Update on PGN Progress
From Instrument and Network Perspectives

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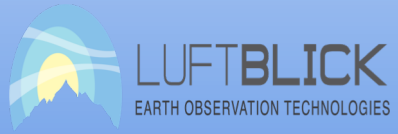
On behalf of LuftBlick and NASA Pandora Project teams

CEOS MTG
12 June 2019



Evolution of the Project and Network

Key Highlights:

- Expansion of networks
- Solidifying of the instrument (Tracker, Fiber Guide, Wedge Window, Detection and Mitigation of HCHO issue)
- Standardization of Network Operations
- Centralization of Data Processing, QA/QC process
- Finalization of the PGN application process
- First PGN STM September 17-20, 2019, hosted in Innsbruck, AT

Hardware Updates

New Sun Tracking System*

- Elevation (zenith) Range: 0°- 270°
- Azimuth Range: 0°- 360°
- 0.01° Step, mechanical encoder
- Improved Communication SW - tracker to PC.
- Improved Hardware, mechanical Encoder, Temp & Error Monitoring, Real time positioning feedback.
- Possibility to add internal heater for extreme cold weather operations.

* **~50** Trackers built by NASA and SciGlob currently being deployed.

Deployed on Moving Platforms w/ Camera

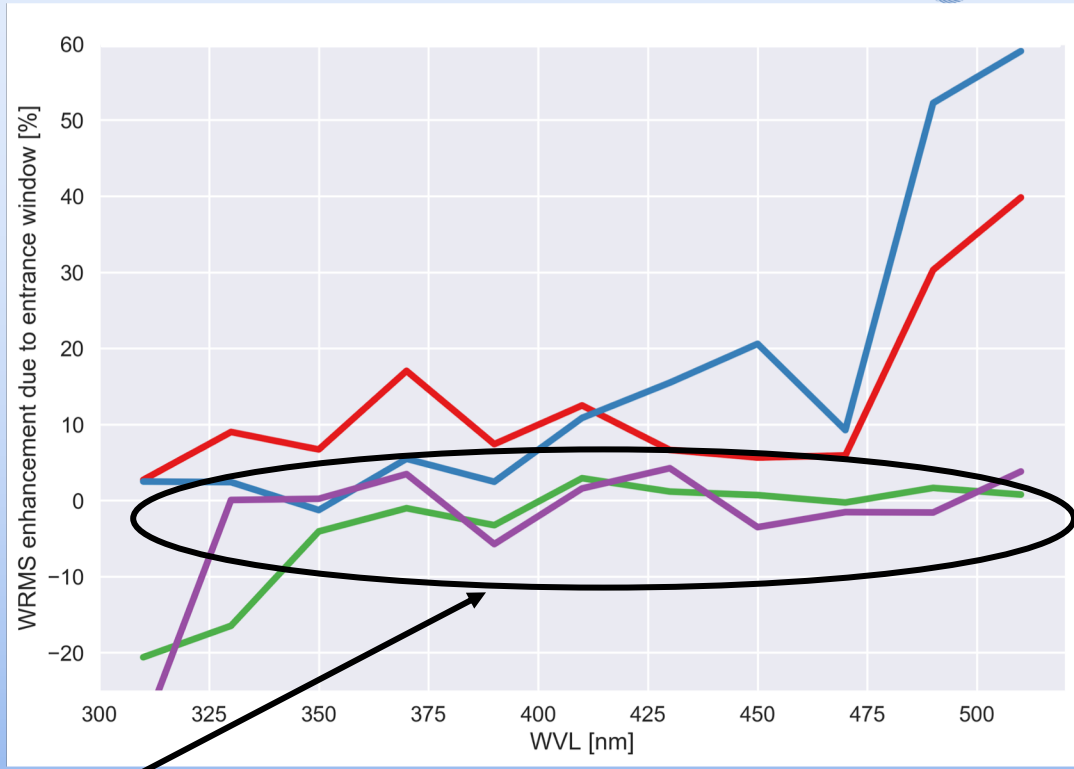
Uses a Simple Camera System - both internal and external
with ~15 deg FOV to help the instrument with real time sun tracking

New tracker performing onboard research vessel during last month's NASA/BOEM SCOAPE Field Campaign

Wedged Window*

- **Issue:**
  - AR-coated parallel lens suffered degradation of coating in the field
- **Solution:**
  - Use of wedged window
- **Benefit:**
  - Eliminate Etaloning Effect
  - Lowering of WRMS

*deployed in ~90% of all current instruments



Standard Window
Impregnated Window
Wedged - Thorlabs
Wedged - Edmunds

Fiber Guide*

- **Issue:**
  - Instability of fiber impacts FOV and RMS, variable if fiber not secure
- **Solution:**
  - Secure first 1.0m of fiber using 3D-printed fiber guide
- **Benefits:**
  - Maintains instrument stability, reproducibility essential for maintaining absolute calibration
  - Protects the fiber from any sharp bends or getting caught
  - Standardization between instruments

