

GEMS WP_GRG_4

Model performance evaluation

Use of MOZAIIC data

WP GRG_4: MOZAIC technical papers

1. **Overview:** Marenco et al., Measurement of ozone and water vapour by Airbus in-service aircraft: the MOZAIC airborne program, An overview, *J. Geophys. Res.*, 103, 25631-25642, 1998.
2. **O3:** Thouret et al., Comparisons of ozone measurements from the MOZAIC airborne program and the ozone sounding network at eight locations, *J. Geophys. Res.*, 103, 25,695-25,720, 1998.
3. **H2O:** Helten et al., Calibration and performance of automatic compact instrumentation for the measurement of relative humidity from passenger aircraft, *J. of Geophys. Res.*, 103, 25643-25652, 1998.
4. **CO:** Nédélec et al., An improved infra-red carbon monoxide analyser for routine measurements aboard commercial Airbus aircraft: Technical validation and first scientific results of the MOZAIC III Program. *Atmos. Chem. And Phys.*, Vol. 3, pp 1551-1564, 29-9-2003..
5. **NO_y:** Volz-Thomas et al., Measurements of total odd nitrogen (NO_y) aboard MOZAIC in-service aircraft: instrument design, operation and performance, *Atmospheric Chemistry and Physics*, 5, pp 583-595, 25-2-2005
6. **NO_y:** Pätz, et al., In-situ comparison of the NO_y instruments flown in MOZAIC and SPURT, *Atmospheric Chemistry and Physics Discussion*, Vol. 6, pp 649-671

WP GRG_4: MOZAIC: recent data analysis papers

1. Nédélec et al. Extreme CO concentrations in the upper troposphere over North-East Asia in June 2003 from the in-situ MOZAIC aircraft data. *Geophysical Research Letters*, 32, L14807, doi:10.1029/2005GL023141, 2005.
2. Sauvage et al. Tropospheric ozone over Equatorial Africa : regional aspects from the MOZAIC data. *Atmospheric Chemistry and Physics*, Vol. 5, pp 311-335, 7-2-2005.
3. Thouret et al. Tropopause referenced ozone climatology and inter-annual variability (1994-2003) from the MOZAIC programme, *Atmospheric Chemistry and Physics Discussion*, 5, 5441-5488, 2005. Accepted at ACP, 2006.
4. Zbinden et al. Mid-latitude tropospheric ozone contents from the MOZAIC programme: Climatology and inter-annual variability. *Atmospheric Chemistry and Physics Discussion*, 5, 5489-5540, 2005. Accepted at ACP, 2006.

WP GRG_4: Use of MOZAIC 2003 data

1. UTLS cruise data

- a. Seasonal averaging (O₃, CO, water vapour, NO_y)
- b. Vertical gradient at the tropopause

2. Tropospheric Vertical Profiles

- a. Seasonal averaging (O₃, CO)
- b. Boundary Layer (content, diurnal variations)
- c. Stratospheric Intrusions (content, frequency)

3. Biomass Burning signatures

- a. Northeastern Siberia
- b. Western Europe

4. Anomalous periods & Interannual variability

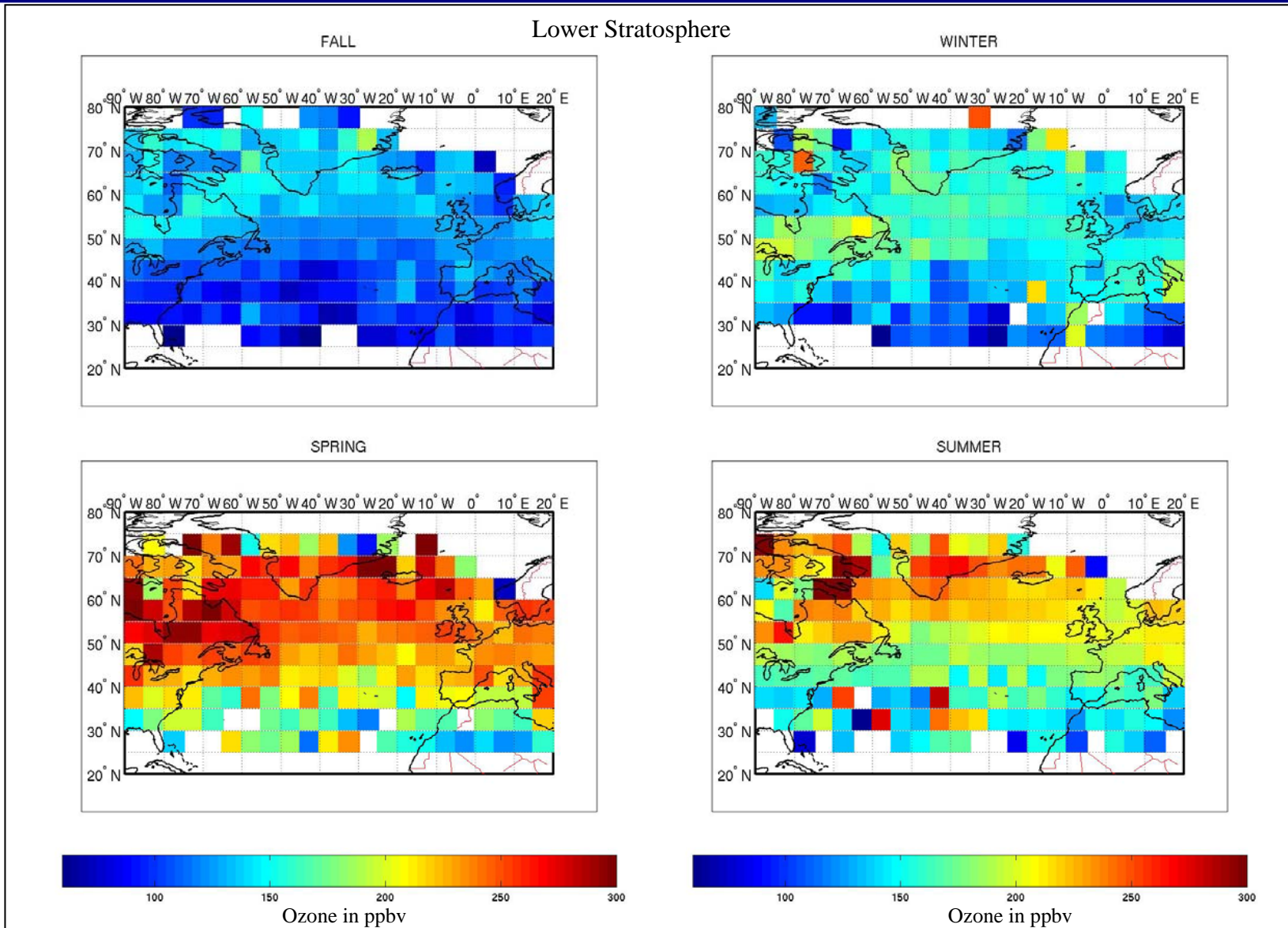
- a. Summer 2003 heat wave over Europe

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Model performance evaluation

