

GLOBAL ATMOSPHERIC CHEMISTRY AND COMPOSITION RESEARCH

KIT-IMK • IFT • MPI-C • DLR-PA • HZG • IUP

CARIBIC

Flying Observatory



The image shows a Lufthansa aircraft in flight over a world map. The aircraft has the website www.caribic-atmospheric.com on its fuselage. Various chemical species are labeled around the map, including:

- Cirrus
- HFC
- O₂
- HCFC
- O₃
- N₂O
- H₂O
- HDO
- CH₄
- AEROSOL
- H, C, N, O, S, K, Ca, Fe
- C₂H₆
- NMHC
- C₂H₂
- C₂H₄
- CH₃OH
- CH₃CHO
- ¹³C
- CH₃Cl
- CFC
- CO
- NO₂
- NO_y
- NO
- AEROSOL
- Hg
- SO₂
- BrO
- HCHO
- CO₂

Deutsche Lufthansa • UEA, Norwich • KMNI, De Bilt • Uni Lund • Uni Bern • CNRS-LSCE, Paris • IAGOS-EC • GMOS-EC • FRAPORT AG



MAX-PLANCK-INSTITUT
FÜR CHEMIE

CARIBIC

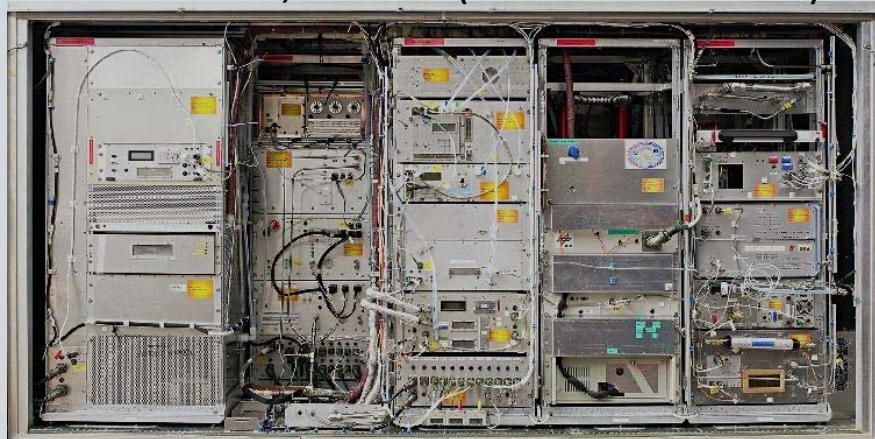


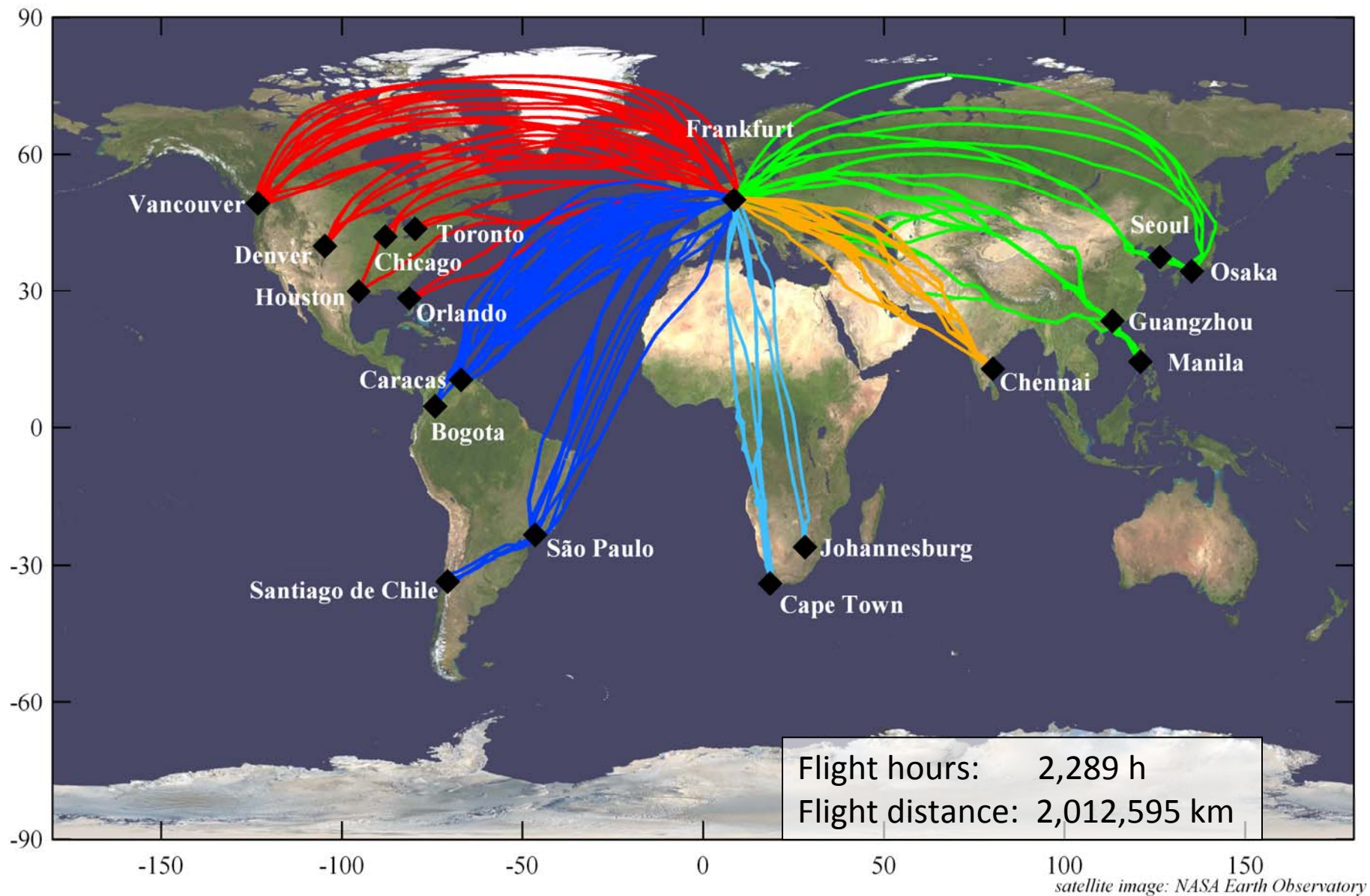
greenhouse gases and non-methane hydrocarbons

Carl Brenninkmeijer, Tanja Schuck, and Angela Baker

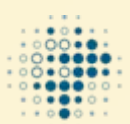


10 feet wide, 1.6 ton (0.4378260 % tow)

