

# The Lagrangian experiment: Model predictions and first results



# Participating platforms



# IDEA

Sample the same air parcels over North America, in the middle of the Atlantic (Azores), and over Europe

Compare the chemical characteristics of these airmasses to infer changes occurring en route between the continents

It is important to sample not only the same plumes, but really the same air parcels within these plumes, i.e. air parcels that are connected in a Lagrangian sense

# Why conventional forecast systems do not provide sufficient information for the Lagrangian experiment

## Eulerian models (CTMs)

advect regional emission tracers and therefore cannot identify Lagrangian relationships other than with their source region

## Trajectory models

give no quantitative information on where pollution plumes are really located (no tracer concentrations)

# New approach

1. Simulate a North American CO tracer with FLEXPART
2. Store all particle positions every 3 hours for a 5-day analysis plus 5-day forecast period
3. Identify quasi-Lagrangian „opportunities“ using suitable criteria

Two cases:

## 1. To plan an upwind flight

Objective: Identify quasi-Lagrangian „opportunities“ for all locations that are within the range of an aircraft

Result: Thousands of „opportunities“, which have to be judged and ranked automatically

- highest CO tracer concentrations
- little dilution
- no more emissions into the air parcel
- reachable by as many aircraft as possible

## 2. To plan downwind flights

Objective: Forecast where „interesting“ observed airmasses are going to

# FLEXPART forecast on 15 July

Total column of species 1 for age class all

Forecast start 20040715.150000 Actual time 20040715.210000

Mean value 0.242E+02

Maximum value 0.764E+03

Minimum value 0.000E+00

## Legend:

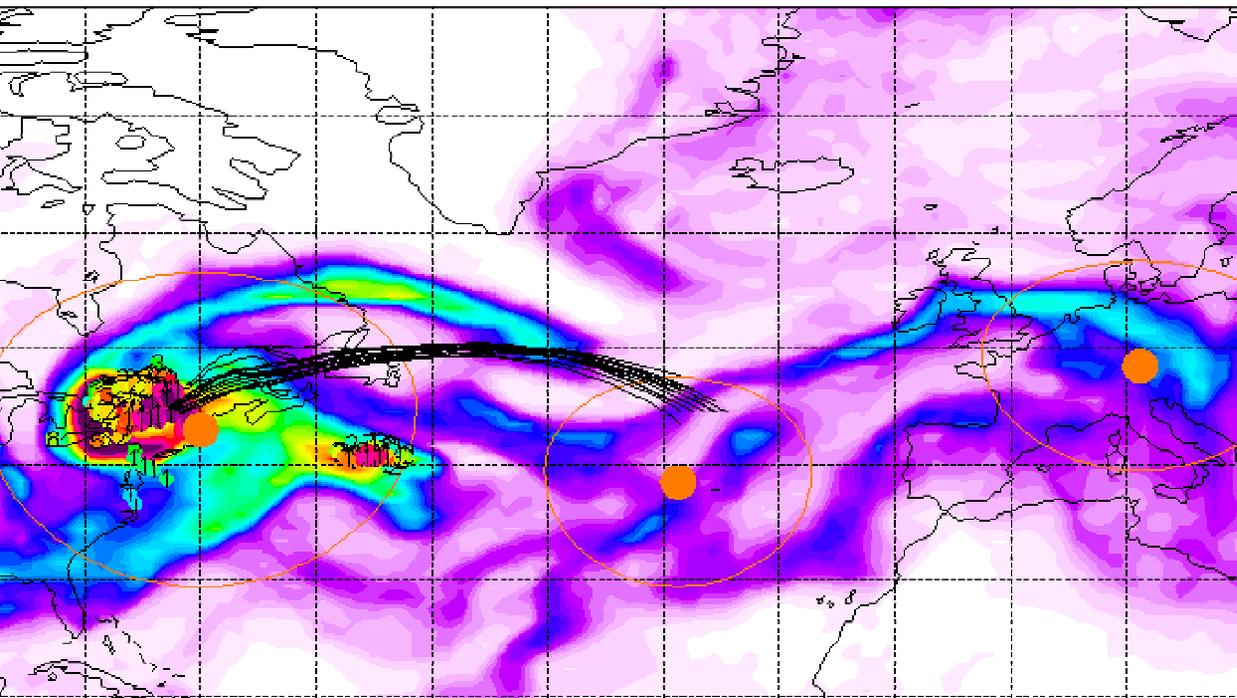
Orange circles: assumed range of aircraft (1500 km)

Black lines: trajectories of the 50 "best" cases

Dots, inner color: actual FLEXPART CO tracer

Numbers on the dots: altitude

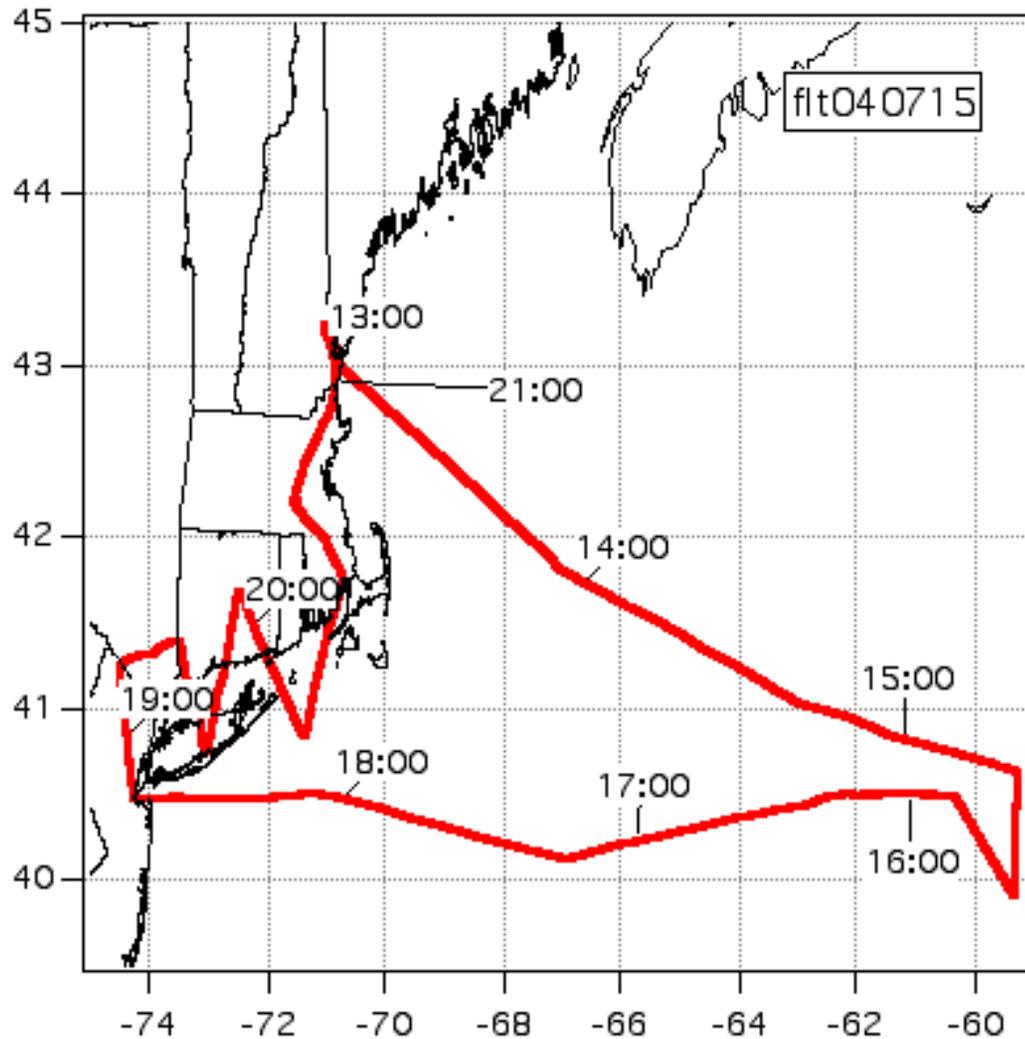
Five large dots (with white circles around): the "golden" opportunities



