Projecting the Regional Climate Change with Statistical Downscaling for Saxony/Germany

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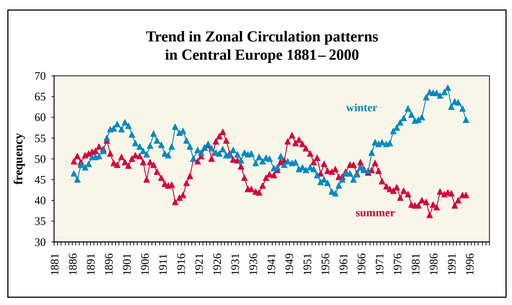
Saxony Region Characteristics

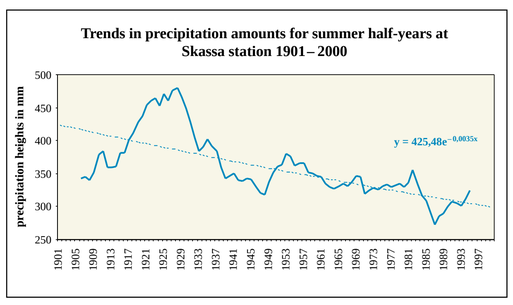
Saxony extends northwards to the lowlands of Leipzig and is further bounded southwards by the uplands of the Ore and Lusatian Mountains. In view of its considerable orographical diversity, this region is characterised by a climate of pronounced spatial and temporal variability resulting from an interplay of both macro-scale and local influences.
In relation to this orographical situation the general circulation as well as their short-term and long-term variations are of great importance for resulting characteristics of weather and climate parameters, respectively.

Circulation Pattern Variability

The large-scale atmospheric circulation is an important driving force of the regional climate in Europe. Regional climate change in Europe is strongly connected with long term changes in circulation patterns. Since the early seventies of the 20th century a significant change in circulation patterns over Europe is detectable. From that time the zonal partitions in weather patterns in summer are decreasing and in winter increasing, respectively, in a striking manner.

These changes are connected with increasing temperatures in last decades.
In addition, dry periodes in Saxony at present and likely in the future will appear more often than in the past because of generally increasing southwest (lee side) and decreasing northwest (weather side) circulation situations over Europe. As to southwest weather types the probability of rain is low in Saxony owing to distinctive lee side effects.



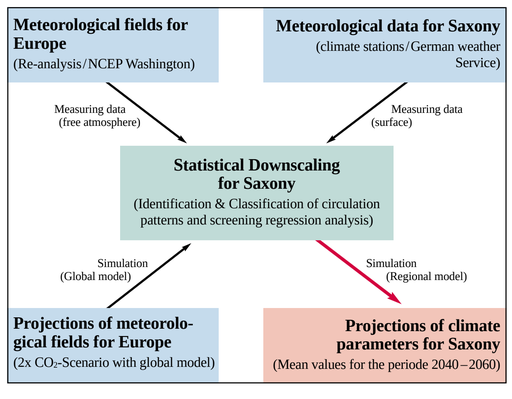


Downscaling Model Characteristics

Regional scenarios for Saxony – until 2050 – was carried out by using a statistical downscaling model with doubled CO_2-concentration. The model is based on the results of global climate simulations (ECHAM4 – OPYC-T42 transient simulation of the Max Planck Institute Hamburg for the IPCC scenario A) and on the assumption that GCM's results reflect mean large-scale climate changes more exactly for a defined region than for a number of grid points. This model is a combination of objectively derived weather patterns and weather pattern-dependent multiple regression analyses.

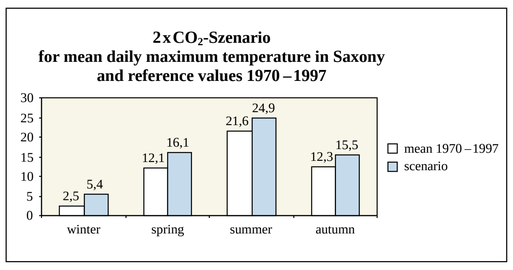
The classification step requires daily grid fields. For our investigation we used geopotential heights of the 1000, 700, and 500 hPa levels and the 700 – 1000, 500 – 1000 and 500 – 700 hPa thickness in the North Atlantic-European sector from the German Weather Service.

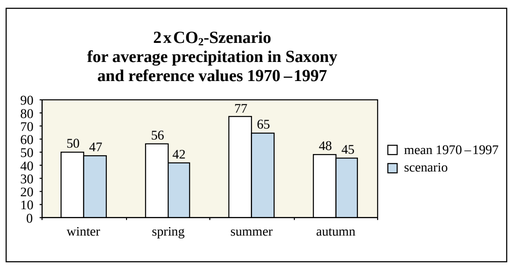
The regression step requires time series of daily surface data. This investigation uses observations at 52 German climate stations obtained from the German Weather Service.
Potential predictors for the screening regression analysis are exclusively derived from upper air geopotential fields.

