Skyradiometer

POM-01 / POM-02

Operation Manual

(Windows OS)

October 19, 2009

PREDE *PREDE Co., Ltd.*

Head Office: 1117, Kusabana, Akiruno-shi, Tokyo, 197-0802, Japan

Research Center: Sasamoto Blg, 1-26-8, Kamidaira, Fussa-shi, Tokyo, 197-0012, Japan

TEL+81-42-539-3755 FAX:+81-42-539-3757

URL: http://www.prede.com/ E-mail: sales@prede.com

Specifications

＜POM-01＞

Half view angle	0.5°								
Min scattering angle	3°								
Band width 50%	10nm								
Wavelength	Channel	1	2	3	4	5	6	7	(nm)
	Wavelength	315	400	500	675	870	940	1020	
	※ Channel 0 is dark reference 940nm is channel for water vapor								
Channel setting	Filter foil type								
Detector	Si photodiode								
Range	2.5mA , 250uA , 25uA , 2.5uA , 250nA , 25nA , 2.5nA								
Temperature control	35°C (built-in Heater)								
Tracking control	Stepping Motor ：2 way, Azimuth and Zenith , Stepping angle：0.0036°/pulse								
Sun sensor	Si photodiode								
Potential tracking area	Azimuth	±300° (South 0°)							
	Zenith	-60 ～ 170° (Horizon 0°)							
Communication	RS232C 30m								
Power consumption	200W (100V/2A)								
Power supply	AC100～AC240/2A								
Weight	Tracker + Sensor / 16kg Tracker dimensions 40×40×55cm								
	Cable / 4kg								

＜POM-02＞

Half view angle	0.5°											
Min scattering angle	3°											
Band width 50%	10nm											
Wavelength	Channel	1	2	3	4	5	6	7	8	9	10	11
	Wavelength	315	340	380	400	500	675	870	940	1020	1627	2200
	※ Channel 0 is dark reference 940nm is channel for water vapor											
Channel setting	Filter foil type											
Detector	Short wave (315nm～1020nm)	Si photodiode										
	Long Wave (1627nm, 2200nm)	InGaAs photodiode										
Range	2.5mA , 250uA , 25uA , 2.5uA , 250nA , 25nA , 2.5nA											
Temperature control	20°C (built-in Heater) option : cooler											
Tracking control	Stepping Motor：2 way, Azimuth and Zenith, Stepping angle 0.0036°/pulse											
Sun sensor	Si photodiode											
Potential tracking area	Azimuth	±300° (South 0°)										
	Zenith	-60 ～ 170° (Horizon 0°)										
Communication	RS422 30m											
Power consumption	200W (100V/2A)											
Power supply	AC100～AC240/2A											
Weight	Tracker + sensor/ 19kg Tracker dimensions 40×40×55cm											
	Cable / 4kg											

Installation

Installation step guide

It is recommended to let a first installation in clear day. Sun sensor can not be active under cloudy sky and that cause the insufficient tracking accuracy.

1) Mount sun tracker on solid and flat place with free field of view especially toward East – South – West direction. Make sure label “S” at tracker bottom looks toward South. For data transfer and power supply a maximum distance of 30m to the PC and power supply are allowed. Larger distance can be offered on request.

2) Load the sensor part on tracker arm and fix that with nuts. Pay attention to the sensor position with arrow sign.

4) Adjust horizontal level using 3 legs with bubble gauge so that it comes to the center of circle.

5) Connect the rain sensor.

6) Connect the cable ④,⑤,⑦ and the sun sensor ⑥. **Assemble all cables into mesh cover not to tangle.**

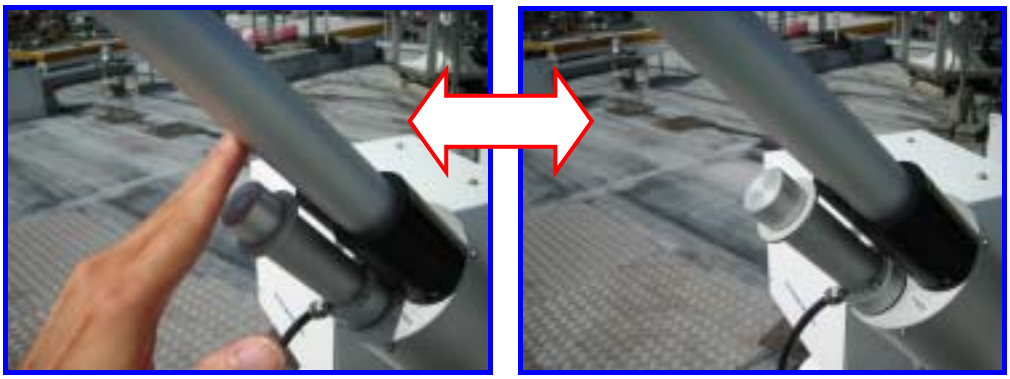
7) Connect the communication cable(RS422) and then the power cable(AC3P). Immediately after connecting power cable, tracker starts origin searching. Be careful of the rotating tracker and obstacle around its rotating area. If tracker doesn't start rotating performance, it means there is any cable connection lack or mechanical trouble.

8) After stop tracker rotating, prepare the PC setting to start measurement.

9) See page XX and edit the measurement schedule and system construction (filter setting). Measurement can start with pressing “OK” on the screen.

＊ Tacking Mode (Calculation mode and Sun sensor mode)

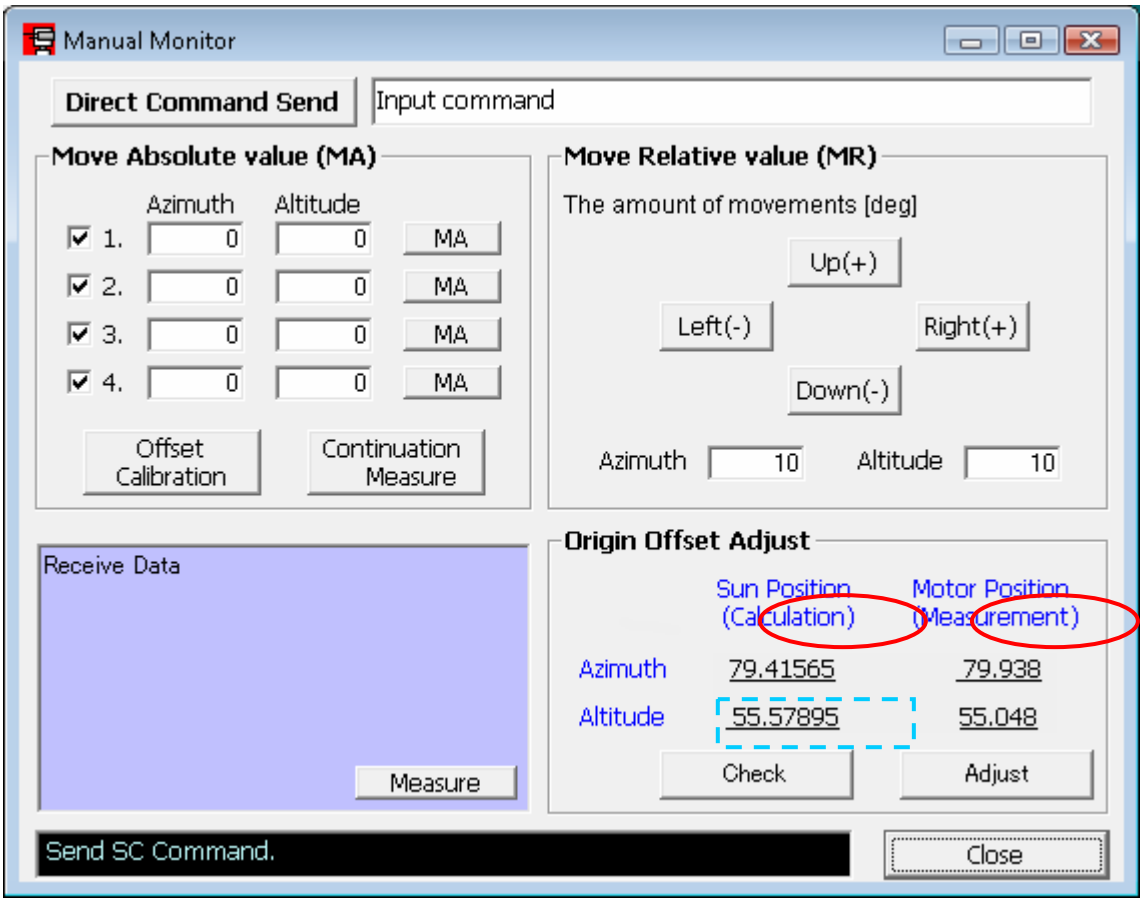
Skyradiometer can track sun position with auto-switching calculation and sun sensor mode. Based on the data (latitude, longitude, time) it can keep sun tracking. This is the so called calculation mode. In addition, skyradiometer increase tracking accuracy with using sun sensor. Sun sensor can respond if it receive sun light within ±5 degree. During sun sensor receive threshold value, skyradiometer keep tracking with sun sensor mode. In other words **user is required tracker is mounted at direction within at least±5 degree from real sun position**. Like next picture if user cover sun sensor by hand and skyradiometer move position, it means there is room to improve the accuracy between calculation mode and sun sensor mode. In this case user is required to bring up the tracker base and turn little its direction clockwise or counterclockwise so that tracker changes its tracking point with very few angle.