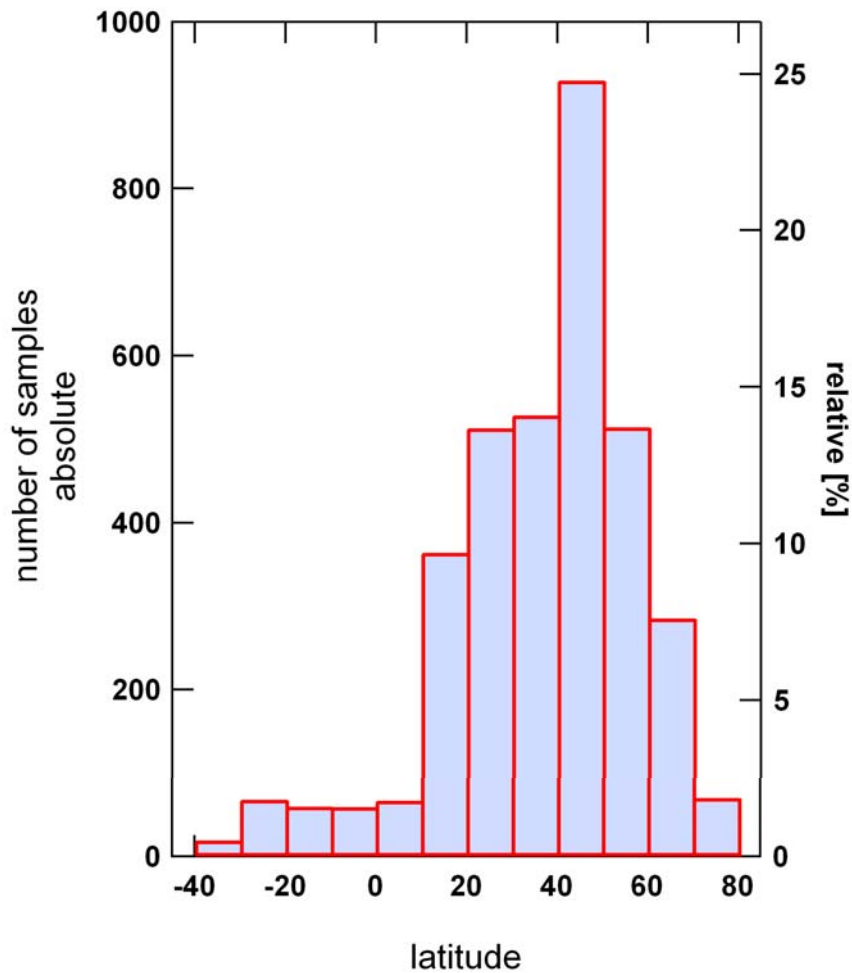




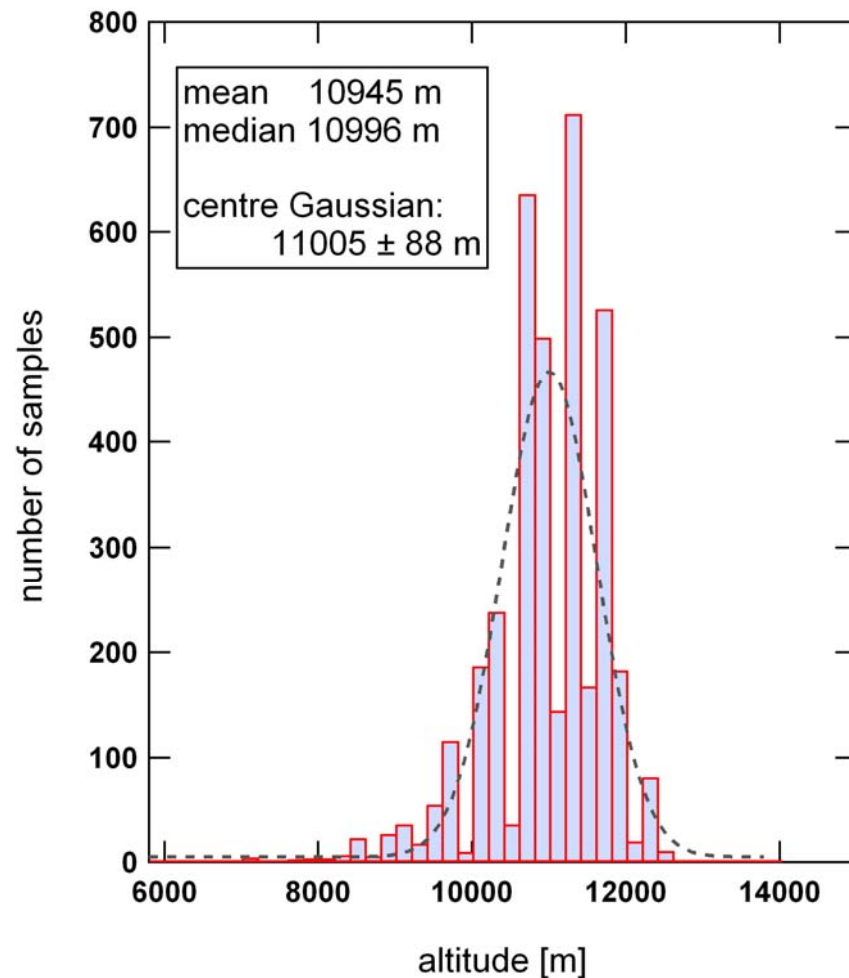
CARIBIC destinations and flight trajectories



Air Sample Statistics



Based on 3764 samples



Pressure altitude 10,999 meter or 36,085 feet

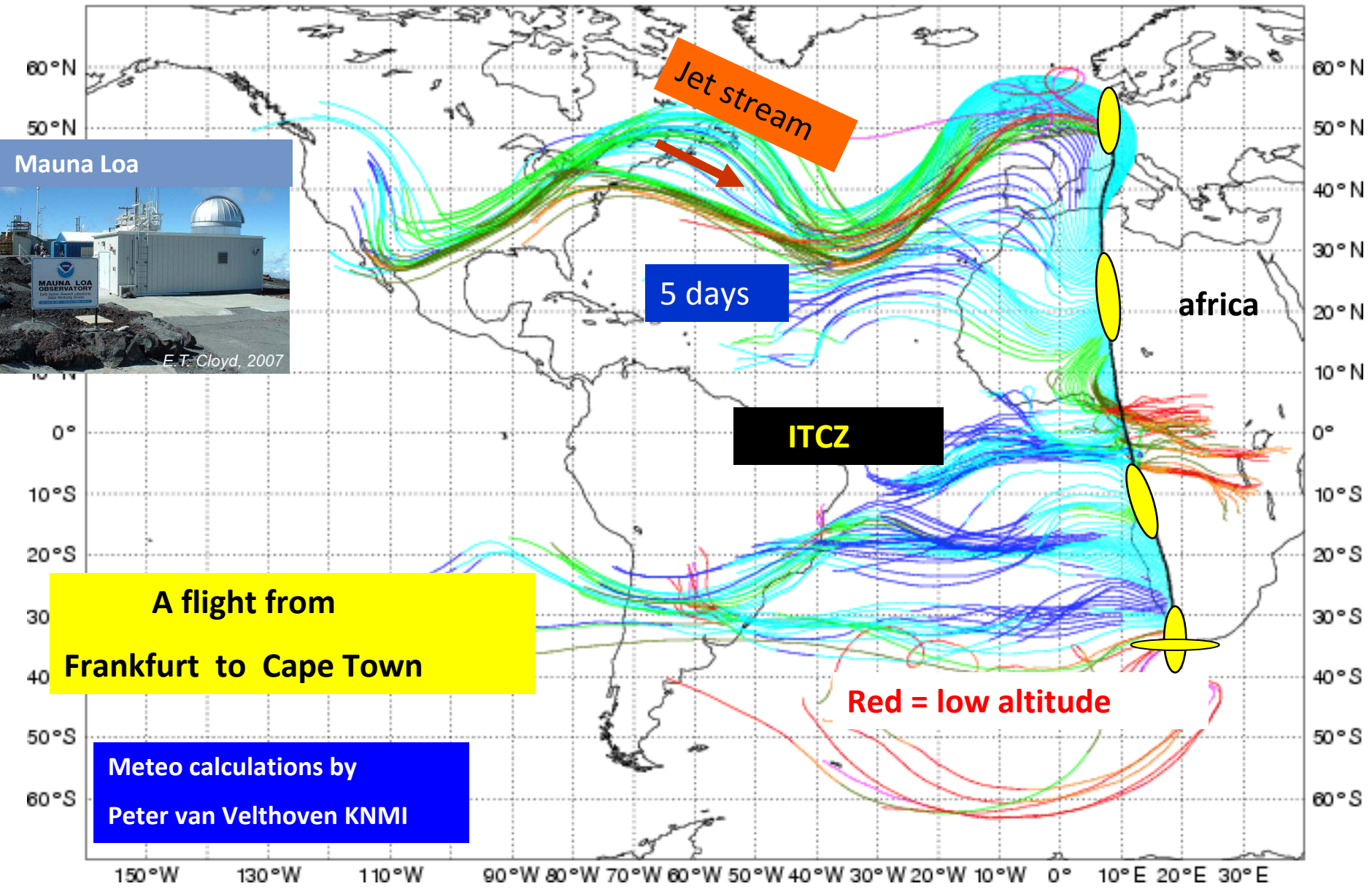
KNMI/ECMWF backward trajectories: 219 from:MA_20091027_FRA_CPT_290_001

first begindate: THURSDAY 22 OCTOBER 2009 23 GMT

last enddate: WEDNESDAY 28 OCTOBER 2009 9 GMT

dark blue<=200hPa<lightblue<= 250Pa<green<= 300Pa<olive<= 400Pa<orange<=500hPa<red<=850hPa<purple