MOZAIC UTLS O3 data
Seasonal averaging

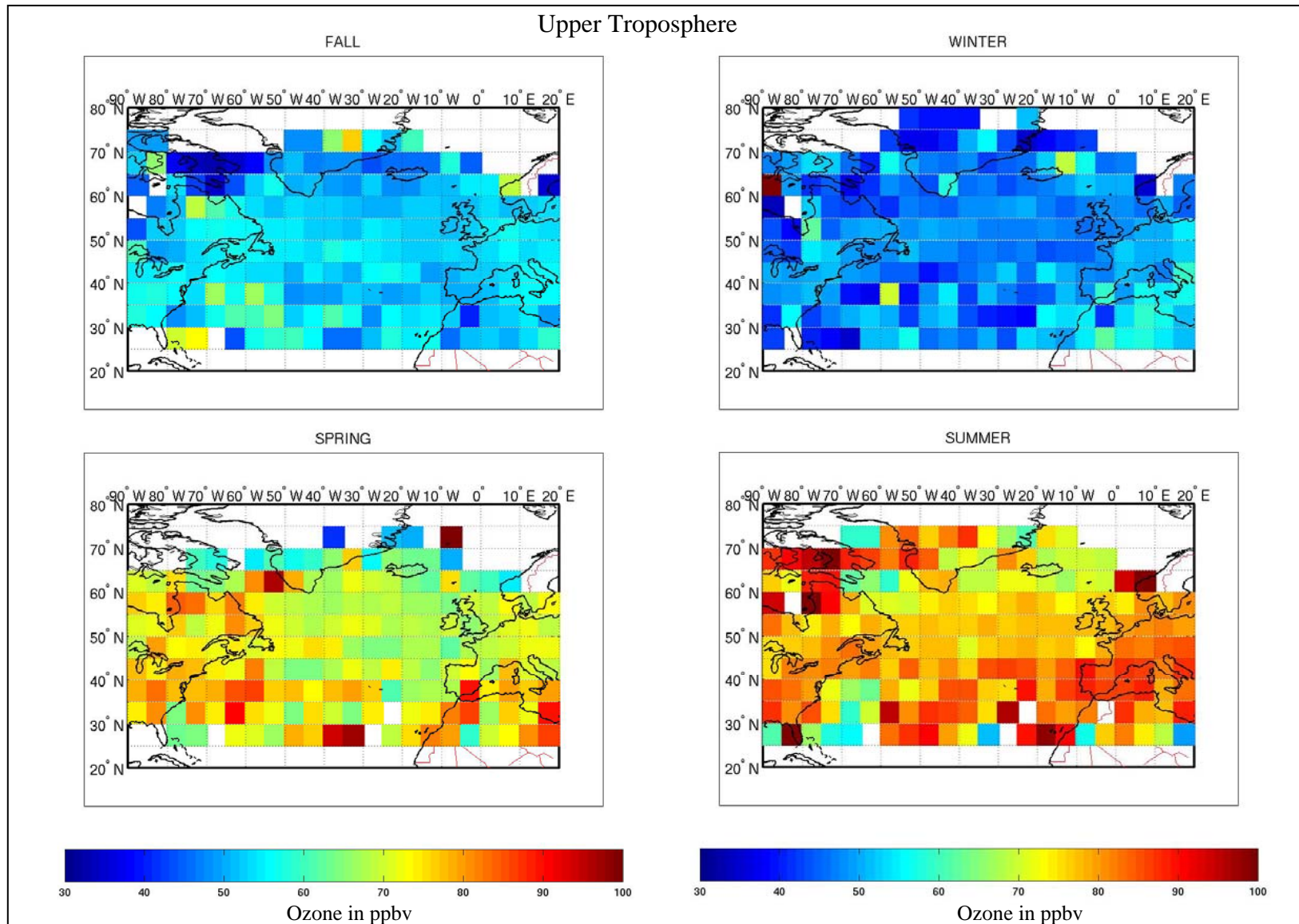
Ozone seasonal cycle in the UTLs



Lower Stratosphere

Thouret et al. (ACP, 2006)

Ozone seasonal cycle in the UTLs



Upper Troposphere

Thouret et al. (ACP, 2006)

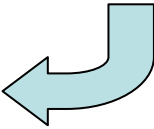
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Model performance evaluation

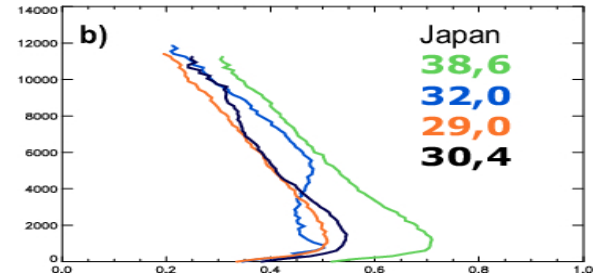
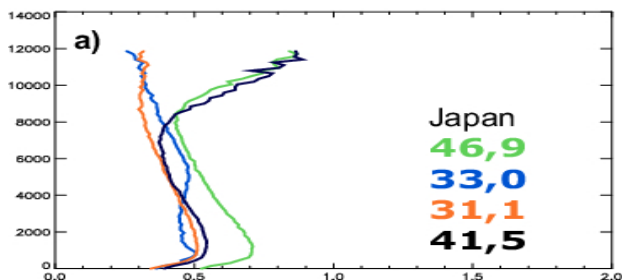
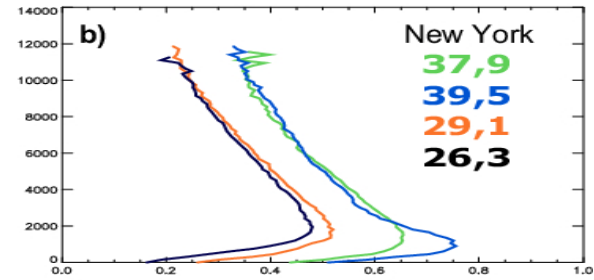
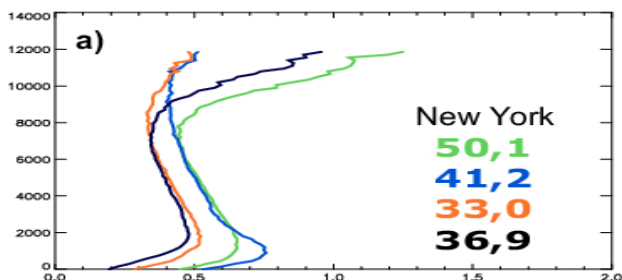
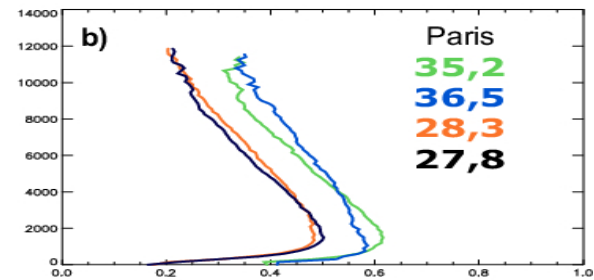
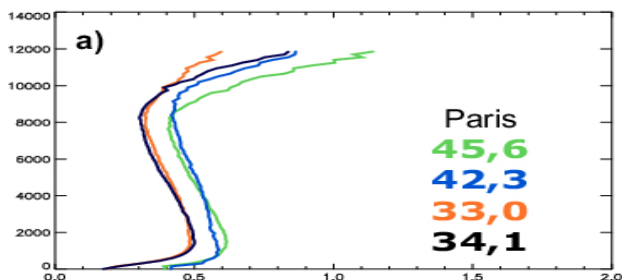
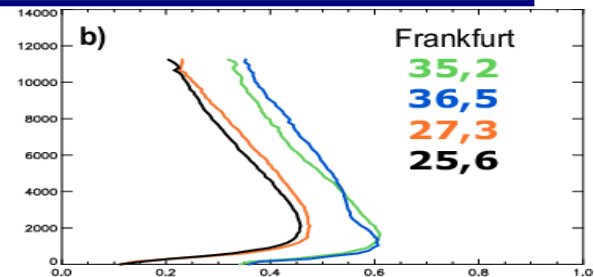
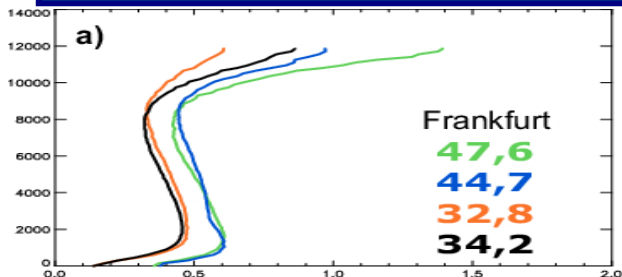
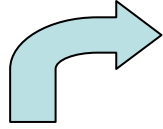
MOZAIC O3 vertical profiles
Seasonal averaging

Ozone seasonal cycle in the UTLs

Seasonal vertical profile of ozone content (DU/150m) and total ozone content (DU)



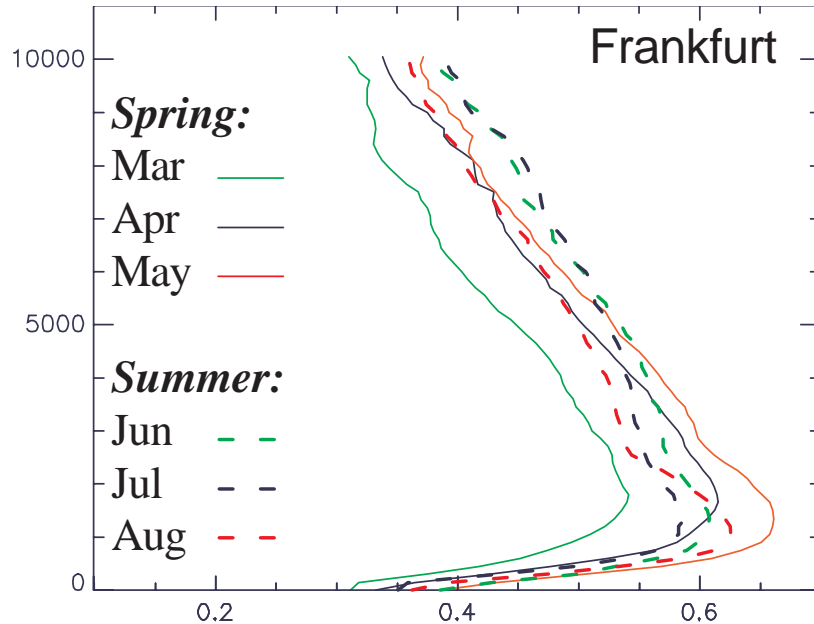
Seasonal tropospheric vertical profile of ozone content (DU/150m) and tropospheric ozone content (DU)



