

MS AERMOD Ready Met Files

Supporting Documentation, March 19,2017

Mississippi Department of Environmental Quality
www.deq.state.ms.us

Bruce Ferguson

MS AERMOD Ready Met Files

Supporting Documentation

The Mississippi Department of Environmental Quality (MDEQ) has posted preprocessed meteorological files for use with the US EPA regulatory model AERMOD on the MDEQ website. The posting of these files in no way dictates their use nor supplants the use of professional judgment in determining whether the files are appropriate for any particular application. This report documents the development of the preprocessed files.

Integrated surface data was obtained from NCDC in DS3505 format (<ftp://ftp.ncdc.noaa.gov/pub/data/noaa/>). Radiosonde observations were obtained from the NOAA/ESRL Radiosonde Database (<http://www.esrl.noaa.gov/raobs/>). When available, one and five minute ASOS wind data was included in the processing of the met data through the use of AERMINUTE – Version 15272. One-and five minute data was obtained through the National Climatic Data Center (NCDC) (<ftp://ftp.ncdc.noaa.gov/pub/data/asos-onemin/> & <ftp://ftp.ncdc.noaa.gov/pub/data/asos-fivemin/>).

When applying the AERMET meteorological processor to prepare the meteorological data for the AERMOD model, the user must determine appropriate values for three surface characteristics: surface roughness length {zo}, albedo {r}, and Bowen ratio {Bo}. AERSURFACE (dated 13016), a tool that processes land cover data to determine these surface characteristics for use in AERMET, was used in the processing of the posted met files.

Aersurface Monthly Seasonal Designations

Winter with continuous snow on the ground does not occur in Mississippi; therefore this seasonal designation was not used in the AERSURFACE input files. The AERMET user's guide defines spring as the 1-2 months after the last killing frost. Freeze/Frost occurrence data was used to determine the beginning of spring using the 50 percent probability date for 28° F. Likewise, the fall 50 percent probability date for 28° F was used to determine the late autumn after frost and harvest seasonal designation. These dates were determined from Frost/Freeze Data 1971-2000 (CLIM20-01), NCDC and

indicate the date on which there is a 50% probability that a freeze date may be later in the spring or earlier in the fall. Dates for the stations within a climate division were averaged.

Months that fall between the fall and spring dates (rounded to beginning or end of month, whichever was closer) were considered to be "Late autumn after frost and harvest."

Midsummer with lush vegetation was assumed to be months with a monthly normal temperature above 70° F. Monthly normal temperatures were taken from "Climatology of the US No. 85, Divisional Normals and Standard Deviations of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000".

Spring months were considered to be those between the determined Late Autumn months and the Midsummer months. Autumn months were considered to be those between the determined Midsummer months and the Late Autumn months. Seasonal designations used are listed in Table 2.

Surface Moisture

Surface Moisture was determined using divisional precipitation ranks on the NOAA website at [https://www.ncdc.noaa.gov/temp-and-precip/us-maps/1/201702?products\[\]=divisionalpcpnrank#us-maps-select](https://www.ncdc.noaa.gov/temp-and-precip/us-maps/1/201702?products[]=divisionalpcpnrank#us-maps-select) . In order to place each month and season into historical context, NCEI assigns ranks for each geographic area (division, state, region, etc.) based on how the temperature or precipitation value compares with other values throughout the entire record when sorted from lowest to highest value. The "Below Normal", "Near Normal", and "Above Normal" shadings on the color maps represent the bottom, middle, and upper tercile (or three equal portions) of the distribution, respectively. The lowest and uppermost decile (or 10%) of the distribution are marked as "Much Below Normal" and "Much Above Normal", respectively. Surface moisture was determined to be dry for ranks of "Below Normal", average for ranks of "Near Normal" and wet for ranks "Above Normal." Table 3 and Table 4 summarize the surface moisture designations for the years 2009 through 2016.

The Memphis, Mobile and Tallulah/Vicksburg stations are not located within Mississippi. The surface moisture for these stations was taken as that in the adjacent climate division in Mississippi.

AERSURFACE Inputs

Locations of the monitoring stations included in the aersurface files were checked by reviewing aerial photography in Google Earth and Bing Bird's Eye View. The locations were also cross referenced to the "ASOS Tropical Cyclone Wind Exposure Documentation Project." No attempts were made to correct aersurface runs for changes in land use after the 1992 determination.