50 100 150 200 250 300 350 400 450 500  
mg/m2 144 ppb

Maximum model CO mixing ratio

# P3 flight on 15 July



# FLEXPART forward projection of measured CO values above 120 ppb

Total column of species 1 for age class all  
Forecast start 20040717.150000 Actual time 20040715.150000  
Mean value 0.237E+02  
Maximum value 0.735E+03  
Minimum value 0.000E+00

## Legend:

Orange circles: assumed range of aircraft (1500 km)

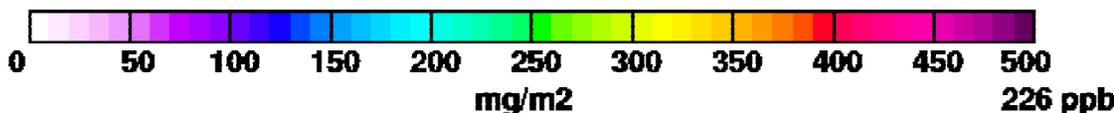
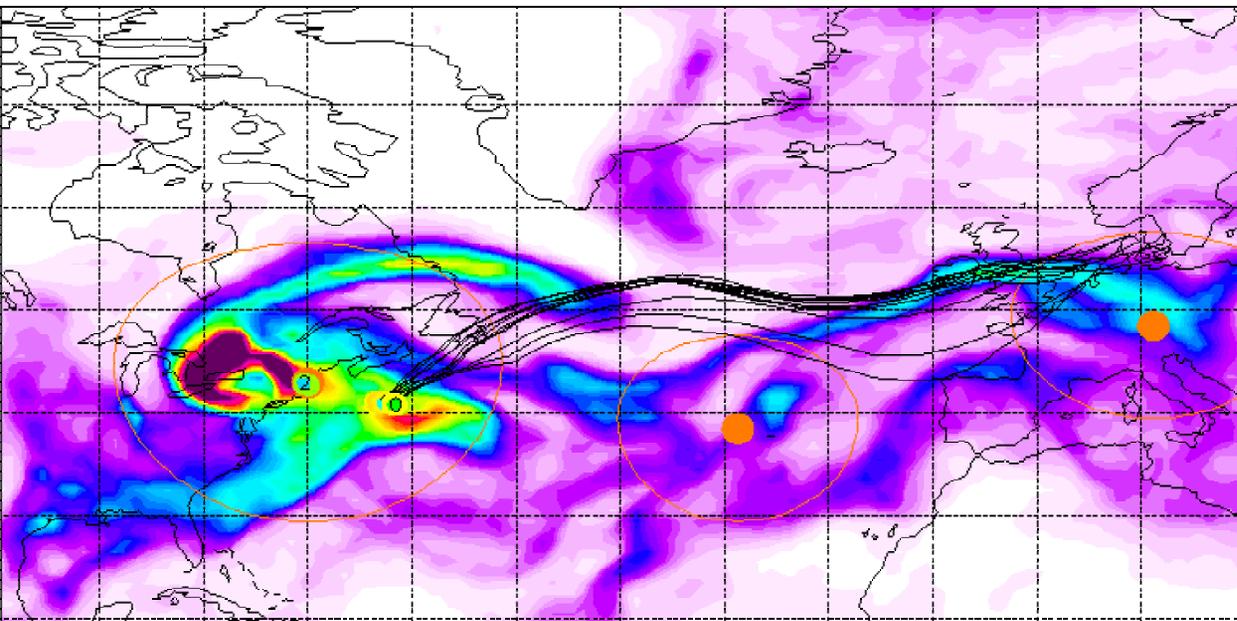
Black lines: trajectories of the 50 "best" cases

