Intercomparison of two state-of-the-art models: MOZART-3.1 and GMI Combo in the UT/LS

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Models:

MOZART3.1/WACCM3 on 2.5° (longitude) × 1.89° (latitude) with 60 vertical levels (0-100 km) for the 1999 atmosphere

GMI Combo/FVGCM for the 1998 atmosphere

Measurements:

Aircraft-based data: ACE1, CARIBIC, NOXAR1, NOXAR2, POLARIS, POLINAT1, POLINAT2, SONEX, SPURT, STRAT, STREAM93~98, SUCCESS, TOTE/VOTE and MOZAIC campaigns

Satellite-based data: MIPAS/ENVISAT and MLS/AURA data

Data sets are downloaded from ETHmeg and Autochem websites

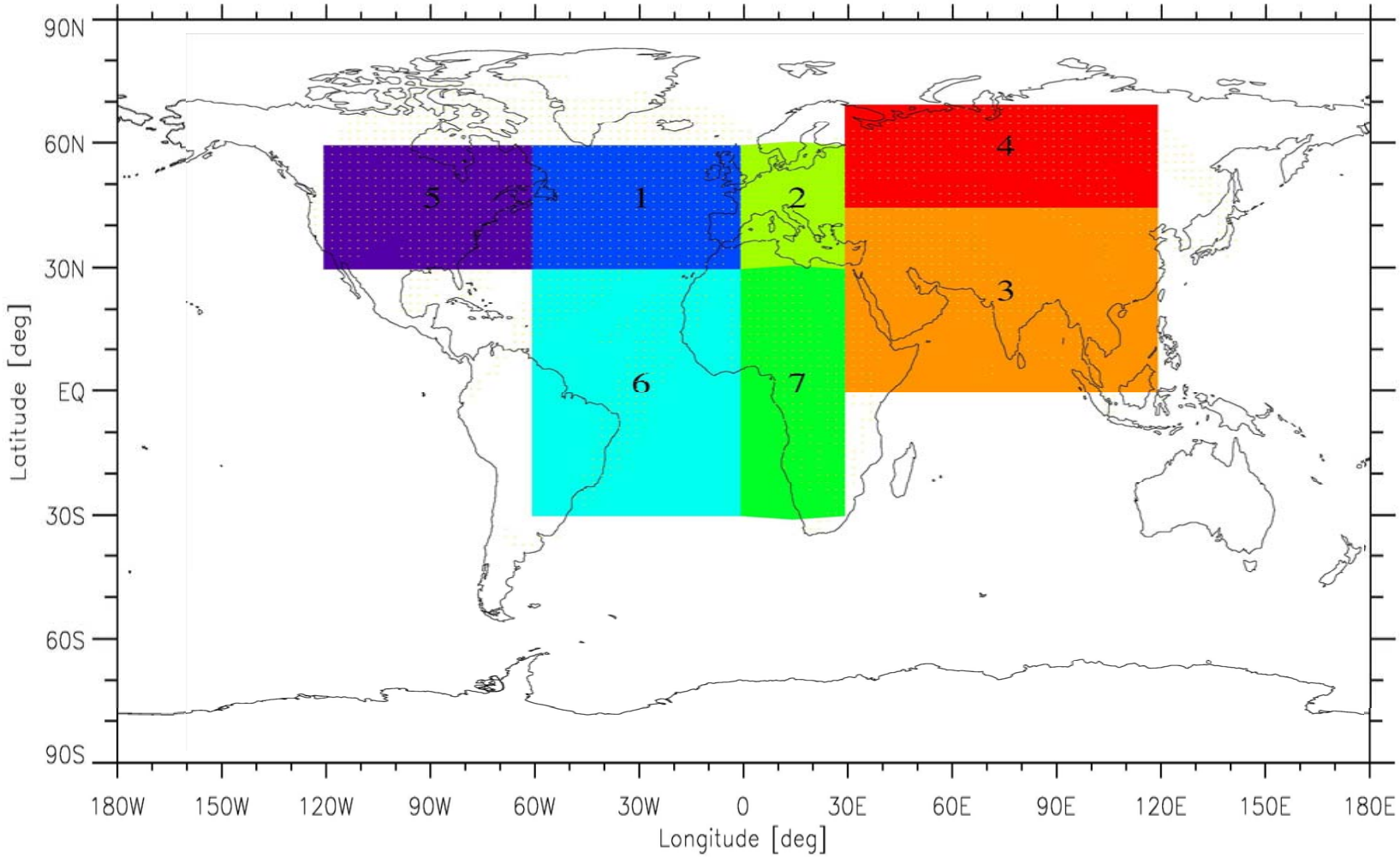
The two models are being compared with the observations in the region of UT/LS

Overview of aircraft data provided by ETHmeg

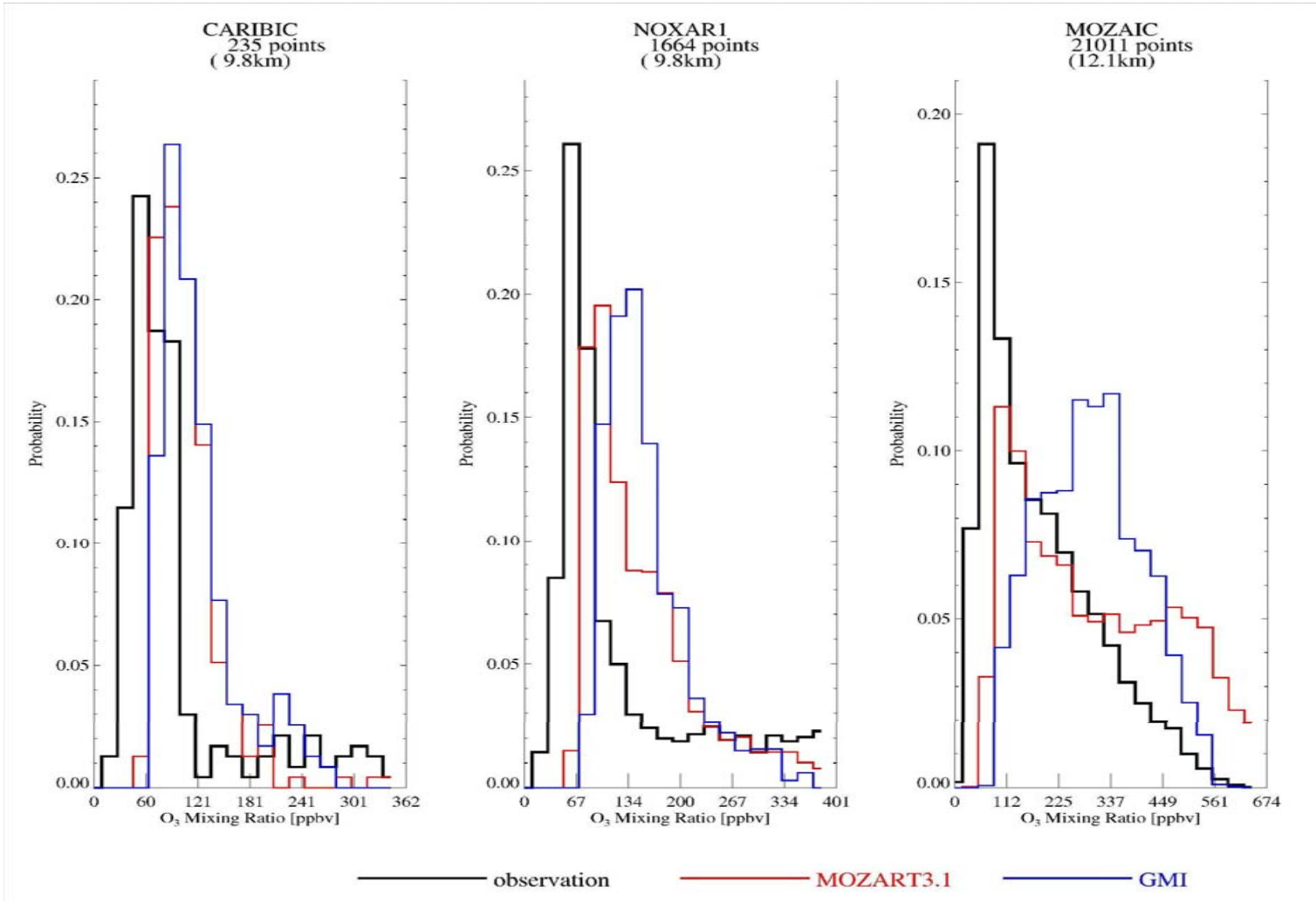
Table. An overview of aircraft campaigns and trace gases in the ETHmeg website (A: available, NA: not available).

