PLUREL

Driving forces
and global trends

Module 1

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D1.2.3

Demographic projections for NUTS2 regions in EU countries based on national probabilistic population projection

Samir KC, Vegard Skirbekk and Tapas Mishra

Responsible partner: IIASA; Participant No. 5
Tel: +43 2236 807 378; Email: skirbekk@iiasa.ac.at

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SIXTH FRAMEWORK PROGRAMME

Contents

Abstract

Objectives / Aims

This deliverable represents population projections for EU-27. Population change by age, sex and location is a key driver of environmental and land use change for peri-urban regions in Europe. Such change determines the context for subsequent work packages, such as WP 1.3 Environmental Drivers within Module 1. The changing demographics also affect Modules 3-5 in terms of creating a framework for likely urbanisation and settlement patterns throughout the project. The changing demographic structure determines factors such as economic activity levels, population density and peri-urban development.

Methodology

This report presents results of the projected population of the EU countries at the NUTS2 level for four PLUREL scenarios: A1-hyper-tech, A2-extreme water, B1-peak oil, B2-fragmentation. We utilise data at the national level from a probabilistic population projection of EU27 countries. The initial data at the NUTS2 level comes from Eurostat and the national statistical agencies of France and the UK. For each PLUREL scenario, a likely future trajectory for each of the various demographic components, namely fertility, mortality, international migration and internal migration, are assessed at the national and NUTS2 levels. The likely future demographic trajectories for each PLUREL scenario are then used to find the closest match with the demographic scenarios at the national and NUTS2 levels in the available data. The final projections at the NUTS2 level for the four PLUREL scenarios are prepared by merging the two sets of data, namely the national level probabilistic population projection and the projection at the NUTS2 level, ensuring the internal consistency in terms of age-sex structure at the two levels of aggregation.

Results

Spatial representation of the population changes in the NUTS2 regions for the four PLUREL scenarios are displayed in Figures 1a, 1b, 1c, and 1d. The mapped estimates in the figures are the percentage changes from 2005-2030. Gradual changes in population

(from higher percentage changes 30% - 50% to lower percentage changes <- 30%) are demarked in the map for the four different scenarios. In total we have about 264 regions within each NUTS2 country. From the geodesic estimates under scenario changes we find that approximately 57% of the regions out of 264 would experience positive changes in total population over the period 2005-2030. Changes in scenarios do not target larger changes in total population over the period for all regions, however, some regions (e.g., Flevoland, Border, Midland and Western, Languedoc-Roussillon, Kypros/Kibris, and Lincolnshire) are expected to witness at least a 30% change in total population in the next two decades. Accordingly, population density in these regions is also likely to increase by at least 30% by 2030. However, the most dense region in 2005 (Inner London: 9228.213 approx and Region du Bruxelles: 6211.18) should not witness the highest population and density changes by 2030. For instance, Inner London's population change is likely to be around 18% under Scenario 1 (and 17% under others) in 2030, whereas Region du Bruxelles' population change would be a mere 0.09% around 2030. It can be concluded that decadal changes in population would trigger higher percentage change in population density, however, that is more likely to depend on the spread of urbanisation and available land in these regions. Figures 1.a-1.d show the percentage change in total population during the period 2005-2030 in the NUTS2 regions of the EU27 countries for four different PLUREL scenarios (A1, A2, B1 and B2).

Popular science description

We present probabilistic population projections up to 2050 for the three selected world regions. These new projections use the same long-term assumptions about the future level of fertility, mortality and migration in the individual world regions as defined for the 2001 IIASA world population projections, but they also include the empirically observed trends up to 2006.

One example: If we take a look at the total population size for Austria in 2020 there is an 80% chance that the total population will be between 8.43 and 8.66 millions, while the probability that the population size will be larger than the upper level or smaller than the lower one is only 10% respectively. There is a 40% chance that the total population will be between 8.50 and 8.59 millions, while the probability that the population size will be larger than the upper level or smaller than the lower one is 30% respectively.

There is an 80% chance that the percentage of the population aged 65+ in Austria in 2030 will be within the interval of 24% and 26%, with 25% being the median of the distribution. Moreover, an 80% of all possible old-age dependency ratio levels for Austria in 2030 falls between 39% and 41%. In Austria in the same year the percentage of population aged 80+ will be closely around 7%, those in working age have an 80% chance to be between 61% and 63%, while for the population aged 0-14 the 80% area lies between 12% and 15%.

Classification of results/outputs:

Spatial scale for results: Regional, national, European	European
DPSIR framework: Driver, Pressure, State, Impact, Response	Driver
Land use issues covered: Housing, Traffic, Agriculture, Natural area, Water, Tourism/recreation	Population distribution by region
Scenario sensitivity: Are the products/outputs sensitive to Module 1 scenarios?	The population projections are part of the scenarios in Module 1
Output indicators: Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	Socio-economic & environmental external constraints
Knowledge type: Narrative storylines; Response functions; GIS-based maps; Tables or charts; Handbooks	Narrative storylines; Tables; Charts

How many fact sheets will be derived from this deliverable:	**1**

PLUREL

1. Introduction

Objectives of the deliverable and links to other parts of PLUREL

In keeping with the objectives of PLUREL (which emphasize the importance of developing new strategies and planning and forecasting tools that are essential for developing sustainable rural-urban land use relationships such that ways can be devised to support the urbanisation process in the EU, mitigating its negative impacts), we present population projections for sub-nationals in the EU based on different scenarios of peri-urban land use and demographic states. Population change by age, sex and location is a key driver of environmental and land use change for peri-urban regions in Europe. Such change determines the context for subsequent work packages, partly through the use of the NEMESIS model in Module 1. The changing demographics also act as input to various models and storylines in Modules 3-5 in terms of creating a framework for likely urbanisation and settlement patterns throughout the project. The changing demographic structure determines factors such as economic activity levels, population density and peri-urban development in Europe.

