



ATMO ACCESS
Access to Atmospheric Research Facilities

Activity report of the TNA to ATMO-ACCESS research infrastructures

Name and First Name:

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TNA title and acronym:

**Ground-based/Satellite Synergies for TrAcers Monitoring in
Urban Areas (GSS-TAMUA)**

Facility/ies accessed: AGORA

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Instructions

Please limit the report to max 3-5 pages, including tables and figures.

The report should be sent as pdf document and include the subheadings listed below. Please make sure to address any comments made by the reviewers (if applicable).

Is the information provided in the report confidential and should not be made available on the ACTRIS website?

- No, the information can be made public.
- Yes, the information should not be made public and access should be restricted to the TNA Team, the ATMO-ACCESS access providers, the reviewers concerned and the ATMO-ACCESS Strategic TNA Board.

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1. Short executive summary (can be made available to reviewers and EU experts)

The Mobile station for air Quality (EMQA) and the SPectrometer for Atmospheric TRAcers Measurement (SPATRAM) (1) have been dislocated from the Evora Atmospheric Science Observatory (EVASO) to the AGORA facility on 29 of February 2023. The following day the O₃, SO₂ and NO_x analysers installed inside the EMQA started (Figure 1). Unfortunately, a problem to the pneumatic part of the NO_x instrument arise, probably due to the trip Evora-Granada, and it was not possible to perform the NO_x monitoring. The meteorological instruments were installed outside the caravan and they started to measure. The SPATRAM instrument was taken to the terrace of the AGORA and housed in a container used for the purpose (Figure2). The two devices for transferring solar radiation inside the spectrometer, the VELOD (Vertical Looking Device) and the MIGE (Multiple Input Geometry Equipment)(2), were fixed outside of the container a few meters from the PANDORA (3) instrument and practically at the same height. The measurements were then started after having verified and set for the SPATRAM-MIGE system the same multi axis geometry of measurements used by the PANDORA.



Figure 1 – The mobile station for Air Quality monitoring inside the AGORA parking in measurement mode.



Figure 2 – The VELOD (red circle) and the MIGE (yellow circle) measuring at the AGORA terrace.

2. User group

Complete the table with details of the user group members who actually accessed the Facility. Duplicate the table below for each member of the user group.

<i>Information on the User group members</i>	
Member # 1	
First and last name	Daniele Bortoli
Gender	<input type="checkbox"/> Female <input checked="" type="checkbox"/> Male <input type="checkbox"/> Prefer not to say
Nationality	
Profile	<input type="checkbox"/> Undergraduate



	<input type="checkbox"/> Postgraduate <input checked="" type="checkbox"/> Expert scientist <input type="checkbox"/> Engineer, Technician <input type="checkbox"/> Other		
Field of activity	<input checked="" type="checkbox"/> ENV-ATMO - Earth and environmental sciences/Atmospheric domain <input type="checkbox"/> ENV-HYDRO - Earth and environmental sciences/Hydrosphere domain <input type="checkbox"/> ENV-LITHO - Earth and environmental sciences/Lithosphere <input type="checkbox"/> ENV-ECOBIO - Earth and environmental sciences/Eco-biosphere <input type="checkbox"/> PHY - Physics astronomy, astrophysics and mathematics <input type="checkbox"/> CHEM - Chemistry and material sciences <input type="checkbox"/> BIO-MED - Biological, medical sciences and biotechnology <input checked="" type="checkbox"/> ENG-TECH - Engineering and technology <input type="checkbox"/> EGY - Energy <input type="checkbox"/> ART - Humanities and arts <input type="checkbox"/> ISC - Information science and communication <input type="checkbox"/> SOC - Social sciences		
Are you a new user?	<input type="checkbox"/> Yes		
	<input checked="" type="checkbox"/> No		
Institution name (employer)			
Institution legal status (employer)	<input type="checkbox"/> Public research (including international research organizations and private research organization controlled by a public authority) <input checked="" type="checkbox"/> University and higher education <input type="checkbox"/> Public authority <input type="checkbox"/> Small Medium Enterprise (SME) <input type="checkbox"/> Other industrial and/or profit private organization <input type="checkbox"/> Other		
Address (employer)	Rua Romao Ramalho 59, Evora	Country	Portugal
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Access start date	29-01-2023	Access end date	03-02-2023

