ASM-V

ARGUS SUSPENSION METER

TURBIDITY PROFILER

* MULTI OBS ARRAY
* PRESSURE & TEMPERATURE GAGE
* TILT SENSOR
* 3-D ANALYSIS SOFTWARE
* Titanium housing

ARGUS
environmental instruments

Content

Part 1: HARDWARE

1. Introduction

The ASM IV instrument was primarily developed for high resolution measurements at the bottom of moving water (ocean/river locations). It records the reflections and the dynamic parameters that are created in the measuring plane by solid particles moving in a multiphase current. It provides an independent contribution to the complex questions which arise from the context of transport of solids in the connecting layer between the bottom, the mud layer and the main body of water.

2. ASM IV principle of measuring

The instrument operates with backscatter infrared sensors (850 nm) embedded in a stainless steel (titanium) rod. The sensors are placed on an active board at a distance of 10 mm. This means that 100 sensors are mounted per meter.

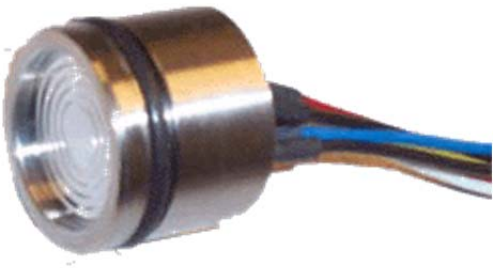
Each sensor consists of an infrared transmitter and a detector. The maximal sample volume can be 10 cm^3. The volume depends on the density of the suspension. The measuring distance range is 0...100 mm in front of each individual sensor.

Optical day light filters and a non-visual light transmitting source prevent interference by other light sources. This makes the instrument suitable for locations like tidal areas with dry periods

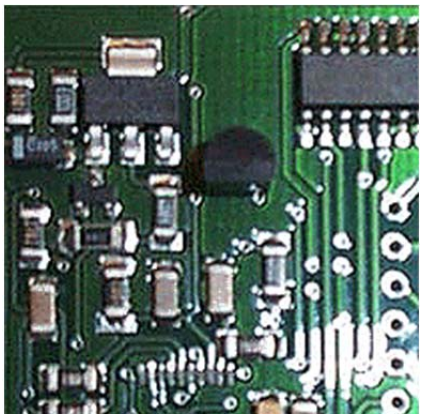
2.1. Additional sensors

The instrument contains three additional sensors.

An inclinometer for two directions will give the actual angle between ground and instrument. The maximum range is 60° in all directions.



A pressure gauge senses the actual depth of the location of the instrument and it gives information about sedimentation's during the turn of the tide.



An on board temperature sensor detects the temperature of the steel housing which is related to the water temperature.

Activation and power supply of the sensors as well as the transmission of the signals are controlled by a battery powered central unit in the head of the instrument. The sealed in unit consists of a microprocessor, a data memory, the additional sensors and the energy supply. The energy consumption is only < 6mAs. That means one 9V block alkaline battery will provide the necessary energy for 2 months, assuming a sample rate of 10 measurements every 5 minutes, or the energy for a standby status of approx. 6 months.

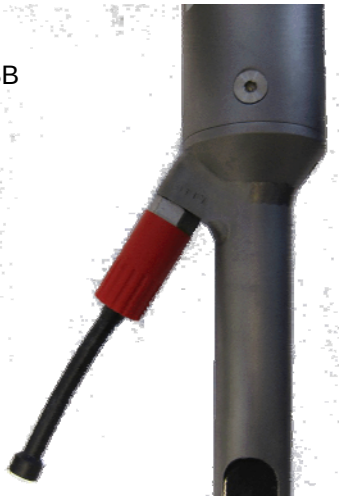
The microprocessor carries out all of the tasks necessary for control. Incoming data is processed by the microprocessor and stored in memory. The capacity of 8 MB will provide a measuring time of approx. 8 weeks in total, without weakening the battery (10min sampling time).

2.2. The instrument

- **Head unit**

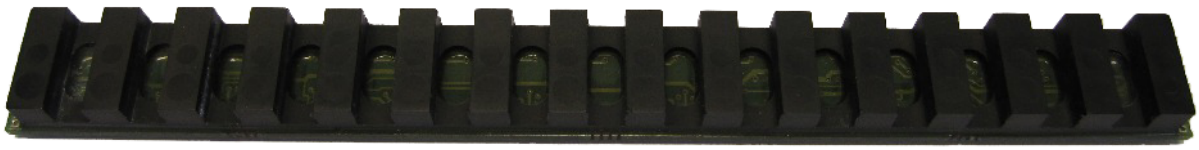
The stainless steel (titanium) head consists of the inclinometer, the temperature sensor and the pressure sensor as well as the micro controller, the memory and the energy supply. On the top end of the housing the optical communication window is visible. The diameter of the head is 60 mm. The rod part with the embedded sensor electronics is 30 mm in diameter. These dimensions make the instrument suitable for the most measuring sites.

A bulk head connector provides a hard wire connection via RS485 and power to the instrument. A 485 to USB unit is been supplied with the instrument



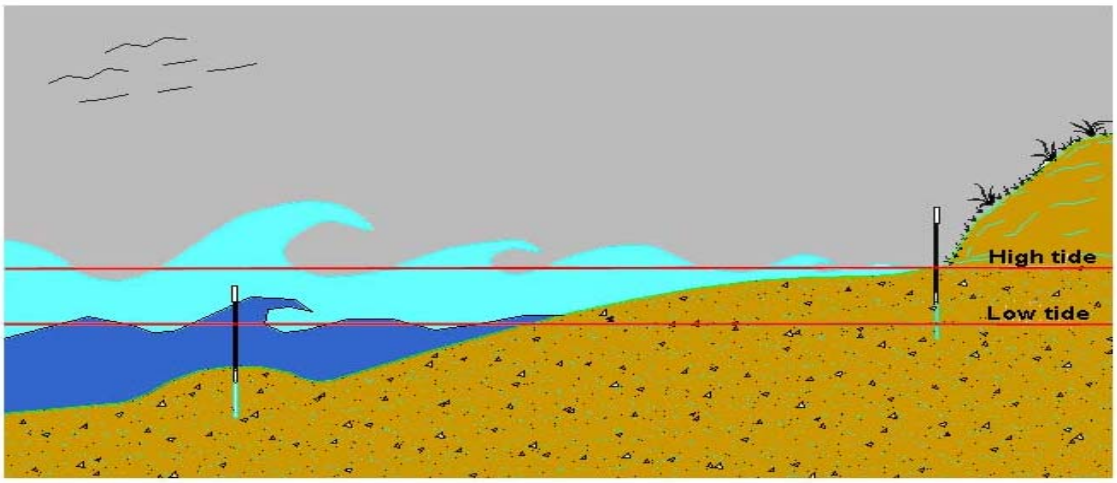
- Sensor rod

The sensor electronic board is only 16 mm wide and is fitted in the stainless steel (titanium) rod. The optical sensors and the additional electronics needed, are mounted on divided boards and are embedded in a special polyurethane casting resin. This prevent the board from breaking, if the rod gets bent e.g. fast running rivers. The smd boards are only 10 mm high incl. optics and fit in a small grove on the steel rod.

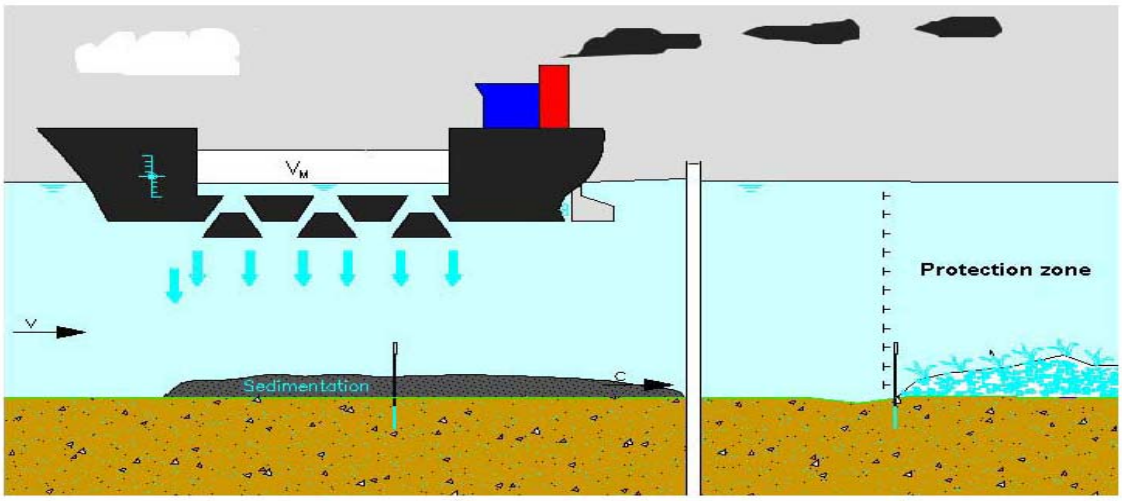


3. Applications

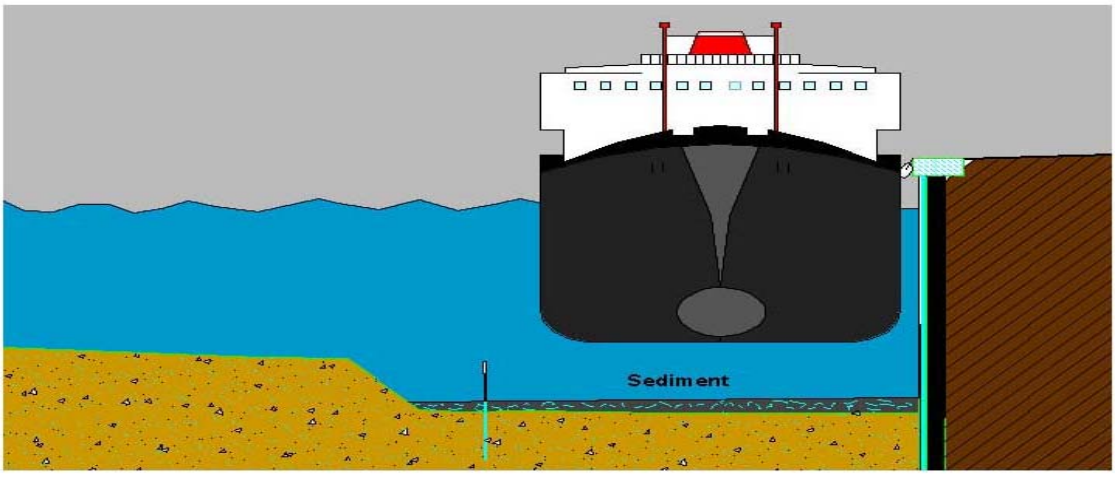
3.1. Shallow water deployment at the shore



3.2. Ocean dumping



3.3. Maintenance dredging



4. Instrument maintenance

To communicate with the instrument an optical serial port is integrated in the head housing. All communications can be done without opening the instrument.

For communication, a PC with ASMA software is needed. If the communication unit OCU-I-USB is plugged into the PC and is placed on top of the instrument, the communication is been built up form the menu button "HARDWARE".

The steps for removing and deploying are listed in the following tables. Critical items are printed in bold type.

- **Table A** describes all of the steps that are necessary to prepare the instrument for installation up until the ready status has been reached.

- **Table B** provides notes on the requirements for installing and removing the instrument since considerable risk potential exists in this area.

- **Table C** describes the steps to be taken at the end of operation.

The program routine for checking and setting the instrument as well as for withdrawing and evaluating data is described separately.

4.1. Deployment

Table A: Steps to be taken before deployment		
Step	Item	Specific comments
A1	Check the instrument visually	If something seems amiss: system check
A2	Check sacrificial zinc anode	**~ 50% disintegration: replace sacrificial anode *Stainless steel version only***
A3	Build up the communication computer and connect the instrument by placing the OCU (optical communication unit) on top of the instrument, or connect via subconn. Check instrument parameters and battery situation.	**Program menu: Hardware** **If battery change is necessary, make sure the batteries are alkaline type or lithium batteries** **Orientation of the OCU-I: Face to face with the communication window on top of the instrument (maximum distance between instrument and OCU <= 50 cm)**
A4	If battery change is necessary open the housing lid	**Instrument does not wake up** 3 nut screws metric 5mm
A5	Remove the weak batteries and insert new ones	Press the spring down and disconnect the battery with a screwdriver. **Self-check: may take some time to restart the instrument**
A 6	Close the housing	**Make sure the o-rings are absolutely clean and rub the seal with silicon grease.**
A7	Start the communication (A3) and set measuring parameters	Program menu: Hardware
A8	Execute communication program: ■ Wait until program wakes up the instrument ■ If no calibration file found execute calibration routine by entering the calibration button and press return ■ Select one of the instrument specific calibration files and load it to the instrument ■ Check the system data from the instrument and set sample rates and starting time ■ Start measurements ■ Close the hardware menu and remove the optical communication unit from the instrument	The battery voltage is important for proper functioning. It should not be less than 8.0 V. **When the communication unit is removed, the instrument switches down to a sleep mode until the pause between the samples. A LED inside the housing is visible through the top window. It lights up every 10 sec. when a measurement has been started** (See program description) If no calibration file to be found the name of the file will be **"undefined"**
The instrument now functions and is ready for installation		
General notes: ■ The system check consists of step-by-step checking of all instrument functions. In case of substantial malfunctioning, the instrument should be examined and serviced by the manufacturer. ■ The housing lid should only be opened indoors. ■ The set of batteries for the energy supply should be replaced each time the instrument is used.		

4.2. Installing and removing

Table B: Steps to be taken when installing and removing the instrument		
Step	Item	Specific comments
B1	Check the instrument visually	If something is amiss: system check
B2	Check if a foot extension is necessary	Foot extension: 1 m (dense ground) 2 m (soft ground) Make sure threads are clean!
B3	Prepare injection support	External or internal (foot extension)
B4	Install in calm water conditions with or without support of a diver ■ Record installation time ■ Record expected water depth	Explanation of the specific requirements on the diver, if necessary, attach a search wire. Recommendation: Utilize bottom information if a diver is working
B5	Geodetic survey – record position of the instrument ■ Local reference system ■ Height ■ Tidal level ■ Installed state (degree covered)	The type and exactness of the survey is determined by location and the equipment available.
B6	Loads on the instrument when in operation ■ Current load and corresponding momentum, especially the joint at the foot extension ■ vibration stress at high currents ■ Critical exposure and instabilities ■ Additional momentum through snare effect ■ Extreme momentum through nets, etc. ■ Theft, vandalism	Loads are mainly random in character. Due to this fact, oceanographic measuring equipment like this needs to be carefully monitored and protected, dependent on the location.
B7	If possible, remove at calm or low water (with or without the support of a diver). Record removal time	Uncontrolled sideward pulling should be absolutely avoided since this presents a risk to the coupling site or the instrument itself.
B8	Clean the instrument with fresh water	Especially on site
B9	Check the instrument visually	If something seems amiss: system check
General notes: ■ The system check consists of step-by-step control of all instrument functions. In case of substantial malfunctioning, the instrument should be examined and serviced by the manufacturer ■ This instrument has been constructed for rough operating conditions, however, care should be taken at each step since this measuring instrument is equipped with many components.		

4.3. End of operation

Table C: Steps to be taken at the end of operation		
Step	Item	Specific comments
C1	Check the instrument visually	Check for mechanical damage
C2	Place the communication unit over the housing	**Do not open the housing until communication test** **Measuring head should be dry!**
C3	Start the hardware communication (A3)	The communication window on top of the housing should be clean. Scratches have no affect on communication procedure
C4	Check the system data and read the stored data	4 MB data takes about 15 minutes to read.
C5	Open the instrument and replace the battery.	If communication is not possible (weak battery) change the battery first. An integrated backup battery for the memory will keep the data stored in the instrument for approx. one year
C6	Store the instrument after using	Add a new pack of batteries, close the housing, and clean the instrument
C8	Execute data transmission according to the program description: ■ with deletion of data afterward ■ without deletion of data	INFORMATION: The last data taken can remain on the memory until the instrument is prepared for the next use.
The instrument is in the sleep mode		
General notes: ■ Executing the above steps indoors only if possible ■ Raw data that has been read out should be checked immediately for plausibility and loss of data (before a restart) ■ **When storing the instrument remove the main batteries. The memory content will be save for three weeks.**		

Note: If a new pack of batteries will be supplied to the instrument the ASM may carry out a self-check. In this time a communication is not possible. This may take approx. 10 minutes.

