

Airborne Spectral Photometric Environmental Collection Technology

ASPECT Air Quality Survey for Hurricane Ida Baton Rouge, LA September 8, 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 17 facilities were surveyed. Ammonia was detected and confirmed at a maximum concentration of approximately 14 ppm in addition to ozone and peroxyacetyl nitrate. Analysis of IR imagery indicated that some facilities are showing hot process units.

ASPECT conducted two data collection missions on September 5 with the focus being facilities in St. Bernard, Terrebonne, St. Charles, and St. James areas. A total of 32 active data collection passes were made covering 21 facilities. Imagery collected within impact areas of the storm showed some oil sheen and releases to secondary containment. No compounds were detected on either mission.

Two data collection missions were conducted by ASPECT on September 7 with the primary focus to collect additional data over targets surveyed on September 5 (St. Bernard, Terrebonne, St. Charles, and St. James areas). A total of 16 data collection

passes (2 test and 14 active) were made over about half of the target list. Weather conditions complicated the mission with numerous convective cells and low clouds in the area. No compounds were detected on either flight.

ASPECT conducted two missions on September 8 with the primary objective to complete the mission of collecting additional data at facilities assigned on September 7. Weather conditions over the target areas within St. Bernard, Terrebonne, St. Charles, and St. James parishes was marginal due to clouds and convective activity. A total of 21 data collection passes (2 test and 19 active) were required to complete the mission with no detections observed.

ASPECT Air Quality Survey

Hurricane IDA

Baton Rouge, LA

September 8, 2021

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, 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.

Two data collection flights were conducted on September 4 focusing on facilities south of Baton Rouge. A total of 29 active data collection passes were made covering 17 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.

ASPECT conducted two data collection missions on September 5 with the focus being facilities in St. Bernard, Terrebonne, St. Charles, and St. James areas. A total of 32 active data collection passes were made covering 21 facilities. Imagery collected within impact

areas of the storm showed some oil sheen and releases to secondary containment. No compounds were detected on either mission.

Due to poor weather, ASPECT did not conduct any flight activities on September 6. ASPECT was tasked with two missions on 7 September consisting largely of revisiting facilities surveyed on September 5 for the purpose of collecting additional data.

ASPECT was tasked with two missions on September 8 for the purpose of collecting additional data for those facilities and sites surveyed on September 5. This report details the significant findings of these two survey missions.

Table 1. Sites Covered on September 8, 2021

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
BASF Corp - Geismar Site	30.18425	-91.002778	Ascension
Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery	30.107684	-90.890796	St. James
Occidental Chemical Corporation - Geismar Facility	30.18819	-90.98188	Ascension
St Rose Refinery LLC - St Rose Refinery	29.950875	-90.328497	St. Charles
Shell Chemical LP - Norco Chemical Plant West Site	30.004925	-90.422381	St. Charles
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
Stolthaven New Orleans, LLC - Braithwaite Facility	29.870919	-89.949339	Plaquemines
Formosa Plastics Corp Louisiana	30.501722	-91.185944	East Baton Rouge
Occidental Chemical Corp - Taft Plant	29.987222	-90.454722	St. Charles
Mosaic Fertilizer LLC - Faustina Plant	30.083914	-90.91345	St. James
NuStar Logistics LP - St James Terminal	30.030065	-90.843463	St. James
Dyno Nobel LA Ammonia LLC - Ammonia Production Facility	29.964789	-90.264625	Jefferson
Kemira Chemicals Inc	29.964722	-90.264722	Jefferson
PHILLIPS 66 PIPELINE LLC	29.923889	-90.482498	St. Charles

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 Tables 2 and 3.

**Table 2. Ground Weather for Baton Rouge, LA, Flight 11
September 8, 2021**

Time	753	853	953	1053
Wind direction	0 degrees N	0 degrees N	22.5 degrees NNE	0 degrees N
Wind speed	0.4 m/s (1.0 mph)	0.4 m/s (1.0 mph)	2.2 m/s (5.0 mph)	0.4 m/s (1.0 mph)
Temperature	22.8 C	23.9 C	26.1 C	27.8 C
Relative humidity	100	96	88	77
Dew point	22.8 C	23.3 C	23.9 C	23.3 C
Pressure	1011.2 mb	1011.6 mb	1012.6 mb	1012.3 mb
Ceiling	Clear	Clear	Clear	Few 1700 Ft

