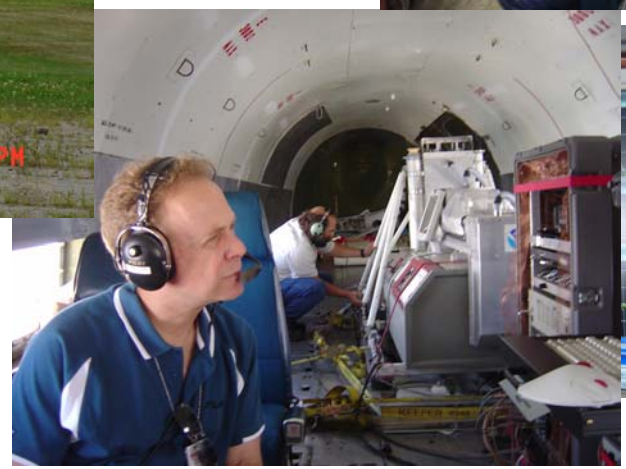
Ozone distribution in the horizontal and vertical – airborne ozone lidar

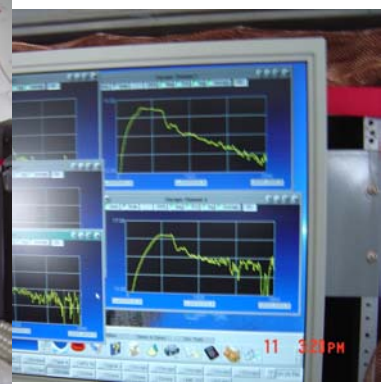
Robert M. Banta, Raul J. Alvarez, Christoph J. Senff, Lisa S. Darby, Scott P. Sandberg, and R. Michael Hardesty

