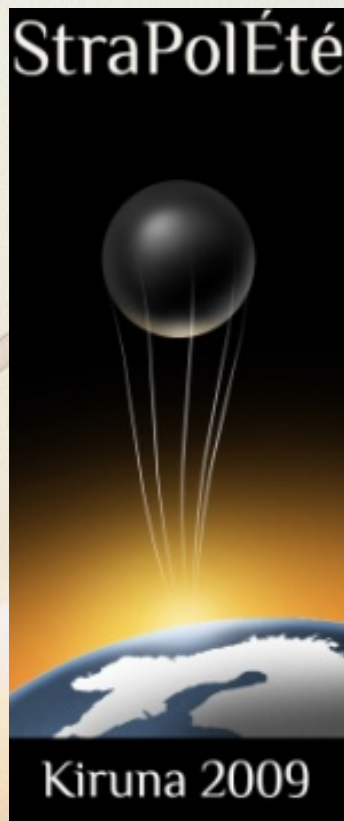




StraPolÉté [January 2009 - January 2013]

dynamics, aérosols et bromine content in the polar stratosphère during summer



Leader LPC2E –OSUC (Orléans,France) **N. Huret**

G. Berthet, V. Catoire, J.-B. Renard, V. Salazar, R. Thiéblemont, C. Robert, B. Gaubicher, M. Chartier, F. Berthet, G. Chalumeau, S. Chevrier, T. Vincent, L. Pomathiod, M.-A. Drouin, F. Jégou

LPMAA-UPMC (Paris,France) : S. Payan, C. Camy-Peyret, J. Bureau, P. Jeseck, I. Pépin, Y. Té

LOA-Univ Lille (Paris,France) : C. Brogniez, C. Verwaerde, J.-Y. Balois, F. Auriol, P. François

LATMOS-CNRS (Orléans,France) : F. Lefèvre, S. Godin-Beekmann, A. Hauchecorne

Univ Heidelberg (Germany): K. Pfeilsticker, M. Dorf

NILU (Norway): Y. Orsolini

FRENCH ETHER database



Général Context

Impact of the stratosphere on Climate change (Baldwin, Science, 2007).

Radiative budget associated with the stratosphere depends on :

- 1°) ozone, greenhouse gases, aerosols,
- 2°) latitudes and seasons.

Scientific questions?

- Which modifications on stratospheric circulation ? (Brewer-Dobson) ?
- troposphere-stratosphere coupling?
- radiative impact of stratospheric aerosols ?

⇒ OZONE – CLIMAT interaction

Why during summer in the polar stratosphere ?

-this season really poorly investigated due to the lack instrumentations able to perform measurements in summer (No solar occultation possible)

- now in situ measurements (SPIRALE), infra-red emission, microwave limb sounder (MIPAS ENVISAT satellite, MLS on AURA platform)

Project organization

Workpackage I : Balloon Campaign

Coordinator: N. Huret, V. Catoire, G. Berthet

From the 3rd August 2009 to the 7th of September 2009:

- **7 big balloon flights** (30 000 m³- 400 000m³)
- **Scientific payloads** from 100 kg to 500kg, launched by CNES team
- **Kiruna, Sweden** (67.9°N, 22.1°E)

Workpackage II : Dynamics

Coordinators: N. Huret and F. Lefèvre

Workpackage III: Stratospheric aerosol content

Coordinator: J.-B. Renard, C. Brogniez

Workpackage IV: Budget of inorganic bromine and trend

Coordinator: G. Berthet

Workpackage V: Reference state of the Summer stratosphere

Coordinator: S. Payan

Workpackage VI: Management

Principal Investigator of the project N. Huret

WP I : Polar Summer Campaign

Objectives:

- *balloon flights and satellite observations*
- *Instrumental developments for bromine and aerosol detections.*



Balloon data obtained

Ether Centre for Atmospheric Chemistry Products and Services

Atmos. chemistry | **Activities** | Data/Services | Community | Introduction to the website

Programs | Model/meas. | Assimilation | Chemistry lab. | Other Sites

StratPolEte > [Flights list](#) > [Flights list](#)

Flights list

Instruments	Species	Flights (yyyy-mm-dd)	
DOAS	NO ₂ , O ₃ , BrO	2009-09-07 and 2009-09-08	2 flights
ELHYSA	H ₂ O	2009-08-26	1 flight
LPMA	CH ₄ , HCL, HF, N ₂ O, NO ₂ , O ₃	2009-09-07	1 flight
μRADIBAL	Aerosols	2009-08-18	1 flight
SALOMON-N2	Aerosols, BrO, NO ₂ , O ₃	2009-08-25	1 flight
SPIRALE	CH ₄ , CO, HCl, HNO ₃ , N ₂ O, NO ₂ , O ₃ , OCS	2009-08-07 and 2009-08-24	2 flights
STAC	Aerosols	2009-08-02, 2009-08-07, 2009-08-14, 2009-08-18, 2009-08-24, 2009-08-25, 2009-08-26, 2009-09-07	8 flights
SWIR	CO ₂ , CO, H ₂ O, O ₃ , OCS	2009-08-14	1 flight

Ether Users : [LOGIN REQUEST](#) | [USER SPACE](#) | [ORDER TRACKING](#) | [USER RIGHTS](#)