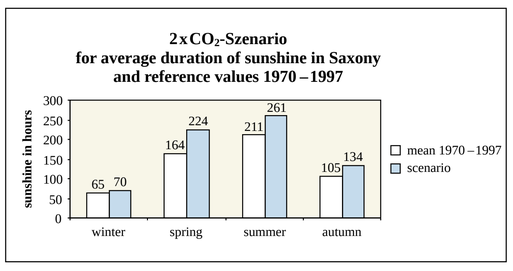


Climate Simulation Results

The model has been used to calculate the change in temperature, precipitation amount and sunshine duration over the next 50 years in response to the doubled CO_2 szenario. The results indicate substantial warming in this period. Estimates indicate that in the Saxony region a rise of the yearly mean temperature of about 3 K is to be expected.







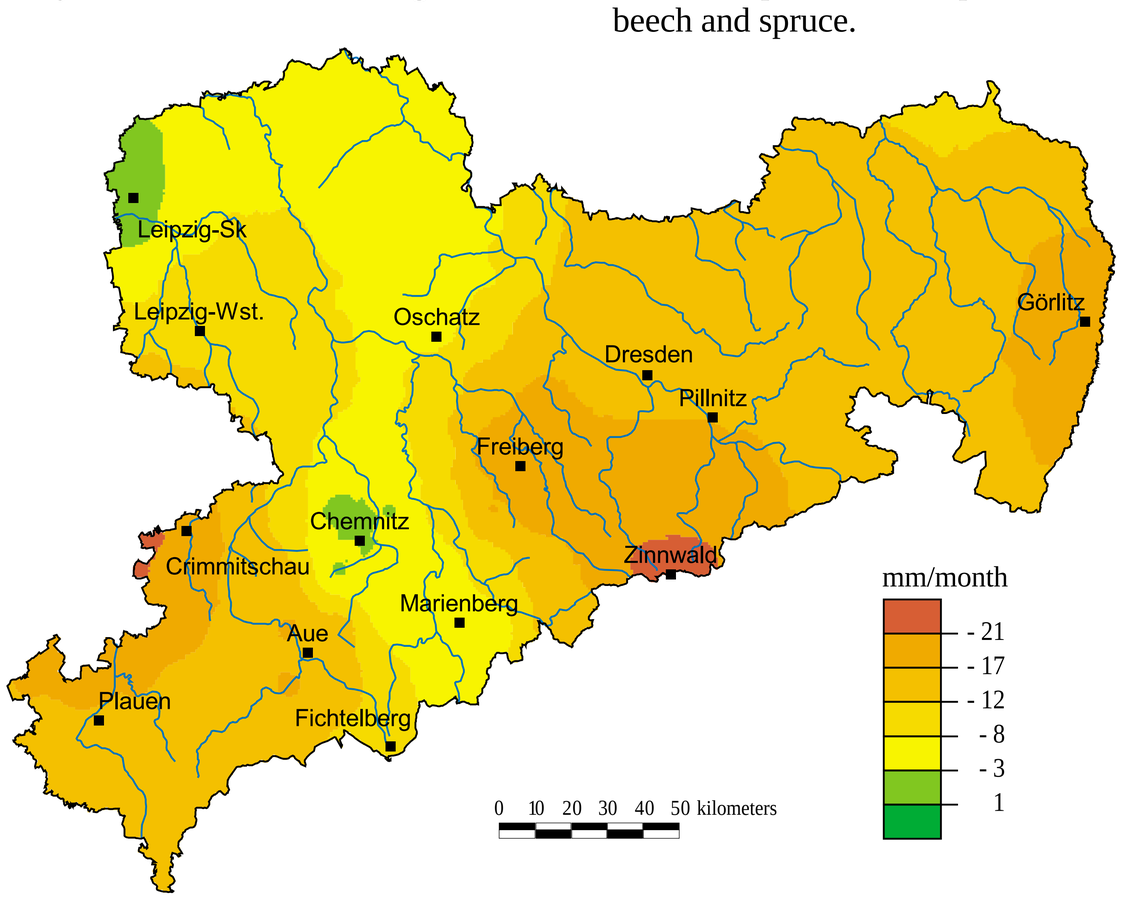
The results suggest that rainfall patterns would likely be substantially altered, too. A striking decrease of precipitation amounts and an increase of sunshine duration, respectively, is mainly expected in spring and summer.

Changes on the Horizon

Predicted changes of Saxony's climate due to global warming involve changes in precipitation and sunshine patterns as well as temperature. Major effects of climate change simulated for Saxony are likely to be felt through changes in the frequency of extreme events, causing more droughts above all.

Effects will be seen primarily in water-dependent activities and forestry. Predicted climate change must be incorporated in the management and planning of our water reservoir systems immediately.

Saxonian ecosystems will likely be especially threatened due to the unfavourable combination and rates of climate parameter change. So, some tree species would disappeare and could be replaced by any drought-tolerant species. Under mountainous conditions upslope shifts are possible for species like beech and spruce.



Decrease in precipitation (summer)

In anticipation of impacts to be expected, Saxony recently has developed a stepwise climate program to evaluate potential impacts, to take preventive measures and to promote public awareness and discussion.

Sächsisches Landesamt für Umwelt und Geologie