ITALY

INTRODUCTION

Italy is active in many areas of stratospheric research, including atmospheric processes, monitoring of ozone and UV levels, modeling of ozone and related species. Most of the research is performed by Universities and Italian Research Council's (CNR) groups, but also by other institutions (i.e., ISPRA, ENEA, Air Force Meteorological Service). In the last years, these research activities have been supported by the Italian Government, Italian Space Agency (ASI), European Space Agency (ESA) and European Union.

Following the recommendations of the fifth meeting of the Ozone Research Managers, in 2003-2005, the ozone-related research has covered the traditional monitoring and archiving of measurements of tropospheric and stratospheric ozone, of other trace species and aerosols; but there was also a strong impulse to the development and implementation of new observational capabilities such as aircraft-based measurements (i.e. APE, Airborne Platform for Earth observation). Moreover, more attention has given to study the interaction between ozone and climate. The modeling activities covered the development of the algorithms for assimilating satellite data in a class of models, as well as, the full chemical and transport parameterization, and trajectory modeling, the latter has been mainly used to interpret the field data.

OBSERVATIONAL ACTIVITIES

Profile measurements of ozone

Old database

Balloon ozone soundings were performed at S. Pietro Capofiume (44.6N, 11.6E) on a weekly base from 1991 to 1997, and after that during short time campaigns. A similar activity was performed at University of L'Aquila (43.3N 13.3E) but the soundings were quite sparse on time base, from 1994 to 2002. Concerning older database, at University of L'Aquila, DIAL (Differential Absorption Lidar) ozone measurements have been also taken almost continuously from 1991 to 1996, more sparse from 1997 to 1999.

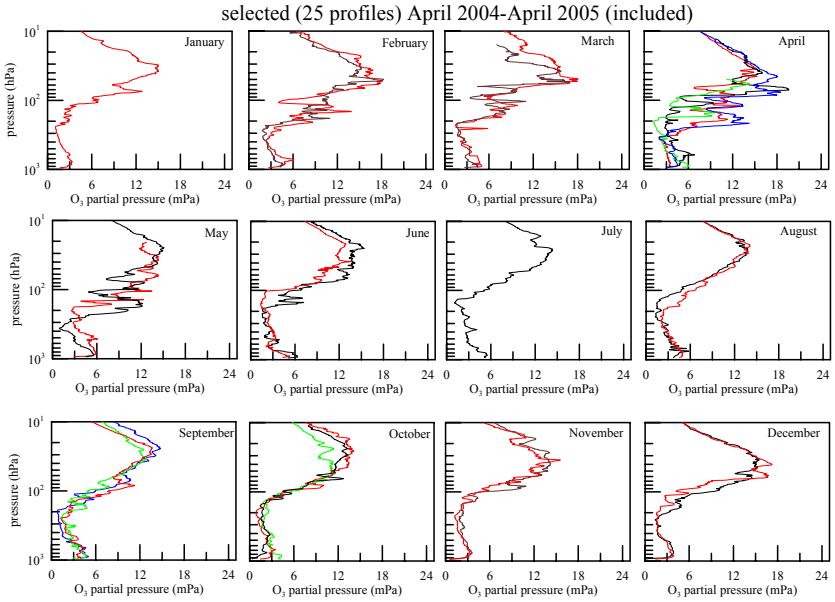

Figure 1: University of L'Aquila/CETEMPS balloon ozone soundings: ozone partial pressure vs. atmospheric pressure, in the period April 2004-April 2005. The data taken in different days are grouped per month.

Recent ozone profile monitoring

According to the commitments included in a convention between University of L'Aquila/CETEMPS (Center of Excellence for the integration of remote sensing techniques and modeling for the forecast of severe weather) and Italian Government/Ministry of Environment, from 2003, balloon ozone soundings are performed (at least 2 per months) at L'Aquila. The latter constitute the more recent and extended database of ozone profiles (see Figure 1 and Figure 2).