Satellite data used

Instrument	Measurements
MLS (AURA)	O ₃ , NO ₂ , HCl, H ₂ O, CO
MIPAS SCIAMACHY (ENVISAT)	O ₃ , N ₂ O, CH ₄ , CO, NO ₂ , HNO ₃
IASI (MetOp)	O ₃ , CO, CH ₄ , N ₂ O, O ₃

Modelling interpretation

MODEL	Type	Characteristics	Outputs
FLEXPART	Trajectories calculations	ECMWF fields	Air mass origin
REPROBUS <i>Lefèvre et al. (1996)</i>	Tridimensional Chemical Transport Model	Comprehensive chemistry	Chemical species maps and vertical profiles
MIMOSA <i>Hauchecorne et al. (2002)</i>	PV contour advection model	High resolution of Potential Vorticity	Potential vorticity maps
MIMOSA_CHIM	Tridimensional Chemical Advection model	Advection on isentropic surfaces + Comprehensive Chemistry	Tracers (N ₂ O, CH ₄) maps and vertical profiles

Now
some preliminary results



WP II: Dynamics

Objectives: Characterization of the dynamical state of the summer polar stratosphere

- *Specific phenomena: “Frozen-In anticyclone”, “polar vortex remnants”*
- *Air mass origin*
- *Assessment of the Chemistry-Transport Models REPROBUS and MIMOSA-CHIM*
- *Diagnostic and improvement of transport representation by tests on the horizontal resolution and on the diabatic descent scheme and use of different assimilated wind fields to constrain model calculations.*

**« Frozen In Anticyclones » FrIACs :
Dynamical structures occurring during spring due to tropical air mass
intrusion injected in the summer polar circulation (~30 km)**

Oral presentation on Wednesday at 10:20, A32B Dynamics :

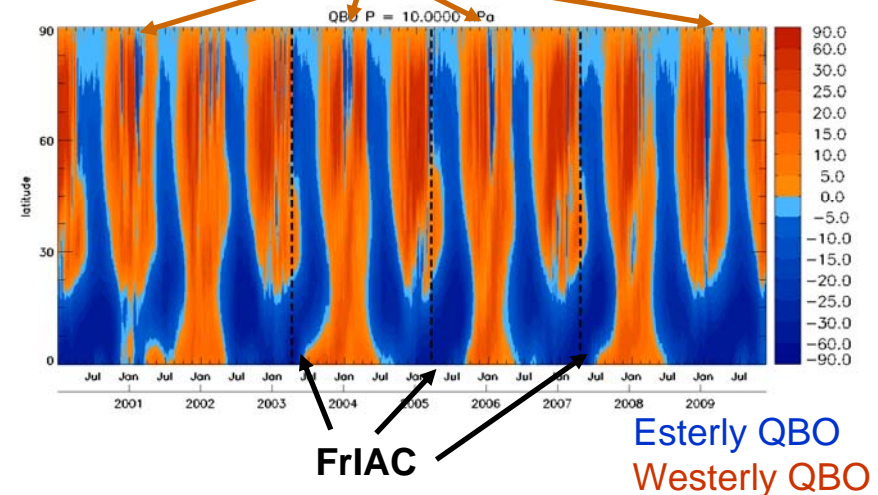
R. Thiéblemont, N. Huret, Y.Orsolini, F.Jégou,, A. Hauchecorne and M.-A. Drouin

FrIAC's climatology during the last decade :

- **3 cases has been identified**
 - **2005 Manney et al. (2006)**
 - **2003 Laohz et al. (2008)**
 - **2007 : this study**
- **And Only 3 cases : this study**

[2000-2009] Mean zonal wind mean
(ECMWF ~30km)

Sudden Stratospheric Warming

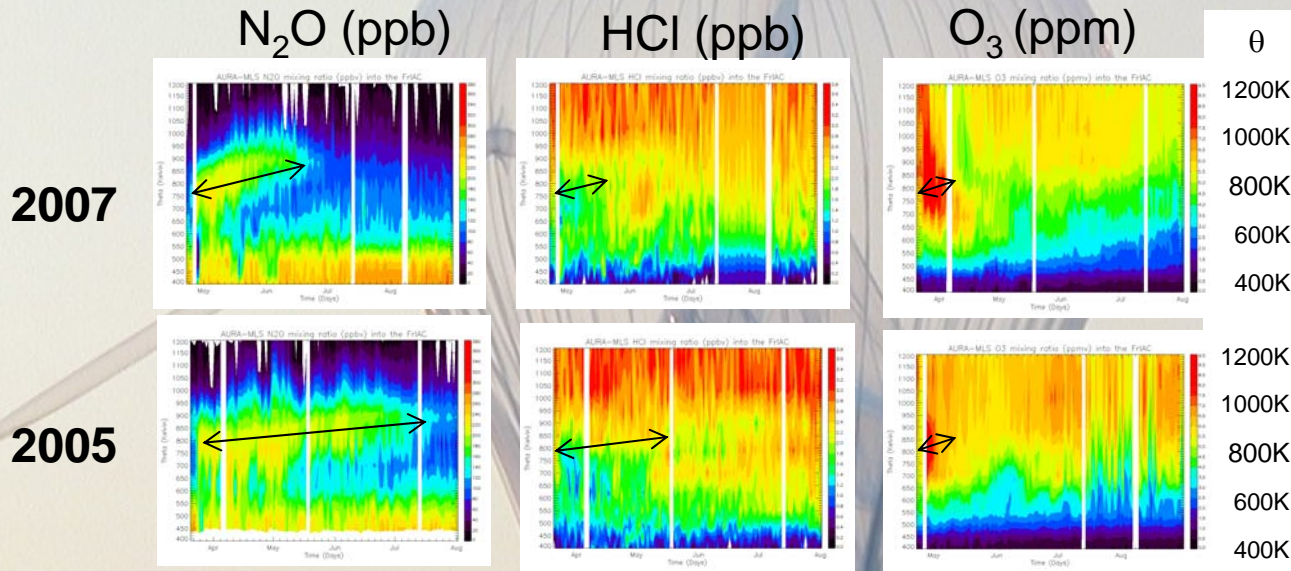


Conditions needed :

- **Esterly phase of the QBO (Quasi biennale Oscillation) in the tropics**
- **No Sudden warming during winter in polar region**

What is the chemical impact ?

