The CaliM&Ro Project: Calibration of Met&Roll Weather Generator for sites without or with incomplete meteorological observations

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project home page: www.ufa.cas.cz/dub/calimaro/calimaro.htm (under construction)
this poster: www.ufa.cas.cz/dub/calimaro/2005-utrecht.pdf (will be available after the conference)

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CaliM&Ro project

has started this year and will last till 2007. The project focuses on calibrating a stochastic single-site daily weather generator (WG) Met&Roll for sites with non-existent or incomplete historical daily weather series (which are normally used to determine WG parameters).

Main aims

(i) If only some daily variables are observed, the missing WG parameters (e.g., parameters for the daily temperature range) will be estimated from those available using empirical relationships established from the learning data.

(ii) If no weather observations are available in the given site, the WG parameters will be interpolated from surrounding stations. Various interpolation techniques (including the neural networks) will be tested, altitude of the sites will be taken into account.

(iii) Estimating WG parameters from a global $0.5^{\circ}\times0.5^{\circ}$ climatological data available from Climate Research Unit (U.K.).

Methodology

Met&Roll weather generator [1, 3, 8]

- precipitation: - occurrence ~ Markov chain (order = 1 .. 3)
  - amount ~ Gamma distribution

- solar radiation
- daily maximum temperature
- daily minimum temperature

~ 1st order autoregressive model

- daily weather generator is conditioned on the AR(1) **monthly generator [8]**

Impact models (used for indirect validation):

- **crop growth models:** **WOFOST, CERES [3, 5, 8, 9, 10], STICS**
- **hydrological models:**
  - **SAC-SMA [2, 8]:** classic conceptual water-balance model of a rainfall-runoff process [2, 8]
  - **HSPF:** a multipurpose environmental analysis system for watershed and water-quality based studies
  - **CE-QUAL-W2 [7]:** reservoir water quality model

Interpolation methods:

- neural networks
- kriging
- multivariate regression
- others

Performance of the weather generator and the method of its calibration will be assessed in following ways:

(A) Direct validation [1, 3, 4, 6, 8, 11]:

(A1) characteristics (e.g. frequency of cold/hot/dry/wet spell) derived from the weather series produced by WG (calibrated from the observed data) will be compared with those derived from the observed weather series

motivation: stochastic structure of observed and synthetic weather series should be the same

(A2) comparison of characteristics derived from the synthetic weather series generated by WG calibrated from observed series vs. surrogate data (e.g. using interpolation)

(B) Indirect validation [3, 8]: comparison of outputs from the impact model (crop model, hydrological model) run with the above weather series (**a.** observed series *vs* **b.** synthetic weather series generated with WG calibrated from observed data *vs* **c.** synthetic weather series generated with WG calibrated from surrogate data)

motivation: what is the effect of the weather generator inaccuracies (detected by direct validation) on the output from the impact models fed by the WG-produced weather series? (requirement: probability distributions of outputs of models fed by observed and synthetic weather series do not differ)

2005: first year of the project (~ results shown in this poster)