Environmental Technology Laboratory / NOAA

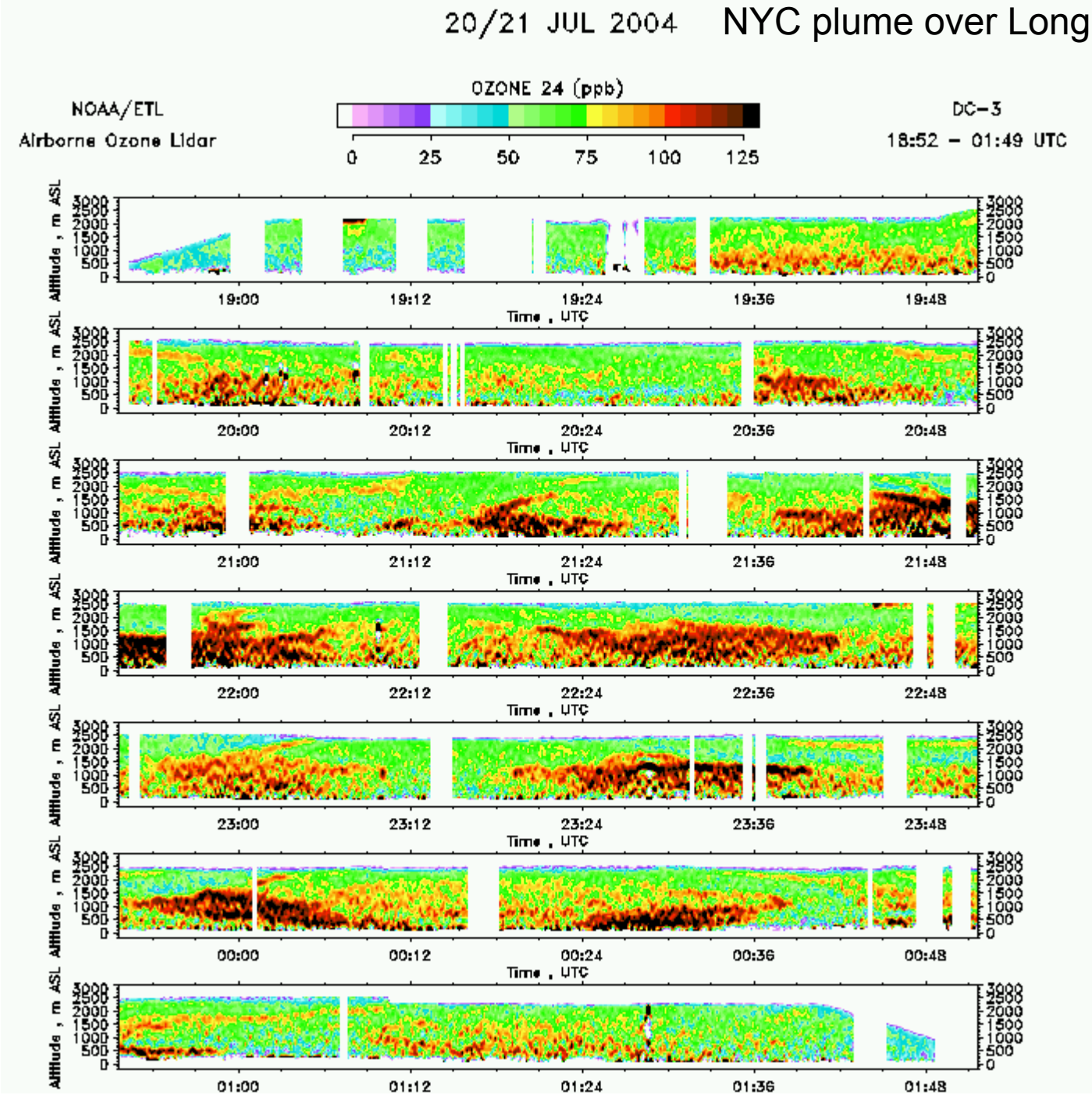
Boulder, Colorado

Airborne O_3 Differential Absorption Lidar (DIAL)