Our purpose is to offer new insights into probable population scenarios which are explicitly guided by the degree of urbanisation. More than mere proportional changes are expected to occur in mortality, fertility and migration behaviour among sub-nationals despite striking similarities in their socio-economic-demographic and environmental characters. Invariably, this would lead to differential patterns in population forecasts in the decades ahead.

Structure of the deliverable

The relevance of population forecasting[1] at national levels has been extensively documented in recent demographic and economic growth literature by eliciting its importance with regard to efficient intergenerational allocation of resources and planning. At sub-national levels, population forecasting is useful in regional planning, thus principally underlining the significance of micro-planning in a macro setting. In Europe, the sub-national projections are carried out by several European national statistical offices (NSO) as well as by Eurostat.[2] Admittedly, performing projections at sub-national levels is challenging and involves far more complexity than at national levels as the volume of data requirements commensurate with the number of regions. Moreover, additional but important difficulties emerge after collecting and preparing data as future assumptions for the trajectories of each of the demographic components at the sub-national level need to be specified. Based on the regional demographic, the

[1] Population forecasting and projections will be used interchangeably throughout the text.
[2] For a detailed discussion refer to Skirbekk et al. (2007).

projections are carried out and the final results are prepared either with the bottom-up or top-down approach. The bottom-up approach requires adding up the sub-national level population projection for recover data at the higher level of aggregation. Similarly, in the top down approach, the projected numbers at the sub-national level are adjusted to match the projection results at the higher order of aggregation (for example at the national level).

When the sub-national population has to be prepared for a large number of countries, it is desirable to have the same methods applied to all of them. In the case of the EU27 countries, we make our assumptions consistent with those of Eurostat's official projections to ensure a comparable methodology and applicability of the results. Also, in the probabilistic projection of the national population (Scherbov and Mamolo 2007), all assumptions regarding the range of values that the future demographic events might follow are made consistent with Eurostat's national projections. In purview of the consistency at the input level, our first choice while preparing the population projection at the NUTS2 level was to use the data from Eurostat as much as possible. However, France and UK were excluded from the Eurostat NUTS2 population projections and we obtained the data from their NSOs.

In the following section (Section 2) we present data and discuss assumptions and method used in preparing the NUTS2 level population projection for the four different PLUREL scenarios: *A1-hyper-tech, A2-extreme water, B1-peak oil, B2-fragmentation* (for details, see Ravetz 2008). The first task was to define the national population scenario closely associated with each of the PLUREL scenarios and link it with the result of the probabilistic population projection (Scherbov and Mamolo 2007). The second task was to define the regional population scenario closely associated with each of the PLUREL scenarios and link it with the different NUTS2 level scenarios of Eurostat. The final task was to combine the population projection data from the national projection with the regional projections. We explain this in detail in the following section. Section 3 presents and discusses the results of the projections. Section 4 concludes with some remarks.

2. Population projections at the NUTS2 level for EU member states

In this section, we present the data architecture and relevant assumptions for performing population projections for the four PLUREL scenarios as mentioned above. A note on the spatial character of the region is in order. The geographical area of the remaining 8 EU countries (out of EU27) is the same as the NUTS2 region for which country-level projection data will be used. The data has been prepared by combining the age and sex structure from Eurostat's NUTS2 projections for 17 EU countries and NUTS2 level projection data from the national statistical offices of the UK and France, and the age-specific (three broad age groups) structure from the probabilistic population projection as reported in Scherbov and Mamolo (2007).

We extracted the national population projection data using the probabilistic population projection method. The results of this projection are presented for the median and for some percentiles (10^{th}, 30^{th}, 50^{th}, 70^{th} and 90^{th}). Note that in traditional population projection methods, the results are usually presented for different variants (such as baseline, high, low and medium in the UN projections) and the user picks one of the variants that closely fits the storyline of a particular scenario. Probabilistic projections, however, present the likelihood of occurrence of a particular value with a given confidence range. The precision of the projection depends on the varying confidence levels which are generally used in wide ranging population forecasting exercises to provide credence to our best belief and likely exceptions. Unlike the straightforward high-low-medium variant scenarios, the results from thousands of simulations are pooled together in probabilistic method and percentiles for specific variables (e.g., population aged 15-64) are reported rather than a specific variant.

Following the probabilistic tradition, we extracted the population for various PLUREL scenarios using the median and percentiles. We analysed each PLUREL scenario in terms of the likely future demographic components at the national level (fertility, mortality, international migration) and at the NUTS2 level (fertility, mortality, international migration and internal migration). A cross table with scenarios in the rows and a demographic component in the columns was prepared. The definition of each PLUREL scenario was analysed and the most probable future scenario of each demographic component was speculated using “medium”, “low” and “high” variants, where “medium” indicates that the trajectory will follow the trend (as does the usual scenario) and “low” and “high” indicate the trajectory lower or higher relative to the “medium” trajectory. Later, all components were put together to come up with an overall population scenario. After this was obtained, we discussed how to decide which percentiles of the result from the probabilistic population projection were to be attached to each of these population scenarios. The results are shown in Table 1.

