THE UNCERTAINTY OF THE FUTURE ANNUAL LONG-TERM GROUNDWATER TABLE FLUCTUATION REGIME IN LATVIA

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The objective and study outline

The objective of this study is to model and analyze the long-term annual regime of relative shallow groundwater levels using 14 regional climate scenarios and additionally to analyze them according to the dominance of continentality in Latvia.

In this study the relative shallow groundwater level fluctuation regime is analyzed in two different time periods thus allowing analysis of the impact of climate change. The periods are identified as reference period (1961-1990) where observations were analyzed and future period (2070-2100) where climate data from multiple regional climate scenarious was used for groundwater level modeling.

Results from multiple regional climate scenarious describing future period were analyzed altogether and represented as uncertainty within 17th and 83th percentiles.

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The structure

- **Materials and methods**
- Observations and outline of the previous work
- The uncertainty of shallow groundwater fluctuation regime

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Materials I

- Observations from ~200 wells (direct data)
- Climatic data for modelling (with groundwater modelling software METUL) (indirect data)
  - Observed
  - From 14 regional climate scenarios (Sennikovs and Bethers, 2008)
    - Future period (2070-2100)

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Materials II

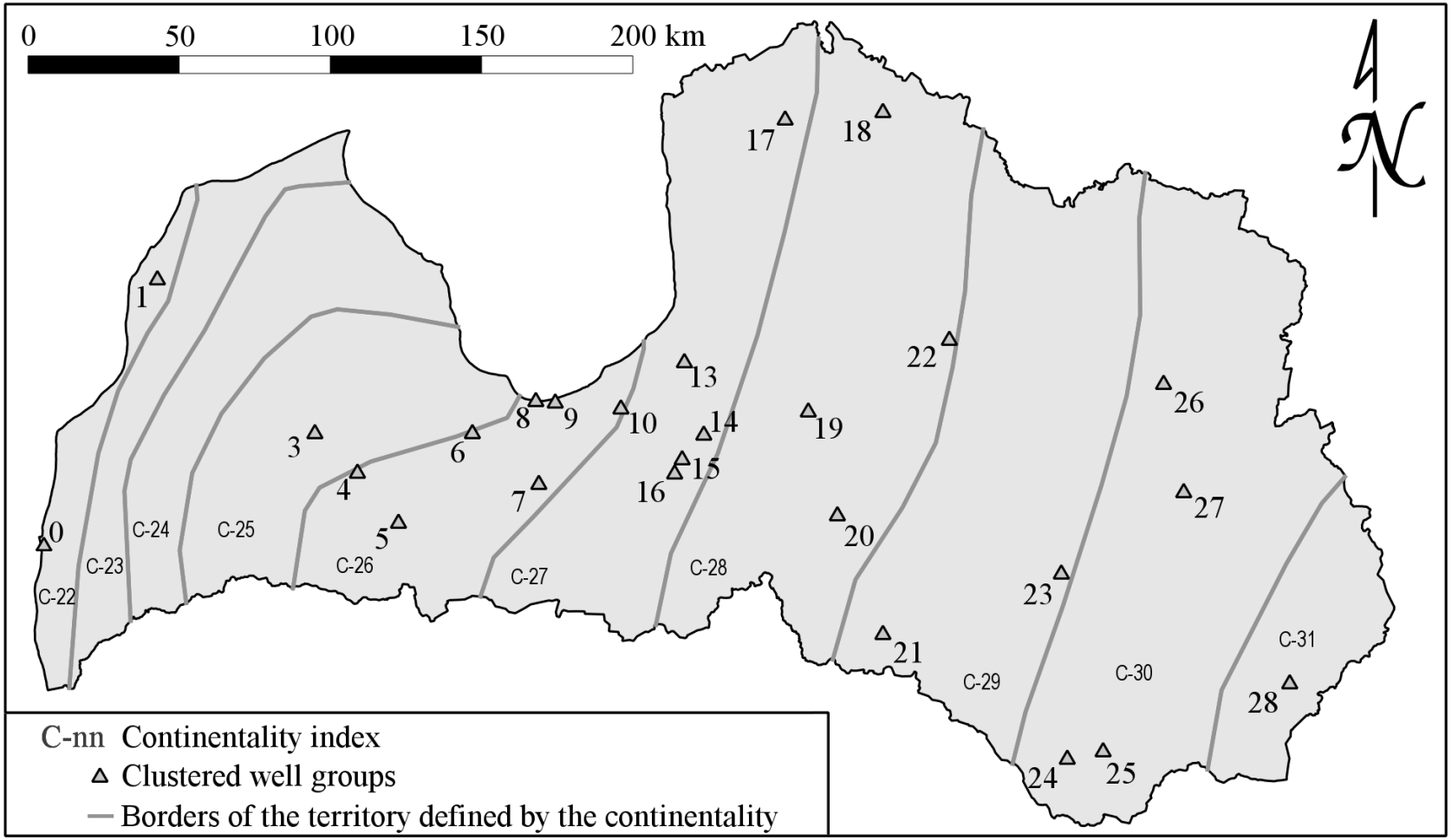

Fig. 1. Map of the clustered well group geographically weighted centres and continentality index. Wells and groundwater level data were obtained from Latvian Environment, Geology and Meteorology Centre. The information about continentality was provided from A. Draveniece dissertation

