POWERED
green energy in Adriatic sea

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ANNEX 4.2 – Guidelines for selection of existing weather stations and technical documents compiling

Author	*Dissemination Level*[1]	*Delivery Date*	*Version*

[1] *Example:*
PU = Public
PP = Restricted to other programme participants
RE = Restricted to a group specified by the consortium.
CO = Confidential, only for members of the consortium.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Introduction

This section deal with the description of the minimum requirements concerning the available sources of meteorological data and provides a guidance on the way their data have to be described for the Powered project purposes. A Powered project output foresee the implementation of a weather stations network for recording meteorological variables. The experimental data collected by the single meteorological station shall be send to a Data Analysis Center, where they all shall be evaluated and integrated in numerical models. This network will be composed either by new weather stations and others that shall be evaluated and selected from the existing ones.

Thus, it is very important to guarantee a minimum level of reliability for the available meteorological weather stations, in order to create a wide number of data sources that could help the numerical models outputs to be more precise. To this purpose, in the first part are describes all the requirements to take in account in the selection of existing weather stations. In the second part is given a description for technical documents composing in order to avoid mistakes and facilitate the data analysis and assimilation into the numerical models.

Part 1: The Meteorological Station requirements

The weather station could be either governmental or private structures. In this last case, they should:

- have a regular and active maintenance service;
- have at least a year old collected series of data;
- be able to give meteorological data for the next years (10 years are welcome);
- have wind speed[2] and direction sensor at height greater or equal to 10 meters above ground level;
- record the meteorological variables indicated in the *Table 1*;
- have the elaboration period[3] for the meteorological variables of 10 minutes or one hour ;

Table 1 meteorological variables needed

Variable	Elaboration type[4]	Note
wind speed	Ave, St.dev.	needful
wind speed	Min, Max	welcome

[2] The wind speed is the wind velocity on the horizontal plane. The vertical velocity is not taken in account.

[3] The elaboration period is the length of the acquisition time interval on witch statistical elaboration, such as average value or standard deviation, are calculated.

[4] The elaboration type is the statistical elaboration made on the data acquired by the instrument during the elaboration period. The main are: Min (minimum value registered), Ave (average value), Max (maximum value), Tot. (total), St.dev. (standard deviation).

Table 1 meteorological variables needed

Variable	Elaboration type[4]	Note
wind direction	Ave	needful
wind direction	Min, Max , St.dev.	welcome
temperature	Ave	needful
temperature	Min, Max	welcome
pressure	Ave	welcome
relative humidity	Ave	welcome
rainfall	Tot	welcome
infrared radiation	Ave	welcome
visible radiation	Ave	welcome
salinity	Ave	welcome
dew-point temperature	Ave	welcome
Datalogger battery voltage	Ave	needful

Part 2: The technical documentation

This section gives a description and the guidelines for compiling the technical documentation to use in the process of selection of weather stations and forwarding their meteorological data. These documents are essentially of two types: the *Weather Station Form* and the *Meteorological Data Document*.

2.1 The Weather Station Form

The *Weather Station Form* is an information tool that is possible to find attached at the present paper in the *Annex 4_1.doc*. The aim of that document is to provide a synthetic and clear view on the main features of the meteorological data source and files format. It shall to send once, on the first transmission of documents, and eventually upgraded after any relevant alteration, such as a measurement sensor change or a different layout in data file. The form should be compiled for each Weather Station individuated and then saved in Adobe Pdf™ format (.pdf). It should be sent via e-mail at the following addresses:

ricci@univpm.it , r.romagnoli@univpm.it, d.vitali@univpm.it and ercole.cauti@gruppometron.it ,

The file name should have the syntax "XXX-NNN_info.pdf", where XXX-NNN is the station identification code. The station identification code is made of two parts: the first three digits are the Partner code in the project (see *Table 2*), the following three digits a progressive number. On compiling, be sure that pictures must be placed inside the relative tables to avoid align problems; the tables will resize according to picture size.

