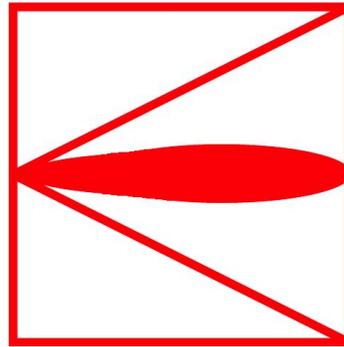


User guide for real-time hazardous plume display software

Plumecast



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Licence

A Plumecast licence covers one installation only. It is however permissible to keep Plumecast loaded on a second PC as a spare for emergency use or for running archive data so long as this second system is not connected to a different sensor suite.

A release of Plumecast will function until about 15 months from the release date. After that time it will become inoperative. There will be new releases of Plumecast at approximately 12 monthly intervals.

Application of this guide

This User Guide covers Plumecast software, release date 2018-11-15

USER GUIDE FOR REAL-TIME PLUME DISPLAY SOFTWARE, PLUMECAST

Contents

Copyright	Preface
Licence	Preface
Application of this guide	Preface
Contents	1
1. Introduction	2
2. Limitations	2
3. Operational notes	3
4. System requirements	3
5. Installation	3
6. Time setting on the PC	4
7. Map	4
8. Sensor site and pollution source	4
9. Display settings	4
10. Setting the likely density of plume material	5
11. Running Plumecast	6
12. Interpreting the display	6
13. Moving the source location	6
14. Plotting a release in real time	7
15. Plotting from stored data	7
16. Stopping the display of a plume	8
17. Exiting Plumecast	8
18. Archive	9
19. Warnings and alarms	10
20. XML output	10
Appendix A, Diagram of a typical Plumecast screen	11
Appendix B, Settings in the Config file	12

1. Introduction

Plumecast is a system to provide real time display of possible and actual dispersion of atmospheric pollutants in a release. It shows emergency services, site operators and incident managers the route of any pollutant escapes into the atmosphere to help them implement appropriate emergency procedures.

Plumecast is a combination of software and an anemometer, linked to a PC based monitor. This User Guide describes the software component of the system. The monitor displays the area that would be at risk from an accidental release and in an emergency it displays the estimated location of an airborne plume and areas at risk from its further spread.

The system can be used for emergency response situations, operational risk assessment and post-analysis of an incident.

Plumecast draws two lines from the potential pollution source over a map of the local area. These enclose an 'area at risk', the area over which airborne pollution might pass in the event of a release. These lines are updated continuously even when there is no current release so that in the event of an accident the area at risk is instantly available. There is absolutely no delay in starting dispersion models and the information is available without contacting off-site authorities.

As an option, in the event of an accidental release Plumecast also plots the likely location of the plume. This takes the form of a plot overlaid on the local area map and is based on a 'puff-release' model. The plot shows not only where the plume is but also where it has been.

2. Limitations

There should not be any terrain with slopes greater than about 1 in 10, averaged over a distance of about 500 metres, in the area of interest. If there is, then plumes plotted over these areas should be treated with caution. Similarly any large buildings can significantly distort the plume. Plumes plotted over areas of large buildings should be treated with caution, especially at ranges less than a kilometre or so or if the plume is denser than air. Plumecast takes a fail-safe approach and makes no allowance for a plume being raised above the surface. It is therefore suitable for dense, neutral or buoyant plumes. It implicitly includes the risk of precipitation bringing pollution to the surface or condensation related 'fall out' from an elevated plume.

It can be run throughout the northern hemisphere but is not suitable for the southern hemisphere.

3. Operational notes

In routine use Plumecast will ideally be left running continuously (but may be minimised). In these circumstances the correct operation of Plumecast should be checked at regular intervals. A daily check on system time and sensor data is also recommended.

The archive should be backed up at regular intervals.

4. System requirements

Plumecast will run on Windows Vista, Windows 7, Windows 8 or Windows 10.

Minimum PC requirements are Pentium 400 or equivalent, 512MB RAM, 100 MB Free Hard Disk space ('compact flash' drives are not suitable) and a suitable port for connection to the sensors.

Plumecast uses NMEA 0183 wind data messages received at 1 second intervals.

Some means of backing up archive data is needed. One day of data can be about 2.5 Mb.