*~50 new guides purchased and being deployed

Instrument HCHO Issue*

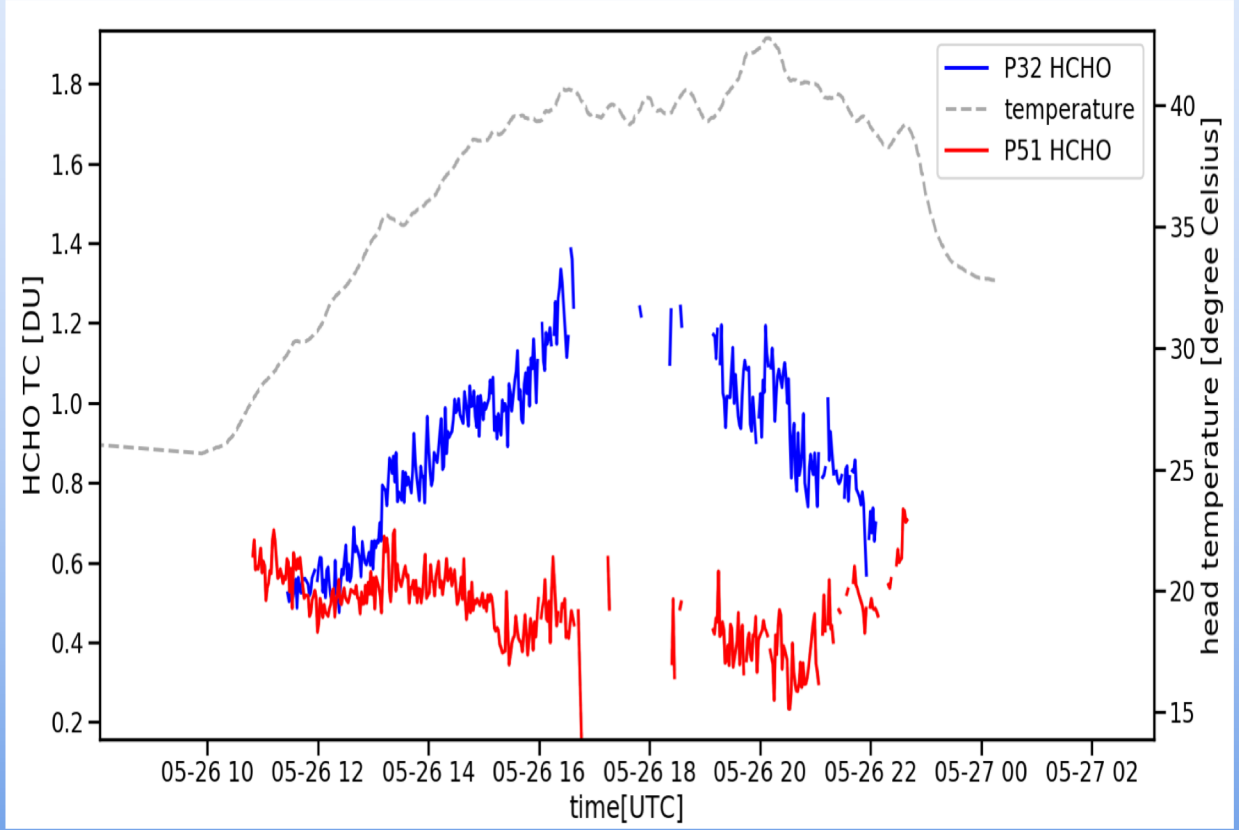
- **Issue:**
  - At high temperatures, Delrin parts inside the head sensor outgas HCHO resulting in spurious direct sun measurements
- **Solution:**
  - Removing parts comprised of Delrin and are currently evaluating Delrin-free alternatives (e.g., nylon, glass-filled nylon, aluminum).
  - 3 Pandora 1S instruments (Pan 51, 64, and 2) currently undergoing evaluation on top of GSFC B34 with Pandora 2S (EPA Pandora 70) to go up shortly

*~50 sets of nylon / Delrin free gears purchased and being deployed

Initial Delrin-free HCHO Results at B34, GSFC

- Comparisons between Pan32 (Delrin) and Pan51 (Nylon parts)*
- Temperature measured inside the Pan51 headsensor
- **Pan32 shows larger HCHO values that rise with temperature**
- **Pan51 appears to not exhibit any temperature dependent response**

*Everything same except for Delrin



Network Updates

Goal: Make PGN operational

- **From June 2018 to May 2019 the focus was mainly to move from “distributed instruments” to an operational network.**

- To run the PGN with a very small number of people, a series of developments had to be finished. E.g.
  - Standard operating procedures for lab and field calibration
  - Development of software packages that allow calibration analysis, data processing, remote network control, etc.

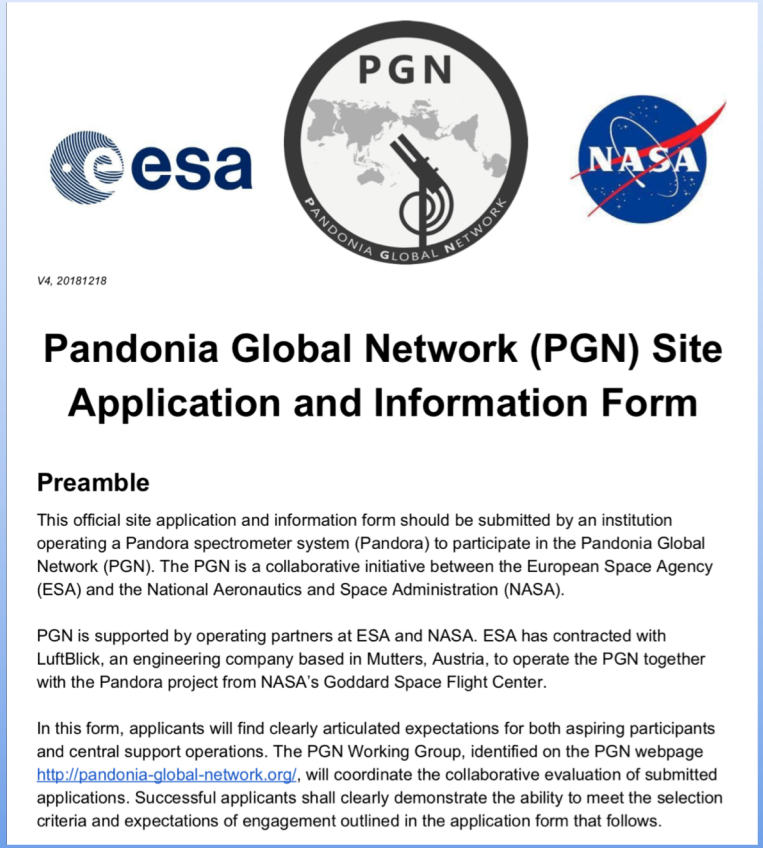
- Since Aug 2018 LuftBlick submits quarterly reports to ESA re. network status, data processing status, software status etc.