11) Make sure all cables firmly connected and recommend to protect those with butyl tape.

12) For POM-02L operation, set sun shading plate on sensor for housing temperature not too high.

Installation check This step is required after first installation.



After start of measurement, open “Manual Operation” and carry out next installation check.

＊ Installation accuracy can affect value of direct sun measurement. Especially in the early morning, sun sensor can't respond even when it is clear sky because sun light is very weak. Skyradiometer performs with calculation mode. Then as sun altitude is increasing with time, Skyradiometer can perform with sun sensor mode. Skyradiometer can receive data at accurate sun position. Here, if there is big position difference, there could be apparent data jump up at when skyradiometer auto-changes its mode. Same event could occur in the evening. Therefore user is required to place skyradiometer with enough accuracy.

(1) Press “Check” at the “Origin Offset Adjust”

(2) Software shows the position accuracy between “Sun Position” and “Motor Position”

(3) 1deg ＞ position accuracy, it means installation is succeeded.

(4) 1deg ＜ position accuracy, it means user needs more adjustment for tracker direction.

- Sun Position ＞ Motor Position ： Turn tracker to west (clockwise)
- Sun Position ＜ Motor Position ： Turn tracker to east(counterclockwise)

(5) Press again “Check” and make sure azimuth accuracy is less than 1 deg. Press “Close” to return to operation.

※ In case tracker is mounted with bolts on the platform and user can not turn tracker direction, press button “Adjust”, this means software temporarily meet motor position to sun position. But this adjustment is not memorized. This button is necessary if user closes software and restarts it again.

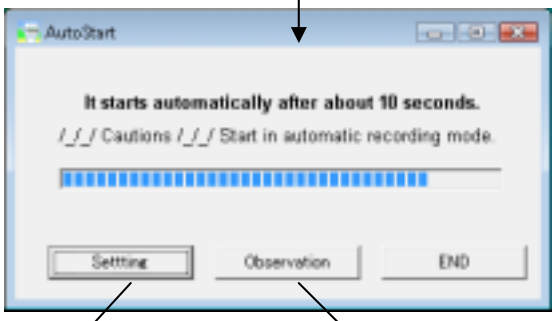
Setting

Required specifications

PC：Pentium2＜　Memory 256MB＜,　Free HDD area 1GB＜、Serial port(RS-422)

OS：Windows XP / Vista

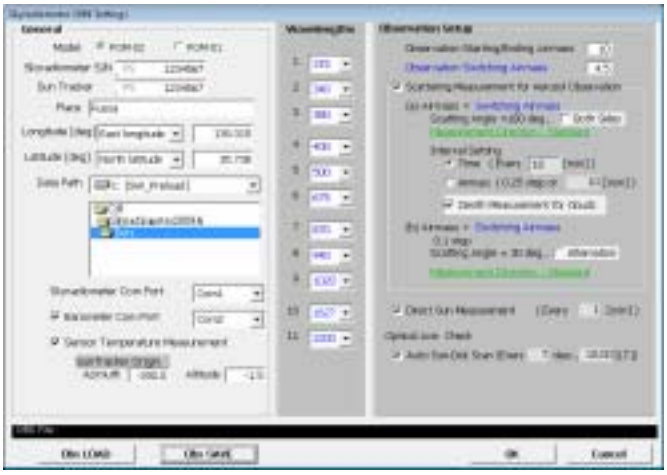
Click “Skyradiometer2009.exe”



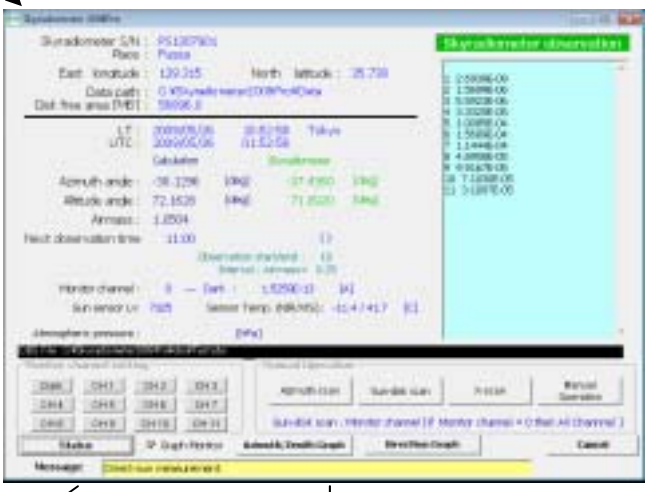
Start window（Fig1）

After 10 seconds, measurement auto-start.