Campaign	Period	O_3	CO	H_2O	OH	H_2O_2	HO_2	CH_4	NO	NO_x	NO_2	N_2O	NO_y	HNO_3
ACE1	95/11~95/12	A	A	A	A	A	NA	NA	A	NA	NA	NA	NA	NA
ACE2_ARAT	97/07~97/07	A	NA	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ACE2_C130	97/06~97/07	A	A	NA	NA	A	NA	NA	NA	NA	NA	NA	NA	NA
CARIBIC	97/11~02/04	A	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NOXAR1	95/05~96/05	A	NA	NA	NA	NA	NA	NA	A	A	NA	NA	NA	NA
NOXAR2	97/08~97/11	A	NA	NA	NA	NA	NA	NA	A	A	NA	NA	NA	NA
PEMTROP A_SOUND	95/01~97/12	A	NA	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POLARIS	97/04~97/09	A	A	A	A	NA	A	A	A	NA	A	A	A	NA
POLINAT1	95/06~95/07	A	NA	A	NA	NA	NA	NA	A	NA	NA	NA	NA	A
POLINAT2	97/09~97/10	A	A	A	NA	NA	NA	NA	A	A	NA	NA	A	A
SONEX	97/10~97/11	A	A	A	A	A	A	NA	A	NA	NA	NA	A	A
SPURT	01/11~03/07	A	A	A	NA	NA	NA	A	A	NA	NA	NA	A	NA
STRAT	95/05~96/12	A	A	A	A	NA	A	A	A	NA	NA	A	A	NA
STREAM93	93/02~93/02	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	A	NA	A
STREAM94	94/07~94/07	A	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	A
STREAM95	05/02~95/12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	A
STREAM96	96/05~96/06	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	A
STREAM97	97/03~97/03	NA	A	A	NA	NA	NA	NA	NA	NA	NA	NA	A	A
STREAM98	98/06~98/07	A	A	A	NA	NA	NA	NA	A	NA	NA	NA	A	A
SUCCESS	96/04~96/05	A	A	A	A	NA	A	NA	A	NA	NA	A	A	NA
TOTEVOTE	95/12~96/02	A	A	A	NA	NA	NA	NA	A	NA	NA	A	A	NA

Comparison with aircraft data including MOZAIC:
Point-by-point comparison in the seven regions