4.4. Measuring time

Settings (example with 4MB memory, with 8MB approx. double):

5 samples per cycle
1s sample interval
Min. max. storage “ON”

Measuring interval	2s	10s	30s	60s	300s	600s	1h
Type of instrument							
ASM-IVS	2.8h	14h	42h	84h	420h	35d	210d
ASM-IVN	2.2h	11h	33h	66h	330h	27.5d	165d
ASM-IVL	1.7h	8.5h	25.5h	51h	255h	21d6h	127.5d

S: seconds, h: hours, d: days
All sampling time settings will be pre calculated by the instrument and displayed after completing the setup table and carrying out a test run.

4.5. Prevention of fouling

The instrument is working with optical sensor arrays and the OBS surface needs to be as clean as possible. Usually if deployed at locations with high current, fouling like mud etc. is not a problem but biofouling. Mud will be washed off by running water. Especially in warm shallow water biofouling can cover the OBS surface. No extra mechanic-like wipers are added to the instrument to save energy and prevent failures. A cleaning term of about a week will be sufficient enough to prevent the instrument from malfunction. Shells have to be removed carefully. Using anti fouling paint is not recommended on the OBS array. The cover will affect the reflection parameters of the sensors. A copper tape will reduce the biofouling risk.

Cleaning the instrument can easily be done**. ATTENTION: DO NOT OPEN THE INSTRUMENT BEFORE CLEANING WILL BE CARRIED OUT!!!** Clean the instrument by brushing of the loose material with a soft brush and if possible with warm soapy water. To remove shells like the barnacle use lime remove liquids after removing the main bodies. If very solid use household vinegar for about 5 to 10 minutes not longer than 24 hours. After, rinse in tap water to remove all acid remains. A check of the surface is necessary looking for deep cuts of approx. 1 mm. If the surface has many scratches, a re-calibration has to be carried out to even the offset and sensitivity of all OBS sensors. Or polishing off the scratches using sand paper of at least no. 800.

ATTENTION:

Do never insert any item into the pressure transducer inlet at the bottom of the head unit. The transducer membrane could be damaged.

5. Specifications

General

- Measuring section: 0.96 m (Type S), 1.44 m (Type N), 1.92 m (Type L)
- Measuring intervals: 1 sec. ....no limit
- Sampling rate: 1 ... 255 samples per burst
- Memory capacity: 8 MB standard
- Energy supply:
  - Main supply: one alkaline 9V block battery minimum
two lithium 9 V block battery for maximum energy source
  - Memory backup: Gold Cap
- Standard lengths of the instrument: 1.9 m (Type S), 2.4 m (Type N), 2.9 m (Type L)
- Dimension of the instrument:
  - Sensor area: 30 mm (Type -S,-N), 35 mm (Type- L)
  - Head: 60mm (diameter)
- Weight: 4.5 kg (Type –S), 5.1 kg (Type -N), 6.8 kg (type –L)
- Ambient temperature: -15...+45°C
- Installation depth: 40 m water depth max.
- Distances:
  - First OBS sensor up: 190 mm
=> Pressure sensor

OBS

- Measuring method: optical
- Sensors: back scatter infrared sensors (850nm),
- Sensor distance: 10 mm
- Number of sensors: 100 per meter
- Measuring range: 50...10,000 mg/l sand (d50=250µm
5...3,000 mg/l mud (d50=20µm)
0…1000 FTU Formazin Turbidity Units
- Resolution: 5%
- Accuracy: +/-10%

Inclination

- Measuring method: gravimetric
- Sensors: 2-D integrated circuit
- Measuring range: 0...60° all directions
- Resolution: 1°
- Accuracy: +/- 1°

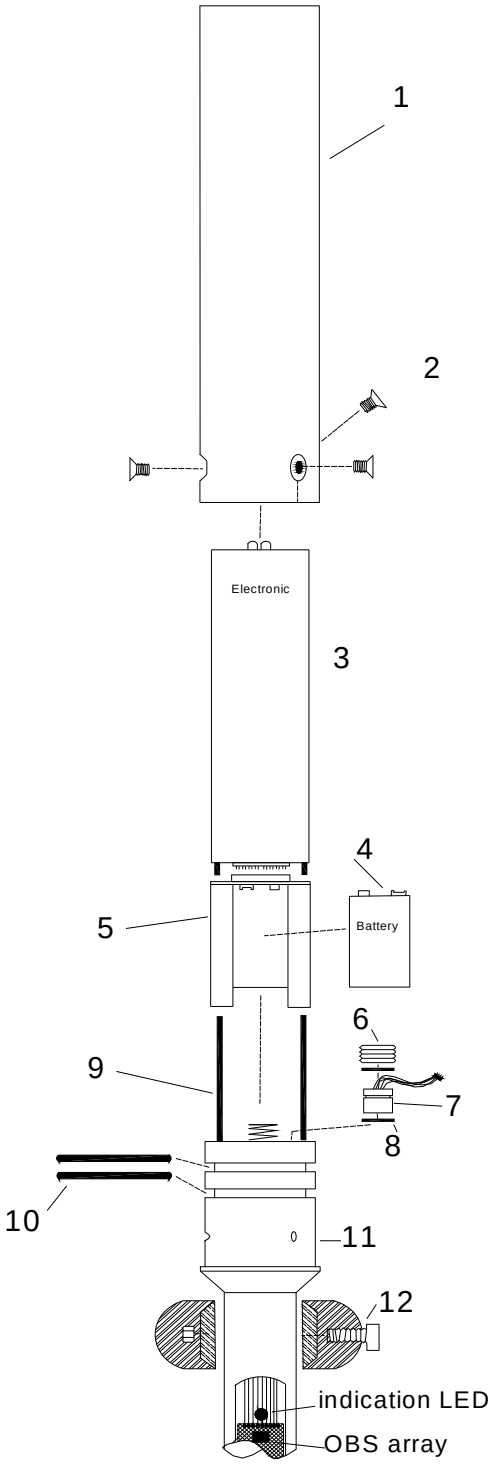
Water depth

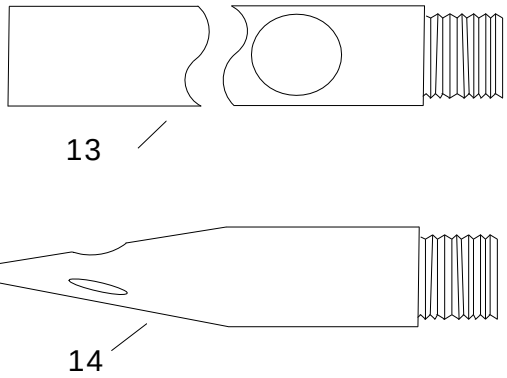
- Measuring method: piezoelectric
- Sensor: stainless steel pressure housing & membrane
- Measuring range: 0...5,000 hPa abs. other ranges on request
- Resolution: 0.5%
- Accuracy +/- 0.3% (full range)

Temperature

- Measuring method resistive
- Sensor: silicon integrated circuit
- Measuring range: -10...45 °C
- Resolution: 1°C
- Accuracy: +/- 0.5°C

6. Exploded view





Part list		
	Description	Stock no.
1	Pressure cover	A-001
2	M5x7 screw	A-101 x3
3	Electronic unit	A-010
4	Battery 9V block alkal.	A-011 x2
5	Battery holder	A-020
6	Pressure sensor fixing	A-110
7	Pressure sensor 5 bar	A-050
8	teflon ring 12.5x18.5mm	A-150 x2
9	Threated rod M3x 68mm	A-111
10	O-ring 52x42mm	A-151
11	OBS-sensor rod	A-002S,N,L
12	Zinc anode	A-999
13	extension pipe	A-003
14	jet head	A-004
15		
16		
17		
18		
19		
20		

7. Hardware Communication

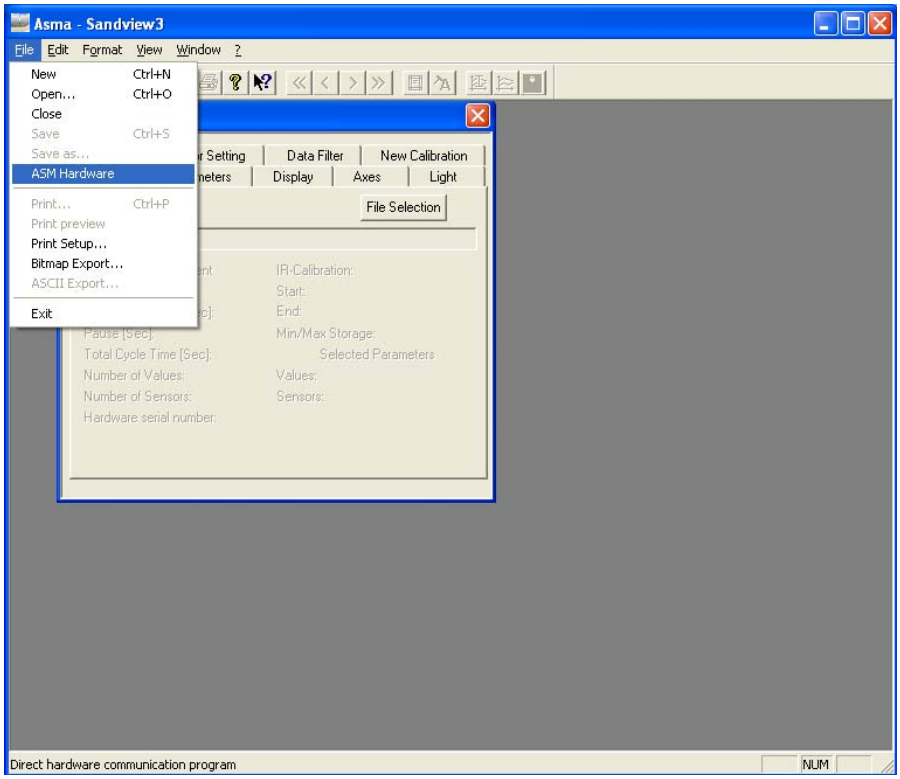
7.1. Getting started

The ASSM communication program is an interior part of the ASMA software. To run the software a Windows based PC is necessary. The minimum computer specification is a PC with 1000MHz, 2 GB RAM and a USB port. The software is running under XP, Vista and Windows 7.

7.2. Software installation

To install the software, insert the CD into the drive and double click on the **install.exe**. Please accept the directory and file names suggested, *do not change or rename*. After successful installation, manually copy *ALL* calibration files with extensions **AGF**, **AGB** and **AGL** directly into the ASMA installation directory. If files are saved in a directory, open, select all files and copy into the ASMA directory. Alternatively, the calibration files can be saved under the folder **Asma/Calibrations/** in the **Documents** (**My Documents** in Windows XP). The directory **Asma/Calibrations/xxxx** where **xxxx** is the serial number padded with zeros (e.g. 0060) is also permitted for the automatic detection of the calibration files. Be sure to not forget any calibration file from the CD.

Note: In order to write calibrations to the **Program Files\Asma** folder, you need administrative privileges. The **Documents\Asma** folder is preferred when Asma is used under only one Windows user.



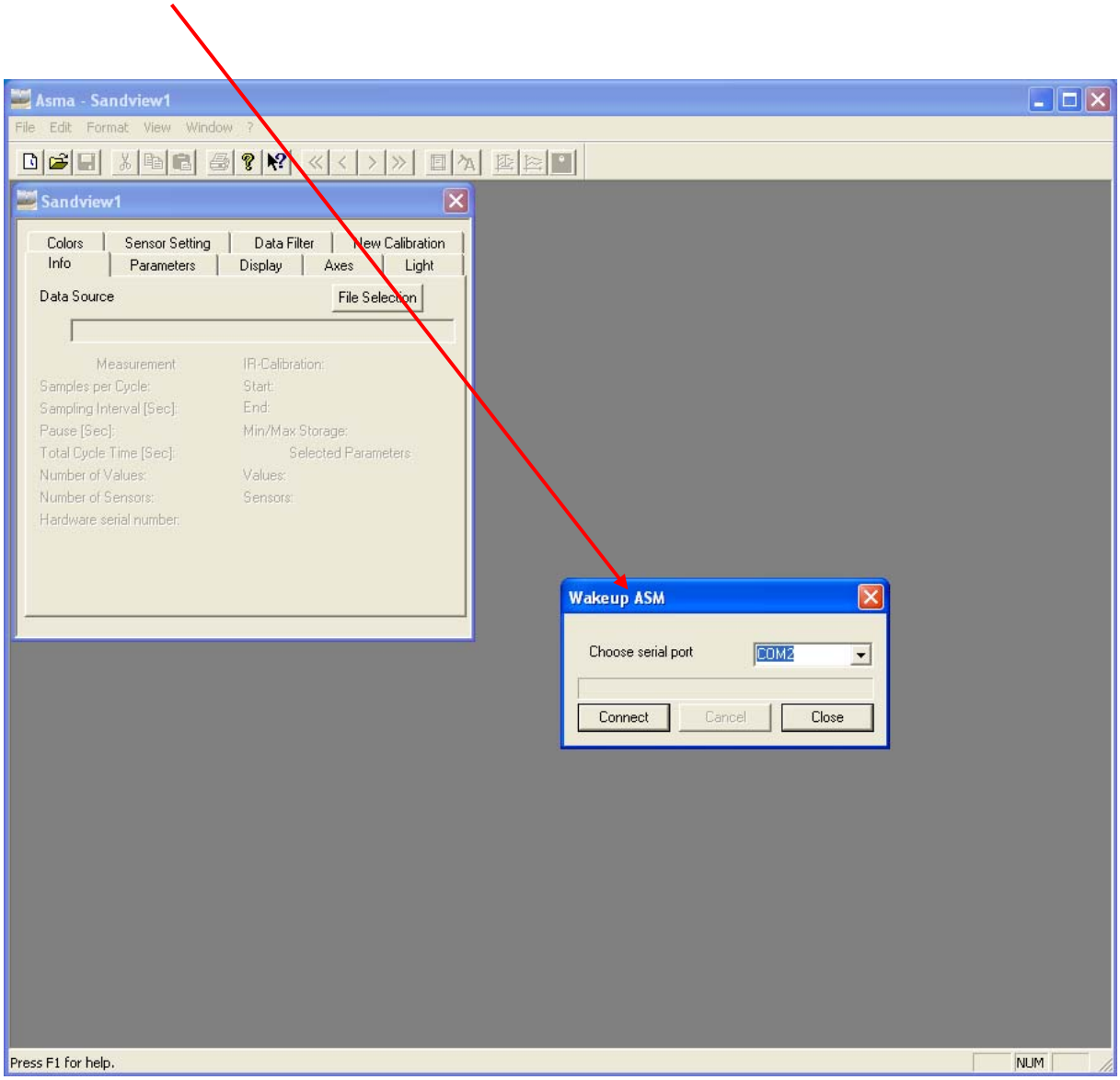
7.3. Communication procedure

1. Place the OCU (optical communication unit) on top of the ASM, or connect via subconnector.

2. Insert the plug into the computer port (or via adapter into the USB socket) and start the computer.

3. Start the program ASMA and select the **ASM Hardware** command from the **File** menu. The **Wake-up ASM** dialog opens where the corresponding serial port can be chosen before clicking on the **Connect button**. After a successful connection the red LED at the instrument in line with the sensor array will flash.

