PANs on the P3 in TRACE-P:

Altitude Profiles, Variations with Longitude, and Correlations among Species

Frank Flocke / Andy Weinheimer

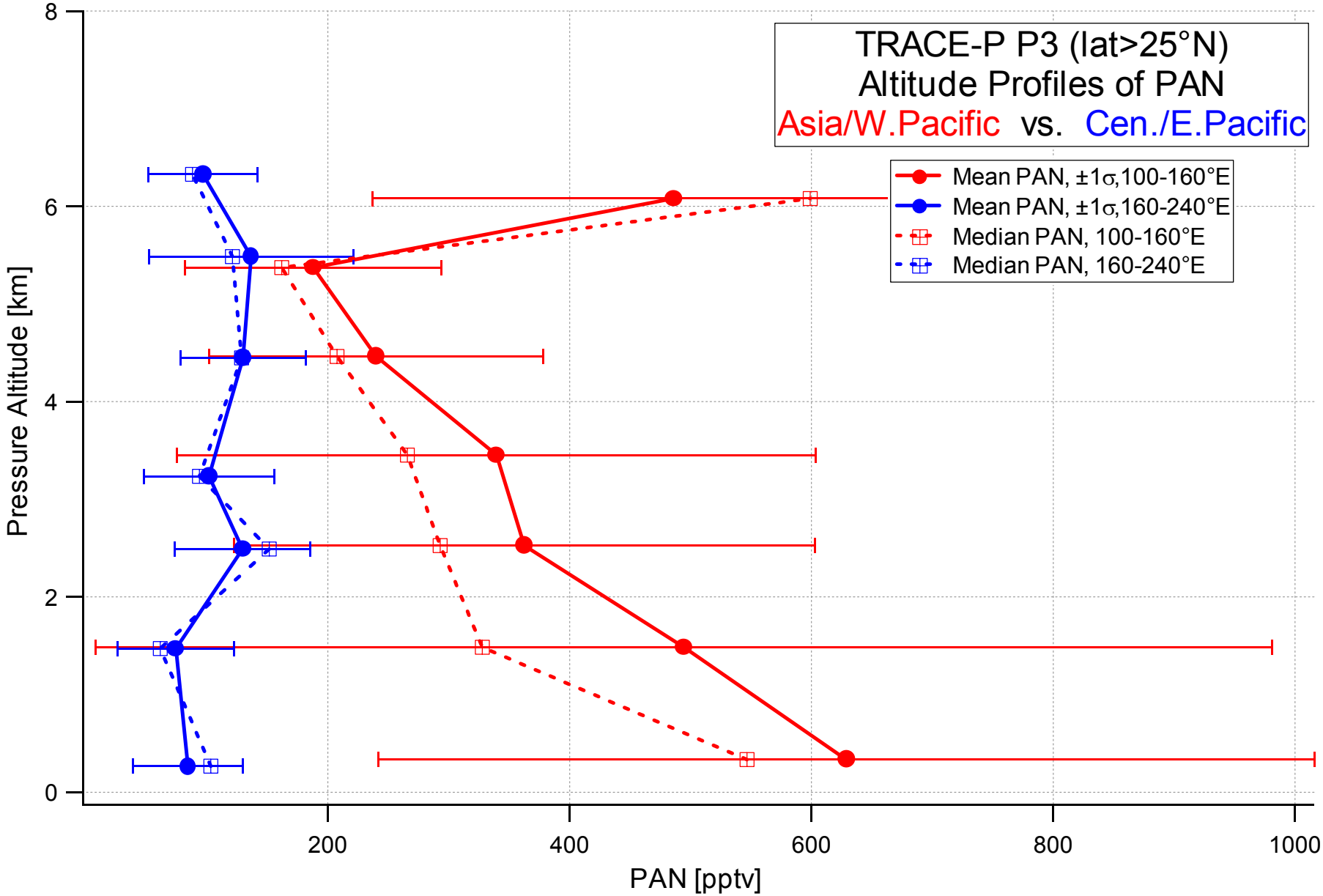
And others on the TRACE-P team:
Avery/Vay et al., Barrick et al., Blake/Blake et al., Fried et al., Kondo/Koike et al., Sachse et al., Singh et al.

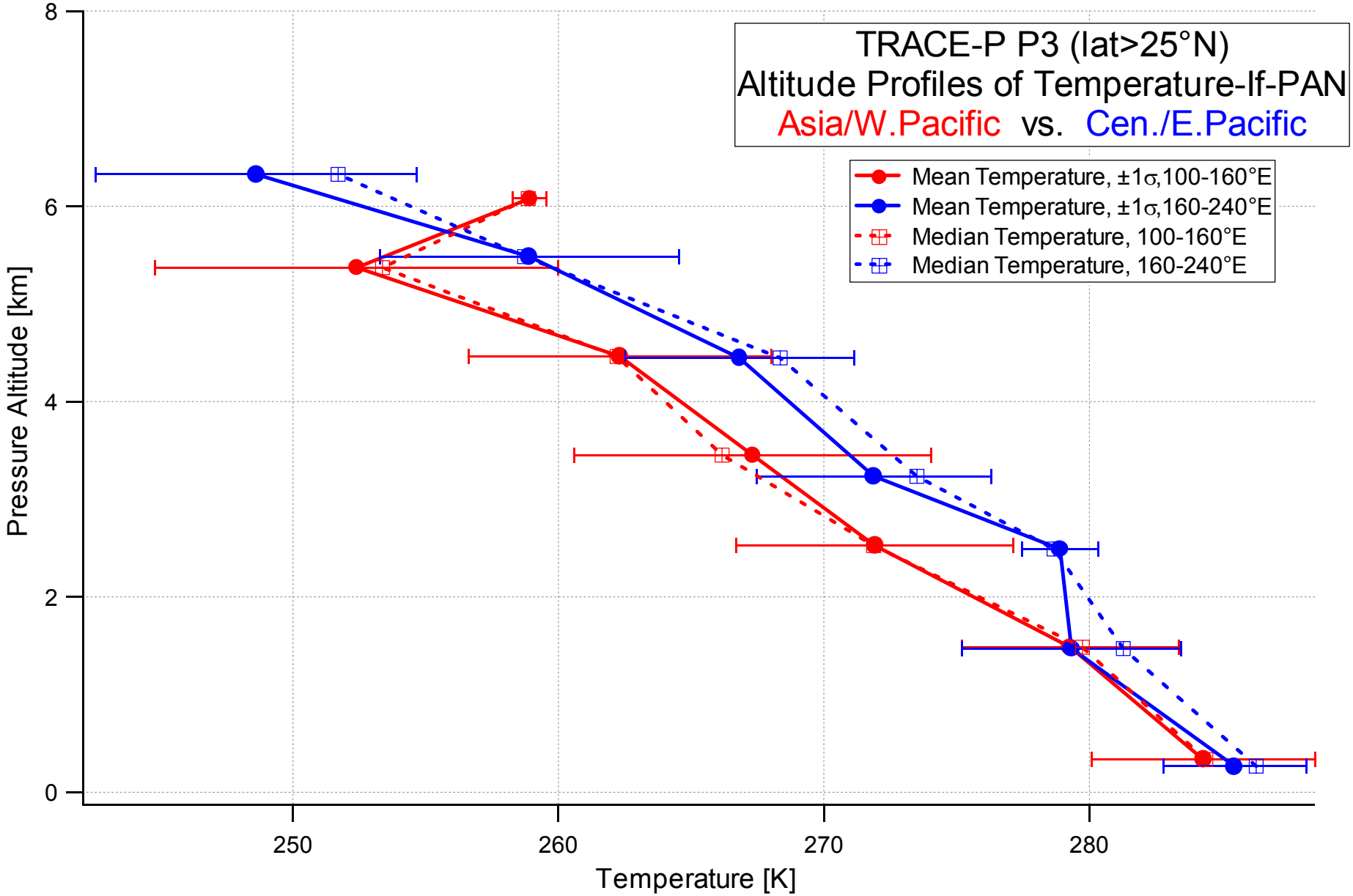
Mission Objectives:

