

Verification of Thunderstorm Occurrence Using the National Lightning Detection Network



Kristen L. Corbosiero and Ross A. Lazear
University at Albany, State University of New York

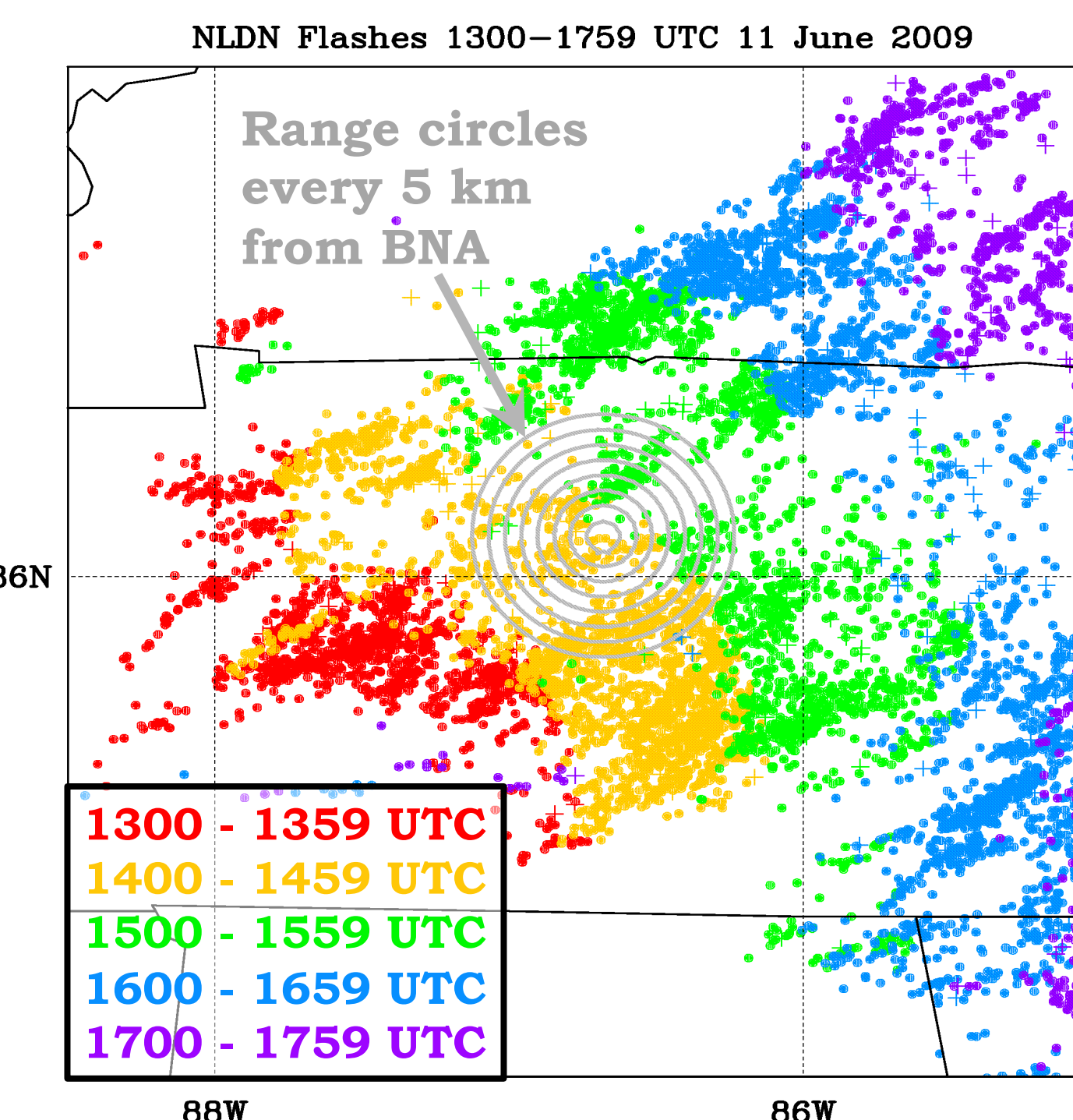
