

ARGENTINA

1. INTRODUCTION

The involvement of Argentina in ozone/UV monitoring and research dates back to 1966, with the establishment of one of the first Dobson instruments in the South America. After the discovery of the Antarctic ozone hole in 1985, the activities in the field became important, now contributing with monitoring over an extended Southern latitude band and important research activities

The Argentine ozone/UV monitoring activities are as follows:

- a) Total column ozone - using Dobson, Brewer, AFO and portable systems.
- b) Vertical profiling of ozone, obtained with the Umkehr method, ozonesonde and LIDAR.
- c) Surface ozone
- d) UV spectrophotometers and integral UV

The Argentine research activities include the following topics:

- a) Regional and global ozone and trace species trends, and variability using satellite and ground-based retrievals..
- b) The role of ozone and the stratosphere in Climate Change
- c) Interactions between the Antarctic ozone hole and mid-latitude processes in the stratosphere and troposphere.
- d) Development and construction of ozone and related species measuring systems.
- e) Chemistry of CFC replacements
- f) UV forecasting and climatology.
- h) UV-B impacts on terrestrial and marine ecosystems.

It must be pointed out that these activities are carried out thanks to the perseverance of Argentine technicians and scientists, given the limitations inherent to a developing country. The current economic situation has pushed this state of affairs to the limit, putting research and monitoring activities in jeopardy. International support is essential to continue with monitoring activities and to prevent the dismemberment of research teams.

2. MONITORING

Argentine monitoring activities cover a wide range of latitudes extending 22 to 55°S in the main territory and as far as 77°S in Antarctica. The specific instrument details and locations can be found in Annex I.

2.1 Total Ozone Monitoring Networks

The main total ozone monitoring network is operated by the Servicio Meteorologico Nacional (S.M.N.).

2.1.1. Dobson instruments

The S.M.N. is responsible for the Southern Cone Ozone Project (SCO3P-GAW), which includes a network of Dobson Spectrophotometers. Routine measurements of total ozone are made a number of times a day by trained personnel from all the above stations. Whenever sky conditions permit, Umkehr observations are also made at the Buenos Aires and Comodoro Rivadavia stations to compute the vertical distribution of ozone. The profiling at Comodoro Rivadavia is made occasionally only.

2.1.1.1 Standardization:

The SMN-SCO3P-GAW Dobson Network instruments were standardized with the World Standard in Dec. 1999

2.1.1.2 Publication of data

The total ozone data collected from the network are being regularly sent in WMO format to World Ozone Data Centre (WOUDC) Toronto, Canada. The Buenos Aires Umkehr profiles were sent to the WOUDC Toronto till February 2002. The total ozone data are also available daily in the S.M.N. Internet Page (<http://www.meteofa.mil.ar>) and are also included in the SCO3P Bulletin.

2.1.2 Total ozone – AFO

The SMN-SCO3P network also operates AFO Spectrophotometer to complete the latitudinal coverage of the network.

2.1.2.1 Standardization:

Buenos Aires is the National and Regional Ozone Calibration Centre for the AFO spectrophotometer and the Dobson Spectrophotometer N° 97 serves as National Standard.

2.1.2.2 Publication of data

The AFO's total ozone data are included daily in the S.M.N Internet Page (<http://www.meteofa.mil.ar>), are also included in the SCO3P Bulletin and are being regularly sent in WMO format to World Ozone Data Centre (WOUDC) Toronto, Canada.

Total ozone monitoring stations are also operated by the Instituto Antartico Argentino (IAA):

2.2 Vertical Distribution of Ozone

Routine ozone profiling activities are carried out at Base Marambio and Belgrano II.

The system at Marambio is operated jointly with the Finnish Meteorological Institute. This is based on a co-operation agreement. Ozone soundings are performed twice monthly, from December through July, and twice weekly during the remaining months, coincident with the ozone hole events. The operations are currently suspended since a fire destroyed the hydrogen generator, as well as balloons, sondes and other supplies. The Centro de Ozono de Altura, at the Observatorio Central Buenos Aires is in charge of the ozonesonde operations at Marambio.

The system at Belgrano II is operated by the Instituto Antártico Argentino with support from Spain.

