

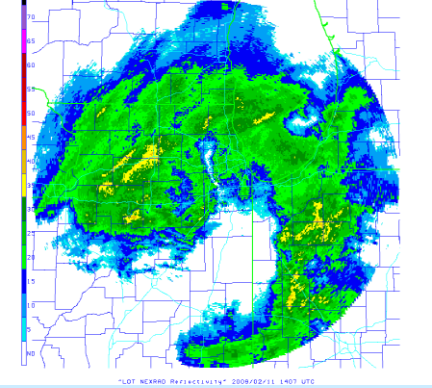
PROWS!

Profiling of Winter Storms

Scientific overview and objectives

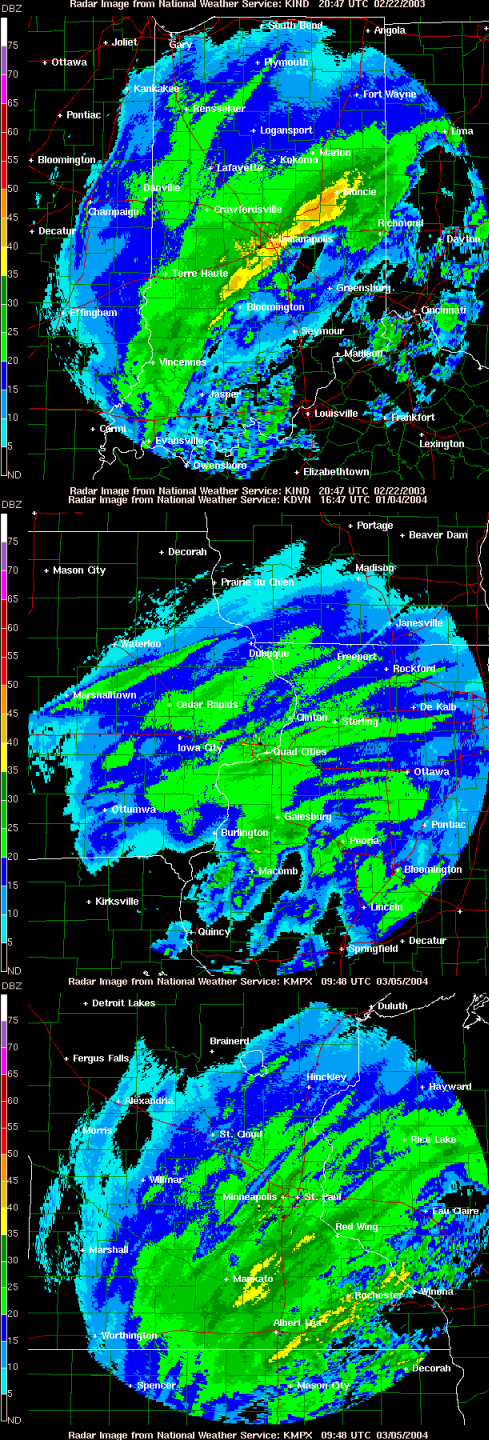


PLOWS



Targeted at understanding the dynamic and microphysical processes that govern the spatial and temporal variability of precipitation within extratropical cyclones .

Field Campaign designed to address outstanding scientific questions targeted at improving our understanding of precipitation substructures in the northwest and warm frontal quadrants of continental extratropical cyclones.



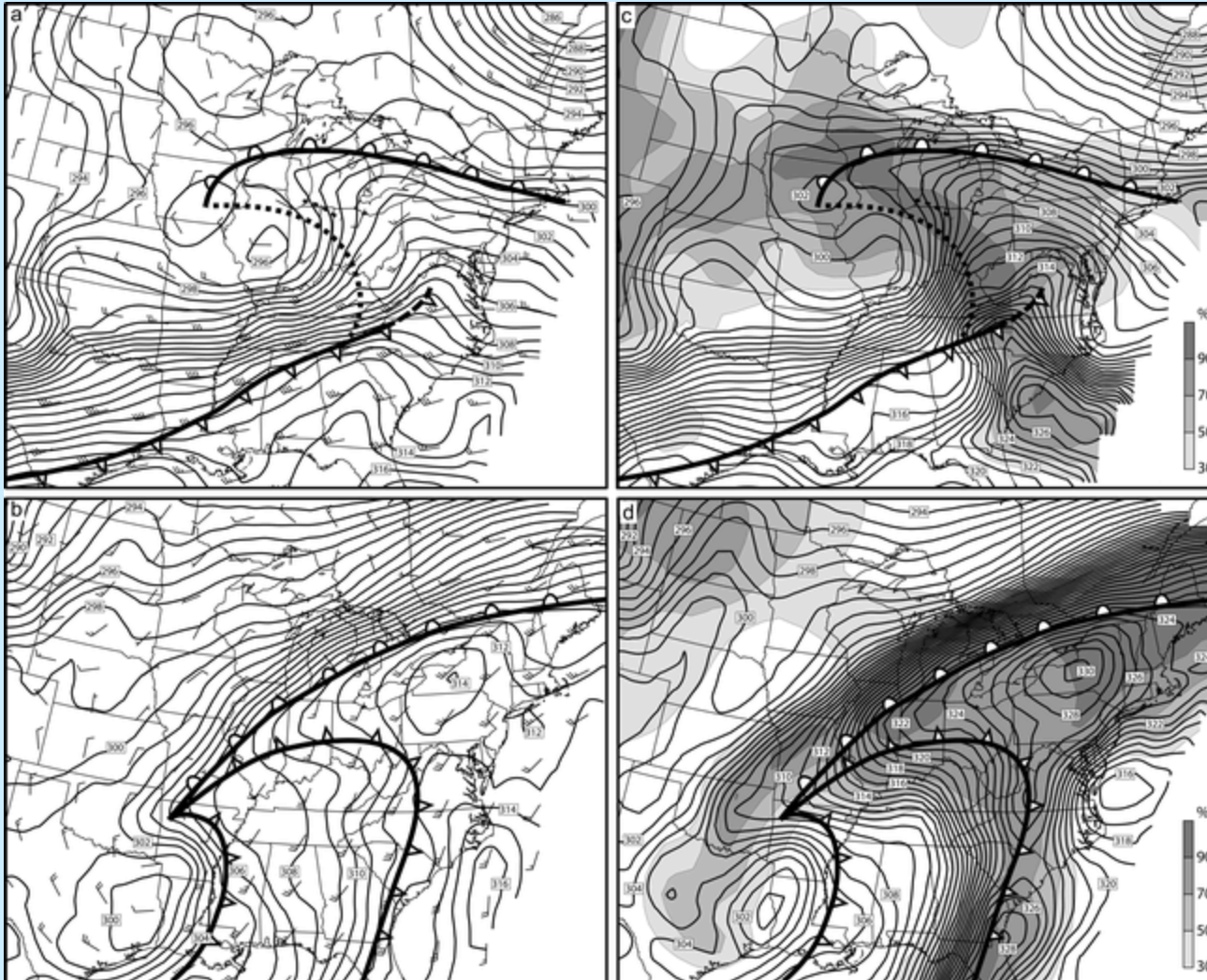
UI/UAH SCIENCE QUESTIONS

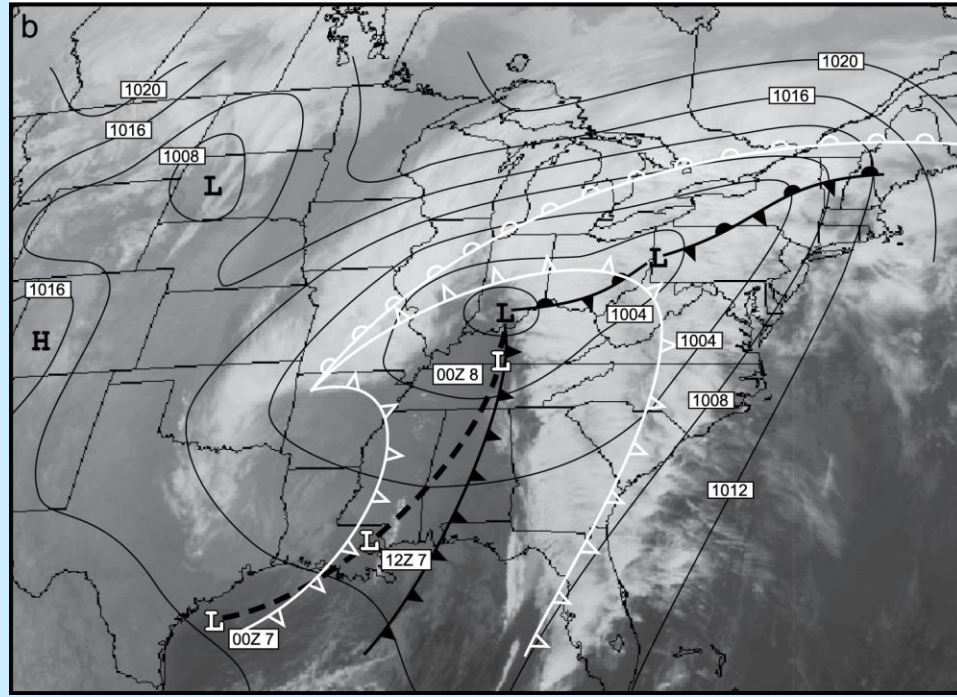
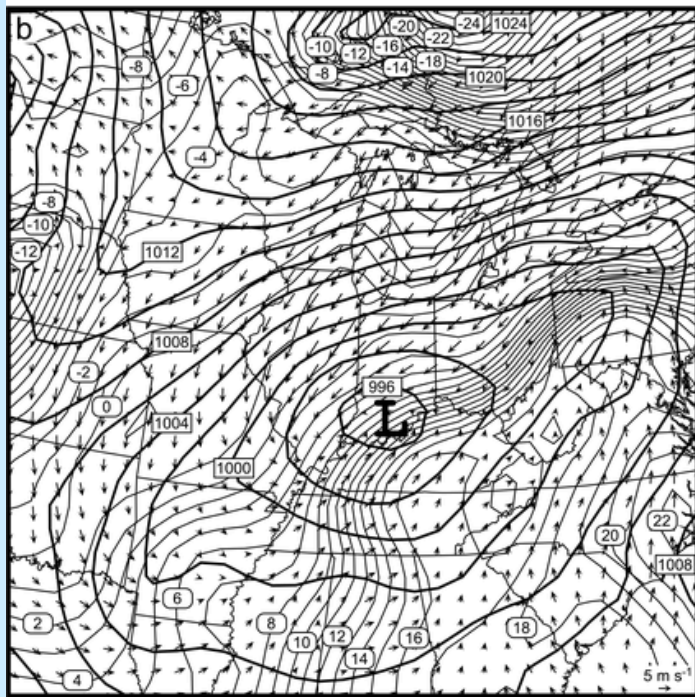
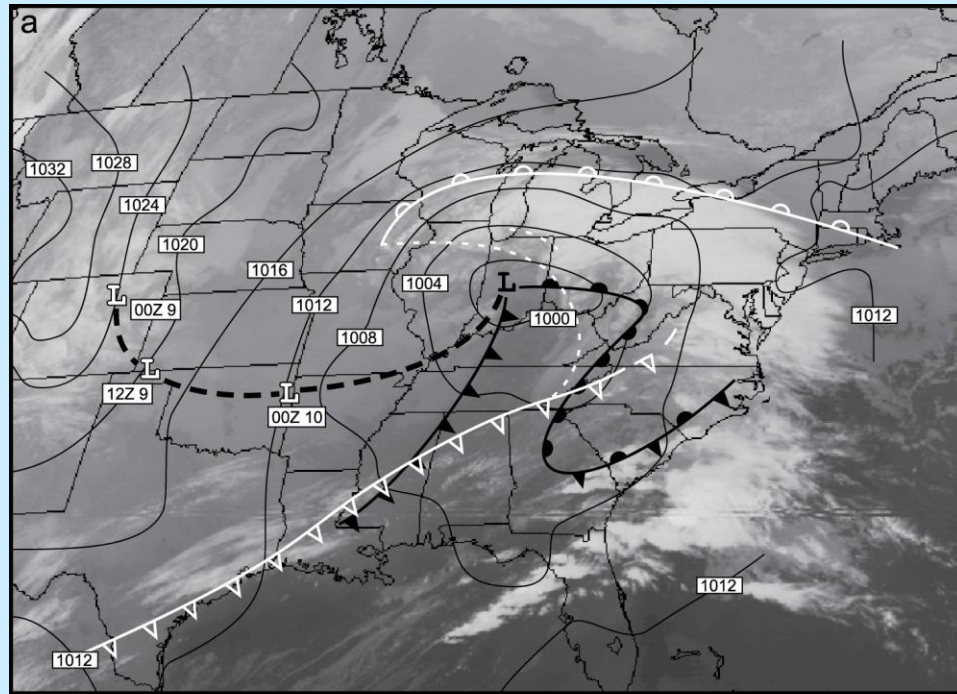
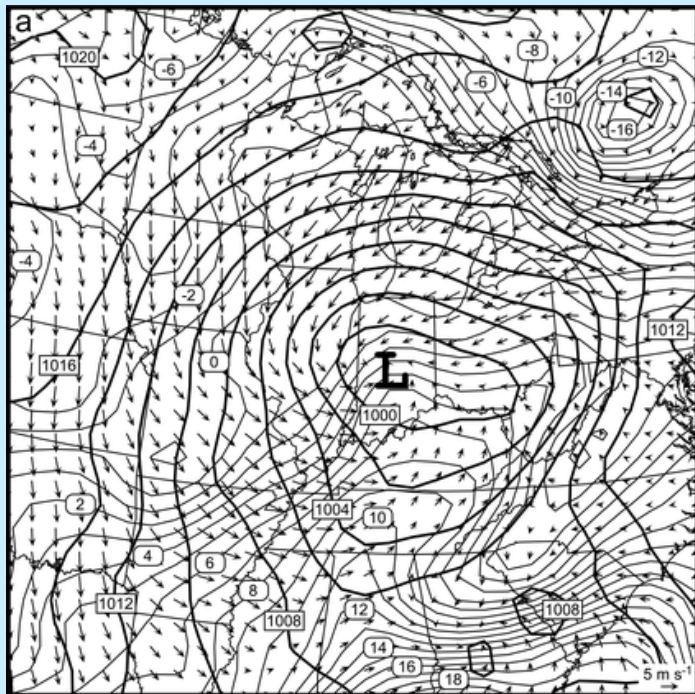
- 1) What are the predominant spatial patterns of organized precipitation substructures, such as bands and generating cells, in these quadrants and how do they evolve?
- 2) How do frontal scale systems above and within the boundary layer such as warm fronts,, cold fronts aloft, and occluded fronts relate to these precipitation substructures?
- 3) What are the thermodynamic and kinematic structures of these frontal systems including the distribution of moisture and vertical motion?
- 4) What instabilities and types of mesoscale forcing (e.g., moist CSI, moist frontogenesis, gravity waves, and elevated upright convection) control the generation and evolution of precipitation substructures?
- 5) How do microphysical processes vary between the different precipitation substructures and what are the consequences?
- 6) Is instability triggered in ice-saturated ascent critical in some of these instances and is it through the release of the latent heat of deposition that instabilities can persist?

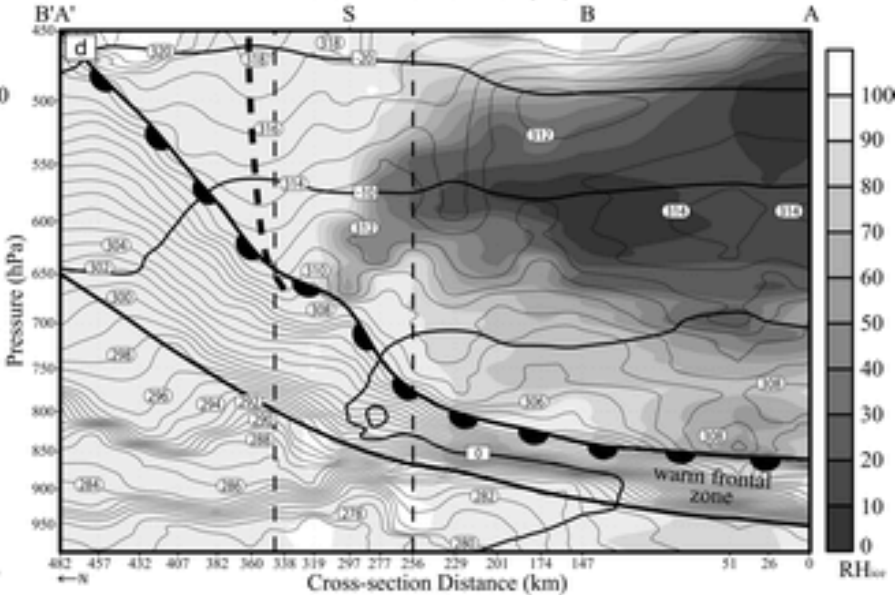
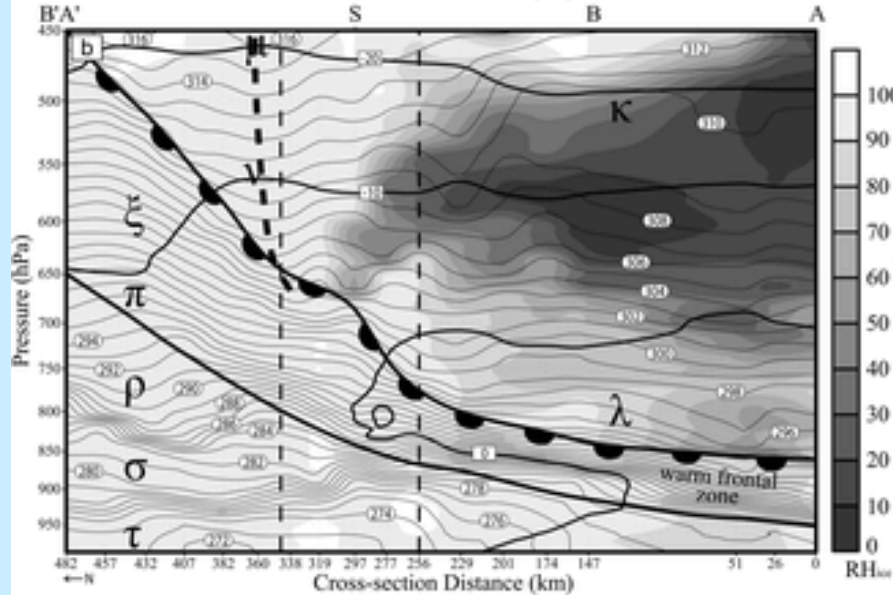
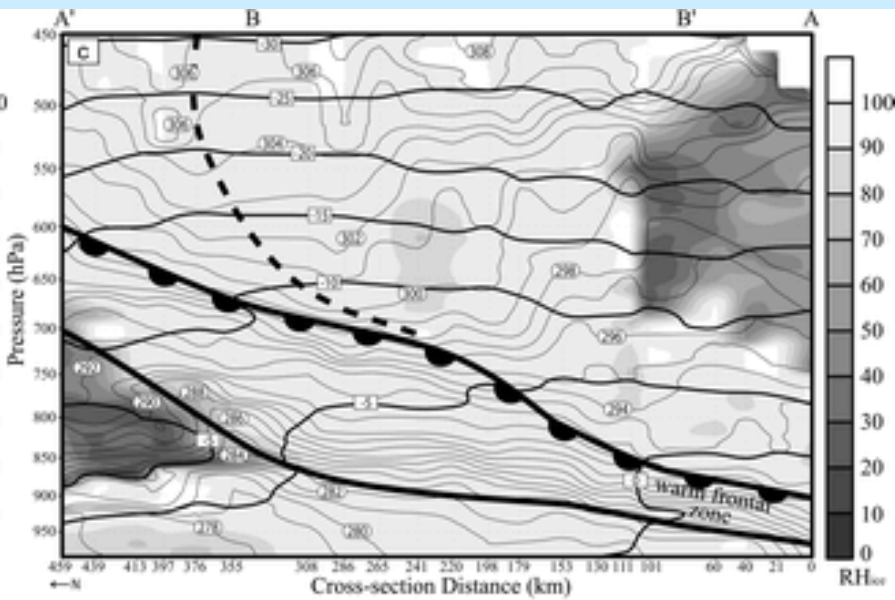
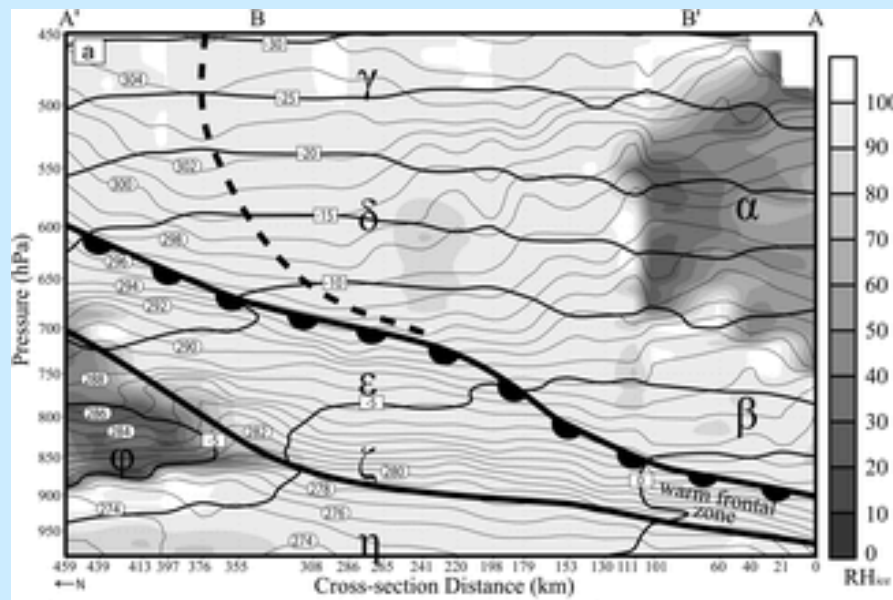
**8:30-9:30 a.m. Scientific overview and objectives of
PLOWS**