- composition of Asian outflow
- its evolution

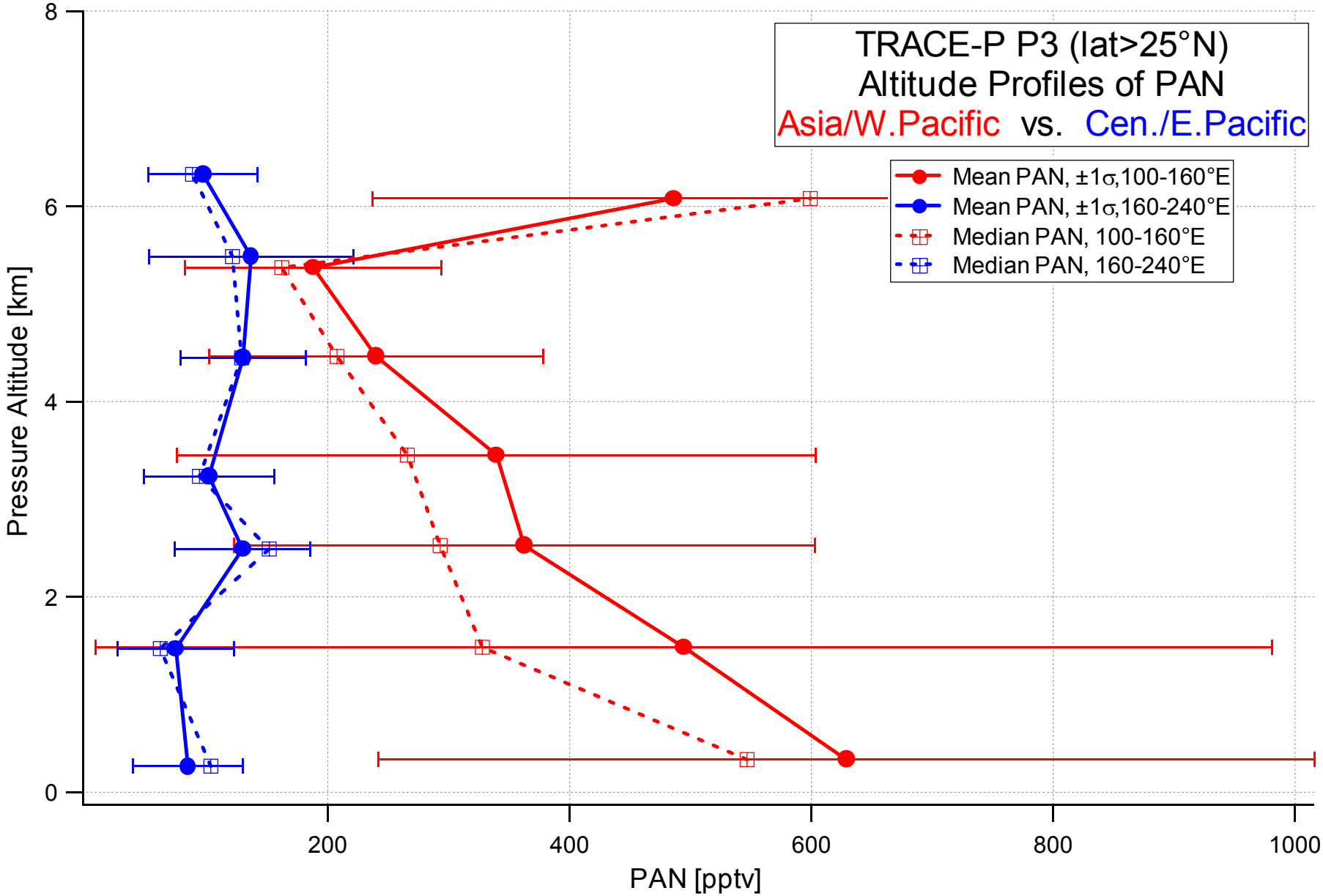
Approach (<u>simple</u>):

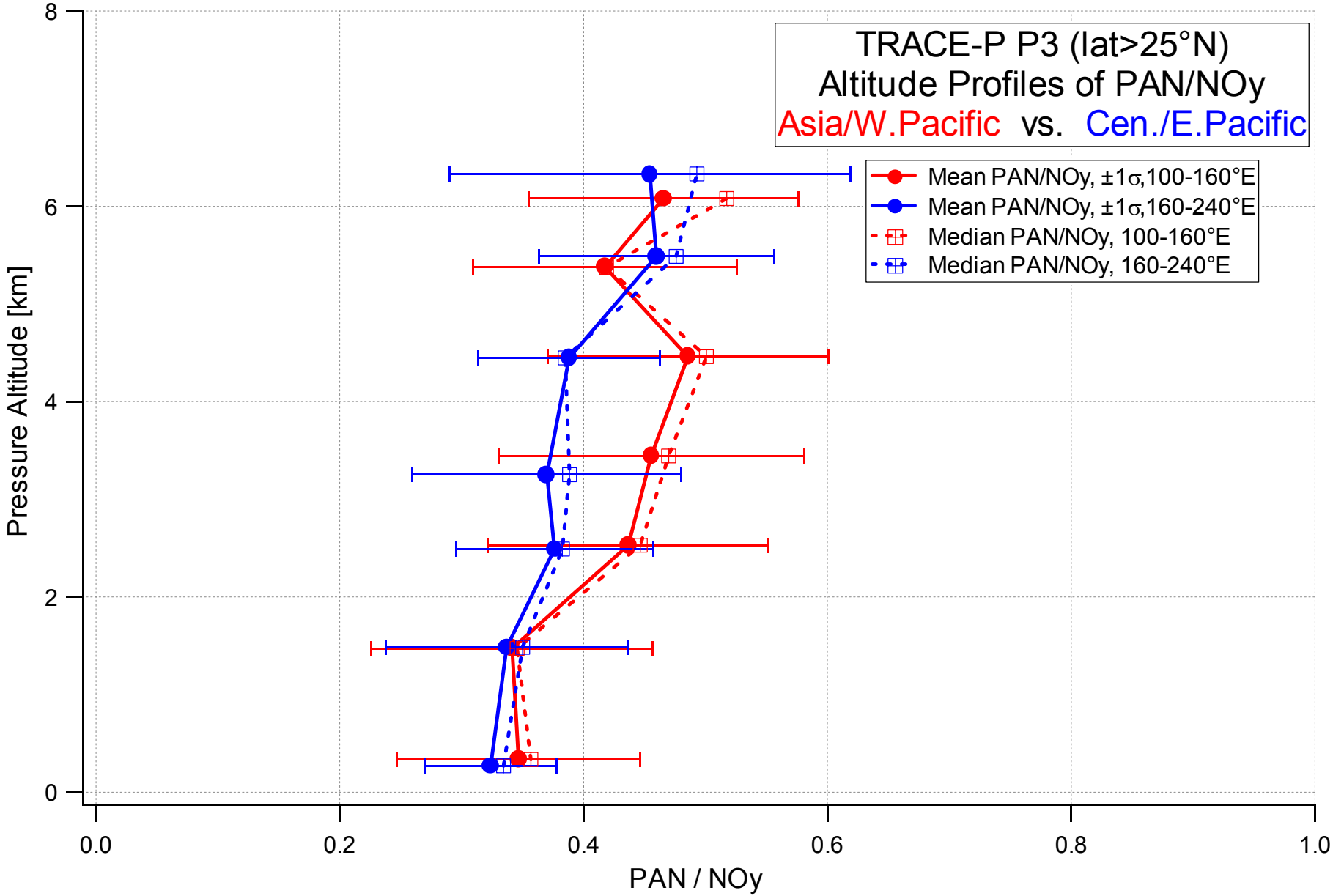
- eastward flow
- bin by longitude (coarse)
- require latitude >25N


TRACE-P P3 (lat>25°N)
Altitude Profiles of PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean PAN, ±1σ,100-160°E
Mean PAN, ±1σ,160-240°E
Median PAN, 100-160°E
Median PAN, 160-240°E
Pressure Altitude [km]
PAN [pptv]
0
2
4
6
8
200
400
600
800
1000

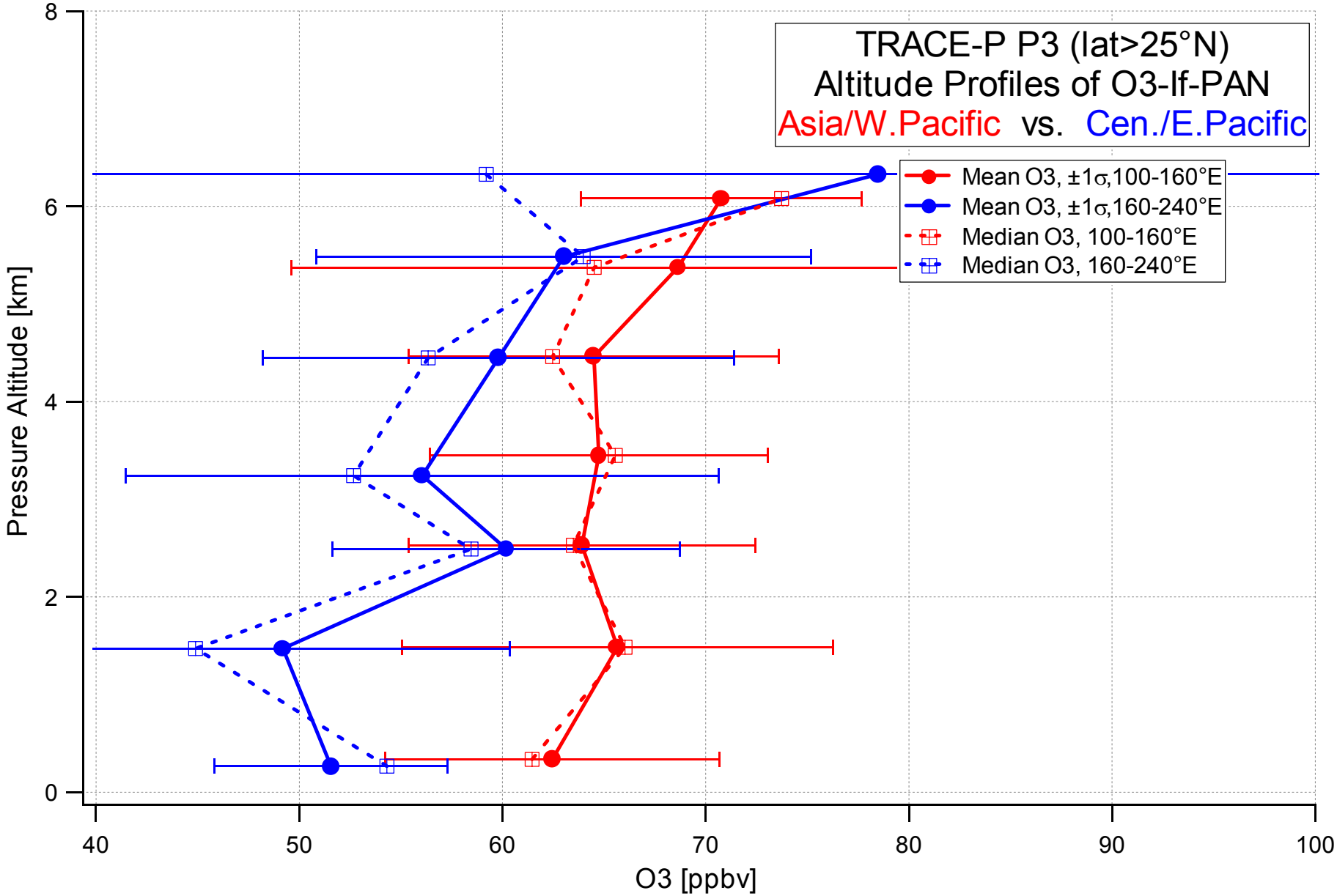

TRACE-P P3 (lat>25°N)
Altitude Profiles of Temperature-lf-PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean Temperature, ±1σ,100-160°E
Mean Temperature, ±1σ,160-240°E
Median Temperature, 100-160°E
Median Temperature, 160-240°E
Pressure Altitude [km]
Temperature [K]
0
2
4
6
8
250
260
270
280