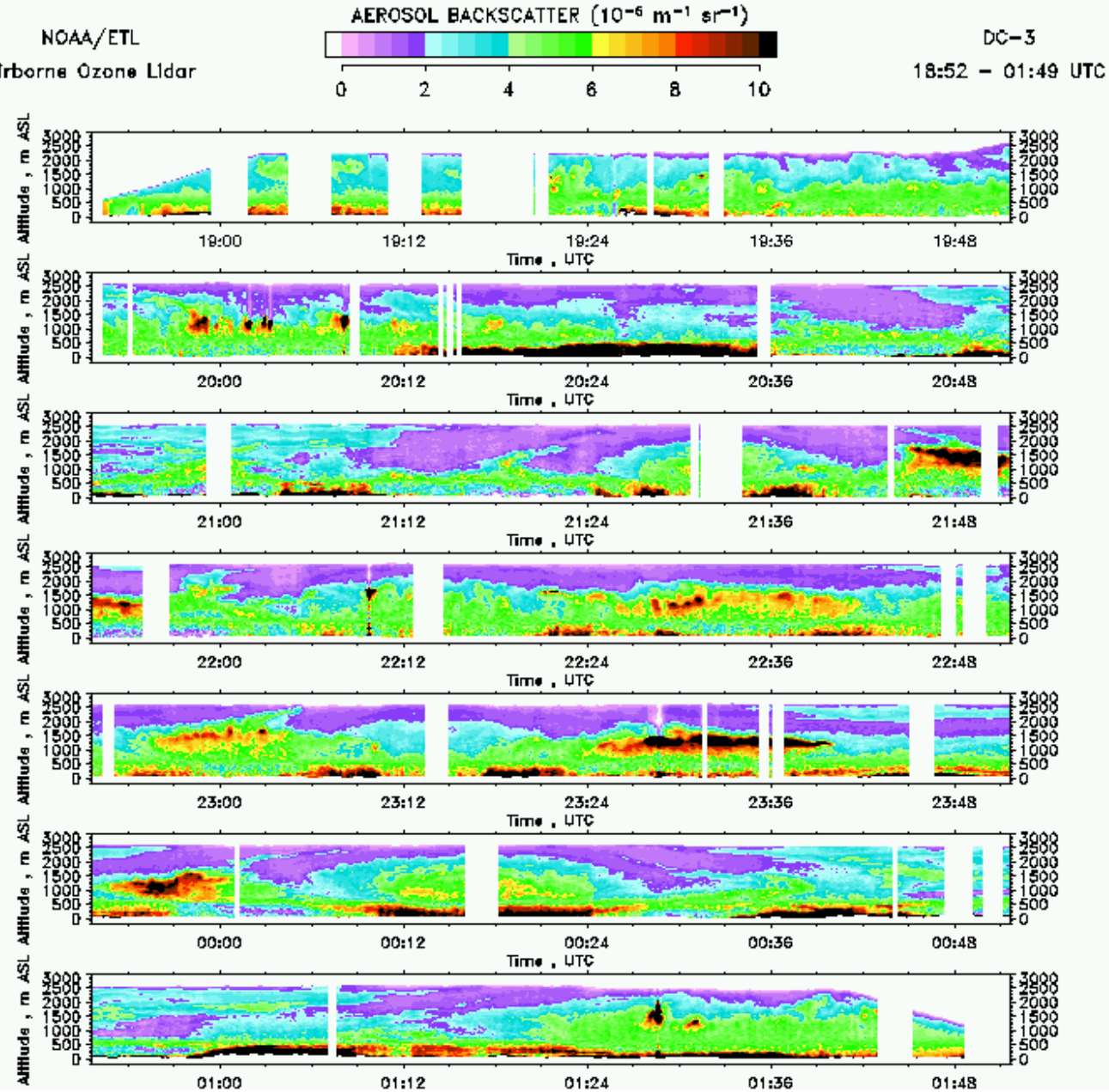




NYC plume over Long Island



Aerosol 20/21 JUL 2004 Over Long Island



Addressing ICARTT objectives

- Atmospheric transport and mixing processes; *'New England' scale*
  - Individual urban plumes
  - Combined 'continental outflow' streams
  - Vertical transport processes
- NWP forecast model validation
  - Distribution, location, structure of O_3 emission cloud, *including vertical*

Individual city emission plume:

O_3 from NYC a.m. rush-hour emissions – 20 July 04

- Dimensions of emission plume, including depth
- Structure and layering
- Context for other line, point measurements; representativeness
- **Model prediction (Flexpart; WRF-Chem similar)**

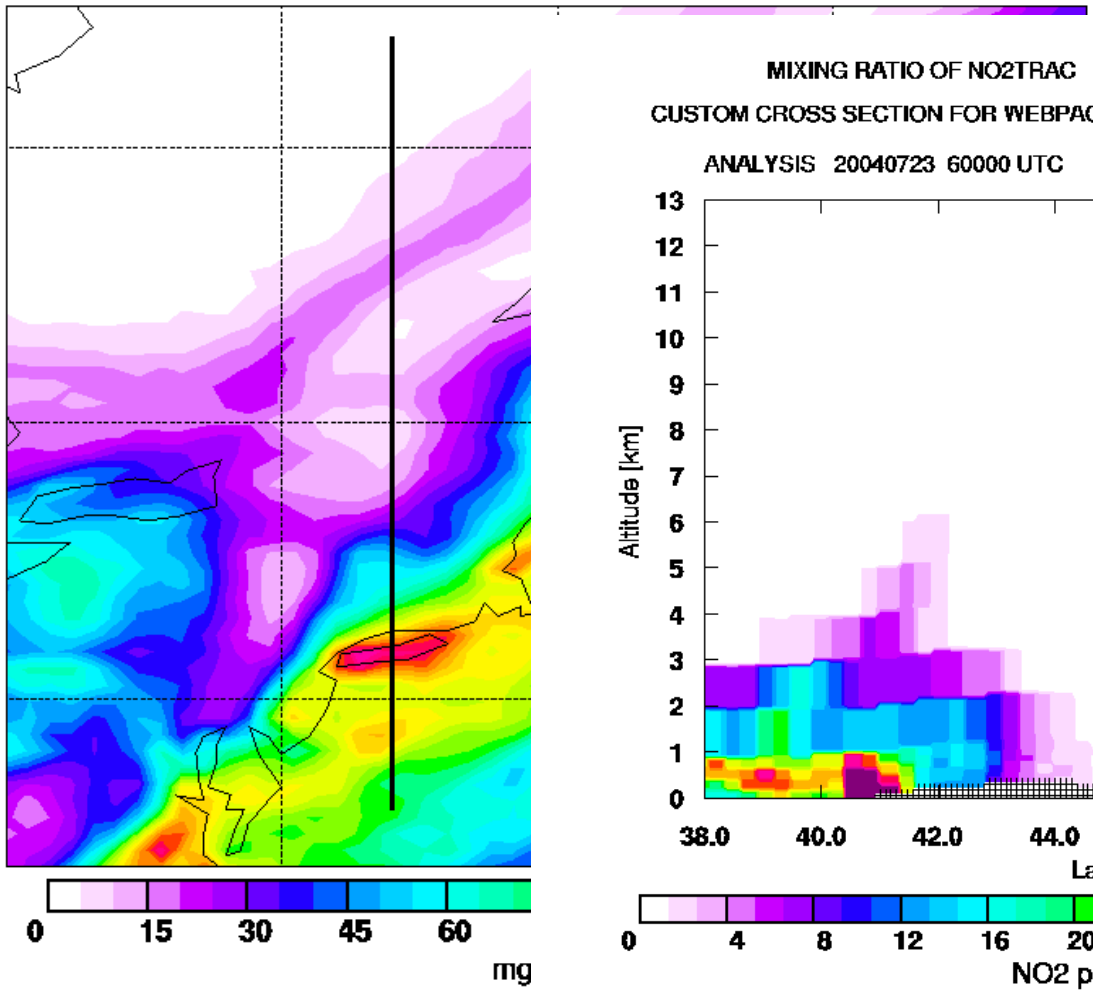
Total column of species 1 for age class all

