Airborne
Spectral
Photometric
Environmental
Collection
Technology

ASPECT Air Quality Survey after Hurricane Ida
Baton Rouge, LA
September 4, 2021

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Acronyms and Abbreviations

Alt	Altitude (in feet)
AGL	Above Ground Level
cm	centimeter
CDT	Central Daylight Time
DEM	Digital Elevation Model
ESF-10	Emergency Support Function #10 – Oil and Hazardous Materials Response
FEMA	Federal Emergency Management Agency
FTIR	Fourier Transform Infrared Spectrometer
FTP	File Transfer Protocol
igm	Spectral data format based on grams format
IR	Infrared
IRLS	Infrared Line Scanner
jpg	JPEG image format
kts	knots
mph	miles per hour
m/s	meters per second
MSIC	Digital photography file from the Imperx mapping camera
MSL	Mean Sea Level Altitude (in feet)
PAN	peroxyacetyl nitrate
Ppm	parts per million
RMP	Risk Management Plan
UTC	Universal Time Coordinated

Executive Summary

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2nd, 2021, the State of Louisiana requested ESF-10 assistance through FEMA and Region 6 asked for the ASPECT plane to be deployed in support of the response to Hurricane Ida. The state wanted assistance monitoring facility emissions in the industrial area between Baton Rouge and New Orleans, where flaring is resulting in the visible emission of black smoke.

ASPECT was tasked to perform remote chemical sensing over target properties to screen for airborne chemicals and take high-resolution photos to provide situational awareness. Potential areas identified for monitoring included: East Baton Rouge, Ascension, Iberville, St. James, St. John, St. Charles, Jefferson, and Orleans. The system conducted one flight mission on 2 September 2021 including air monitoring survey collections over the target area with favorable weather conditions for all passes. Although two black plumes were visible over one of the sites, no major emissions were detected with the FTIR.

A continuation of the overall Baton Rouge facility survey was conducted on September 3. Two data collection flights were conducted which bracketed a Presidential temporary flight restriction not allowing any flight activity. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

Flight 5 and 6 were conducted as part of survey operations conducted on September 4. A total of 19 facilities were surveyed. No compounds were detected other than levels of ozone and peroxyacetyl nitrate. Analysis of IR imagery indicated that some facilities are showing hot process units.

ASPECT Air Quality Survey
Hurricane IDA
Baton Rouge, LA
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Background and Operational Overview

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2, 2021, ASPECT was tasked to conduct a wide area air quality screening level assessment of areas populated with Risk Management Plan (RMP) sites and petrochemical facilities using the ASPECT system for detections of any airborne contaminants from ASPECT's 76 chemical detection library in the areas affected by Ida. The Region wanted to know if any detections were found, the location of the detection, and the concentration detected. Sites including Marathon Petroleum Company, Shell Norco Facility, and Phillips 66 pipeline site were surveyed. There were no chemical detections at the sites surveyed. Extremely slow satellite transmission speeds (possibly due to high bandwidth use by other first responders) resulted in long delays in data collection. Some chemical photos were pulled down during flight, with the majority needing to be pulled down with a more high-speed internet connection on the ground.

On September 3, ASPECT was tasked with a continuation of the general Baton Rouge area survey and conducted two flights. 8 locations in the Baton Rouge area were surveyed as part of two flights. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

Flight 5 and 6 were conducted as part of survey operations conducted on September 4. Collectively, a total of 19 facilities were surveyed.

Table 1. Sites Covered on September 4, 2021 Flights 5 and 6

LBC Baton Rouge LLC - Sunshine Terminal	30.294444	-91.148333
EnLink LIG Liquids LLC - Plaquemine Gas Processing Plant	30.236389	-91.241389
Syngenta Crop Protection LLC - St Gabriel Plant	30.246728	-91.103508
TOTAL Petrochemicals & Refining USA Inc - Carville Polystyrene Plant	30.229786	-91.073631
NOVA Chemicals Olefins LLC - Geismar Ethylene Plant	30.230619	-91.052884
Lone Star NGL Refinery Services LLC - Geismar Fractionation Plant	30.218889	-91.035833
Kinder Morgan Liquids Terminals LLC - Geismar Methanol Terminal	30.205389	-91.023792
Methanex USA Services LLC - Geismar Methanol Plant	30.206667	-91.020833
Westlake Vinyls Co LP	30.209167	-91.017222
Rubicon LLC - Geismar Facility	30.20139	-91.01222
BASF Corp - North Geismar Site	30.20594	-90.99195
BASF Corp - Geismar Site	30.18425	-91.002778
Occidental Chemical Corporation - Geismar Facility	30.18819	-90.98188
CF INDUSTRIES	30.08328002	-90.957665
Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery	30.107684	-90.890796
Occidental Chemical Corporation - Convent Facility	30.055885	-90.830594
South LA Methanol LP - St James Methanol Plant	30.039917	-90.863819
Mosaic Fertilizer LLC - Uncle Sam Plant	30.037222	-90.8275
NuStar Logistics LP - St James Terminal	30.030065	-90.843463

General Mission Objectives

Once granted access to fly over the sites, the following general mission objectives were employed in conducting data collection with ASPECT:

1. To capture an overall, situational awareness of the incident using aerial photography with:
    - Oblique camera—photos taken by hand from the view/position of the co-pilot, and
    - MSIC photos—advanced camera mounted underneath the plane for a top-down view of the designated sites.
2. To qualitatively locate and characterize any the visible and non-visible components of a plume, as well as any areas on fire:
    - Using the Infrared Line Scanner (IRLS)
3. To screen for the presence and location of specific chemicals within ASPECT's automated chemical detection library:
    - Using the Fourier Transform Infrared (FTIR) Spectrometer

Flight Conditions and Status

Weather and Site Conditions

Prior to each flight, an updated status of the current and forecasted weather, site conditions and any potential flight obstacles including radio towers impacting safety is assessed by the crew. A summary of the ground weather conditions during the missions can be found in Table 2 and 3.