**Table 3. Ground Weather for Baton Rouge, LA, Flight 12
September 8, 2021**

Time	1253	1353	1453	1553	1653
Wind direction	0 degrees	0 degrees	292.5 degrees WNW	0 degrees	0 degrees N
Wind speed	1.3 m/s (3.0 mph)	1.3 m/s (3.0 mph)	2.7 m/s (6.0 mph)	2.7 m/s (6.0 mph)	3.1 m/s (7.0 mph)
Temperature	30.6 C	31.1 C	30.6 C	30.6 C	30.0 C
Relative humidity	63	66	65	65	67
Dew point	22.8 C	23.9 C	23.3 C	23.3 C	23.3 C
Pressure	1011.2 mb	1010.9 mb	1009.9 mb	1009.5 mb	1009.5 mb
Ceiling	Few 2800 Ft	Scattered 4100 Ft	Broken 3500 Ft	Scattered 3600 Ft	Scattered 3100 Ft

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 Flight 11 and 12, the St. Bernard, Terrebonne, St. Charles, and St. James areas were surveyed, and the flight paths are shown in Figures 1 and 2.

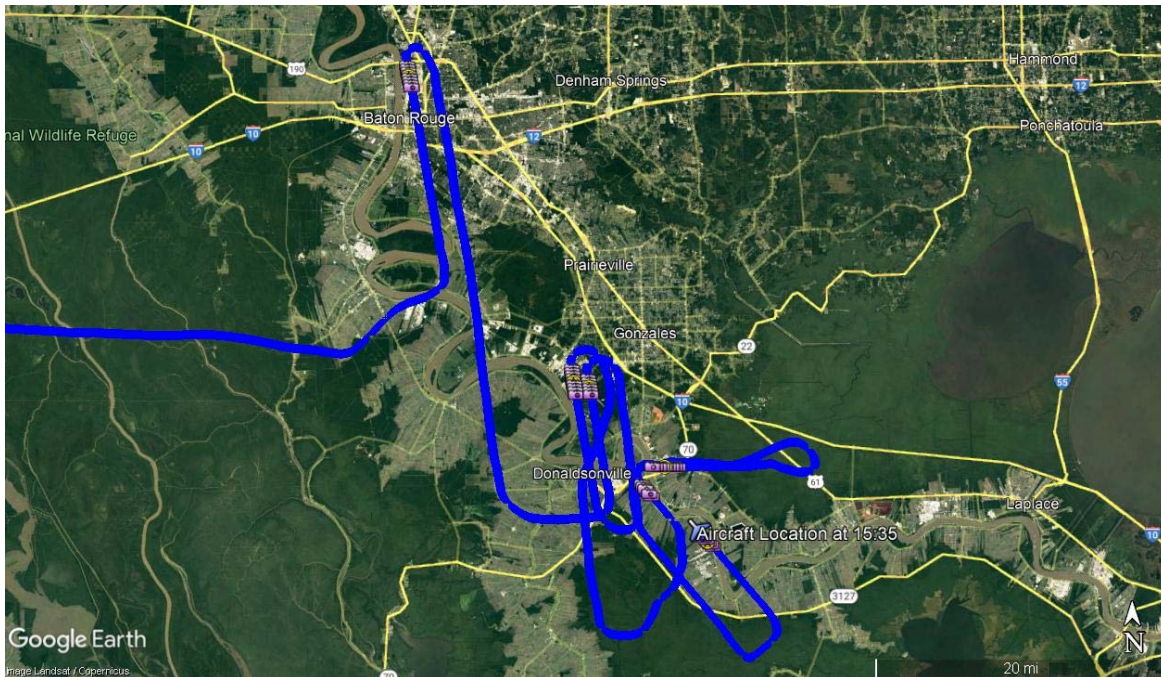


Figure 1. Data Collection Flight Path,
St. Bernard, Terrebonne, St. Charles, and St. James, Flight 11,
September 8, 2021



Figure 2. Data Collection Flight Path, St. Bernard, Terrebonne, St. Charles, and St. James, Flight 12, September 8, 2021

Line Scanner Data Results

A total of 21 data collection runs (2 tests and 19 active) 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 Shell Convent refinery. Analysis of the image shows elevated piping and hot units in the main process section of the facility. No discharges can be seen leaving the facility. Figure 4 shows a similar image collected over the Valero Refining Meraux Refinery. Hot flares in the lower portion of the image in addition to some hot process piping is evident.