150°W 130°W 110°W 90°W 80°W 70°W 60°W 50°W 40°W 30°W 20°W 10°W 0° 10°E 20°E 30°E



Jet stream

5 days

ITCZ

africa

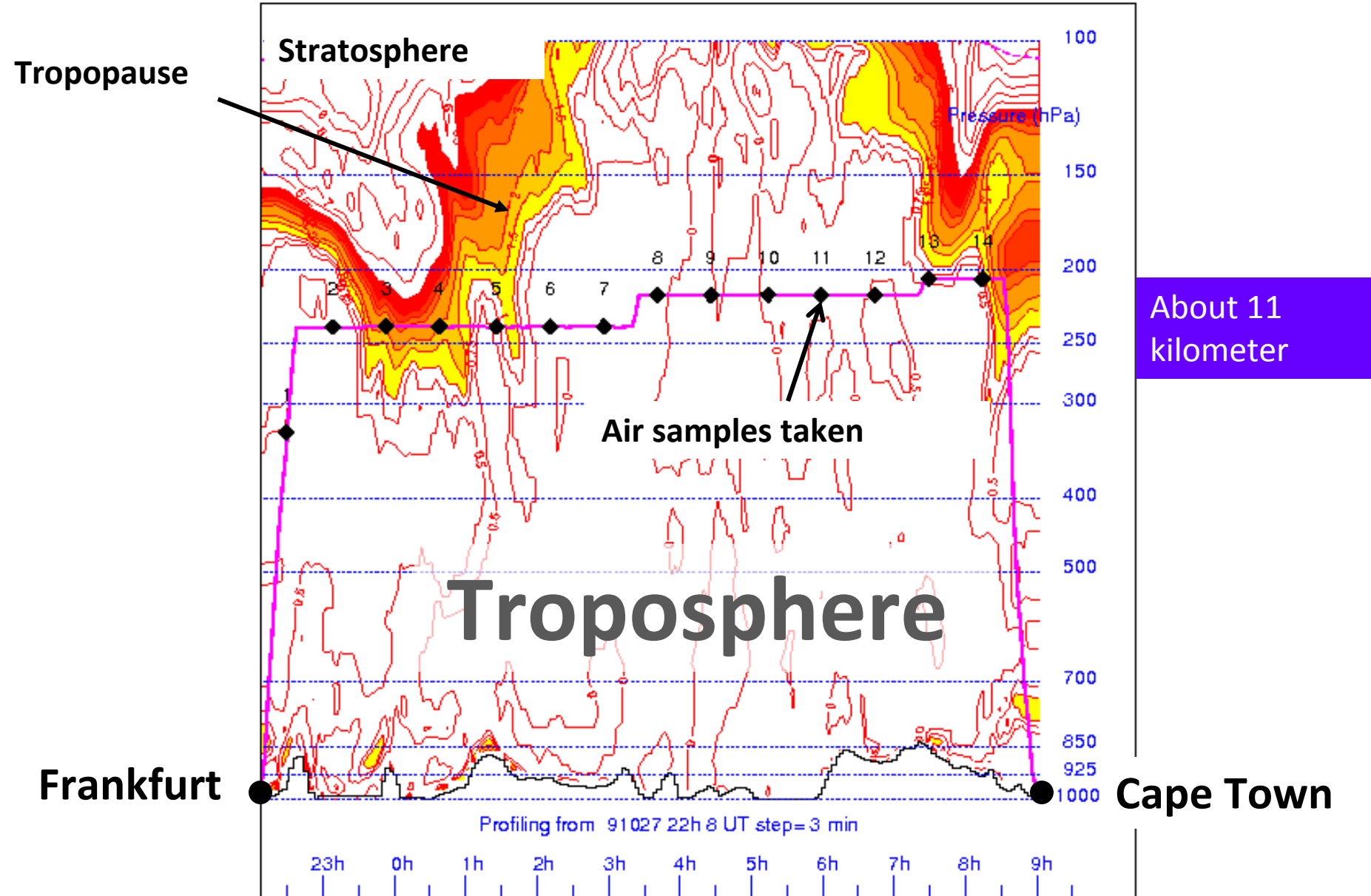
A flight from Frankfurt to Cape Town

Meteo calculations by Peter van Velthoven KNMI

Red = low altitude

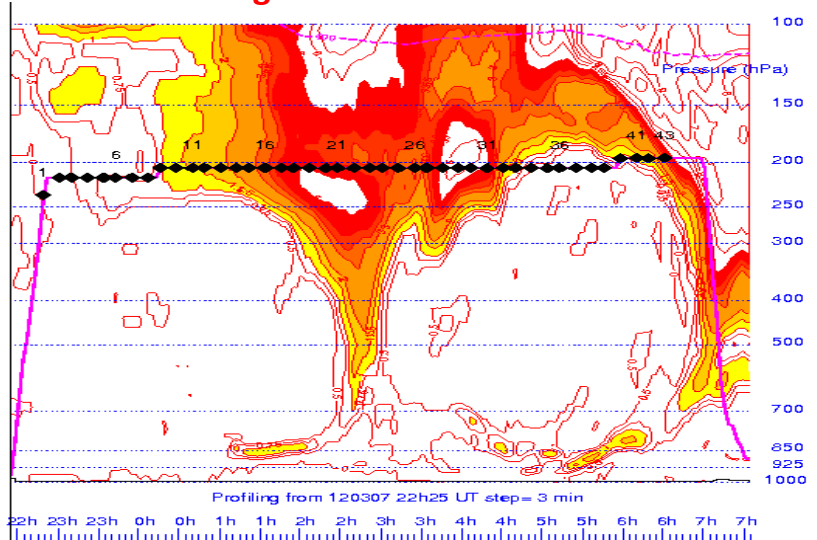


from 28-10-2009 at 0 Z + 0 from model level data
Potential vorticity (PVU)
KNMI/ECMWF CARIBIC



Stratosphere or Troposphere or both ?