The AERSURFACE inputs were selected to be consistent with the "AERMOD Implementation Guide." Twelve sectors were used for the determination and the surface parameters were selected as described above. The standard AERSURFACE input file used was as follows:

| | |
|------------------------|--|
| [NLCD 1992File] | ** Land use data file |
| [AERSURFACE.out] | ** Output file with sfc values for AERMET Stage 3 |
| LATLON | ** Coordinate type (UTM, LATLON) |
| [surface station lat] | ** Latitude [obtained from Table 1] |
| [surface station long] | ** Longitude [obtained from Table 1] |
| NAD83 | ** Datum |
| 1.0 | ** Study radius for surface roughness (km) |
| Y | ** Vary by sector? (Y/N) |
| 12 | ** Number of sectors |
| M | ** Temporal resolution (A=ANNUAL, M=MONTHLY, S=SEASONAL) |
| N | ** Continuous snow cover at least one month? (Y/N) |
| Y | ** Reassign months to seasons? (Y/N) |
| [Table 2] | ** Late autumn after frost and harvest, or winter with no snow |
| [Table 2] | ** Transitional spring (partial green coverage, short annuals) |
| [Table 2] | ** Midsummer with lush vegetation |
| [Table 2] | ** Autumn with unharvested cropland |
| Y | ** Airport? (Y/N) |
| N | ** Arid region? (Y/N) |
| [varied with rainfall] | ** Surface Moisture (A=Average, W=Wet, D=Dry) |

Aersurface was run with each of the surface moisture condition, Wet, Dry and Avg. The aersurface output file for each year was merged from the three runs based on the surface moisture conditions listed in Table 3 and Table 4. The merged files were used in Stage 3 of AERMET.

The Aersurface run for KPQL identified 5 sectors which had transitional classifications greater than 10% of the sector. Stations KGPT and KMOB each had one sector which contained the transitional warning. No attempts were made to update any of the NLCD92 data. Historical photographs of these stations are depicted in Figure 1 through Figure 6.

AERMET 16216 Inputs

Integrated surface data in DS3505 format was obtained from NCDC for each station. Upper air data was downloaded in FSL format from the NOAA/ESRL Radiosonde Database. Observations obtained from Slidell, LA were used for the Mobile station and stations located in the Coastal Division. Observations obtained from Jackson, MS were

used for all other divisions. Running individual surface files as downloaded from NCDC results in missing data for the last 6 hours of each year. To avoid this missing data in each year, the surface files were merged to include all of the years being evaluated. The upper air data was downloaded as one file encompassing the entire study period. Individual years were run from Jan 1 to Jan 1, therefore, each output file contains one year plus the first day of the next year. These extra days can be removed from the files prior to running AERMOD or AERMOD can be set up to only read dates from the desired year.

When available, ASOS 1-minute and 5-minute data was incorporated using AERMINUTE version 15272. The threshold wind speed was set at 0.5 m/s in Stage 3 when ASOS 1-minute data was used. The SUBNWS parameter was also used with ASOS 1-minute data to replace wind data from the standard NWS format. The SUB_CC and SUB_TT parameters were indicated in the stage 3 input files. The AERMET user's guide indicates that these are default parameters unless the application involves both NWS and ONSITE surface data. The data was processed with and without the ADJ_U* option in Stage 3.

Example input files for the Jackson, MS station are presented below.

Stage 1

JOB

REPORT KJAN.RP1
MESSAGES KJAN.MG1

UPPERAIR

DATA "C:\meterological Data\Mississippi\Jan 12 to 16 raob_soundings20140.txt" FSL
EXTRACT KJAN.UAX
QAOUT KJAN.UQA