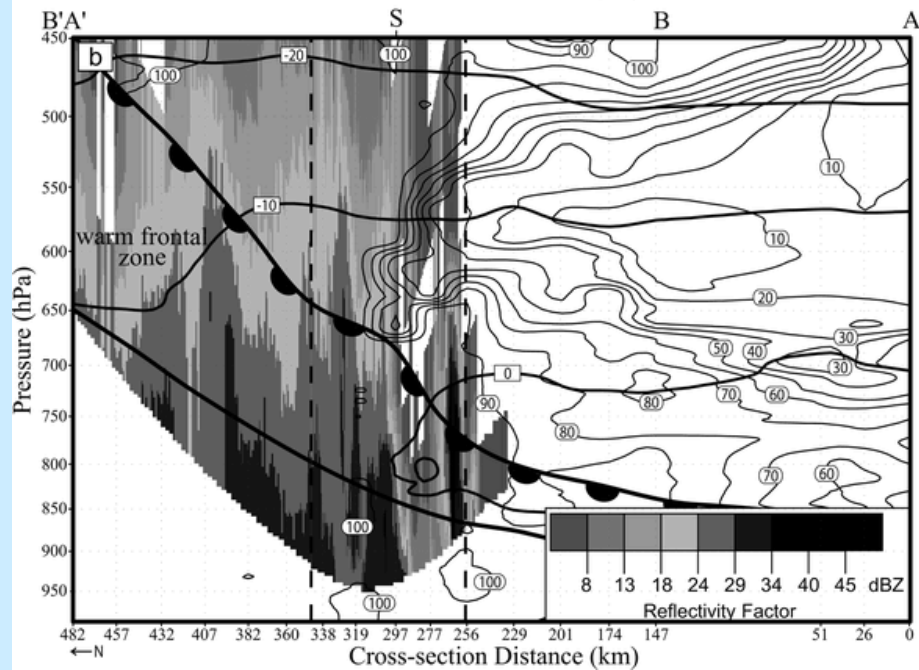
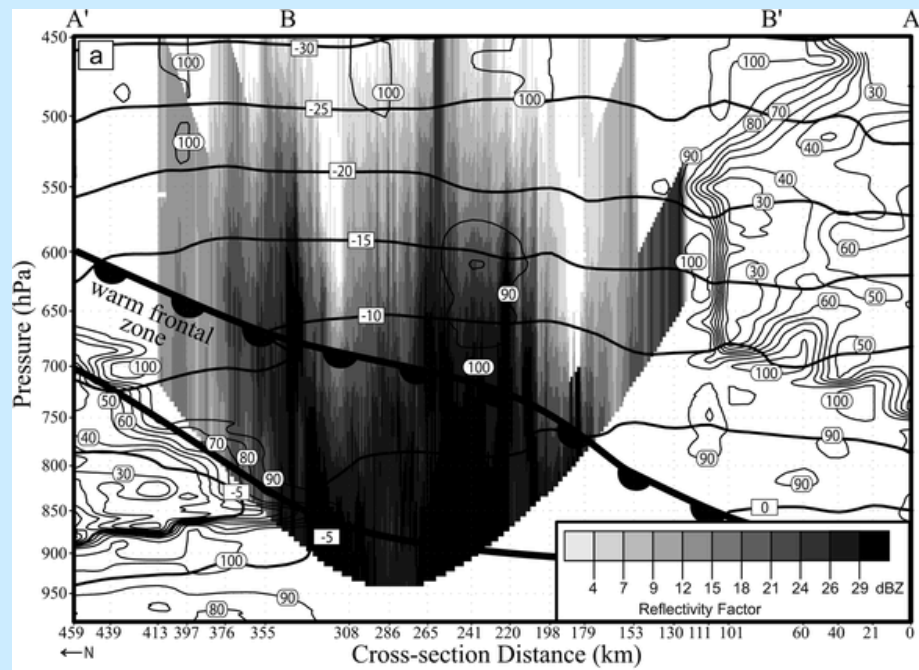
Mesoscale dynamics	(Rauber)
Microphysics	(McFarquhar)
Numerical Simulations	(Jewett)
University of Missouri	
Winter Storm electrification	(Market)
Clarkson University/NCAR RAF	
Aerosol and interstitial sampling	(Dhaniyala)

Background: SNOWBAND CYCLONES - 1998

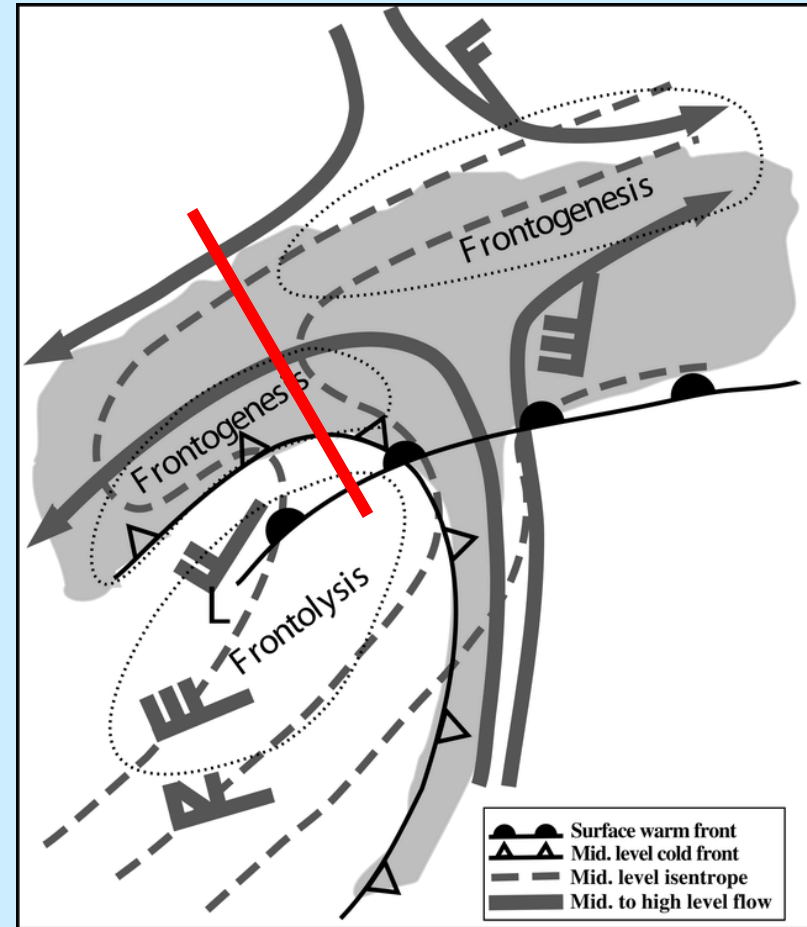
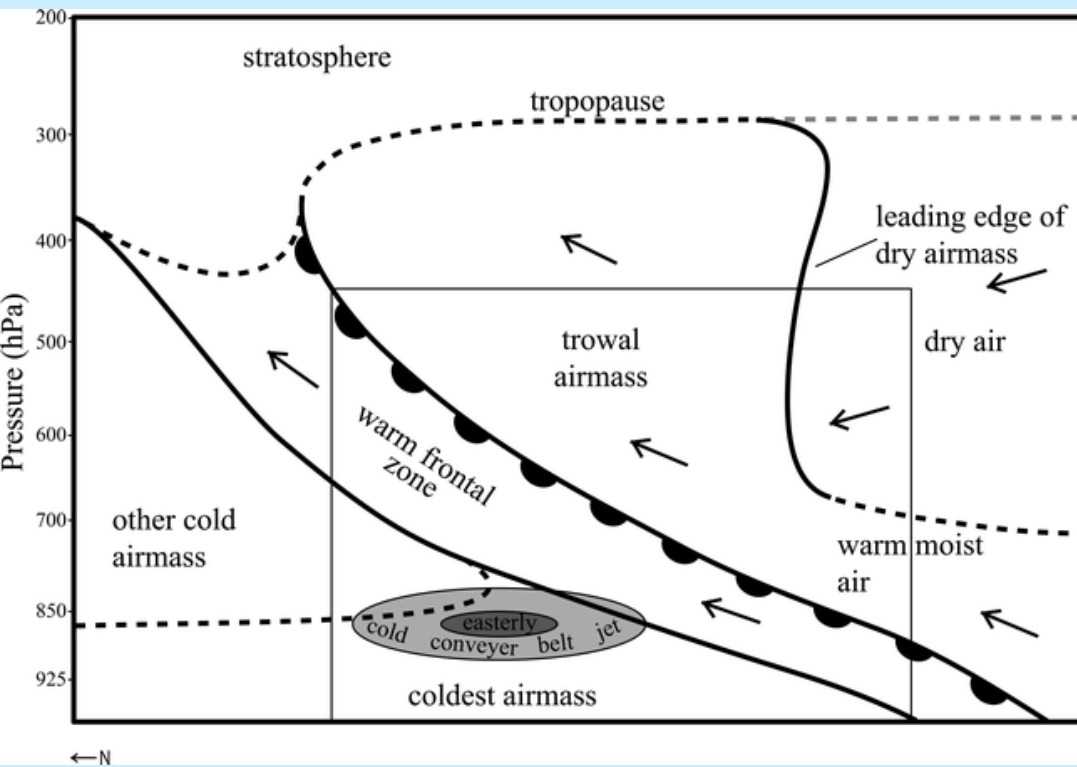










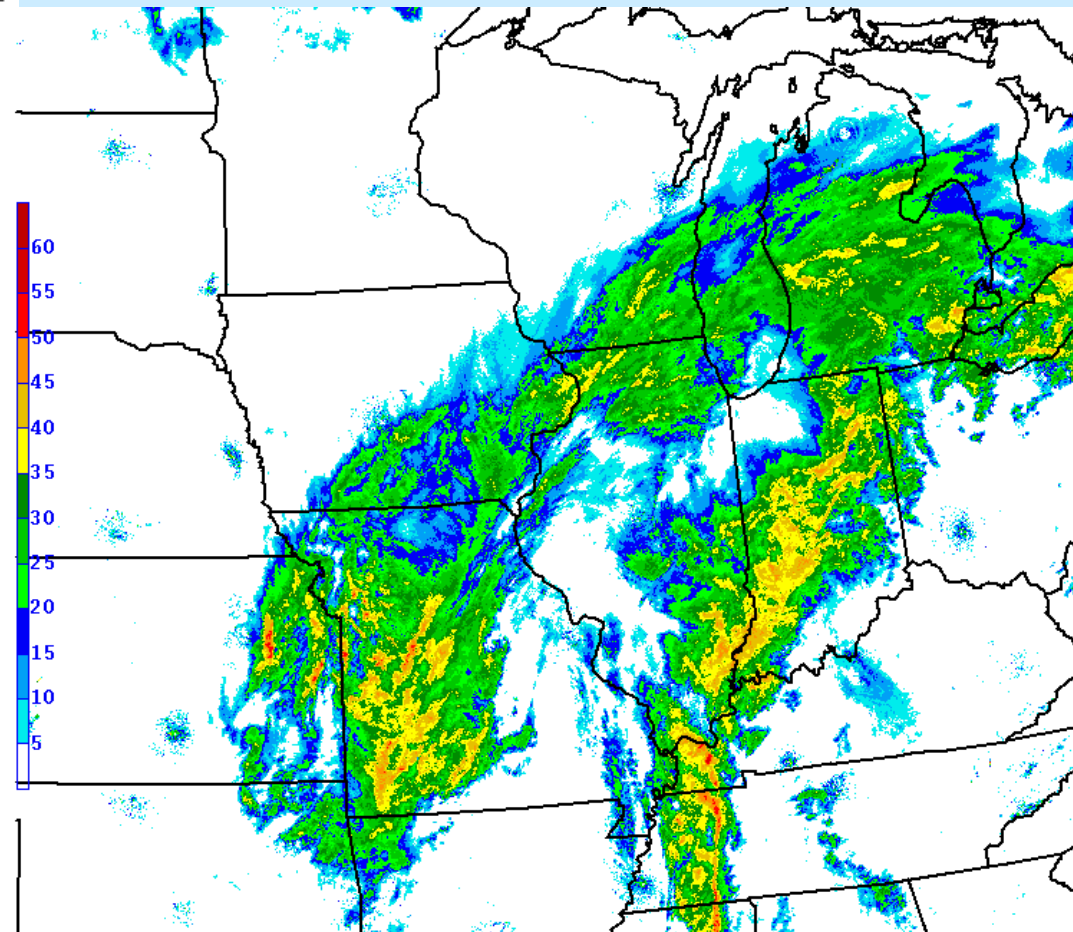
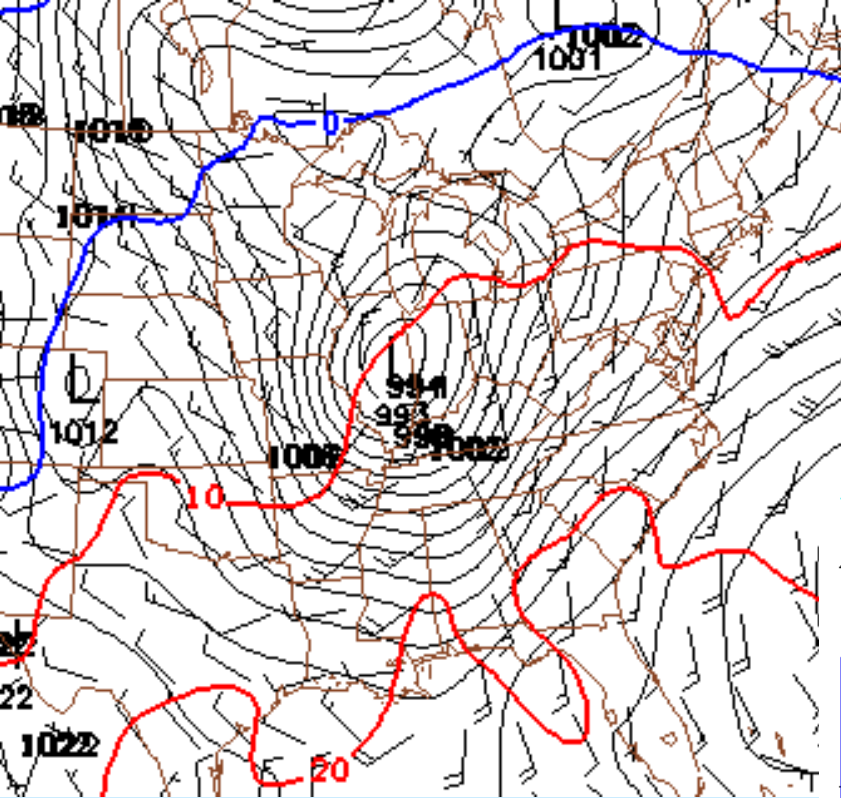


SNOWBAND Conceptual Models of Storms

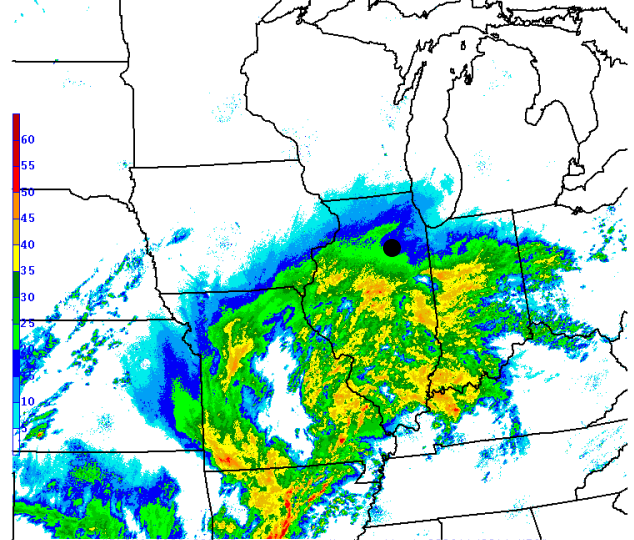


-  Surface warm front
-  Mid. level cold front
-  Mid. level isentrope
-  Mid. to high level flow

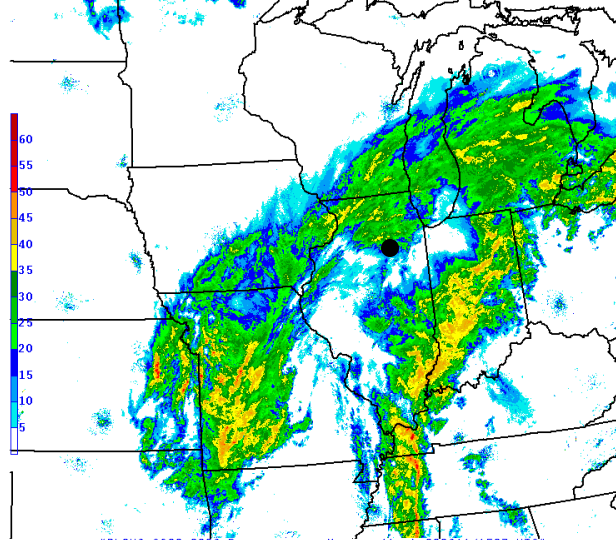
PLOWS IOP-1 Cyclone 11 Feb 09



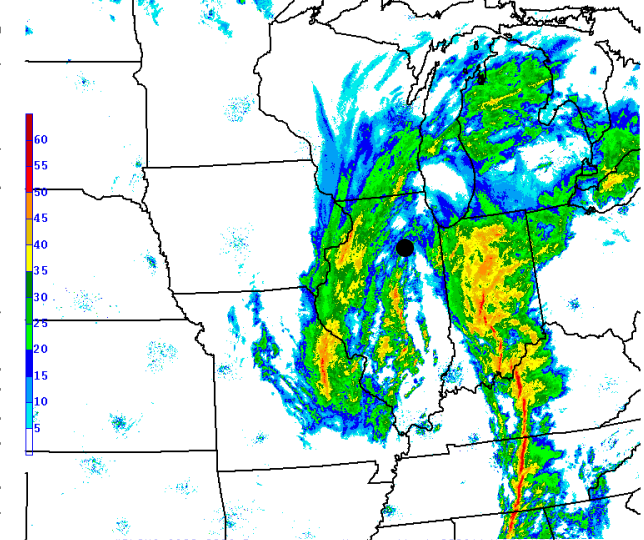
"PLOWS 2008-2009 Reflectivity Mosaic (1km) 090211/1527 UTC"



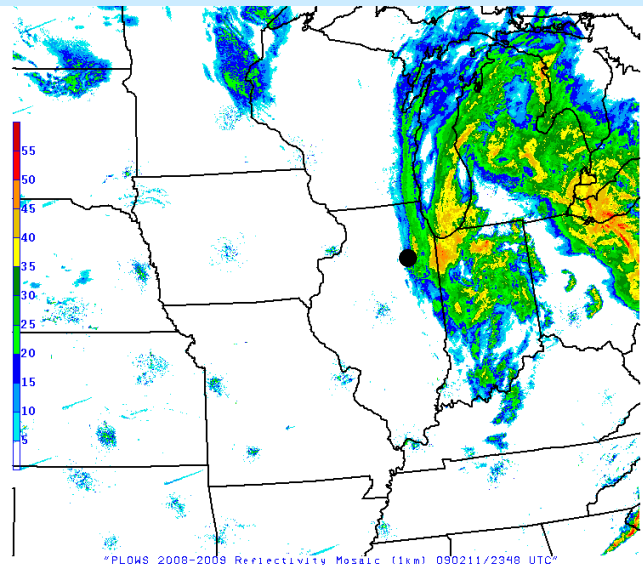
"PLOWs 2008-2009 Reflectivity Mosaic (1km) 030211/0811 UTC"



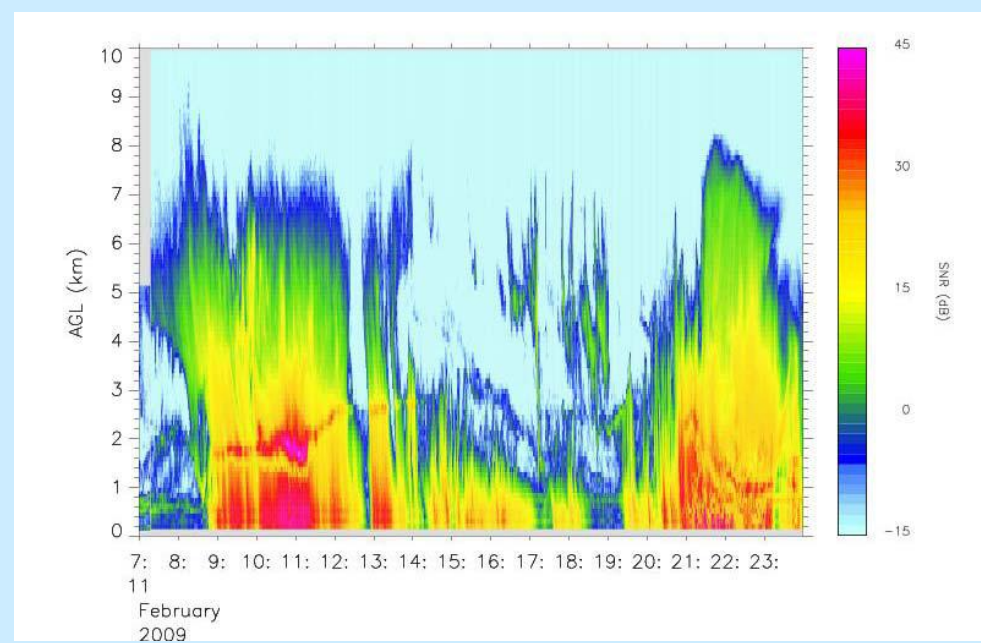
"PLOWs 2008-2009 Reflectivity Mosaic (1km) 030211/1527 UTC"