— Winter — Spring
— Fall — Summer

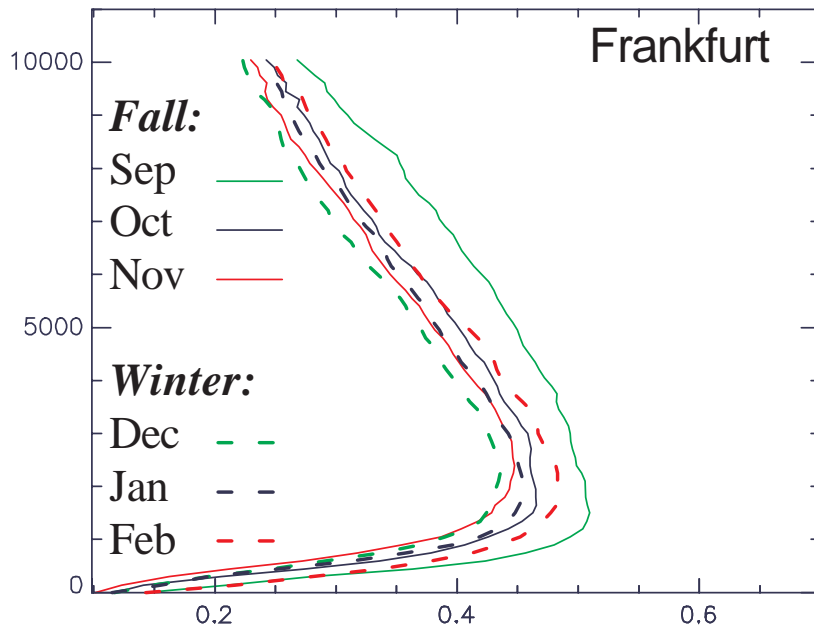
Zbinden et al. (ACP, 2006)

Ozone seasonal cycle in the UTLS



Monthly-mean tropospheric profiles of Ozone Layer Thicknesses (DU/150 m) over Frankfurt.

(The Ozone Layer Thickness is defined as the contribution to the Tropospheric Ozone Column of a 150m vertical depth atmospheric layer)



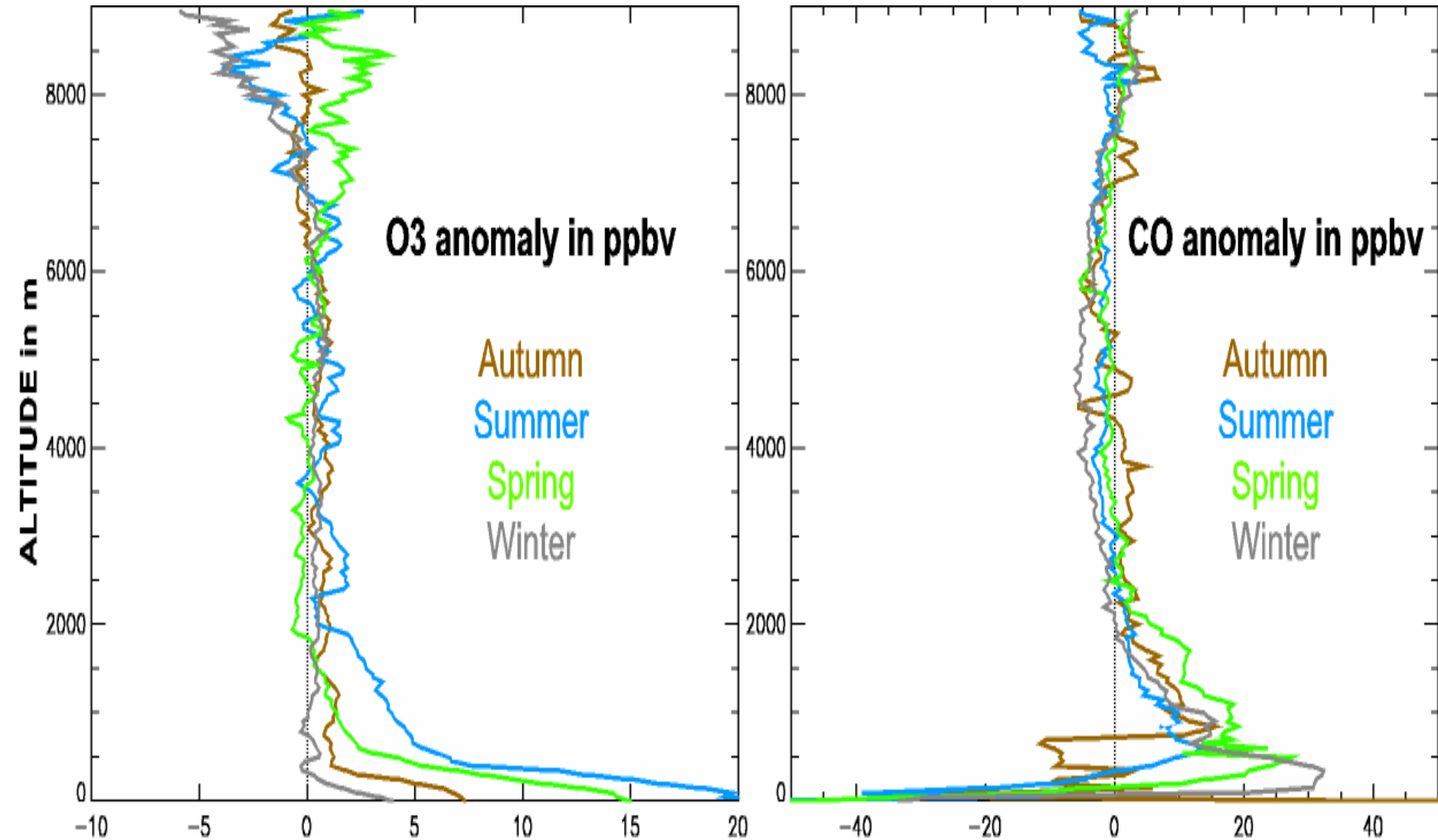
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Model performance evaluation

MOZAIC O3 data

Boundary layer diurnal variations
Seasonal averaging

Day-Night seasonal departures of O_3 and CO on vertical profiles over FRANFURT [0m \rightarrow 9km, 1994 \Leftrightarrow 2004]



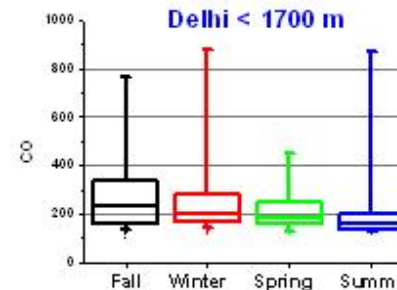
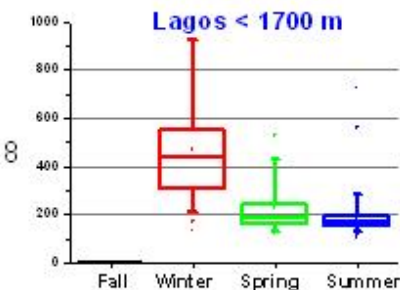
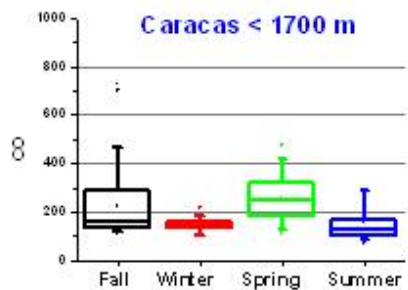
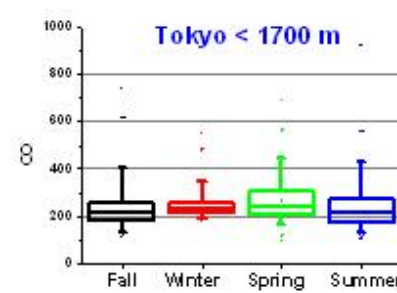
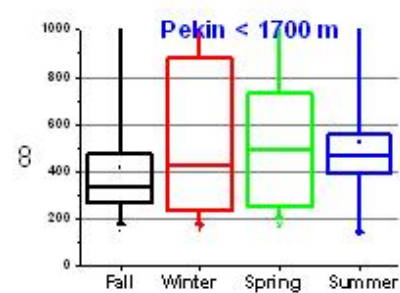
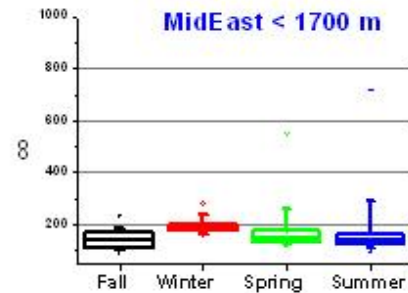
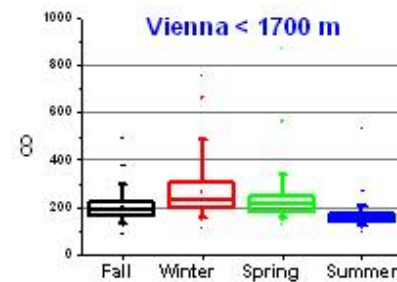
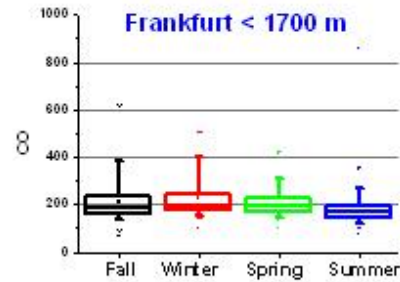
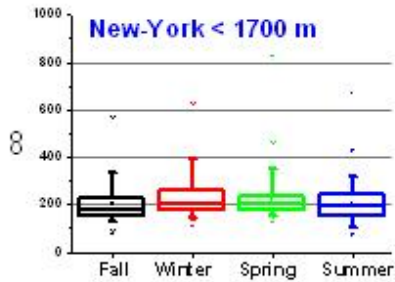
R. ZBINDEN and J.P. CAMMAS

