Pandonia Global Network (PGN)

With the start of the 21th century, the focus of atmospheric satellite missions has shifted gradually from the stratosphere (ozone chemistry) to the troposphere (air quality, aerosols, clouds, greenhouse gases). With this new situation NASA and ESA have identified a number of gaps in the satellite validation infrastructure for reactive trace gases such as nitrogen dioxide, ozone, sulfur dioxide, formaldehyde, etc. Studies have shown that due to the intrinsic difference in the field of view between satellite and ground data, large statistics (long time series at many locations) are needed in order to perform meaningful validation activities. This is especially true for (spatially and temporally) highly variable species such as nitrogen dioxide. Therefore it was concluded that a large-scale global monitoring network of (quasi-)autonomous stations is needed. Such a network did not exist for those species, with the exception of the Dobson/Brewer network for total ozone column measurements.

In 2005 NASA initiated an effort at Goddard Space Flight Center (GFSC) to address this issue by starting to develop a cost-effective, compact, easy to deploy, ground-based, passive remote sensing spectrometer system capable of performing sun, moon and sky observations called "Pandora". Pandora has continuously evolved since then with support from NASA and ESA and has been manufactured by SciGlob LLC since 2010. Soon Pandoras were distributed around the globe to form a validation network. In 2013 ESA joined NASA in funding this development through prime contractor LuftBlick OG, Innsbruck, Austria. Since 2018, this network is called "Pandonia Global Network" (PGN) and endeavors to ensure systematic processing and dissemination of the data to the greater global community in support of air quality monitoring and satellite validation. The PGN is carried out jointly by NASA and ESA as part of their "Joint Program Planning Group Subgroup" on calibration and validation and field activities, with additional collaboration from other institutions, most notably via the US Environmental Protection Agency (EPA) integration of instruments at long-term air quality monitoring stations.

The PGN provides real-time, standardized, calibrated and verified air quality data and associated uncertainty values. In the context of satellite validation PGN data sets are representing Fiducial Reference Measurements. PGN also seeks to coordinate and implement network standards regarding common algorithms and data processing, instrument operating routines, quality control, real-time data processing and data archiving. The instruments of the PGN are owned and operated by a large number of individual participating institutions (see the PGN distribution map). Participation in the PGN, which is open to anybody, entitles the instrument owner to receive support in instrument installation, operation, and maintenance by the PGN team and ensures that data produced by that instrument will be calibrated, processed, visualized, and distributed on the PGN central server. If you are interested in joining the PGN, contact any person listed in the "Contacts" section or simply write to operation[at]pandonia-global-network.org!

Question: What is the procedure to join the PGN?

Answer: Send an email to operation[at]pandonia-global-network.org with a brief summary of the plans you have for the instrument and request to join the PGN. From this moment on the PGN administrators will contact you and guide you through the process. Take into account that the procedure could take a few weeks to be completed. We recommend you start early to have it done before the instrument arrives at your field location.

Question: What are the requirements to join the PGN?

Answer: Those are the key elements for it (more details can be seen on the PGN application form):

- Have a Pandora.
- Install the Pandora permanently, for long term operation, in a proper location without too many obstacles in the field of view.
- Have Internet access with enough speed to be able to push all the captured data to the PGN servers, and also to allow remote support from the Network Operators.
- Have the instrument connected to a good power grid in order to keep it running without too many interruptions.
- Provide at least one person, who is in charge of maintaining the instrument operation at your location. This is the local operator for the Pandora who needs to perform regular maintenance actions such as cleaning the optics of the instrument when needed.
- Allow sharing of your data.

Question: I have filled the PGN agreement form and I am waiting for an answer. Is there something I can do in the meanwhile?

Answer: In the meanwhile, you could connect the Pandora operating computer to the Internet, contact the group of Network Operators (N.O.) via the email pgn-ops[at]pandonia-global-network.org, and give them the credentials of the remote access software of the computer. The N.O. manager will send you a “Welcome email”, which contains useful recommendations to take into account for a safe installation of your instrument. He will also assign your instrument to a specific N.O. from the group.