Table 2 Partners identification code in the Powered Project

Partner	Id. Code
Abruzzo Region	LB
Ministry of Economy of Montenegro	B1
Veneto Agricoltura	B2
Province of Ravenna	B3

Table 2 Partners identification code in the Powered Project

Partner	Id. Code
Marche Region	B4
Molise Region	B5
Apulia Region	B6
Marche Polytechnic University	B7
CETMA Consortium	B8
Micoperi marine contractors srl	B9
Italian Ministry for Environment and Land and Sea	B10
Ministry of Economy, Trade and Energy of Albania	B11
Municipality of Komiza	B12

For the evaluation of the orographic elements that could influence the weather station measurements, could be useful to see the task *"4.2 Setting up of the first-rate weather station network"* at chapter *"2 Guidelines for proper installation of the meteorological towers".*

2.2 The Meteorological Data Document

The meteorological data given by each weather station of the Powered network should be send to

ricci@univpm.it , r.romagnoli@univpm.it, d.vitali@univpm.it and ercole.cauti@gruppometron.it

In order to avoid mistakes and facilitate the data analysis elaboration and assimilation into numerical models, it is essential to know what informations are sent and the way they are written. In this section is explained how to describe the main features of the meteorological data file taken from any Weather Station.

2.2.1 The file name

Each file should consist of one-year data. The file name should have the syntax "XXX-NNN_YYMMNN.txt", where:

- XXX-NNN = weather station identification code
- YY = year in two digits
- MM = start month in two digits
- NN = end month in two digits

So, as example, the filename "*B7-001_090112.txt*" has meteorological data from January to December 2009.

2.2.2 The file format

The file should be in text format (.txt), extended ASCII (8 bits encode is welcome), tab-separated value[5], or eventually in (.dat) format.

[5] In tab separated value files, each line in the file represents a row of data and, within each line of the file, the different data fields are separated from one another using a tab spacing.

2.2.3 The header block

In some cases the first rows of the data file contain the main informations of the meteorological station and the investigation parameters (header block). Indicate if the file has it and eventually give a brief description.

2.2.4 The data block

The body of the file is the data block, where all the meteorological data are stored for each elaboration period. A standard data block has a first row that contains the variables names (header row), the first of witch is always related to the date and time. Starting from the second row, the meteorological values are stored following the variable order of the header row. The values format could vary depending on the variable (especially for the number of decimal digits and for the decimal separation value).

2.2.5 The time format

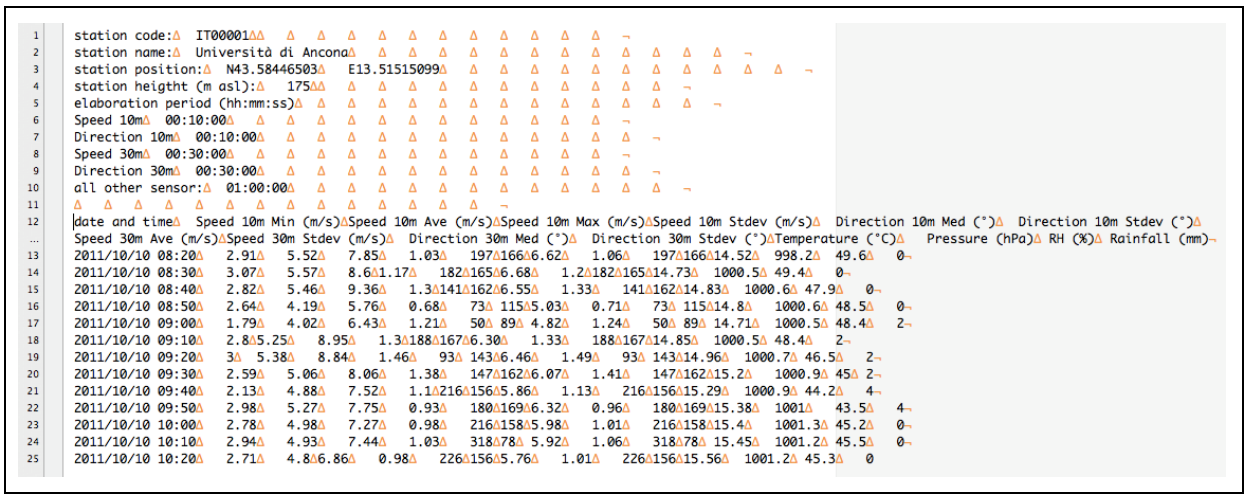
The date and time data could be recorder in many different ways, so it should be indicated the one is used in the Meteorological Data Document. The legend in *Table 3* should be used.

