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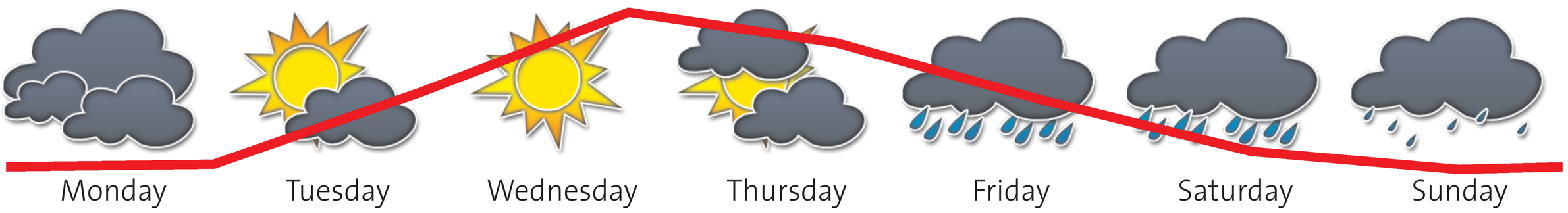
Weekly periodicities in climatology?



Abstract

There is no natural seven-day cycle known, which lasts over a longer period of several years. Regarding the dynamics in meteorology one can underpin this statement with statistical tests.

Many human beings do “live” a weekly cycle: weekdays are usually working days, while weekends overlap with workfree-days.

Several studies attend to the weekly cycles in air pollution as for e. g. ozone, PM10, and so on. Only a few are concerned with the 7-day cycle in climatological variables.

The authors of this poster research in exactly this topic and analyse — in line with a master thesis — the weather data from the automatic stations over Switzerland.

Introduction

Bäumer et al. found weekly periodicities in climatological variables as over Germany. By analysing data from 12 WMO stations between 1991 until 2005 they found a negative temperature anomaly for weekends and a positive one for weekdays. The analysis of the precipitation data shows that there is generally more precipitation on weekends than on weekdays. Gong et al. found very similar results in China. Both groups assume that this seven-day-cycle is caused by aerosols, although the mechanism of action is not well understood.

Results for Switzerland

The analysis of the PM 10 data between 1998 and 2005 provide a significant weekly cycle with a minimum at Sundays (**figure 1**). The one sided Wilcoxon ranking test between the maximum (Wednesday) and the minimum (Sunday) is highly significant. This 7-day cycle can also be seen clearly in the periodogram which shows a peak at 1/7 and its multiples (**figure 2**).

PM 10: Weekly Cycle

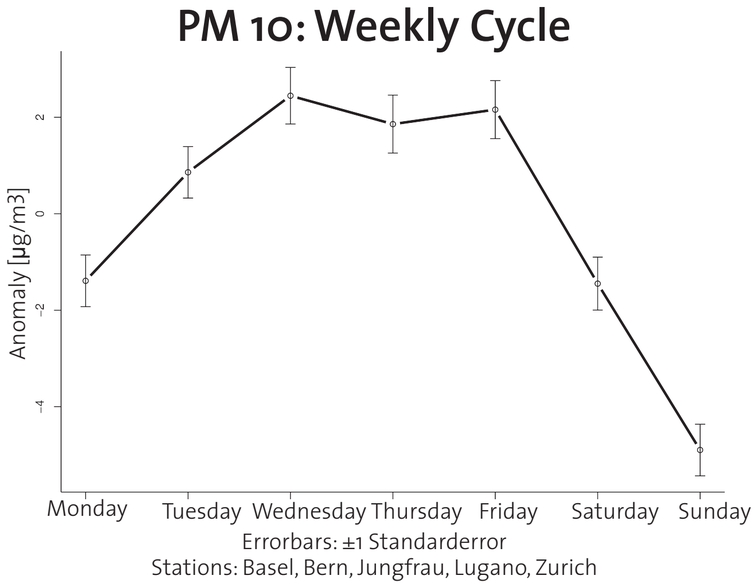


Fig. 1: Weekly cycle of PM10; values from 1998-01-01 to 2005-12-31.
p-value < 2.2e-16, Wilcoxon rank sum test with continuity correction one side (Maximum vs. Minimum)

PM 10: Periodogram

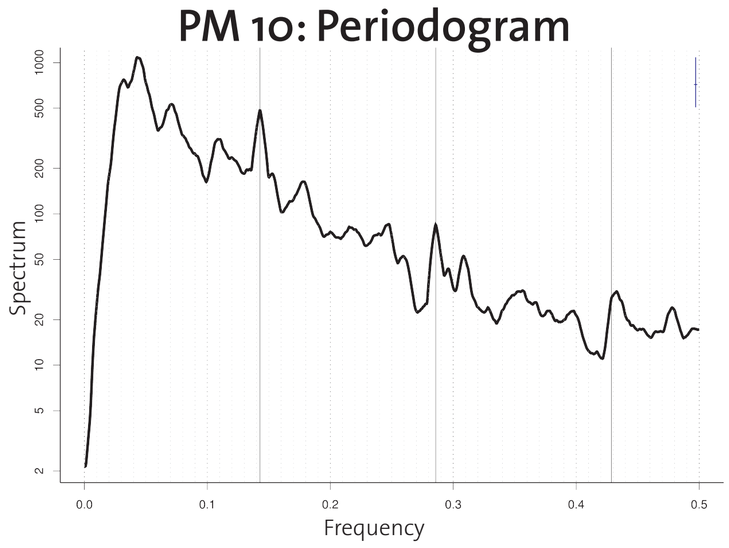


Fig. 2: Smoothed Periodogram of PM10, values from 1998-01-01 to 2005-12-31.
Black vertical lines show the frequency of a week (1/7 and multiples of it).

