Project #33
Alternative Fuels Database Library

ASCENT AVIATION SUSTAINABILITY CENTER

ILLINOIS

UDRI University of Dayton Research Institute

Project Motivation & Objectives

A **foundational database of current and newly emerging alternative jet fuels** (AJF) to aid in design and certification of new jet fuels

- Compile centralized knowledgebase of AJF data
- Integrate knowledge on AJF development path
- Support national and international research and certification initiatives

Database Scope & Annual Approach

Scope: Focus on AJF *testing* and *approval*
Year 1: Identify spectrum of available data
Year 2: Prioritize and construct web portal
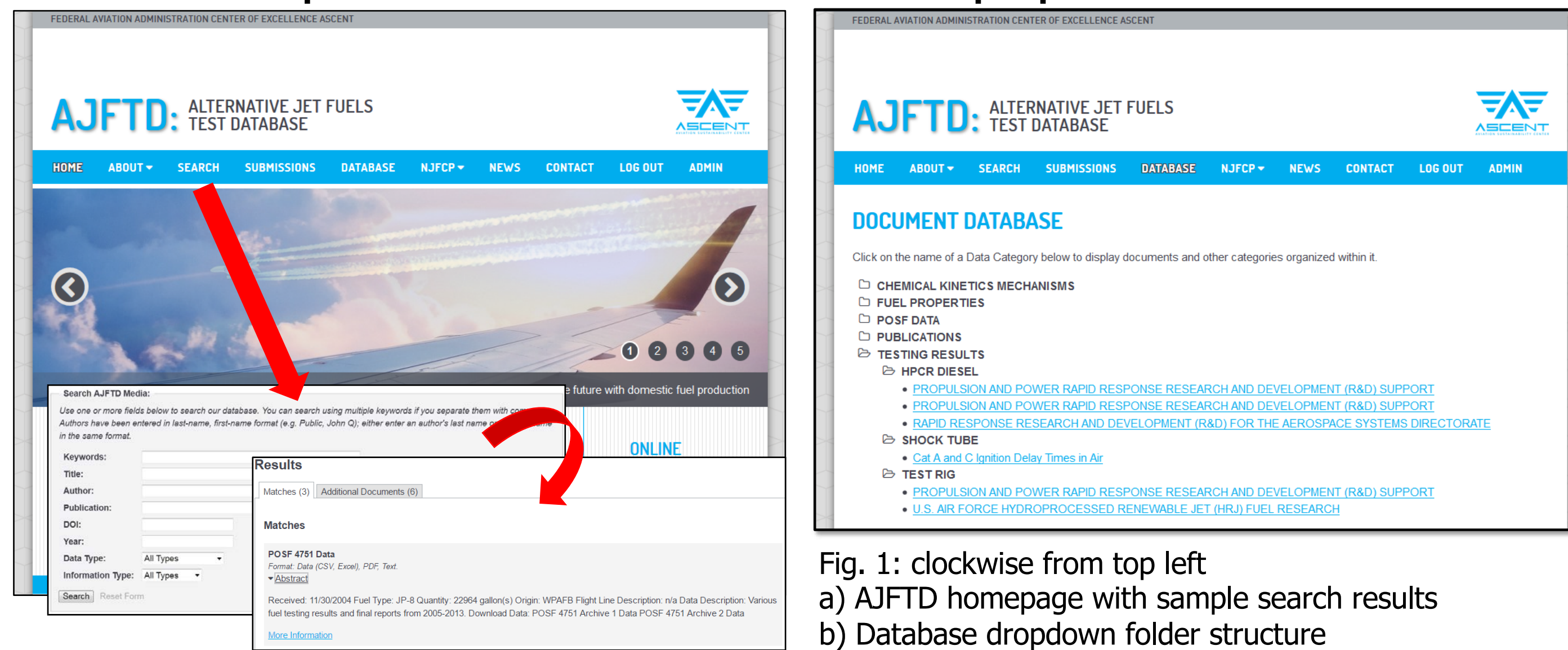- Develop database structure and populate with data

Fig. 1: clockwise from top left
a) AJFTD homepage with sample search results
b) Database dropdown folder structure

Year 3: Understand variability present in AJFs
- Evaluate tools for fuel blend property predictions