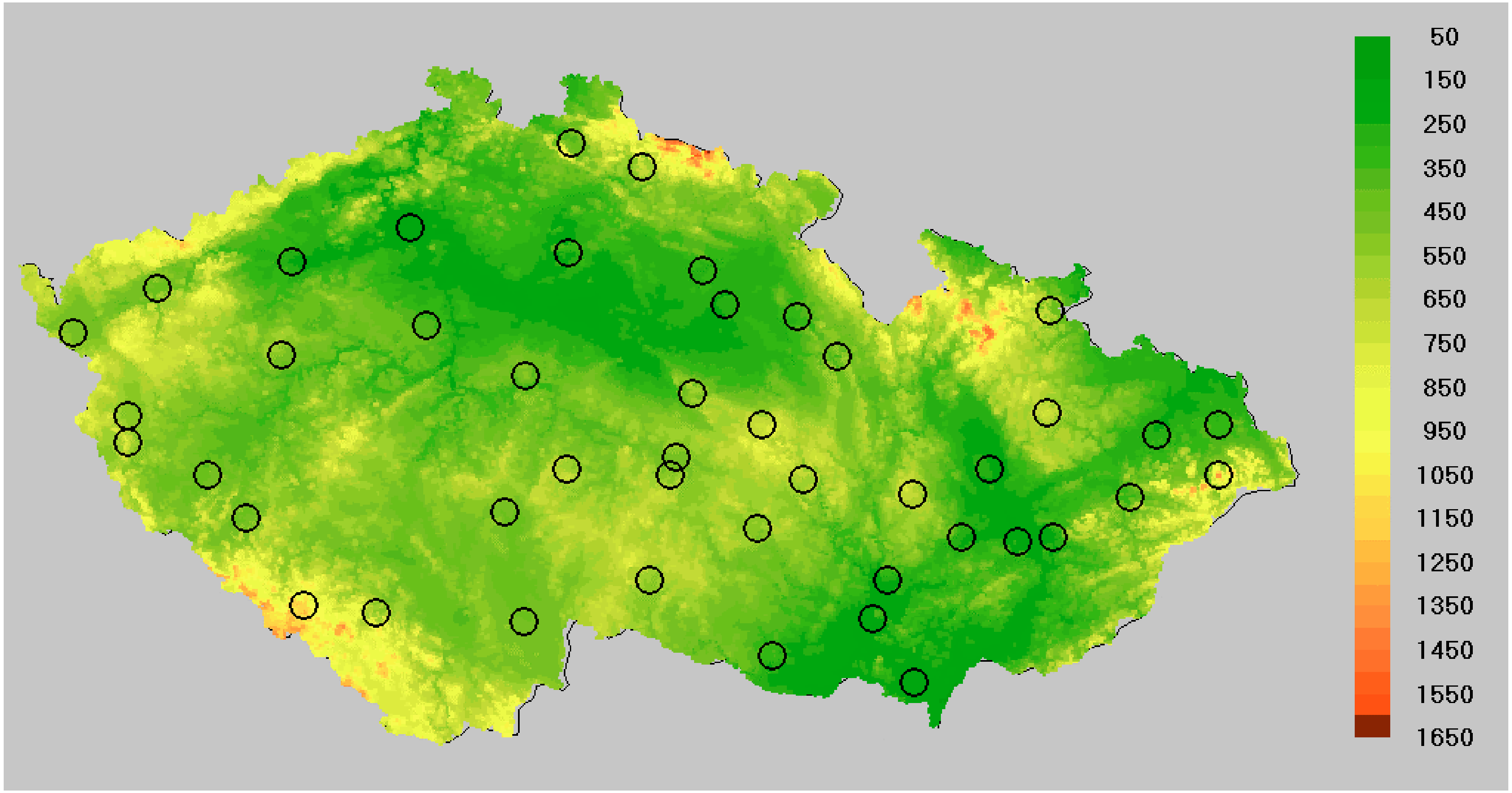
- **collecting daily weather data:** 45 stations are presently available (Figure), approx. 50-60 stations will be available at the end of this year

- **calibration of the impact models:** crop growth model WOFOST, rainfall-runoff model SAC-SMA (more models will be implemented in the following years)

- **development of the software shell**, which allows (i) to run the whole procedure (interpolation of WG parameters, generating synthetic weather series,running the impact models, statistical and graphical processing of the validation tests) in a single batch, and (ii) to display the results