Dots, inner color: actual FLEXPART CO tracer

Dots, outer color: measured CO

Numbers on the dots: altitude

Five large dots (with white circles around): the "golden" opportunities

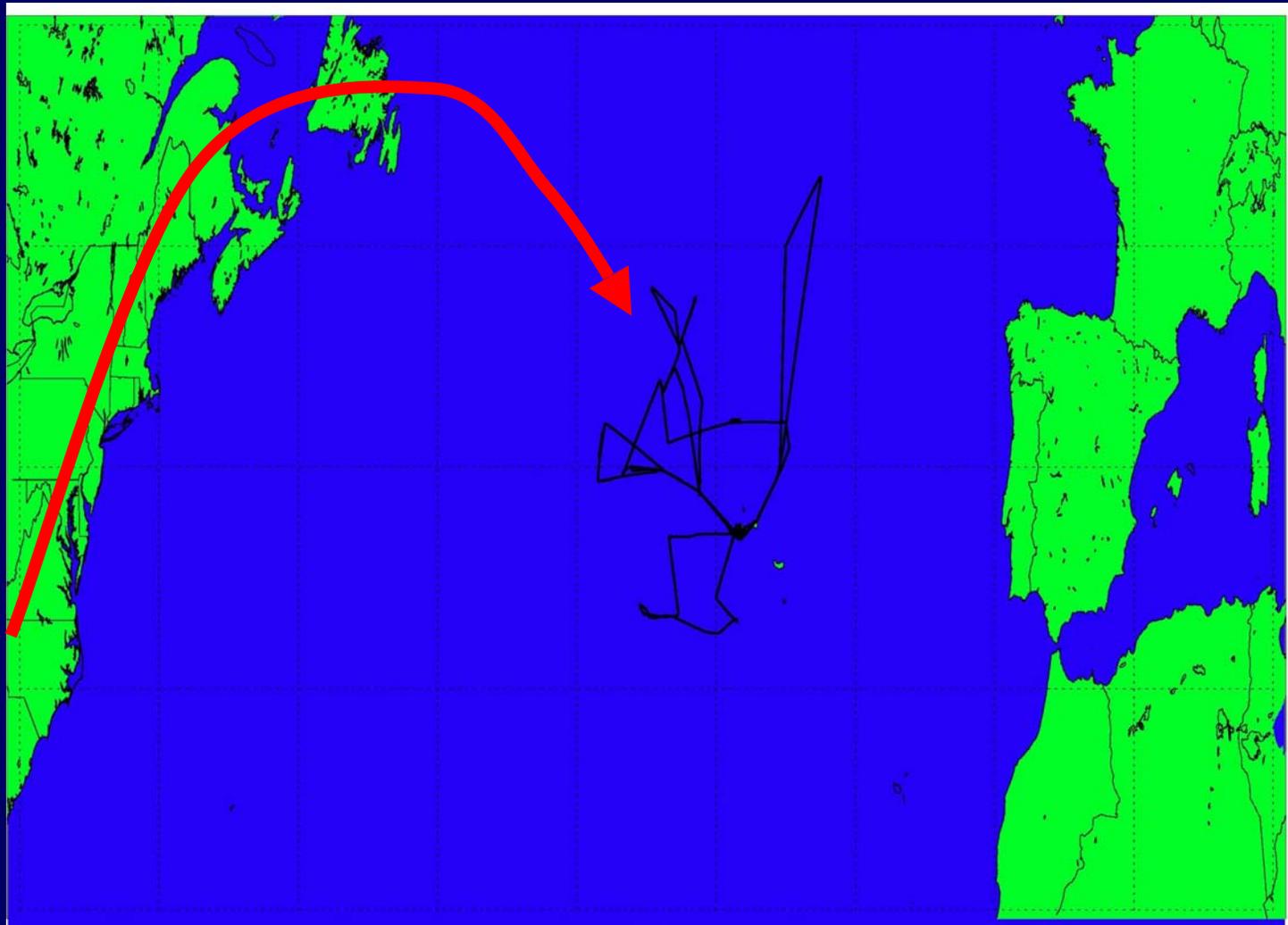


Maximum model CO tracer  
Maximum measured CO

# British BAE 146 – Stationed at the Azores

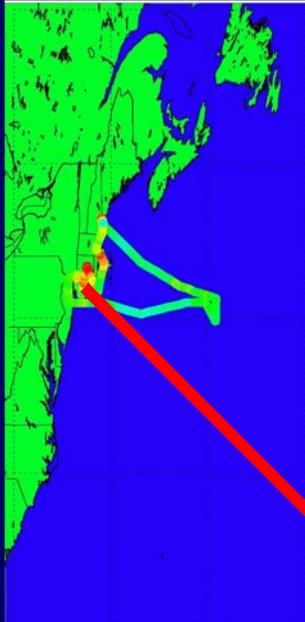
Tracks of the flights performed so far

Thanks to Mat Evans for making these slides!!!

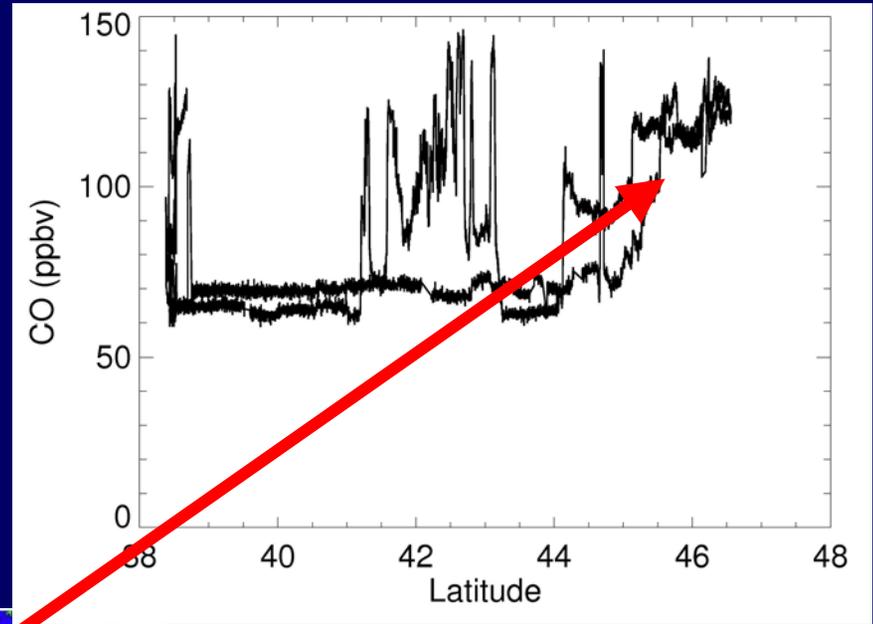
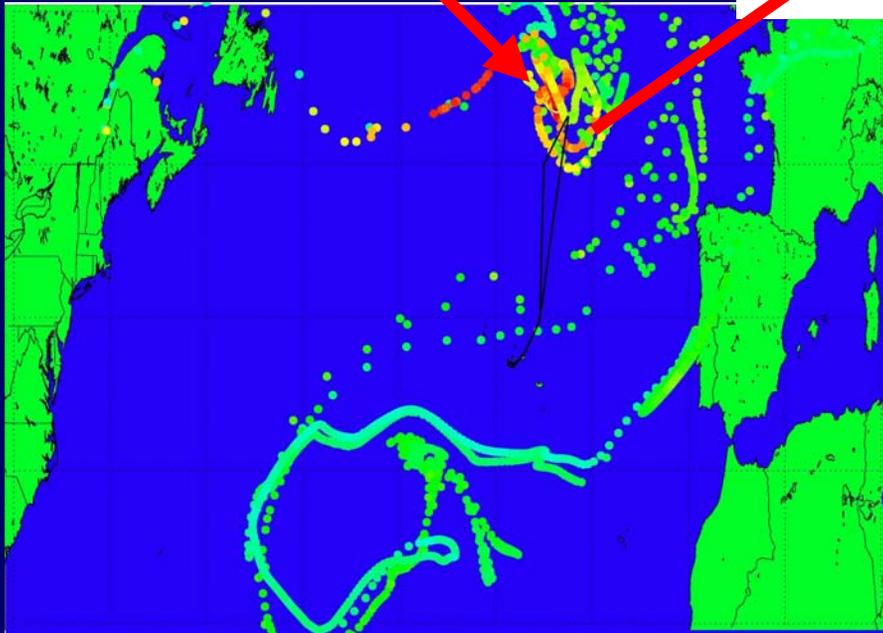


