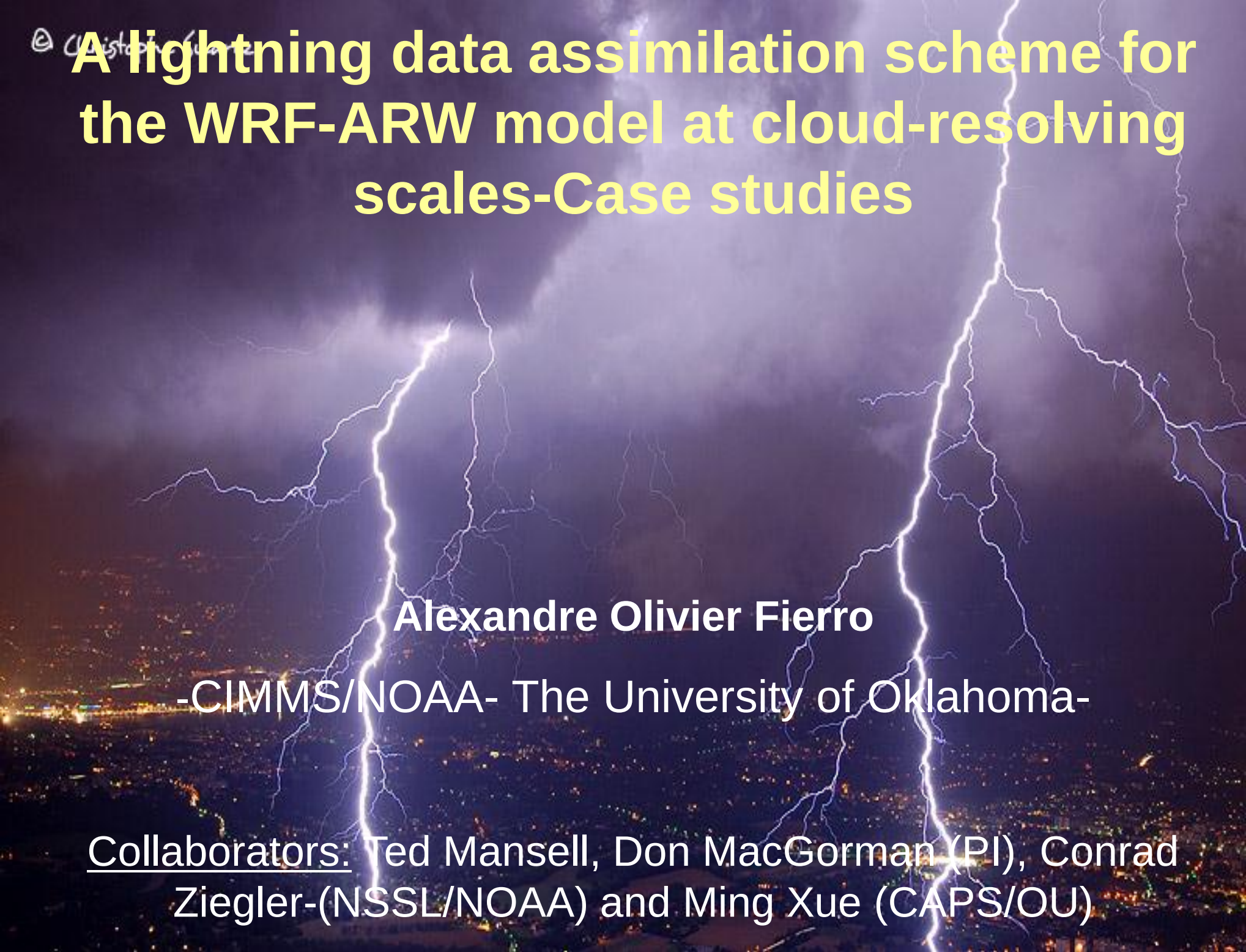

A lightning data assimilation scheme for the WRF-ARW model at cloud-resolving scales-Case studies

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Scientific Goals:

•Occurrence of lightning is correlated to basic storm quantities often diagnosed/predicted in NWP models:e .g., graupel mixing ratio, w, supercooled water, supersaturation over ice and/or water

•Therefore a natural question to ask is:

Can total lightning data (IC+CG) be used as a tool within NWP models to provide better Initial Conditions for convection at cloud resolving scales (dx <= 5km)?