Table 2. Ground Weather for Baton Rouge, LA, Flight 5
September 4, 2021

Time	953	1053	1153	1253	1353	1453
Wind direction	67.5 degrees ENE	112.5 degrees ESE	292.5 degrees WNW	315 degrees NW	0 degrees	0 degrees
Wind speed	1.3 m/s (3.0 mph)	2.2 m/s (5.0 mph)	2.2 m/s (5.0 mph)	2.2 m/s (5.0 mph)	2.7 m/s (6.0 mph)	1.3 m/s (3.0 mph)
Temperature	27.8 C	30.0 C	31.1 C	31.7 C	31.7 C	32.8 C
Relative humidity	74	70	66	61	61	56
Dew point	22.8 C	23.9 C	23.9 C	23.3 C	23.3 C	22.8 C
Pressure	1013.9 mb	1014.3 mb	1013.9 mb	1013.6 mb	1013.3 mb	1012.3 mb
Ceiling	Clear	Clear	Scattered 4200 Ft	Few 3900 Ft	Scattered 4200 Ft	Few 4600 Ft

Table 3. Ground Weather for Baton Rouge, LA, Flight 6
September 4, 2021

Time	1653	1753	1853	1953
Wind direction	0 degrees N	0 degrees N	337.5 degrees NNW	337.5 degrees NNW
Wind speed	4.5 m/s (10.0 mph)	2.7 m/s (6.0 mph)	1.3 m/s (3.0 mph)	2.2 m/s (5.0 mph)
Temperature	23.9 C	24.4 C	23.9 C	21.7 C
Relative humidity	69	67	71	79
Dew point	17.8 C	17.8 C	18.3 C	17.8 C
Pressure	983.8 mb	983.8 mb	983.8 mb	984.1 mb
Ceiling	Overcast 2700 Ft	Broken 2800 Ft	Few 3200 Ft	Clear

Data Results

The following data is provided as a summary analysis. All data products are available for the Region to access on a shared FTP site. For a complete list of available products, see Appendix A. The data collected during these missions included a flight path summary, IRLS images, FTIR chemical identification and quantification, high resolution MSIC photos, and oblique photos.

Flight Paths

Wide, slow turns are required to be made in between runs to keep the instruments stable. The blue lines indicate the flight path while the green lines indicate the specific sections of the flight where chemical data was collected and processed. On Flights 5 and 6 the Baton Rouge area was surveyed, and the flight paths are shown in Figures 1 and 2.

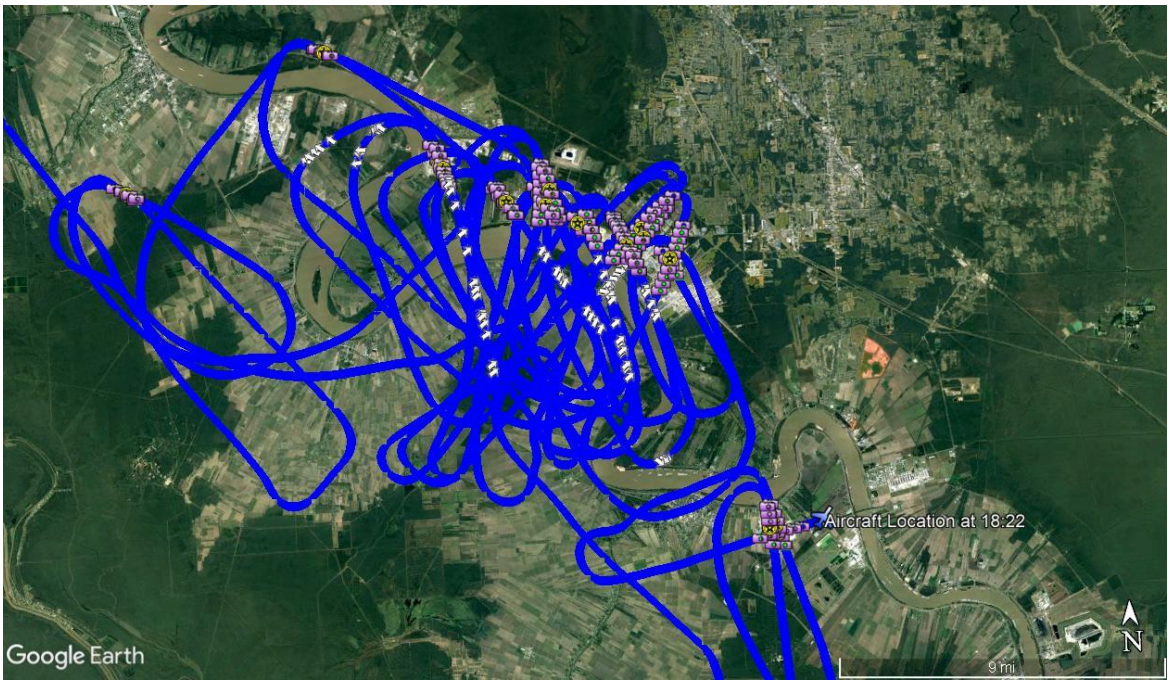

Figure 1. Data Collection Flight Path over the Baton Rouge Area Flight 5, September 4, 2021

