Data Management (Aircraft User Case)
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UND ATMOSPHERIC SCIENCES

CPC Inlet

Antennas

UHF Antenna

TDL Inlet

Dew Point Temp.

Optical Window

Nevzorov Probe

Pitot Tube

Icing Probe

CSI

TAMDAR

IPHEx Setup

2D-S

2D-C

Hot Wire LWC Probe

CDP

Temp. Probe

CPI

Pitot Tube

Temp. Probe

HVPS3

Listen or Try Hands-on Data Analysis

- **Aircraft (*.iph) and HRRR Profile Comparison**
  - Modify/combine the python code to compare aircraft ascent profile to HRRR profile.
    - Use NasaFile.py, iphex_plot.py, fetch_data.py
    - Open netCDF file in IDV and combine with HRRR
- **Microphysical Algorithm Development**
  - Modify/combine python code to overlay radar reflectivity composite image and aircraft flight track.
    - Use NasaFile.py, iphex_plot.py, fetch_data.py
    - Open netCDF file in IDV and combine with radar and/or satellite data.

Management of Data from Instrument Observations to Scientific Analysis

- Objective is to manage the production of data (observations) to enable meaningful scientific analysis.
  - Platform deployed (planned flight path) to obtain useful measurements for scientific analysis.
  - Instrument performance validated to be free of systematic errors (quality control).
  - Data sets reviewed by instrument experts (quality assurance)
  - Software used to collect, process and *analyze* measurements needs to be free from mistakes that affect scientific conclusions (open source and reproducible).
  - Data submitted to archive in structure (file and directory formats) that allow for easy visualization and analysis.

NASA Data Set Archive

ftp://gpm.nsstc.nasa.gov/gpm_validation/iphex/cloud_microphysics_Citation/UND_cloud_microphysics/data/QC_Processed/20140525_185917/2014_05_25_18_59_17.iphex

Delene, David J. and M. Poellot, 2015: GPM Ground Validation UND Citation Cloud Microphysics IPHEX. Dataset available online [http://ghrc.nsstc.nasa.gov] from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center Huntsville, Alabama, U.S.A. (39 Citation Research Aircraft (N555DS) Flights, 1 May - 15 June 2014)

Airborne Data Processing and Analysis (ADPAA) Software Package (http://sourceforge.net/projects/adpaa/)

- Independent, Open, and Freely Available
- GNU/GPL v3 Licensed (Only non-commercial use)
- Started in 2007, Version 2314 - June 2014
- Approximately 227,981 Lines of Code (IDL, Perl, Bash, csh, FORTRAN, C, Python, etc.)
- Subversion (SVN) Source Code Management System
- Feature Requests, Bug Tracker, Forum and **Wiki**

Delene, D. J., et al. (2015), Airborne Data Processing and Analysis (Revision Version 2000), Source Forge, URL: http://sourceforge.net/projects/adpaa/, Retrieved January 18, 2015, DOI: 10.5281/zenodo.14053.

Delene, D. J., Airborne Data Processing and Analysis Software Package, Earth Science Informatics, 4(1), 29-44, 2011, URL: http://dx.doi.org/10.1007/s12145-010-0061-4, DOI: 10.1007/s12145-010-0061-4.

