A Discussion of the Development of a Geospatial Blowing Snow Susceptibility Index

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Research Assistant

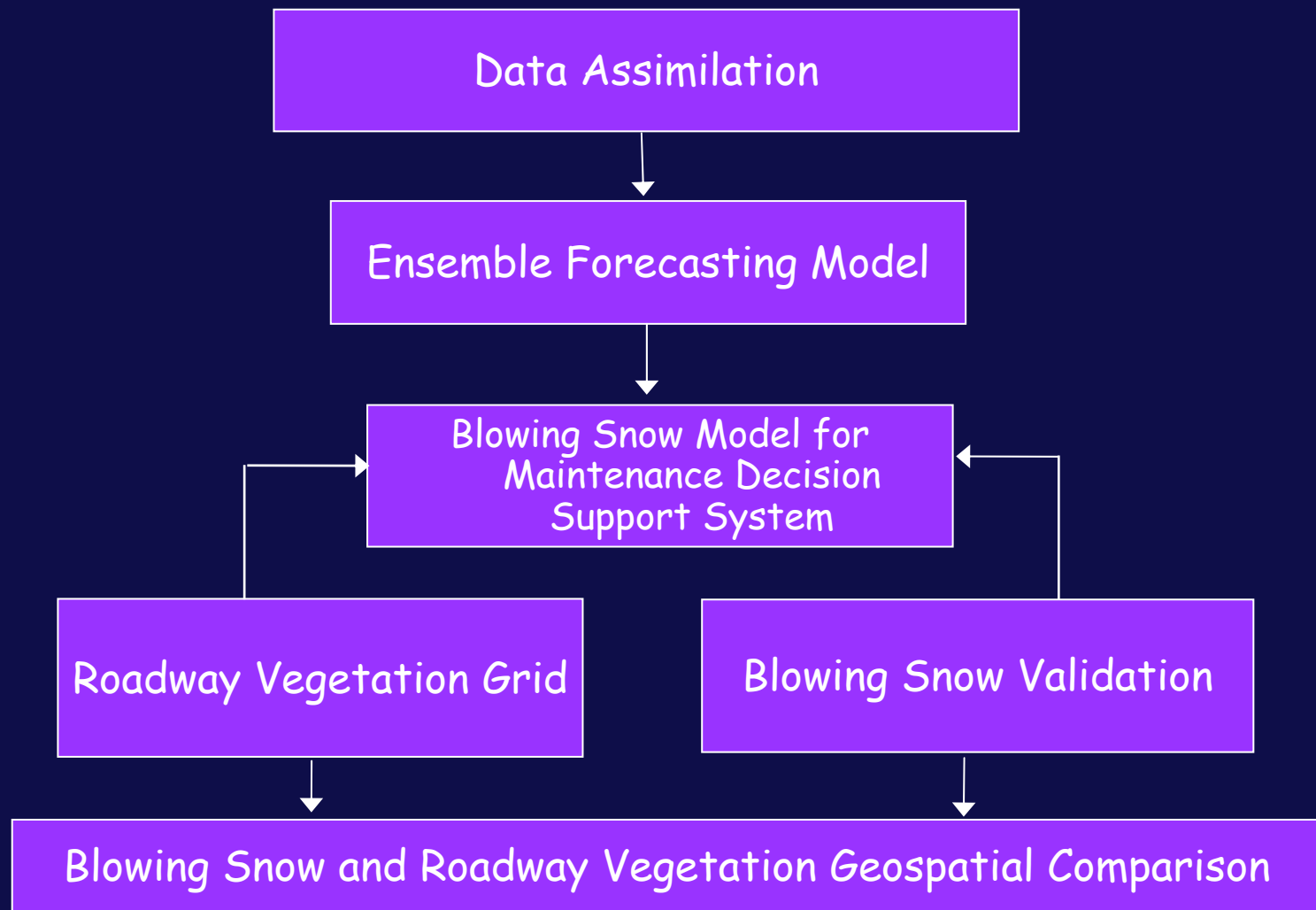**Surface Transportation Weather Research Center**