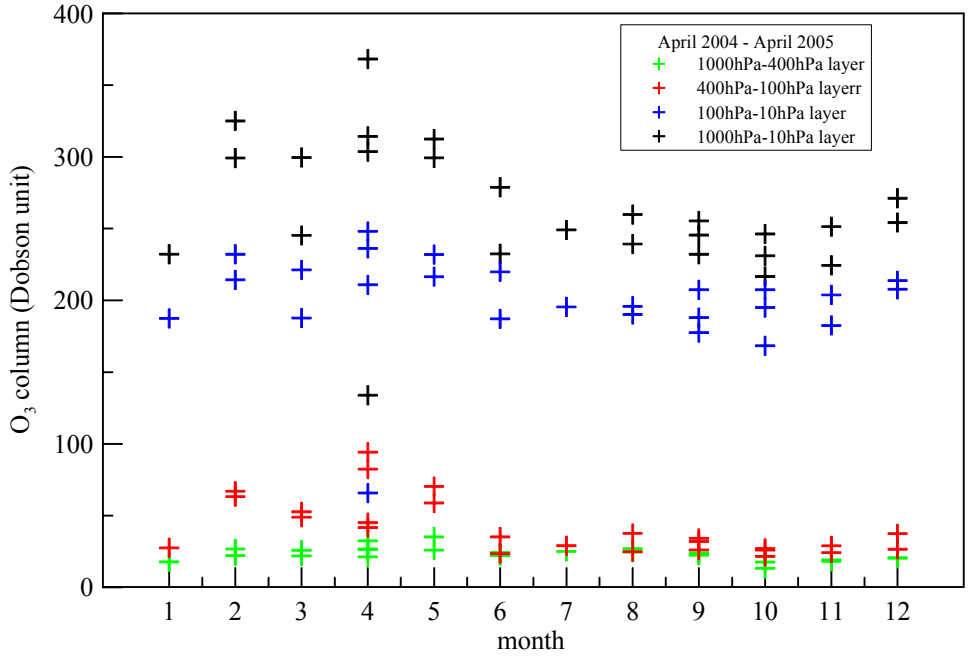

Figure 2: Ozone columnar densities (Dobson unit) at different height levels, as derived from the ozone profiles in Figure 1.

These data allows to figure out a good representation of the climatological behaviour of the stratospheric ozone in a geographical region centred over Italy. The ozone profile data analysis is in progress: the weather and dynamical patterns on continental scale should be considered for each observation to discriminate among the different processes affecting the evolution of the stratospheric and tropospheric ozone content.

UV and ozone column measurements

Currently, there are more than 10 UV/total ozone monitoring instruments (Brewers, pyranometers, spectrophotometers, see Table 1). The operating agencies are ISPRA, ENEA, Italian Meteorogical Service, CNR, and several universities.

Table 1: Some of the Italian UV/total ozone monitoring instruments (Brewers, pyranometers, spectrophotometers).

Instruments	Location
17 Brewer Mark IV	Modena
21 RB-501	Bolzano
22 Brewer Mark IV	Ispra
24 Bentham DM 150	Ispra
78 Brewer Mark IV	Rome

304 Brewer Mark IV	Vigna di Valle
305 Brewer Mark IV	Brindisi
306 Brewer Mark IV	Messina
Brewer Mark III	Lampedusa
UVB/UVA Pyranometer (YES)	Ispra
UVB/UVA Pyranometer (YES)	L'Aquila
UVB Pyranometer (YES)	Rome

Data from most of the stations are regularly sent to the central and coordinated database (e.g. WOUDC). These activities, still continuing, have been described in details in the previous report (WMO Global Ozone Research and Monitoring Project, Italian national report, Report no. 46, 2002).

In November 2003, within the cited convention between University of L'Aquila/CETEMPS and Italian Government/Ministry of Environment, two pyrometers (Yankee Environmental Systems) for UV-A and UV-B continuous monitoring were installed at L'Aquila, to be used in conjunction with the balloon ozone soundings. The UV data, as well as the ozone profiles, constitute the base for the compilation of the Italian Government annual report on ozone and UV status.

RESULTS FROM OBSERVATIONS AND ANALYSIS

The analysis of time ozone and UV components of the Italian stations (and others) have been investigated in order to single out any effective ozone trend together with the role of ozone fluctuations due to weather patterns. Many research groups adopted filtering techniques and an advanced statistical methodologies to be applied to the Dobson ozone long time series. Sensitivity studies are performed using models for the UV spectral and integrated irradiance. Most of the research groups involved in these studies have acquired enough experience so far: the main results indicate that, in spite of the unavoidable uncertainties in the input parameters (ozone, aerosol, surface albedo, pressure, temperature, relative humidity, cloud cover), measured and computed clear sky irradiances are in reasonable agreement..