•Improved Initial Conditions will provide a better physical background for variational ensemble methods such as EnKF at analysis time to improve short term severe weather forecasts.

•In this work; **the total lightning** data from networks such as the WTLN or LMA+NLDN were assimilated or nudged into the WRF-ARW model using a computationally inexpensive smooth analytical function and tested for several cases studies at cloud resolving scales.

Future/Ongoing work: Continue testing/refining assimilation technique using other lightning networks and/or with other numerical models and/or for other case studies. The latter will include several types of convective regimes in different environments (supercell, MCS, TC), again focusing on assimilating **total lightning**.

24 May 2011 case: Setup in a 'flash':

•Triple nested grid with 9/3/1 km: from GEOS-R to convection resolving scales

•No feedbacks between grids allowing independent comparisons of the model output

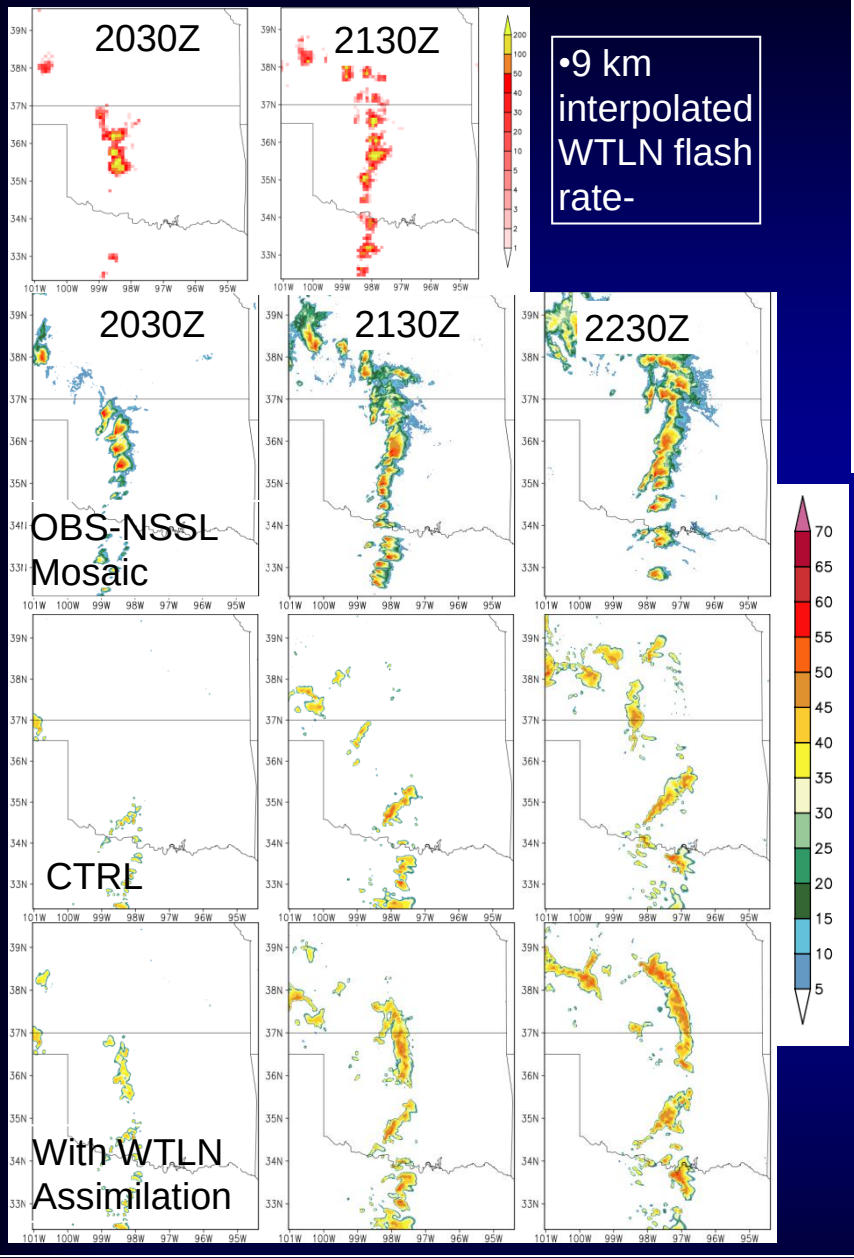
•12Z NAM 40 km data used as input for IC/BC (00Z runs not shown).