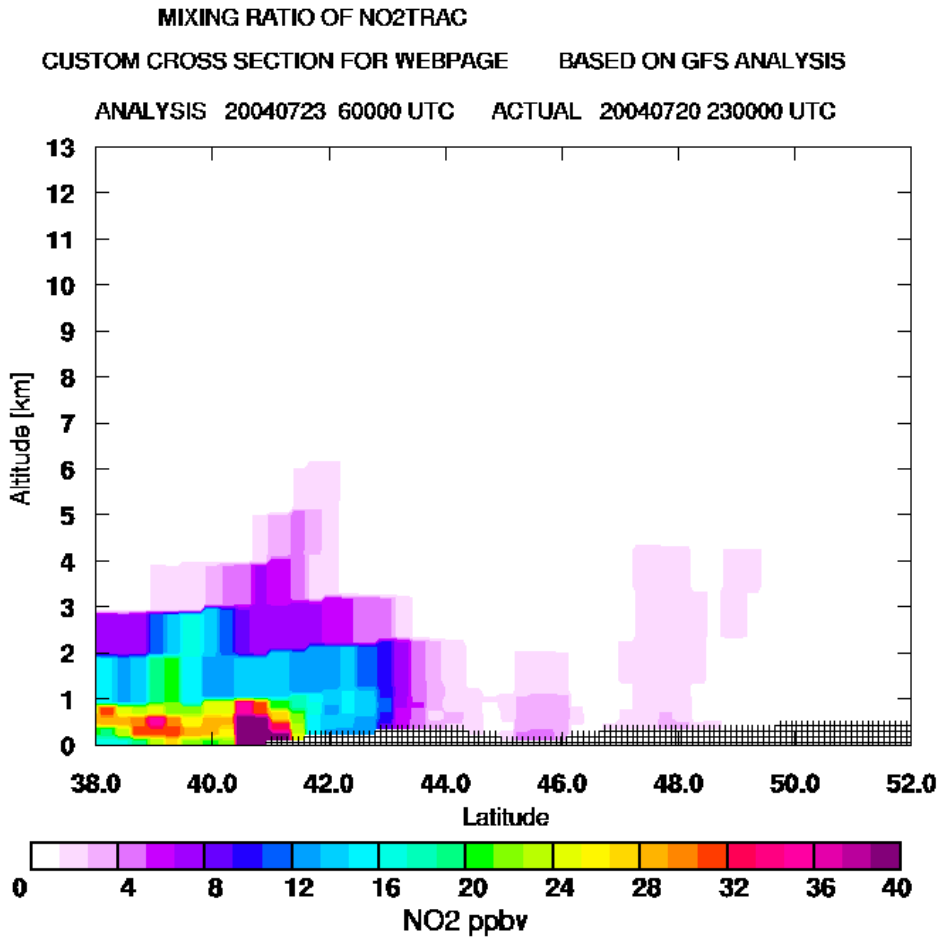
Simulation start 20040723. 90000 Actual time 20040720.230000