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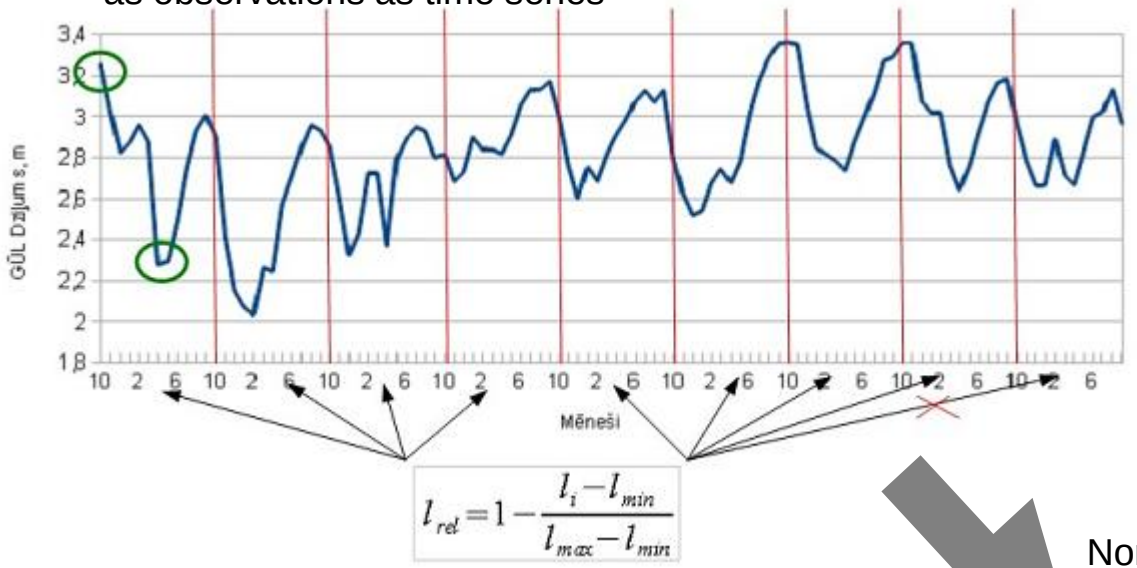
Methods I

Multiple regional climate models as well as observations as time series



$$l_{rel} = 1 - \frac{l_i - l_{min}}{l_{max} - l_{min}}$$

There are multiple criteries which defines validity of the observed time serie

Interpolating daily values

Normalizing inversely

First time

Comparing of all valid data series within the group

(Finding the “best” for groundwater level modelling)

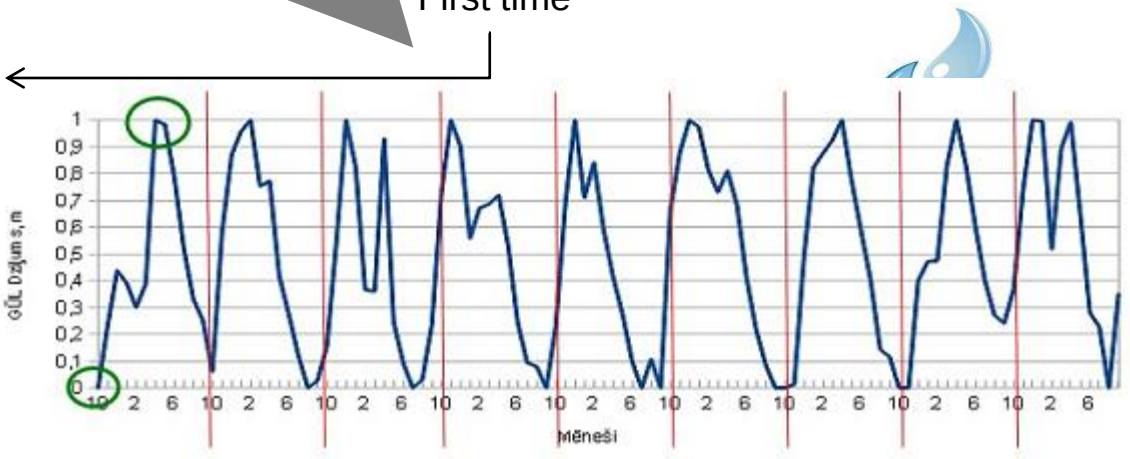


Fig. 2. Mathematical transformations of the groundwater data series

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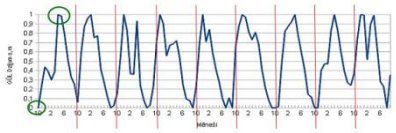
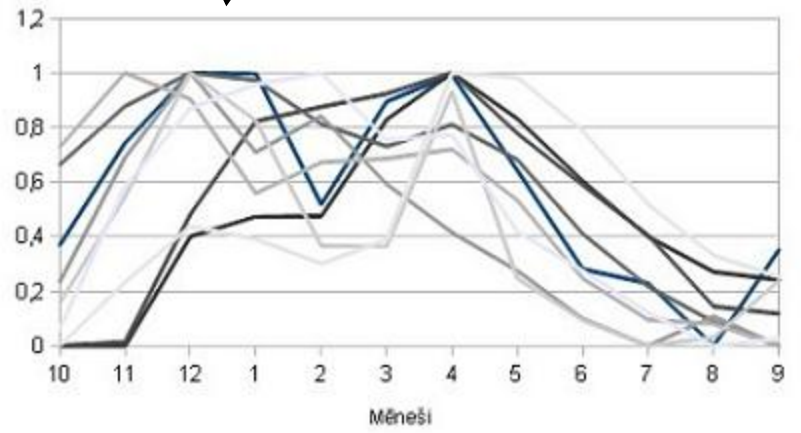
Methods II



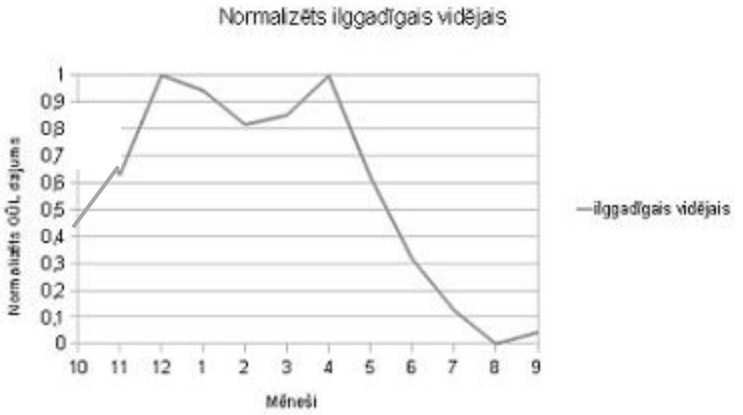


Yearly averaging

Normalisation (not inverse)

