Satellite Data & Flight Planning Tools from GSFC-UMD-Ames

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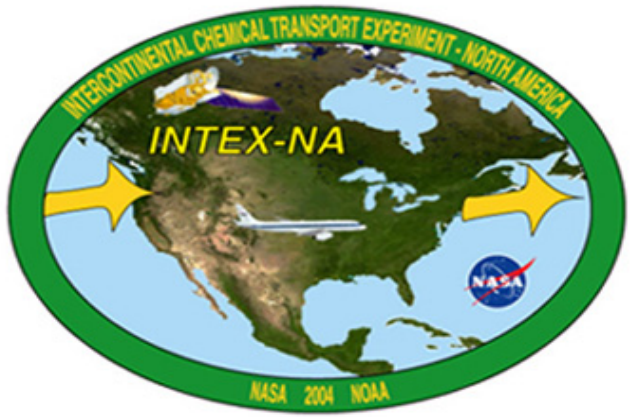
*** Poster**



INTEX Science Team Meeting, Virginia Beach, Mar 05

Presentation

- Website – Data Types for Analysis (AMT)
  - <http://croc.gsfc.nasa.gov/intex>

- Satellite Data (AMT)
  - Example of Met Product Use
  - Example of Aerosol Use
  - Convective Influence (LP – Poster)

- Considerations about Lightning Data (KEP)
  - 12/7, 25/7 – Illustrations
  - Collaborative Plans

INTEX-NA (INtercontinental chemical Transport EXperiment - North America)

Mission Planning Images: A NASA/NOAA Aircraft Mission

Products available on this site are provided by Anne Thompson (PI) and Co-Investigators - K. Pickering, L. Pfister, R. Selkirk, J. Witte and T. Kucsera

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NEW CLICK HERE FOR MISSION ANALYSES NEW

To retrieve analyses for the day of interest:

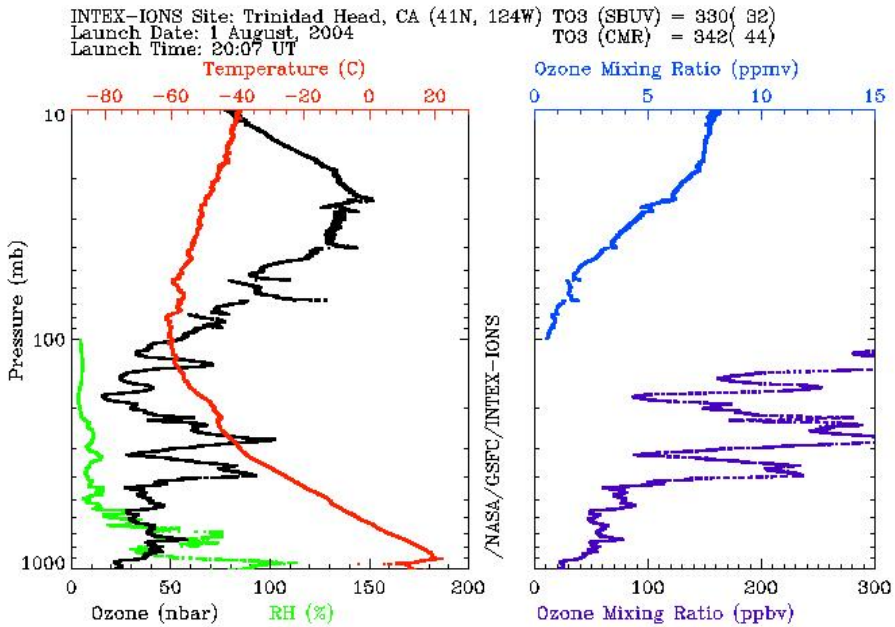
Select Year, Month, Day, Hour (GMT) and Forecast hour of interest from the following pull-down menus, then click the *SUBMIT* button below.

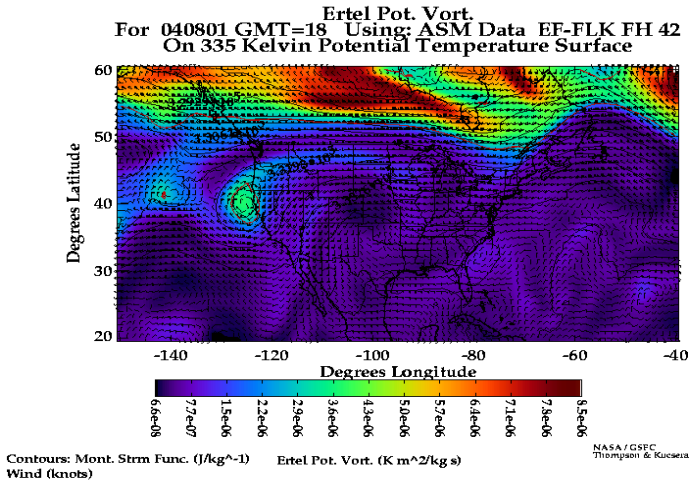
Year: 2004 **Month:** July **Day:** 5 **Hour:** 18 **Forecast:** latest

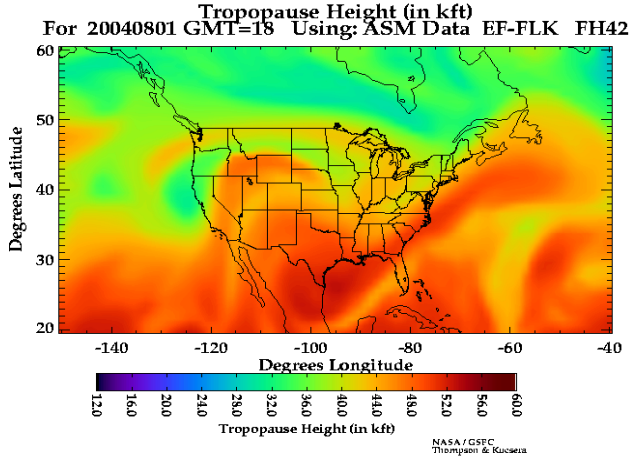
SUMMARY OF MODEL PRODUCTS AND ANALYSES FOR INTEX

Product	Image Labeled in Archive as:
Air Parcel Exposure to Aircraft Products	Fuel, NOx, HC, CO [kg/day] **EA**YYYYMMDDHH_FHXX, Press sfc's = 700,500,300 hPa, and also on theta sfc's = 325,340 K
Lightning Exposure	**EL**YYYYMMDDHH_FHXX, Press sfc's = 500,300 hPa, Theta sfc's = 325, 340 K
Dust Exposure	**ED**YYYYMMDDHH_FHXX, 850,700,500 hPa pressure sfc's
Reverse domain fill - Ertel's Potential Vorticity	**RD**YYYYMMDDHH_FHXX, on Theta sfc's= 325, 340 K
Tropopause Height (Kft)	**TH**YYYYMMDDHH_FHXX
Ertel's Pot. Vort., Mont. Strm. Func, Winds	**PT**YYYYMMDDHH_FHXX, on Theta sfc's = 360, 355, 350, 345, 340, 335, 330, 325 (K)
Temp. field, Geopotenial Ht, Winds	**PP**YYYYMMDDHH_FHXX, on Press sfc's = 925, 850, 700, 500, 300, 250 (hPa)
Relative Humidity images	**SPFH**YYYYMMDDHH_FHXX, on Press sfc's = 925, 850, 700, 500, 300, 250 (hPa)
Cloud Mass Flux images	**CDMS**YYYYMMDDHH_FHXX, on Press sfc's = 850, 700, 500, 300 (hPa)
Detrainment Cloud Mass Flux images	**CDDT**YYYYMMDDHH_FHXX, on Press sfc's = 850, 700, 500, 300 (hPa)
Area Field of Kinematic 5-day Back Trajectories	**BF**YYYYMMDDHH_FHXX, on Press sfc's= 850,700,500,300 hPa, Theta sfc's=325,340 K
Regional TOMS Aerosol Index images	**TN**YYYYMMDD, Daily images
Global TOMS Aerosol Index images	**TS**YYYYMMDD, Daily images
Regional Lightning Count images	**LN**YYYYMMDD, Daily images
Vertical Curtain Plot along flight path	**CP**YYYYMMDDHH_FHXX
Kinematic 5-day Back Trajectories for Flight Path	**BT**YYYYMMDDHH_FHXX

