Using RWIS in Winter Operations

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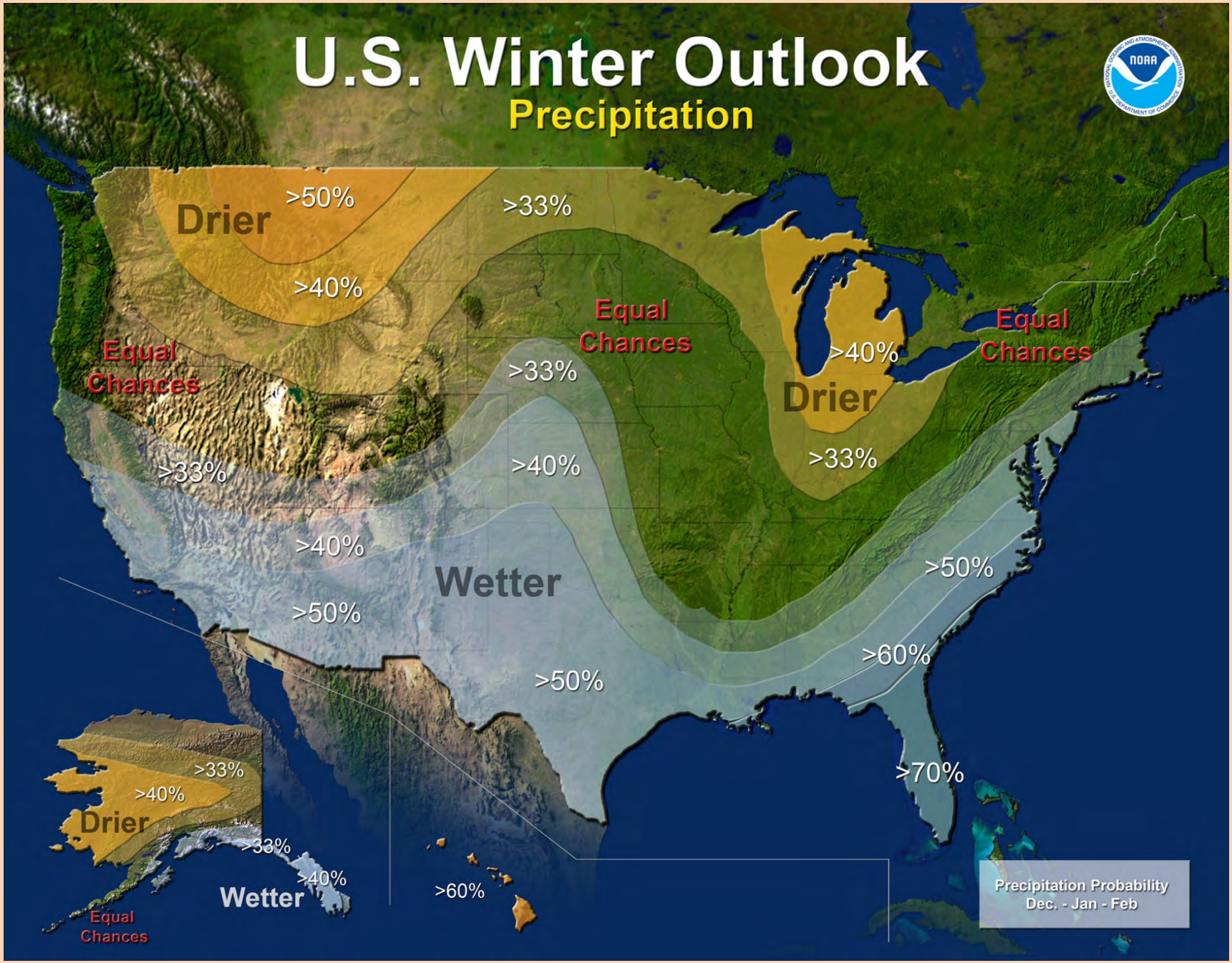
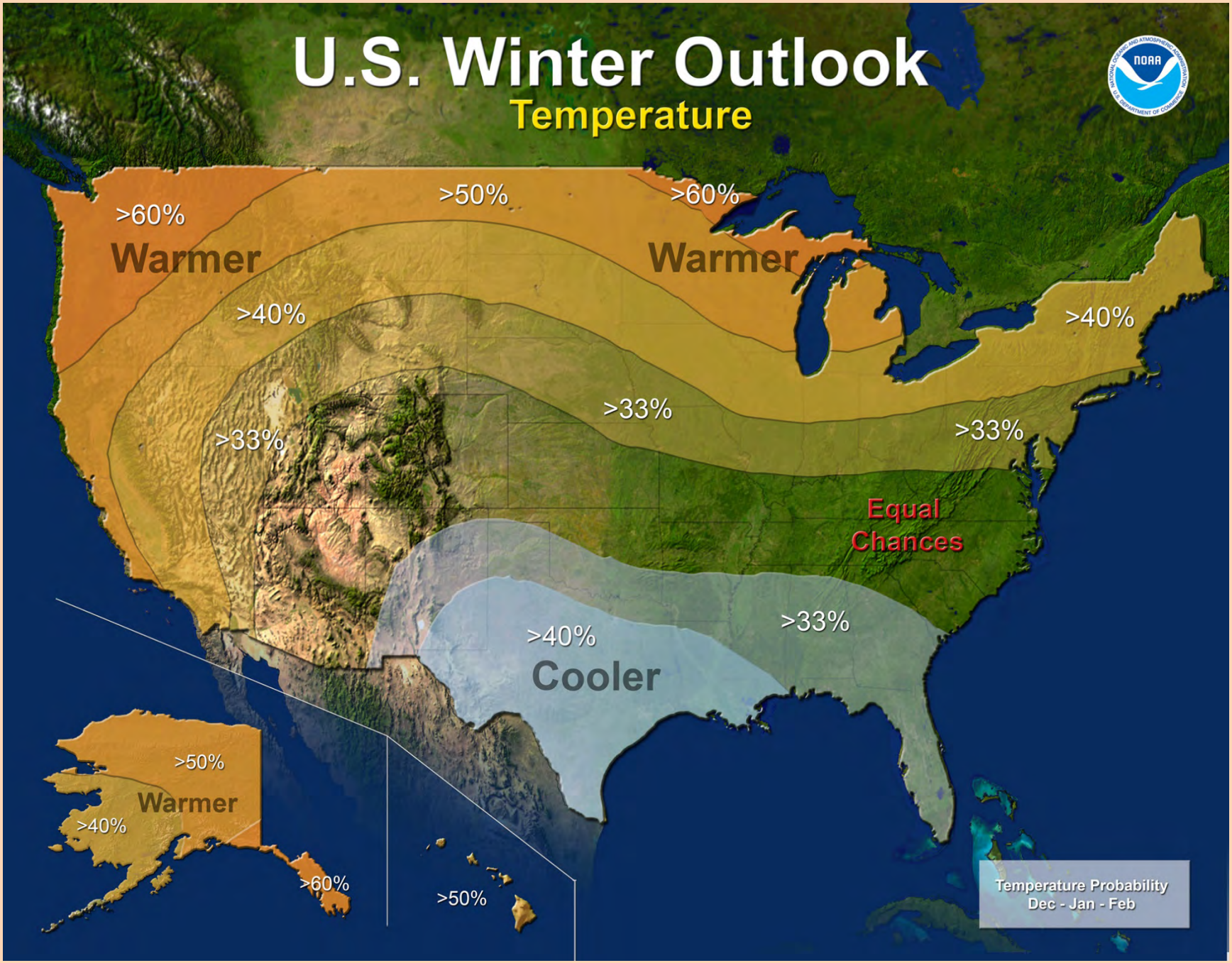

U.S. Winter Outlook
Precipitation
Drier
>50%
>33%
>40%
Equal Chances
Equal Chances
>33%
>40%
Drier
Equal Chances
>33%
>40%
>40%
Wetter
>50%
>50%
>50%
>60%
>70%
>33%
>40%
Drier
>33%
>40%
Wetter
Equal Chances
>60%
Precipitation Probability
Dec. - Jan - Feb


U.S. Winter Outlook
Temperature
>60%
Warmer
>50%
>60%
Warmer
>40%
>40%
>33%
>33%
>33%
Equal
Chances
>40%
Cooler
>33%
>50%
Warmer
>40%
>60%
>50%
Temperature Probability
Dec - Jan - Feb

