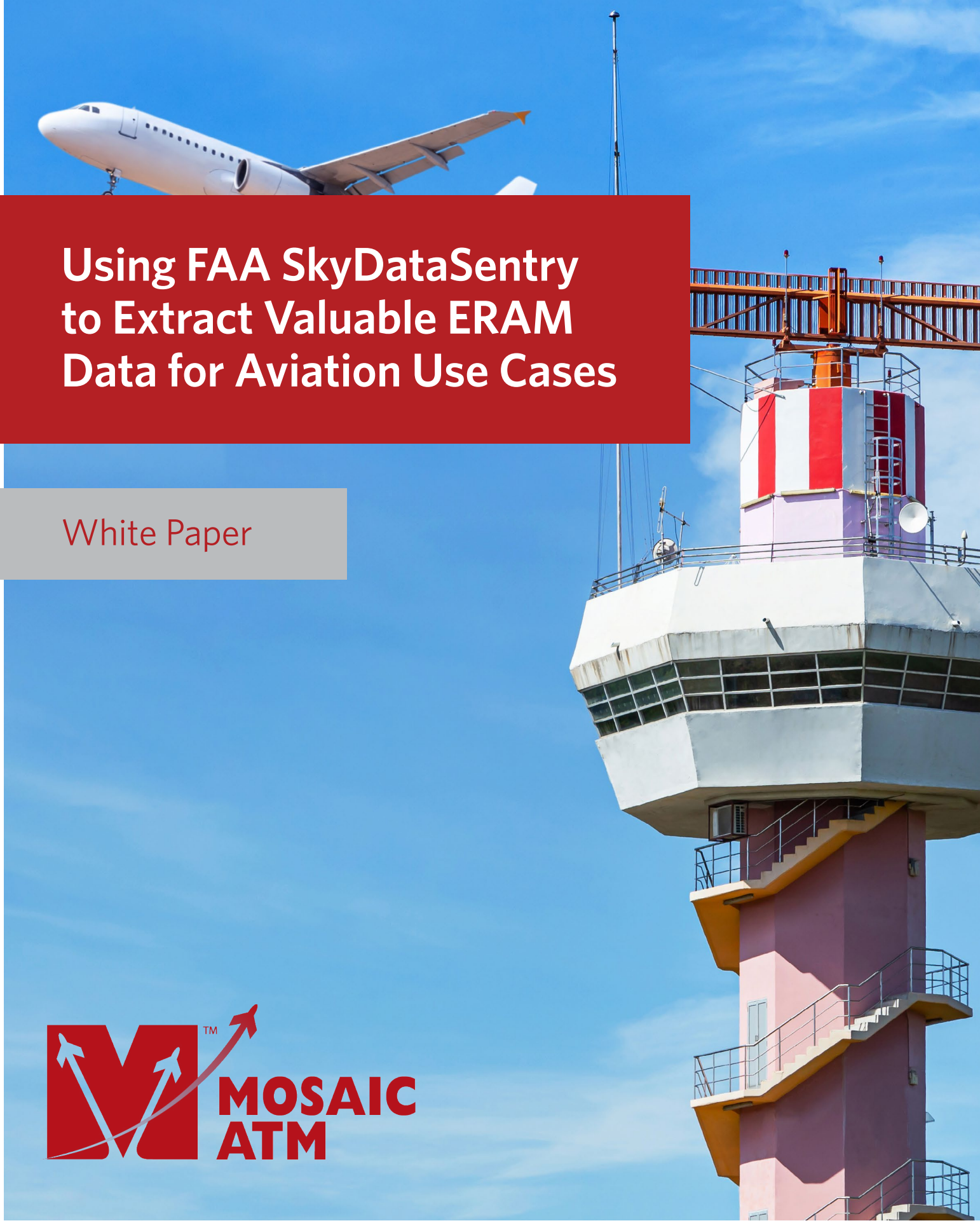


Using FAA SkyDataSentry to Extract Valuable ERAM Data for Aviation Use Cases

White Paper

MOSAIC ATM™

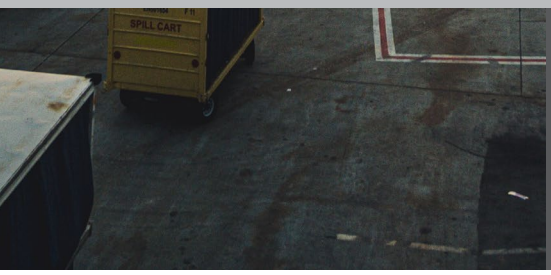
Using FAA SkyDataSentry to Extract Valuable ERAM Data for Aviation Use Cases

