WMO SPICE

SITE COMMISSIONING PROTOCOL

V2.0 (OCT, 8 2012)
V3.0 (JUL, 17 2013)

Criteria for the new version 3.0:

- **to improve the legibility of the features of the instruments (say, Appendix A)**
- **to remove or at least to substitute weekly plots of Test 3 (Site Validation Test) with 24h plots (sufficient to check the correct data transfer from the Site archive to the SPICE archive). Are they really necessary here?**
- **to organize the metadata for each instrument in view of keeping track of the operations made during the SPICE experiment (ordinary/extraordinary maintenance, malfunction reports,**

Last updates:

9 July 2013

- **Site layout and general site pictures overview to be reported at the beginning of the Appendix A. This should give a first idea about site configuration.**
- **Field calibration, 48h plot and individual instrument picture moved below each instrument specifications sheet (not all together at the end of the document)**
- **Instrument Data Validation table: a column has been added for data transfer to SPICE server (Yes/No). If the answer is YES this may imply that the data received at the SPICE data archive (NCAR) have been already checked and they match the data archived at the local site server, without reporting additional plots.**
- **Alternative to the point above: Test 3: 7 days period plots at least replaced with 24h period plots for Site Validation Test**

17/7/2013

- **Comments from: Craig, Anton, Mareile, Jordy, Shane, Mike and Isabelle**
- **Overall Site installation pictures number reduced to 4 (N,E,S,W).**
- **Sky view - horizon image of Site installation suggested**
- **R0 section created in Appendix A.**

- **Precipitation detector (R2 and R3): IOC-SPICE 4 – DAT Team recommendations reported in the table (ref. *Protocol_SPICE_DAT-Teleconf_20130710.pdf*)**
- **R3 section. Headings of Pictures, Field calibration table and 48h plots, modified to include both weighing gauges (1 and 2)**
- **Section A4 - Test 3. A third option has been added (insert 24h plots ONLY IF any discrepancies is reported)**
- **Section A5. Site Documentation Checklist revised to match the modifications (i.e. pictures and e2e validation check)**

23/7/2013

- **Comments from: Anton, Mike, Shane, Francesco**
- **Section A2 - R3. Precipitation detector. As far as I know for R3 reference there's no a specific recommendation for precipitation detector position, so it is sufficient to fill in the table originally provided (Francesco – Anton)**
- **Section A4 Test 3: Simplified. No distinction between "initiated" and "validated". Test 3 is passed (YES) when data transfer and validation are both accomplished. NO plots or dataset or error log to be reported here (they must be retained "offline" by the site manager and provided upon request) (Francesco)**
- **Section A4: "Additional information required:" removed (Mike)**
- **Section A4. Instrument Data Validation table moved below Test 1, 2 and 3 explanations**
- **Section A5: references to "Datasets" in the Site checklist table removed (Mike)**

TABLE OF CONTENTS

1. ORGANIZATION OF THE DOCUMENT

The Commissioning Protocol is organized into four parts:

1. **The site components,** data transfer and sharing pathways, and project organizational structure are outlined in Section 3;
2. **The site commissioning procedures**, including pre-commissioning activities and the Interaction with the Instrument Providers, Sections 4 to 6;
3. **SPICE Data Archive,** Section 7**.**
4. **Appendix A: the template for the Proof of Performance (POP) Report**, in which all site configuration details and commissioning activities are documented.

Appendix B outlines the SPICE Data Levels and Data Sets, and Appendix C includes a list of acronyms used throughout the document.

The first two sections are intended to provide background information on the commissioning process within the scope of the SPICE project, while the Appendix A contains the forms which are required to be filled out as part of the commissioning of the site. Once completed, these forms become the Commissioning Report.

The SPICE data archive section outlines the requirements regarding the SPICE data levels and datasets and the planned strategy for the archival of SPICE data to a central location(s).