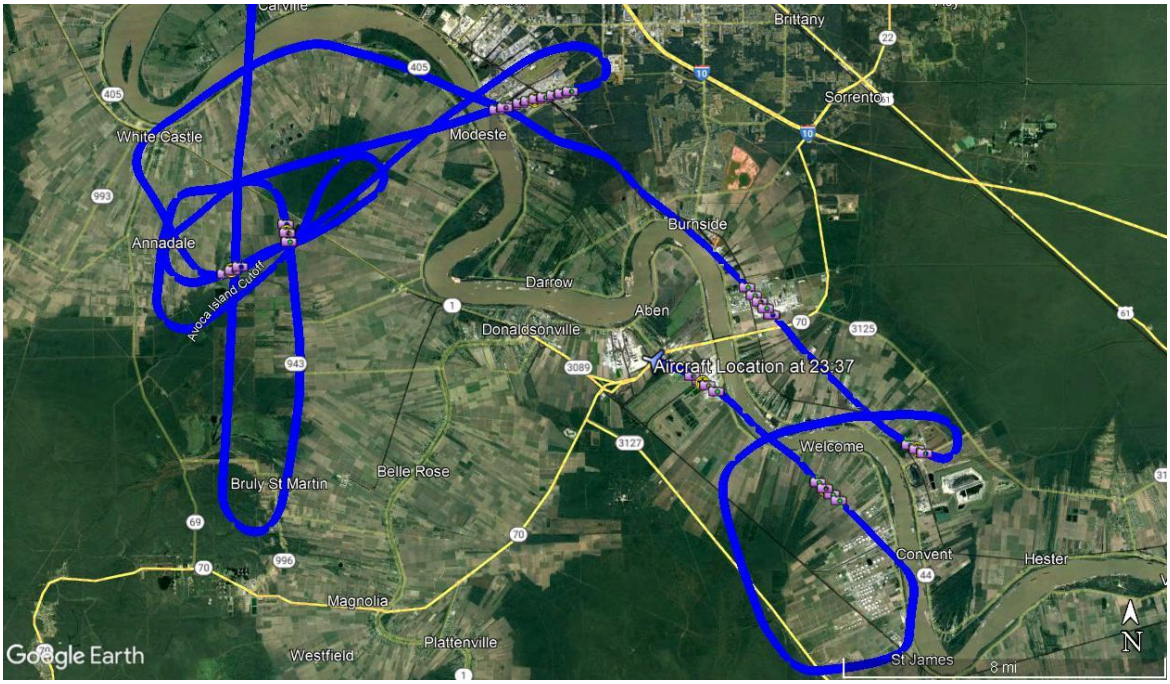

Figure 2. Data Collection Flight Path over the Baton Rouge Area Flight 6, September 4, 2021

Line Scanner Data Results

A total of 31 data collection runs were made over the target facilities and an infrared line scanner image was generated for each collection run. Figure 3 shows a 3-band infrared image collected over the CF Industries facility. Thermal analysis shows that many of the facilities are showing process units have some activity. The process unit located in the middle of Figure 3 indicates hot units and hot piping. Other than thermal, no chemical plumes can be observed being emitted from the facility. Figure 4 shows a similar image collected on Flight 6 over the Occidental Chemical facility.

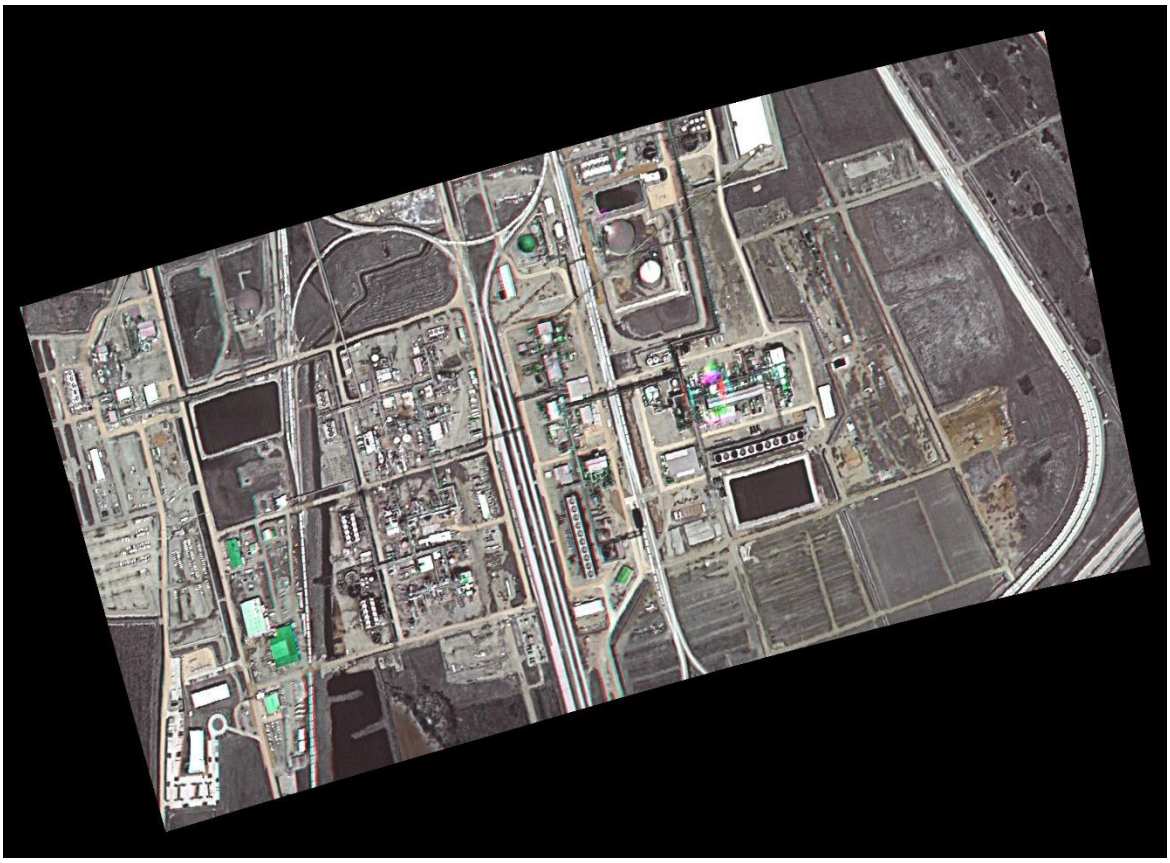

Figure 3. Three band IR image, CF Industries in the Baton Rouge Area, Run 23, Flight 5, September 4, 2021