Monitor screens should have a resolution of 1024 x 768.

5. Installation

Plumecast should be run on a PC allocated to it exclusively. In particular it should not share a PC with another program that also has a role in the event of an accidental release.

Plumecast is installed from files supplied typically on a data stick. To install Plumecast load the stick or files into the PC. Locate the set up file, *setup.exe*, in the folder '*installer\volume*'.

Double click on the *setup.exe* file and then follow the instructions on the screen

The program installs into '*C:\Program Files (x86)\Plumecast*'

The program will ask you to accept licence terms for National Instruments software. This can be done because a NI licence is included with the Plumecast licence.

The support files install into '*C:\ProgramData\Plumecast*' and the configuration options are stored in '*C:\ProgramData\Plumecast\config.ini*'

The folder '*C:\Program Data*' may be hidden. If so make it visible as follows: -

Go to *WindowsControlPanel* and find *FolderOptions* or *File Explorer Options*. Click to open the *View* screen and click *ShowHiddenFiles&Folders* in the *HiddenFiles&Folders* options.

In order to enable you to modify the file 'C:\Program Data\Plumecast\Config.ini' you may have to right click on folder C:\Program Data\Plumecast and click *Properties_Security*. Then edit the permissions to allow full control

The parameters set in the *config.ini* file are listed in Appendix B

6. Time setting

Although Plumecast can be run for any longitude the time zone for the PC running Plumecast should be set to GMT. The PC time should be kept accurate to within 5 minutes as time is used in the model and is also used to time mark archive files.

7. Map

A map is needed centred on the plume source. It can be either *.jpg, *.png or *.bmp format but must cover an area of 40km by 40km and be 1240 by 1240 pixels.

8. Sensor site and pollution source

Plumecast relies on data from a sensor site. This does not have to be located at exactly the centre of the map. However the sensor data must be representative of the risk area. The area over which the sensor data may be used will vary according to location.

9. Display Settings

Plumecast provides two ways of displaying the likely rate of spread of a toxic plume. One is 'range-rings' within the area at risk; the other is a pattern of straight lines drawn at intervals. Both are spaced at intervals equivalent to the expected spread over 10 minutes. The type used is selected by clicking boxes in the display. The lines are most useful if the wind direction has changed dramatically during an incident.

There are two controls for setting the appearance of the plume if the plume plotting option is in use. One is an icon showing the plume colour. Clicking on this allows different colours to be selected. The other is a 'slide control' labelled 'transparency'. This adjusts the opacity of the plume. By clicking and dragging the slide the plume becomes more or less opaque. These features can be used to change the plume appearance to make the plume easily visible against various backgrounds or to allow text on the map to be read when overlaid by the plume.

10. Setting the likely density of plume material

Given information on the likely nature of the released material it is possible to narrow down the possible spread of pollution. This is achieved by ticking any combination of three boxes on the display screen. Three options are available and are described below.

The main purpose of setting different plume densities is that, combined with meteorological sensor data, it alters the height the plume is expected to reach. This in turn is important because Plumecast makes allowances for wind speed and direction changes through the atmospheric boundary layer. The depth of this layer varies widely and the heights given below for relevant plume heights are for general guidance only. As a default all options are set and all possible options should be kept set. The options can be changed at any time, including during an emission, but the changes will not be applied retrospectively and will only apply to subsequent movement of the plume.

High density plume

This should be used if the material is denser than air such as heavy dust or a dense gas such as chlorine. This option used alone gives the narrowest plume but is the most sensitive to the effects of terrain or large buildings. If information on plume height is available this option is appropriate to plumes rising no more than about 30m or 100ft.

Neutral density plume

This should be used if the pollution is likely to have a similar density to the surrounding air, for example a gas with density close to that of air or fine dust. Note that if the pollution is significantly warmer than the surrounding air then the buoyant option should be set also. If information on plume height is available this option is appropriate to plumes rising up to roughly 500m or 1500 feet.

