Dynamax

InteliMet Advantage 5 Weather Station

User Manual v. 1.1

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InteliMet Advantage 5 V1.1

This manual refers to Lascano-Van Bavel ETP computation algorithm, implementation of the algorithm in InteliMet Advantage 5 weather station, including PC200 data logger support software for InteliMet Advantage 5 Weather station.

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Includes documentation for Lascano-van Bavel RCM ET computation algorithm. Programs written and algorithms verified by

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TABLE OF CONTENTS

1.0 INTRODUCTION TO INTELIMET ADVANTAGE 5

InteliMet Advantage 5 weather station is completely pre-wired, and assembled in a weatherproof enclosure, including software to read data from weather sensors. Data is collected and stored in data logger non-volatile memory. Up to 32,000 data points (85 days) can be stored in the data logger. Block diagram of InteliMet Advantage 5 weather station logger is shown in the following chapters. Data logger and weather sensors are supplied with a 4ft. metal pipe 1" in diameter. Crossbar is used for mounting for weather transmitter, pyranometer mounting, leveling stand, and optional sensors if any as shown in the figure below. Grounding rod, Lightening arrestor, and ground rod cables are required to protect system from lightening surges. The InteliMet Advantage 5 weather station is a specially designed automated system to record the critical weather parameters affecting the growth and harvest yield of crops.

Each station includes program for reading weather sensors, Lascano-Van Bavel Evapotranspiration (ETP) for computing ETP in mm/hr. Crop growth models and Crop Water Index can be developed with this information for grower applications of irrigation, pest control, and performing the optimum harvest. Many other crop manager decisions can benefit from the hourly weather records, and current information. Standard evapotranspiration modeling software is packaged with the InteliMet Advantage 5 weather station. The purpose is to compute the potential evapotranspiration from short grass (ETP) in mm per hour on an hourly basis. The algorithms are based on the method originally proposed by Penman, but with several modifications by Dr. C.H.M. Van Bavel and Dr. Robert J. Lascano, that updated the procedure.

InteliMet Advantage 5 System Features

- GMX500 Compact weather station
- Wind Speed & Direction
- Air Temperature
- Relative Humidity
- Barometric Pressure
- Dew Point
- Solar Radiation
- Tipping Bucket Rain Gauge
- CR200 data logger
- 10W Solar Panel
- Lightning Rod
- Easy to use PC200W Software
- Battery and charger circuit
- 32,000 data values (85 days) in recorded data memory
- RS-232 Interface and PC 9-pin cable (6')

1.1 Unpacking, Bill of materials

Using the following bill of materials, open the cartons and check off the items to see that all material was received in good condition. Notify Dynamax no later than 10 days after receipt if there are any discrepancies. Notify the shipper and Dynamax immediately if goods are damaged in transit by mishandling. The white InteliMet Advantage 5 enclosure contains the CR200 logger and battery. Sensor cables with sensors installed on the end, exit from the bottom of the system enclosure. 6' RS232 interface cable tucked inside the enclosure. Each sensor lead is labeled identifying the sensor type and constants if any.

InteliMet Advantage 5 software CD-ROM is supplied with each system, unless otherwise ordered for advanced software such as Logger Net or PC400. The software CD contains PC200w installation, Lascano-VanBavel ETP programs, Documentation.

1.1.1 Bill of materials

1. CR200 Data Logger
2. MaxiMet GMX500 Compact Weather Station
3. IMETA-PYRP Pyranometer
4. IMETA-LEV Pyranometer Leveling Base
5. CM225 Pyranometer Mounting Stand
6. 6ft SDI-12 Cable
7. USB-CONV1 Serial to USB Adapter
8. RG-100 Rain Gauge with shelf
9. .75 & 1.0 x 1.25” Aluminum Pipe Holder
10. MaxiMet Support Tube, 10” Threaded
11. ¾” SCH 40 Aluminum Pipe x 36”
12. 4ft Vertical Pipe, Reducer 2-1”
13. 4ft Copper Ground Rod & Clamp
14. 10 X 8” Enclosure with Hardware
15. IMET 12V/2.9Ahr Battery
16. AC Power Transformer
17. Lightning Rod
18. 10W Solar Panel with Mounts

Optional

1. PC400 or LoggerNet – Advanced data logger support software.
2. CM6 – 2m Tripod with collapsible leveling collars and ground stakes.
3. GSM-F1/2 GSM – Cell Modem Kit.
4. RFMX – RF Communications.

Optional Sensors

1. IMETA-109 – Soil Temperature Probe
2. IMETA-SM150T – Soil Moisture & Temperature Theta Probe
3. IMETA-QST – Quantum Sensor

1.1.2 List of Tools required

Hardware supplied by the user

2” metal pipe, 4’ long (or) other compatible mounting pole/ tower

A general list of tools required

- Shovel – or post hole digger
- Large bucket or container to mix concrete
- 12” pipe wrench
- Teflon tape or pipe dope
- Small sledge hammer
- 12’ tape measure
- Felt-tipped marking pen
- Open-end wrenches: 3/8”, 7/16”, ½”, 9/16”
- Socket wrench and 7/16” deep well socket
- Level (12” – 24”)
- 5/64” Allen wrench
- Straight-bit screwdrivers (small, medium)
- Magnetic compass
- Volt/ Ohm meter
- Wire ties and tabs
- Conduit and associated tools as required for optional sensors
- 6’ ladder
- Lock and key for enclosure

Installation supplies needed:

- 2” metal pipe, 6’ long, threaded on one end for 2 in pipe thread.
- Concrete (quick set) mix to secure the vertical pipe, and fill a 4 ft hole (1-2 bags). 2-4 gals water as recommended by concrete mix.
- Wooden stakes with tape, or bricks / rocks to hold the pipe vertically while setting.

1.2 Communication Options

InteliMet Advantage 5 weather station based on CR200 logger offers a variety of communication choices of user to connect between logger and PC using PC200 or PC400 or LoggerNet for advanced network applications. Optional RS232, 150 to 250 ft RS232 extension cables can be added for direct communication at 1200 baud. In addition, InteliMet Advantage 5 supports remote communication options given below with easy to use software features.

(Model COM210) Land-line Modem for remote field retrieval and control:

Customer provides telephone connections and PC MODEM (Hayes compatible) at computer location. Many models are supported by the telecommunication software package included in PC400 or LoggerNet.

(Model: SHM) Short haul modem for communication using 4-wire cable:

For cable communication of up to 4Miles not possible using 9-wire serial cable. DIP switch selectable. Easy to install and establish communication. Short-haul modems are line-powered, i.e. powered from communicating device PC or data Logger. Refer to sections 8.2 for a detailed discussion on Modem setup and hardware required.

CR206 or CR216 Spread spectrum radio data transmission

(with Model: RFMX base station)Radio Modem

Stand-alone radio modems provide efficient and low-cost serial communication to remote installations for long distances of up to 40 Miles @ 9600 baud rate. The CR206 operates at 915 Mhz in the USA, and CR216 operates ate 2.4 Ghz in most other countries.

RFMX modems allow point-to-point and point-to-multi-point configurations between central PC and multiple data loggers connected to it. RFMX modems can be setup using PC400 or LoggerNet software. RFMX is also offered in a modem kit (Model: RFMXMK) with surge protector, high-gain antenna and connectors assembled in a weatherproof enclosure. Optional solar panels are available to power the modem continuously. Contact Dynamax representative for selecting suitable products for your application.

(Model: GSM) Dual-band GSM Cellular modem (900/1800, 850/1900):

GSM cellular modem for serial data rates of up to 115,200 bps uses cellular network where available. GSM modem is very low power modem with 5 AHr battery capacity of 33Hours of communication and 20Days on idle. GSM modem installed in remote site can be connected to PC using a 56K landline modem (Model: DNX9600) and telephone network. GSM-CMK is a cellular modem kit that includes modem, surge protector, antenna and 15' long antenna cable assembled in a weatherproof enclosure, optional solar panels for continuous powering the modem. Software setup for GSM modem is same as that of Data Modem. Contact Dynamax representative for selecting suitable product for your application.

2.0 SOFTWARE INSTALLATION

InteliMet Advantage 5 is a completely integrated weather station capable of reading a variety of meteorological sensors. Sensor readings are then stored in data logger's memory. Data from the logger is available for down load using support software. Downloaded data contains measurements from individual sensors at the interval defined in the program and calculated ETP in mm/hour using Lascano-Van Bavel Evapotranspiration (ETP) algorithm on an hourly basis. InteliMet Advantage 5 weather station is based on CR200 data logger. Hence, can be operated using any of the following data logger support software,

- PC200w – Included as standard with the weather station IMET-ADV, direct connection with logger / PC only.
- PC400 – Option for dial-up, RF MODEMs, and point to multi-point loggers
- LoggerNet – Comprehensive networking options, with scheduling automatic data retrieval and pakbus protocol networks. All communication links are supported: RF, Tel MODEM, LANs, etc.

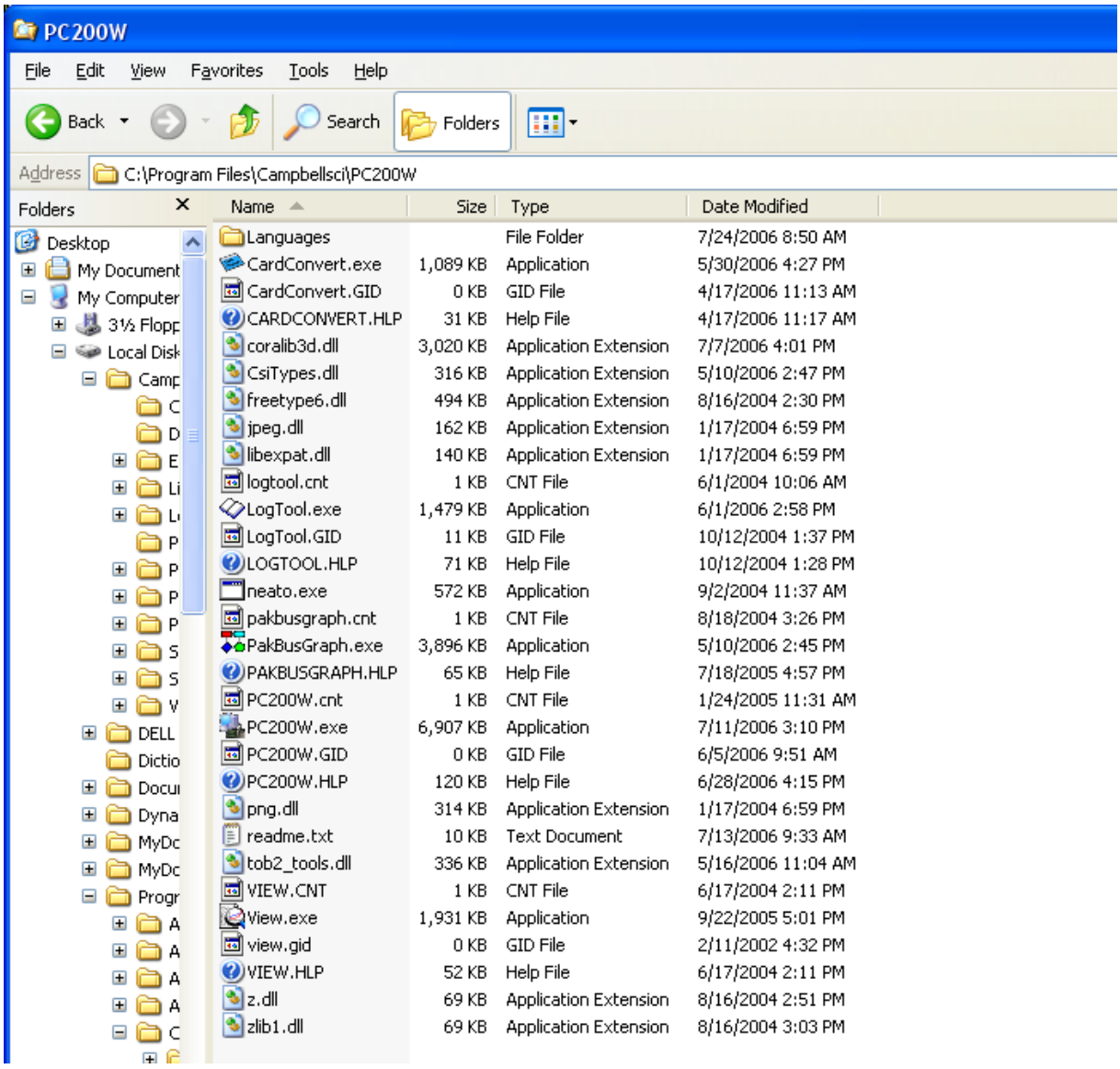
Each InteliMet Advantage 5 weather station is supplied with PC200w software in a CD along with CR200 programs to read sensors and calculate ETP.

For the procedure to connect, program and download data, refer to chapter 5. In this manual we describe working with InteliMet Advantage 5 weather station using PC200w. Full capabilities of InteliMet Advantage 5 weather station is obtained by using two sets of software programs,

1. Data logger support software - PC200w
2. Data logger program IMET_MP2_Main.CR2 to load in to CR200 data logger for reading variety of weather sensors, compute weather data and ETP from electrical measurements and store to logger memory. A test program Imet_MP2_Tst.CR2 is also supplied for setting up or troubleshooting.
3. In addition custom weather station configurations may require a modified version of ImetCust1.cr2 program.

2.1 PC200 Installation

PC200 Logger utilities software installation is provided in the InteliMet Advantage 5 CD-ROM. Insert the CD into the CD-ROM. Open windows explorer (My Computer) to view the list of files on the install CD. Double click on pc200w_3.2.exe to launch the installation. The installation panels will guide you through the process. Once the installation is complete the, PC200 software will be installed in the specified directory. A PC200w icon will be placed on the desktop to give easy access to the software application. Open My computer and navigate to the directory where software is installed. Verify that all the required files are present in the directory as shown in the list below.

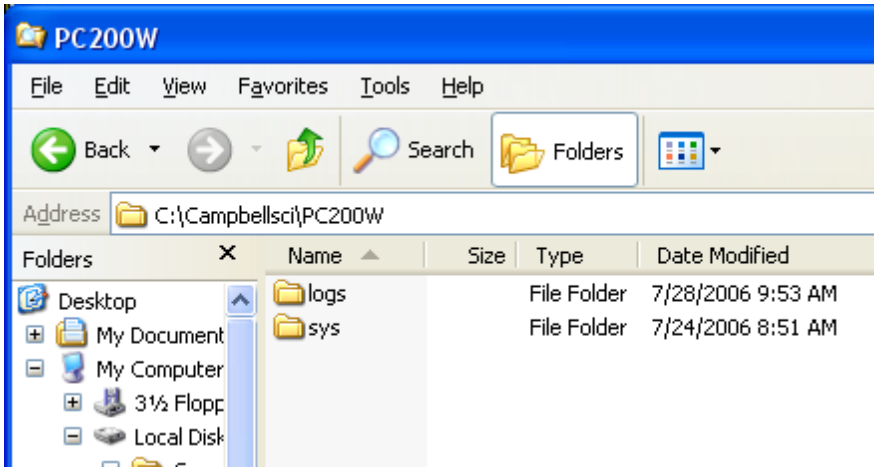


2.1.1 Working Directory Location

PC200 install wizard prompts for working directory location. By default working directory is

C:\CampbellSci\PC200

This can be changed by specifying a different path location on the hard-drive. Location of working directory will not affect the operation of PC200. This directory stores temporary files. Following is a typical list of files in working directory when working directory and PC200 executables are stored in different locations.



2.2 Lascano-VanBavel ET program for InteliMet Advantage 5 (CR200)

Each InteliMet Advantage 5 weather station is supplied with a standard CR200 program IMET_MP2_Main.CR2 and a test program IMET_MP2_tst.CR2. These programs are supplied in InteliMet Advantage 5 software CD in the **Programs** directory. IMET_MP2_Main.CR2 program is loaded into the logger before it is shipped out. Copy programs directory containing, IMET_MP2_Main.CR2 and IMET_MP2_tst.CR2 programs to your PC on to the directory

C:\\Dynamax\Imet\.

These are READ ONLY files. Any changes to these files are not allowed; you can make changes in the CRBasic editor or other text editor and save the modified program with a new file name.