Meteorological Fields from GMAO – EPV (335K), Trop. Height – 1 August STE – Cutoff Low – Trinidad Head







Analyze with INTEX GMAO fields:

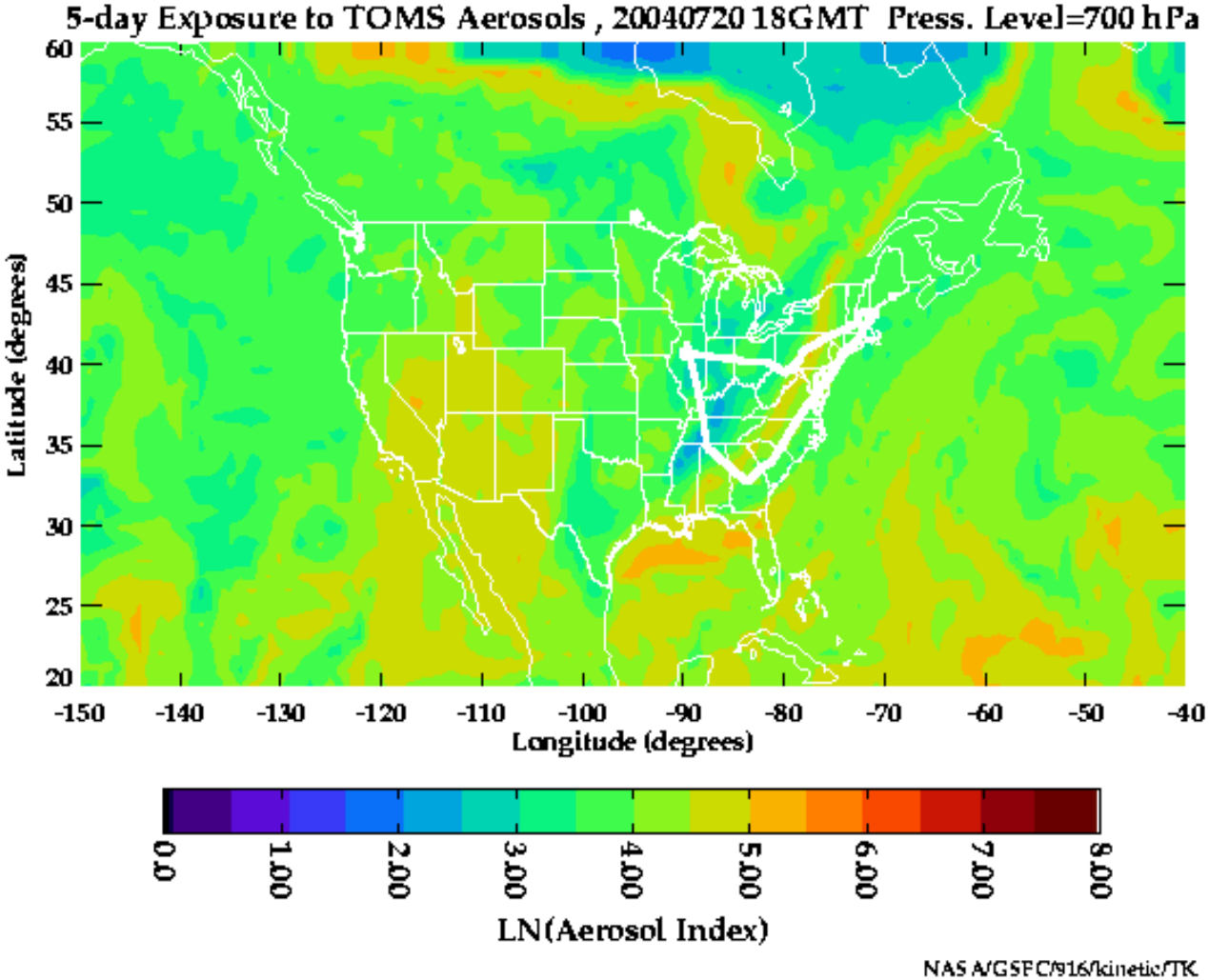
http://croc.gsfc.nasa.gov/intex

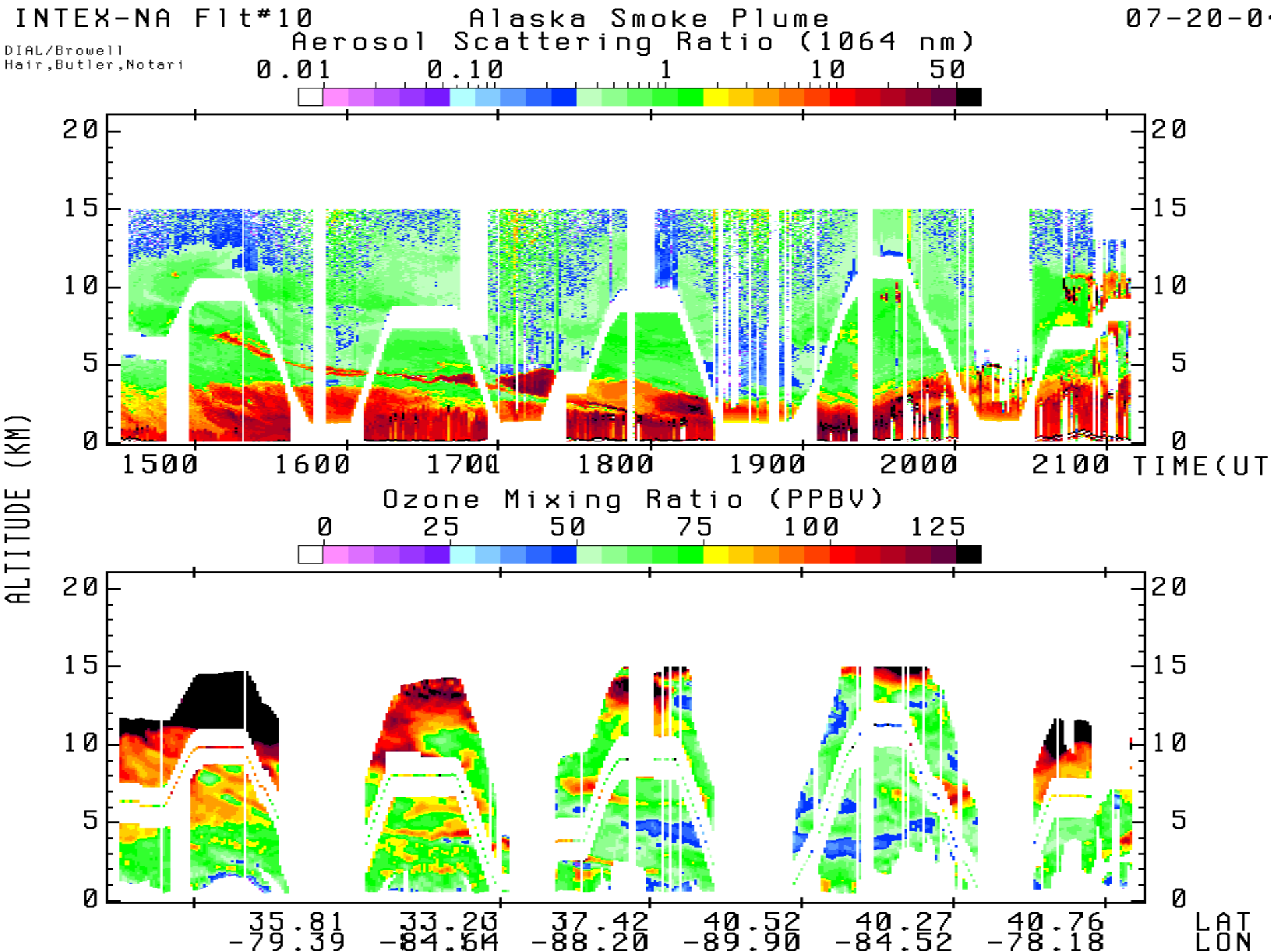
Images at ICARTT archive.

