Assessing Global Change Impact on the US using National Lightning Data

Project Scope & Activities Meeting
National Climate Assessment
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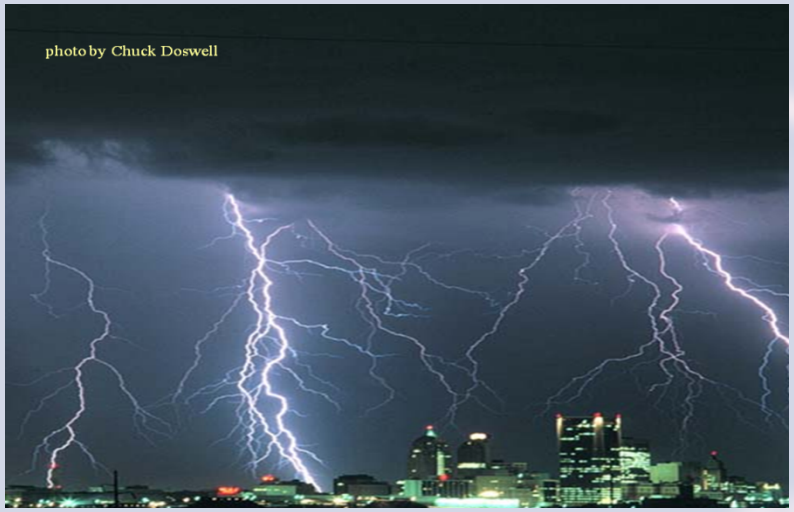
Interconnections & Assessments

Interconnections:



Increased Lightning
(& increases in fraction of +CGs)

Increased Thunderstorms & Extreme Wx

Enhanced Tropopause "Ice Factory"

Enhanced Upper Trop NOx

Enhanced Upper Trop H20 vapor

Enhanced Upper Trop Ozone

Increased Convection

Temp Increase

Enhanced Greenhouse Gases

IMPACTS	COSTS
Increased Human Deaths & Injuries	Increased Medical Costs
Increased Livestock Deaths/ Injuries & Crop Damage	Increased Food Prices
Increased Power Outages	Increased Repair, Research, & Protection Costs
Increased Fires to Wildlands & Buildings	Increased Mitigation & Insurance Costs
Increased Delays to Outside Operations: Airport, Launches, Mining, Fed Ex, etc.	Time is Money
Increased Use of Generator Power (by: hospitals, op radars, emergency managers, military facilities)	Increased Generator Fuel Costs
Increased Tropospheric Ozone	Increase Costs to Industry trying to meet National Ambient Air Quality Standards (NAAQS)

ASSESSMENT VARIABLES:

Item	Assessment Parameter	Description	Use
1	NUMALL	Total number of CGs	Increase is indicative of warming climate, & more fatalities/damage.
2	NUMPOS	Total number of +CGs	Increase is indicative of warming climate, & more fires.
3	NUMNEG	Total number of –CGs	Increase is indicative of warming climate, & more fatalities/damage.
4	RATIO	Fraction of +CGs (ratio of NUMPOS to NUMALL)	Increase is an additional indicator of warming climate & more fires.
5	CURABS	Average absolute value CG peak current (in kiloamps)	Increase implies more power outages & fires, and more NOx/O_3 (all else being the same).
6	CURPOS	Average peak current of +CGs (in kiloamps)	Increase implies more power outages & fires, and more NOx/O_3 (all else being the same).
7	CURNEG	Average peak current of –CGs (in kiloamps)	Increase implies more power outages & fires, and more NOx/O_3 (all else being the same).
8	MULALL	Average multiplicity of CGs (# of strokes in CG flash)	Increase implies more power outages & fires, and more NOx/O_3 (all else being the same).
9	MULPOS	Average multiplicity of +CGs (# of strokes in +CG flash)	Increase implies more power outages & fires, and more NOx/O_3 (all else being the same).
10	MULNEG	Average multiplicity of –CGs (# of strokes in –CG flash)	Increase implies more power outages & fires, and more NOx/O_3 (all else being the same).
11	NFAT	Number of fatalities due to lightning as reported in *Storm Data*.	Increases with increasing # of CGs (all else being the same).
12	NINJ	Number of injuries due to lightning as reported in *Storm Data*.	Increases with increasing # of CGs (all else being the same).
13	NDAM	Number of damage (property + crop) reports due to lightning as reported in *Storm Data*.	Increases with increasing # of CGs (all else being the same).
14	DCOST	Damage (property + crop) costs due to lightning as reported in *Storm Data*.	Increases with increasing # of CGs (all else being the same).
15	NPOW	Number of lightning-caused power outages [from utility companies].	Increases with increasing # of CGs (all else being the same).
16	NWILD	Number of lightning-caused wild land fires [from National Interagency Fire Center, NIFC; and National Fire Incident Reporting System (NFIRS)].	Increases with increasing # of CGs (all else being the same).

