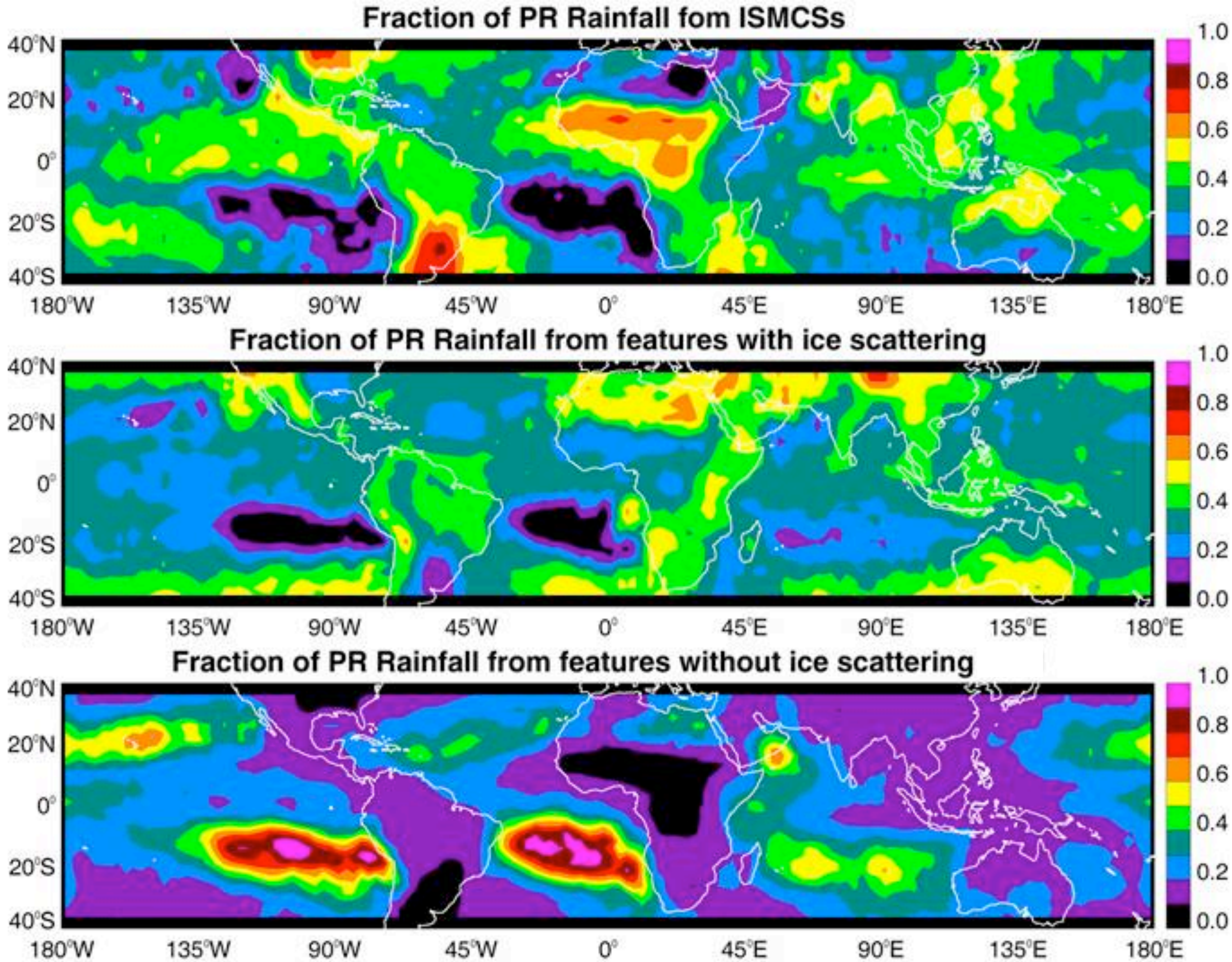
Fraction of Total Rainfall by PF Type



Courtesy: S. Nesbitt, U. of Illinois

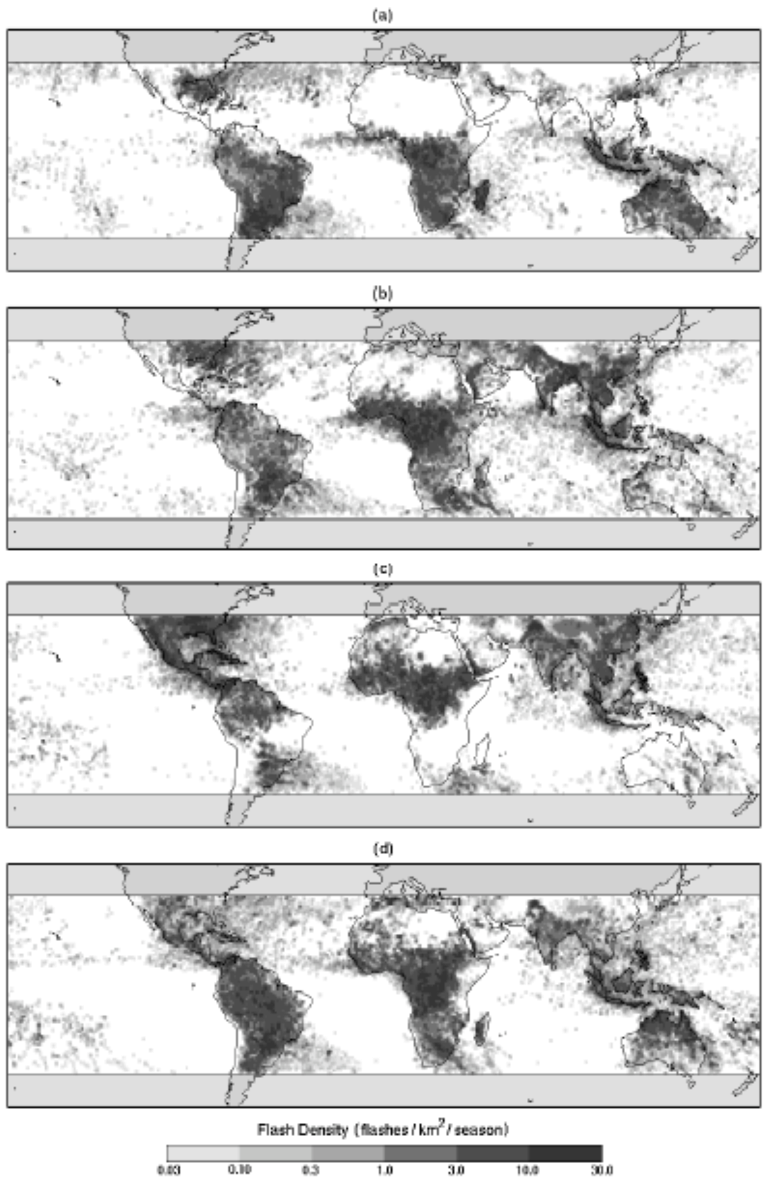


Figure 4. The 1998 seasonal distribution of lightning flashes as observed by LIS for (a) December, January, and February, (b) March, April, May, (c) June, July, and August, and (d) September, October, and November.