			Blend Ratio (A1:C1)				
Speed of Sound	Equation	Density	Equation	Specification	90:10	70:30	50:50	30:70	10:90
WFS	y=-4.113x+1403.7	WFS	y=-0.7216x+815.5	Density [D4052]	1.19	0.48	0.00	0.36	0.12
HEFA	y=-2.748x+1371.4	SKA	y=-0.7439x+796.8	Flash Point [D93]	4.90	2.01	8.79	3.31	2.50
		Viscosity	Equation	Viscosity [D445]	4.83	4.09	3.01	3.74	2.37
Specific Heat	Equation	WFS	y=2.849*0.9750ˣ	Viscosity [D445]	7.26	5.06	13.21	8.56	1.16
WFS	y=0.0036x+1.560	SKA	y=3.091*0.9815ˣ	Freeze Point [D5972]	0.72	0.57	3.76	1.67	1.92
FT	y=0.0030x+1.784	HEFA	y=2.894*0.9777ˣ	Cetane Index [D976]	1.75	0.22	0.86	0.22	0.00
FSJF	y=0.0018x+1.580			Aromatics [D6379]	5.80	3.38	6.22	1.95	0.47

Table 1 (L): Sample thermophysical relations for fuel categories
Table 2 (R): Percent error for actual vs. predicted FCAST NJFCP
A1:C1 fuel blend properties

Year 4: Expand analysis capabilities and data storage
- Convert fuel data to JSON files for integration
- Extract useful fuel statistics (e.g. category distributions)
- Store NJFCP experimental and modeling results

Fig. 2: (L to R) a) Original fuel analysis report (PDF), b) Fuel data extraction (Excel), c) Converted fuel data (JSON file)

Jet Fuel Data Integration
altjetfuels.illinois.edu

- Fuel data collection features:
  - Nearly 300 unique POSF IDs for conventional and AJFs
  - Advanced, basic, and dropdown search functions
  - Direct data file download
- Fuel database analysis capabilities:
  - Dynamic data schema built using JSON data files
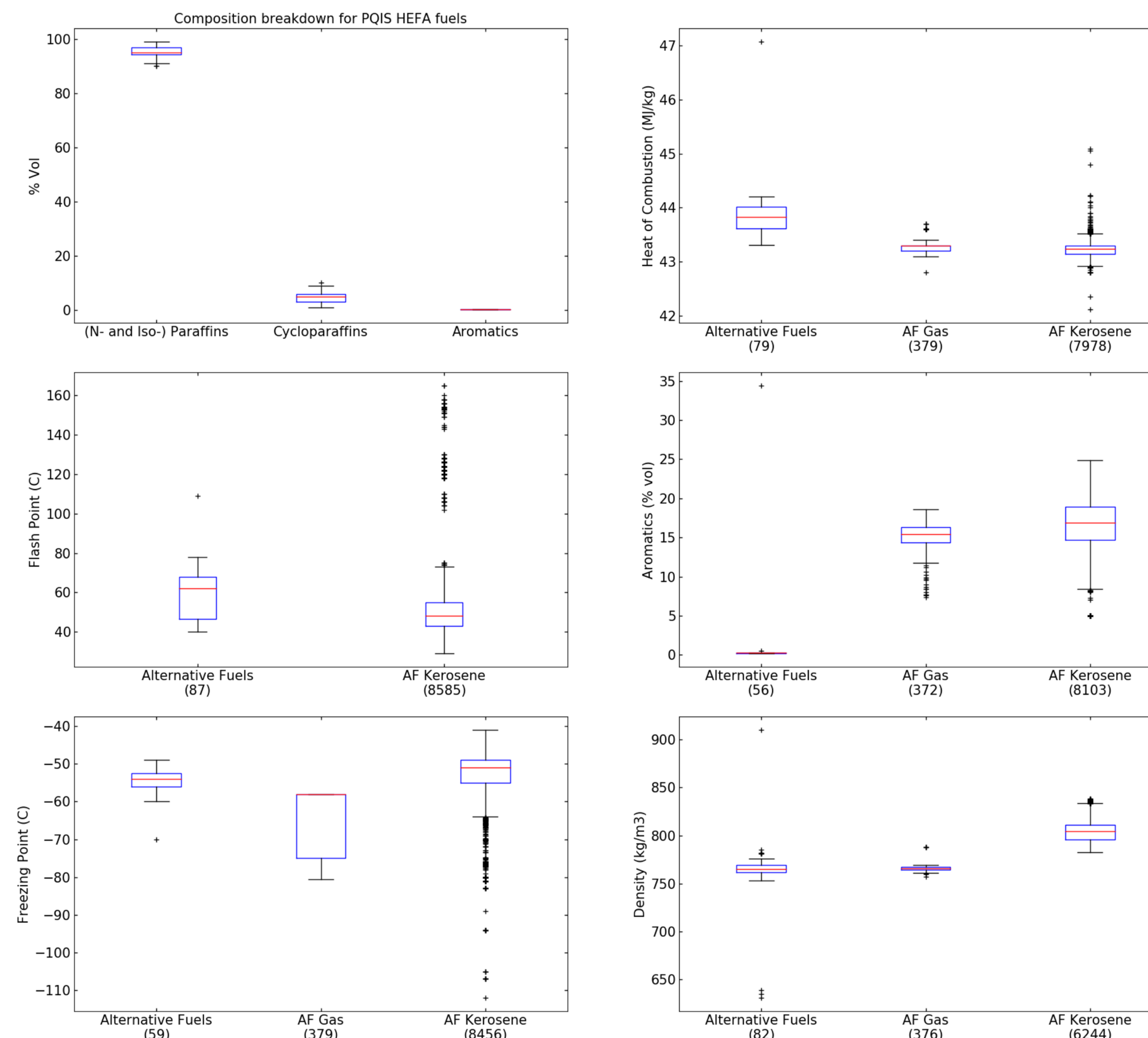 - Process data for existing jet fuel resources to obtain data averages, distributions, plots, etc.