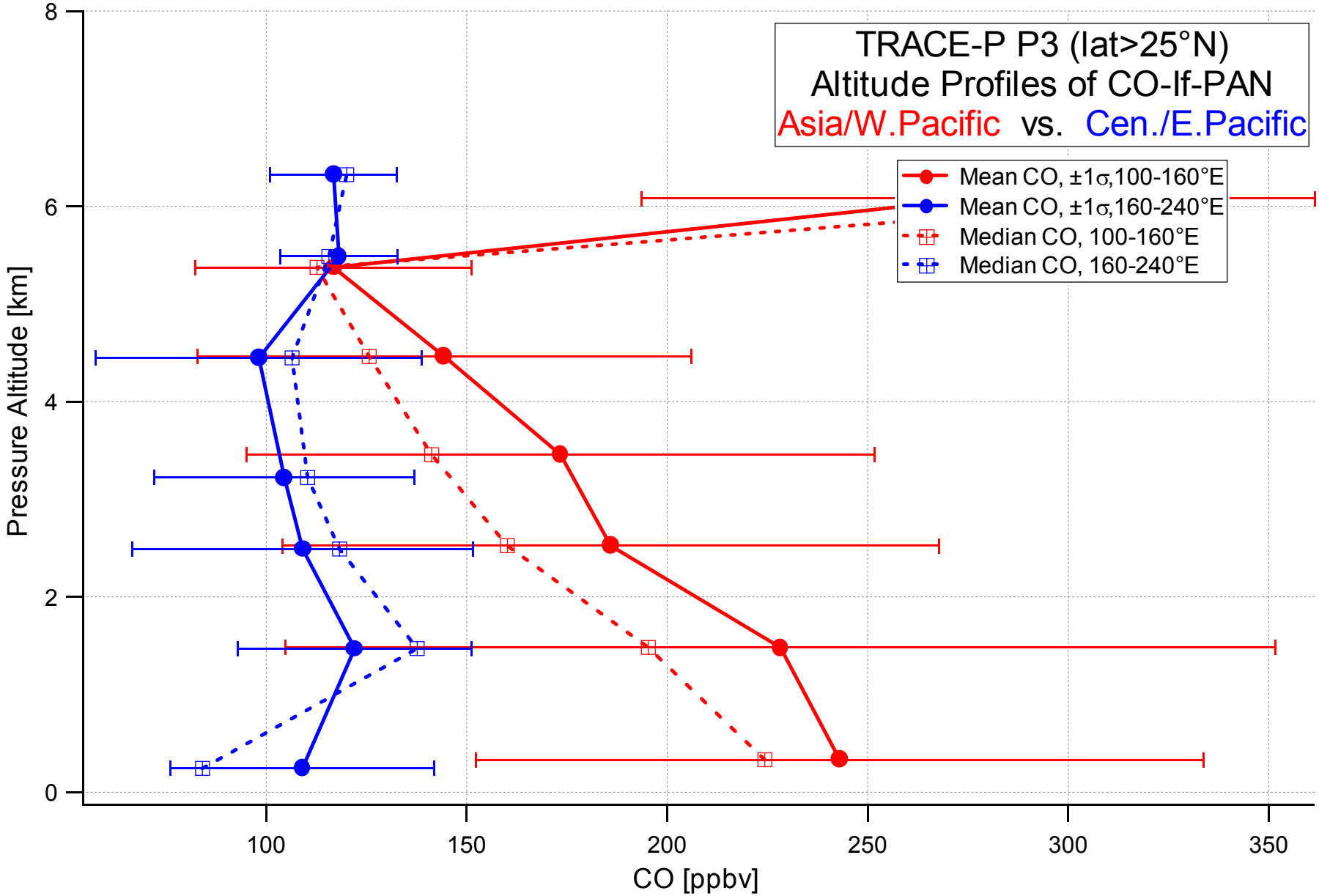
Temp


TRACE-P P3 (lat>25°N)
Altitude Profiles of PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean PAN, ±1σ,100-160°E
Mean PAN, ±1σ,160-240°E
Median PAN, 100-160°E
Median PAN, 160-240°E
Pressure Altitude [km]
PAN [pptv]
0
2
4
6
8
200
400
600
800
1000

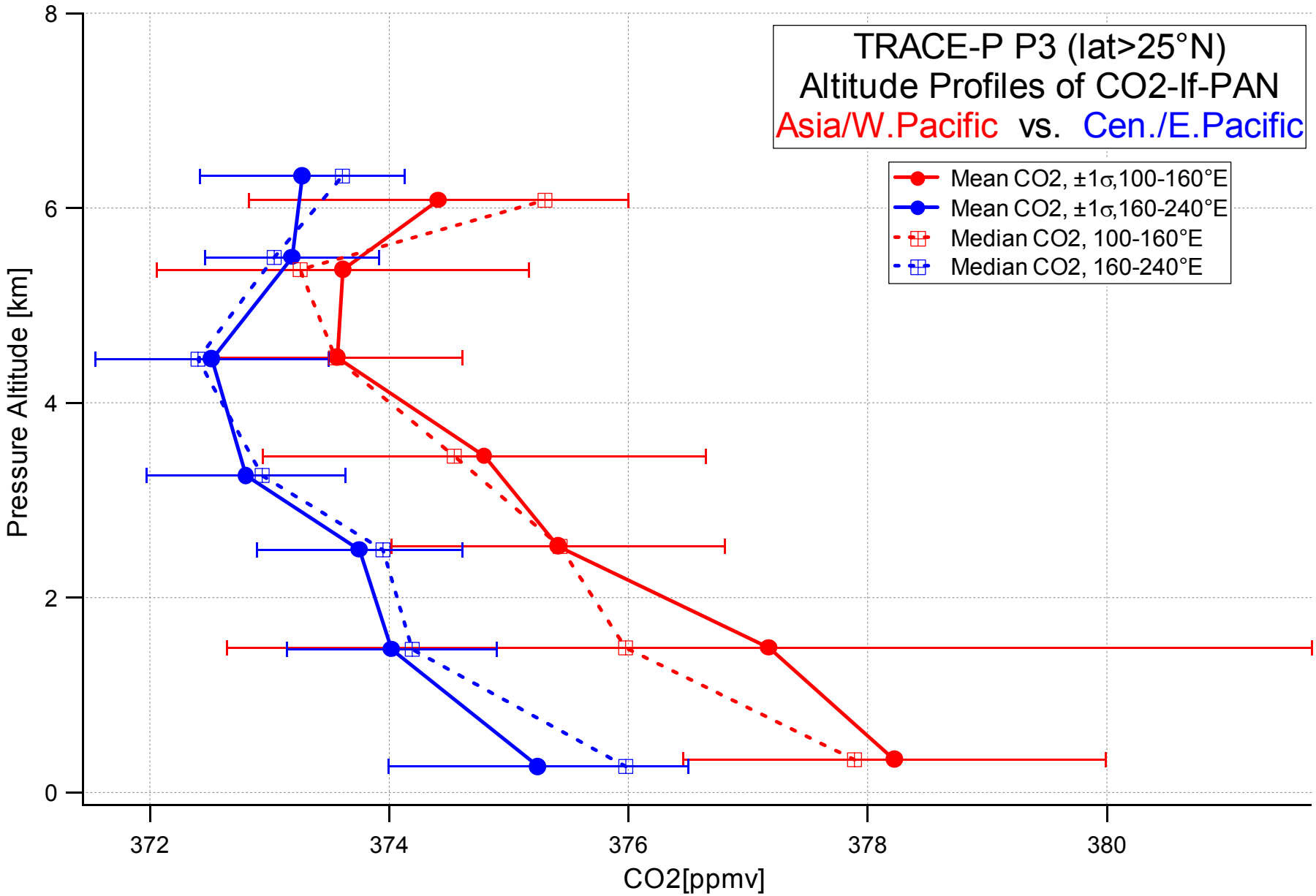

TRACE-P P3 (lat>25°N)
Altitude Profiles of PAN/NOy
Asia/W.Pacific vs. Cen./E.Pacific
Mean PAN/NOy, ±1σ,100-160°E
Mean PAN/NOy, ±1σ,160-240°E
Median PAN/NOy, 100-160°E
Median PAN/NOy, 160-240°E
Pressure Altitude [km]
PAN / NOy
0
2
4
6
8
0.0
0.2
0.4
0.6
0.8
1.0

