

Transport characteristics of the UTLS region based on tracers with different lifetimes using the MOZART3 model

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- ❑ Motivation, Model Description
- ❑ Examples of tracer behavior for two specific meteorological cases
- ❑ Statistical analysis of different regions and meteorological cases using tracer-tracer correlations of tracer with different lifetimes
- ❑ Conclusions

NCAR Chemical Transport Model MOZART3

MODEL Framework	Meteorology	Tracer Advection	Resolution	Chemistry
Extension of the NCAR Community Atmospheric Model version 3 (CAM3)	Driven by meteorological fields: ECMWF EXP147	Flux Form Finite Volume (Lin, 2004)	Horizontal: 1.9° x 2.5° Vertical: 60 levels 0-65 km	Middle Atmosphere Mechanism 115 species mechanism includes the MA + NMHCs.

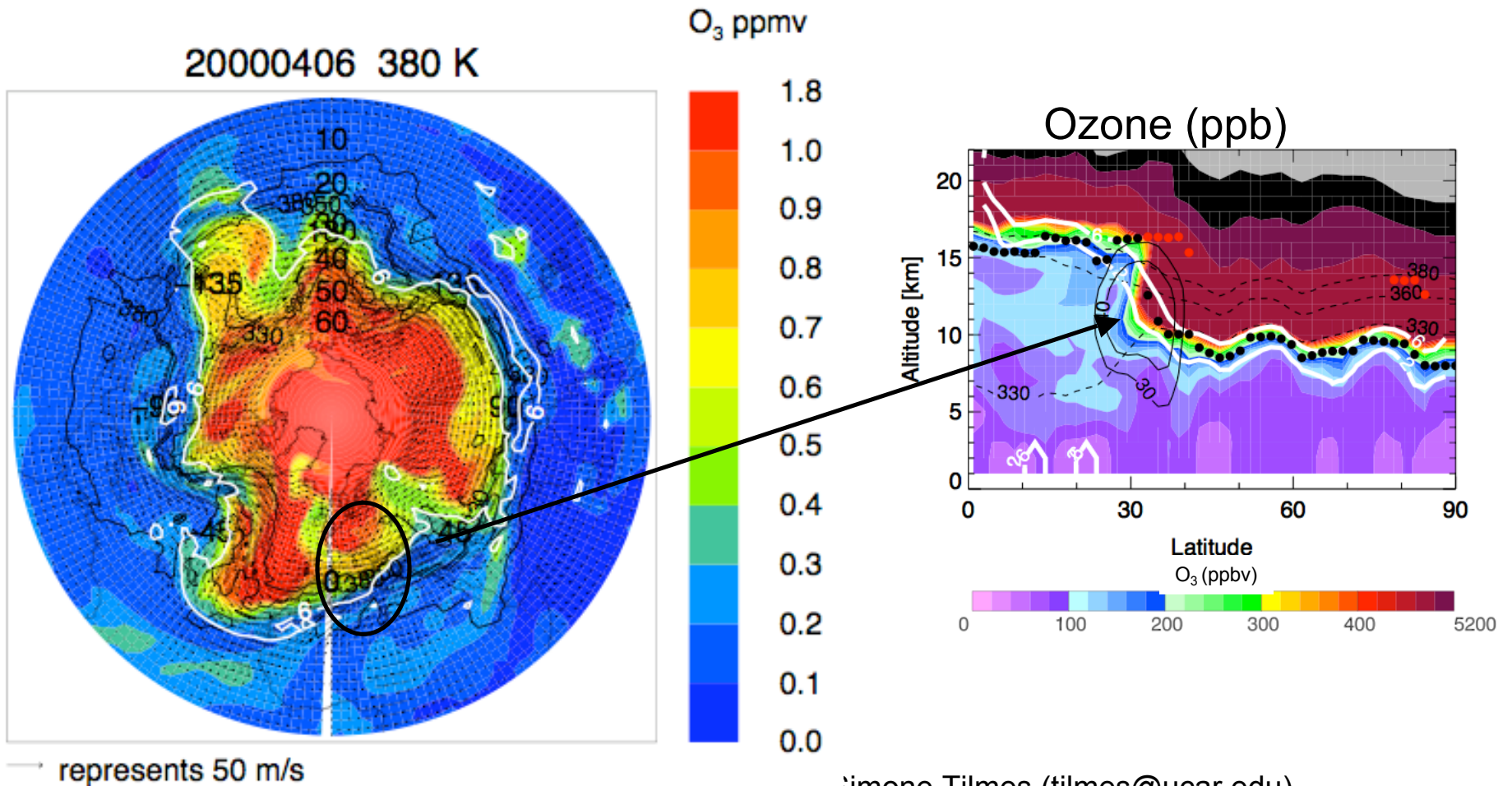


Exchange processes in the Extra-Tropical UTLS region:

- ❑ **Sharp change of the Tropopause across the Subtropical Jet**
- ❑ **Tropospheric intrusion on top of the Subtropical Jet (in connection with a double tropopause)**
- ❑ Stratospheric Intrusion
- ❑ Convection
- ❑ Gravity Waves

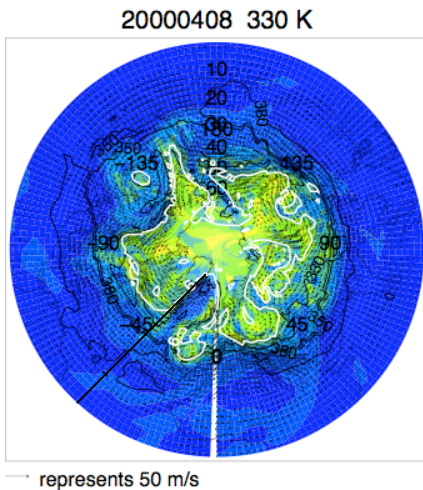
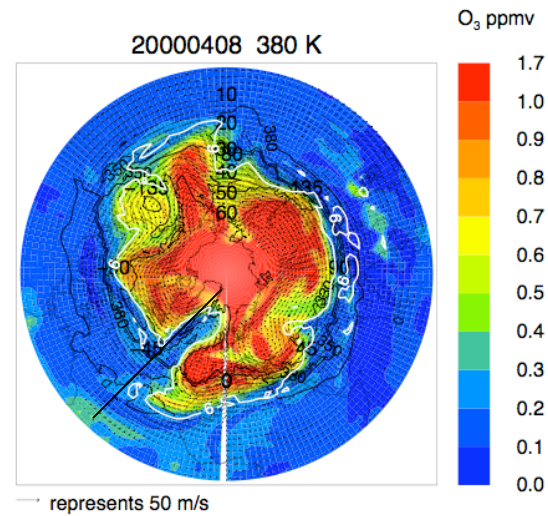
Sharp change of the Tropopause height across the subtropical jet

Different mixing behavior on two sides of the jet

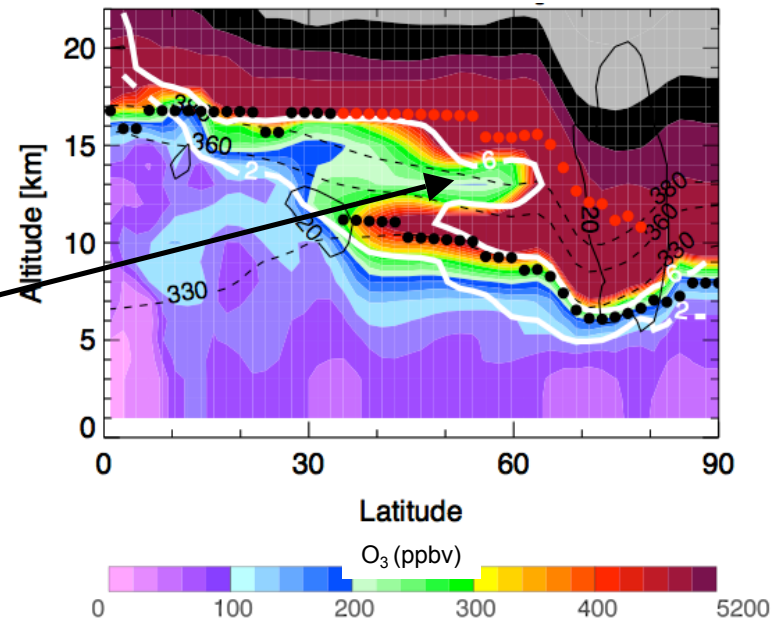


Mixing on top of the Sup-tropical jet

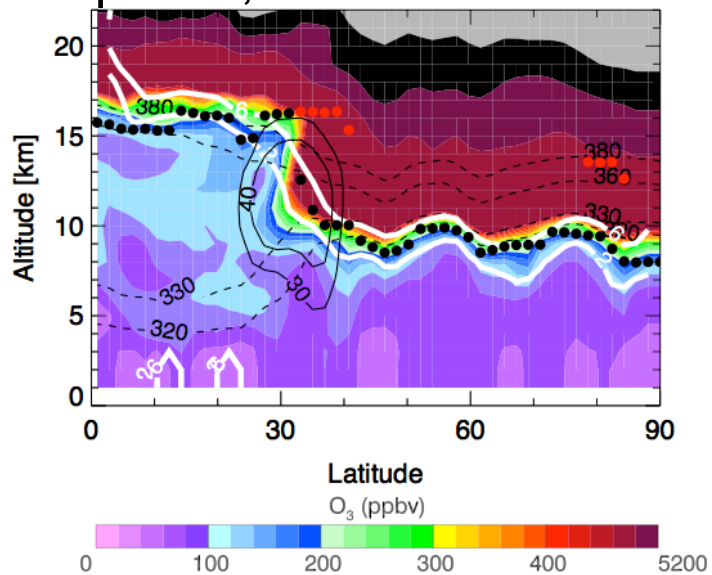
Tropospheric intrusion and the presence of secondary tropopause