Data Processing

- Missing Values Codes

- Levels of Data Processing

  - Raw Recorded Data

  - Convert to Physical Units

  - Single Instrument Files

  - Combined Instrument Files

- Automatic Post-processing

- ASCII Meta-data Header

- Handles Synonymous and Asynchronous Data of any Frequency

- Creates Project Science Analysis File (i.e. <u>2014_05_25_18_59_17.iphex</u>)

```
$ process_all_iphex
Processing the 14_05_25_18_59_17.sea file ..................... Done
Creating 14_05_25_18_59_17.applanix.1Hz ....................... Done
Creating 14_05_25_18_59_17.analog.1Hz ......................... Done
Creating 14_05_25_18_59_17.counts.cdp.1Hz ..................... Done
Processing the 14_05_25_18_59_17.analog.raw file .............. Done
Processing the 14_05_25_18_59_17.serial.GPS.raw file .......... Done
Creating the 14_05_25_18_59_17.physical.10Hz file ............. Done
Creating the 14_05_25_18_59_17.physical.1Hz file .............. Done
Processing the 14_05_25_18_59_17.physical.? file .............. Done
Creating 14_05_25_18_59_17.basicP1T1.1Hz ...................... Done
Creating 14_05_25_18_59_17.basicP1T2.1Hz ...................... Done
Creating 14_05_25_18_59_17.basicP2T1.1Hz ...................... Done
Creating 14_05_25_18_59_17.basicP2T2.1Hz ...................... Done
Creating 14_05_25_18_59_17.basic.10Hz ......................... Done
Creating 14_05_25_18_59_17.basic.1Hz .......................... Done
Processing the 14_05_25_18_59_17.counts.pcasp.raw file ........ Done
Creating 14_05_25_18_59_17.basic.8Hz .......................... Done
Processing the 14_05_25_18_59_17.counts.cdp.raw file .......... Done
Creating 14_05_25_18_59_17.king.raw ........................... Done
Processing the 14_05_25_18_59_17.applanix.raw file ............ Done
Processing the 14_05_25_18_59_17.serial.cpc.raw file .......... Done
Creating 14_05_25_18_59_17.angles.applanix.1Hz ................ Done
Creating 14_05_25_18_59_17.king.1Hz ........................... Done
Creating 14_05_25_18_59_17.conc.cdp.1Hz ....................... Done
Creating 14_05_25_18_59_17.hum.raw ............................ Done
Creating 14_05_25_18_59_17.egg.raw ............................ Done
Creating 14_05_25_18_59_17.wind.raw ........................... Done
Creating 14_05_25_18_59_17.nevwc.raw file ..................... Done
Creating 14_05_25_18_59_17.nevwc.1Hz .......................... Done
Creating 14_05_25_18_59_17.cwc.csi.raw file ................... Done
Creating 14_05_25_18_59_17.serial.GPS.10sec ................... Done
Creating 14_05_25_18_59_17.REAL.winds.1Hz ..................... Done
Creating 14_05_25_18_59_17.550nm.scat.raw ..................... Done
Creating 14_05_25_18_59_17.conc_stp.pcasp.raw ................. Done
Creating 14_05_25_18_59_17.iphex file ......................... Done
```
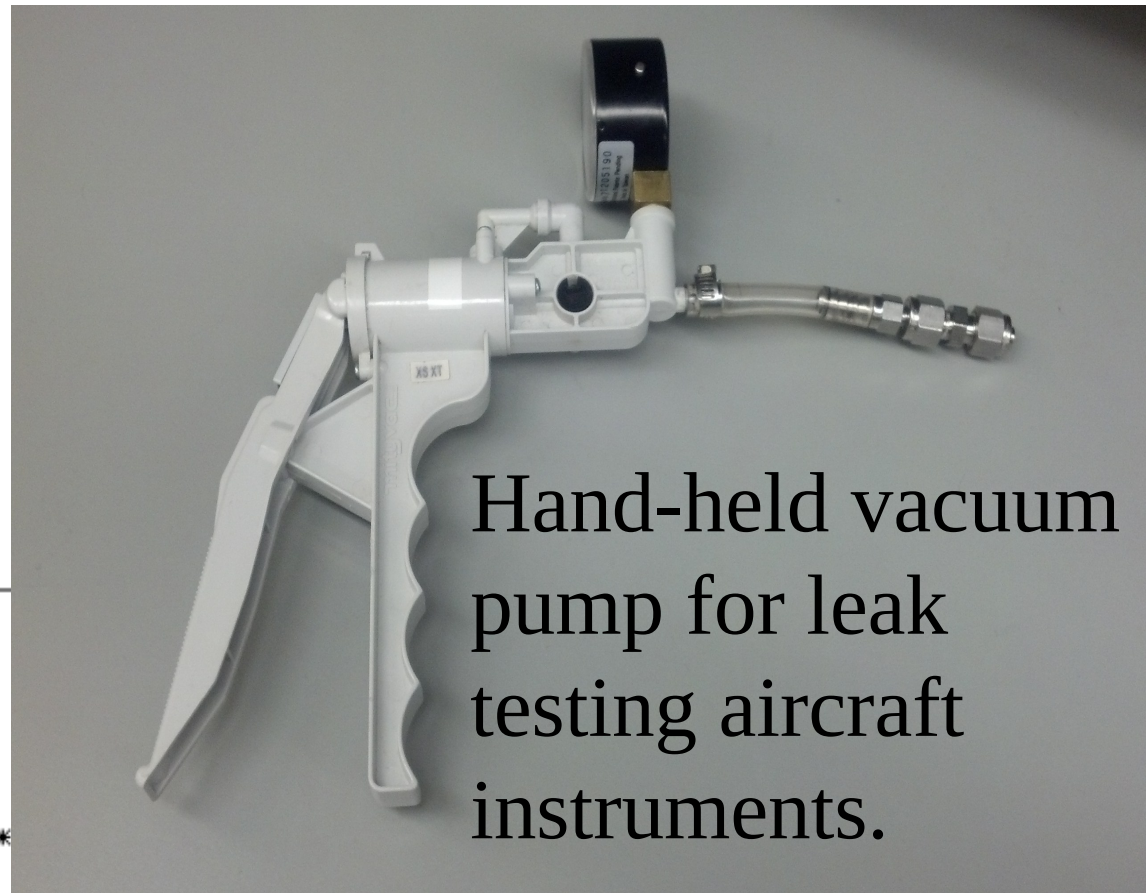
Data Set Quality Assurance