Buoyant plume

This should be used if the pollution is likely to be less dense than air. For example low density gases, hot gases or smoke. Obviously this is only a risk at the surface if there is a possibility of fallout. This could be caused by chemical reactions in the plume creating denser material, condensation of vapour to liquid, cooling of a hot plume or smoke particles falling from a plume. The use of this option will be rare. It may give very wide areas of risk as wind direction changes over a larger depth of the boundary layer. If information on plume height is available this option is appropriate to plumes rising more than roughly 500m or 1500ft in daytime. At night, especially in winds less than around 5 m/s or 10kts this should be used for plumes rising to 100m or 300 ft.

11. Running Plumecast

To start 'Plumecast' double click on the 'Plumecast' Icon.

Note Plumecast is intended to run continuously in order to be available immediately it is needed.

12. Interpreting the display

The normal display screen, Appendix A, shows a map 20 km square. The source site is at the centre.

If a valid 'area at risk' is available then this is shown in the form of two lines running from the source. The sector between is the area at risk from a plume emitted from the source. The angle between these is calculated on the basis of the previous run of wind, the likelihood of a change in mean wind direction through various angles and wind shear and its effect on plumes of different densities.

In addition arcs are shown through the area at risk to indicate the distances the plume is estimated to travel over ten minutes. These are for guidance and their spacing is based on the recent run of wind and assumptions on likely windshear. Straight lines at the same intervals, drawn at right angles to the expected plume centreline can be displayed instead.

Plumecast also shows the current wind speed and wind direction (the direction shown is the direction the wind is from). These are not instant values but the values over the averaging period Plumecast is using for its assessment of areas at risk. Units for wind speed can be set to knots, metres per second, kilometres per hour or miles per hour and are specified at the time of ordering or configured later.

In addition the Plumecast display shows the bearings of the calculated area at risk lines and the distance the plume will travel in 10 minutes.

13. Moving the source location

This is to allow a Plumecast system to display risk areas from releases at different locations so long as the wind data is appropriate to that location.

An icon labelled 'Map' gives a drop down menu allowing the map to be 'unlocked'. If this is selected the source location on the map can be changed just by clicking on the new location. Sliders are also provided for coarser adjustment over the map.

14. Plotting a release in real time.

Click on the large orange emission button 'START'. This will immediately start the plot of actual plume spread, see fig. 1. Note this icon is 'greyed out' until 100 seconds data is available. When clicked the button flashes red indicating that a release is taking place and being plotted.

'START' will be replaced with the text 'STOP'.

If chosen the plume will continue to be plotted but no new emission will be added. The emission button returns to its previous form and is again labelled 'START'. If this is chosen then a new, additional plume will recommence. If chosen it will not be checked but executed immediately.

Note if the plume passes beyond the map boundary plotting will continue as the plume could still spread sideways if wind direction or turbulence characteristics change.

15. Plotting from stored data

Click on the 'File' icon in the top left of the screen. This gives 3 options. The options 'close' and 'exit' refer to restarting and exiting the program. 'Open' allows 'Plumecast' to run on a sample dataset or a dummy dataset for test or training purposes or from an archive dataset. Note that if running from an archive dataset then only the sensor data is used. Settings for plume density or an emission in progress have to be made in the usual way (see sections 9, 10 and 13).

Plumecast can use NMEA standard datasets in text format (*.txt) or archive datasets in comma separated variable (*.CSV) format. The programme automatically identifies which type is selected. If the selected dataset is in archive format Plumecast gives an option for selecting the start time for running the dataset by entering or editing numbers in display boxes as shown below and clicking on 'SUBMIT'. The default is the time of the first line of the dataset.

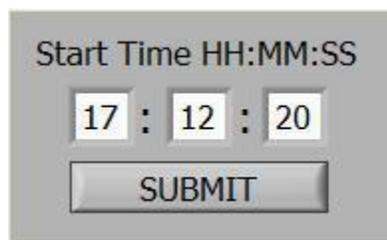


Figure 1. Choosing start time for plotting from archive data

16. Stopping the display of a plume

If the plume plotting option is in use stopping the plotting of a plume will be by clicking on the 'File' icon in the top left of the screen. If clicked this gives 3 options. The 'Close' option, after checking for confirmation, ends the current plot and clears the screen. It returns 'Plumecast' to its initial state. The option 'Exit', also after checking for confirmation, closes the Plumecast programme altogether.

It is important to note the difference between stopping the emission and 'Close' as described above. The former means that pollution is no longer leaving the source, existing pollution will continue to be plotted and moved across the map according to received data. The latter means that both emission and plotting stop and the screen is cleared.