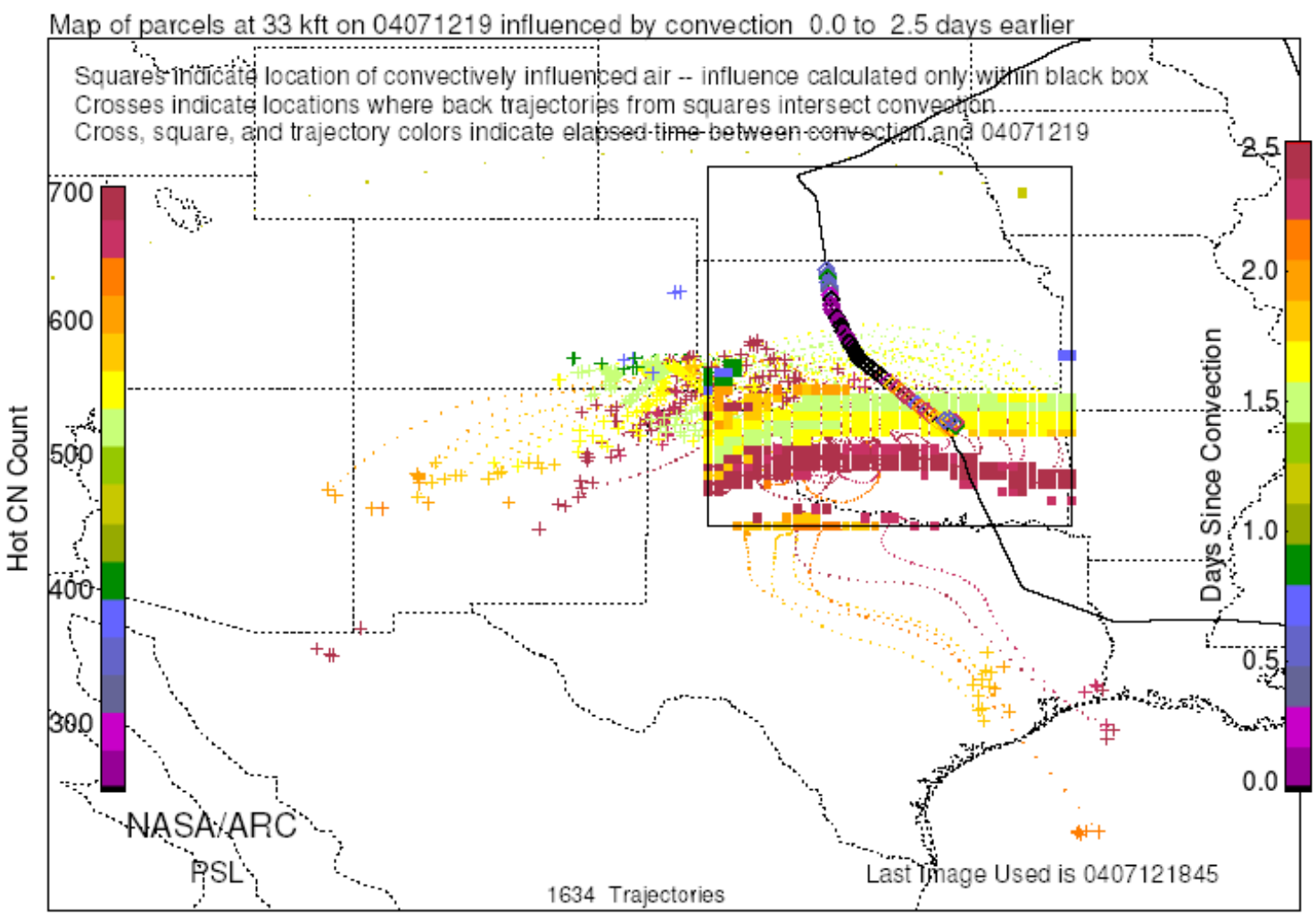
Data POC – tlk@croc.gsfc.nasa.gov

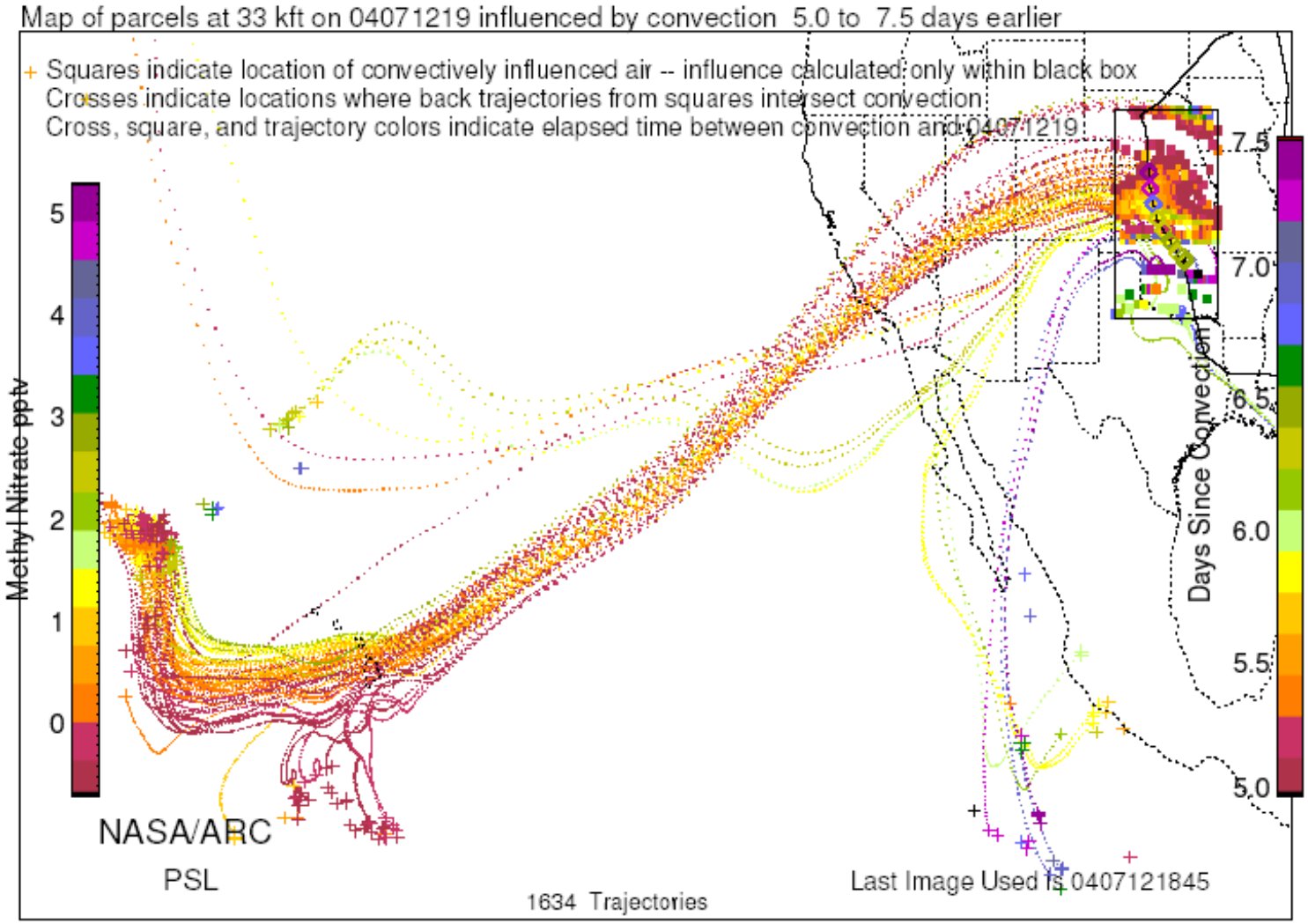
Trajectory-based Exposure/Influence Products

