SEAS AutoIMET Data Logger User's Guide

Introduction

The SEAS AutoIMET (**Auto**matic [Air-Sea] **I**nteraction **Met**eorology system) Data Logger is a real time data acquisition, data processing, data recording, and data transmitting application that operates on the Voluntary Observing Ship program (VOS) vessels to produce high quality marine weather observations.

As shown in Figure 1, the SEAS AutoIMET Data Logger software connects to the Remote Computer System using sockets or serial port to retrieve a comma delimited data stream containing the measured weather parameters. The data are transmitted on a user-determined schedule; typically this is hourly using the meteorological observation BBXX format.

The message is placed in the transmit queue. Periodically, the transmit queue is scanned and if a suitable file is ready for delivery, a connection is stablish and they will delivered to the distribution address.
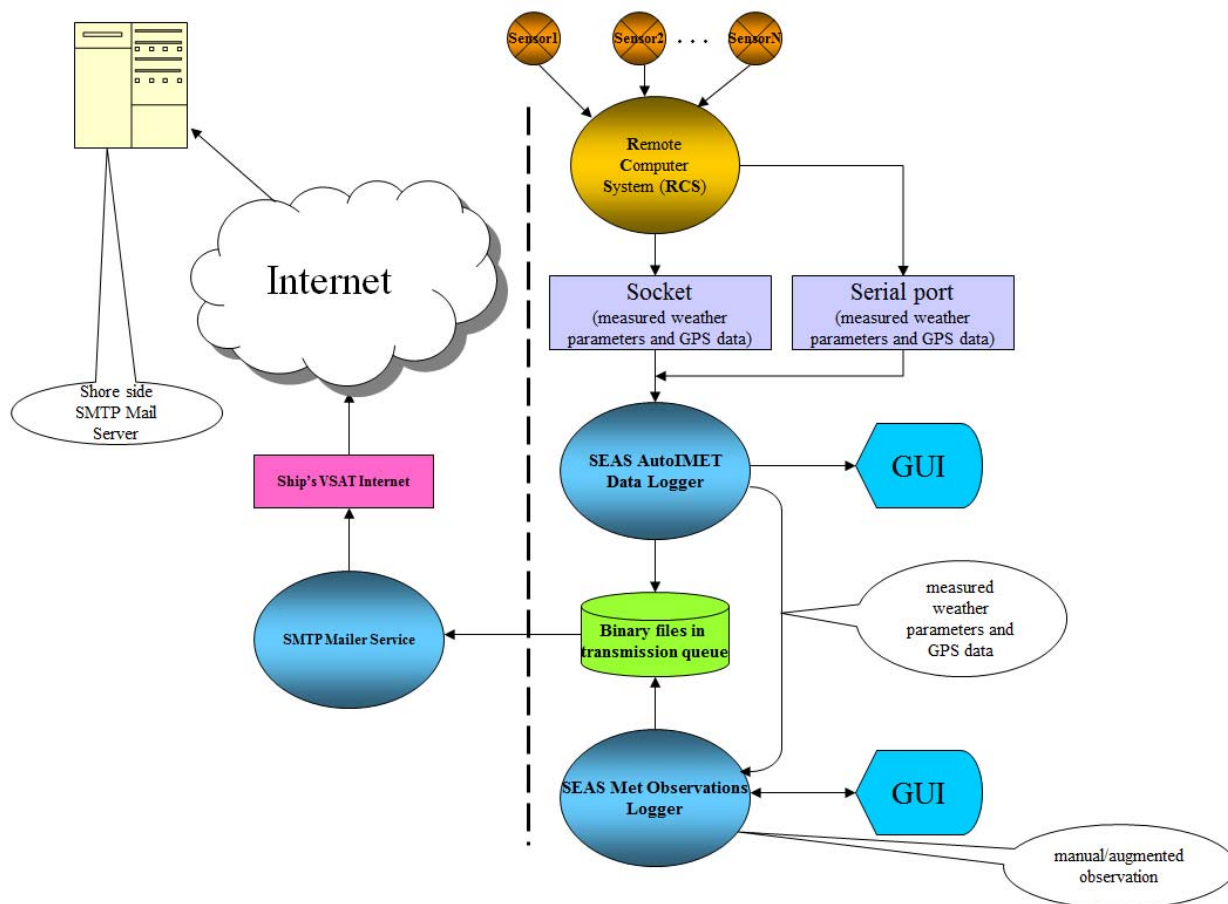
Figure 1

It was developed in the Integrated Development Environment (IDE) from Microsoft Visual Studio C++ 2008 Standard Edition under Windows 7.

Contact Information

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User Interface

The design of the SEAS AutoIMET Data Logger apply some basic principles making the design something the user will enjoy working with it every day.

Main screen

Ship information group:

- **Company Name** is indicating the company's name.

- **Ship Name** is indicating the ship's name.

- **IMO Number** is indicating the ship's IMO number.

- **Call Sign** is indicating the ship's call sign.

These fields have to be filling out in the **SEAS Console** application's **Main menu > Setup > Administration**. It is mandatory to fill out prior to producing any type of weather observations.

AutoIMET data

- **Date:** Shows formatted date that has been gotten from Remote Computer System.

- **Time:** Shows formatted time that has been gotten from Remote Computer System.

- **Latitude:** Shows formatted latitude (DD MM) that has been gotten from Remote Computer System.

- **Longitude:** Shows formatted longitude (DDD MM) that has been gotten from Remote Computer System.

- **Speed over ground:** Shows formatted sheep speed that has been gotten from Remote Computer System.

- **Course over ground:** Shows formatted sheep course that has been gotten from Remote Computer System.

- **Barometric pressure with the correction factored in:** Shows a calculated value**.** The barometric pressure is different at different heights. The barometric pressure sensor is up on a pole and the pressure wanted is the pressure at the ship height.

- **Barometric height:** Shows the barometer height above SSL previously set in **SEAS Met Observations Logger** application **Main menu > Setup > Meta data > Barometer** tab.

Used algorithm:

```cpp
CString CMetDataLoggerDoc::GetBarometricPressureWithCorrection(const CString& sBarometerHeight)
{
    // Calculate the Barometric Pressure witht the correction factored in.
    double dBarometerHeight;
    CString sResult;

    dBarometerHeight = atof(sBarometerHeight);
    if(dBarometerHeight < MIN_BAROMETER_HEIGHT || dBarometerHeight > MAX_BAROMETER_HEIGHT)
        dBarometerHeight = 0;

    CString sInstrumentBarometricPressure = m_pScsDataManager->GetScsData()->GetMeteorologicalData()->GetBarometricPressure();
    double m_dInstrumentBarometricPressure = atof(sInstrumentBarometricPressure);

    // If barometric pressure out of bound no point in calcualting it.
    if(m_dInstrumentBarometricPressure < MIN_BARRO_PRESS ||
       m_dInstrumentBarometricPressure > MAX_BARRO_PRESS)
     sResult = sInstrumentBarometricPressure;
    else
    {
        m_dBarometricPressureWithCorrection = m_dInstrumentBarometricPressure + dBarometerHeight * (0.12);
        sResult.Format("%.2f", m_dBarometricPressureWithCorrection);
    }
    return sResult;
};
```

- **Barometric pressure:** Shows formatted barometric pressure that has been gotten from Remote Computer System.