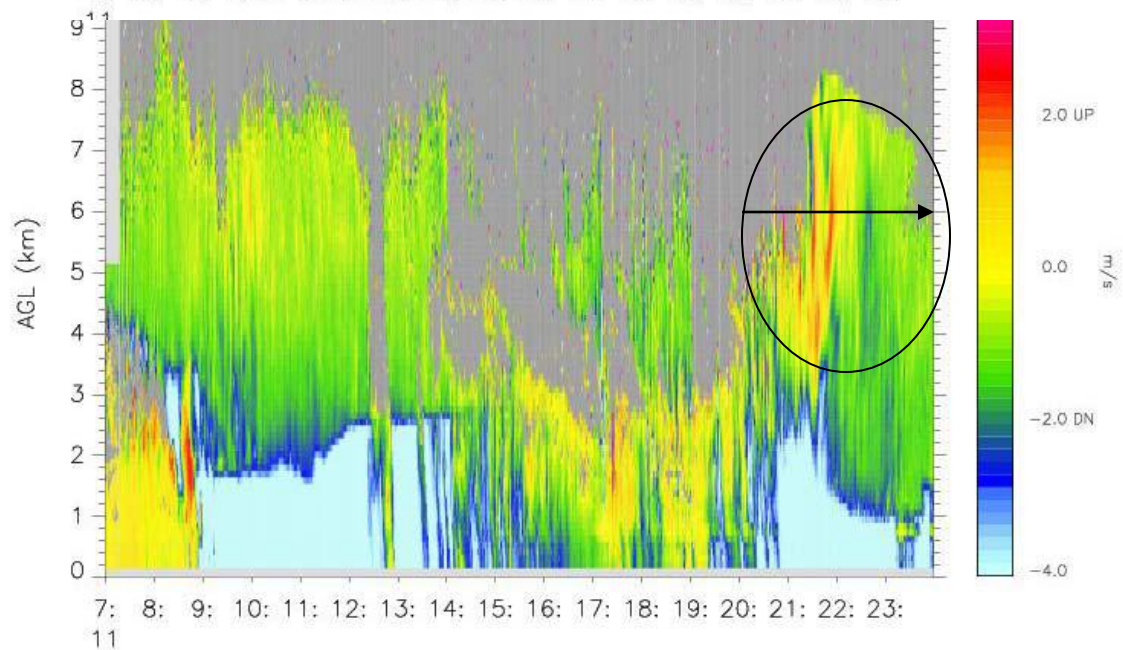
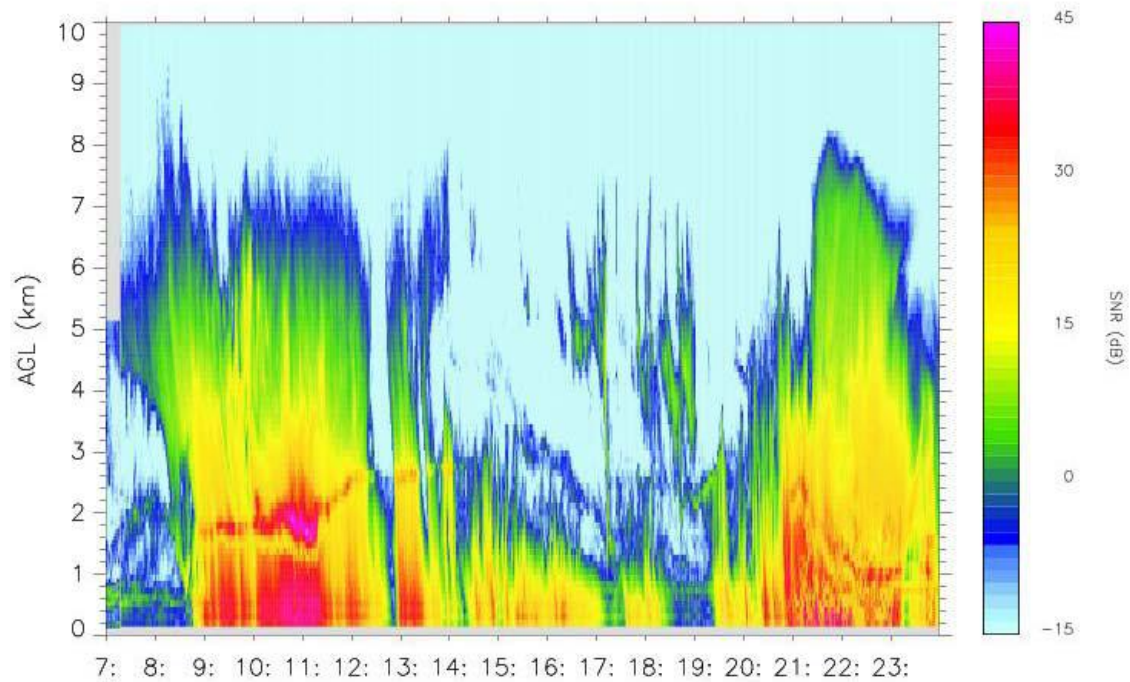


"PLOWs 2008-2009 Reflectivity Mosaic (1km) 030211/1858 UTC"

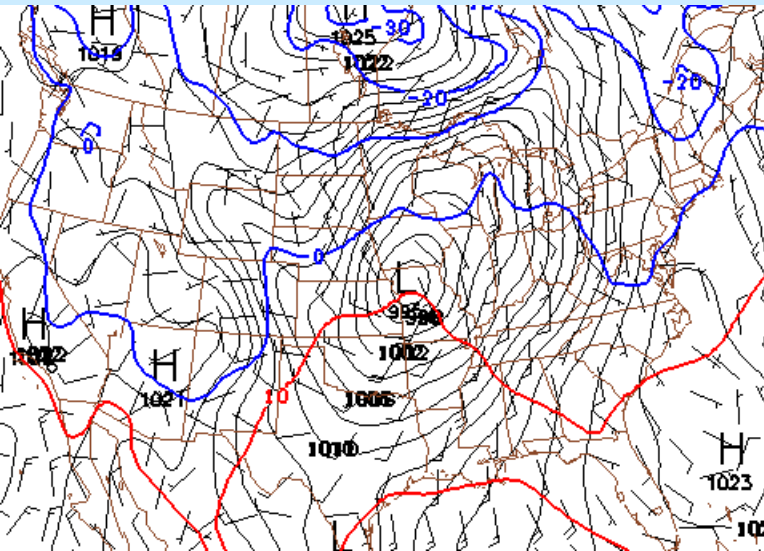


"PLOWs 2008-2009 Reflectivity Mosaic (1km) 030211/2348 UTC"

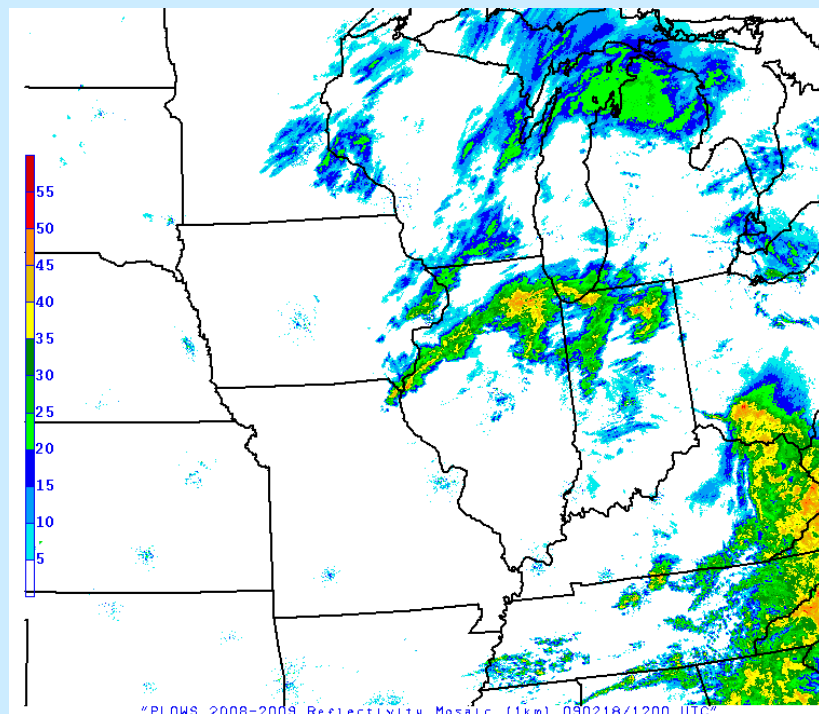
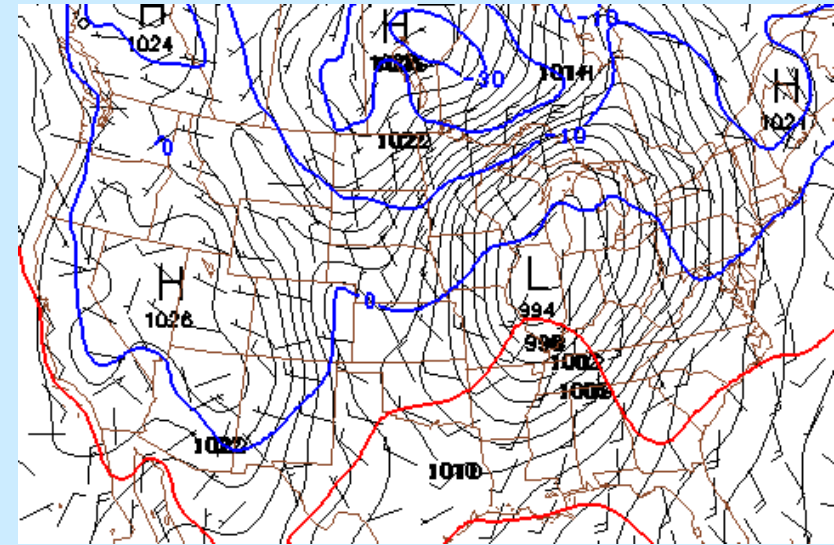




EXPERIENCE WITH 78-60 hr FORECASTING – ONE WORD...UNCERTAINTY



Example 1
IOP-2
(a bust)

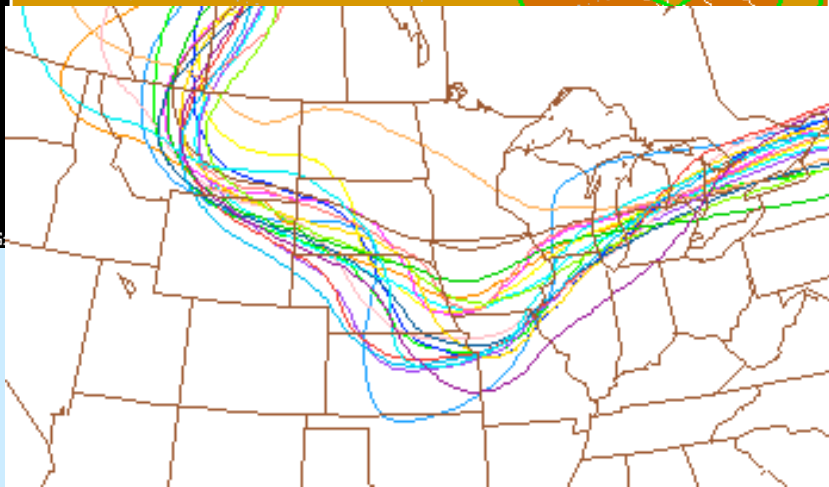
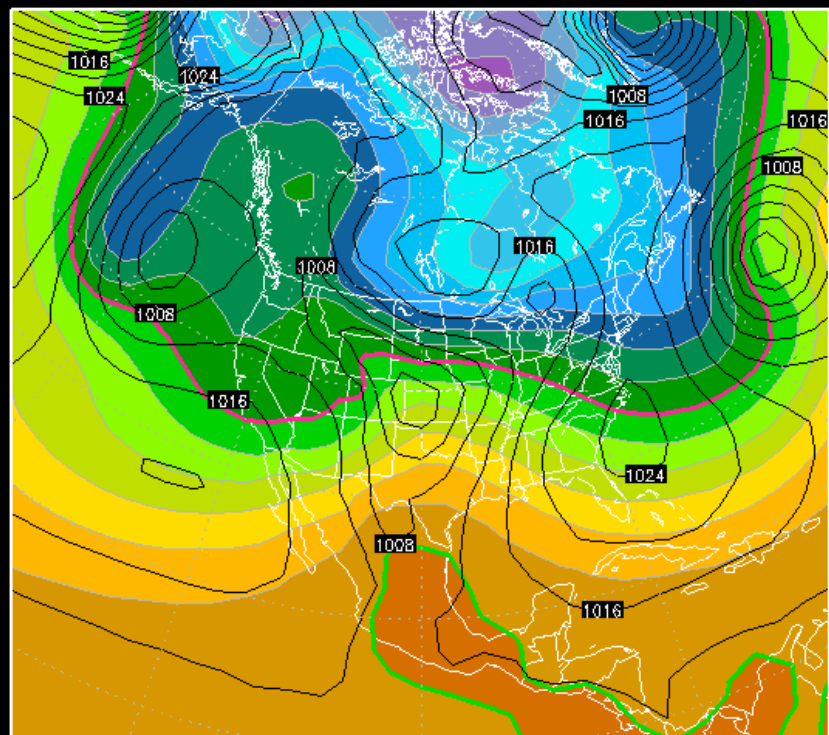


"PLOWs 2008-2009 Reflectivity Mosaic (1km) 090218/1200 UTC"

NCEP ENS MEAN:MSLP(mb)/1000:500mb THK(m)

072H Forecast from: 00Z Sun FEB,15 2009

Valid time: 00Z Wed FEB,18 2009

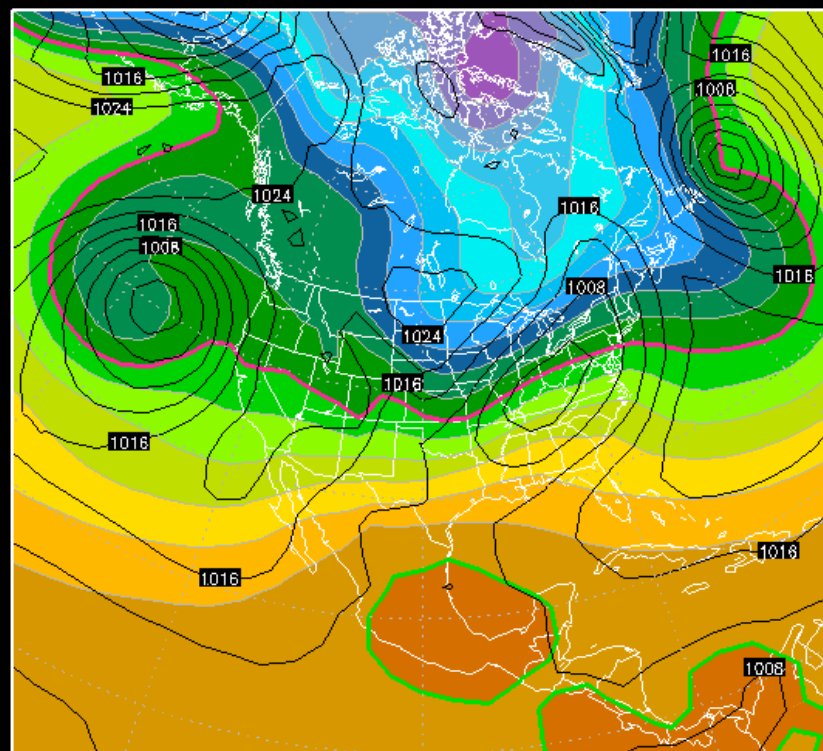


GrADS

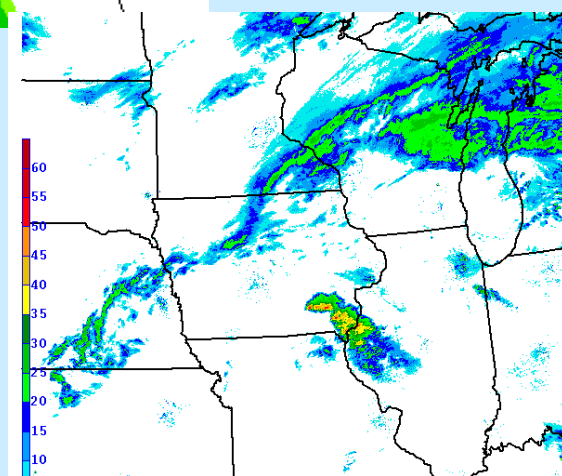
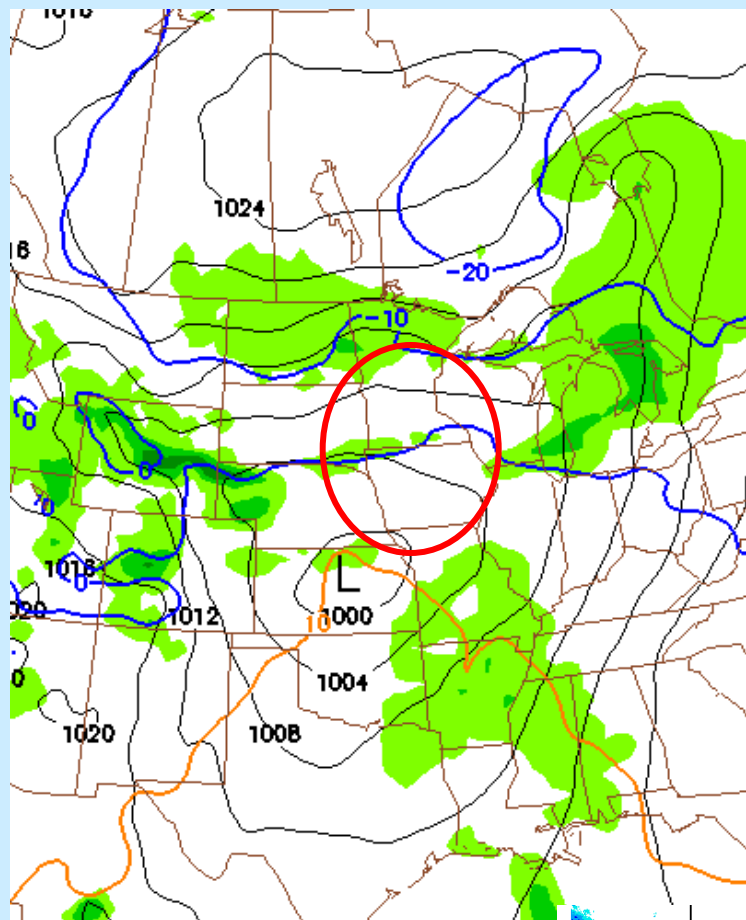
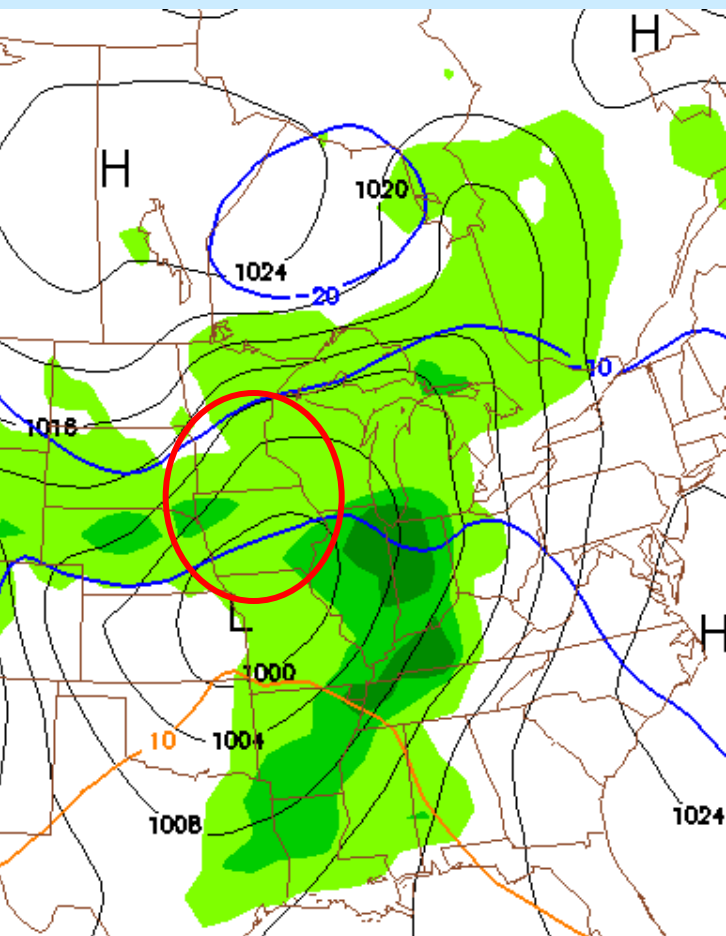
NCEP ENS MEAN:MSLP(mb)/1000:500mb THK(m)

096H Forecast from: 00Z Sun FEB,15 2009

Valid time: 00Z Thu FEB,19 2009



GrADS: COLA/IGES

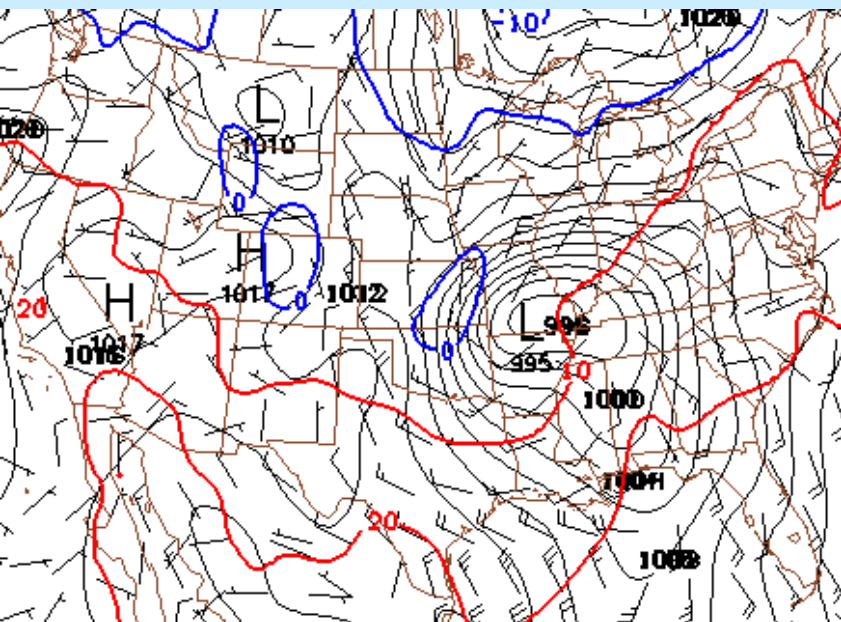


GFS 66 Hr forecast
IOP-2 Cyclone
Valid 0600 18 Feb 09

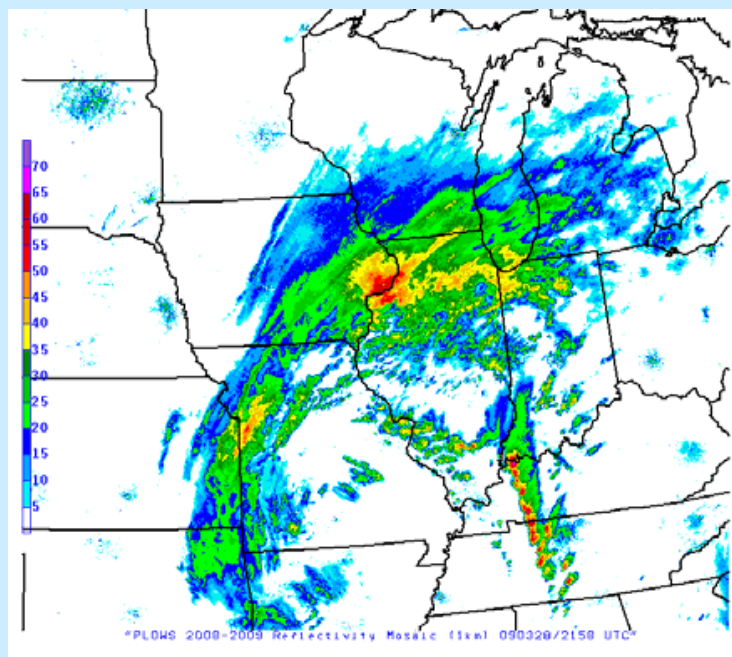
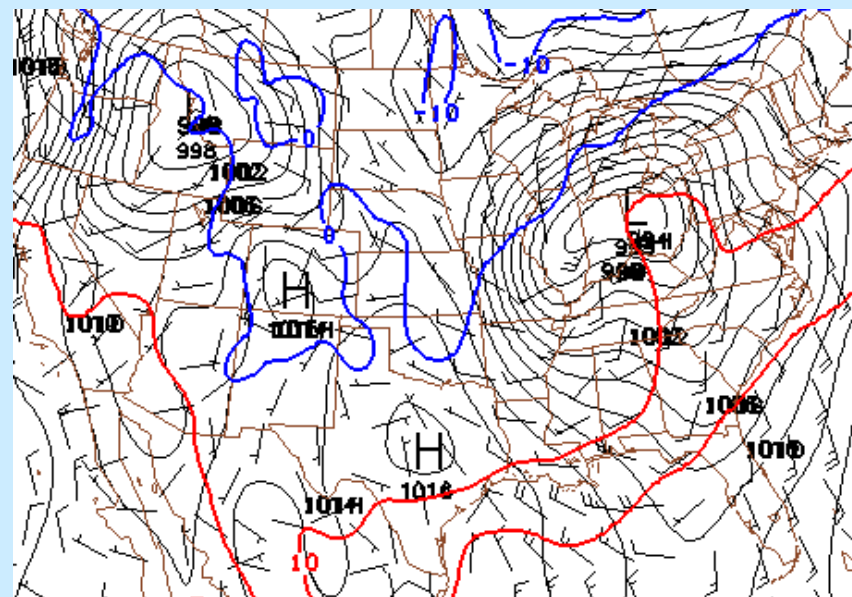
NAM 66 Hr forecast
IOP-2 Cyclone
Valid 0600 18 Feb 09