Dec-Feb

Mar-May

June-Aug

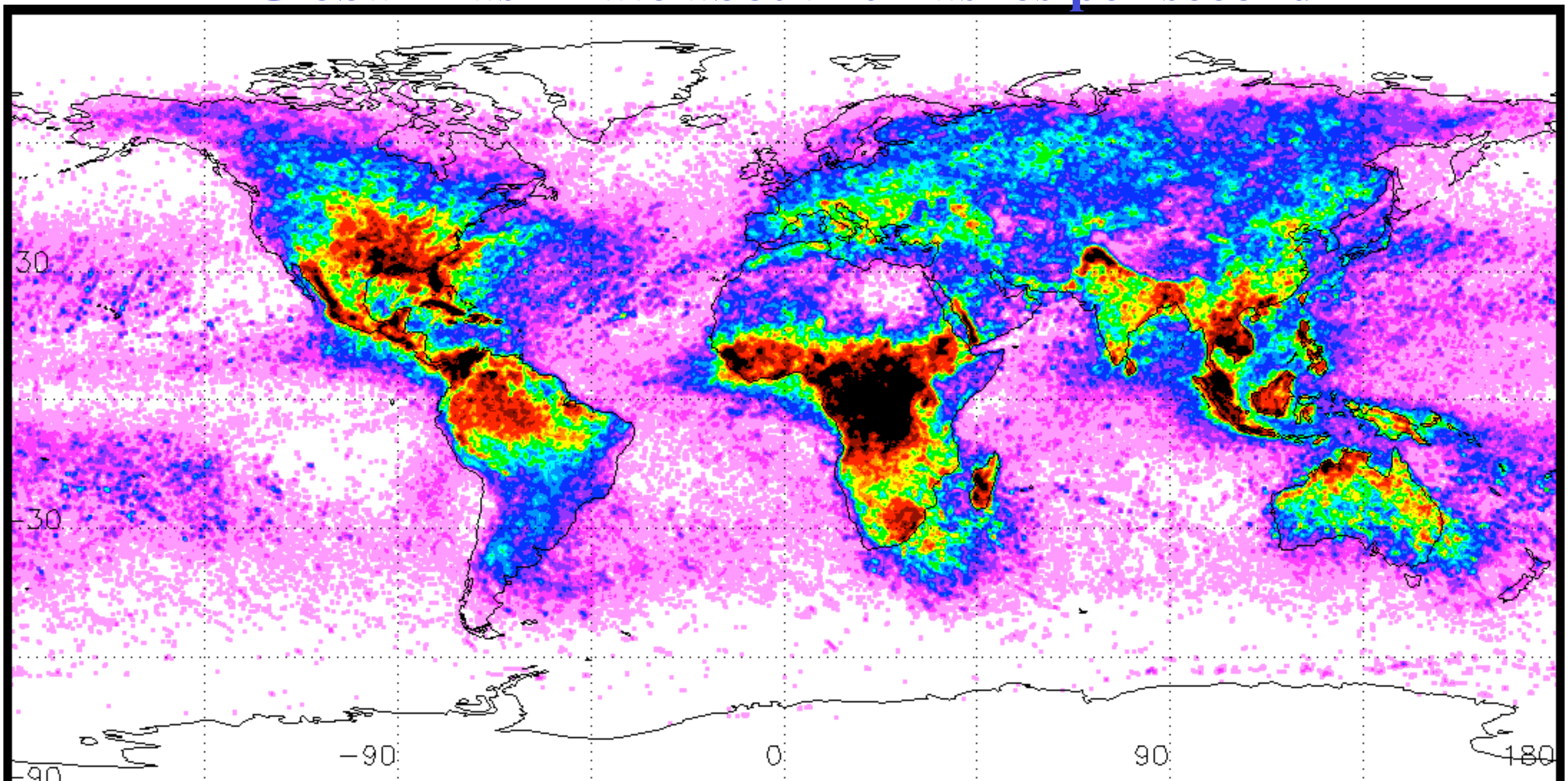
Sept-Nov

Christian et al. (2000)

Seasonal lightning flash densities from TRMM/LIS for 1998.

Global Lightning Observed from the NASA-OTD
10-1000 times more lightning over land than Ocean

Global Flash Rate about 40 flashes per second



Orbits	17371
Areas	808854
Flashes	4345364
Groups	20727622
Events	42265608

(Created : 02/15/100)