4. The communication table should appear in a couple of seconds. If not, check interface and port selection.



7.4. Data read

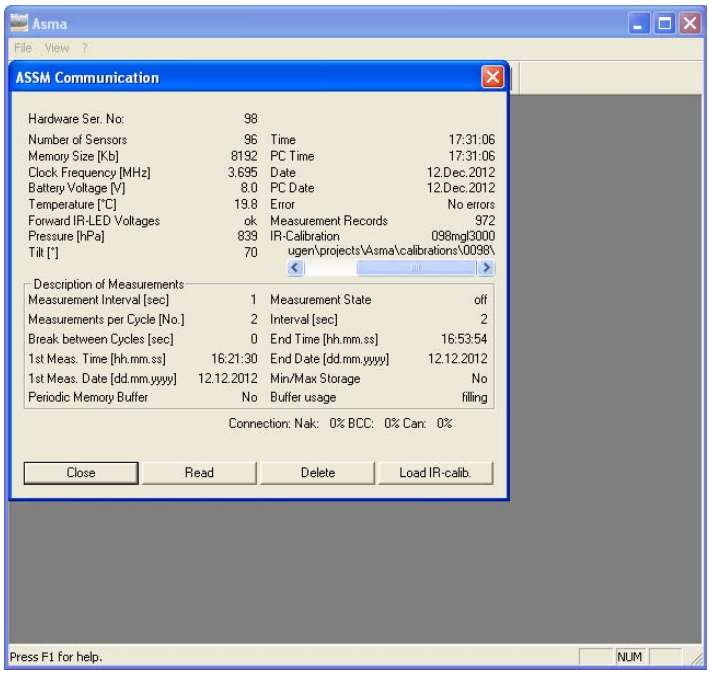
After the connection had been made the information window below will appear.
The Hardware Ser. no. indicates the instrument serial number and gives all the relevant current information from the instrument. The **Number of sensors** shows how many optical sensors are available. The second line tells about the present **Memory size** of the instrument. The **Clock frequency** indicates that the instrument works with the right time set (range: 3.5 – 3.8MHz). The **Battery voltage** * is the present value of the internal power supply (normally 9V). The line **Forward IR-LED Voltages** gives information about the proper functioning of sensors. If one sensor fails a number combination appears. In this case the instrument needs to be taken in for service. The **Temperature**, **Pressure** and **Tilt** lines are showing the values taken during the last measurement. These values need to be calibrated.

***Attention!** On a new instrument or after changing batteries a new measurement has to be carried out to get meaningful information on battery voltage, temperature, forward voltages, pressure and tilt.

The Description of Measurements section displays if the measurements is in measurement or off mode and the current measurement settings. **Measurement State** indicates the current status of the instrument. Other parameters are set in the **Measurement** dialog.

The SOFTWARE section (right part of the table) is a status table. It gives information about:

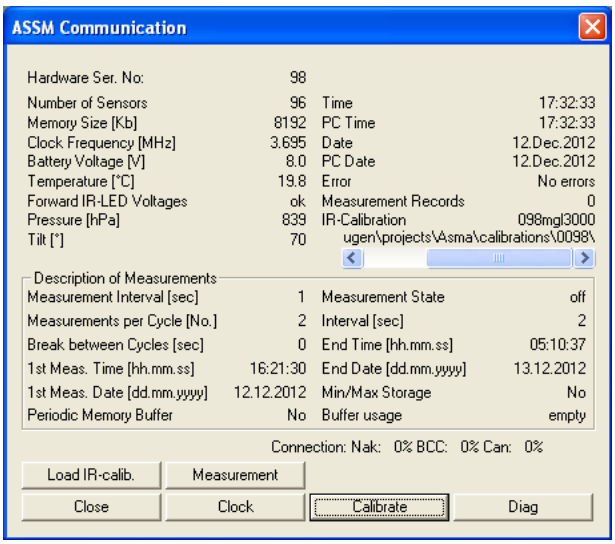
- present time and date
- errors which may have occurred during the measurements
- the value of records the instrument had taken
- the status of measurement (running, or off)
- the chosen measuring interval
- the date and time the measurement will be shutoff (if the **Periodic Memory Buffer** was not set).
- The calibration file (name and path)



Close	will end the communication and close the **ASSM Communication** dialog.
Read	read the stored data from the instrument using the current calibration.
Delete	will delete the data without storing in a file. The data will remain stored in the memory if no new measurement will be started.
Load IR-calib	allows choosing a different calibration.

Hardware section

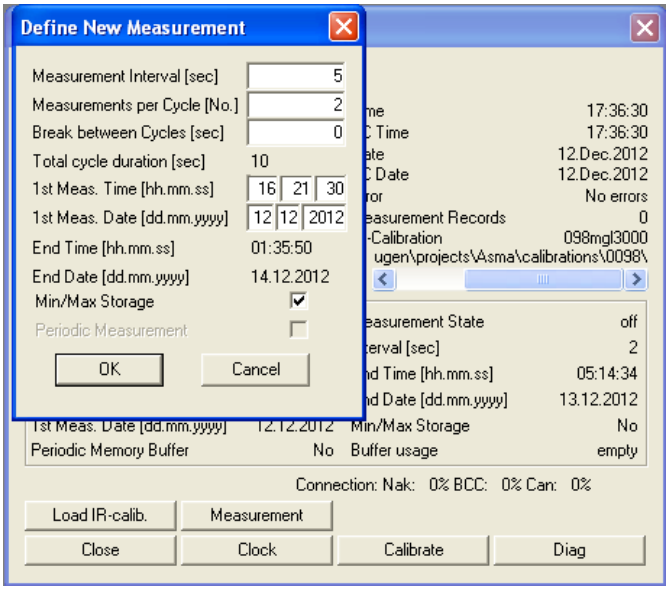
After reading out the memory or deleting existing data, new buttons will appear.



Close	will end the communication and close the ASSM Communication dialog.
Clock	will set the instrument time at the PC time.
Calibrate	will allow to load a new calibration file.
Diag	needs a password to enter a hardware check circle (only for qualified personnel).
Load IR-calib	allows choosing a different calibration.
Measurement	gives access to the measurement definition setup table.

7.5. Starting new measurements

The **Measurement** button will show a window where new measurement settings can be set.



Measurement interval:	time delay between each individual measurement during one burst
Measurements per cycle	the number of measurements to be carried out during one burst
Break between cycles	time delay between each burst
Total cycle duration	time between beginnings of two consecutive bursts
1 st Measurement time	indicate the time when the measurement should start
1 st Measurement date	indicate the date when the measurement should start. If the time and date are set to some moment in the past, then new measurements will start immediately after clicking on the **OK** button.
End Time, **End date**	Indicates the time when ASM's memory will be full with measurements. The computation is based on the indicated 1st measurement date and time and on other information in this dialog. If the **Periodic Measurement** is checked, then this field indicates when the old measurements will be overwritten with the new measurements.
Min/Max storage	store min/max values of each measurement
Periodic Measurement	store measurements in a ring type of memory. If the memory buffer is full, then new measurements will overwrite the oldest values. With this option it is then possible to read data without stopping ASM from taking measurements. It is available only for instrument's serial numbers 2000 or higher.

Example

The sample time range is 1...255 sec. It sets the delay between each individual measurement carried out for all sensors incl. the additional ones. The range of measurements per cycle is 1...255. It sets the no. of measurements delayed by the sample time. For example one burst set at a sample time of 10 sec. with 6 measurements takes 60 sec. (1 minute). The break range between each burst can be set freely and ahead of 255 sec. If set at 7200 sec. the complete sample interval will be 7260 sec. which equals with 2h 1min.

7.6. Sampling schedule

Location	Measurement interval [sec.]	Measurements per cycle [no.]	Break [sec.]	Sampling time [sec.]
River (slow) (fine sediments)	5-10	5-20	0	25-200 sec
River (fast) (coarse sediments)	1-5	100-255	0	100-1000 sec
Surf zone	1	255	0-300	555 sec
Estuary	5-20	10-50	0	50-1000 sec
Off shore (lakes)	1-100	2-6	0-600	2-1200 sec

8. Selecting calibration

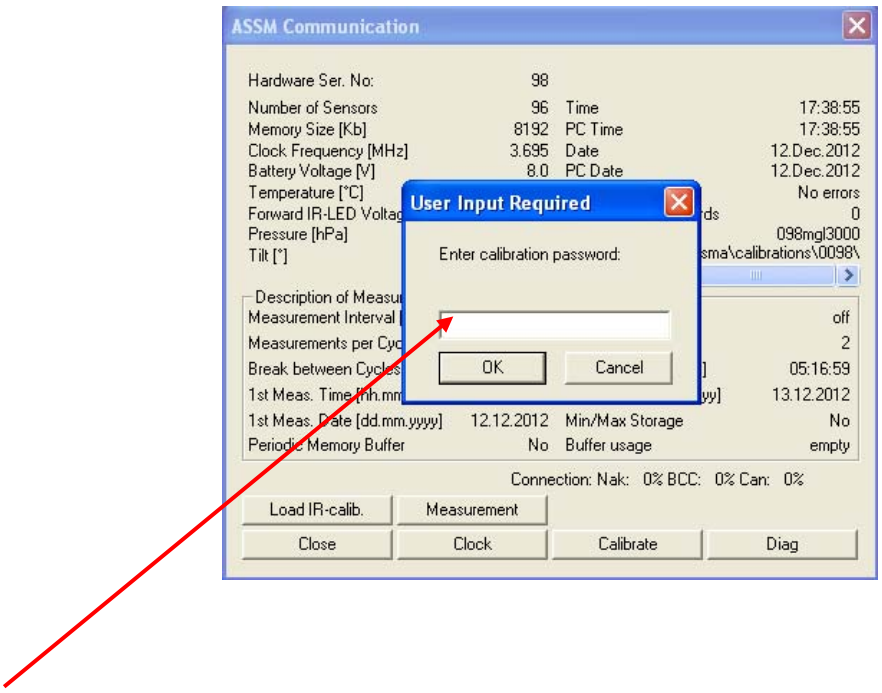
To get access to the calibration file selection click on **Load IR-calib** button. Pick the calibration file needed for the next measurement. For the automatic detection of calibrations, the program will look into the following folders:
Documents\Asma
Documents\Asma\Calibrations
Documents\Asma\Calibrations\xxxx
Program Files\Asma\Calibrations
Program Files\Asma\Calibrations\xxxx
Program Files\Asma
where **xxxx** is the serial number padded with zeros (e.g. 0060 or 0102).

Note: In order to write calibrations to the **Program Files\Asma** folder, you need administrative privileges. The **Documents\Asma** folder is preferred when Asma is used under only one Windows user.

Note: **Windows 7** does not allow programs to save files in the **Program Files(x86)** directory. If you try to save calibration files into **Program Files(x86)\Asma** within the **Asma** software, then the calibrations will be actually saved under **c:\Users\username\AppData\Local\VirtualStore\Program Files(x86)\Asma**, where **username** is the Windows user which is currently logged-in on your computer.

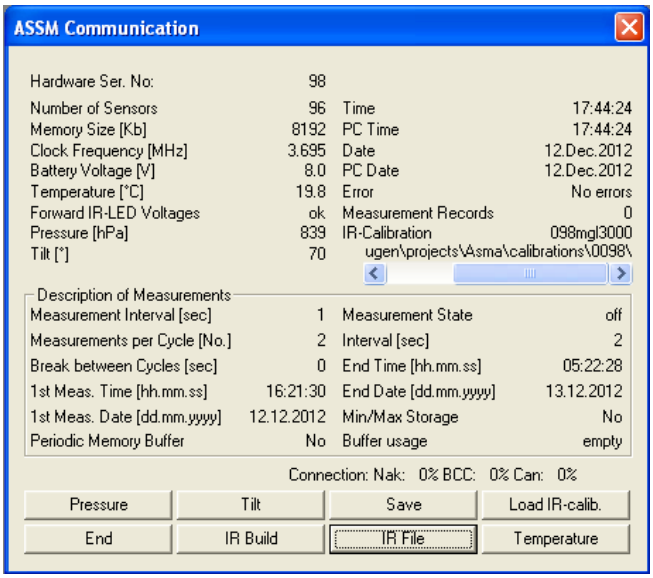
8.1. Calibrating an ASM

To get access to the customer calibration section of the instrument a password must be entered to the question bar (ask your agent for the password).



Now a new window will appear to give access to the interior calibration table were each individual sensor can be custom calibrated.

ATTENTION! THE MOST COMMON CAUSE OF ERRORS IN OPTICAL BACKSCATTER DATA IS AN IMPROPER CALIBRATION



IR Build **OBS sensors assemble from IR Files**
Create an IR calibration file (AGB extension) assembling a selection of sensor AGF files.

IR File **Optical Backscatter (OBS) sensor dens-set files**
Insert the instrument in a tube and create different IR files (AGF extension). The whole OBS array must be covered. Start with clean tap water. Keep a clearance of about 10cm in front of the sensors (tube wall, brackets, etc.).

Temperature **temperature sensor** will be calibrated with ambient temperature during this routine.

Pressure **pressure sensor** needs well known pressure feat into the entrance of the sensor on the instrument (just below the head tube).

Tilt **the tilt sensor** needs three calibrations. Zero
90° X direction
90° Y direction

Save combine the IR Build file and extra sensor calibrations and **Save** the calibration carried out (the AGL file must have the same name as the AGB file).

Load IR-calib gives a selection of present calibration files.

End will close the calibration table access.

8.2. ASM Calibration method for concentration measurements

The calibration of the infrared sensors of the ASM has been changed to better accommodate the non-linear transfer function of the device. The non-linearity is caused by the sensor itself and the physical properties of the surrounding medium within the measurement volume. Therefore a multi-step calibration procedure had been implemented that relates a certain ASM measurement value to a known physical quantity provided by the calibration set up. A set of reference measurements can thus be obtained and stored. This set can further be assembled into a disk file, which is then used to extract the physical value from the ASM raw data.

The transfer function of the sensors with regard to the physical quantity is interpolated using spline functions. The inverse function of the spline is computed and used to calculate the measurement result in physical units.

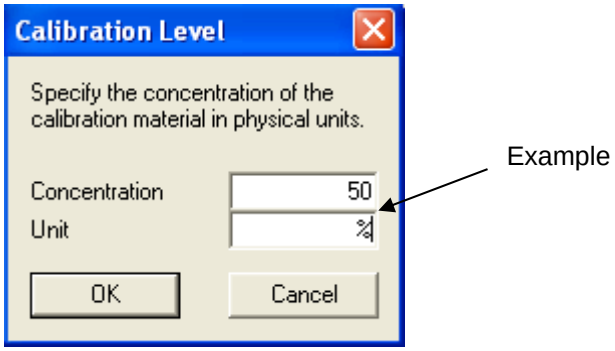
Known issues and limitations

Spline functions tend to oscillate if the dependent variable is too closely spaced and if the function itself is misbehaved. To avoid this problem the spacing of the reference values is limited to at least 10 % of the overall interval, i.e. if a 0 and 100% measurement has been used, a 9% or 91% measurement would be invalid.

As we are dealing with a sensor system whose transfer function is continuous and monotonic, Spline functions are a good choice because they maintain this property. The calibration process has to ensure that all the sensors remain monotonic in the calibration process. If the physical value is increasing then all the sensor measurements have to increase as well. Otherwise the inverse function of the spline does not exist and the calibration cannot be used. Such situations could occur if the calibration set up is flawed, i.e. dirt has assembled in front of a sensor and is impairing its monotonicity.

Usage:

Open the ASMA program with the ASM connected. Find and click the entry **ASM Hardware** in the file menu. The communication program should open and display its main screen. Hit the **Calibrate** button (you might have to read or delete a measurement first), and enter the password. The main screen has two new buttons labelled **IR Build** and **IR File**. Submerge the well cleaned ASM unit into a suspension of known physical value using a suitable **Calibration Tank** and click the **IR File** button. Enter the concentration level and unit in the window shown next page.

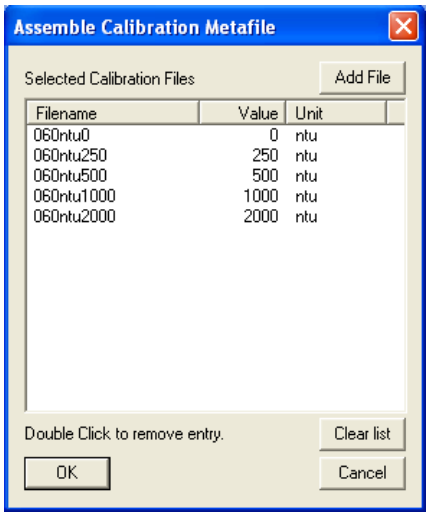


After pressing the **OK** button, a calibration measurement is performed and all the measurements are recorded and averaged. After letting the device measure for some time (averaging process for calibration), depending on the coarseness of the sediment, click on the **Meas. End** button. A file dialog is opened such that you can name the reference measurement. The file extension must be .AGF.