# British Lagrangian flight 2

NOAA flight on  
July 15th

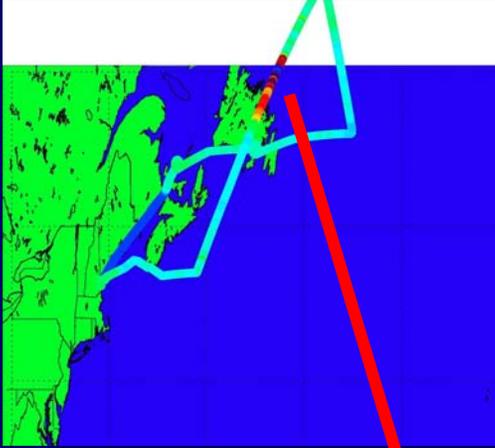


UK flight on  
July 19th

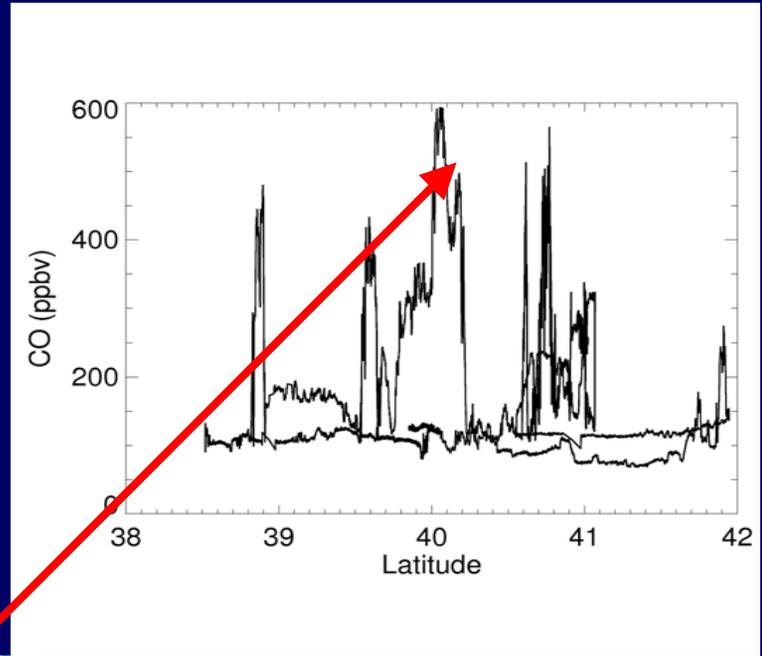
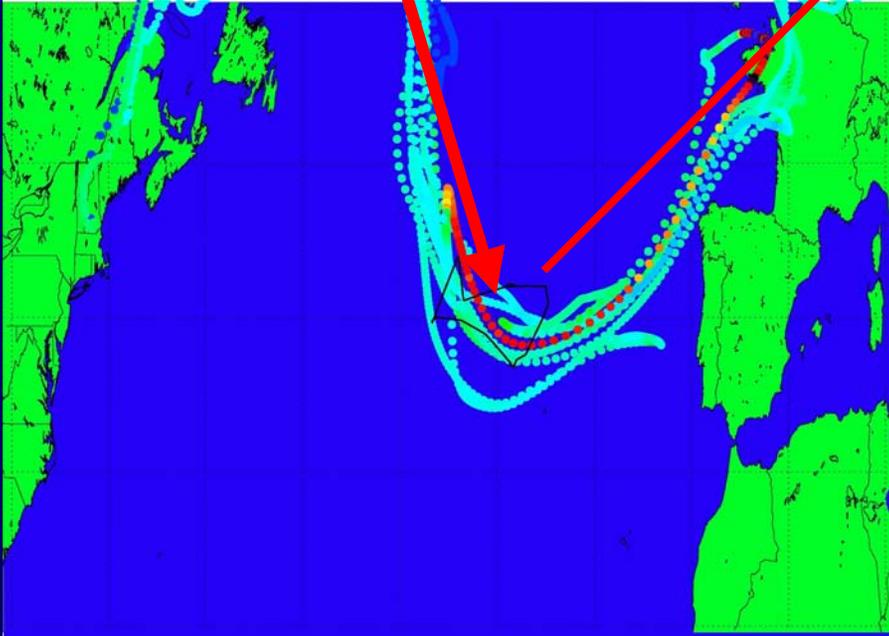


# British Lagrangian flight 3

NASA flight on  
July 18th



UK flight on  
July 20th



# German/ French ITOP Campaign in Creil (France)

Hans Schlager & Kathy Law (Coordinators)



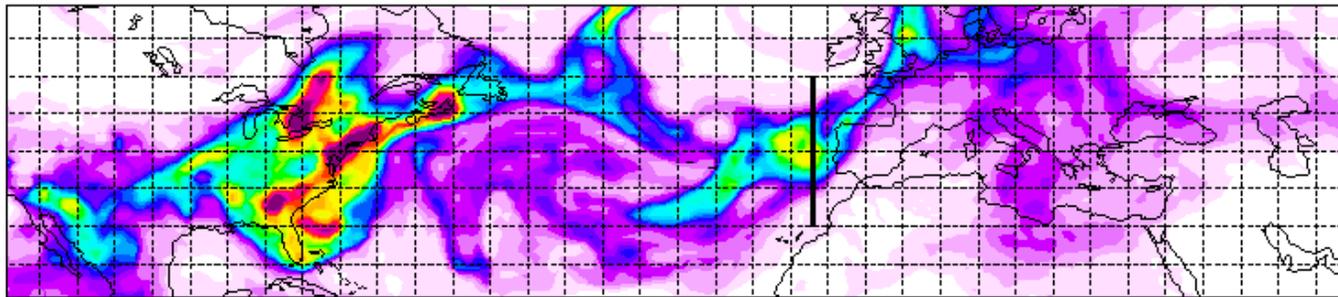
Falcon at Creil

Quicklooks from Flights on 22/23 July 04

Objectives:

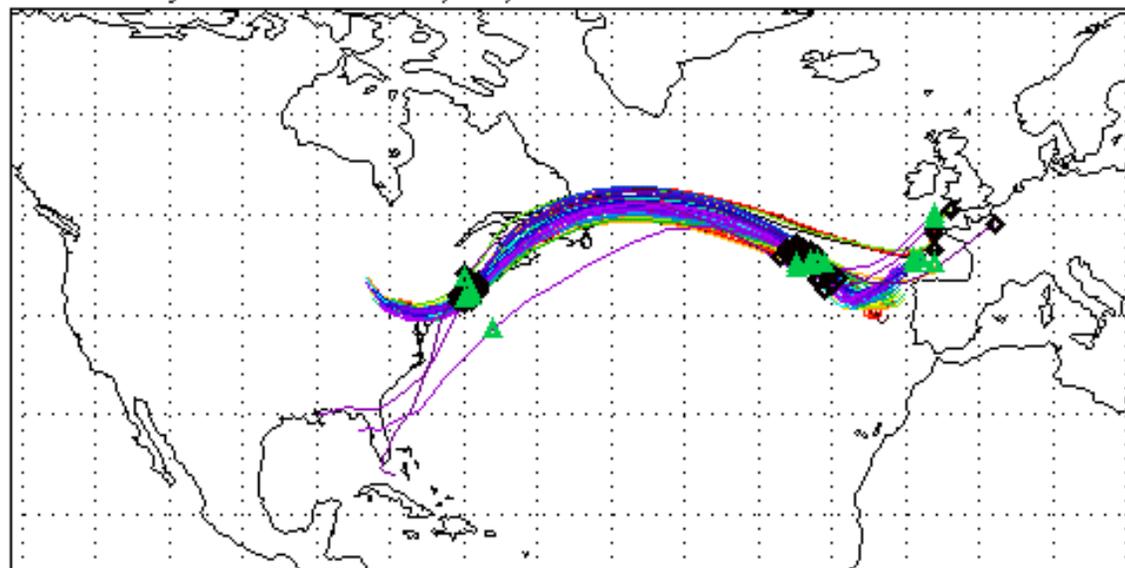
- Probing of “New York Plume” already measured by NOAA P3 on 15 July 04 and BAE146 on 19 July 04
- Probing of “Alaskan Forest Fire Plume” already measured by DC-8 on 18 July and BAE146 on 20 July 04