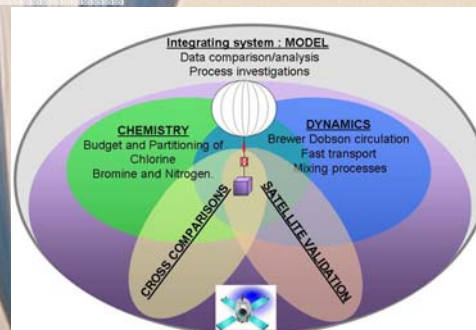
➤ *temporal evolution from April to August in the core of the FriAc*



Measurements from
MLS Instrument
on AURA platform

The duration of chemical perturbation depends on :
-the chemical species
-the event

Project : ENRICHED
European collaboration for Research on
stratospheric CHEmistry and Dynamics

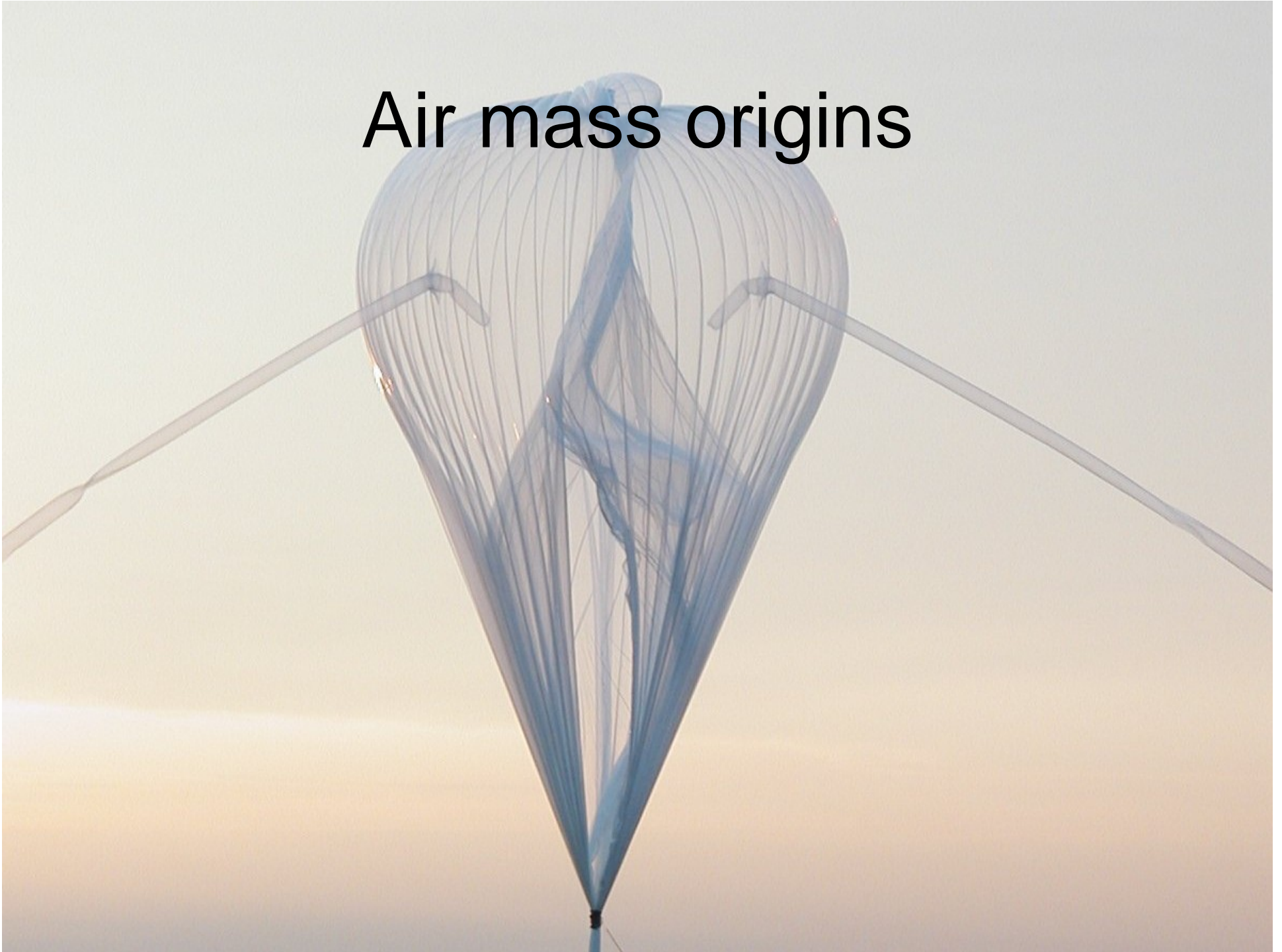


**Ballons flights planned
at Kiruna on April 2011**

- High vertical resolution
- long lived species
- Short lived species

Impact on reactive chemistry and ozone budget ?