PAN/NOy

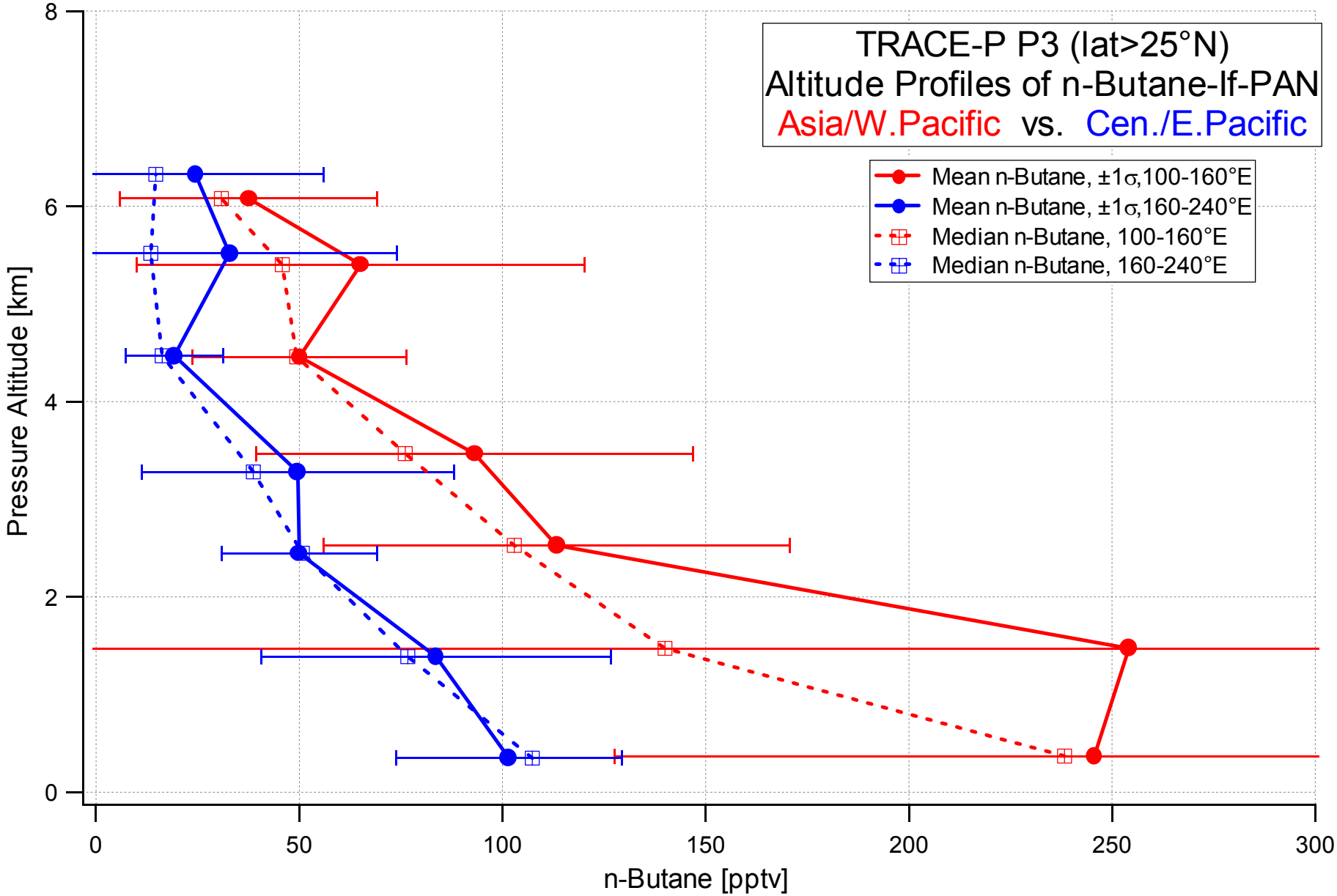

TRACE-P P3 (lat>25°N)
Altitude Profiles of O3-lf-PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean O3, ±1σ,100-160°E
Mean O3, ±1σ,160-240°E
Median O3, 100-160°E
Median O3, 160-240°E
Pressure Altitude [km]
O3 [ppbv]
0
2
4
6
8
40
50
60
70
80
90
100


TRACE-P P3 (lat>25°N)
Altitude Profiles of CO-lf-PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean CO, ±1σ,100-160°E
Mean CO, ±1σ,160-240°E
Median CO, 100-160°E
Median CO, 160-240°E
Pressure Altitude [km]
CO [ppbv]
0
2
4
6
8
100
150
200
250
300
350

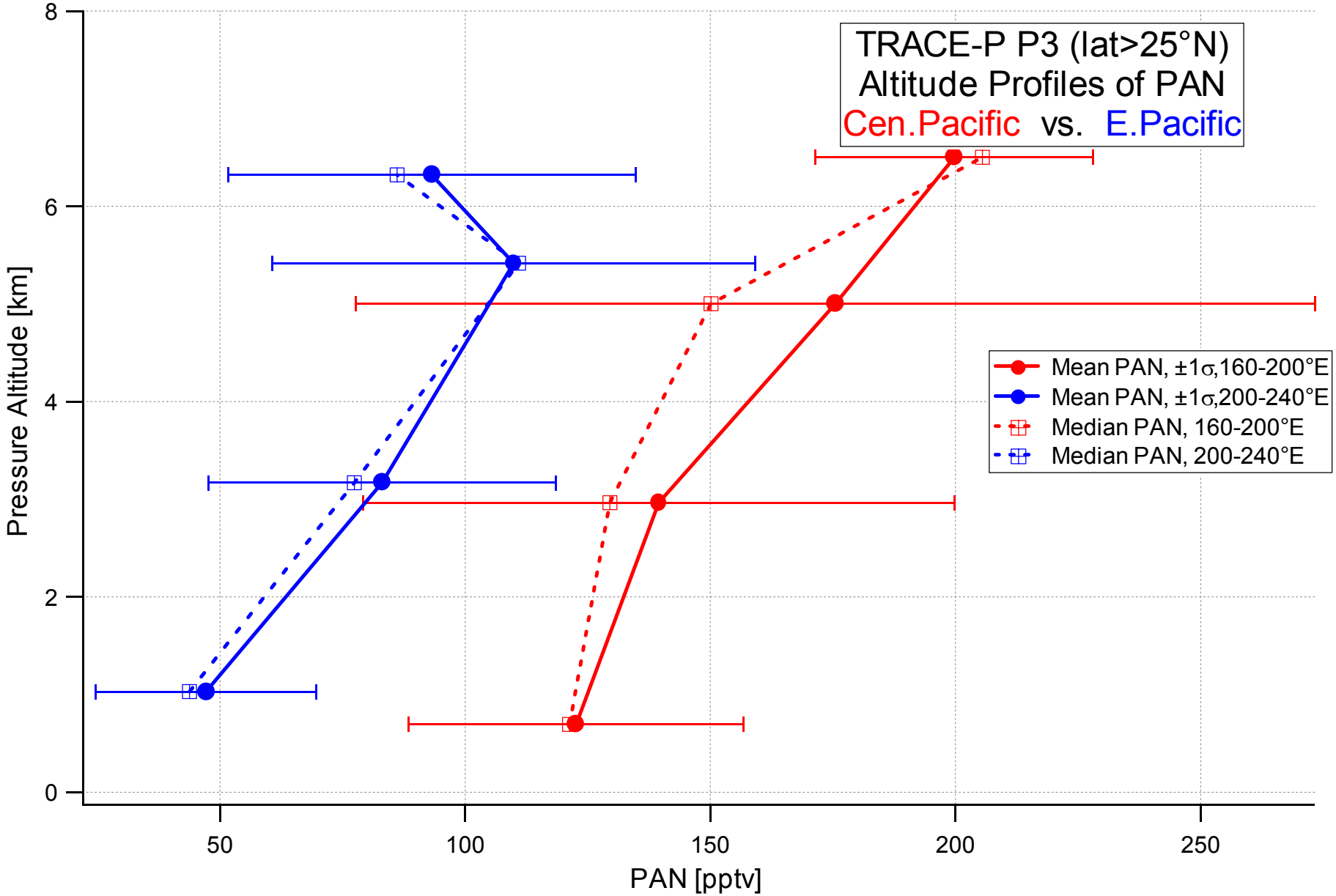
CO


TRACE-P P3 (lat>25°N)
Altitude Profiles of CO2-lf-PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean CO2, ±1σ,100-160°E
Mean CO2, ±1σ,160-240°E
Median CO2, 100-160°E
Median CO2, 160-240°E
Pressure Altitude [km]
0
2
4
6
8
372
374
376
378
380
CO2[ppmv]

