WRF Simulation of Lake-effect Snowstorms
OWLES Meeting June 24, 2013

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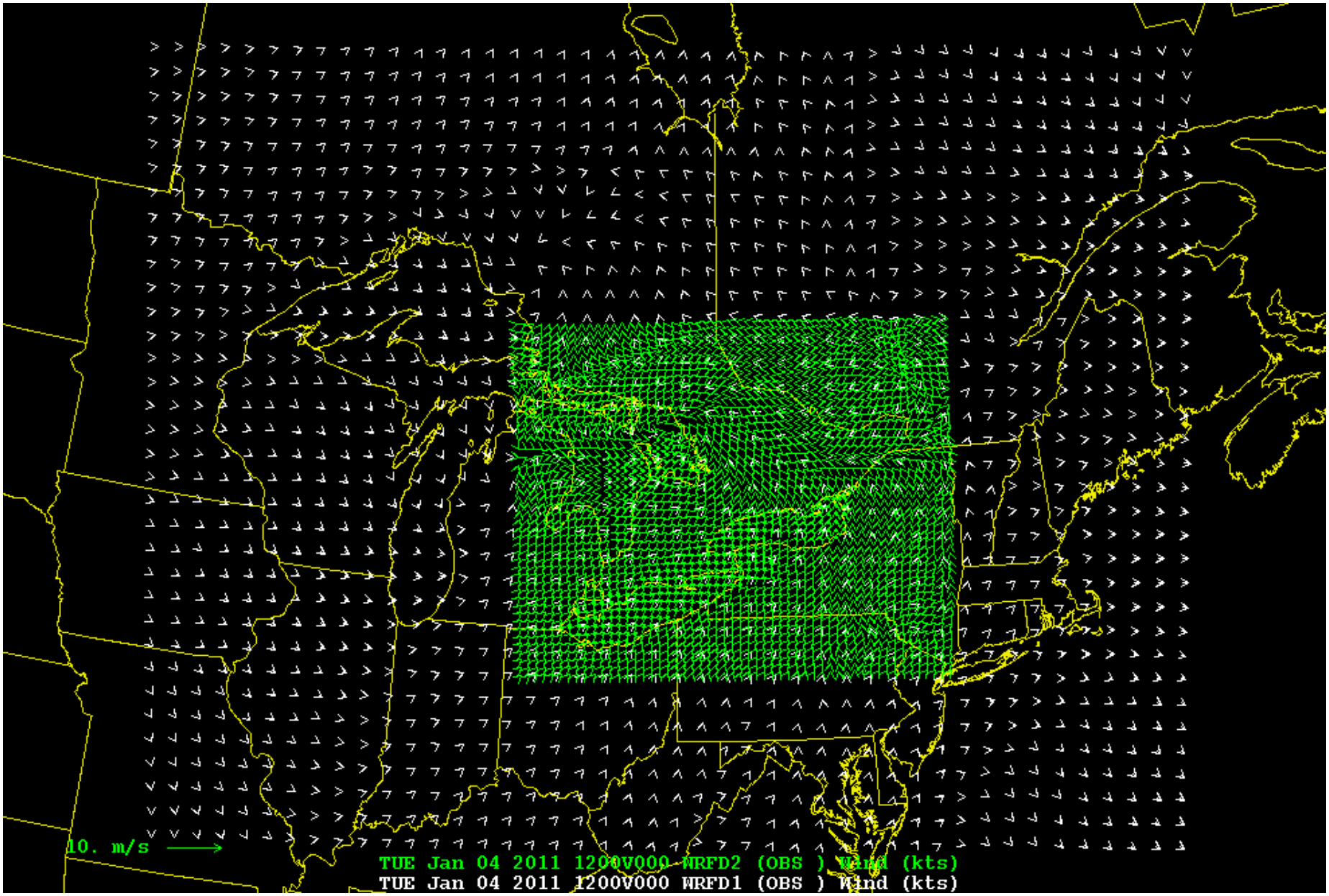
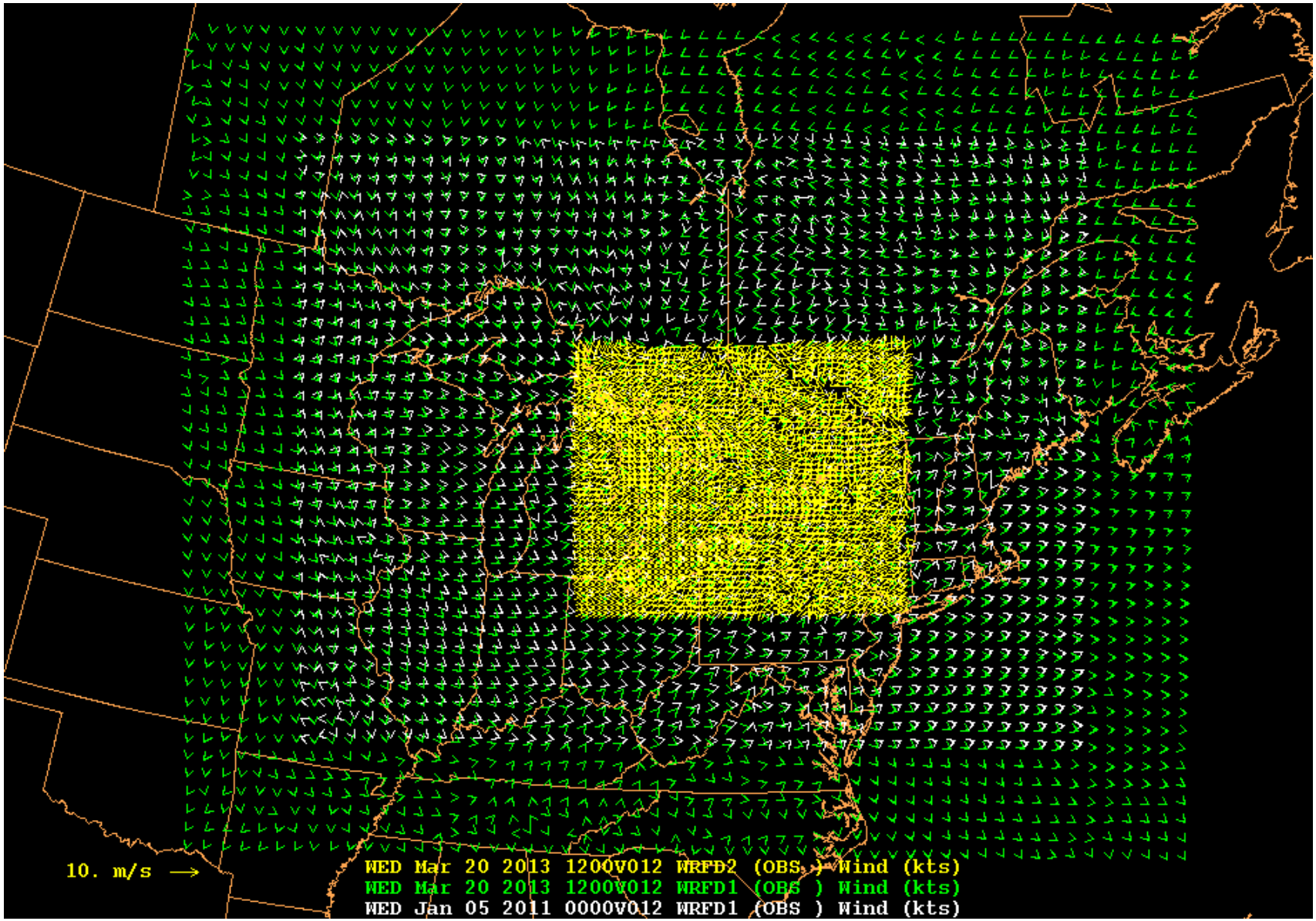
Modeling Strategy

- In support of field operations during December 2013 and January 2014, faculty and meteorology students at SUNY Oswego will run WRF-ARW Version 3.5 on a 12-km large-grid covering all of the Great Lakes and a 4-km nested-grid covering the eastern Great Lakes. Currently, we are testing various grid configurations and physics schemes to optimize the accuracy of WRF simulations.
- Following the termination of field operations, we will run a higher-resolution version of WRF to compare model output with field observations.

Large Grid (12 km, white); Nested 4-km grid



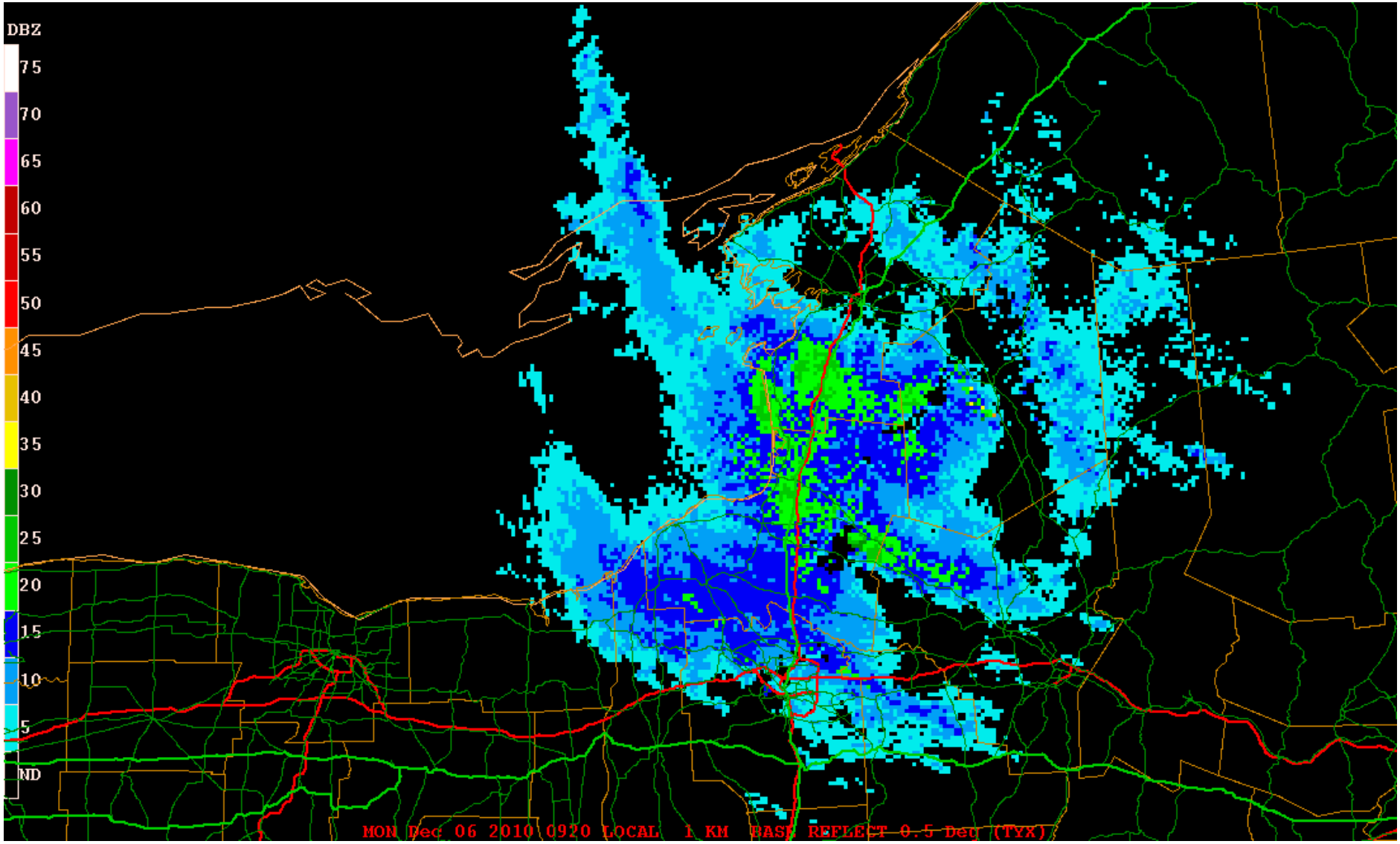
Large Grid (white); Nested (yellow); expanded (green)



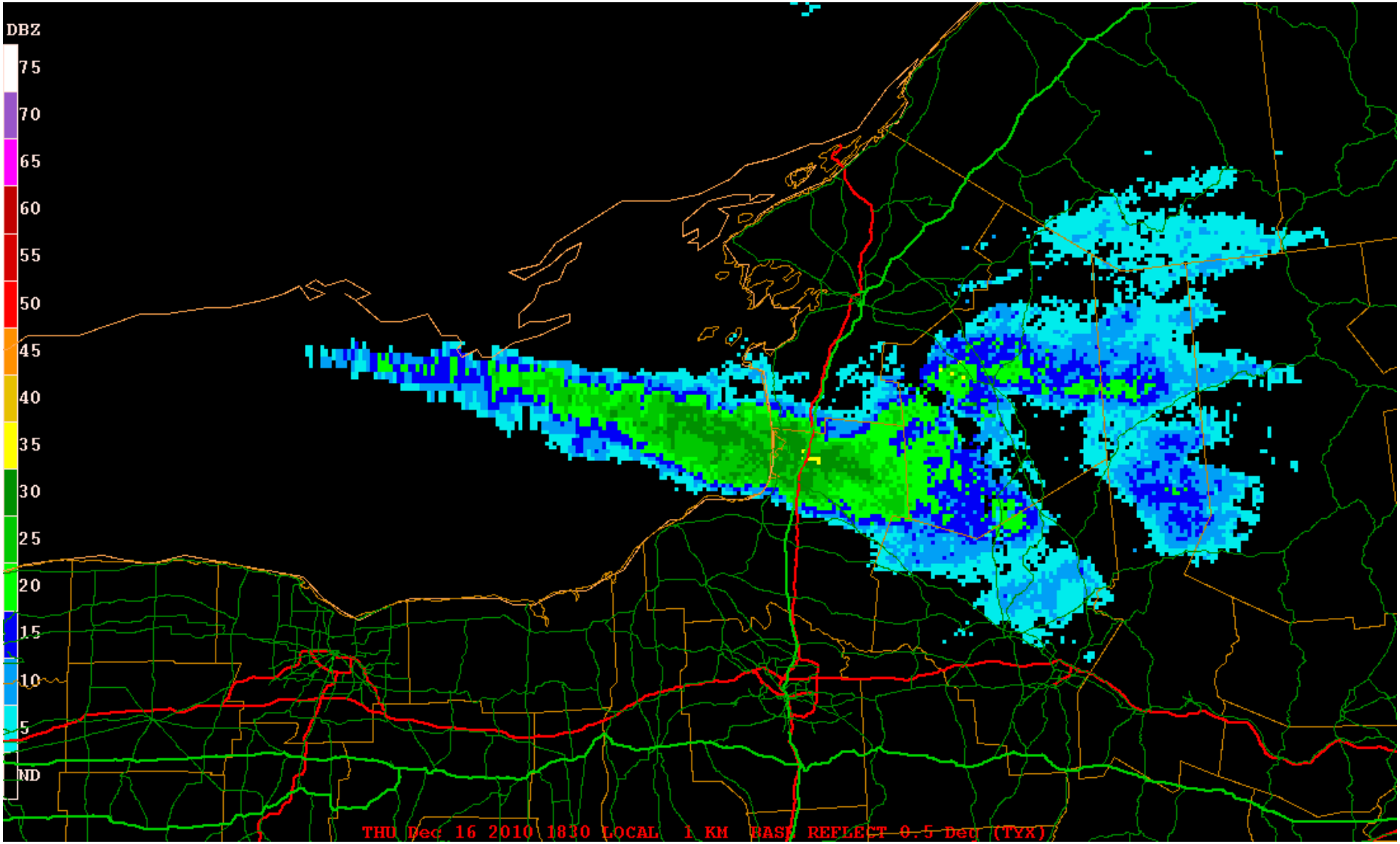
List of Lake-effect Snowstorms

- 1. Dec 06, 2010; 2. Dec 16, 2010
  3. Jan 04, 2011; 4. Jan 16, 2009;
  5. Jan 22, 2013; 6. Jan 30, 2012
  7. Feb 02, 2013; 8. Feb 10, 2008;
  9. Feb 20, 2009; 10. Feb 20, 2013
  11. Mar 20, 2013

