

Airborne Spectral Photometric Environmental Collection Technology

ASPECT Air Quality Survey after Hurricane Ida Baton Rouge, LA September 7, 2021



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Table of Contents

Acronyms and Abbreviations.....	3
General Mission Objectives	8
Flight Conditions and Status	9
Weather and Site Conditions	9
Data Results	9
Flight Paths	10
Line Scanner Data Results	11
FTIR Data Results	12
Conclusion	15
Appendix A: File Names of Data Collected During Flight	16
Appendix B: Priority Sites Provided by EPA Region 6 & Louisiana Department of Environmental Quality	18
Appendix C: ASPECT Systems.....	20

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 September 2 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 3 September 2021. 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 4 September 2021. 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 with single passes 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 13 facilities. 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 data collection missions on September 7 with the focus being facilities in St. Bernard, Terrebonne, St. Charles, and St. James areas.

ASPECT Air Quality Survey

Hurricane IDA

Baton Rouge, LA

September 7, 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, 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.

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 September 7 consisting largely of revisiting facilities surveyed on September 5 for the purpose of collecting additional data.

Table 1. Sites Covered on September 7, 2021 Flights 9 and 10

Facility Name	Latitude	Longitude	Parish
Marathon Petroleum Co LP	30.068394	-90.596364	St. John the Baptist
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
Denka Performance Elastomer LLC	30.053928	-90.524792	St. John the Baptist
Mosaic Fertilizer LLC - Uncle Sam Plant	30.037222	-90.8275	St. James
Occidental Chemical Corporation - Convent Facility	30.055885	-90.830594	St. James
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
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
Port Fourchon Oil	29.133491	-90.201808	Lafourche

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 9
September 7, 2021**

Time	853	953	1053	1153	1253
Wind direction	202.5 degrees SSW	202.5 degrees SSW	202.5 degrees SSW	202.5 degrees SSW	270 degrees W
Wind speed	3.1 m/s (7.0 mph)	3.6 m/s (8.0 mph)	4.0 m/s (9.0 mph)	4.0 m/s (9.0 mph)	2.7 m/s (6.0 mph)
Temperature	23.9 C	25.6 C	28.3 C	30.0 C	31.7 C
Relative humidity	66	60	55	53	50
Dew point	17.2 C	17.8 C	18.3 C	19.4 C	20.0 C
Pressure	980.7 mb	980.4 mb	980.4 mb	980.0 mb	980.0 mb
Ceiling	Clear	Clear	Clear	Clear	Clear

**Table 3. Ground Weather for Baton Rouge, LA, Flight 10
September 7, 2021**

Time	1353	1453	1553	1653	1753
Wind direction	270 degrees W	315 degrees NW	337.5 degrees NNW	0 degrees N	337.5 degrees NNW
Wind speed	4.5 m/s (10.0 mph)	4.0 m/s (9.0 mph)	4.0 m/s (9.0 mph)	6.3 m/s (14.0 mph)	4.0 m/s (9.0 mph)
Temperature	32.2 C	33.3 C	32.8 C	32.2 C	30.6 C
Relative humidity	52	51	49	40	45
Dew point	21.1 C	21.7 C	20.6 C	16.7 C	17.2 C
Pressure	980.0 mb	980.0 mb	980.0 mb	980.4 mb	980.7 mb
Ceiling	Clear	Clear	Few 4800 Ft	Clear	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 9 and 10, the St. Bernard, Terrebonne, St. Charles, and St. James areas were surveyed, and the flight paths are shown in Figures 1 and 2.

