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Performance of the Statistical Downscaling Method WEREX V in Reproducing Climate Extremes

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INTRODUCTION

Climate extremes are of utmost importance, if possible impacts of a changing climate on socio-economic sectors are considered. Global Circulation and Regional Climate Models (GCM, RCM) mostly feature considerable deviations to observed climate extremes, what makes them often difficult to use for impact research. Empirical Statistical Downscaling Methods (ESDM) mostly provide results which coincide better with observations, because measured values are directly used in the method. On behalf of the Saxon State Agency for Environment, Agriculture and Geology (LFULG) the performance of the ESDM WEREX V concerning the reproduction of temperature and precipitation extremes was analyzed.

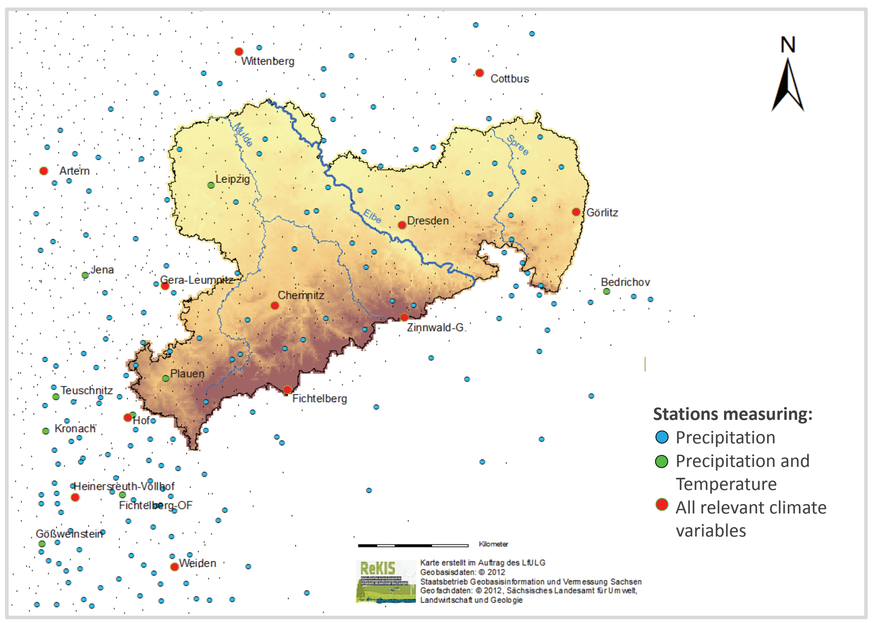

Fig. 1: Case Study Region: Topography of the Free State of Saxony

METHODS

Analysis of the height of percentile and threshold based indices:

- Precipitation: R80p, R80p, R95p, R99p and RX1day, Rx5day
- Minimal and maximal air temperature TX10, TX90, TN10, TN90

Analysis of the occurrence frequency

- of above mentioned percentiles and
- of Ice/Frost/Summer/Heat Days as well as Cold and Heat spells

Drought periods

- Standard Precipitation Evaporation Index: SPEI3, 6 and 12 (VICENTE-SERRANO 2010)
- Definition of the begin of a drought period (Fig. 2): SPEI <= -1
- End of a period: when it reaches >=0.
- Drought magnitude: sum of the SPEI values within the period

Analysis was performed for all stations measuring precipitation (200), temperature (21) and sunshine duration (12), see Fig. 1.

Differences between observed and modeled values were assessed by ranks (Tab. 2)

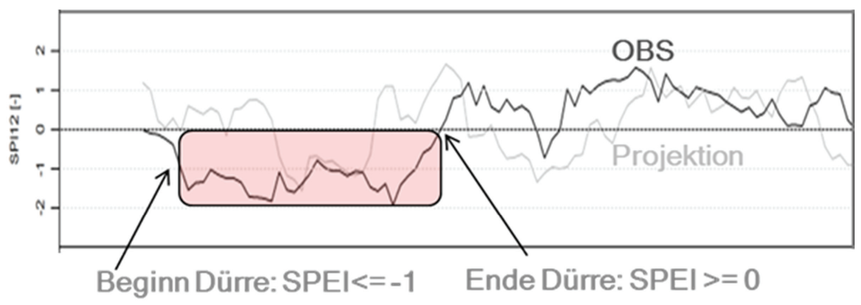

Fig. 2: Definition of drought periods based on SPEI 12

Tab. 2: Thresholds for rank analysis

Bias of temperature percentiles	Bias of all other indices	Rank
< 0.5 K	< 10%	1
< 1.0 K	< 20%	2
< 1.5 K	< 30%	3
≥ 1.5 K	≥ 30%	4

REFERENCES

Kreienkamp F, A. Spekat, W. Enke, 2011: WEREX V-Bereitstellung eines Ensembles regionaler Klima-projektionen. Fichtelberg,.