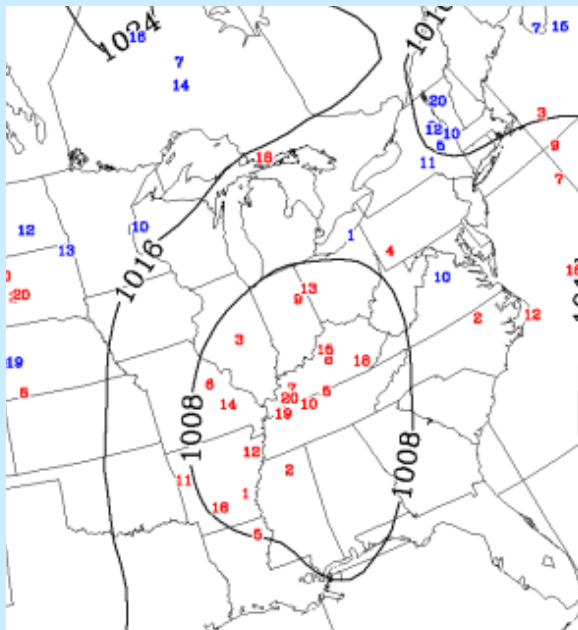
What happened... 0600 18 Feb 09

EXPERIENCE WITH 78-60 hr FORECASTING – ONE WORD...UNCERTAINTY

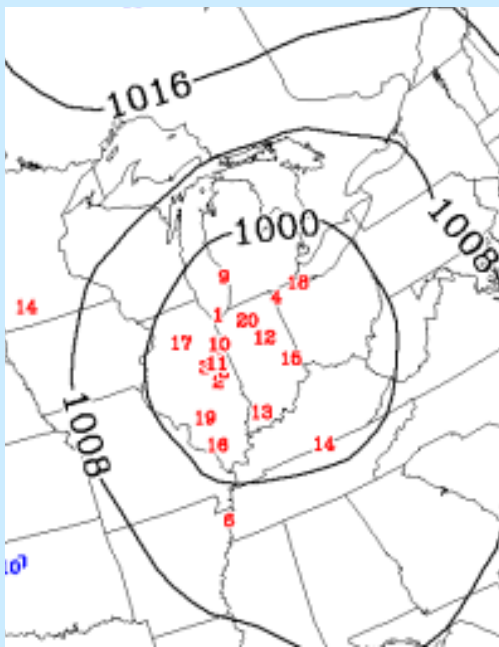


IOP-5
(a hit)

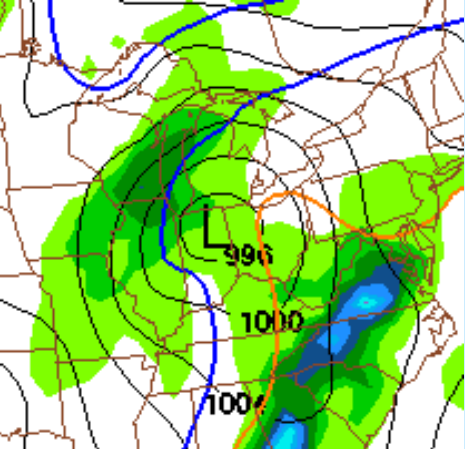




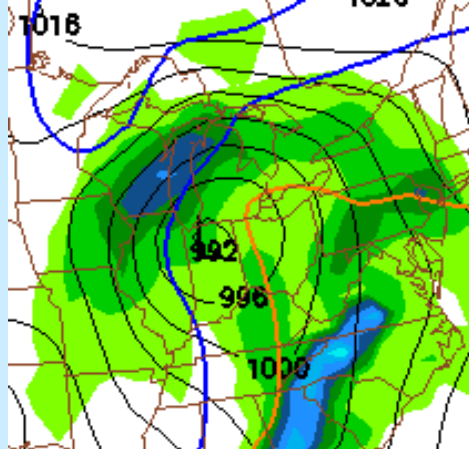
Canadian Ensemble positions of low pressure System positions valid at 12 Z 28 March 09 at forecast Given at 1800 UTC on 25 March 09



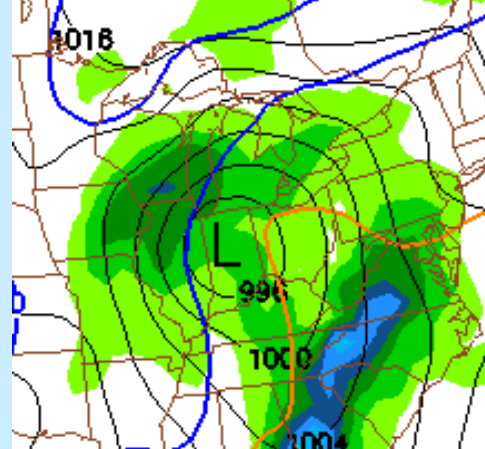
Canadian Ensemble positions of low pressure System positions valid at 00 Z 29 March 09 at forecast Given at 1800 UTC on 26 March 09



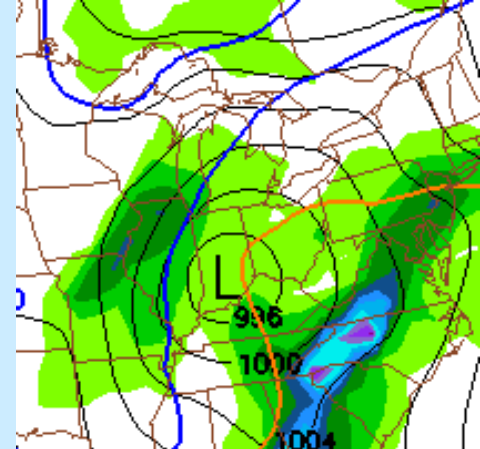
GFS 78 hr



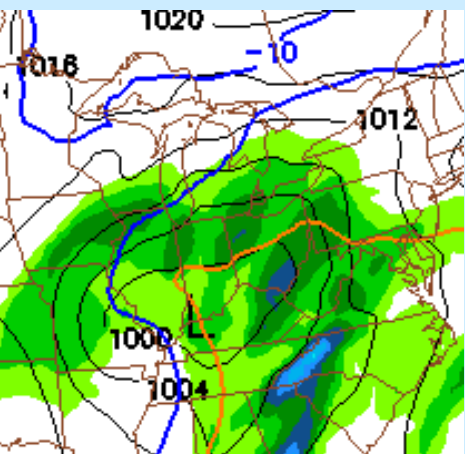
GFS 72 hr



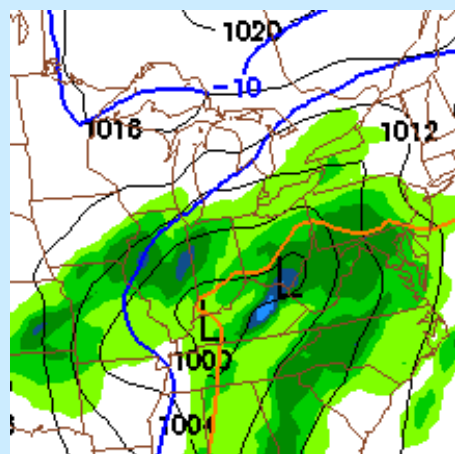
GFS 66 hr



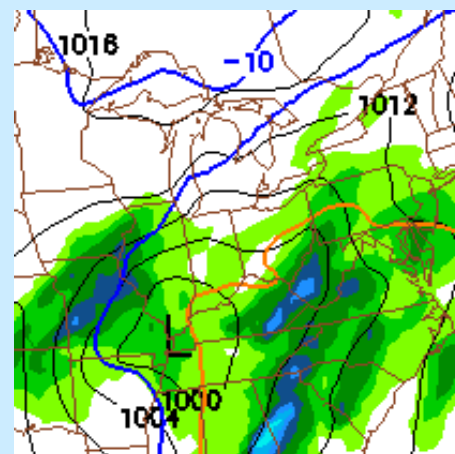
GFS 60 hr



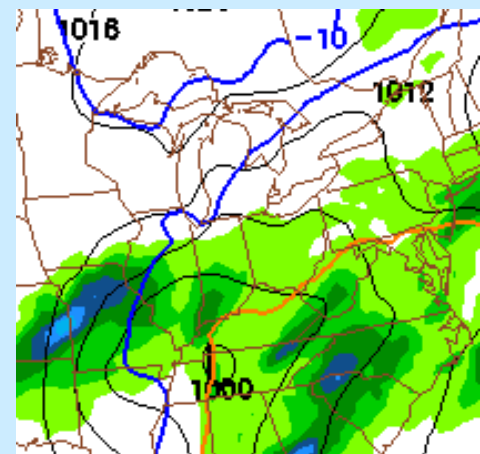
NAM 78 hr



NAM 72 hr

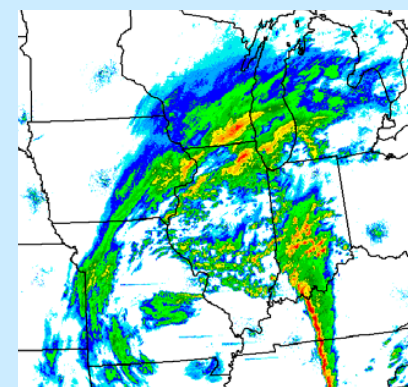


NAM 66 hr

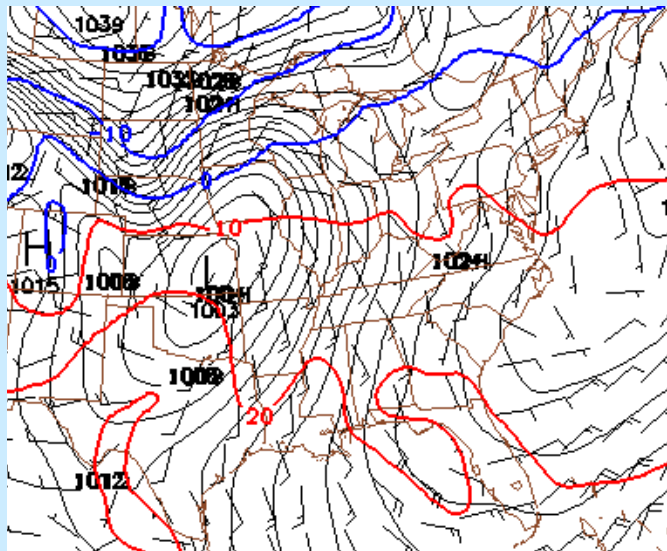


NAM 60 hr

What happened... 0000 29 Mar 09

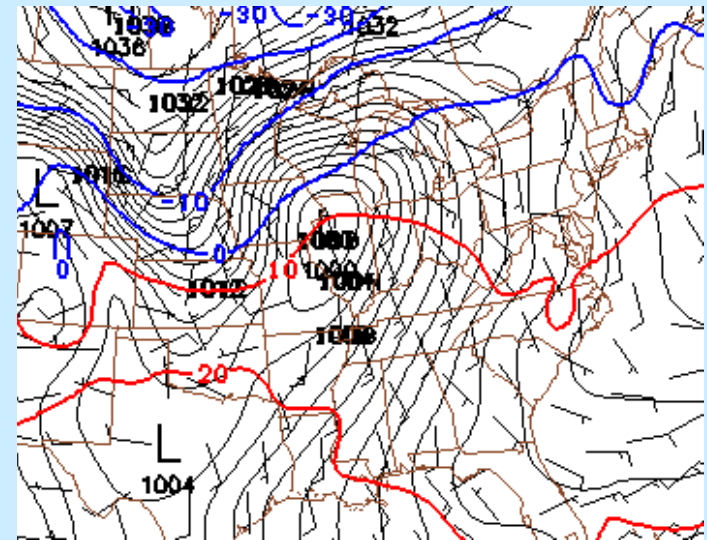


EXPERIENCE WITH 24-48 hr FORECASTING – ONE WORD...UNCERTAINTY



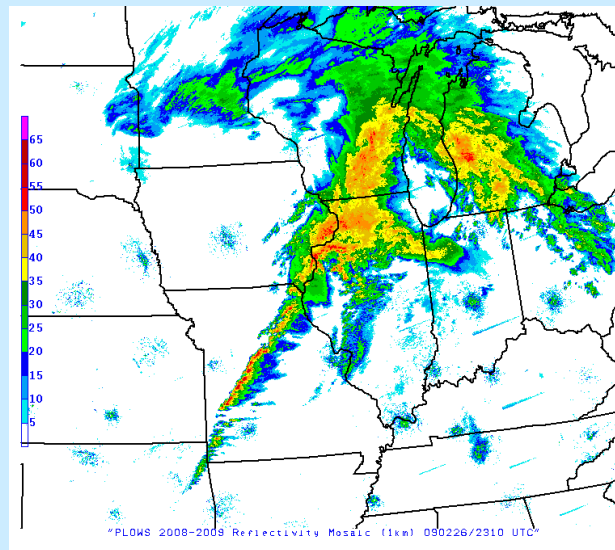
26 Feb 09 18 UTC

Example 3
IOP-3
(storm
north of
ideal
position)

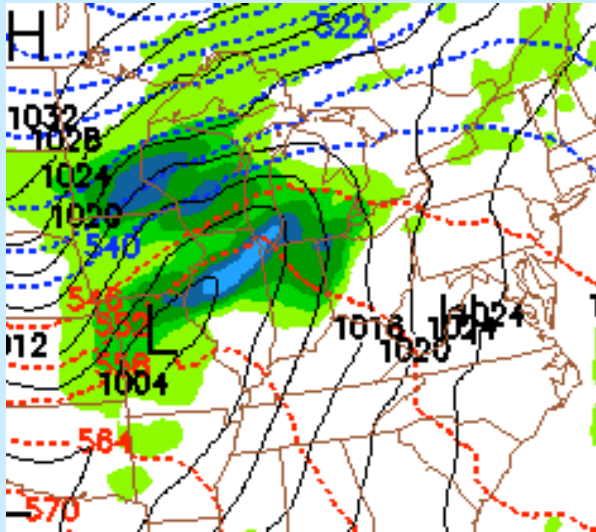


27 Feb 09 00 UTC

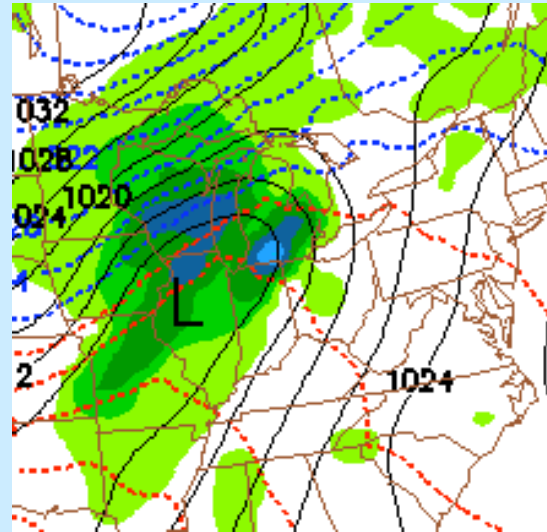
26 Feb 09 2310 UTC



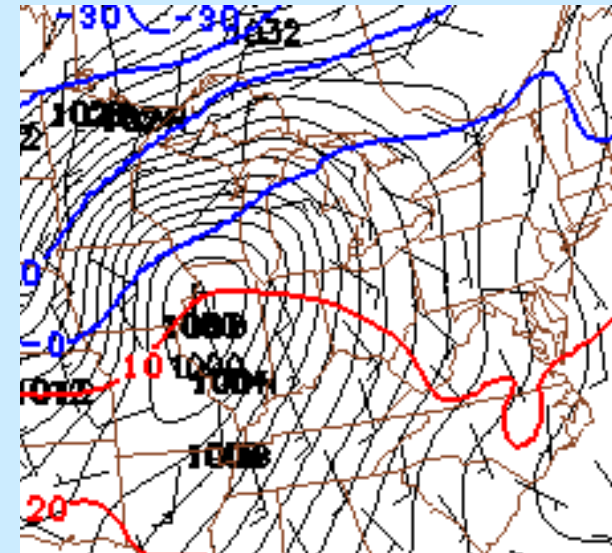
All Valid 27 Feb 00 UTC



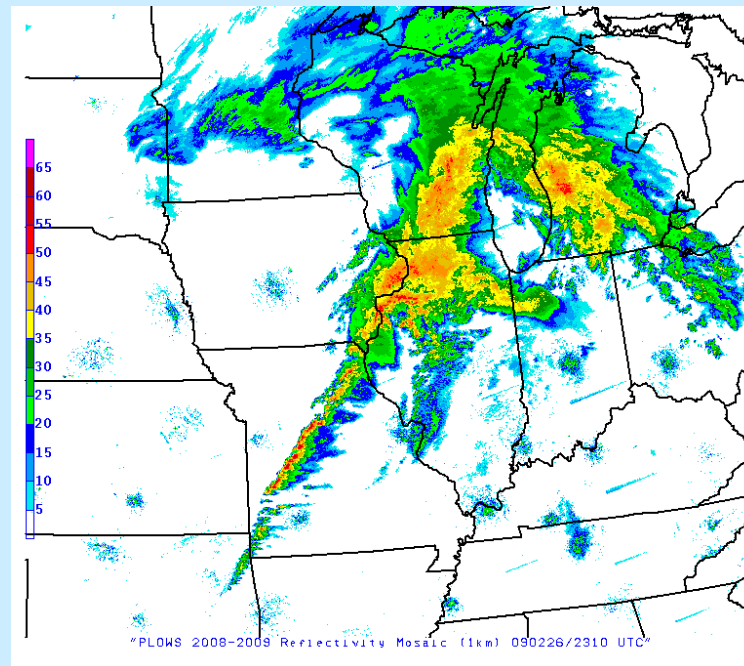
NAM 36 hr



GFS 36 hr



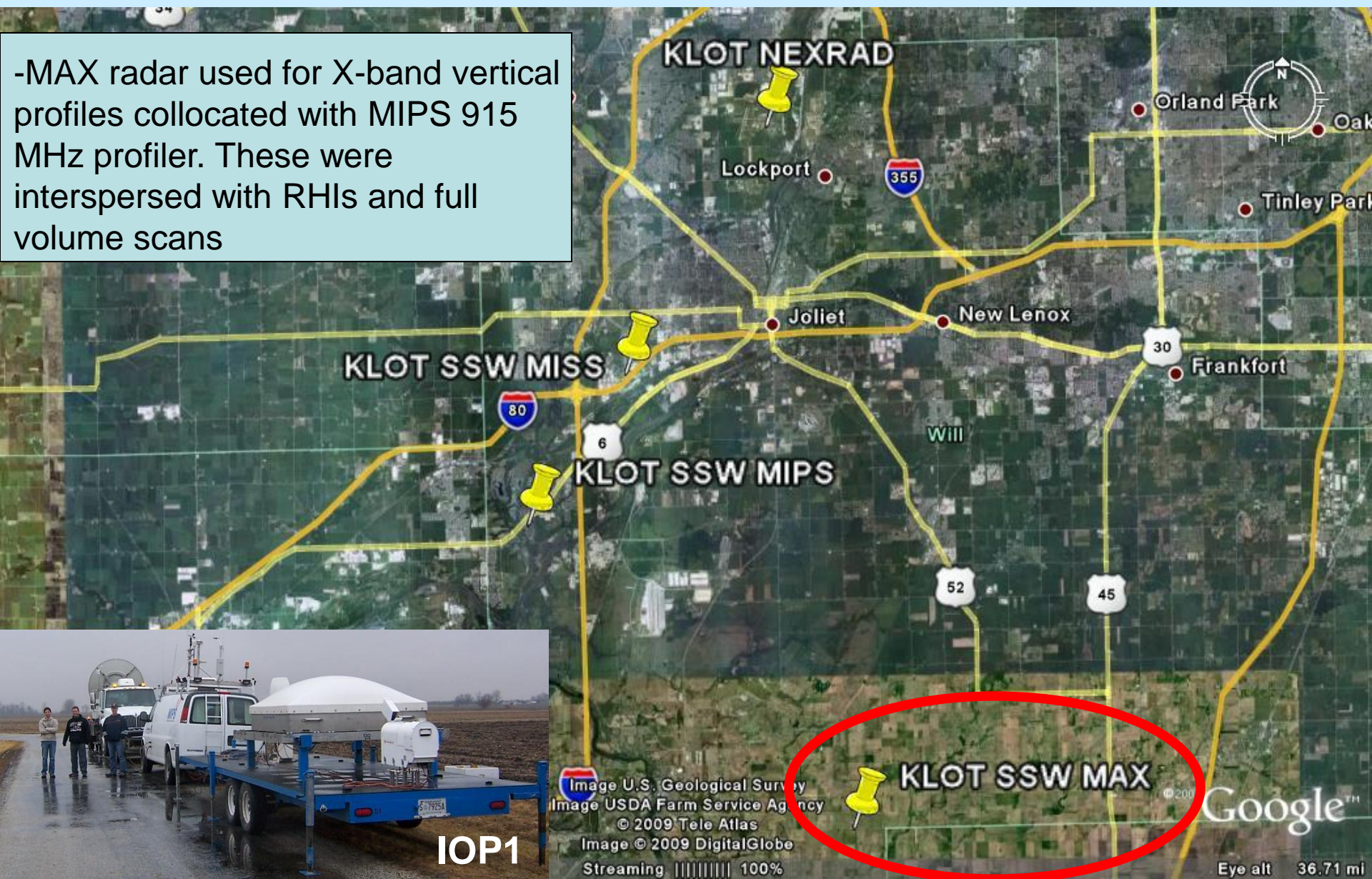
Analysis



Pre-PLOWS operations/logistics

MAX / MIPS collocated in all IOPs

-MAX radar used for X-band vertical profiles collocated with MIPS 915 MHz profiler. These were interspersed with RHIs and full volume scans



IOP1

Image U.S. Geological Survey
Image USDA Farm Service Agency
© 2009 Tele Atlas
Image © 2009 DigitalGlobe
Streaming 100%

Google™

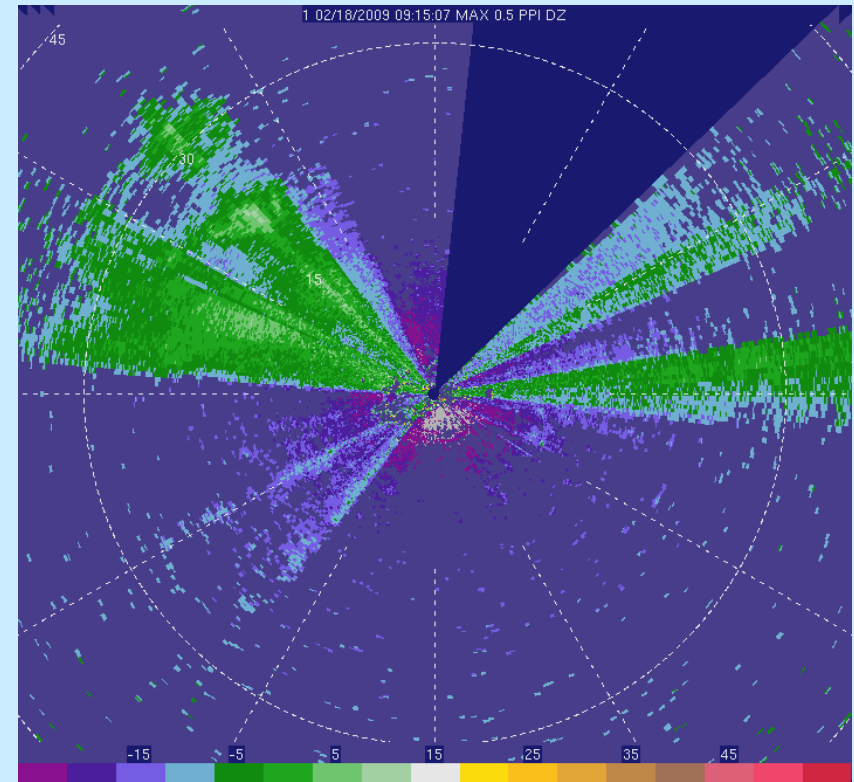
Eye alt 36.71 mi

Rawinsonde launches

- During first IOP, MISS / Univ. Missouri rawinsonde site found to have issues with line-of-sight between sonde package and receiver. Later deployments scouted for more open sites to avoid data dropout and signal issues.
- Launches in heavy rain often had issues near freezing level as water froze, slowing or bursting some balloons; decreased signal strength noted in heavy rain
- Launches needed many more crewmembers than originally planned due to strong winds in relatively open launch sites (e.g., IOP5), reducing the rest periods for the crew
- Source for replenishing helium supplies?