Note: In order to write calibrations to the **Program Files\Asma** folder, you need administrative privileges. The **Documents\Asma** folder is preferred when Asma is used under only one Windows user.

Note: **Windows 7** does not allow programs to save files in the **Program Files(x86)** directory. If you try to save calibration files into **Program Files(x86)\Asma** within the **Asma** software, then the calibrations will be actually saved under **c:\Users\username\AppData\Local\VirtualStore\Program Files(x86)\Asma**, where **username** is the Windows user which is currently logged-in on your computer.

Repeat the above process with different levels of sediment. It is recommended to perform at least two measurements: One threshold measurement with the smallest concentration where all the sensors are above zero. Another measurement with the maximum concentration expected in the application. To further increase the precision, a number of intermediate calibration measurements can and should be performed. After having measured a set of calibration measurements use the **IR-Build** button to assemble the reference measurements into a calibration set using the following window:



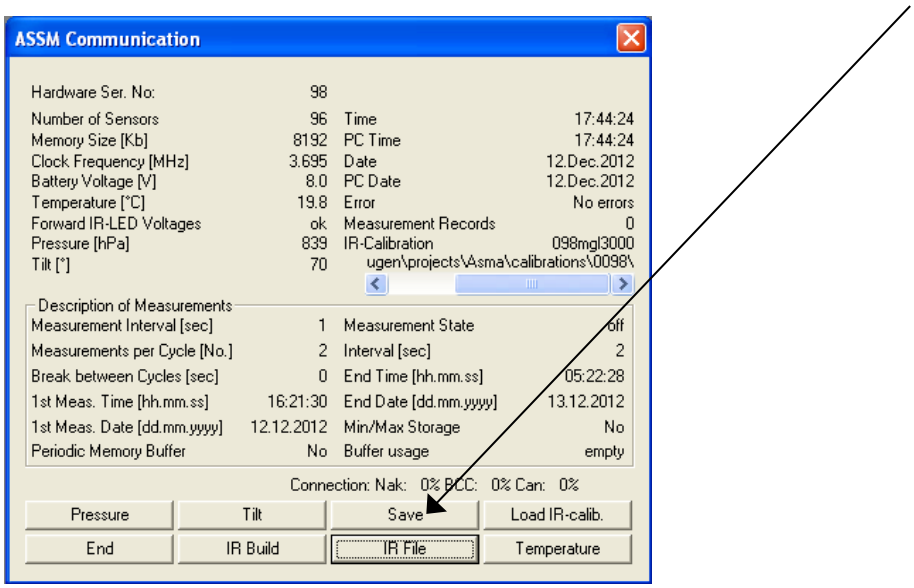
1.1. Averaging process for calibration

Medium	Size	No. Samples (process time)
Clay	<=20µm	30 sec. (n. o. S.)
Silt	20...63µm	30 sec. (n. o. S.)
Fine sand	63...125µm	600 sec. (n. o. S.)
Medium sand	250...500µm	2400 sec. (n. o. S.)

(n. o. S.) number of samples

Use the **Add File** button to add your reference measurements. If you need to delete a measurement from the list, double click the entry. The file is purged from the list but not physically erased, it can be re-entered anytime. After pressing **Ok**, a file menu is opened such that you can name the calibration set. It is this name that will later be used and displayed to describe the calibration. The file extension must be .AGB and the file must be located in the same folder as the AGF files. The name of the calibration file and a checksum will be transferred to the ASM such that a strict correlation between the measurement values to be recorded and the calibration is established.

The last step to be carried out to complete the calibration is to assemble the OBS calibration (AGB extension) with the other sensor calibration (temperature, tilt and pressure). To complete an AGL file, which is the only one can be load on the instrument without entering the password, press the **Save** button at the calibration window and enter ***the same name as for the assembling AGB file.***



Now deploy the instrument and perform the desired measurement task. Read the data with the **Read** button and store the measurement file (SAN). For this process to succeed, all the AGF files, the AGB file and the AGL file as well from the calibration routine have to be accessible. The program will search its start directory, the system search path, the current directory and the last working directory for the files. If one of the files is not available or has changed, an error message will be generated. If successful, the measurement data along with the calibration information is stored in the SAN file. These files are now completely self-contained and can be stored and mailed by themselves without further reference to the calibration files.

Trick:

In the unlikely event, that a calibration set is lost and an important measurement needs to be recovered, a post-measurement calibration can be done. An existing measurement is overwritten only once a new measurement commences. Pressing the **Delete** button before entering the calibration mode does not affect the stored data. Now perform the calibration as described before with matching sediment material. Build the calibration set and load it into the ASM. Then quit the ASMA program and re-enter the ASM Hardware section. Now download the data with the **Read** button. At this point the data will be stored with the new post-measurement calibration.

Error Messages

- **ASSM calibration data corrupt, build or load new!**
  Reason: ASM Memory or transmission error
- **File format error**
  Reason: Inconsistent file data
- **Invalid file format or read error**
  Reason: An .AGF file did not have the expected file structure or got corrupted
- **Calibration file could not be created**
  Reason: Access error or file system full
- **AGL: Buffer format error**
  Reason: The ASM calibration buffer is corrupt
- **Spline: Function not monotonic increasing**
  Reason: 1) The calibration specified an increasing physical value but the reference measurement for the sensor is decreasing. 2) The Spline function is degenerated because the reference values and/or the reference measurements are too close.
- **spline: error: as posed, problem of computing spline is singular**
  Should not occur
- **Calibration file changed, checksum error**
  Reason: The calibration files are not the same as when the “IR Build” command was issued. The information stored in the ASM is not the same as the associated .AGB file.
- **Checksum error, file inconsistent**
  The .AGF reference file got corrupted
- **Number of sensors mismatch**
  Reason: The number of sensors found does not match the .AGF file entries
- **Serial number mismatch**
  Reason: The .AGF file was created with a different ASM device.
- **Unit not compatible, must be same**
  Reason: The physical unit for the reference measurement needs to be identical: I.e. one measurement defines mg/L, the other g/L.
- **Values in list would be less than 10% apart**
  Reason: The spacing of the physical values of at least one pair of reference measurements is closer than 10 % apart.

ATTENTION! THE MOST COMMON CAUSE OF ERRORS IN OBS DATA IS AN IMPROPER CALIBRATION

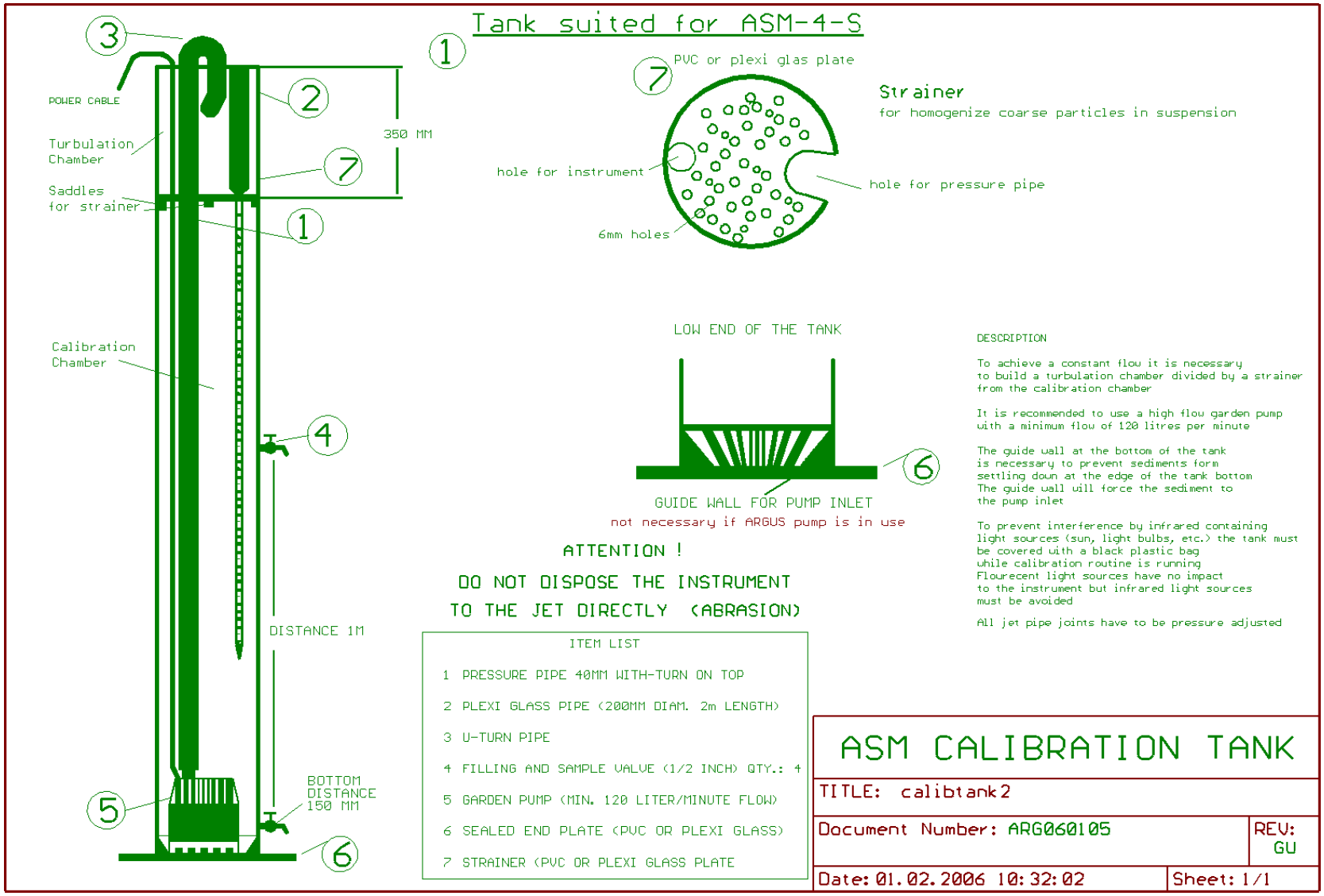
8.3. Calibration Tank

To keep particles in suspension a circulation facility and high power pump is recommended, it becomes more important the coarser the particles in suspension are, due to gravitation processes.

A single OBS calibration can be carried out easily by using a simple bucket and a stir propeller as is used for mixing wall paint.

To calibrate a multi stage OBS system (ASM) all sensors have to be calibrated submerged in a homogeneous suspension. At the same time all individual OBS sensors need to be equalised as well.

Calibration tank ASMCT



PART 2: ASMA

Reference of the program ASMA

Version 4.5 Copyright: © ARGUS GST 2012

9. Release Notice ASMA Rev. 4.5

9.1. Description

The program ASMA is used for the analysis of data files from the ASM-IV instrument. The stored ASM data files (*.SAN) extracted from the measuring data files can be processed graphically and displayed on the screen. The freely by the user defined displays include all relevant adjustments and can be managed comfortably.

The second part of the reference provides common information of the ASMA software and the default application and can be skipped by the experienced user. In case of doubt the summed information is available as online **Help** as well.

9.2. ASCII conversion

Beside visualization, ASMA allows exporting data into ASCII format. Subsequently data can be further imported and processed with the third-party software, such as a spread sheet program, MatLab®, GNU plot, etc.

ASCII Export Window

The data are exported using the **ASCII Export** dialog, which can be accessed from the **File** menu. This dialog (show in the figure below) allows dumping the measured data of the current document to a plain ASCII file. This way it is possible to process the data with third-party software, such as a spread sheet program.

The four buttons correspond to the five types of data that can be exported:

- **Reflectivity Values:** extracts reflectivity from OBS sensors
- **Variability of Reflectivity:** extracts variability from OBS sensors
- **Optional Sensors:** extracts data from pressure, temperature and tilt sensors, without their dynamics or minima / maxima.
- **Sediment level:** extracts the computed bottom detection layer. This function uses the **Sediment LED** method, unless the **Sediment laser** is currently selected for display.
- **Extract calibration and raw data** is a full conversion of the SAN file into text file. This will extract calibration files (AGL, AGB and AGF) and the uncalibrated data in the digital format.

For each of these export types, additional configuration can be applied by checking the check boxes:

- **Digit:** if this is checked, then the export data are numbers coming from analogue to digital converter. Only numbers from OBS sensors are calibrated so that they can be linearly scaled to match the real physical values. If this box is unchecked, then only physical values with their measuring units are exported. Note that currently **Asma** does not support the export of variability with its physical units.
- **Entire time range:** the data from all measurements are exported. If unchecked then the time range is taken from the current plot time range.
- **Entire sensor range:** is considered only for **Reflectivity Values** or **Variability of Reflectivity** exports and specifies that data from all OBS sensors must be exported. If unchecked then the sensor range is taken from the current plot sensor range.

If neither of the above two options is selected, then the time and sensor range of data are extracted as WYSIWYG. If any filter was applied to the displayed data, this will also apply to the exported data.

After clicking on the corresponding export button, a **Save As** dialog will appear asking for the path and the filename of the file where data will be exported into. After clicking on the **Save** button, a progress bar at the bottom of the dialog will show the status of the process. The dialog cannot be closed then. The process can be stopped by clicking on the **Cancel** button. When the process has stopped, then all fields become again active. The dialog can be closed by clicking on the **Close** button.

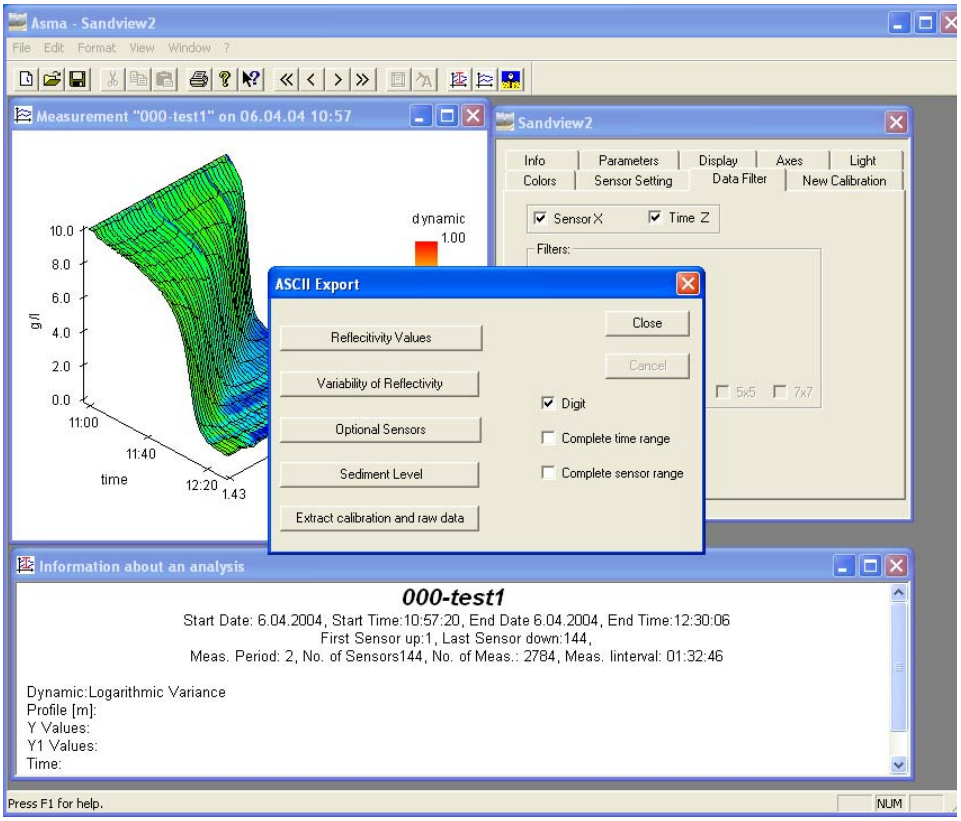


Figure: **ASCII Export** dialog

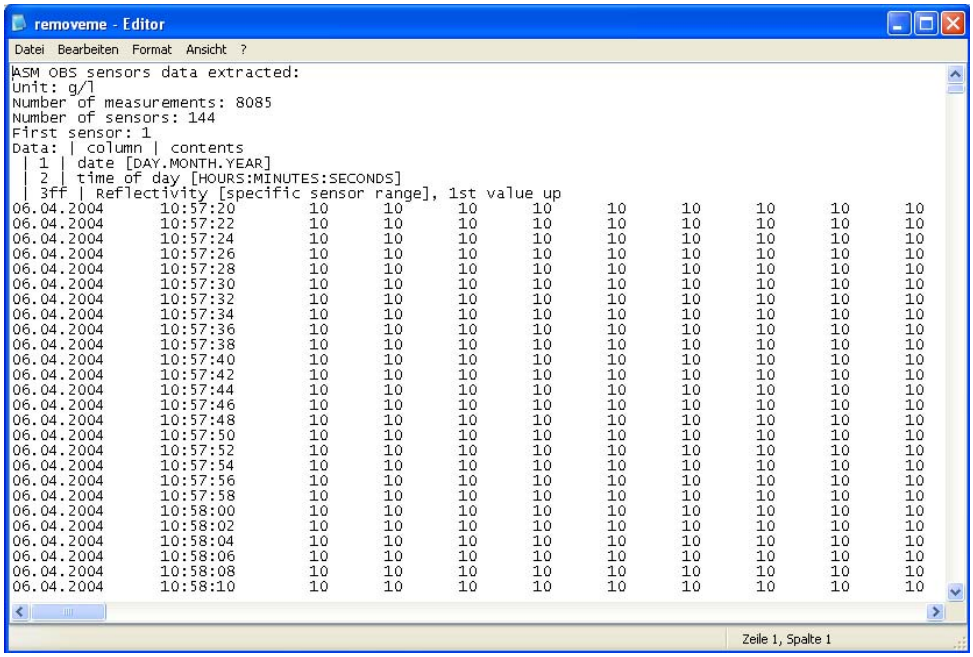


Figure: An example of the output of the **ASCII Export** dialog.