- Rapid Data Review by Instrument Scientist Expert(s)
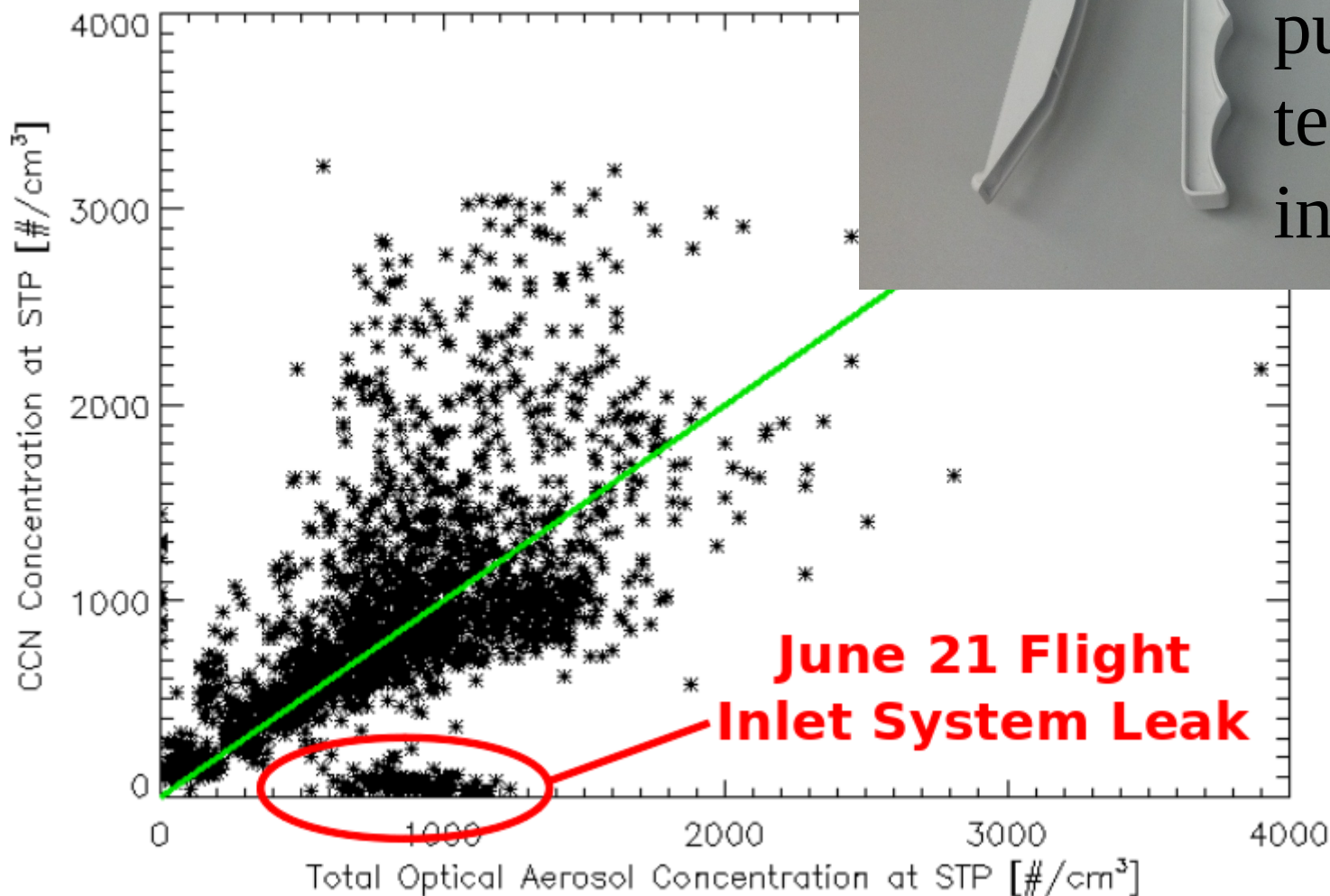