Air mass origins



Preliminary results from SPIRALE balloon-borne *in situ* stratospheric

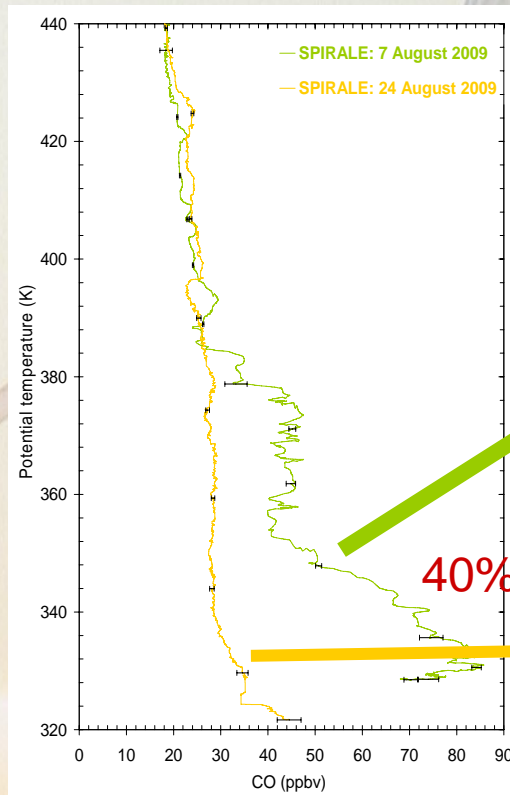
07 August 2009: DAYTIME

Poster session :

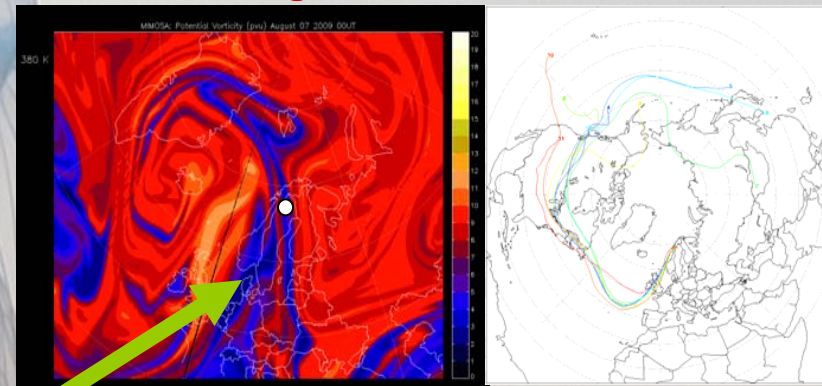
Wednesday 13:40

Troposphere and stratosphere ozone

G. Kryztofiak V. Catoire, N. Huret,
G. Berthet, R.Thiéblemont, C. Robert

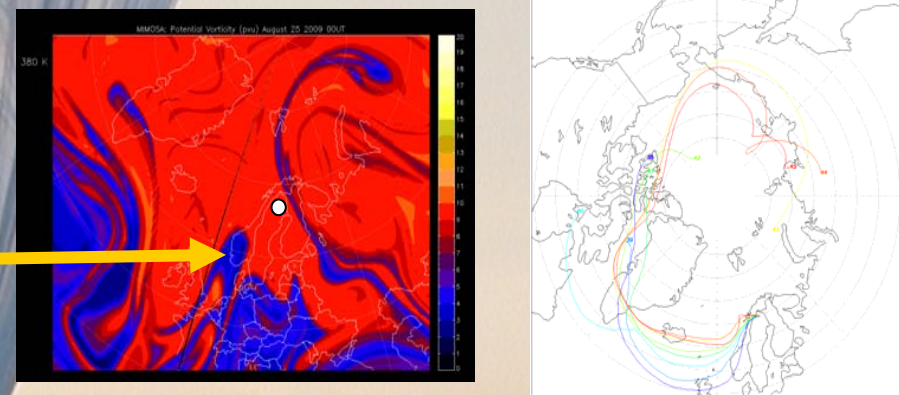


40%-60%



PV MIMOSA map (at 380K) 10 days Backward trajectories
⇒ Intrusion of recent air from USA and north
pacific mid-latitudes