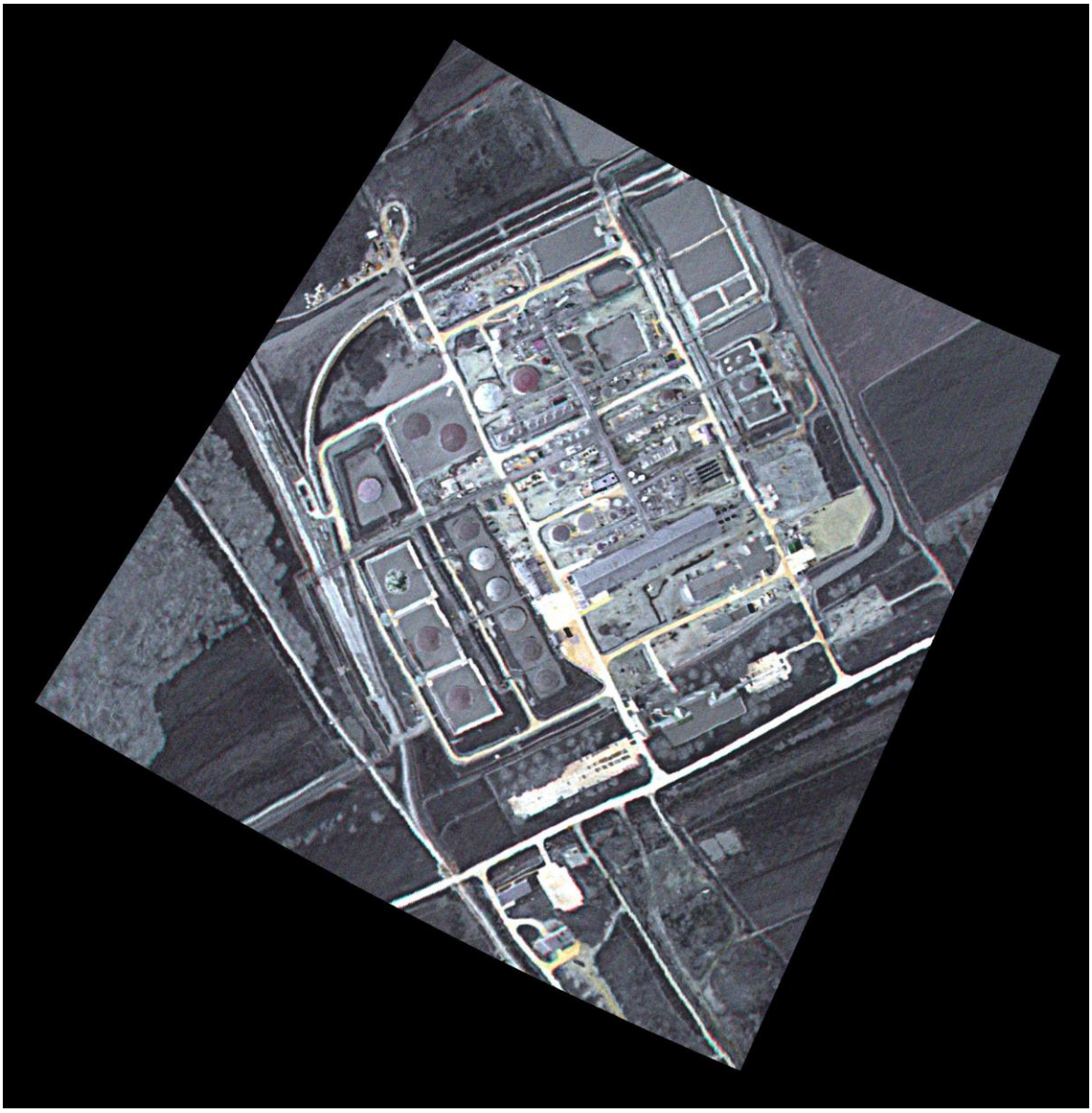

Figure 4. Three band IR image, Occidental Chemical Facility in the Baton Rouge Area, Run 5, Flight 6, September 4, 2021

FTIR Data Results

FTIR spectral data at a resolution of 16 wavenumbers was collected for each run. ASPECT uses an automated detection algorithm to permit compounds to be automatically analyzed while the aircraft is in flight. Seventy-six chemical compounds are included in the airborne algorithm library (the list is provided in Appendix B, Table 1). In addition, collected data was also manually quality checked against a collection of published library spectra for each chemical detected.

Ground analysis and confirmation of airborne data found detectable quantities of ammonia on passes 10 and 11 at a maximum concentration of approximately 14.7 ppm. Figure 5 shows a plot of detected ammonia with the characteristic peaks at 930 and 960 wavenumbers. Figure 6 shows the locations of the ammonia detections. No other significant detections were noted in the survey. Details of the monitoring results can be found in Tables 4 and 5.

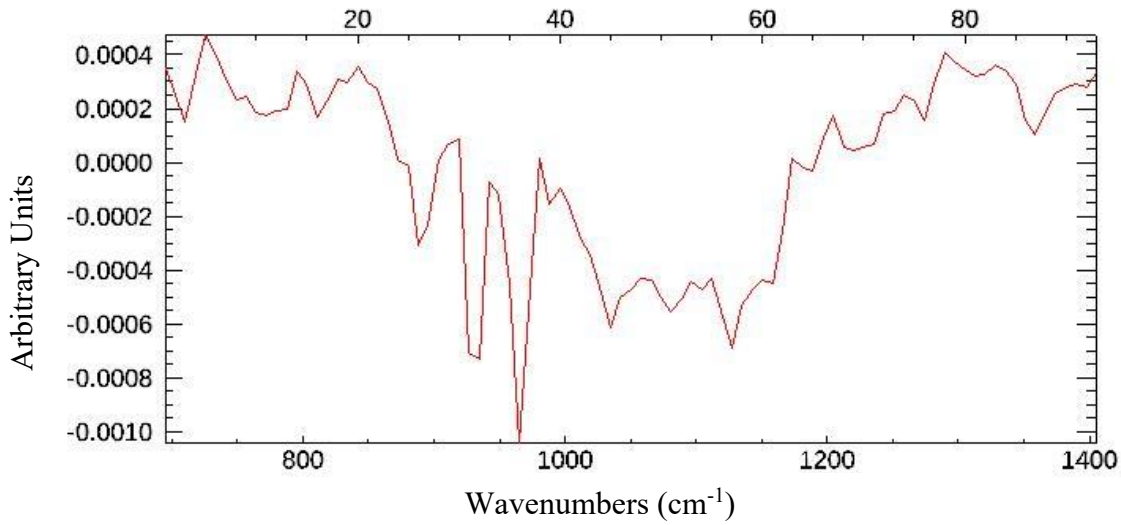

Figure 5. Ammonia Spectrum Flight 5, Run 10

Figure 6. Ammonia Detection Locations, Flight 5, Runs 10 and 11

Table 4. Chemical Results Summary
Baton Rouge Collection Area, Flight 5

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-04	14:13:50	Test	Test
2		15:01:22	ND	ND
3		15:12:15	ND	ND
4		15:24:47	ND	ND
5		15:32:46	ND	ND
6		15:42:23	ND	ND
7		15:51:20	ND	ND
8		16:02:17	ND	ND
9		16:09:39	ND	ND
10		16:18:48	Ammonia	10.4
11		16:27:35	Ammonia	14.7
12		16:35:25	ND	ND
13		16:45:24	ND	ND
14		16:52:56	ND	ND
15		17:07:25	ND	ND
16		17:18:42	ND	ND
17		17:28:17	ND	ND
18		17:34:43	ND	ND
19		17:49:52	ND	ND
20		17:56:26	ND	ND
21		18:08:41	ND	ND
22		18:15:49	ND	ND
23		18:21:56	ND	ND

Table 5. Chemical Results Summary
Baton Rouge Collection Area, Flight 6

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-04	22:50:57	ND	ND
2		22:54:08	ND	ND
3		23:05:33	ND	ND
4		23:22:35	ND	ND
5		23:25:21	ND	ND
6		23:34:31	ND	ND
7		23:36:23	ND	ND

Aerial Photography Results

A full set of high-resolution aerial digital photography were collected as part of each data collection pass. Weather conditions over the Baton Rouge area allowed high quality aerial images to be collected. Figure 7 shows a representative aerial image collected over the

Syngenta Crop Protection facility. Figure 8 shows a representative oblique with evidence of plant activity due to the steam plume.