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Model performance evaluation

MOZAIC Boundary layer CO data
Seasonal averaging

CO measurements into the Planetary Boundary Layer



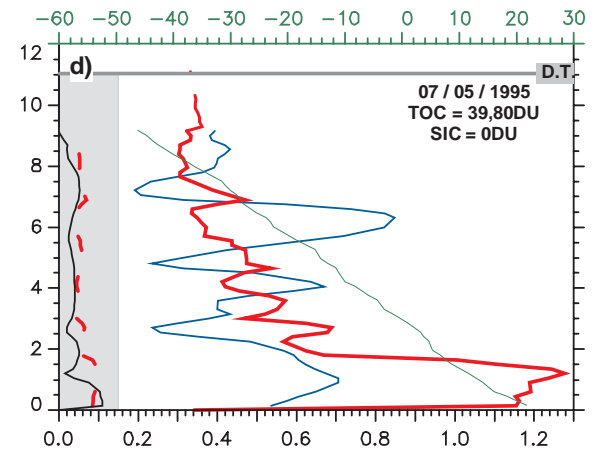
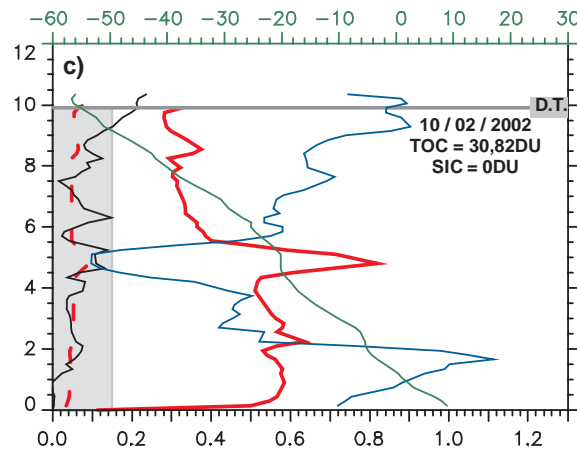
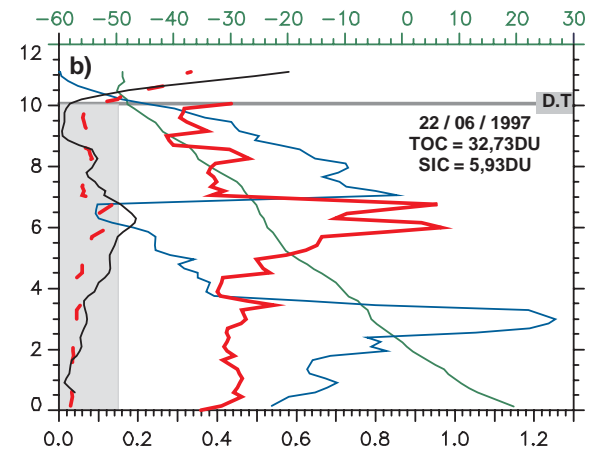
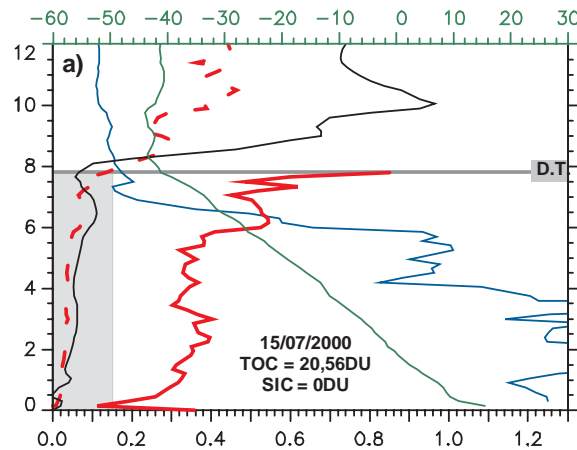
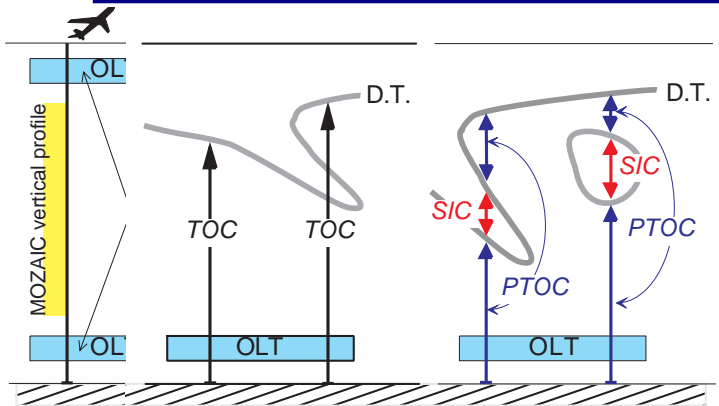
Thouret et al. (2004, MOZAIC final report)

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Model performance evaluation

MOZAIC O3 vertical profiles
Tropospheric Ozone Columns
Stratospheric Intrusion Content

Tropospheric Ozone Column and Stratospheric Intrusion Content



Zbinden et al. (ACP, 2006)

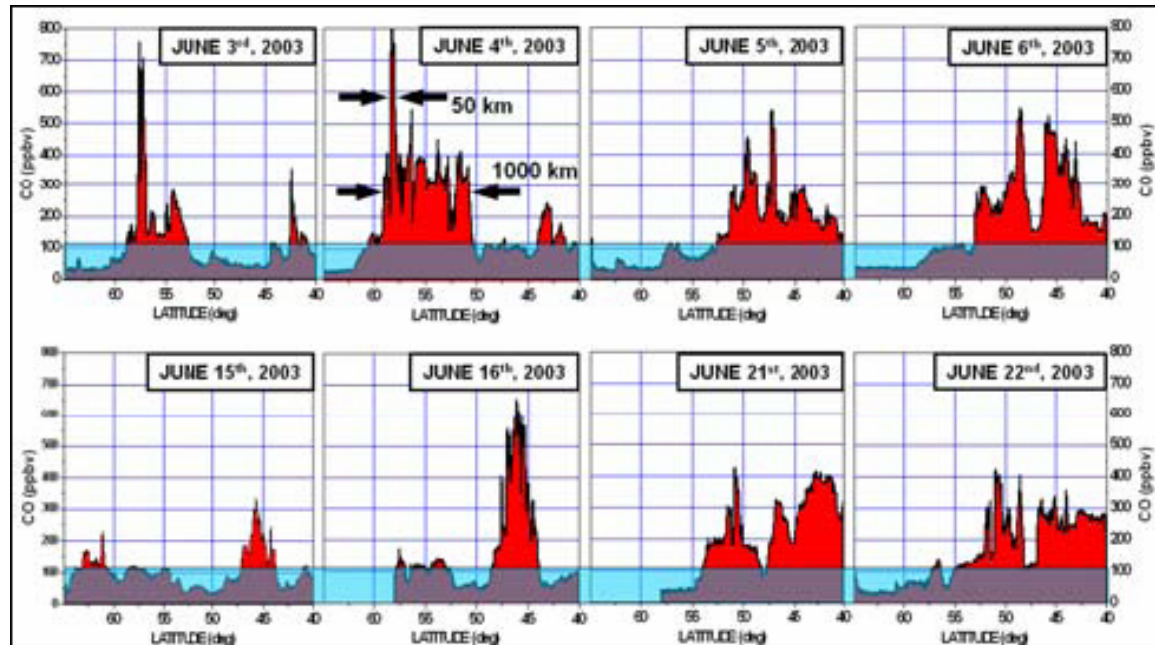
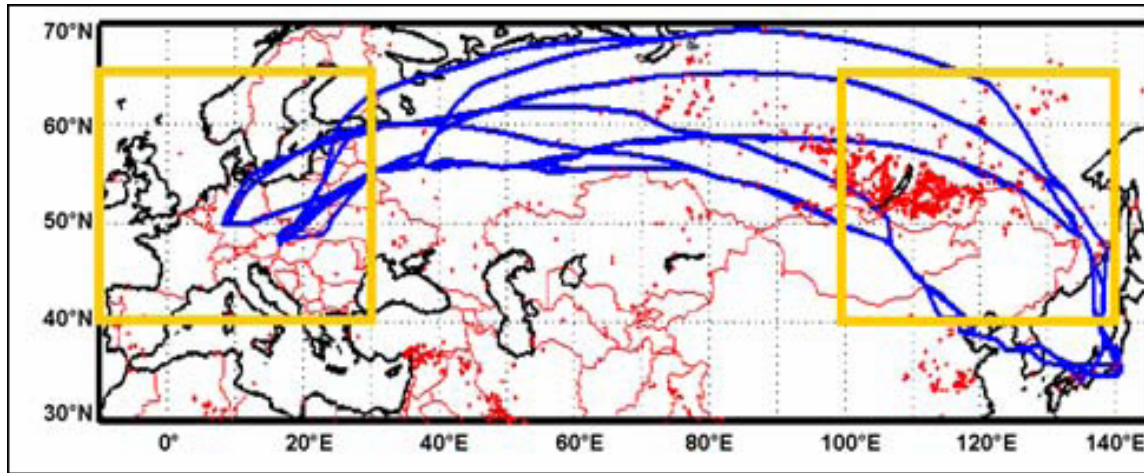
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Model performance evaluation