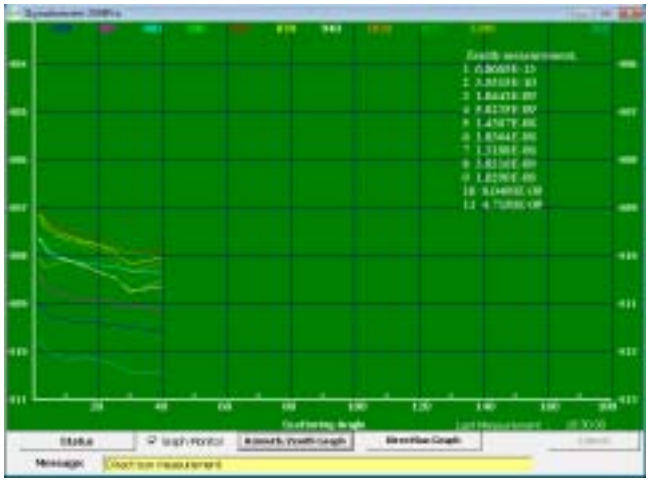
Setting page



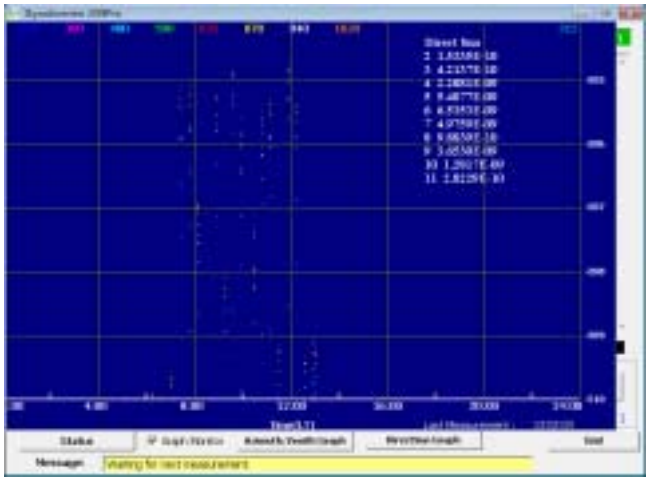
Observation page



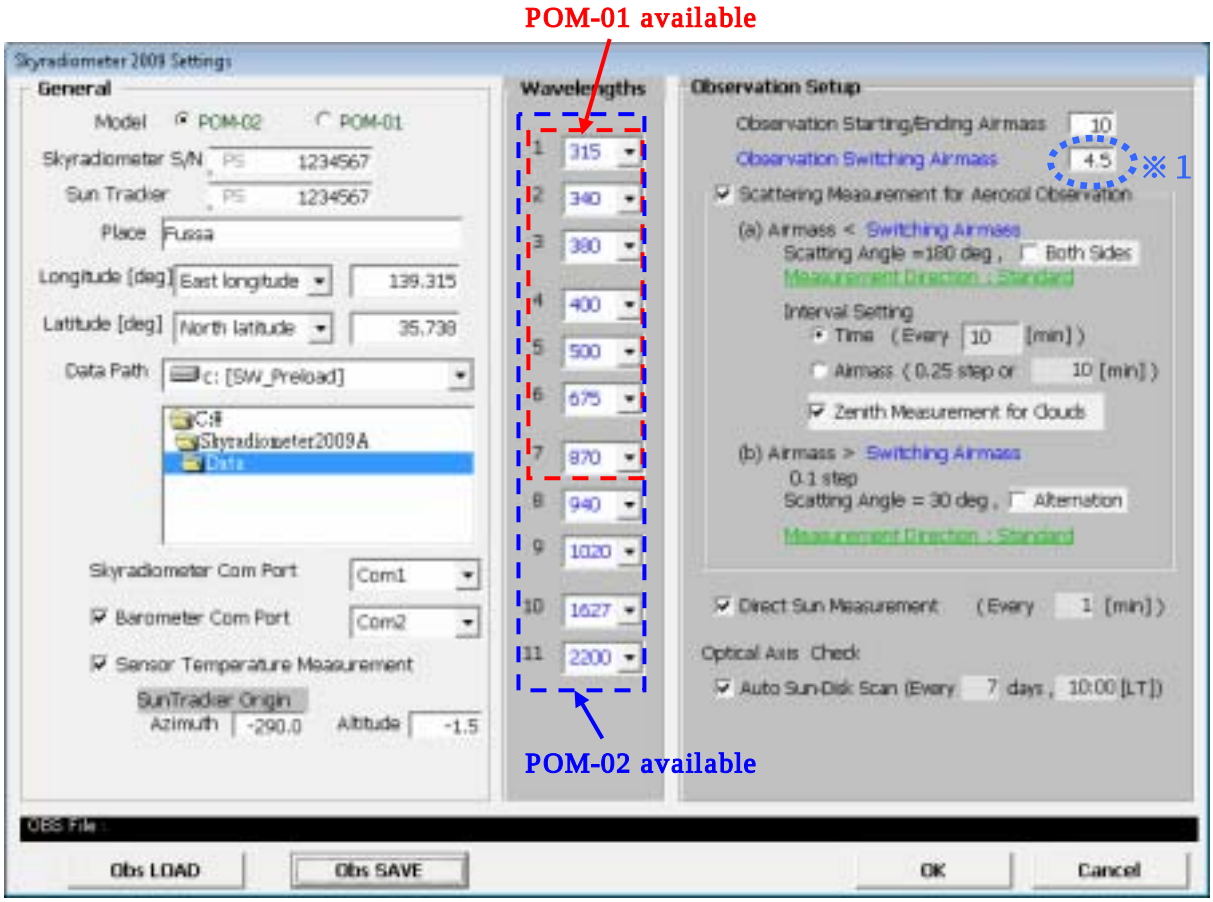
Aerosol observation



Direct sun observation



Setting screen



Please fill in the field.

General

Model	:	POM-02 or POM-01
Skyradiometer S/N	:	Serial number PS＊＊＊＊＊＊＊
Sun Tracker	:	Serial number PS＊＊＊＊＊＊＊
Place	:	
Latitude [deg]	:	Three places of decimals
Longitude [deg]	:	Three places of decimals
Data path	:	It is necessary to specify new path to data directory.
		Important: User needs to create sub-directory on your hard disk.
Skyradiometer Com Port	:	Serial port for skyradiometer operation
Barometer Com Port	:	Serial port for barometer (option)
Sensor Temperature Measurement	:	Record sensor temperature (option)
SunTracker Origin	:	Tracker offset (See inspection sheet)

※Sun tracker origin affects sun tracking accuracy.

Wavelengths

Important : Please make sure your filter set with inspection sheet.

Set wavelength of each channel

・ POM-01

Number of wavelength : **7**（315nm ～ 1020nm）

Standard set : **315, 400, 500, 675, 870, 940, 1020** [nm]

・ POM-02

Number of wavelength : **11**（315nm ～ 2200nm）

Standard set : **315, 340, 380, 400, 500, 675, 870, 940, 1020, 1627, 2200**[nm]

Observation Setup

Observation Starting/Ending Airmass ：

Observation Switching Airmass ： Airmass to switch the way of measurement ※1

Scattering Measurement for Aerosol Observation ： If user do not select, skyradiometer perform only direct sun measurement.

（a）Airmass ＜ Switching Airmass ： Airmass is smaller than ※1, max scattering angle = 180 deg

・Both Side ： skyradiometer steps to scattering angle both clockwise/counterclockwise direction（※Page 12）

・Interval Setting ： Select time / airmass

・Zenith Measurement for Clouds ： measurement at altitude 90 deg （Page 11）

（b）Airmass ＞ Switching Airmass ： Airmass is larger than ※1, max scatting angle = 30 deg

・Alternation ： Change the direction of scattering step alternately clockwise or counterclockwise.（※Page12）

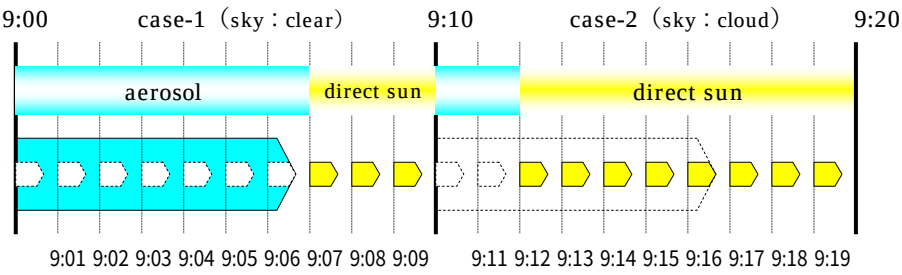
Direct Sun Measurement ： Minimum interval 1 minute