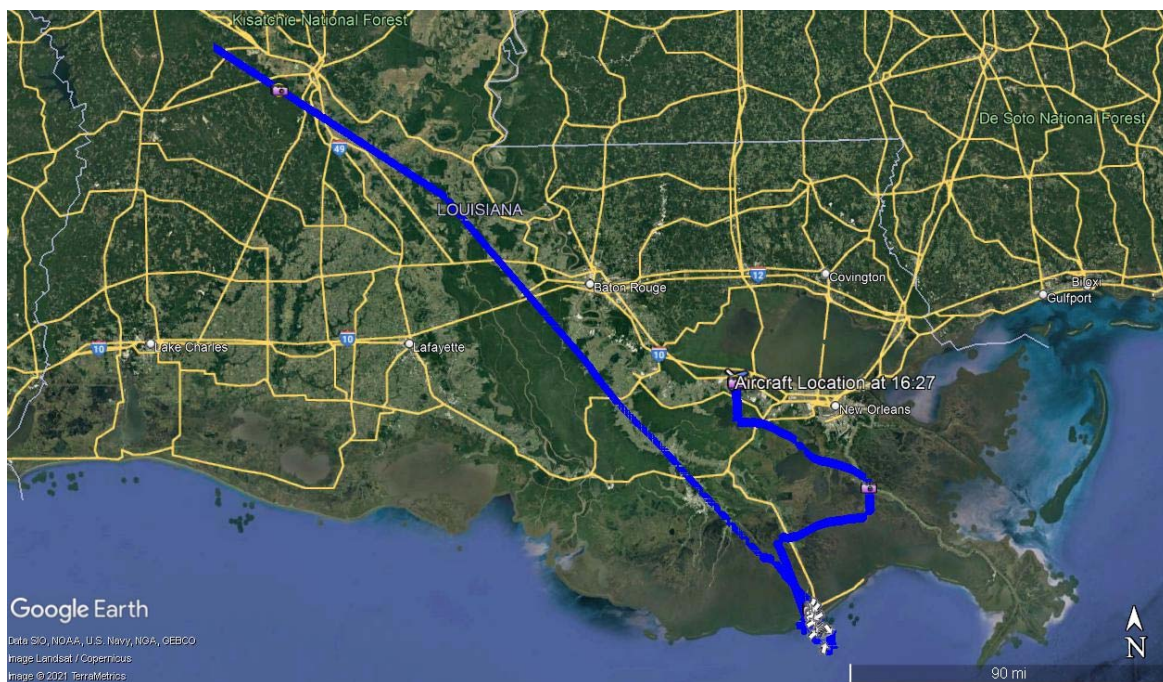


Figure 1. Data Collection Flight Path,
St. Bernard, Terrebonne, St. Charles, and St. James, Flight 9,
September 7, 2021