Table 1: Future Demographic National Level Scenario for Four PLUREL Scenarios

PLUREL scenario	Fertility	Life expectancy	International migration	Population scenario	Percentile PPP*
A1-hyper-tech	Medium	High	Medium	Medium-high	70^{th}
A2-extreme water	Medium	Medium	Medium	Medium	50^{th}
B1-peak oil	Low	Low	Low	Low	30^{th}
B2-fragmentation	Medium	Medium	Medium	Medium	50^{th}

*Percentile of probabilistic population projection in terms of overall population size

Notice (from Table 1) that at the national level, there are three population scenarios: Low (B1-peak oil), medium (A2-extreme water and B2-fragmentation) and medium-high (A1-hyper-tech). At the NUTS2 level there are two scenarios: High (A1-hyper-tech and B2-fragmentation) and low (A2-extreme water and B1-peak oil). Each PLUREL scenario is unique at the NUTS2 level with a combination of national and regional scenarios resulting in different age-sex structures.

It is known that an important aspect of the NUTS2 projections is its main assumptions about future demographic variants that consider how differences in regions converge to the national pattern. These assumptions are shown in Table 2. The four PLUREL scenarios reflect some common patterns with respect to convergence. For instance, while scenarios A1 and B2 indicate convergence with respect to fertility, mortality and international migration at the regional levels, they remain unchanged for scenarios A2 and B1. It is interesting to note that convergence occurs at the national level with low urbanisation in the high regional population scenario. It appears that the high regional population scenario results in 'demand push' to induce high innovation that occurs with respect to the hyper-tech (A1) and fragmentation (B2) scenarios. This ultimately gives rise to the convergence of regional differences in fertility and mortality. Convergence with respect to international migration occurs due to 'equal rise in the demand for high-end personals' across borders such that sub-national knowledge spillovers offshoot the demand in each region.

Table 2: Future Demographic NUTS2 Level Scenario for Four PLUREL Scenarios

PLUREL scenario	Regional fertility	Regional mortality	Regional international migration	Internal migration	National scenario	Regional population scenario
A1-hyper-tech	Convergence	Convergence	Convergence	Low urbanisation	Medium-high	High
A2-extreme water	No change	No change	No change	High urbanisation	Medium	Low
B1-peak oil	No change	No change	No change	High urbanisation	Low	Low
B2-fragmentation	Convergence	Convergence	Convergence	Low urbanisation	Medium	High

2.1 Preparing the national data

The national level probabilistic population projection is available for three broad age groups (0-14, 15-64 and 65+) and is not disaggregated by sex. The disaggregation was performed by taking the age-sex structure of Eurostat's national population projection (variant method) for each of the broad age groups. The Eurostat national population projection is available for three scenarios (high, medium and low). In the probabilistic projection, the 80% uncertainty interval for fertility, mortality and migration was taken from Eurostat's low and high variant. We can say that the 90th and 10th percentile corresponds to Eurostat's low and high as extreme cases. Since PLUREL's national population scenarios (low and medium-high) (see Table 1) are the 30th and 70th percentiles in the probabilistic projection, the age-sex structure for these two national population scenarios was derived by averaging Eurostat's low and medium variants, and medium and high variants, respectively. The age-sex structure was then adjusted proportionally to the total population in each age group. As per consultation with the user (NEMESIS), the data for national scenarios were prepared for males and females separately in the age groups 0-14, 15-24, 25-64 and 65+. The data was prepared for 27 EU countries from 2005 to 2050 in five year intervals.

2.2 Preparing the NUTS2 data

The age (single age) and sex structure for the three NUTS2 scenarios (baseline, low and high) for 17 EU countries were obtained from Eurostat. For each PLUREL scenario, the corresponding age-sex structure of the population at the NUTS2 level was proportionally adjusted to the age-sex distribution of the corresponding national scenario (data prepared in earlier section). This process ensures consistency at the two levels of geographical aggregation and takes into account the national level scenario as the main scenario determining the population size and the NUTS2 level scenario as the sub-scenario determining the proportional age-sex distribution. The data is thus available for 17 EU countries.

The data for France and the UK were not available from Eurostat. We collected data for the UK from four different statistical offices for each of the territories: England, Wales, Scotland and Northern Ireland. For France, we purchased data from INSEE (National Institute for Statistics and Economics Studies, www.insee.fr). The NUTS2 projection from the five sources (four for the UK and one from France) are mostly for a single baseline scenario, hence, for these countries, the NUTS2 level data is for a single scenario. The consequence is that the age-sex (there is no sex disaggregation for France) proportional distribution for these countries at the NUTS2 level is the same for all four PLUREL scenarios. The data for the NUTS2 level are presented in single year age groups for males and females separately for the period 2005-2030 in five year intervals.

3. Results and discussion

In this section we discuss the results of likely population change with respect to the defined four scenarios. Both spatial and non-spatial characters of the results are presented. An idea of the overall trend of the NUTS2 countries are studied first which are presented in Tables 4-7. Geographical distribution of population change under the scenarios is presented next.

