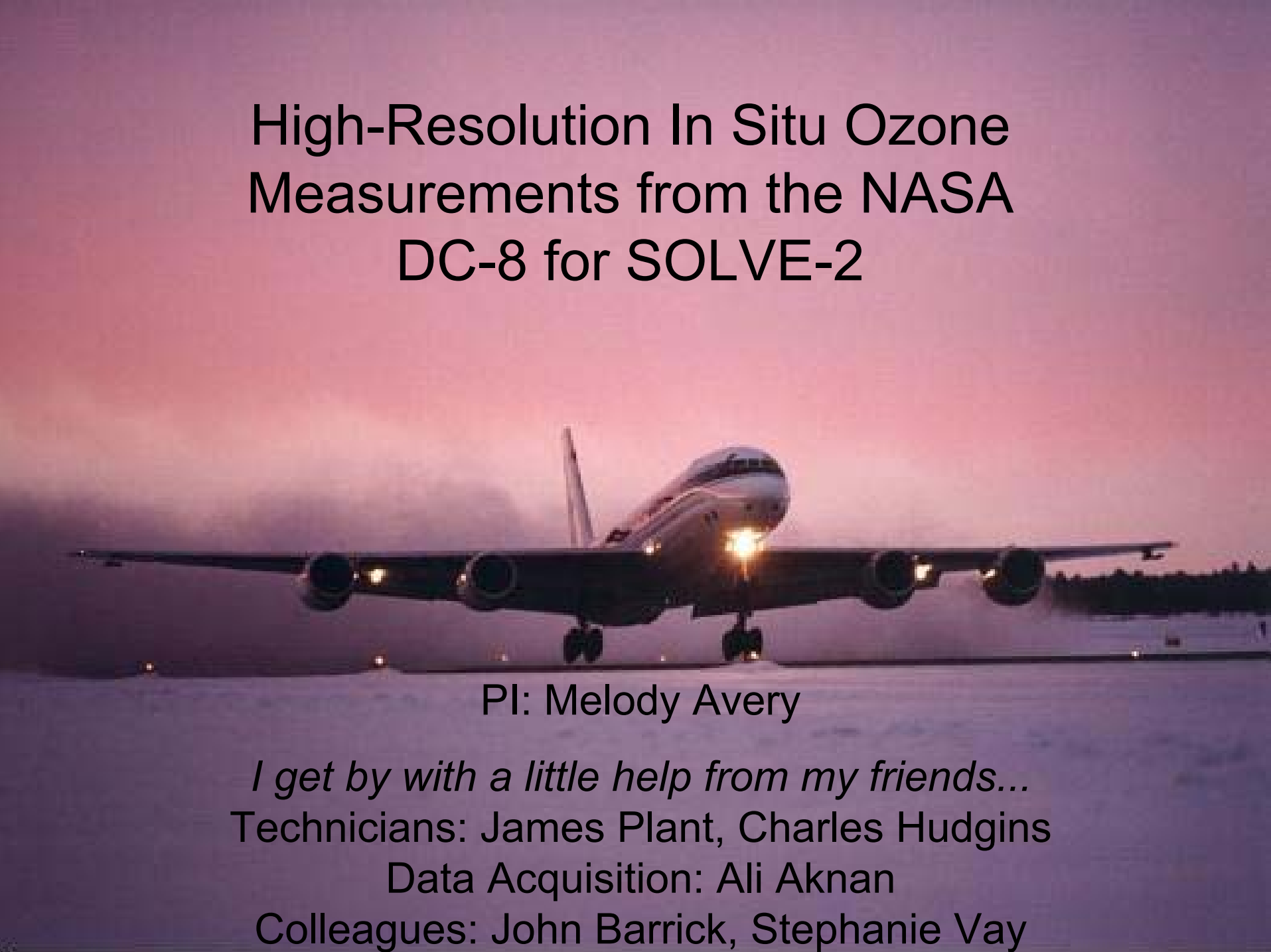
High-Resolution In Situ Ozone Measurements from the NASA DC-8 for SOLVE-2



PI: Melody Avery

I get by with a little help from my friends...

Technicians: James Plant, Charles Hudgins
Data Acquisition: Ali Aknan
Colleagues: John Barrick, Stephanie Vay

In Situ Ozone Measurement Program at NASA Langley

- Chemiluminescent Reaction of Ozone with Nitric Oxide
- Forward-Facing J-Probe (aircraft attitude insensitive)
- Measurement independent of clouds and aerosol concentration
- Calibrated by reference to NIST standard

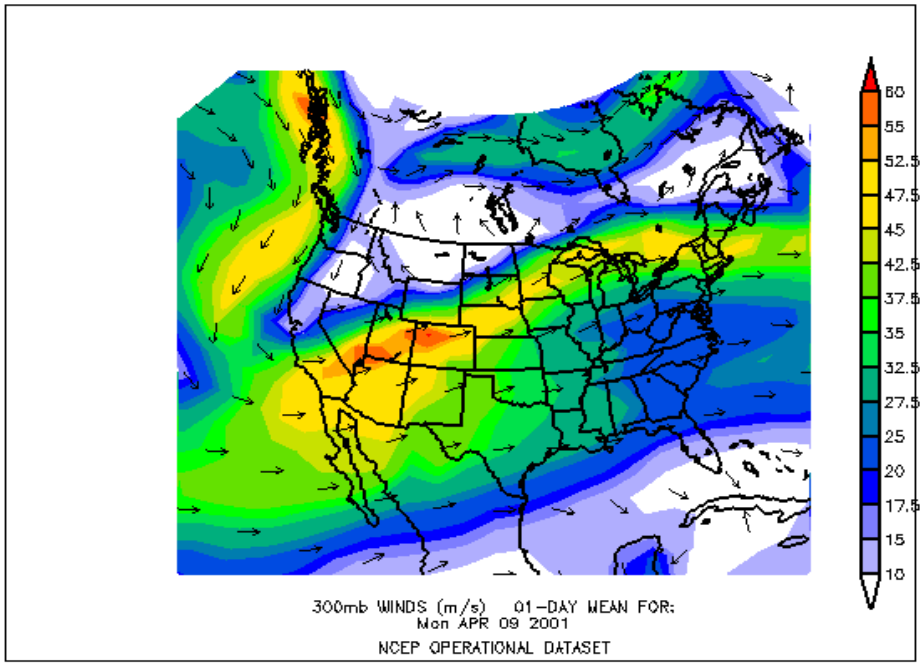
- Fast Response: 2-3 Hz
- 8-50 m Vertical Resolution
- 130-230 m Horizontal Resolution
- Large Dynamic Range: 0.75 - 2500 ppbv
- Accuracy: 3% or 2 ppbv
- Precision: 1% or 0.75 ppbv
- Reliability: 96-98% data coverage during TRACE-P

