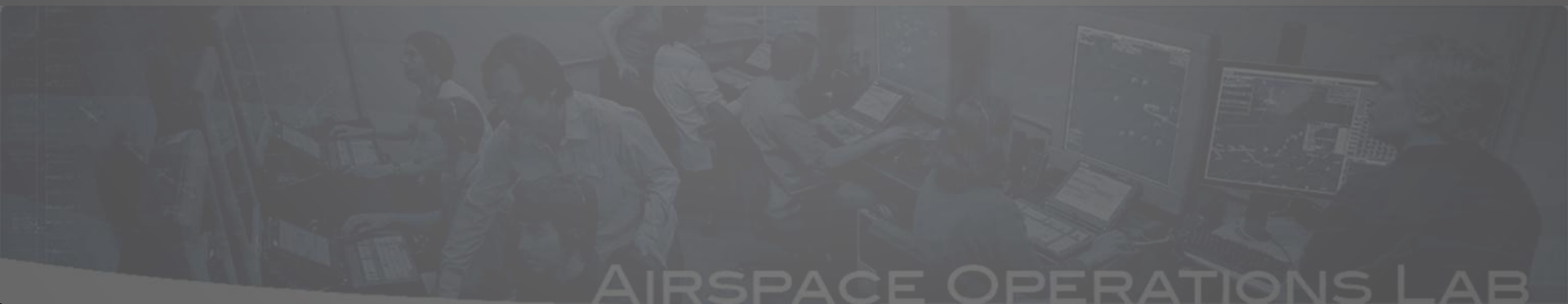
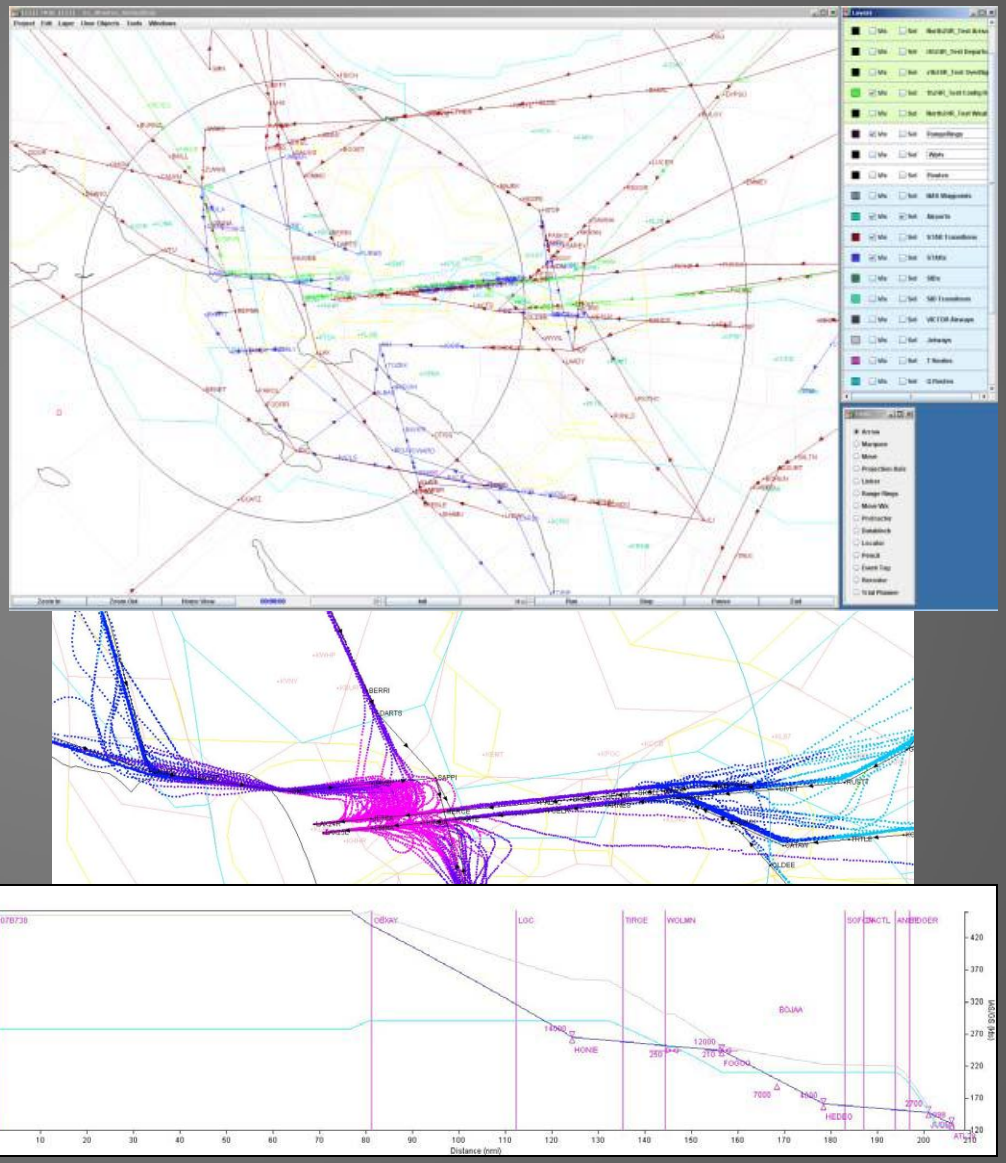
TRAC Overview

Todd Callantine & Michael Kupfer



What is TRAC?