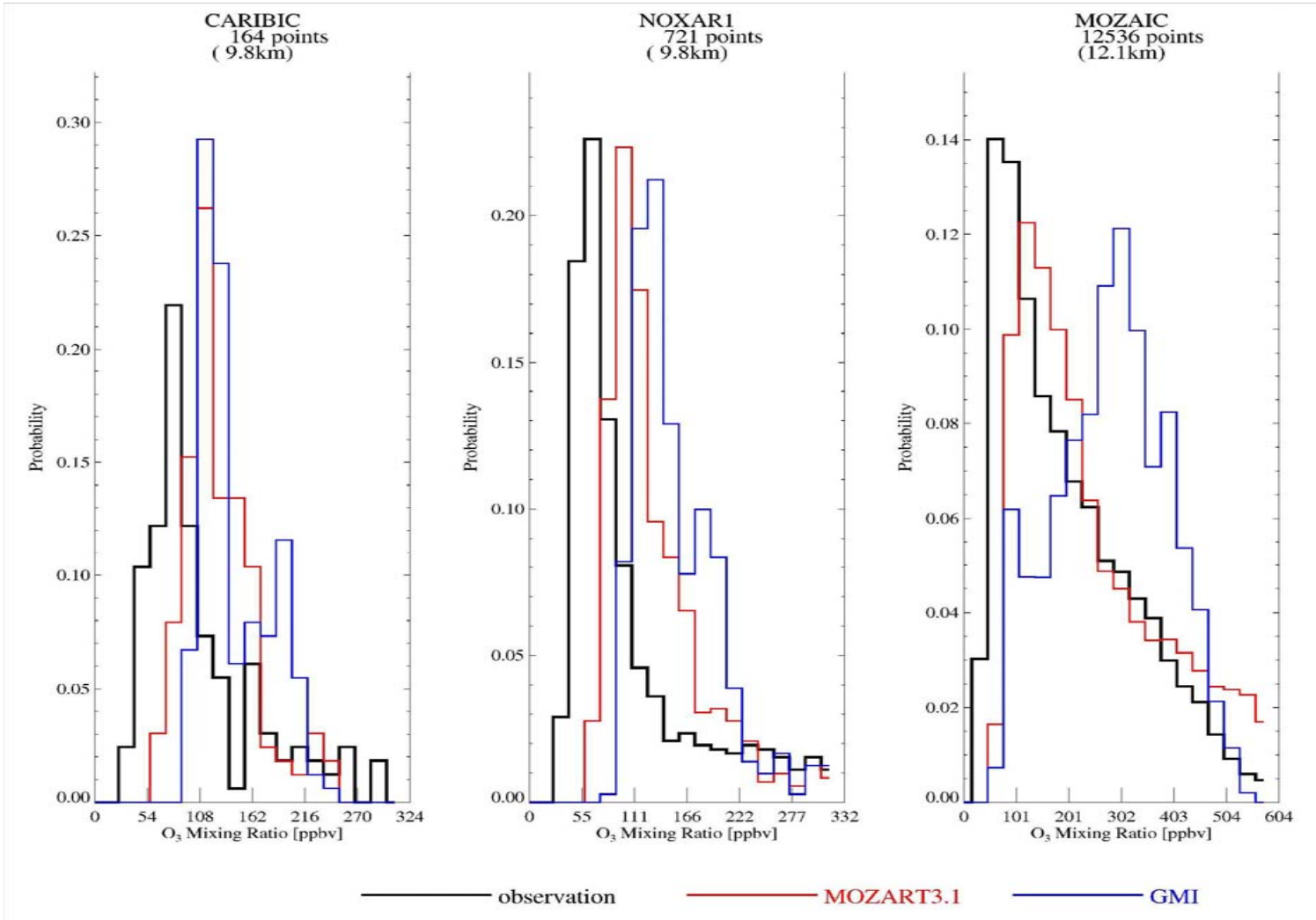


O_3 probabilities over region 1



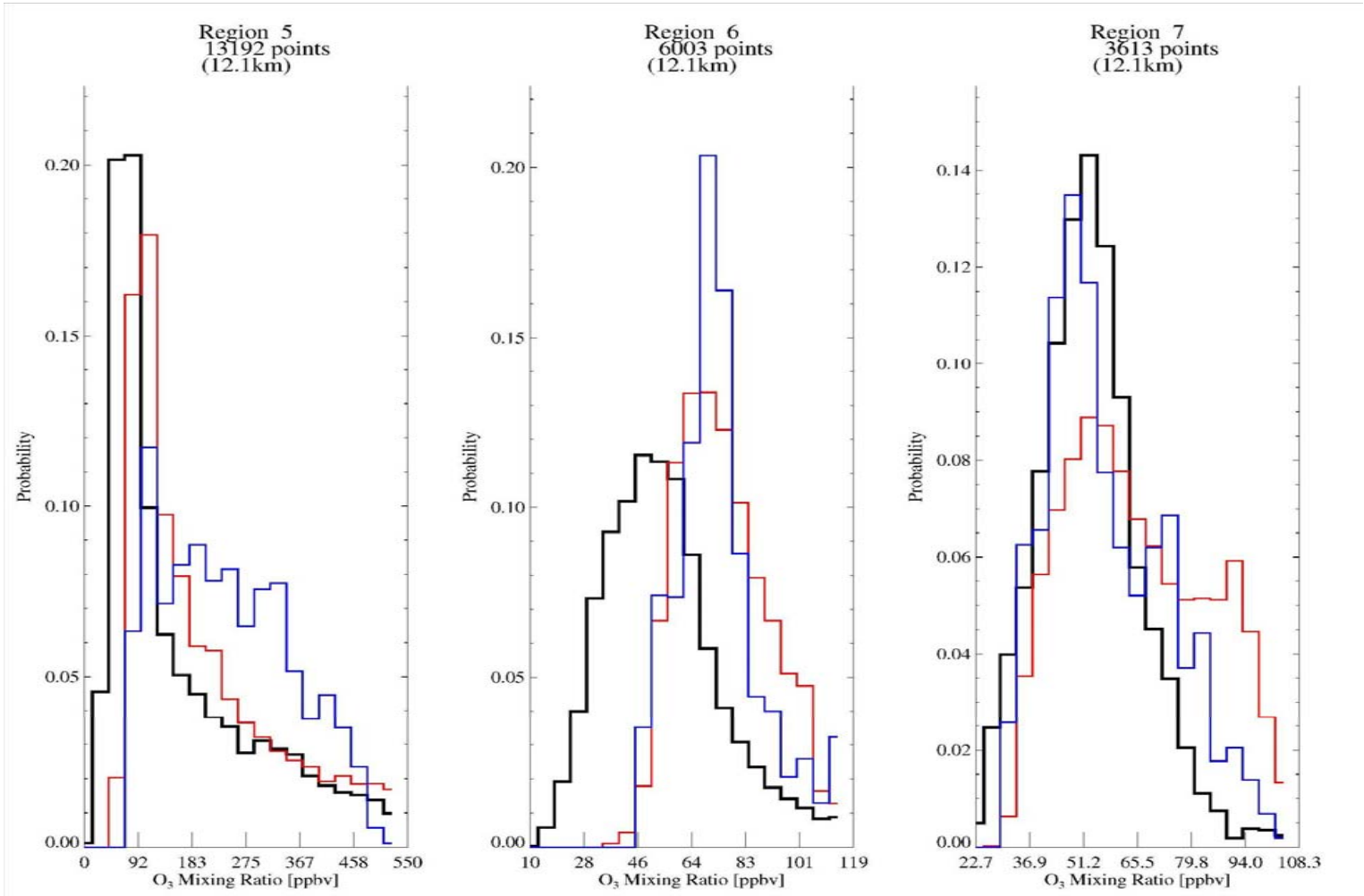
O_3 at cruising levels during JJA above the North Atlantic Ocean

O_3 probabilities over region 2



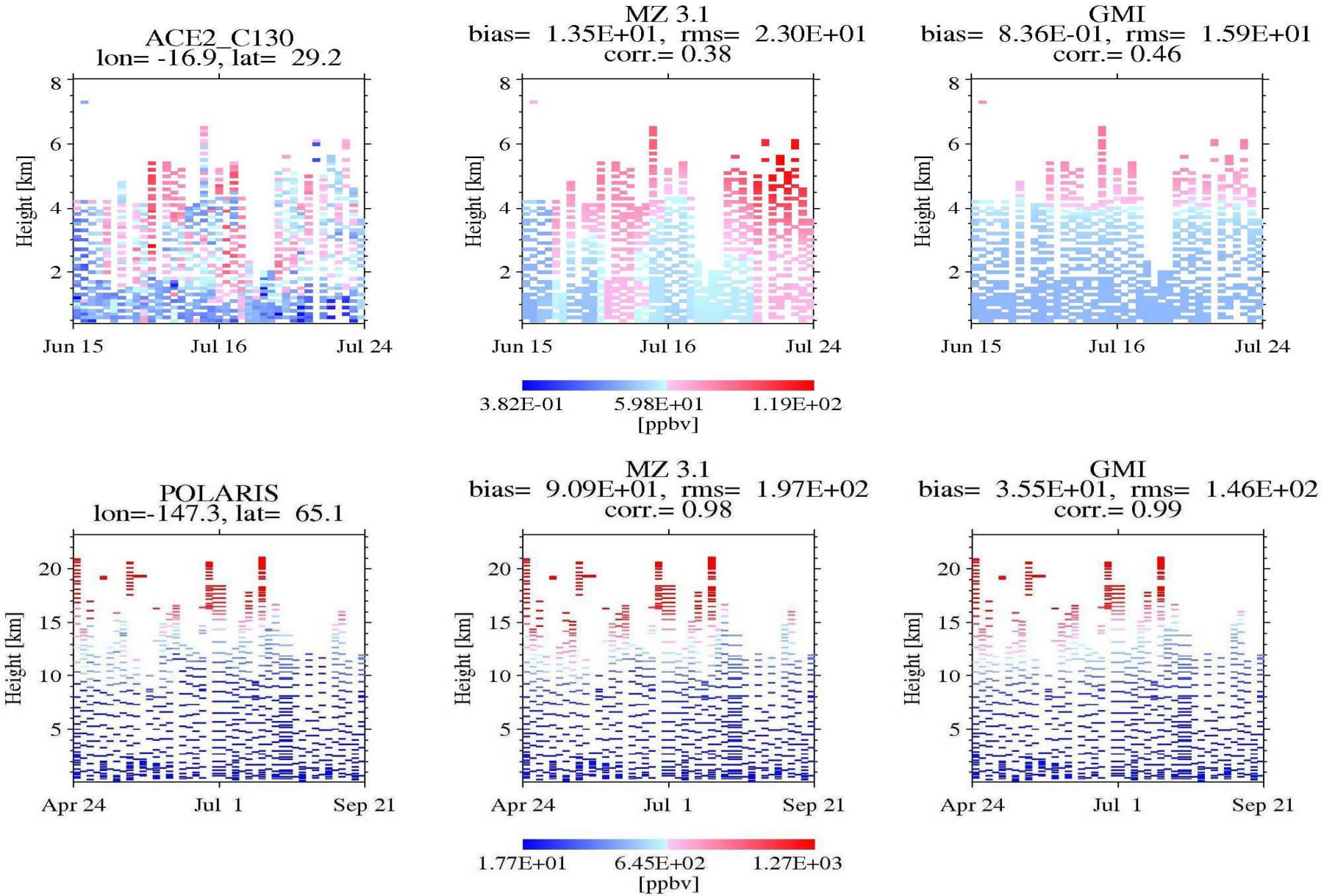
O_3 at cruising levels during JJA above the Europe