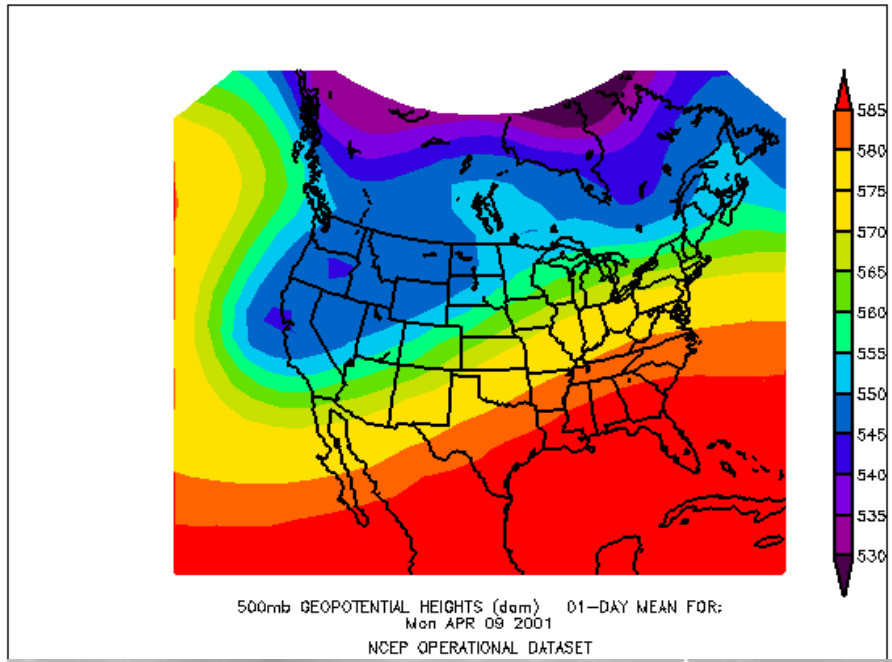
Purpose of High-Resolution Ozone Measurements

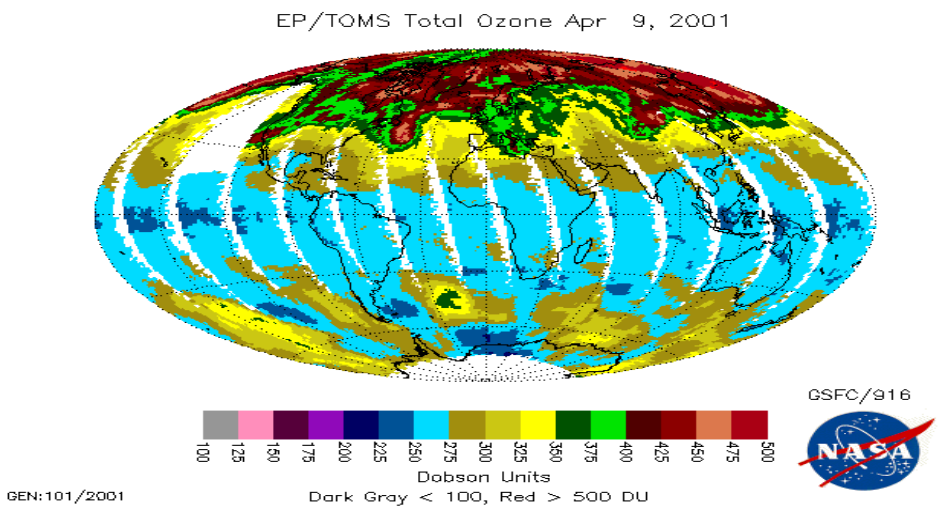
We are a peg on which you might hang your hat...

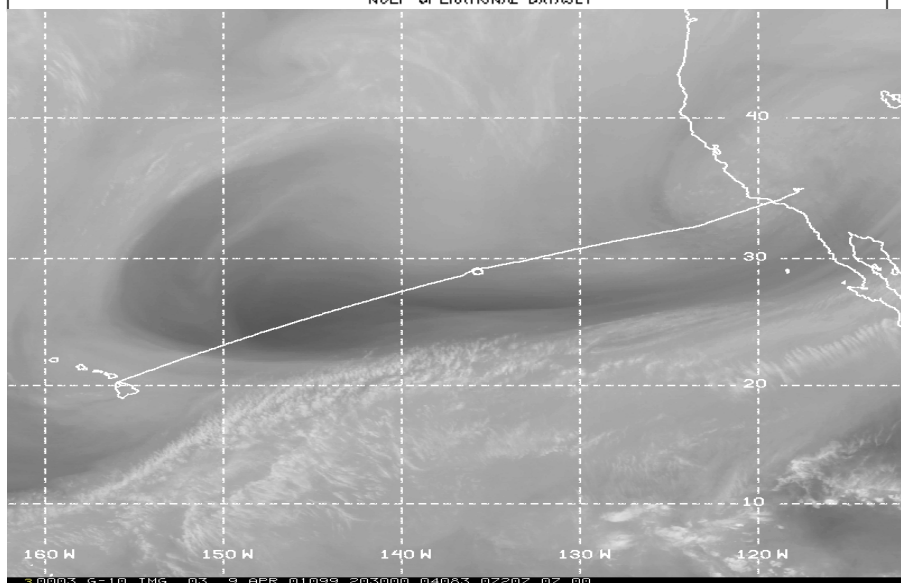
- High Accuracy and Precision
- Correlative measurement for satellite photometric ozone observations
- Correlative measurement for remote ozone profile measurements, such as onboard lidars and interferometers
- Proxy measurement for potential vorticity (dynamical model validation)
- Characterization of stratospheric/tropospheric exchange, upper-level frontal structure

