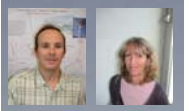
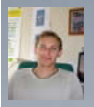
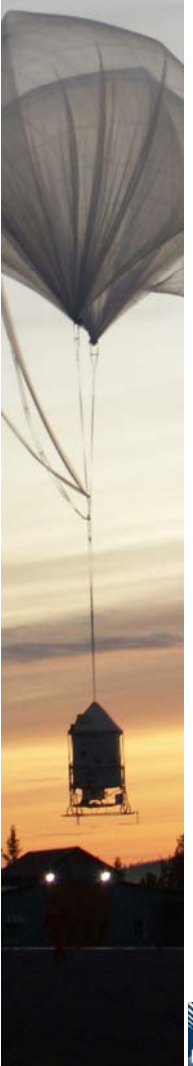




Preliminary results from SPIRALE balloon-borne *in situ* stratospheric measurements during 2009 polar summer

Valéry Catoire, Nathalie Huret, Gwenaël Berthet, Gisèle Krysztofiak, Rémi Thiéblemont, Claude Robert
LPC2E-OSUC, UMR 6115 CNRS-Université d'Orléans,
3A Avenue de la Recherche Scientifique, 45071 Orléans Cedex 2, France

The SPIRALE (french acronym for infrared absorption spectroscopy by tunable laser diodes) balloon-borne instrument has been launched twice within 17 days in the polar region (Kiruna, Sweden, 67.9°N - 21.1°E) during summer, at the beginning and at the end of august 2009. In situ measurements of the trace gases O3, CH4, CO, OCS, N2O, HNO3, NO2 and HCl have been performed between 10 and 34 km height, with very high vertical resolution (~5 m). The stratospheric profiles of these species present specific structures associated with tropical intrusion in the low levels. The both flight results are compared between each other in order to evaluate the impact of the turn-around occurring during this season on the chemical composition of the stratosphere. Their interpretation is made with the help of results from several modelling tools and available satellite data. SPIRALE flights were part of the balloon campaign conducted by CNES within the frame of the StraPolÉté project funded by French agencies ANR, CNES and IPEV, contributing to the International Polar Year.

The SPIRALE instrument: Infrared absorption spectroscopy of tunable laser diodes



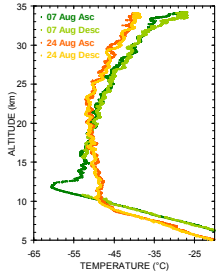
✓*In situ* measurements of several tracers and chemically active species.
✓Laser absorption takes place in an open air Herriott cell with 6 diodes as light sources in the domain 1250 - 3000 cm^{-1}.
✓Very long absorption path (434 m here) between 2 mirrors due to a deployable mast 3.5 m.
✓ Fast measurements (every 1.1 s) permit a vertical resolution of 5 m.
✓ Detection limits of few ppbv with uncertainties of 3% - 30% depending on the abundance of the species.

The sequence of the flights:

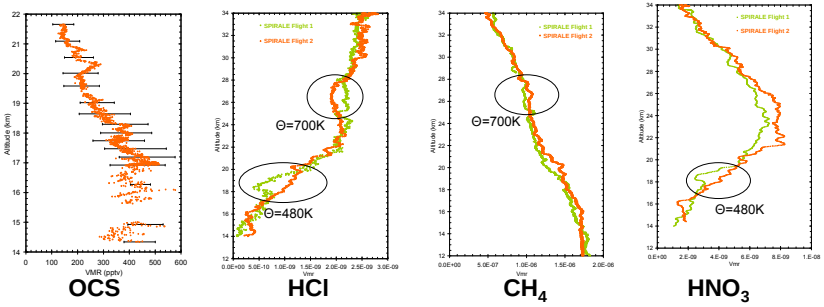
✓ SPIRALE 1st flight: 07 Aug 2009: DAYTIME
Measurements from 01:45 to 06:00 UT (3h45-8h local)