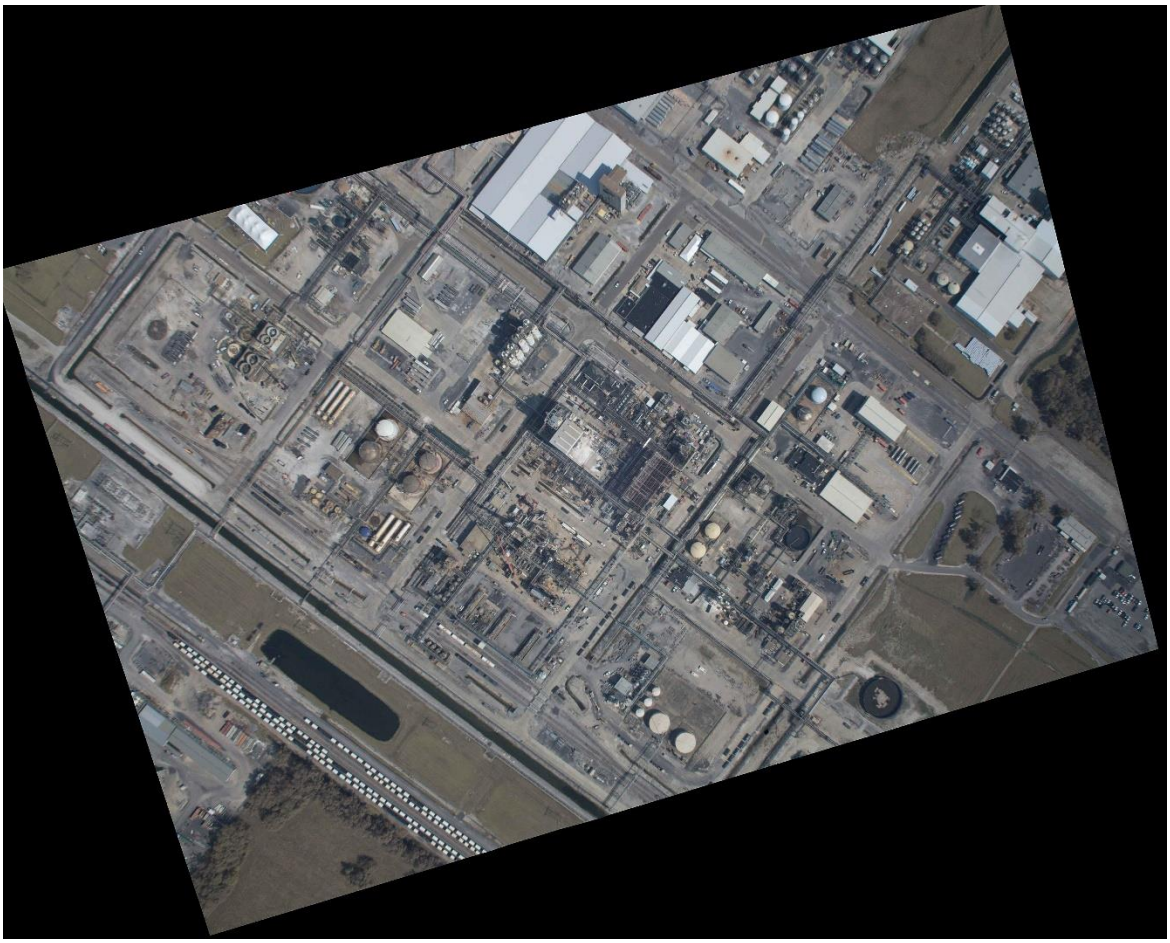

Figure 7. MSIC image of the Syngenta Crop Protection facility, Flight 5, September 4, 2021

Figure 8. Oblique photo taken over the Shintech Facility as part of Flight 5, September 4, 2021

Conclusion

Two data collection flights were conducted on September 4, 2021 focusing on facilities south of Baton Rouge. A total of 29 active data collection passes were made covering 19 facilities. Analysis of IR imagery indicated that some facilities are showing hot process units. Ammonia was detected and confirmed at a maximum concentration of approximately 14 ppm at one site.

Appendix A: File Names of Data Collected During Flight

Baton Rouge Collection Areas, Flight 5, September 4, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	14:13:50	5761	155	20210904141356969.jpg 20210904141403318.jpg 20210904141409674.jpg	20210904_141354_A.igm	2021_09_04_14_13_55_R_01 TA=20.6;TB=41.4;Gain=3	
2	15:01:22	2861	105	20210904150128661.jpg 20210904150135011.jpg 20210904150141375.jpg	20210904_150125_A.igm	2021_09_04_15_01_28_R_02 TA=22.5;TB=42.4;Gain=3	
3	15:12:15	2899	106	20210904151221430.jpg 20210904151227795.jpg 20210904151234138.jpg	20210904_151219_A.igm	2021_09_04_15_12_20_R_03 TA=24.9;TB=44.9;Gain=3	
4	15:24:47	2883	108	20210904152453167.jpg 20210904152459532.jpg 20210904152505881.jpg	20210904_152450_A.igm	2021_09_04_15_24_52_R_04 TA=25.0;TB=44.9;Gain=3	
5	15:32:46	2885	107	20210904153252537.jpg 20210904153258886.jpg 20210904153305250.jpg 20210904153312514.jpg	20210904_153249_A.igm	2021_09_04_15_32_52_R_05 TA=24.7;TB=44.9;Gain=3	
6	15:42:23	2904	105	20210904154229045.jpg 20210904154235410.jpg 20210904154241760.jpg 20210904154248110.jpg 20210904154254474.jpg 20210904154301728.jpg	20210904_154226_A.igm	2021_09_04_15_42_28_R_06 TA=26.1;TB=45.2;Gain=3	
7	15:51:20	2901	105	20210904155126521.jpg 20210904155132871.jpg 20210904155139231.jpg 20210904155145580.jpg 20210904155151945.jpg 20210904155158294.jpg	20210904_155123_A.igm	2021_09_04_15_51_25_R_07 TA=24.6;TB=44.7;Gain=3	
8	16:02:17	2891	110	20210904160222922.jpg 20210904160229287.jpg 20210904160235646.jpg 20210904160241995.jpg 20210904160249259.jpg	20210904_160220_A.igm	2021_09_04_16_02_22_R_08 TA=25.5;TB=45.4;Gain=3	
9	16:09:39	2926	105	20210904160945066.jpg 20210904160951431.jpg 20210904160958685.jpg 20210904161005049.jpg 20210904161011398.jpg 20210904161014122.jpg	20210904_160942_A.igm	2021_09_04_16_09_45_R_09 TA=26.2;TB=46.4;Gain=3	
10	16:18:48	2917	108	20210904161854355.jpg 20210904161900704.jpg 20210904161907054.jpg 20210904161913419.jpg 20210904161920673.jpg 20210904161927037.jpg	20210904_161851_A.igm	2021_09_04_16_18_54_R_10 TA=26.4;TB=46.4;Gain=3	
11	16:27:35	2931	107	20210904162741837.jpg 20210904162748186.jpg 20210904162754551.jpg 20210904162800900.jpg 20210904162807249.jpg 20210904162813614.jpg	20210904_162738_A.igm 20210904_162817_A.igm	2021_09_04_16_27_41_R_11 TA=26.3;TB=46.6;Gain=3	