Goal: Make PGN operational

- PGN working group established Sept 2018 with members from NASA, ESA, EPA, SciGlob and LuftBlick. This Group decides about PGN logistics and holds a telecon ~ two months
- NASA held N. American Pandora Workshop June 4, 2019 as a precursor to the larger, inaugural PGN workshop. ~85 participants with more than 14 institutions presenting
- ***The 1st PGN meeting and workshop will take place 17-20 Sep 2019 in Innsbruck. Open to everybody interested in Pandora!*** Contact: alexander.cede@luftblick.at

Global Distributions - Moving from Unofficial to Official PGN Instruments

Standardized Application Form Complete with Clearly Defined Expectations



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Pandonia Global Network (PGN) Site Application and Information Form

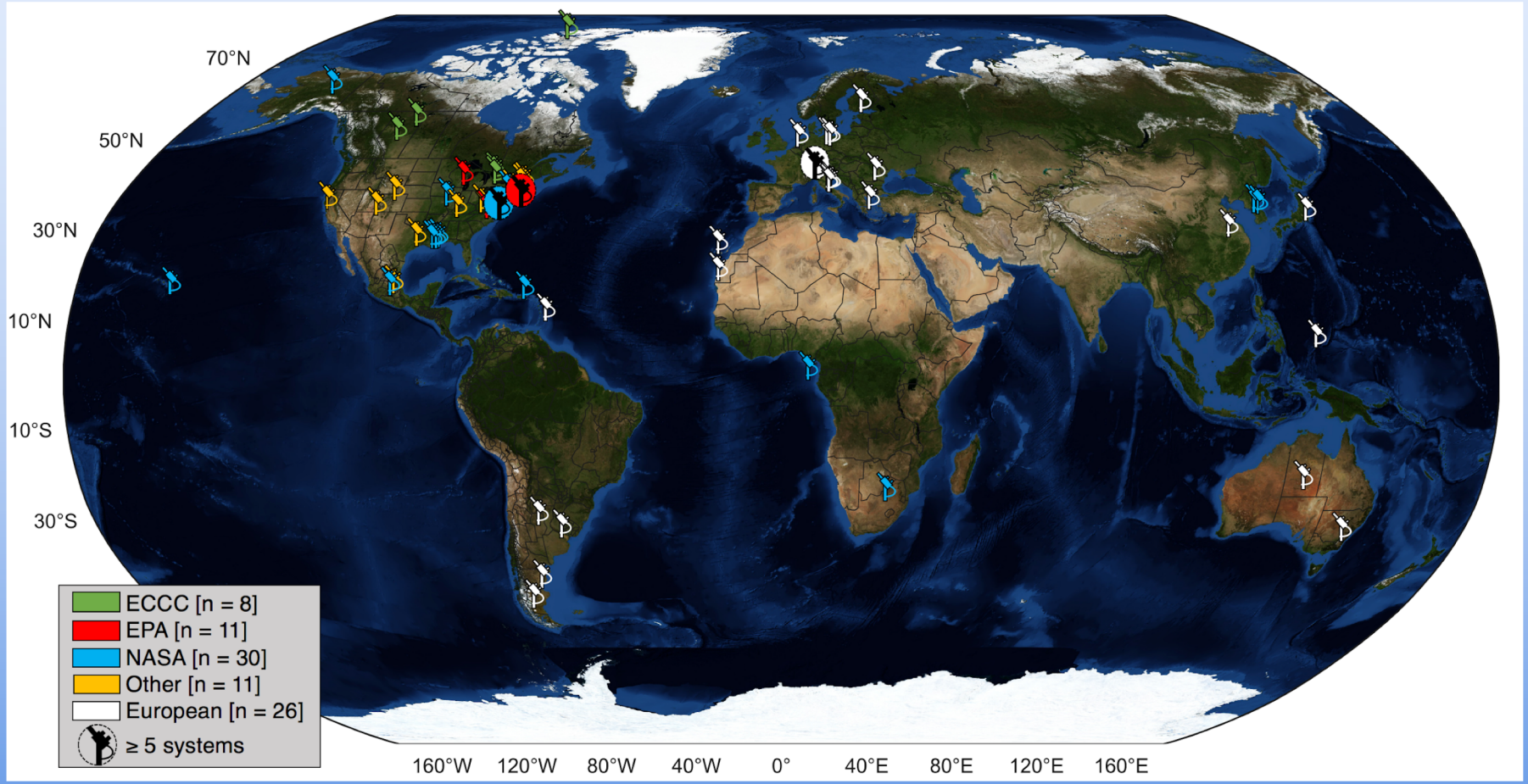
Preamble

This official site application and information form should be submitted by an institution operating a Pandora spectrometer system (Pandora) to participate in the Pandonia Global Network (PGN). The PGN is a collaborative initiative between the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA).

PGN is supported by operating partners at ESA and NASA. ESA has contracted with LuftBlick, an engineering company based in Mutters, Austria, to operate the PGN together with the Pandora project from NASA's Goddard Space Flight Center.