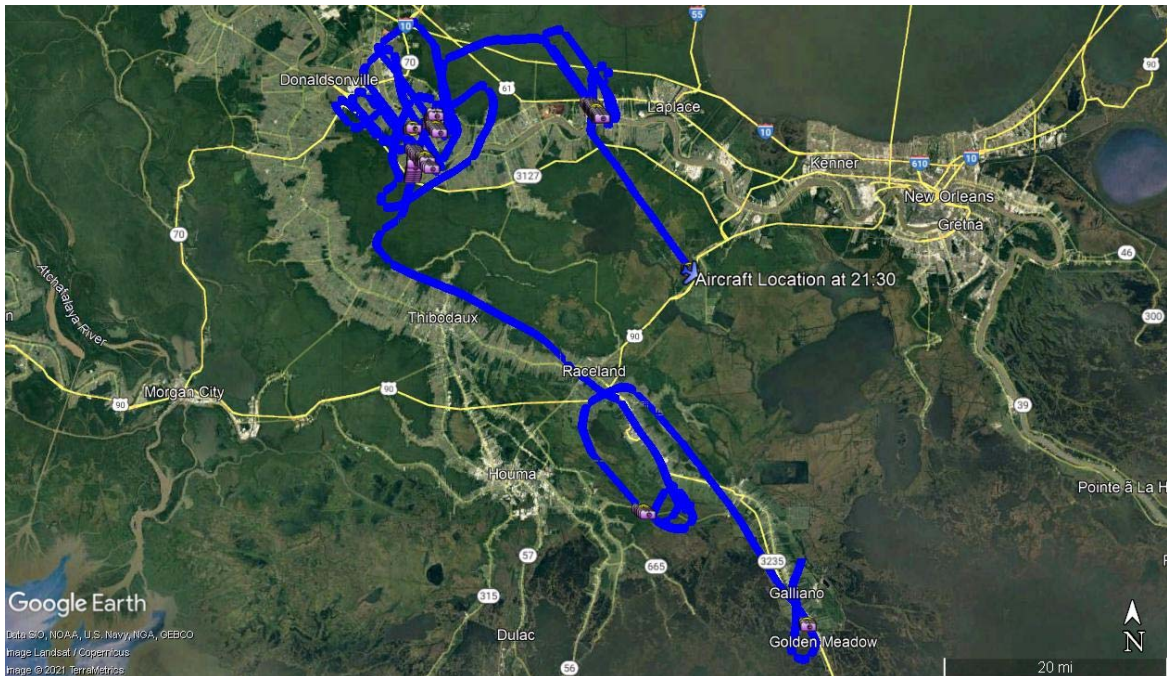


Figure 2. Data Collection Flight Path,
St. Bernard, Terrebonne, St. Charles, and St. James, Flight 10,
September 7, 2021

Line Scanner Data Results

A total of 16 data collection runs (2 test and 14 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 Marathon Petroleum Company near Garyville. No significant features are evident in the image (such as flare or steam vents) and no discharges can be seen leaving the facility.

