NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

Intercomparisons of TCCON and EM27/SUN measurements

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April 25, 2024

Goals

Key Objective

Develop framework and perform ongoing intercomparison analysis

Why?

We all aim to tie our remote sensing data to internationally recognized standards.

AND

The science community wants to use multiple remote sensing datasets together

Current focus

CO2 is a key focus of this work

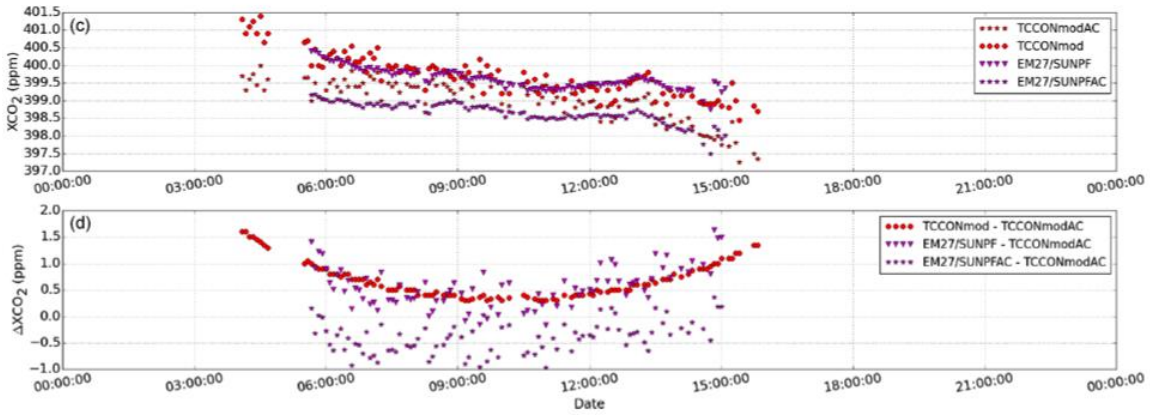
But CH4 is on the radar too

TCCON measurements and EM27/SUN (COCCON) are the focal point

These datasets form the backbone of satellite validation for CO2 and CH4

What is new about this effort

This work aims to build on the body of work that has been published in the scientific literature



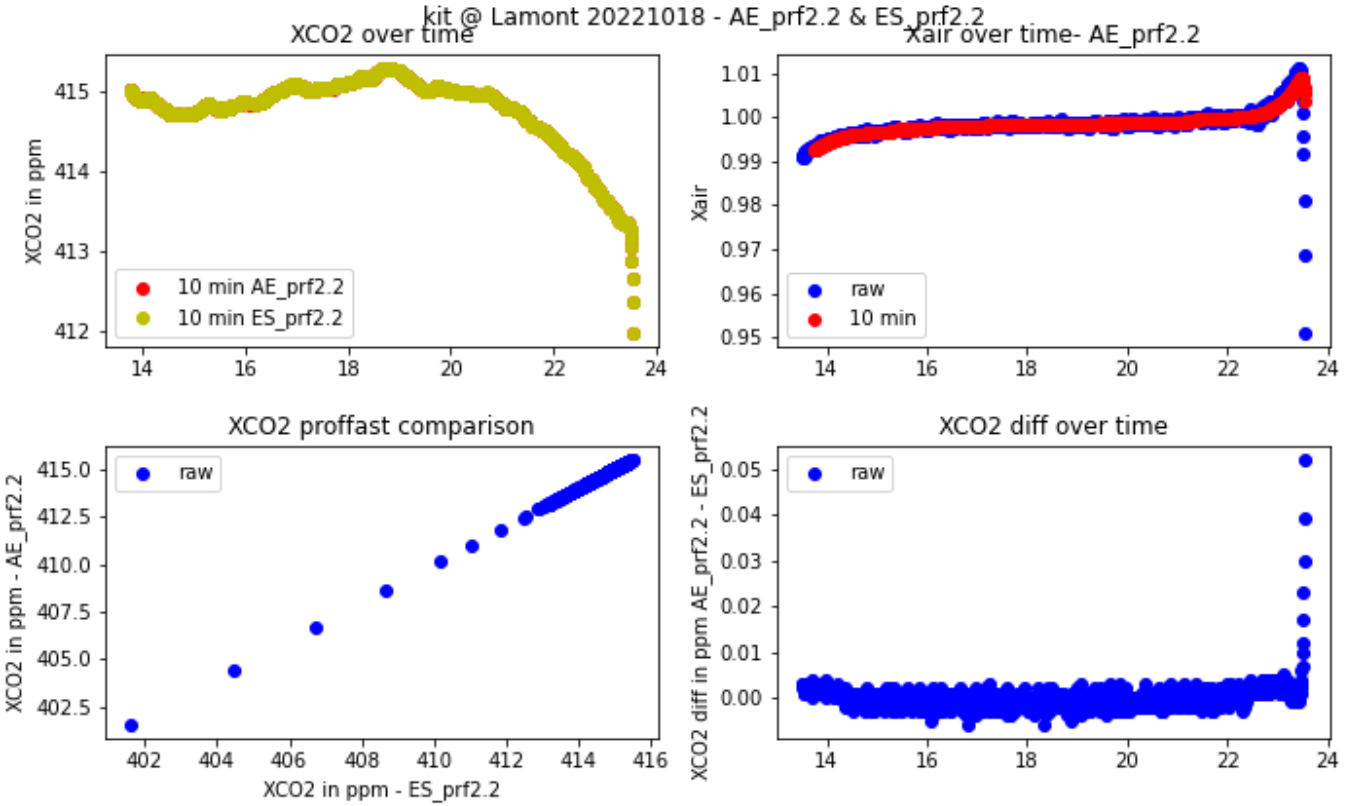
Sha et al., 2020 AMT https://doi.org/10.5194/amt-13-4791-2020

