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Patterns of Mortality Improvement over Age and Time for 201 Countries or Areas

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Abstract

Mortality improvement map is a useful tool for monitoring mortality dynamics over age and time. Mortality improvement maps have been estimated for 201 countries providing deeper yet concise insights into the global mortality dynamics.

Introduction

Temporal mortality dynamics is usually analyzed by exploring trends in mortality indicators such as life expectancy at birth or age-specific death rates. Deeper yet succinct insights into mortality dynamics could be gained by exploring surfaces of mortality improvement over age and time. Mortality improvement surfaces could be thought as a part of exploratory data analysis aiming at concise presentation of trends in age-specific death rates. The tool is gaining more importance now as more and more data becomes available while time and

resources for the analysis remains limited. Mortality improvement surfaces are also helpful for data quality assessment as data problems could produce unusual trends in death rates at specific ages or in the specific time periods. Or, another way around, any unusual trends picked up by this visualization tool need to be further explored and explained excluding date quality problems as a possible culprit. Finally, mortality improvement surfaces are useful as a first building block for developing models aimed at explaining and forecasting trends in mortality.

Estimation

Given force of mortality at age *x* and time *t*

$$\mu(x,t)$$

rate of mortality improvement is defined as -log derivative in time direction

$$r(x,t) = -\frac{d}{dt} ln\, \mu(x,t)$$

As mortality was largely declining over last decades, the positive rates of mortality improvement correspond to declining mortality trends.

Mortality estimates are commonly available for single ages and calendar years as a matrix of death rates

$$m_{xt}$$

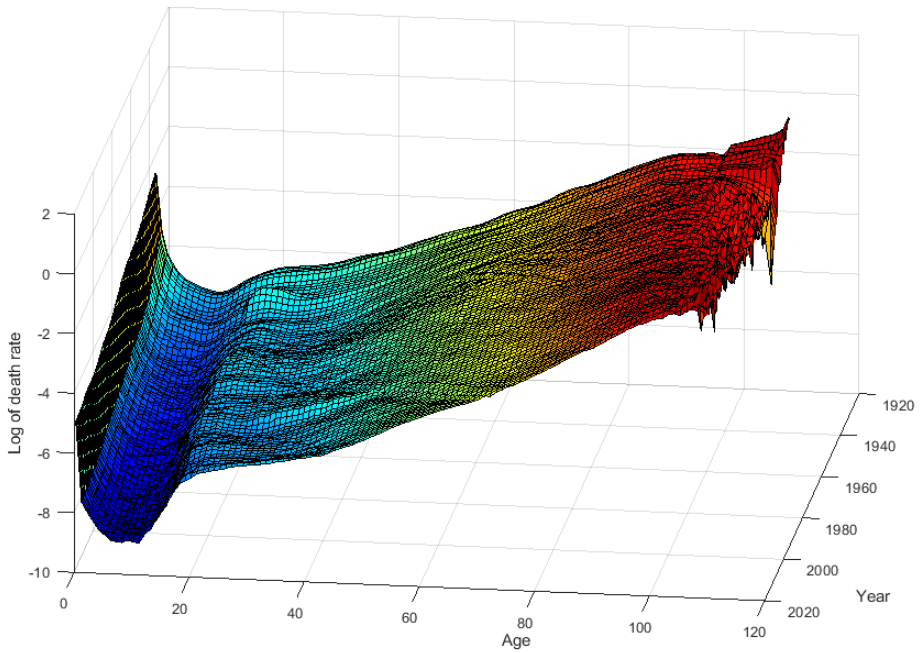
In this case, direct estimate of mortality improvement surface can be computed as a matrix of

$$r_{xt} = -ln \frac{m_{x,t+1}}{m_{x,t}} \quad (1)$$

Figure 1 shows an example of three-dimensional surfaces of log death rates, m_{xt} and the corresponding direct estimate of mortality improvement surface, r_{xt} for United States, males, years 1933-2019. The same information could be also presented with Lexis maps as in many cases Lexis maps provide more informative display (Fig. 2). As it seen from both figures, the direct estimate r_{xt} is quite noisy with only a few features barely discernable.

Figure 1. Three-dimensional surfaces of log death rates and direct estimates of mortality improvement for United States, Males, years 1933-2018

a) Log death rates, m_{xt}



b) Direct estimates of mortality improvement rates, r_{xt}

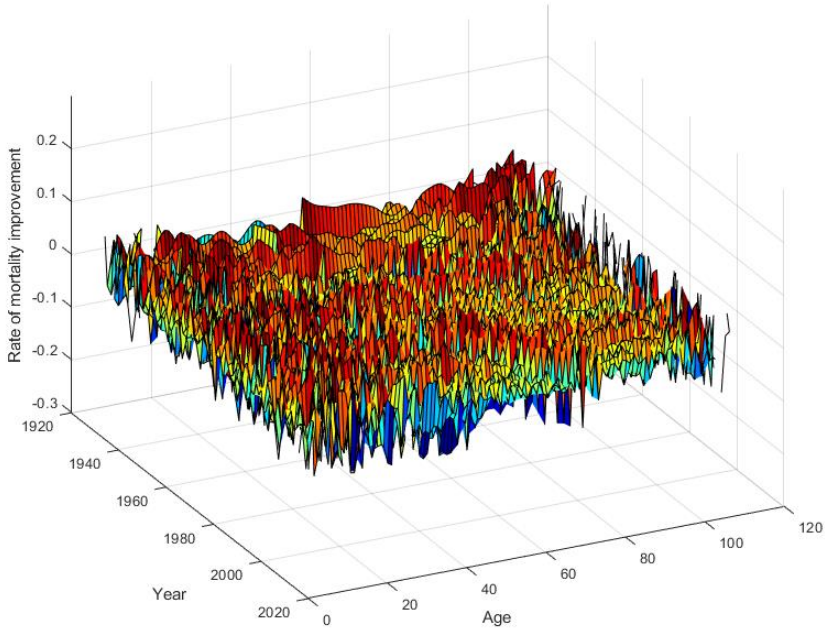
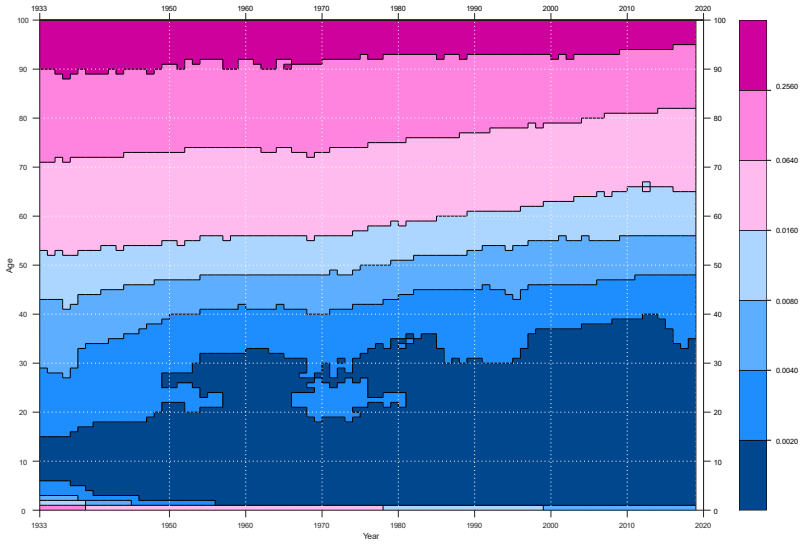
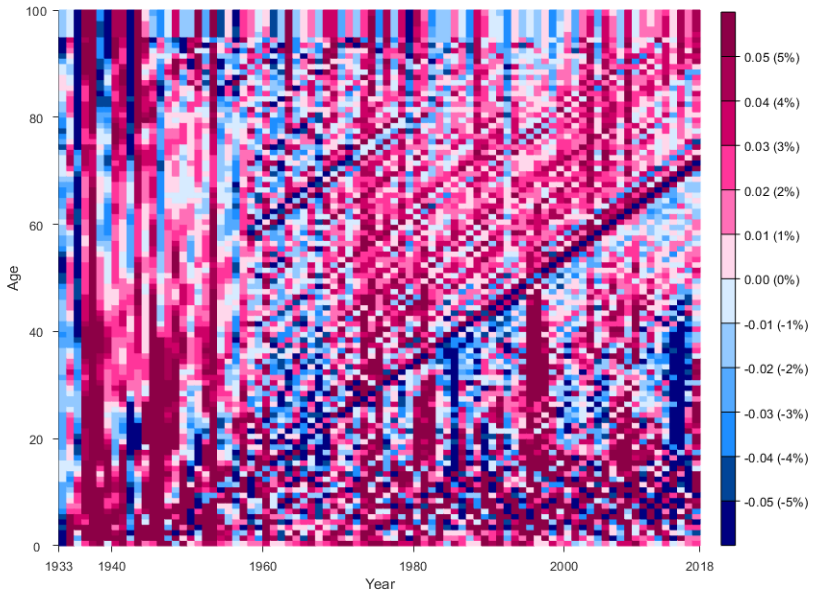


Figure 2. Lexis maps of death rates and direct estimates of mortality improvement for United States, Males, years 1933-2018

a) Death rates, m_{xt}



b) Direct estimates of mortality improvement rates, r_{xt}



With lack of theoretical background for dynamics of mortality over time, smoothing is a preferable way of obtaining further insights into the trends of death rates over age and time. By "smoothing" it is commonly understood a wide battery of methods that do not assume any "rigid" parametric form (Hastie and Tibshirani, 1990). We need to note that boundaries between parametric and nonparametric methods, and "rigid" and "not rigid" models, are somewhat blurred. Splines, for example, are commonly cited to be nonparametric methods due to flexible shapes they could take. Each spline, however, can be represented as a combination of b-splines, and coefficients of b-splines could be estimated as ordinary parameters making a spline a parametric function.

Mortality improvement surface, r_{xt}, could be estimated either by smoothing death rates, m_{xt}, first, and then by applying Eq. (1) to compute r_{xt} directly from m_{xt}, or, first, by computing direct estimate of r_{xt} from the unsmoothed matrix of m_{xt}, and then by applying a smoothing procedure to r_{xt}. In the simplest case, a smoothing procedure could be applied to trend of death rates at each age, that is treating death rates at each age as independent time series. Any procedure developed for smoothing univariate time series or scatter plots could be used for this purpose. Common choice includes moving average (possibly with several iterative applications of the same procedure), kernel smoothing (a moving average with custom weights), LOESS smoother (Cleveland, 1979), smoothing splines (Hastie and Tibshirani, 1990; McNeil et al., 1993; Dierckx, 1993; De Boor, 2001), or p-splines (Eilers and Marx, 1996; Camarda, 2012), among others. As Poisson regression is frequently used to analyze series of death rates, provided that both series of deaths and corresponding population exposures are readily available, it could be also applied locally in a way similar to LOESS smoother thus accounting for variably in death rates based in different number of deaths in the numerator of the rate. Poisson regression approach, for example, was used by Andreev (1999) for estimating surface of mortality improvement (progress) for Denmark—the first mortality improvement surface ever estimated in demographic research[1].

Univariate smoothing methods could be further extended to handle two-dimensional data. In this case we assume that data at neighboring ages provide useful information for estimating rates of mortality improvement along with the data at neighboring years. Existing techniques include bivariate kernel smoothers with various kernels (Hastie and Tibshirani, 1990), tensor

[1] To the best knowledge of the author

product splines (De Boor, 2001), or extensions of p-spline into two dimensions (Eilers and Marx, 1996; Camarda, 2012). LOESS and Poisson local regression techniques could be also easily adapted for two dimensions as well.

Several smoothing techniques have been tested on the data for the United States by Andreev (2018). A few useful conclusions from this exercise as follows. First, the results appeared to be similar among the smoothing techniques provided that their degrees of smoothing were similar (the degree of smoothing was measured as reduction in variance of the directly computed matrix of r_{xt}). Second, the selected degree of smoothing appeared to be more important that the smoothing method itself. Finally, exploratory analysis of mortality dynamics appeared to be highly benefited by computing estimates at different degrees of smoothing and exploring them in an animation-like fashion to minimize bias due to under- or over-smoothing.

Accordingly, the maps of mortality improvement presented here were computed by iterative kernel smoother with Gaussian 3x3 kernel. For each country the smoother was run for 100 iterations to produce 100 estimates of the r_{xt} surface. These estimates were further combined into animation files, and further examined. The maps presented in this document are based on the selected number of iterations depending how many blobs an estimate produced given the selected scale and on reduction of variance in the directly computed r_{xt} matrix. All additional material is available from the author. The maps are being currently uploaded at MortalityTrends.org and in future will be included as a standard output.

Example of mortality improvement map for United States, Males

In this section, main features of mortality improvement map for United States, Males are discussed (Fig. 3). This detail example is provided to facilitate interpretation of mortality improvement maps for other countries as well. The data on death rates, m_{xt}, for the United States[2] are available for the period from 1933 to 2018, and mortality improvement rates, r_{xt} could be estimated for the period from 1933 to 2017[3]. Figure 3 shows final estimate of mortality

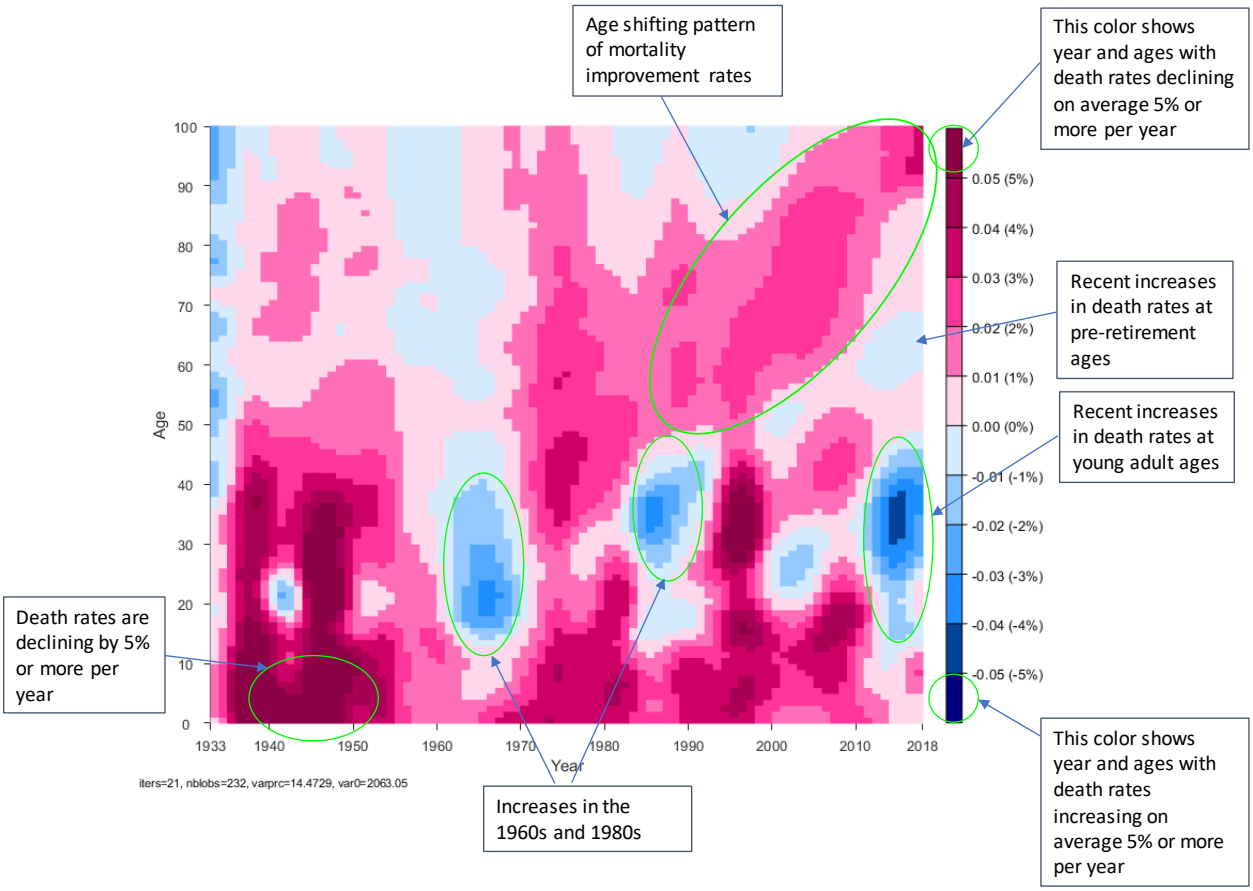
[2] The data are available at http://www.mortalitytrends.org.
[3] One needs two death rates at two adjacent years to estimate a single rate of mortality improvement so the time span is reduced by a single year

improvement matrix. Each small rectangle on this map refers to the single r_{xt} for the given year and age. The scale on the right partitions all r_{xt} into groups assigning colors depending on their value. For example, all values of r_{xt} that are less than -5% are painted in deep blue color. The areas painted in deep blue, for this reason, are depicting years and ages where death rates were *increasing* at 5% or more annually. On the other hand, all rectangles painted in magenta color show areas where death rates were declining, with the fastest declines, more than 5% annually, painted in deep magenta color. The final estimate of r_{xt} shown in figure is based on 21 iterations of bivariate kernel smoother with Gaussian 3x3 kernel applied to an initial matrix of direct estimates of r_{xt} computed with Eq. (1). The final estimate of r_{xt} has 232 blobs and its variance is only 14% of the variance of the direct estimate.

For males of the United States there is a single area of deep blue color showing where death rates were rapidly increasing: in the years around 2015 and at ages 30-40. This unfavorable development in the U.S. mortality is referred in the literature as “deaths of despair” (Case and Deaton, 2020). Similar, but less dramatic increases in mortality are noticeable at young adult ages in the 1960s, 1980s, and the 2000s. Death rates at pre- and early-retirement ages, ages 60-70, in recent years, were also slightly increasing as shown by the lightest blue hue used for the scale range from -1% to 0.

The fastest declines in death rates took place at child and young adult ages from the mid-1930s to the mid-1950s, as depicted by the deep magenta area for r_{xt} at the level 5% or larger. Moreover, rapid rates of mortality improvements at child ages, age 15 or less, occurred throughout the entire period shown in Fig. 3. Other two features of this map are rapid decline in young adult mortality, age group 20-40, in the late 1990s, and accelerated decline in mortality at older ages 50 and older, the decline that started in the mid-1970s. Before the 1970s, death rates at older ages where virtually stagnant.

Figure 3. Mortality improvement map for United States, Males



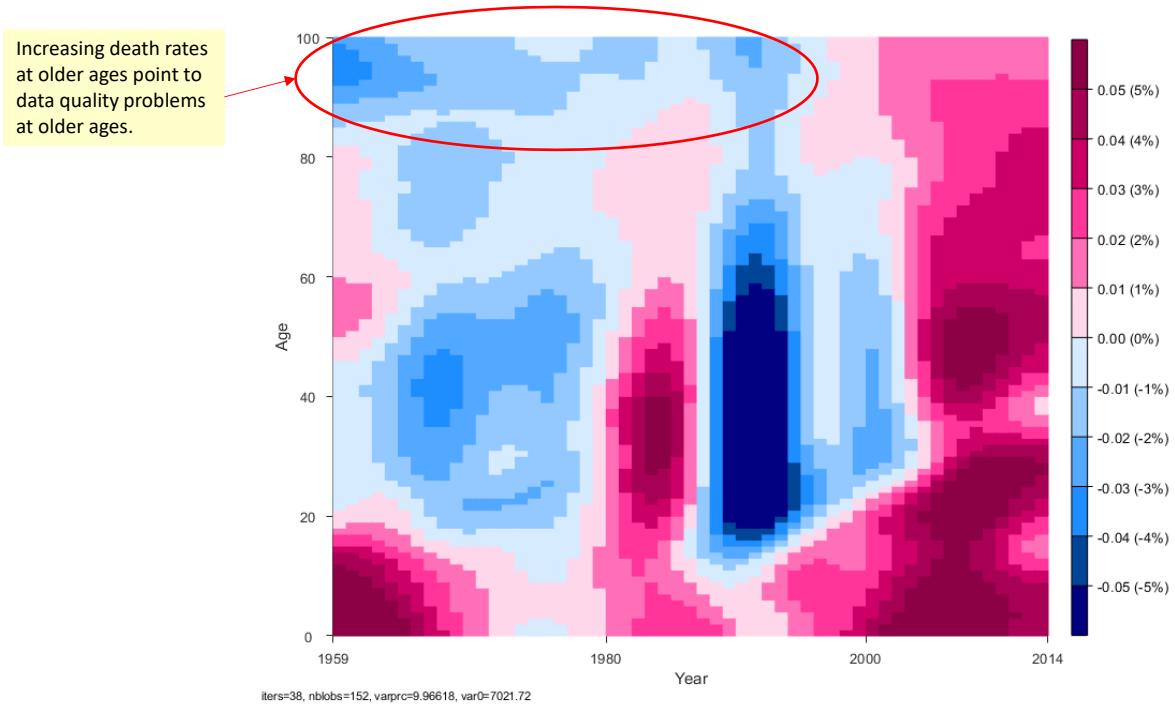
Example of predominantly period pattern of mortality improvement, Russia, Males

Figures 4 provides an example of predominantly period pattern of mortality improvement as based on estimates for Russia, Males. Until the early 1980s, substantial progress has been done in infant and child mortality while mortality at adult ages and older ages was increasing. In the 1980s, death rates at adult ages started to decline rapidly, and the progress made in child ages continued. The progress against mortality in the 1980s was fueled mainly by Gorbachev's anti-alcohol campaign instantiated instituted in 1985. With abolishment of Gorbachev's policies by Yeltsin's government following the dissolution of Soviet Union, with rapid transition to market

economy and with carrying out privatization of the state equity virtually in a year or two, Russian adult death rates surged again eliminating virtually all progress made against mortality over last decades. At child ages, the progress largely stagnated. It is not until the mid-2000s, a decade later, that mortality started to decline again.

Mortality improvement in this country is driven mostly by period effects with no clear evidence of any cohort effects. Increases at older ages, 80 years or older, until the year 2000, are manifestation of improvements in data quality rather indication of deteriorating health conditions. As age misreporting biases death rates at older ages downwards, improvements in data quality over time will gradually increase directly computed death rates to their true values. Visually it appears as increasing trends in death rates even if true values are not changing over time, simply by virtue of eliminating of erroneous records. It is not until the year 2000 or so that directly computed death rates could be regarded as reliable and be used without adjustments, at least up to age 90 or so (Andreev *et al.*, 2017).

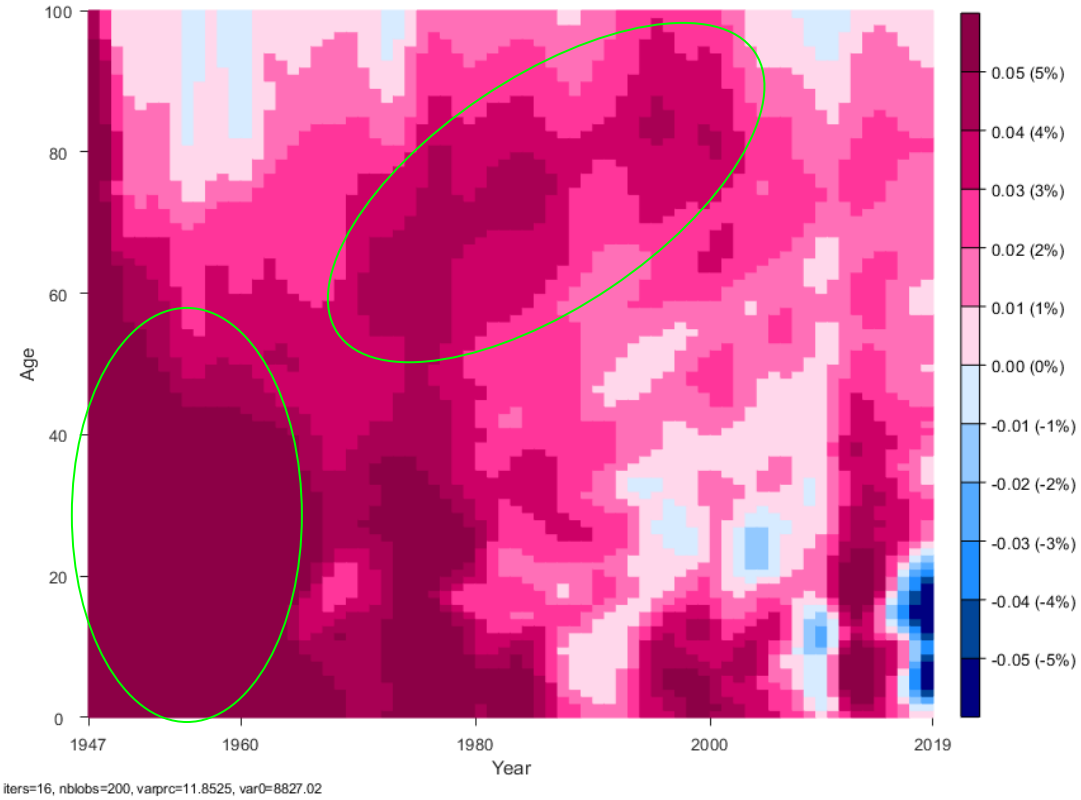
Figure 4. Mortality improvement map for Russia, Males



Example of age-shifting pattern of mortality improvement, Japan, Females

In many high-longevity countries, structural shifts in mortality improvement patterns took place in the 1970s—if before this period most of the progress in reducing mortality took place in childhood and young adult ages, then after this period rapid mortality progress shifted to the older ages. Mortality dynamics in Japanese female population is one of the noticeable examples of such structural shift (Fig. 5). The two green ellipses in Fig. 5 highlight age shift in mortality improvements rates.

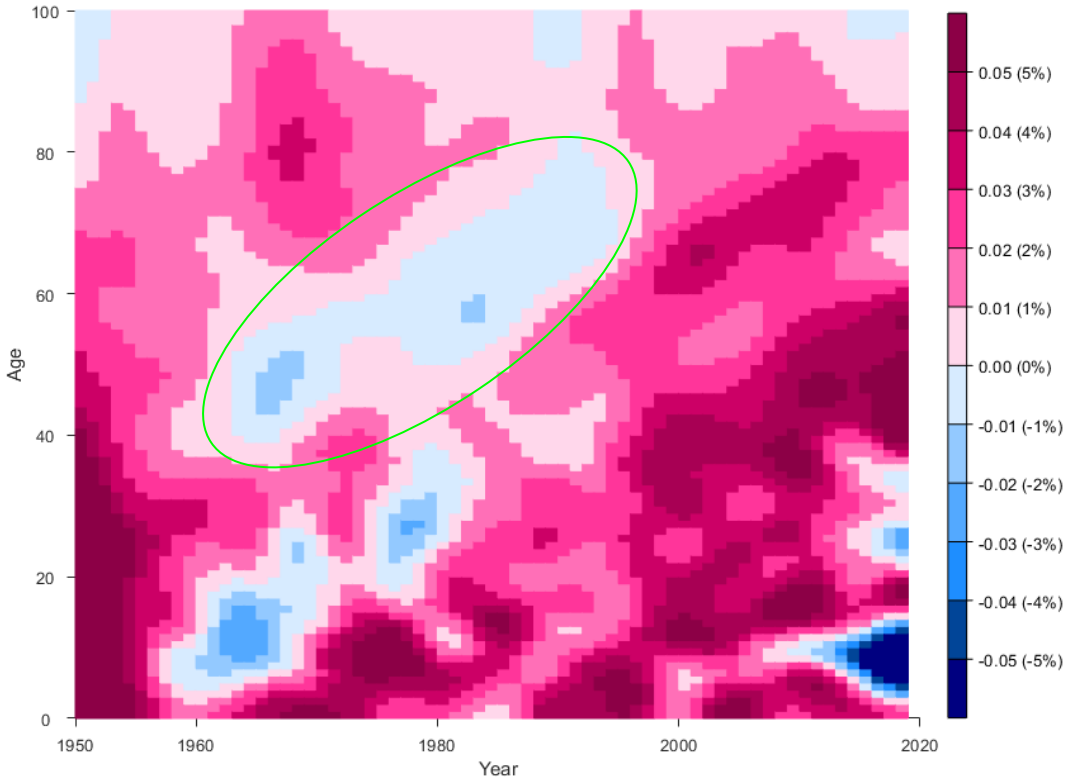
Figure 5. Mortality improvement map for Japan, Female



Example of a negative cohort effect, Denmark, Females

Danish females born approximately in the 1925-1935 period exhibit increasing mortality (Fig. 6, blue area designated with a green ellipse). This negative cohort effect is attributed mostly to smoking habits of this particular cohort (Jacobsen *et al.*, 2006).

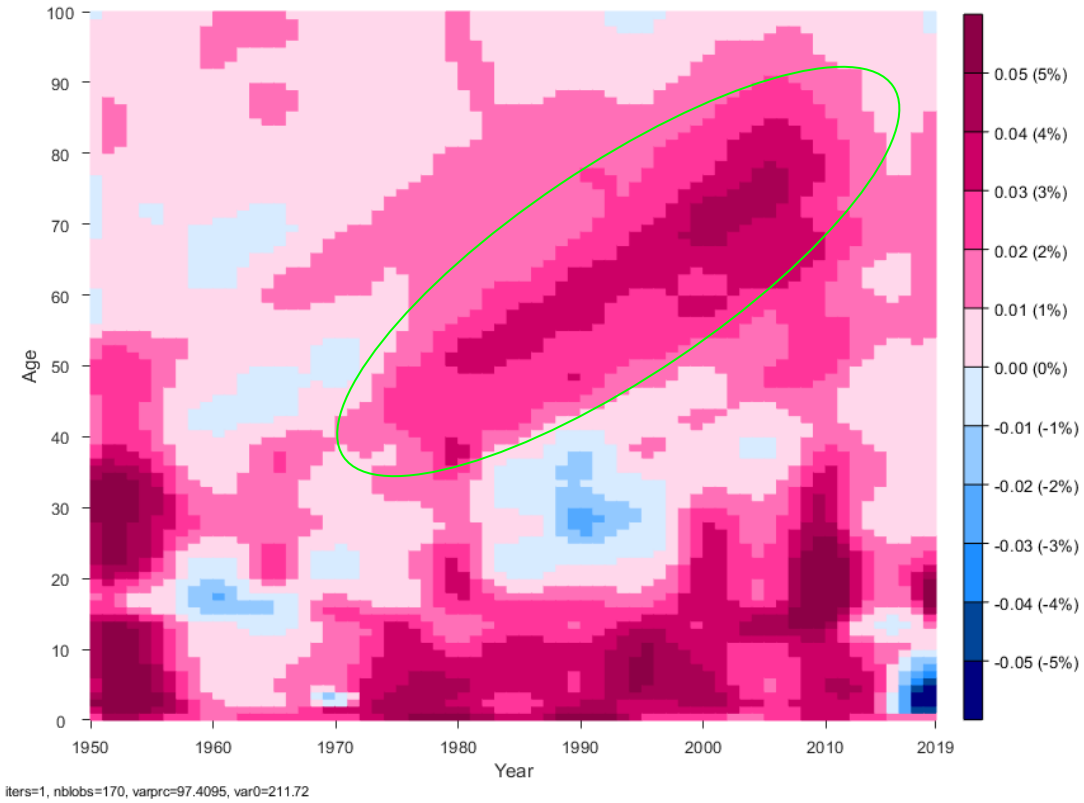
Figure 6. Mortality improvement map for Denmark, Females



Example of a positive cohort effect, United Kingdom, Males

Contrasting with mortality dynamics in female population of Denmark, the U.K. male cohorts born in the 1930s demonstrate an accelerated mortality decline. Rates of mortality improvement for these cohorts were clearly much higher than for the rest of the population (Fig. 7). This cohort effect was widely discussed in actuarial studies.

Figure 7. Mortality improvement map for United Kingdom, Males



Conclusion

Maps of mortality improvements it is a useful display for summarizing mortality trends over age and time in a large body of population data. They are easy to produce[4] and thus could be examined at a routine basis, along with more traditional methods. They are not, however, readily available and to address this need we are currently adding them to our web site application (MortalityTrends.org). Further advances in exploratory analysis of mortality trends could be to be produced by computing estimates of mortality improvement maps at different degrees of smoothing and exploring them in a movie-like fashion to minimize bias due to under- or over-smoothing. It is not very technically challenging but more computationally and storage demanding.

[4] The method used could be coded just in a few lines of code

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Mortality Improvement Mapes for 201 Countries or Areas

The maps are shown in order of country population size. Updated mortality improvement maps will be available at

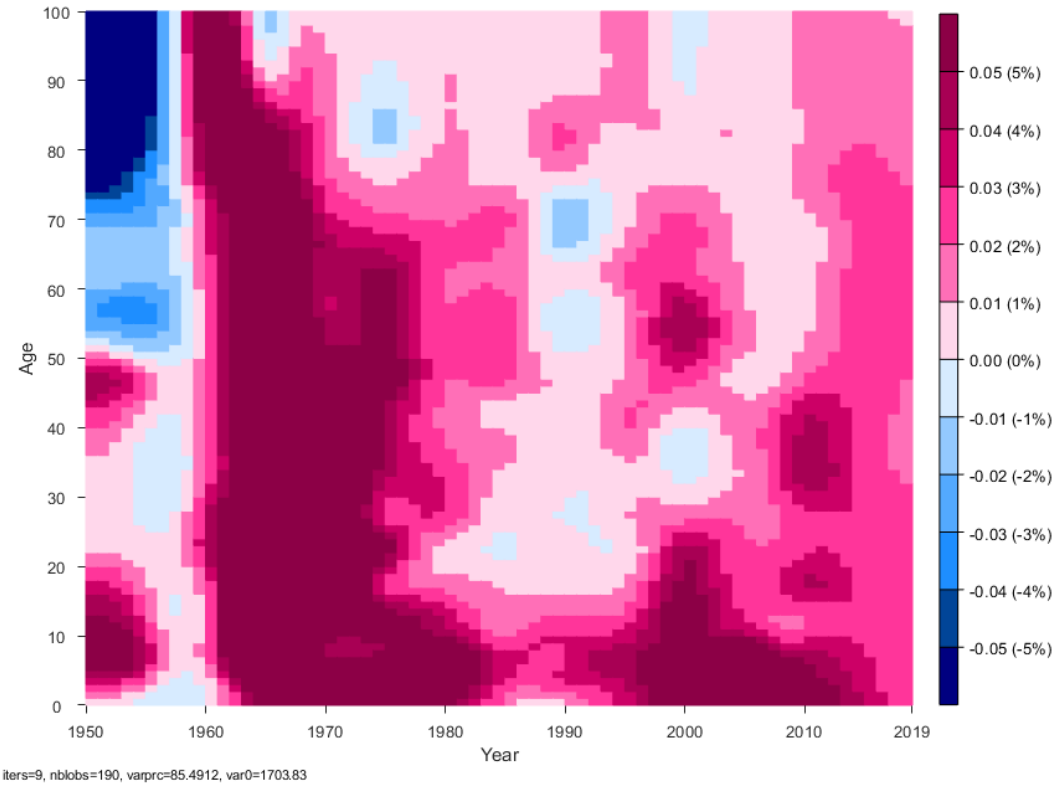
www.mortalitytrends.org

This file is available at

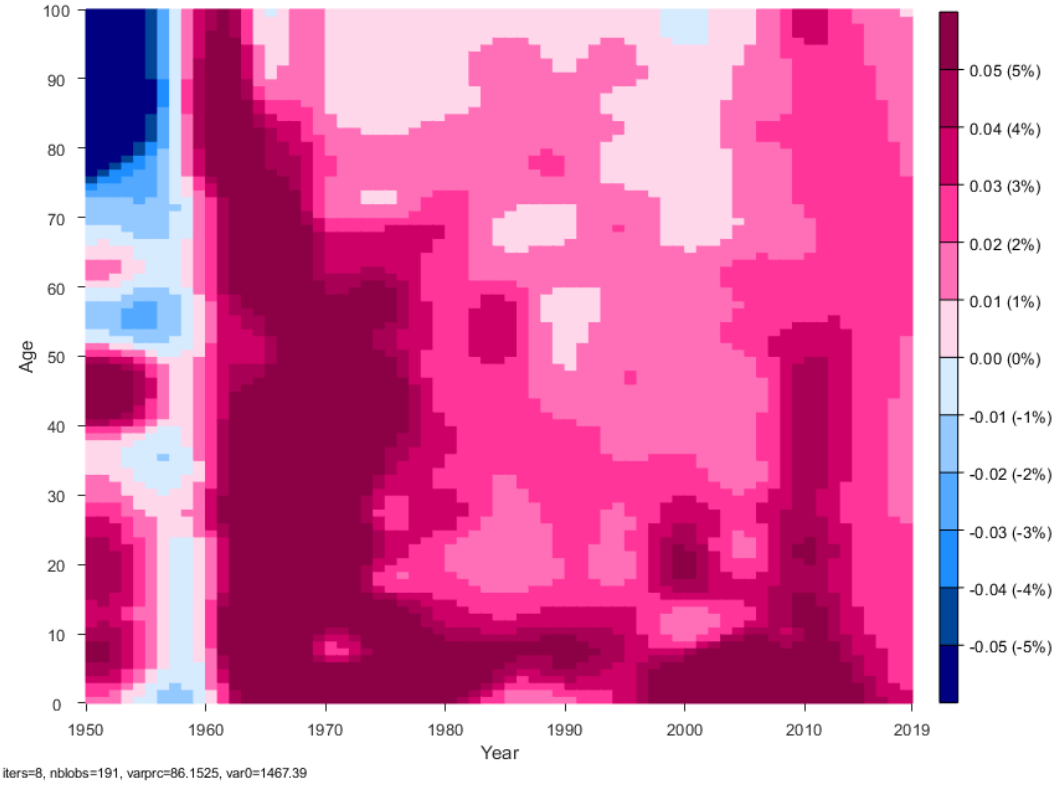
http://kirillandreev.com/2021_PAA/Andreev_MortalityImprovementMaps_FinalPaper_2021PAA.pdf

China

Males

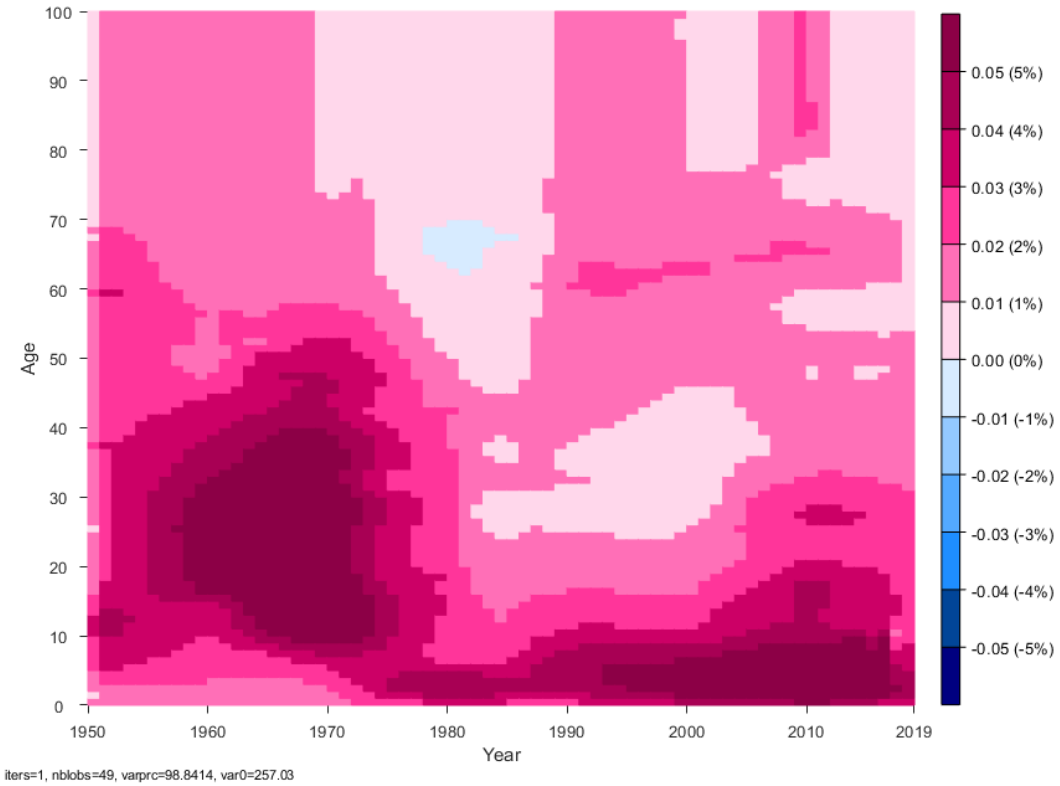


Females



India

Males



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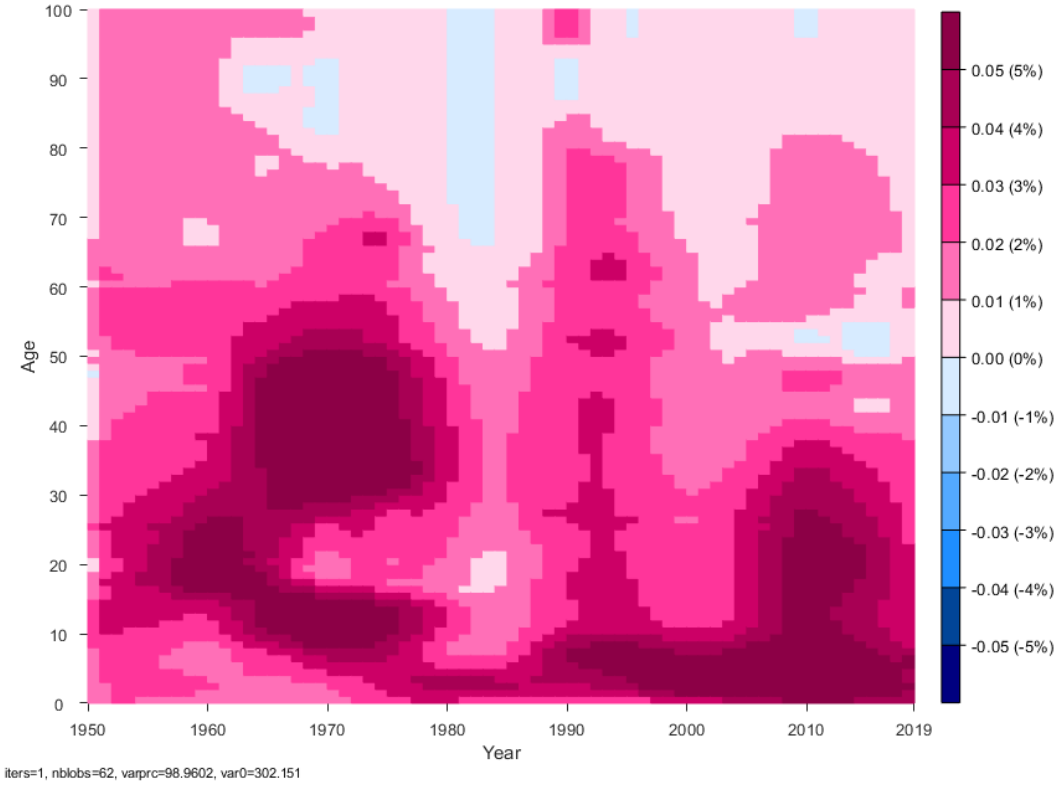
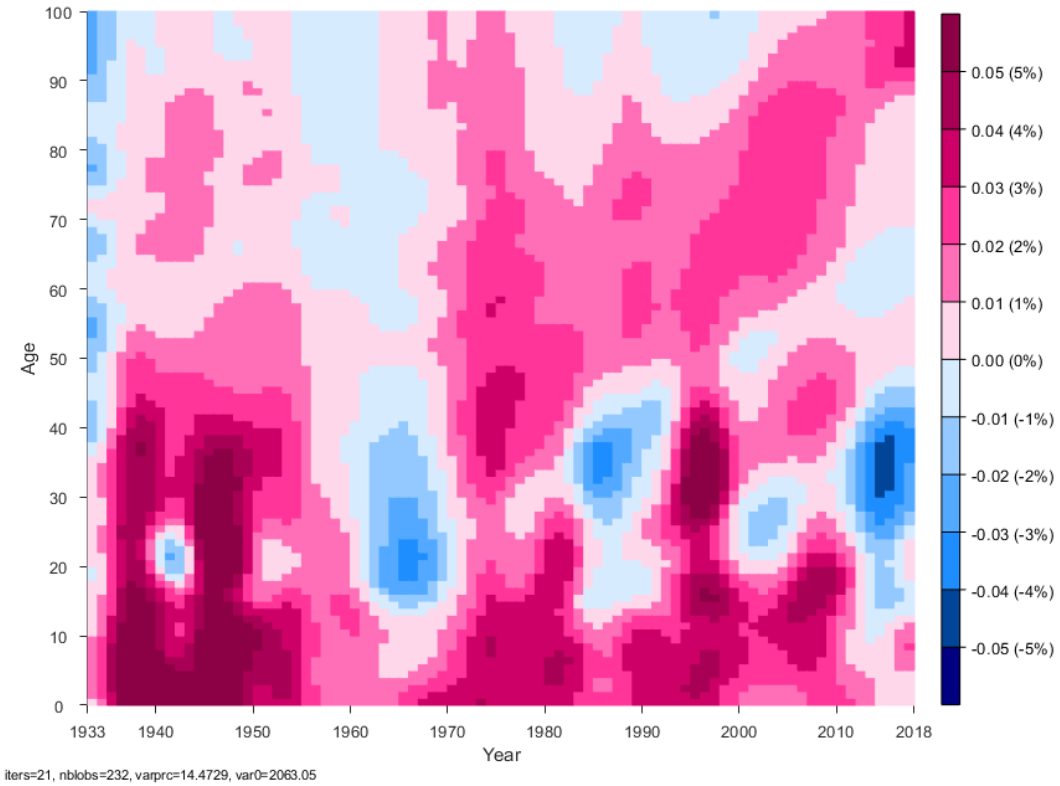


United States of America

Males



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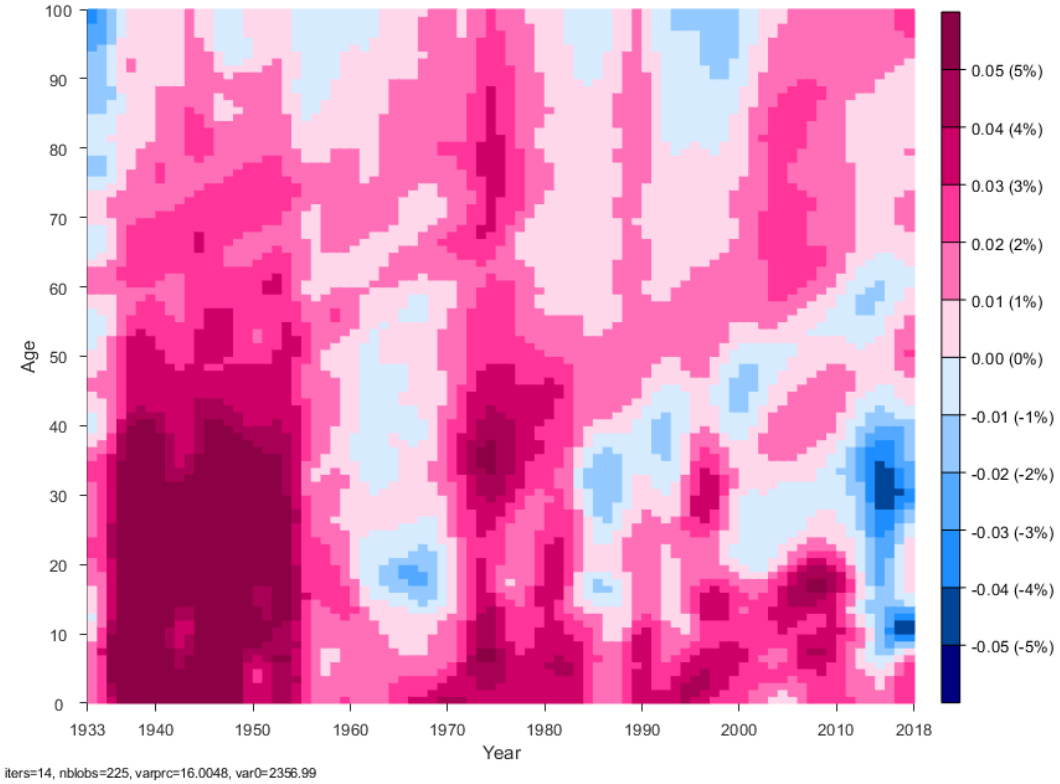
Females



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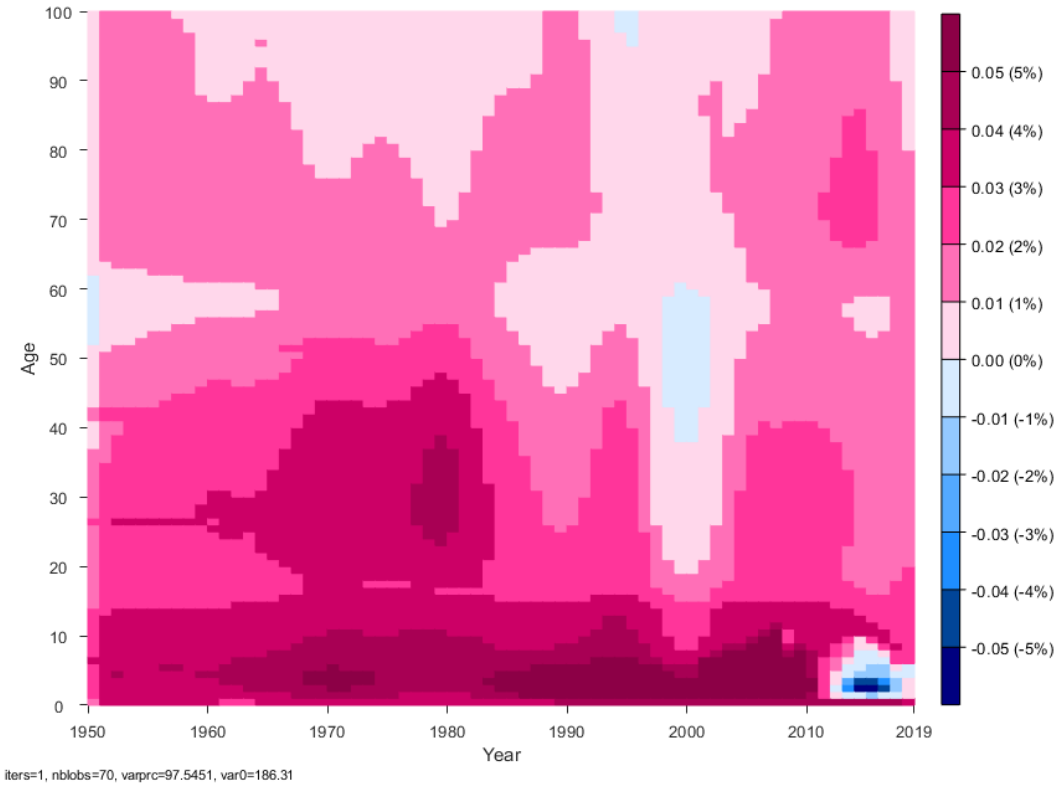
Indonesia

Males



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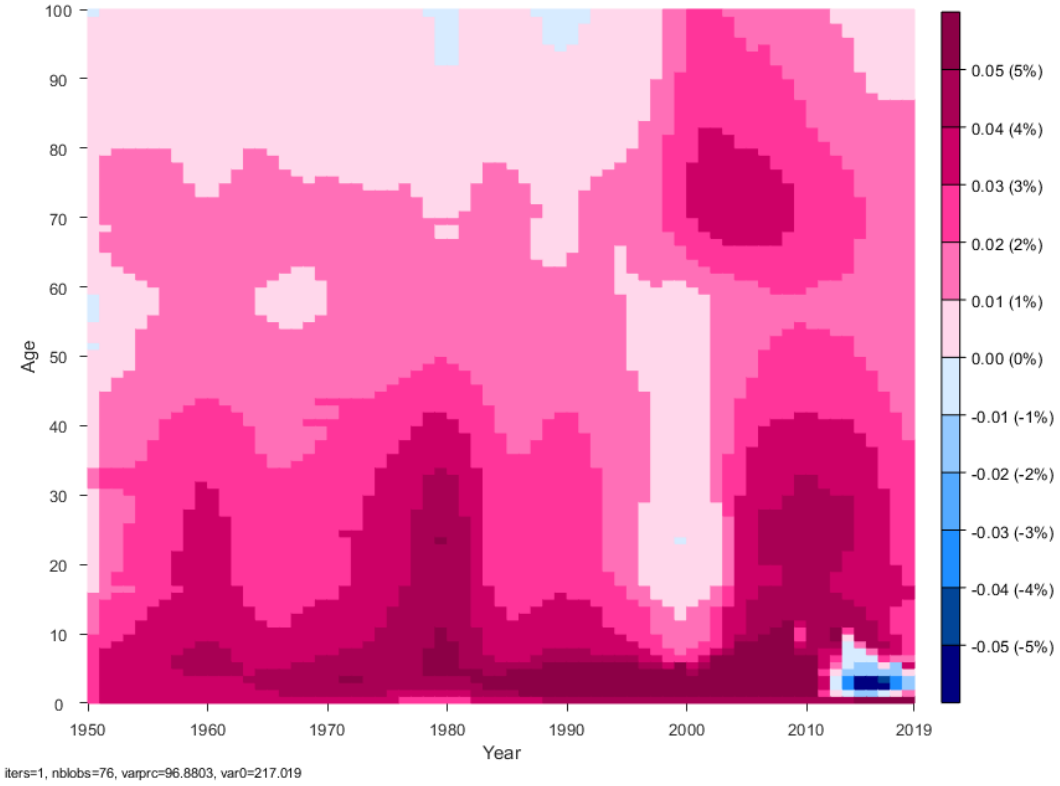
Females



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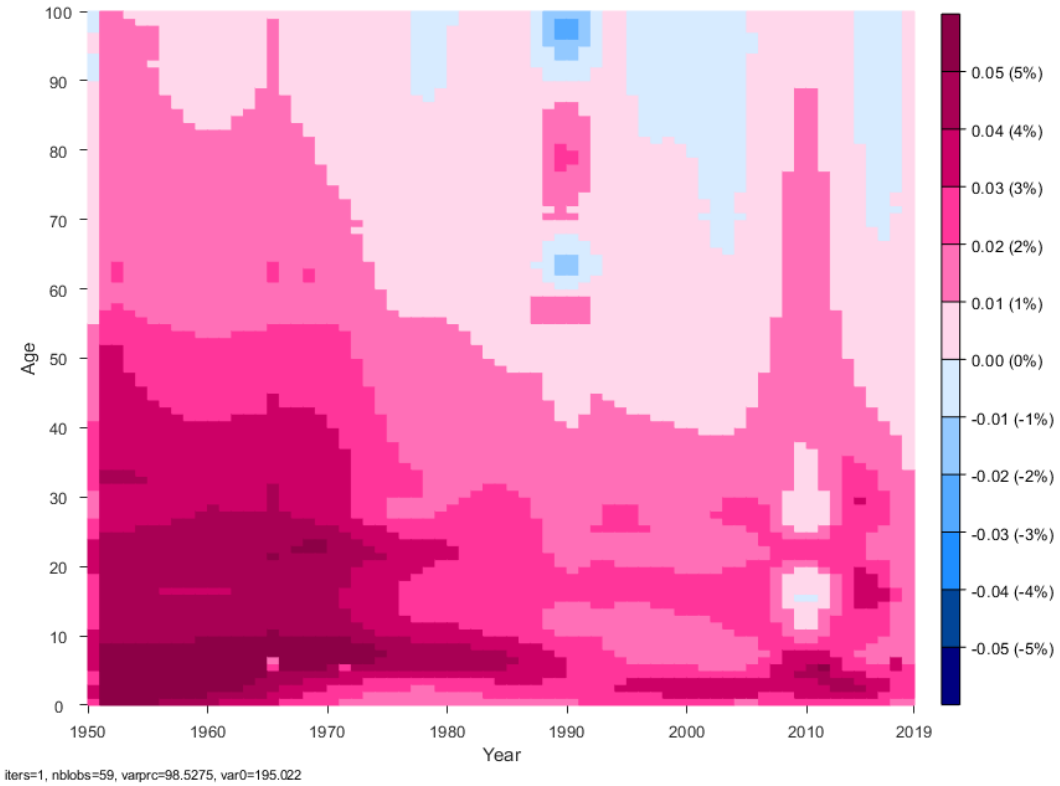
Pakistan

Males



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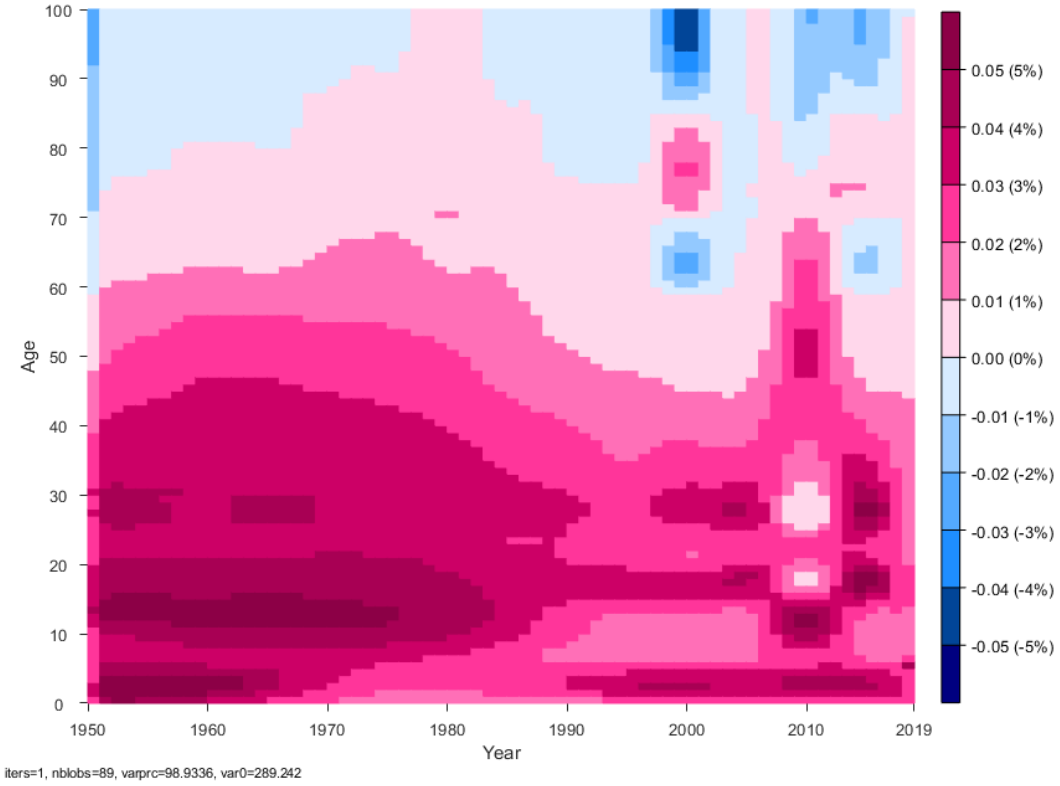
Females



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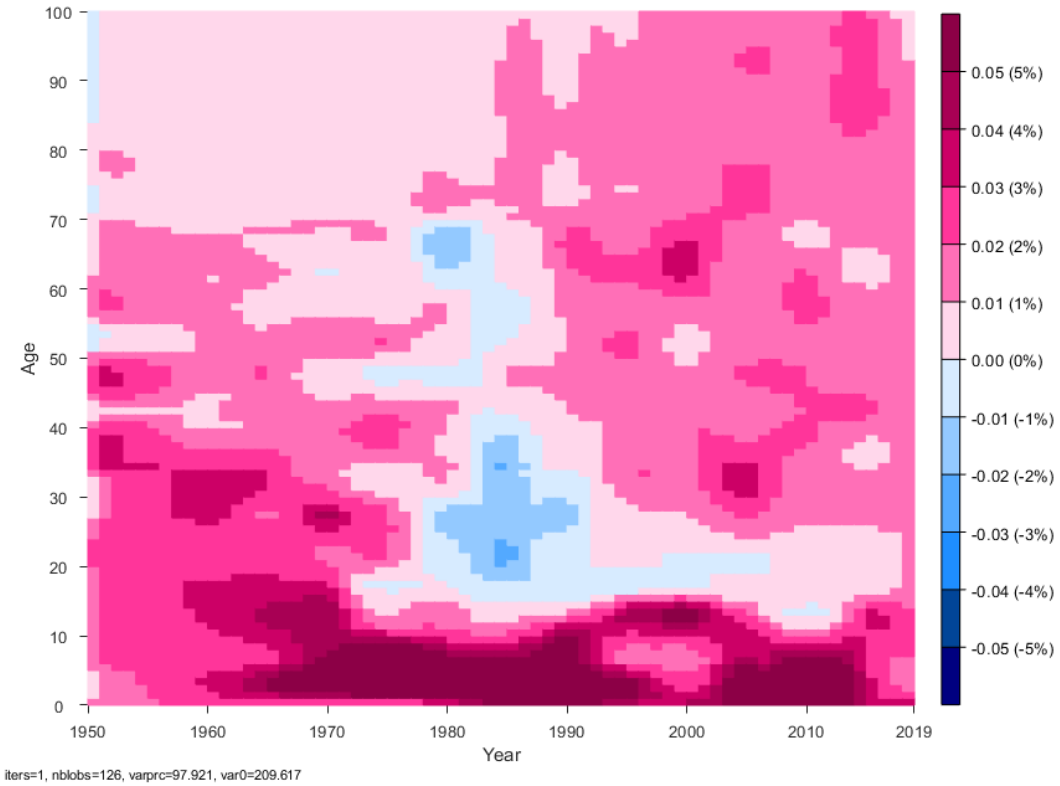
Brazil

Males



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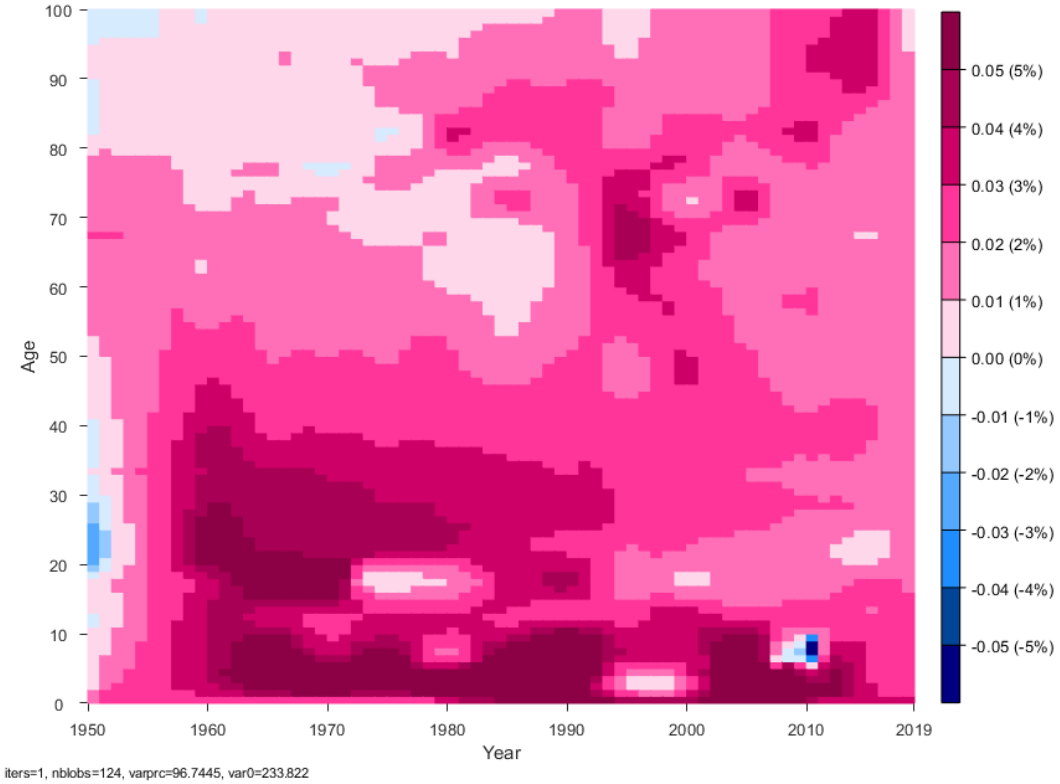
Females



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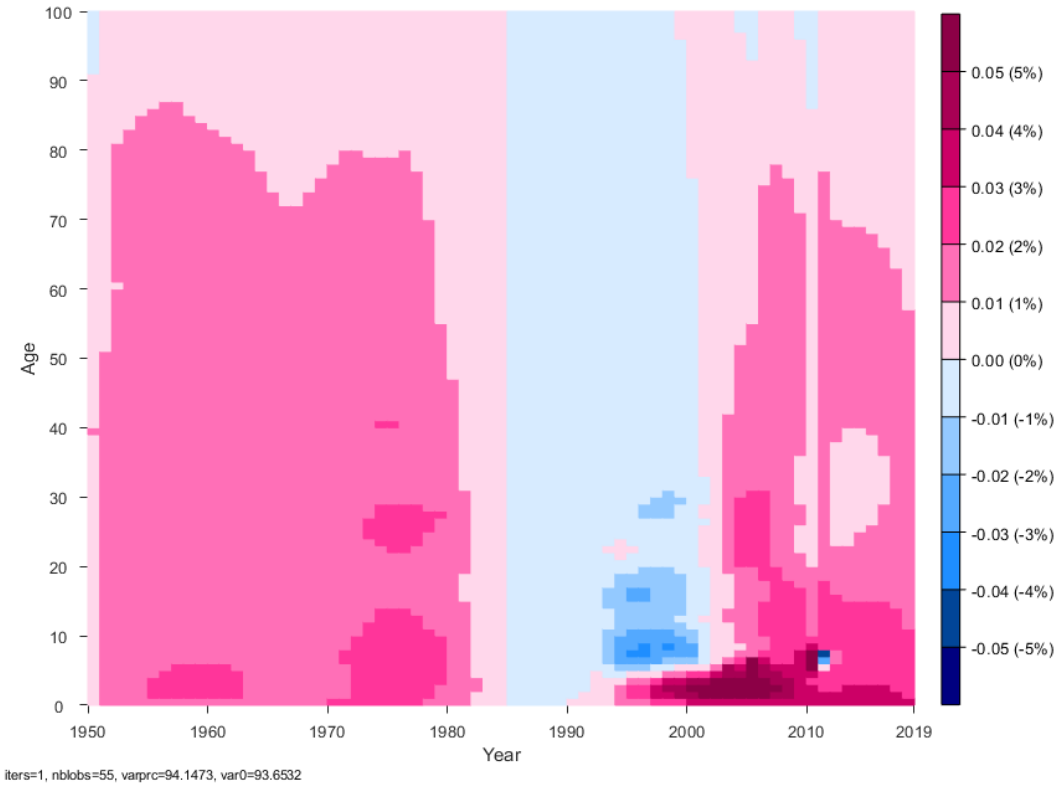
Nigeria

Males



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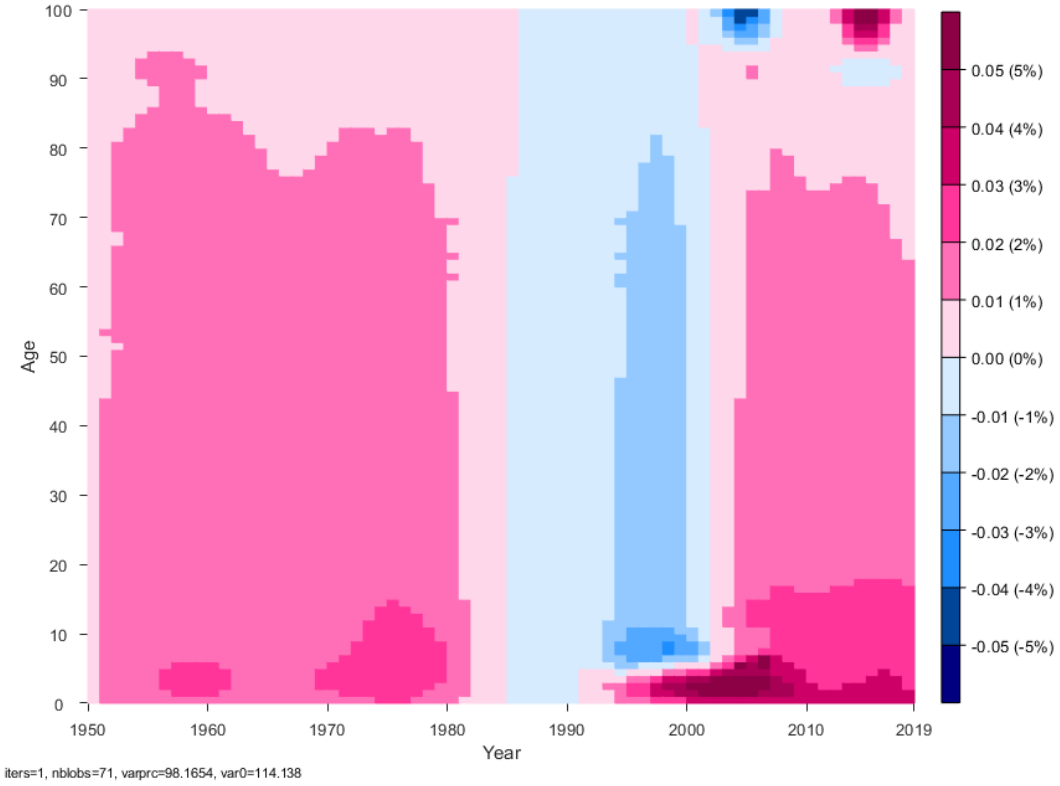
Females



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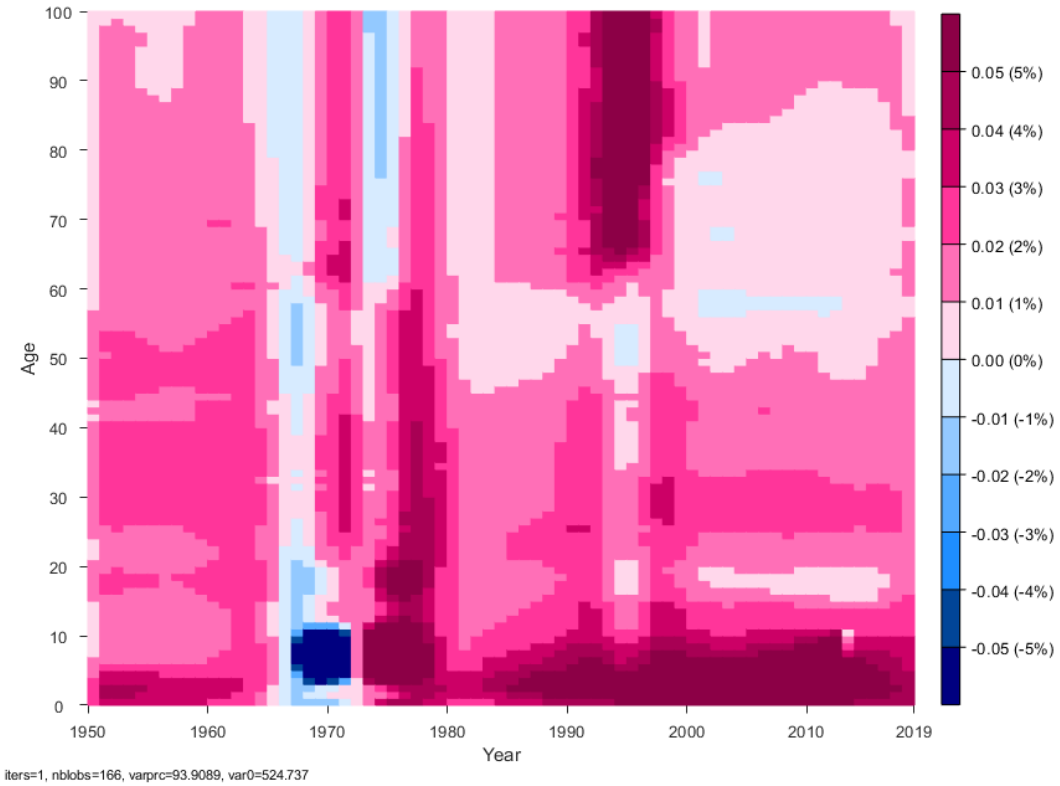
Bangladesh

Males



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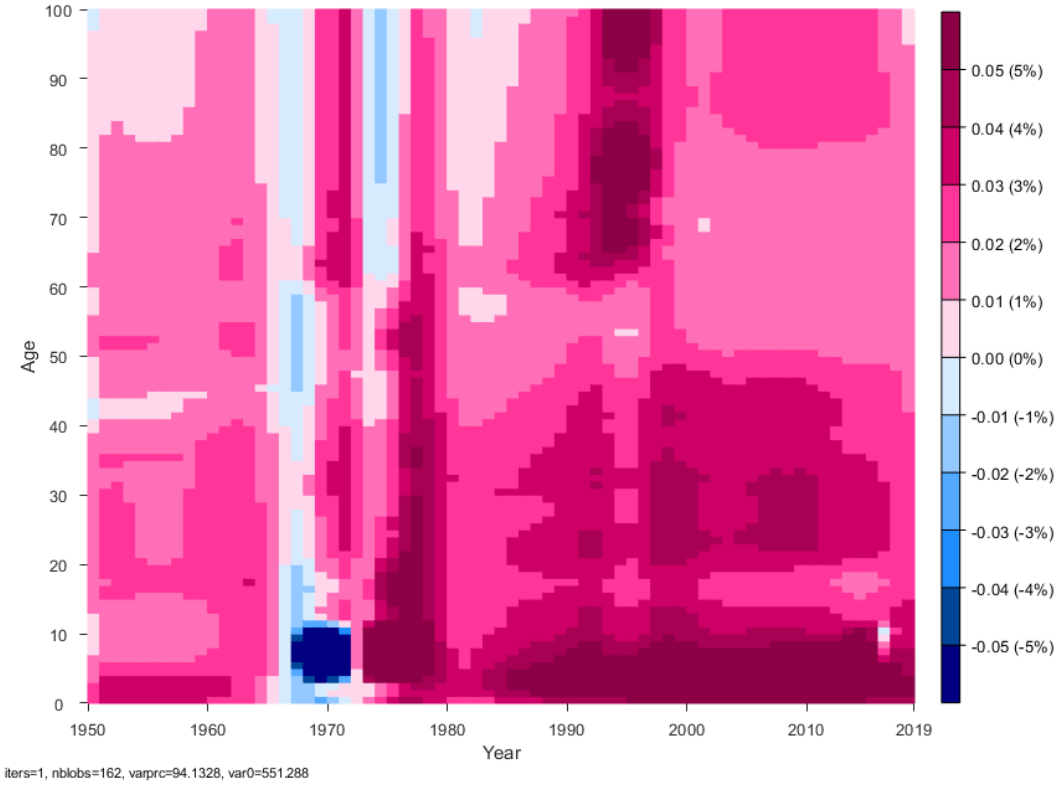
Females



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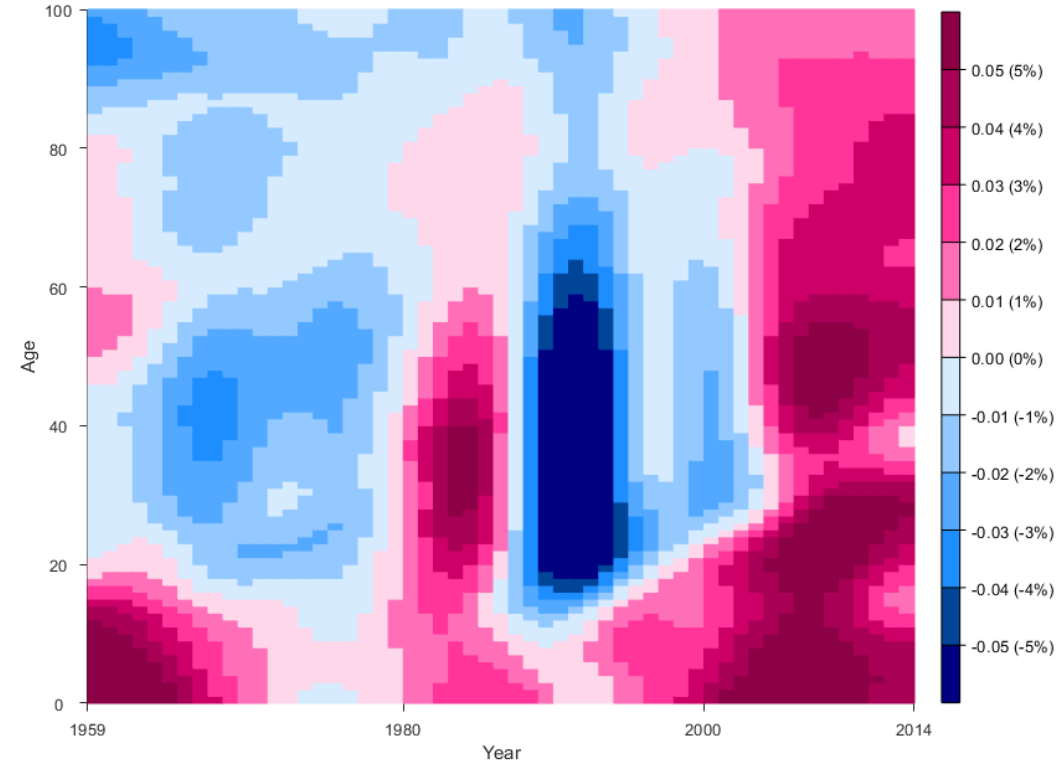
Russian Federation

Males



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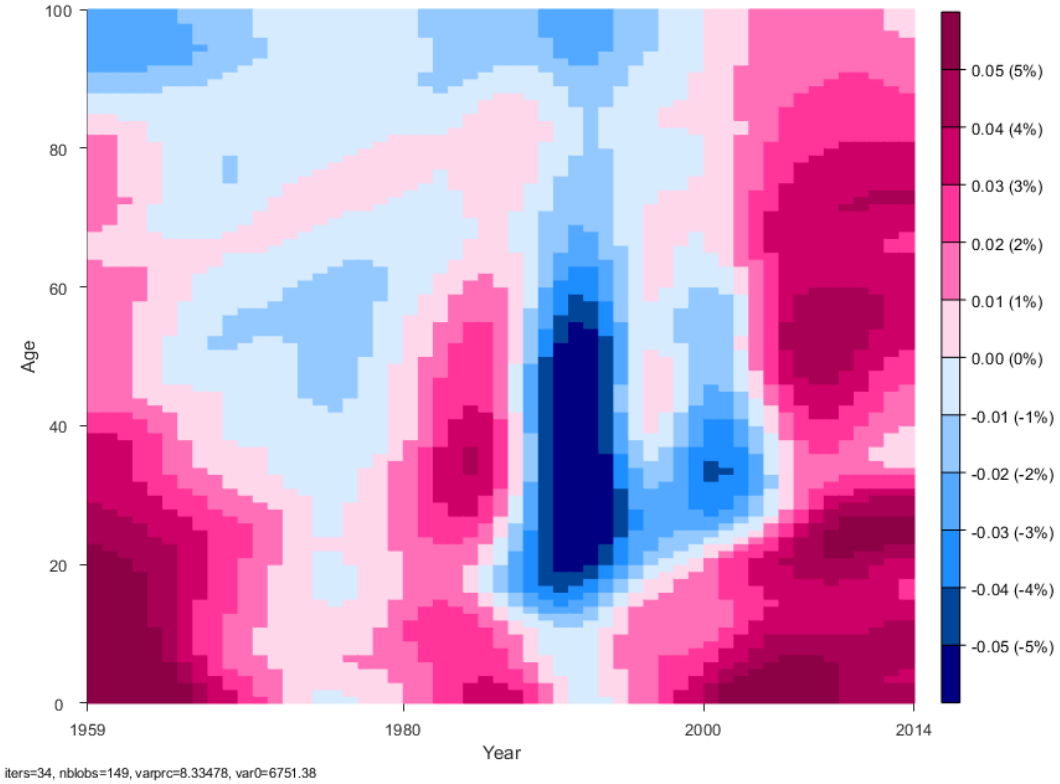
Females



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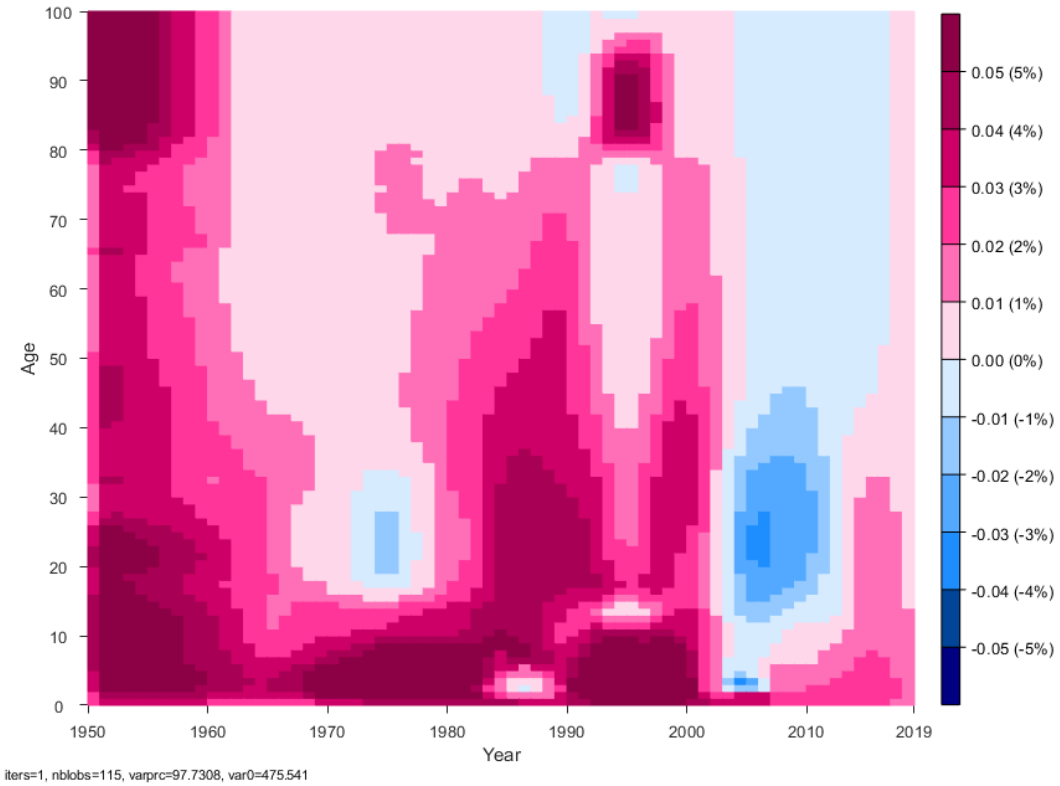
Mexico

Males



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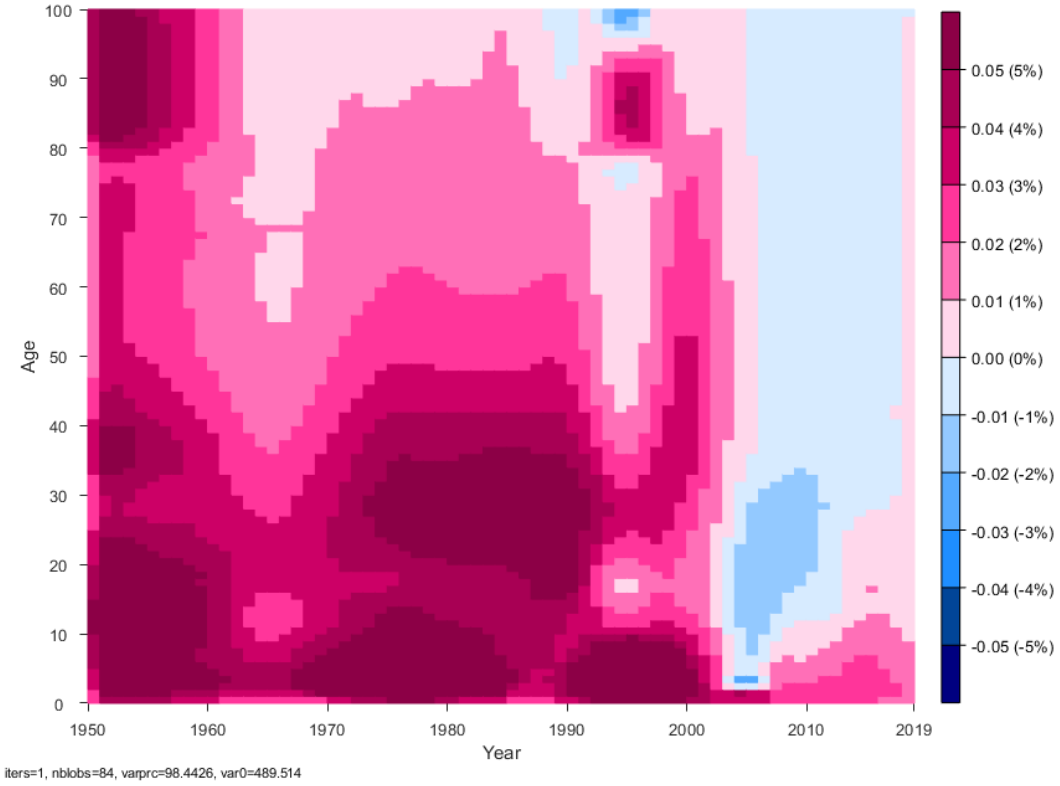
Females



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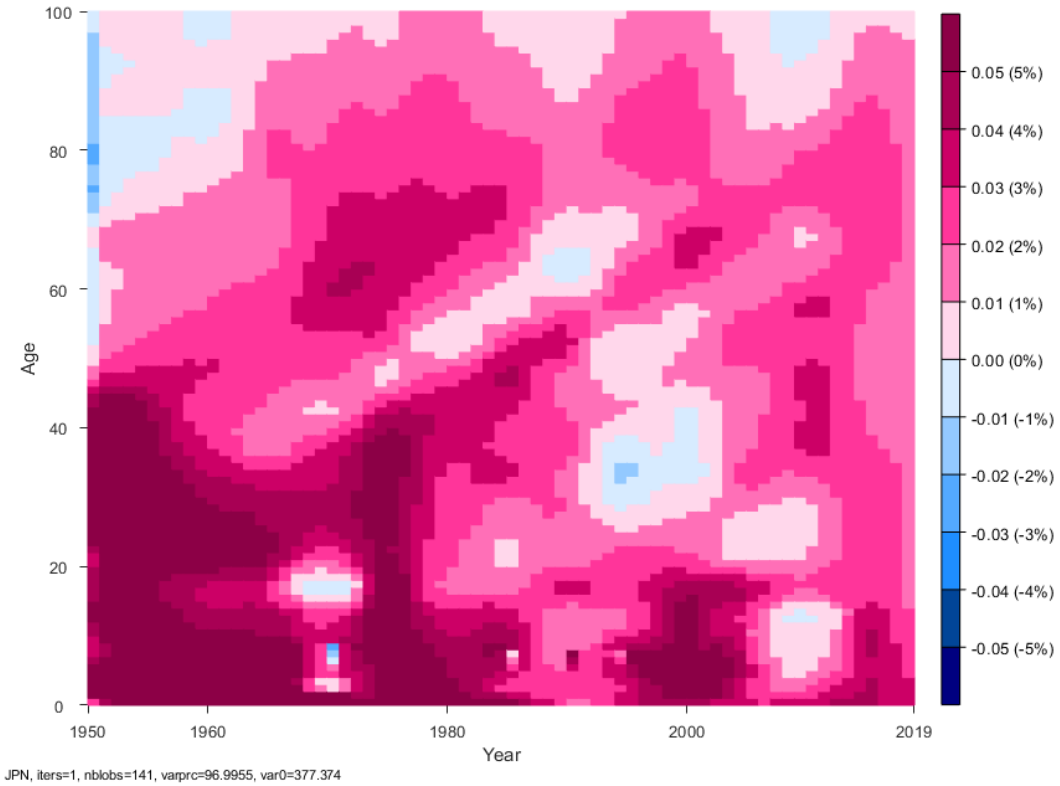
Japan

Males



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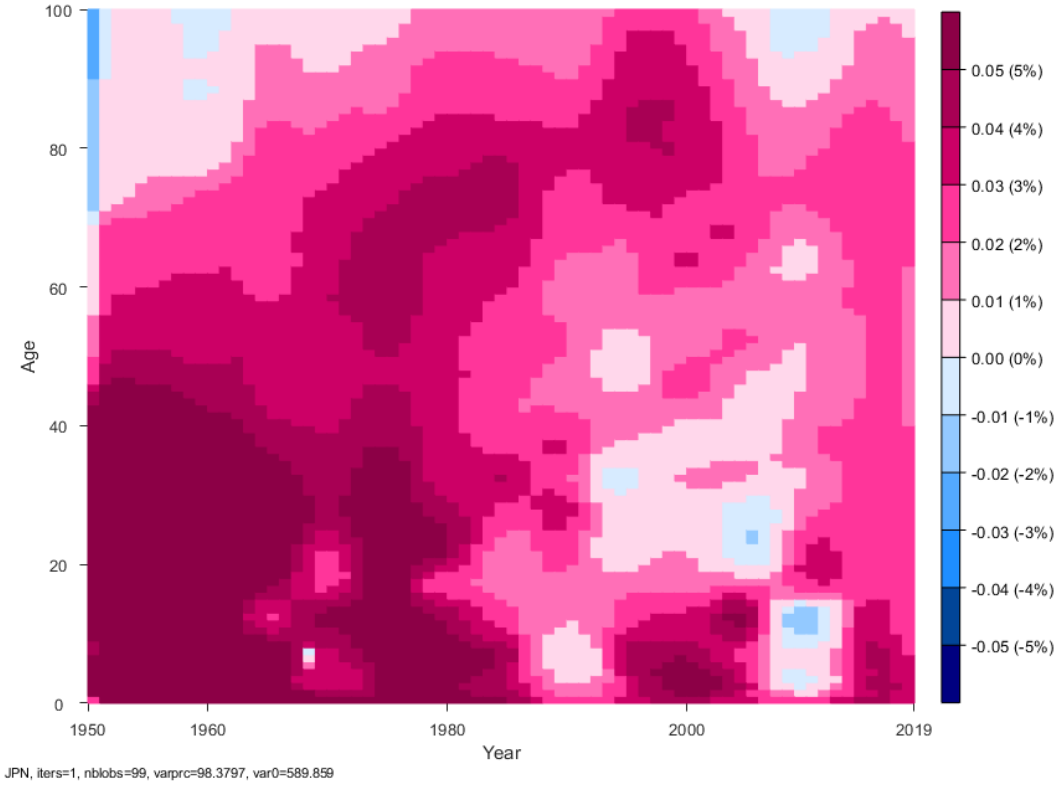
Females



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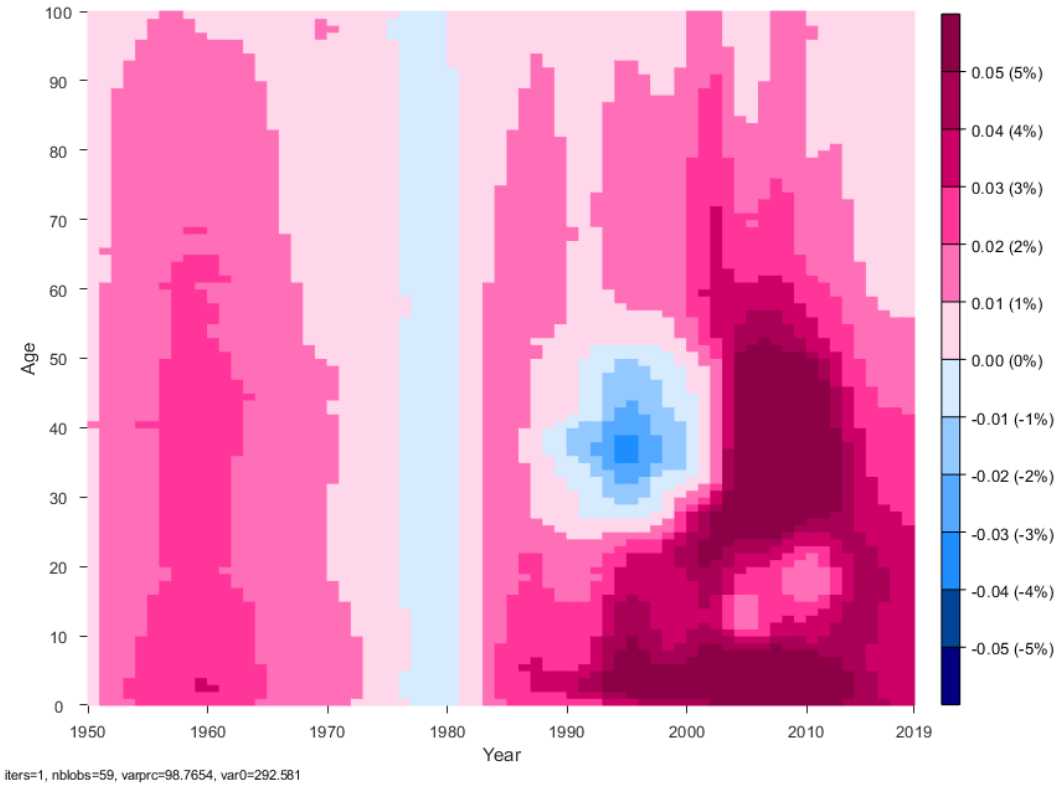
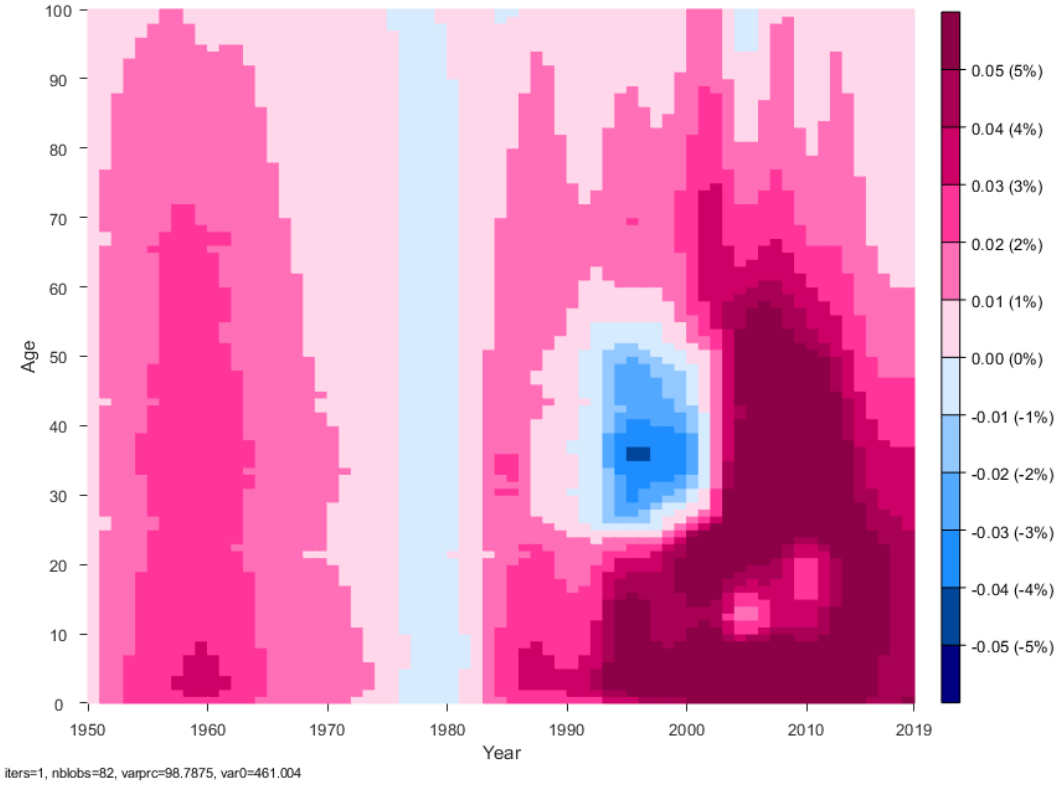
Ethiopia

Males

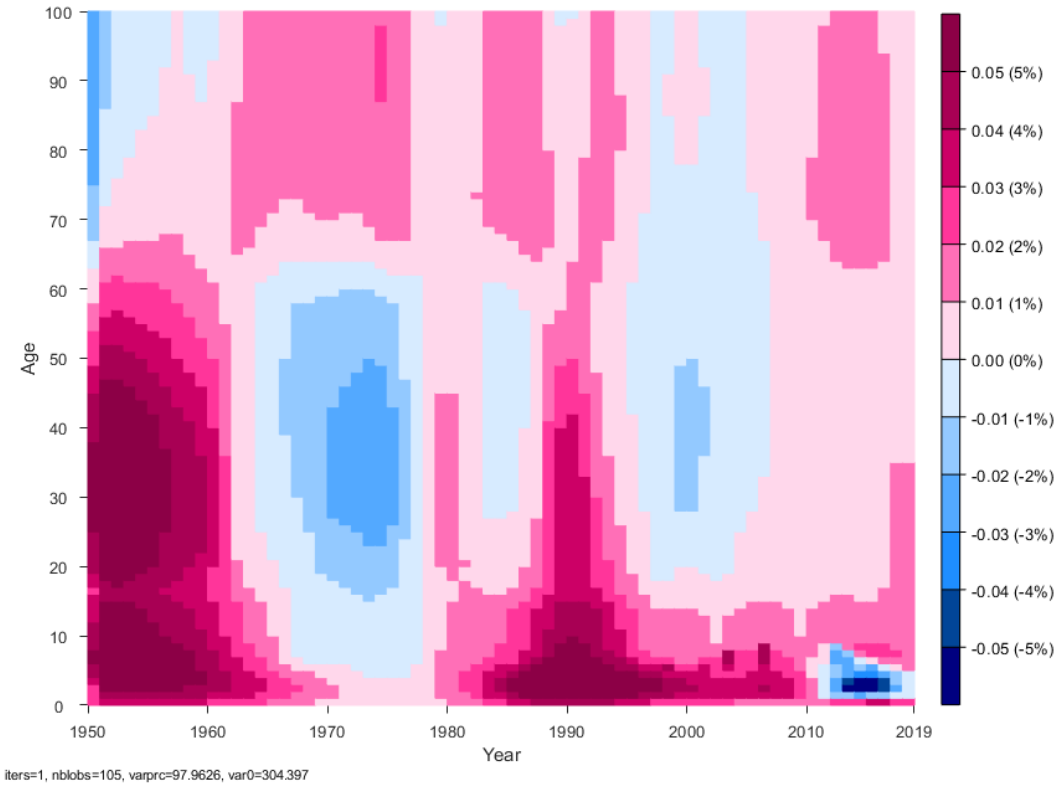


Females

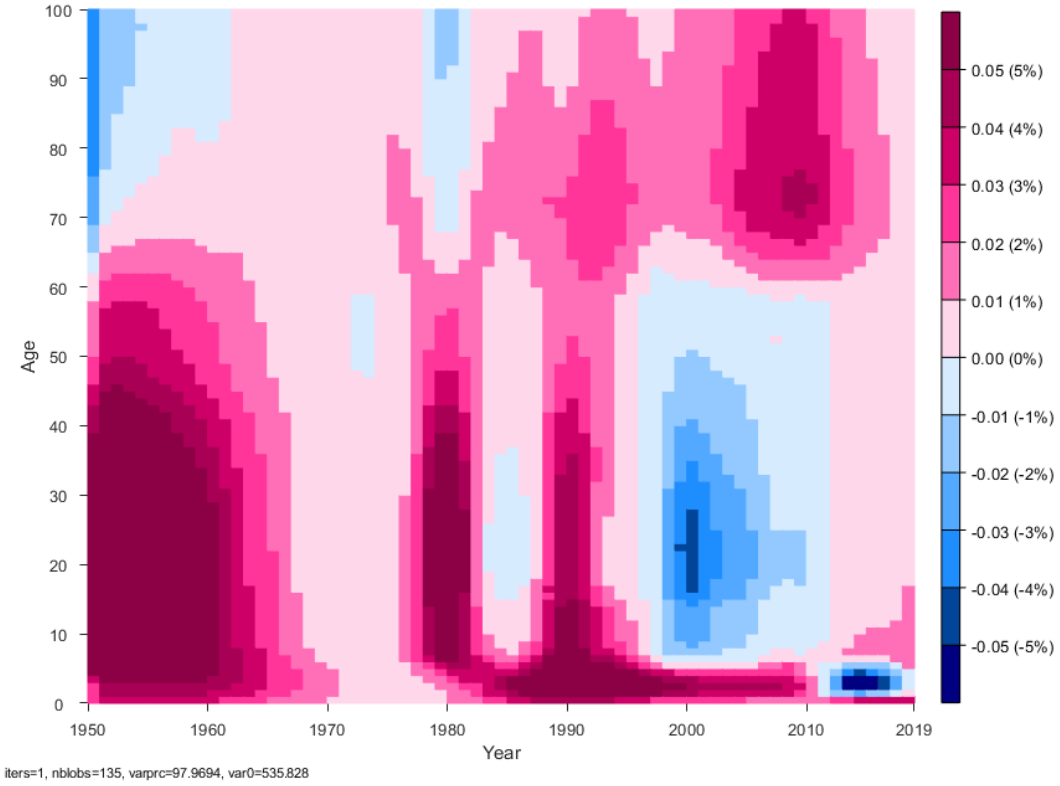


Philippines

Males

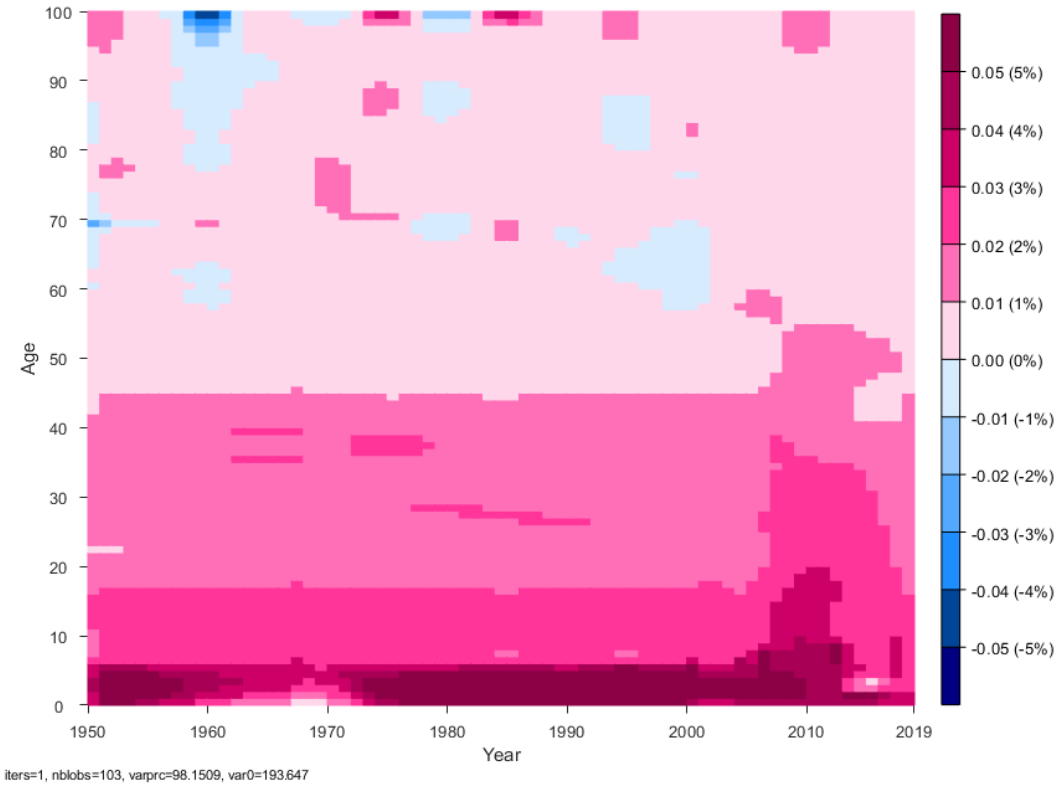


Females



Egypt

Males



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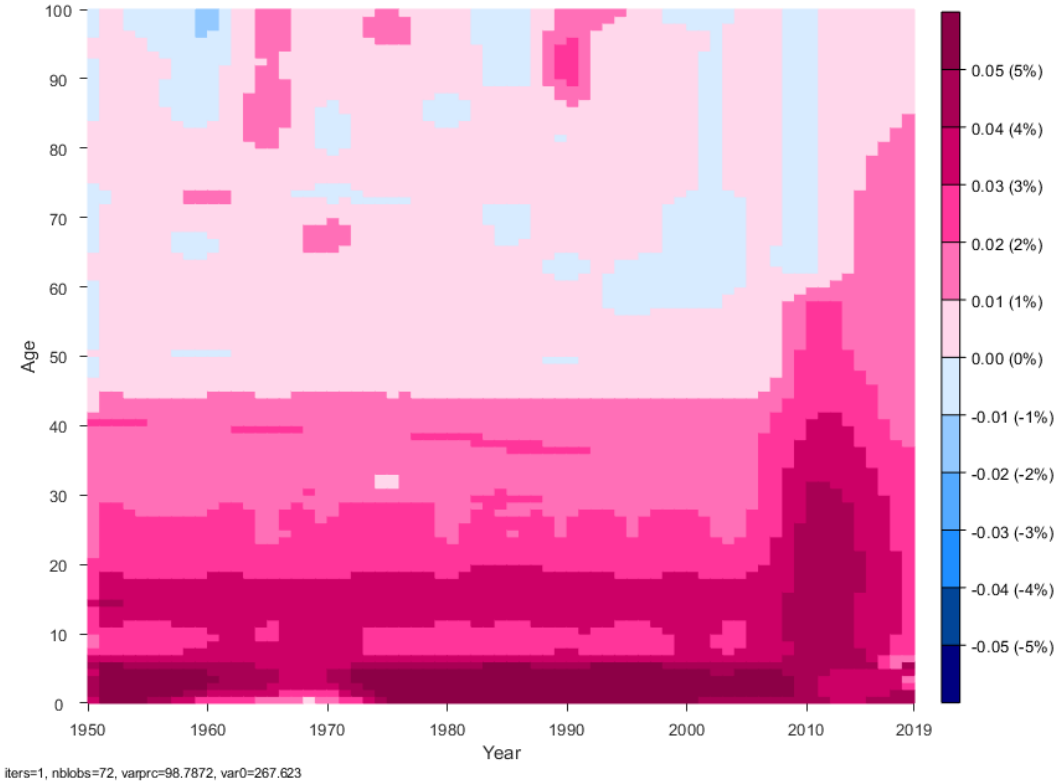
Females



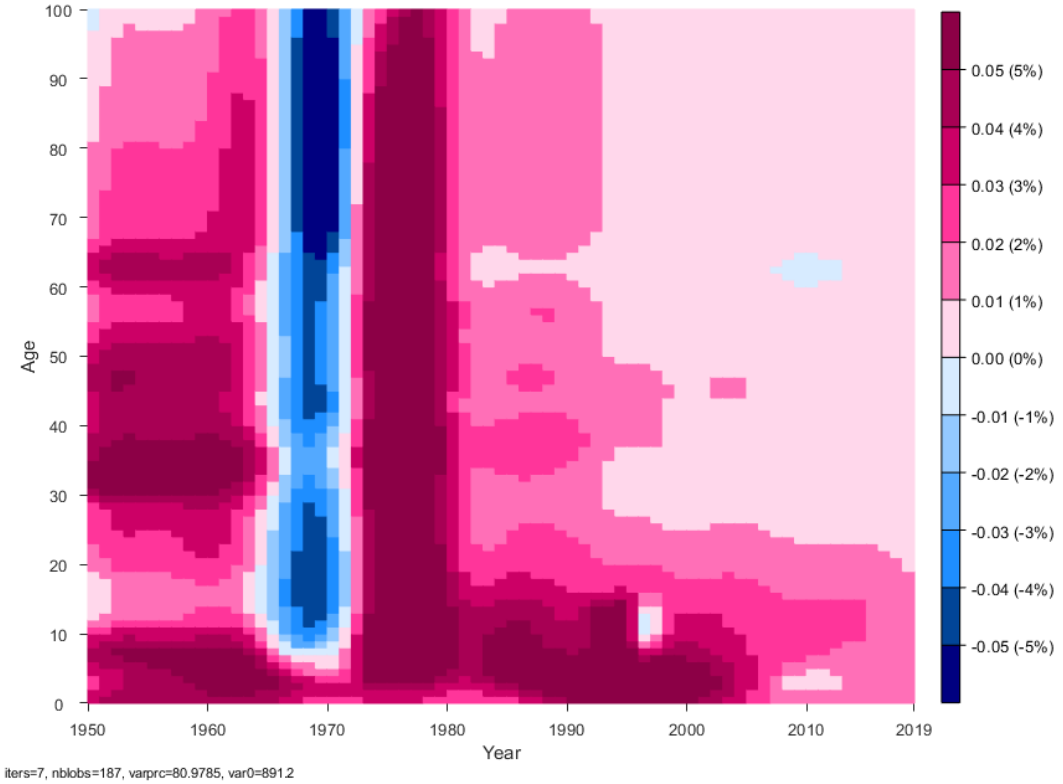
iters=1, nblobs=72, varprc=98.7872, var0=267.623

Viet Nam

Males

iters=6, nblobs=193, varprc=83.0933, var0=1170.09

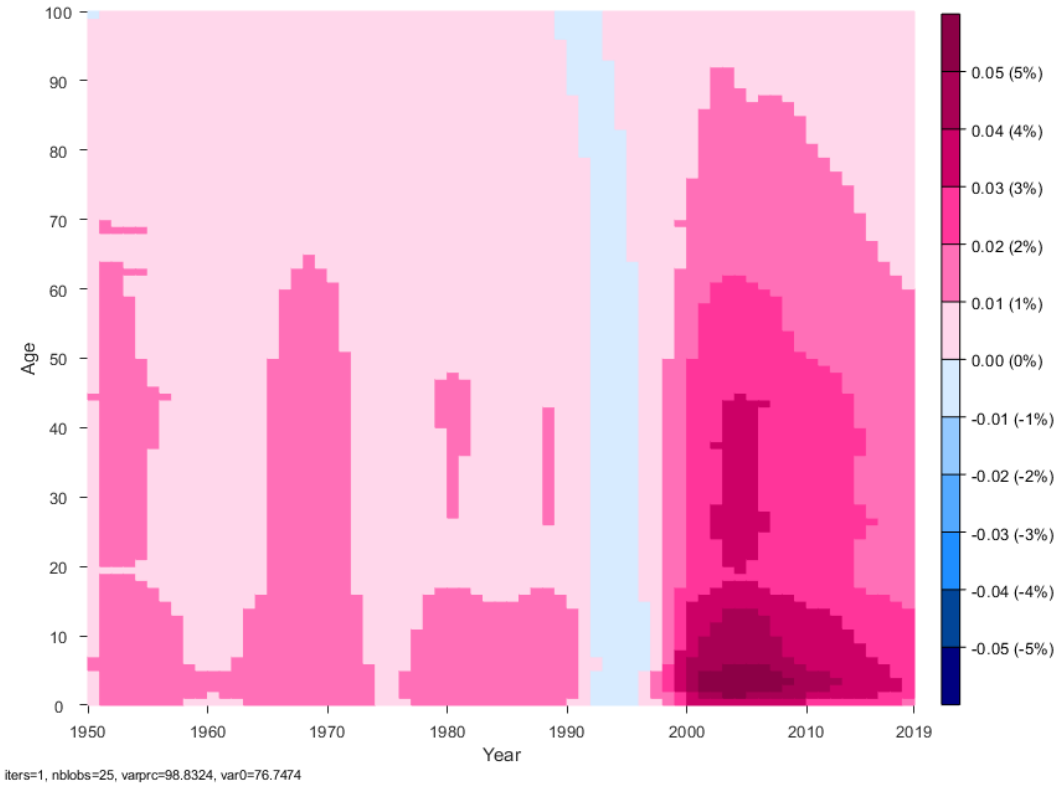
Females



iters=7, nblobs=187, varprc=80.9785, var0=891.2

Dem. Republic of the Congo

Males



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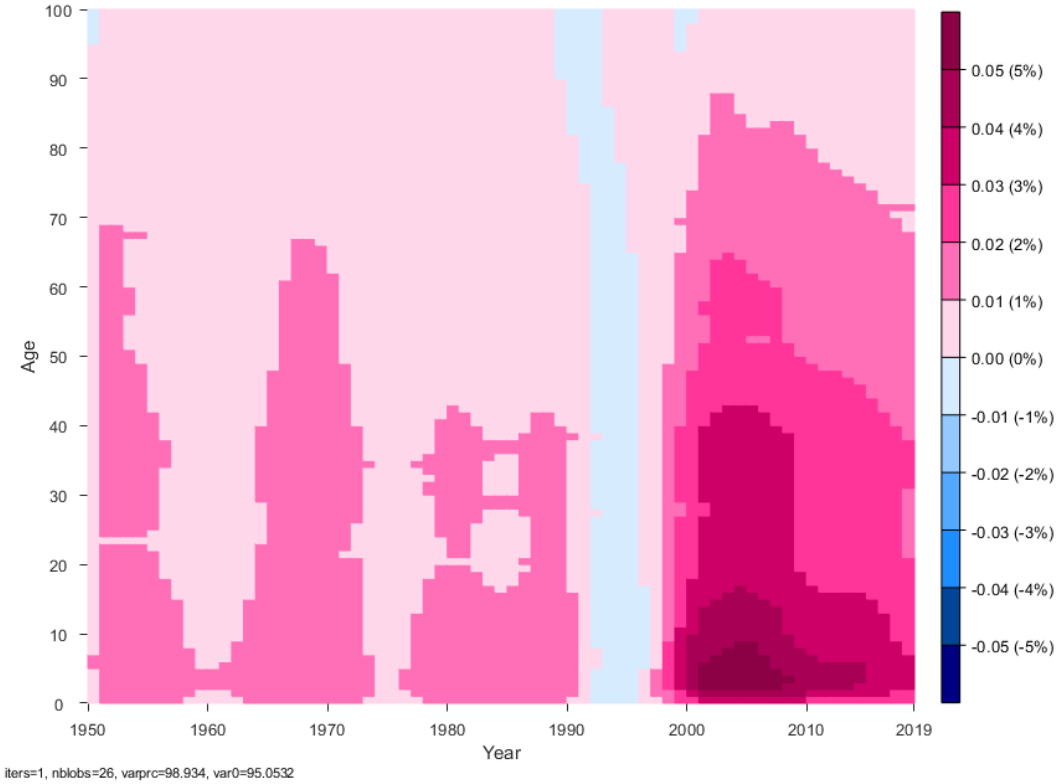
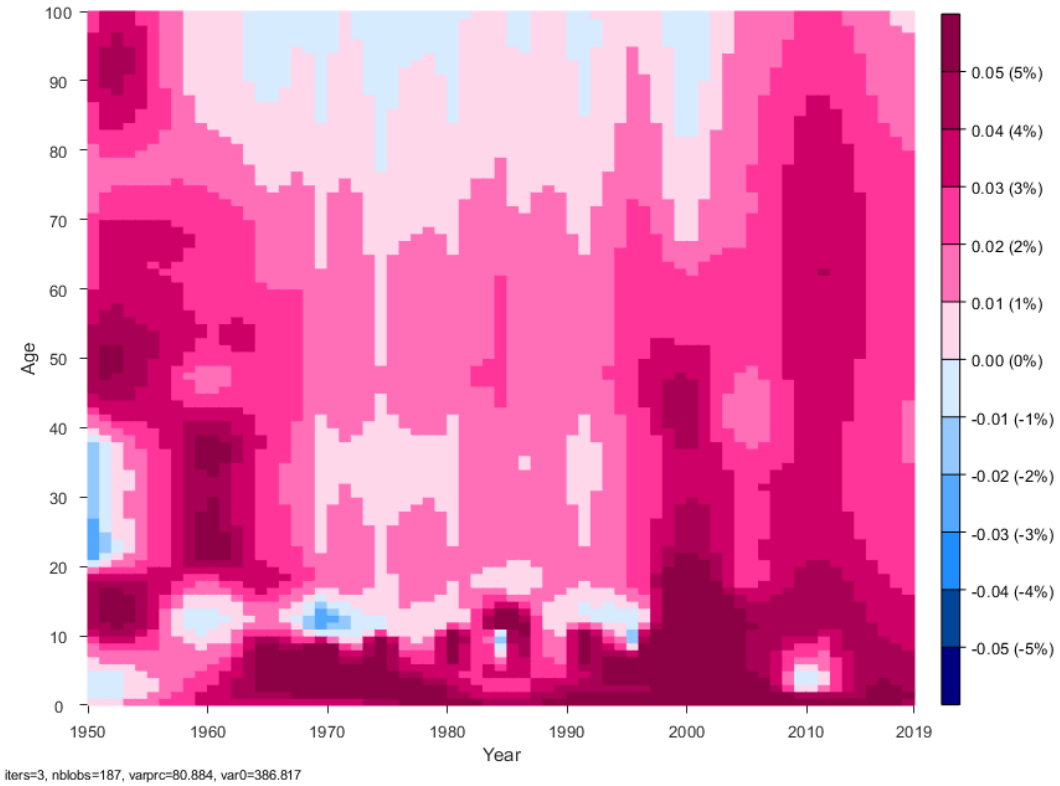
Females



iters=1, nblobs=26, varprc=98.934, var0=95.0532

Turkey

Males



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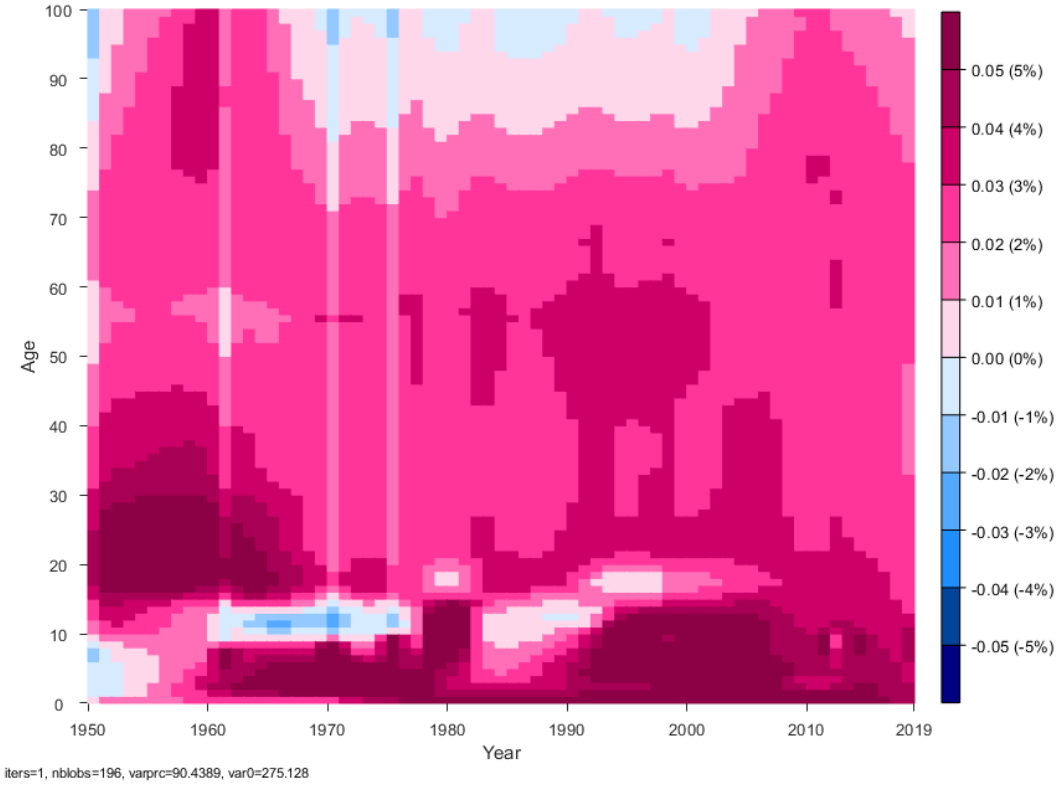
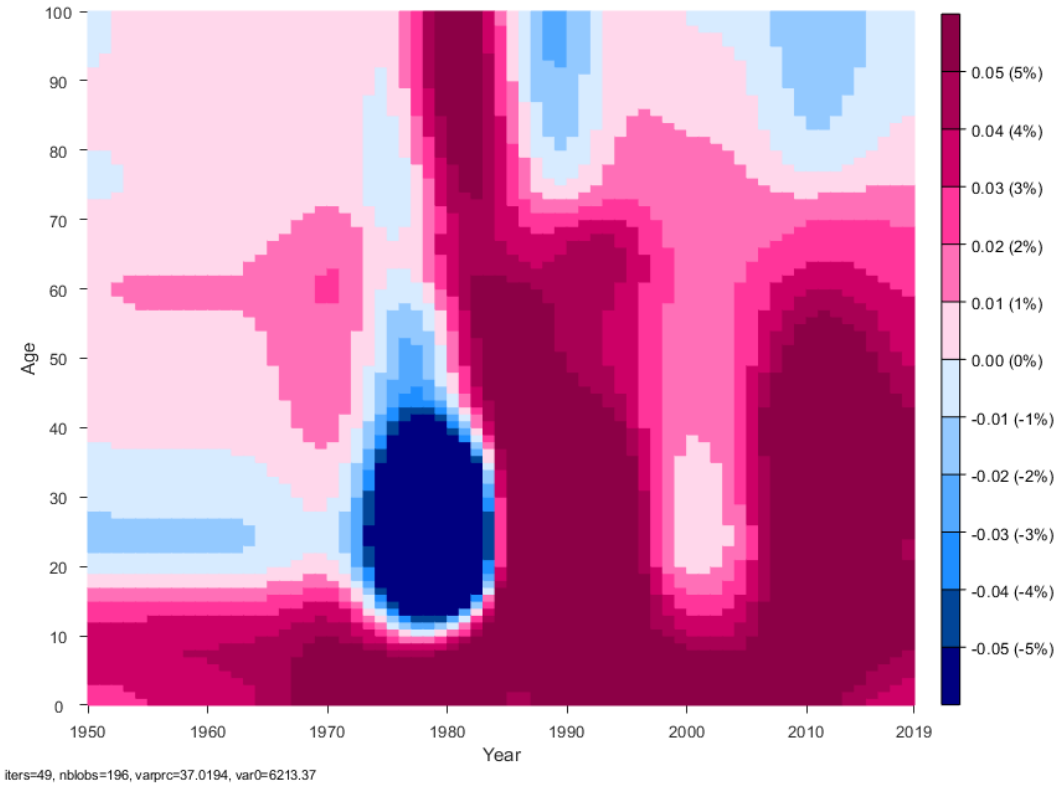
Females



iters=1, nblobs=196, varprc=90.4389, var0=275.128

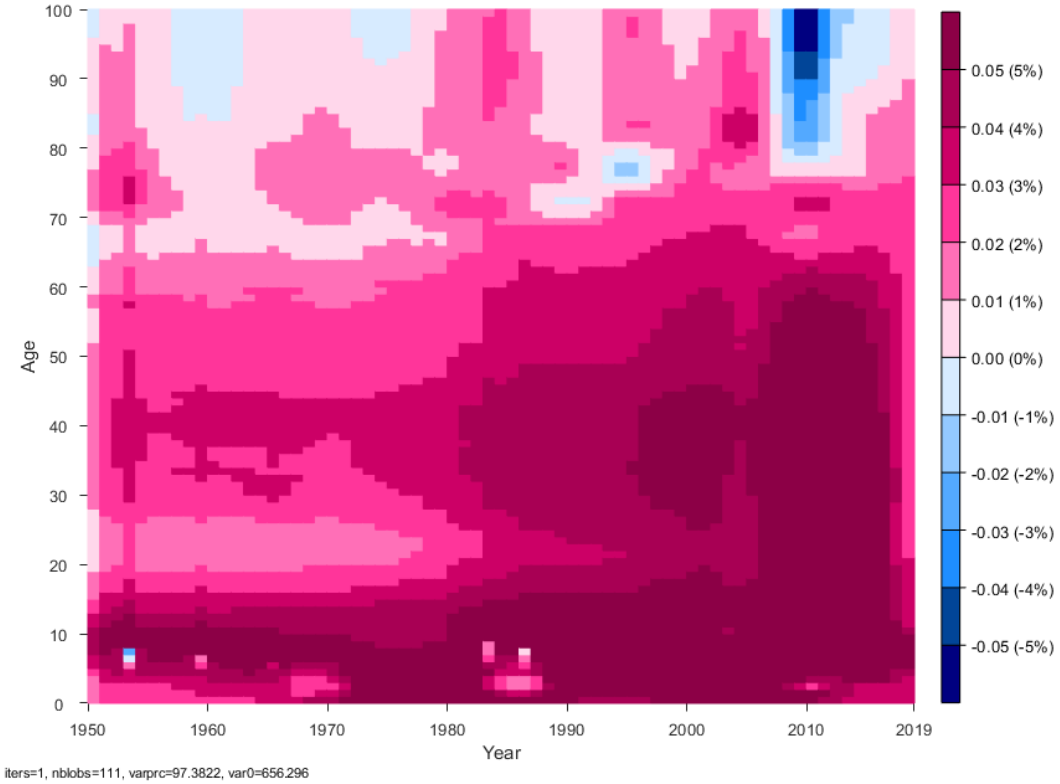
Iran (Islamic Republic of)