- **Relative humidity:** Shows formatted relative humidity that has been gotten from Remote Computer System.

- **Air temperature:** Shows formatted air temperature that has been gotten from Remote Computer System.

- **Wet bulb:** Shows formatted wet bulb that has been gotten from Remote Computer System.

- **Dew Point:** In this field would show a gotten from Remote Computer System value or a calculated value using the recommended WMO formula. The dew point temperature is the temperature at which the air can no longer hold all of its water vapor, and some of the water vapor must condense into liquid water. At 100% relative humidity, the dew point temperature and real temperature are the same.

Used algorithm:

```cpp
// function calculates the pressure dependency of the
// saturation vapour pressure
//
// IN:  pressure - given pressure for the calculation
// OUT: f_p      - pressure dependency
double CMetDataLoggerDoc::PressureDependency(const double& pressure)
{
    return 1.0016 + 0.00000315 * pressure - 0.074 / pressure;
};


// function calculates and returns the saturation vapour pressure
// in the pure phase with regard to water (e_w) or
// with regard to ice (e_i) at the given temperature
//
// IN:  pressure           - given pressure for the calculation
//      temperature        - given temperature for the calculation
//                           of the saturation vapour pressure
//      iced               - measurements over ice yes / no
// OUT: satVapourPressure  - saturation vapour pressure
double CMetDataLoggerDoc::SatVapourPressure(const double& pressure, const double& temperature, const bool& iced)
{
    double satVapourPressure;
    double f_p = PressureDependency(pressure); // pressure dependency

    if (iced == false)
        satVapourPressure = f_p * 6.112 * exp(17.62 * temperature / (243.12 + temperature));
    else
        satVapourPressure = f_p * 6.112 * exp(22.46 * temperature / (272.62 + temperature));

    return satVapourPressure;
};
// function calculates the actual vapour pressure (e_prime)
//
// IN:  pressure       - pressure of moist air in hPa
//      t_dry          - dry-bulb temperature in °C
//      t_wet          - wet-bulb temperature in °C
//      iced           - measurements over ice yes / no
// OUT: vapourPressure  - actual vapour pressure
double CMetDataLoggerDoc::VapourPressure(const double& pressure, const double& t_dry, const double& t_wet, const bool& iced)
{
    double vapourPressure;
    double satVapourPressure = SatVapourPressure(pressure, t_wet, iced);

    if (iced == false)
        vapourPressure = satVapourPressure - 0.000653 * (1 + 0.000944 * t_wet) * pressure * (t_dry - t_wet);
    else
        vapourPressure = satVapourPressure - 0.000575 * pressure * (t_dry - t_wet);

    return vapourPressure;
};
```

```
|// function to calculate the dewpoint from the given values for
// pressure, dry-bulb and wet-bulb temperature
//
// all used formulas are taken from
// WMO-No.8, 7th edition, 2008, Part I, Annex 4.B
//
// IN:  pressure   - pressure of moist air in hPa (pressure at the height of the temperature measurements.)
//      t_dry      - dry-bulb temperature in °C
//      t_wet      - wet-bulb temperature in °C
// OUT: dewpoint   - dewpoint in °C
// Returns FALSE if the dew point can not be computed.
//
|BOOL CMetDataLoggerDoc::CalculateDewPointWMO(const double& t_dry, const double& t_wet, const double& pressure, double& dewPoint)
{
    BOOL bReturn = TRUE;

    try
    {
        // iced - measurements over ice yes / no
        bool iced;
        if(t_wet <= 0)
            iced = true;
        else
            iced = false;

        double ln_value = VapourPressure(pressure, t_dry, t_wet, iced) / (6.112 * PressureDependency(pressure)); // interim value,
        if (ln_value <= 0)
            ln_value = 0.00000001;

        if (iced == false)
            dewPoint = (243.12 * log(ln_value)) / (17.62 - log(ln_value));
        else
            dewPoint = (272.62 * log(ln_value)) / (22.46 - log(ln_value));

        // Checks a given double-precision floating-point value for not a number (NAN).
        if (_isnan(dewPoint) != 0)
            bReturn = FALSE; // Dewpoint NaN;
    }
    catch (...)
    {
        bReturn = FALSE;
    };

    return bReturn;
};
```

- **Sea temperature:** Shows formatted sea temperature that has been gotten from Remote Computer System.

- **True wind speed:** Shows formatted true wind speed that has been gotten from Remote Computer System.

- **True wind direction:** Shows formatted true wind direction that has been gotten from Remote Computer System.

- **Ship's heading:** Shows formatted ship's heading that has been gotten from Remote Computer System.

- **Relative wind direction:** Shows formatted relative wind direction that has been gotten from Remote Computer System.

- **Relative wind speed:** Shows formatted relative wind speed that has been gotten from Remote Computer System.

Unchecked elements will not be included in the message; the user has to insure that each item that is in use is checked.

If Dew point is unchecked and Air temperature and Wet bulb are available it will be calculated.

The grayed fields that precede each value represent its sequence on the incoming message.

When the data is out of bounds, it will be display in red. If the observer sees that the element is in red, he/she can toggle off that particular element.

Bounds:

Min Value	Field	Max Value
900	Barometric pressure	1099
30	Relative humidity	100
-40	Air temperature	55
-30	Wet bulb	50
-30	Dew point	50
-6	Seas temperature	40
0	True wind speed	200
0	True wind direction	360
0	Ship's heading	359
0	Relative wind direction	360
0	Relative wind speed	200

VOSClim: Indicates if the vessel participates in VOSClim project or not.

Raw data: Shows every second unformatted comma delimited data stream containing the measured weather parameters that has been gotten from Remote Computer System.

Archive: Displays the archive observations process status.

At: Displays the date when the last archive observations process occurred.

Transmission: Displays the transmission observations process status.

**At:** Displays the date when the last transmission observations process occurred.

Note: US government and international government agencies agreed upon all the data in the AutoIMET software. It should only be changed by agreement of these agencies.

Save button: Saves into the persistent platform the application setup.