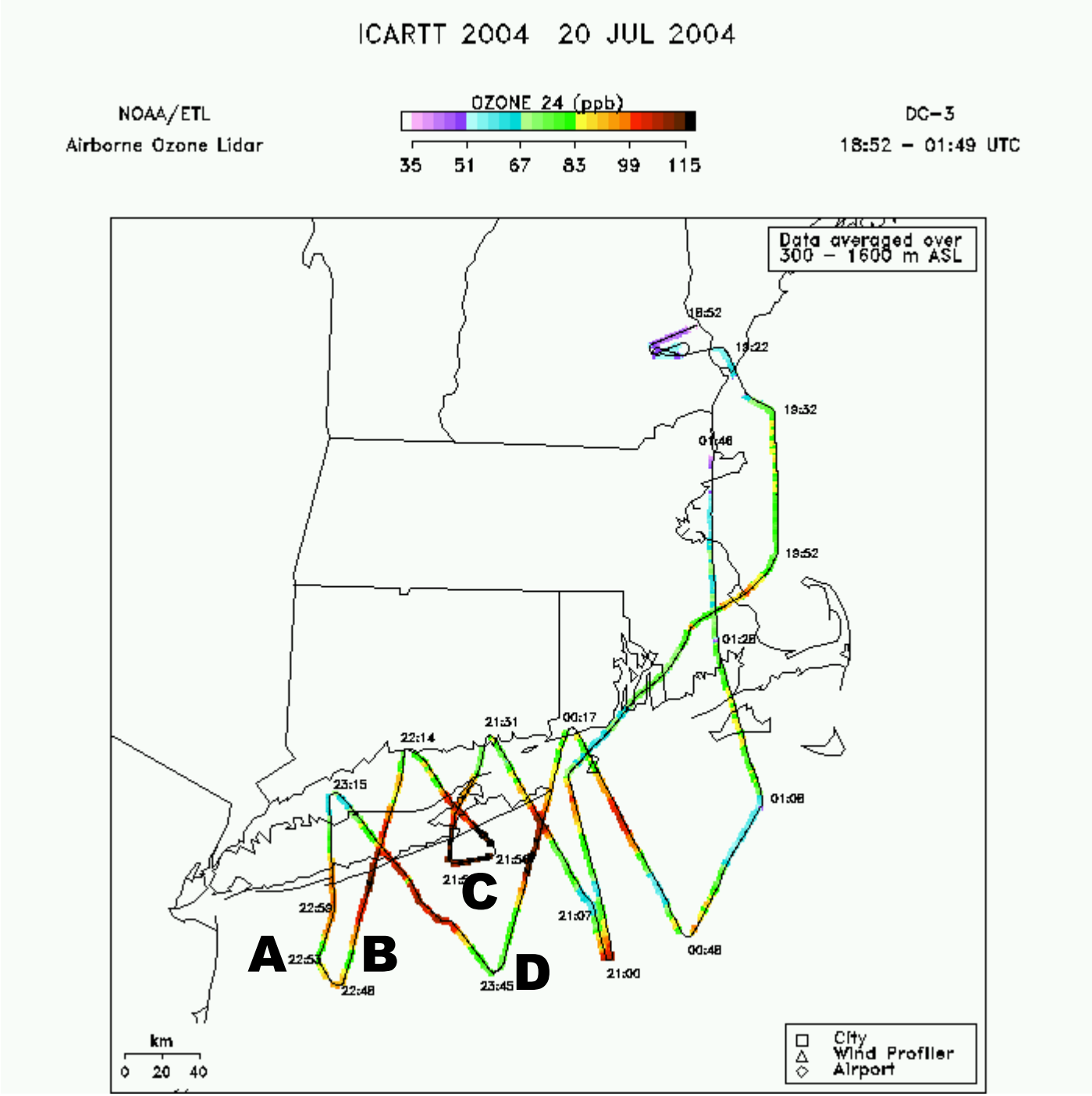
Mean value 0.120E+02

Maximum value 0.165E+03

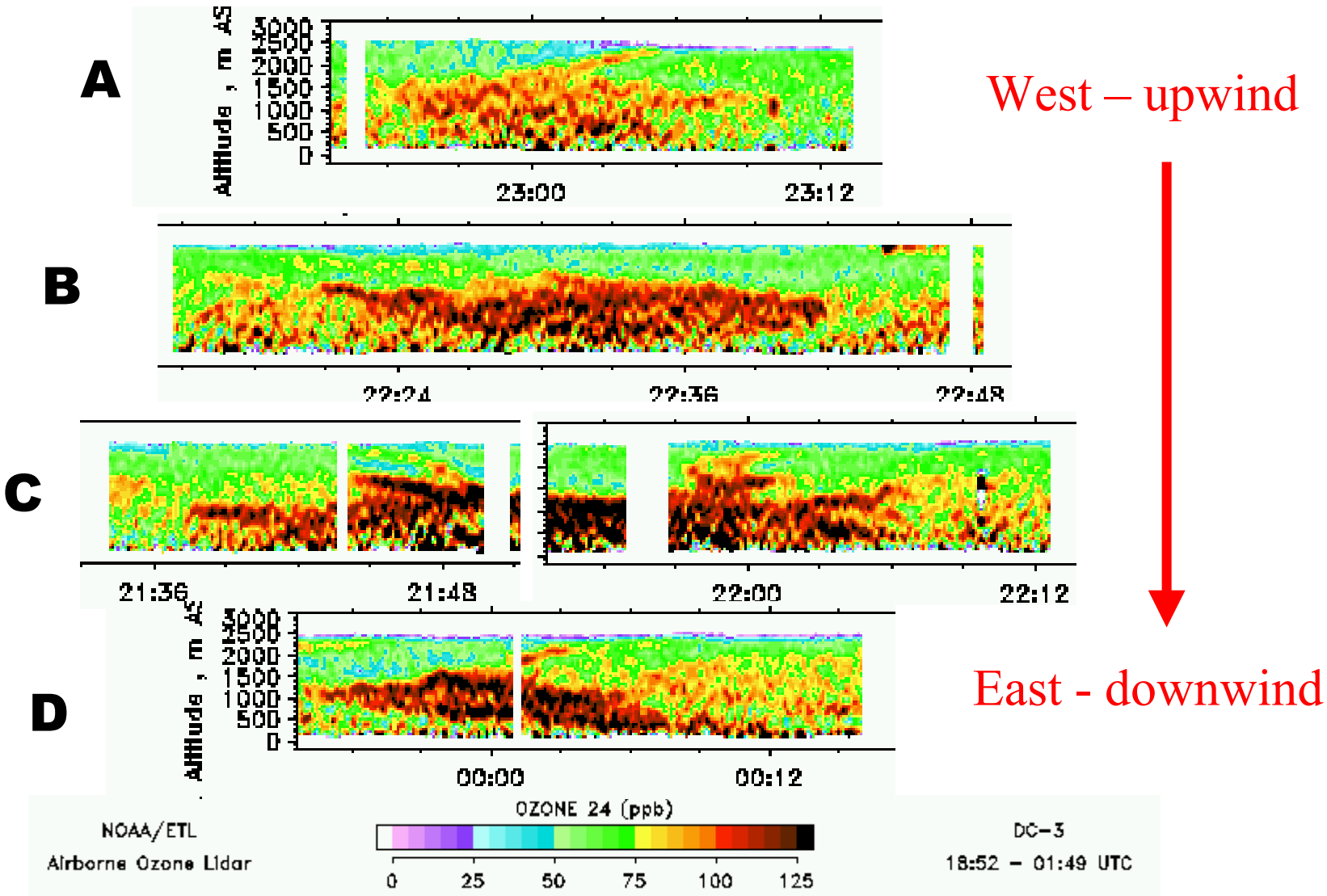
Minimum value 0.000E+00






ICARTT 2004 20 JUL 2004
NOAA/ETL
Airborne Ozone Lidar
OZONE 24 (ppb)
35 51 67 83 99 115
DC-3
18:52 - 01:49 UTC
Data averaged over
300 - 1600 m ASL
18:52
19:22
19:32
01:46
19:52
01:28
00:17
21:31
22:14
23:15
01:08
21:56
22:59
21:07
00:48
22:53
22:48
23:45
21:00
A
B
C
D
km
0 20 40
City
Wind Profiler
Airport