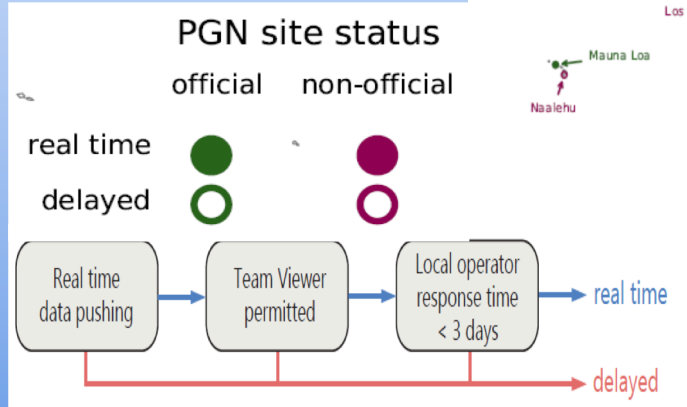
In this form, applicants will find clearly articulated expectations for both aspiring participants and central support operations. The PGN Working Group, identified on the PGN webpage http://pandonia-global-network.org/, will coordinate the collaborative evaluation of submitted applications. Successful applicants shall clearly demonstrate the ability to meet the selection criteria and expectations of engagement outlined in the application form that follows.