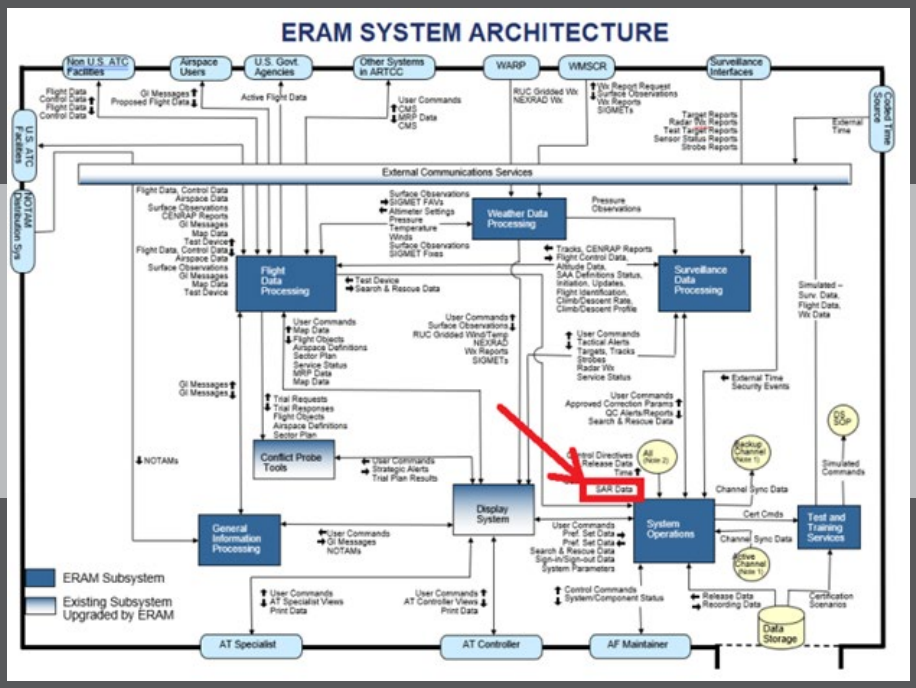
There are three domains in air traffic control: tower, TRACON, and ARTCC. En Route Automation Modernization (ERAM) is the core processing and display system of air traffic control in the ARTCC environment. ERAM generates a rich set of data that has tremendous value to the FAA and contractors like Mosaic. This data for aviation includes, but is not limited to:

- Aircraft position reports (typically from either ADS-B or radar)
- Trajectory predictions
- Conflict alerts
- Sector configurations
- Airspace statuses
- Controller inputs, and much more.

