LuftBlick Report 2014008

ESA Ground-Based Air-Quality Spectrometer Validation Network and Uncertainties Study

Network Design - Development Document

	Name	Company	Date
prepared by	Alexander Cede	LuftBlick	9 Sep 2014
	Martin Tiefengraber	LuftBlick	9 Sep 2014
checked by	Katherine Cede	LuftBlick	9 Sep 2014
approved by			

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Document Change Record

Issue	Date	Page	Observations
0.1	22 Jul 2014	All	First draft version
1.0	30 Jul 2014	All	Minor changes; correct typos
1.1	9 Sep 2014	All	Applied changes based on ESA-review

Acronyms and Abbreviations

AOD	Aerosol optical depth
ESRIN	European Space Research Institute
Pandonia	ESA Ground-Based Air-Quality Spectrometer Validation Network
Pandora	Pandora spectrometer system
Pandora-2S	Pandora dual spectrometer system
UV	Ultraviolet

1 Introduction

This report is deliverable D08 of the ESA Ground-Based Air-Quality Spectrometer Validation Network (Pandonia) project [2, 1]. Section 2 summarizes the findings of *Cede* [3], which are the base for the selection of network stations. Section 3 gives a suggestion for the locations of the first four instruments distributed within this project.

1.1 Applicable Documents

[1] Ground-Based Air-Quality Spectrometer Validation Network and Uncertainties Study [Proposal], LuftBlick Proposal 201309A, Issue 2, 2013.

[2] ESA Ground-Based Air-Quality Spectrometer Validation Network and Uncertainties Study [Statement of Work], ENVI-SPPA-EOPG-SW-13-0003, Issue 1, Revision 3, 2013.

1.2 Reference Documents

[3] A. Cede. ESA Ground-Based Air-Quality Spectrometer Validation Network and Uncertainties Study, LuftBlick Report 2014003: Instrument System Requirements Document, Network System Requirements Document, Instrument Locations and Validation Strategy plan, 2014.

[4] A. Cede, M. Tiefengraber, and A. Redondas. ESA Ground-Based Air-Quality Spectrometer Validation Network and Uncertainties Study, LuftBlick Report 2014001: Network Intercalibration Procedure, 2014.

[5] C. Guirado et al. Optical calibration facility at the Izañ a Atmospheric Research Center. *Optica Pura Aplicada*, 45(1):57–62, 2012.

[6] D. Pissulla et al. Comparison of atmospheric radiance measurements from five independently calibrated systems. *Photochemical and Photobiological Sciences*, 8:516 – 527, 2009.

2 Conclusions from *Cede* [3]

Sections 3 and 4 of *Cede* [3] list the logistical requirements and topographic considerations for a network location respectively. From this we derive the mandatory requirements for a network location (section 2.1) and optional criteria making a network site more suitable (section 2.2).

2.1 Mandatory requirements for a network location

1. The measurement platform needs enough (at least 1 m^2) space to locate the outside pieces of the Pandora spectrometer system (Pandora) or the Pandora dual spectrometer system (Pandora-2S).
2. The space needed for the spectrometer box is about 1 m^2.
3. The instrument base plate must be mounted on a stable surface. Soft surfaces (e.g. grass) or surfaces that change with temperature (like some metallic roofs) cannot be used.
4. The distance between the outside pieces and the spectrometer cannot not exceed 20 m and should preferably be below 10 m.
5. AC-power must be available. Pandora-2S has power consumption maxima of 245 W.
6. The operating laptop has to be on a fast and stable Internet connection, as the remote instrument control and the data upload are done through the web.
7. A selected Pandonia location must offer local support (not financed by the project). Local support means that local personnel acts as station operators and fulfill the duties outlined in section 3.3 of *Cede* [3].

2.2 Optional criteria making a network location more suitable

1. The spectrometer box is located inside a room. This allows better temperature control and reduces the amount of moisture in the spectrometer box. This is especially important in humid environments.
2. The distance between the outside pieces and the spectrometer is below 10 m, which reduces the signal loss for ultraviolet (UV) radiation.
3. The local support at the station is experienced in handling instrumentation and active in its interaction with the network operator.
4. The horizon of the instrument is unobstructed in most directions.
5. The location possesses equipment measuring auxiliary data such as temperature, humidity, pressure, wind speed, aerosol optical depth (AOD), and trace gas column amounts, surface concentrations or profile information.
6. The location is an urban or rural-urban environment.