Males



iters=49, nblobs=196, varprc=37.0194, var0=6213.37

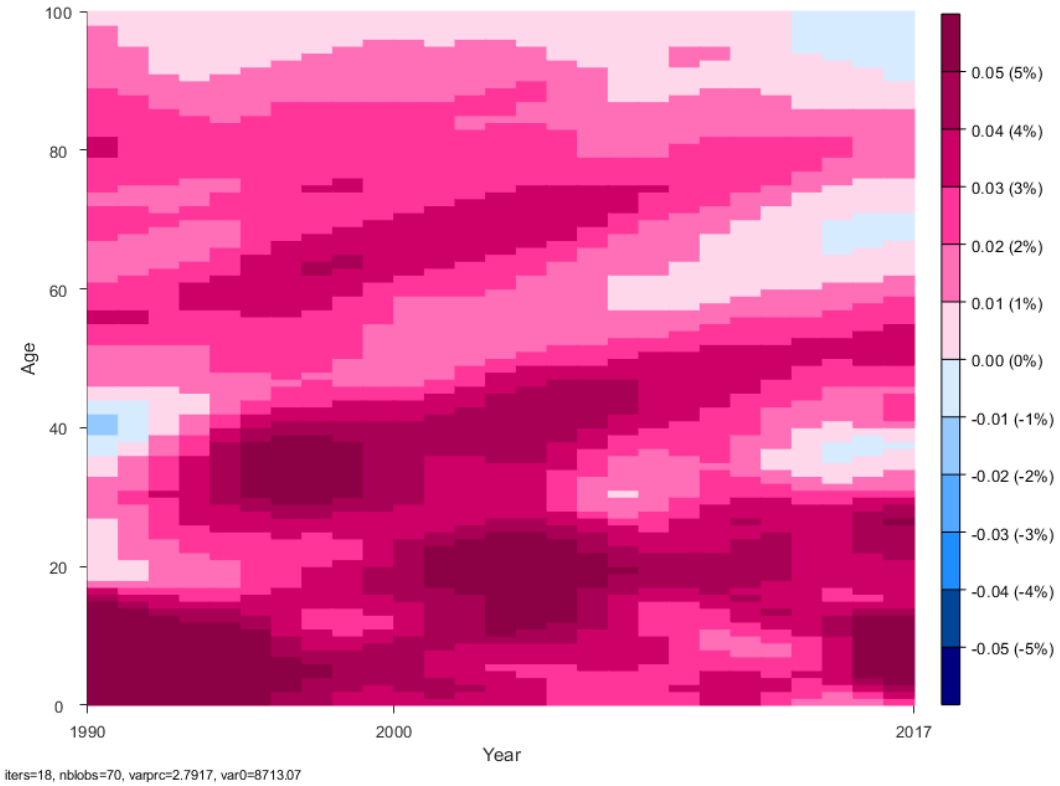
Females



iters=1, nblobs=111, varprc=97.3822, var0=656.296

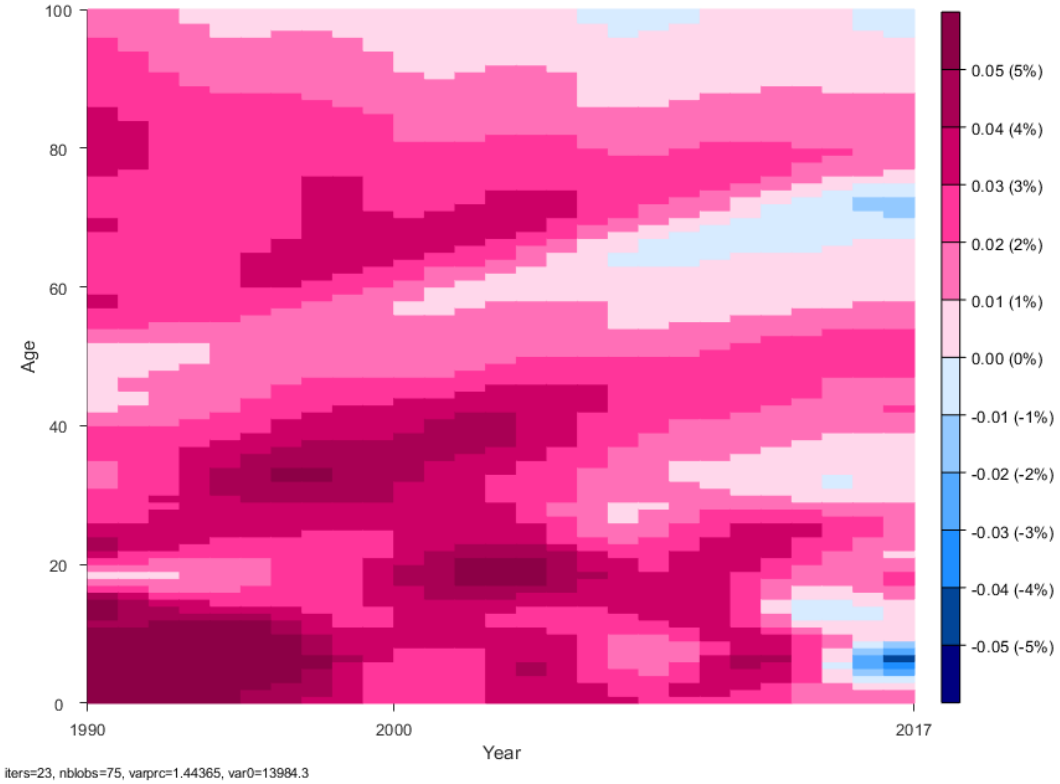
Germany

Males



iters=18, nblobs=70, varprc=2.7917, var0=8713.07

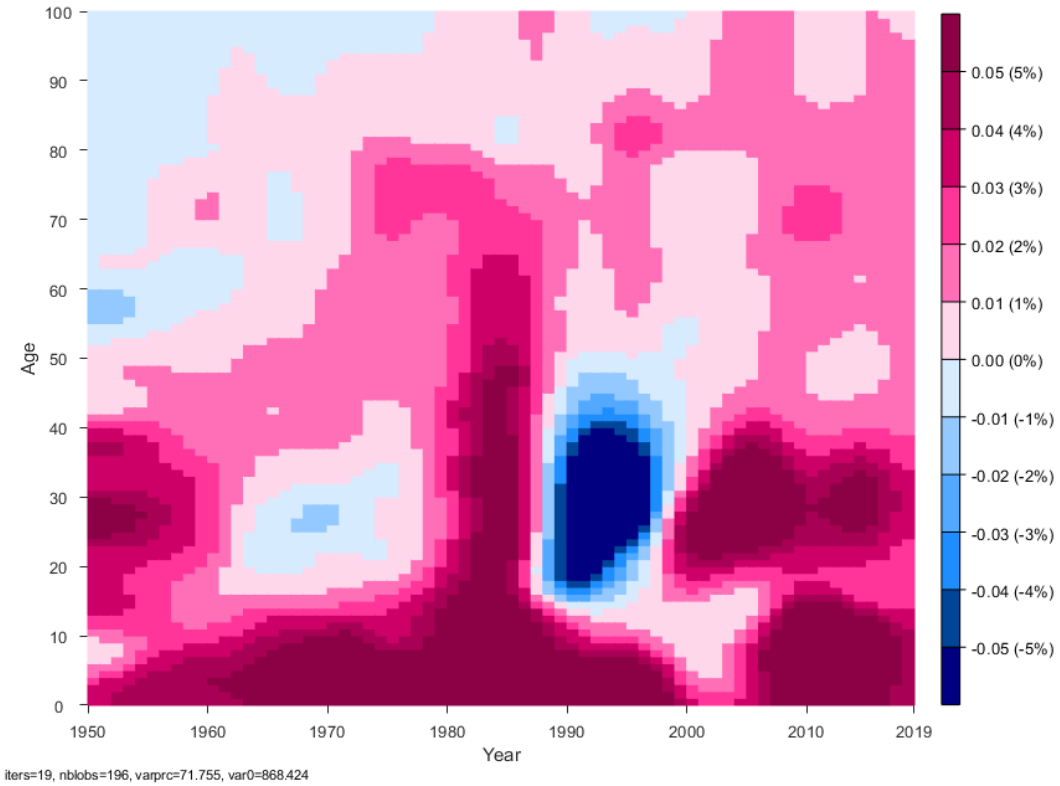
Females



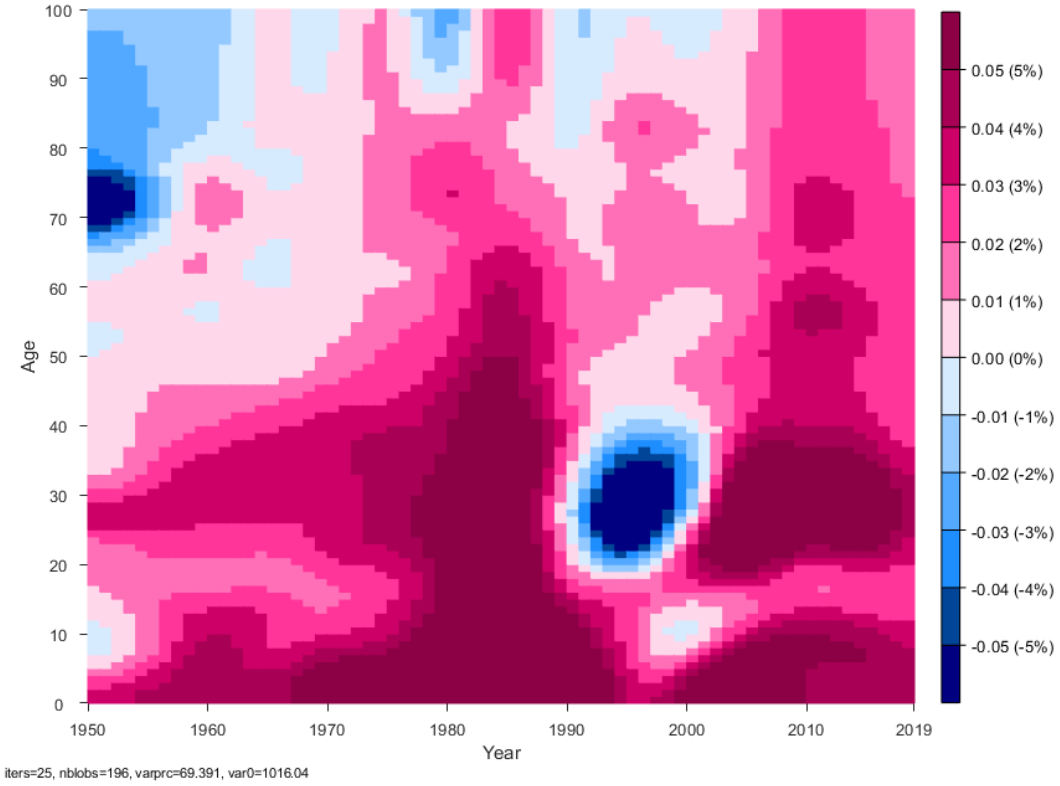
iters=23, nblobs=75, varprc=1.44365, var0=13984.3

Thailand

Males

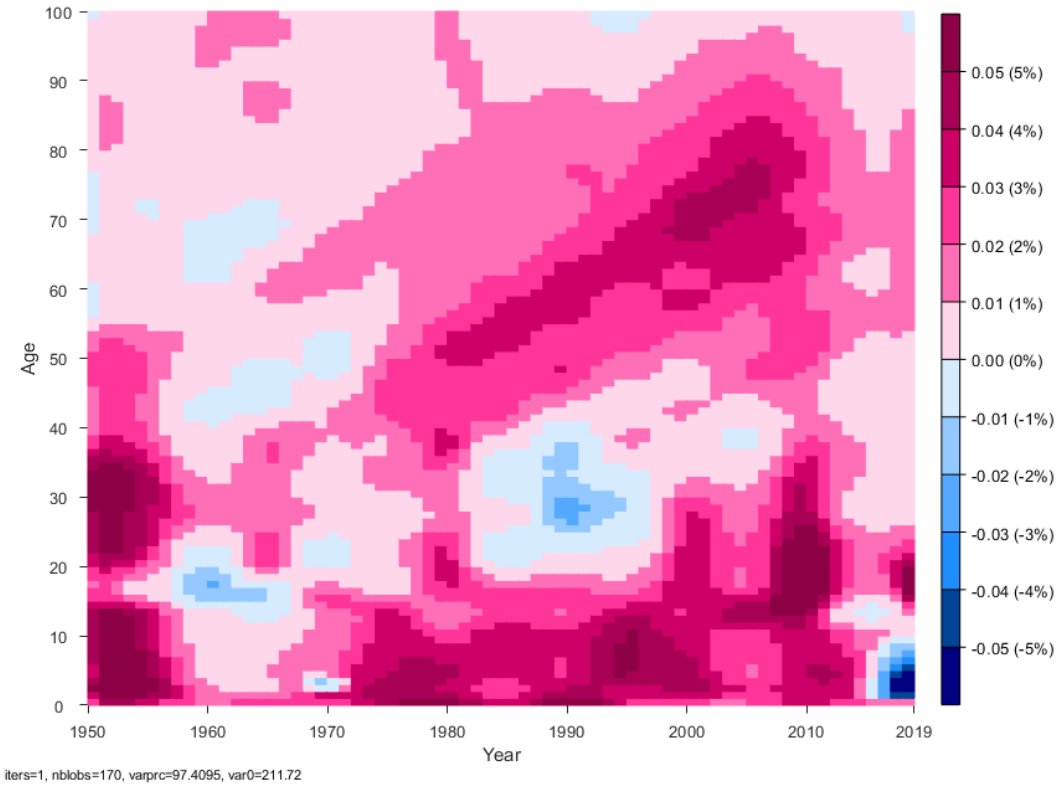


Females

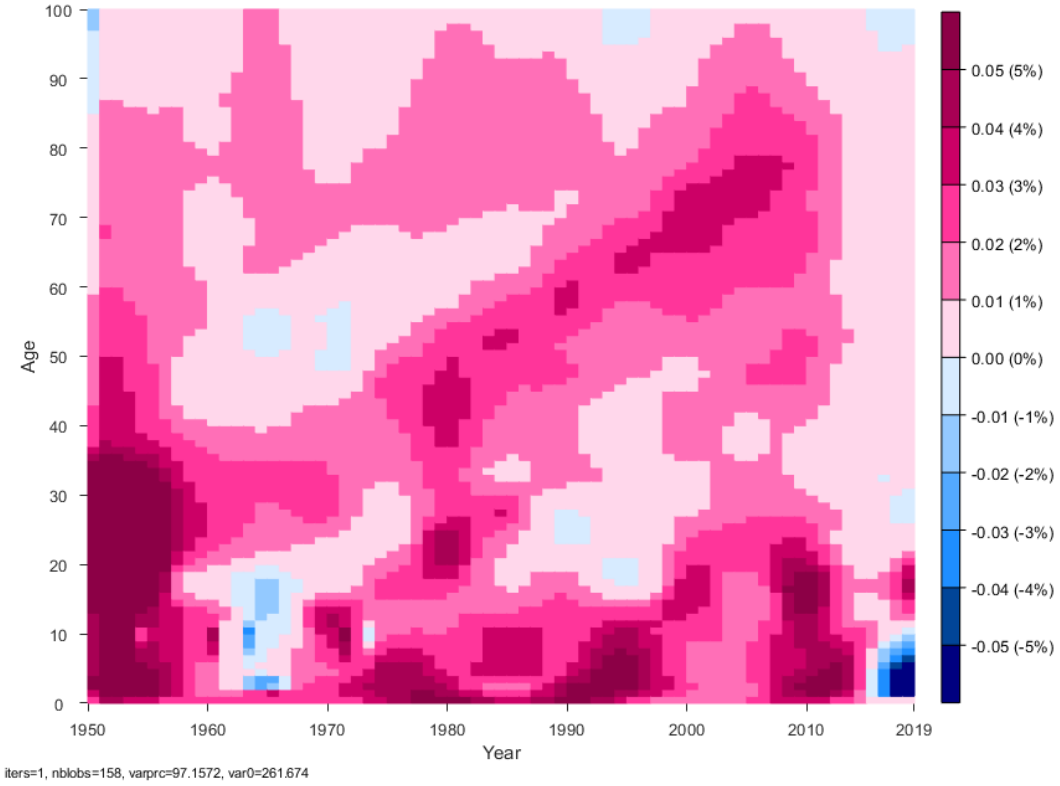


United Kingdom

Males

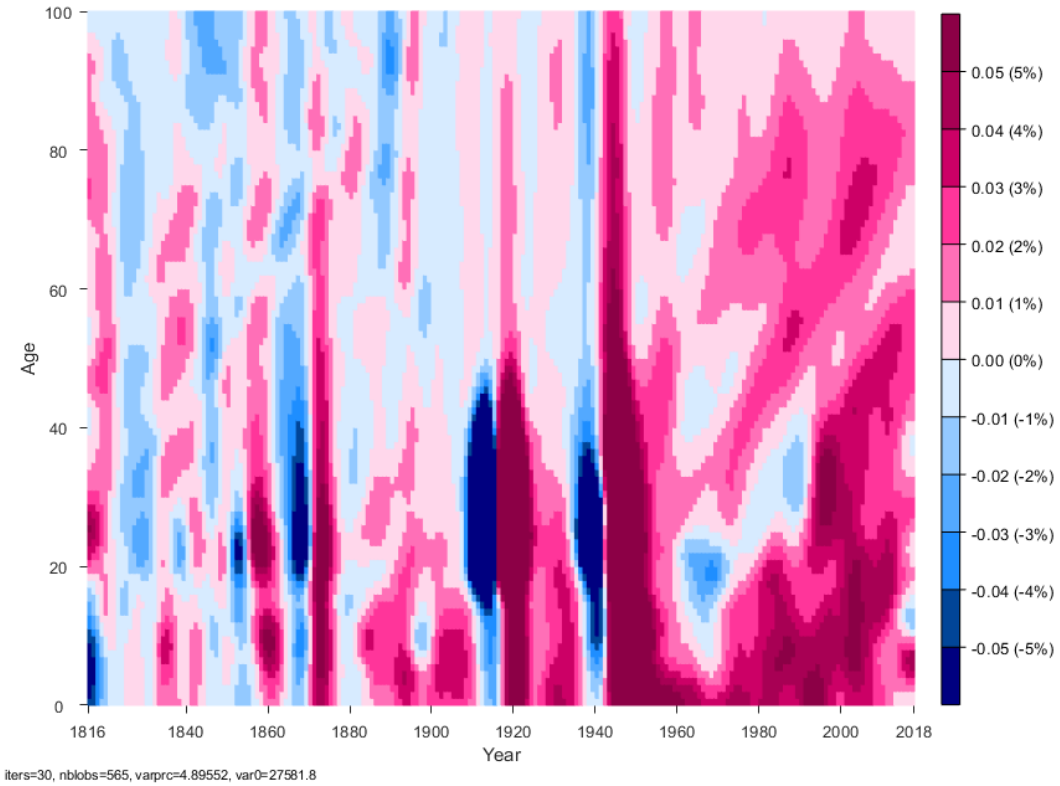


Females



France

Males



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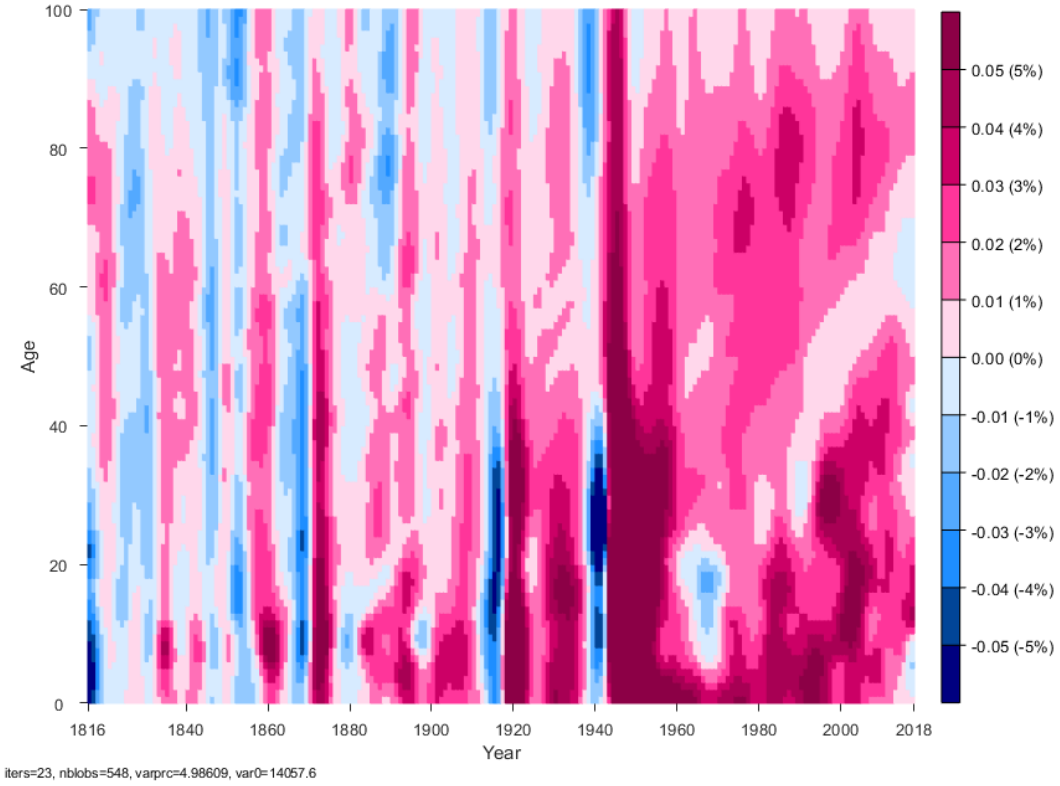
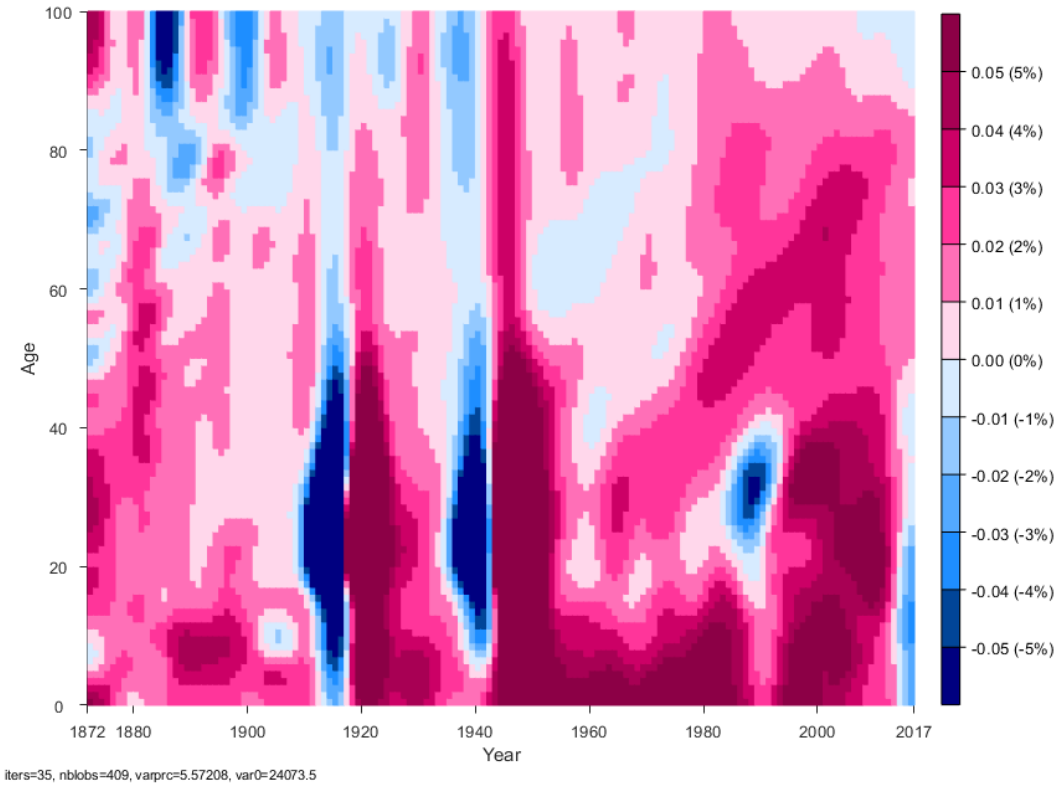
Females



iters=23, nblobs=548, varprc=4.98609, var0=14057.6

Italy

Males



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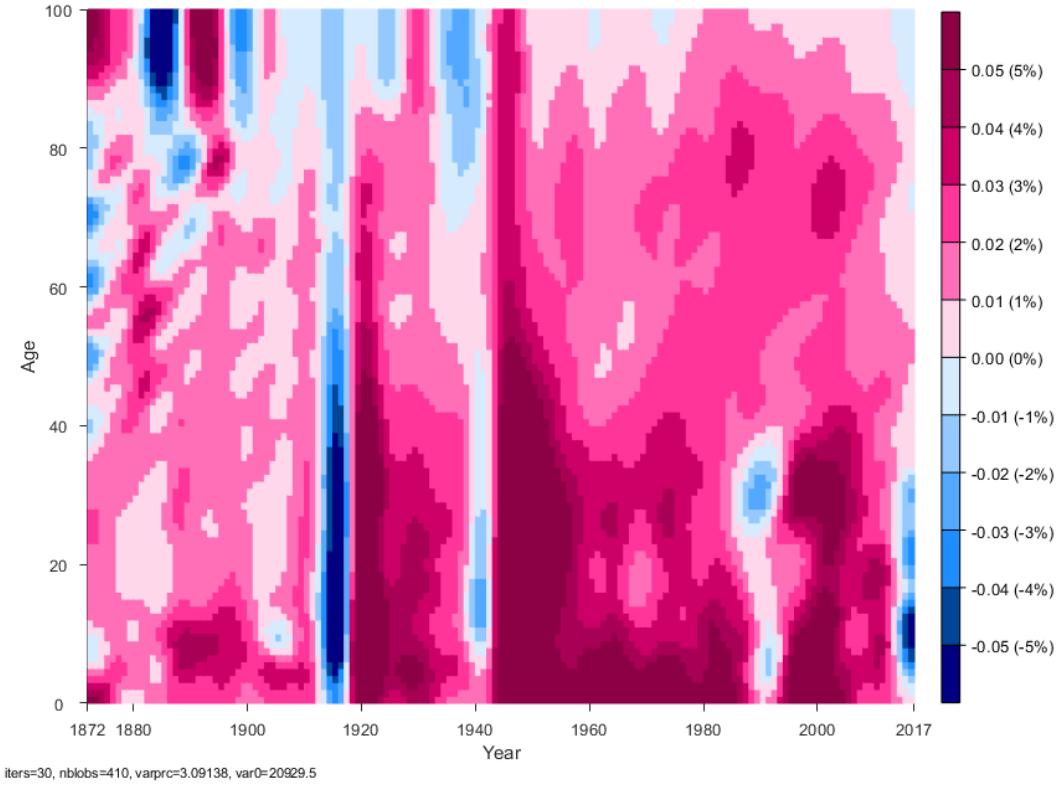
Females



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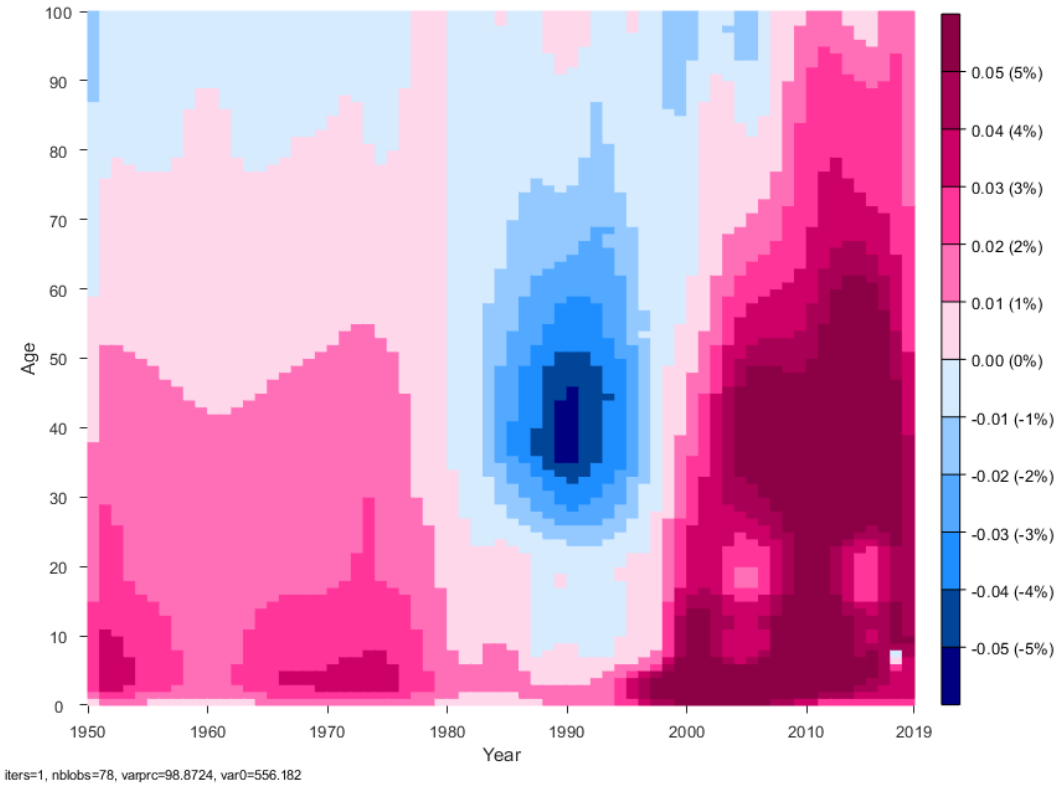
United Republic of Tanzania

Males



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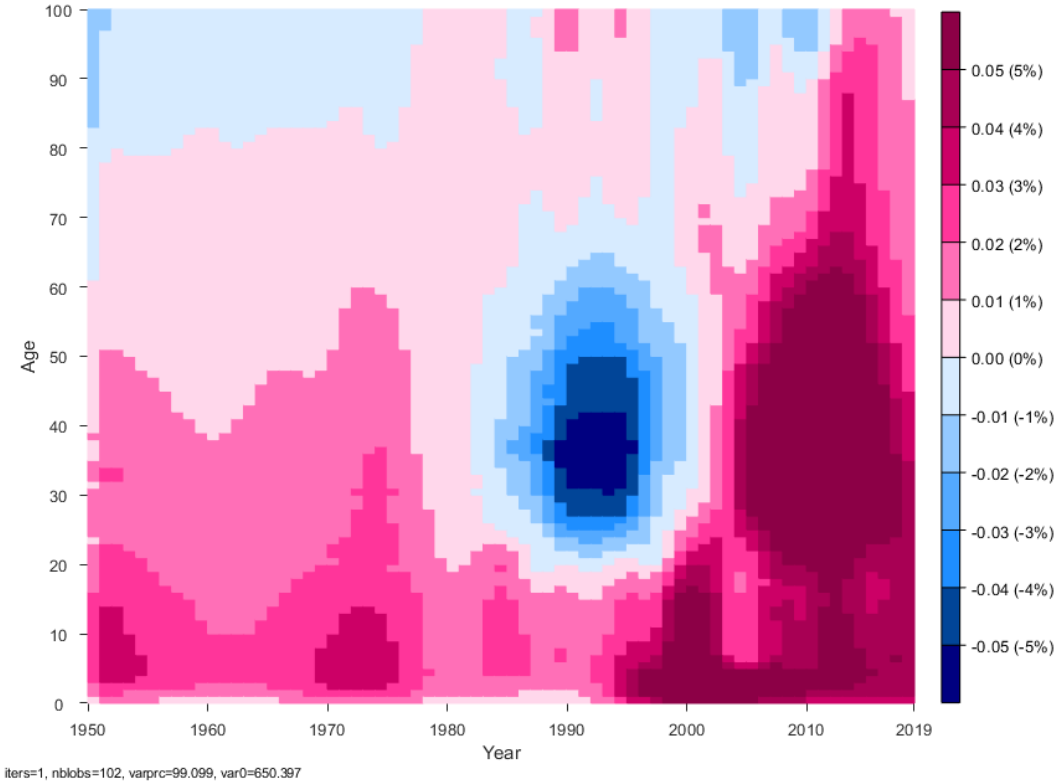
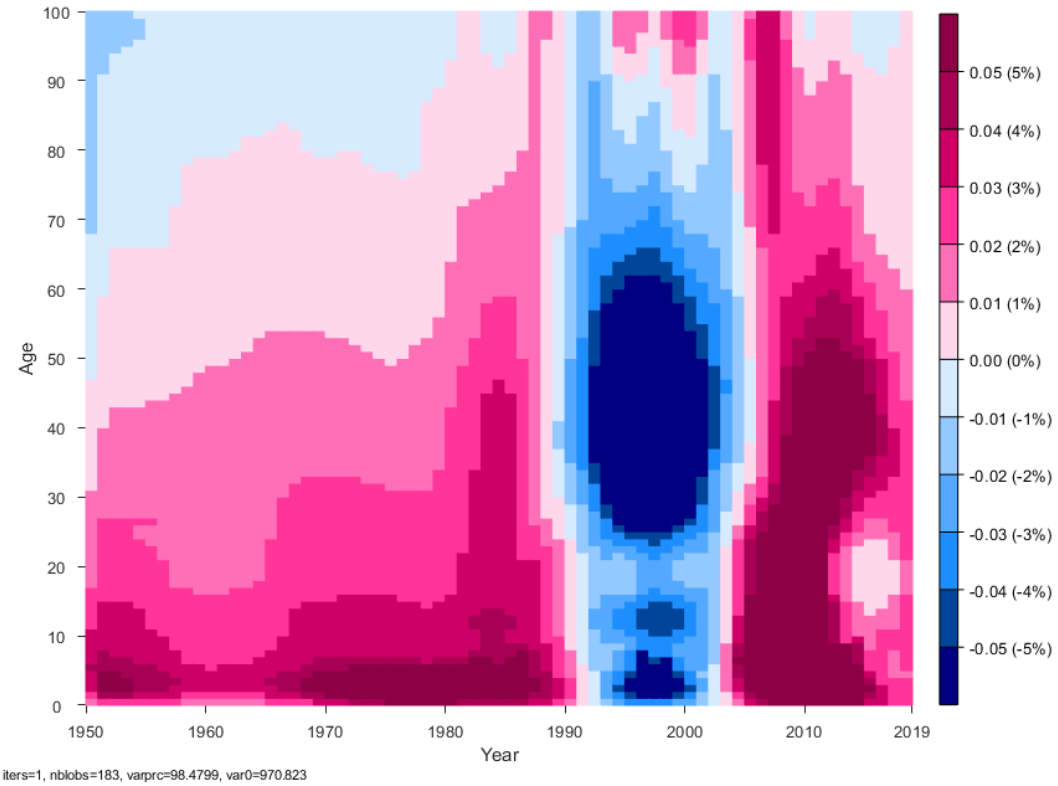
Females



iters=1, nblobs=102, varprc=99.099, var0=650.397

South Africa

Males



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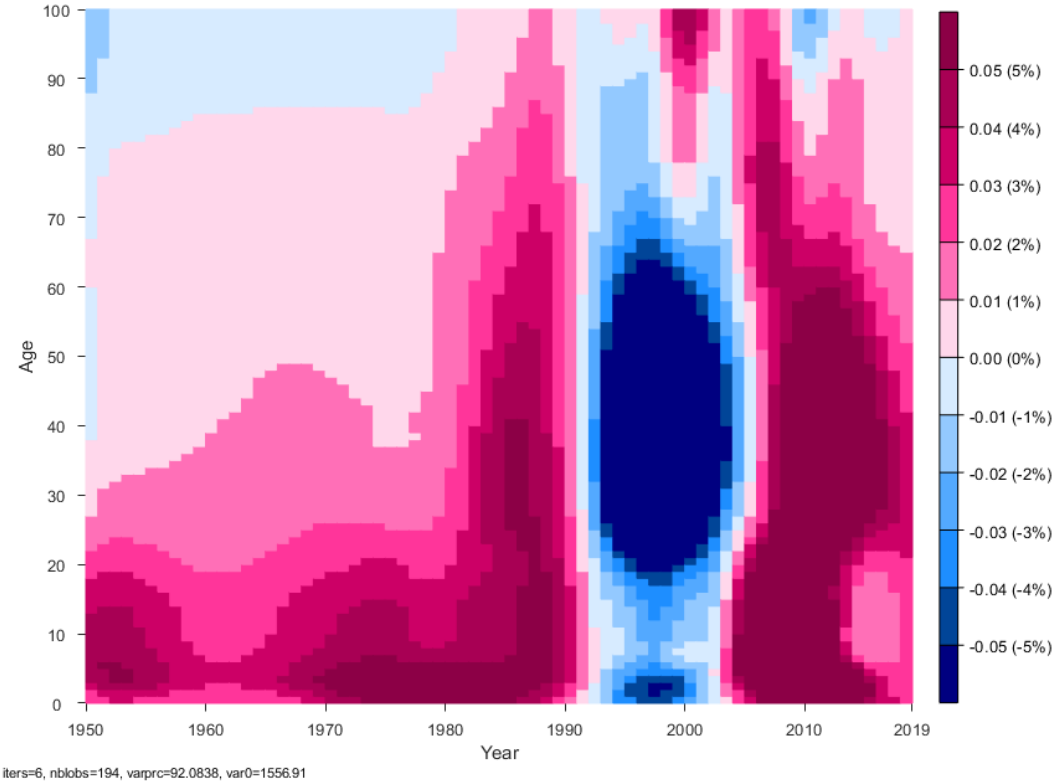
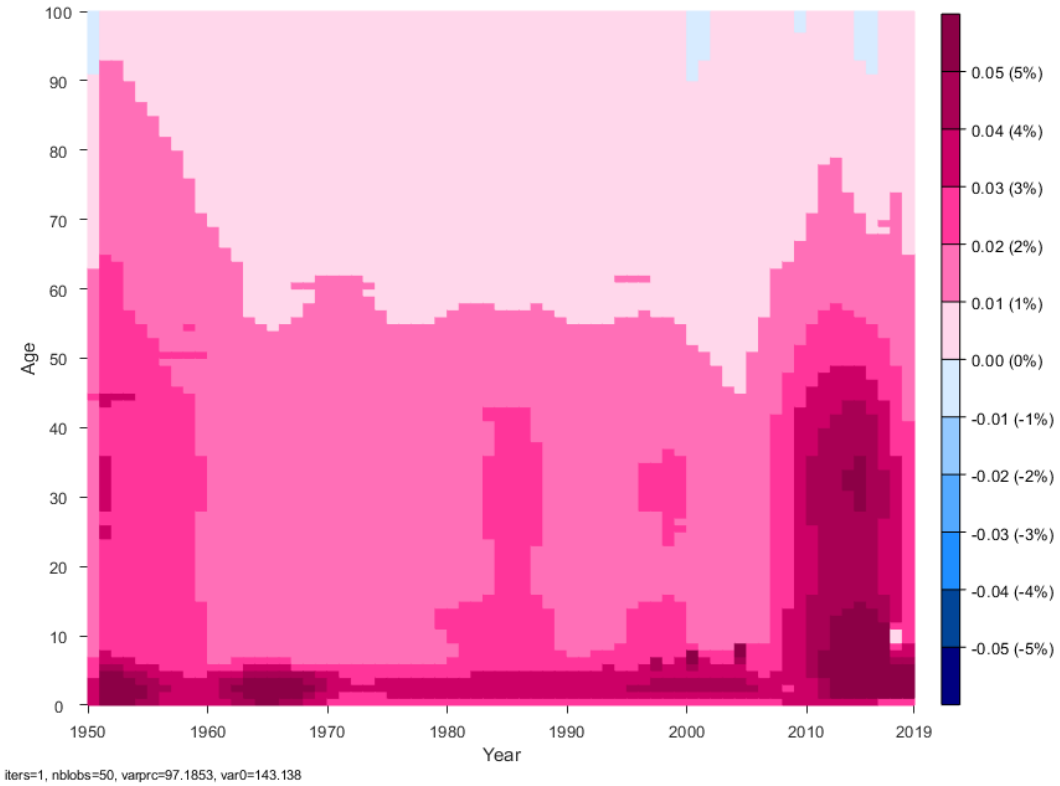
Females



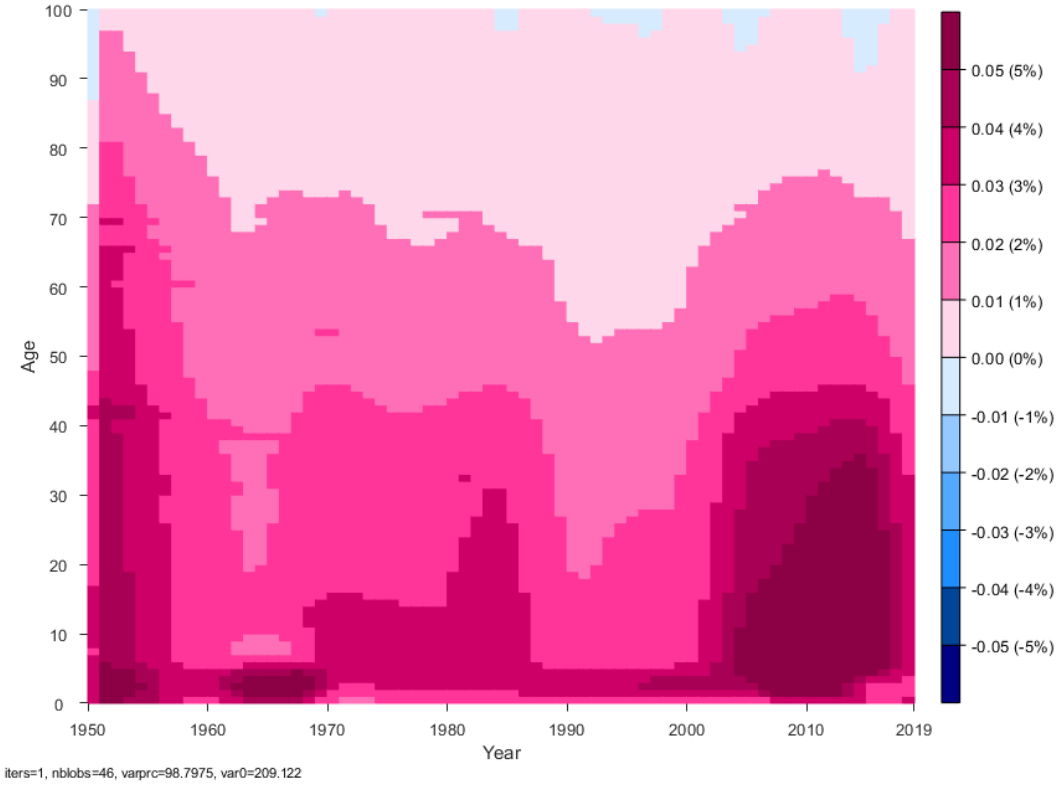
iters=6, nblobs=194, varprc=92.0838, var0=1556.91

Myanmar

Males

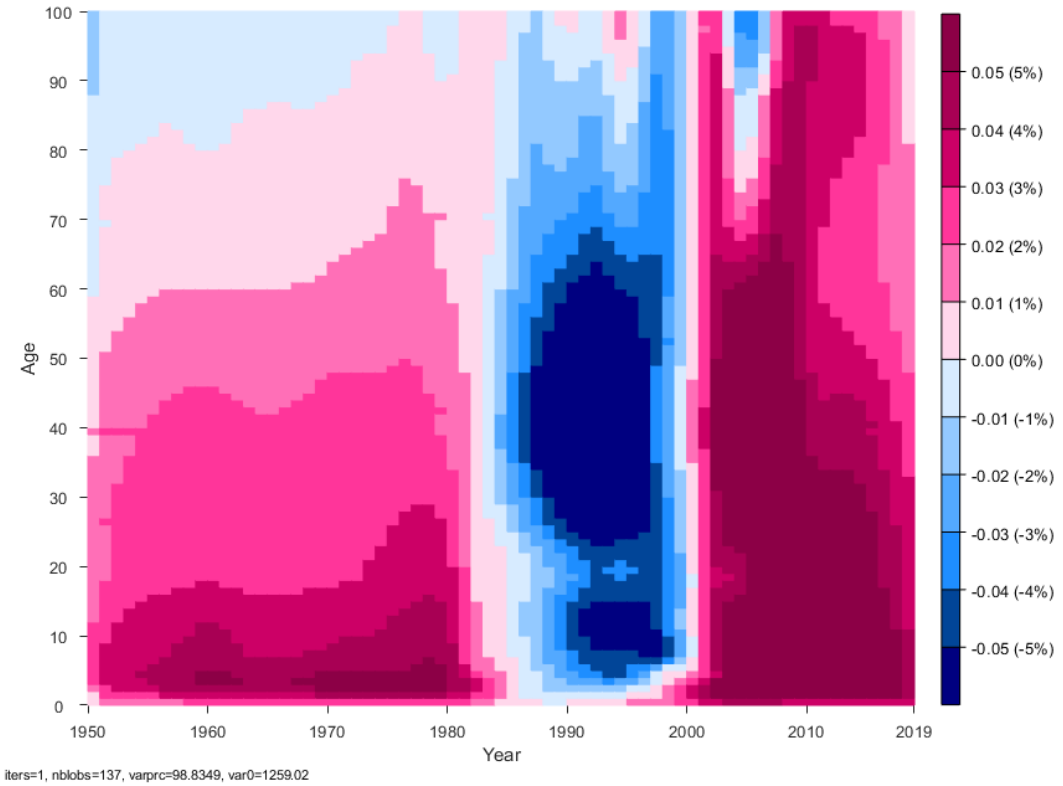


Females



Kenya

Males



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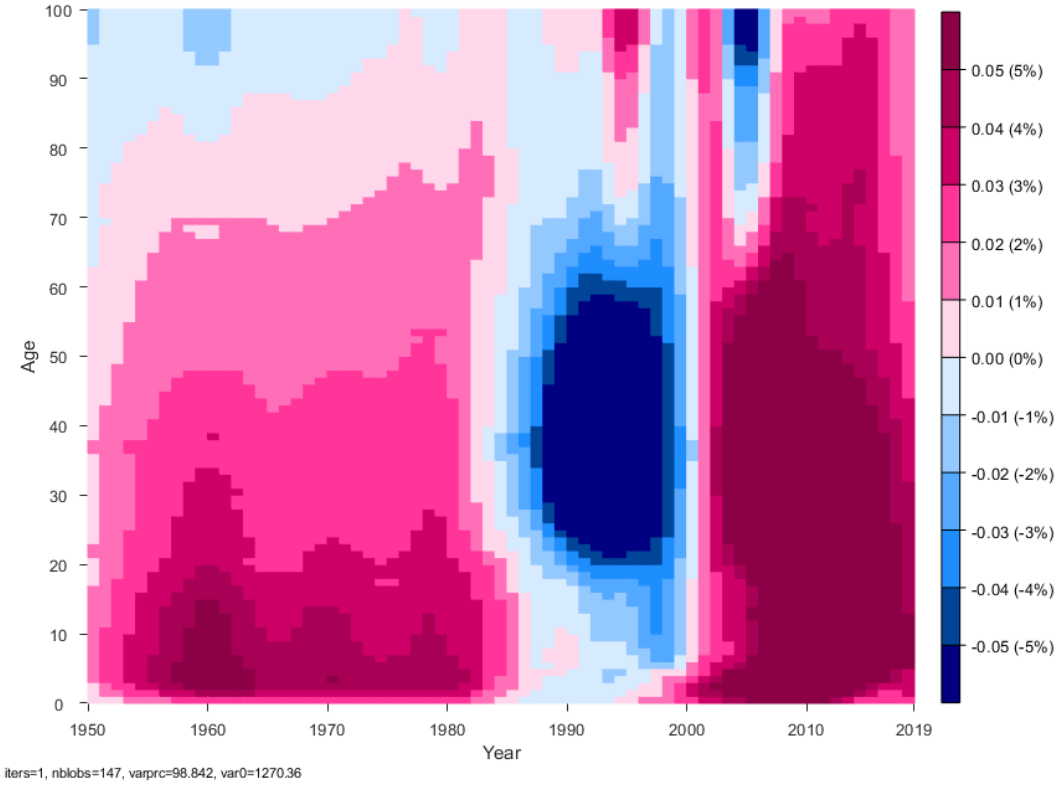
Females



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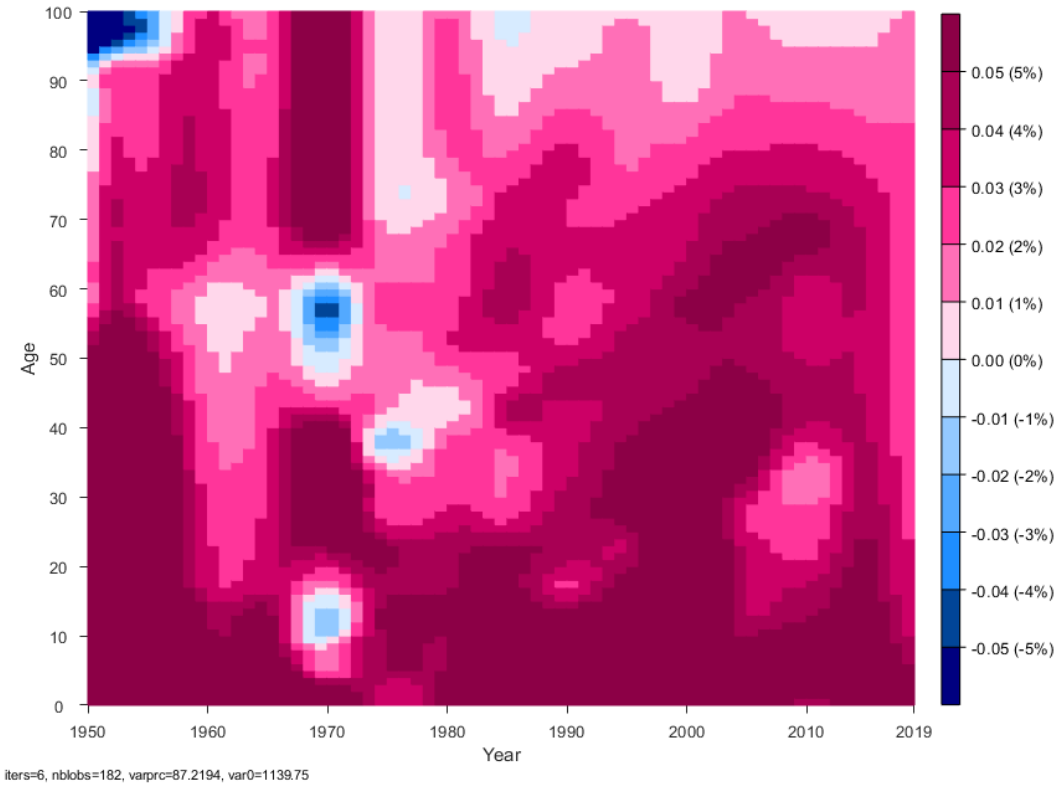
Republic of Korea

Males



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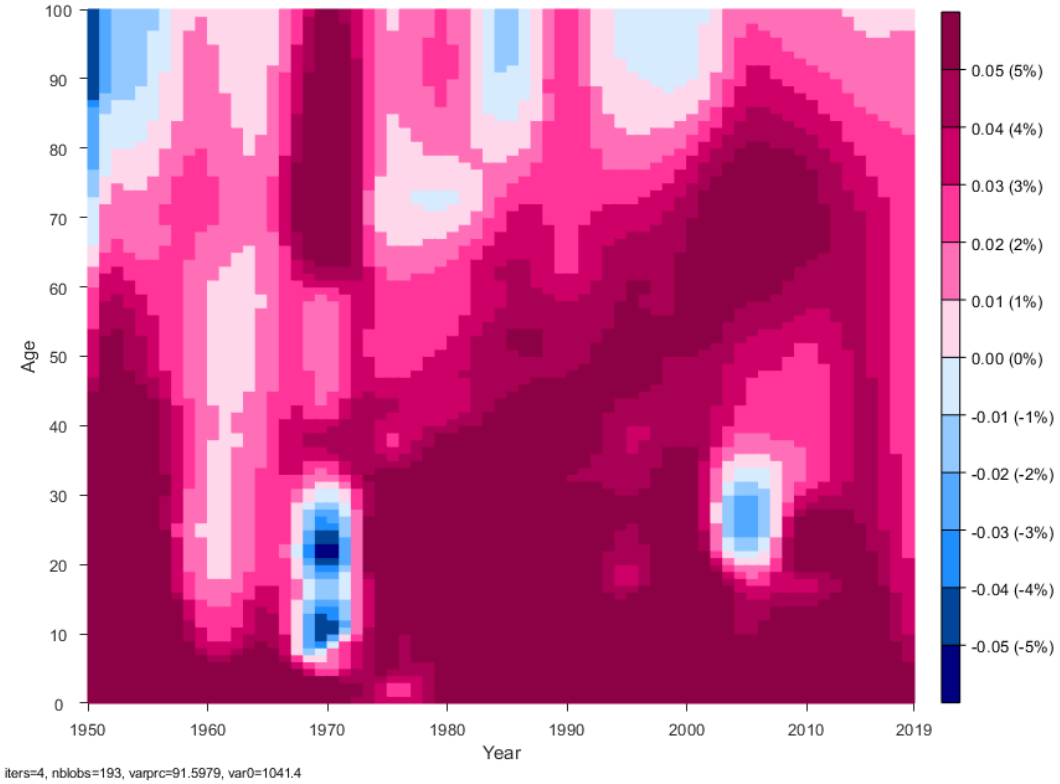
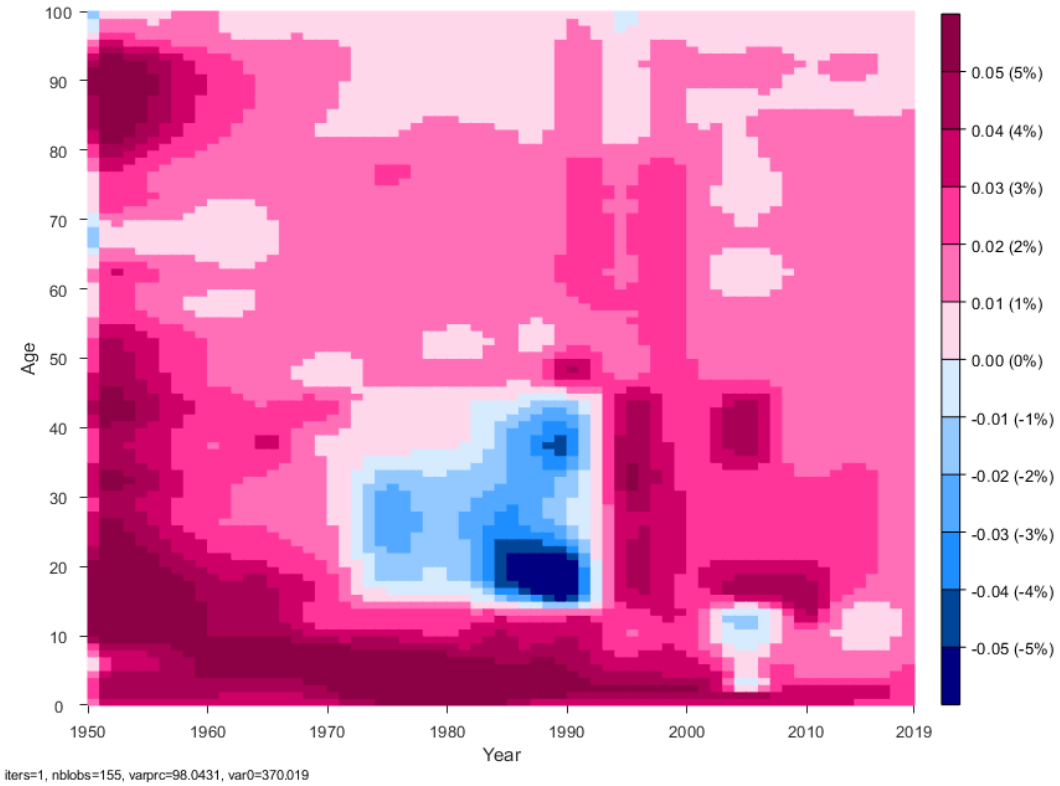
Females



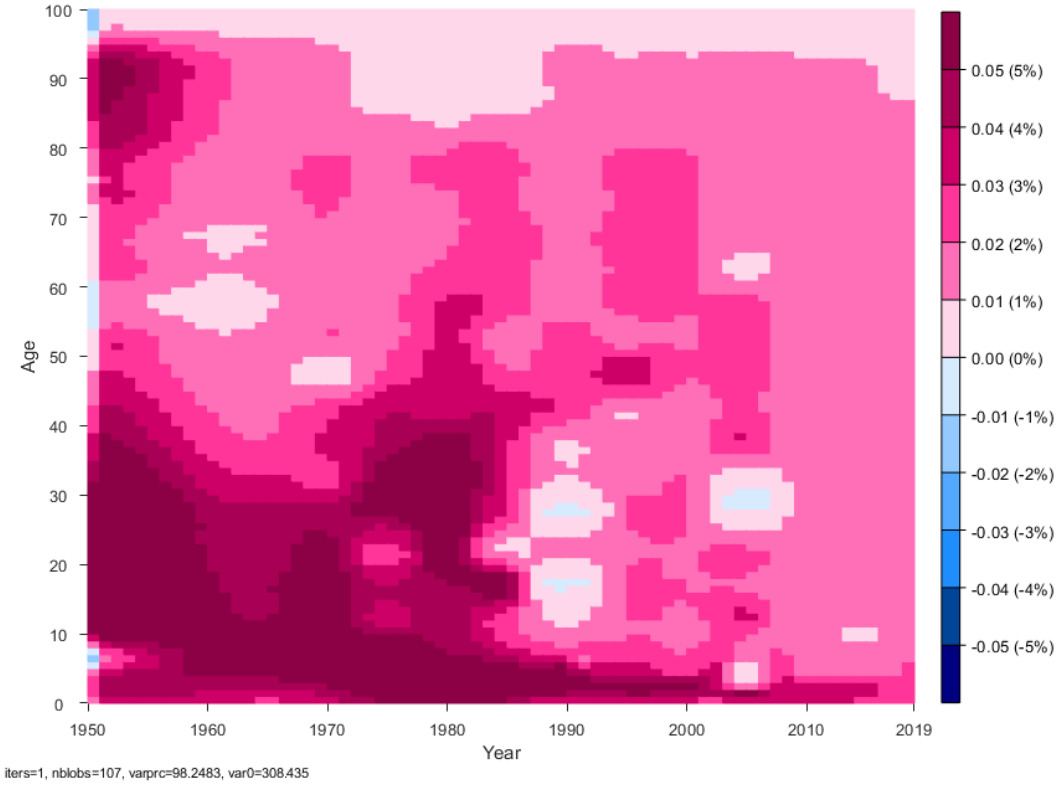
iters=4, nblobs=193, varprc=91.5979, var0=1041.4

Colombia

Males

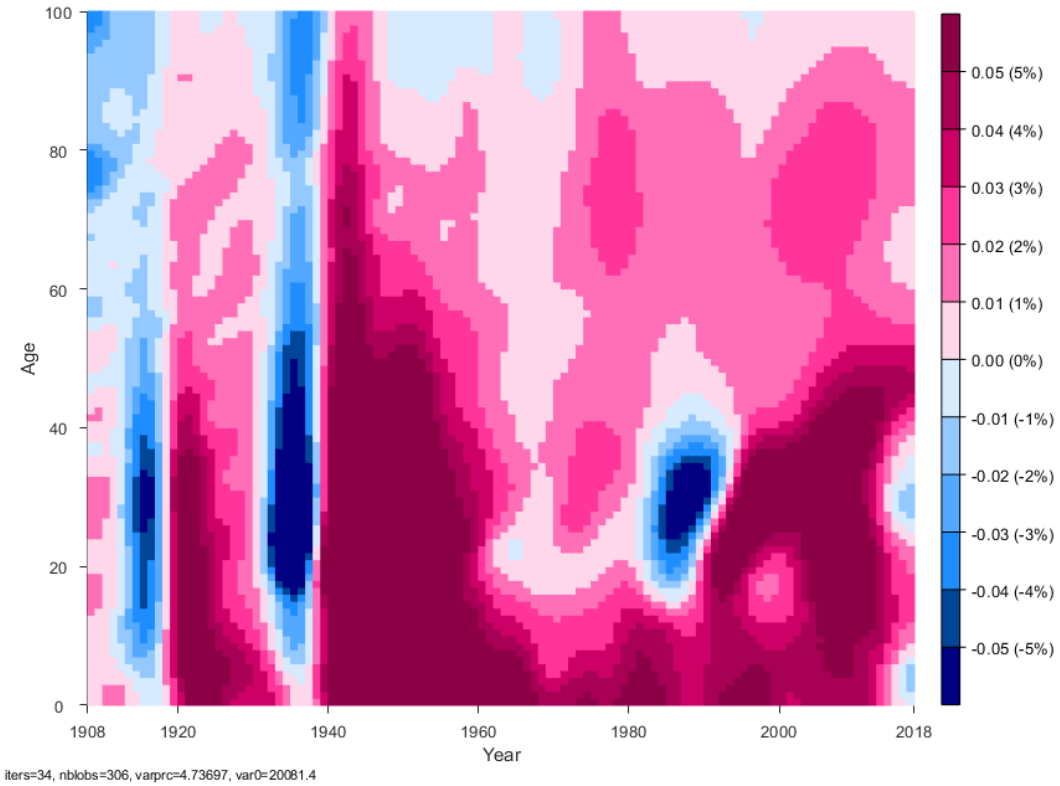


Females



Spain

Males



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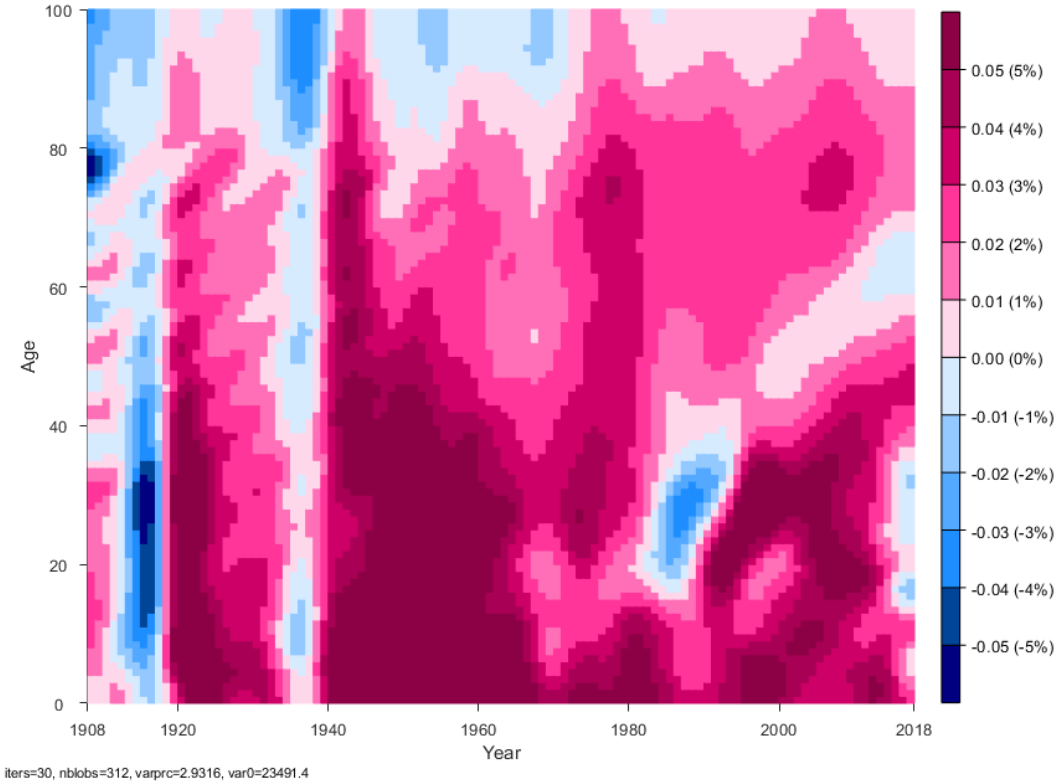
Females



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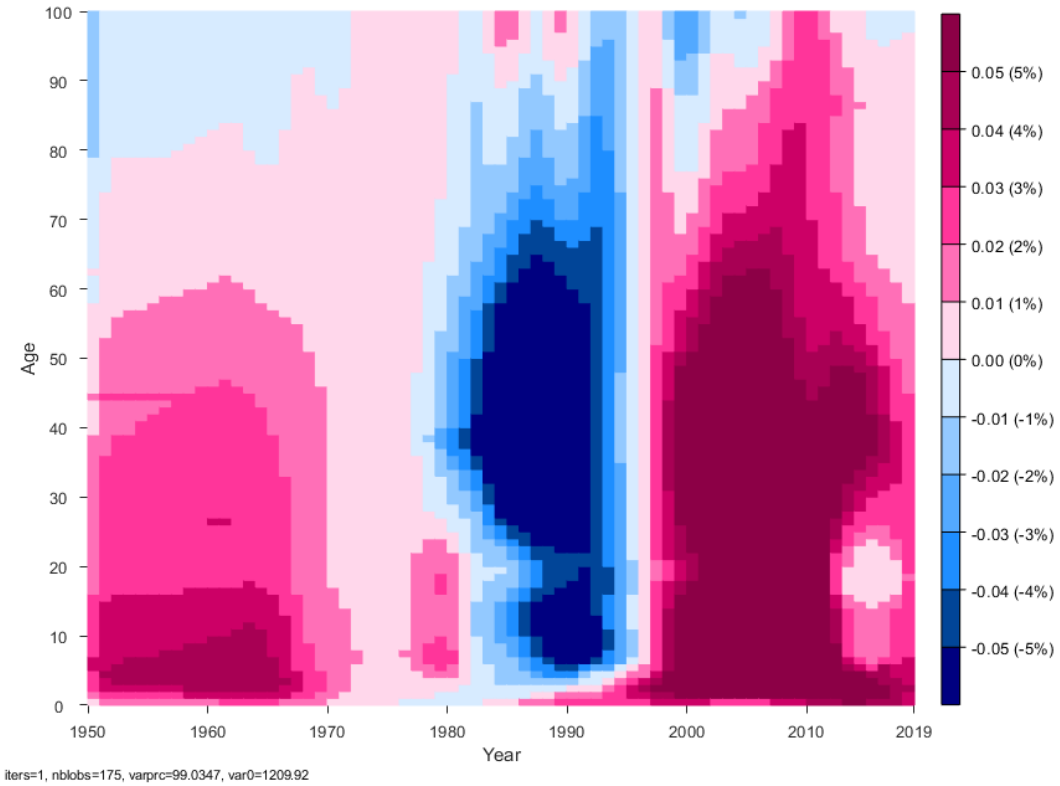
Uganda

Males



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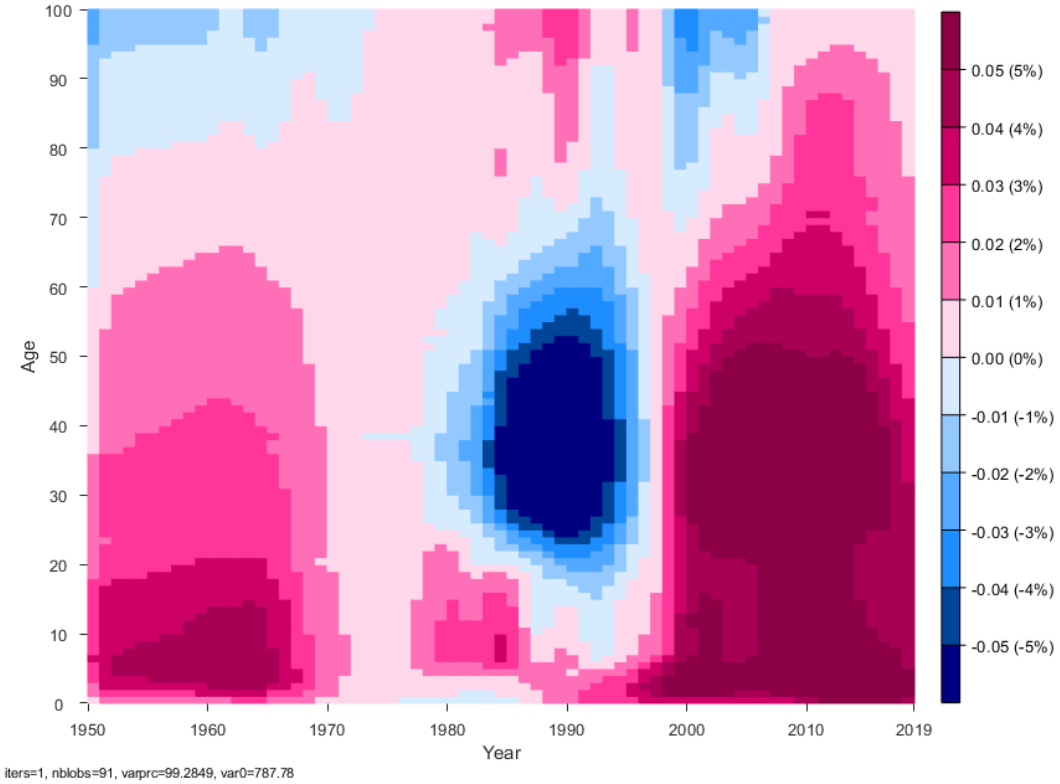
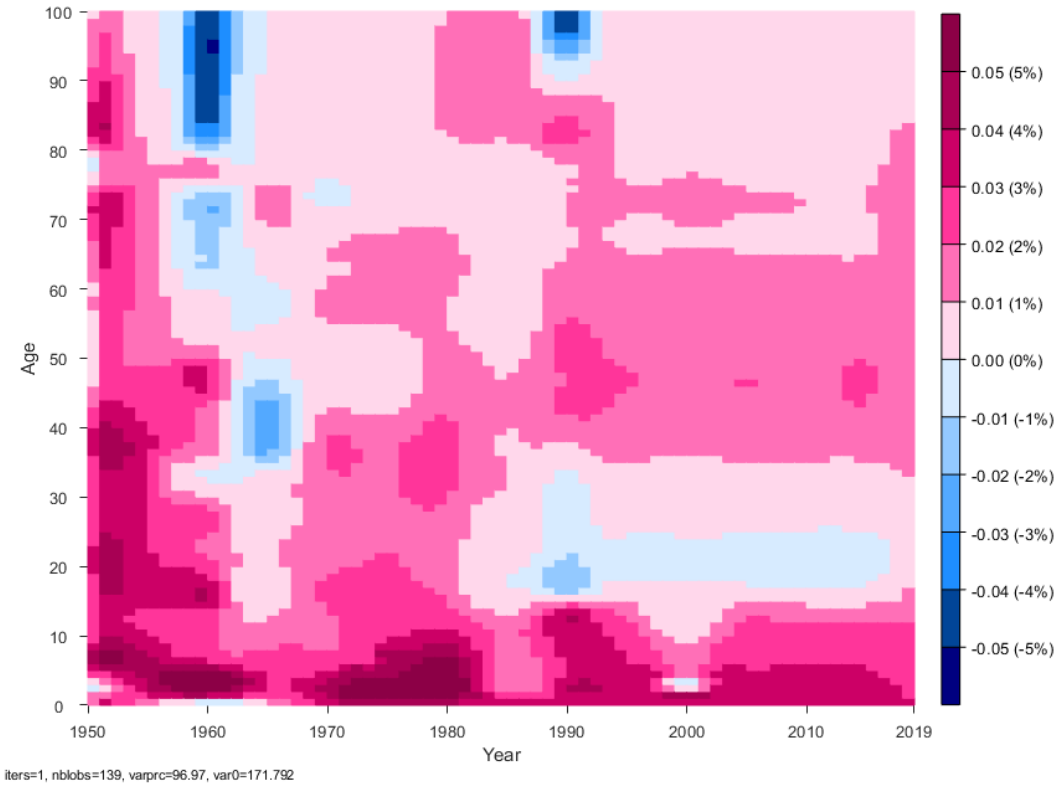
Females



iters=1, nblobs=91, varprc=99.2849, var0=787.78

Argentina

Males



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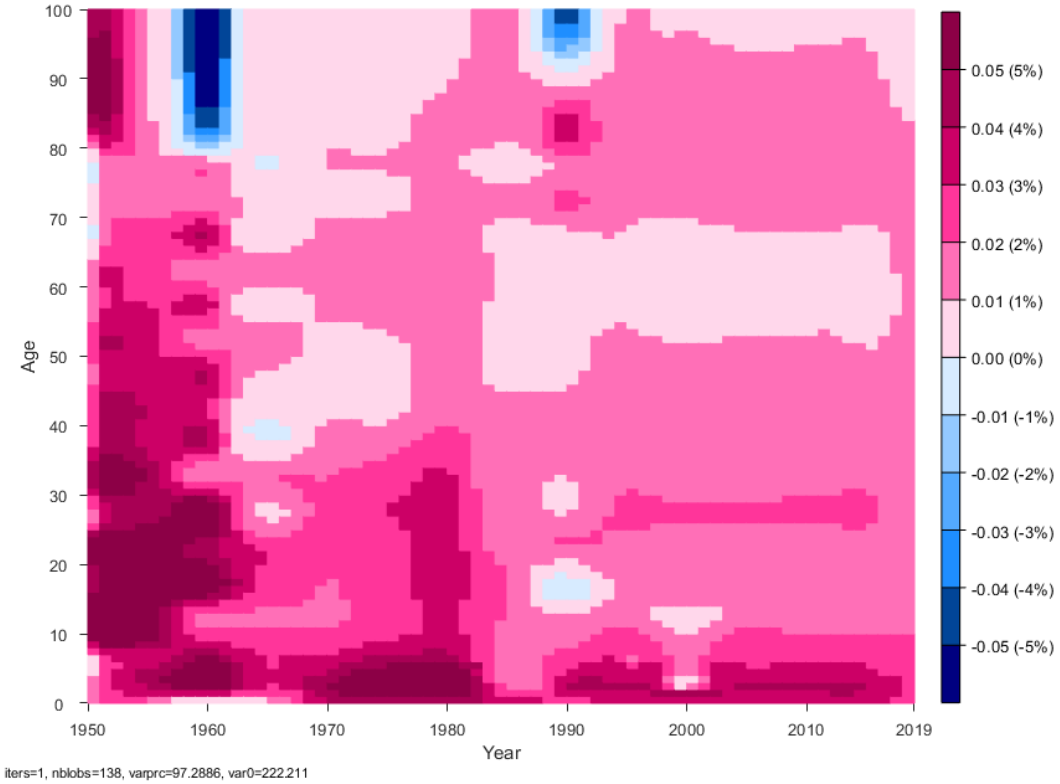
Females



iters=1, nblobs=138, varprc=97.2886, var0=222.211

Algeria

Males

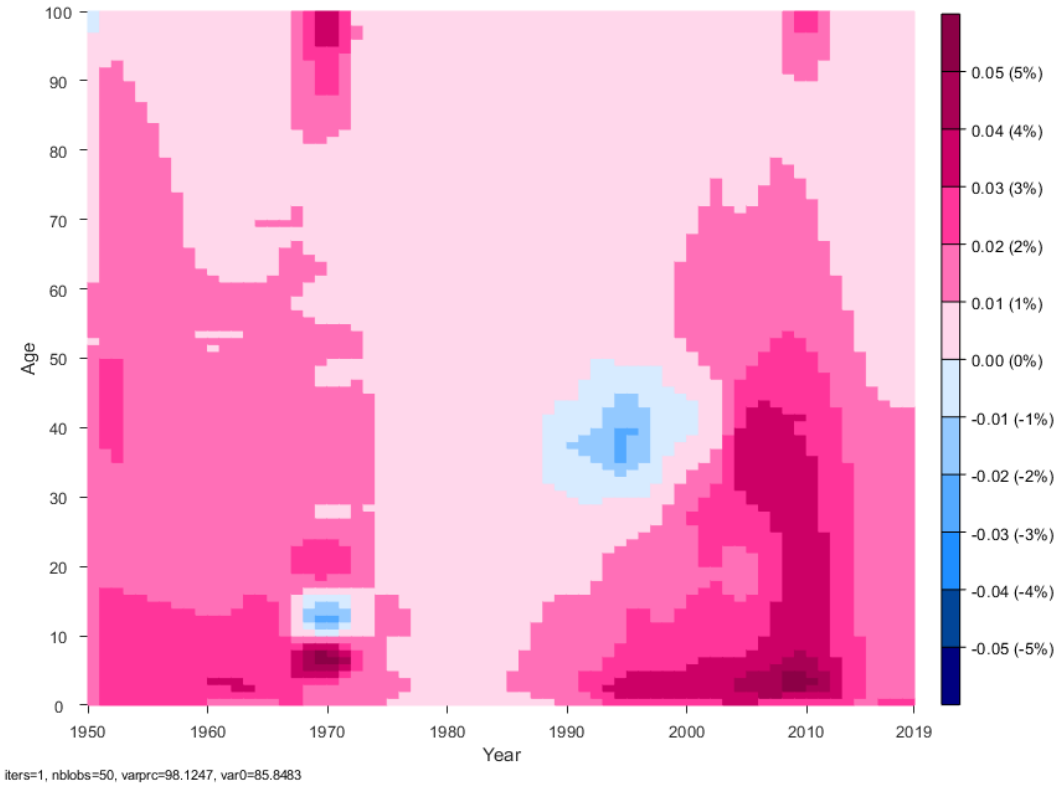
iters=1, nblobs=64, varprc=98.4308, var0=387.653

Females

iters=1, nblobs=75, varprc=98.4675, var0=521.559

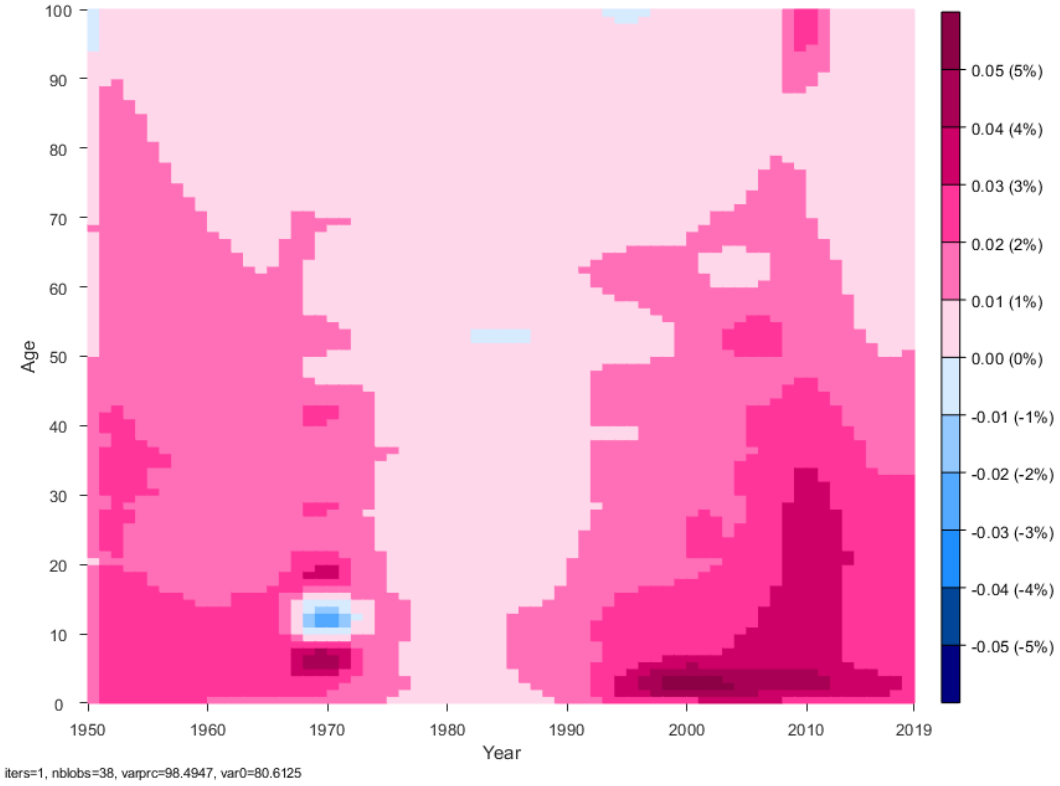
Sudan

Males



iters=1, nblobs=50, varprc=98.1247, var0=85.8483

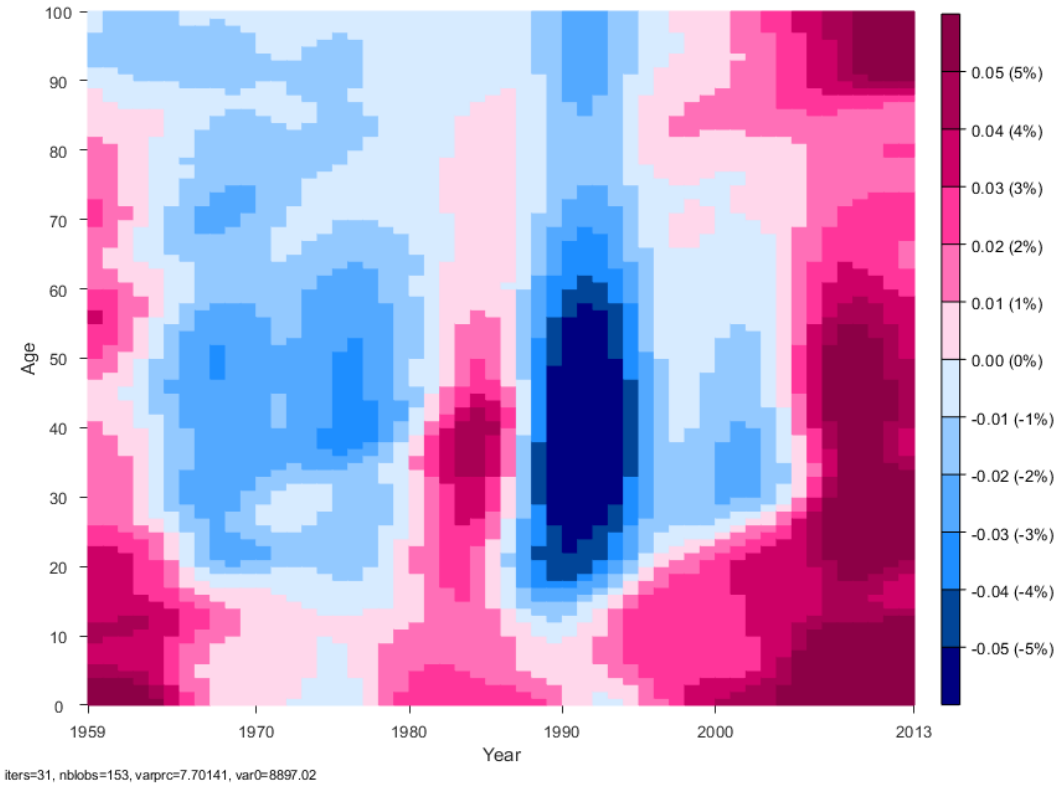
Females



iters=1, nblobs=38, varprc=98.4947, var0=80.6125

Ukraine

Males



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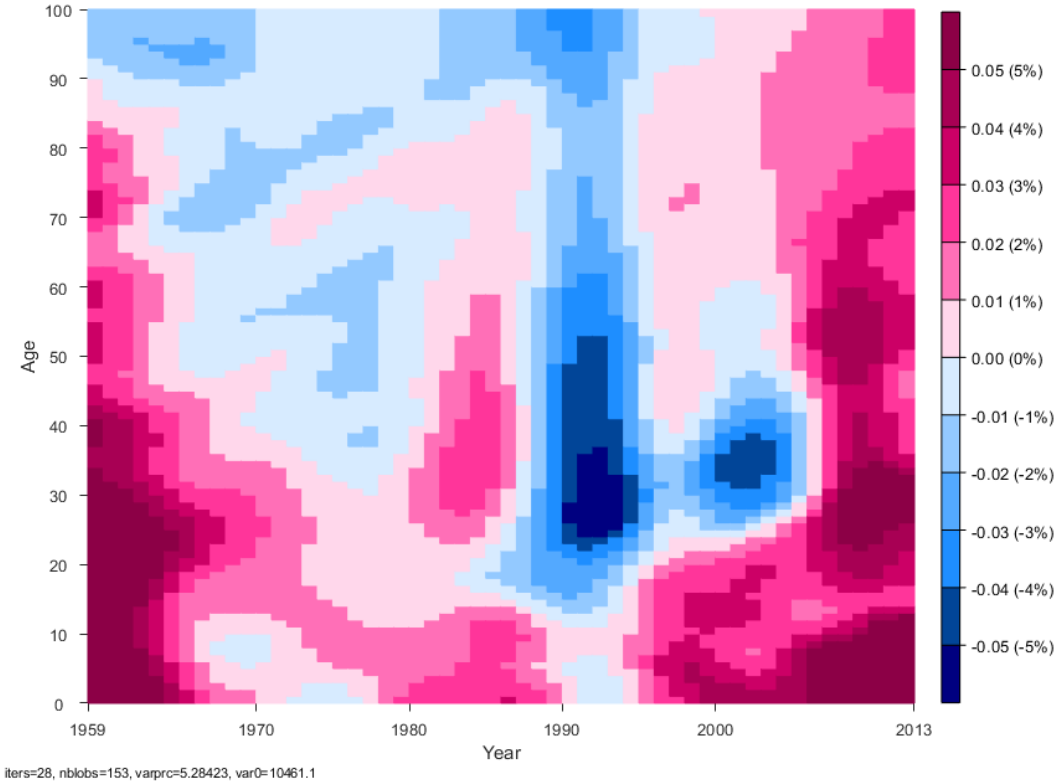
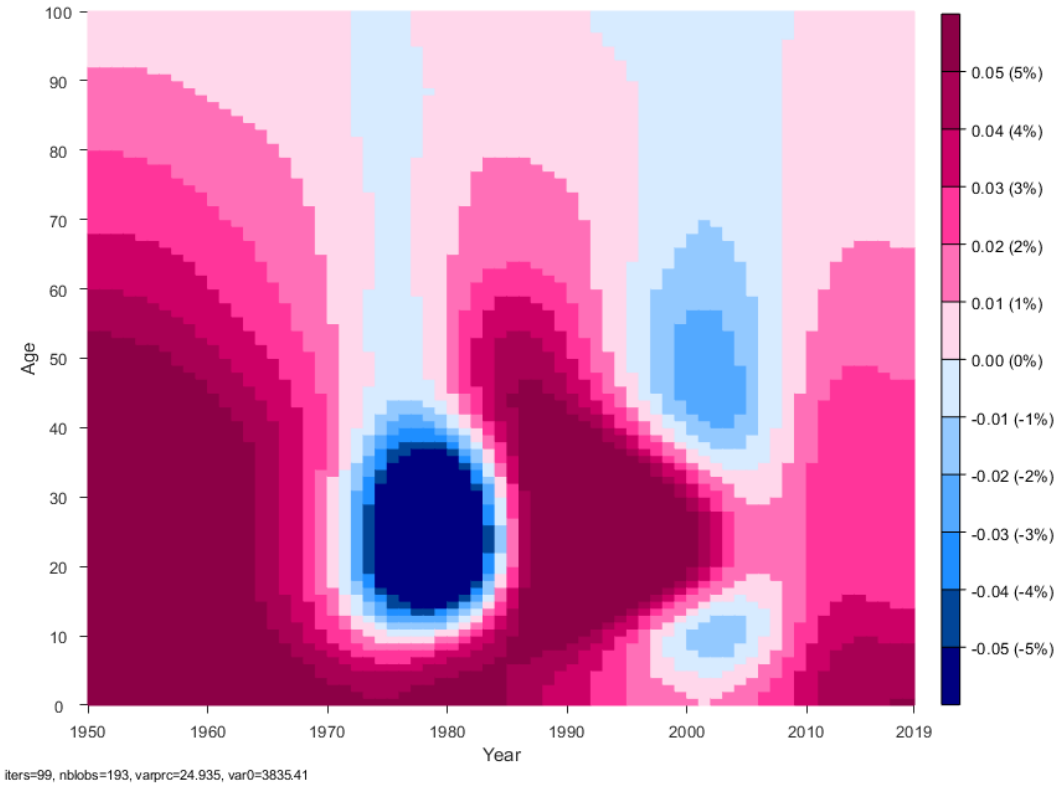
Females



iters=28, nblobs=153, varprc=5.28423, var0=10461.1

Iraq

Males



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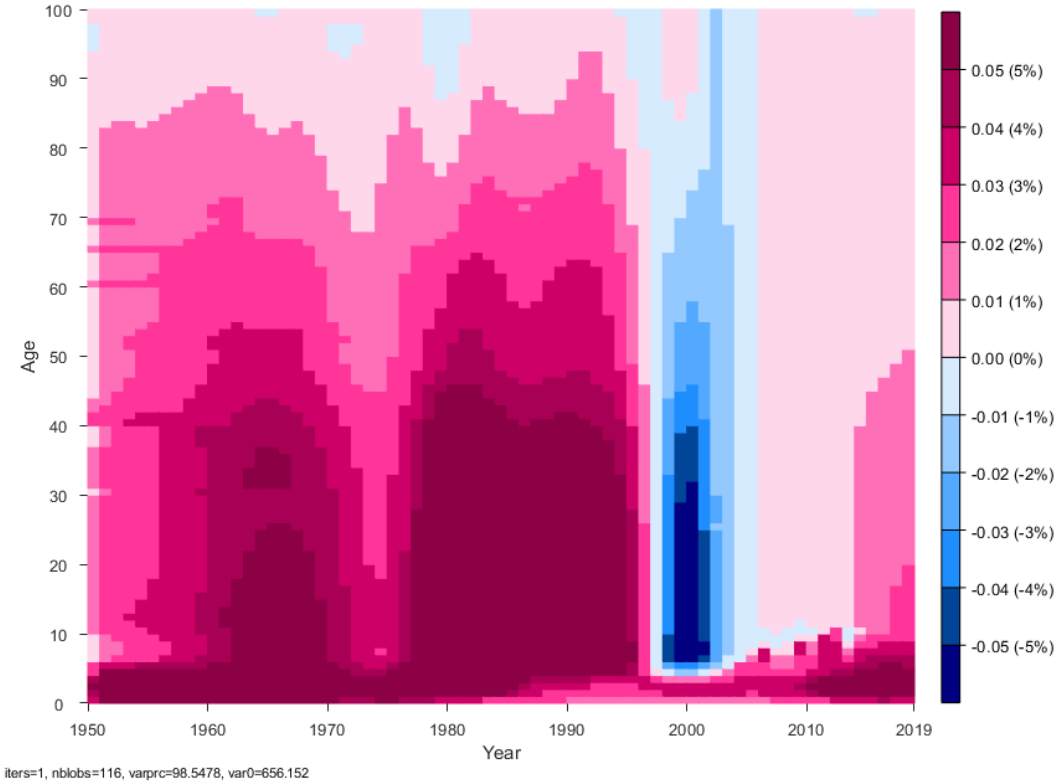
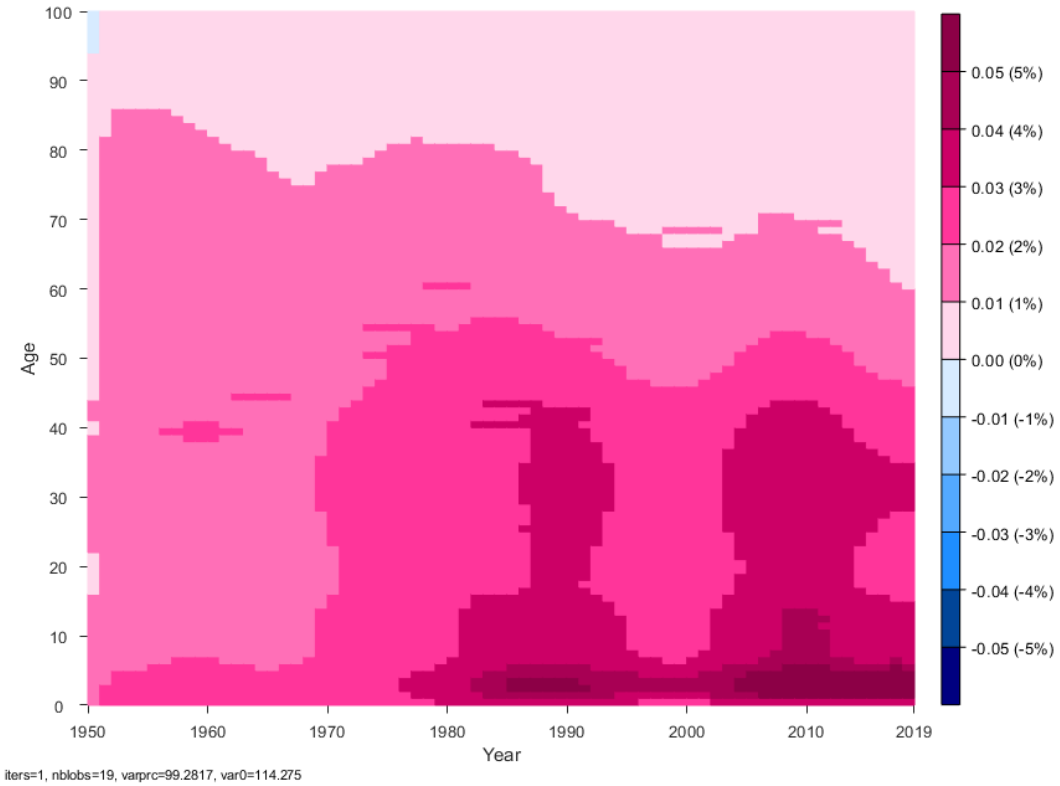
Females



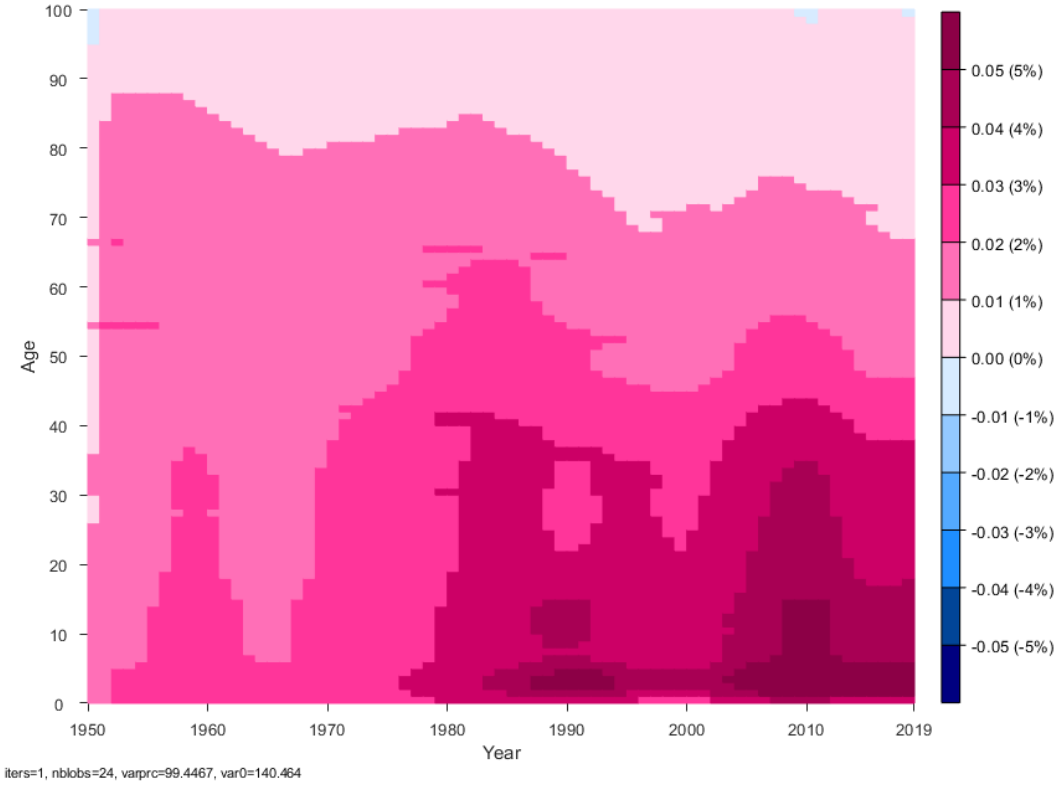
iters=1, nblobs=116, varprc=98.5478, var0=656.152

Afghanistan

Males

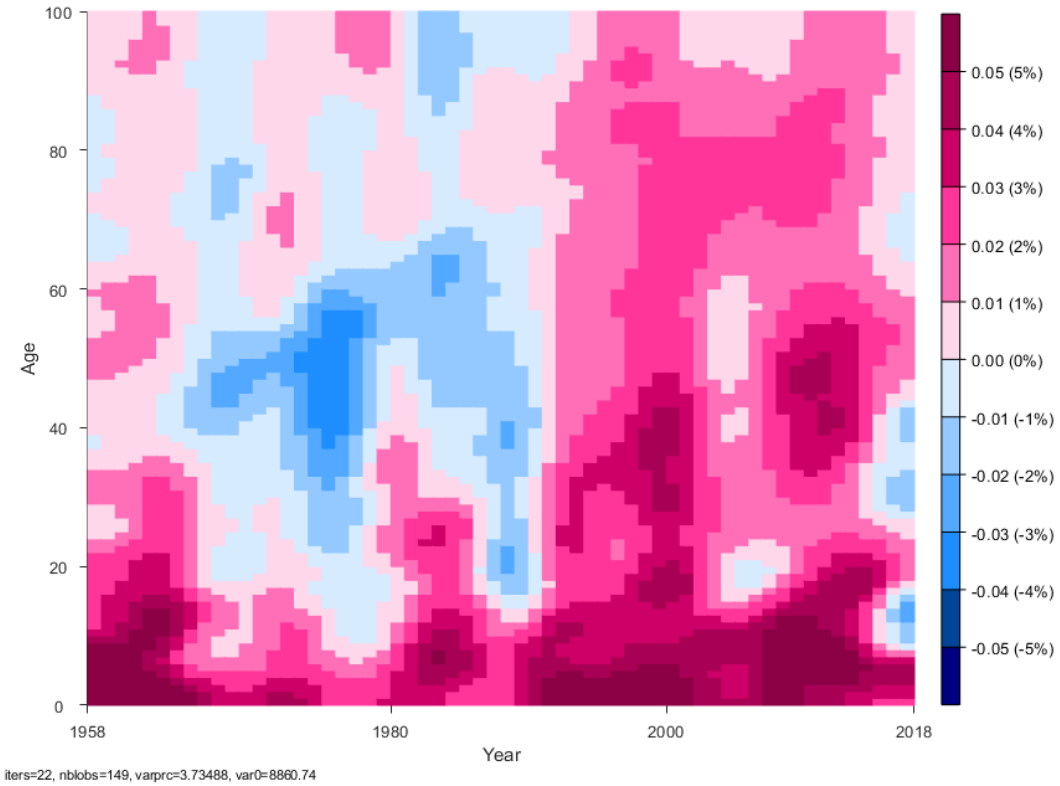


Females



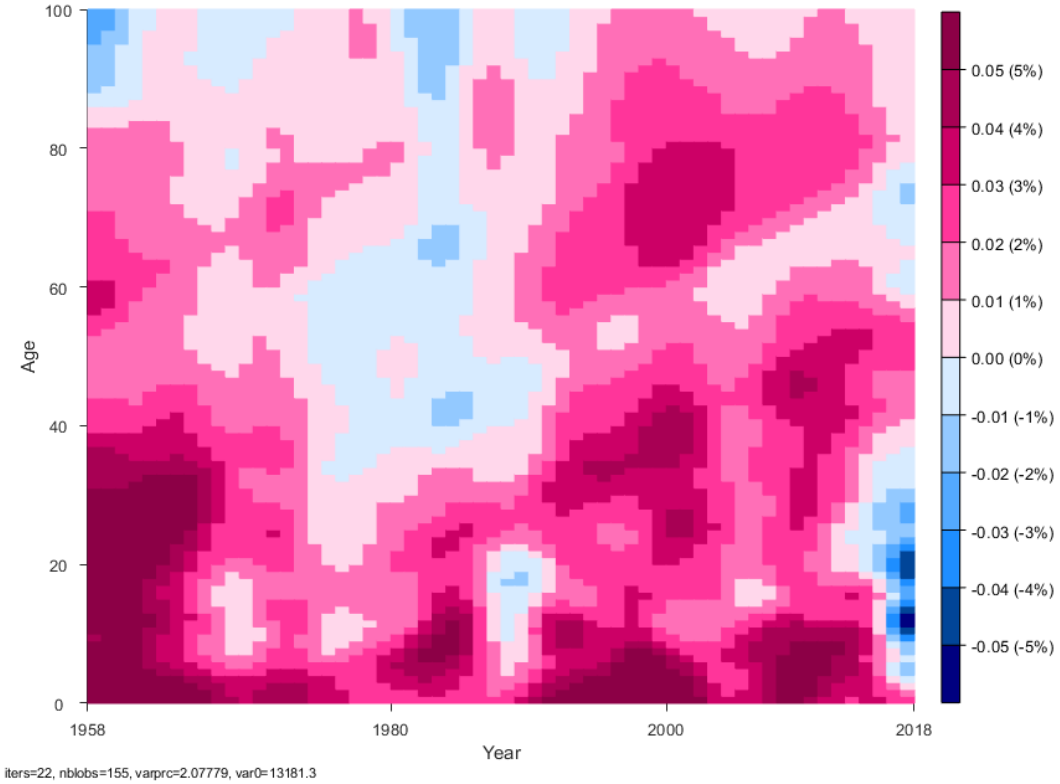
Poland

Males



iters=22, nblobs=149, varprc=3.73488, var0=8860.74

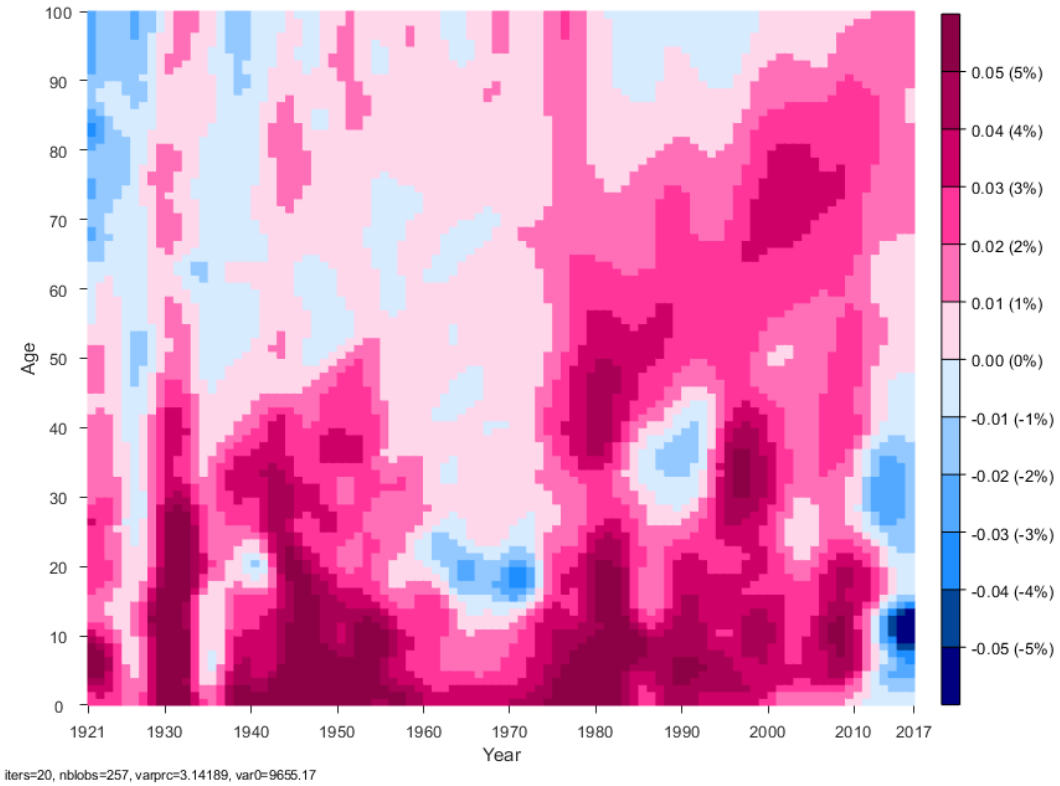
Females



iters=22, nblobs=155, varprc=2.07779, var0=13181.3

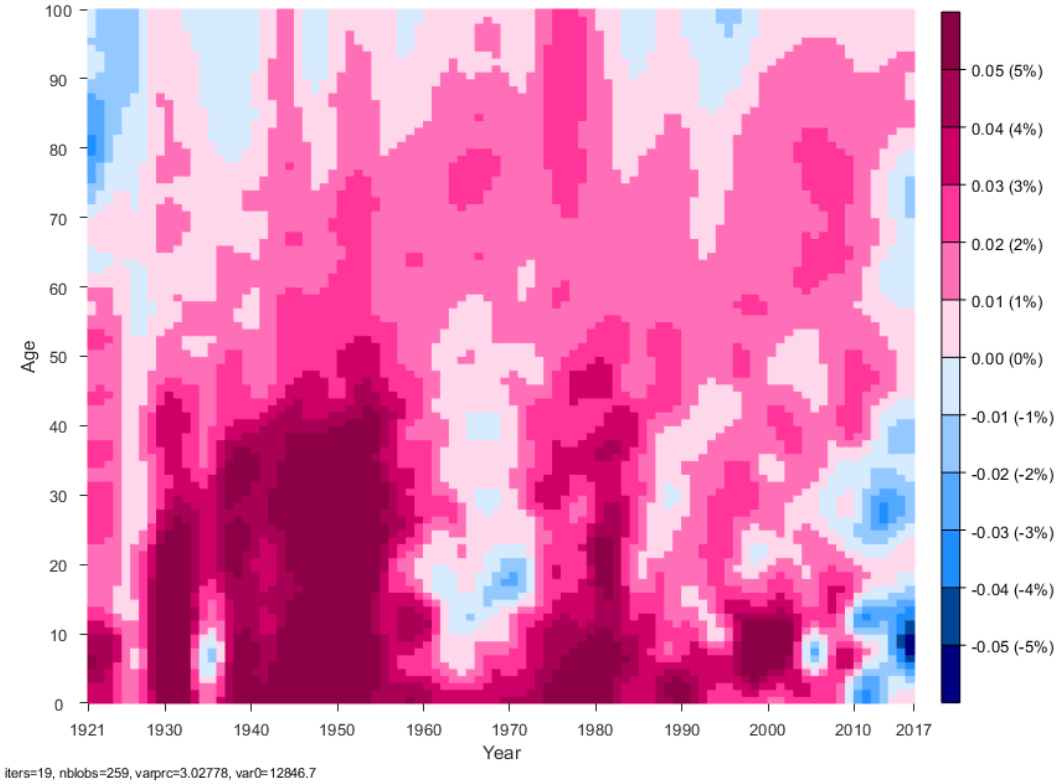
Canada

Males



iters=20, nblobs=257, varprc=3.14189, var0=9655.17

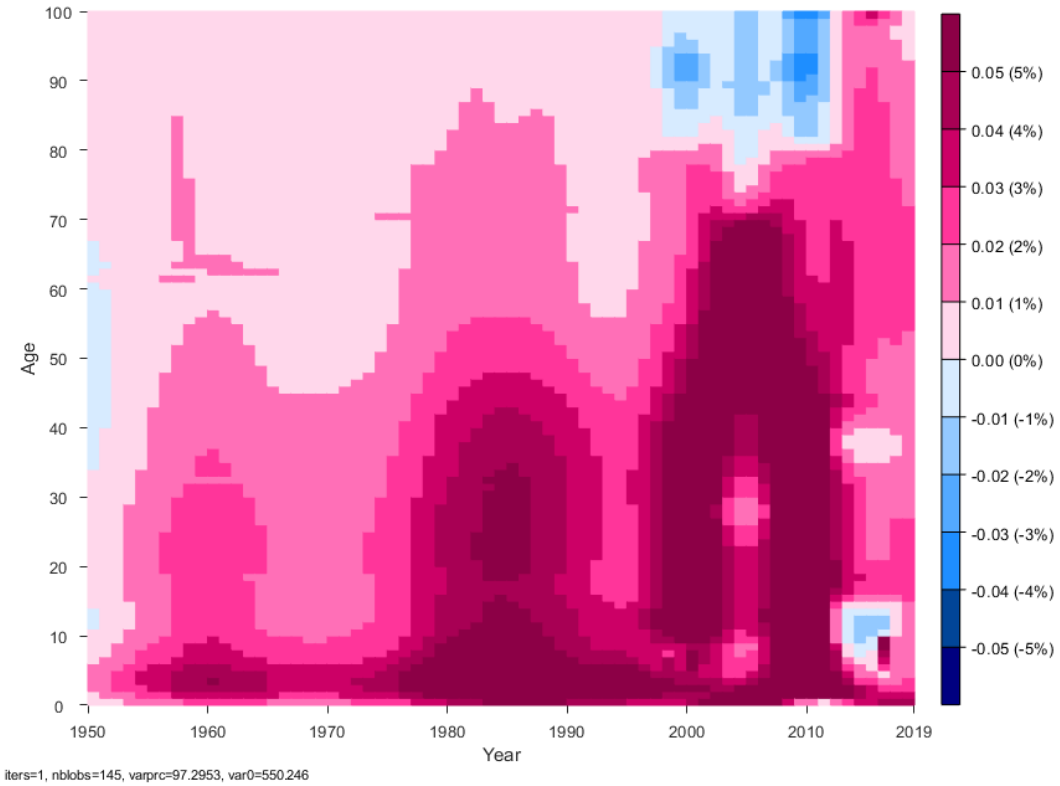
Females



iters=19, nblobs=259, varprc=3.02778, var0=12846.7

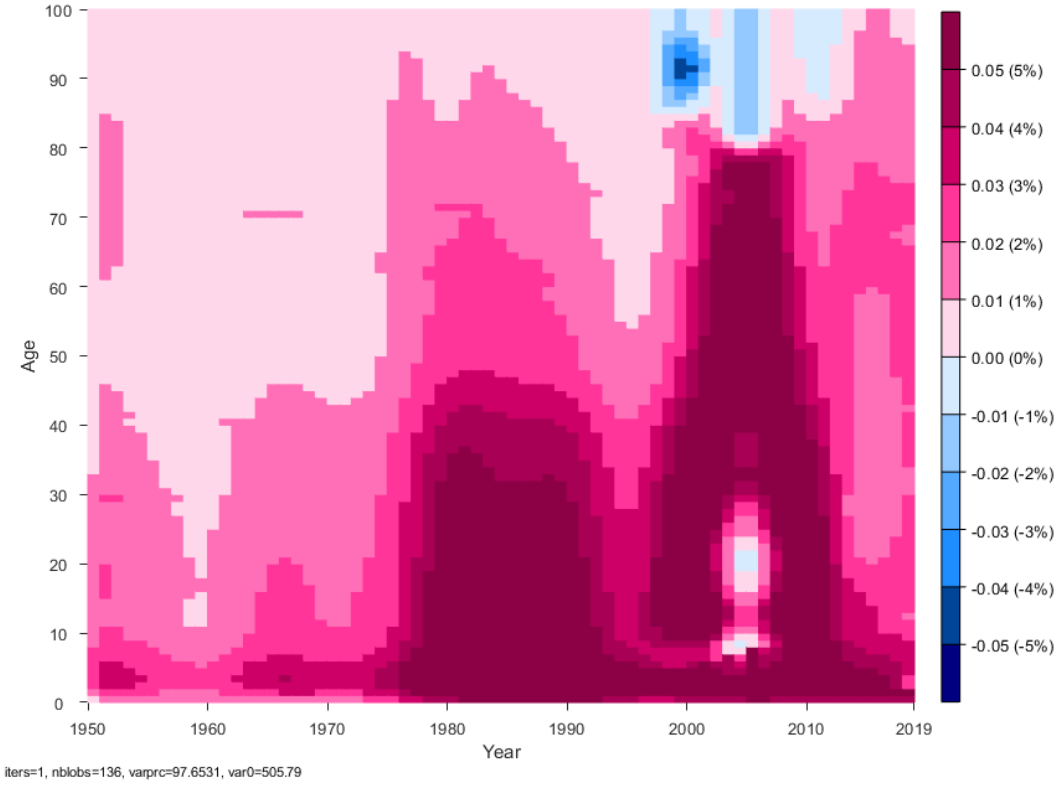
Morocco

Males



iters=1, nblobs=145, varprc=97.2953, var0=550.246

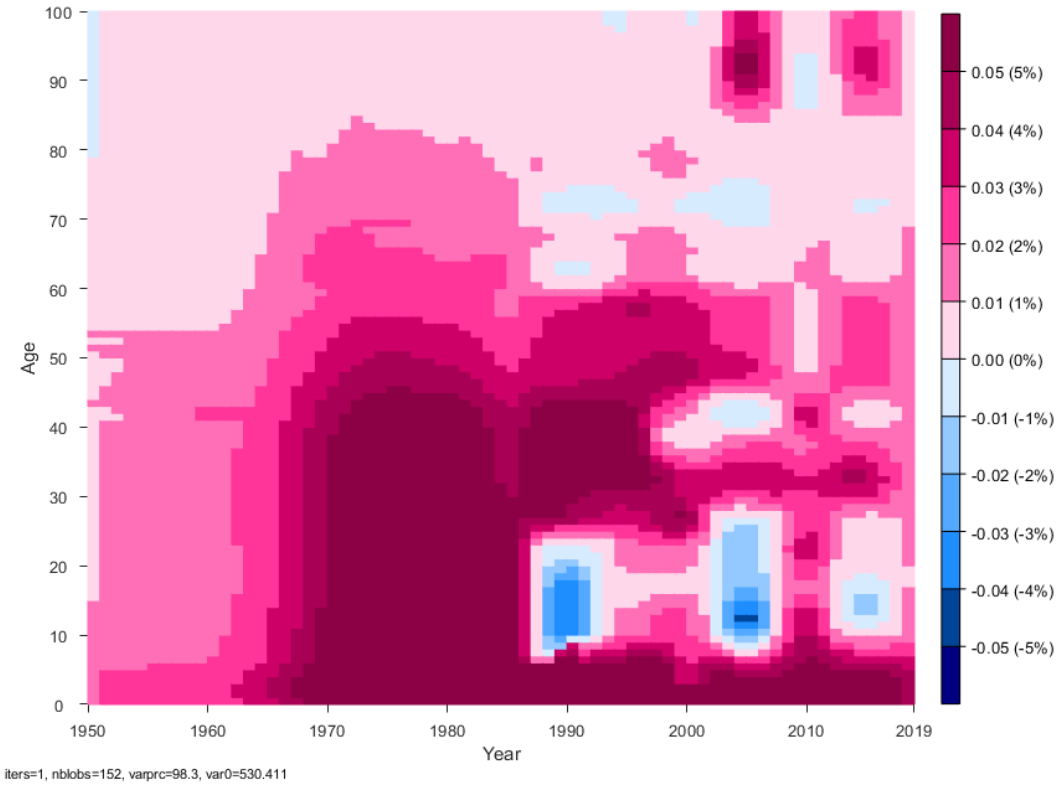
Females



iters=1, nblobs=136, varprc=97.6531, var0=505.79

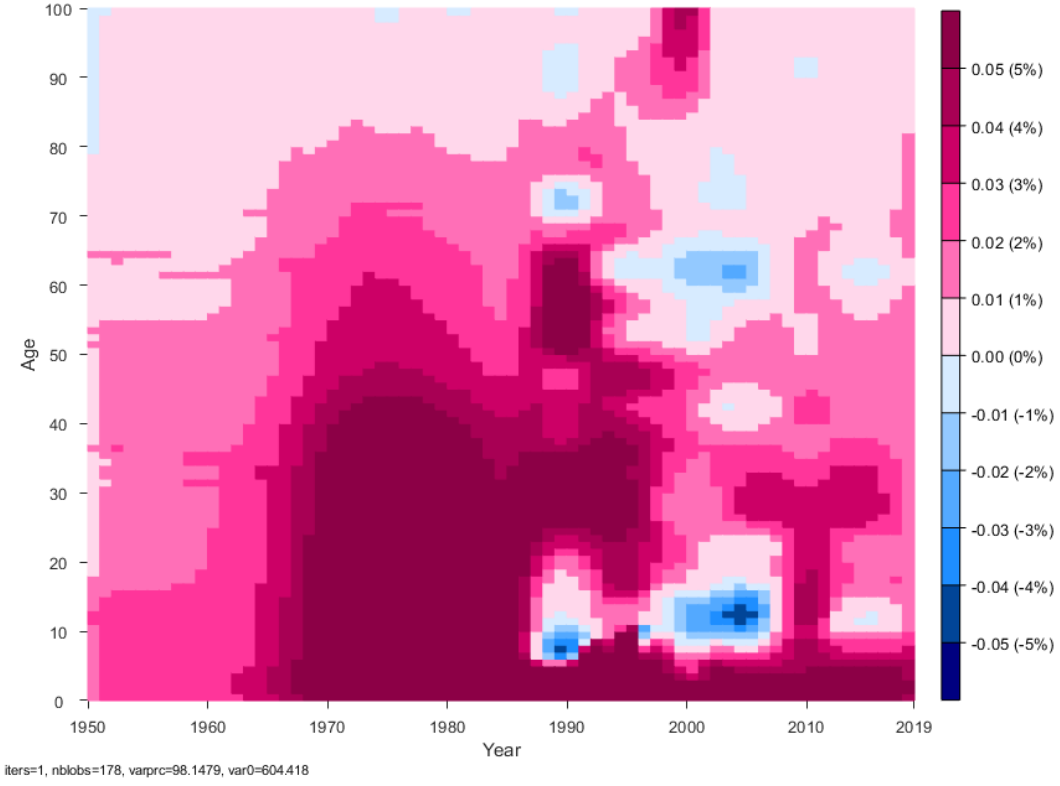
Saudi Arabia

Males



iters=1, nblobs=152, varprc=98.3, var0=530.411

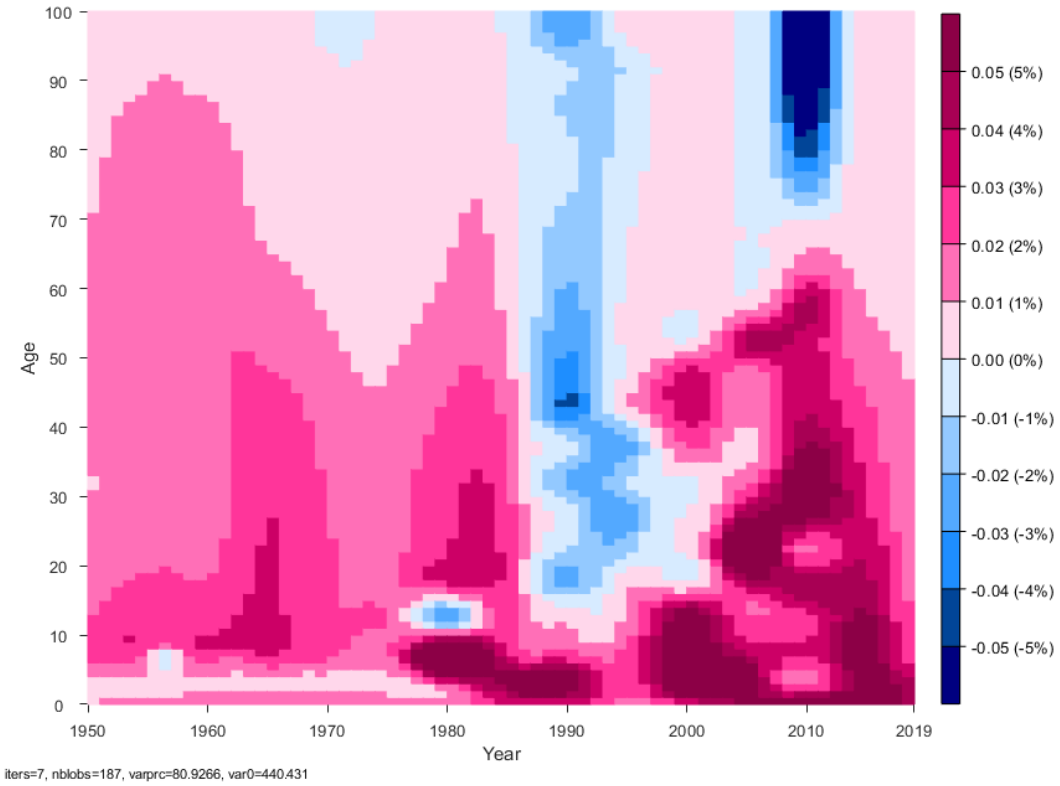
Females



iters=1, nblobs=178, varprc=98.1479, var0=604.418

Uzbekistan

Males



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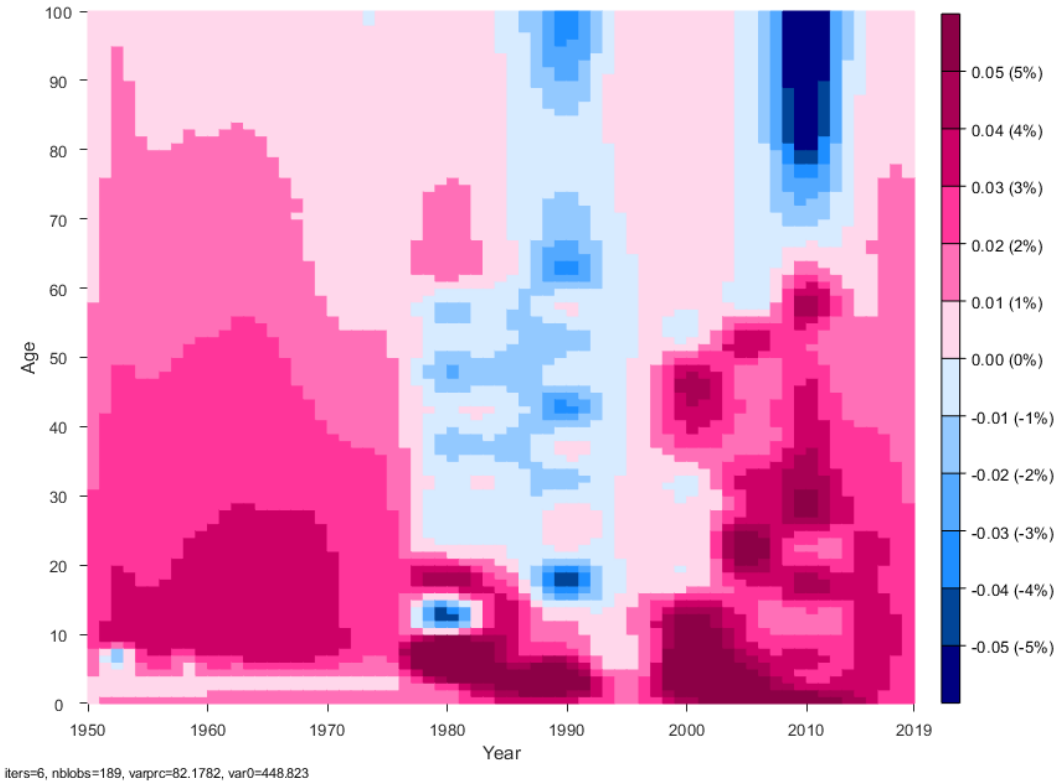
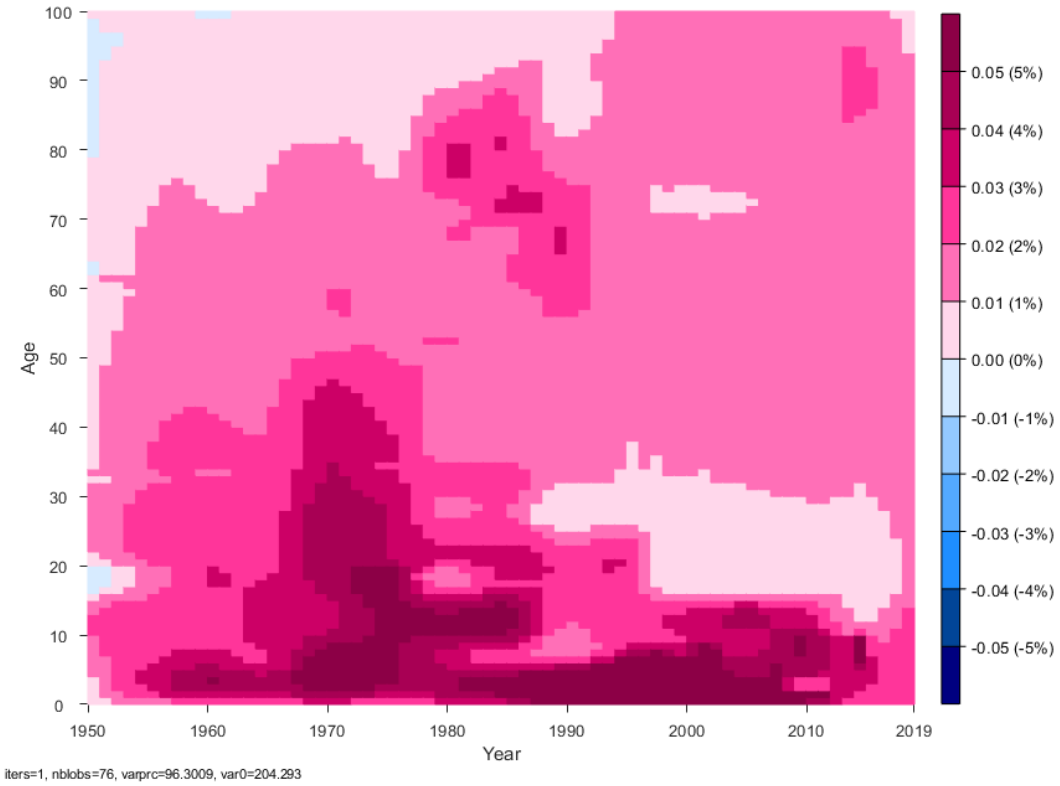
Females



iters=6, nblobs=189, varprc=82.1782, var0=448.823

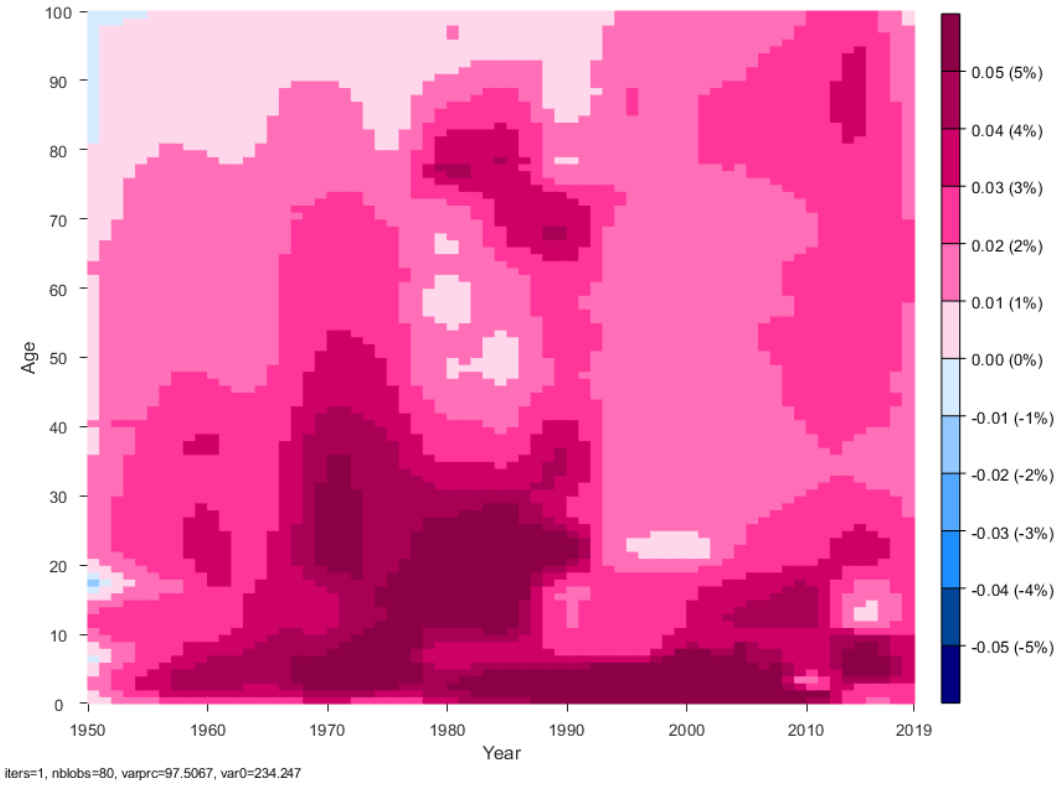
Peru

Males



iters=1, nblobs=76, varprc=96.3009, var0=204.293

Females



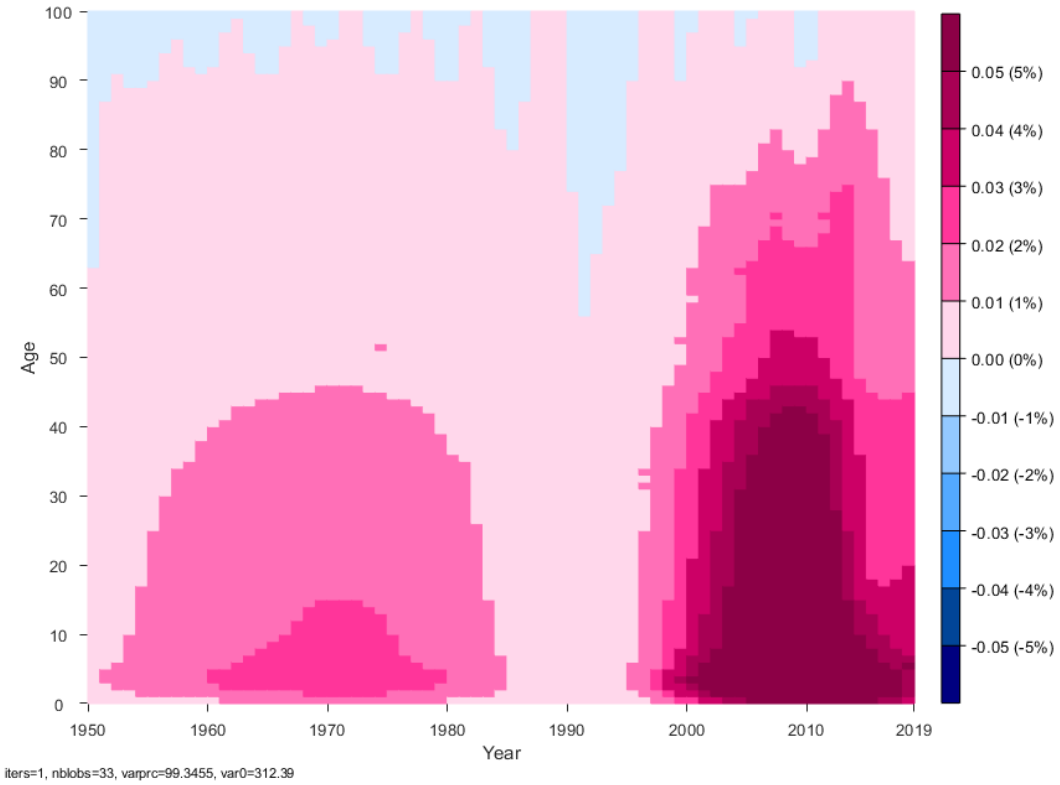
iters=1, nblobs=80, varprc=97.5067, var0=234.247