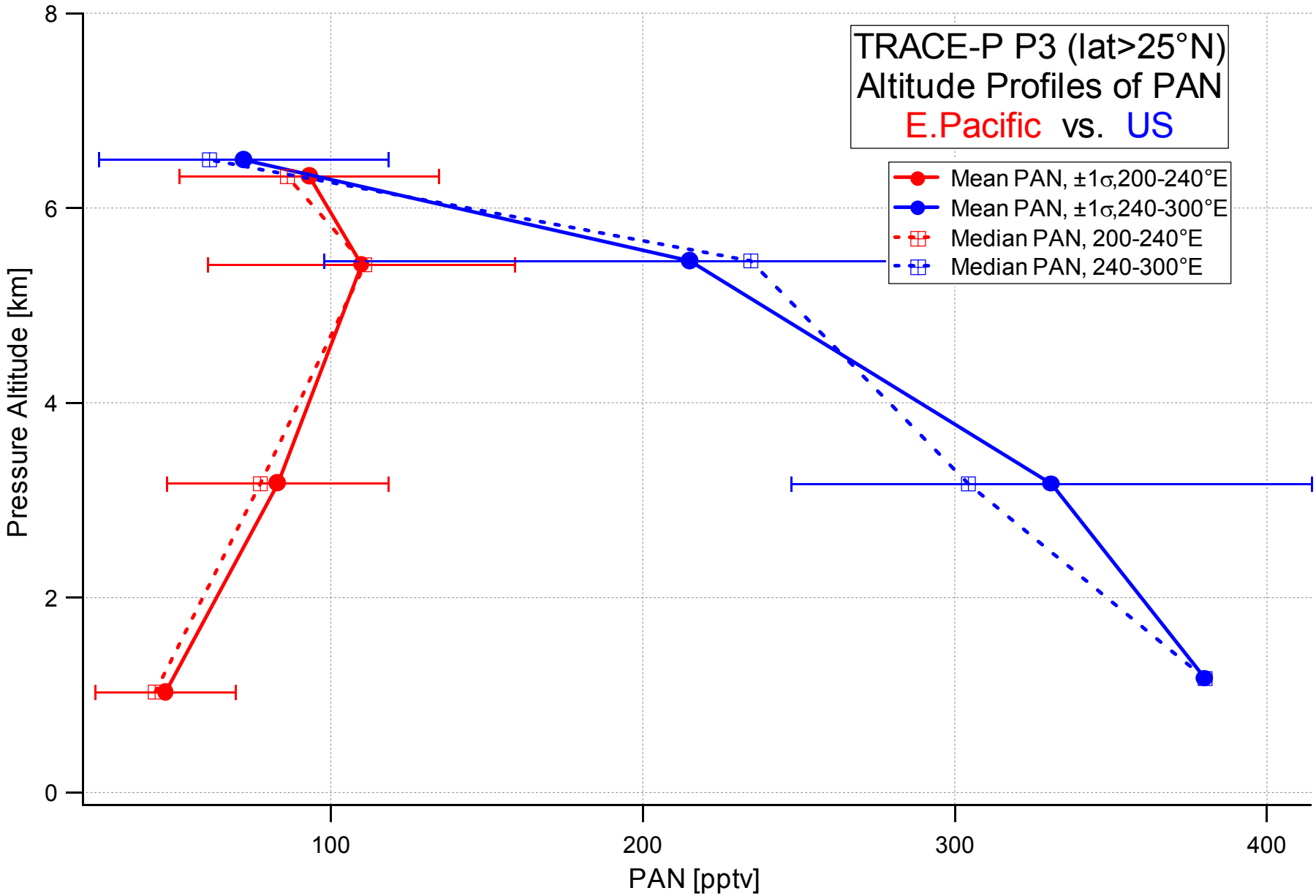
CO2


TRACE-P P3 (lat>25°N)
Altitude Profiles of n-Butane-lf-PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean n-Butane, ±1σ,100-160°E
Mean n-Butane, ±1σ,160-240°E
Median n-Butane, 100-160°E
Median n-Butane, 160-240°E
Pressure Altitude [km]
n-Butane [pptv]
0
2
4
6
8
0
50
100
150
200
250
300