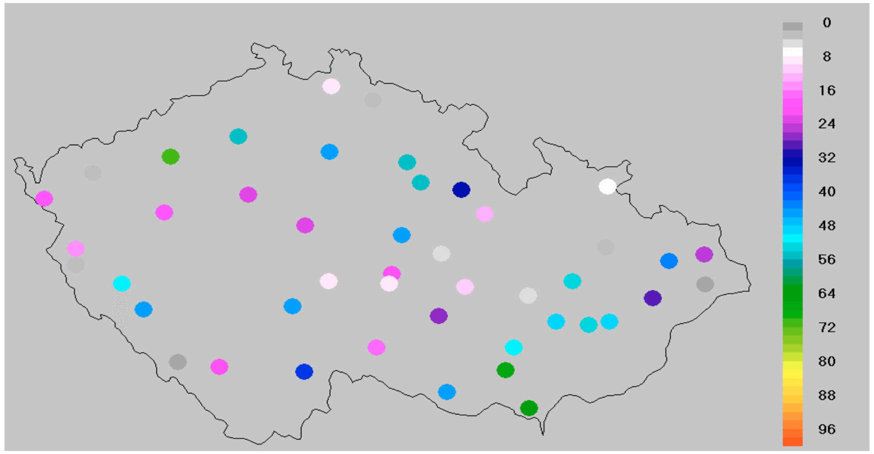
- **implementation of the simple (but applicable!) interpolation technique**, which is based on the locally weighted tri-variate regression (x = longitude, y = latitude, z = altitude)

Topography of the study area and location of the 45 stations with available observational weather data