Angola

Males

iters=1, nblobs=32, varprc=99.2279, var0=243.399

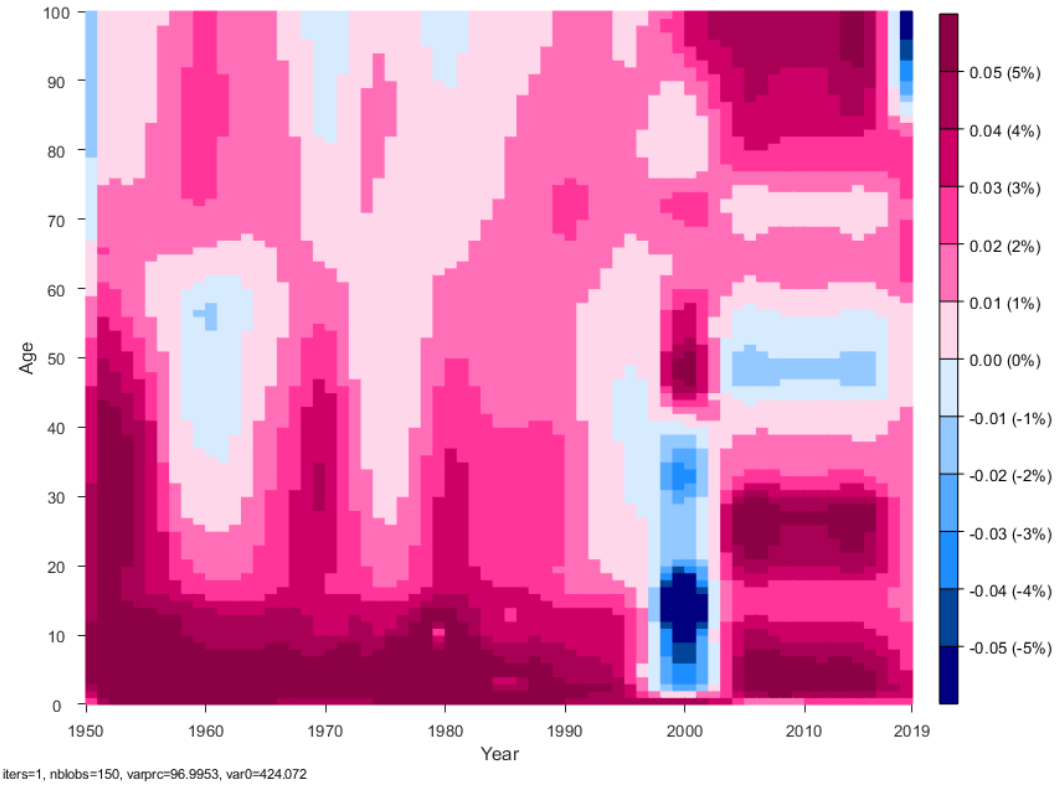
Females



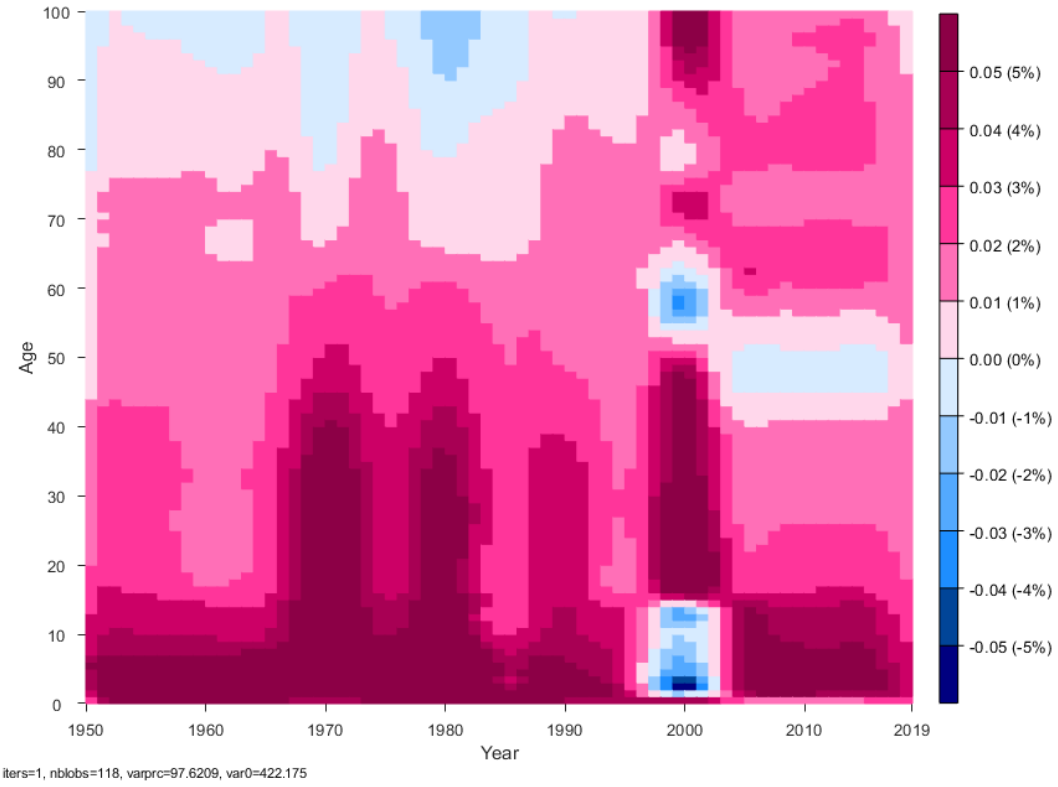
iters=1, nblobs=33, varprc=99.3455, var0=312.39

Malaysia

Males

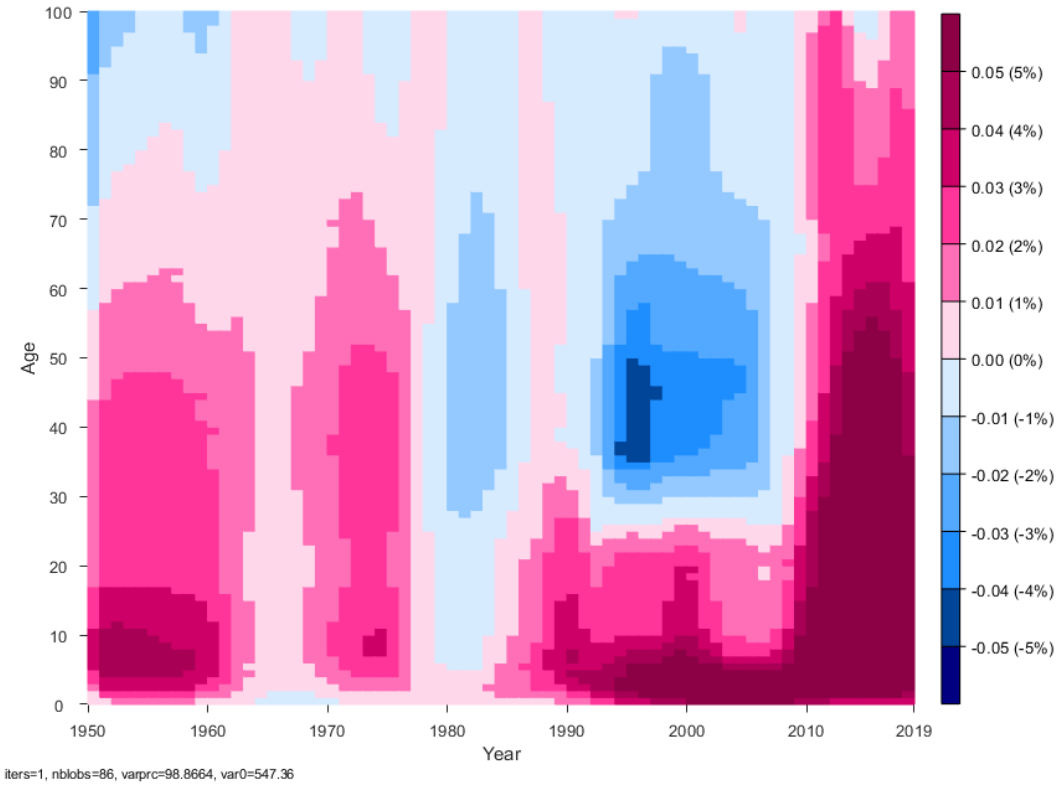


Females

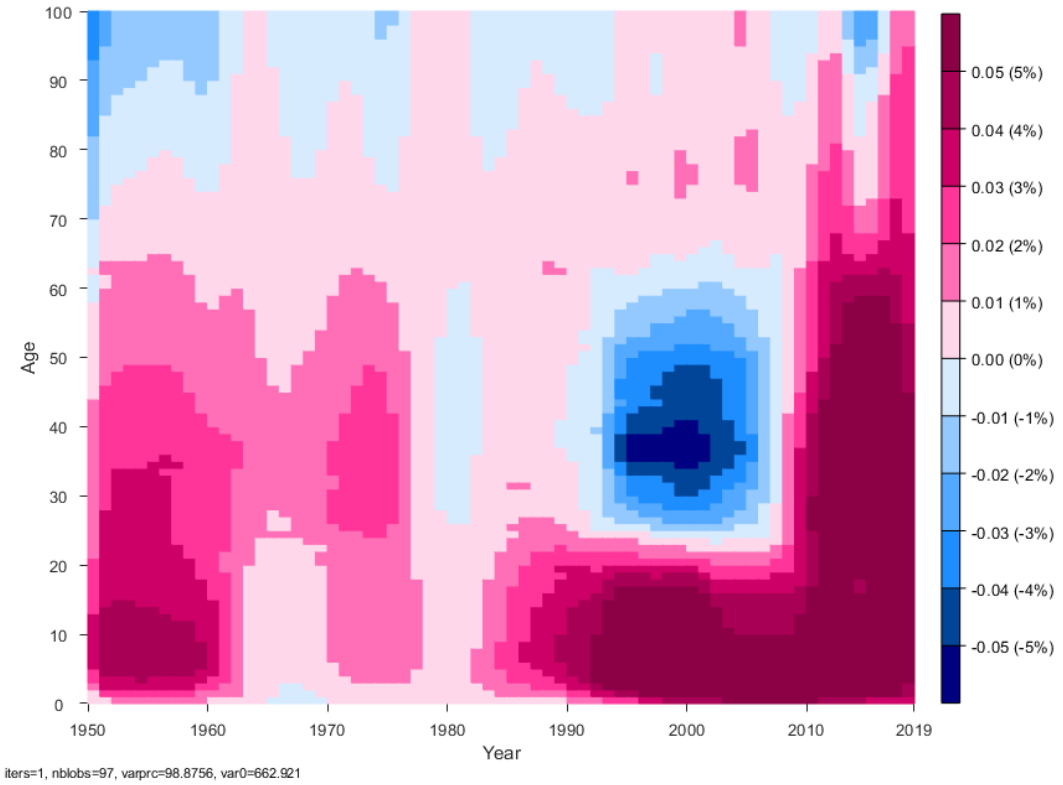


Mozambique

Males

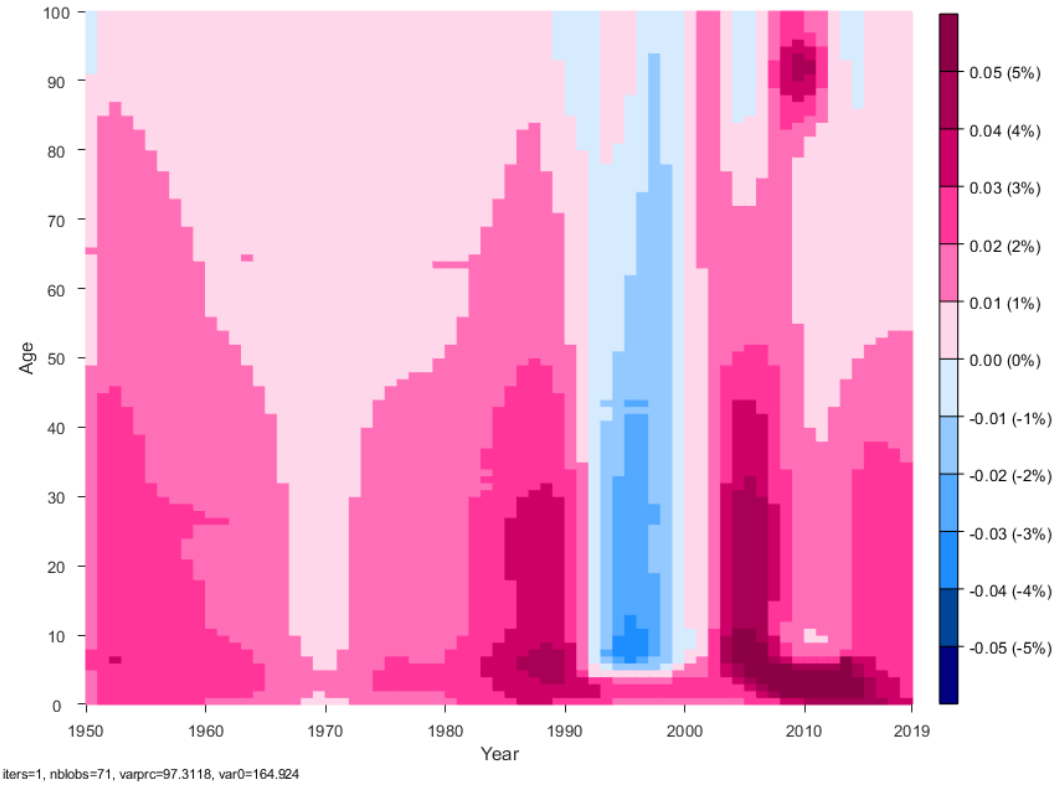


Females



Ghana

Males



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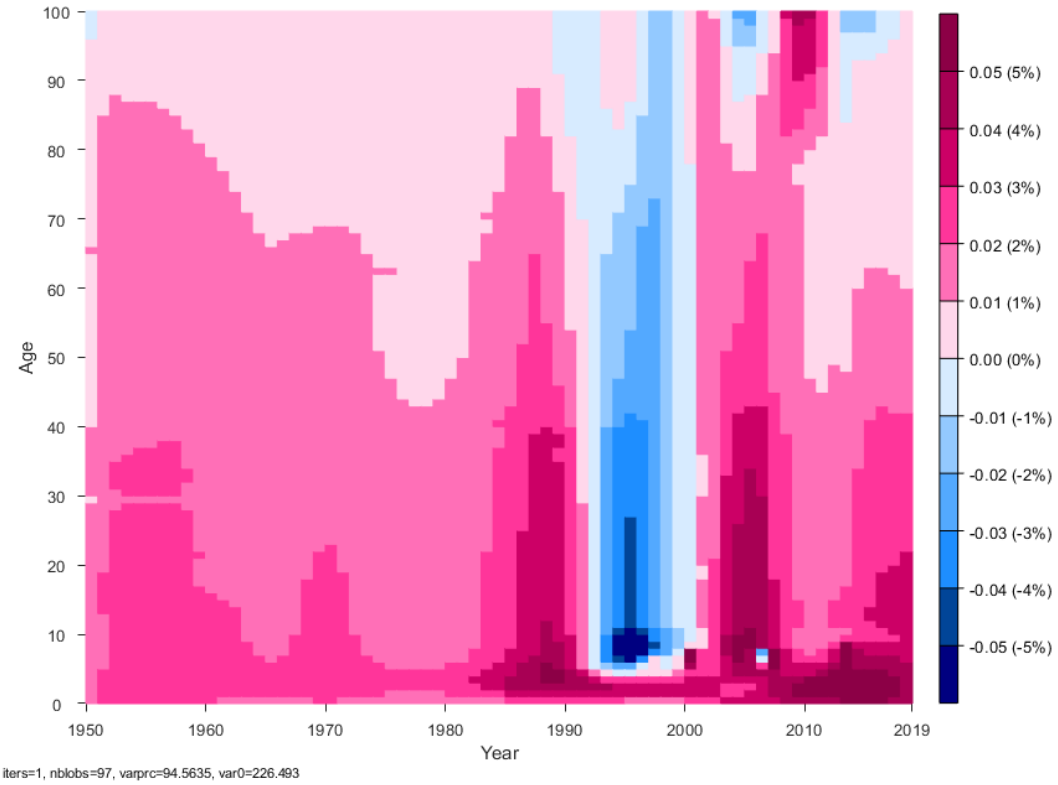
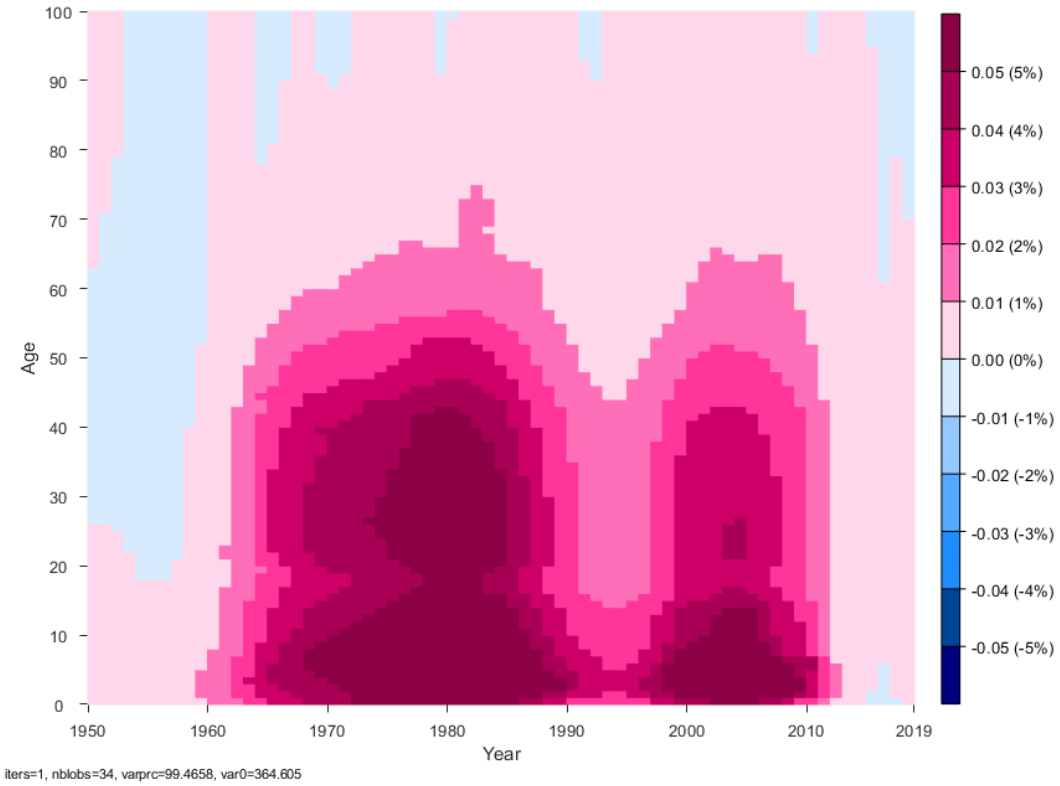
Females



iters=1, nblobs=97, varprc=94.5635, var0=226.493

Yemen

Males



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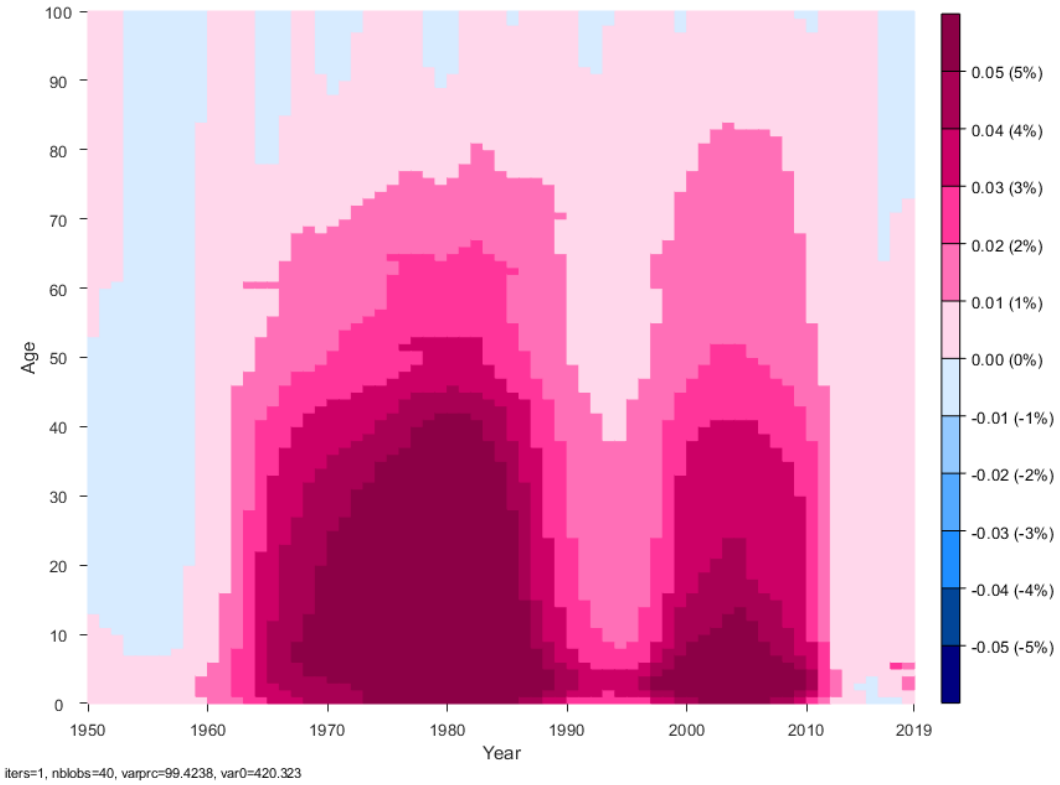
Females



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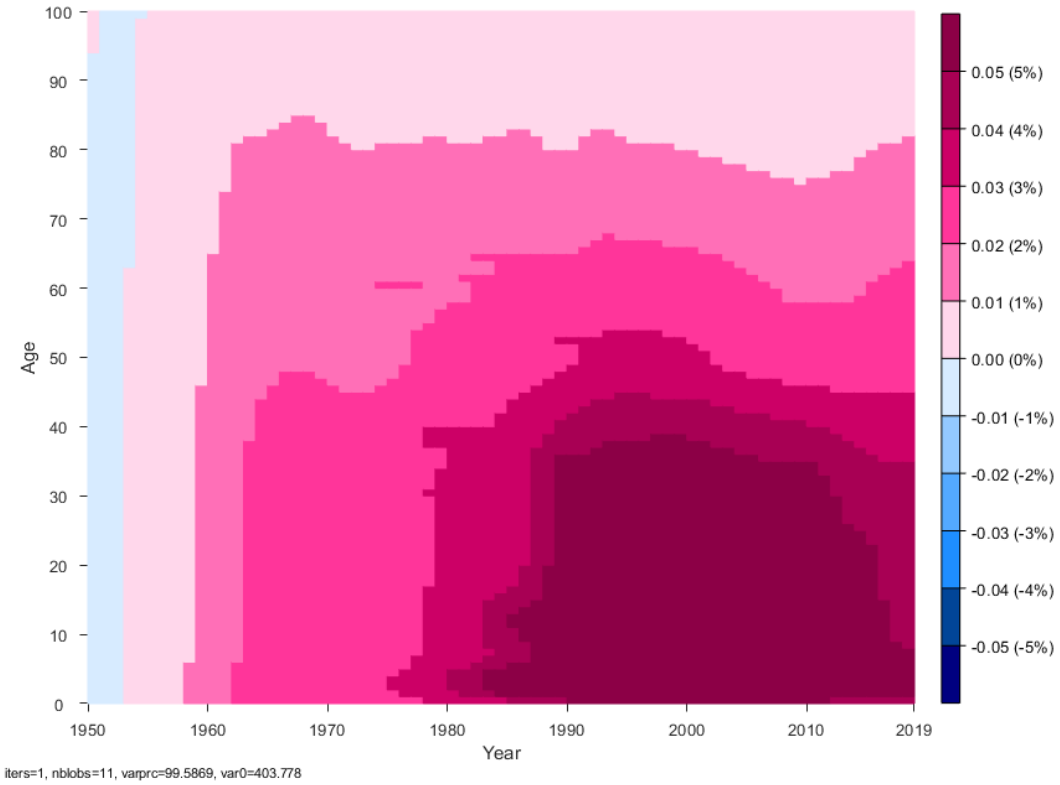
Nepal

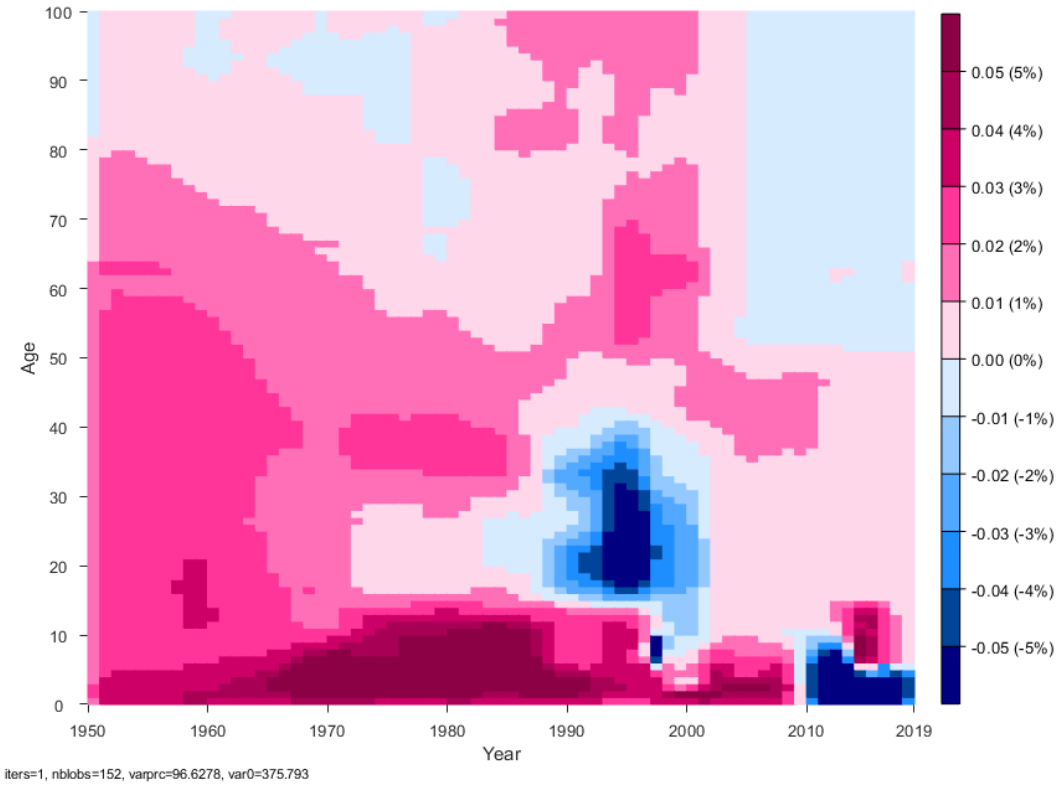
Males

Females



Venezuela (Bolivarian Republic of)

Males



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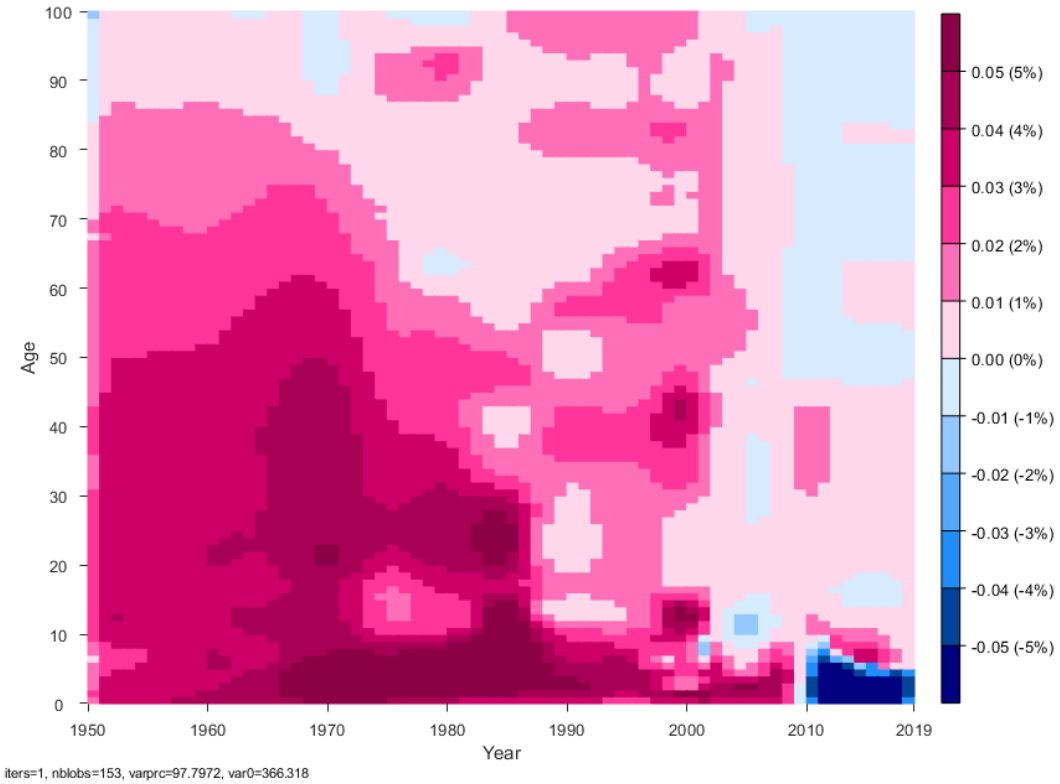
Females



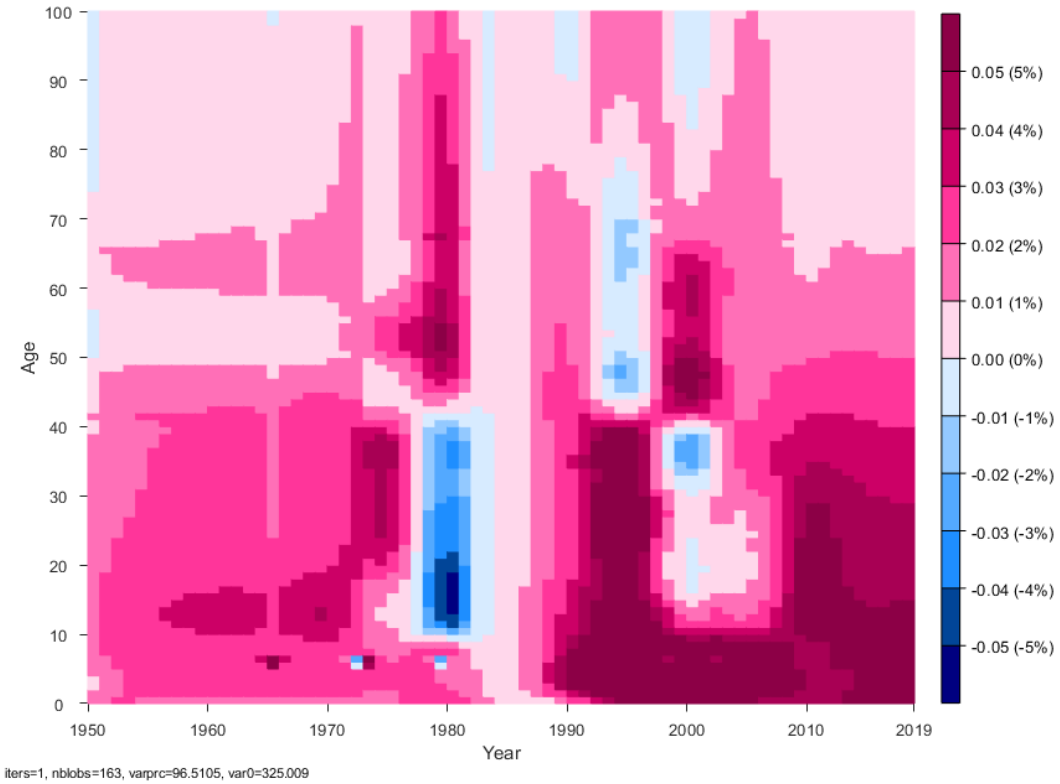
iters=1, nblobs=153, varprc=97.7972, var0=366.318

Madagascar

Males

iters=1, nblobs=125, varprc=96.4106, var0=309.445

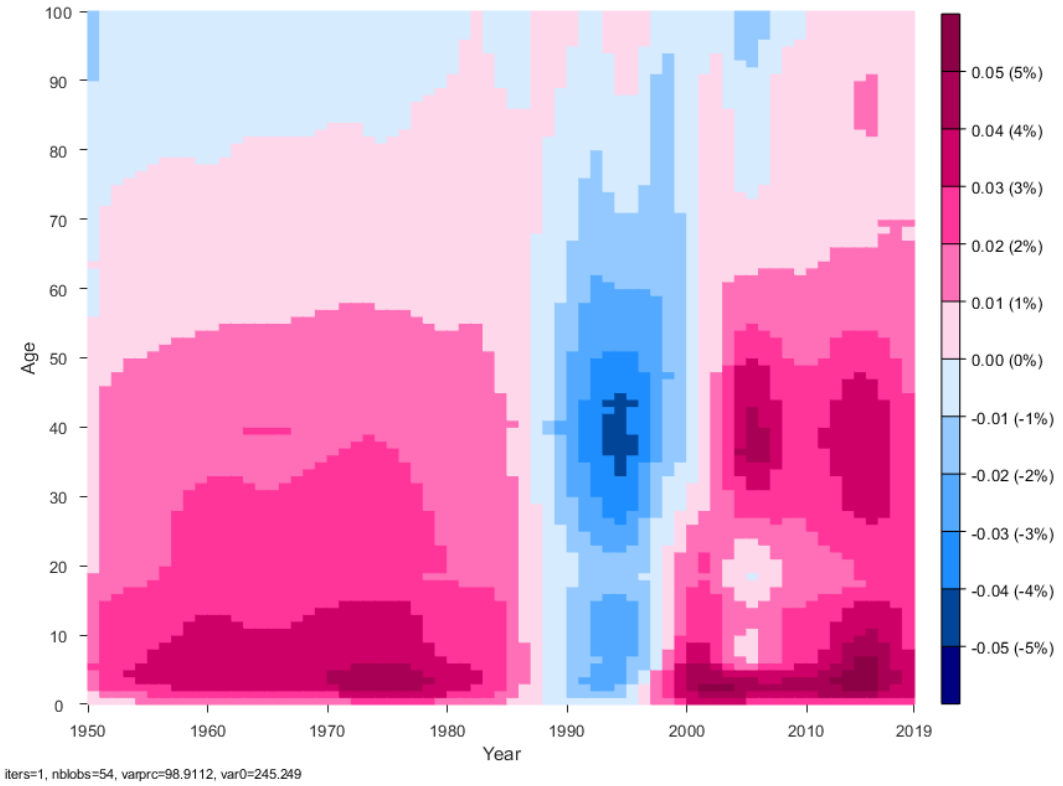
Females



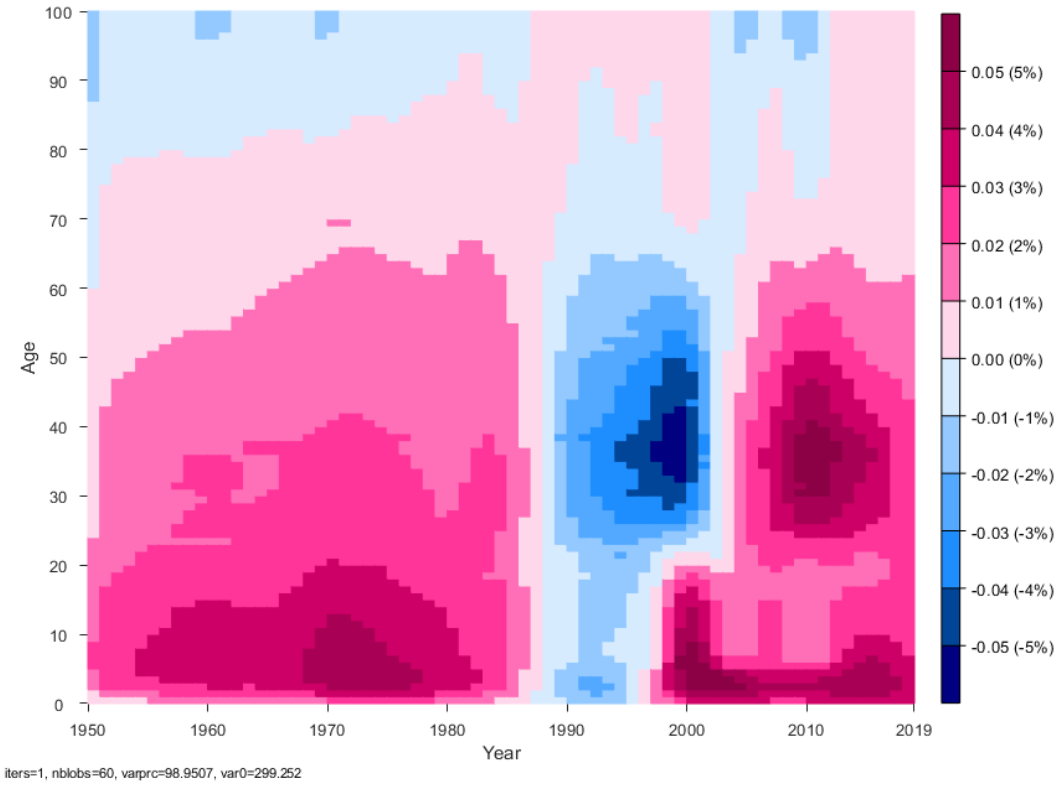
iters=1, nblobs=163, varprc=96.5105, var0=325.009

Cameroon

Males

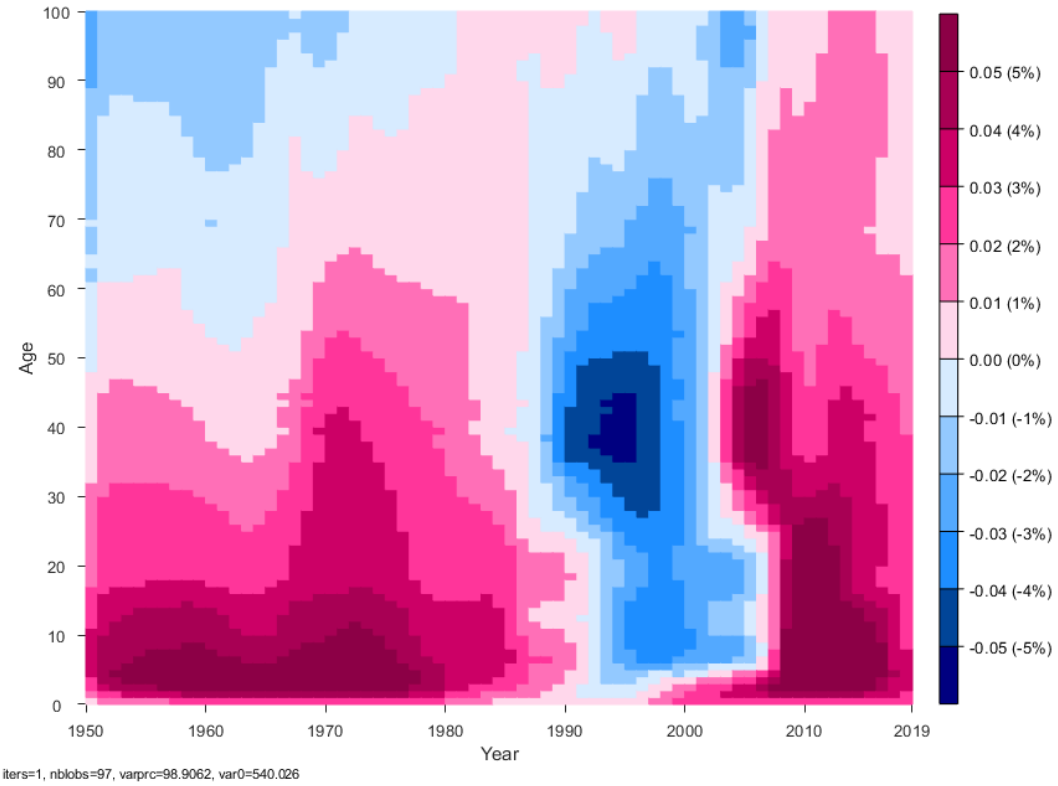


Females



Cd'Ivoire

Males



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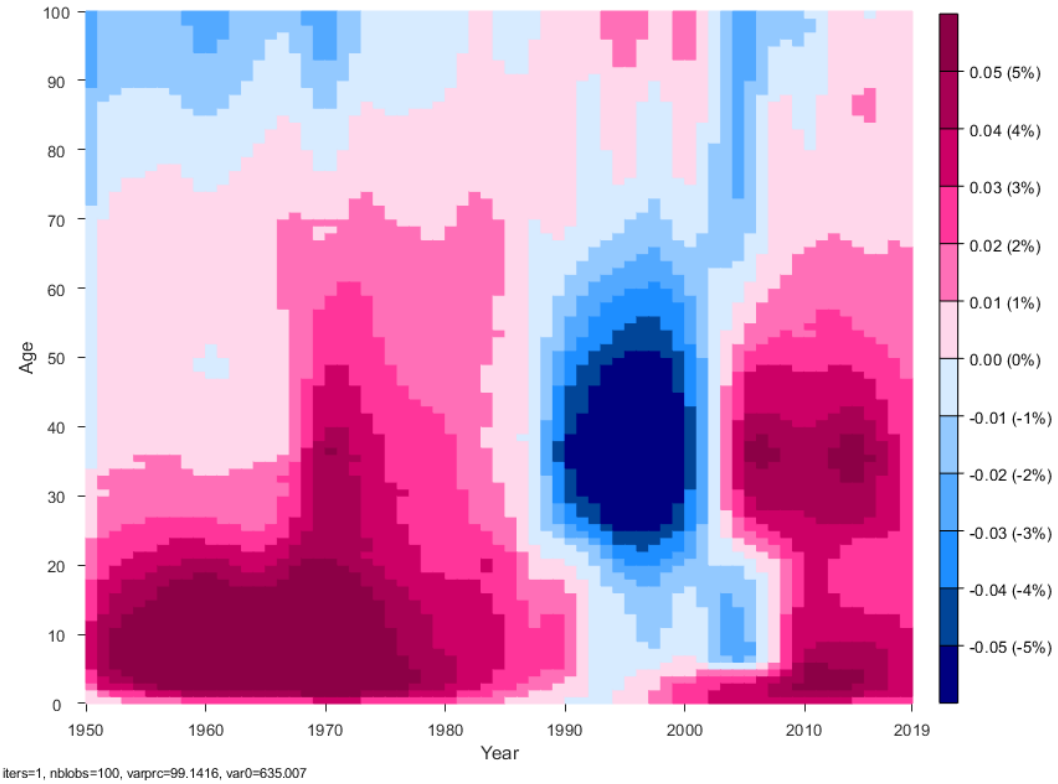
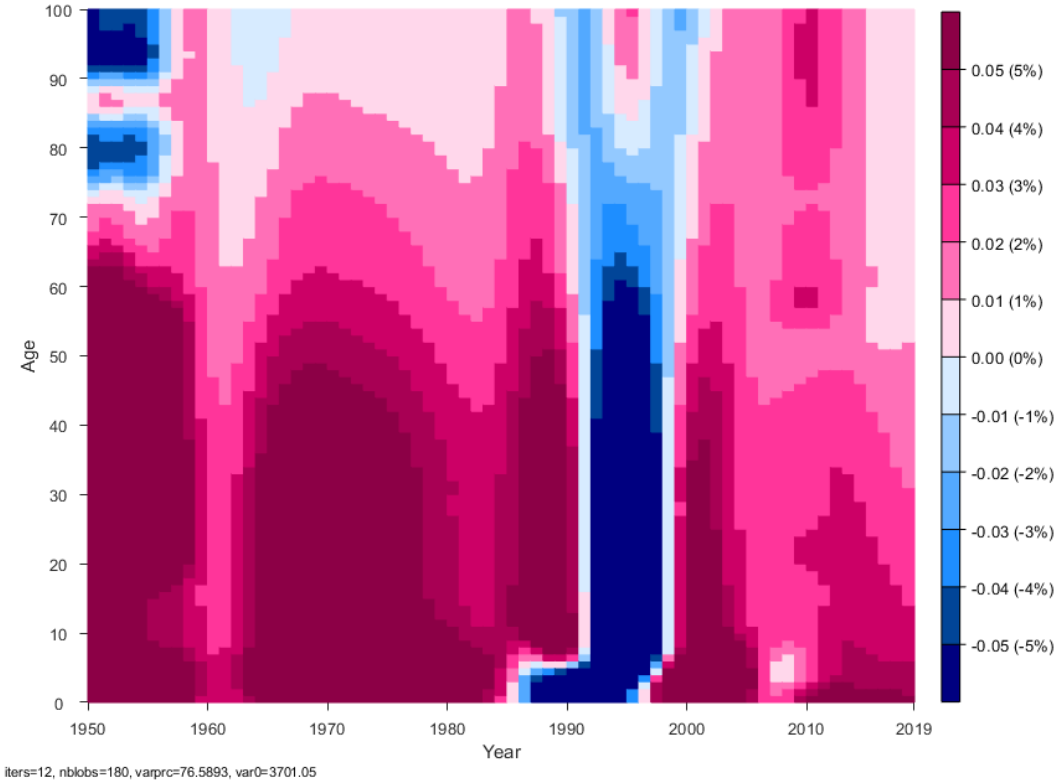
Females



iters=1, nblobs=100, varprc=99.1416, var0=635.007

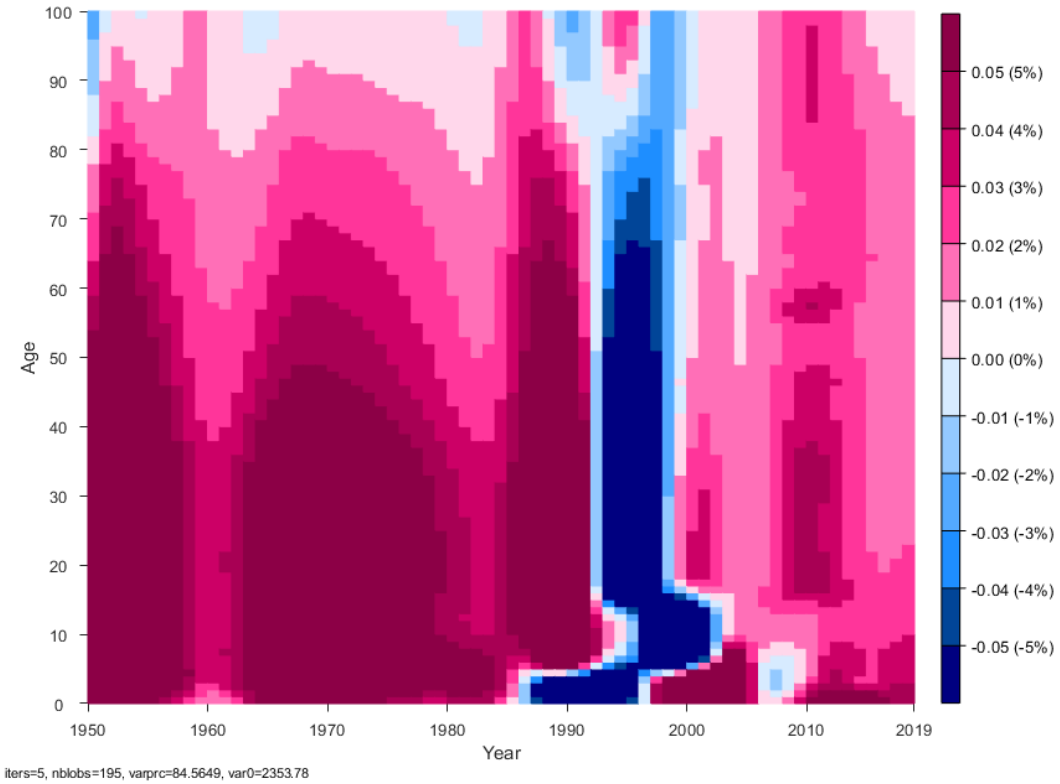
Dem. People's Rep. of Korea

Males



iters=12, nblobs=180, varprc=76.5893, var0=3701.05

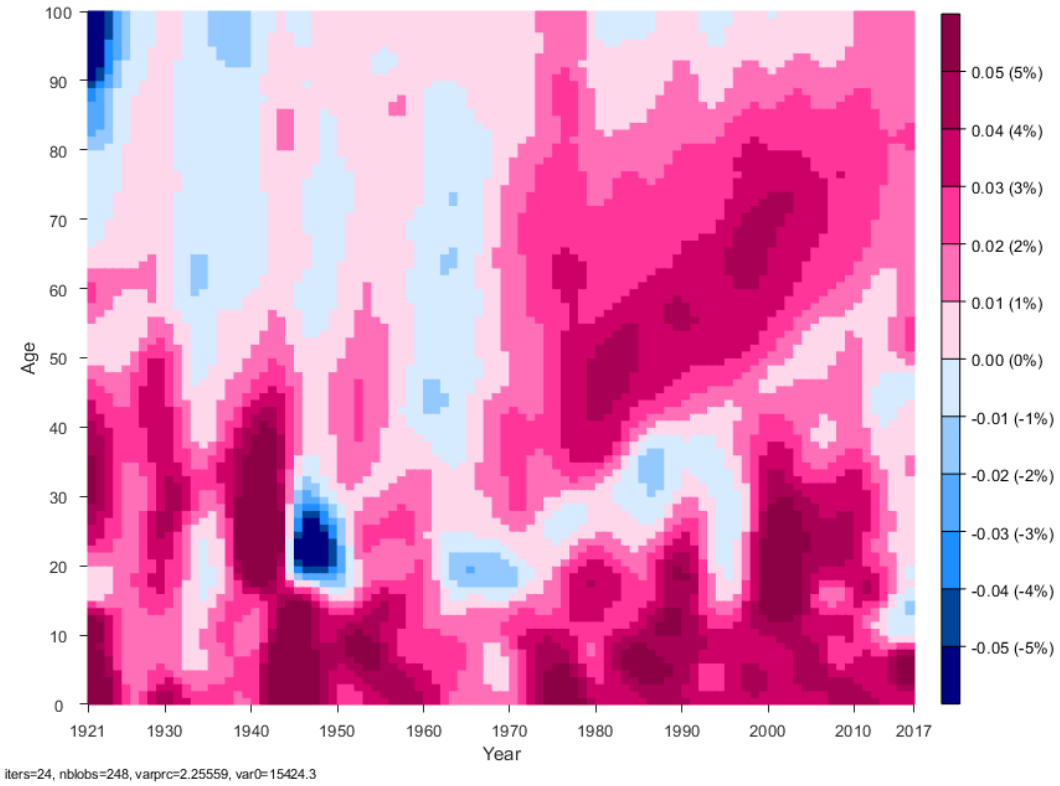
Females



iters=5, nblobs=195, varprc=84.5649, var0=2353.78

Australia

Males



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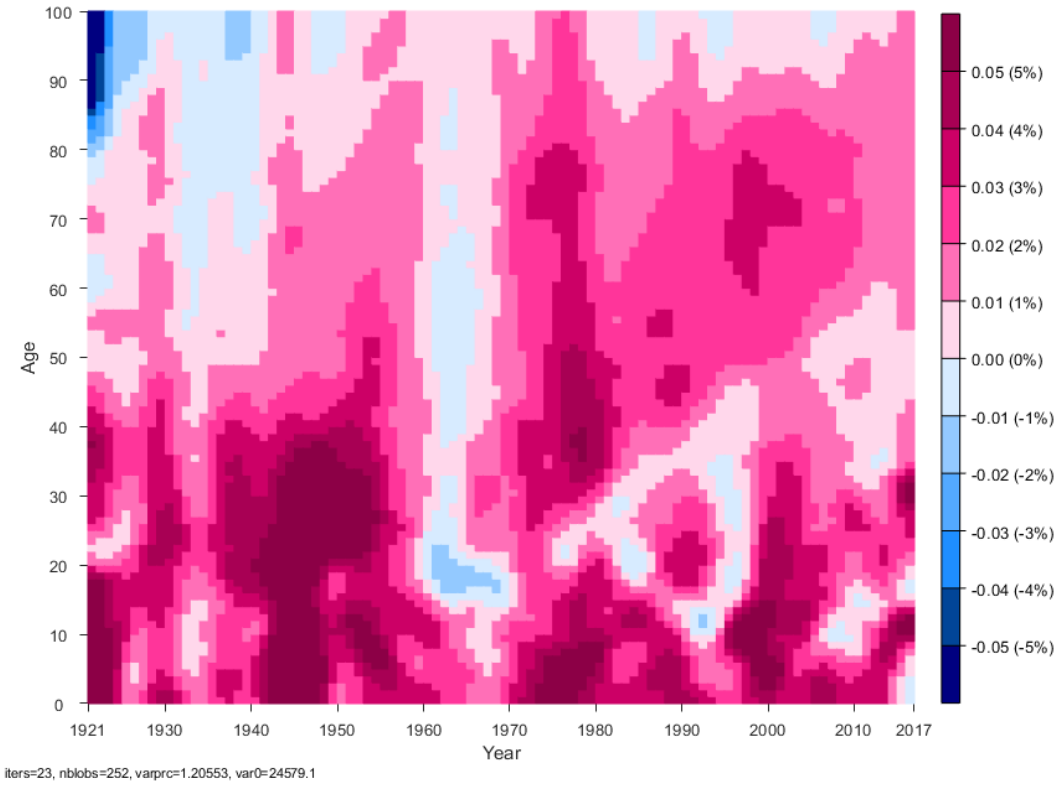
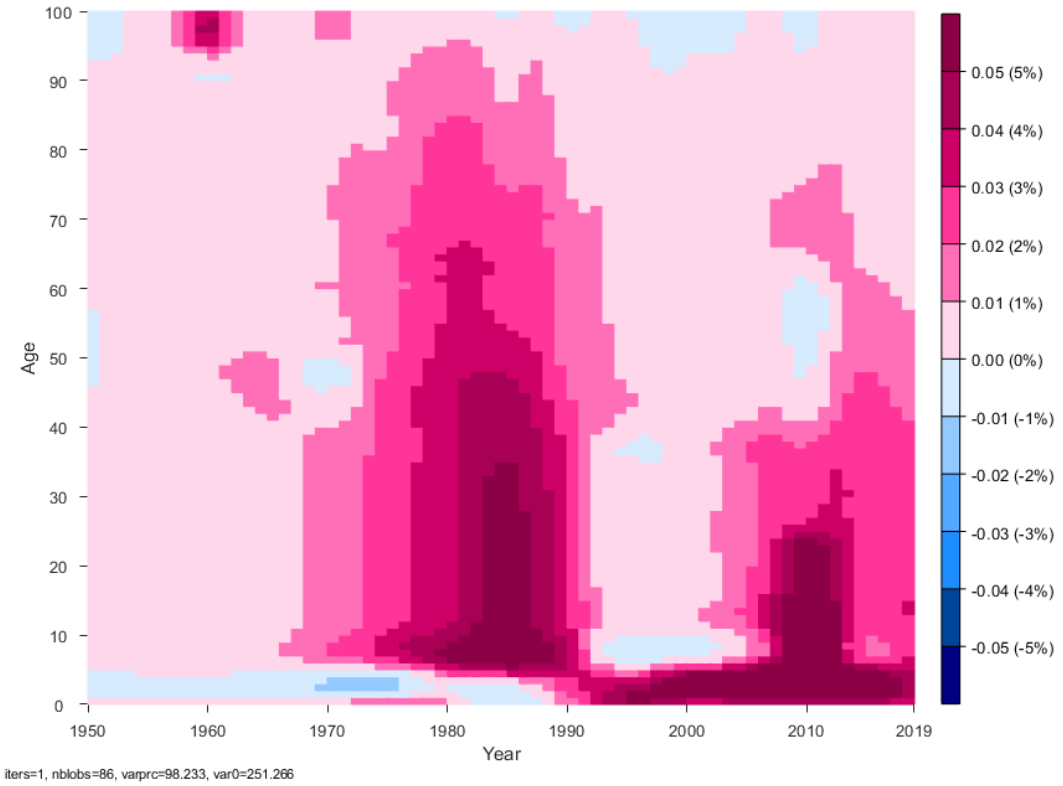
Females



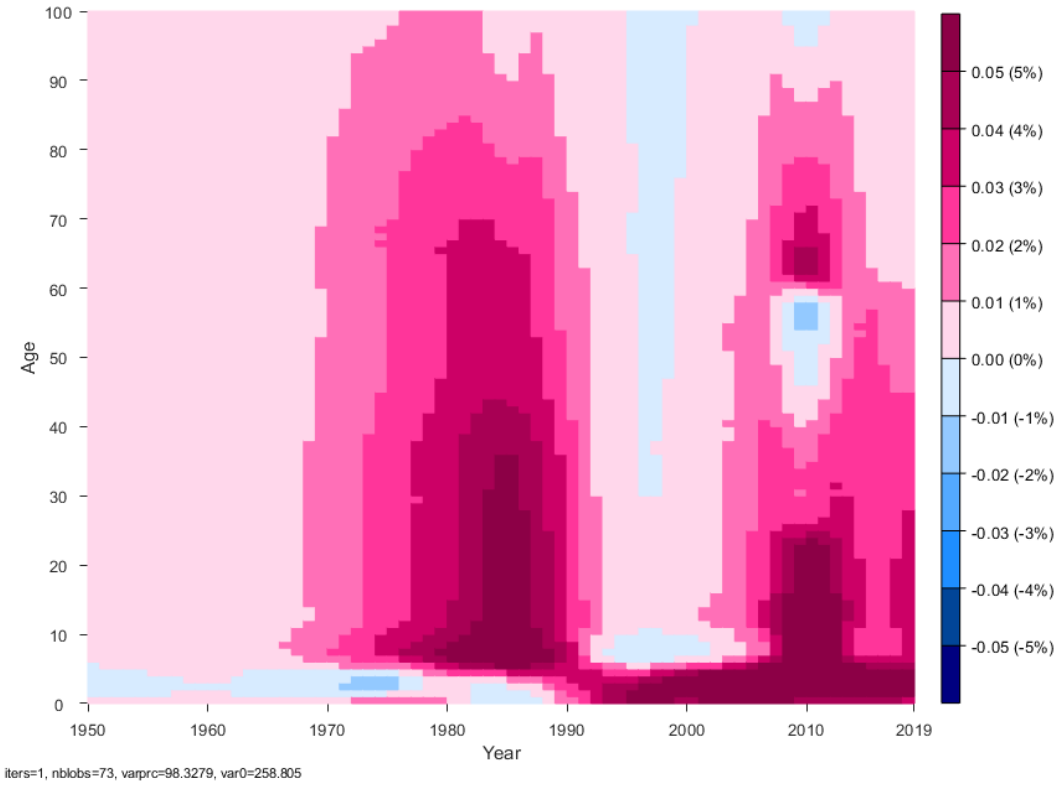
iters=23, nblobs=252, varprc=1.20553, var0=24579.1

Niger

Males

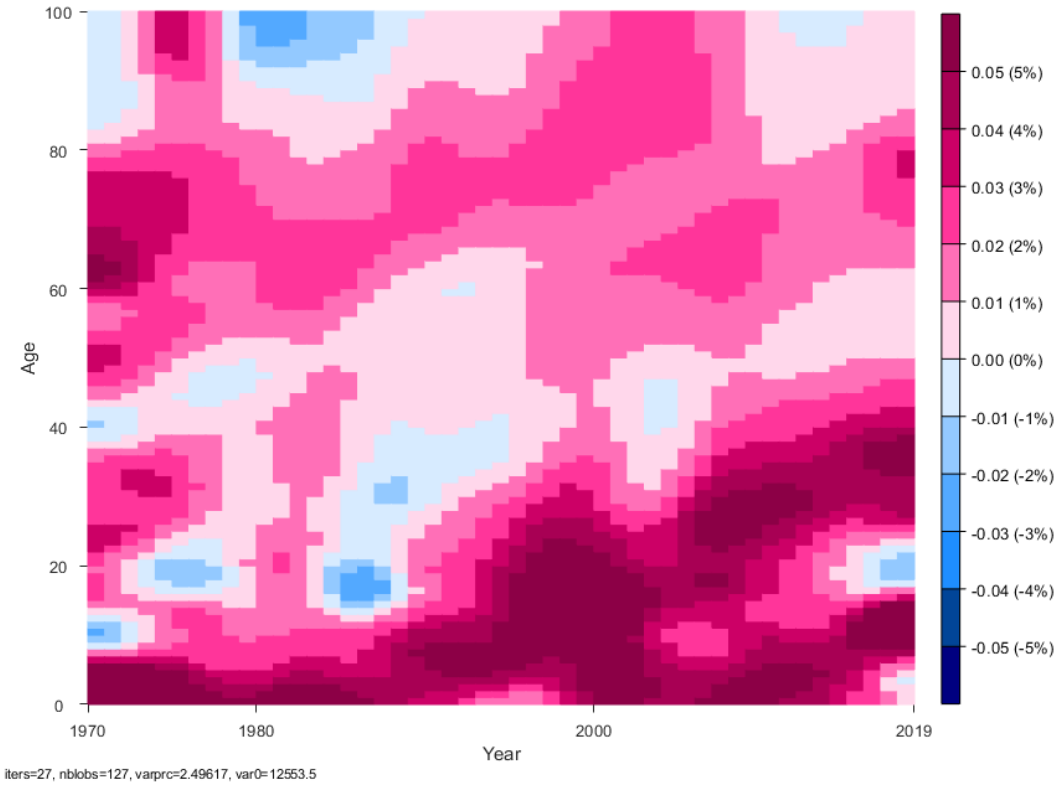


Females



China, Taiwan Province of China

Males



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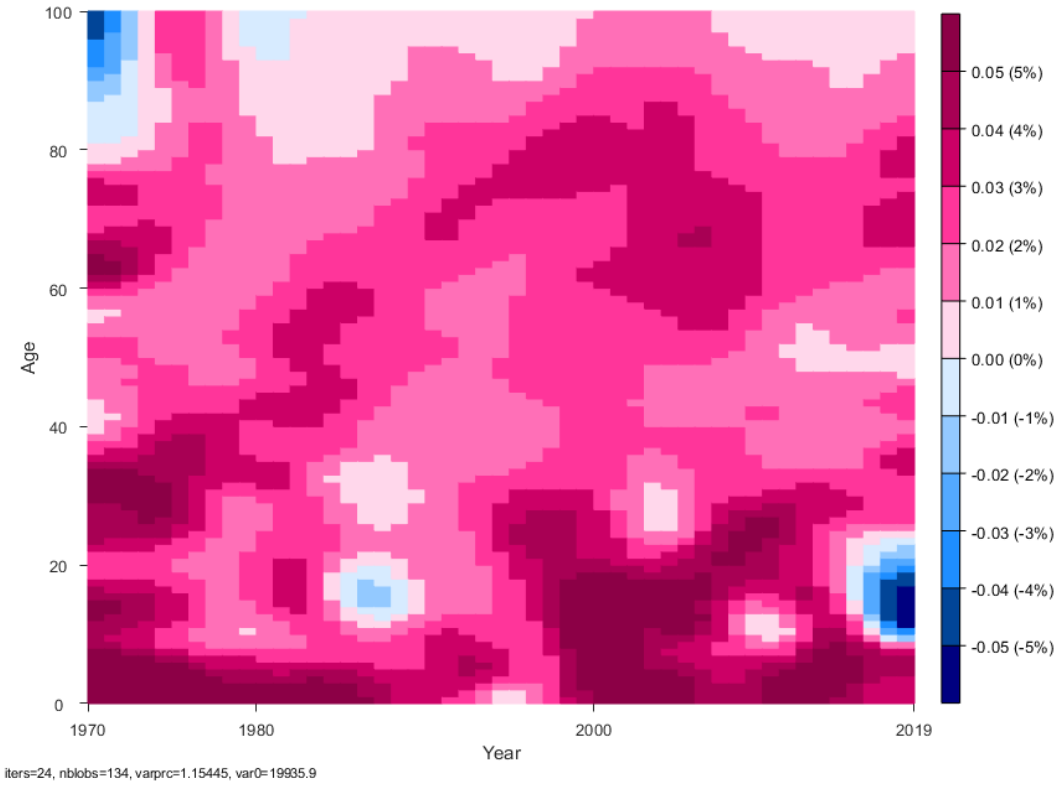
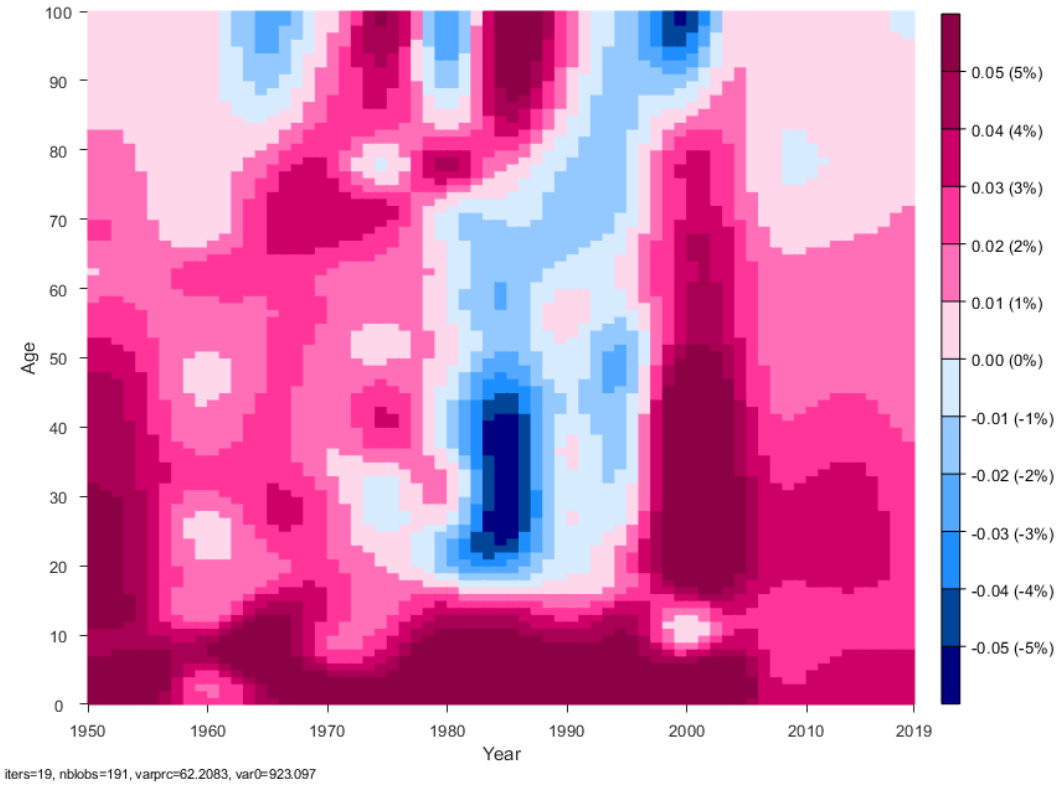
Females



iters=24, nblobs=134, varprc=1.15445, var0=19935.9

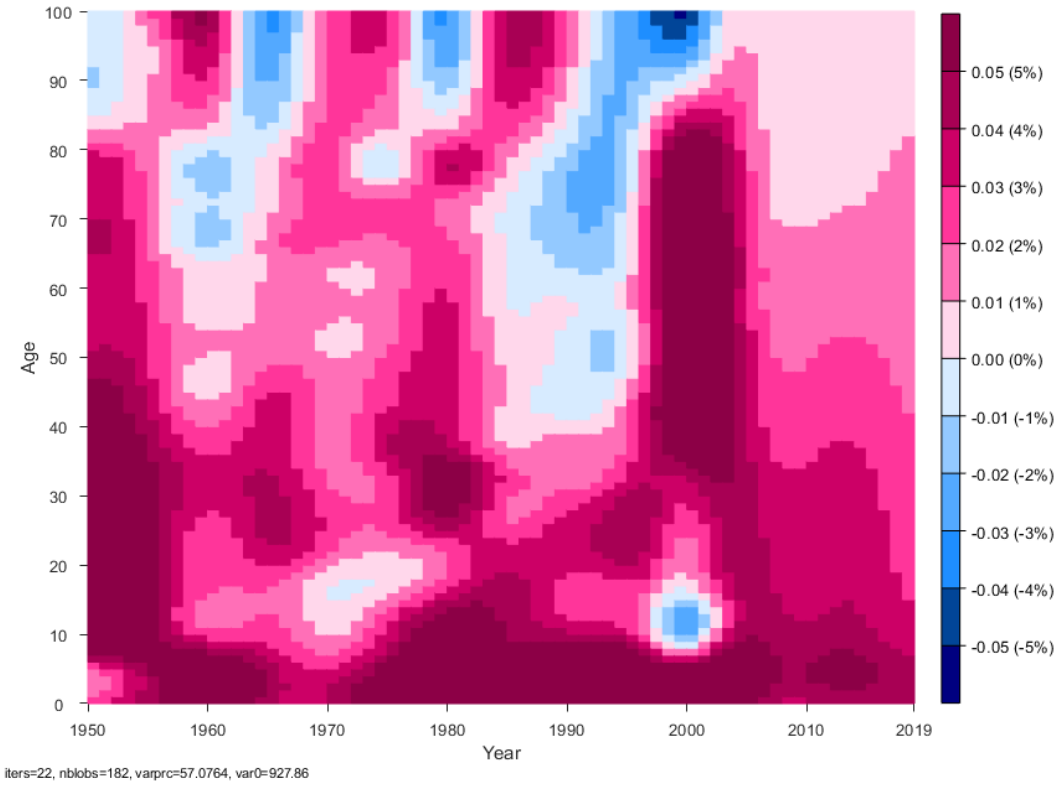
Sri Lanka

Males



iters=19, nblobs=191, varprc=62.2083, var0=923.097

Females



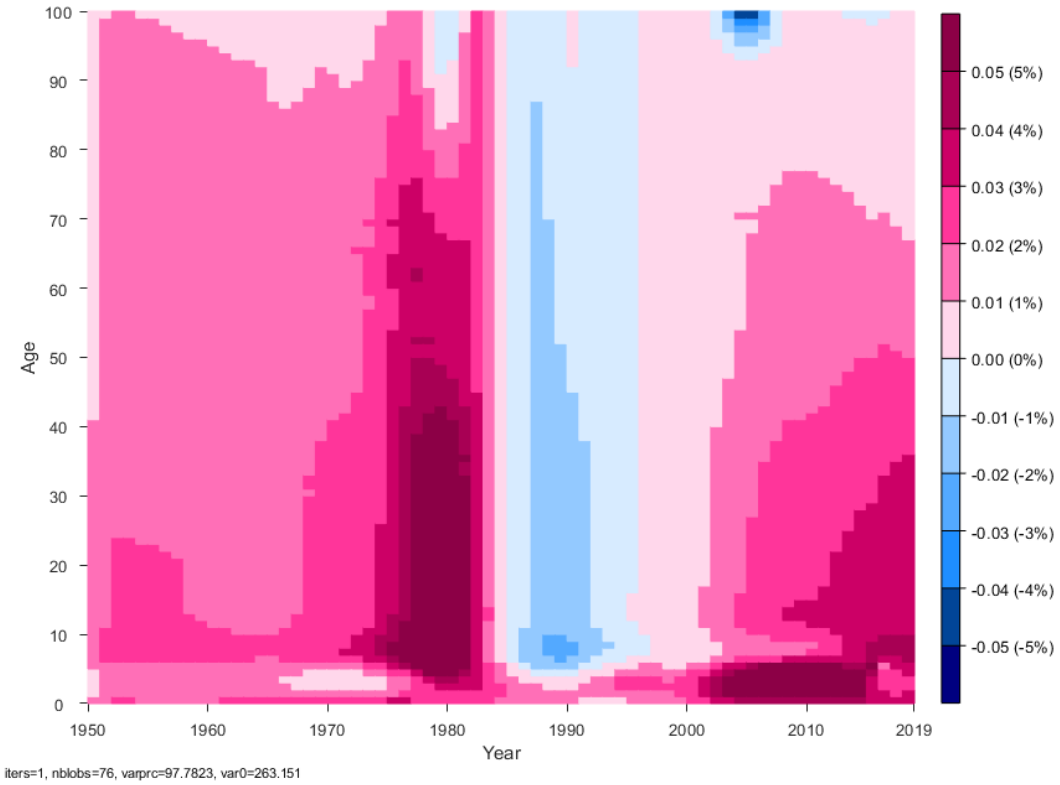
iters=22, nblobs=182, varprc=57.0764, var0=927.86

Burkina Faso

Males

iters=1, nblobs=82, varprc=97.9838, var0=326.944

Females

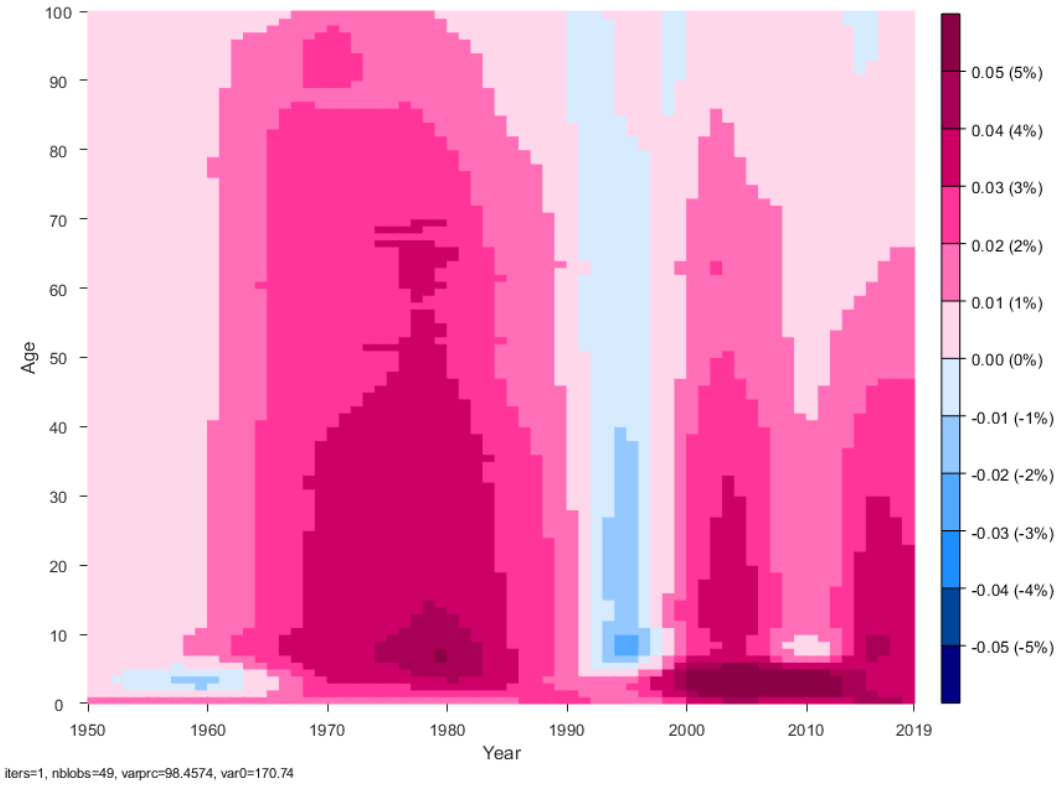


iters=1, nblobs=76, varprc=97.7823, var0=263.151

Mali

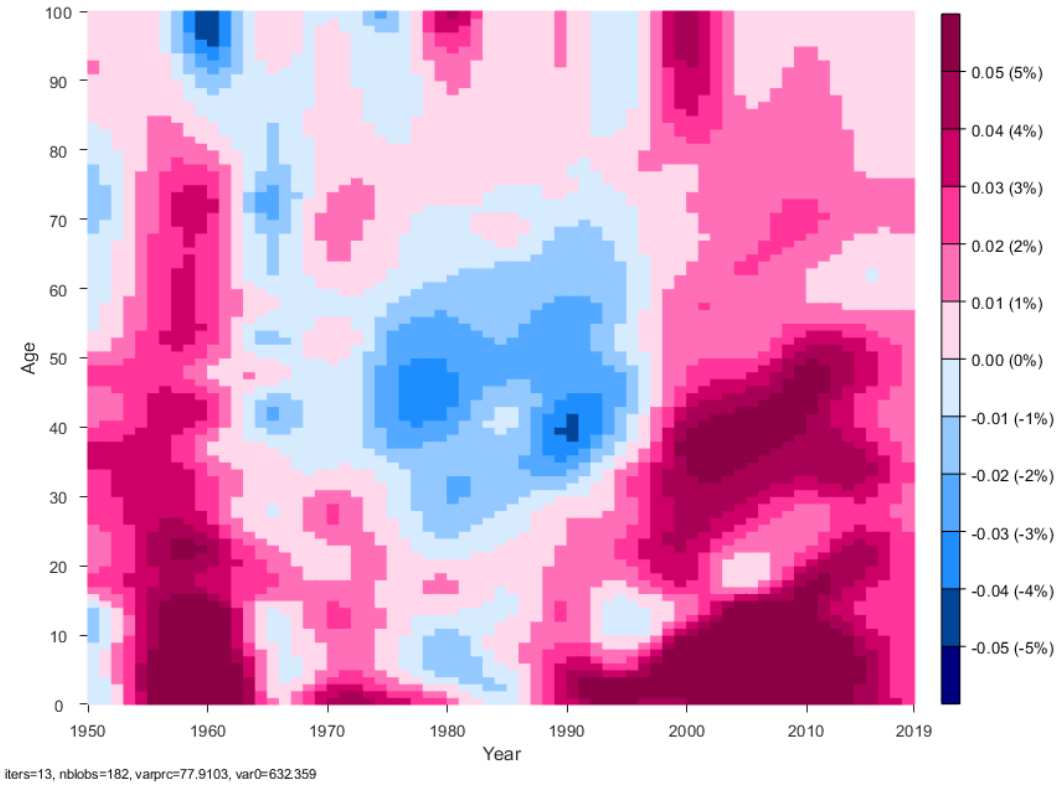
Males

Females



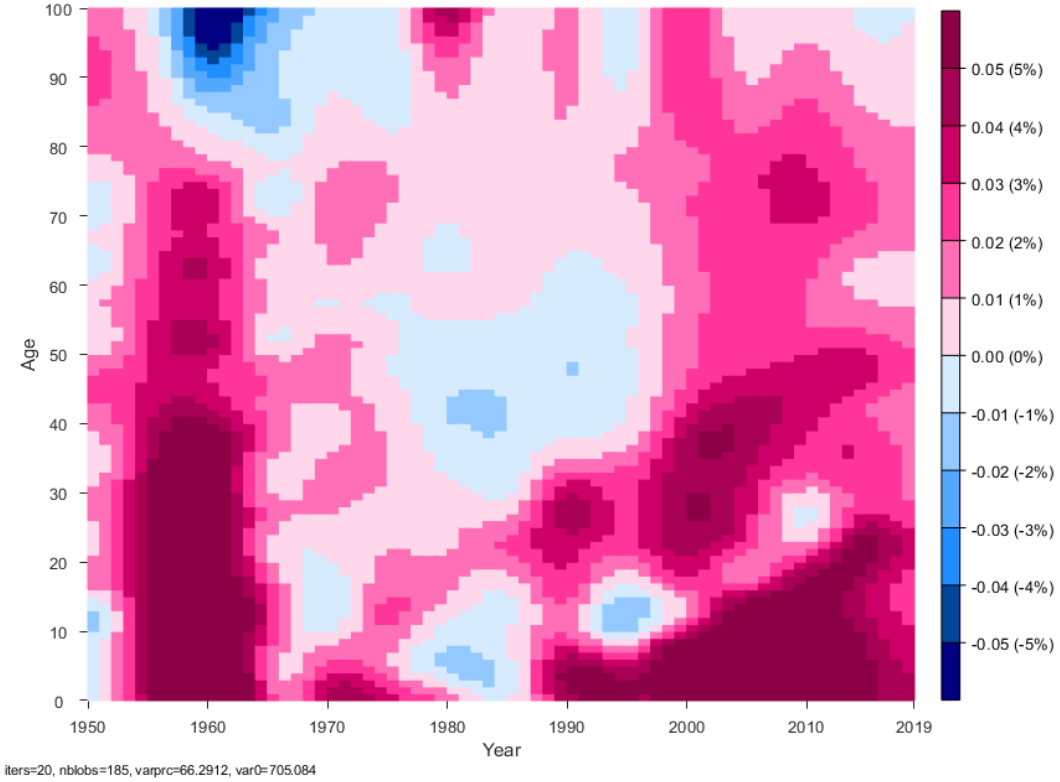
Romania

Males



iters=13, nblobs=182, varprc=77.9103, var0=632.359

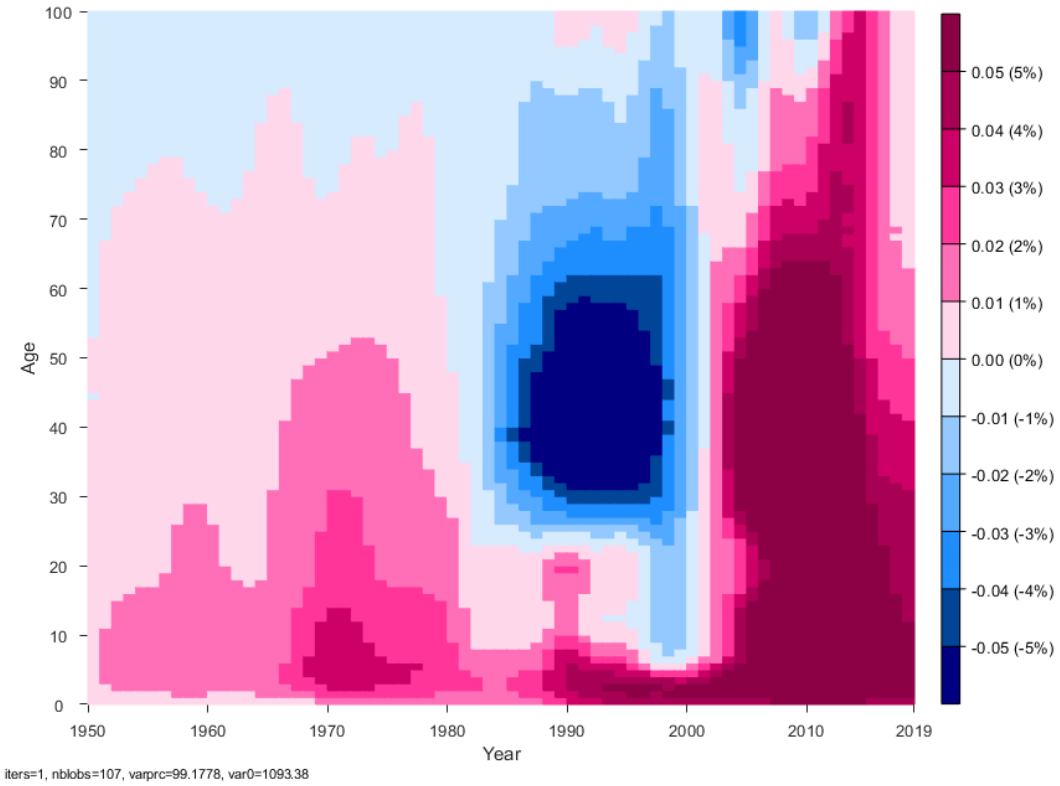
Females



iters=20, nblobs=185, varprc=66.2912, var0=705.084

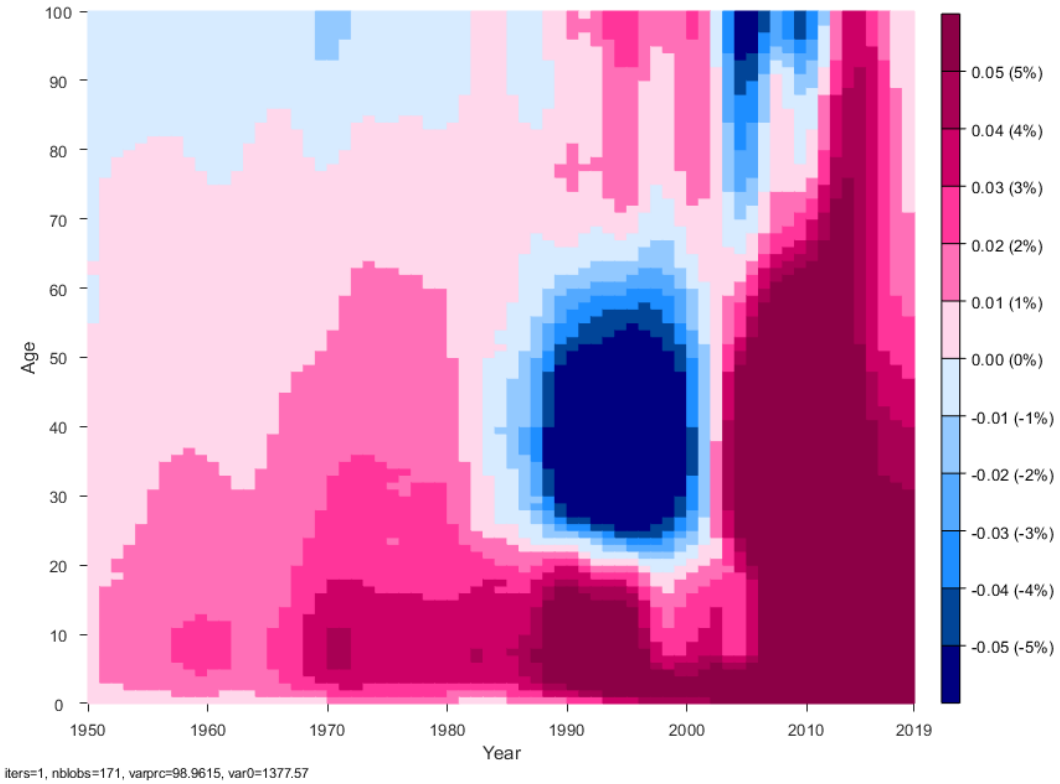
Malawi

Males



iters=1, nblobs=107, varprc=99.1778, var0=1093.38

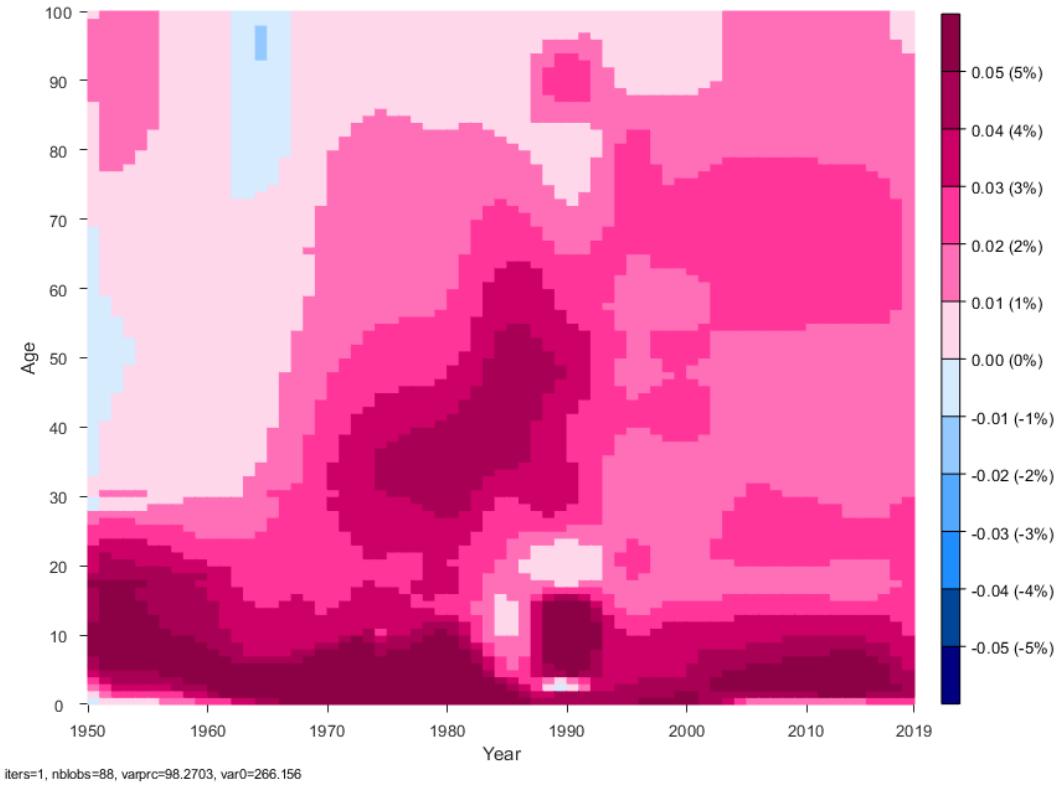
Females



iters=1, nblobs=171, varprc=98.9615, var0=1377.57

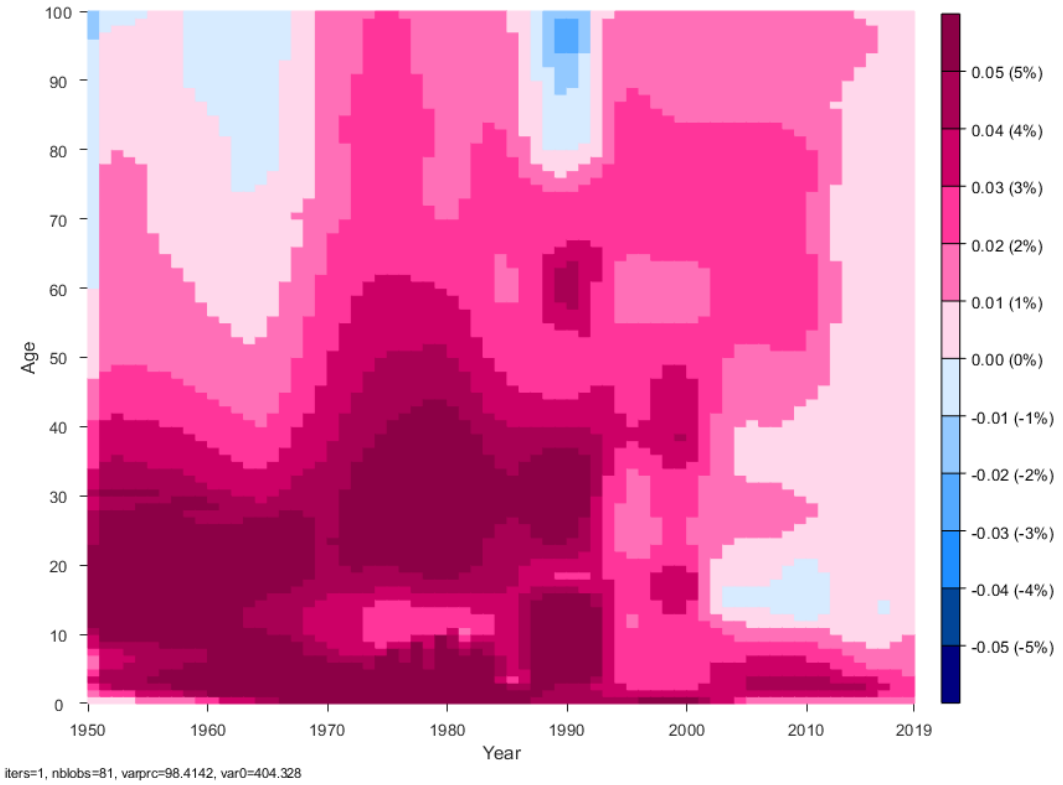
Chile

Males



iters=1, nblobs=88, varprc=98.2703, var0=266.156

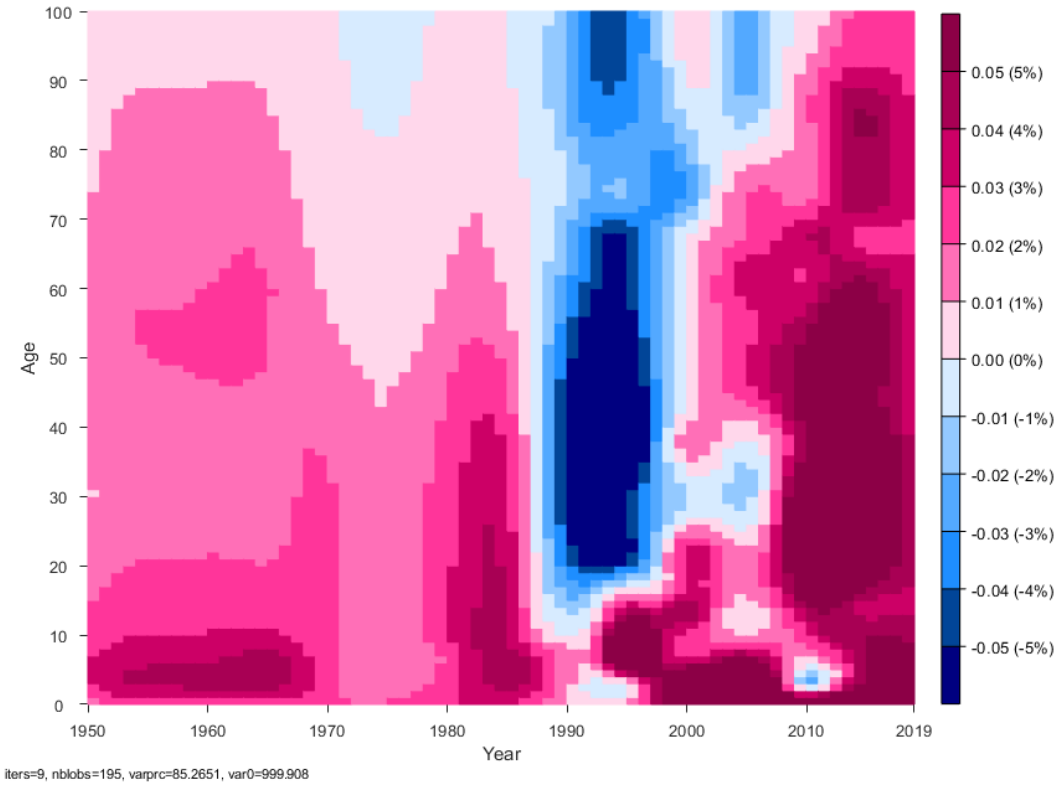
Females



iters=1, nblobs=81, varprc=98.4142, var0=404.328

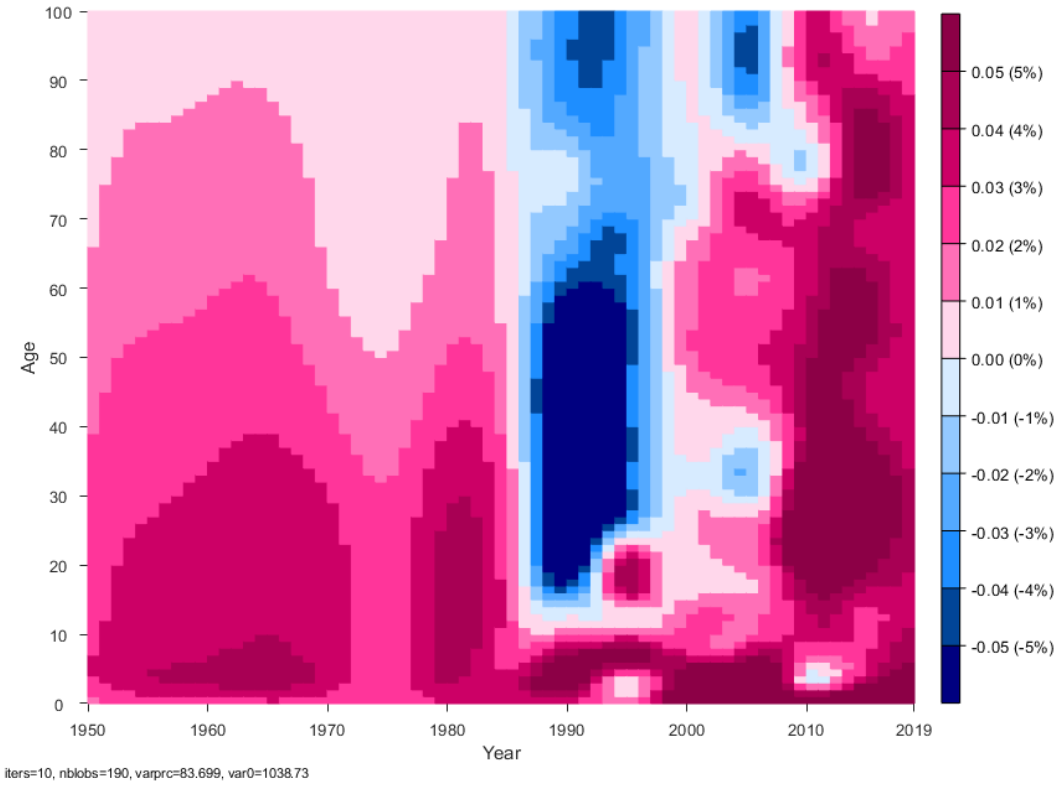
Kazakhstan

Males



iters=9, nblobs=195, varprc=85.2651, var0=999.908

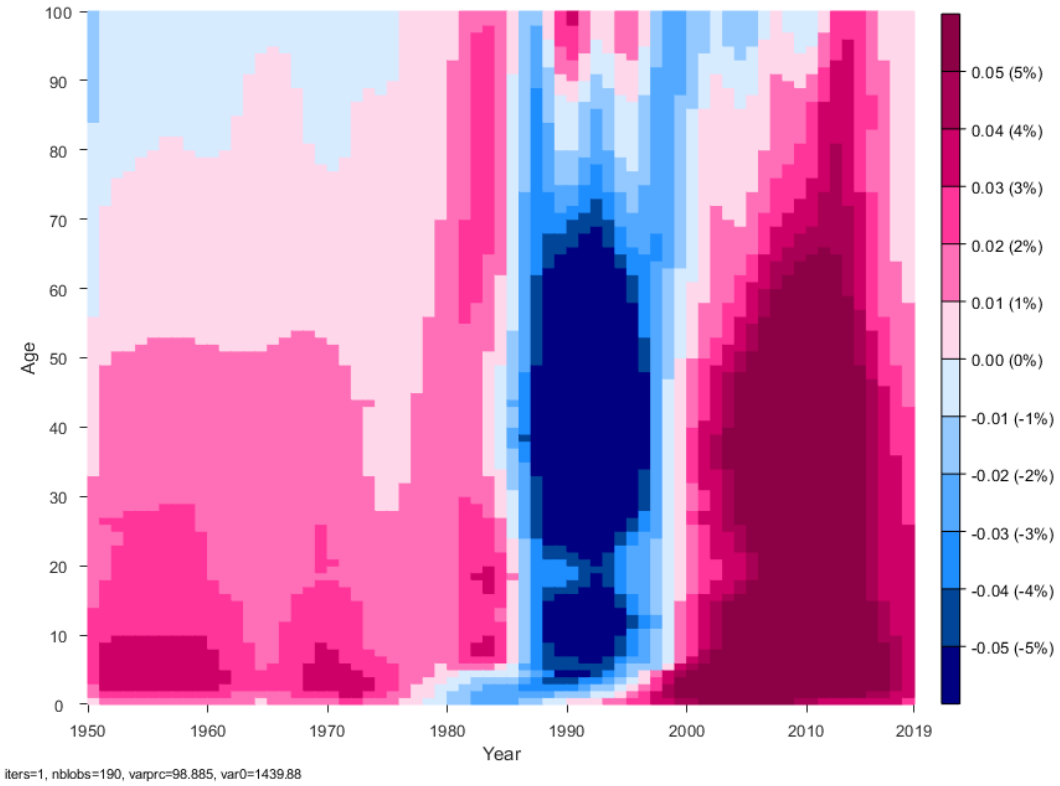
Females



iters=10, nblobs=190, varprc=83.699, var0=1038.73

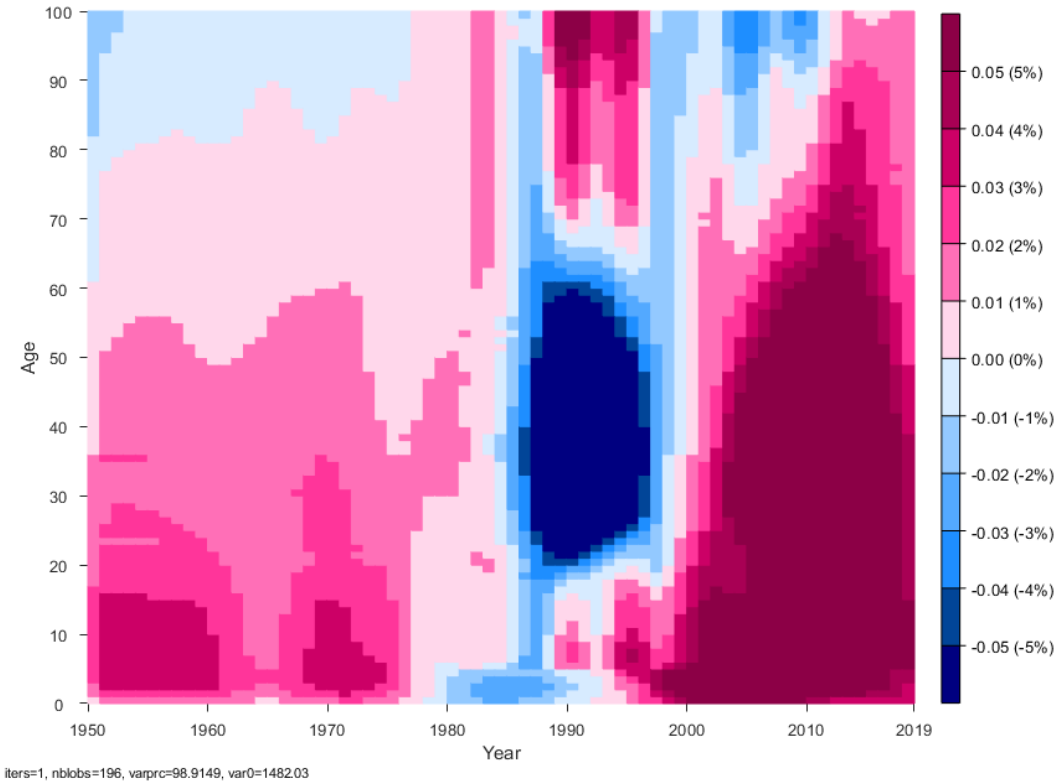
Zambia

Males



iters=1, nblobs=190, varprc=98.885, var0=1439.88

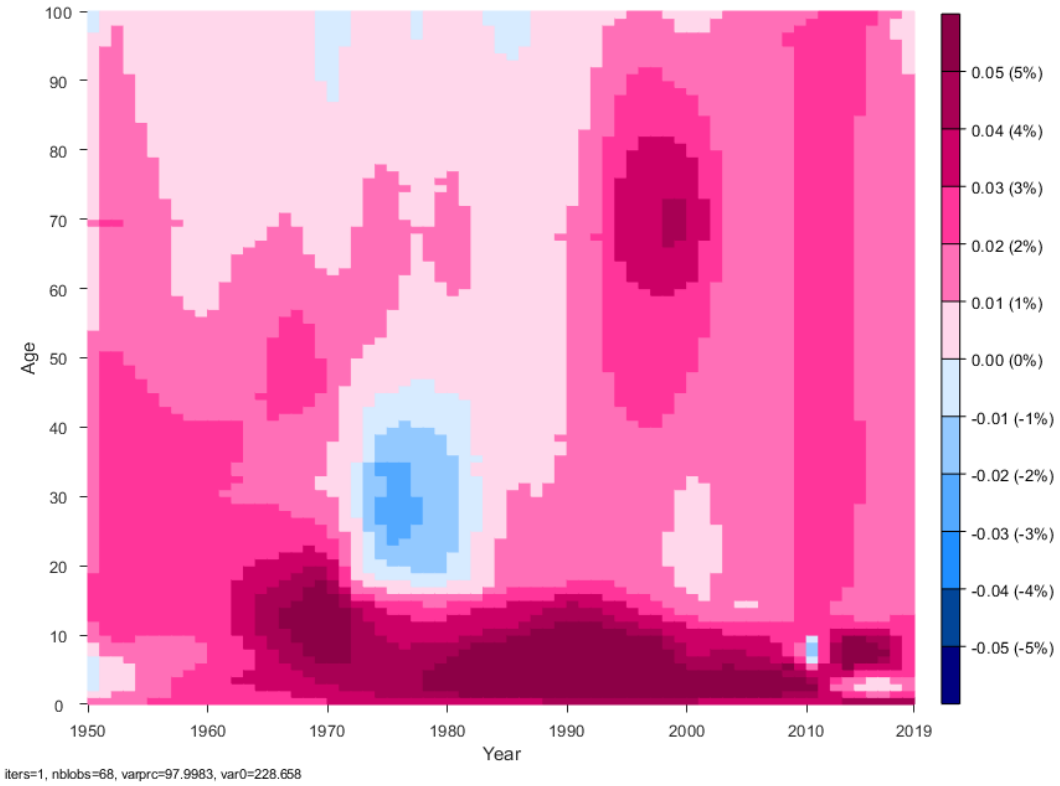
Females



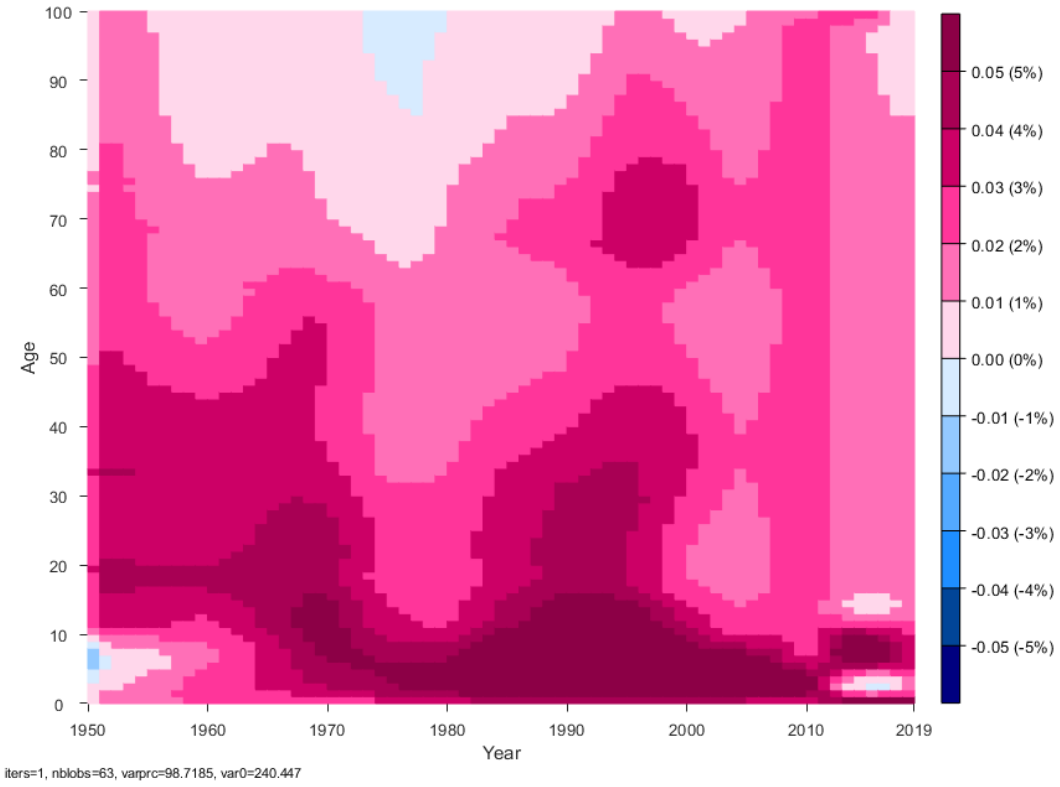
iters=1, nblobs=196, varprc=98.9149, var0=1482.03

Guatemala

Males

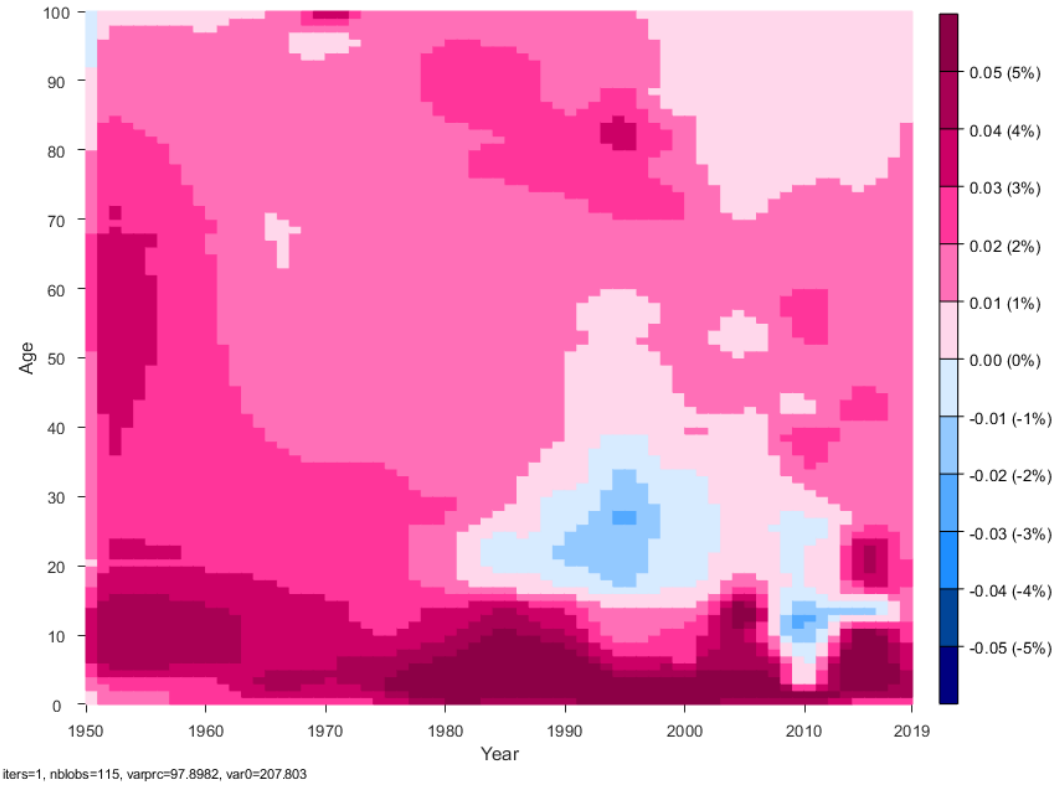


Females



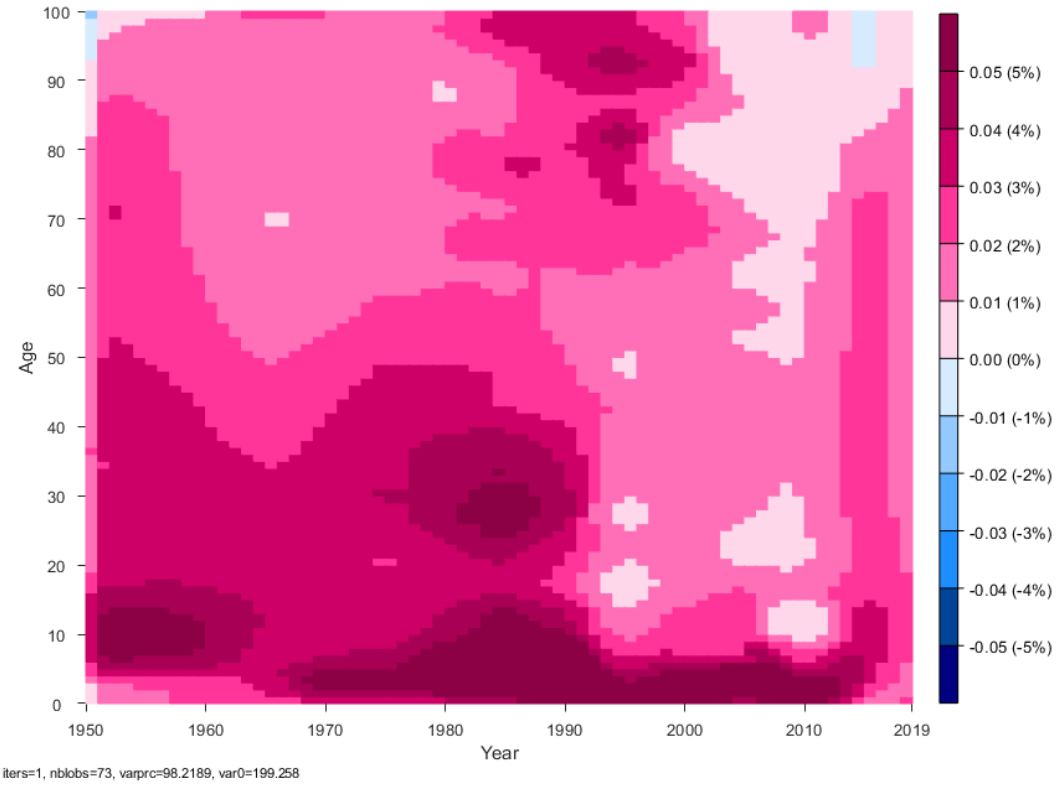
Ecuador

Males



iters=1, nblobs=115, varprc=97.8982, var0=207.803

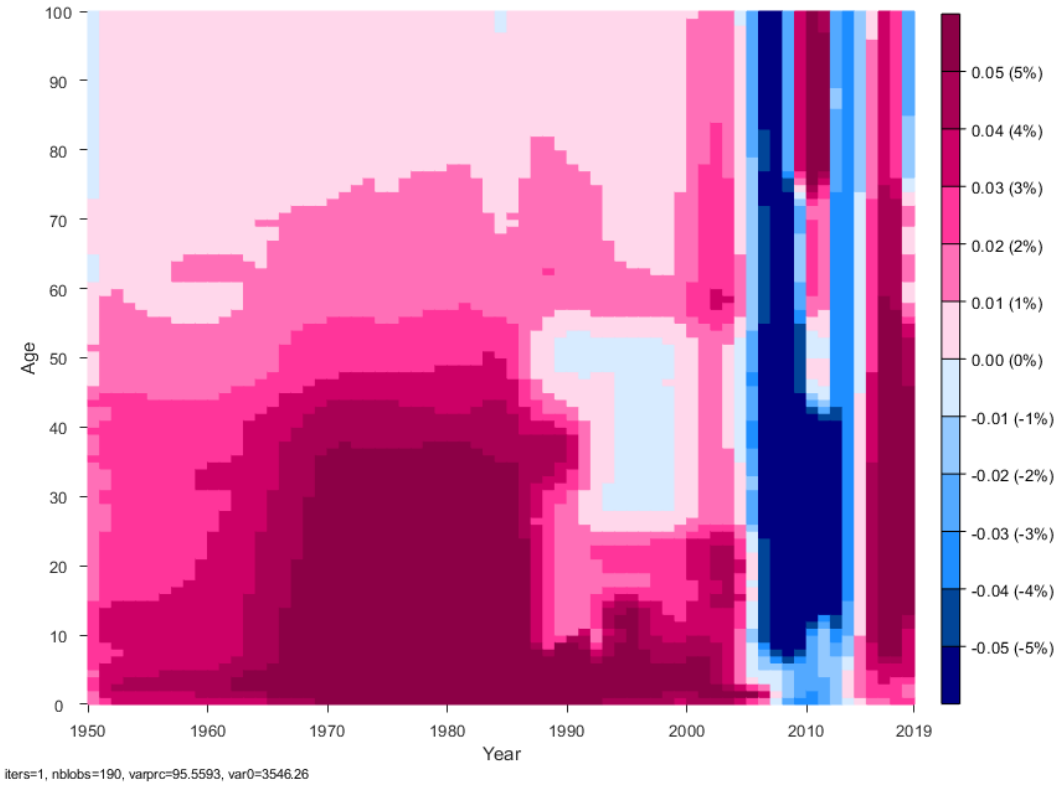
Females



iters=1, nblobs=73, varprc=98.2189, var0=199.258

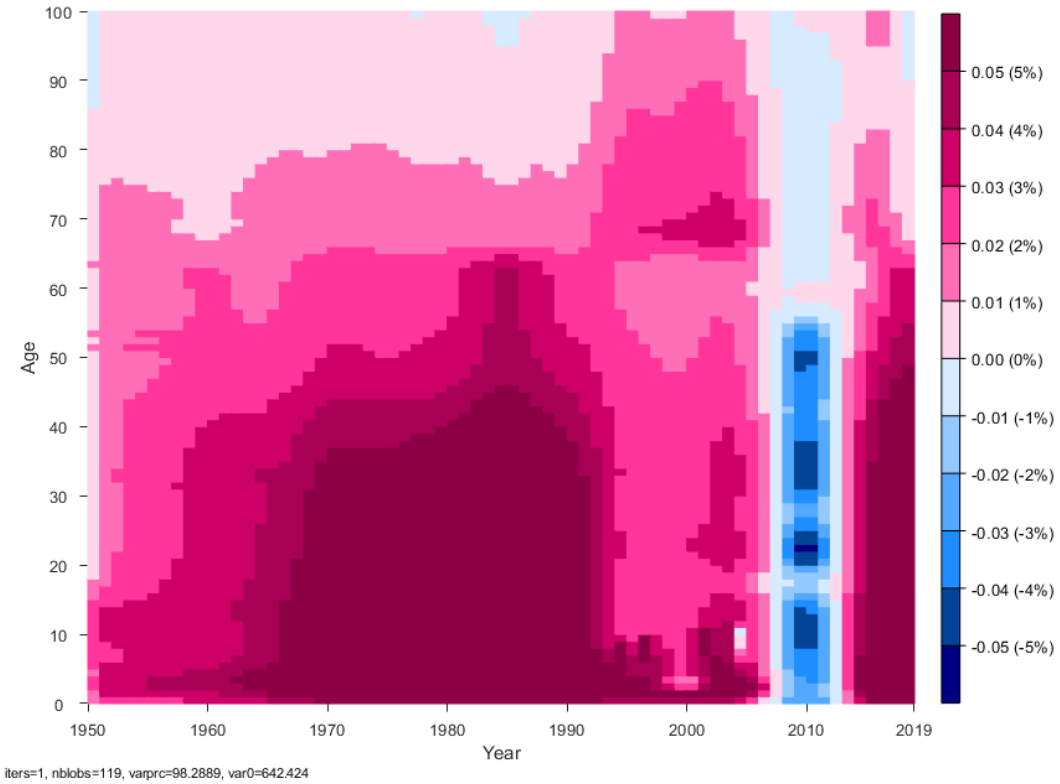
Syrian Arab Republic

Males



iters=1, nblobs=190, varprc=95.5593, var0=3546.26

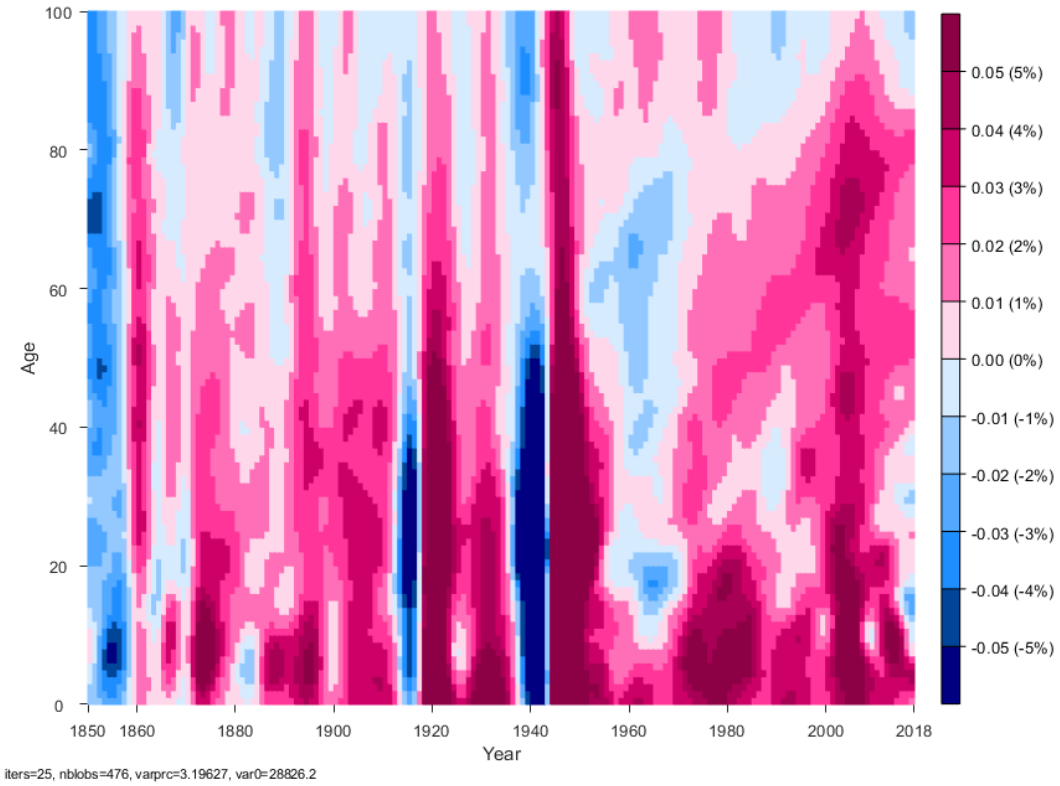
Females



iters=1, nblobs=119, varprc=98.2889, var0=642.424

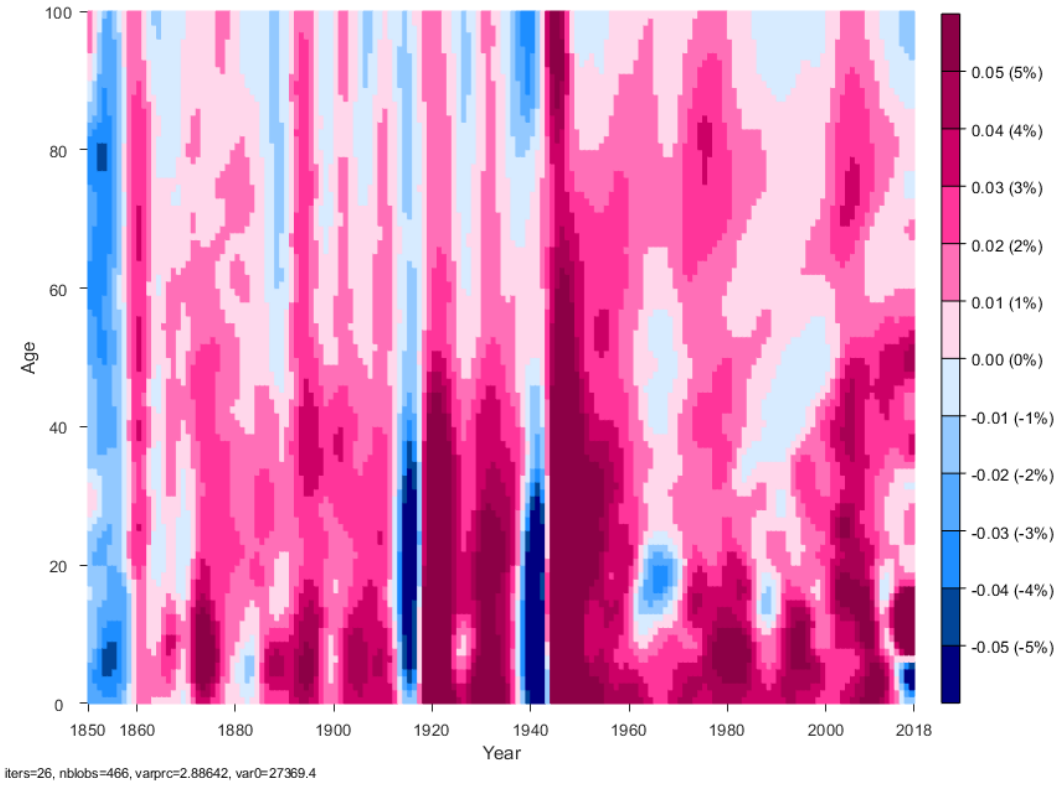
Netherlands

Males



iters=25, nblobs=476, varprc=3.19627, var0=28826.2

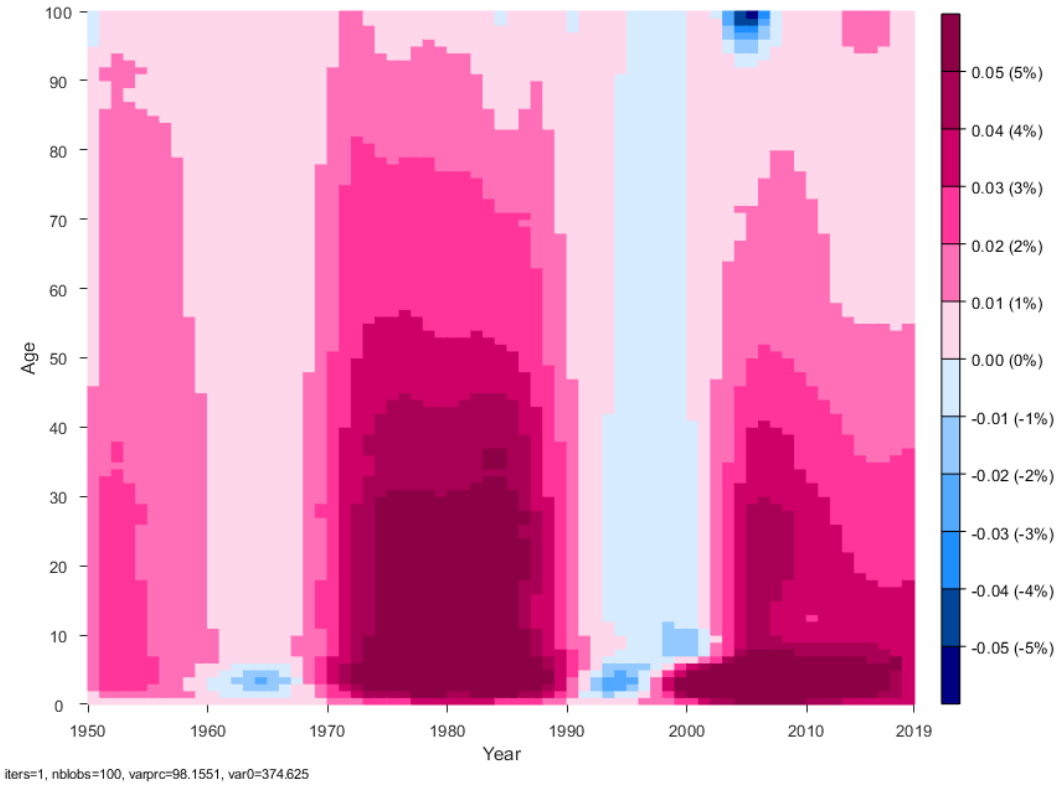
Females



iters=26, nblobs=466, varprc=2.88642, var0=27369.4

Senegal

Males



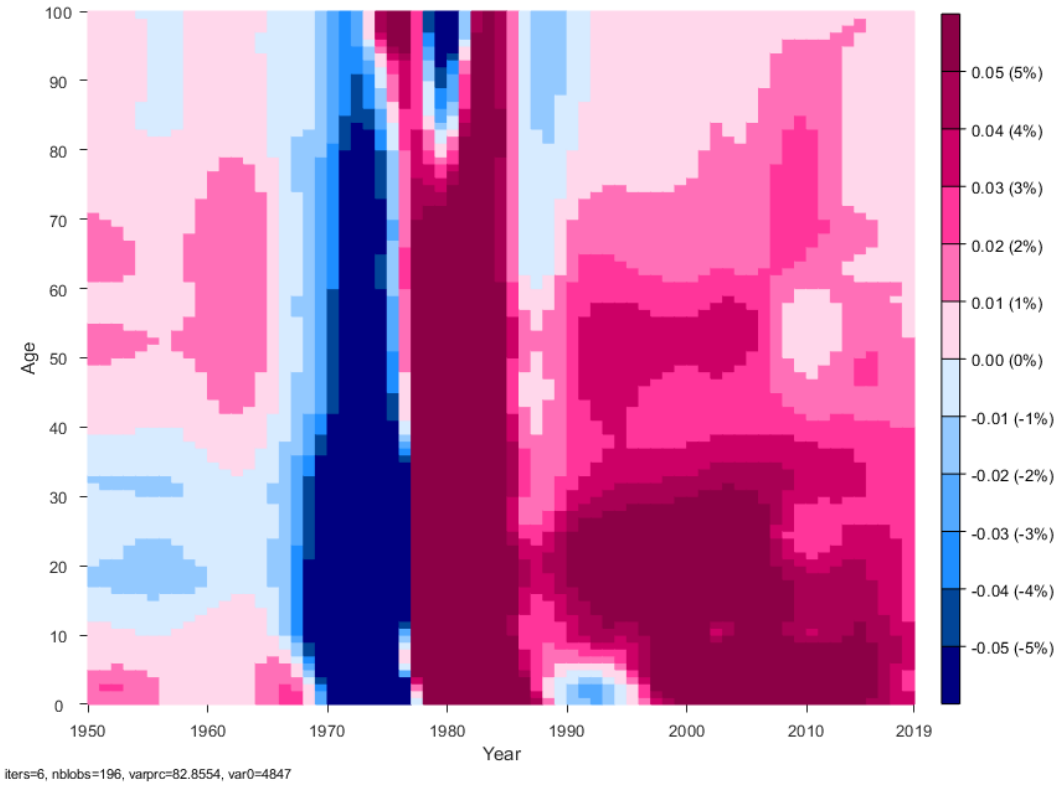
iters=1, nblobs=100, varprc=98.1551, var0=374.625