The Lightning Data

National Lightning Network

❑ National Lightning Detection Network™ (NLDN)

❑ Owned by Vaisala (a Finnish company that develops, manufactures and markets products and services for environmental and industrial measurement).

❑ Applications & Customer Base (http://www.vaisala.com)

✓ Weather forecasting: Help predict severe weather for public warning
✓ Electric power utilities: Pre-position field crews for approaching storm threats and to improve engineering and design with lightning analysis
✓ Air traffic control: Re-route aircraft around hazardous thunderstorms
✓ Airports: Suspend high-risk activities like fueling during lightning threats
✓ Insurance and arson: Investigate lightning as the cause of property damage or fire
✓ Power-sensitive manufacturing and processing operations: Prepare for storm-caused power outages by switching to back-up power early
✓ Hazardous materials handling: Warn personnel working near explosives and flammable materials to evacuate
✓ Forestry: Dispatch crews to suspected fire starts for more successful initial attack
✓ Golf and outdoor recreation: Warn players to seek safety from storms
✓ Launch facilities: Monitor for safest weather conditions for satellite launches

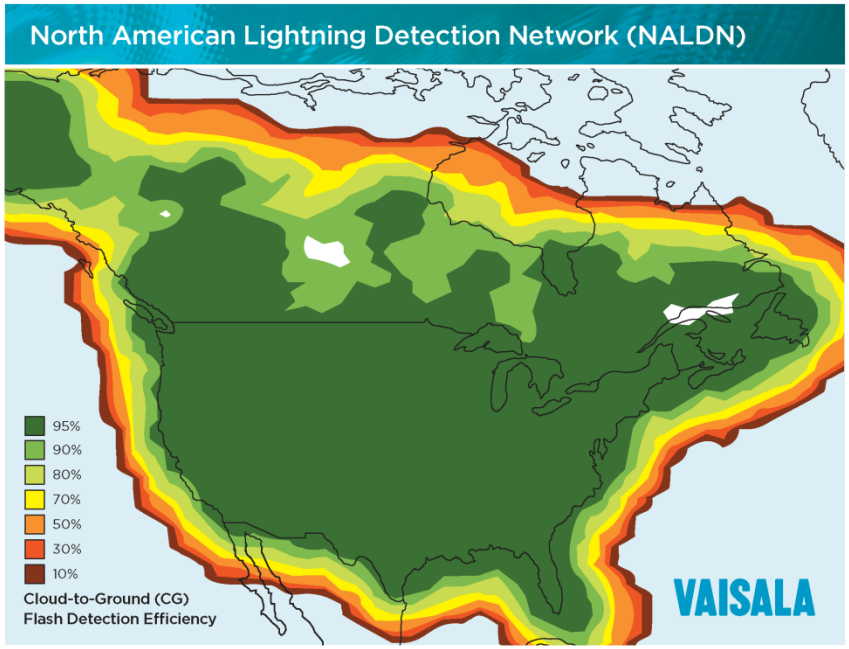
Brief Network History

- 1976: Invention of lightning Magnetic Direction Finding (MDF) technology (Krider).
- 1984-1989: Three separate regional networks developed using MDF.
- 1989: Regional networks share data to establish a national network, the NLDN.
  - ✓ Cooperative project funded by Electric Power Research Institute (EPRI)
  - ✓ Operated by State University of New York (SUNY) at Albany
  - ✓ ~70% DE
- 1991: Real-time & historic lightning data become commercially available
- 1993: NLDN Network Control Center moved to its current location in Tucson, AZ
- 1995: 1st Major Network Upgrade
  - ✓ added IMPACT sensors that combine MDF with time-of-arrival (TOA).
  - ✓ ~85% DE
- 2003: 2nd Major Network Upgrade
  - ✓ replacement of aging & old technology sensors w/third gen IMPACT ESP sensors
  - ✓ ~90% DE or better
- Present: with further upgrades, Vaisala claiming ~95% DE

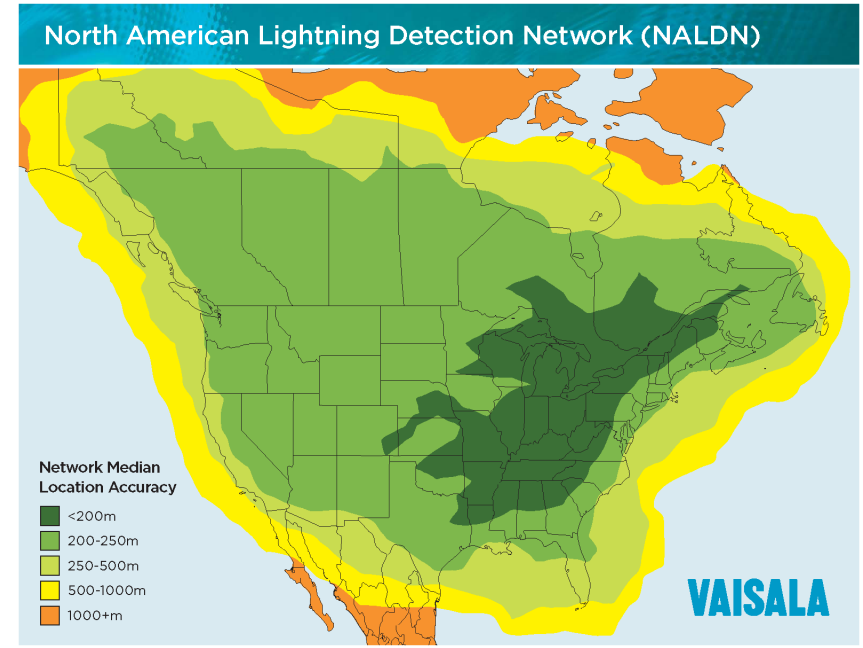
Present NLDN Data Characteristics

- > 114 sensors
- 90-95% Detection Efficiency (Vaisala claims even higher)
- Location Accuracy < 500 m
- 24/7 Coverage
- Data free-of-charge to this NCA project
- **Hence, time is right for this NCA Lightning Project!**