Auto Sun-Disk Scan ： Disk scan is recommended to schedule every 7 days

【Example】

Aerosol （every 10min）

and Direct sun （every 1min）



Obs SAVE

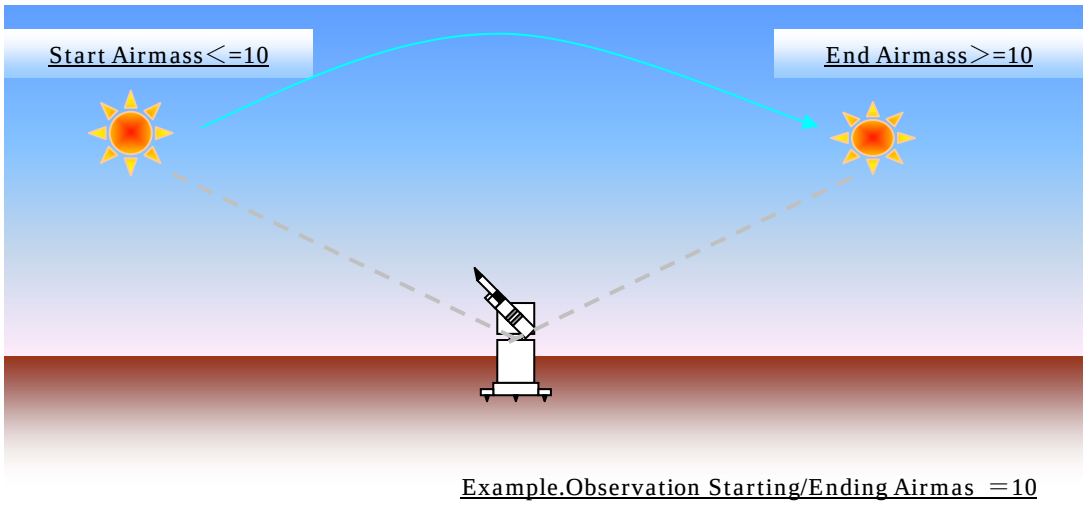
User can save obs file with button [Obs SAVE] and select several files at different location. User can read out saved file with button [Obs LOAD].

Complete setting with button “OK”.

Observation sequence

Skyradiometer operates during airmass is under registered value.

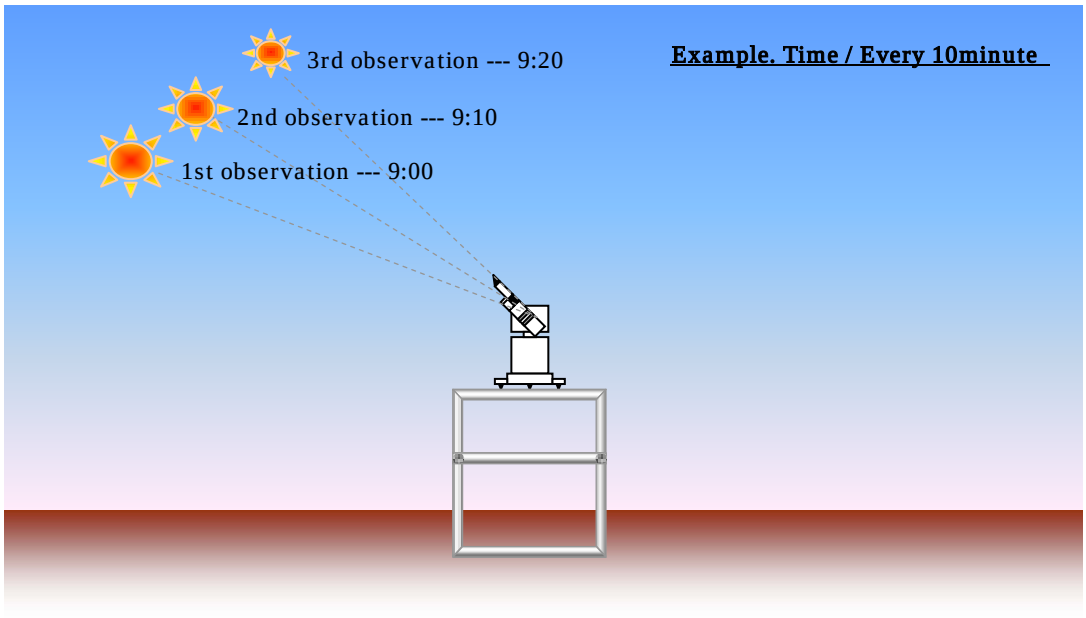
1. observation start （end） ： Airmass ＜= 10

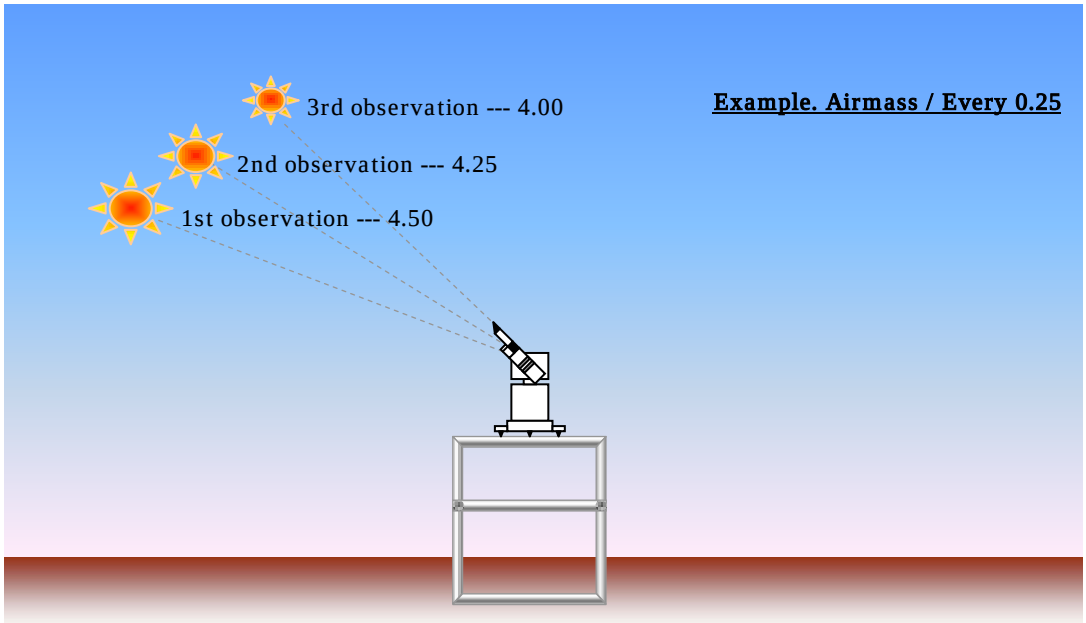


Example.Observation Starting/Ending Airmas ＝10

2. Aerosol observation interval ： Time (Every 10minute)

or Airmass (Every 0.25 step or 20minute)