3.1 Cross-sectional results

At the national level, the results of the projection for the four national scenarios were prepared in an excel file by four broad age groups for males and females separately for all 27 EU countries for the period 2005-2050 in five year intervals. An example for Austria is presented in Table 3. At the NUTS2 level, the results of the projection for the four national scenarios are presented in an excel file by single age (0, 1, 2, ..., 80+) for males and females separately for 17 EU countries. An example of a region in Austria is presented in Table 4.

While some specific characteristics of the projected population can be gauged by looking at the overall movement of projected estimates from 2005-2050 for the 27 EU countries, the estimates for Austria in Table 3 might render an overall likely scenario for others. For illustration, the age groups have been divided into young (0-14), working age 1 (low labour force participation, 15-24), working age 2 (high labour force participation, 25-64), and retired age (65+). Table 3 shows that the young age population will steadily decline after 2020-2025. This is consistent with the four scenarios. Despite a decline from 2005 to 2010 for the 0-14 age groups in all scenarios, the low productivity and high productivity working age population (15-24 and 25-64, respectively) appear to have increased in numbers during that time, but in the coming decades their numbers appear to fall on average. Expectedly, the age group 65+ will experience a steady increase until 2050. This is true for all scenarios.

Interesting intuitions emerge from the above. First, the general upward trend for the retired population through the decades implies that changes in urbanisation scenarios would not alter the natural progression rate from working age to retired. The crucial demographic states so contingent upon environmental and social factors would be less affected than the younger and working age population. Degrees of urbanisation and the extreme environmental states would certainly affect the productivity of the working class and the health status of the young age population. Hence, conducive demographic-environmental and social changes would keep the demographic growth momentum constant. Exceptions, as evinced through different scenarios, are thus expected to change the population pattern in the future, which is evident from the decadal changes (in most cases decline) in the numbers within the age components. Similar conclusions can be drawn from other NUTS2 countries, e.g., France, UK and Poland (Tables 5, 6, and 7).

Note that the data for France was available in five year age groups for both sexes together, hence, the data is presented accordingly in an excel file at the NUTS2 level. Table 5 gives an example of a single region in France. Data for the UK was available in five year age groups (0-4, 5-9, ..., 80+) for males and females separately and is reported accordingly in an excel file. Table 6 gives an example for a region in the UK.

Table 3: Data for Austria (in thousands)

PLUREL			Year									
Scenario	Age group	sex	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
A1-hyper-tech	0-14	m	638	612	579	585	584	586	543	536	532	522
	15-24	m	490	500	493	457	443	442	450	447	430	413
	25-64	m	2270	2301	2349	2374	2340	2220	2116	2034	1985	1947
	65+	m	789	884	929	977	1064	1201	1334	1412	1449	1462
	0-14	f	672	643	610	618	618	622	577	570	566	555
	15-24	f	507	517	507	471	460	462	473	471	454	437
	25-64	f	2258	2290	2339	2367	2337	2223	2130	2069	2032	2006
	65+	f	516	623	684	741	825	955	1078	1141	1171	1189
A2-extreme water	0-14	m	638	612	578	582	584	542	535	499	488	481
	15-24	m	490	498	489	450	426	422	418	415	400	380
	25-64	m	2270	2300	2347	2366	2317	2235	2113	2049	2004	1939
	65+	m	789	883	926	971	1064	1198	1314	1378	1396	1418
	0-14	f	672	642	608	614	618	576	568	531	520	512
	15-24	f	507	515	503	464	442	440	439	438	422	402
	25-64	f	2258	2289	2336	2357	2312	2235	2122	2078	2046	1993
	65+	f	516	622	683	737	826	952	1062	1112	1124	1146
B1-peak oil	0-14	m	638	612	576	579	544	536	501	489	445	436
	15-24	m	490	495	485	445	419	401	396	384	375	355
	25-64	m	2270	2302	2342	2358	2330	2226	2131	2030	2016	1939
	65+	m	789	883	923	967	1066	1184	1287	1350	1343	1359
	0-14	f	672	642	606	611	575	569	532	520	473	463
	15-24	f	507	513	499	459	435	419	416	405	397	375
	25-64	f	2258	2291	2329	2348	2323	2223	2137	2055	2053	1989
	65+	f	516	622	681	733	827	941	1039	1087	1078	1093
B2-fragmentation	0-14	m	638	612	578	582	584	542	535	499	488	481
	15-24	m	490	498	489	450	426	422	418	415	400	380
	25-64	m	2270	2300	2347	2366	2317	2235	2113	2049	2004	1939
	65+	m	789	883	926	971	1064	1198	1314	1378	1396	1418
	0-14	f	672	642	608	614	618	576	568	531	520	512
	15-24	f	507	515	503	464	442	440	439	438	422	402
	25-64	f	2258	2289	2336	2357	2312	2235	2122	2078	2046	1993
	65+	f	516	622	683	737	826	952	1062	1112	1124	1146

Table 4: Data for a NUTS2 region in Austria: A11 (Burgenland) (in thousands)

