PNNL-16149

Pacific Northwest
National Laboratory
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ARAMS/FRAMES JOINT FREQUENCY DATA (JFD) GENERATOR

An Interface Based on a Revised Version of the EPA STAR Meteorological Joint Frequency Program

J. G. Droppo
M. A. Pelton

September 2006

Prepared for
Engineer Research and Development Center
U.S. Army Corps of Engineers
Vicksburg, MS
under Contract DE-AC05-76RL01830

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Summary

An Adaptive Risk Assessment Modeling System/Framework for Risk Analysis in Multimedia Environmental Systems (ARAMS/FRAMES) utility entitled the “Joint Frequency Data (JFD) Generator” provides the capability of creating joint frequency tables. The resultant JFD tables contain summaries of the frequency of occurrence of meteorological dispersion, wind speed, and wind direction. This capability was developed to assist the users of these systems in the preparation of JFD input files required by the climatological air dispersion models.

The JFD Generator computations are made by an updated version of the U.S. Environmental Protection Agency (EPA) STAR (STAbility ARray) program. Surface observations are combined with computed seasonally and diurnally varying solar flux rates to estimate the ambient atmospheric dispersion rates, represented as a stability category. The wind speeds and directions are obtained directly from the hourly surface-observation data. The product is a file in a format that can be directly read by an air-dispersion model.

The JFD Generator can input hourly meteorological surface observation data in CD-144, Samson, and Support Center for Regulatory Atmospheric Modeling (SCRAM) data formats. An enhanced joint frequency table file that can be read directly by the ARAMS/FRAMES interface is produced. The output file has a format that can be used by the Multimedia Environmental Pollution Assessment System air-dispersion program or can be modified for input to other models requiring joint frequency input.

Acronyms

ARAMS	Adaptive Risk Assessment Modeling System
EPA	Environmental Protection Agency
FRAMES	Framework for Risk Analysis in Multimedia Environmental Systems
IMOD	Image Processing, Modeling, and Display program
JFD	joint frequency data
LCD	liquid crystal display
MEPAS	Multimedia Environmental Pollution Assessment System
NCC	National Climatic Center
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
SCRAM	Support Center for Regulatory Atmospheric Modeling website
STAR	STAbility ARray computer program
STARR	STAR revised computer program

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Figures

1.0 Introduction

Joint frequency tables refer to tabular summaries of the frequency of occurrence of meteorological dispersion, wind speed, and wind direction. Joint frequency tables are used as input in climatological air-dispersion models. This report documents an Adaptive Risk Assessment Modeling System/Framework for Risk Analysis in Multimedia Environmental Systems (ARAMS/FRAMES) utility entitled "Joint Frequency Data (JFD) Generator" that provides the capability of creating joint frequency tables.

The JFD Generator interface enables conversion of meteorological surface observation data sets to JFD summary data tables. The interface made this conversion using a revised and updated version of the U.S. Environmental Protection Agency (EPA) STAR (STAbility ARray) program (EPA 2006). The original STAR program converts CD-144 format (the format used historically in the United States to record hourly meteorological surface-observation data) to joint frequency tables for use in a number of EPA air-dispersion programs. Surface observations are combined with computed seasonally and diurnally varying solar flux rates to estimate the ambient atmospheric dispersion rates, represented as a stability category. The wind speeds and directions are obtained directly from the hourly surface observation data. The product is a file in a format that can be used as input to air-dispersion models.

The JFD Generator has the capability of using hourly meteorological surface observation data in CD-144, Samson, and Support Center for Regulatory Atmospheric Modeling (SCRAM) data formats. The Samson format was adopted by NCC for distribution of meteorological surface observation data on compact disks(CDs). SCRAM is an abbreviated version of the CD-144 format adopted by the US EPA for air dispersion modeling applications. An enhanced joint frequency table file is produced that includes important surface station and table characteristics data. This file is in a format that can be read directly by the ARAMS/FRAMES interface for use in the Multimedia Environmental Pollution Assessment System (MEPAS) air-dispersion program or can be modified for input to other models requiring joint frequency input. The documentation for the new formats is in Appendices A and B. The testing of the JFD Generator is documented in Appendices C to F.

2.0 JFD Generator Interface

The JFD Generator creates climatological summary files containing the frequencies of occurrence of meteorological dispersion, wind speed, and wind direction. These climatological data are used by air-dispersion models to compute contaminant concentration patterns in air and on soil. These data are based on records from the nearest meteorological observation station that will have weather conditions that are most representative of the area to be modeled. In the United States, the Environmental Data Service, National Oceanic and Atmospheric Administration (NOAA), National Climatic Center (NCC) in Asheville, North Carolina, is the major supplier of such data. Alternatively, other agencies and organizations supply summaries of meteorological data.

The JFD generator is based on an updated version of the EPA STAR program (EPA 2006). The EPA STAR program converts hourly meteorological surface observation data (in CD-144 data format only) to joint frequency tables for use in a number of EPA air-dispersion programs. Surface observations are combined with computed seasonally and diurnally varying solar flux rates to estimate the ambient atmospheric dispersion rates (i.e., stability category). The wind speeds and directions are obtained directly from the hourly surface observation data.

The JFD Generator represents an updated version of the EPA STAR program that uses those data to create JFD files for use in air-dispersion models. In addition to the CD-144 format, the updated version of the software can read Samson and SCRAM data formats available on a number of web sites, including EPA (http://www.epa.gov/scram001, EPA 2006), Lakes-Environmental (http://www.lakes-environmental.com, Lakes Environmental 2006), and NOAA (http://www.nws.noaa.gov, NOAA 2006). Before using this program, the user will need to obtain a file containing historical records of surface meteorological observations from an onsite or nearby location. The data file must have either a “DAT” or “SAM” extension and should be stored in an accessible directory on the host machine. If the data file has a “DAT” extension, Figure 2.1 presents an example of the JFD Generator input window. If the data file has a “SAM” extension, Figure 2.2 presents an example of the JFD Generator input window. Note that the required user-defined input information for the “SAM” file is less than that required for the “DAT” file. These JFD Generator input windows provide the capability of generating JFD files (*.JFD) for use by air-dispersion codes.

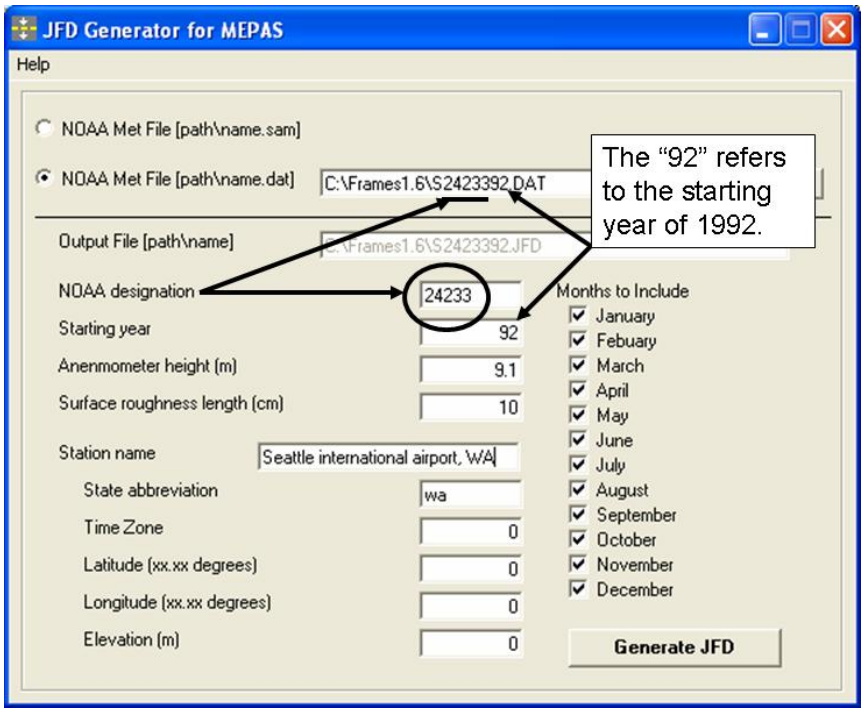


Figure 2.1. Example JFD Generator Input Window for Data Files with a "DAT" Extension

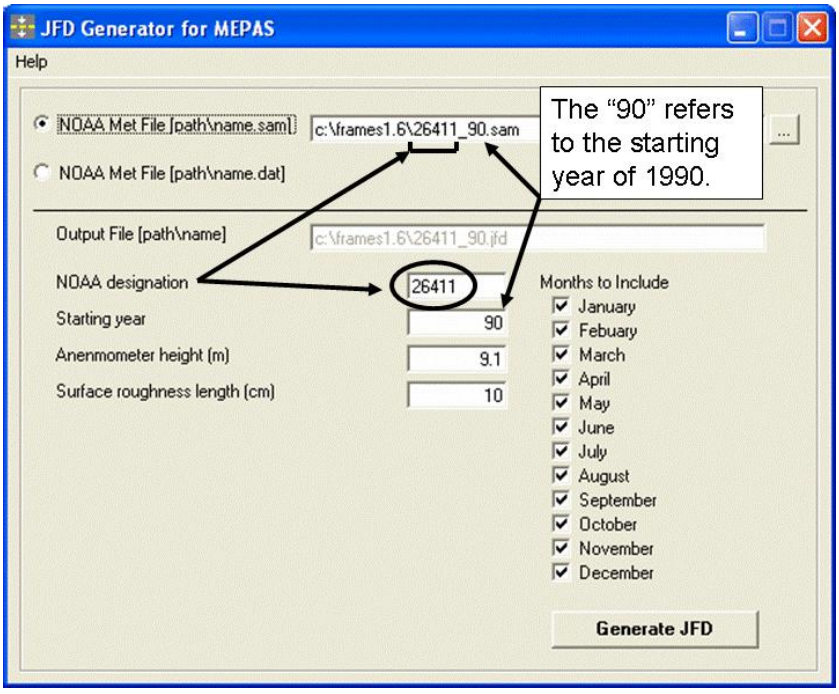


Figure 2.2. Example JFD Generator Input Window for Data Files with a "SAM" Extension

These user interfaces require user-defined input to allow the program to generate the *.JFD files. A summary and definition of each input requirement is presented as follows:

2.1 NOAA Met File [path\name]

Identify the input data file with an annual cycle of hourly surface observation data. The square browse button on the right should be used to select the input data file and its path. Note that a data file containing meteorological observations representative of the analyses area (with either a "DAT" or "SAM" extension) must be obtained before using this program. Sources of such data are discussed above. The JFD generator supports the input of Samson (SAM extension), CD-144 (DAT extension), and SCRAM (DAT extension) data file formats. Additional parameter inputs are required for the DAT files (to define information that is contained within the SAM files). Once a DAT file is selected, the program recognizes which type of DAT file (CD-144 or SCRAM) has been selected.