O_3 probabilities over regions 5-7

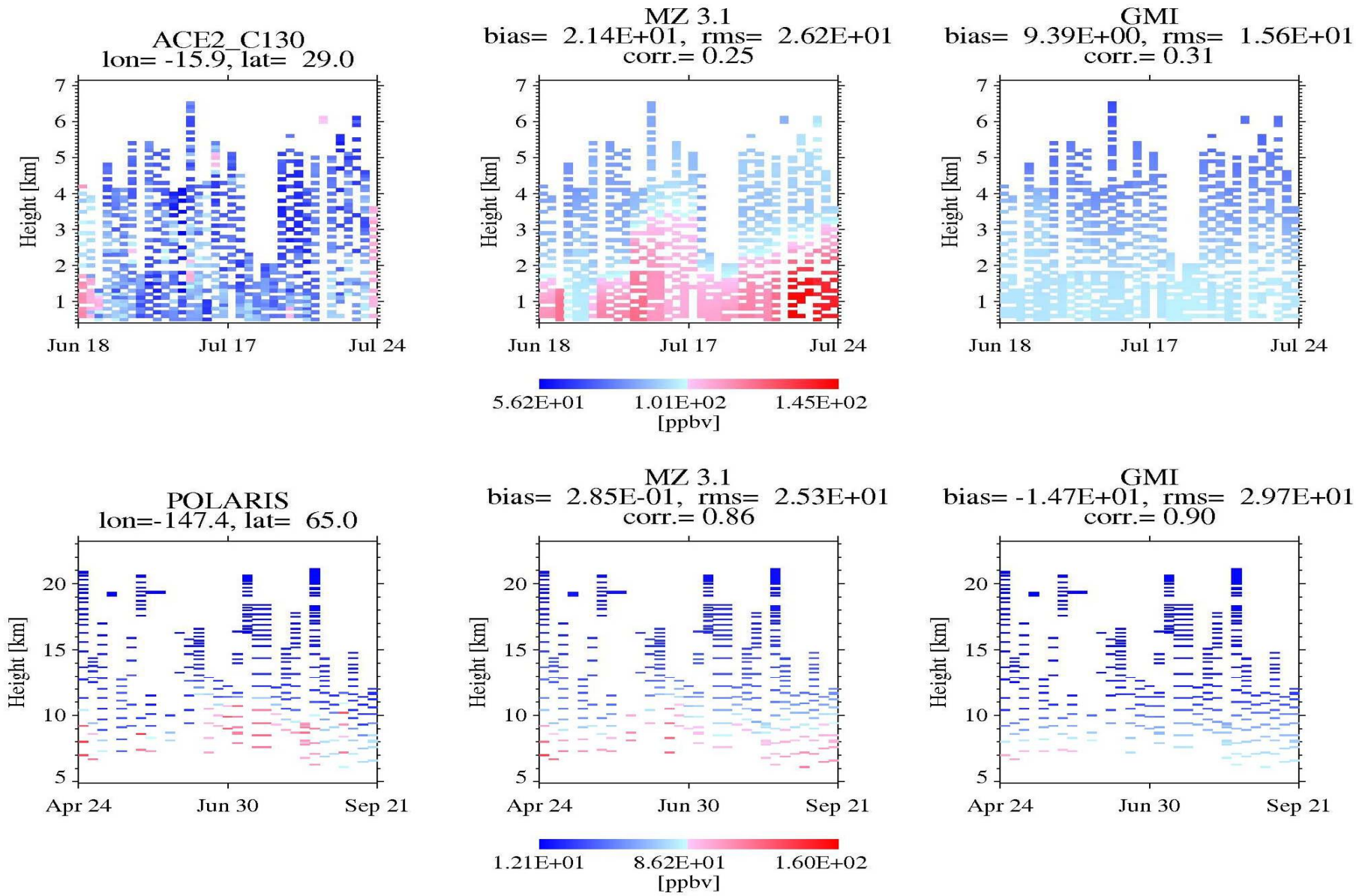


O_3 at cruising levels during JJA above the North America, equatorial Atlantic, Africa