•Lightning nudging carried out using a smooth continuous function for water supersaturation within the mixed-phase region as a function of flash rate and graupel mixing ratio.

•WTLN total lightning data interpolated onto a 9 km grid mimicking GOES-R resolution.

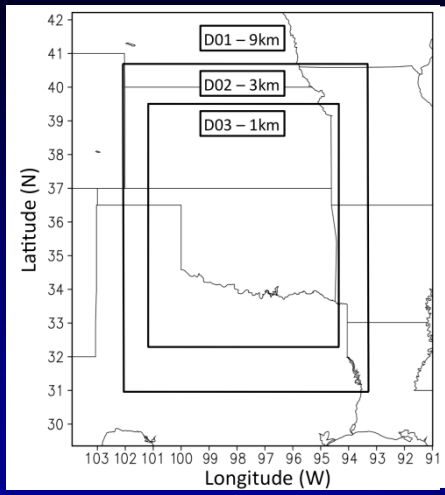
Results 1930-2130Z (Z=2km) 3 km grid

2130Z=analysis time / 2230Z=1h forecast

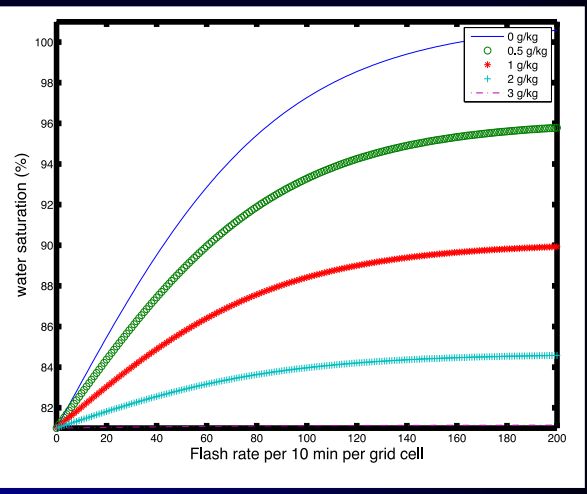


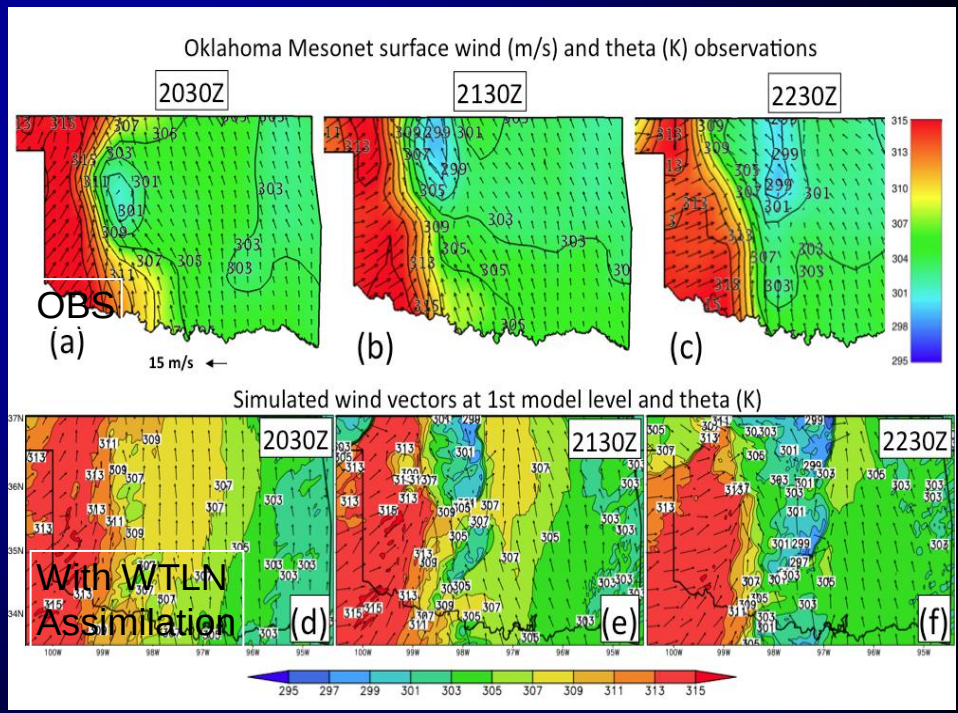
•9 km interpolated WTLN flash rate-

Domains



Nudging function



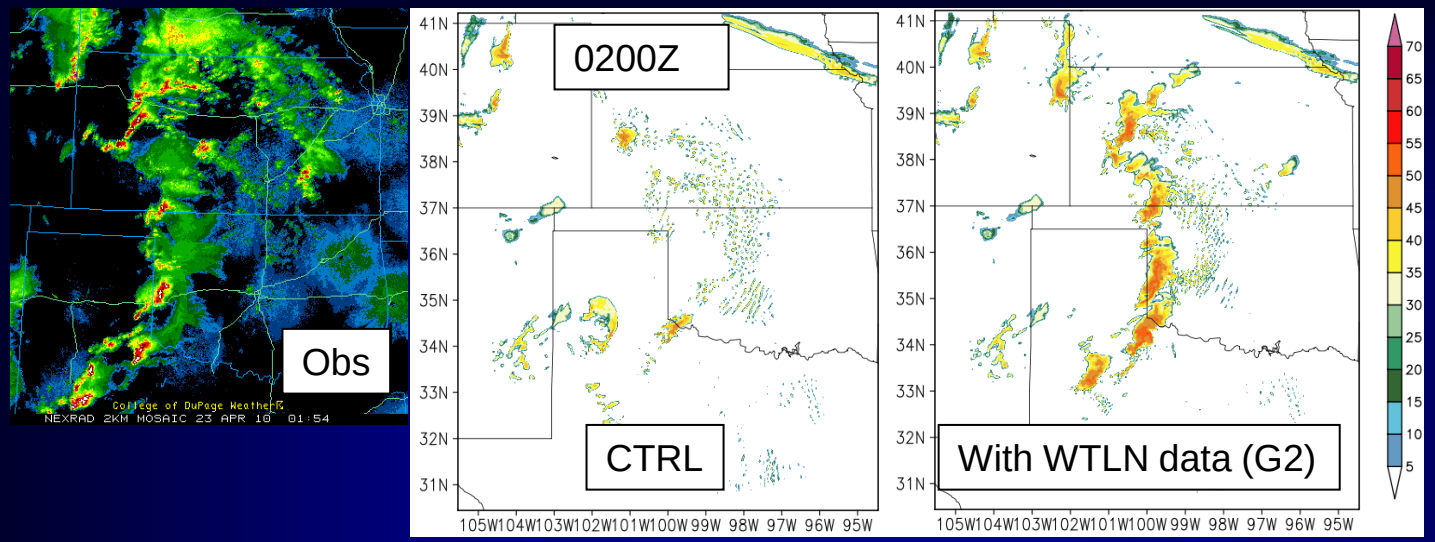


•This new cloud-scale lightning assimilation scheme showed promising results in producing a better representation of the observed convection and the cold pools at analysis time at 3 km and 1 km.