# FLEXPART Forecast for 22 July 04, 1200 UT

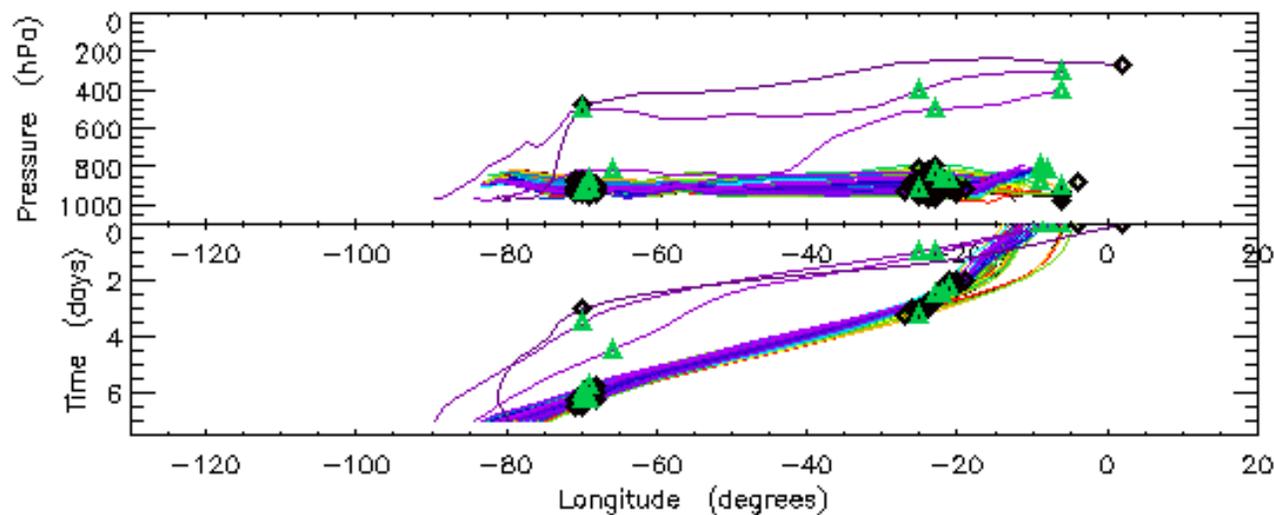


# Backward trajectories

Back trajs from 12UT 22/07/2004 000 hrs into met forecast

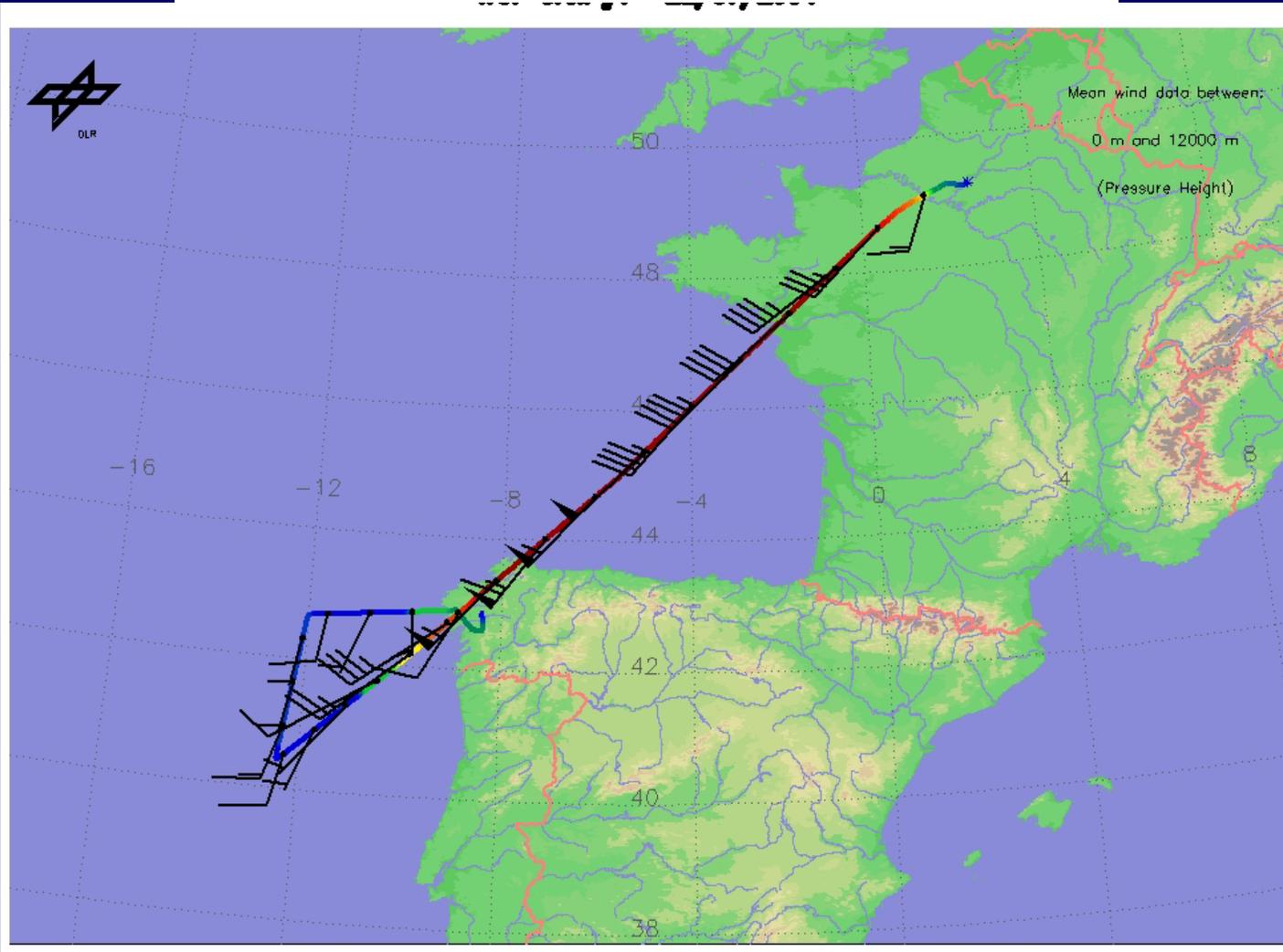


“New York Plume”



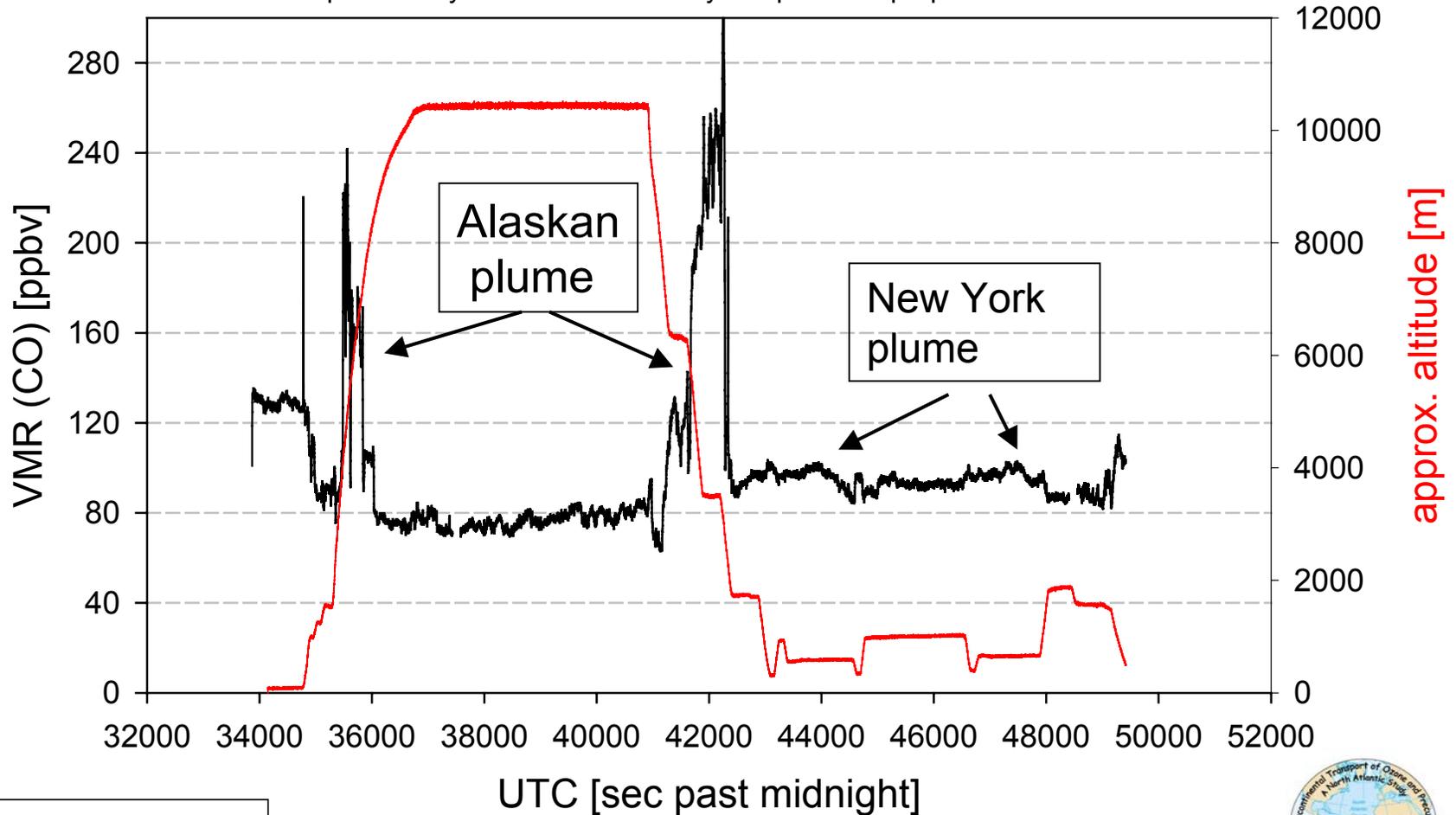
(provided by Isabelle Bey)

