Research on the stratospheric ozone layer in France
- Courtesy translation -

Research on the stratospheric ozone layer in France is mainly performed by the following laboratories :

- LATMOS http://www2.latmos.ipsl.fr/index.php/en
- LACy http://lacy.univ-reunion.fr/home/
- Laboratoire d'Aérologie http://www.aero.obs-mip.fr/
- CNRM http://www.cnrm.meteo.fr/

Moreover, Sophie Godin-Beekmann (Observatoire de Versailles Saint-Quentin-en-Yvelines) is the Secretary of International Ozone Commission (IO_3C).

It focuses on the following topics :

1. Monitoring of ozone long term evolution at global scale

The surveillance of the ozone layer is based on measurements performed within ground-based observation networks (e.g. NDACC – Network for the Detection of Atmospheric Composition Changes and GAW - Global Atmosphere Watch), on board aircrafts (e.g. IAGOS – In situ Aircraft for a Global Observing System) or satellite (e.g. GOMOS instrument aboard the ENVISAT platform).

LATMOS and LACy contribute to NDACC through (1) lidar measurements of ozone, temperature and aerosols vertical distribution in the stratosphere and (2) UV-Visible spectrometer measurements of ozone and nitrogen dioxide integrated contents. Measurements are performed at several key NDACC stations: Observatoire de Haute Provence (France), Dumont d'Urville (Antarctica), Réunion Island (France), Alomar (Norway) and within the SAOZ network that includes 13 UV-Visible spectrometers implemented in stations located in France, Siberia, Brasil and Antarctica. Measurement time series of more than 30 years for some of them provide a detailed picture of the long term evolution of ozone and associated parameters. They enable the quantification of ozone decreasing trends up to the end of the 1990s and show its stabilization thereafter with signs of increase at some stations (Figure 1).

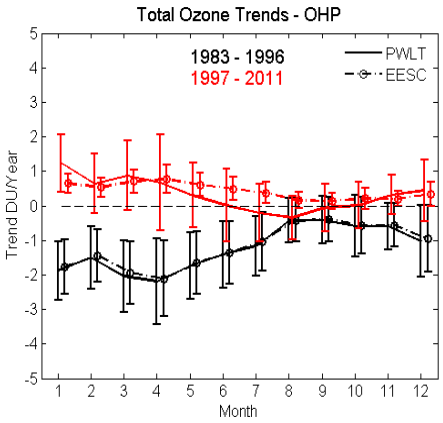

Figure 1 : Total ozone trends at Observatoire de Haute-Provence for the two periods (1983-1996 et 1997-2011), using two methods for the evaluation of the long term evolution of ozone depleting substances in the stratosphere (Piecewise linear trend and Equivalent Effective Stratospheric Chlorine), from Nair et al., 2013[1].

1 Nair, P. J., Godin-Beekmann, S., Kuttippurath, J., Ancellet, G., Goutail, F., Pazmiño, A., Froidevaux, L., Zawodny, J. M., Evans, R. D., Wang, H. J., Anderson, J., and Pastel, M.: Ozone trends derived from the total column and vertical profiles at a northern mid-latitude station, Atmos. Chem. Phys., 13 (20), 10373-10384, 2013, doi:10.5194/acp-13-10373-2013

Laboratoire d'Aérologie, together with the Forschungszentrum Jülich (Germany), is responsible for the MOZAIC and IAGOS airborne observations of ozone in the upper troposphere and lower stratosphere (UTLS). MOZAIC observations (August 1994 - today) are airborne in-situ measurements for ozone, water vapor, carbon monoxide, and total nitrogen oxides (NO_y). Data acquisition is automatically performed during round-trip international flights (ascent, descent and cruise phases) from Europe to America, Africa, Middle East, and Asia. IAGOS observations (July 2011 - today) include ozone, water vapor, carbon monoxide, and cloud droplets (number and size). The time series of MOZAIC-IAGOS ozone measurements allow the quantification of ozone long-term trends in the critical UTLS region.

2. Evaluation of ozone chemical destruction in the springtime in the polar regions

The study of ozone destruction in the polar regions is performed by LATMOS, using satellite or ground-based measurements of ozone, together with chemical transport models (e.g. REPROBUS or MIMOSA-CHIM) developed at the laboratory. Of particular importance was the study of the record ozone depletion in the Arctic spring 2011. Very unusual meteorological conditions in the Arctic characterized by a cold and prolonged polar vortex induced a chemical ozone destruction that was similar to the destruction observed in the 1980s in Antarctica (Figure 2)

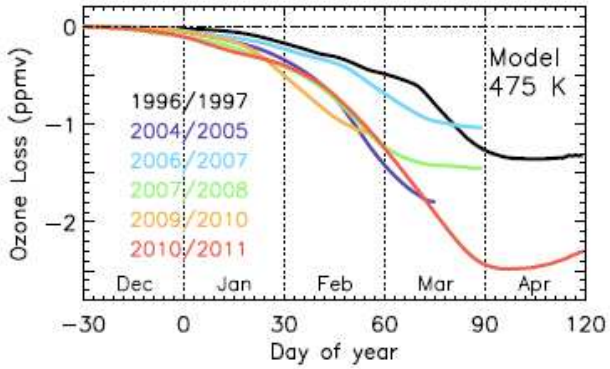

Figure 2 : Ozone loss at around 18 km altitude simulated by the MIMOSA-CHIM chemical transport model for various Arctic winters in the period 1997 – 2011, from Kuttipurath et al., 2012[2].

3. Simulation of the stratospheric ozone recovery and impact of climate change

The study of the ozone recovery is performed by LATMOS and CNRM using the global chemistry-climate models LMDz-REPROBUS, a component of the IPSL Earth system model, and CNRM-ACM. Several simulations were made based on different scenarios for the evolution of stratospheric halogen content and greenhouse gases emissions. The performance of the models were also tested by comparing hindcast simulations with observations, in the frame of a large scale chemistry climate model evaluation exercise (CCMVal project) organised for the last WMO UNEP international report on the state of the ozone layer (WMO, 2011)[3].

4. Next international report on the state of the ozone layer, to be published in 2014

The following French researchers are contributing to this report:

- Slimane Bekki (LATMOS): editor of chapter 3 (Polar Ozone)
- Cathy Clerbaux (LATMOS): co-author of chapter 1 (Ozone-Depleting Substances)
- Sophie Godin-Beekmann (OVSQ): lead author of chapter 3 (Polar Ozone)
- Kathy Law (LATMOS): co-author of chapter 5 (Scenarios, Information, and Options for Policymakers).

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2 Kuttippurath, J., S. Godin-Beekmann, F. Lefèvre, G. Nikulin, M. L. Santee, and L. Froidevaux, Record-breaking ozone loss in the Arctic winter 2010/2011: comparison with 1996/1997, Atmos. Chem. Phys., 12(15), 7073-7085, 2012, doi: 10.5194/acp-12-7073-2012

3 WMO, Report 53, Scientific assessment of ozone depletion; 2010, Global ozone research and monitoring project, Geneva, 2011.