- Total for Unrealistic Values Discovery
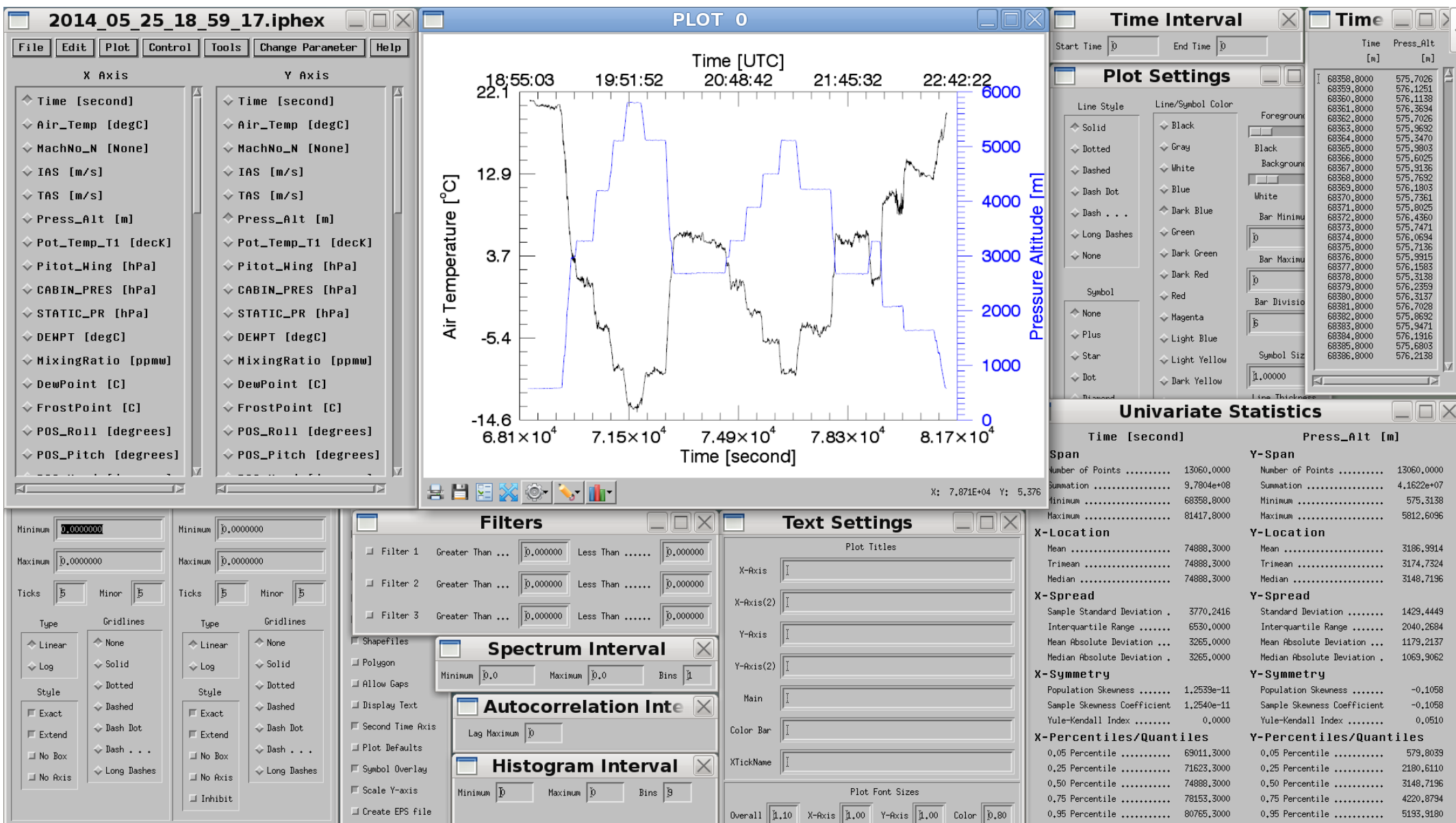
Quality Control