XDATES 2012/01/01 TO 2017/01/01

** Station: JACKSON/THOMPSON FIELD, MS
LOCATION 3940 32.320N 90.070W 6

SURFACE

** Location of the Surface Data File

** C:\meterological Data\Mississippi\KJAN\722350-03940\KJAN.ish

DATA KJAN.ish ISHD ASOS
EXTRACT KJAN.SAX
QAOUT KJAN.SQA

XDATES 2012/01/01 TO 2017/01/01

** Station: JACKSON/THOMPSON FIELD, MS
LOCATION 3940 32.317N 90.083W 6 91.00

Stage 2

JOB

REPORT KJAN.RP2
MESSAGES KJAN.MG2

UPPERAIR

QAOUT KJAN.UQA

SURFACE

QAOUT KJAN.SQA

** Location of the Hourly Wind Data File

** C:\meterological Data\Mississippi\KJAN\722350-03940\KJAN_AERMIN\AERMINUTE_hour.dat
ASOS1MIN KJAN_AERMIN\AERMINUTE_hour.dat

MERGE

OUTPUT KJAN.MRG

XDATES 2012/01/01 TO 2017/01/01

Stage 3

JOB

REPORT KJAN_2012.RP3
MESSAGES KJAN_2012.MG3

METPREP

DATA KJAN.MRG
MODEL AERMOD

OUTPUT aermet.sfc
PROFILE aermet.pfl

XDATES 2012/01/01 TO 2013/01/01

METHOD REFLEVEL SUBNWS
METHOD WIND_DIR RANDOM
METHOD STABLEBL ADJ_U* [Note: Stage 3 was run both with and without ADJ_U*]
METHOD CCVR SUB_CC
METHOD TEMP SUB_TT
THRESH_1MIN 0.50
NWS_HGT WIND 10.00

** Primary Surface Characteristics

AERSURF KJAN_2012.AS.txt

Data Completeness

The processed met files were used in test runs with AERMOD version 16216r. The files were run by quarter and the percentage of missing hours noted from the AERMOD output file. Table 5 summarizes the results of the completeness check. Additional years of met data were processed for each site until five years of complete data, by year, were obtained. For the majority of the sites, the five years of data is consecutive years. For some sites, the years are not consecutive.

Table 1 – Station List

| City | Station Name | WBAN | INT CALL | Latitude | Longitude | Aerminute Available | Anemometer Height (m) |
|--------------------|--|-------|----------|-----------|------------|---------------------|-----------------------|
| GREENVILLE | MID DELTA REGIONAL AIRPORT | 13939 | KGLH | 33.477228 | -90.984658 | No | 10 |
| GREENWOOD | GREENWOOD-LEFLORE AIRPORT | 13978 | KGWO | 33.496194 | -90.089419 | Yes | 10 |
| GULFPORT | GULFPORT-BILOXI INTERNATIONAL AIRPORT | 93874 | KGPT | 30.412000 | -89.081000 | Yes | 10 |
| HATTIESBURG | BOBBY L CHAIN MUNICIPAL AIRPORT | 13833 | KHBG | 31.269483 | -89.256108 | Yes | 10 |
| JACKSON | HAWKINS FIELD AIRPORT | 13927 | KHKS | 32.337572 | -90.221397 | Yes | 10 |
| JACKSON | JACKSON INTERNATIONAL AIRPORT | 3940 | KJAN | 32.319836 | -90.077756 | Yes | 10 |
| McCOMB | MC COMB/PIKE COUNTY/JOHN E LEWIS FIELD AIRPORT | 93919 | KMCB | 31.182278 | -90.472025 | Yes | 10 |
| MERIDIAN | KEY FIELD AIRPORT | 13865 | KMEI | 32.334861 | -88.750728 | Yes | 10 |
| PASCAGOULA | TRENT LOTT INTERNATIONAL AIRPORT | 53858 | KPQL | 30.463058 | -88.531556 | Yes | 7.92 |
| TALLULAH/VICKSBURG | VICKSBURG/TALLULAH REGIONAL AIRPORT | 3996 | KTVR | 32.348000 | -91.030000 | Yes | 10 |
| TUPELO | TUPELO REGIONAL AIRPORT | 93862 | KTUP | 34.262131 | -88.771161 | Yes | 10 |
| COLUMBUS | GOLDEN TRIANGLE RGNL | 53893 | KGTR | 33.456278 | -88.592656 | No | 10 |
| COLUMBUS | COLUMBUS AFB | 13825 | KCMB | 33.652258 | -88.457136 | No | 10 |
| NATCHEZ | NATCHEZ/HARDY(AWOS) | 3961 | KHEZ | 31.615919 | -91.297267 | No | 10 |
| HATTIESBURG | HATTIESBURG LAUREL | 53808 | KPIB | 31.465756 | -89.333464 | No | 10 |
| METCALFE | TUNICA MUNI | 23903 | KUTA | 34.676575 | -90.343956 | No | 10 |
| MEMPHIS | MEMPHIS INTL ARPT | 13893 | KMEM | 35.036472 | -89.971861 | Yes | 10 |
| MOBILE | MOBILE/BATES FIELD | 13894 | KMOB | 30.688222 | -88.245969 | Yes | 10 |