2.3 Surface Ozone

The SMN-SCO3P-GAW operates as well a network of surface O₃ analysers.

2.3.1 Standardization

The Calibration Center for surface ozone network calibration is operated at the Observatorio Central Buenos Aires. The Instituto de Quimica del Medio Ambiente (INQUIMAE –University of Buenos Aires) is also carrying routine measurements in Buenos Aires.

2.3.2 Future Activities.

Characterization of the S.M.N.-SCO3P surface ozone data, and the relation with different synoptic situations.

2.4 UV-B Radiation

S.M.N.-SCO3P integrated UV network has an extensive coverage throughout the national territory.

2.4.1 Standardization

The integrated UV-B calibration center operates at Observatorio Central Buenos Aires. since April 1998. The instruments were characterized in September-October 1998. An in-situ calibration using a spectromete of the Institute of Medical Physics of the University of Innsbruck, Austria, was carried out between Nov. 1998 and Feb. 1999. A new calibration should be carried out during 2002, though it has been provisionally suspended until funding is obtained.

2.4.2. Publication of data

The data will be submitted to the Toronto WOUDC as soon as the data correction method, using the final calibration and intercomparison report, is implemented. The data will also be included in the SCO3p Bulletin.

2.4.3 Latitudinal UVR-PAR monitoring network

This network, funded and operated by the Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET) uses GUV-511 broadband spectroradiometers to monitor UV radiation along the N-S axis of the Argentine territory. The network operates since September 1994. The instruments are calibrated each year with a reference radiometer, property of Biospherical Instruments Inc., San Diego, CA, USA. The data are being updated for most instruments on a real-time basis at the network database. The data can be found at: <http://www.dna.uba.ar>. This network is part of an almost complete South American network operating with GUV511 instruments operating all the way to the Is. of San Andres, Colombia, in the Caribbean.

2.4.4 CADIC.

A high resolution spectroradiometer SUV-100, operates in Ushuaia since November 1988. This instrument is the northernmost one in a cross-Antarctic network that is managed by the National Science Foundation (USA). The data is stored at CADIC and at Biospherical Instruments Inc. The data is available in CD-ROM, free of charge for all scientists that request it.

2.5 UV-Forecasting

Since the summer of 1995 the S.M.N provides a UV index (Intensidad Solar Ultravioleta – ISUV) daily forecast during summer for the Humid Pampas region and Uruguay. Since Jan. 2000 the forecast has been extended to all of the national territory. The ISUVn also provides maximum UV radiation expected at maximum solar intensity taking into account the forecast cloud cover. It includes the cloud cover in the calculation. The corresponding maps and radiation charts are available by INTERNET. Both forecast methods were developed jointly with the Instituto de Fisica Rosario –IFIR- and the Observatorio Astronomico de Rosario

2.6 Associated Stratospheric Trace Species.

A number of associated trace species are currently being monitored:

1) Aerosols

a) Aerosol LIDAR at CITEFA - Villa Martelli, Prov. of Buenos Aires, 34°35'S 58°29'W. This instrument, built locally in co-operation with France has been measuring aerosols since 1995. The data is stored at CITEFA

b) A J100 sunphotometer , on loan from NOAA, operates since March 1997 at the Universidad Nacional de la Patagonia Austral (UNPA), Rio Gallegos, Prov. of Santa Cruz (). The filters are locally calibrated and the data is stored at UNPA.

2.7 Intercomparison Requirements

All of the instruments described above, as well as those currently in the research stage described below, require periodic intercomparisons with world standard instruments abroad or following the recommended methodology for testing the equipment. Financial support is required to meet the high expenses of transportation of bulky equipments and travel of operators and experts.

3. RESEARCH

The SPARC Programme (WCRP) convened its 2nd Scientific Assembly in November 2000, in Mar del Plata, Argentina. This highly successful meeting, together with a special Associated Workshop on the impacts of UV radiation on terrestrial and aquatic ecosystems, signified an important boost for research activities in South America. Research activities have also resulted MSc and PhD thesis, some already completed. Some of the publications made in recent years are included below.