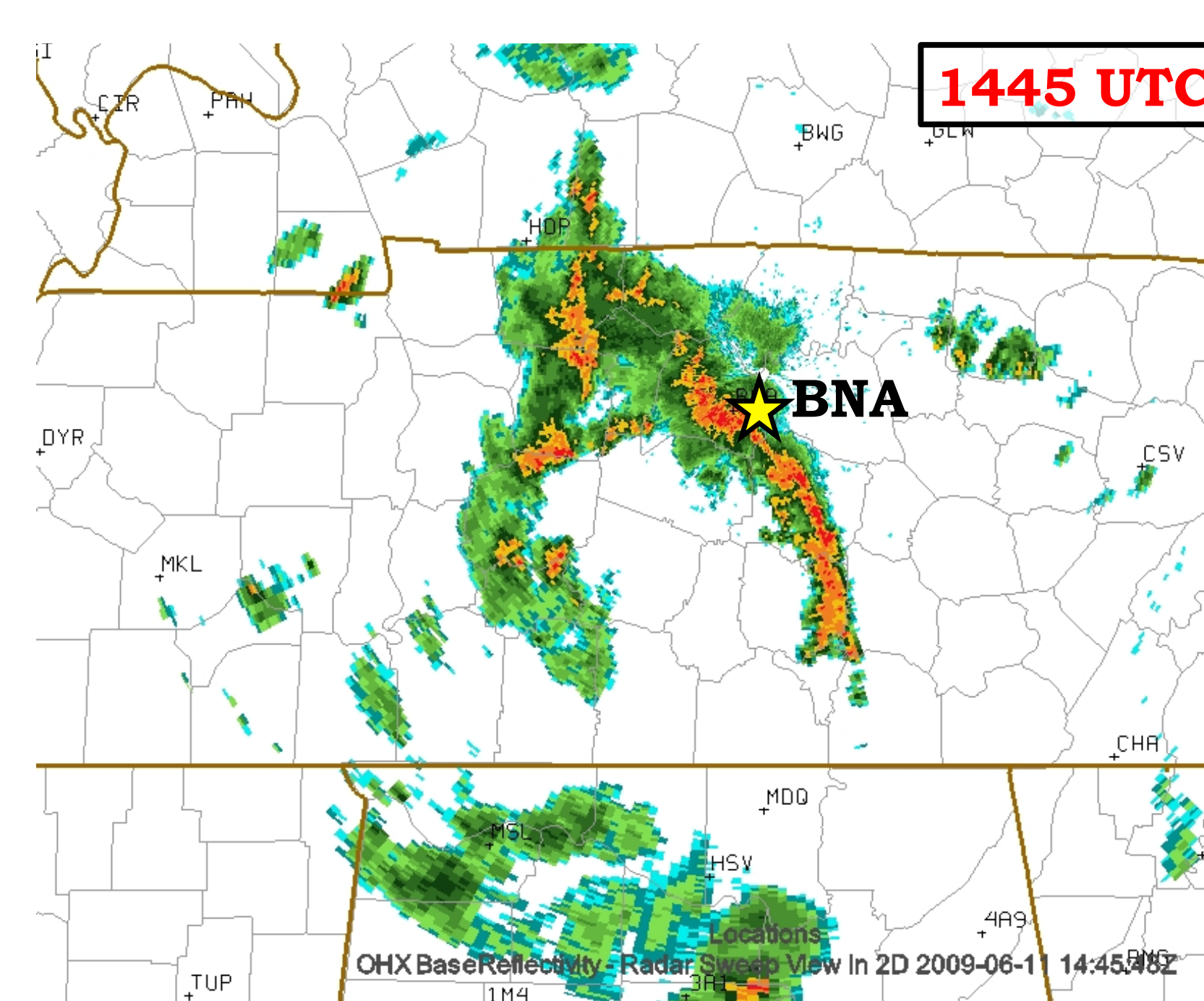
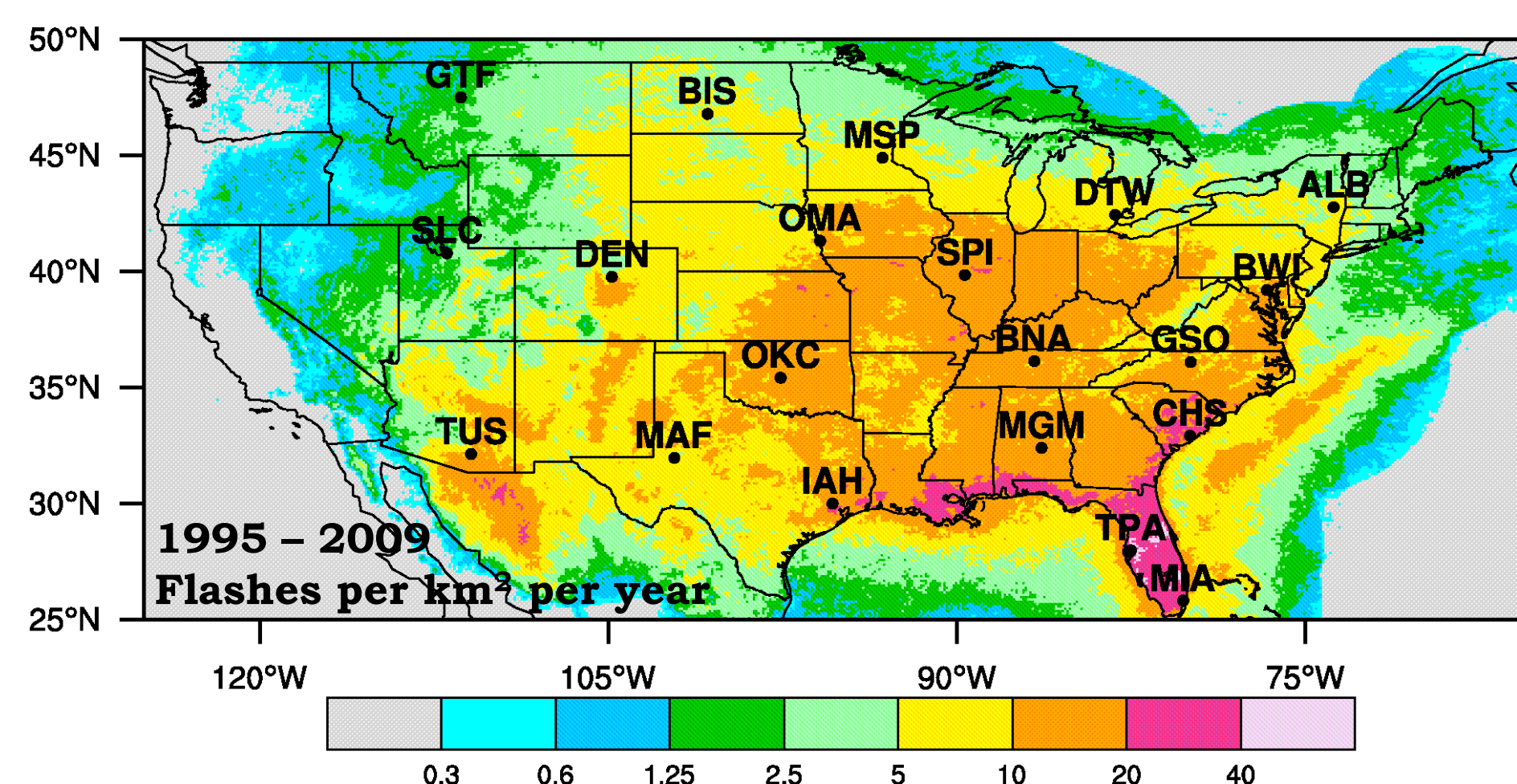


