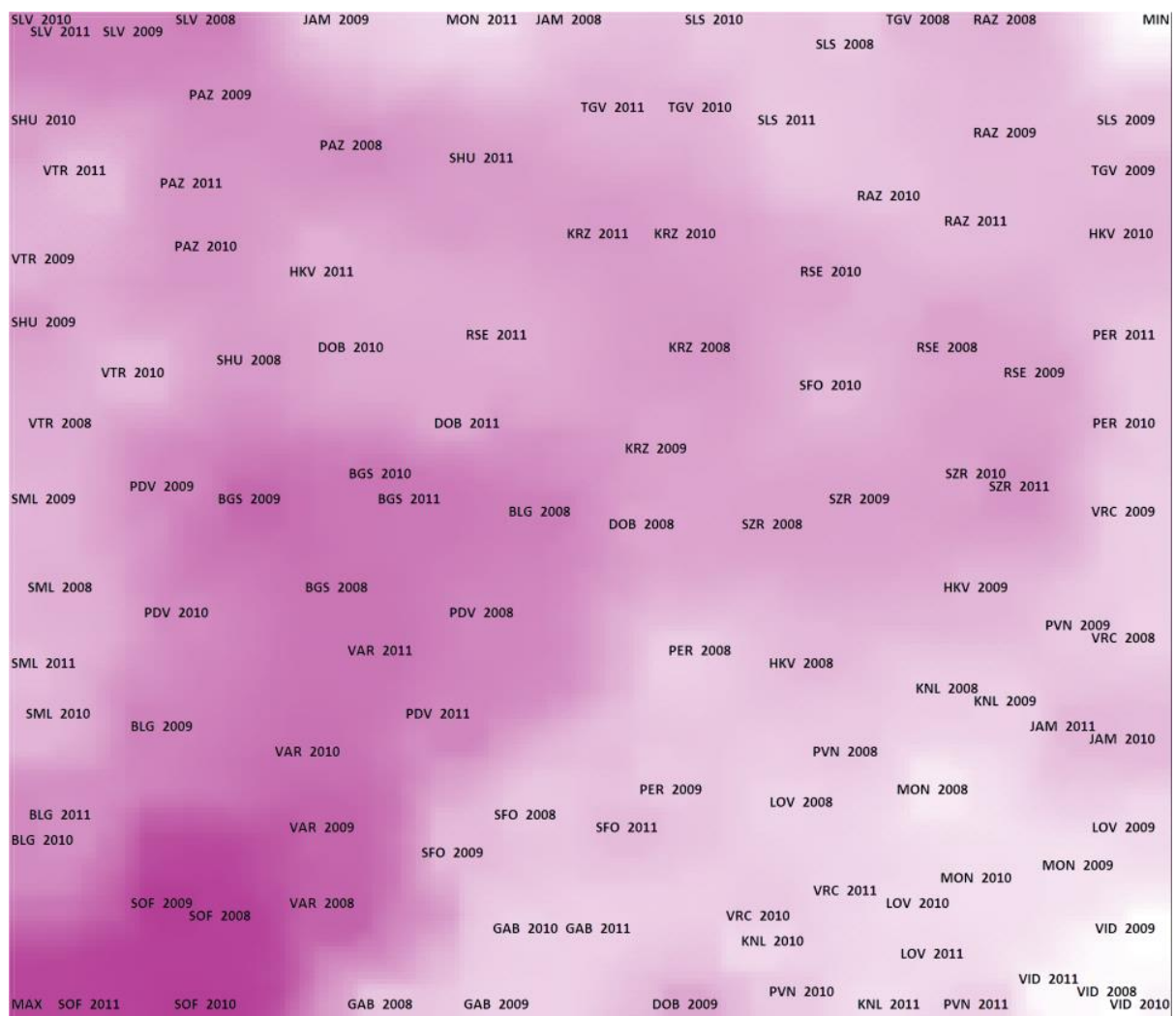