Note also that to prevent the accidental ending of an emission in progress the 'X' icon in the top right corner is not enabled and cannot be used to close, minimise or exit 'Plumecast'. It is possible to run additional programmes in windows 'on top of' Plumecast but beware of doing this during an incident with programmes that might deprive Plumecast of memory or other resources.

17. Exiting Plumecast

To exit 'Plumecast' click on the 'File' icon in the left hand corner. This will give a drop down menu including the option 'Exit'. Clicking this will close the program.

It is important to note the difference between 'Close' and 'Exit'. The former means that the programme is still running and receiving data but the display is cleared. The latter stops 'Plumecast' running so that data collection will stop. If Plumecast is restarted it will need to collect a 1km run of data.

Note also that to prevent the accidental ending of an emission in progress the 'X' icon is not enabled and cannot be used to close, minimise or exit 'Plumecast'.

18. Archive

Plumecast generates an archive of sensor data stored in the directory 'C:/Program files/Plumecast/Archive'. One file is generated per day and runs from midnight to midnight UTC. Archive file formats are *.CSV files, each line is 1 second of data.

Each file is labelled with a date, as follows: -

YYYYMMDD where YYYY is the year, MM the month and DD the day. For example dataset 20180801.csv would cover the 1st August 2018.

A whole day dataset occupies about 2.5Mb.

The format of each line is: -

HH:MM:SS, DIR, SPEED, SRAD, DIR1, DIR2, RANGE, PUFF, E,D,N,B, SOURCEX, SOURCEY, MAP

Where HHMMSS is hours, minutes and seconds (UTC)

DIR is wind direction in whole degrees

SPEED is wind speed in m/s with one place of decimals

SRAD is solar radiation in whole W/m² (if in use, default '0')

DIR1 is the direction of the anti-clockwise area at risk boundary line

DIR2 is the direction of the clockwise area at risk boundary line

RANGE is the distance to the 10 minute marker rings in metres

PUFF is the radius of the released puffs in metres

E indicates if an emission is in progress (1 = yes, 0 = no)

D indicated dense plume option is set (1 = yes, 0 = no)

N indicated neutral plume option is set (1 = yes, 0 = no)

B indicated buoyant plume option is set (1 = yes, 0 = no)

SOURCEX is the x co-ordinate of the plume source in use in pixels

SOURCEY is the y co-ordinate of the plume source in use in pixels

(co-ordinates are based on the screen image, origin at centre. Co-ordinates are positive east of the origin and positive north of the origin. The image is 1240 x 1240 pixels in size.)

MAP is the name of the map in use

In the example below the line of data was recorded at 22:57:58 UTC, wind direction was 103 degrees, wind speed was 1.9 m/s and SRAD was 0. The area at risk lines were 189 and 310 degrees and the distance to the 10 minute range ring was 5690m. The puff radius was 100m.

There was no release in progress but all plume density options were set.

The source was located at 310 by 310 pixels on a map called MAP1.JPG.

22:57:58,103,1.9,0,189,310,5690,100,0,1,1,1,310,310,MAP1.JPG

19. Warnings and alarms

The following warnings and alarms may be given: -

'< 1000m Wind Data', this is shown red if Plumecast does not have sufficient data to calculate the spread of the plume, e.g. because it has not run long enough to have a record of a 1km run of wind. It does not mean data is not being received. This will only normally be seen when the Plumecast program is first started or when recovering from a light wind alarm or break in data.

'Low Wind Warning' is amber if there are a significant number of low wind speeds being used in the spread calculation. Light winds are more prone to large direction changes due to various local effects. Normal plotting of areas at risk and actual plumes will continue.

'Low Wind Alarm' is red if more than a certain percentage of low wind speeds are being recorded. Plotting of areas at risk and actual plumes will be discontinued. The area at risk is not shown and the displayed plume is frozen.

'Wind Discontinuity' is red for ten minutes following a major sustained change in wind speed or direction. In this case Plumecast only uses data back to the discontinuity.