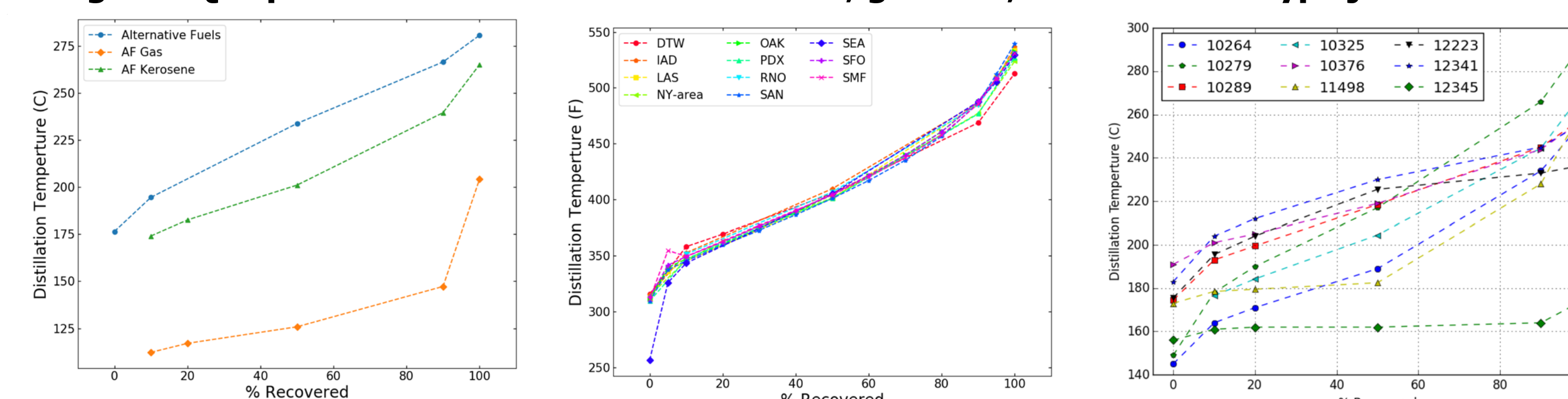Fig. 3: PQIS processed fuel data for alternative, gasoline, and kerosene type jet fuels

Fig. 4: (L to R) Distillation curve results for PQIS, Metron, and NJFCP project fuel data