# DLR Falcon Flight Track 22 July 04



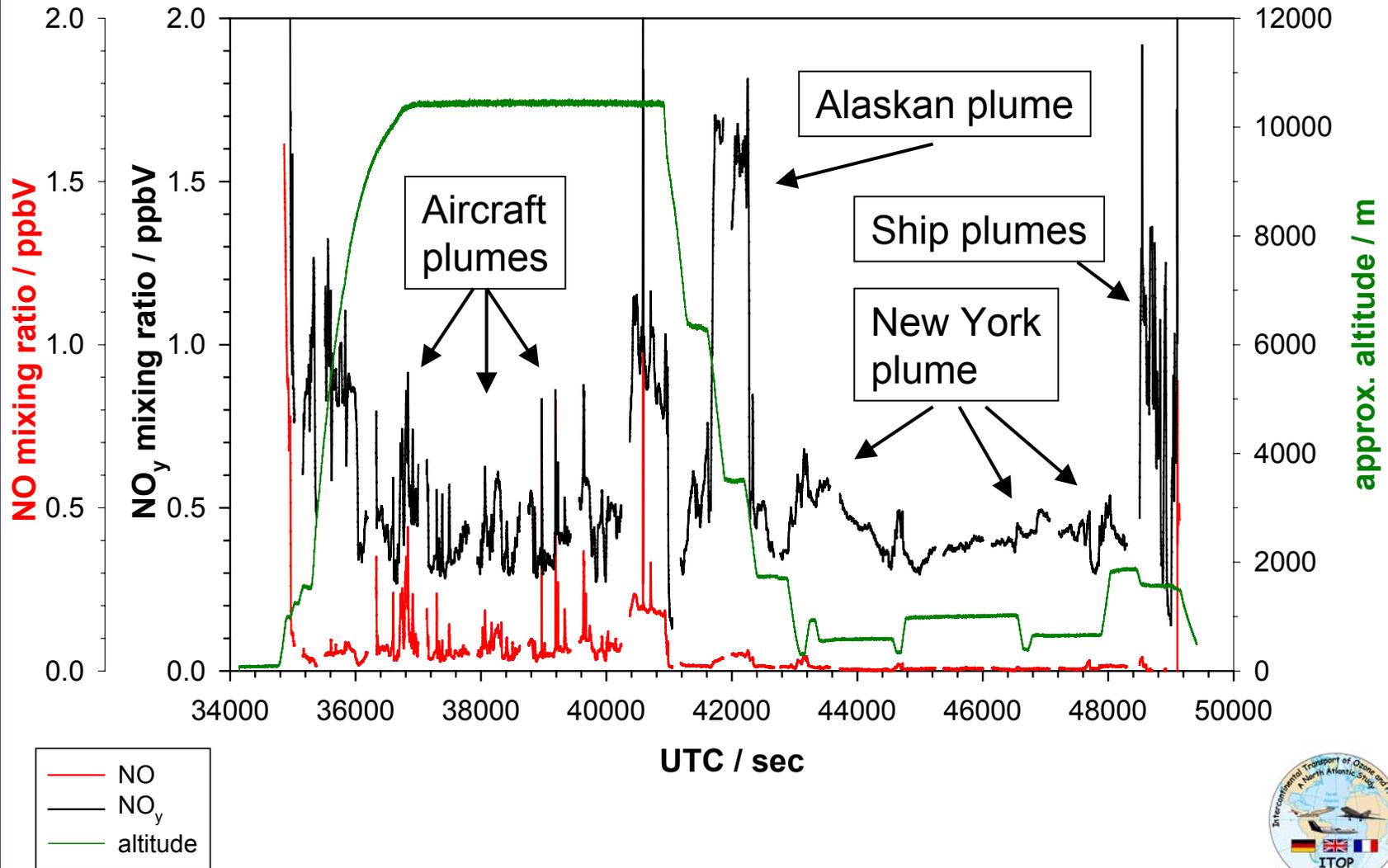
# CO Quicklook Data ITOP flight f040722a