- **Tracking Weather**
- **Tracking Surfaces**
- **RWIS**

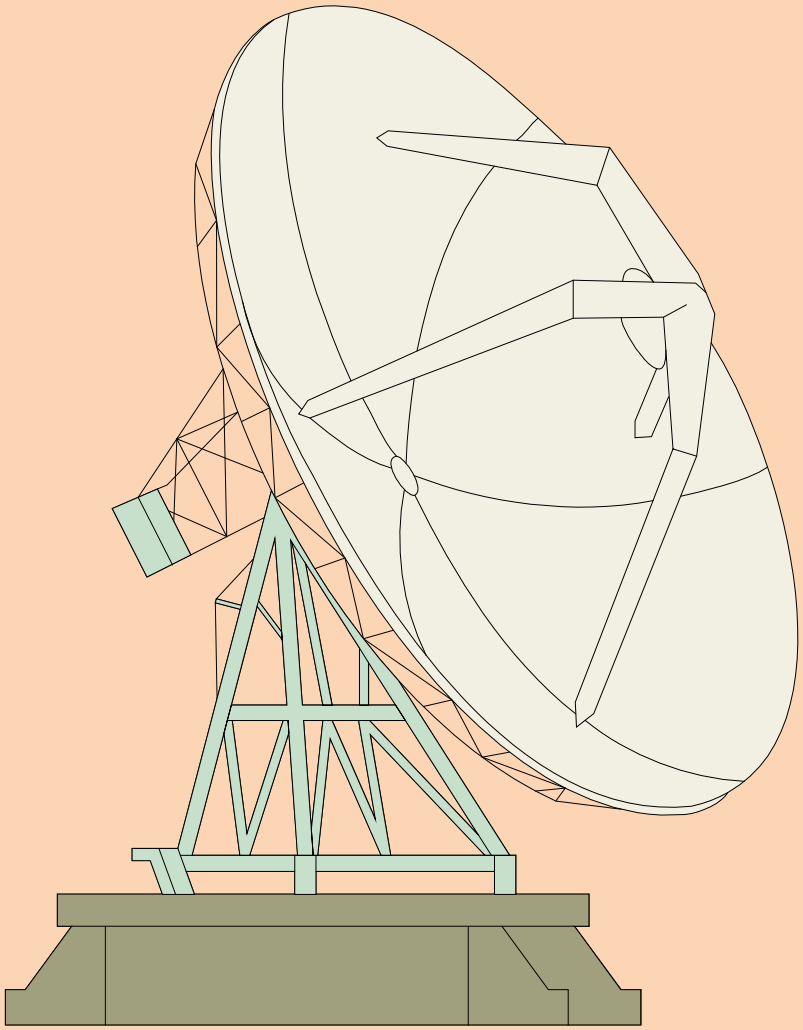
Tracking Weather

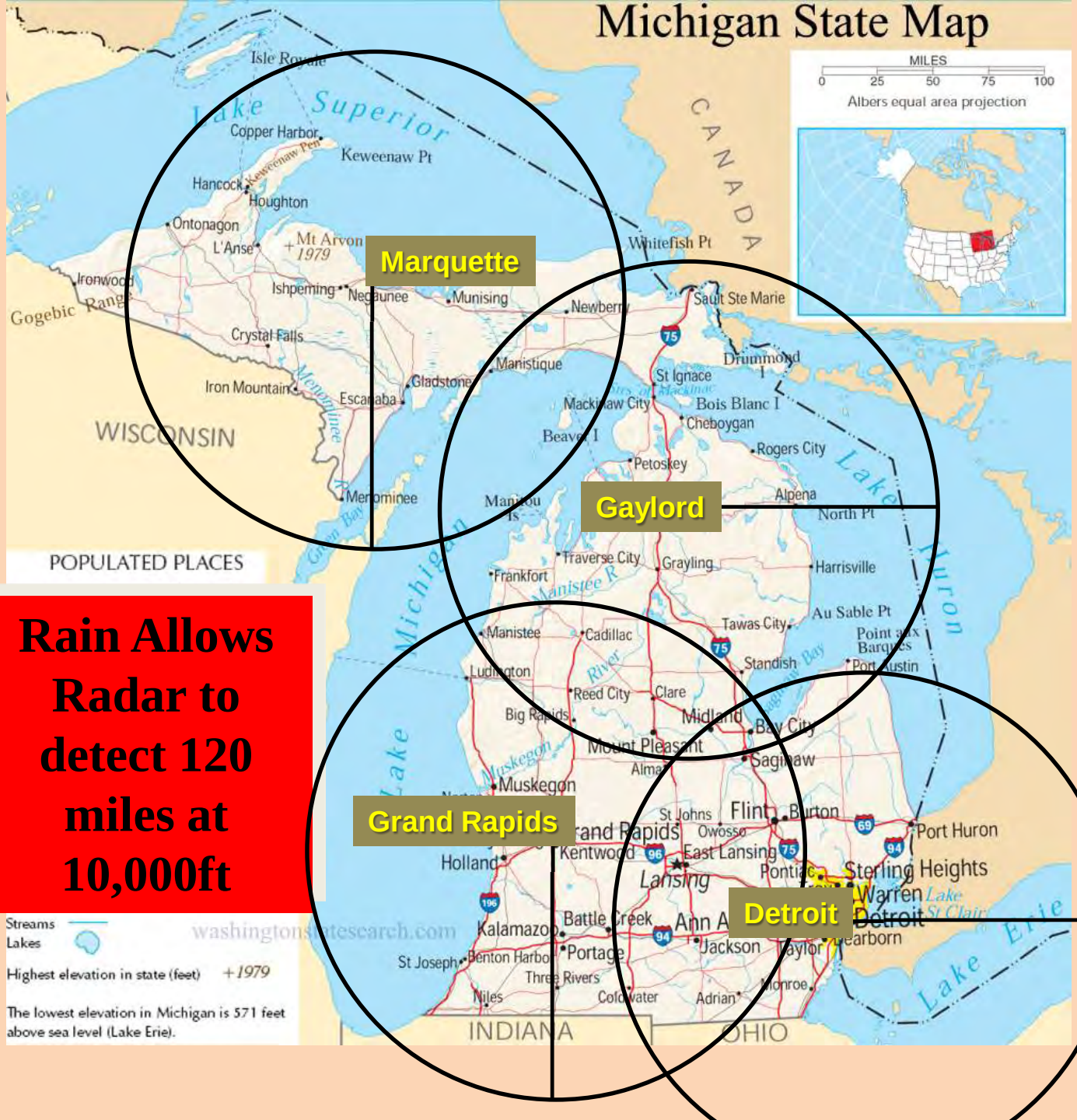
Key Manager Questions:

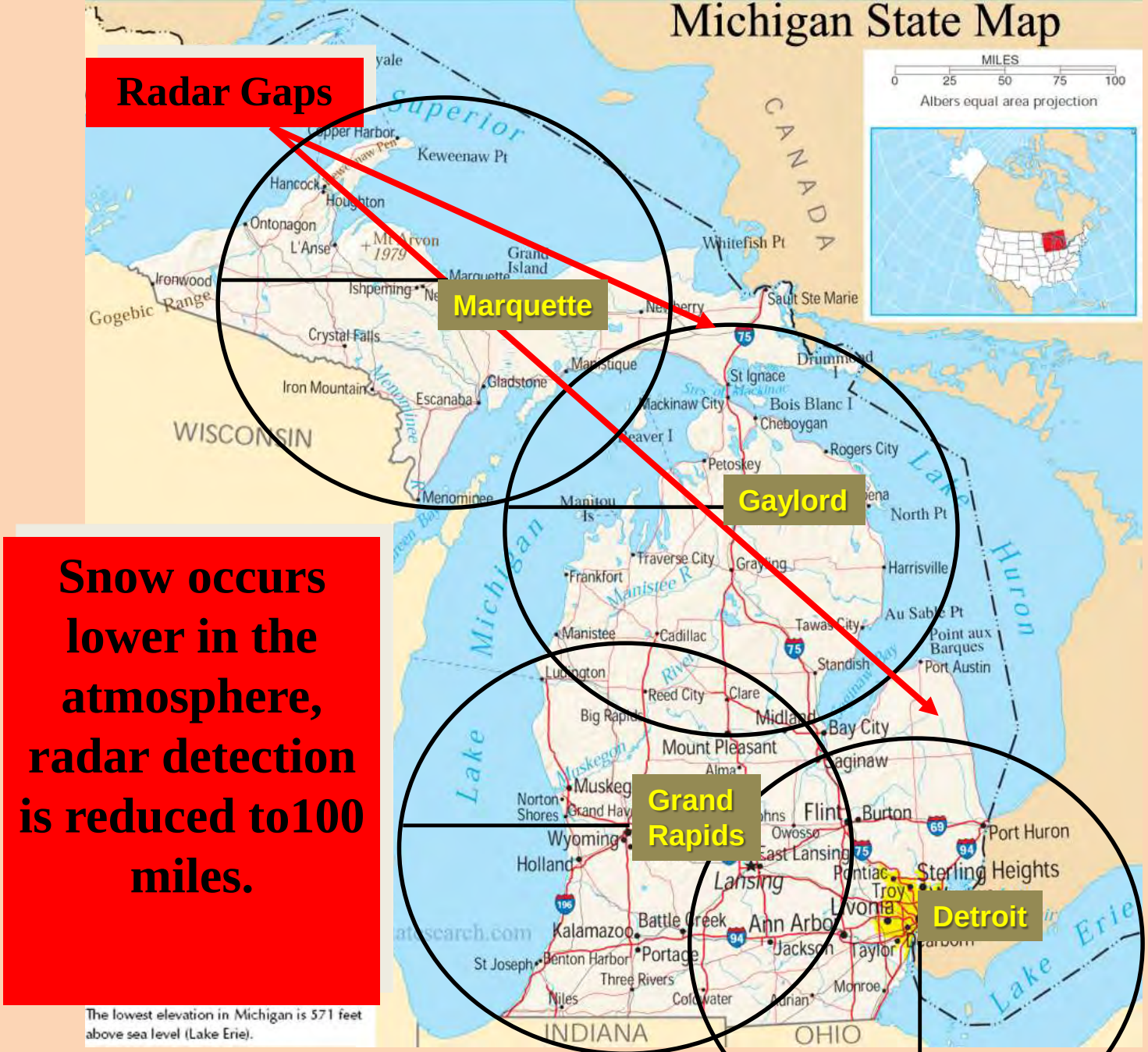
“What Am I Going To Get?”
“When Am I Going To Get It?”