In addition if the InteliMet Advantage 5 system shipped is a custom set of sensors, with additional soil moisture sensors etc., these are shipped with custom programs ImetCust1.CR2 and ImetCust1Tst.CR2 or similar names in a standard CD. In this case, as before copy the contents of CD in addition to the standard programs to,

C:\\Dynamax\Imet\

3.0 INTELIMET ADVANTAGE 5 AND SENSOR INSTALLATION

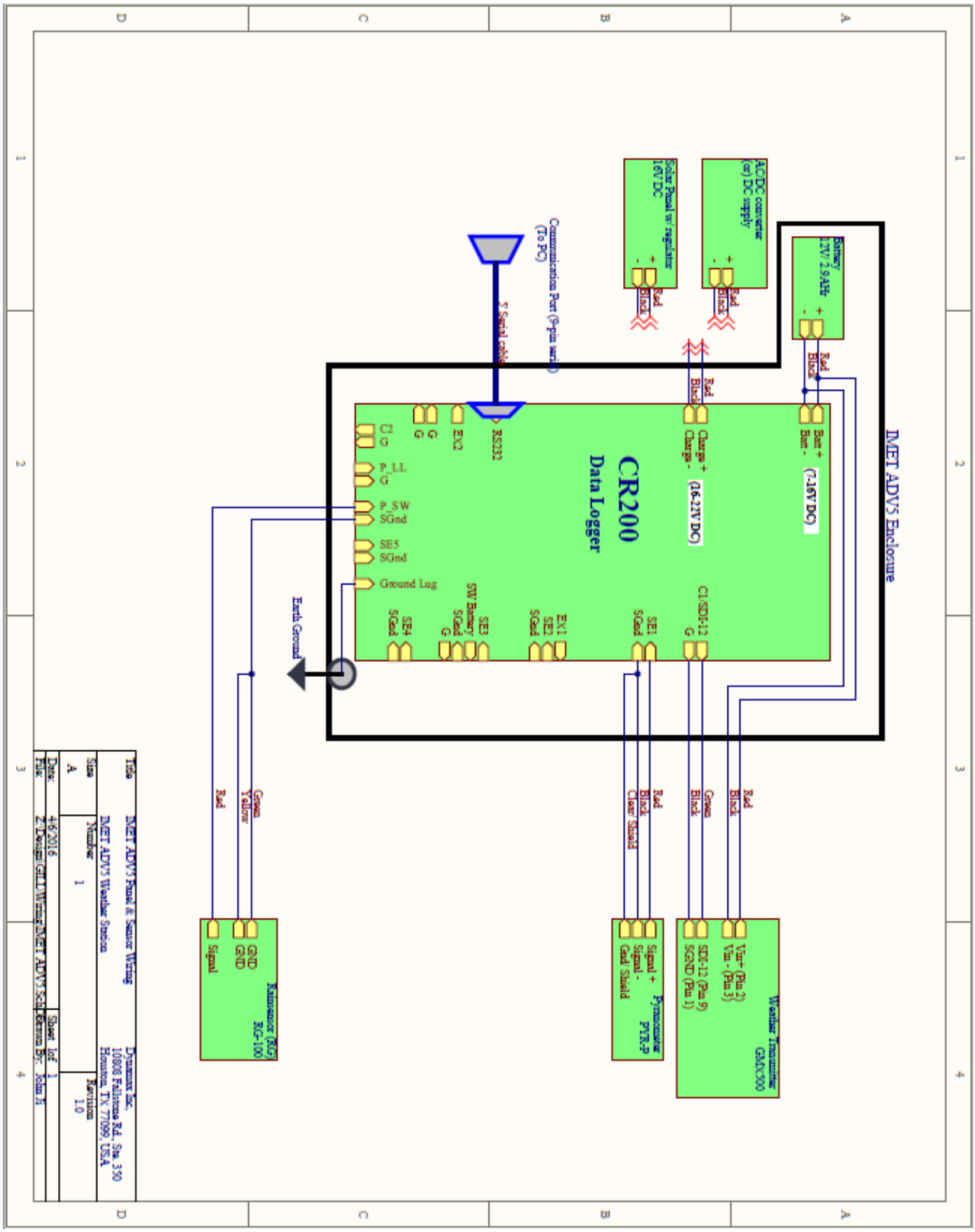
InteliMet Advantage 5 weather station is completely integrated system with data collection/ processing and storage unit along with basic meteorological sensors. IMET_MP2_Main.CR2 program supplied with the system can read all the basic weather sensors (solar radiation, air temperature, RH, Wind speed, wind direction, rain gauge, optional soil temp. and soil moisture), process data according to the applied algorithms and constants, compute ETP and store in data loggers memory for retrieval at a later time. InteliMet Advantage 5 weather station custom stations will be assembled and programmed with a custom program before the units are shipped from our factory. So, all the assembly and programming of the weather station is performed at our factory. This leaves the end-user with only installation of the weather station at the required site.

This chapter discusses basics of installation on a steel pipe mast (standard), system mounting, sensor wiring and solar panel installation. A separate manual is provided for optional tripod installation. Selecting an appropriate site for installation of weather station is critical to obtain accurate meteorological data. The site should be away from urban and natural obstructions such as buildings and trees, or sprinkler irrigation. This chapter explains steps involved in

- Pole installation
- InteliMet Advantage 5 weather station installation
- Solar panel installation
- Sensor installation

Refer to the following chapters for software setup, programming and data retrieval.

InteliMet Advantage 5 stations components and wiring is shown in the diagram below.

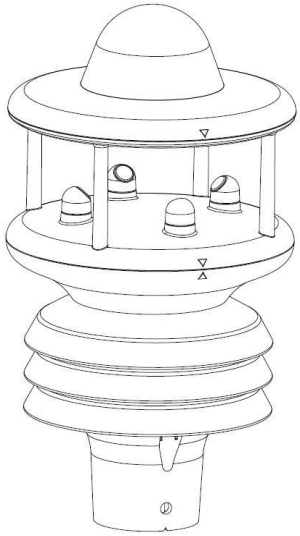

IMET ADV5 Enclosure
CR200
Data Logger
Battery 12V 2.9 AHr
ACDC converter (or) DC supply
Solar Panel w/ regulator 16V DC
Communication Port (9-pin serial)
RS232
Batt + (7-16V DC)
Batt -
Charge + (16-32V DC)
Charge -
C2
P_LL
P_SW
SGnd
SE5
SGnd
Ground Lug
Earth Ground
SE4
SE3
SW Battery
EX1
SE1
SE1
C1/SDI-12
Rain gauge (TBR) RG-100
Signal
GND
GND
Red
Green
Yellow
Pyranometer PYR-P
Signal +
Signal -
Cond Shield
Red
Black
Clear Shield
Weather Transmitter GMX500
Vout+ (Pin 2)
Vin - (Pin 3)
SDI-12 (Pin 9)
SGND (Pin 1)
Green
Black
Red
Black
Title: IMET ADV5 Panel & Sensor Wiring
IMET ADV5 Weather Station
Dynamax Inc.
10808 Fallstone Rd., Ste. 350
Houston, TX 77099, USA
Size: A
Number: 1
Revision: 1.0
Date: 4/6/2016
File: Z:\Designs\GMX\Wiring\IMET ADV5 Sch\Drawing1.SchDoc
Sheet 1 of 1
Drawn By: John H

3.1 MaxiMet GMX500

MaxiMet GMX500 is an advanced compact weather station designed and manufactured by Gill instruments using proven technology to measure meteorological and environmental parameters to international standards.

- The MaxiMet uses the Gill WindSonic wind speed and direction sensor. The WindSonic measures the times taken for an ultrasonic pulse of sound to travel from the North (N) transducer to the South (S) transducer, and compares it with the time for a pulse to travel from S to N transducer. Likewise times are compared between West (W) and East (E), and E and W transducer.

- If, for example, a North wind is blowing, then the time taken for the pulse to travel from N to S will be faster than from S to N, whereas the W to E, and E to W times will be the same. The wind speed and direction can then be calculated from the differences in the times of flight on each axis. This calculation is independent of factors such as temperature.



- The compass point and polarity of U and V if the wind components along the U and V axis are blowing in the direction of the respective arrows.

- MaxiMet can output the following wind readings depending on use of a Compass or GPS.
    - Relative wind – wind speed and/or direction, uncorrected, but relative to the north marker, which may not be facing North.
    - Corrected wind – with the aid of the Compass Magnetic North corrected wind direction can be output.
    - True wind – wind speed and/or direction information corrected by GPS for any direction misalignment of the north marker and/or for any motion of the station. (E.g. vehicle or vessel).

- A Met Spec Multi-Plate Radiation Shield is used. The special shield plate geometry, with its double louvre design, provides excellent response time performance of quick ambient temperature changes while still working effectively as a baffle to stop larger contaminants such as salt or dirt from reaching the temperature and humidity sensor. The shield benefits from very robust material choice and extremely high UV protection requiring no maintenance.

- There is an internal solid state instrument contained within the Radiation shield that provides digital output signals for Relative Humidity, Temperature and calculated Dew point.

- Barometric pressure output is provided by a solid-state device fitted on to a circuit board inside a MaxiMet molding.

- MaxiMet contains a 2-axis compass and magnetic field sensing module using Magneto-Inductive (MI) sensors. The sensor changes inductance by 100% over its field measurement range. It incorporates a temperature and noise stabilized oscillator/counter circuit. The compass has a high degree of azimuth accuracy. MaxiMet uses the internal compass to electronically sense the difference in the earth's field from the system's magnetic field, then an on-board microprocessor electronically subtracts out the system's magnetic fields, reporting highly accurate compass readings. Wind direction data is corrected for the orientation of the sensor. The output of the wind direction is relative to magnetic North. The MaxiMet compass is calibrated at Gill Instruments before the unit is delivered. Prior to installing MaxiMet it is suggested that for best accuracy a declination figure should be entered. Use of the Compass Corrected Wind direction readings allows the unit be installed such that accurate positioning of the MaxiMet North Marker is not required.

- Declination is the magnetic declination (the angle between Magnetic North and True North) in degrees. This is a correction factor that is added to the magnetic north heading from the compass. Map and declination figures in decimal figures can be obtained from

  http://www.ngdc.noaa.gov/geomag/declination.shtml

- MaxiMet uses a highly accurate GPS (Optional) antenna receiver module including a ceramic GPS patch antenna. The module is capable of receiving signals from up to 48 GPS satellites and transferring them into position and timing information that can be read over a serial port. Small size and high-end GPS functionality are combined with low power consumption.

- When GPS Speed and GPS heading are available and GPS Speed transitions are above 5m/s, Corrected Wind Speed shall be computed as the True Wind speed using GPS speed and GPS heading.

- When GPS Speed is available and GPS Speed transitions are below 4m/s, Corrected Wind Speed shall be computed as the True Wind Direction using GPS speed and Compass heading.

3.2 InteliMet Advantage 5 and Tripod Installation

Operation, Overview and Quick start guide

1. Site selection and preparation.
2. Unpacking the system.
3. Mount user supplied pipe in the ground and add 1” pipe on top to give a total height of 6ft.
4. Install GMX500 on center pipe, orient to the North.
5. Mount InteliMet Advantage 5 enclosure, connect sensor cables, connect Power, and Connect Grounding.
6. Install optional: solar panel, lightning rod, antenna (if applicable).
7. Connect personal computer.
8. Install datalogger support software (PC200w) on PC.
9. Connect power to the weather station. InteliMet Advantage 5 starts collecting data every minute and calculates ET and saves to logger memory every hour using the default program stored in the loggers non-volatile memory.
10. Using data logger support software, connect to the InteliMet Advantage 5 weather station. Set the logger internal clock with the PC time/date **Click on the Set Data logger Clk**
11. Download **IMET_MP2_tst.CR2** to logger InteliMet Advantage 5 weather station starts measuring sensors every 10s and store the collected data and calculations to memory every minute. Monitor sensor output and calculated ET data. If the sensors data and ETP output are with in the acceptable ranges, means that the sensors and system are installed properly.
12. Now send the original logging program IMET_MP2_Main.CR2 program, for site-specific parameters, save with a different name. Compile the new program and send to logger. Now the data logger collects sensor data every minute, compute ET every hour and store hourly and daily data to the logger.
13. After few days down load data stored in the logger memory.
    PC200 -> Connect -> Collect all button
    Retrieve data into *.csv files.
14. The retrieved data contains average weather sensor measurements at 1 hour intervals and calculated ETP at 1 hour interval.

3.2.1 Single Pole Installation:

The sensor default height is 6 ft or 2m above the ground surface. If you wish to add height to 3m or more, an optional tripod or mast mounting system is required for stability in the field.

The following parts are supplied as part of the field installation kit.

- 4ft 1 in. Vertical Pipe, and 2 in x 1 in reducer coupling
- 1in x 1-1/4 in Reducer
- GMX500 Support Tube, 1.25" ID 10" Threaded aluminum custom fitting
- ¾" aluminum pipe, 3' long cross arm
- MT-204BK, .75 &1.0 x .125 aluminum pipe holder
- Lightning Rod with Clamp (optional)
- Grounding Rod with Clamp
- 10', 12AWG wire ground wire
- Cable ties

In addition the user must supply the following materials:

- 2" metal pipe, 6' long, threaded on one end for 2 in pipe thread.
- Concrete (quick set) mix to secure the vertical pipe, and fill a 4 ft hole (1-2 bags). 2-4 gals water as recommended by concrete mix.
- Wooden stakes, and tape to position and hold pipe while setting concrete.
- Tools listed in the previous sections

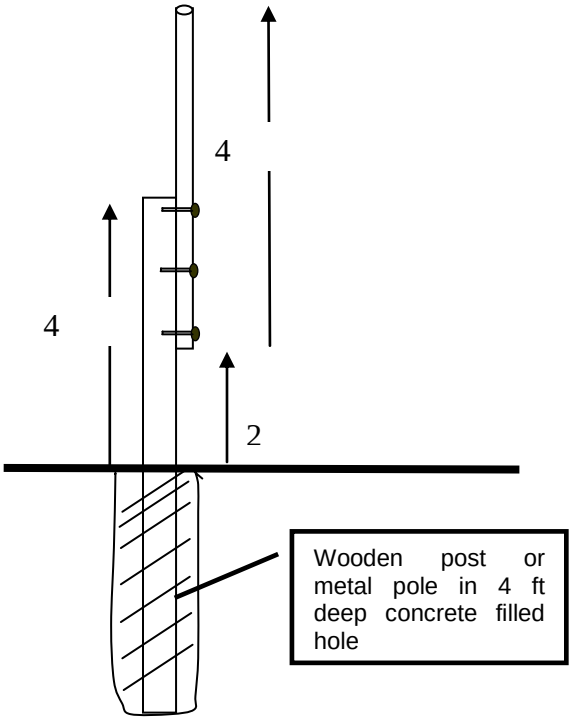
- Select site for installing tripod and weather station. The site should be away from obstructions and sprinklers. A flat ground is recommended for installation, even though the unit can be installed in many different terrains with some professional help.
- Prepare an area of 10' diameter for installing tripod with little disturbance to the ground surface or vegetation.
- Dig a posthole of 6- 8 in diameter and four ft deep with a shovel or with a posthole digger. Mix two bags of quick set concrete mix and pour into the hole. Insert the 2" pipe in the pit and fix the pole position vertically with wooden stakes and tape.
- The 2" pipe should extend only two feet above the ground surface.
- You may also tap the pole into the bottom of the hole with a hammer as long as the threads are protected. Then pile rocks or bricks around the pole to hold the position vertical. Check the vertical pole with a level to make sure it is vertical before leaving for the day. Wait for about 24 hours while the concrete sets.
- Apply pipe dope or Teflon tape to threads on the threaded pipes. To prevent cross threading, hand thread the bell reducer and then tighten with a pipe wrench. Then hand thread the 4 ft X1" pipe mast into the threaded reducer and then tighten with a pipe wrench.
- Install aluminum pipe holder on the end of 4'X1" diameter pipe, both supplied with the weather station. Adjust to 1 ft. 5 in below the top of the mast, so the cross arm will point roughly east and west. Tighten the setscrews.

- Insert ¾ in cross arm in the horizontal bore of the aluminum pipe holder. Center the cross arm, and tighten using set screws.

- Thread the 10” MaxiMet support tube into 1-1/4” side of 1” X 1-1/4” reducer as shown.

- Before installing the GMX500, disconnect the cable from the data logger. Run the cable through the designated hole in the support tube as shown. Then connect the cable connector to the GMX500. Turn the connector clock wise until you hear a click. Secure the GMX500 with 3 X M5 screws.