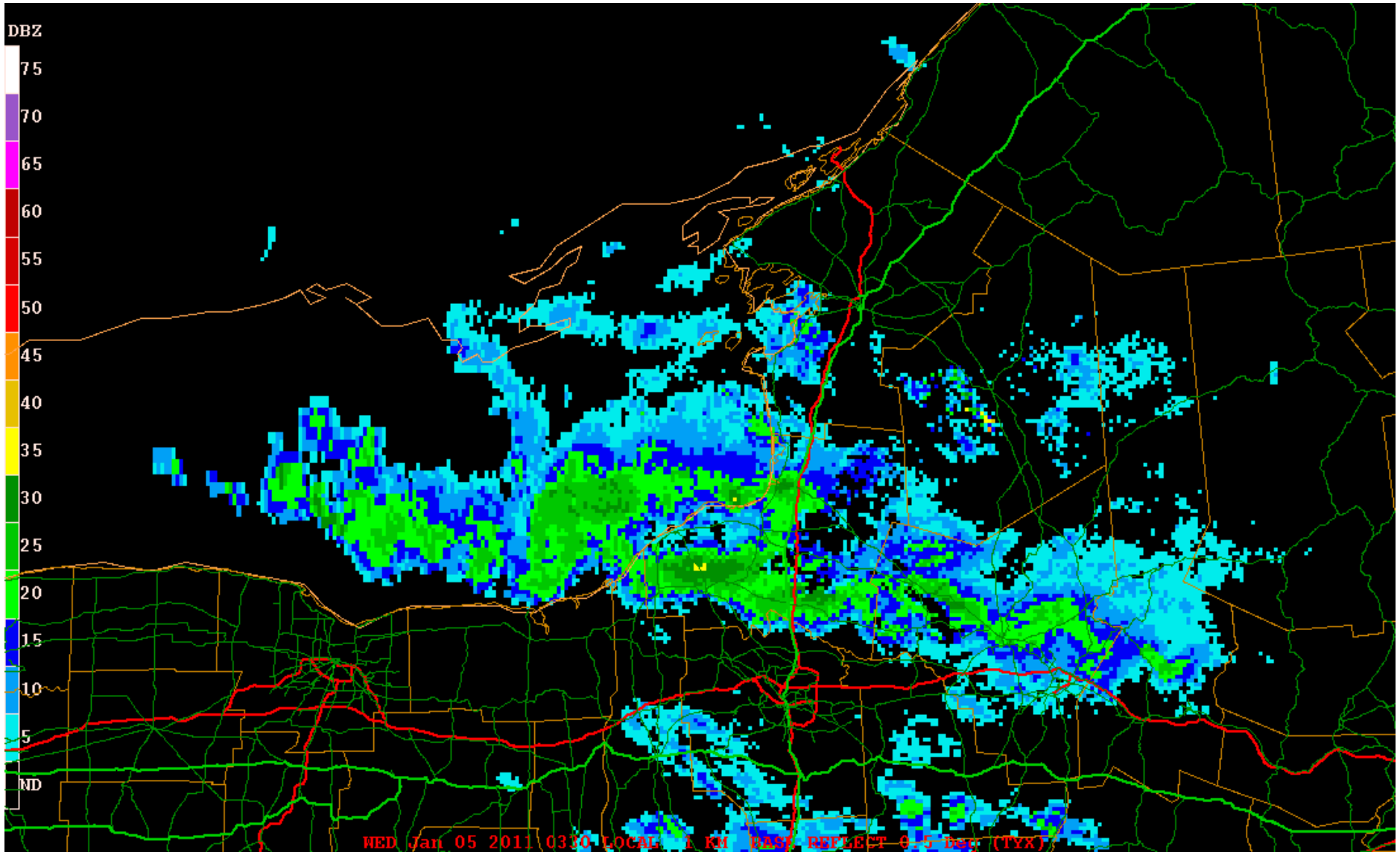
KTYX radar image 0920 UTC 06 Dec 2010



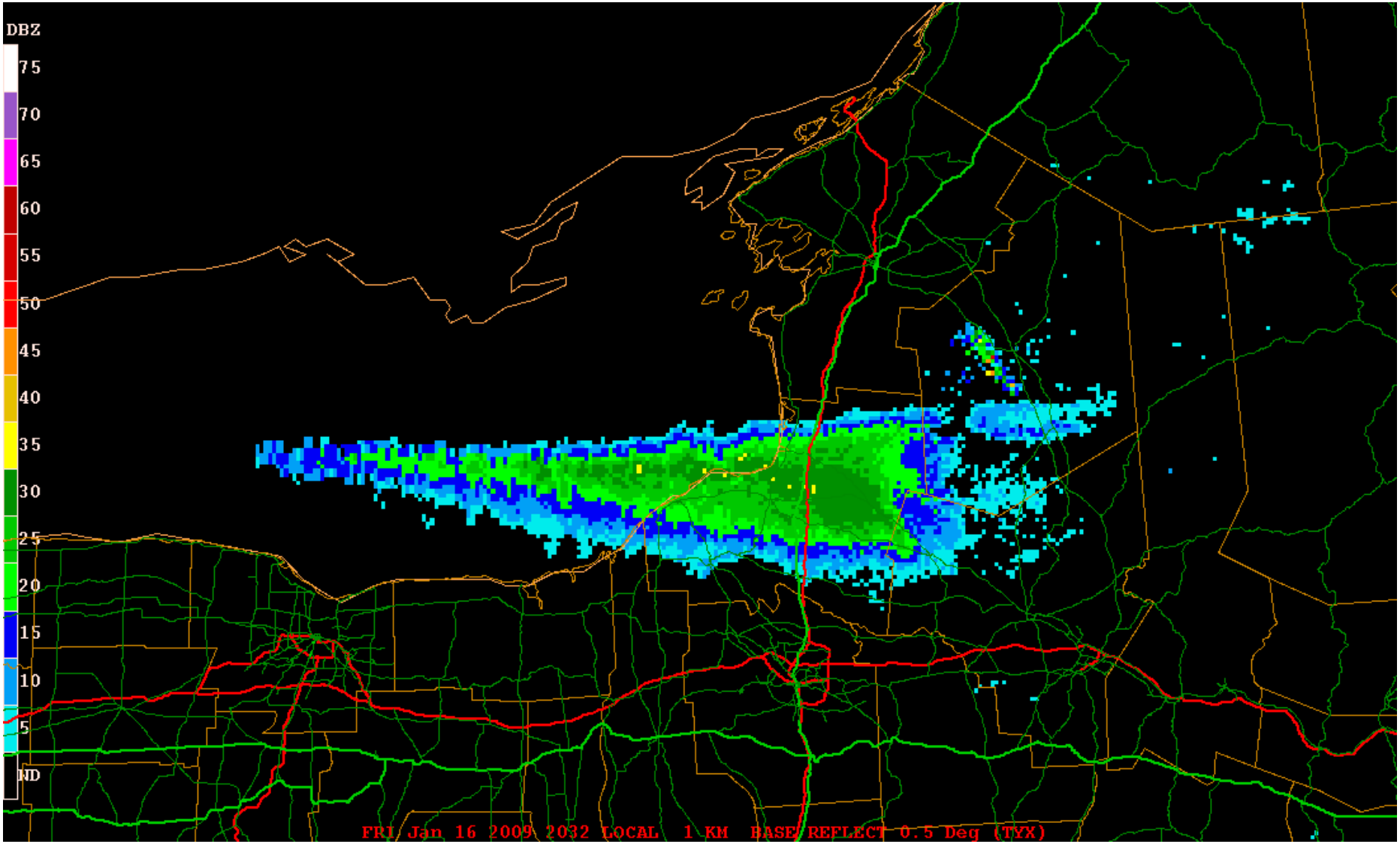
KTYX radar image 1830 UTC 16 Dec 2010



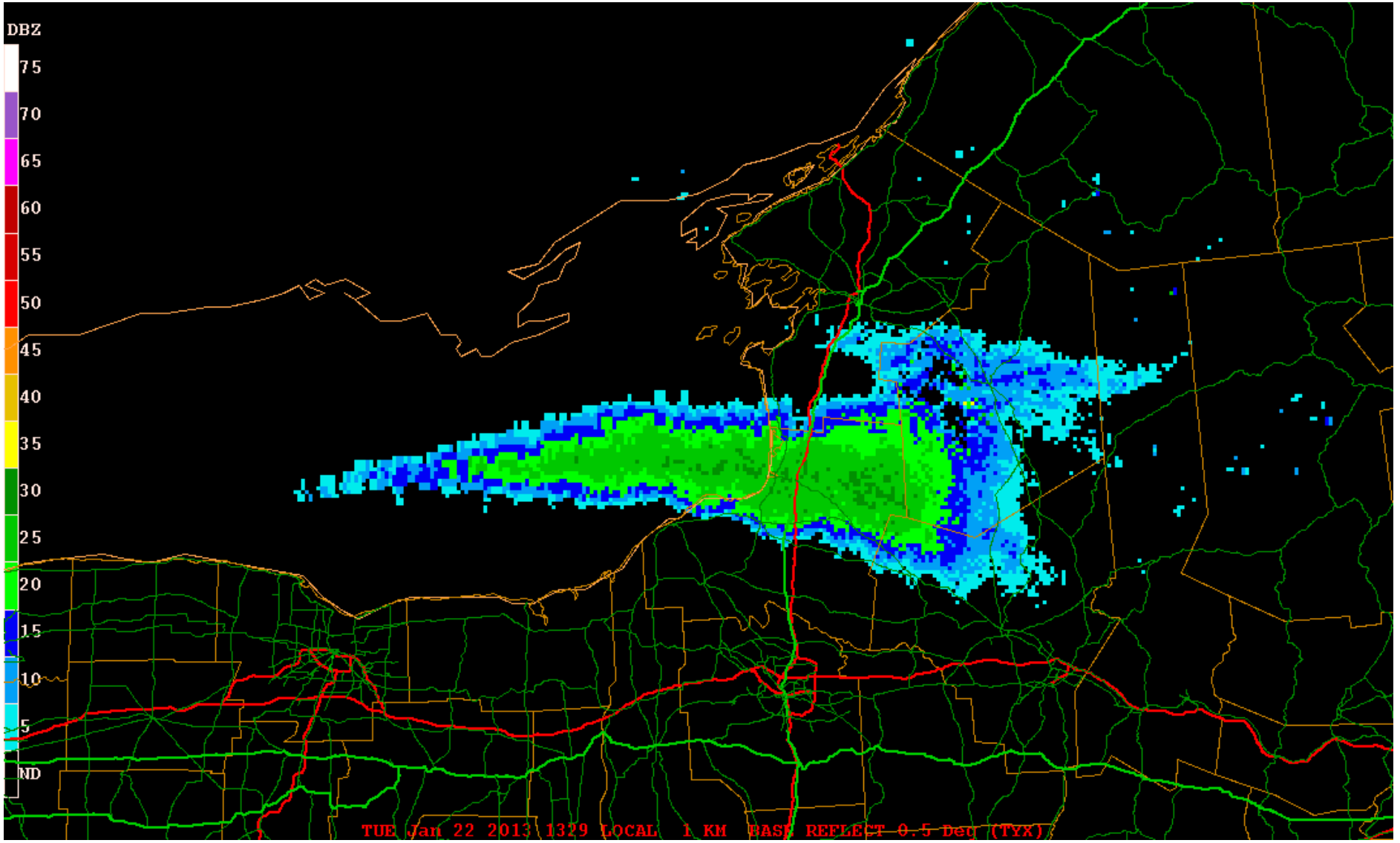
KTYX radar image 0331 UTC 05 Jan 2011



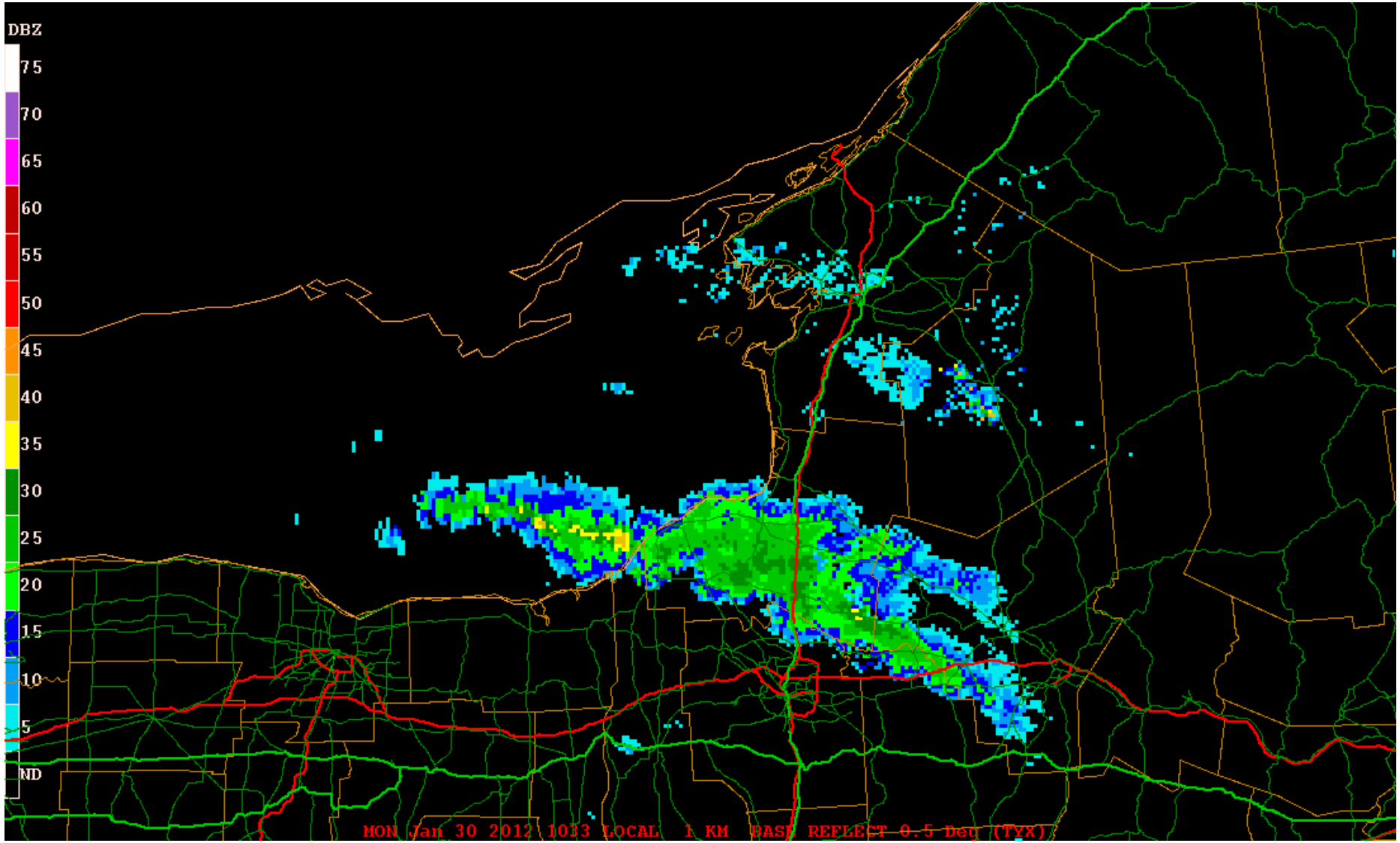
KTYX radar image 2032 UTC 16 Jan 2009



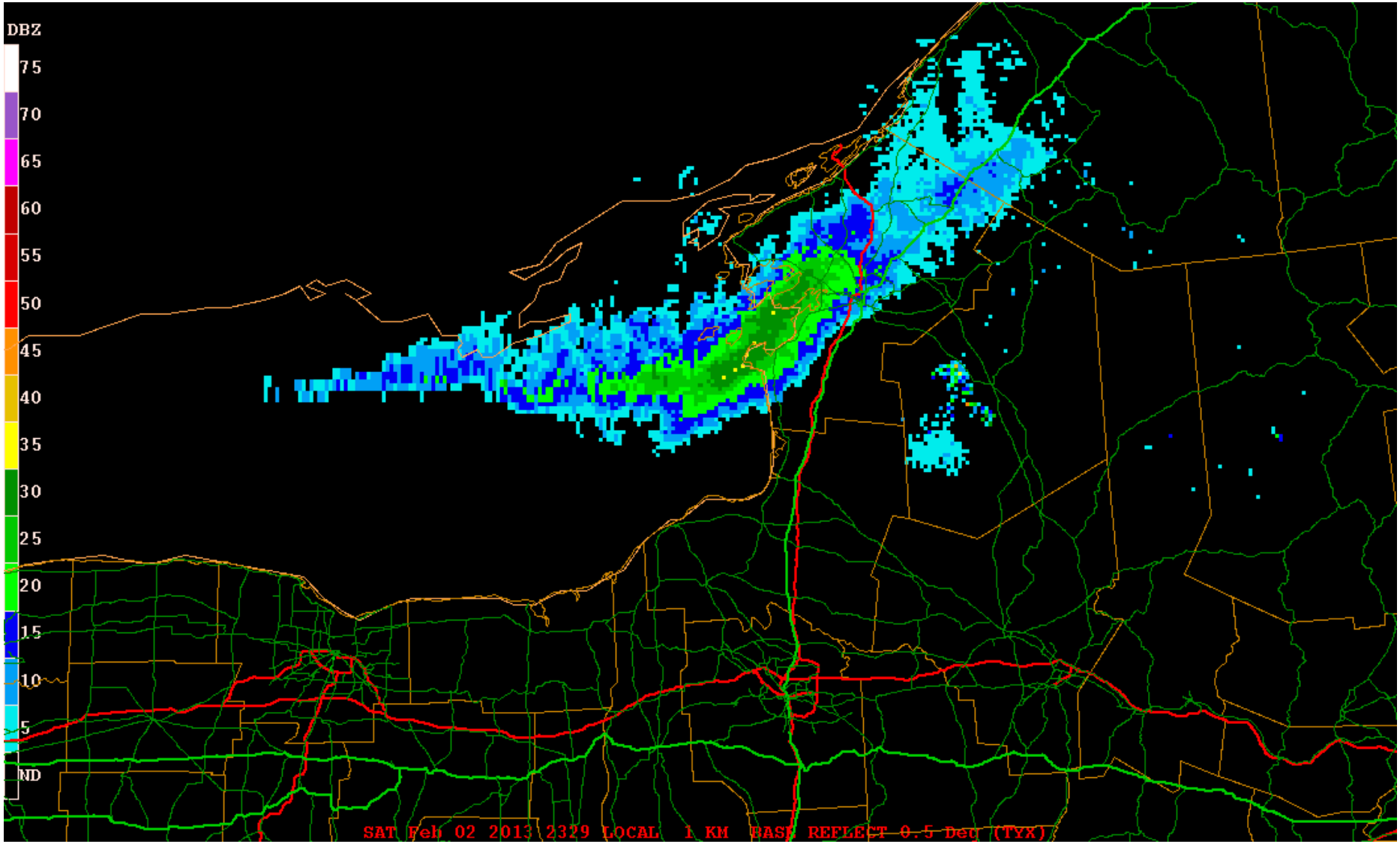
KTYX radar image 1329 UTC 22 Jan 2013



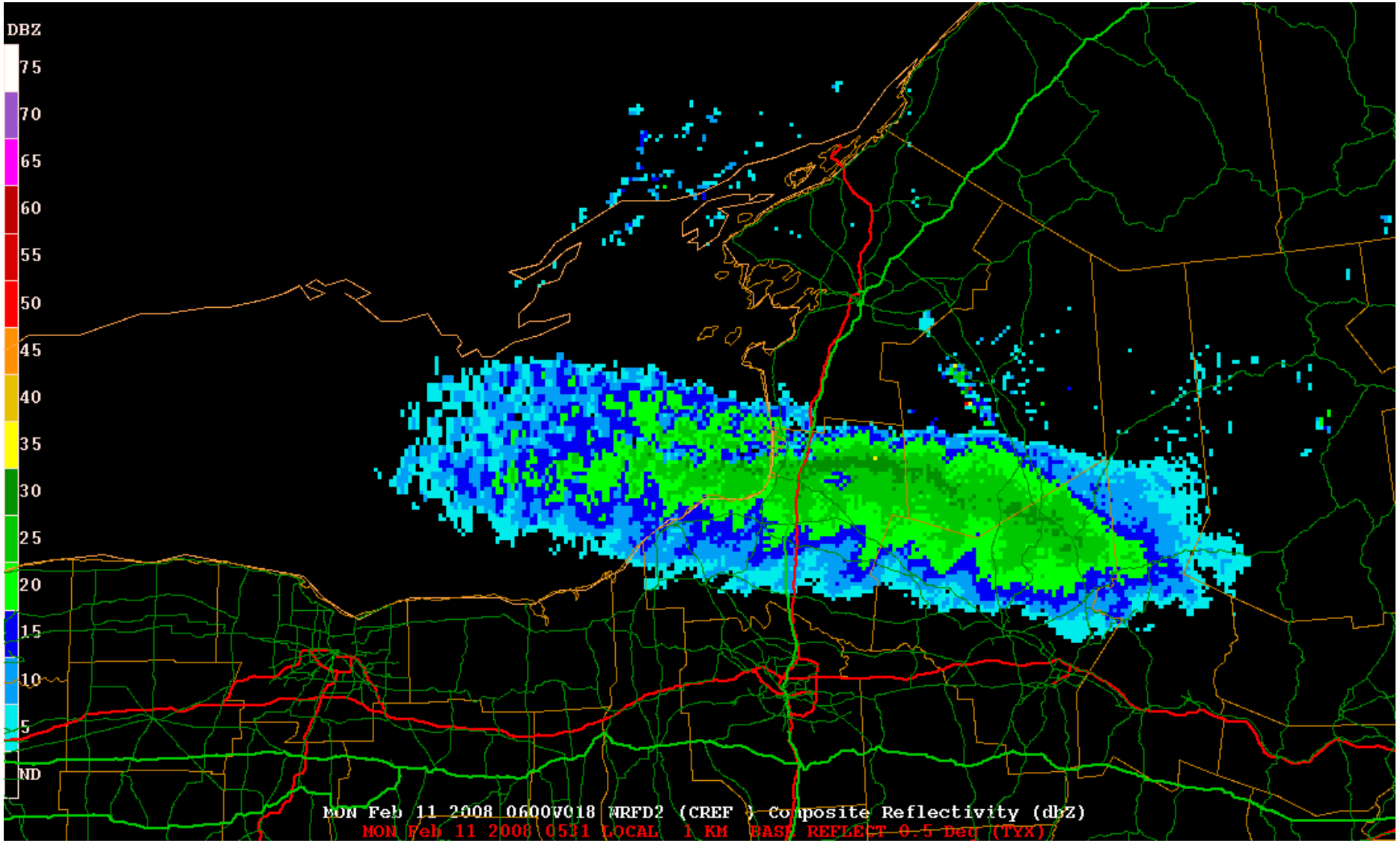