24 August 2009: NIGHTTIME



PV MIMOSA map (at 380K) 10 days Backward trajectories

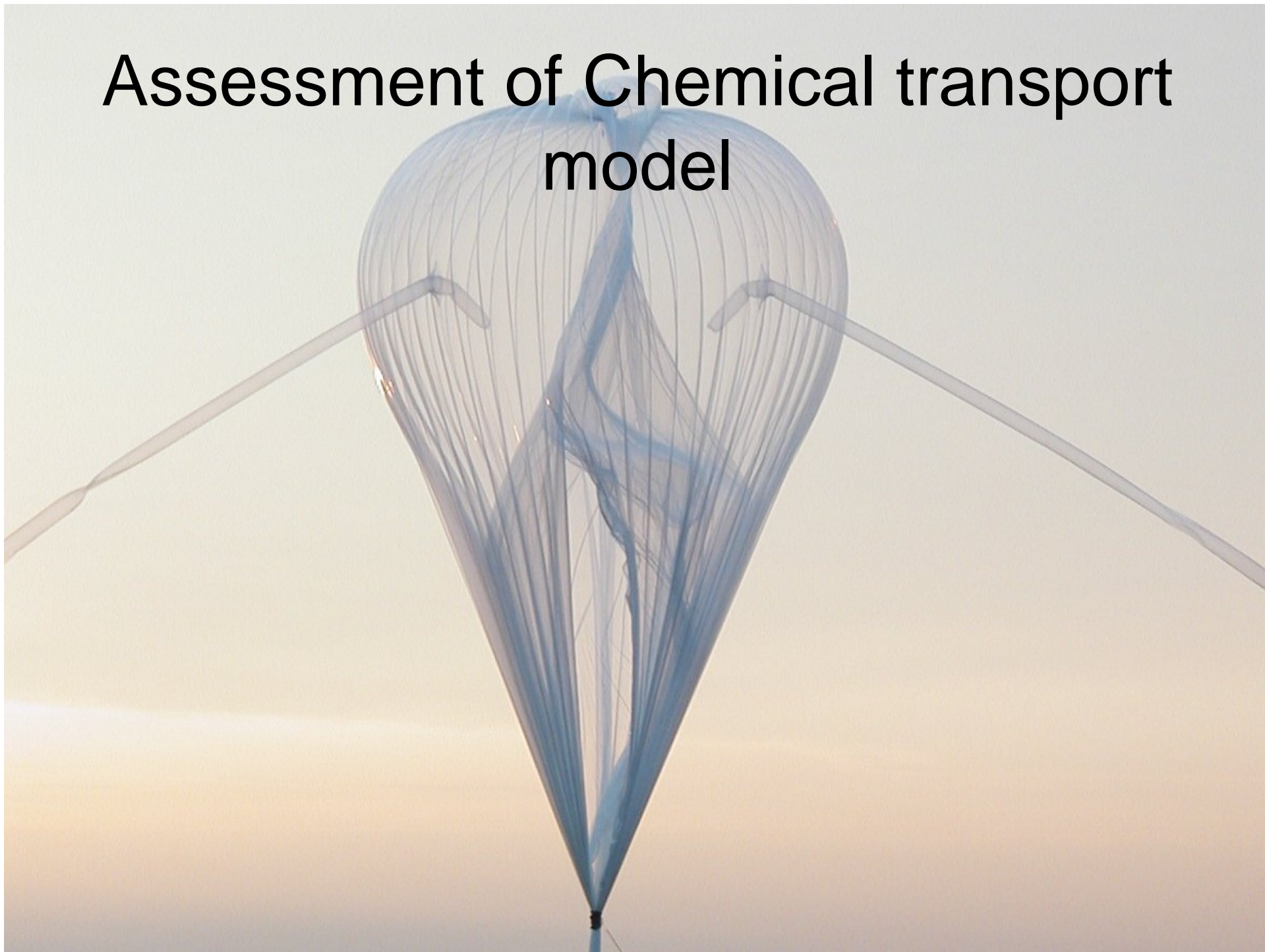
⇒ Typical polar summer air.

Recent air in polar stratosphere

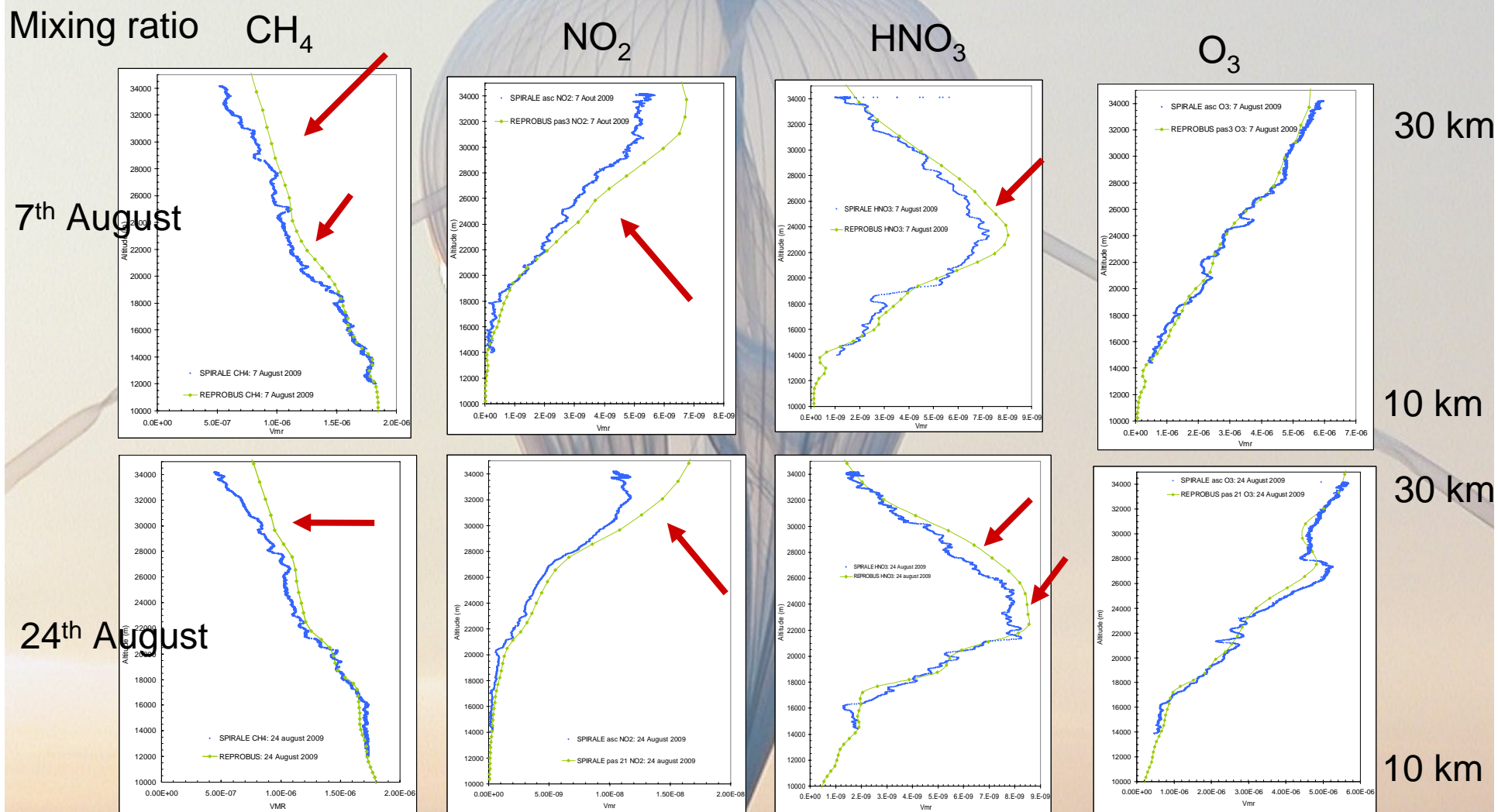
⇒ Using the correlations between CO and O₃, we calculate the percentage of recent air in polar stratosphere for the both flights.