Table 2 - AERSURFACE Monthly Designations

| Station | Months Normal above 70°F | Spring 50% Probability @ 28° F. | Fall 50% Probability @ 28° F | Late Autumn Months | Transitional Spring Months | Midsummer Months | Autumn Months |
|---------------------|--------------------------|---------------------------------|------------------------------|--------------------|----------------------------|------------------|---------------|
| MS-01 Upper Delta | May-Sep | 3-Mar | 21-Nov | 12, 1, 2 | 3,4 | 5,6,7,8,9 | 10,11 |
| MS-02 North Central | June-Sep | 20-Mar | 9-Nov | 11,12, 1, 2,3 | 4,5 | 6,7,8,9 | 10 |
| MS-03 Northeast | June-Sep | 19-Mar | 12-Nov | 11,12, 1, 2,3 | 4,5 | 6,7,8,9 | 10 |
| MS-04 Lower Delta | May-Sep | 23-Feb | 26-Nov | 12, 1, 2 | 3,4 | 5,6,7,8,9 | 10,11 |
| MS-05 Central | May-Sep | 11-Mar | 15-Nov | 12, 1,2 | 3,4 | 5,6,7,8,9 | 10,11 |
| MS-06 East Central | May-Sep | 10-Mar | 15-Nov | 12, 1,2 | 3,4 | 5,6,7,8,9 | 10,11 |
| MS-07 Southwest | May-Sep | 25-Feb | 26-Nov | 12, 1, 2 | 3,4 | 5,6,7,8,9 | 10,11 |
| MS-08 South Central | May-Sep | 27-Feb | 25-Nov | 12, 1, 2 | 3,4 | 5,6,7,8,9 | 10, 11 |
| MS-09 Southeast | May-Sep | 2-Mar | 24-Nov | 12, 1, 2, | 3,4 | 5,6,7,8,9 | 10,11 |
| MS-10 Coastal | May-Sep | 12-Feb | 16-Dec | 1 | 2,3,4 | 5,6,7,8,9 | 10,11,12 |

Table 4 - Surface Moisture Based on NCEI Divisional Precipitation Ranks 2013-2016