- Back trajectories (5 days) computed from grid of points in flight area (kinematic and isentropic)
- Aerosol exposure (from TOMS AI) – initialize trajectories, run over 5-days
  - Accumulate influence & display
  - 850, 700, 500 hPa
- Convective influence – trajectory run until intersects deep convective cloud (based on GOES-IR imagery)
  - Location of influence
  - Storm location, elapsed time displayed
- Lightning exposure – Grid NLDN CG flashes hourly
  - Trajectories run through the NLDN grids and flashes are accumulated along trajectories
  - Plot total over 5 days


5-day Exposure to TOMS Aerosols , 20040720 18GMT Press. Level=700 hPa
Latitude (degrees)
60
55
50
45
40
35
30
25
20
-150
-140
-130
-120
-110
-100
-90
-80
-70
-60
-50
-40
Longitude (degrees)
0.0
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
LN(Aerosol Index)
NASA/GSFC/916/kinetic/TK
DC-8 flight path (in white)


INTEX-NA Flt#10
Alaska Smoke Plume
07-20-0
DIAL/Browell
Hair,Butler,Notari
Aerosol Scattering Ratio (1064 nm)
0.01
0.10
1
10
50
ALTITUDE (KM)
20
15
10
5
0
1500
1600
1700
1800
1900
2000
2100
TIME(UT
Ozone Mixing Ratio (PPBV)
0
25
50
75
100
125
35.81
-79.39
33.20
-84.64
37.42
-88.20
40.52
-89.90
40.27
-84.52
40.76
-78.18
LAT
LON

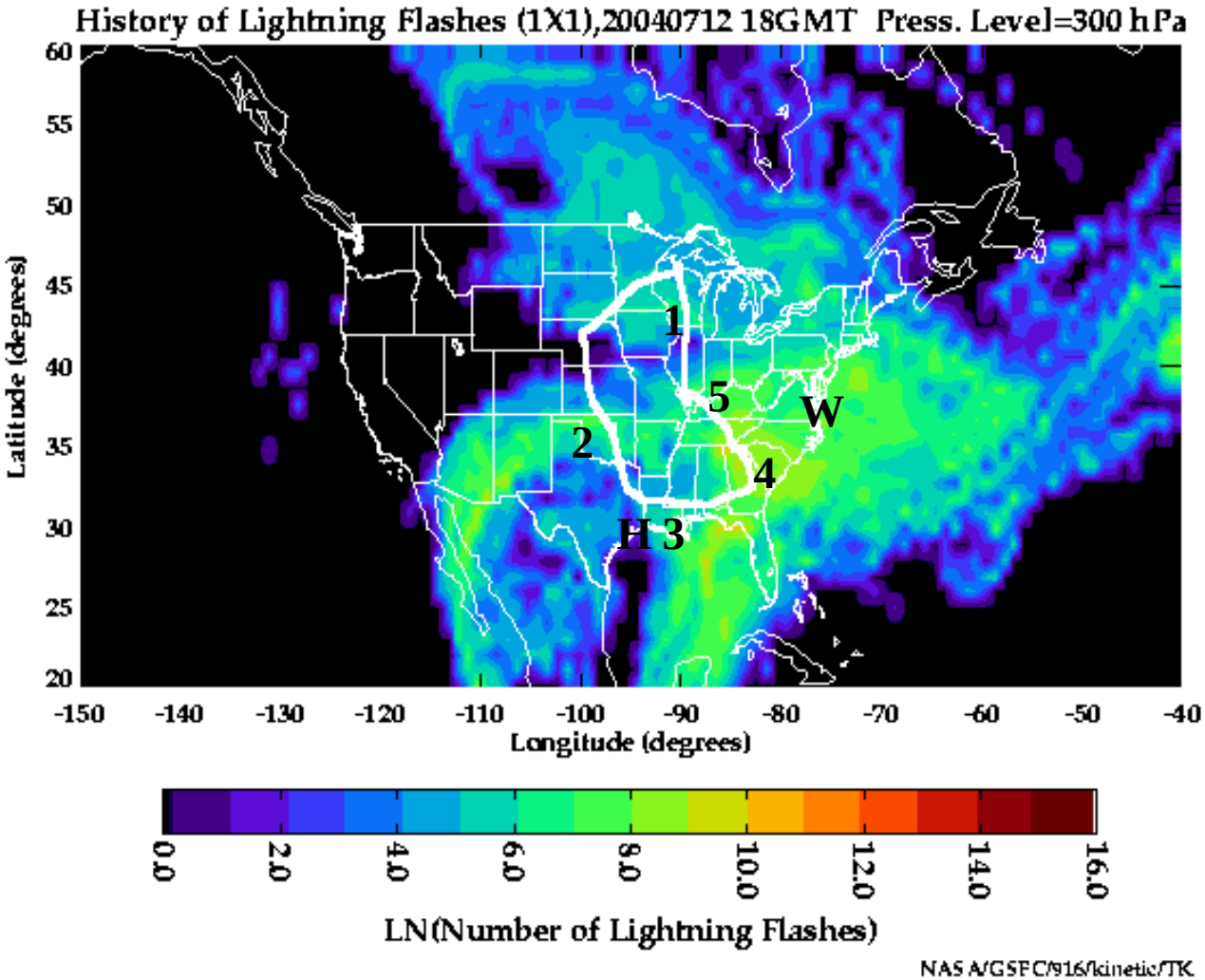

Map of parcels at 33 kft on 04071219 influenced by convection 0.0 to 2.5 days earlier
Squares indicate location of convectively influenced air -- influence calculated only within black box
Crosses indicate locations where back trajectories from squares intersect convection
Cross, square, and trajectory colors indicate elapsed time between convection and 04071219
Hot CN Count
700
600
500
400
300
Days Since Convection
2.5
2.0
1.5
1.0
0.5
0.0
NASA/ARC
PSL
1634 Trajectories
Last Image Used is 0407121845