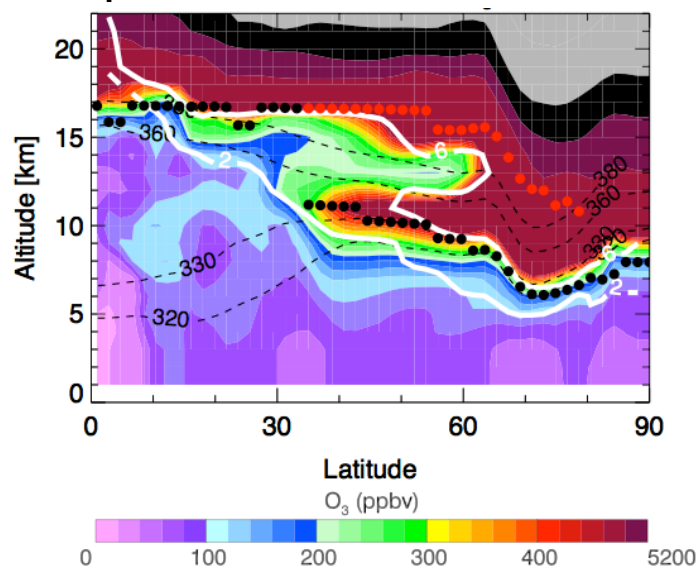
Ozone



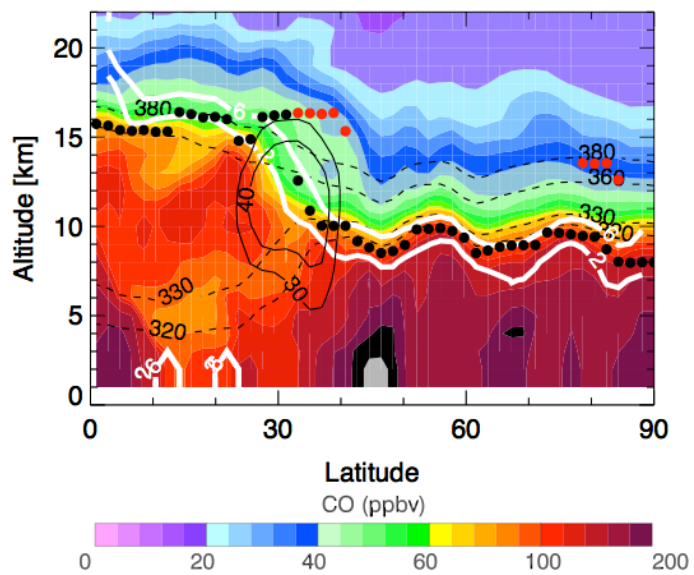
April 06, 2000. Lon. 10W



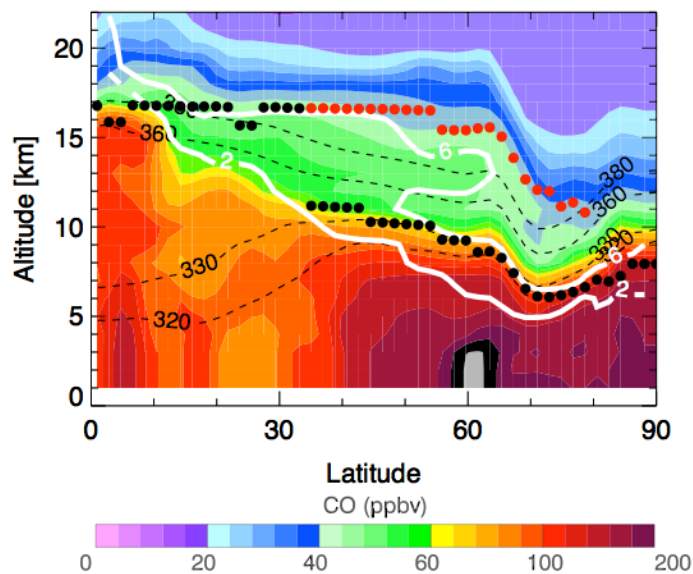
April 08, 2000. Lon. 325W



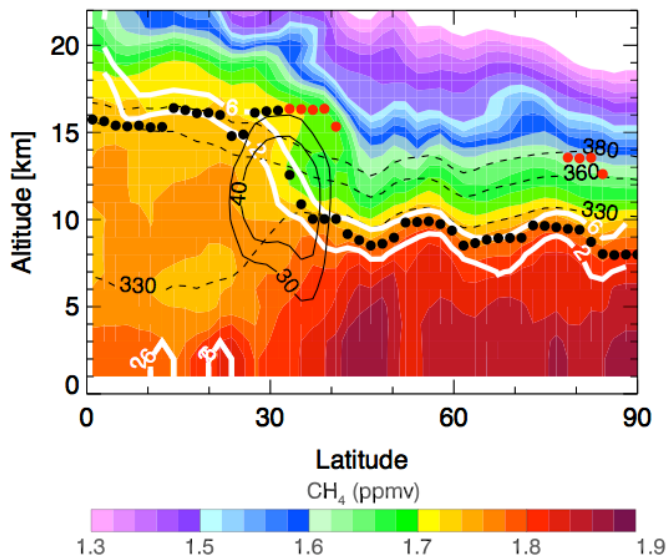
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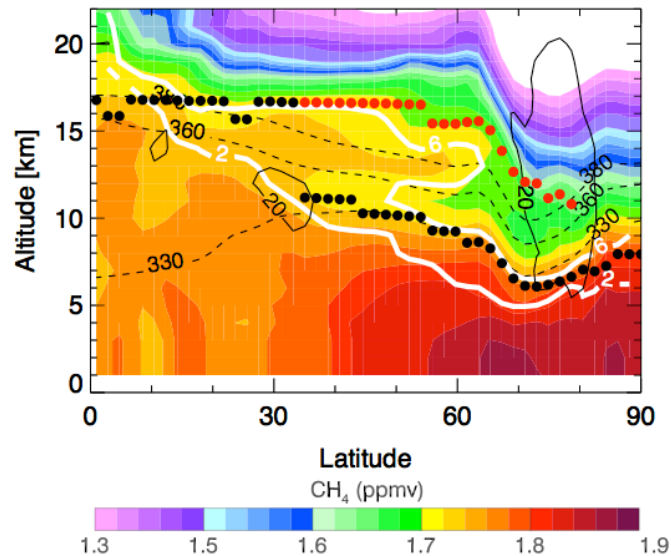
CO



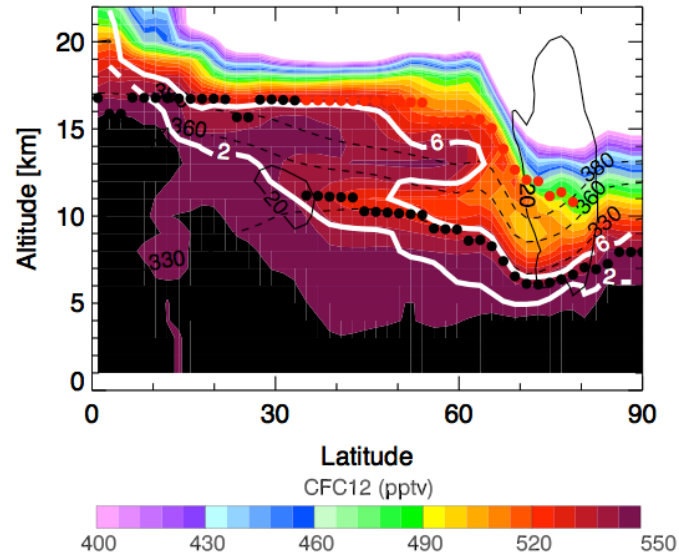
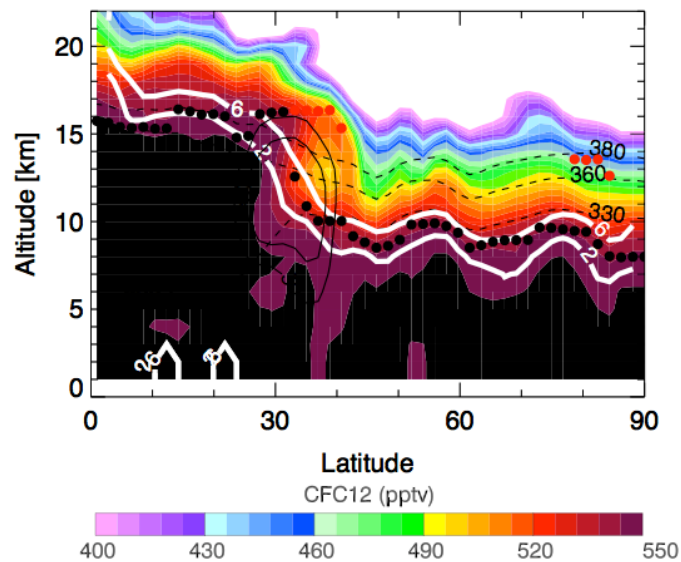
April 06, 2000. Lon. 10W