2. PURPOSE AND SCOPE

This document is prepared by the WMO SPICE IOC. It outlines the procedures for post-installation testing and commissioning of the sites participating in the WMO SPICE experiment and documents the responsibilities for each aspect of the commissioning process.

Commissioning of a WMO SPICE site refers to the act of "turning it on" and marking the start of the collection of the "official" observations and measurements from the instruments included in the intercomparison (reference, instruments under test, ancillary measurements), and their archival on the designated Site Data Archive.
For this purpose, each site will designate a location for the Site Data Archive, which must protect the integrity of the intercomparison data.

End-to-end data quality and integrity for each instrument on each SPICE site will be verified before the commissioning can take place. It is essential that:

- Only agreed upon instruments are to be installed, in an accepted and standardized configuration;
- Each component be properly tested, and its performance verified, prior to commissioning;
- The transfer of instrument data to the Site Data Archive is validated and the archive secured.

Various individuals and organizations are referred to in this document as having responsibilities.

- SPICE IOC
- SPICE Project Team
- SPICE Data Analysis Team
- Site Manager
- Site (SPICE) Project Team
- ER refers to the Evaluation Representative, an individual named by the SPICE IOC
- IR, the Installation Representative, is identified by the Site Manager, responsible for the site configuration.
- Instrument Providers

3. CONFIGURATIONS AND ASSOCIATED COMMISSIONING REQUIREMENTS

3.1 SPICE SITE COMPONENTS

The SPICE Components include all or some of the following components:

- Field working reference systems (R3, and where applicable R2, and R1: site-specific)
- Reference measurements for snow on the ground (where applicable)
- Instruments under test provided by the host;
- Instruments under test supplied by the Instrument Providers;
- Ancillary measurements (both required and desired measurements listed):
  - Precipitation occurrence/intensity/size/type
  - Station pressure
  - Temperature/dew point
  - Relative humidity
  - Wind speed/direction (2-D and/or 3-D): different heights;
  - Manual observations
  - Vertical particle velocity
  - Net radiation
  - Snow Water Equivalent (SWE)
  - Icing occurrence
  - Visibility
  - Sky condition
- Derived or modeled ancillary parameters: wet bulb temperature, upper air temperature, snow particle density;
- Photography and video equipment for recording and archival of site conditions;

3.2 COMMUNICATION INTERFACES

The SPICE site teams are led by their respective Site Managers and are responsible to setup and manage an effective data communication system collecting, transmitting and archiving the site dataset, continuously, or at predefined intervals (e.g. daily) on the Site Data Archive.

As stated in the report of the SPICE IOC-2 meeting (Boulder), it is recommended that 6 s data be collected for gauges in reference systems and instruments under test, where possible; alternatively, 10 s or 60 s sample intervals can be used.
The frequency of the collection of ancillary measurements will be similar to that of the instruments under test, to the extent possible.

Data communication for SPICE includes the following components:

- Instrument to data logger (site specific);
- Instrument to a site data acquisition system located on site, site specific;
- Transmission of SPICE data from the site to a designated Site Data Archive;
- Transmission of SPICE data from the Site Data Archive to SPICE Archive(s) (See Section 7);
- Transmission of gauge-specific and requisite ancillary SPICE data to Instrument Providers for review.

The communication components and any future changes that may impact the availability of instruments will be documented. Any change to the configuration will be subject to a period of testing to ensure that the availability of instrument data is not affected. The IOC will review and accept the final configuration.

3.3 SPICE SITE PROJECT TEAM

The Site Manager will document the membership of the SPICE Site Project Team, including the names of the individuals who are engaged in the SPICE experiment on the respective site. This information will include reference to the roles relative to the SPICE experiment.
During the project, the participation in the SPICE Site Project Team could change. The Site Manager will to update the Site Documentation to reflect the changes (people, roles).