ATTENTION: Take care to indicate <u>all</u> the symbols that compose the time string, as dots, blank spaces, underscores and so on.

Table 3 legend of symbols to use to describe time format used in the Meteorological Data Documents

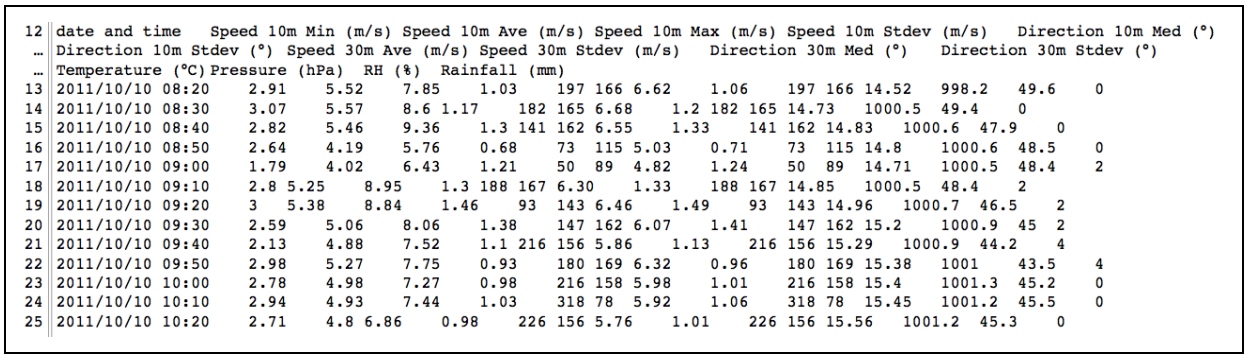
Symbol	Meaning
YYYY	year in 4 digits
YY	year in two digits
MM	month in two digits
DD	day
hh	hours
mm	minutes
ss	seconds
/	bar
.	dot
_	underscore
-	minus
<b>	blanck space
:	doble dot