Figure 3. Three band IR image, Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery, Flight 11, September 8, 2021

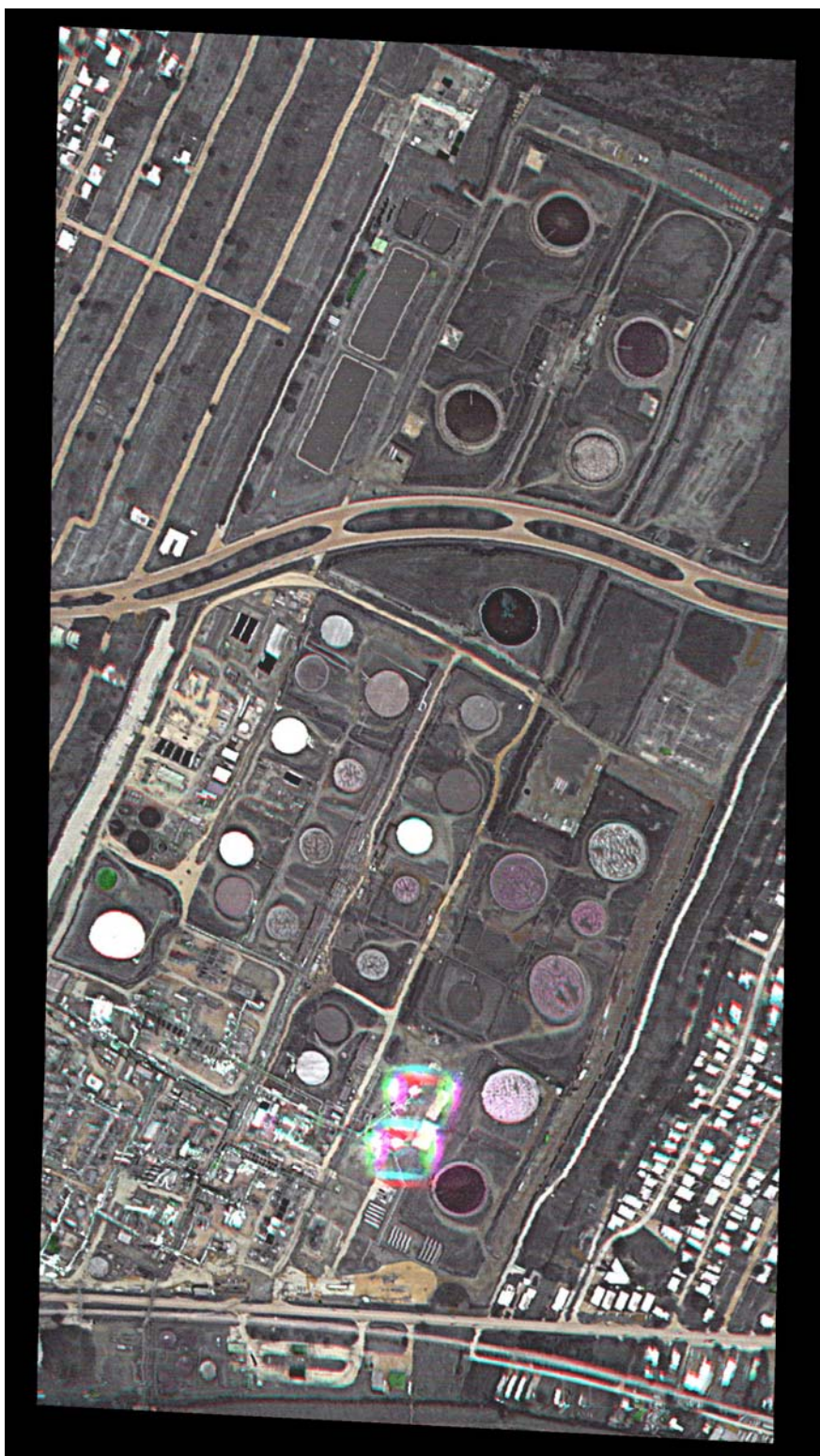


Figure 4. Three band IR image, Valero Refining - Meraux LLC - Meraux Refinery, Flight 12, September 8, 2021

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.

ASPECT did not detect any programmed compounds (those found in Appendix B, Table 1) as part of the mission over the target areas on the two flights conducted on September 8. Details of the monitoring results can be found in Tables 4 and 5.