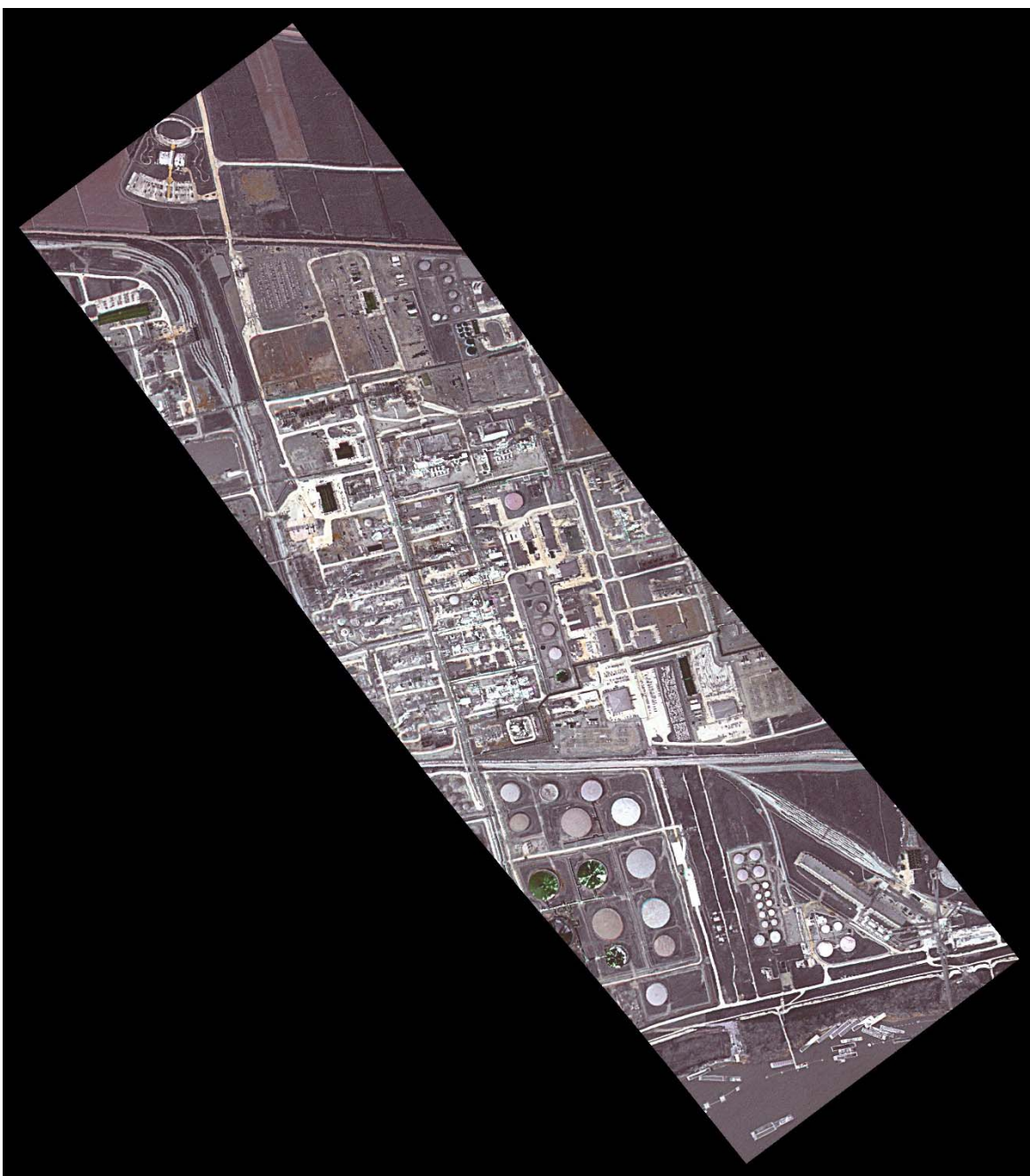


Figure 3. Three band IR image, Marathon Petroleum Company, Run 11, Flight 9, September 7, 2021

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 C, Table 1). In addition, collected data was also manually quality checked against a collection of published library spectra for each chemical detected.

ASTECT did not detect any programmed compounds (those found in Appendix C, Table 1) as part of the mission over the target areas on the two flights conducted on September 7. 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 9**

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-07	14:06:47	Test	Test
2		15:34:20	ND	ND
3		16:05:22	ND	ND
4		16:26:25	ND	ND

**Table 5. Chemical Results Summary
St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 10**

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-07	19:03:23	Test	Test
2		19:22:25	ND	ND
3		19:52:24	ND	ND
4		19:54:57	ND	ND
5		20:11:16	ND	ND
6		20:12:24	ND	ND
7		20:28:48	ND	ND
8		20:41:54	ND	ND
9		20:54:50	ND	ND
10		21:06:26	ND	ND
11		21:16:22	ND	ND
12		21:30:25	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 survey were challenging with both low ceiling and convective activity within the survey areas. These conditions made some images marginal. Figure 4 shows a representative aerial image collected over the Marathon

Petroleum Company in the Garyville area. No significant damage or activity is evident in the image. Figure 5 shows an oblique image of a flooded tank battery near Port Fourchon. Although flooded, no product appears to be leaking from the facility.



Figure 4. MSIC image of the Marathon Petroleum Company, Garyville, LA, Flight 10, September 7, 2021



Figure 5. Oblique photo of a flooded tank battery, Flight 9, September 7, 2021

Conclusion

Two data collection missions were conducted by ASPECT on September 7, 2021 with the primary focus to collect additional data over targets surveyed with single passes on 5 September 2021 (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.

Appendix A: File Names of Data Collected During Flight

St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 9, September 7, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	14:06:47	5147	150	20210907140653888.jpg 20210907140700247.jpg 20210907140706596.jpg	20210907_140651_A.igm	2021_09_07_14_06_51_R_01 TA=25.0;TB=45.5;Gain=3	
2	15:34:20	2563	105	20210907153426146.jpg 20210907153432495.jpg 20210907153438860.jpg 20210907153445210.jpg 20210907153451568.jpg 20210907153457918.jpg 20210907153505181.jpg 20210907153511546.jpg	20210907_153423_A.igm 20210907_153502_A.igm	2021_09_07_15_34_24_R_02 TA=16.0;TB=36.0;Gain=3	
3	16:05:22	2534	108	20210907160528252.jpg 20210907160534601.jpg 20210907160540960.jpg	20210907_160525_A.igm	2021_09_07_16_05_26_R_03 TA=25.1;TB=45.0;Gain=3	
4	16:26:25	2063	107	20210907162632040.jpg 20210907162637485.jpg 20210907162642033.jpg 20210907162647478.jpg 20210907162652923.jpg	20210907_162628_A.igm	2021_09_07_16_26_30_R_04 TA=26.0;TB=46.0;Gain=3	