2.2.6 Examples



```
1  station code:Δ  IT00001ΔΔ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
2  station name:Δ  Università di AnconaΔ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
3  station position:Δ  N43.58446503Δ  E13.51515099Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
4  station heigtht (m asl):Δ  175ΔΔ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
5  elaboration period (hh:mm:ss)Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
6  Speed 10mΔ  00:10:00Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
7  Direction 10mΔ  00:10:00Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
8  Speed 30mΔ  00:30:00Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
9  Direction 30mΔ  00:30:00Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
10 all other sensor:Δ  01:00:00Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
11 Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  Δ  ¬
12 date and timeΔ  Speed 10m Min (m/s)ΔSpeed 10m Ave (m/s)ΔSpeed 10m Max (m/s)ΔSpeed 10m Stdev (m/s)Δ  Direction 10m Med (°)Δ  Direction 10m Stdev (°)Δ
…  Speed 30m Ave (m/s)ΔSpeed 30m Stdev (m/s)Δ  Direction 30m Med (°)Δ  Direction 30m Stdev (°)ΔTemperature (°C)Δ  Pressure (hPa)Δ RH (%)Δ Rainfall (mm)¬
13 2011/10/10 08:20Δ  2.91Δ  5.52Δ  7.85Δ  1.03Δ  197Δ166Δ6.62Δ  1.06Δ  197Δ166Δ14.52Δ  998.2Δ  49.6Δ  0¬
14 2011/10/10 08:30Δ  3.07Δ  5.57Δ  8.6Δ1.17Δ  182Δ165Δ6.68Δ  1.2Δ182Δ165Δ14.73Δ  1000.5Δ 49.4Δ  0¬
15 2011/10/10 08:40Δ  2.82Δ  5.46Δ  9.36Δ  1.3Δ141Δ162Δ6.55Δ  1.33Δ  141Δ162Δ14.83Δ  1000.6Δ 47.9Δ  0¬
16 2011/10/10 08:50Δ  2.64Δ  4.19Δ  5.76Δ  0.68Δ  73Δ 115Δ5.03Δ  0.71Δ  73Δ 115Δ14.8Δ  1000.6Δ 48.5Δ  0¬
17 2011/10/10 09:00Δ  1.79Δ  4.02Δ  6.43Δ  1.21Δ  50Δ 89Δ 4.82Δ  1.24Δ  50Δ 89Δ 14.71Δ  1000.5Δ 48.4Δ  2¬
18 2011/10/10 09:10Δ  2.8Δ5.25Δ  8.95Δ  1.3Δ188Δ167Δ6.30Δ  1.33Δ  188Δ167Δ14.85Δ  1000.5Δ 48.4Δ  2¬
19 2011/10/10 09:20Δ  3Δ 5.38Δ  8.84Δ  1.46Δ  93Δ 143Δ6.46Δ  1.49Δ  93Δ 143Δ14.96Δ  1000.7Δ 46.5Δ  2¬
20 2011/10/10 09:30Δ  2.59Δ  5.06Δ  8.06Δ  1.38Δ  147Δ162Δ6.07Δ  1.41Δ  147Δ162Δ15.2Δ  1000.9Δ 45Δ 2¬
21 2011/10/10 09:40Δ  2.13Δ  4.88Δ  7.52Δ  1.1Δ216Δ156Δ5.86Δ  1.13Δ  216Δ156Δ15.29Δ  1000.9Δ 44.2Δ  4¬
22 2011/10/10 09:50Δ  2.98Δ  5.27Δ  7.75Δ  0.93Δ  180Δ169Δ6.32Δ  0.96Δ  180Δ169Δ15.38Δ  1001Δ  43.5Δ  4¬
23 2011/10/10 10:00Δ  2.78Δ  4.98Δ  7.27Δ  0.98Δ  216Δ158Δ5.98Δ  1.01Δ  216Δ158Δ15.4Δ  1001.3Δ 45.2Δ  0¬
24 2011/10/10 10:10Δ  2.94Δ  4.93Δ  7.44Δ  1.03Δ  318Δ78Δ 5.92Δ  1.06Δ  318Δ78Δ 15.45Δ  1001.2Δ 45.5Δ  0¬
25 2011/10/10 10:20Δ  2.71Δ  4.8Δ6.86Δ  0.98Δ  226Δ156Δ5.76Δ  1.01Δ  226Δ156Δ15.56Δ  1001.2Δ 45.3Δ  0
```