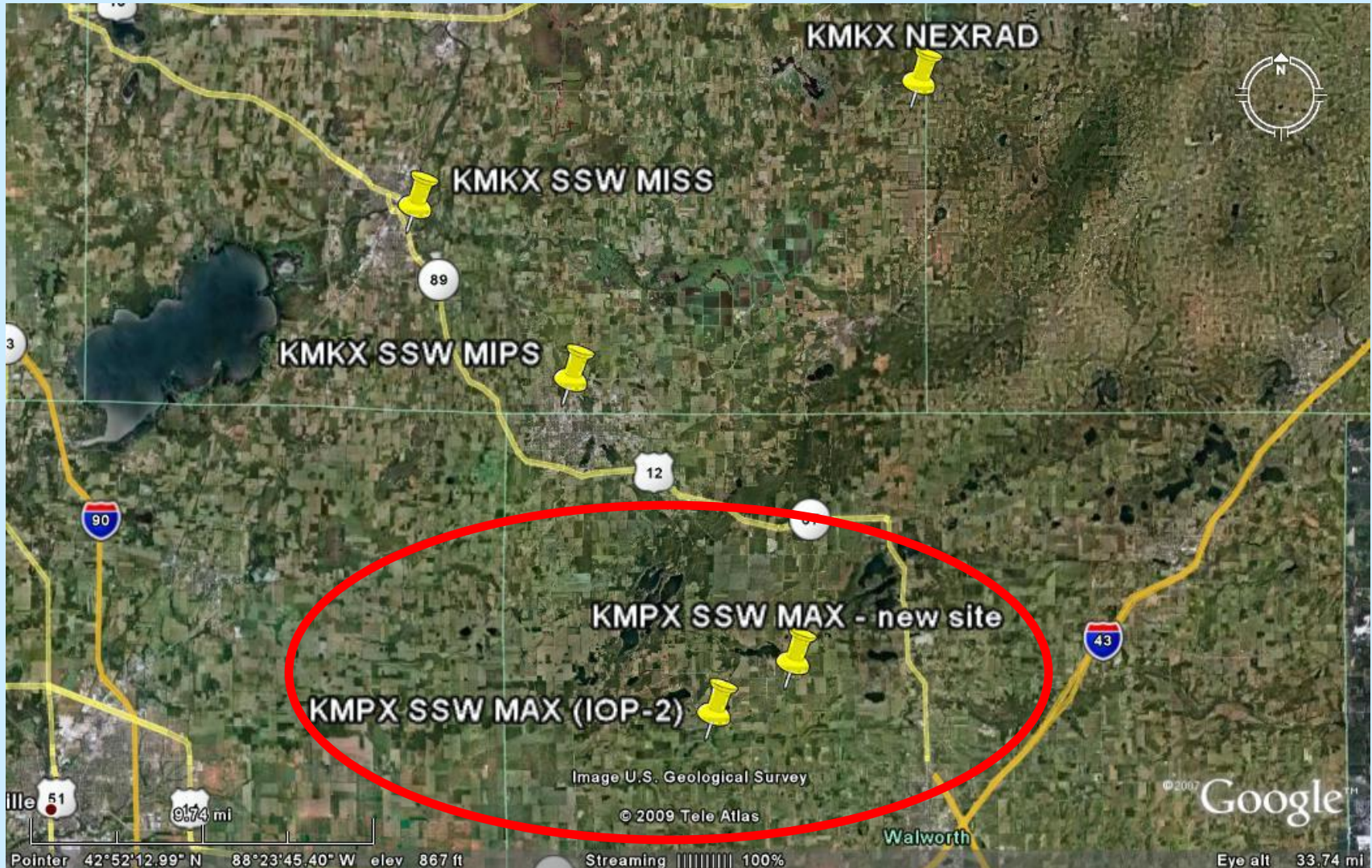
Site issues - KMKX

- MAX / MIPS site in IOP2 set in depression; blockage in MAX's lowest two elevation angles
- Scouted another MAX / MIPS site as a possibility for future KMKX deployments



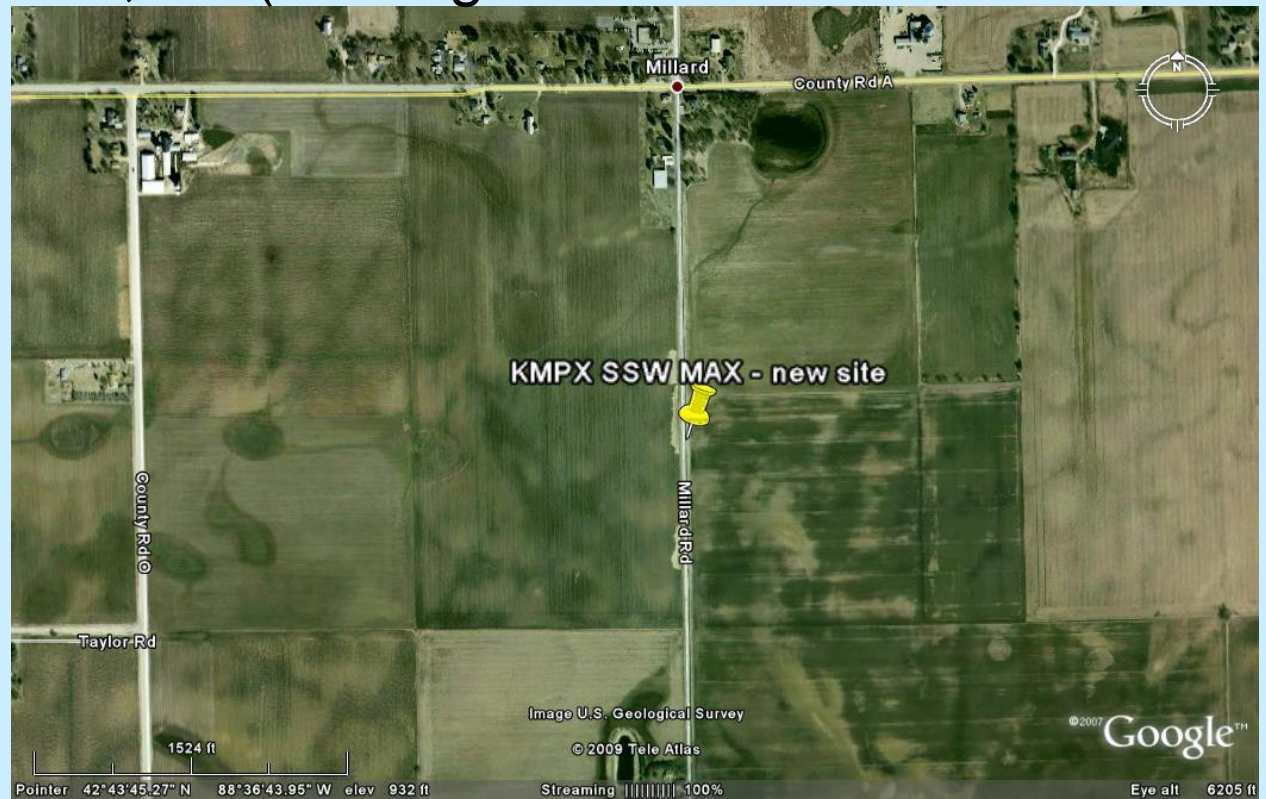
Site issues - KMKX

- New possibility for MAX / MIPS site ([Link to 360 view](#))

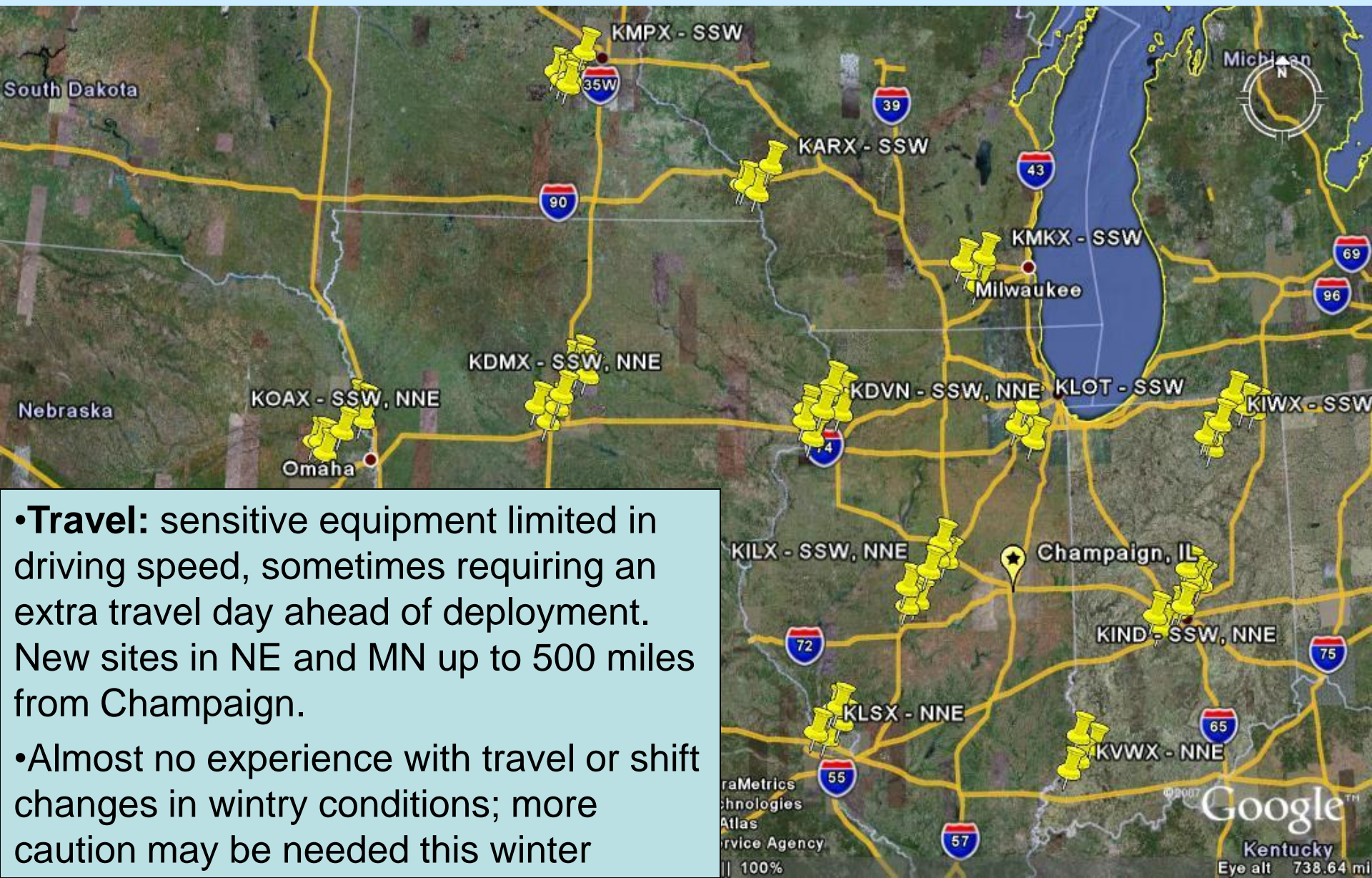


Site issues - KMKX

- New possibility for MAX / MIPS site ([Link to 360 view](#))
- Pros: relatively close to original site but with much less blockage; wider, paved road with vegetated shoulders rather than pure dirt
- Cons: close to Millard, WI (although not much traffic observed)

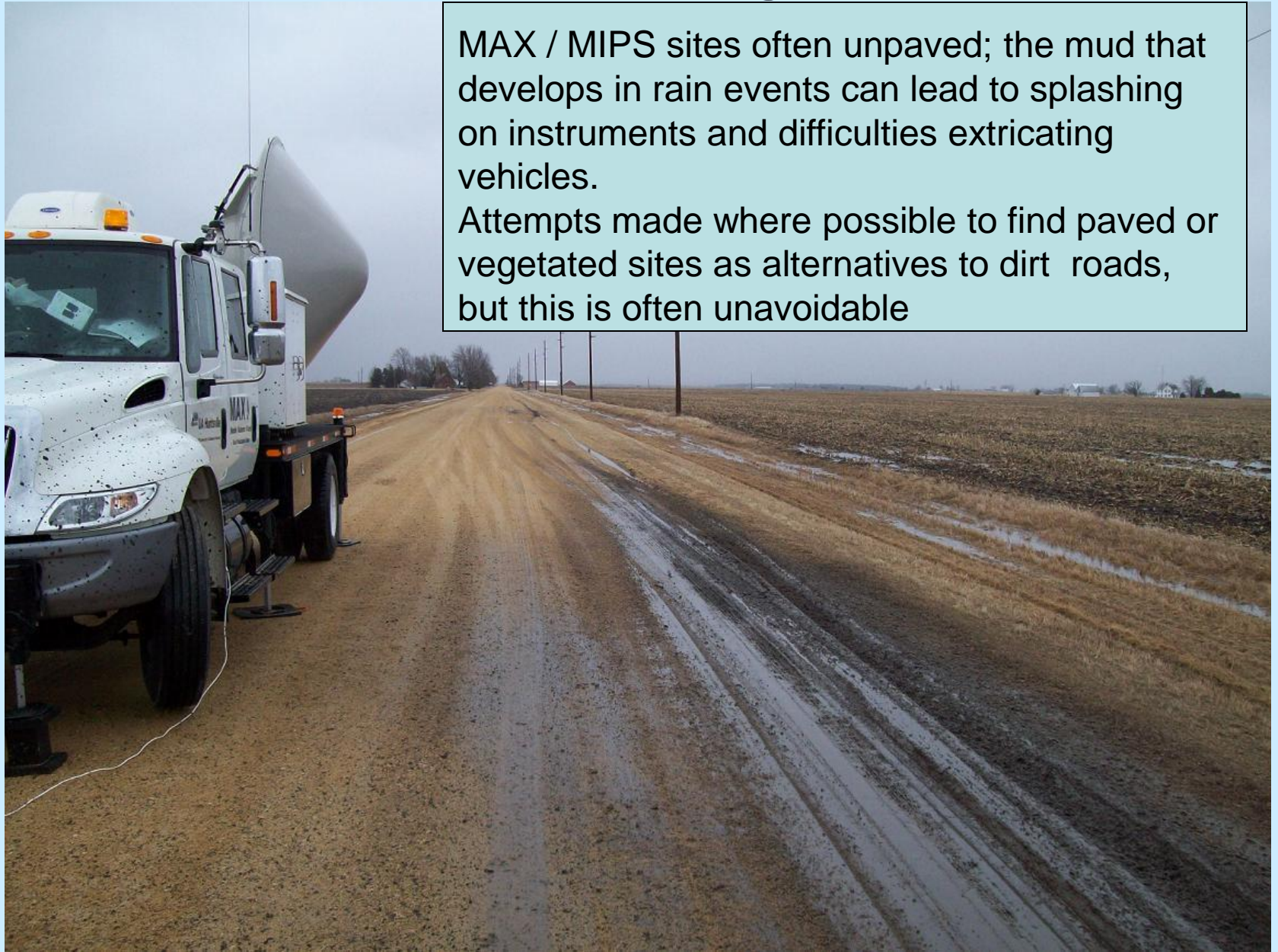


Site issues - general



- **Travel:** sensitive equipment limited in driving speed, sometimes requiring an extra travel day ahead of deployment. New sites in NE and MN up to 500 miles from Champaign.
- Almost no experience with travel or shift changes in wintry conditions; more caution may be needed this winter

Site issues - general



MAX / MIPS sites often unpaved; the mud that develops in rain events can lead to splashing on instruments and difficulties extricating vehicles.

Attempts made where possible to find paved or vegetated sites as alternatives to dirt roads, but this is often unavoidable