Status bar: Provides status information from Remote Computer System communication, and application.
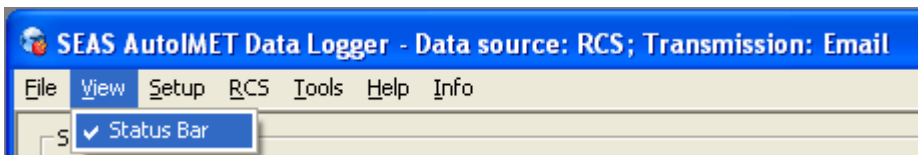
Main Menu

File > Exit: Exit the application
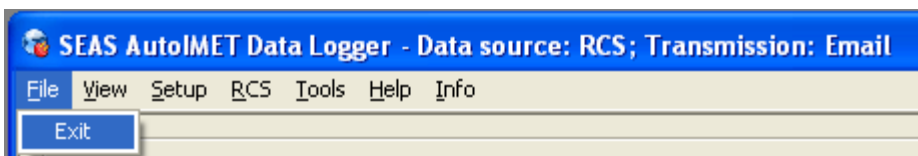
Use this command to end the AutoIMET Data Logger application. You can also use the **Close** command on the application **Control** menu.

View > Status Bar: Show or hide the Status Bar.

Use this command to display and hide the status bar, which describes the action to be executed by the selected menu item, and keyboard latch state. A checkmark appears next to the menu item when the status bar is displayed.

The status bar is displayed at the bottom of the AutoIMET Data Logger window. The left area of the status bar describes actions of menu items as you use the arrow keys to navigate through menus. This area similarly shows messages that describe the application's status.
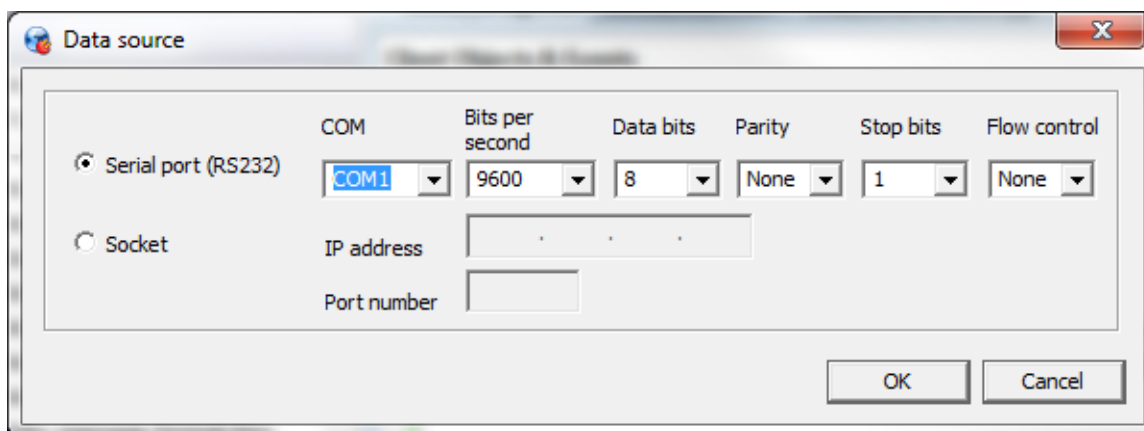
The right areas of the status bar indicate which of the following keys are latched down:

Indicator	Description
CAP	The Caps Lock key is latched down.
NUM	The Num Lock key is latched down.
SCRL	The Scroll Lock key is latched down.
DATE	The system clock.

Setup > Data source…: Manages the data source's settings.
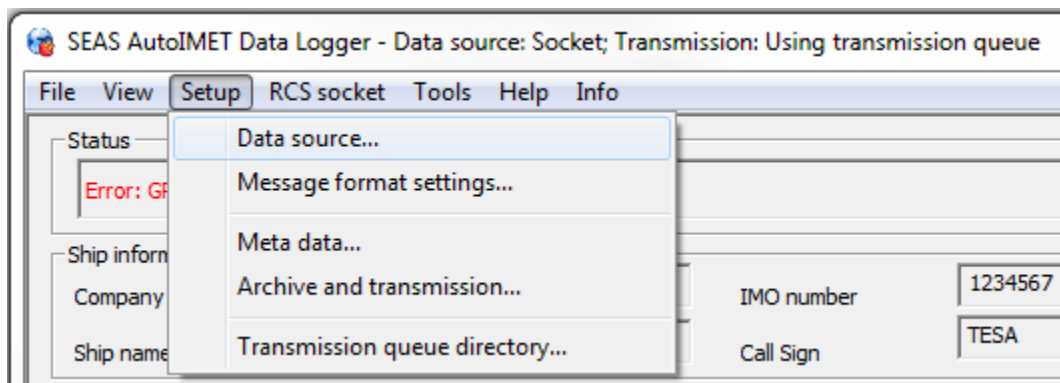
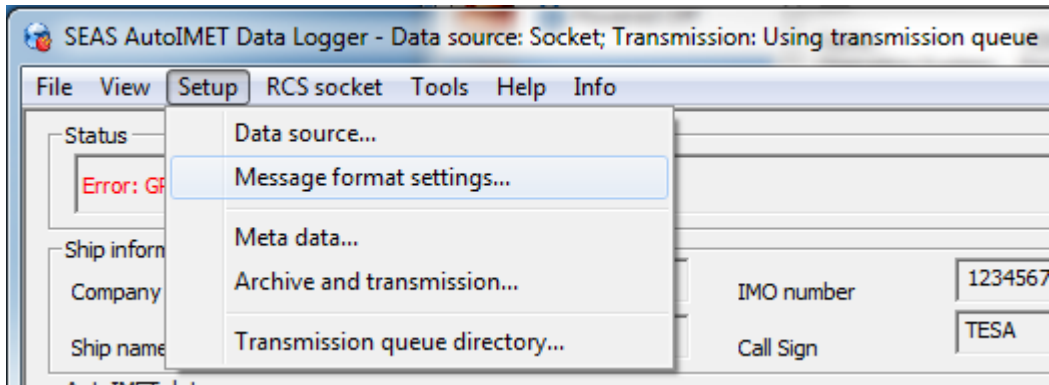Once selected the windows **Data source** appears.

The user can select to connect SEAS AutoIMET Data Logger software to the Remote Computer System using socket or serial port to retrieve a comma delimited data stream containing the measured weather parameters.

If the selection is **Serial port (RS232)** set up the serial port communication then click **OK**. The SEAS AutoIMET Data Logger will be fed through the serial port. The sent lines of data have to start with "$", and terminate in a semi-colon.