Introduction and Motivation

Since 1983, a **daily thunderstorm probability forecast contest** has been organized by the Department of Atmospheric and Environmental Sciences (DAES) at the **University at Albany** during the summer months of June, July, and August.

DAES Contest Consensus, Entry, and Verification Viewer

VERIFICATION TABLE - 6/10/2009										
KALB	KGSO	KBNA	KTPA	KOKC	KOMA	KSPI	KBIS	KDEN	KSLC	
N/O	T/10	N/O	T/10	N/O	T/10	N/O	T/10	N/O	T/10	
M = Missing, N = No Thunder, L = Lgt Observed, no Thunder, T = Thunder, G = GR 10 Thunder, N and D Go Back to Contest Page										
COMPLETE CONSENSUS TABLE - 6/10/2009										
KALB	KGSO	KBNA	KTPA	KOKC	KOMA	KSPI	KBIS	KDEN	KSLC	
0	0	0	0	0	0	0	0	0	0	
ENTRIES AND RANGES										
FORECASTER	KALB	KGSO	KBNA	KTPA	KOKC	KOMA	KSPI	KBIS	KDEN	KSLC
CONSENSUS	1	5	5	2	8	4	7	6	6	6
(T)	0/2	3/6	3/7	1/4	6/10	2/8	5/9	0/1	5/8	5/9
VOLUNTARILY										
"GFS"	0	4	8	3	6	2	5	0	7	5
"NAM"	2	6	5	4	5	5	5	2	6	6
Kevin Cappelen	0	6	4	3	6	4	7	0	5	5
Gary Dennis	2	4	5	2	10	3	5	1	5	5
ENCON	2	5	7	4	8	2	6	0	6	6
Russ Lazar	2	6	7	2	7	3	7	1	6	6
Scott Runyon	1	6	4	2	5	4	6	1	6	7
Kevin Tyle	1	3	3	1	7	3	5	0	6	7
Mike Verence	1	6	7	1	9	8	9	0	7	9



The contest involves **predicting** the **probability** to the nearest 10% that a thunderstorm (TS) will be **reported** during a 24-hour period at **10 locations** across the continental U.S. listed in the table above.