Case Study from TRACE-P: A Tropopause Fold

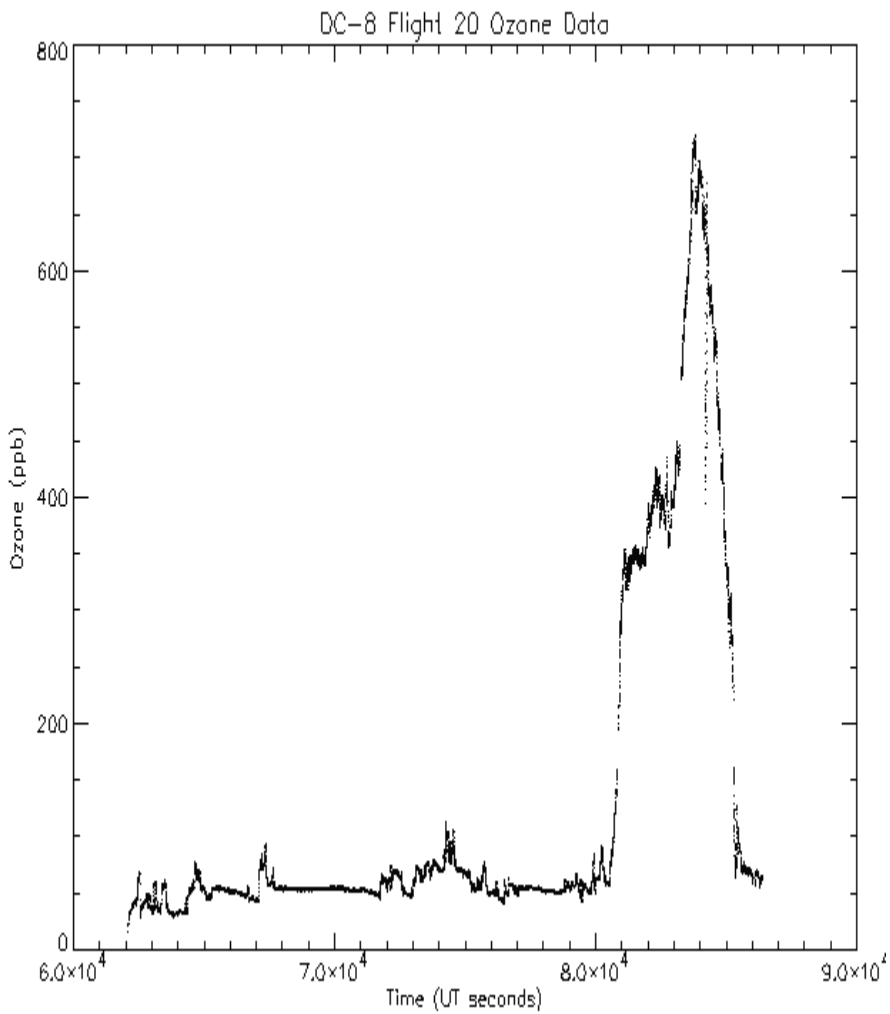


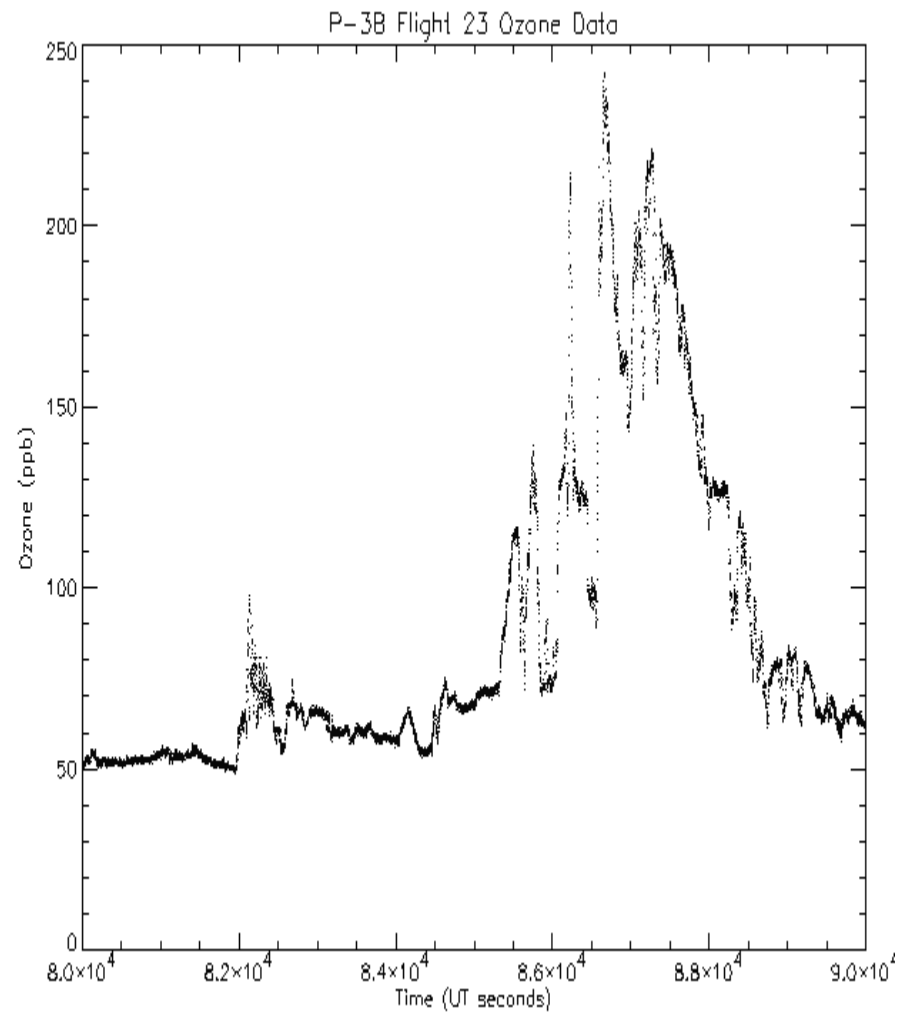






In Situ Ozone Observations

