SIMBADA RADIOMETER - INSTRUCTIONS

The SIMBADA instrument is an above-water radiometer designed and manufactured by the Laboratoire d'Optique Atmosphérique of the University of Lille, France. It measures both water-leaving radiance and aerosol optical thickness in 11 spectral bands (each bandwidth of 10 nm), centered at 350, 380, 412, 443, 490, 510, 565, 620, 670, 750, and 870 nm by viewing the sun (sun-viewing mode) and the ocean surface (sea-viewing mode) sequentially. The same optics, with a field-of-view of about 3°, the same interference filters, and the same detectors are used in both ocean-viewing and sun-viewing mode. A different electronic gain, high and low, is used for each mode, respectively. The optics is fitted with a vertical polarizer to reduce reflected skylight when the instrument is operated in ocean-viewing mode. Pressure, temperature, and viewing angles are also acquired automatically. Attached in the front of the instrument, a GPS antenna acquires automatically the geographic location at the time of measurement and a display provides various types of information (see below). The instrument is designed to operate from internal batteries or a main power supply of 110-240 V, 50hz-60hz.

Measurements should be made in clear sky conditions (i.e, clouds not obscuring the sun disk), outside the glitter region (relative angle between solar and viewing directions of 135°), and at a nadir angle of about 45°. For those angles, reflected skylight is minimized as well as residual water-body polarization. The measurements can be made on a steaming ship; there is no need to stop the ship to make measurements. To normalize water-leaving radiance, incident solar radiation is not measured, but computed using the aerosol optical thickness data. Measurements can also be made in any type of cloudy conditions, but in such conditions concomitant measurements of down welled solar radiation (e.g., PAR) are required to normalize water-leaving radiance. The operator can select, in addition to ocean-viewing and sun-viewing modes, dark current and calibration modes. Each series of measurements lasts 10 seconds. Frequency of measurements is about 8 Hz.

1. Experimental procedures

The SIMBADA radiometer measures direct sunlight intensity by viewing the sun and water-leaving radiance by viewing the ocean surface at 45° from nadir and 135° from the sun's vertical plane. It is powered by batteries, which allow about

8 hours of continuous use. Accessories include a battery charger, and a cable to download the data via the interface for windows® described below.

1) To switch on the device, you have to turn on the button on the back and then push the green left button on the front.

2) The message "No GPS" in the bottom right of the display indicates that the GPS antenna is initializing. The number of satellites signals found is indicated in the top right. When more than 3 satellites signals are found, the GPS antenna is initialized and the message "GPS Ok" is displayed.

3) Press the green left button, select one of three scenarios/modes, namely DARK (measurement of dark current), SUN (sun viewing), or SEA (ocean viewing). The experimental procedure is to make, consecutively, one DARK measurement, three SUN measurements, six SEA measurements, three SUN measurements, and one DARK measurement.

-DARK mode: Press the green left button until the message "BLACK" is displayed. Place the cover at the end of collimator and/or a dark cloth, so that no light can enter the instrument. Press the red right button. A decreasing time count is displayed in the top right. The measurement lasts 10 seconds. A beep indicates the end of the measurement.

-SUN mode: Press the green left button once. (The message “SUN” is displayed). Aim at the sun (the sun image must be seen through the sight) and press the red right button. The measurement lasts 10 seconds. A beep indicates the end of the measurement. The sun's azimuth angle is stored in memory.

-SEA mode: Press the green left button once. (The message “SEA” is displayed). Go to the side of the ship, and aim at the ocean. The instrument should be positioned at 135° from the sun's vertical plane. Press the right button. The measurement lasts 10 seconds. A beep indicates the end of the measurement.

NOTE: To avoid viewing the ship trail or whitecaps, it is better to scan continuously the sea between 30° and 60°. Make sure that the tilt IS NOT greater than about 20°, so that the polarizer remains in a suitable position.

The SIMBADA measurements should be made during daytime, when the surface is lit by the sun (i.e., sun not obscured by clouds), and outside foam and

whitecaps. However, they can also be made in cloudy conditions if a measurement of down welled solar radiation (e.g., PAR) is made concomitantly. In overcast conditions, since skylight is diffuse, the position of the instrument in azimuth with respect to the sun is irrelevant.

Ideally, weather permitting, the measurements should be made 1) at each station during daytime (if the ship stops offshore), and 2) while the ship is moving around local noon (time of satellite overpass). The best ship location to make the measurements is the bow. Avoid ship shadows.

En route measurements should be made only when there is no risk of wetting the instrument (i.e., in relative calm seas). If seawater gets on the instrument, immediately turn off the instrument, clean the exterior optics (see above), and dry the instrument. Wait until the instrument is completely dry to turn on the instrument again.

In humid environments (e.g., tropical regions), condensation may occur on the optics when the instrument is moved from an air-conditioned lab to the outside. Check the exterior optics and allow some time for condensation to disappear.

After each series of measurements, ancillary data should be acquired and logged on a sheet (do not forget to precise units). They include: date, time, latitude, longitude, cloud cover (fraction) and type, air temperature, relative humidity, surface air pressure, visibility, wind speed and direction, whitecaps (none, low, moderate, or high), swell height, direction, and period, water temperature, and surface chlorophyll (or fluorometer reading). Some of these data may be available from the bridge log. Cloud cover, surface air pressure, and wind speed must be recorded, otherwise the SIMBADA data cannot be processed.

2. Downloading the data

Connect the PC cable to the instrument. Turn the instrument on. Run the SIMBADA executable program, and follow instructions on the menu as explained below (section Working with the PC interface). Save the data on a floppy disk, a zip disk, or on the HD. Delete the data from the internal memory. Turn off the instrument.