2.2 Output File [path\name]

The name and path of the output JFD data file that will be produced are displayed. The name and path of the input data file are used to define this output file.

2.2.1 NOAA Designation

Enter the "Surface Station Number" for the selected meteorological observation station. This number is normally incorporated in the name of the input data file as well as in the data contained in the input data file. In the United States, this number represents a five digit "Surface Station Number" assigned to each location where meteorological surface observations are available. When the JFD are imported into MEPAS, the NOAA designation for "Surface Station Number" will be loaded into the MEPAS variable "AC-LCDREF—Reference weather station."

2.2.2 Starting Year

Enter the two-digit code for year of data to be processed (i.e., 88, 90, 02). This year code is normally incorporated in the input data file name. The JFD generator will also process the file if a four-digit year is entered.

2.2.3 Station Name (required for DAT files only)

Document the source of the joint frequency summary data. Enter a name that describes the location at which the joint frequency data were taken (normally the name of a nearby city or airport). Use a descriptive name to designate the location where onsite data were taken. When the JFD are imported into MEPAS, the "Station Name" will be loaded into the MEPAS variable "AJ-STATNM—Data station."

2.2.4 Two-Letter State Abbreviation (required for DAT files only)

Enter the two-letter postal code abbreviation for the state in which the surface station is located.

2.2.5 Time Zone (required for DAT files only)

Enter a numeric code for the time zone in which the station is located. The STAR program supports the four time zones used in the contiguous United States. The time codes are:

- Eastern Time Zone = 075
- Central Time Zone = 090
- Mountain Time Zone = 105
- Pacific Time Zone = 120
- Alaska Time Zone = 150

2.2.6 Latitude (xx.xx degrees) (required for DAT files only)

Enter north latitude of station.

2.2.7 Longitude (xx.xx degrees) (required for DAT files only)

Enter west longitude of station.

2.2.8 Elevation (m) (required for DAT files only)

Enter the elevation of the station above sea level in meters.

2.2.9 Anemometer Height (m)

Enter the height at which the winds were measured for the joint frequency distribution. This height can be obtained from the source of the joint frequency data (i.e., facility documentation for onsite data), from the last page of the liquid crystal display (LCD) summary for National Climatic Data Center (NCDC) data, or weather station documentation reports. A typical value for the height of a joint-frequency anemometer is approximately 3 m. When the JFD are imported into MEPAS, the "Anemometer height" will be loaded into the MEPAS variable "AJ-ANEMHT—Anemometer height." This parameter is not used in the generation of the JFD file, but it is needed for subsequent computations by the air-dispersion model using the JFD.

2.2.10 Surface Roughness Length (cm)

Enter an average roughness length for the area surrounding the weather station being used to generate a summary for wind joint frequency. The typical value for roughness length is 10 cm. When the JFD are imported into MEPAS, the "Surface roughness length" will be loaded into the MEPAS variable "AJ-RLEN—Average roughness length." This parameter is not used in the generation of the JFD file but is needed for subsequent computations by the air-dispersion model using the JFD.

2.2.11 Months to Include

Check the months during the year that are to be used to generate the JFD. Climatological air-dispersion models such as MEPAS consider annual exposures—and normally all months are checked to create an annual JFD summary. This option allows JFD files to be created based on some subset of the months with emissions—the months with emissions should be checked.

2.2.12 Generate JFD

When all the required fields are populated, click on this button to create an output JFD data file.

3.0 JFD Generator Application Notes

The JFD Generator needs to be applied in a fashion consistent with certain application constraints. If the output JFD data file fails to be created, the cause is normally an early termination of the STAR program by an incorrect entry for one of the input parameters. Also, it is important to select the input file by using the browse button (rather than by typing the path and name) to confirm that the path is properly set in the program. The JFD Generator needs to be applied in a fashion consistent with the following assumptions:

- All surface observation data processed should be for 1964 or later. The revised STAR program does not apply to data formats for wind direction used before 1964.

- The revised STAR program should be used only to generate the JFD files in the enhanced JFD format. These files are in a format that can be directly read by MEPAS or with modifications by other air-dispersion models. The enhanced format for the JFD files facilitates the accurate transfer of important site and table data needed to properly use the JFD. Although the capability still exists in the revised STAR code to generate summaries for other models, that capability has not been tested for the revised version of the STAR program and thus is unavailable in the JFD generator interface.

- The revised STAR program implements a proportional directional binning of observations. The original STAR program had a bias for certain wind directions generated by the process of binning reported wind-direction observations in thirty-six 10-degree sectors into the sixteen 22.5-degree sectors used in the JFD tables. The revised STAR program eliminates this bias such that the input of uniform frequencies of winds in thirty-six 10-degree sectors gives uniform frequencies in the sixteen 22.5-degree sectors.

- Calm conditions are not listed separately in the JFD output tables but rather are binned as low-wind-speed occurrences by the STAR program. This assignment of calms to low-wind conditions is equivalent to the manner in which calm conditions are used in the MEPAS code.

- The STAR program is designed for use only with data from the United States.

Additional documentation for the JFD Generator is provided in the Appendices. Appendix A documents the content of the enhanced JFD file format, and Appendix B details revised input file formats used to select run-time options.

4.0 Test Cases

Two test cases are provided. The first is based on the test case distributed with the STAR software. Appendices C and D contain the results of test runs with the original STAR program and the revised STAR program (STARR), respectively. Appendices D, E, and F contain the results and input data for a test case with uniform frequency of wind directions in all directions. Appendix G contains a list of test files for distribution with the STARR program.

These test cases verify that the STARR program is computing stability categories and binning observations in a manner consistent with the STAR program. Although the STARR program provides the same frequencies for a given stability/wind speed column, the frequencies of occurrence are slightly shifted. These shifts reflect the upgrade in the revised version that corrects the EPA STARR code such that “uniform winds” in the input also results in “uniform winds” in the output. The corrected issue applies to processing winds reported in 10-degree sectors to the 22.5-degree sectors in the STAR output.

5.0 References

Lakes Environmental. 2006. "Risk Assessment and Air Dispersion Modeling Website." Meteorological Data. Available at: http://www.lakes-environmental.com/, accessed October 2, 2006.

National Oceanic and Atmospheric Administration (NOAA). 2006. *National Weather Service*. Available at: http://www.nws.noaa.gov, accessed October 2, 2006.

U.S. Environmental Protection Agency (EPA). 2006. "Support Center for Regulatory Atmospheric Modeling (SCRAM)." Meteorological Data, available at: http://www.epa.gov/scram001/, accessed October 2, 2006.

Appendix A

Enhanced JFD File Format

Appendix A: Enhanced JFD File Format

The formats for the enhanced JFD file are:

Line 1: Free format comma-separated variable
Format Information (A10)
The first column is always equal to 6.
Columns 2 to 10 contain the Fortran format for subsequent lines of data.
Station ID, Integer (I5)
Year, Integer (I2)
Station, Alphanumeric (A20)
State, Alphanumeric (A2)
N/S, "N" (A1)
Latitude, XX.XX DEG (F8.3)
E/W, "W" (A1)
Longitude, XXX.XX DEG (F8.3)
Station Elevation, m (I4)
Wind Measurement Height, HT (m)
Local Surface Roughness, ZO (cm)
Fraction of year modeled, F7.4
Months of year modeled (4 values, I3)
Time Zone, ZON (F5.0)
ETZ = 075
CTZ = 090
MTZ = 105
PTZ = 120
Alaska Time Zone = 150

Lines 2 to 113 (7*16 + 1)
Seven joint frequency tables for stability (A-G) where each table has 16 lines, one for each wind direction, starting at North and turning clockwise, and each line has six entries, one for each wind speed group.

Lines 114 to 115
Frequency information for seven stability categories. Note that calm entries are distributed in the main summary table, and these entries will always be zero using the JFD generator.

Line 116

Mid-points for the wind-speed groups used in generating the JFD tables.

An example of the enhanced JFD output file is shown in Table A.1 based on the STAR test case.

Table A.1. Example of Enhanced JFD Output Format (STAR Test Case)

```
6(6F10.3) ,94823,"Pittsburgh 1964 cdm2  ","PA",  0,"N",40.50,"W", 80.22, 721, 6.1, 10.,  .2500,000,000,000,111, 75.
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000000   .000000   .000000   .000000
   .000000   .000000   .000397   .000000   .000000   .000000
   .000000   .000000   .000170   .000000   .000000   .000000
   .000000   .000000   .000793   .000000   .000000   .000000
   .001272   .000453   .000000   .000000   .000000   .000000
   .000747   .000906   .000397   .000000   .000000   .000000
   .000247   .000114   .000057   .000000   .000000   .000000
   .001342   .001246   .000000   .000000   .000000   .000000
   .000360   .000000   .000000   .000000   .000000   .000000
   .000719   .000000   .000000   .000000   .000000   .000000
   .001381   .000057   .000057   .000000   .000000   .000000
   .001734   .000567   .000397   .000000   .000000   .000000
   .000512   .000567   .000736   .000000   .000000   .000000
   .000612   .001472   .000170   .000000   .000000   .000000
   .000138   .000510   .000510   .000000   .000000   .000000
   .000000   .000000   .000397   .000000   .000000   .000000
   .000124   .001303   .001416   .000000   .000000   .000000
   .000215   .002265   .002039   .000000   .000000   .000000
   .000027   .000284   .000793   .000000   .000000   .000000
   .000199   .002095   .001812   .000000   .000000   .000000
   .000716   .002322   .001755   .000000   .000000   .000000
   .001222   .002435   .003680   .000000   .000000   .000000
   .000209   .002208   .002322   .000000   .000000   .000000
   .000678   .001925   .002208   .000000   .000000   .000000
```