If the selection is **Socket** type the IP address of the computer where the Remote Computer System is running, and insert the port number designated for your particular ship; each ship will have its own unique port number, it may be the same but it will probably be different. Click **OK**. The SEAS AutoIMET Data Logger will connect with this remote computer via socket.
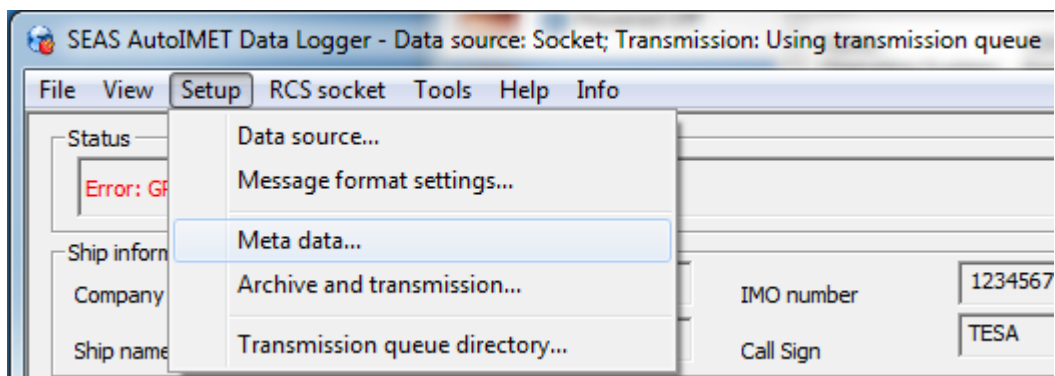
**Setup > Message format settings…:** Sets the Remote Computer System message format.

Once selected the window **RCS Message format** appears and the user can establish the measured value sequence in the incoming Remote Computer System's message. Also the user can set the possible delimiters.
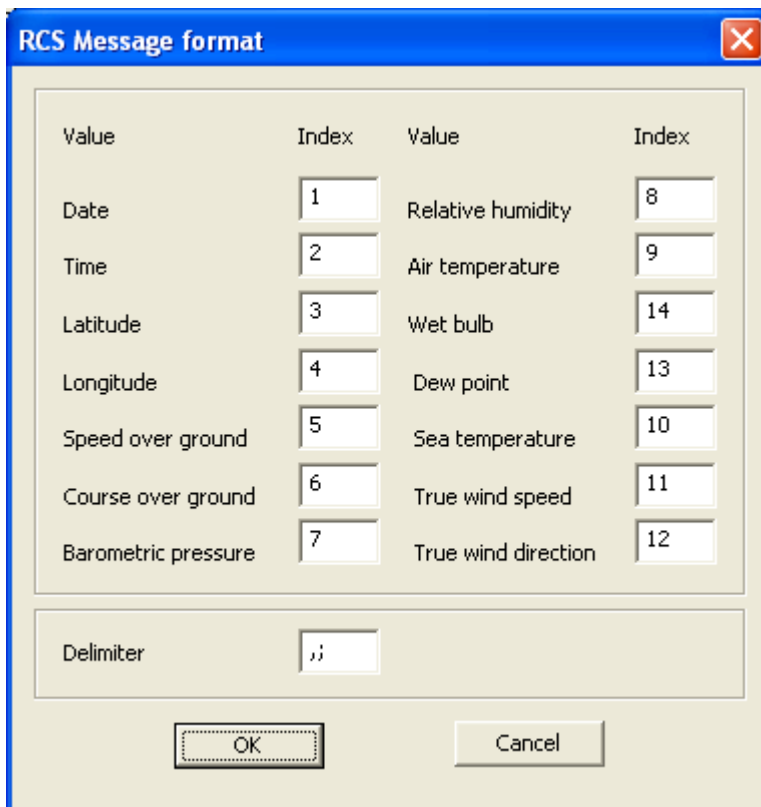
Setup > Meta data…: Displays the meta-data's settings.

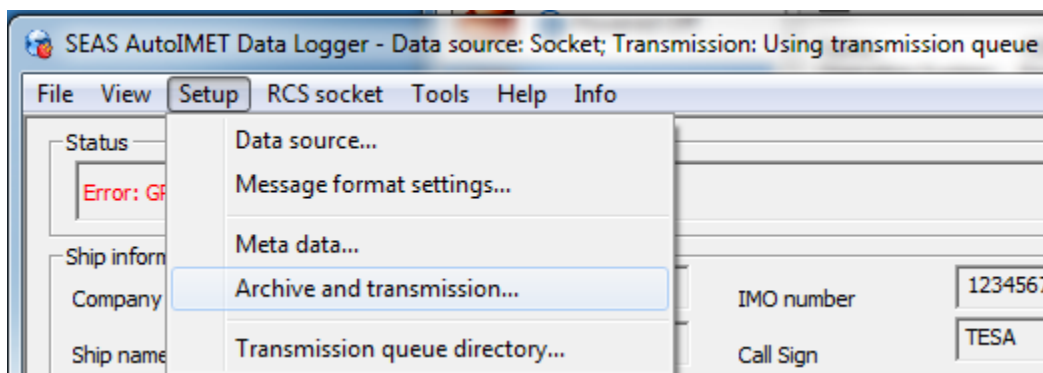Once selected the window **Meta data** appears.
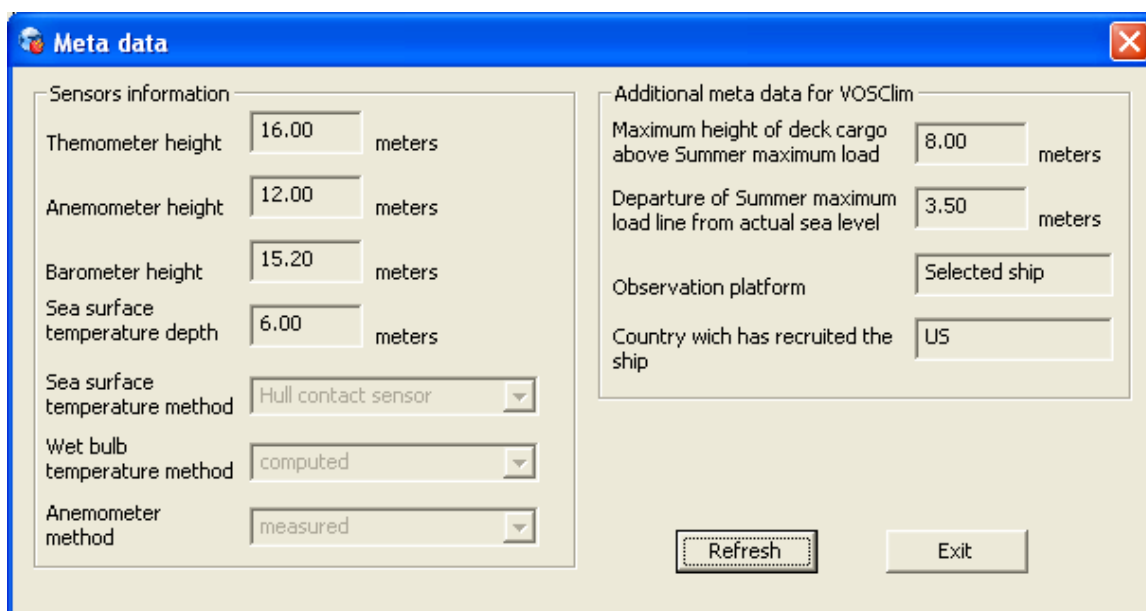
- **Thermometer height** is indicating the height of the thermometer sensor above sea level.

- **Anemometer height** is indicating the height of the anemometer sensor above sea level.