Process of conducting tests to ensure measurements are being made correctly and accurately.
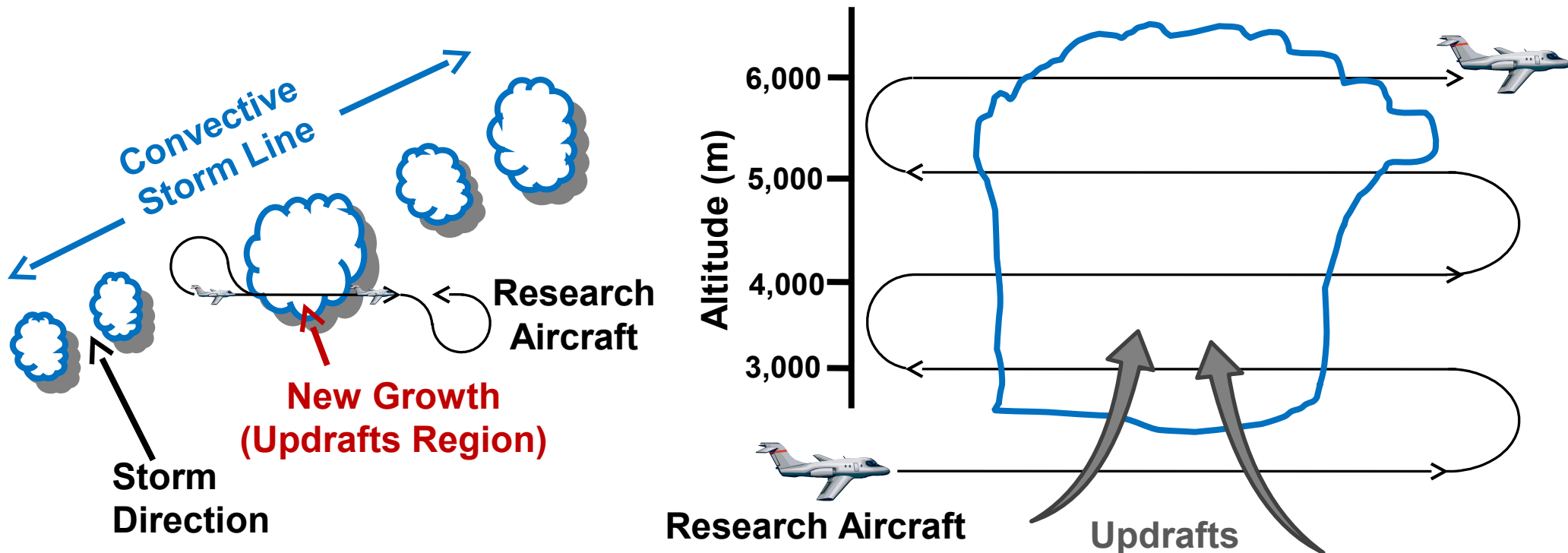
Hand-held vacuum pump for leak testing aircraft instruments.

