Final project report

Project ID: 2002/6.01
Title: Thin optical depth stratospheric gases measurements with ground-based off-axis UV-visible spectrometer at Dome Concordia NDSC station

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Duration: 2002-2003
Assigned funding: € 60,000,00

Activities and results

The main results of this project can be summarized as i) the technological ones, meaning the development and setup of the new equipment called SPATRAM/DC+MIGE (Spectrometer for Atmospheric Tracers Measurements/DomeC + Multiples Input Geometry) thanks to the collaboration between the ISAC-CNR institute, the Geophysics Centre of the University of Evora (Portugal) and ENEA; ii) the scientific ones regarding the deep studies of the atmospheric Nitrogen Dioxide and Ozone at mid-latitude and in Antarctic Regions in terms of diurnal and seasonal variations. Furthermore, advanced inversion methods allowed for the retrieval of the vertical distribution of the above mentioned atmospheric compounds.

i) The SPATRAM is based on the optic module of the GASCOD (Gas Analyzer Spectrometer Correlating Optical Differences) installed at the Mario Zucchelli station since ’95. The new spectrometer allows for the retrieval of minor compounds in the atmosphere with improved temporal resolution, flexible management and enhanced capability of measurements in comparison with GASCOD. The SPATRAM Optical Mechanical Unit is equipped with an already tested monochromator, allowing for reliable and trustfully measurements of the radiation entering from the slit. The opto-mechanical modules of this equipment (primary input, optic fibres inputs, external devices for the transmission of the radiation with optic fibres and the optic fibres itself) were developed and selected taking into account the features of the monochromator (mainly the f-number) in order to ensure the optimum optical matching. One of the main enhancements of this equipment is the possibility to change the input of the radiation allowing for quasi simultaneous measurements in the same spectral region from different geometry; i.e. i)measurements of zenith sky radiation from the primary input; ii) measurement in directions different from the zenith one by means of a different optic system for the input of the radiation via optic fibre (using the optic fibre input); iii) measurements in active mode using a telescope including the source coupled with a retro reflector mirror.

ii) The analysis of the spectral data obtained at the Mario Zucchelli Station allowed for some improvements to the Differential Optical Absorption Spectroscopy (DOAS) technique. In particular, the algorithm that allows for the best spectral alignment between a high-resolution wavelength-calibrated spectrum and the spectrum obtained with the GASCOD spectrometer, which is then utilized as the reference spectrum in the DOAS methodology. This last result give a reduction of the systematic errors that a non-wavelength calibrated reference spectrum could introduce in the slant column value retrieval. A new method for the estimation of the magnitude of the NO2 slant column value corresponding to the reference spectrum used in the DOAS analysis is developed. In the Antarctic region the maximum nitrogen dioxide content is achieved during the summer season, while the minimum values are observed in winter, as expected considering its photochemical activity.

The close relation between NO2 Vertical Column (VC), stratospheric temperature and potential vorticity, is examined. The NO2 VC low values obtained during 2002 can be explained in the frame of the stratospheric warming phenomena that had lead to the anticipated extinction of
the polar vortex. At mid-latitudes, one SPATRAM was installed in 2004 at the Observatory of the CGE in Portugal and the analysis of the dataset for the O3 total column let to the identification of the occurrence of strong variations in the period October 2006-March 2007 and the marked inter annual variability in O3 content. The vertical profiles obtained for ozone and nitrogen dioxide allow for the identification of events of tropospheric pollution occurring at the Observatory of Évora.

Unfortunately it was not possible to install the new equipment in the DOME/C station during the period of the project due to structural delays. In this regard the foresee goals of the research project were partially reached. Anyway the SPATRAM/DC+MIGE are ready for the installation in Antarctic Regions.

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**Products**

A – papers in scientific magazines


B – book chapters

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C - proceedings of international conferences

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Ronchi, Anno LX, n.4 Selected Papers of Gold IEEE Remote Sensing Conference, M. Migliaccio and A. Iodice Eds, pg 689-695, 2005


D – proceedings of national meetings and conferences


E – thematic maps

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F – patents, prototypes and data bases


G – exhibits, organization of conferences, editing and similar

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

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Research units

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Notes