- **Barometer height** is indicating the height of the barometer sensor above sea level.

- **Seas surface temperature depth** is indicating the height of the particular sensor above sea level.

- **Sea surface temperature type** is indicating how determine the sea surface temperature, i.e., "intake measured", "hull contact", "bucket measured" or "neither intake, bucket or hull".

- **Wet bulb temperature method** is indicating whether the wet bulb is "measured" or "computed".

- **Anemometer method** is indicating whether the wind is "measured" or "estimated".

- **Maximum height of deck cargo above maximum load line** is used as metadata when ships are participating in VOSClim project. It is not transmitted but collected and archived.

- **Departure of summer maximum load line from actual sea level** Consider the difference positive when the Summer maximum load line is above the level of the sea and negative if below the water line. It is used as metadata when ships are participating in VOSClim project. It is not transmitted but collected and archived.

- **Observation platform** is indicating the platform where the observation is done.

- **Country which has recruited the ship**

All these values are managed in **Met Observations Logger** application **Main menu > Setup > Meta data**. Click **Refresh** to see the current setting.

Setup > Archive and transmission: Manages the archive and transmission's settings.

Once selected the window **Archive and transmission setup** appears.
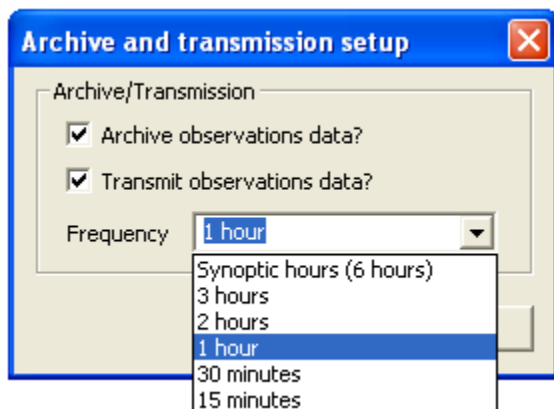
- **Archive observation data?:** Determines either the user want to archive the acquired data or not.

- **Transmit observation data?:** Determines either the user want to transmit the acquired data or not.

- **Frequency:** Determines the transmission schedule.

  Synoptic hours (6 hours): Observations taken at 6-hourly interval, at 00:00, 06:00, 12:00, 18:00 UTC. These are also known as the main synoptic times.

  3 hours: Observations taken at 3-hourly interval, at 00:00, 03:00, 06:00, 09:00, 12:00, 15:00, 18:00, 21:00 UTC.

  2 hours: Observations taken at 2-hourly interval, at 00:00, 02:00, 04:00, 06:00, 08:00, 10:00, 12:00, 14:00, 16:00, 18:00, 20:00, 22:00 UTC.

 **1 hour:** Observations taken at 1-hourly interval at the top of the hour.

  30 minutes: Observations every 30 minutes. So at 0 minutes and 30 minutes passed the top of the hour.

  15 minutes: Observations taken at 0 minutes, 15 minutes, 30 minutes, 45 minutes passed the top of the hour.

Setup > Transmission queue directory: Select the transmission queue path.
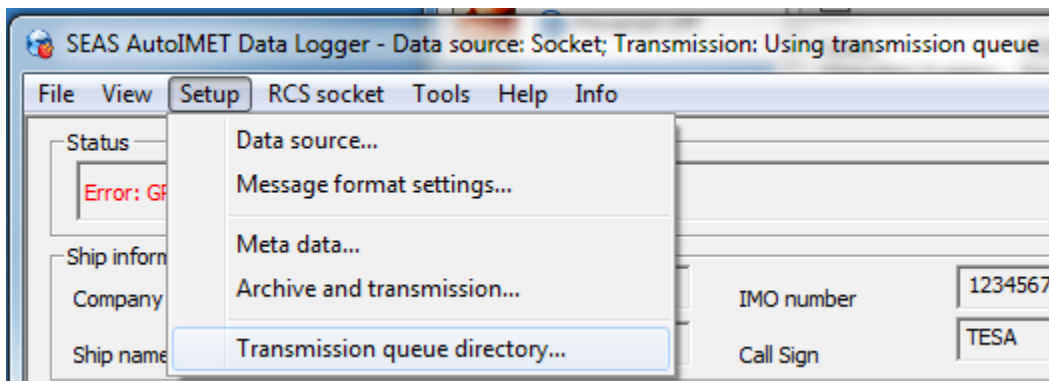

Use this command to select the transmission queue directory, where SEAS AutoIMET Data Logger will post the files ready to transmit. A **Browser for Folder** dialog appears that allows the user to select a folder.
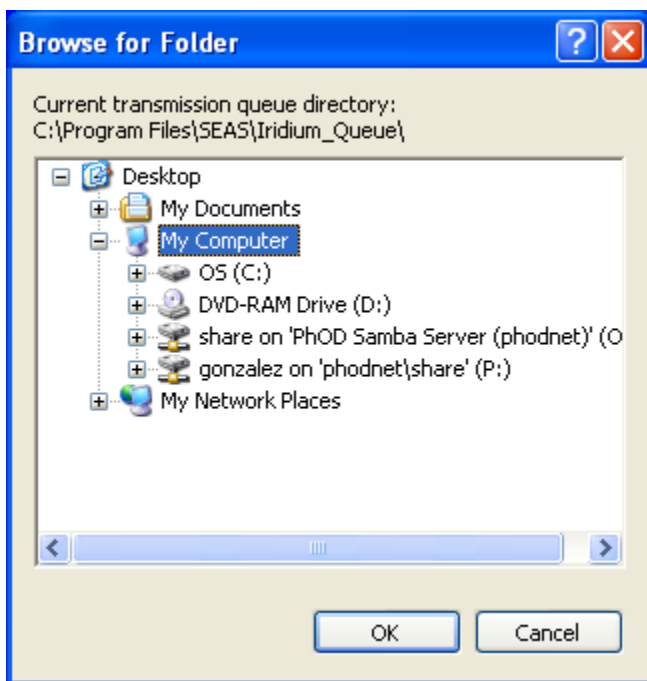