**Table 4. Chemical Results Summary
St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 11**

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-08	13:33:30	Test	Test
2		14:17:52	ND	ND
3		14:40:19	ND	ND
4		14:52:31	ND	ND
5		15:09:37	ND	ND
6		15:21:28	ND	ND
7		15:34:50	ND	ND

**Table 5. Chemical Results Summary
St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 12**

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-08	18:34:18	Test	Test
2		19:01:56	ND	ND
3		19:15:34	ND	ND
4		19:44:16	ND	ND
5		19:55:29	ND	ND
6		20:07:03	ND	ND
7		20:19:49	ND	ND
8		20:32:08	ND	ND
9		20:42:11	ND	ND
10		20:54:08	ND	ND
11		21:13:18	ND	ND
12		21:24:24	ND	ND
13		21:35:33	ND	ND
14		21:56:30	ND	ND

Aerial Photography Results

A full set of high-resolution aerial digital photography were collected as part of each data collection pass. As with the missions on September 7, flight conditions were complicated by low ceiling and convective activity. An aerial image of the St. Rose refinery is given in Figure 5. No significant damage or activity is evident in the image. An oblique image of the Valero Meraux Refinery is shown in Figure 6. As indicated in IR images of the same facility, two flares can be observed indicating some activity within the facility.



Figure 5. MSIC image of the St Rose Refinery LLC - St Rose, Flight 12, September 8, 2021



Figure 6. Oblique photo of the Valero Meraux Refinery, Flight 12, September 8, 2021

Conclusion

ASPECT conducted two missions on September 8, 2021 with the primary objective to complete the mission of collecting additional data at facilities assigned on 7 September. Weather conditions over the target areas within St. Bernard, Terrebonne, St. Charles, and St. James parishes was marginal due to clouds and convective activity. A total of 21 data collection passes (2 test and 19 active) were required to complete the mission with no detections observed.

Appendix A: File Names of Data Collected During Flight

St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 11, September 8, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	13:33:30	3592	152	20210908133336255.jpg 20210908133342604.jpg 20210908133348968.jpg 20210908133350778.jpg	20210908_133333_A.igm	2021_09_08_13_33_34_R_01 TA=22.8;TB=43.6;Gain=3	
2	14:17:52	2868	106	20210908141759050.jpg 20210908141805409.jpg 20210908141811758.jpg 20210908141818122.jpg 20210908141824471.jpg 20210908141830826.jpg 20210908141837175.jpg 20210908141843533.jpg	20210908_141755_A.igm 20210908_141835_A.igm	2021_09_08_14_17_57_R_02 TA=18.0;TB=38.0;Gain=3	
3	14:40:19	2885	107	20210908144025438.jpg 20210908144031788.jpg 20210908144038152.jpg 20210908144044501.jpg 20210908144050860.jpg 20210908144057209.jpg	20210908_144022_A.igm	2021_09_08_14_40_24_R_03 TA=20.9;TB=41.0;Gain=3	
4	14:52:31	2887	107	20210908145237194.jpg 20210908145244464.jpg 20210908145250811.jpg 20210908145257176.jpg 20210908145303525.jpg 20210908145309874.jpg 20210908145316233.jpg 20210908145322582.jpg 20210908145328947.jpg	20210908_145235_A.igm 20210908_145314_A.igm	2021_09_08_14_52_36_R_04 TA=22.7;TB=42.6;Gain=3	
5	15:09:37	2946	103	20210908150943111.jpg 20210908150949454.jpg 20210908150955818.jpg 20210908151002170.jpg 20210908151008519.jpg 20210908151014883.jpg	20210908_150939_A.igm	2021_09_08_15_09_41_R_05 TA=23.9;TB=43.9;Gain=3	
6	15:21:28	2875	106	20210908152133983.jpg 20210908152140335.jpg 20210908152146684.jpg 20210908152153041.jpg 20210908152159406.jpg 20210908152205749.jpg 20210908152212114.jpg 20210908152219367.jpg 20210908152225732.jpg	20210908_152130_A.igm 20210908_152210_A.igm	2021_09_08_15_21_32_R_06 TA=23.2;TB=43.3;Gain=3	
7	15:34:50	2914	106	20210908153456558.jpg 20210908153502907.jpg 20210908153509271.jpg 20210908153515620.jpg 20210908153521979.jpg	20210908_153453_A.igm	2021_09_08_15_34_55_R_07 TA=22.4;TB=42.5;Gain=3	