.000461	.004869	.001020	.000284	.000000	.000000
.000584	.001586	.001076	.000170	.000000	.000000
.000170	.001133	.000623	.000000	.000000	.000000
.000386	.004077	.007190	.000170	.000000	.000000
.000236	.002491	.004020	.000736	.000000	.000000
.000118	.001246	.003397	.000850	.000000	.000000
.000097	.001020	.001586	.000057	.000000	.000000
.000000	.000000	.000850	.000000	.000000	.000000
.000787	.003680	.018230	.007473	.000000	.000000
.000762	.004133	.010530	.004813	.000000	.000000
.000478	.005152	.004190	.000453	.000057	.000000
.000595	.007360	.003963	.002548	.000397	.000000
.000832	.006511	.004643	.001586	.000000	.000000
.001185	.006341	.003114	.001020	.000000	.000000
.001239	.009285	.008606	.007360	.000000	.000000
.000663	.008209	.016475	.002831	.000000	.000000
.000800	.009908	.018060	.007417	.000000	.000000
.000430	.005322	.010644	.009794	.000000	.000000
.001151	.005152	.024910	.028816	.004416	.000453
.003045	.005888	.015286	.028080	.004586	.001076
.001449	.004303	.016928	.036346	.005832	.001020
.000293	.003624	.017494	.032270	.004756	.000963
.001930	.005718	.022872	.022306	.005775	.000623
.000220	.002718	.024627	.014323	.000000	.000397
.000000	.001133	.002775	.000000	.000000	.000000
.000000	.001020	.001416	.000000	.000000	.000000
.000000	.001586	.001416	.000000	.000000	.000000
.000000	.005096	.000397	.000000	.000000	.000000
.000000	.006511	.000284	.000000	.000000	.000000
.000000	.010644	.001359	.000000	.000000	.000000
.000000	.009228	.002095	.000000	.000000	.000000
.000000	.006737	.001755	.000000	.000000	.000000
.000000	.009681	.001699	.000000	.000000	.000000
.000000	.004756	.005549	.000000	.000000	.000000
.000000	.003510	.008719	.000000	.000000	.000000
.000000	.004303	.010021	.000000	.000000	.000000
.000000	.003737	.010474	.000000	.000000	.000000
.000000	.003624	.004416	.000000	.000000	.000000
.000000	.003680	.003737	.000000	.000000	.000000
.000000	.002661	.003227	.000000	.000000	.000000
.001930	.001133	.000000	.000000	.000000	.000000
.002176	.003510	.000000	.000000	.000000	.000000
.005011	.004699	.000000	.000000	.000000	.000000

.006807	.005265	.000000	.000000	.000000	.000000
.009194	.006115	.000000	.000000	.000000	.000000
.011062	.007134	.000000	.000000	.000000	.000000
.007326	.006058	.000000	.000000	.000000	.000000
.006174	.003624	.000000	.000000	.000000	.000000
.010809	.010361	.000000	.000000	.000000	.000000
.004306	.006454	.000000	.000000	.000000	.000000
.005839	.007983	.000000	.000000	.000000	.000000
.007115	.009681	.000000	.000000	.000000	.000000
.009888	.010757	.000000	.000000	.000000	.000000
.005423	.006737	.000000	.000000	.000000	.000000
.005742	.006681	.000000	.000000	.000000	.000000
.002655	.003907	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000					
.771666	2.057776	3.858330	6.331618	9.343415	12.709790

Appendix B

Revised Star Run-Time Format

Appendix B: Revised Star Run-Time Format

The revised STAR program, STARR, can be run in Command Mode using the following command:

STARR.EXE MET.IN SURFACE.DAT OUTFILE.LST OUTFILE.JFD

where MET.IN is a runtime file, SURFACE.DAT is the name of the surface data-input file, OUTFILE.LST is the name of the run documentation file, and OUTFILE.JFD is the name of the JFD output file. OUTFILE.LST includes a copy of the data in OUTFILE.JFD.

STARR uses a revised file format in MET.IN to define run-time options. This run-time file has one line of data values in free format (comma separated), which for the STAR test case has the form of:

```
94823,64,'Pittsburgh 1964 cdm2','PA',40.5,80.22,75,3,1,0,0,0,0,0,0,0,0,1,1,1,721,06.1,10.0
```

Table B.1. documents the parameters contained in this run-time file.

Table B.1. Contents of Revised STAR Program Run-time Options File[a]

Parameter Name	Typical Format[(b)]	Units	DAT Files	SAM Files	Description	STAR Test Case
Site ID	I5	integer	Yes	Yes	Same as JFD User Interface	94823
Year	I2	integer	Yes	Yes	Same as JFD User Interface	64
Station	A20	text	No	Yes	Same as JFD User Interface	'Pittsburgh 1964 cdm2'
State	A2	text	No	Yes	Same as JFD User Interface	'PA'
Lat.	F8.3	degrees	No	Yes	Same as JFD User Interface	40.5
Long.	F8.3	degrees	No	Yes	Same as JFD User Interface	80.22
Time Zone	I3	none	No	Yes	ETZ=075, CTZ=090, MTZ=105, PTZ=120	75
IMOD[(c)]	I1	none	No	No	Model format selection: CDM-2=1, ISCLT=2, LONGZ=2, VALLEY=2, MEPAS=3	3
ITST	I1	none	No	No	Use Months Options, ITST: ITST: YES=1 or NO=0.	1
IMO(12)	I1		No	No	If ITST is YES IMO defines what months (1-12) where YES=1 or NO=0.	0,0,0,0,0,0,0,0,0,1,1,1
ELEVATION	I3	m	Yes	Yes	Same as JFD User Interface	721
WINDHT	F8.1	m	Yes	No	Same as JFD User Interface	6.1
ZO	I3	cm	Yes	No	Same as JFD User Interface	10

(a) IMOD, ITST, IMO, and ELEVATION are run option control variables used in STAR and STARR. WINDHT (wind measurement height) and ZO (surface roughness length) are surface station characteristics data variables required by STARR.

(b) Parameters are entered on the input line in a comma-separated free format.

(c) IMOD = image processing, modeling, and display program.

Appendix C

STAR Test Case: STAR Runs

Appendix C: STAR Test Case: STAR Runs

The test case distributed with the USEPA STAR program for an image processing, modeling, and display program (IMOD) option of "2" is used to test if the revised version of the STAR program is working correctly (i.e., providing the same results as the original distributed version). The test case is run using the command:

STAR.EXE<TEST2.IN SFC2.DAT>FILE2.OUT OUT2.MOD

TEST2.IN is the run-time file that has one line of data:

```
94823640pittsburgh 1964 cdm2    40.5   80.2207521000      111
```

SFC2.DAT is the CD-144 format file distributed with the STAR program. FILE2.OUT and OUT2.MOD are the STAR output programs.

FILE2.OUT has the following content:

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0

W	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	

NUMBER OF OCCURENCES OF A STABILITY = 0

NUMBER OF CALMS WITH A STABILITY = 0

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ENE	.000000	.000000	.000000	.000000	.000000	.000000	.000000

E	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ESE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
S	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
W	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF A STABILITY = .000000

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = .000000

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	0	0	0	0	0	0	0
NNE	0	0	1	0	0	0	1
NE	0	0	0	0	0	0	0
ENE	0	0	2	0	0	0	2
E	2	1	0	0	0	0	3
ESE	1	2	1	0	0	0	4
SE	0	0	0	0	0	0	0
SSE	2	3	0	0	0	0	5
S	1	0	0	0	0	0	1
SSW	1	0	0	0	0	0	1
SW	2	0	0	0	0	0	2
WSW	3	1	1	0	0	0	5
W	1	2	2	0	0	0	5
WNW	0	3	0	0	0	0	3

NW	0	1	1	0	0	0	2
NNW	0	0	1	0	0	0	1
TOTAL	13	13	9	0	0	0	

NUMBER OF OCCURENCES OF B STABILITY = 42

NUMBER OF CALMS WITH B STABILITY = 7

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000453	.000000	.000000	.000000	.000453
NE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ENE	.000000	.000000	.000906	.000000	.000000	.000000	.000906
E	.001272	.000453	.000000	.000000	.000000	.000000	.001724
ESE	.000819	.000906	.000453	.000000	.000000	.000000	.002177

SE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSE	.001515	.001359	.000000	.000000	.000000	.000000	.002874
S	.000575	.000000	.000000	.000000	.000000	.000000	.000575
SSW	.000575	.000000	.000000	.000000	.000000	.000000	.000575
SW	.001150	.000000	.000000	.000000	.000000	.000000	.001150
WSW	.001846	.000453	.000453	.000000	.000000	.000000	.002752
W	.000819	.000906	.000906	.000000	.000000	.000000	.002630
WNW	.000366	.001359	.000000	.000000	.000000	.000000	.001724
NW	.000122	.000453	.000453	.000000	.000000	.000000	.001028
NNW	.000000	.000000	.000453	.000000	.000000	.000000	.000453
TOTAL	.009058	.005888	.004076	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF B STABILITY = .019022

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = .003170

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

	SPEED(MPH)						
DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	0	4	5	0	0	0	9
NNE	0	4	3	0	0	0	7
NE	0	0	1	0	0	0	1
ENE	0	4	4	0	0	0	8
E	1	7	5	0	0	0	13
ESE	2	5	8	0	0	0	15
SE	0	4	4	0	0	0	8
SSE	1	4	5	0	0	0	10
S	0	13	3	1	0	0	17
SSW	1	2	2	0	0	0	5
SW	0	2	1	0	0	0	3
WSW	0	8	14	0	0	0	22
W	0	7	13	2	0	0	22
WNW	0	3	6	2	0	0	11
NW	0	2	3	0	0	0	5
NNW	0	0	2	0	0	0	2

TOTAL	5	69	79	5	0	0

NUMBER OF OCCURENCES OF C STABILITY = 165

NUMBER OF CALMS WITH C STABILITY = 7

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000171	.001812	.002264	.000000	.000000	.000000	.004247
NNE	.000171	.001812	.001359	.000000	.000000	.000000	.003342
NE	.000000	.000000	.000453	.000000	.000000	.000000	.000453
ENE	.000171	.001812	.001812	.000000	.000000	.000000	.003795
E	.000796	.003170	.002264	.000000	.000000	.000000	.006230
ESE	.001206	.002264	.003623	.000000	.000000	.000000	.007093
SE	.000171	.001812	.001812	.000000	.000000	.000000	.003795
SSE	.000667	.001812	.002264	.000000	.000000	.000000	.004743

S	.000557	.005888	.001359	.000453	.000000	.000000	.008256
SSW	.000581	.000906	.000906	.000000	.000000	.000000	.002393
SW	.000086	.000906	.000453	.000000	.000000	.000000	.001444
WSW	.000343	.003623	.006341	.000000	.000000	.000000	.010307
W	.000300	.003170	.005888	.000906	.000000	.000000	.010264
WNW	.000129	.001359	.002717	.000906	.000000	.000000	.005110
NW	.000086	.000906	.001359	.000000	.000000	.000000	.002350
NNW	.000000	.000000	.000906	.000000	.000000	.000000	.000906
TOTAL	.005435	.031250	.035779	.002264	.000000	.000000	