PLUREL scenario	Age Group	Sex	Year 2005	2010	2015	2020	2025	2030
A1-hyper-tech	0	m	1062	1026	968	959	926	901
	1	m	1038	1063	1002	996	966	942
	...	...	...	...	...	...	...	...
	79	m	1174	1275	1197	1791	964	1750
	80+	m	5704	7158	8103	9147	10186	11368
	0	f	1108	1068	1013	1007	977	955
	1	f	1214	1108	1050	1047	1020	999
	...	...	...	...	...	...	...	...
	79	f	937	913	951	1316	750	1286
	80+	f	6109	8000	8734	9328	10062	11194
A2-extreme water	0	m	1062	967	906	909	901	820
	1	m	1038	1012	943	946	938	856
	...	...	...	...	...	...	...	...
	79	m	1174	1271	1188	1763	953	1722
	80+	m	5704	7100	7945	8837	9776	10754
	0	f	1108	1005	944	951	949	867
	1	f	1214	1054	985	991	989	905
	...	...	...	...	...	...	...	...
	79	f	937	912	950	1308	749	1282
	80+	f	6109	7943	8587	9061	9744	10713
B1-peak oil	0	m	1062	967	903	905	839	810
	1	m	1038	1012	941	942	873	846
	...	...	...	...	...	...	...	...
	79	m	1174	1270	1183	1754	954	1702
	80+	m	5704	7099	7915	8793	9795	10630
	0	f	1108	1005	941	947	882	857
	1	f	1214	1054	981	986	919	894
	...	...	...	...	...	...	...	...
	79	f	937	912	947	1303	751	1267
	80+	f	6109	7945	8560	9021	9762	10586
B2-fragmentation	0	m	1062	1025	966	954	927	835
	1	m	1038	1062	1000	990	967	872
	...	m	...	...	...	...	...	...
	79	m	1174	1274	1194	1780	965	1745
	80+	m	5704	7149	8081	9091	10190	11335
	0	f	1108	1066	1010	1000	977	884
	1	f	1214	1107	1047	1040	1020	924
	...	...	...	...	...	...	...	...
	79	f	937	912	949	1309	751	1283
	80+	f	6109	7992	8717	9278	10073	11165

Table 5: Data for a NUTS2 region in France: F10 (Île de France)

PLUREL scenario	Age Group	Year					
		2005	2010	2015	2020	2025	2030
A1-hyper-tech	0-4	814096	799492	791870	783738	784151	795860
	5-9	716164	750894	750637	743609	735896	736389
	...	...	...	...	...	...	...
	90-94	65532	49951	91198	99288	109005	112118
	95+	22106	26158	21627	35151	40937	45515
A2-extreme water	0-4	814096	798849	791233	783108	783520	795221
	5-9	716164	750291	750034	743011	735305	735797
	...	...	...	...	...	...	...
	90-94	65532	49911	91124	99208	108917	112028
	95+	22106	26137	21610	35122	40904	45478
B1-peak oil	0-4	814096	798335	790724	782604	783016	794709
	5-9	716164	749808	749551	742533	734832	735323
	...	...	...	...	...	...	...
	90-94	65532	49879	91066	99144	108847	111956
	95+	22106	26121	21596	35100	40877	45449
B2-fragmentation	0-4	814096	798849	791233	783108	783520	795221
	5-9	716164	750291	750034	743011	735305	735797
	...	...	...	...	...	...	...
	90-94	65532	49911	91124	99208	108917	112028
	95+	22106	26137	21610	35122	40904	45478

Table 6: Data for a NUTS2 region in the UK: UKC1 (Tees Valley and Durham)

PLUREL scenario	Age Group	Sex	Year					
			2005	2010	2015	2020	2025	2030
A1-hyper-tech	0-4	f	30	31	31	30	30	29
	5-9	f	37	33	31	32	31	32
	...	...	...	...	...	...	...	...
	80-84	f	17	13	14	16	17	21
	85+	f	14	13	14	16	19	21
	0-4	m	32	29	29	29	28	27
	5-9	m	39	32	30	30	30	30
	...	...	...	...	...	...	...	...
	80-84	m	11	15	17	20	22	27
	85+	m	6	10	12	16	19	22
A2-extreme water	0-4	f	30	31	30	30	30	29
	5-9	f	37	33	31	31	31	32
	...	...	...	...	...	...	...	...
	80-84	f	17	13	14	16	17	21
	85+	f	14	13	14	16	19	21
	0-4	m	32	29	29	28	28	27
	5-9	m	39	32	30	30	30	30
	...	...	...	...	...	...	...	...
	80-84	m	11	15	17	20	22	27
	85+	m	6	10	12	16	19	22
B1-peak oil	0-4	f	30	31	30	30	30	29
	5-9	f	37	33	31	31	31	32
	...	...	...	...	...	...	...	...
	80-84	f	17	13	14	16	17	21
	85+	f	14	13	14	16	19	21
	0-4	m	32	29	29	28	28	27
	5-9	m	39	32	30	30	30	30
	...	...	...	...	...	...	...	...
	80-84	m	11	15	17	20	22	27
	85+	m	6	10	12	16	19	22
B2-fragmentation	0-4	f	30	31	30	30	30	29
	5-9	f	37	33	31	31	31	32
	...	...	...	...	...	...	...	...
	80-84	f	17	13	14	16	17	21
	85+	f	14	13	14	16	19	21
	0-4	m	32	29	29	28	28	27
	5-9	m	39	32	30	30	30	30
	...	...	...	...	...	...	...	...
	80-84	m	11	15	17	20	22	27
	85+	m	6	10	12	16	19	22

PLUREL

Table 7: Data for NUTS2 regions in Poland: PL12 (Mazowieckie), PL22 (Slaskie), PL32 (Podkarpackie)

