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A model for weather-related traffic variations and accident probabilities on roads

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Weather conditions affect both road traffic volume and the probability of road accidents. The aim of this study is improve the understanding of both effects as well as their interactions. In a first step, we develop generalized linear models for hourly road traffic counts at 1400 traffic stations on German federal roads and highways. It is distinguished between different vehicle types, including motorbikes, cars, delivery vans and trucks. Different meteorological variables are derived from reanalysis and radar data. The impacts of these variables on the predictive skill of the models is analyzed. In particular models for motorbike counts show large improvements, if meteorological predictors are added to the model. At weekends in the afternoon the mean squared errors of modeled motorbike counts are reduced by up to 60%. Temperatures around 25°C, no precipitation, low cloud cover and low wind speeds lead to the highest motorbike counts. In a second step, the information derived from the traffic models is used to improve models for hourly probabilities of road accidents. These models are based on police reports, which are available at the level of administrative districts, and can now explicitly take traffic volume into account. It is shown that in particular winter conditions like precipitation and freezing temperatures lead to a significant increase in accident probability. Especially the probabilities of roadway departures show an increase under such conditions. The models presented in this study are suitable for the integration in risk-based warning systems and have the potential to improve risk perception and behavior of warning recipients.