Courtesy : G. Kryztofiak, LPC2E, Orléans, France

Assessment of Chemical transport model



REPROBUS 3D CTM
 SPIRALE in-situ measurements



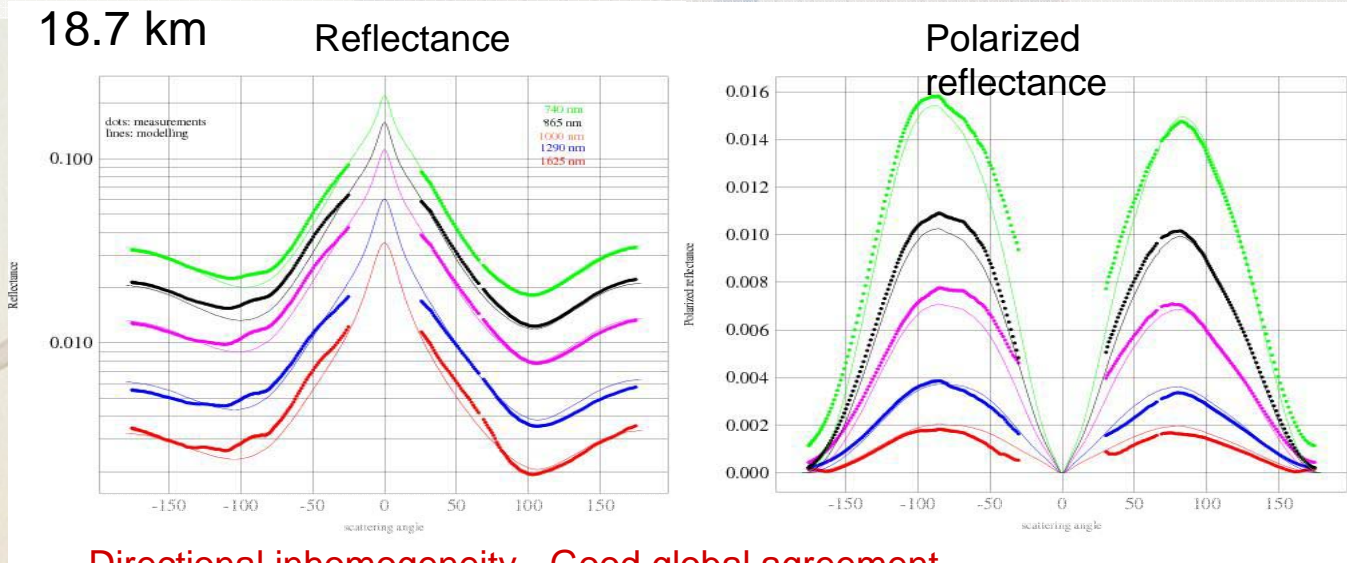
Over estimation of REPROBUS for CH₄ HNO₃, NO₂
 Altitude range of the discrepancies depends on the species considered

Courtesy : F. Jegou, LPC2E, Orleans, France

WP III: Summer stratospheric aerosol content

- *Determination of partitioning between liquid (sulphate droplets) and solid (soots and interplanetary dusts) particles.*

Preliminary results of microRadibal Brogniez et al. (2003) instrument



Directional inhomogeneity - Good global agreement

Above ≈ 28 km : **soot** particles $r_m \approx 0.5 \mu\text{m}$, $\sigma \approx 0.6$, $N \approx 0.015 \text{ cm}^{-3}$

Below ≈ 22 km : **sulfate** aerosols : $r_m \approx .075 \mu\text{m}$, $\sigma \approx 0.55$, $N \approx 20 \text{ cm}^{-3}$