Second time

$$l_{rel} = \frac{l_i - l_{min}}{l_{max} - l_{min}}$$



Calculation of the 17th and 83th percentile

Fig. 3. Mathematical transformations of the groundwater data series

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By continentality

Overall the entire Latvia

REFERENCE
Observed
1961-1990

REFERENCE
Modeled
1961-1990

FUTURE
Modeled
2070-2100

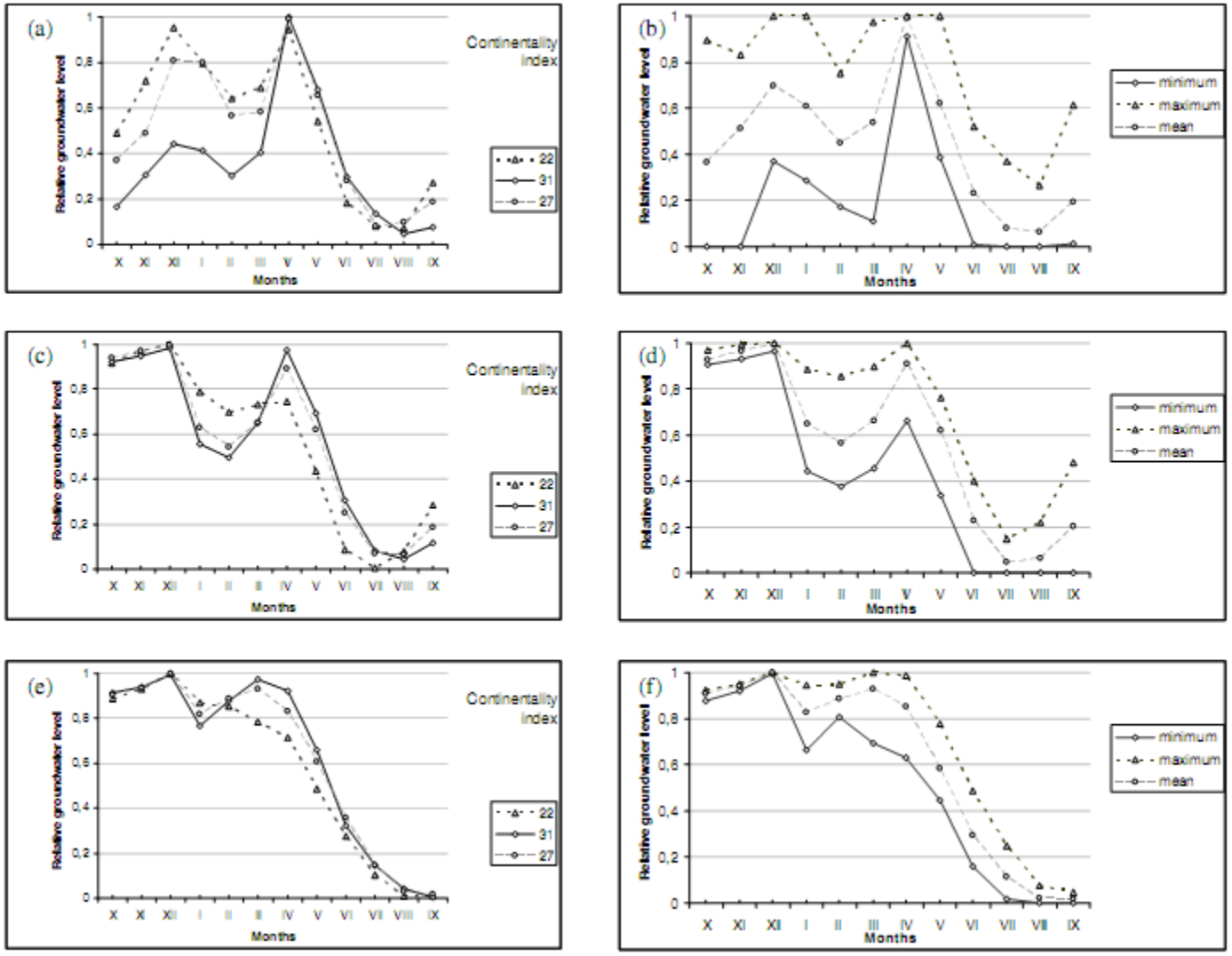


Fig. 4. (a) Observed groundwater levels by continentality index; (b) Observed groundwater levels by maximum and minimum in Latvia; (c) modelled groundwater levels in reference period by continentality index, (d) modelled groundwater levels in reference period by maximum and minimum in Latvia; (e) modelled groundwater levels in future period by continentality index, (f) modelled groundwater levels in future period by maximum and minimum in Latvia

One regional climate model for gw level modelling

Fig. 5 Observed, modelled on observations and on climate model in two different time periods long term monthly mean groundwater as relative values averaging over the groups.