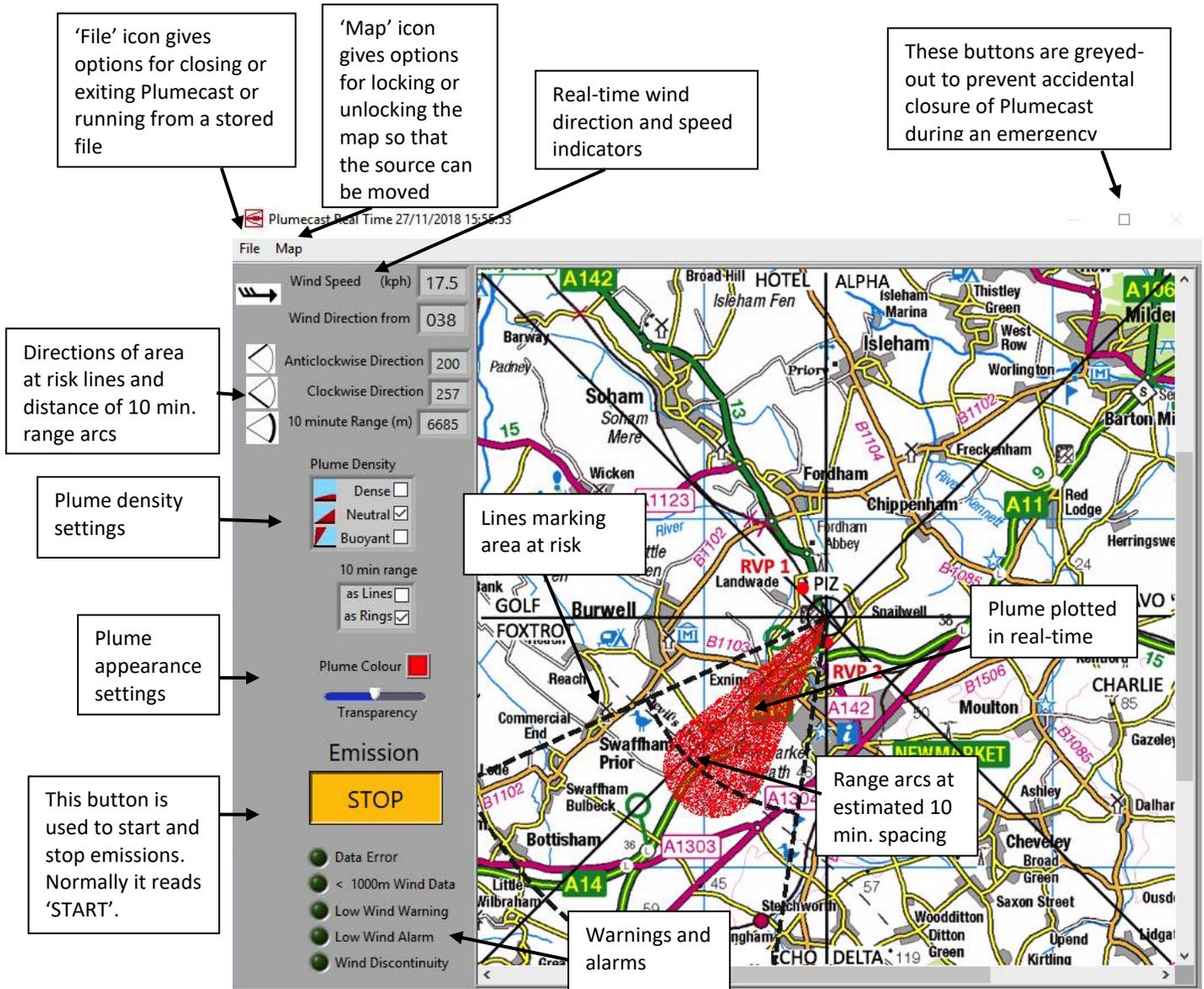
'Data Error' is red if there is no data or corrupt data at the serial port for a period set in the config file.

20. XML output

Plumecast can produce an output of the area at risk in *.XML format. This is intended to allow this information to be shared with other systems, in particular Geographical Information Systems (GIS). If this is to be used then information on the destination file is needed at the time of installation or a subsequent modification is needed. Refer to your Plumecast supplier for further advice.

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Appendix A, Diagram of a typical Plumecast screen.