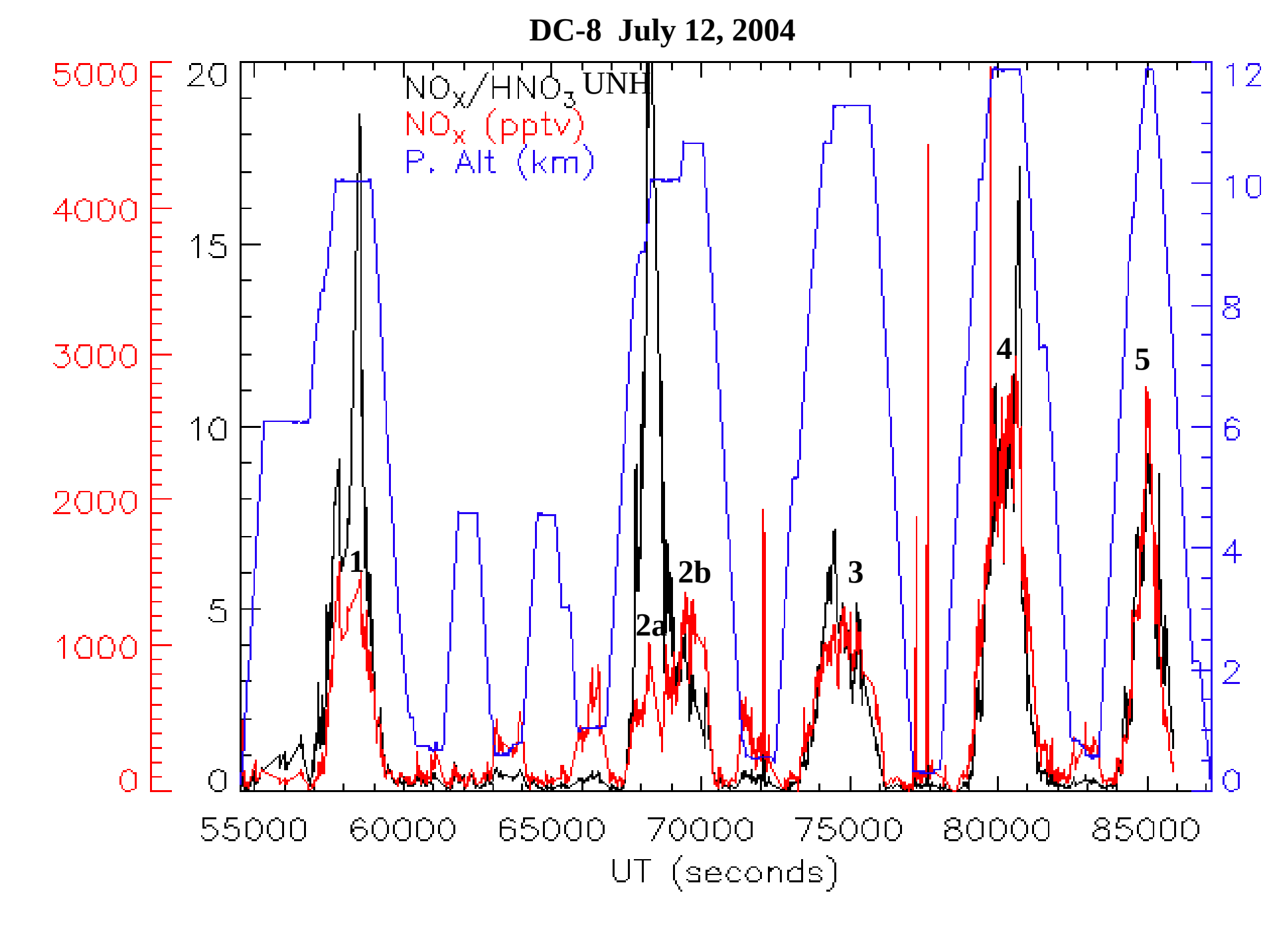

Map of parcels at 33 kft on 04071219 influenced by convection 5.0 to 7.5 days earlier
+ Squares indicate location of convectively influenced air -- influence calculated only within black box
Crosses indicate locations where back trajectories from squares intersect convection
Cross, square, and trajectory colors indicate elapsed time between convection and 04071219
Methyl Nitrate pptv
5
4
3
2
1
0
Days Since Convection
7.5
7.0
6.5
6.0
5.5
5.0
NASA/ARC
PSL
1634 Trajectories
Last Image Used is 0407121845

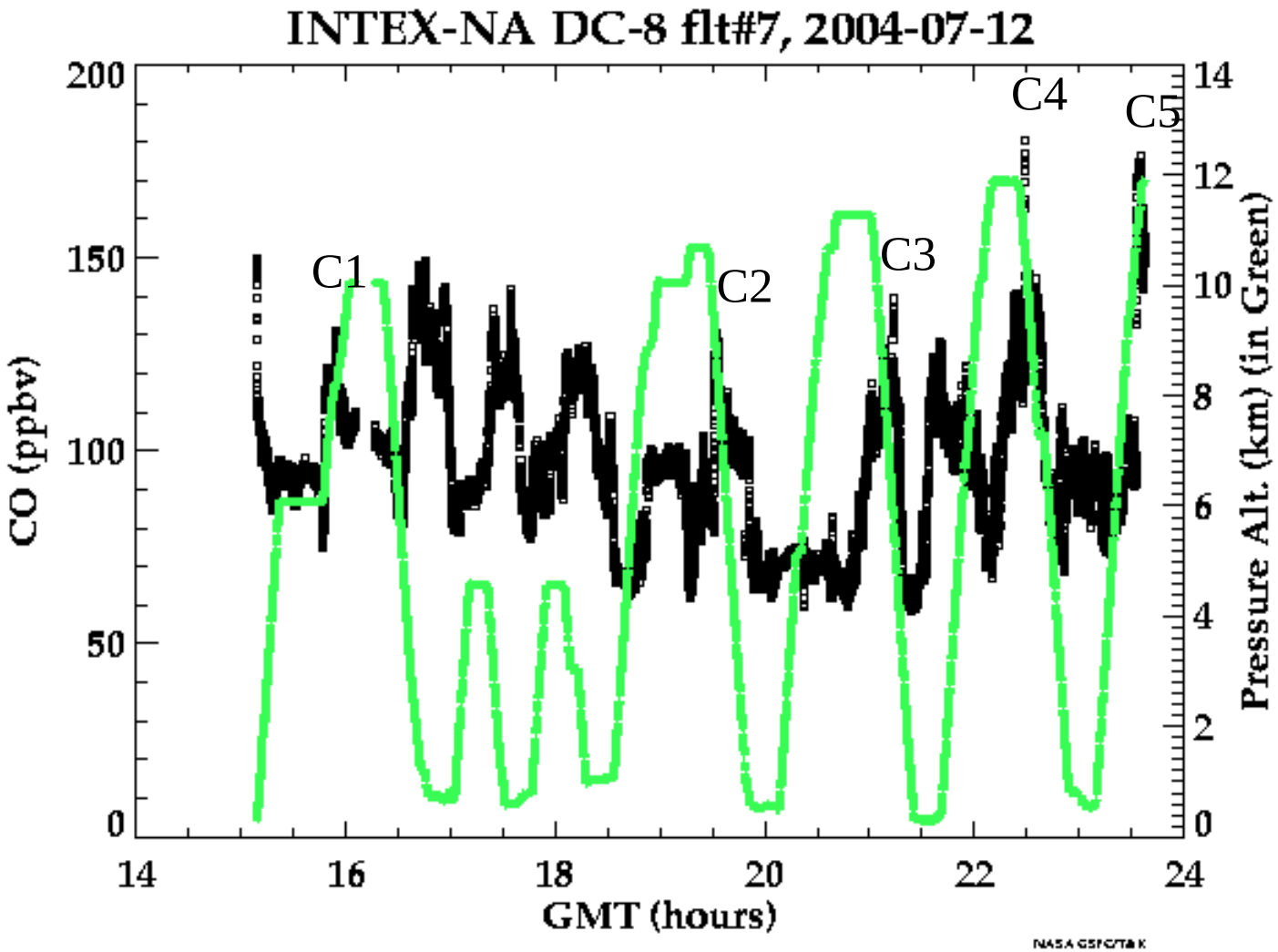
CAVEAT

- **NLDN cloud-ground (CG) flashes are being used as a proxy for total lightning.**
- **However, intracloud (IC) lightning exceeds CG lightning by a factor of 3 over the continental US (Boccippio et al., 2002).**
- **The IC/CG ratio is highly variable by region (approx. 1 – 10) and by individual storm (even larger range).**