- Install Pyranometer leveling base (CM225) on the other end of the cross arm as shown in the picture using U-bolts and nuts supplied. (Refer to section 3.3.2)

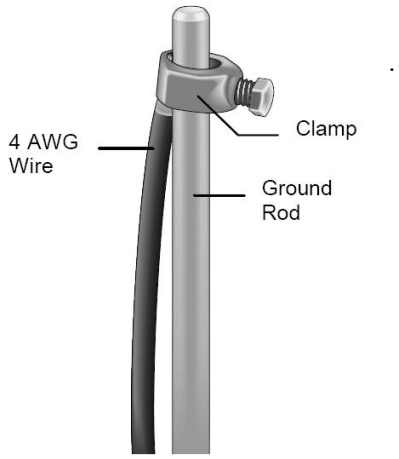


POST ALTERNATIVE:

Alternative mounting without a 2" diameter-mounting pole is possible for a permanent position. Dig a posthole and mount a base pole or post that is made from an 8 ft long pipe with at least 2 in inside diameter or a wooden post with 4" or greater size O.D. Then drill three holes in the lower ½ of the 1" pipe (supplied as the mast) along the same line in the center. With mounting bolts, you then attach the mast to the post or pipe, and align the assembly vertically. Then pour the concrete and fix the position until the concrete has set.

If the post is wooden, a grounding wire should be run from the metal pipe to the copper grounding rod.

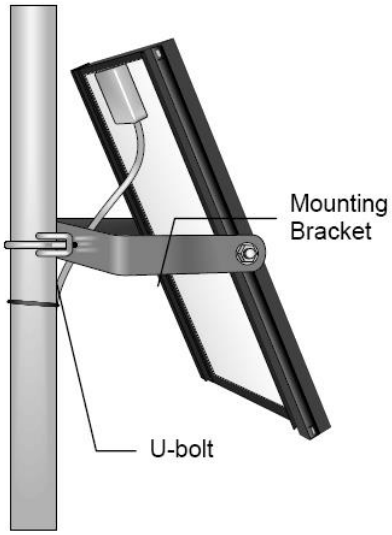
- Install pyranometer sensor on the leveling plate and secure with bottom screw.
- Install pyranometer leveling plate on top of the mounting bracket, leave the inner screws loose for now.
- Install leveling assembly and bracket onto the cross arm opposite the GMX500 transmitter. The u-bolts can be tightened after you level the plate roughly. Now adjust the Allen (hex) set screws to level the bubble in the leveling plate, and then tighten the inner fixing screws with a screwdriver.
- Install lightning rod (if applicable) on the pole mast.
- Rotate the threads and make sure the reducer coupling is holding both 2" and 1" pipes firmly.
- **Lightning Rod:** Position the lightning rod 4" down from the top of the mast, attach lightning rod to the mast and make sure the lightning rod set screw is tight.
- **Grounding:** Slide the clamp down the ground rod before driving it in the ground. Drive Ground rod close to the mounting pole using a fence post driver or sledgehammer. In hard soils use water to prime the soil and hole to make driving the rod easier.



Loosen bolt that attached clamp to the ground rod. Draw Ground wire (Green) from the InteliMet Advantage 5 enclosure and insert it between the rod and the clamp. Tighten the clamp bolt.

3.2.2 Solar Panel Installation

Solar panel without regulator model (MSX-xx) is shipped with InteliMet. A 15' cable is attached to the solar panel and the other end of the cable must be connected to the pigtail hanging from the InteliMet Advantage 5 conduit labeled "Solar Panel". Mount solar panel to the mast, facing south (in northern hemisphere) Position solar panel mounting at the top of the 1 ¼" diameter section of the mast. Install U-bolt muffler clamp and nuts. Solar panel should be oriented to receive maximum insolation over the course of the year. Below table lists tilt angles at various latitudes. Once the tilt angle is determined, loosen two bolts that attach mounting bracket to the panel. Adjust the angle and finally tighten the bolts as shown below.

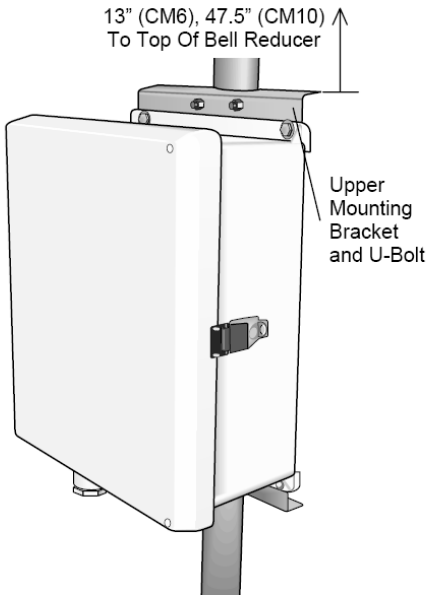


(For MSX10, MSX20 Setup)

(For MSX5 Setup)

3.2.3 Install InteliMet Advantage 5 Enclosure

InteliMet Advantage 5 weather station enclosure contains CR200 data logger, and other storage or communication peripherals if any. RF or GSM modem if purchased is assembled inside the enclosure with surge protector. Sensor cables, Power cables, Communication cables connected to the data logger or any peripherals routed out of the enclosure through cable glands each marked outside the enclosure or on the cable itself. So it is not necessary for an end-user to make any wiring inside the enclosure. All the connectors are accessible out of the box. Position the enclosure on the north side of the mast or tower (northern hemisphere). Secure enclosure as shown in the figure using U-bolts and mounting brackets. Route the 12AWG wire from the Ground Lug on the enclosure to the tripod-grounding clamp. Tighten the screws. Grounding is critical not only for the accuracy of data/ reduce signal noise but also to protect equipment from any lightening surges.



3.3 Sensor Installation

InteliMet Advantage 5 weather station sensors basic or additional are supplied with sensors connected to the data logger in the InteliMet Advantage 5 enclosure. In this section we discuss the procedure to install the sensors on tripod along with InteliMet Advantage 5 enclosure, cable routing, setting up/ orientation of the sensors and entering parameters in the InteliMet Advantage 5/ CR200 program.

Connect the GMX500 wiring back into the CR200X data logger. The following table shows the channel wiring. Lift each clamp, insert each wire, then push down the clamp to secure the wire.

MaxiMet GMX500 Channel Wiring

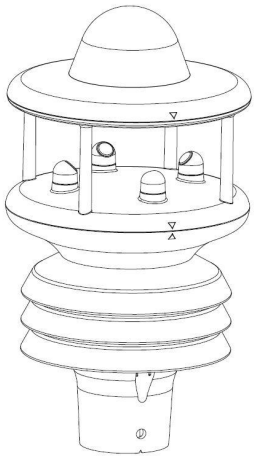
Color	***Function***	***Channel Wiring CR200X***
Black	Ground	S-Gnd
Green	Signal	SDI-12
Red	12V	12V
Black	Battery Gnd	Battery Gnd
Clear/ Shield	Shield	SGnd

3.3.1 MaxiMet GMX500

MaxiMet GMX500 is an advanced compact weather station designed and manufactured by Gill instruments using proven technology to measure meteorological and environmental parameters to international standards.

- The MaxiMet uses the Gill WindSonic wind speed and direction sensor. The WindSonic measures the times taken for an ultrasonic pulse of sound to travel from the North (N) transducer to the South (S) transducer, and compares it with the time for a pulse to travel from S to N transducer. Likewise times are compared between West (W) and East (E), and E and W transducer.

- If, for example, a North wind is blowing, then the time taken for the pulse to travel from N to S will be faster than from S to N, whereas the W to E and E to W times will be the same. The wind speed and direction can then be calculated from the differences in the times of flight on each axis. This calculation is independent of factors such as temperature.



- The compass point and polarity of U and V if the wind components along the U and V axis are blowing in the direction of the respective arrows.

- MaxiMet can output the following wind readings depending on use of a Compass or GPS.
    - Relative wind – wind speed and/or direction, uncorrected, but relative to the north marker, which may not be facing North.
    - Corrected wind – with the aid of the Compass Magnetic North corrected wind direction can be output.
    - True wind – wind speed and/or direction information corrected by GPS for any direction misalignment of the north marker and/or for any motion of the station. (E.g. vehicle or vessel).

- A Met Spec Multi-Plate Radiation Shield is used. The special shield plate geometry, with its double louvre design, provides excellent response time performance of quick ambient temperature changes while still working effectively as a baffle to stop larger contaminants such as salt or dirt from reaching the temperature and humidity sensor. The shield benefits from very robust material choice and extremely high UV protection requiring no maintenance.

- There is an internal solid state instrument contained within the Radiation shield that provides digital output signals for Relative Humidity, Temperature and calculated Dew point.

- Barometric pressure output is provided by a solid-state device fitted on to a circuit board inside a MaxiMet molding.

- MaxiMet contains a 2-axis compass and magnetic field sensing module using Magneto-Inductive (MI) sensors. The sensor changes inductance by 100% over its field measurement range. It incorporates a temperature and noise stabilized oscillator/counter circuit. The compass has a high degree of azimuth accuracy. MaxiMet uses the internal compass to electronically sense the difference in the earth's field from the system's magnetic field, then an on-board microprocessor electronically subtracts out the system's magnetic fields, reporting highly accurate compass

readings. Wind direction data is corrected for the orientation of the sensor. The output of the wind direction is relative to magnetic North. The MaxiMet compass is calibrated at Gill Instruments before the unit is delivered. Prior to installing MaxiMet it is suggested that for best accuracy a declination figure should be entered. Use of the Compass Corrected Wind direction readings allows the unit be installed such that accurate positioning of the MaxiMet North Marker is not required.

- Declination is the magnetic declination (the angle between Magnetic North and True North) in degrees. This is a correction factor that is added to the magnetic north heading from the compass. Map and declination figures in decimal figures can be obtained from

  http://www.ngdc.noaa.gov/geomag/declination.shtml

- MaxiMet uses a highly accurate GPS (Optional) antenna receiver module including a ceramic GPS patch antenna. The module is capable of receiving signals from up to 48 GPS satellites and transferring them into position and timing information that can be read over a serial port. Small size and high-end GPS functionality are combined with low power consumption.

- When GPS Speed and GPS heading are available and GPS Speed transitions are above 5m/s, Corrected Wind Speed shall be computed as the True Wind speed using GPS speed and GPS heading.

- When GPS Speed is available and GPS Speed transitions are below 4m/s, Corrected Wind Speed shall be computed as the True Wind Direction using GPS speed and Compass heading.

3.3.2 Solar Radiation (PYR-P)

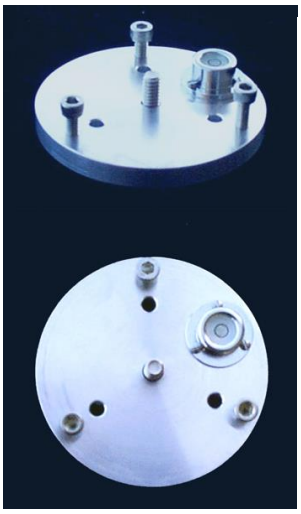
PYR-P solar radiation sensor is supplied with Leveling plate LEV and mounting fixture (CM225). The base includes a bubble lever, sensor holding screw and three adjustment screws for level setting.

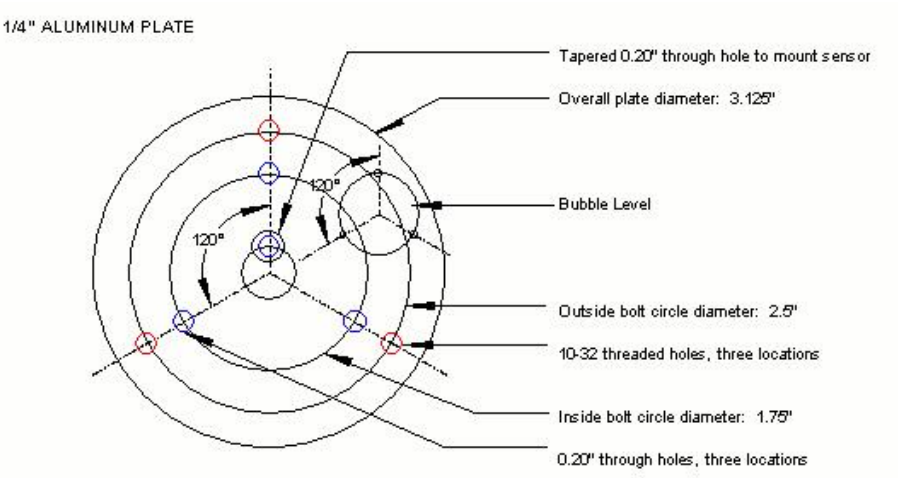
- The LEV leveling plate is set on top of the mounting fixture (CM225) and the mounting fixture is attached to cross arm as shown below using u-bolt and nuts.

- Position the base of the sensor in the leveling plate and tighten the mounting screw from the bottom. Mount the leveling plate on the mounting plate stand, and loosely attach using the three inner screws through the top holes with about 4 turns each. Now, adjust the three Allen (hex socket) leveling screws such that the bubble is in the center showing the

sensor and leveling plate are horizontal. Tighten the three inner set screws to fix the position. Remove the red protective cap when ready to use.

- The PYR-P sensor comes pre-wired to the data logger. Simply route the cable from data logger to the sensor and secure with tie straps.





3.3.3 Soil Temperature sensor (109)

The 109 is designed to measure the temperature of air, water, or soil. For air temperature measurements, the 41303-5A solar radiation shield is typically used to house the probe, while limiting solar loading on the sensor. The temperature probe can also be buried or submerged to 50 feet. The probe is not weighted for submergence (ie, it will float), so the installer should plan to add a weighting system or secure the probe to a fixed, submerged object, such as a piling. The 109 has a measurement temperature range of -50° to +70°C and outputs a full scale range of 0 to 2.2 Volts. Recommended lead lengths are 25, 50, 75, and 100 feet, although the 109 may be ordered with lead lengths up to 1000 ft. Therm109 instruction is used to excite the sensor(s), measure the sensor output voltage and calculate output in degrees C.

Therm109 (Dest, Reps, SEChan, ExChan, Mult, Offset)

Color	***Function***	***CR200 channel wiring***
Black	Excitation	Switched Excitation
Red	Signal	Single-ended channel
Purple	Signal Ground	SGnd
Clear/ Shield	Shield	SGnd

3.3.4 Soil Moisture Sensor (SM150T)

SM150T soil moisture sensor measures volumetric soil moisture content by the principle of dielectric constant of the medium changes with water content. The change in dielectric constant is measured in mV DC voltage. Weather station reads the DC voltage and converts to volumetric soil content in %. Soil moisture sensor SM150T is wired to the InteliMet-Advantage weather station. Select the location for installing the SM150T sensor, usually close to the sprinkler fall area or under the drip nozzle. Push the sensor in to the soil until the rods are fully covered. Route wire to the station and secure it from any damage. Based on the type of soil in which measurements are made, identify the constants slope and offset parameters. Enter these values in CR200 program to calculate soil moisture for either organic or mineral soil using polynomial equation.