<10 >10 >25 >50 >100 >150 >200 >300 >400 >500 >750 >1000

Flash scale

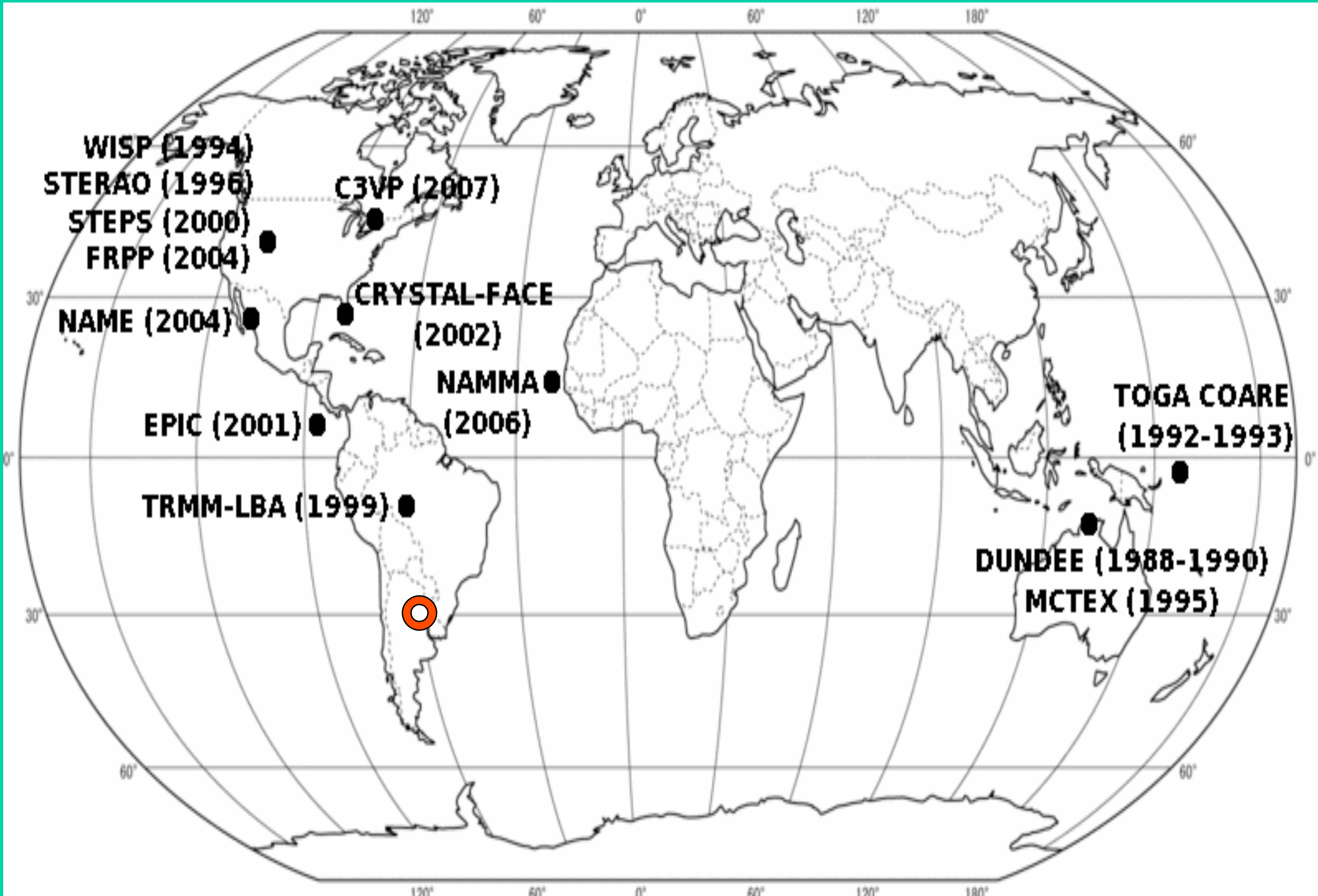
April 12, 1995 – December 31, 1999

OPTICAL TRANSIENT DETECTOR

NASA / MSFC

CSU Radar Meteorology Group Interests in LPB

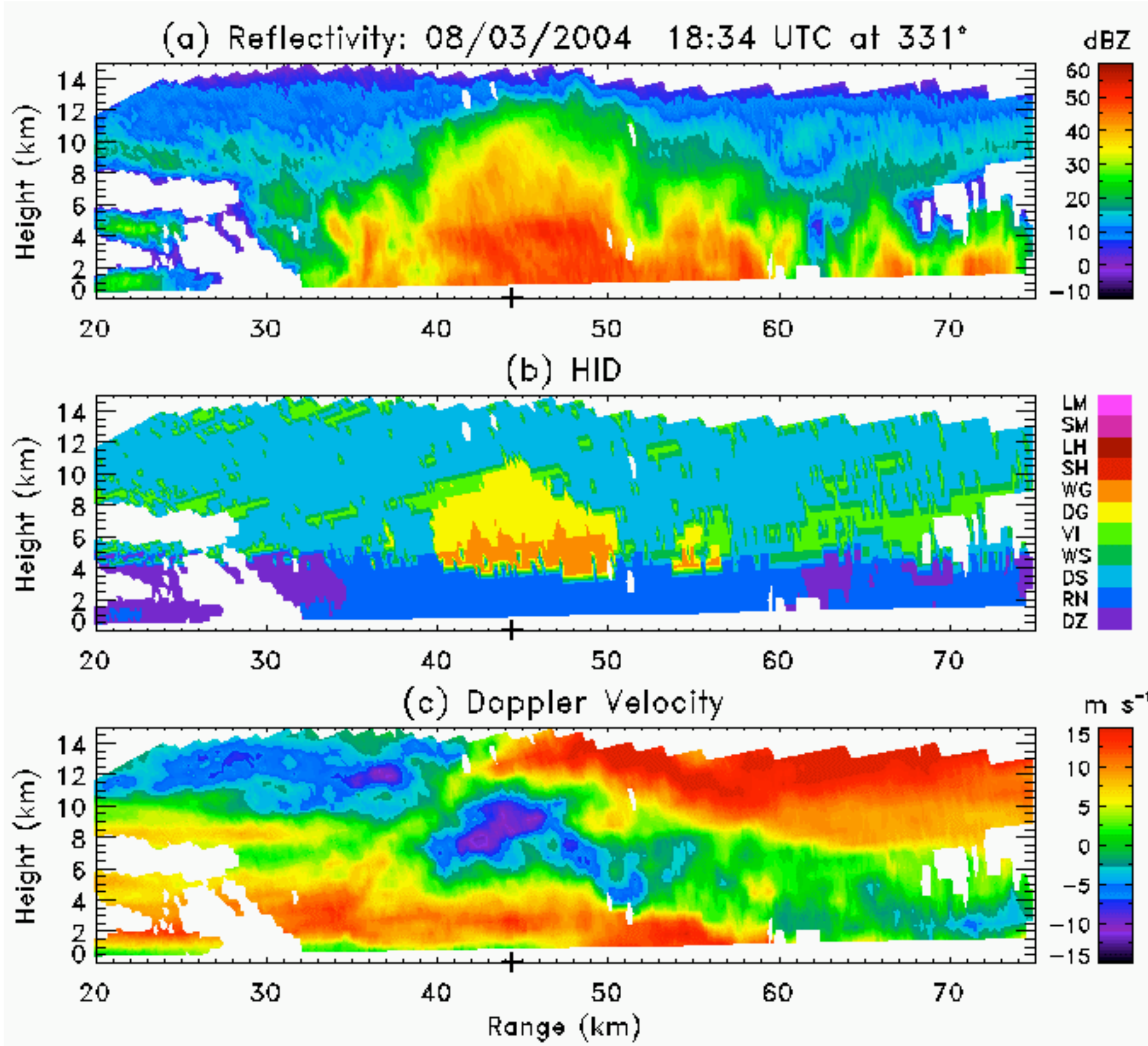
- Connect mostly to MCS related scientific objectives
- Convective scale dynamics and microphysics
- Radar-based rainfall estimation (couple to hydrology goals)
- Precipitation and aerosol influences (biomass burning, pollution)
- Electrification and lightning studies
  - Flash rates, polarity in convection and MCSs
  - Sprites

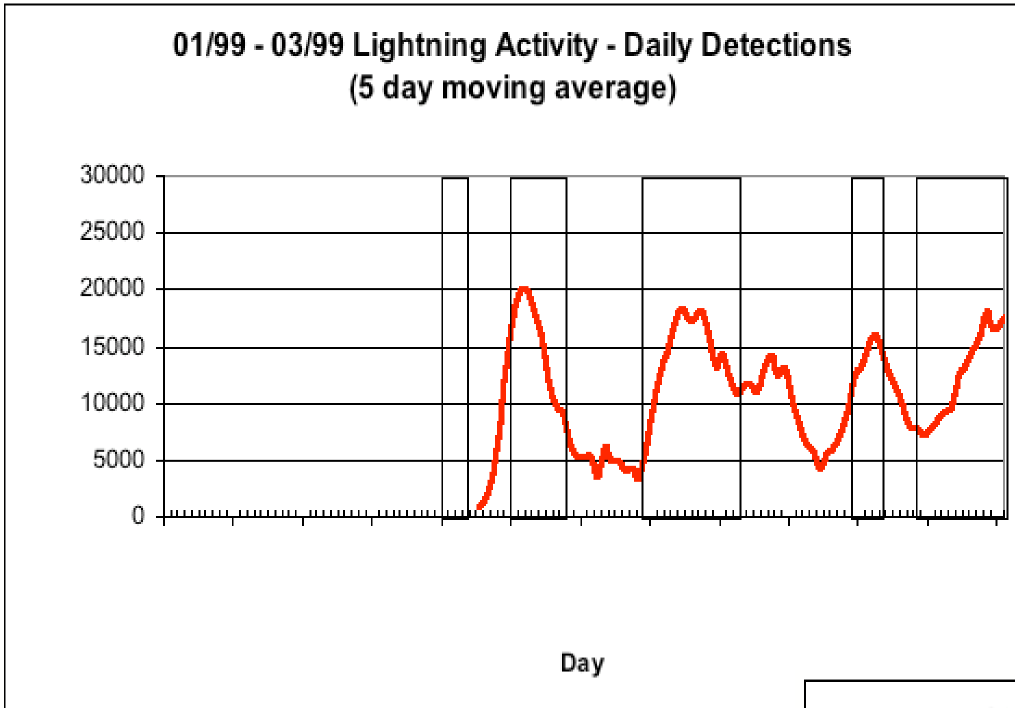


WISP (1994)
STERAO (1996)
STEPS (2000)
FRPP (2004)
C3VP (2007)
CRYSTAL-FACE (2002)
NAME (2004)
NAMMA (2006)
EPIC (2001)
TRMM-LBA (1999)
TOGA COARE (1992-1993)
DUNDEE (1988-1990)
MCTEX (1995)