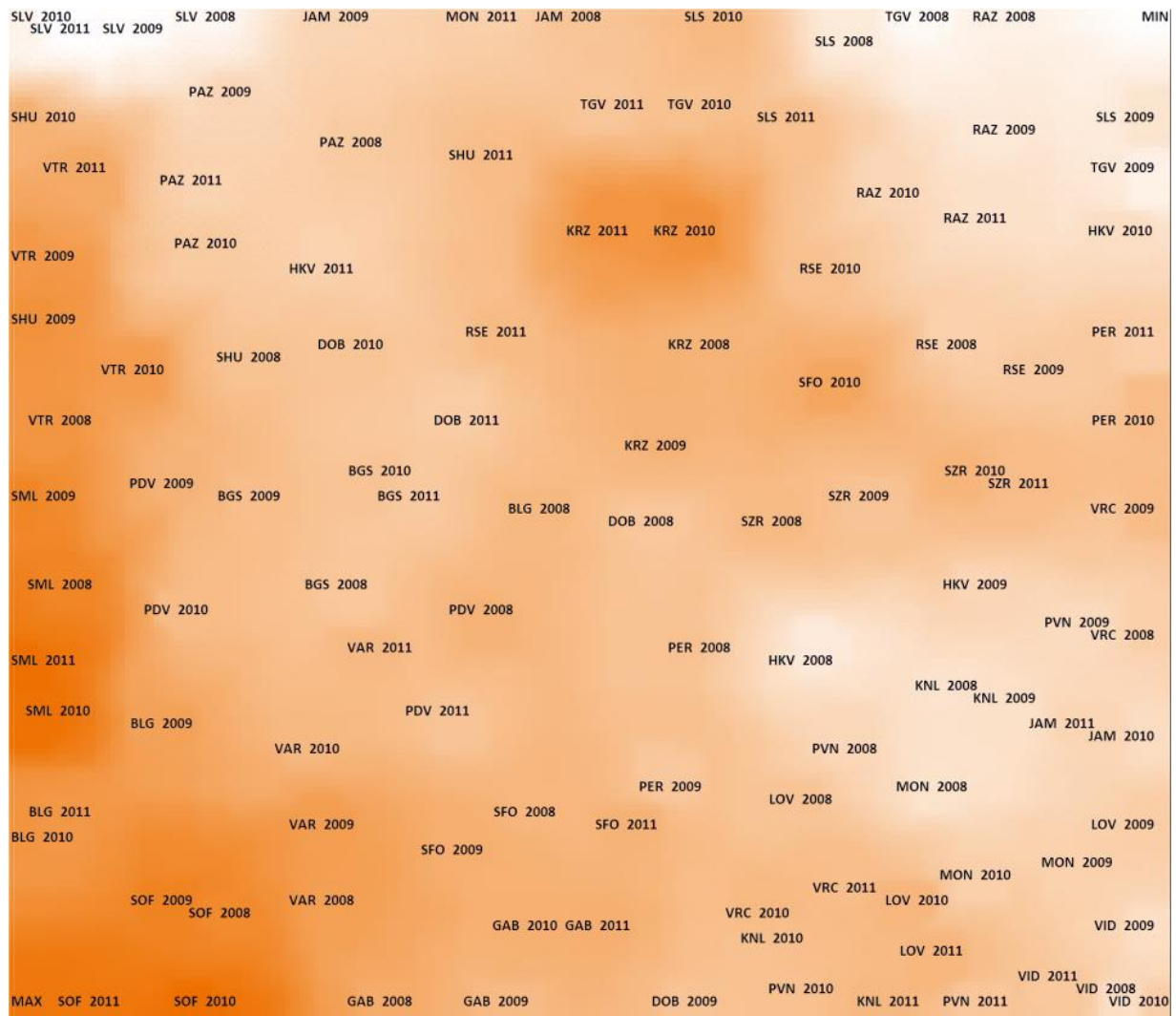
Education