FREQUENCY OF OCCURENCE OF C STABILITY = .074728

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = .003170

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	1	10	50	21	0	0	82
NNE	1	9	21	10	0	0	41
NE	0	10	8	0	0	0	18
ENE	0	14	7	5	1	0	27
E	1	20	14	5	0	0	40
ESE	1	12	6	2	0	0	21
SE	1	19	17	16	0	0	53
SSE	0	16	28	3	0	0	47
S	0	26	53	22	0	0	101
SSW	0	11	22	21	0	0	54
SW	1	10	51	60	9	1	132
WSW	5	11	28	49	9	2	104
W	3	14	49	108	17	3	194
WNW	0	7	38	62	9	2	118
NW	3	12	45	44	12	1	117
NNW	0	5	50	30	0	1	86
TOTAL	17	206	487	458	57	10	

NUMBER OF OCCURENCES OF D STABILITY = 1253

NUMBER OF CALMS WITH D STABILITY = 18

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000855	.004529	.022645	.009511	.000000	.000000	.037540
NNE	.000818	.004076	.009511	.004529	.000000	.000000	.018934
NE	.000366	.004529	.003623	.000000	.000000	.000000	.008518
ENE	.000512	.006341	.003170	.002264	.000453	.000000	.012740
E	.001221	.009058	.006341	.002264	.000000	.000000	.018884
ESE	.000928	.005435	.002717	.000906	.000000	.000000	.009986
SE	.001184	.008605	.007699	.007246	.000000	.000000	.024735
SSE	.000585	.007246	.012681	.001359	.000000	.000000	.021871
S	.000950	.011775	.024004	.009964	.000000	.000000	.046693
SSW	.000402	.004982	.009964	.009511	.000000	.000000	.024859

SW	.000855	.004529	.023098	.027174	.004076	.000453	.060185
WSW	.002849	.004982	.012681	.022192	.004076	.000906	.047686
W	.001980	.006341	.022192	.048913	.007699	.001359	.088484
WNW	.000256	.003170	.017210	.028080	.004076	.000906	.053698
NW	.001907	.005435	.020380	.019928	.005435	.000453	.053537
NNW	.000183	.002264	.022645	.013587	.000000	.000453	.039132
TOTAL	.015851	.093297	.220562	.207428	.025815	.004529	

FREQUENCY OF OCCURENCE OF D STABILITY = .567482

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = .008152

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	0	4	8	0	0	0	12

NNE	0	2	2	0	0	0	4
NE	0	3	3	0	0	0	6
ENE	0	9	1	0	0	0	10
E	0	20	1	0	0	0	21
ESE	0	22	3	0	0	0	25
SE	0	18	4	0	0	0	22
SSE	0	12	3	0	0	0	15
S	0	27	6	0	0	0	33
SSW	0	9	12	0	0	0	21
SW	0	7	17	0	0	0	24
WSW	0	8	19	0	0	0	27
W	0	12	31	0	0	0	43
WNW	0	7	7	0	0	0	14
NW	0	7	7	0	0	0	14
NNW	0	5	7	0	0	0	12
TOTAL	0	172	131	0	0	0	

NUMBER OF OCCURENCES OF E STABILITY = 303

NUMBER OF CALMS WITH E STABILITY = 0

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.001812	.003623	.000000	.000000	.000000	.005435
NNE	.000000	.000906	.000906	.000000	.000000	.000000	.001812
NE	.000000	.001359	.001359	.000000	.000000	.000000	.002717
ENE	.000000	.004076	.000453	.000000	.000000	.000000	.004529
E	.000000	.009058	.000453	.000000	.000000	.000000	.009511
ESE	.000000	.009964	.001359	.000000	.000000	.000000	.011322
SE	.000000	.008152	.001812	.000000	.000000	.000000	.009964
SSE	.000000	.005435	.001359	.000000	.000000	.000000	.006793
S	.000000	.012228	.002717	.000000	.000000	.000000	.014946
SSW	.000000	.004076	.005435	.000000	.000000	.000000	.009511
SW	.000000	.003170	.007699	.000000	.000000	.000000	.010870
WSW	.000000	.003623	.008605	.000000	.000000	.000000	.012228

W	.000000	.005435	.014040	.000000	.000000	.000000	.019475
WNW	.000000	.003170	.003170	.000000	.000000	.000000	.006341
NW	.000000	.003170	.003170	.000000	.000000	.000000	.006341
NNW	.000000	.002264	.003170	.000000	.000000	.000000	.005435
TOTAL	.000000	.077899	.059330	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF E STABILITY = .137228

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = .000000

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	3	4	0	0	0	0	7
NNE	0	7	0	0	0	0	7
NE	3	9	0	0	0	0	12

ENE	5	10	0	0	0	0	15
E	11	18	0	0	0	0	29
ESE	9	15	0	0	0	0	24
SE	5	12	0	0	0	0	17
SSE	5	6	0	0	0	0	11
S	10	27	0	0	0	0	37
SSW	0	13	0	0	0	0	13
SW	2	16	0	0	0	0	18
WSW	2	19	0	0	0	0	21
W	8	29	0	0	0	0	37
WNW	1	14	0	0	0	0	15
NW	3	13	0	0	0	0	16
NNW	0	9	0	0	0	0	9
TOTAL	67	221	0	0	0	0	

NUMBER OF OCCURENCES OF F STABILITY = 445

NUMBER OF CALMS WITH F STABILITY = 157

STATION: 94823 YEAR: 64 RUN ID: pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.003087	.001812	.000000	.000000	.000000	.000000	.004899
NNE	.001728	.003170	.000000	.000000	.000000	.000000	.004899
NE	.004321	.004076	.000000	.000000	.000000	.000000	.008397
ENE	.005968	.004529	.000000	.000000	.000000	.000000	.010497
E	.012142	.008152	.000000	.000000	.000000	.000000	.020294
ESE	.010002	.006793	.000000	.000000	.000000	.000000	.016795
SE	.006462	.005435	.000000	.000000	.000000	.000000	.011896
SSE	.004980	.002717	.000000	.000000	.000000	.000000	.007698
S	.013664	.012228	.000000	.000000	.000000	.000000	.025892
SSW	.003210	.005888	.000000	.000000	.000000	.000000	.009097
SW	.005350	.007246	.000000	.000000	.000000	.000000	.012596
WSW	.006091	.008605	.000000	.000000	.000000	.000000	.014696
W	.012758	.013134	.000000	.000000	.000000	.000000	.025892
WNW	.004156	.006341	.000000	.000000	.000000	.000000	.010497

NW	.005309	.005888	.000000	.000000	.000000	.000000	.011197
NNW	.002222	.004076	.000000	.000000	.000000	.000000	.006298
TOTAL	.101449	.100091	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF F STABILITY = .201540

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = .071105

.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000453	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000906	.000000	.000000	.000000
.001272	.000453	.000000	.000000	.000000	.000000
.000819	.000906	.000453	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000

.001516	.001359	.000000	.000000	.000000	.000000
.000575	.000000	.000000	.000000	.000000	.000000
.000575	.000000	.000000	.000000	.000000	.000000
.001150	.000000	.000000	.000000	.000000	.000000
.001847	.000453	.000453	.000000	.000000	.000000
.000819	.000906	.000906	.000000	.000000	.000000
.000366	.001359	.000000	.000000	.000000	.000000
.000122	.000453	.000453	.000000	.000000	.000000
.000000	.000000	.000453	.000000	.000000	.000000
.000172	.001812	.002265	.000000	.000000	.000000
.000172	.001812	.001359	.000000	.000000	.000000
.000000	.000000	.000453	.000000	.000000	.000000
.000172	.001812	.001812	.000000	.000000	.000000
.000796	.003171	.002265	.000000	.000000	.000000
.001206	.002265	.003624	.000000	.000000	.000000
.000172	.001812	.001812	.000000	.000000	.000000
.000668	.001812	.002265	.000000	.000000	.000000
.000557	.005888	.001359	.000453	.000000	.000000
.000582	.000906	.000906	.000000	.000000	.000000
.000086	.000906	.000453	.000000	.000000	.000000
.000343	.003624	.006341	.000000	.000000	.000000
.000300	.003171	.005888	.000906	.000000	.000000
.000129	.001359	.002718	.000906	.000000	.000000
.000086	.000906	.001359	.000000	.000000	.000000
.000000	.000000	.000906	.000000	.000000	.000000
.000856	.004529	.022645	.009511	.000000	.000000
.000819	.004077	.009511	.004529	.000000	.000000
.000366	.004529	.003624	.000000	.000000	.000000
.000512	.006341	.003171	.002265	.000453	.000000
.001221	.009058	.006341	.002265	.000000	.000000
.000929	.005435	.002718	.000906	.000000	.000000
.001185	.008606	.007700	.007247	.000000	.000000
.000585	.007247	.012682	.001359	.000000	.000000
.000951	.011776	.024004	.009964	.000000	.000000
.000403	.004982	.009964	.009511	.000000	.000000
.000856	.004529	.023098	.027174	.004077	.000453
.002850	.004982	.012682	.022193	.004077	.000906
.001981	.006341	.022193	.048914	.007700	.001359