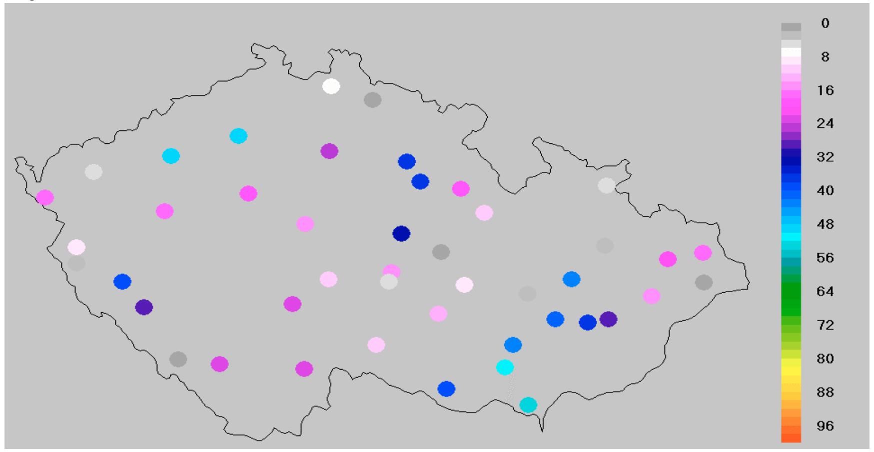


Direct validation of the weather generator: number of heat waves in 40y series

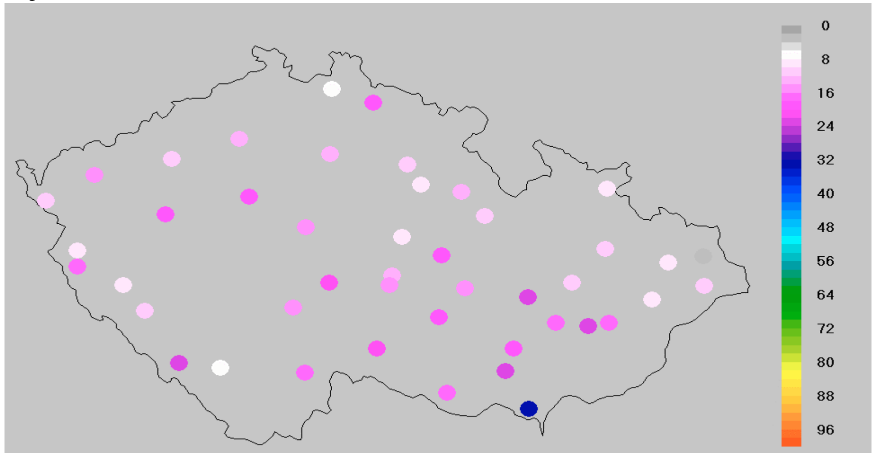
A. observed weather series



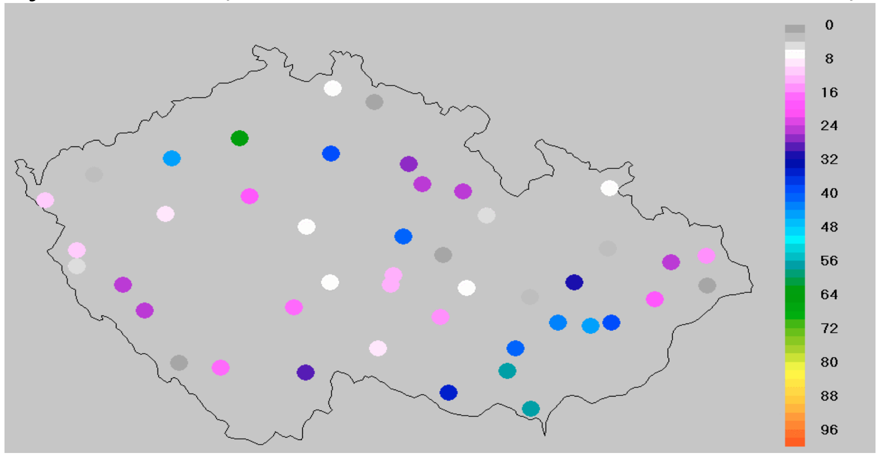
B. synt. series (WG parameters derived from obs.series)



C. synt. series (WG parameters interpolated; XY method)



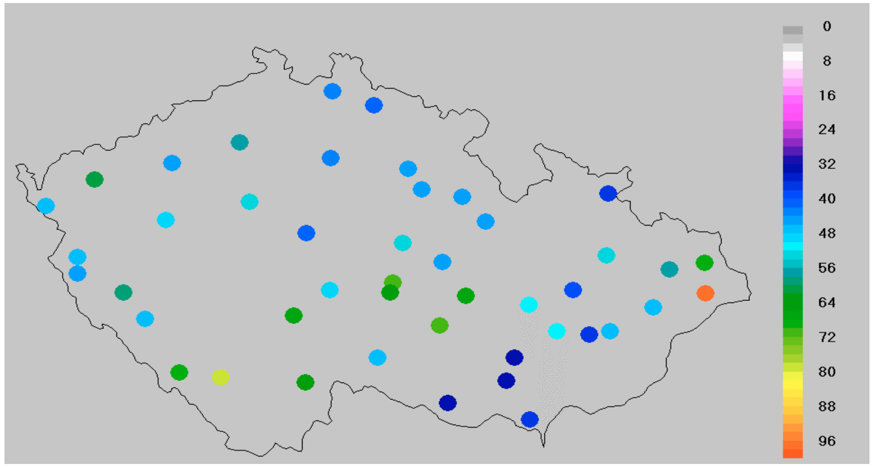
D. synt. series (WG parameters interpoled; XYZ method)



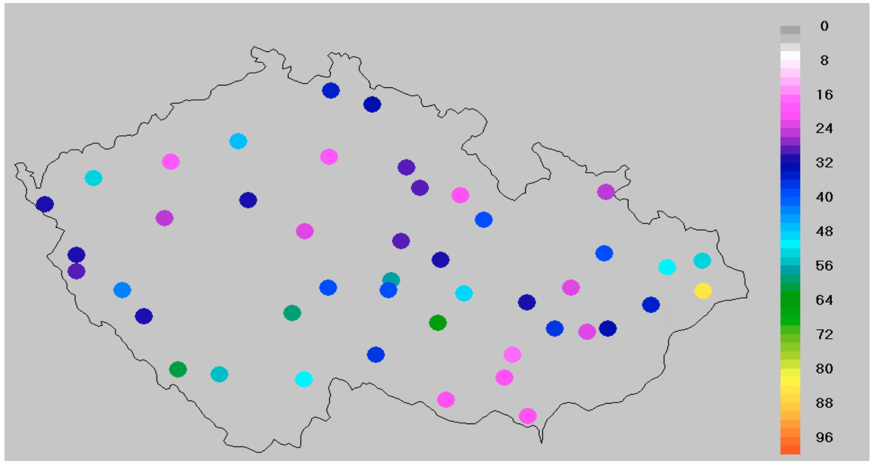
[see Kyselý and Dubrovský (2005) for the definition of heat and cold waves]