| Division | MS 01 | MS 02 | MS 03 | MS 04 | MS 05 | MS 06 | MS 07 | MS 08 | MS 09 | MS 10 | MS 01 | MS 02 | MS 03 | MS 04 | MS 05 | MS 06 | MS 07 | MS 08 | MS 09 | MS 10 |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 2013 | | | | | | | | | | 2014 | | | | | | | | | |
| Jan | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry |
| Feb | Avg | Avg | Avg | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Avg | Avg | Avg | Avg | Avg | Wet | Wet | Wet | Wet |
| Mar | Avg | Avg | Avg | Dry | Avg | Avg | Dry | Dry | Dry | Dry | Avg | Dry | Dry | Avg | Avg | Avg | Avg | Avg | Wet | Wet |
| Apr | Wet | Wet | Avg | Wet | Avg | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet |
| May | Wet | Wet | Wet | Wet | Wet | Avg | Wet | Wet | Wet | Wet | Avg | Avg | Avg | Avg | Avg | Dry | Wet | Wet | Avg | Wet |
| Jun | Dry | Avg | Avg | Wet | Wet | Avg | Avg | Wet | Wet | Avg | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Avg | Avg |
| Jul | Avg | Avg | Avg | Dry | Dry | Wet | Avg | Avg | Avg | Wet | Avg | Avg | Wet | Avg | Avg | Dry | Dry | Dry | Dry | Dry |
| Aug | Avg | Dry | Avg | Dry | Dry | Dry | Dry | Wet | Avg | Wet | Wet | Avg | Avg | Avg | Avg | Avg | Wet | Avg | Dry | Dry |
| Sep | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Dry | Dry | Avg | Avg | Dry | Avg | Dry | Avg | Avg | Avg | Dry |
| Oct | Wet | Wet | Dry | Avg | Avg | Dry | Avg | Dry | Avg | Dry | Wet | Wet | Wet | Wet | Wet | Wet | Avg | Avg | Avg | Avg |
| Nov | Wet | Wet | Avg | Wet | Wet | Wet | Wet | Avg | Wet | Avg | Dry | Avg | Avg | Dry | Avg | Avg | Avg | Dry | Dry | Dry |
| Dec | Avg | Avg | Wet | Avg | Avg | Wet | Dry | Wet | Wet | Wet | Avg | Avg | Avg | Avg | Avg | Wet | Avg | Avg | Wet | Wet |
| | 2015 | | | | | | | | | | 2016 | | | | | | | | | |
| Jan | Avg | Dry | Dry | Avg | Avg | Avg | Avg | Avg | Avg | Avg | Dry | Dry | Dry | Avg | Avg | Dry | Dry | Dry | Dry | Avg |
| Feb | Avg | Avg | Avg | Avg | Avg | Avg | Dry | Dry | Dry | Dry | Wet | Wet | Avg | Avg | Wet | Wet | Avg | Avg | Avg | Avg |
| Mar | Wet | Avg | Avg | Avg | Avg | Avg | Wet | Avg | Avg | Avg | Wet | Wet | Avg | Wet | Wet | Wet | Wet | Wet | Wet | Wet |
| Apr | Wet | Wet | Wet | Avg | Avg | Wet | Avg | Avg | Avg | Wet | Avg | Avg | Avg | Avg | Avg | Avg | Avg | Avg | Wet | Wet |
| May | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Avg | Avg | Avg | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Avg |
| Jun | Dry | Wet | Avg | Avg | Avg | Avg | Avg | Avg | Avg | Avg | Dry | Dry | Avg | Wet | Avg | Avg | Avg | Avg | Wet | Wet |
| Jul | Wet | Avg | Wet | Dry | Dry | Avg | Dry | Avg | Avg | Avg | Wet | Wet | Avg | Wet | Wet | Avg | Wet | Wet | Dry | Dry |
| Aug | Avg | Wet | Wet | Dry | Dry | Avg | Dry | Dry | Dry | Dry | Wet | Avg | Wet | Wet | Wet | Avg | Wet | Wet | Wet | Wet |
| Sep | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Avg | Avg | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Avg | Dry | Dry |
| Oct | Wet | Avg | Avg | Wet | Wet | Avg | Wet | Wet | Wet | Wet | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry |
| Nov | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Avg | Avg | Avg | Avg | Avg | Avg | Avg | Avg | Dry | Dry |
| Dec | Wet | Wet | Wet | Avg | Avg | Wet | Avg | Wet | Wet | Wet | Avg | Avg | Avg | Avg | Avg | Dry | Avg | Avg | Avg | Wet |