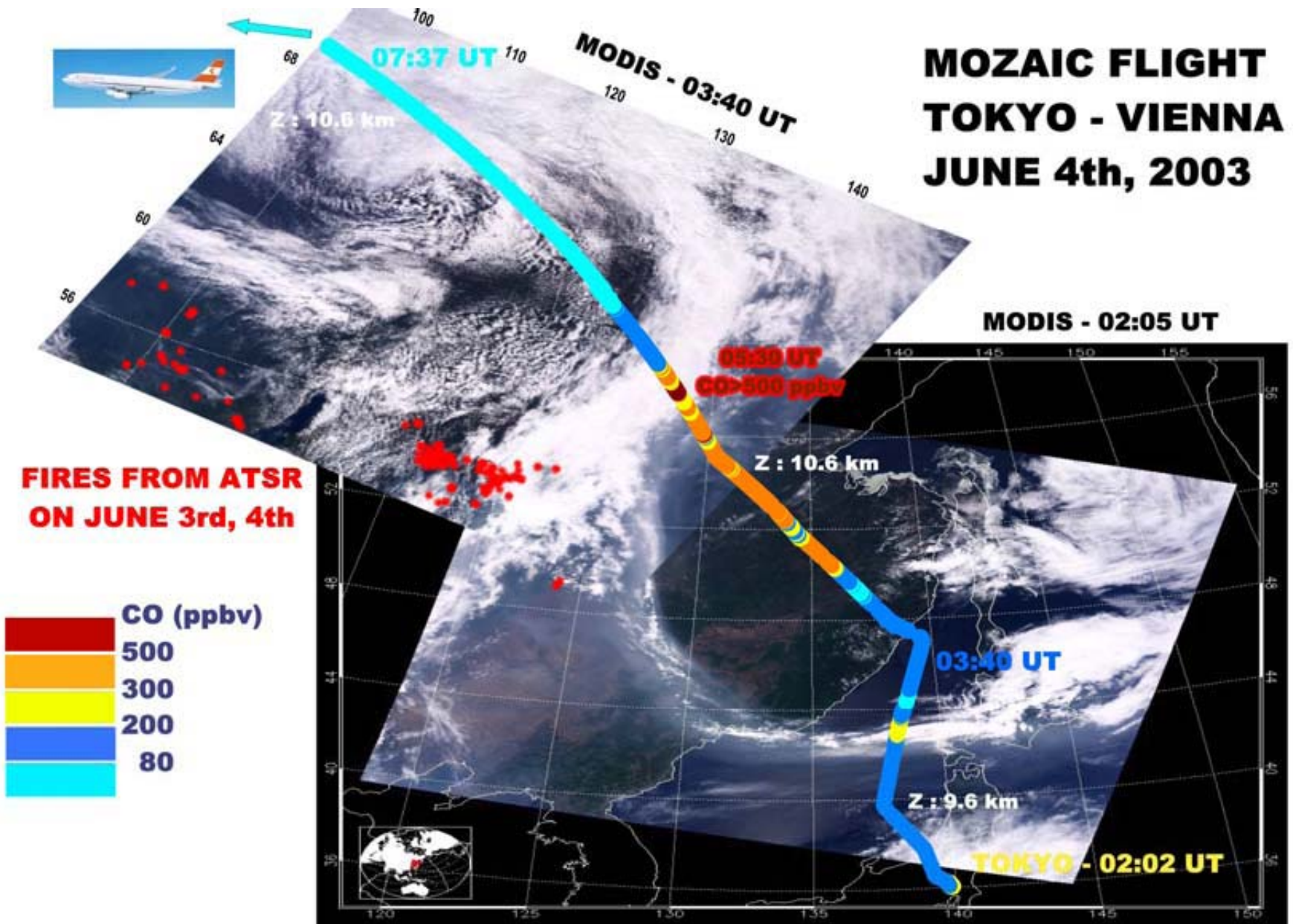
MOZAIC data

Biomass burning signatures

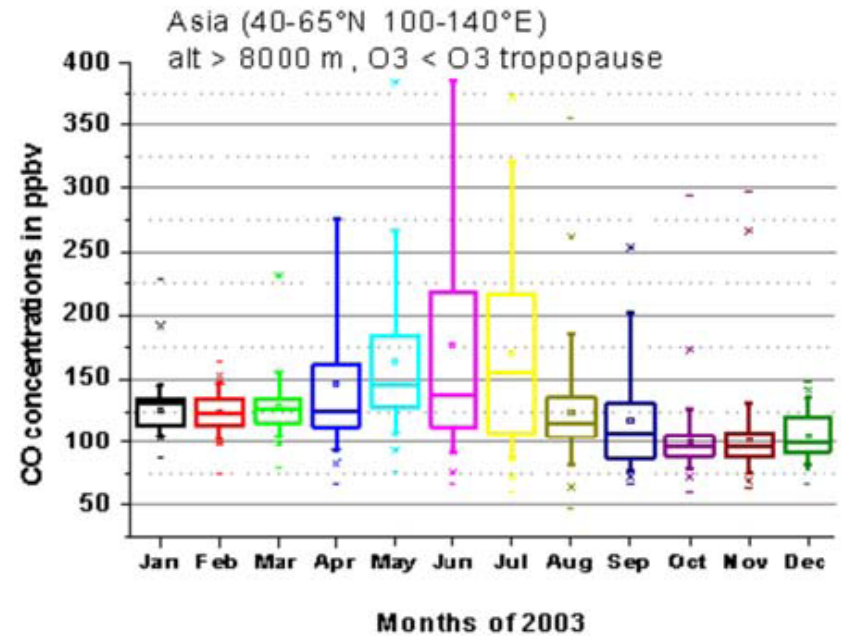
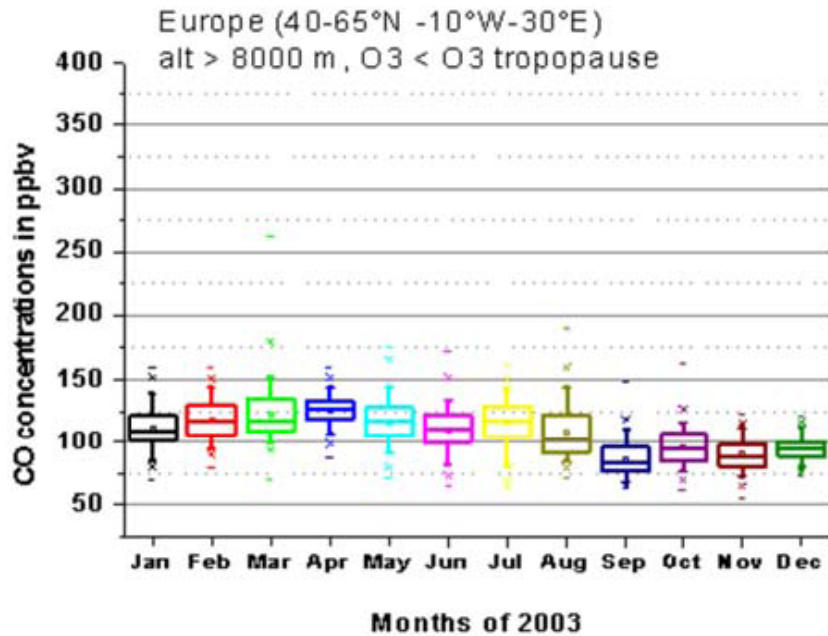
Biomass fires over Northeastern Asia in Spring 2003: evidence of daily extreme CO concentrations in the upper troposphere with MOZAIC observations



MOZAIC FLIGHT TOKYO - VIENNA JUNE 4th, 2003



Biomass fires over Northeastern Asia in Spring 2003: evidence of daily extreme CO concentrations in the upper troposphere with MOZAIC observations



“Box charts” of the CO monthly frequency distributions for altitudes over 8000 m over Europe (left panel) and over North-East Asia (right panel) for 2003. Horizontal bars in the boxes give the median, while the boxes themselves extend from the 25% for the 75% percentiles. The small squares inside the boxes give the mean value, and the vertical bars give the 5% and 95% percentiles. Crosses give the 1% and 99% percentiles. Small dashes give the minimum and the maximum.