- **Alberta Clippers**
- **Gulf or Pacific Low**
- **Lake Effect Snows**

Radar

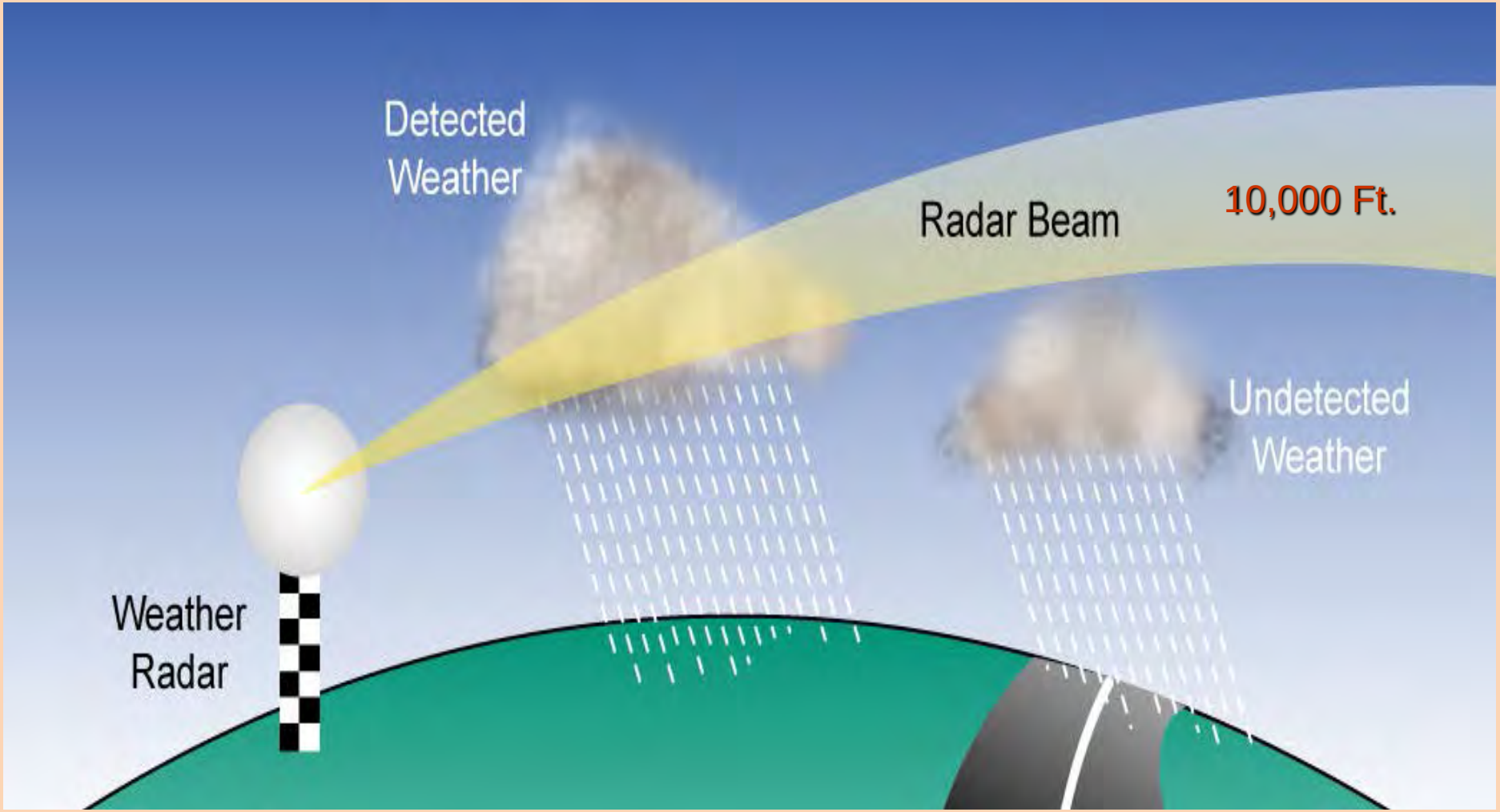


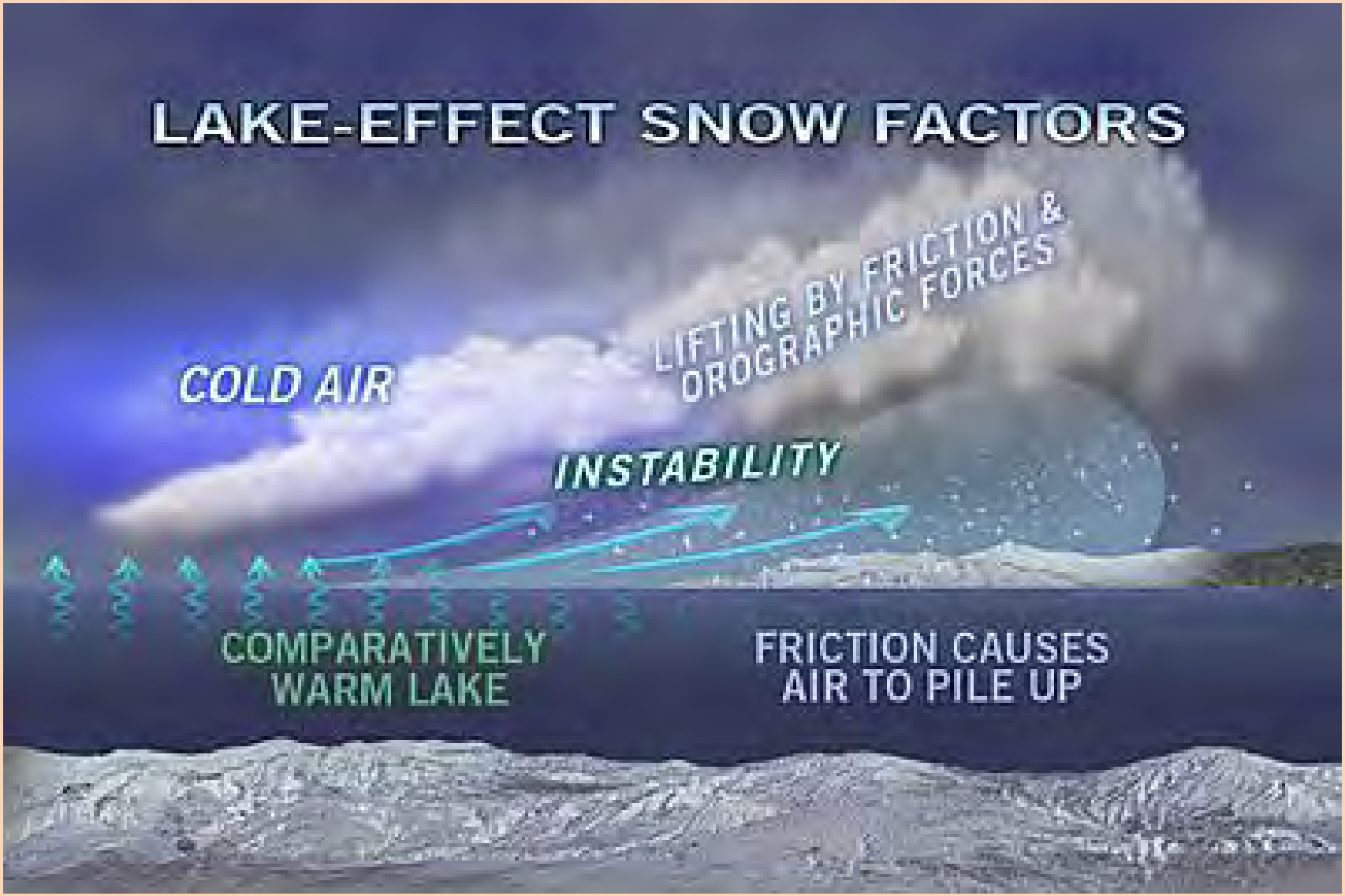

Michigan State Map
MILES
0 25 50 75 100
Albers equal area projection
Marquette
Gaylord
Grand Rapids
Detroit
Rain Allows Radar to detect 120 miles at 10,000ft
POPULATED PLACES
Streams
Lakes
Highest elevation in state (feet) +1979
The lowest elevation in Michigan is 571 feet above sea level (Lake Erie).
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
CANADA
WISCONSIN
INDIANA
OHIO
Isle Royale
Copper Harbor
Keweenaw Pt
Hancock
Houghton
Ontonagon
L'Anse
Mt Arvon +1979
Ironwood
Gogebic Range
Ishpeming
Negaunee
Munising
Crystal Falls
Iron Mountain
Escanaba
Gladstone
Menominee
Manistique
Whitefish Pt
Newberry
Sault Ste Marie
Drummond
St Ignace
Mackinaw City
Bois Blanc I
Cheboygan
Beaver I
Rogers City
Petoskey
Alpena
North Pt
Harrisville
Au Sable Pt
Point aux Barques
Port Austin
Tawas City
Standish
Bay City
Midland
Saginaw
Traverse City
Grayling
Frankfort
Manistee
Cadillac
Ludington
Reed City
Clare
Big Rapids
Mount Pleasant
Alma
Muskegon
St Johns
Flint
Burton
Owosso
Port Huron
Grand Rapids
Kentwood
East Lansing
Lansing
Holland
Pontiac
Sterling Heights
Warren
Detroit
Dearborn
Kalamazoo
Battle Creek
Ann Arbor
Jackson
Taylor
St Joseph
Benton Harbor
Portage
Three Rivers
Niles
Coldwater
Adrian
Monroe
Manitou Is
75
69
94
96
196



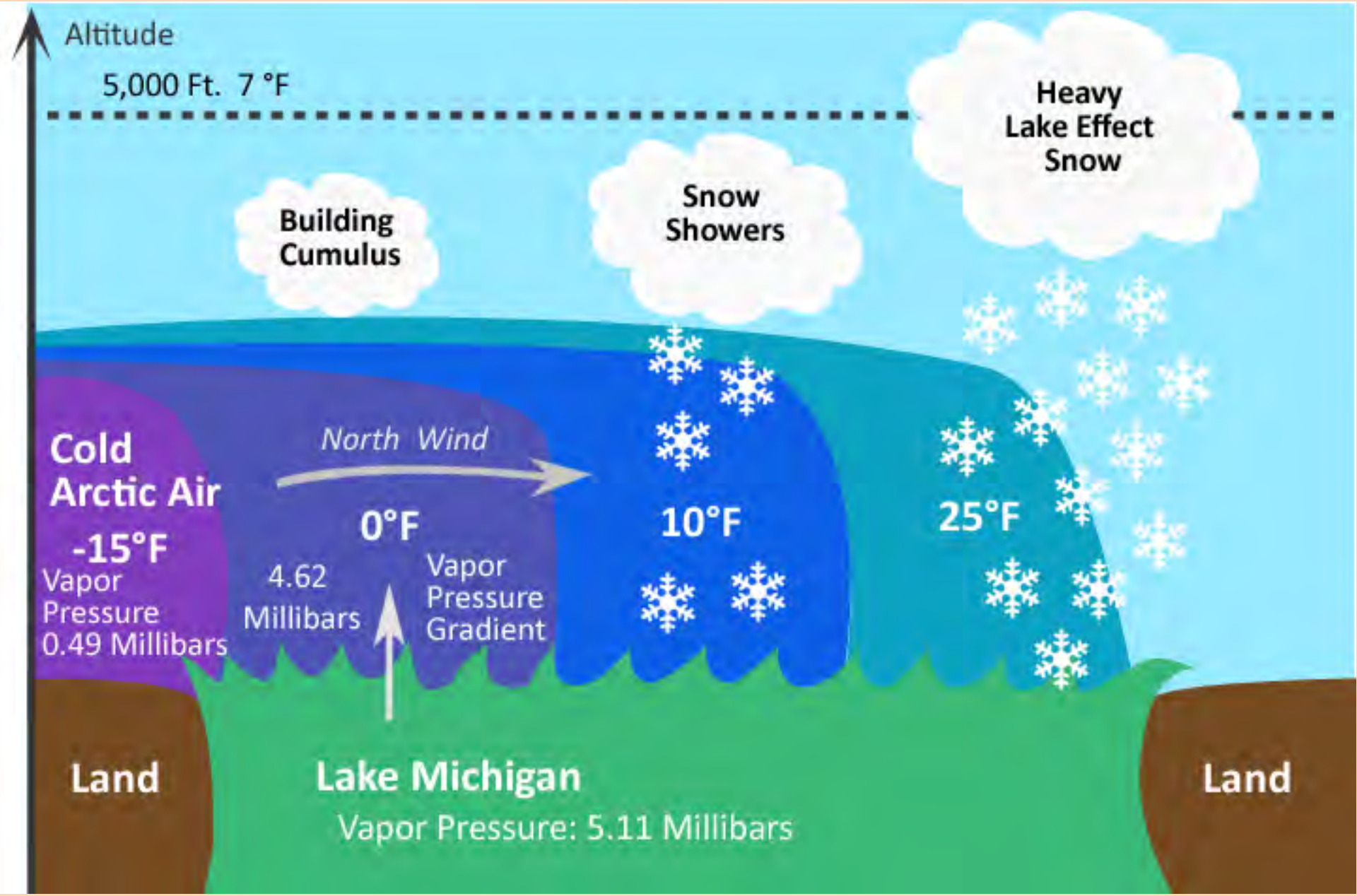
The lowest elevation in Michigan is 571 feet above sea level (Lake Erie).