Table 5 - Data Completeness by Quarter

| | 2009 | | | | 2010 | | | | 2011 | | | | 2012 | | | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | | | |
|------|------|------|-----|-----|------|-----|------|-----|------|------|------|-----|------|-----|-----|-----|------|------|-----|------|------|-----|-----|-----|------|-----|------|------|------|------|------|-----|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 |
| KGLH | 0.6 | 0.1 | 0.4 | 0.4 | 0.5 | 1.7 | 2.7 | 0.8 | 0.0 | 4.7 | 1.9 | 0.1 | 0.2 | 8.3 | 2.9 | 0.8 | 0.8 | 1.1 | 0.4 | 0.5 | 0.5 | 1.3 | 4.1 | 0.2 | 2.1 | 1.7 | 7.5 | 2.5 | 0.1 | 4.1 | 5.3 | 2.7 | | | |
| KGPT | 0.0 | 0.9 | 0.4 | 0.4 | 0.3 | 1.5 | 0.6 | 1.3 | 3.3 | 0.5 | 2.2 | 0.5 | 0.2 | 0.7 | 0.7 | 0.0 | 8.5 | 0.5 | 0.3 | 0.0 | 0.6 | 0.6 | 0.5 | 0.1 | 0.6 | 1.8 | 1.5 | 0.1 | 1.8 | 1.4 | 1.4 | 0.1 | | | |
| KGTR | 10.2 | 13.1 | 7.4 | 6.0 | 3.2 | 6.7 | 5.0 | 6.3 | 5.4 | 6.1 | 9.3 | 6.4 | 2.7 | 4.2 | 5.2 | 4.0 | 4.4 | 4.7 | 8.5 | 2.8 | 7.2 | 5.0 | 2.8 | 4.0 | 3.0 | 5.5 | 1.7 | 1.6 | 5.5 | 4.2 | 4.5 | 6.0 | | | |
| KGWO | 0.6 | 0.1 | 0.4 | 0.4 | 0.5 | 1.7 | 2.7 | 0.8 | 0.5 | 0.6 | 2.4 | 0.8 | 1.0 | 0.2 | 0.5 | 0.5 | 0.1 | 1.1 | 0.2 | 0.1 | 1.4 | 0.4 | 0.9 | 0.3 | 5.7 | 3.9 | 3.1 | 2.4 | 2.5 | 2.0 | 1.9 | 0.5 | | | |
| KHBG | 0.7 | 0.7 | 0.3 | 0.4 | 0.1 | 1.8 | 0.6 | 0.6 | 1.4 | 1.4 | 2.0 | 2.2 | 0.7 | 0.6 | 0.0 | 0.5 | 0.1 | 1.2 | 0.1 | 0.5 | 0.1 | 0.4 | 0.5 | 0.1 | 0.5 | 1.7 | 1.3 | 1.6 | 2.8 | 4.5 | 6.1 | 4.5 | | | |
| KHEZ | 1.5 | 3.1 | 0.1 | 0.5 | 0.0 | 1.1 | 1.0 | 3.4 | 3.2 | 2.8 | 11.5 | 2.4 | 0.1 | 5.9 | 1.5 | 9.9 | 1.3 | 14.6 | 2.8 | 0.3 | 1.1 | 1.5 | 0.6 | 0.2 | 1.8 | 2.2 | 8.2 | 4.0 | 1.5 | 14.4 | 20.4 | 0.7 | | | |
| KHKS | 0.7 | 1.8 | 1.1 | 0.4 | 0.1 | 2.9 | 1.8 | 0.4 | 1.4 | 1.8 | 2.1 | 0.1 | 0.6 | 0.8 | 0.6 | 0.1 | 0.4 | 1.3 | 0.0 | 0.4 | 0.0 | 4.8 | 1.5 | 0.1 | 2.7 | 2.5 | 1.5 | 1.3 | 0.2 | 1.3 | 1.2 | 2.0 | | | |
| KJAN | 0.0 | 0.8 | 0.4 | 0.5 | 0.5 | 1.9 | 0.9 | 0.6 | 0.3 | 1.8 | 0.8 | 0.1 | 0.0 | 0.5 | 0.1 | 0.1 | 0.1 | 1.2 | 0.4 | 0.1 | 0.1 | 0.1 | 0.7 | 0.1 | 0.4 | 1.8 | 1.0 | 1.0 | 0.3 | 0.4 | 1.1 | 0.5 | | | |