Vincente-Serrano SM, Begería S, López-Moreno JI (2010) A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index. J. Climate, 23, 1696–1718

WHAT IS WEREX V?

WEREX is an Empirical Statistical Downscaling Method and bases on the same approaches as WETTREG (weather situation-based regionalization, Kreienkamp 2011), but was set up escpecially for the Free State Saxony. It combines atmospheric circulation patterns with local climate. Observed climate episodes of some days length are newly combined according to the frequency of projected (GCM or RCM) circulation patterns. WEREX V comproses 120 realisation, which were produced on the basis of different GCMs, RCMs and model runs (Tab. 1).

GCM	RCM	Run	WEREX V realisations
ECHAM5	–	1	20
ECHAM5	CCLM	1	10
ECHAM5C	–	1	10
ECHAM5	–	2	10
ECHAM5	CCLM	2	10
ECHAM5	–	3	10
ECHAM5	RACMO	3	10
ECHAM5	REMO	3	10
HadCM3C	–	1	20
HadGEM2	–	1	20

Tab. 1: WEREX V Ensemble

Results & Discussion

Precipitation

- Height of all extreme precipitation extremes was underestimated by 11-18 % (see, e.g., Fig. 3)
- Intra-annual variations not adequately simulated

Temperature

- Extremes are cutted
- Underestimation of cold related event days by <14 %, and heat related days by 19-28 %
- Cold and heat spells with errors larger than 30 %

Droughts

- Short periods are modelled too frequent (error >25 %), long periods to seldom (error >30 %)
- Drought magnitude modelled well
- SPI3 better than SPI12 (errors 12-18 % and 17-25 %, resp.)

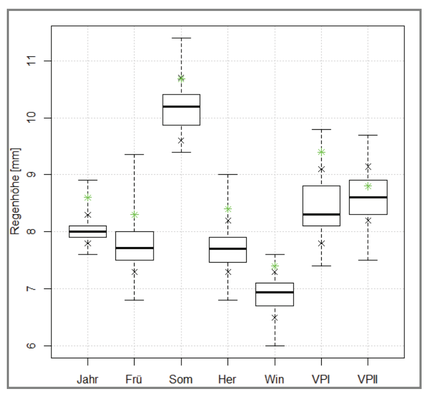

Fig. 3: Modeled height of the 95. precipitation percentiles (box pot) vs. observations (green star) for various seasons of the year (VP=vegetation period) for Dresden-Klotzsche

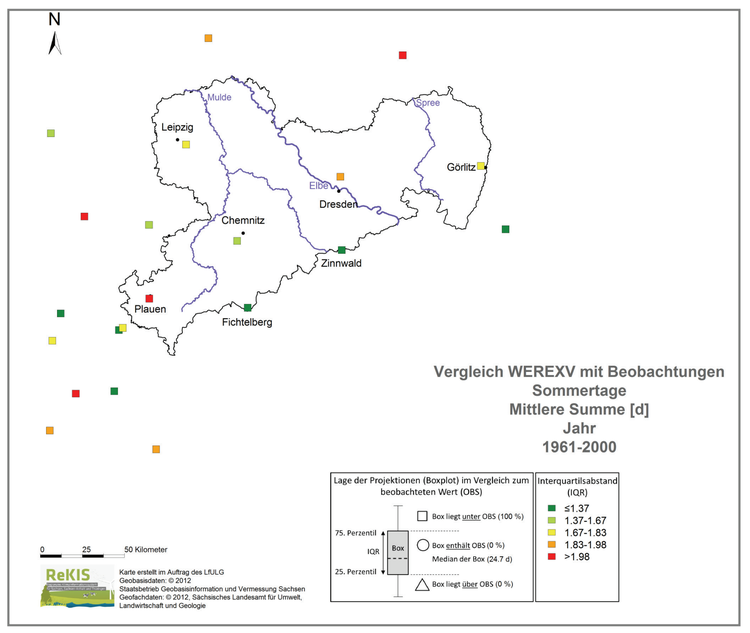

Fig. 4: Modeled summer days in comparison to observations (square=underestimation of summer days; from green to red= increasing interquartile range)

Summary

- The more extrem the index the worse the reproduction by WEREX V
- Unsufficient reproduction of long periods
- No dependency of the performance on altitude and location of the station
- Best performance for all analysed indices. EH5-CLM_L1, EH5-RACMO_L3, EH5-REMO_L3, HCG2_L1
- Effort of the modell cascade GCM-RCM-ESDS has paid off

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