Variation of Snow Cover along a Highway Maintenance Route

project summary

Objectives

To investigate the variation of snow cover along a highway during winter storms within the scale of a plow route.

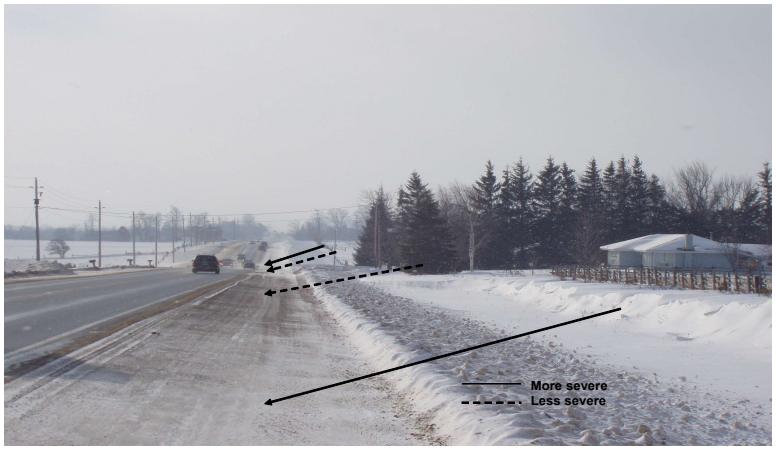
Understanding the variance can help highway maintenance personnel by

- Providing guidance in extrapolating surface condition information from Road Weather Information Systems' (RWIS) measuring sites to other locations along the highway,
- Locating RWIS stations where road weather conditions are representative of a larger area,
- Predicting differences in maintenance demand along or between maintenance routes.

Problem Statement

Snow accumulation on highway pavements increases the risk of accidents and travel delay during winter months. The risk can be reduced by planning snow control operations with support from RWIS.

RWIS use physical measurements of pavement and atmospheric conditions at sensor locations to improve forecasts of frost and snow accumulation on the pavement at the sensor location. Road managers use the pavement-specific forecasts to help schedule plowing, salting, and sanding operations, including selection of materials and application rates.



Micro-scale variations in snow drifting related to roadside terrain

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Aurora

working to advance road weather information systems technology

RESEARCH PROJECT TITLE
Variation of Snow Cover and Extrapolation of RWIS Data along a Highway Maintenance Route– Aurora Project 2003-05

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PROJECT CHAMPION
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ABOUT AURORA
Aurora is an international partnership of public agencies performing joint research, evaluation, and deployment initiatives related to road weather information systems (RWIS).

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Extrapolation along a maintenance route may be aided by linear mapping of surface temperatures or by spatial interpolation of meteorological conditions, but neither of these approaches addresses variations in snow accumulation within the scale of a maintenance route. Such variations are commonly treated as random events that are predictable only through the experience of highway patrollers.

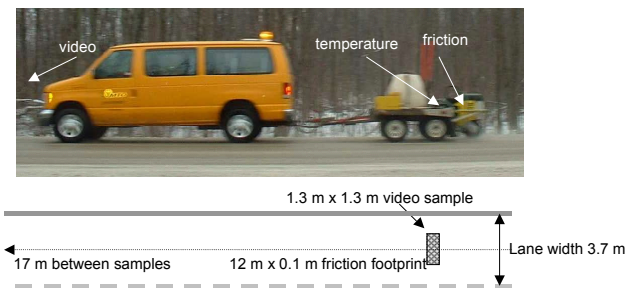
Technology Description

This study explores the variance of snow cover with meteorological conditions and roadside terrain, and the relationship of roadside terrain to the underlying geomorphologic setting. It is particularly concerned with snow drifting along a plow route and focuses on the following two hypotheses:

- snow cover during drifting conditions is controlled by roadside terrain and vegetation features and,
- terrain zones are important factors controlling variance in snow cover along a plow route at the time scale of a winter storm.

In order to test these hypotheses, snow cover, terrain features, and other meteorological data along maintenance routes must be collected. Snow cover is, however, difficult to measure in a continuous and frequent manner along a highway; and direct measurements of variation in space and time during a snow storm are not available. Perchanok (2002) developed an approach to estimating the fractional cover of snow on the pavement using a continuous friction measuring device (CFM). Friction between a vehicle tire and pavement decreases as snow cover increases.

Friction was measured using a Norsemeter RUNAR Mk1 or ROAR Mk2 variable slip friction trailer.



Mobile data acquisition system

Key Findings

This study has shown that friction, which is highly correlated with a snow covered area of a highway surface, varies along a highway maintenance route; and that the structure of its variance is controlled by the interaction of roadside terrain with drifting snow. Susceptibility to snow drifting is related to roadside vegetation and topographic features and that in turn is related to the morphology of the surrounding terrain.

Snow cover is not uniform within the spatial scale of either a weather system or at the scale of a plow route, but varies at the scale of roadside terrain zones and individual terrain features that control snow drifting within the zones.

Implementation Benefits

The application of friction measurements as a surrogate for snow cover provides new opportunities to analyze fine detail in the spatial pattern of snow accumulation. It allows a detailed understanding of factors controlling snow cover from the micro scale of individual terrain elements to the meso scale of terrain zones to the macro scale of highway routes.

Friction measurement also provides access to frequency domain analysis methods that have not been applied previously to highway operations or to snow cover mapping. In this study the spectral signature of friction along a plow route was used to identify the influence of terrain elements on snow cover and to discriminate terrain zones by their influence on snow cover during calm and windy conditions. This line of analysis may conceivably be expanded to predict trajectories of snow cover under characteristic progressions of storm conditions to predict local differences in demand for winter maintenance operations or for road salt.

Implementation Recommendations

The local control of drifting on snow cover implies that estimates of snow cover that are based on data from RWIS can be interpolated with confidence within similar terrain zones but cannot be interpolated to dissimilar terrain zones, even when those are located within a short distance of the observing station.