April 08, 2000. Lon. 325W



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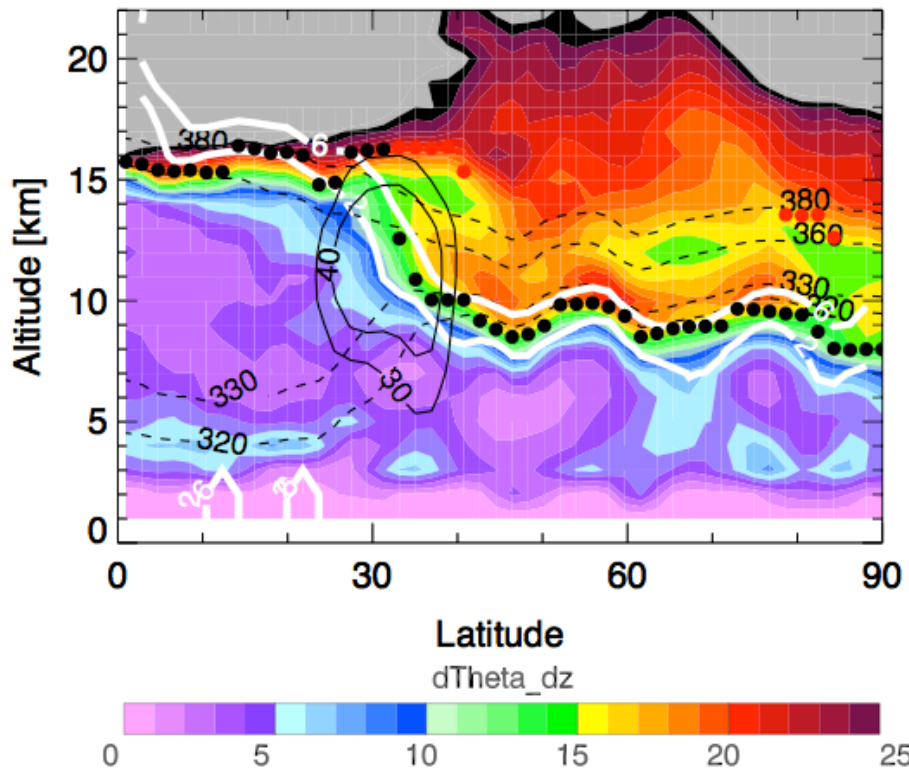


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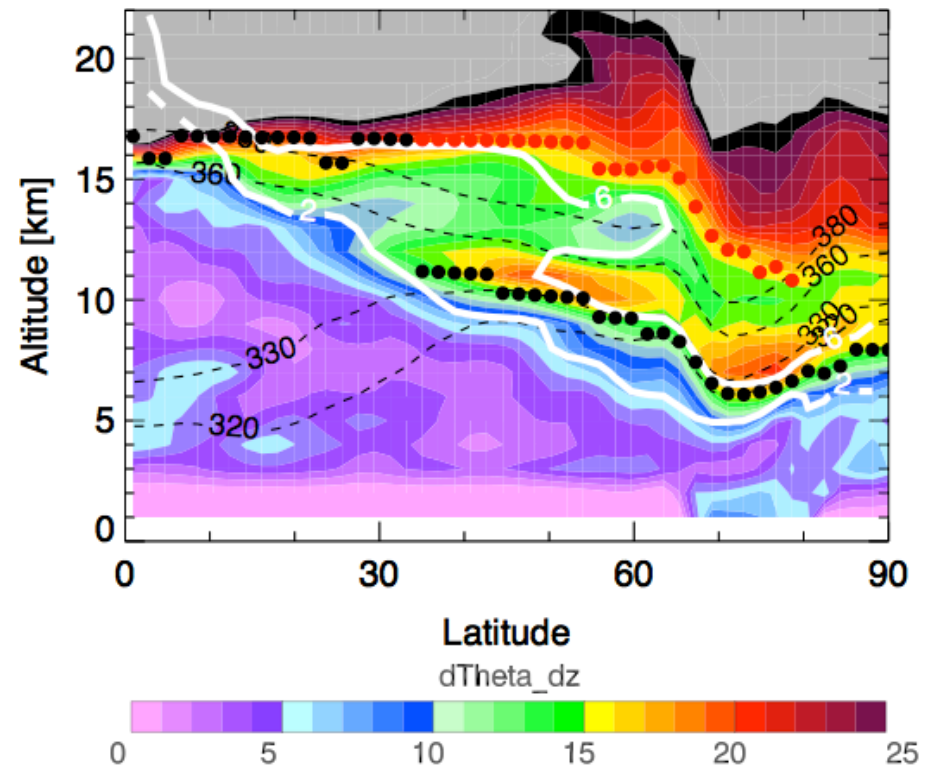
Identify regions influenced by tropospheric intrusion