10. Menu of the ASMA program

10.1. Commands of the menu File

The menu **File** contains the following commands:

New	Prepares to open a new SAN file.
Open	Opens an existing ANS document
Close	Closes an opened document
Save	Stores an opened document with its current file name
Save As...	Stores an opened document with a new file name
ASM Hardware	Starts the instrument communication
Print	Prints out a document
Print preview	Presents the document as: WHAT YOU SEE IS WHAT YOU GET
Print setup	Chooses a printer and a printer interface
Bimap Export	Give the possibility to store the current Image into Bitmap-format.
Ascii Export	Dumps the measured data as plaint text to a file (see section 9.2)
Exit	Closes down ASMA

The command New

Use this command for establishing a new document in ASMA.

Short cuts

Toolbar : 

Keyboard : STRG+N

The command Open

Use this command, to open an existing document in a new window. Several windows can be opened simultaneously. Using the **Window** menu can shift between several opened documents. See the command **Window 1, 2,** ...

Short cuts

Toolbar : 

Keyboard : STRG+O

The command Close

It closes the active document. ASMA will propose to save the changes in your document before closing. If you close a document without saving, all changes will be lost, which you have carried out since the last session. Before a document is closed without titles, ASMA indicates the dialog window Save as and proposes to name the document and store.

The command Save

Use this command, to store the active document as it momentary name and list. At the first storage of a document, ASMA indicates the dialog area Save as , to name the document. If you want to change the name and list of an existing document, choose likewise the command **Save as**.

Short cuts

Toolbar : 
Keyboard : STRG+S

The command Save as…

Use this command, to store and name the active document. ASMA indicates the dialog field save as, so that you can indicate a name for your document.

The command Print

Use this command to print a document. This command presents a **Print dialog**, where you may specify the range of pages to be printed, the number of copies, the destination printer, and other printer setup options.

Shortcuts

Toolbar: 
Keys: CTRL+P

Print dialog box

The following options allow you to specify how the document should be printed:

Printer

This is the active printer and printer connection. Choose the Setup option to change the printer and printer connection.

Setup

Displays a Print Setup dialog box, so you can select a printer and printer connection.

Print Range

Specify the pages you want to print:

All	Prints the entire document.
Selection	Prints the currently selected text.
Pages	Prints the range of pages you specify in the From and To boxes.

Copies

Specify the number of copies you want to print for the above page range.

Collate Copies

Prints copies in page number order, instead of separated multiple copies of each page.

Print Quality

Select the quality of the printing. Generally, lower quality printing takes less time to produce.

Print Progress Dialog

The Printing dialog box is shown during the time that <<YourApp>> is sending output to the printer. The page number indicates the progress of the printing. To abort printing, choose Cancel.

The command Print Preview

Use this command to display the active document as it would appear when printed. When you choose this command, the main window will be replaced with a print preview window in which one or two pages will be displayed in their printed format. The **print preview toolbar** offers you options to view either one or two pages at a time; move back and forth through the document; zoom in and out of pages; and initiate a print job.

Print Preview toolbar

The print preview toolbar offers you the following options:

Print
Bring up the print dialog box, to start a print job.

Next Page
Preview the next printed page.

Prev Page
Preview the previous printed page.

One Page / Two Page
Preview one or two printed pages at a time.

Zoom In
Take a closer look at the printed page.

Zoom Out
Take a larger look at the printed page.

Close
Return from print preview to the editing window.

The command Print Setup

The following options allow you to select the destination printer and its connection.

Printer
Select the printer you want to use. Choose the Default Printer; or choose the Specific Printer option and select one of the current installed printers shown in the box. You install printers and configure ports using the Windows Control Panel.

Orientation
Choose Portrait or Landscape.

Paper Size
Select the size of paper that the document is to be printed on.

Paper Source
Some printers offer multiple trays for different paper sources. Specify the tray here.

Options
Displays a dialog box where you can make additional choices about printing, specific to the type of printer you have selected.

Network...
Choose this button to connect to a network location, assigning it a new drive letter.

The command Close

Use this command to finish of your session with ASMA. Alternatively choose the command **Close** from the system menu of the application. ASMA inquires, if you want to store documents without changes.

Short cuts
Keyboard : ALT+F4

10.2. The ASCII Export command

This command dumps the measured data of the current document to a plain ASCII file. See section 9.2 for more information.

10.3. The Command ASM Hardware

This command provides the user to communicate with the instrument using an IRDA optical communication unit. Select a com port on your PC and connect the **OCU-I** unit and place the unit on top of the instrument. Start the ASMA software and select **ASM Hardware.** Then the port communication window will show serial interface information.

The Hardware communication

A communication window will show the present com port selection and the progress bar. If the communication is not possible, check the com port list by scrolling from the ASM wakeup window. If the chosen port is the right one, the ASSM COMMUNICATION PROGRAMM will start.

The ASSM communication

The Hardware program table gives all relevant information from the instrument. The ***number of sensors*** shows how many OBS are in use. The second line tells about the present ***memory size*** of the instrument. The ***clock frequency*** says that the instrument works with the right time set (range: 3.5 – 3.9MHz). The ***battery voltage*** is the present value from the internal power supply (reg. 9V). The line ***forward voltage*** gives information about the proper functioning of sensors. If one sensor fails a number combination appears. In this case the instrument needs to be taken in for service. The ***temperature, pressure*** and ***tilt*** line are showing the values taken during the last measurement. These values need to be calibrated. When choosing the calibration function the bottom line pops up, allowing for separate calibration of each internal sensor (authorized person only).

The DESCRIPTION OF MEASUREMENTS section can be modified by the user. It is a time setting table and a possibility to disable or enable the storage of min/max data.

The SOFTWARE section is a status table. It gives information about:

- present time and date
- errors which may have occurred during the measurements
- the value of records the instrument had taken
- the status of measurement (running, or off)
- the chosen measuring interval
- the date and time the measurement will be shutoff.
- The calibration file

10.4. The command Bitmap Export

When you select this command, a window (View and Save Bitmap-format) containing the graphic and its information will pop up. There you can perform the save process.

The Windows : View and Save Bitmap-format

On this windows you can see the current Image and its Information derived directly from the source without change anything, except the size of the graphic.
Additionally he contains two Button **Save** and **Close**. The **Close**-button closes the windows

The command save from Bitmap Export Windows

If you click on this button, a dialog-box will pop up, giving you the possibility to save the showing image and its Information into a default name **Graphic,** that can be changed, as well as the directory-file

10.5. Commands of the menu Edit

The menu **Edit** contains the following commands

Undo	Undo the last operation
Cut	cutting document and transfers them to the temporary storage
Copy	Copies data from the document to the temporary storage
Paste	Submits data from the temporary storage to the document

The command Undo

This command is activated only while editing data files. Use this option, to undo the last action, if

necessary.
Short cuts

Toolbar : 
Keyboard : STRG+Z or
ALT- DEL

The command Cut

Use this command, to remove currently marked data from the document and transfer to temporary storage. The command has validity while editing the information for the evaluation and can not be selected, if momentarily no data is marked.

Cutting and transmitting data into the temporary storage will replace the data, which will previously found.
Short cuts

Toolbar : 
Keyboard : STRG+X

The command Copy

Use this command, to copy marked data into the clipboard. The command can not be selected, if momentarily no data is marked.
Short cuts

Toolbar : 
Keyboard : STRG+C

The command Paste

Use this command, to insert a copy from the temporary storage at the paste location. This command is not valid if the clipboard is empty.
Short cuts

Toolbar : 
Keyboard : STRG+V

10.6. Commands of the menu View

The menu **View** contains the following commands:

Toolbar	Shows the toolbar in or off
Status bar	Shows the status bar in or off
Info	Shows in the info window

The command Toolbar

Use this command setting the toolbar in or out. The toolbar contains some icons of the most common commands of ASMA, for example **File Open.** If the toolbar is indicated, a tick appears beside this menu entry.

Toolbar

The toolbar is indicated horizontally above in the user window underneath the menu bar.
It provides fast access on many tools of ASMA by using the mouse.

To set the toolbar in or out, select the command **Toolbar** (ALT,A,S) from the menu **View**

Icon

 Opens a new document

 Opens an existing document. Indicates the dialog area **Open**, were you can find and open the desired file.

 Stores the active document or the active pattern under the current name. If you have not yet named the document, ASMA shows the dialog area **Save as.**

 Removes the marked data from the document and transfers it to the temporary storage

 Copies the marked data to the temporary storage

 Submits the content the temporary storage to the paste location

 Prints the active document.

 Tracks back one page of the data, if not cursor at the beginning.

 Tracks back one time step of the data, if the cursor is not at the beginning.

 Tracks forward one time step of the data, if the cursor is not at the end.

 Tracks forward one page of the data, if not cursor at the end.

 Discontinues the distribution and page format. Activated, if the info window is in the edit mode.

 Adjusts the text format respectively the font style.

The command Status bar

Use this command, to set in or out the status. The status bar describes the action, which is executed by the selected menu entry or a pressed down button at the toolbar. It indicates the condition of the detectable keys. If the status bar is indicated, a tick appears beside the menu entry of this command.

The status bar is indicated at the lower edge of the window of ASMA. You can set in or out the status bar at the menu **View** using the command **Status bar**.

While you move through menus by using the *direction keys*, the left area describes the function of the menu entries of the status. If buttons kept pressed down, descriptions will be indicated in this area on the function of icon buttons of the toolbar. If you do not want to execute the pertinent command of an icon button of the toolbar after you have read the description, release the mouse key, while moving the mouse cursor away from the icon button. At the right location of the status bar will show which of the following keys are locked:

Indication	**Description**
CAPS	The SHIFT LOCK is activated
NUM	The key NUM is locked
SCRL	The key SCROLL is locked

The command Info

Use this command to view the copyright - reference and the version no. of your copy of ASMA. Use this command, to set in the info window for the current data analysis. The info window contains editable text info, which explains the presented graphic. There objects can be bounded, which serve as place markers for changeable information

10.7. Commands of the menu window

The menu **Windows** offers settings, which allow arranging multiple views:

Cascade	Arranges the windows overlapping
Tile	Arranges the windows side by side
Arrange windows	Arranges the windows which are reduced to symbols
window 1...2...	Changes over to the window indicated

The command Cascade

Use this command, to arrange the opened windows overlapped.

The command Tile horizontally

Use this command, to arrange the opened windows side by side.

The command Arrange Windows

Use this command, to arrange the symbols of the minimized windows in the lower area of the main window. If there is an opened document window located, it can happen, that some or all symbols are concealed, because they are located behind this window.

The Command 1, 2, ... (menu window)

At the end of the menu **Window,** ASMA present a list of currently opened document windows. In front of the document name of the active window a tick appears. Choose a document from the list, to activate.

10.8. Commands of the menu Help

The menu Help contains commands, which will provide assistance for present application:

Help finder	Indicates the list of the themes, were help is available
About ASMA	Shows the ASMA version number.

The command Help Finder

Use this command, to enter the content of the help menu. From this menu you can jump to the ASMA commands, which show the application of ASMA step by step, or different types of references info to look at. As soon as you have opened the help file (it is always possible) click the icon button **content**, to return to the content menu.

The command About ASMA

Use this command to view the copyright - reference and the version number of your copy of ASMA.

The command Context help

Use the command **Context Help**, to get help for a certain part of ASMA. If you select the icon button "context help" from the toolbar, the mouse cursor change to the appearance of an arrow with question marks. Click by using the mouse somewhere in the window of ASMA. The corresponding help theme to the element clicked, will be indicated.

Short cut

Toolbar : 

Keyboard : SHIFT+F1

11. The processing and administration of views

Views are showing a certain amount of possibilities from ASM-IV files. All user defined preferences are managed by viewing the data. While opening a view, all parameters will be on loaded, which determine a defined list of views and selections and a representative specification can be done. Thereby it is possible to make certain evaluations creating that equal picture again and again without further settings at each restart and storing. There are supported arbitrarily many views on measuring data. The measuring raw data itself is not changed by created views and several different views can be presented simultaneously from the same measuring data. Opening a view, a setting card window will appear were all possibilities are listed to be used and had been used by the instrument during the measurement. For questions regarding individual setting cards, press <F1> for help, or read following references.

The following file cards are available:

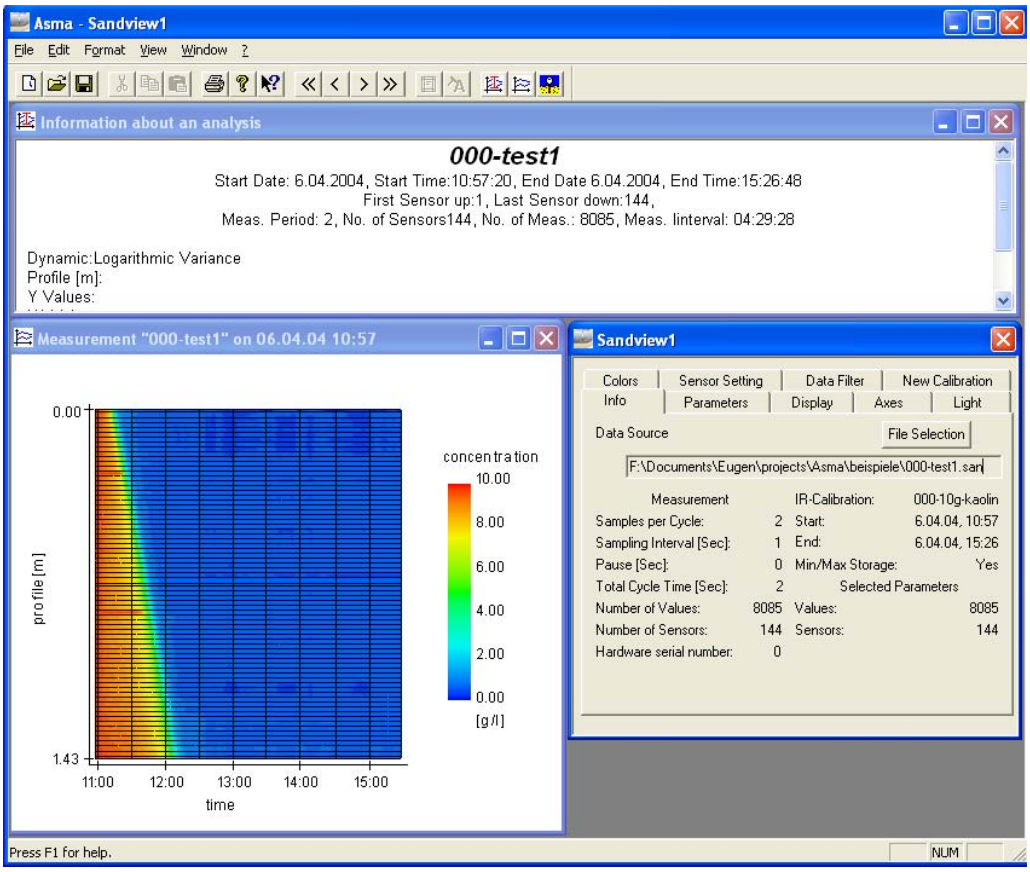
- Info
- Parameters
- Display
- Axes
- Light
- Colours
- Sensor Settings
- Data Filter
- New Calibration

At the **Info** card the name of the SAN file need to be indicated. Before a corresponding selection all fields are deactivated. Surging for a data file, the symbol **File selection** can be used. While opening the data

file, the data format will be examined and initializing for the view is accomplished. At an existing view the data source can be changed and a compatibility of settings of the view will be carried out automatically. After successfully read the data file the graphic window of the evaluation will be opened immediately. All changes of the view can be seen (some edit windows require a confirmation <return> for the display). Text information and commentaries for the respective evaluation will be managed by the Info window for evaluations. Manual text information will be reported as a page header at a print out. If desired the info window can be deactivated. Use the command Info (Menu **View**).

