CUBA

Introduction

The Institute of Meteorology of the Ministry of Science, Technology and Environment of Cuba is the institution responsible for the activities directed to the study of the behavior of the Ozone Layer and ultraviolet Solar Radiation.

The investigations are specifically carried out through the investigation projects:
"Study of the behavior of the Ozone Layer on Cuba" and "Climatology of the ultraviolet solar radiation. Valuation of its potential effects upon health", all in the frame of the National Research Program "Global Changes and the Evolution of the Cuban Environment" that the Agency for the Environment of the Ministry develops.

Program of measurements of the total amount of atmospheric ozone and ultraviolet solar radiation (UV-B)

Measurements of total amount of atmospheric ozone began to be carried out in a regular way in Cuba by mid 1981, using for these purposes filter ozonometers type M-83 and M-124 of Soviet origin. The program of measurements continues until the present, with intervals without measurements during 1984 and from December 1992 until November 1998, due to the lack of ozonometers in the required technical condition. This monitoring program, from 1985 on, was framed as the investigation topic; "Study of the variations of the total amount of atmospheric ozone in the presence of tropical hurricanes", in the Cuban-Soviet collaboration program for the study of the tropical atmosphere and hurricanes, what allowed, in first place, to establish a regular regime of measurements of the ozone layer in our territory, and the development of investigations about the variability of the atmospheric ozone in the presence of tropical hurricanes for our region. The results of this investigations were materialized with the presentation of contributions to the International Symposia on Tropical Meteorology, that were held in Havana (April, 1987) and Obninsk (1991) and the publication of several papers (Gushchin et al, 1987), (Gushchin. G.P, Peláez. J.C et al, 1991).

The program of surveillance of the Ozone Layer continues until present without interruptions and ozonometers M-124 #297 and 192 were calibrated last time in August 1999 at the Main Geophysical Observatory of Russia in Saint Petersburg thanks to the support granted by the WMO.

The program of measurements of the total amount of ozone and ultraviolet solar radiation (UV-B) is in charge of the group of Solar Radiation of the Center of Physics of the Atmosphere of the Institute of Meteorology and is carried out at the station of Havana (23° 10′ N, 82° 21′ W, 50 m) - site of the Institute of Meteorology of Cuba.

The measurements of the total amount of ozone are carried out in manual way and rather through the measurement of direct solar radiation. The processing of measurements is carried out on a PC where they are coded and stored in magnetic support together with the parameters of the meteorological situation corresponding to the day of the measurements. Specialists of the Institute of Meteorology of Cuba developed the data processing and storage computer programs in 1987.

The program of surveillance of the ultraviolet radiation had its beginnings in a program of measurements that was carried out in the station of Havana (23° 10′ N, 82° 21′ W, 50 m) from 1984 to 1985 with the use of a filters instrument developed at the Main Meteorological Observatory in Postdam. Starting on January 30 2002 a program of measurements of the solar ultraviolet erythemal radiation has begun as part of the project "Study of the behavior of the Ozone Layer on Cuba" in collaboration with the Observatory of Solar Radiation of the Institute of Geophysics of the

Autonomous University of Mexico, the instrument used is a Biometer 501 #2853 manufactured by the firm Solar Light.

Together with the measurements of the total amount of ozone and ultraviolet solar radiation the Group of Solar Radiation of the Center of Physics of the Atmosphere of the Institute of Meteorology of Cuba is in charge of a research program for the solar radiation and other related magnitudes in the country. Next we relate the complete program of measurements carried out in the station Havana.

Measurements regime:

1. Direct Irradiance (S)
2. Diffuse Irradiance (D)
3. Global Irradiance (Q)
4. Short wave reflected Irradiance (Rc)
5. Global erythemal ultraviolet Irradiance (UV-B)
6. Photosyntetically Active Radiation (PAR)
7. Net balance of radiation (B)
8. Total content of Atmospheric Ozone (CTO)
9. Sunshine
10. Atmospheric turbidity and optical thickness of the aerosols
11. Temperature of the ground (Ts)
12. Condition of the active surface
13. Cloudiness and condition of the sky

Installed instruments

1. Yanishevski type Actinometer, model M-3
2. Linke Feussner Actinometer, model Kipp and Zonen
3. Yanishevski type Piranometer, model M-80-M
4. EKO type spectral Piranometer, model SBP-801
5. KIPP and ZONEN type Piranometer, model CM-5
6. PAR Piranometer, developed at the INSMET
7. BIOMETER 501 A #2853. –Solar Light
8. Yanishevski type Balanzometer, model M-10
9. EKO type Pirgeometer, model CN-11
10. Sontag type Difusometer (Germany)
11. M-124 type Ozonometer (Russia)
12. EKO data logger, model MP-110

The sampling period for the fluxes of solar irradiance – for all the components, included UVB- is 2 minutes and they are automatically stored into a PC.

Main lines of research

The main lines of investigation embraced in the project “Study of the behavior of the Ozone Layer in Cuba” are directed to the investigation of possible variations of the total amount of ozone in the presence of tropical hurricanes for our region. Equally it is objective of the project to characterize the behavior of the total content of ozone in our region.

With regard to the characterization of regime of ultraviolet solar radiation and in the specific case of the ultraviolet solar radiation of erythemal effect, it is necessary to point out that due to the location of the Havana station (urban type), the program of measurements is directed to the study of the behavior of this component of the radiation flux only for the City of Havana. A no less important

objective of the project is the forecast of the index of UV radiation in several locations of the country that require of this type of information for its socioeconomic importance.

From the instrumental point of view work is in progress in the development of algorithms that allow to use the information of the 3rd filter of the M-124 ozonometers together with filters I and II in the calculation of the optical thickness of the atmospheric aerosols (AOT) in the ultraviolet region of the spectrum.

The project “Climatology of the ultraviolet solar radiation. Valuation of the potential effects upon health” contemplates to evaluate the regime of solar radiation on the national territory and it is specifically directed to the study of the impact of ultraviolet solar radiation upon human health. This project is developed with the participation of specialists in oncology, dermatology, ophthalmology and immunology of several institutions of the Ministry of Public Health of Cuba.

With regard to the V/3 Decision of the Fifth Meeting of the Conference of the Parties of the Vienna Convention for the Protection of the Ozone Layer (Beijing, 29 Nov-3 Dec., 1999), we can inform that Cuba – as is pointed out in all the previously exposed work - continues its measurements program for the Surveillance of the Ozone Layer, and it incorporated since January 30 2002 the monitoring of ultraviolet solar radiation. The project “Climatology of the ultraviolet solar radiation. Valuation of the potential effects upon health” closely links the investigations on the regime of ultraviolet solar radiation with the possible impacts on health and specialists of different medical institutions of the country participate in it, with the objective of being able to apply the results of the investigation in the people's well-being and the security.

The Institute of Meteorology of the Ministry of Sciences, Technology and Environment has specialists qualified enough to be able to extend and to enrich the program of investigations and surveillance of the Ozone Layer and the Ultraviolet Solar Radiation to the region of the Caribbean and Central America. We express by this means our readiness to help in the formation of specialists and the establishment of new stations in this region of the Caribbean and Central America, through international funding institutions as could be GEF (global Environment Facility) that guarantee the financing for the acquisition of instruments and necessary means.

In order to maintain our programs of measurements we also request some financial aid that allow us to be able to calibrate our ozonometers and sensors of ultraviolet solar radiation. This year (2002) we expect to calibrate our ozonometers in the Geophysical Observatory of Saint Petersburg through the assistance of the WMO.

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