Between : mixing of **sulfate** aerosols + **absorbing** particles

Perspectives

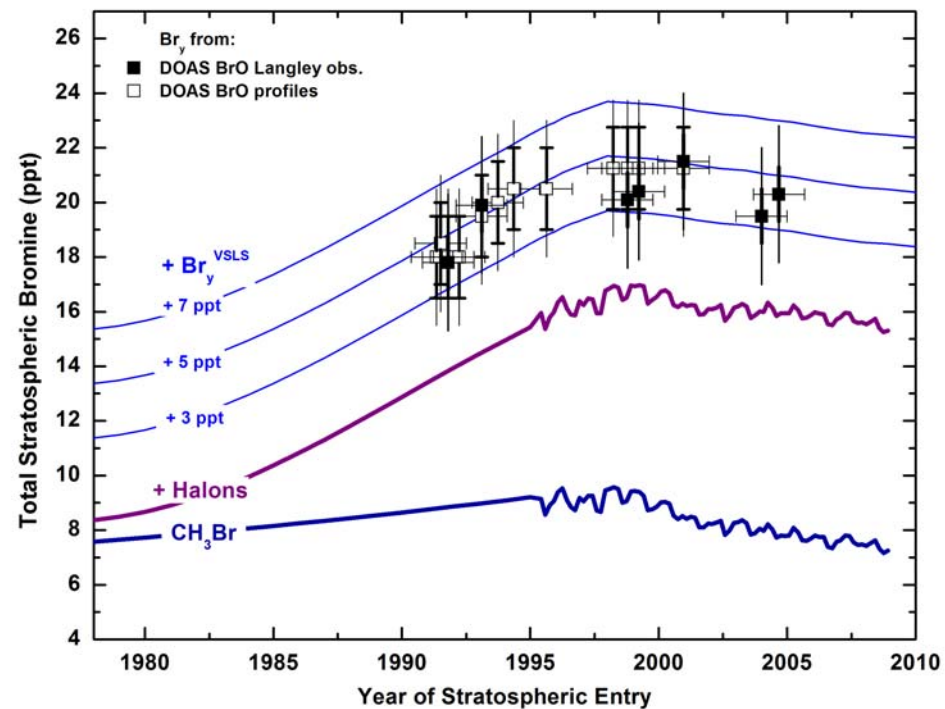
- Try distribution of absorbing **non-spherical** particles
- Compare with STAC in-situ aerosols counter measurements

Courtesy : C. Brogniez, LOA-Univ Lille, France

WP IV: Budget of inorganic bromine and trend

Objectives:

Measurements of the BrO radical amounts in the stratosphere
Determinate of the stratospheric bromine trend (WMO, 2006;
Dorf et al., 2006).