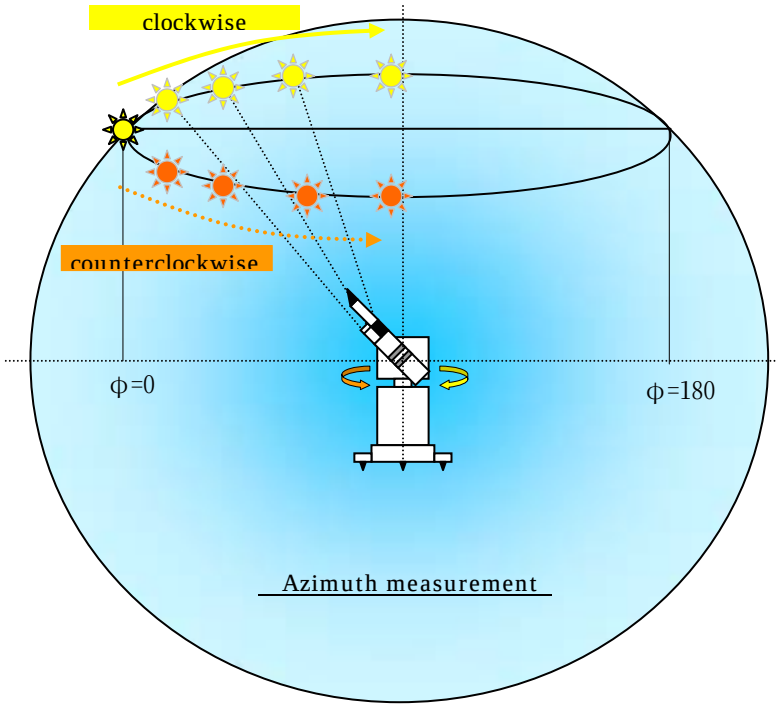


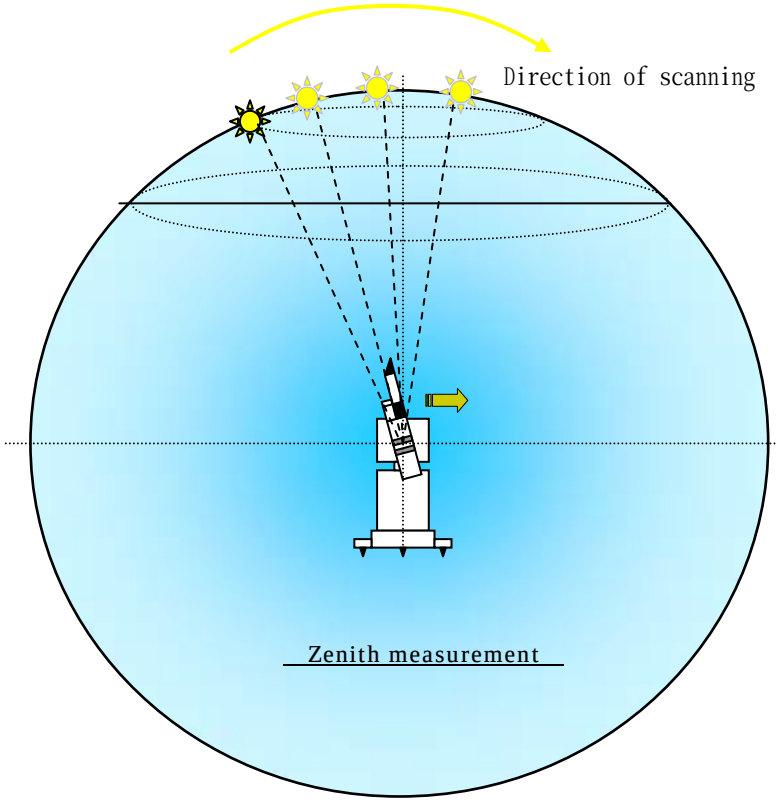


3. Direct sun observation interval ： Time (60 sec)

4. ： Scattering direction　Skyradiometer steps clockwise (morning) and counterclockwise (afternoon) while sun altitude is below 75deg.

Skyradiometer steps to zenith direction while sun altitude is over 75deg.





Scattering angle　：Max 24 point　(depending on sun altitude)

0,2,3,4,5,7,10,15,20,25,30,40,50,60,70,80,90,100,110,120,130,140,150,160

Disk scan schedule ： interval day and time are editable（Default : every 7day, 10:00AM）
Disk scan is executed at schedule for selected wavelength on the condition sky is clear (sun sensor threshold).

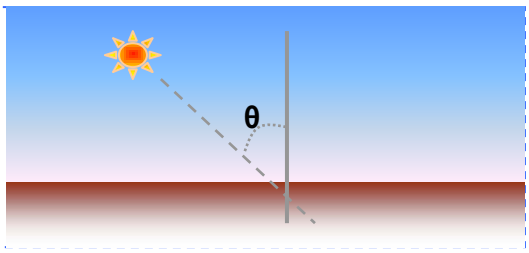
Time proofreading for tracker ： 23:00
Clock built-in tracker adjust PC time.

Rain sensor ： Skyradiometer stops sun tracking and remains at waiting position downward.
Waiting position is direction south and altitude －30deg.

Reference

Airmass ＝ 1／COS θ

[θ = Solar altitude * （π／180）]



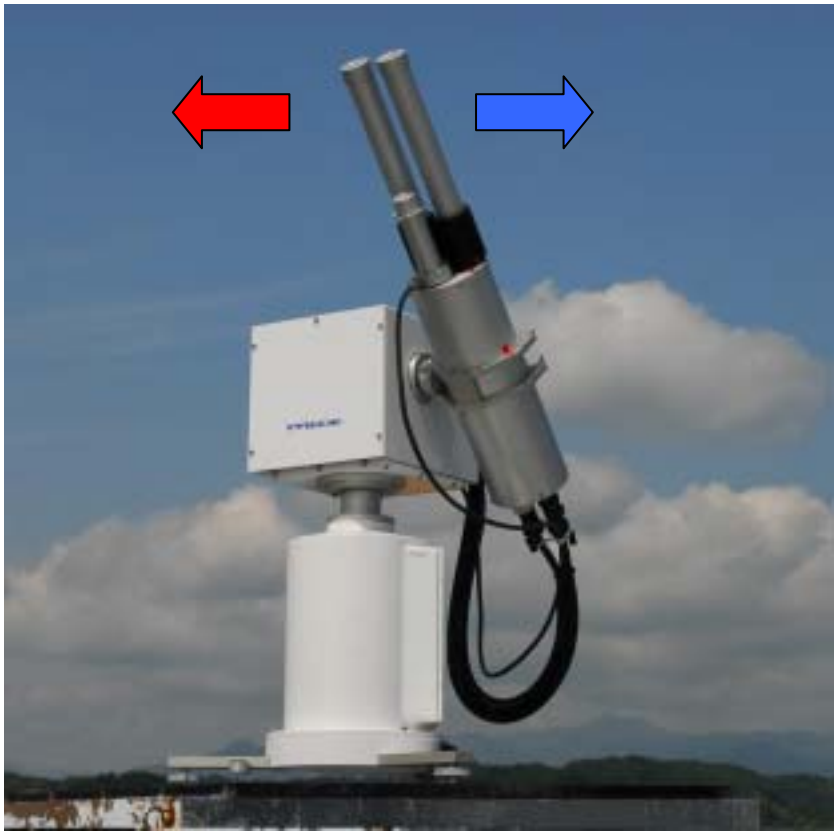
Scan guide (Option menu in setting file)

■ POM-02 Zenith measurement for clouds

■ Both Side

Every aerosol observation, skyradiometer scan at both direction.