preliminary data to be used only for quicklook purposes

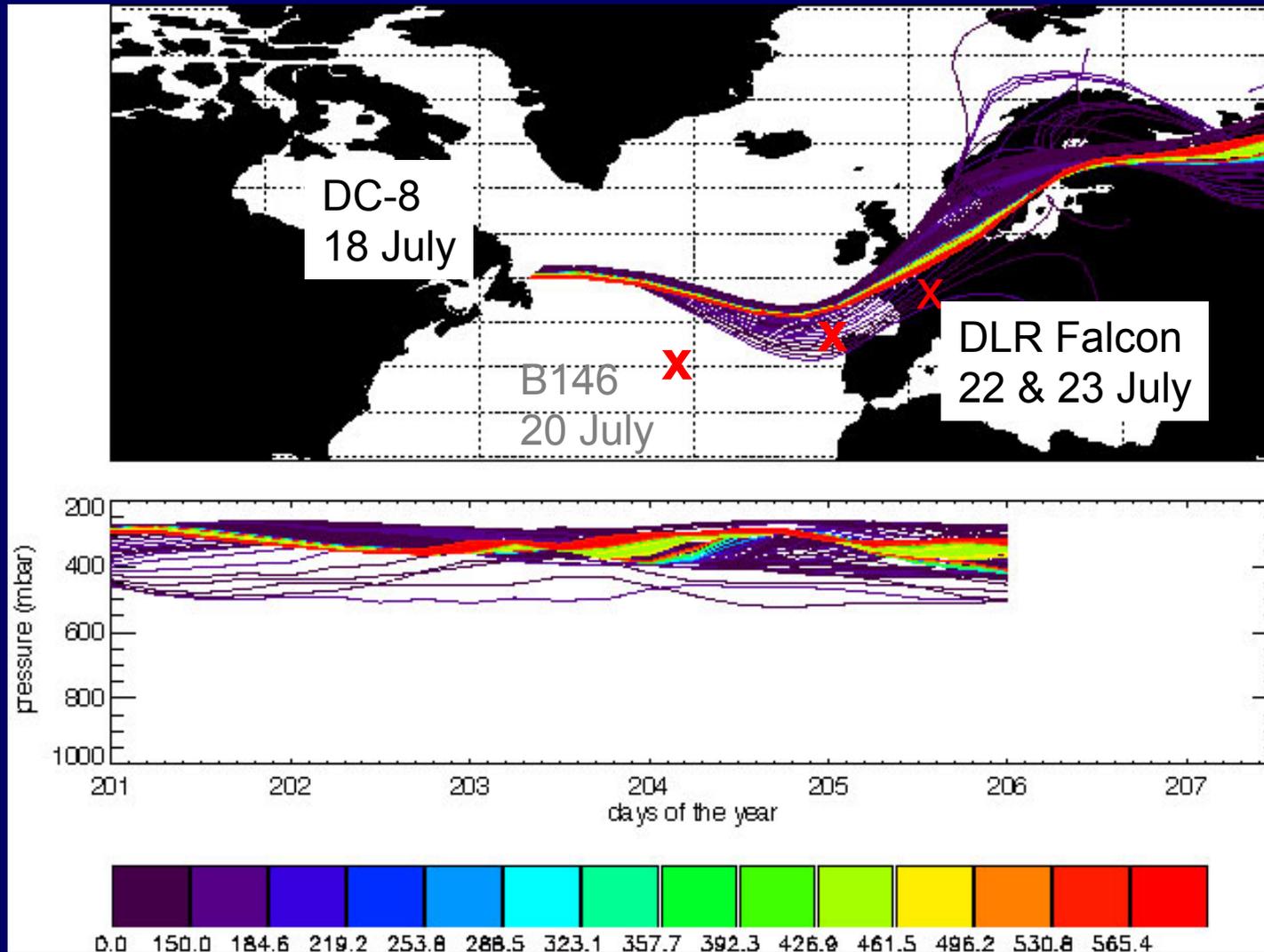


— VMR (CO) [ppbv]  
— approx. altitude [m]





# Forward trajectories from DC-8 flight on 18 July 04 from flight segment 19.00 - 19.25 UT (high CO)



# DLR Falcon 23 July 04

**SIRTA** INSTITUT PIERRE  
SIMON LAPLACE

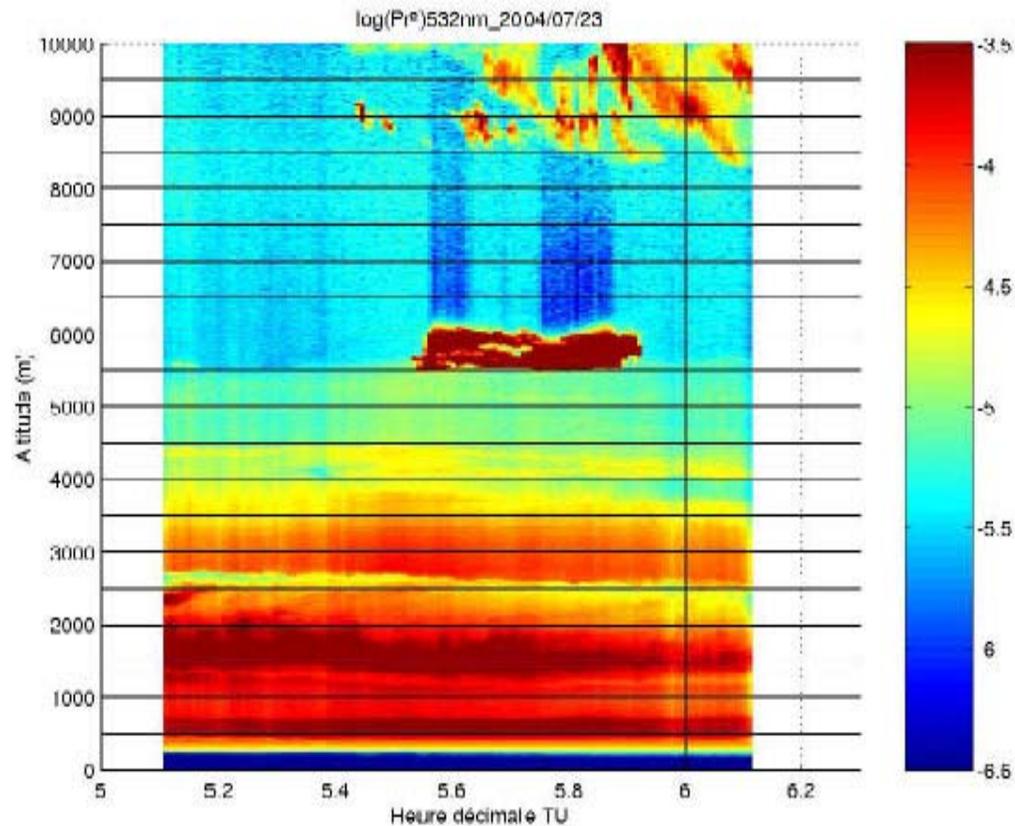
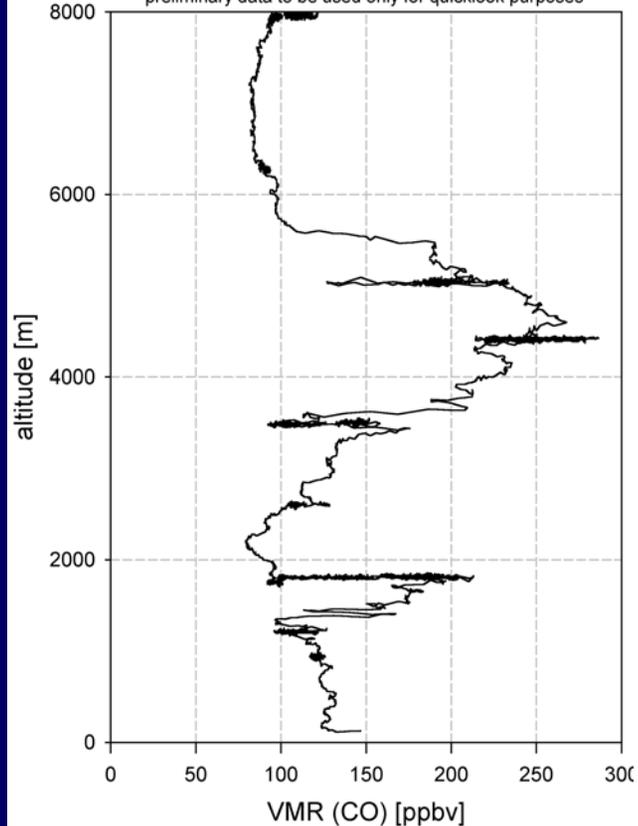
DES SCIENCES DE L'ENVIRONNEMENT

SITE INSTRUMENTAL DE RECHERCHE PAR TÉLÉDETECTION ATMOSPHÉRIQUE

2004/07/23

## CO-Profile Quicklook Data ITOP flight f0423

preliminary data to be used only for quicklook purposes



Courtesy: Martial Haeffelin & Christophe Pietras (IPSL, Paris)

(Courtesy: Hans Schlager)

**Present your ICARTT results during the  
General Assembly of the  
European Geosciences Union  
Vienna, Austria, 25 - 29 April 2005**



**Session AS3.04, Conveners: M. Lawrence, A. Stohl, Y. Yin**  
**Vertical and long-range transport of trace gases and aerosols**

**In 2005 ICARTT contributions will be especially invited**