Timeseries of O_3 vertical profile

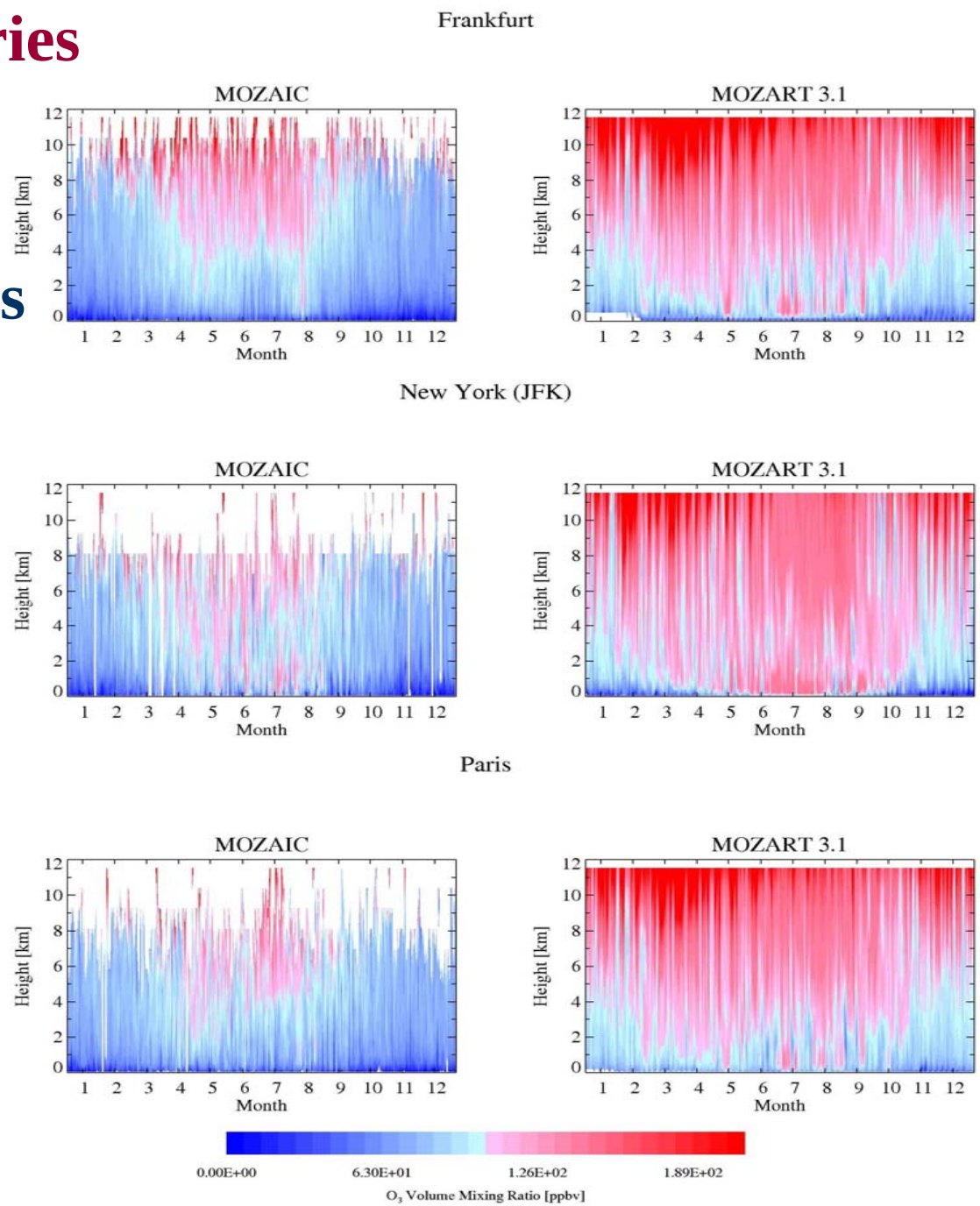


Timeseries of CO vertical profile



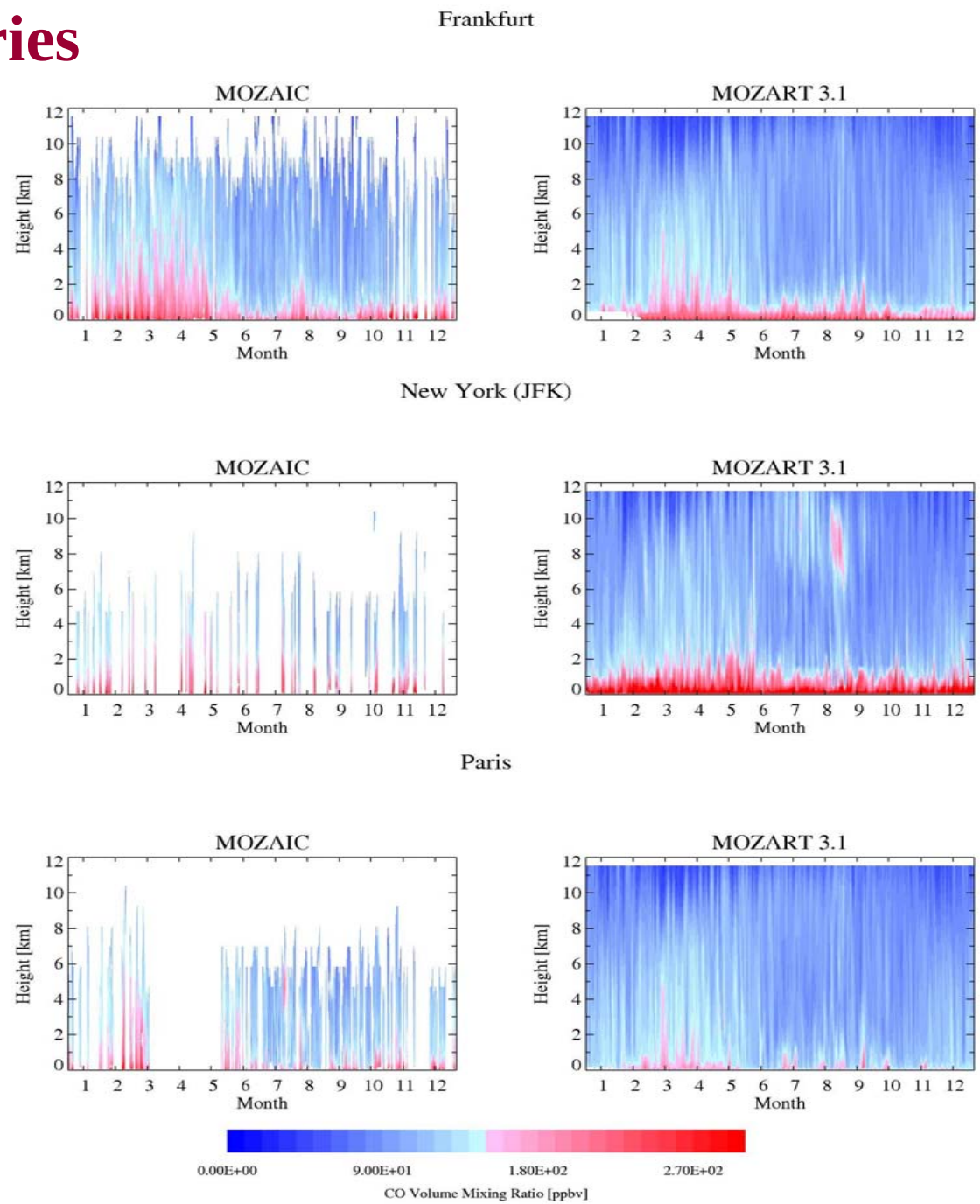
MOZAIC Timeseries

Daily O3 above three airports

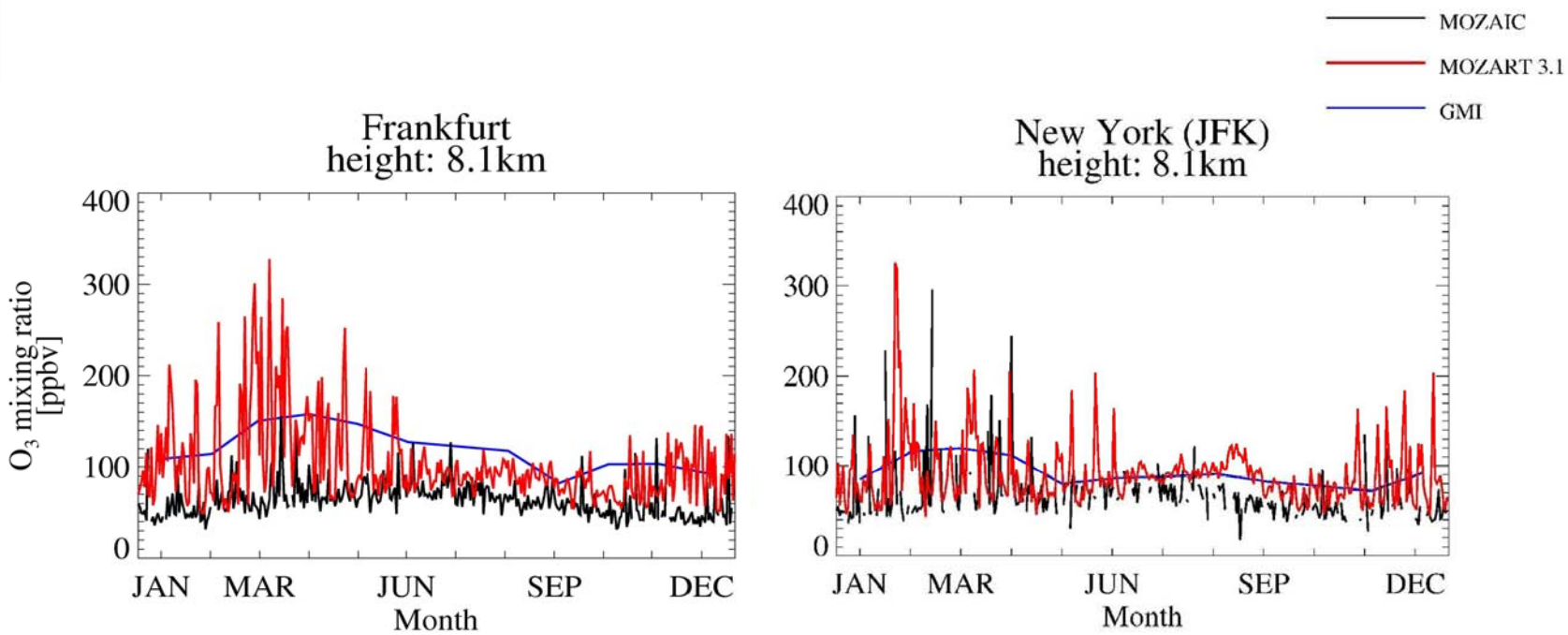