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Model performance evaluation

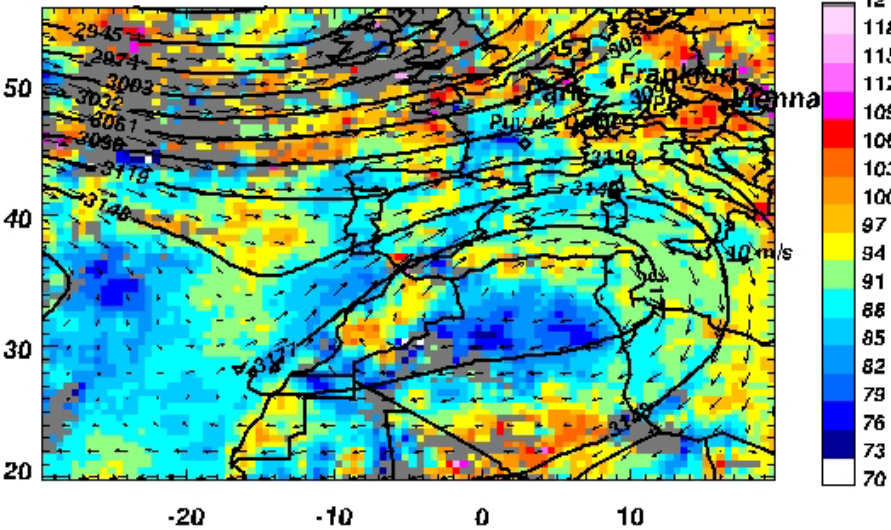
MOZAIC data

European summer 2003 heat wave

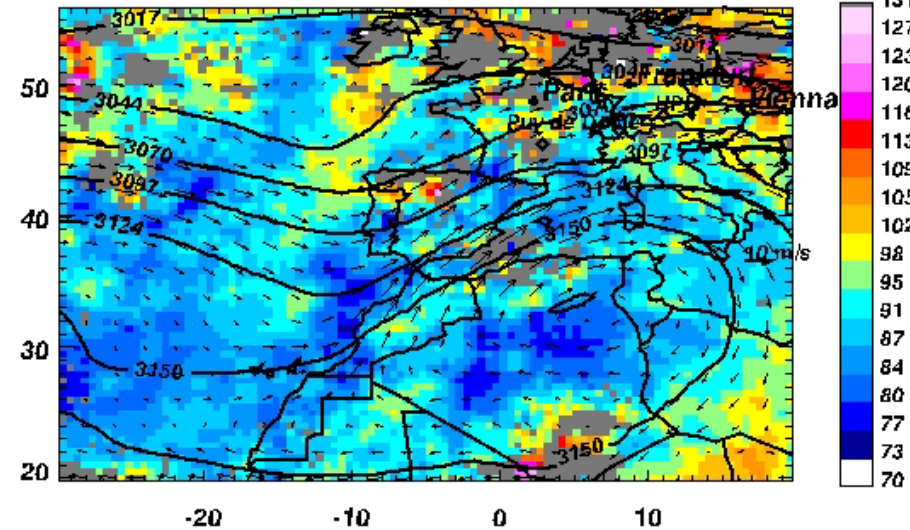
Summer 2003 Heat Wave as seen by MOPITT

Attié et al., submitted at GRL

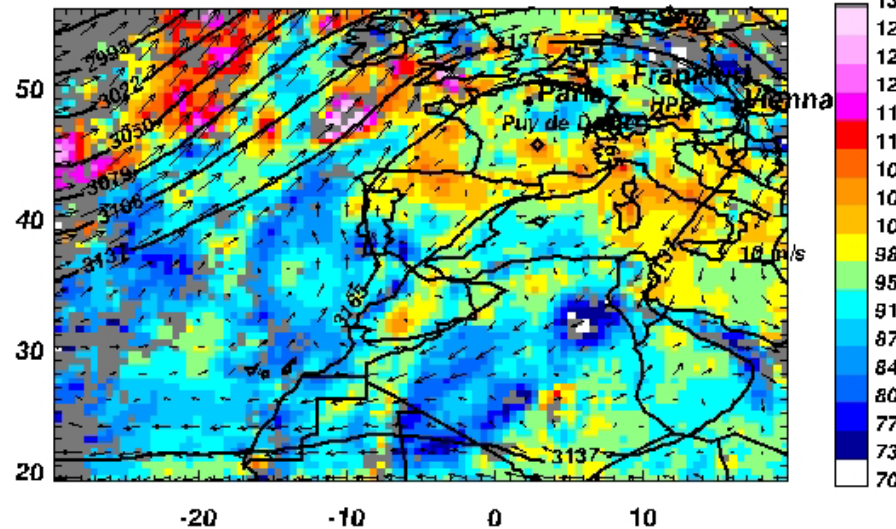
(a) BEFORE THE HEATWAVE 0716-0731



(c) AFTER THE HEATWAVE 0816-0831



(b) DURING THE HEATWAVE 0802-0814



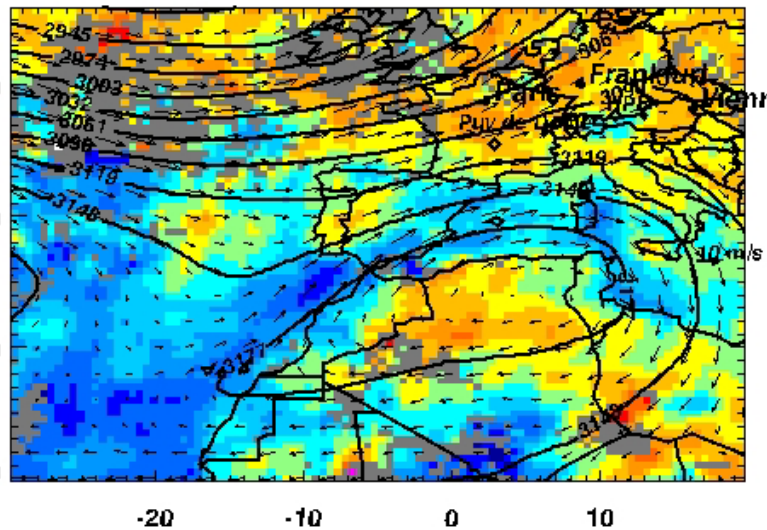
CO (ppbv) @ 350 hPa

Z (m) @ 700 hPa

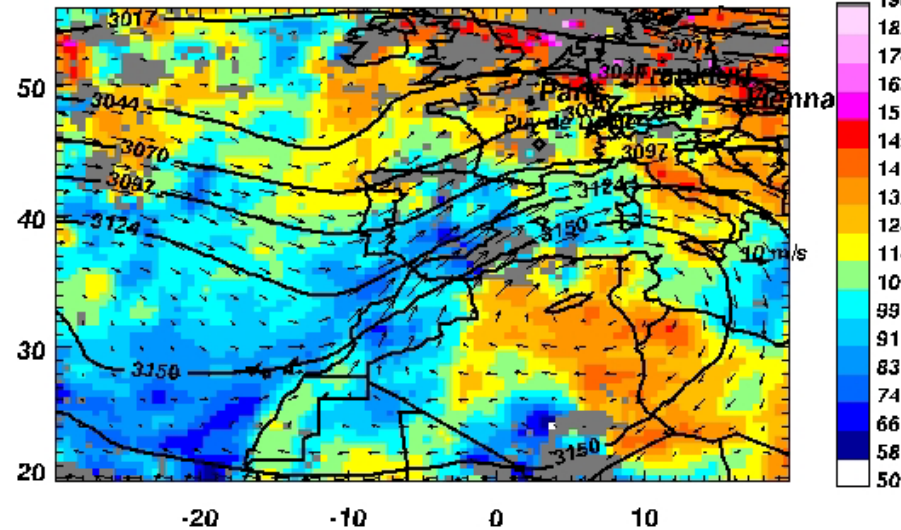
Summer 2003 Heat Wave as seen by MOPITT