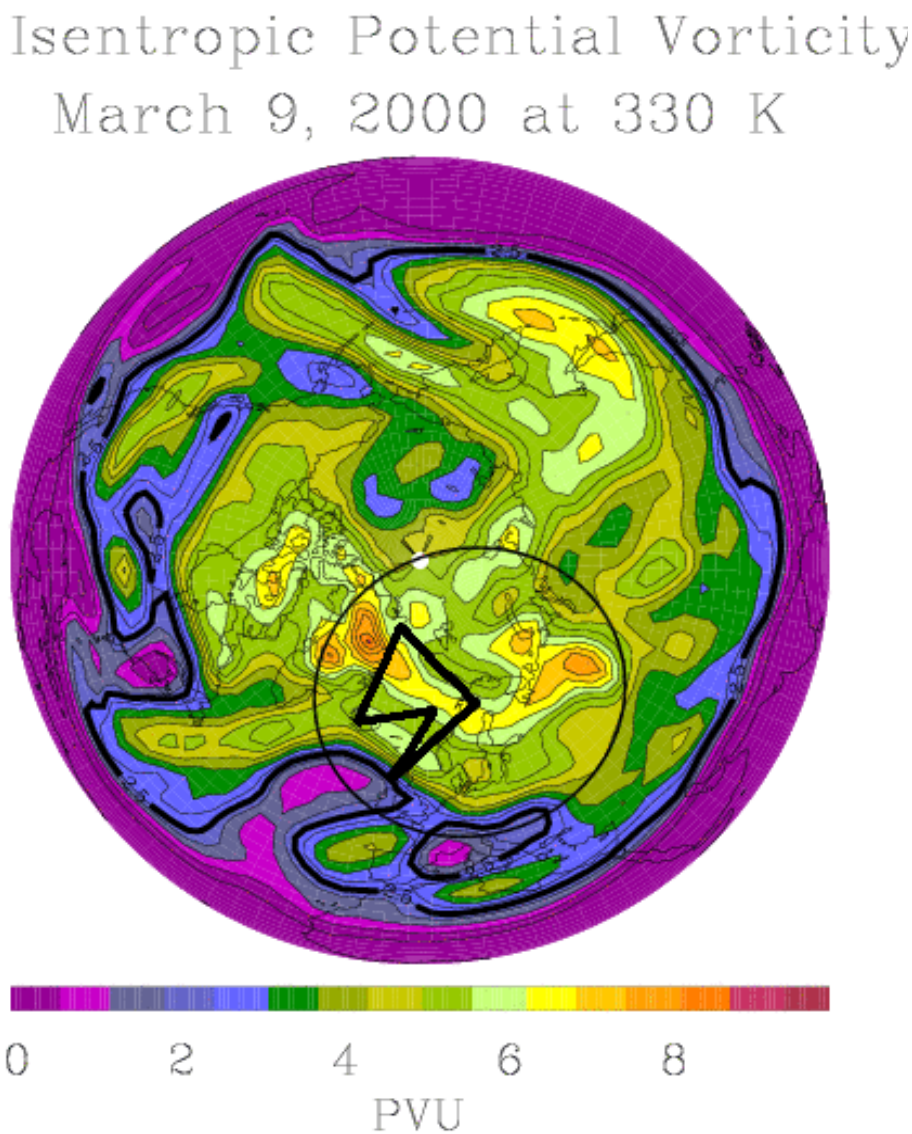


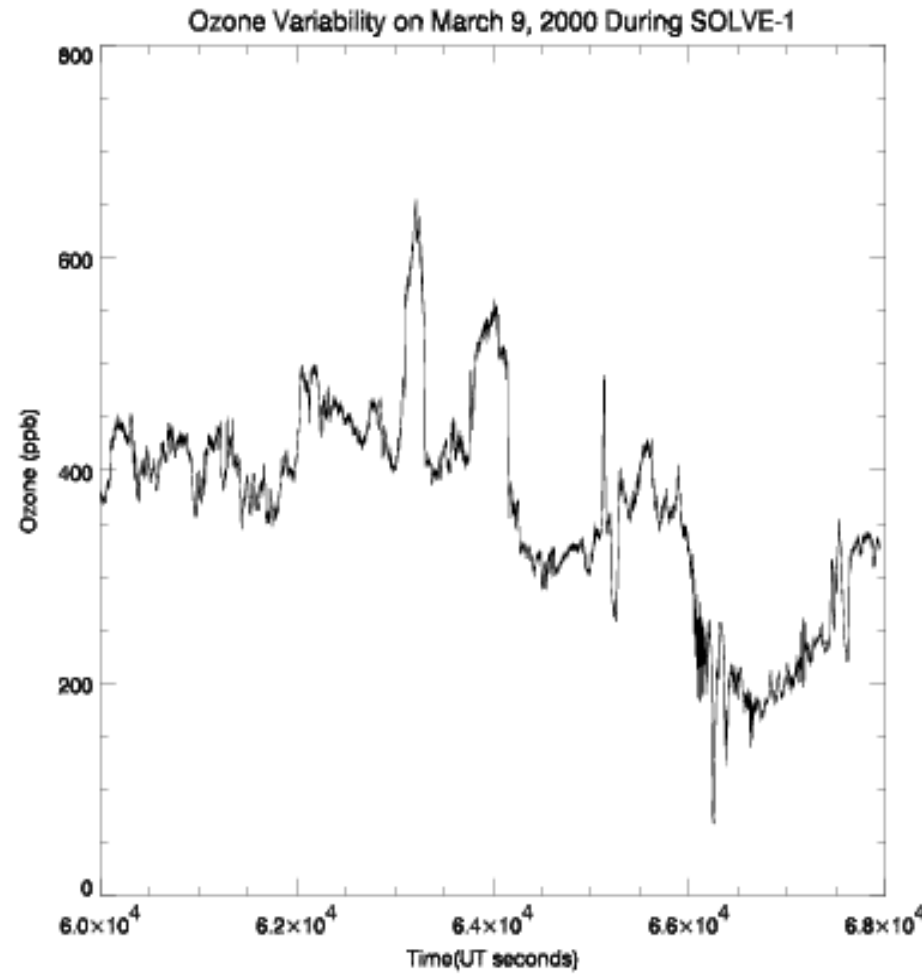


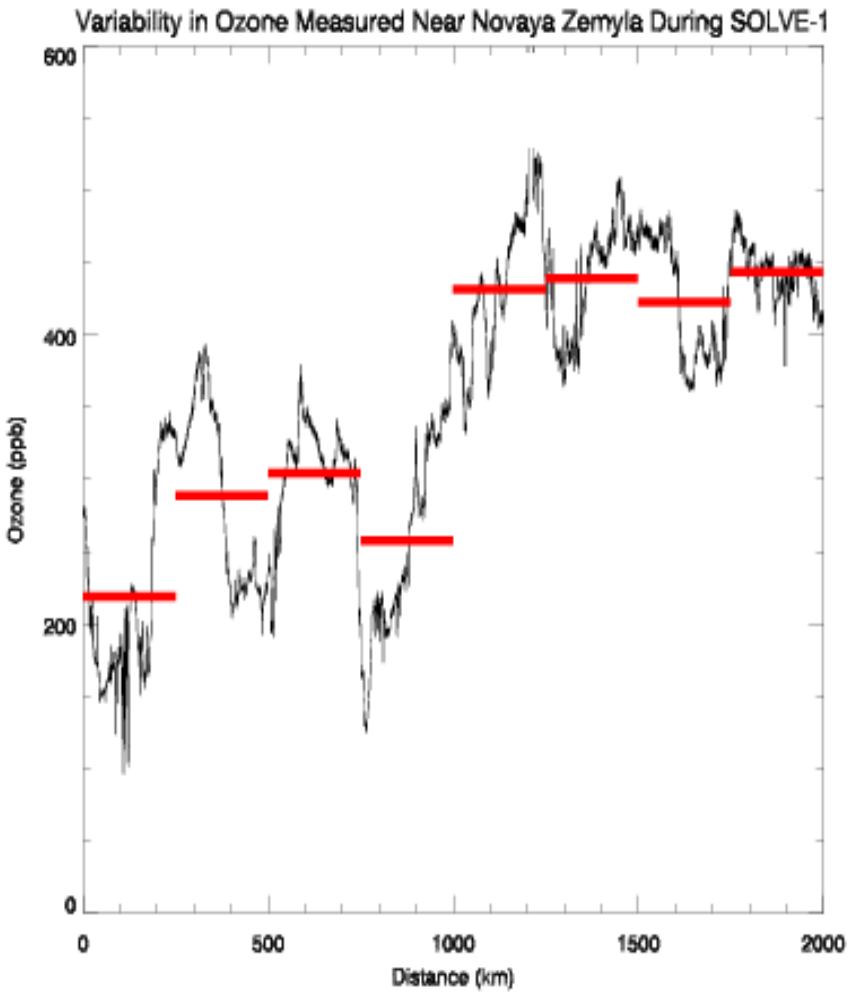
Science Questions that we hope to Answer After SOLVE-2:

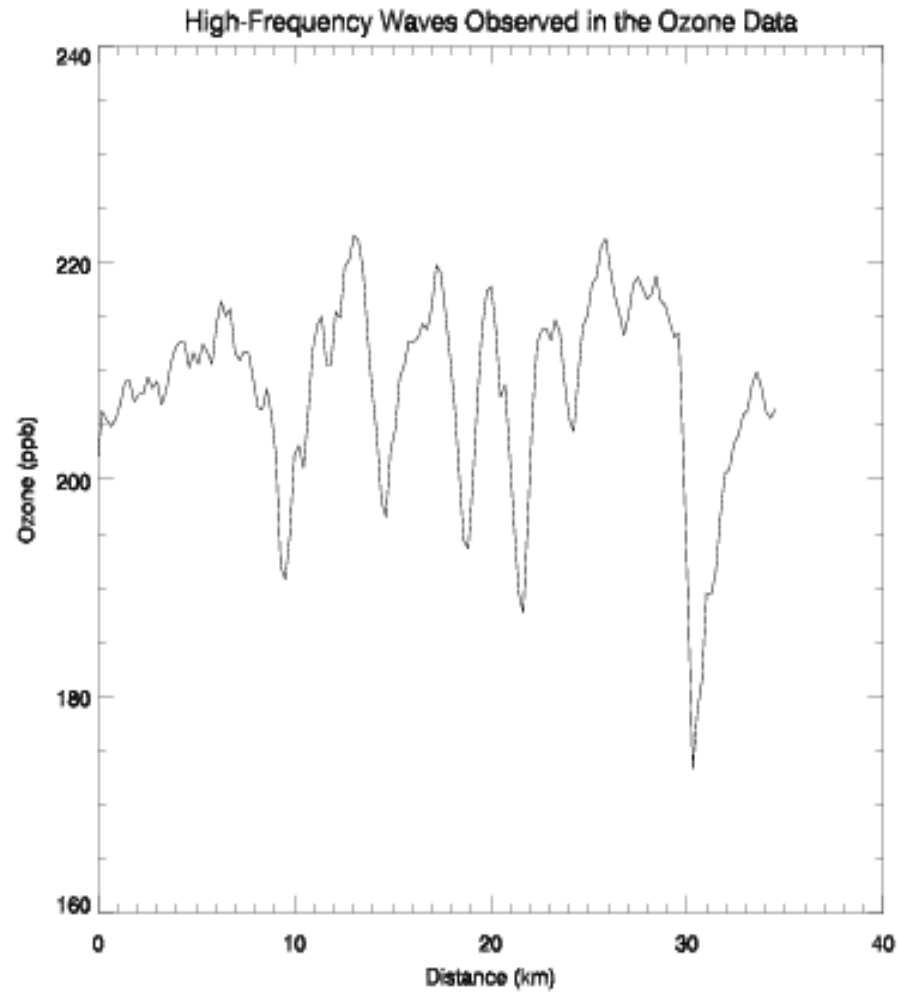
Does coarse-resolution sampling over the inhomogeneous lower stratosphere produce the same result as averaging over the finer-scale measurements?