One of the most important results obtained was the study of the preferential positioning of the polar vortex/ozone hole, towards Southern South America and how it moves and stretches towards southern midlatitudes over the neighbouring oceans and the mainland in this sector of the hemisphere. A significant effort has been made in studies linking the variability of the ozone layer with meteorological processes and the Southern Hemisphere storm track. Climatological studies of stratospheric variables seem to indicate a change in the dynamics of the stratosphere between the '80s and the '90s. UV studies include the study of the response of local aquatic and terrestrial ecosystems in different parts of Argentina to enhanced UV levels. The period of UV continuous UV monitoring now spans a decade and UV climatology studies are now under way.

Despite some, albeit short-lived, improvements in the late '90's, the main difficulty has been the lack of adequate funding for research in all its aspects, including positions for young scientists. The important activities that have been nevertheless carried out in recent years include:

3.1 Ozone and Trace Species Observing Systems Development

1) Centro de Investigaciones Tecnológicas de las Fuerzas Armadas. CITEFA., Villa Martelli, Prov. of Buenos Aires.

Development of LIDAR systems to monitor atmospheric aerosols and stratospheric ozone. The DIAL ozone LIDAR began operations in 1998. The observations were compared with ozonesondes launched from Buenos Aires and with satellite profiles. Work is underway to upgrade the system and to install it in a movable container for campaign studies. Intensive working is underway to improve the retrieval algorithms. This activity is carried out in co-operation and with support from France. The aerosol lidar continues operations to study boundary layer and stratospheric aerosols, in order to carry out variability studies.

2) Instituto de Investigaciones sobre Medio Ambiente, Universidad de Mendoza, Prov. of Mendoza.

Development and construction passive microwave radiometers to monitor column water vapour and ClO. Campaigns have been carried out in the high Andes at Puente del Inca, Prov. of Mendoza. This activity is carried out in co-operation and with support from Germany.

3.2 Stratospheric Dynamics, Climatology and Chemistry.

1) Grupo de Atmosfera Media, Departamento de Ciencias de la Atmosfera, Universidad de Buenos Aires.

Climatology and dynamics of the stratosphere/troposphere system, using ground-based and satellite retrievals (TOMS, MSU, UARS, SAGE). The interactions between the Polar vortex/ozone hole and midlatitude stratospheric processes and ozone depletion are studied. Recent developments include the study of the interactions between tropospheric processes, ozone variability at mid-latitudes and polar vortex /ozone hole dynamics. This work includes vortex modelling activities and its interaction with tropospheric processes. In 2000 monitoring of column trace species (CO and CH₄) begun in Peninsula Valdez for MOPPITT validation. These activities include interactions with research teams in Uruguay, in Europe, USA and Canada.

2) Centro de Investigaciones de la Atmósfera (CIMA - Universidad de Buenos Aires/CONICET)/Laboratorio de Ozono y UV-CADIC. Study of the interannual total ozone variability at high southern latitudes and the relationship with tropospheric synoptic activity. Study of cloud transmittance and the effects of clouds on UV radiation.

3) Laboratorio de Energia Solar, Universidad Nacional de San Luis, Prov. of San Luis. Study of the ozone anomalies over the Andes and the high Altiplano, observed in the TOMS retrievals. An analysis of polar vortex dynamics and its midlatitude excursions was carried out, showing how the vortex edge can stretch over the Argentine and Chilean territory during those periods. Intercomparison of the TOMS retrievals with total ozone measured by the Dobson network in Argentina.

4) S.M.N.

Climatology of the ozone and the UVB in the country our data and satellite retrievals (TOMS, TOVS).

5) Departamento de Fisico-Quimica, Facultad de Ciencias Quimicas, Universidad Nacional de Cordoba, Prov. of Cordoba.

Chemistry of ozone depletion and CFC replacement substances, interacting with CITEFA in Argentina and the UK and Germany, abroad.

6) INIFTA, Universidad Nacional de La Plata (UNLP)

Study of reaction rates between ozone and various trace species. The activities are carried out in co-operation with Germany.