Information on the User group members

Member # 2

First and last name Miguel Potes



Gender	<input type="checkbox"/> Female <input checked="" type="checkbox"/> Male <input type="checkbox"/> Prefer not to say		
Nationality			
Profile	<input type="checkbox"/> Undergraduate <input type="checkbox"/> Postgraduate <input checked="" type="checkbox"/> Expert scientist <input type="checkbox"/> Engineer, Technician <input type="checkbox"/> Other		
Field of activity	<input checked="" type="checkbox"/> ENV-ATMO - Earth and environmental sciences/Atmospheric domain <input type="checkbox"/> ENV-HYDRO - Earth and environmental sciences/Hydrosphere domain <input type="checkbox"/> ENV-LITHO - Earth and environmental sciences/Lithosphere <input type="checkbox"/> ENV-ECOBIO - Earth and environmental sciences/Eco-biosphere <input type="checkbox"/> PHY - Physics astronomy, astrophysics and mathematics <input type="checkbox"/> CHEM - Chemistry and material sciences <input type="checkbox"/> BIO-MED - Biological, medical sciences and biotechnology <input checked="" type="checkbox"/> ENG-TECH - Engineering and technology <input type="checkbox"/> EGY - Energy <input type="checkbox"/> ART - Humanities and arts <input type="checkbox"/> ISC - Information science and communication <input type="checkbox"/> SOC - Social sciences		
Are you a new user?	<input type="checkbox"/> Yes		
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Access start date	29-01-2023	Access end date	03-02-2023



Information on the User group members			
Member # 3			
First and last name	Andre' Albino		
Gender	<input type="checkbox"/> Female <input checked="" type="checkbox"/> Male <input type="checkbox"/> Prefer not to say		
Nationality			
Profile	<input type="checkbox"/> Undergraduate <input type="checkbox"/> Postgraduate <input type="checkbox"/> Expert scientist <input checked="" type="checkbox"/> Engineer, Technician <input type="checkbox"/> Other		
Field of activity	<input checked="" type="checkbox"/> ENV-ATMO - Earth and environmental sciences/Atmospheric domain <input type="checkbox"/> ENV-HYDRO - Earth and environmental sciences/Hydrosphere domain <input type="checkbox"/> ENV-LITHO - Earth and environmental sciences/Lithosphere <input type="checkbox"/> ENV-ECOBIO - Earth and environmental sciences/Eco-biosphere <input type="checkbox"/> PHY - Physics astronomy, astrophysics and mathematics <input type="checkbox"/> CHEM - Chemistry and material sciences <input type="checkbox"/> BIO-MED - Biological, medical sciences and biotechnology <input checked="" type="checkbox"/> ENG-TECH - Engineering and technology <input type="checkbox"/> EGY - Energy <input type="checkbox"/> ART - Humanities and arts <input type="checkbox"/> ISC - Information science and communication <input type="checkbox"/> SOC - Social sciences		
Are you a new user?	<input type="checkbox"/> Yes		
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Institution name (employer)			
Institution legal status (employer)	<input type="checkbox"/> Public research (including international research organizations and private research organization controlled by a public authority) <input checked="" type="checkbox"/> University and higher education <input type="checkbox"/> Public authority <input type="checkbox"/> Small Medium Enterprise (SME) <input type="checkbox"/> Other industrial and/or profit private organization <input type="checkbox"/> Other		
Address (employer)	Rua Romao Ramalho 59, Evora	Country	Portugal



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Access start date	29-01-2023	Access end date	03-02-2023

3. Scientific objectives

The main objective of TNA is the participation of the EMQA to the measurement campaign MANTRA (coMparison of gAses seNsor aT gRanada) organized by AGORA in winter 2022/23 to study the influence of the atmospheric dynamics in the evolution of gas concentration, identifying causes, processes and sources. This information helps to know how, where and from which sources to act to effectively reduce emissions of pollutants and improve air quality, which implies not only a scientific benefit but also a social and economic one. In the frame of instruments intercomparison in terms of validation/calibration of the obtained results, the project foresees the working side by side of the two spectrometric systems known as PANDORA and SPATRAM. The first belonging to the well known PANDONIA network and part of the NDACC (Network for the Detection of Atmospheric Composition Changes) and the second belonging to the SPATRAM/GASCOD family that was developed in the '90s and in the 2010 suffered a deep upgrade in order to improve the instrument performances and be able to apply the MAX-DOAS measurements configuration. The activities deployed in the TNA project will furnish the calibration of the SPATRAM system allowing to obtain trustfully and validated data for total columns and vertical profile for the atmospheric tracers such as ozone, nitrogen dioxide, formaldehyde and bromine monoxide.