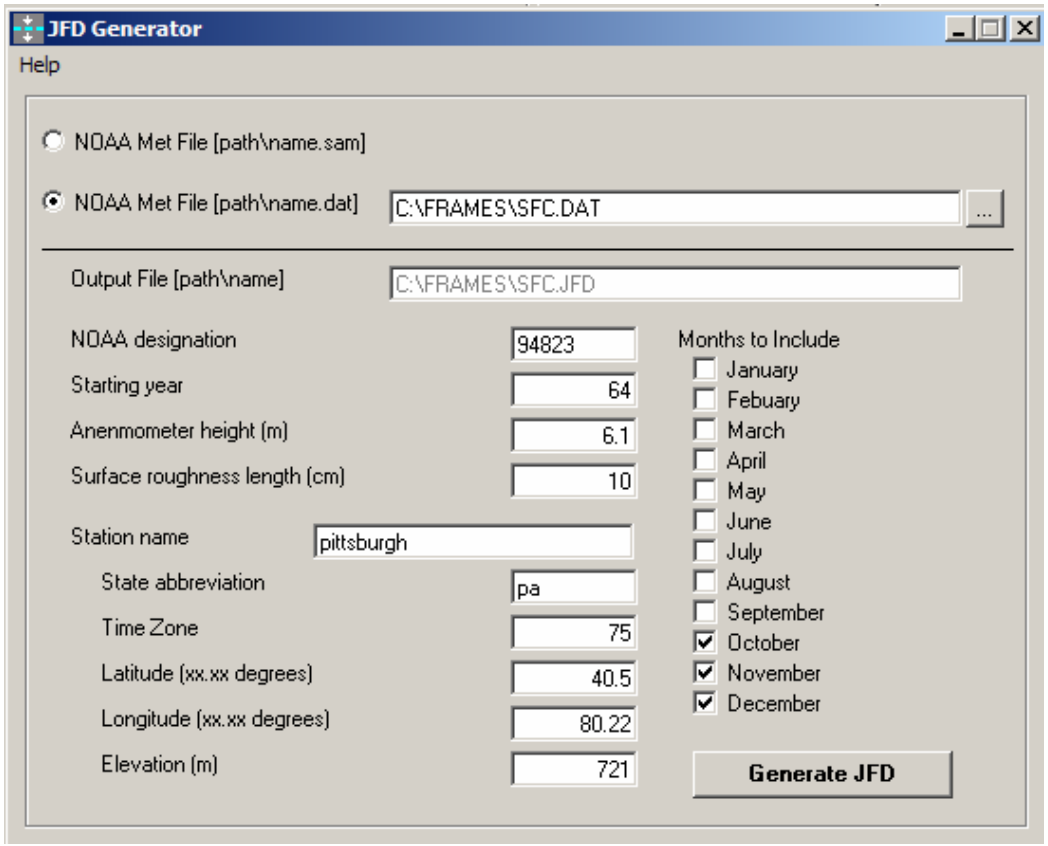
```
.000256   .003171   .017211   .028080   .004077   .000906
.001908   .005435   .020381   .019928   .005435   .000453
.000183   .002265   .022645   .013587   .000000   .000453
.000000   .001812   .003624   .000000   .000000   .000000
.000000   .000906   .000906   .000000   .000000   .000000
.000000   .001359   .001359   .000000   .000000   .000000
.000000   .004077   .000453   .000000   .000000   .000000
.000000   .009058   .000453   .000000   .000000   .000000
.000000   .009964   .001359   .000000   .000000   .000000
.000000   .008153   .001812   .000000   .000000   .000000
.000000   .005435   .001359   .000000   .000000   .000000
.000000   .012229   .002718   .000000   .000000   .000000
.000000   .004077   .005435   .000000   .000000   .000000
.000000   .003171   .007700   .000000   .000000   .000000
.000000   .003624   .008606   .000000   .000000   .000000
.000000   .005435   .014040   .000000   .000000   .000000
.000000   .003171   .003171   .000000   .000000   .000000
.000000   .003171   .003171   .000000   .000000   .000000
.000000   .002265   .003171   .000000   .000000   .000000
.003087   .001812   .000000   .000000   .000000   .000000
.001729   .003171   .000000   .000000   .000000   .000000
.004322   .004077   .000000   .000000   .000000   .000000
.005968   .004529   .000000   .000000   .000000   .000000
.012142   .008153   .000000   .000000   .000000   .000000
.010002   .006794   .000000   .000000   .000000   .000000
.006462   .005435   .000000   .000000   .000000   .000000
.004981   .002718   .000000   .000000   .000000   .000000
.013665   .012229   .000000   .000000   .000000   .000000
.003210   .005888   .000000   .000000   .000000   .000000
.005350   .007247   .000000   .000000   .000000   .000000
.006091   .008606   .000000   .000000   .000000   .000000
.012759   .013135   .000000   .000000   .000000   .000000
.004157   .006341   .000000   .000000   .000000   .000000
.005309   .005888   .000000   .000000   .000000   .000000
.002223   .004077   .000000   .000000   .000000   .000000

          PROGRAM HAS FINISHED
Stop - Program terminated.
```

Appendix D

STAR Test Case: STARR (Revised Code) Runs

Appendix D: STAR Test Case: STARR (Revised Code) Runs

The test case distributed with the U.S. Environmental Protection Agency STAR program for an IMOD option of "2" is used to test if the revised version of the STAR program is working correctly (i.e., providing the same results as the original distributed version). The revised version may be run using the JFD Generator using



or by running the command line:

```
STARR.EXE TEST2.IN SFC.DAT TEST2.LST TEST2.JFD
```

TEST2.IN is the run-time file which has one line of data (note the format is different that used for the STAR test run). This file is created automatically by the JFD Generator:

```
94823,64,'Pittsburgh 1964 cdm2','PA',40.5,80.22,75,3,1,0,0,0,0,0,0,0,0,1,1,1,721,06.1,10.0
```

SFC.DAT is the CD-144 format file distributed with the STAR program. TEST2.LST AND TEST2.JFD are the STAR output programs.

TEST2.LST has the following content:

```
 ARAMS/FRAMES Version of EPA STAR Program
JG Droppo, Pacific Northwest National Laboratory
PO Box 999, Richland WA 99352
Version: (05Sept2006) STARR

Wind Speed Midpoints (based on inverse averages):
 1     .77 m/s
 2    2.06 m/s
 3    3.86 m/s
 4    6.33 m/s
 5    9.34 m/s
 6   12.71 m/s

CD-144 Format Data
 NSTA,IYEAR
      94823          64
 LOCA=Pittsburgh 1964 cdm2
 ALAT=      40.500000
 ALON=      80.220000
 ZON=      75.000000
 IMOD=           3
 IMETHOD =           2
 IMEP=           0
 ITST=           1
```

```
MONTHS  000 000 000 111
 Wind HT(m)=       6.100000
 ZO(cm) =      10.000000
 Elevation(m) =        721
END OF DATA, Total obs =    2208.000000
             Obs/365   =       6.049315
             Obs/365/24=   2.520548E-01
```

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	.00	.00	.00	.00
0	NNE	.00	.00	.00	.00	.00	.00	.00
0	NE	.00	.00	.00	.00	.00	.00	.00
0	ENE	.00	.00	.00	.00	.00	.00	.00
0	E	.00	.00	.00	.00	.00	.00	.00
0	ESE	.00	.00	.00	.00	.00	.00	.00
0	SE	.00	.00	.00	.00	.00	.00	.00
0	SSE	.00	.00	.00	.00	.00	.00	.00
0	S	.00	.00	.00	.00	.00	.00	.00
0	SSW	.00	.00	.00	.00	.00	.00	.00
0	SW	.00	.00	.00	.00	.00	.00	.00
0	WSW	.00	.00	.00	.00	.00	.00	.00
0	W	.00	.00	.00	.00	.00	.00	.00
0	WNW	.00	.00	.00	.00	.00	.00	.00
0	NW	.00	.00	.00	.00	.00	.00	.00
0	NNW	.00	.00	.00	.00	.00	.00	.00
	TOTAL	.00	.00	.00	.00	.00	.00	

NUMBER OF OCCURENCES OF A STABILITY = 0

NUMBER OF CALMS WITH A STABILITY = .00

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ENE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
E	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ESE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
S	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
W	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF A STABILITY = .000000

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = .000000

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	.00	.00	.00	.00
0	NNE	.00	.00	.88	.00	.00	.00	.88
0	NE	.00	.00	.38	.00	.00	.00	.38
0	ENE	.00	.00	1.75	.00	.00	.00	1.75
0	E	2.00	1.00	.00	.00	.00	.00	3.00
0	ESE	.88	2.00	.88	.00	.00	.00	3.75
0	SE	.38	.25	.13	.00	.00	.00	.75
0	SSE	1.75	2.75	.00	.00	.00	.00	4.50
0	S	.63	.00	.00	.00	.00	.00	.63
0	SSW	1.25	.00	.00	.00	.00	.00	1.25
0	SW	2.38	.13	.13	.00	.00	.00	2.63
0	WSW	2.75	1.25	.88	.00	.00	.00	4.88
0	W	.63	1.25	1.63	.00	.00	.00	3.50
0	WNW	.38	3.25	.38	.00	.00	.00	4.00
0	NW	.00	1.13	1.13	.00	.00	.00	2.25
0	NNW	.00	.00	.88	.00	.00	.00	.88
	TOTAL	13.00	13.00	9.00	.00	.00	.00	

NUMBER OF OCCURENCES OF B STABILITY = 42

NUMBER OF CALMS WITH B STABILITY = 7.00

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000396	.000000	.000000	.000000	.000396
NE	.000000	.000000	.000170	.000000	.000000	.000000	.000170
ENE	.000000	.000000	.000793	.000000	.000000	.000000	.000793
E	.001272	.000453	.000000	.000000	.000000	.000000	.001724
ESE	.000747	.000906	.000396	.000000	.000000	.000000	.002049
SE	.000246	.000113	.000057	.000000	.000000	.000000	.000416
SSE	.001341	.001245	.000000	.000000	.000000	.000000	.002587
S	.000359	.000000	.000000	.000000	.000000	.000000	.000359
SSW	.000719	.000000	.000000	.000000	.000000	.000000	.000719
SW	.001380	.000057	.000057	.000000	.000000	.000000	.001494
WSW	.001733	.000566	.000396	.000000	.000000	.000000	.002696
W	.000512	.000566	.000736	.000000	.000000	.000000	.001814
WNW	.000612	.001472	.000170	.000000	.000000	.000000	.002254
NW	.000137	.000510	.000510	.000000	.000000	.000000	.001156
NNW	.000000	.000000	.000396	.000000	.000000	.000000	.000396
TOTAL	.009058	.005888	.004076	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF B STABILITY = .019022

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = .003170

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	2.88	3.13	.00	.00	.00	6.00
0	NNE	.00	5.00	4.50	.00	.00	.00	9.50
0	NE	.00	.63	1.75	.00	.00	.00	2.38
0	ENE	.00	4.63	4.00	.00	.00	.00	8.63
0	E	1.00	5.13	3.88	.00	.00	.00	10.00
0	ESE	2.00	5.38	8.13	.00	.00	.00	15.50
0	SE	.00	4.88	5.13	.00	.00	.00	10.00
0	SSE	1.00	4.25	4.88	.00	.00	.00	10.13
0	S	.00	10.75	2.25	.63	.00	.00	13.63
0	SSW	.88	3.50	2.38	.38	.00	.00	7.13
0	SW	.13	2.50	1.38	.00	.00	.00	4.00
0	WSW	.00	9.00	15.88	.38	.00	.00	25.25
0	W	.00	5.50	8.88	1.63	.00	.00	16.00
0	WNW	.00	2.75	7.50	1.88	.00	.00	12.13
0	NW	.00	2.25	3.50	.13	.00	.00	5.88
0	NNW	.00	.00	1.88	.00	.00	.00	1.88
	TOTAL	5.00	69.00	79.00	5.00	.00	.00	