Linear constants		
	Slope	**Offset**
Mineral Soil	0.059788	3.87
Organic Soil	0.066439	6.995

SM150T Wiring		
Color	***Function***	***CR200 channel wiring***
Red	Excitation	Switched Battery
White	Signal	Single-ended channel
Shield	Ground	SGnd

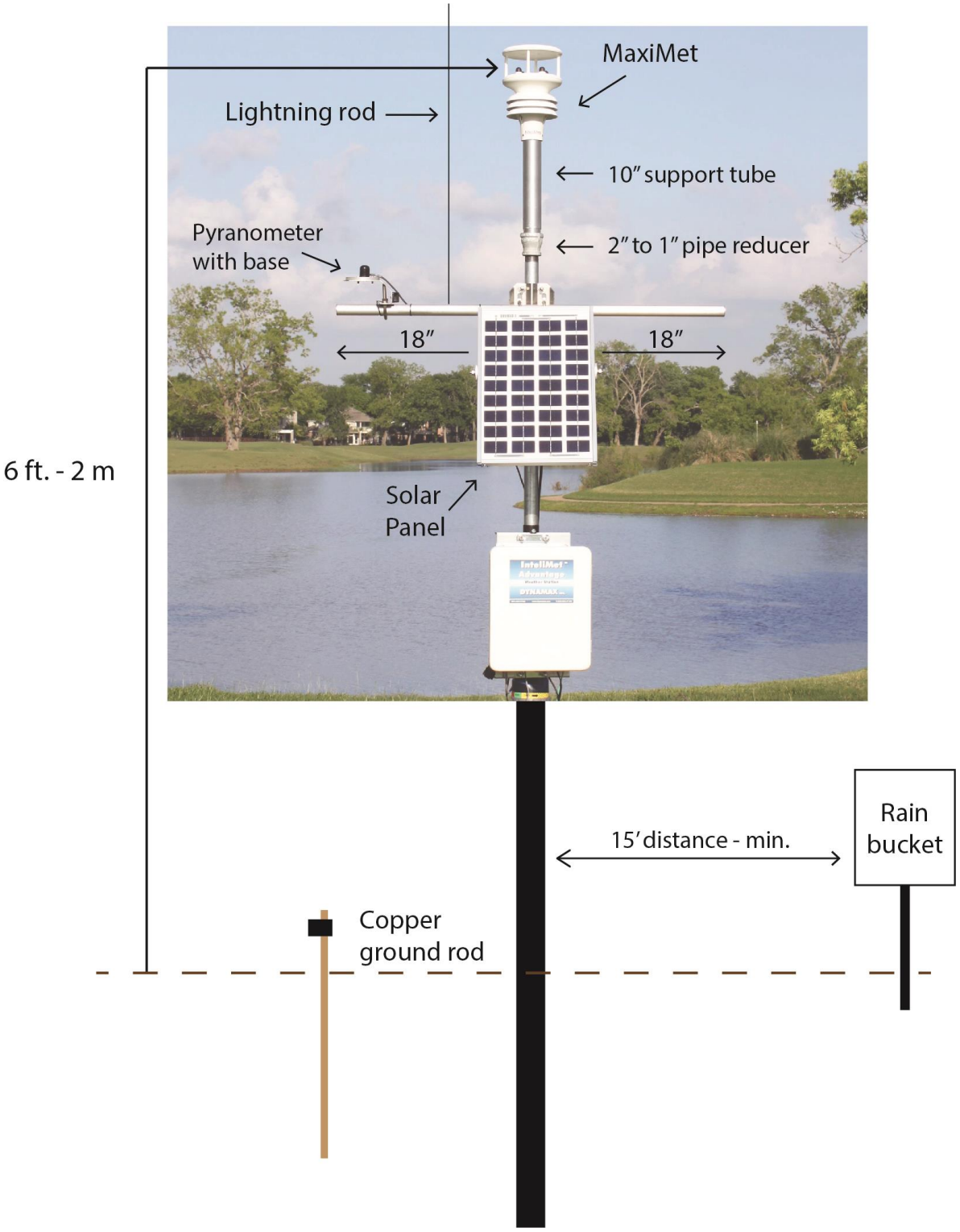
For custom sensors added to CR200 refer to the application notes supplied with the system / sensor manual

3.3.5 Rain Gauge (RG100)

The RG100 Rain gauge is a tipping bucket gauge with magnetic reed switch. The bucket tips when it has collected an amount of water equal to the increment in which the collector measure (0.2 mm). As the bucket tips, it causes a switch closure and brings the second tipping bucket chamber into position. The rain water drains out through the screened rains in the base of the collector. It is made with UV inhibited ABS plastic. It comes equipped with a universal rain gauge mounting shelf and hardware mounts to a fence post or mounting pole not included.

The rain gauge should be installed at least 15 feet away from the main weather station mast to prevent interference.

-


MaxiMet
Lightning rod
10″ support tube
Pyranometer
with base
2″ to 1″ pipe reducer
18″
18″
6 ft. - 2 m
Solar
Panel
Rain
bucket
15′ distance - min.
Copper
ground rod

4.0 LASCANO-VAN BAVEL ETP PROGRAM

The value of ETP (Potential Evapotranspiration) is a reference measure of the evaporative demand, as determined by weather conditions. Using Lascano-VanBavel ET algorithm we calculate ETP estimation from a well-watered short grass. ETP is normally expressed in mm/hr or inch/hr and daily-accumulated values are expressed in mm/day or inches/day. It can be related to hourly or daily data for the sap flow rate, and used to normalize such data against day-to-day variations in the weather, or to identify deviations in the sap flow rate from normal patterns. ETP is also used to create and index reference to schedule irrigation and to calculate crop coefficients. Lascano-VanBavel ET algorithm is embedded in Dynamax weather stations to calculate and output ETP. In addition custom weather station programs can also be supplied with embedded ET calculations. The new Lascano-VanBavel RCM algorithm for ETP does not assume a value for temperature and saturation humidity at the evaporation surface, but rather derives both from closing the energy balance.

In InteliMet Advantage 5 weather station, weather measurements and ET computation are integrated hence, there is no further processing of the collected data. Output of data loggers already contains average weather measurements, computed ET, ready for observation and analysis.

4.1 Application of ETP Information – with Sap Flow

In the interpretation of data on the sap flow rates in crops and trees it is essential to compare their hourly pattern within that of the concurrent evaporation demand. A general comparison can also be made of daily totals, as an indication of water stress, or other influences that cause the plant to use less water than expected.

For example, the weather data may give a value of 10.3 mm/day for ETp and, from stem flow gauges, the total water used by a tree on 10 m2 of land is found as 94 kg/day (converts to 9.4 mm/day). This converts to a Kc of 0.91. On the next day, if the value for ETp is 10.6 mm/day, but the water use measured as 46 kg/day (4.6 mm), stomatal closure and reduced transpiration has occurred. The reduced transpiration can be a result of reduced soil water availability, but possibly a result of other factors such as low root zone temperature, vascular disease, or others.

In the case of irrigation management, a comparison of the ETp rates with the stem flow data serves the dual purpose of diagnosing the need for supplying water and the basis for calculating how much water should be applied. For example, if a four-day sequence of water use a transpiration showed, respectively, 94 kg/day (well watered), 96 kg/day, 50 kg/day (stressed), and 28 kg/day (stressed), while the ETp was essentially constant, we would know that irrigation is needed and overdue, on the 4th day. In this case the plant water stress caused a decrease in ETa by about 70%.

By adding up the sap flow, we also know that the total amount that has to be replaced equals 266 kg. To this amount we must add the losses by soil evaporation, which must be estimated from previous data. Assuming one tree occupies a 10 m2 area, and if the transpiration is 80% of ETp, then the suggested irrigation is 333 kg or 86 gallons (per 10 m2), ie 266 kg / 80%. That would translate to an irrigation of 33.3 mm to replenish the water used over four days. Many variations on this theme can be formulated for a specific application.

One caution should be stated. The ETp estimate is only a quantitative measure of the evaporative demand of a well watered turf grass ¾ " high, and is not intended to be an estimate of the actual water use by the crop or the trees, even if they are well watered. Therefore, the two variables, ETp and stem or trunk flow rate, are expressed as mm per hour and kg/plant/hour, respectively, even though the water use by vegetation is often also expressed as mm per hour or per day. The relation between daily ETp and daily transpiration is not even necessarily linear, as most Kc constants will assume. ETa – Actual Evapotranspiration may not be constant over the entire range of weather conditions or the development period of a crop.

4.2 ET Program Basics

This section covers the basics of Evapotranspiration algorithms and the ET algorithm implemented in IMET_MP2_Main.CR2. ET program contains two constants that are always set for the installation site, and two constants that could be modified for various situations. Only persons thoroughly familiar with ETP modeling should modify parameters lev and zot. Normally, the last two constants are altered to account for the barometric pressure and the height of the wind measurement. The present form of the program is adapted to metric units. Each user needs to know the height of the weather station above ground level.

zom = 2.0	wind speed height of measurement in meters, 2 m typical.

Only an advanced user with expertise and knowledge in the various ET models and roughness parameters for various crops must attempt to change the following parameters.

zot = 0.0005	surface roughness parameter in m, for ¾ in. high turf grass
lev = 2.44×10^6	latent heat of vaporization – J/kg
has = 1004.0	Specific air heat capacity in J/KgC at 30^0 C

In this section we discuss definition of these parameters and their units followed by procedure to modify these parameters in CR200 program to meet the geography of the location of weather station.

4.3 ET Variables and complete algorithm

Constants or site-specific variables:

Notation	***Description***	***Units***
zom	Height of measurement	M
Zot	Roughness parameter for heat and vapor profile	M
Lev	Latent Heat of vaporization	J/Kg
has	Specific heat air capacity	J/Kg.degC at 30C

Input variables:

Notation	***Description***	***Units***
hgr	Hourly average solar radiation	W/m2
hta	Hourly average of air temperature	degC
hrh	Hourly average or relative humidity	%
hpr	Average Barometric Pressure	MBar
hws	Hourly average of wind speed	M/s

Calculated variables:

Notation	***Description***	***Units***
had	Air Density	Kg/m3
hum	Ambient Humidity	Kg/m3
has	Aerodynamic resistance	S/m
skl	Sky long-wave radiation	W/m2
htc	Surface temperature	DegC
rnt	Net radiation balance	W/m2
sht	Sensible heat flux	W/m2
hums	Humidity at the surface	Kg/m3
evt	Evapotranspiration	Kg/m2.s
EVT	Evapotranspiration in standard units	mm/hour

RCM ET Algorithm:

Site Specific Variables :

$lev = (2.501 - 0.002361 \cdot hta) \cdot 10^6$ (*given here for reference only*)

$abp = 1013.2 \cdot e^{(-elf \cdot 3.817E - 0.5)}$

Note: abp is measured by the InteliMet Advantage 5, so no calculation is needed.

Dew Point Calculation :

$$e_s(T_a) = 6.1078 \cdot e^{\left(\frac{17.2693882 T_a}{237.3 + T_a}\right)}$$

$$e_a = e_s(T_a) \cdot hrh$$

$$hdp = \frac{\left(237.3 \cdot \ln\left(\frac{e_a}{6.1078}\right)\right)}{\left(17.2693882 - \ln\left(\frac{e_a}{6.1078}\right)\right)}$$

RCM algorithm for ET calculation :

$$had = 1.1548 \cdot \frac{abp}{1013.2}$$

$$hum = 1.323 \cdot \frac{e^{\left(17.269 \frac{hdp}{hdp+237}\right)}}{hdp + 273.2}$$

$$ras = \frac{\ln\left(\frac{zom}{zot}\right)^2}{0.16 \cdot hws} \quad or \quad ras = \frac{\ln\left(\frac{zom}{zot}\right)^2}{0.16 \cdot (hws + 0.1)} \quad when\ hws < 0.1$$

$$skl = 5.67E - 8 \cdot (hta + 273.2)^4 \cdot (0.70 + 0.08241 \cdot hum \cdot e^{\left(\frac{1500}{hta+273.2}\right)})$$

$$htc = root^{htc=10}\left[\left\{\left(0.80 \cdot hgr - 5.67E - 8 \cdot (htc + 273.2)^4 + skl\right) + \frac{(hta - htc) \cdot had \cdot has \cdot 303.16}{(hta + 273.2) \cdot ras} - \frac{1.323 \cdot \frac{e^{\left(17.269 \frac{htc}{htc+237}\right)}}{htc + 273.2} - hum}{ras} \cdot lev\right\} \cdot \frac{ras}{\left(\frac{had \cdot has \cdot 303.16}{hta + 273.2}\right)}, htc\right]$$

$$rnt = \left(0.80 \cdot hgr - 5.67E - 8 \cdot (htc + 273.2)^4 + skl\right)$$

$$sht = \left[\frac{had \cdot has \cdot 303.16 \cdot (hta - htc)}{(hta + 273.2) \cdot ras}\right]$$

$$evt = \frac{rnt + sht}{lev}$$

$$EVT = evt \cdot 3600$$

4.4 CR200 Program for InteliMet Advantage 5 and ET computation

Every standard and custom InteliMet Advantage 5 weather station is tested at our factory and supplied with a program to read sensors every minute, calculate average, compute ET and store to logger every hour. This enables the user to simply power up the weather station and the unit starts collecting data as long as all the sensors are connected and operating properly. In addition to this each system is supplied with software CD containing CR200 program loaded into the logger and a test program. For example a test program can read sensors every 5 seconds and calculate and store to logger memory every minute. This test program is helpful as a learning tool for a new user as well as for testing the installation for any problems. This is also a helpful tool in trouble shooting the weather station, sensors, cabling or installation.

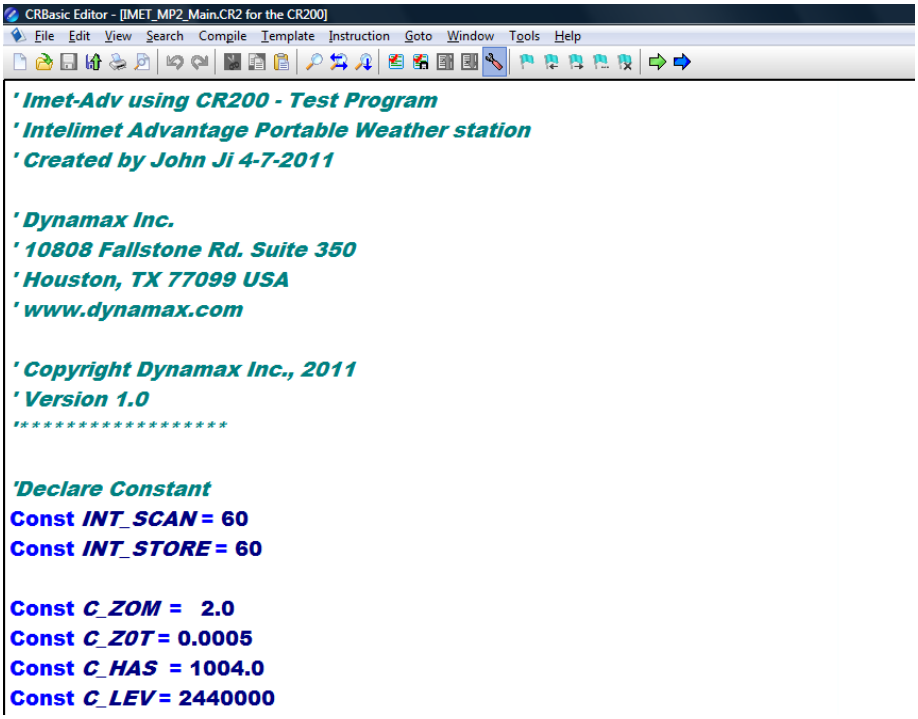
Even though InteliMet weather station is shipped ready to flip the switch and operate, we recommend the user to modify the site specific constants/ variables to meet the geography of the location where the station is setup, compile the program and send the new program to logger. These site specific variables are,

Parameter	***Constant notation in program***	***Description***	***Units***	***Default Values***
zom	C_ZOM	Height of measurement	M	2.0
zot	C_ZOT	Roughness parameter for heat and vapor profile (Default for ¾ " turf grass)	M	0.0005
lev	C_LEV	Latent heat of vaporization	J/Kg	2.44 x10^6
has	C_HAS	Specific Air Heat capacity	J/Kg.degC at 30C	1004.0

In addition an advanced user familiar can experiment with timing loops in the program such as scan interval and log interval.

Notation	***Description***	***Units***	***Default Values***
INT_SCAN	Time interval in seconds between successive reading of the data from meteorological sensors	sec	60
INT_STORE	Time interval in minutes at which to calculate average of the raw weather variables, calculate ETP and store to logger memory	min	60

Program supplied with InteliMet Advantage 5 weather station has the above list of variables present at the top of the program. Following is screen capture of the program IMET_MP2_Main.CR2 as viewed in CR Basic editor.



Notice in the figure timing loop parameters and site-specific parameters appear at the top of the program to enable any users identify these variables and make changes if necessary.

Const INT_SCAN
Const INT_STORE

Const C_ZOM
Const C_ZOT
Const C_LEV
Const C_HAS

The following site-specific parameters must be modified to meet the geographical location at which the station is setup to collect data. Timing loop parameters are options as the industry standard is to collect data every hour.

Const C_ZOM
Const C_ZOT
Const C_LEV
Const C_HAS

4.5 Customizing the Program

Following examples show how to modify the parameters, save and compile the program before making it ready to send to the logger.

Procedure to Modify the Program:

- Open CR Basic Editor by clicking on CRBasic icon 

or your favorite text editor.
- Open the file IMET_MP2_Main.CR2 in the editor.
- Now identify the site-specific or timing loop variables at the top of the program as shown in the previous above.
- Modify values assigned to the constants as required.
- Save the program under a different file name (ImetSiteA.cr2) so that the original program is not modified.
- Now the new program ImetSiteA.cr2 is ready to send to logger.

Example 1:

InteliMet Advantage 5 weather station is setup on top of a tower whose height is 10m. Roughness parameter of the location of the installation is found to be 0.001m and the specific air heat capacity is 1002.0 J/KgC. Modify the program IMET_MP2_Main.CR2 and send to logger so that the weather station can calculate ET using the Lascano-VanBavel RCM algorithm.