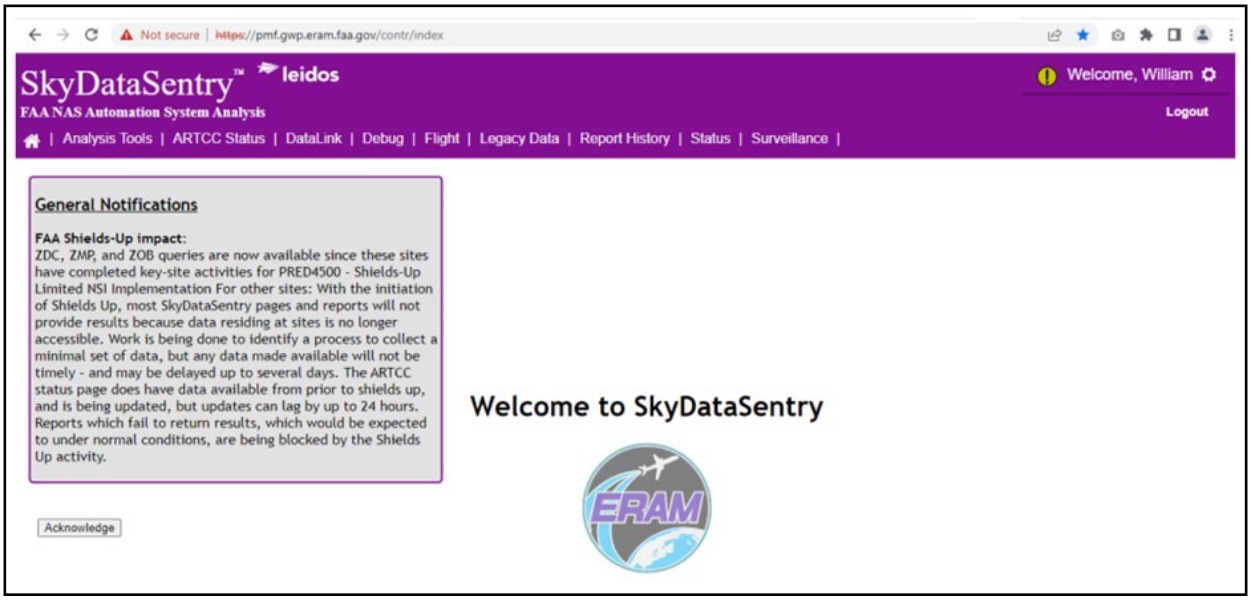
Mosaic's ability to support the FAA is greatly enhanced by ready access to this data. We are frequently called on to analyze operational data for aviation to support innovations such as improvements to trajectory prediction, improvements to the management of special activity airspace, improvements to conflict detection and much more.

The following graphic shows the ERAM system architecture. Highlighted in red is the System Analysis Recording (SAR) data.





The System Wide Information Management (SWIM) Flight Data Publication Service (SFDPS) makes some of this data available to SWIM consumers. Mosaic ATM subscribes to this service over SWIM. Another way to get at the SAR data is through the FAA's SkyDataSentry (SDS) interface. The FAA Tech Center hosts SDS, which receives data for aviation from all 20 ARTCCs and makes it available to users. SDS is web-based and the home screen looks like this:



Challenges and Opportunities With SDS

Accessing the SDS platform is a difficult process as it requires FAA network access and an account the ERAM Production and Maintenance Facility website (ERAM Home). Users must submit justification for their account and have an FAA sponsor.

The SDS site is also notorious for its lack of user-friendliness. The FAA does not maintain a valid SSL certificate, so users must click through the warnings about the web site being unsafe – as shown by the "not secure" indicator in the URL bar.

Once a user gets past the roadblocks of maneuvering the site, they could find there is restricted access to some SDS data. The connections between the ARTCCs and the Tech Center were dropped for a period of time in connection with a government-wide security program (Shields Up) but have resumed for qualifying ARTCCs.

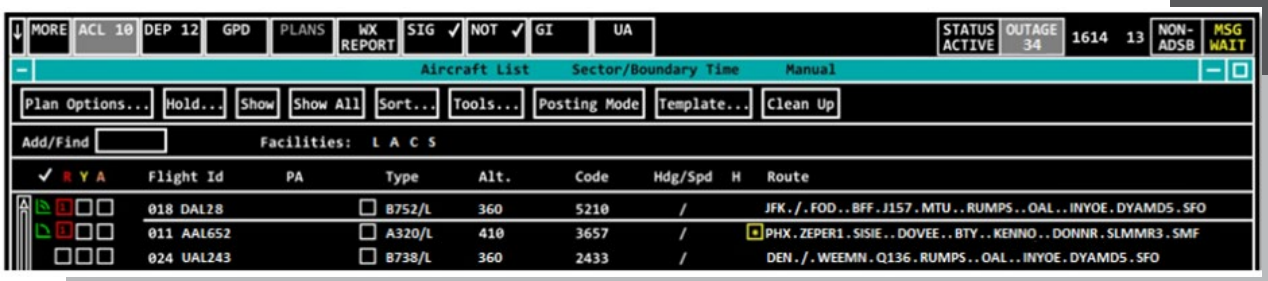
With all these obstacles, why would anyone bother using SDS? There are several reasons:

- SDS is schema agnostic, while SFDPS is schema dependent (i.e., FIXM).
- SFDPS data is provided in an XML format, so the data sets are going to be much larger in size and require parsing. If the mechanisms for consuming this data and writing it to a database are already established then it's not an issue, but if you have to start from scratch then there's likely a lot of work involved.
- Conflict data (Probe and Alert) and trajectory data for aviation are only available in SDS, not in SFDPS.