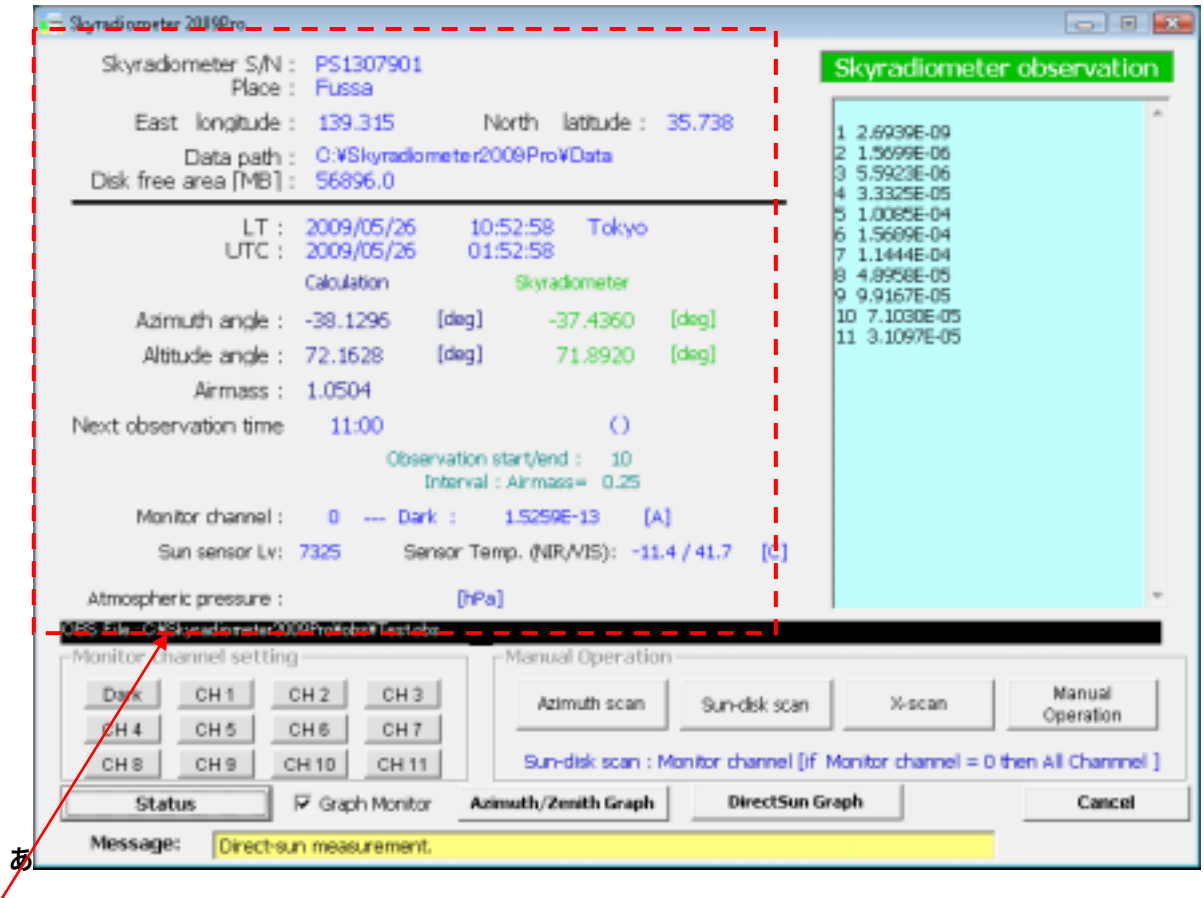
■ Alternation



Every aerosol observation, skyradiometer changes the scattering direction alternately.

Operation screen

Main screen

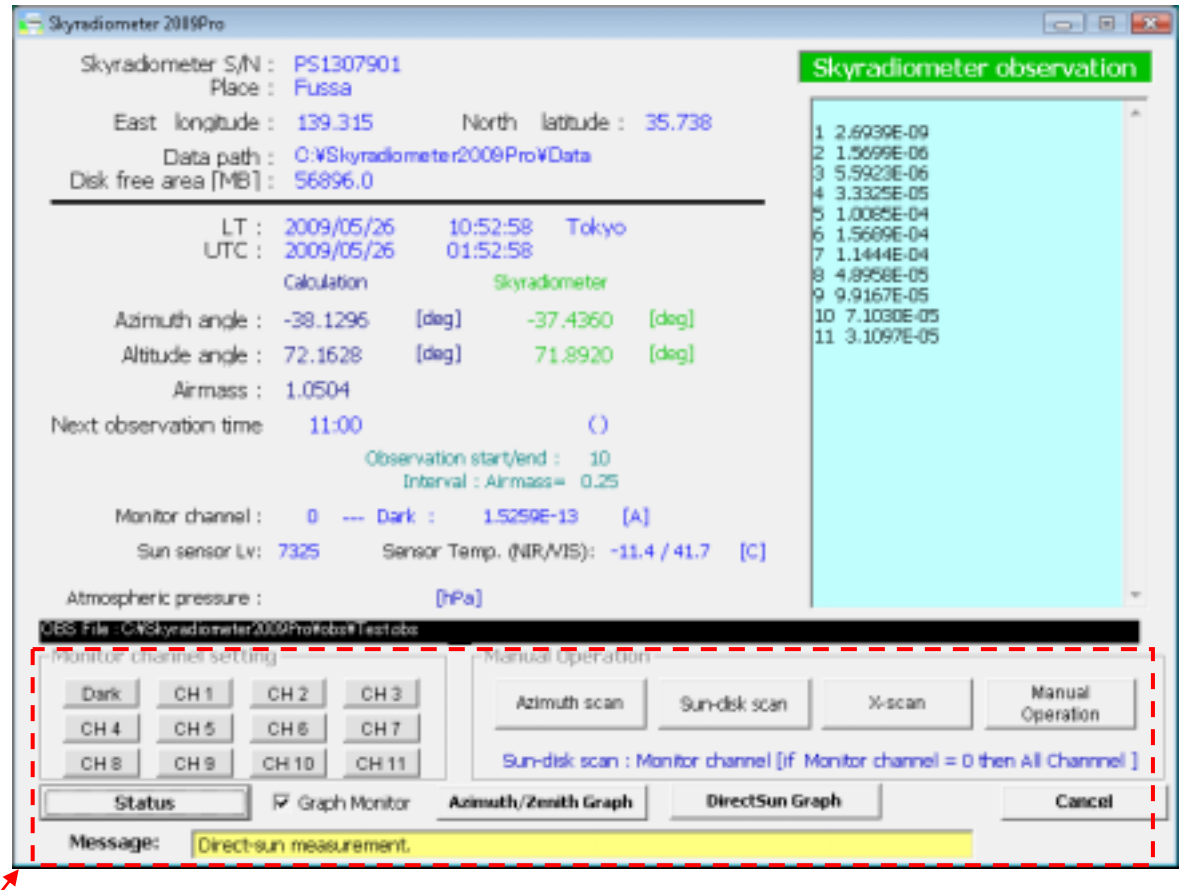


あ

Main screen display

◆Status

LT	:	Local time
UTC	:	Universal time coordinateded
Azimuth angle	:	sun azimuth calculated from PC clock （East:－90 ° South: 0 ° West: +90 ° North: 180 ° ）calculated position / real position
Altitude angle	:	sun altitude calculated from PC clock （Nadir: －90 ° Horizon: 0 ° Zenith: 90 ° ） calculated position / real position
Airmass	:	airmass calculated from PC clock
Next observation time	:	scheduled next observation time and airmass
Monitor channel	:	Output[A] of selected wavelength Return to channel 0 (Dark position) to prevent filter degradation after aerosol measurement
Sun sensor Lv	:	Output of sun sensor count (Aerosol measurement is executed at sun sensor Lv threshold)
Sensor Temp(NIR/VIS)	:	NIR sensor temperature / sensor housing temperature [C]
Atmospheric pressure	:	Barometer on request
OBS File	:	Here you can see the path to the data directory.



Button guide

Monitor channel setting

・Dark～CH11 ： User can select monitor channel

※ Return to Dark after aerosol and direct sun observation.

Manual Operation

・Azimuth scan ： Aerosol measurement

・Sun-Disk Scan ： Disk scan with all wavelength

data stored at each wavelength folder

・X-scan ： scan (0.1 ° step)along horizontal and vertical direction from the center(sun) ±1 ° area. Center of gravity is indicated at bottom line. Value within 0.030 is best for optical axis (alignment).