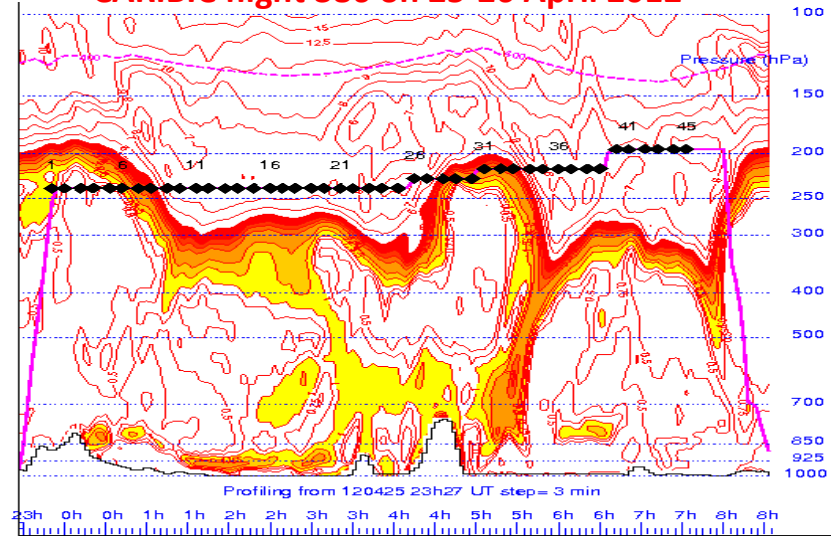
CARIBIC flight 380 on 7-8 March 2012



Caracas

Frankfurt

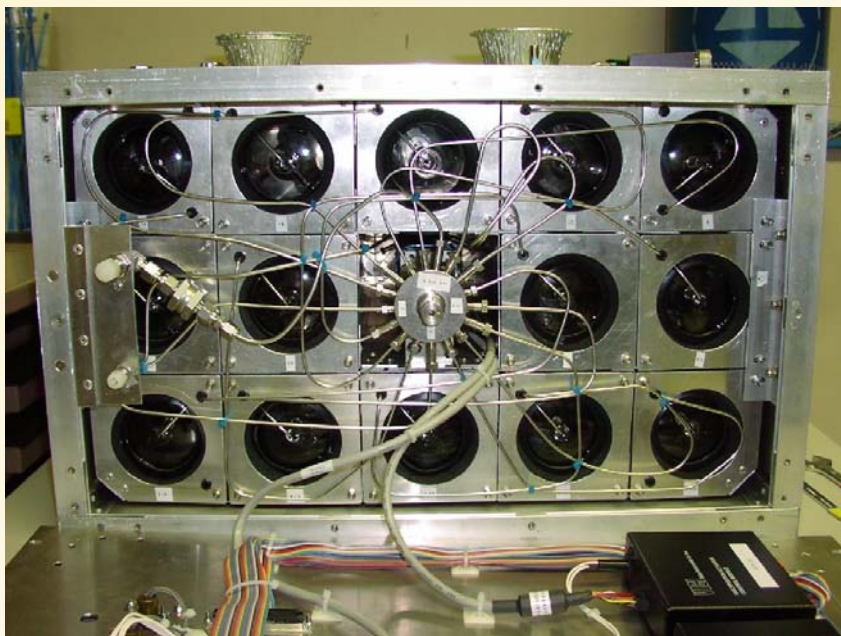
CARIBIC flight 386 on 25-26 April 2012



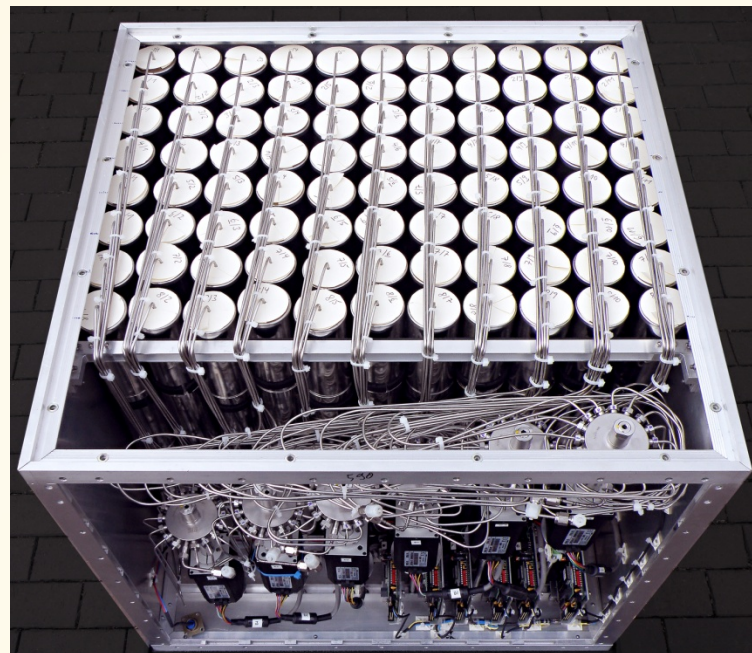
Vancouver

Frankfurt

CARIBIC Air Sample Collection



28 @ 2.5 liter glass flasks since 2005

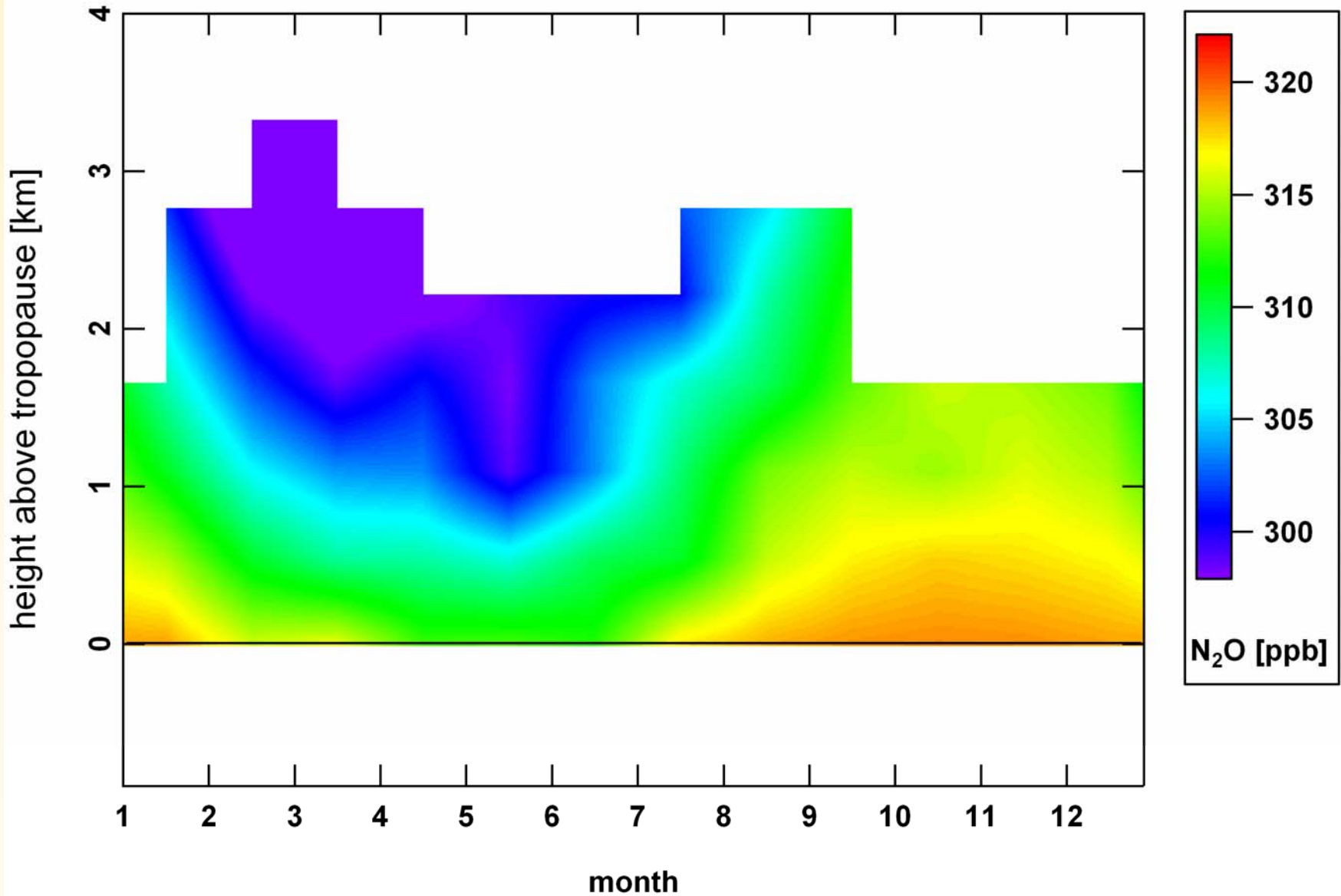


Additional 88 stainless steel 1 liter flasks since 2010