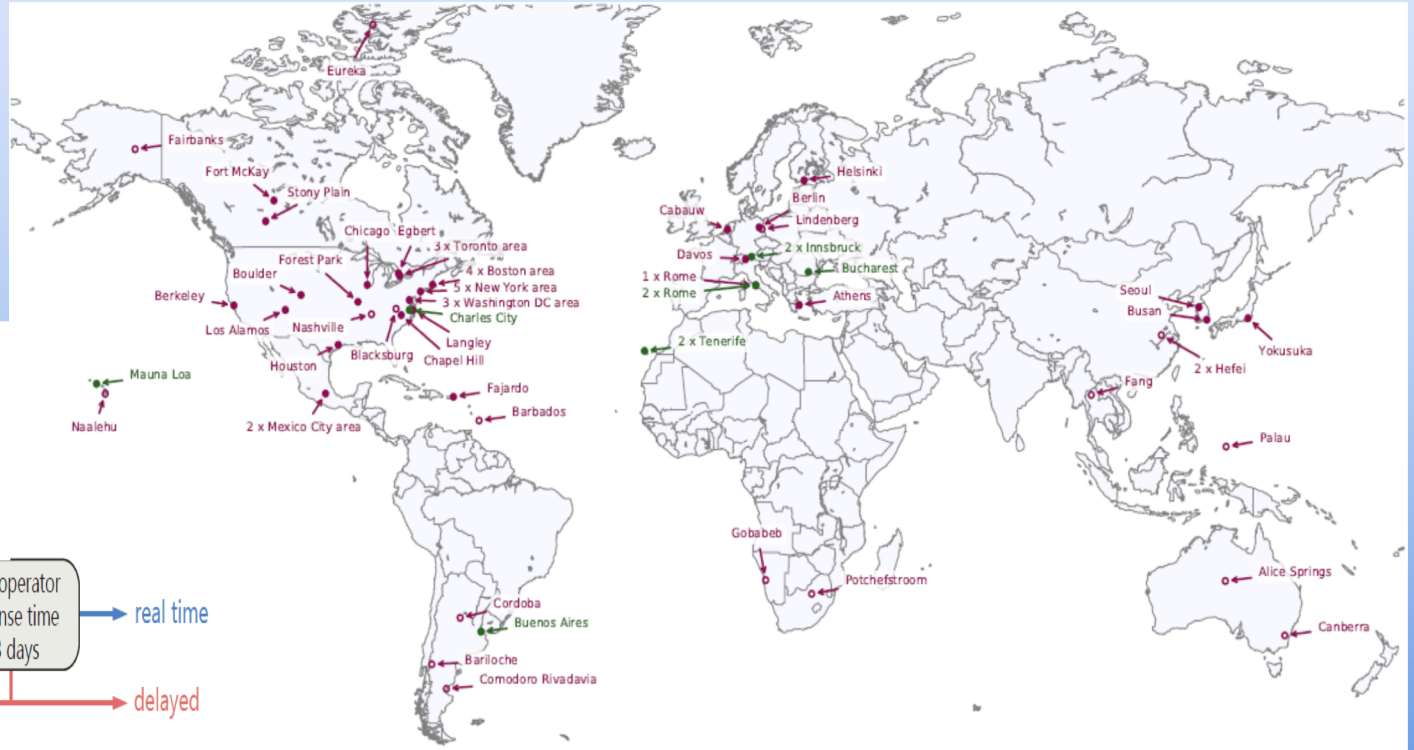
Global Pandora Distribution



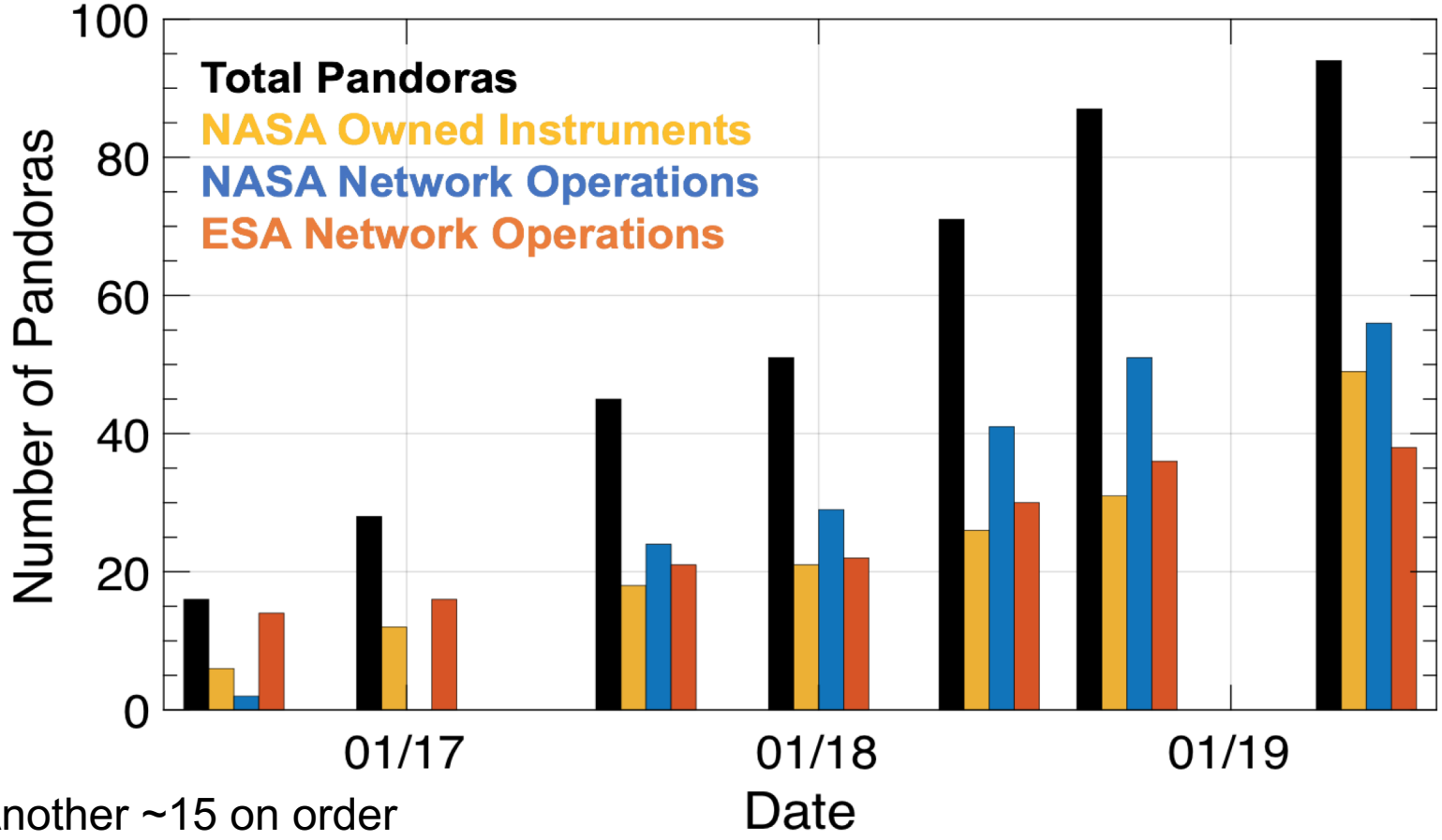
Migration - Unofficial to Official PGN

- Since May 2019 instruments “officially moved” into the PGN (e.g. Greenbelt, Mauna Loa) one by one; process includes completing laborious “instrument