Radar Targeting Accounts for:
Curvature of the Earth
Obstructions (Buildings, Trees, etc.)

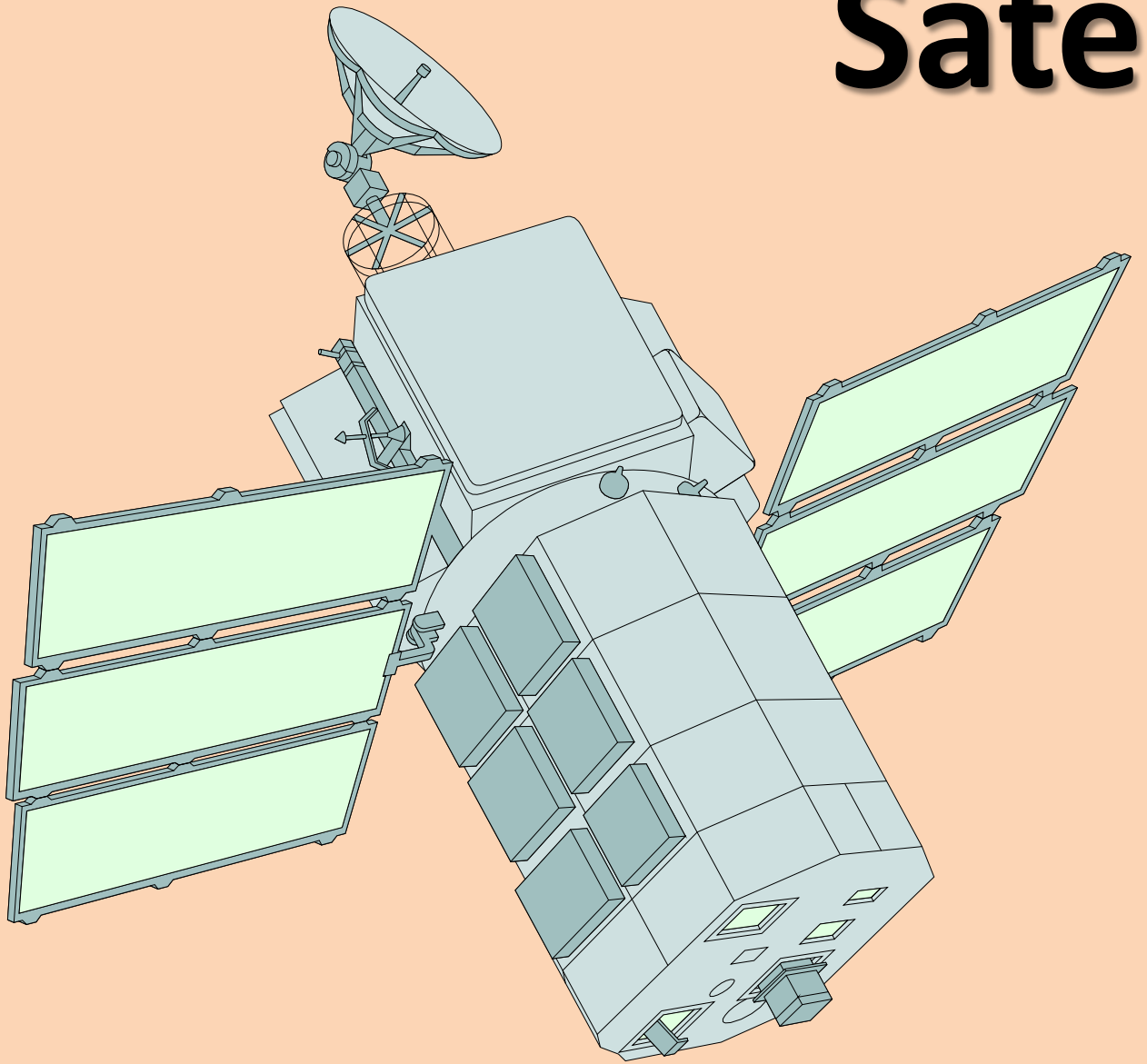



LAKE-EFFECT SNOW FACTORS
COLD AIR
LIFTING BY FRICTION & OROGRAPHIC FORCES
INSTABILITY
COMPARATIVELY WARM LAKE
FRICTION CAUSES AIR TO PILE UP

Lake Effect


Altitude
5,000 Ft. 7 °F
Heavy
Lake Effect
Snow
Snow
Showers
Building
Cumulus
Cold
Arctic Air
-15°F
Vapor
Pressure
0.49 Millibars
North Wind
0°F
4.62
Millibars
Vapor
Pressure
Gradient
10°F
25°F
Land
Lake Michigan
Vapor Pressure: 5.11 Millibars
Land

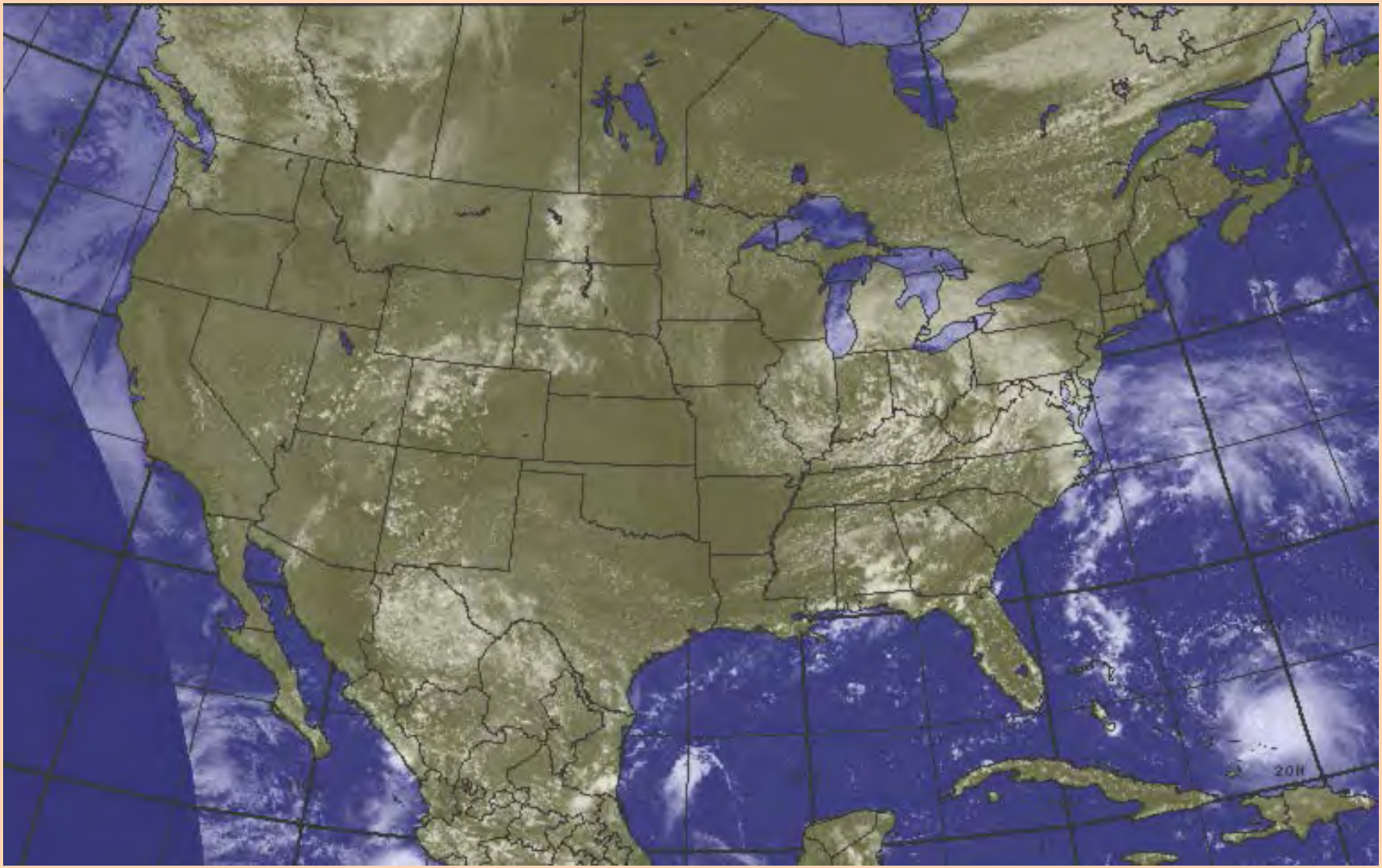
Satellite



Visible

Good: Easy to Understand

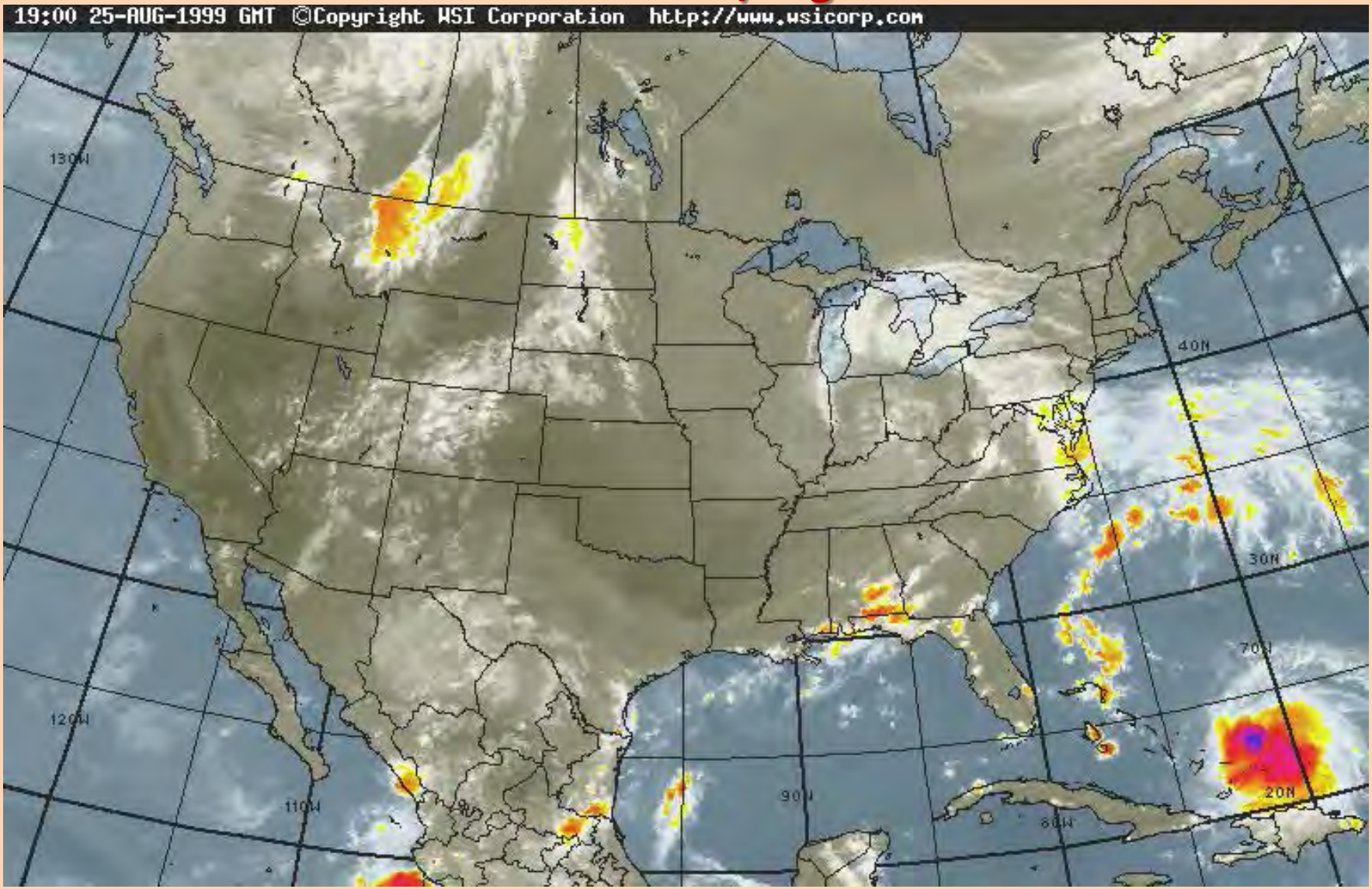
Bad: Daytime Images Only (No Floodlights in Space!)