Scenario A1-hyper-tech			Years					
age	***sex***	***geo***	***2005***	***2010***	***2015***	***2020***	***2025***	***2030***
0-19	m	PL12	595104	538021	523173	510457	511492	490608
20-64	m	PL12	1618606	1693963	1707159	1657542	1577353	1548965
65+	m	PL12	462407	472540	484661	552919	626503	662874
0-19	f	PL12	595198	542442	531891	522444	525961	504677
20-64	f	PL12	1585645	1664265	1688716	1658592	1597528	1579233
65+	f	PL12	280220	293256	319702	384454	451721	485893
0-19	m	PL22	531685	451119	413788	382280	368281	350500
20-64	m	PL22	1530655	1512115	1415221	1283478	1195129	1163265
65+	m	PL22	380870	431362	445903	501458	554605	581160
0-19	f	PL22	532078	455791	424456	395734	380797	360288
20-64	f	PL22	1486180	1479471	1408477	1298071	1216129	1186774
65+	f	PL22	226034	251420	275912	335154	394980	427344
0-19	m	PL32	287228	246906	223214	204275	200981	199364
20-64	m	PL32	640477	651015	617283	570136	549321	550960
65+	m	PL32	169244	178290	181632	201633	224188	242860
0-19	f	PL32	288118	249961	229301	212632	208986	205595
20-64	f	PL32	603727	617339	596389	562720	547419	552291
65+	f	PL32	99584	105261	112994	132241	153584	169332
Scenario A2-extreme water								
0-19	m	PL12	595104	538017	523439	512927	475763	458407
20-64	m	PL12	1618606	1697707	1714326	1662051	1619247	1597413
65+	m	PL12	462407	472319	484053	558060	633784	656423
0-19	f	PL12	595198	541690	530687	523073	487615	470676
20-64	f	PL12	1585645	1665628	1690290	1654612	1632182	1627190
65+	f	PL12	280220	293068	319004	386829	453748	475649
0-19	m	PL22	531685	450242	409708	371945	317574	285272
20-64	m	PL22	1530655	1493288	1365455	1176537	1037139	926442
65+	m	PL22	380870	430621	442671	497959	541333	538952
0-19	f	PL22	532078	455359	421418	387459	332629	298591
20-64	f	PL22	1486180	1463520	1367203	1212461	1099146	1016127
65+	f	PL22	226034	250804	273569	332334	385541	398531
0-19	m	PL32	287228	246754	221380	198952	172479	159329
20-64	m	PL32	640477	638895	585893	503882	445333	396335
65+	m	PL32	169244	178134	180644	200503	218214	222633
0-19	f	PL32	288118	250314	228595	209420	183121	168878
20-64	f	PL32	603727	607578	571470	511407	470238	437539
65+	f	PL32	99584	105060	112137	131148	149556	156845
Scenario B1-peak oil								

0-19	m	PL12	595104	545734	501060	488894	453789	454041
20-64	m	PL12	1618606	1705462	1724713	1668197	1621221	1596951
65+	m	PL12	462407	446809	487097	560184	641593	649491
0-19	f	PL12	595198	549436	506497	497047	463507	465058
20-64	f	PL12	1585645	1672051	1697847	1656391	1628208	1620127
65+	f	PL12	280220	277119	320621	387296	457249	467318
0-19	m	PL22	531685	456591	392611	355107	303481	282651
20-64	m	PL22	1530655	1500111	1373730	1180891	1038404	926173
65+	m	PL22	380870	407362	445452	499856	547997	533260
0-19	f	PL22	532078	461768	402585	368762	316777	295113
20-64	f	PL22	1486180	1469168	1373310	1213765	1096465	1011716
65+	f	PL22	226034	237156	274952	332734	388516	391553
0-19	m	PL32	287228	250214	212325	189959	164734	157835
20-64	m	PL32	640477	641811	589440	505745	445876	396224
65+	m	PL32	169244	168511	181778	201265	220902	220282
0-19	f	PL32	288118	253812	218542	199314	174317	166893
20-64	f	PL32	603727	609923	574021	511958	469093	435640
65+	f	PL32	99584	99345	112708	131307	150709	154099
Scenario B2-fragmentation								
0-19	m	PL12	595104	537409	521167	510036	486018	471506
20-64	m	PL12	1618606	1691944	1700415	1638224	1584810	1569568
65+	m	PL12	462407	471955	482752	554596	626527	644532
0-19	f	PL12	595198	541565	529284	521348	498227	483744
20-64	f	PL12	1585645	1661151	1679122	1634666	1601564	1598546
65+	f	PL12	280220	292833	318200	384807	449578	468896
0-19	m	PL22	531685	450605	412205	381869	350439	337229
20-64	m	PL22	1530655	1510308	1409628	1268519	1200781	1178737
65+	m	PL22	380870	430828	444147	502980	554626	565080
0-19	f	PL22	532078	455057	422369	394800	361276	345792
20-64	f	PL22	1486180	1476702	1400471	1279346	1219202	1201285
65+	f	PL22	226034	251053	274618	335457	393107	412395
0-19	m	PL32	287228	246627	222354	204048	191122	191619
20-64	m	PL32	640477	650237	614839	563488	551921	558287
65+	m	PL32	169244	178068	180916	202246	224197	236140
0-19	f	PL32	288118	249559	228170	212121	198181	197150
20-64	f	PL32	603727	616184	592996	554603	548801	559052
65+	f	PL32	99584	105111	112465	132364	152856	163407