history” (hardware, operation, calibration status etc.)





Growth in Long Term Fixed Pandoras



*Another ~15 on order

Quarterly reports - instrument operation / issue statistics

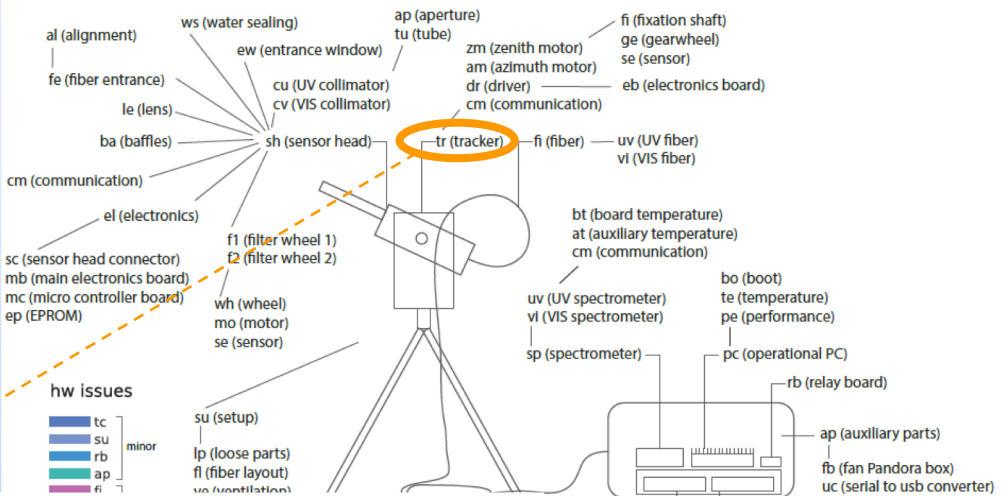
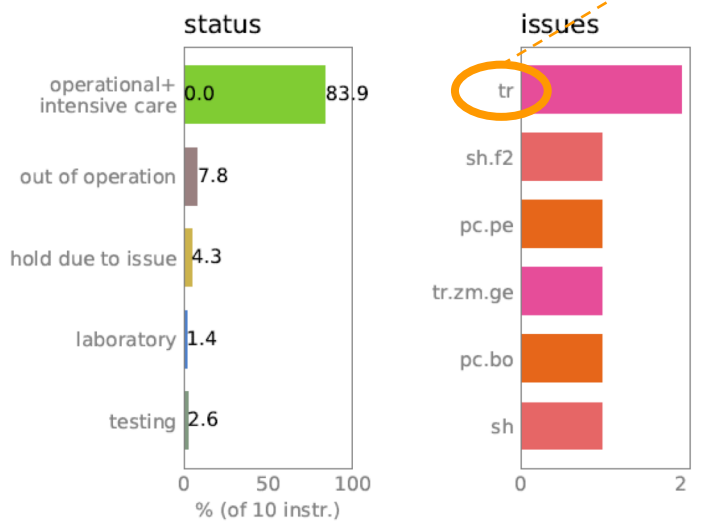
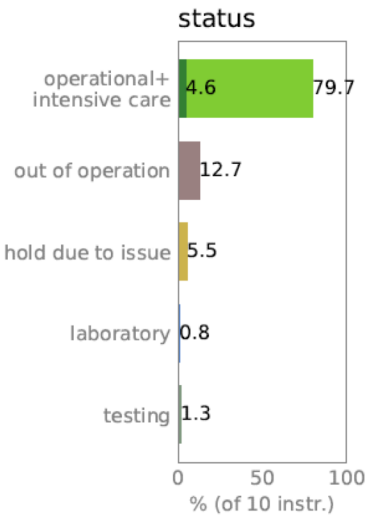