When this dialog box comes up, it displays the **Desktop** folder as the parent and all the other folders can be located from it. To use it, the user can click one of the folders or drives and click **OK**. If the desired folder is not seen but is available, the user can expand the existing folders and drives, click the desired folder, and click **OK**. If the necessary folder is not available at all, the user should first create the desired folder outside the application.
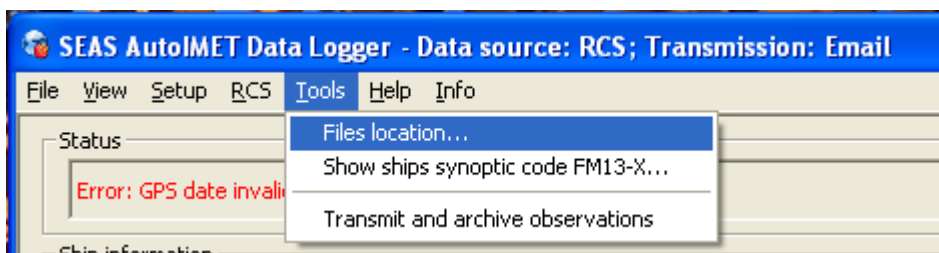
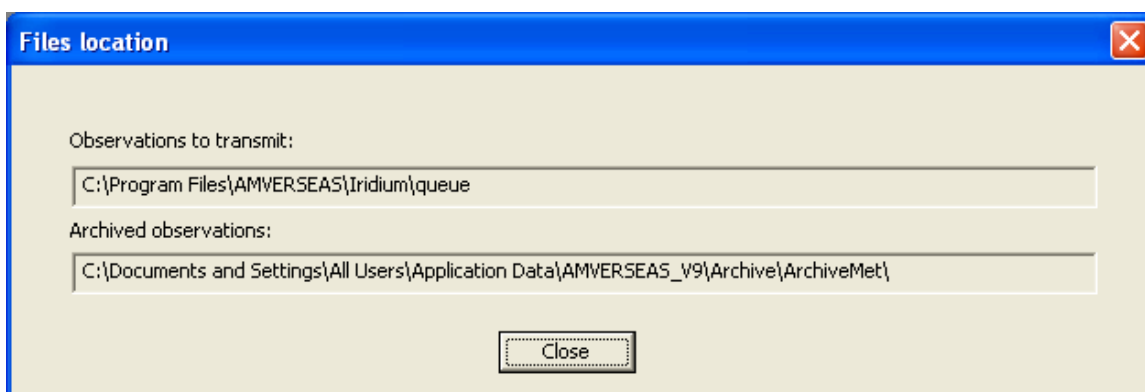**RCS > Connect socket**: Connects the Remote Computer System socket.
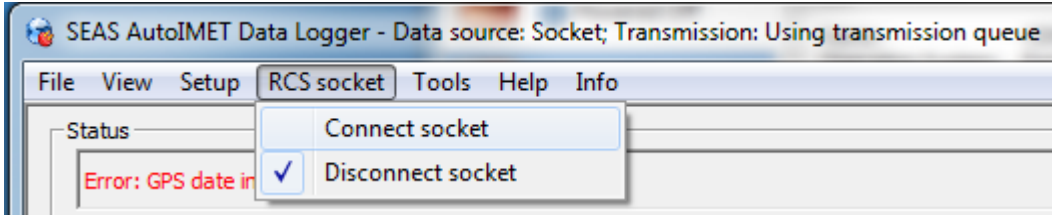
RCS > Disconnect socket: Disconnects the Remote Computer System socket.
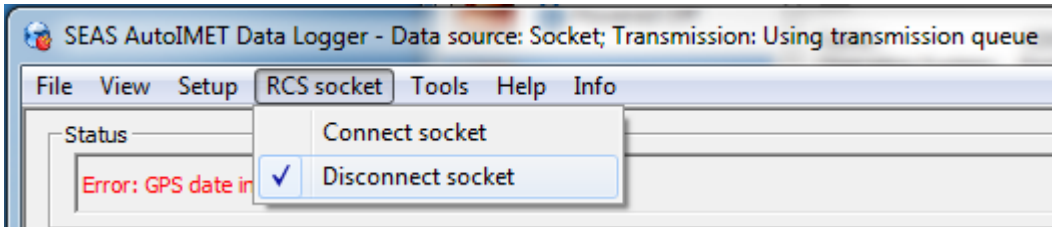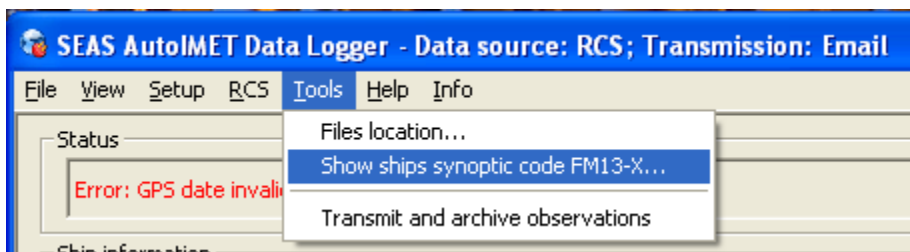
Tools > Files location: Displays the application files path where SEAS AutoIMET Data Logger's files can be found.
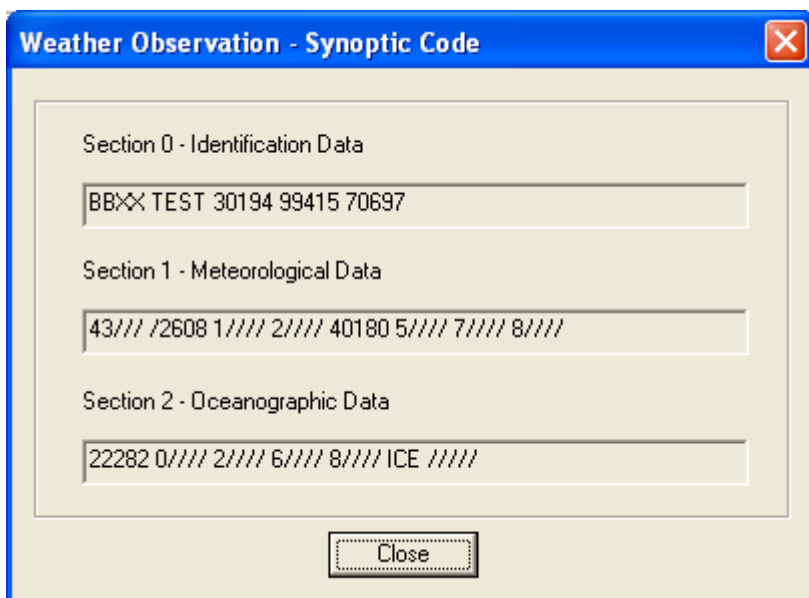

Once selected the window **Files location** will appear:


Tools > Show ships synoptic code FM13-X: Shows the observation message in BBXX format. Instantaneous data (that is received closest to the display time) is displayed.

Once selected the window **Weather Observation – Synoptic Code** appears.