KTYX radar image 1033 UTC 30 Jan 2012



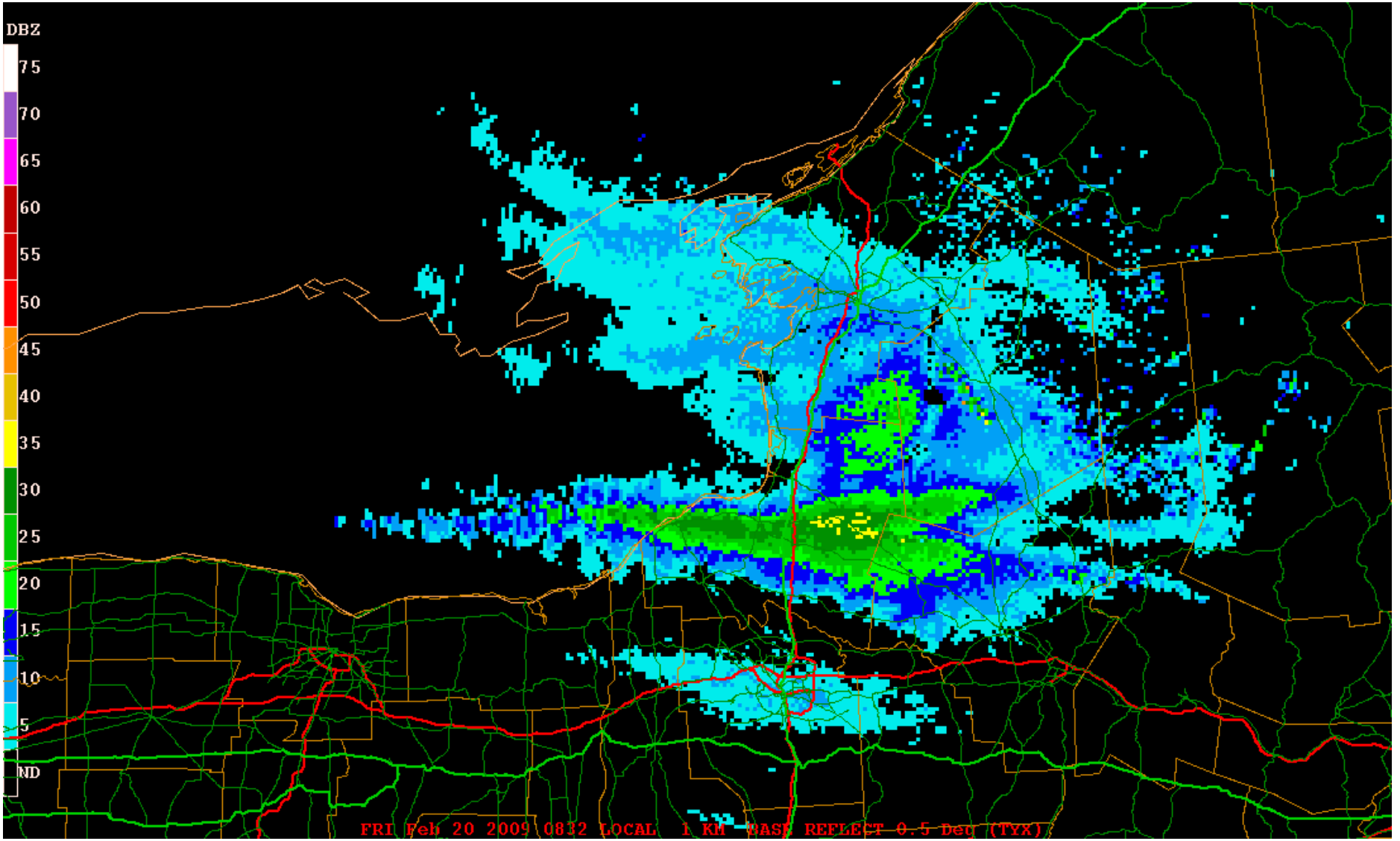
KTYX radar image 2329 UTC 02 Feb 2013



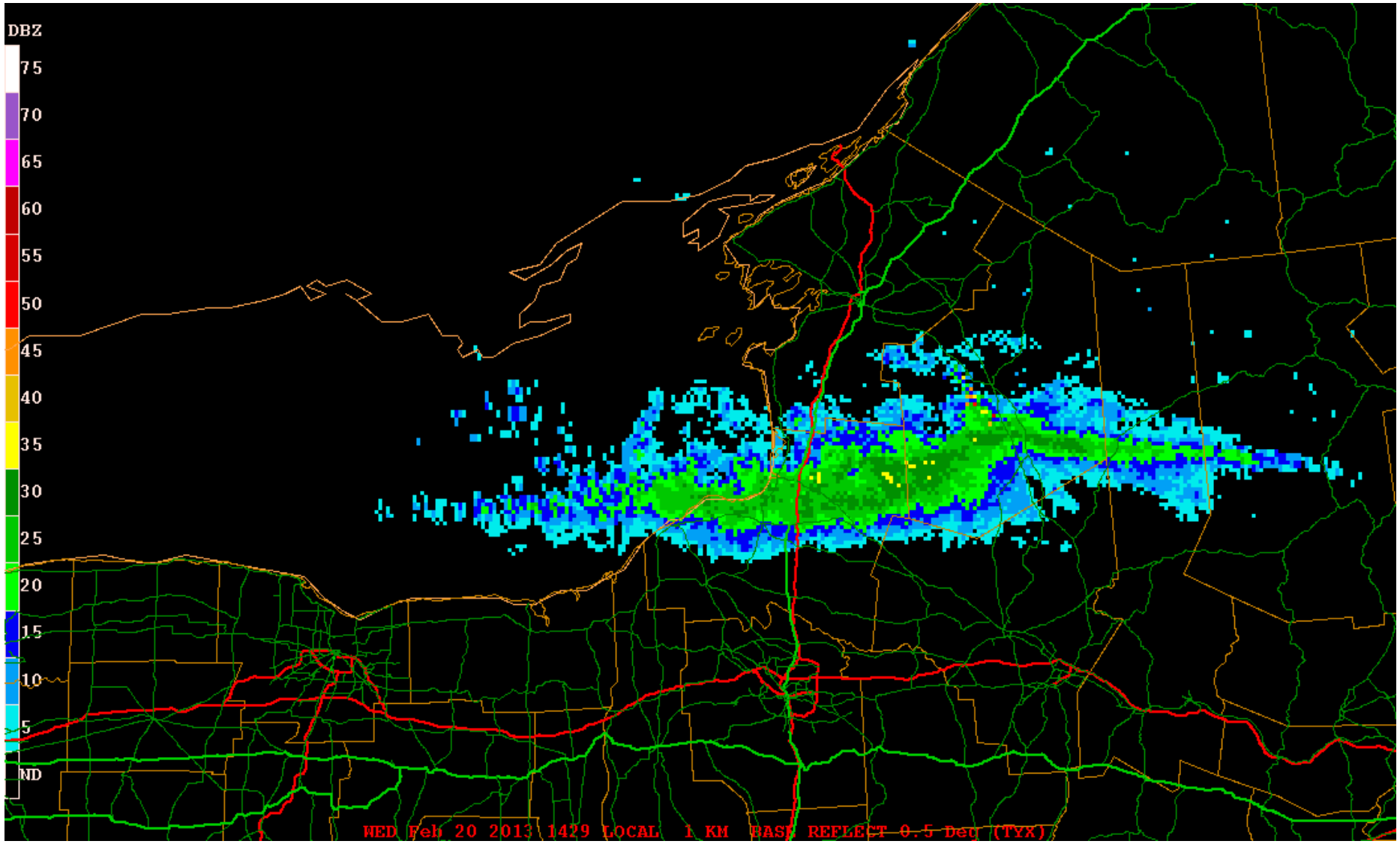
KTYX radar image 0531 UTC 11 Feb 2008



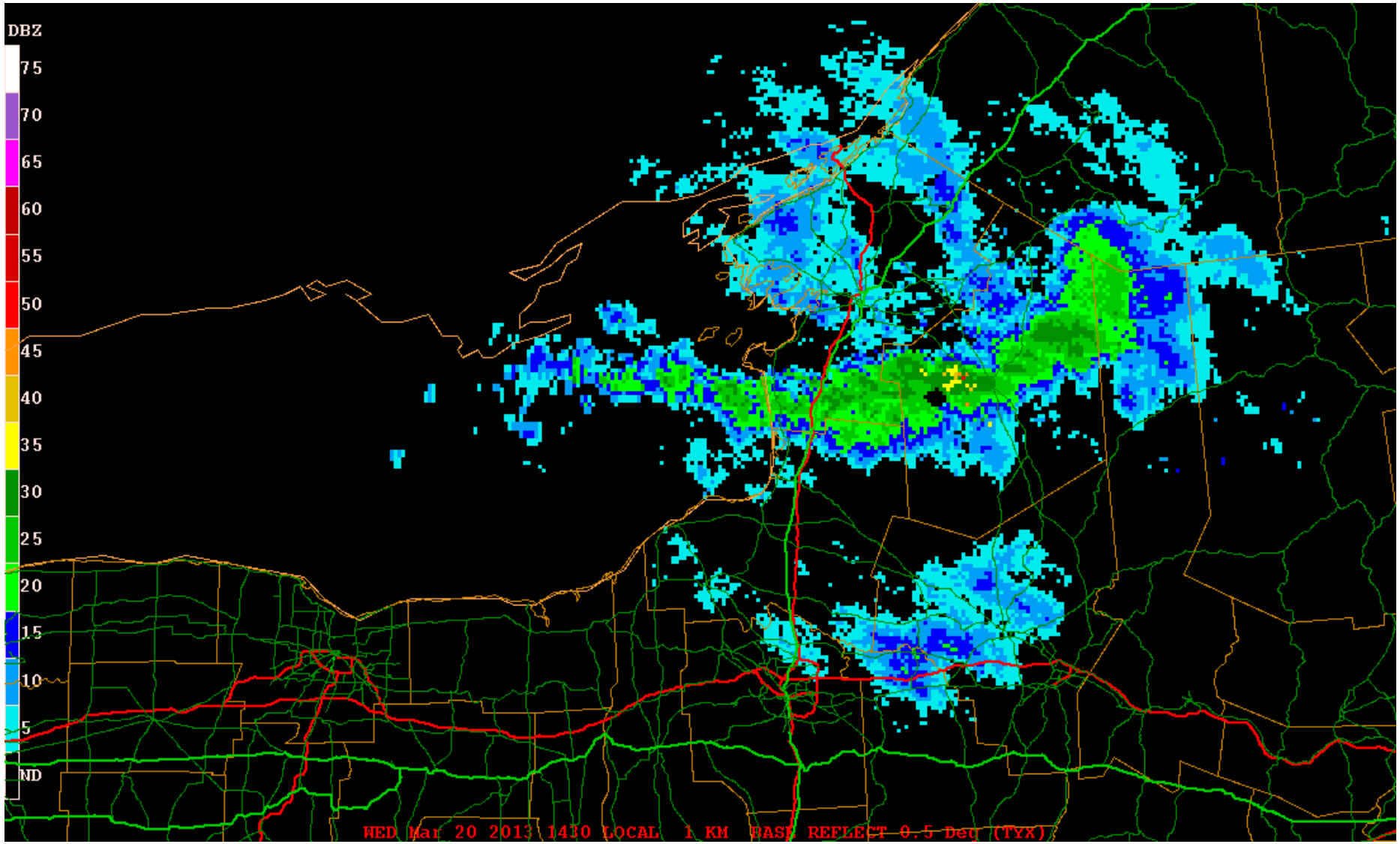
KTYX radar image 0832 UTC 20 Feb 2009



KTYX radar image 1429 UTC 20 Feb 2013



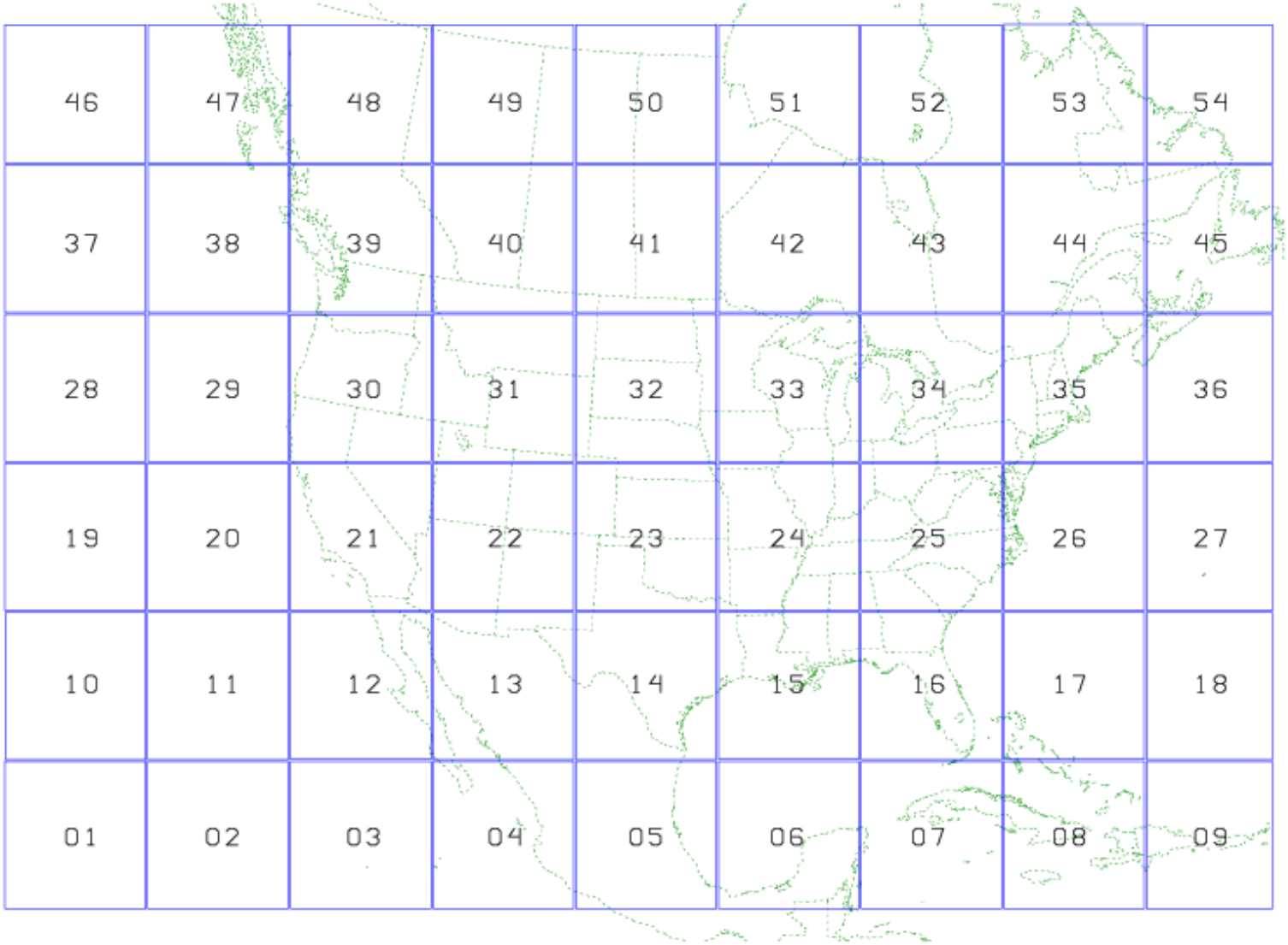
KTYX radar image 1430 UTC 20 Mar 2013



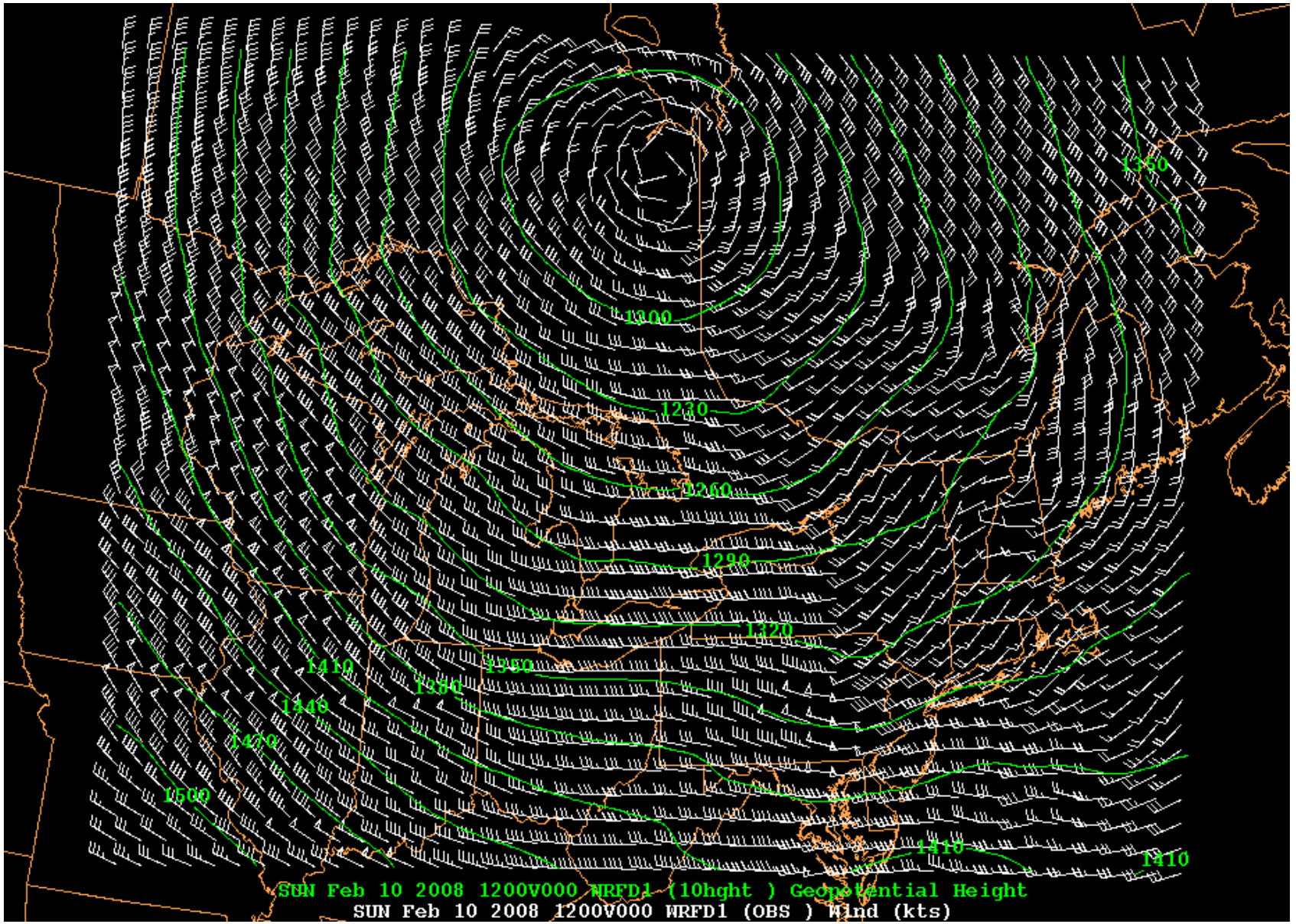
Initial Data and Boundary Conditions

- For WRF simulations during the field phase of OWLeS, we will use the 12-km nam218 ‘tiles’ (available via ftp four times/day from NCEP) to provide initial conditions and boundary conditions (every three hours) on our large grid. We plan to run WRF out to 36 hours to give scientists an ‘early’ prediction of lake-effect activity. A second ‘later’ run out to 72 hours will be made on another computer to help with extended planning.