・Manual Operation ： Overhaul use

Status ： Measurement window appears

Graph Monitor ： Aerosol or direct sun graph appears

Azimuth／Zenith Graph ： Displays aerosol observation graph

DirectSun Graph ： Displays direct sun observation graph

Cancel / End ： cancel operation or end program

Message ： operating status or error information

Aerosol observation graph

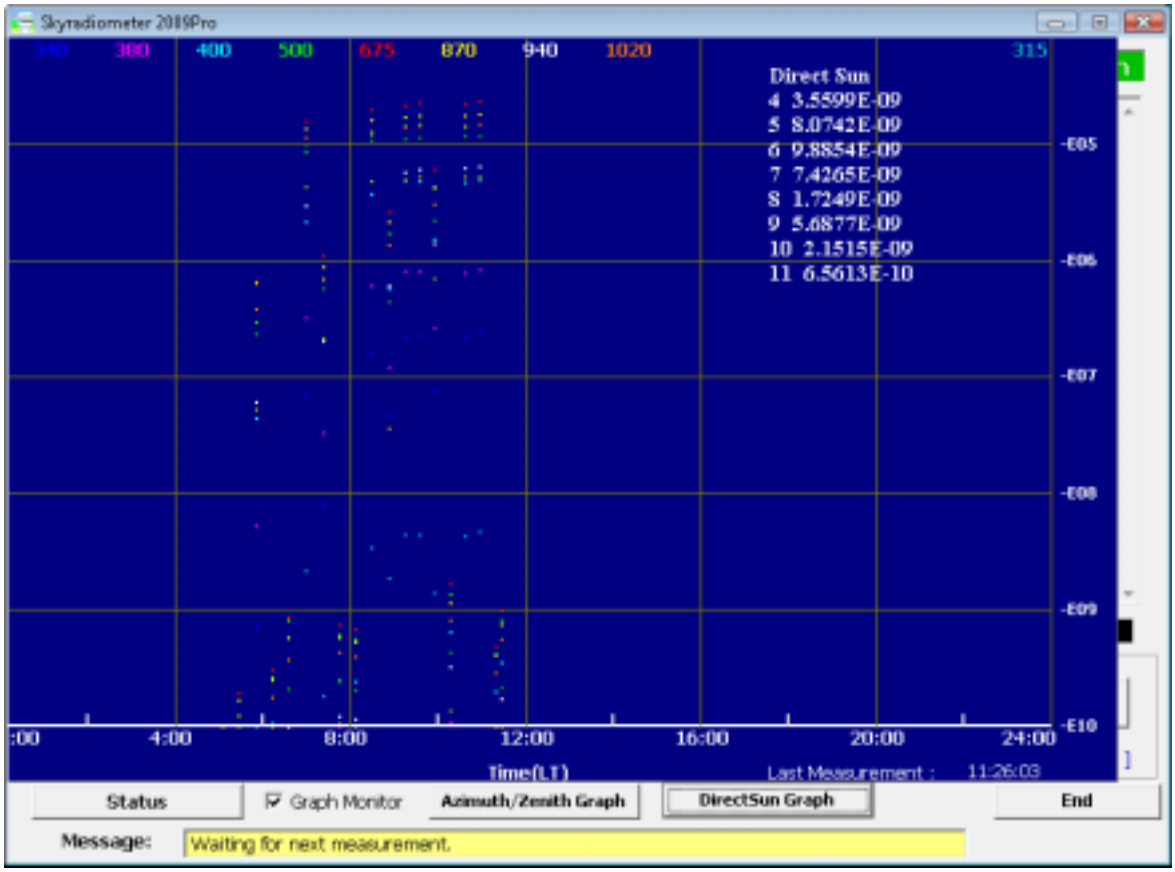
Display a graph of aerosol measurement with all wavelength. X-axis is scattering angle. Unit is ampere (Log scale).

Type	:	Line chart
X-axis	:	Scattering angle [deg]：0（Min）～180(Max)
Y1-axis	（POM－01）：	400nm,500nm,675nm,870nm,940nm,1020nm [A] [Log]
	（.POM－02）：	340nm,380nm,400nm,500nm,675nm,870nm,940nm,1020nm 1627nm,2200nmk[A] [Log]
Y2-axis	:	315nm [A] [Log]

Upper right corner shows real time value at scattering angle and bottom shows time record.

Direct sun observation graph

Display a graph of direct measurement thorough a day. Unit is ampere (Log scale).

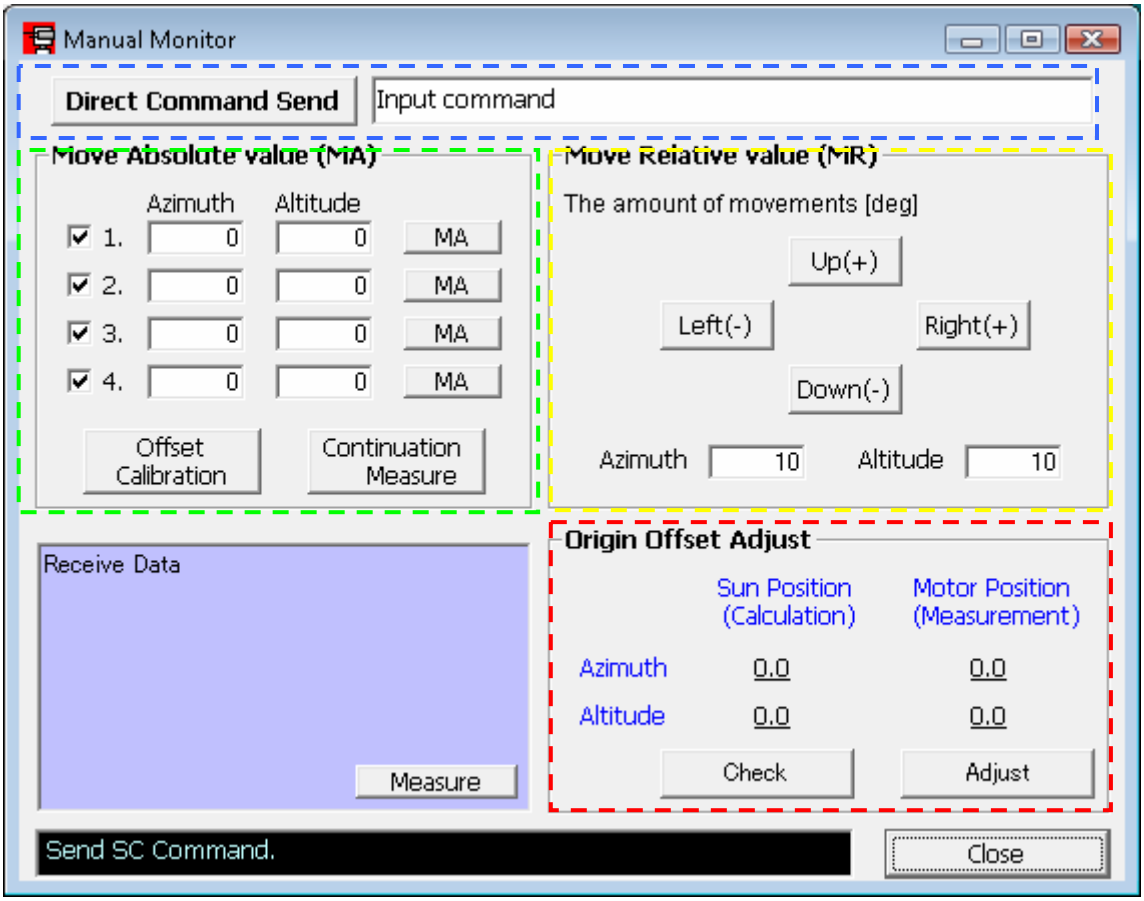


Type		:	Plot type
X-axis		:	Time [Local time]
Y1-axis	(POM-01)	:	400nm,500nm,675nm,870nm,940nm,1020nm [A] [Log]
	(POM-02)	:	340nm,380nm,400nm,500nm,675nm,870nm,940nm,1020nm, 1627nm, 2200nm [A] [Log]
Y2-axis		:	315nm [A] [Log]

Upper right corner shows real time value and bottom shows time record.

Manual Operation

This window is enable user to operate sun tracker and sensor manually.



青　枠　：　Send command directly. Response is seen at Receive Data area.

緑　枠　：　Operate the direction of sensor manually.　Angle is Absolute angle. (0.0, 0.0：South, Horizon)

Offset calibration　：　receive offset for 7 gains and the result on receive data area.