Fierro, A. O., E.R. Mansell, D. R. MacGorman and C. Ziegler 2011: Application of a lightning data assimilation technique in the WRF-ARW model at cloud-resolving scales: for the tornado outbreak od May 24 2011. *To be Submitted to MWR, September/October 2011-*

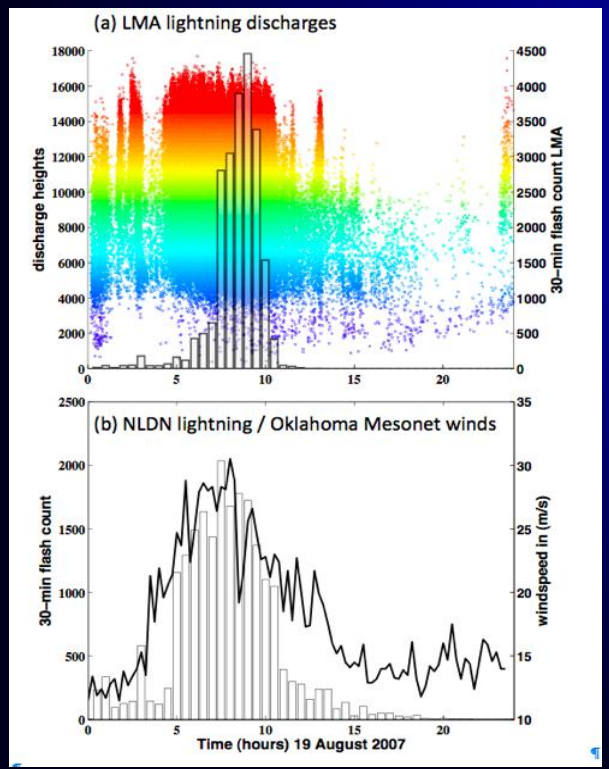
Other case studies (again, using WRF-ARW):

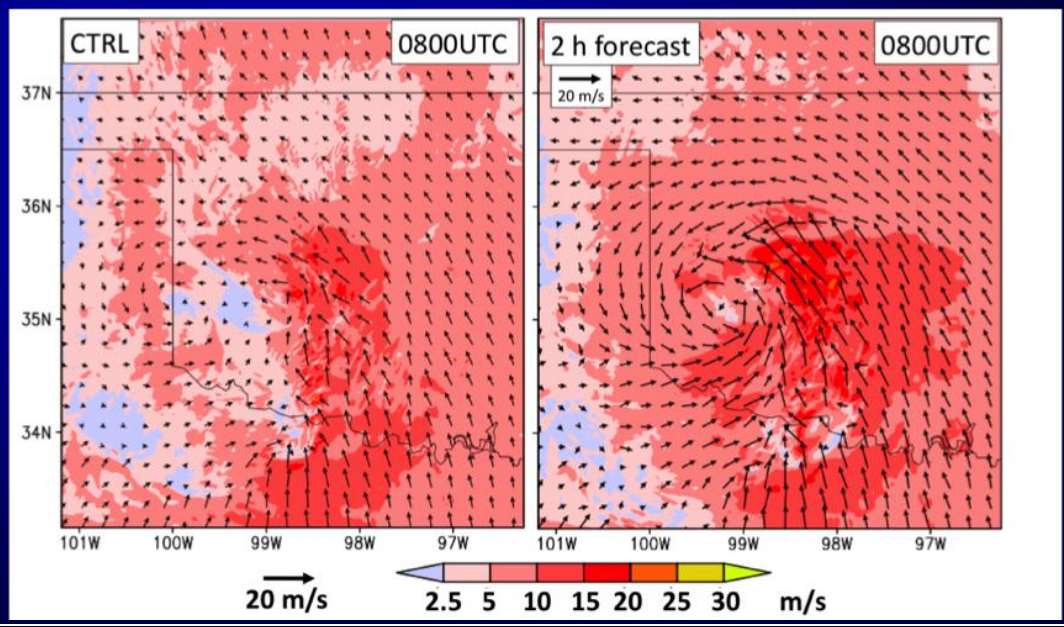
23 April: 2 h WTLN assimilation



Supercellular activity *at analysis time* is again much better resolved using lightning.

TS Erin (2007)-Using NLDN+LMA data:





Assimilation of 6h of NLDN+LMA improved intensity of Erin surface winds, which was otherwise not captured in the CTRL run.

Fierro, A. O., E.R. Mansell, D. R. MacGorman and C. Ziegler 2011: Application of a lightning data assimilation technique in the WRF-ARW model at cloud-resolving scales: Tropical Cyclone Erin (2007). *Submitted to MWR, June 2011-*