3.3 Ozone/UV Relationships.

The study of ozone/UV relationships is carried out in various institutions, using different sources of data, in particular comparing TOMS total ozone measurements with the behaviour of surface UV-B radiation. Such activities are carried out in particular by the scientists operating the UV-PAR latitudinal network, the S.M.N. the groups at the Instituto de Fisica de Rosario, Universidad Nacional de Rosario, Province of Santa Fe, CADIC and the Laboratorio de Energia Solar, Universidad Nacional de San Luis. The latter is also responsible for the collection of ozone and UV data measured by a set of portable radiometers built in a co-operative project between the Centro de Investigaciones Opticas (CIOP/UNLP) and Spain.

3.4 UV Climatology

The group operating the UV-PAR latitudinal network is carrying out a climatological study of UV-radiation over Argentina. The S.M.N is now also starting with the data from the SMN-SCO3P.

3.5 UV-B Impacts on Ecosystems.

The impacts of ecosystems both marine and terrestrial are carried out by a diversity of groups. The Estacion de Fotobiologia Playa Union, Province of Chubut and the Instituto Antartico Argentino carry out research on the effects of UV-B on phytoplankton and other marine species, including the use of underwater UV-profiling sensors. A biology group from the Universidad Nacional del Comahue, Province of Rio Negro, is studying the impacts of UV in the lake ecosystems of the Patagonian Andes. Researchers from the Facultad de Agronomia are involved in the study of the consequences of enhanced UV-B on the grasslands of Tierra del Fuego. These activities are made in co-operation with CADIC and the UV monitoring networks.

3.6 Publication

The results of the above activities are being published in national and international journals. The following list includes recent publications in international journals. A number of papers are now under review process.

- Canziani P.O., Compagnucci R.H.C., Bischoff S.A., Legnani W.E. A study of impacts of tropospheric synoptic processes on the genesis and evolution of extreme total ozone anomalies over Southern South America Submitted J. Geophys. Res., accepted Jan. 2002
- Compagnucci, R.H., M.A. Salles, P.O. Canziani, The spatial and temporal behaviour of the lower stratospheric temperature over the Southern Hemisphere: the MSU view. Part I: methodology and temporal behaviour. Int. J. Climatology, 21, 419-437, 2001
- Perez, A., Crino E., Aguirre de Carce I., Jacque F., Low Ozone events and three-dimensional transport at midlatitudes of South America during springs of 1996 and 1997
- Salles, M.A., P.O. Canziani, R.H. Compagnucci, The spatial and temporal behaviour of the lower stratospheric temperature over the Southern Hemisphere: the MSU view. Part II: spatial behaviour. Int. J. Climatology, 21, 439-454, 2001.
- Vigliarolo P.K., Vera C.S., Díaz S.B. Southern Hemisphere winter ozone fluctuations Quart. J. Roy. Met Soc., 127, 559-577, 2001.

3.7 Future Research Activities

The intent is to continue with the activities listed above. Nevertheless the present economic crisis does not ensure the continuation of present activities. The planning of future activities is not possible unless support is obtained from abroad.

4. TRAINING AND REFRESHING COURSES FOR OPERATORS AND SCIENTISTS

A number of national and regional training activities have continued to take place, both for operators of the various instruments included in the Argentine and regional networks, at the Observatorio Central Buenos Aires (S.M.N.), Pilar Obs (S.M.N.), CADIC as well as scientists in the various interdisciplinary fields needed to understand the ozone/UV issues. The latter includes the preparation of Msc. and Phd. dissertations. A series of workshop/seminars have been held since 1998, organized jointly by the Departamento de Ciencias de la Atmosfera, Universidad de Buenos Aires (WMO Regional Training Center) with participation from NCAR, USA, and the University of Toronto, Canada. Financial support was provided by a grant from the InterAmerican Institute for Climate Change Research, for postgraduate students and young scientists from the MERCOSUR countries.

4.1 Requirements

Unless additional support is obtained the workshop/seminar activities will cease this year. Support is needed for the travel expenses of instrument operators that need to attend training programs abroad. This also is needed for the scientists attending training activities.