Infrared

Good: Differentiates Heat/Cold Variation

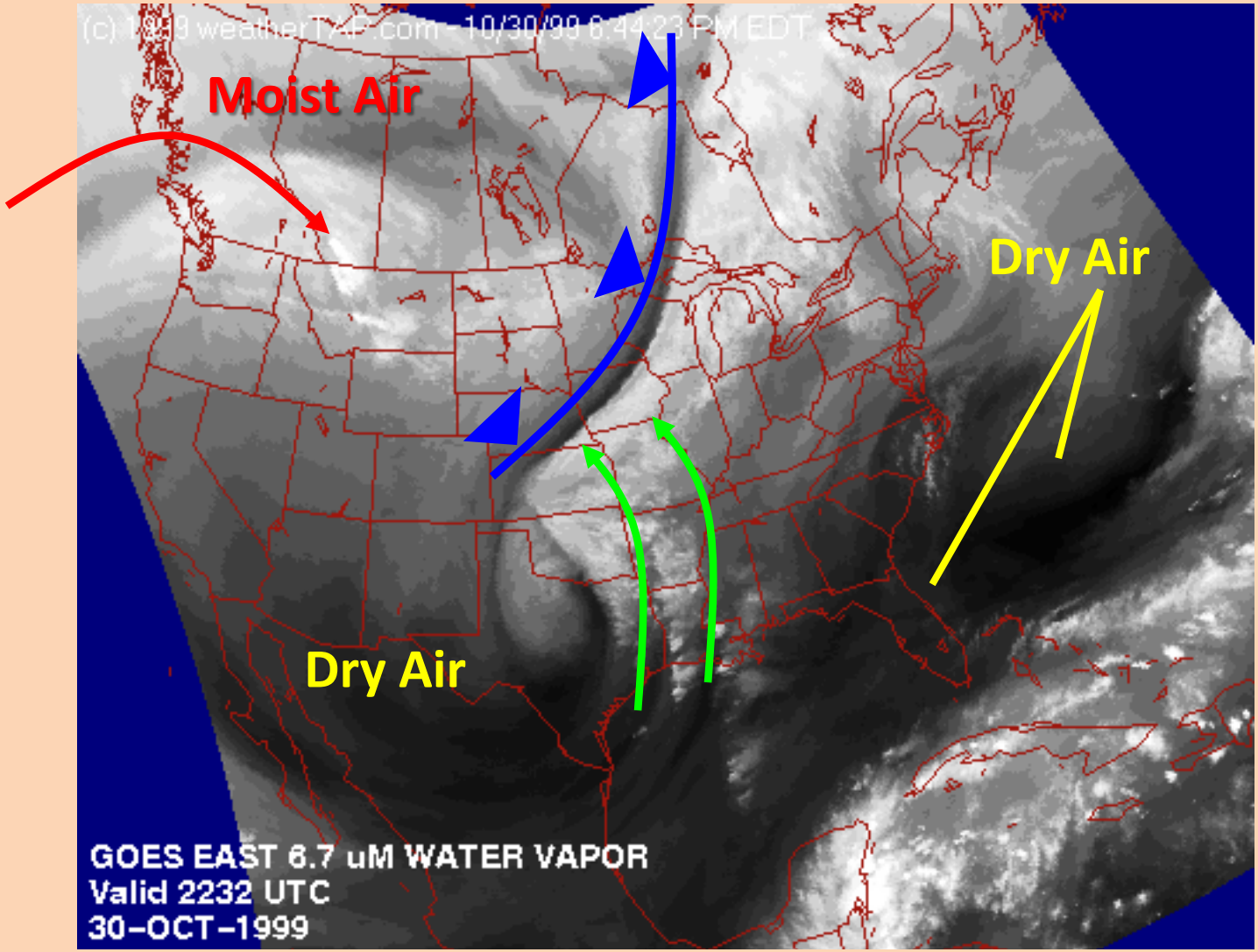
Bad: Can't 'See' Clouds/Fog Near the Ground



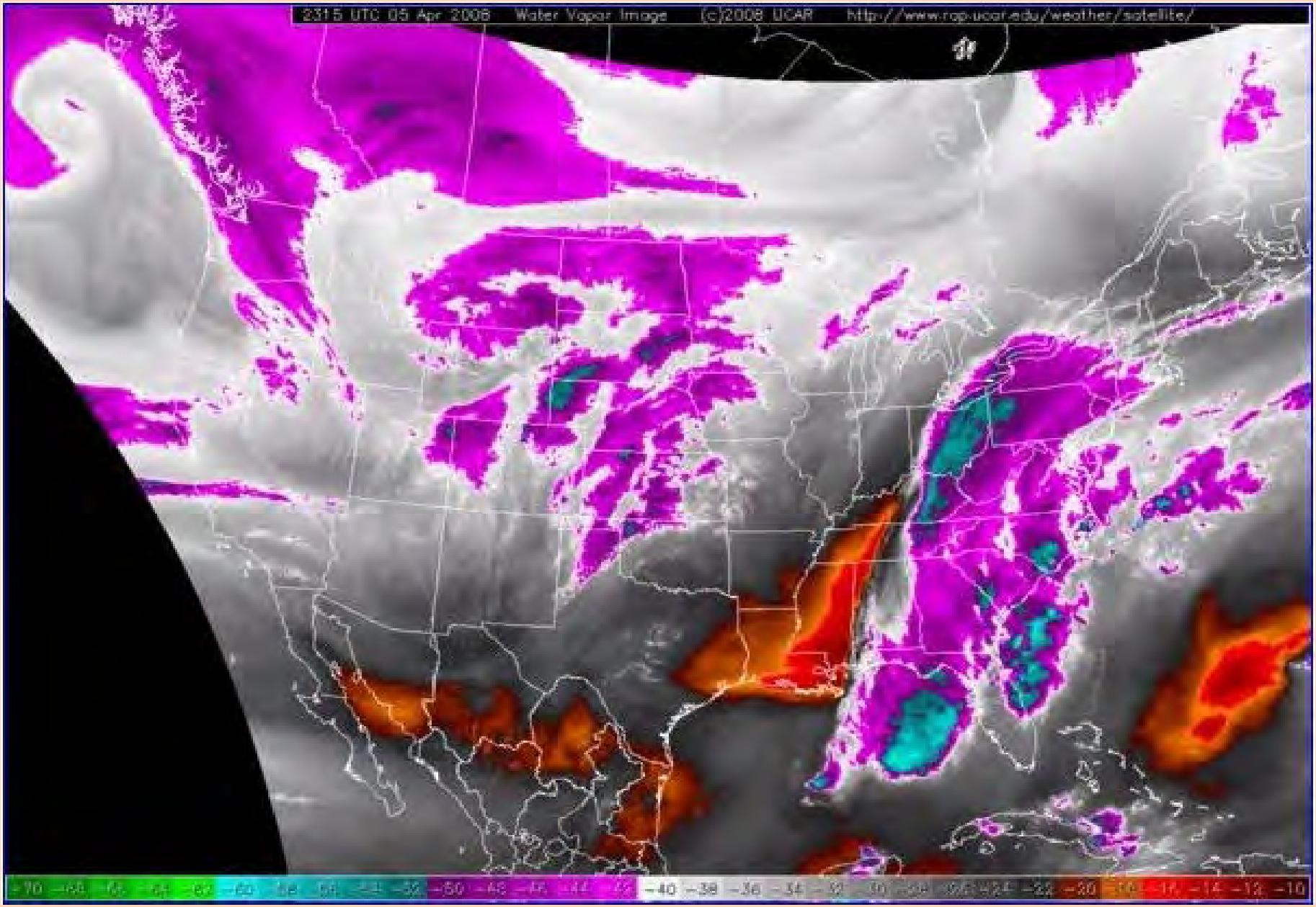
Water Vapor Image

Good: Tracking Moisture Movements Like Fronts, Troughs, Ridges

Bad: Not Great for Lake Effect



Water Vapor Satellite Images



ITERIS (Meridian)
Forecast Table w/ MDSS

Tracking Surfaces

Pavement Temperatures

Directly Impact Snow & Ice Maintenance Operations

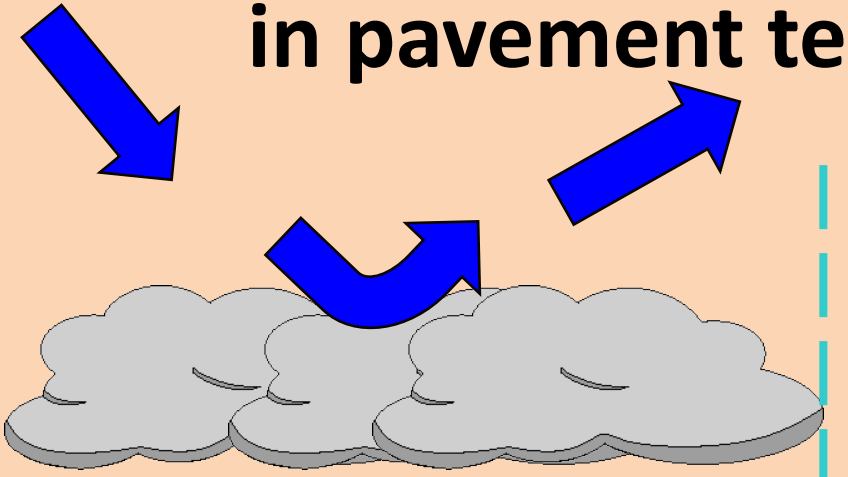
Pavement Temps Determine:

Timing, Type and Duration of S&I Responses

RWIS is the Only Tool Which Monitors Pavement Temperature & Condition

Daytime

Cloud Cover affects changes in pavement temperature.