4. Reasons for choosing the Facility/ies

The AGORA observatory managed by the University of Granada - Spain, was selected for several reasons: i) is located almost in the center of the Granada city and it is one of the most complete laboratory in Spain, ii) it is on the way of enhancing the measurement capabilities of the station with the inclusion of ACTRIS compliant DOAS spectrometers; iii) for their high-qualified expertise in active/passive remote sensing techniques and solar instrumentation; iv) for its participation in numerous research campaigns and national/international projects related to what proposed in this TNA.

5. Activities during the TNA (research, training, events, ...)

During the TNA, the Portuguese team participated to interesting internal seminars organized by the host dealing with the new activities occurring in the AGORA facility. In addition, deep training on the new lidar instrument from Raymetrics recently acquired in the frame of ACTRIS-SP framework was exploited. The new Doppler lidar was also presented. We participated also in preparation and launches of some radio-soundings from the facility. The Pandora users/operators gave us the necessary information and documentation to understand the working geometries of the instrument, namely the alt/azimuth angles of measurements.

By our side, we explained the working principles of the in situ analyzers installed in the EMQA mobile station: beta gauge monitor for PM10, PM2.5 and PM1, ozone analyzer, NOx, NO, NO₂ analyzer, CO analyzer and SO₂ analyzer. The meteorological probes installed at the exterior of the EMQA for wind direction and intensity (Vaisala), as well as the ones for radiation, relative humidity and temperature were presented.

As added-value, since during the TNA it raised the possibility to leave the SPATRAM instrument in measurement mode for a longer period than the planned time, the full explanation of the setup and operation of the spectrometer were furnished to the AGORA staff in order to ensure the goodness of the



measurements and to operate in case of necessity. The status of the system was regularly checked with remote access during the period the instrument was measuring. The frequency of access was of 4 times per week for 4 weeks and every access had an average duration of about 45 minutes.

6. Method and set-up of research

- 1) to carry-out measurements of trace gases in the Granada urban environment that during the winter season can be considered almost isolated due to the presence of the Sierra Nevada surrounding the city;
- 2) to perform intercomparison / validation of algorithms and results obtained with types of instruments applying distinct measurement techniques (in situ / remote sensing) from different point of view (ground-based / satellite) and vertical profiles and atmospheric boundary layer pollution in strato / troposphere and at the surface;
- 3) to fix the best measurement protocols aiming for the minimization of the uncertainties associated to the obtained results and of the costs in this type of monitoring;
- 4) to create alerts to be disseminated in the population in case of exceeding the thresholds for the concentration of pollutants;
- 5) to strengthen the collaboration between the atmospheric physics groups of the University of Granada and the University of Évora which in the past have already collaborated actively through ACTRIS projects and master/doctoral exchanges.

7. Preliminary project results and conclusions

During the full period of the physical TNA, the EMQA instruments devoted to meteorological observations worked as expected and the observed atmospheric temperatures, pressures and relative humidity are shown in Figure 3. Wind direction and speed measured with a Vaisala WXT520 instrument are reported in Figure 4.

