

# WINTER ROAD CLIMATE INVESTIGATIONS USING GIS

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## ABSTRACT

Problems with transportation due to adverse weather conditions affect many areas of the society. The goal with road climate research is to understand the spatial and temporal variations in road conditions and what processes that interact to create these conditions. This knowledge can be used to improve forecasts, make actions against problematic conditions more efficient and when planning new road sections.

This thesis mainly deals with the applications of climate knowledge to winter road conditions. The advantages of using GIS (geographical information systems) in spatial analysis and description are shown. Each specific geographical environment creates its own climate with characteristic spatial and temporal patterns. The relationships on different scales were investigated and the effect of adverse road conditions on road safety was also studied. Data from the Swedish road weather information system (RWIS) was used to define road conditions. Digital elevation and landuse data was used for terrain descriptions.

A method is presented that makes it possible to follow formation of road slipperiness during a weather change. Data from the RWIS has high spatial and temporal resolution suitable for studying road conditions during front passages. The distribution of specific slipperiness types can be studied if slipperiness is defined from meteorological variables measured at the stations. The hazardous situation when rain or sleet falls on a frozen road surface was studied. The approach enabled dynamic studies and gave an increased understanding of the interactions between synoptic and road conditions. Comparisons between spatial patterns and terrain data can be made with GIS.

The relationship between spatial variations in road slipperiness and geographical parameters was investigated. It was shown how this knowledge could be used to further evaluate the locations of RWIS stations. A station could then be optimally equipped based on the prevalence of specific slipperiness types. The selected site-specific parameters explained a considerable amount of the variations in road slipperiness. Latitude and elevation explained most of the variation in southern Sweden. Sky view photographs could also contribute to objective station descriptions. A new method for calculating sky view factors from digital images was developed.

Results also showed that there was an increased risk for accidents during slippery road conditions. Twenty percent of the accidents were verified as occurring during slippery conditions both by RWIS data and accident reports. At the time of the accidents during the two road conditions with highest accident risk ("rain or sleet on a frozen road surface" and "snowfall together with hoarfrost") there was 100% maintenance activity. It suggests that in order to reduce the number of accidents during these situations, public awareness must be increased. It can be accomplished by providing information about road conditions to drivers and by further studies of road climate variations.

## Keywords:

*Road climate, slipperiness, GIS, RWIS, traffic accidents, sky view factor, winter road maintenance*