NUMBER OF OCCURENCES OF C STABILITY = 165

NUMBER OF CALMS WITH C STABILITY = 7.00

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000123	.001302	.001415	.000000	.000000	.000000	.002841
NNE	.000214	.002264	.002038	.000000	.000000	.000000	.004517
NE	.000027	.000283	.000793	.000000	.000000	.000000	.001102
ENE	.000198	.002095	.001812	.000000	.000000	.000000	.004104
E	.000715	.002321	.001755	.000000	.000000	.000000	.004791
ESE	.001222	.002434	.003680	.000000	.000000	.000000	.007336
SE	.000209	.002208	.002321	.000000	.000000	.000000	.004738
SSE	.000678	.001925	.002208	.000000	.000000	.000000	.004811
S	.000461	.004869	.001019	.000283	.000000	.000000	.006631
SSW	.000584	.001585	.001076	.000170	.000000	.000000	.003414
SW	.000169	.001132	.000623	.000000	.000000	.000000	.001924
WSW	.000386	.004076	.007190	.000170	.000000	.000000	.011821
W	.000236	.002491	.004019	.000736	.000000	.000000	.007482
WNW	.000118	.001245	.003397	.000849	.000000	.000000	.005609
NW	.000096	.001019	.001585	.000057	.000000	.000000	.002757
NNW	.000000	.000000	.000849	.000000	.000000	.000000	.000849
TOTAL	.005435	.031250	.035779	.002264	.000000	.000000	

FREQUENCY OF OCCURENCE OF C STABILITY = .074728

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = .003170

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	1.00	8.13	40.25	16.50	.00	.00	65.88
0	NNE	.88	9.13	23.25	10.63	.00	.00	43.88
0	NE	.13	11.38	9.25	1.00	.13	.00	21.88
0	ENE	.00	16.25	8.75	5.63	.88	.00	31.50
0	E	.63	14.38	10.25	3.50	.00	.00	28.75
0	ESE	1.38	14.00	6.88	2.25	.00	.00	24.50
0	SE	1.00	20.50	19.00	16.25	.00	.00	56.75
0	SSE	.00	18.13	36.38	6.25	.00	.00	60.75
0	S	.00	21.88	39.88	16.38	.00	.00	78.13
0	SSW	.00	11.75	23.50	21.63	.00	.00	56.88
0	SW	1.50	11.38	55.00	63.63	9.75	1.00	142.25
0	WSW	5.25	13.00	33.75	62.00	10.13	2.38	126.50
0	W	2.25	9.50	37.38	80.25	12.88	2.25	144.50
0	WNW	.00	8.00	38.63	71.25	10.50	2.13	130.50
0	NW	3.00	12.63	50.50	49.25	12.75	1.38	129.50
0	NNW	.00	6.00	54.38	31.63	.00	.88	92.88
	TOTAL	17.00	206.00	487.00	458.00	57.00	10.00	

NUMBER OF OCCURENCES OF D STABILITY = 1253

NUMBER OF CALMS WITH D STABILITY = 18.00

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000786	.003680	.018229	.007473	.000000	.000000	.030168
NNE	.000762	.004133	.010530	.004812	.000000	.000000	.020236
NE	.000477	.005152	.004189	.000453	.000057	.000000	.010328
ENE	.000594	.007360	.003963	.002548	.000396	.000000	.014860
E	.000831	.006510	.004642	.001585	.000000	.000000	.013569
ESE	.001185	.006341	.003114	.001019	.000000	.000000	.011658
SE	.001239	.009284	.008605	.007360	.000000	.000000	.026488
SSE	.000663	.008209	.016474	.002831	.000000	.000000	.028176
S	.000800	.009907	.018059	.007416	.000000	.000000	.036182
SSW	.000430	.005322	.010643	.009794	.000000	.000000	.026188
SW	.001150	.005152	.024909	.028816	.004416	.000453	.064895
WSW	.003045	.005888	.015285	.028080	.004586	.001076	.057959
W	.001449	.004303	.016927	.036345	.005831	.001019	.065873
WNW	.000292	.003623	.017493	.032269	.004755	.000962	.059396
NW	.001930	.005718	.022871	.022305	.005774	.000623	.059222
NNW	.000219	.002717	.024626	.014323	.000000	.000396	.042282
TOTAL	.015851	.093297	.220562	.207428	.025815	.004529	

FREQUENCY OF OCCURENCE OF D STABILITY = .567482

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = .008152

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	2.50	6.13	.00	.00	.00	8.63
0	NNE	.00	2.25	3.13	.00	.00	.00	5.38
0	NE	.00	3.50	3.13	.00	.00	.00	6.63
0	ENE	.00	11.25	.88	.00	.00	.00	12.13
0	E	.00	14.38	.63	.00	.00	.00	15.00
0	ESE	.00	23.50	3.00	.00	.00	.00	26.50
0	SE	.00	20.38	4.63	.00	.00	.00	25.00
0	SSE	.00	14.88	3.88	.00	.00	.00	18.75
0	S	.00	21.38	3.75	.00	.00	.00	25.13
0	SSW	.00	10.50	12.25	.00	.00	.00	22.75
0	SW	.00	7.75	19.25	.00	.00	.00	27.00
0	WSW	.00	9.50	22.13	.00	.00	.00	31.63
0	W	.00	8.25	23.13	.00	.00	.00	31.38
0	WNW	.00	8.00	9.75	.00	.00	.00	17.75
0	NW	.00	8.13	8.25	.00	.00	.00	16.38
0	NNW	.00	5.88	7.13	.00	.00	.00	13.00
	TOTAL	.00	172.00	131.00	.00	.00	.00	

NUMBER OF OCCURENCES OF E STABILITY = 303

NUMBER OF CALMS WITH E STABILITY = .00

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.001132	.002774	.000000	.000000	.000000	.003906
NNE	.000000	.001019	.001415	.000000	.000000	.000000	.002434
NE	.000000	.001585	.001415	.000000	.000000	.000000	.003000
ENE	.000000	.005095	.000396	.000000	.000000	.000000	.005491
E	.000000	.006510	.000283	.000000	.000000	.000000	.006793
ESE	.000000	.010643	.001359	.000000	.000000	.000000	.012002
SE	.000000	.009228	.002095	.000000	.000000	.000000	.011322
SSE	.000000	.006737	.001755	.000000	.000000	.000000	.008492
S	.000000	.009681	.001698	.000000	.000000	.000000	.011379
SSW	.000000	.004755	.005548	.000000	.000000	.000000	.010303
SW	.000000	.003510	.008718	.000000	.000000	.000000	.012228
WSW	.000000	.004303	.010020	.000000	.000000	.000000	.014323
W	.000000	.003736	.010473	.000000	.000000	.000000	.014210
WNW	.000000	.003623	.004416	.000000	.000000	.000000	.008039
NW	.000000	.003680	.003736	.000000	.000000	.000000	.007416
NNW	.000000	.002661	.003227	.000000	.000000	.000000	.005888
TOTAL	.000000	.077899	.059330	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF E STABILITY = .137228

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = .000000

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	1.88	2.50	.00	.00	.00	.00	4.38
0	NNE	.38	7.75	.00	.00	.00	.00	8.13
0	NE	3.50	10.38	.00	.00	.00	.00	13.88
0	ENE	5.63	11.63	.00	.00	.00	.00	17.25
0	E	8.38	13.50	.00	.00	.00	.00	21.88
0	ESE	10.25	15.75	.00	.00	.00	.00	26.00
0	SE	5.75	13.38	.00	.00	.00	.00	19.13
0	SSE	6.00	8.00	.00	.00	.00	.00	14.00
0	S	7.38	22.88	.00	.00	.00	.00	30.25
0	SSW	1.13	14.25	.00	.00	.00	.00	15.38
0	SW	2.13	17.63	.00	.00	.00	.00	19.75
0	WSW	2.63	21.38	.00	.00	.00	.00	24.00
0	W	5.75	23.75	.00	.00	.00	.00	29.50
0	WNW	2.50	14.88	.00	.00	.00	.00	17.38
0	NW	3.00	14.75	.00	.00	.00	.00	17.75
0	NNW	.75	8.63	.00	.00	.00	.00	9.38
	TOTAL	67.00	221.00	.00	.00	.00	.00	

NUMBER OF OCCURENCES OF F STABILITY = 445

NUMBER OF CALMS WITH F STABILITY = 157.00

STATION:: 94823 YEAR: 64 RUN ID: Pittsburgh 1964 cdm2
MONTHS SELECTED: OCT NOV DEC

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.001929	.001132	.000000	.000000	.000000	.000000	.003062
NNE	.002176	.003510	.000000	.000000	.000000	.000000	.005686
NE	.005011	.004699	.000000	.000000	.000000	.000000	.009710
ENE	.006806	.005265	.000000	.000000	.000000	.000000	.012071
E	.009194	.006114	.000000	.000000	.000000	.000000	.015308
ESE	.011061	.007133	.000000	.000000	.000000	.000000	.018195
SE	.007326	.006058	.000000	.000000	.000000	.000000	.013384
SSE	.006174	.003623	.000000	.000000	.000000	.000000	.009797
S	.010809	.010360	.000000	.000000	.000000	.000000	.021169
SSW	.004305	.006454	.000000	.000000	.000000	.000000	.010759
SW	.005839	.007982	.000000	.000000	.000000	.000000	.013821
WSW	.007114	.009681	.000000	.000000	.000000	.000000	.016795
W	.009887	.010756	.000000	.000000	.000000	.000000	.020644
WNW	.005422	.006737	.000000	.000000	.000000	.000000	.012159
NW	.005741	.006680	.000000	.000000	.000000	.000000	.012421
NNW	.002654	.003906	.000000	.000000	.000000	.000000	.006561
TOTAL	.101449	.100091	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF F STABILITY = .201540