30°

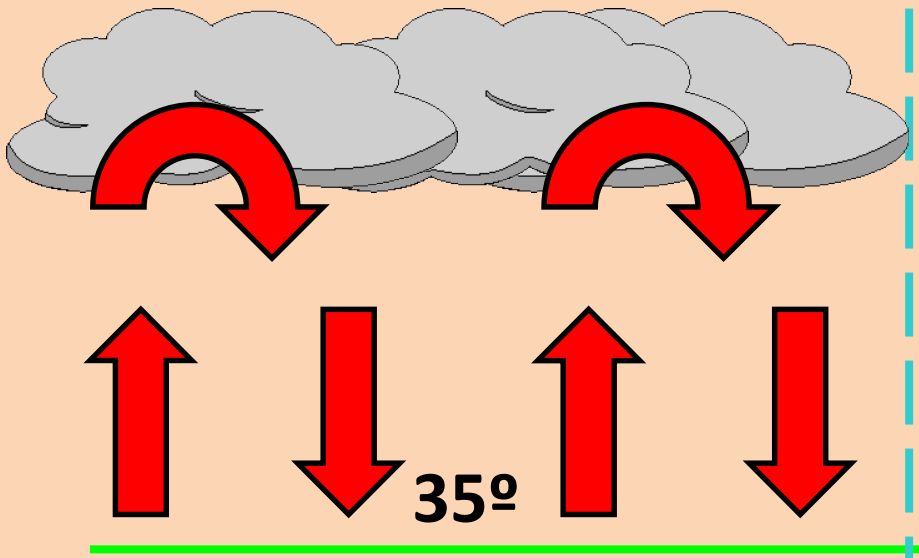
50°

Thick cloud cover blocks thermal heating of pavement

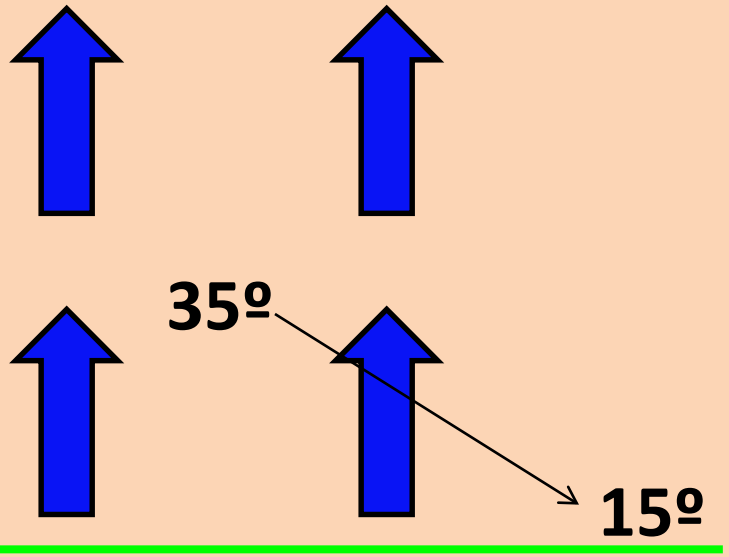
Clear skies before a storm, help by warming the pavement

Nighttime

Cloud Cover affects changes in pavement temperature.

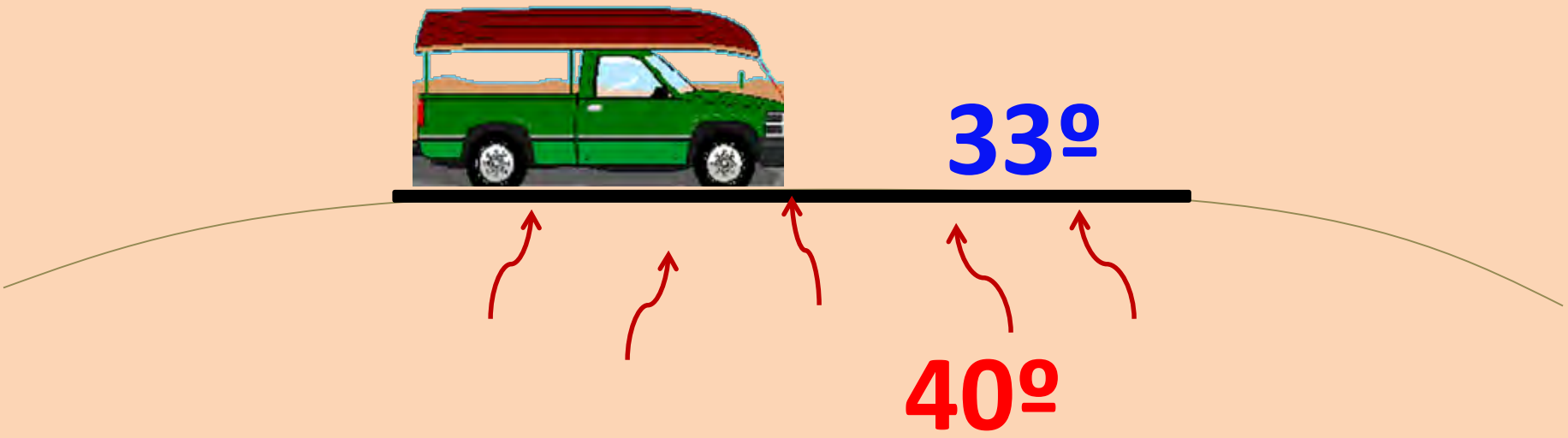


Thick cloud cover at night reduces heat loss.



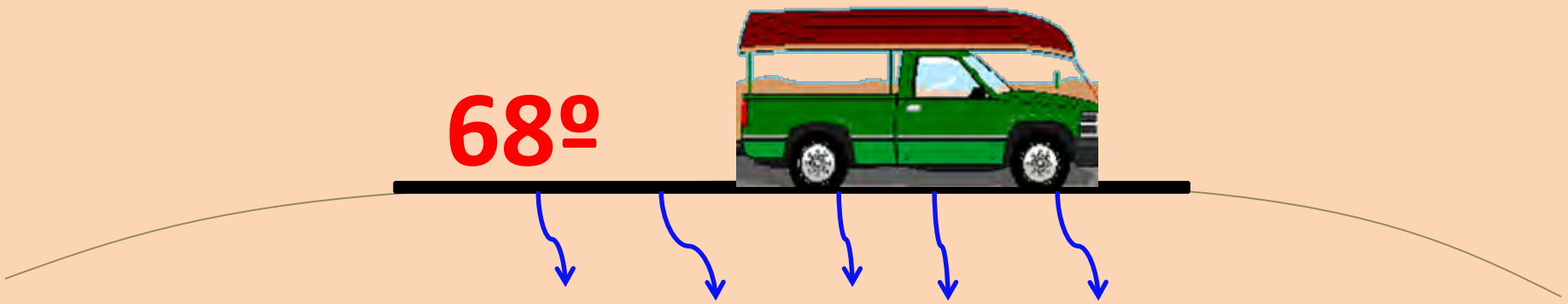
Clear skies before a storm often results in colder pavements.