- “TCSim Route Analyzer/Constructor” or “Trajectory-based Route Analysis/Control” tool
- Graphical airspace/ route design, simulation, and data analysis tool
- Standalone Java application; executable is publically available



Capabilities and Assumptions

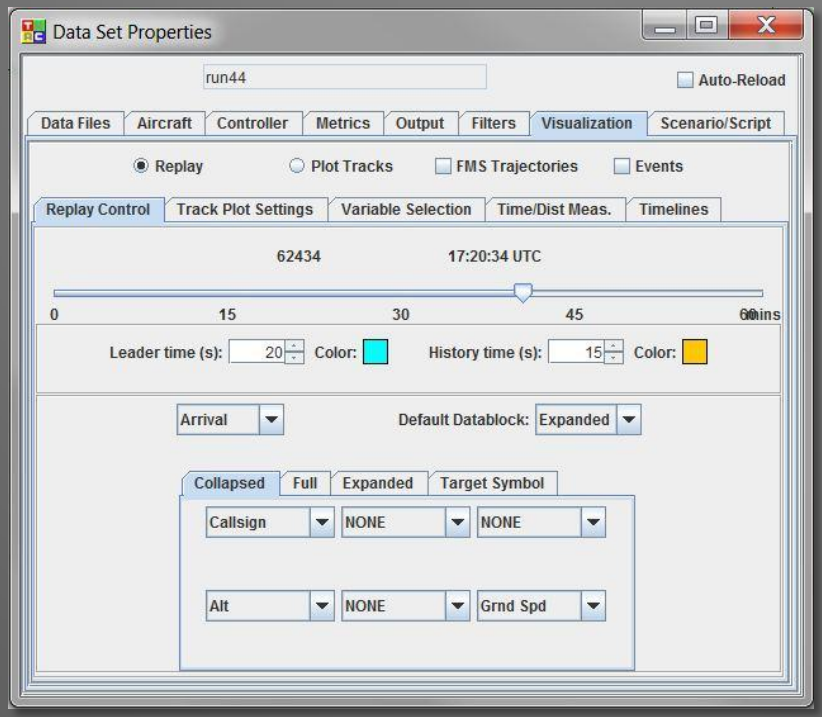
- Airspace/Route Design:
  - NFDC ’56-day update’
  - Tools for graphical route/sector construction and analysis
- Fast-Time Simulation
  - BADA model
  - Trajectory-based operations ONLY
  - Tools for constructing traffic scenarios, schedules, and visualizing and trial-planning trajectories
- Data Visualization and Analysis
  - Loads variety of traffic data formats
  - ‘Pure’ data presentation
  - Tools for organizing and visualizing data, conducting analyses, constructing simulations from data

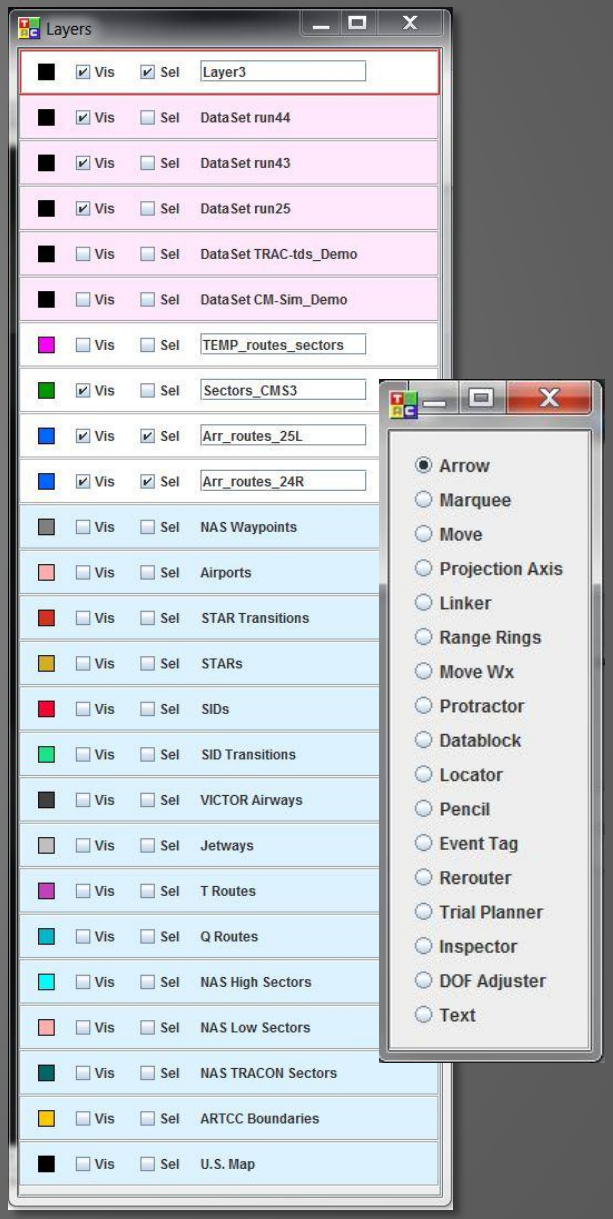
TRAC Support for MACS

- Read/write MACS airspace/route formats
- Read and analyze MACS/ADRS data
  - Output typical metrics
  - Adjust ‘open-loop’ MACS traffic scenarios
- Present actual/simulated track data in MACS tabular format to support scenario development