DE

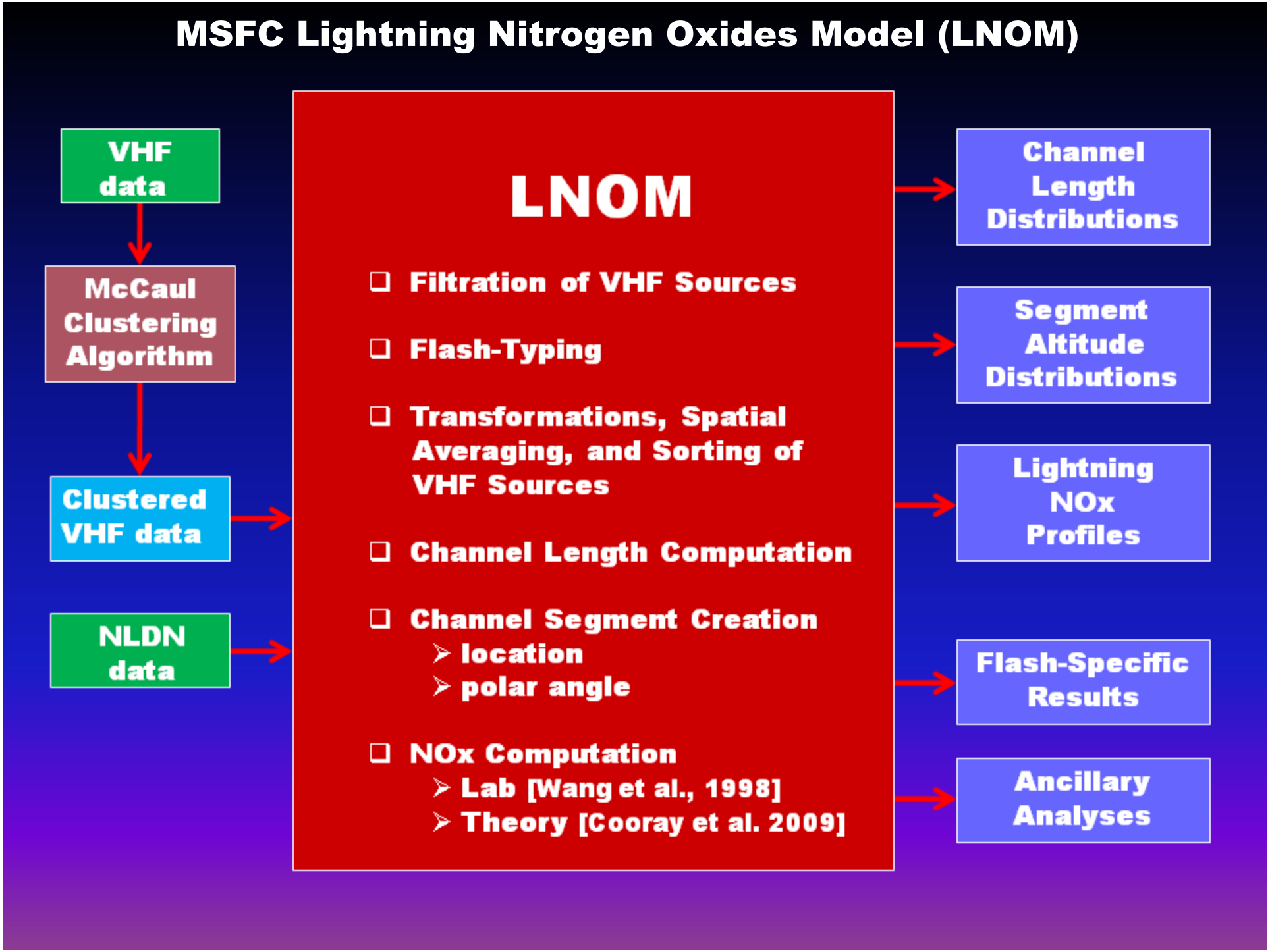


LOCATION ACCURACY

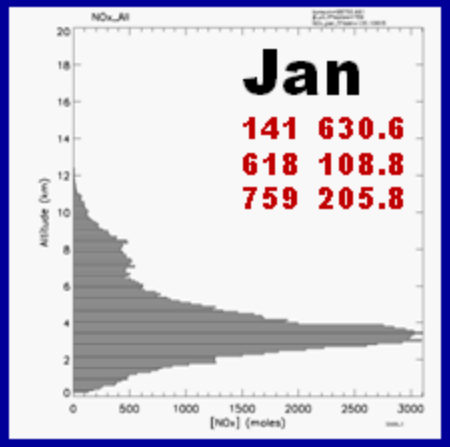


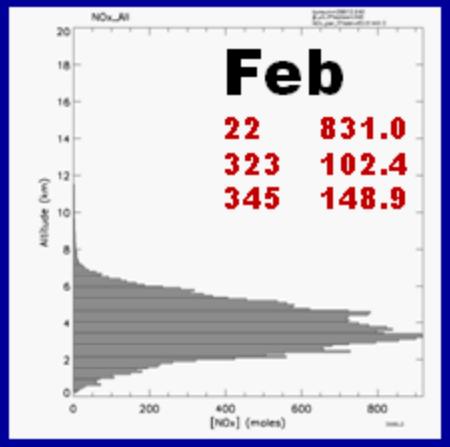
parallel/synergistic activities