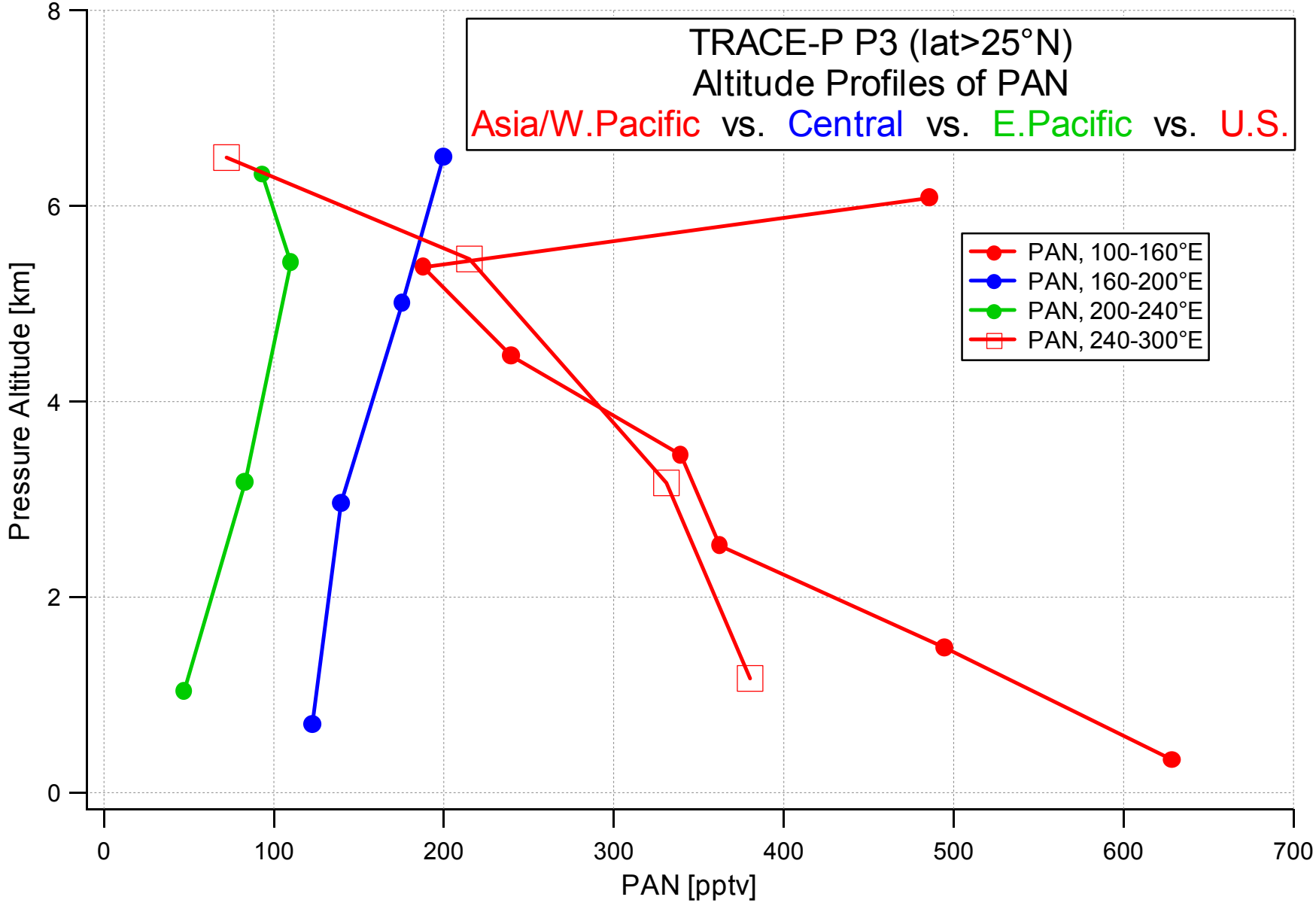
nButane

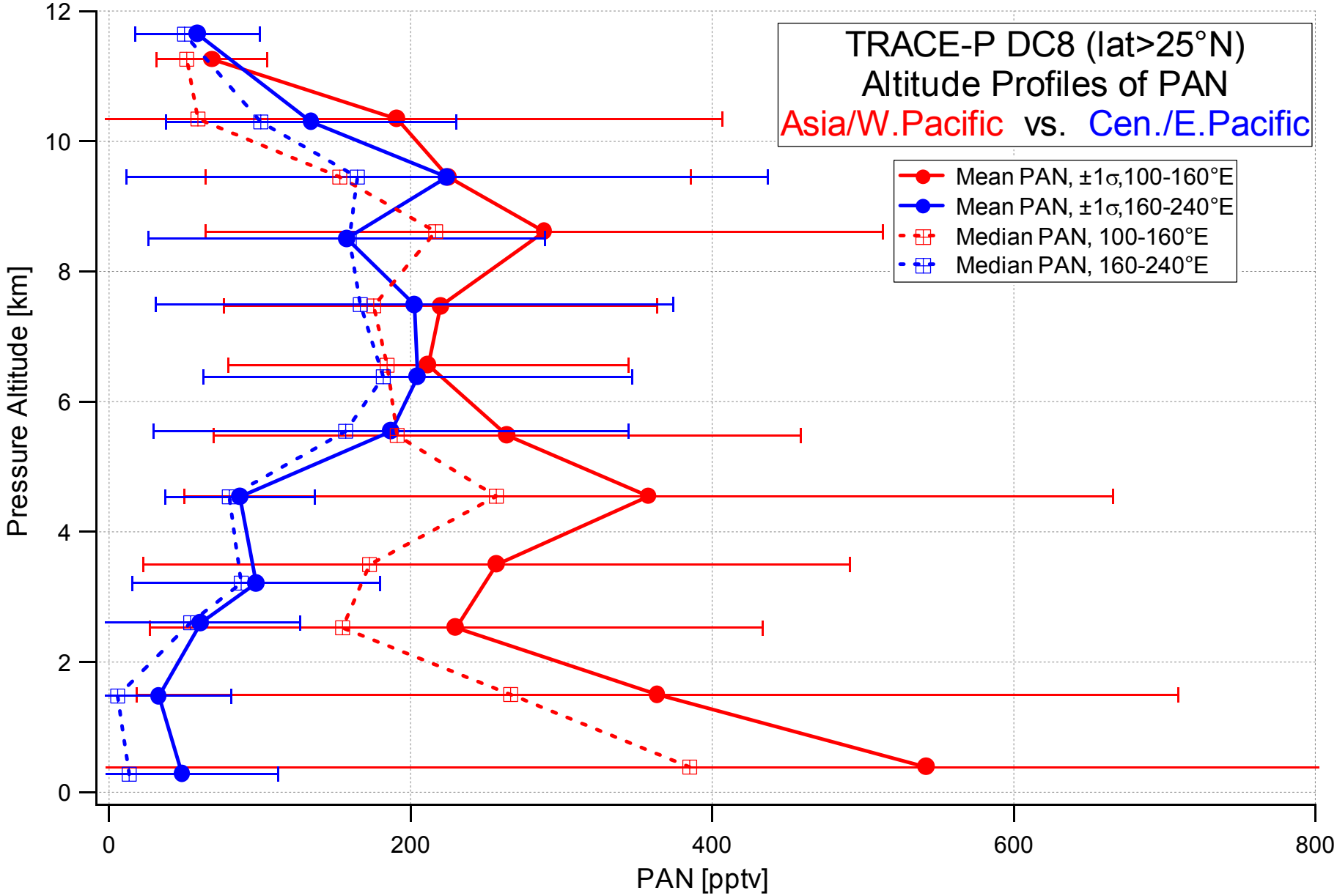

TRACE-P P3 (lat>25°N)
Altitude Profiles of PAN
Cen.Pacific vs. E.Pacific
Mean PAN, ±1σ,160-200°E
Mean PAN, ±1σ,200-240°E
Median PAN, 160-200°E
Median PAN, 200-240°E
Pressure Altitude [km]
PAN [pptv]
0
2
4
6
8
50
100
150
200
250

PAN_CvE

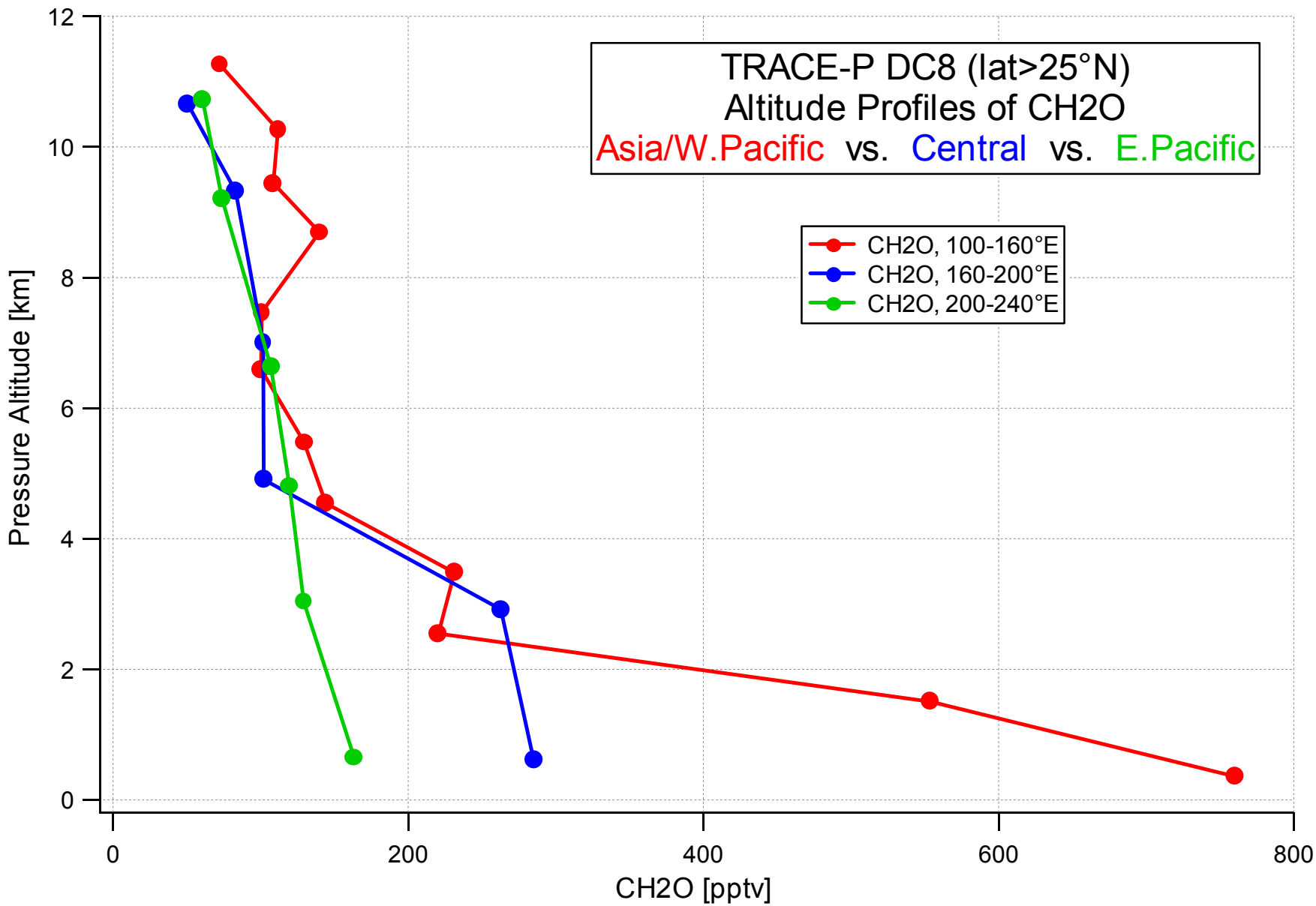

TRACE-P P3 (lat>25°N)
Altitude Profiles of PAN
E.Pacific vs. US
Mean PAN, ±1σ,200-240°E
Mean PAN, ±1σ,240-300°E
Median PAN, 200-240°E
Median PAN, 240-300°E
Pressure Altitude [km]
PAN [pptv]
0
2
4
6
8
100
200
300
400

PAN_EvU


TRACE-P P3 (lat>25°N)
Altitude Profiles of PAN
Asia/W.Pacific vs. Central vs. E.Pacific vs. U.S.
PAN, 100-160°E
PAN, 160-200°E
PAN, 200-240°E
PAN, 240-300°E
Pressure Altitude [km]
PAN [pptv]
0
2
4
6
8
0
100
200
300
400
500
600
700


TRACE-P DC8 (lat>25°N)
Altitude Profiles of PAN
Asia/W.Pacific vs. Cen./E.Pacific
Mean PAN, ±1σ,100-160°E
Mean PAN, ±1σ,160-240°E
Median PAN, 100-160°E
Median PAN, 160-240°E
Pressure Altitude [km]
PAN [pptv]
0
2
4
6
8
10
12
0
200
400
600
800