Attié et al., submitted at GRL

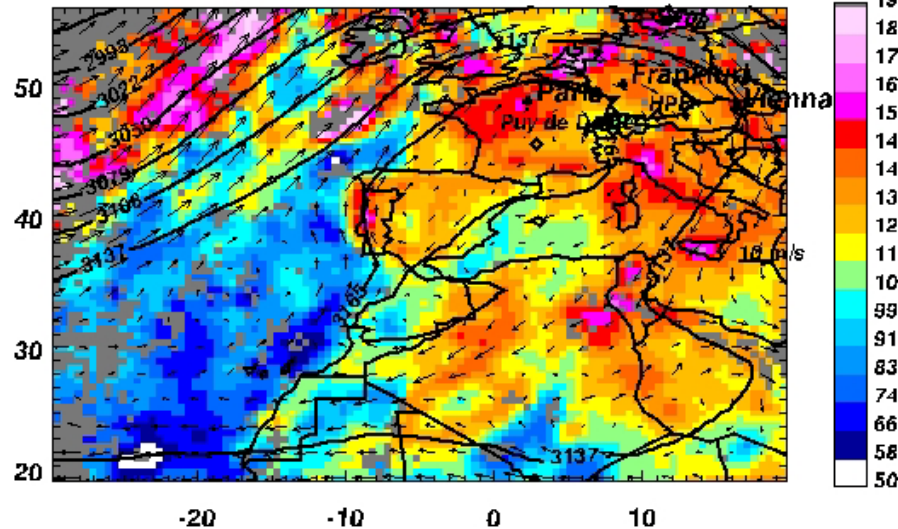
(a) BEFORE THE HEATWAVE 0716-0731



(c) AFTER THE HEATWAVE 0816-0831



(b) DURING THE HEATWAVE 0802-0814

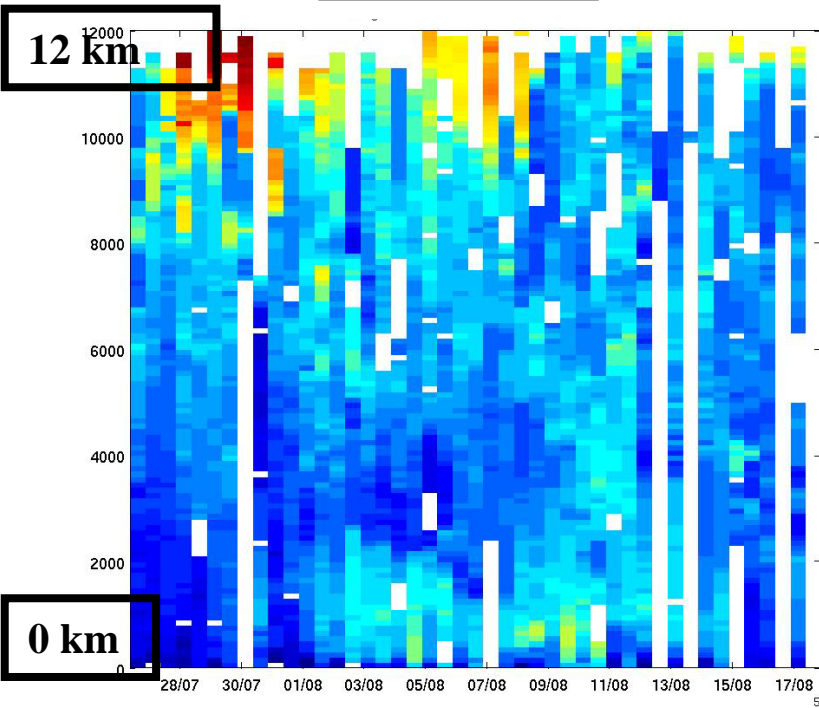


CO (ppbv) @ 700 hPa

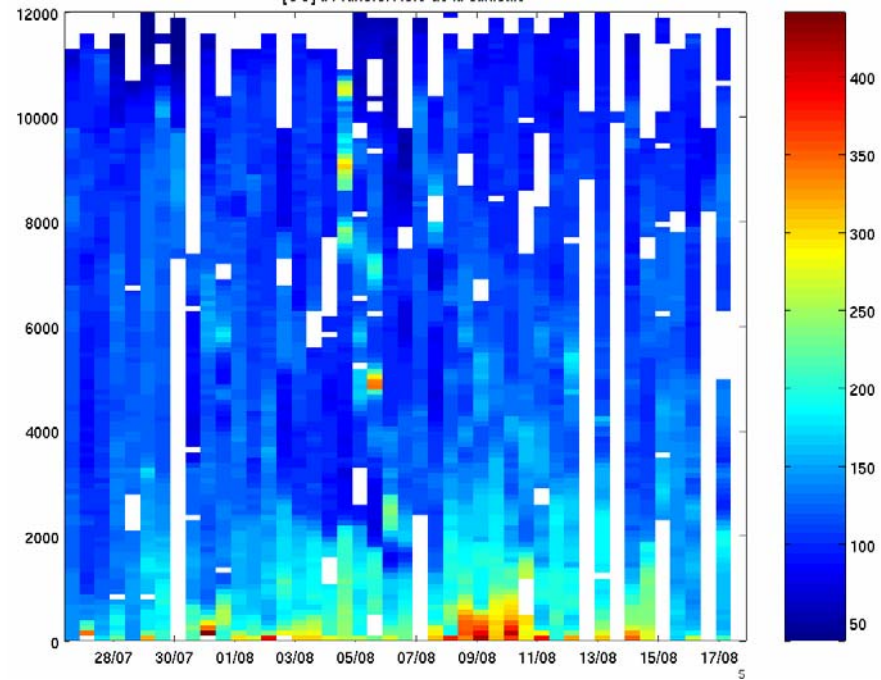
Z (mgs) @ 700 hPa

Summer 2003 Heat Wave in Frankfurt: MOZAIC observations

O₃ (ppbv)



CO (ppbv)



July 26 → August 17

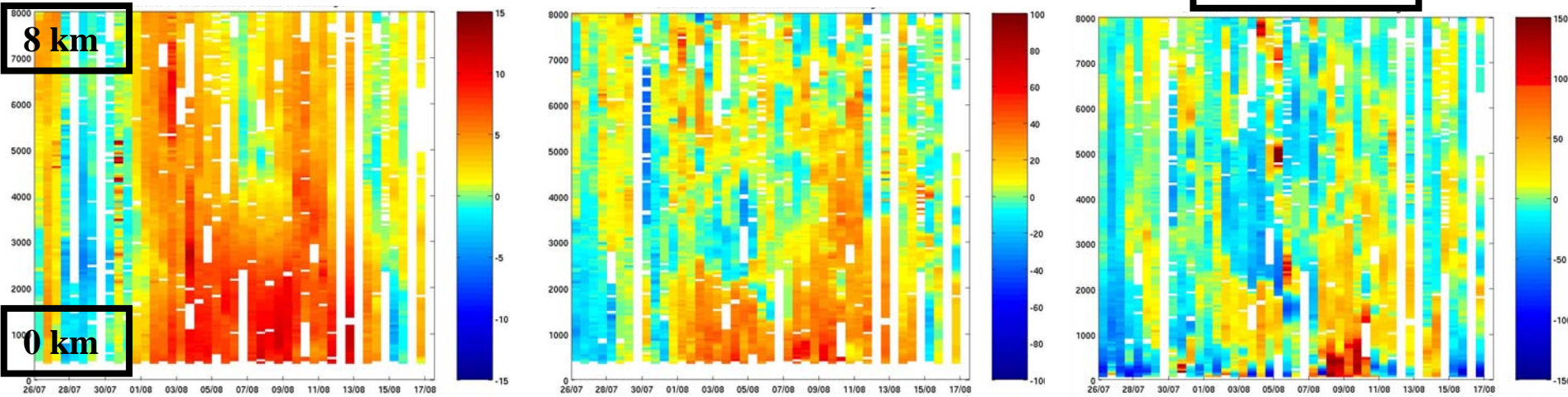
July 26 → August 17

Summer 2003 Heat Wave in Frankfurt: Deviations from the MOZAIC climatology

T (°C)

O3 (ppbv)

CO (ppbv)