Sub-Surfaces



Warmer Sub-Surfaces *Slow Down*

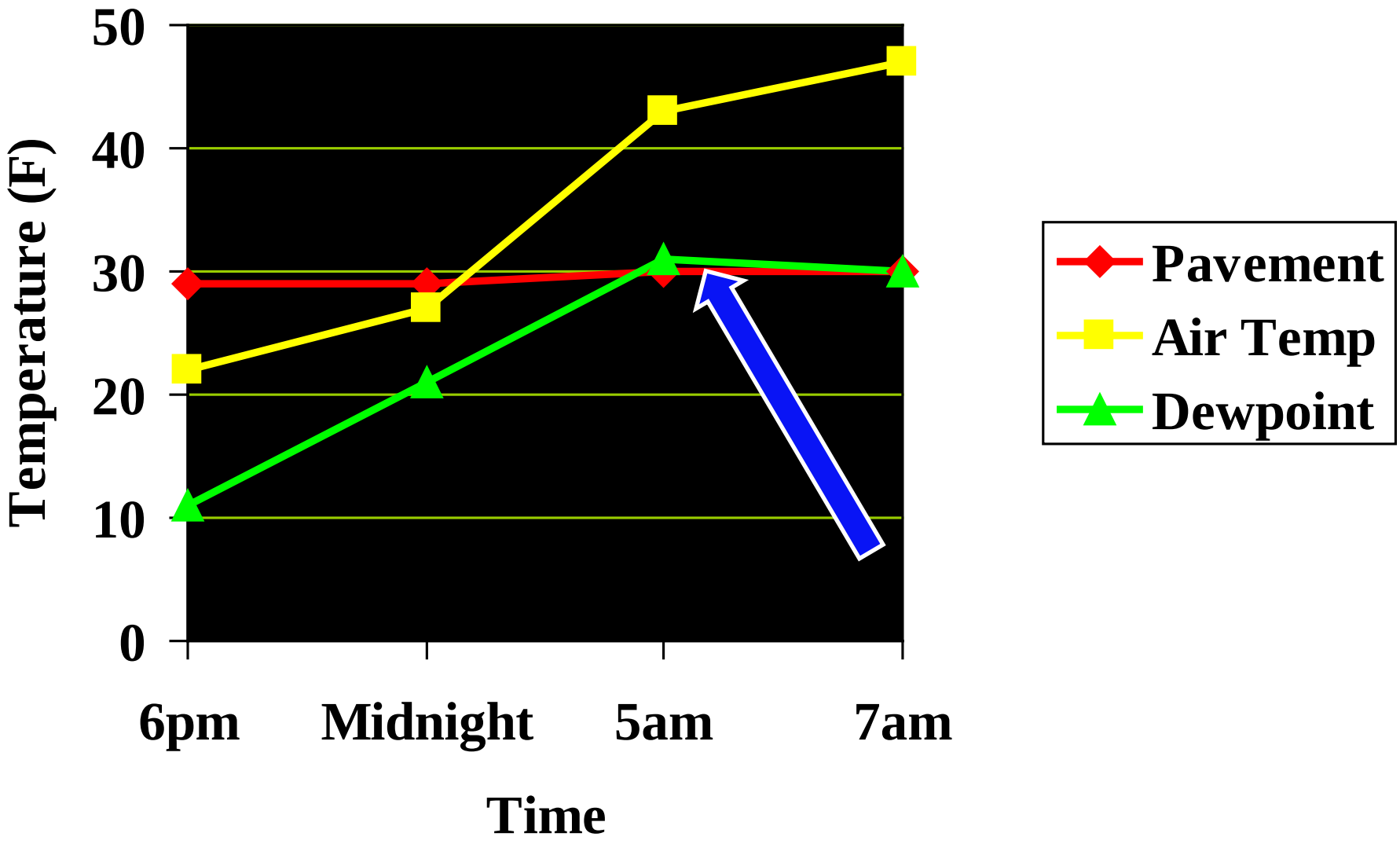
Overnight Pavement Cooling



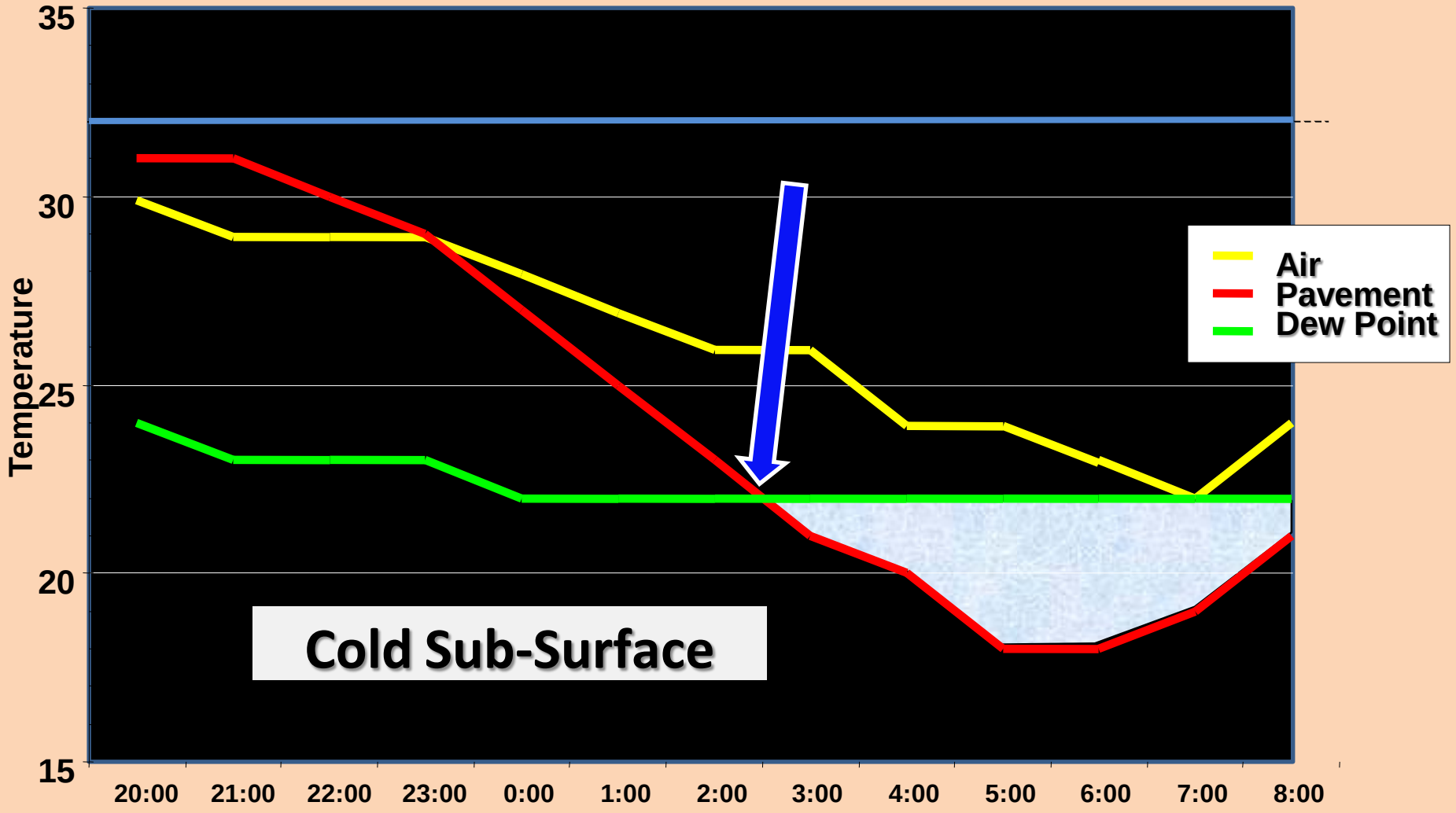
Cooler Sub-Surfaces *Draw Heat* as the Sun Goes Down.

Frost & Black Ice

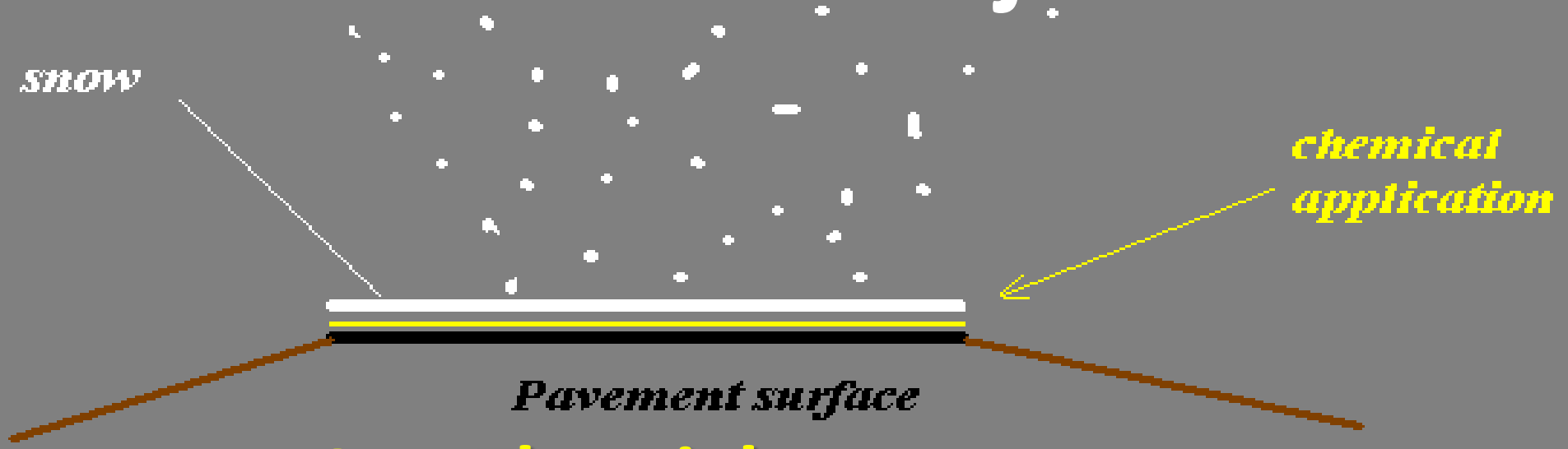
Black Ice


50
40
30
20
10
0
Temperature (F)
6pm
Midnight
5am
7am
Time
Pavement
Air Temp
Dewpoint

Black Ice


35
30
25
20
15
Temperature
20:00
21:00
22:00
23:00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
Air
Pavement
Dew Point
Cold Sub-Surface

S&I Control Objective



1. The Right ***Treatment***
2. The Right ***Place***
3. The Right ***Amount***, at;
4. The Right ***Time***

To Prevent or Delay Ice from Bonding to the Pavement

Frost & Black Ice

Occurs Independent of Other Precipitation

Requires Tracking Actual Condition Trends

- **Air Temp**
- **Surface Temp**
- **Dew Point Temp *(below surface temp)***
- **Wind**
- **Clear Skies**

3 Types of Environmental Threat Strategies for:
Snow, Ice, High Winds, Rain, Flooding, etc.

1) **Advisory Strategies – Condition Information for Managers and Motorists**

2) **Control Strategies – Permit, Regulate or Restrict Traffic Flow and Capacity.**

3) **Treatment Strategies – Application of Resources to Minimize or Eliminate Weather Impacts**

RWIS

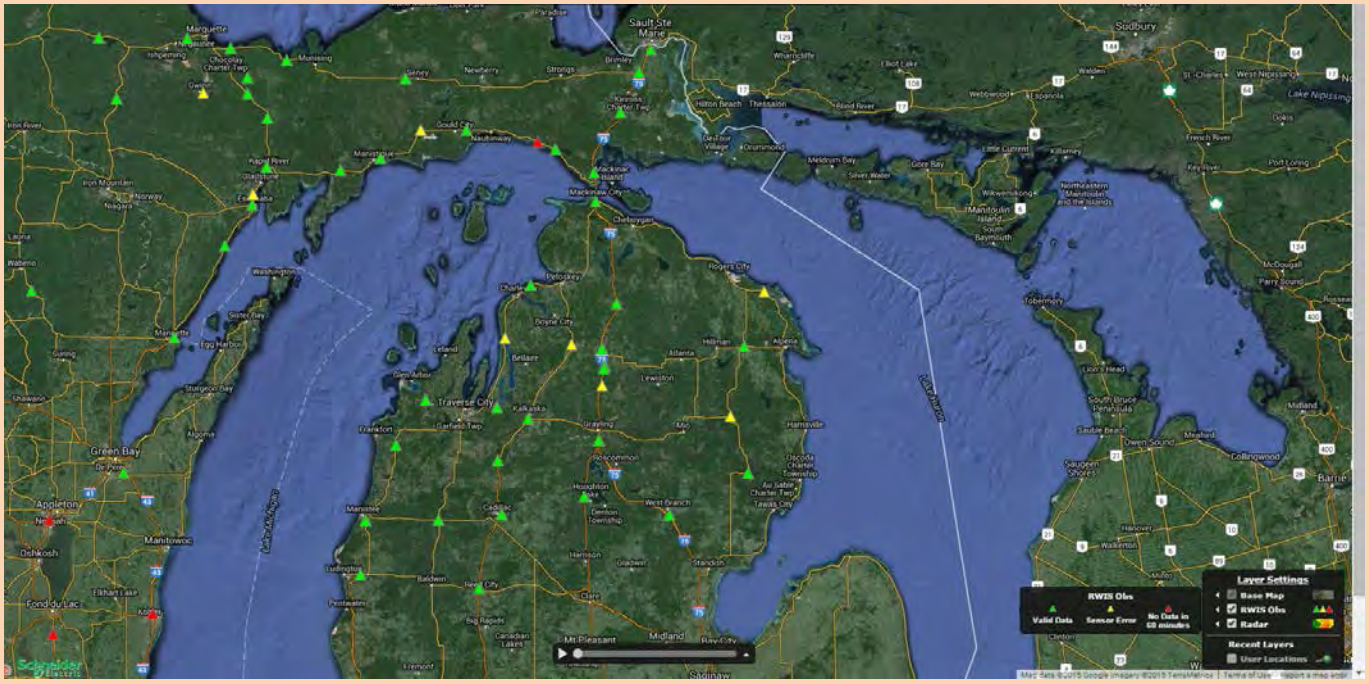
(Road & Weather Information Systems)