Question: Why does the network operator need access to the operating computer of my instrument?

Answer: The assigned Network Operator (N.O.) is your main contact person and assists you in the installation, operation and maintenance of the instrument. In order to do this, the N.O. needs to be able to access your instrument remotely. At present the PGN uses the remote control

software TeamViewer for this purpose. If such remote access is not possible, the N.O. cannot help you and you will not be able to get any support from the PGN.

Question: Why should I have TeamViewer installed on the Pandora operation computer?

Answer: At present TeamViewer is the remote control software used by the PGN Network Operators to remotely connect to your instrument, so that they can provide you with assistance in instrument operation and maintenance e.g. to fix small configuration problems, apply operative software updates, and perform regular checks of the instrument operativity. In the instrument PC, it is not needed to have Team Viewer logged in with any Team Viewer account, it is just needed to have Team viewer Installed.

Question: May I install another remote access software on the Pandora operation computer in addition to TeamViewer?

Answer: Of course you may. This is done by many PGN locations already because the local staff often does not have a paid license of Team Viewer.
Therefore alternative remote access software can be installed in the instrument pc's for your own access to the instrument such as AnyDesk, UltraVNC, Windows Remote Desktop, Chrome Remote Desktop, etc.

Question: Where can I get help in the installation of the instrument?

Answer: For the case that nobody from of the PGN team is present to help you installing the instrument, you can choose one of the following procedures:

1. Follow the description given in the installation manual, which is in this section of the PGN webpage.
2. Look at the installation manual, but wait with the installation until a Network Operator (N.O.) is assigned to your location. The N.O. will then guide you through the process.

We recommend that you choose option B as our experience has shown that this gives better results.

Question: What is the Local Log and why should I keep it updated?

Answer: The Local Log file is a text document which is usually called "Pandora**N**_Local_Log_File.rtf" (**N** is the instrument number) and located in C:\Blick\data\. It acts as a logbook for the history of the instrument, where the local operator should note all

actions performed on the instrument. Such actions are starting or stopping of the measurement schedules, changing the operational schedule, changing of any of the configuration files of the software, cleaning the entrance window or collimators, unmounting the instrument, unplugging the fiber, translocating the instrument, etc. This information is extremely useful for the Network Operators and the PGN members responsible for the data quality control to figure out whether any of the logged actions is related to their observations on the instrument performance or the data quality.

Question: Why should I keep the assigned Network Operator updated about the actions done on my instrument?

Answer: The assigned Network Operator (N.O.) is in charge of monitoring the status of your instrument on a weekly basis. He/she is also in charge of updating the official instrument history on a PGN database, called BlickM. In order for this information to be complete, the local operators should write their actions on the instrument into the Local Log file, or alternatively, send an email to the assigned N.O. Note that every information you can give the N.O. with respect to the instrument operativity is useful. The N.O.s have a lot of experience in identifying possible instrument problems, and also in anticipating possible issues, which could arise from actions undertaken with the instrument. Also notify your N.O. about your planned future actions on the instrument, as the N.O. will be able to give you suggestions on how to apply them in the best way to the instrument.

Question: Why should I not edit the instrument operation file on my own?

Answer: Two instrument specific files are needed to produce PGN data: the instrument operation file (IOF) and the instrument calibration file (ICF). Both files are supplied to you to enable you to locally produce your own data. In order for the Pandora data production to work, the IOF and ICF must be synchronized in certain ways. If the IOF is changed, you run the risk that the centralized data production on the PGN server does not work anymore. Therefore, if you believe that a change is needed, you should contact your Network Operator and discuss this with her/him.

Question: When is it needed to update the PGN application form?

Answer: The PGN application form is bound to the combination of Instrument + Location + Principal Investigator. If any of those are changed, then a new application form needs to be created. If any other entry of the form changes, the existing application form should be updated. This can be done using the same link as provided to you in the initial invitation to complete the form. Just change the respective entry and send the form again. In either case, you should contact operation[at]pandonia-global-network.org about your action, with a copy to the assigned Network Operator.

Question: I'm planning to move my instrument temporarily to another location. Can I receive support from the PGN during that time?