				20210904162819963.jpg 20210904162826328.jpg			
12	16:35:25	2916	108	20210904163531214.jpg 20210904163537563.jpg 20210904163543928.jpg 20210904163551184.jpg 20210904163557549.jpg 20210904163603898.jpg 20210904163610263.jpg 20210904163616612.jpg	20210904_163528_A.igm 20210904_163608_A.igm	2021_09_04_16_35_31_R_12 TA=26.5;TB=46.6;Gain=3	
13	16:45:24	2914	114	20210904164531333.jpg 20210904164537688.jpg 20210904164544037.jpg	20210904_164527_A.igm	2021_09_04_16_45_30_R_13 TA=26.5;TB=46.6;Gain=3	
14	16:52:56	2877	109	20210904165302552.jpg 20210904165309821.jpg 20210904165316170.jpg 20210904165322535.jpg 20210904165328885.jpg	20210904_165300_A.igm	2021_09_04_16_53_02_R_14 TA=27.1;TB=47.3;Gain=3	
15	17:07:25	2888	107	20210904170731415.jpg 20210904170737764.jpg 20210904170744113.jpg 20210904170751383.jpg 20210904170757737.jpg 20210904170804102.jpg 20210904170810445.jpg 20210904170816810.jpg 20210904170823153.jpg 20210904170829518.jpg 20210904170835867.jpg 20210904170842232.jpg	20210904_170729_A.igm 20210904_170808_A.igm	2021_09_04_17_07_31_R_15 TA=26.7;TB=46.7;Gain=3	
16	17:18:42	2896	103	20210904171848705.jpg 20210904171855055.jpg 20210904171902324.jpg 20210904171908673.jpg 20210904171915023.jpg 20210904171921387.jpg 20210904171927737.jpg 20210904171934101.jpg 20210904171940451.jpg 20210904171946800.jpg 20210904171948625.jpg	20210904_171845_A.igm 20210904_171924_A.igm	2021_09_04_17_18_49_R_16 TA=32.7;TB=52.1;Gain=3	
17	17:28:17	2896	109	20210904172823395.jpg 20210904172829744.jpg 20210904172836109.jpg 20210904172842458.jpg 20210904172848823.jpg 20210904172856077.jpg 20210904172902442.jpg 20210904172908785.jpg	20210904_172820_A.igm 20210904_172859_A.igm	2021_09_04_17_28_23_R_17 TA=28.2;TB=48.3;Gain=3	
18	17:34:43	2872	100	20210904173449245.jpg 20210904173455610.jpg 20210904173501959.jpg 20210904173508324.jpg 20210904173514673.jpg 20210904173521943.jpg 20210904173528292.jpg 20210904173534651.jpg 20210904173541000.jpg	20210904_173446_A.igm 20210904_173525_A.igm	2021_09_04_17_34_49_R_18 TA=29.1;TB=49.0;Gain=3	
19	17:49:52	2912	124	20210904174958958.jpg 20210904175005323.jpg	20210904_174954_A.igm	2021_09_04_17_49_58_R_19 TA=31.1;TB=51.0;Gain=3	

				20210904175011672.jpg 20210904175018021.jpg			
20	17:56:26	2882	102	20210904175632080.jpg 20210904175638430.jpg 20210904175644794.jpg 20210904175651151.jpg 20210904175658405.jpg 20210904175704754.jpg 20210904175711119.jpg 20210904175717468.jpg 20210904175723832.jpg 20210904175730182.jpg	20210904_175629_A.igm 20210904_175709_A.igm	2021_09_04_17_56_32_R_20 TA=29.7;TB=49.6;Gain=3	
21	18:08:41	2901	99	20210904180847467.jpg 20210904180854731.jpg 20210904180901096.jpg 20210904180907445.jpg 20210904180913794.jpg 20210904180920159.jpg	20210904_180844_A.igm	2021_09_04_18_08_48_R_21 TA=28.3;TB=48.5;Gain=3	
22	18:15:49	2905	113	20210904181555083.jpg 20210904181601447.jpg 20210904181607797.jpg 20210904181614161.jpg 20210904181620511.jpg 20210904181627780.jpg	20210904_181551_A.igm	2021_09_04_18_15_55_R_22 TA=33.5;TB=53.6;Gain=3	
23	18:21:56	2896	114	20210904182201886.jpg 20210904182209140.jpg 20210904182215489.jpg 20210904182221854.jpg 20210904182228203.jpg 20210904182234568.jpg	20210904_182158_A.igm	2021_09_04_18_22_02_R_23 TA=33.4;TB=53.6;Gain=3	