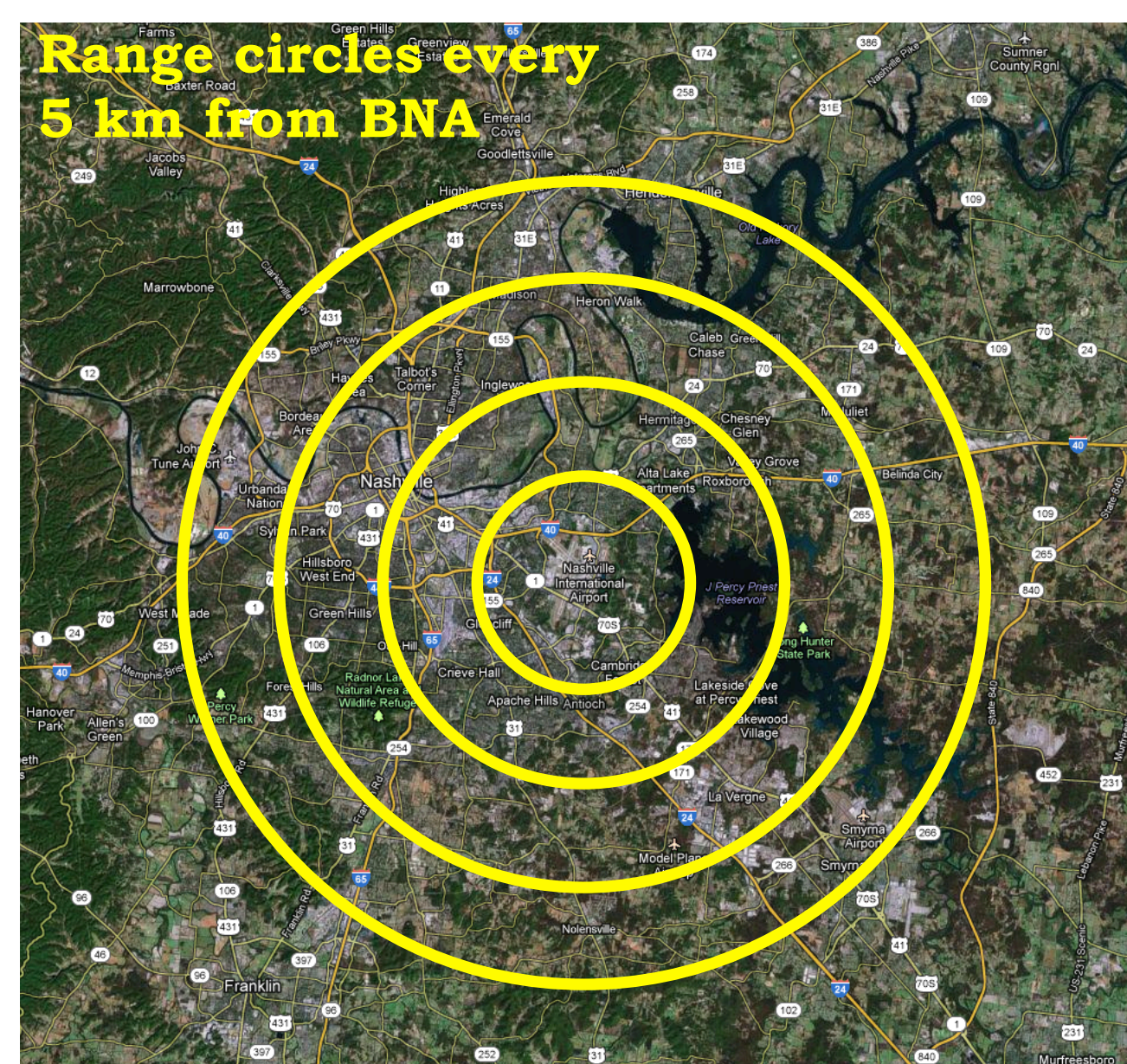
In recent years however, there have been **several instances** in which a **TS failed to be reported despite its occurrence**.

KBNA 111353Z VRB04KT 10SM SCT048 SCT075 BKN130 BKN200 26/22
 KBNA **111453Z** AUTO 27011G30KT 5SM R02L/1600V2400FT **+RA BR** FEW011
 KBNA **111458Z** AUTO 29007G16KT 1/2SM R02L/1800V4000FT **+RA FG** BKN004
 KBNA **111506Z** AUTO 36007KT 1SM R02L/3500VP6000FT **+RA BR** FEW003
 KBNA **111510Z** AUTO 00000KT 2 1/2SM R02L/4500VP6000FT **-RA BR** FEW003
 KBNA 111517Z AUTO 23004KT 10SM **-RA** FEW005 BKN013 OVC075 20/19
 KBNA 111523Z AUTO 00000KT 10SM **-RA** FEW005 SCT021 OVC070 20/19
 KBNA 111553Z AUTO 29006KT 10SM BKN045 BKN060 OVC075 21/19

Given its continuous space and time coverage, average detection efficiency of ~95% and mean location errors of <500 m, using the NLDN to verify TS occurrence is explored between 2001 and 2011 at the original 10 stations of the Albany forecast contest, plus 10 additional cities to cover the full spectrum of summertime, synoptic environments and rates of thunderstorm occurrence across the continental U.S.