3 Suggested network sites

As outlined in the Statement of Work [2], six instruments will be acquired and distributed within this project; one Pandora and five Pandora-2S. The following are our suggested destinations for each unit:

- **Instrument 1 (Pandora 106)**: arrived at Innsbruck, Austria, in July 2014. It will be installed at the observation platform of the Biomedical Physics, Medical University Innsbruck (`http://www.uv-index.at/`). This platform has been modified to hold up to two Pandoras (figure 1). As pointed out in the proposal [1], Innsbruck is a testing and research site for Pandonia equipped with a fully functional laboratory [6].
- **Instrument 2**: is the first prototype of Pandora-2S will be tested at Innsbruck (planned for fall 2014). Following calibration it will be moved to the Izaña Atmospheric Observatory, Tenerife, Spain (`http://izana.aemet.es/`). As pointed out in *Cede et al.* [4], Izaña is the host site for the stationary reference instruments and also equipped with a fully functional laboratory [5]. The platform at Izaña is large enough to accommodate several Pandoras for short-term intercomparisons (figure 2).
- **Instrument 3**: as a Pandora-2S will serve as a companion instrument to the Pandora currently operating at Innsbruck (2015). Instrument 3 will be considered the monitoring unit at this location measuring the full wavelength range up to 900 nm, while instrument 1 as a research unit used for special tests in laboratory and field.
- **Instrument 4**: will be installed in 2015. Our suggested location is European Space Research Institute (ESRIN), Italy (`http://www.esa.int/About_Us/ESRIN`) as it fulfills all requirements listed in section 2.1 and covers also items 3, 4, and 6 of section 2.2.
- **Instrument 5**: we suggest to make a mobile reference instrument [4], i.e. based at Izaña and visiting monitoring sites for calibration checks.
- **Instrument 6**: is planned for installation in 2016, location yet to be determined.