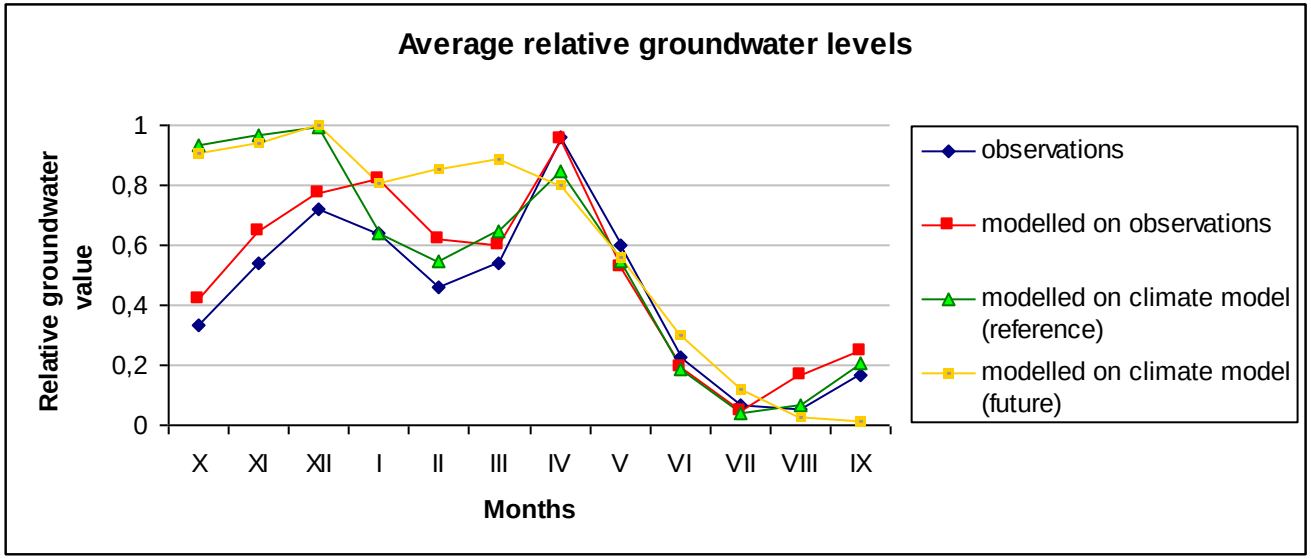
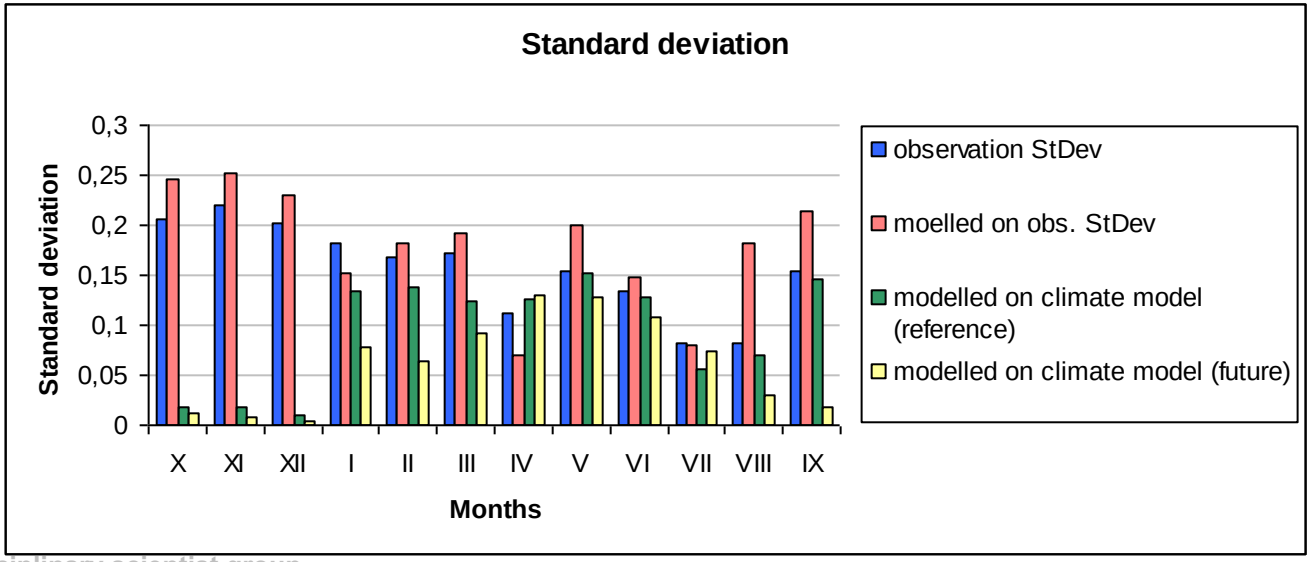


Fig. 6. Standard deviation over all groups in all four datasets. Larger standard deviation shows greater spatial variability.



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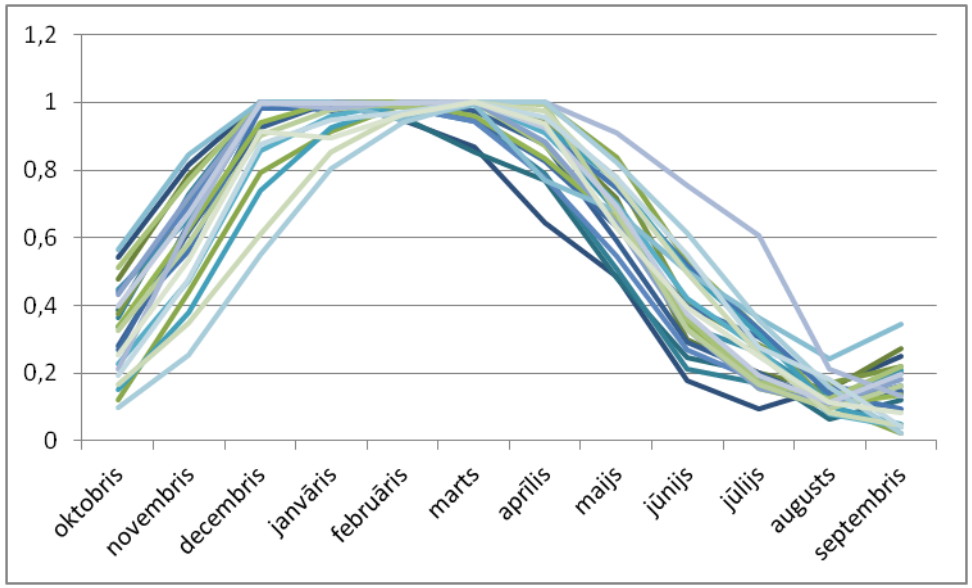

Fig. 7 25 different series which represents 83`th percentile uncertainty boundarty of regime in one well each.