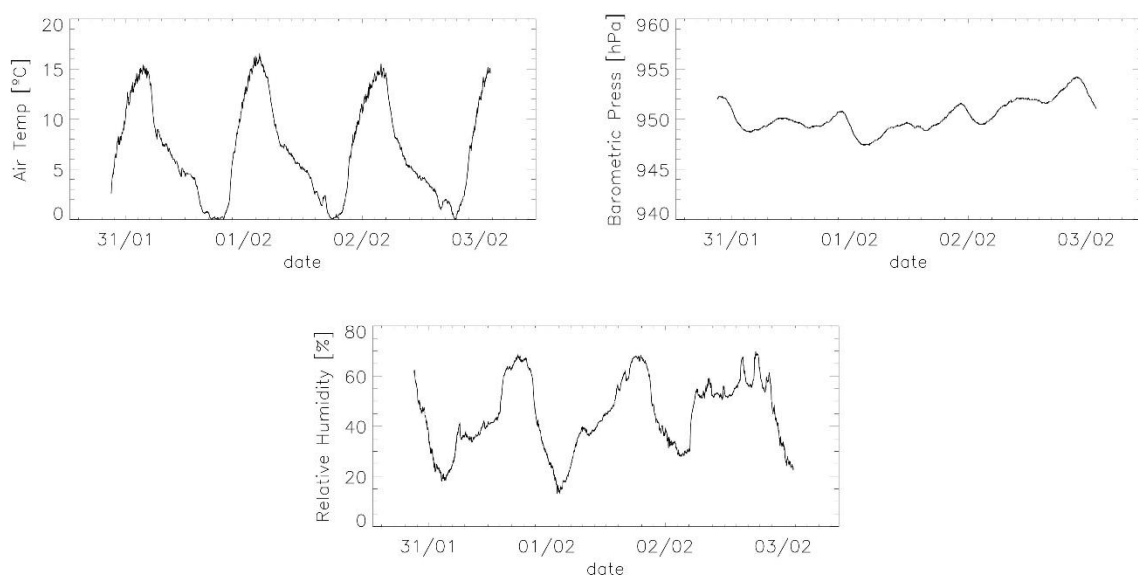


Figure 3 – Meteorological parameter measured with EMQA sensors.



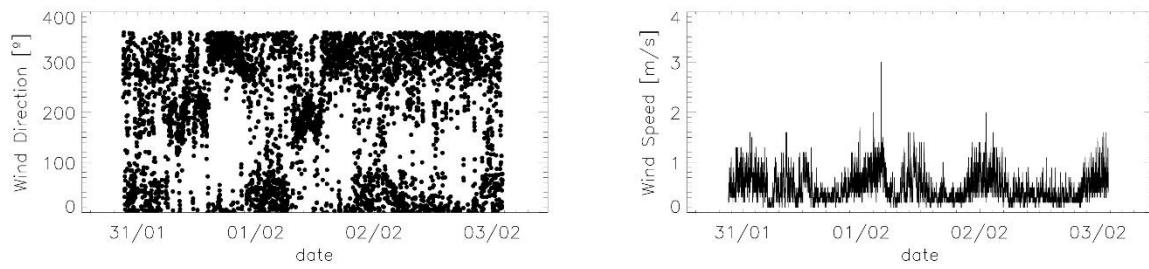


Figure 4 – Wind direction (left panel) and wind speed (right panel) measured during the GSS-TAMUA project.

The observations for PM₁₀, PM_{2.5} and PM₁ carried out by the particles analyzer MP401 by ENVEA are shown in Figure 5. These are the measurements obtained with the optical module of the analyzer. The instrument is also capable of measuring the PM₁₀ with gravimetric method based on the beta radiation extinction (not showed here).

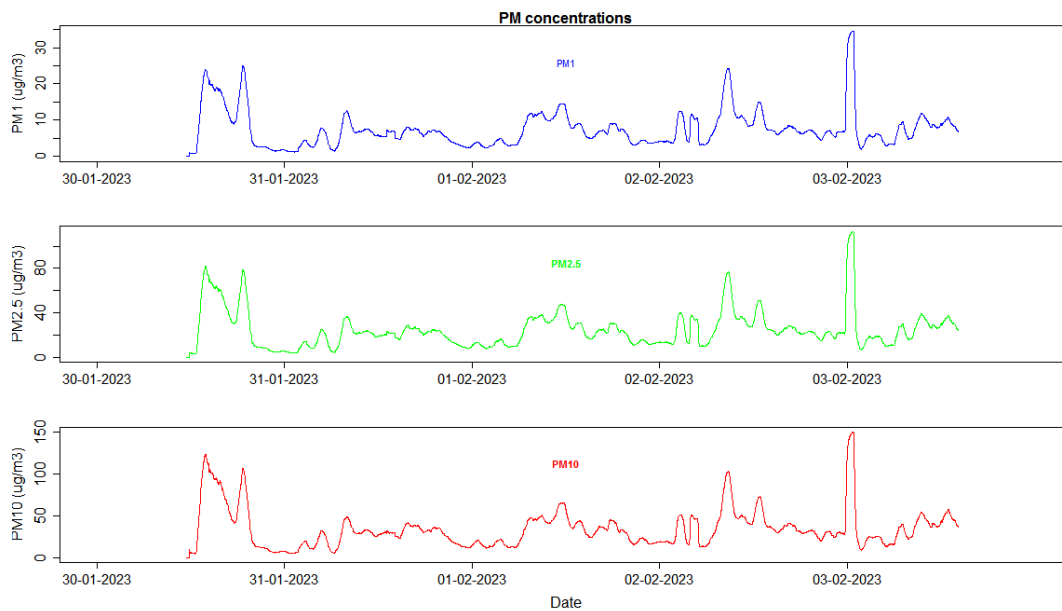


Figure 5 – PM concentrations from the MP401 Envea analyzer.

