1. WHAT IS THE LNOM?

The NASA Marshall Space Flight Center (MSFC) Lightning Nitrogen Oxides Model (LNOM) [Koshak et al., 2009, 2010, 2011; Koshak and Peterson 2011, 2013] analyzes VHF Lightning Mapping Array (LMA) and National Lightning Detection Network (NLDN) data to estimate the lightning nitrogen oxides (LNOx) produced by individual flashes. Figure 1 provides an overview of LNOM functionality.

2. BENEFITS OF LNOM

• Does away with unrealistic “vertical stick” lightning channel models for estimating LNOx.
• Uses ground-based VHF data that maps out the true channel in space & time to < 100 m accuracy.
• Therefore, true channel segment height (ambient air density) is used to compute LNOx.
• True channel length is used! (typically tens of kilometers since channel has many branches & “wiggles”).
• Distinction between ground and cloud flashes are made.
• For ground flashes, actual peak current from NLDN used to compute NOx from lightning return stroke.
• NOx computed for several other lightning discharge processes (based on Cooray et al., 2009 theory):
  • Hot core of stepped leaders and dart leaders
  • Corona shaft of stepped leader
  • K-changes
  • Continuing Currents
  • M-components
• LNOM statistics (see later) can be used to parameterize LNOx production for regional air quality models (like CMAQ), and for global chemical transport models (like GEOS-Chem).

3. STATISTICS

The LNOM data archive at (http://lightning.nsstc.nasa.gov/data/index.html#LNOM_DATA) now contains LNOx analyses for 468,928 flashes. Most of these flashes are derived from 9 years of North Alabama Lightning Mapping Array (Koshak et al, 2004) data as shown below in Figure 2; the remaining flashes are from 4 years of data derived from the DC metropolitan LMA network.

4. REFERENCES

Koshak, W. J., S. S. Peterson, E. W. McCaul, A. Biazar, Estimates of the lightning NOx profile in the vicinity of the North Alabama Lightning Mapping Array, International Lightning Detection Conference (ILDC), Atlanta, FL, April 19-20, 2010
Koshak, W., H. Peterson, M. Khan, A. Biazar, L. Wen, A summary of the NASA Lightning Nitrogen Oxides Model (LNOM) and recent results, 10th Annual Community Modeling and Analysis System (CMAS) Conference, Chapel Hill, NC, October 24-26, 2011.