11.1. Info

The first essential setting option is the file name of the ASM data. ASM data have a file name with a .SAN extension. The file name can be entered directly or by surging with the help of **File selection**. All further options of the program remain disabled until successful specification of an ASM data file.



Samples per cycle The number of single measurements, which are summed up at one data file.

Sampling interval [sec.] The time interval between the single measurements of the sand meter counted in seconds.

Pause [sec.] The time length of one measuring pause after all single measurements taken out.

Total cycle time [sec.] Here the total duration of the measuring program is reported in seconds. This duration is firmly dependent by program that has been chosen at the start of ASM- IV measuring. The ASM-IV has already calculated the arithmetical average respectively pre evaluated all measurements within this period of time into a data file internally.

Number of values Here the number of measurements stored in the ASM file are located. Thereby a stored measurement exists of several single measurements.

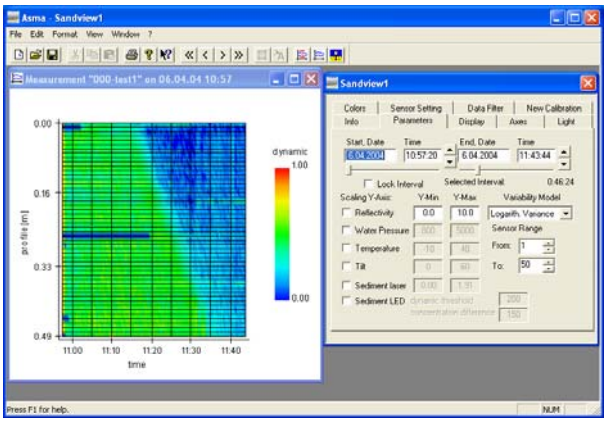
Number of sensors Here the total number of sensors is located existing in the ASM-IV.

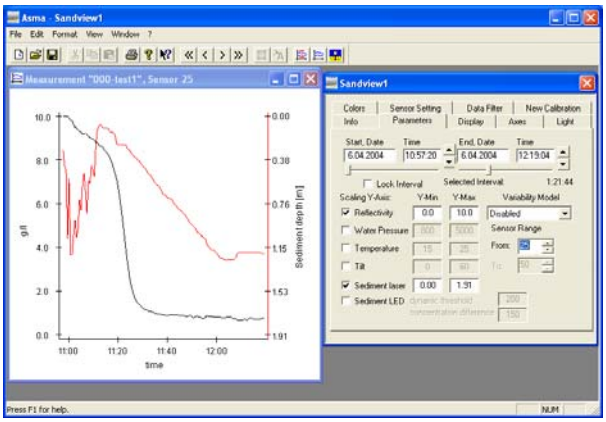
At the right page location you will find:

Start	Date and time at the ASM-IV deployment start.
End	Date and time at the ASM-IV deployment end.
Min/Max storage	Informs if minimum- and maximum values were stored as well together with the measuring program.

11.2. Parameter

The upper part of the window allows selecting the display time range, by trimming the beginning or the end. If **lock interval** is set and the start date/time is changed, then the end date/time is changed as well in order to preserve the interval duration. If the start time is equal to the end time, then the plot becomes two-dimensional, showing only reflectivity sensors for that time.





The reflectivity sensor range can be chosen on the right. The first sensor is located closest to the instrument's head. The display range of the reflectivity can be set on the left, in the **Reflectivity** row, by setting its display minimum and maximum. This works as zoom function for the reflectivity sensor. In the 2D plot, points outside the range are not displayed. In the 3D plot, if there are data points bigger than the value of the reflectivity in **Y-Max**, then these points are displayed with value **Y-Max**. Same applies to values smaller than **Y-Min**.

For the 3D plot, the **Reflectivity** option must be unchecked and the **Reflectivity Height/Variability Colour** must be selected in the **Display** window. By checking the **Reflectivity** option, a two dimensional graph will display the reflectivity and dynamics of one sensor, which is specified in the **From** field in the **Sensor Range** section.

Water pressure, water temperature, tilt of the instrument and sediment thickness can be indicated via sensor units. The measurements depends on the availability of optional sensors at the ASM-IV while the display of sediment thickness. At all measurements the y - axis can be scaled freely.

Water pressure	Indicates the water pressure in hPa over the time.
Temperature	Indicates the water temperature at degree Celsius over the time
Tilt	Indicates a possible change of the tilt situation of the ASM-IV. The display indicates the deviation of the tilt of the ASM with respect to the vertical in angle degrees. Arrows inform about the direction of the possible angle, which are drawn to the tilt diagram at differently times. Thereby it is possible to view an angle coming along with a possible rotation simultaneously. The direction is

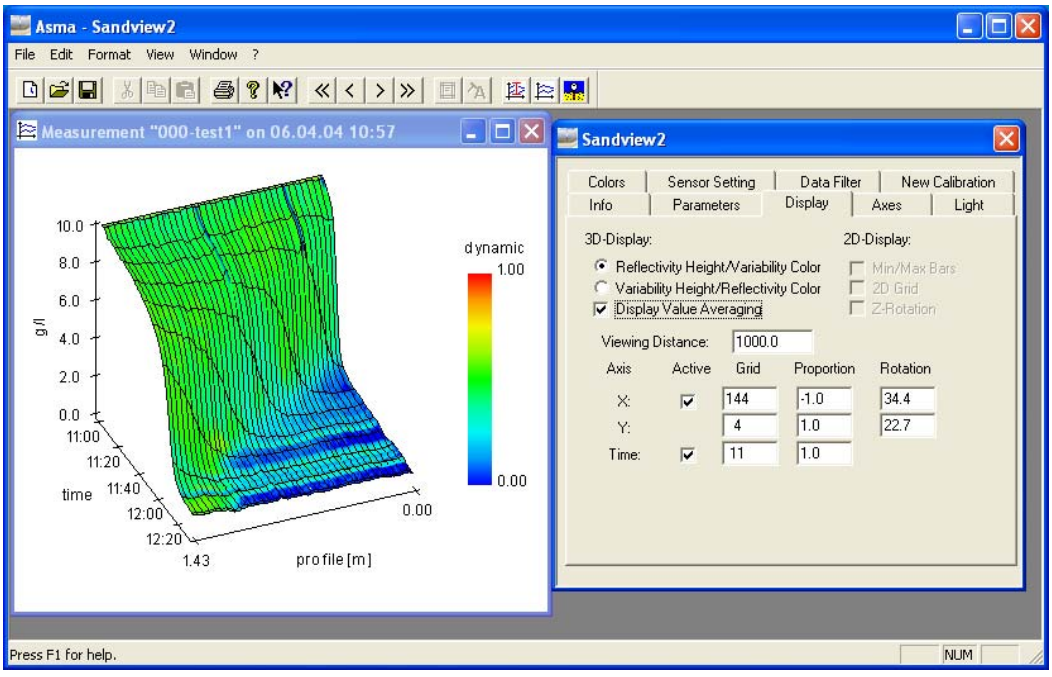
defined as follows. An arrow down means the ASM is tipped in direction of the sensors. An arrow up means the sensor is tipped in opposite direction of the sensors. Arrows to the right and to the left are analogously to the tilt of the ASM with respect to the beam orientation right respectively left of the sensors.

Sediment The sediment thickness is determined for each point in time with a regression to the reflection of the material in front the sensors. The display results in sensor ranges. This task is only valid if erosion and sedimentation processes are measured. There are two ways of computing the sediment level, depending on the optical sensors type. The **Sediment laser** option assumes that the reflectivity in the sediment is much higher than in water. The algorithm looks for the increase in the concentration level. The **Sediment LED** option assumes that the concentration in the sediment almost does not change during 14 hours and the dynamics is very low. The maximum allowed change in concentration can be specified in **concentration difference** (0 to 4095), whereby the maximum allowed dynamics should be specified in the **dynamics threshold** (0 to 66000).

The **Variability Model** allows disabling or enabling the display of the dynamics. Enabling is done by selecting one of the three available dynamics computations: **Logarithm. Variance**, **Standard Deviation** or **Variance**. The dynamics appears on the right of the two-dimensional plots. In order to plot another sensor instead of the dynamics on the right, the dynamics must be first disabled and then a sensor type selected.

11.3. Display

In this card the display can be changed between 2D and 3D. This can be done on and off switching of the axes. Switching off of the X - axis (sensors) leads to a Y (reflection), Z (time) view and to a time-dependent display of the reflection for a certain sensor .The chosen sensor can be fixed at the **Parameter** selection for the display, by changing the lower boundary of the sensor range as well. The **Averaging** button has to be deactivated. Switching off of the time - axis leads to a two-dimensional display to form Y as reflection, X as sensor array. In this case it is possible, to evaluate an individual ASM measurement for the focused sensor range. The point in time of the evaluation is chosen by the point of time at the **Parameter** selection for the display. The **Averaging** has to be deactivated.



Proportions

With the choice of the proportions the volume can be chosen, in which the data are presented. By stretching or compressing axes certain aspects of the graphic can be emphasized. All scaling are converted on the new proportions automatically. Here no values should be entered exceeding 10, since high asymmetrical displays are very unwieldy for the user. Negative values lead to **mirroring of axes**, whereby scaling and graphic turn back themselves for this axis. The rotation of the graphic can be entered directly. The angle by 0 degrees in X and Y direction means, that the user is visualizing the graphic from the front directly. Thereby the look goes in the negative Z - direction (at not mirrored Z - axis) and in the positive X - direction (at not mirrored X - axis) which is located right hand at the screen. The rotation will better be carried out by using the mouse at the Graphic window of the evaluation directly.

Viewing Distance

By choice of the viewing distance an adjustment of a prospective display is possible. This functions like the focus selection of a zoom lens at the photography. A long focus width leads to a parallel perspective display, at which the objects are not shortened in the depth prospectively. A short focus width on the contrary leads to a prospective shortening objects behind (fish eyes effect). Both possibilities have advantages and disadvantages. At a long focus width all angles and lengths have been accomplished, preserved and exact measurements at objects can be carried out in the depth. Indeed the display can be aesthetically unsatisfactorily, because the 3D visualizing expectation leads to an optic deceit that the visualizing volume appears not as a rectangular solid, but as a pyramid stump. By shortening the viewing distance this impression can be compensated, if the proportions and the viewing distance are chosen that way, which subjectively the impression emerges of a rectangular solid shaped volume at the consideration of the graphic. The price for the aesthetics however is, that exact measurements of objects behind are no more possible. If the viewing distance exceeds the length of the Z - axis (see proportions) twenty times, this will be examined as endless viewing distance and an exactly rectangular projection will be chosen

Averaging

In the graphic window of the evaluation an option for averaging the data is available. This is important, if more measuring values line up than the availability of screen pixels of the display. At this moment several measurements are covering one single pixel. The display results without averaging this case. At activated averaging on the contrary, a median value is formed from all measurements coming on that point first and then the calculated means will be indicated. This calculation can take some time; it should be executed at two-stages. That means, that first of all a direct selection of the measurements is indicated, while the background will be calculated by average. After the background display will be shifted to the average data.

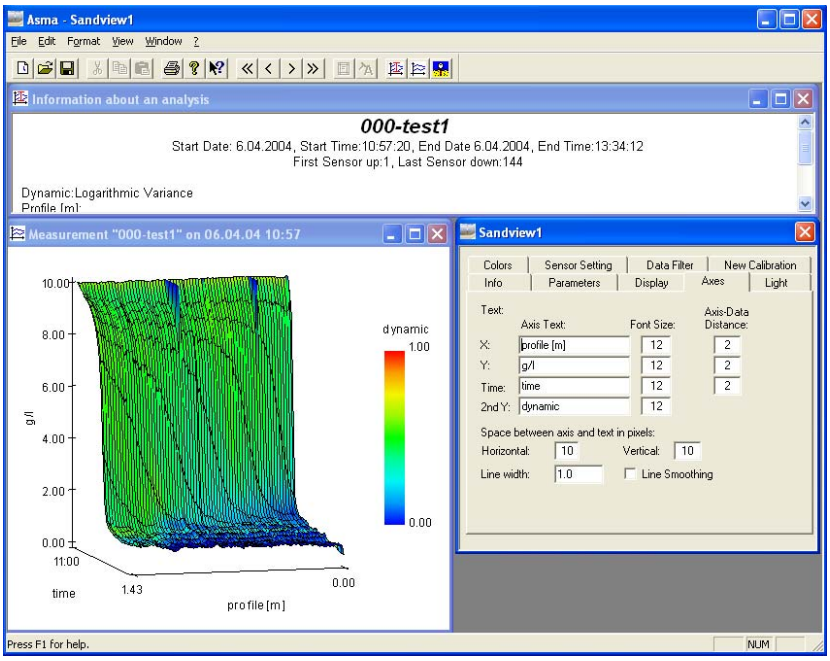
Minimum and Maximum evaluation

If the SAN file contains minimum and maximum values, these can be displayed in 2D plots by checking **Min/Max Bars**.

11.4. Axes

Axis text

For each axis the text parameter can be chosen individually. Individual axes can be deactivated, if they have no meaning for the respective display mode. If a text gets too long or the font size becomes too large, the text will be deactivated in the graphic automatically. The no. of the font indicated in the graphic depends on the size of the display window also.



Position of axes

The displacement of the axes relatively to the graphic opens an additional area for the inscription and preparation of the axes. The statements are indicated in relation to the expansion of the graphic at the respective direction and will be given in per cents. Increasing or decreasing these parameters will change distances on the diagram.

Text position

Adjustments of the text position at the axes. The adjustment carried out will affect the distances in absolute pixels. Increase these parameters, if the texts of two axes run into each other.

Grids

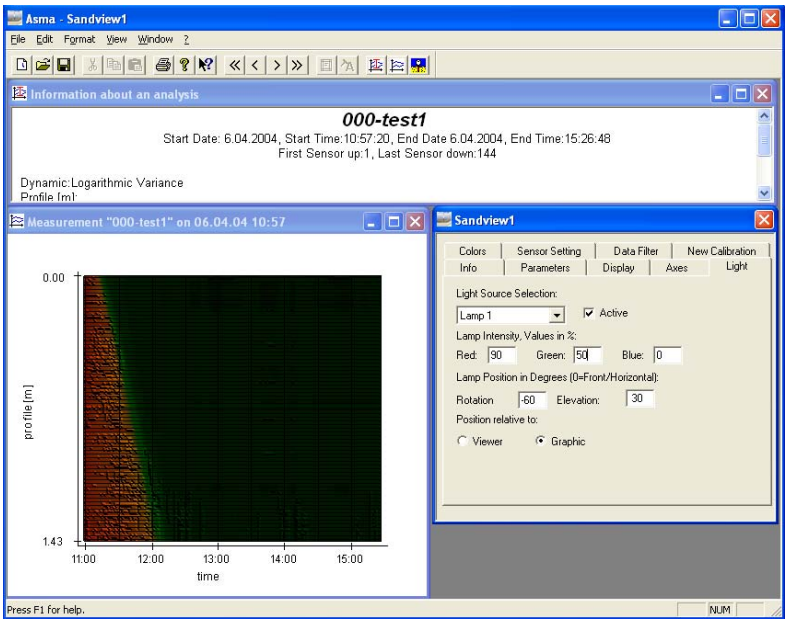
A grid can be activated in Z - and X – direction depending on the number of subdivisions. These grids are helpful for orientation. If the graphic window is too small, the program grids can be disabled.