Females

iters=1, nblobs=95, varprc=98.478, var0=491.988

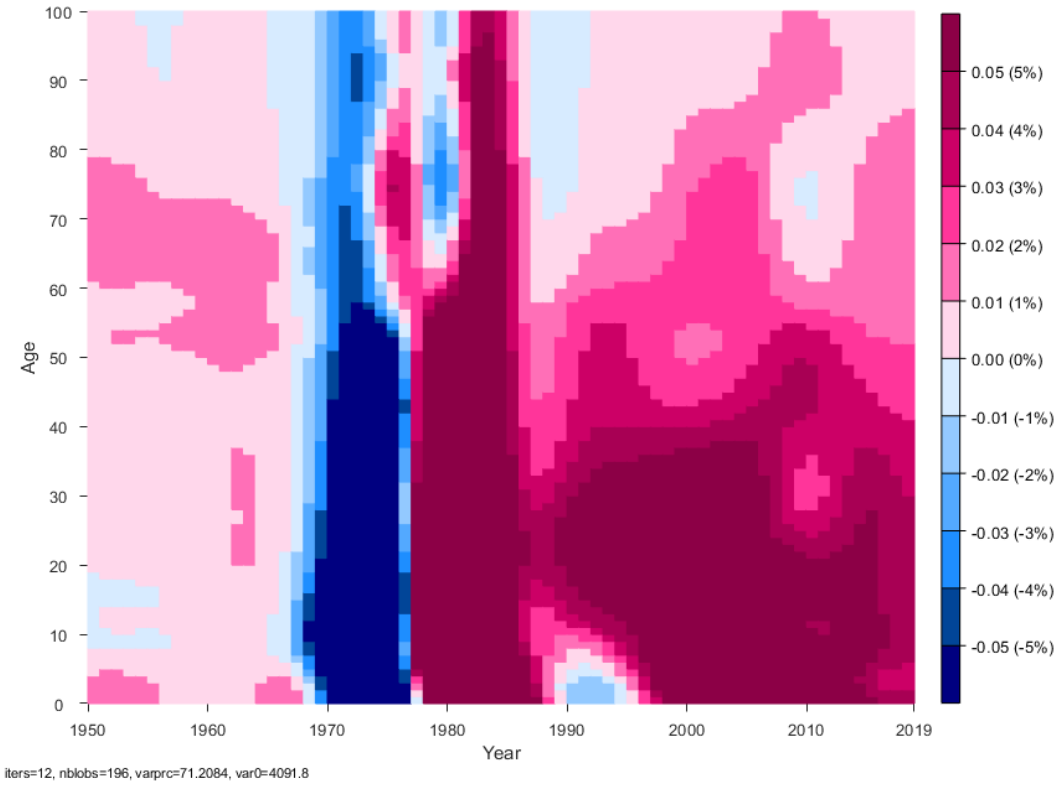
Cambodia

Males



iters=6, nblobs=196, varprc=82.8554, var0=4847

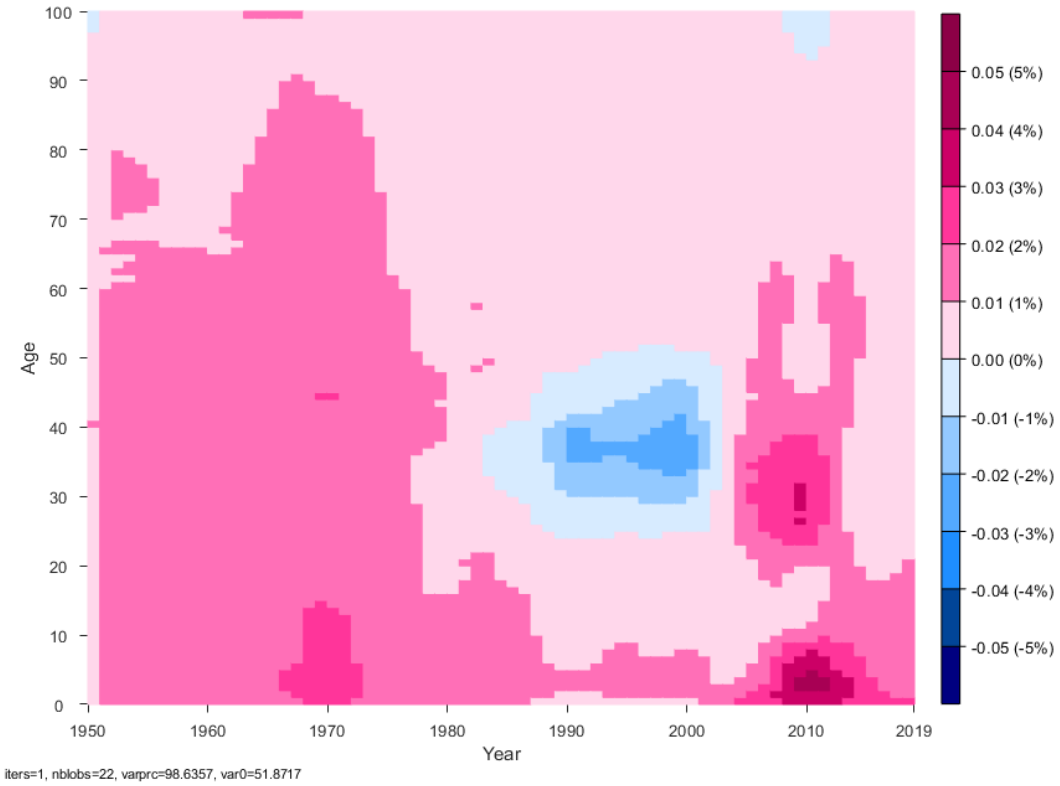
Females



iters=12, nblobs=196, varprc=71.2084, var0=4091.8

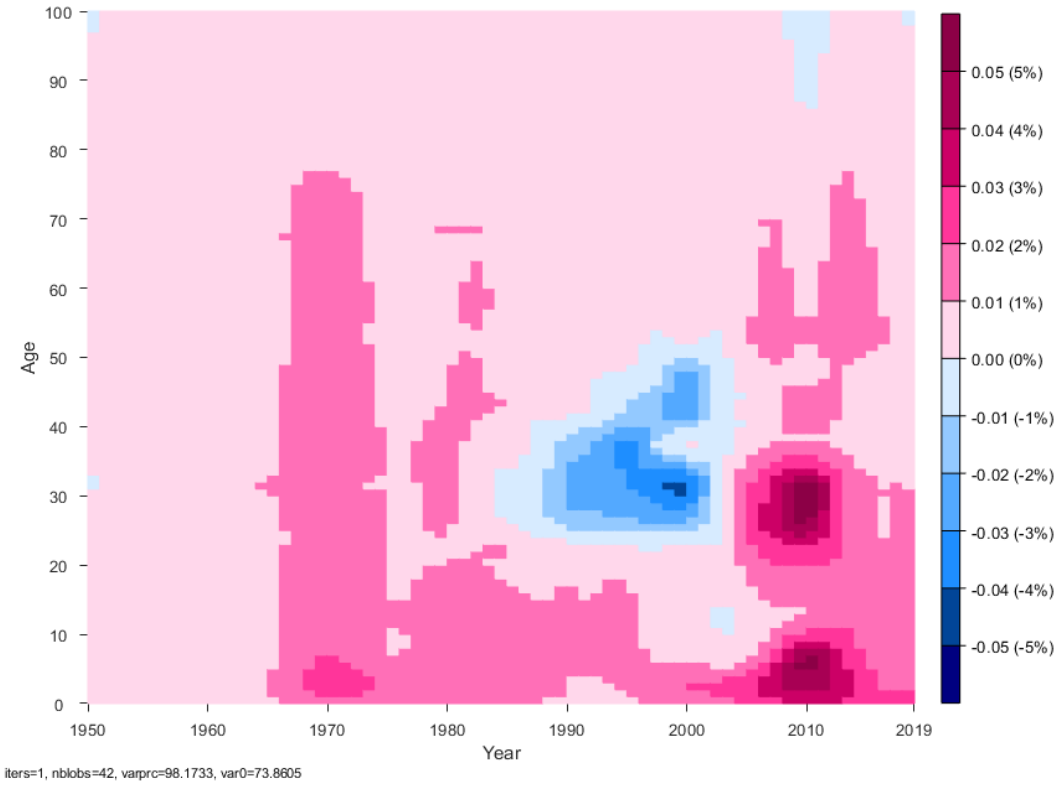
Chad

Males



iters=1, nblobs=22, varprc=98.6357, var0=51.8717

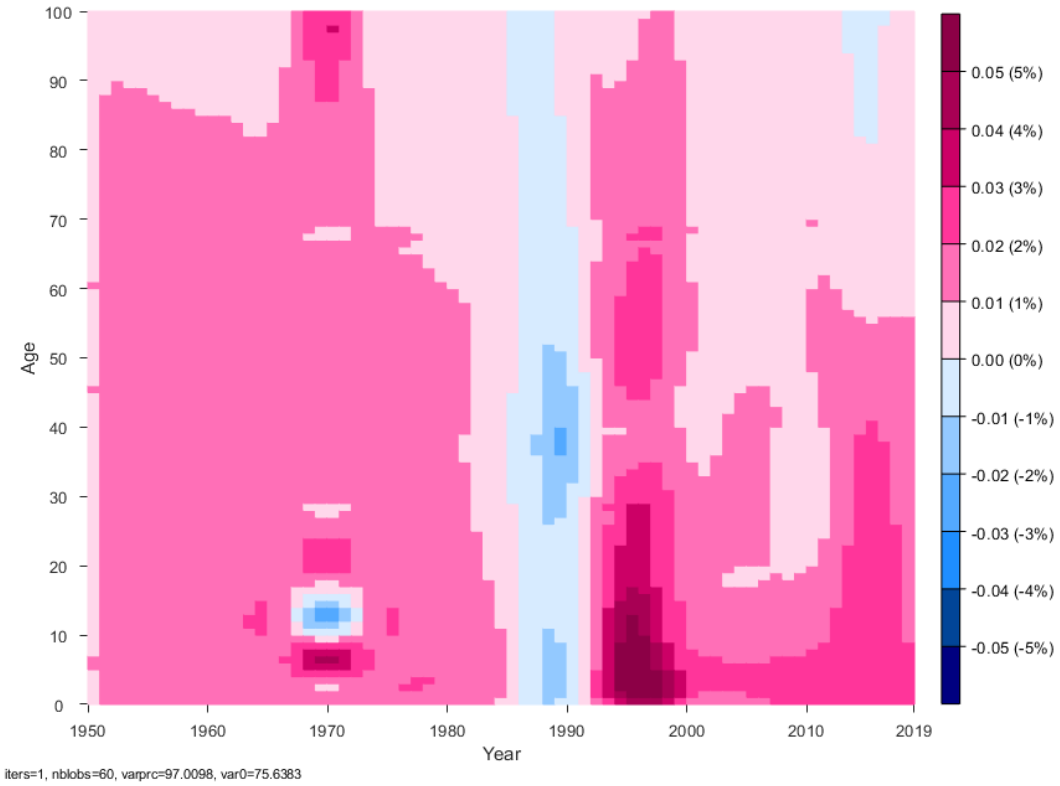
Females



iters=1, nblobs=42, varprc=98.1733, var0=73.8605

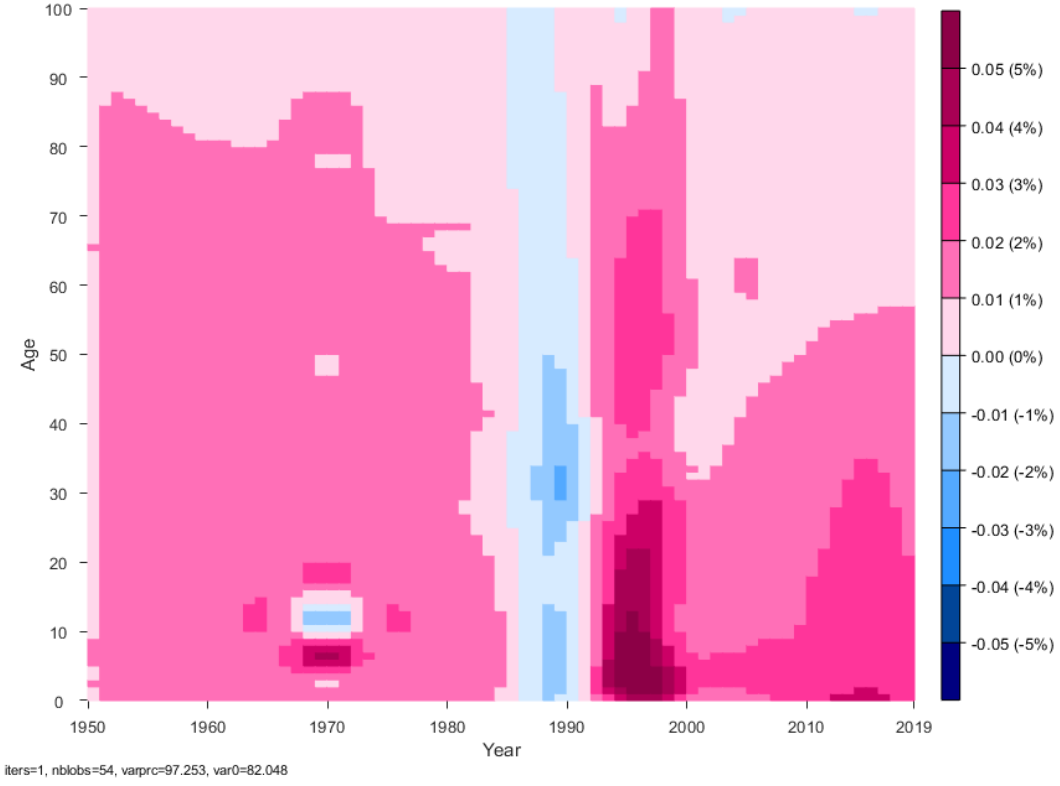
Somalia

Males



iters=1, nblobs=60, varprc=97.0098, var0=75.6383

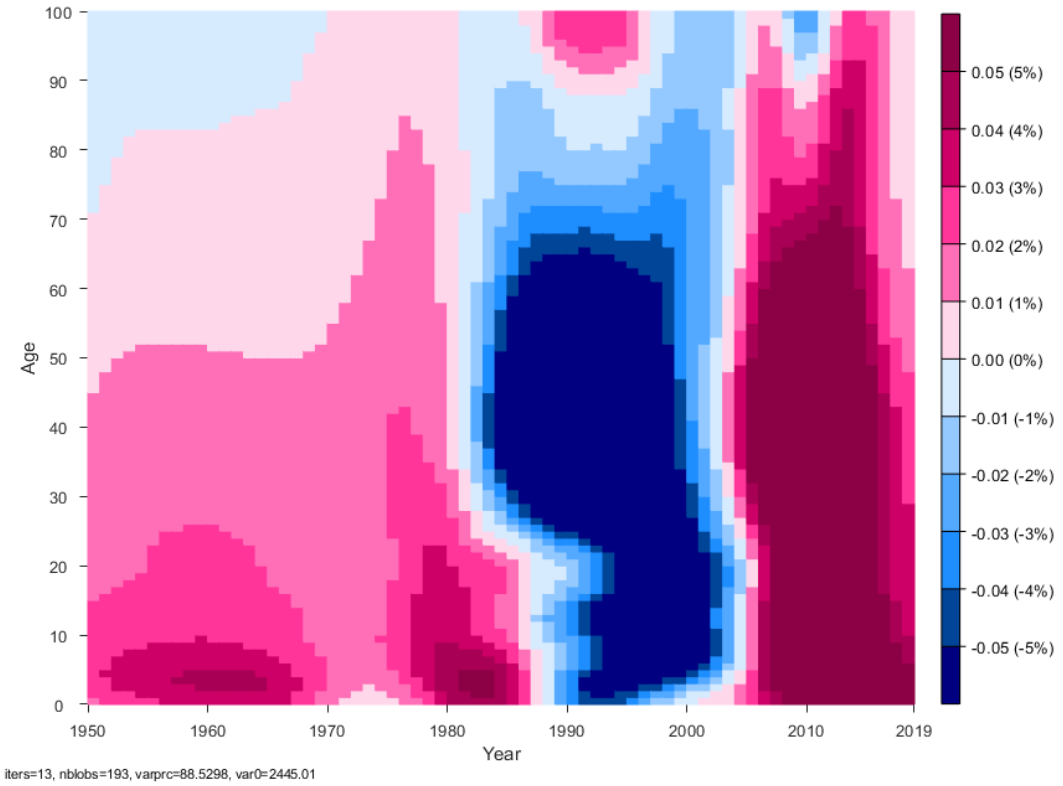
Females



iters=1, nblobs=54, varprc=97.253, var0=82.048

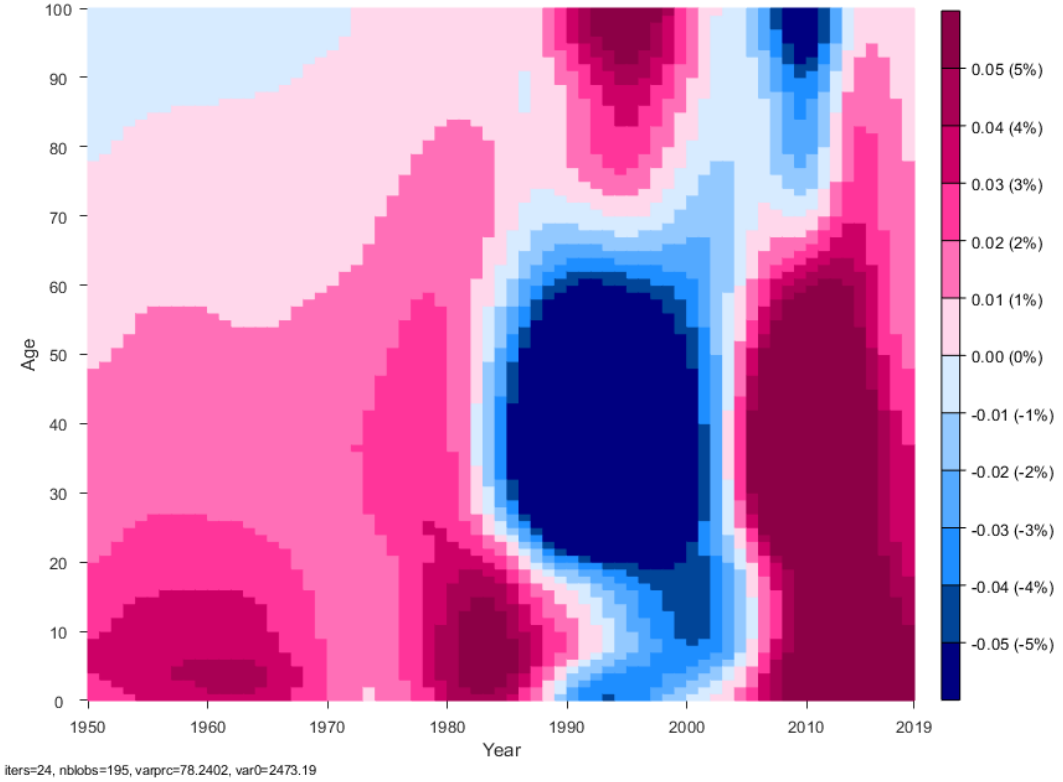
Zimbabwe

Males



iters=13, nblobs=193, varprc=88.5298, var0=2445.01

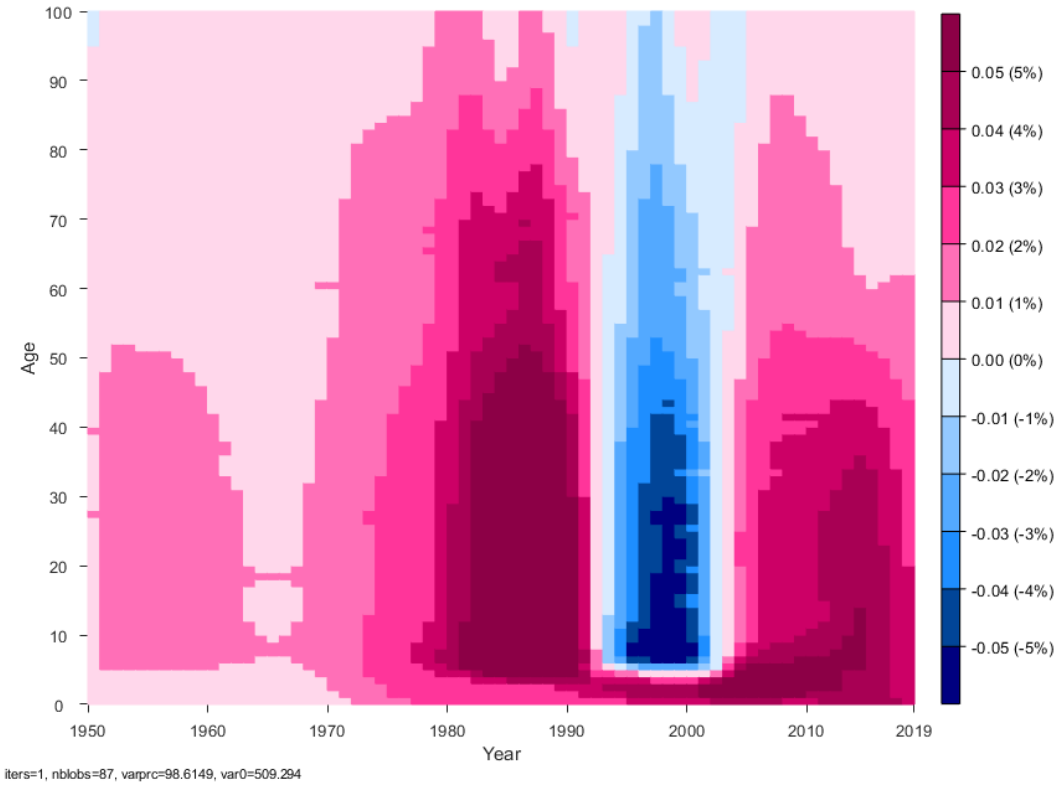
Females



iters=24, nblobs=195, varprc=78.2402, var0=2473.19

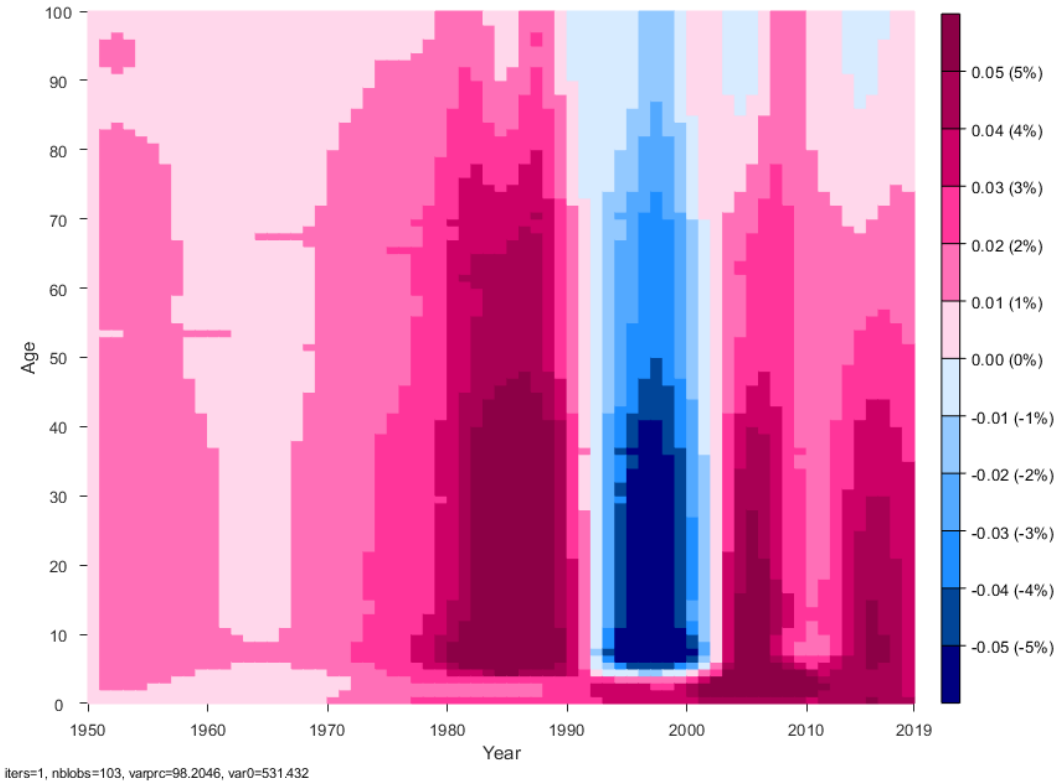
Guinea

Males



iters=1, nblobs=87, varprc=98.6149, var0=509.294

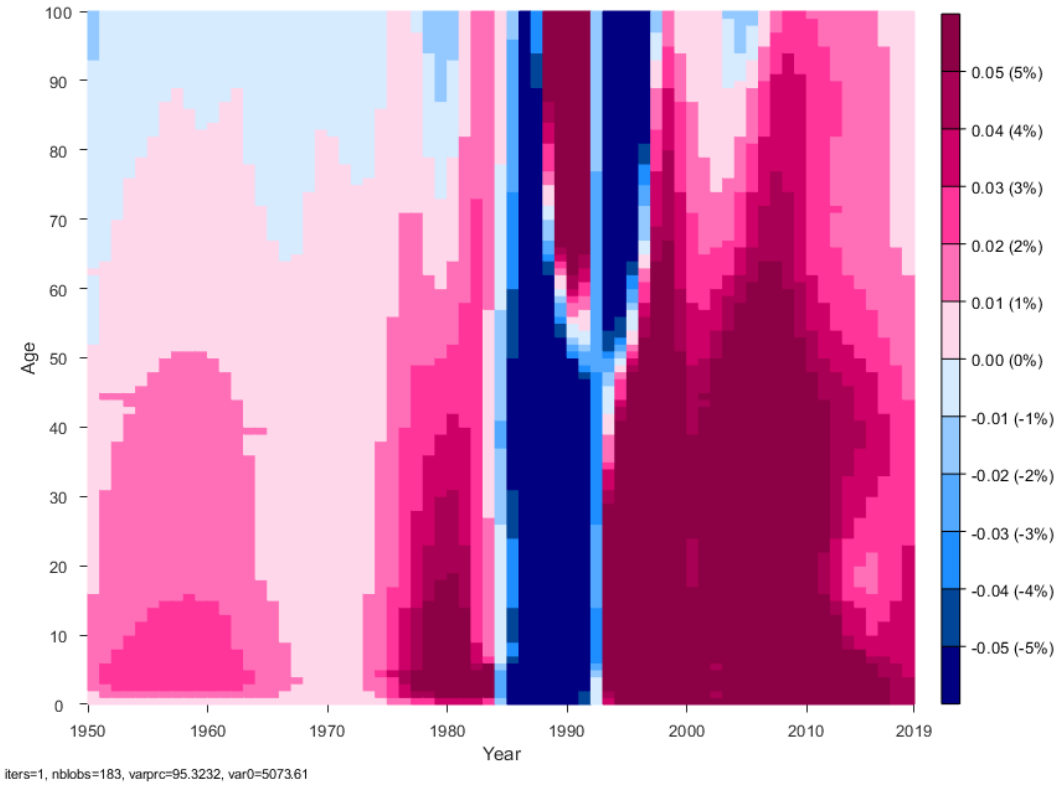
Females



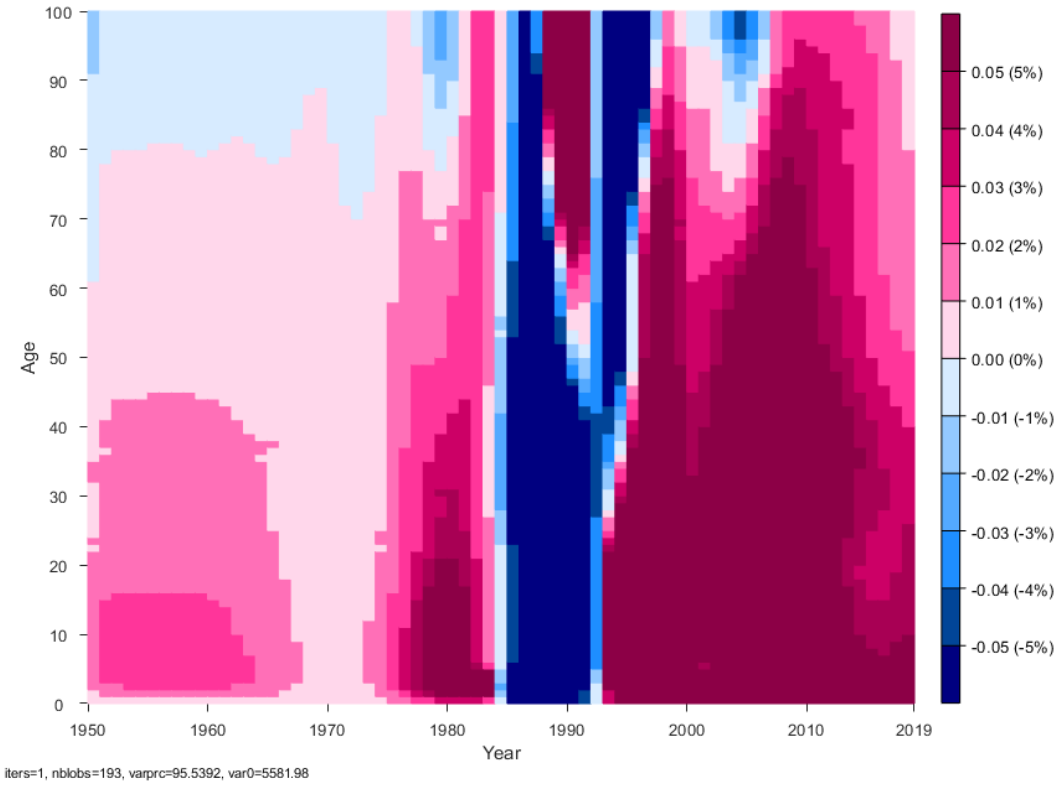
iters=1, nblobs=103, varprc=98.2046, var0=531.432

Rwanda

Males

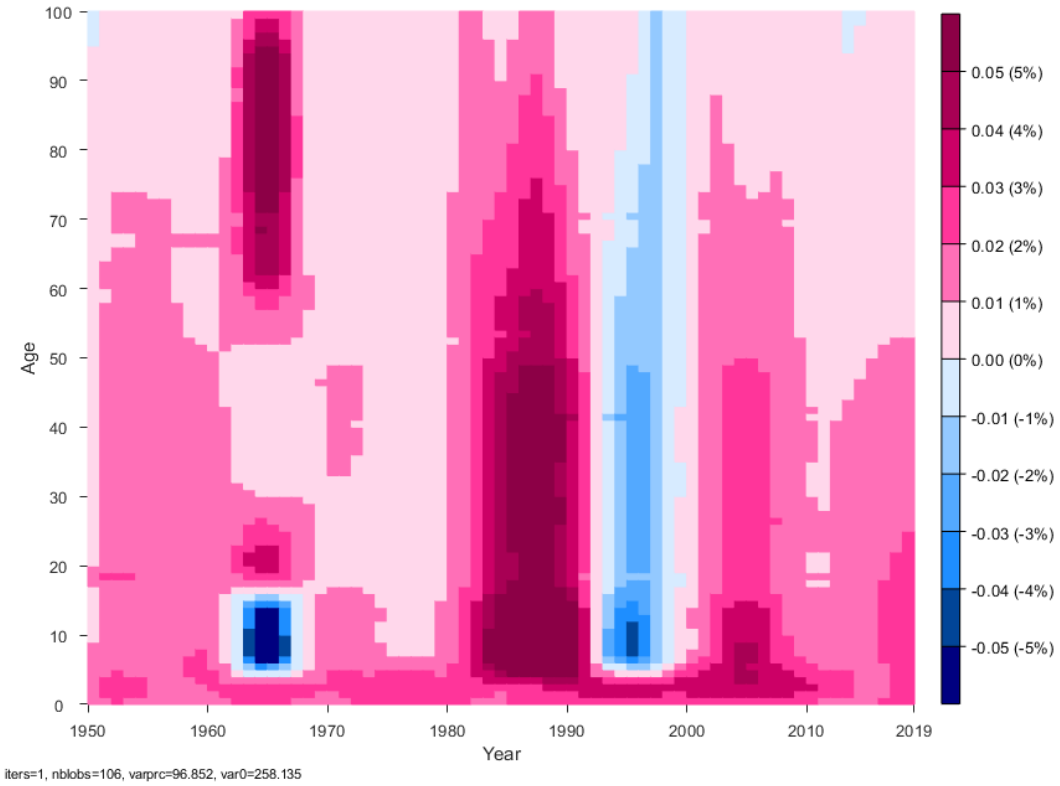


Females



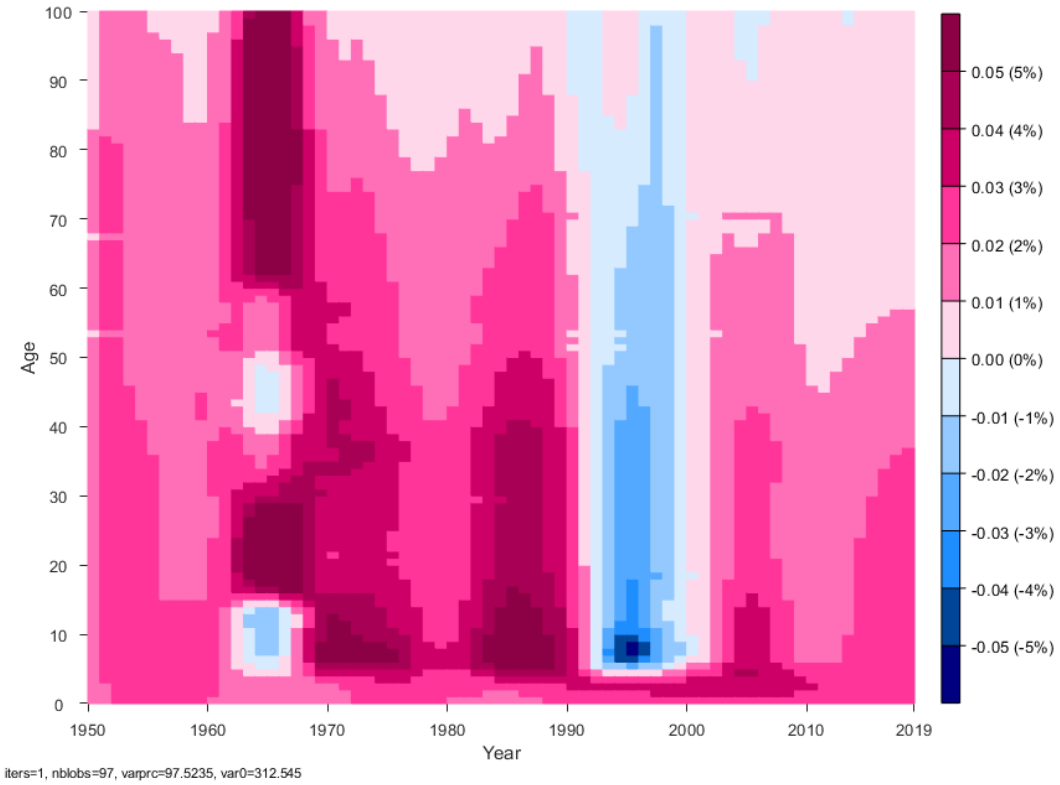
Benin

Males



iters=1, nblobs=106, varprc=96.852, var0=258.135

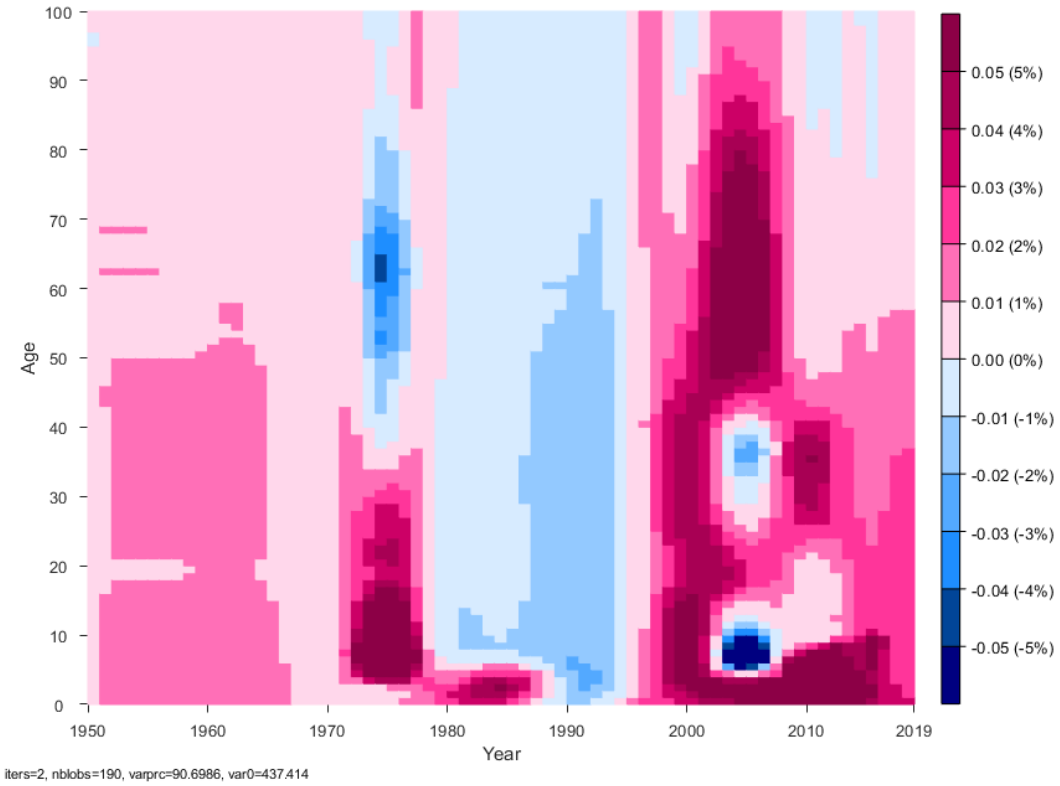
Females



iters=1, nblobs=97, varprc=97.5235, var0=312.545

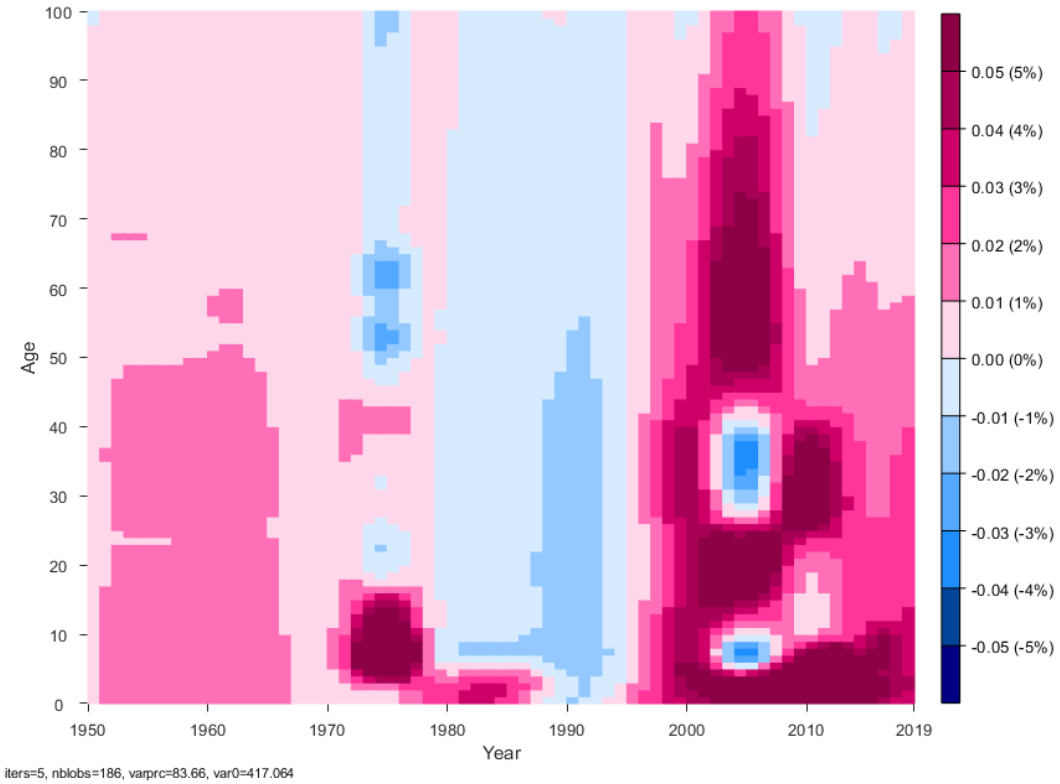
Burundi

Males



iters=2, nblobs=190, varprc=90.6986, var0=437.414

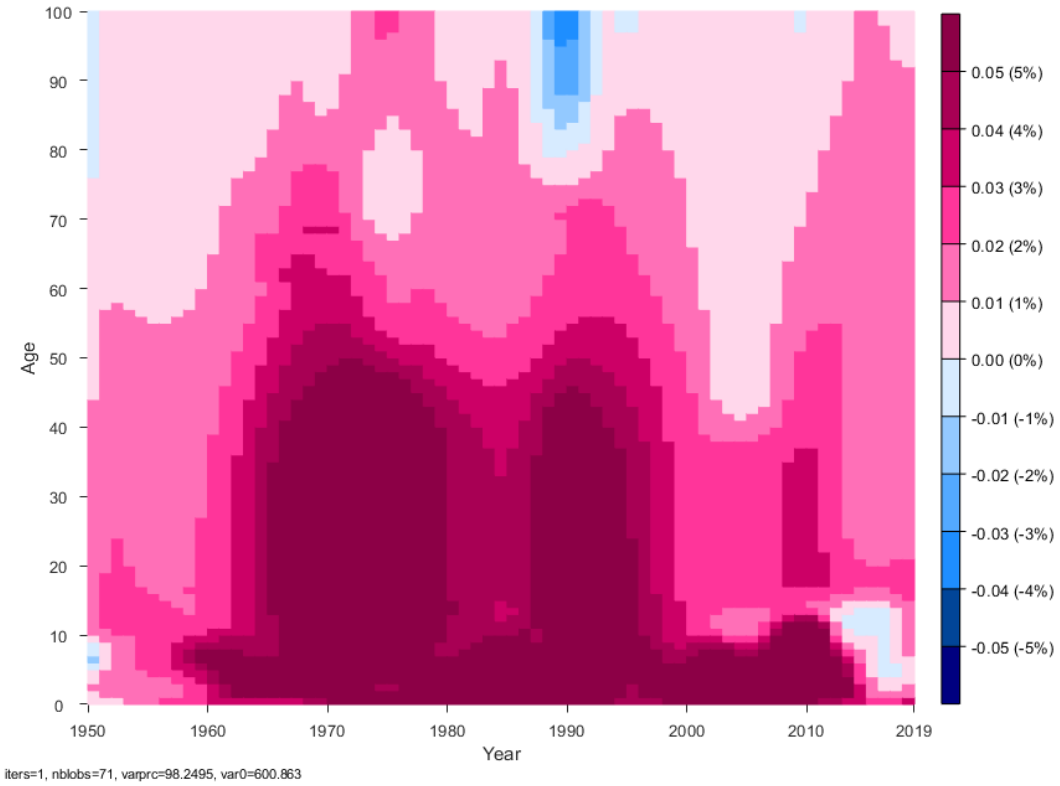
Females



iters=5, nblobs=186, varprc=83.66, var0=417.064

Tunisia

Males



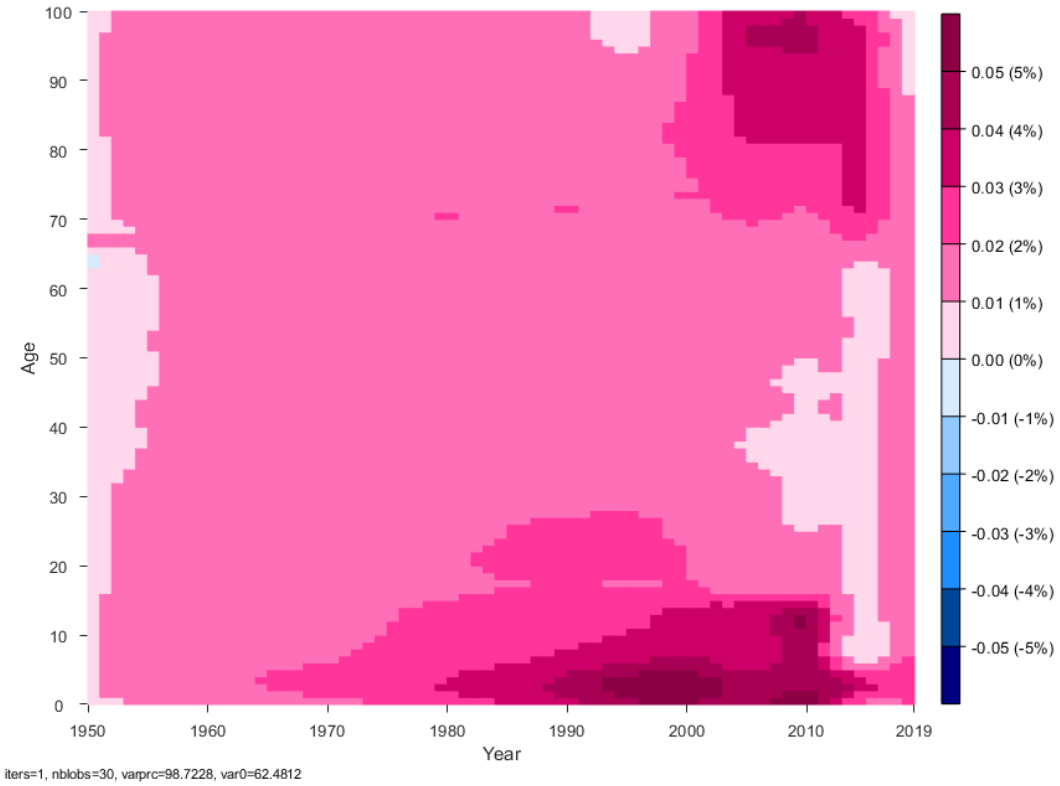
iters=1, nblobs=71, varprc=98.2495, var0=600.863

Females

iters=1, nblobs=103, varprc=97.9858, var0=719.316

Bolivia (Plurinational State of)

Males



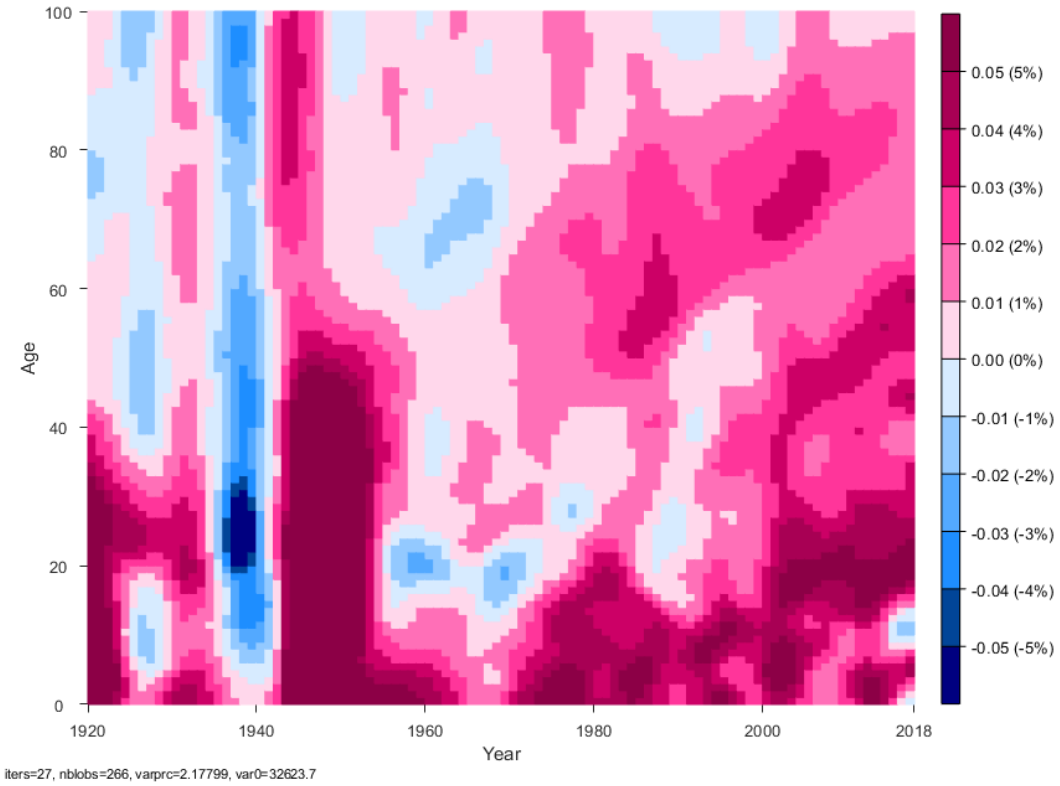
iters=1, nblobs=30, varprc=98.7228, var0=62.4812

Females

iters=1, nblobs=32, varprc=98.992, var0=113.119

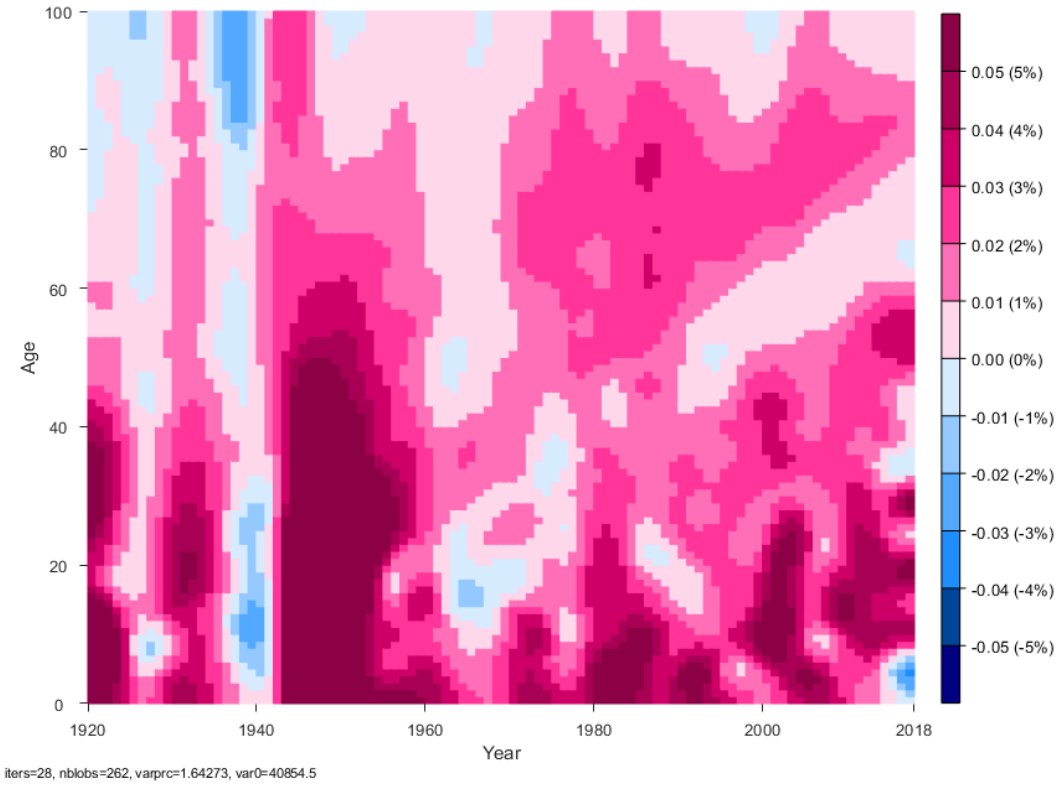
Belgium

Males



iters=27, nblobs=266, varprc=2.17799, var0=32623.7

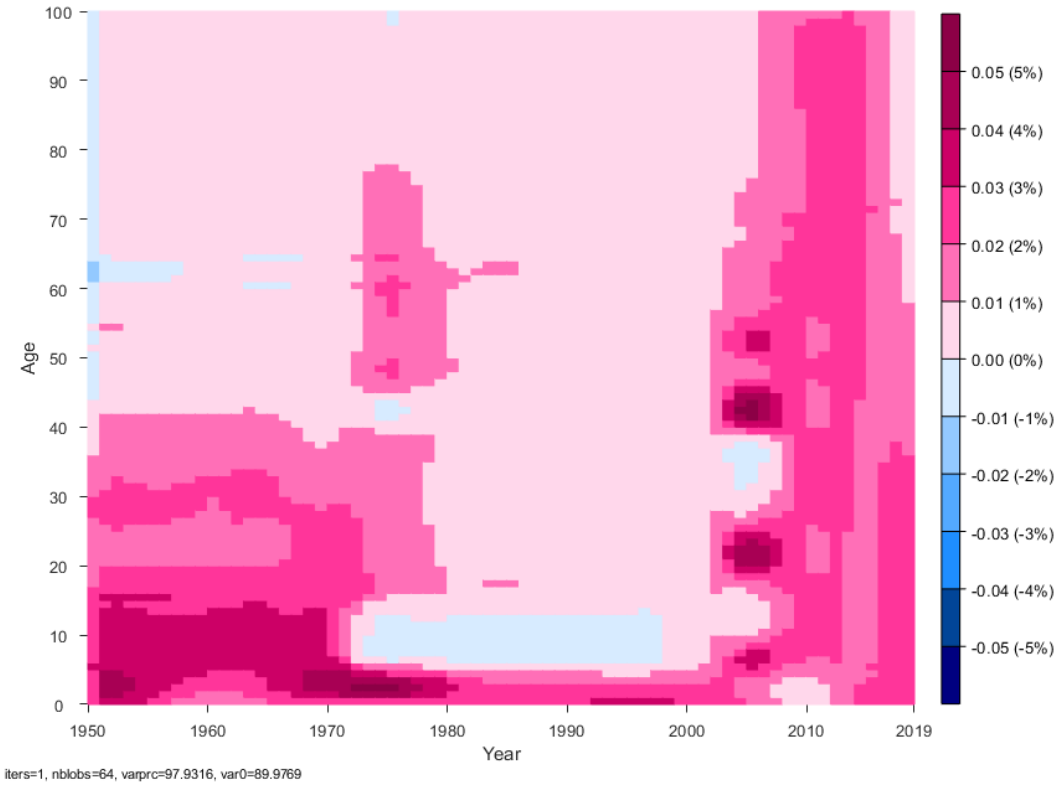
Females



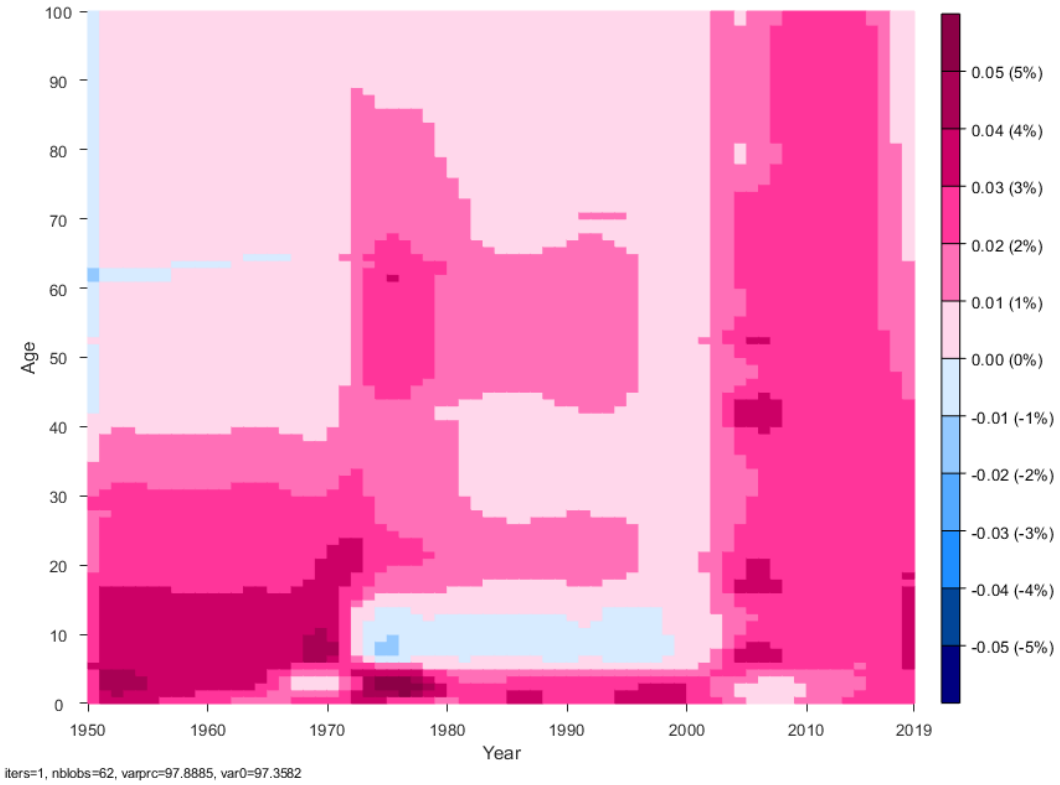
iters=28, nblobs=262, varprc=1.64273, var0=40854.5

Haiti

Males

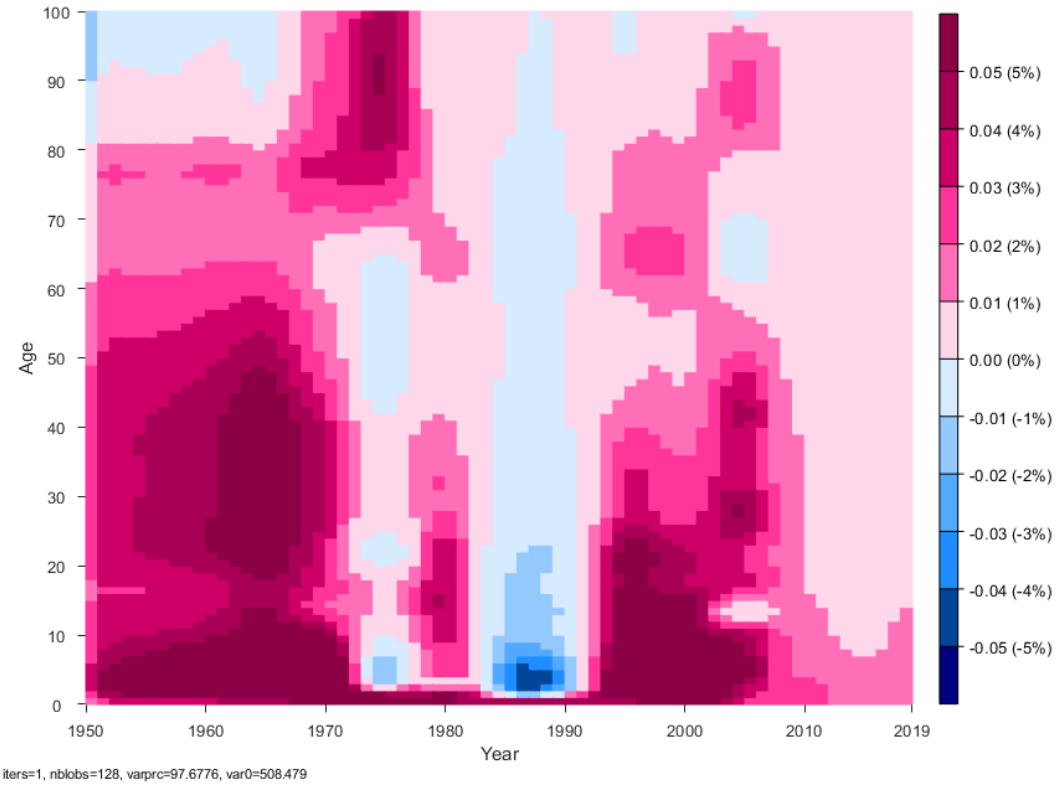


Females

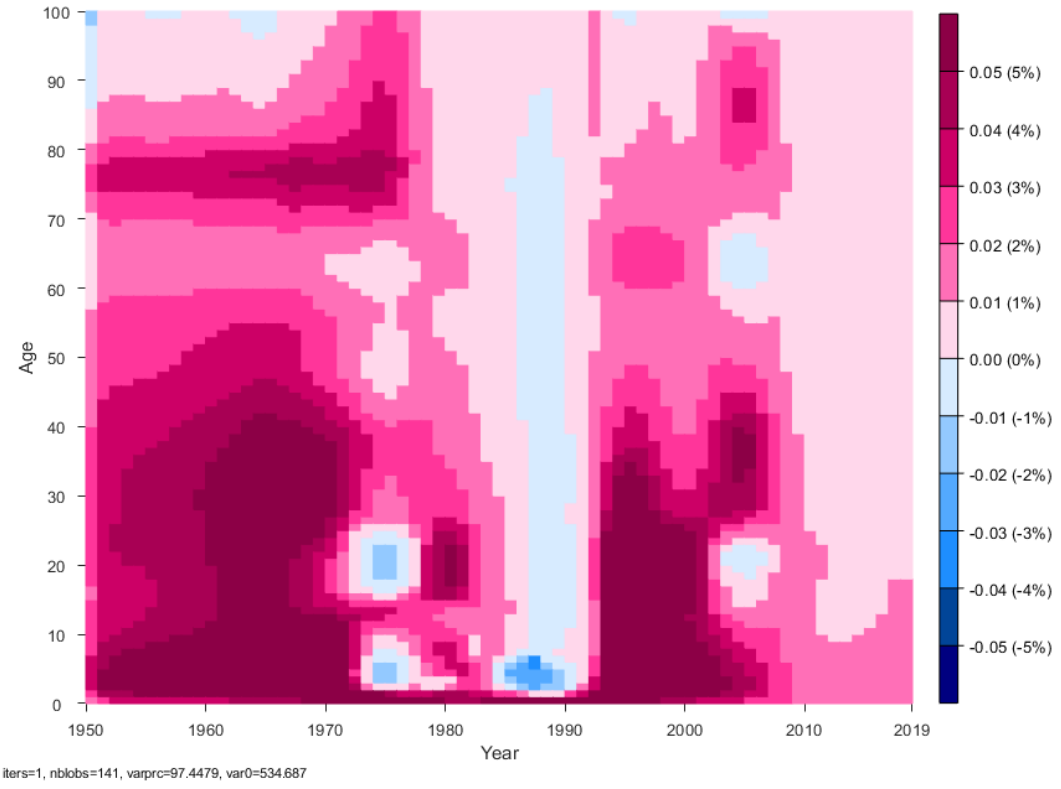


Cuba

Males

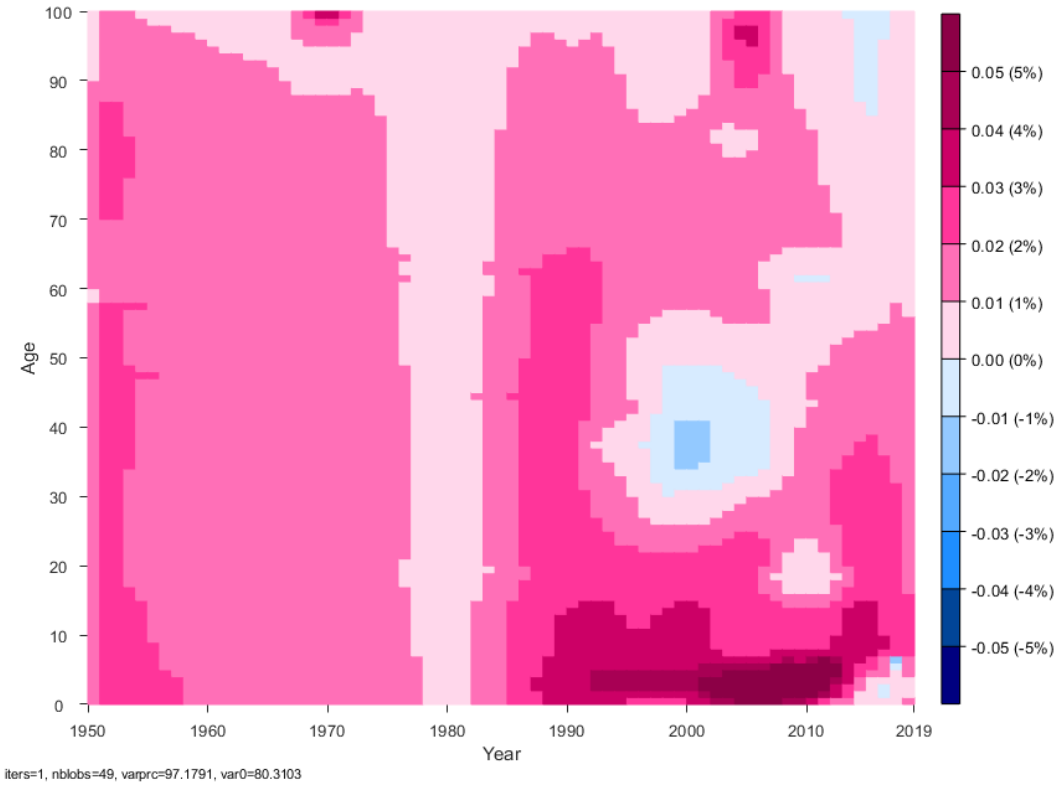


Females

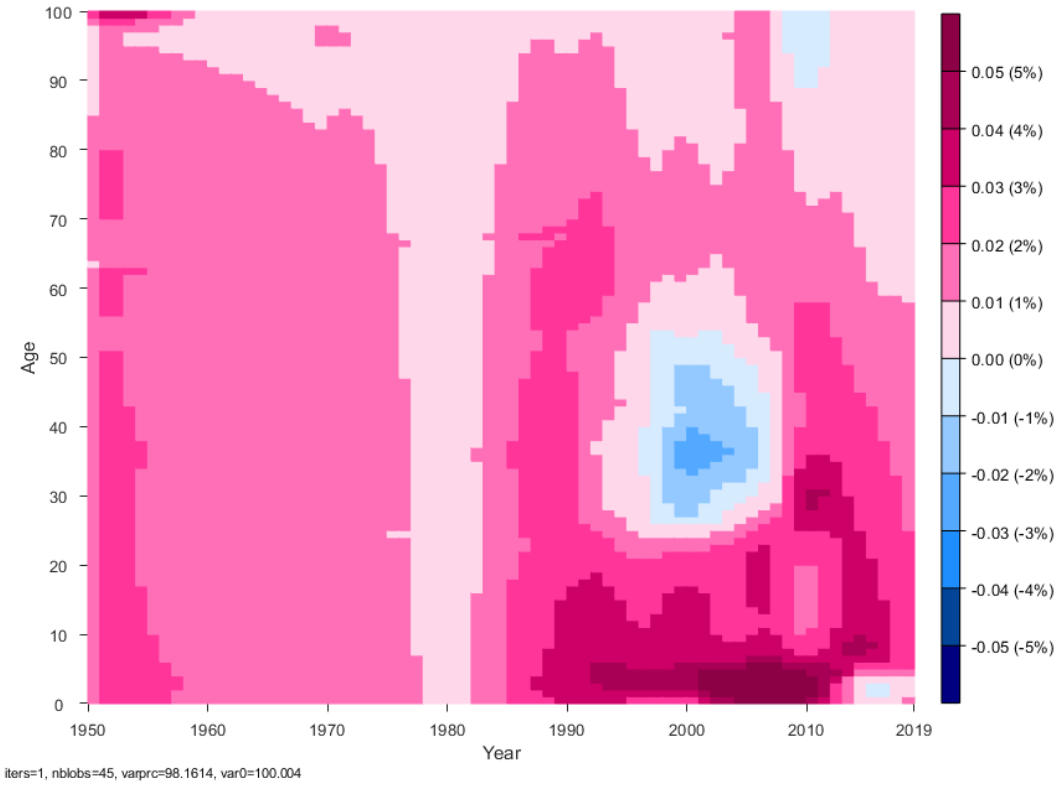


South Sudan

Males

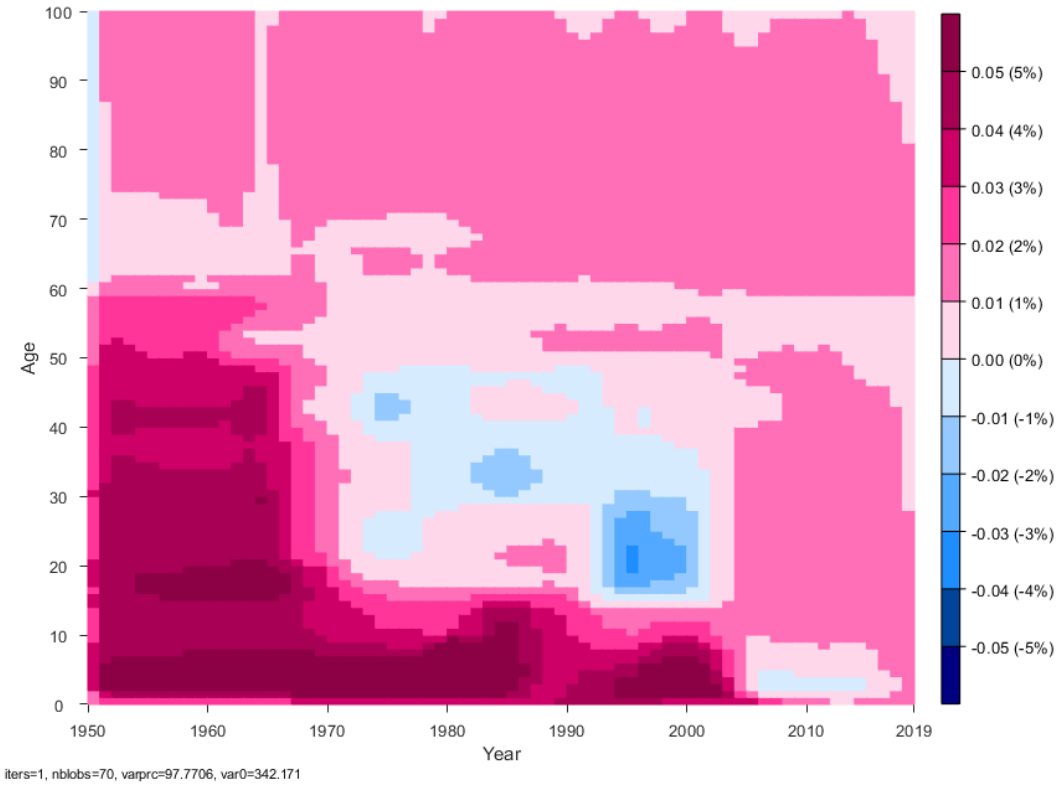


Females

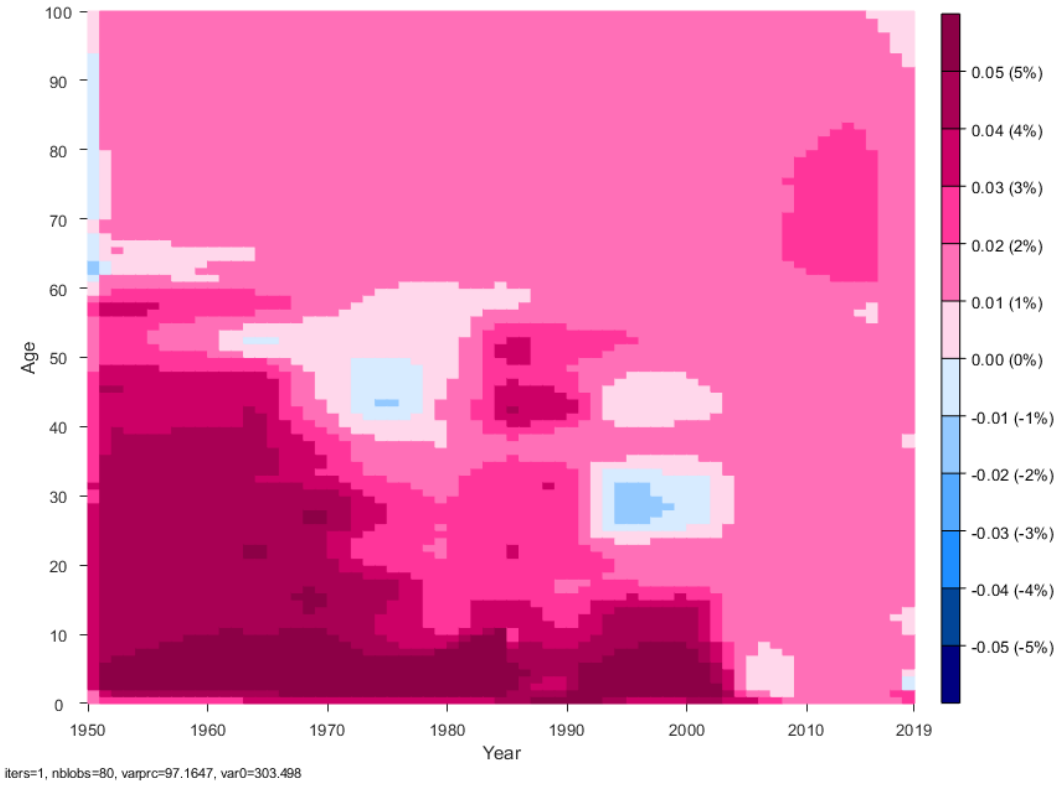


Dominican Republic

Males

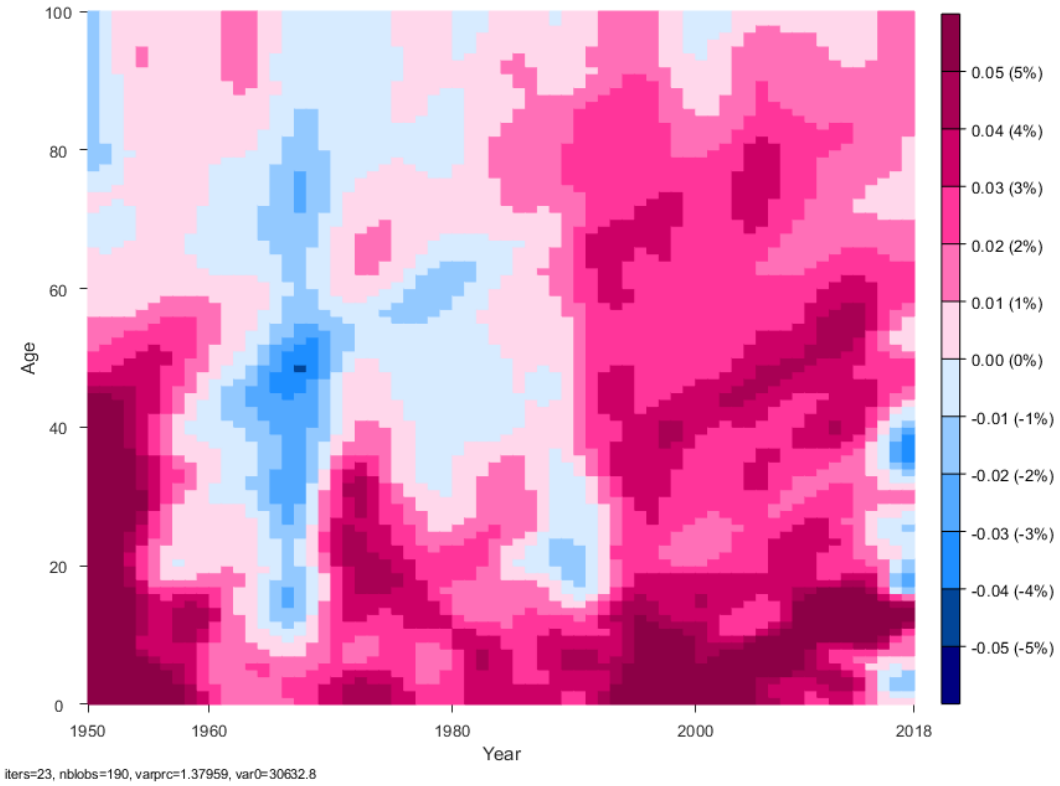


Females



Czechia

Males



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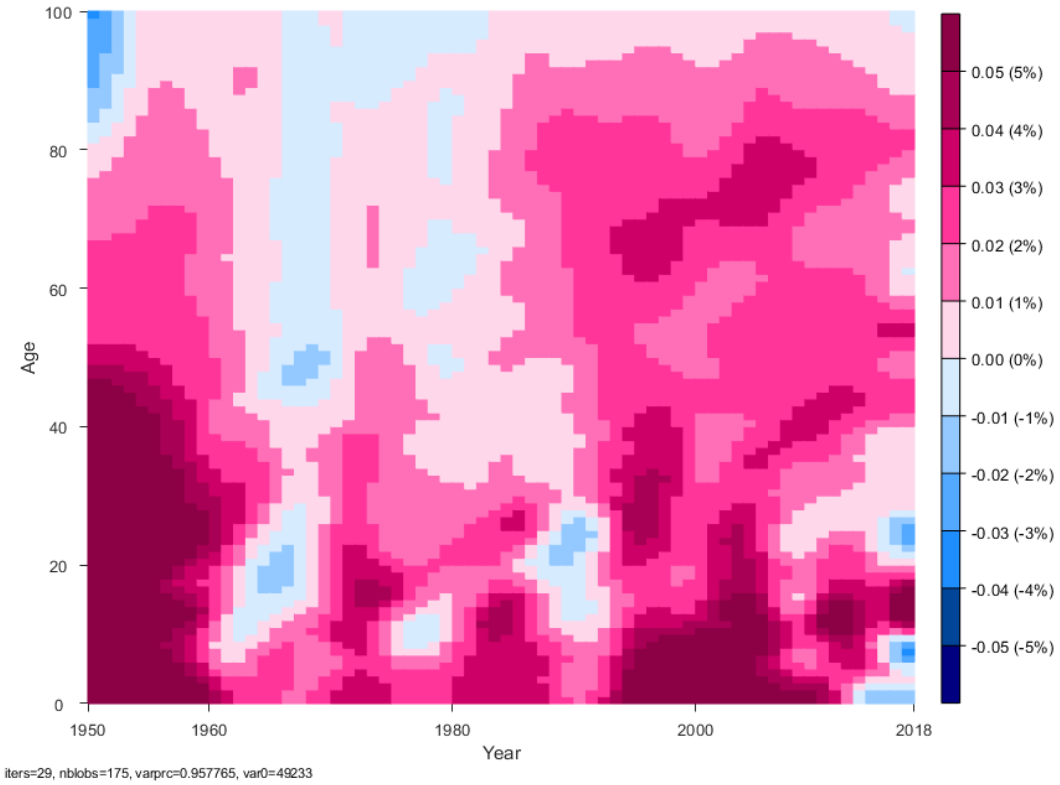
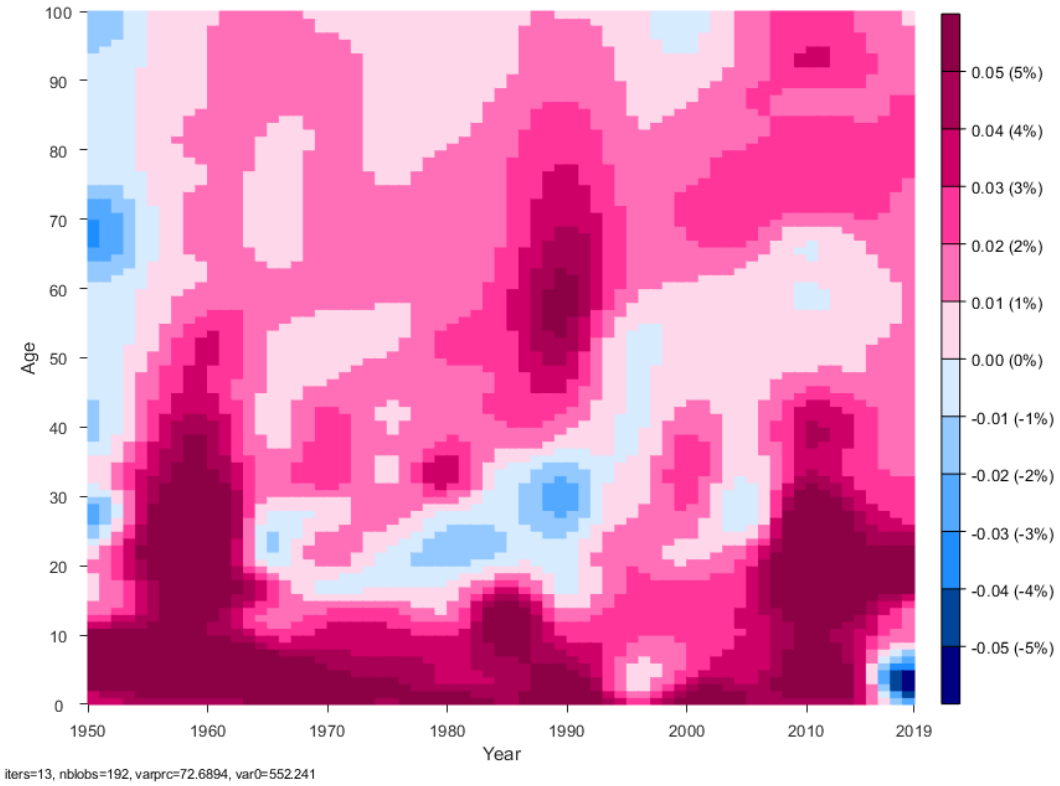
Females



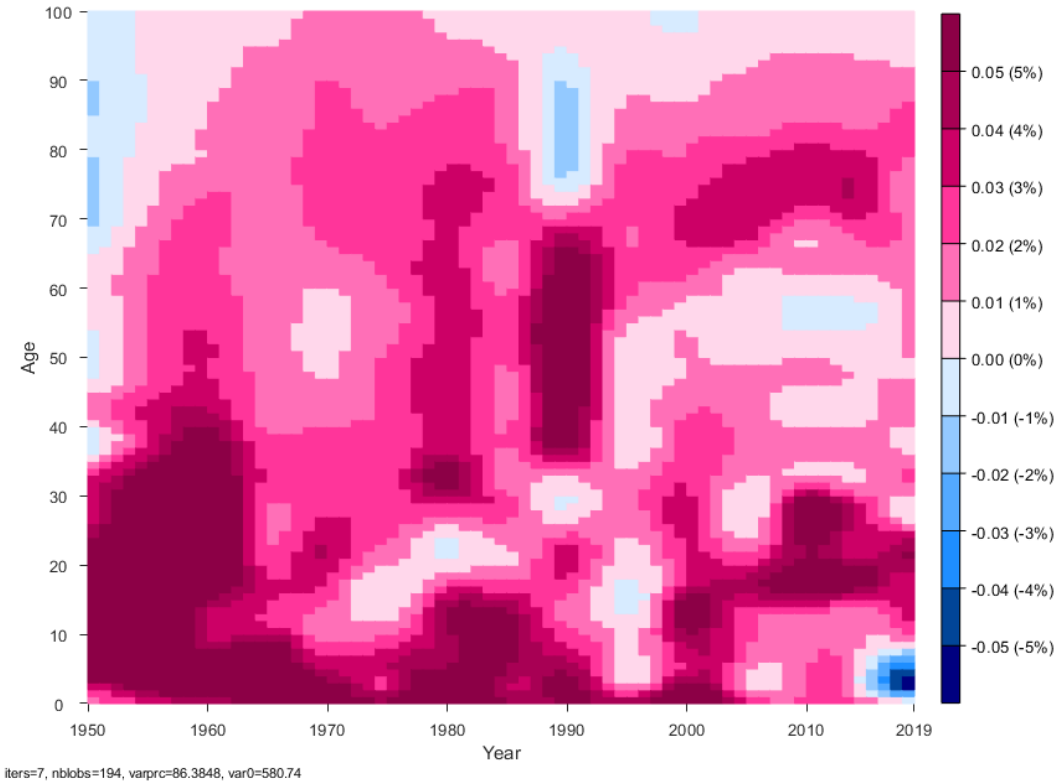
iters=29, nblobs=175, varprc=0.957765, var0=49233

Greece

Males

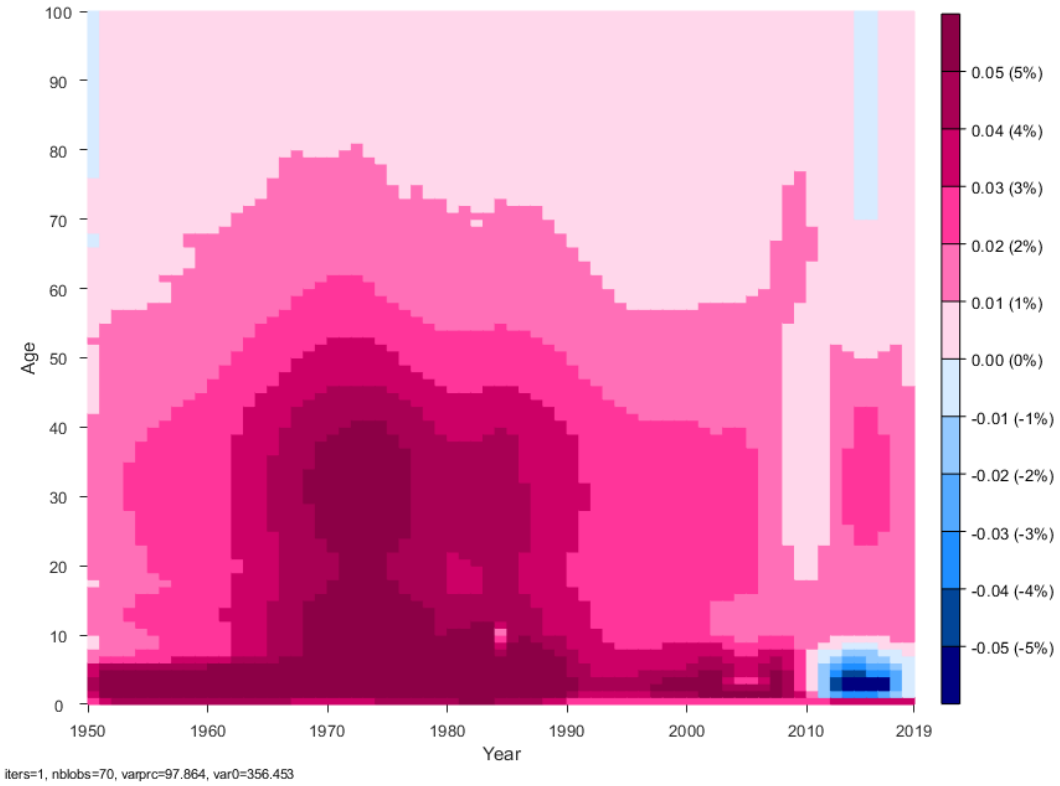


Females

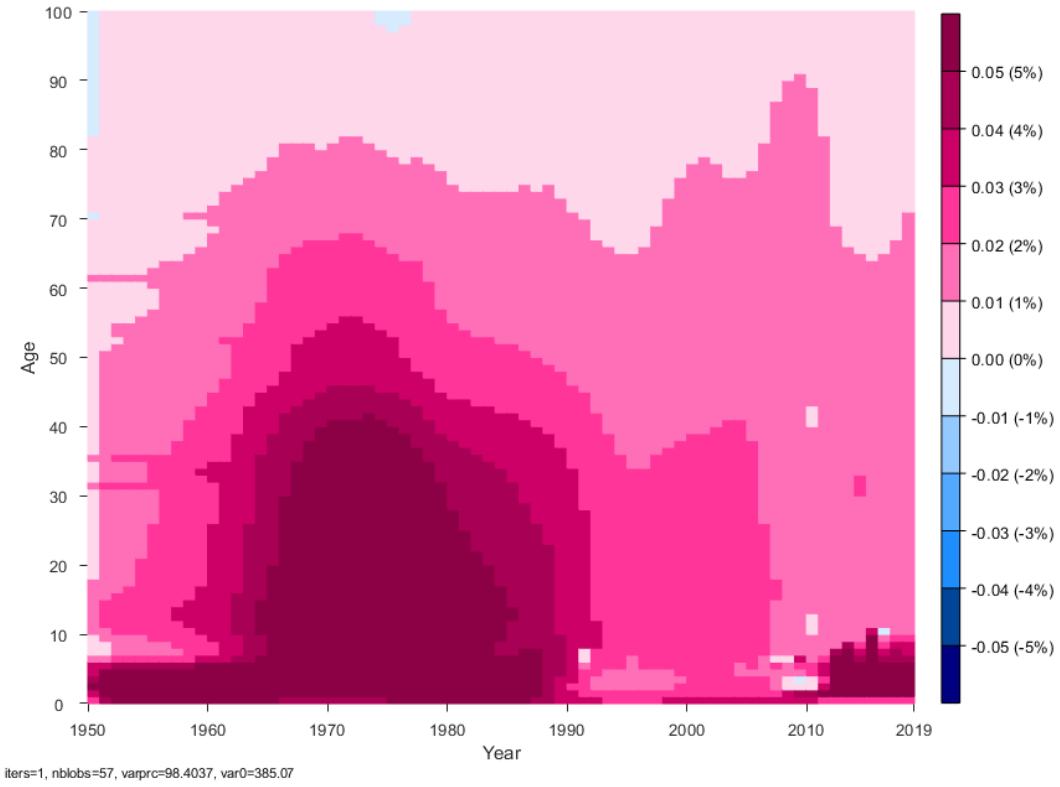


Jordan

Males

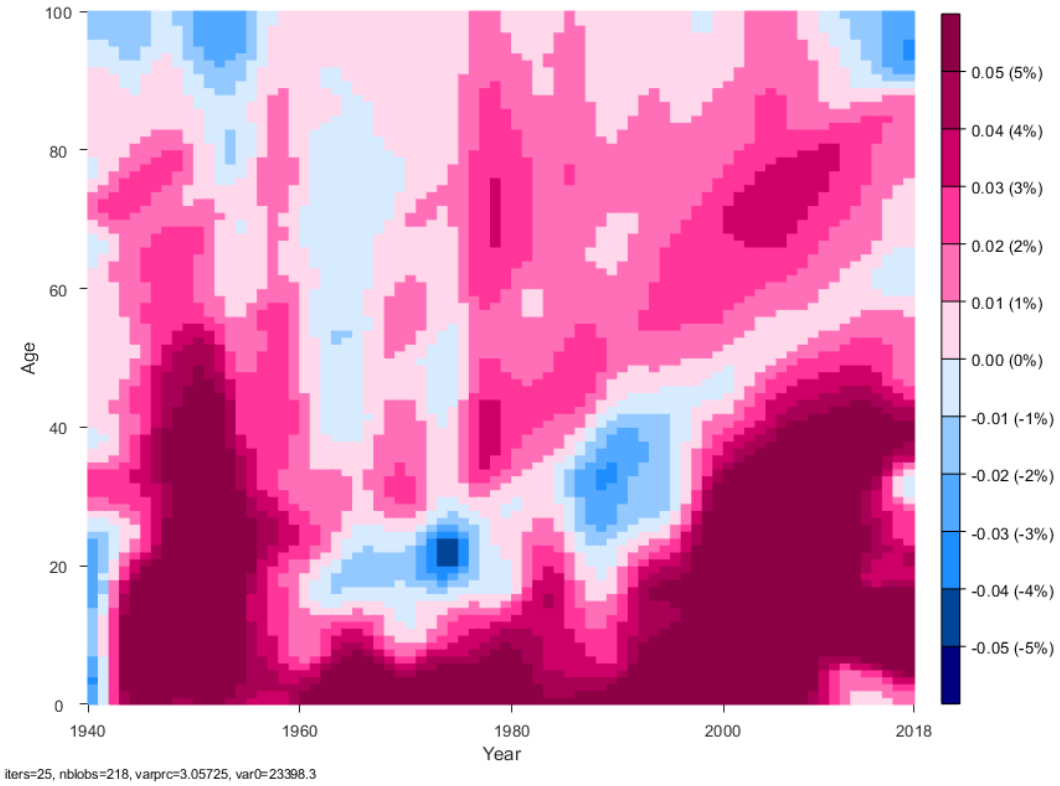


Females



Portugal

Males



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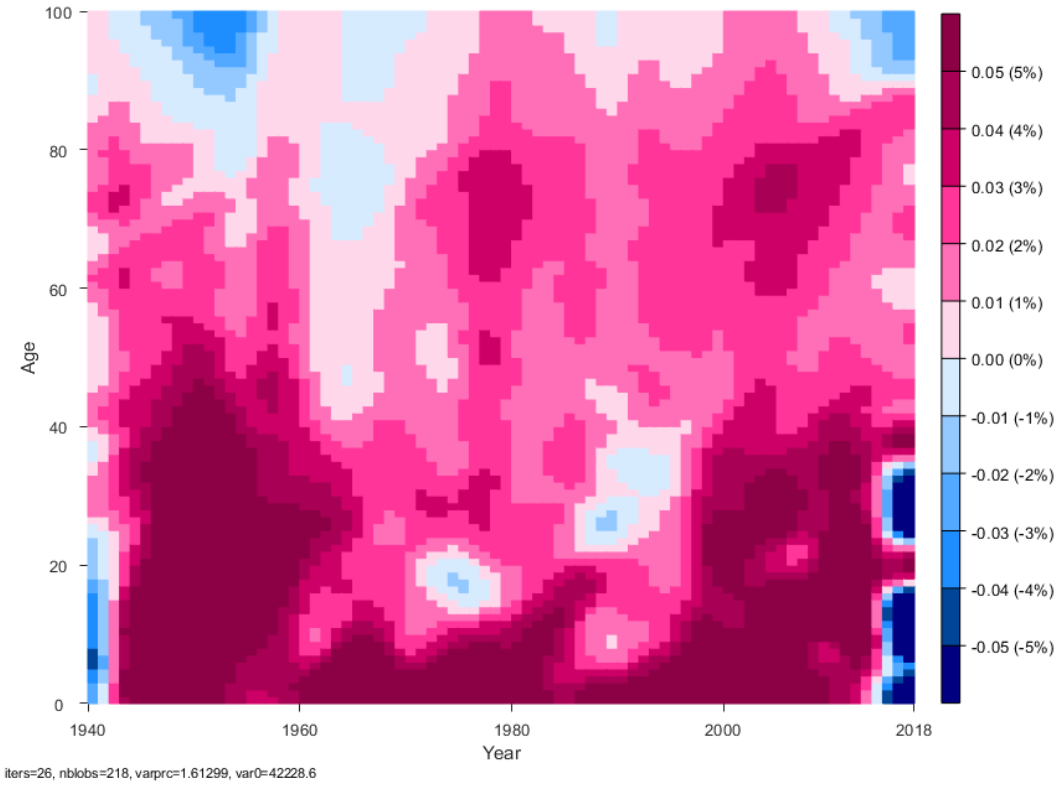
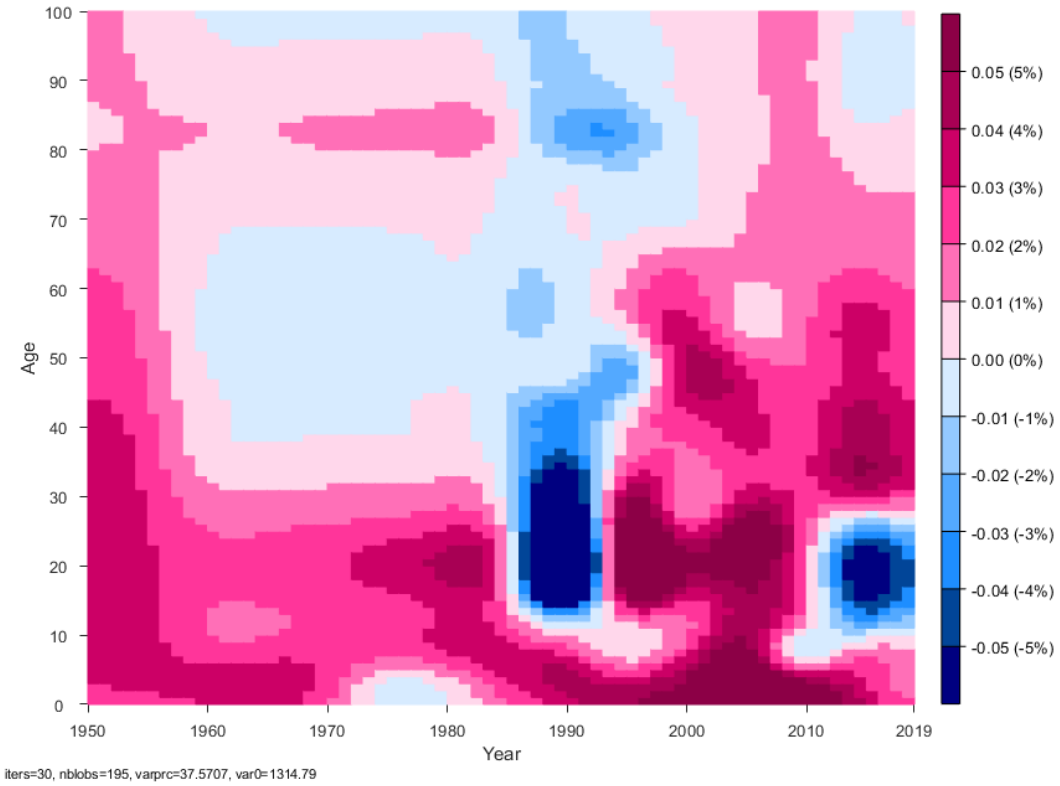
Females



iters=26, nblobs=218, varprc=1.61299, var0=42228.6

Azerbaijan

Males



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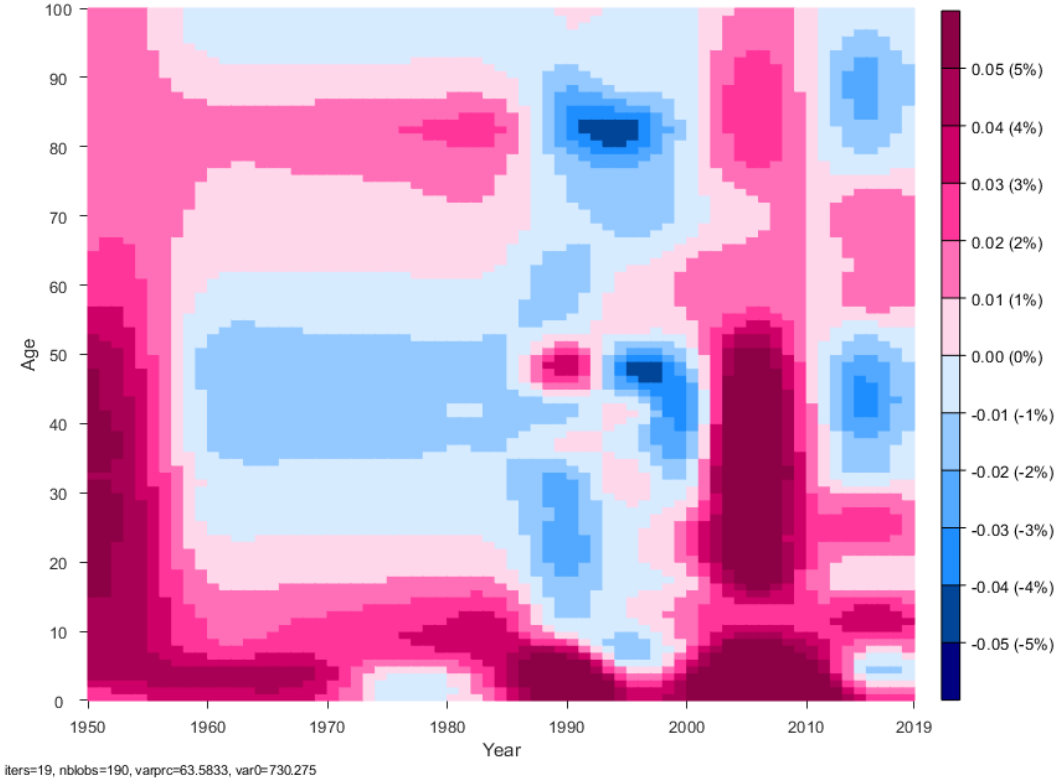
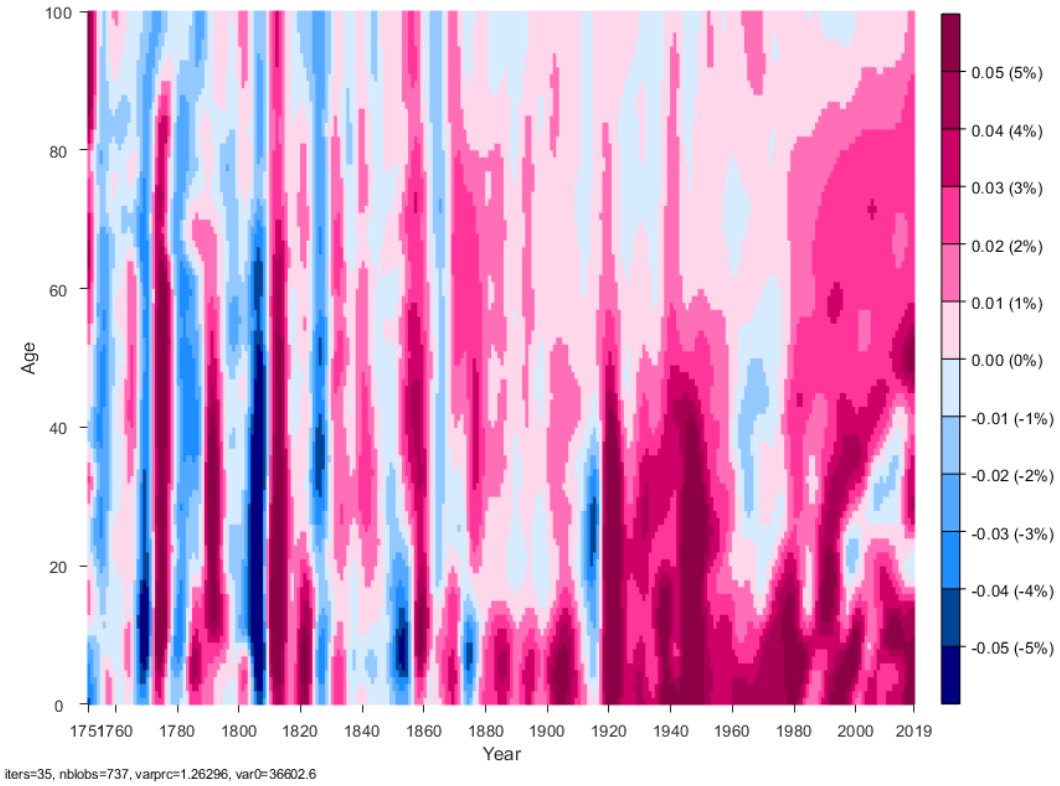
Females



iters=19, nblobs=190, varprc=63.5833, var0=730.275

Sweden

Males



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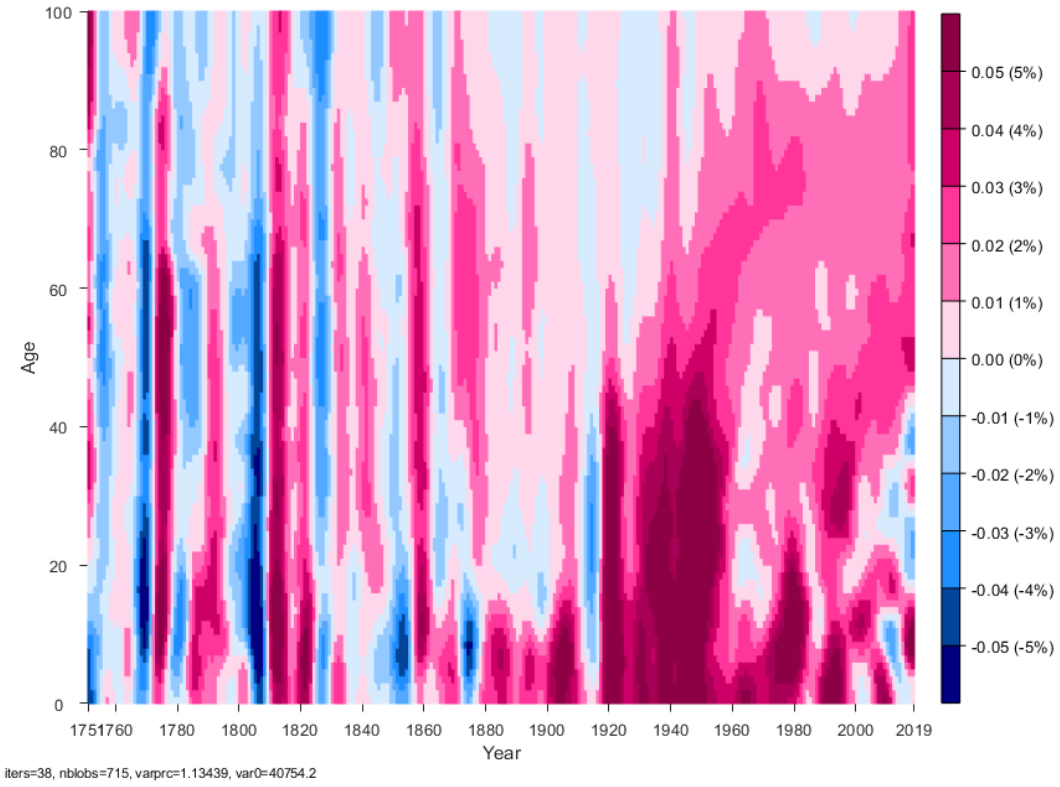
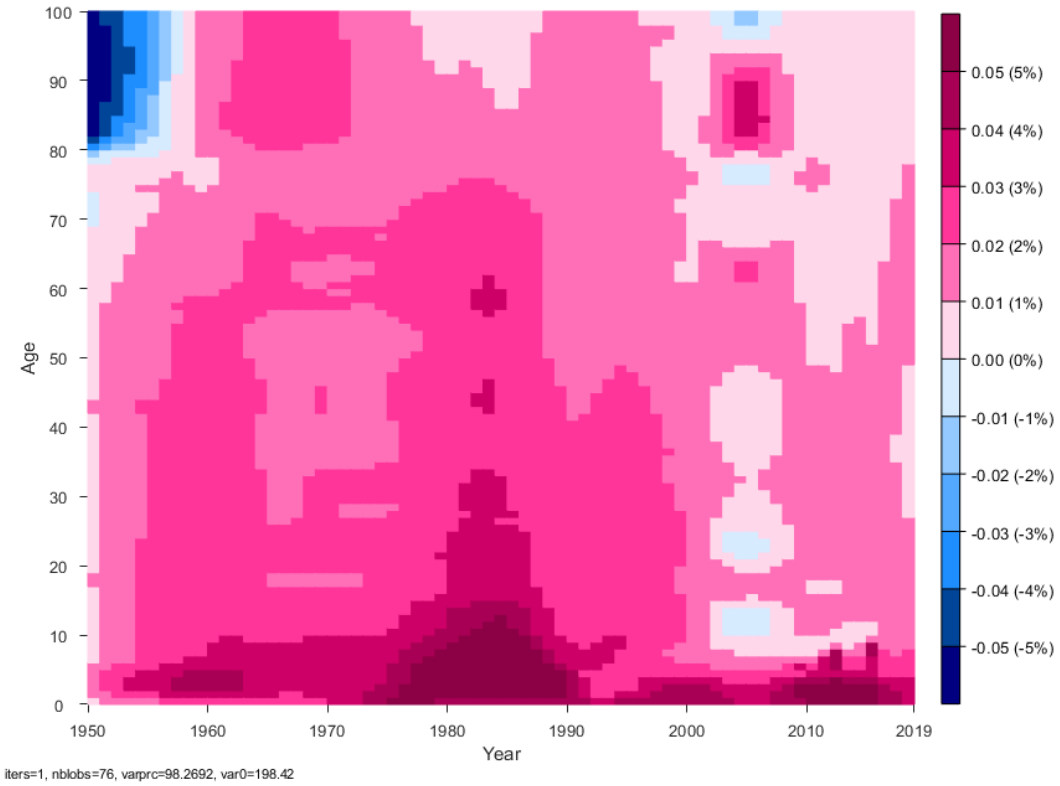
Females



iters=38, nblobs=715, varprc=1.13439, var0=40754.2

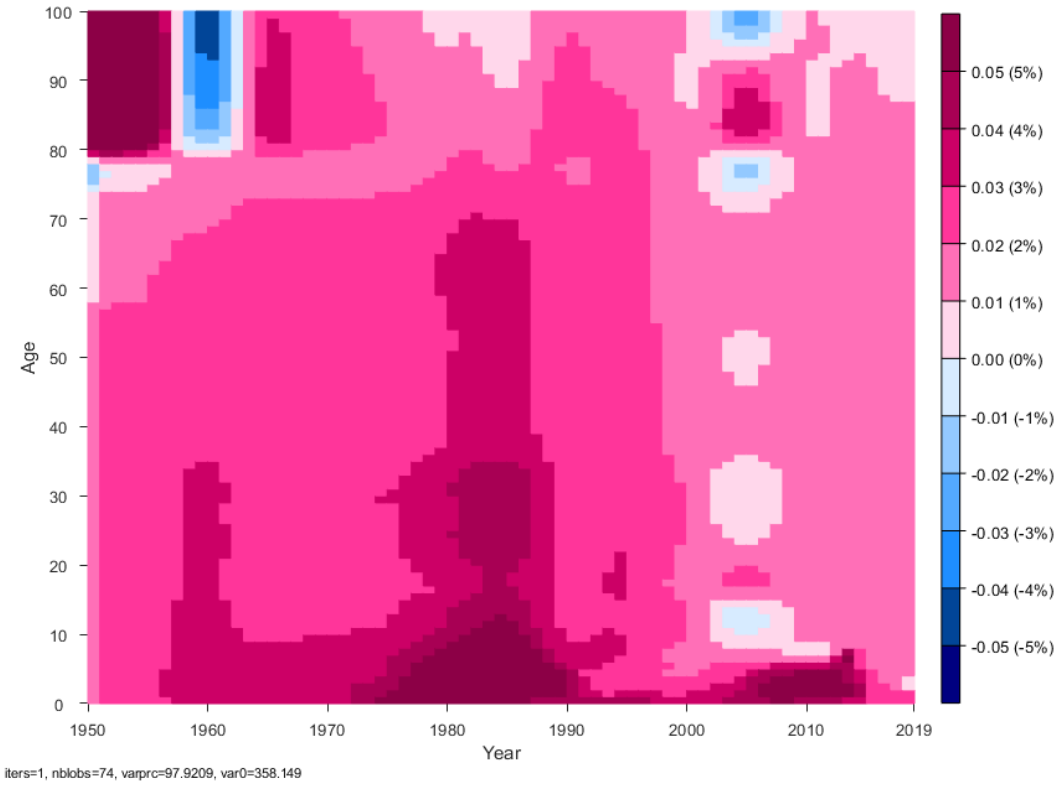
Honduras

Males



iters=1, nblobs=76, varprc=98.2692, var0=198.42

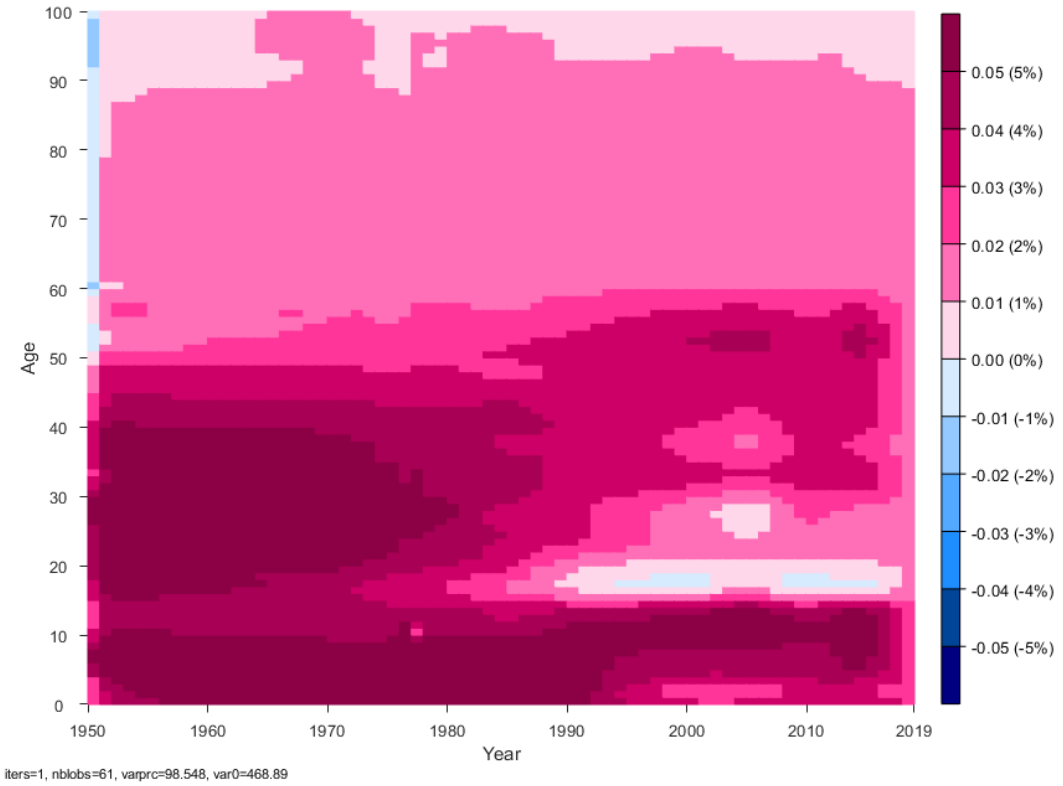
Females



iters=1, nblobs=74, varprc=97.9209, var0=358.149

United Arab Emirates

Males



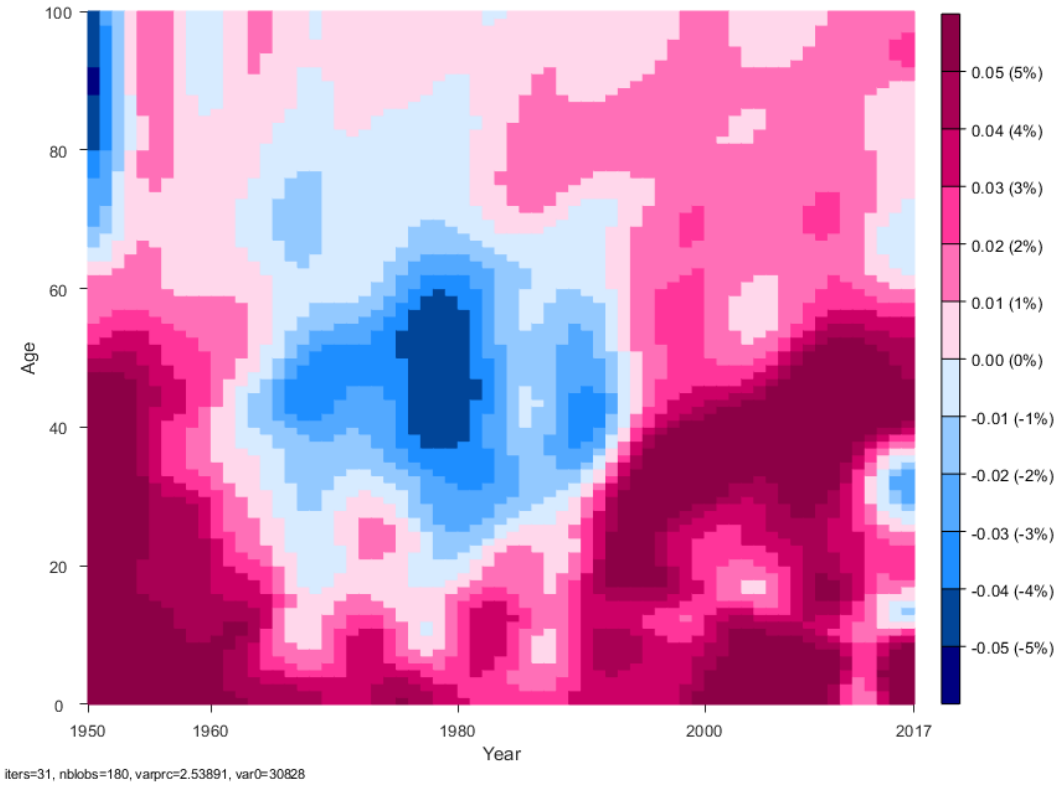
iters=1, nblobs=61, varprc=98.548, var0=468.89

Females

iters=1, nblobs=61, varprc=98.6367, var0=634.078

Hungary

Males



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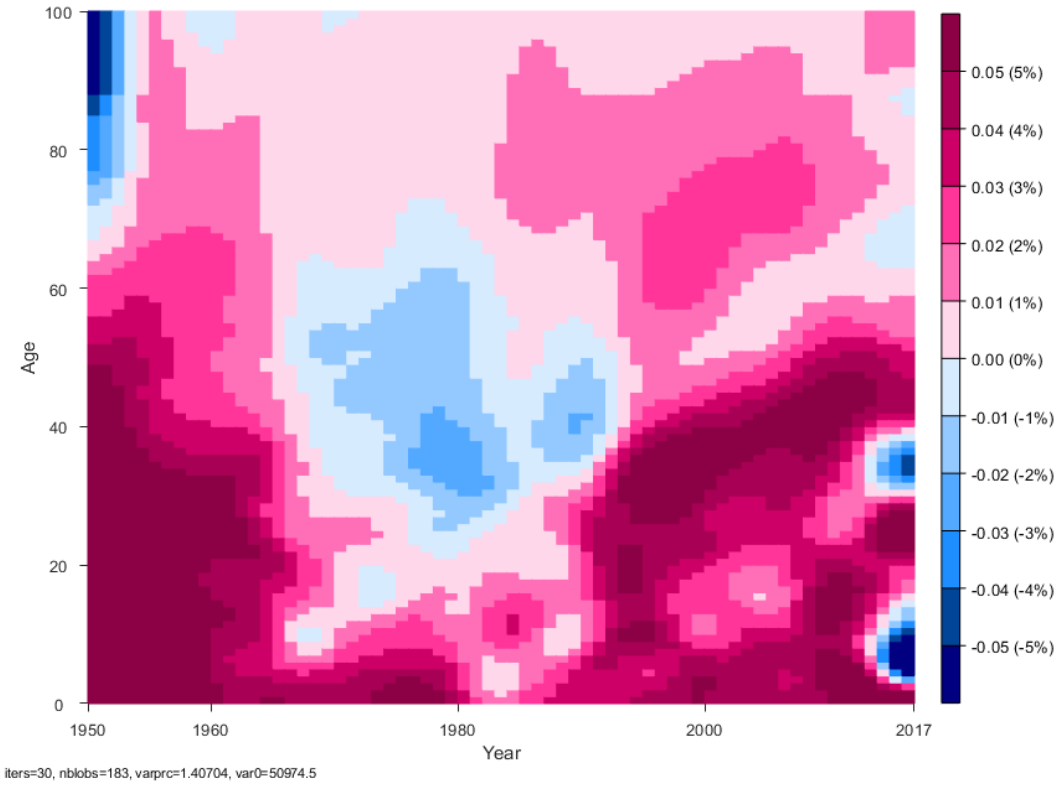
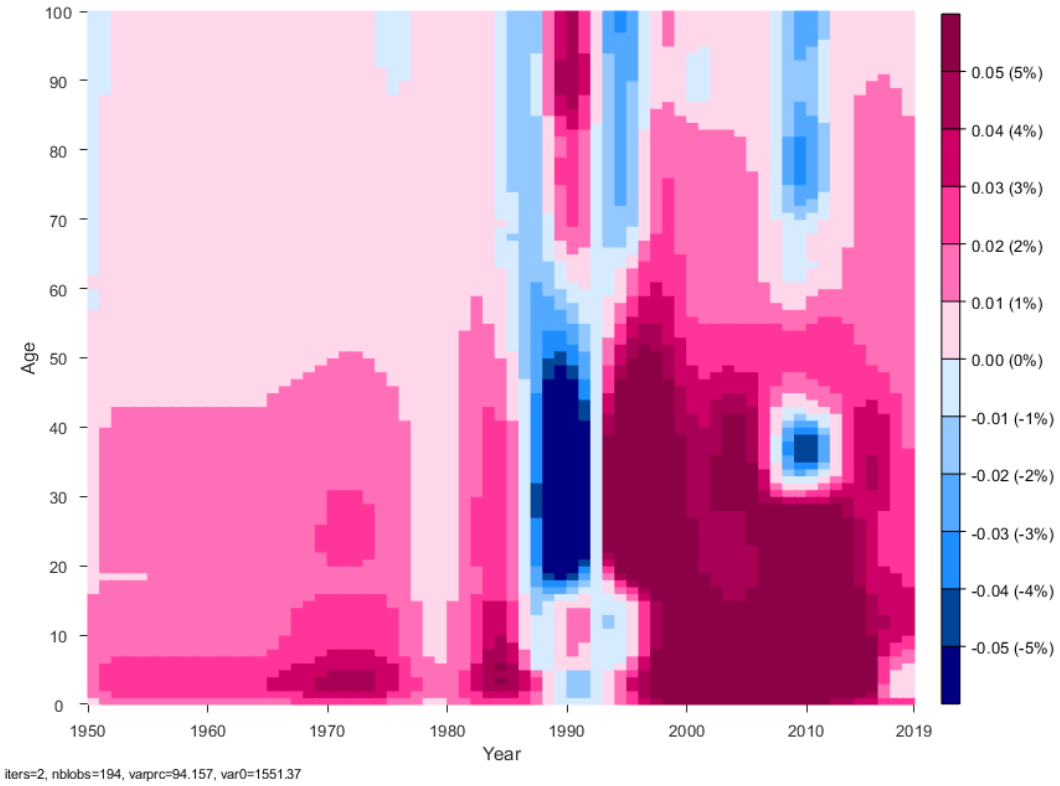
Females



iters=30, nblobs=183, varprc=1.40704, var0=50974.5

Tajikistan

Males



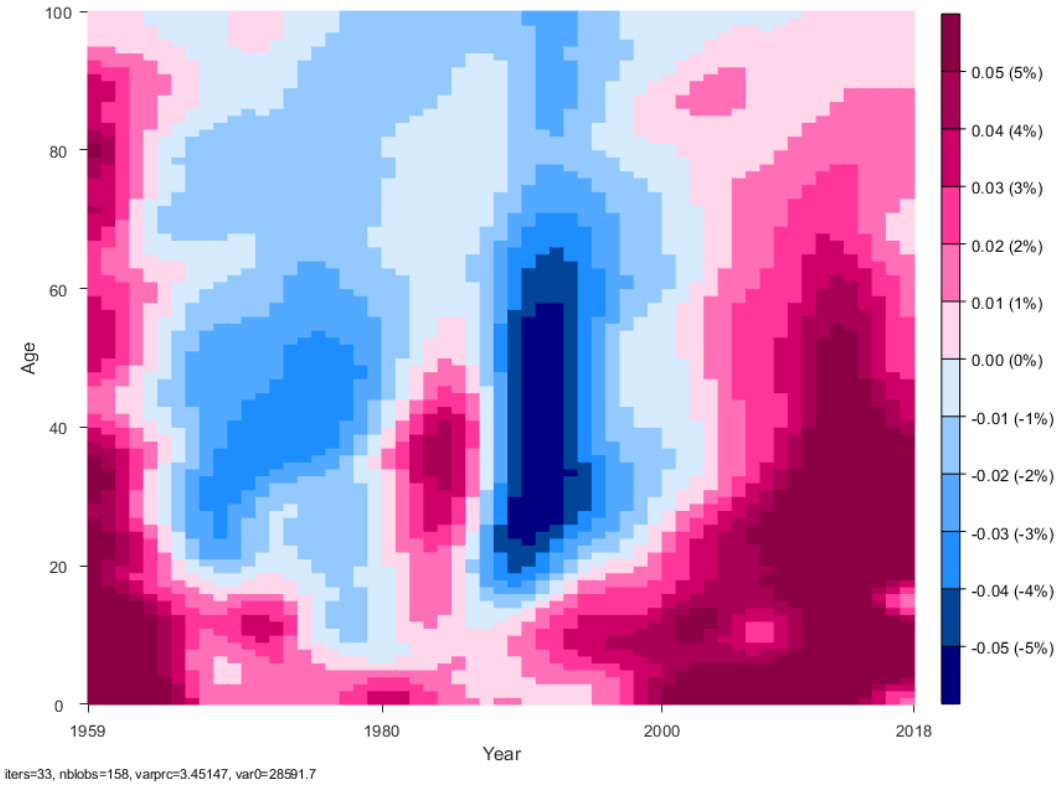
iters=2, nblobs=194, varprc=94.157, var0=1551.37