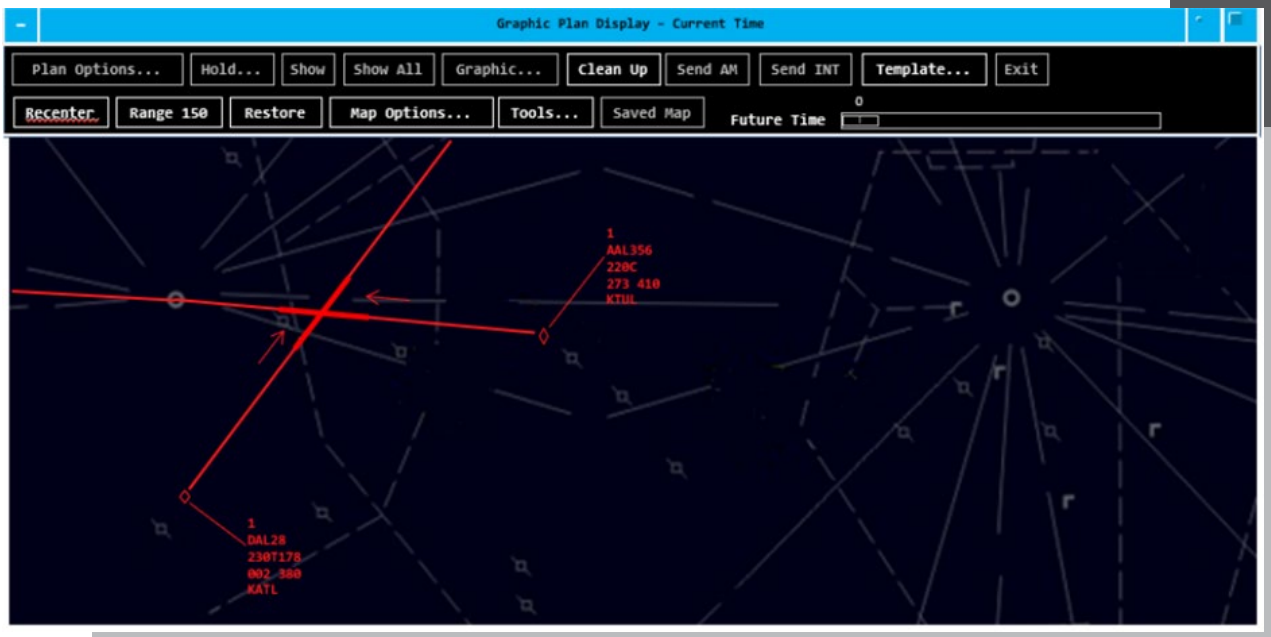
The following are a few samples of the data one can get from SDS involving conflict detection. There are two different ways that ERAM evaluates and displays its conflict predictions: Conflict Probe (CP) and Conflict Alert (CA).

Conflict Probe (CP)

CP provides alerts to controllers of predicted conflicts in the medium-term time frame, up to 20 minutes ahead. Its algorithm considers the currently cleared route as known to ERAM and makes some very generic (and often incorrect) assumptions about climb and descent profiles. It displays only on the D-side (the display of flight plan information that supplements the radar display), showing a red or yellow X in the Aircraft List (both DAL430 and AAL652 have alerts in the graphic below).



The controller has the option of visualizing the conflict using the “Show” or “Show All” button, which bring up the graphic below.