Appendix B Settings in the Config file

Note it may be necessary to rename the config file from 'config.ini' to 'config.txt' in order to edit it. It should then be renamed as 'config.ini'.

Line in Config file	Notes
[Station]	Comment, station information follows
Name=1	Station name or number
Grid=OS	Grid used for GIS data, OS = ordnance survey
GridRef=NY21821267	Grid reference in above system
Longitude=0	Site Longitude to the nearest degree, West is +ve, East -ve. All values (+/-180) are possible.
Latitude=52	Site latitude to the nearest degree, only northern hemisphere is possible in this version.
Map=map.jpg	Map file name
MeasHeight=10.0	Measurement height in metres
[Origin]	Comment, information on initial plume origin follows. Note these are re-written with the values in use when Plumecast is exited. Co-ordinates refer to an origin at the top left of the centre 10 x 10km square of the map not the co-ordinates in the archive file and should not need adjustment.
Horizontal=310	Initial x location of plume origin in pixels.
Vertical=310	Initial y location of plume origin in pixels
[FTP]	Comment, information on FTP address for XML files follows
Visible=False	Destination FTP file data
Minute=1	XML file transmission interval
URL="homepages.fred.net"	Destination FTP file URL
User="fredbloggs"	Destination FTP file user name
Password="pword"	Destination FTP file user password
Account=	Destination FTP file data
StartPath=	Destination FTP file data
SendType=True	XML file transmission data, required
Binary=True	XML file transmission data, required
Active=False	XML file transmission data, required
[Options]	Comment, option information follows
RichReplay=False	If set 'false' while replaying an archive only wind data is extracted. If set 'true' then plume density and map settings are also extracted and cannot be set during replay.
PlotEmission= False	Reserved, default false
WindDisplayUnit=0	0=mps,1=knots, 2=kph, 3=mph
MinimumWindRun=1000	Reserved, default 1000
Terrain=False	Reserved, default 'False'
SolarRadn=False	Reserved, default 'False'
Rough=True	Sets surface roughness, 'True' = Rough, 'False' = smooth
[Risk Pen]	Comment, pen settings for area at risk lines and Range rings follow
Width=2	Line width in pixels
Style=2	Line style (0=Solid, 1=Dash, 2=Dot, 3=DashDot, 4=DashDotDot)

[InitialPuffRadius]	Comment, radius of initial puff for real time plot follows. This is also taken into account in setting the radius of the circle used to plot the area at risk lines.
Normal=10	Radius if dense plume is not set in metres
Dense=500	Radius if dense plume is set in metres
[LightWinds]	Comment, light wind settings follow
Threshold=0.5	Threshold speed for light winds in m/s
Alarm=20	Percentage of light wind for alarm condition, default 20
Warning=10	Percentage of light wind for warning icon lit, default 10
[Sensor]	Comment, sensor data to follow
WDOffset=0.0	Wind direction offset in degrees , if +ve it is added to each direction measurement, if -ve it is subtracted
Threshold=0	Estimated threshold speed of wind sensor in m/s
InstrErr=5	Estimated error in measurement, degrees
[DAQ]	Comment, data acquisition information follows.
RealTime=1000	For demonstration purposes, sets time interval, ms, for display from 'slider' values. Should be 1000 for real applications. Speeds up display by (1000/RealTime)
File=1000	For demonstration purposes, sets time interval, ms, for display from stored data. Should be 1000 for real applications. Speeds up display by (1000/RealTime)
StabilitySmoothingSamples=60	Sets the number of samples in the rolling average used for wind shear. Should not need adjustment.
[SerialComms]	Comment, communication settings follow.
COM=1	Sets comport to use. COM=0 enables 'sliders' on display to set values for demonstration.
Baud=9600	Baudrate
Databits=8	Databits
Stopbits=1	(1, 1.5 or 2)
Parity=0	(0=none, 1=odd, 2=even, 3=mark, 4=space)
FlowControl=0	(0=none, 1=XON/XOFF, 2=RTS/CTS, 3=XON/XOFF & RTS/CTS, 4=DTR/DSR 5=XON/XOFF & DTR/DSR)
Timeout=3000	Serial data timeout in ms
Checksum=True	Message checksums are checked and if they show an error then the Data error icon is red. "Checksum = false" disables checking but this is normally only used in test and development.

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