Baton Rouge Collection Areas, Flight 6, 4 September 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	22:50:57	2910	109	20210904225102949.jpg 20210904225109314.jpg 20210904225115663.jpg	20210904_225100_A.igm	2021_09_04_22_51_01_R_01 TA=29.8;TB=50.5;Gain=3	
2	22:54:08	2934	102	20210904225413613.jpg 20210904225419962.jpg 20210904225426327.jpg	20210904_225411_A.igm	2021_09_04_22_54_12_R_02 TA=23.1;TB=43.9;Gain=3	
3	23:05:33	2920	101	20210904230539979.jpg 20210904230546344.jpg 20210904230552693.jpg 20210904230559042.jpg 20210904230605407.jpg 20210904230611757.jpg 20210904230618106.jpg 20210904230625375.jpg 20210904230631725.jpg 20210904230638089.jpg	20210904_230537_A.igm 20210904_230617_A.igm	2021_09_04_23_05_38_R_03 TA=23.0;TB=43.2;Gain=3	
4	23:22:35	2870	107	20210904232240461.jpg 20210904232247728.jpg 20210904232254077.jpg 20210904232300442.jpg 20210904232306791.jpg	20210904_232239_A.igm	2021_09_04_23_22_39_R_04 TA=24.3;TB=44.4;Gain=3	
5	23:25:21	2928	103	20210904232528425.jpg 20210904232534774.jpg 20210904232541139.jpg	20210904_232525_A.igm	2021_09_04_23_25_26_R_05 TA=24.3;TB=44.3;Gain=3	

6	23:34:31	3002	111	20210904233437701.jpg 20210904233444050.jpg 20210904233450402.jpg 20210904233456767.jpg	20210904_233434_A.igm	2021_09_04_23_34_35_R_06 TA=21.9;TB=41.8;Gain=3	
7	23:36:23	2878	109	20210904233628468.jpg 20210904233635722.jpg 20210904233642081.jpg 20210904233648430.jpg	20210904_233627_A.igm	2021_09_04_23_36_27_R_07 TA=21.9;TB=41.8;Gain=3	

Appendix B: Priority Sites Provided by EPA Region 6 & Louisiana Department of Environmental Quality

Facility_Name	Latitude	Longitude	Parish
Deltech LLC - Baton Rouge Facility	30.552892	-91.200536	East Baton Rouge
ExxonMobil Chemical Co - Baton Rouge Plastics Plant	30.551419	-91.175611	East Baton Rouge
ExxonMobil Baton Rouge Chemical Plant	30.484336	-91.169644	East Baton Rouge
Marathon Petroleum Co LP	30.068394	-90.596364	St. John the Baptist
Westlake Vinyls Co LP	30.209167	-91.017222	Ascension
Valero Refining - Meraux LLC - Meraux Refinery	29.930222	-89.944917	St. Bernard
Cornerstone Chemical Company	29.964722	-90.264722	Jefferson
Chalmette Refining LLC	29.937903	-89.969903	St. Bernard
ExxonMobil Chemical Company - Baton Rouge Chemicals North Plant	30.50465	-91.173219	East Baton Rouge
Equilon Enterprises LLC - Norco Refinery	29.995372	-90.410167	St. Charles
The Dow Chemical Company - Louisiana Operations	30.313927	-91.240586	Iberville
Rubicon LLC - Geismar Facility	30.20139	-91.01222	Ascension
BASF Corp - Geismar Site	30.18425	-91.002778	Ascension
Union Carbide Corp - St. Charles Plant	29.982289	-90.455622	St. Charles
Phillips 66 Co - Alliance Refinery	29.68406	-89.98145	Plaquemines
Axiall LLC - Plaquemine Facility	30.267167	-91.184258	Iberville
ExxonMobil Fuels & Lubricants Co - Baton Rouge Refinery	30.484392	-91.169444	East Baton Rouge
Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery	30.107684	-90.890796	St. James
Marathon Petroleum Company LP - Louisiana Refining Division - Garyville Refinery	30.061322	-90.593528	St. John the Baptist
BASF Corp - Zachary Site	29.547603	-90.523231	East Baton Rouge
Occidental Chemical Corporation - Geismar Facility	30.18819	-90.98188	Ascension
St Rose Refinery LLC - St Rose Refinery	29.950875	-90.328497	St. Charles
ExxonMobil Chemical Co - Baton Rouge Polyolefins Plant	30.56215	-91.20387	East Baton Rouge
Shell Chemical LP - Norco Chemical Plant West Site	30.004925	-90.422381	St. Charles
NOVA Chemicals Olefins LLC - Geismar Ethylene Plant	30.230619	-91.052884	Ascension
Roehm America LLC - MMA Plant	29.9575	-90.265833	Jefferson
Valero Refining - New Orleans LLC - St Charles Refinery	29.985781	-90.3955	St. Charles
Shell Chemical LP - Norco Chemical Plant - East Site	29.995556	-90.409722	St. Charles
BASF Corp - North Geismar Site	30.20594	-90.99195	Ascension
Stolthaven New Orleans, LLC - Braithwaite Facility	29.870919	-89.949339	Plaquemines
Shintech Louisiana LLC - Shintech Plaquemine Plant	30.273611	-91.173333	Iberville
Denka Performance Elastomer LLC	30.053928	-90.524792	St. John the Baptist

Formosa Plastics Corp Louisiana	30.501722	-91.185944	East Baton Rouge
DuPont Specialty Products USA LLC - Pontchartrain Site	30.05388	-90.52472	St. John the Baptist
Occidental Chemical Corp - Taft Plant	29.987222	-90.454722	St. Charles
Syngenta Crop Protection LLC - St Gabriel Plant	30.246728	-91.103508	Iberville
Mosaic Fertilizer LLC - Faustina Plant	30.083914	-90.91345	St. James
Mosaic Fertilizer LLC - Uncle Sam Plant	30.037222	-90.8275	St. James
LBC Baton Rouge LLC - Sunshine Terminal	30.294444	-91.148333	Iberville
Occidental Chemical Corporation - Convent Facility	30.055885	-90.830594	St. James
TOTAL Petrochemicals & Refining USA Inc - Carville Polystyrene Plant	30.229786	-91.073631	Iberville
Targa Midstream Services LLC	29.237034	-89.384977	Plaquemines
EnLink LIG Liquids LLC - Plaquemine Gas Processing Plant	30.236389	-91.241389	Iberville
EnLink LIG Liquids LLC - Gibson Gas Processing Plant	29.643056	-90.961944	Terrebonne
NuStar Logistics LP - St James Terminal	30.030065	-90.843463	St. James
Enterprise Gas Processing LLC - Norco Fractionation Plant	30.015411	-90.402958	St. Charles
Lone Star NGL Refinery Services LLC - Geismar Fractionation Plant	30.218889	-91.035833	Ascension
INEOS Oxide - A Division of INEOS Americas LLC	30.313889	-91.240278	Iberville
Discovery Producer Services LLC - Discovery Paradis Fractionation Plant	29.858889	-90.453333	St. Charles
Plains Marketing LP - St James Terminal	30.004341	-90.848449	St. James
Methanex USA Services LLC - Geismar Methanol Plant	30.206667	-91.020833	Ascension
Dyno Nobel LA Ammonia LLC - Ammonia Production Facility	29.964789	-90.264625	Jefferson
Kinder Morgan Liquids Terminals LLC - Geismar Methanol Terminal	30.205389	-91.023792	Ascension
South LA Methanol LP - St James Methanol Plant	30.039917	-90.863819	St. James
YCI Methanol Plant	29.97481	-90.86775	St. James
IGP Methanol LLC - Gulf Coast Methanol Complex	29.625453	-89.926611	Plaquemines
KMe St James Holdings LLC - Methanol Terminal	29.990919	-90.841239	St. James
Kemira Chemicals Inc	29.964722	-90.264722	Jefferson
PHILLIPS 66 PIPELINE LLC	29.923889	-90.482498	St. Charles
CF INDUSTRIES	30.08328	-90.957665	Ascension