THEORY, MODELING, AND OTHER RESEARCH

The modeling studies of different Italian institutions (Universities, CNR, ISPRA, etc.) concern the development and the test of 3D-atmospheric chemistry transport models with high spatial resolution, and also ozone/UV-related radiation transport modeling. At the moment, the main purpose is to understand the interplay of ozone, aerosols and greenhouse gases for a better assessment of climate effect of ozone in comparisons with that of non-reactive greenhouse gases.

The radiative forcing from ozone changes and from ozone depleting substances is significant. For this reasons the connections between ozone depletion and climate changes are strong and more complex that those simply related to CFC-control international protocols. In particular, the ozone distribution in the future will depend on the emission and impact of other greenhouse gases and not just those that deplete ozone. Scientific assessment of ozone depletion in the future can be meaningful only by coupling chemical and climate processes in numerical global models. This is the reason for including long time dependent simulations from chemistry-climate coupled models in the more recent IPCC (IPCC, 2005, Special report on ozone and climate. Issues related to HFCs and PCFs) and WMO assessments. The University of L'Aquila Atmospheric modeling research group has taken part in these efforts and it is participating in the international assessment campaign (CCMVal, Eyring et al., Overview of planned coupled chemistry-climate simulations to support upcoming ozone and climate assessments, SPARC newsletter, 25, July 2005), as well as in other projects (e.g. SCOUT-O3 - EC) for the climate-chemistry numerical simulations activity.

Other activities concern the assimilation of data in global models and air mass trajectory modelling: an assimilation code has been developed into a stratospheric 3D Chemical Transport Model, and it is used for the assimilation of ozone data from ENVISAT instruments, as a support of the ENVISAT Calibration/Validation campaign. In this framework, Lagrangian trajectory modelling have been also used to analyze field and satellite data and as a support to the middle latitude and arctic APE airborne missions. Other studies, based on statistical analyses and climatological models outputs, have investigated the climatic impact of the observed antarctic ozone changes onto stratosphere and troposphere, using as input total column ozone trends.

A joint project devoted to the study of the dynamical/climatic behaviour of the antarctic ozone hole and its impact on middle latitudes, is ongoing since 2003 under the Italy/Argentina bilateral scientific programme.

DISSEMINATION OF RESULTS

Data reporting

One of the deliverable product of the Convention between University of L'Aquila/CETEMPS and Italian Government/Ministry of Environment is an annual report on the status of the ozone layer; it is mainly focused on the Italian geographical region, and should also enlighten evidences of general trends, which can have social and political consequences.

Information to the public

The activities related to the monitoring of the ozone and UV have made possible to build up the solar UV geographic patterns in Italy. The daily dose in the range 290–325nm is computed at sites where a thorough and homogeneous climatology is available. In addition, several institutions made public the estimations of the UV index. Most of them make also use, in standard radiative transfer models, of the Global Forecast System (NCEP/NOOA) for the evaluation of the ozone column and cloud coverage over several Italian sites (resolution 1x1 degrees). Some of the estimations also include the surface albedo and the terrain characteristics, others can also account for the local pollutants concentrations.

The maps of solar UV patterns for Italy meets the study requirements in the field of skin and eye epidemiology, as well as, in other investigations dealing with the impact of UV on the biosphere.

PROJECTS AND COLLABORATION

Main EU ozone-related projects (active in 2002-2005) with Italian co-partnership:
Trade-off between climate and air pollution policies, JRC research ref.2212
ENSEMBLES, IP, ref. 505539
SCOUT-O3, IP, ref. 55390

FUTURE PLANS

The traditional UV data and the ozone profile long term monitoring will constitute, in the near future, a solid database for improving the studies of the ozone-related atmospheric processes.

In addition, it is expected that with new satellite data (i.e., ENVISAT) and the growing interaction with the numerical weather forecasting community valuable advantage will be take by new and existing research facilities, also in the issues concerning the ozone-climate interactions.

Most of the information and results reported in this document has been taken from public documents and scientific papers.

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