3. Charging the batteries

After use, turn off the instrument, secure the instrument, and connect the charging cable to the instrument and to an electric outlet (AC 110V or 220V). The instrument does not need to be turned on for the batteries to charge. About 2 hours of charge should be enough to proceed with one day of measurements.

4. Cleaning the optics

The SIMBADA exterior optics should be cleaned regularly, typically before or after each series of measurements (or once a day when several series are collected) with non-abrasive paper, mil-Q water, and ethanol. Do not put mil-Q and ethanol directly on the optics, because it may leak into the internal optics, but on the non-abrasive paper.

5. Working with the PC interface

The SIMBADA-PC interface has been widely tested and works with Windows 95®, Windows 98®, and Windows NT® operating systems. We summarize below the different menus and what they allow to do. Remember that to switch on the device, you have to turn on the button "0/1" to the "1" position on the back of the instrument and then to push the green left button on the front.

5.1 Installation

If you install the SimbadA's interface for the first time, you need to decompress the archive file Simprog.zip (winzip format), and install it in a dedicated folder, for example "C:\simbada\".

NOTE: From the version 1.2.2.2 of the interface, you do not need to install again this archive, the procedure is explained below. However, to upgrade this version of the interface (version 1.2.2.0) to the version 1.2.2.2, you do need to download this winzip archive Simupdt.zip, place it in the same folder, and execute the file Simist.exe to upgrade.

5.2 Menu "Setup"

You can choose the serial port Com1 or Com2 on which the SimbadA device is connected. If the device is present and connected to the PC, you will read the message "simbada21 connected" (is you're working with the instrument No. 21) in the bottom left corner. Otherwise you will read "no connection". In that case, either the instrument is not switched on, or the device is not connected to the specified serial port.

A "Tec Cal Sheet" button displays a dialog box where you can change the values of technical parameters, the identification of the instrument, by clicking on the update button.

With the version 1.2.2.2, if you have a connection to Internet, you can also query periodically from an update of this interface by clicking on the "check for update" button. A dialog/box will then appear. If an update is available, the upgrade will be done automatically without downloading any archive or file.

5.3 Menu "Data"

In the menu "Data", you can obtain the instantaneous numerical count for a given channel and gain. You can check if each electronic channel works correctly. (You can also check whether the battery, pressure, temperature, heading, pitch and roll sensors work well. In addition, an instantaneous wavelength spectrum is displayed in log-log scale.

NOTE: When the instrument is connected to the PC and only when the interface is in the menu "Data", you cannot get and save data (Dark, Sun, or Sea measurement) in the memory. To do that, you have to choose another menu.

5.4 Menu "Files"

The menu "Files" allows you to manage the content of the data memory. By clicking on the "List" button on the right hand side, you can list the files that have been recorded in the memory, and also the percentage of memory used.

Each file takes up one line on the grid. For each file, there are several pieces of information: Name of the file, date of record, time of record, type of file

(Dark, Sun, Sea, Extra Sun, Extra Sea, etc.), flag of validity, and recording number.

You can visualize the content of one particular file by selecting it with the mouse, and clicking on the "Quick look" button. You can save either one file by clicking with the mouse on the name of the file or a selection of files by selecting them with the mouse and the Shift key. You can also save all the files in memory by clicking on the "Select all" button in the lower left corner.

You have the choice to save the data on disk in the folder specified in the box on the lower right corner, either in a "file by file" format by choosing "From: Instrument To: Files " or in an archive file. This archive can be read again by choosing "From: Archive To: Files", and then the files can be saved on disk as indicated previously.

If you need to empty the data memory, you can perform it by clicking on the "Erase" button. A dialog box will then appear to confirm your intention. You can then verify that the memory is empty by clicking again on the "Files" button.

5.5 Menu "GPS"

The menu "GPS" allows you to obtain information coming from "Global Positioning System" satellites. You can know how many satellite signals are received, and date, time (UT), latitude, longitude, altitude (from at least 3 satellite signals), track, and speed.

5.6 Menu "Calibration"

The menu calibration allows you to display and save the mean and standard deviation for a given gain (low or high) and for a given number (< 400) of records. To save the results in the specified folder, you just have to click on the "File name" button. You can also add a comment in the lower right box. If you have a device printer correctly configured, you can also print the calibration data.

5.7 Menu "Test"

The menu "Test" allows you to record data (Dark, Sun, Sea, Extra Sun, or Extra Sea measurement), by clicking on the appropriate button as if you have pushed

the right red button on the front of the instrument. It allows you to make several measurements without having to move the instrument (useful in front of a calibration sphere, for example).

6. Trouble shooting and advice

Please wait for the GPS signal to be found, even if it is sometimes a little bit long. It is especially long to find the GPS signal when the SIMBADA radiometer has been off for a long time or when it has been moved without activities (after travel, for example). You may sometimes have to wait for up to an hour. We advise you to plug the device on the main power supply and to get GPS acquisition as soon as you receive the device. Then it will be quicker to get acquisition during the ship cruise.

Do not hesitate to scan the tilt between 30° and 60°, insisting around 45°-50°. Aim at the sun when recording SUN files, aim at the sea when recording SEA files, and cover the entrance optics when recording DARK files. Also, when recording a SEA file, be careful to keep the SIMBADA radiometer as horizontal as possible, for the polarizer to cut properly the reflected skylight. When recording a DARK or a SEA file, do not stand under the sun (some photons could introduce parasite reflectance).