Climatology and Interannual Variability

July 2001-2011					August 2001-2011				
METAR	5	10	15	20	METAR	5	10	15	20
.17	.13	.18	.23	.26	.16	.12	.14	.21	.23
.24	.19	.27	.33	.36	.20	.15	.21	.26	.29
.35	.21	.30	.35	.41	.24	.14	.20	.26	.32
.42	.32	.41	.47	.52	.37	.26	.35	.43	.53
.41	.41	.55	.65	.70	.41	.50	.61	.68	.76
.55	.48	.66	.76	.81	.54	.46	.62	.74	.80
.23	.16	.23	.29	.32	.15	.09	.16	.21	.24
.37	.28	.42	.50	.54	.29	.19	.31	.40	.47
.25	.20	.28	.34	.38	.22	.18	.26	.32	.35
.18	.16	.21	.25	.26	.18	.16	.22	.26	.28
.21	.15	.20	.23	.26	.20	.15	.19	.21	.23
.38	.32	.43	.51	.58	.30	.28	.33	.39	.44
.25	.16	.21	.25	.28	.23	.18	.22	.25	.28
.17	.13	.17	.21	.24	.24	.18	.23	.27	.30
.28	.19	.26	.28	.33	.19	.13	.17	.21	.24
.17	.10	.15	.17	.22	.21	.15	.21	.26	.30
.43	.22	.33	.41	.48	.38	.20	.31	.40	.45
.35	.26	.39	.51	.56	.39	.24	.35	.43	.54
.14	.10	.17	.22	.28	.12	.06	.14	.17	.23
.19	.07	.14	.19	.23	.22	.11	.19	.23	.28



The tables to the left explore the number of METAR TS and NLDN lightning days without taking into account whether the days match. The **tables below** take **date matching** into account and explore two questions:

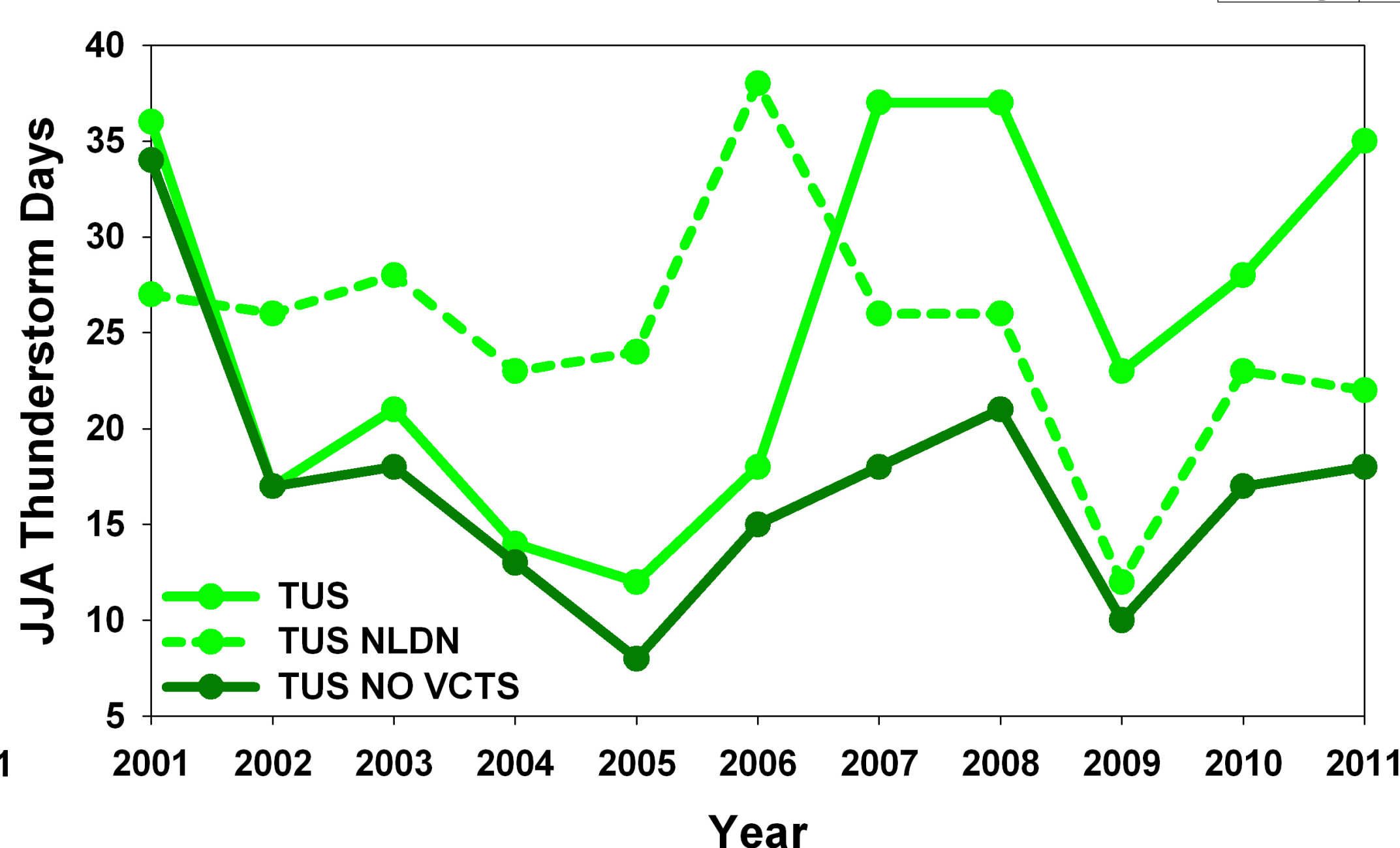
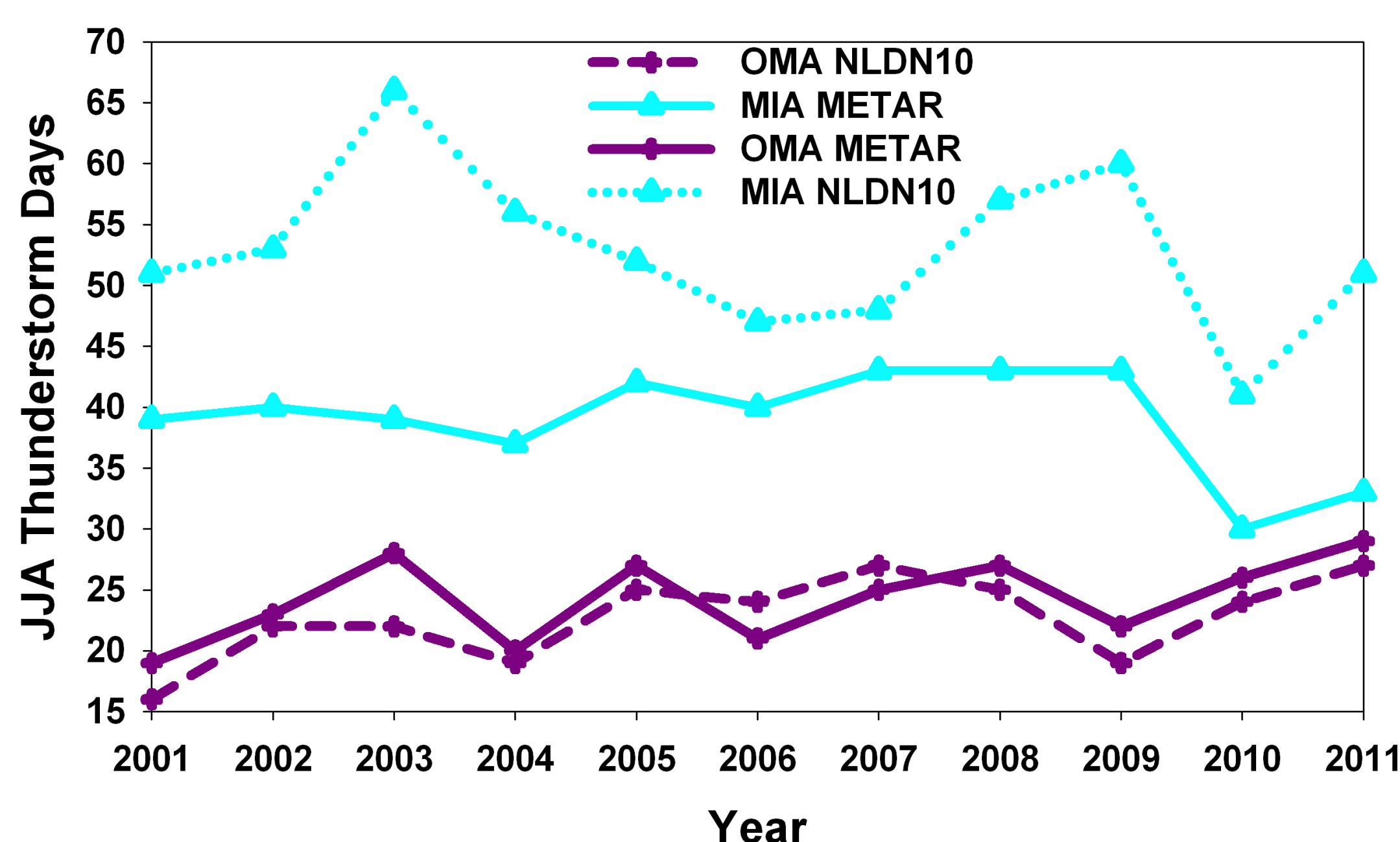
If the NLDN detects lightning within X km of a station, what percentage of the time does that station report a TS?