| KMCB | 0.1 | 0.6 | 1.0 | 0.7 | 0.2 | 2.2 | 0.8 | 0.5 | 0.2 | 7.7 | 5.6 | 0.5 | 0.0 | 1.2 | 0.1 | 0.1 | 0.1 | 2.7 | 0.2 | 0.1 | 0.5 | 0.1 | 0.9 | 0.1 | 0.5 | 1.7 | 0.9 | 1.1 | 0.2 | 0.6 | 1.5 | 0.4 | | | |
| KMEI | 0.1 | 0.3 | 0.3 | 0.3 | 0.1 | 1.2 | 0.1 | 0.4 | 0.1 | 0.9 | 0.6 | 0.1 | 0.0 | 0.3 | 0.1 | 0.0 | 0.1 | 1.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.6 | 0.0 | 0.5 | 2.0 | 0.7 | 1.8 | 0.2 | 0.6 | 1.5 | 0.5 | | | |
| KMEM | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 1.2 | 0.4 | 0.5 | 0.0 | 0.3 | 0.6 | 0.1 | 0.0 | 0.2 | 0.0 | 0.1 | 0.1 | 1.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.6 | 0.0 | 0.5 | 1.7 | 0.7 | 0.8 | 0.3 | 0.1 | 1.4 | 0.4 | | | |
| KMOB | 0.0 | 0.5 | 0.1 | 0.4 | 0.3 | 2.7 | 0.2 | 0.4 | 1.1 | 0.6 | 1.2 | 0.4 | 0.0 | 0.5 | 0.6 | 0.1 | 0.0 | 0.1 | 0.1 | 0.1 | 0.4 | 0.9 | 0.0 | 0.1 | 0.5 | 1.7 | 0.5 | 0.1 | 1.7 | 0.7 | 1.1 | 0.1 | | | |
| KPIB | 4.4 | 3.0 | 0.1 | 7.8 | 8.0 | 1.3 | 18.4 | 0.6 | 0.1 | 13.9 | 18.7 | 0.1 | 0.6 | 5.9 | 0.6 | 0.3 | 0.1 | 1.1 | 0.6 | 34.2 | 1.2 | 0.1 | 9.6 | 0.1 | 0.5 | 2.1 | 0.7 | 2.5 | 0.1 | 1.2 | 1.6 | 0.5 | | | |
| KPQL | 2.7 | 2.0 | 2.5 | 0.6 | 3.9 | 1.4 | 1.5 | 0.5 | 1.1 | 4.0 | 6.2 | 0.3 | 0.1 | 0.6 | 0.8 | 0.3 | 0.1 | 0.1 | 0.5 | 0.0 | 1.4 | 0.5 | 0.0 | 0.1 | 0.7 | 1.8 | 0.6 | 1.6 | 2.0 | 0.9 | 1.5 | 0.2 | | | |
| KTUP | 0.0 | 0.6 | 0.5 | 0.8 | 1.3 | 3.1 | 0.9 | 1.1 | 0.7 | 0.8 | 1.0 | 0.2 | 0.0 | 0.8 | 0.1 | 0.1 | 0.0 | 1.1 | 0.1 | 0.5 | 0.6 | 0.3 | 1.8 | 2.7 | 1.1 | 2.5 | 2.7 | 0.8 | 0.6 | 0.9 | 2.5 | 1.9 | | | |
| KTVR | 0.4 | 1.5 | 5.3 | 1.7 | 1.7 | 2.8 | 0.6 | 1.3 | 0.0 | 2.5 | 2.1 | 0.6 | 0.4 | 0.2 | 1.6 | 0.1 | 0.4 | 4.4 | 9.5 | 4.6 | 0.3 | 1.7 | 1.2 | 0.4 | 8.5 | 1.8 | 1.0 | 1.3 | 3.3 | 2.8 | 3.0 | 0.5 | | | |
| KUTA | 0.1 | 1.0 | 0.4 | 0.6 | 2.2 | 2.7 | 1.8 | 3.7 | 24.4 | 3.2 | 0.7 | 2.4 | 0.4 | 0.4 | 0.9 | 0.9 | 0.5 | 2.0 | 1.4 | 0.5 | 0.7 | 0.1 | 1.6 | 0.3 | 0.8 | 2.2 | 12.6 | 33.5 | 11.2 | 0.1 | 2.4 | 0.7 | | | |
| KCMB | 9.2 | 5.9 | 4.4 | 4.8 | 4.5 | 5.9 | 7.8 | 2.8 | 4.8 | 6.1 | 3.9 | 5.9 | 3.2 | 7.5 | 5.1 | 2.7 | 4.7 | 6.4 | 8.2 | 4.2 | 5.4 | 5.5 | 9.7 | 4.7 | 4.8 | 9.6 | 9.5 | 7.9 | 6.6 | 10.1 | 10.5 | 3.7 | | | |