Direct validation of the weather generator: number of cold waves in 40y series

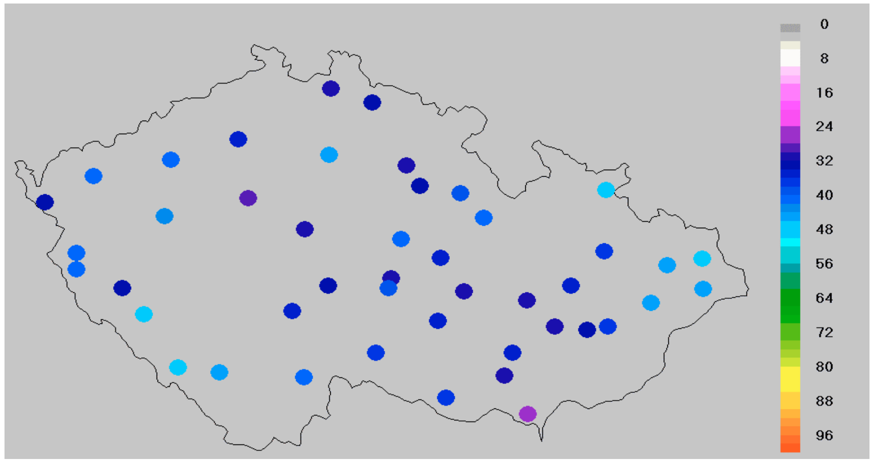
A. observed weather series



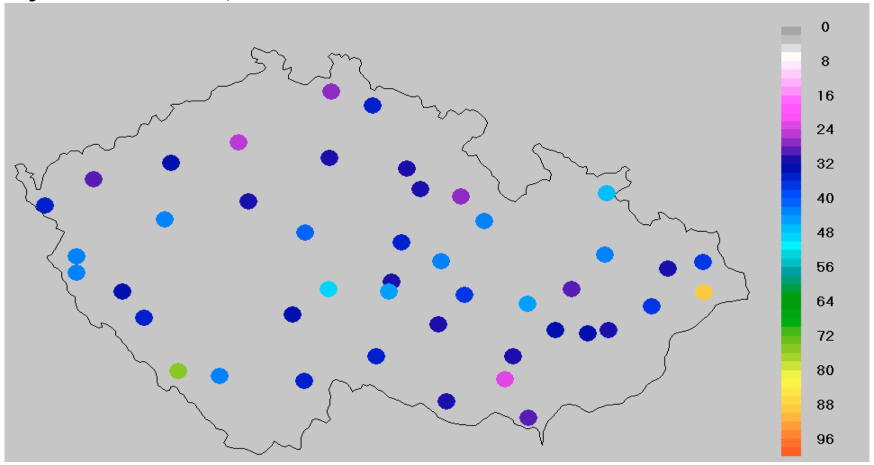
B. synt. series (WG parameters derived from obs. series)



C. synt. series (WG parameters interpolated; XY method)



D. synt. series (WG parameters interpolated; XYZ method)



notes: *- interpolation: WG-parameter = f(long, lat) [XY method]*
= f(long, lat, alt) [XYZ method]

*- perfect fit between panels **A** and **B** would mean perfect performance of weather generator*
*- perfect fit between panels **B** and **C** (or **B** and **D**) would mean perfect interpolation method*