TRMM-LBA

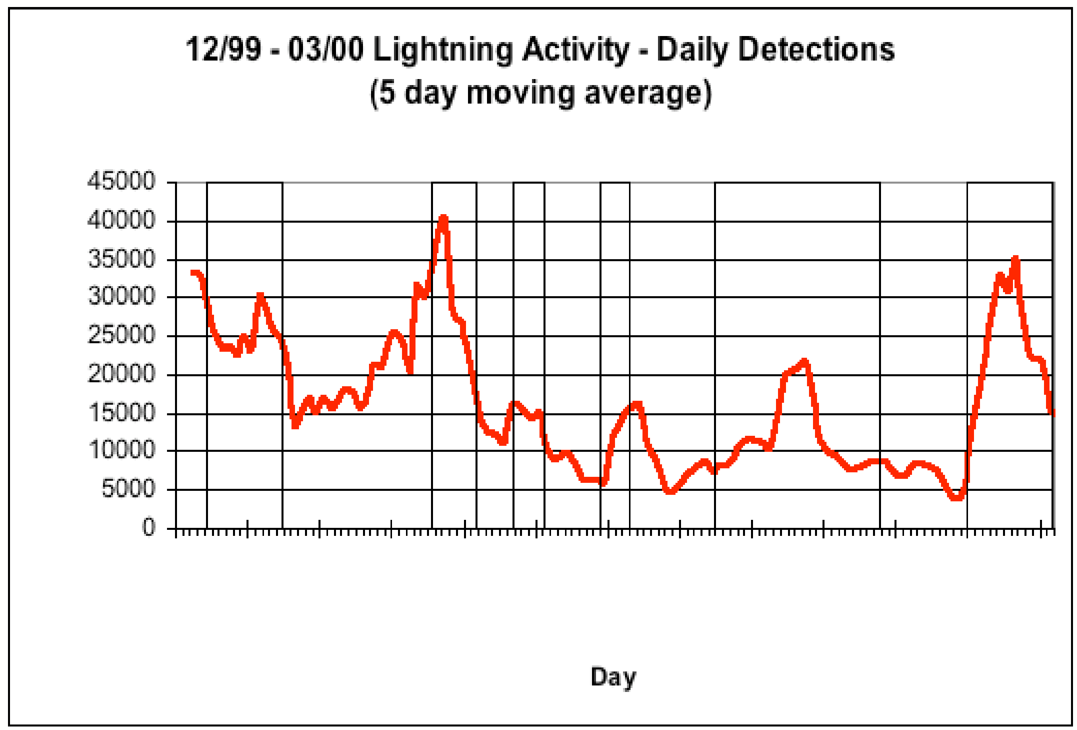
Bogotá
COLOMBIA
VENEZUELA
GUYANA
SURINAME
FRENCH GUIANA
Boa Vista
GUIANA HIGHLANDS
MARAJÓ ISLAND
Macapá
Marajó Bay
ATLANTIC OCEAN
Equator
Belém
São Marcos Bay
Negro
Amazon
Manaus
Tefé
Santarém
Tapajós
Xingu
São Luís
Fortaleza
Teresina
Cape São Roque
Natal
João Pessoa
Campina Grande
Recife
BRAZILIAN HIGHLANDS
BANANAL ISLAND
Pôrto Velho
Rio Branco
Palmas
São Francisco
Maceió
Aracaju
Almas Peak 6,068 ft.
Salvador
All Saints Bay
Itabuna
PERU
ANDES MOUNTAINS
Cuiabá
Brasília
Goiânia
Lake Titicaca
La Paz
BOLIVIA
PANTANAL
ESPINHAÇO MOUNTAINS
PACIFIC OCEAN
São José do Rio Prêto
Campo Grande
Belo Horizonte
Vitória
PARAGUAY
Tropic of Capricorn
Nova Iguaçu
Duque de Caxias
São Gonçalo
Santo André
Rio de Janeiro
Asunción
São Paulo
CHILE
ARGENTINA
Iguaçu
Curitiba
Florianópolis
Passo Fundo
Caxias do Sul
Novo Hamburgo
Canoas
Pôrto Alegre
ATLANTIC OCEAN
Patos Lagoon
Rio Grande
URUGUAY
Montevideo
©1999, Encyclopædia Britannica, Inc.
70°
60°
50°
40°
0°
10°
20°
30°


(a) Reflectivity: 08/03/2004 18:34 UTC at 331°
dBZ
60
50
40
30
20
10
0
−10
Height (km)
14
12
10
8
6
4
2
0
20
30
40
50
60
70
(b) HID
LM
SM
LH
SH
WG
DG
VI
WS
DS
RN
DZ
(c) Doppler Velocity
m s⁻¹
15
10
5
0
−5
−10
−15
Range (km)



Brazilian Lightning Detection Network (BLDN):

- Oscillations apparent
- East (west) anoms =more (less) lightning.

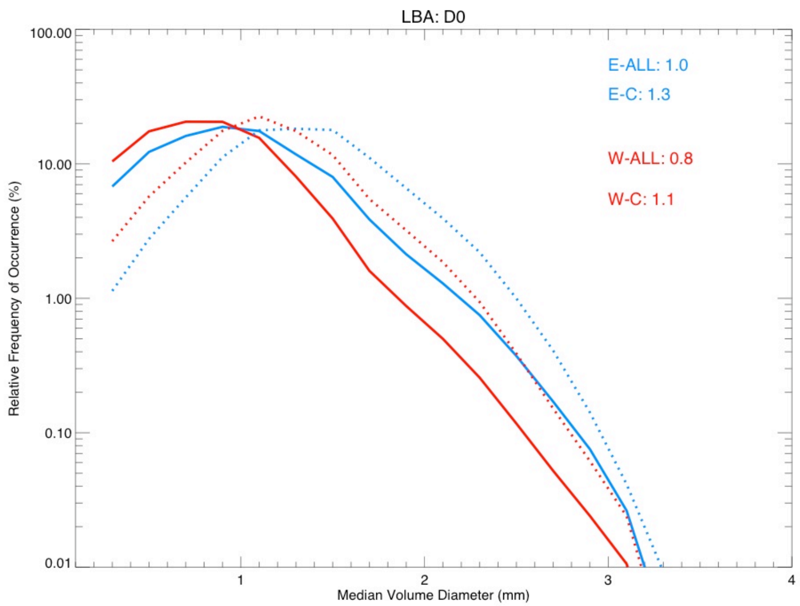


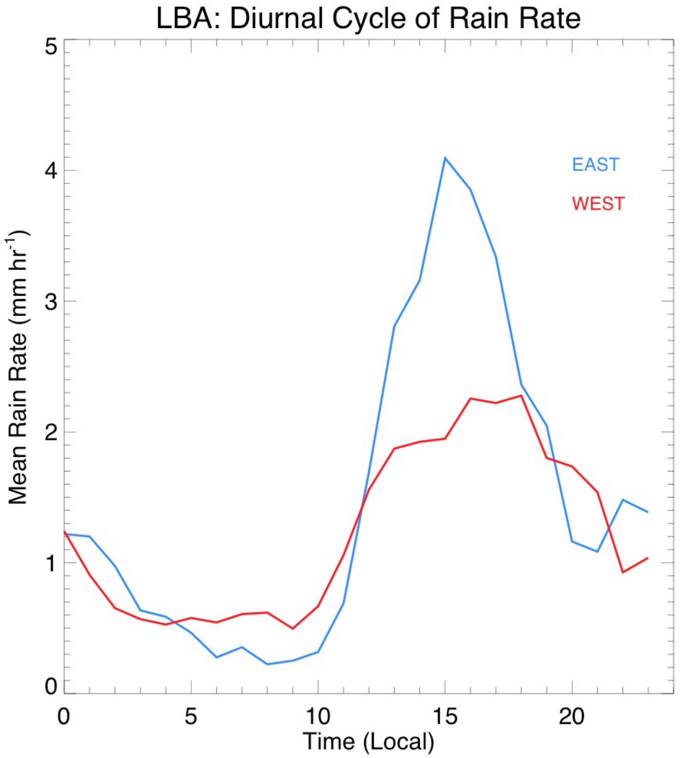
= East anomaly* regime

*as defined by wind

Petersen et al., 2001

Microphysical differences between east and west regimes. Larger D_0 in east regime linked to stronger CAPE and stronger ice-based precipitation. Strong diurnal cycle in east regime.