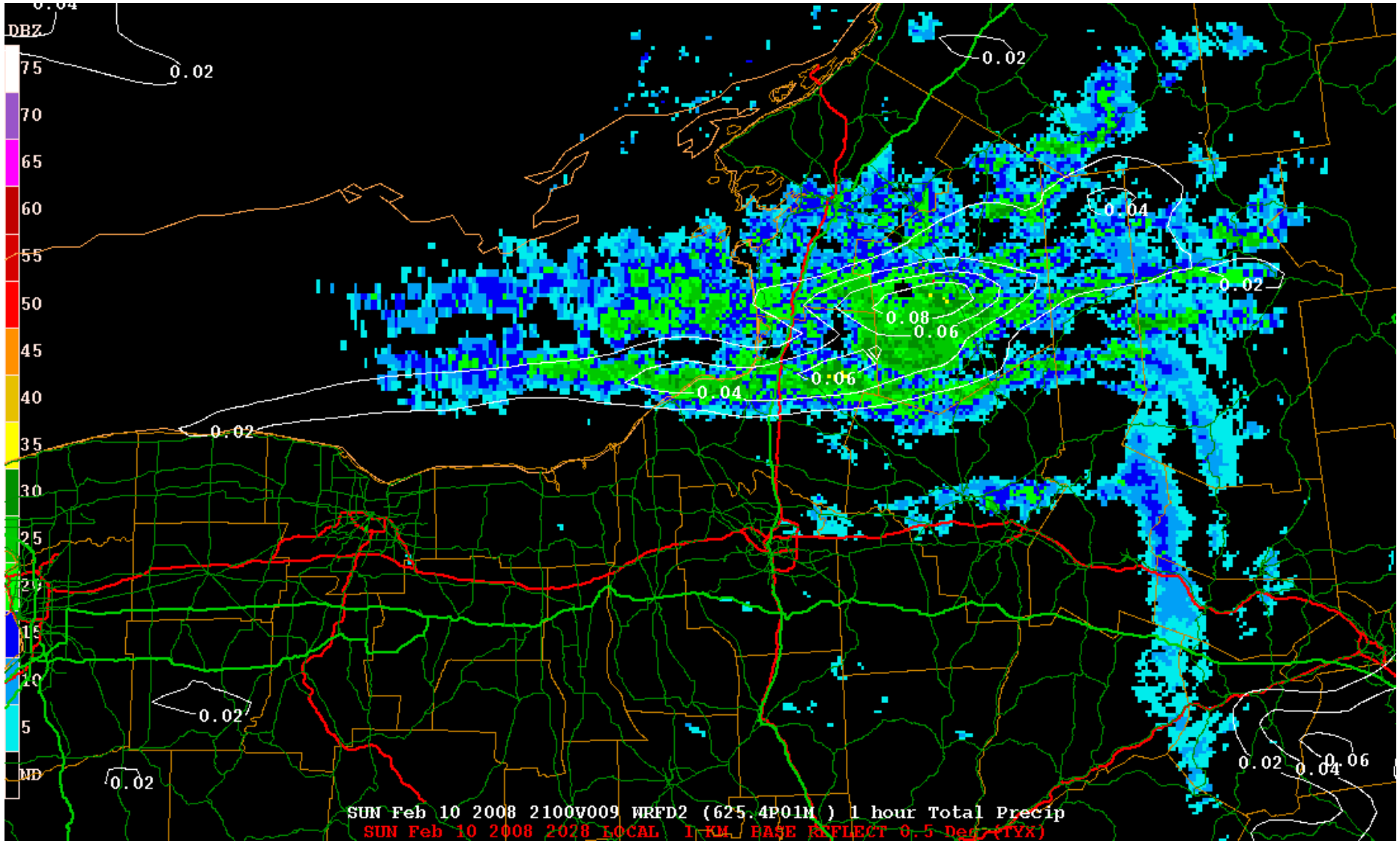
NAM218 12-km Tiles



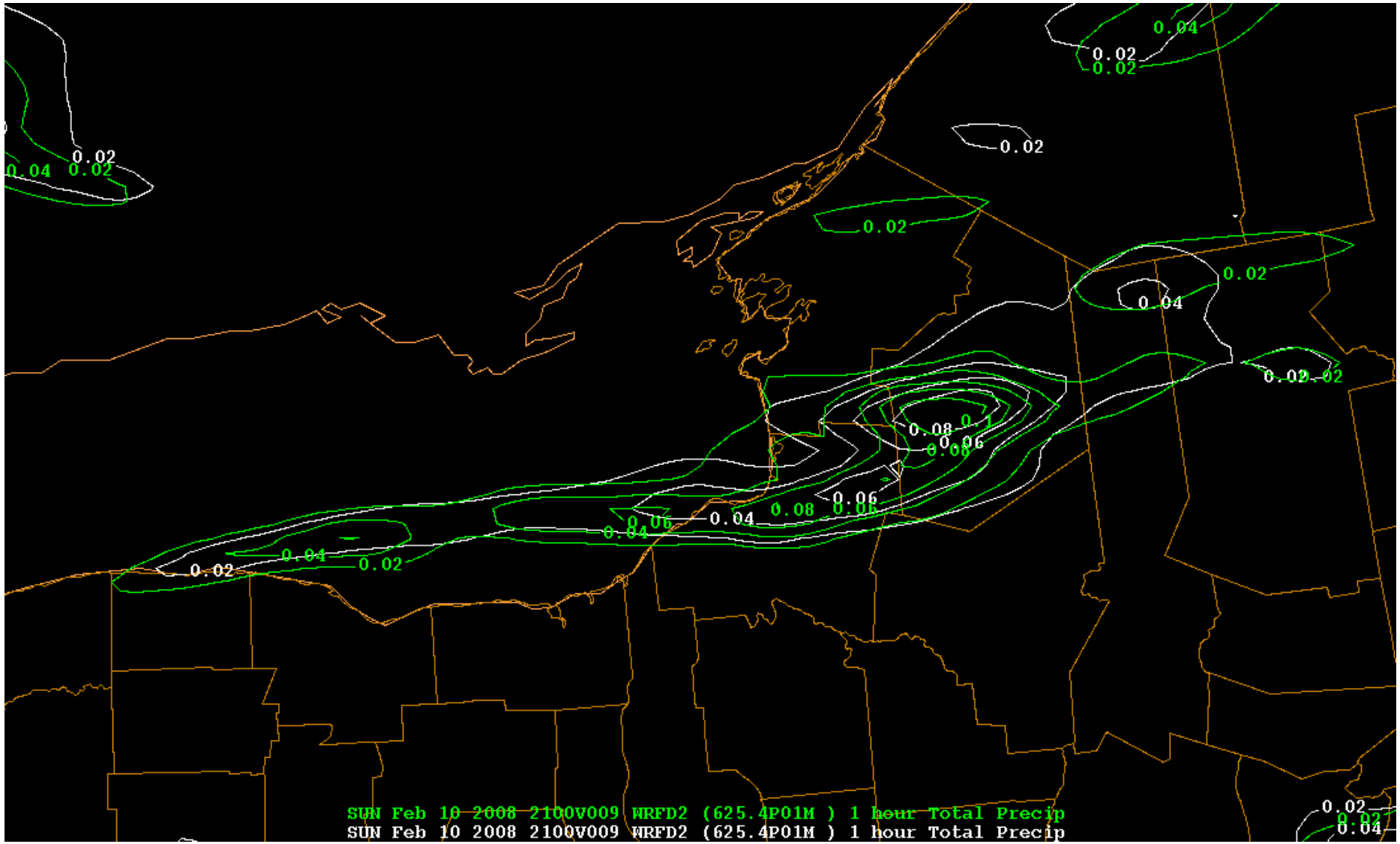
850-hPa Loop for 10 Feb 2008 storm



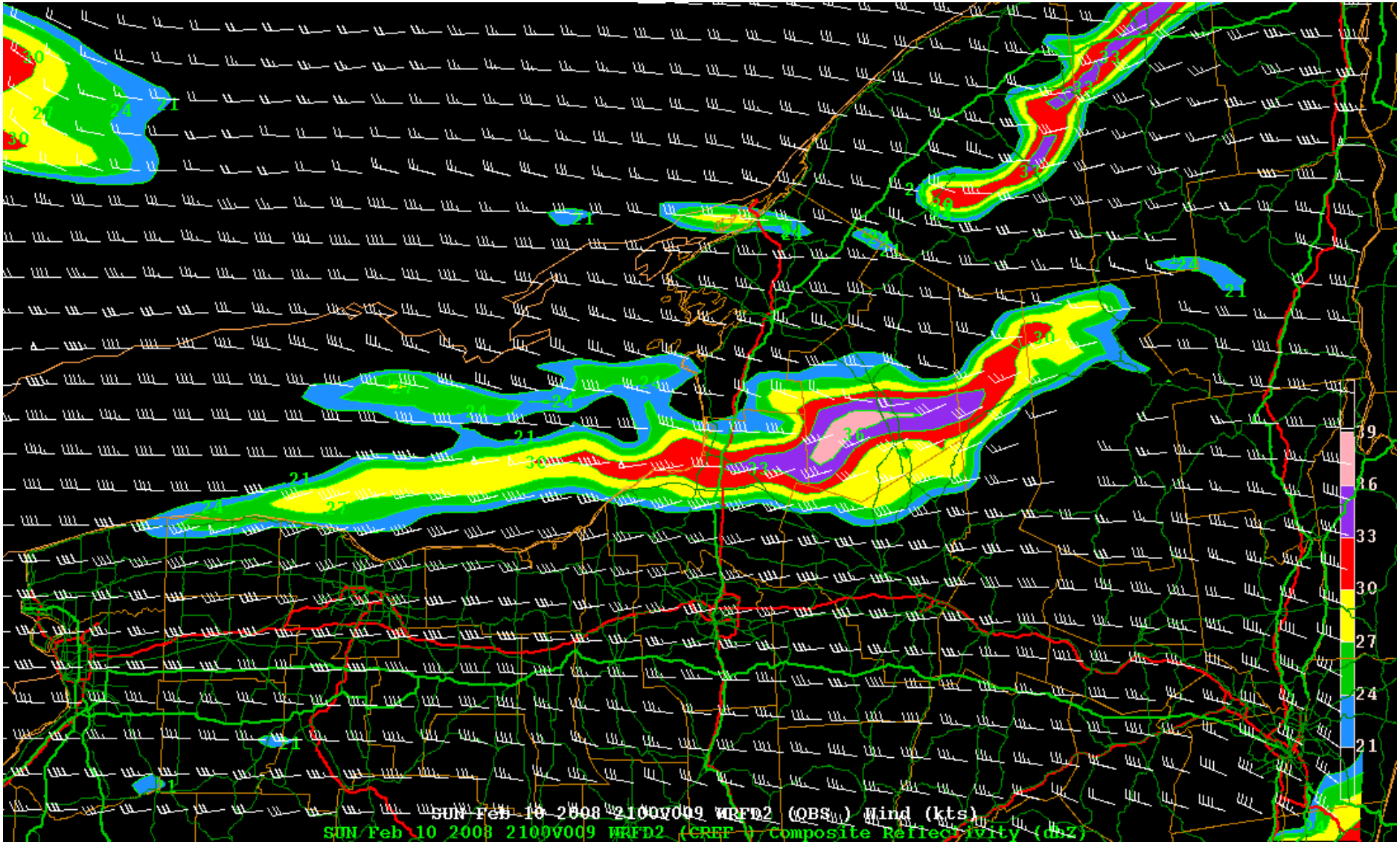
10 Feb 2008: WRF-Goddard MP vs TYX



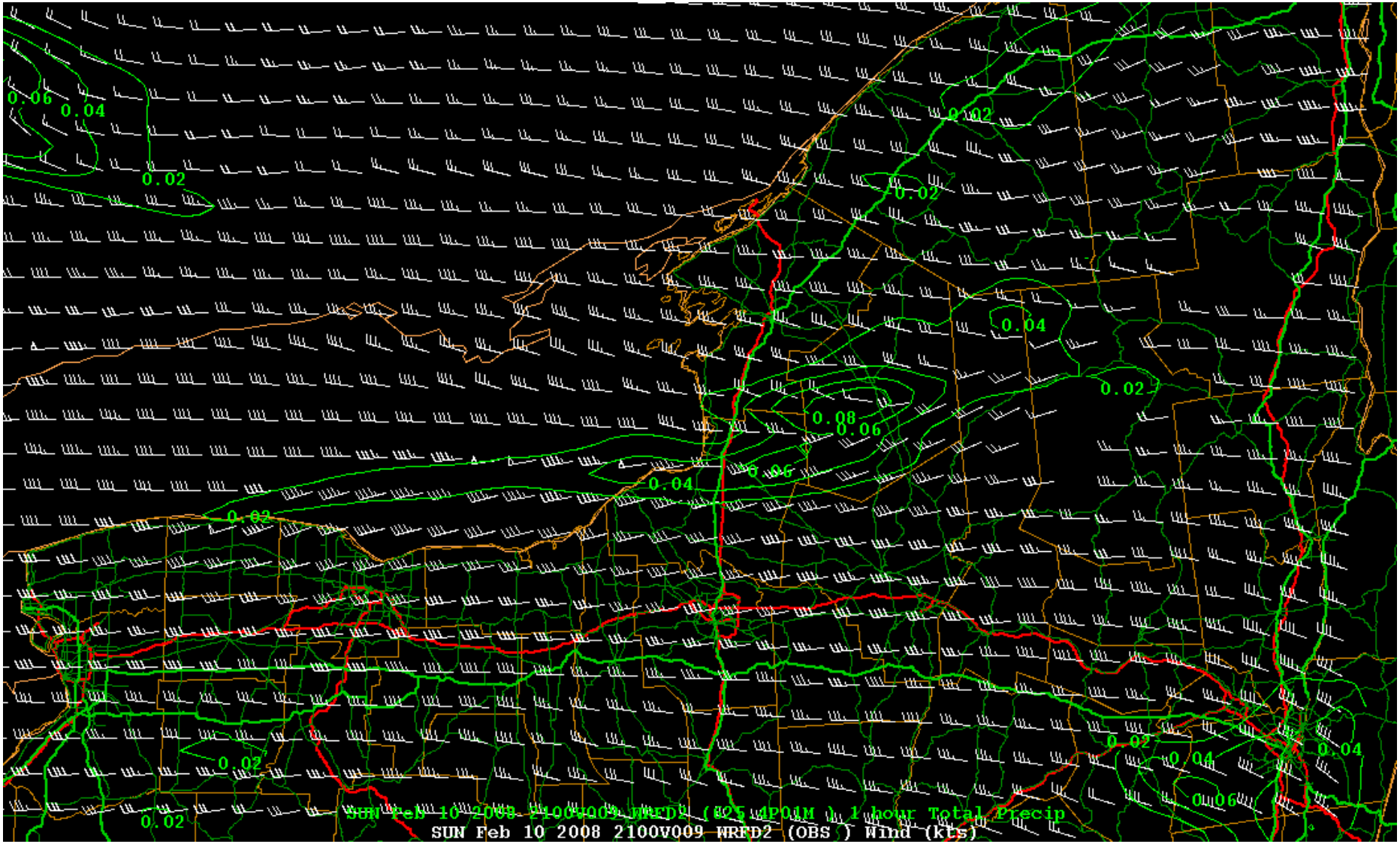
10 Feb 08: Goddard vs 3-phase scheme



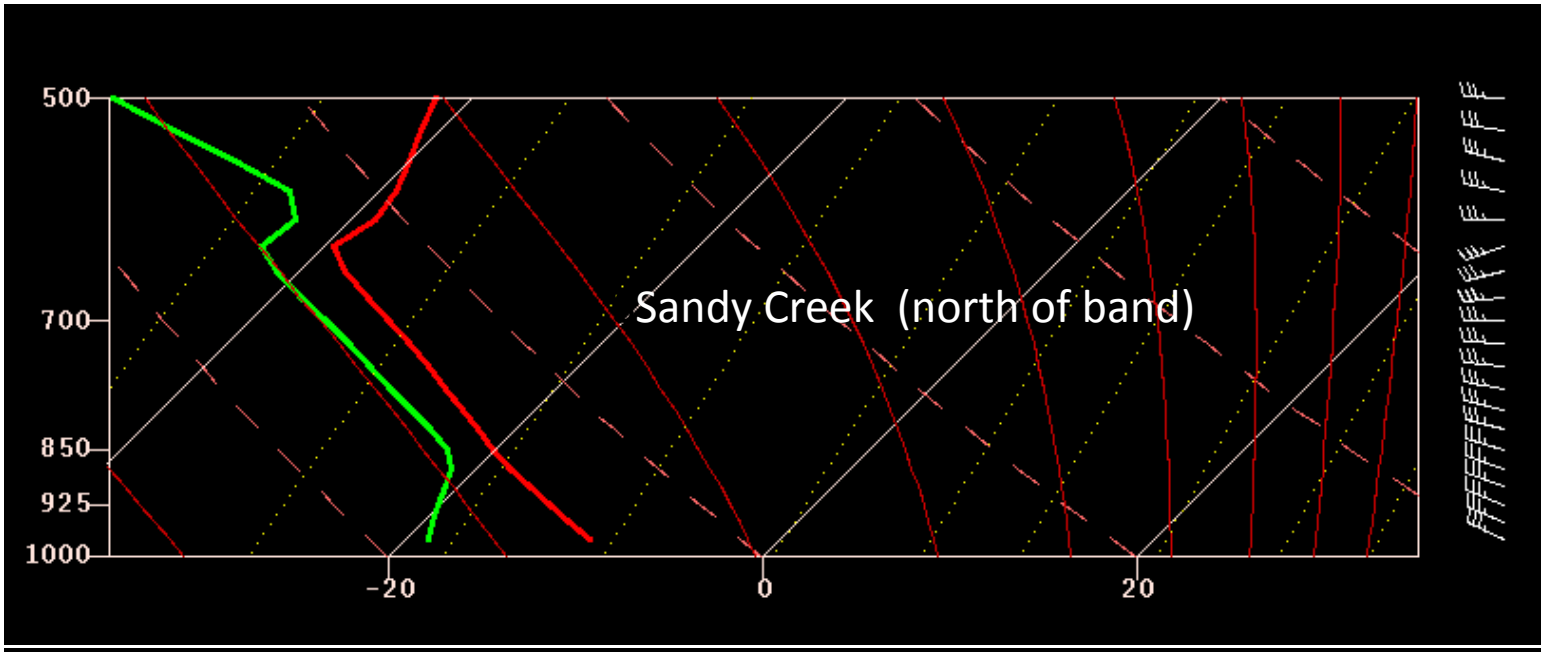
10 Feb 2008: WRF CREF & 925 wind