University of North Dakota

Grand Forks, North Dakota

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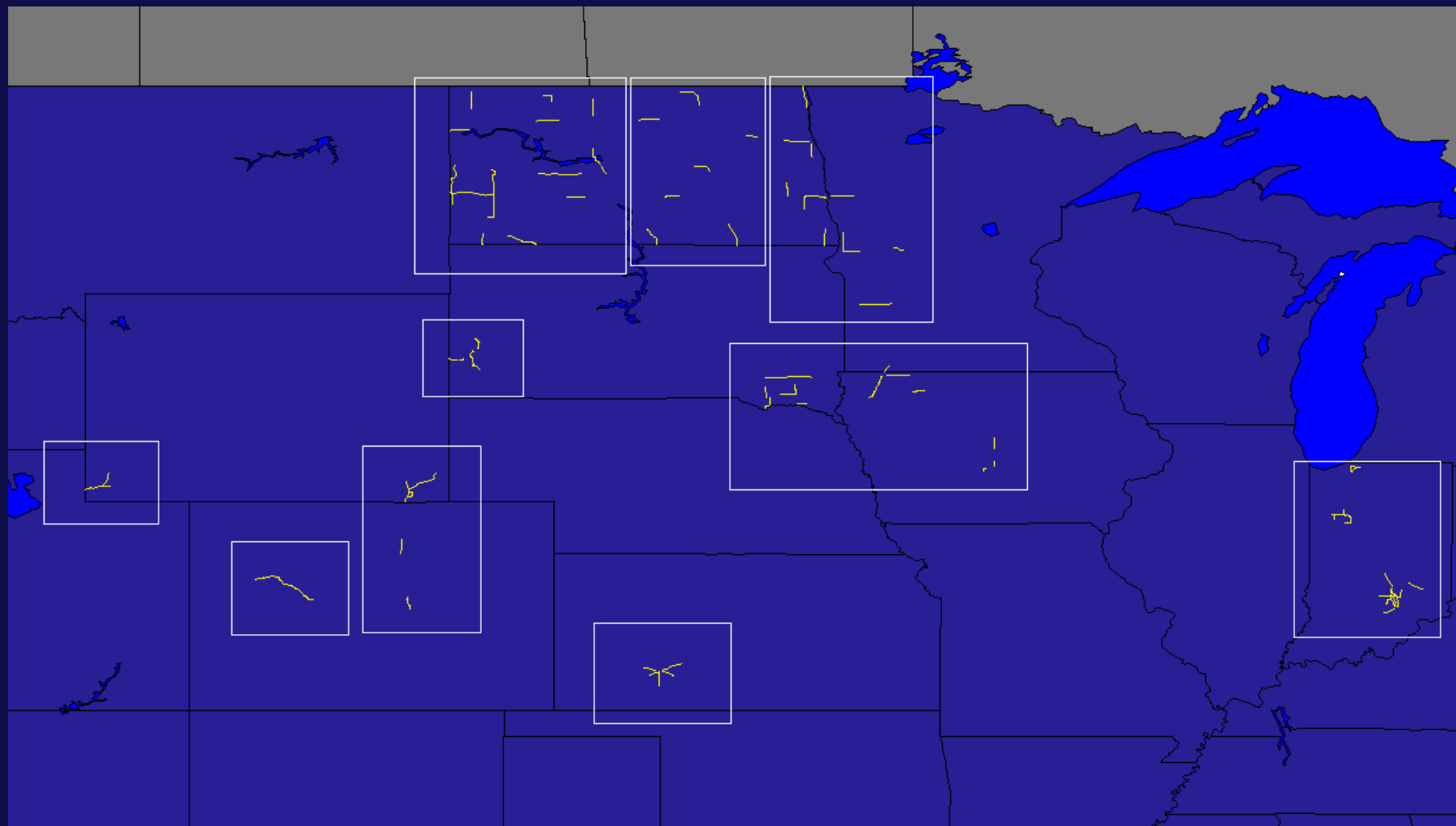UNIVERSITY OF NORTH DAKOTA, GRAND FORKS, NORTH DAKOTA
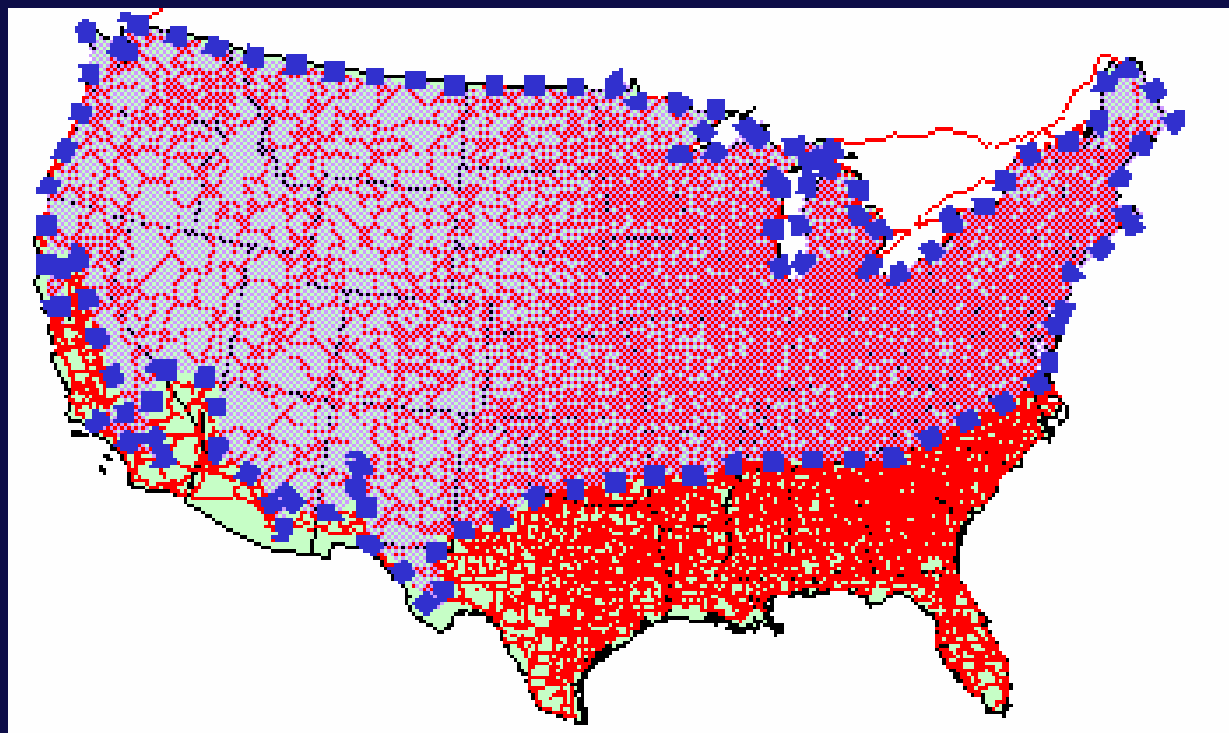
Roadway Vegetation Outline