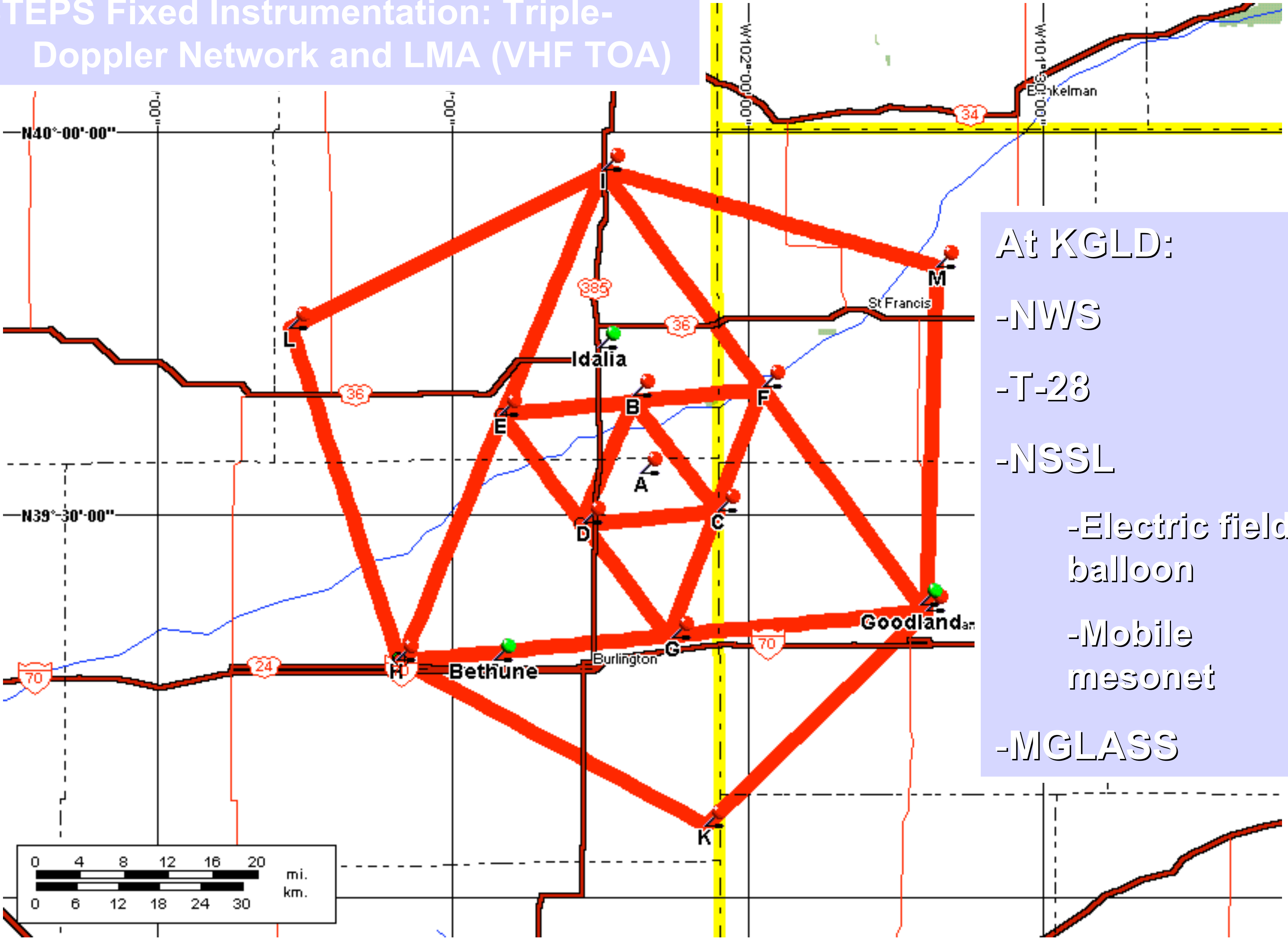




Aerosol influences may be detected through changes in D_0

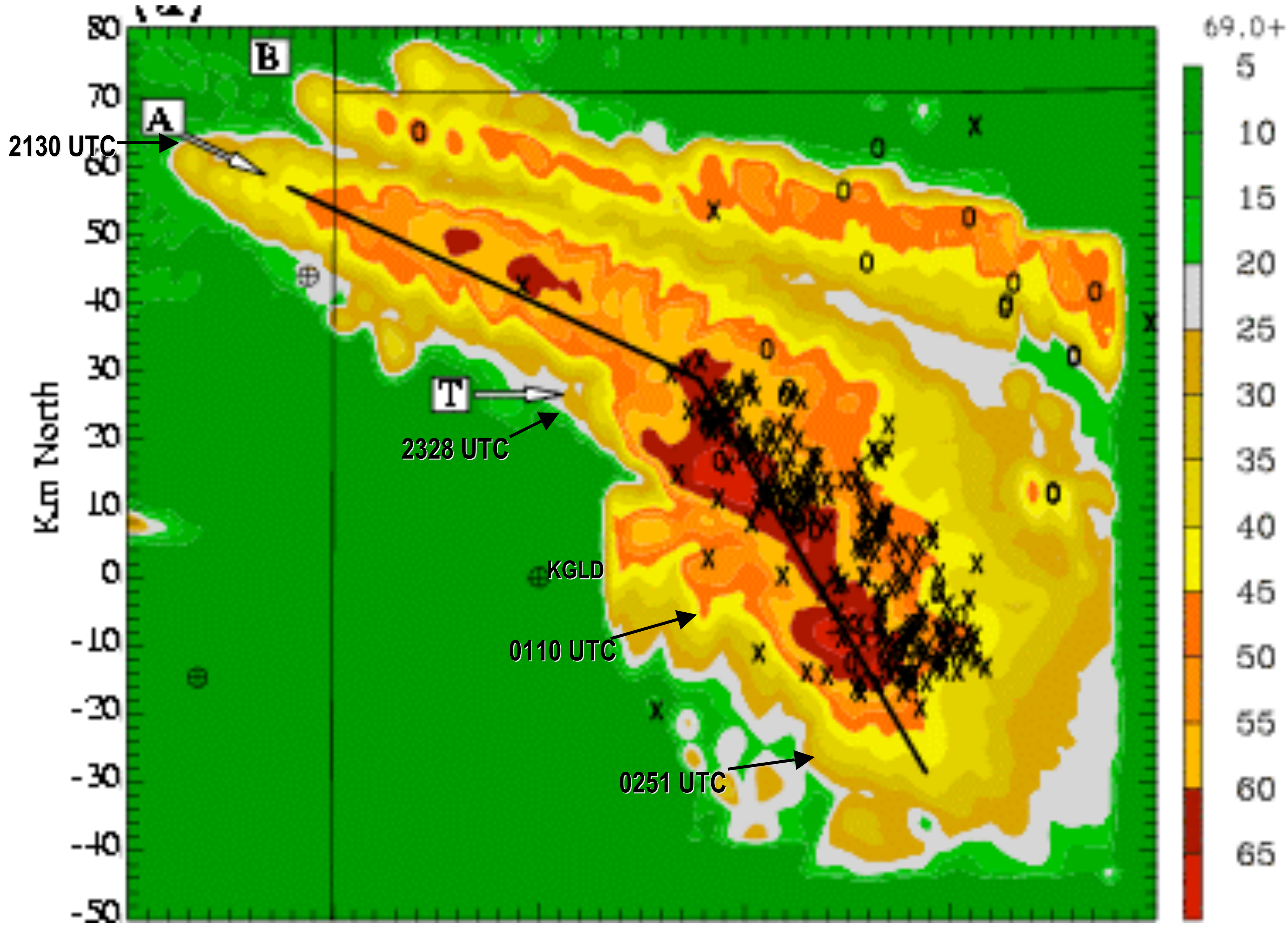
STEPS
Severe Thunderstorm Electrification and Precipitation Study
May-July 2000

STEPS Fixed Instrumentation: Triple-Doppler Network and LMA (VHF TOA)



At KGLD:

- -NWS
- -T-28
- -NSSL
  - -Electric field balloon
  - -Mobile mesonet
- -MGLASS



Tessendorf et al., ***JAS***, *2005*

Storm swath of base reflectivities (2100-0251 UTC) with NLDN lightning data overlaid.