O_3 in NYC pollution plume

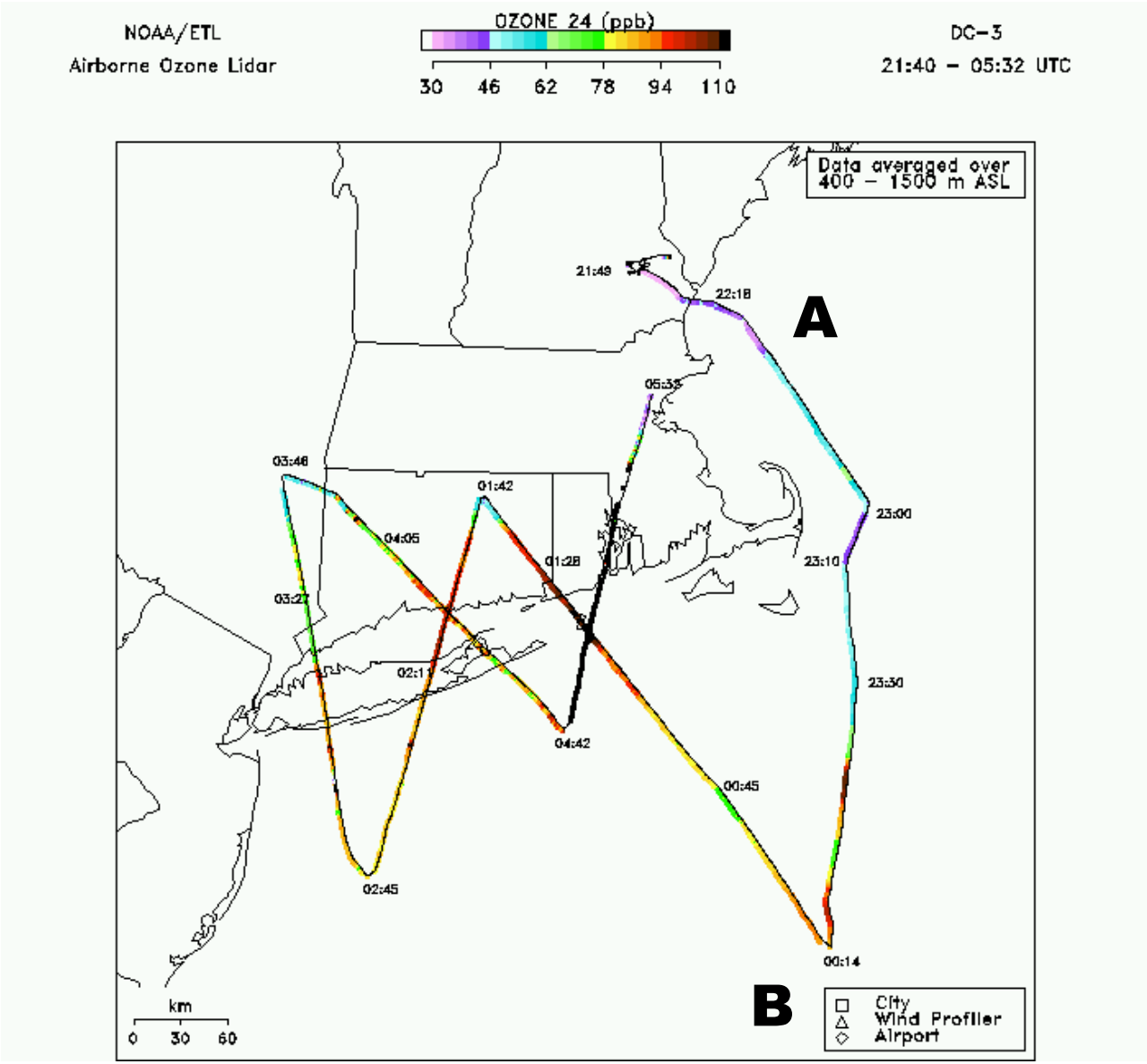


‘Amalgamated’ outflow stream

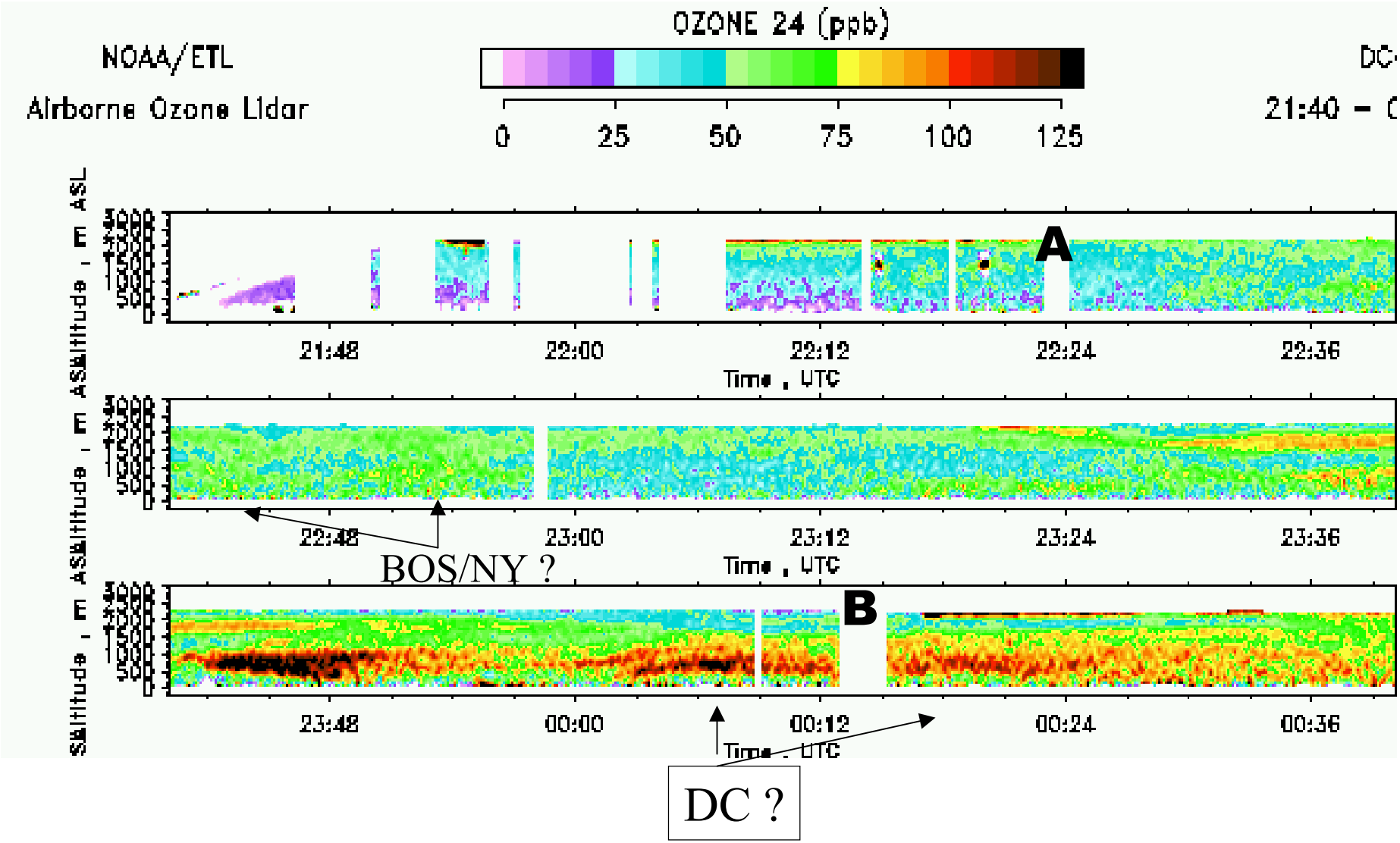
- Overall region of relatively higher O_3
  - 50-60 ppb stream, e.g., within…
  - 30-40 ppb ‘clean’ background
- Higher O_3 plumes embedded

  (could be 70-80 ppb or more)
- Agrees with NWP model picture
- Have seen a few times already

Map of ozone values – 17 July 04



Ozone cross sections – 17 July 04



Additional issues to be addressed

- Continental outflow during subtropical high stagnation, weak transport
- Role of small-scale features in vertical transport (sea breeze, terrain, nocturnal LLJ, etc.)
- Study mixed-layer depth (aerosol)
- Detailed evaluation of NWP forecasts
- Data set includes drop-wind-sonde profiles [T(z), p(z), humidity(z), winds(z)]