- **Roadway vegetation importance**
- **Highlight test areas and methods**
- **Example of data collected**
  - Raw data
  - Processed data for model input
- **Blowing snow validation**
  - Differences in blowing snow types
  - Video examples of collected data
- **Highlights**

Roadway Vegetation Mapping

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┌─────────────────────────────────────┐
│          Data Assimilation          │
└─────────────────────────────────────┘
                    │
                    ▼
      ┌───────────────────────────┐
      │ Ensemble Forecasting Model│
      └───────────────────────────┘
                    │
                    ▼
      ┌───────────────────────────┐
      │  Blowing Snow Model for   │
  ┌──▶│  Maintenance Decision     │◀──┐
  │   │  Support System           │   │
  │   └───────────────────────────┘   │
  │                                   │
┌──────────────────────┐   ┌──────────────────────┐
│ Roadway Vegetation   │   │ Blowing Snow         │
│ Grid                 │   │ Validation           │
└──────────────────────┘   └──────────────────────┘
        │                           │
        ▼                           ▼
┌──────────────────────────────────────────────────┐
│ Blowing Snow and Roadway Vegetation Geospatial    │
│ Comparison                                         │
└──────────────────────────────────────────────────┘
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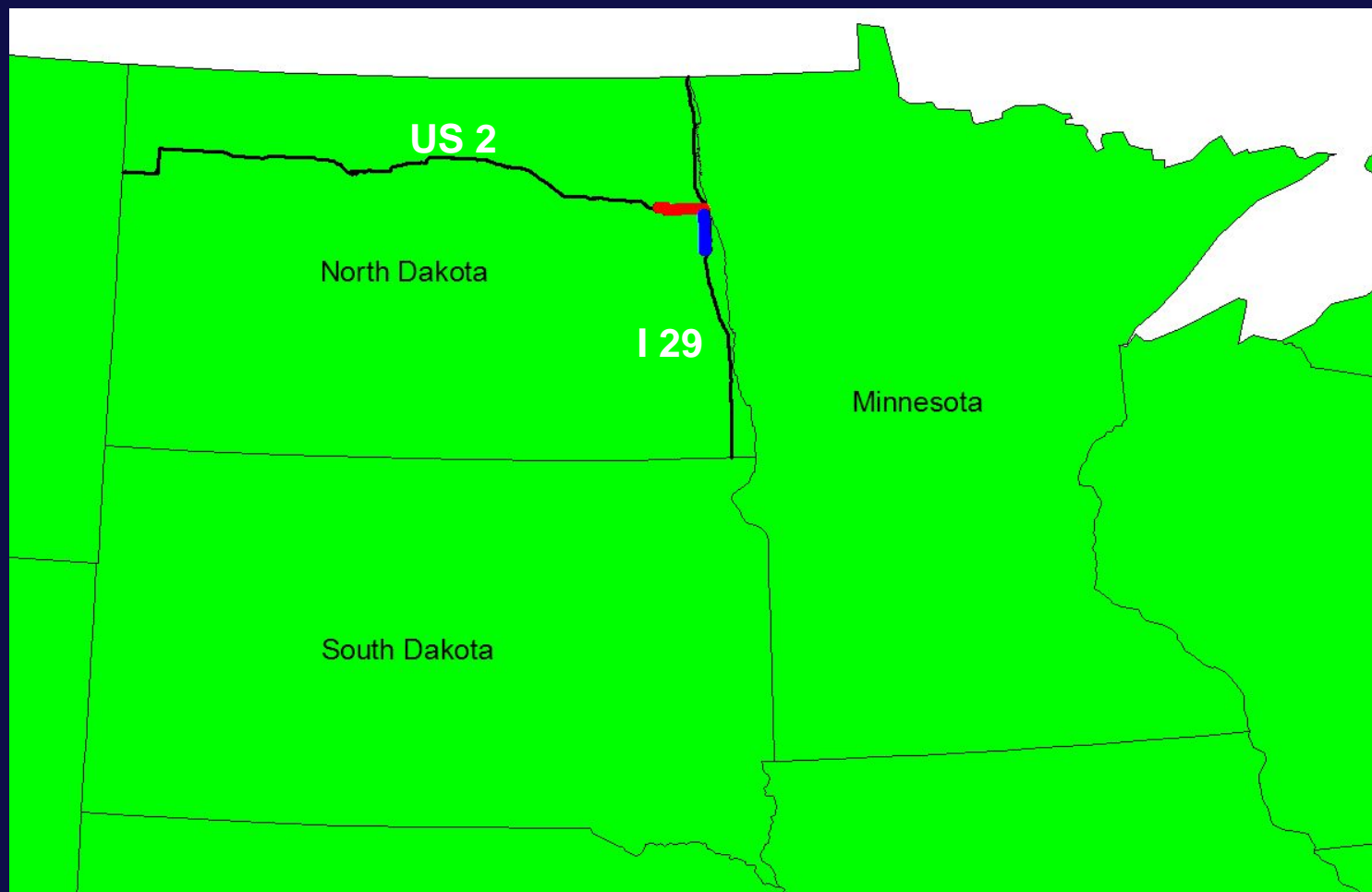UNIVERSITY OF NORTH DAKOTA, GRAND FORKS, NORTH DAKOTA

Maintenance Decision Support System

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Winter Maintenance Region of the United States: Approx. 33 States

Why the need for a geospatial blowing snow susceptibility index within surface transportation weather research?

Winter travel in the Snow Belt areas can be hazardous during times of blizzards, winter storms, and blowing snow events.

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For surface transportation precipitation does not have to be falling in order for travel to become hazardous.

Wind alone can transport snow, from previous snow events onto the roadway, which reduces visibility and can begin to accumulate.