The inscription of the axes orientates itself in relation to the grid, whereby only even subdivisions of text locations and Grids been carried out. Therefore it is important to enter favourable numbers. The no. of lines will be indicated. The value of the subdivisions must be one number higher than the number of lines (A line divides in 2 areas, 2 lines divide in 3 areas etc.). Favourable values for the amount of the lines are such numbers at which the next higher whole number is well divisible. Therefore: 3, 5, 7, 11, 15 and 17. Very unfavourable numbers are those which are one number smaller than a prime number: 6, 10, 12, 16; no symmetrical subdivision is possible.

The button **2D Grid** can be activated for two dimensional displays.

11.5. Light

The light adjustment is active for 3D displays only. With selecting the lamp adjustments on the view can be changed. Thereby it has to be distinguished between the ambient light and the individual lamps. The ambient light comes from all sides evenly, like the diffuse light of a cloudy day.
The ambient light creates no shadows and has no falling direction. The ambient light is important for a basic alight of the graphic, which records also areas which are not illuminated by a lamp directly.
1 and 2 are lamps which provide direct light sources e.g. the sun or a desk lamp. Thereby the alighting depends on the orientation of the lamp in relation to the area of the graphic. The lamp averted area receives no light, while the exposed one receives it. The lighting by lamps contributes considerably to the improvement of the comprehending possibilities of the 3-dimensional display.



Adjustments of lamps

Each light source can be activated or deactivated individually by the **Active** button. All adjustments only refer to active light source. Colour and intensity of the light source can be adjusted by the relative intensity of the 3 components red, green and blue in per cent. Thereby arbitrarily coloured lighting can be realized. Recommendable is to be limited however itself to white light and to adjust all components with the same intensity. To be consider, that the sum of the light intensity of all lamps is limited on 100% at one location. Too many and too bright lamps lead to the overexposure and the loss of shadows and the possibility of interpretation. If all lamps are deactivated, the light / shadow evaluation will be deactivated as well and a display is indicated without shadows.

ATTENTION: All light sources have to deactivated while using the colour bar at the 3-D-model

Lamp position

The position of the lamp is indicated in a polar coordinate system with direction (Azimut) and height (elevation). On direction:

0 Degrees	The light comes from in front
90 Degrees	The light comes from on the right
-90 Degrees	The light comes from on the left
180 Degrees	The light comes from behind

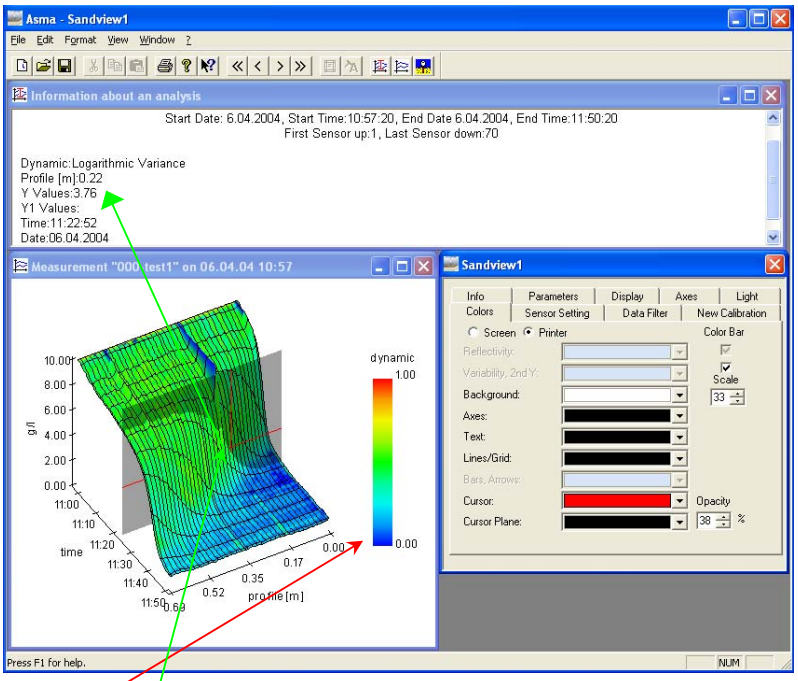
On elevation:

0 Degrees	The light appears exactly horizontal
90 Degrees	The light appears Vertically from above
-90 Degrees	The light appears Vertically from below

To change the graphic, particularly at a turn, there are two possibilities the lamps can behave. You can remain rotate as well or stay quite together with the viewer. This is adjustable by the selection **relatively to the viewer/to the graphic.** At a statement of the position in relation to the graphic, constant light and shadow activities remain independently from the rotation always. Like as if the viewer ran around a desk with the graphic and fixed lighting. Otherwise light and shadows change dependent on the rotation, like as if the viewer turned the graphic on his desk with fixed lighting.

11.6. Colours

The colour selection allows the free configuration of the colour exposition of the program. According to graphic hardware, up to a million different colours are supported. Thereby two colour tables are managed, which refer to the printer and the screen. Thereby it is possible, to adjust the printer colour in wide boundaries, full independently by the screen colour. All adjustments become comprehended at the graphic window.



Colour Bar

The reflectivity or the variability can now be displayed via a colour bar that is intuitively related to a heat scale. The colour blue means cold (low) and the colour red meaning hot (high). This new feature can be selected using the **Colour** tab as well. The scaling of the colour bar can be adjusted to compensate for display colour variations. The precise scaling of the colour bar is documented by a legend that is displayed on the right side of the graphics window. If the ASM was calibrated using physical units, then the units are included in the legend.

The formatting of the legend, that is the number of annotations, and the font size and colour corresponds to the y-axes, either the variability, or the reflectivity axis. When using the colour bar, it is recommended to switch off lighting using the “Light” tab. The variation of the colour due to lighting effects might otherwise impair the correct reading of the data values.

Data Cursor

A data cursor plane can now be placed on top of the graphics by clicking **right mouse button** on the axes in a 3D plot or by clicking inside the data window of a 2D plot. The cursor can be switched on by clicking the **right mouse button** again on the cursor plane. The associated colours can be chosen using the

Colour tab. The cursor is represented as a crossed line within the 2D plot and a semi-transparent plane in a 3D plot. The opacity of the plane can also be specified using the **colour** tab. Once the plane has been specified, a cursor can be placed on top of that plane by clicking inside of it. This provides a 3D cursor and a plane of reference in each of the possible dimensions (i.e. time, depth/sensors, reflectivity/variability). The corresponding values of the cursor can be inserted into the information window using the variables: <CursorX>, <CursorY>, <CursorY1>, <CursorTime>, <CursorDate>. This provides precise documentation of points in time-space with special importance.

Print colours

By clicking this button presentation will be shifted to the printer colour representation, the graphic screen changes also for control in situ. Presupposed a colour printer is connected and adjustments were carried out at the print picture as well, the colour adjustments appear. To deactivate this mode click the **Screen** button.

Variability model

With the variability model the relative amplification of the variability size can be selected. The ASM-IV stores the variability linearly. I.e. the variability is calculated and stored as a arithmetic median value of the deviations of single measurements of the total average. Die Adjustment Variability displays this value with a linear copy as a colour nuance (at the 3D- display). The physical end value of the variability at the ASM-IV is limited at a certain maximum value by experiment, larger variability are stored as maximum value. The limit of the standard deviation is at 0.06 units of the standardized unit reflection. Reaching this maximum value leads to the maximum saturation of the chosen variability colour. Smaller variability values lead to proportionally weaker colours. The combination described is identical, if other models are chosen for the variability display. The standard deviation as well as a logarithmic display is still possible. The both last-named models reproduce the measured variability values with a square root - respectively a logarithmic function on the colours. The scaling will be adjusted on a full swing of the variability of the ASM-IV and correspond to a maximum shade by the application of the model. This leads to the standard deviation and the logarithmic display to an amplification of small variability values. In the area below on the left side of the window expanded evaluations can be indicated as two-dimensional displays. The expanded evaluations are two-dimensional evaluations. Water pressure, water temperature, tilt of the instrument and sediment thickness via sensor units can be indicated. The measurements depend to the availability of optional sensors at the ASM-IV and the display of sediment thickness. At all measurements the y - axis can be scaled freely, whereby an emphasis of certain value ranges is possible.

Colour adjustments

All colour adjustments are indicated in percentage of the respective primary colour. Thereby a million colours are mixable. The colour can be chosen by pressing the down arrow and selecting one from a drop down list.

Colour of reflectivity	Set of the primary colour for the reflection tinting of the 3D graphics. Activated if the variability is at the Y - axis, see: Choice of the display.
Colour of variability	Set of the primary colour for the variability tinting of the 3D graphics.
Background	Background colour of the back panel. White print colours should be chosen.
Axes	The colour of the axes.
Text	Colour of the text
Lines	Help lines inking

Min/max/arrows Colour of the minimum / maximum, scale of the colour bar, opacity of the cursor plane, beams at 2D displays (only if at the ASM activates) and the colour of the arrows to display the orientation of the ASM can be set.

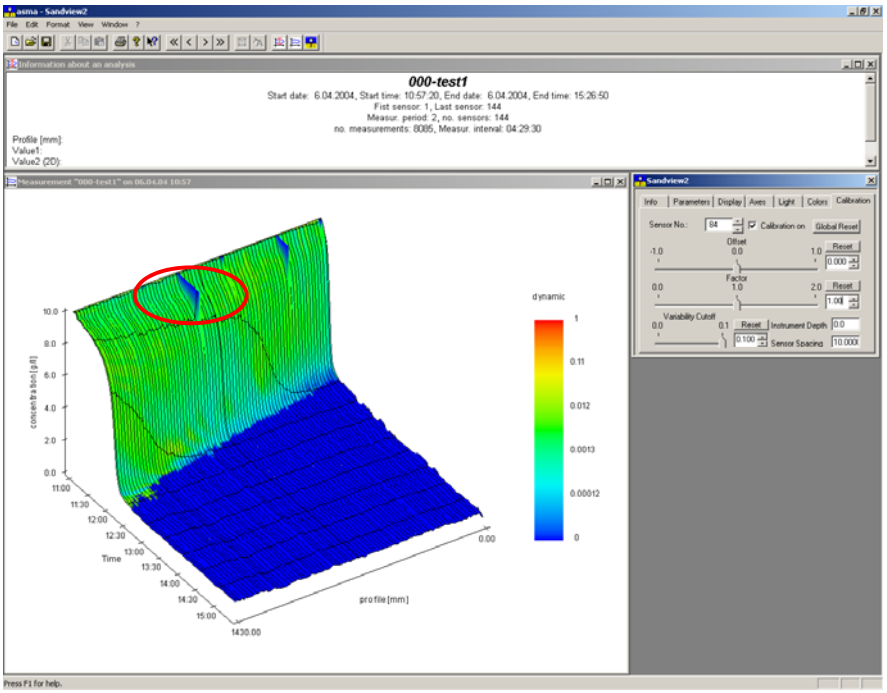
11.7. Sensor settings

The follow up comparison for individual sensors is needed to equalize appeared fouling or other obstructions of sensors during the operation. Offset and amplification can be calibrated at each sensor. The original data of the ASM (*.san) data will be not affected. The calibration possibilities can be activated

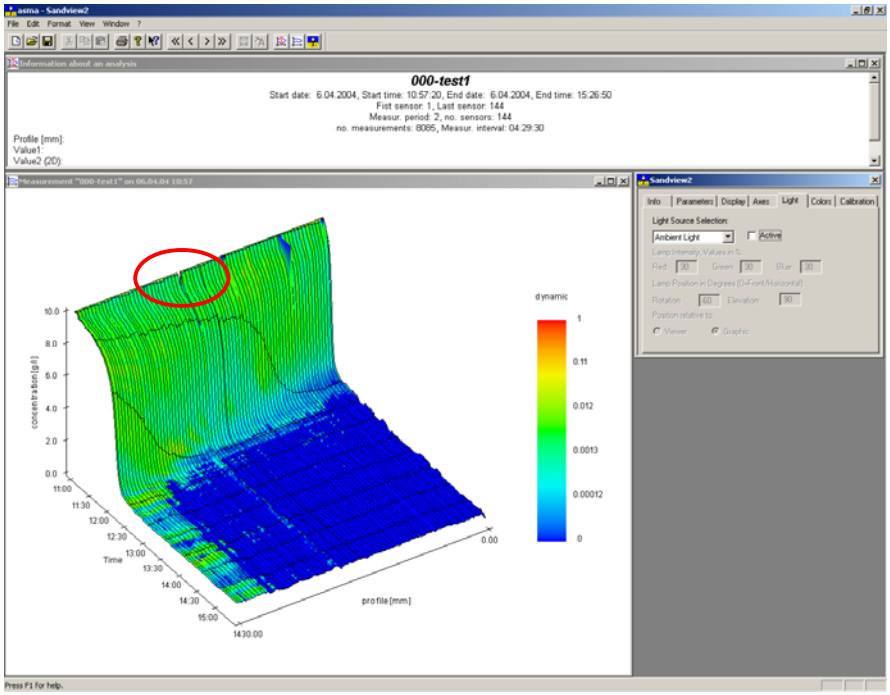
centrally for all sensors with the calibration on button. All following adjustments can be changed only at calibration on. To change the calibration, a specified sensor which should be adjusted needs to choose in the window Sensor No. The following adjustment is an evaluation of measuring data and the specific deviation is defined. The adjustments for offset and factor as well can be done by typing in concrete numbers as well as using the graphic icons. By changing offset and factor, each single sensor can be modified. An online check is possible at the graphic window any time. It is cautious to go ahead taking small steps avoiding overcompensation with an inevitable decrease of the sensitivity. The icon **Reset** switches back the respective parameter to the default value.

The button **Global reset** deletes the user calibration completely, while all offsets of sensors are set on nonentity and the corresponding elements on egg. The variability cut-off will be switched off. The user calibration becomes deactivated by the global reset automatically.

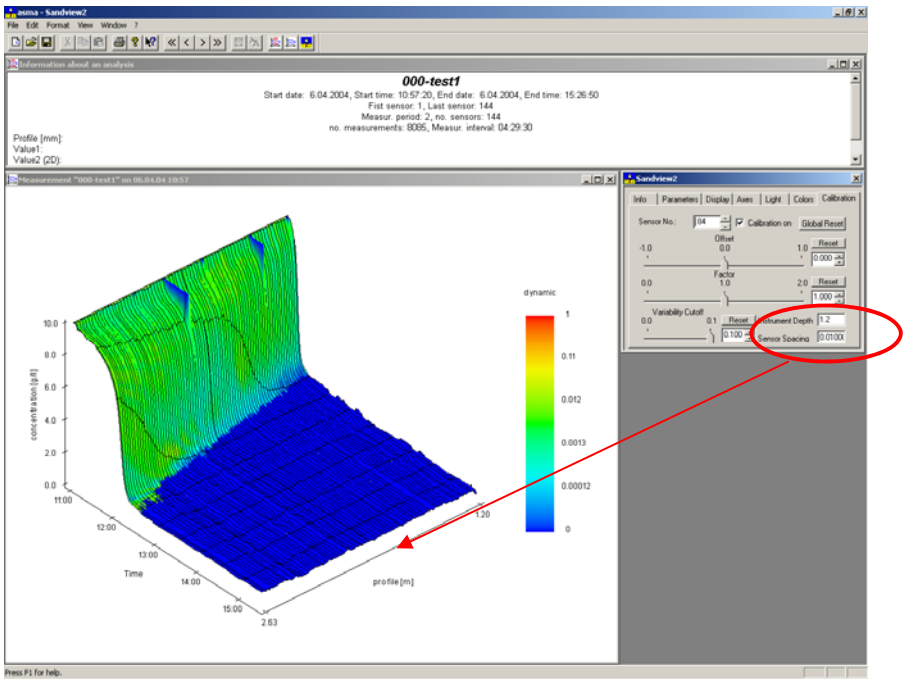
- before post calibration



- Sensor calibration: calibrating the reflectivity of each sensor (***offset and factor***) example: sensor 84 with an factor of at ***0.799*** to remove the spike and a variability cut-off of 0.081.

