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Global Warming and Beer

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What Kind of Months?
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Climate-Change-Driven Beer Warming: Threats and Opportunities

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Abstract

Climate change challenges mankind: Higher temperatures will lead to faster warming of beer. Since temperature and time limit the comfortable beer drinking range of temperate climates (CBDR_{tc}) (Fig. 1), we hypothesize that the CBDR_{tc} will decrease during the 21st century. This was tested by applying a climate simulation on a calibrated beer-warming model. Results are sobering. Nevertheless, effective measures of adaptation were identified.

Material and Methods

Newton's heating model was used to predict the increase in beer temperature as depending on ambient air temperature:

$$\Delta T_h = \alpha (T_a - T_h) \text{ with} \quad (\text{eq. 1})$$

ΔT_b : Increment in the temperature of beer [°C]

T_a, T_b : Ambient air temperature, temperature of beer [°C]

α : Beer warming coefficient

The model was cautiously calibrated (Fig. 2) by measuring the temperature for a reasonable period of time in 0.3 L and 0.5 L bottles of beer. For safety reasons, no beer was warmed and measurements were conducted with water. The model was subsequently validated by drinking real beer, tracking beer temperature and weight in time in a controlled environment (not shown). We generously extrapolated α (eq. 1) to volumes from 0.1 to 1.0 L. Following the IPCC process,

we took climate model data and used them as input for our model. For this purpose, hourly temperature time series of the regional climate model REMO (emission scenario A1B) from 783 locations across Lower Saxony, Germany (horizontal resolution approx. 0.088°) were taken to project beer warming inside a beer glass for the period 1981 to 2100. The climatic signal was subsequently analysed, considered as the change to the reference period 1981-2010, and a beer of 0.3 L with initial temperature of 7° C at 4 PM. The time of warming until reaching the upper acceptable temperature boundary of the CBDR_{tc} of 10° C was tracked. Although the authors do not agree with the scale, the range of 7 to 10° C was taken as an exemplary beer drinking temperature range after consulting about a dozen beer guides, such as Michael Jackson's 5-level-scale

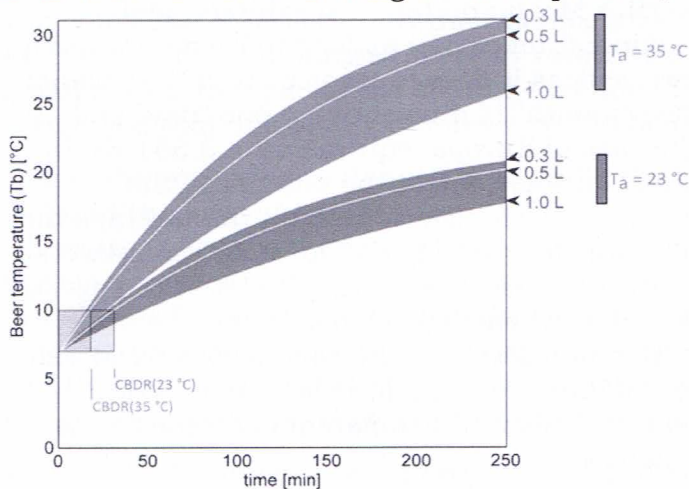


Fig. 1. Examples of the comfortable beer drinking range of temperate climates (CBDR_{tc}), illustrated for lightly chilled / cool beer at varying ambient temperature and volumes. T_a = ambient temperature.

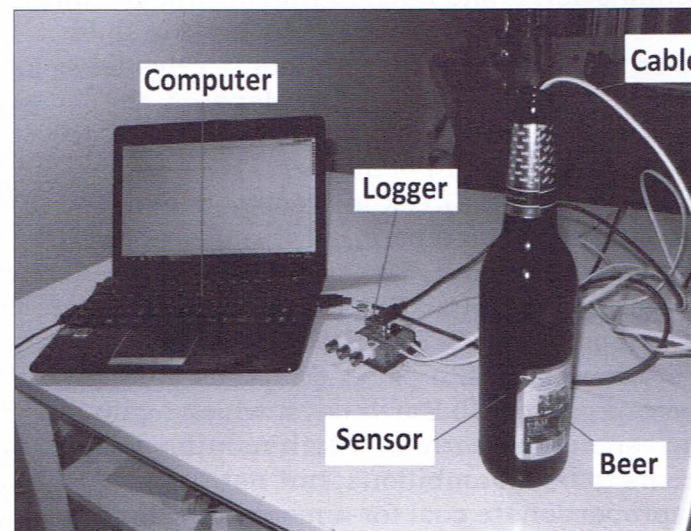


Fig. 2. Experimental set-up.

