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# GIS based analysis of spatio-temporal variation of climatological growing season for Austria

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## Introduction

***The temperature-driven length of growing season significantly influences management and productivity of grassland. In the past decades a trend of an earlier start of growing has been observed in many European regions, especially in the temperate zones. To spatialize this information a GIS model has been developed by using daily temperature surfaces.***

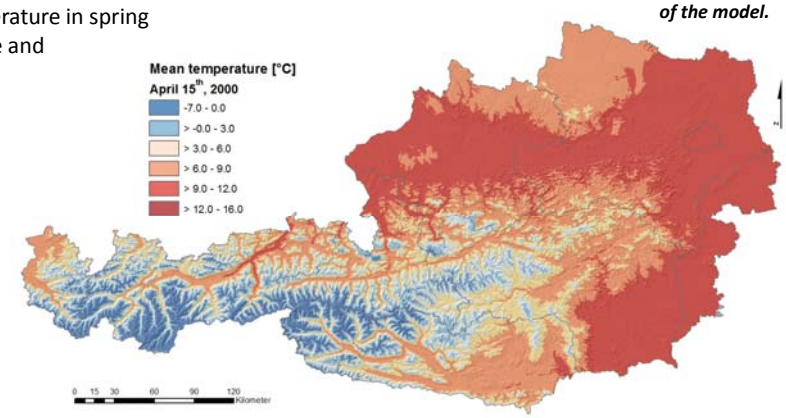
## Materials and Methods

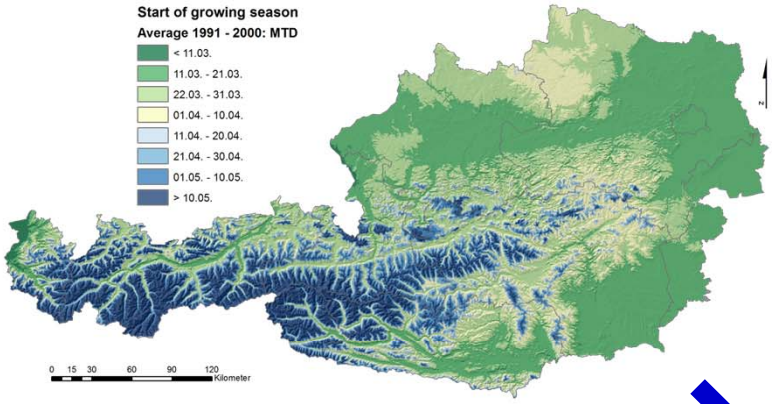
The analysis of spatio-temporal changes of growing season needs long time series of observations of daily mean air temperature. They are interpolated day by day with the state of the art method *Residual Kriging* (Goovaerts, 1997) and integrated in a simple GIS model.

The start of growing season is assumed when daily mean temperature in spring exceeds a certain threshold for some consecutive days. A simple and widely used criterion (*Simple Thermal Definition - STD)* found in literature is a threshold of 5 °C and a period of five days.

STD with one single temperature-threshold is mainly used for station based analysis but causes problems if spatial data with continuous temperature fields are taken into account. Therefore, we extended the STD approach to a *Multiple Thermal Definition (MTD)*. Different thresholds of daily mean and minimum temperature are combined to balance the regional sensibility of determination of start and end of growing season.

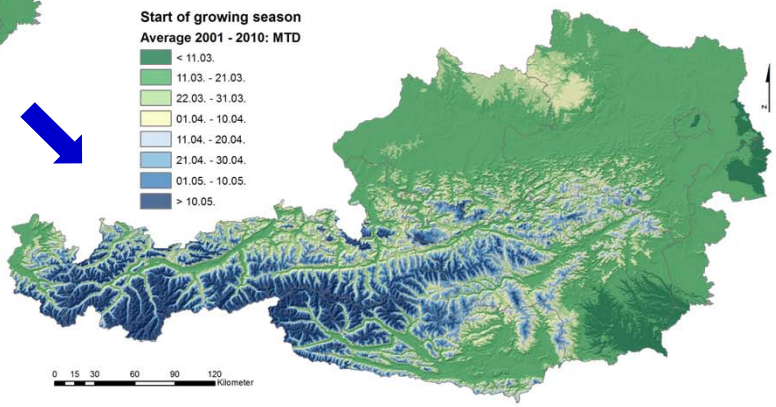
***Temperature surfaces are the base of the model.***



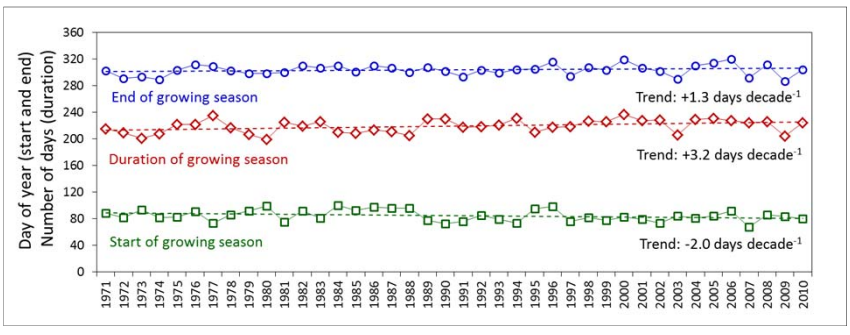

## Results

Raster surfaces of start, end and length of growing season according to STD and MTD have been calculated for the years 1971 to 2010 for the entire area of Austria at 250 meter resolution.




Trends of start and end are comparable to the findings of Menzel and Fabian (1999) who analysed long-term observations of phenological phases. The growing season starts earlier and ends later compared to the begin of our study period and results in an increase of duration with 3.2 days decade$^{-1}$.

***Growing season (STD) trends for Austria over 40 years (average at all weather station sites)***




## Conclusions

***The climatological growing season does not consider the growth requirements of individual plant species, but gives a temperature driven average with focus on climate.***

***To observe, visualize and evaluate changes also in their spatial dimension a GIS based analysis of growing season is needed and proposed by this work.***

***Climate impact on grassland management can better be estimated – a pre-condition to work on efficient adaption strategies.***

Goovaerts, P. (1997): Geostatistics for Natural Resources Evaluation. Applied Geostatistics Series, Oxford University Press, New York, Oxford, 483 S.
Menzel, A. and Fabian, P. (1999): Growing season extended in Europe. Nature 397 (6721), 659-659.

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