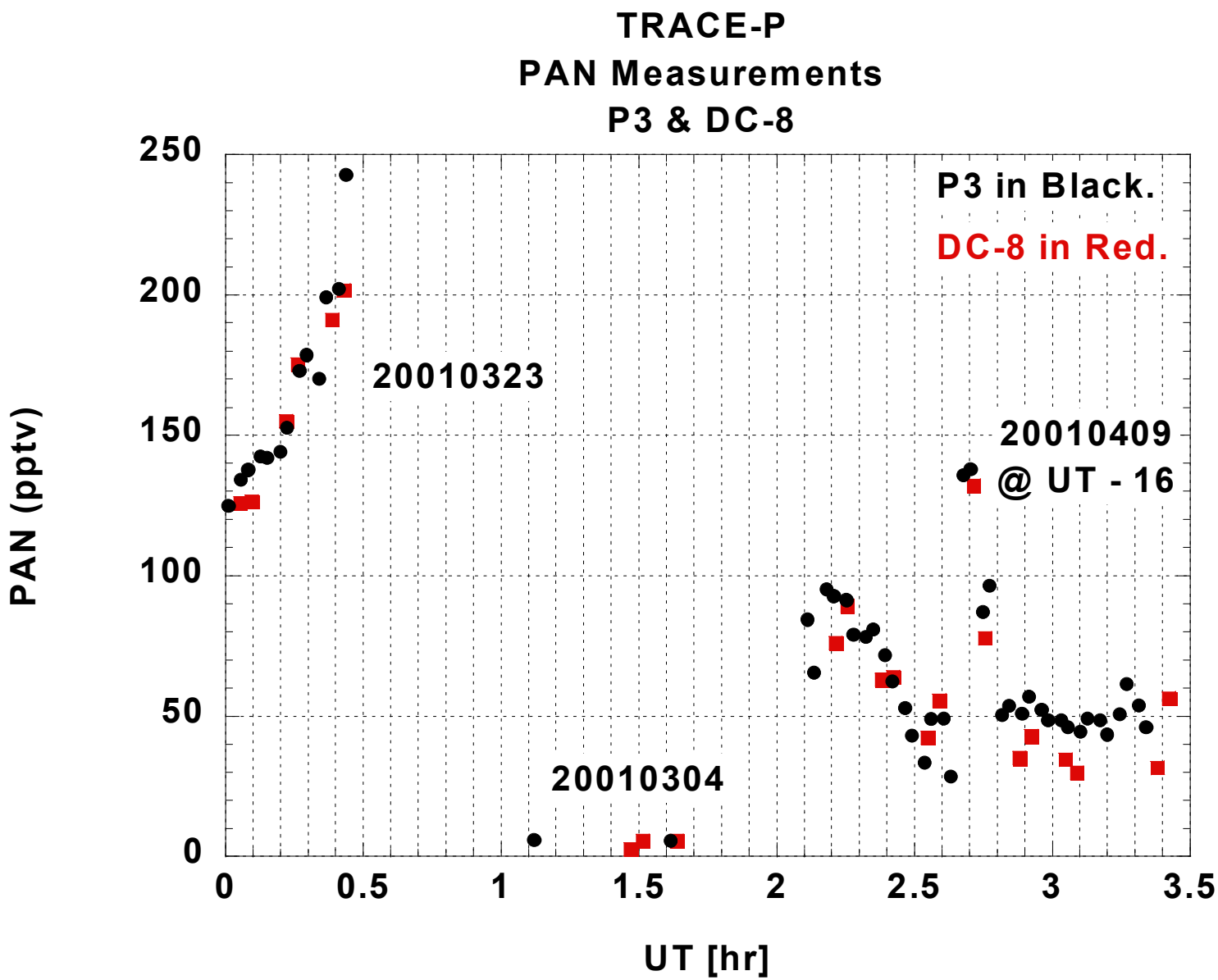
PAN_DC8


TRACE-P DC8 (lat>25°N)
Altitude Profiles of CH2O
Asia/W.Pacific vs. Central vs. E.Pacific
CH2O, 100-160°E
CH2O, 160-200°E
CH2O, 200-240°E
Pressure Altitude [km]
CH2O [pptv]
0
2
4
6
8
10
12
0
200
400
600
800

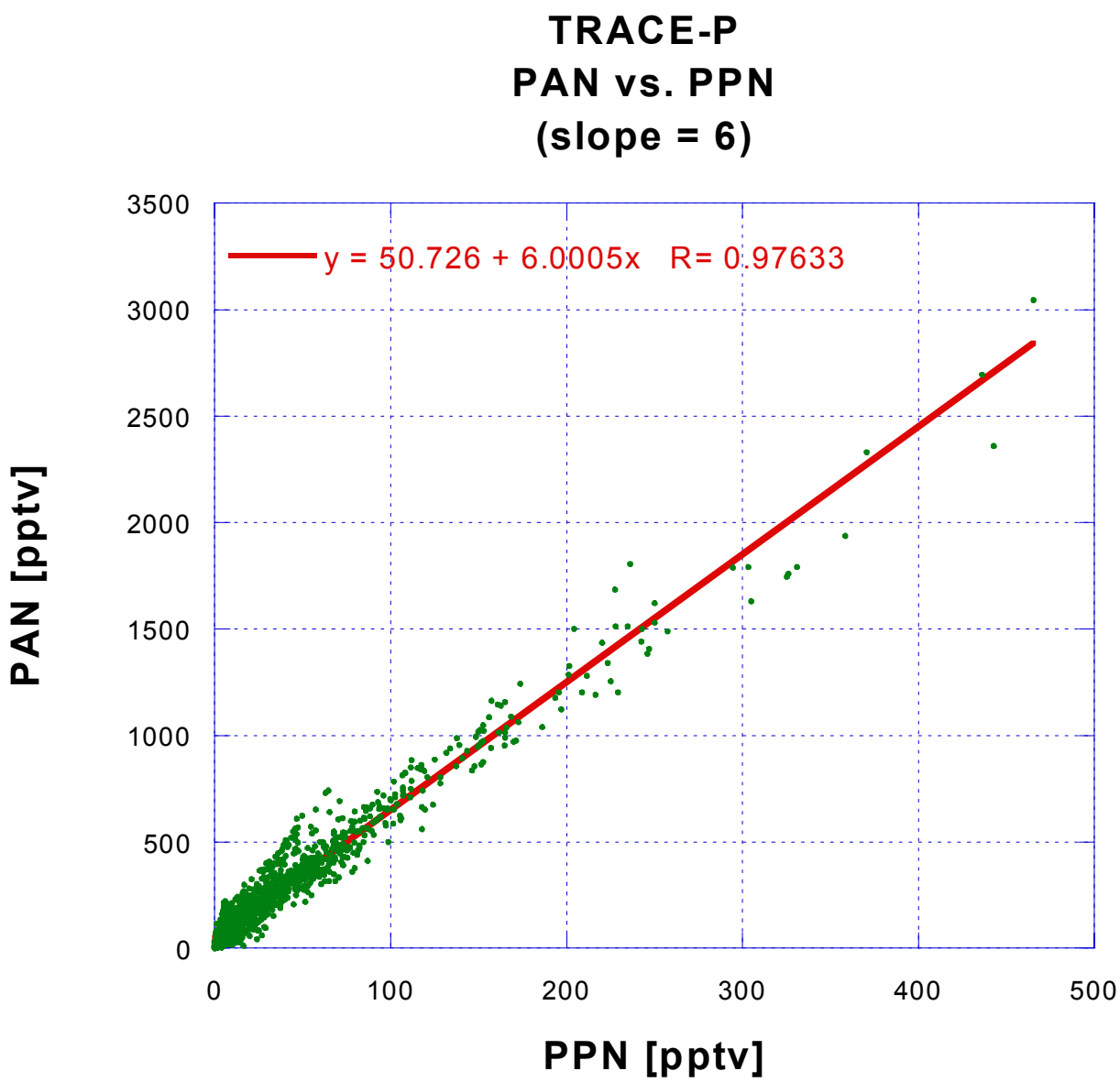
3xCH2O

The speciation of the PANs reflects the speciation of the HCs that are precursors to O3 formation.

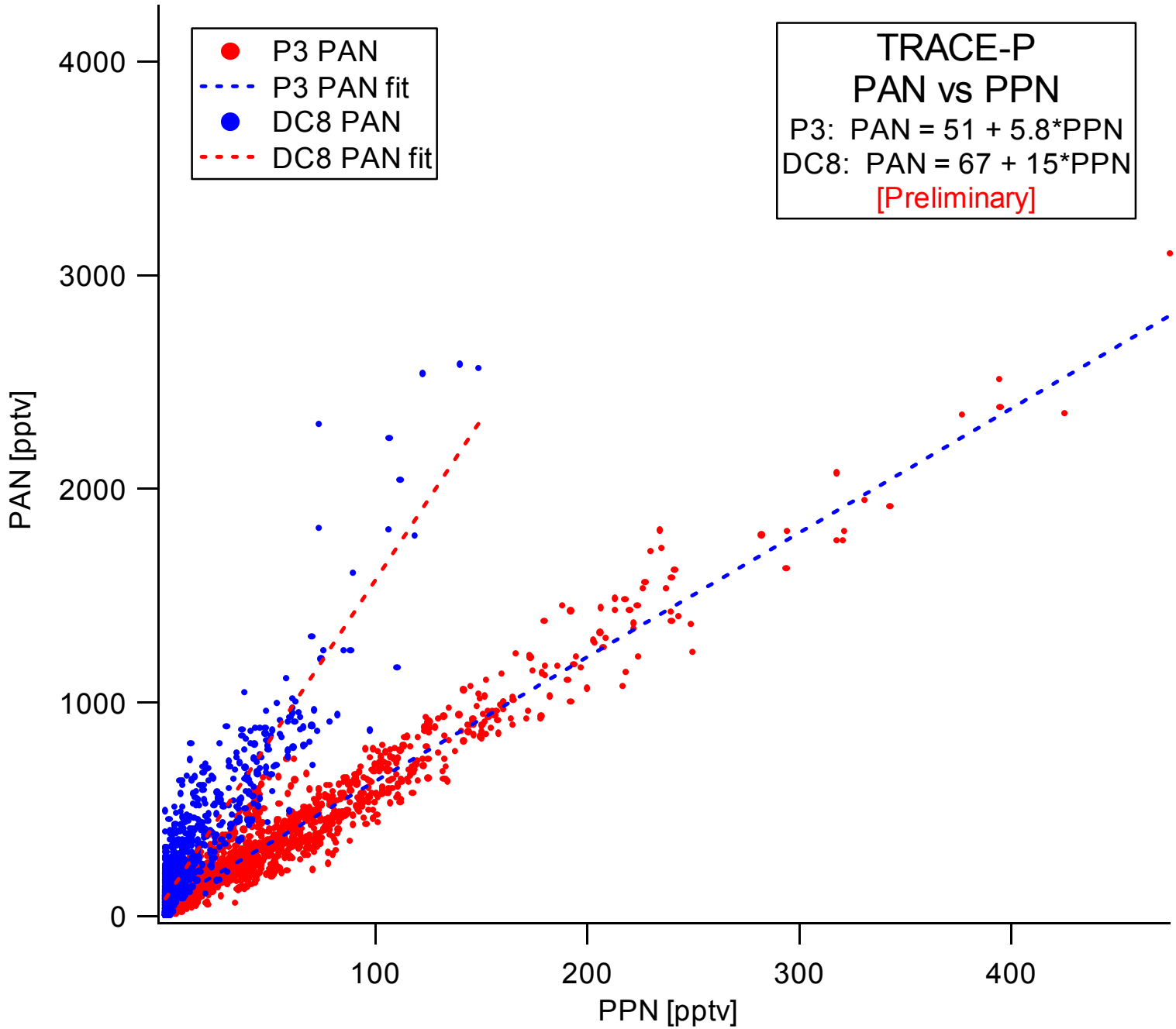
(and PPN comparison, P3 vs. DC8)