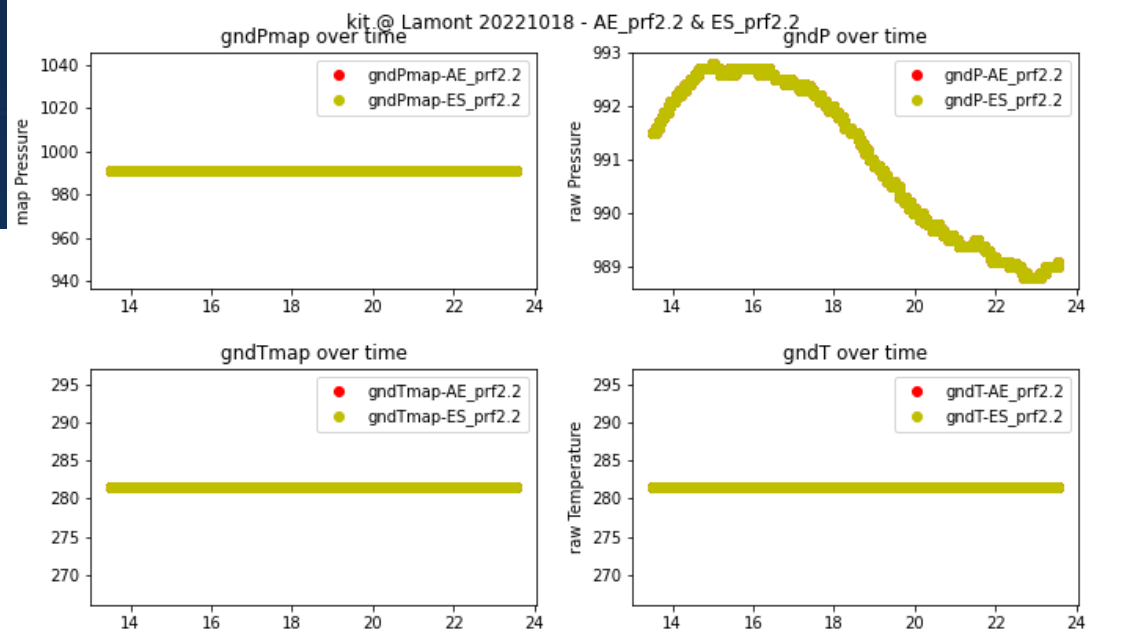
BUT

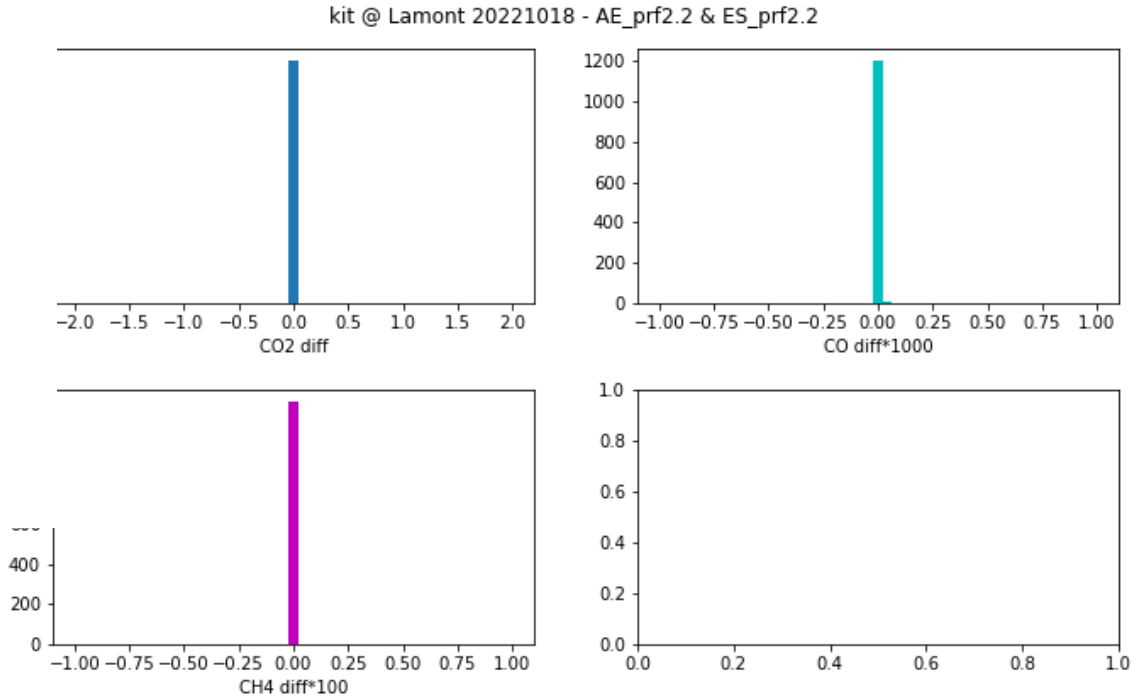
As algorithms get updated, the published results become out of date

We aim to begin an ongoing activity to execute and maintain analysis and intercomparisons