From the program it is clear that the required station parameters are,
zom = 10 m
zot = 0.001 m
lev = 2.44 x 10^6
has = 1002.0 J/KgC

Open the program in IMET_MP2_Main.CR2 in CRBasic or favorite text editor. As shown below are the default parameters.

```
' Copyright Dynamax Inc., 2011
' Version 1.0
'******************

'Declare Constant
Const INT_SCAN = 60
Const INT_STORE = 60

Const C_ZOM =  2.0
Const C_ZOT = 0.0005
Const C_HAS  = 1004.0
Const C_LEV = 2440000
```

Now modify the station parameters/ constants in the program to reflect the new settings.

C_ZOM = 10

C_ZOT = 0.0005

C_LEV = 2440000

C_HAS = 1004.0

Enter these values in program as shown below.

```
' Copyright Dynamax Inc., 2011
' Version 1.0
'*****************

'Declare Constant
Const INT_SCAN = 60
Const INT_STORE = 60

Const C_ZOM =  10
Const C_ZOT = 0.001
Const C_HAS  = 1002.0
Const C_LEV = 2440000
```

Save the program as a different name ImetEx1.Cr2. The program is ready for sending to logger for data collection and ET computation with the revised parameters.

Example 2:

InteliMet Advantage 5 weather station is setup on top of a tower whose height is 5m. Roughness parameter of the location of the installation is found to be 0.004m and the specific air heat capacity is 1002.0 J/KgC. The station is located in a research site and the project requires sensor data to be read every 60 seconds and store to logger every 15 minutes. Modify the program IMET_MP2_Main.CR2 and send to logger so that the InteliMet Advantage 5 weather station can calculate ET using the Lascano-VanBavel RCM algorithm.

From the program it is clear that the required station parameters are,
zom = 5 m
zot = 0.004 m
lev = 2.44 x 10^6.
has = 1002.0 J/KgC

Scan interval = 60 sec
Store interval = 15 min

Open the program in IMET_MP2_Main.CR2 in CRBasic or favorite text editor. As shown below are the default parameters.

```
' Copyright Dynamax Inc., 2011
' Version 1.0
'*****************

'Declare Constant
Const INT_SCAN = 60
Const INT_STORE = 60

Const C_ZOM =  2.0
Const C_ZOT = 0.0005
Const C_HAS  = 1004.0
Const C_LEV = 2440000
```

Now modify the station parameters/ constants in the program to reflect the new settings.

INT_SCAN = 60

INT_STORE = 15

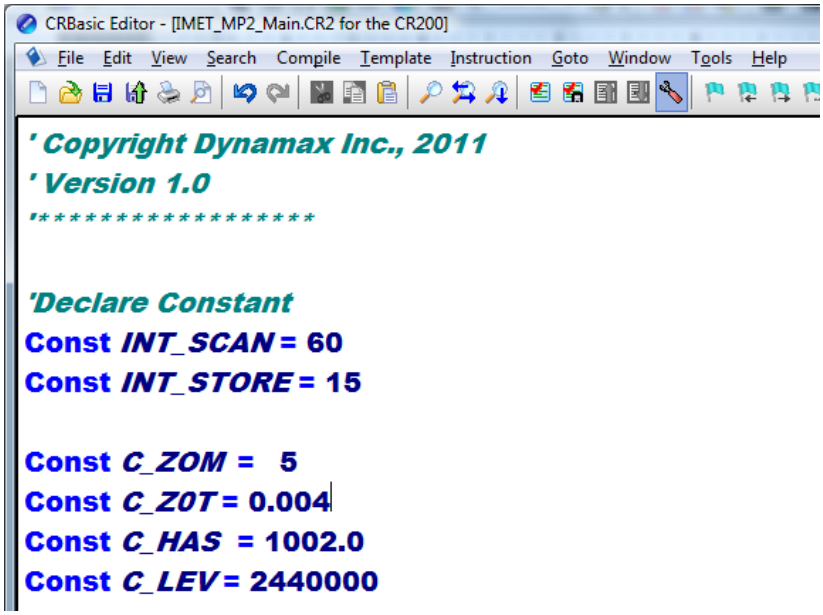
C_ZOM = 5

C_ZOT = 0.004

C_LEV = 2440000

C_HAS = 1002.0

Enter these values in program as shown below.



Save the program as a different name ImetEx2.Cr2. New program is ready for sending to logger for data collection and ET computation with the revised parameters.

4.6 Sensor Constants

A basic InteliMet Advantage 5 weather station is supplied with the following sensors,

GMX500 Integrated weather transmitter

PYR-P Pyranometer

GMX500 is factory configured for use with InteliMet Advantage 5 weather station. Similarly PYR-P pyranometer sensor is factory configured to read global solar radiation in W/m2. All PYR-P sensors are factory calibrated for a multiplier of 5.00. Hence it is not necessary to make any changes to the pyranometer settings.

In addition to the basic sensors, InteliMet Advantage 5 weather station can be added with optional sensors such as

Soil Moisture sensor (SM150T)

Soil temperature sensor (109)

Quantum Sensors (QSO)

In the case of optional sensors it may be necessary to enter constants for those sensors. Please refer to the documentation supplied with the custom sensors for constants and programming. An example of how to change the constants for soil moisture sensor (SM150T) is explained below.

Soil moisture sensor SM150T measures % soil moisture by volume in the sample. The sensor measures voltage output that is proportional to the dielectric constant of the soil. This voltage output can then be converted to %SM using a multiplier and an offset representing the type of soil. The following table lists the multiplier and offset for mineral or organic soil.

Linear constants		
	Slope	**Offset**
Mineral Soil	0.059788	3.87
Organic Soil	0.066439	6.995

Identify the type of soil and corresponding slope and offset from the table above. Open the program IMET_MP2_Main.CR2 or other program if saved in a different name in CRBasic. Identify the SM150T constants at the top of the program after the system constants as shown below.

These constants are,

SM150T_Slope

SM150T_Offset

Enter values for these constants corresponding to the type of soil mineral/ organic in the program. Save the program and compile. Example shown above is for mineral soil.

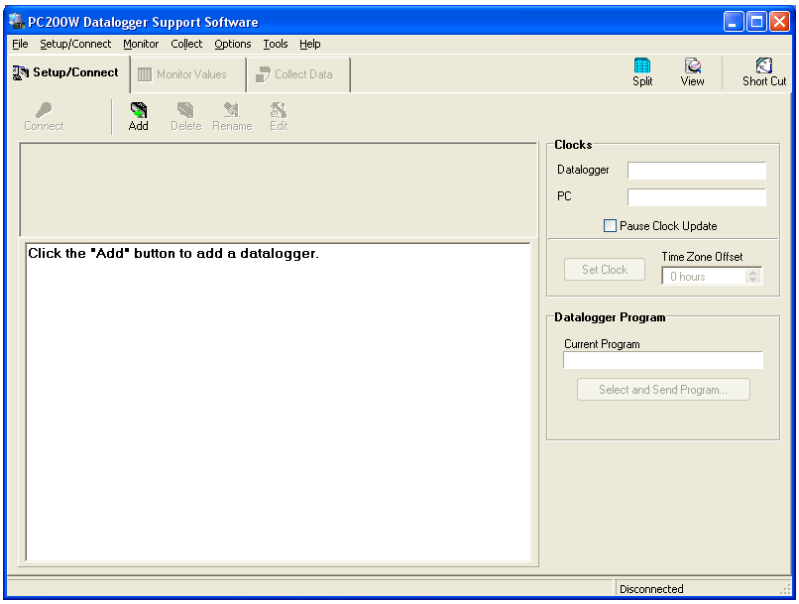
```
' Constants
Const INT_SCAN = 60
Const INT_STORE = 60

Const C_ZOM = 2.0
Const C_ZOT = 0.0005
Const C_HAS = 1004.0
Const C_LEV = 2440000

' When using linearization constants
'Mineral soil Slope = 0.059788    offset = 3.87
'Organic soil Slope = 0.066439    offset = 6.995
Const SM200_Slope = 0.059788
Const SM200_Offset = 3.87
```

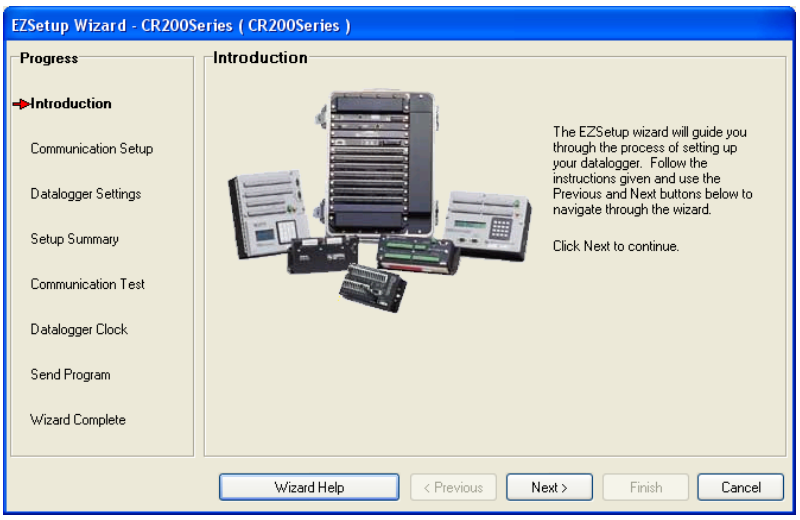
For custom sensors added to CR200 refer to the application notes supplied with the system/ sensor manual

5.0 USING PC200w

5.1 Setup, Program Logger And Communications

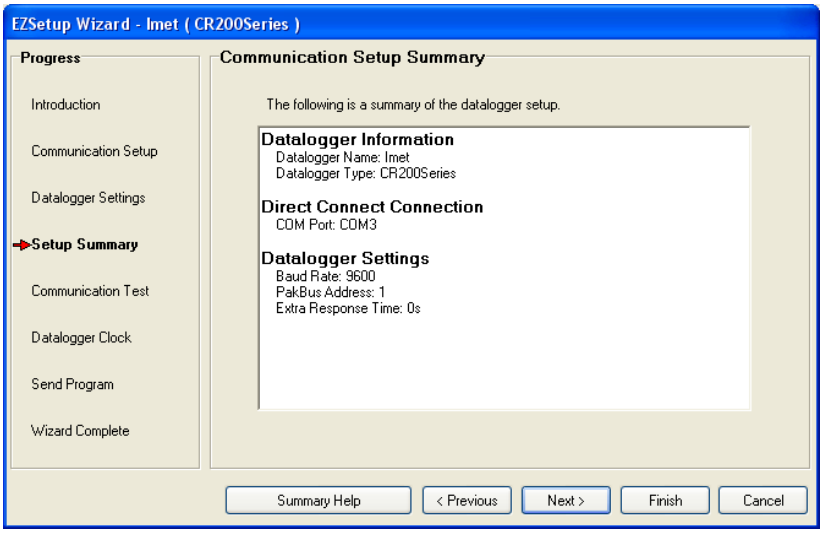
1. If this first time using software or to add a new logger station to the software setup click on **Add** button. **PC200w offers a easy to use step-by-step EZSetup wizard** that will guide through adding stations and connecting to logger. If the station is already added in the list, proceed with connect to logger in section 5.2.





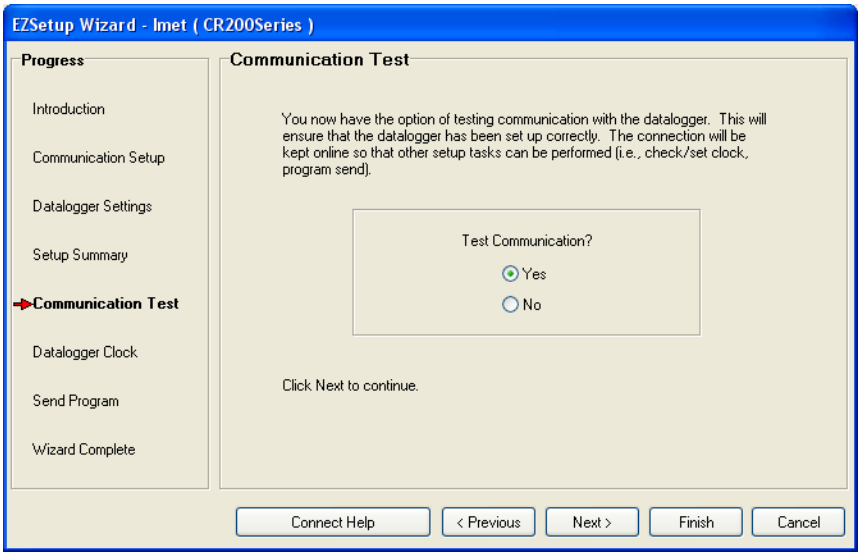
2. EzSetup wizard is shown in the screen below. Click **Next** to start the wizard and complete setup process. Select the data logger as CR200, assign Imet (or any name of your choice) as the Name of the data logger and enter following settings in the setup wizard.

3. Setup wizard displays a summary of the settings as follows in the setup summary window. For any changes such as COM port, baud rate click Previous button to change the settings. When all the parameters are entered as required click next to proceed with setup wizard.



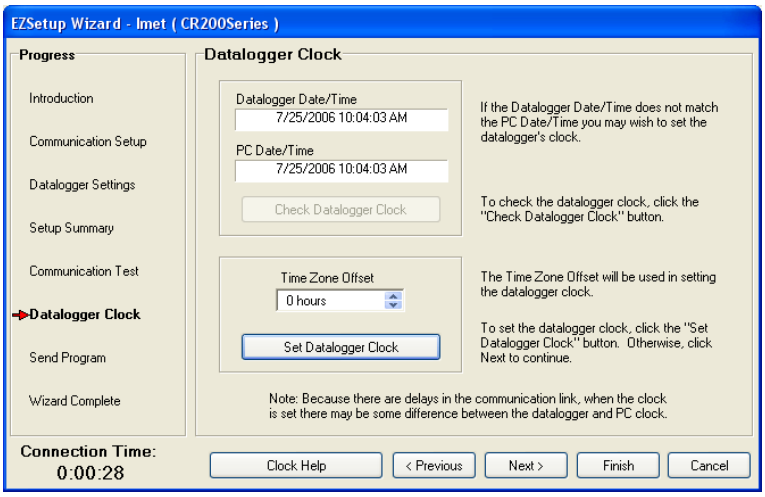
4. At this point if data logger is connected to PC COM port using 5' RS232 communication cable, you may proceed with communication test by selecting **Yes** for the radio button clicking **Next**. Or click **Finish** to close setup wizard, add this station (**Imet**) to the station list for connection and data retrieval in future.

5. If **Test Communication** is selected in the previous window, PC200 software tries to connect to the specified logger on the COM port assigned in the setup wizard. If the Communication test is unsuccessful software responds with **Communication test Failed** message and reverts back to the communication test window. At this point make sure communication cable is connected to PC and the logger is powered, retry the communication test. Click Finish to skip communication test and connect at a later time.

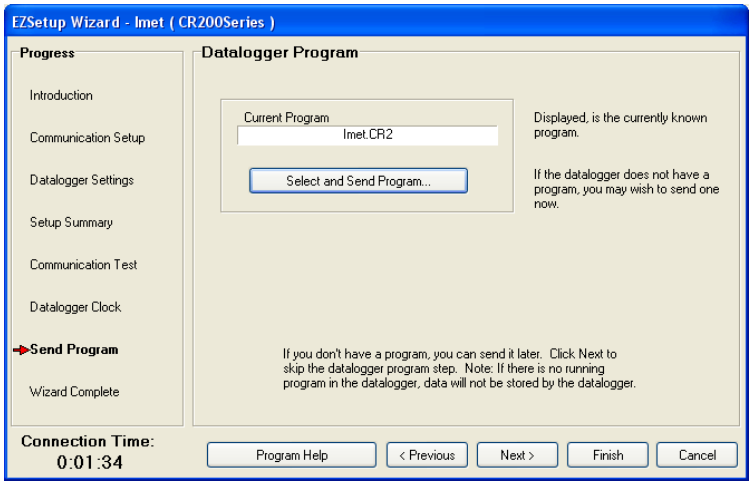


6. If the communication test is successful **Communication test successful** window will be displayed. Click Next to continue with setup wizard.

7. In the **Datalogger clock** window is displayed as shown in the figure. If Datalogger Date/Time is different from the PC Date/Time, select time zone offset between data logger and PC and click **Set Datalogger Clock** command button. Click **Next** to continue.

