

# Winter Road Conditions and Traffic Accidents in Sweden and UK

## Present and Future Climate Scenarios

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## Abstract

This thesis investigates the distribution of slippery roads in Sweden and the UK for the present climate and how this may be affected by climate change for the rest of the century. It also addresses future scenarios for traffic accidents and winter road maintenance.

The purpose of this thesis is to get a better understanding of winter road conditions and relationships to motor vehicle accidents. A variety of scales are studied in this thesis ranging from nationwide studies in Sweden to smaller scale case studies in Sweden and the UK. The Swedish Road Weather Information System (RWIS) is one of the most extensive in the world with a total of 720 outstations. Air and road surface temperatures are measured at each outstation along with relative humidity, precipitation and wind.

In this thesis four different types of slipperiness are considered: Slippery conditions due to moderate hoarfrost (HR1), severe hoarfrost (HR2), road icing (HT) and rain or sleet on a cold road (HN). These four slipperiness types can be combined to form a winter index (WI). However, other types of precipitation are studied where appropriate.

Four papers are included in this thesis. The first aims of these papers include an analysis of the geographical distribution of different slipperiness types in Sweden and how these different types of slipperiness relate to traffic accidents. Further on the impact of climate change on road surface temperatures is also considered and in particular, what impact a changing climate would have on the number of traffic accidents, both in the Gothenburg area, Sweden and West Midlands, UK.

In Sweden, the frequency of occasions with road slipperiness increases towards the north, with the exception for the slipperiness type road icing (HT), which actually decrease towards the north. When a mild winter was compared to a winter with a temperature marginally warmer than the baseline winter (1961-1990), slippery roads caused more accidents in the mild winter where as snow was the cause of most accidents in the colder winter.

Climate change scenarios show that the number of days with temperatures below zero degrees will gradually decrease over the next century. By the 2080s (2070-2100), there will be a 22% reduction of the number of days in the Gothenburg area (Sweden) and a 48% reduction in the Birmingham area (UK). By using derived statistical relationships with traffic accidents, this translates to a theoretical reduction in the number of accidents occurring when the temperature is below zero degrees by 20% respectively 43%. Winter maintenance costs are likely to be reduced by at least 15% in the Gothenburg area until the 2080s. This can be compared with a decline of 38% per annum in the Birmingham area.

There may be a disadvantage with a warming climate at least when considering accidents. Since the temperature is rising the number of days with temperatures above zero degrees increases quite rapidly until 2080s. If the ratio between accidents and number of days at each degree will remain unchanged there will be an increase in the number of traffic accidents with as much as 88% at temperatures above zero degrees. Despite this great increase, the total amount of accidents will only increase by 2%.

Keywords: Winter road condition, Slipperiness, Traffic accident, Winter road maintenance, Climate change