SDS offers multiple forms for viewing CP data. One is the summary report shown in the graphic below. This provides a single line for each conflict, where individual conflicts are delineated by ERAM and assigned a conflict ID (not shown).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	date	site	national rel	local rel	channel	channel mode	time	criticality	trial plan	notified sector	conflict start time	conflict stop time	flight1	flight2
2	20220130	ZBW	eae5001h	ba80a127	operational_b	ACTIVE	20220130 0006:06.704	LOW	F	47	20220130 0007:34.657	20220130 0010:38.135	HBIXL	SAS926
3	20220130	ZBW	eae5001h	ba80a127	operational_b	ACTIVE	20220130 0027:12.069	LOW	F	0	20220130 0039:16.308	20220130 0041:24.418	ACA876	SWG319
4	20220130	ZBW	eae5001h	ba80a127	operational_b	ACTIVE	20220130 0033:30.057	HIGH	F	0	20220130 0036:09.253	20220130 0037:33.450	TFF904	AAL92
5	20220130	ZBW	eae5001h	ba80a127	operational_b	ACTIVE	20220130 0034:54.832	HIGH	F	0	20220130 0036:08.631	20220130 0037:32.967	TFF904	AAL92
6	20220130	ZBW	eae5001h	ba80a127	operational_b	ACTIVE	20220130 0035:16.735	LOW	F	0	20220130 0039:08.298	20220130 0039:25.080	TFF904	DAL14
7	20220130	ZBW	eae5001h	ba80a127	operational_b	ACTIVE	20220130 0037:48.321	HIGH	F	0	20220130 0039:08.298	20220130 0039:31.700	TFF904	DAL14
8	20220130	ZBW	eae5001h	ba80a127	operational_b	ACTIVE	20220130 0044:24.096	HIGH	T	0	20220130 0117:12.061	20220130 0117:38.898	EJA147	JZA7603

The data consists of detailed CP data with 74 data elements, including every update made for each conflict, which can range from 1 row of data to scores. Aircraft-to-airspace CP data is also available.

Conflict Alert (CA)

CA is meant to assist the controller in a more tactical sense, and only evaluates the physics of the trajectories based on previous position reports, ignoring the cleared route but accounting for the assigned altitude. Because immediate action is often required, CA appears directly on the radar display. The data blocks of the involved aircraft will flash (bright and dim) at about half-second intervals. The table below shows some of the columns in a sample of this data.

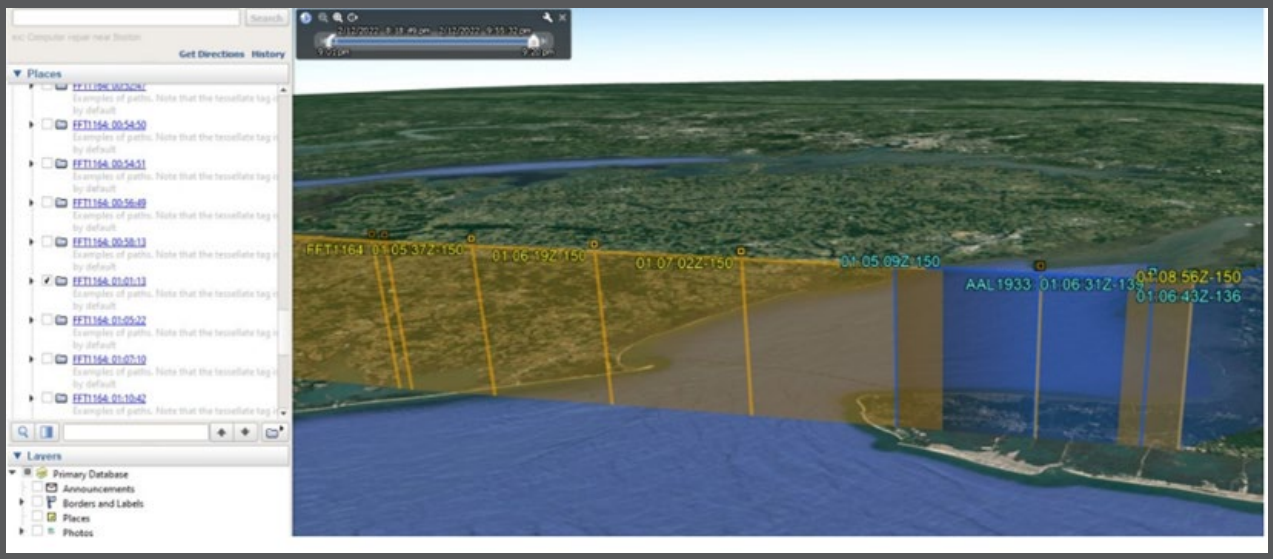
	B	G	H	J	L	N	O	P	S	T	U	V	W	X	Y	Z	AA
1	site	time1	caid	state	predTimeTo StartOfCoVi	type	aid1	cid1	sec	stat1	lat1C	lon1C	alt1C	lat1P	lon1P	alt1P	aid2
045	ZDC	20190701 1622:02.592	287491	NEW	59.677582	PREDICTED	N236CA	346	5	DISPLAYED	38.4456399	-79.1706779	174	38.4745743	-79.0256623	157	ANVIS21
046	ZDC	20190701 1622:16.556	287491	CONTINUE	45.594676	PREDICTED	N236CA	346	5	DISPLAYED	38.4530311	-79.1395663	170	38.4756056	-79.0272665	158	ANVIS21
047	ZDC	20190701 1622:28.705	287491	CONTINUE	32.199388	PREDICTED	N236CA	346	5	DISPLAYED	38.4583596	-79.1072514	167	38.4734284	-79.0301313	158	ANVIS21
050	ZDC	20190701 1622:42.015	287491	CONTINUE	18.864915	PREDICTED	N236CA	346	5	DISPLAYED	38.4637454	-79.0764836	163	38.4723398	-79.0313345	158	ANVIS21
054	ZDC	20190701 1622:55.847	287491	CONTINUE	6.013531	PREDICTED	N236CA	346	5	DISPLAYED	38.4716522	-79.0450282	159	38.4746316	-79.0299021	158	ANVIS21