Figure 1 -Pascagoula Station Aerial Photograph Feb. 18, 1992.

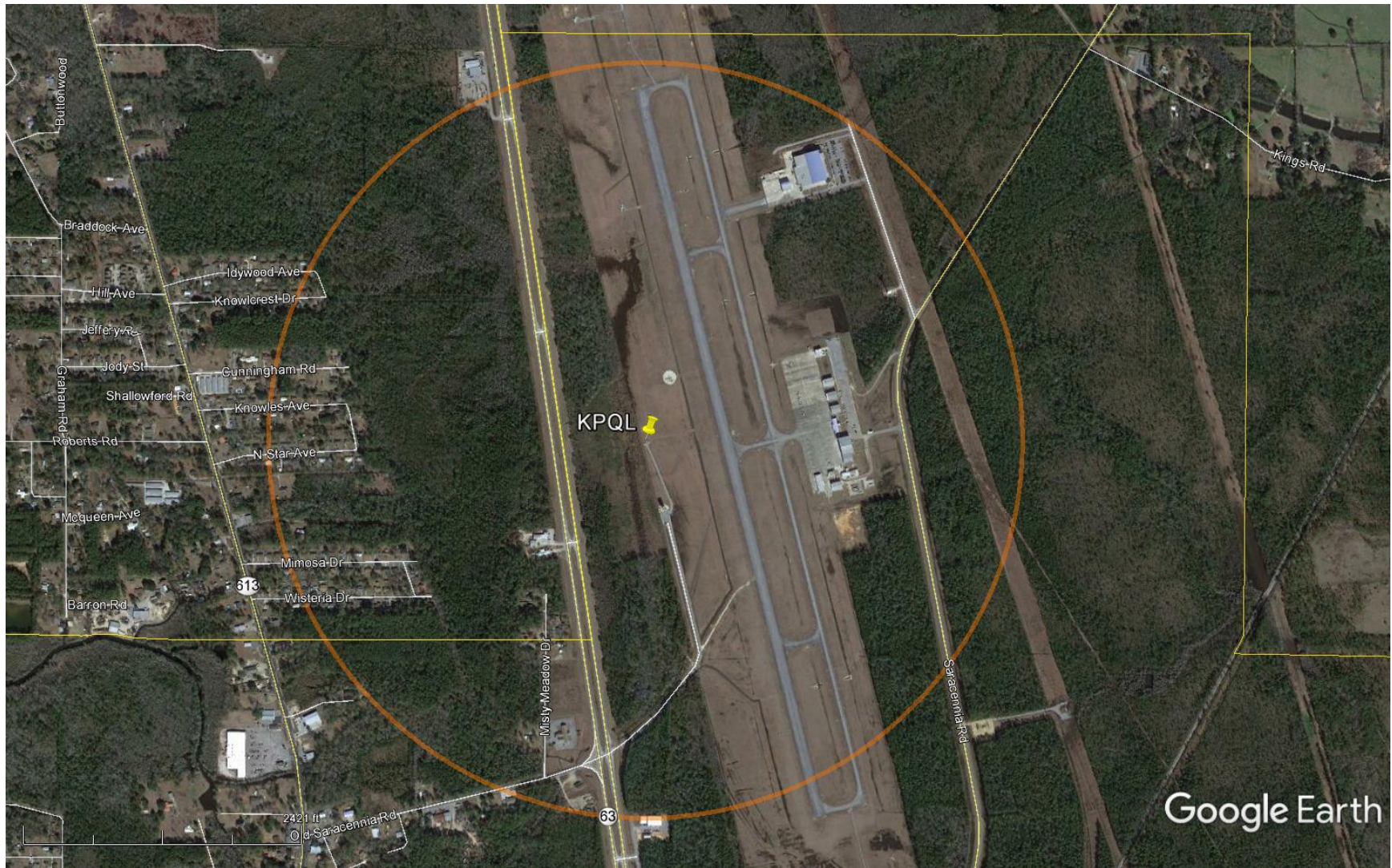


Figure 2 - Pascagoula Station Aerial Photograph Jan. 26, 2015.



Figure 3 - Mobile Station Aerial Photograph Feb. 10, 1997.



Figure 4 - Mobile Station Aerial Photograph Dec. 9, 2016.



Figure 5 - Gulfport Station Aerial Photograph Feb. 18, 1992.



Figure 6 - Gulfport Station Aerial Photograph Feb. 24, 2016.