Good correspondence of 5-day lightning influence and enhanced UT ozone



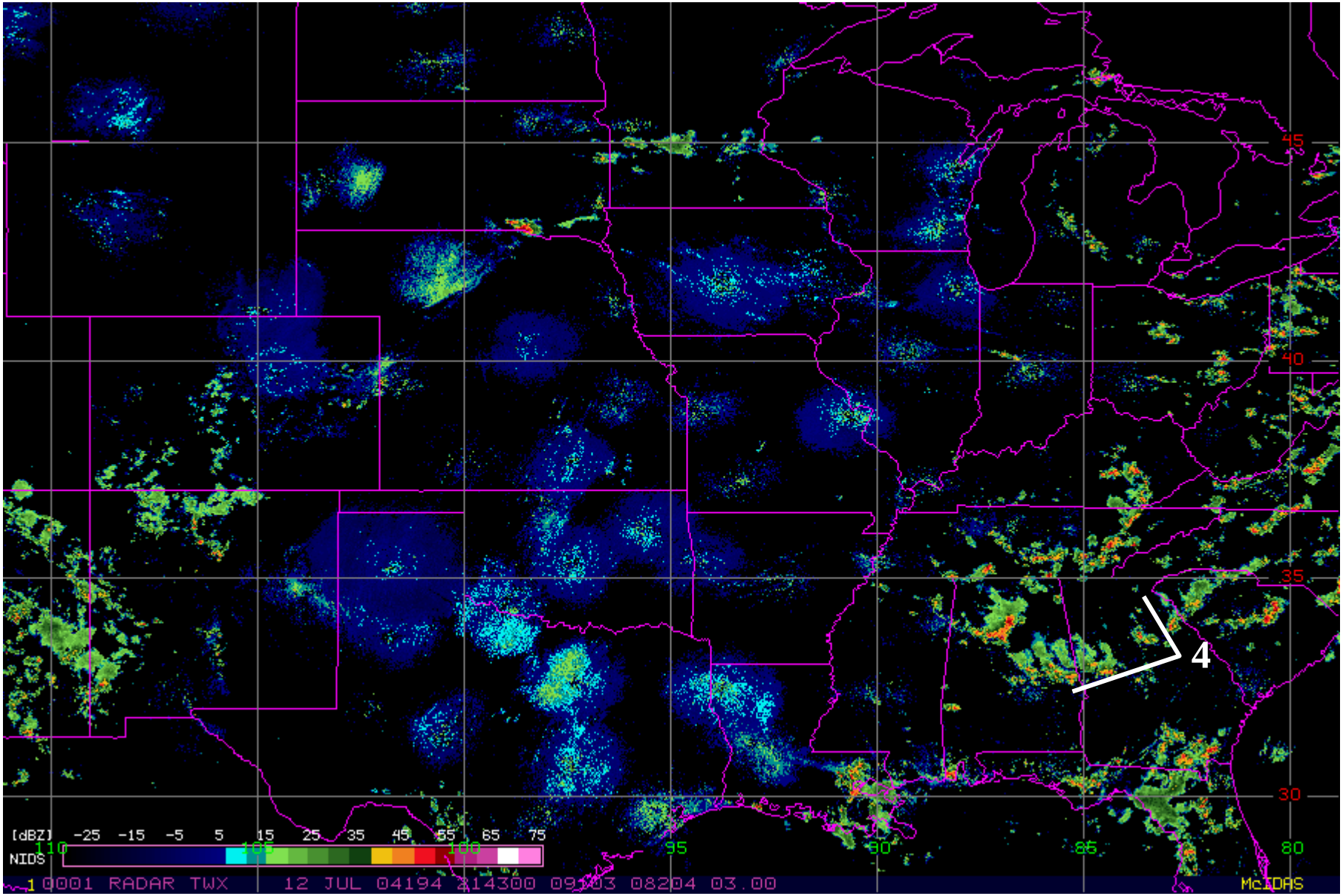

DC-8 July 12, 2004
NOx/HNO3 UNH
NOx (pptv)
P. Alt (km)
5000
4000
3000
2000
1000
0
20
15
10
5
0
12
10
8
6
4
2
0
1
2a
2b
3
4
5
55000
60000
65000
70000
75000
80000
85000
UT (seconds)