Females

iters=1, nblobs=103, varprc=97.8125, var0=1212.39

Belarus

Males



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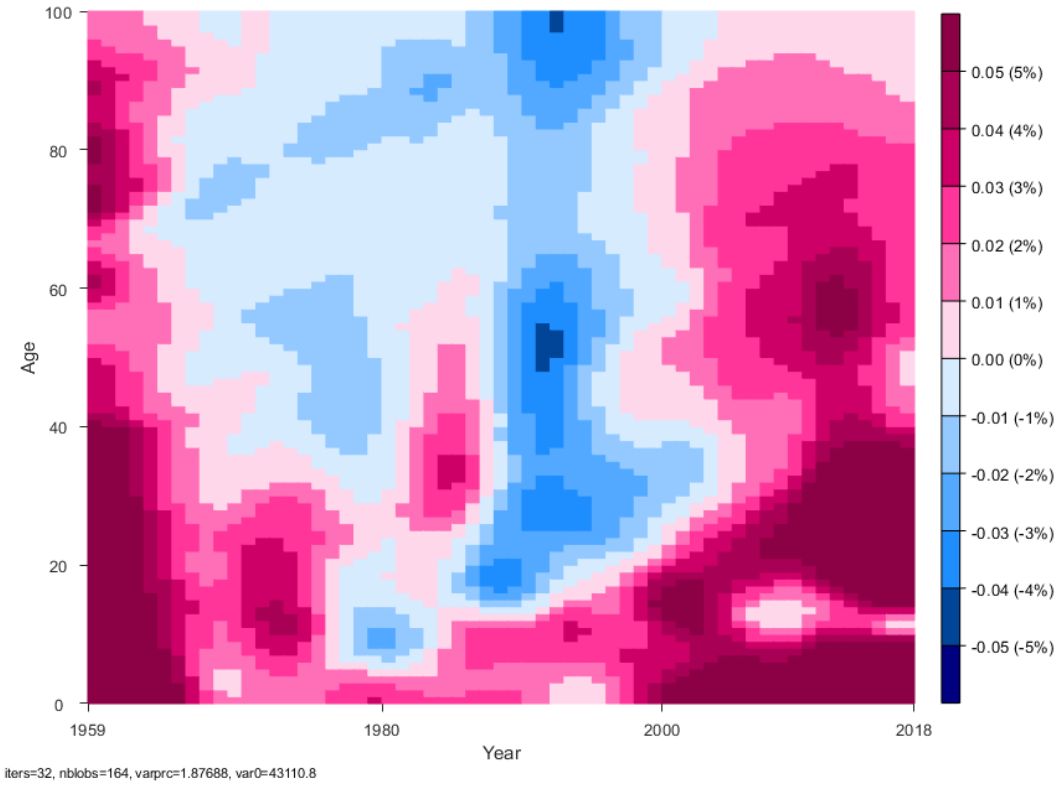
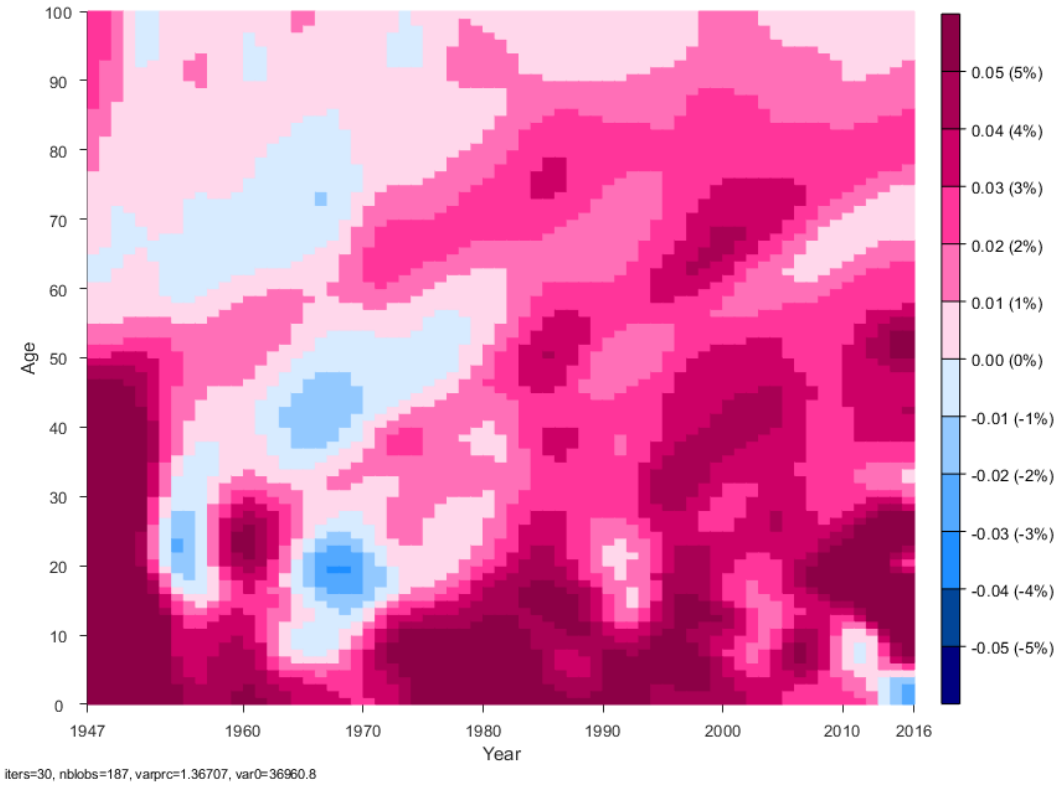
Females



iters=32, nblobs=164, varprc=1.87688, var0=43110.8

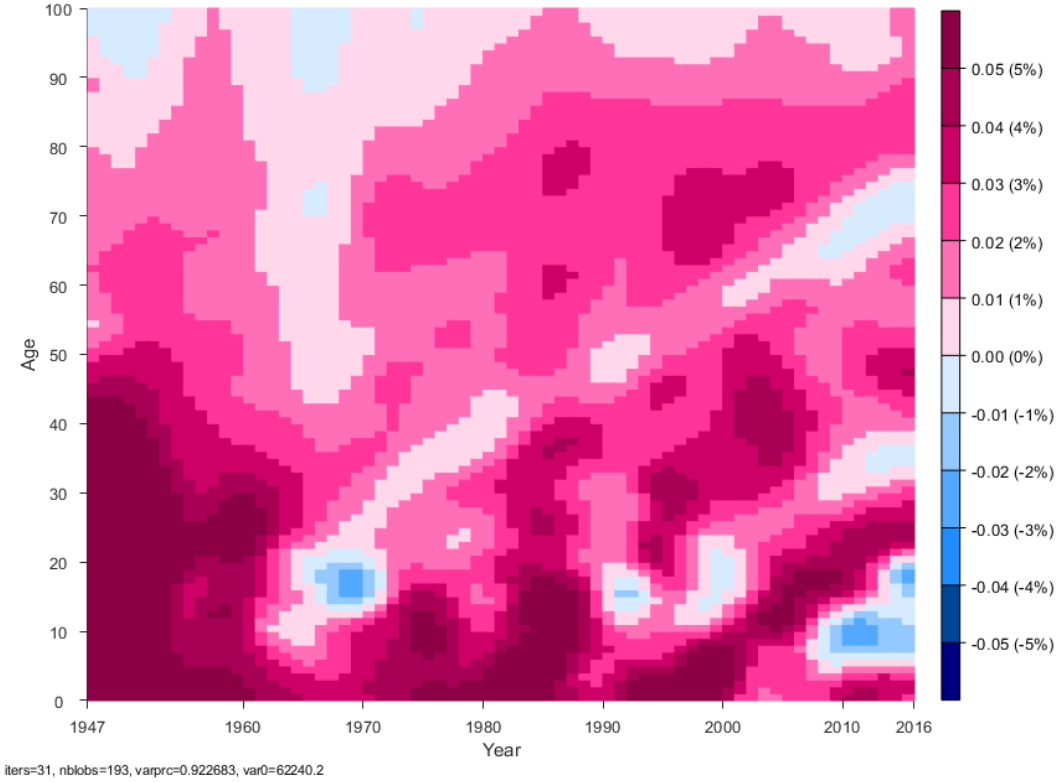
Austria

Males



iters=30, nblobs=187, varprc=1.36707, var0=36960.8

Females



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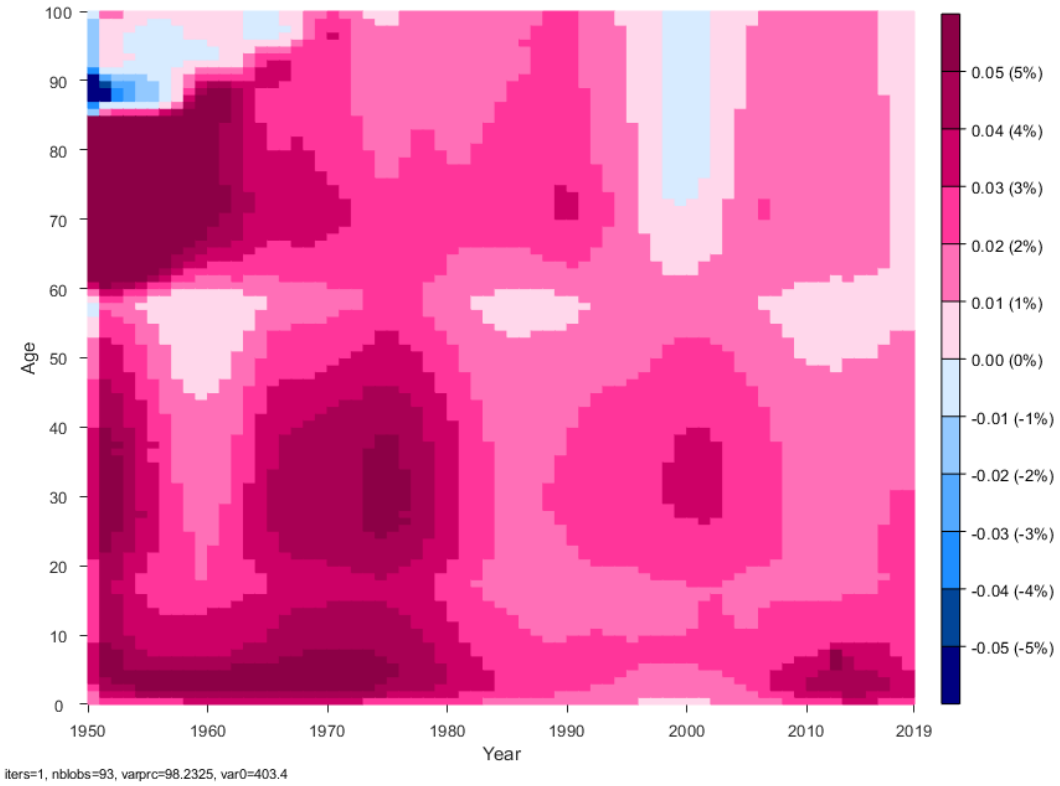
Papua New Guinea

Males



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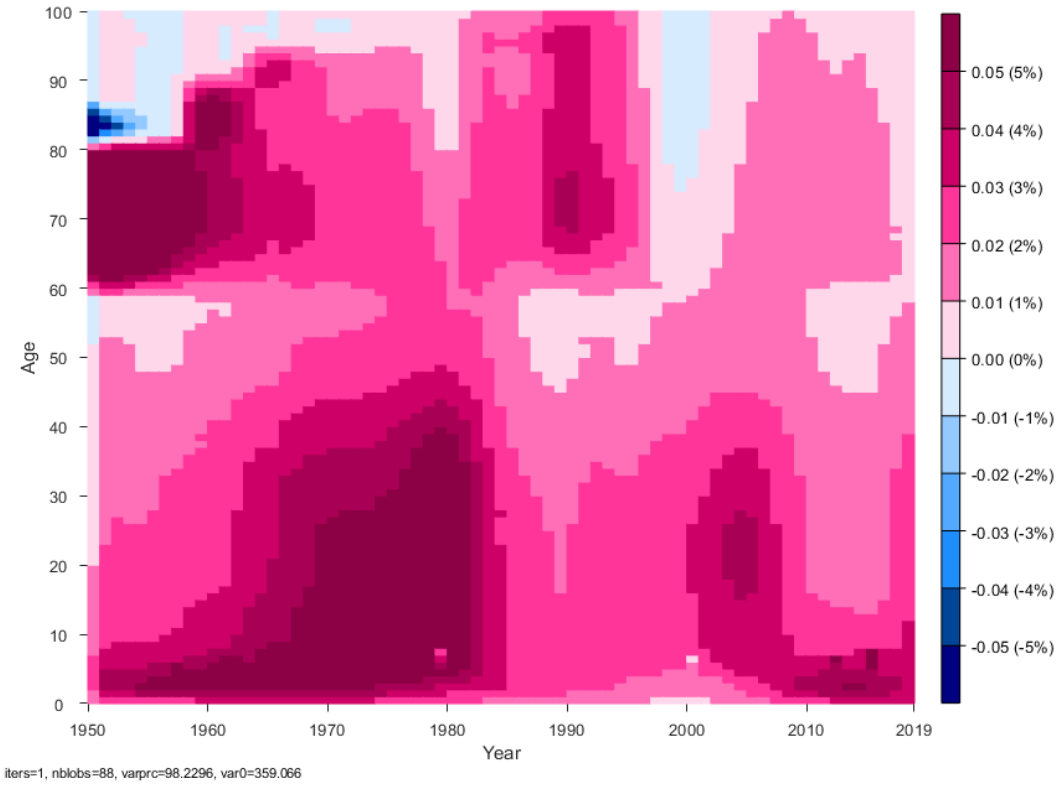
Females



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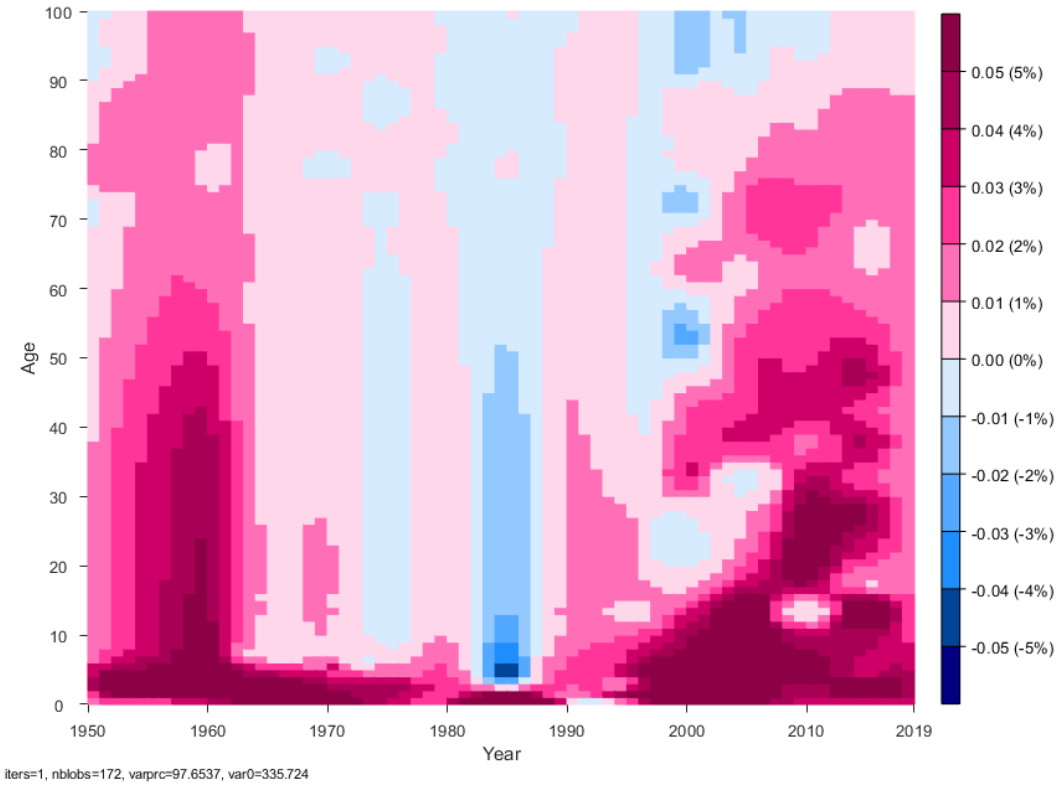
Serbia

Males



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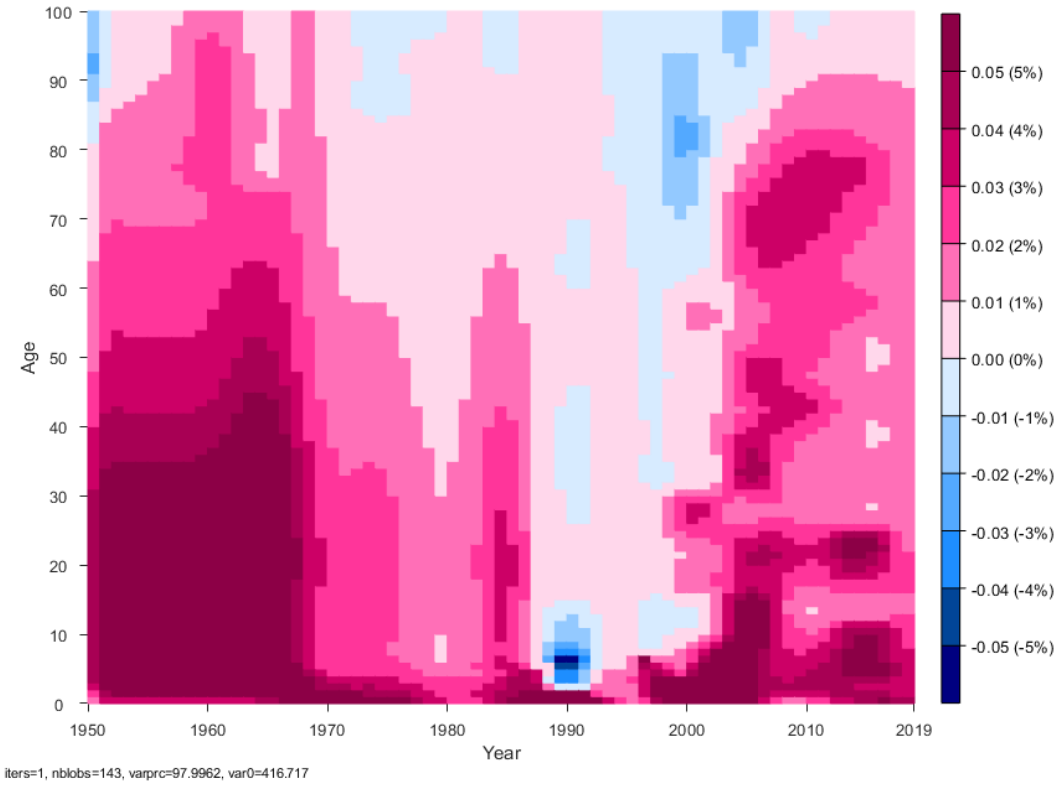
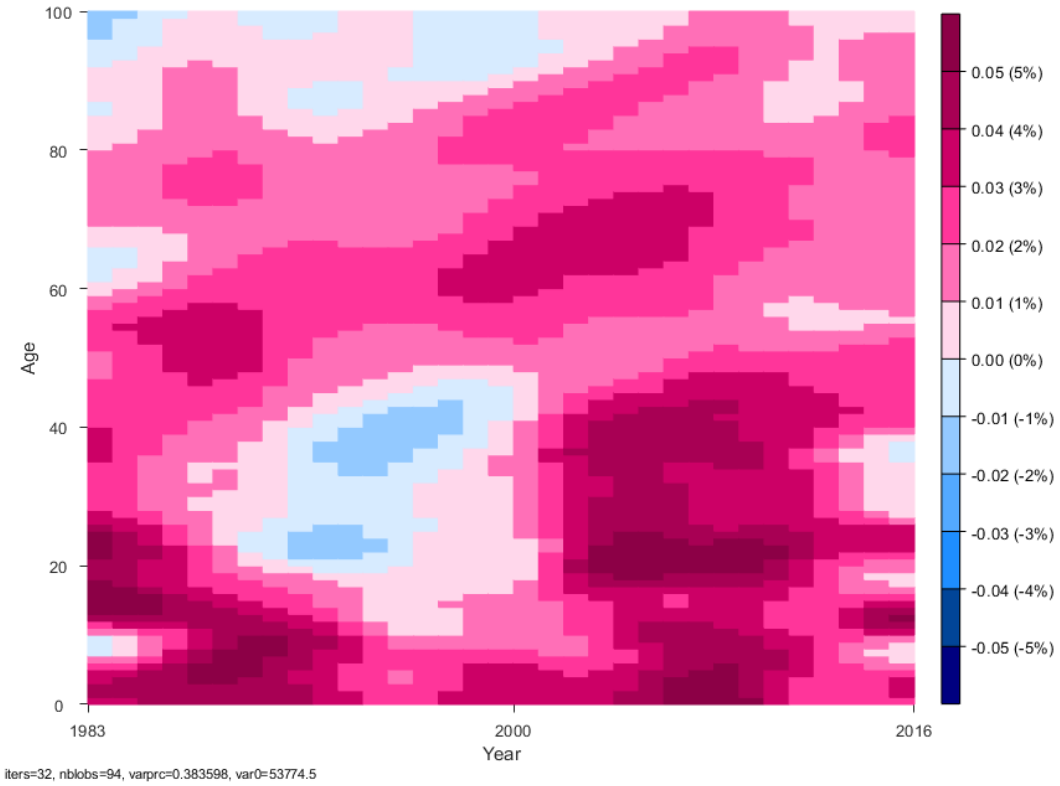
Females



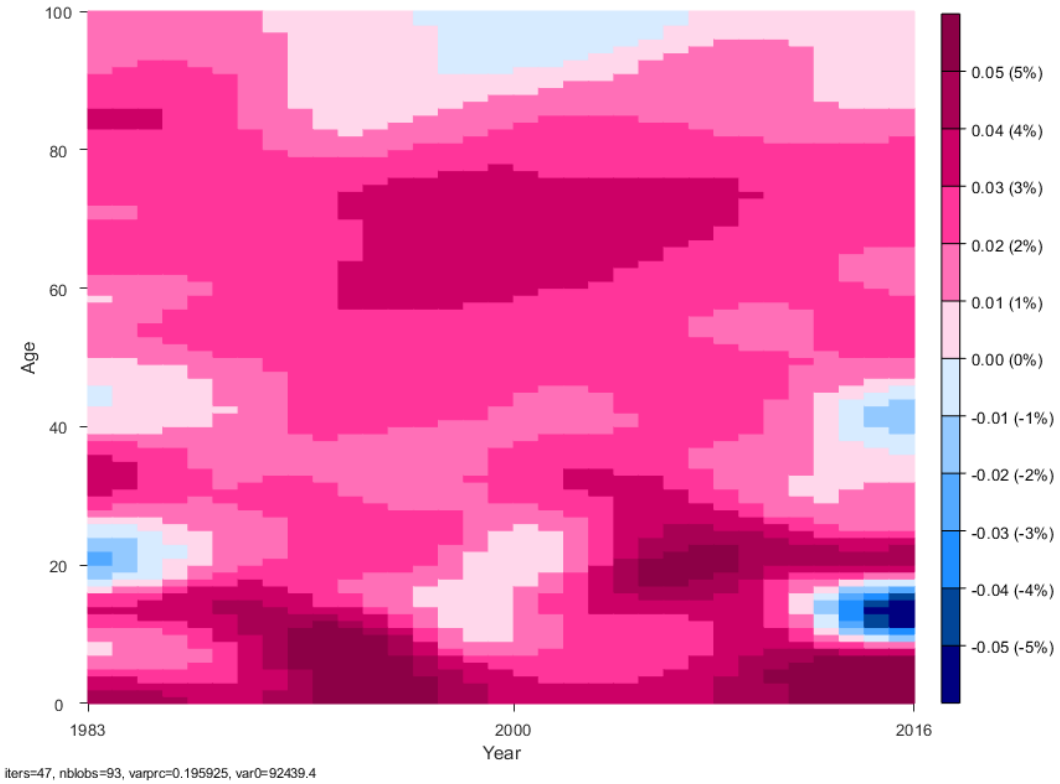
iters=1, nblobs=143, varprc=97.9962, var0=416.717

Israel

Males

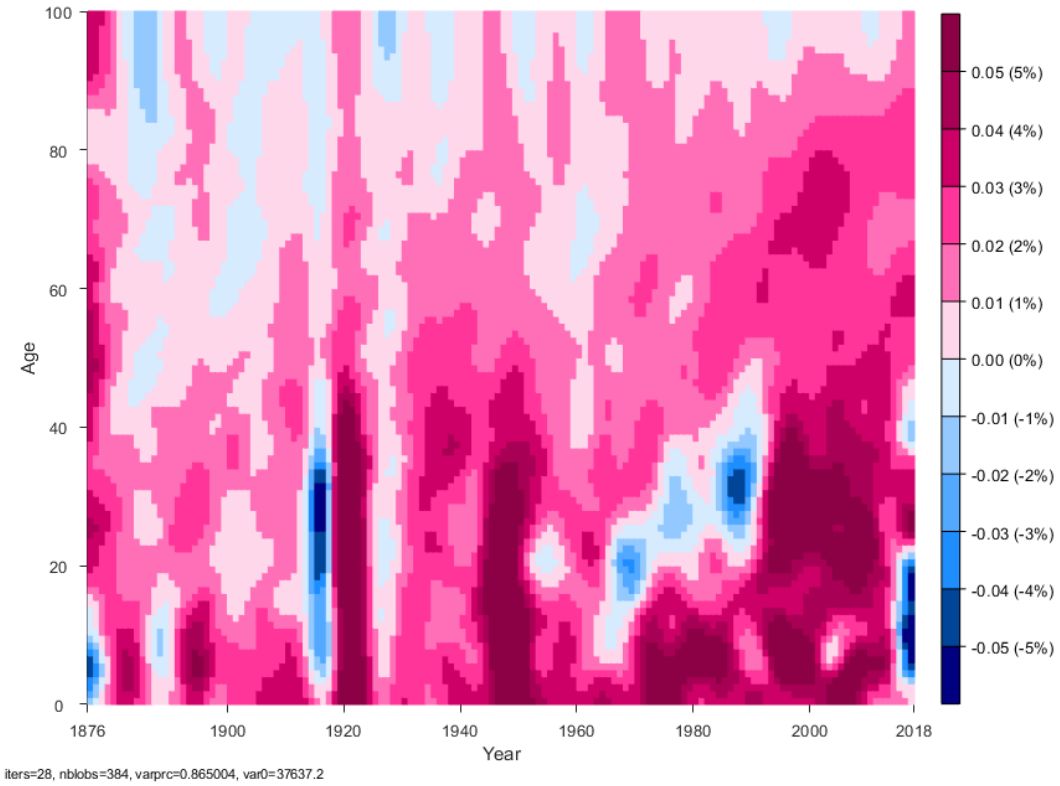


Females



Switzerland

Males



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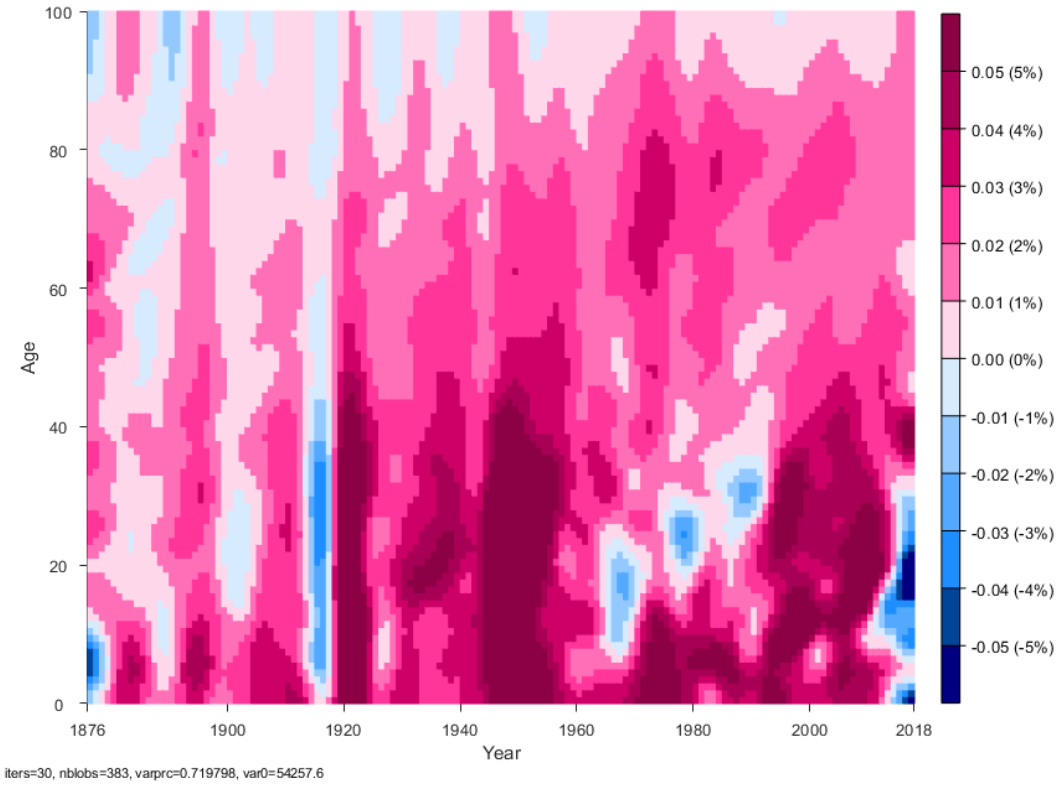
Females



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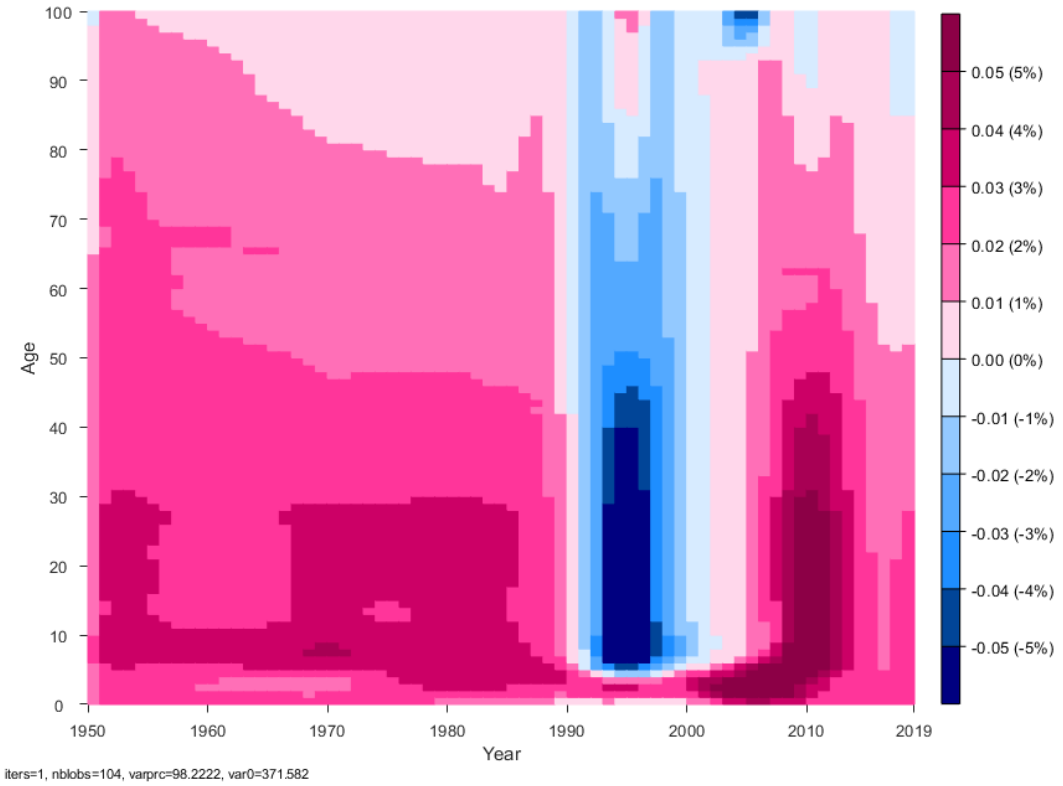
Togo

Males



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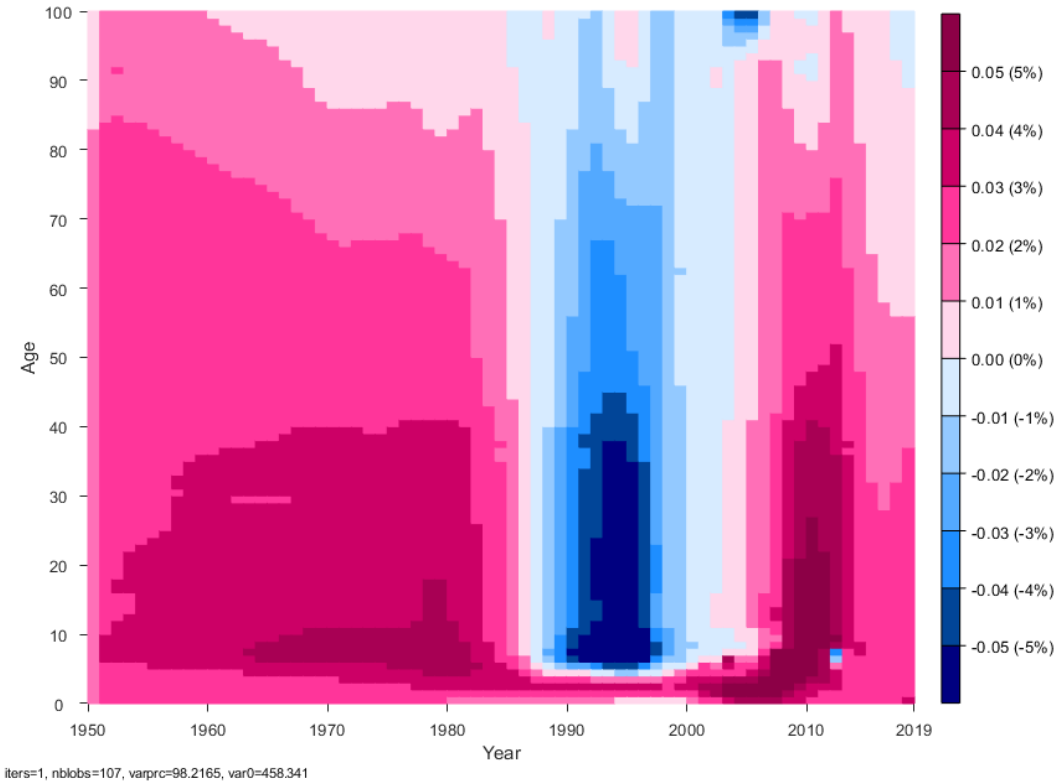
Females



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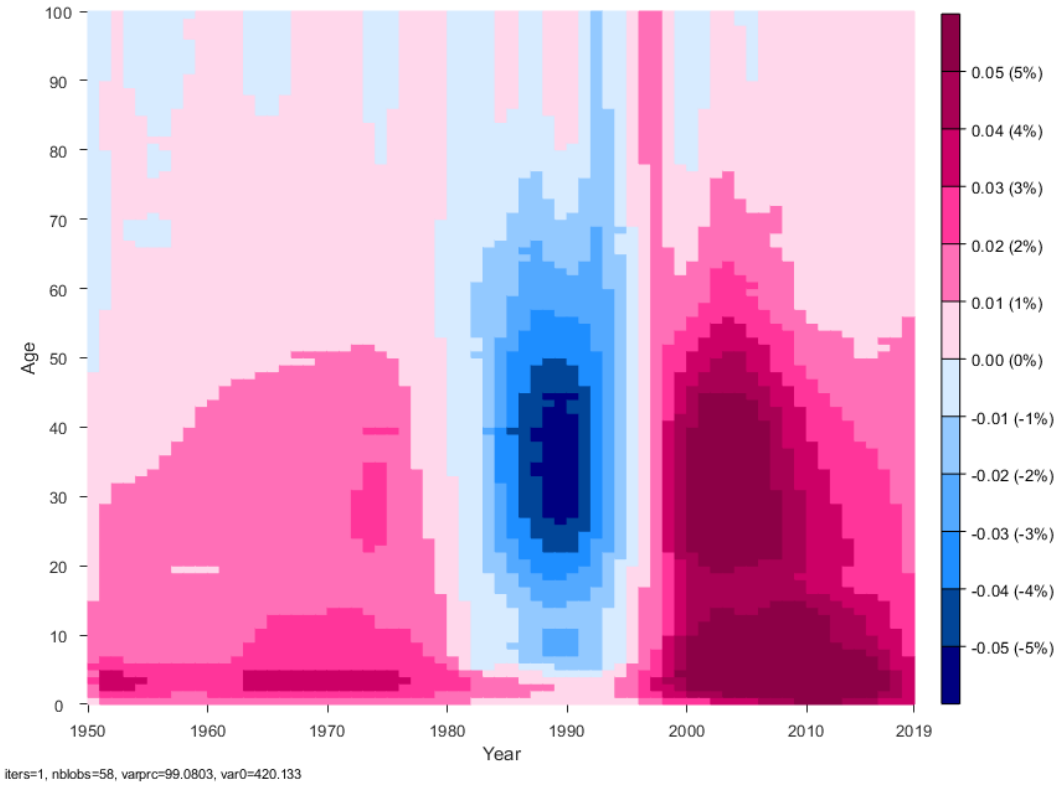
Sierra Leone

Males



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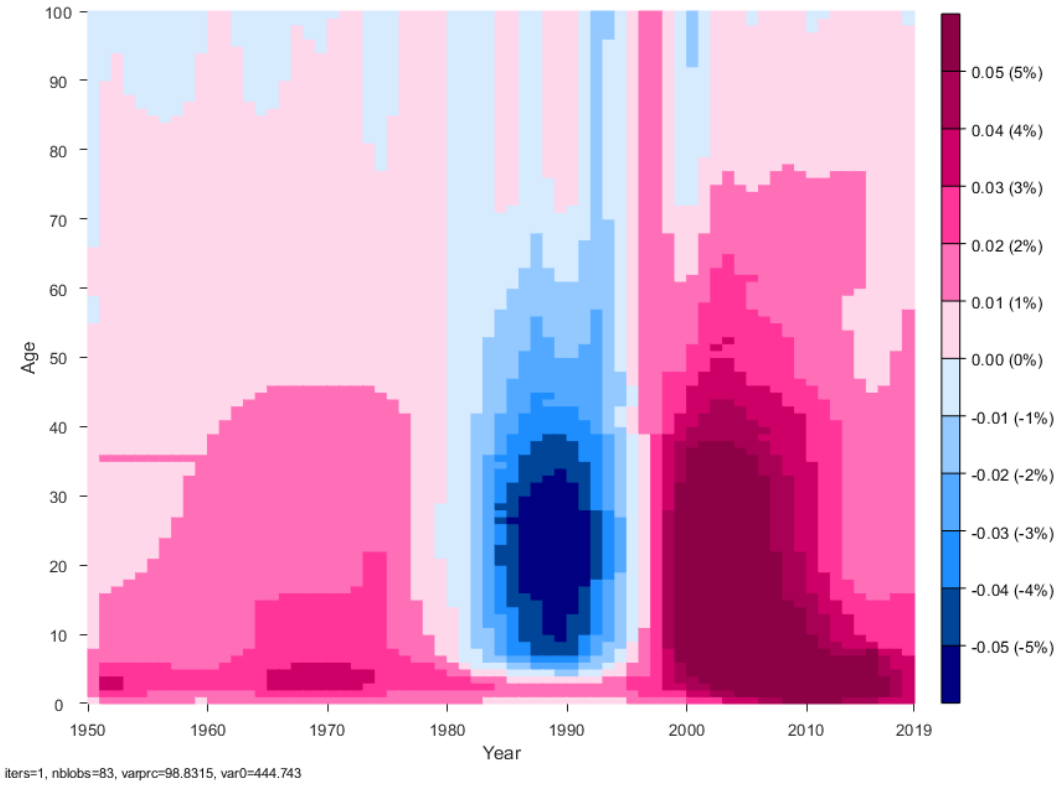
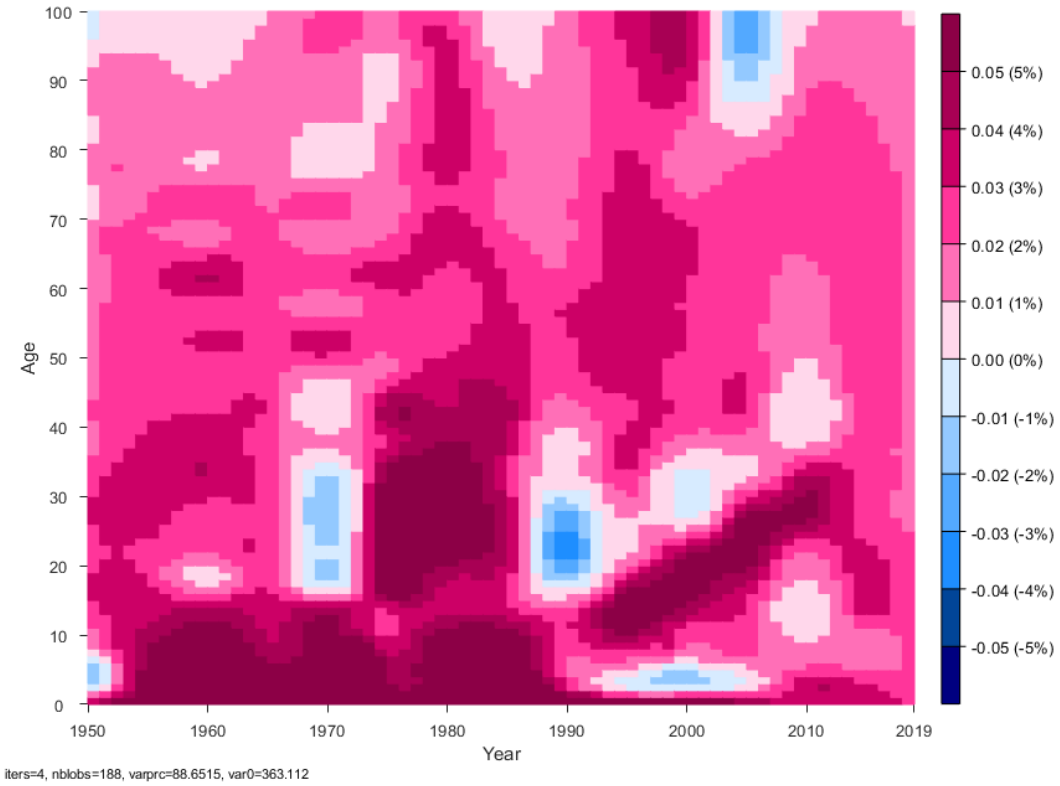
Females



iters=1, nblobs=83, varprc=98.8315, var0=444.743

China, Hong Kong SAR

Males



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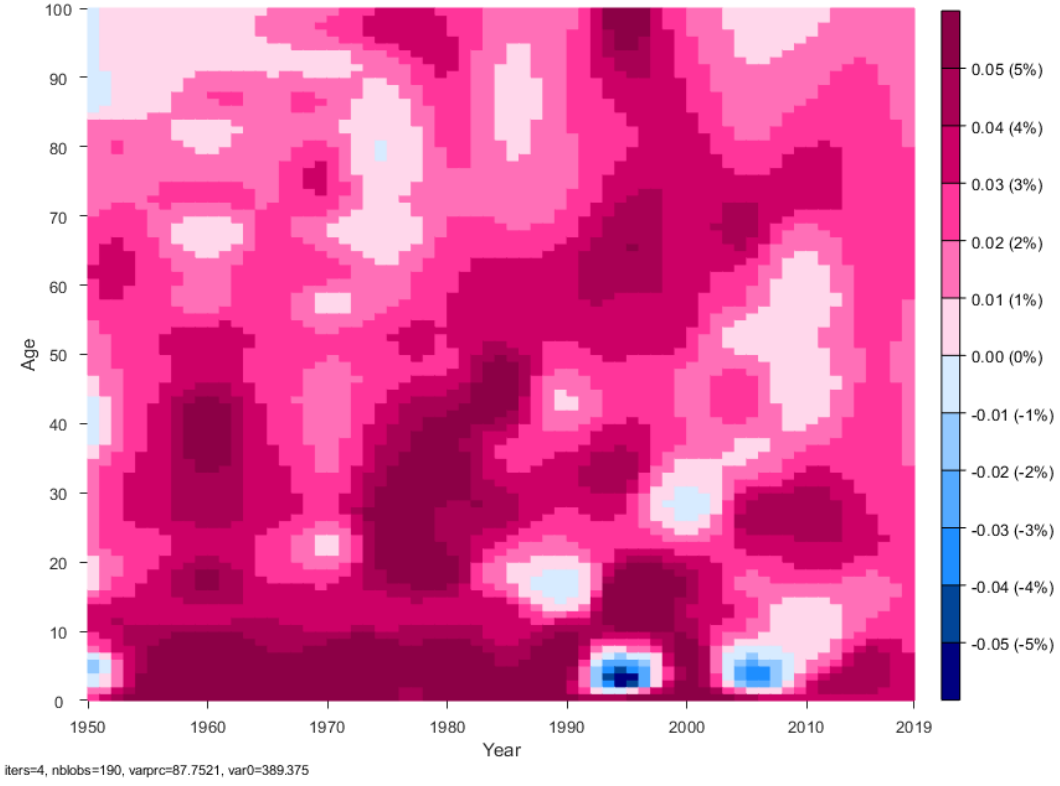
Females



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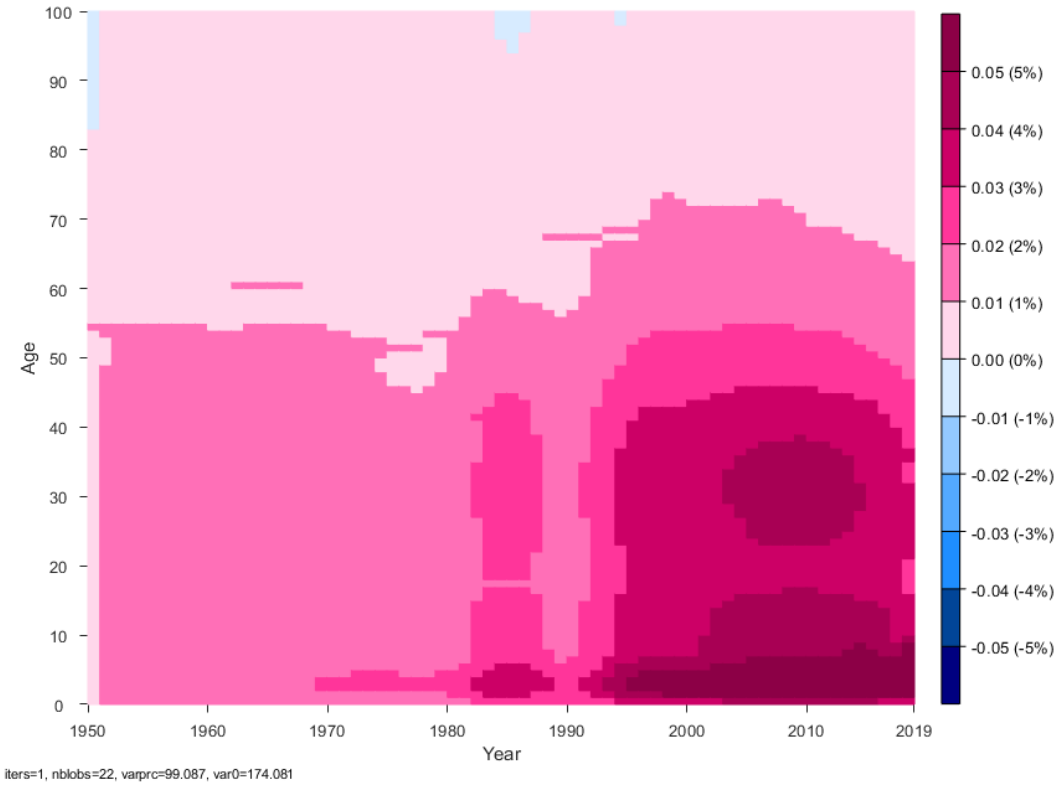
Lao People's Dem. Republic

Males



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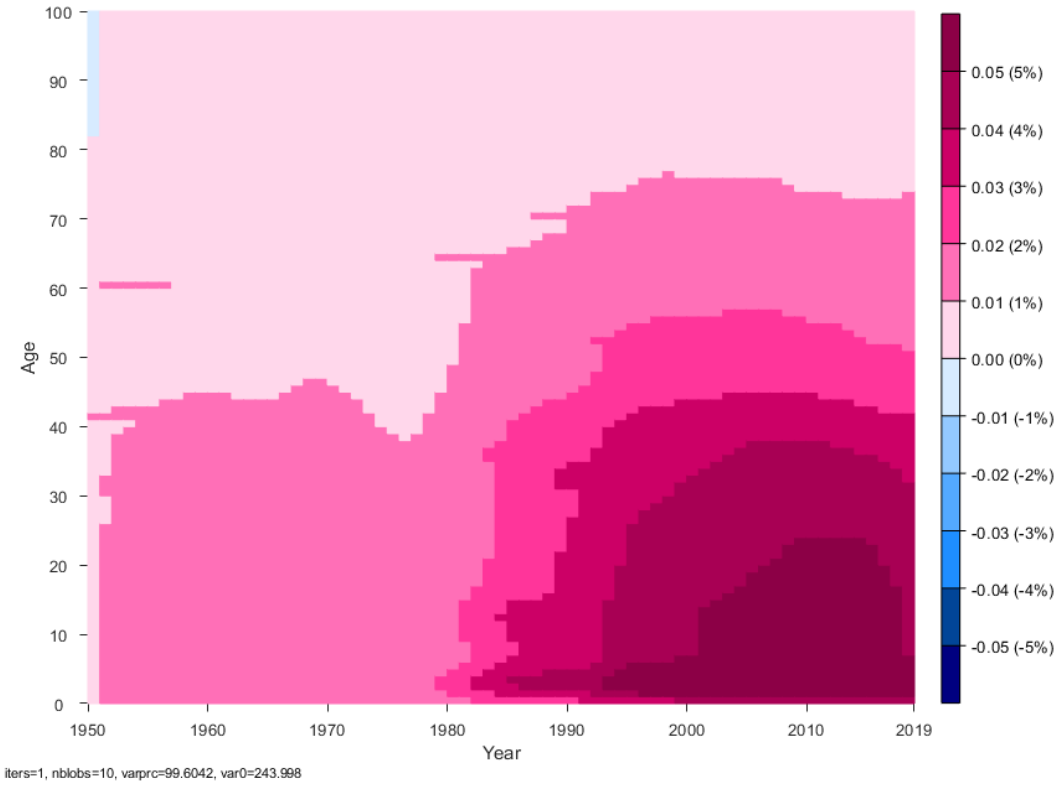
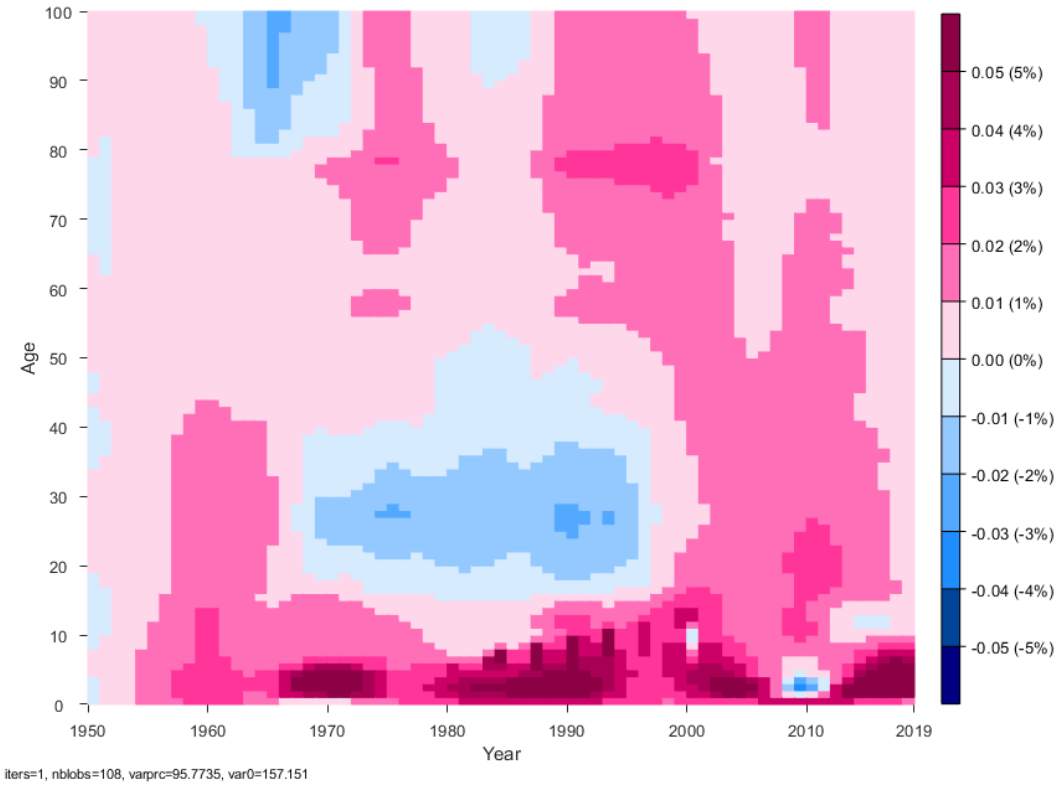
Females



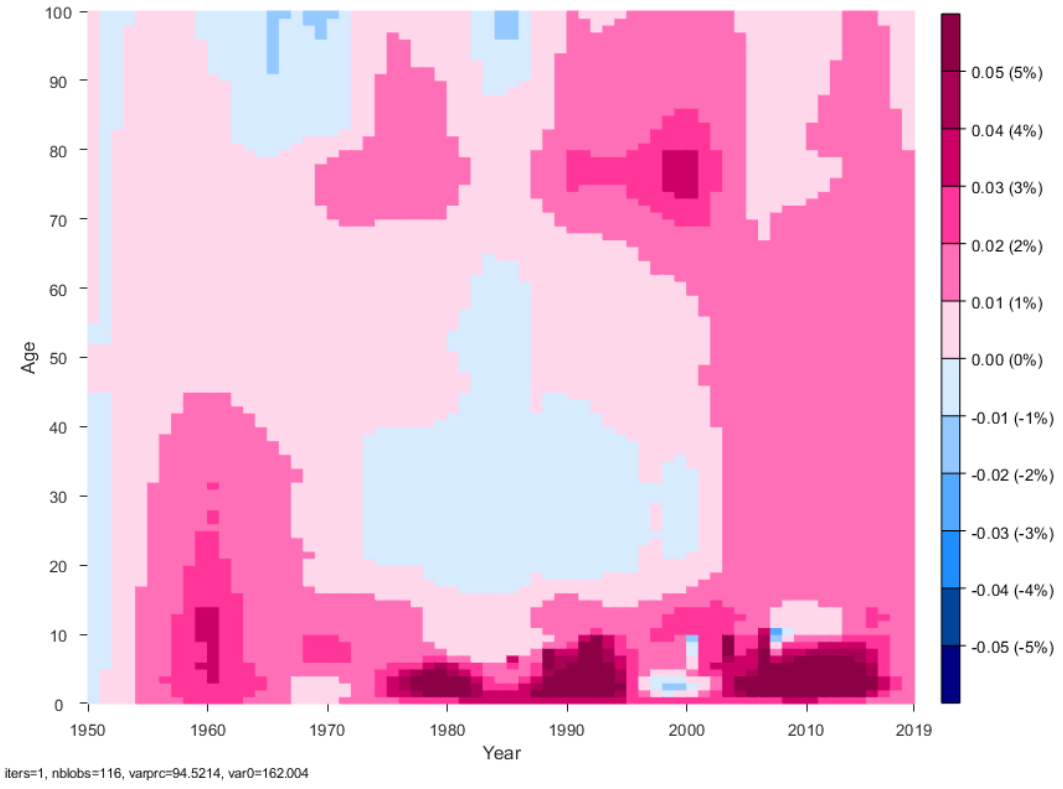
iters=1, nblobs=10, varprc=99.6042, var0=243.998

Paraguay

Males

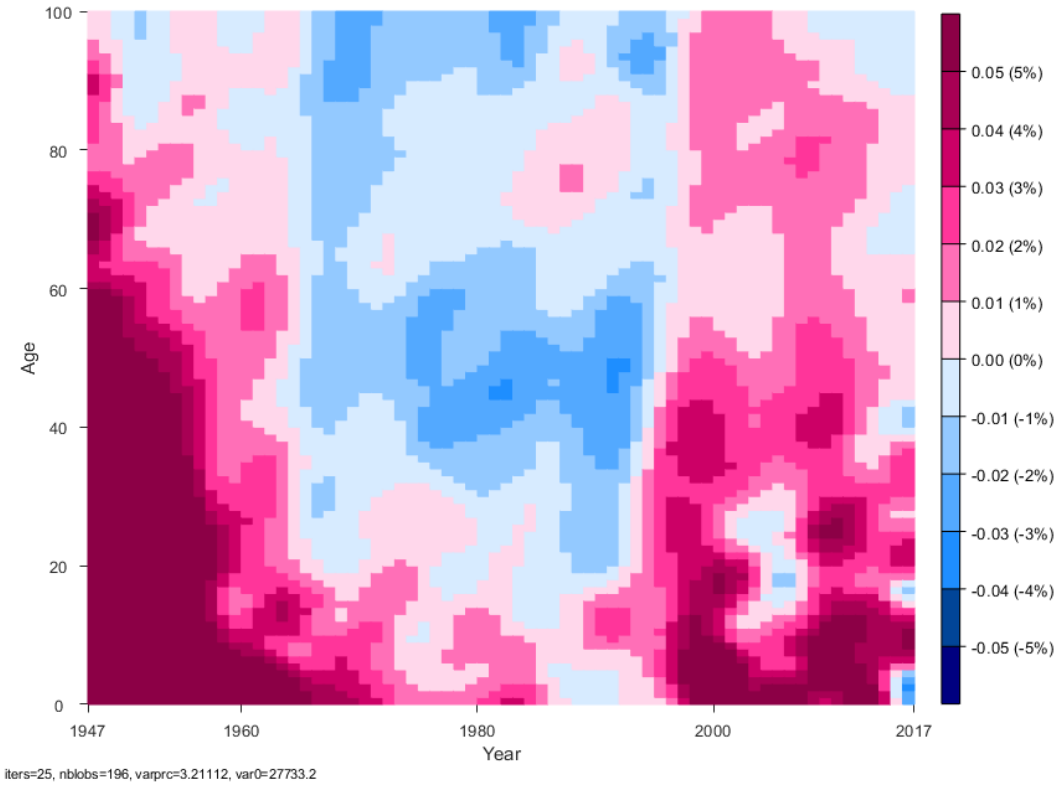


Females

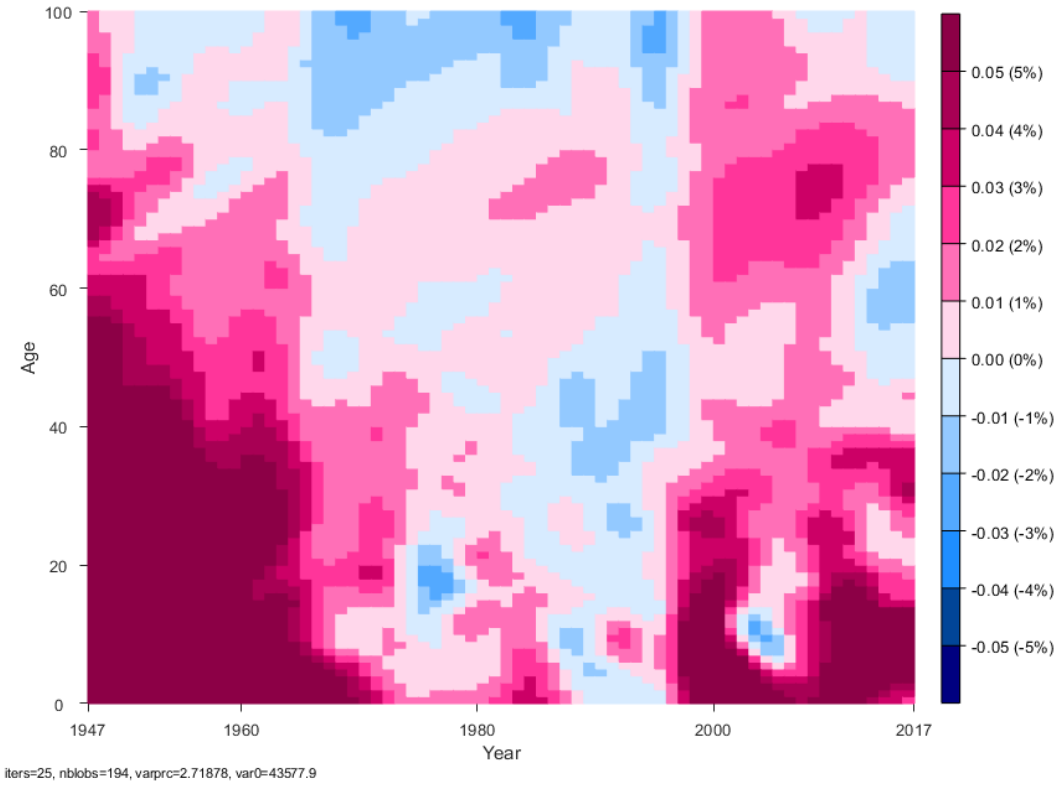


Bulgaria

Males

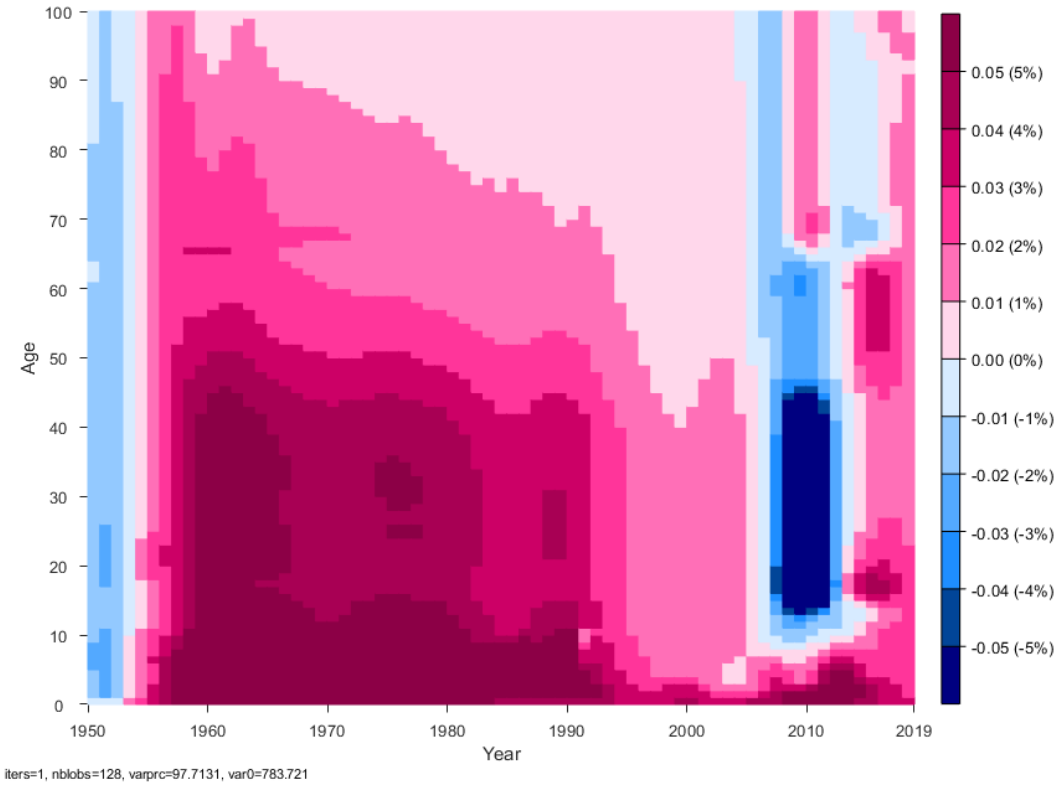


Females



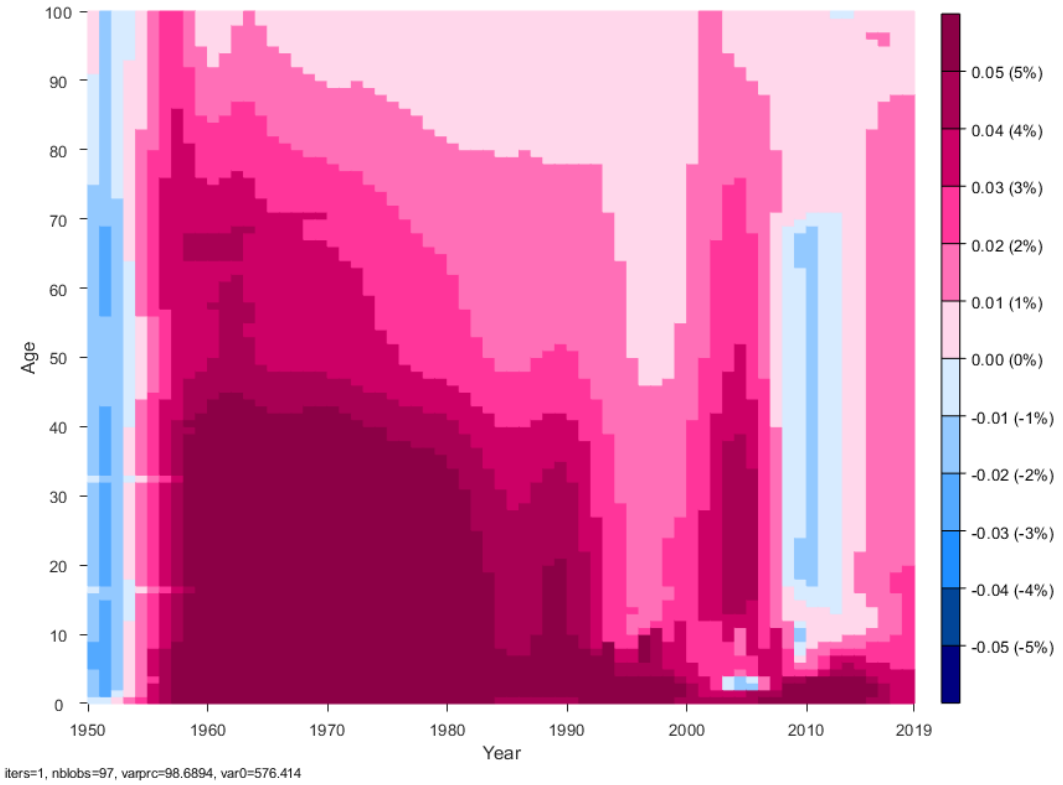
Libya

Males



iters=1, nblobs=128, varprc=97.7131, var0=783.721

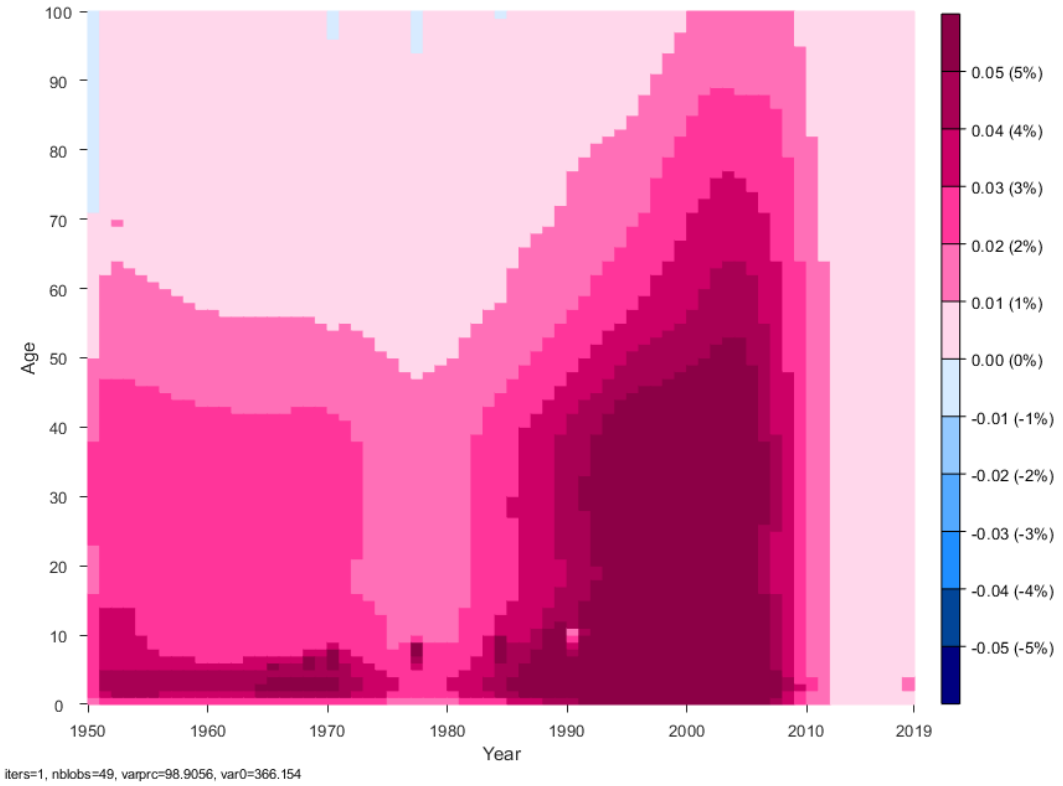
Females



iters=1, nblobs=97, varprc=98.6894, var0=576.414

Lebanon

Males



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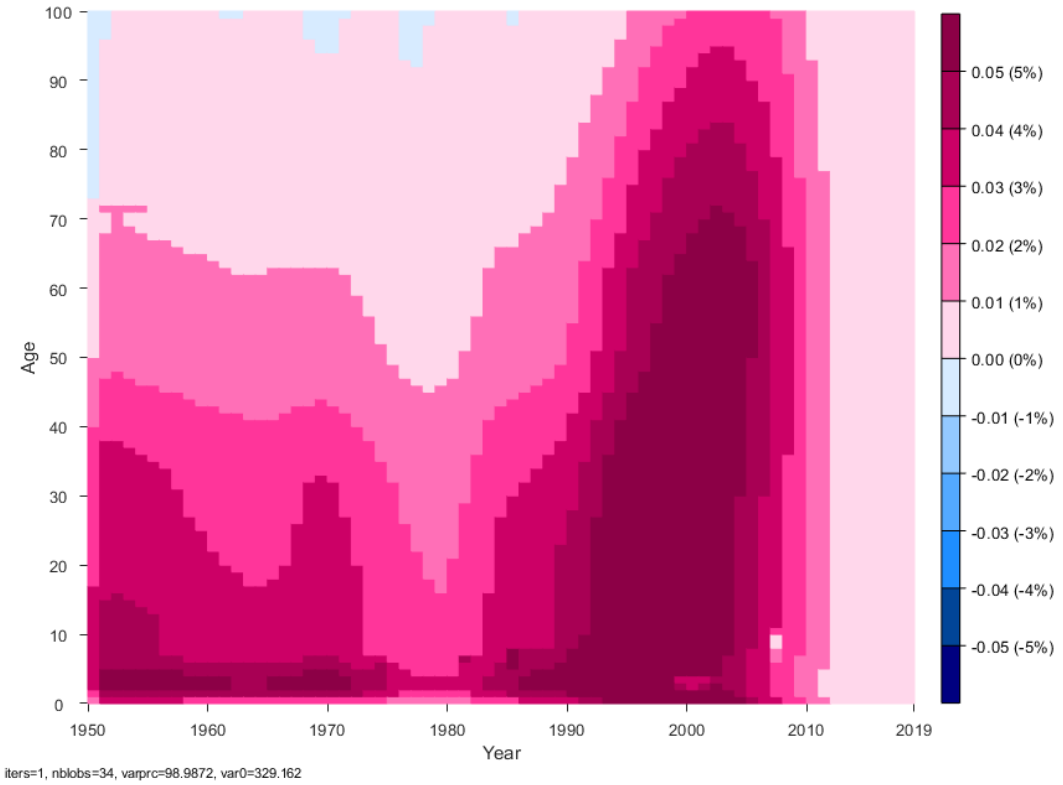
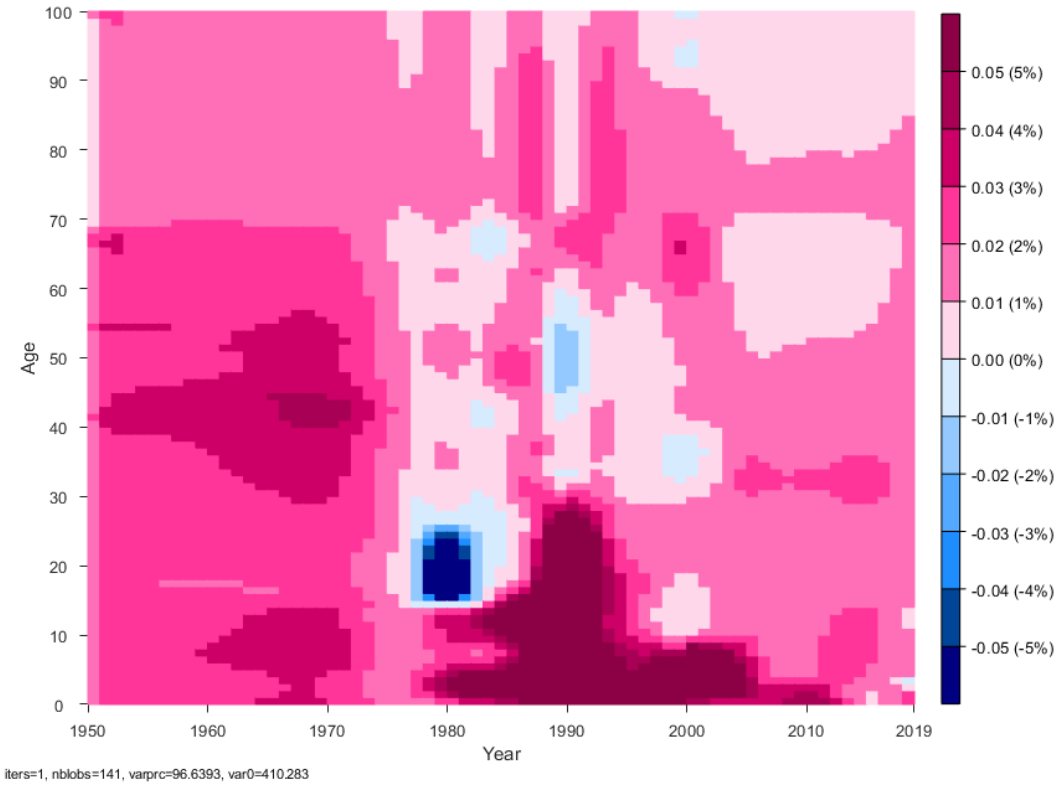
Females



iters=1, nblobs=34, varprc=98.9872, var0=329.162

Nicaragua

Males



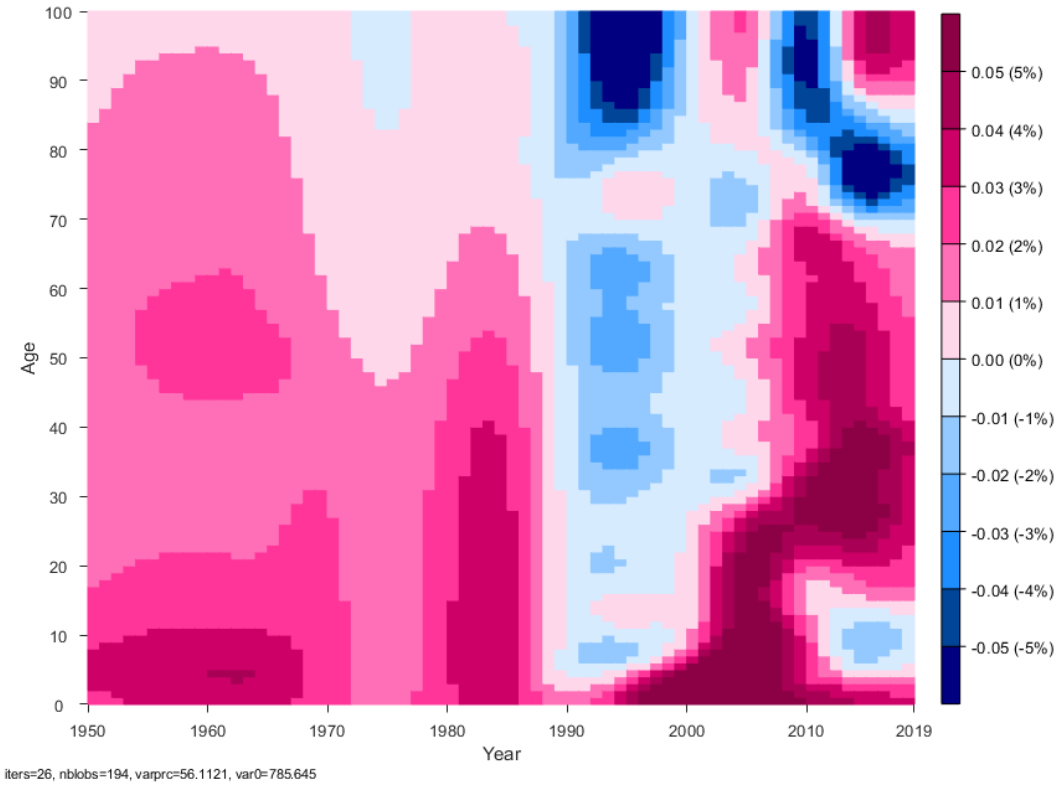
iters=1, nblobs=141, varprc=96.6393, var0=410.283

Females

iters=1, nblobs=90, varprc=97.4924, var0=268.808

Kyrgyzstan

Males



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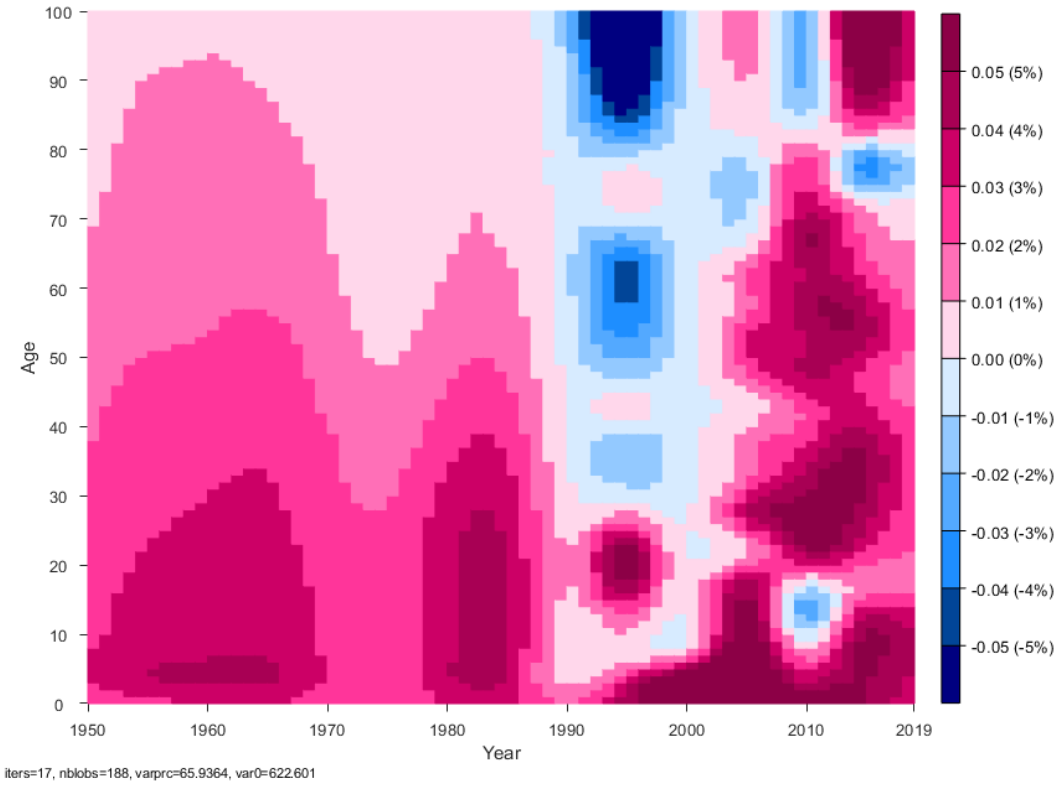
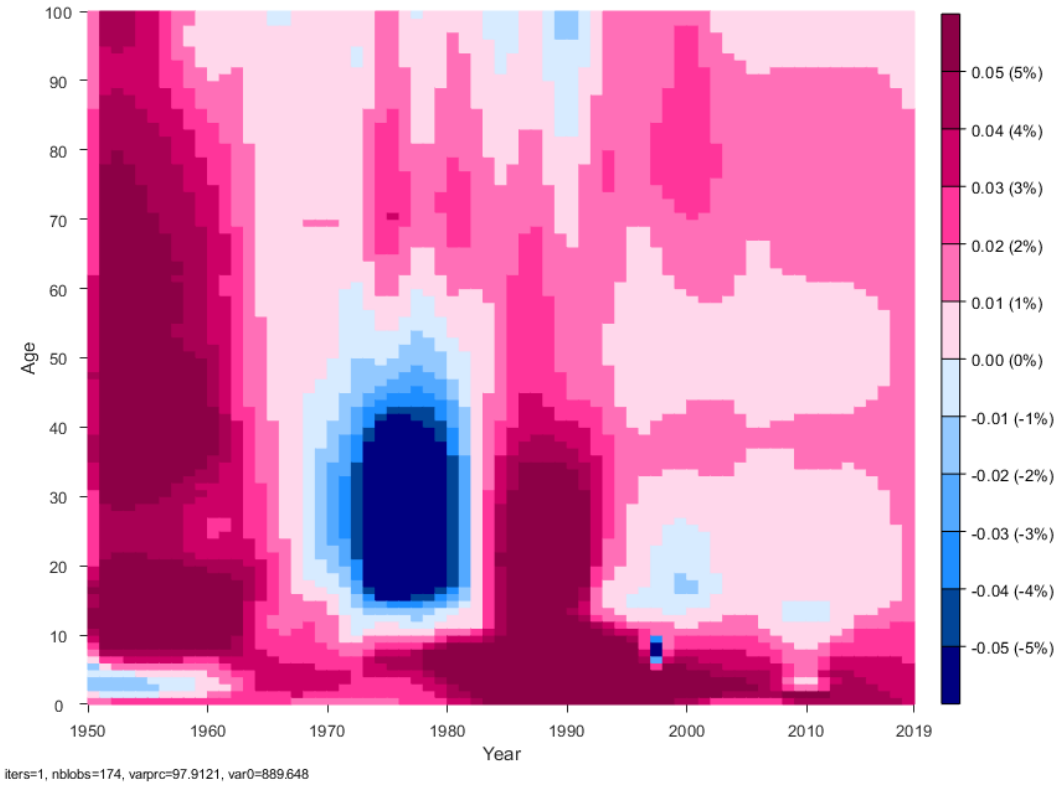
Females



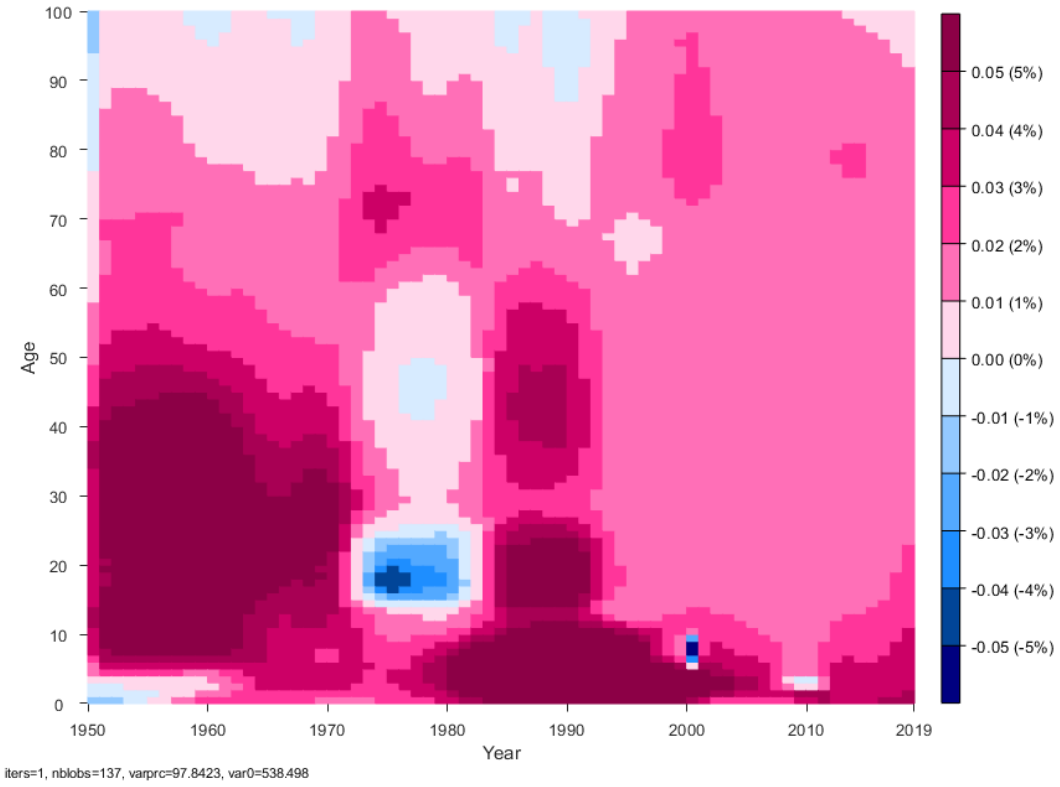
iters=17, nblobs=188, varprc=65.9364, var0=622.601

El Salvador

Males



Females

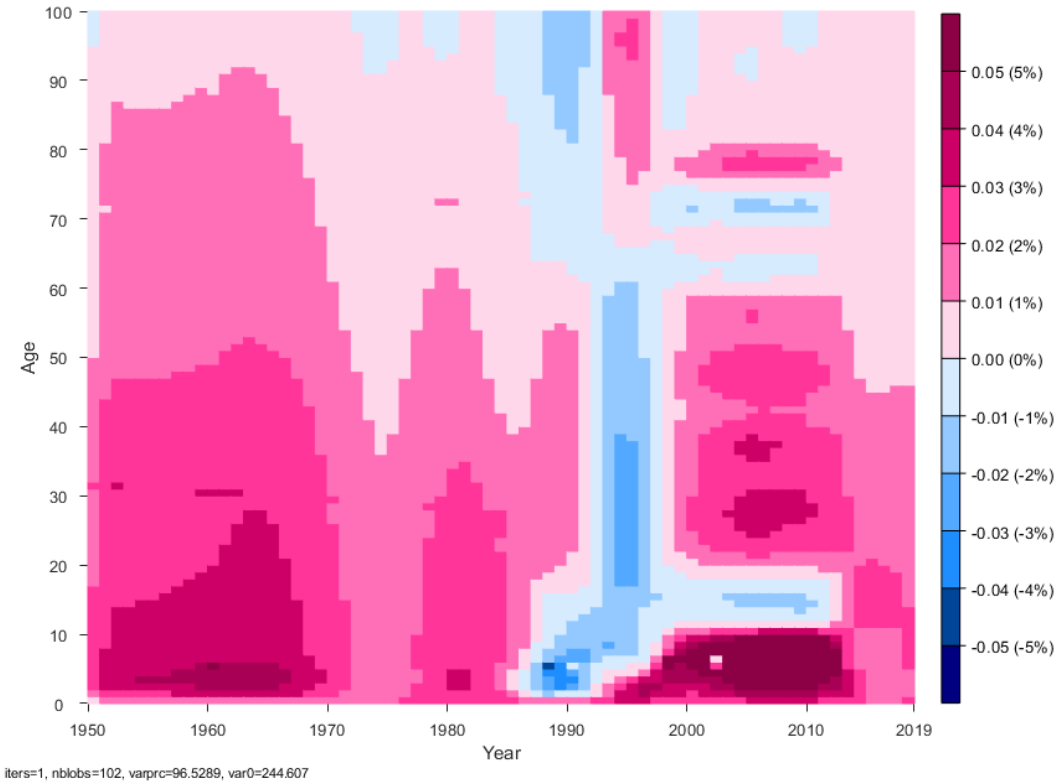


Turkmenistan

Males

iters=1, nblobs=87, varprc=94.4663, var0=232.912

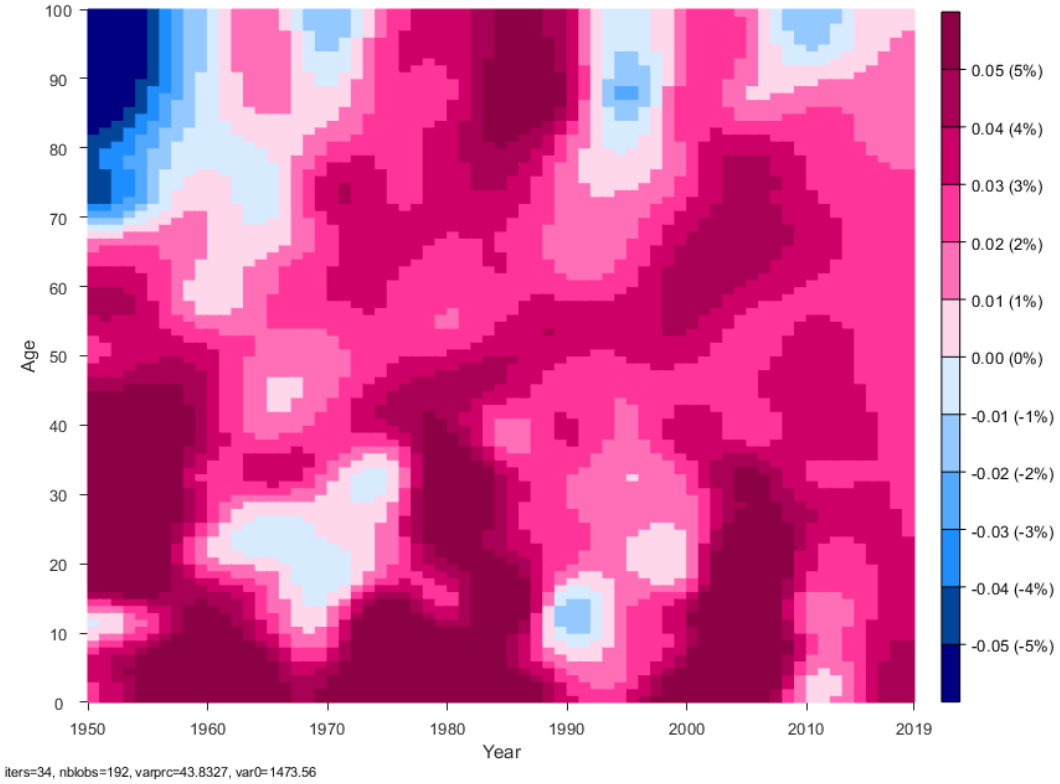
Females



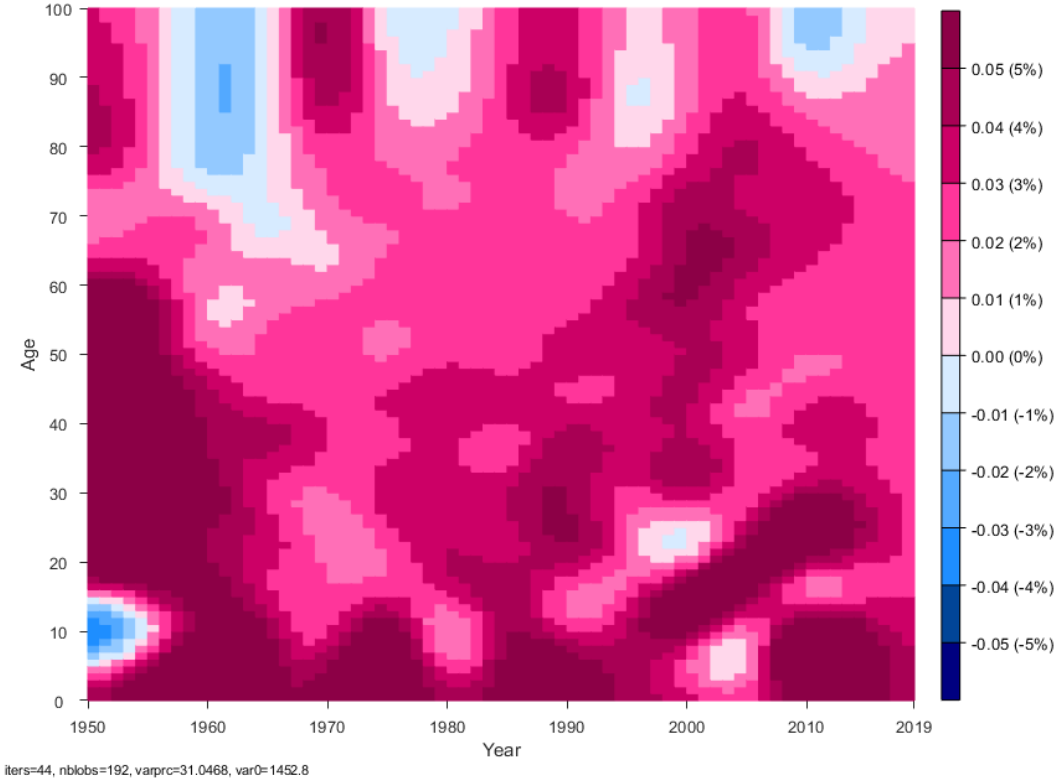
iters=1, nblobs=102, varprc=96.5289, var0=244.607

Singapore

Males

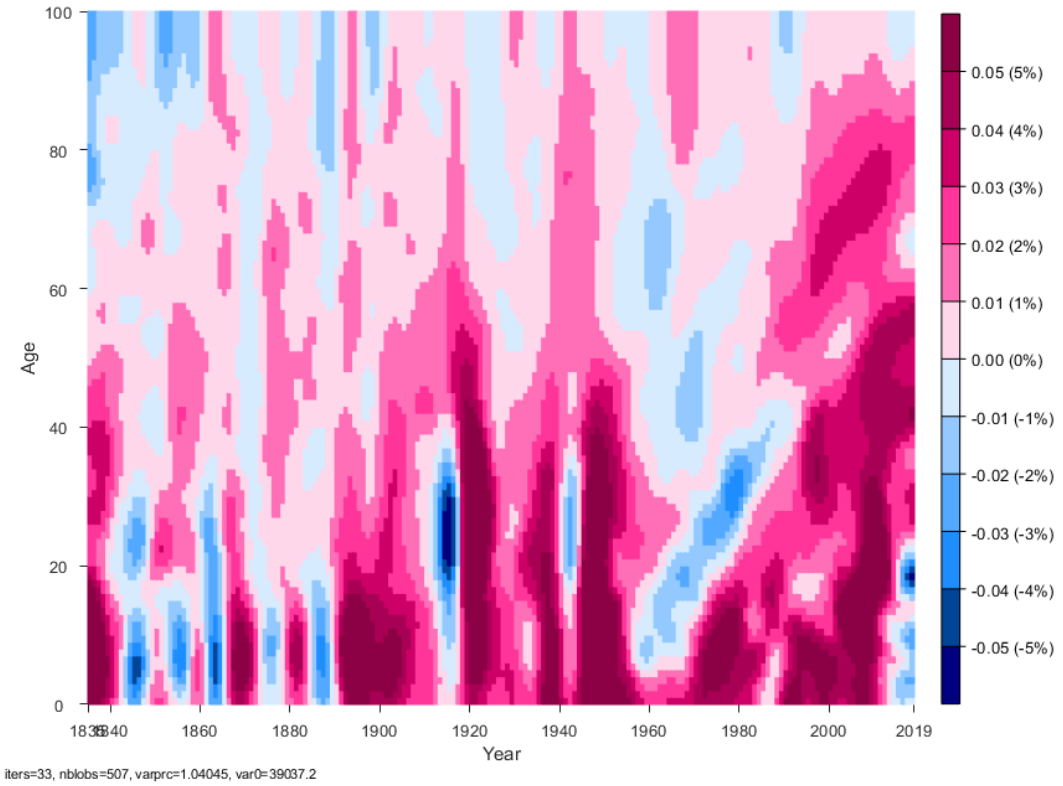


Females



Denmark

Males



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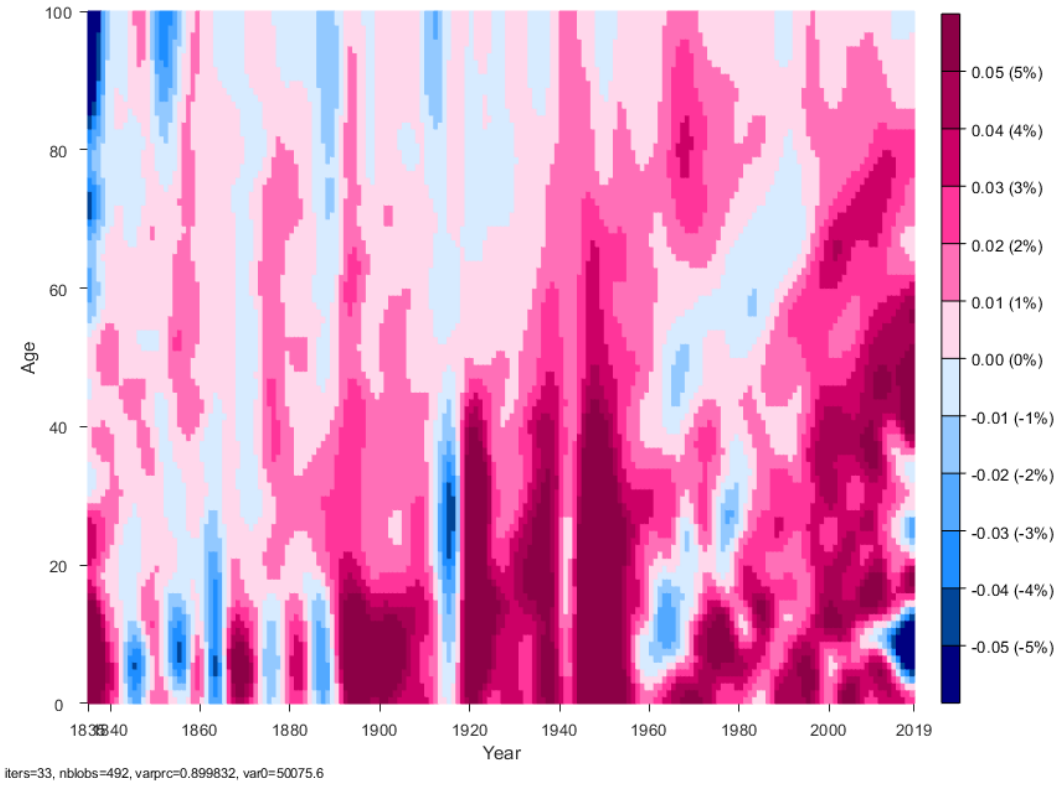
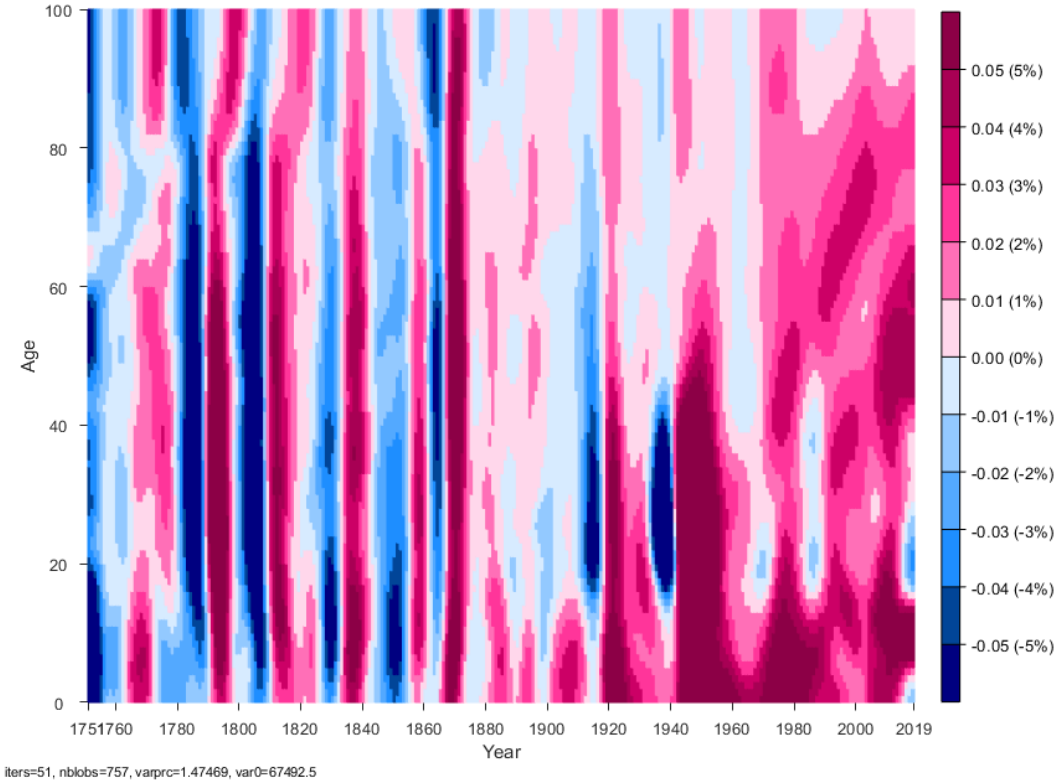
Females



iters=33, nblobs=492, varprc=0.899832, var0=50075.6

Finland

Males



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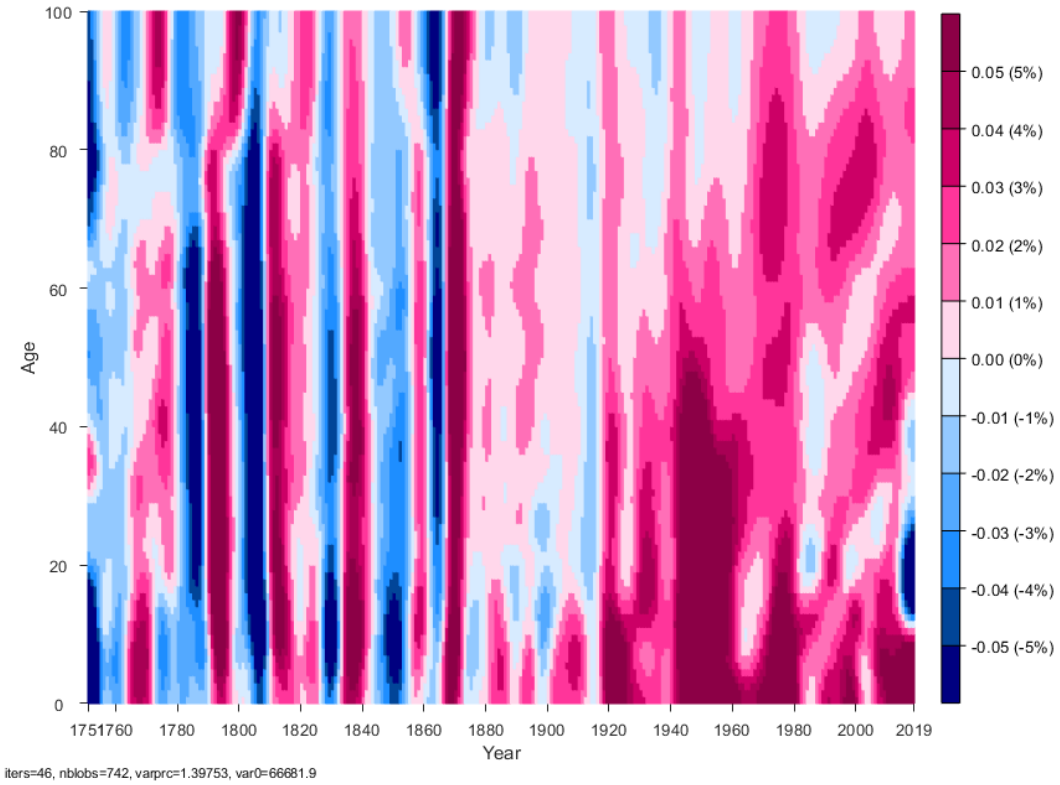
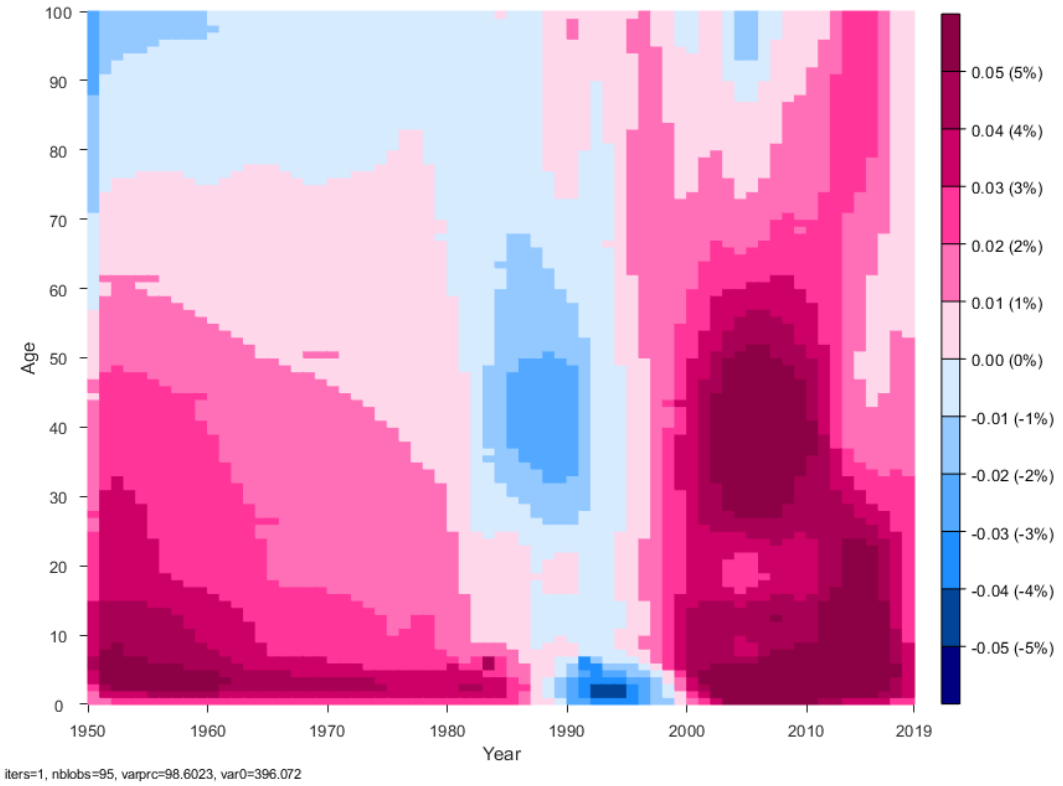
Females



iters=46, nblobs=742, varprc=1.39753, var0=66681.9

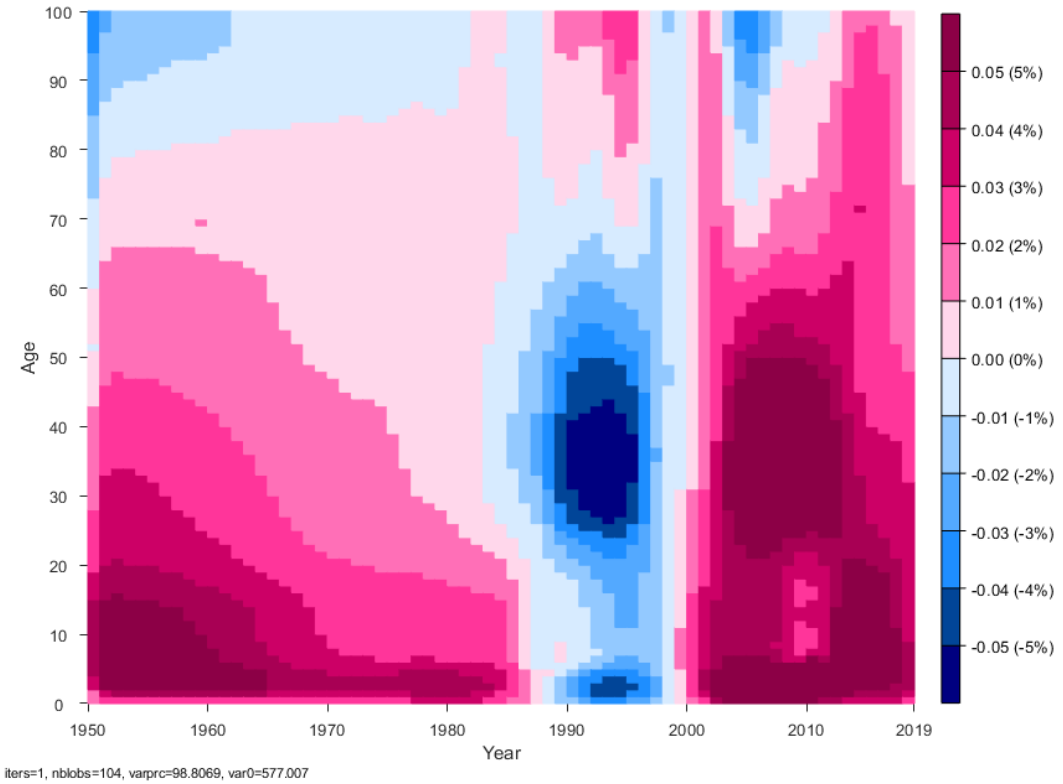
Congo

Males



iters=1, nblobs=95, varprc=98.6023, var0=396.072

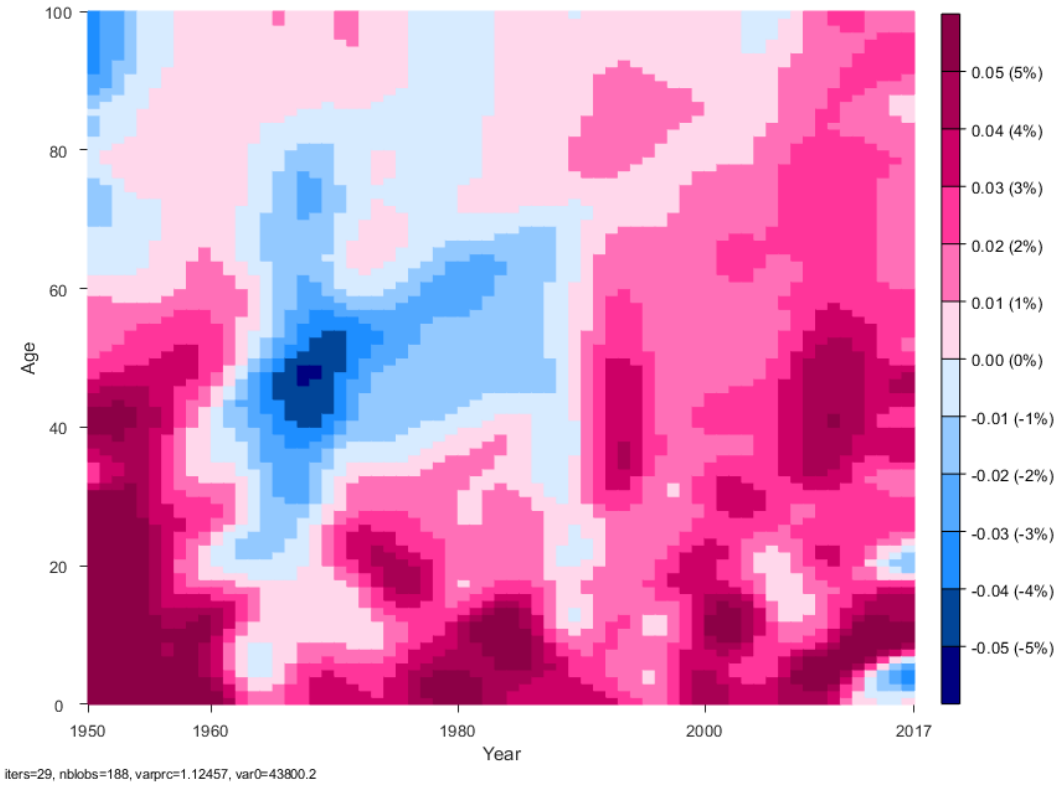
Females



iters=1, nblobs=104, varprc=98.8069, var0=577.007

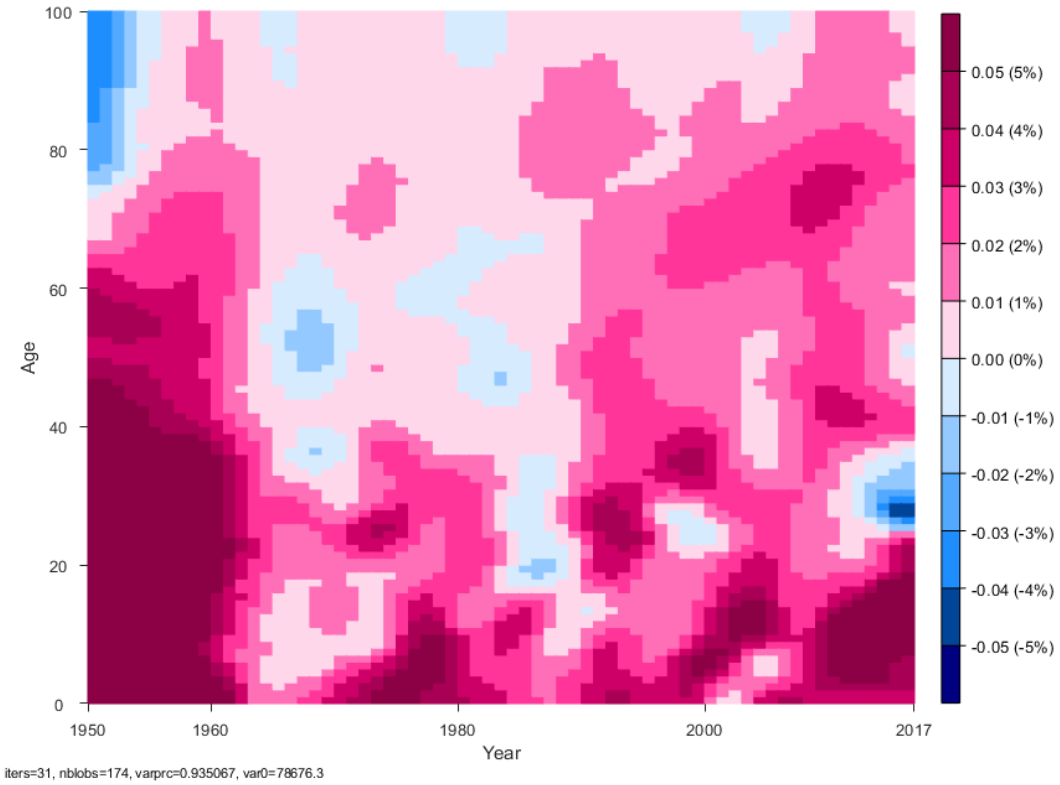
Slovakia

Males



iters=29, nblobs=188, varprc=1.12457, var0=43800.2

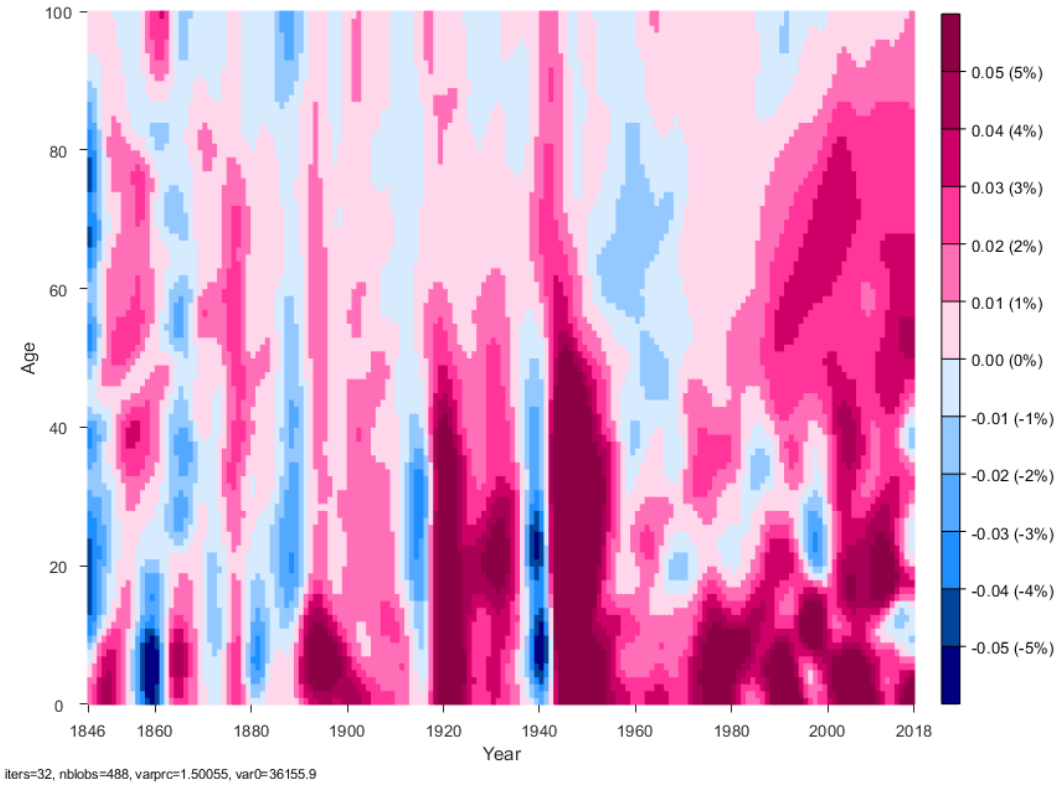
Females



iters=31, nblobs=174, varprc=0.935067, var0=78676.3

Norway

Males



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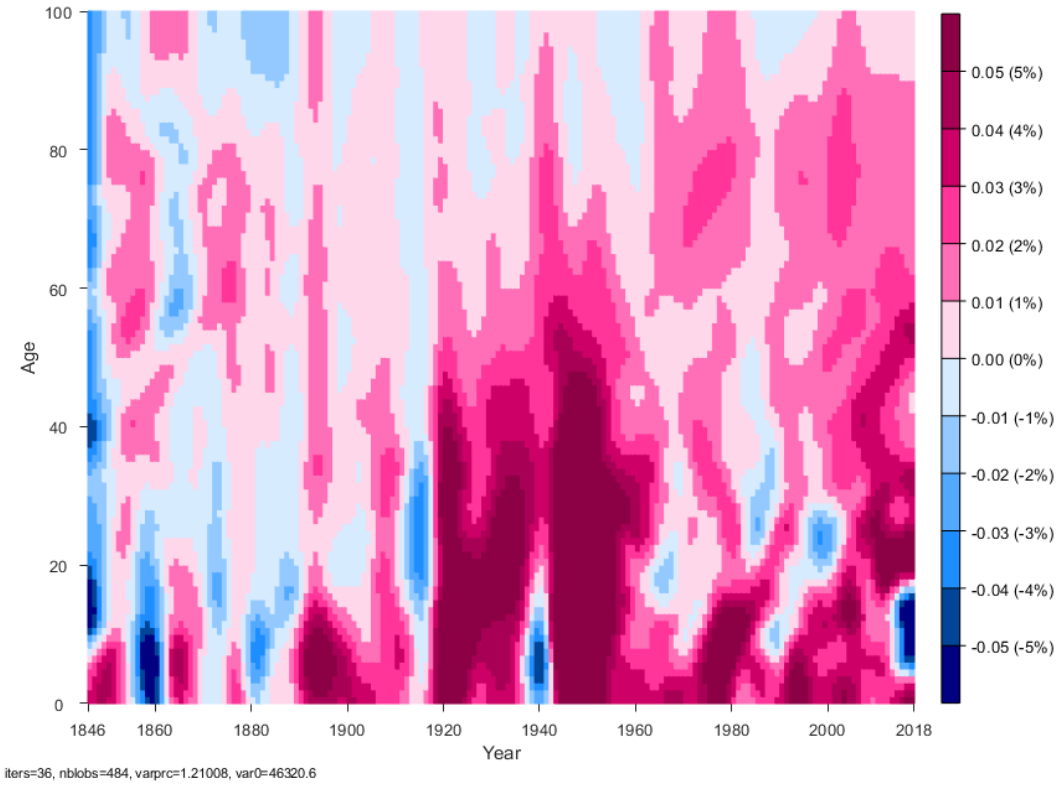
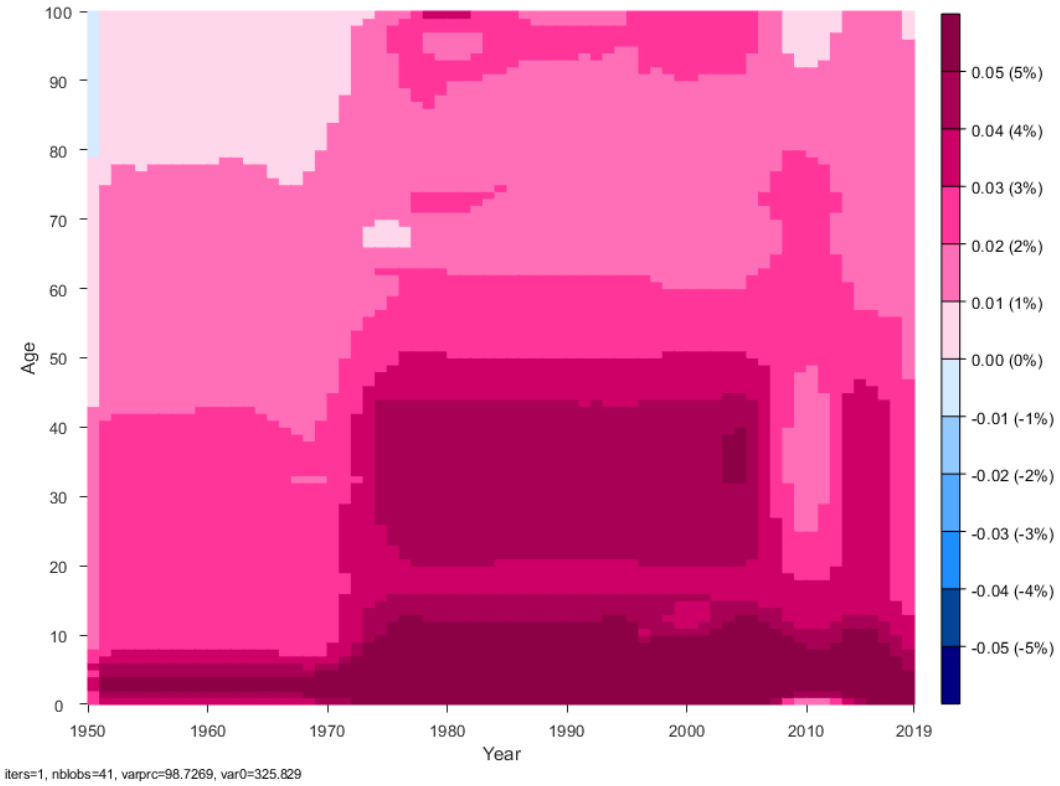
Females



iters=36, nblobs=484, varprc=1.21008, var0=46320.6

Oman

Males



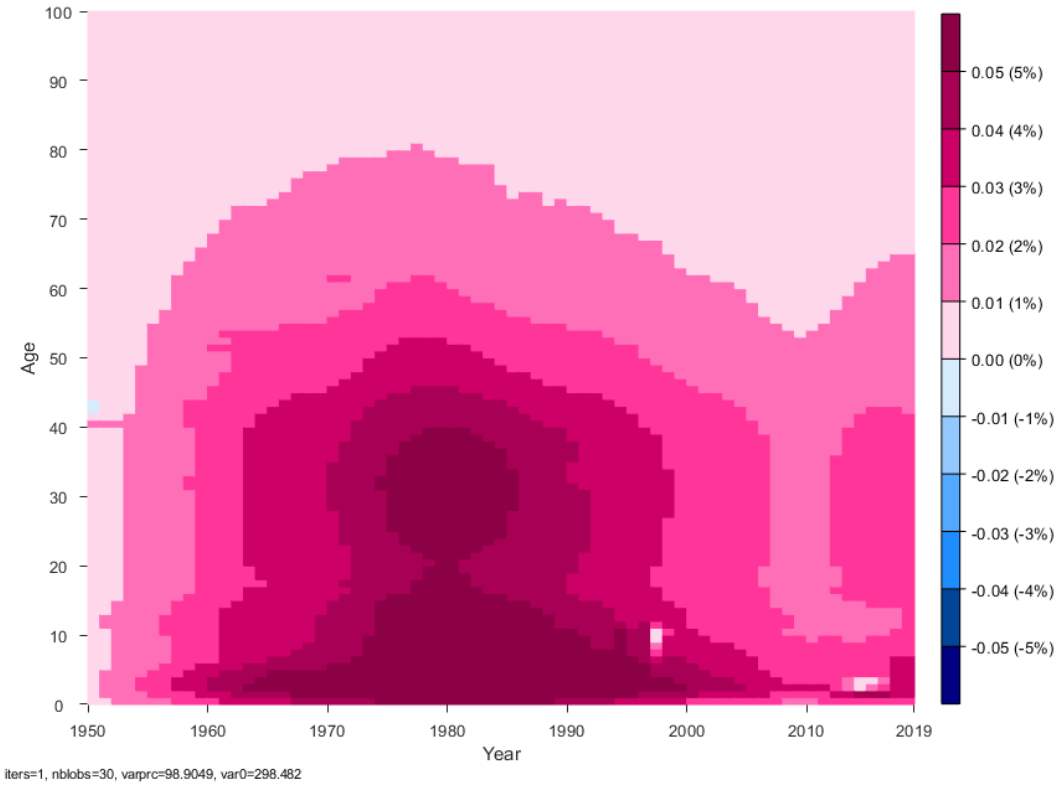
iters=1, nblobs=41, varprc=98.7269, var0=325.829

Females

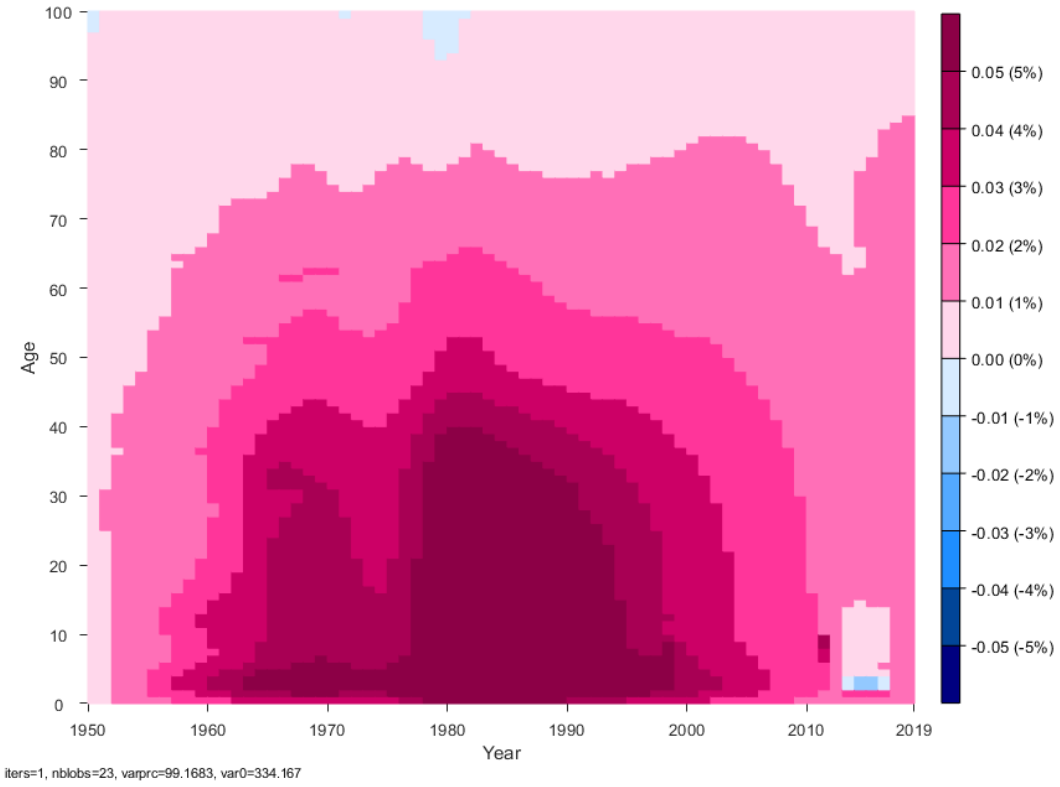
iters=1, nblobs=60, varprc=98.4489, var0=510.037