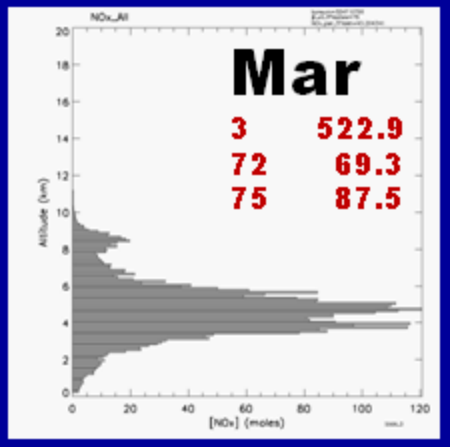
MSFC Lightning Nitrogen Oxides Model (LNOM)

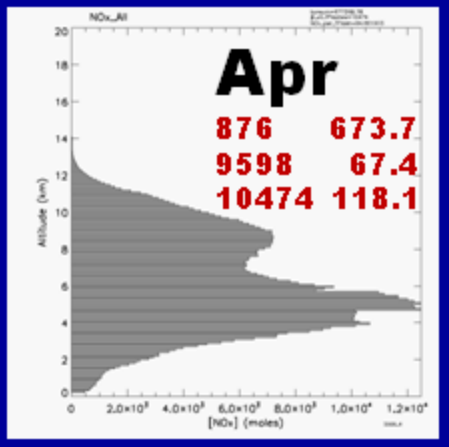


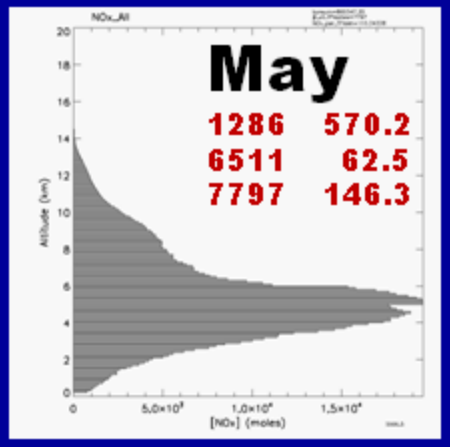
NOx Profiles in LNOM Analysis Cylinder. Year: 2006