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Fuel Property Analyses

- *Multivariate Linear Regression* (MLR)
  - Extended prior work (Won, 2016) evaluating critical combustion properties using AJFTD resources
  - Supports need for continued AJFTD expansion to encompass recent fuel property and test data
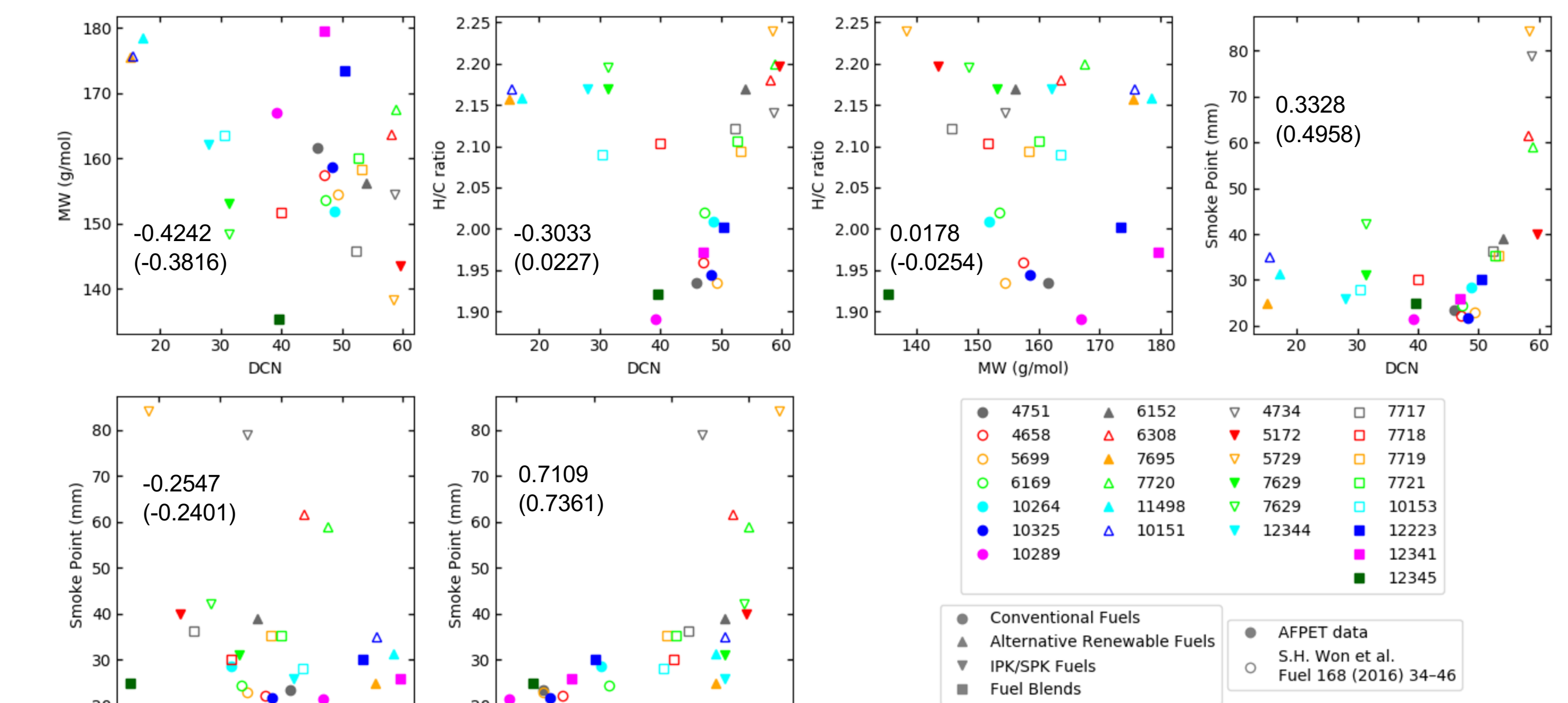

Fig. 5: Statistical analysis correlation results for selected combustion properties of AJFTD fuels with Won data from 2016
Pearson correlation coefficients for AJFTD data with Won coefficients shown in parentheses