ERAM is constantly generating trajectory predictions for all aircraft; they are used by Conflict Probe as input. The graphic below shows some of the fields available in a single trajectory prediction.

	A	B	E	F	G	H	I	J	K	L	M	P	R	T
1	Date	aid	actype	departure	destination	Kind	TrajVer	CuspTime	CoordX	CoordY	Altitude	Airspeed	TargetAlt	Speed
437	20220213 0048:17.566000	AAL1933	A319	TLPL	KPHL	AIRCRAFT	13	20220213 0107:36.246000	-74.86	39.254444	15000	380	8000	391.695455
438	20220213 0048:17.566000	AAL1933	A319	TLPL	KPHL	AIRCRAFT	13	20220213 0108:51.117000	-74.906389	39.376944	12839.91492	333.3421623	8000	343.7316084
439	20220213 0048:17.566000	AAL1933	A319	TLPL	KPHL	AIRCRAFT	13	20220213 0109:46.675000	-74.936944	39.457778	11237.04671	298.7202089	8000	308.7823686
440	20220213 0048:17.566000	AAL1933	A319	TLPL	KPHL	AIRCRAFT	13	20220213 0110:25.036000	-74.956111	39.508333	10130.31172	274.8147332	8000	279.4330557
441	20220213 0048:17.566000	AAL1933	A319	TLPL	KPHL	AIRCRAFT	13	20220213 0110:48.738000	-74.967222	39.537778	9564.323842	274.3619429	8000	243.5360793
442	20220213 0048:17.566000	AAL1933	A319	TLPL	KPHL	AIRCRAFT	13	20220213 0111:33.172000	-75.023056	39.562778	8503.267671	273.5130979	8000	263.2858444
443	20220213 0048:17.566000	AAL1933	A319	TLPL	KPHL	AIRCRAFT	13	20220213 0111:47.548000	-75.033889	39.578056	8100	273.1904838	8000	262.9591155

Each row shows a “cusp” or point in the trajectory, with the CuspTime field showing the estimate at the point, which is identified by the CoordX and CoordY fields. The Altitude, Airspeed, and Speed fields provide the estimates at that point. This data can then be processed for various purposes, including into a KML file for trajectory visualization.

The graphic below shows the trajectories of two successive arrivals to Philadelphia, crossing over Rehoboth Beach, DE and Cape May, NJ. As mentioned, ERAM generates lots of trajectories for each aircraft, so the trajectories shown are selected to match when they were valid.



Conclusion

Overall, when it comes to SDS there is a treasure trove of data for those willing to pay the price to get it. If one has access to a government laptop or some other means into the FAA network (it can be done from other devices), one should apply for an ERAM account.

Note that when Shields Up was activated, SkyDataSentry data was severely restricted. SDS has connections to each ARTCC through which ERAM data for aviation is passed. During Shields Up, these connections were severed. We called the FAA ATO Help Desk and received extremely helpful support.