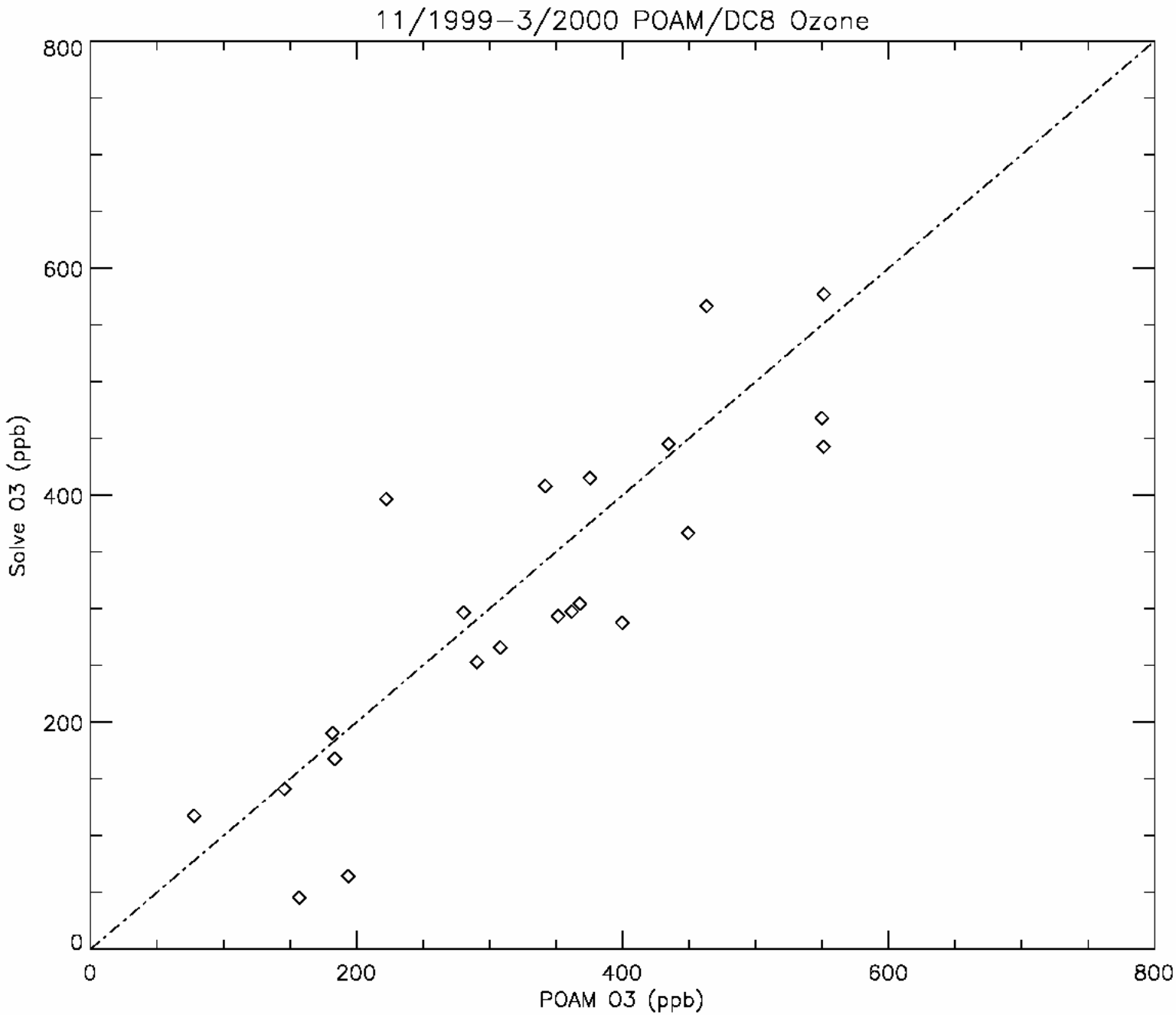
Do model-generated ozone fields accurately capture the natural variability of the lower stratosphere?