Appendix C: ASPECT Systems

The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 3,000 ft AGL). The system consists of an airborne high-speed Fourier Transform Infra-Red (FTIR) spectrometer coupled with a wide-area IR Line Scanner (IRLS). The ASPECT IR systems can detect chemical compounds in both the 8-to-12-micron (800 to 1200 cm-1) and 3 to 5 micron (2000 to 3200 cm-1) regions. List of chemicals and detection limits are listed in Table 1. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon - non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The carbon - hydrogen stretch is very common in this region.

An Imperx mapping camera (29 mega pixels; mapping focal plane array) is concurrently operated as part of all chemical collections. These images are often digitally processed in lower resolution, so they can be transmitted via satellite communication. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while in flight or approximately 600 frames per hour can be processed once the data are downloaded from the aircraft. The high-resolution images (>20 MB each) are pulled from the ASPECT after the sortie and are available later.

All aerial photographic images collected by the ASPECT system are ortho-rectified and geospatially validated by the scientific reach back team. In general, this consists of conducting geo-registration using a USGS Digital Elevation Model (DEM) which promotes superior pixel computation and lessens topographic distortion. The image is check by the team (using a Google Earth base map) for proper location and rotation.

Airborne radiological measurements are conducted using three fully integrated multi-crystal sodium iodide (NaI) RSX4 gamma ray spectrometers. Each RSX4 spectrometer contains four 4”x2”x16” doped NaI crystals each having an independent photomultiplier/ spectrometer assembly. One RSX unit is configured with an additional upward NaI crystal utilized to provide real-time cosmic ray correction. Count and energy data from each crystal and pack is combined using a self-calibrating signal processor to generate a virtual detector output. All radiological spectrometer “packs” are further combined using a signal console controlled by the on-board central computer in the aircraft. Altitude correction data is provided by a radar altimeter with internal GPS systems within the packs serving as a backup. It should be noted that no radiological measurements were conducted on this mission.

Data is processed using automated algorithms onboard the aircraft with preliminary results being sent using a satellite system to the ASPECT scientific reach back team for QA/QC analysis. Upon landing, preliminary data results are examined and validated by the

scientific reach back team.

Table 1. ASPECT Automated Compounds

This table contains ASPECT's library of automated compounds.
Detection limits are for each chemical is found in parenthesis in units of parts per million (ppm)

Acetic Acid (2.0)	**Cumene (23.1)**	**Isoprene (6.5)**	**Phosphine (8.3)**
Acetone (5.6)	**Diborane (5.0)**	**Isopropanol (8.5)**	**Phosphorus Oxychloride (2.0)**
Acrolein (8.8)	**1,1-Dichloroethene (3.7)**	**Isopropyl Acetate (0.7)**	**Propyl Acetate (0.7)**
Acrylonitrile (12.5)	**Dichloromethane (6.0)**	**MAPP (3.7)**	**Propylene (3.7)**
Acrylic Acid (3.3)	**Dichlorodifluoromethane (0.7)**	**Methyl Acetate (1.0)**	**Propylene Oxide (6.8)**
Allyl Alcohol (5.3)	**1,1-Difluoroethane (0.8)**	**Methyl Acrylate (1.0)**	**Silicon Tetrafluoride (0.2)**
Ammonia (2.0)	**Difluoromethane (0.8)**	**Methyl Ethyl Ketone (7.5)**	**Sulfur Dioxide (15)**
Arsine (18.7)	**Ethanol (6.3)**	**Methanol (5.4)**	**Sulfur Hexafluoride (0.07)**
Bis-Chloroethyl Ether (1.7)	**Ethyl Acetate (0.8)**	**Methylbromide (60)**	**Sulfur Mustard (6.0)**
Boron Tribromide (0.2)	**Ethyl Acrylate (0.8)**	**Methylene Chloride (1.1)**	**Sulfuryl Fluoride (1.5)**
Boron Triflouride (5.6)	**Ethyl Formate (1.0)**	**Methyl Methacrylate (3.0)**	**Tetrachloroethylene (10)**
1,3-Butadiene (5.0)	**Ethylene (5.0)**	**MTEB (3.8)**	**1,1,1-Trichloroethane (1.9)**
1-Butene (12.0)	**Formic Acid (5.0)**	**Naphthalene (3.8)**	**Trichloroethylene (2.7)**
2-Butene (18.8)	**Freon 134a (0.8)**	**n-Butyl Acetate (3.8)**	**Trichloromethane (0.7)**
Carbon Tetrachloride (0.2)	**GA (Tabun) (0.7)**	**n-Butyl Alcohol (7.9)**	**Triethylamine (6.2)**
Carbonyl Fluoride (0.8)	**GB (Sarin) (0.5)**	**Nitric Acid (5.0)**	**Triethylphosphate (0.3)**
Carbon Tetraflouride (0.1)	**Germane (1.5)**	**Nitrogen Mustard (2.5)**	**Trimethylamine (9.3)**
Chlorodifluoromethane (0.6)	**Hexafluoroacetone (0.4)**	**Nitrogen Trifluoride (0.7)**	**Trimethyl Phosphite (0.4)**
Chloromethane (12)	**Isobutylene (15)**	**Phosgene (0.5)**	**Vinyl Acetate (0.6)**