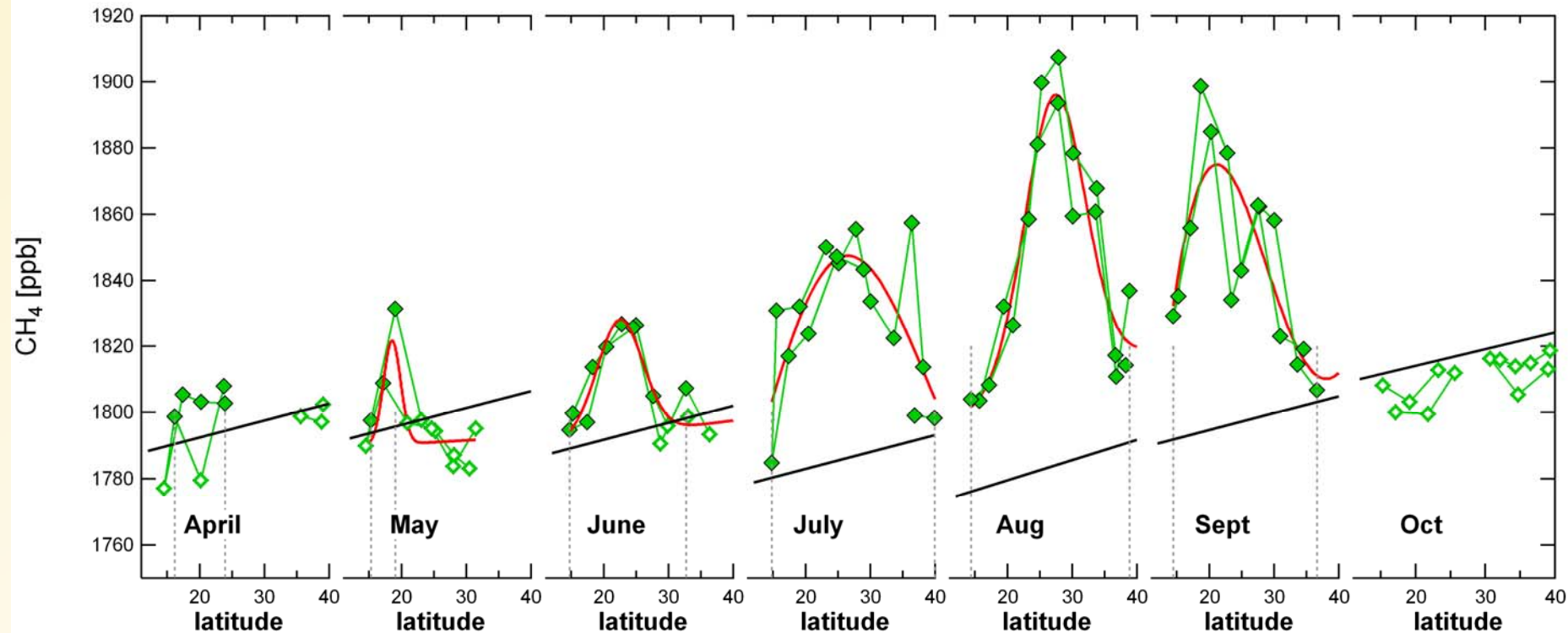
N₂O above the Tropopause



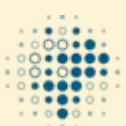
Using the yardstick of Andreas Zahn



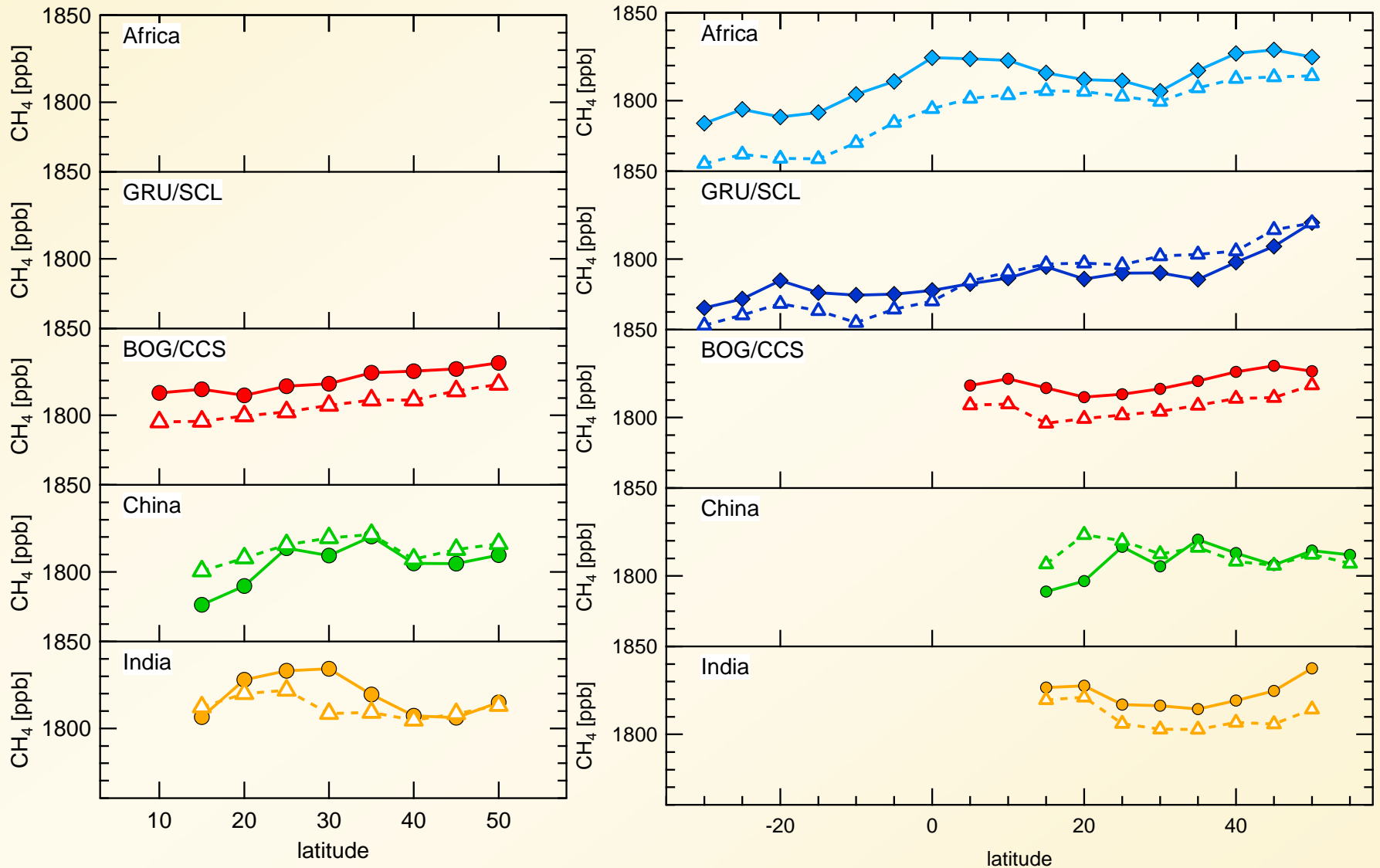
The Indian Summer Monsoon Methane Plume

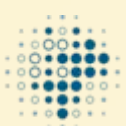


Background: MLO (at 19°N) monthly averages for 2008.
The gradient is derived from CARIBIC October data