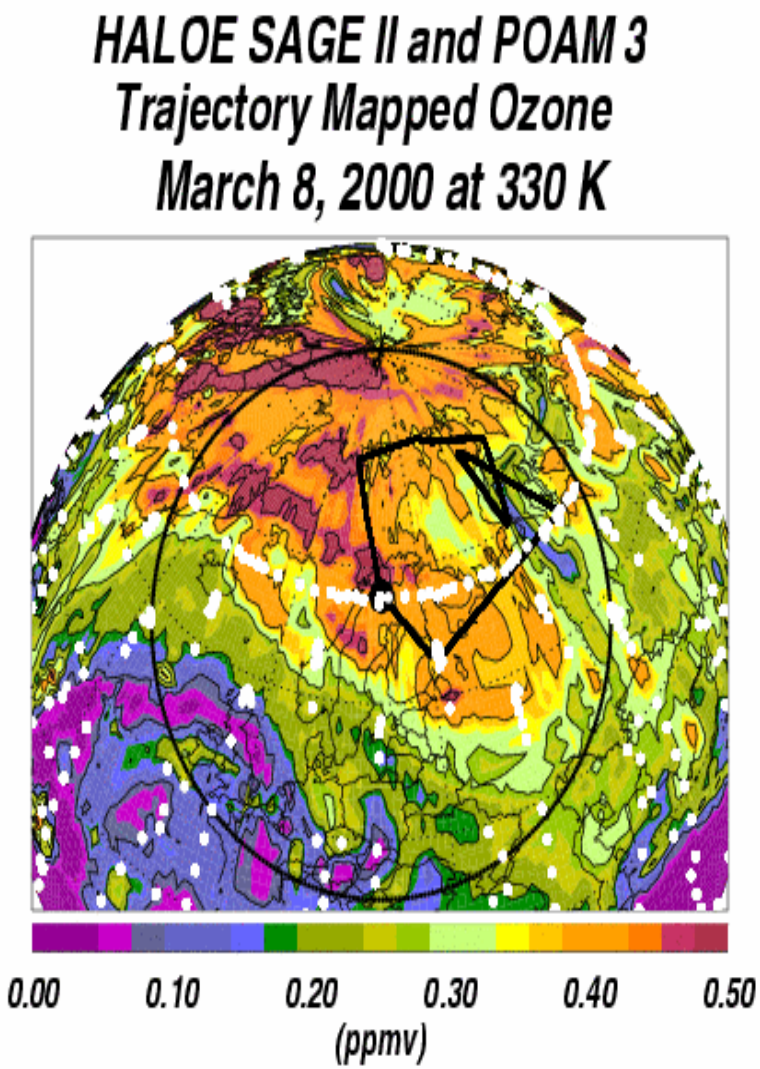

Isentropic Potential Vorticity
March 9, 2000 at 330 K
0
2
4
6
8
PVU

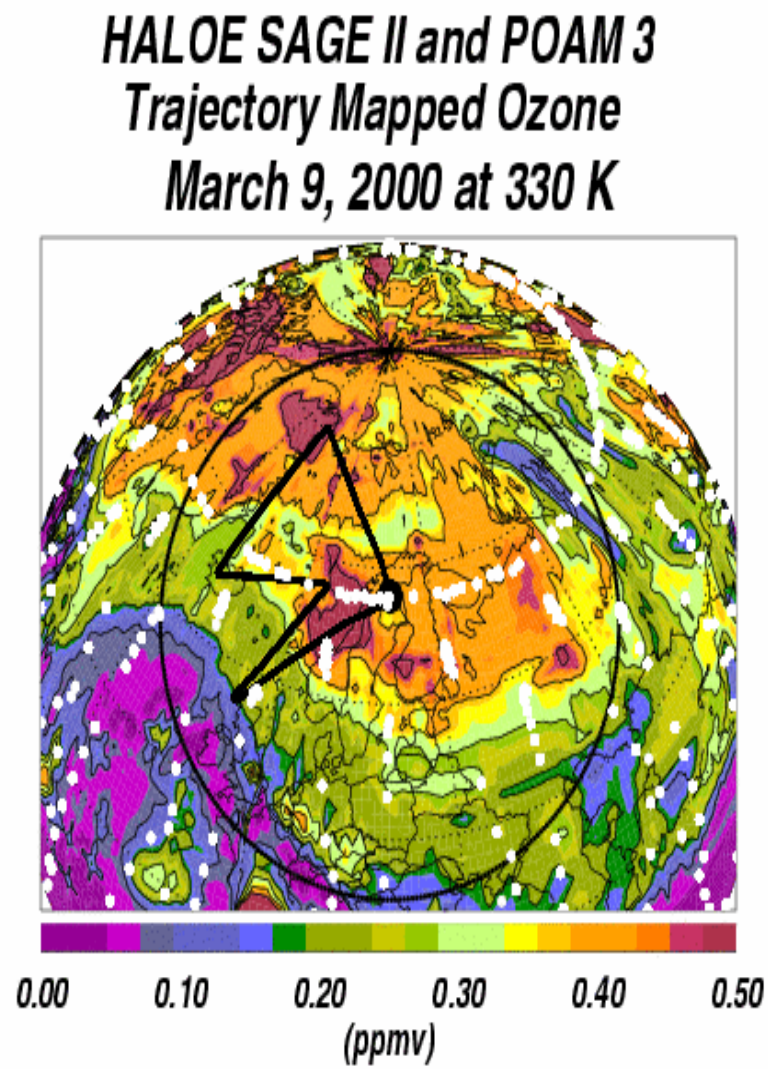

Ozone Variability on March 9, 2000 During SOLVE-1
800
600
400
200
0
Ozone (ppb)
6.0×10^4
6.2×10^4
6.4×10^4
6.6×10^4
6.8×10^4
Time(UT seconds)

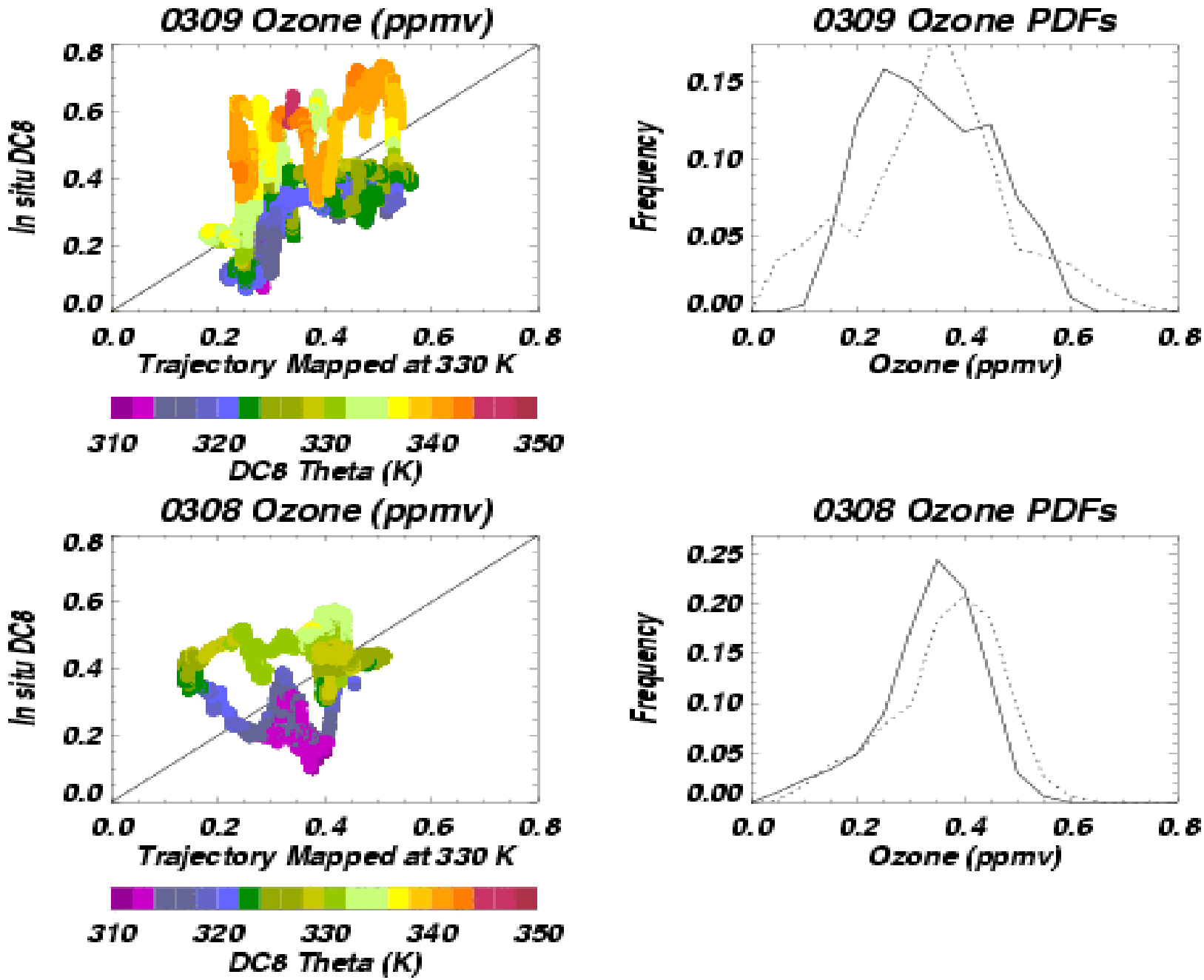

Variability in Ozone Measured Near Novaya Zemyla During SOLVE-1
Ozone (ppb)
Distance (km)
0
200
400
600
0
500
1000
1500
2000