State of Palestine

Males

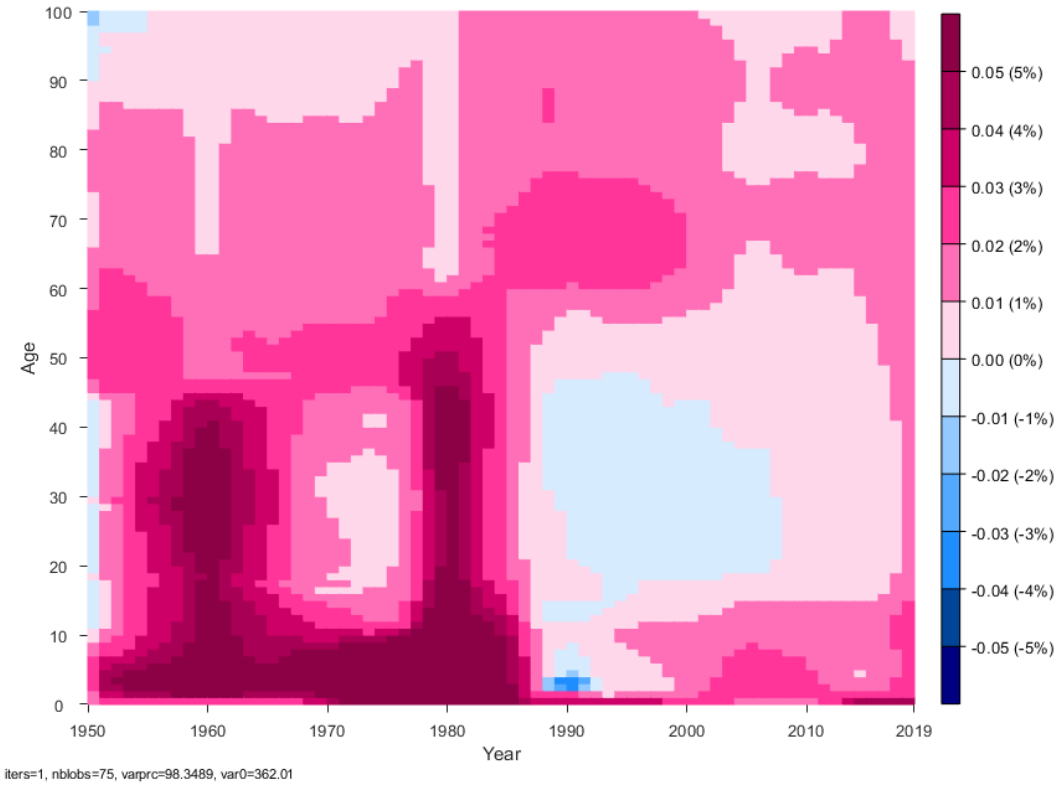


Females



Costa Rica

Males



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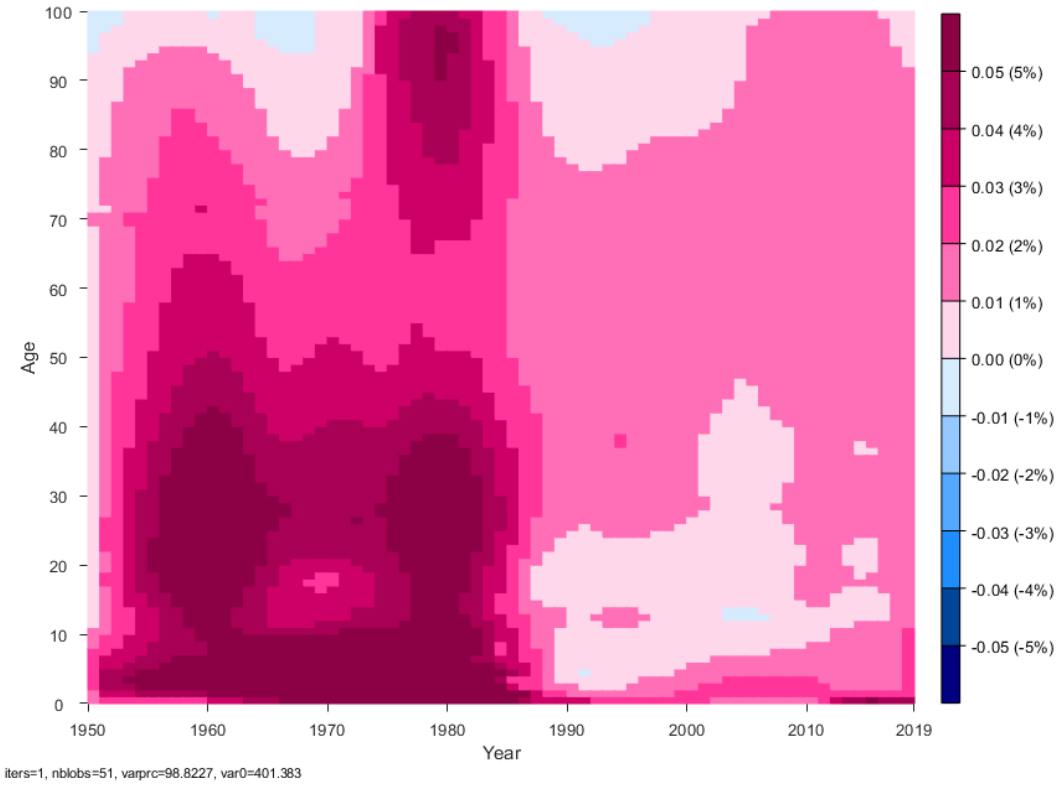
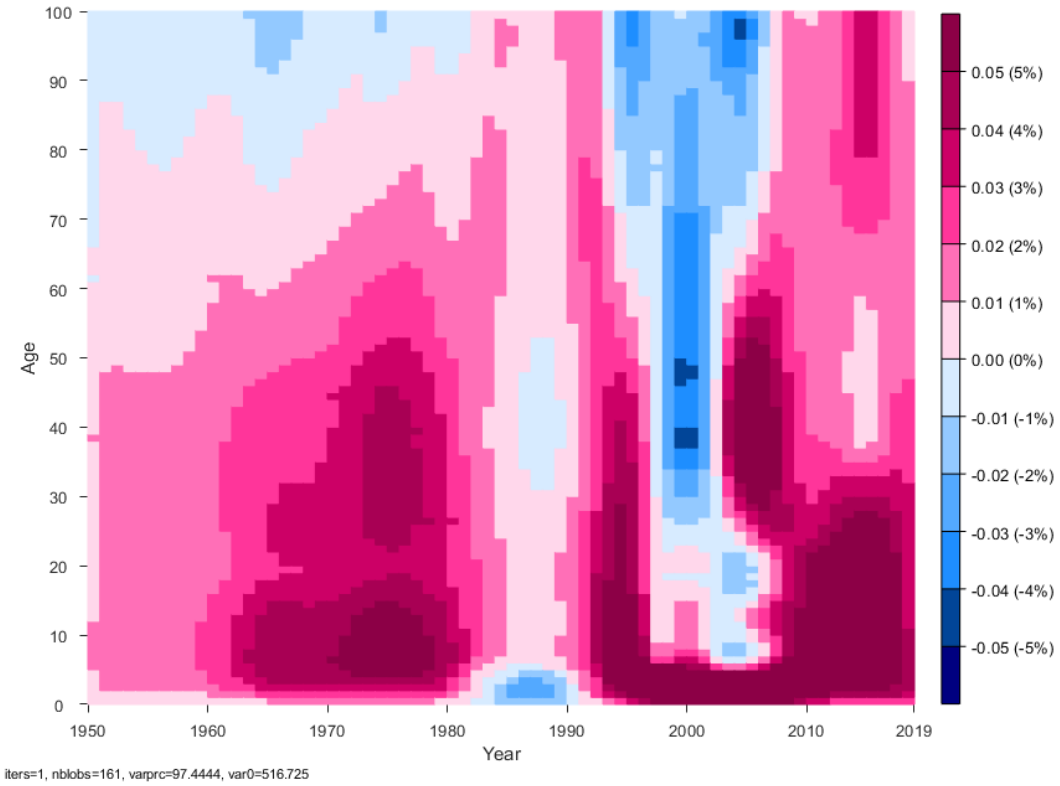
Females



iters=1, nblobs=51, varprc=98.8227, var0=401.383

Liberia

Males



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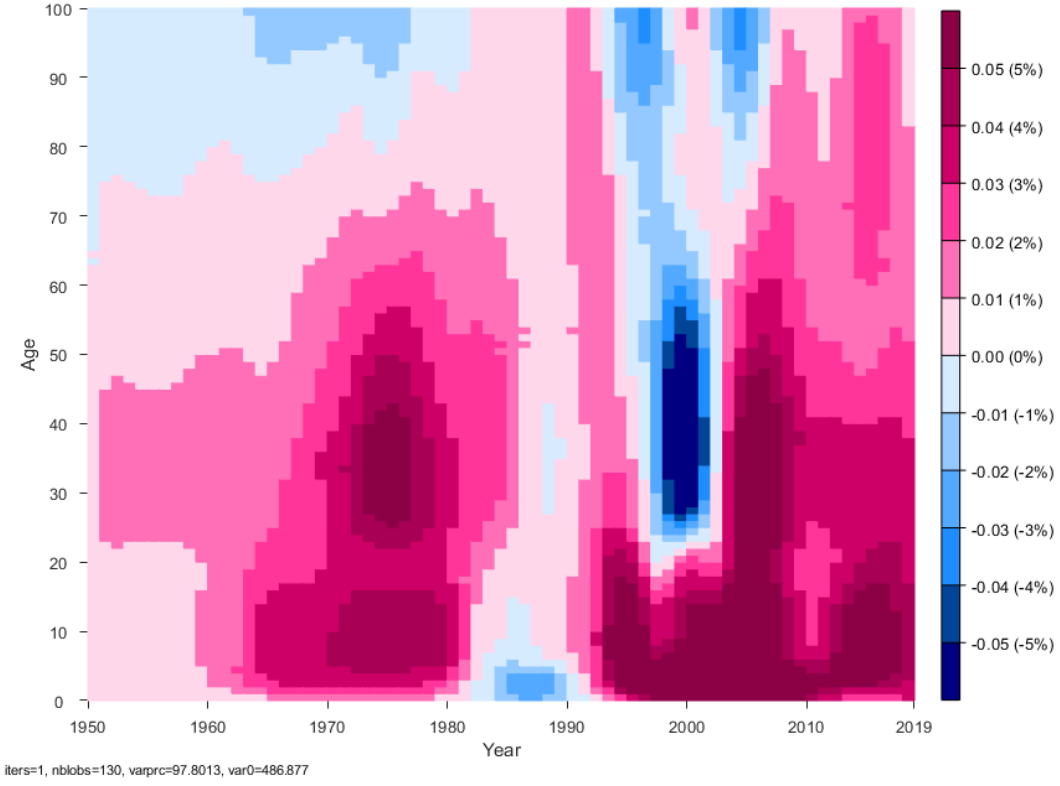
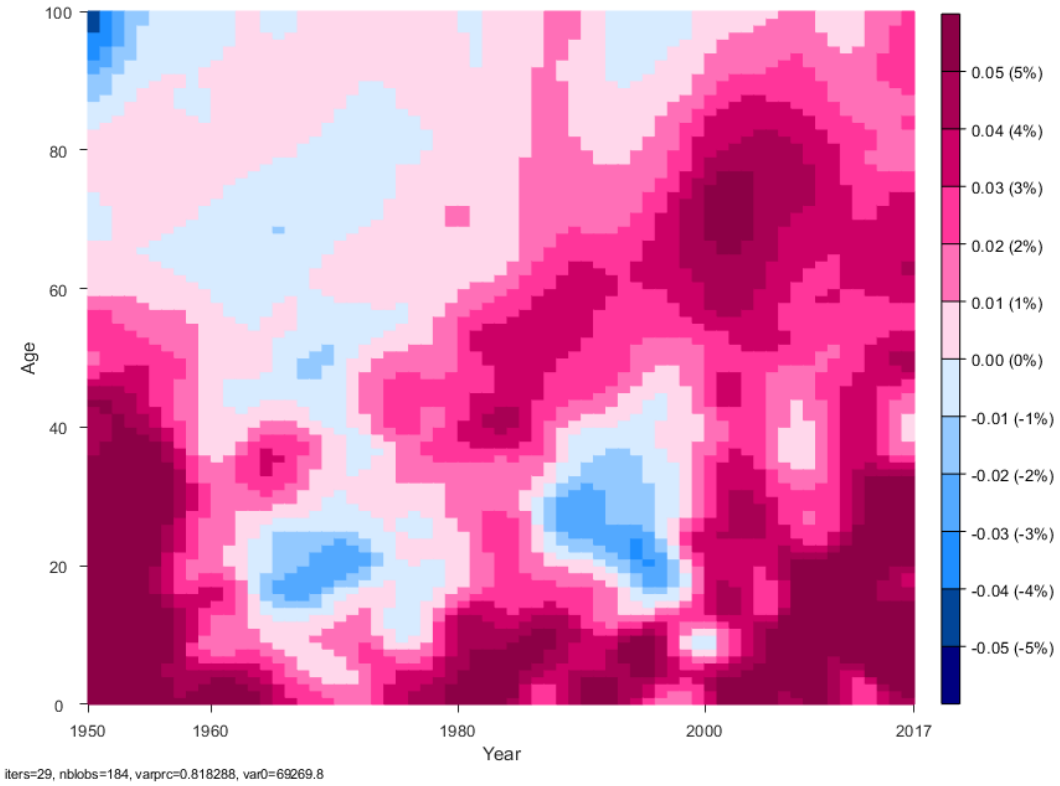
Females



iters=1, nblobs=130, varprc=97.8013, var0=486.877

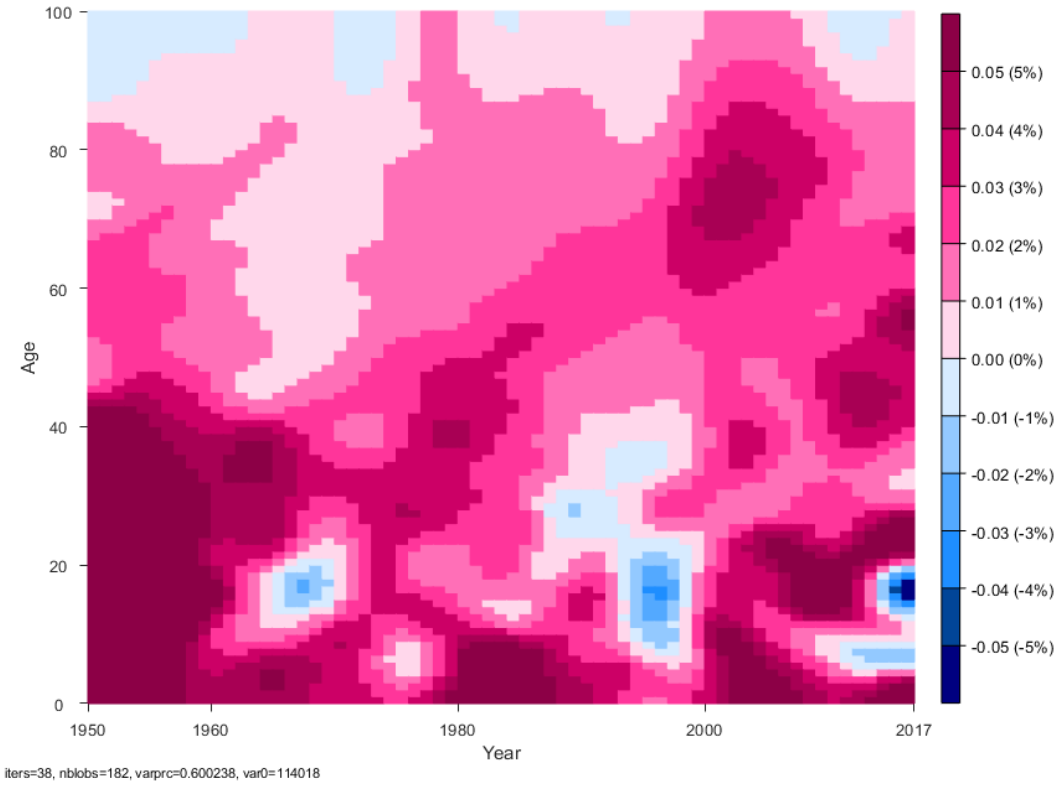
Ireland

Males



iters=29, nblobs=184, varprc=0.818288, var0=69269.8

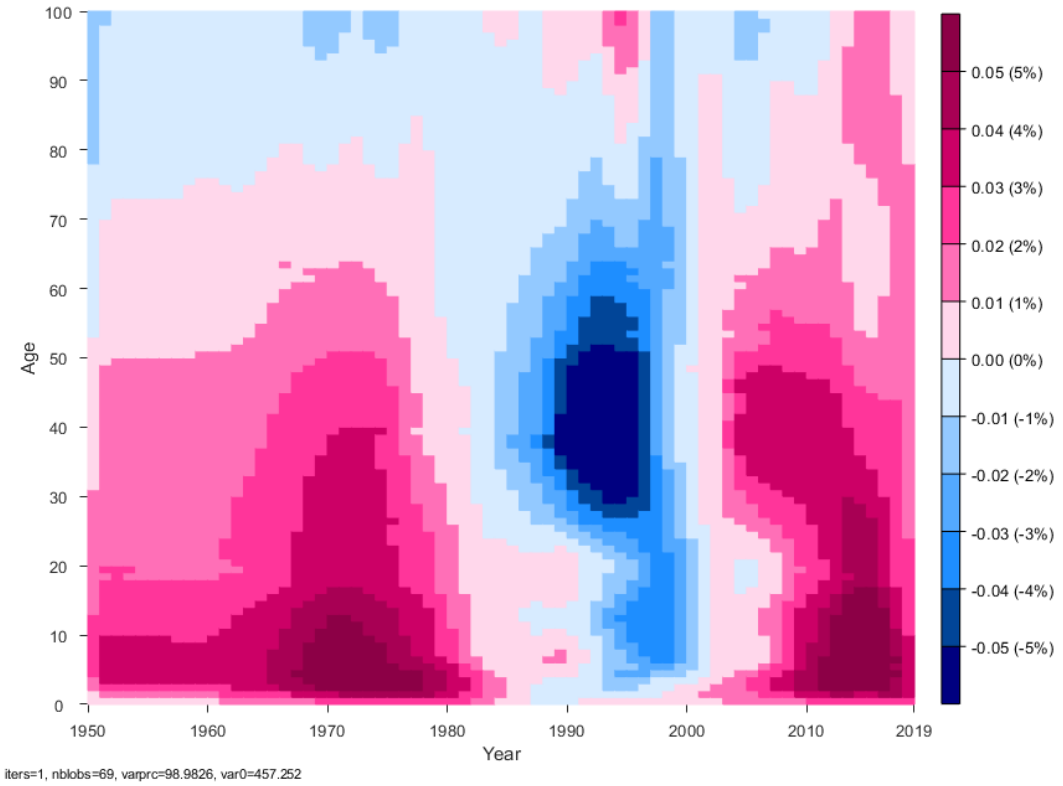
Females



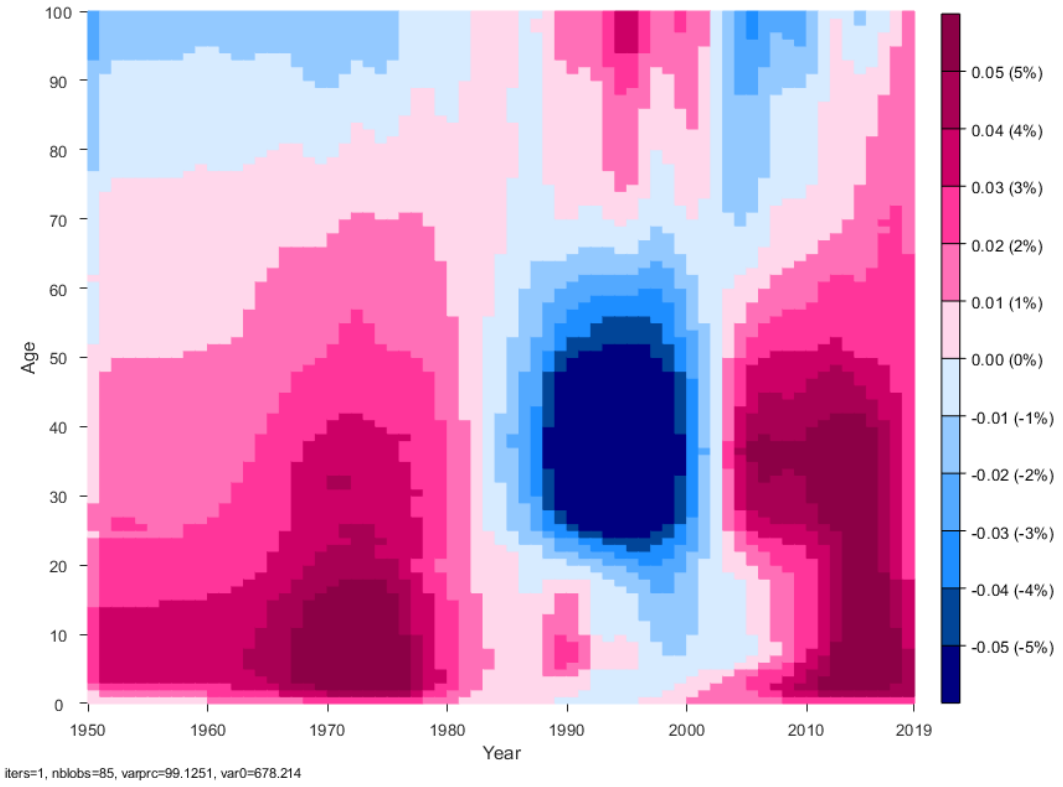
iters=38, nblobs=182, varprc=0.600238, var0=114018

Central African Republic

Males

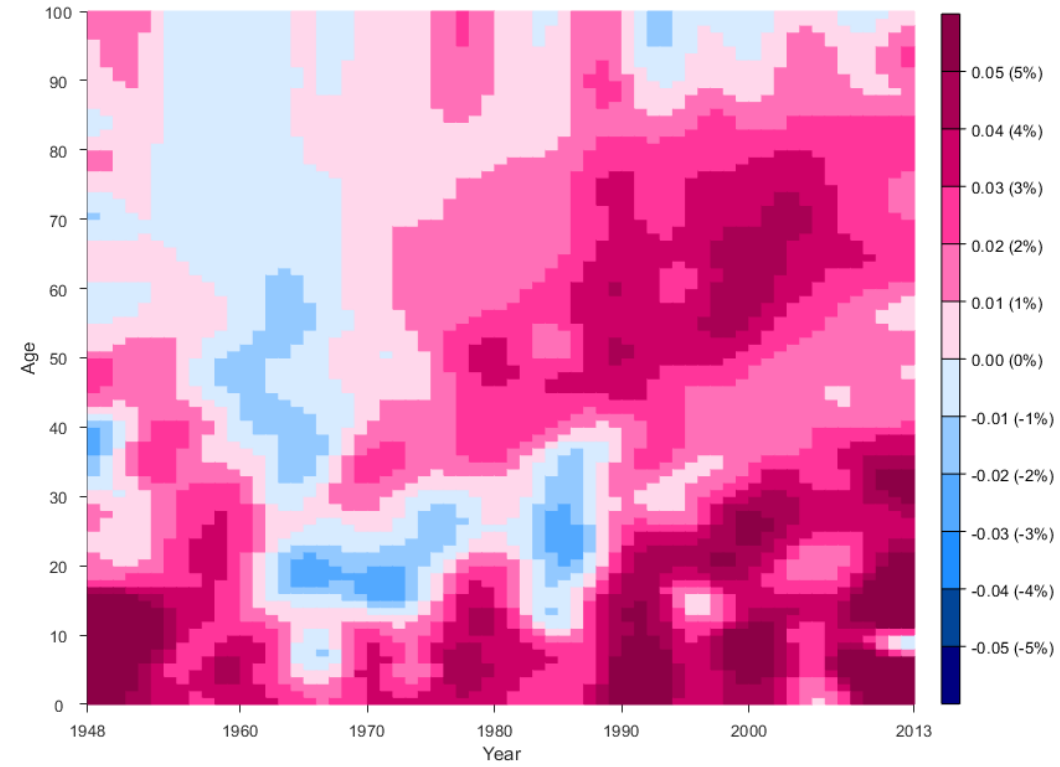


Females



New Zealand

Males



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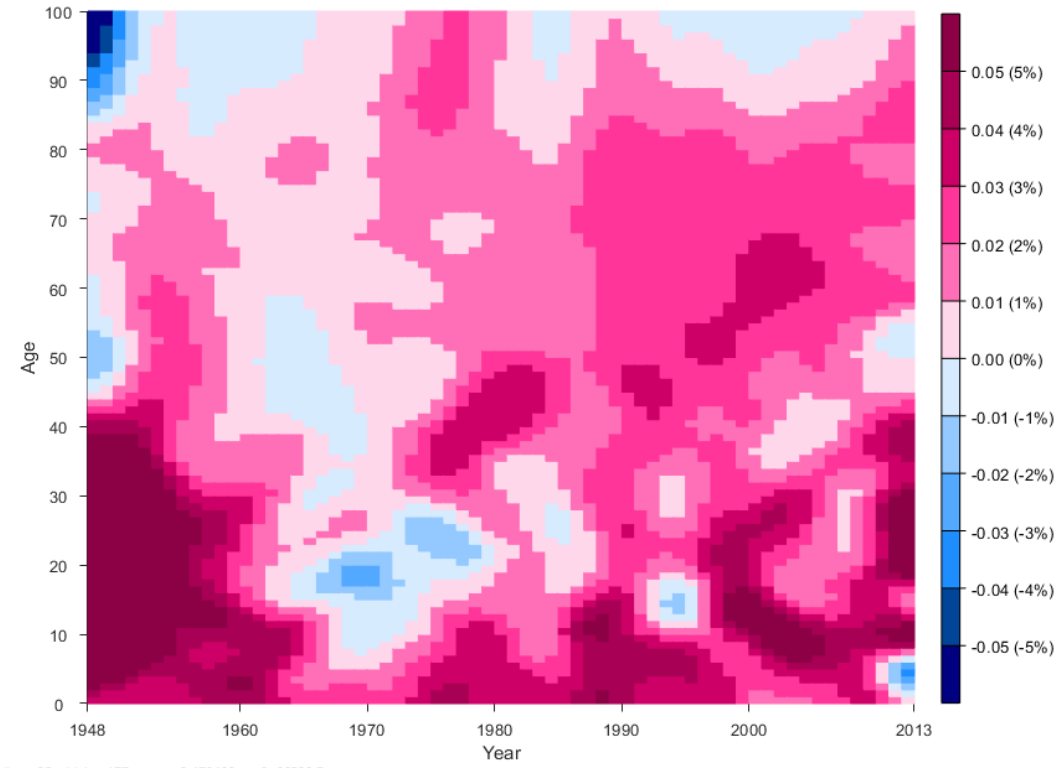
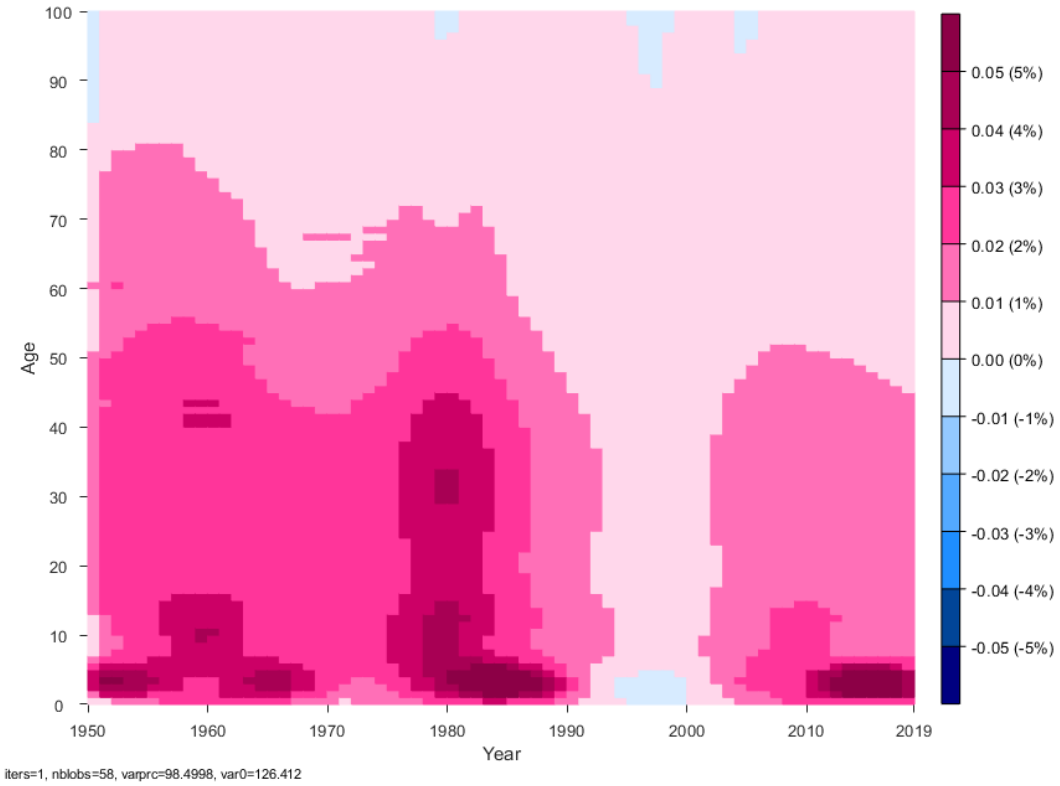
Females



iters=35, nblobs=177, varprc=0.470489, var0=93586.7

Mauritania

Males



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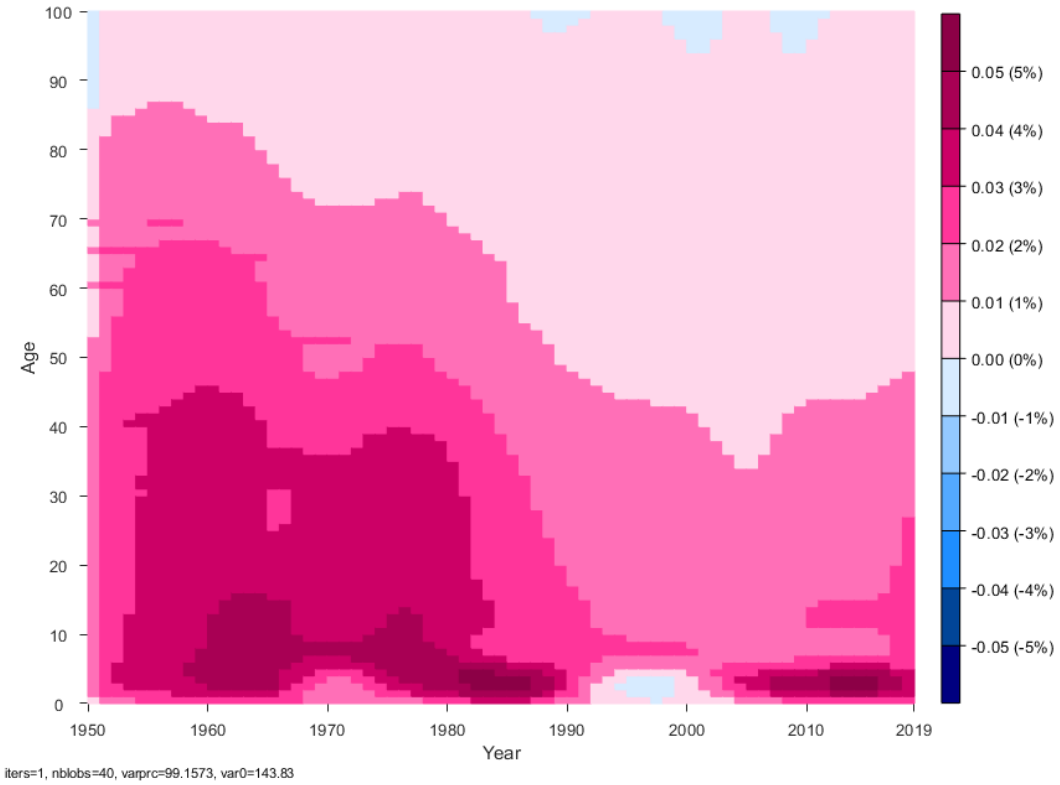
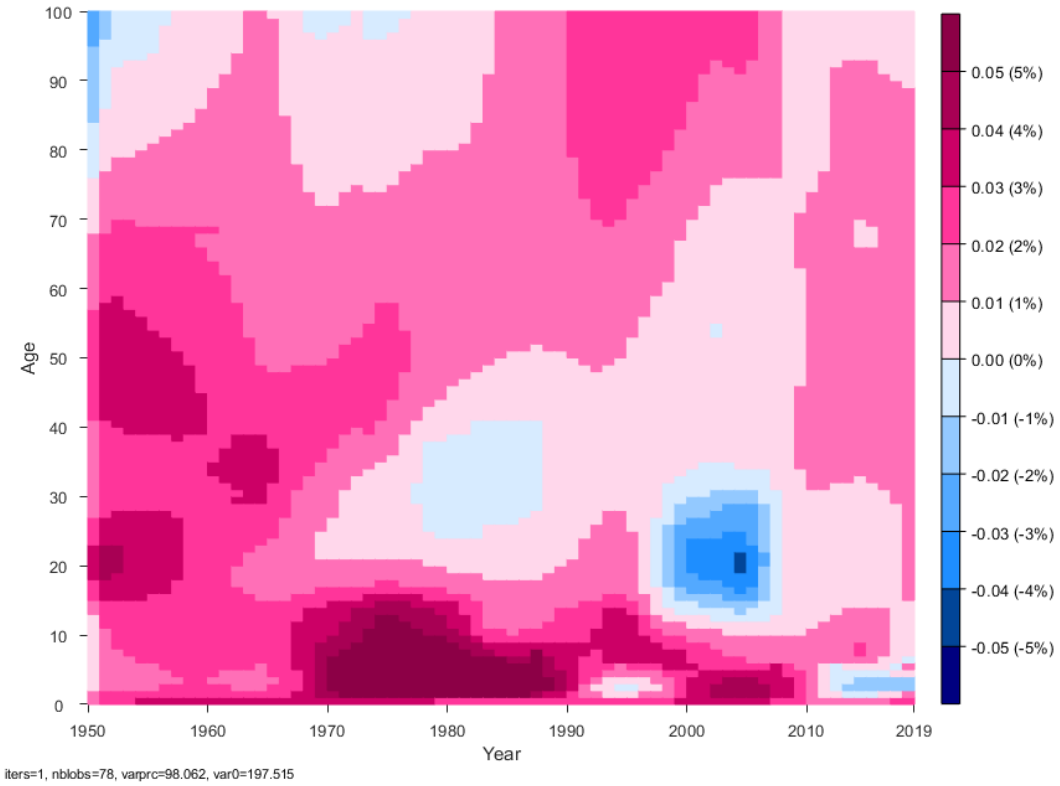
Females



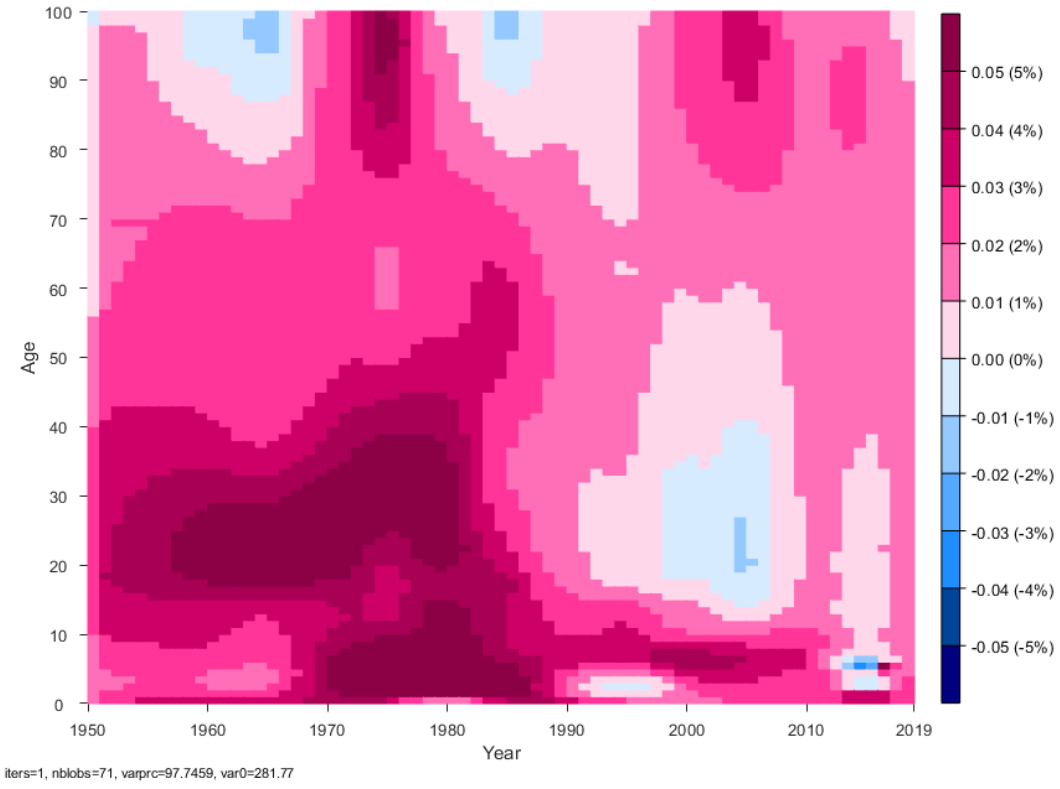
iters=1, nblobs=40, varprc=99.1573, var0=143.83

Panama

Males

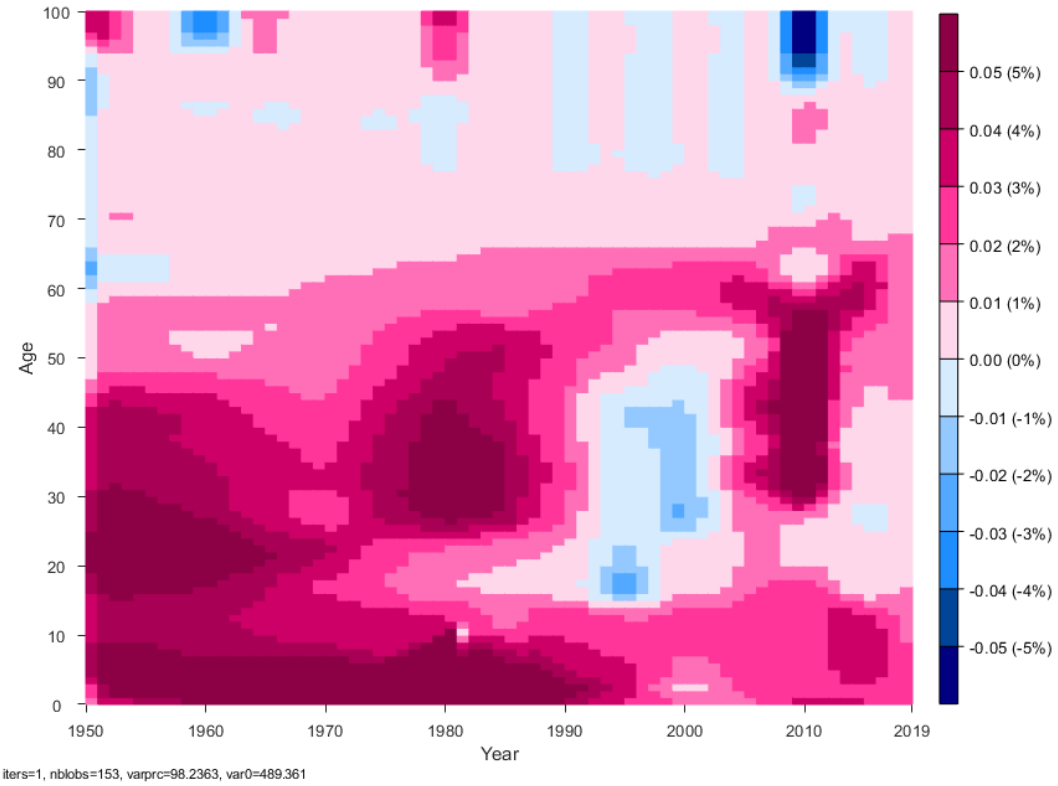


Females



Kuwait

Males



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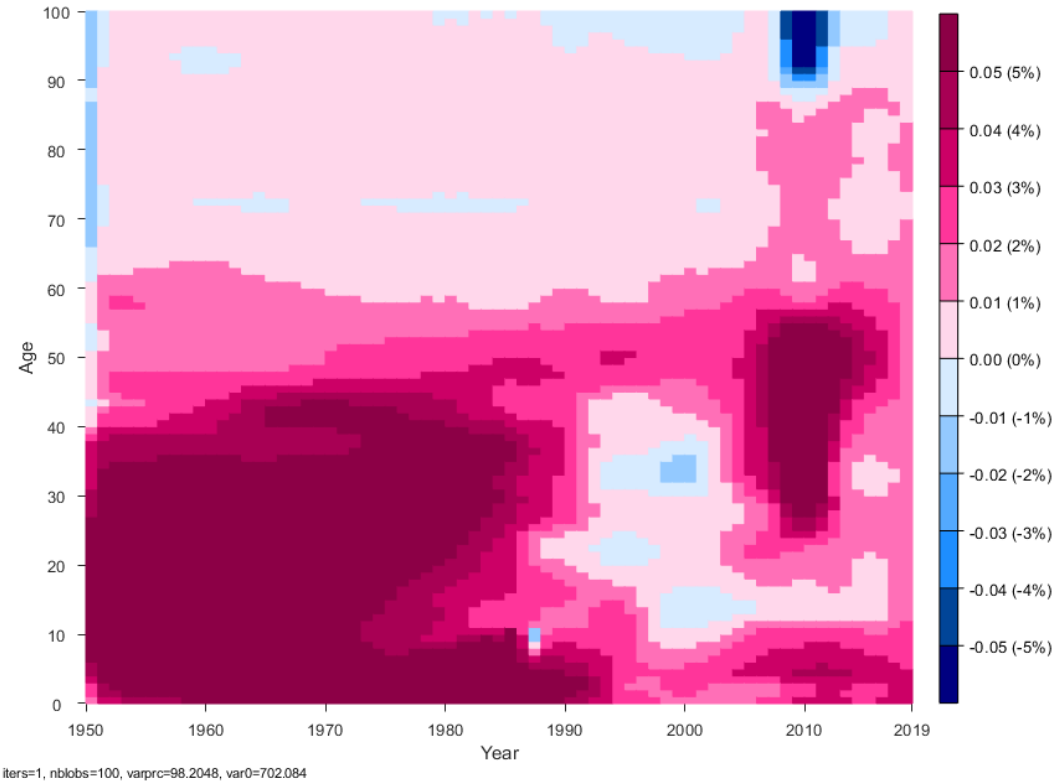
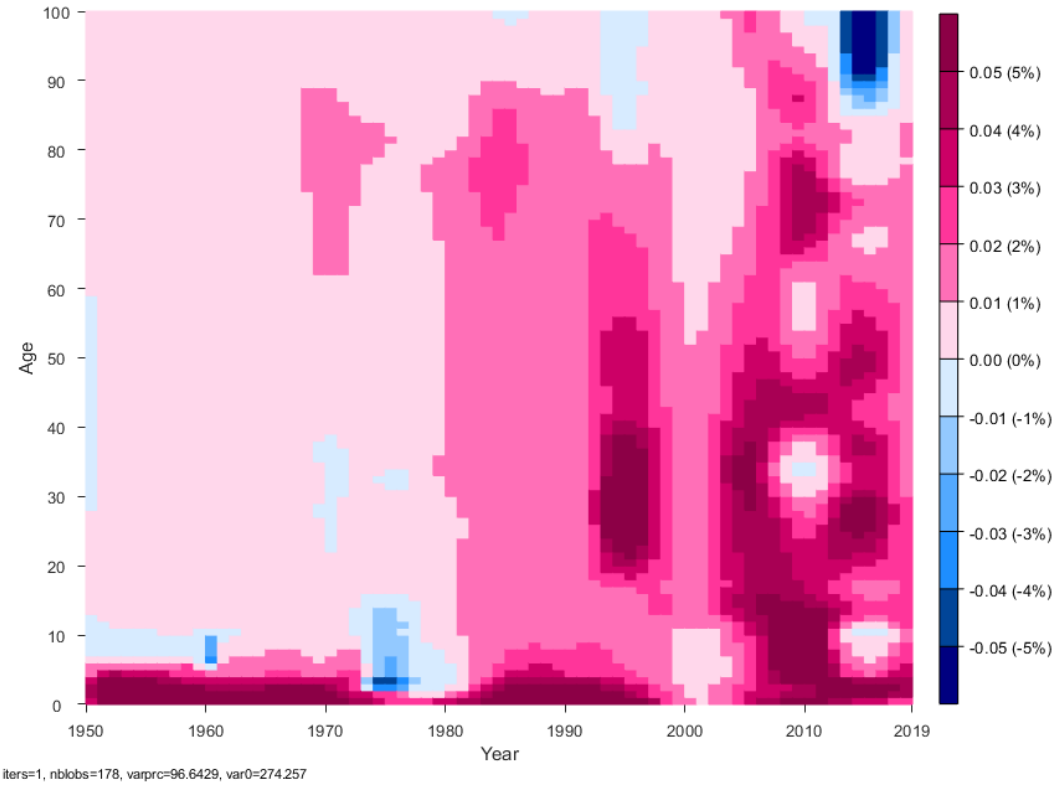
Females



iters=1, nblobs=100, varprc=98.2048, var0=702.084

Croatia

Males



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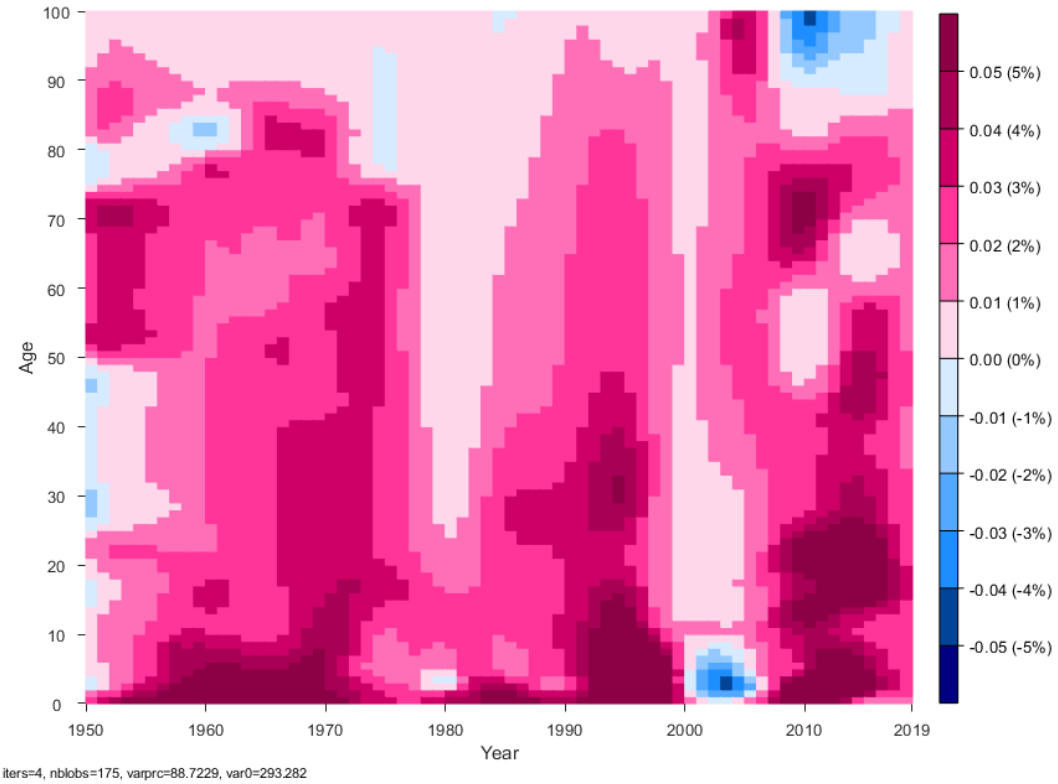
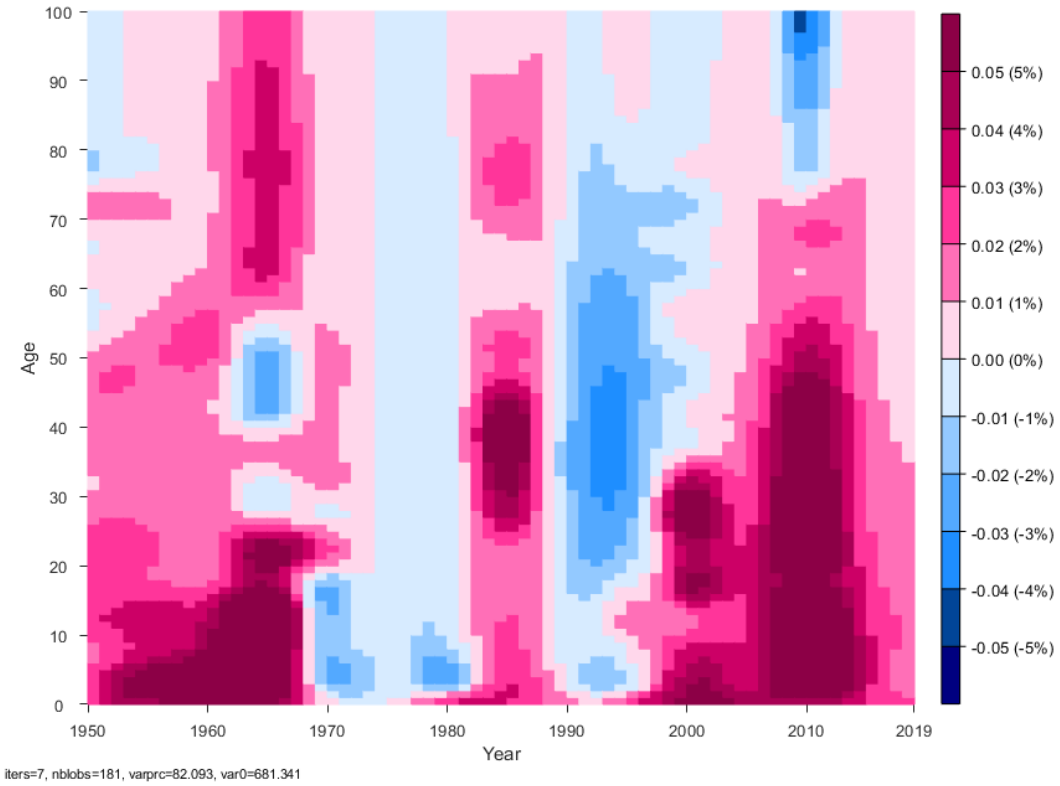
Females



iters=4, nblobs=175, varprc=88.7229, var0=293.282

Republic of Moldova

Males



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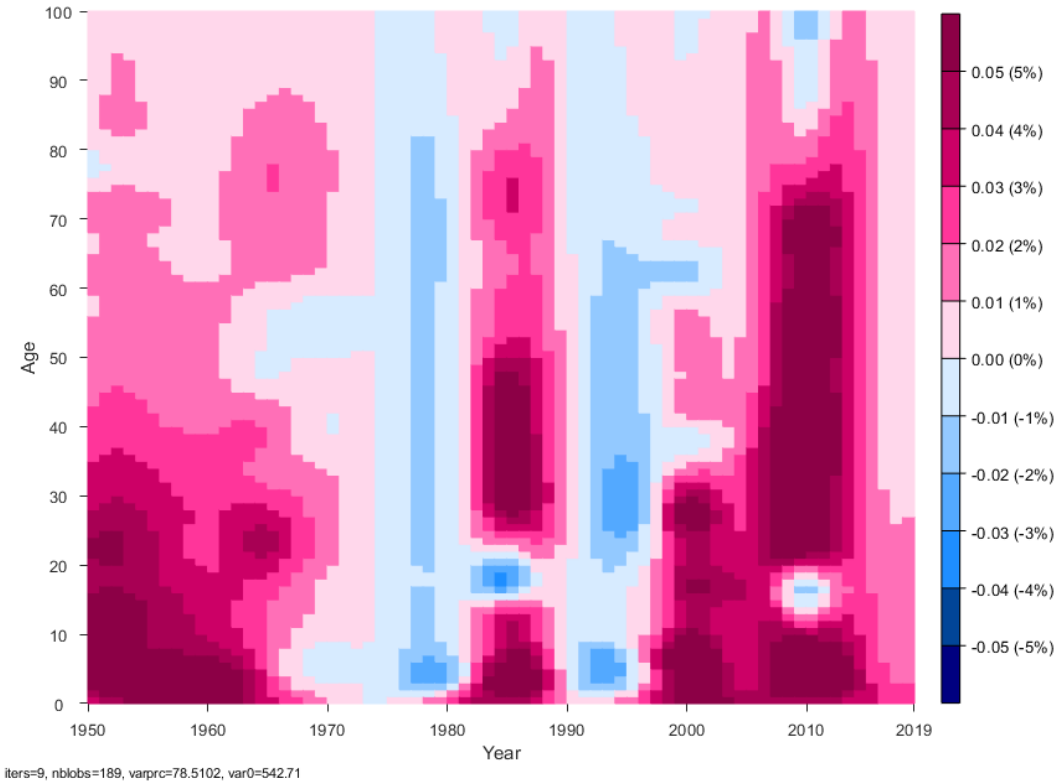
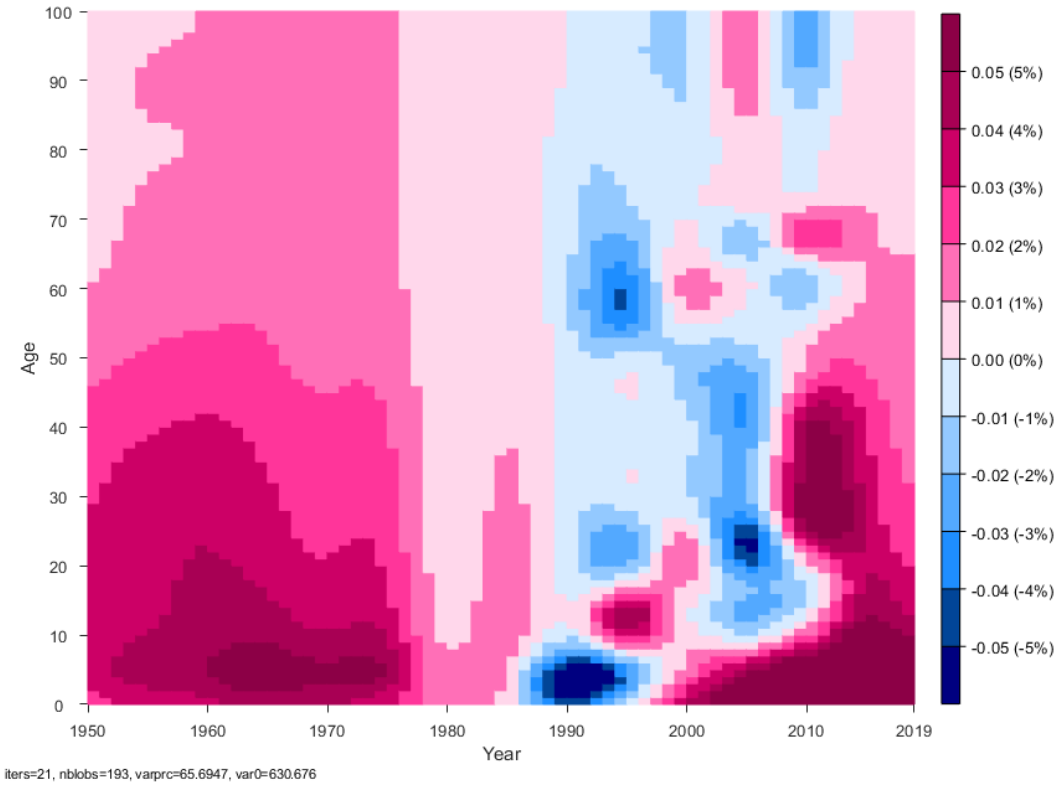
Females



iters=9, nblobs=189, varprc=78.5102, var0=542.71

Georgia

Males



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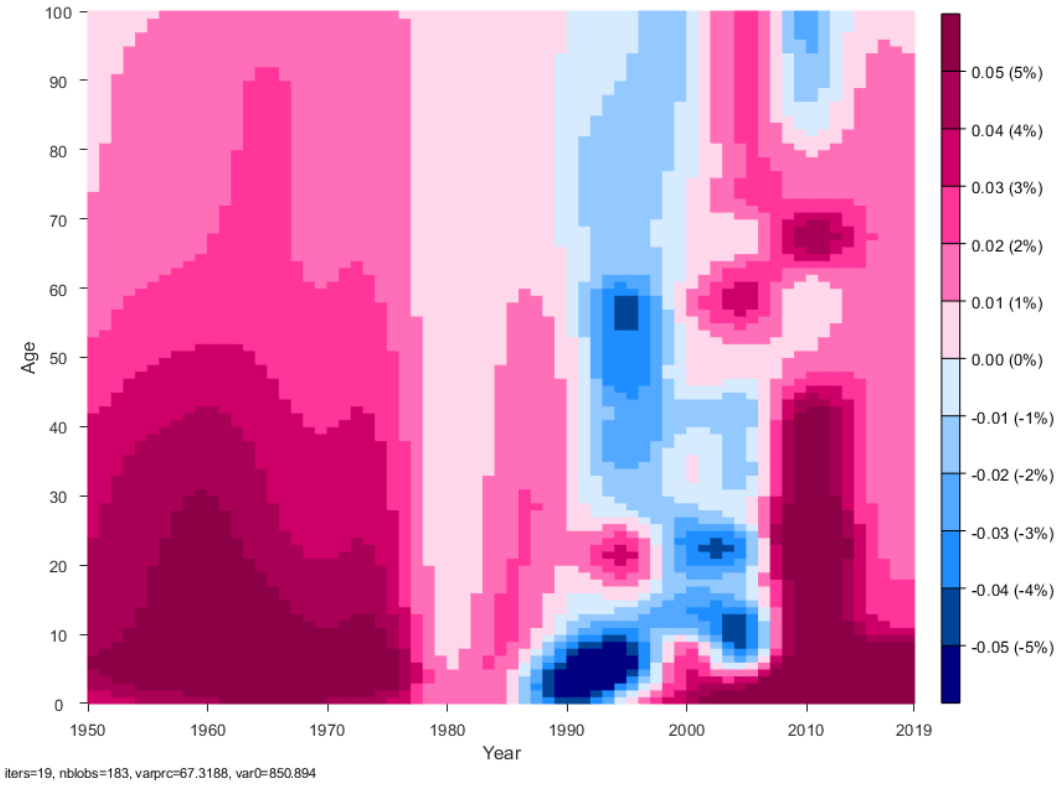
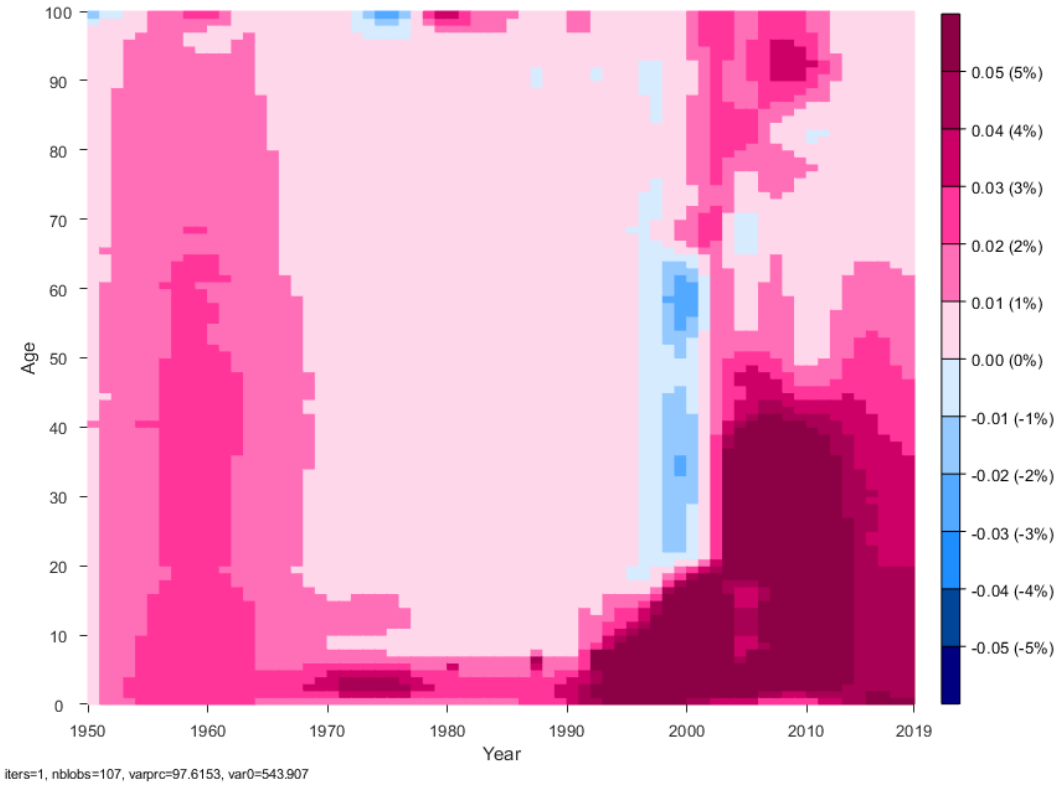
Females



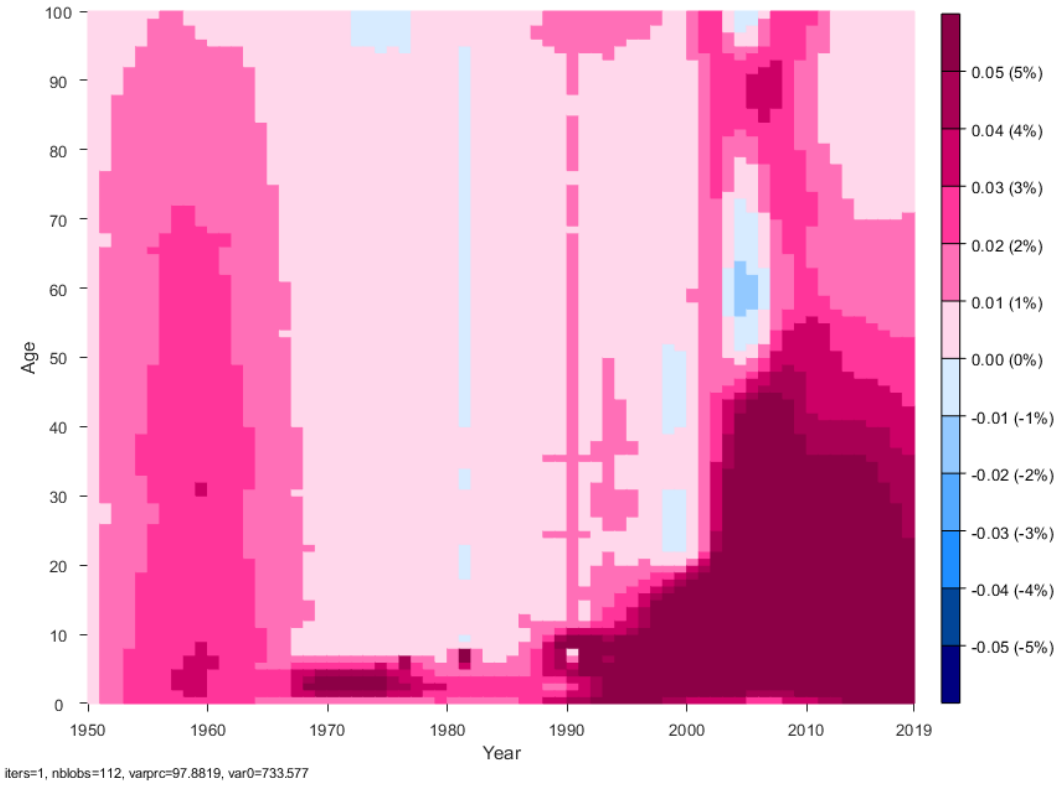
iters=19, nblobs=183, varprc=67.3188, var0=850.894

Eritrea

Males

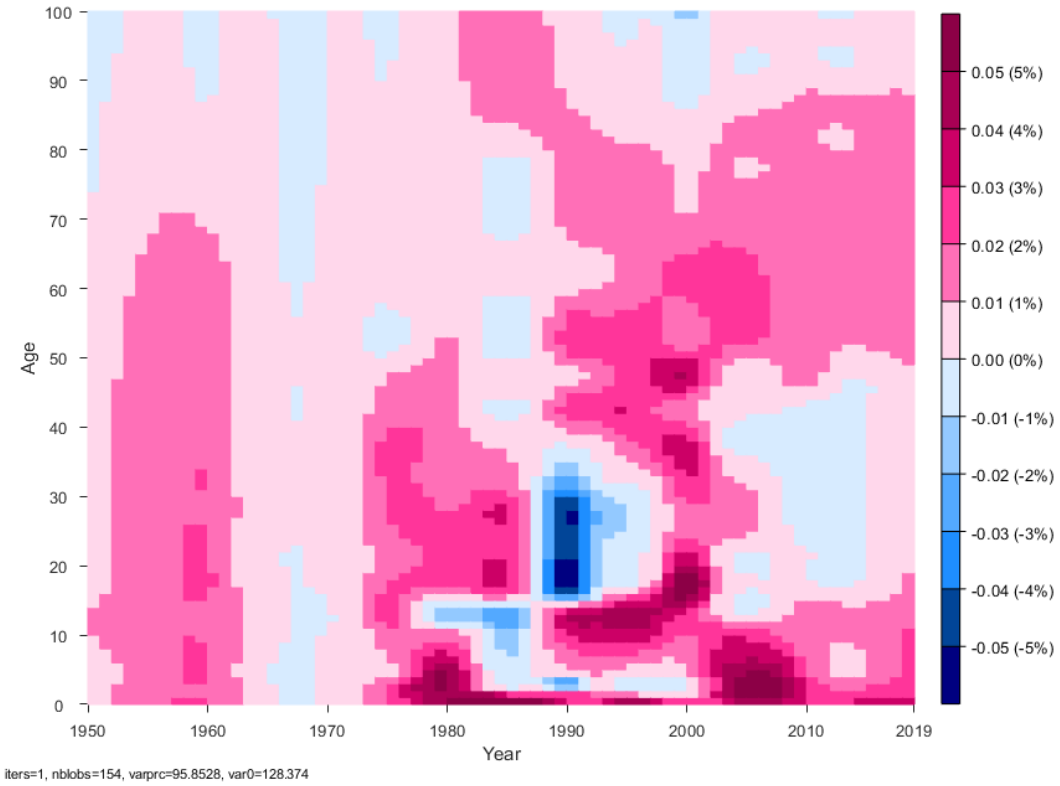


Females

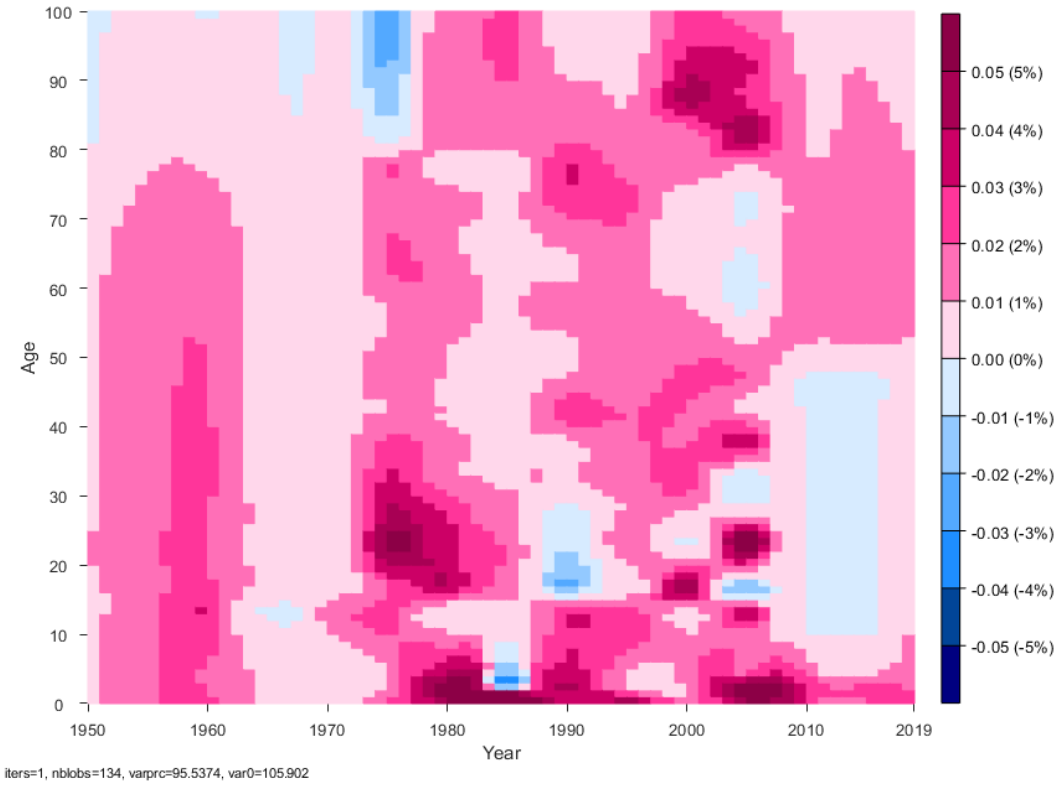


Uruguay

Males

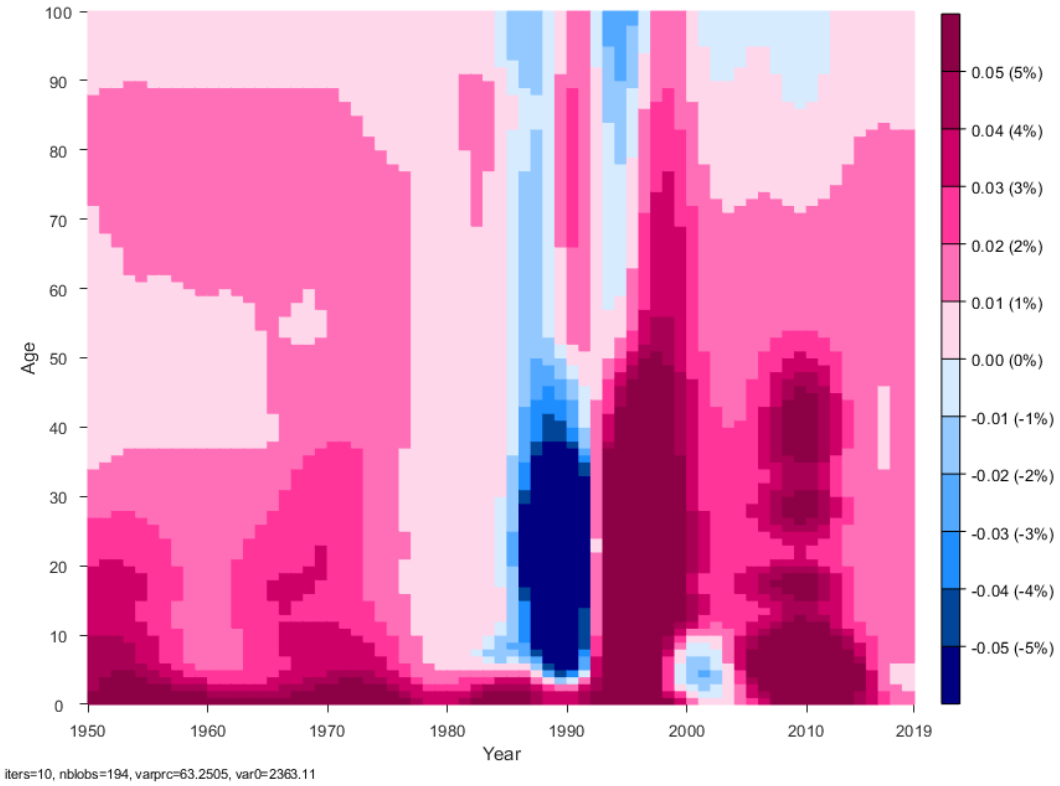


Females

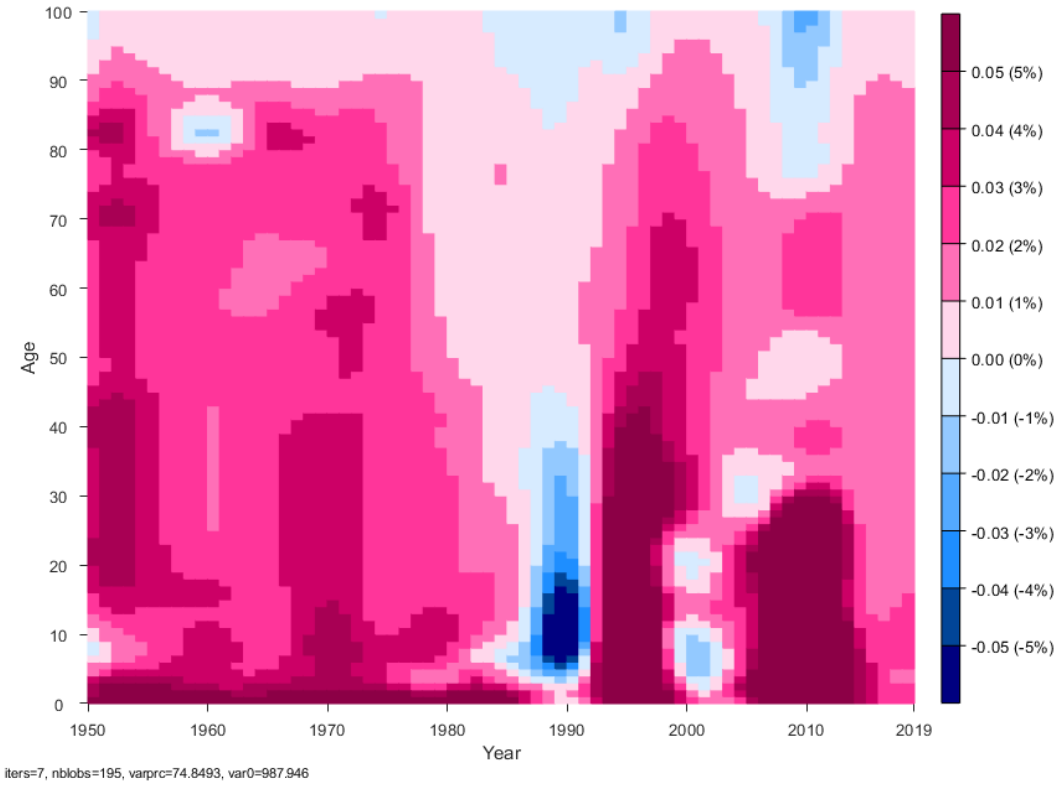


Bosnia and Herzegovina

Males

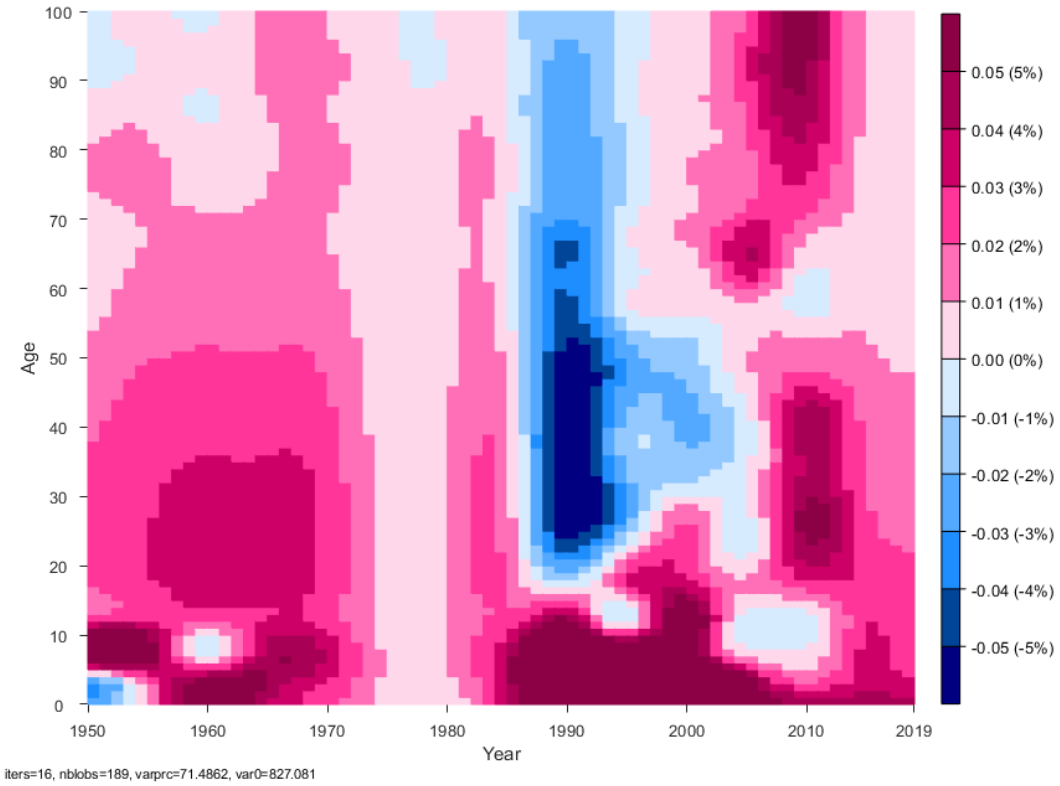


Females

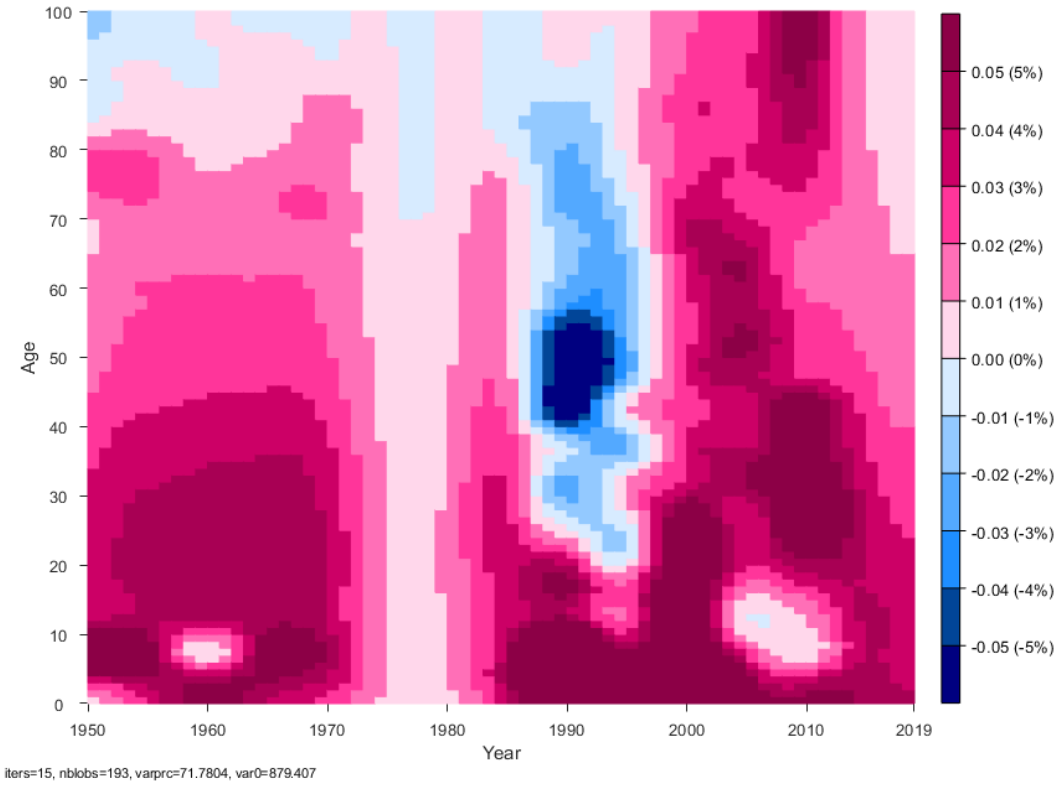


Mongolia

Males

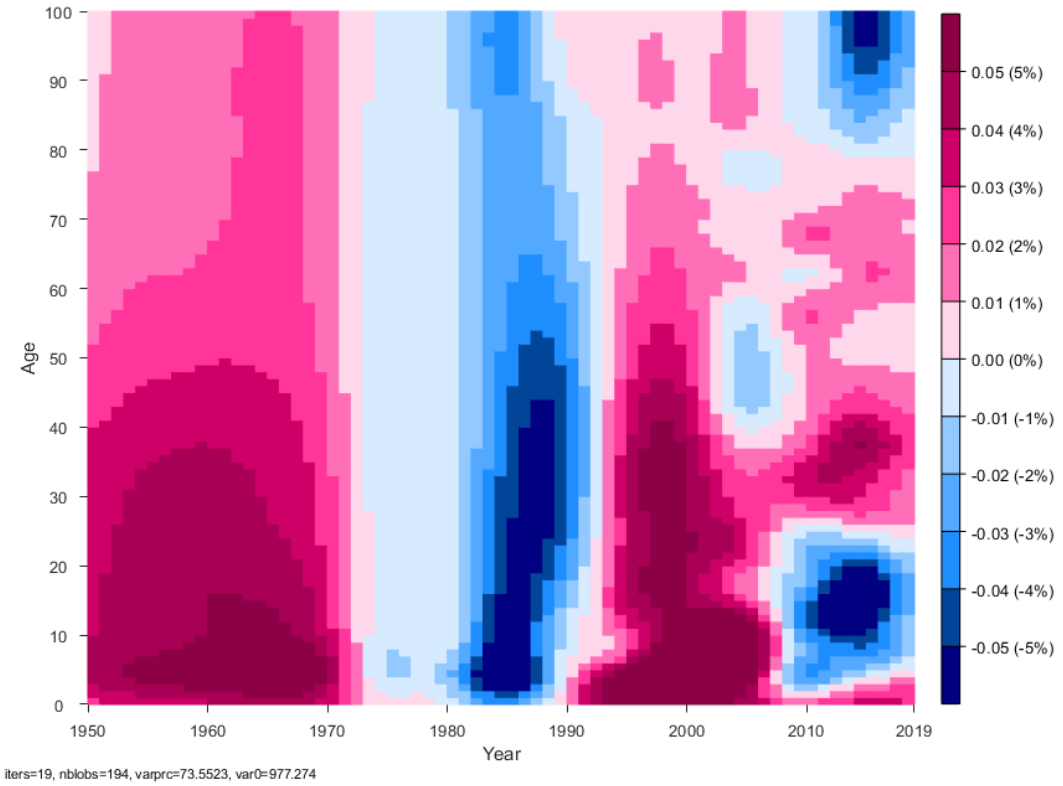


Females



Armenia

Males



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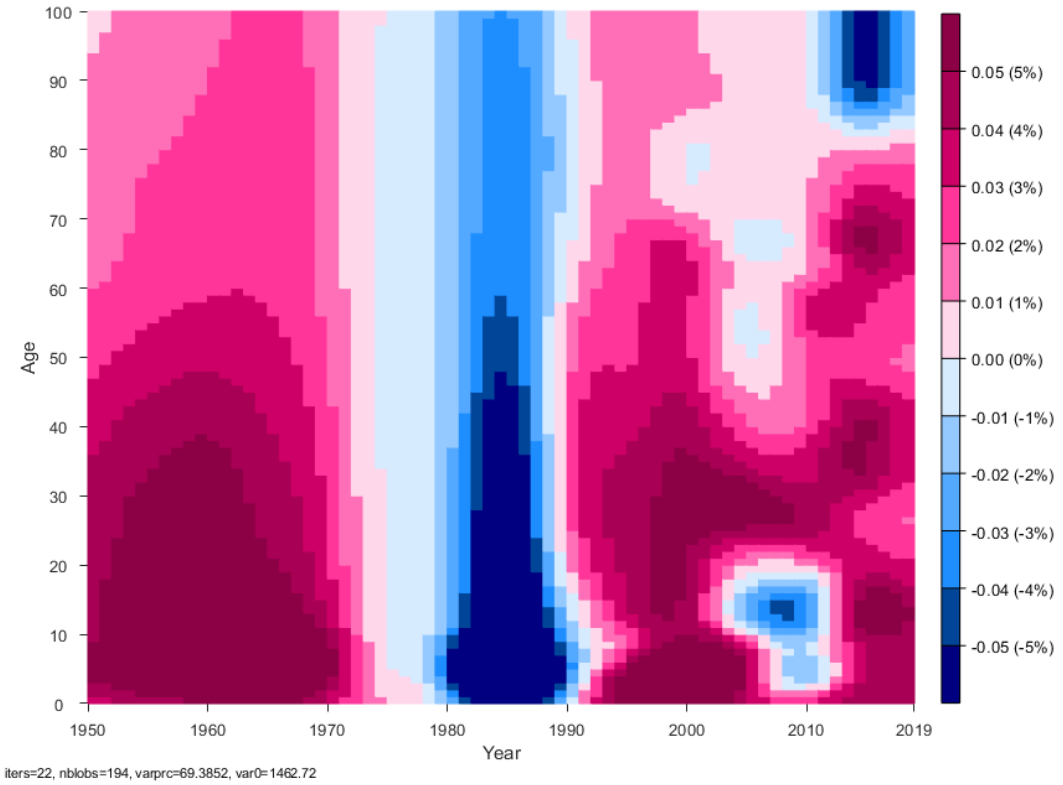
Females



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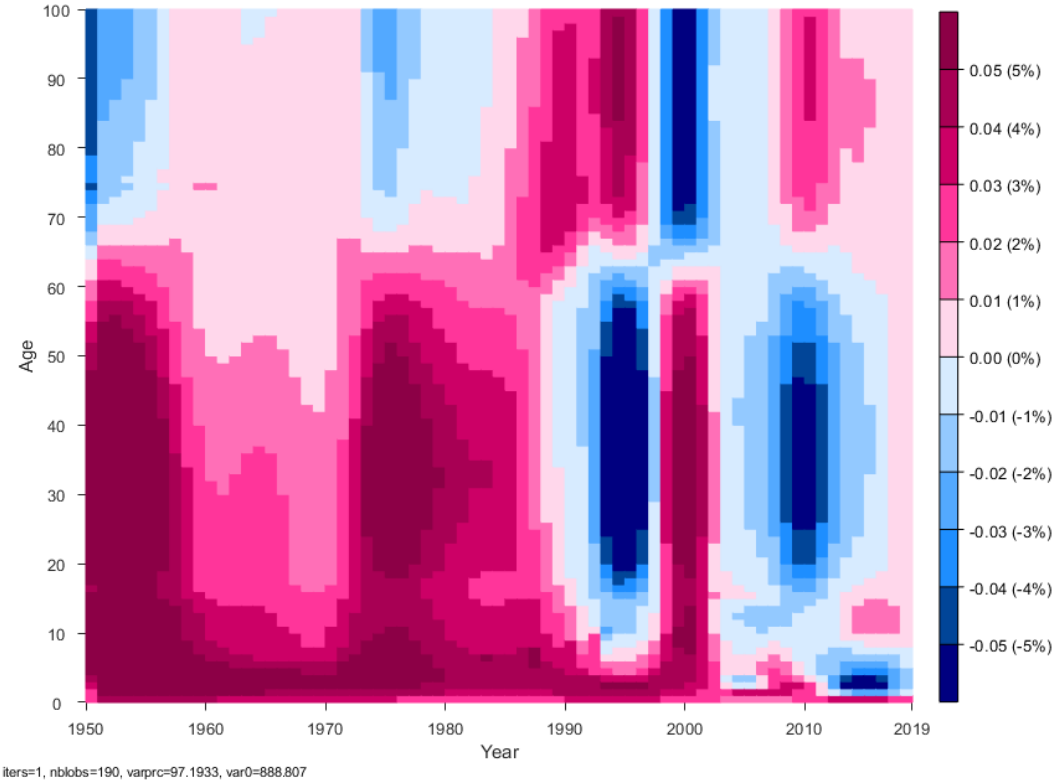
Jamaica

Males



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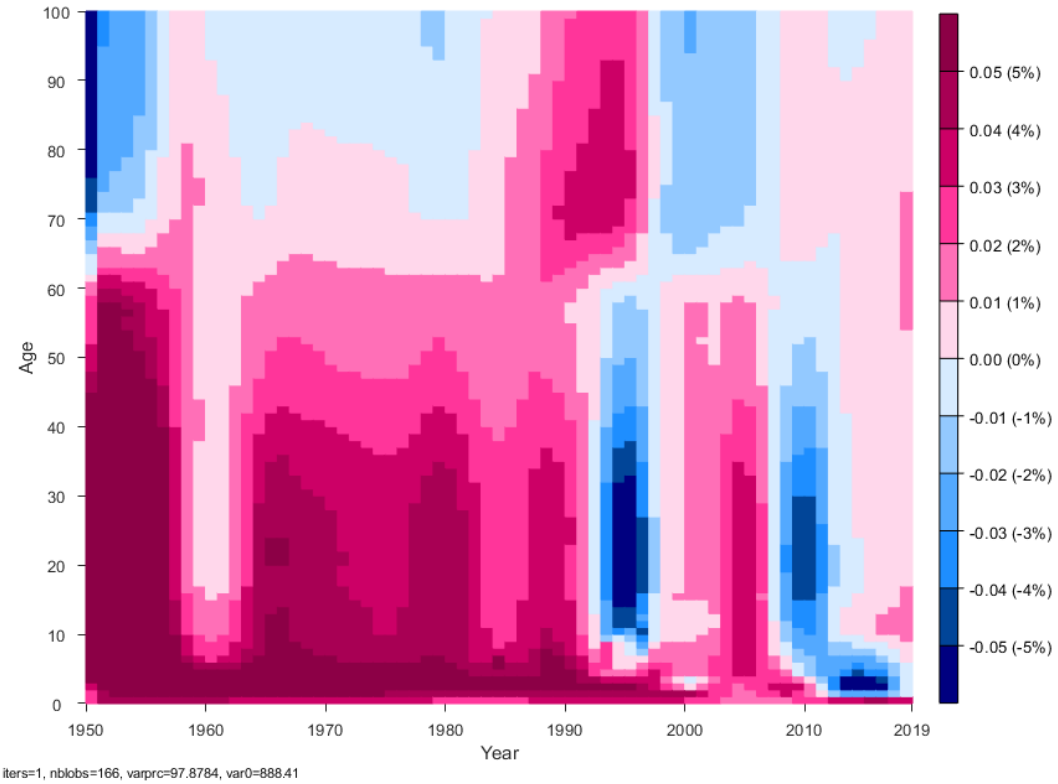
Females



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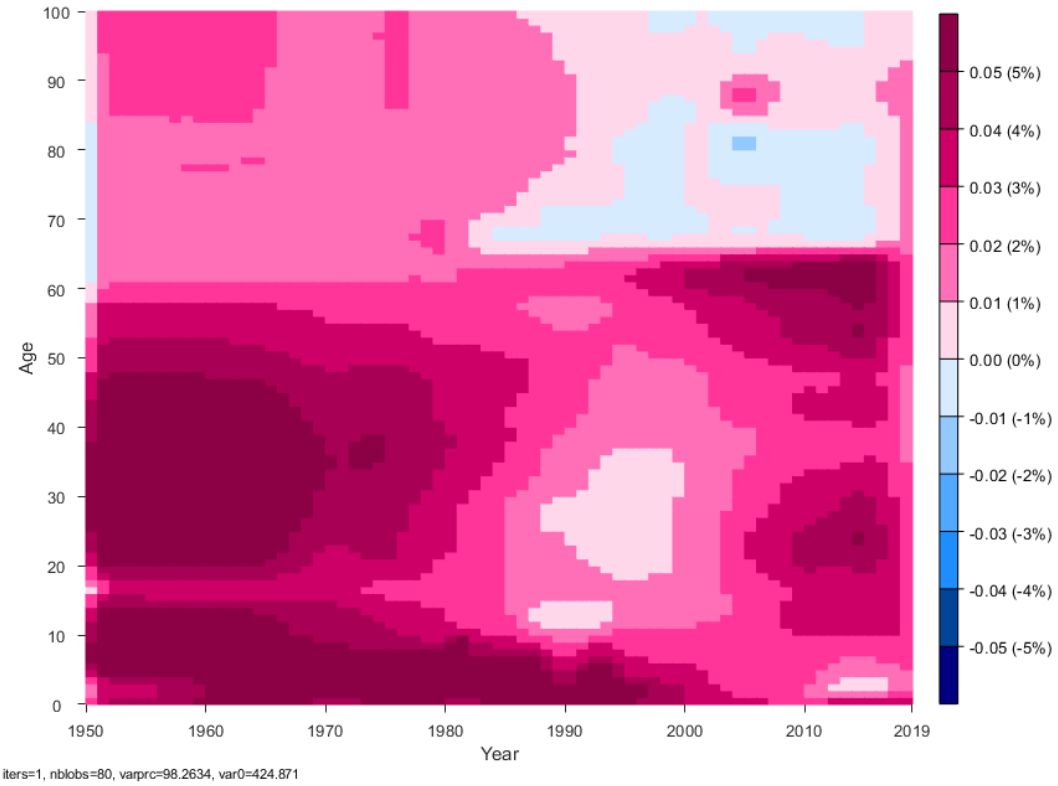
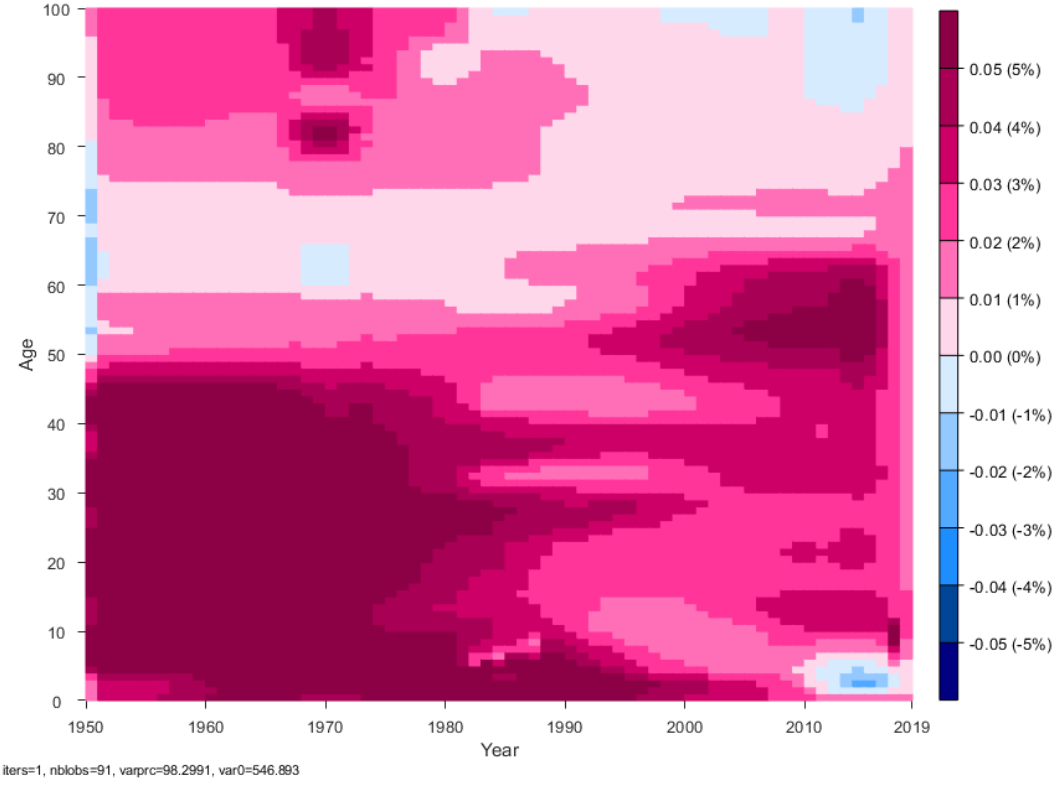
Qatar

Males

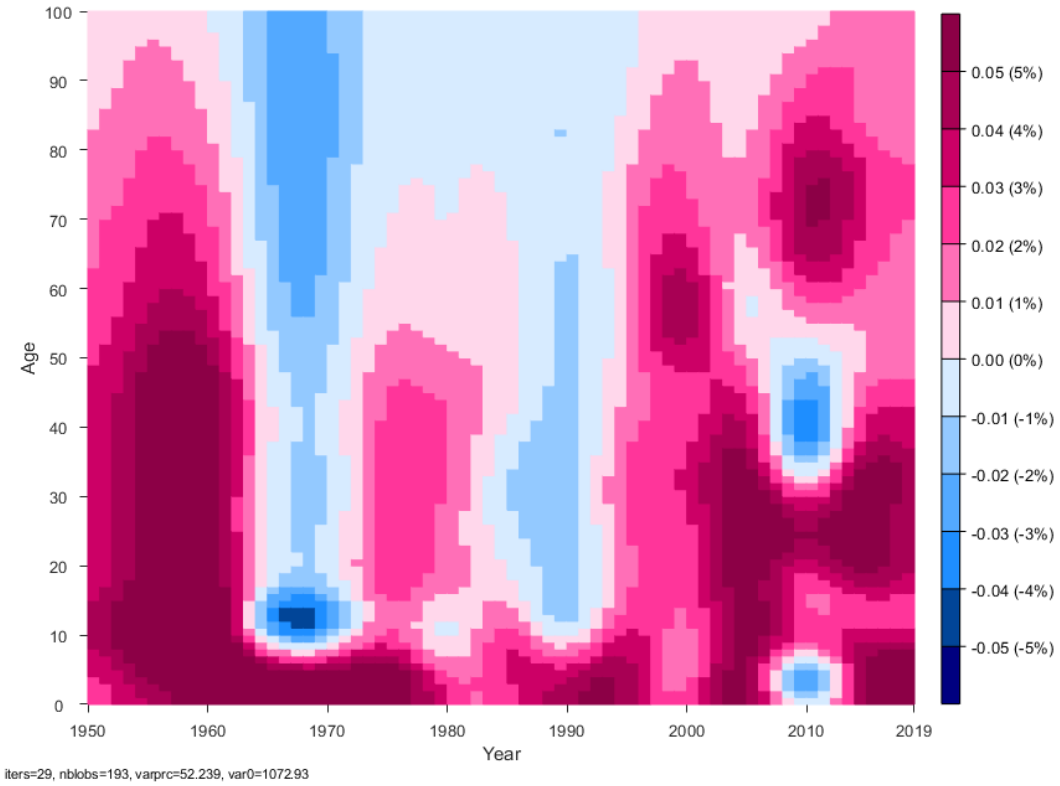


Females



Albania

Males



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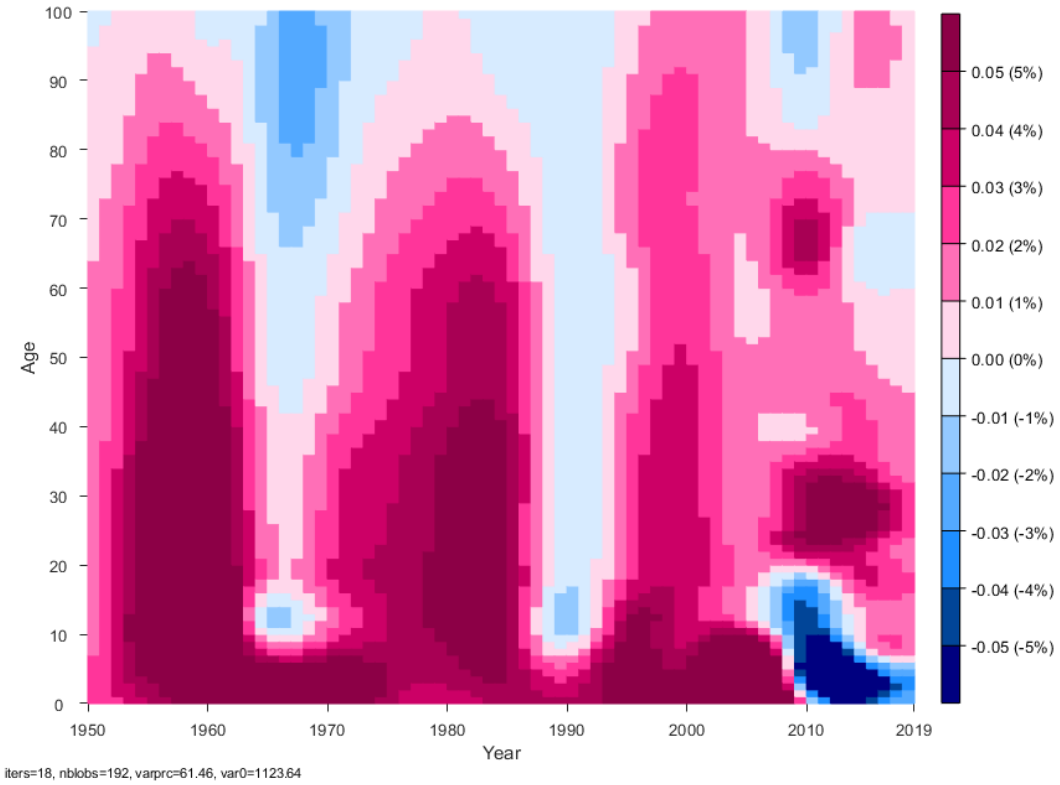
Females



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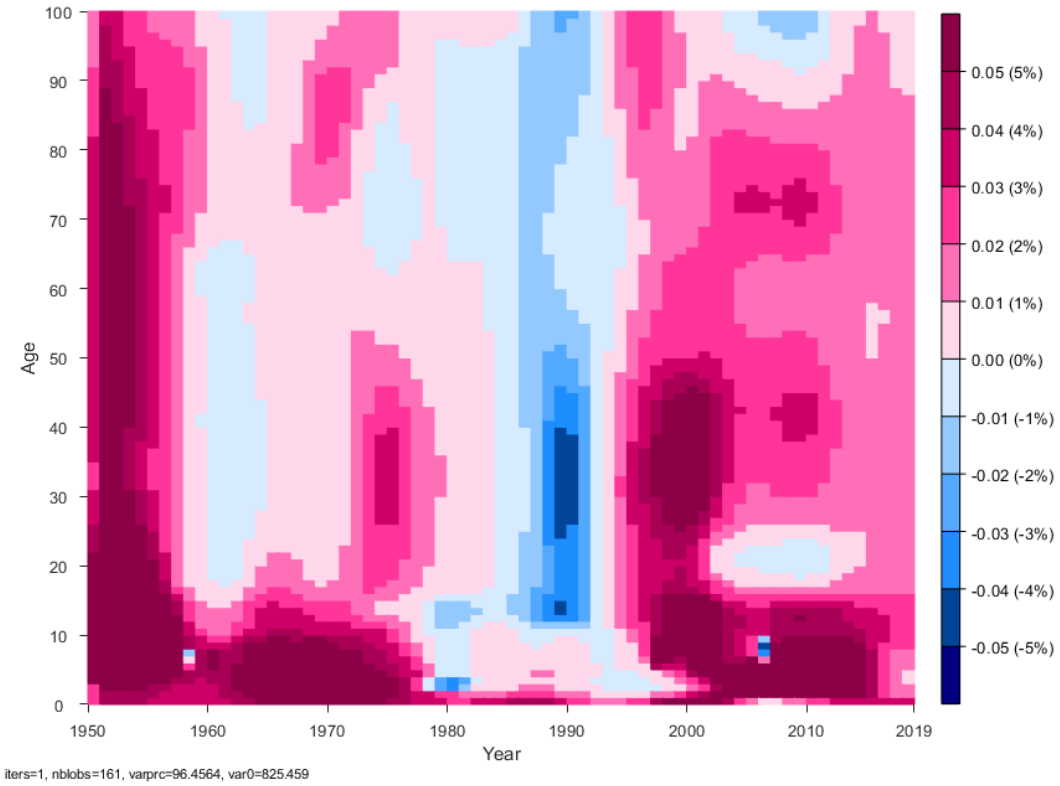
Puerto Rico

Males



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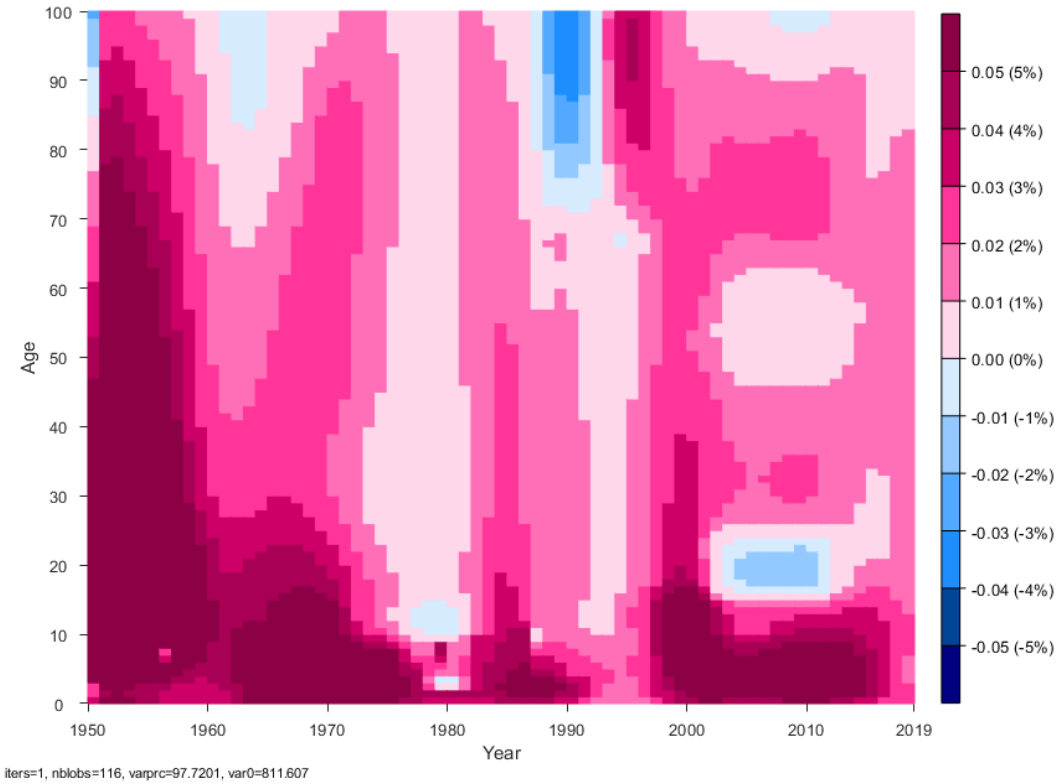
Females



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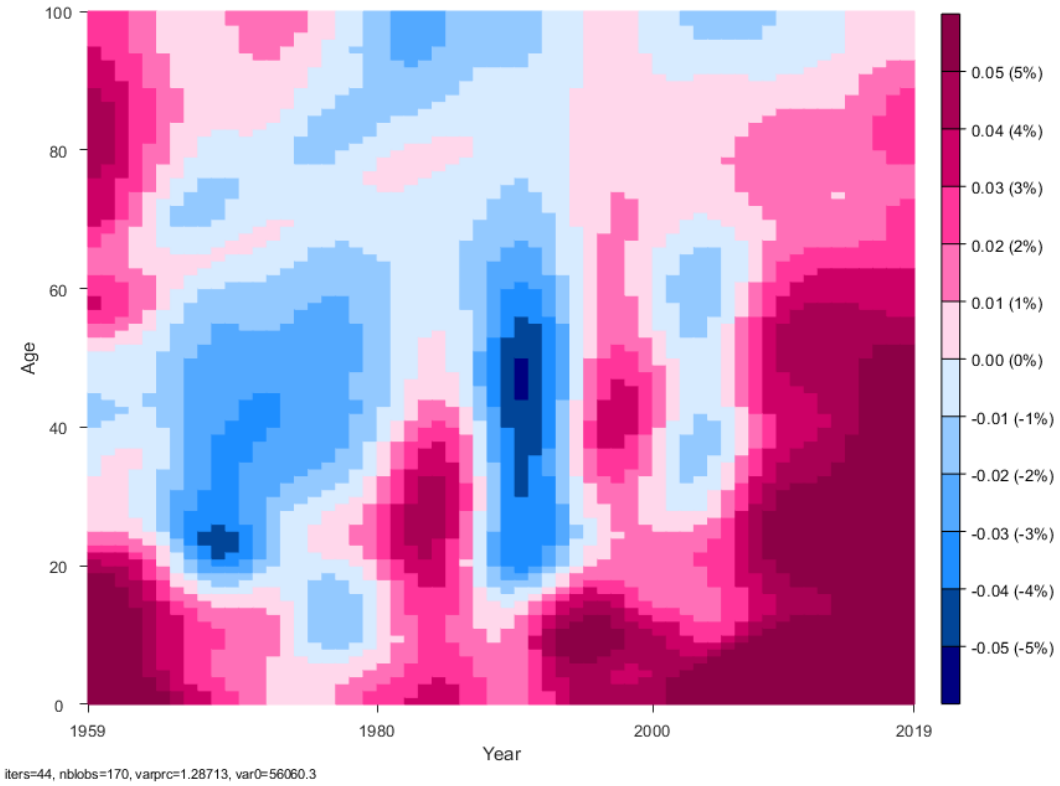
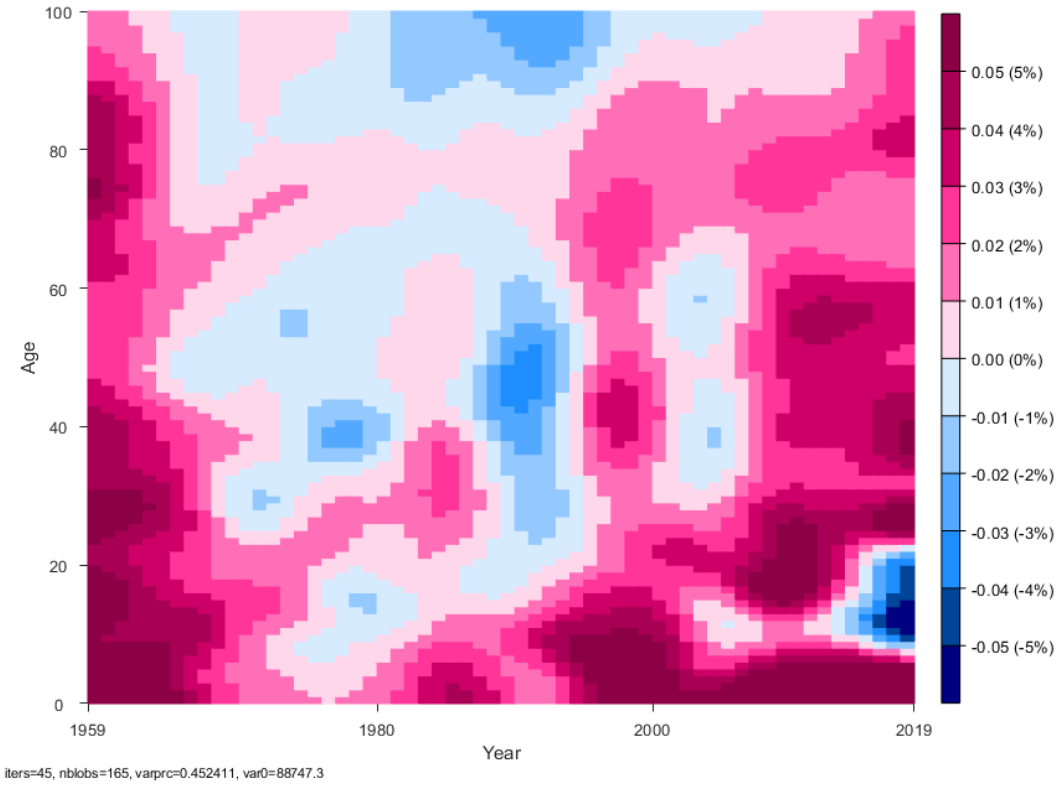
Lithuania

Males

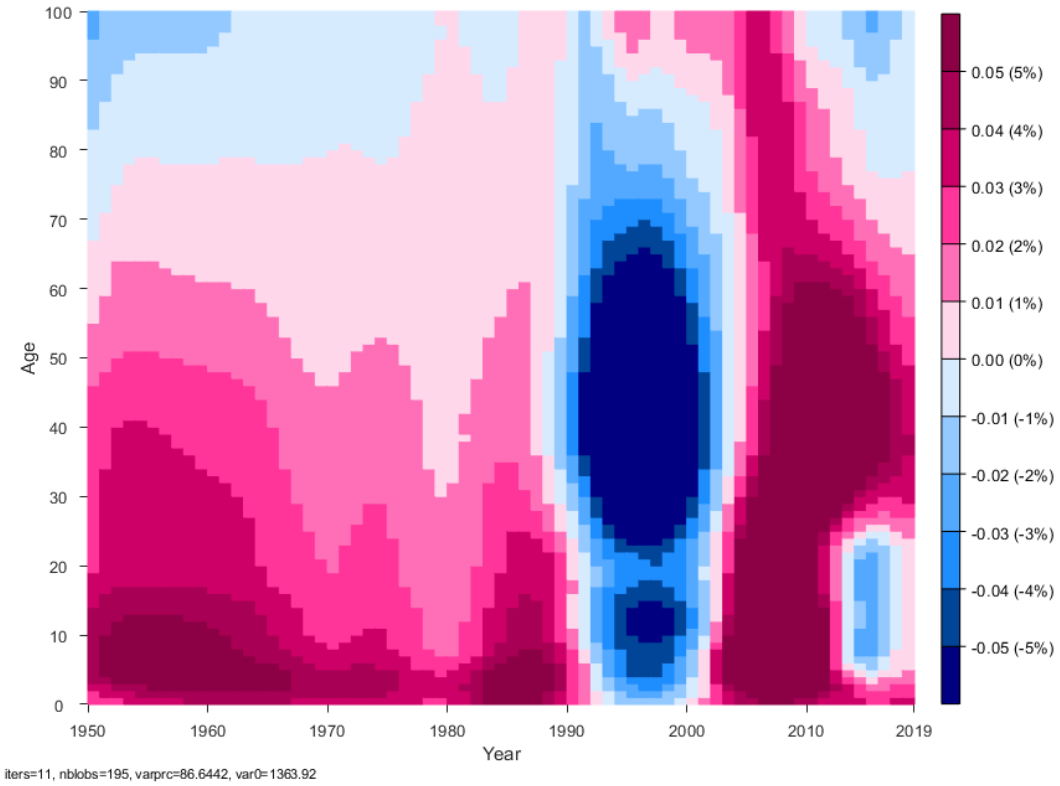


Females

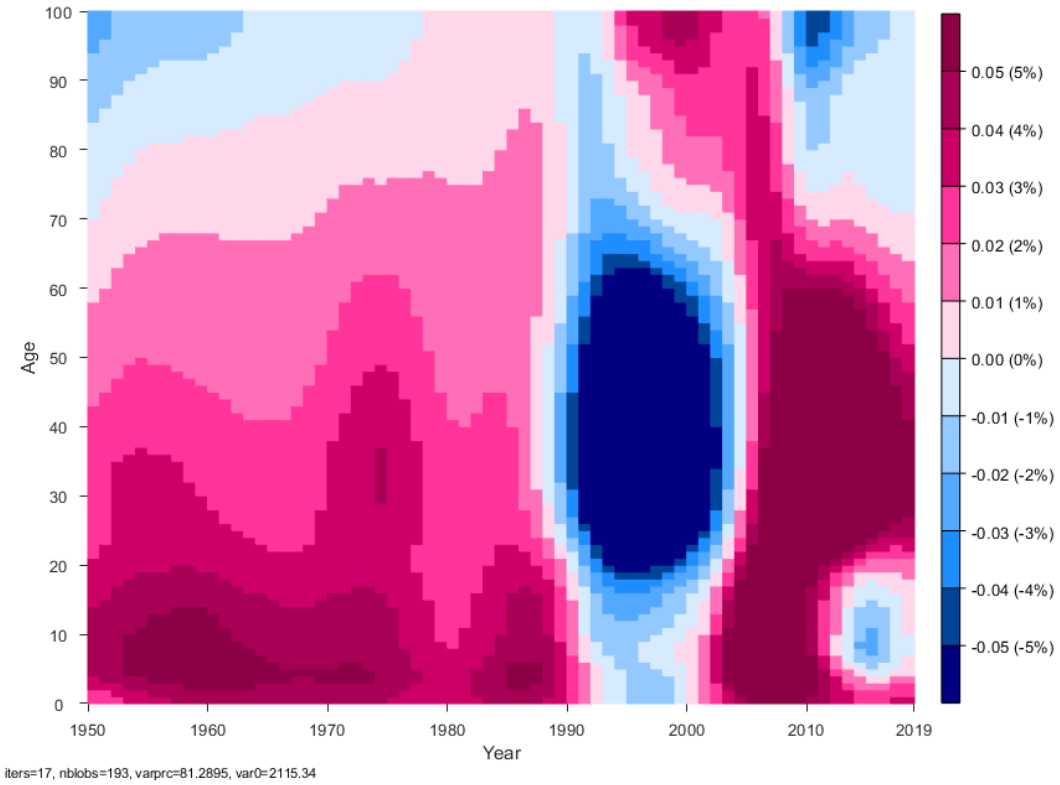


Namibia

Males



Females



Gambia

Males

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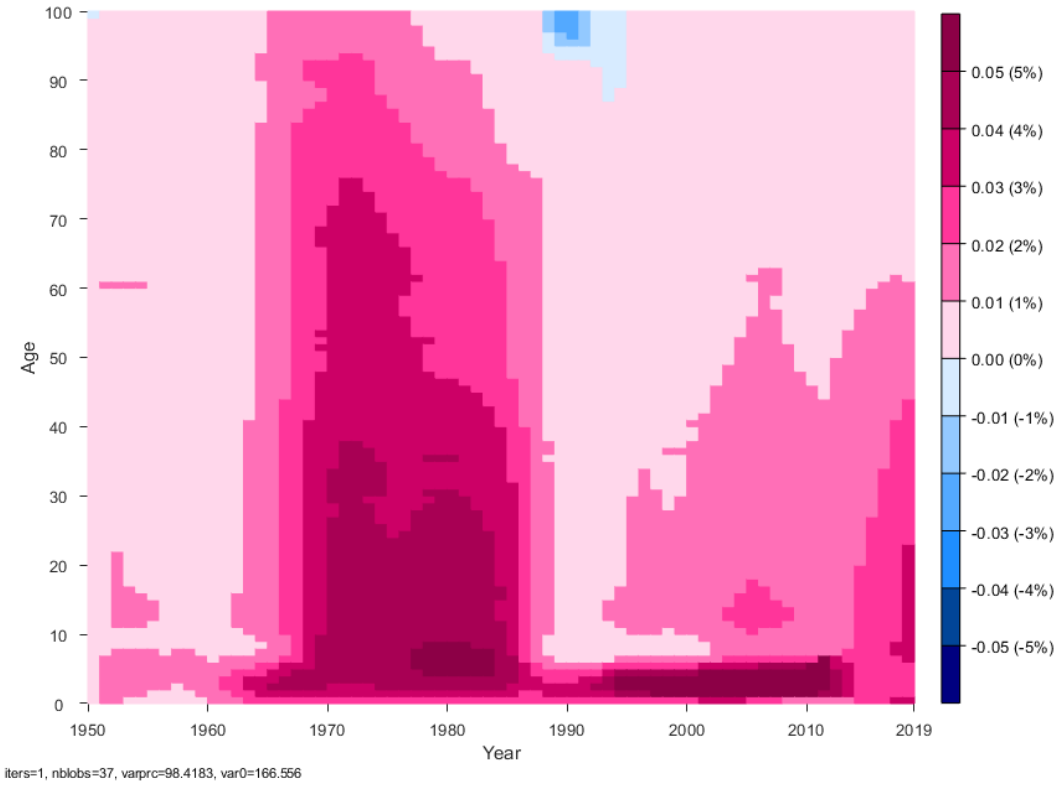
Females



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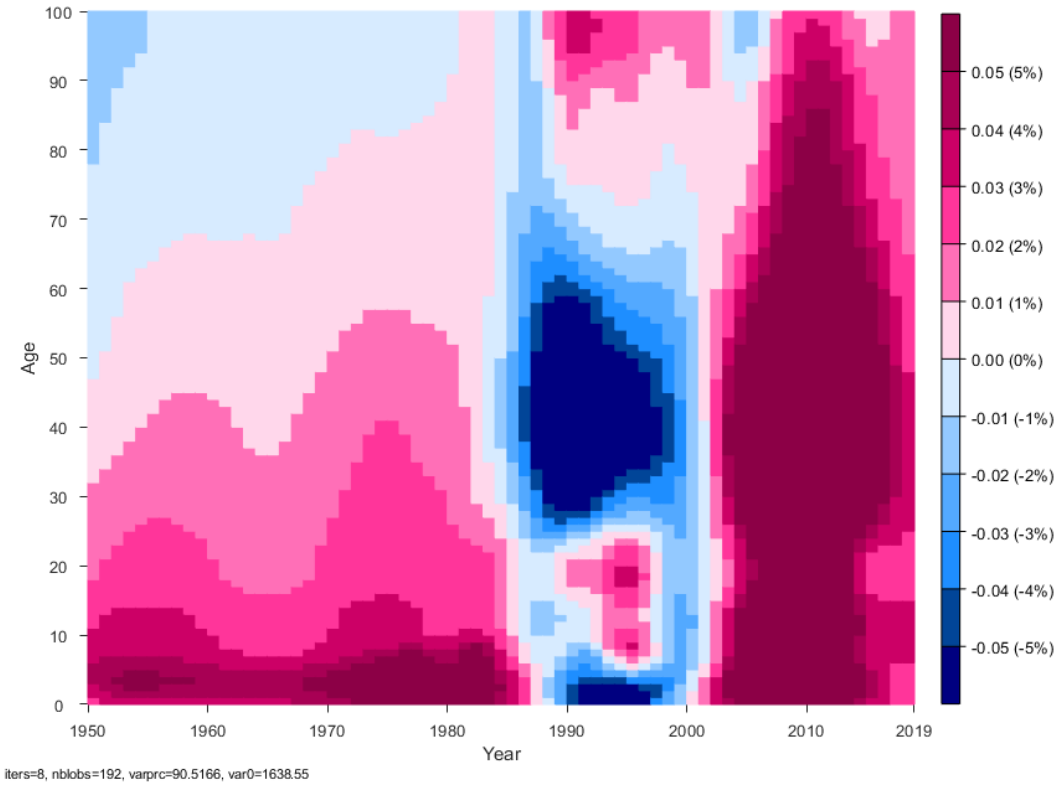
Botswana

Males



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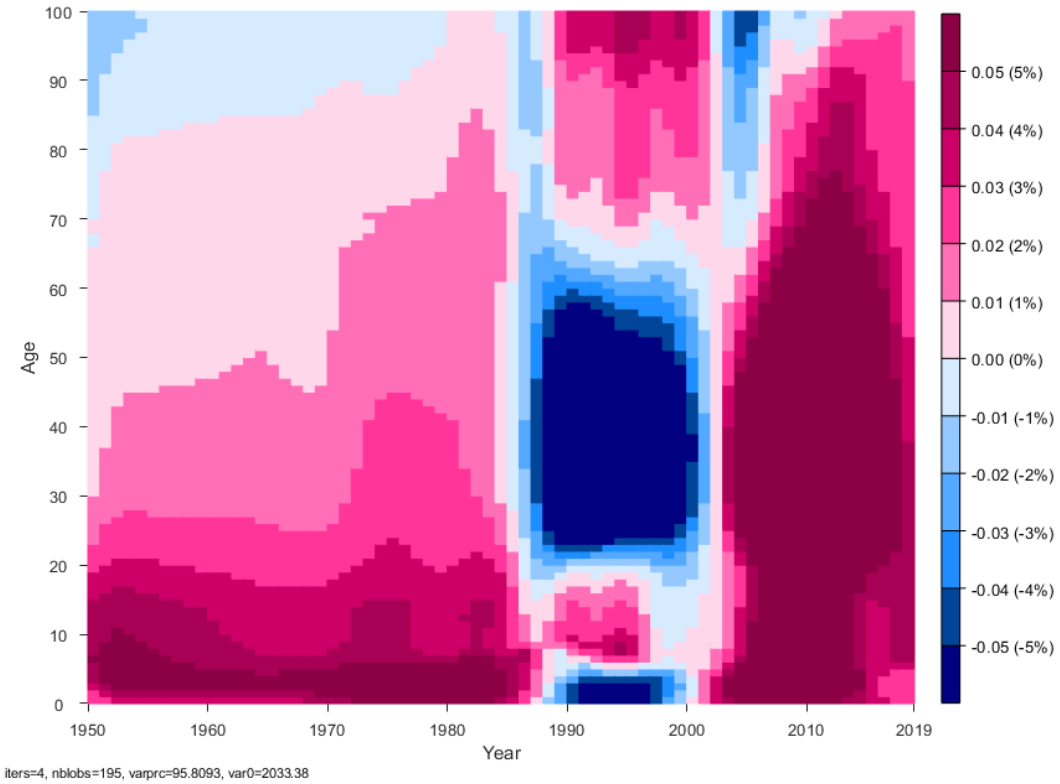
Females



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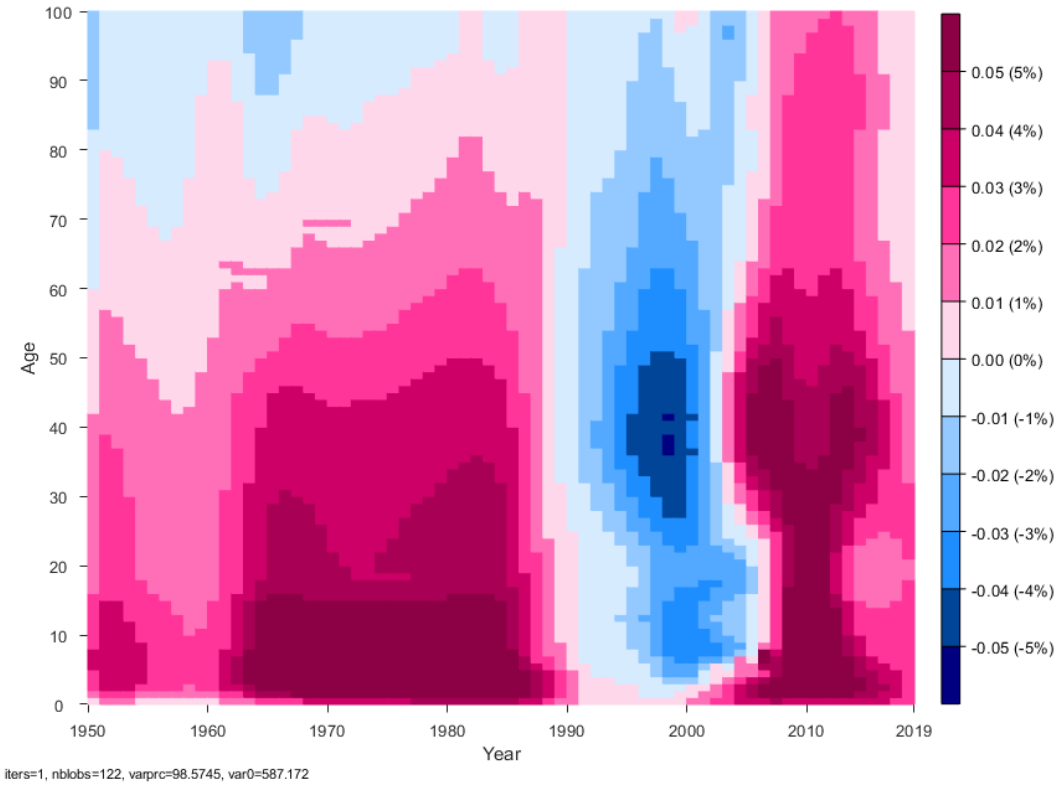
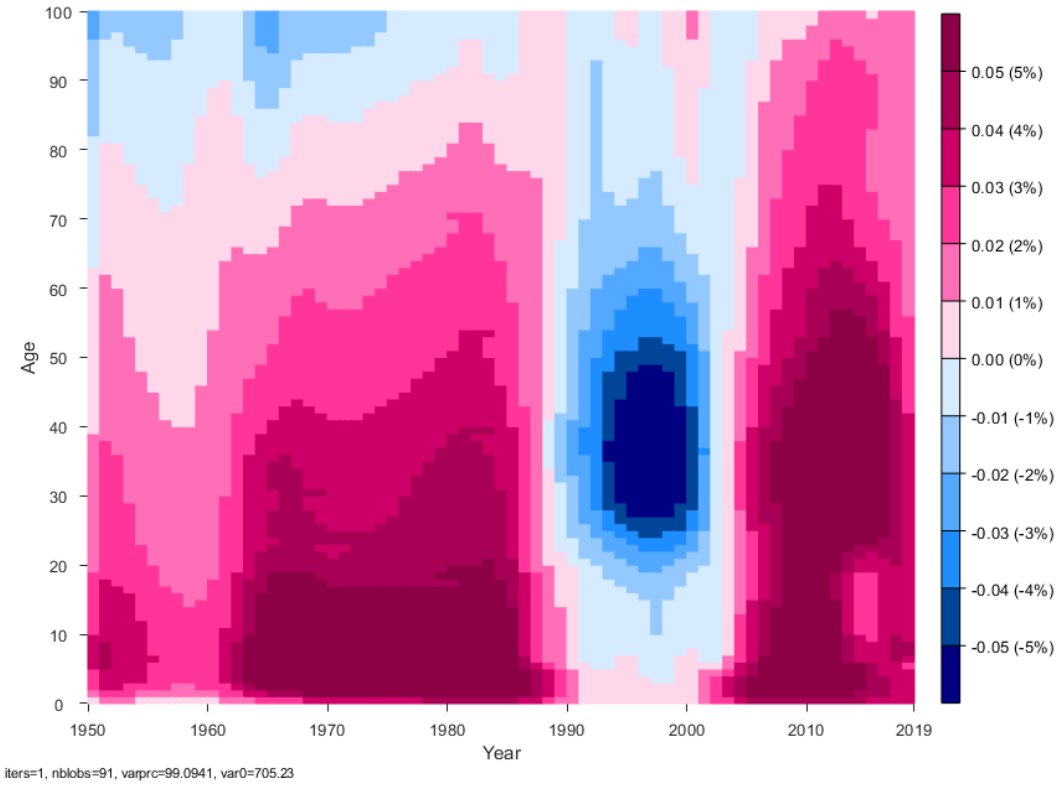
Gabon