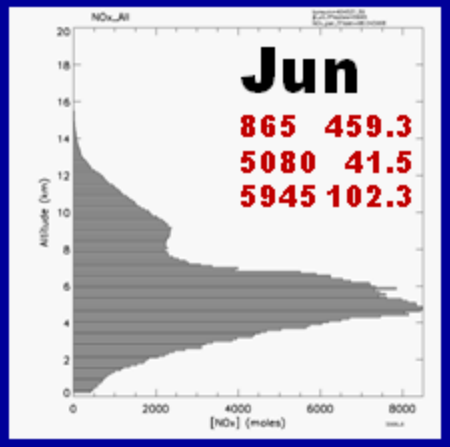


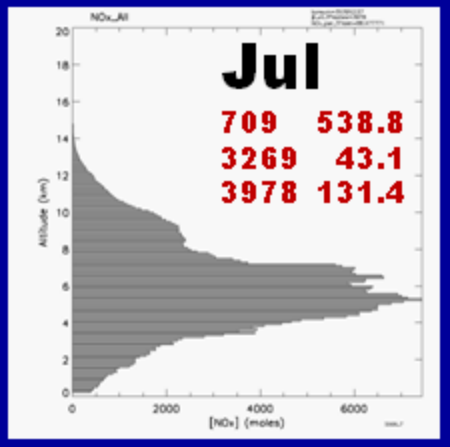


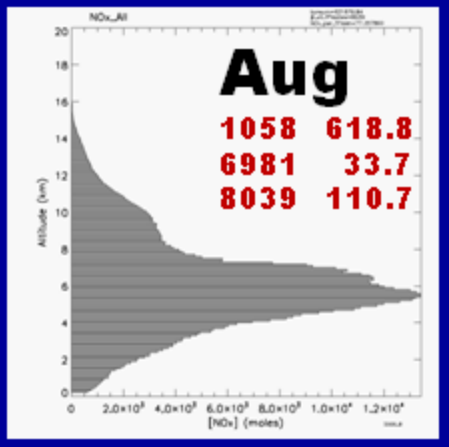


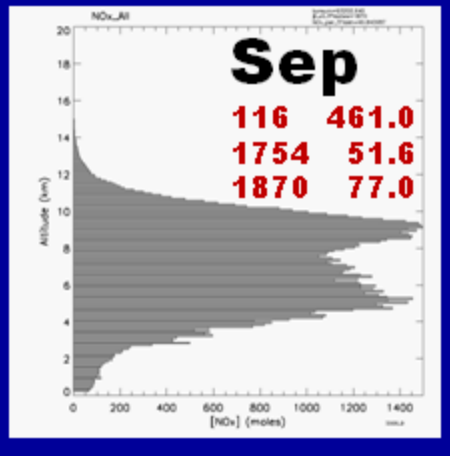


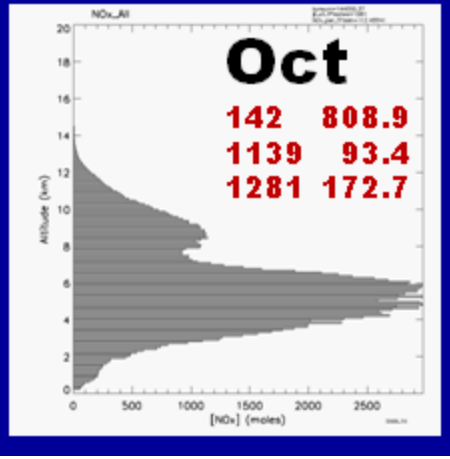