- **News, Not Forecasts**
  - ***Frequent Updates***
  - ***Multiple Locations***
  - ***Critical Areas***
- **Actual, Not Anticipated**
  - ***Air Temperature***
  - ***Dew Point***
  - ***Wind*** ***(Speed /Gusts /Direction)***
  - ***Precipitation*** ***(Type, Intensity)***
- **Pavement, Not ‘Surface’**
  - ***Temperature***
  - ***Wet/Dry Condition***

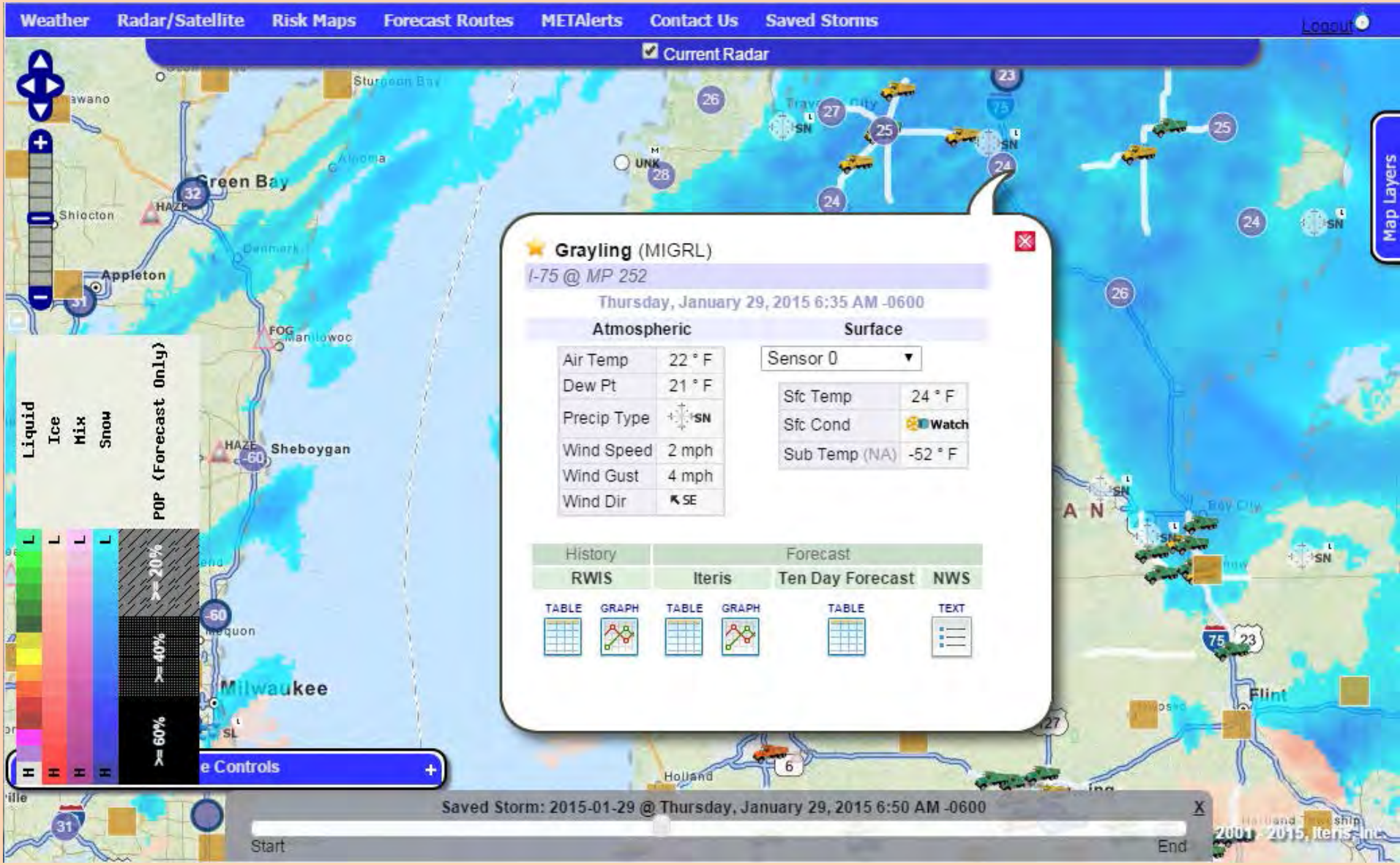
What Is RWIS?

Road & Weather Information Systems

- Environmental Sensing Stations (ESS)
- Communications Process
- Data Collection and Distribution Process
- Other Processes (Cameras, Forecasting, MDSS, etc.)



ITERIS (Meridian)
RWIS Site Report



ITERIS (Meridian)
RWIS History Table

Weather | Radar/Satellite | Risk Maps | Forecast Routes | METAlerts | Contact Us | Saved Storms | Logout

Williamsburg [MIWLM]
M-72 @ Williamsburg Rd

Table View
Last updated: 8:35:41pm

Time (GMT-0500)	Atmospheric							Sensor 0		Sensor 0: Subsfc 0: Depth: NA	Sensor 1		Time (GMT-0500)
	Air Temp (° F)	Dew Pt (° F)	Humidity (%)	Speed (mph)	Direction	Type	Rate (in/hr)	Cond	Temp (° F)	Temp	Cond	Temp (° F)	
Thu 6:30am	---	---	---	---	UNK	---	---	Watch	27	---	Watch	27	Thu 6:30am
Thu 6:25am	24	22	92	2	SE	SN	0.28	---	---	---	---	---	Thu 6:25am
Thu 5:25am	24	22	92	1	ENE	SN	0.08	Warn	27	---	Watch	27	Thu 5:25am
Thu 4:25am	24	22	91	2	SE	SN	0.75	Warn	26	---	Warn	26	Thu 4:25am
Thu 3:25am	26	18	72	6	SSE	SN	0.04	---	---	---	---	---	Thu 3:25am
Thu 3:20am	---	---	---	---	UNK	---	---	Watch	26	---	Watch	26	Thu 3:20am
Thu 2:25am	---	---	---	---	UNK	---	---	Dry	28	---	Dry	28	Thu 2:25am
Thu 2:20am	28	13	54	4	SSE	UNK	0.00	---	---	---	---	---	Thu 2:20am
Thu 1:25am	28	11	49	5	S	None	0.00	Dry	28	---	Dry	28	Thu 1:25am
Thu 12:25am	29	9	43	6	E	None	0.00	Dry	28	---	Dry	28	Thu 12:25am
Wed 11:25pm	29	8	41	6	E	None	0.00	Dry	28	---	Dry	28	Wed 11:25pm
Wed 10:25pm	29	8										---	Wed 10:25pm
Wed 10:20pm	---	---										28	Wed 10:20pm

Saved Storm: 2015-01-29 @ Thursday, January 29, 2015 6:50 AM -0600 X
Start End

History Graph	Scale	Data Options

Event Start Time: 02/13/07 01:00 Hrs
Air Temp: 32 / Pav't Temps 30

End Date: (mm/dd/yyyy hh:mm) 2/15/2007 01:00

Time period: 6 hrs, 12 hrs, 24 hrs, 48 hrs (selected), 7 days

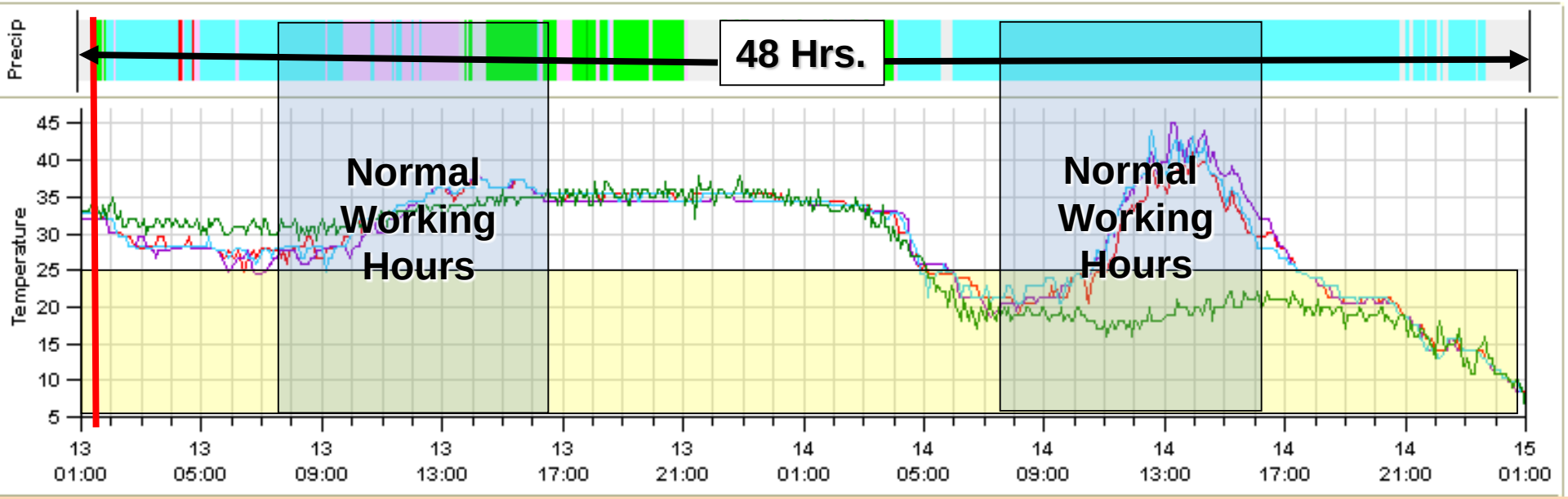
Air Temp, Dew Temp, Freeze Temp, Surface Temp

IR77 North Bound Driving (0)
IR77 North Bound Passing (1)
IR77 South Bound Passing (2)
IR77 South Bound Driving (3)

Legends, Update, Reset

Generated: 10/01/2007 15:55 EDT

Sf / Pc. Table | Sf / Atm. Table | Atmos. Table | Precip. Table



Reminders:

- **Radar Has Gaps; Satellite has Limitations**
- **Lake Effect Forms at Around 5,000 ft.**
- **Air Temp/Dew Point '5 Degree' Suggestion**
- **When Dew Point is Higher than Road/Ramp/Bridge Temp, Look for Moisture/Ice**
- **Pavement Temps Impact Operations**
- **Sub-Surface Temps Impact Surface Temps**
- **RWIS is Actuality, Not Probability**

Using RWIS in Winter Operations

Questions?

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