Climate Change and Atmospheric Trace Gas Monitoring Station at University Gozo Campus Laboratory and the Giordan Lighthouse Station

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The atmospheric research programme at the Gozo campus was established in 1996 and now houses a team of five scientists; the actual instruments are located at Giordan Lighthouse which is in a clean air area and thus enables us to study the Mediterranean background. Location of the scientific team at the Gozo Campus is fundamental, as easy and frequent access to the lighthouse by the team is essential in view of the "state of the art" instruments which need frequent adjustment.

Background

The establishment of a climate change/trace gas monitoring station in the Central Mediterranean arose out of a synergy in 1993 between Prof Raymond Ellul of the Physics department, Prof P Serracino Inglott, Rector of the University of Malta and Prof Paul Crutzen, Director of the Max Planck institute for Airchemistry, Mainz, Germany (Also 1995 Nobel Prize Laureate in Atmospheric chemistry).

It was realised that the strategic position of the Maltese islands midway between Europe and North Africa in the Central Mediterranean could be utilised to make unique measurements of long range trace gas concentrations transported from both continents as well as further afield and hence contribute to a worldwide programme on climate change. With the added help of Dr Guesten of the IMK, Karlsruhe research centre and the German International Bureau for Scientific affairs in Bonn as well as the impetus of the Max Planck organisation, Giordan lighthouse on Gozo was selected as the ideal and only possible site on the Maltese islands where extremely sensitive trace gas measurements could be made on a routine basis uncontaminated by local pollution.

In 1996 the first monitors were donated by the German institutions in question and installed at Giordan lighthouse. Further equipment was later installed so that the lighthouse today hosts ozone, carbon monoxide, and sulphur dioxide monitors as well as sensors for all meteorological parameters and global radiation measurements.
Today we know that the data collected (1996-2006) include the influence of long range atmospheric transport mechanisms not only from Europe and Africa but also from as far away as the United States and South East Asia.

The Gozo centre at Xewkija hosts the laboratory where the data are processed and studied and are made available worldwide.

The lighthouse at Ta' Giordan

International, National and University Use

In recognition of the importance of the results from the Giordan lighthouse station to the international scientific community the World Meteorological Organisation in 2001 formally recognised this as a regional Global Atmospheric Watch (GAW) station. WMO hosts several hundred such stations worldwide, all located in geographically strategic positions; the results from all such stations are published annually and constitute a detailed record of climate variability with details of greenhouse and aerosol trace gas pollutants contributing to this climate change. Renowned institutes worldwide (eg. MPI, Hamburg, Germany; NCAR, Boulder, Colorado, USA) use these results to extrapolate theoretical model calculations to predict the climate scenarios for the next 50/100 years and form the basis of the Intergovernmental Panel on Climate Change (IPCC) reports issued every four years by the UN.

The Giordan lighthouse results are included in the results published since 2002 and form the basis of climate and pollution trends for the Mediterranean. This is therefore the Maltese contribution to the UN/International community's programme on climate change. The formal appointment of the Giordan lighthouse station as a GAW station also implies that the University of Malta is the Maltese agency responsible for the provision of background atmospheric data from Malta.

On the national front these results are used by various organisations including MIA meteorological office, MEPA for reports to the EEA, Civil Protection when major pollution events take place (eg. Etna eruptions) as well as Wasteserv and directly the ministry for rural affairs and the environment who sometimes solicit advice on Mediterranean situations. All these organisations need to relate local data and situations to the wider picture in the Central Mediterranean.

The University of Malta has itself benefited in its role as educator and researcher in environmental matters. The work employs students both undergraduate and postgraduate and several student thesis including an MSc and a PhD have been produced from the ongoing work. More student work is in the pipeline and there is growing interest from Gozitan students for whom the centre is a ready made source of research projects and possible employment.

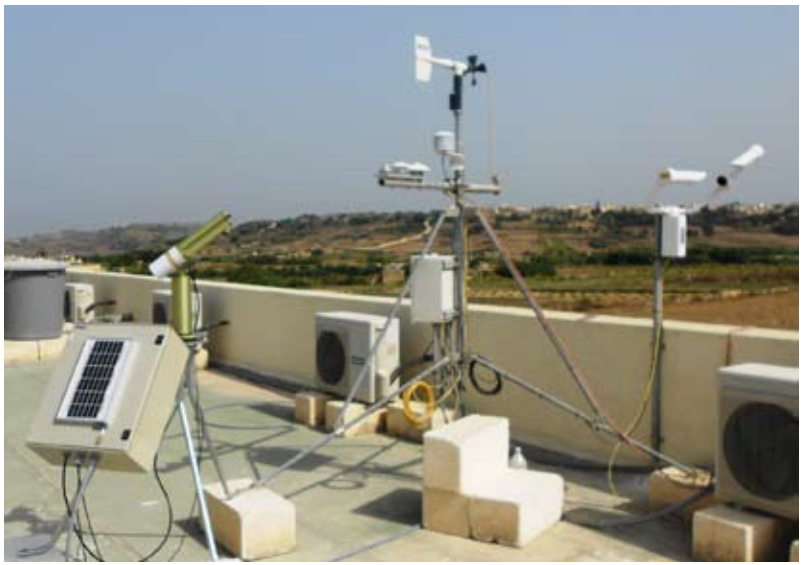
Most importantly the centre has established an international scientific reputation (see also list of publications) which forms the basis of much cooperative work taking place. Ongoing cooperation takes place with German, Greek, British, Norwegian, French and Italian scientific organisations as well as WMO on a worldwide basis. This scientific reputation is the basis on which future international cooperative programmes can continue to be built particularly with the European Union. In recognition of the work done here Prof. R Ellul sits on several European Commission expert environmental evaluation committees.