3.2. Spatial analysis

Spatial representation of the population changes in the NUTS2 regions for the four PLUREL scenarios are displayed in Figures 1a, 1b, 1c, and 1d. The mapped estimates in the figures are the percentage changes from 2005-2030. Gradual changes in population (from higher percentage changes 30% - 50% to lower percentage changes <- 30%) are demarked in the map for the four different scenarios. In total we have about 264 regions within each NUTS2 country. From the geodesic estimates under scenario changes we find that approximately 57% of the regions out of 264 would experience positive changes in total population over the period 2005-2030. Changes in scenarios do not target larger changes in total population over the period for all regions, however, some regions (e.g., Flevoland, Border, Midland and Western, Languedoc-Roussillon, Kypros/Kibris, and Lincolnshire) are expected to witness at least a 30% change in total population in the next two decades. Accordingly, population density in these regions is also likely to increase by at least 30% by 2030. However, the most dense region in 2005 (Inner London: 9228.213 approx and Region du Bruxelles: 6211.18) should not witness the highest population and density changes by 2030. For instance, Inner London's population change is likely to be around 18% under Scenario 1 (and 17% under others) in 2030, whereas Region du Bruxelles' population change would be a mere 0.09% around 2030. It can be concluded that decadal changes in population would trigger higher percentage change in population density, however, that is more likely to depend on the spread of urbanisation and available land in these regions. Figures 1.a-1.d show the percentage change in total population during the period 2005-2030 in the NUTS2 regions of the EU27 countries for four different PLUREL scenarios (A1, A2, B1 and B2).