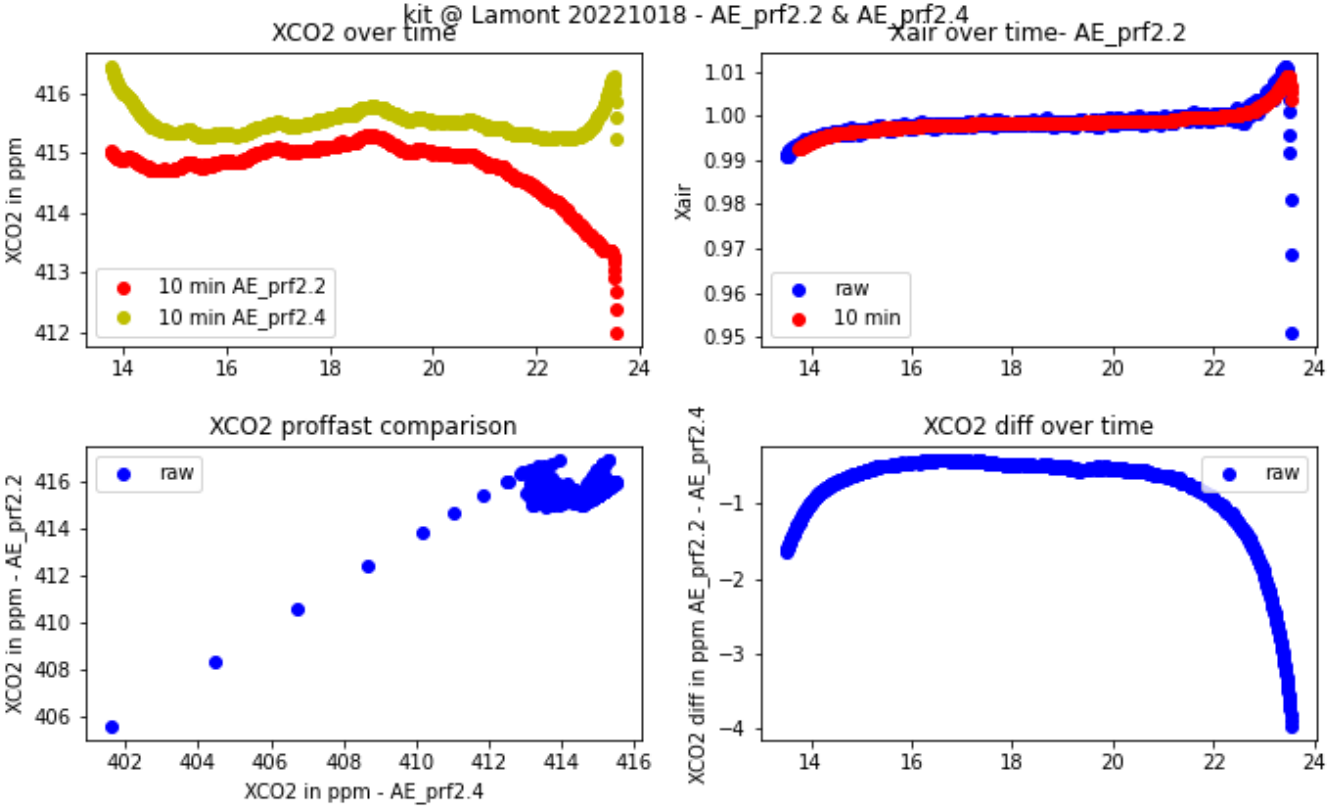
2.2 run by two AE & ES

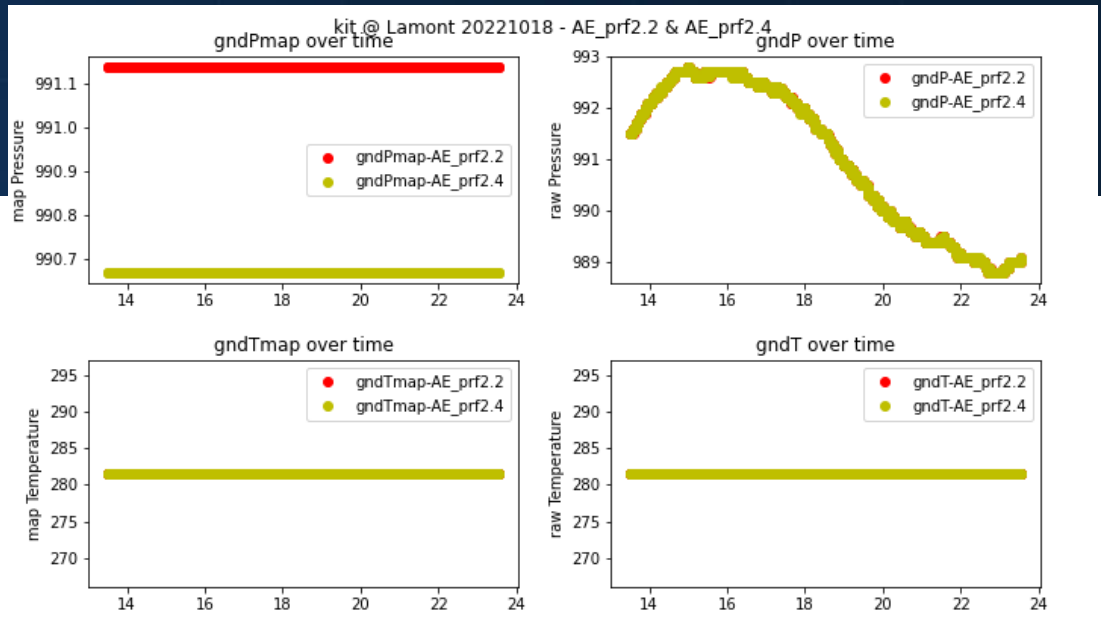


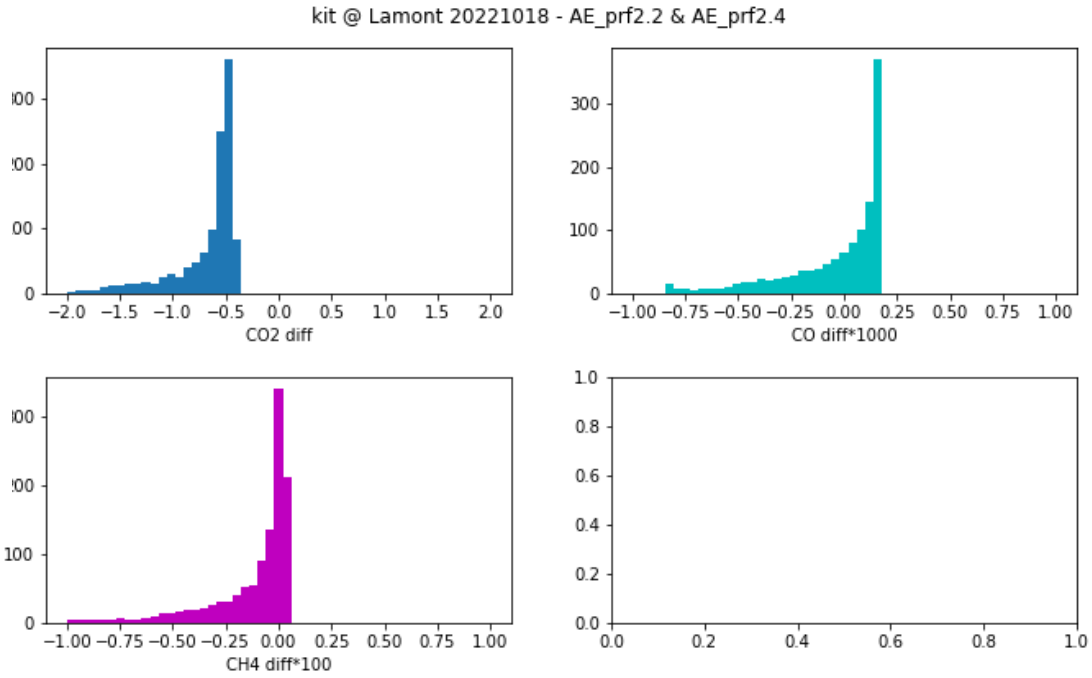




2.2 and 2.4 – need to dig in





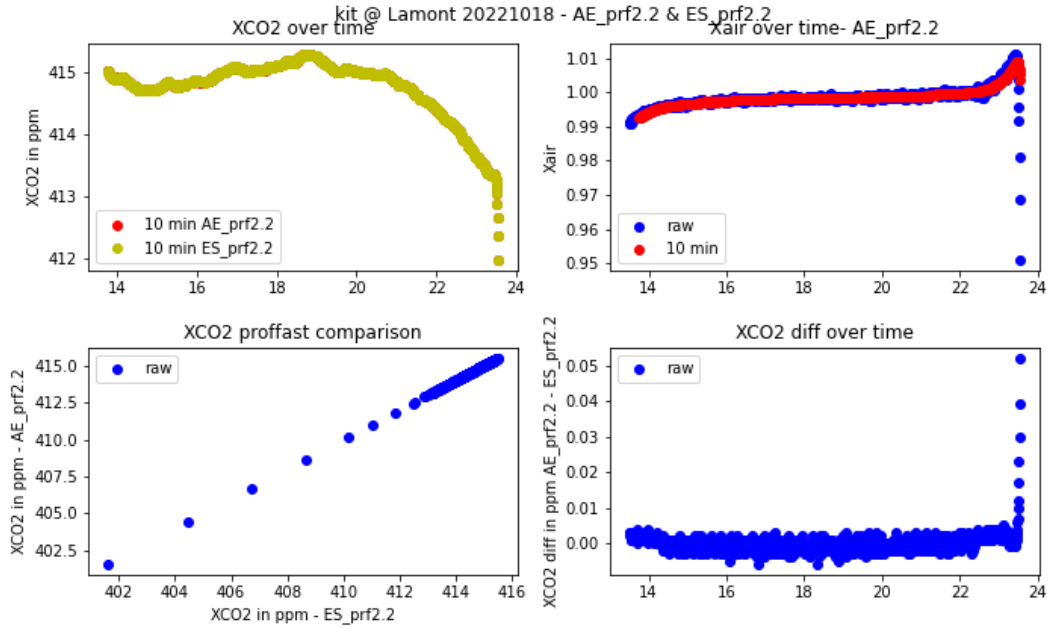


Starting point

Analysis starting point

- Published datasets (such as Sha, Frey, Pak)
- GGG2020
- Proffast 2.4

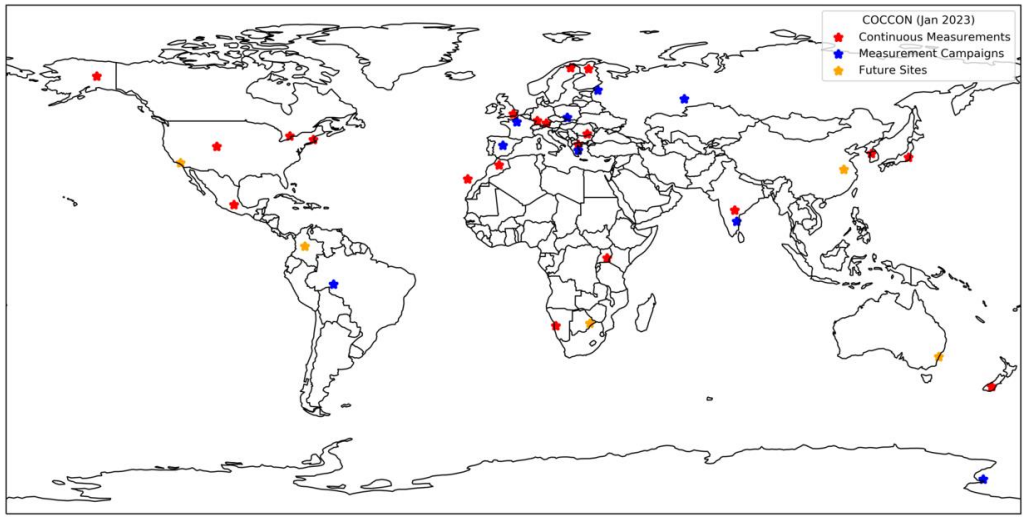
```
[ane8@hercules:~/code/proffastpylot_1.3/test_ES_ARM] $more slurm-201167.out
2024-04-01 19:24:53,587, INFO: ++++ Welcome to PROFFASTpylot ++++
2024-04-01 19:24:53,634, INFO: Run information:
Retrieval for Instrument SN155 at Lamont with time offset -5.0.
The following dates will be processed:
2022-10-17, 2022-10-18, 2022-10-19.
```



Approaches to Data Collection and Analysis