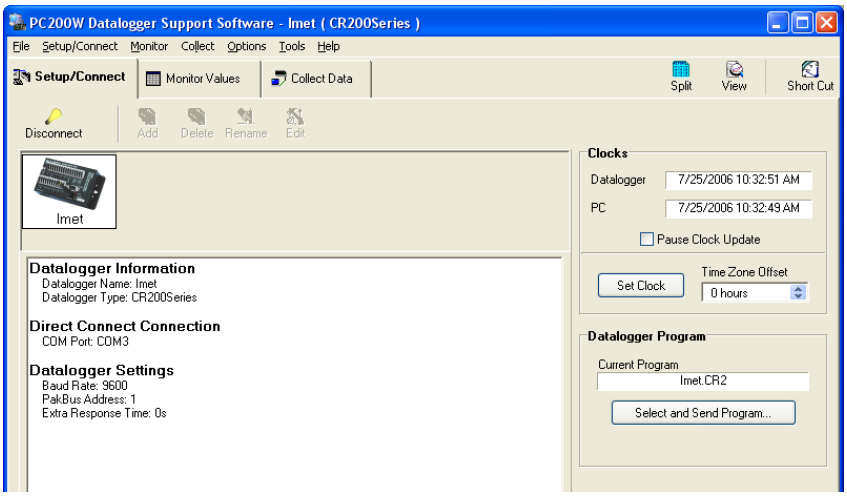


8. In the **Send Program** window click command button **Select and Send Program** to select *.cr2 program (IMET_MP2_Main.CR2) using windows file selector and send to the data logger. Alternatively, you many click on command button **Select and associate program** for sending to data logger at a later time.



9. Click Next to complete the wizard and then Finish to close the Ezsetup wizard and revert back to PC200 main window as shown below. Choose stay connected to keep the communication and close the Ezsetup wizard. Notice that a new station “Imet” is added in the station list, along with the station parameters entered while in the setup wizard.

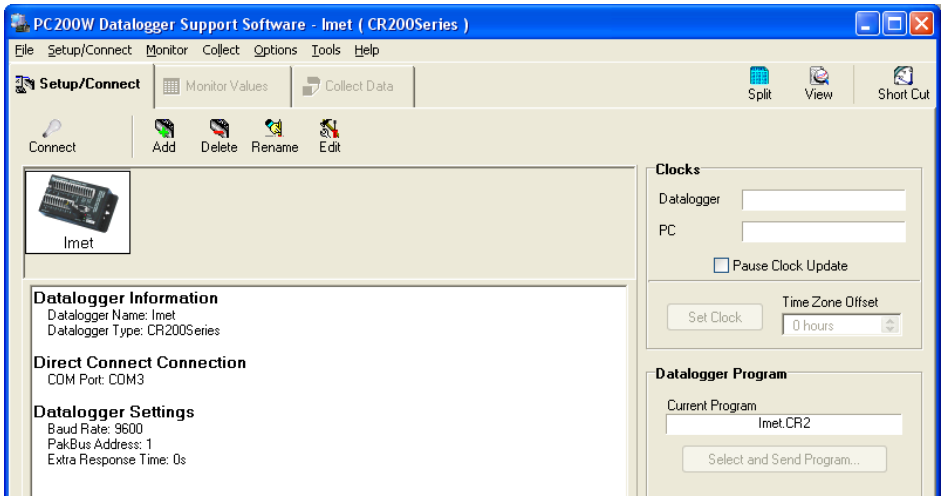
10. In the PC200 **Setup/Connect Tab** notice “Disconnect button is displayed” as shown in the figure below and on the bottom right corner displays Connection time, implying software is currently connected to the data logger. Also data logger clock and data logger program can be set from this window.



11. Connecting to a data logger already setup in the software is described in the next section.

5.2 Connect To Logger

PC200 saves data logger setting once added in the software for future connections. A list of stations with name assigned is displayed in the **Setup/ Connect** tab of PC200 software as shown in the figure. A summary of the previously assigned settings in the software is displayed on in this window as shown below. Click on a station to view the settings previously entered to that particular station. To change or edit a station's settings simply click Edit button while the station is selected.

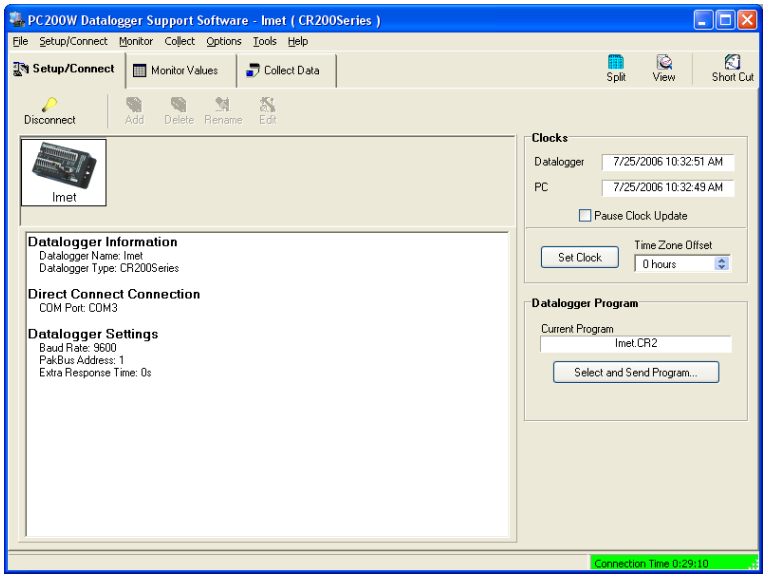


To connect to a logger for setting up program or data retrieval, simply select the station name and click on **Connect** button.

If the connection is successful Connect button changes to **"Disconnect"** and Connection time is displayed at the bottom right corner indicating software is currently connected to the data logger.

If data logger clock and PC clock are different select **Offset** and click **Set Clock** to update data logger clock.

Click command button **Select and Send Program** to send a new program to the logger.



5.3 Monitor Data In Real Time

With communication established between software and the data logger, select **Monitor Values** tab in PC200 window. This is similar to Numeric panel in PC208 and LoggerNet.

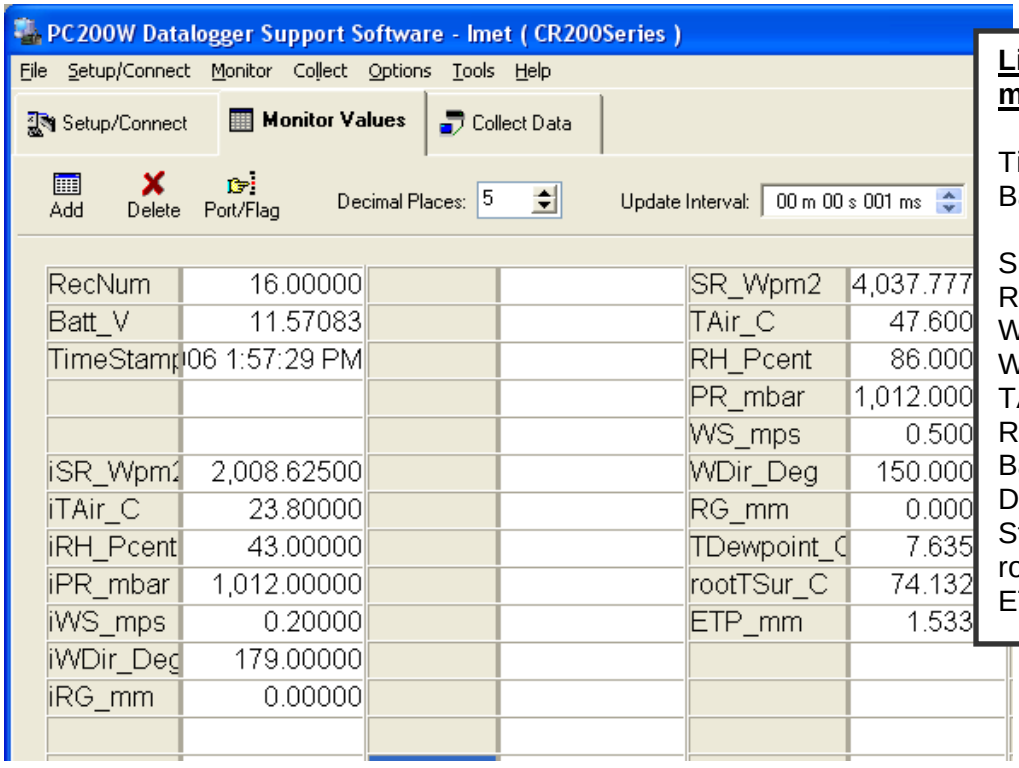
1. Click on Add button to open the signal list. Select Public from the left column to display public variables available in the right column. Select desired signals from the right column. Click on a cell in the Monitor values window, Click Paste button. All the selected signals will be displayed in the Monitor values window. Note that if you have a long averaging interval, it will take that amount of time to see a new reading. You may want to temporarily select a smaller interval or use maintenance program to test the operation. And then download the program with required long term averaging interval later. Any unwanted signals/ variables in Monitor window can be removed simply by selecting the cell and click **Delete** button.

2. Once in the Add menu, to select a range of values select the starting label, click on the beginning (for example TCAir_C) and then a **SHIFT-Click** on the ending of the range (for example RG_mm) and then click the **Paste** button.

3. Variable names are self explanatory with units. Any variable name starting with an "i" is an internal variable or the raw data from the sensor. The same variable name without an "i" is the variable stored in the logger.

4. Note any variables displaying a "-NAN" are out of range, or in the case of a sensor input location, it is a open circuit wire.

5. In the figure below all Imet sensor variables are displayed in the monitor mode.



List of variable for monitoring:

Time Stamp
Batt_V

SR_Wpm2
RG_mm
WindSpeed
WindDir
TAmbient
RH
BaroP
Dewpoint
Status
rootTSur_C
ETP_mm

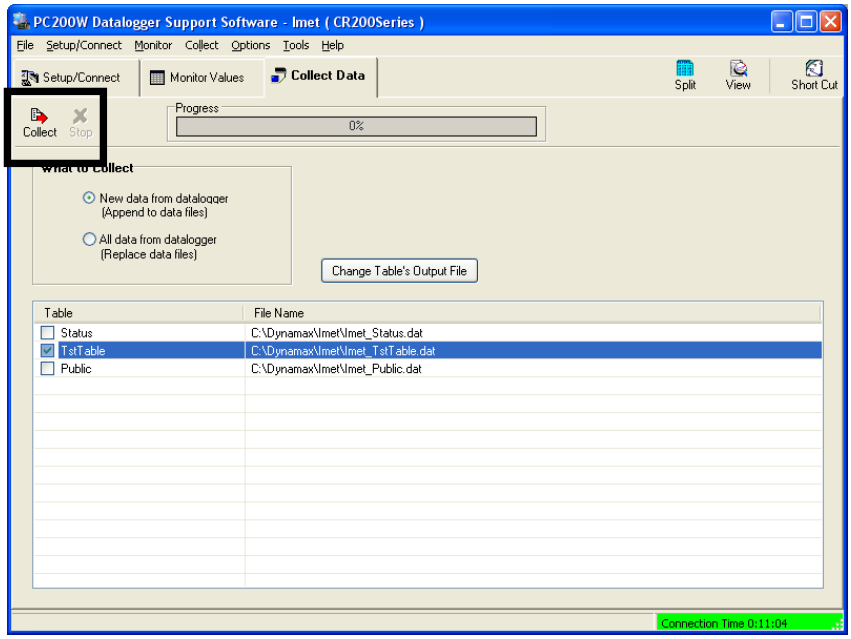
5.4 Data Collection

An active communication to the data logger is required to connection between software and weather station and for collecting data. In labs, nearby field tests or environmental chambers, the logger can be within RS232 cable connection range (100 ft), or within the range of a broadband radio link up to 40 miles (using Dynamax's RFMX modem). In addition to data collection real-time monitoring of data can be performed from a remote station explained in the previous sections. Following steps explain data retrieval manually at will.

1. With software connected to the data logger select **Collect Data** tab in PC200 software to display data retrieval options and controls.

2. Select the required tables to collect by simply enabling the check box to the left of the table name. If desired change the file name or path by double clicking on the table name or by clicking on **Change the Table's output file** command button while the required table is selected. Notice that the output files can be assigned .csv, .dat, .prn etc and corresponding file formats. We recommend using a .csv format such that the downloaded data files can be viewed easily using any spreadsheet application such as Excel.

3. In the **what to collect** options choose **New data from logger** option to collect only new data since the last retrieval and appends to specified file name. Choose **All data from logger** collect and dump all the data present in the logger and overwrite the specified file name. **Note: All data from logger option over-writes any existing data in the file.**



4. Before proceeding make sure desired file name and properties are displayed in Collect tab.

5. Click **Collect** button to start data collection and save to file. Wait for software to complete retrieval and respond with "Collection Complete" message. Click on **stop** command button to stop data collection at any time.

6. Now the data is collected and saved to data file for further processing and analysis.

PC200 supports only manual data collection. For applications using network communication options, automatic data retrieval and schedule choose advanced data logger support softwares such as LoggerNet.

PC200 is not capable of communicating using Dial-up or GSM modem. If you are planning to setup an advanced RF network/ GSM network / communicate using a dialup modem, select PC400 or LoggerNet.

6.0 DATA FORMAT, VIEW AND GRAPHS

This section discusses in detail

- File formats
- Data formats
- Open data file using VIEW, Plot signals
- Open data file using Excel, Plot signals

As explained in the previous chapter section, “Collect data for offline processing”, the tables (files) of interest to the end-user is only,

Out Table…… saved in…… Imet_OutTable.csv

6.1 File Format

As explained in the previous chapter, section “Data Collection”, InteliMet Advantage 5 data files can be saved with the .csv, .dat, .txt, .prn extensions. Comma separated (.csv) is the recommended file format as it allows the files to be viewed using any of the spreadsheet applications such as Excel. Here is a list of some of the key differences among the file formats.

. csv Data points with in a line are delimited by a comma. Simply open the file in Excel to view the data in a more readable format in rows and columns.

6.2 Data Format

Data collected from InteliMet Advantage 5 is in one file /table as shown below. Files is saved with a header showing the logger type, column header/ variable name.

Out Table…… saved in…… Imet_OutTable.csv

Out Table file contains average sensors measurements averaged over the storage interval along with calculated Dew Point in degC, calculated Surface temperature in degC using iterative RCM algorithm, calculated ETP using Lascano-VanBavel recursive algorithm. Custom sensors such as quantum sensor, soil moisture and soil temperature also are stored in the output table. Below is the sequence of variables in the output file from standard program.