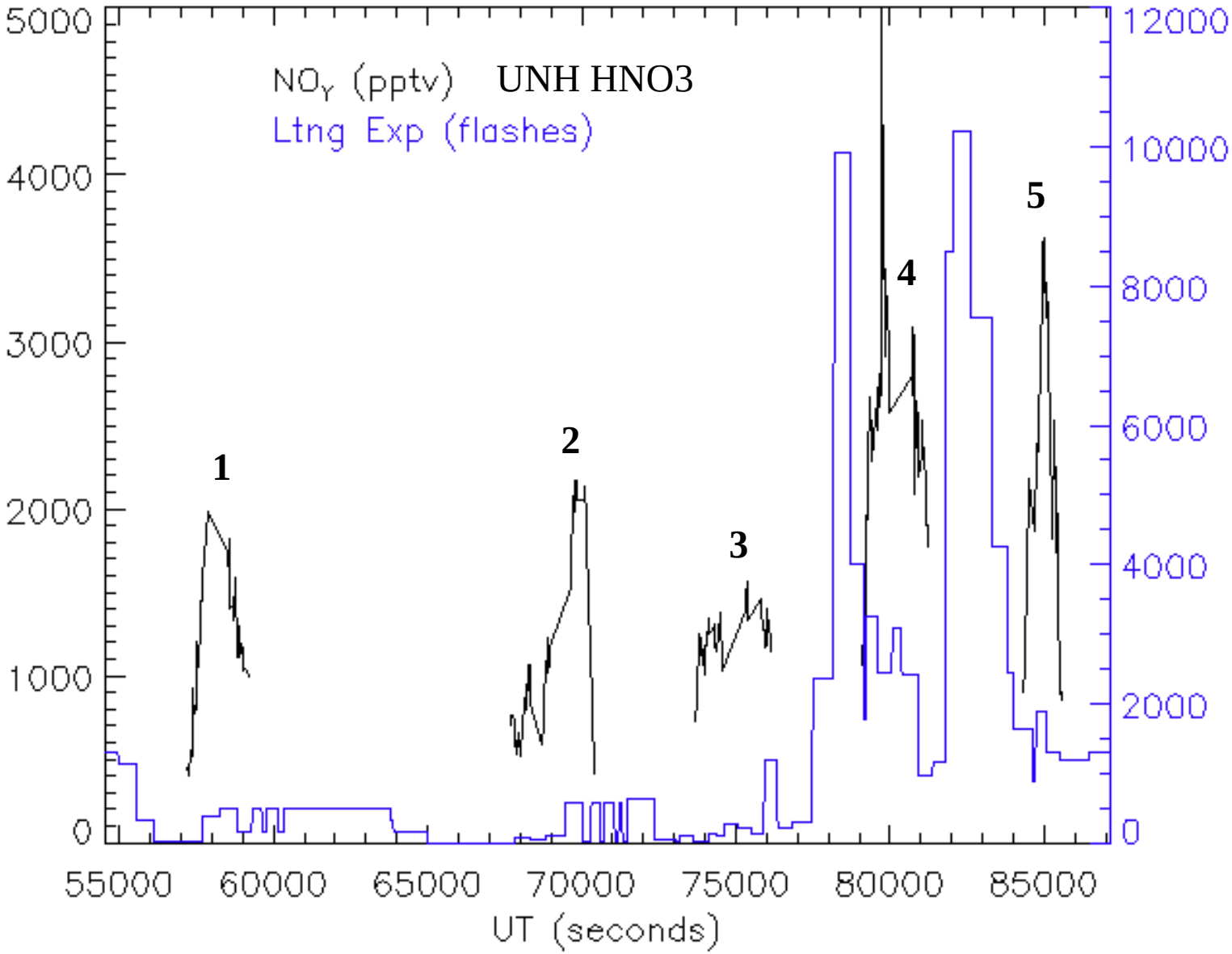
C – Convective influence

Note CO peaks are at lower altitude than NO_x peaks

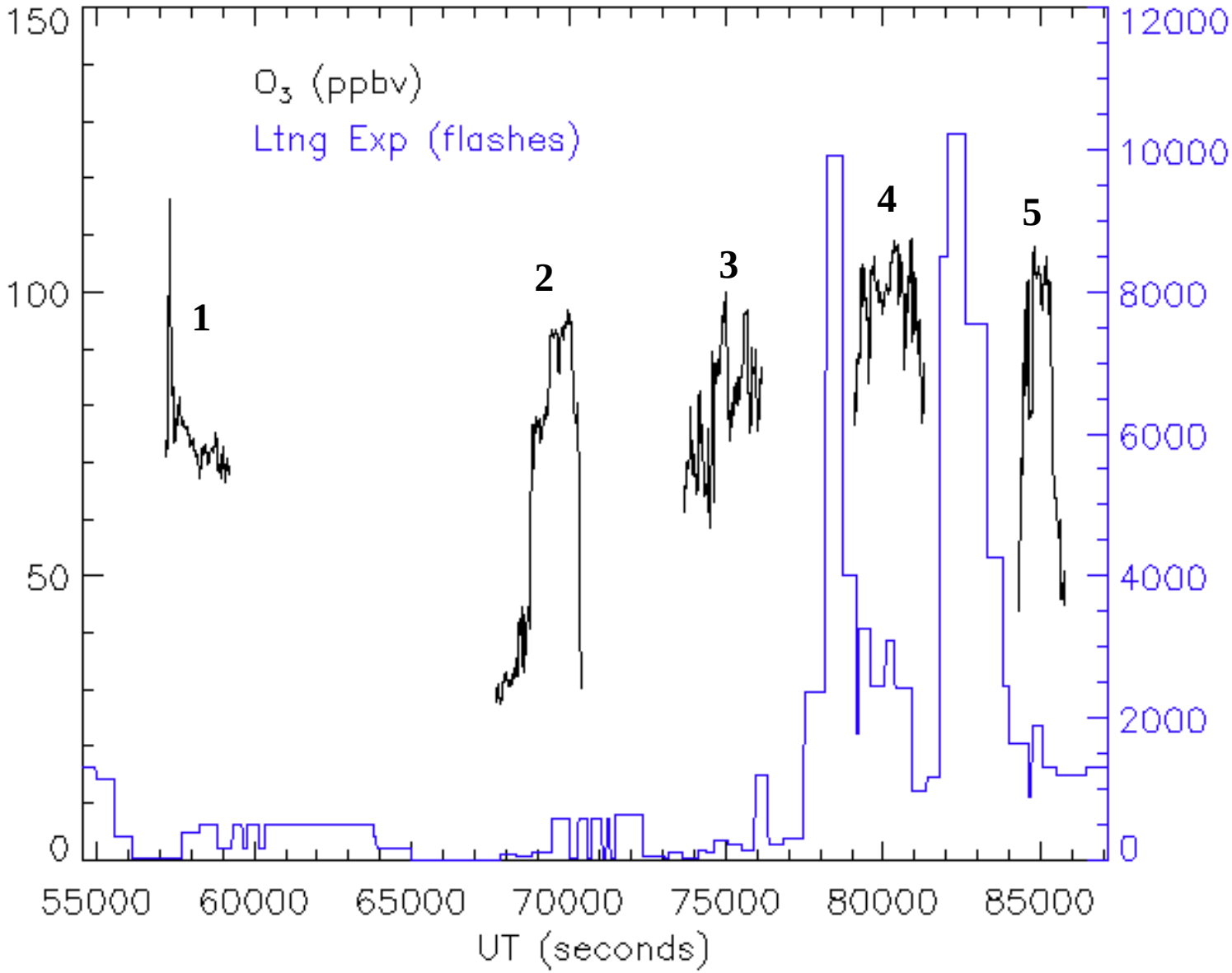
G. Sachse

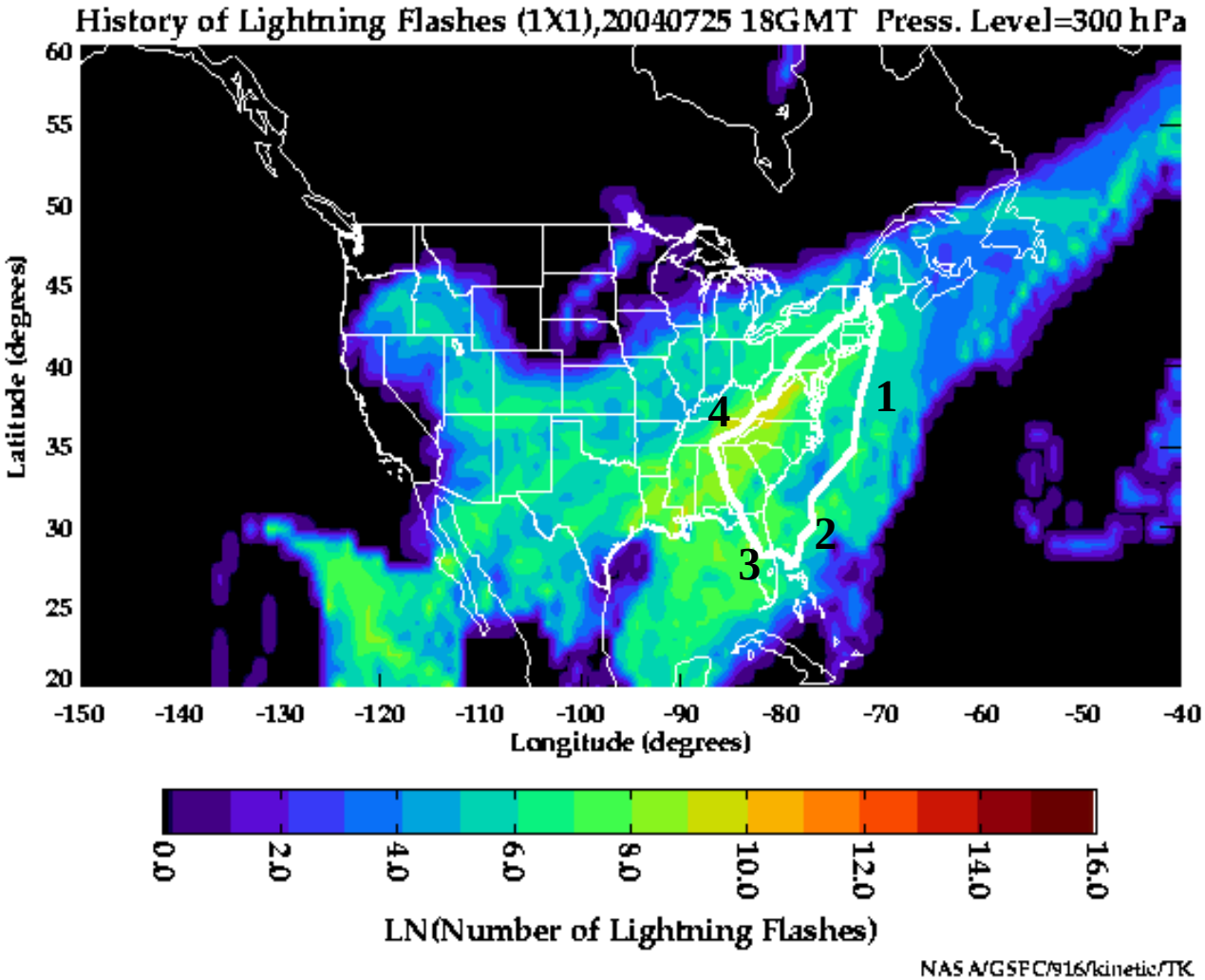

45
40
35
30
110
105
100
95
90
85
80
4
[dBZ] -25 -15 -5 5 15 25 35 45 55 65 75
NIDS
1 0001 RADAR TWX 12 JUL 04194 214300 09103 08204 03.00
McIDAS