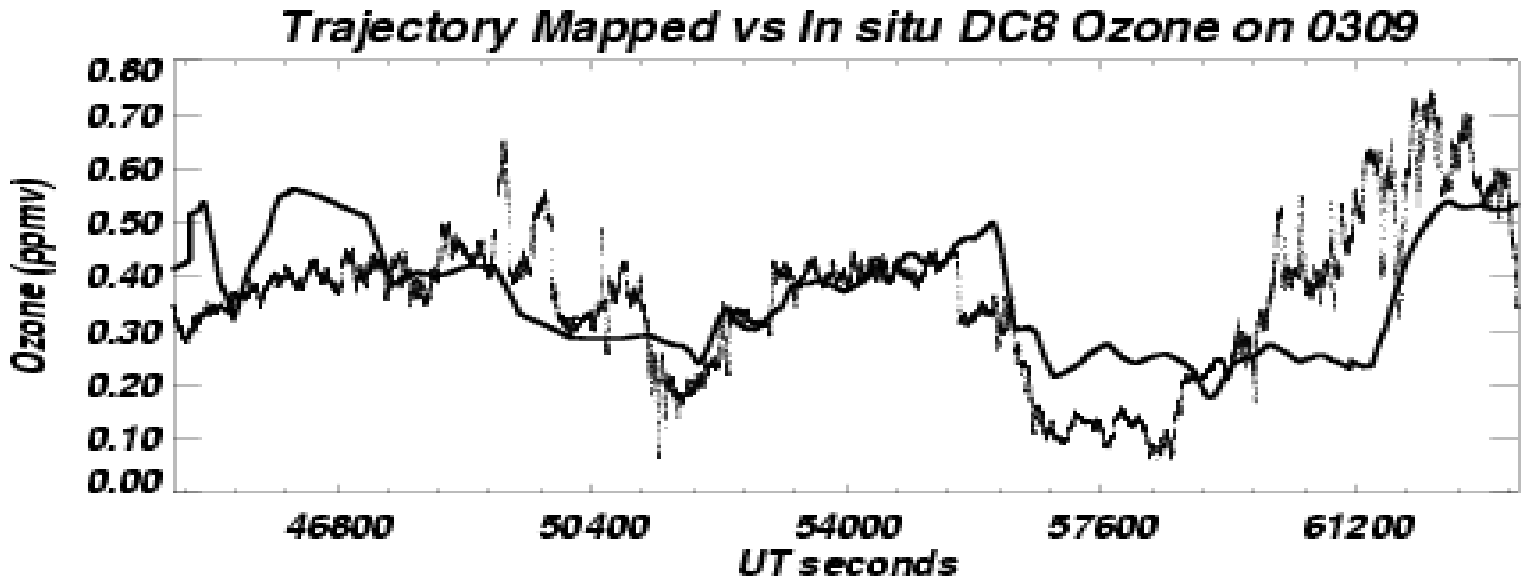

High-Frequency Waves Observed in the Ozone Data
Ozone (ppb)
Distance (km)
160
180
200
220
240
0
10
20
30
40

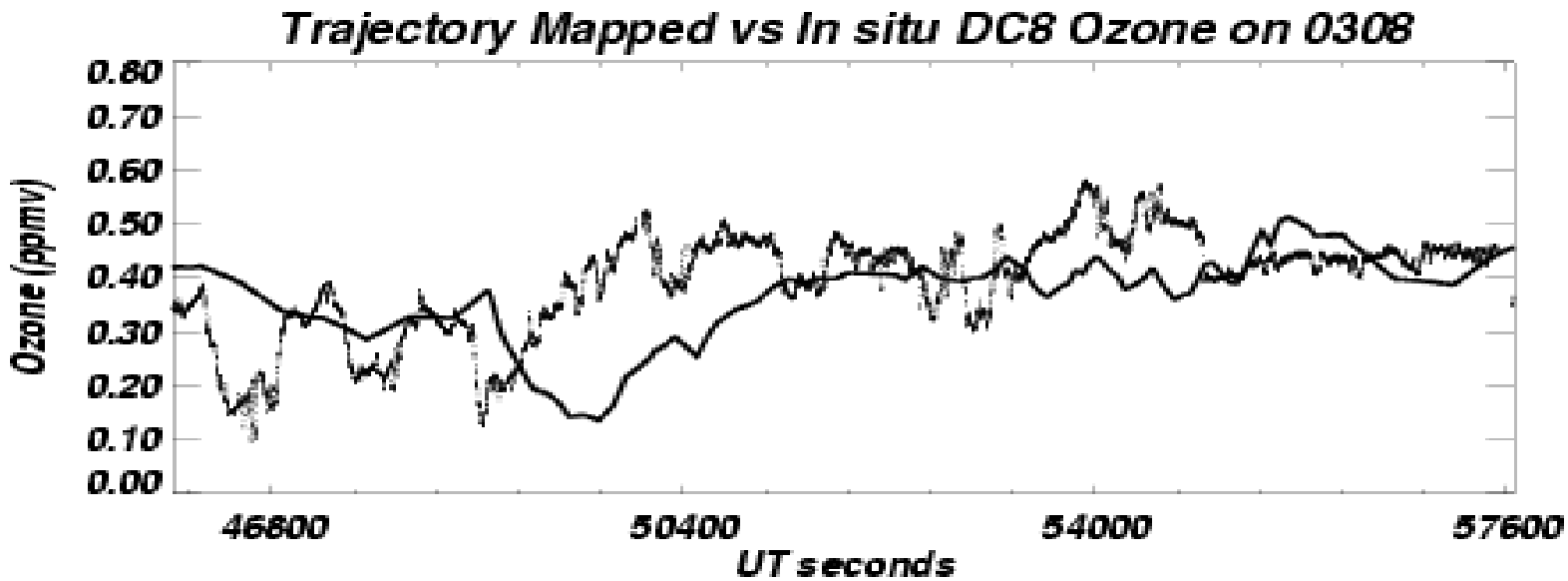

11/1999–3/2000 POAM/DC8 Ozone
Solve O3 (ppb)
POAM O3 (ppb)
0
200
400
600
800


HALOE SAGE II and POAM 3
Trajectory Mapped Ozone
March 8, 2000 at 330 K
0.00
0.10
0.20
0.30
0.40
0.50
(ppmv)


HALOE SAGE II and POAM 3
Trajectory Mapped Ozone
March 9, 2000 at 330 K
0.00
0.10
0.20
0.30
0.40
0.50
(ppmv)


0309 Ozone (ppmv)
In situ DC8
Trajectory Mapped at 330 K
DC8 Theta (K)
0309 Ozone PDFs
Frequency
Ozone (ppmv)
0308 Ozone (ppmv)
In situ DC8
Trajectory Mapped at 330 K
DC8 Theta (K)
0308 Ozone PDFs
Frequency
Ozone (ppmv)


Trajectory Mapped vs In situ DC8 Ozone on 0309
Ozone (ppmv)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
46800
50400
54000
57600
61200
UT seconds


Trajectory Mapped vs In situ DC8 Ozone on 0308
Ozone (ppmv)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
46800
50400
54000
57600
UT seconds