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Localized areas of blowing/drifting snow

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Benefits of Vegetation/Snow Mapping

- **What would be the benefits of improved forecasting of the spatial distribution of blowing and drifting snow to road maintenance?**
  - Blowing Snow Model validation
  - Reactive: "deicing" vs. Proactive: "anti-icing"
    - Currently done now but hopefully with more spatial efficiencies

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Detailed 3D Digital Elevation Model of Eastern North Dakota

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Roadway Orientation Example…

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Selected Routes

Selected Routes (East-West   North-South)

Roadway Vegetation Mapping

Red=Obstructions   Yellow=No Obstructions
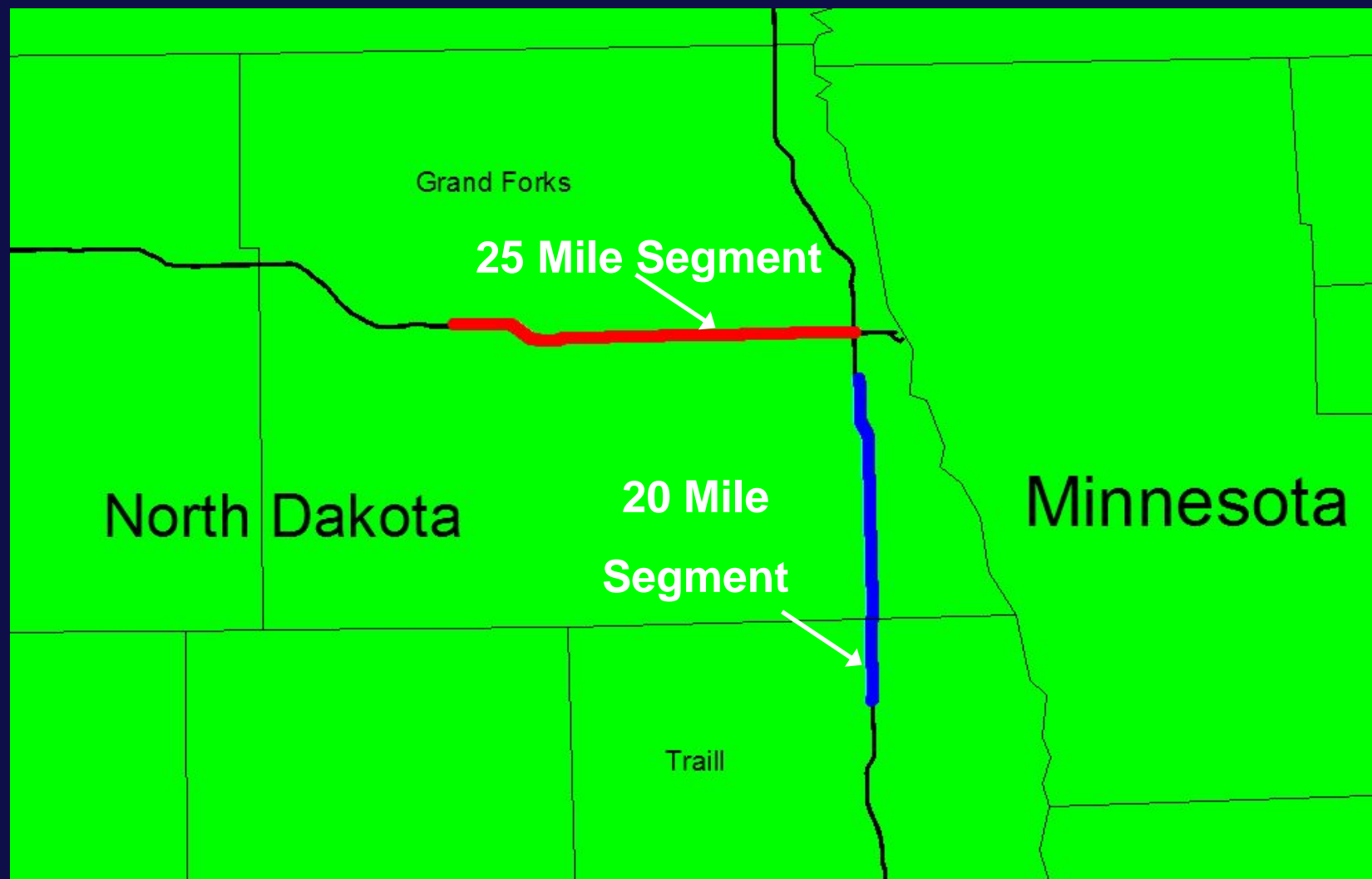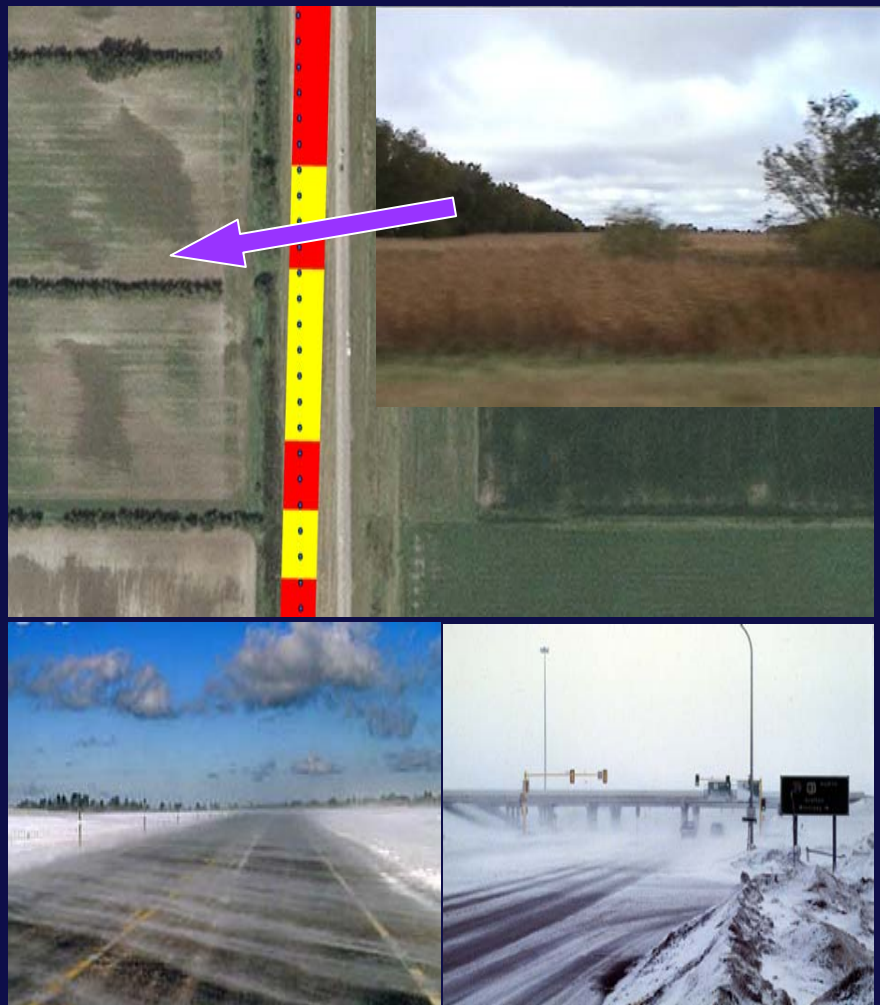
- **Construct a dataset that better represents the spatial variability of roadside vegetation**