Static Stability

April 06, 2000. Lon. 10W



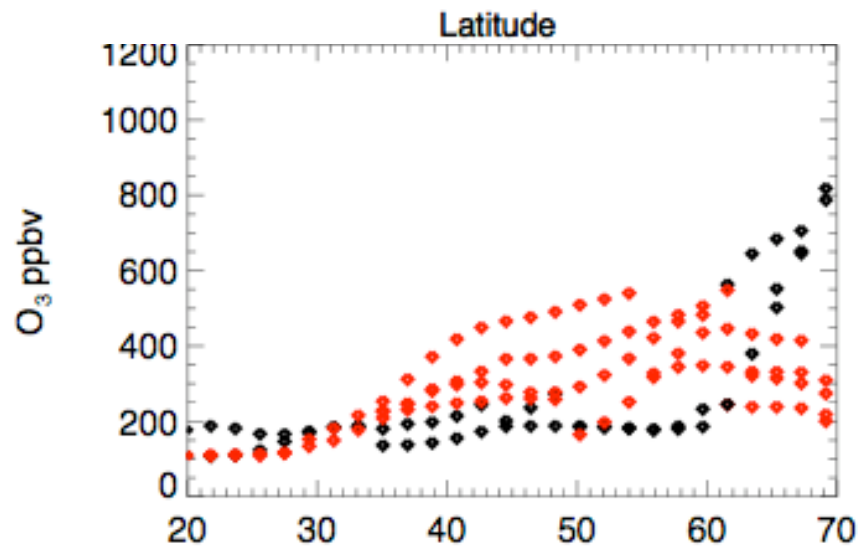
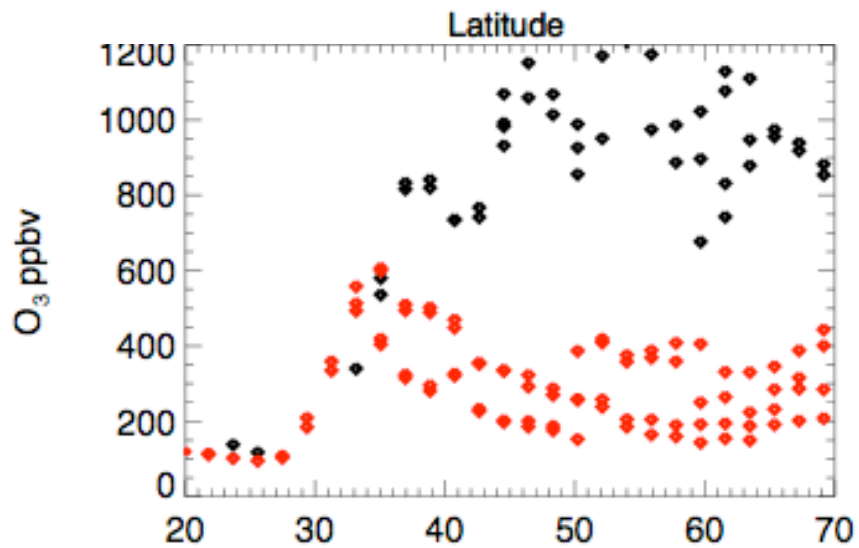
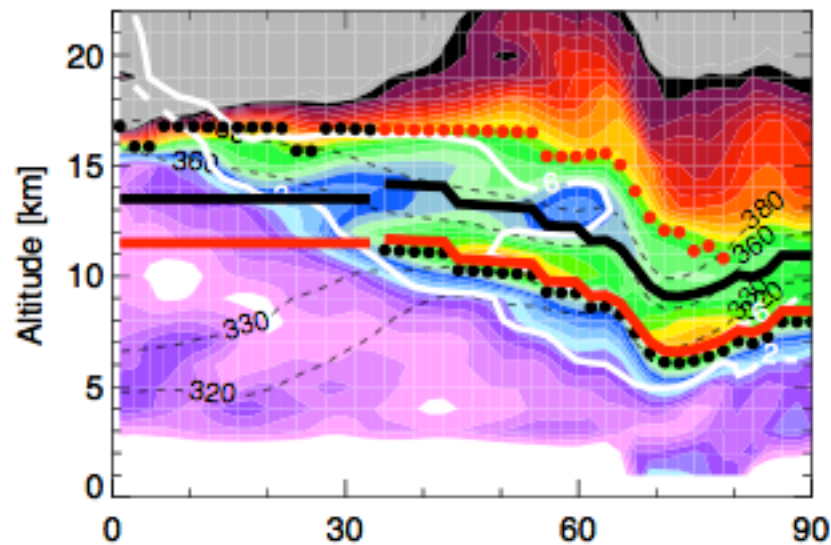
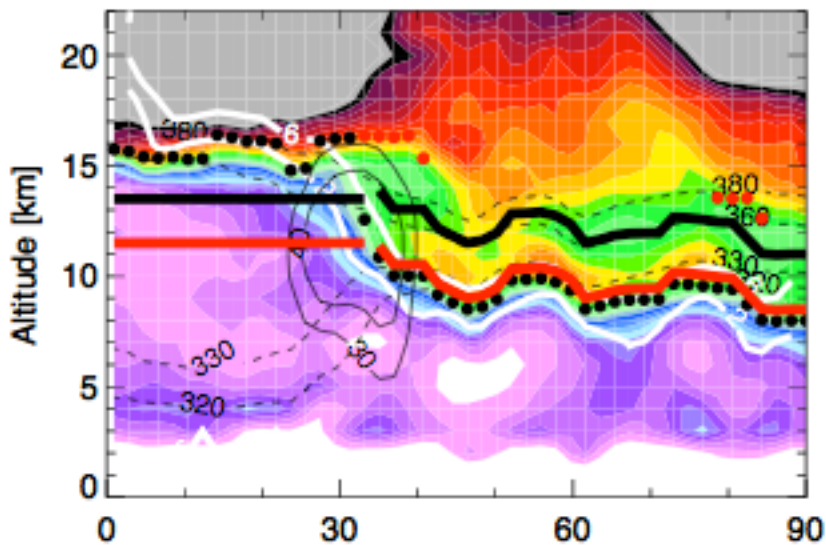
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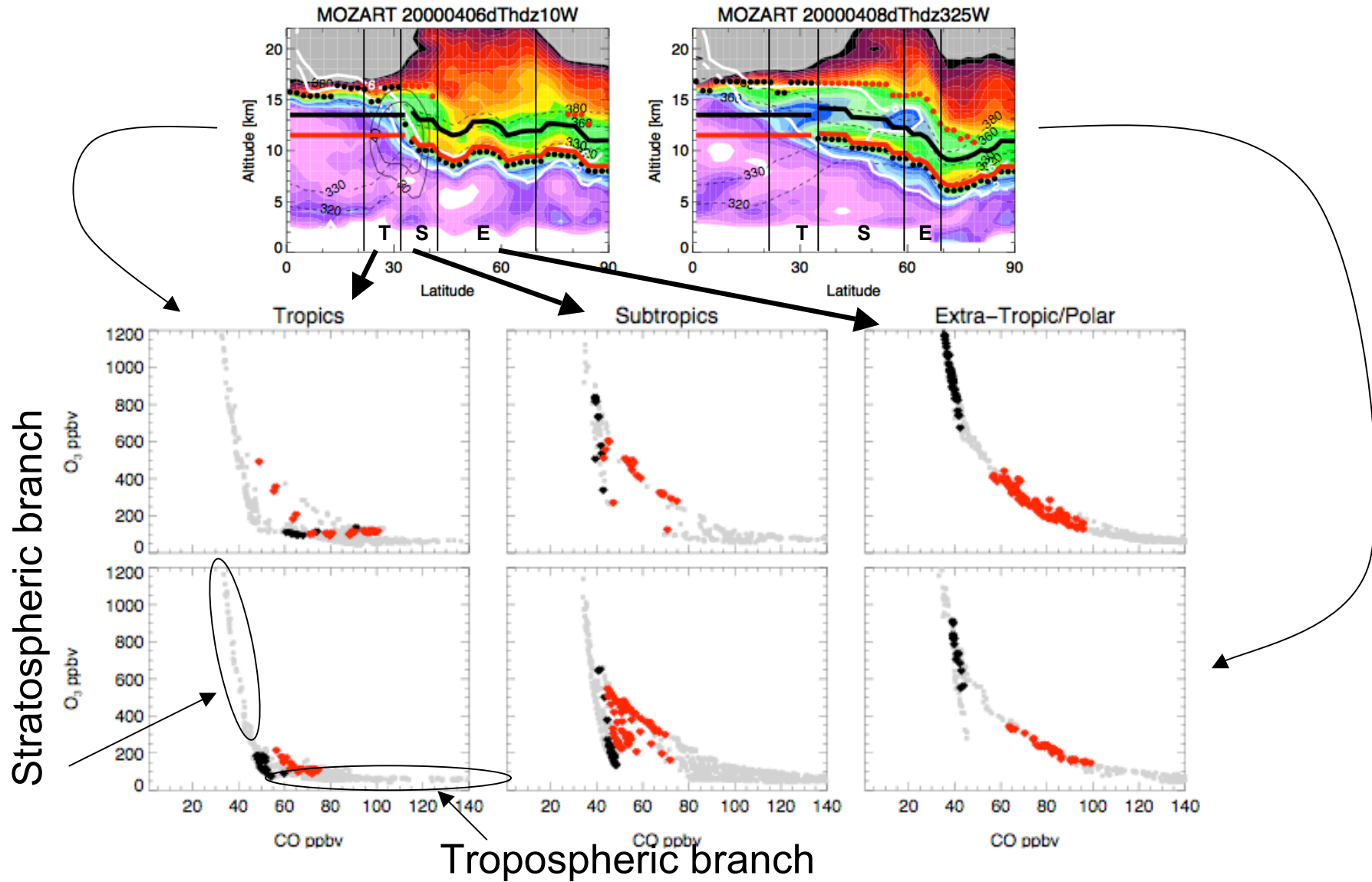
Example of a horizontal path through the region of interest

April 06, 2000. Lon. 10W

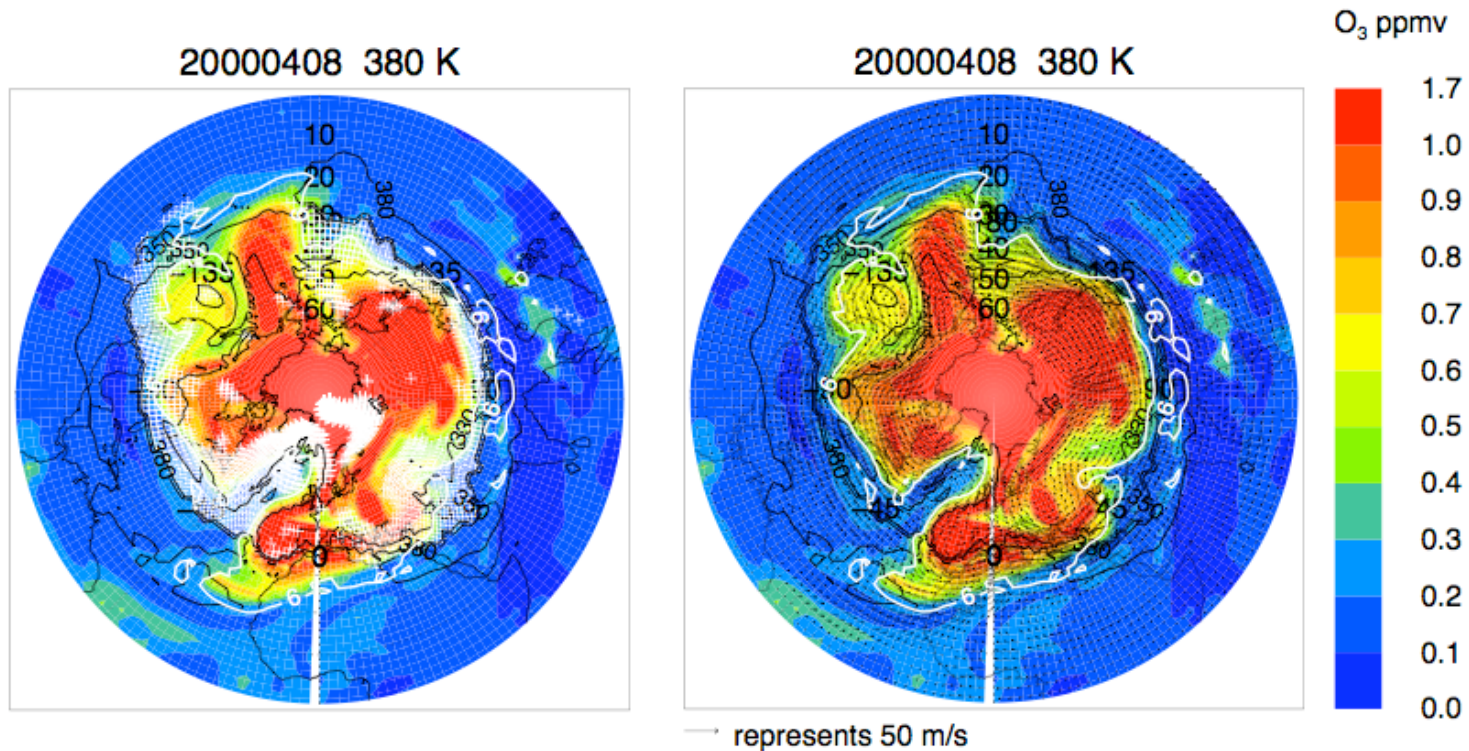
April 08, 2000. Lon. 325W



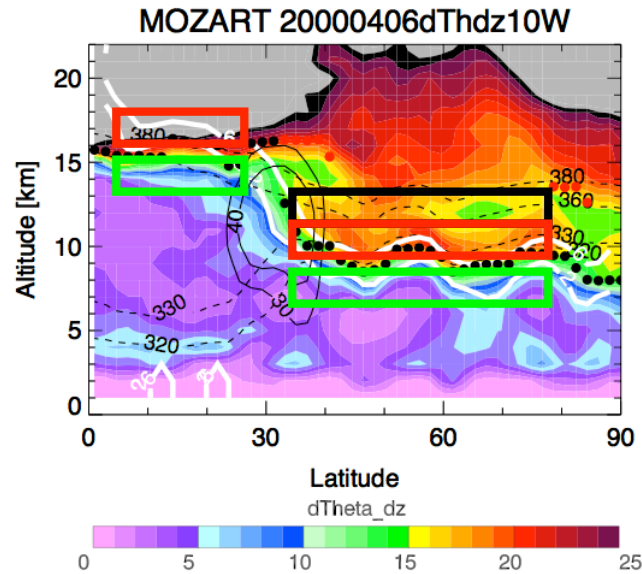
Identification of Mixing Processes using Tracer-Tracer Correlations



