PENALTY FUNCTION FOR MEASURE OF CONTEMPORARY AND FUTURE CLIMATE DIFFERENCES

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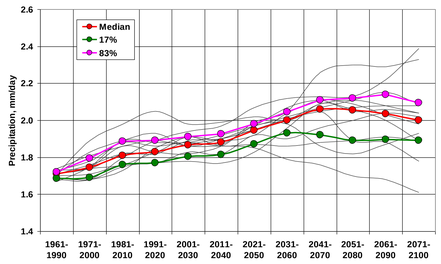
Abstract

The problem of finding the locations on the globe where contemporary climate matches the future climate projections of particular region (Latvia) is addressed. The penalty function is developed assuming usage of 30-year long time series of gridded climate parameters. The penalty function is constructed for measurement of climate deviations in two geographical locations; it accounts for seasonal cycle of temperature and precipitation regime.

The result of the study was the distribution of the penalty function characterising the deviation of the moderately, averagely and significantly changed Latvia climate from the contemporary climate over the globe.

Annual mean precipitation in Riga according to bias corrected (down-scaled) model run results of EU ENSEMBLES project



How to measure climate deviation between the different regions on the Earth?
How to determine the regions which represent the future climate of the particular location nowadays?

We propose measuring deviations of the climate by comparing the normalized sum of differences in monthly average temperatures ***T*** and precipitation intensities ***p*** averaged over time interval t_i .

$$\Delta T_{t_i}^{lon,lat} = \frac{1}{12}\sum_{m=1}^{12}\left|T_{t_0,m}^{lon,lat} - T_{t_i,m}^{LV}\right| \qquad \Delta p_{t_i}^{lon,lat} = \frac{1}{12}\sum_{m=1}^{12}\left|p_{t_0,m}^{lon,lat} - p_{t_i,m}^{LV}\right|$$

$$\Delta_{t_i}^{lon,lat} = 120.5\left(\frac{\Delta T_{t_i}^{lon,lat}}{\max_{lon,lat}(\Delta T_{t_i}^{lon,lat})} + \frac{\Delta p_{t_i}^{lon,lat}}{\max_{lon,lat}(\Delta p_{t_i}^{lon,lat})}\right)$$

t_i is one of the time intervals:

- t_0 - contemporary climate (1961-1990)
- t_1 - near future climate projections for Latvia (2021-2050)
- t_2 - far future climate projections for Latvia (2071-2100)

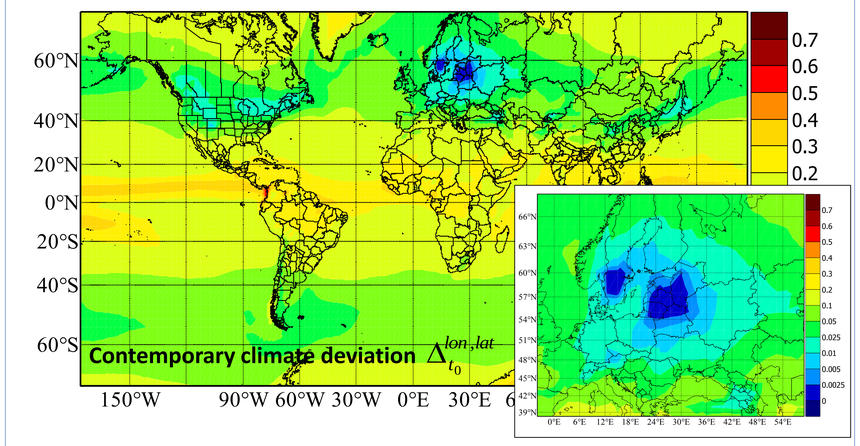
lon, lat is geographical location;

The global contemporary data($p_{t_0,m}^{lon,lat}, T_{t_0,m}^{lon,lat}$) from the ECMWF reanalysis data sets were used (ERA-40) .

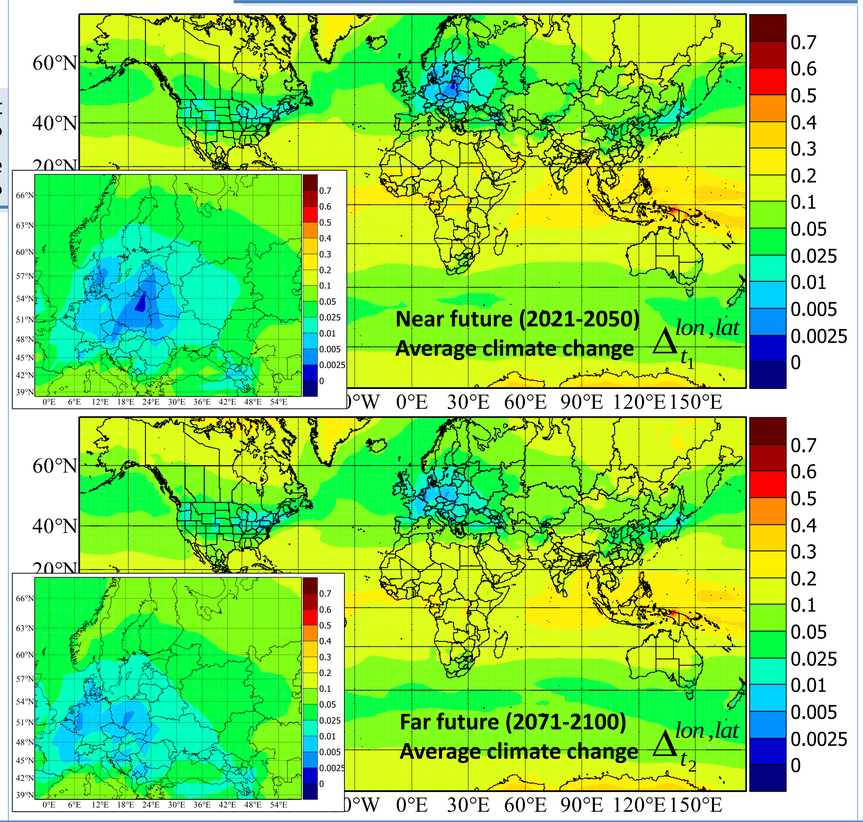
The future climate projections ($p_{t_i,m}^{LV}, T_{t_i,m}^{LV}$) ($t_1$,$t_2$) for the Latvia were constructed by the following approach:

a) The ensemble of the regional climate model (RCM) runs from the EU ENSEMBLES project was considered.
b) The RCM outputs – temperature and precipitation – were bias corrected via statistical downscaling method (Sennikovs and Bethers, 2009) for the contemporary climate represented by the observed data series over the territory of Latvia. The downscaling method included the equalization of cumulative distribution functions of the observed and modelled data series in a moving time window.
c) The bias correction method was applied for the future climate projections by RCMs.
d) The ranking of the magnitude of climate change by different models was performed for the ensemble of future climate projections. Moderate, average and significant climate change were considered as the 17th, 50th and 83rd percentile of the ensemble members.

Where are the regions which represent the contemporary climate of Latvia?



Where nowadays are the regions which represent the future climate of Latvia?



Landscapes of the similar climate areas

Images of Latvian landscape

Images of areas with similar climate

Acknowledgements

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ESF project "Establishment of interdisciplinary scientist group and modelling system for groundwater research"

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