Station	5	10	15	20
ALB	90	82	71	65
BWI	94	83	74	67
GSO	96	88	84	74
CHS	96	90	81	75
MIA	82	71	65	59
TPA	91	80	72	67
DTW	90	80	73	65
MGM	89	80	71	65
BNA	86	79	70	64
SPI	86	79	76	71
MSP	99	92	88	82
IAH	90	82	72	66
OMA	96	93	89	82
OKC	97	91	83	77
BIS	93	88	85	80
MAF	91	85	78	70
DEN	98	96	92	87
TUS	81	71	72	68
GTF	78	71	60	53
SLC	97	91	86	77
Average	91	84	77	71

If a TS is reported by a station, what percentage of the time does the NLDN detect lightning within X km?

Station	5	10	15	20
ALB	66	78	89	92
BWI	71	87	95	97
GSO	57	76	87	94
CHS	69	87	96	98
MIA	81	96	99	99
TPA	79	95	100	100
DTW	62	83	89	93
MGM	65	87	96	98
BNA	71	92	97	98
SPI	74	89	96	100
MSP	68	85	95	98
IAH	81	95	97	99
OMA	66	84	94	96
OKC	74	87	94	97
BIS	59	78	88	97
MAF	58	78	95	95
DEN	50	75	91	97
TUS	58	80	92	100
GTF	55	85	90	94
SLC	40	70	96	96
Average	65	84	94	97

The **tables above** show the **July** and **August METAR TS** and **NLDN lightning climatologies** within 5, 10, 15 and 20 km of each station as the fraction of days with a TS report/flash. **Red** numbers show the **radial distance** with the **NLDN** value **closest to the METAR** value.



MSP, OKC and **DEN** are **excellent verifiers**, while **MIA, GTF** and **TUS** verify quite **poorly**.

A strong **east/west dichotomy** is noted with stations in the **western U.S.** verifying **TSs with lightning** detected at **much farther distances** than stations in the **east**.

As can be seen in the **figures** to the **left**, **significant interstation** and **interannual variability** exists in TS reporting.