Figure 1.a: Population change for the NUTS2 regions using PLUREL Scenario 1

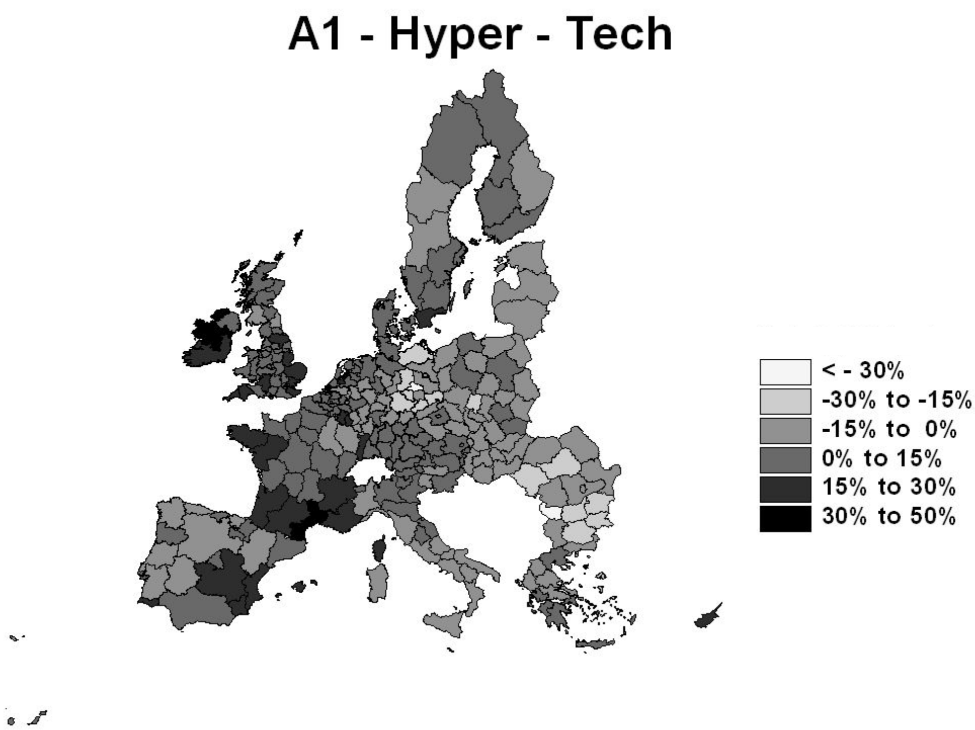


Figure 1.b: Population change for the NUTS2 regions using PLUREL Scenario 2

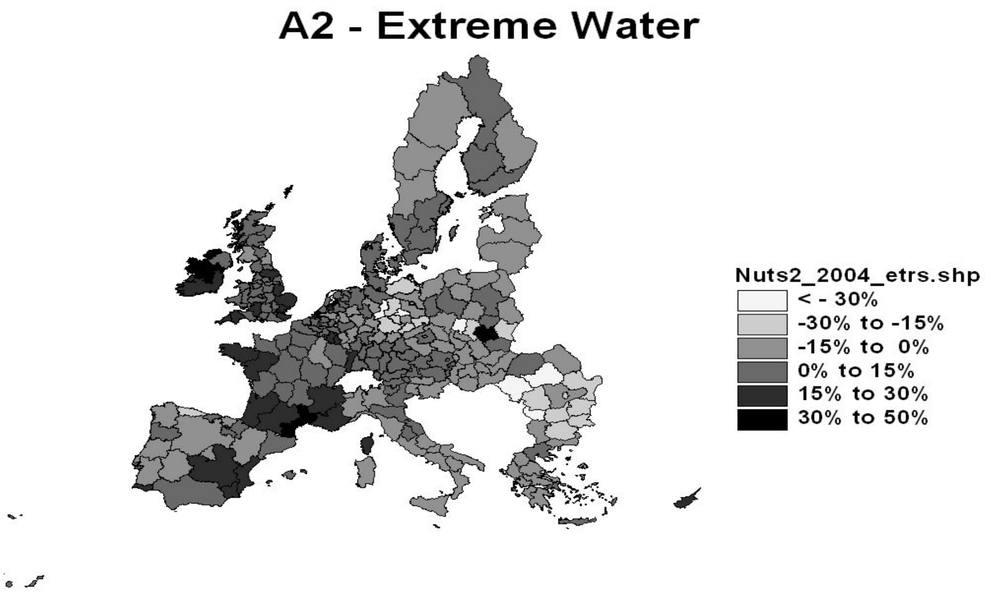


Figure 1.c: Population change for the NUTS2 regions using PLUREL Scenario 3

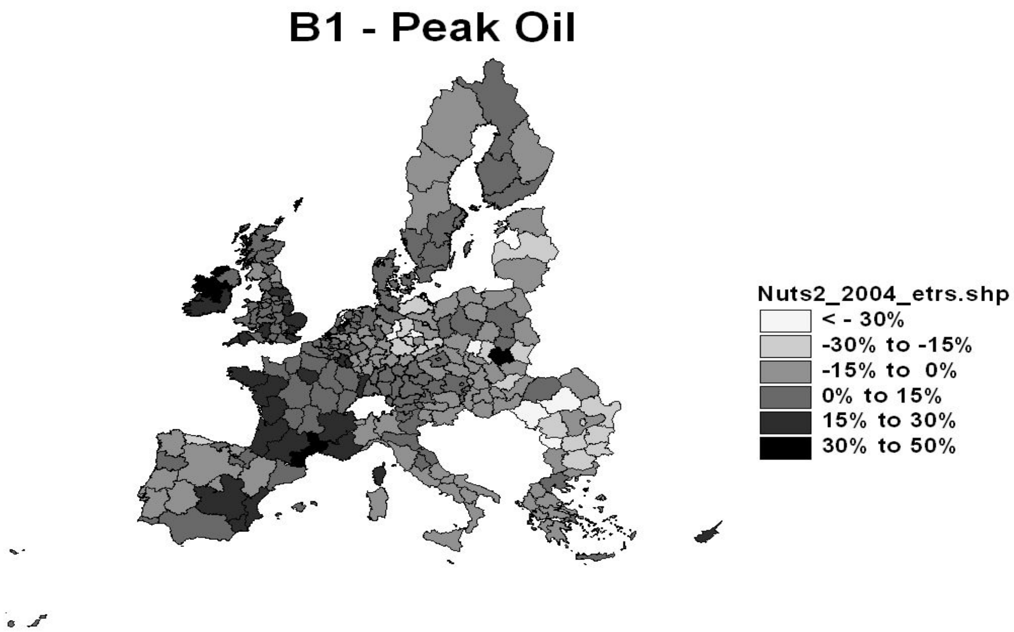
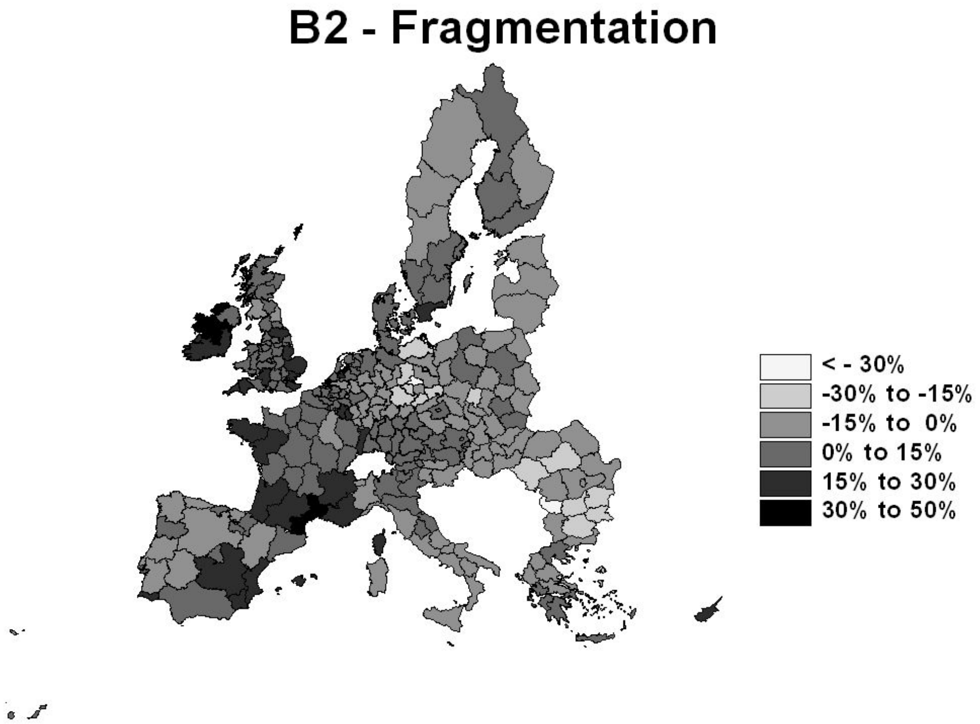


Figure 1.d: Population change for the NUTS2 regions using PLUREL Scenario 4



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Partners

Partici-pant no.	Participant organisation	Role in the consortium	Contact persons	Country
5	IIASA, International Institute for Applied Systems Analysis	M1: Demographic projections	Vegard Skirbekk	AT