Model offers the possibility to examine different meteorological case statistically:
(three days in April, all longitudes)



Selection criteria for different cases:

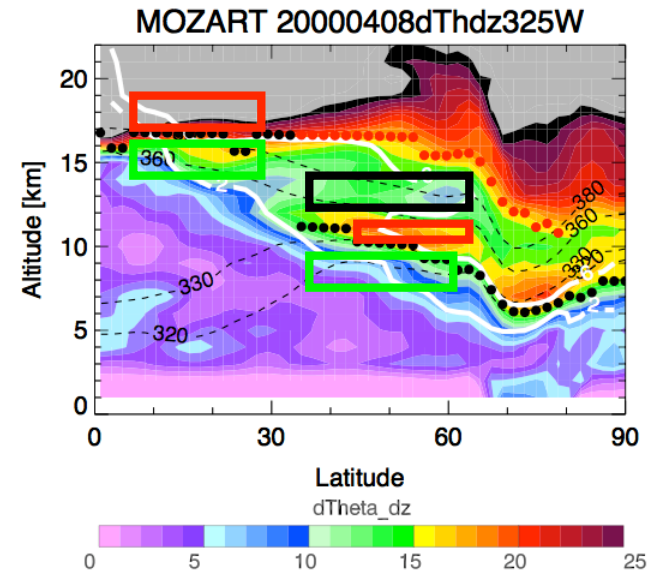


No double tropopause:

0-2 km above the Tropopause

0-2 km below the Tropopause

2-4 km above the Tropopause



Double tropopause:

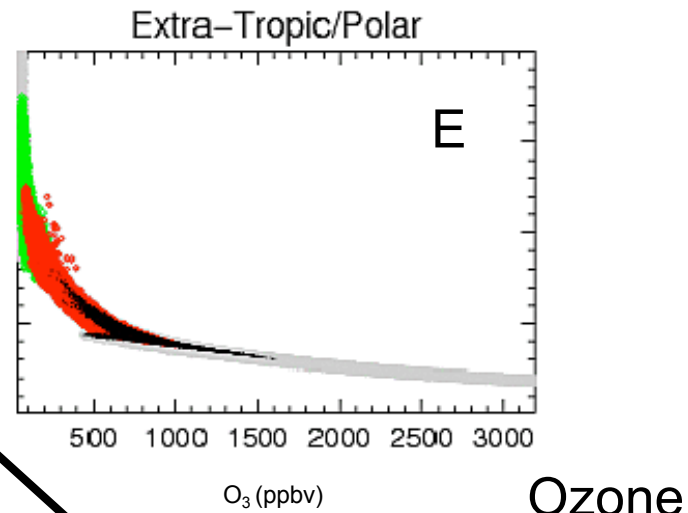
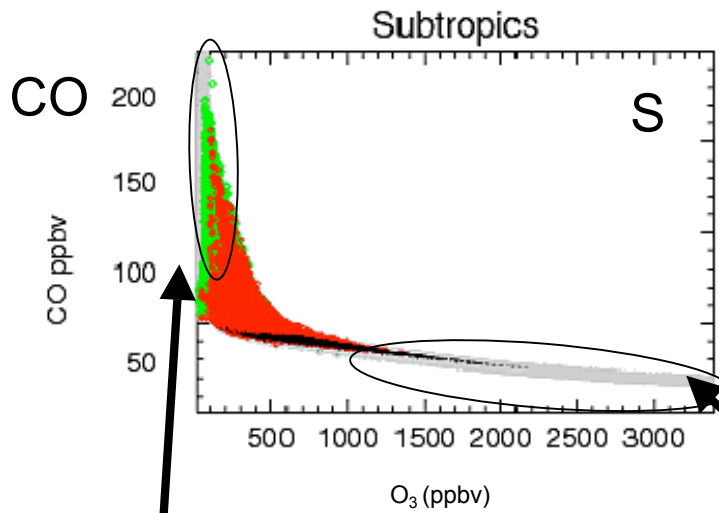
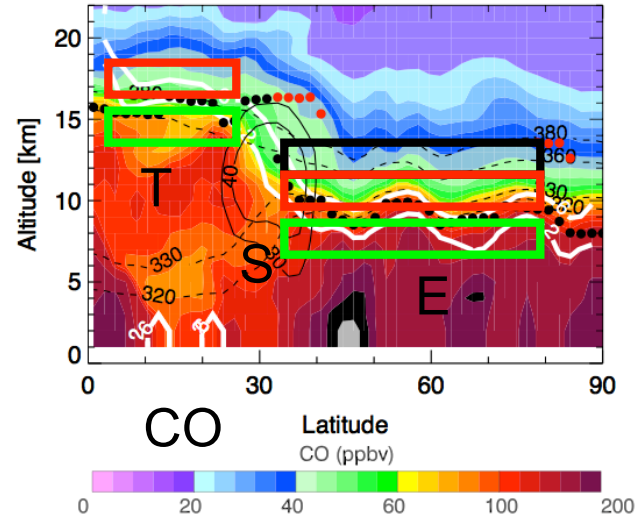
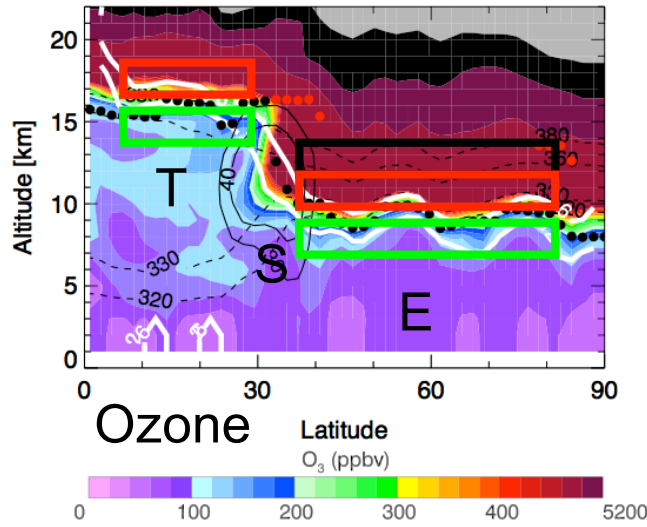
0-2 km above the Tropopause

0-2 km below the Tropopause

between 2 Tropopauses with
 $d\Theta/dz > 15$

Tracer-Tracer Correlations, different regions

No double tropopause:



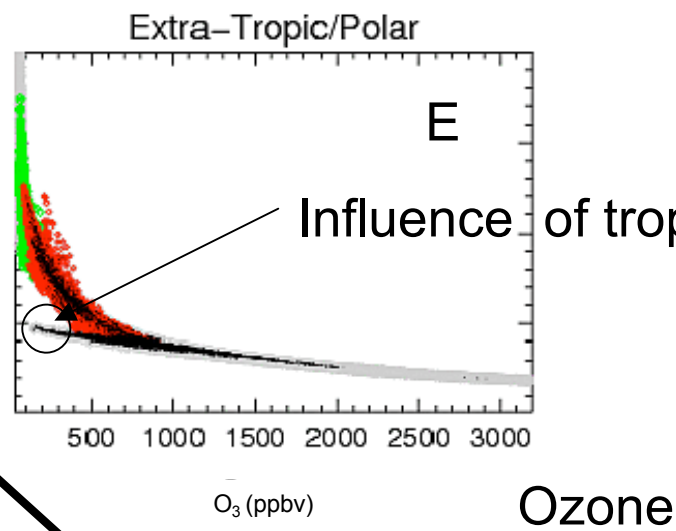
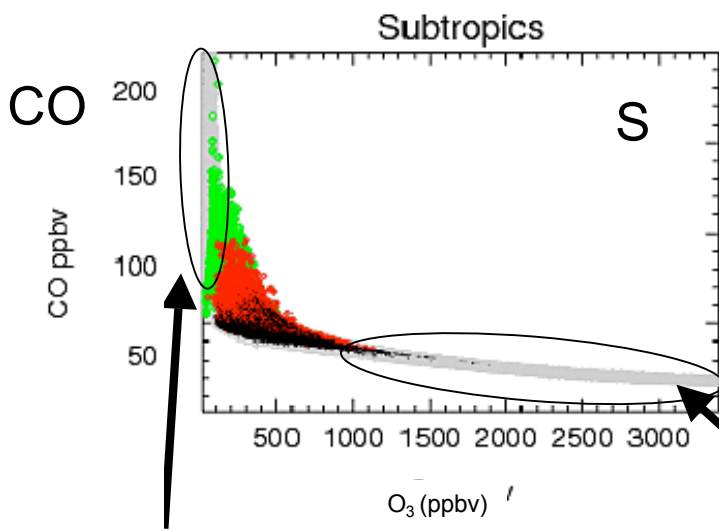
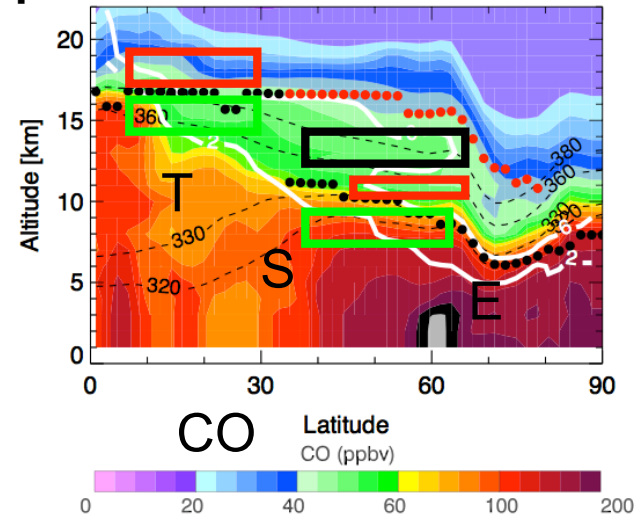
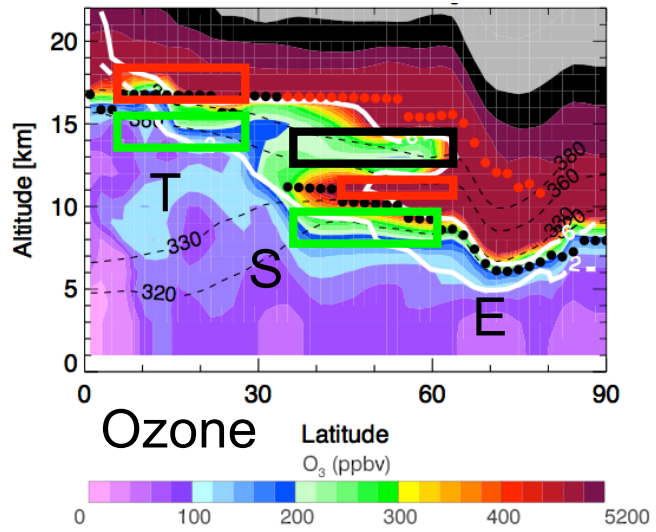
Tropospheric branch

