Institut für Meteorologie

Freie Universität Berlin

Extreme weather events in southern Germany – Climatological risk and development of a large-scale identification procedure

A. Matthies, G.C. Leckebusch, G. Rohlfing and U. Ulbrich

Contact: anne.matthies@met.fu-berlin.de, www.geo.fu-berlin.de/met/

Approach

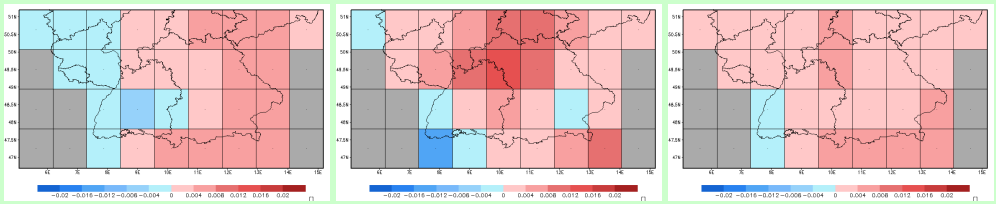
Regional risk-analyses are highly required by parts of economy sensitive to extreme weather events. As a part of the colla-borative klimazwei-project RegioExAKT (www.regioexakt.de), this study is making such an attempt in a three-step-strategy:

1. Identification of extreme weather periods in summer and winter via station data (precipitation form and amount)
   - ➢ 90th Percentile of precipitation amount was found to be a suitable threshold for identification of extreme impact relevant precipitation events
2. Diagnostic of large-scale processes causing these events with gridded global data for recent climate (ERA40) by classifying characteristics, intensity and frequency of relevant situations - **first results shown here**
3. Transfer of findings to simulations of an AOGCM (ECHAM5-OM1) and RCM (CLM driven by ECHAM5-OM1) to detect a possible climate change signal (A1B scenario) **upcoming work**

Large-scale processes

NE: **WW:** **CY:**

Diff VA 500-700 hPa



Mean over all days with RR>90th Percentile in more than 50 % of the gridboxes. **Positive values indicate lability** and therefore are a hint of convective activity. Diff VA is positive in wide areas in all three cases and reaches the highest values for western circulation which is also the one with the highest probability of extreme precipitation.

TT-Index

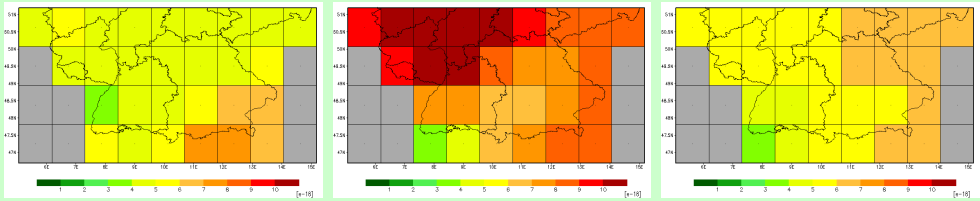
224 days	RR>90th Perc	RR<90th Perc
TT>45	15.3%	43.4%
TT<45	8.0%	33.2%

926 days	RR>90th Perc	RR<90th Perc
TT>45	11.3%	52.3%
TT<45	3.7%	32.7%

1125 days	RR>90th Perc	RR<90th Perc
TT>45	21.5%	64.8%
TT<45	3.4%	10.3%

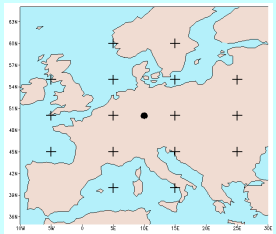
Total-Totals-Index: Sum of Vertical Totals (T_{850}-T_{500}) and Cross Totals ($T_{d,850}$-T_{500}) $TT=T_{850}+T_{d,850}-2T_{500}$. Contains information about static instability and humidity. Thunderstorms are possible, if TT>45 (Miller, 1972)[2]. **Too many days with TT>45 but no extreme RR**. Inversion layers can prevent convection in spite of high TT-values.