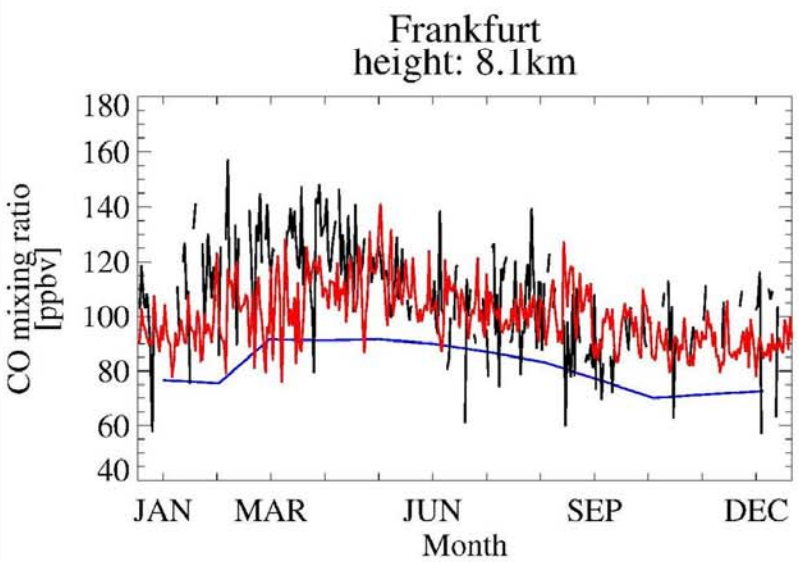
MOZAIC Timeseries

Daily CO above three airports



MOZAIC Timeseries

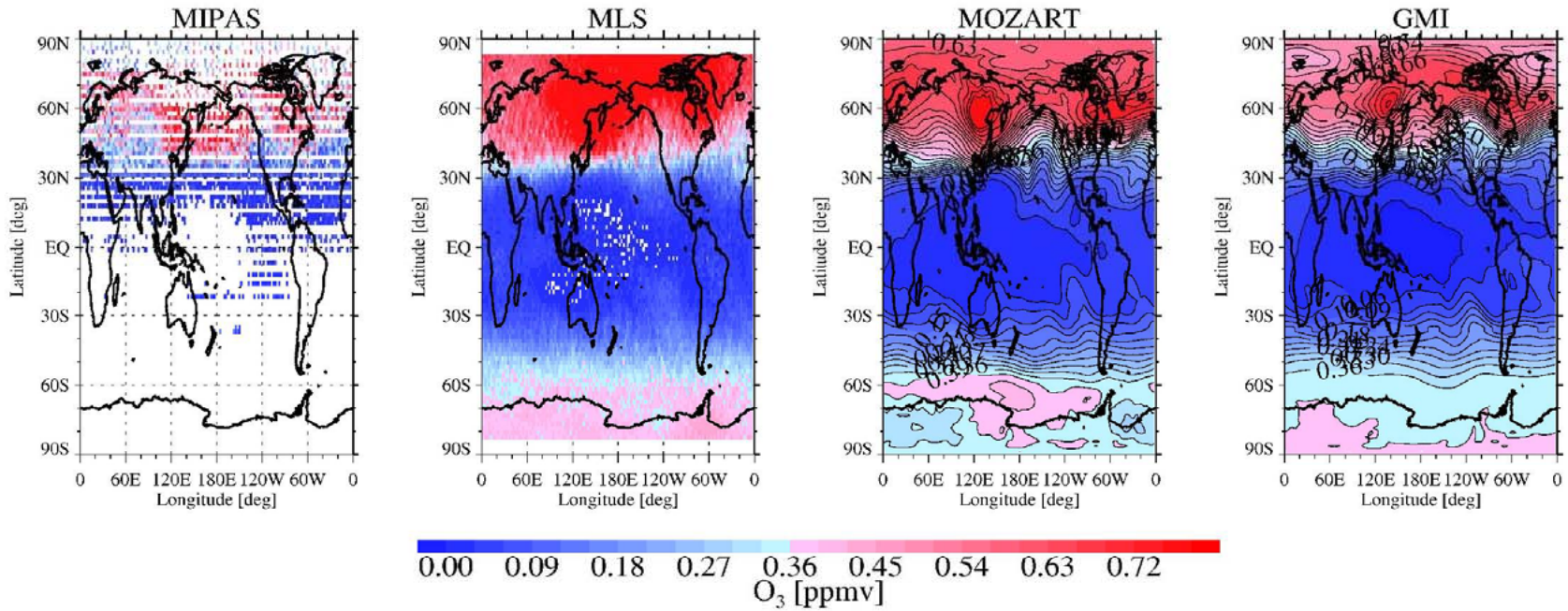




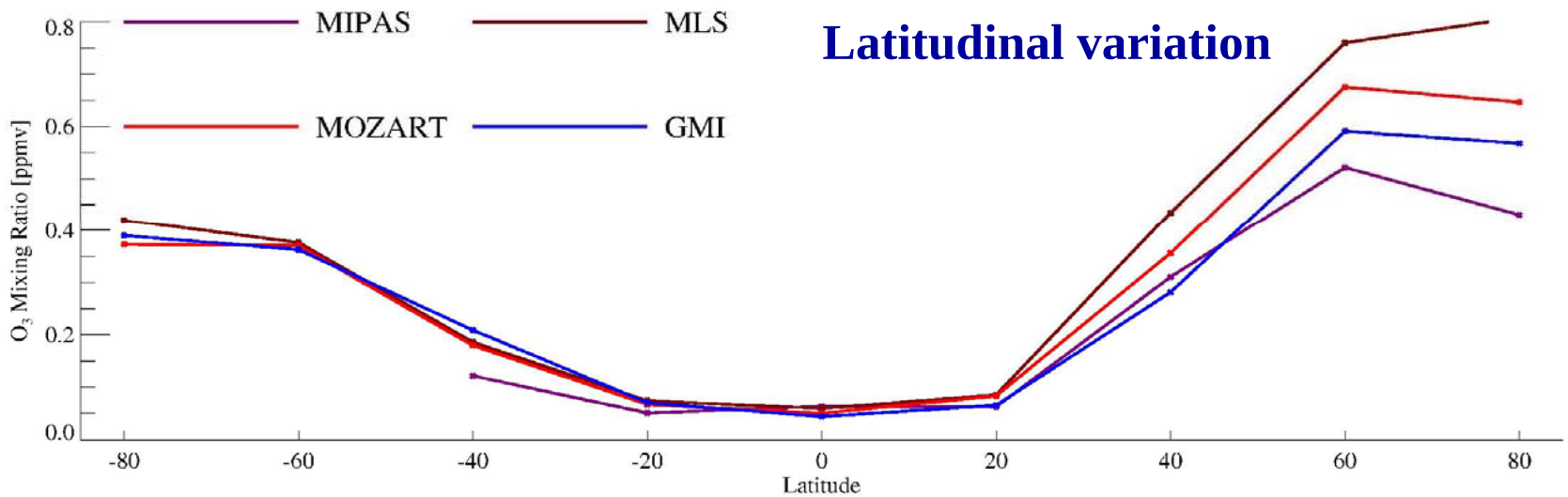
O_3 and CO time series above New York and Frankfurt