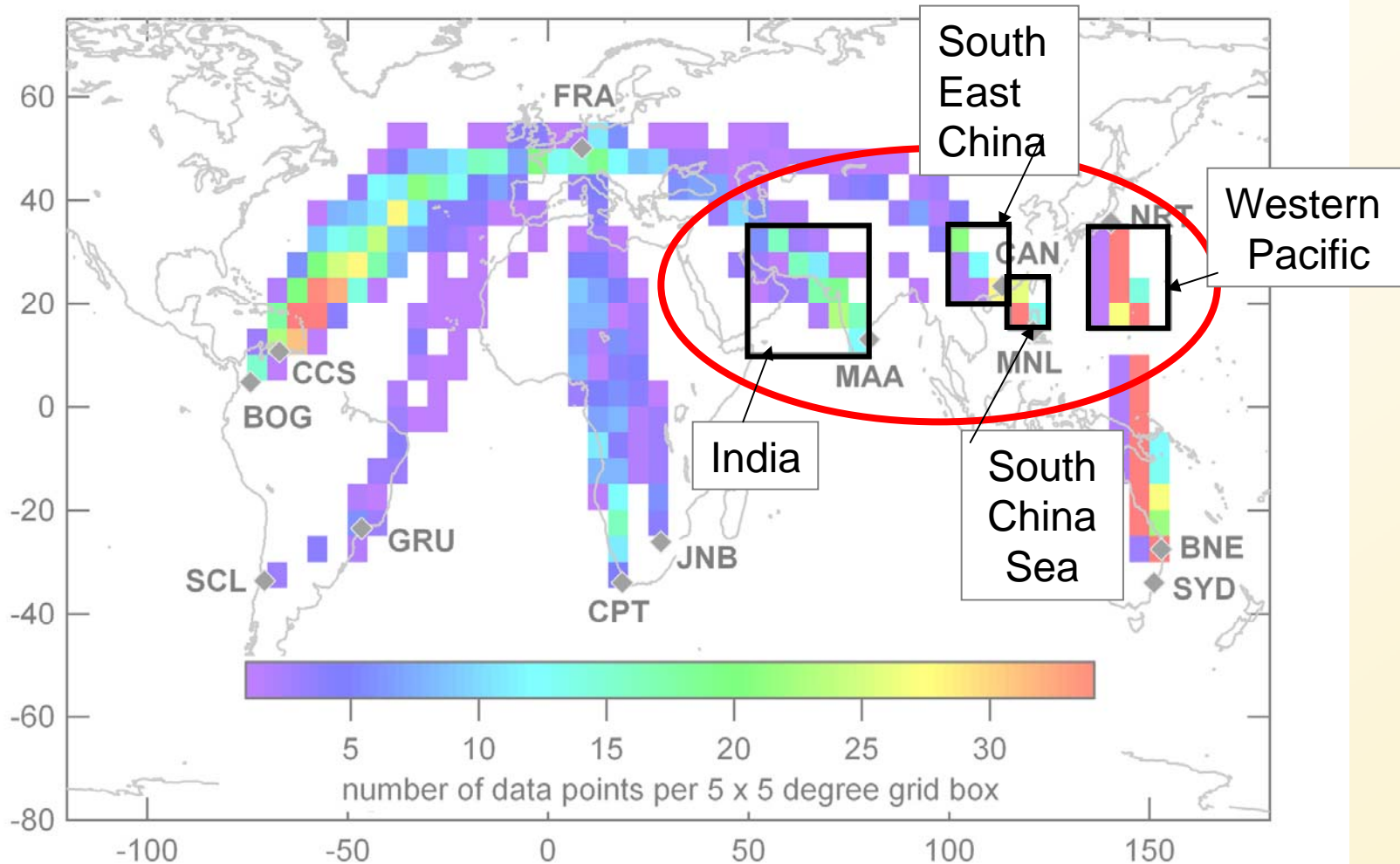


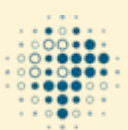
CARIBIC - ACTM comparison



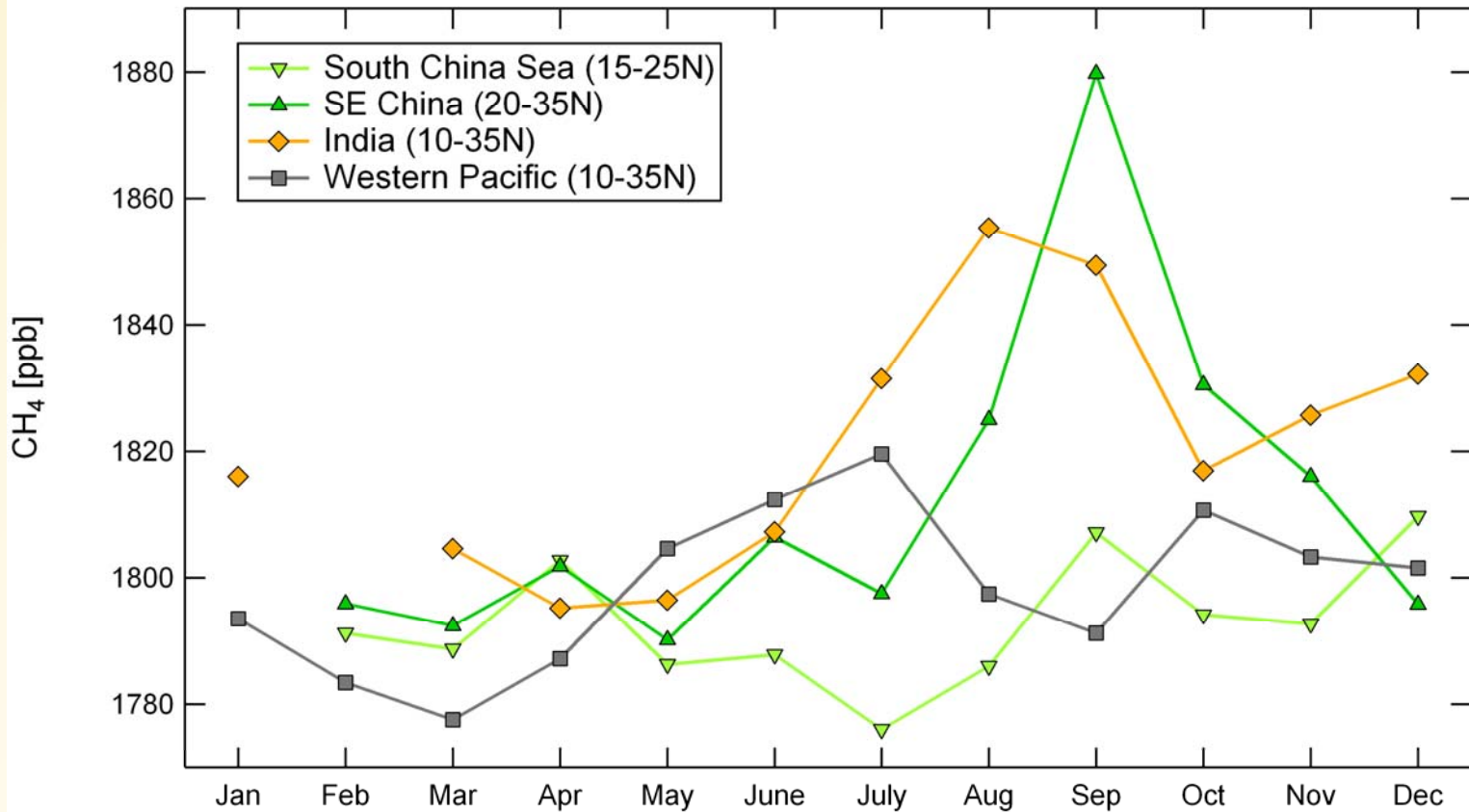


Different Regions in Tropical Asia

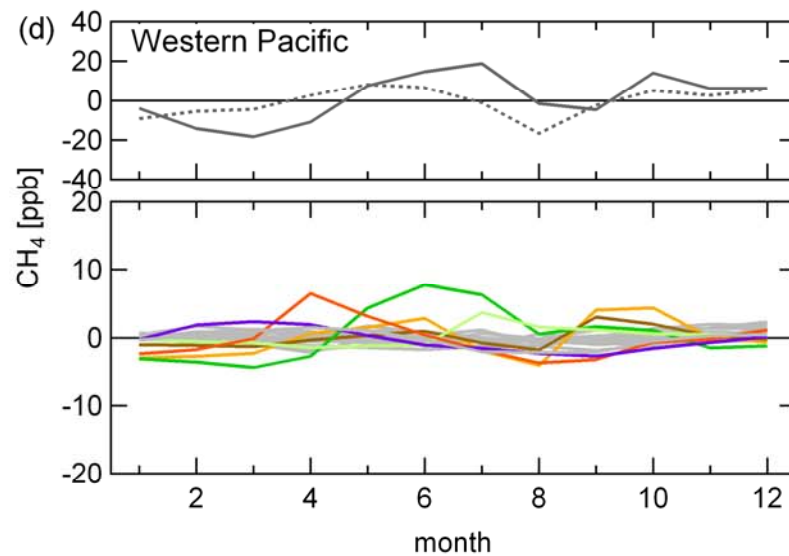
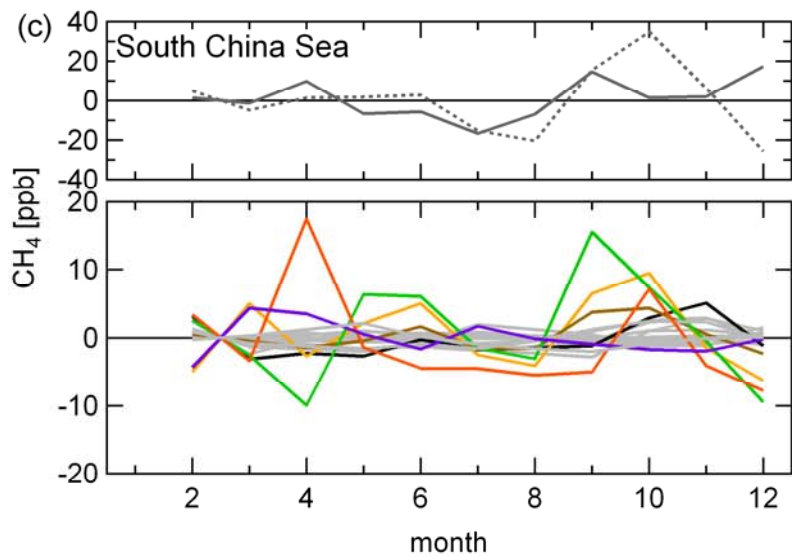
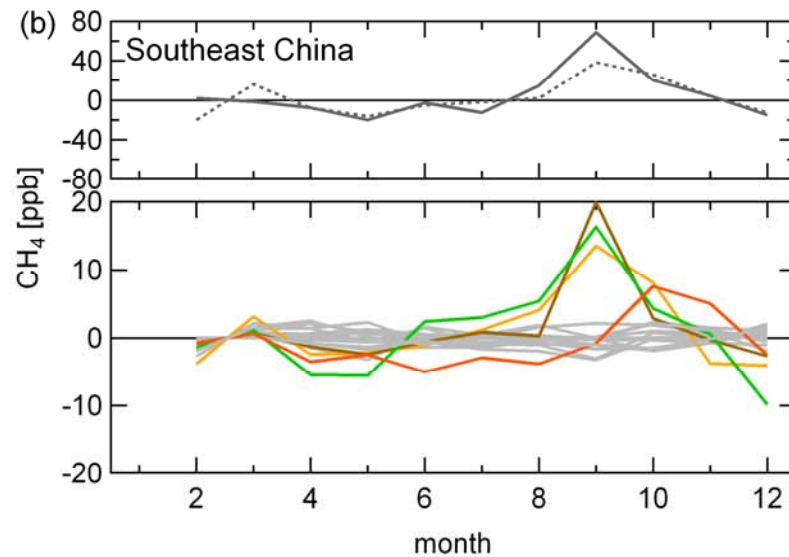
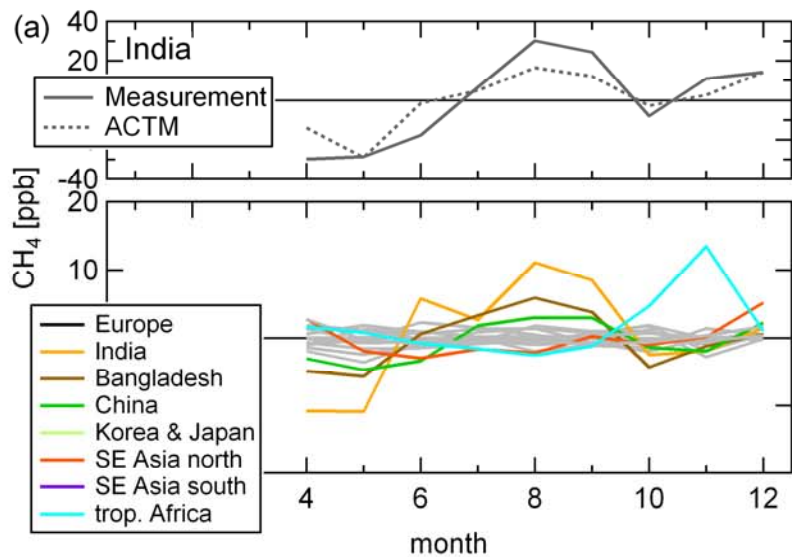