DSI 600 hPa

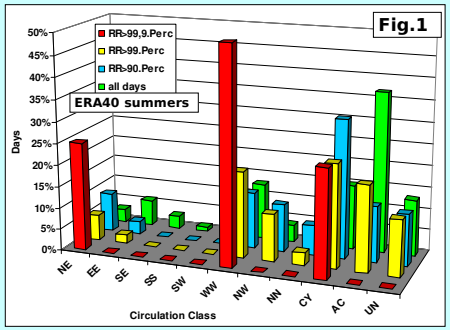


Mean over all days with RR>90th Percentile in more than 50 % of the gridboxes. The Dynamic State Index (DSI) describes the deviation from a stationary, inviscid, dry solution of the adiabatic primitive equations (Weber and Névir, 2008)[3]. Results denote that **thresholds indicating extreme weather events can be defined**, but have to be chosen separately for every CWT.

Circulation Weather Types and extreme RR



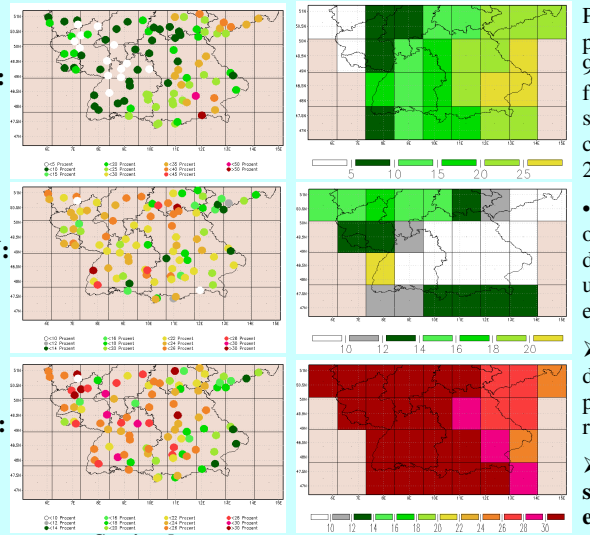
Lamb's CWT's, calculated with information at 16 gridpoints (crosses) on 2.5°x2.5° Grid for 50°N, 10°E (black circle) in ERA40 summers 1961-2000 according to the objective scheme by Jones et al. (1993)[1].



- Figure 1 shows days with RR over certain thresholds for the gridbox containing Munich
- proportion of days is constantly increasing with higher thresholds for class WW, but stagnating for CY AC has a high part of days over the 99th percentile but no days over the 99.9th percentile
- southerly circulation does not cause extreme precipitation in the area around Munich.

➢ **certain CWT's are prone to heavy precipitation, others have low risk to cause such events**

NE: **WW:** **CY:**



Pictures on the left show probability for exceeding the 90th percentile of precipitation for three CWT's in summer for station data 1996-2000 (left column) and ERA40 1961-2000 (right column).

- spatial patterns of probability of exceeding RR90 are well depicted, despite of systematic underestimation in ERA40, except CY
- ➢characteristics of horizontal distribution of extreme precipitation probability can be reproduced by ERA40 model
- ➢**further analyses of large-scale processes causing extreme precipitation are thus responsible**

Conclusions

Large-scale parameters are tested in connection with CWT's to find out a combination that has the highest skill to identify extreme precipitation events in gridded data. Differential vorticity advection and DSI seem to be suitable. Ongoing work is focused on testing further parameters or combinations of parameters to possibly upgrade recent results plus application of findings to GCM data.

References: [1]Jones, Hulme and Briffa (1992): International Journal of Climatology, 13: 655-663; [2]Miller(1972): Tech. Rep. 200 (rev), AWS,U.S. Air Force: 102pp (Headquarters, AWS, Scott AFB, IL 62225); [3]Weber and Névir (2008): Tellus A, 60(1): 1-10