83%

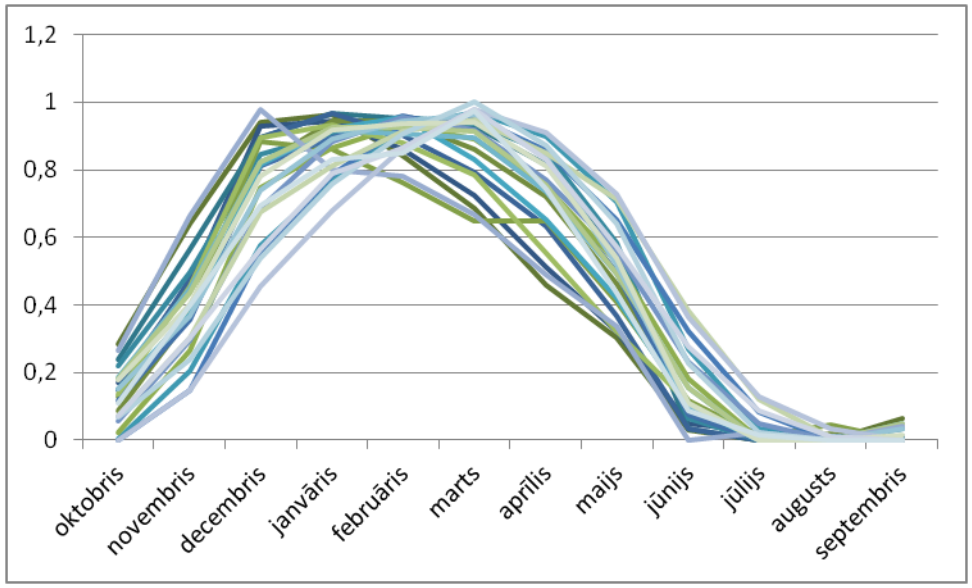

Fig. 8 25 different series which represents 17`th percentile uncertainty boundarty of regime in one well each.

17%

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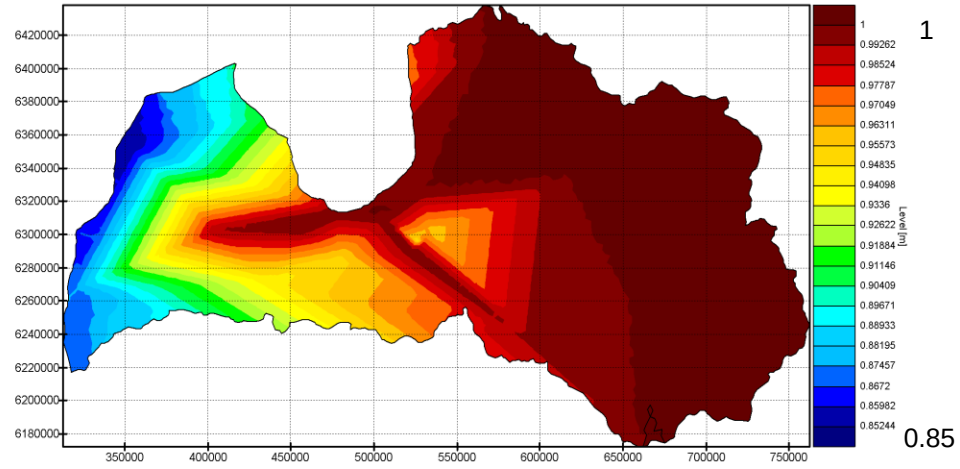
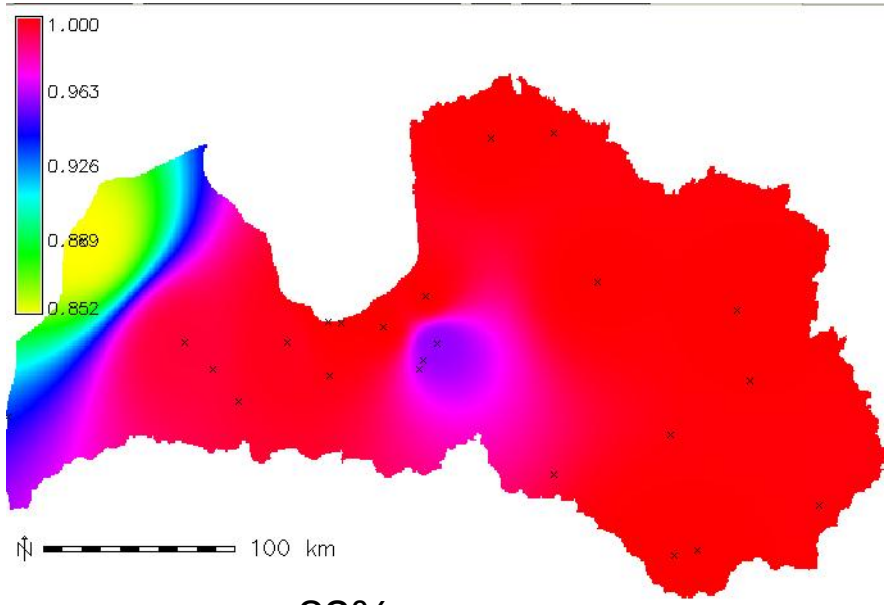