Stratospheric branch

Ozone

Tracer-Tracer Correlations, different regions

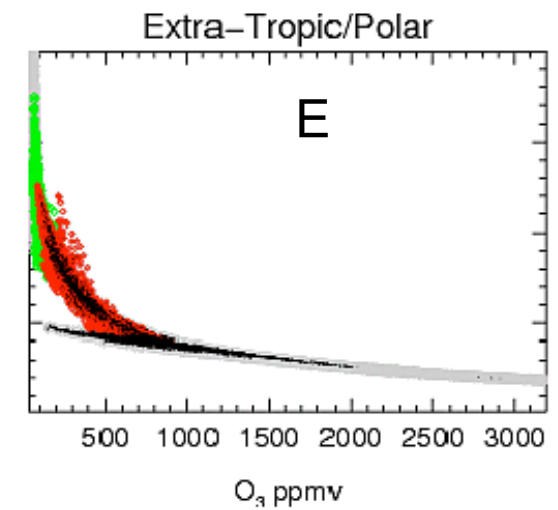
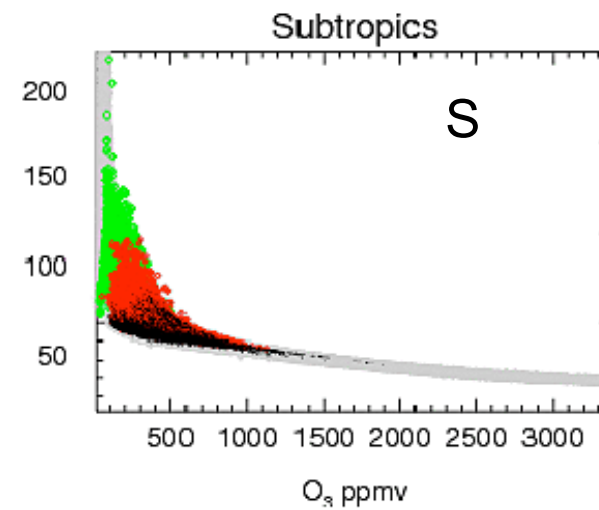
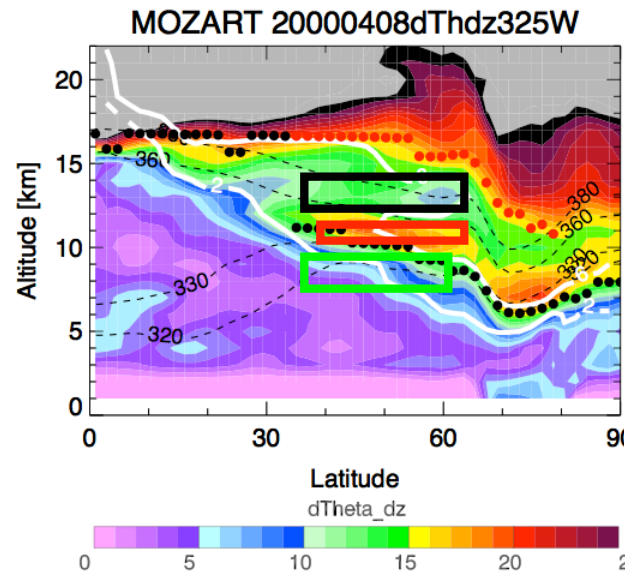
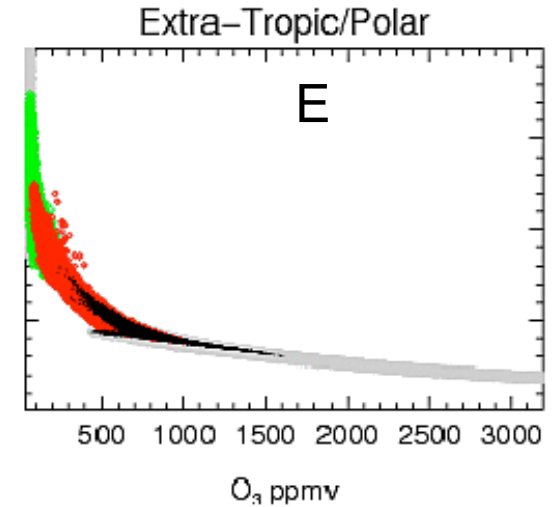
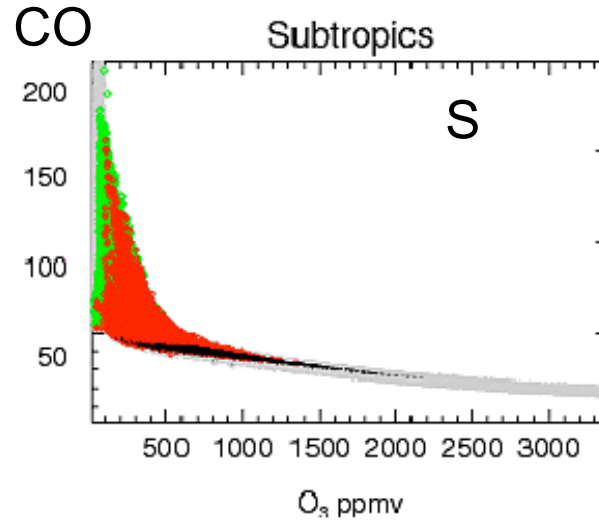
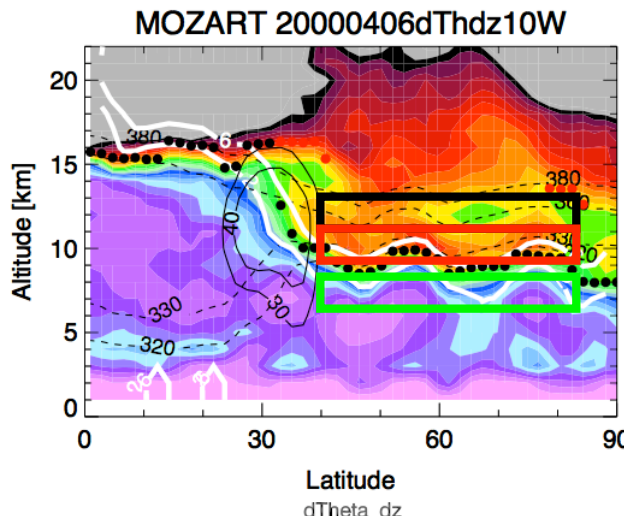
Double tropopause:



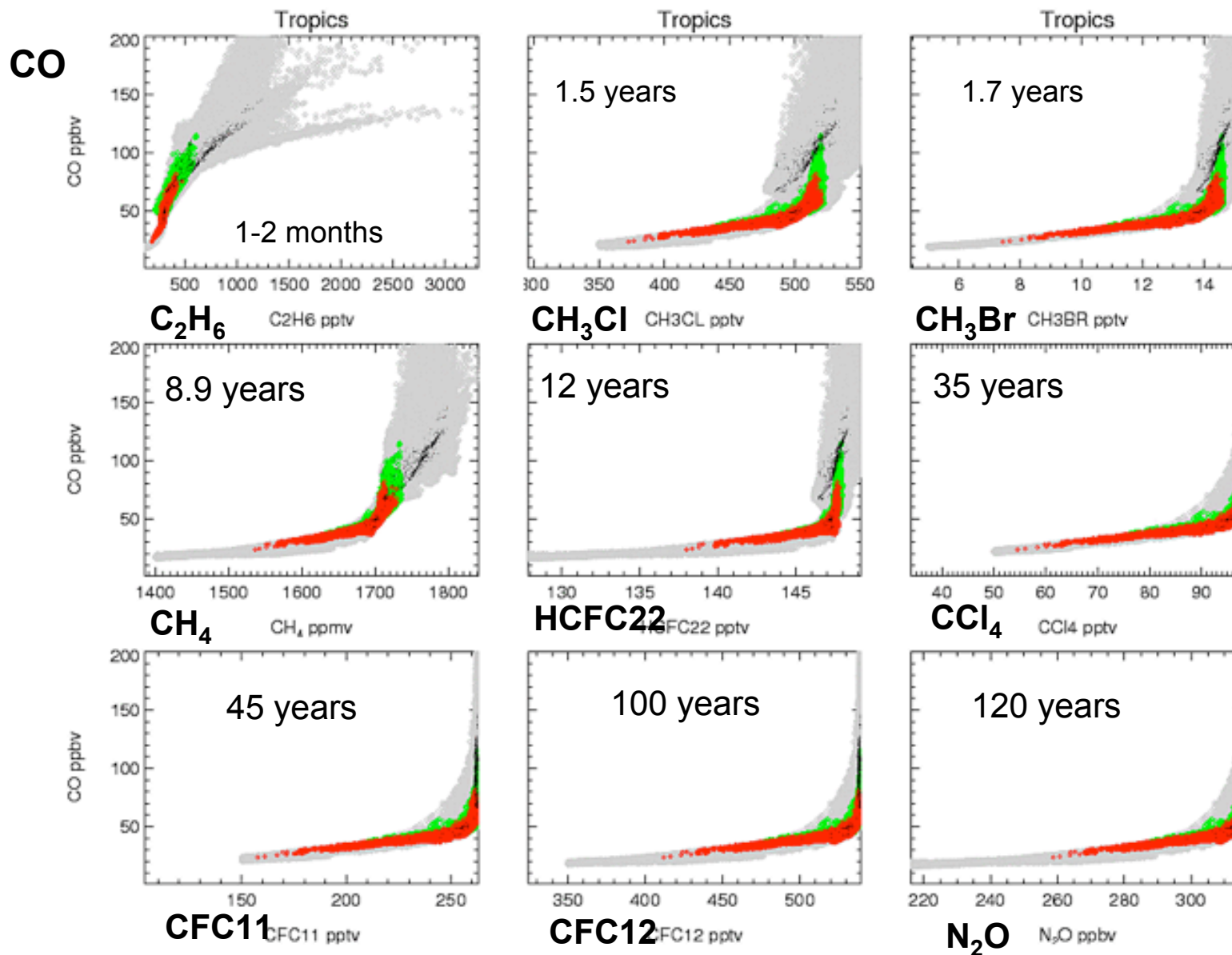
Tropospheric branch

Stratospheric branch

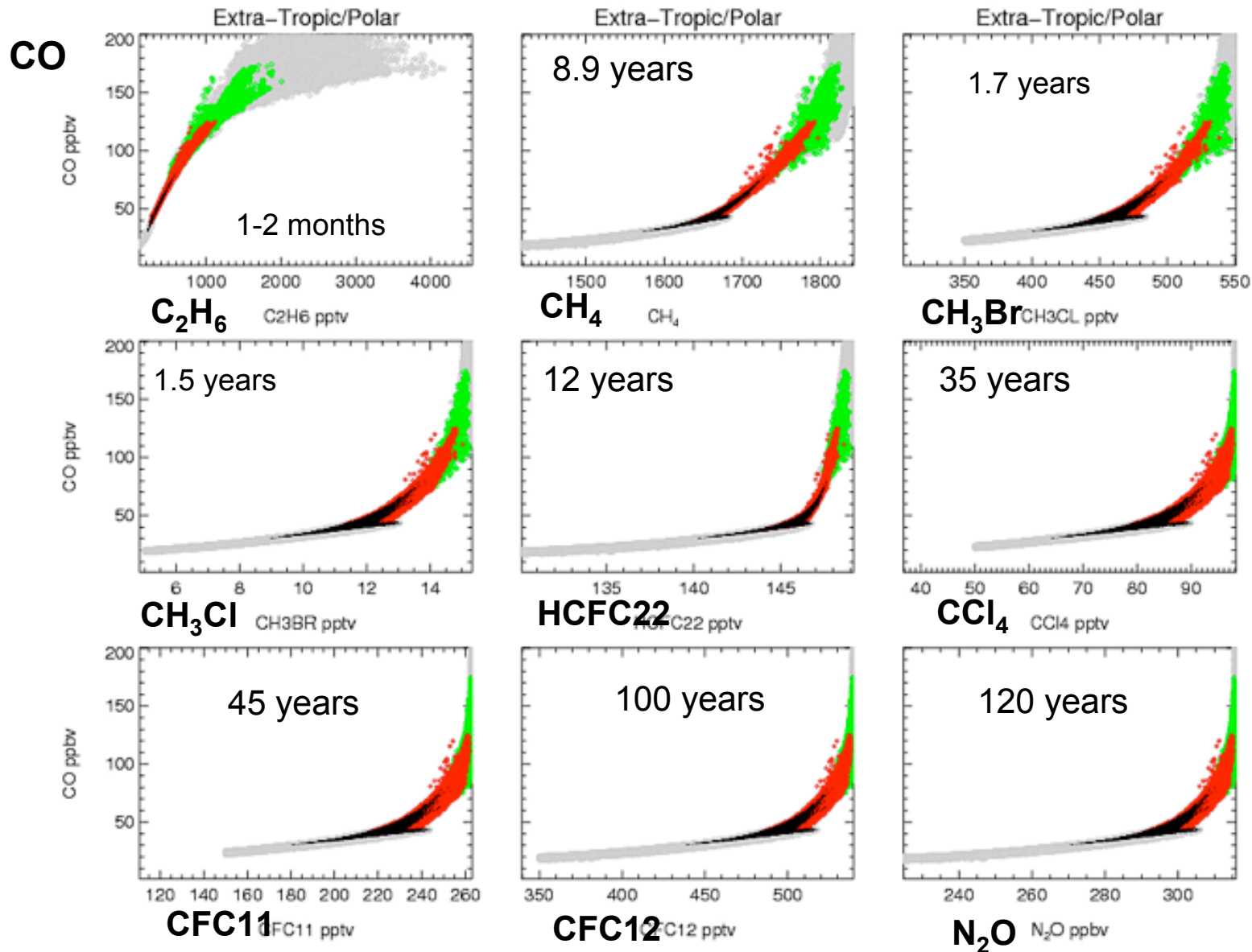
Tracer-Tracer Correlations, different regions