TRAC/MACS Workflow Examples

- MACS Data Analysis
- Route/Airspace Design
- Data Visualization
- Scenario Design

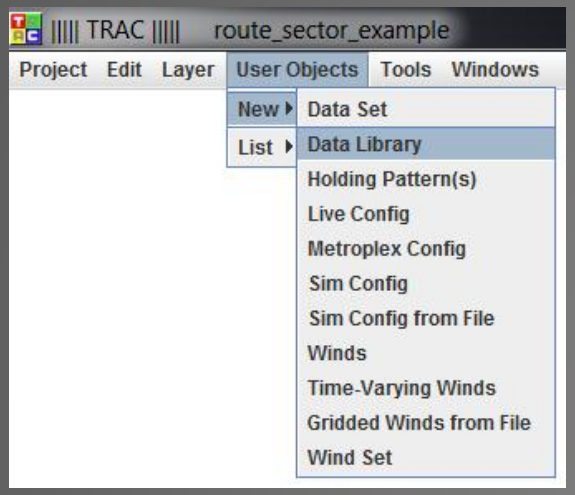




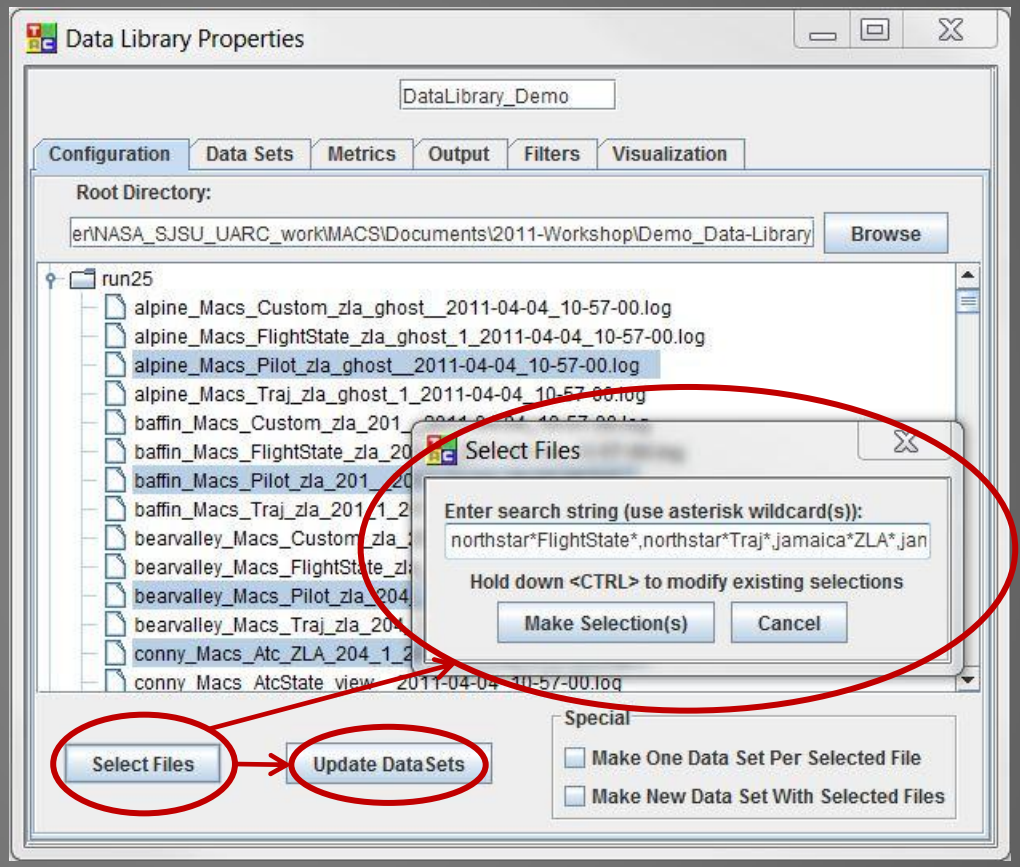
MACS Data Analysis

- Data Visualization
- Compute metrics and output

MACS Data Analysis



- Create Data Library



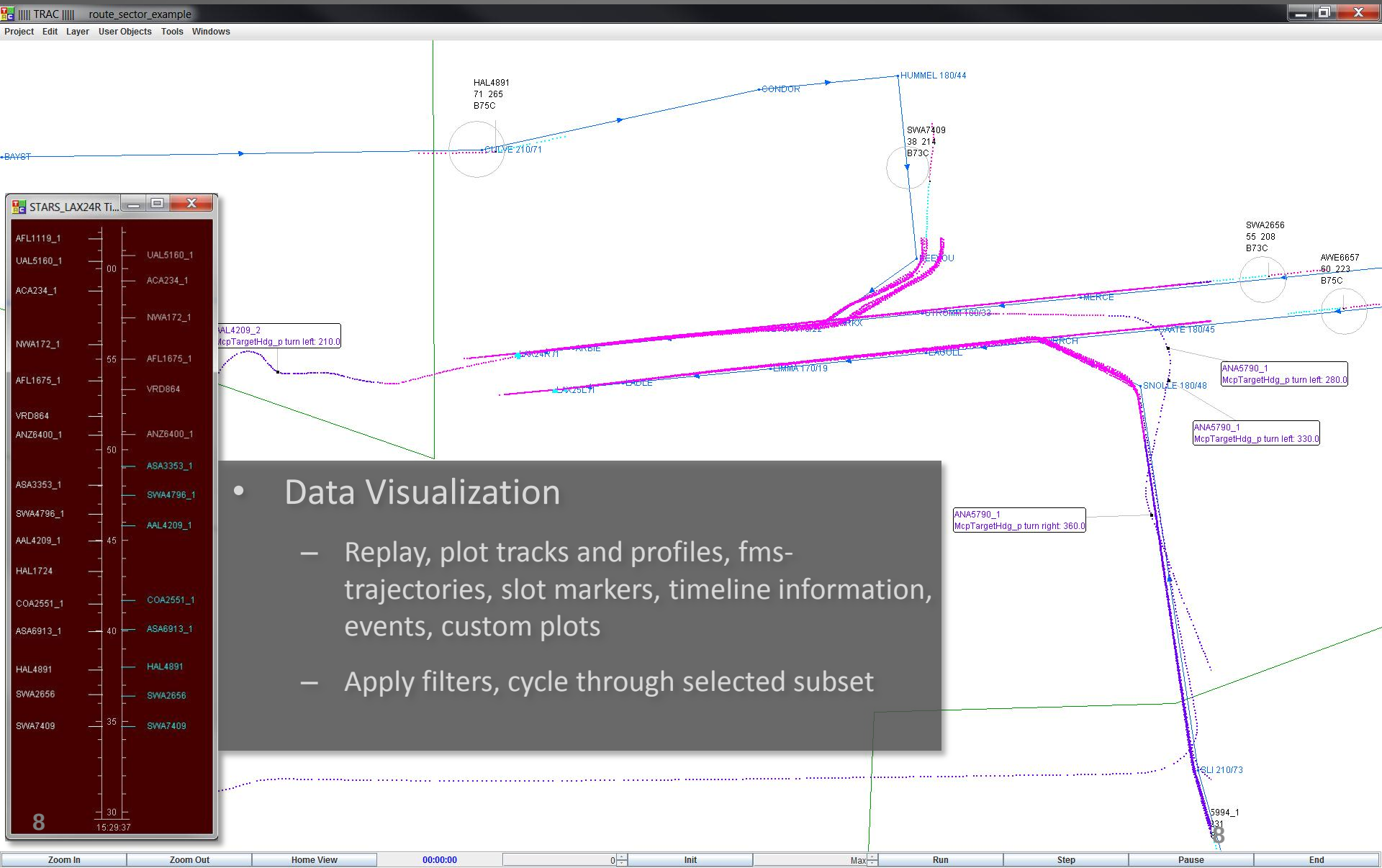
- **FlightState**
- **Traj_plan_b**
- **Atc**
- **Macs_Pilot**
- **TimelineMeterList**

Select MACS data log files using data library search strings

- full MACS data except ATC states (including confederates):
- full MACS data including ATC states (including confederates)
- full MACS data except ATC States (no confederates, no slot markers, no timelines)
- …

7

MACS Data Analysis



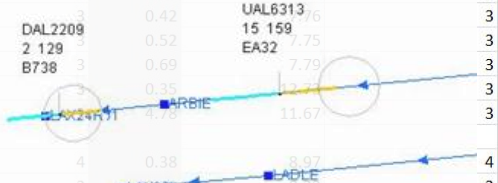
- Data Visualization
  - Replay, plot tracks and profiles, fms-trajectories, slot markers, timeline information, events, custom plots
  - Apply filters, cycle through selected subset

MACS Data Analysis

Metrics:

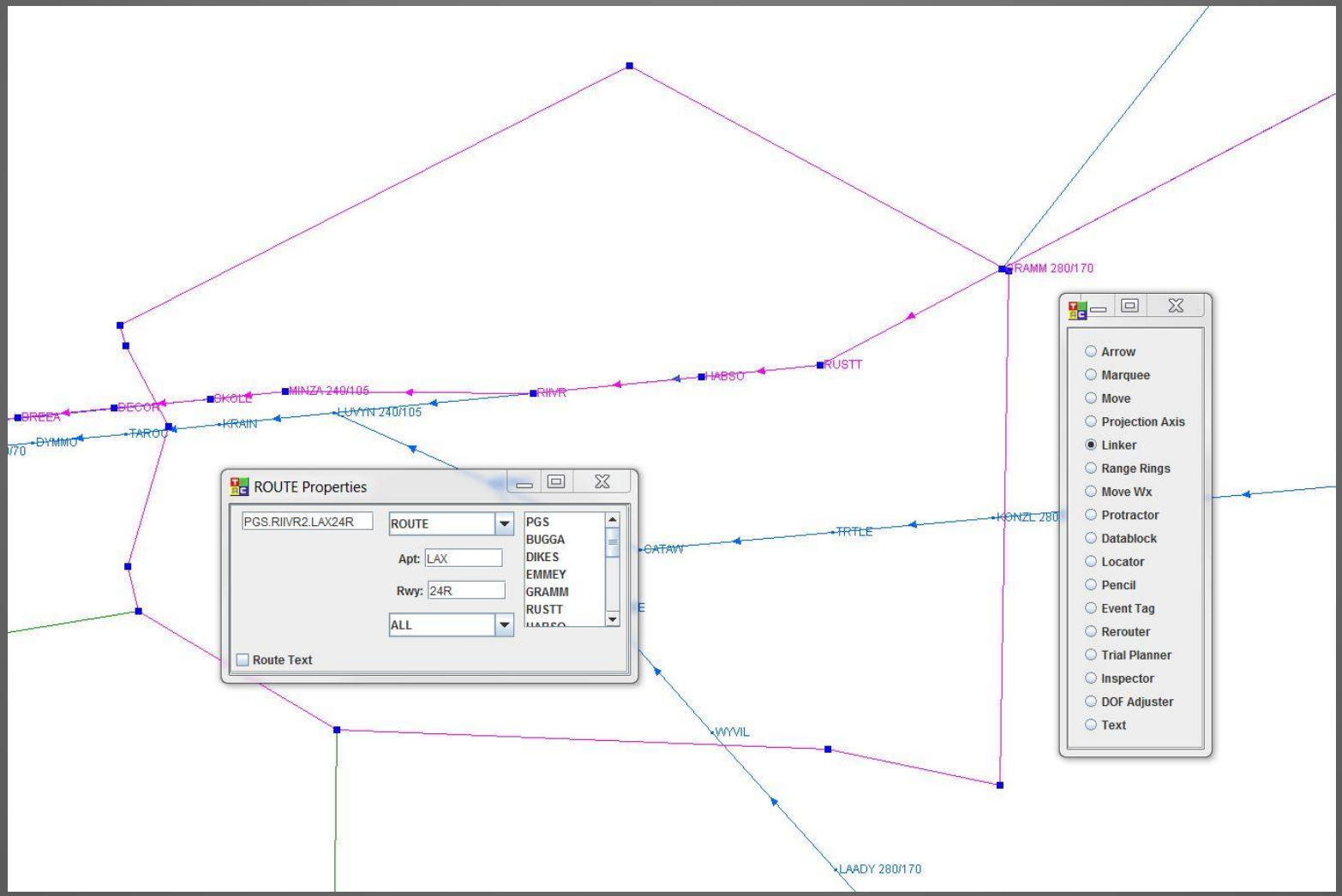
- Known waypoint crossing times
- Waypoint Crossing Details (incl. schedule conformance)
- Overall Separation Violations
- Sequence Data
- Average Interarrival Data
- Interarrival Data
- Control Gate Flux
- Level Segment Data
- Sel. Route Conformance
- Control Gate Schedule Conformance
- Schedule Adjustment Data
- ETA-STA error
- Try time-to-fly-tool
- Script (schedule conformance)