In Figure 6 are reported the results obtained for O₃ with the O342M Analyzer. The diurnal cycle of O₃ is clearly visible as well as the nocturnal O₃ concentrations increasing.



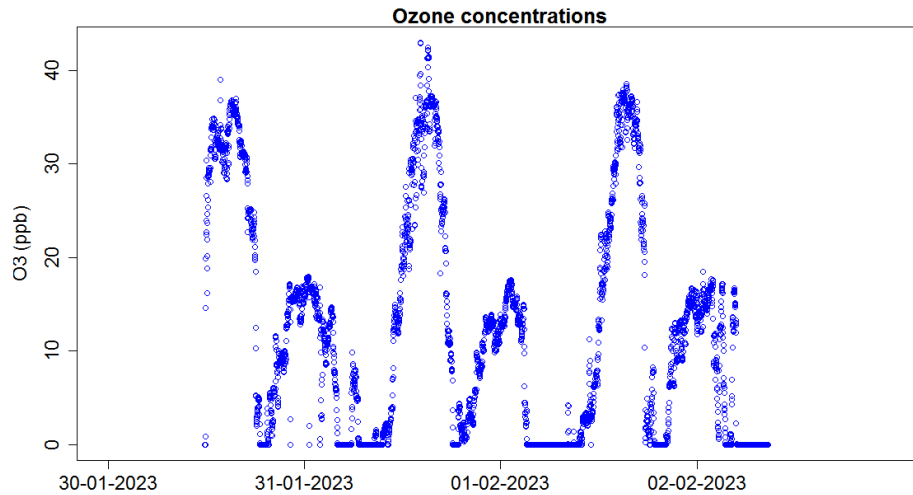


Figure 6 – time series of O₃ concentration.

Finally, in Figure 7 are reported the preliminary results for NO₂ slant column densities obtained (SCD) from the SPATRAM observations in zenith sky configuration (VELOD measurements). For NO₂ also the diurnal cycle is clearly visible and the SCDs values at sunrise are lower than at sunset as expected due to the photochemistry activity of NO₂.