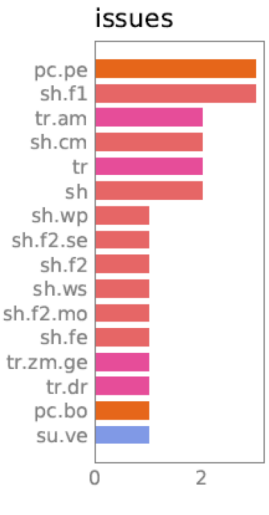
Figure 5: PGN overall instrument and issue status by 31st May 2019

(a) Last three months

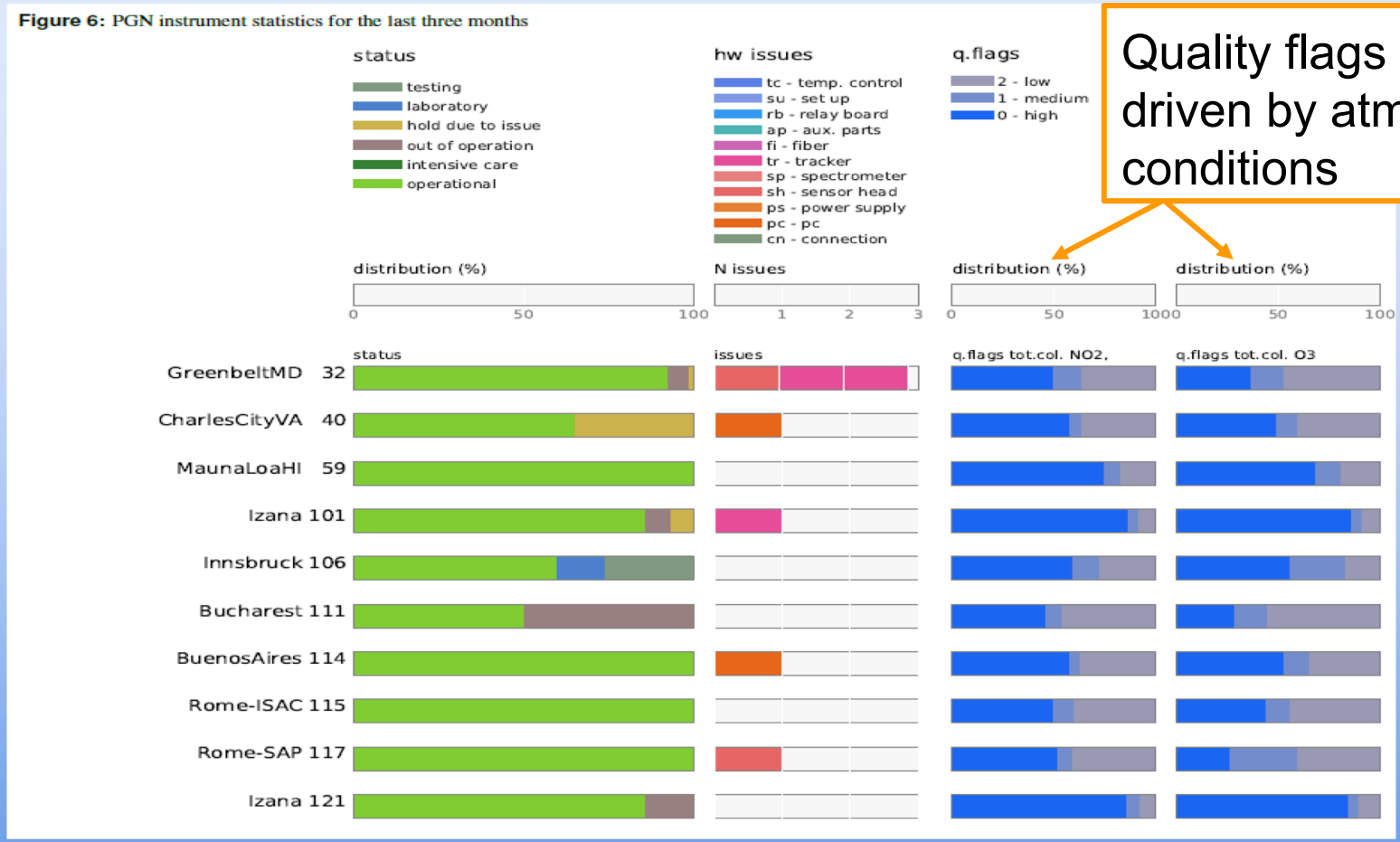


(b) Last year





Quarterly reports - quality flags

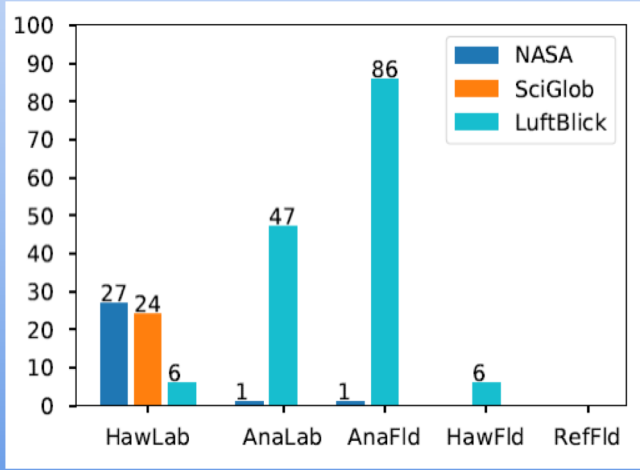


Quality flags mostly driven by atmospheric conditions

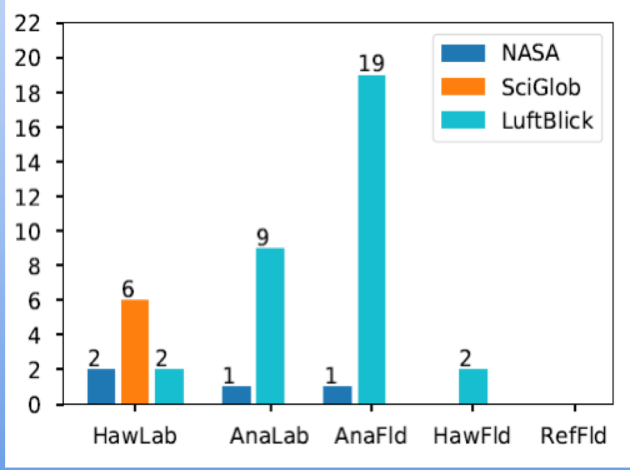
Calibration Updates and Reports

- Harmonization of calibration process between NASA, Luftblick, and SciGlob
- Investment in Goddard calibration facilities (e.g. addt'l labs, lasers (325, 355, 377, 404, 447, 490, 514, 532, 561, 640, 686, 726 nm) to characterize stray light and FOV - a must for O_3 and CH_2O)
- May 2019: Calibration course at Innsbruck, NASA/EPA staff trained by LuftBlick in instrument calibration for intensive 3 weeks; expanding and standardizing calibration analysis capabilities between LuftBlick and NASA

(a) 1st January 2018 to 31st May 2019

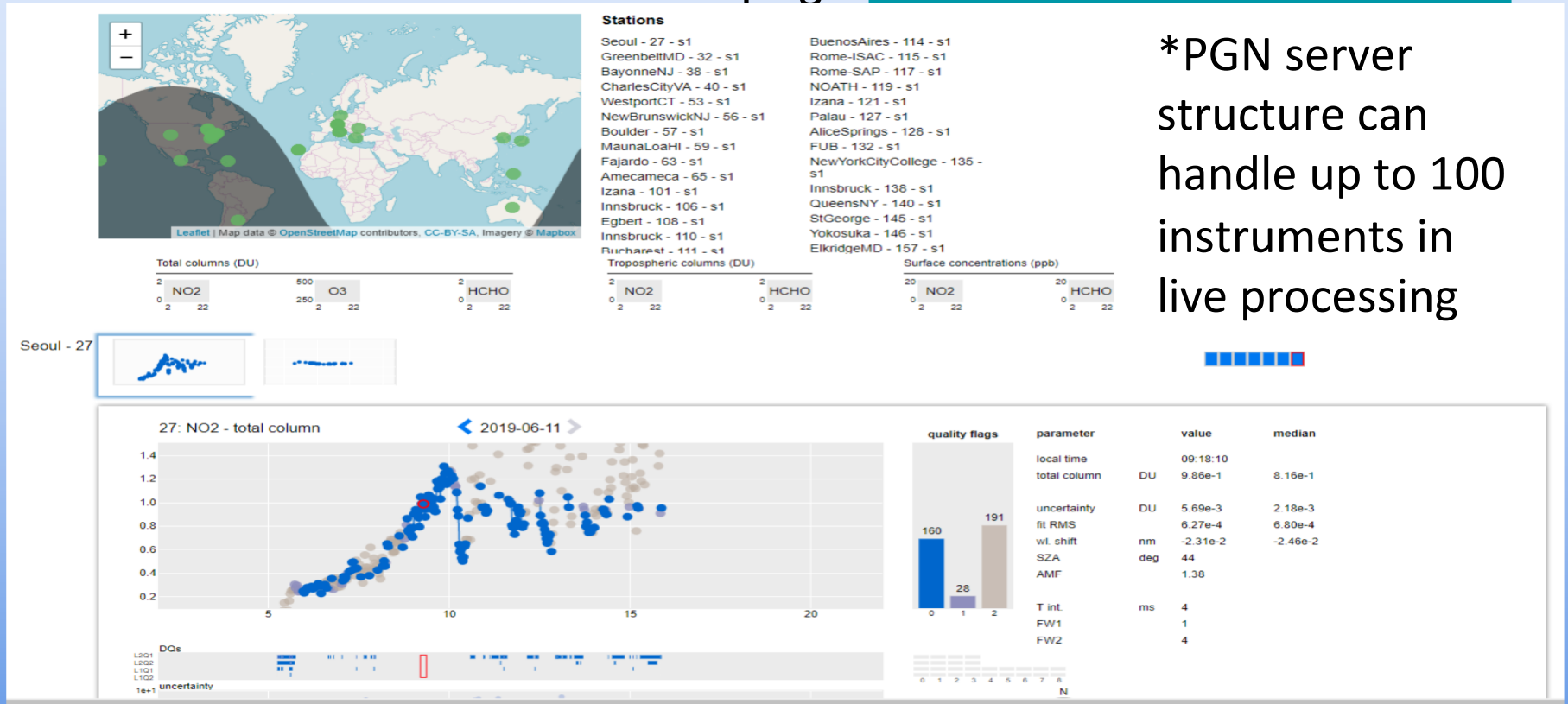


(b) 1st March 2019 to 31st May 2019



Webpage & Live processing

- Soon all PGN related topics (live data*, info, etc.) will be moved into the new official PGN webpage pandonia-global-network.org