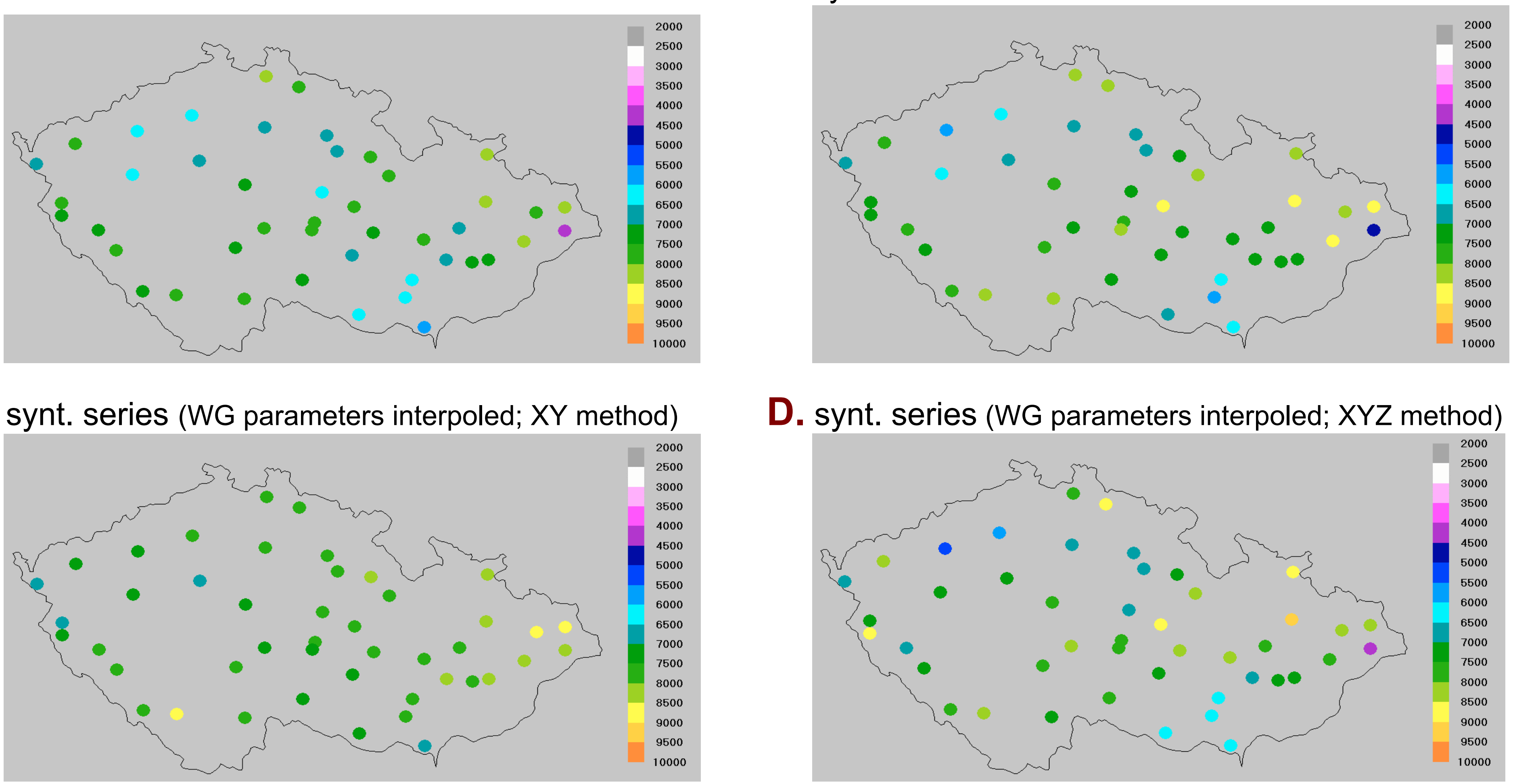
Indirect validation of the weather generator
Mean (40-years) model wheat yields simulated by WOFOST fed with

A. observed weather series

B. synthetic weather series

C. synt. series (WG parameters interpoled; XY method)

D. synt. series (WG parameters interpoled; XYZ method)



notes: *- the differences between panels **A** and **B** indicate sensitivity of the WOFOST model to inaccurracies of the weather generator*

*- the fit between panels **B** vs. **C** (or **B** vs. **D**) indicates performance of the interpolation method*

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