29 June Supercell

- Inverted tripole
- +CGs

3 June storm

- Inverted dipole
- No CGs

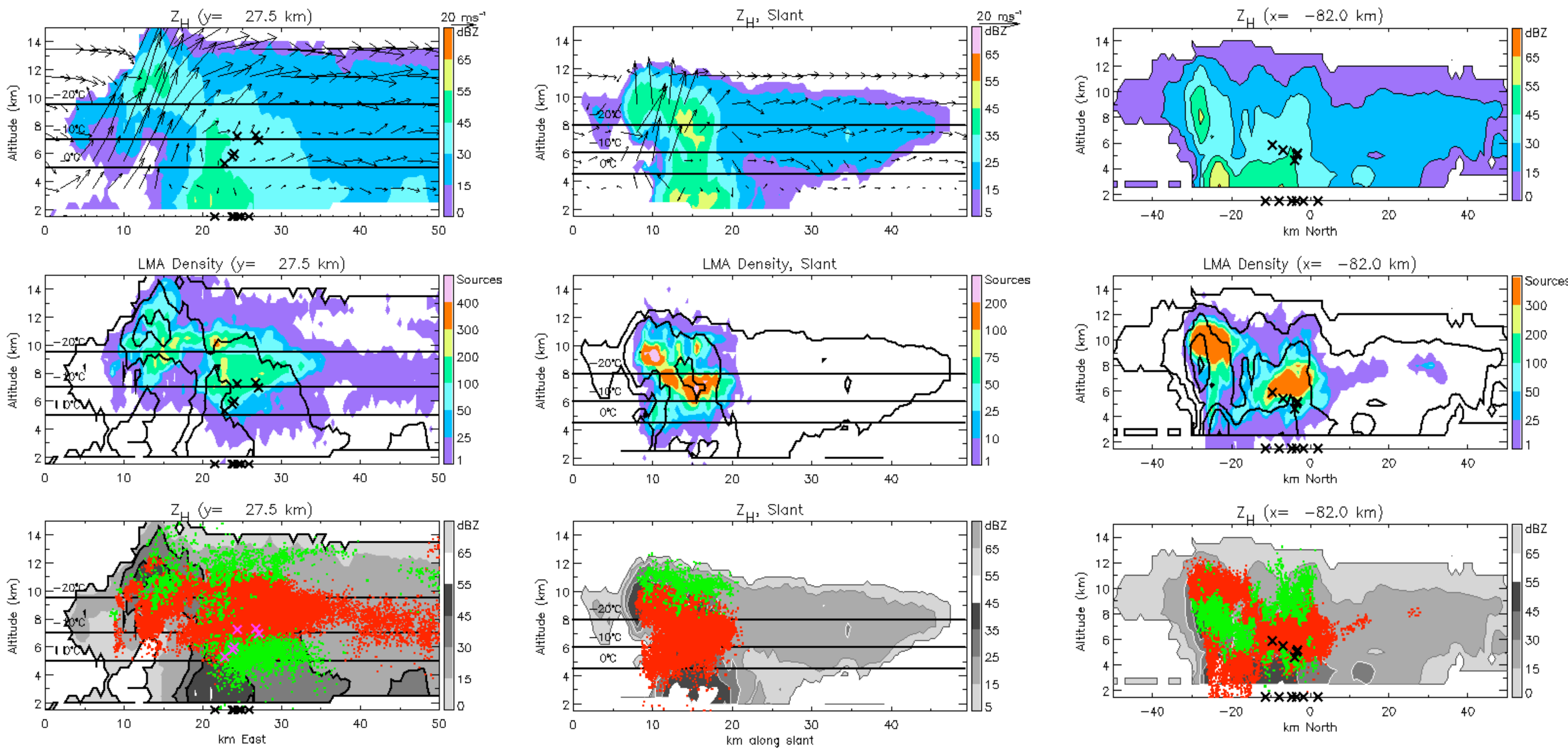
23 June storm

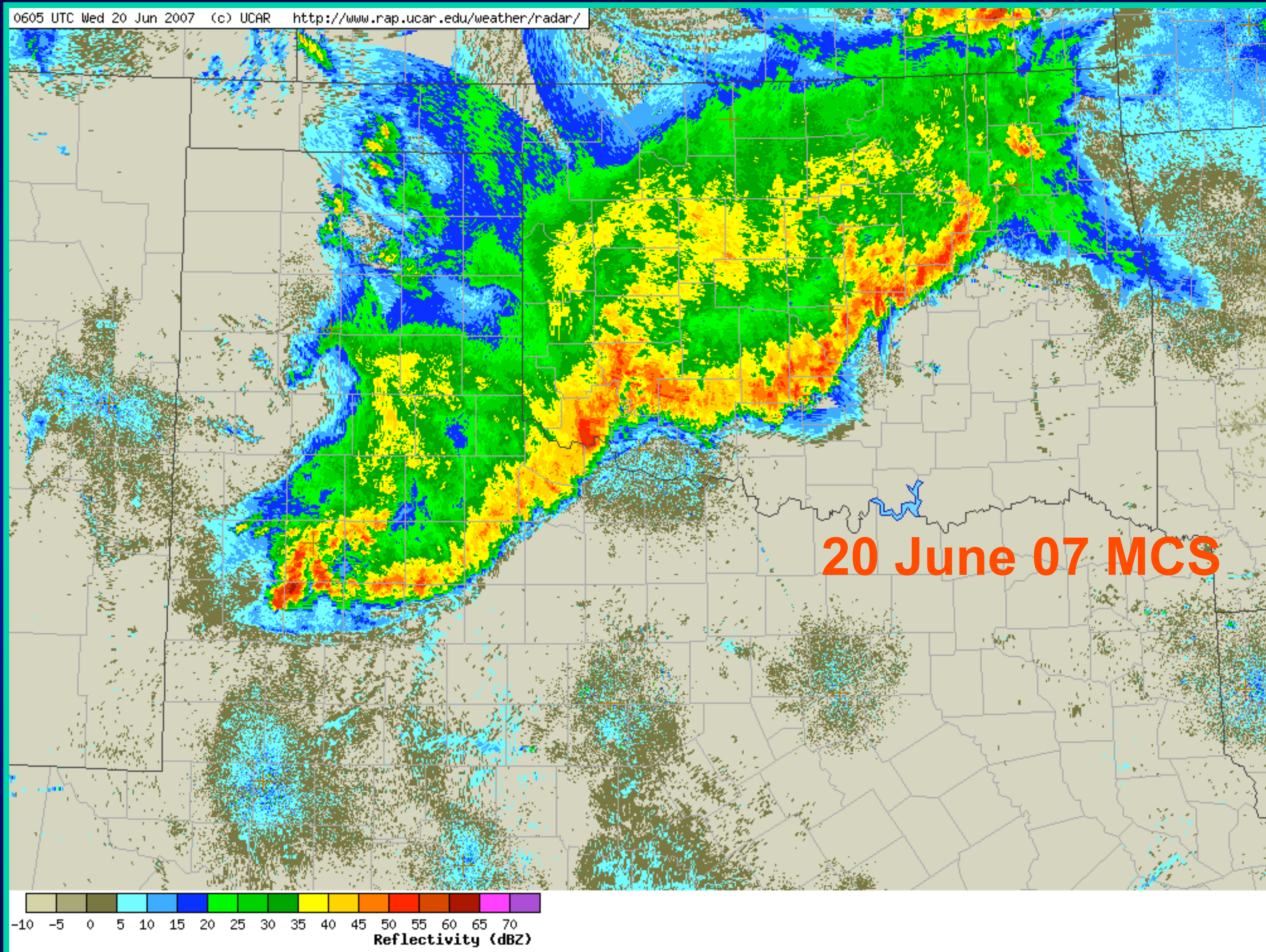
Early:

normal tripole, -CGs

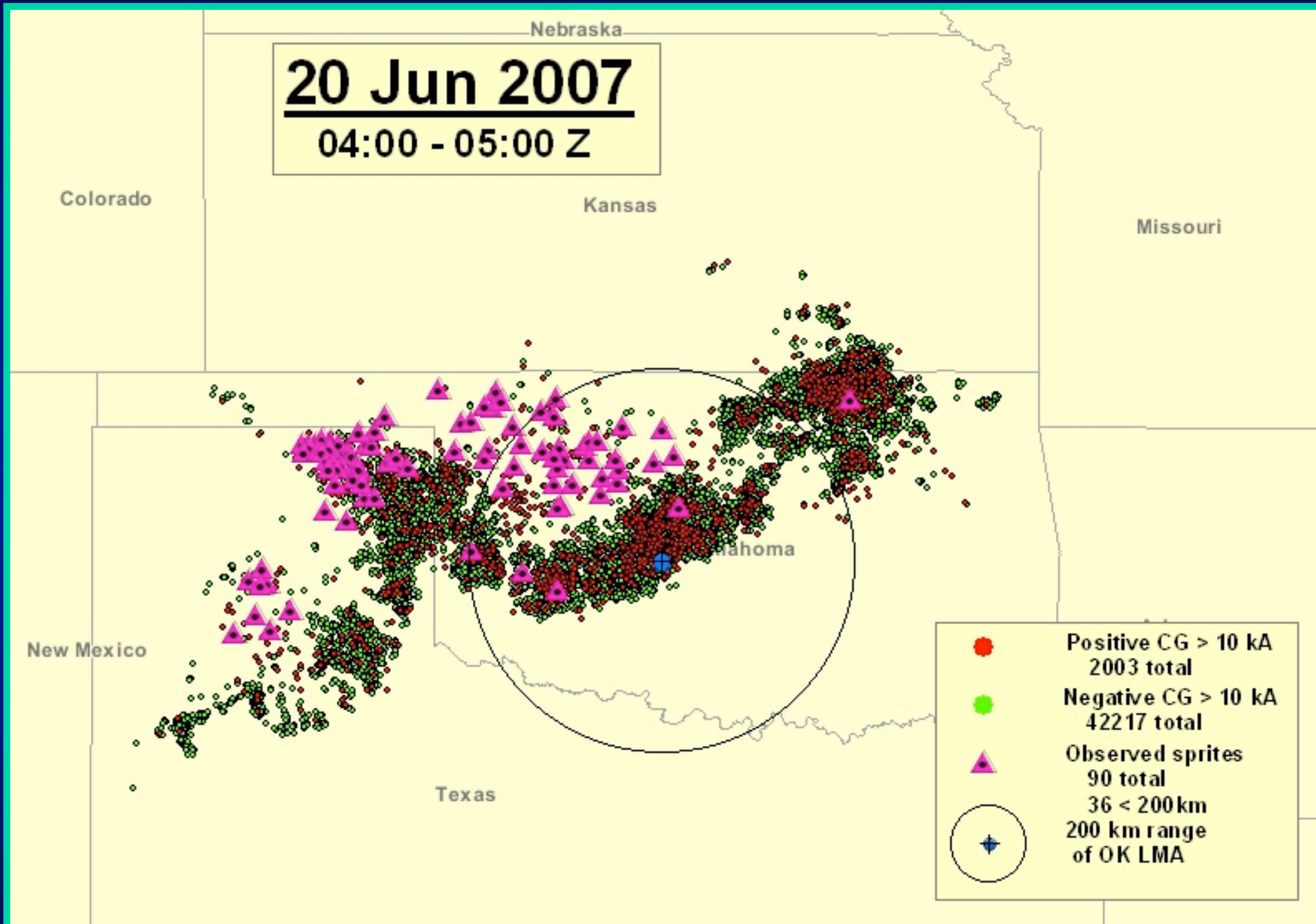
Later, collapse:

inverted tripole, +CGs

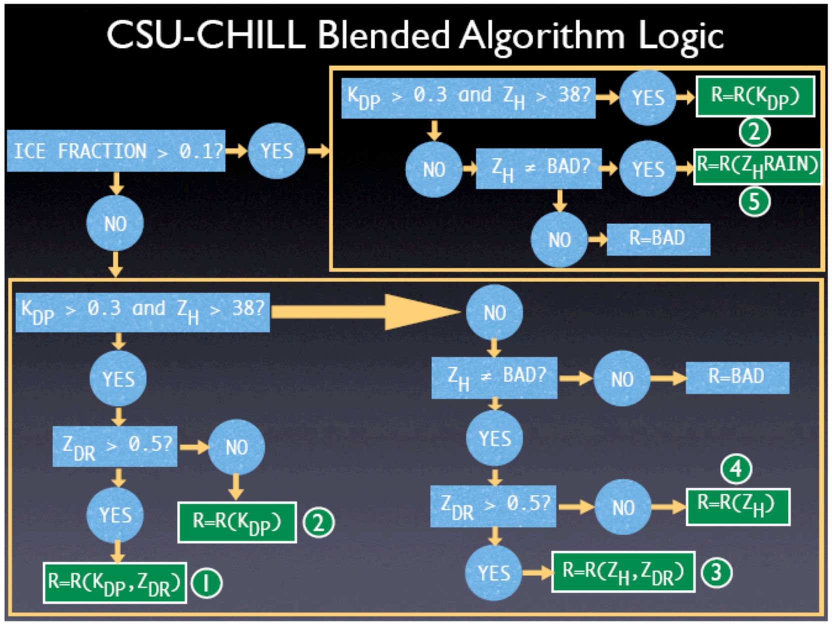




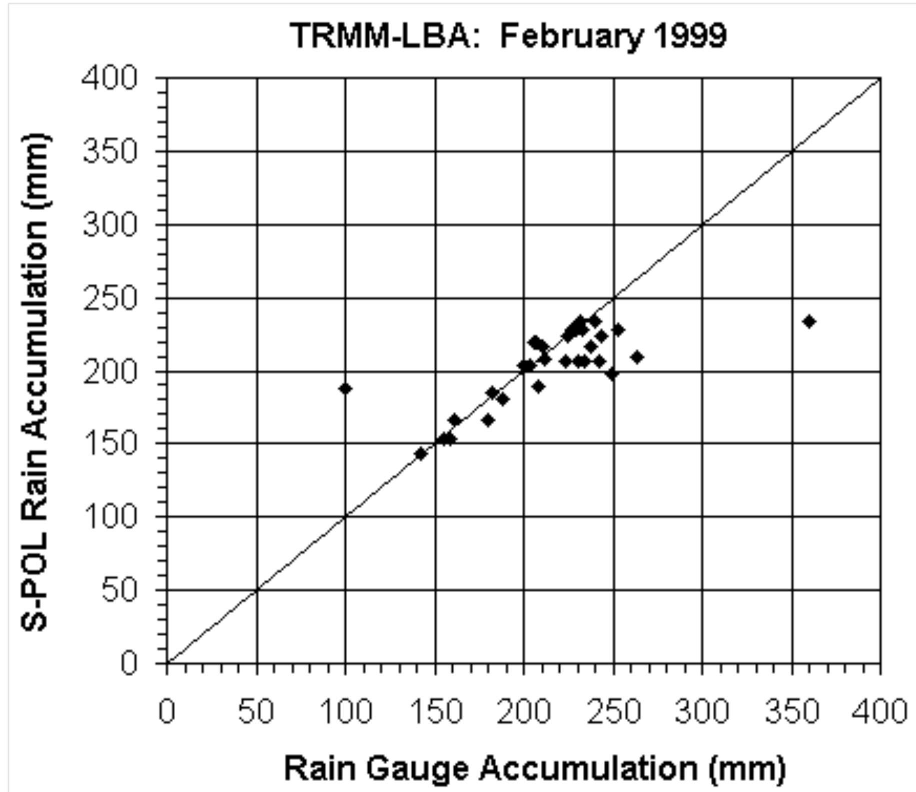
0605 UTC Wed 20 Jun 2007 (c) UCAR http://www.rap.ucar.edu/weather/radar/
20 June 07 MCS
-10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
Reflectivity (dBZ)



20 Jun 2007
04:00 - 05:00 Z
Nebraska
Colorado
Kansas
Missouri
New Mexico
Texas
Positive CG > 10 kA
2003 total
Negative CG > 10 kA
42217 total
Observed sprites
90 total
36 < 200km
200 km range
of OK LMA