St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 12, September 8, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	18:34:18	2559	130	20210908183424447.jpg 20210908183429907.jpg 20210908183435351.jpg	20210908_183421_A.igm	2021_09_08_18_34_22_R_01 TA=26.6;TB=46.8;Gain=3	
2	19:01:56	2560	107	20210908190202275.jpg 20210908190208624.jpg 20210908190214974.jpg 20210908190221338.jpg 20210908190227688.jpg	20210908_190200_A.igm	2021_09_08_19_02_00_R_02 TA=22.9;TB=43.0;Gain=3	
3	19:15:34	2545	100	20210908191540278.jpg 20210908191546643.jpg 20210908191552992.jpg	20210908_191537_A.igm	2021_09_08_19_15_38_R_03 TA=24.6;TB=44.5;Gain=3	
4	19:44:16	2545	106	20210908194422556.jpg 20210908194428908.jpg 20210908194436178.jpg 20210908194442527.jpg 20210908194448892.jpg	20210908_194420_A.igm	2021_09_08_19_44_21_R_04 TA=22.9;TB=42.8;Gain=3	
5	19:55:29	2538	105	20210908195535298.jpg 20210908195541663.jpg 20210908195548012.jpg 20210908195554377.jpg 20210908195600726.jpg 20210908195607080.jpg 20210908195613430.jpg 20210908195619799.jpg	20210908_195532_A.igm 20210908_195611_A.igm	2021_09_08_19_55_33_R_05 TA=26.8;TB=46.6;Gain=3	
6	20:07:03	2531	107	20210908200708943.jpg 20210908200715292.jpg 20210908200721641.jpg 20210908200728911.jpg 20210908200735260.jpg 20210908200741625.jpg 20210908200747974.jpg 20210908200754339.jpg 20210908200800688.jpg 20210908200807942.jpg 20210908200814307.jpg 20210908200820656.jpg	20210908_200707_A.igm 20210908_200745_A.igm 20210908_200759_A.igm	2021_09_08_20_07_07_R_06 TA=24.4;TB=44.1;Gain=3 2021_09_08_20_08_00_R_07 TA=24.3;TB=44.3;Gain=3	
7	20:19:49	2523	104	20210908201956101.jpg 20210908202002466.jpg 20210908202008815.jpg 20210908202015180.jpg 20210908202021529.jpg 20210908202027878.jpg	20210908_201953_A.igm	2021_09_08_20_19_54_R_08 TA=27.6;TB=47.6;Gain=3	
8	20:32:08	2533	108	20210908203214224.jpg 20210908203220573.jpg 20210908203226938.jpg 20210908203233287.jpg	20210908_203211_A.igm	2021_09_08_20_32_13_R_09 TA=26.9;TB=46.9;Gain=3	
9	20:42:11	2545	104	20210908204217063.jpg 20210908204223428.jpg 20210908204229782.jpg 20210908204237036.jpg 20210908204243396.jpg 20210908204244301.jpg	20210908_204215_A.igm	2021_09_08_20_42_16_R_10 TA=27.2;TB=47.3;Gain=3	

10	20:54:08	2547	106	20210908205414302.jpg 20210908205421558.jpg 20210908205427923.jpg 20210908205434282.jpg 20210908205440631.jpg 20210908205446980.jpg 20210908205453345.jpg 20210908205459694.jpg	20210908_205412_A.igm 20210908_205452_A.igm	2021_09_08_20_54_13_R_11 TA=27.8;TB=47.8;Gain=3	
11	21:13:18	2550	104	20210908211324610.jpg 20210908211330959.jpg 20210908211337309.jpg 20210908211343673.jpg 20210908211350023.jpg	20210908_211322_A.igm	2021_09_08_21_13_23_R_12 TA=24.1;TB=44.2;Gain=3	
12	21:24:24	2539	103	20210908212430088.jpg 20210908212436447.jpg 20210908212442796.jpg 20210908212449155.jpg	20210908_212427_A.igm	2021_09_08_21_24_29_R_13 TA=23.8;TB=43.9;Gain=3	
13	21:35:33	2566	104	20210908213540115.jpg 20210908213546464.jpg 20210908213552826.jpg 20210908213559175.jpg 20210908213605534.jpg 20210908213611899.jpg	20210908_213536_A.igm	2021_09_08_21_35_38_R_14 TA=23.0;TB=42.8;Gain=3	
14	21:56:30	2558	105	20210908215635735.jpg 20210908215642084.jpg 20210908215649354.jpg 20210908215655701.jpg 20210908215702065.jpg 20210908215708415.jpg 20210908215714779.jpg 20210908215721129.jpg 20210908215727478.jpg	20210908_215633_A.igm 20210908_215712_A.igm	2021_09_08_21_56_35_R_15 TA=24.2;TB=44.1;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 checked 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 Trifluoride (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 Tetrafluoride (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)