✓ SPIRALE 2nd flight: 24 Aug 2009: NIGHTTIME
Measurements from 20:49 to 01:38 UT (22h29 – 3h38 local)



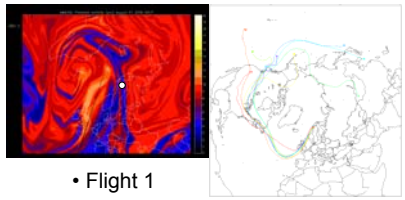



Preliminary results: Intrusions tropical indications



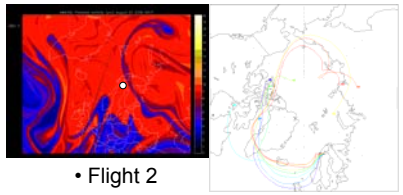
⇨Like CO, explanations will be found for the specific structures of these profiles.

Exploitation of the results : Detection of recent air in polar stratosphere



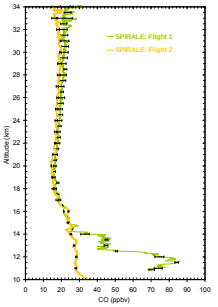
• Flight 1

MIMOSA map (at 380K) and FLEXTRA map (below 14 km during 10 days)



• Flight 2

MIMOSA map (at 380K) and FLEXTRA map (below 14 km during 10 days)



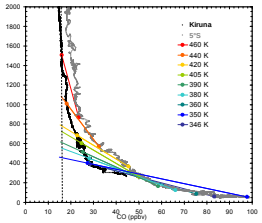


Figure: O_3-CO correlation for Teresina (5°S in 2005) and for Kiruna (in 2009). The lines represent the isentropic surfaces.

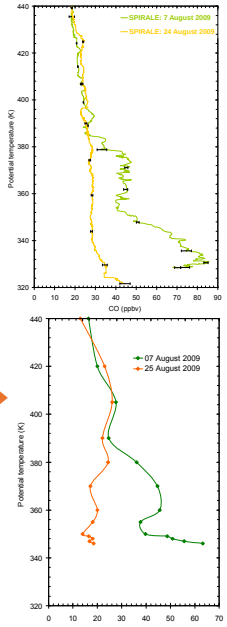


Figure: CO concentration profile (SPIRALE) and percentage of recent air for the 2 flights.

•Pirre et al. (2008) used the O_3-CO correlations between two different latitudes to measure the percentage of recent air in the stratosphere at midlatitude. We did the same reasoning for the Kiruna latitude.

⇨ Next step: Influence of the intrusions of recent air on the chemistry of the polar stratosphere in summertime.

• The first flight of SPIRALE occurred in specific condition.
•The origin of air masses influences the concentration profile of some species such as CO.

REFERENCES:
Hauchecorne et al., Quantification of the Transport of Chemical Constituents from the Polar Vortex to Middle Latitudes in the Lower Stratosphere using the High-Resolution Advection Model MIMOSA and Effective Diffusivity, J. Geophys. Res., 107, 8289–8302, 2002.
Lefèvre et al., Chemistry of the 1991-1992 stratospheric winter : Three-dimensional model simulations, J. Geophys. Res., 99, 9183-8195, 1994.
Stohl et al., Interpolation errors in wind fields as a function of spatial and temporal resolution and their impact on different types of kinetic trajectories, J. Appl. Meteor., 34, 2149-2165, 1995.
Huret N. et al. "An overview of the StraPolEté project : dynamics, aerosols and bromine content of the polar region in summertime" Presentation A11I-01
Thiéblemont R. et al. "On the occurrence, the characterization and the dynamical processes associated with FrIAC's (Frozen In Anticyclones) events" Presentation A32B-07
Pirre, M., I. Pisso, V. Marecal, V. Catoire, Y. Mebarki, and C. Robert (2008), "Intrusion of recent air in midlatitude stratosphere revealed by in situ tracer measurements and trajectory calculations", *J. Geophys. Res., 113, D11302, doi: 10.1029/2007JD009188*

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