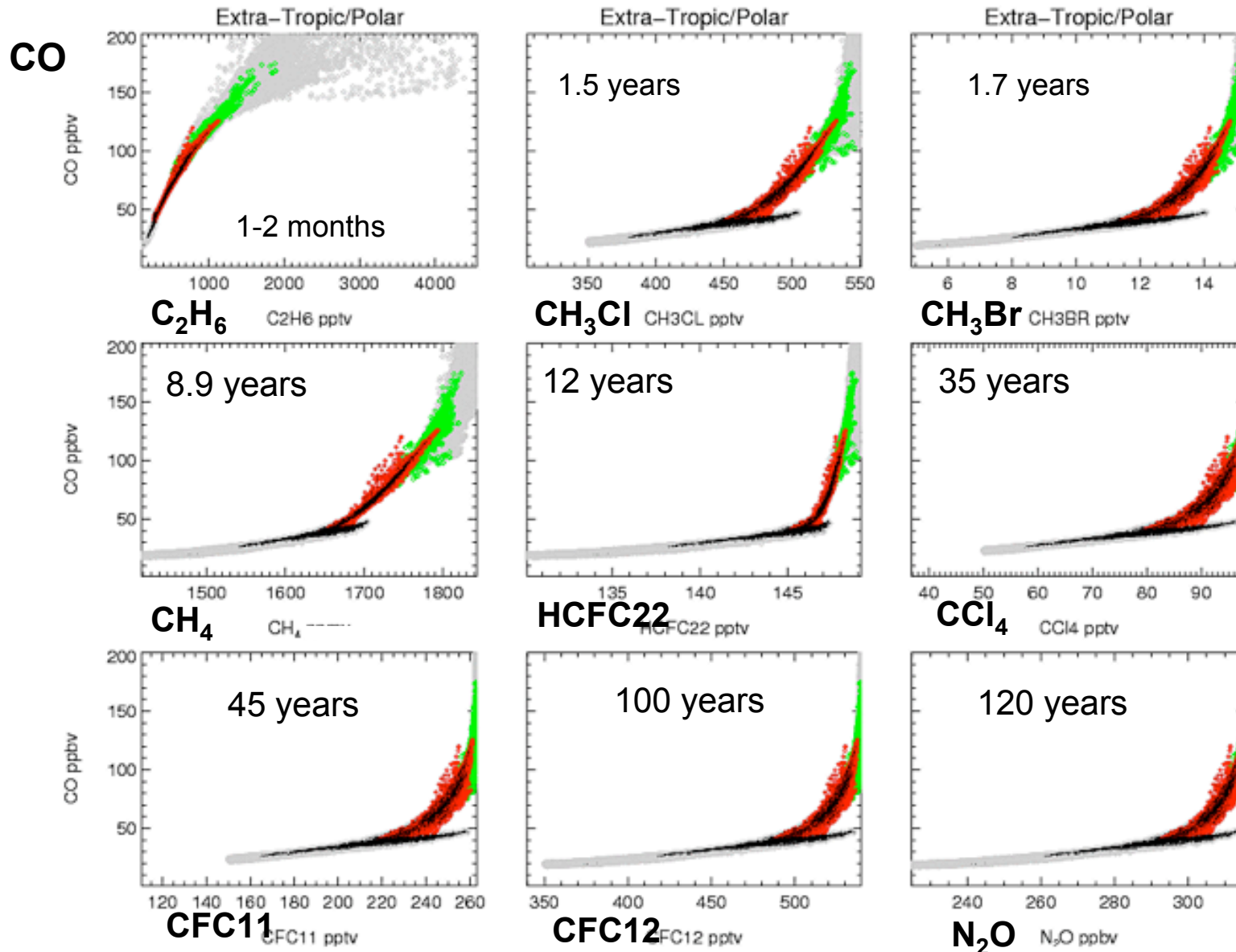
Tracer-Trace Correlations, Tropics



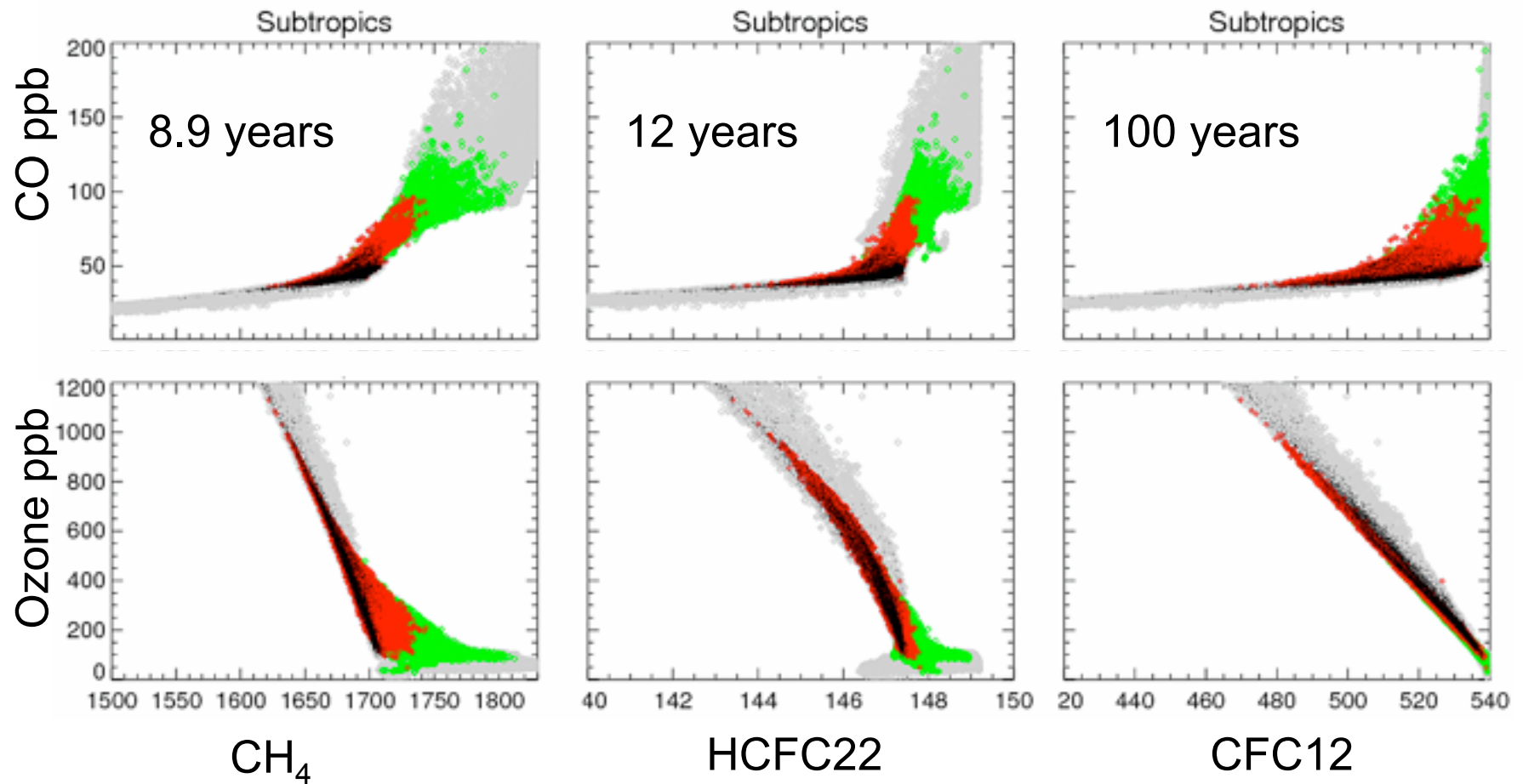
Tracer-Tracer Correlations, Extra-Tropics / Polar,



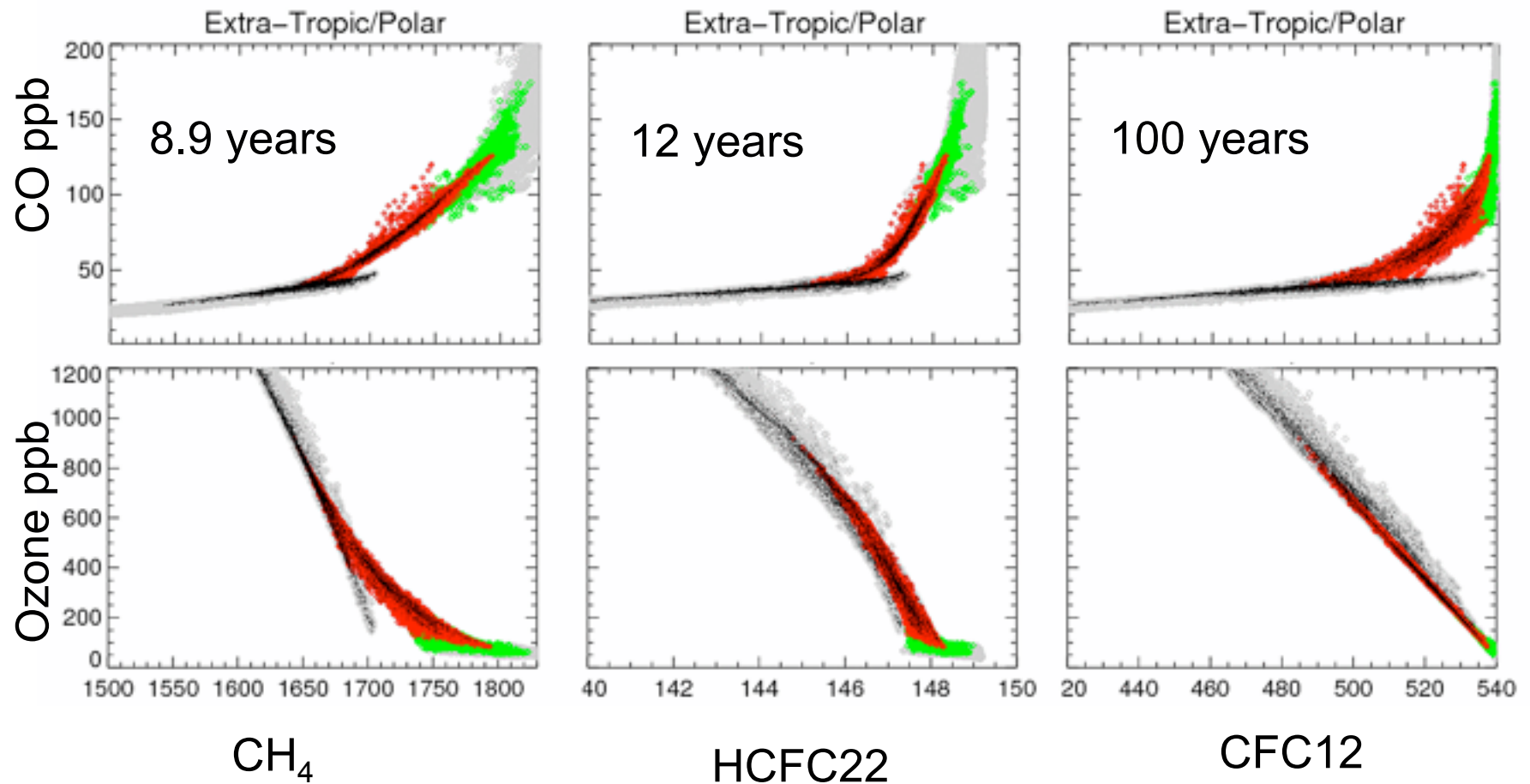
Tracer-Tracer Correlations, Extra-Tropics/Polar, Double tropopause case



Tracer-Tracer Correlations, Sub-Tropics



Tracer-Tracer Correlations, Extra-Tropics/Polar



Conclusions

Model results show:

- ❑ Tracer-tracer correlations of species with different lifetimes can help to understand mixing processes
- ❑ Tropical air masses and their composition can be identified using tracer-tracer correlations.
- ❑ Thickness of the transition layer are identified using tracers with tropospheric gradient
- ❑ Observations will use to detect uncertainties of the model