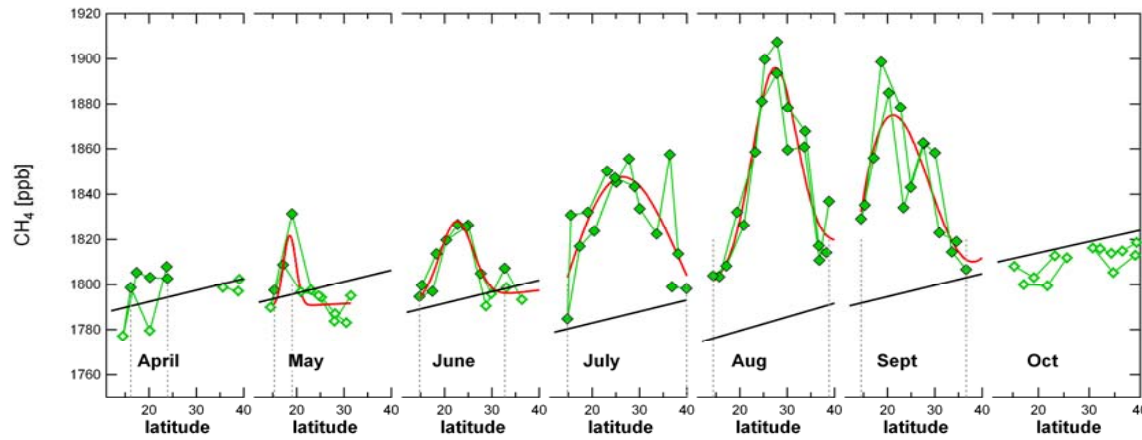
Methane Seasonality over Asia



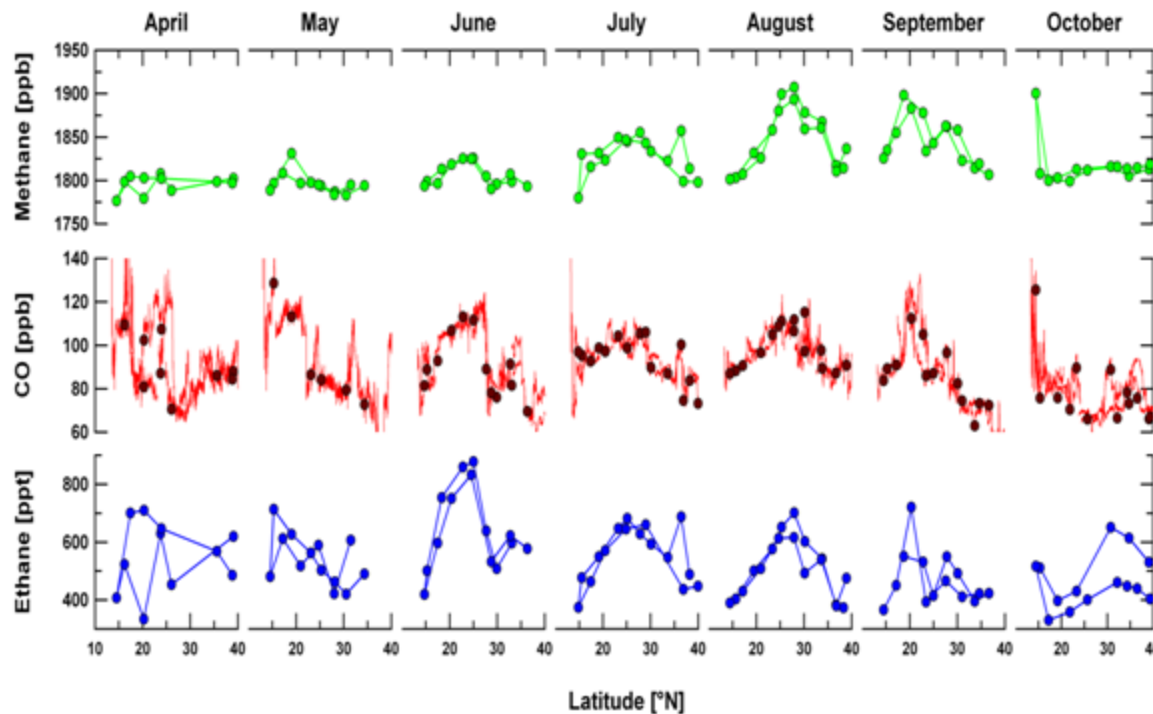
Methane Seasonality over Asia



Monsoon-related - biogenic - methane emissions



CH_4

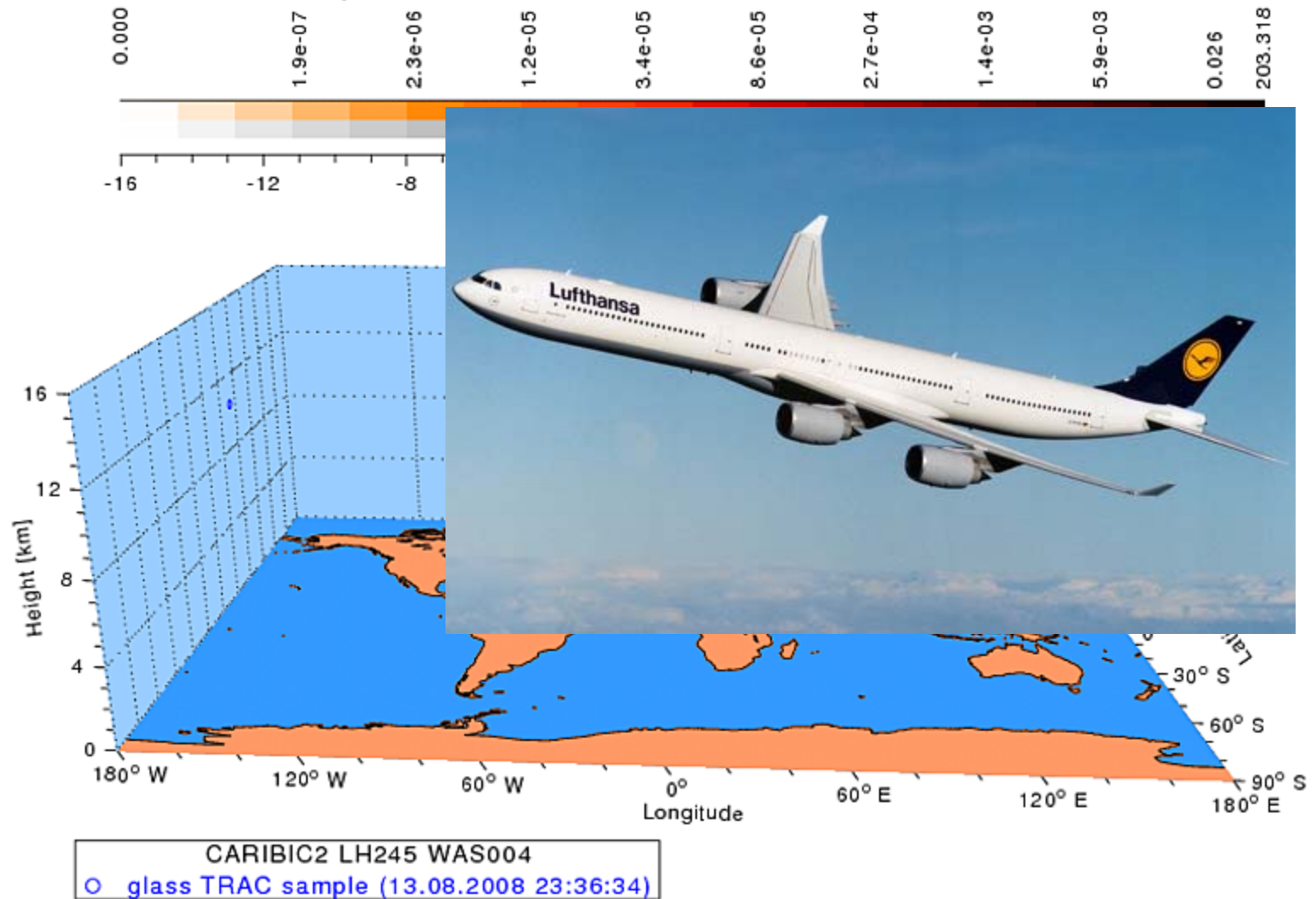


CH_4

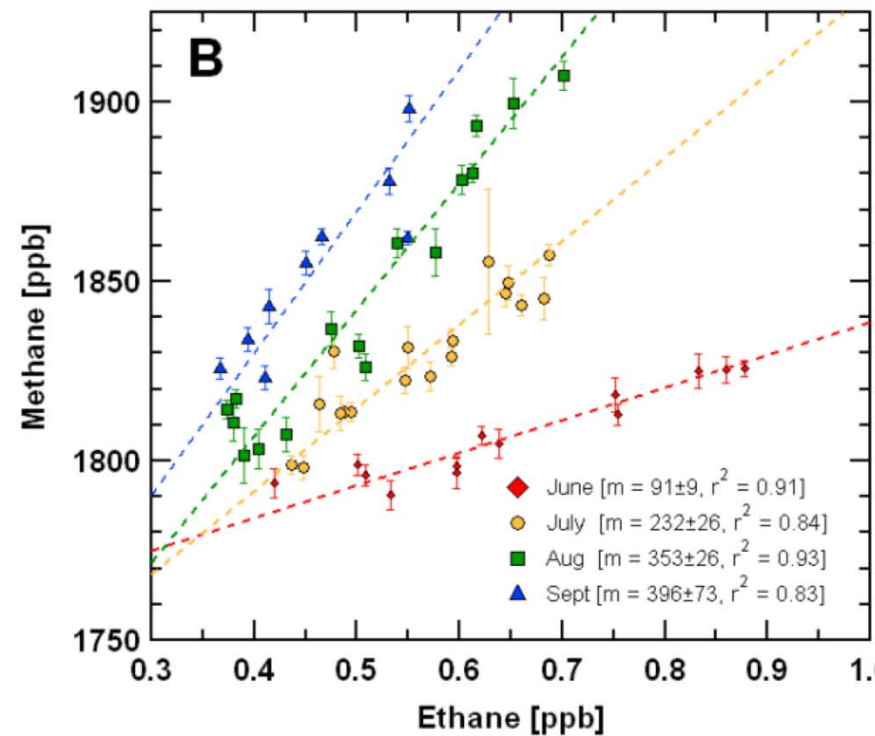
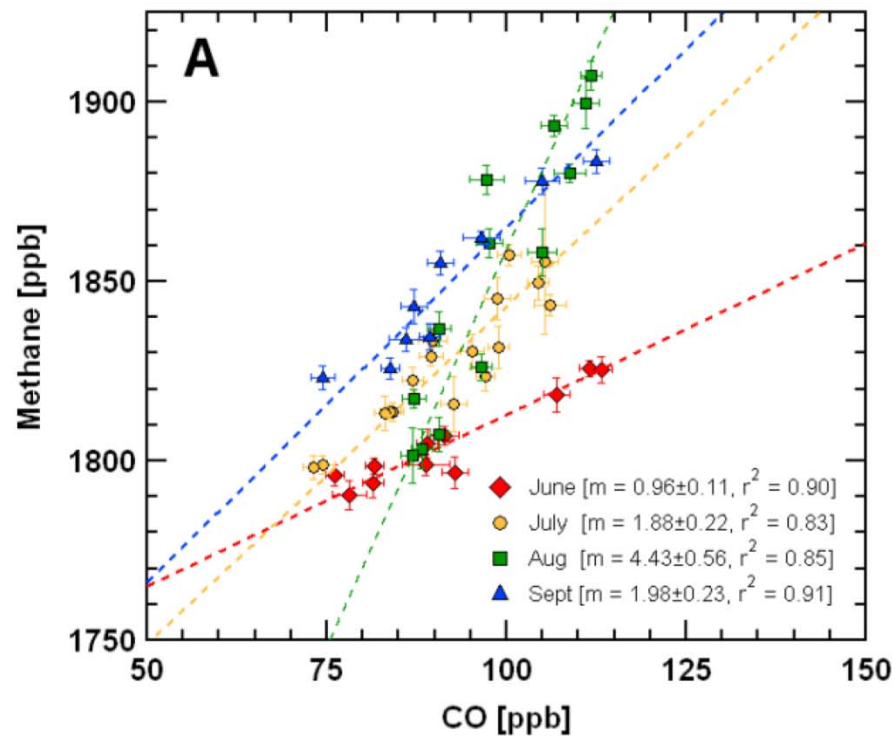
CO

Ethane

FLEXPART dispersion for LH245 WAS004 at 14.08.2008 00:13:20



Calculations by Armin Rauthe-Schöch using Flexpart (Andreas Stohl)