Answer: In general PGN support is only provided when your instrument operates at the assigned location, since a change of location creates a significant amount of additional work for the PGN team. However, it is possible that an exception is made. This is usually the case if the PGN decides that your change of location is of such scientific importance that allocating PGN resources for such support is justified. In order to know this, you need to send at least 4 months before your planned move an email to operation[at]pandonia-global-network.org, where you describe your plans and purpose.

Question: Are there guidelines about the proper handling when moving my instrument?

Answer: Here are a few general recommendations in case you are moving your instrument for a campaign or other purposes.

- Never unplug the fibers from the head side, always from the spectrometer side.
- Note the mark on the fiber and the spectrometer while unplugging the fiber(s). You shall use them again, when you reconnect the fiber to put it back in the same exact position.
- Do not touch the back part of the head while unmounting/mounting the head into the tracker bracket. This part is very sensitive. If the fiber entrance alignment is changed, then the instrument will need a new field calibration, which takes time from the PGN team. Be very careful with this part when packing the head for the transport.
- Transport the head plus fibers in a separate case than the rest of the instrument.
- Put some stickers on the packages, warning that the content is fragile. Try to avoid vibrations during the transport.
- Inform the Network Operator (N.O.) about the new location information, in order to have a new locations file prepared in advance. This will enable you to select the new location in the operation software BlickO once the instrument is mounted in the new location.
- At the new place, don´t forget to properly close the spectrometer housing case, in order to avoid condensation (there is a temperature controller inside the case, hence this can happen easily). You could also add a few bags of Carbon Silica Gel Bags inside this box to help keep the spectrometers dry.
- Only change the temperature controller setting temperature in the middle of a campaign if it is absolutely necessary. Discuss this first with your N.O.
- Follow the packaging instructions given in the Pandora installation manual, which is in this section of the PGN webpage.

Question: Who is in charge of the calibration of my instrument?

Answer: The calibration is done by a dedicated group within the PGN team (see the organigram). They make an initial calibration of your instrument based on the laboratory measurements and data from the first weeks of your instrument at your location. They also perform periodic quality checks on the data produced by your unit and decide whether a re-calibration is necessary. The result of the calibration is reflected in the instrument calibration file (ICF). With this file data products can be produced from your instrument, which is automatically done at the PGN server. The ICF is provided to you, so that you can do local processing as well.

Question: How often is it needed to re-calibrate my instrument?

Answer: The calibration group within the PGN team (see the organigram) performs periodic quality checks on the data produced by your unit and decides whether a re-calibration is necessary. How often a re-calibration is needed depends mostly on the stability of the instrument operation. In general, instruments that stay at the same place and do not get any damage from improper operation or environmental events keep their calibration longer (sometimes several years) than instruments, where the operation is not that stable. In most cases a re-calibration will only need a new "field calibration", which uses the data from your instrument at your location and the instrument does not need to be moved. In some cases, e.g. if the fiber breaks, it will be necessary to send the instrument back to one of the PGN laboratories for a repair and a full new calibration.

Question: Why is it necessary to have the BlickF software running, while the instrument operates?

Answer: The BlickF software serves two purposes. The "File Handling task" is used to automatically push files from your operating computer to the PGN server. The "Operation Monitoring task" is used to monitor the operation software BlickO and restart it if needed. Hence if you are not running BlickF, then your data are not pushed and therefore not processed, and your instrument will not resume measurements e.g. after a power outage.

Question: What are the contact emails I should use when I have questions?

Answer: Depending on your needs, you should choose one of the following emails:

- For specific technical questions with respect to your instrument use pgn-ops[at]pandonia-global-network.org or directly contact your Network Operator (N.O.). The N.O. will also redirect your questions to the proper member of the PGN staff in case it does not fall in their responsibility.
- For administrative and managerial questions use operation[at]pandonia-global-network.org. This includes issues with the application form, questions about data usage, specific measurements campaigns, etc.

- For questions about the data from your instrument or PGN data in general use productinfo[at]pandonia-global-network.org. A typical case would be that you observe results which seem strange to you, and want to discuss this with the PGN team members.