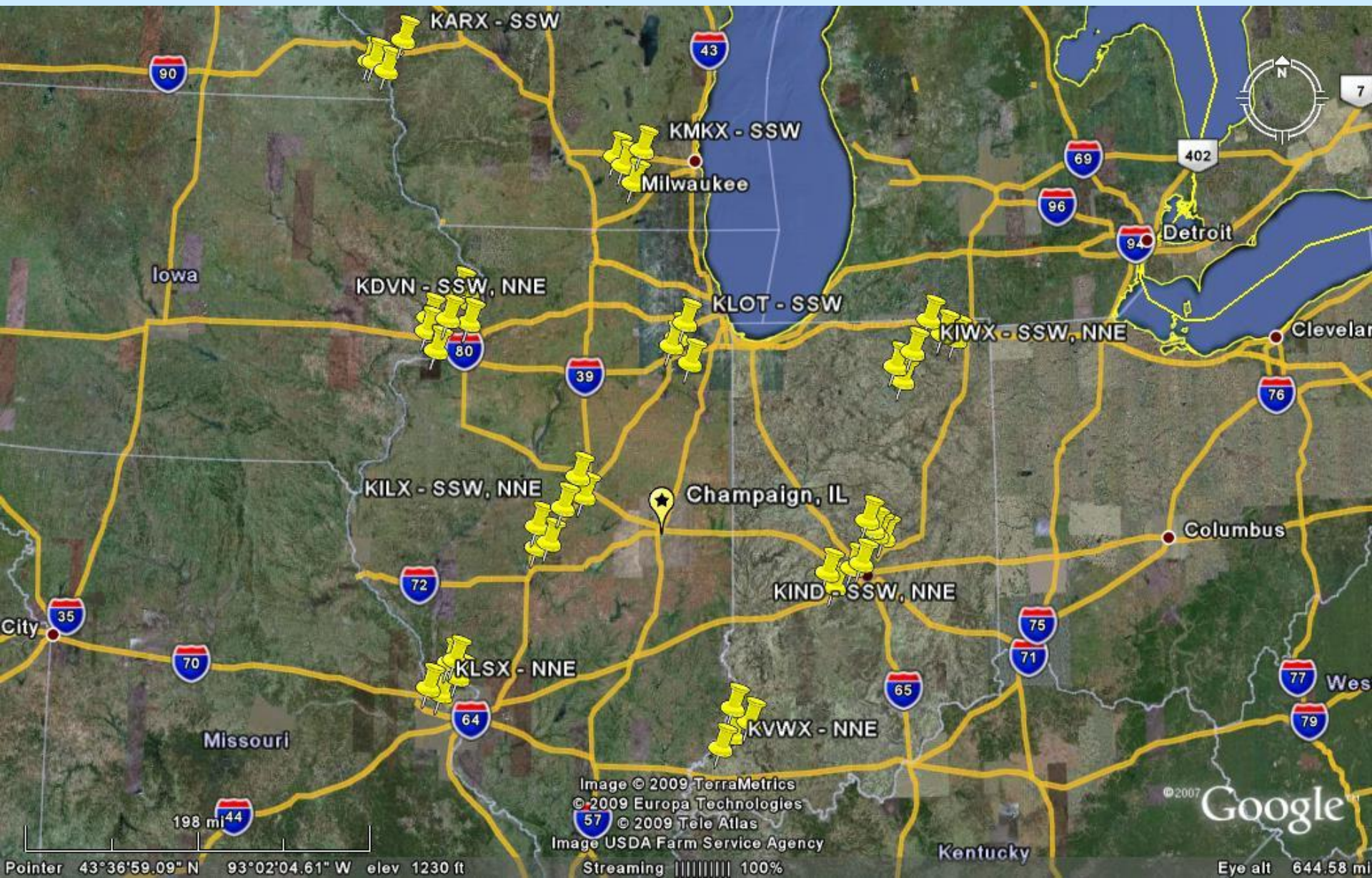
Site issues - general



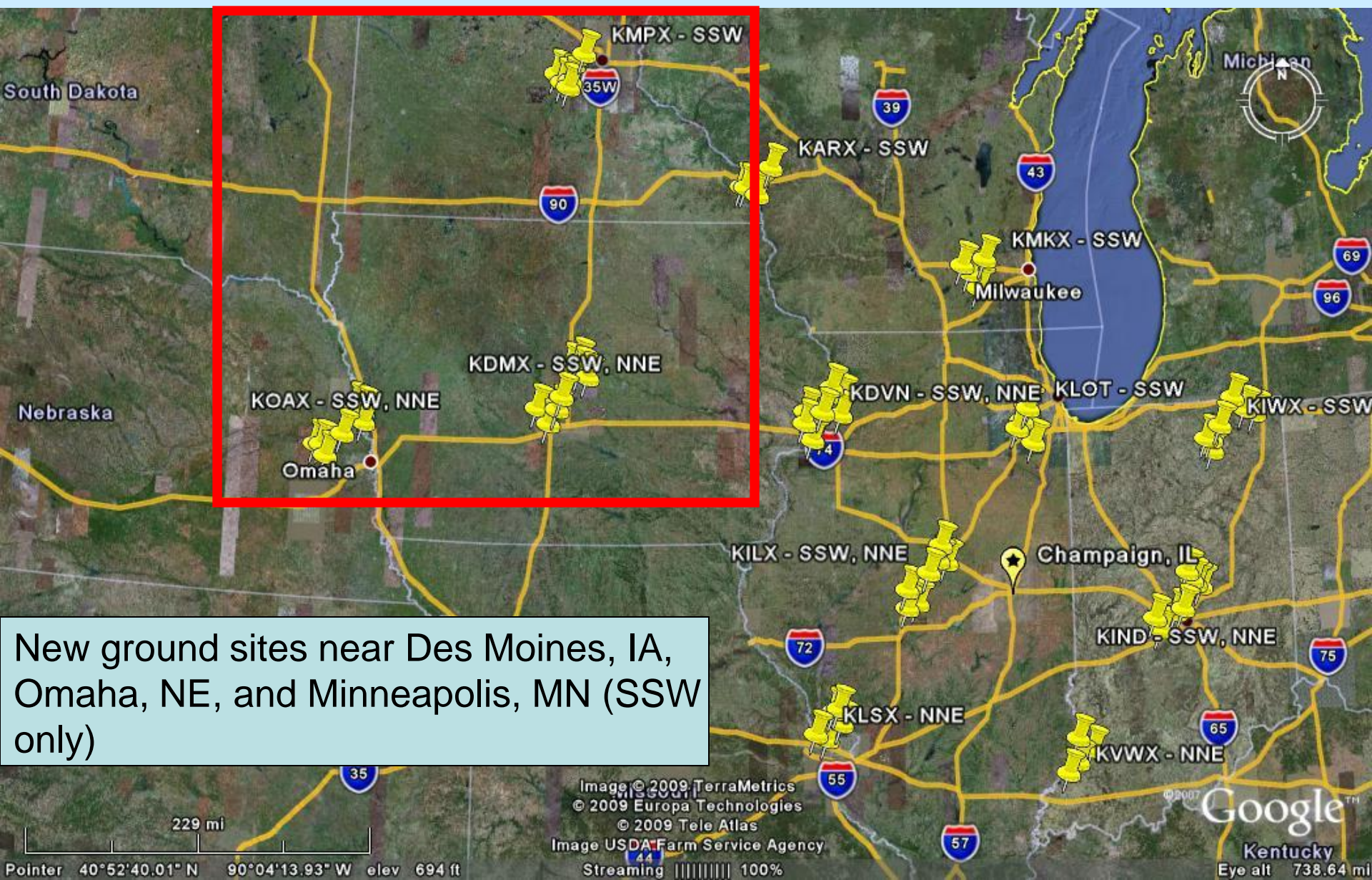
Some beam blockage is unavoidable, particularly with powerlines present along many roads. Where possible, sites have been chosen such that blockage is in less critical directions.

New ground sites for 2009/10

Pre-PLOWS sites

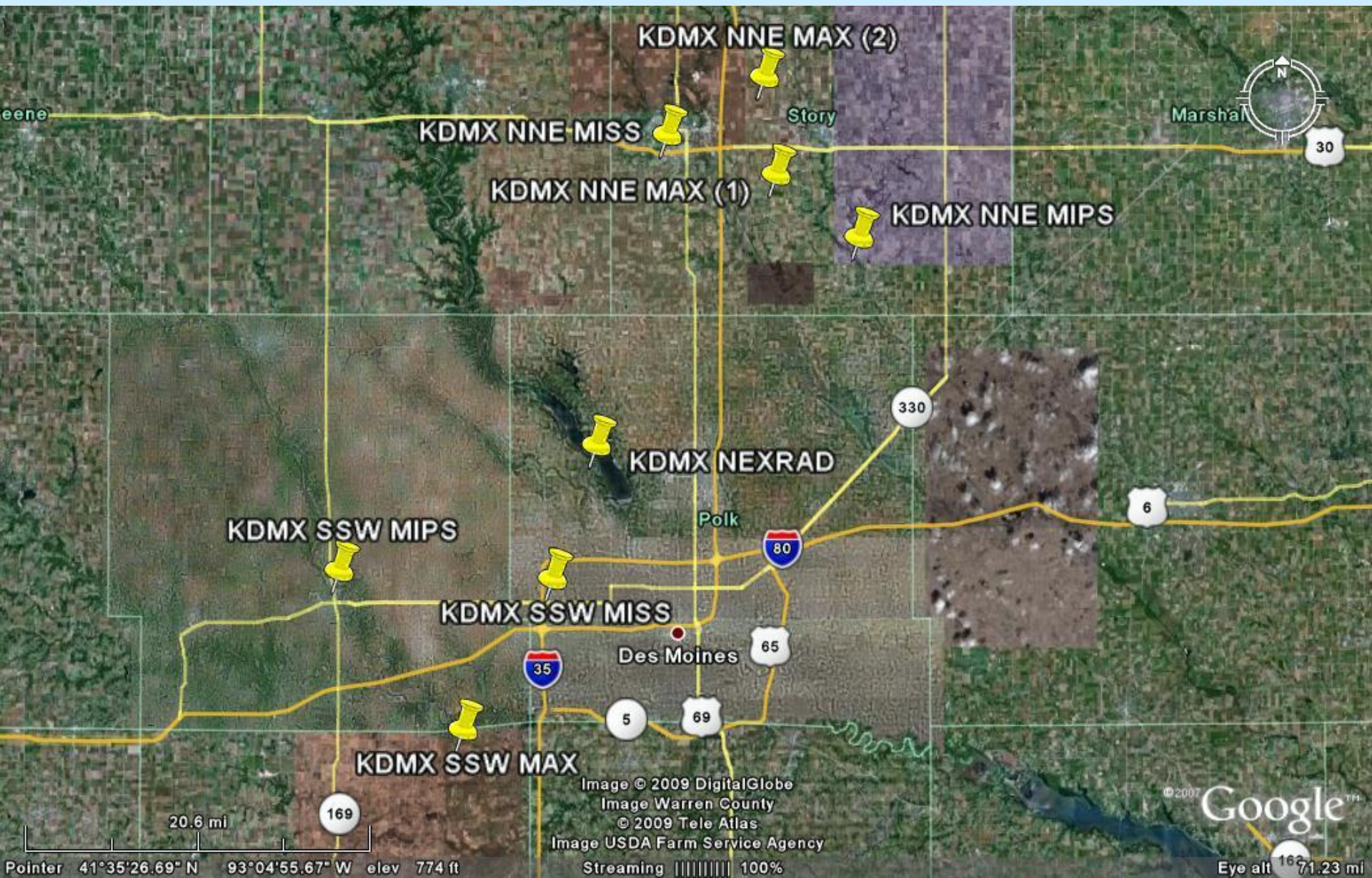


New ground sites for 2009/10



New ground sites near Des Moines, IA, Omaha, NE, and Minneapolis, MN (SSW only)

Des Moines, IA (KDMX)

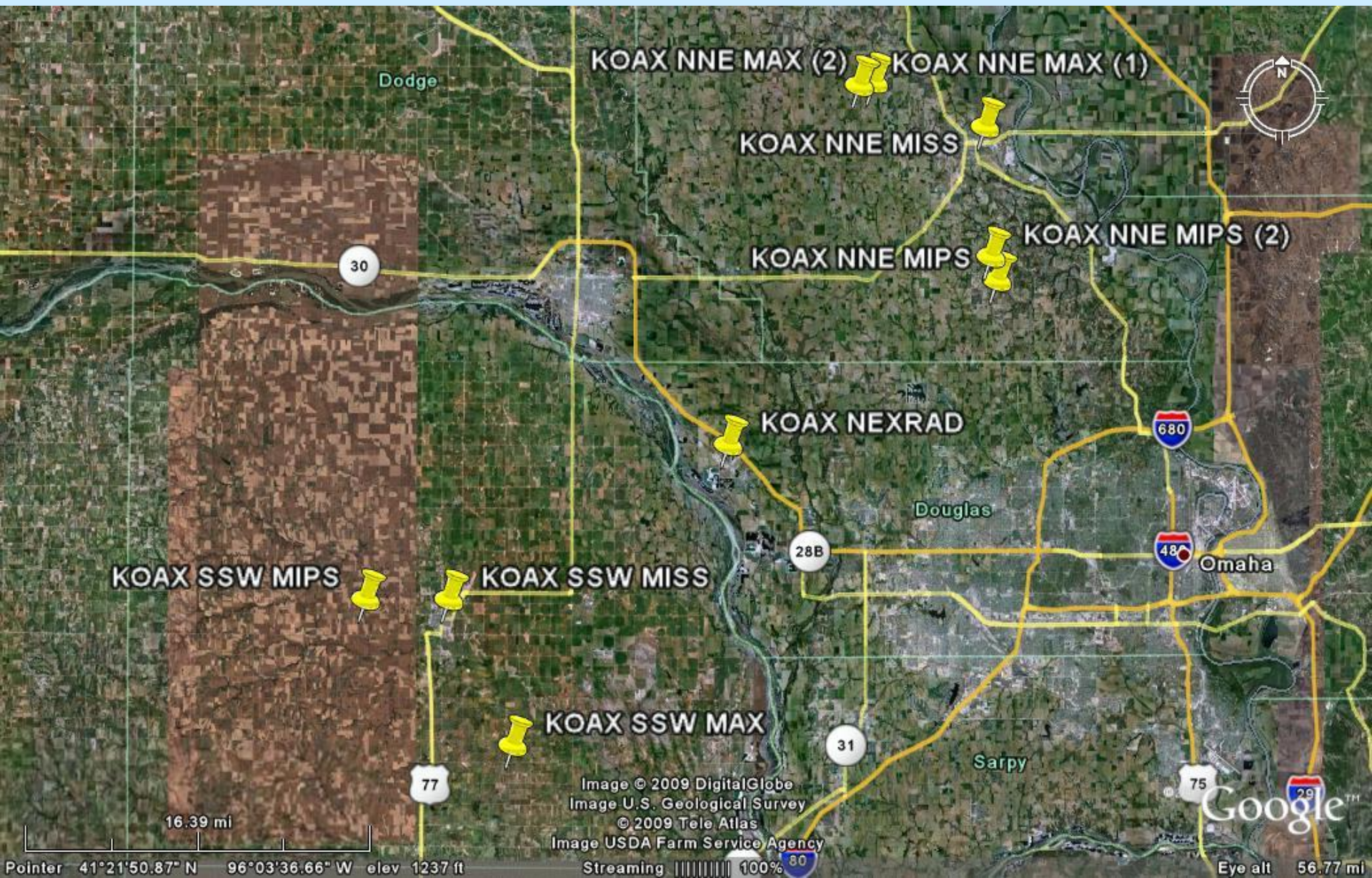


Des Moines, IA (KDMX)

- **Link to [NNE sites](#)**
- MAX: two possibilities, both along E-W dirt/gravel roads. First choice has slightly more trees along horizon, but no powerlines.
- MIPS: along small road with trees and fields; no heavily-trafficked roads in view
- MISS: hotel parking lot, balance between blockage for profiler and line-of-sight for rawinsondes

- **Link to [SSW sites](#)**
- MAX: along very open N-S dirt/gravel road, powerlines are the only issue
- MIPS: choice of several community lots in Riverside Park, Adel, IA
- MISS: hotel parking lot, only site in area with usable line-of-sight for rawindonde launches

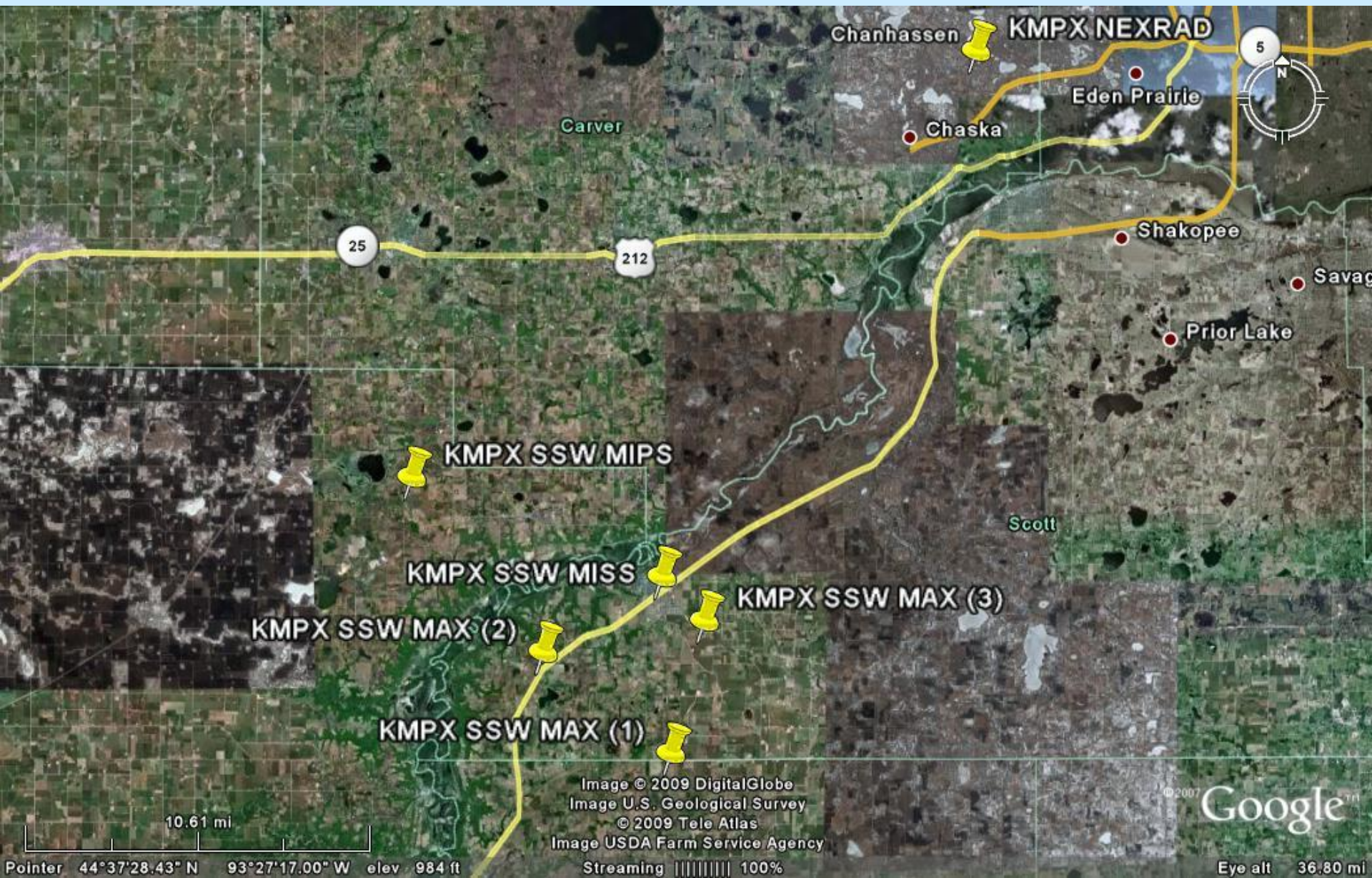
Omaha, NE (KOAX)



Omaha, NE (KOAX)

- **Link to [NNE sites](#)**
- MAX: two possibilities near one another, both on dirt/gravel in open farmland, although second choice again has powerlines
- MIPS: best site is in tree farm (contact before deployments), should have good blockage to sides. Alternate site is gated lot, which may not be usable.
- MISS: motel lot, should be usable; no good alternatives nearby
- **Link to [SSW sites](#)**
- MAX: on N-S dirt/gravel road, powerlines on east side
- MIPS: out on N-S gravel road, no good alternative sites
- MISS: open lot near motel; again, no usable alternative sites nearby

Minneapolis, MN (KMPX)



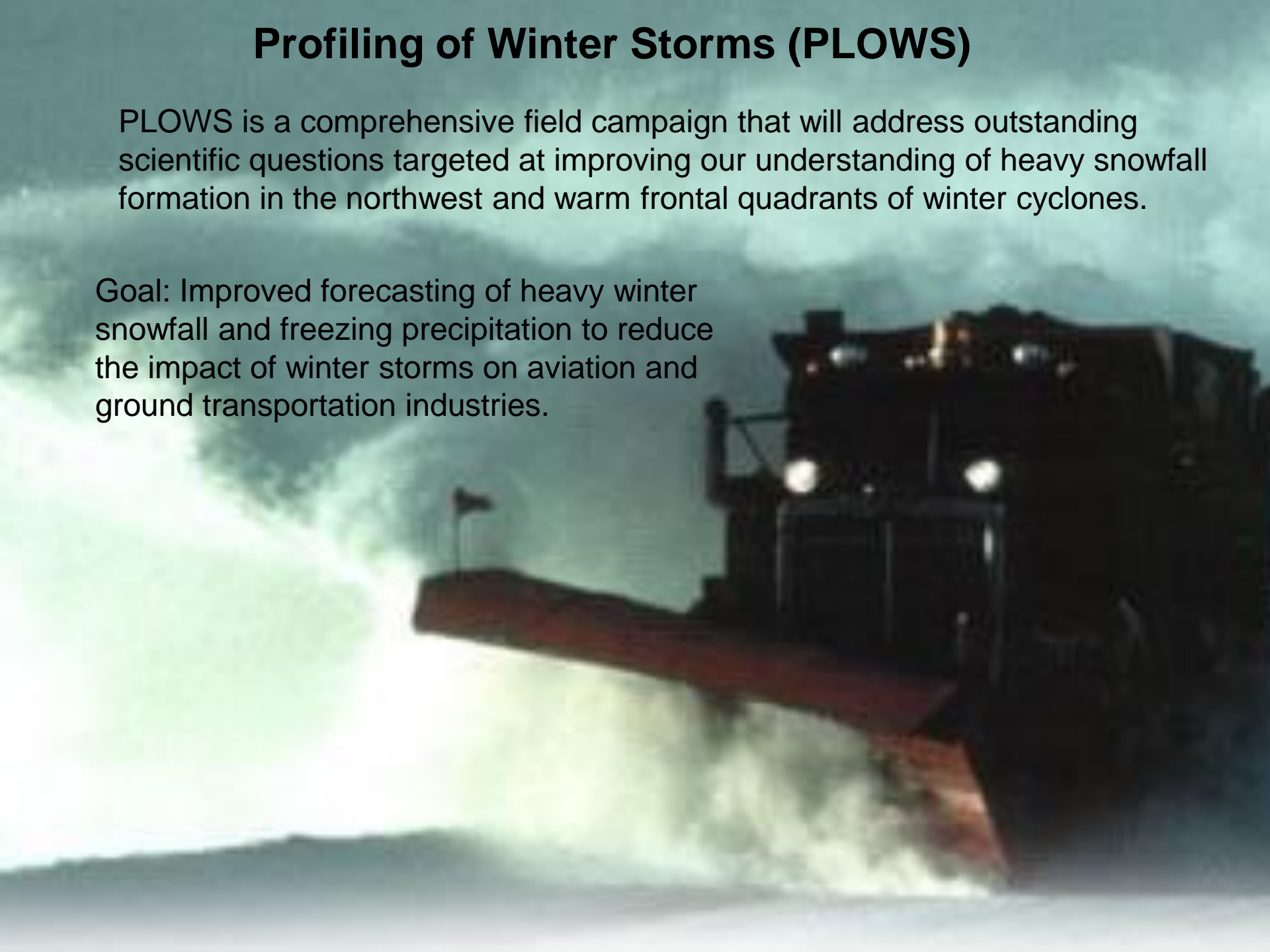
Minneapolis, MN (KMPX)

- **SSW only, [link to sites](#)**
- MAX: best site is on open dirt/gravel road, only concern is if ground will become too soft in rain event for equipment setup. Two alternate sites found, one paved but near interstate, and one on harder gravel but with more blockage.
- MIPS: at rural T-intersection, away from significant traffic.
- MISS: hotel parking lot, closer than ideal to traffic, but should be usable. Best of the local possibilities.