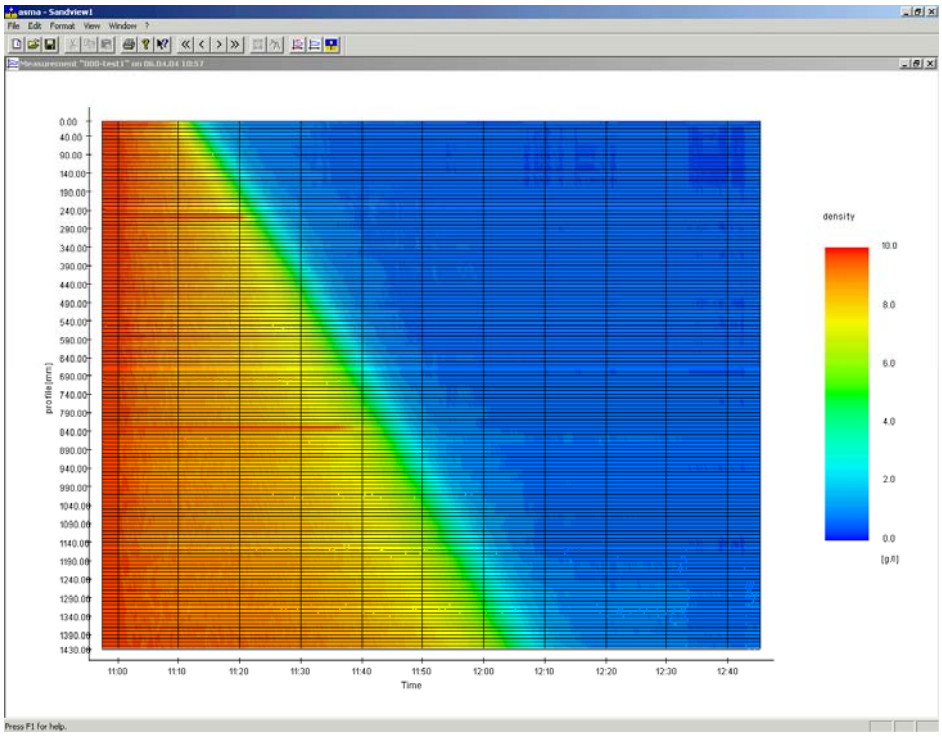


- Sensor spacing: units of sensor measuring range can be set as well as the value no. It is also possible to set the real level of the bed mapped. It does not affect the absolute sensor range



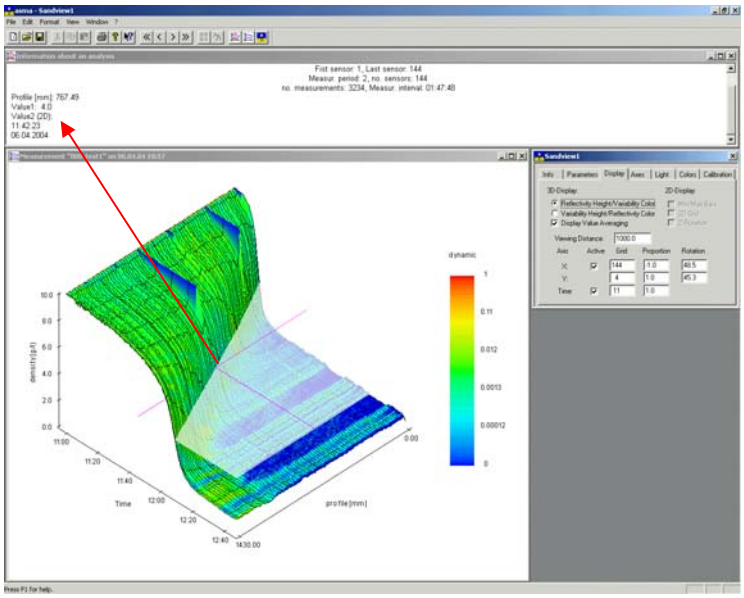
Example

The 2-d graphic is showing a settlement data file taken at the laboratory. The probe was located in a clear fibre glass tank with kaolin sediment (10g/l at its maximum). The diameter of the tank is 20 cm and the height 2,50 m. Each horizontal line means 1 cm vertical measuring range (distance between each OBS sensor). The sample rate is 2 seconds. The average was taken from two samples, one per sec. This is the smallest setting to measure the variability process. The profile shows that it only took three approx. an hour for re- sedimentation. The settling process is linear due to the homogeneous particle size distribution.

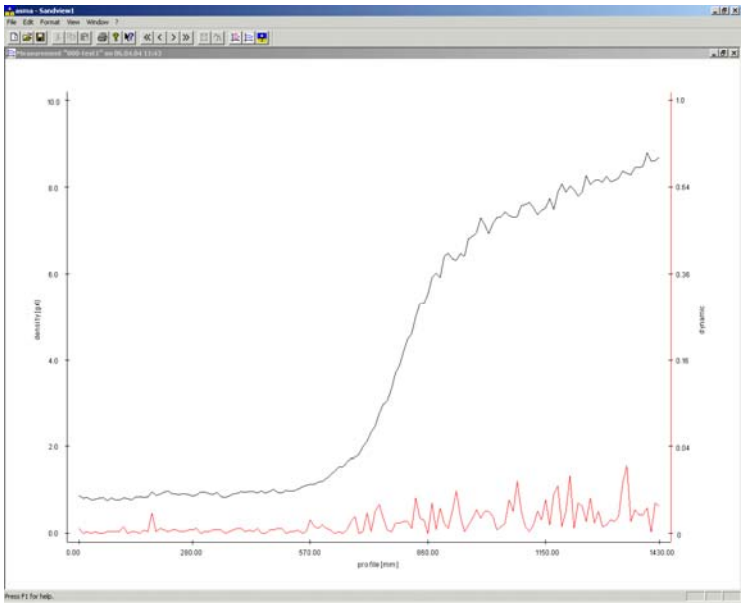


At this test measurement, different colouration is visible. High concentration here is coloured red (10gr/l). The orange to yellow and the green to blue area as well indicate lower concentrations during the settling process. The settling time can also be evaluated at the time axes. At 12:00 hours the sedimentation process is finished.

This diagram is showing the same sample as before but as a 3D version and different visualization. The sedimentation process can be followed through the complete pre-selected time range. The cursor show the exact range of the profile were 4 g/l (kaolin) at what time is expected.



This diagram is showing the 2D reflection, at the left y-axis the SSC (suspended sediment concentration) is visible (0-10 g/l kaolin). The right y-axis is showing the variability (standard deviation) of the reflection of materials.



11.8. Data Filter

Asma software allows removing spikes or visually extracting some features by applying corresponding data filters. A filter can be applied to either the X axis (across data from OBS sensors for each moment of time) or the Z axis (across time for each sensor separately) or for both simultaneously. In order to filter in the X-axis, the check box **Sensor X** must be checked. For the time axis **Time Z** must be checked. If neither of these is checked, then no filter is applied.
Below are filters supported by **Asma**. Note that only one filter can be applied at any instance of time; they are not cumulative.

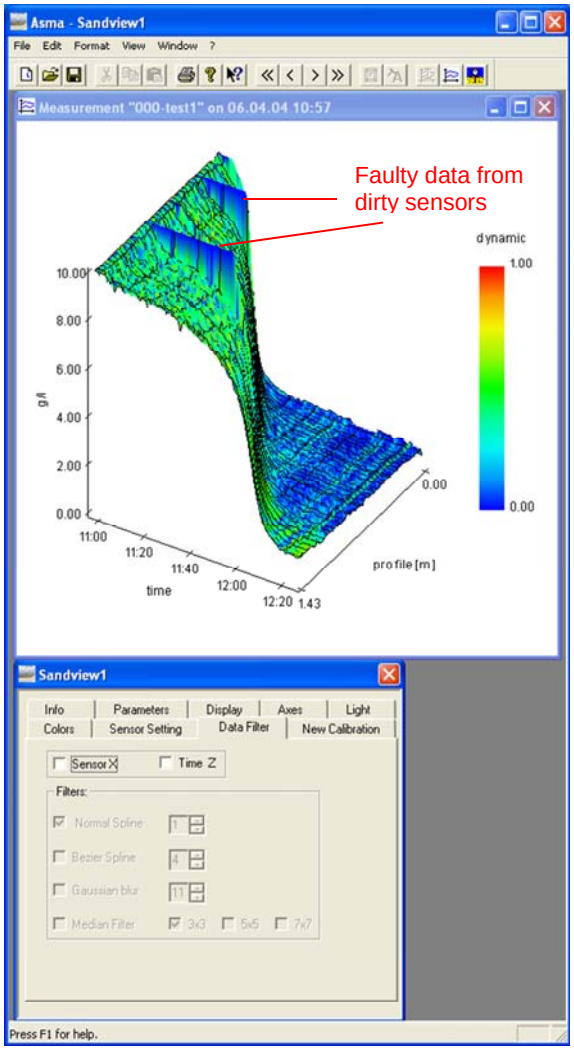
- **Normal spline:** each point is an average of its value and its direct neighbours. The effect is smoothing out of data and removing spikes, however it also decreases from the dynamics. If the process is repeated too many times, then the data become constant. The number of the filter repetition can be specified in the box to the right where 1 indicates that the filter is applied only once.
- **Bezier spline:** finds a Bezier curve (or surface) through data points. This filter has the least impact on the dynamics of reflectivity, but also only slightly decreases spikes. The box on the right indicates how many neighbouring points are used for the computation of the Bezier curve.
- **Gaussian blur:** is similar to the normal spline with the exception that neighbour values do not enter into the average exactly as the original value, but rather with a weight, which is determined by the distance from the original point. If a neighbour is further, then its weight decreases exponentially and thus its impact in the new value is lesser. The effect of this filter is blurring the image. The blurring depends on the filter's radius, which is entered in the box to the right. The radius is defined as the distance to the neighbour whose weight is only 10%.
- **Median filter:** chooses the media value among *N* (or *N* x *N*) of its neighbours. This has the strongest effect on removing spikes in the data, while also strengthening edges. *N* is specified by values on the right: *N=3, N=5* or *N=7*. If none of the check boxes is selected, then the filter is not applied.

Note that increasing the power of these filters requires more processing time and more patience. The progress bar below indicates the processing status. Until the progress bar has reached the end, only unfiltered data are displayed.

Examples:

This graphic contains two errors derived from two dirty sensors. The following figure shows an activity from the **Normal**-filter, which eliminates those errors-data.

Before:



After **Normal spline** filter:

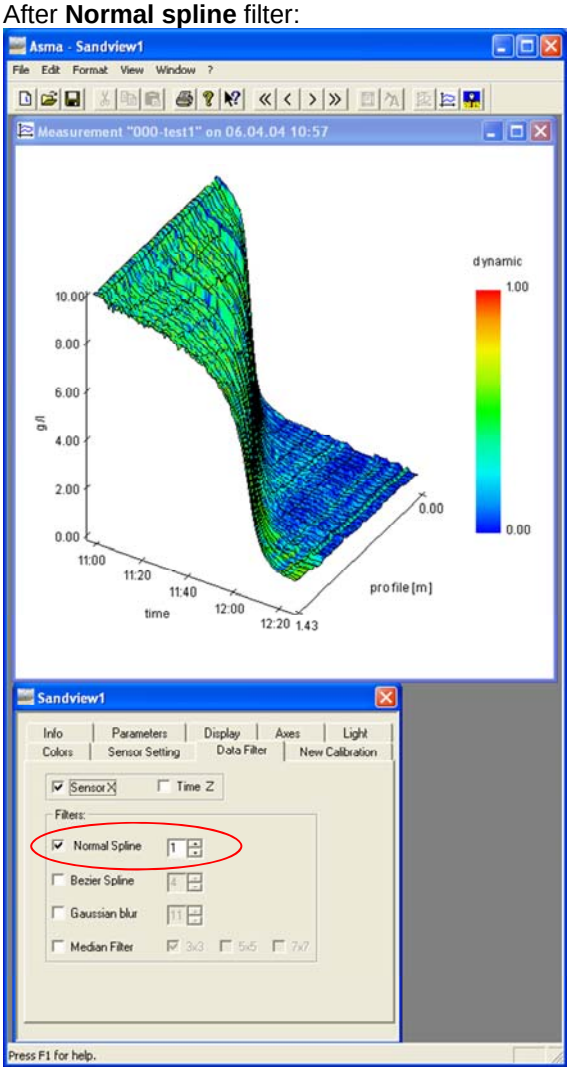
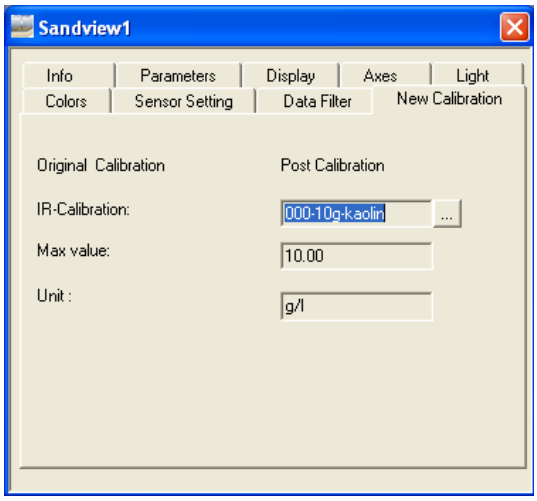


Figure: an example of how a filter can be used to “remove” the dirty sensors.

11.9. Post Calibration

The **New Calibration** card shows information about the calibration which was used when the measurements were done. The information comprises the file name of the calibration file, the maximum value and units.
The sediment data file (**.san**) stores both raw data and the calibration information. This allows for the possibility to change the calibration data if a better one was found later. It is also possible to create a new calibration in the lab using the sediment found at the actual location (post calibration). The change of the



IR-Calibration file is done by clicking the button **[…]** on the right of the current name and then selecting the correct file. The sediment file will be reloaded with the new calibration information. The original data on the hard disk are not modified. The change to the SAN file can be saved permanently by choosing the menu **File**->**Save** or **File**->**Save As...** and answering **Yes** to the prompt to save the sediment file. For safety reasons it is not possible to overwrite the old sediment file.

12. Information about an analysis

In the info window of the evaluations, text information is summed up to the currently presented graphic. These serve particularly the expression of a head for the graphic, which the graphic describes. Beside the user commends and descriptions variables can be bound also, which return to the current information of the view. So the start of the measurement can be recorded e.g. as variable, which automatically change interactive, if the user considers another time range. If you want to process the content of the info window, you must first shift to the edit – mode. This happens by double clicking at the info window or by using the right mouse button. All variables are presented now as variable name of the form *<variable>.* You can complete text now, format and insert new variables. For the entry of variables you use the right mouse button and select via object the desired variable. If possible, all formats will be converted into an equivalent print output.

12.1. Page and paragraph format for info text

The page - and paragraph format is summed up in one window. The left section thereby serves the registration of the margins. The statements are to be recorded in centimetres. Clicking the arrows beside the editor window changes the edge at respectively one millimetre. The right section of the window discontinues the alignment of the current distribution. Here a selection between right - and left level as well as of centred display is possible.

12.2. Fonts for info texts

At the font format all typical Windows format characteristics are supported. Here the font, font size and further format characteristics can be selected.

13. The graphic window of the analysis

At this window the certain graphic from the data of the view is presented. At the 3D - display a turn of the graphic can be achieved by keeping the left mouse button pressed and movement of the mouse at the same time. During the rotation process it will be shifted to a black-and-white mode. Each change of data of the view becomes directly comprehended at the graphic window at the pertinent file cards. The changes can result two-stage if an arithmetic value is desired (see Display). Thereby the simpler display is taken off by the arithmetic value display after arithmetic calculation. The scale of the Z (time) - axis is expressed in hours and minutes. The date the measurement starts is visible in the headline of the window. The scale of the X (sensor) axis is expressed in number of sensors, whereby the sensor number 0 (zero) is located at the very upper end at the instrument head. The scale of the Y (reflection) axis is expressed (besides at some 2D displays) in ASM calibration units. The size of this window can be changed by pulling at the window frame arbitrarily. Rotations carried out last however long, the larger the window. It is advisable, executing rotations at small window sizes and increasing that window afterwards.

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