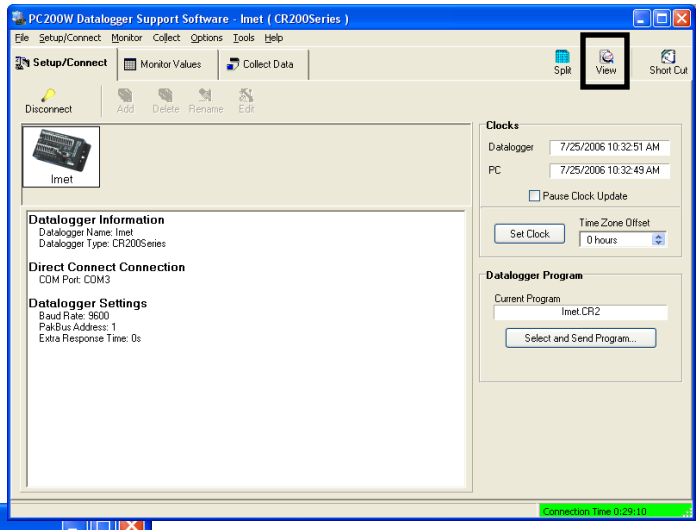
Output Table Format:

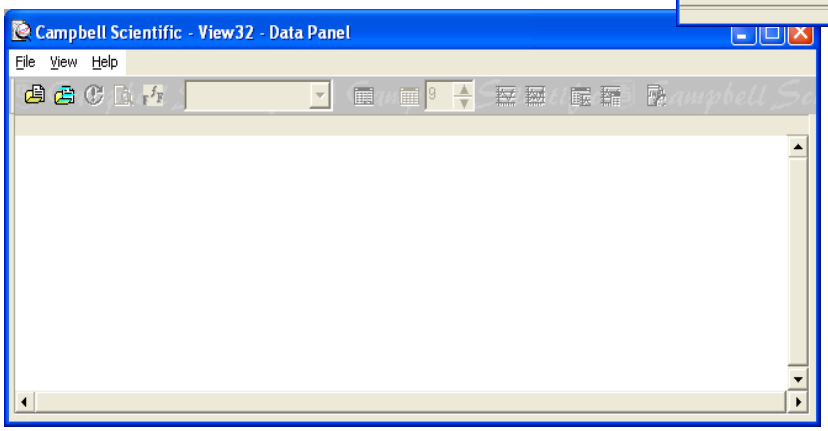
Time Stamp
Record #
Batt_V

SR_Wpm2
RG_mm
Wind Vector (Speed, Direction, SD)
TAmbient
RH
BaroP
Dewpoint
Status
rootTSur_C
ETP_mm

6.3 Open Data – Using "View"

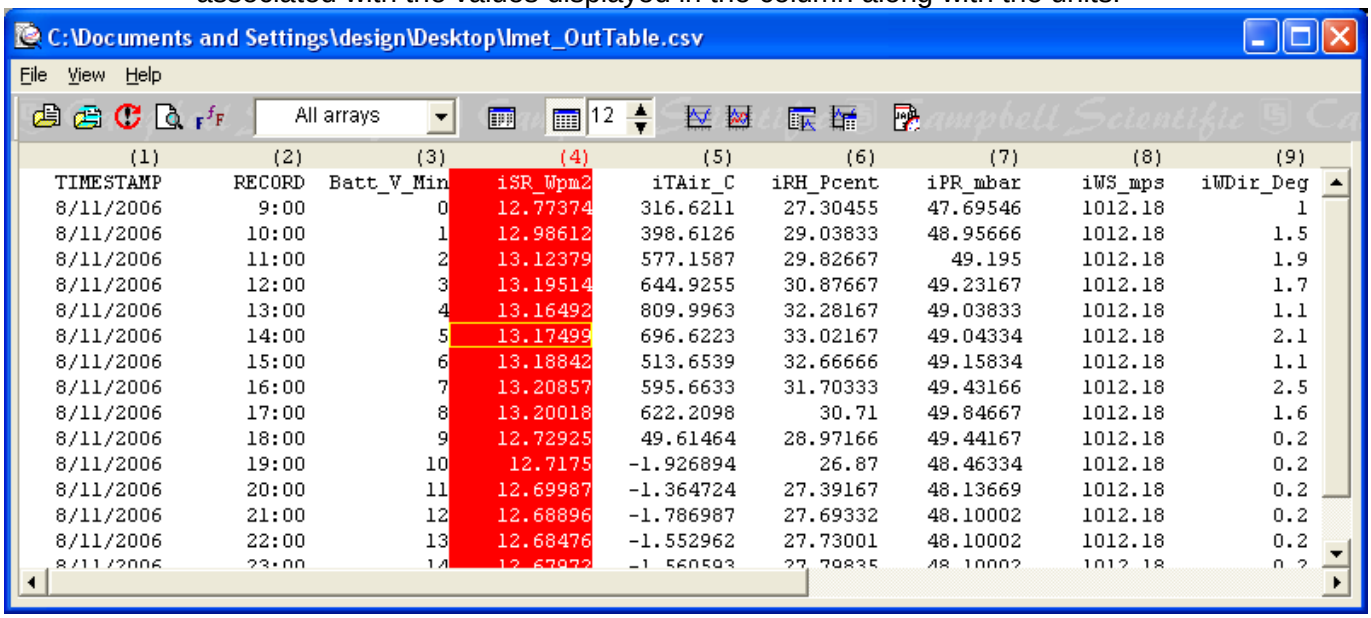
1. Now that the data is retrieved form the CR200 logger, PC200 VIEW utility is a great tool for a quick look at the data. VIEW also allows plotting two columns at a time for observation and save to bitmap file. Click on the VIEW button on the PC200 main toolbar to launch VIEW utility.





1. Click on **File Menu** and browse down to **Imet_OutTable.csv**

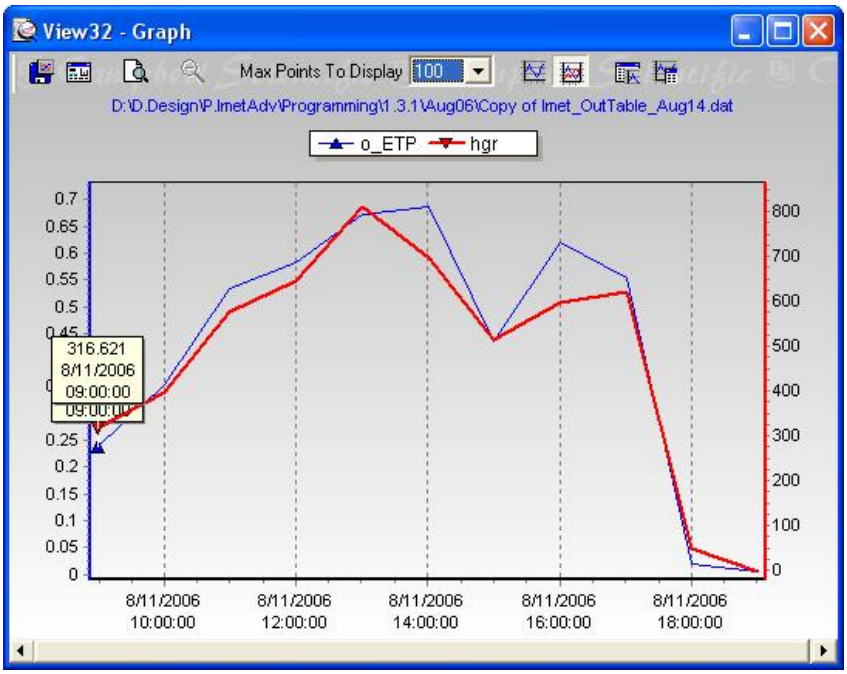
2. Now the output table is displayed in the VIEW window in csv format. Click on View Menu and then Expand tabs to see the data in the column format, shown below. Format of the data was discussed earlier. Column header shows the variable name associated with the values displayed in the column along with the units.



(1) TIMESTAMP	(2) RECORD	(3) Batt_V_Min	(4) iSR_Wpm2	(5) iTAir_C	(6) iRH_Pcent	(7) iPR_mbar	(8) iWS_mps	(9) iWDir_Deg
8/11/2006	9:00	0	12.77374	316.6211	27.30455	47.69546	1012.18	1
8/11/2006	10:00	1	12.98612	398.6126	29.03833	48.95666	1012.18	1.5
8/11/2006	11:00	2	13.12379	577.1587	29.82667	49.195	1012.18	1.9
8/11/2006	12:00	3	13.19514	644.9255	30.87667	49.23167	1012.18	1.7
8/11/2006	13:00	4	13.16492	809.9963	32.28167	49.03833	1012.18	1.1
8/11/2006	14:00	5	13.17499	696.6223	33.02167	49.04334	1012.18	2.1
8/11/2006	15:00	6	13.18842	513.6539	32.66666	49.15834	1012.18	1.1
8/11/2006	16:00	7	13.20857	595.6633	31.70333	49.43166	1012.18	2.5
8/11/2006	17:00	8	13.20018	622.2098	30.71	49.84667	1012.18	1.6
8/11/2006	18:00	9	12.72925	49.61464	28.97166	49.44167	1012.18	0.2
8/11/2006	19:00	10	12.7175	-1.926894	26.87	48.46334	1012.18	0.2
8/11/2006	20:00	11	12.69987	-1.364724	27.39167	48.13669	1012.18	0.2
8/11/2006	21:00	12	12.68896	-1.786987	27.69332	48.10002	1012.18	0.2
8/11/2006	22:00	13	12.68476	-1.552962	27.73001	48.10002	1012.18	0.2

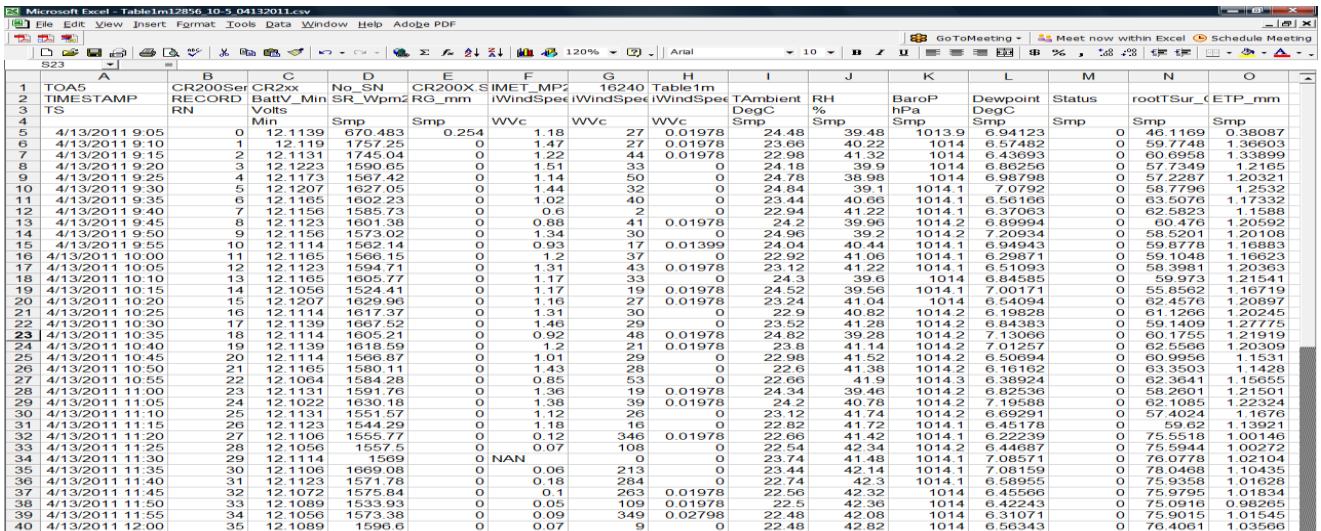
3. Now select one or more of the required columns to view in a chart format. Example shown here is for ETP (in Blue) and Global radiation (in Red). To select multiple columns click on the second column

with mouse while holding down the shift key. Once the required columns are selected, click on the tool bar button, show graph (2Y axes) to display the chart of the selected data.



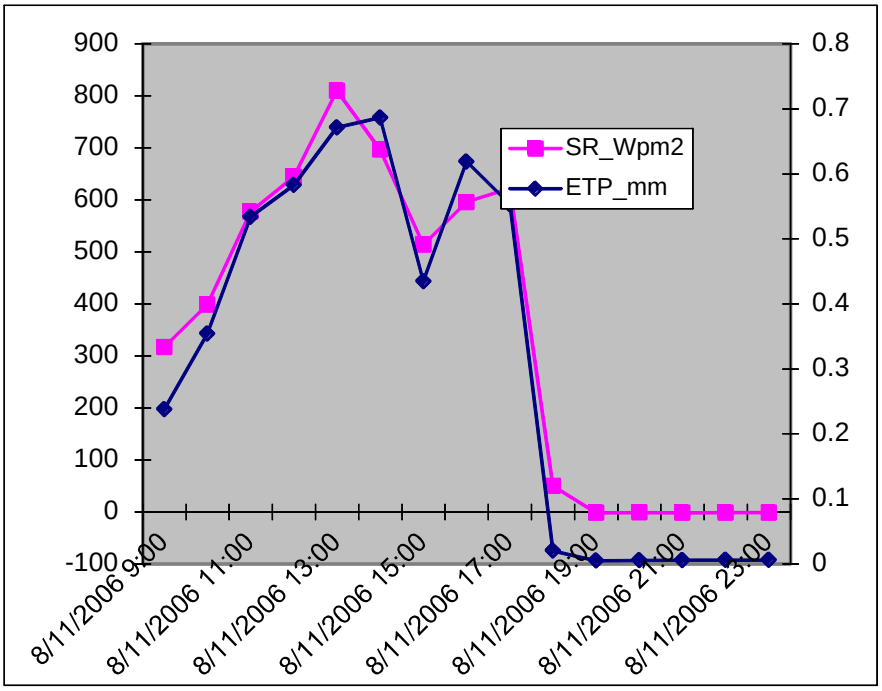
6.4 Open Data – Using EXCEL

1. In the earlier sections it was recommended to save collected data in .csv format such that the collected data can be readily opened in Excel or any preferred spreadsheet application. In the windows explorer navigate to the location where data files are saved. Select the required file (saved in .csv) format and double click to open this Excel. Alternatively, Launch Excel application, and open the file using open wizard and csv format. Figure below shows the Output table file Imet_OutTable.csv as displayed in excel window.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	TOA5	CR200Ser	CR2xx	No_SN	CR200X S	IMET_MP2	16240	Table1m							
2	TIMESTAMP	RECORD	BattV_Min	SR_Wpm2	RG_mm	iWindSpee	iWindSpee	iWindSpee	TAmbient	RH	BaroP	Dewpoint	Status	rootTSur_(	ETP_mm
3	TS	RN	Volts						DegC	%	hPa	DegC			
4			Min	Smp	Smp	WVc	WVc	WVc	Smp	Smp	Smp	Smp	Smp	Smp	Smp
5	4/13/2011 9:05	0	12.1139	670.483	0.254	1.18	27	0.01978	24.48	39.48	1013.9	6.94123	0	46.1169	0.38087
6	4/13/2011 9:10	1	12.119	1757.25	0	1.47	27	0.01978	23.66	40.22	1014	6.57482	0	59.7748	1.36603
7	4/13/2011 9:15	2	12.1131	1745.04	0	1.22	44	0.01978	22.98	41.32	1014	6.43693	0	60.8958	1.33899
8	4/13/2011 9:20	3	12.1223	1590.65	0	1.51	33	0	24.18	39.9	1014	6.86256	0	57.7349	1.2165
9	4/13/2011 9:25	4	12.1173	1567.42	0	1.14	50	0	24.78	38.98	1014	6.98798	0	57.2287	1.20321
10	4/13/2011 9:30	5	12.1207	1627.05	0	1.44	32	0	24.84	39.1	1014.1	7.0792	0	58.7796	1.2532
11	4/13/2011 9:35	6	12.1165	1602.23	0	1.02	40	0	23.44	40.66	1014.1	6.56166	0	63.5076	1.17332
12	4/13/2011 9:40	7	12.1156	1585.73	0	0.6	2	0	22.94	41.22	1014.1	6.37063	0	62.5823	1.1588
13	4/13/2011 9:45	8	12.1123	1601.38	0	0.88	41	0.01978	24.2	39.96	1014.2	6.89994	0	60.476	1.20592
14	4/13/2011 9:50	9	12.1156	1573.02	0	1.34	30	0	24.96	39.2	1014.2	7.20934	0	58.5201	1.20108
15	4/13/2011 9:55	10	12.1114	1562.14	0	0.93	17	0.01399	24.04	40.44	1014.1	6.94943	0	59.8778	1.16883
16	4/13/2011 10:00	11	12.1165	1566.15	0	1.2	37	0	22.92	41.06	1014.1	6.29871	0	59.1048	1.16623
17	4/13/2011 10:05	12	12.1123	1594.71	0	1.31	43	0.01978	23.12	41.22	1014.1	6.51093	0	58.3981	1.20363
18	4/13/2011 10:10	13	12.1165	1605.77	0	1.17	33	0	24.3	39.6	1014	6.84585	0	59.973	1.21541
19	4/13/2011 10:15	14	12.1056	1524.41	0	1.17	19	0.01978	24.52	39.56	1014.1	7.00171	0	55.8562	1.16719
20	4/13/2011 10:20	15	12.1207	1629.96	0	1.16	27	0.01978	23.24	41.04	1014	6.54094	0	62.4576	1.20897
21	4/13/2011 10:25	16	12.1114	1617.37	0	1.31	30	0	22.9	40.82	1014.2	6.19828	0	61.1266	1.20245
22	4/13/2011 10:30	17	12.1139	1667.52	0	1.46	29	0	23.52	41.28	1014.2	6.84383	0	59.1409	1.27775
23	4/13/2011 10:35	18	12.1114	1605.21	0	0.92	48	0.01978	24.82	39.28	1014.2	7.13066	0	60.1755	1.21919
24	4/13/2011 10:40	19	12.1139	1618.59	0	1.2	21	0.01978	23.8	41.14	1014.2	7.01257	0	62.5566	1.20309
25	4/13/2011 10:45	20	12.1114	1566.87	0	1.01	29	0	22.98	41.52	1014.2	6.50694	0	60.9956	1.1531
26	4/13/2011 10:50	21	12.1165	1580.11	0	1.43	28	0	22.6	41.38	1014.2	6.16162	0	63.3503	1.1428
27	4/13/2011 10:55	22	12.1064	1584.28	0	0.85	53	0	22.66	41.9	1014.3	6.38924	0	62.3641	1.15655
28	4/13/2011 11:00	23	12.1131	1591.76	0	1.36	19	0.01978	24.34	39.46	1014.2	6.82536	0	58.2601	1.21501
29	4/13/2011 11:05	24	12.1022	1630.18	0	1.38	39	0.01978	24.2	40.78	1014.2	7.19588	0	62.1085	1.22324
30	4/13/2011 11:10	25	12.1131	1551.57	0	1.12	26	0	23.12	41.74	1014.2	6.69291	0	57.4024	1.1676
31	4/13/2011 11:15	26	12.1123	1544.29	0	1.18	16	0	22.82	41.72	1014.1	6.45178	0	59.62	1.13921
32	4/13/2011 11:20	27	12.1106	1555.77	0	0.12	346	0.01978	22.66	41.42	1014.1	6.22239	0	75.5518	1.00146
33	4/13/2011 11:25	28	12.1056	1557.5	0	0.07	108	0	22.54	42.34	1014.2	6.44687	0	75.5944	1.00272
34	4/13/2011 11:30	29	12.1114	1569	0	NAN	0	0	23.74	41.48	1014.1	7.08571	0	76.0778	1.02104
35	4/13/2011 11:35	30	12.1106	1669.08	0	0.06	213	0	23.44	42.14	1014.1	7.08159	0	78.0468	1.10435
36	4/13/2011 11:40	31	12.1123	1571.78	0	0.18	284	0	22.74	42.3	1014.1	6.58955	0	75.9358	1.01628
37	4/13/2011 11:45	32	12.1072	1575.84	0	0.1	263	0.01978	22.56	42.32	1014	6.45566	0	75.9795	1.01834
38	4/13/2011 11:50	33	12.1089	1533.93	0	0.05	109	0.01978	22.5	42.36	1014	6.42243	0	75.0916	0.98265
39	4/13/2011 11:55	34	12.1056	1573.38	0	0.09	349	0.02798	22.48	42.08	1014	6.31071	0	75.9015	1.01545
40	4/13/2011 12:00	35	12.1089	1596.6	0	0.07	9	0	22.48	42.82	1014	6.56343	0	76.4061	1.03566
41	4/13/2011 12:05	36	12.103	1588.54	0	0.1	157	0.01978	23.66	41.76	1014	7.12136	0	76.471	1.03719