- **Used as input dataset to provide for a more accurate blowing/drifting snow model**

- **Localized areas of vegetative wind obstructions not picked up with current datasets that cause localized areas of blowing snow**

Surface Roughness

Identifying the surface roughness or vertical extent of the vegetation is a geospatial problem that can be accomplished with ground-based observations.

Roadway Vegetation Mapping

- **Side pointed Video-GPS unit**
  - Georeferenced video data
  - Red Hen Systems, Inc (www.redhensystems.com)
- **Mapped obstructions along two test segments**
  - East-West, North-South with similar patterns
  - Divided vegetation into major and minor
    - i.e. mature trees and cattails or non-mowed grass
  - Constructed template to post-process data within ArcGIS
- **Also mapped non-mowed ditch vegetation**
  - Cattails, marsh grasses, scrub brush
    - Influences holding capacity within the right of way

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Vegetative Pattern

Shelterbelt – road view

Not Just Trees!

Corn Field

Cattails

Not Just Trees!

Brush ~ 8'
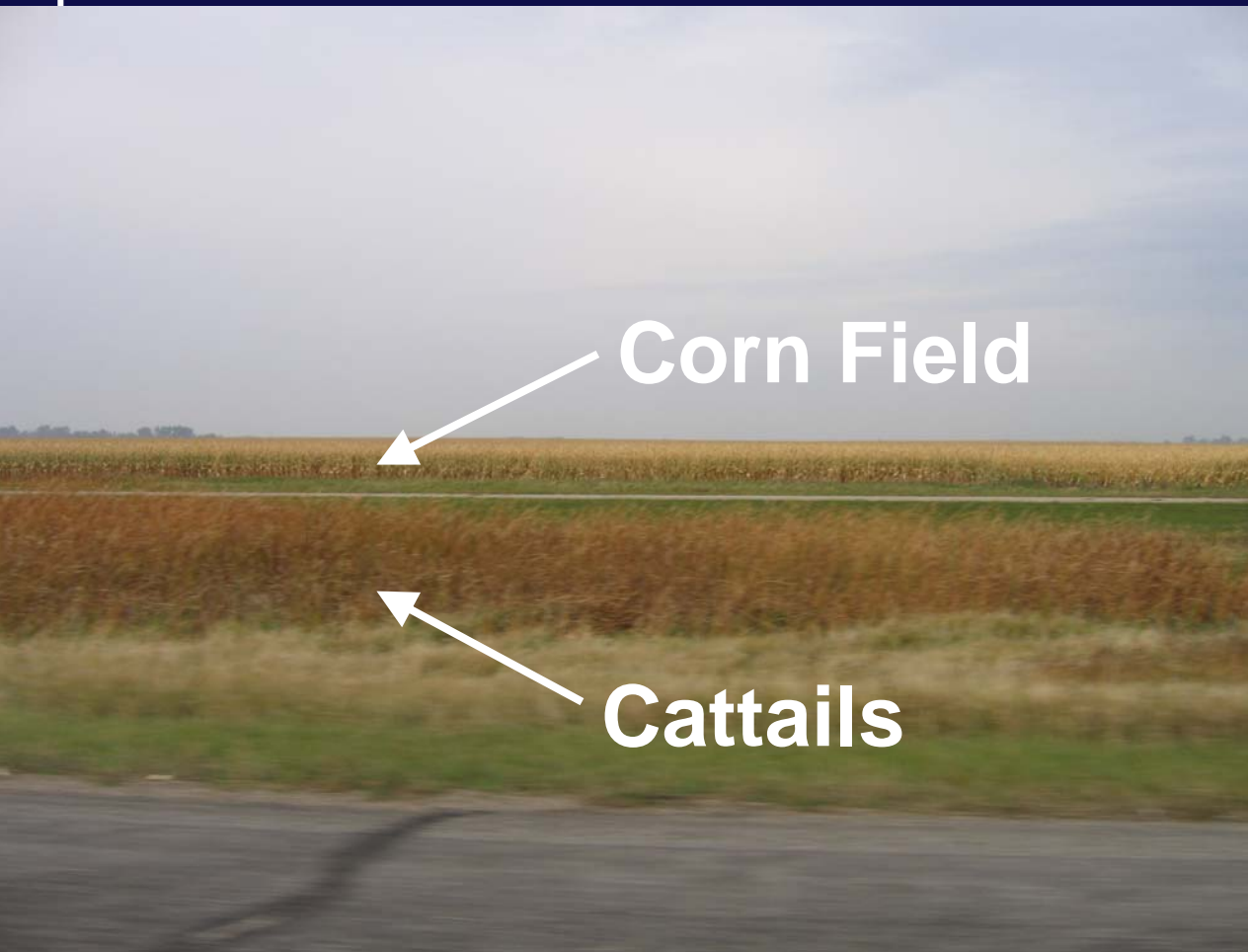
Initial Obstruction Ratio
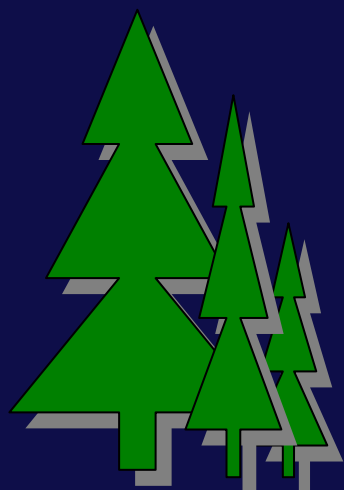
X
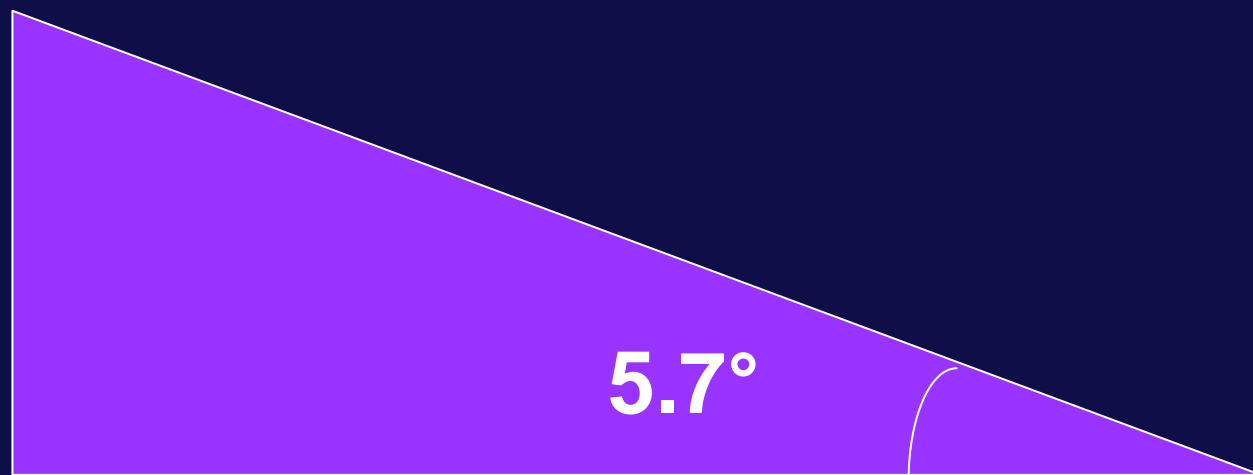
5.7°