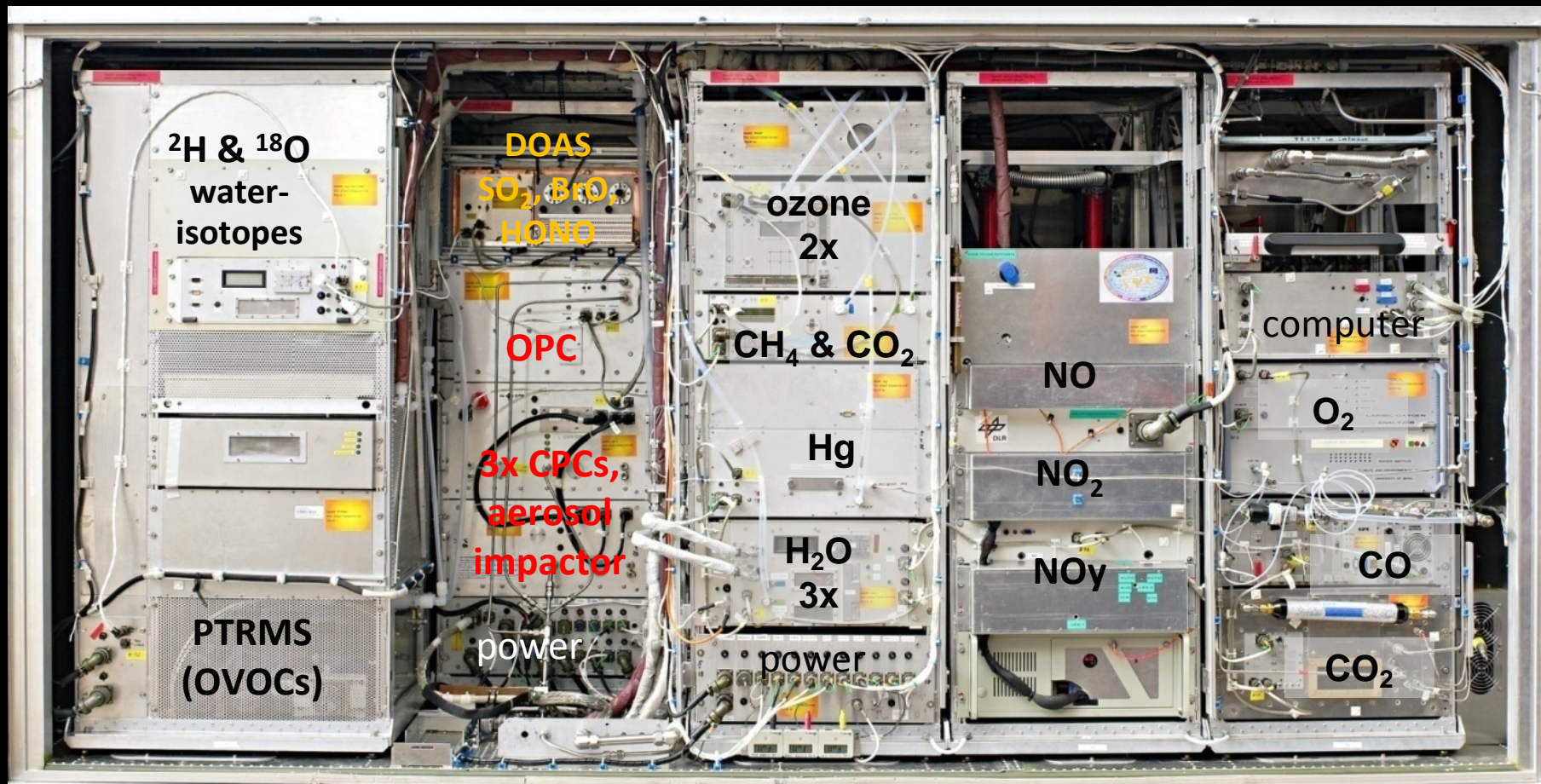
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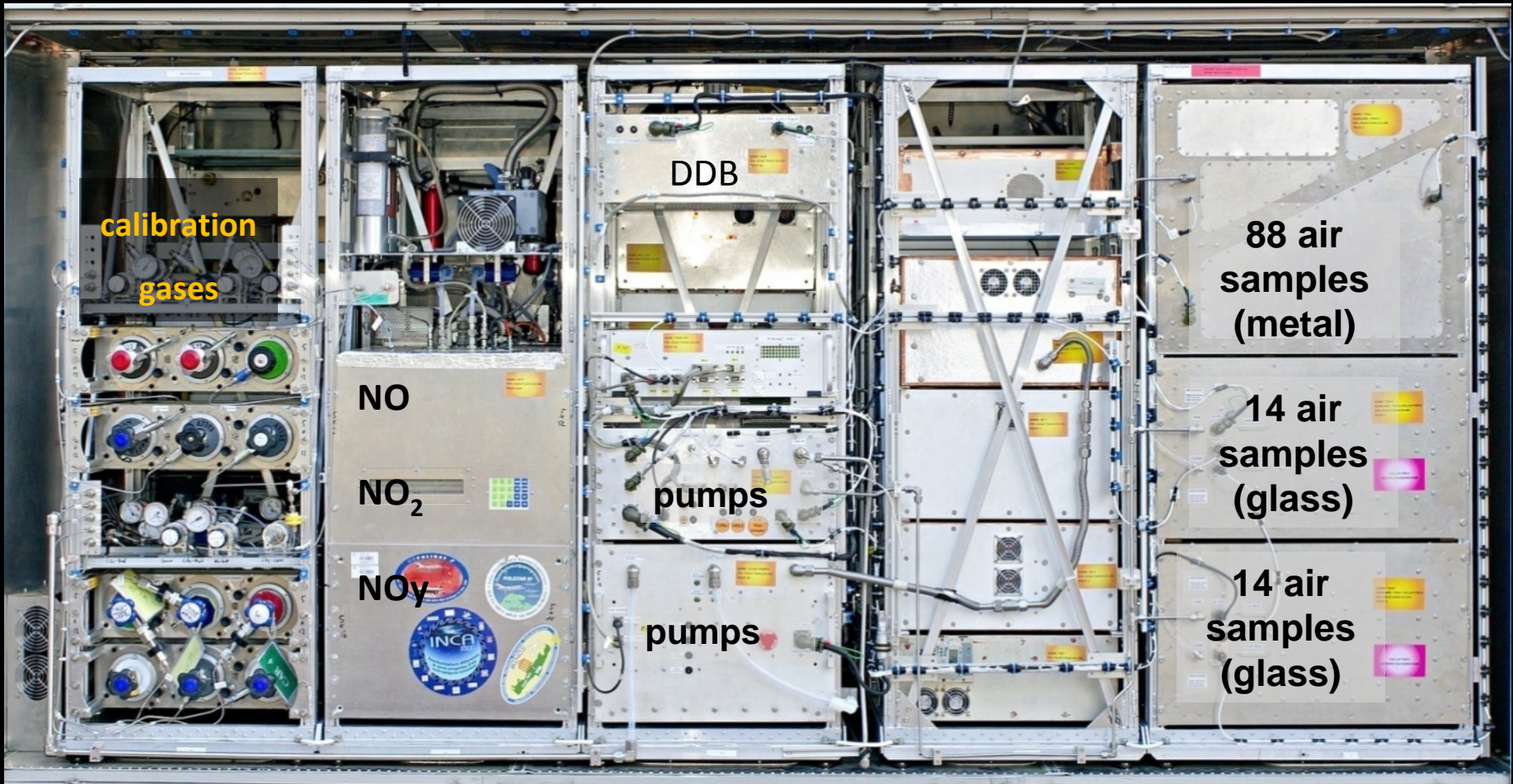
NOAA-ESRL, thank you for your support over all these years

Acknowledgements go to all CARIBIC partners, please consult www.caribic-atmospheric.com

Front View



Rear View



calibration
gases

NO

NO₂

NO_y

DDB

pumps

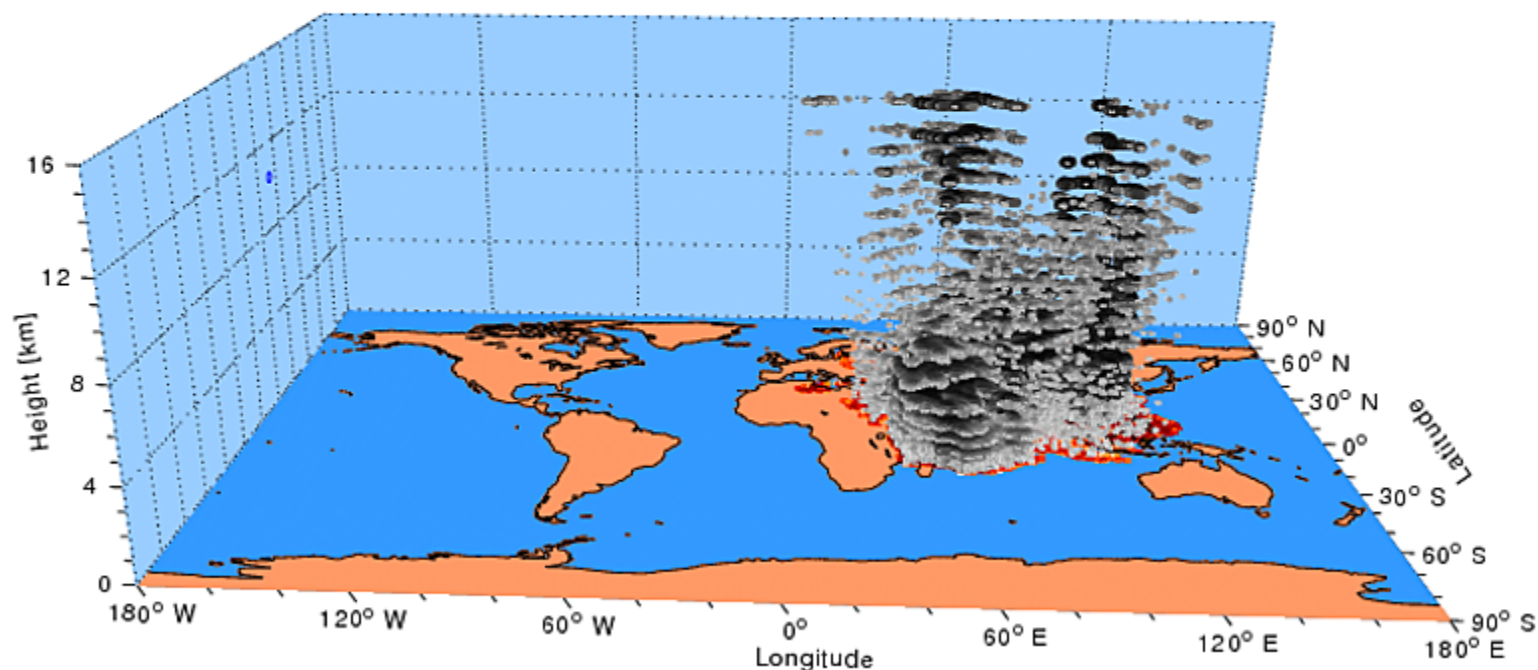
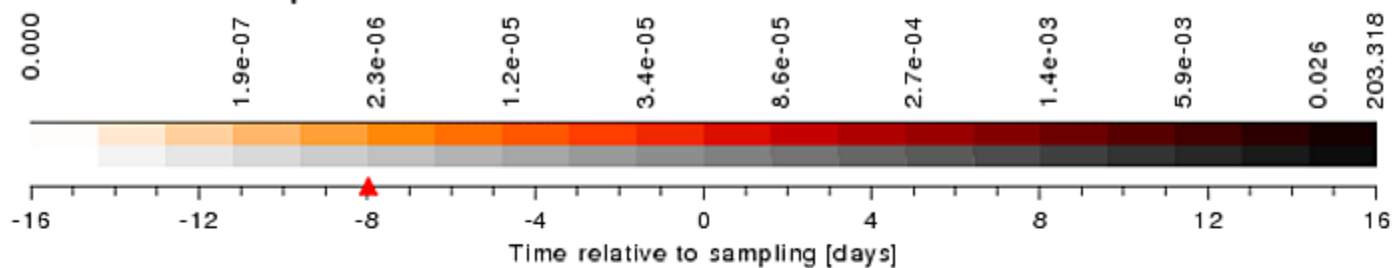
pumps

88 air
samples
(metal)

14 air
samples
(glass)

14 air
samples
(glass)

FLEXPART dispersion for LH245 WAS004 at 06.08.2008 00:13:20



CARIBIC2 LH245 WAS004
○ glass TRAC sample (13.08.2008 23:36:34)