COCCON provides a method of standardization within the community.

- Prescribed data collection frequency
- Calibration with respect to the Karlsruhe TCCON station
- Common data processing, QA/QC



https://www.imk-asf.kit.edu/english/3884.php

However, some parts of the EM27/SUN community find benefits and merit in other approaches.

- Processing data with GGG instead of PROFFAST
- Different data collection frequencies
- Unique QA/QC

Regardless of approach, comparing PROFFAST and GGG to a standard (like TCCON) is useful to data analysis and comprehension.

This is a community project!

Need the community's involvement:

- **Experience with the coders**
- **Insights from your work**
- **Guidance for us as we proceed with analysis**

- Thank you for joining in the conversation.

EM27/SUN Community Survey Responses

There is a lot of data diversity within the research community!

- Collection resolution from 1 to 20 double-sided forward/backward scan pairs
- Temporal averaging between 2 and 30 minutes for TCCON comparisons (or no averaging, just truncating TCCON ifgs to match the EM27)

There are also concerns around data collection and handling. Here are some of them:

- Code version control, readability, and documentation of what is “under the hood” could be improved
- Lack of protocol for data collection, processing, QC, and bias correction
- Uncertainty around handling corrections to TCCON when deploying elsewhere
- Maintenance guidance and an agreed upon ILS procedure

A quote from survey responses: **“it’s hard to know what is trustworthy data”**

Concerns We Plan to Address:

Providing a Thorough Background

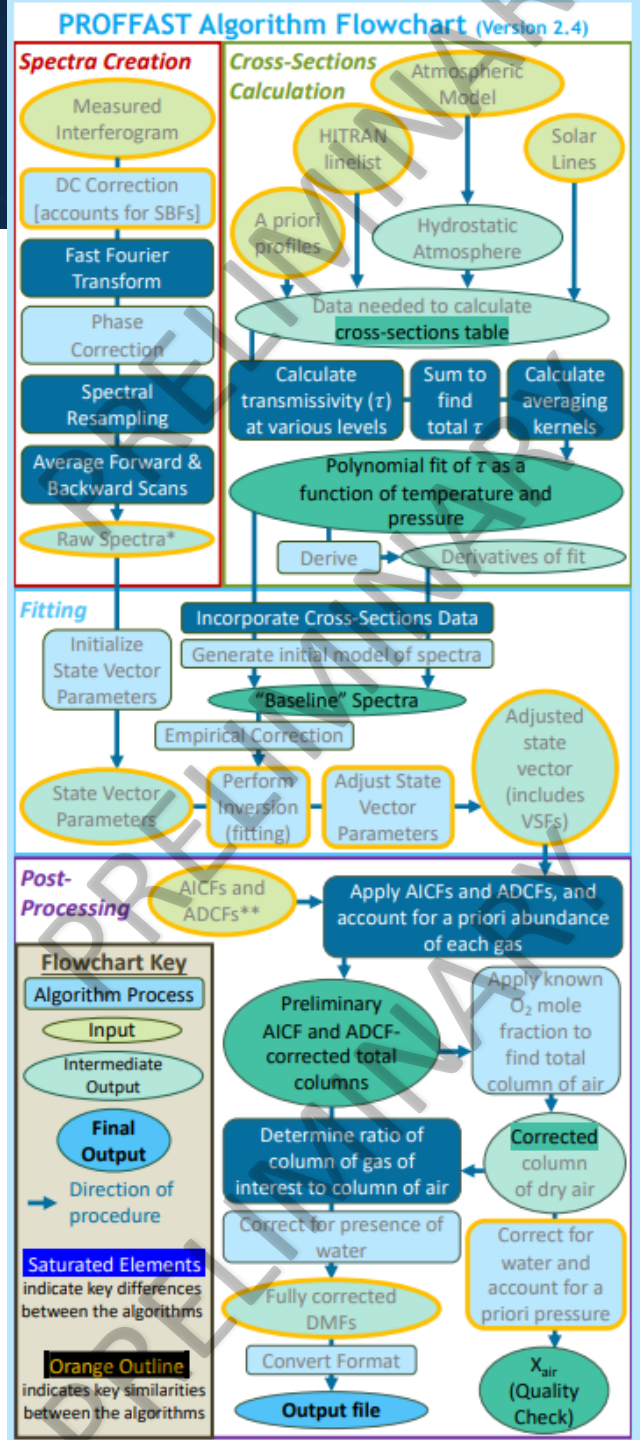
Planning to include:

- In-depth discussion of both GGG and PROFFAST in their current versions
- A summary of differences between the algorithms
- Detailed flowcharts of each algorithm

Considering including:

- A history of notable algorithm changes coinciding with version changes

Are there other things we should include?



PROFFAST flowchart created by Noah Schneiderman

Concerns We Plan to Address:

Strengthening Trust in Collected Data

Analysis plan

- Timeseries analysis of XCO2, XCO, XCH4, Xair/Xluft
  - Processing data through PROFFAST using COCCON standards
  - Processing data through PROFFAST without averaging of interferograms
  - Processing data through GGG
- Histograms of differences
- Analysis of seasonal and airmass dependences
- Spectral residual analysis
- Estimation of error budget in retrieval results

Which of these is the most important to you and your future work?

What concerns do we fail to address with this approach?

Sparking Future Conversations

The concerns and suggestions shared in the survey covered a broad range of topics.

Not everything can or should be put into this paper, but we hope to facilitate future conversations to cover the concerns we haven't touched on yet:

- Lack of protocol for data collection, processing, QC, and bias correction
- Uncertainty around handling corrections to TCCON (or another calibration standard) when deploying elsewhere
- Is there a prescribed way that travel standard EM27/SUNs are being operated and maintained?
- Maintenance guidance and an agreed upon ILS procedure

Are we missing any key topics for this paper?

Are there other concerns that we haven't discussed that you would be interested in exploring?

Next Steps

We hope to host meetings with focus groups in the future and send out periodic status reports to ensure that our work continues to support the community in the best way possible.

Encourage your fellow EM27/SUN community members to take our survey: https://forms.gle/fTpJDZ9r39qerAhy9