Males

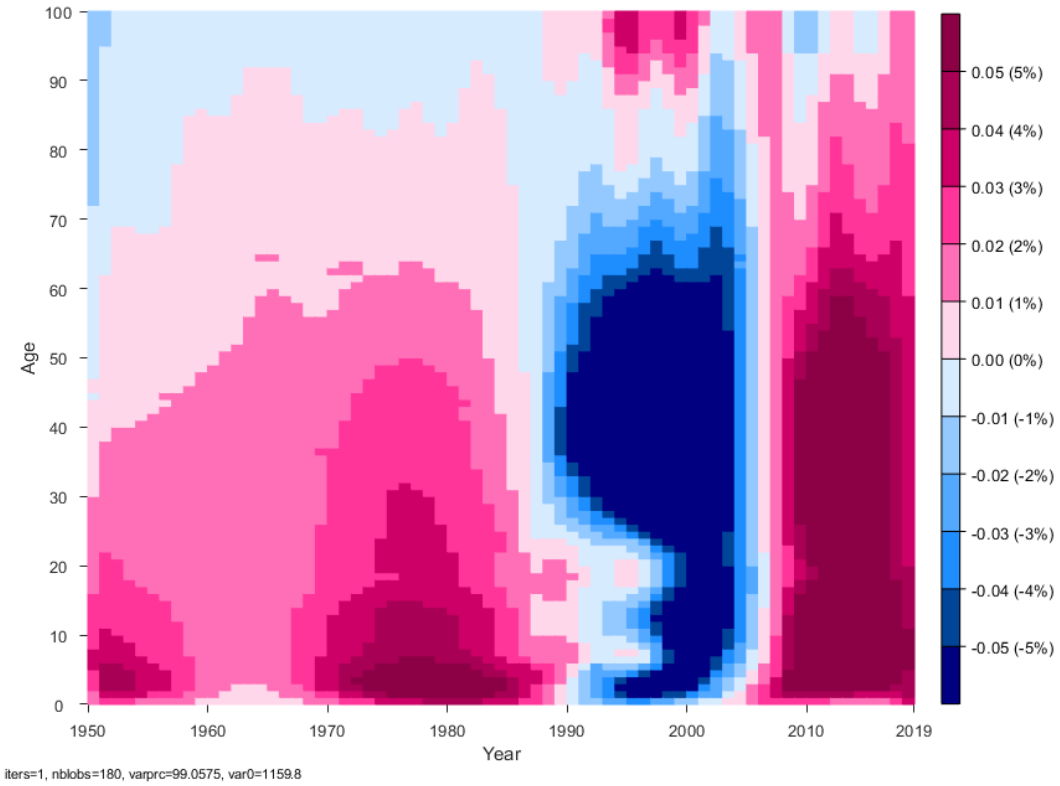


Females



Lesotho

Males



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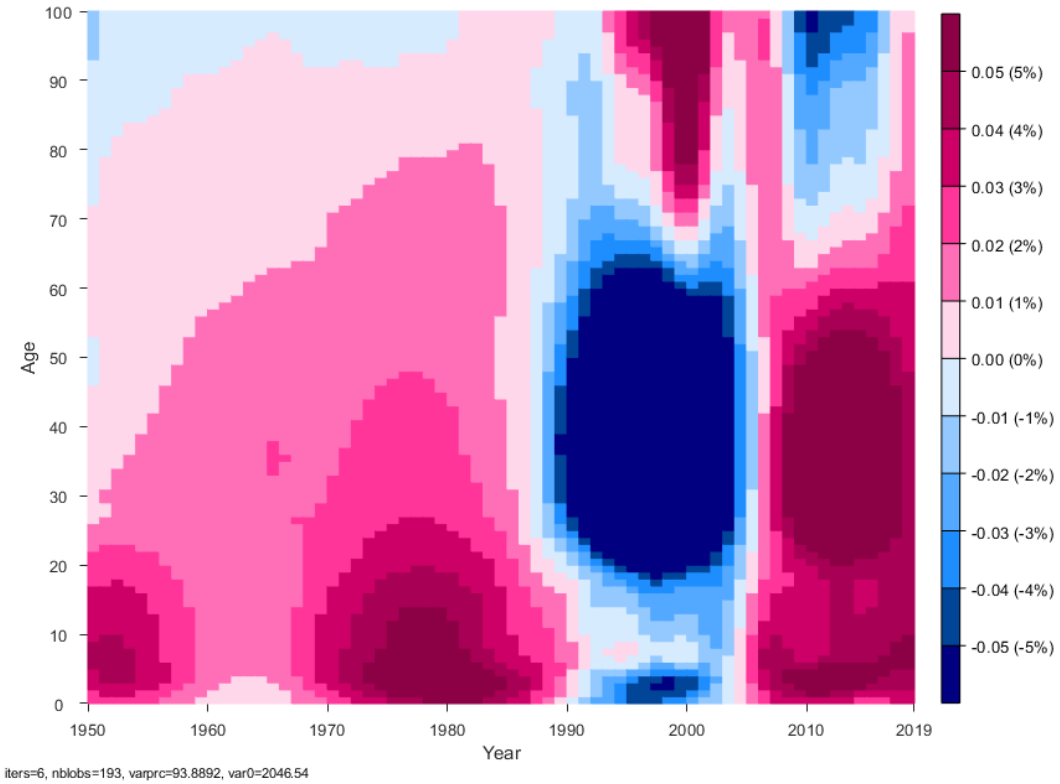
Females



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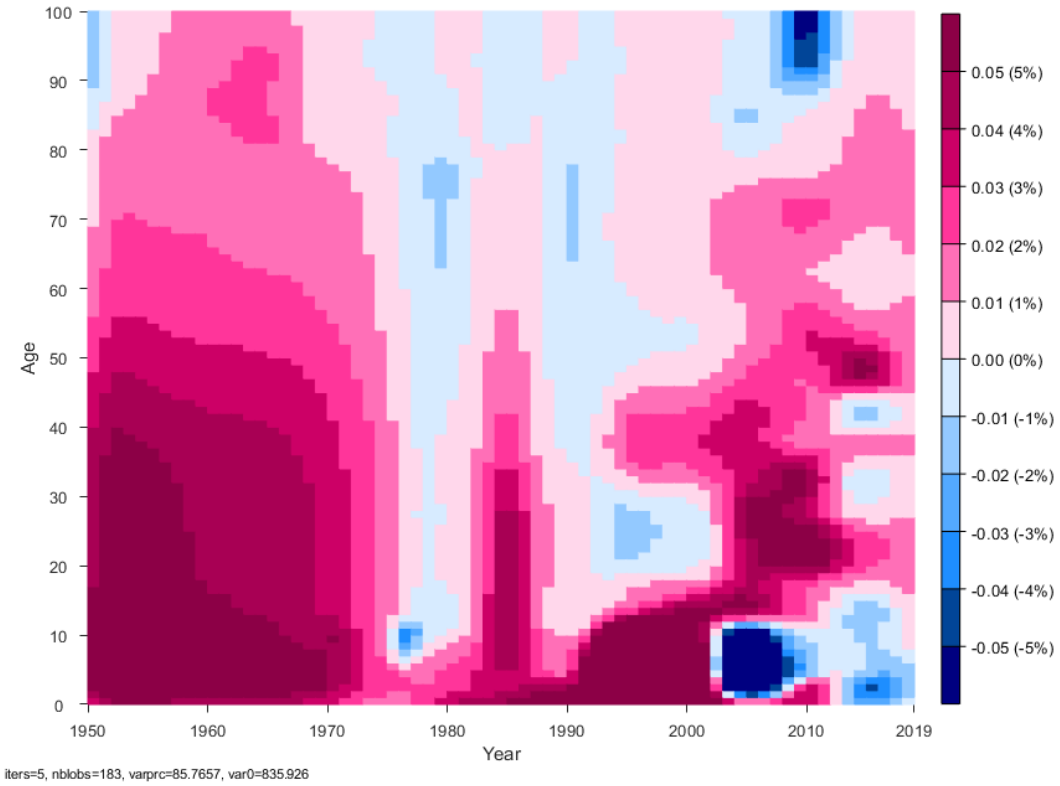
North Macedonia

Males



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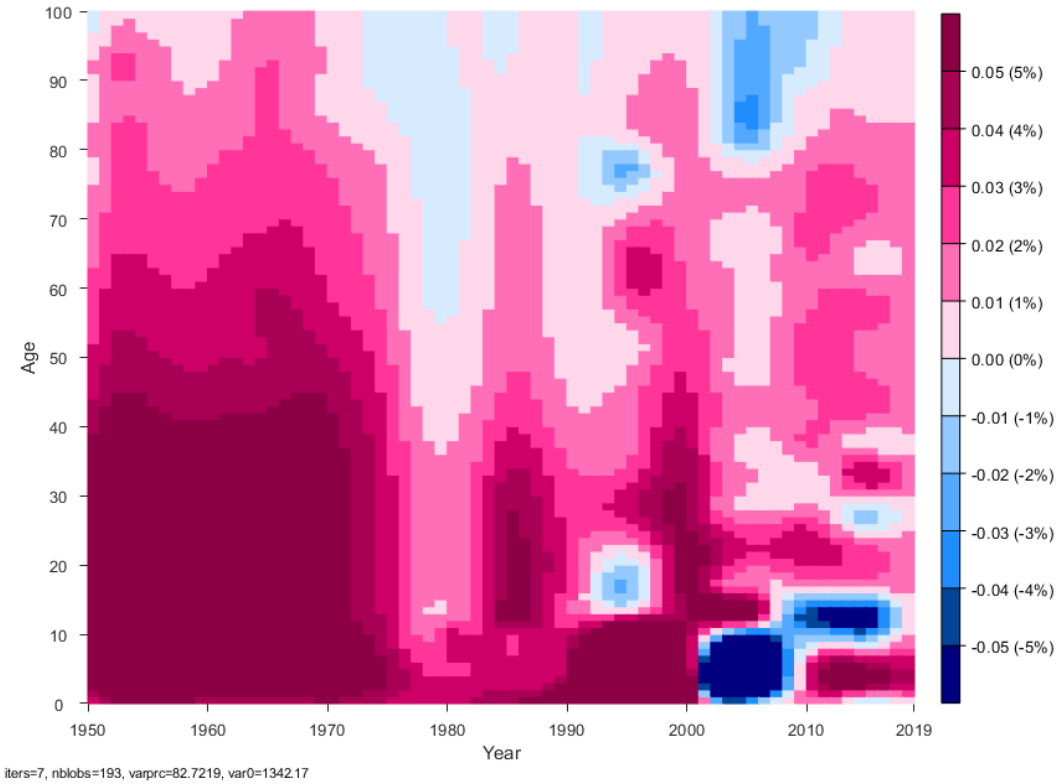
Females



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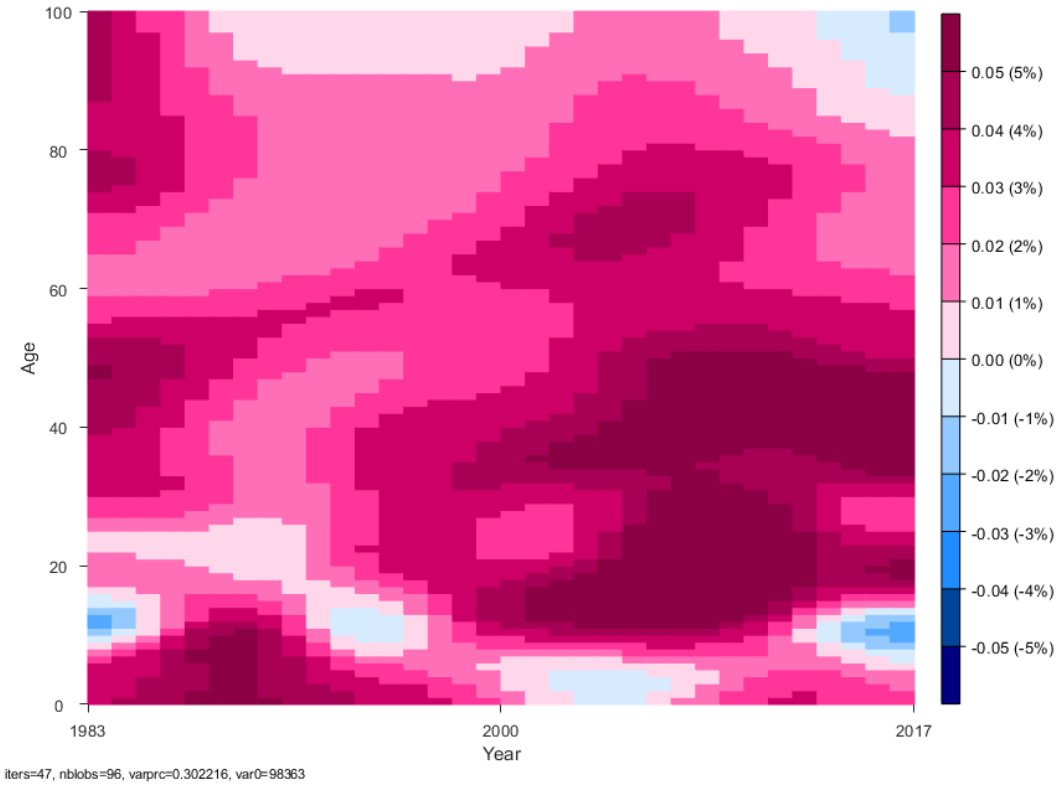
Slovenia

Males



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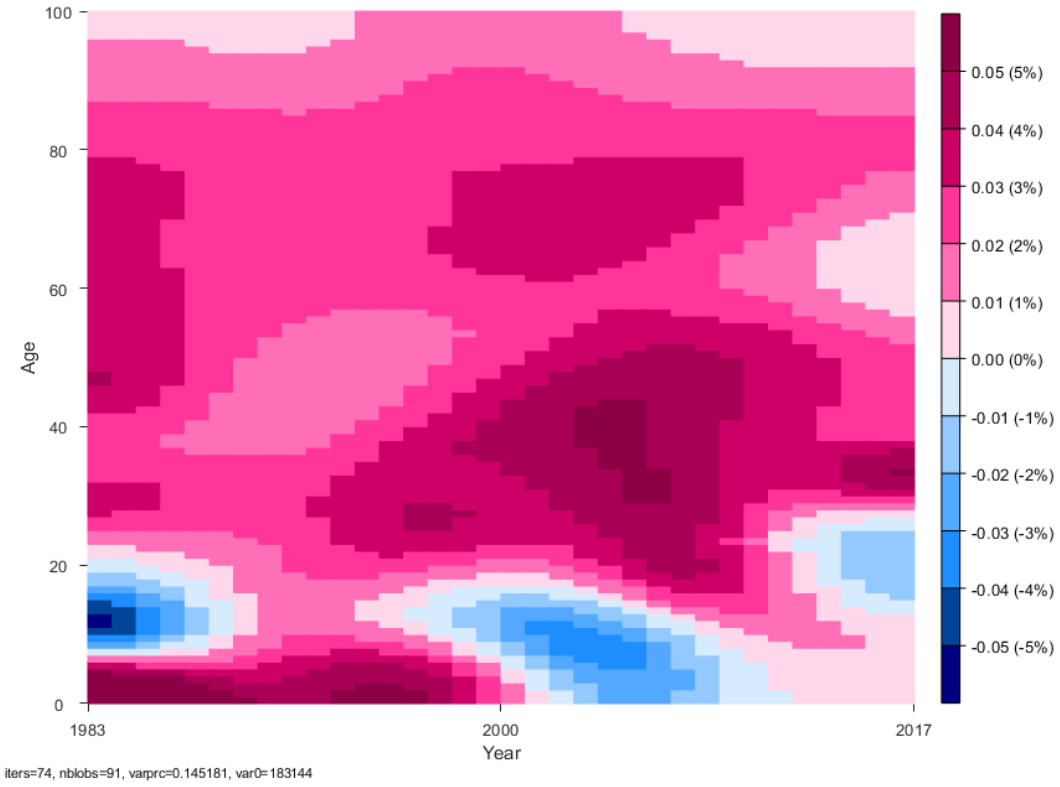
Females



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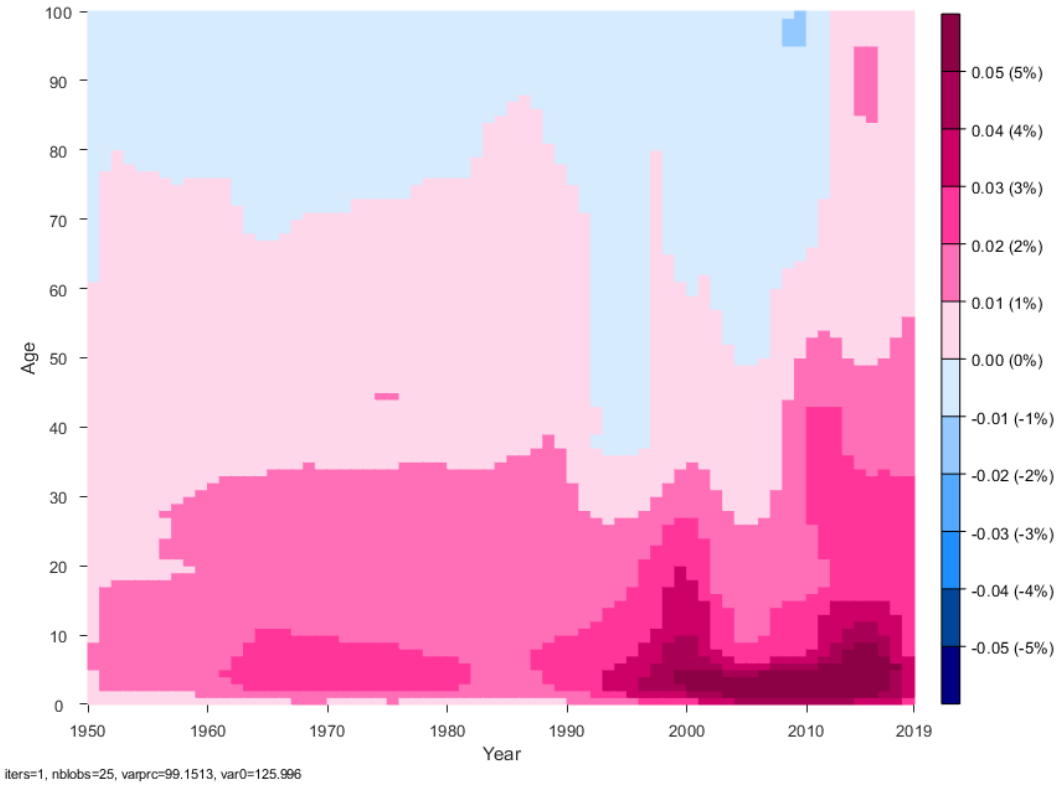
Guinea-Bissau

Males



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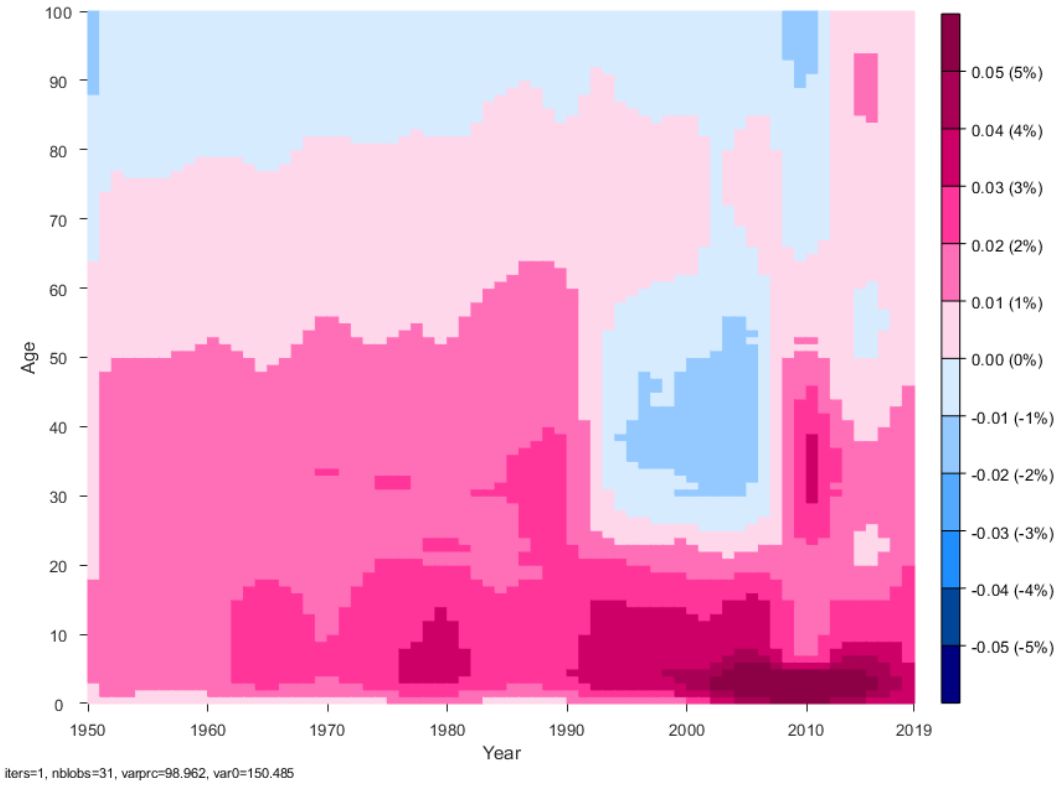
Females



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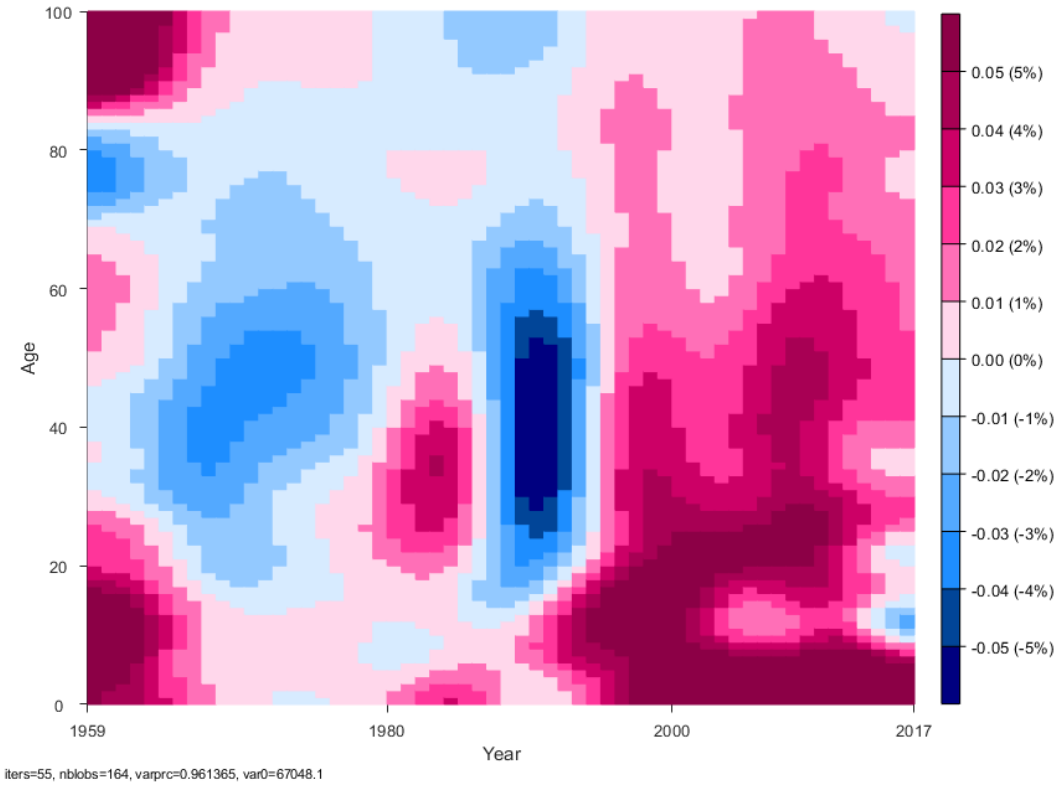
Latvia

Males



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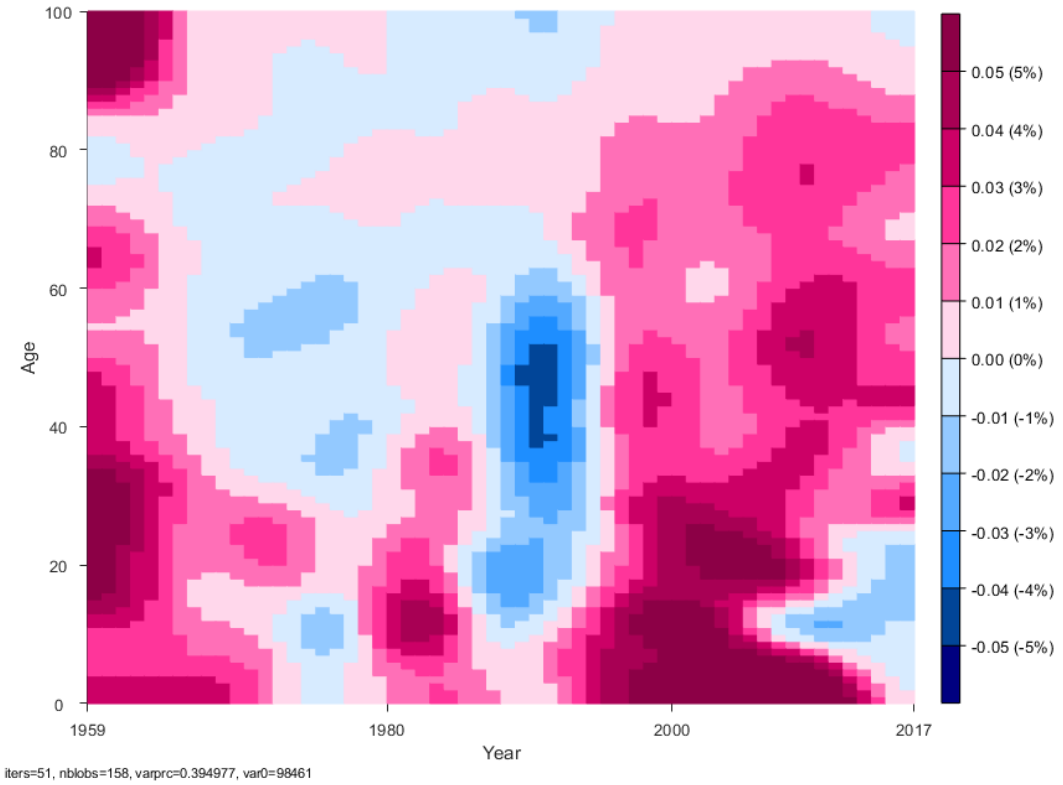
Females



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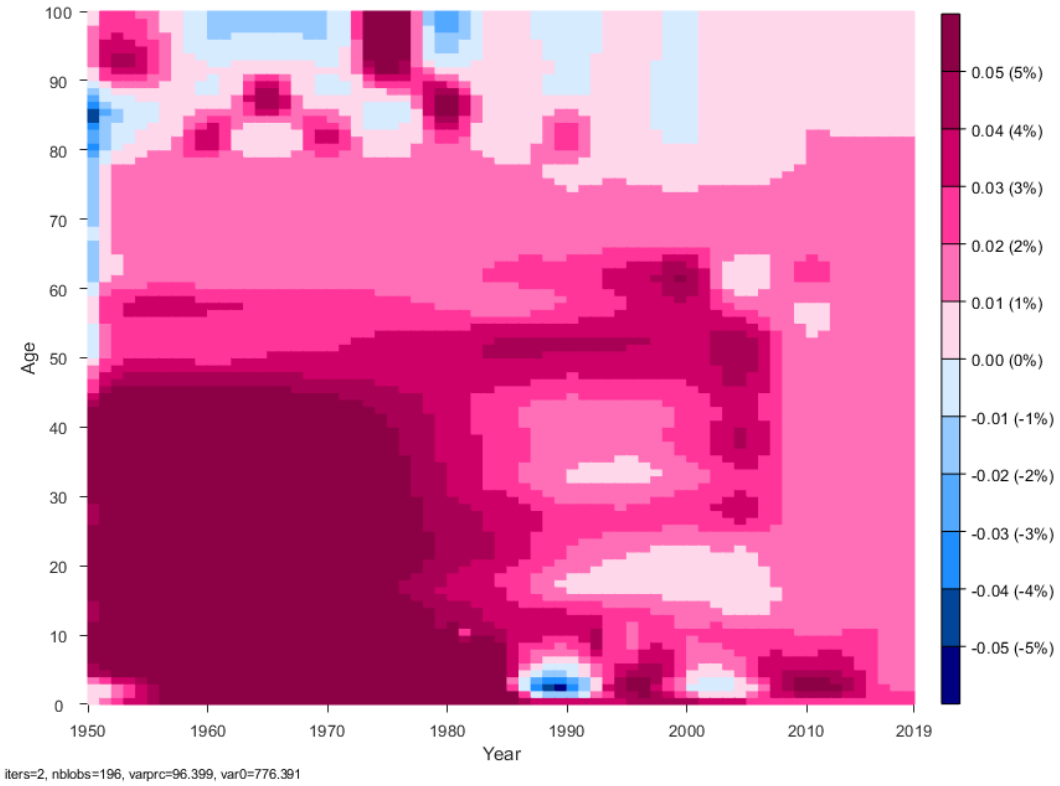
Bahrain

Males



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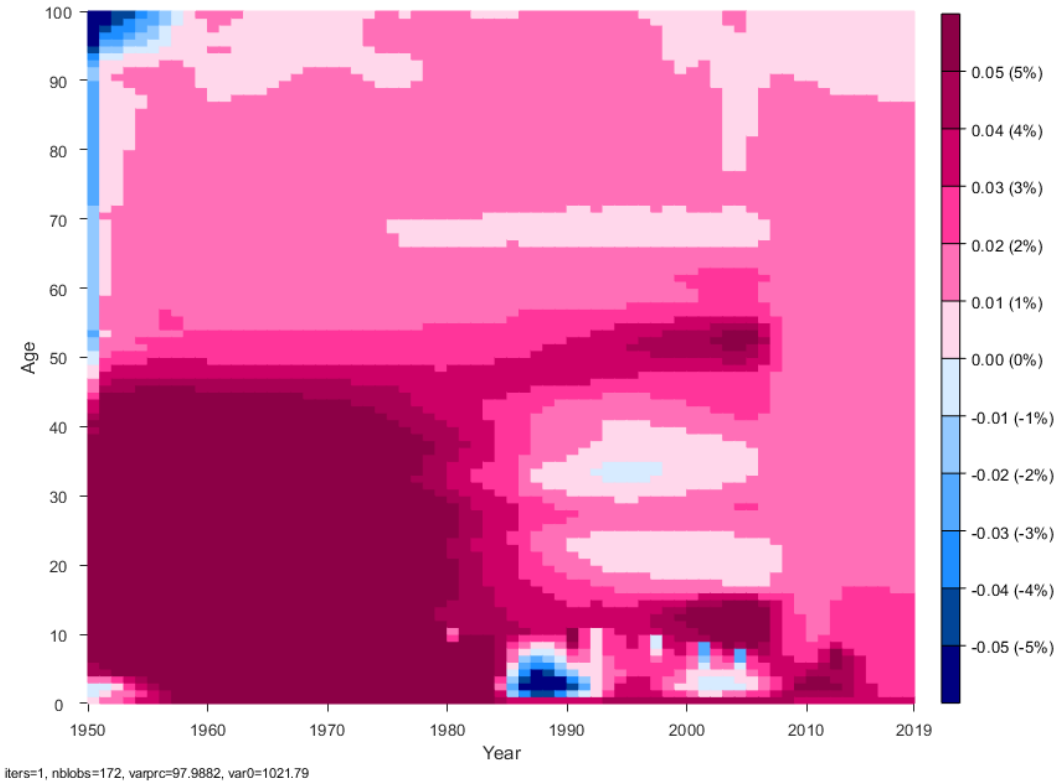
Females



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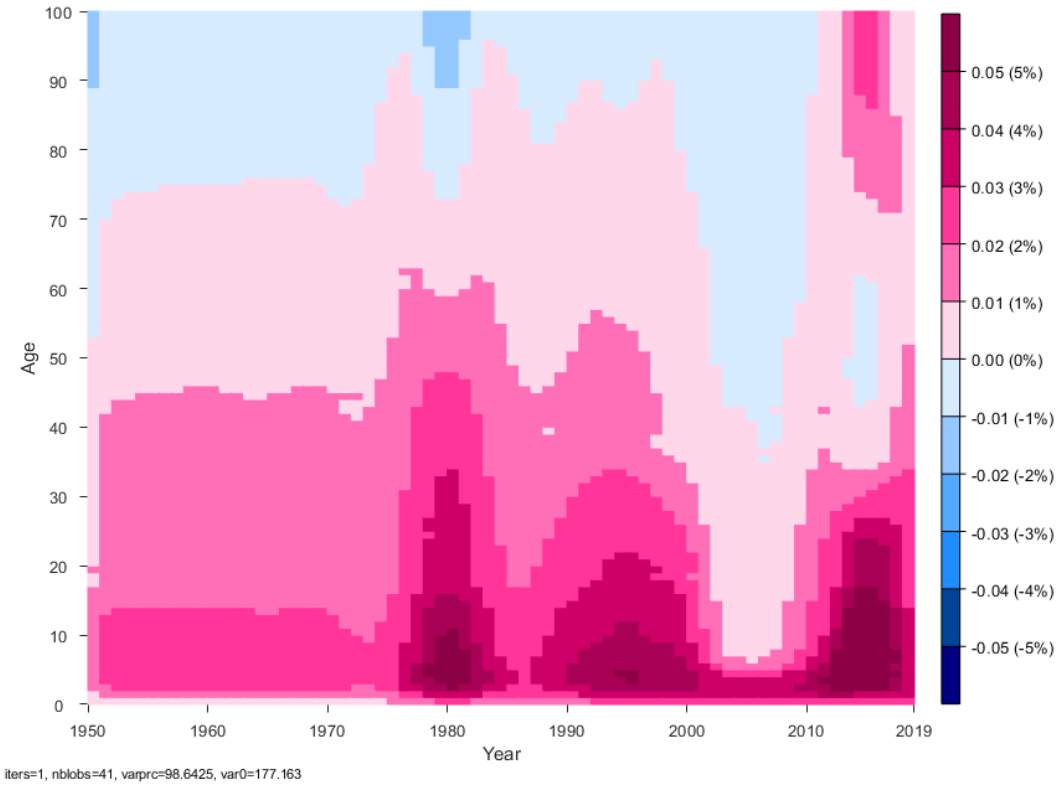
Equatorial Guinea

Males



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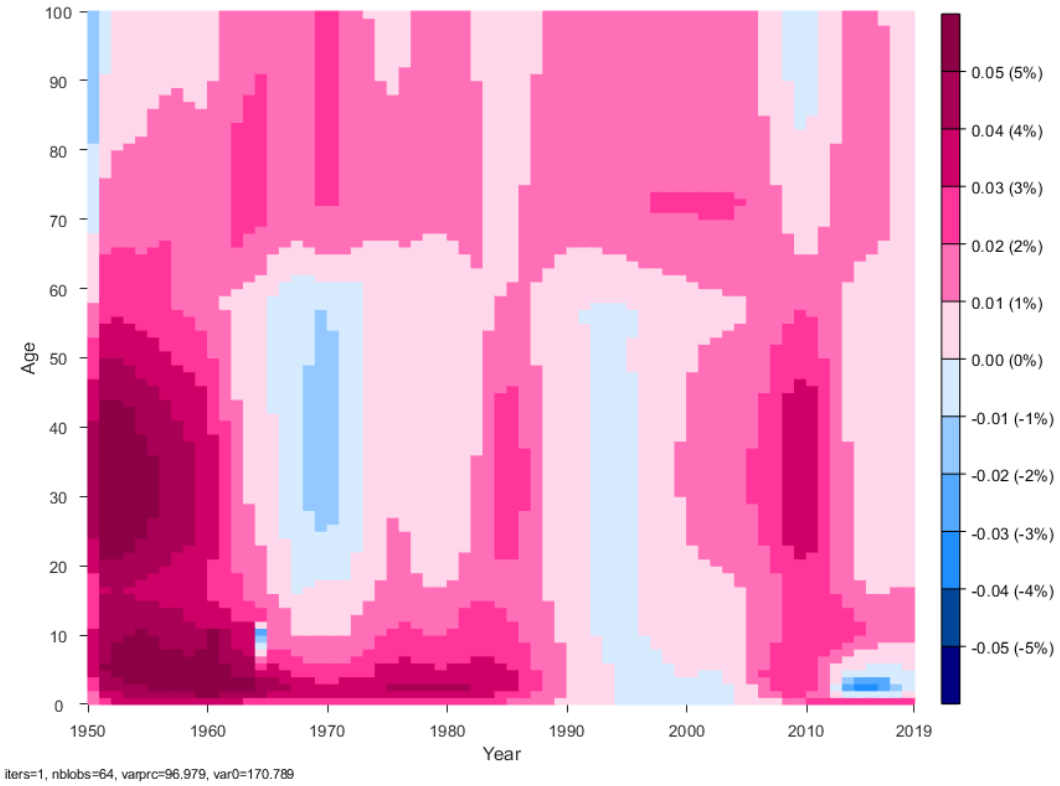
Females

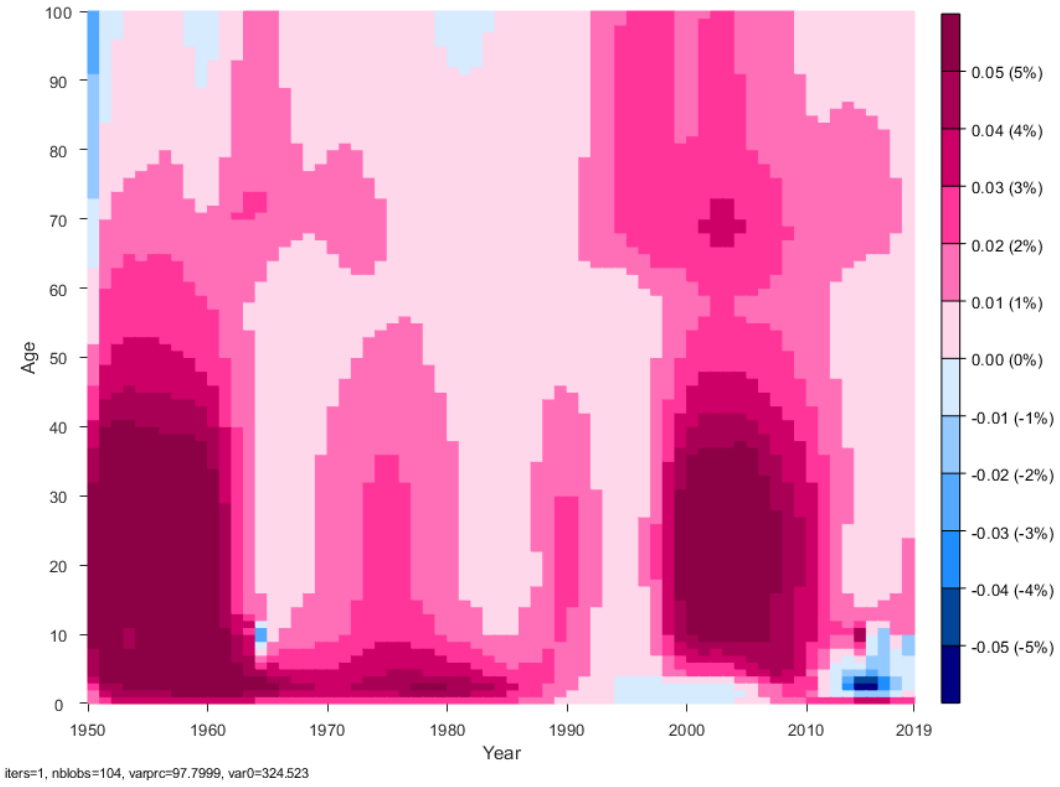
iters=1, nblobs=36, varprc=98.6605, var0=164.745

Trinidad and Tobago

Males

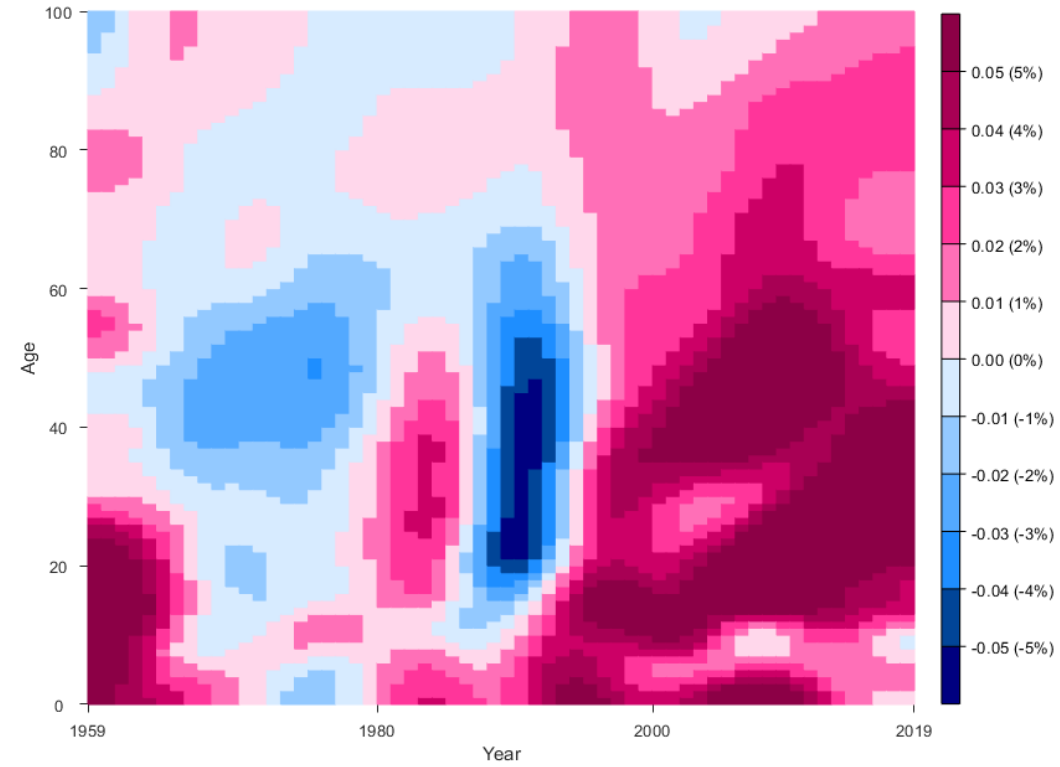


Females



Estonia

Males



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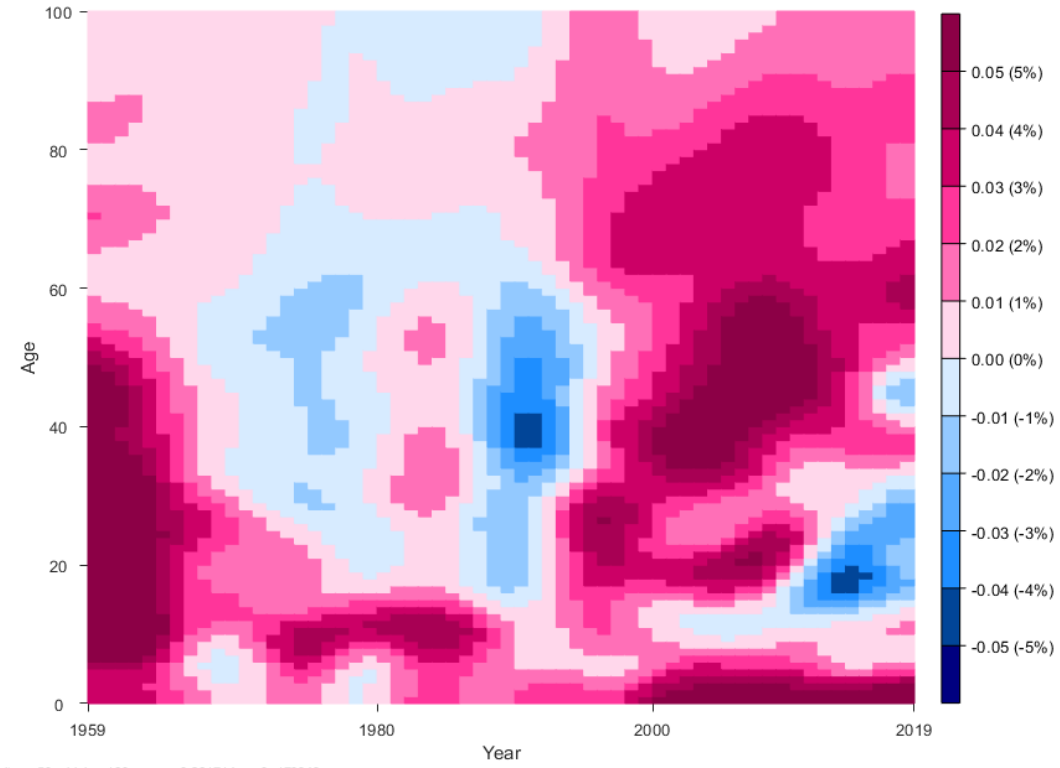
Females



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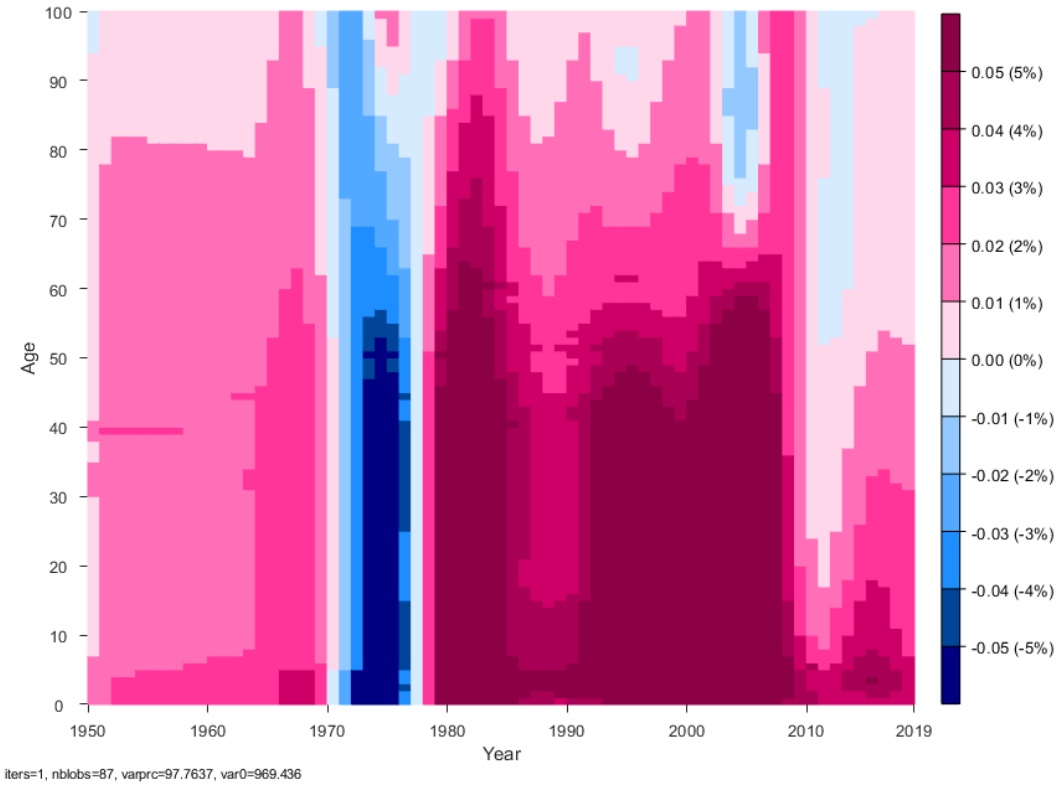
Timor-Leste

Males



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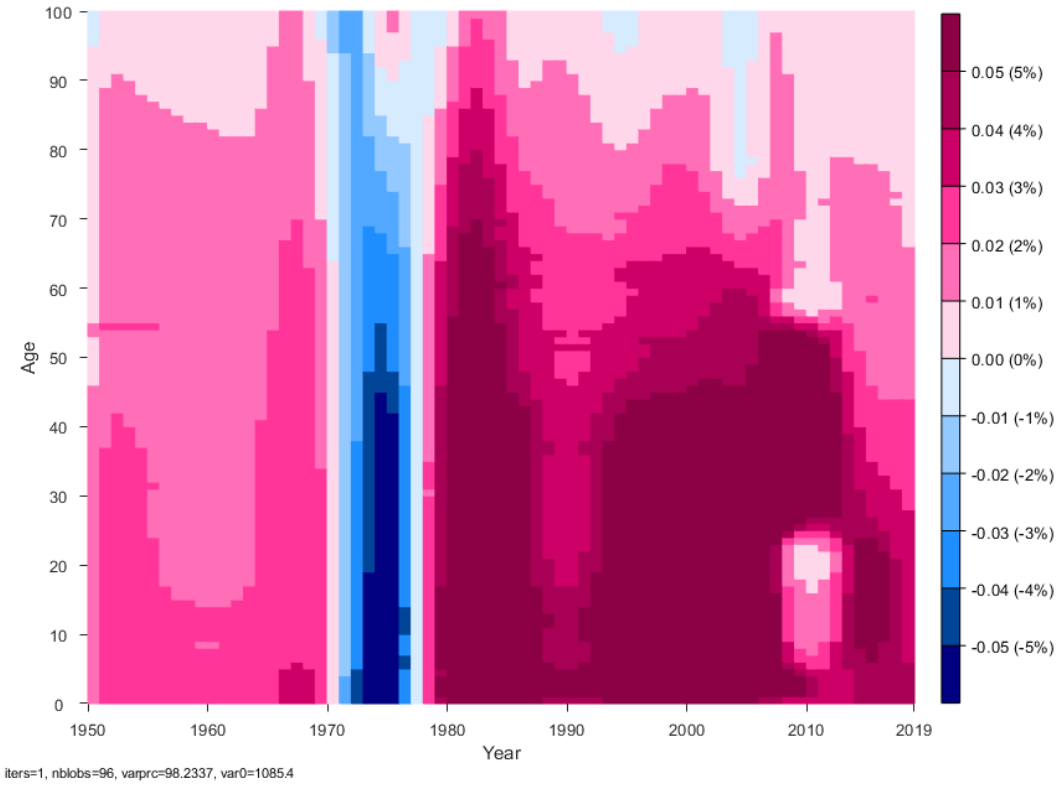
Females



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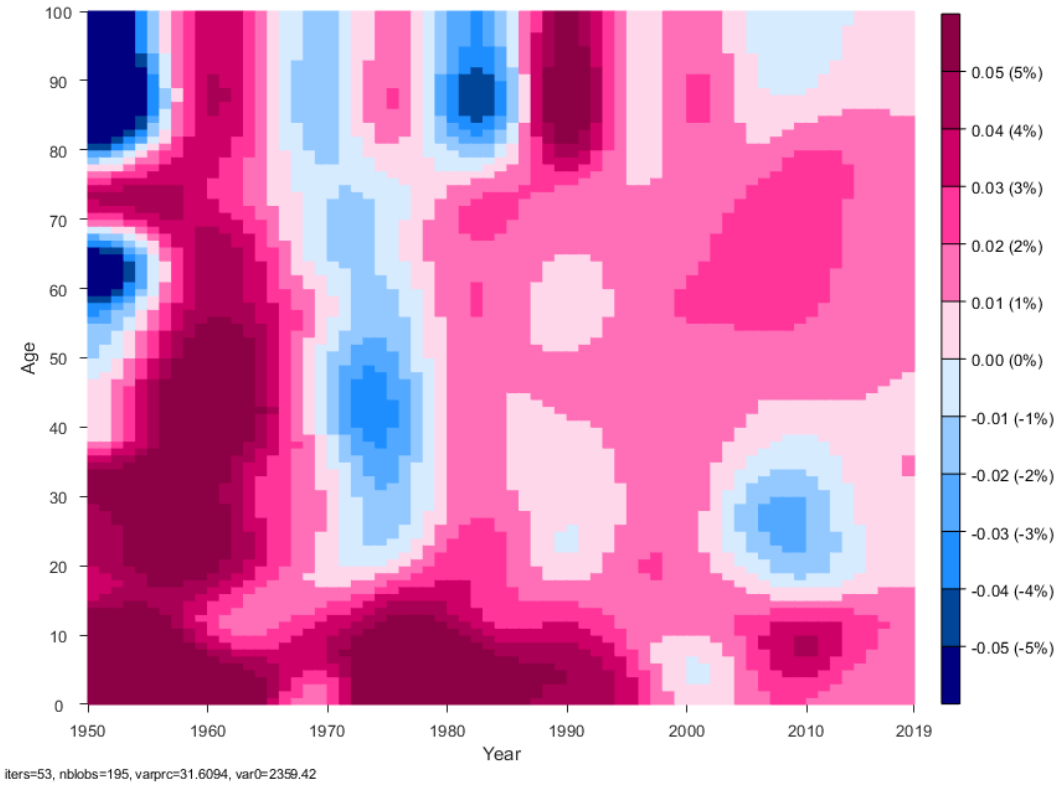
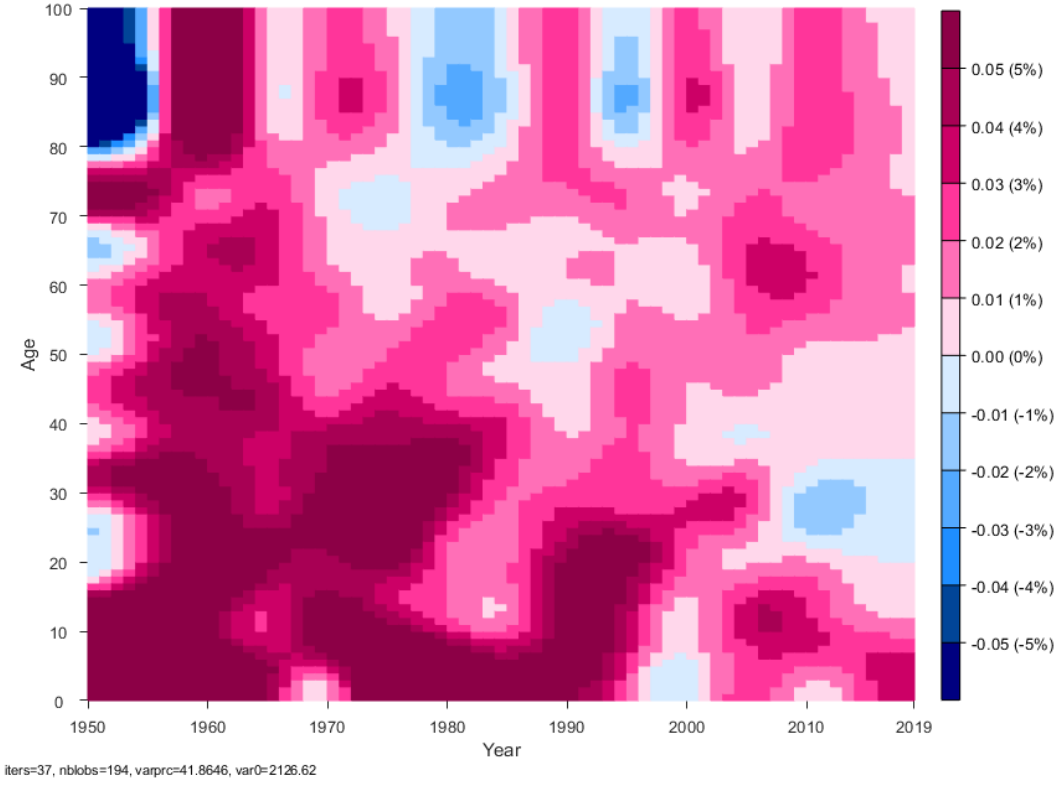
Mauritius

Males

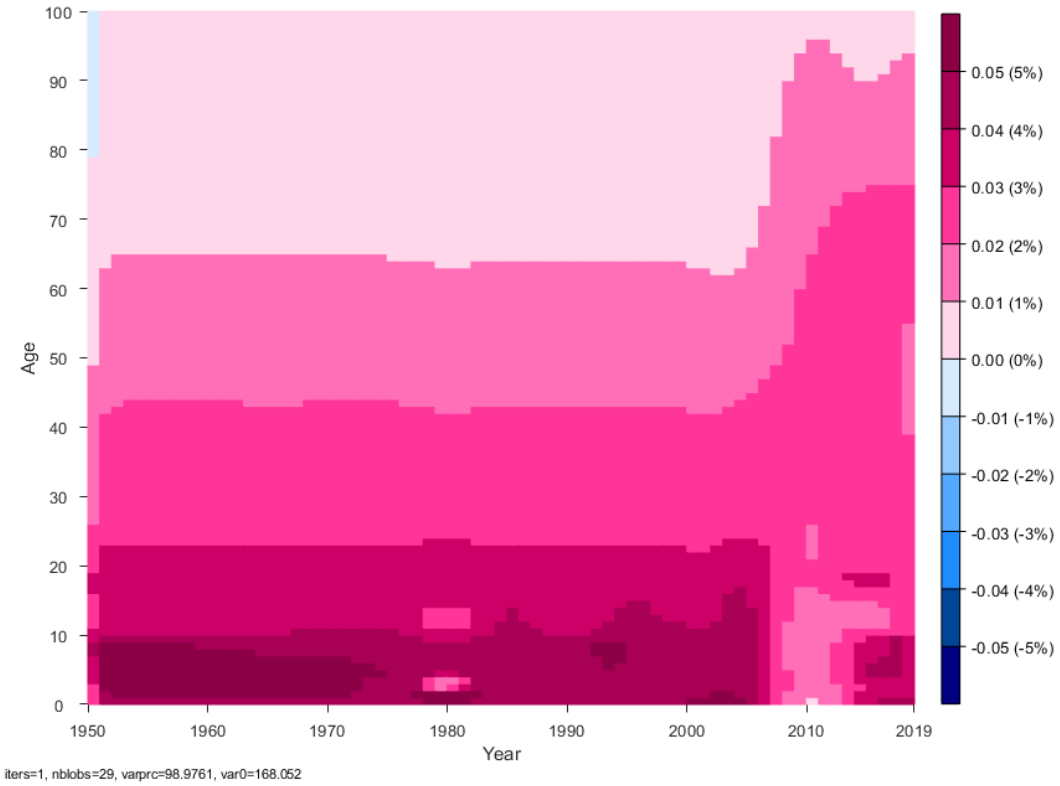


Females



Cyprus

Males



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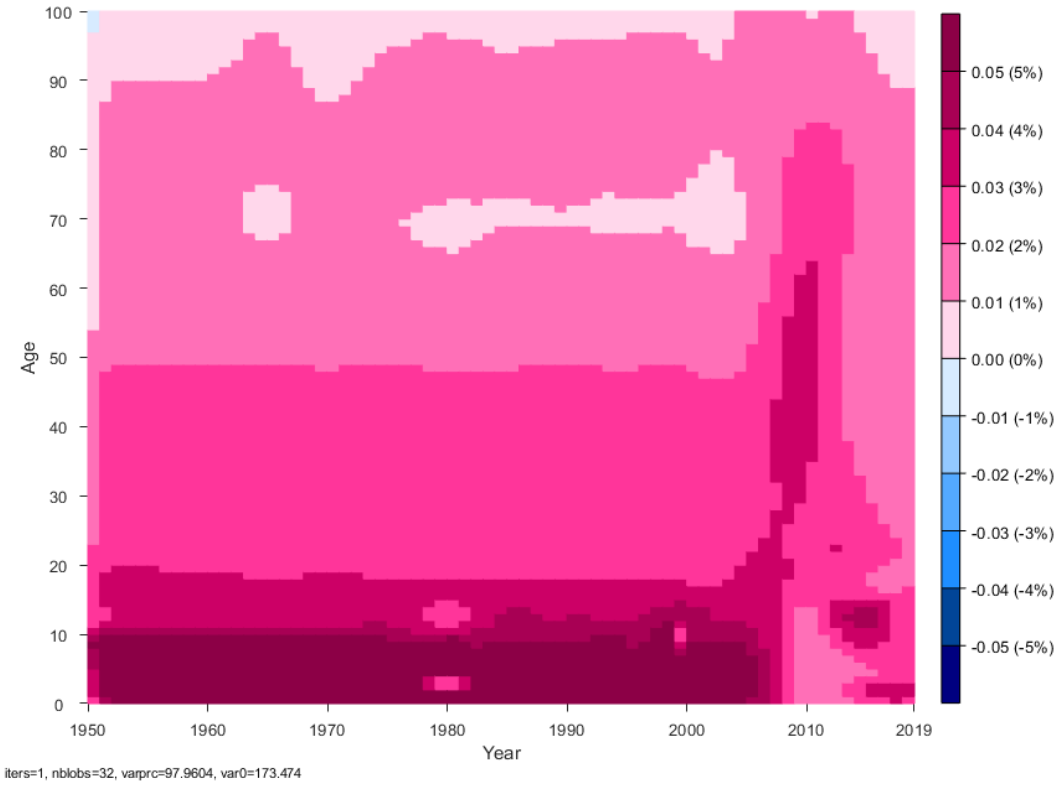
Females



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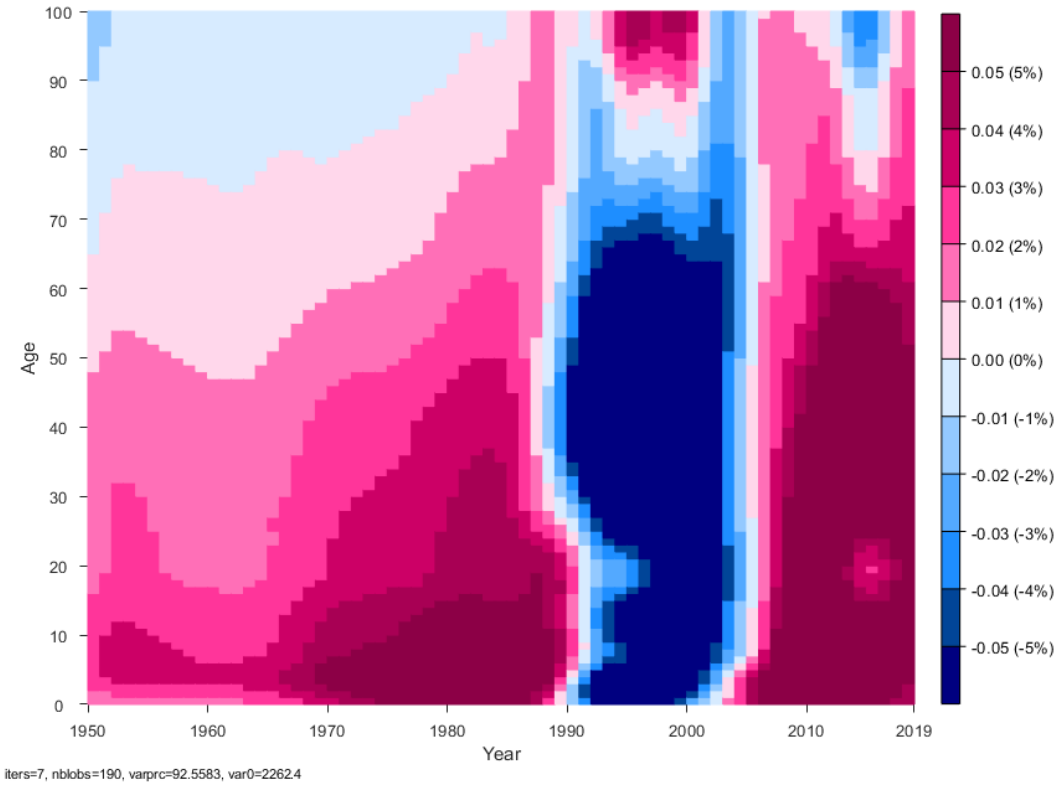
Eswatini

Males



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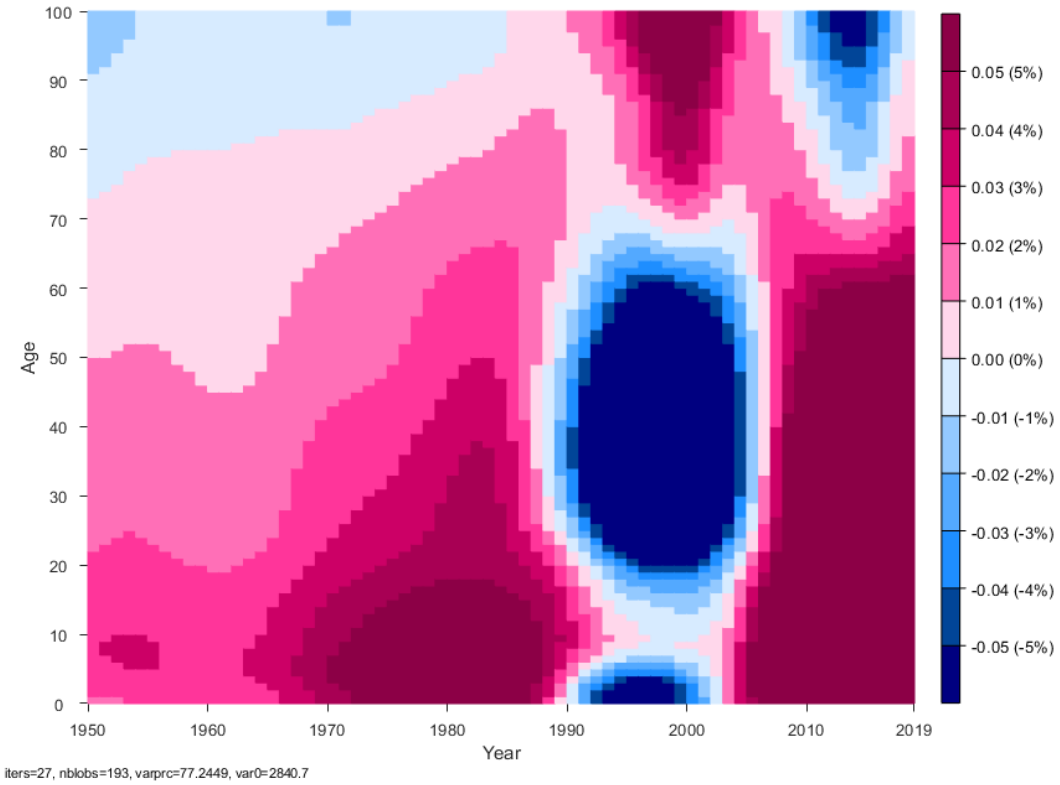
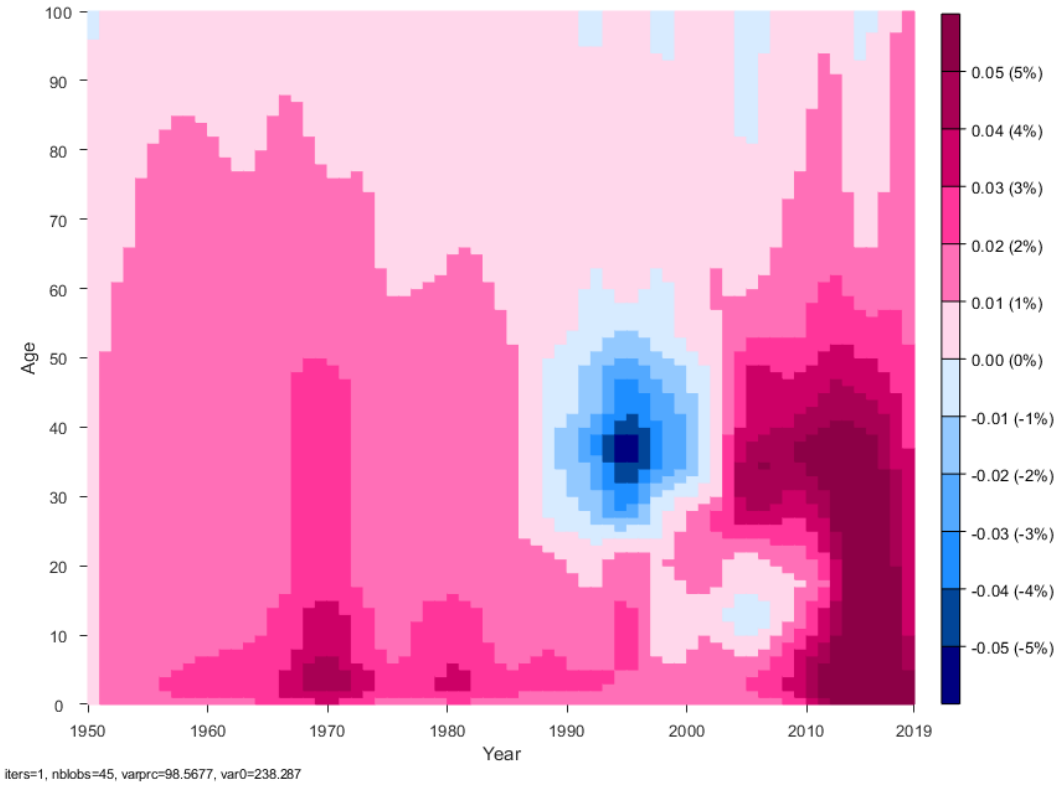
Females



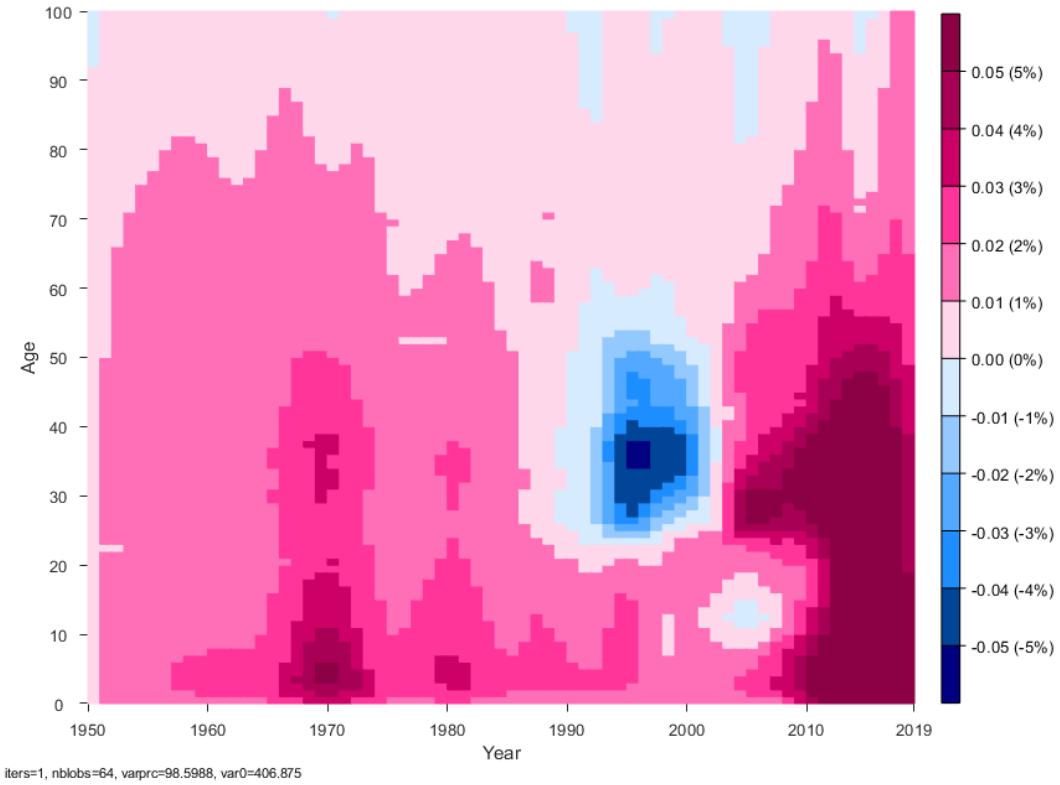
iters=27, nblobs=193, varprc=77.2449, var0=2840.7

Djibouti

Males

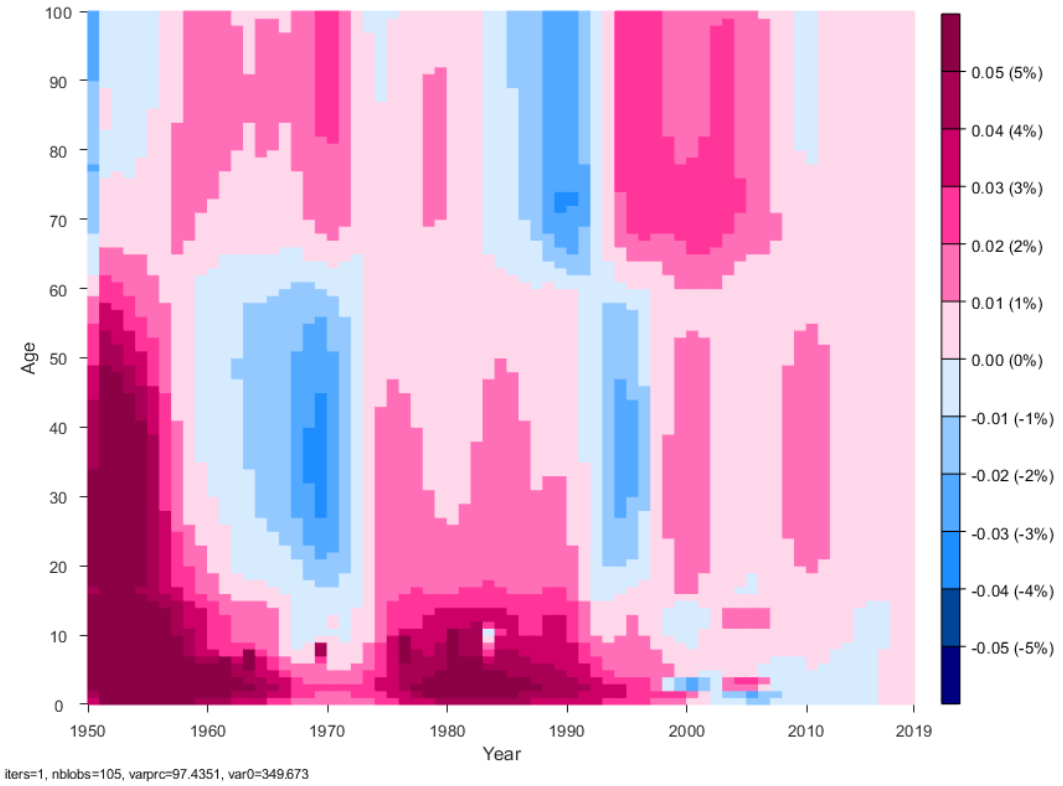


Females

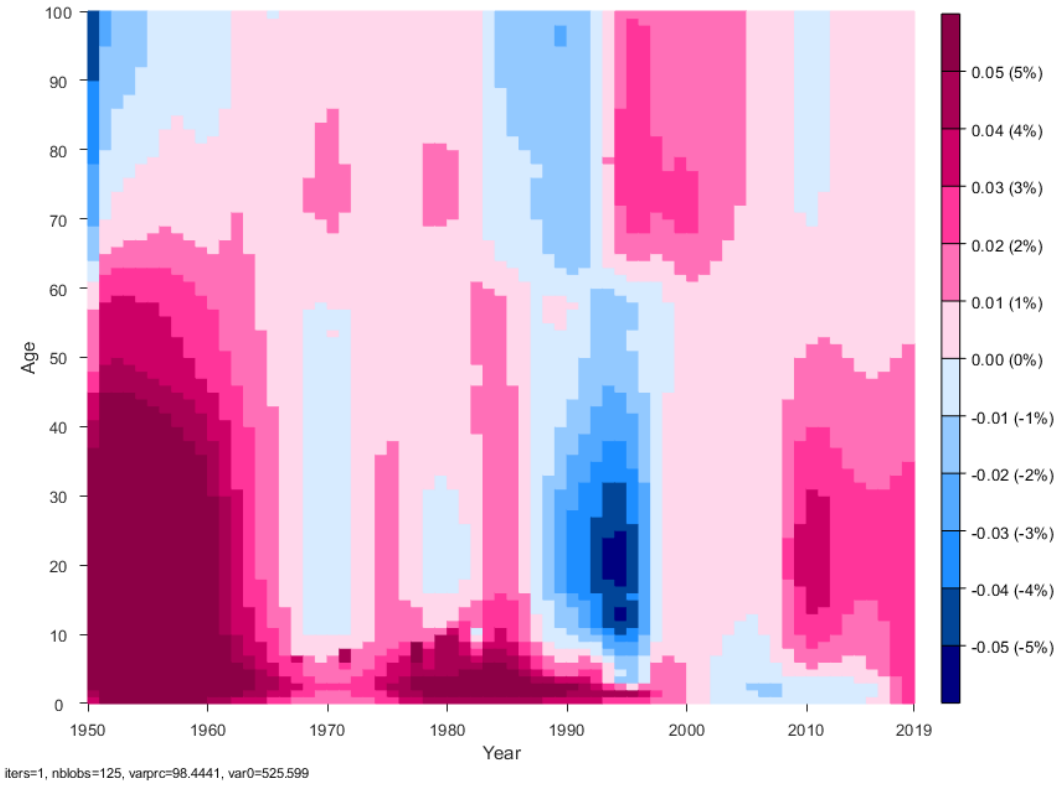


Fiji

Males

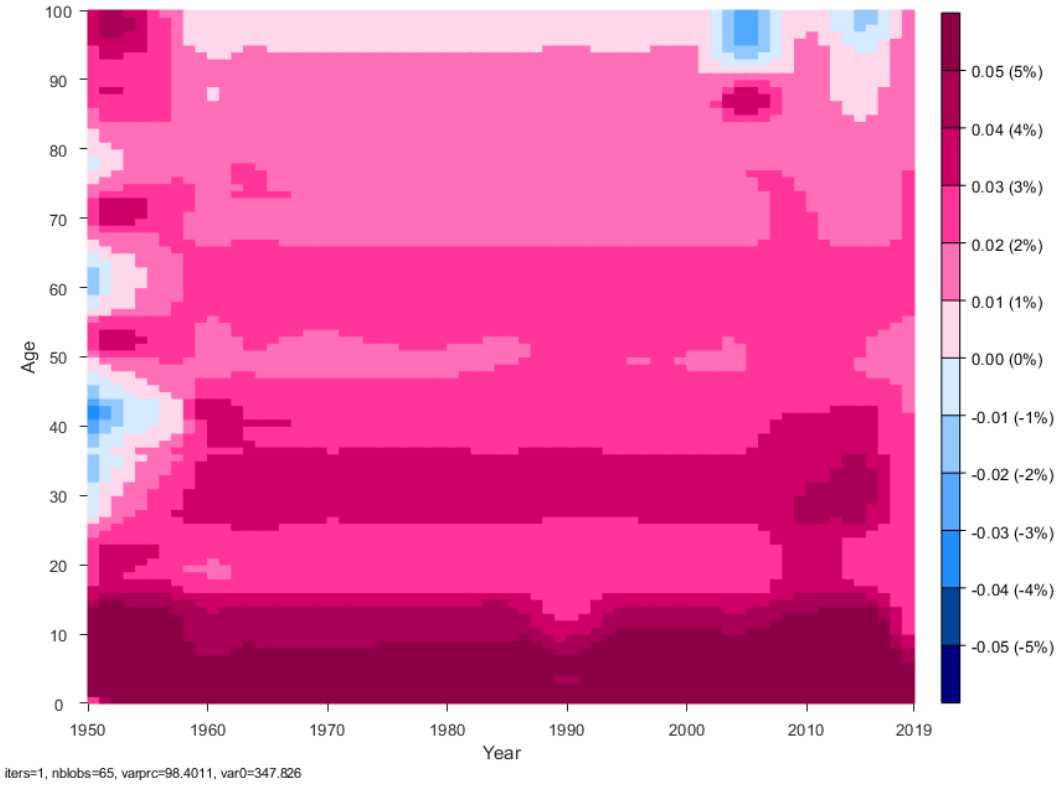


Females



R鴿ion

Males



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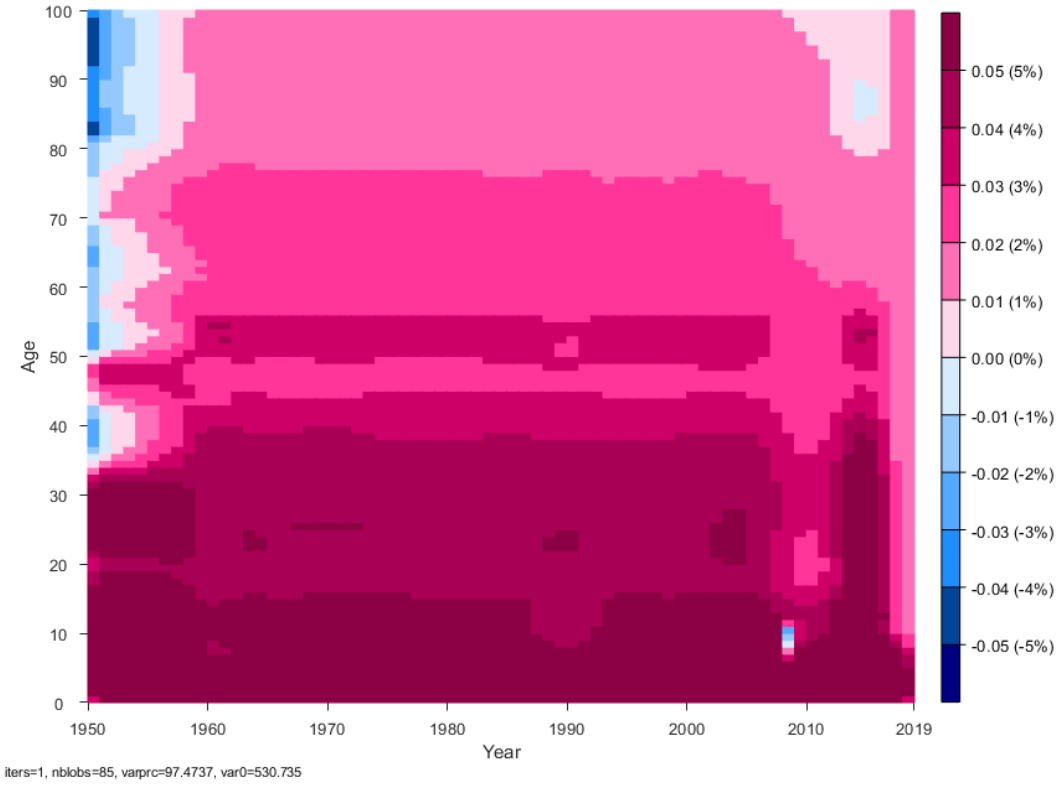
Females



iters=1, nblobs=85, varprc=97.4737, var0=530.735

Comoros

Males

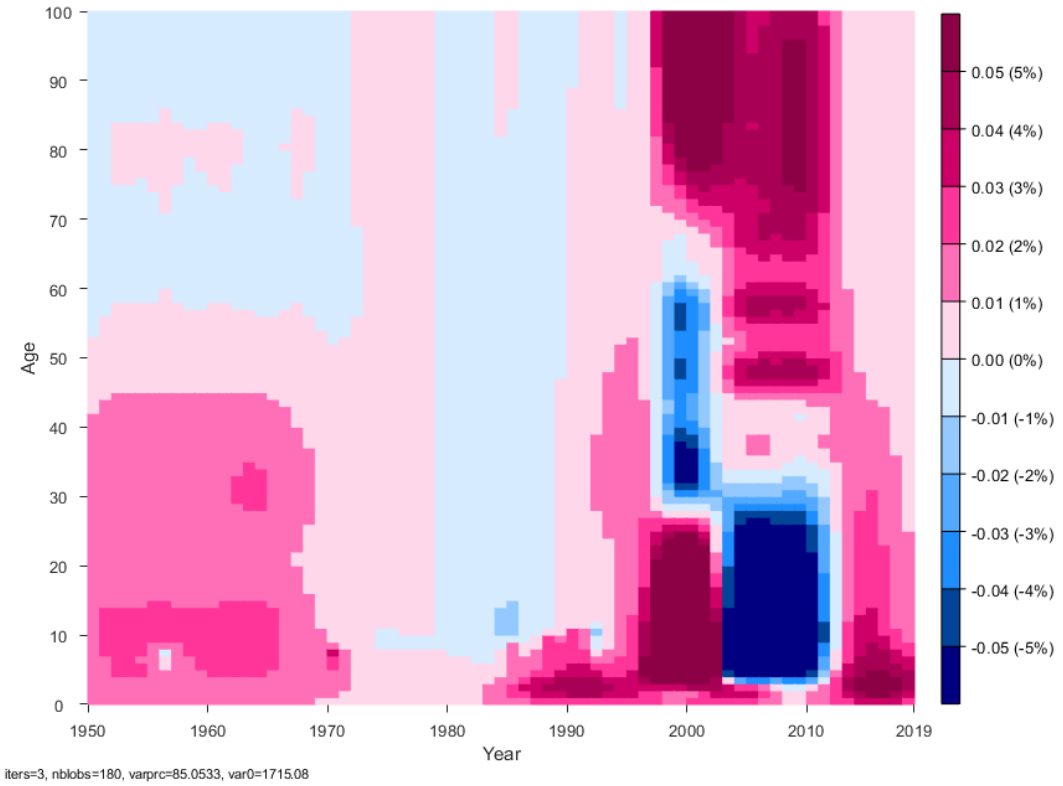
iters=1, nblobs=23, varprc=99.1717, var0=97.0368

Females

iters=1, nblobs=23, varprc=99.17, var0=111.36

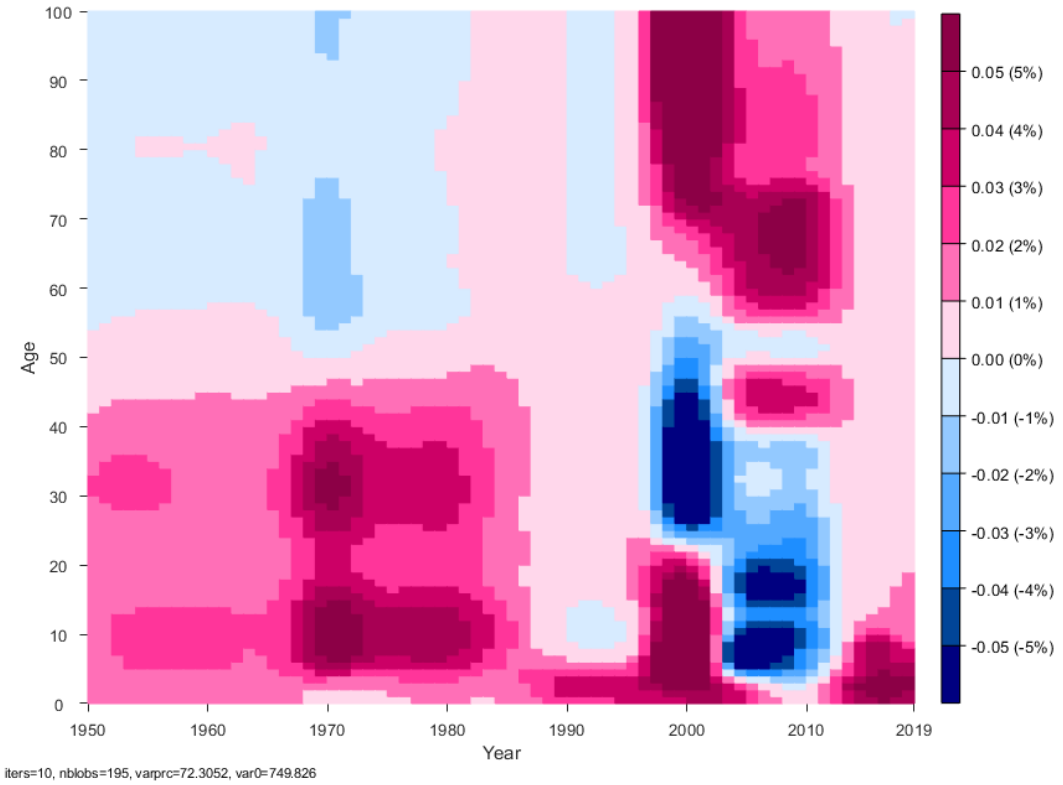
Guyana

Males



iters=3, nblobs=180, varprc=85.0533, var0=1715.08

Females



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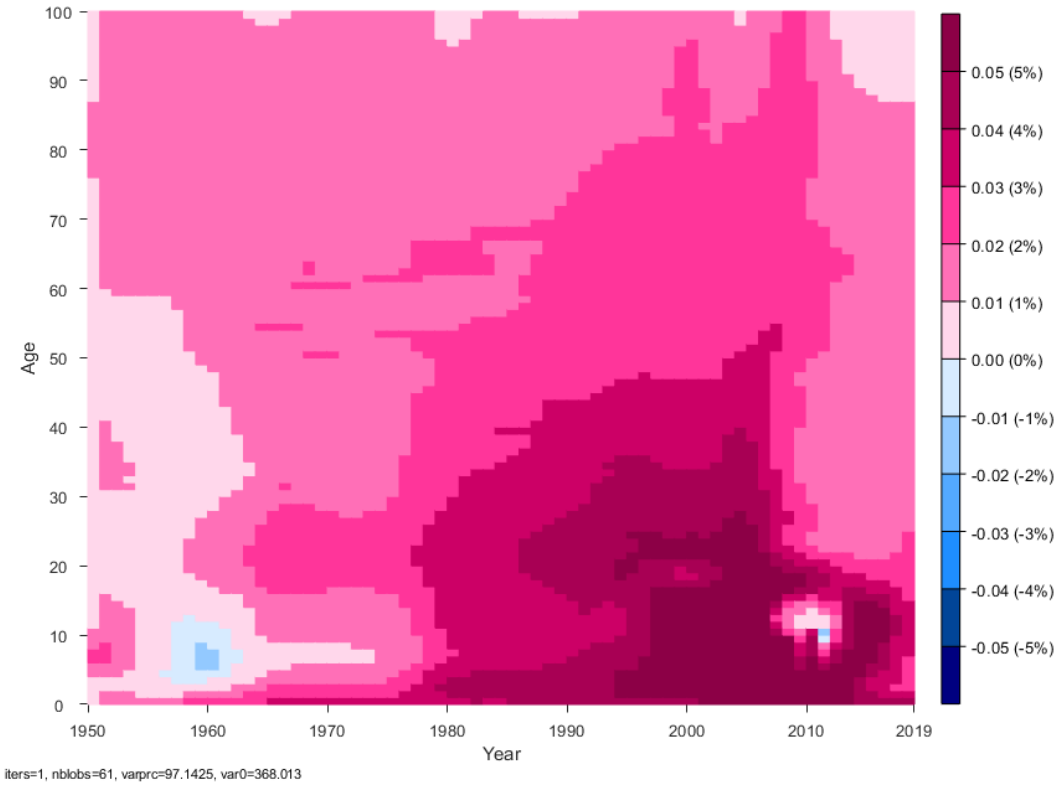
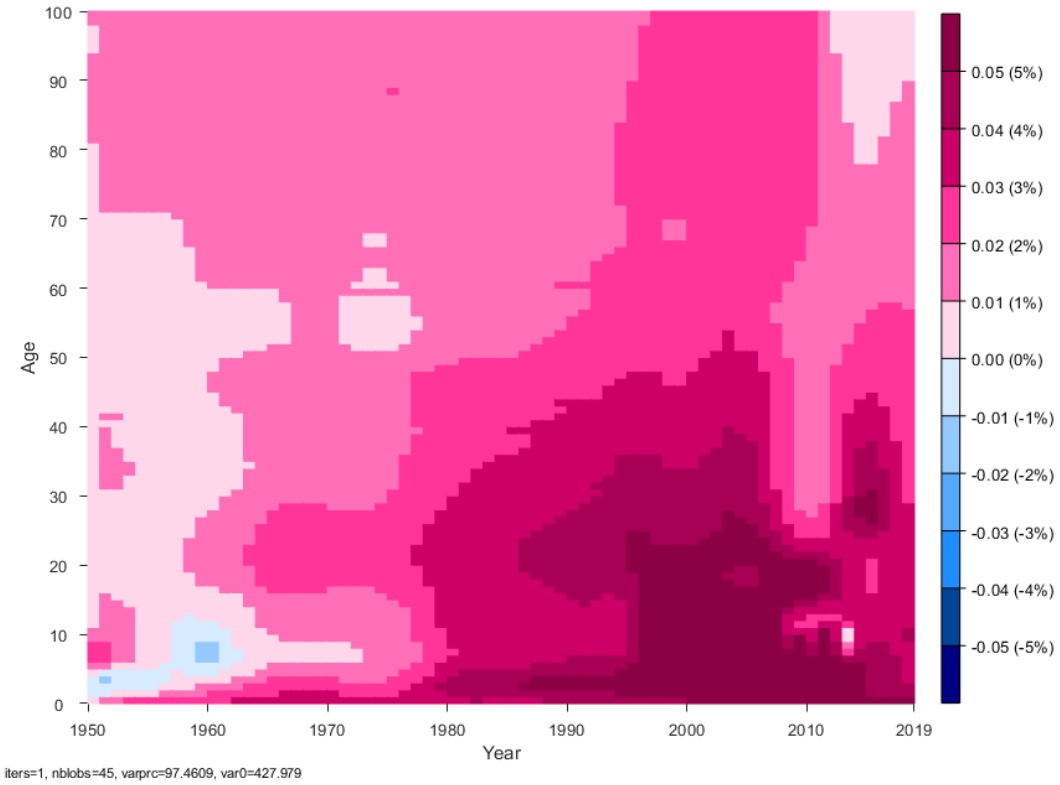
Bhutan

Males



iters=1, nblobs=61, varprc=97.1425, var0=368.013

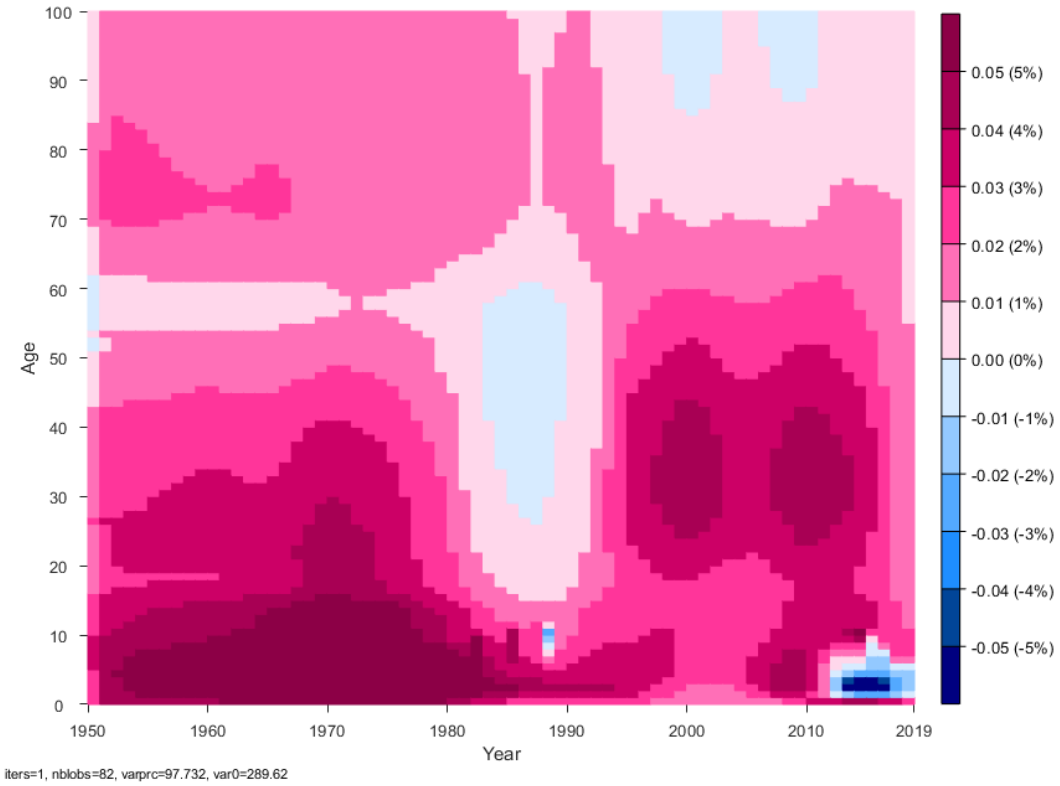
Females



iters=1, nblobs=45, varprc=97.4609, var0=427.979

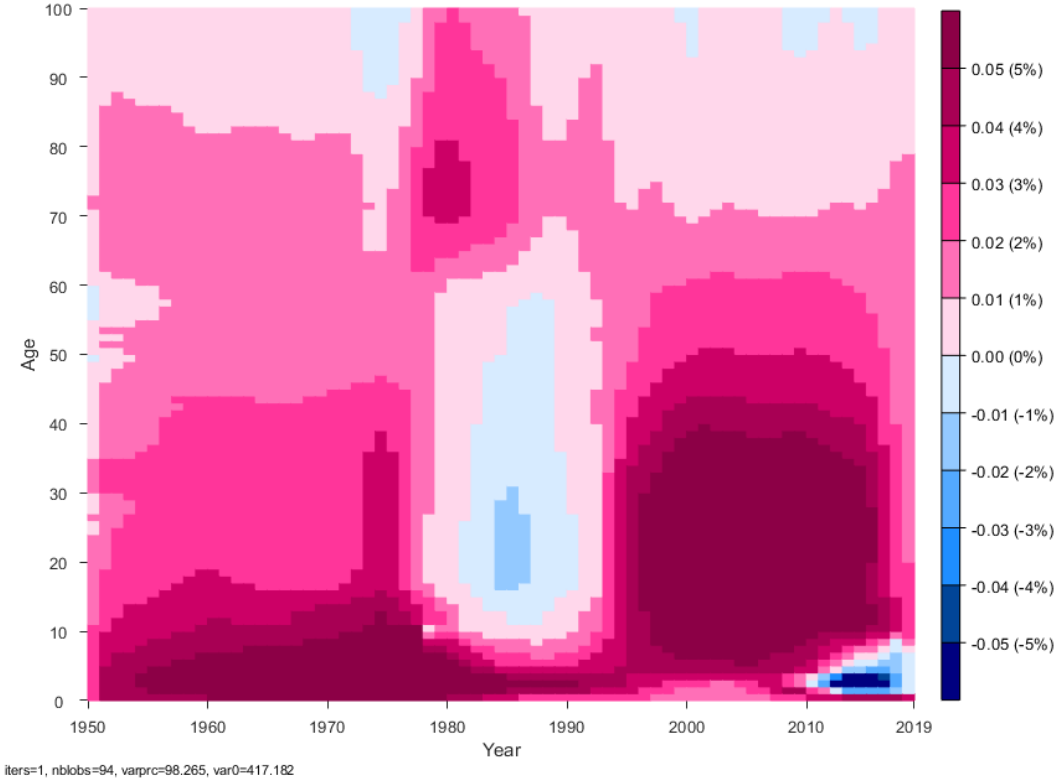
Solomon Islands

Males



iters=1, nblobs=82, varprc=97.732, var0=289.62

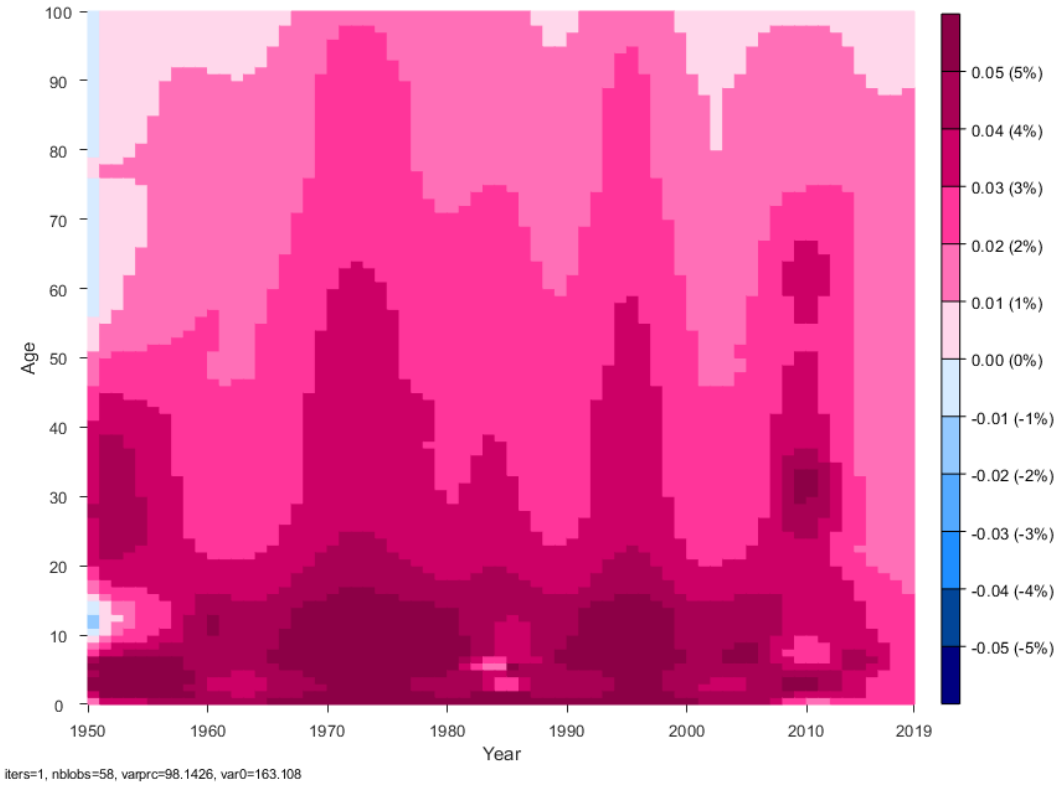
Females



iters=1, nblobs=94, varprc=98.265, var0=417.182

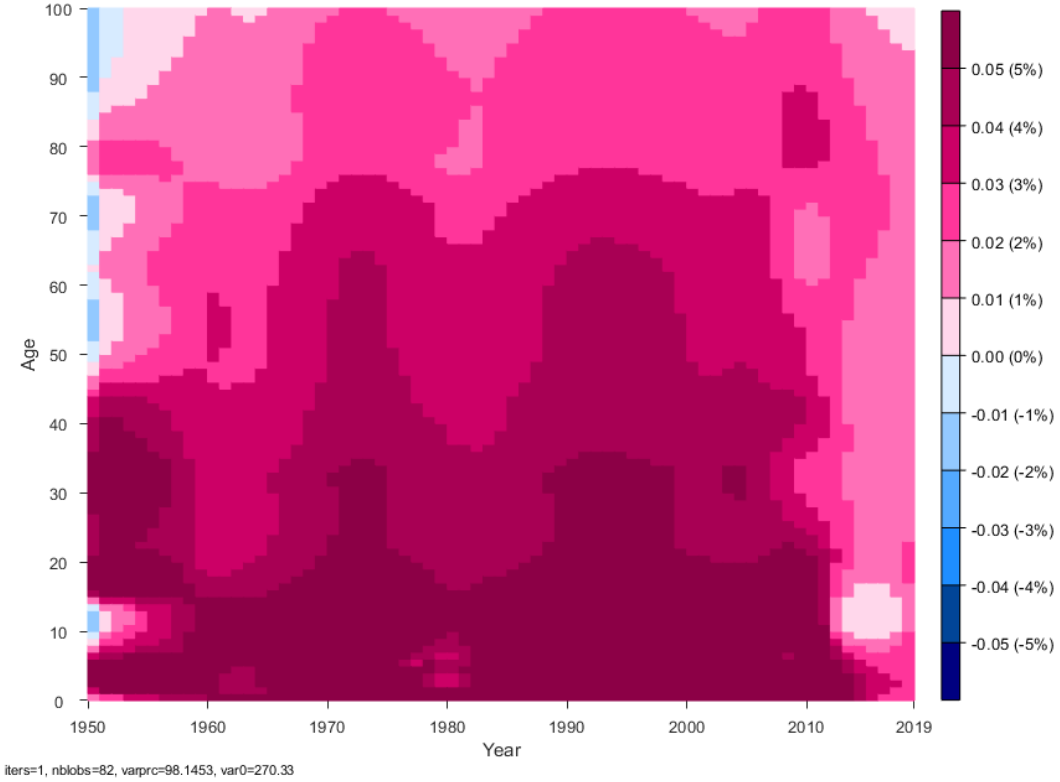
China, Macao SAR

Males



iters=1, nblobs=58, varprc=98.1426, var0=163.108

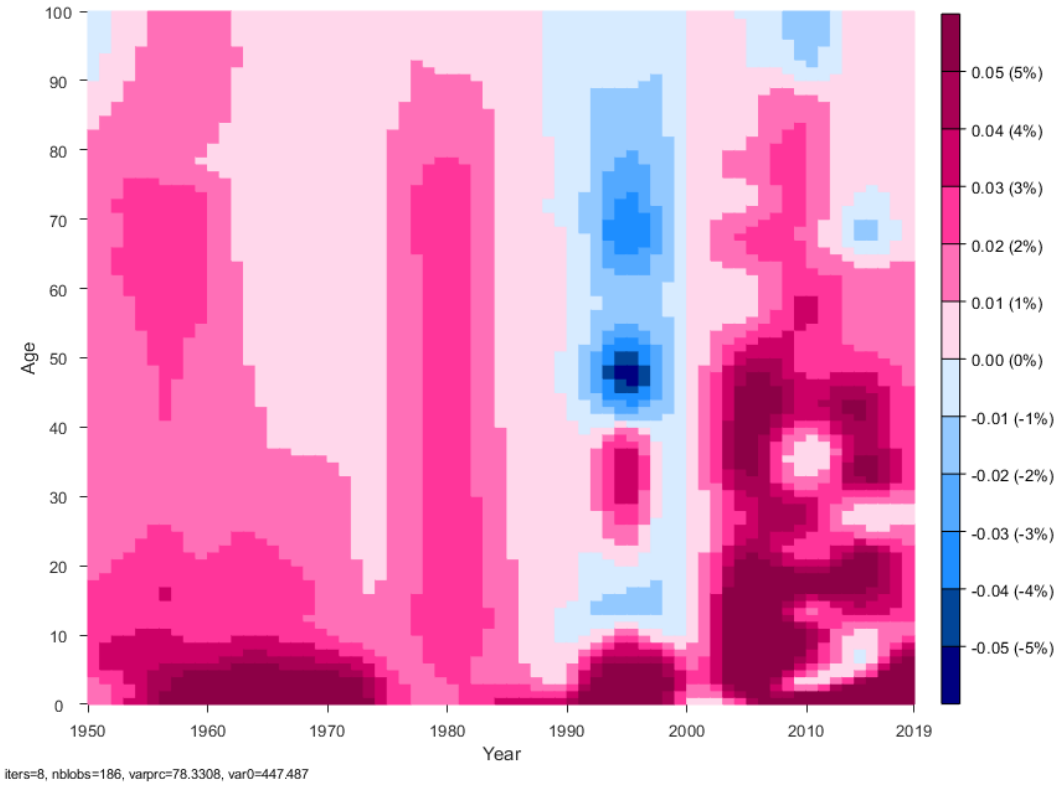
Females



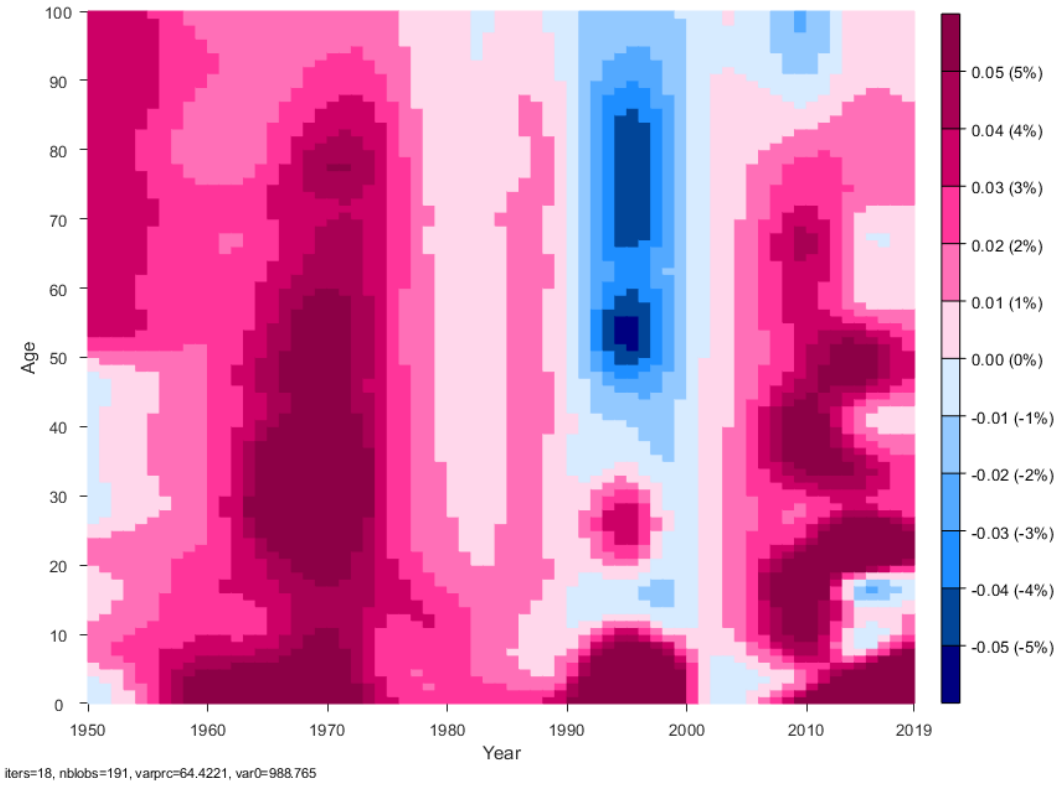
iters=1, nblobs=82, varprc=98.1453, var0=270.33

Montenegro

Males

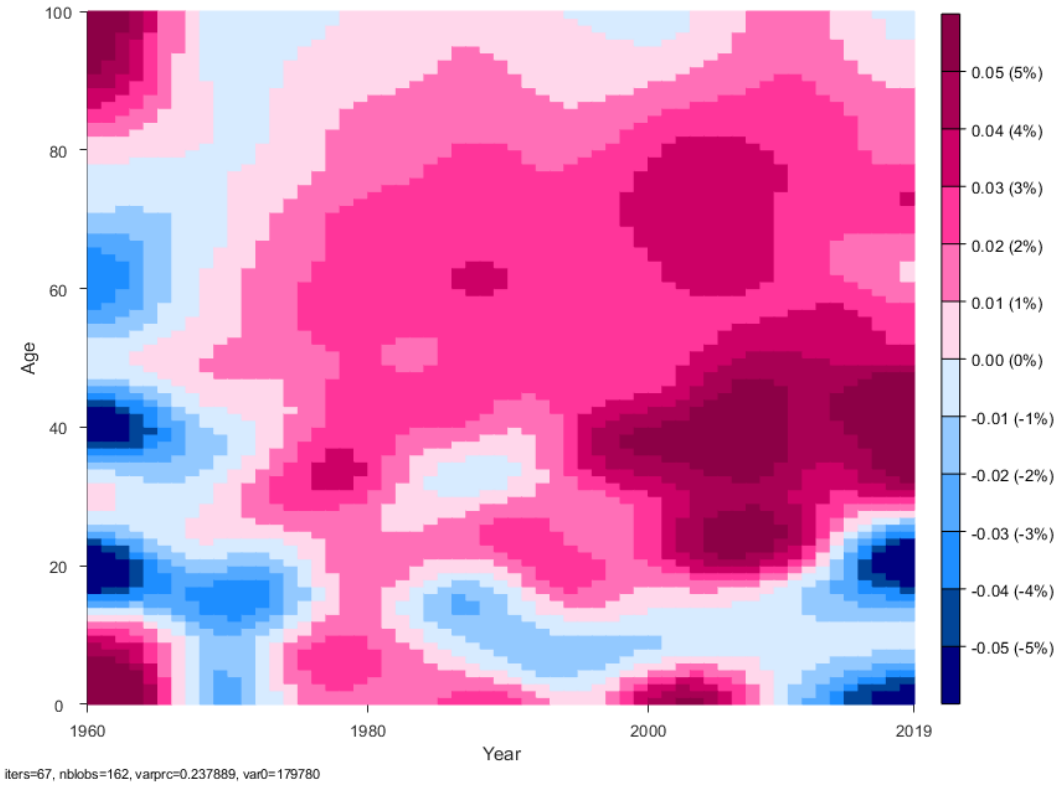


Females



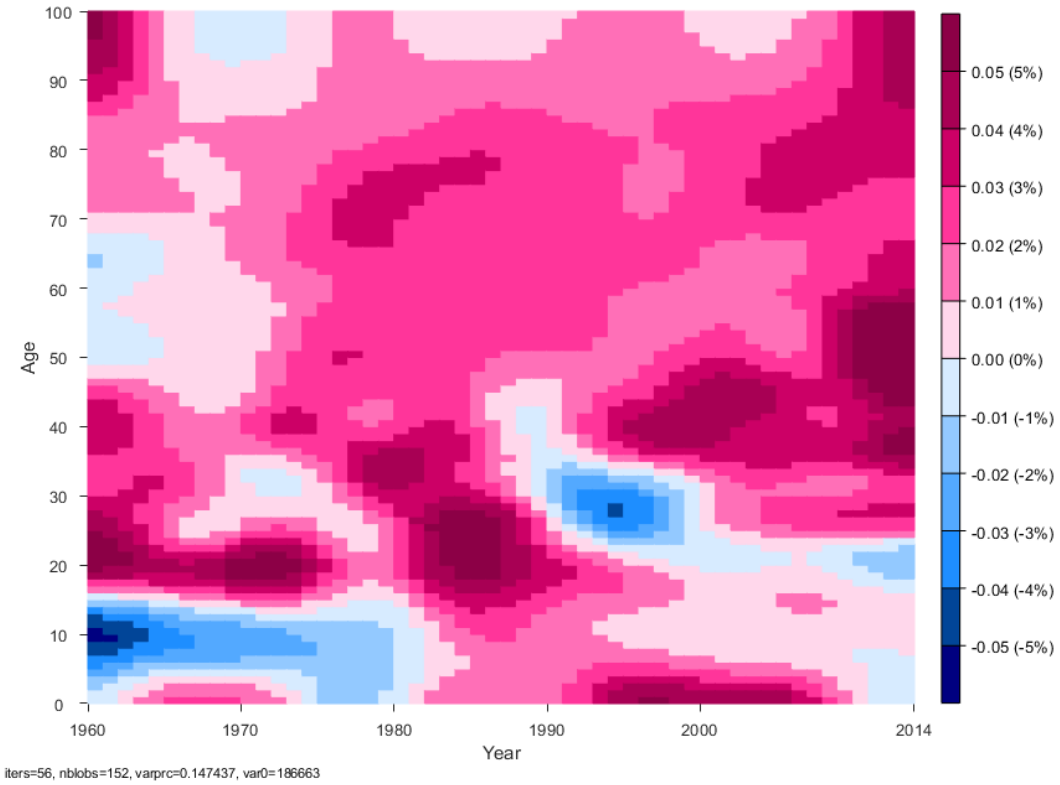
Luxembourg

Males



iters=67, nblobs=162, varprc=0.237889, var0=179780

Females



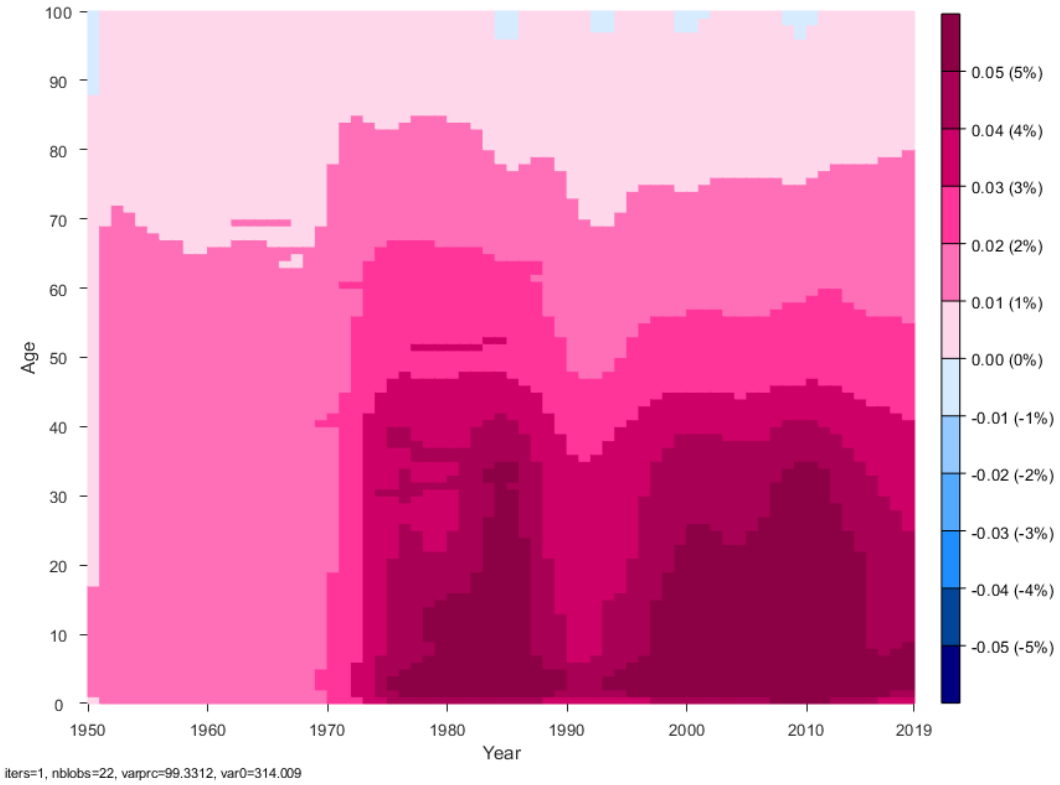
iters=56, nblobs=152, varprc=0.147437, var0=186663

Western Sahara

Males

iters=1, nblobs=25, varprc=98.9544, var0=242.07

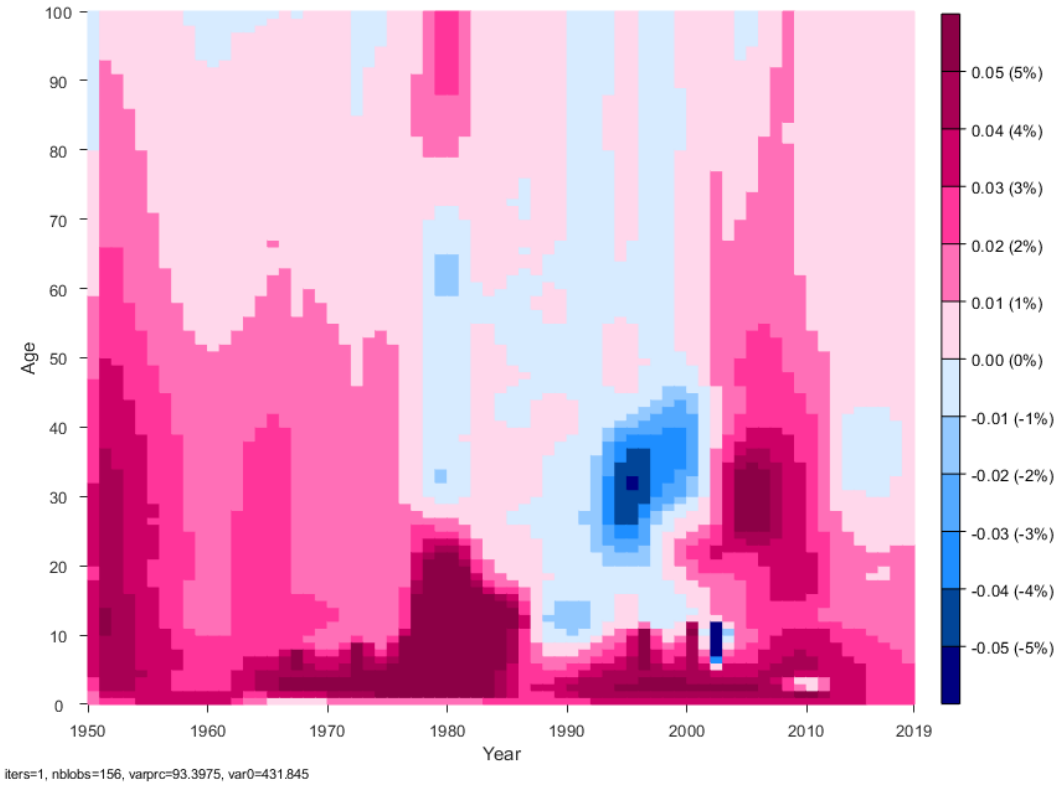
Females



iters=1, nblobs=22, varprc=99.3312, var0=314.009

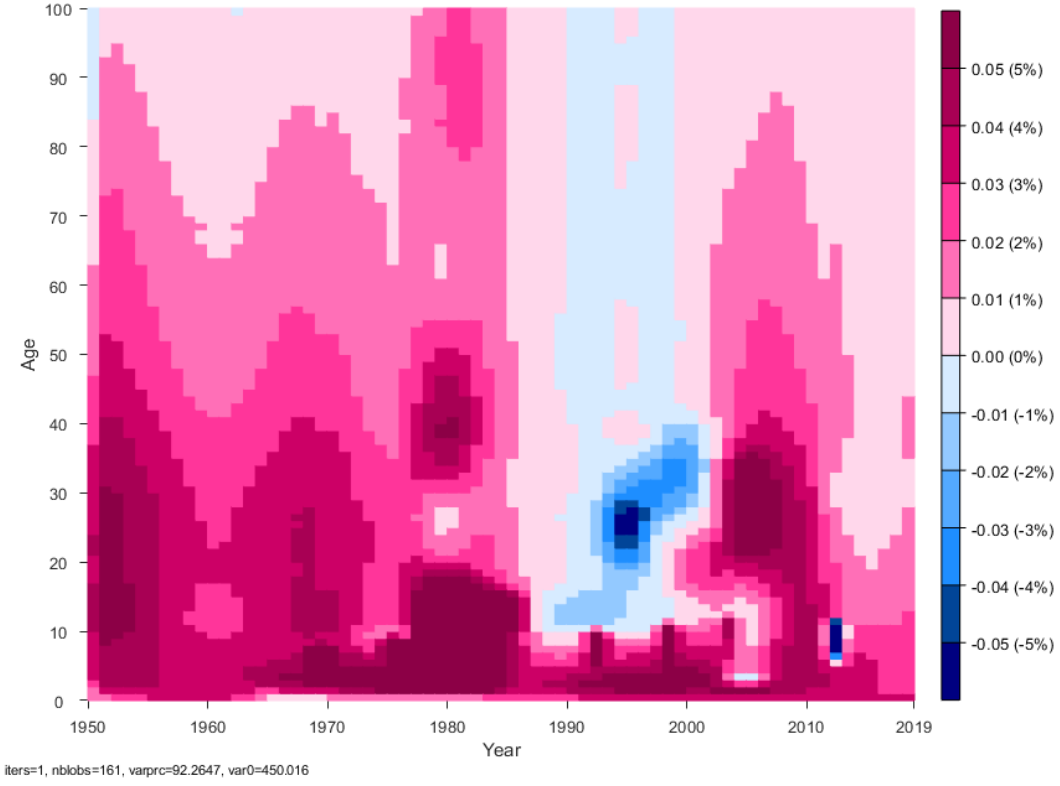
Suriname

Males



iters=1, nblobs=156, varprc=93.3975, var0=431.845

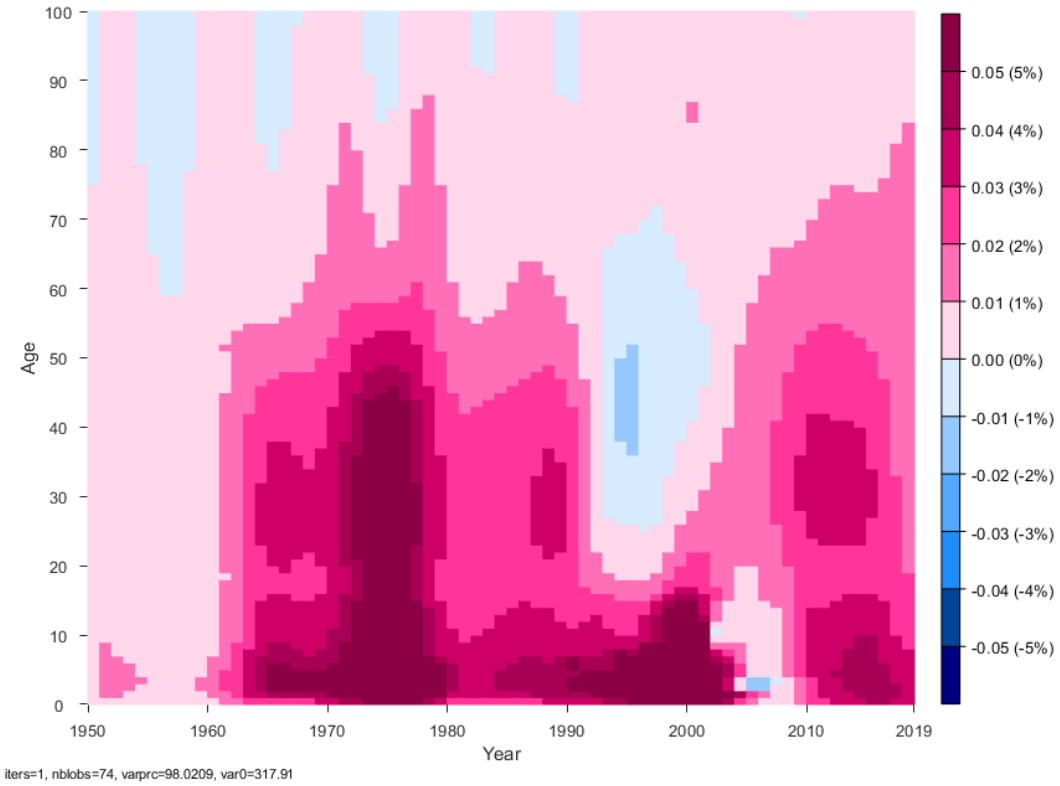
Females



iters=1, nblobs=161, varprc=92.2647, var0=450.016

Cabo Verde

Males



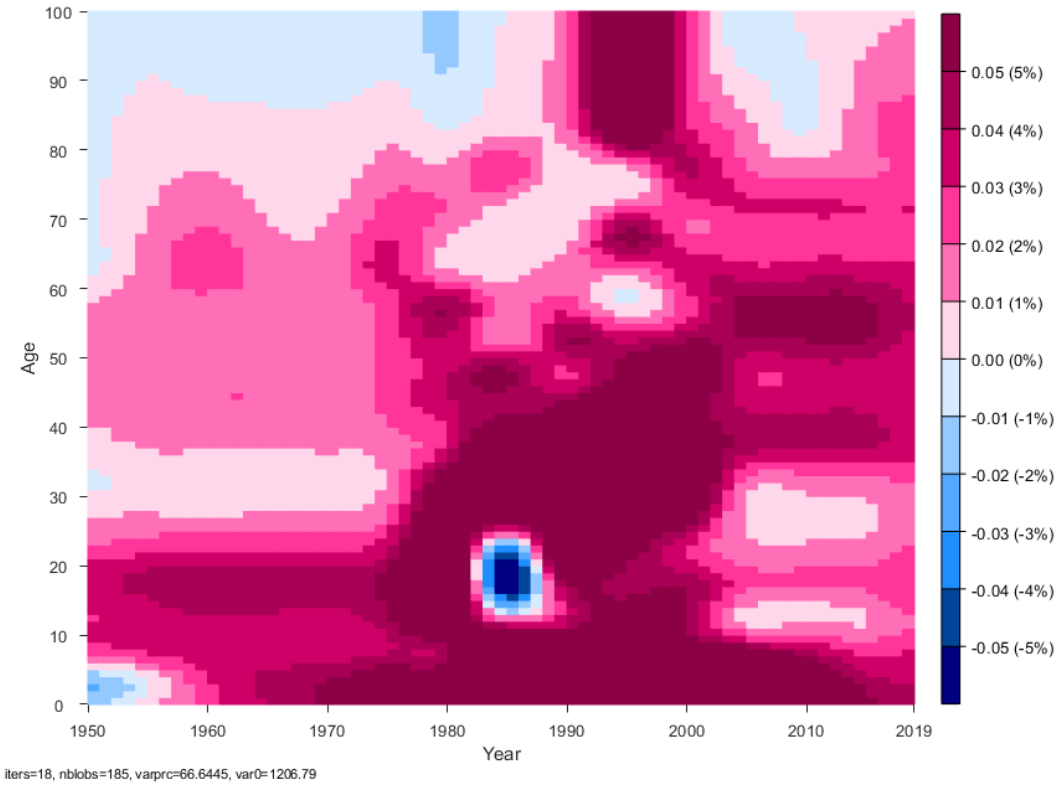
iters=1, nblobs=74, varprc=98.0209, var0=317.91