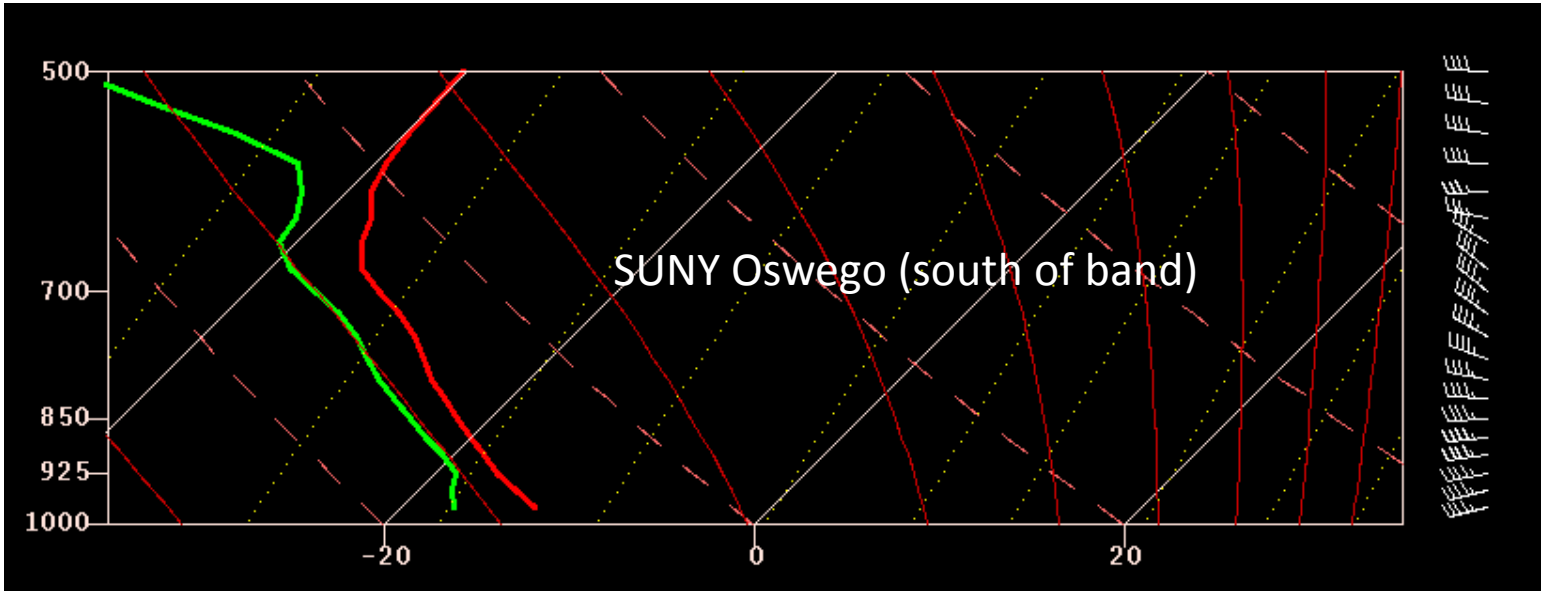


10 Feb 2008: WRF Prcp & 925 wind

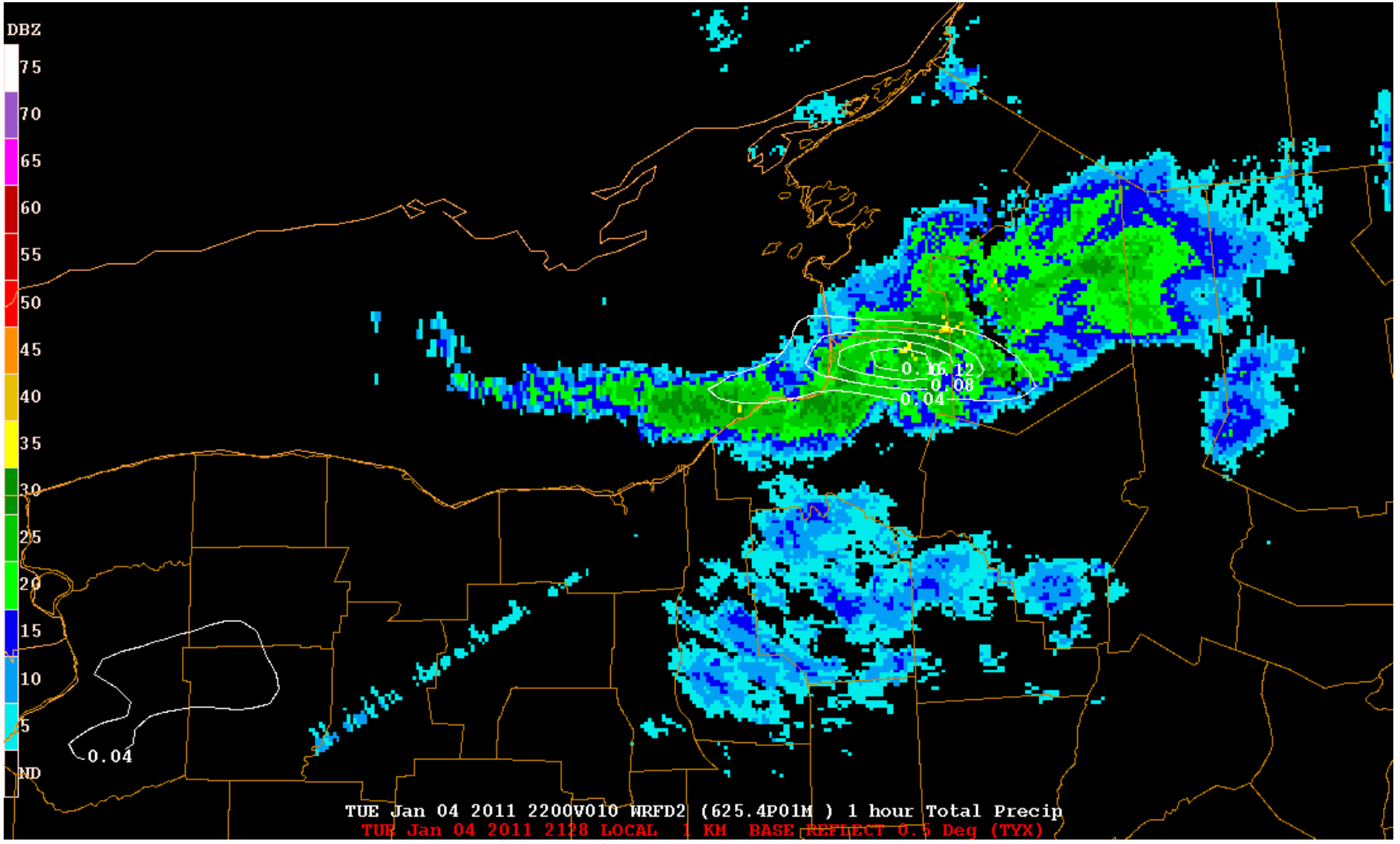


WRF soundings at 0000 UTC 11 Feb

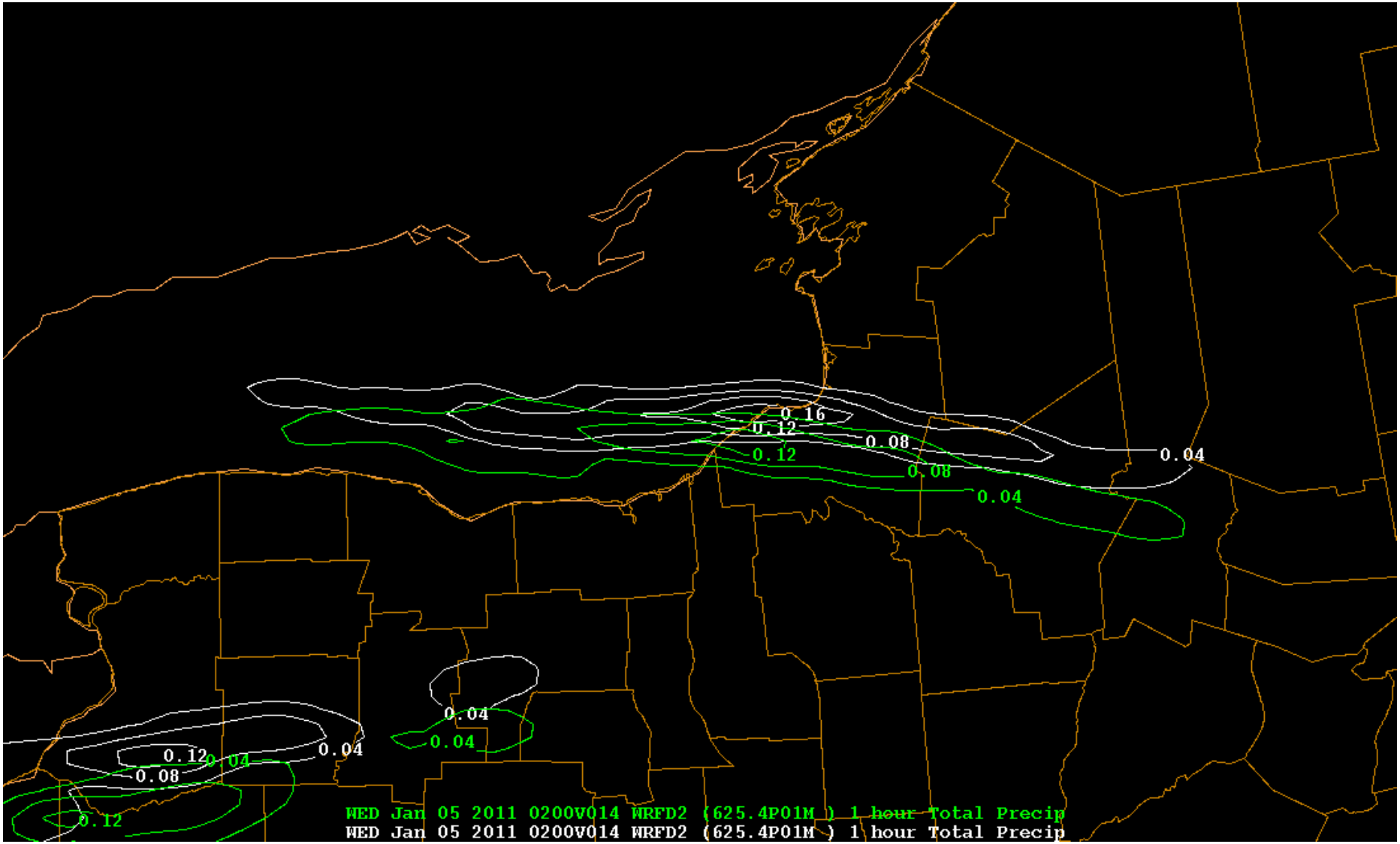




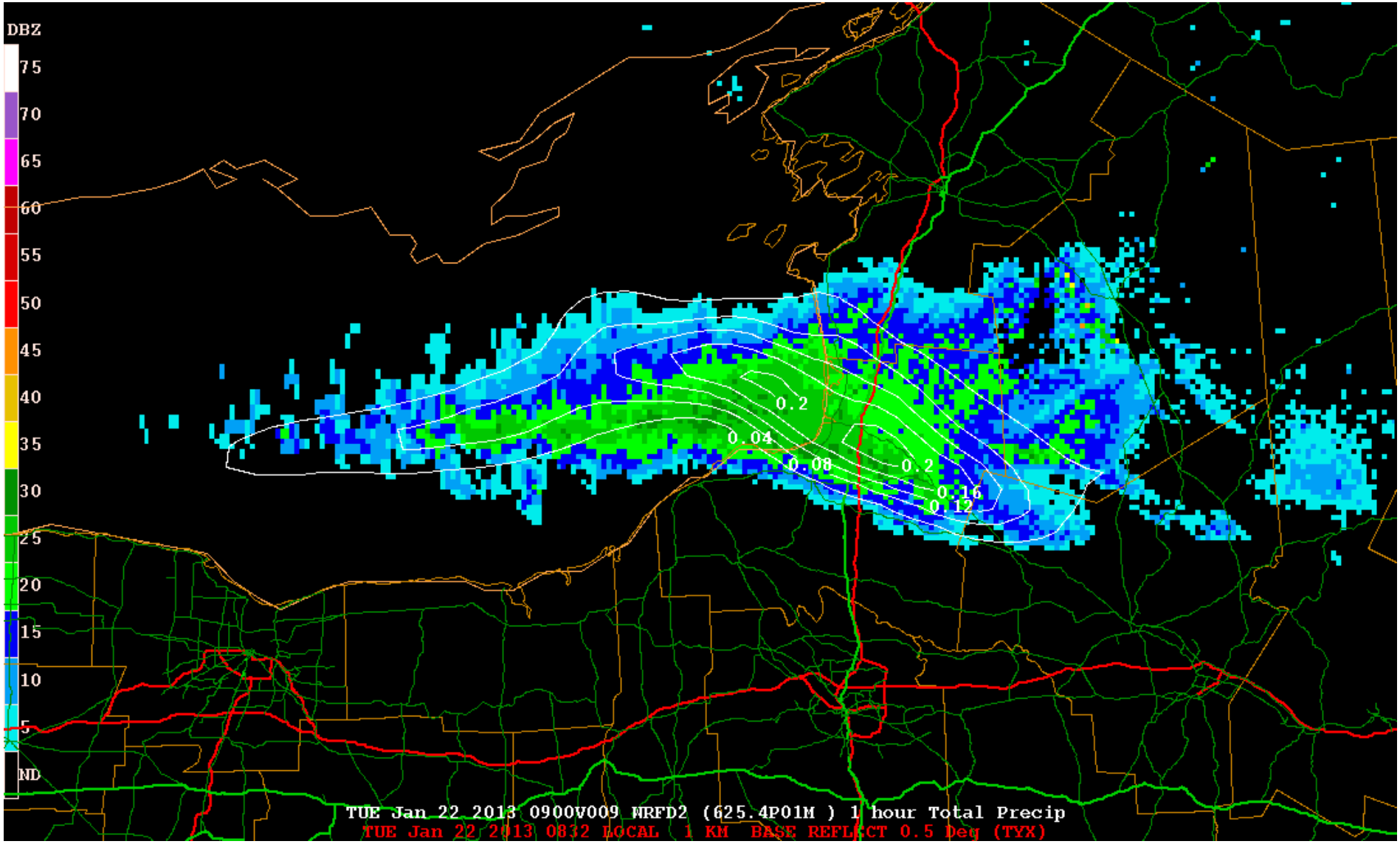
04-05 Jan 2011 Storm



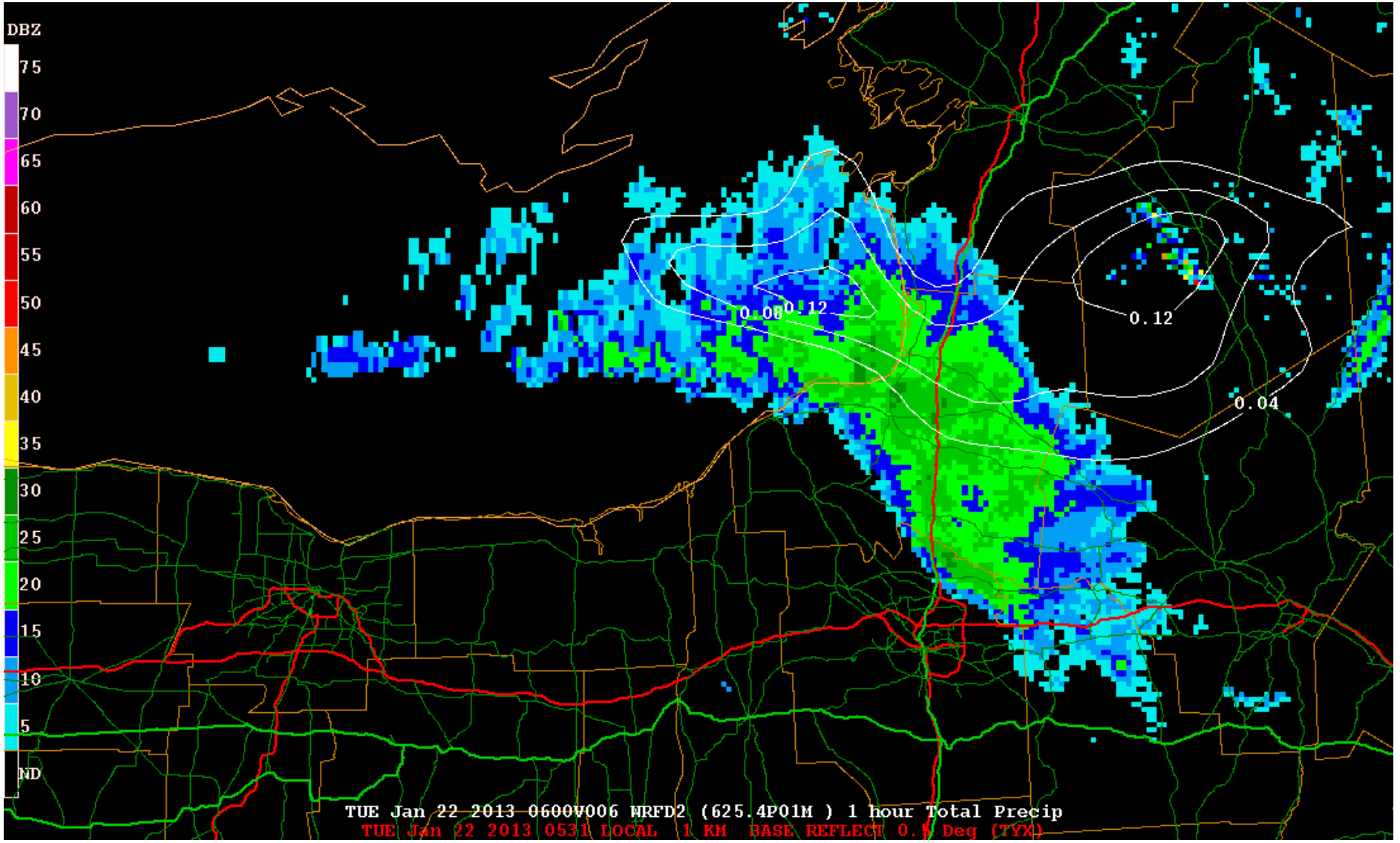
05 Jan 2011: Namtiles (white), NOMADS (green)