June 21 Flight
Inlet System Leak

Operations Plan: Convective Clouds

- Sampling conducted at fixed speed of 160 knots IAS.

- Ascent and turns (90-270 degrees) conducted outside of cloud, and a constant altitude pass through cloud.

- Vertical climb rate is 500 ft/min.

- Penetration legs vary (1-20 min) depending on cloud.

Convective Storm Line

Research Aircraft

New Growth (Updrafts Region)

Storm Direction

Altitude (m)

6,000
5,000
4,000
3,000

Research Aircraft

Updrafts

Hands-on Data Analysis

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Comments on Scientific Data Management

- Mission planning and execution.
  - Operational plans, Web, NASA Mission Tool, **IDV**
- Quick processing, visualization, and quality control.
  - ADPAA, Wiki, Cplot, Cplot2, cloud, SVN, **docker**
- Quality assurance of data sets by scientists is required.
  - Cplot, Cplot2
- Archive data sets containing raw, edit, and clean data files and quality control documentation.
  - standard directories, NASA DAAC, **Ramadda**
- Conduct analysis using documented file formats that include missing value codes and meta data.
  - ADPAA, Python, **MetPY, siphon, IDV, Ramadda**

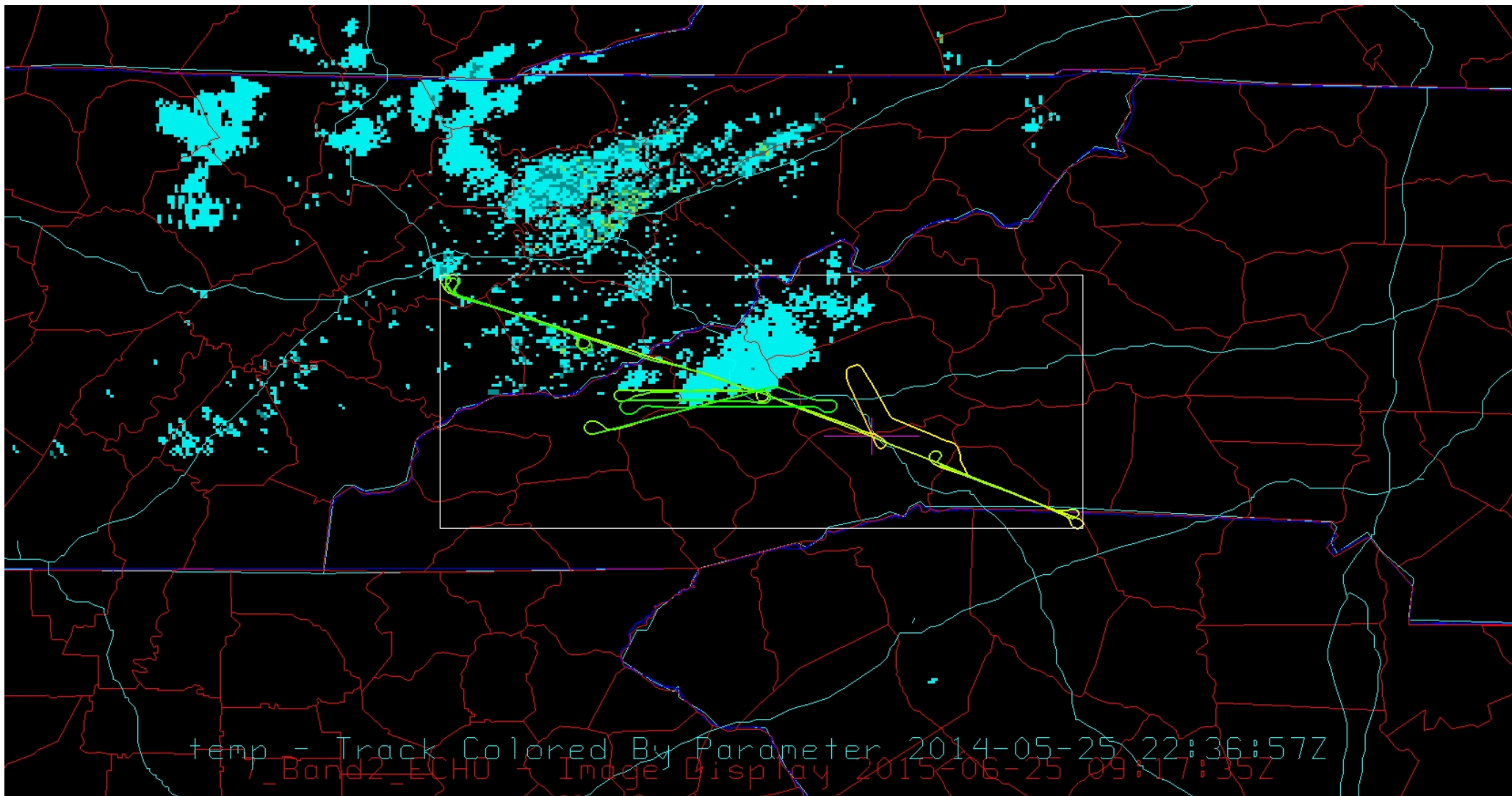# Aircraft Sounding Plot
./iphex_plot.py 2014_05_25_18_59_17.iphex
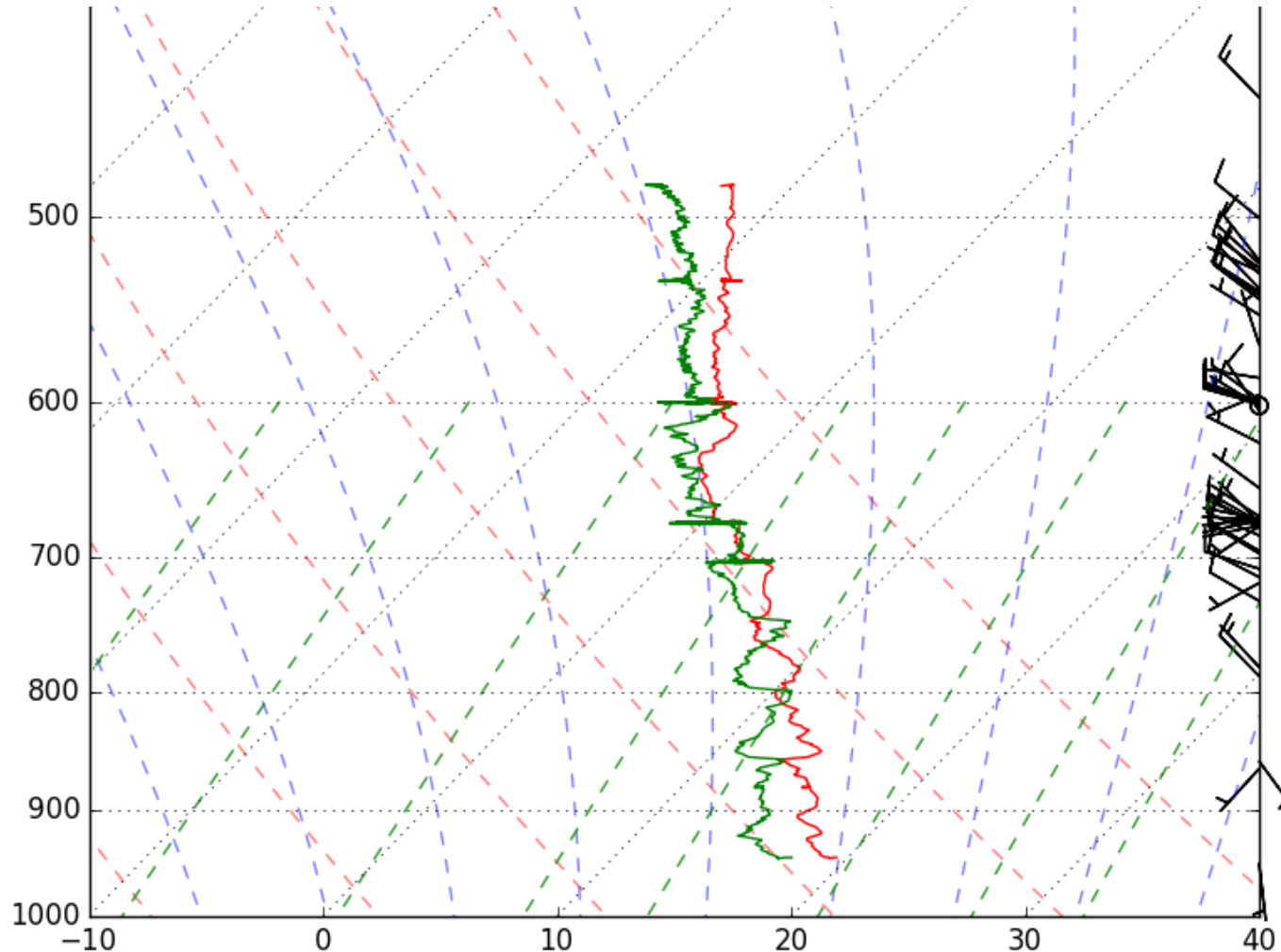
Use python and metpy to create profile plot.

Use siphon to combine with recent HRRR data?

Radar and Aircraft Track Results
./create_CFnetCDFTrajectory.py

Use IDV combine flight track and recent radar composite image.