Results

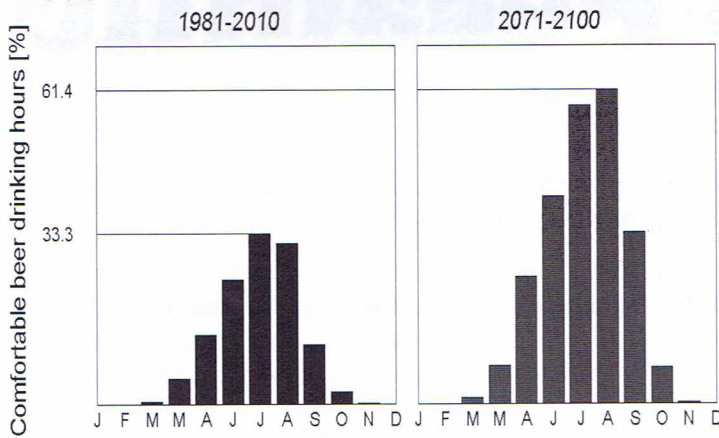
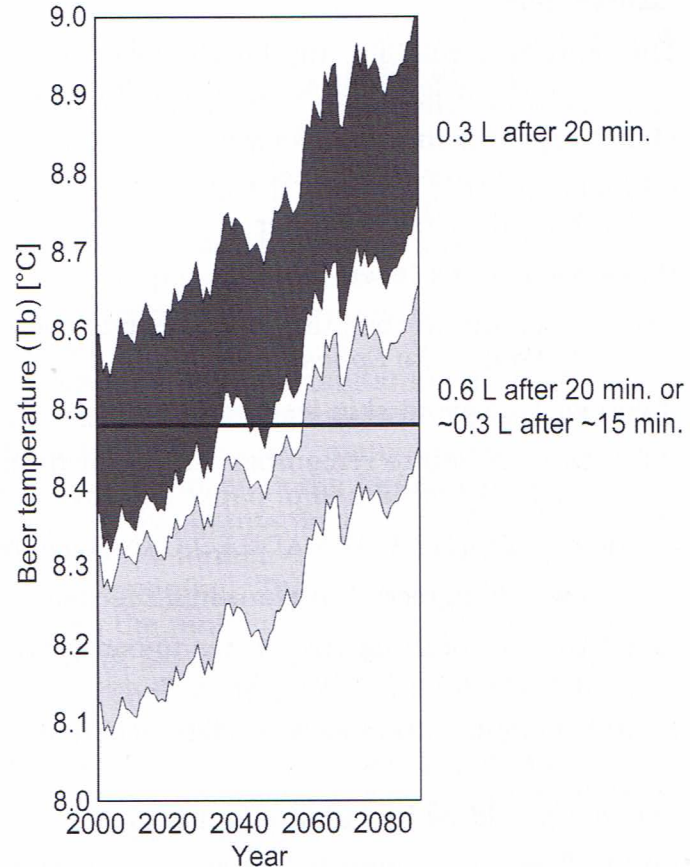


Fig. 3. Projected mean monthly fraction of comfortable beer drinking hours.

Fig. 4. Climate change impact on beer temperature of a daily beer at 4 PM (10 year floating mean). Colored areas display the 15-to-85 percentiles across 783 locations in the region.

The number of comfortable drinking hours ($T_a > 18^\circ\text{C}$) will nearly double (Fig. 3). However, beer will warm considerably faster. To compensate for 21st century warming, either the initial volume of 0.3 L or uptake speed must be increased (Fig. 4) or time of consumption in the future must be shifted prior to 11:04 AM or later than 7:08 PM.



Discussion & Conclusions

Future climate is very likely to narrow your CBDR_{tc} . Mitigation can be achieved by increasing volume. **About 63% more beer must be drunk in temperate climates at the end of the 21st century to feel as comfortable as today.** Furthermore the comfortable range can be optimized by adapting the time of uptake. The rule “No beer before 4 PM” might not be valid for the future since results urge to consume also during morning hours <11:04 o’clock. Additionally, the speed of uptake should be increased as warming equalled roughly an increase of drinking speed of about 5 minutes.

Contrastingly, the number of outside temperatures suitable for open air beer drinking will almost double. Large effects on society are expected. We do not take responsibilities for the consequences of people adapting, emphasizing the limitations of this study. Further measures such as changing beer variety or initial temperature are possible, but limited. Proven measures from warmer climates (such as “stubby holder”) were considered, but require very drastic changes in drinking tradition.

References

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