TRACE-P
PAN Measurements
P3 & DC-8
P3 in Black.
DC-8 in Red.
20010323
20010409
@ UT - 16
20010304
PAN (pptv)
UT [hr]
250
200
150
100
50
0
0
0.5
1
1.5
2
2.5
3
3.5

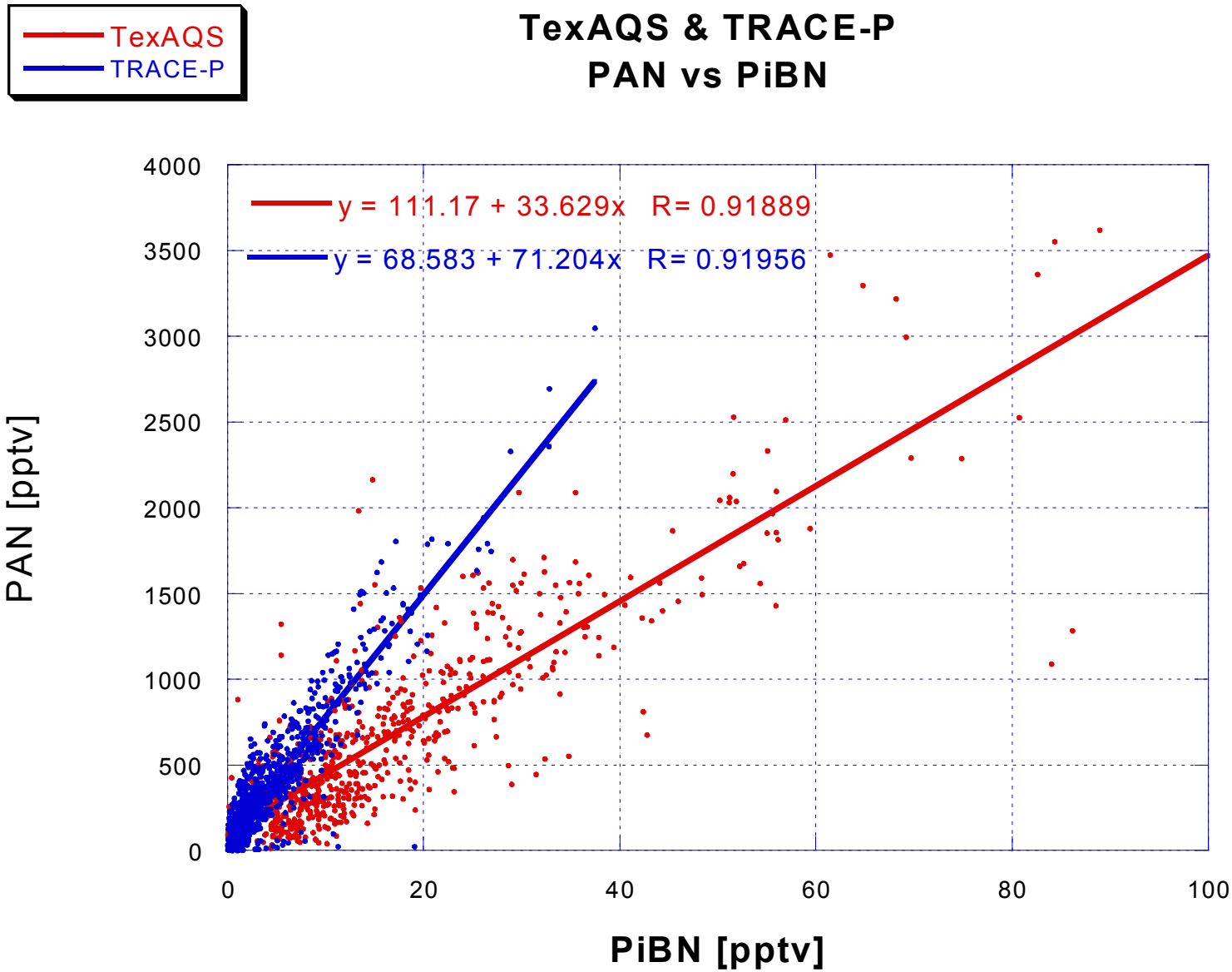
PANcomp

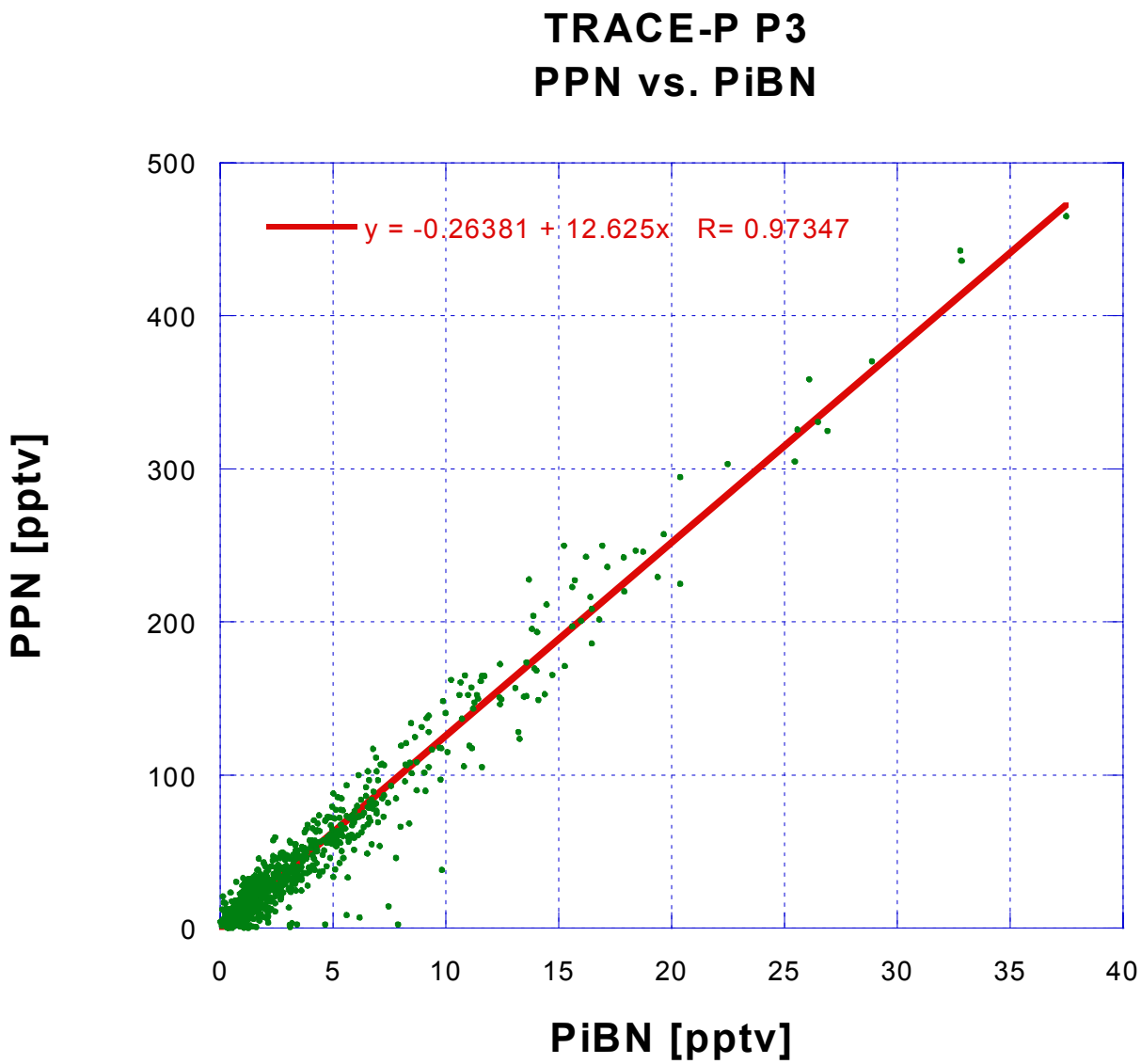

TRACE-P
PAN vs. PPN
(slope = 6)
y = 50.726 + 6.0005x R= 0.97633
PAN [pptv]
PPN [pptv]
0
500
1000
1500
2000
2500
3000
3500
0
100
200
300
400
500

PAN-PPN1


P3 PAN
P3 PAN fit
DC8 PAN
DC8 PAN fit
TRACE-P
PAN vs PPN
P3: PAN = 51 + 5.8*PPN
DC8: PAN = 67 + 15*PPN
[Preliminary]
PAN [pptv]
PPN [pptv]
0
1000
2000
3000
4000
100
200
300
400

PPNcomp


TexAQS
TRACE-P
TexAQS & TRACE-P
PAN vs PiBN
y = 111.17 + 33.629x R= 0.91889
y = 68.583 + 71.204x R= 0.91956
PAN [pptv]
PiBN [pptv]
0
500
1000
1500
2000
2500
3000
3500
4000
0
20
40
60
80
100


TRACE-P P3
PPN vs. PiBN
y = -0.26381 + 12.625x R= 0.97347
PPN [pptv]
PiBN [pptv]
0
100
200
300
400
500
0
5
10
15
20
25
30
35
40

SUMMARY:

- PANs deliver NOx to Pacific:
  - eastward flux
  - downward flux (Cen./E.)
- Correlations among P3 PANs:
  - PAN vs. PPN as elsewhere (m = 6)
  - PiBN differs from Houston
  - MPAN very small (< few pptv)
- P3 vs. DC8:
  - PAN compares well
  - PAN vs. PPN slopes differ
- Future:

  Extend analysis using trajectories to characterize outflow and its evolution during transport toward N.A.