It must also be pointed out that despite WMO running many such stations worldwide there is no direct allocation of funds from the UN, WMO programme. Each country takes care of and funds its own individual monitoring stations through the University, research institute or agency responsible.

Long Term Future

The Giordan lighthouse station has enabled the University Physics Department and the country to:

- Establish a sound international scientific reputation.
- Is the Maltese direct contribution to the UN's Climate Change Programme.
- Has enabled us to train scientists in environmental matters.



Instrument on the roof of the Atmospheric Research Unit at the University Gozo Campus

- Has established important international cooperative programmes around the Mediterranean and the rest of Europe.

New GAW Station as from 2010

In 2008 ERDF funds were applied for and successfully obtained. This has resulted in a brand new set of equipment being installed in 2010. We are now able to monitor a vastly increased range of trace gases and aerosols and are able to interact with the global atmospheric community in a much more direct way. At the Xewkija offices we now employ four graduates:

Martin Saliba who did his MSc with us and is now employed as the chief technical officer responsible for maintaining the

equipment. Francelle Azzopardi who is a mechanical engineering graduate and is reading for her PhD concentrating on the shipping emissions in the Malta Sicily channel. Alexander Smyth who is doing his Masters with a view to continuing his PhD in aerosol chemistry. Miriam Azzopardi who is a graduate trainee and assists with administration and the collection of data.

The new setup has already attracted further international funds in the shape of an agreement over a project with the Instituto Nazionale di Geofisika e Vulkanologia (INGV) of Catania wherein the monitoring of emissions from Etna is now taking place. New equipment for the study of volcanic ash is to be installed in the next six months and this phenomenon will be studied to ascertain its effect on aircraft movements. The total amount of equipment to be finally installed at Giordan lighthouse will be of the order of Euro 750,000 all told.

Publications

Over 40 publications have directly or indirectly resulted from work carried out at the Atmospheric Pollution Monitoring Centre between March 1996 and June 2010. The list includes scientific reports, journal publications, conference publications and associated reports. A few of the more important publications are listed hereunder.

Ellul, R. (ed) (2000). *Proceedings of the Atmospheric Pollution Seminar held on the 9th April 1999 at L-Imġarr Hotel, Gozo, Malta*. Malta University Press.

Ellul, R. & Nolle, M. (2001). *Long Term Trends of Background Ozone Concentrations in the Central Mediterranean - Diurnal and Seasonal Variations as measured on the island of Gozo*. Contribution to TOR Project, Eurotrac Programme Proceedings, Munich, Germany.

Nolle, M., Ellul, R., Güsten, H. & Heinrich, G. (2002). *A Long term study of Background Ozone Concentrations in the Central Mediterranean-Diurnal and Seasonal Variations on the Island of Gozo*. Atmospheric Environment, Vol 36: 1391-1402.

Nolle, M., Ellul, R., Güsten, H. & Heinrich, G. (2002). *GAW Station on the Island of Gozo in the Central Mediterranean*. Proceedings of WMO Workshop, Riga, Latvia - May 27-30th 2002.

Ellul, R. & Nolle, M. (2003). *Long Term Trends of Trace Gas Concentrations in the Central Mediterranean as Measured at The GAW station on the island of Gozo*. Tropospheric Ozone Research; EUROTRAC-2. Subproject Final Report edited by Lindksog, A. Germany: International Scientific Secretariat, National Research Centre for Environment and Health.

Loye Pilot, M.D., Mihalopoulos, N, Kouvarakis, G., Markaki, Z., Oikonomou, C., Nolle, M. & Ellul, R. (2004). *One year data set of atmospheric deposition of Saharan dust and nutrients at Malta*. ADIOS Report to European Commission. Deliverable No. 44.

Kalabokas, P. D., Kouvarakis, G., Mihalopoulos, N., Ellul, R., Kleanthous, S. & Repapis, C.C. (2005). *Rural surface ozone levels in the Eastern Mediterranean (Malta, Greece, Cyprus)*. Proceedings of EGU 2005 Conference, Vienna. Geophysical Research Abstracts: Vol 7, 06252, 2005.

Nolle, M., Ellul, R., Güsten, H. & Ventura, F. (2005). *A study of historical surface Ozone Measurements (1884-1900) on the island of Gozo in the central Mediterranean*. Atmospheric Environment, Vol 39, Issue 30: 5608-5618.

Saliba, M., Ellul, R., Camilleri, L. & Güsten, H. (2008). *A ten year study of background surface ozone concentrations on the island of Gozo in the Central Mediterranean*. Journal of Atmospheric Chemistry 60, Issue 2: 117.

Kalabokas, P. D., Mihalopoulos, N., Ellul, R., Kleanthous, S. & Repapis, C.C. (2008). *An investigation of the factors influencing the rural surface ozone levels in the Eastern Mediterranean (Malta, Greece, Cyprus)*. Atmospheric Environment, Vol 42: 7894-7906.

Ellul, R. (2009). *Summary of a 12 Year Study of Atmospheric Pollution in the Central Mediterranean*. Proceedings of WMO Workshop held at WMO, Geneva, Switzerland 5 – 7th May. WMO Secretariat.