10x

Roadway Vegetation Mapping

Segment between North Dakota mile reference markers 130 and 123 along Interstate 29

Roadway Vegetation Mapping

Minor vegetative obstructions:

L. Blue = no, D. blue = yes

Mature vegetative obstructions:

Yellow = no, red = yes

Blowing Snow Model Validation

- **Vegetation map outputs for the use within a blowing snow model**

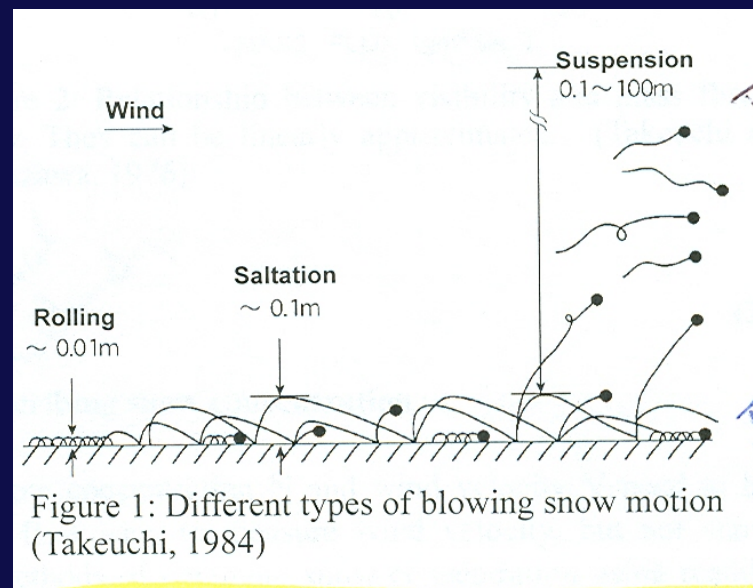- **Similar techniques used for validating blowing snow model outputs**

Blowing Snow Validation

Types of blowing snow

- Rolling snow < 0.01 m
- Saltating snow < 0.1 m
- Suspended snow 0.1 – 100 m

Figure 1: Different types of blowing snow motion (Takeuchi, 1984)

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Blowing Snow Validation
Saltating and Suspended Snow Example

Segment between North Dakota mile reference markers 130 and 123 along Interstate 29

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Blowing Snow Validation
Rolling Snow Example

Segment between North Dakota mile reference markers 130 and 123 along Interstate 29

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Roadway Vegetation and Blowing Snow

- **Develop a better data set for more accurate blowing snow modeling**
- **Find correlation between blowing snow and roadway vegetation variables**
  - Wind speed and direction
  - Snow pack conditions
  - Available vegetation holding capacity

Geospatial Blowing Snow Susceptibility Index

- **Programs Involved**
  - Rural Geospatial InnovationS (RGIS)
    - Geospatial technologies and expertise
    - Data processing
    - 8 national member consortium
    - www.ruralgis.org
  - Surface Transportation Weather Research Center
    - STWRC
    - Atmospheric modeling and monitoring
    - Data collection
    - www.stwrc.rwic.und.edu

Acknowledgements

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Thank You!