St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 10, 7 September 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	19:03:23	2589	114	20210907190329891.jpg 20210907190335335.jpg 20210907190340787.jpg	20210907_190327_A.igm	2021_09_07_19_03_28_R_01 TA=25.9;TB=46.7;Gain=3	
2	19:22:25	2572	102	20210907192232007.jpg 20210907192237452.jpg 20210907192242896.jpg 20210907192248344.jpg 20210907192253803.jpg 20210907192259248.jpg	20210907_192229_A.igm	2021_09_07_19_22_30_R_02 TA=26.0;TB=46.2;Gain=3	
3	19:52:24	2535	106	20210907195230529.jpg 20210907195235973.jpg 20210907195241418.jpg 20210907195246872.jpg 20210907195252316.jpg 20210907195257760.jpg 20210907195303220.jpg 20210907195308665.jpg 20210907195314109.jpg 20210907195319553.jpg	20210907_195227_A.igm 20210907_195306_A.igm	2021_09_07_19_52_29_R_03 TA=25.9;TB=46.0;Gain=3	
4	19:54:57	2507	104	20210907195503059.jpg 20210907195508503.jpg 20210907195513947.jpg 20210907195519392.jpg 20210907195524836.jpg 20210907195530296.jpg 20210907195535740.jpg	20210907_195501_A.igm	2021_09_07_19_55_01_R_04 TA=26.0;TB=46.0;Gain=3	

5	20:11:16	2576	105	20210907201122663.jpg 20210907201128108.jpg 20210907201133568.jpg	20210907_201120_A.igm	2021_09_07_20_11_21_R_05 TA=26.0;TB=46.0;Gain=3	
6	20:12:24	2549	102	20210907201230757.jpg 20210907201236202.jpg 20210907201238932.jpg	20210907_201227_A.igm	2021_09_07_20_12_29_R_06 TA=26.0;TB=46.0;Gain=3	
7	20:28:48	2563	106	20210907202854916.jpg 20210907202900361.jpg 20210907202905805.jpg 20210907202911250.jpg 20210907202916710.jpg 20210907202922154.jpg 20210907202927604.jpg 20210907202933048.jpg 20210907202938492.jpg 20210907202943937.jpg 20210907202949381.jpg 20210907202954841.jpg 20210907203000286.jpg 20210907203005730.jpg	20210907_202851_A.igm 20210907_202932_A.igm	2021_09_07_20_28_54_R_07 TA=25.1;TB=44.9;Gain=3	
8	20:41:54	2593	110	20210907204200238.jpg 20210907204205682.jpg 20210907204211142.jpg 20210907204216587.jpg	20210907_204156_A.igm	2021_09_07_20_41_58_R_08 TA=27.3;TB=47.1;Gain=3	
9	20:54:50	2552	105	20210907205456491.jpg 20210907205501935.jpg 20210907205507380.jpg 20210907205512825.jpg 20210907205518285.jpg 20210907205523730.jpg	20210907_205453_A.igm	2021_09_07_20_54_55_R_09 TA=18.3;TB=38.5;Gain=3	
10	21:06:26	2544	101	20210907210632840.jpg 20210907210638285.jpg 20210907210643729.jpg 20210907210649189.jpg 20210907210654634.jpg 20210907210700078.jpg 20210907210705523.jpg 20210907210710967.jpg 20210907210716427.jpg 20210907210721871.jpg	20210907_210630_A.igm 20210907_210710_A.igm	2021_09_07_21_06_32_R_10 TA=25.6;TB=45.5;Gain=3	
11	21:16:22	2578	103	20210907211628411.jpg 20210907211633863.jpg 20210907211639307.jpg 20210907211644767.jpg 20210907211650212.jpg 20210907211655656.jpg 20210907211701101.jpg 20210907211706545.jpg 20210907211711993.jpg 20210907211717439.jpg 20210907211722899.jpg	20210907_211625_A.igm 20210907_211705_A.igm	2021_09_07_21_16_27_R_11 TA=23.5;TB=43.5;Gain=3	
12	21:30:25	2570	108	20210907213031849.jpg 20210907213037293.jpg 20210907213042753.jpg	20210907_213029_A.igm	2021_09_07_21_30_31_R_12 TA=23.0;TB=42.8;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 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)