The periodogram of temperature does not reveal such a peak (**figure 3**).

Temperature: Periodogram

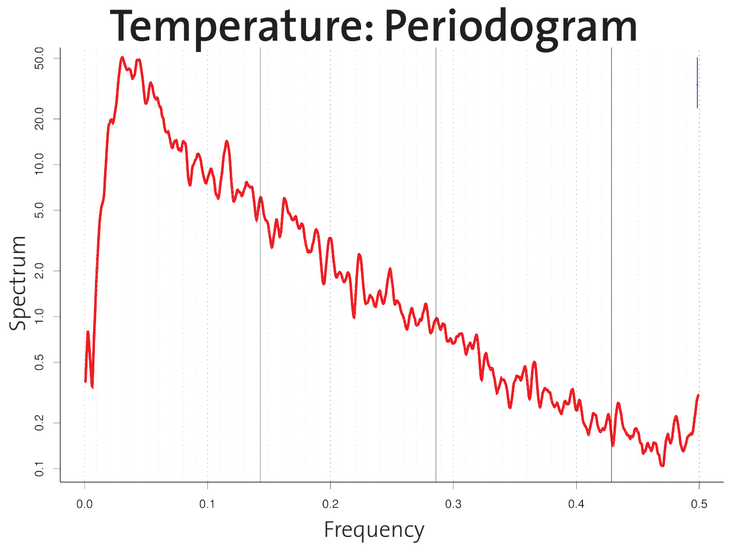


Fig. 3: Smoothed Periodogram of Temperature, values from 1998-01-01 to 2005-12-31.
Black vertical lines show the frequency of a week (1/7 and multiples of it).

The analysis of the temperature anomaly for each week day provides a 7-day-cycle with a very small magnitude (**figure 4**). The Wilcoxon ranking test between the maximum and the minimum does not show a significance.

Temperature: Weekly Cycle

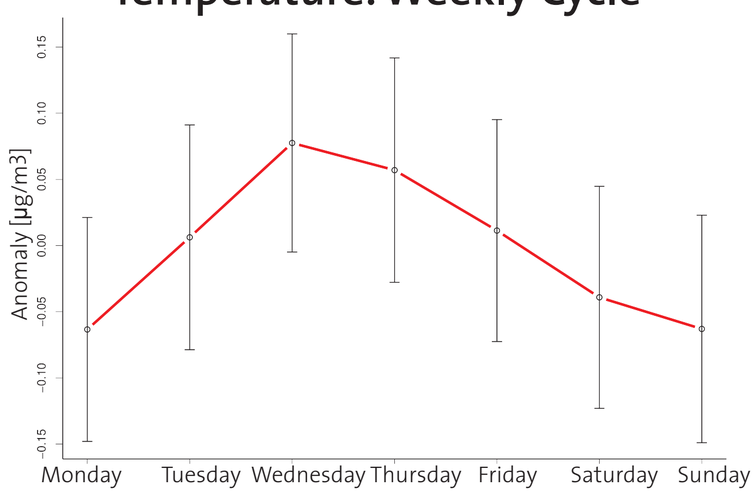


Fig. 4: Weekly cycle of Temperature; values from 1998-01-01 to 2005-12-31.
p-value = 0.095, Wilcoxon rank sum test with continuity correction one side (Maximum vs. Minimum)

Random Simulation

The random simulation (5000 runs of the model) with the real temperature data provides a histogram which reveals that a magnitude of about 0.2°C between the maximum and the minimum is the most likely case (**figure 5**).

Temperature: Histogram Simulation

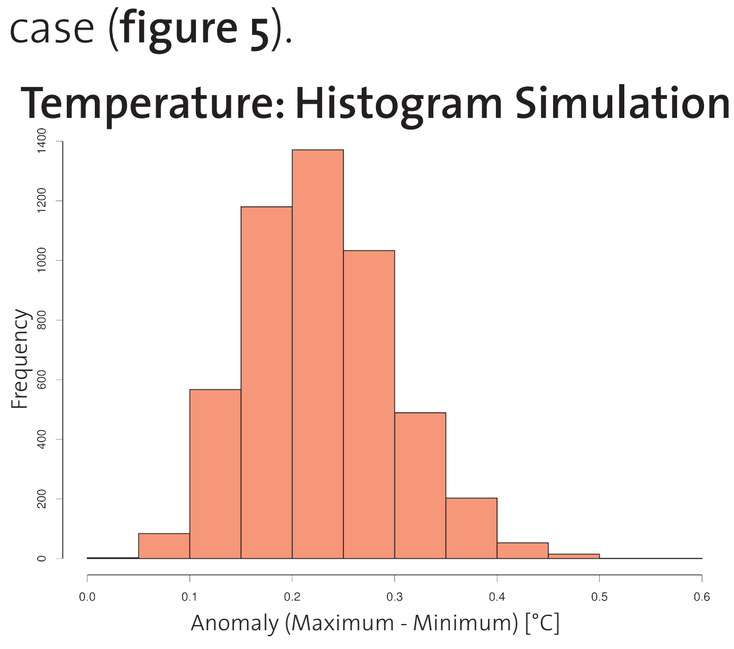


Fig. 5: Random smulation with the real temperature data.

Literature

- Dominique Bäumer and Bernhard Vogel (2007), An unexpected pattern of distinct weekly periodicities in climatological variables in Germany, Geophysical Research Letter
- Dao-Yi Gong, Dong Guo and Chang-Hoi Ho (2006), Weekend effect in diurnal temperature range in China: Opposite signals between winter and summer, Journal of Geophysical Research-Atmospheres
- R Development Core Team (2005), R: A language and environment for statistical computing