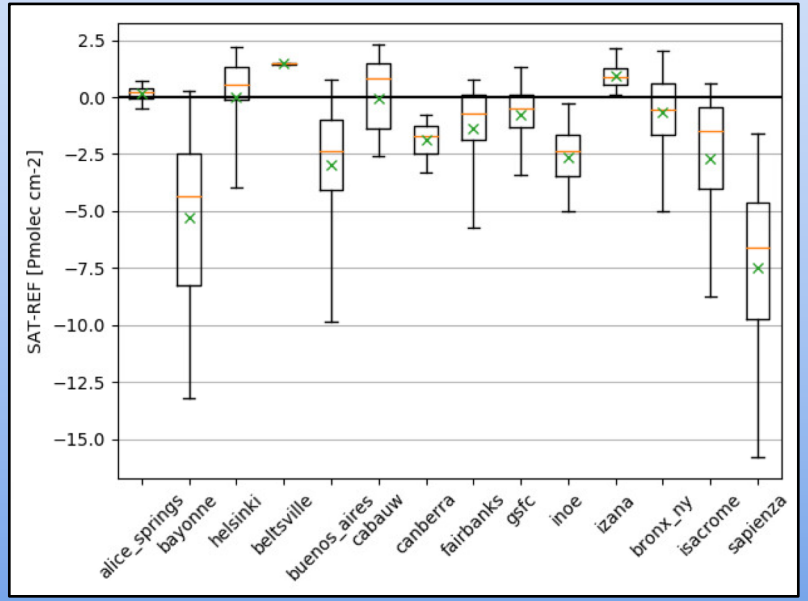


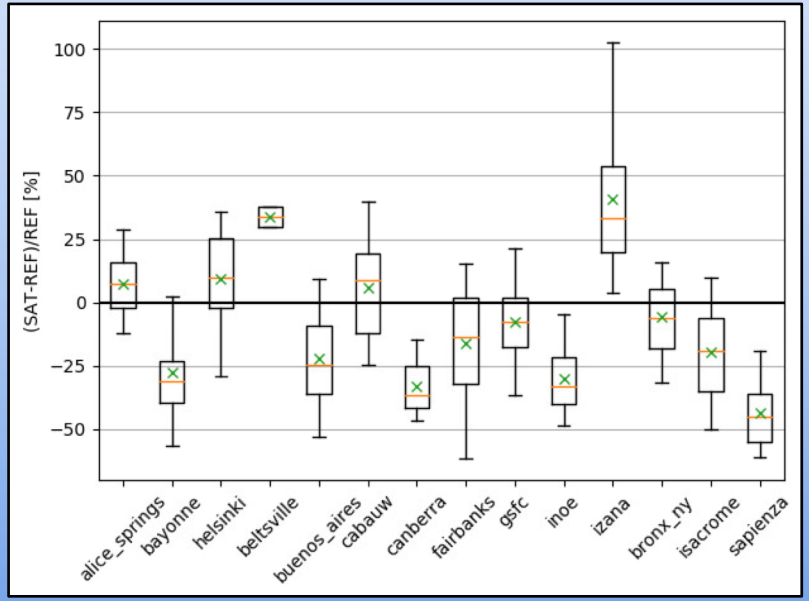
*PGN server structure can handle up to 100 instruments in live processing

EVDC data submission

- Since Sept 2018 PGN NO2 tot. columns operationally sent to EVDC
- Note: station name in EVDC-GEOMS files not always identical to native PGN files

Preliminary results of PGN versus S5P NO2 made by EVDC team (May 2019)





Priorities Thru End of 2019

- **Priority 1:** Supporting our National (e.g. EPA/NOAA, State agencies) and International Partners/Colleagues (e.g. ESA, NIER, ECCC, UNAM)
- **Priority 2:** Supporting Satellite (e.g. OMI, TEMPO, S5P, GEMS) validation/ verification activities
- **Priority 3:** Resolving HCHO – requires working with EPA/others w HCHO capabilities, deployment of 3-4 Delrin free instruments alongside existing ones
- **Priority 4:** TOLNET deployments – (e.g. UAH, TMF, ARC)
- **Priority 5:** Conducting first PGN Workshop in Innsbruck Sept. 2019

Priorities Thru End of 2019

- **Priority 6:** Returns of reconfigured instruments to the field – (e.g. WFF, LaRC, VCU, UMBC, HU-Beltsville **in addition to 24 already returned**)
- **Priority 7:** Support of Field Campaigns (FIREX, European Campaigns) for satellite and air quality activities
- **Priority 8:** Continuation of bringing home, upgrading* existing and redeploying NASA/ESA/SciGlob fleet of instruments (e.g. SLU, UAF, Rutgers, etc. - ongoing)
- **Priority 9:** new builds - ongoing - ~15 new instruments on order

***Upgrades include tracker, PCB, fiber guide, nylon, etc.**

Thank You!

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