## MOTIVATION

**Popular believe:** "there is always bad weather on weekends"



### in Austria

Is there a higher chance of precipitation on weekends?

### DATA

HOMSTART project (http://www.zamg.ac.at/forschung/klimatologie/klimawandel/homstart/)

- homogenized precipitation time series for 57 Austrian meteorological stations
- ▶ 1948-2009
- altogether almost 1,120,000 observations

### METHODS

structured additive regression (STAR) models (Fahrmeir et al., 2004; Brezger and Lang, 2006): Itexible regression model that can deal simultaneously with possible nonlinear temporal effects as well as the inherent spatial correlation of meteorological stations.

$$\Phi^{-1}\left\{P( ext{rain}_{it}\leq r)
ight\}=\eta^{(r)}_{it},$$

 $\Phi(\cdot)$ : cumulative distribution function of standard normal distribution

r: rain intensity: (none=0mm, low=1mm, medium=5mm)

i: stations  $(1, \ldots, 57)$ 

$$t$$
: time  $t=1,\ldots,22645$ 

 $\eta_{it}^{(r)} = \xi_r - \{f_{\mathrm{kr}}(\mathrm{long}_i, \mathrm{lat}_i) + f_{\mathrm{ps}}(t) + f_{\mathrm{ps}}(t) \}$  $lpha_{i,1}\cdot\cos(2\pi\cdot t+\phi_{i,1})+lpha_{i,2}\cdot\cos(4\pi\cdot t+\phi_{i,2})+$  $\omega_i \cdot I_{ ext{weekend}}(t) \},$ 

 $\xi_r$ : category specific threshold

 $f_{kr}(\cdot, \cdot)$ : nonlinearly-correlated spatial effect of the meteorological stations (kriging; Fig. 1)  $f_{ps}(\cdot)$ : nonlinear time trend in t (P-splines; Fig. 2)

 $lpha_{i,1}\cdot\cos(2\pi\cdot t+\phi_{i,1})$ ,  $lpha_{i,2}\cdot\cos(4\pi\cdot t+\phi_{i,2})$ : harmonic seasonal terms at annual and half-annual frequencies with station-specific amplitude parameters  $\alpha_{i,1}$ ,  $\alpha_{i,2}$  and phases  $\phi_{i,1}$ ,  $\phi_{i,2}$  (Fig. 3)  $\omega_i$ : spatial weekend effect of station *i* (Fig. 5)

Model fitting is carried out in R using **R2BayesX** (Umlauf et al., 2011),



# Why does it always rain on me? A spatio-temporal analysis of precipitation in Austria

## WEEKEND EFFECT

Fig. 5: Weekend effect  $\hat{\omega}_i$ (scale approx. one magnitude smaller!) higher precipitation probability on weekends lower precipitation probability on weekends

 $(\pm 0.07 \text{ compared to e.g. } \pm 0.5 \text{ of spatial effect})$ 

## SUMMARY

- ► No significant time trend (Fig. 2)
- pattern is pronounced (Fig. 3).
- ► No spatial pattern of weekend effect (Fig. 5)
- (Fig. 5)

### **CONCLUSION:**

there is no evidence of a weekend effect for precipitation in Austria

data.

### References

Umlauf, N., G. Mayr, J. Messner, and A. Zeileis, 2012: Why does it always rain on me? A spatio-temporal analysis of precipitation in austria. Austrian Journal of Statistics, 41, 81-92, http://www.stat.tugraz.at/AJS/ausg121/121Zeileis.pdf Brezger, A. and S. Lang, 2006: Generalized structured additive regression based on Bayesian P-splines. *Computational Statistics & Data Analysis*, **50**, 947–991. Fahrmeir, L., T. Kneib, and S. Lang, 2004: Penalized structured additive regression for space time data: A Bayesian perspective. *Statistica Sinica*, **14**, 731–761. Umlauf, N., S. Lang, T. Kneib, and A. Zeileis, 2011: Structured Additive Regression Models: An R Interface to BayesX. R package version 0.1-1/r242, http://bayesr.R-Forge.R-project.org/.

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► Rain probabilities increase from south-east to north-west (Fig. 1)

Precipitation in southern regions has a clear annual peak, while in northern regions the semiannual

Amplitudes pertaining to the anual frequency are higher in the south (Fig. 4) Compared to the other effects the weekend effect is extremely small and in both directions

Acknowledgements: We are thankful to Stefan Lang and Thomas Kneib for help and support for BayesX, and Ingeborg Auer for the HOMSTART