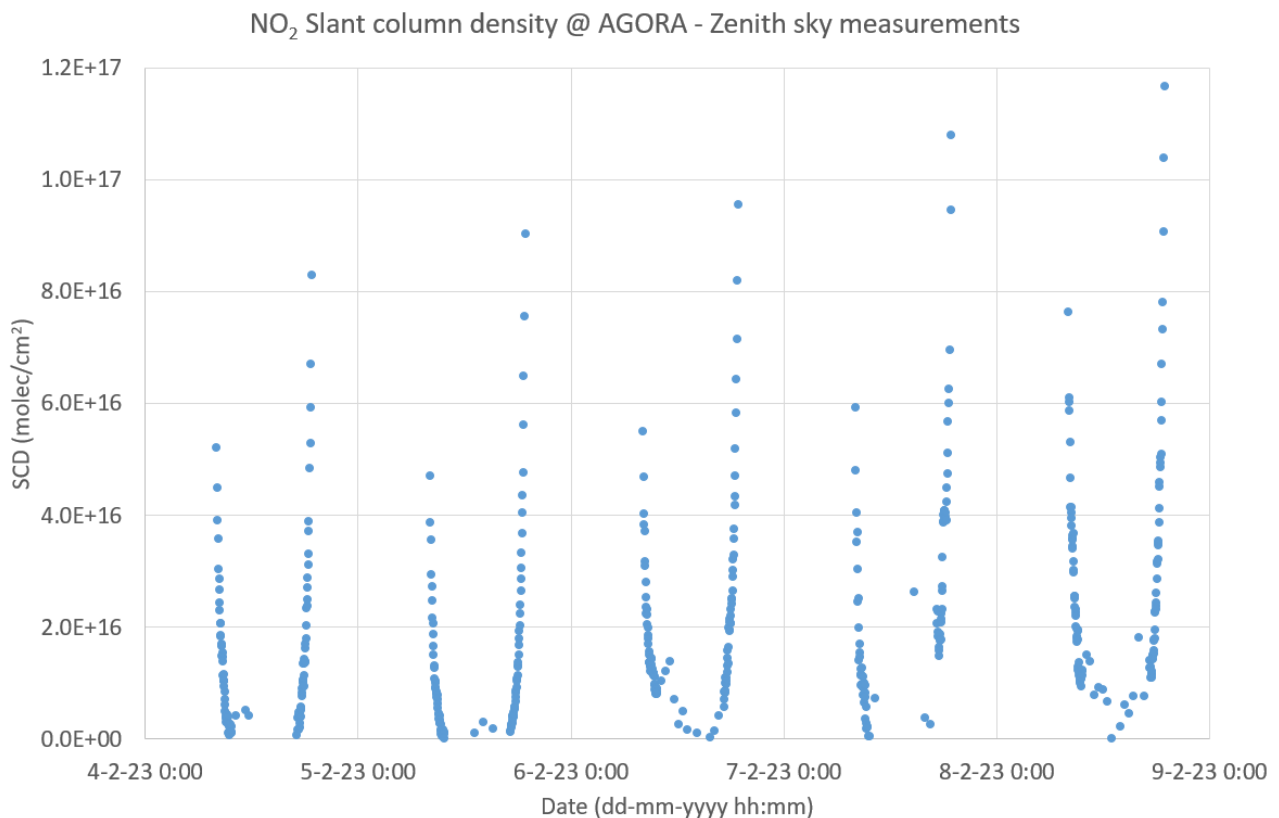


Figure 7 – NO₂ SCD in zenith sky configuration.



8. Outcomes and future studies

We had the chance to leave the SPATRAM system installed in AGORA for almost 1 month after the official end of the TNA. This will allow to have a relatively long data timeseries in order to calibrate/validate the SPATRAM measurements with the PANDORA ones, considering this as an intercomparison of the SPATRAM system with an ACTRIS compliant system as PANDORA is.

Regarding the EMQA observations, they will be compared with the measurements obtained with similar instrumentation at the AGORA station and deep studies using back trajectories are foreseen.

The main objectives of this experiment, namely the side by side measurements of the SPATRAM and PANDORA systems were reached. In addition, the measurements performed with the beta gauge monitor and with the TSI Optical Particle Sizer (OPS) in situ analyzers for air quality assessment, will allow to infer a good estimation of the particle load in the week of working. As a preliminary and only qualitative result, the visual analysis of the filter strip of the beta gauge revealed a rate of pollution mainly due to black carbon. More details of this will be furnished in one of the publications resulting from this work. Also the meteorological devices installed in the Mobile station were measuring for the whole period of the physical campaign furnishing important data that are useful for the characterization of the gravimetric observations. Unfortunately the in situ measurements of gaseous pollution was not 100% successfully since of the 4 analyzers deployed (NO_x, SO₂, CO and O₃) only the last one worked for the full period of the campaign, Problems due mainly to the mechanical stress during the dislocation of the caravan from Évora to Granada caused the malfunction of the other 3 instruments. Only the SO₂ worked for 3 of the 6 days of the campaign.

9. Plans for publications

(in peer-reviewed journals, conference proceedings, etc. acknowledging the support by ATMO-ACCESS). Details, including the DOI, need to be provided as soon as available.

We plan to have a couple of publication dealing with:

- 1) the SPATRAM/PANDORA intercomparison
- 2) the air quality assessment in Granada during the execution of the TNA

and 1 or 2 presentations in international conferences and/or in Project meetings.

Following the ATMO-ACCESS rules for the raw data obtained during TNAs, the spectral data carried out with the SPATRAM system are available at the AGORA facility as well as the time series of the instrument installed in the mobile station (meteo, PM₁₀, PM_{2.5}, PM₁ and O₃).

10. References

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<http://dx.doi.org/10.1117/12.830104>



3 - Tzortziou, M., Herman, J. R., Cede, A., and Abuhassan, N.: High precision, absolute total column ozone measurements from the Pandora spectrometer system: comparisons with data from a Brewer double monochromator and Aura OMI, *J. Geophys. Res.*, 117, D16303, 2012

<http://dx.doi.org/10.1029/2012JD017814>