Tools > Transmit and archive observation: Forces transmissions placing in the SMTP transmit queue the observation message in BBXX format. Instantaneous data (that is received closest to the transmit time) is transmitted.
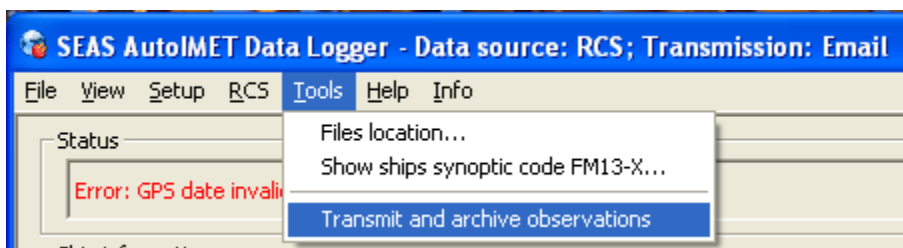
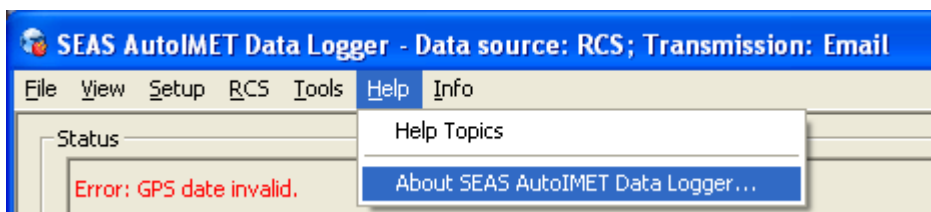**Help > Help Topics**: Displays the opening screen of help. From the opening screen, you can jump to step-by-step instructions for using AutoIMET Data Logger and various types of reference information.
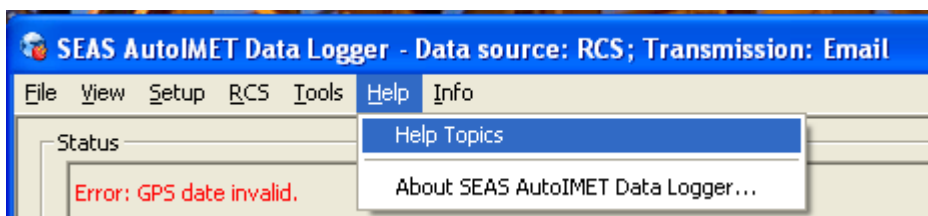
Help Help > About SEAS AutoIMET Data Logger…: Use this command to displays the copyright notice and version number of your copy of AutoIMET Data Logger.

Once selected the window **About SEAS AutoIMET Data Logger** appears.
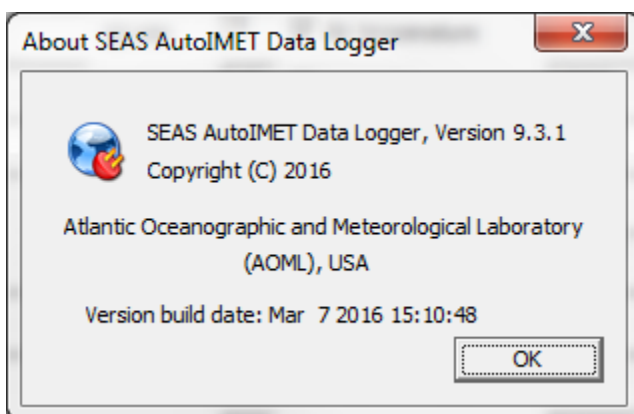
Info: This menu provides you links to documents that can help you work with Met Observations Logger.
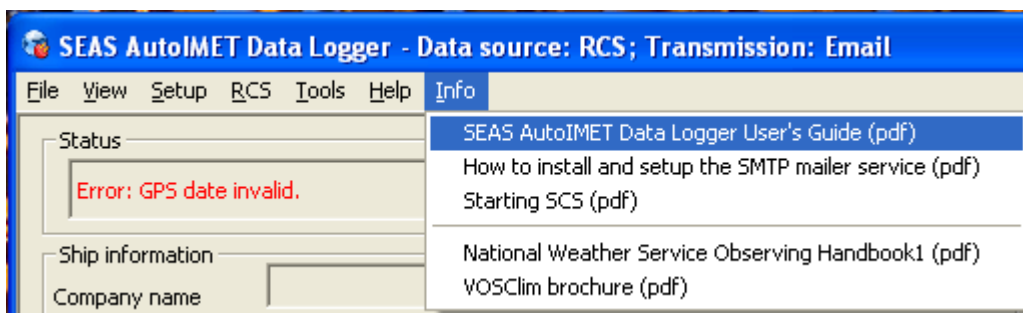
It contain following documents:

- SEAS AutoIMET Data Logger User's Guide.
- How to install and setup the SMTP mailer service.
- Starting SCS.
- National Weather Service Observing Handbook1.
- VOSClim brochure.

Ships synoptic code FM13-X

The ships synoptic code FM-13-X-SHIP is the form of the message as distributed on the Global Telecommunications System (GTS), and is the standard set forth by the World Meteorological Organization. This code is comprised of 23 groups of symbolic letters representing meteorological and oceanographic elements, report identification and ship location data. The code has three main sections - 0, 1, and 2.

SECTION 0 — IDENTIFICATION DATA
$BBXX$ $D\ldots D$ $YYGGi_w$ $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$

SECTION 1 — METEOROLOGICAL DATA
i_Ri_xhVV $Nddff$ $00fff$ $1s_nTTT$ $2s_nT_dT_dT_d$
$4PPPP$ $5appp$ $7wwW_1W_2$ $8N_hC_LC_MC_H$

SECTION 2 — OCEANOGRAPHIC DATA
$222D_sv_s$ $0s_sT_wT_wT_w$ $2P_wP_wH_wH_w$ $3d_{w1}d_{w1}d_{w2}d_{w2}$ $4P_{w1}P_{w1}H_{w1}H_{w1}$
$5P_{w2}P_{w2}H_{w2}H_{w2}$ $6I_sE_sE_sR_s$ $8s_wT_bT_bT_b$ ICE $c_iS_ib_iD_iz_i$

Section 0, consisting of the first 5 code groups, contains the identification data (ship report identifier, ship's call sign, date, time, location), and units of wind speed used.

$BBXX$ $D\ldots D$ $YYGGi_w$ $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$

Section 1 consists of code groups 6-14 and contains most of the meteorological data of the report (precipitation and weather data indicators, cloud base height, visibility, cloud cover, wind direction and speed, air and dew point temperatures, sea level pressure, tendency, and amount of change, present and past weather, and cloud type).

i_Ri_xhVV $Nddff$ $00fff$ $1s_nTTT$ $2s_nT_dT_dT_d$
$4PPPP$ $5appp$ $7wwW_1W_2$ $8N_hC_LC_MC_H$

Section 2 consists of code groups 15-23 and contains ships movement data (ships course and speed), oceanographic data (sea surface temperature, sea period and height, primary and secondary swell direction, period, and height), and ice data (for any ice accreting on ship or on the sea surface), and the wet bulb temperature group.