2. In excel it is much simpler to plot required columns and there is no limitation on the number of columns that can be displayed in a chart. Ideally all the variables saved in the OutTable can be displayed in the same chart using multiple axes option. Select column/ columns for charting along with the Time stamp for X-axis. Click on chart wizard button, follow steps in the wizard and display chart as shown below for ETP, Global radiation.



3. Plots for other variables can be displayed in the same manner.

Appendix A: LASCANO-VAN BAVEL ITERATIVE ET ALGORITHM

Constants or site-specific variables:

Notation	*Description*	*Units*
zom	Height of measurement	M
Zot	Roughness parameter for heat and vapor profile	M
Lev	Latent Heat of vaporization	J/Kg
has	Specific heat air capacity	J/Kg.degC at 30C

Input variables:

Notation	*Description*	*Units*
hgr	Hourly average solar radiation	W/m2
hta	Hourly average of air temperature	degC
hrh	Hourly average or relative humidity	%
hpr	Average Barometric Pressure	MBar
hws	Hourly average of wind speed	M/s

Calculated variables:

Notation	*Description*	*Units*
had	Air Density	Kg/m3
hum	Ambient Humidity	Kg/m3
has	Aerodynamic resistance	S/m
skl	Sky long-wave radiation	W/m2
htc	Surface temperature	DegC
rnt	Net radiation balance	W/m2
sht	Sensible heat flux	W/m2
hums	Humidity at the surface	Kg/m3
evt	Evapotranspiration	Kg/m2.s
EVT	Evapotranspiration in standard units	mm/hour

RCM ET Algorithm:

Site Specific Variables :

$lev = (2.501 - 0.002361 \cdot hta) \cdot 10^6$ (*given here for reference only*)

$abp = 1013.2 \cdot e^{(-elf \cdot 3.817E - 0.5)}$

Note: abp is measured by the InteliMet Advantage 5, so no calculation is needed.

Dew Point Calculation :

$$e_s(T_a) = 6.1078 \cdot e^{\left(\frac{17.2693882 T_a}{237.3 + T_a}\right)}$$

$$e_a = e_s(T_a) \cdot hrh$$

$$hdp = \frac{\left(237.3 \cdot \ln\left(\frac{e_a}{6.1078}\right)\right)}{\left(17.2693882 - \ln\left(\frac{e_a}{6.1078}\right)\right)}$$

RCM algorithm for ET calculation :

$$had = 1.1548 \cdot \frac{abp}{1013.2}$$

$$hum = 1.323 \cdot \frac{e^{\left(17.269 \frac{hdp}{hdp+237}\right)}}{hdp + 273.2}$$

$$ras = \frac{\ln\left(\frac{zom}{zot}\right)^2}{0.16 \cdot hws} \quad or \quad ras = \frac{\ln\left(\frac{zom}{zot}\right)^2}{0.16 \cdot (hws + 0.1)} \quad when\ hws < 0.1$$

$$skl = 5.67E - 8 \cdot (hta + 273.2)^4 \cdot (0.70 + 0.08241 \cdot hum \cdot e^{\left(\frac{1500}{hta+273.2}\right)})$$

$$htc = root\left[\left\{\left(0.80 \cdot hgr - 5.67E - 8 \cdot (htc + 273.2)^4 + skl\right) + \frac{(hta - htc) \cdot had \cdot has \cdot 303.16}{(hta + 273.2) \cdot ras} - \frac{1.323 \cdot \frac{e^{\left(17.269 \frac{htc}{htc+237}\right)}}{htc + 273.2} - hum}{ras} \cdot lev\right\} \cdot \frac{ras}{\left(\frac{had \cdot has \cdot 303.16}{hta + 273.2}\right)}, htc, 10\right]$$

$$rnt = \left(0.80 \cdot hgr - 5.67E - 8 \cdot (htc + 273.2)^4 + skl\right)$$

$$sht = \left[\frac{had \cdot has \cdot 303.16 \cdot (hta - htc)}{(hta + 273.2) \cdot ras}\right]$$

$$evt = \frac{rnt + sht}{lev}$$

$$EVT = evt \cdot 3600$$

Appendix B: REFERENCES

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Appendix C: DATA SHEETS

InteliMet Advantage 5
Weather Station

The InteliMet Advantage 5 is a complete ETp (Evapotranspiration) weather station which included the DynaLog200 data logger and the MaxiMet 500 compact weather station kit. The system comes with all software for programming, data collection, and calculation of ETp. A battery and solar panel, grounding kit, and lightning rod kit are also included. The InteliMet 5 is low-cost weather station ideal for research, commercial, or agricultural applications. The system comes ready to mount on a 2" rigid pipe, or tripod.

This automatic ET weather station includes features offered only by the leaders in weather instrument technology. We back all components with a one-year warranty.

Logger, battery and data retrieval software are included and ready to go. Data may be retrieved by a PC, a portable PDA or by long distance communication options. All parts and cables are supplied except for a 6 ft. base pole (a standard 2 in. water pipe) in a cement footing. The crossbar system installed 6 ft. high is light and strong. We supply all the unique parts and let you save money on a costly tripod or tower.

1 in. x 3 ft long pole and cross-arm give flexibility and is easy to mount on any 2" pipe or tower with pipe adapters and mounting hardware supplied by Dynamax.

Dynamax proprietary software records data from the innovative Gill MaxiMet™ GMX500 and a reliable radiation sensor for plant or crop weather applications. The station internally calculates ETo evapotranspiration from the most advanced solution prepared by the Texas A&M University research staff to enhance the accuracy of prior ET computations, (Lascano, Van Bavel – A.S.A. 2006).

MaxiMet™

MaxiMet is an advanced compact weather station designed and manufactured by Gill Instruments using proven technology to measure meteorological and environmental parameters to international standards. MaxiMet incorporates all the measurement parameters that meet the requirements of users in demanding applications where cost, quality and performance are essential.

Features

- **MaxiMet 500 Compact weather station**
- **Wind Speed & Direction Measurement**
- **Air Temperature Measurement**
- **Relative Humidity Measurement**
- **Barometric Pressure Measurement**
- **Solar Radiation Measurement**
- **Dew Point Measurement**
- **Lightning rod**
- **10 W Solar Panel Included**
- **CR200 data logger**
- **512 kB of storage**

Specifications

CR200 Logger	
A/D converter	12 bit
Scan rate	once per second (max)
Single-ended analog channel	5, individually configured
Analog voltage range	0 to +2500 mV
Measurement resolution	0.6 mV
Excitation channels	2, programmable for either +2.5 or +5 volts
Switched battery port	1
Pulse count channels	2
Control ports	2
Battery voltage range	7 to 16 Vdc
On-board 12 Vdc lead acid battery charger	
Communications	RS-232

Wind Speed	
Range	0.1 m/s to 60 m/s
Accuracy	± 3% to 40 m/s, ± 5% to 60 m/s
Resolution	0.01 m/s (0.02 mph)
Wind Direction	
Range	0 to 359°
Accuracy	± 3° to 40 m/s, ± 5° to 60 m/s
Resolution	1°
Barometric Pressure	
Range	300 to 1100
Accuracy	± 0.5 hPa @ 25°C
Resolution	0.1 hPa
Units of measure	hPa, bar, mmHg, inHg
Air Temperature	
Range	-40°C to +70°C
Accuracy	± 0.3°C @ 20°C
Resolution	0.1 °C (0.1 °F)
Units of measure	°C, °F, °K
Relative Humidity	
Range	0-100% RH
Accuracy	± 2% @ 20°C (10%-90% RH)
Resolution	1% RH
Units of measure	% Rh, g/m3, g/Kg

Dew Point	
Range	-40°C to +70°C
Resolution	0.1 °C (0.1 °F)
Units of measure	°C, °F, °K
Accuracy	± 0.3°C @ 20°C
Rain Gage	
Sensor Type	Tipping bucket with magnetic reed switch
Housing Material	UV-stabilized ABS plastic
Rainfall Accuracy	±4 %, ±1 rainfall count 0-50 mm/hr (0.01” and 2.00” per hour)
Resolution	0.25 mm (0.01”)
Environmental	
Protection class	IP66
EMC	BS EN 61326 : 2013 FCC CFR47 parts 15.109
Operating Temperature	-40°C to +70°C
Solar Radiation	
Absolute Accuracy	± 5%
Spectral Range	380 to 1120 nanometers
Operating Temperature	-40 to 60 °C

MaxiMet

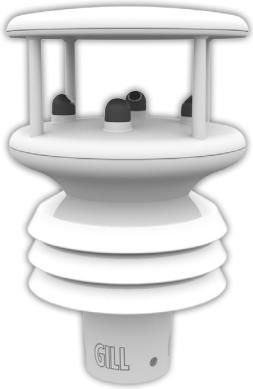
GMX500 Compact Weather Station

The MaxiMet range of compact weather stations is designed and manufactured by Gill Instruments. MaxiMet products use reliable, high quality instruments to provide accurate meteorological information in a wide variety of applications.

GMX500 Features

Temperature, humidity, pressure. A combined instrument mounted inside three double louvered, naturally aspirated radiation shields with no moving parts. The results are high performance across each measurement over long periods of time.

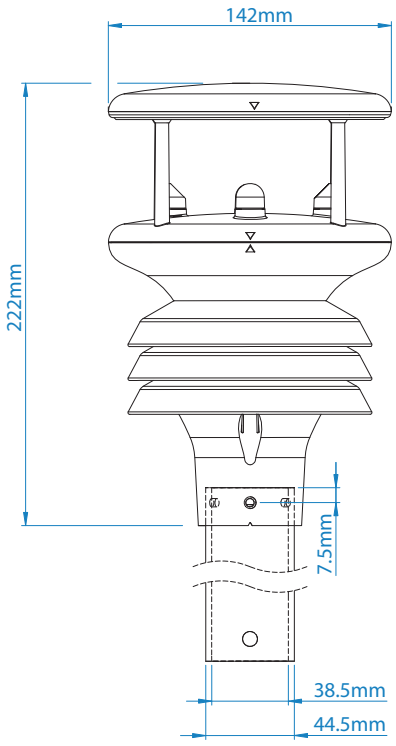
Wind. Wind speed and direction measurements are provided via an ultrasonic sensor and the addition of an electronic compass provides apparent wind measurements. Average speed and direction together with WMO averages and gust data is also provided. Add GPS (optional) to provide true wind and other features.



TEMP, HUMIDITY & PRESSURE	WIND	GPS (OPTION)
▪ Air Pressure / Temperature ▪ Relative / Absolute humidity ▪ Naturally aspirated UV stable radiation shield ▪ Protection against wind-blown precipitation/dust	▪ Wind speed & direction ▪ Apparent and true wind (with GPS) ▪ WMO wind averages and gust ▪ Compass ▪ GPS (optional) gives height above sea level, latitude and longitude	▪ Height above sea level *m* ▪ Sunrise/sunset ▪ Position of the sun ▪ Twilight ▪ MSL pressure

PARAMETERS

- Temperature *°C / °F / °K*
- Relative humidity *% Rh, g/m³,* g/kg
- Barometric pressure *hPa, bar, mm Hg*
- Wet bulb temperature *°C / °F / °K*
- Absolute humidity *g/m³*
- Air density *kg/m³*
- Wind speed
  m/s, km/hr, mph, kts, ft/min
- Wind direction °
- Wind chill *°C / °F / °K*
- True/apparent wind
- Outputs
  RS232, 422, 485 (ASCII), SDI-12, NMEA, MODBUS, Analogue (option)



All MaxiMet Models Feature

- Quality Measurements
- Lightweight and Robust
- Low Power Mode
- Free of Charge Software
- Gill Proven Reliability
- Compact Integrated Design
- Real Time Output
- Easy Installation
- Bluetooth Service Port
- Gill Customer Support
- 2 Year Warranty

Applications

- Building and Industrial Controls
- Authorities
- Transport
- Coastal
- Agricultural
- Safety
- Educational
- Commercial
- Energy

WIND SPEED	
Range	0.1 m/s to 60 m/s
Accuracy	± 3% to 40 m/s, ± 5% to 60 m/s
Resolution m/s	0.01
Starting Speed	0.1 m/s
Sampling Rate	1 Hz
Units	m/s, km/hr, mph, kts, ft/min

WIND DIRECTION	
Range	0-359°
Accuracy	± 3° to 40 m/s ± 5° to 60 m/s
Resolution	1°
Sampling Rate	1 Hz
Units	Degrees

TEMPERATURE	
Range	-40°C to +70°C
Resolution	0.1
Accuracy	± 0.3°C @ 20°C
Sampling Rate	1 Hz
Units	°C, °F, °K

HUMIDITY	
Range	0-100%
Resolution	1%
Accuracy	± 2% @ 20°C (10%-90% RH)
Sampling Rate	1 Hz
Units	% Rh, g/m3, g/Kg

DEW POINT	
Range	-40°C to +70°C
Resolution	0.1
Accuracy	± 0.3°C @ 20°C
Units	°C, °F, °K
Sampling Rate	1 Hz

PRESSURE	
Range	300 to 1100
Resolution	0.1 hPa
Accuracy	± 0.5 hPa @ 25°C
Sampling Rate	1 Hz
Units	hPa, bar, mmHg, inHg

OUTPUTS	
Output rate	1/s, 1/min, 1/hr
Digital Comms Modes	Serial RS232, RS422, RS485, SDI-12, NMEA, MODBUS, ASCII
Analogue Outputs	Available via separate optional device

POWER	
Power Supply	5 to 30 Vdc
Power (Nominal) 12 Vdc	25 mA continuous high mode. 0.05 mA eco-power mode (1 hour polled)

ENVIRONMENTAL CONDITIONS	
IP Rating	66
Operational Temperature Range:	-40°C to +70°C
EMC Standard:	BS EN 61326 : 2013 FCC CFR47 parts 15.109
CE Marking	YES
RoHS compliant	YES
Weight	0.6 Kg
Origin	UK

Specifications may be subject to change without prior notice

Dynamax

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