	# Interarrival Data:																
2773	# Lead	LeadType	LeadTime	Trail	TrailType	TrailTime	Wpt	Merge	RelAlt	Time	ReqTimeSpc	RelTime	Dist	ReqDistSpc	RelDist	DistTwoBehind	ReqDistTwoBehind
2844	DAL2704	Large	60928	DAL6716	Large	61013	LAX24R	0	1.57	85	80	5	3.05	3	0.05	6.99	3
2845	DAL6716	Large	61013	SKW7797	Large	61115	LAX24R	0	-4.62	102	80	22	3.5	3	0.5	7.74	3
2846	SKW7797	Large	61115	AAL4795	Heavy	61202	LAX24R	0	4.1	87	80	7	3.37	3	0.37	9.68	3
2847	AAL4795	Heavy	61202	USA2475	Large	61353	LAX24R	0	0.66	151	120	31	5.51	5	0.51	9.73	5
2848	USA2475	Large	61353	ASA5063	Large	61445	LAX24R	0	-4.1	92	80	12	3.27	3	0.27	7.34	3
2849	ASA5063	Large	61445	UAL6897	B757	61545	LAX24R	0	4.75	100	80	20	3.6	3	0.6	8.85	3
2850	UAL6897	B757	61545	DAL2209	Large	61665	LAX24R	0	-1.79	120	100	20	4.38	4	0.38	8.42	4
2851	DAL2209	Large	61665	UAL6313	Large	62970	LAX24R	1	-0.73	1305	80	1225	2.78	3	-0.22	6.44	3
2852	UAL1205	Large	61849	UAL2904	B757	61967	LAX24R	0	3.22	118	80	38	3.79	3	0.79	9.49	3
2853	UAL2904	B757	61967	AAL5376	Heavy	62093	LAX24R	0	0.51	126	100	26	4.27	4	0.27	10.52	4
2854	AAL5376	Heavy	62093	UAL1015	Heavy	62217	LAX24R	0	-4.21	124	100	24	5.29	4	1.29	11.12	5
2855	UAL1015	Heavy	62217	AAL1522	Large	62360	LAX24R	0	1.71	143	120	23	5.15	5	0.15	9.35	5
2856	AAL1522	Large	62360	AAL6660	Large	62460	LAX24R	0	2.83	100	80	20	3.36	3	0.36	7.5	3
2857	AAL6660	Large	62460	SWA1844	Large	62557	LAX24R	0	-3.37	97	80	17	3.42	3	0.42	7.6	3
2858	SWA1844	Large	62557	UAL2974	Large	62654	LAX24R	0	2.49	97	80	17	3.52	3	0.52	7.75	3
2859	UAL2974	Large	62654	UAL224	Large	62763	LAX24R	0	0.36	109	80	29	3.69	3	0.69	7.79	3
2860	UAL224	Large	62763	SWA696	Large	62860	LAX24R	0	0.95	97	80	17	3.35	3	0.35	7.7	3
2861	SWA696	Large	62860	UAL3883	B757	63058	LAX24R	0	-4.64	198	80	118	7.78	4	4.78	11.67	3
2862	UAL6313	Large	62970	UAL1205	Large	61849	LAX24R	1	-0.52	-1121	80	-1201					
2863	UAL3883	B757	63058	AAL1907	Large	63186	LAX24R	0	2.72	128	100	28	4.38	4	0.38	8.97	4
2864	AAL1907	Large	63186	USA7225	Large	63288	LAX24R	0	-0.86	102	80	22	3.43	3	0.43	8.52	3
2865	USA7225	Large	63288	UAL7297	Heavy	63375	LAX24R	0	-1.36	87	80	7	3.66	3	0.66	9.75	3
2866	UAL7297	Heavy	63375	FFT6388	Large	63525	LAX24R	0	-1.21	150	120	30	5.55	5	0.55	10.2	5
2867	FFT6388	Large	63525	JZA6826	Large	63622	LAX24R	0	1.61	97	80	17	3.49	3	0.49		