DC-8 at > 8 km July 12, 2004

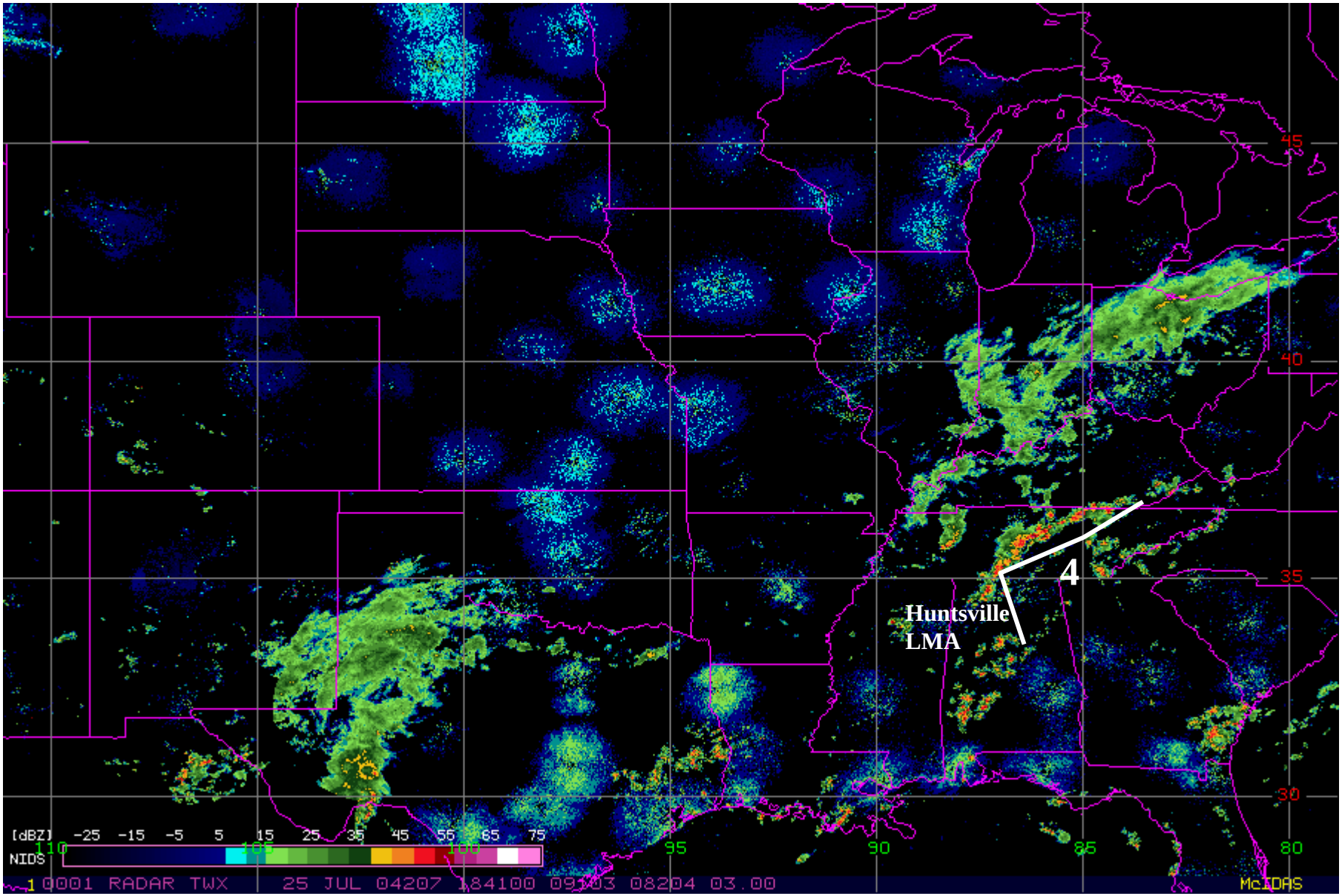


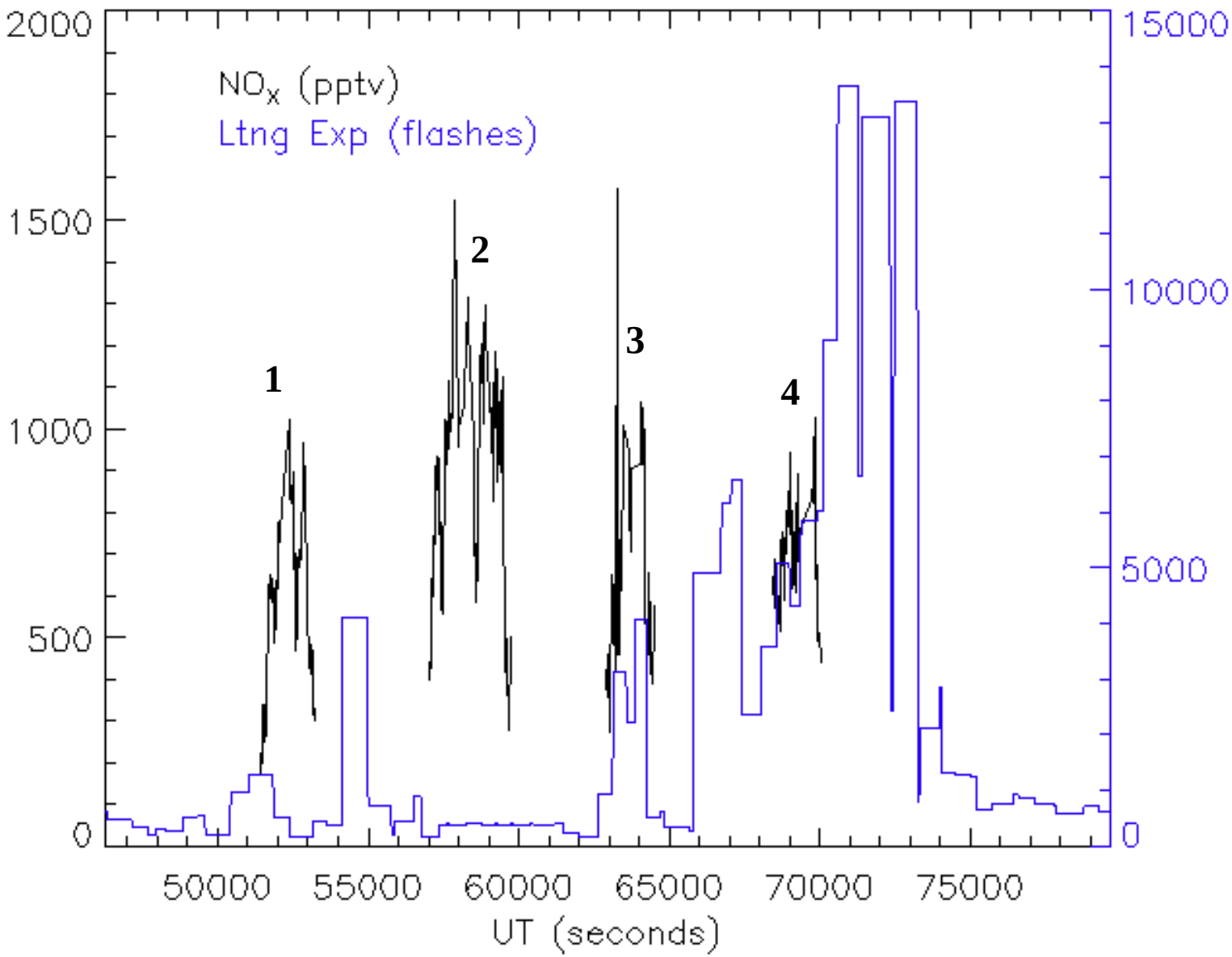
DC-8 at > 8 km July 12, 2004





DC-8 flight path (in white)


4
Huntsville
LMA
[dBZ] -25 -15 -5 5 15 25 35 45 55 65 75
NIDS
45
40
35
30
110
105
100
95
90
85
80
1 0001 RADAR TWX 25 JUL 04207 184100 09103 08204 03.00
McIDAS


DC-8 at > 8 km
July 25, 2004
2000
1500
1000
500
0
15000
10000
5000
0
NOx (pptv)
Ltng Exp (flashes)
1
2
3
4
50000
55000
60000
65000
70000
75000
UT (seconds)

Many Uncertainties Concerning Lightning NO Production in Regional/Global Chemical Transport Models: Can INTEX Data Help?

Analysis of DC-8 Data:

- What does the vertical profile of lightning NO_x look like at the end of a storm?

Using Huntsville LMA/Cloud model

- What is the average number of molecules of NO produced per flash or per unit flash length?
- Is NO production in cloud-to-ground flashes different from that in intracloud flashes?

Forthcoming Analysis and Modeling

Analyses

- Estimate lightning contribution to observed NO_x using ratios to CO and other tracers of boundary layer air (e.g., ethane, ethyne) - collaboration with Porter/Fuelberg)
- Estimate vertical profile of lightning NO_x using data from DC-8 ascents and descents. (collaboration with Porter/Fuelberg)
- Analyze lightning exposure relative to convective influence (work with Lenny Pfister)
- Evaluate GEOS-4 convection using NLDN data and convective influence analysis

Forthcoming Analysis and Modeling

Modeling

- Run cloud/chemistry model with lightning for cases of active convection near DC-8 flight track to estimate required NO production per flash to yield observed NO_x and relative importance of IC and CG flashes.
- Run regional/global chemical transport model (UMD-CTM) to test lightning flash rate and NO parameterizations using NLDN, DC-8 NO_x observations, and SCIAMACHY NO_2 columns.
- Estimate lightning contribution to NO_x, NO_y, O_3 in the INTEX region