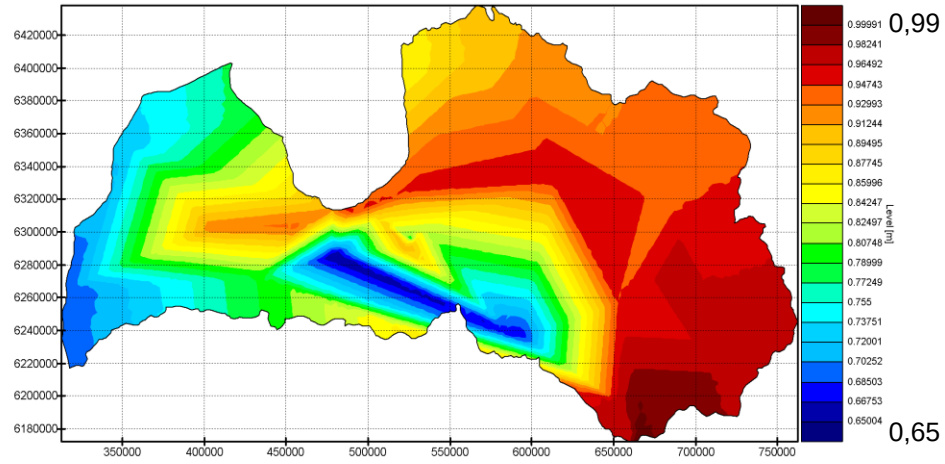
83%



83%

March

17%



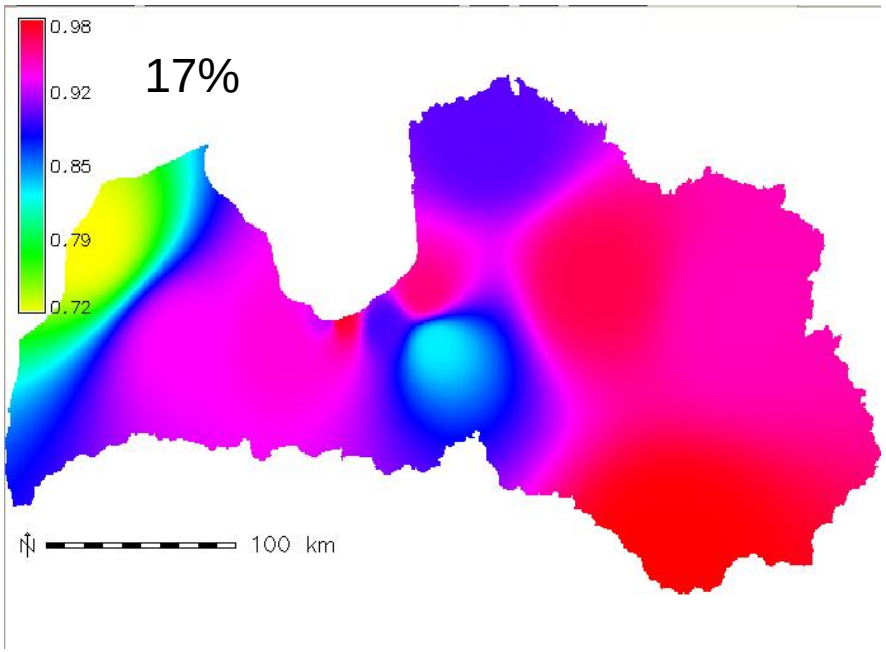
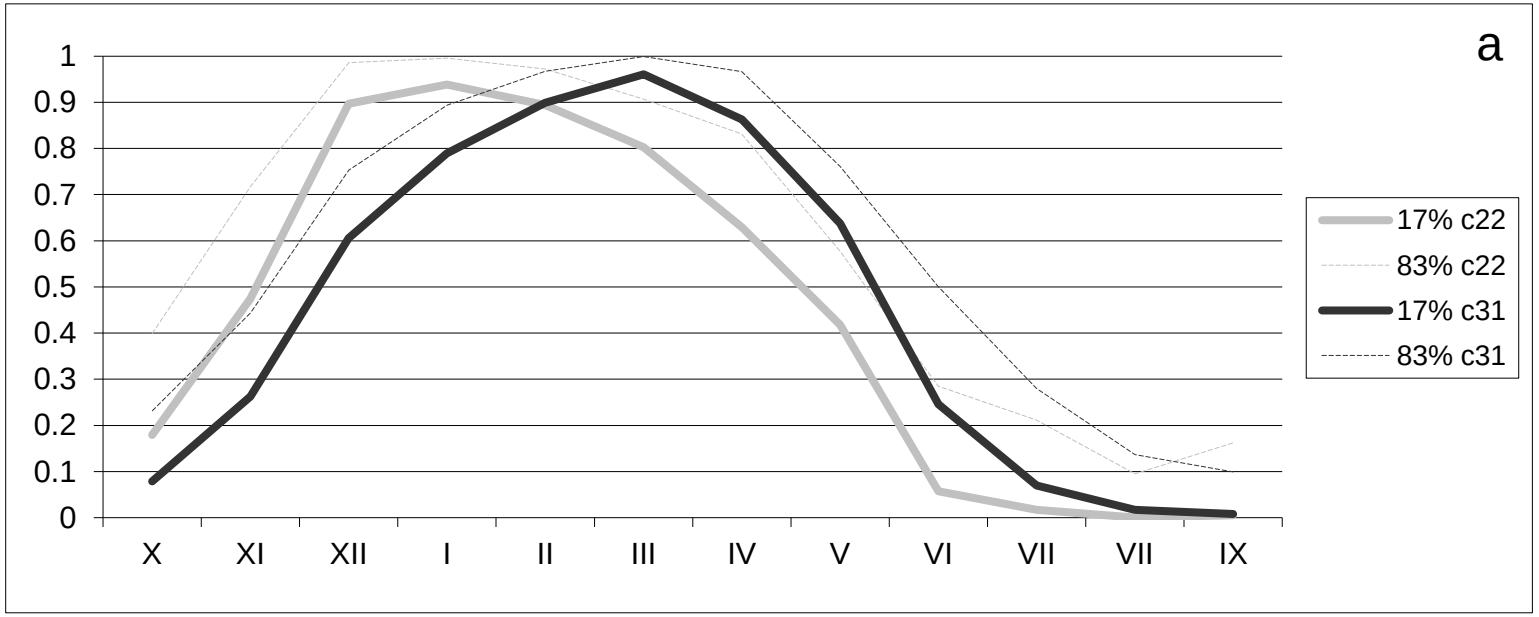