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = .071105

```
1
6(6F10.3) ,94823,”Pittsburgh 1964 cdm2  “,”PA”,  0,”N”,40.50,”W”, 80.22, 721, 6.1, 10.,  .2500,000,000,000,111, 75.
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000397   .000000   .000000   .000000
    .000000   .000000   .000170   .000000   .000000   .000000
    .000000   .000000   .000793   .000000   .000000   .000000
    .001272   .000453   .000000   .000000   .000000   .000000
    .000747   .000906   .000397   .000000   .000000   .000000
    .000247   .000114   .000057   .000000   .000000   .000000
    .001342   .001246   .000000   .000000   .000000   .000000
    .000360   .000000   .000000   .000000   .000000   .000000
    .000719   .000000   .000000   .000000   .000000   .000000
    .001381   .000057   .000057   .000000   .000000   .000000
    .001734   .000567   .000397   .000000   .000000   .000000
    .000512   .000567   .000736   .000000   .000000   .000000
    .000612   .001472   .000170   .000000   .000000   .000000
    .000138   .000510   .000510   .000000   .000000   .000000
    .000000   .000000   .000397   .000000   .000000   .000000
    .000124   .001303   .001416   .000000   .000000   .000000
    .000215   .002265   .002039   .000000   .000000   .000000
    .000027   .000284   .000793   .000000   .000000   .000000
    .000199   .002095   .001812   .000000   .000000   .000000
```

.000716	.002322	.001755	.000000	.000000	.000000
.001222	.002435	.003680	.000000	.000000	.000000
.000209	.002208	.002322	.000000	.000000	.000000
.000678	.001925	.002208	.000000	.000000	.000000
.000461	.004869	.001020	.000284	.000000	.000000
.000584	.001586	.001076	.000170	.000000	.000000
.000170	.001133	.000623	.000000	.000000	.000000
.000386	.004077	.007190	.000170	.000000	.000000
.000236	.002491	.004020	.000736	.000000	.000000
.000118	.001246	.003397	.000850	.000000	.000000
.000097	.001020	.001586	.000057	.000000	.000000
.000000	.000000	.000850	.000000	.000000	.000000
.000787	.003680	.018230	.007473	.000000	.000000
.000762	.004133	.010530	.004813	.000000	.000000
.000478	.005152	.004190	.000453	.000057	.000000
.000595	.007360	.003963	.002548	.000397	.000000
.000832	.006511	.004643	.001586	.000000	.000000
.001185	.006341	.003114	.001020	.000000	.000000
.001239	.009285	.008606	.007360	.000000	.000000
.000663	.008209	.016475	.002831	.000000	.000000
.000800	.009908	.018060	.007417	.000000	.000000
.000430	.005322	.010644	.009794	.000000	.000000
.001151	.005152	.024910	.028816	.004416	.000453
.003045	.005888	.015286	.028080	.004586	.001076
.001449	.004303	.016928	.036346	.005832	.001020
.000293	.003624	.017494	.032270	.004756	.000963
.001930	.005718	.022872	.022306	.005775	.000623
.000220	.002718	.024627	.014323	.000000	.000397
.000000	.001133	.002775	.000000	.000000	.000000
.000000	.001020	.001416	.000000	.000000	.000000
.000000	.001586	.001416	.000000	.000000	.000000
.000000	.005096	.000397	.000000	.000000	.000000
.000000	.006511	.000284	.000000	.000000	.000000
.000000	.010644	.001359	.000000	.000000	.000000
.000000	.009228	.002095	.000000	.000000	.000000
.000000	.006737	.001755	.000000	.000000	.000000
.000000	.009681	.001699	.000000	.000000	.000000
.000000	.004756	.005549	.000000	.000000	.000000

.000000	.003510	.008719	.000000	.000000	.000000
.000000	.004303	.010021	.000000	.000000	.000000
.000000	.003737	.010474	.000000	.000000	.000000
.000000	.003624	.004416	.000000	.000000	.000000
.000000	.003680	.003737	.000000	.000000	.000000
.000000	.002661	.003227	.000000	.000000	.000000
.001930	.001133	.000000	.000000	.000000	.000000
.002176	.003510	.000000	.000000	.000000	.000000
.005011	.004699	.000000	.000000	.000000	.000000
.006807	.005265	.000000	.000000	.000000	.000000
.009194	.006115	.000000	.000000	.000000	.000000
.011062	.007134	.000000	.000000	.000000	.000000
.007326	.006058	.000000	.000000	.000000	.000000
.006174	.003624	.000000	.000000	.000000	.000000
.010809	.010361	.000000	.000000	.000000	.000000
.004306	.006454	.000000	.000000	.000000	.000000
.005839	.007983	.000000	.000000	.000000	.000000
.007115	.009681	.000000	.000000	.000000	.000000
.009888	.010757	.000000	.000000	.000000	.000000
.005423	.006737	.000000	.000000	.000000	.000000
.005742	.006681	.000000	.000000	.000000	.000000
.002655	.003907	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000

```
     .000000   .000000   .000000   .000000   .000000   .000000
     .000000
     .771666  2.057776  3.858330  6.331618  9.343415 12.709790
1          PROGRAM HAS FINISHED
```

Appendix E

Uniform Winds by Direction Test Case

Appendix E: Uniform Winds by Direction Test Case

A test case with a uniform distribution of winds in all directions within one stability class and wind speed group is used in this appendix. Running this test case with the distributed version of the U.S. Environmental Protection Agency STAR program resulted in tabular summaries that do not have the expected uniform distribution of winds in all directions. The revised code contains an update that fixes this anomaly. With the revised code, when a uniform distribution of winds is input, a uniform distribution of winds is output. This test case demonstrates this performance.

The revised version may be run using the JFD Generator or by running the command line:

STARR.EXE spok.IN test1.SAM test1.lst test1.jfd

spok.IN is the run-time file which has one line of data (note the format is different that used for the STAR test run). This file is created automatically by the JFD Generator:

```
24157,90,'SpokaneWa  1990 cdm2','WA',47.6,117.22,075,3,0,1,1,1,1,1,1,1,1,1,1,1,721,06.4,10.0
```

TEST1.SAM as a SAMSON format file with the input surface observations (See Appendix E)

test1.lst and test1.jfd are the STARR output programs.

test1.lst has the following content:

```
ARAMS/FRAMES Version of EPA STAR Program
JG Droppo, Pacific Northwest National Laboratory
PO Box 999, Richland WA 99352
Version: (05Sept2006) STARR

Wind Speed Midpoints (based on inverse averages):
 1     .77 m/s
 2    2.06 m/s
 3    3.86 m/s
 4    6.33 m/s
 5    9.34 m/s
 6   12.71 m/s

SAMPSON DATA
24157 SPOKANE
 NSTA,IYEAR
      24157          90
 LOCA=SPOKANE
 ALAT=      47.633340
 ALON=     117.533300
 ZON=     120.000000
 IMOD=           3
 IMETHOD =           2
 IMEP=           0
 ITST=           0
MONTHS  111 111 111 111
 Wind HT(m)=       6.400000
 ZO(cm) =      10.000000
 Elevation(m) =        721
END OF DATA, Total obs =      41.000000
             Obs/365   =   1.123288E-01
             Obs/365/24=   4.680365E-03
```

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	.00	.00	.00	.00
0	NNE	.00	.00	.00	.00	.00	.00	.00
0	NE	.00	.00	.00	.00	.00	.00	.00
0	ENE	.00	.00	.00	.00	.00	.00	.00
0	E	.00	.00	.00	.00	.00	.00	.00
0	ESE	.00	.00	.00	.00	.00	.00	.00
0	SE	.00	.00	.00	.00	.00	.00	.00
0	SSE	.00	.00	.00	.00	.00	.00	.00
0	S	.00	.00	.00	.00	.00	.00	.00
0	SSW	.00	.00	.00	.00	.00	.00	.00
0	SW	.00	.00	.00	.00	.00	.00	.00
0	WSW	.00	.00	.00	.00	.00	.00	.00
0	W	.00	.00	.00	.00	.00	.00	.00
0	WNW	.00	.00	.00	.00	.00	.00	.00
0	NW	.00	.00	.00	.00	.00	.00	.00
0	NNW	.00	.00	.00	.00	.00	.00	.00
	TOTAL	.00	.00	.00	.00	.00	.00	

NUMBER OF OCCURENCES OF A STABILITY = 0

NUMBER OF CALMS WITH A STABILITY = .00

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ENE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
E	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ESE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
S	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
W	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF A STABILITY = .000000

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = .000000

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	.00	.00	.00	.00
0	NNE	.00	.00	.00	.00	.00	.00	.00
0	NE	.00	.00	.00	.00	.00	.00	.00
0	ENE	.00	.00	.00	.00	.00	.00	.00
0	E	.00	.00	.00	.00	.00	.00	.00
0	ESE	.00	.00	.00	.00	.00	.00	.00
0	SE	.00	.00	.00	.00	.00	.00	.00
0	SSE	.00	.00	.00	.00	.00	.00	.00
0	S	.00	.00	.00	.00	.00	.00	.00
0	SSW	.00	.00	.00	.00	.00	.00	.00
0	SW	.00	.00	.00	.00	.00	.00	.00
0	WSW	.00	.00	.00	.00	.00	.00	.00
0	W	.00	.00	.00	.00	.00	.00	.00
0	WNW	.00	.00	.00	.00	.00	.00	.00
0	NW	.00	.00	.00	.00	.00	.00	.00
0	NNW	.00	.00	.00	.00	.00	.00	.00
	TOTAL	.00	.00	.00	.00	.00	.00	

NUMBER OF OCCURENCES OF B STABILITY = 0

NUMBER OF CALMS WITH B STABILITY = .00

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ENE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
E	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ESE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
S	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
W	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF B STABILITY = .000000

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = .000000

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	.00	.00	.00	.00
0	NNE	.00	.00	.00	.00	.00	.00	.00
0	NE	.00	.00	.00	.00	.00	.00	.00
0	ENE	.00	.00	.00	.00	.00	.00	.00
0	E	.00	.00	.00	.00	.00	.00	.00
0	ESE	.00	.00	.00	.00	.00	.00	.00
0	SE	.00	.00	.00	.00	.00	.00	.00
0	SSE	.00	.00	.00	.00	.00	.00	.00
0	S	.00	.00	.00	.00	.00	.00	.00
0	SSW	.00	.00	.00	.00	.00	.00	.00
0	SW	.00	.00	.00	.00	.00	.00	.00
0	WSW	.00	.00	.00	.00	.00	.00	.00
0	W	.00	.00	.00	.00	.00	.00	.00
0	WNW	.00	.00	.00	.00	.00	.00	.00
0	NW	.00	.00	.00	.00	.00	.00	.00
0	NNW	.00	.00	.00	.00	.00	.00	.00
	TOTAL	.00	.00	.00	.00	.00	.00	

