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MODELING THE SNOW DISTRIBUTION ALONG A TREELINE SHELTERBELT IN THE NORTHERN PLAINS USING WEATHER RADAR, GEOGRAPHIC INFORMATION SYSTEMS, AND FIELD MEASUREMENTS.

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1. INTRODUCTION

In the Northern Plains wintertime precipitation plays a vital role in the hydrological cycle. Understanding the spatial and temporal variations of snowfall are key in modeling the hydrological response of a watershed during springtime melt.

2. BACKGROUND

Modeling of spring snowmelt often starts late in the winter season using estimates of the snowpack derived from National Weather Service measurements and cooperative observer data collection points. Typically there are few point estimates within a basin, and due to the nature of spatial variability of snow, the data collected are not representative of the snow distribution. Radar is an alternate tool for measuring the dynamic variability of snowfall.

Snowfall and snow redistribution are driven by many factors including the atmospheric conditions; wind speed, wind direction, temperature, humidity, and surface features of vegetation, topography, slope and aspect of the land. The spatial and temporal variability of these factors makes the modeling of snow pack complex.

The use of a Geographic Information System (GIS) allows for correlating atmospheric conditions and spatial features to quantify how much snow will accumulate under various conditions. Under this framework it is possible to determine the snow depth and snow water equivalent at a location while taking into consideration the inherent variability of snow distribution factors, i.e. land-cover, land-use, and topography.

3. PROCEDURE

During the winters of 1999-2000 and 2000-2001 a field site located near Grand Forks, North Dakota, was instrumented to collect atmospheric conditions, soil temperature and moisture. A snow course was also established to collect weekly snow depth and snow water equivalent measurements. Land-use and land-cover data sets were used along with the USGS 10 meter Digital Elevation Model (DEM).

WSR-88D level 2 radar data was processed and a comprehensive precipitation distribution data set was then used as an input into the blowing snow model.

The blowing snow model is a three-dimensional mass-transport model that uses derived forcing functions to determine the wind shear stress at the surface, snow transport by both saltation and turbulent suspension, and the sublimation of the snow.

4. RESULTS

Data collected were used to validate the results of a three-dimensional blowing snow model. The effect of using radar-estimated snowfall as data input verses in situ measured point values was evaluated as well as the importance of vegetation, particularly a living snow fence, on snow distribution.

5. REFERENCES

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