Profiling of Winter Storms (PLOWs)

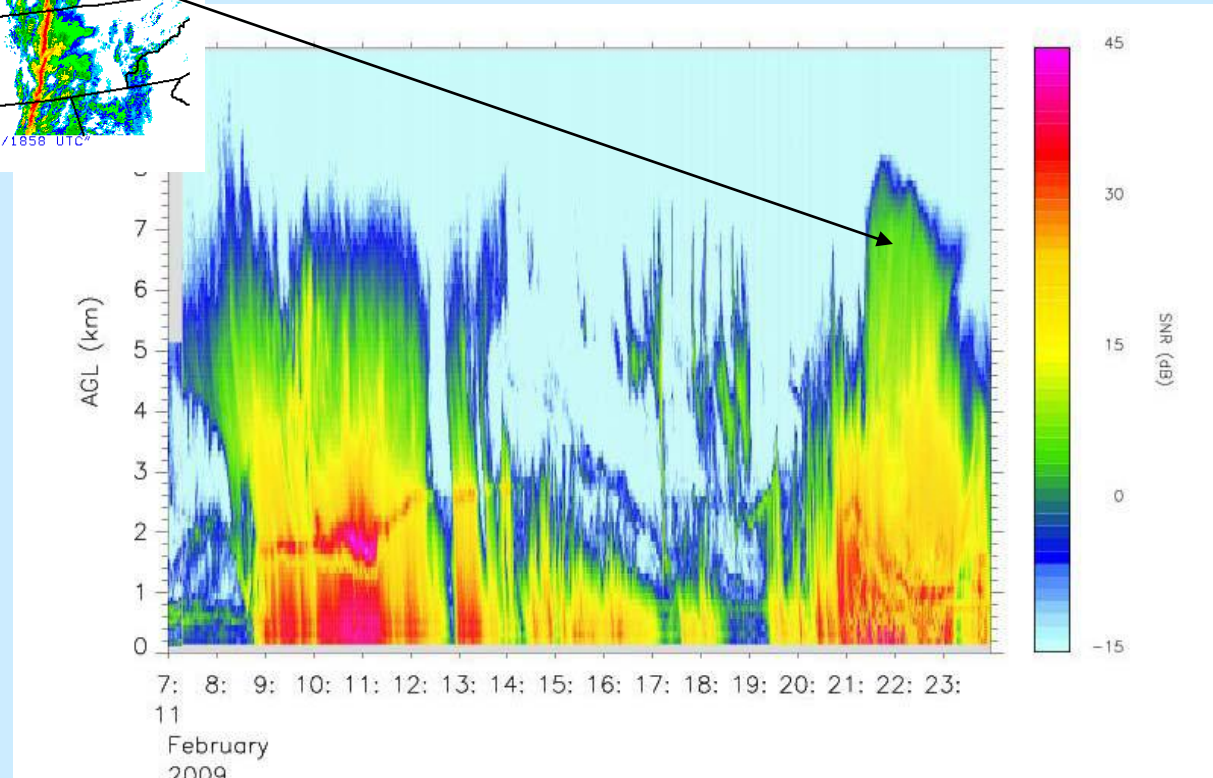
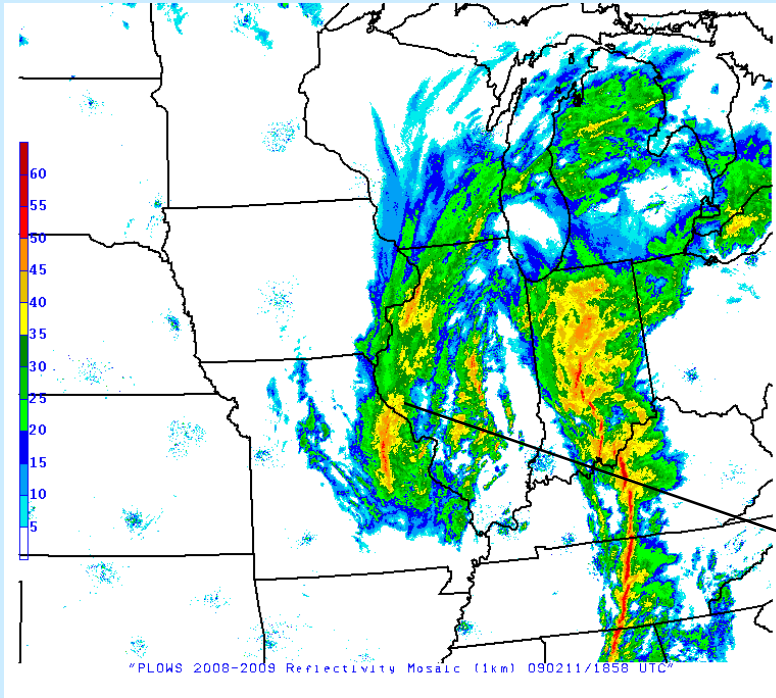
PLOWs is a comprehensive field campaign that will address outstanding scientific questions targeted at improving our understanding of heavy snowfall formation in the northwest and warm frontal quadrants of winter cyclones.

Goal: Improved forecasting of heavy winter snowfall and freezing precipitation to reduce the impact of winter storms on aviation and ground transportation industries.



PLOWS Research focus:

Understand the forcing mechanisms for Heavy snowfall produced by deep banded features (high reflectivity regions) within cyclones