Comparison with satellite data

Horizontal distribution of O_3 in January on 139 hPa

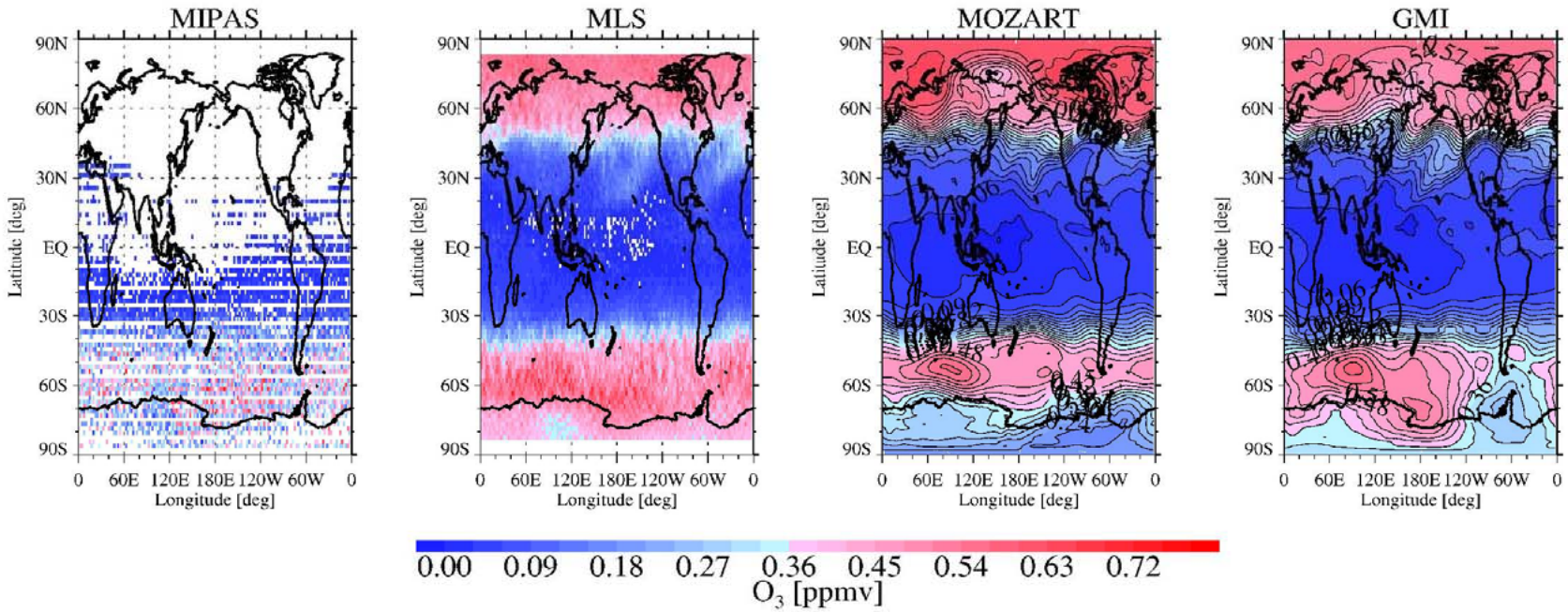


Latitudinal variation

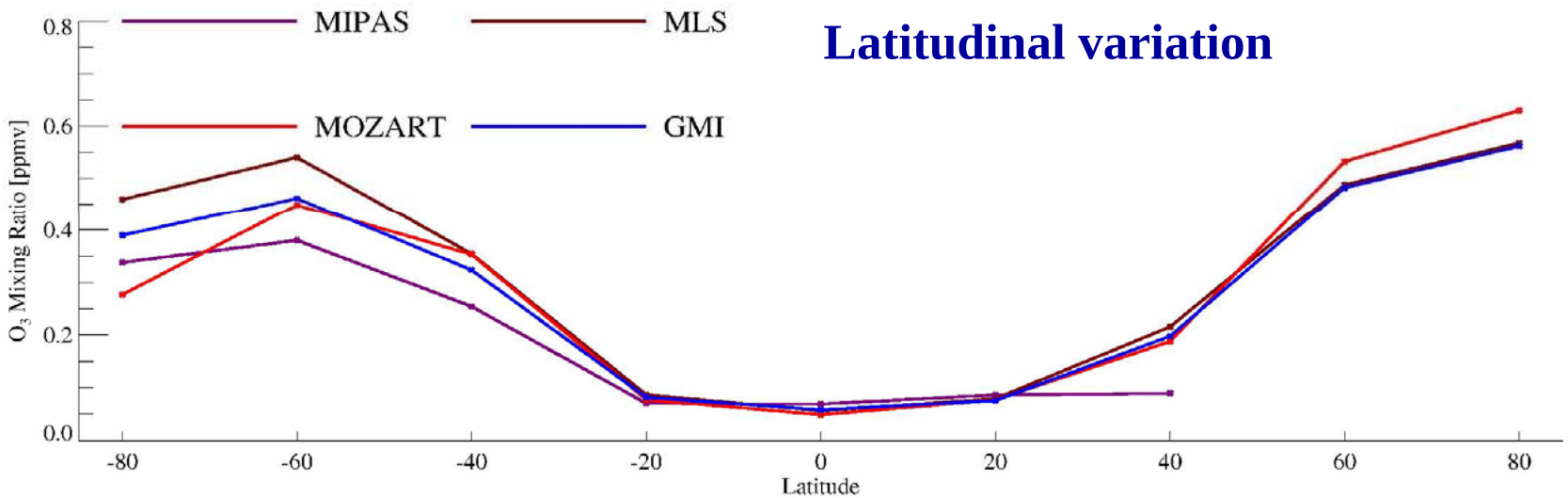


Comparison with satellite data

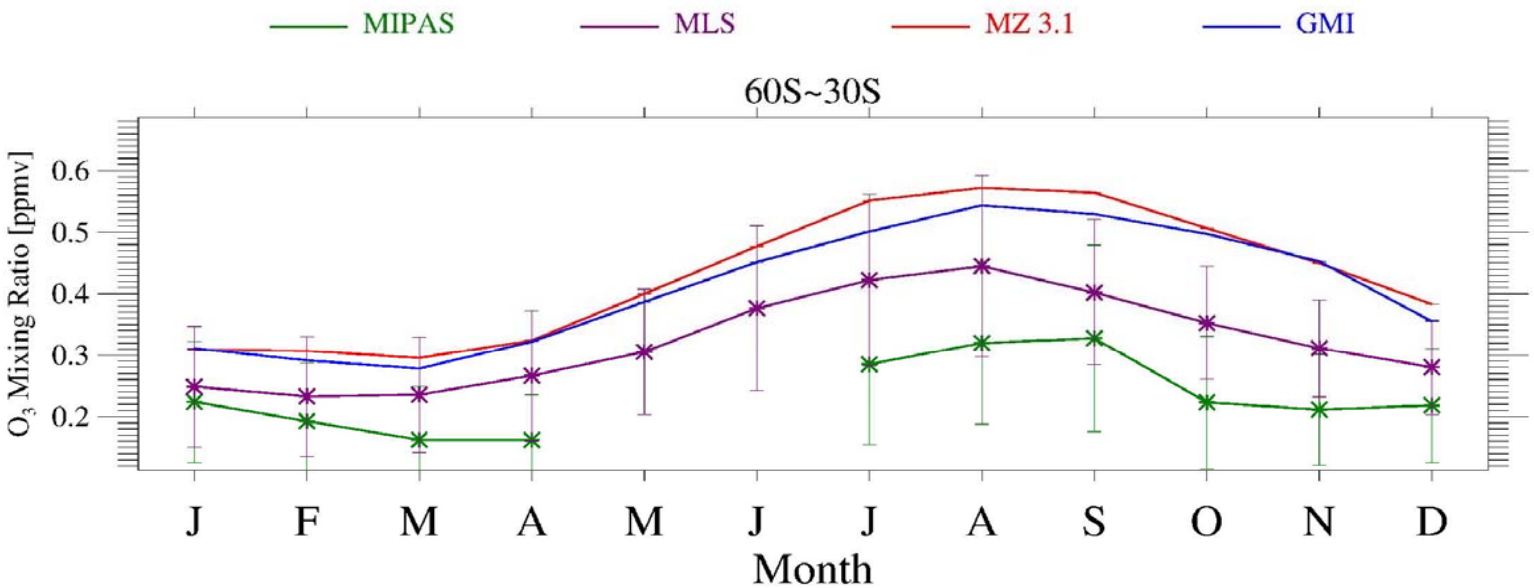
Horizontal distribution of O_3 in July on 139 hPa

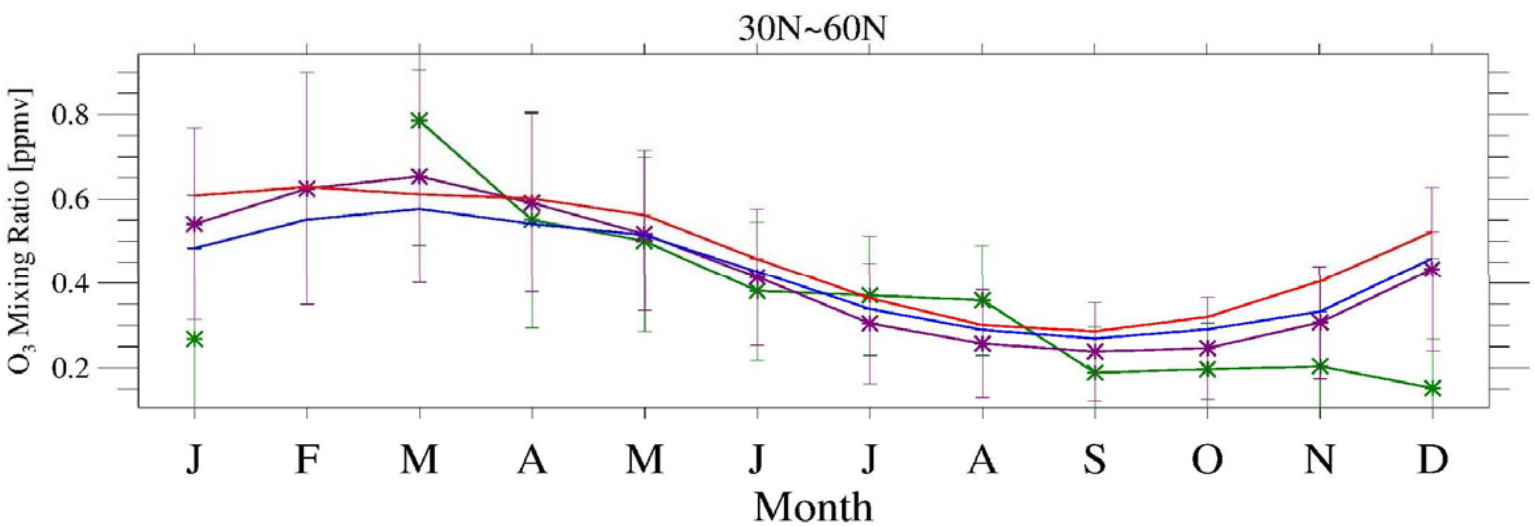


Latitudinal variation



Seasonal cycle of O_3





Summary and plan

- **Point-by-point comparisons of the two global CTM outputs with aircraft observations in the UT/LS region are briefly shown using PDFs and time series in JJA.**
  1. **Ozone from both models are generally higher than those from aircraft measurements over the UT/LS regions.**
  2. **CO from both models have positive bias (negative bias for other campaigns, so regionally different bias).**
  3. **MOZART CO compares better with MOZAIC than GMI.**
- **Horizontal patterns and seasonal cycle of ozone from the two models compare well with satellite observations in the UT/LS during January and July.**

For a better intercomparison, the two models need to use the same meteorological fields and source gases (e.g., mixing ratio boundary conditions and emissions database of source gases).

A more complete comparison in the troposphere and stratosphere as well as the UT/LS needs to be done.

Evaluations such as partitioning, tracer correlations, and analyses of transport process need to be addressed.

	O3	CO	H2O	OH	H2O2	HO2	CH4	NO	NO_x	NO2	N2O	NO_y	HNO3
MIPAS	A		A				A				A		
MLS	A	A	A			A				A			A
SONDE	A												
ETH	19	13	13	5	3	4	3	12	3	1	5	9	8
MOZAIC	A	A	A										