Annex I - Ozone and UV monitoring instruments operated by Argentina

1. Dobson network operated by S.M.N.

Station	Location	Since	Last calibration	Date of Last Submission
1. Buenos Aires	34°35'S-58°29'W	Jan. 1966	December 1999	Feb. 2002
2. Com. Rivadavia	45°47'S-67°30'W	Sep 1995	December 1999	Feb. 2002
3. Ushuaia – GAW	54°49'S-68°19'W	Sep. 1994	December 1999	Feb. 2002
4. Base Marambio	64°14'S-56°43'W	Sep. 1987	August 2001	Feb. 2002

2. AFO network operated by S.M.N.

Station	Location	Since	Instrument No Last Calibration	Date of Last Submission
2. Pilar	31°40'S-63°53'W	Oct. 1998	AFO 7- Sep. 1998	As above
3. San Julián	49°19'S-67°45'W	Oct 1998	AFO 5 - Set 1998	As above

3. The Instituto Antártico Argentino operates the following instruments

Station	Location	Instrument	Since	Last Known Calibration
Belgrano II	77°52'S 34°37'W	Brewer MKIV+ EVA*	January 1992 January 1995	Sept. 1997 -----
Marambio	64°14'S 56°37'W	EVA*	January 1994	January 1999
Ushuaia	54°48'S 68°19'W	Brewer MKIV** EVA***	September 1994 January 1994	January 1999

+ In co-operation with the CNR/IFA (Italy)

* Differential Absorption Visible Spectrometry instrument. Operated in co-operation with the Instituto de Tecnicas Aeroespaciales de España

** Operated in co-operation with the CNR/IFA (Italy) and Centro Austral de Investigaciones Cientificas (CADIC/Consejo Nacional de Investigaciones Cientificas y Tecnologicas)

*** Operated in co-operation with the Instituto de Tecnicas Aeroespaciales de España and CADIC/CONICET

The data is stored at the IAA and also submitted to the S.M.N.

4. Ozonesonde profiling

Station	Location	Since	Instrument No Last Calibration	Date of Last Submission
1 Marambio	64°14'S 56°43'W	September 1989	Vaisala ECC	Feb. 2002
2. Belgrano II	77°52'S 34°37'W	1999	Vaisala ECC	

5. Surface ozone network operated by S.M.N.

Station	Location	Altitude (m asl.)	Instrument Last Calibration	Since
La Quiaca Obs.	22°06'S 65°06W	3459	TEI 49 mod. 003 June 1997*	January 1996
Pilar Obs.	31°40'S 63°53'W	338	TEI 49 mod. 003 June 1997*	June 1995
San Julián	49°19'S 67°45'	62	TEI 49 mod. 003 June 1997*	October 1997
Ushuaia-GAW	54°48'S 68°19'W	7	TEI 49 mod. 003 June 1997*	October 1994

6. UV network operated by the S.M.N.

Station	Location	Altitude (m asl.)	Instrument Last Calibration	Since
La Quiaca Obs.	22°06'S 65°06W	3459	UV Pyranometer YES-UV-B1, Feb. 1999	January 1996
Pilar Obs.	31°40'S 63°53'W	338	UV Pyranometer YES-UV-B1, Dec. 1998	June 1995
			Solar Light UV-501, Dec. 1998	Feb. 1996
Planetario Rosario	32°55'S 60°47'	25	UV Pyranometer YES-UV-B1, Nov. 1998	November 1998
Mendoza	32°53'-68°51'	827	Solar Light UV-501, Mar. 1999	Mar 1999
Buenos Aires	34°35'S-58°29'W	25	Solar Light UV-501, Dec. 1998	September 1995
Comodoro Rivadavia	45°47'S-67°30'W	6	Solar Light UV-501, Feb. 1999	February 1997
San Julián	49°19'S 67°45'	62	UV Pyranometer YES-UV-B1, Feb. 1999	October 1997
Ushuaia GAW	54°48'S 68°19'W	7	Solar Light UV-501, Dec. 1998	April 1997
Marambio	64°14'S 56°43'W	198	Solar Light UV-501, Jan. 1999	May 1997

7. UV-B PAR National monitoring network with GUV-511 instruments.

Station	Location
Ushuaia	54°48'S 68°19'W
Trelew	43°14'S 65°19'W
Buenos Aires	34°35'S 58°29'W
Huaico Hondo	24°10'S 65°01'W
