

Final project report

Project ID: 2002/6.5
Title: The minor atmospheric gases and UV solar radiation as climatic impact factors: sampling and modelling

Principal investigator: C. Rafanelli
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Duration: two years
Assigned funding: € 103.229,00

Activities and results

The project has analysed the time evolution and climatology of some minor atmospheric gases, by ground-based measurements. The project has been structured in three research lines: studies of stratospheric ozone hole in Antarctic polar vortex during the austral spring. In this line the ozone depletion by UV spectral measurements was been studied. The second line studied the UV irradiance level at ground in remote site, both as consequence of the atmospheric photochemistry and as cause of effects on biosphere. It studies the UV modelling for a right reconstruction of irradiance spectra. Finally the third line has studied the background levels of CO₂, by continuous automatic sampling in Antarctica Peninsula, to evaluate the trend and the time evolution for the implication in large-scale phenomena such as oceanographic event of "El Niño".

The results of Project has been the studies of ozone depletion over Ushuaia (Argentina) and Belgrano II (Antarctica) Similar studies was carries out in Arctic region, NY Ålesund (Svalbard Islands, Norway), and in particular has been activated a full control of the Brewer spectrophotometer by remoteness. This will be important for the next campaigns during the polar nights.

Other results have been the studies about vertical profiles of ozone in the same Arctic and Antarctic areas. Several papers on the consequences in stratosphere, by solar energetic particles (SEP) were publishes. In agreement with WMO, all the data are uploaded into the WOUDC data Center to forecast the ozone hole.

Other result of the Project is the developing of the solar UV modelling with a new model of irradiance, settled by the Project, named WL4UV. This model will be very useful to evaluate the environmental dose for the human protection from UV, studies carried out with other PNRA-Project directed by dr. G. Mariutti of ISS of Rome. With this project was carried out studies on personal dosimetry for human protection in presence of low values of ozone and consequent increasing of solar UV radiation fluxes.

Studies on developing of prototypes have produced a prototype of a total-sky camera (TSC) to evaluate in real time, by hardware and software, the cloud situation of the sky. A second prototype is a fast spectral-radiometer (UV spectrograph) for the UV radiation with 250–400 nm of spectral range. It will be useful both outdoor and indoor measurements.

The last line of research studies the climatologic trend of background tropospheric CO₂. By continuous measurements in Jubany base (Antarctica) the effect on large scale phenomena, like El Niño have been studied. As the ozone data, also the carbon dioxide concentration data have been uploaded into the WDCG data base.

Products

A – papers in scientific magazines

1. Roscoe H.K., Colwell S.R., Shanklin J.D., Karhu J.A., Taalas P., Gil M., Yela M., Rodriguez S., Rafanelli C., Cazeneuve, H.; Villanueva C.A., Ginsburg M., Diaz S.B., de Zafra R.L., Muscari G., Redaelli G., Dragani R. –

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2005 - *Measurements from ground and balloons during APE-GAIA – A polar ozone library*. Advances in Space Research, 36 (5). 835-845. doi:10.1016/j.asr.2005.03.016.

2. Anav A., C. Rafanelli, I. Di Menno, M. Di Menno – 2004 - *An algorithm to evaluate solar irradiance and effective dose rates using spectral UV irradiance at four selected wavelengths* - Radiation Protection Dosimetry, 111, n°2. pag. 239-250.
3. Colacino M., C. Rafanelli - 2003 - Italian researches on Antarctic Atmosphere - *Prof. Giorgio Fiocco's 70th Birthday: An International Conference on Atmospheric Research Progress and More* - Roma 17-18 September 2001. Annals of Geophysica, vol. 46 n° 2, 259-267.

B – book chapters

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C - proceedings of international conferences

1. Rafanelli C., A. Anav, I. Di Menno, A. Damiani, E. Piervitali, M. Di Menno, G. R. Casale - 2004 - *UV irradiance at ground: a new model for environmental studies with multichannel radiometers* - Conference Proceeding Vol. 89, "Italian Research on Antarctic Atmosphere and SCAR Workshop on Oceanography".
2. Mariutti G.F., E. Bortolin, A. Polichetti, A. Anav, G. Casale, M. Di Menno, C. Rafanelli - 2003 - *UV dosimetry in Antarctica (Baia Terra Nova): analysis of data from polysulphone films and GUV 511 radiometer* - Proceedings SPIE Ultraviolet ground- and space-based measurements, models and effects - San Diego, Ca. USA, 4-6 Agosto - pag. 5156.
3. Rafanelli C., A. Anav, I. Di Menno, M. Di Menno, G. R. Casale - 2003 - *UV solar irradiance with cloudiness at high latitudes; a comparison between radiometer GUV 511 and model's outputs* - Proceedings SPIE Ultraviolet ground- and space-based measurements, models and effects - San Diego, Ca. USA, 4-6 Agosto.
4. Mariutti G. F., A. Polichetti A. Anav, C. Rafanelli G. R. Casale – 2004 - *Use of polysulphone films for personal uv dosimetry at high latitudes* – Proceeding of International NIR, Workshop & Symposium - Siviglia, Spain – 20/22 May.
5. Rafanelli C., A. Anav, I. Di Menno, M. Di Menno – 2004 - *The solar uv as environmental factor: measurements and models* – Proceedings of "Cell Biology and Instrumentation: UV Radiation, Nitric Oxide and Cell Death in Plants" - Yalta, Ukraine, September 8 - 11

D – proceedings of national meetings and conferences

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E – thematic maps

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F – patents, prototypes and data bases

1. Prototype of TSC.
2. Prototype of fast UV spectroradiometer (spettrograph).

G – exhibits, organization of conferences, editing and similar

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H - formation (PhD thesis, research fellowships, etc.)

1. A. Damiani, PhD thesis on "Evaluation of Solar activity on ozone layer in Polar and sub-Polar areas" – Siena University – PhD School in Polar Sciences, XX cycle.
2. E. Piervitali, PhD thesis on "The solar UV irradiance in Polar areas and its consequences on radiative transfer model in presence of clouds" – Siena University – PhD School in Polar Sciences, XX cycle.

Research units

- Andrea Anav – Senior Scientist CNR – IDAC
- Luigi Ciattaglia – Senior Scientist CNR – IDAC
- Ivo Di Menno - Technician CNR – IDAC
- Massimo Di Menno - Technician CNR – IDAC
- Elena Benedetti - fellowship CNR - IDAC
- Alessandro Damiani - fellowship CNR – IDAC
- Luca Mannella - fellowship CNR - IDAC
- Emanuela Piervitali – fellowship CNR – IDAC

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