This map shows the state and development of education in the regions during the four-year period. Sofia (capital), Blagoevgrad, Varna and Smolyan have well-developed education systems, as demonstrated by the saturated color of the zones on the map occupied by the regions during the entire period.

The regions with worst-developed education systems are Sliven, Targovishte, Razgrad and Silistra (and, therefore lowest color saturation on the map).

Targovishte region has a positive dynamics of educational development during the period, demonstrated by their transition from low color saturation in 2008 to a much higher saturation in 2010 and 2011.

Healthcare

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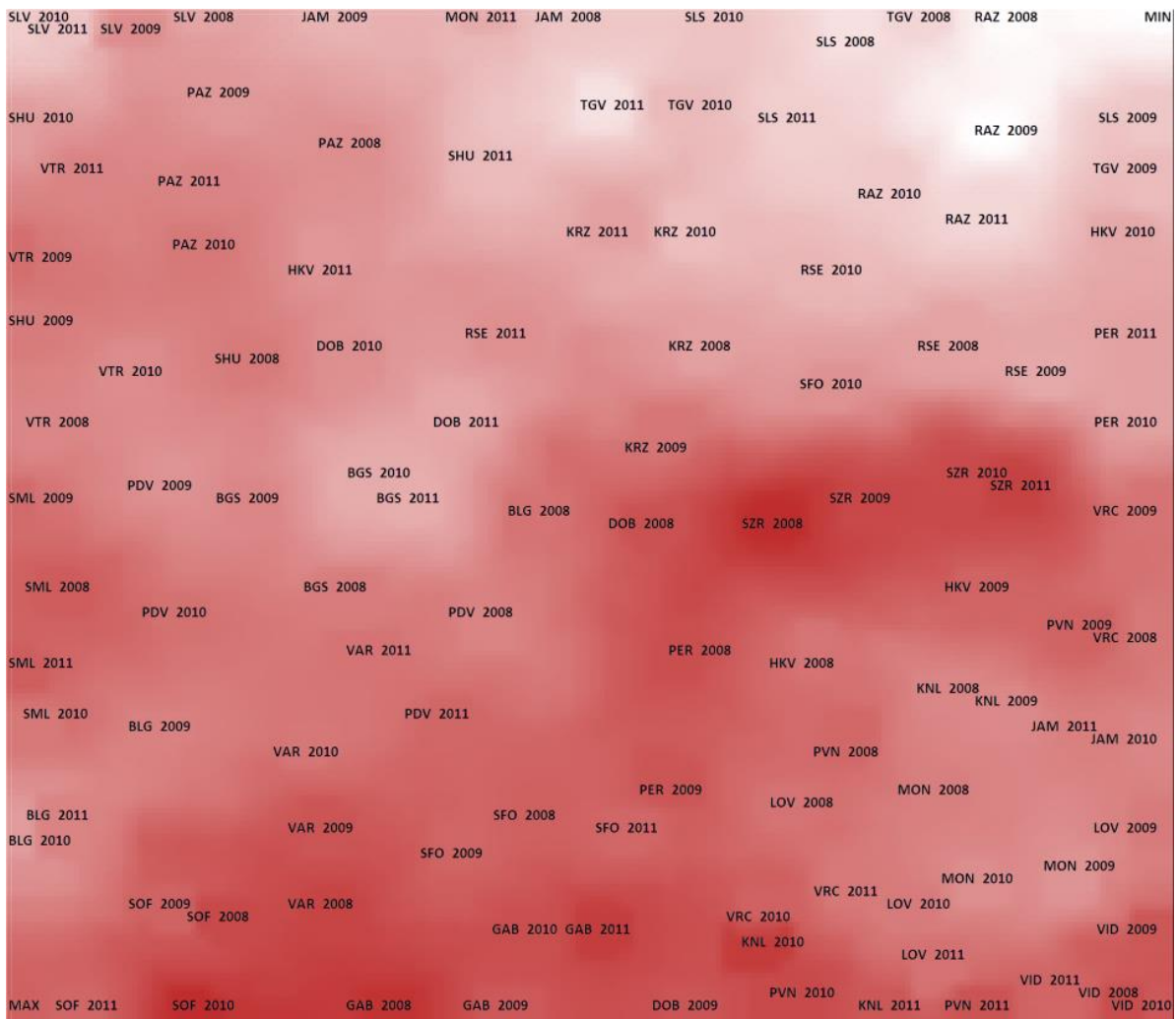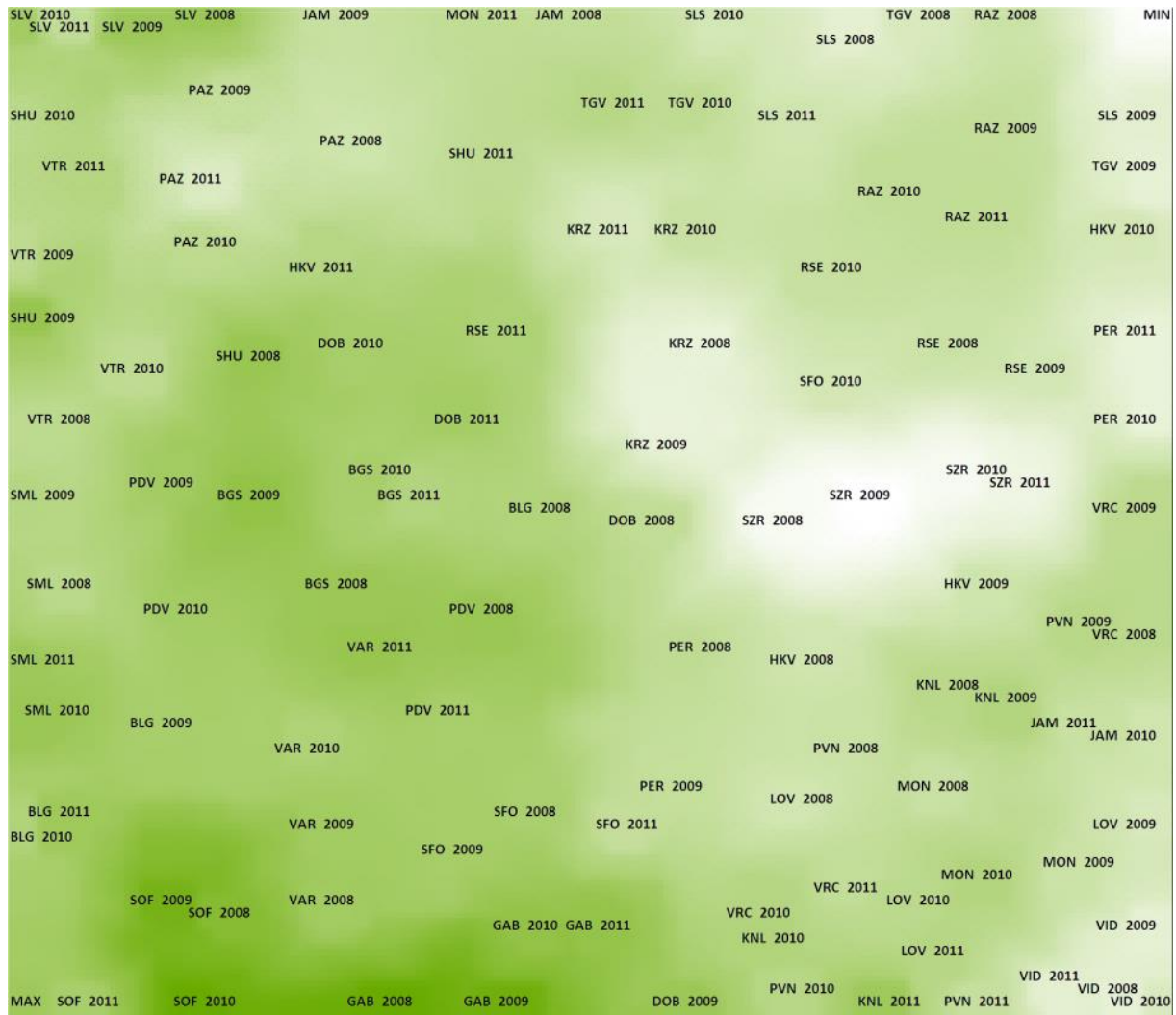
Environment

This map shows the state and development of the environment in the regions during the four-year period.

As can be seen by the low-saturated color on the map, Stara Zagora has the worst state of the environment during the entire period.

Gabrovo and Sofia (capital) have relatively good environmental conditions until 2010, which is demonstrated by the highly-saturated color on the map.

Social environment

This map shows the state and development of the social environment of the regions during the four-year period.

Unlike the other categories (economy, for instance), the social environment indicators have more pronounced dynamics. The color saturation on the map demonstrates negative development trends in the most regions, for example – Blagoevgrad, Sofia (capital), Gabrovo, Ruse, Stara Zagora and so on.

In practice, Smolyan had the best social environment in the country for 2011, what's more the positive trend is present during the entire period.

There are hardly any other districts with positive trends during the four-year period.