Measure　：Tracker direct position at selected position (Azimuth, Altitude) and execute measurement.

黄　枠　：　Operate the direction of sensor manually.　Move from current position

赤　枠　：　Display the tracker installation accuracy. See page5

Close　：　Return to main screen

Data format

Skyradiometer create four kinds of data file as follows;

1.**Aerosol obsevation** … **FileName : yymmddnn.dat**

2.Direct sun observation … **FileName : yymmddnn.sun**

3.Disk scan data file … **FileName : yymmddnn.V****

4.Cloud scan data file … **FileName : yymmddnn.cld**

”yymmdd” yy:year mm:month dd:day nn:file number(00～99).

Common header

A common header is added with two lines of each observation data file.

【Contents】

1st line： POM Type(6) , Tracker No.(7) , Sensor No.(7) , latitude(8) , Longitude(8) , Date/UTC(8) , Time/UTC(8) , Date/Local time(8) , Time/Local time(8) ,

2nd line： Number of channels , 1ch , 2ch , 3ch , ～ 11ch (wavelength)

【Example】POM-02,1822105,1957002, 139.315, 035.738,09/05/19,20:10:05,09/05/20,05:10:05
11,0315,0340,0380,0400,0500,0675,0870,0940,1020,1627,2200

1.Aerosol observation data file

File name：09052000.dat … Date Year:2009, Month:5, Day:20, File number00

【Example】

09/05/19,20:30:05,09/05/20,05:30:05,H,Fussa,
20:30:05,05:30:05,-106.89,009.62,3.6880E-09,1.9538E-09,1.3190E-08,1.7071E-07,3.8078E-06,
～ 2.6970E-05,4.6799E-05,4.9362E-06,4.6783E-05,6.5872E-05,3.4393E-05,-21.3,18.1,0000

1st line： Day(UTC) , Time(UTC) , Day(Local time) , Time(Local time) , Scan type , Location
※Scan type H：Horizontal scan ／ V：Vertical scan
Header is added every aerosol scan executed

2nd line ： Time(UTC) , Time(Local Time) , Azimuth angle , Zenith angle , Data(Ch1)、Data(Ch2) …
… Data(Ch10) , Data(Ch11) , NIR sensor temperature , Housing temperature , Barometer

・Azimuth angle and zenith angle is motor position.

・Unit of output data is ampere.

・Data is recorded as scattering angle order.

※Without barometer installed, com is selected, data record 0000 / com is not selected, data record -999.

2.Direct sun measurement data file

File name：09052000.sun … Date Year:2009, Month:5, Day:20, File number00

【Example】

09/05/19,20:11:36,09/05/20,05:11:36,S,Fussa,
20:40:04,05:40:04,-105.54,011.51,4.1847E-09,3.0655E-09,2.5963E-08,3.0296E-07,5.1796E-06,
～ 3.2005E-05,5.2956E-05,6.9740E-06,5.2269E-05,7.2594E-05,3.8612E-05,-21.1,18.5,0000,01209

1st line： Day(UTC) , Time(UTC) , Day (Local time) , Time(Local time) , Measure type , Location

※Measure type S: Direct sun measurement

2nd line： Time(UTC) , Time(Local Time) , azimuth angle , zenith angle ,
Data(Ch1)、Data(Ch2) …… Data(Ch10) , Data(Ch11) , NIR temperature , housing temperature,
Barometer, Sun sensor level

・azimuth angle and zenith angle is motor position.

・Unit of data is ampere.

※Without barometer installed, com is selected, data record 0000 / com is not selected, data record -999.

3.Disk scan data file

File name：09052600.**V01** … Date Year:2009, Month:5, Day:20, File number00, Filter channel=1

【Example】

09/05/26,05:13:41,09/05/26,14:13:41,D,315,Fussa,
-1.0,9.0790E-12,1.0757E-11,1.2512E-11,1.4191E-11,1.6556E-11,1.9302E-11,2.1973E-11,……
-0.9,1.0529E-11,1.2283E-11,1.4496E-11,1.6785E-11,2.0370E-11,2.3880E-11,2.8534E-11,……
⋮
1.0,8.4686E-12,9.9182E-12,1.1215E-11,1.2817E-11,1.4648E-11,1.6403E-11,1.8234E-11,……

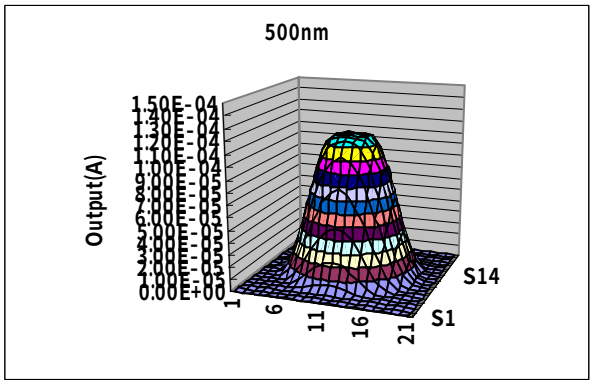
1st line： Day(UTC) , Time(UTC) , Day(Local time) , Time(Local time) , Measure type , Location

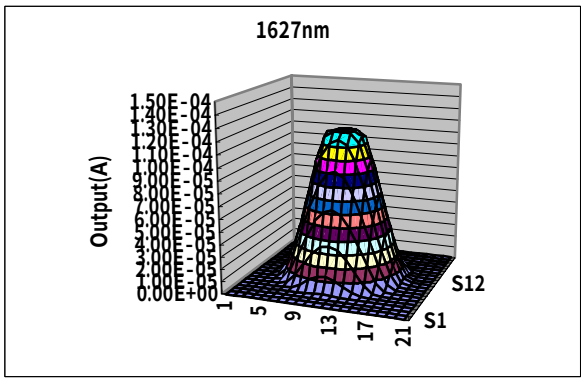
※Measure type D: Disk scan

2nd line： Relative angle from real sun position

zenith -1.0° data(azimuth -1.0), data(azimuth -0.9), data(azimuth -0.8) ……
zenith -0.9° data(azimuth -1.0), data(azimuth -0.9), data(azimuth -0.8) ……
⋮ (plus 0.1°)
zenith +1.0° data(azimuth -1.0), data(azimuth -0.9), data(azimuth -0.8) ……

Unit of data is ampere.





Result can be visualized with MS excel.

4.Cloud scan data file

File name：09052000.**cld** … Date Year:2009, Month:5, Day:20, File number00

【Example】

09/05/19,20:53:41,09/05/20,05:53:41,C,Fussa,
00:22:40,09:22:40,-071.44,056.18,8.4686E-12,1.8448E-10,5.3902E-10,3.0594E-09,5.1849E-09,
～ 3.2906E-09,1.4713E-09,5.3253E-10,8.9104E-10,5.6458E-10,4.1199E-10,-17.4,30.0,0000

1st line： Day(UTC) , Time(UTC) , Day(Local time) , time(Local time) , Measure type , Location

※Measure type C : Cloud scan

2nd line： Time(UTC) , Time(Local time) , Azimuth angle , Zenith angle , Data(Ch1)、Data(Ch2) …
… Data(Ch10) , Data(Ch11) , NIR sensor temperature , Housing temperature , Barometer

・Azimuth angle and zenith angle is motor position.

・Unit of output data is ampere.

・Data is recorded as scattering angle order.

※ Without barometer installed, com is selected, data record 0000 / com is not selected, data record -999.

User Maintenance

Before maintenance, please end the operation program and disconnect power cable.

・Silica gel replacement

There is silica gel case under cable connector. Remove that and if color is changed pink, replace with new one. When you set silica gel case back sensor, make sure not to loose.

・Lens cleaning

Remove black cover for both short wave and long wave tube with hex wrench.

Blow air on lens and squirt some liquid cleaner on the surface.