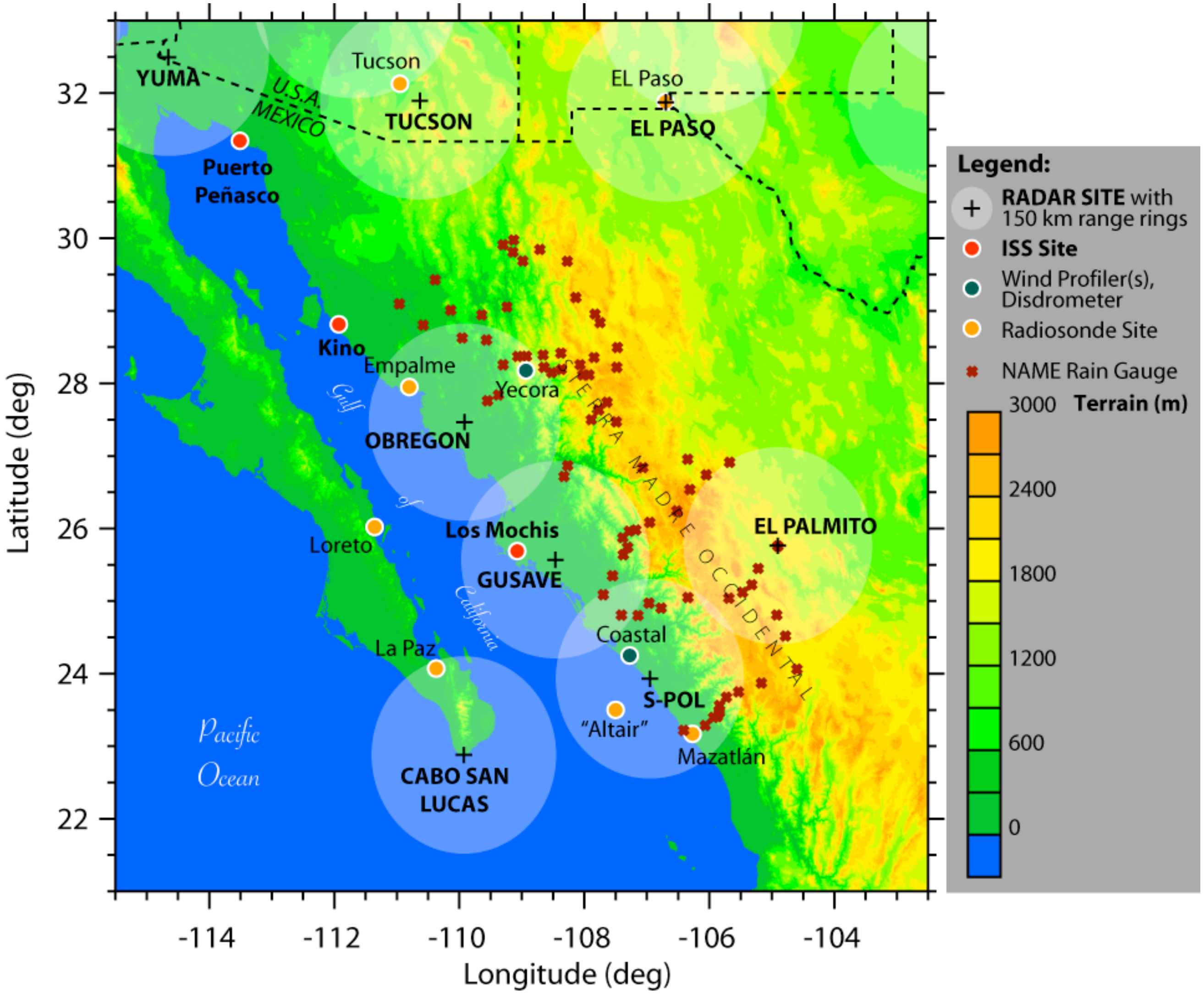


Courtesy R. Cifelli



For non polarimetric radars, use a "pole-tuned" Z-R relationship; did this for NAME and other projects where S-pol was embedded within an operational network

NAME Radar Network



Courtesy T. Lang

Planned

- S-Pol
- 4 SMN Radars
- SMN radars run in full-volume 360s
- 15-min resolution

Actual

- S-Pol (7/8-8/21)
- Cabo (7/15-Fall)
- Guasave (6/10-Fall)
- SMN radars single low-level sweep (high temporal resolution)

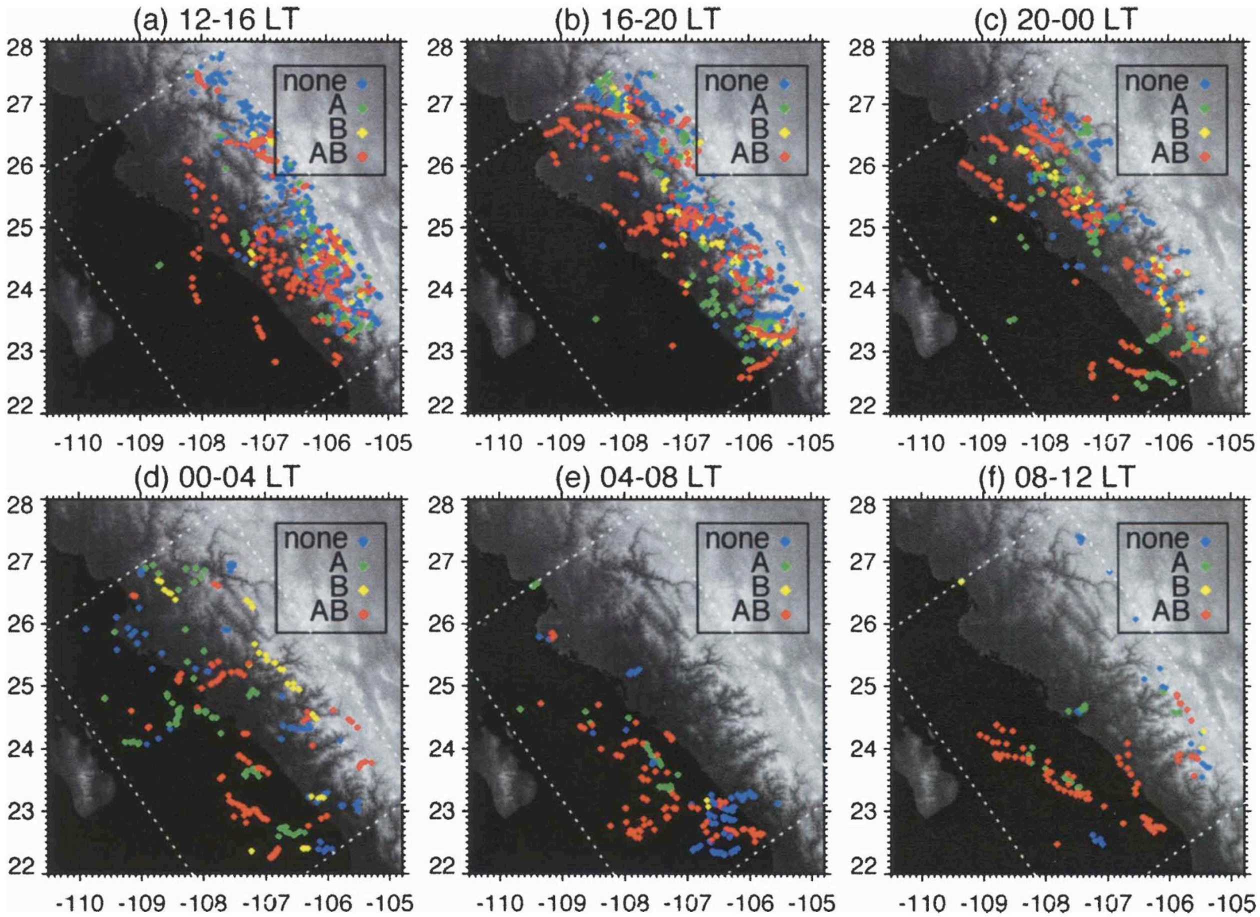


FIG. 11. Centroid locations of organized features as a function of regime (see legends) during the following 4-h periods: (a) 1200–1600, (b) 1600–2000, (c) 2000–0000, (d) 0000–0400, (e) 0400–0800, and (f) 0800–1200 LT. Topography is shaded in the background (grayscale).

Ground radar based climatology from NAME radar network; Lang et al. (2007)

Observations

- Dual-Doppler
- Polarimetric radar, ideally not part of the dual-Doppler network
- LMA network
- CG lightning detection network
- Dual-Doppler network should be centered within sounding array for mutual benefit
- Sprite detection via LCD cameras
- Aerosol measurements present a huge challenge
- What are existing quantitative radar and lightning network infrastructures?