Fig. 9. Different interpolation methods. Left up and left down – linear, Right up and down – IDW (Inverse distance weighted)



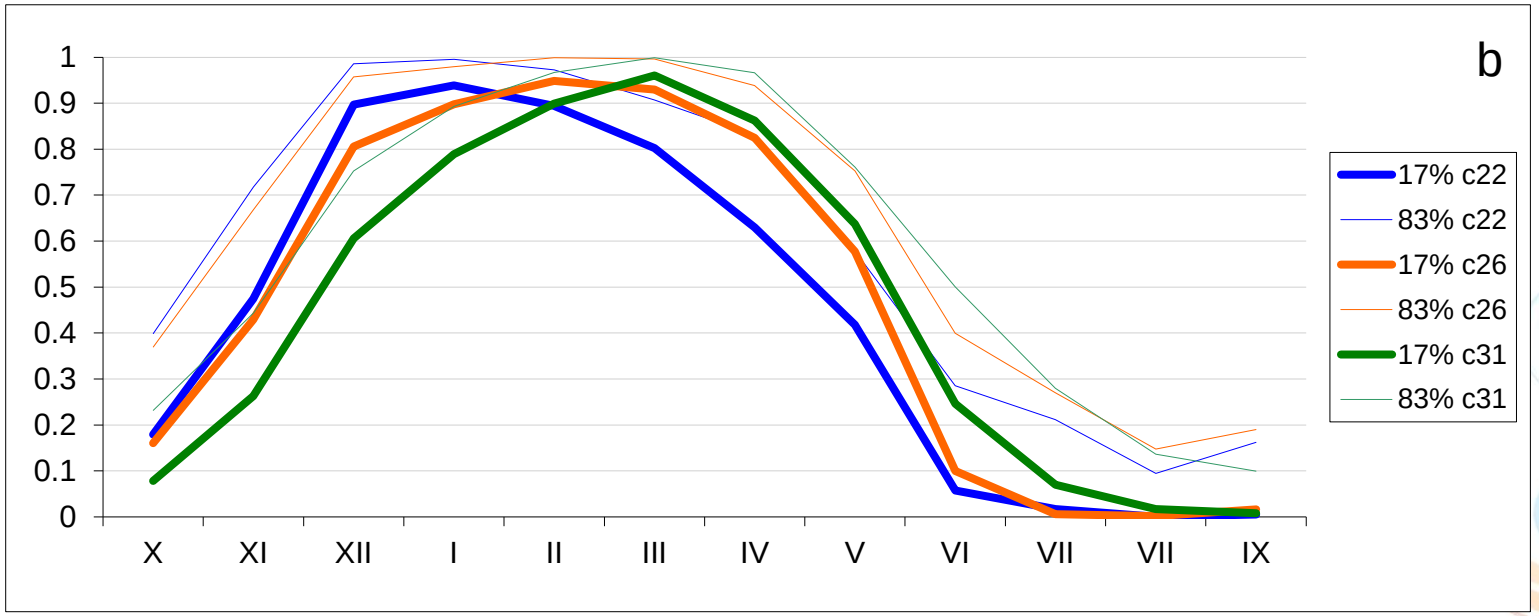


Fig. 9. Figure *a* represents the 17 and 83 percentiles in territories with continetality index 22 and 31. Figure *b* represents the same but the continentality 26 is added.
C22 represents the terriotory closer to the sea, in the western part of the Latvia with continentality index 22, C31 represents the most south-eastern part of the Latvia with continentality index 31. C26 represents the territory between C22 and C31

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Fig. 10. The width between 17`th and 83`th percentiles in three territories with different continentality index.