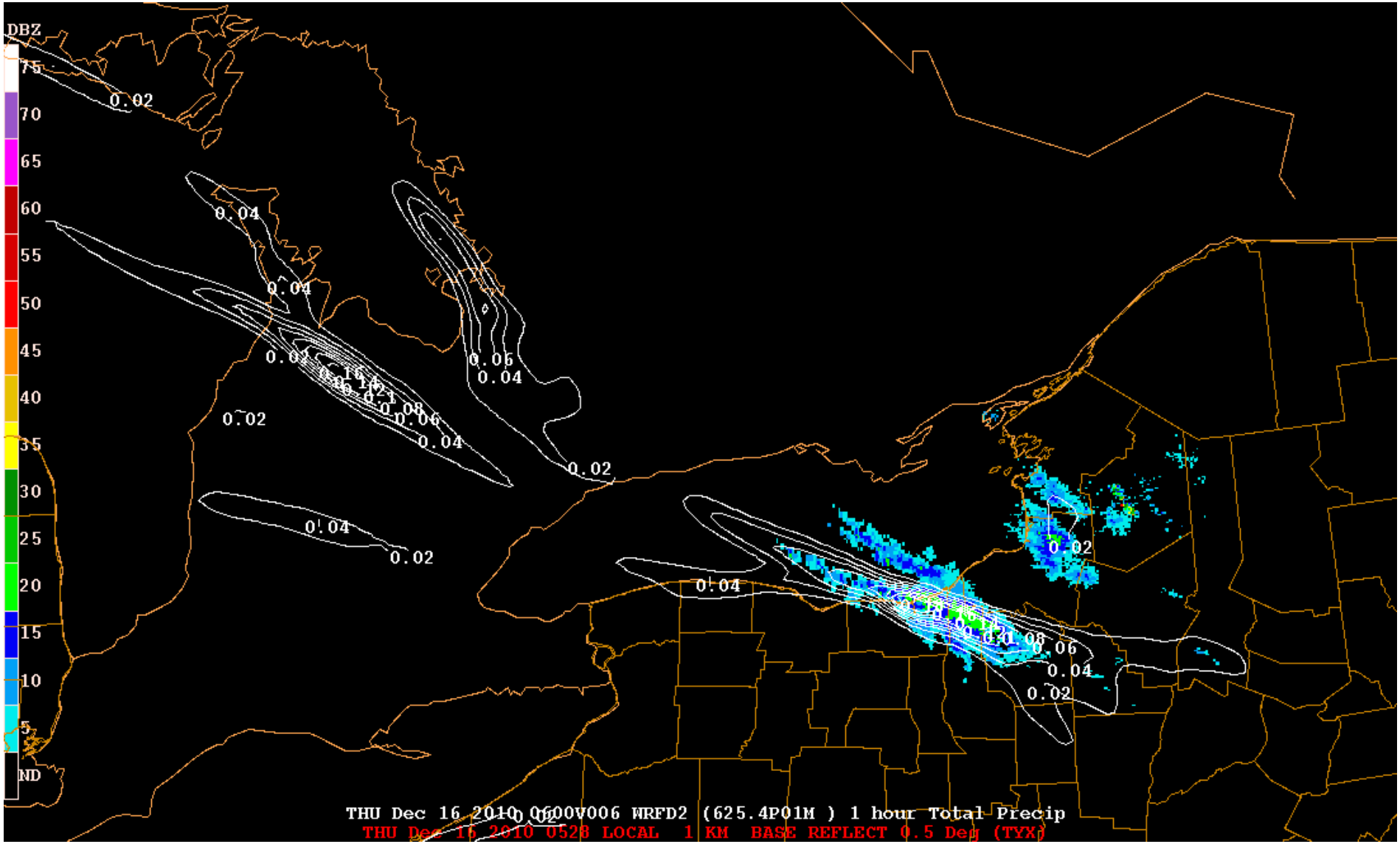
22 Jan 2013: 3-phase scheme



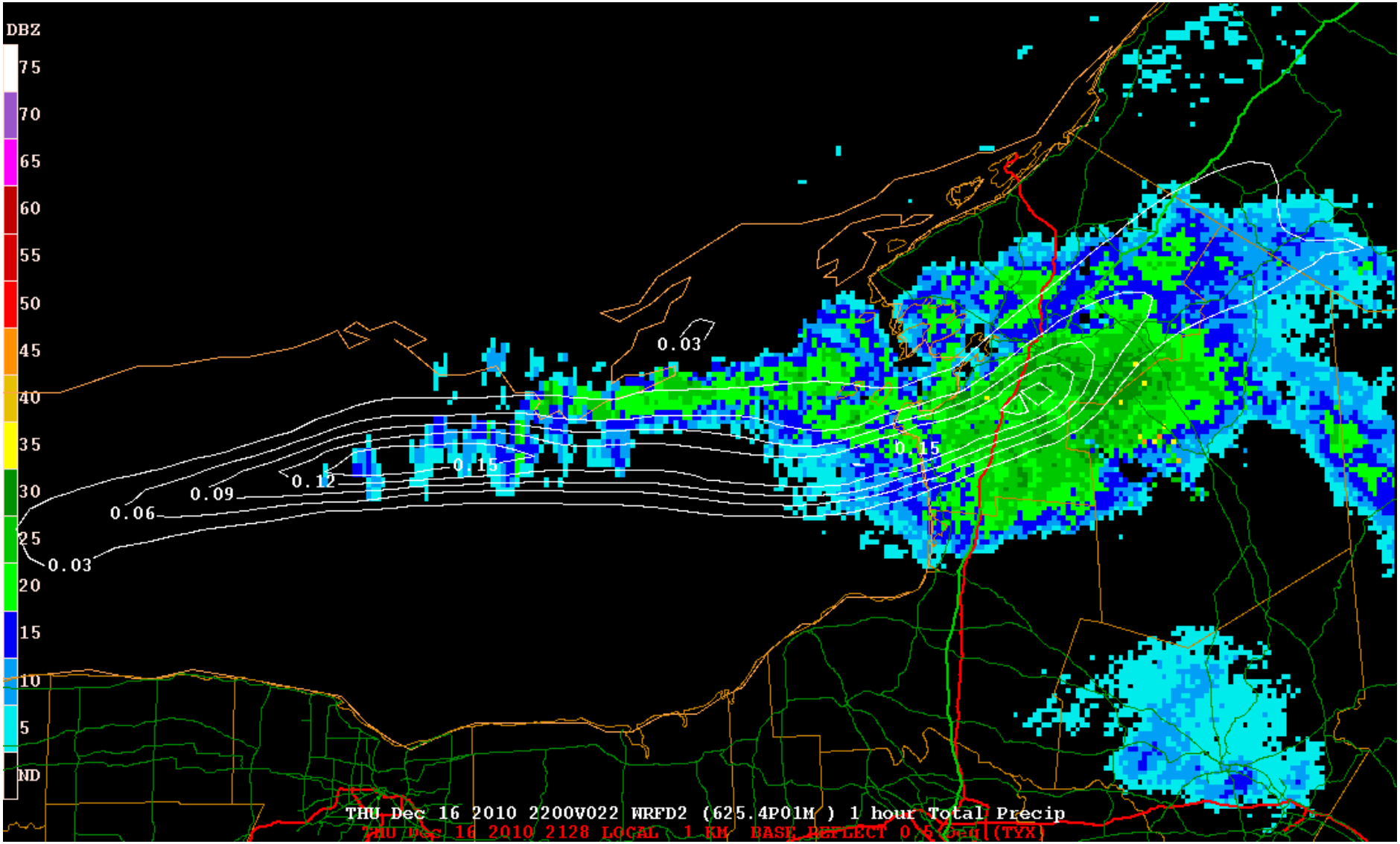
22 Jan 2013: Goddard scheme



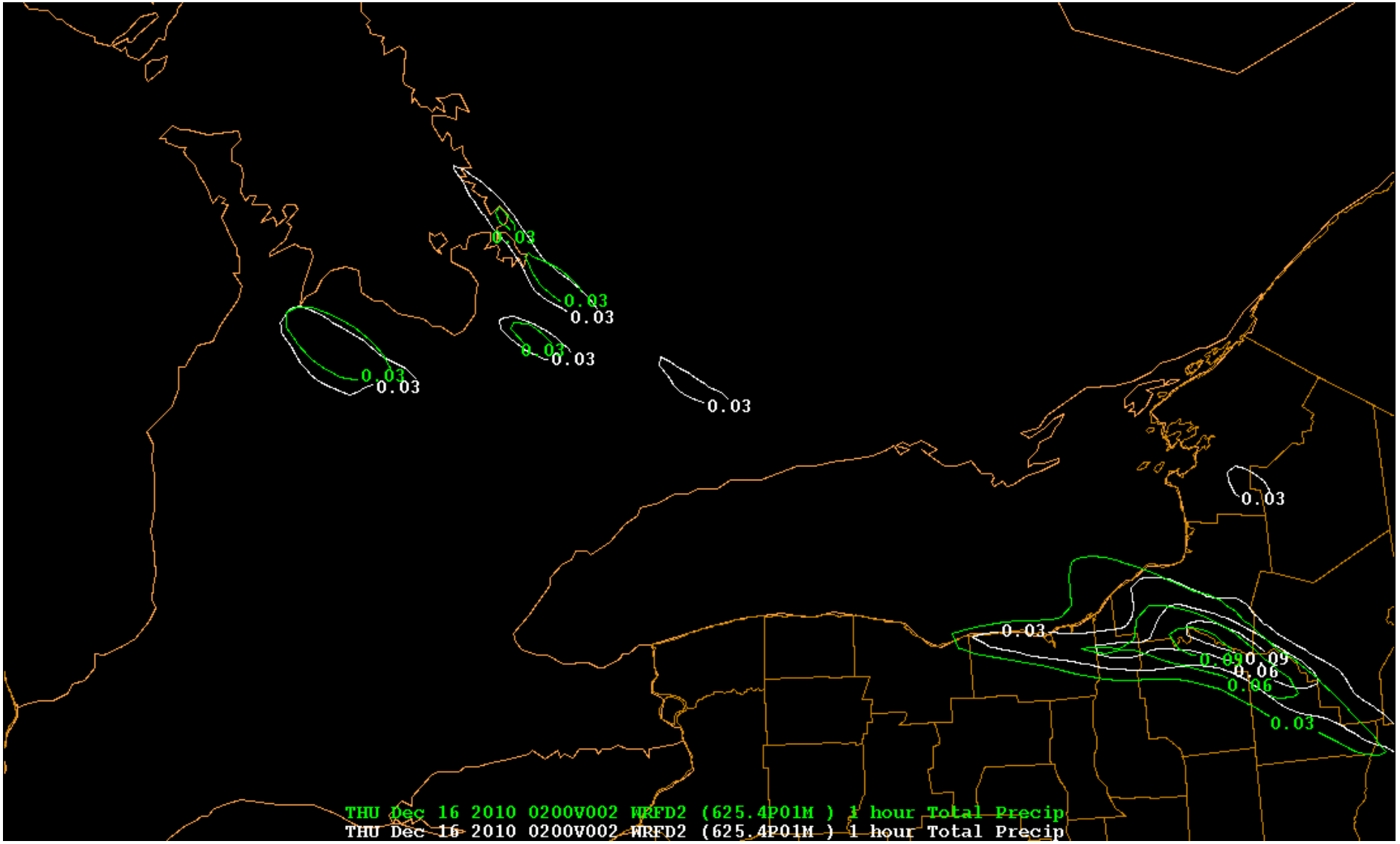
16 Dec 2010: WRF prcp vs TYX radar



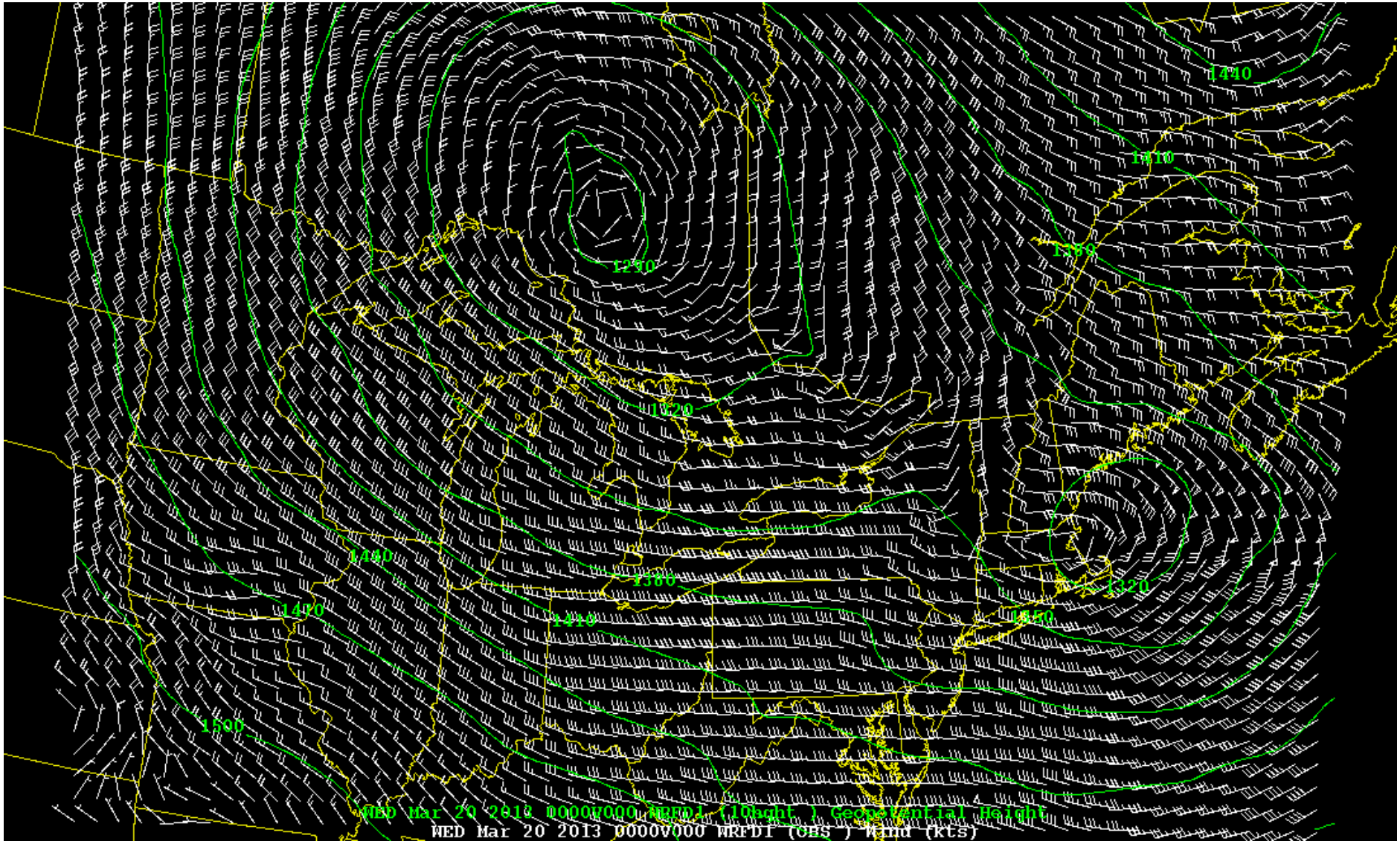
16 Dec 2010: TYX vs WRF nested at 22Z



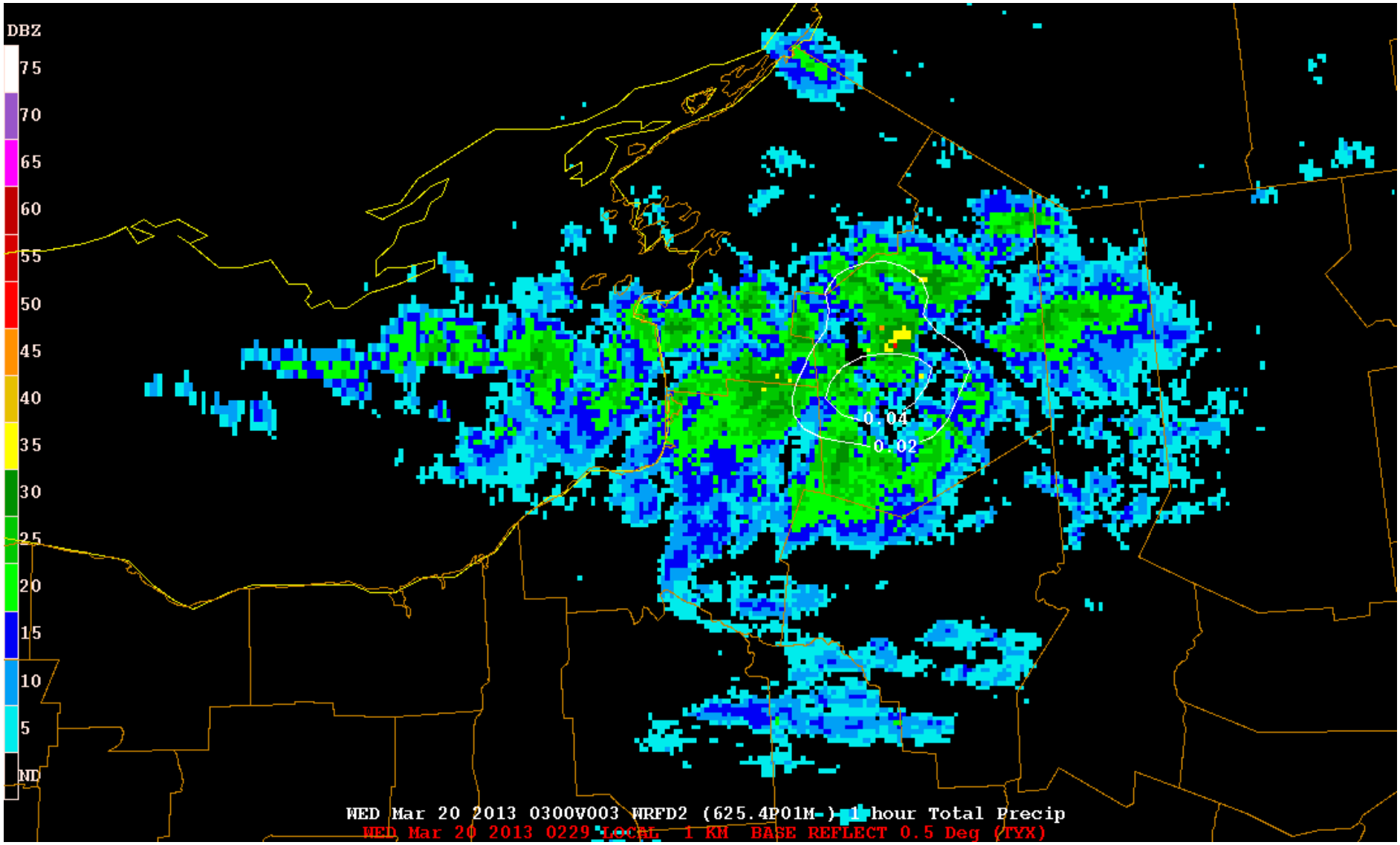
De1610: Nested run vs Only 4km grid



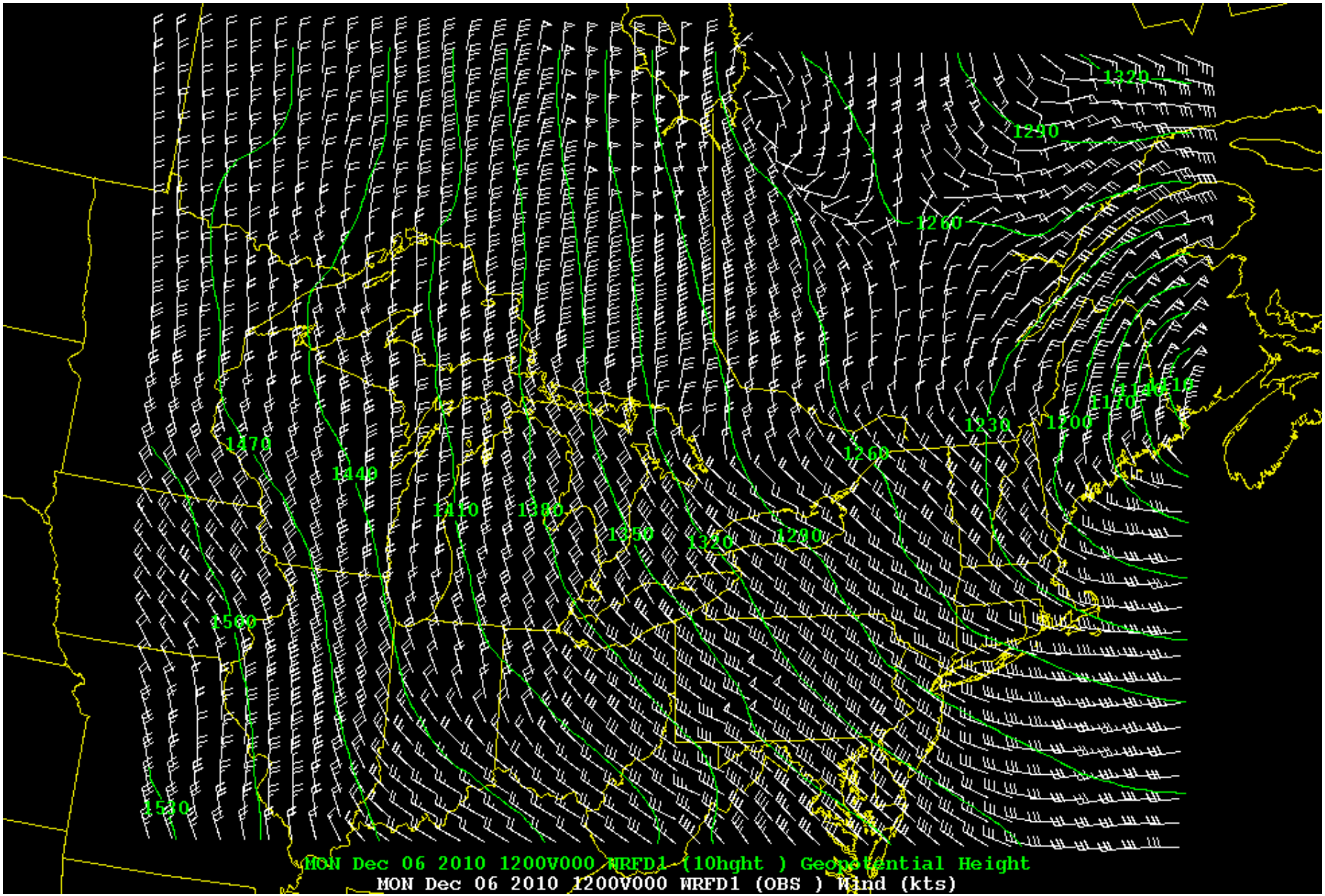
20 Mar 2013: 850 hPa loop



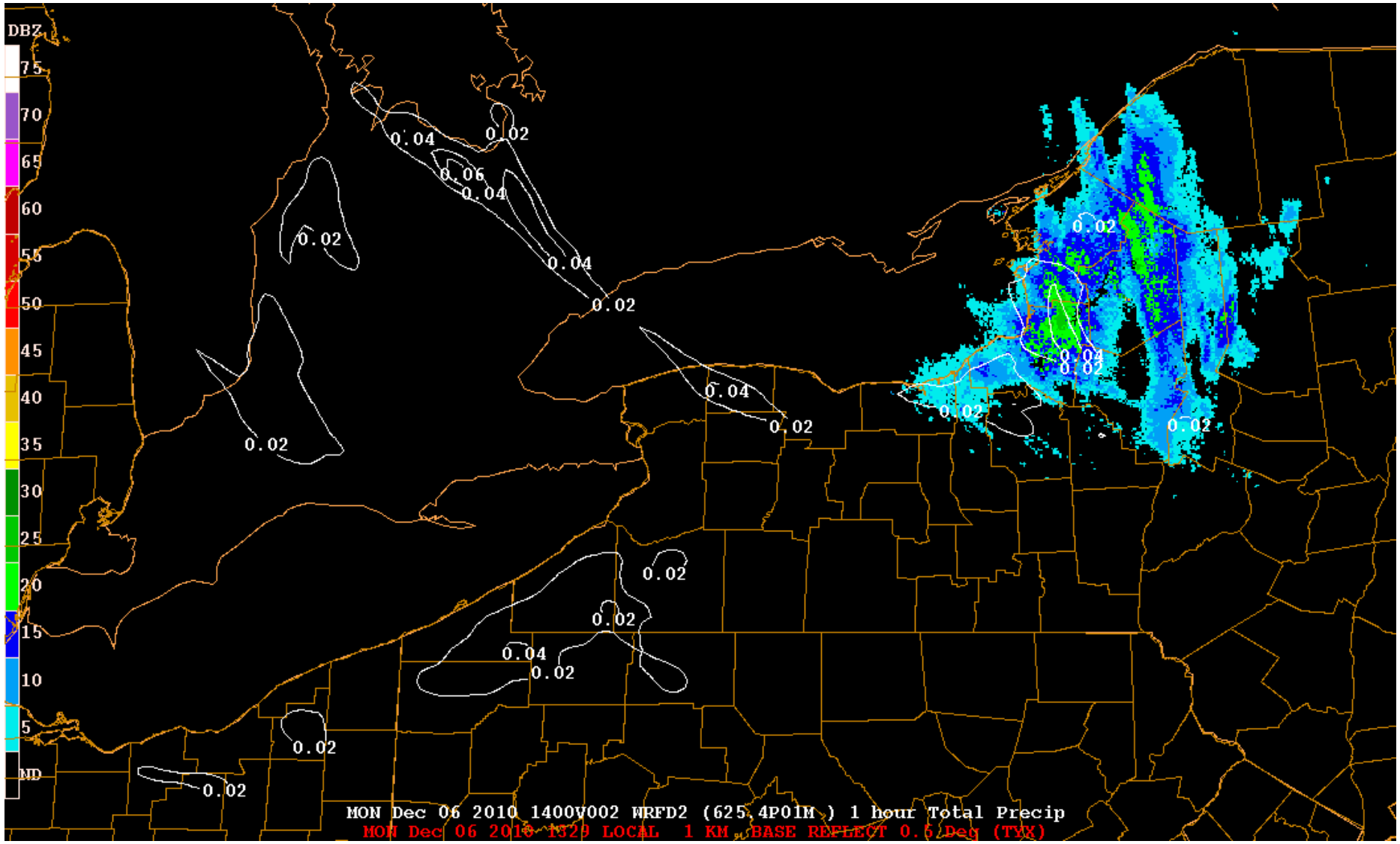
20 Mar 2013 WRF vs TYX radar



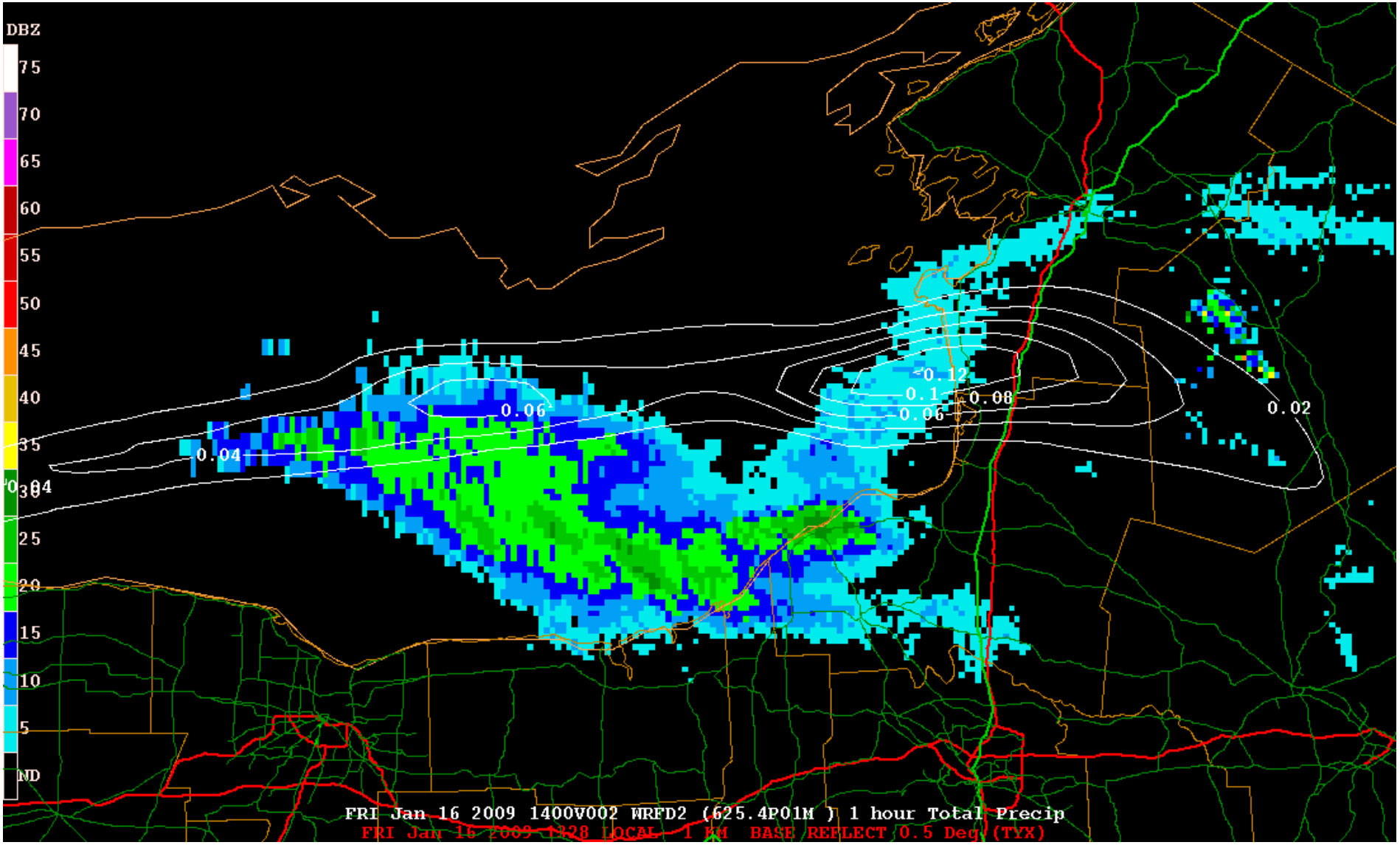
06 Dec 2010: 850 hPa loop



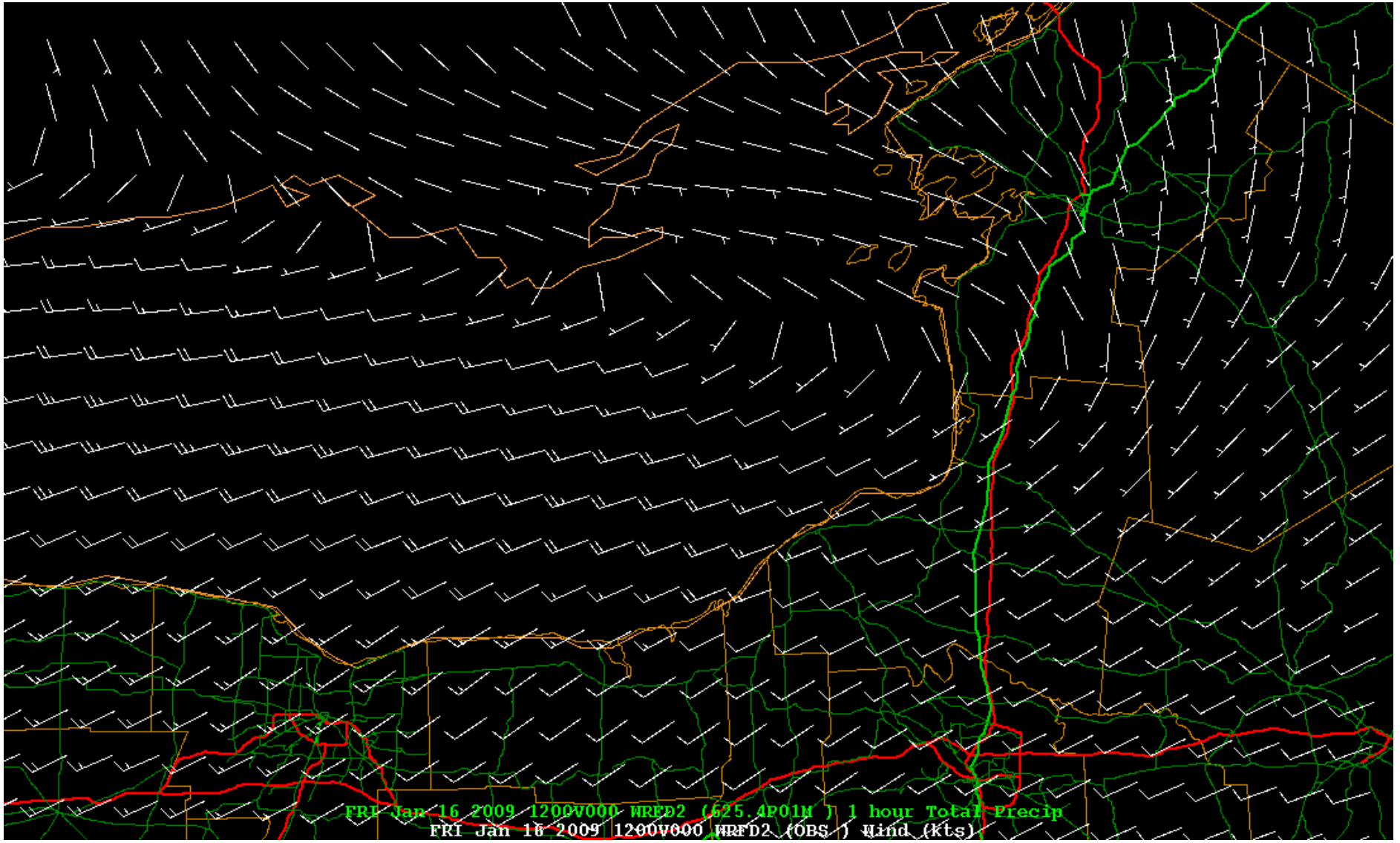
06 Dec 2010: WRF-prcp vs TYX radar



16 Jan 2009: TYX vs WRF prcp



16 Jan 2009: WRF prcp and 10m wind



Moist Physics Options

- 3-class: Simple efficient scheme with ice and snow
- 5-class: ice, snow, mixed-phase, supercooled water
- Eta: Operational NCEP microphysics
- 6-class: ice, snow and graupel
- Goddard: ice, snow, graupel
- Lin et al: ice, snow, graupel
- Thompson, et al.: ice, snow, graupel, rain # concen.
- Stony Brook (Lin): 5-class with riming intensity
- **We will use the 3-class scheme in 'Control Runs'**

Planetary Boundary Layer Options

- Yonsei (YSU): Parabolic K-profile, explicit entrainment layer for unstable mixed layers
- MYJ: 1-dim TKE with local vertical mixing
- ACM2: asymmetric convective model, local upward and downward mixing
- QNSE: TKE option, eddy diffusivity mass flux (da
- LES: large-eddy simulation of PBL
- Topo wind: topographic correction for surface winds to provide extra drag at hill tops (with YSU)
- **The YSU scheme will be used with 'Control Runs'**