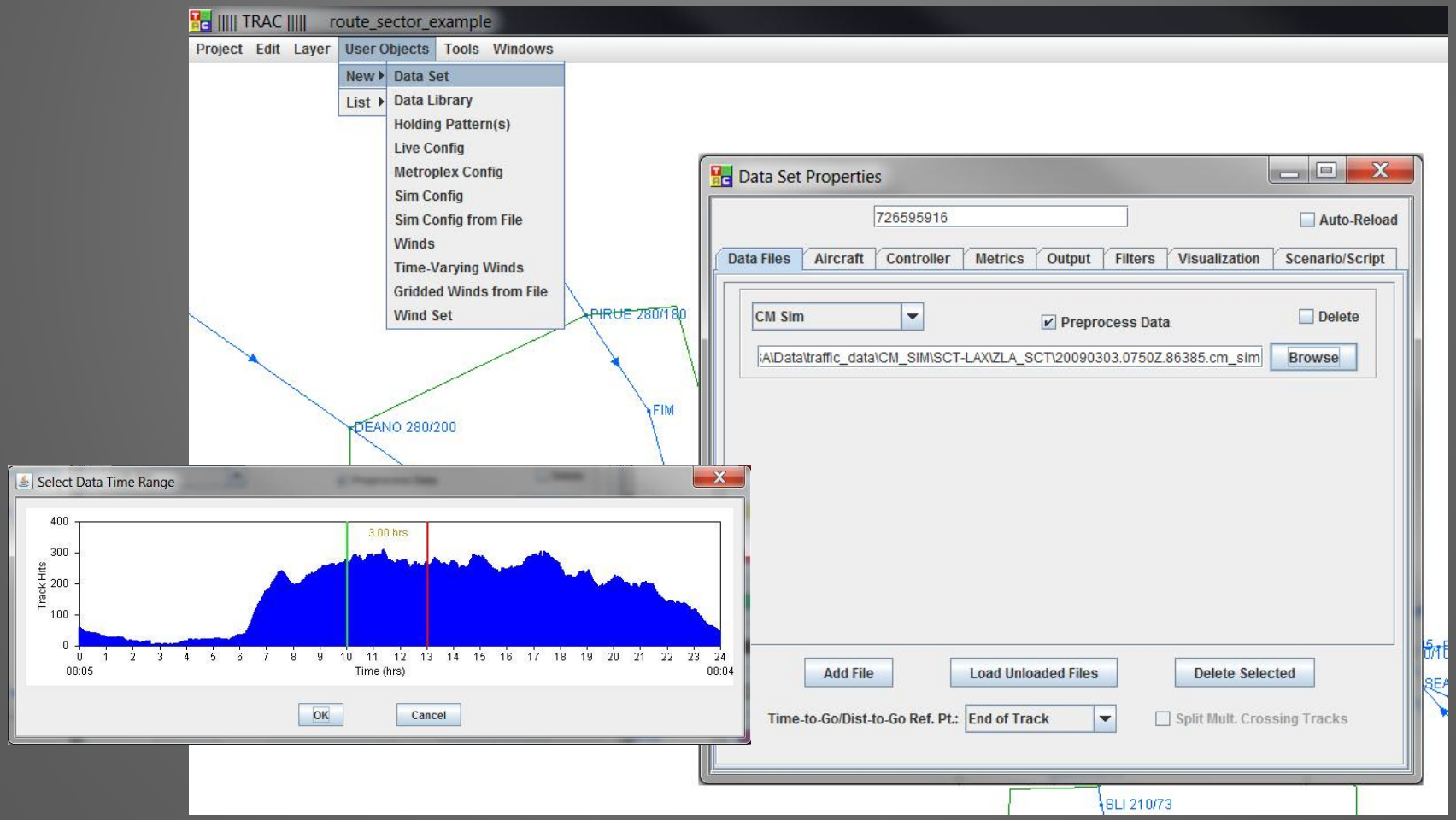
Route/Airspace Design

- Draw a sector in TRAC and export to MACS format
- Draw a route in TRAC and export it to MACS format

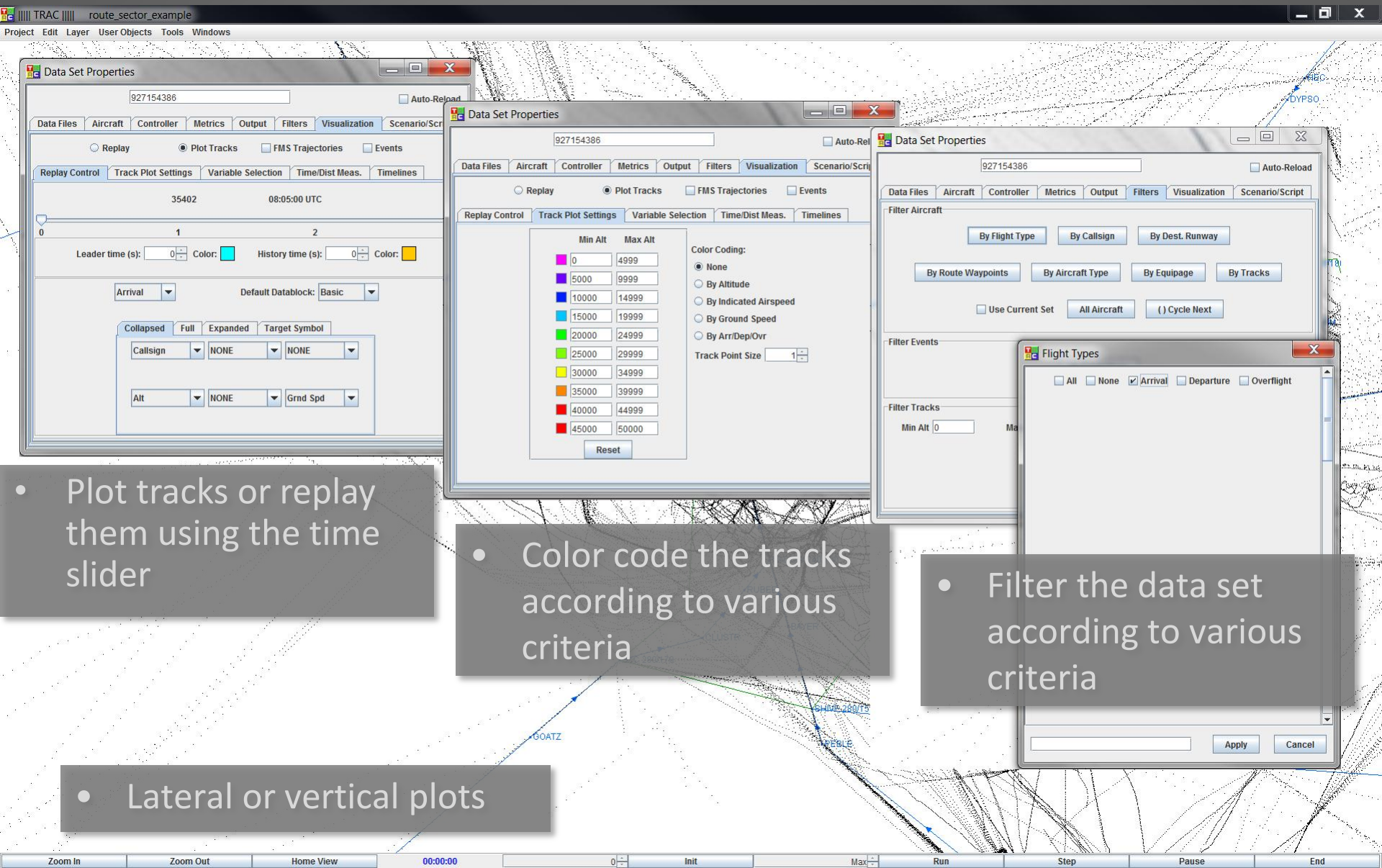


Data Visualization

- Add a data set, select a data file, load it
- Various supported formats: CM-Sim, Adrs, TRAC tds, … (for large files use preprocess data)