Ongoing & Future Work

- *National Jet Fuel Combustion Program*
  - Continuing to serve as data repository for NJFCP
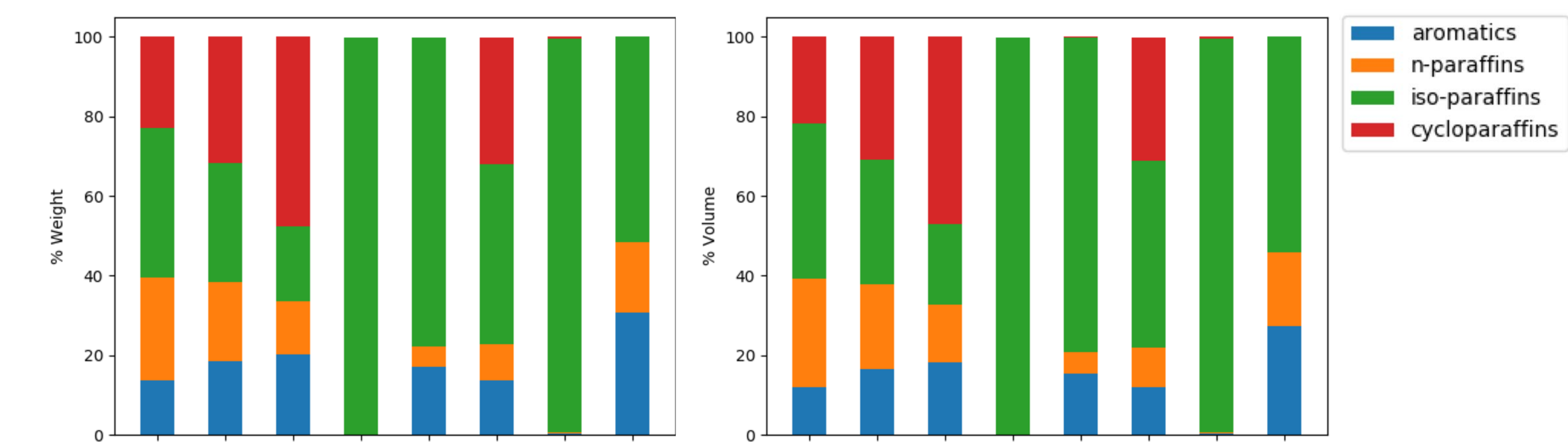 - Processing fuel data to integrate into AJFTD

Fig. 6: Hydrocarbon type breakdown for NJFCP fuels by (L) weight and (R) volume

- Facilitated data processing for related efforts
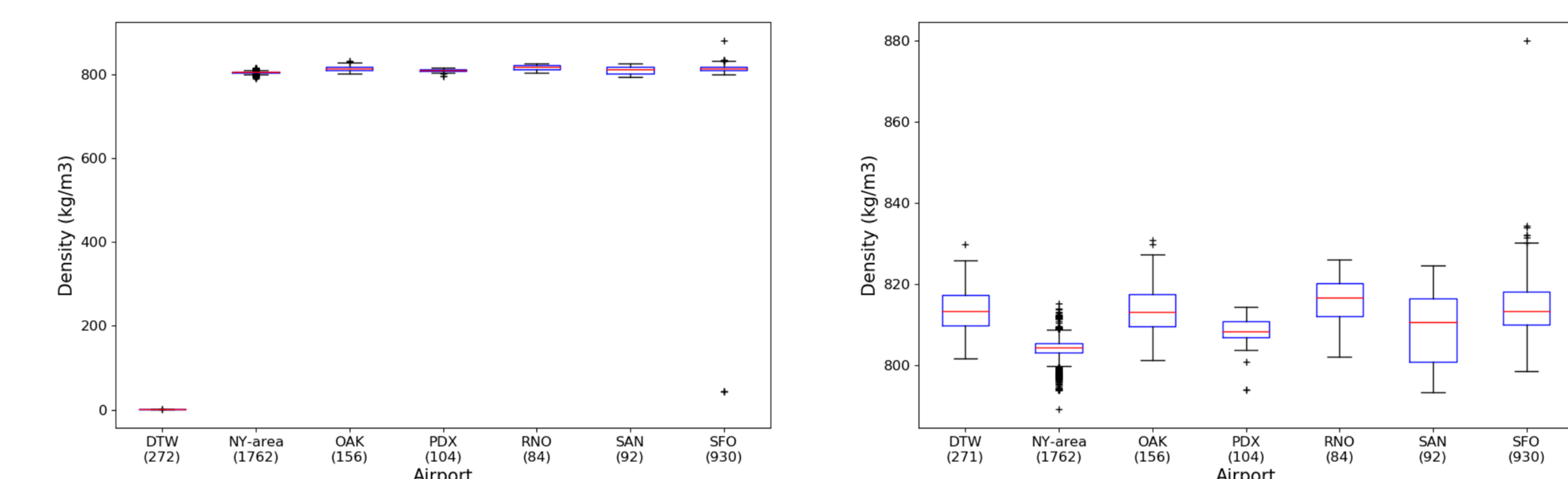 - AJFTD can provide migration of data into readily accessible JSON format to accelerate analysis

Fig. 7: Processed Metron airport fuel data elucidating effect of data recording errors on fuel density measurements (L) and corrected results (R)