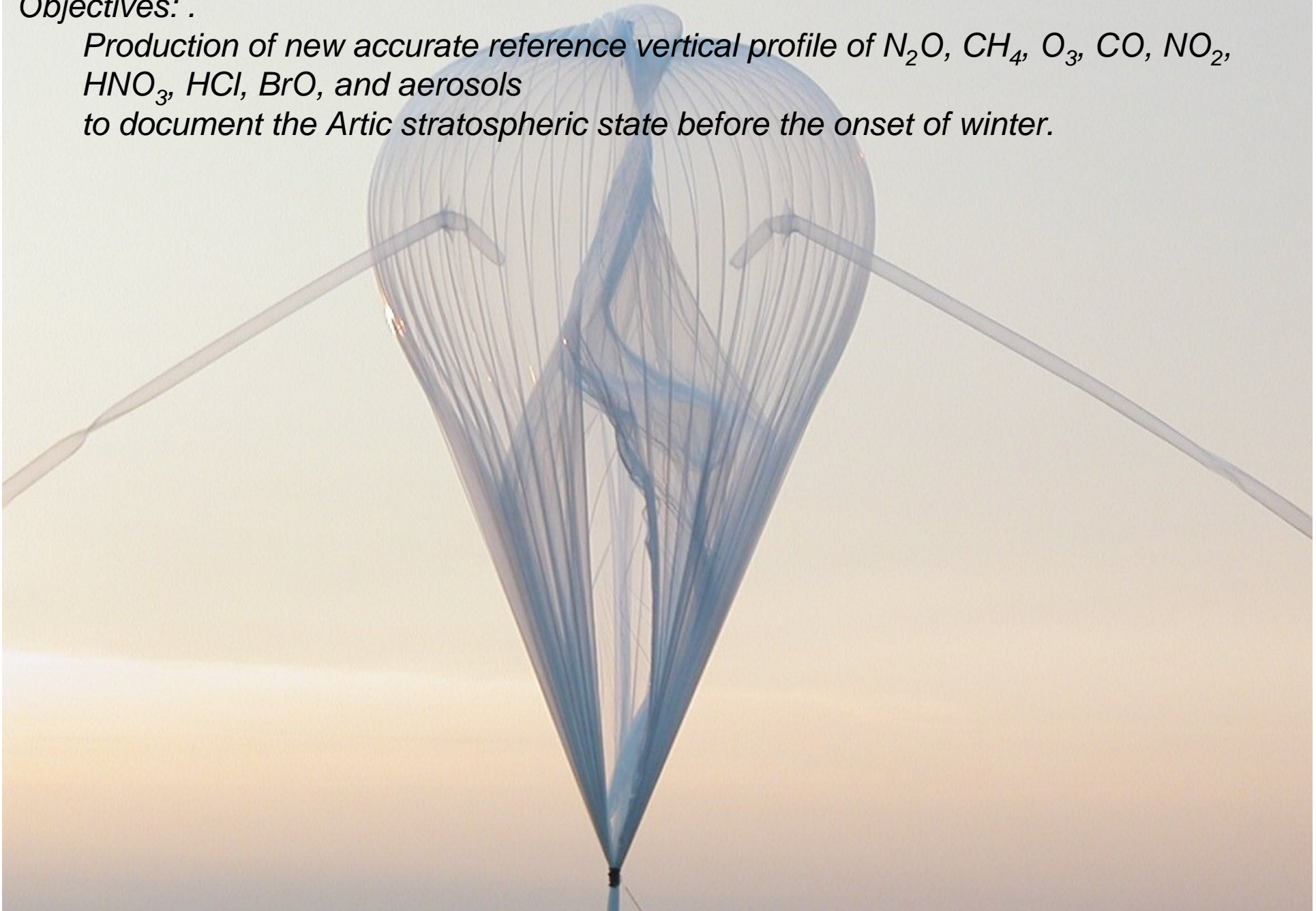


Courtesy : M. Dorf and K. Pfeiltsicker, Univ Heidelberg, Germany

WP V: Reference state of the Summer stratosphere,

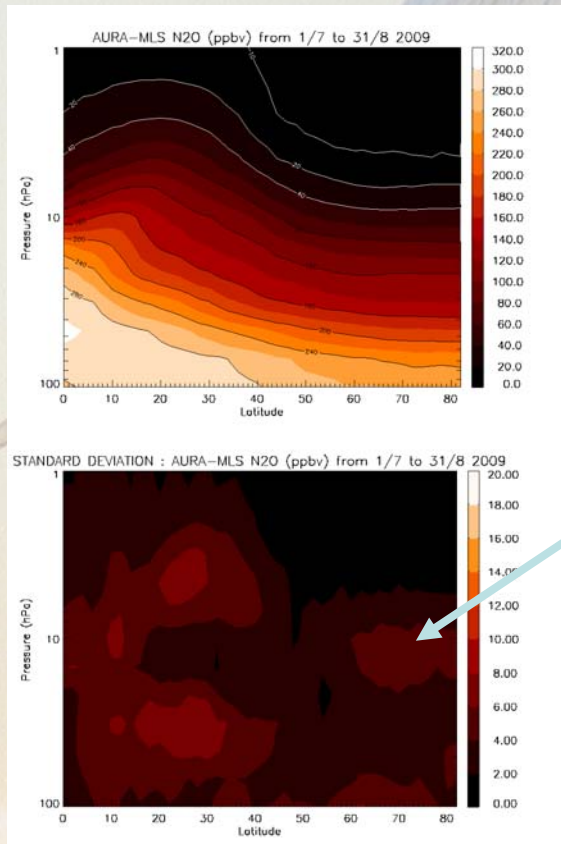
Objectives: .

Production of new accurate reference vertical profile of N_2O , CH_4 , O_3 , CO , NO_2 , HNO_3 , HCl , BrO , and aerosols to document the Arctic stratospheric state before the onset of winter.

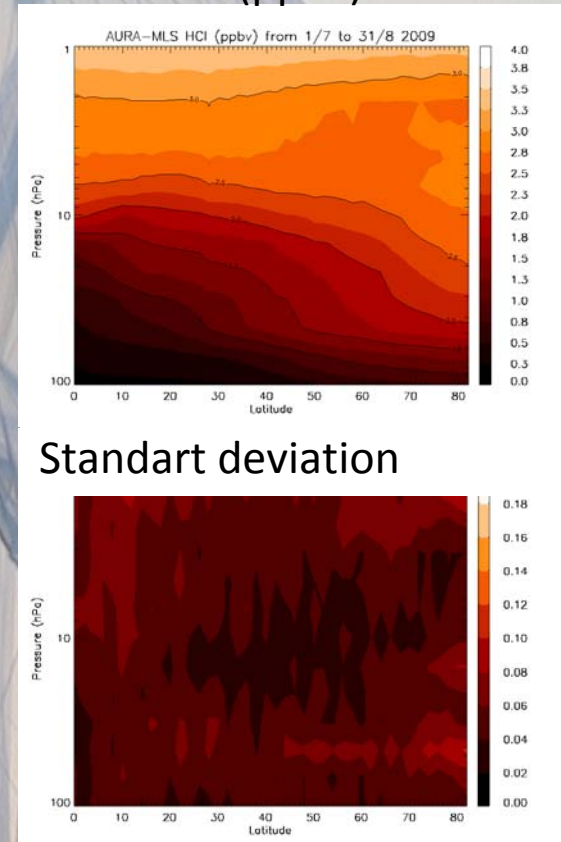


Example of climatology with MLS from July and August

N₂O (ppbv)



HCl (ppbv)



Perspectives

- Compare with MIPAS measurement on ENVISAT satellite
- Compare several years
- Compare with CTM REPROBUS model

Courtesy : S. Payan, LPMA-UPMC , Paris, France

Web site of the project : <http://lpce-strapoete.fr>

StraPolÉté
Kiruna 2009

Home
News
Partners
Workpackages
Instruments
Campaign
Calendar
Download Data
Jobs
Download Docs
Photo Gallery
New
Bibliography
Mailing Lists
Contacts & Links

Welcome
StraPolÉté Project

**Summer Polar Stratosphere:
dynamics, aerosols and bromine content**

Logos: CNES, ANR, IPEV, and others.

Principal Investigator: [Nathalie HURET](#)

Supported by ANR decision BLAN08-1_316271
©January 2009 - Marc-Antoine Drouin
Last update 11/16/2010

Thanks for your attention