Data Visualization

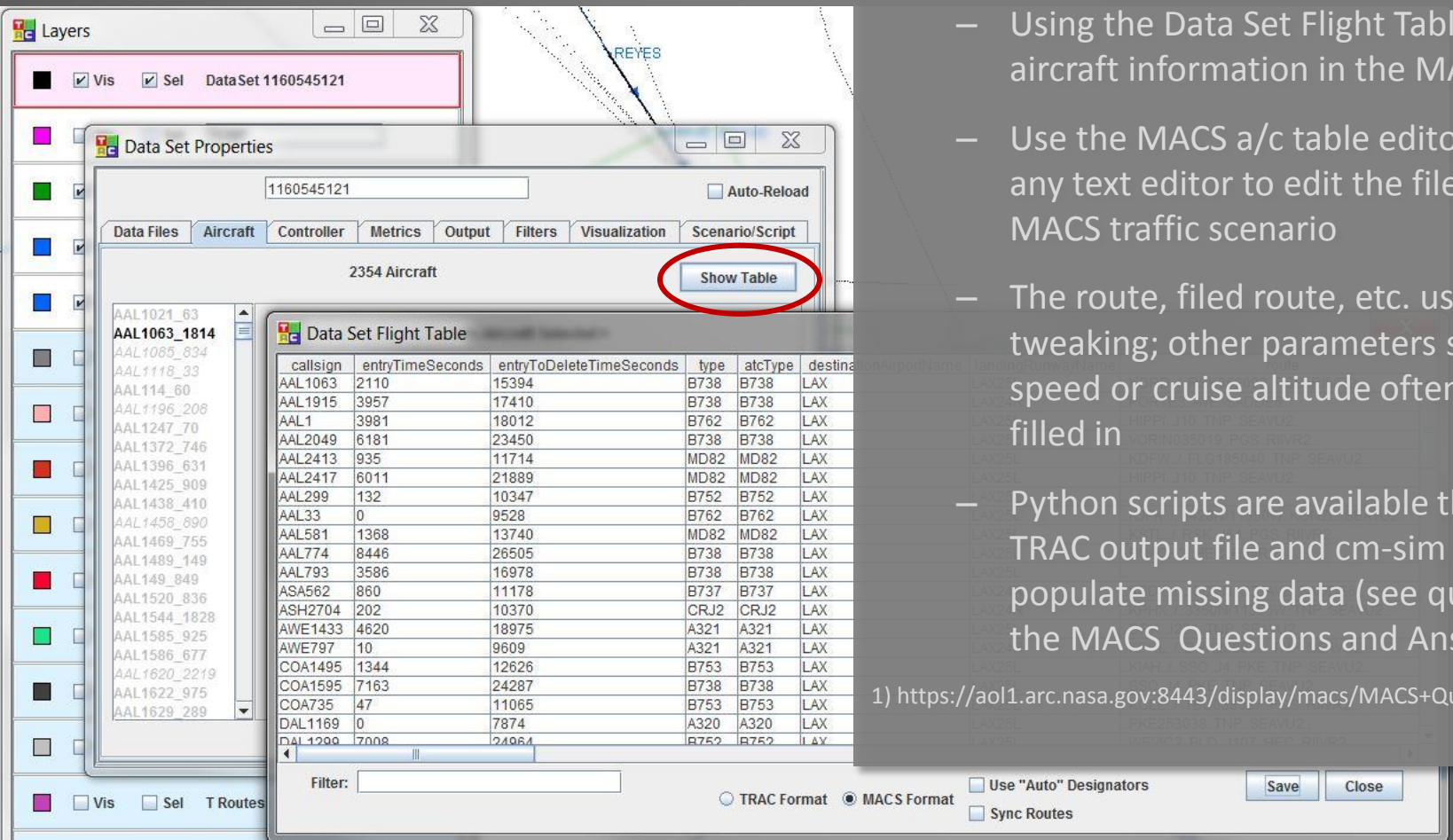


- Plot tracks or replay them using the time slider
- Color code the tracks according to various criteria
- Filter the data set according to various criteria
- Lateral or vertical plots

Scenario Design

- Usage of actual traffic recordings (CM-Sim)
  - Load traffic file and filter flights (flight type, destination runway, etc.)
  - Using the Data Set Flight Table save the aircraft information in the MACS format
  - Use the MACS a/c table editor, MS Excel, or any text editor to edit the file to build a MACS traffic scenario
  - The route, filed route, etc. usually need tweaking; other parameters such as cruise speed or cruise altitude often need to be filled in
  - Python scripts are available that use the TRAC output file and cm-sim data to populate missing data (see question 27) in the MACS Questions and Answers[1])

1) https://aol1.arc.nasa.gov:8443/display/macs/MACS+Questions+and+Answers



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Additional Information

- Contacts:
  - Todd Callantine: todd.callantine@nasa.gov (650) 604-2631
  - Michael Kupfer: michael.kupfer@nasa.gov (650) 604-6424

- URL: http://humansystems.arc.nasa.gov/groups/AOL/technologies/trac.html

- Other documentation available:
  - Basic TRAC tutorial slides
  - TRAC shortcuts and keyboard functions
  - Documentation of MACS log file output options using python scripts in TRAC
  - Documentation of BADA calculations using python scripts in TRAC

Questions and Answers