Assessing Global Change Impact on the US using National Lightning Data

Project Scope & Activities Meeting
National Climate Assessment
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(abbreviated version)

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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).

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
- Hence, time is right for this NCA Lightning Project!

parallel/synergistic activities

Following results from the Lightning Nitrogen Oxides Model (LNOM) improve CMAQ ozone forecasts

Koshak, W. J., H. S. Peterson, A. P. Biazar, M. Khan, and L. Wang, 2014: The NASA Lightning Nitrogen Oxides Model (LNOM): application to air quality modeling, *Atmos. Res.*, 135-136, 363-369.

NOx Profiles in LNOM Analysis Cylinder. Year: 2006