$222D_sv_s$ $0s_sT_wT_wT_w$ $2P_wP_wH_wH_w$ $3d_{w1}d_{w1}d_{w2}d_{w2}$ $4P_{w1}P_{w1}H_{w1}H_{w1}$
$5P_{w2}P_{w2}H_{w2}H_{w2}$ $6I_sE_sE_sR_s$ $8s_wT_bT_bT_b$ ICE $c_iS_ib_iD_iz_i$ (or plain language)

Synoptic Code Symbols with Range of Values

Symbol	Description	Range
BBXX	Ship Weather Report Indicator	BBXX
D....D	Radio call sign	Call Sign
YY	Day of the month	01-31
GG	Time of observation	00-23
i_w	Wind indicator	3, 4
$L_aL_aL_a$	Latitude	000-900
Q_o	Quadrant	1, 3, 5, 7
$L_oL_oL_oL_o$	Longitude	0000-1800
i_R	Precipitation data indicator	4
i_x	Weather data indicator	1, 3
h	Cloud base height	0-9, /
VV	Visibility	90-99
N	Cloud cover	0-9, /
dd	Wind direction	00-36, 99
ff	Wind speed	00-99
fff	High Speed Wind	Knots (099-)
s_n	Sign of temperature	0, 1
TTT	Dry bulb temperature	Celsius Degrees
$T_dT_dT_d$	Dew point temperature	Celsius Degrees
PPPP	Sea level pressure	Actual Hp or Mb (omit 1 in thousandths)
a	3-hour pressure tendency	0-8
ppp	3-hour pressure change	Hp or Mb
ww	Present weather	00-99
W_1	Past weather (primary)	0-9
W_2	Past weather (secondary)	0-9
N_h	Lowest cloud cover	0-9, /
C_L	Low cloud type	0-9, /
C_M	Middle cloud type	0-9, /
C_H	High cloud type	0-9, /
D_s	Ship's course	0-9
V_s	Ship's average speed	0-9
S_s	Sign/type sea surface temp.	0-7
$T_wT_wT_w$	Sea surface temp.	Celsius Degrees
P_wP_w	Sea period	Seconds
H_wH_w	Sea height	Half Meters
$d_{w1}d_{w1}$	Primary swell direction	01-36, 99
$d_{w2}d_{w2}$	Secondary swell direction	01-36, 99, //
$P_{w1}P_{w1}$	Primary swell period	Seconds
$H_{w1}H_{w1}$	Primary swell height	Half Meters
$P_{w2}P_{w2}$	Secondary swell period	Seconds
$H_{w2}H_{w2}$	Secondary swell height	Half Meters
I_s	Ice accretion cause on ship	1-5
E_sE_s	Ice accretion thickness on ship	Centimeters
R_s	Ice accretion rate on ship	0-4
S_w	Sign/type wet bulb temp.	0-7
$T_bT_bT_b$	Wet bulb temp.	Celsius Degrees
c_i	Sea ice concentration	0-9, /
S_i	Sea ice development	0-9, /
b_i	Ice of land origin	0-9, /
D_i	Ice edge bearing	0-9, /
z_i	Ice trend	0-9, /

More information can be finding into the National Weather serving Observing Handbook1

Any elements not reported or out of bound are normally coded with a slash (/) to indicated missing data.

In the first five groups, this is the Synoptic Code Section 0, all values are mandatory, if any error occurs or any data is missing, the entire report will be discarded.

Archiving data

The SEAS AutoIMET Data Logger collects marine weather data from Remote Computer System about once every 1 minute; the data is transmitted using the meteorological observation BBXX format on a user-determined schedule, typically this is hourly or when the user hit the **Main Menu > Tools > Transmit and archive observation** command. Instantaneous data (that is received closest to the transmit time) is transmitted.
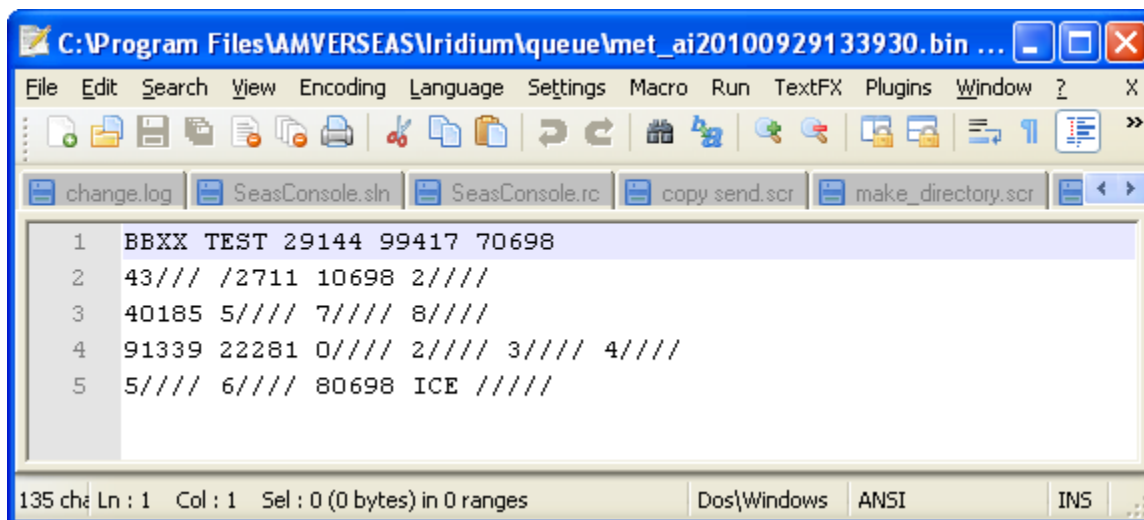
The application archives the collected data in **IMMT.txt** file into the archive directory C:\Users\Public\Public Documents\AMVERSEAS_V9\Archive\ArchiveMet.

The IMMT.txt file is a recording of all observations taken on the vessel in International Maritime Meteorological Tape (IMMT) version IMMT-5 format. . Port Meteorological Officers (PMO) should retrieve the archived file when they meet the ship and send the data to the National Climatic Data Center (NCDC).

The supported Minimum Quality Control Standards (MQCS) version is the Version 7.

Data transmission

It is very important that observations be transmitted quickly. This ensures that the report will arrive in time for use by the marine forecaster. The name of the binary formatted file is **CallSign_YYYYMMDDHHMMSS_AI_MET.bin**. This file has a "bin" extension but it is really a "txt" file. It is a SMTP's requirement.

The messages will be transmitted automatically also it can be transmitted from the main menu by selecting **Tool > Transmit and archive observations** command. The

transmission process in SEAS AutoIMET Data Logger application is a pseudo transmission process. It consists to post the generated CallSign_YYYYMMDDHHMMSS_AI_MET.bin file into the Iridium's queue located in the user-selected directory for the real transmission via satellite using the Iridium Mailer Service.

.INI files

The .ini files are plain-text files that contain configuration information. "INI" stands for *initialization***.** The files will be created during the installation process and never should be manually changed.

- **AutoImetDataLogger.ini** is used to save information about the application setup, and preferences.

Directory structure

Archive directory

➢ C:\Users\Public\Public Documents\AMVERSEAS_V9\Archive\ArchiveMet.