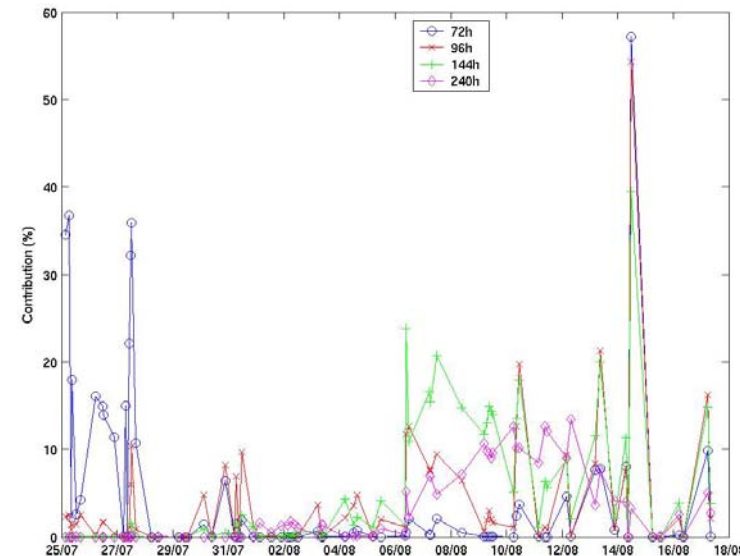


July 26 → August 17

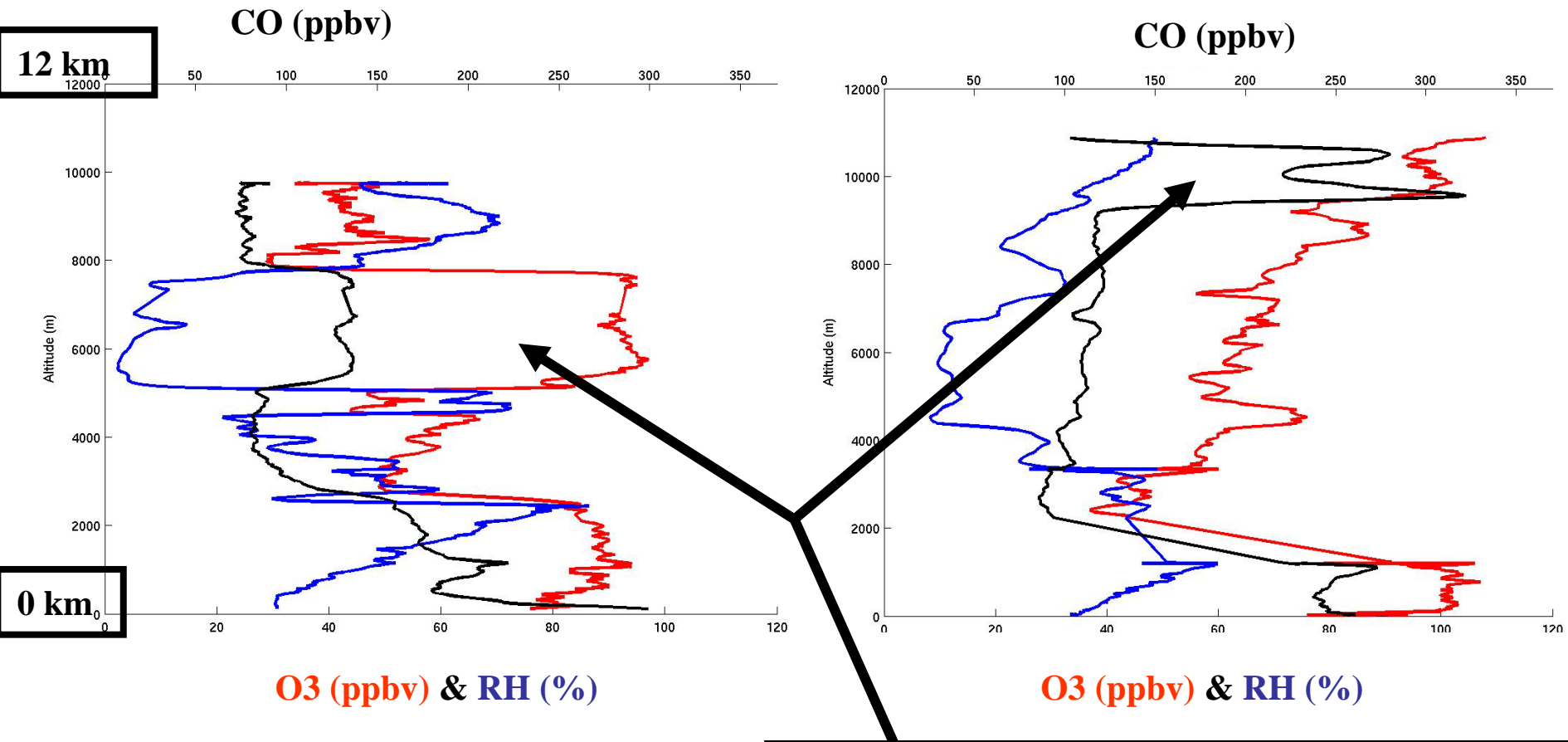
**Boundary layer air composition in Frankfurt:
Contribution of air masses affected by biomass-
fires over Portugal**

Flexpart calculations

M. Tressol, Ph.D. thesis



Summer 2003 Heat Wave in Frankfurt: MOZAIC observations



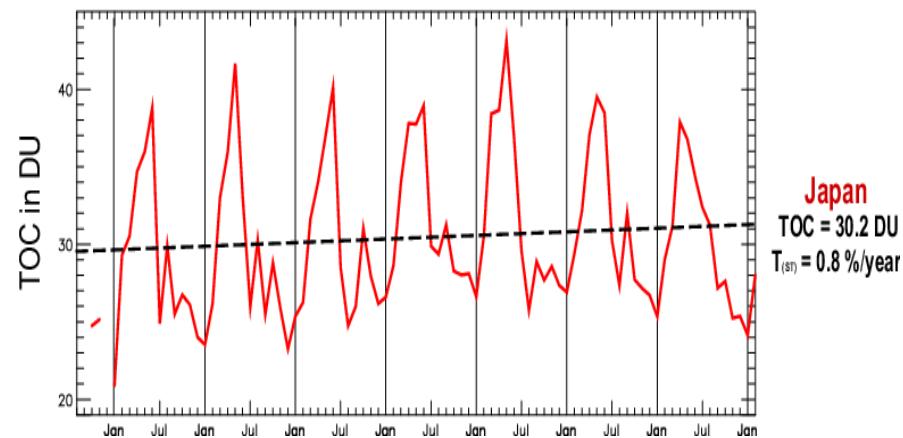
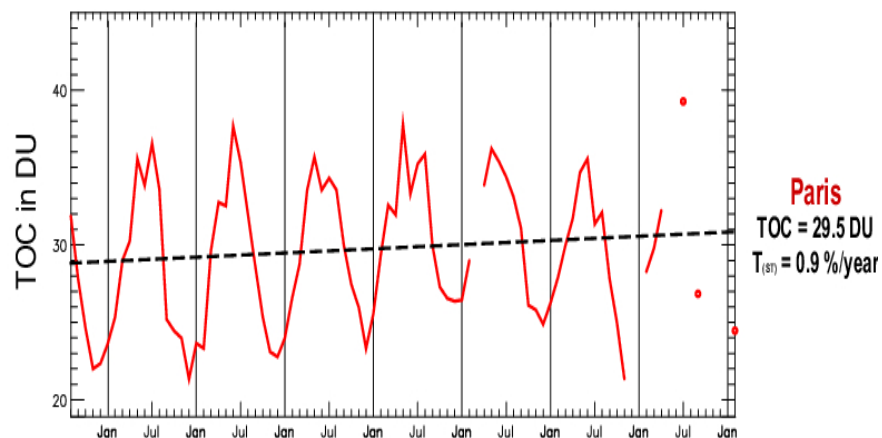
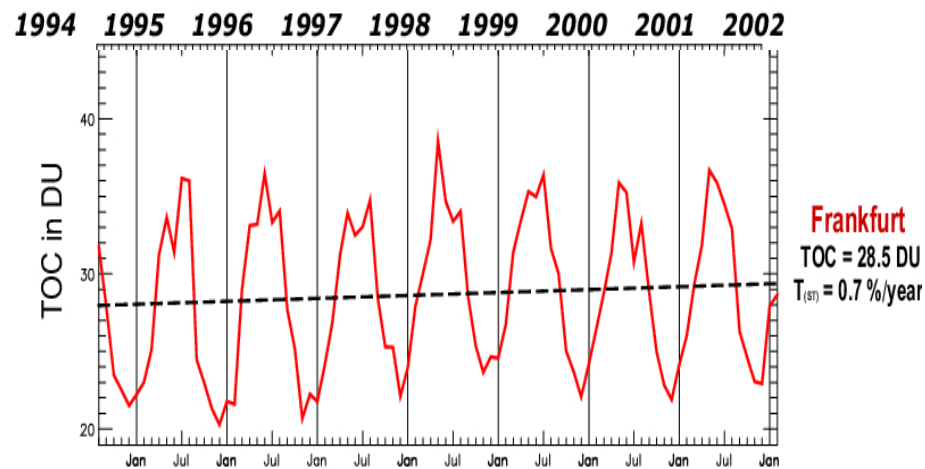
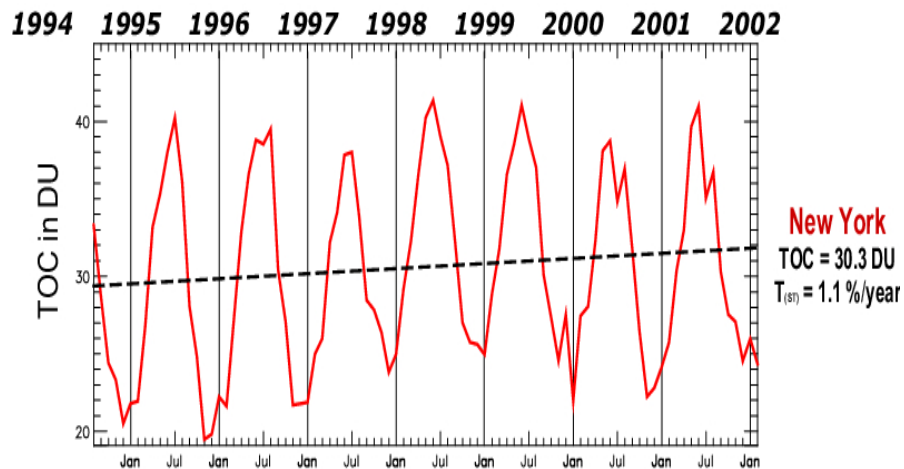
Biomass fire plumes from Alaska & Canada

GEMS WP_GRG_4

Model performance evaluation

MOZAIC data
Inter-annual variability

Inter-annual variability of Tropospheric Ozone Content (TOC)



Tropospheric Ozone Content (TOC), North Atlantic Oscillation (NAO)