Females

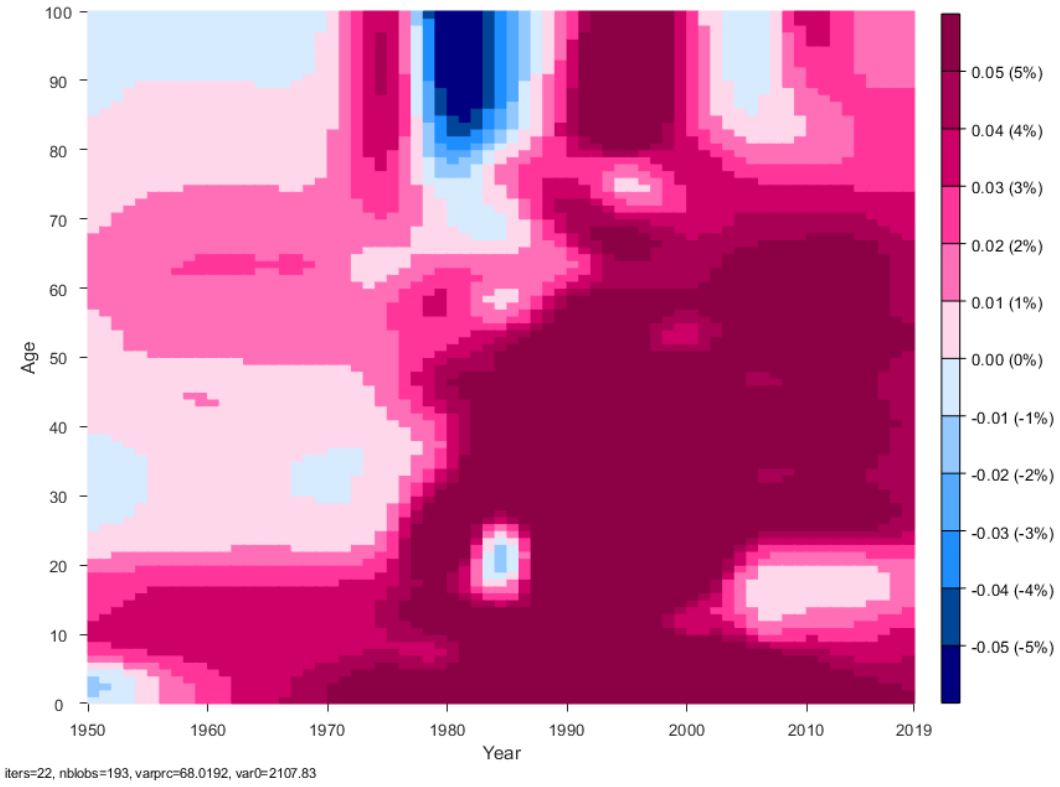
iters=1, nblobs=52, varprc=98.8144, var0=634.176

Maldives

Males

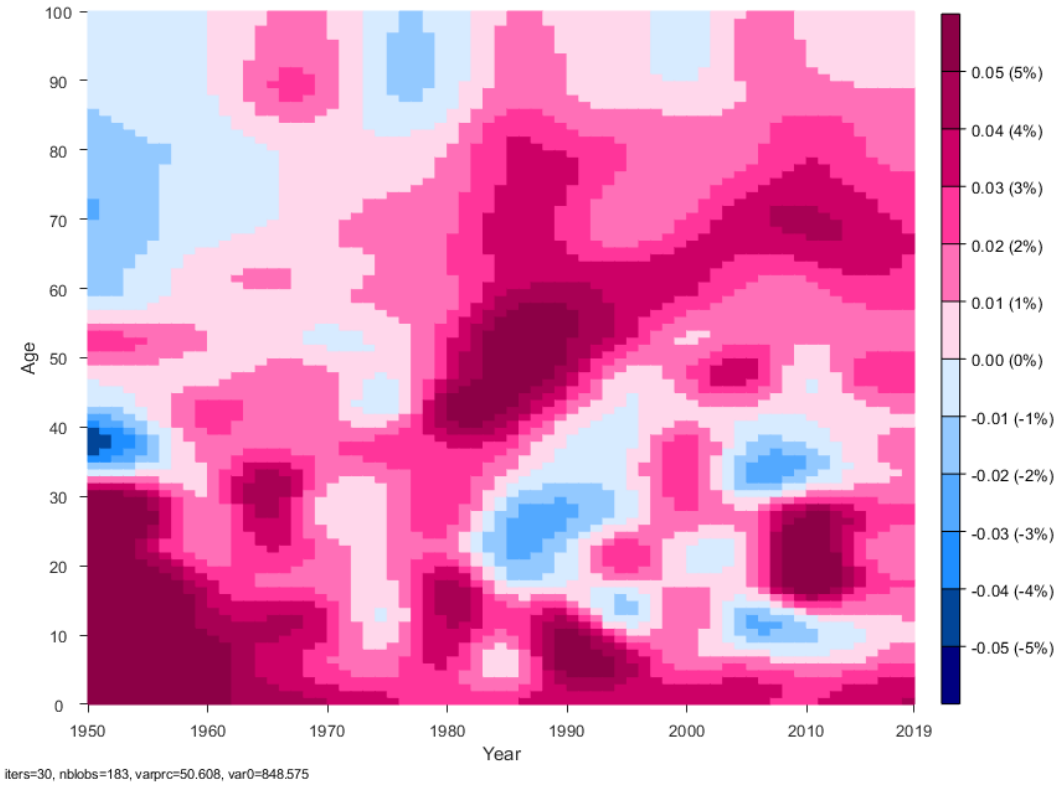


Females



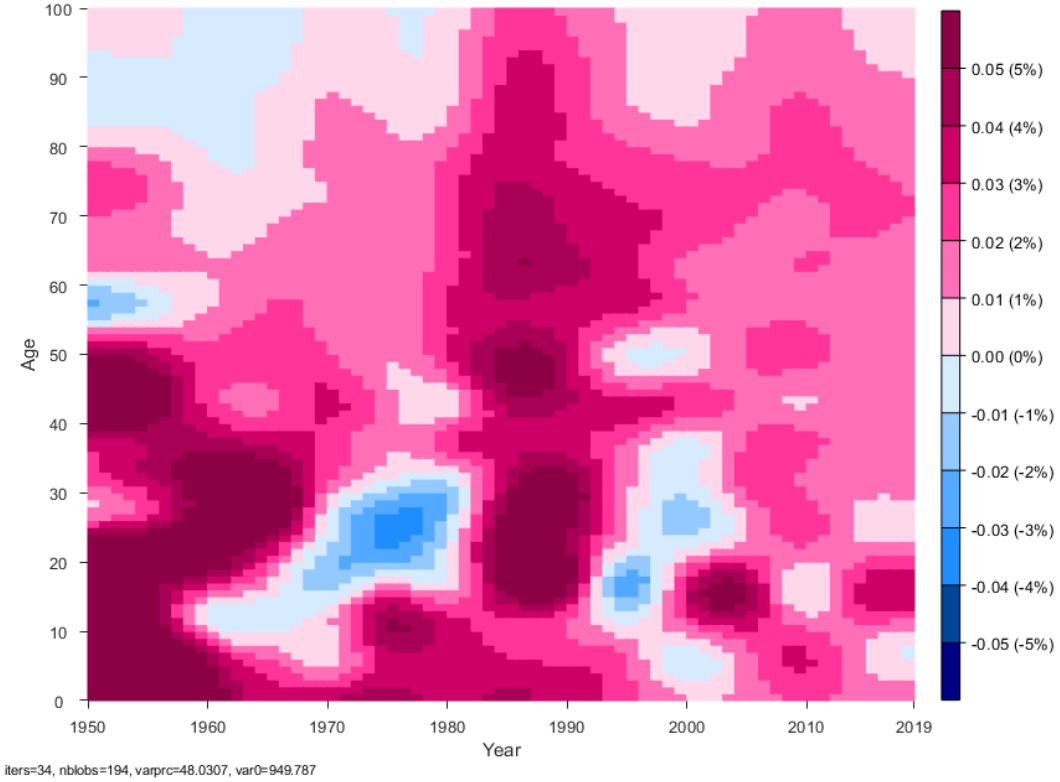
Malta

Males



iters=30, nblobs=183, varprc=50.608, var0=848.575

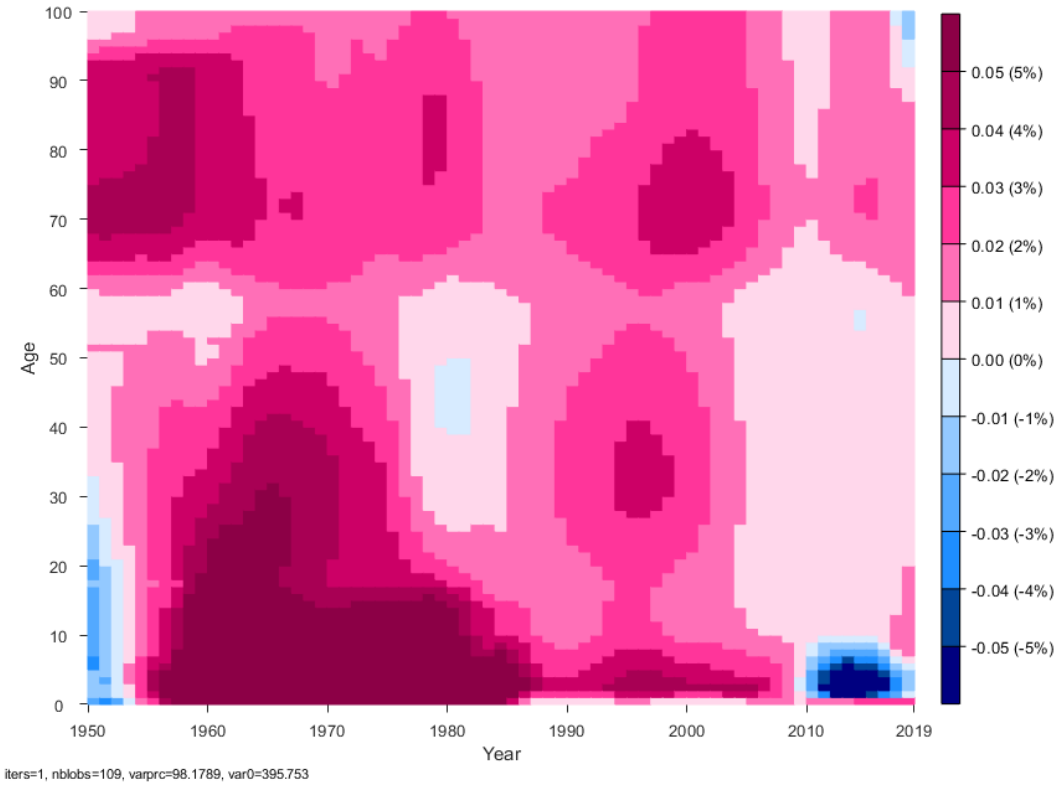
Females



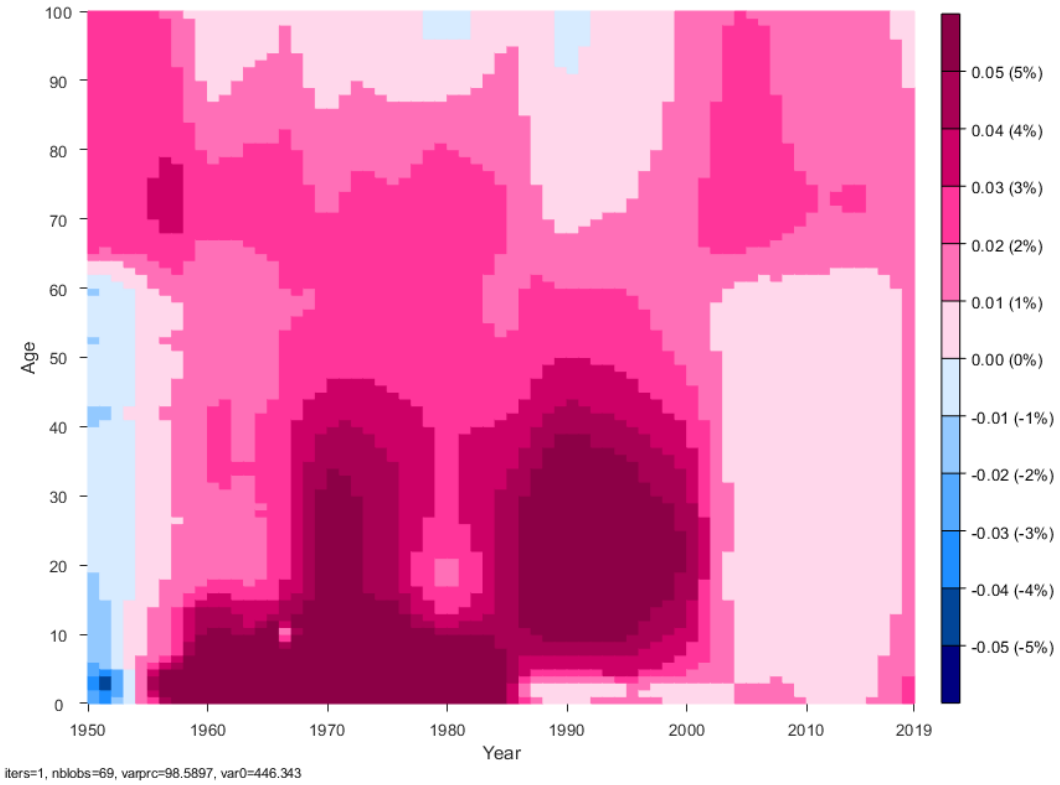
iters=34, nblobs=194, varprc=48.0307, var0=949.787

Brunei Darussalam

Males

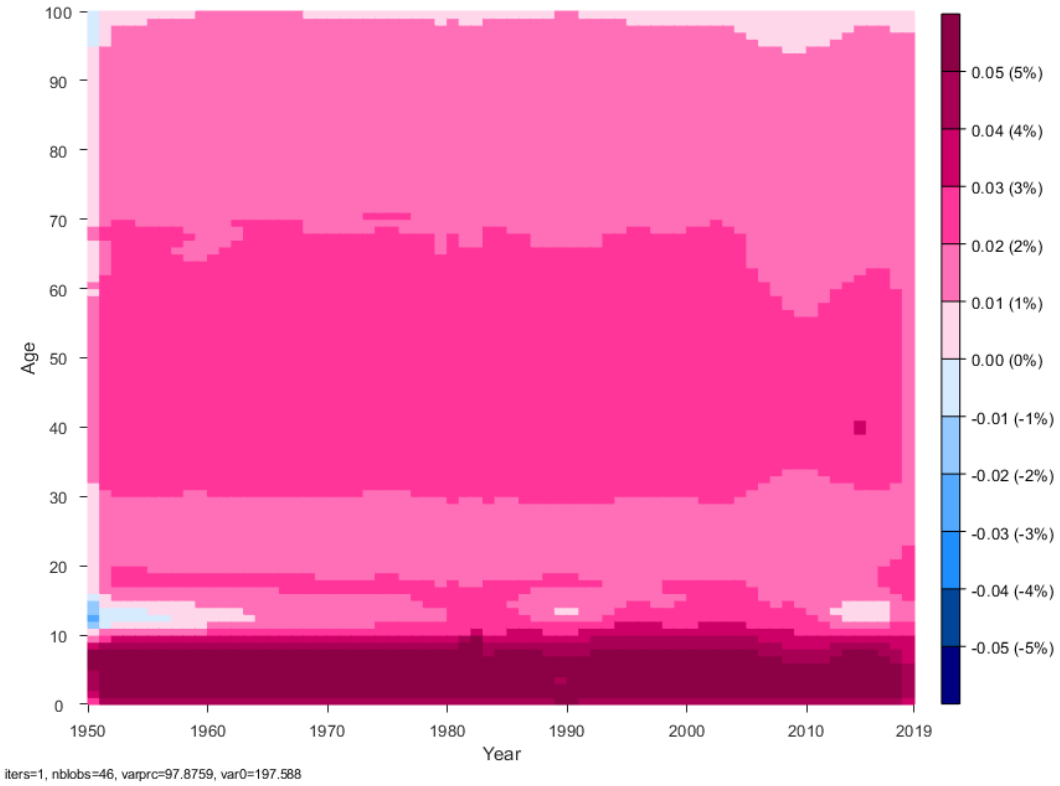


Females



Guadeloupe

Males



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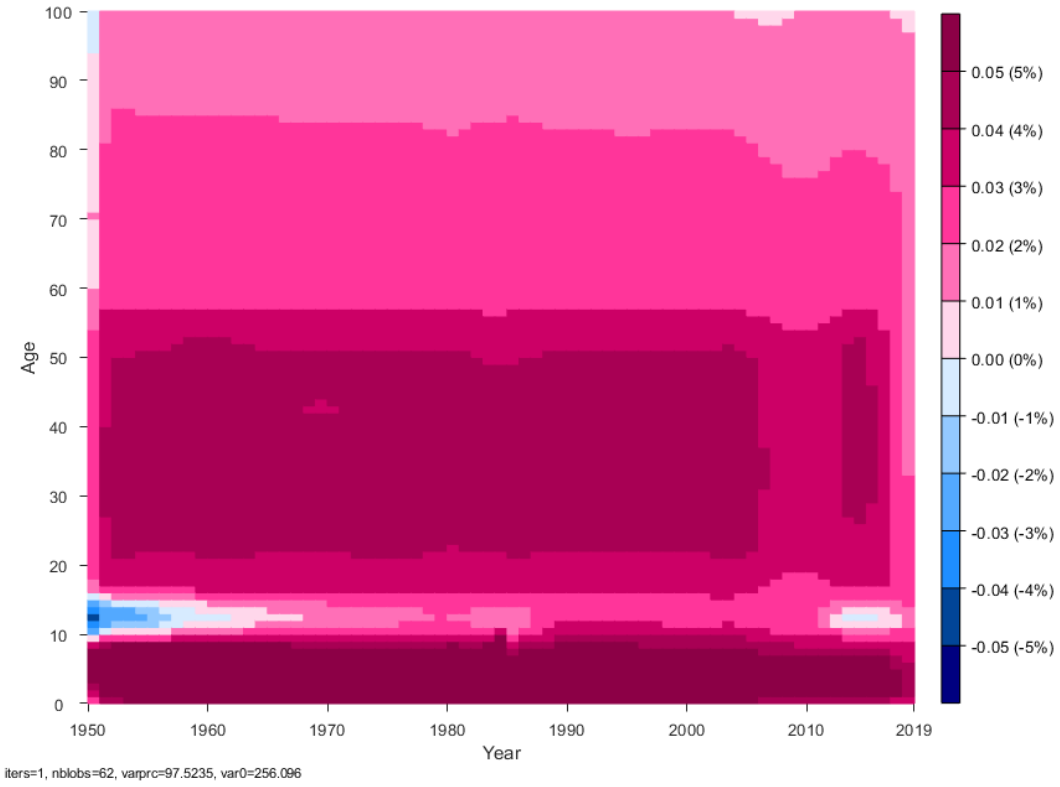
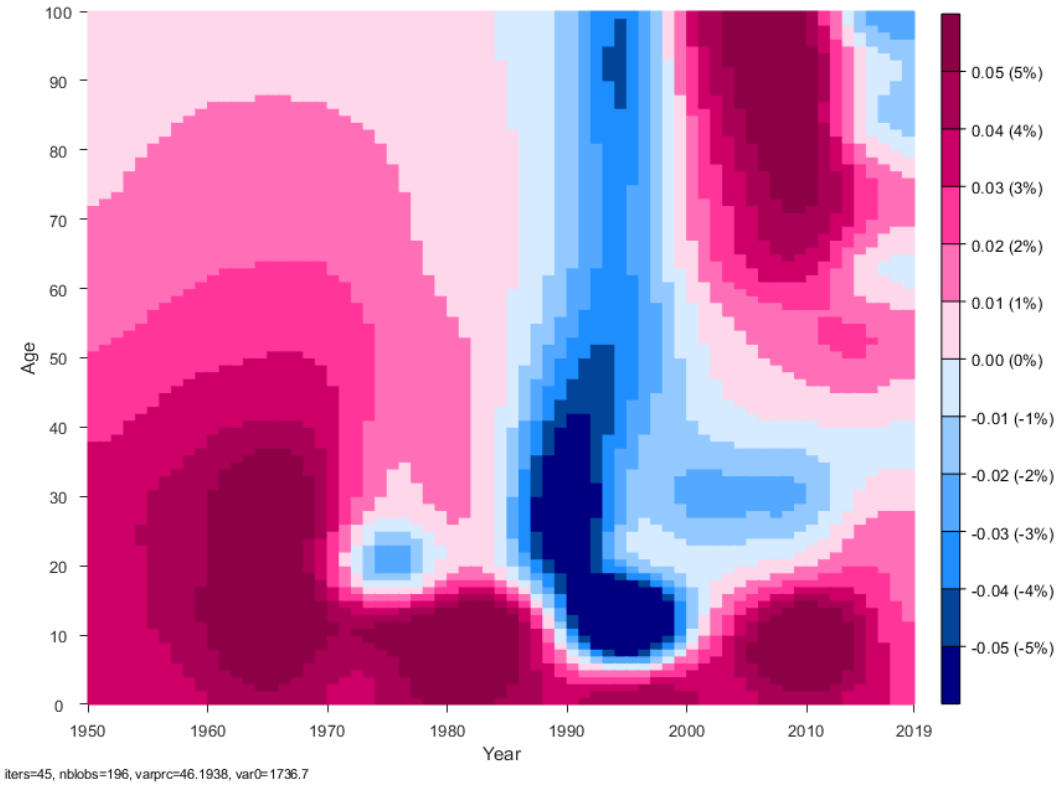
Females



iters=1, nblobs=62, varprc=97.5235, var0=256.096

Belize

Males



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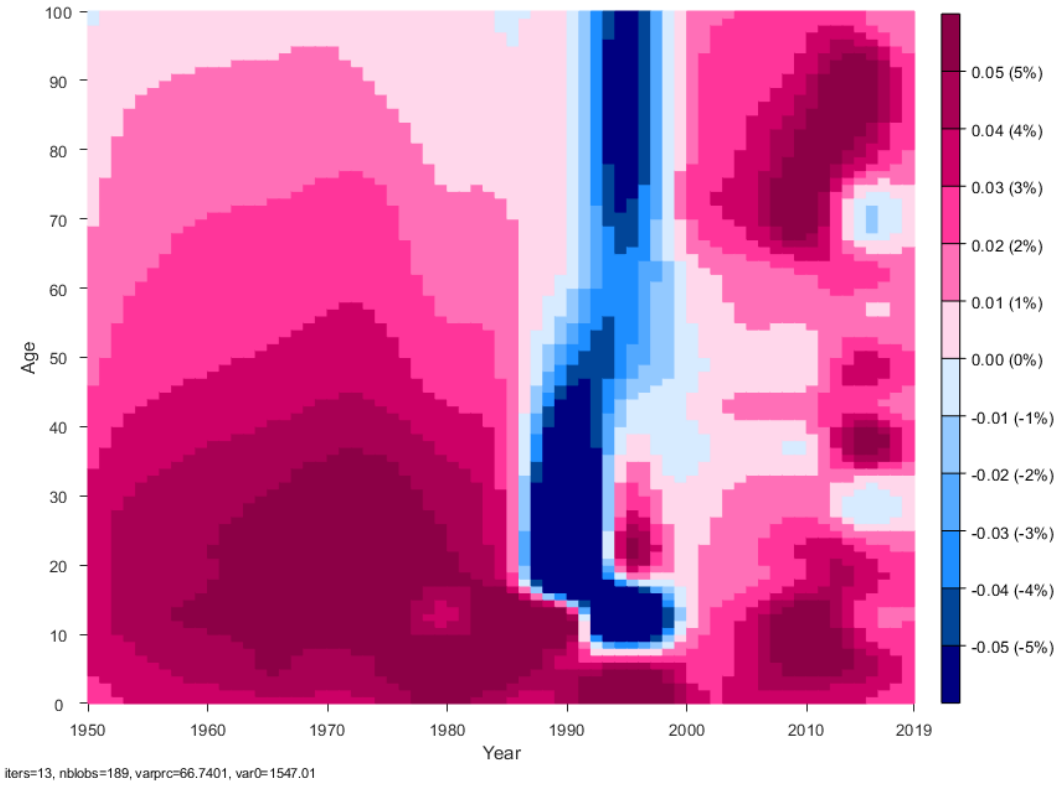
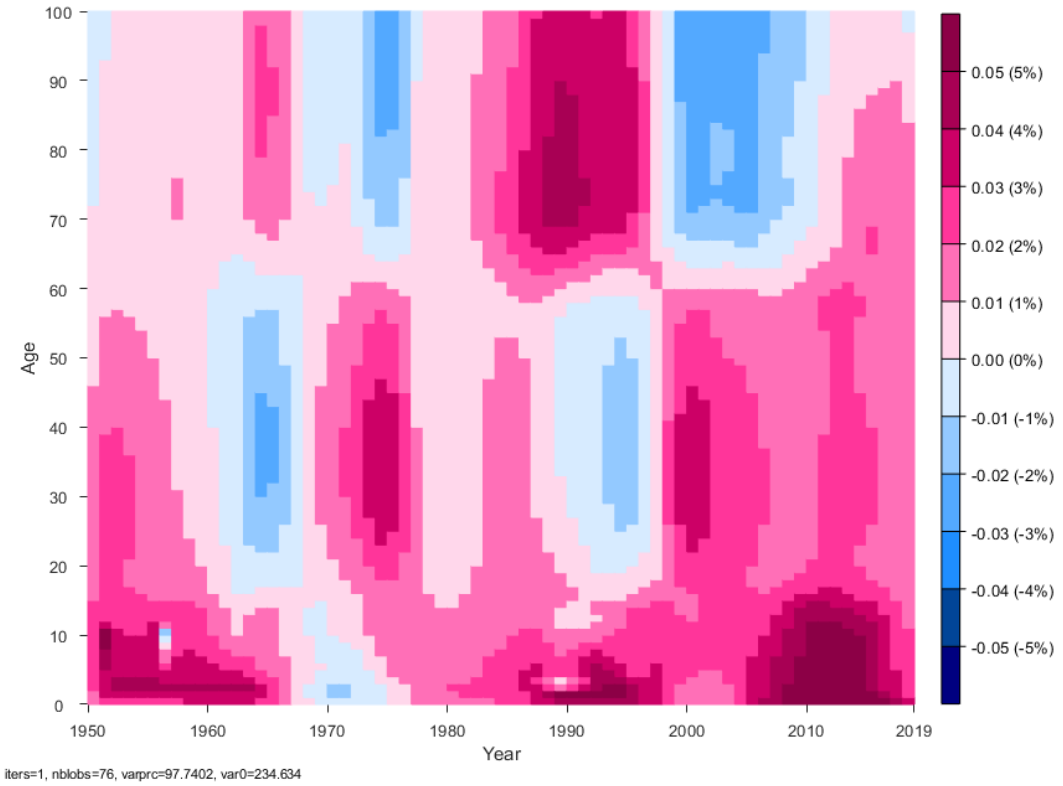
Females



iters=13, nblobs=189, varprc=66.7401, var0=1547.01

Bahamas

Males



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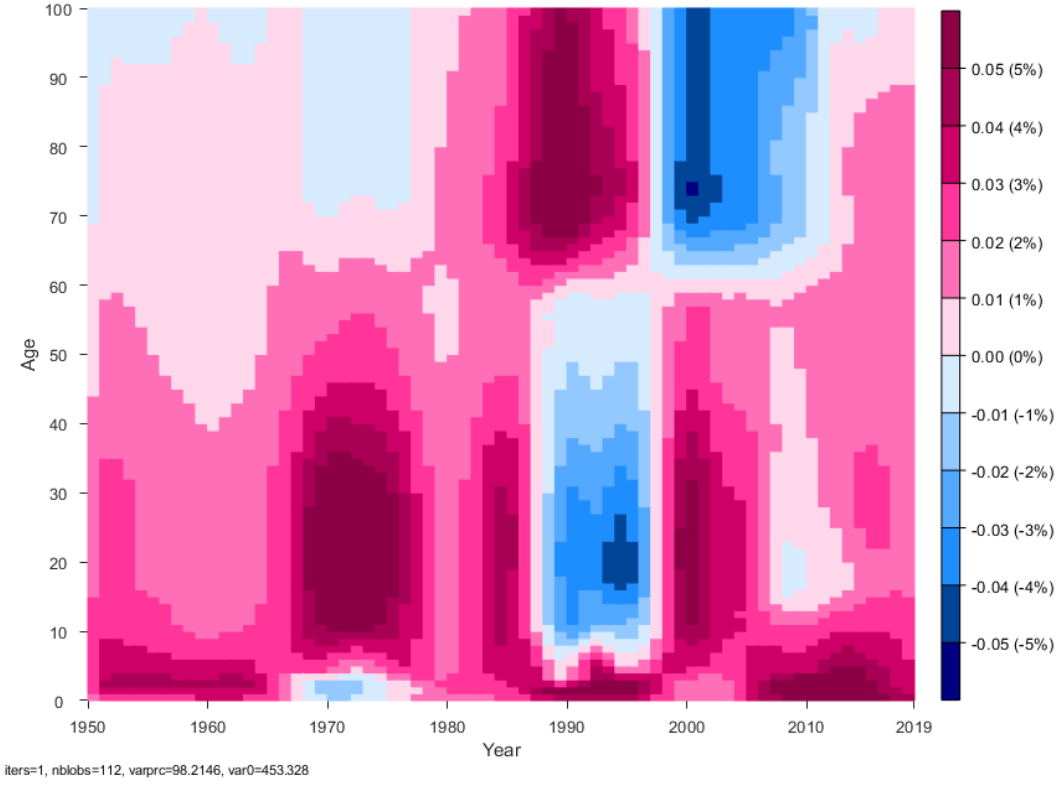
Females



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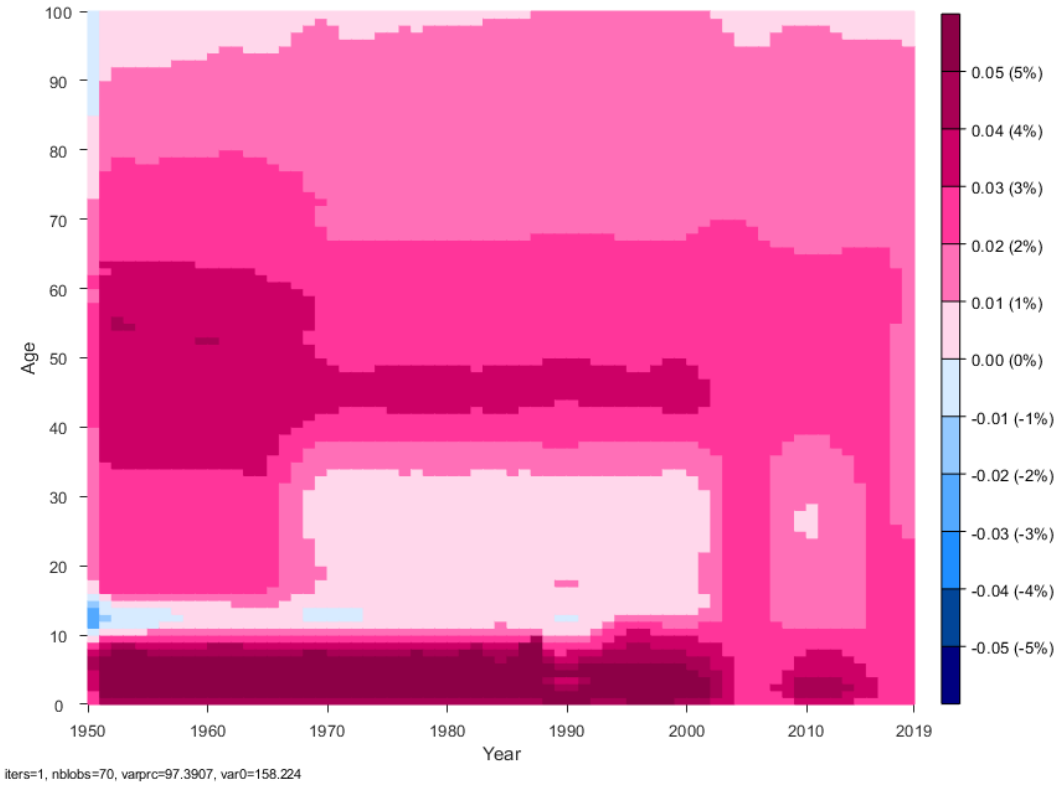
Martinique

Males



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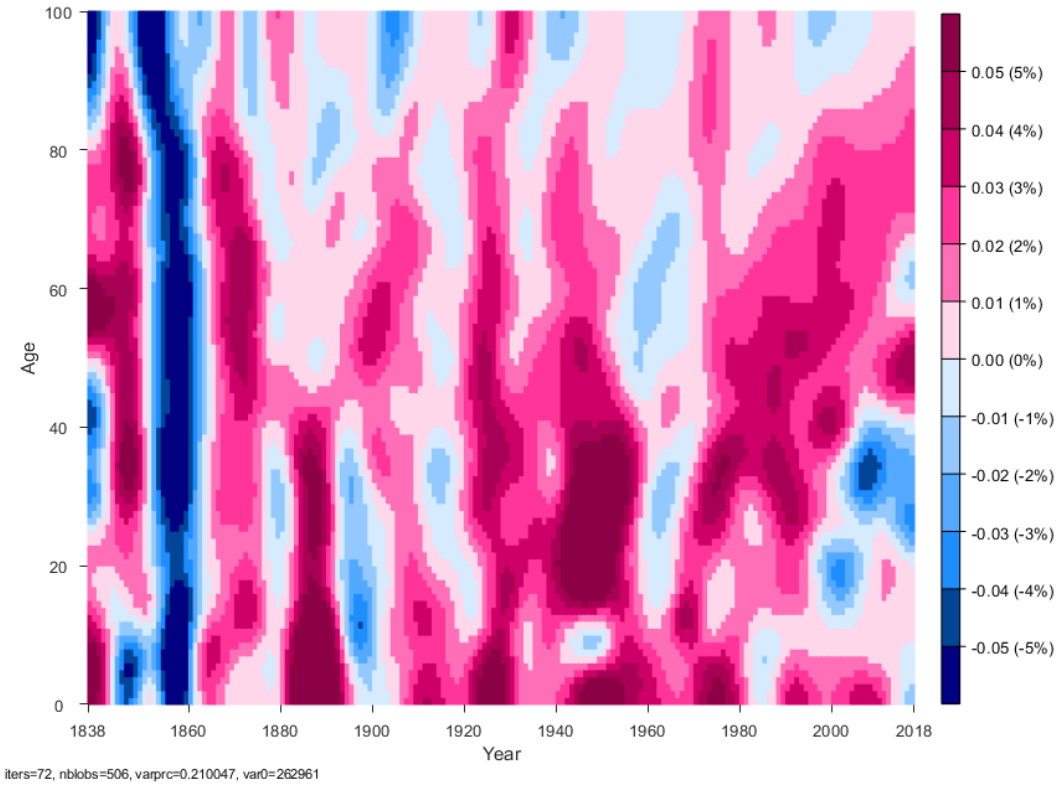
Females

iters=1, nblobs=67, varprc=96.4734, var0=175.026

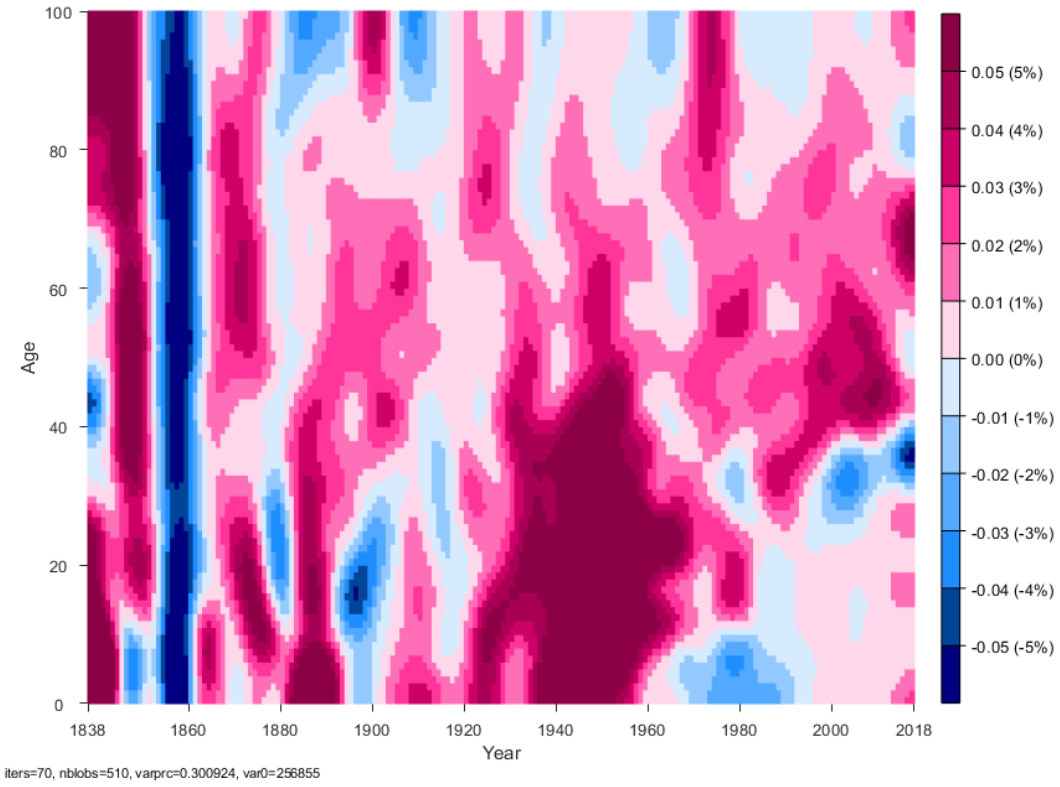
Iceland

Males



iters=72, nblobs=506, varprc=0.210047, var0=262961

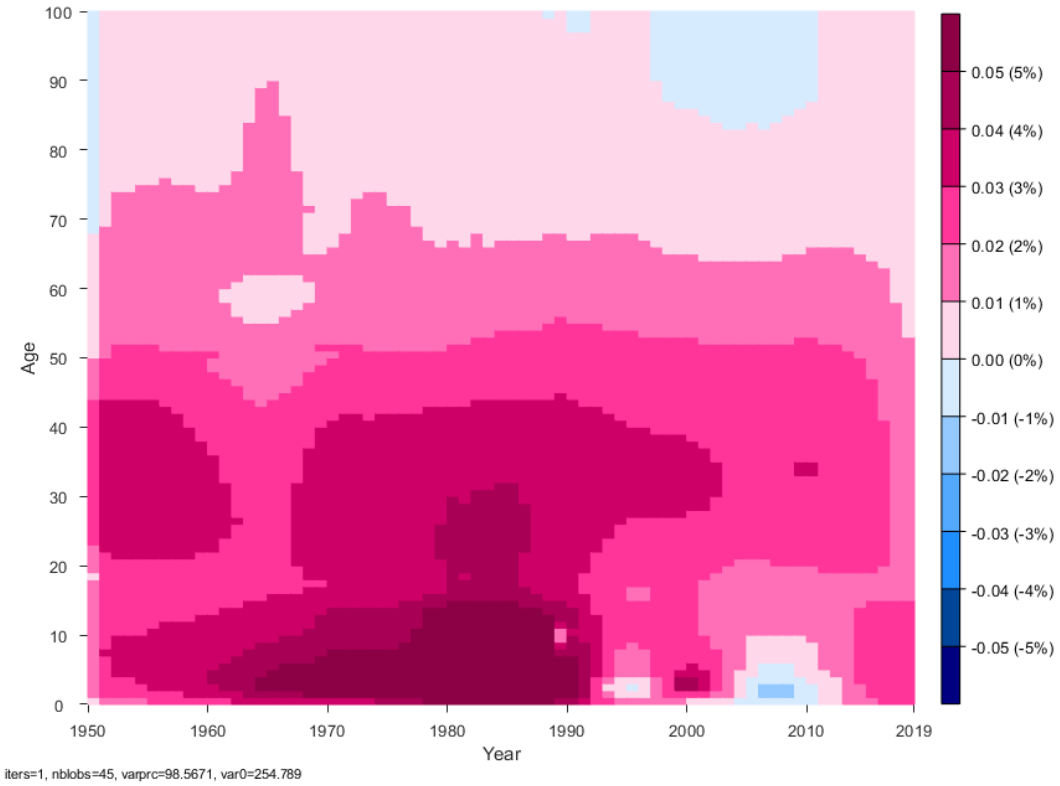
Females



iters=70, nblobs=510, varprc=0.300924, var0=256855

Vanuatu

Males



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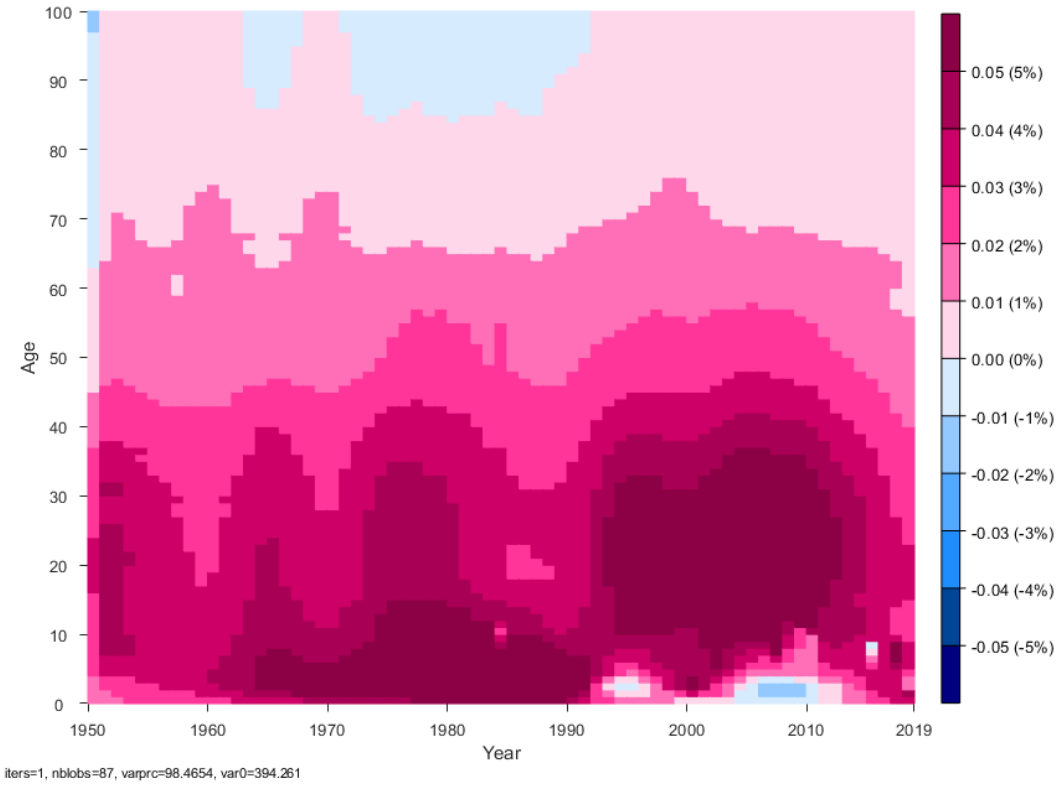
Females



iters=1, nblobs=87, varprc=98.4654, var0=394.261

French Guiana

Males

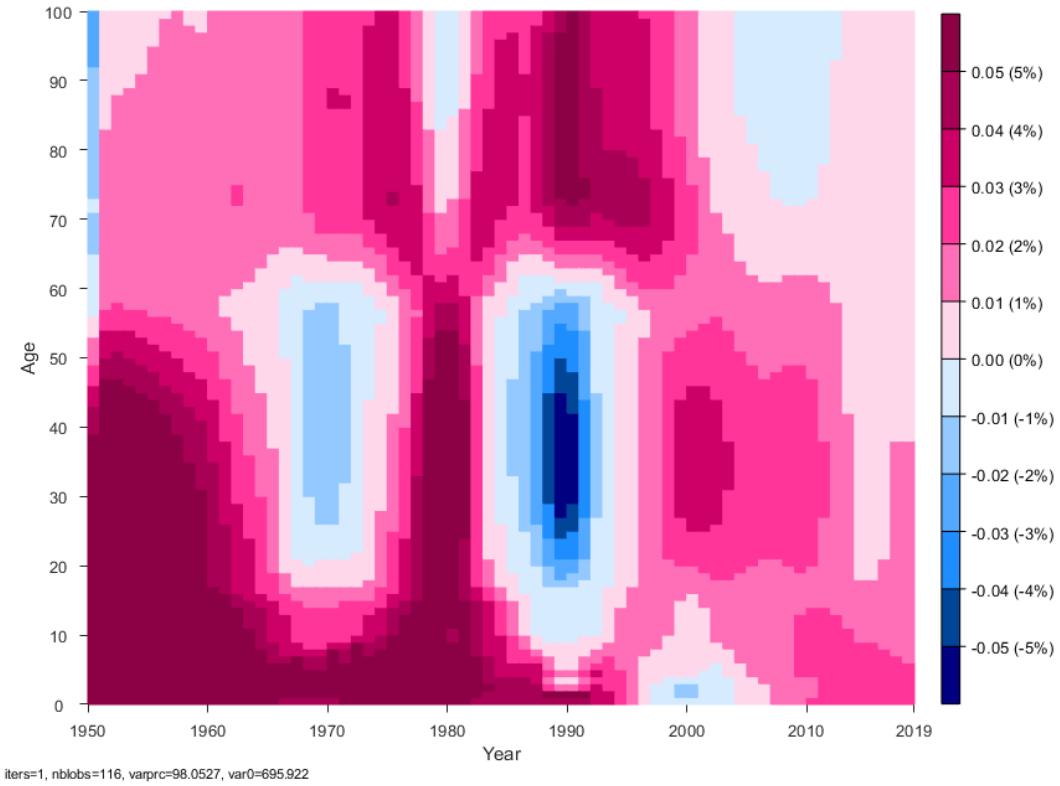
iters=1, nblobs=64, varprc=98.3, var0=416.76

Females

iters=1, nblobs=54, varprc=98.3091, var0=469.266

Barbados

Males



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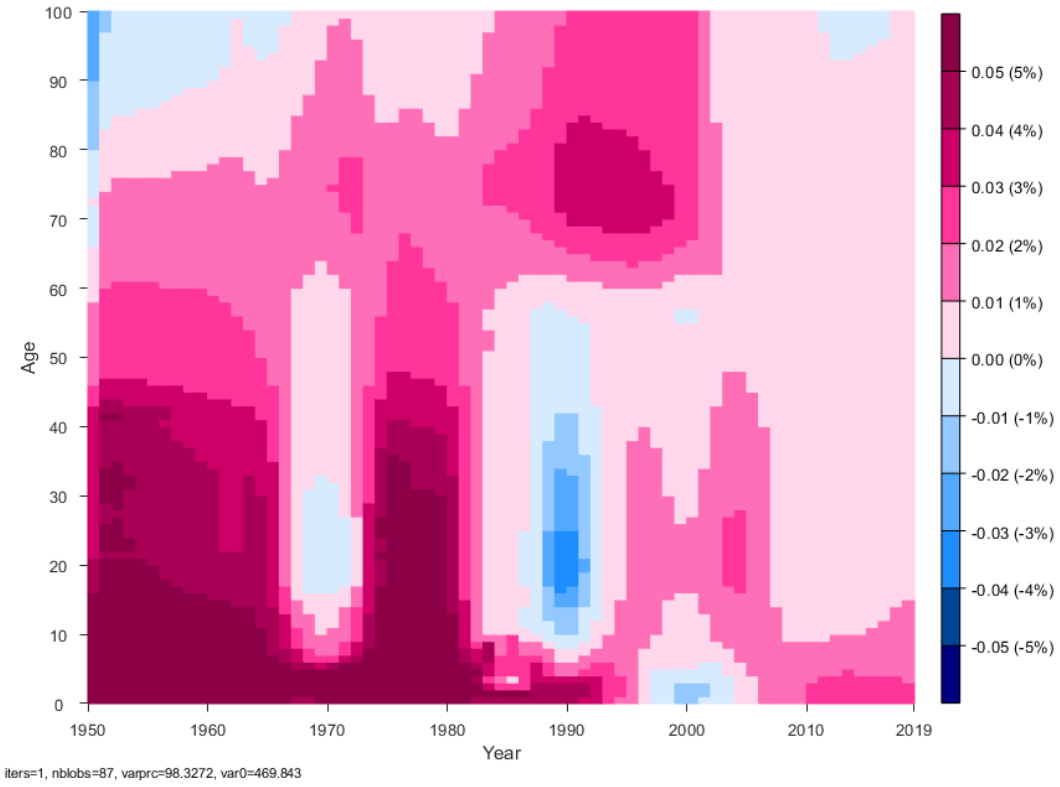
Females



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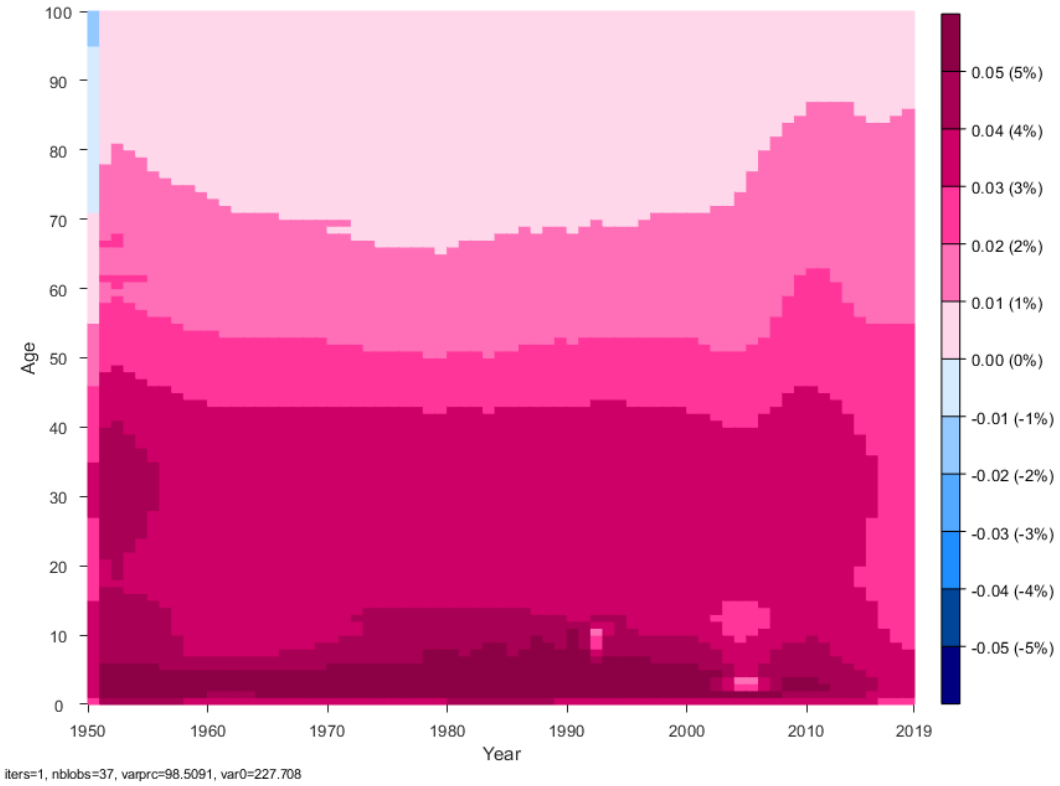
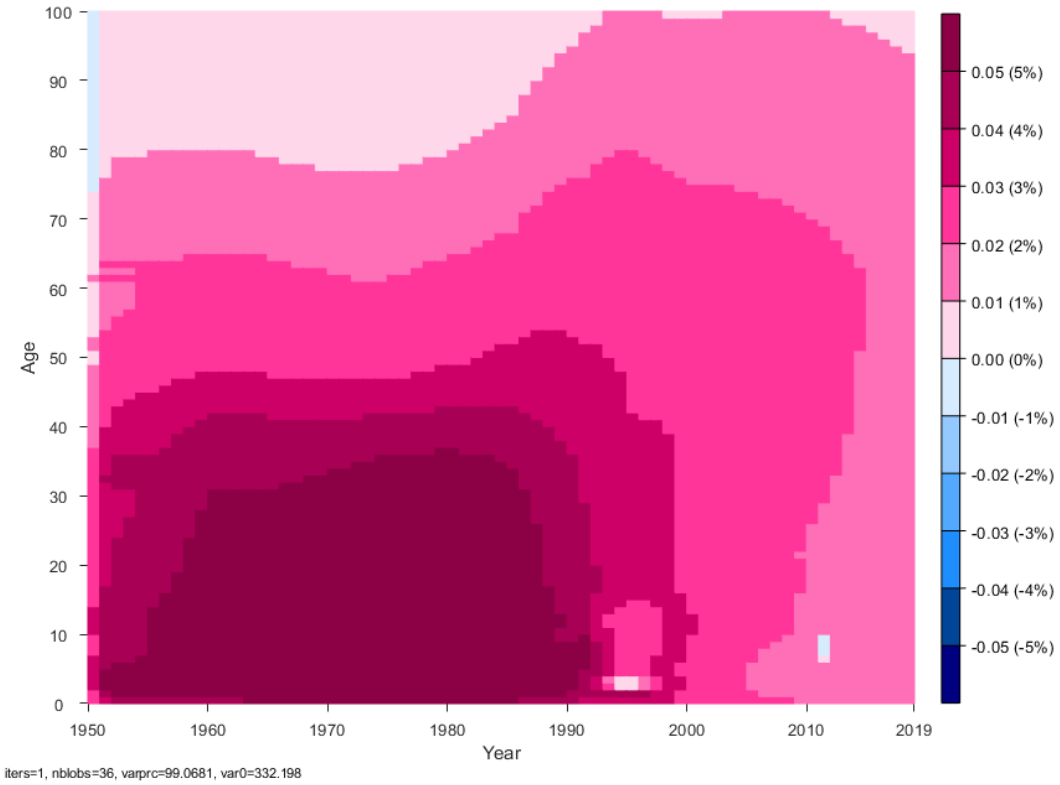
New Caledonia

Males



iters=1, nblobs=37, varprc=98.5091, var0=227.708

Females



iters=1, nblobs=36, varprc=99.0681, var0=332.198

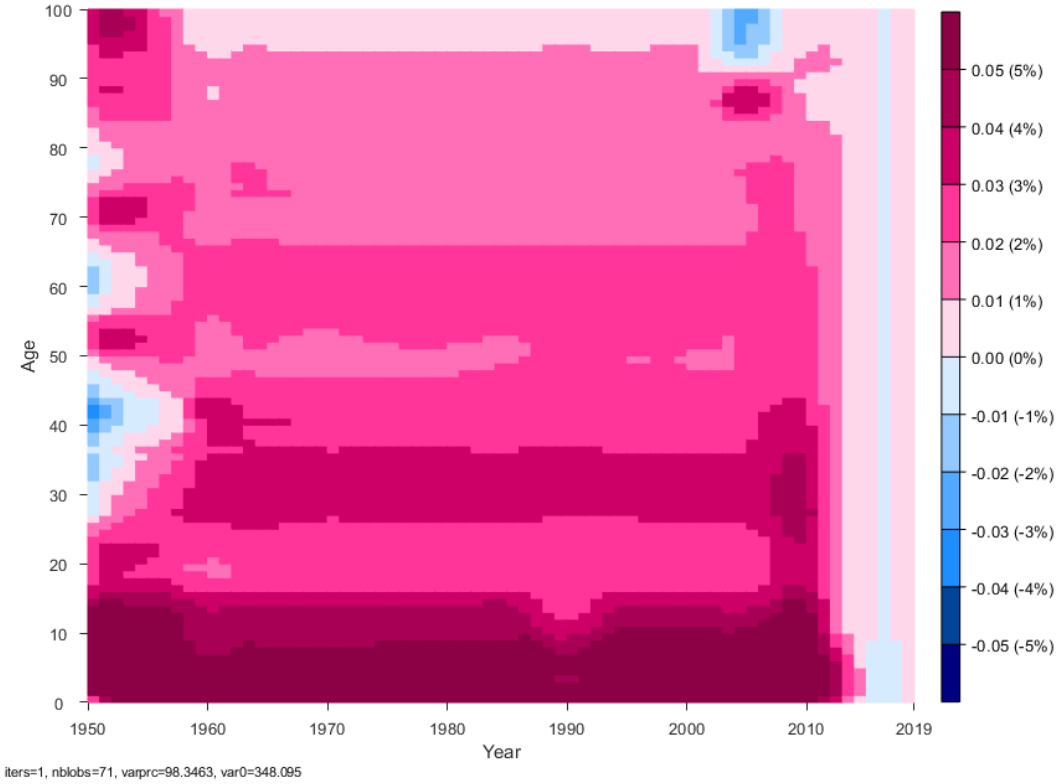
French Polynesia

Males

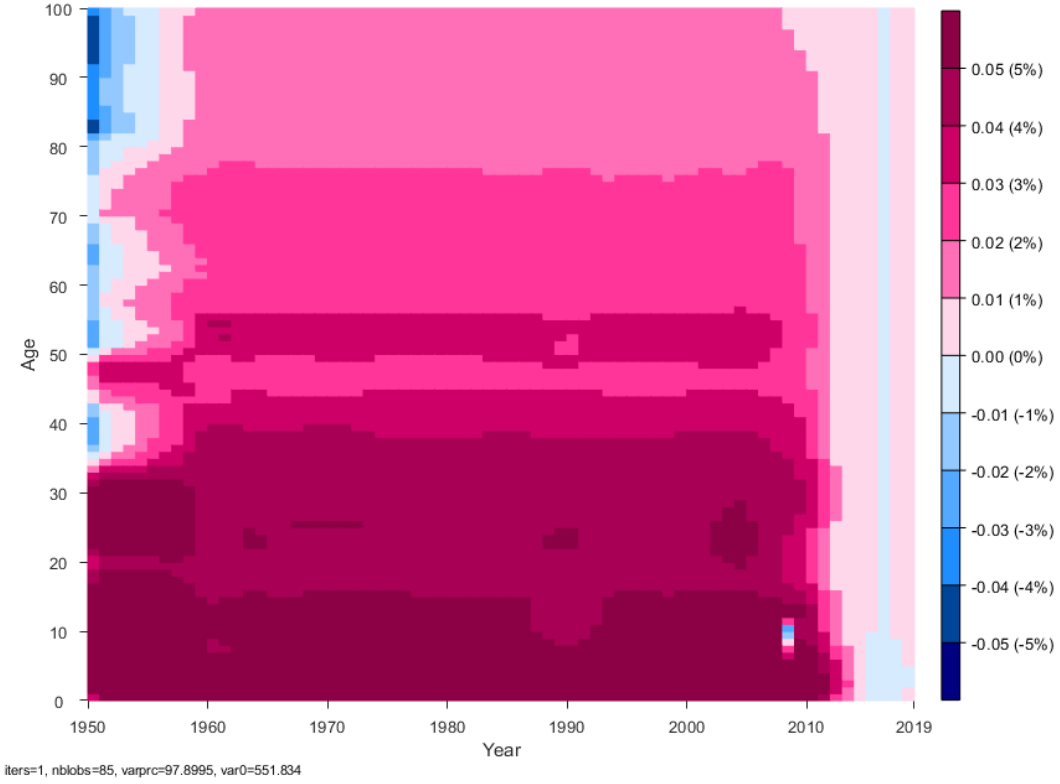
Females

Mayotte

Males

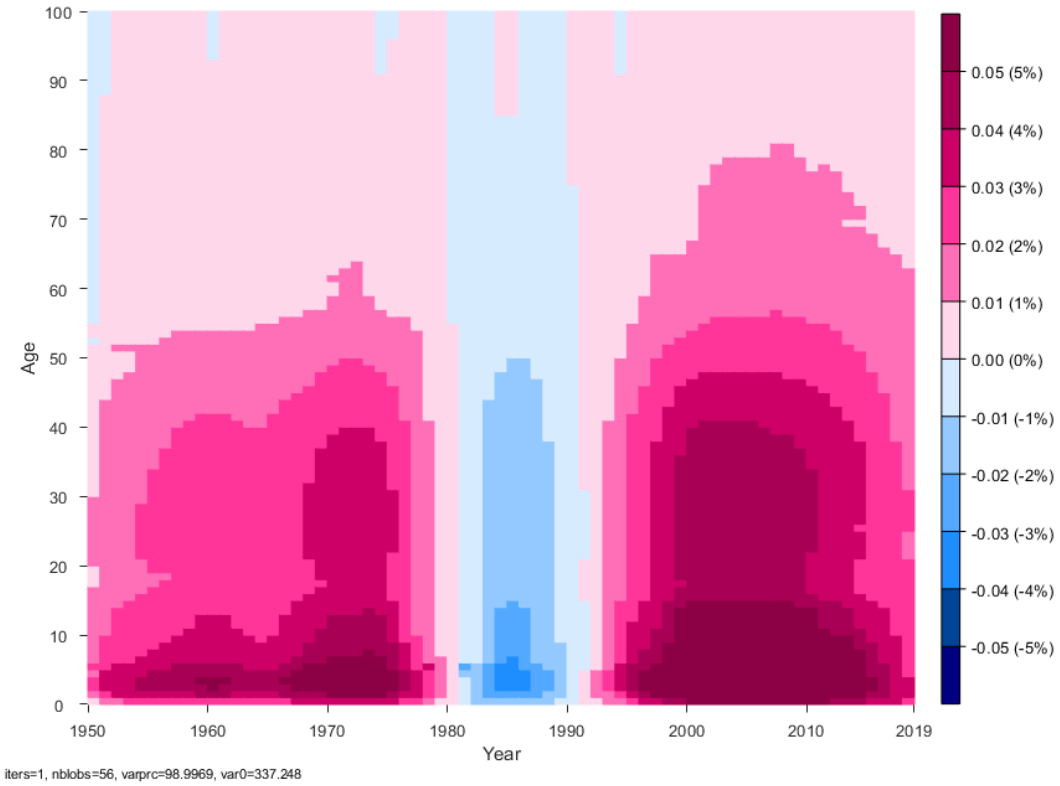


Females



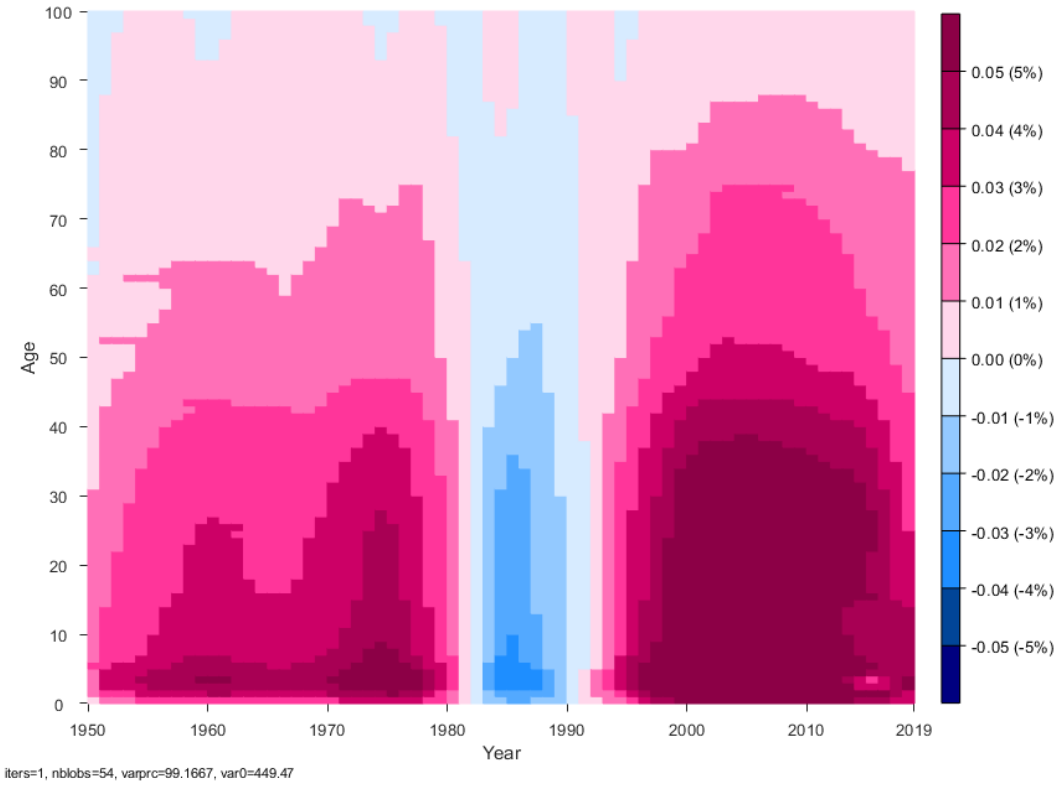
Sao Tome and Principe

Males



iters=1, nblobs=56, varprc=98.9969, var0=337.248

Females



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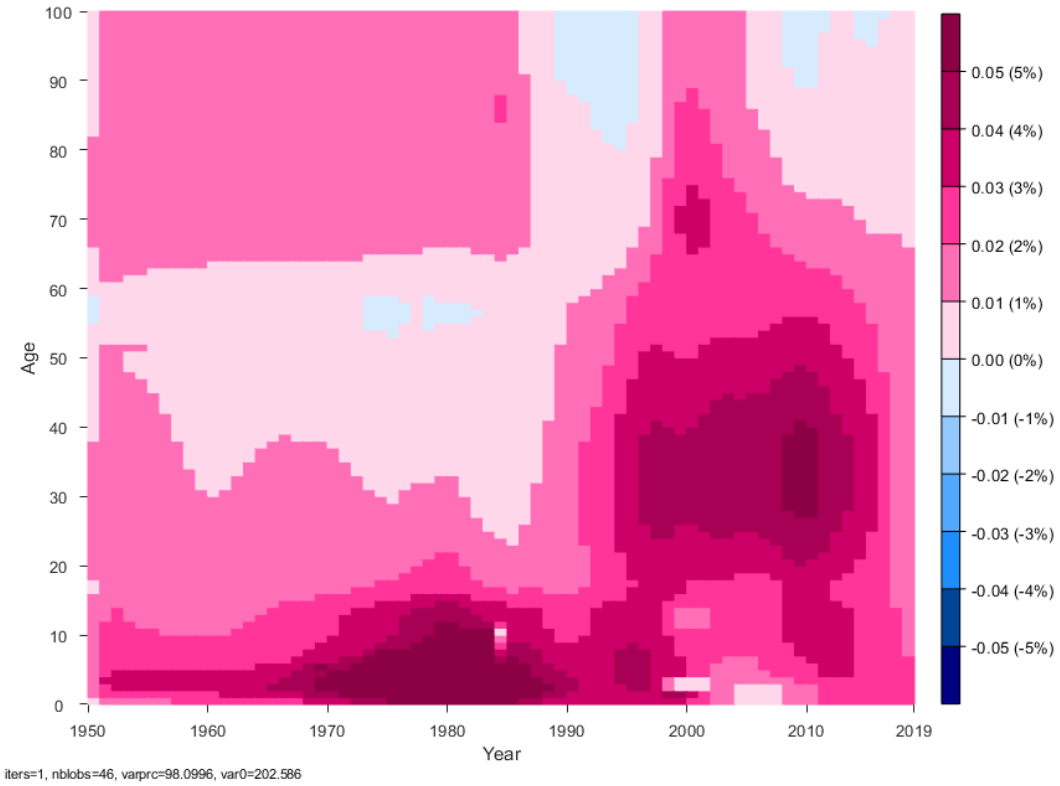
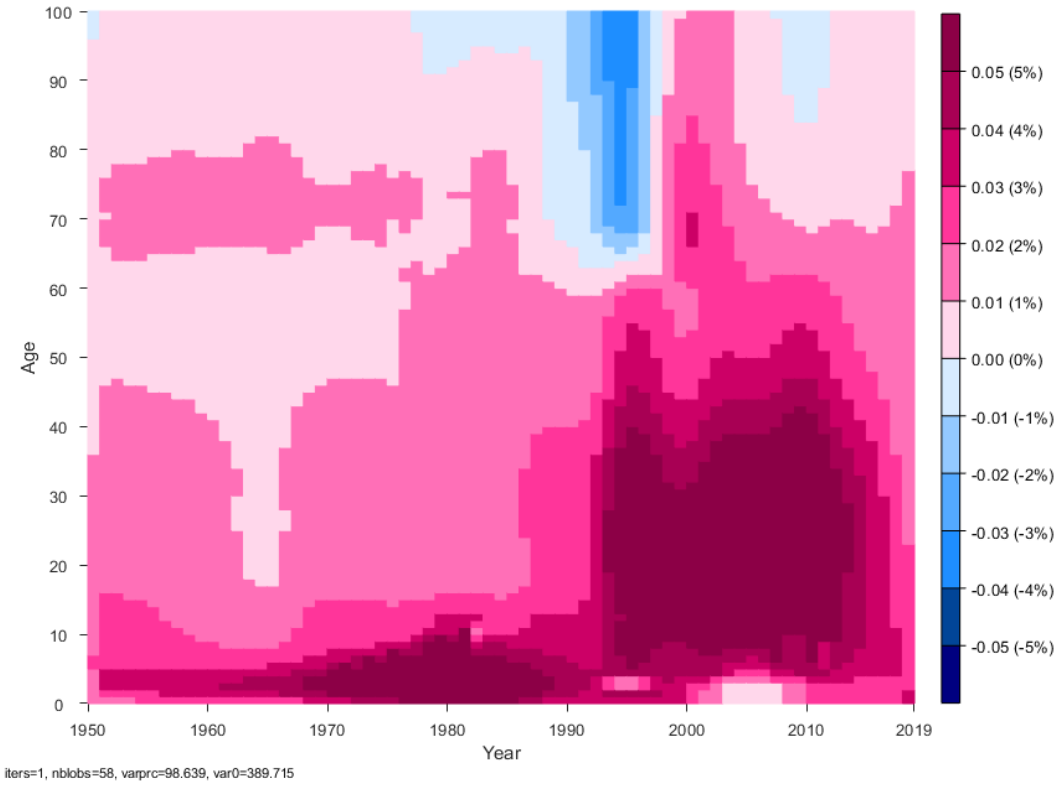
Samoa

Males



iters=1, nblobs=46, varprc=98.0996, var0=202.586

Females



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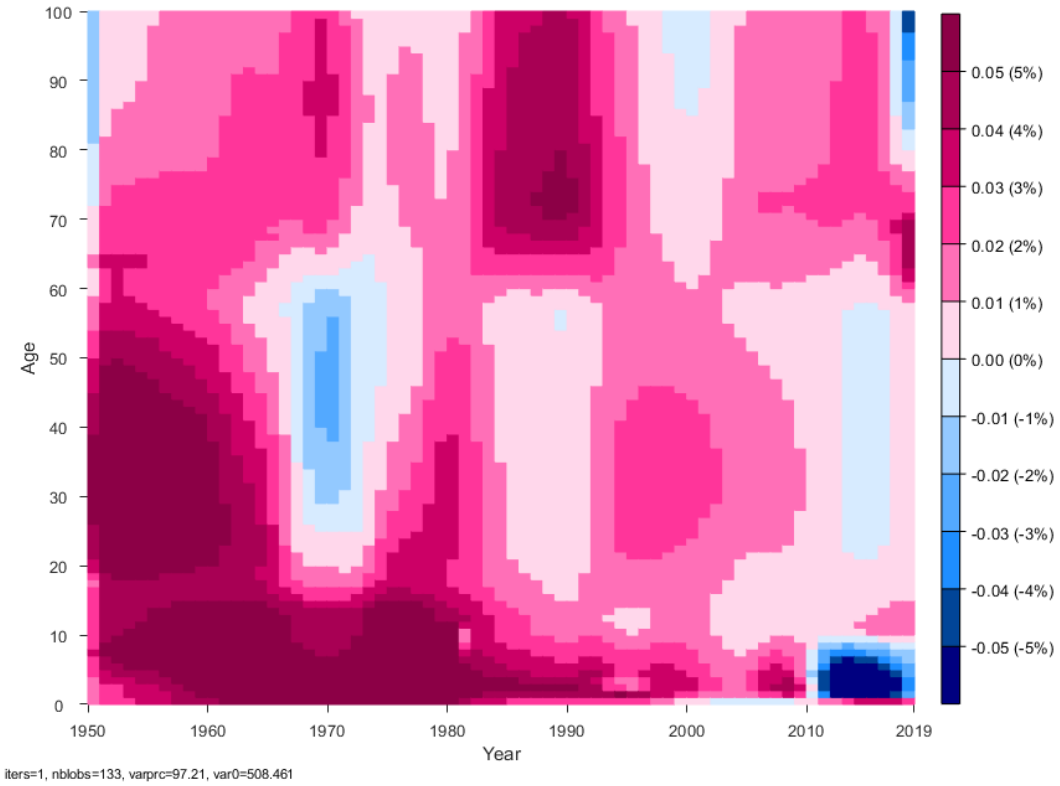
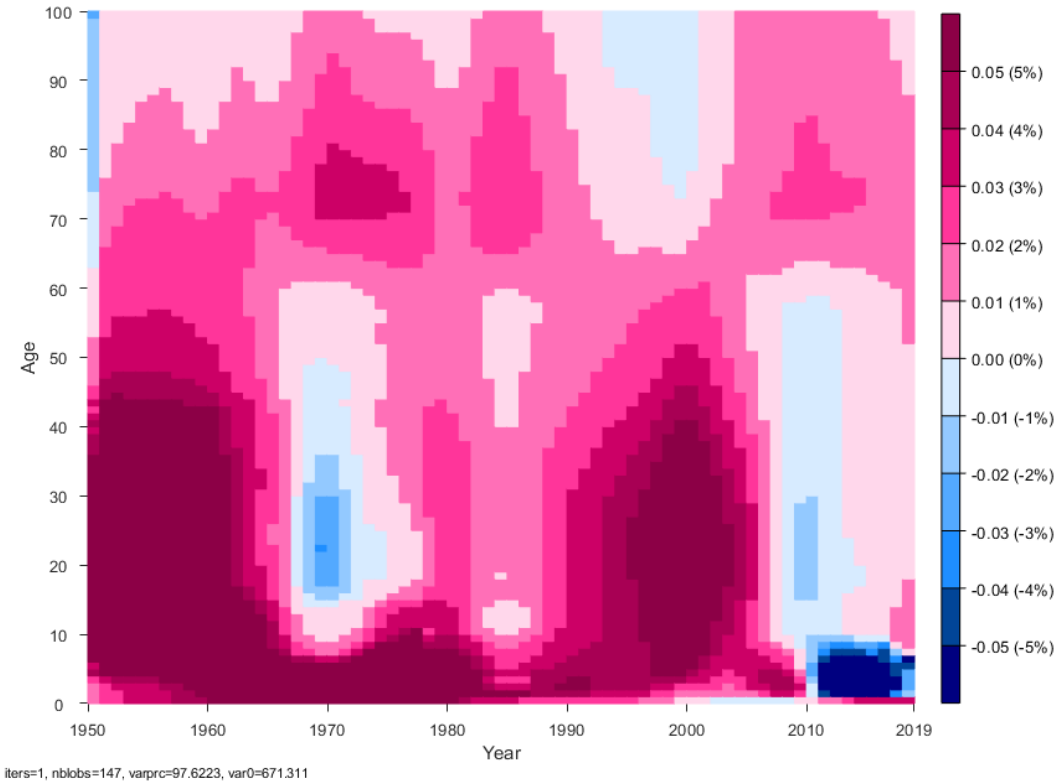
Saint Lucia

Males



iters=1, nblobs=133, varprc=97.21, var0=508.461

Females



iters=1, nblobs=147, varprc=97.6223, var0=671.311

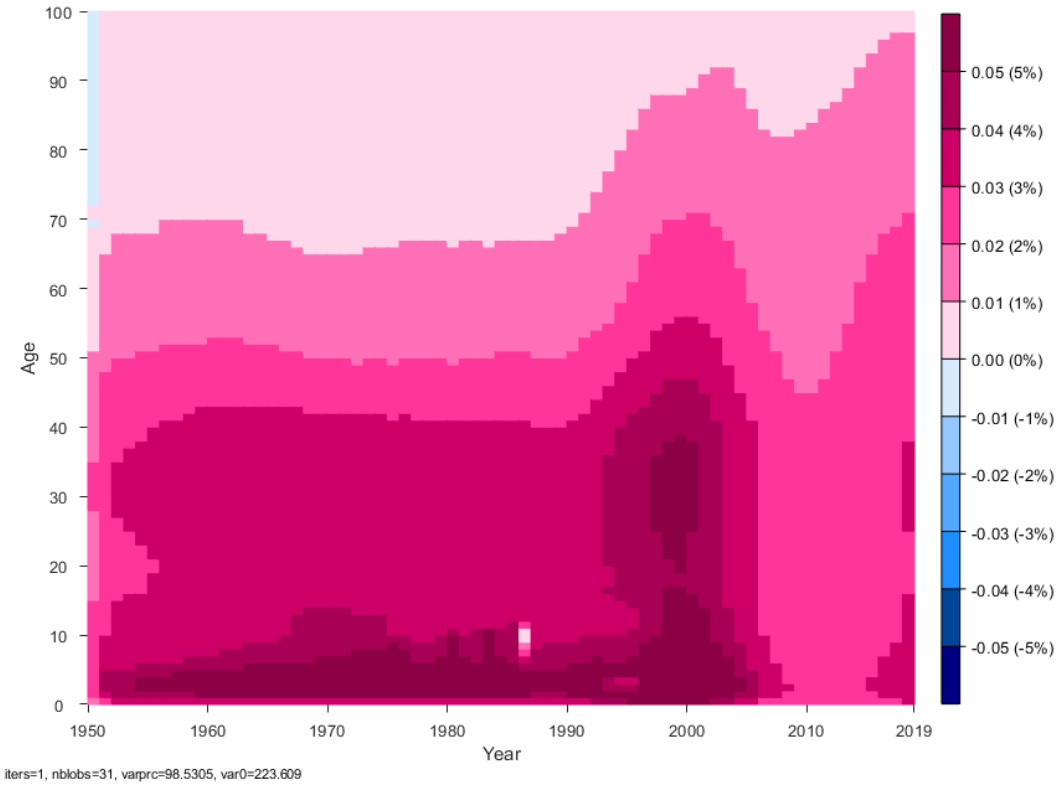
Channel Islands

Males

Females

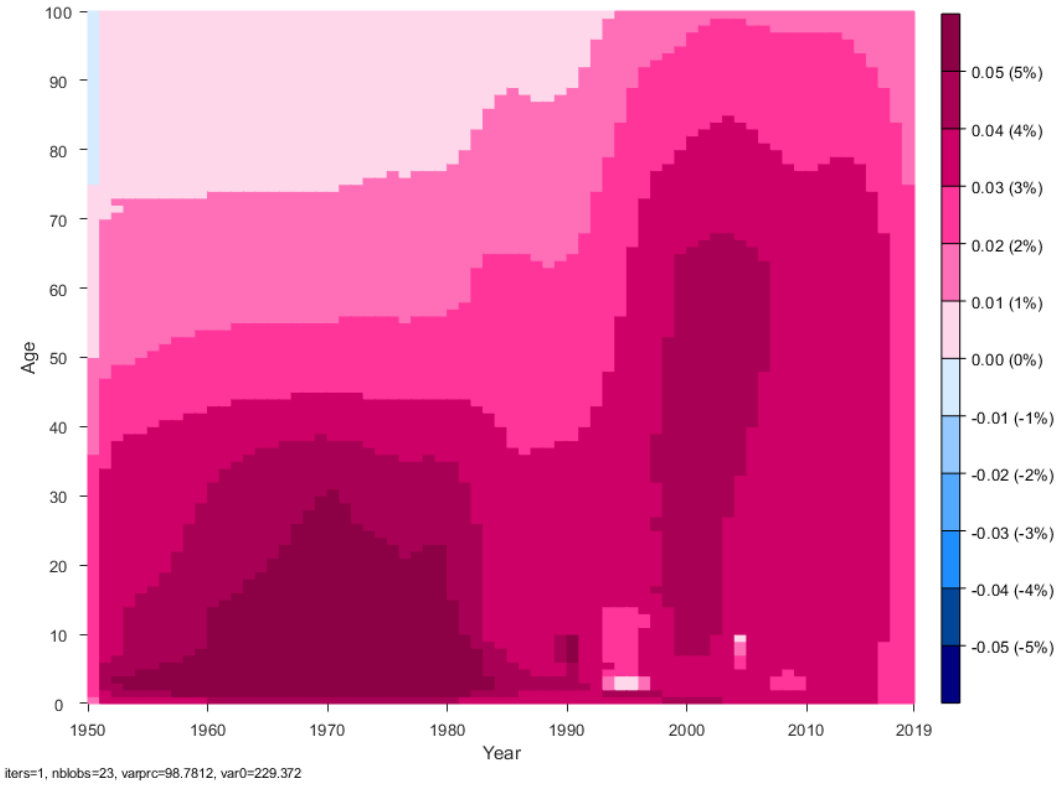
Guam

Males



iters=1, nblobs=31, varprc=98.5305, var0=223.609

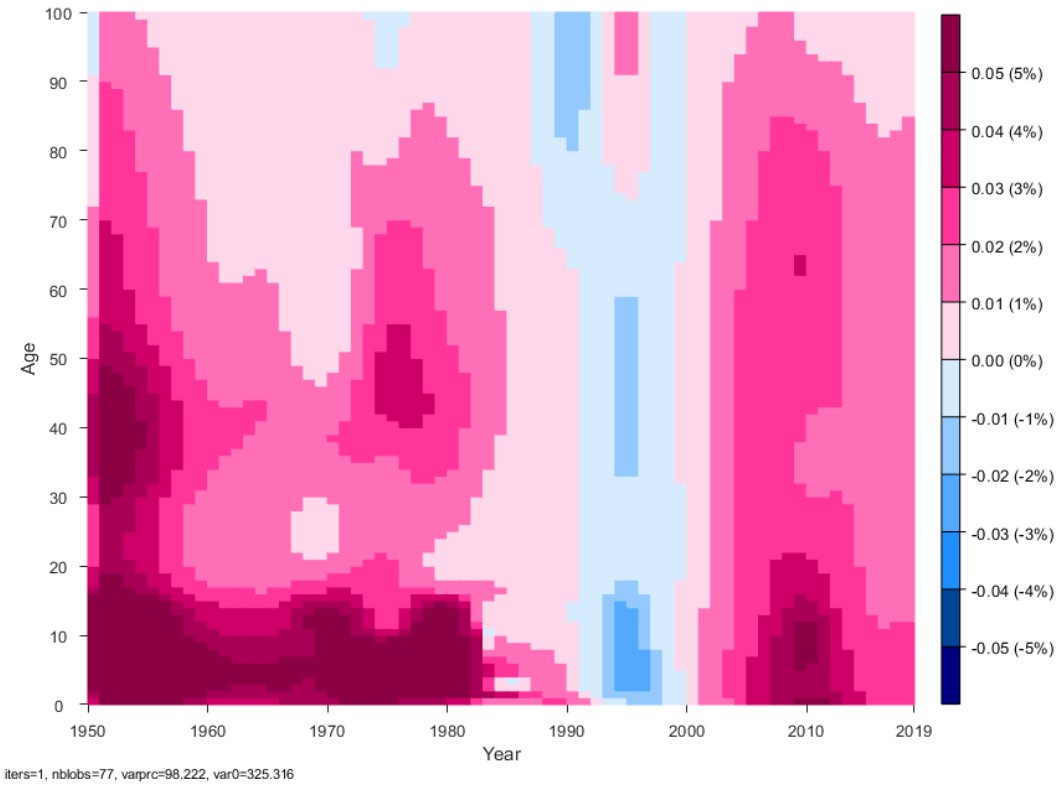
Females



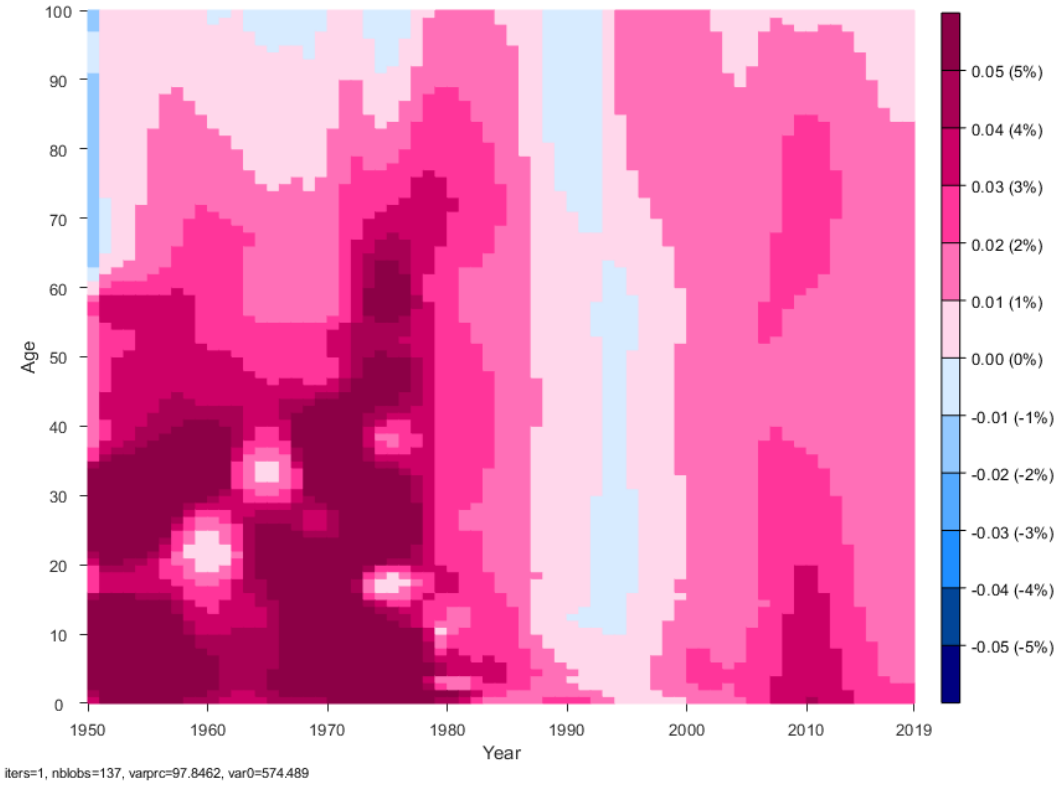
iters=1, nblobs=23, varprc=98.7812, var0=229.372

Cura硯

Males

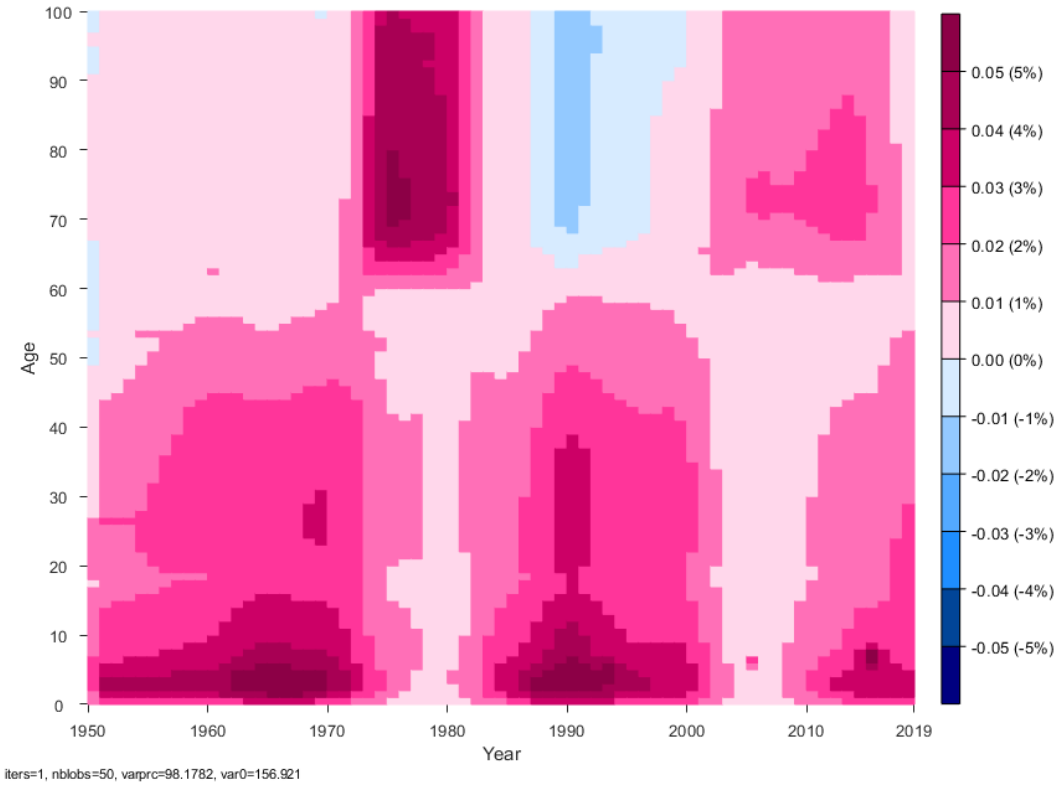


Females



Kiribati

Males



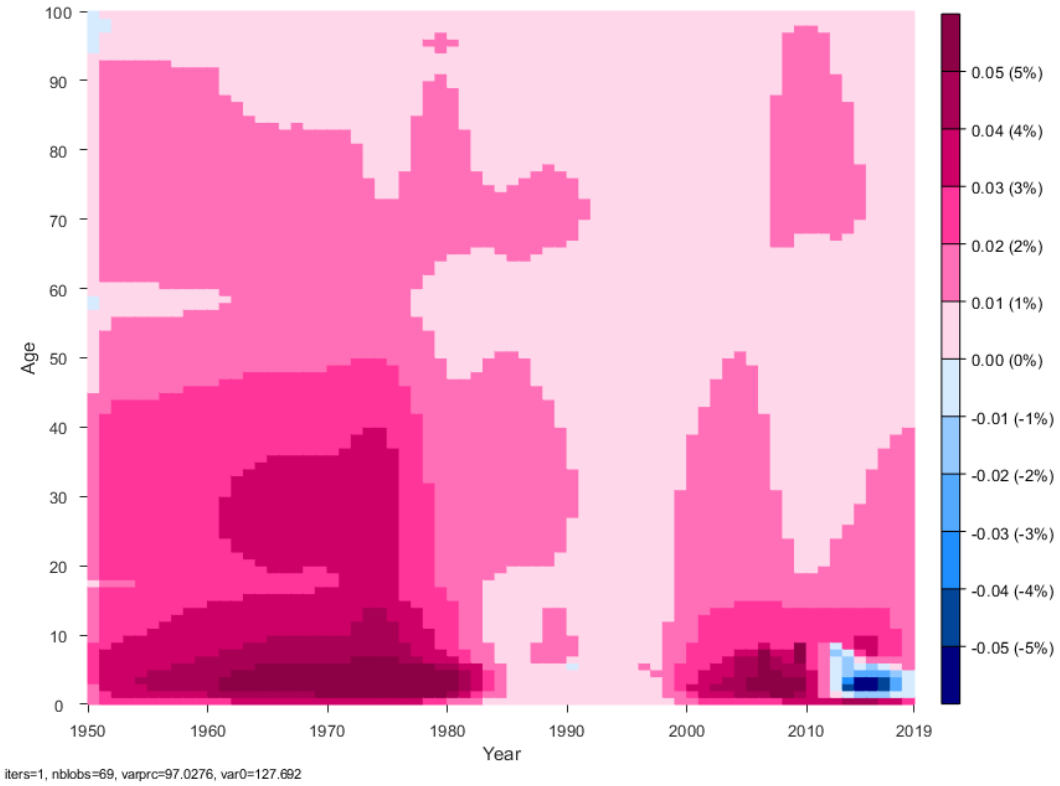
iters=1, nblobs=50, varprc=98.1782, var0=156.921

Females

iters=1, nblobs=44, varprc=98.4578, var0=264.452

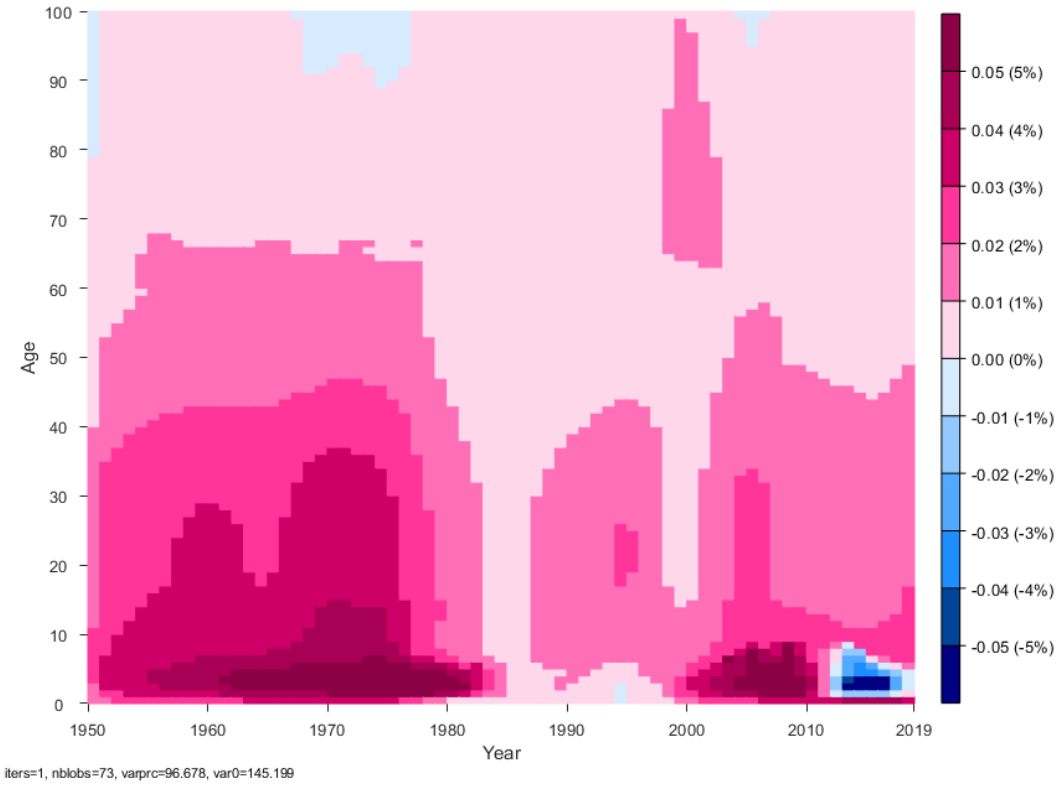
Micronesia (Fed. States of)

Males



iters=1, nblobs=69, varprc=97.0276, var0=127.692

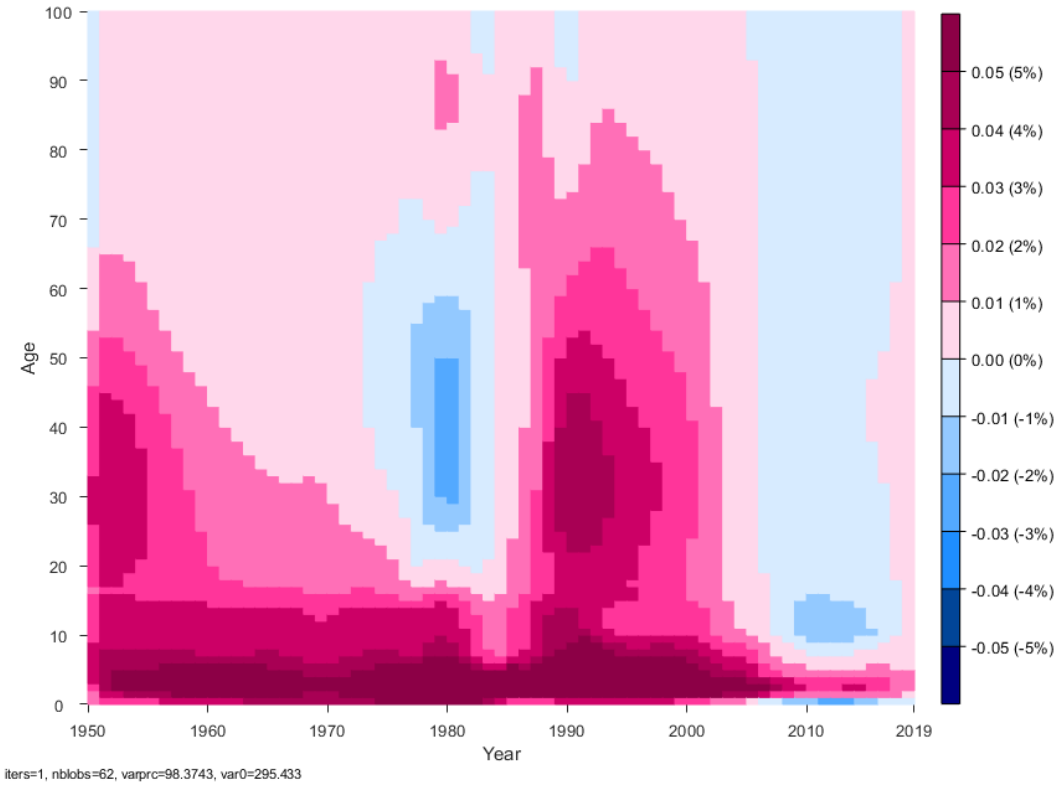
Females



iters=1, nblobs=73, varprc=96.678, var0=145.199

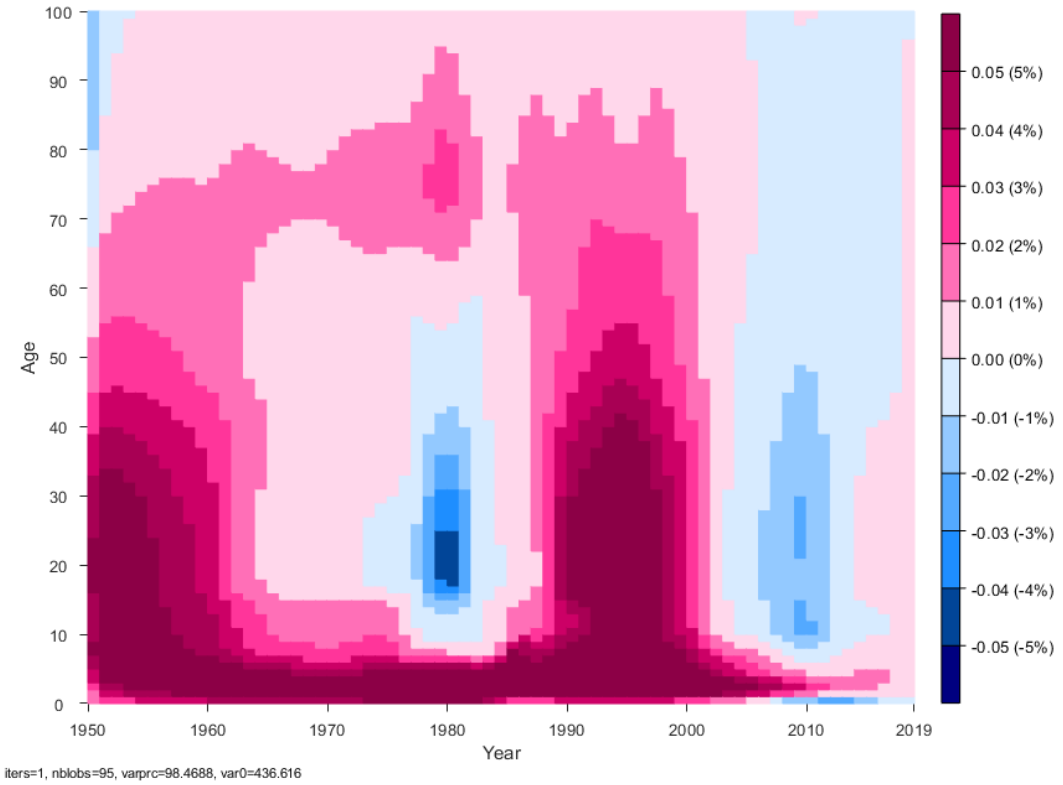
Grenada

Males



iters=1, nblobs=62, varprc=98.3743, var0=295.433

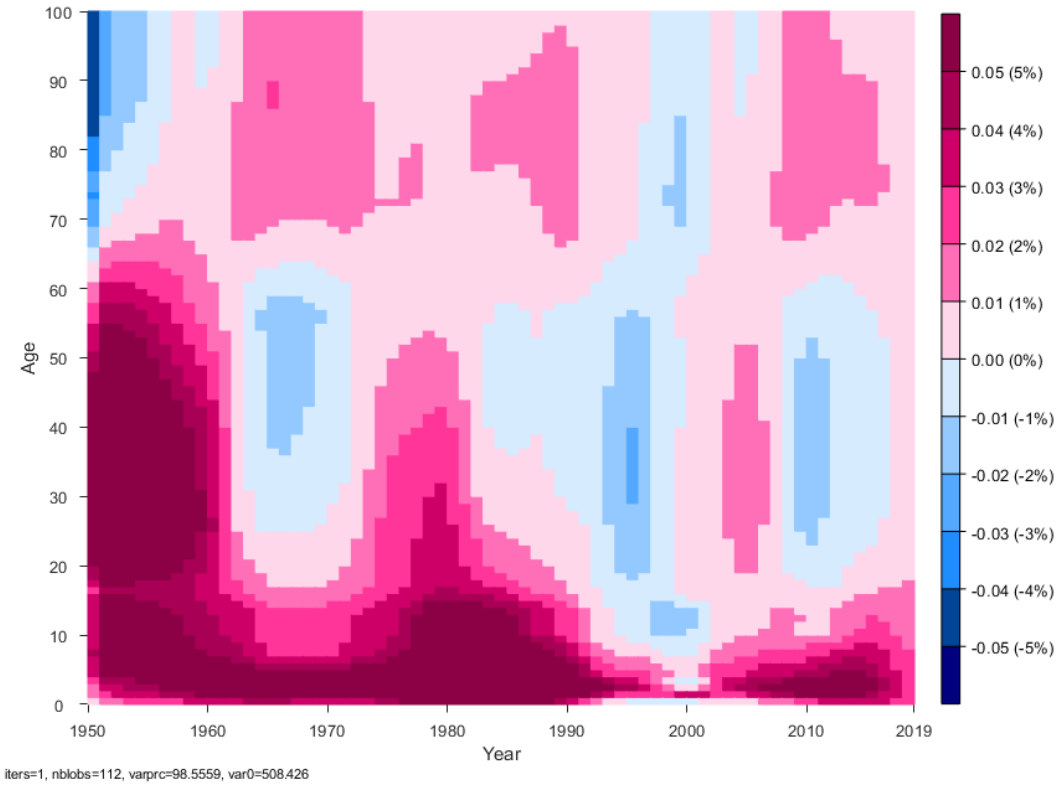
Females



iters=1, nblobs=95, varprc=98.4688, var0=436.616

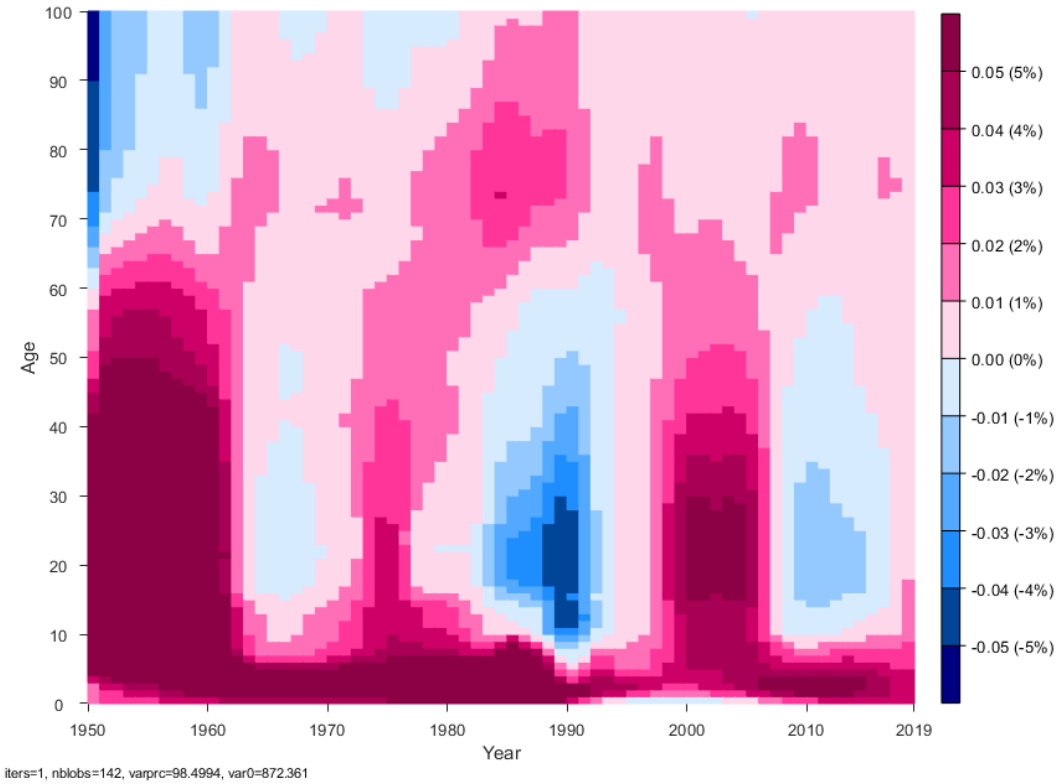
Saint Vincent and the Grenadines

Males



iters=1, nblobs=112, varprc=98.5559, var0=508.426

Females

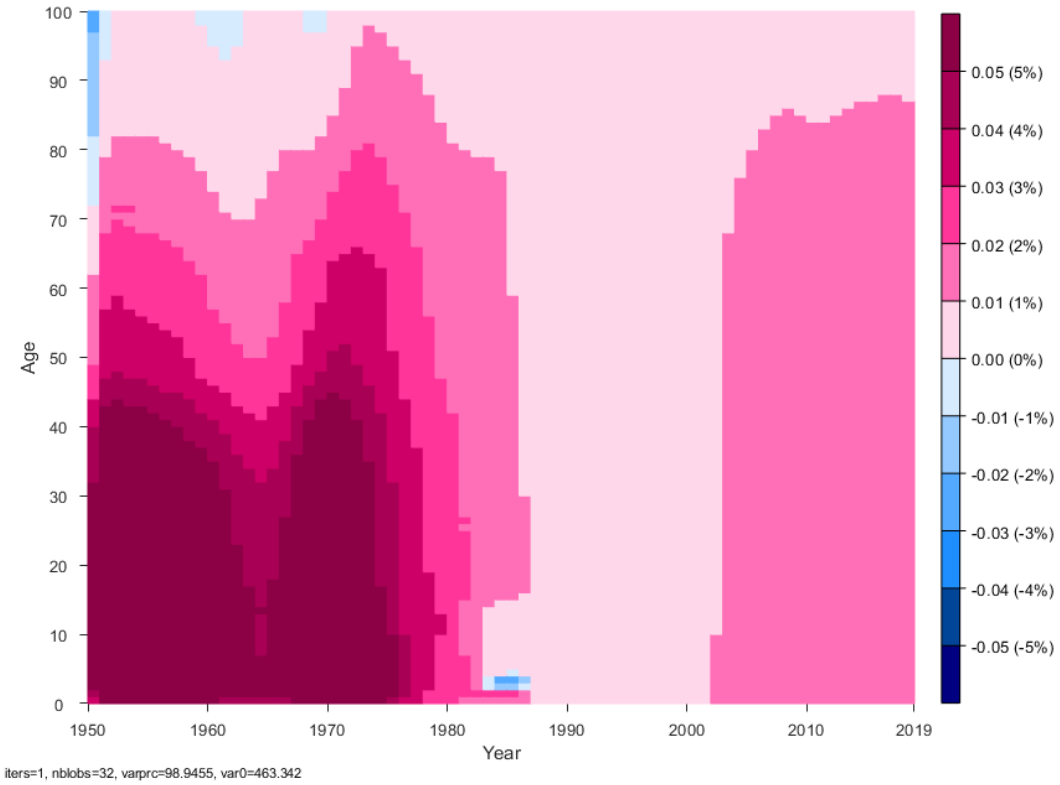


iters=1, nblobs=142, varprc=98.4994, var0=872.361

Aruba

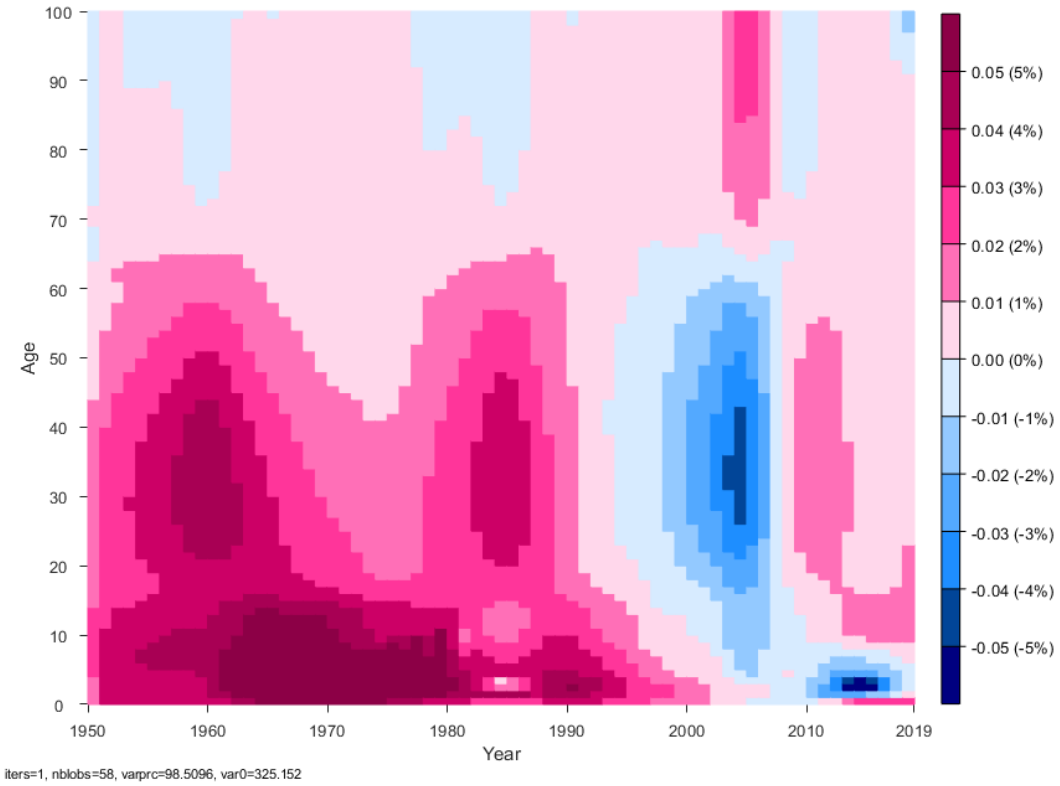
Males

Females



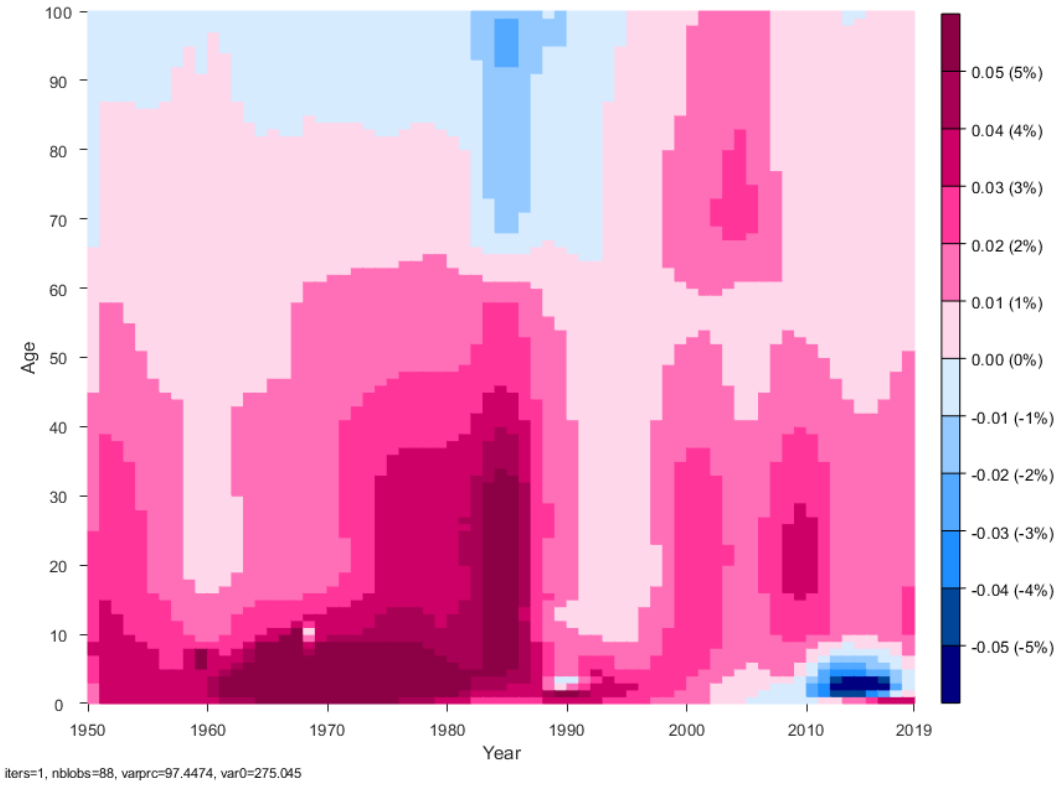
Tonga

Males



iters=1, nblobs=58, varprc=98.5096, var0=325.152

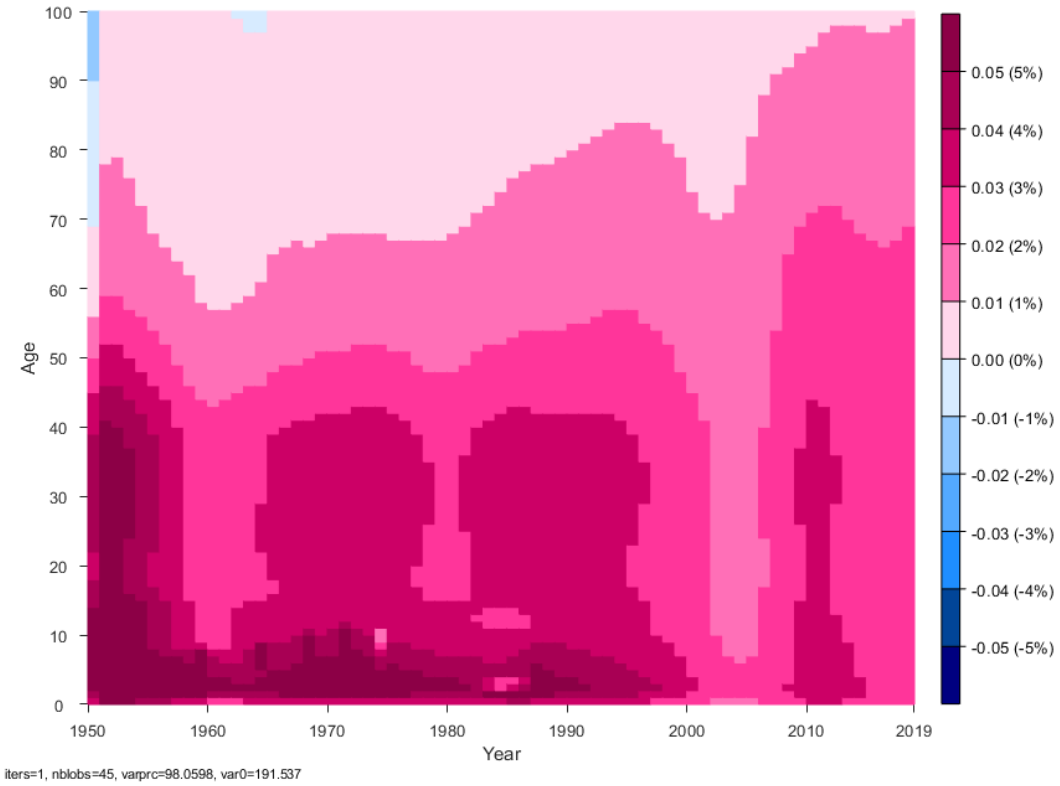
Females



iters=1, nblobs=88, varprc=97.4474, var0=275.045

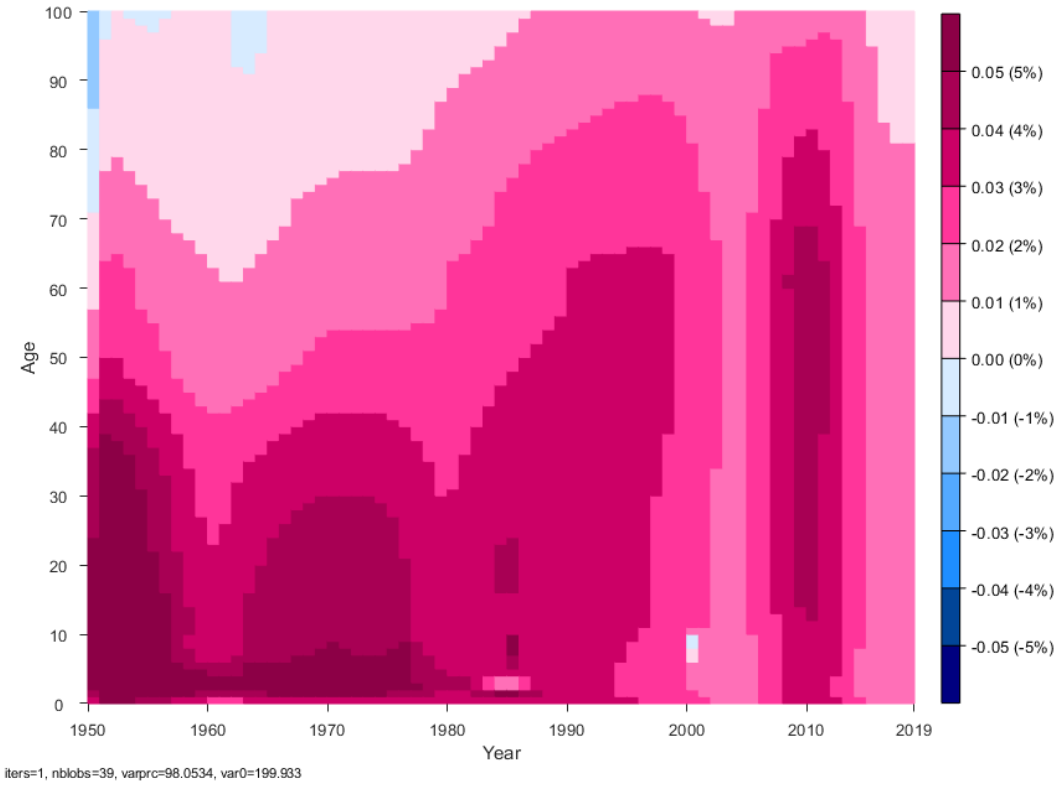
United States Virgin Islands

Males



iters=1, nblobs=45, varprc=98.0598, var0=191.537

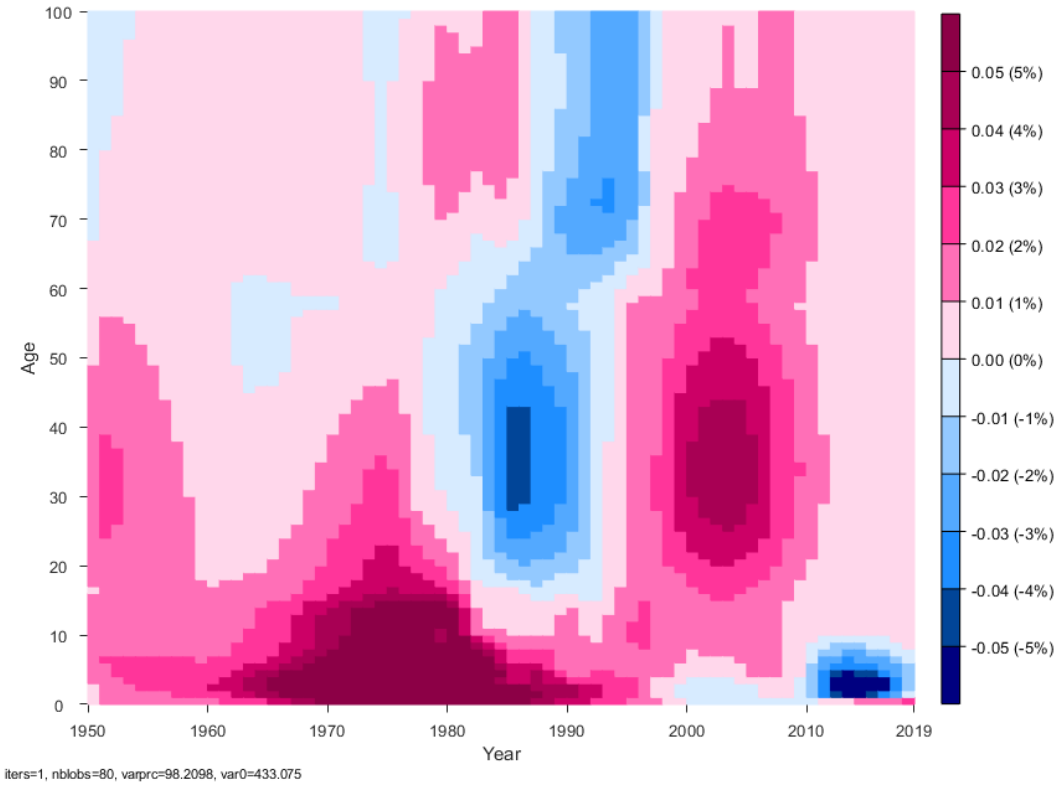
Females



iters=1, nblobs=39, varprc=98.0534, var0=199.933

Seychelles

Males



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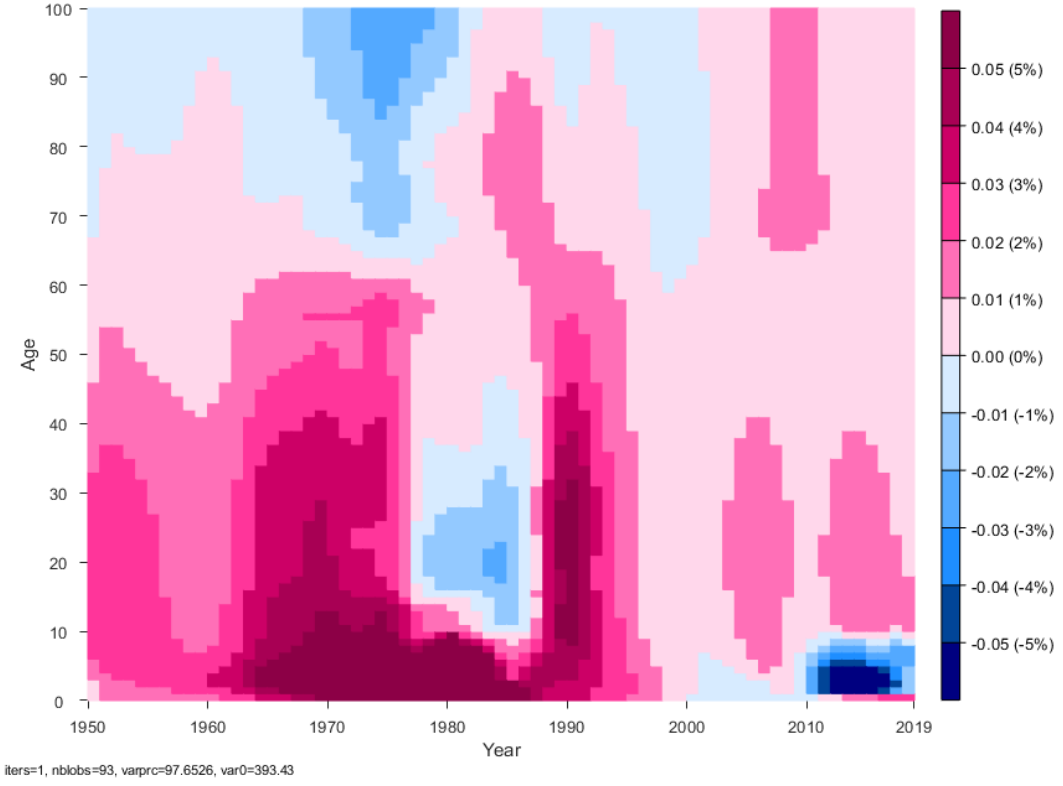
Females



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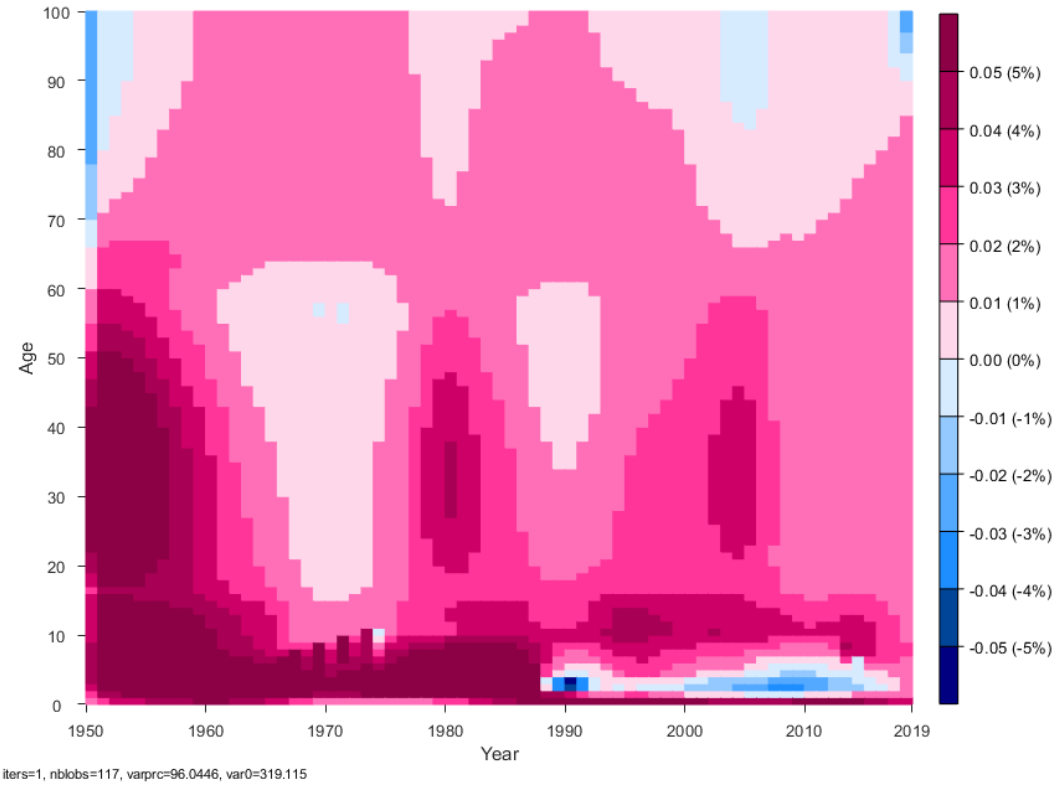
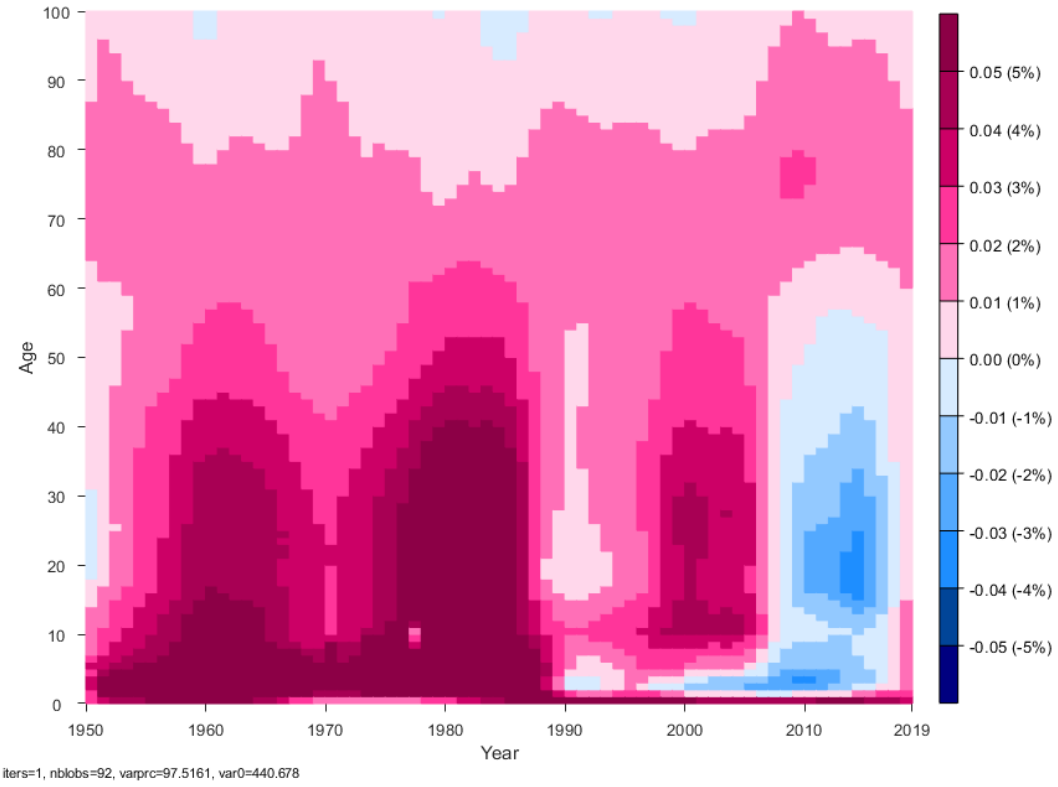
Antigua and Barbuda

Males



Females