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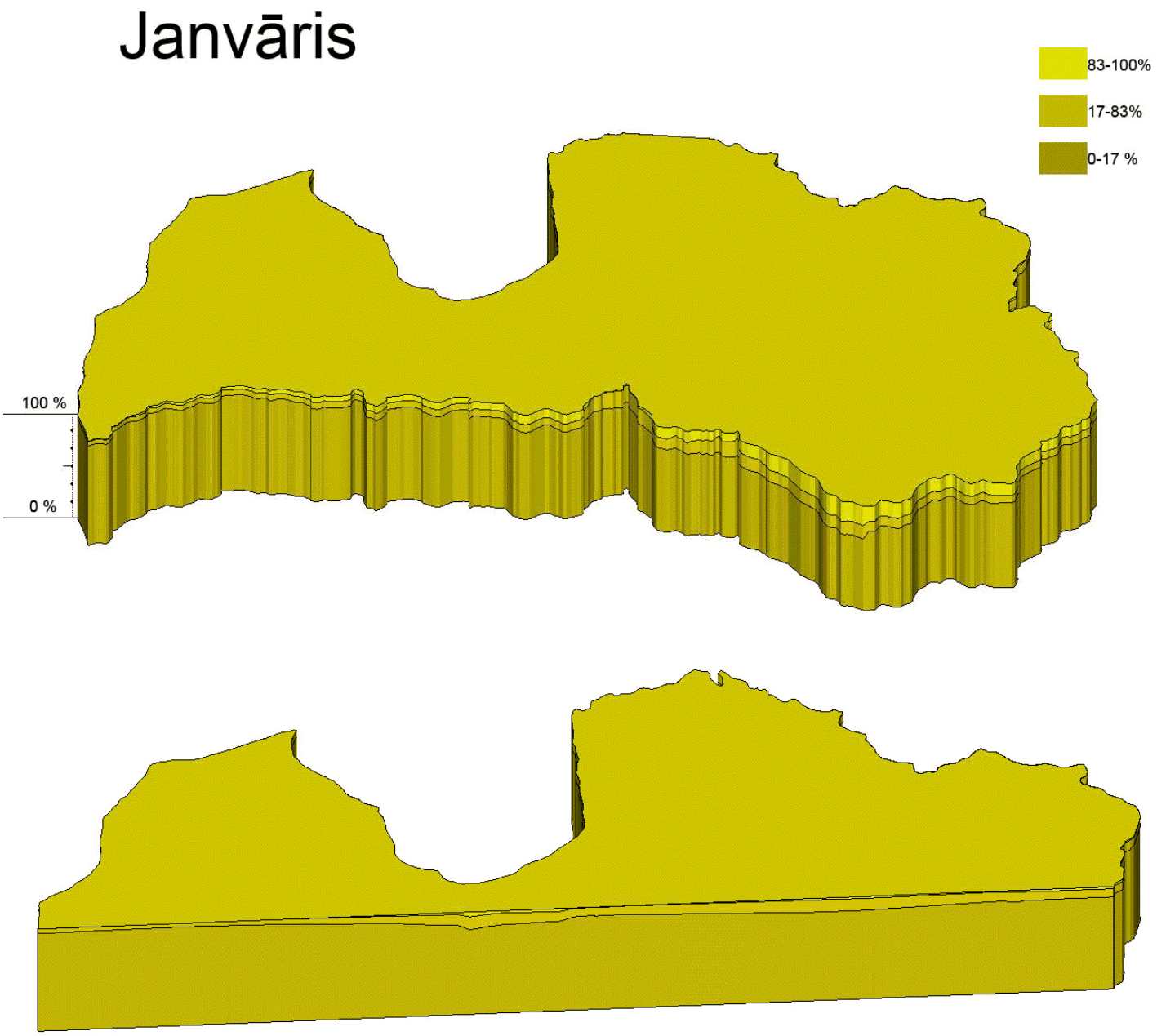
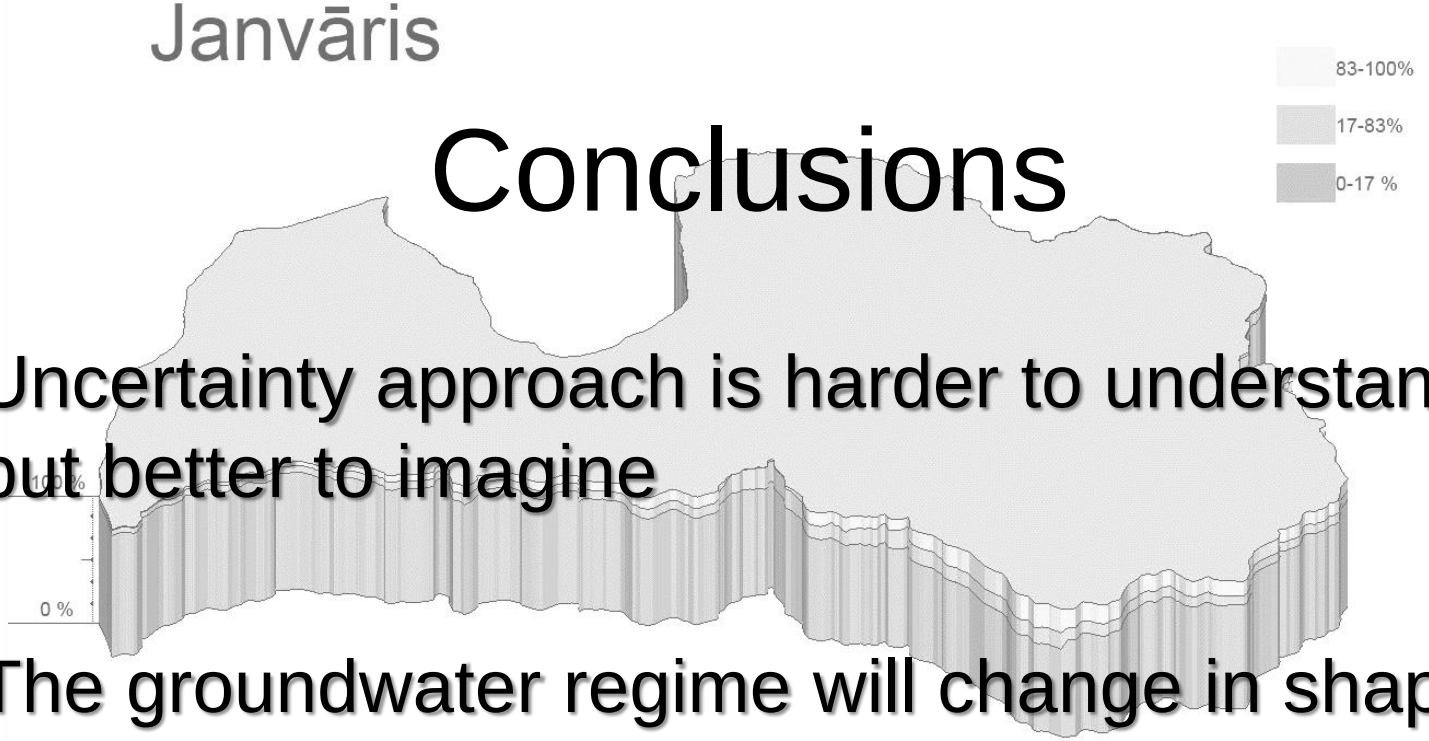


Fig. 11. The spatiotemporality of annual long–term monthly mean relative shallow groundwater table fluctuations.

Conclusions



- Uncertainty approach is harder to understand, but better to imagine
- The groundwater regime will change in shape despite the multiple regional climate scenarious
- There is temporal offset between territories with different continentality index despite the multiple regional climate scenarious

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Thank you for attention!

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