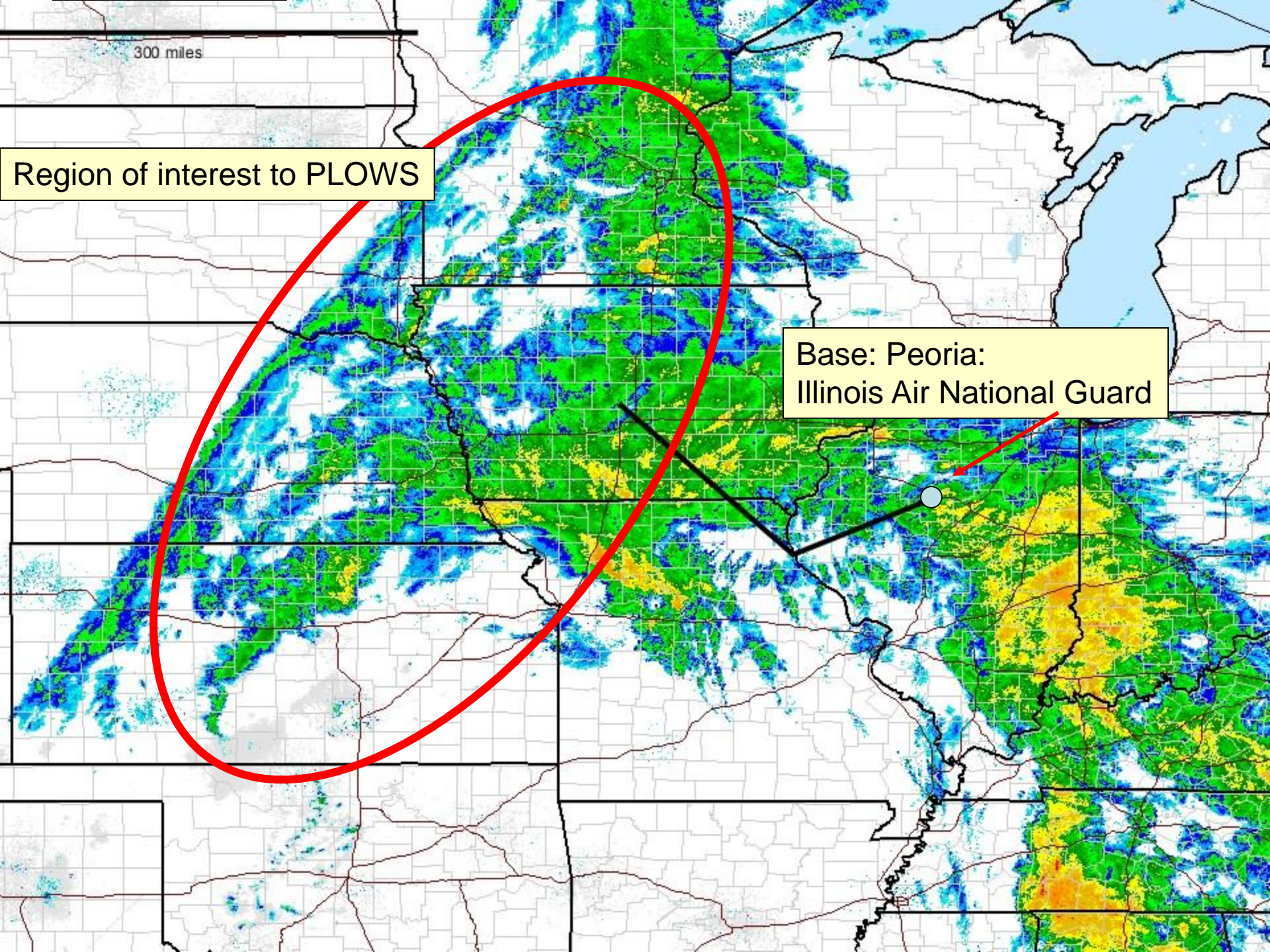
Typical flight in a winter cyclone



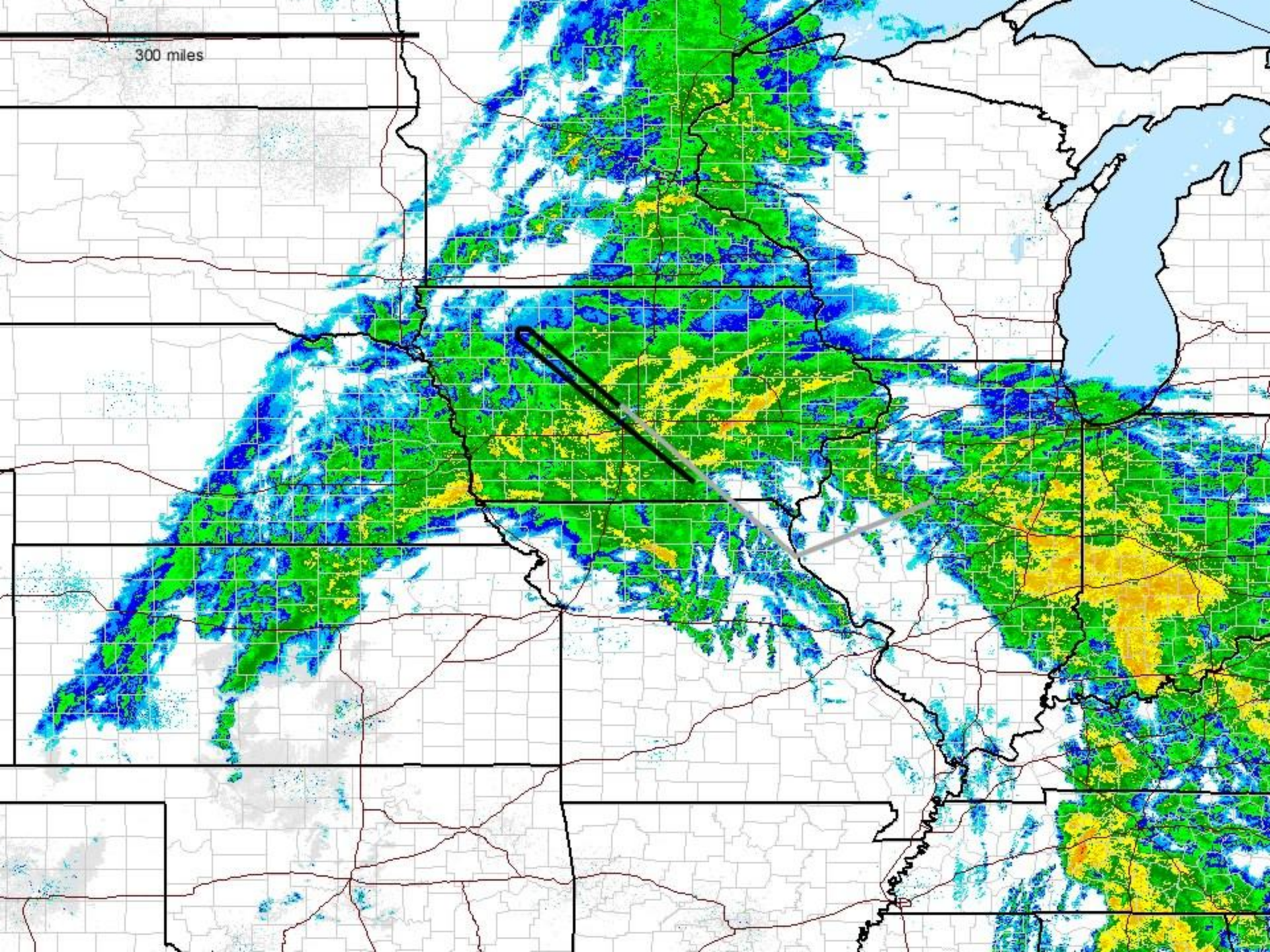
300 miles

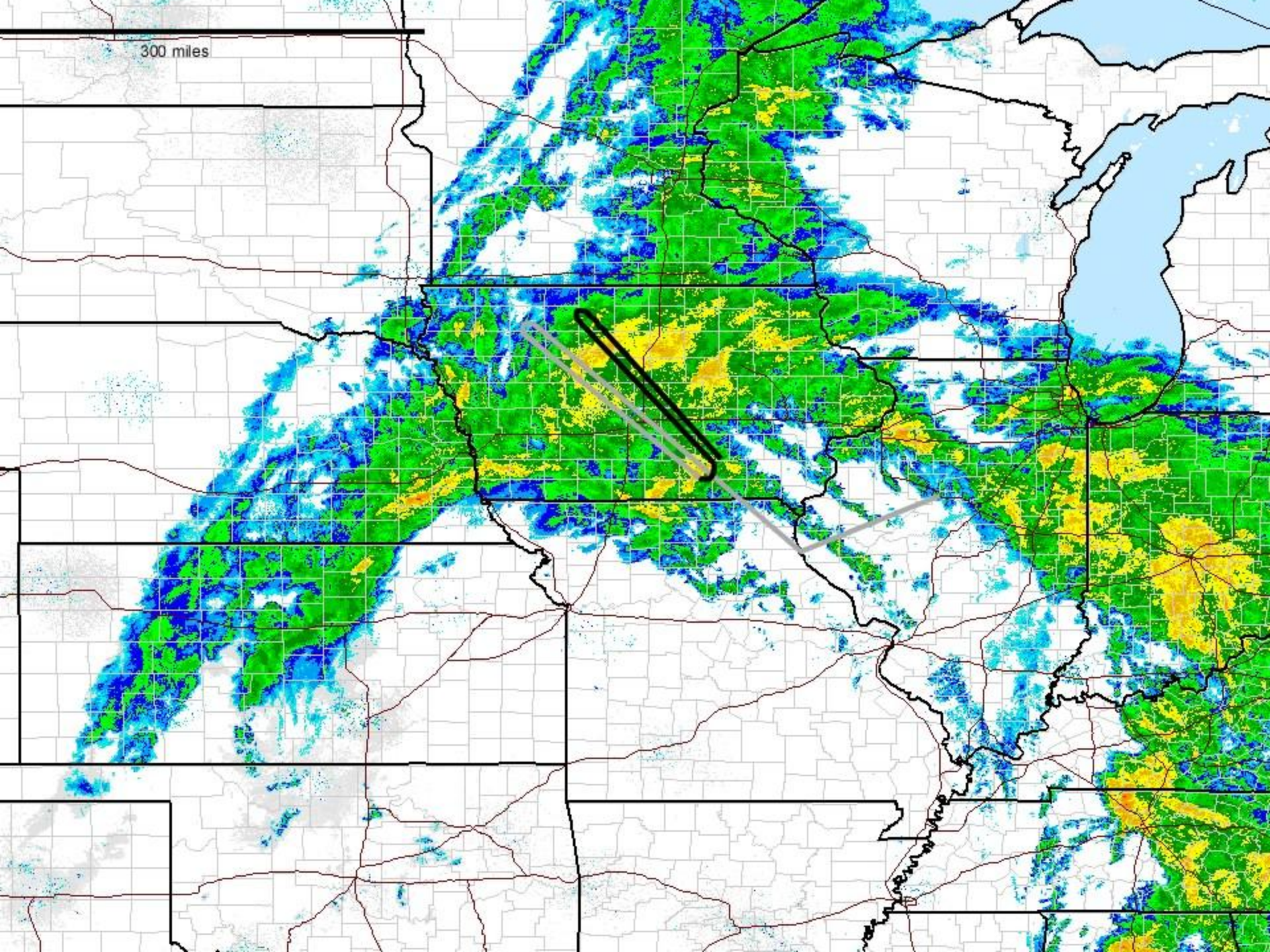
Region of interest to PLOWS

Base: Peoria:
Illinois Air National Guard

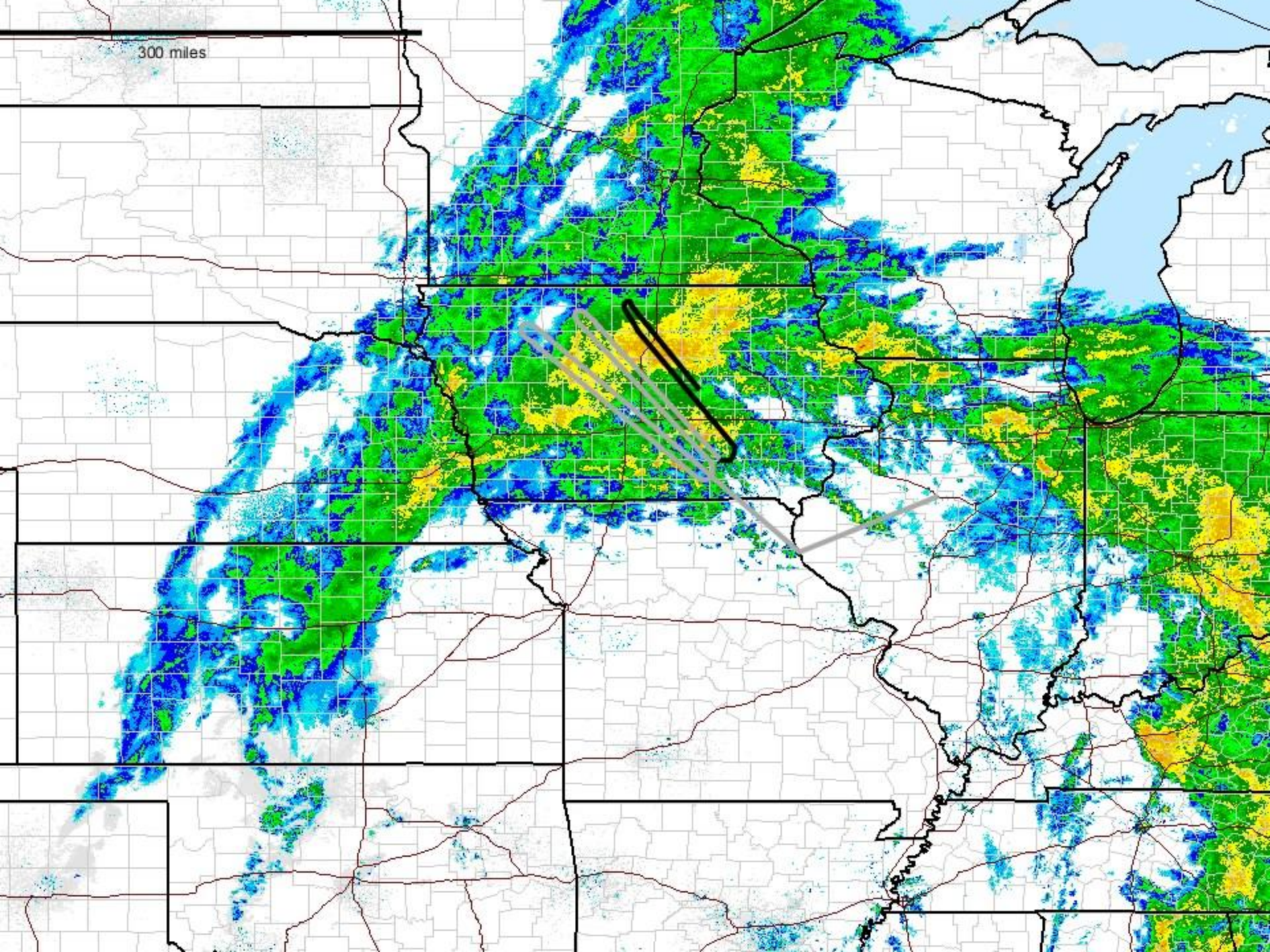


300 miles

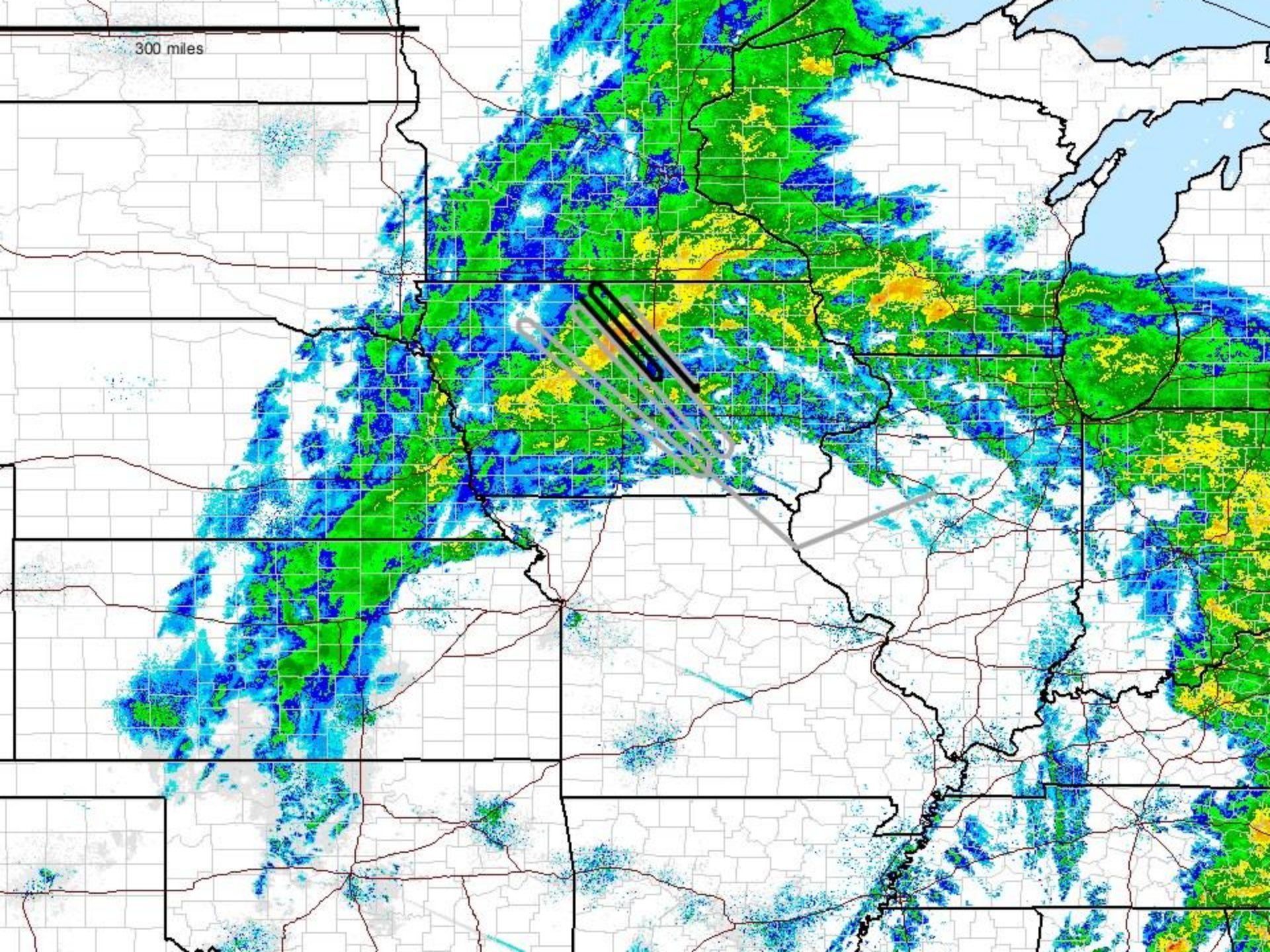




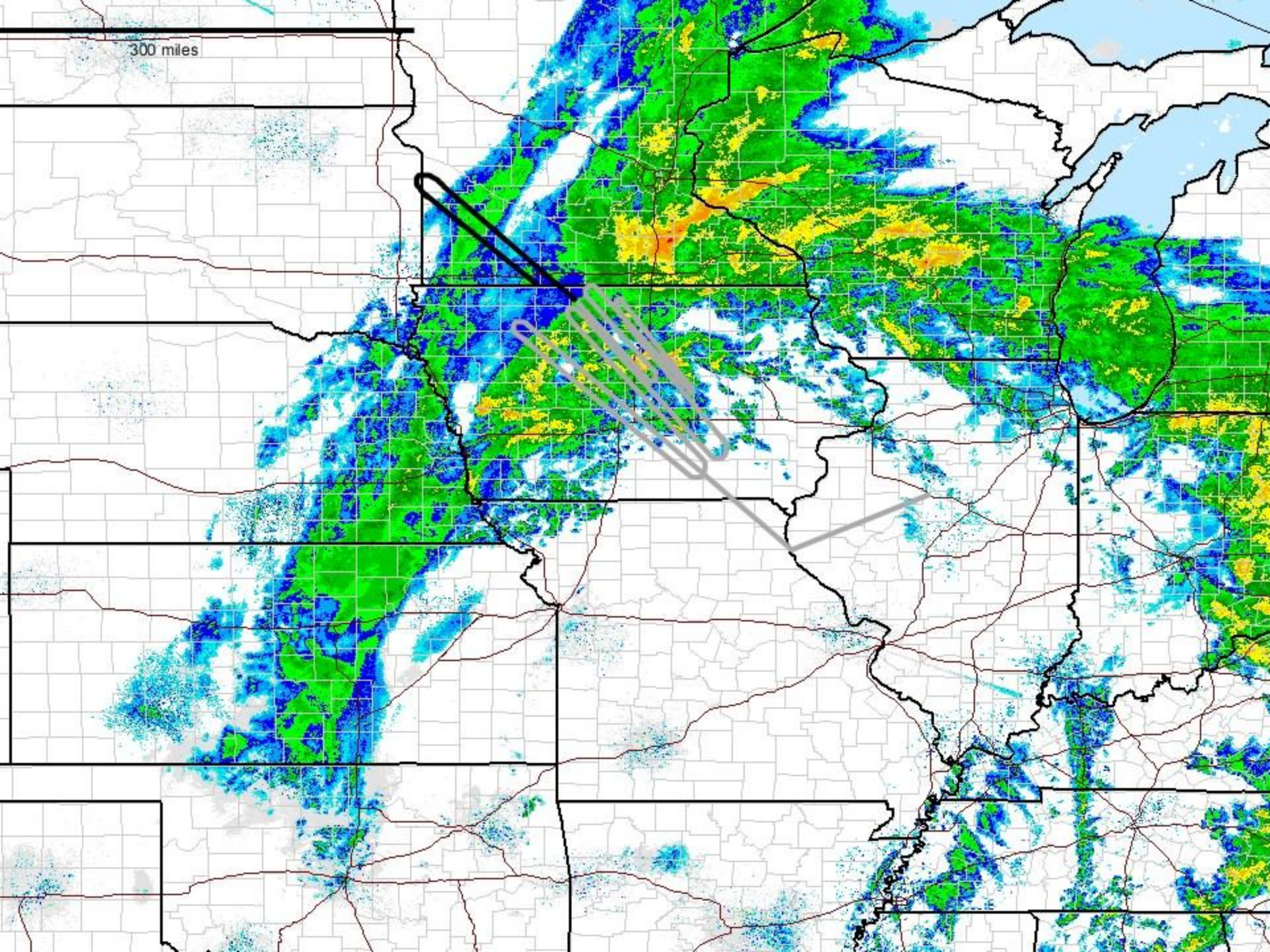
300 miles



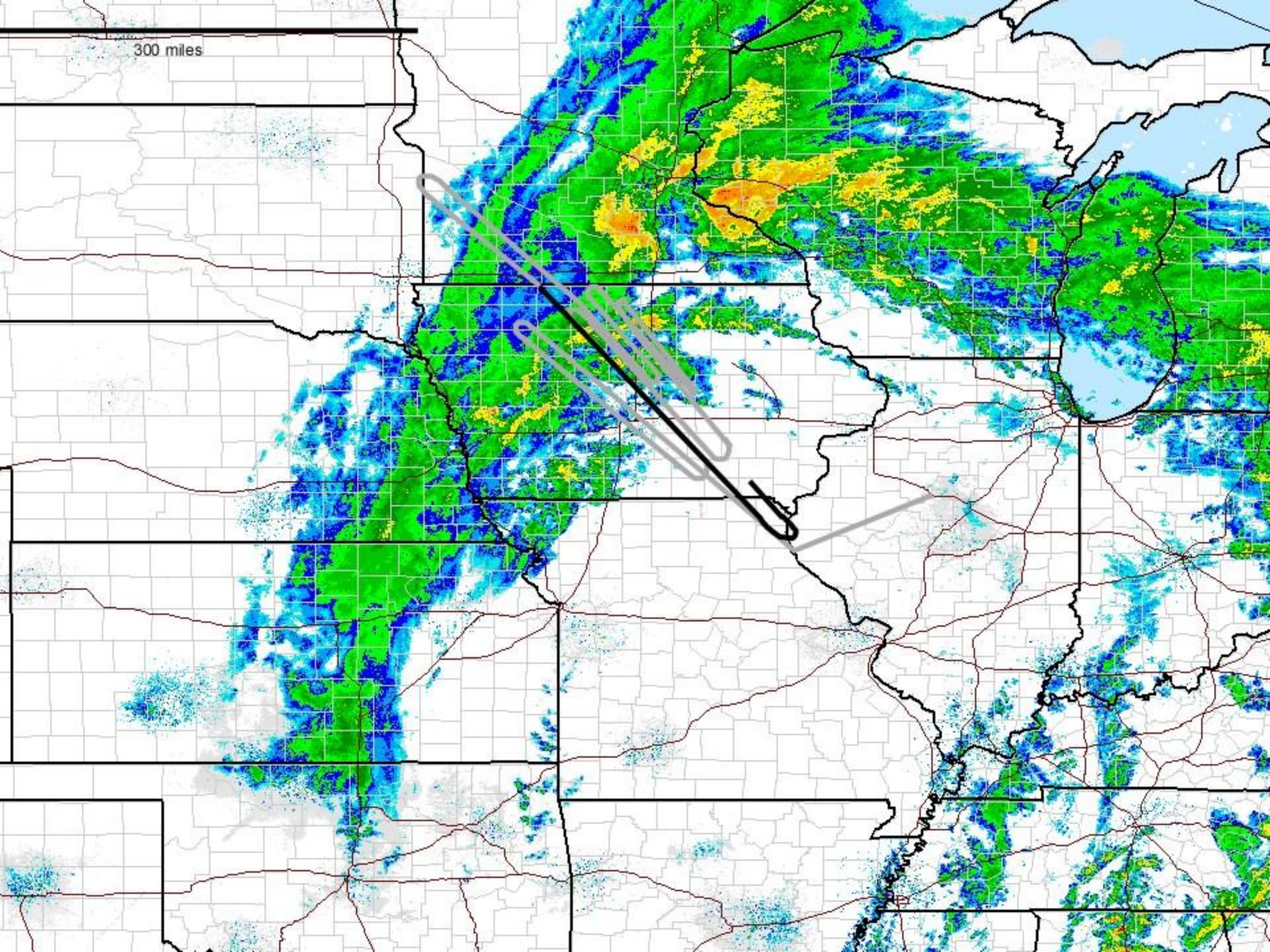
300 miles



300 miles

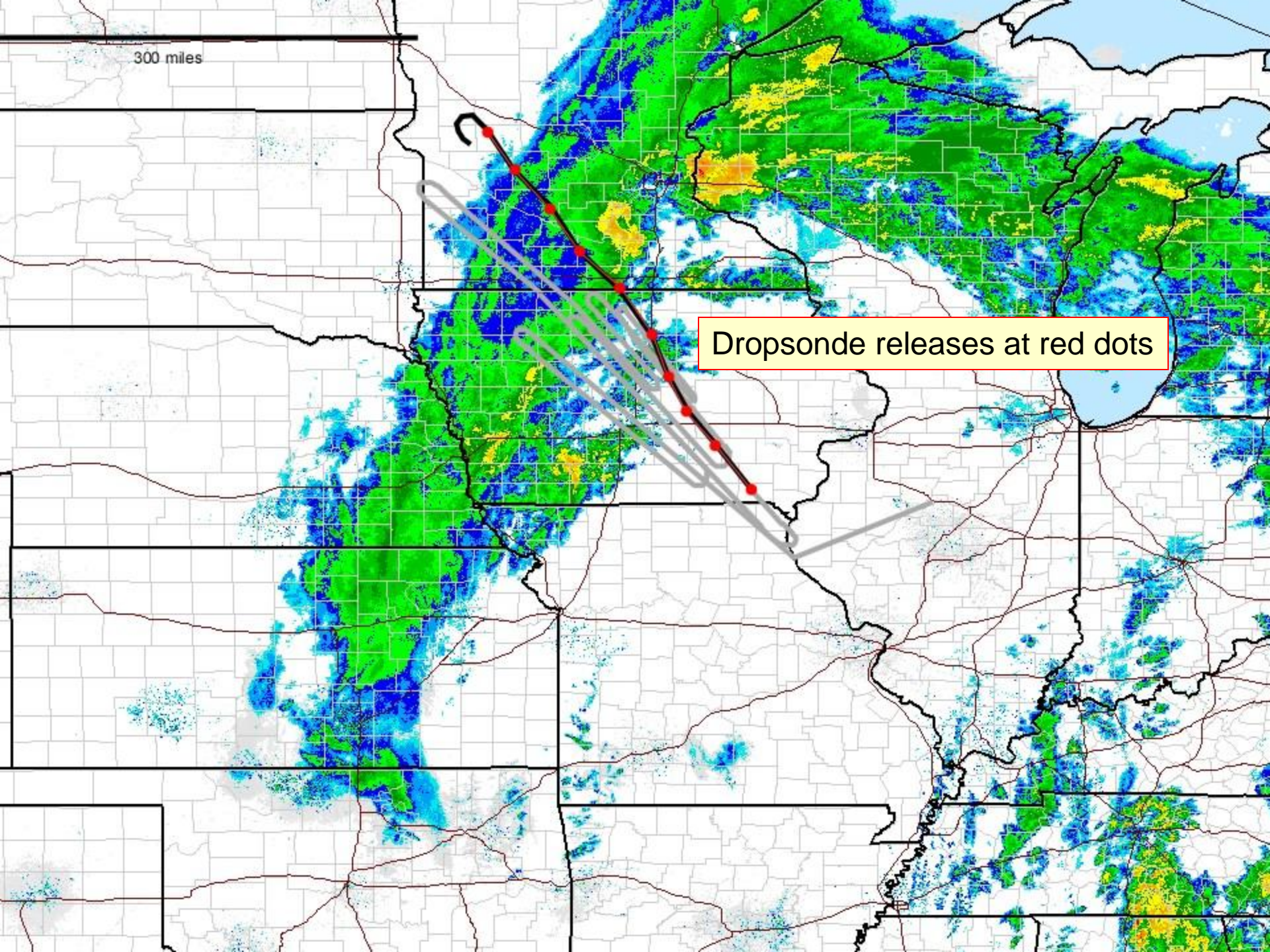


300 miles



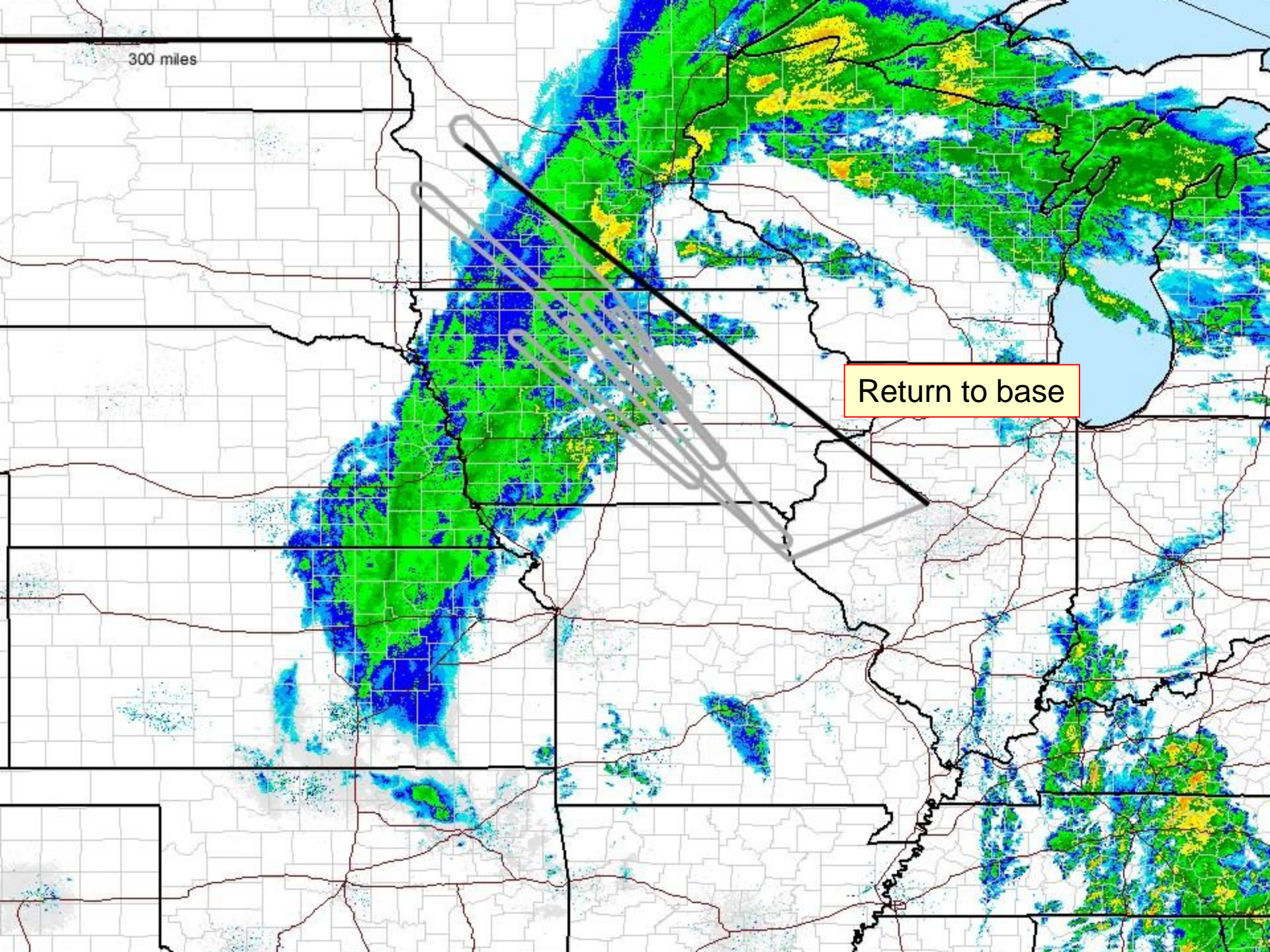
300 miles

Dropsonde releases at red dots

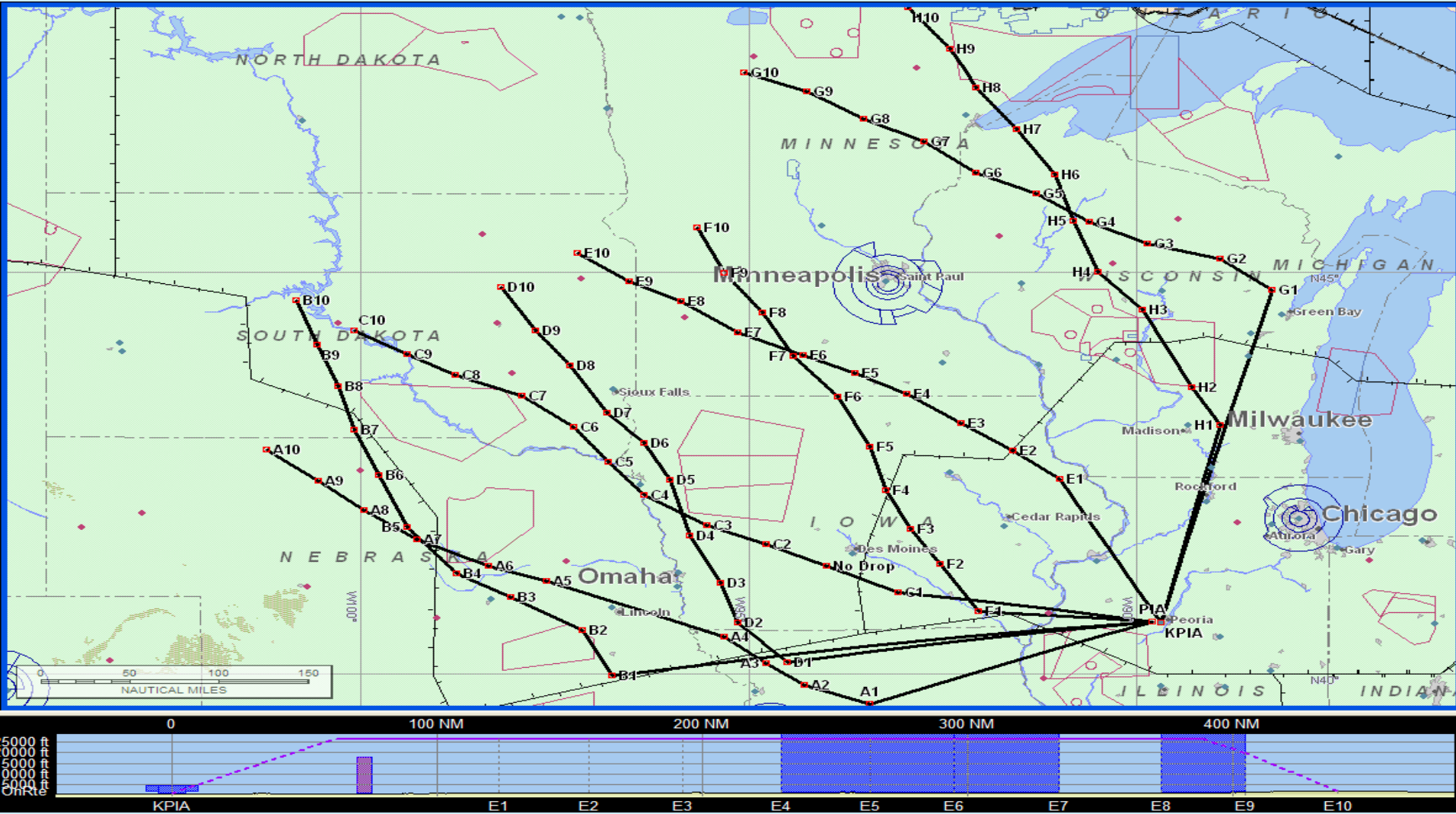


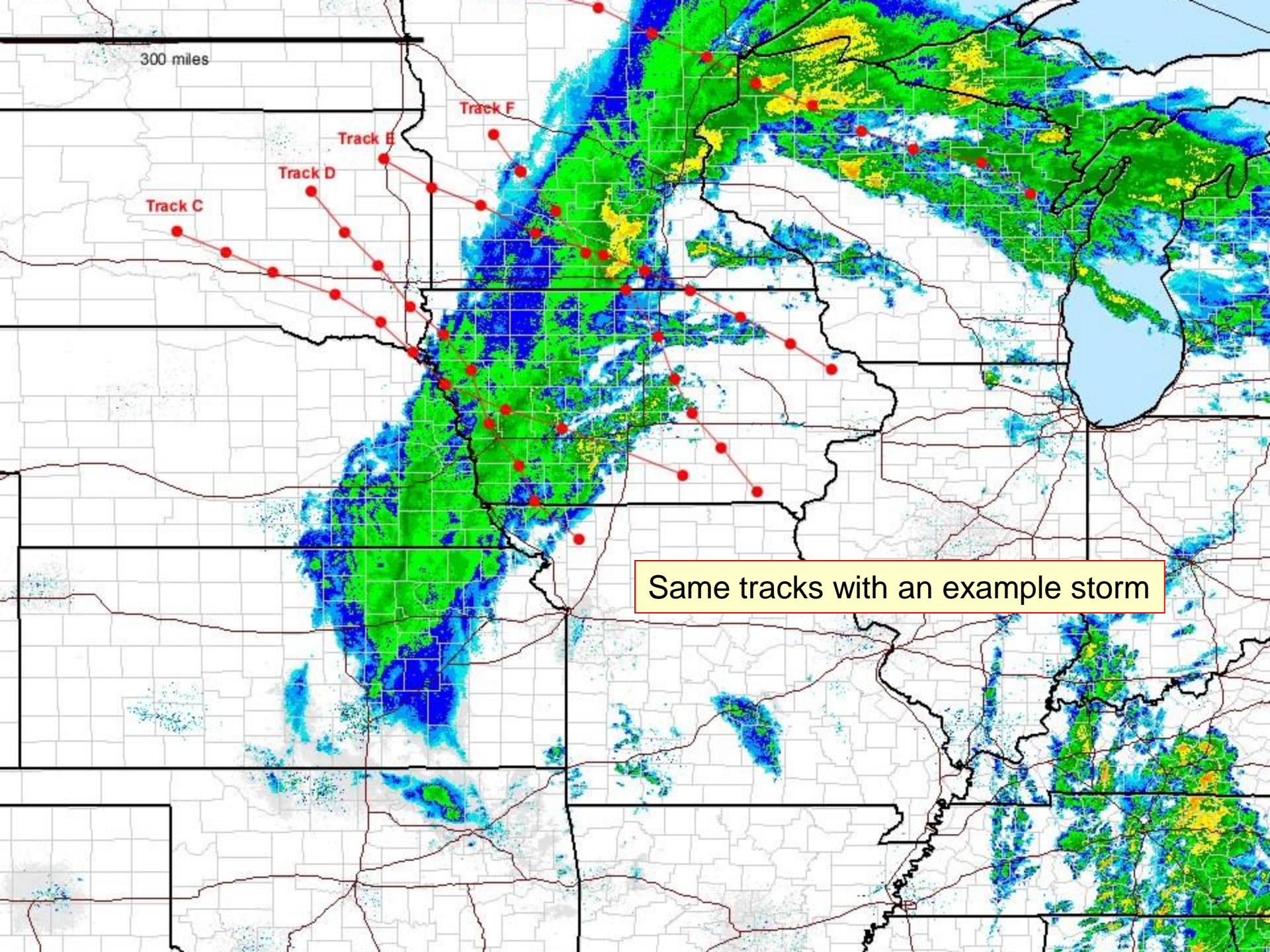
300 miles

Return to base



Potential Dropsonde release tracks in different storms





300 miles

Track C

Track D

Track E

Track F

Same tracks with an example storm