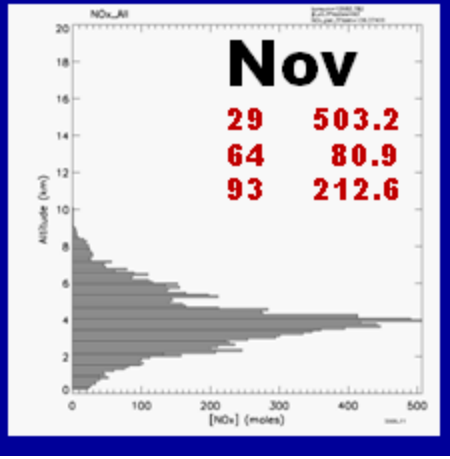


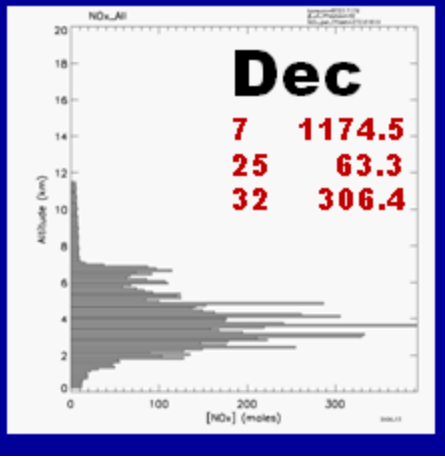












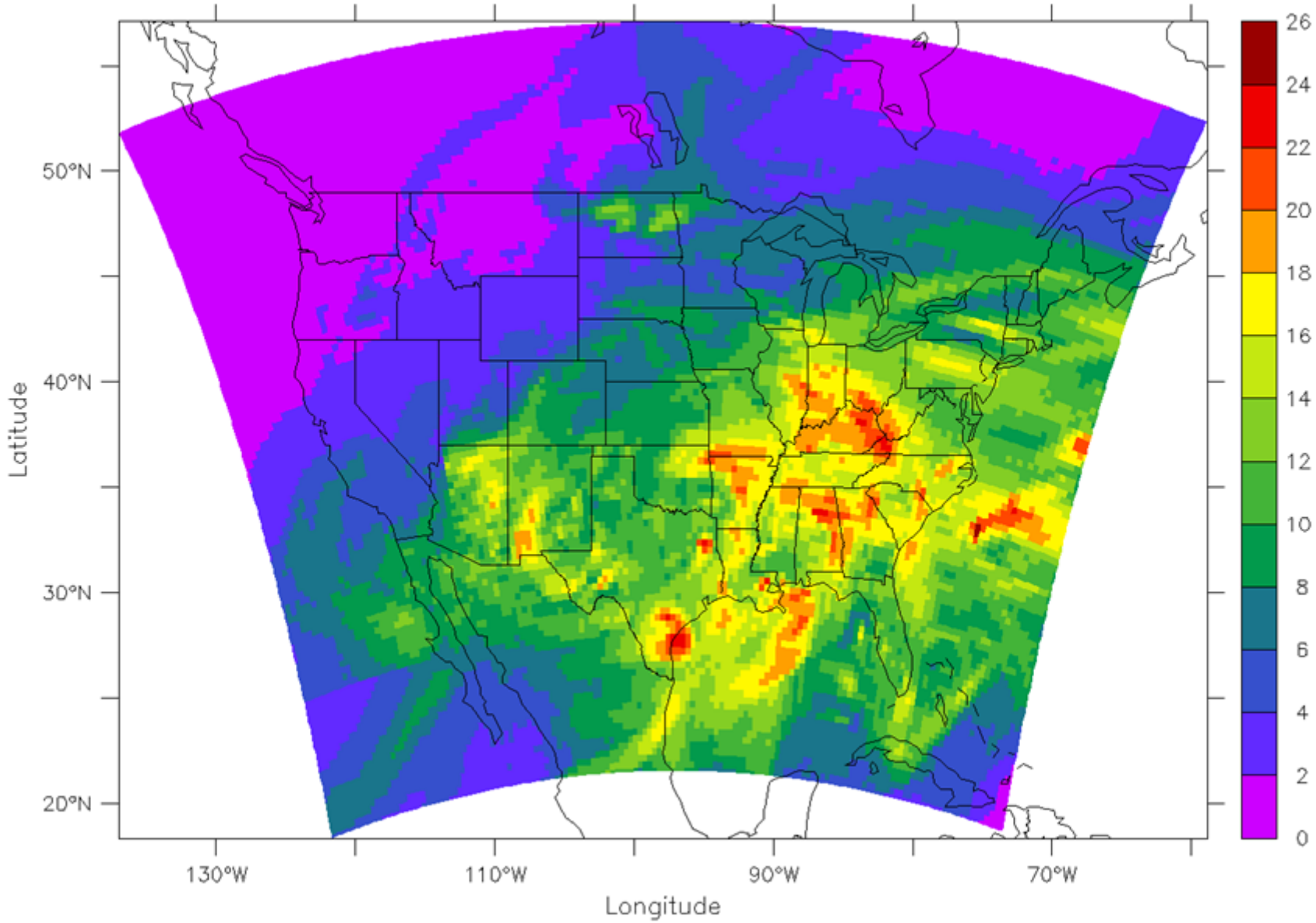


Figure 11. Maximum domain-wide increase in O_3 due to lightning NOx (ppb).

Questions?