NUMBER OF OCCURENCES OF C STABILITY = 0

NUMBER OF CALMS WITH C STABILITY = .00

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ENE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
E	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ESE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
S	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
W	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF C STABILITY = .000000

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = .000000

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	3.25	.00	.00	3.25
0	NNE	.00	.00	.00	2.25	.00	.00	2.25
0	NE	.00	.00	.00	2.25	.00	.00	2.25
0	ENE	.00	.00	.00	2.25	.00	.00	2.25
0	E	.00	.00	.00	2.25	.00	.00	2.25
0	ESE	.00	.00	.00	2.25	.00	.00	2.25
0	SE	.00	.00	.00	2.25	.00	.00	2.25
0	SSE	.00	.00	.00	2.25	.00	.00	2.25
0	S	.00	.00	.00	2.25	.00	.00	2.25
0	SSW	.00	.00	.00	2.25	.00	.00	2.25
0	SW	.00	.00	.00	2.25	.00	.00	2.25
0	WSW	.00	.00	.00	2.25	.00	.00	2.25
0	W	.00	.00	.00	2.25	.00	.00	2.25
0	WNW	.00	.00	.00	2.25	.00	.00	2.25
0	NW	.00	.00	.00	2.25	.00	.00	2.25
0	NNW	.00	.00	.00	2.25	.00	.00	2.25
	TOTAL	.00	.00	.00	37.00	.00	.00	

NUMBER OF OCCURENCES OF D STABILITY = 37

NUMBER OF CALMS WITH D STABILITY = .00

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.079268	.000000	.000000	.079268
NNE	.000000	.000000	.000000	.054878	.000000	.000000	.054878
NE	.000000	.000000	.000000	.054878	.000000	.000000	.054878
ENE	.000000	.000000	.000000	.054878	.000000	.000000	.054878
E	.000000	.000000	.000000	.054878	.000000	.000000	.054878
ESE	.000000	.000000	.000000	.054878	.000000	.000000	.054878
SE	.000000	.000000	.000000	.054878	.000000	.000000	.054878
SSE	.000000	.000000	.000000	.054878	.000000	.000000	.054878
S	.000000	.000000	.000000	.054878	.000000	.000000	.054878
SSW	.000000	.000000	.000000	.054878	.000000	.000000	.054878
SW	.000000	.000000	.000000	.054878	.000000	.000000	.054878
WSW	.000000	.000000	.000000	.054878	.000000	.000000	.054878
W	.000000	.000000	.000000	.054878	.000000	.000000	.054878
WNW	.000000	.000000	.000000	.054878	.000000	.000000	.054878
NW	.000000	.000000	.000000	.054878	.000000	.000000	.054878
NNW	.000000	.000000	.000000	.054878	.000000	.000000	.054878
TOTAL	.000000	.000000	.000000	.902439	.000000	.000000	

FREQUENCY OF OCCURENCE OF D STABILITY = .902439

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = .000000

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	.00	.00	.00	.00
0	NNE	.00	.00	.00	.00	.00	.00	.00
0	NE	.00	.00	.00	.00	.00	.00	.00
0	ENE	.00	.00	.00	.00	.00	.00	.00
0	E	.00	.00	.00	.00	.00	.00	.00
0	ESE	.00	.00	.00	.00	.00	.00	.00
0	SE	.00	.00	.00	.00	.00	.00	.00
0	SSE	.00	.00	.00	.00	.00	.00	.00
0	S	.00	.00	.00	.00	.00	.00	.00
0	SSW	.00	.00	.00	.00	.00	.00	.00
0	SW	.00	.00	.00	.00	.00	.00	.00
0	WSW	.00	.00	.00	.00	.00	.00	.00
0	W	.00	.00	.00	.00	.00	.00	.00
0	WNW	.00	.00	.00	.00	.00	.00	.00
0	NW	.00	.00	.00	.00	.00	.00	.00
0	NNW	.00	.00	.00	.00	.00	.00	.00
	TOTAL	.00	.00	.00	.00	.00	.00	

NUMBER OF OCCURENCES OF E STABILITY = 0

NUMBER OF CALMS WITH E STABILITY = .00

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ENE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
E	.000000	.000000	.000000	.000000	.000000	.000000	.000000
ESE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSE	.000000	.000000	.000000	.000000	.000000	.000000	.000000
S	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
SW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WSW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
W	.000000	.000000	.000000	.000000	.000000	.000000	.000000
WNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
NNW	.000000	.000000	.000000	.000000	.000000	.000000	.000000
TOTAL	.000000	.000000	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF E STABILITY = .000000

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = .000000

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

	DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
0	N	.00	.00	.00	.00	.00	.00	.00
0	NNE	.00	.00	.00	.00	.00	.00	.00
0	NE	.00	.00	.00	.00	.00	.00	.00
0	ENE	.00	.00	.00	.00	.00	.00	.00
0	E	.00	.00	.00	.00	.00	.00	.00
0	ESE	.00	.00	.00	.00	.00	.00	.00
0	SE	.00	.00	.00	.00	.00	.00	.00
0	SSE	.00	.00	.00	.00	.00	.00	.00
0	S	.00	.00	.00	.00	.00	.00	.00
0	SSW	.00	.00	.00	.00	.00	.00	.00
0	SW	.00	.00	.00	.00	.00	.00	.00
0	WSW	.00	.00	.00	.00	.00	.00	.00
0	W	.00	.00	.00	.00	.00	.00	.00
0	WNW	.00	.00	.00	.00	.00	.00	.00
0	NW	.00	.00	.00	.00	.00	.00	.00
0	NNW	.00	.00	.00	.00	.00	.00	.00
	TOTAL	.00	.00	.00	.00	.00	.00	

NUMBER OF OCCURENCES OF F STABILITY = 4

NUMBER OF CALMS WITH F STABILITY = 4.00

STATION:: 24157 YEAR: 90 RUN ID: SPOKANE
ANNUAL RUN

FREQUENCY DISTRIBUTION

SPEED(MPH)

DIRECTION	1 - 3	4 - 7	8 - 12	13 - 18	19 - 24	GREATER THAN 24	TOTAL
N	.006098	.000000	.000000	.000000	.000000	.000000	.006098
NNE	.006098	.000000	.000000	.000000	.000000	.000000	.006098
NE	.006098	.000000	.000000	.000000	.000000	.000000	.006098
ENE	.006098	.000000	.000000	.000000	.000000	.000000	.006098
E	.006098	.000000	.000000	.000000	.000000	.000000	.006098
ESE	.006098	.000000	.000000	.000000	.000000	.000000	.006098
SE	.006098	.000000	.000000	.000000	.000000	.000000	.006098
SSE	.006098	.000000	.000000	.000000	.000000	.000000	.006098
S	.006098	.000000	.000000	.000000	.000000	.000000	.006098
SSW	.006098	.000000	.000000	.000000	.000000	.000000	.006098
SW	.006098	.000000	.000000	.000000	.000000	.000000	.006098
WSW	.006098	.000000	.000000	.000000	.000000	.000000	.006098
W	.006098	.000000	.000000	.000000	.000000	.000000	.006098
WNW	.006098	.000000	.000000	.000000	.000000	.000000	.006098
NW	.006098	.000000	.000000	.000000	.000000	.000000	.006098
NNW	.006098	.000000	.000000	.000000	.000000	.000000	.006098
TOTAL	.097561	.000000	.000000	.000000	.000000	.000000	

FREQUENCY OF OCCURENCE OF F STABILITY = .097561

FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = .097561

1

```
6(6F10.3) ,24157,”SPOKANE                “,”WA”, -8,”N”,47.63,”W”,117.53, 721, 6.4, 10., 1.0000,111,111,111,111,120.
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
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    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
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    .000000   .000000   .000000   .000000   .000000   .000000
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    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
    .000000   .000000   .000000   .000000   .000000   .000000
```

.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.079269	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.054879	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
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.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000

.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
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.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.006098	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
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.000000	.000000	.000000	.000000	.000000	.000000
.000000	.000000	.000000	.000000	.000000	.000000
.000000					
.771666	2.057776	3.858330	6.331618	9.343415	12.709790

Appendix F

Uniform Winds By Direction Test Case Meteorological Data (spok.sam)

Appendix F: Uniform Winds By Direction Test Case Meteorological Data (spok.sam)

```
6~24157 SPOKANE                WA  -8  N47 38  W117 32   721
~YR MO DA HR I   1    2       3       4       5  6  7     8     9  10   11  12    13     14     15        16   17     18   19  20       21
 90  1  1  1 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  00   0.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  1 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  00   0.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  1 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  00   0.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  1 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  00   0.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  1 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  00   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  2 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  10   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  3 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  20   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  4 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  30   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  5 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  40   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  6 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  50   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  7 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  60   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  8 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  70   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1  9 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  80   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 10 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929  90   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 11 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 100   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 12 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 110   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 13 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 120   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 14 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 130   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 15 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 140   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 16 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 150   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 17 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 160   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 18 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 170   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 19 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 180   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 20 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 190   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 21 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 200   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 22 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 210   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 23 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 220   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  1 24 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 230   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  1 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 240   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  2 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 250   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  3 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 260   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  4 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 270   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  5 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 280   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  6 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 290   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  7 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 300   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  8 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 310   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2  9 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 320   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2 10 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 330   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2 11 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 340   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2 12 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 350   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2 13 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 360   7.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2 14 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 360  99.0    8.0    210 999999099   9 99999.   0   0       0
 90  1  2 15 0   0    0    0 ?0    0 ?0    0 ?0  9 10   0.6  -0.6  92  929 999   .60    8.0    210 999999099   9 99999.   0   0       0
```

Appendix G

List of Test Files

Appendix G: List of Test Files

The following test files are distributed with the JFD Generator:

Distribution test case:

SFC.DAT, SFC2.DAT—Meteorological observations data—STAR test case in CD-144 format

FILE2.OUT—Original STAR model results for test case distributed with STAR program.
Results file using SFC.DAT—Output listing for STAR run with model option 2.

TEST2.lst, SFC.jfd—Results files using SFC.DAT—Output listing for revised STARR run.

Uniform frequency by direction test case:

TEST1.SAM—Meteorological observations data—Uniform wind frequencies in all directions text case in Samson format

TEST1.lst, TEST1.jfd—Results file using SFC.DAT—Output listings from revised STARR run.