Fig. 1 Example of layout for a Meteorological Data Document in text tab-separated value format with header and data blocks. The numbers on the left are the row numbers: they are not in the file code, but they are just a print utility for a better reading. So are the orange characters (mainly triangles), used to indicate the tab-spacing.



```
12 date and time   Speed 10m Min (m/s) Speed 10m Ave (m/s) Speed 10m Max (m/s) Speed 10m Stdev (m/s)   Direction 10m Med (°)
…  Direction 10m Stdev (°) Speed 30m Ave (m/s) Speed 30m Stdev (m/s)   Direction 30m Med (°)   Direction 30m Stdev (°)
…  Temperature (°C) Pressure (hPa)  RH (%)  Rainfall (mm)
13 2011/10/10 08:20    2.91    5.52    7.85    1.03    197 166 6.62    1.06    197 166 14.52   998.2   49.6    0
14 2011/10/10 08:30    3.07    5.57    8.6 1.17    182 165 6.68    1.2 182 165 14.73   1000.5  49.4    0
15 2011/10/10 08:40    2.82    5.46    9.36    1.3 141 162 6.55    1.33    141 162 14.83   1000.6  47.9    0
16 2011/10/10 08:50    2.64    4.19    5.76    0.68    73  115 5.03    0.71    73  115 14.8    1000.6  48.5    0
17 2011/10/10 09:00    1.79    4.02    6.43    1.21    50  89  4.82    1.24    50  89  14.71   1000.5  48.4    2
18 2011/10/10 09:10    2.8 5.25    8.95    1.3 188 167 6.30    1.33    188 167 14.85   1000.5  48.4    2
19 2011/10/10 09:20    3   5.38    8.84    1.46    93  143 6.46    1.49    93  143 14.96   1000.7  46.5    2
20 2011/10/10 09:30    2.59    5.06    8.06    1.38    147 162 6.07    1.41    147 162 15.2    1000.9  45  2
21 2011/10/10 09:40    2.13    4.88    7.52    1.1 216 156 5.86    1.13    216 156 15.29   1000.9  44.2    4
22 2011/10/10 09:50    2.98    5.27    7.75    0.93    180 169 6.32    0.96    180 169 15.38   1001    43.5    4
23 2011/10/10 10:00    2.78    4.98    7.27    0.98    216 158 5.98    1.01    216 158 15.4    1001.3  45.2    0
24 2011/10/10 10:10    2.94    4.93    7.44    1.03    318 78  5.92    1.06    318 78  15.45   1001.2  45.5    0
25 2011/10/10 10:20    2.71    4.8 6.86    0.98    226 156 5.76    1.01    226 156 15.56   1001.2  45.3    0
```

Fig. 2 Detail of the data block of the file in the previous figure.

Variable Header (as is in the file)	Variable Type	SI Units	Elaboration type	Data Format[10]	Height agl (m)
date and time	date and time	---	---	MM/DD/YYYY<b>hh:mm	--- m
Speed 10m Min (m/s)	wind speed	m/s	Min	999.99	10 m
Speed 10m Ave (m/s)	wind speed	m/s	Ave	999.99	10 m
Speed 10m Max (m/s)	wind speed	m/s	Max	999.99	10 m
Speed 10m Stdev (m/s)	wind speed	m/s	Standard dev	999.99	10 m
Speed 10m Min (m/s)	wind speed	m/s	Min	999.99	10 m
Direction 10m Ave (°)	wind direction	deg	Ave	999	10 m
Direction 10m Stdev (°)	wind direction	deg	Standard dev.	999	10 m
Speed 30m Ave (m/s)	wind speed	m/s	Ave	999.99	30 m
Speed 30m Stdev (m/s)	wind speed	m/s	Standard dev	999.99	30 m
Direction 30m Ave (°)	wind direction	deg	Ave	999	30 m
Direction 30m Stdev (°)	wind direction	deg	Standard dev.	999	30 m
Temperature (°C)	air temperature	°C	Ave	(-) 999.99	-- m
Pressure (hPa)	air pressure	hPa	Ave	9999.9	-- m
RH (%)	relative humidity	%	Ave	999.99	-- m
Rainfall (mm)	rainfall	mm	Tot	99	-- m

Fig. 3 Example of compiling the Variable Header Table (Table n.4) in the section "THE FILE FORMAT OF THE METEROLOGICAL DATA" of the WEATHER STATION FORM. Data are referred to the previous figures.