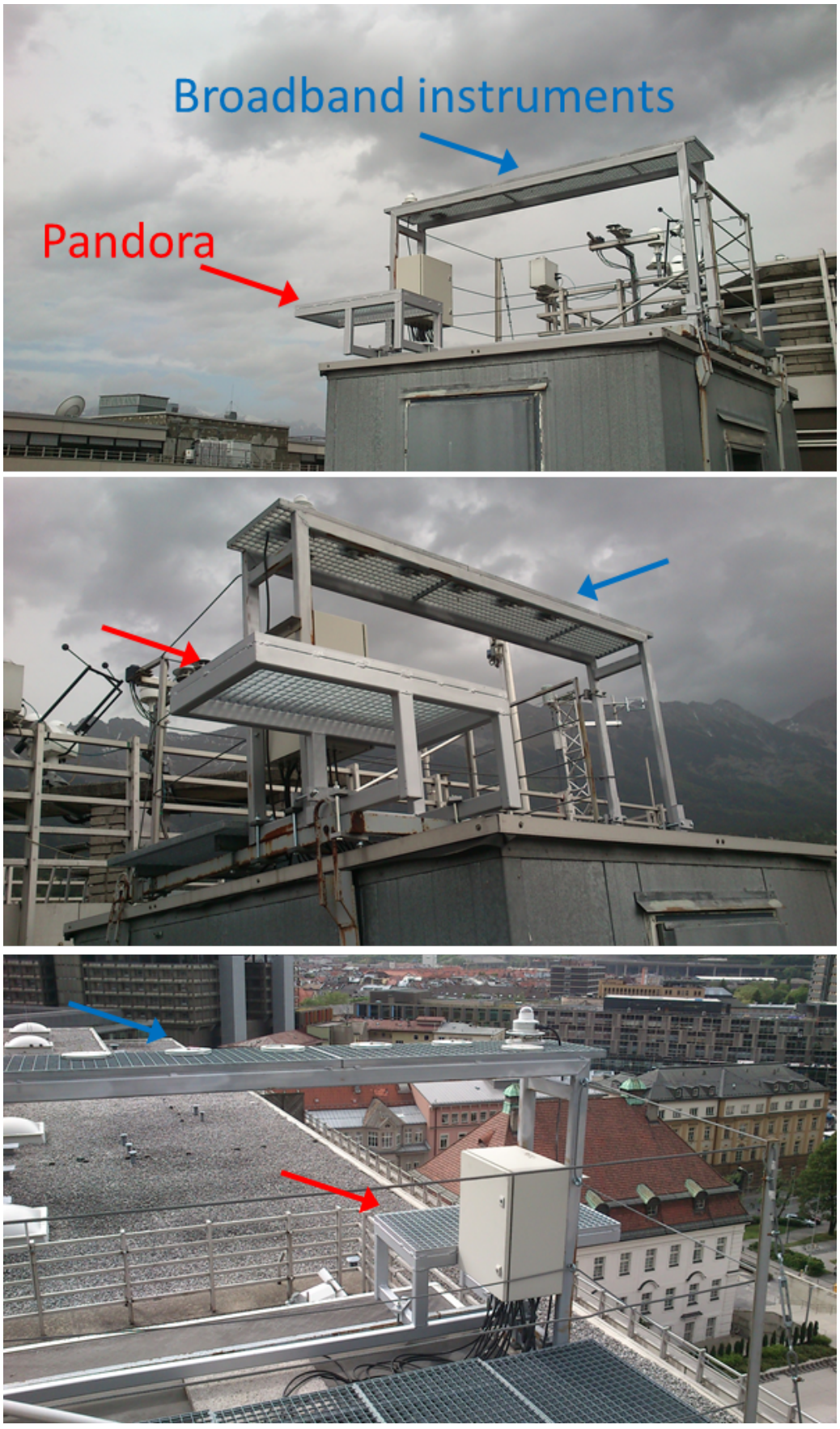

Figure 1: Pictures of the observation platform of the Biomedical Physics, Medical University Innsbruck. The Pandoras will be installed at the lower base (red arrow), so that the Pandoras head sensor is at the same height as the broadband instruments (blue arrow). Top panel is view from South-East. Middle panel is view from South-West with the mountain chain Nordkette in the background. Bottom panel is view from North

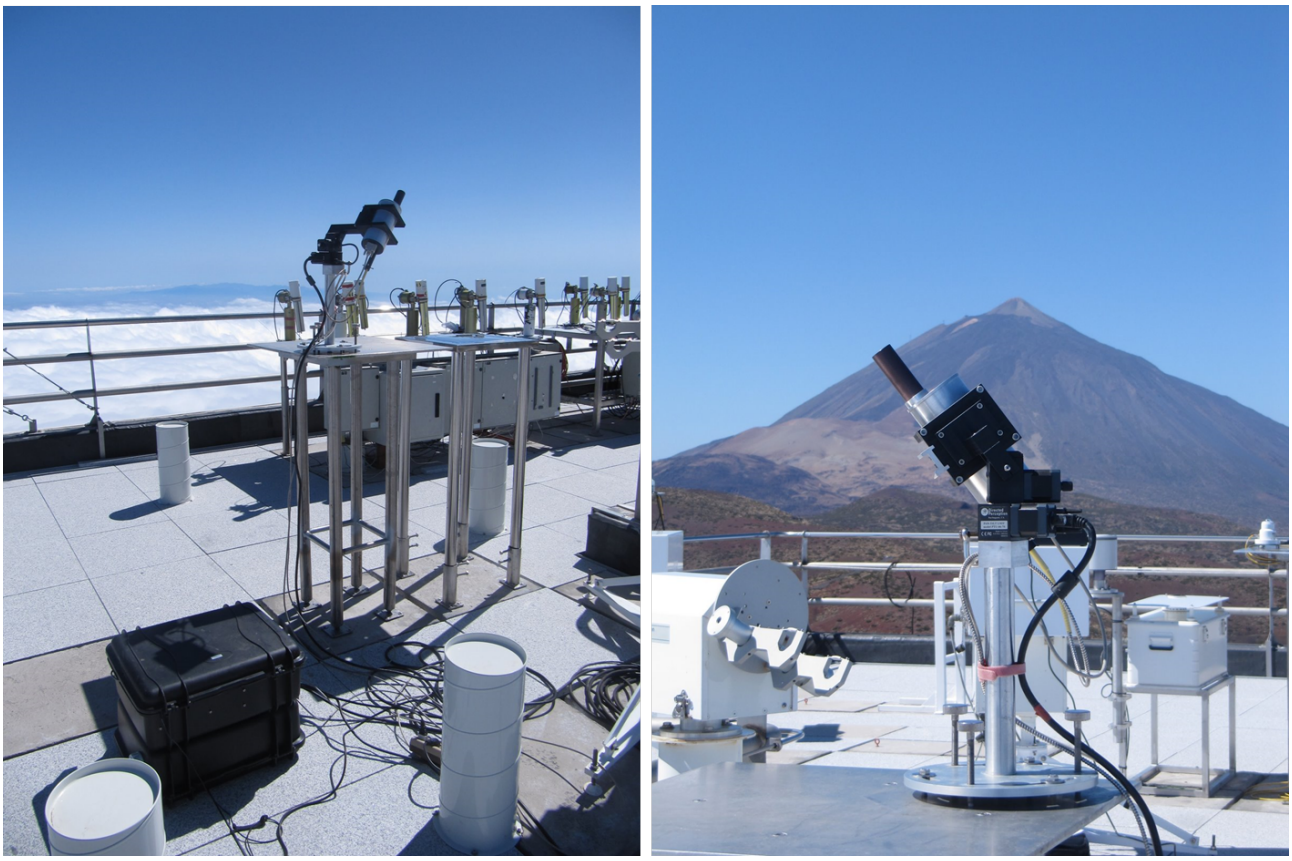

Figure 2: Pictures of the observation platform of Izaña Atmospheric Observatory. Left panel is view from North-West. Right panel is view from East with the mountain Teide in the background.