4. PRE-COMMISSIONING ACTIVITIES

The pre-commissioning activities are an integral part of the process of ensuring the quality of the experiment. The following sections detail the pre-commissioning activities ensuring that site infrastructure and procedures are properly managed and documented.

4.1 STATION INSTALLATION AND SCHEDULING

The IOC and the Site Managers will develop target dates for the installation and commissioning of each SPICE Site. An Installation Representative will be identified by the Site Manager to manage the installation. Site drawings, instrument siting and installation according to national standards, IOC agreed guidelines, or manufacturer recommendations, and exceptions will be documented as part of the POP Report.

4.2 TESTING OF INSTRUMENTS INCLUDED IN THE INTERCOMPARISON

The testing of instruments is conducted by the SPICE Site Project Team. Based on the results, the Site Manager will determine the readiness of instruments and the site for the formal phase of the experiment.

4.2.1 SITE DOCUMENTATION

Technical documentation for each SPICE component will include, but not limited to, the site layout, instruments details and configuration, data collection (including the data format), number of similar instruments, installation details, maintenance standards.
Specific information on the Site Documentation is provided in Appendix A.

4.2.2 MONITORING OF PERFORMANCE

The Site Manager will establish feasible procedures for monitoring the performance of instruments, identifying problems with the data, and initiating and tracking remedial actions. This may include:

- Review data, diagnostic data, quick view plots, QC reports, etc.
- Establishing Site Journals/Blogs documenting the performance and intervention on the instruments (directly – e.g. snow clearing - or indirectly – e.g. system reset -)

4.2.3 SITE MAINTENANCE

The SPICE Site Manager will ensure that site maintenance is available to limit the periods or data outage.

5. COMMISSIONING ACTIVITIES

The commissioning of a SPICE site is led by the Site Manager. The SPICE POP Report will document the status of the site operation at the start of the intercomparison.

The site commissioning process consists of the following steps:

- Determine the instrument readiness, including;
  - ⇒ Installation and configuration of the instruments participating in the experiment;
  - ⇒ Data integrity confirmation at the Site Data Archive;
- Review and approval of the POP Report by the IOC;
- Agreement on the official start of the experiment on the site.

5.1 DETERMINATION OF SITE READINESS

This sub-section details the activities to be conducted following the installation of instruments, and which are completed prior to the official start of the SPICE experiment on the site.

5.1.1 SITE READINESS EVALUATION

The Site Manager will initiate the evaluation of the SPICE Site and will provide to the IOC adequate notice of the SPICE site commissioning.

The IOC will name a representative (the ER) to conduct the evaluation of the Site Documentation prepared by the Site Manager. The ER will work with the Site Manager on the evaluation of the POP Report.

The site readiness evaluation should be sufficient to ensure proper operation of all instruments and interfaces. The assessments will include:

- Satisfactory performance of the field reference system(s).
- Satisfactory performance of each instrument under test.
- Satisfactory performance of instruments providing ancillary measurements.
- Satisfactory performance of site communication components and interfaces.
- Satisfactory performance of the data transmission to the Site Data Archive;
- Proper functioning of service backup capabilities for that particular site, if available.
- Maintenance capacity.

5.1.2 COMPLETION OF POP REPORT

The SPICE Site POP Report documents the readiness of the site and is approved by the IOC.

The POP Report includes:

- A form for recording station information and configuration, including the site layout;
- A form for documenting the configuration of SPICE field working reference configurations, including both manual and automatic measurements;
- Forms for recording the specifications of instruments under test and instruments used to provide ancillary measurements ;
- Details of tests conducted for instrument data validation;
- Details of tests conducted for end-to-end data validation;
- A checklist for all additional documentation to be recorded and submitted ;
- A table for recording commissioning milestones.

The Site Manager will provide the POP Report to the IOC, for final review.

5.1.3 INVOKING WORKAROUNDS

A workaround is a temporary solution to a system limitation that requires special attention and will be removed eventually. Any workarounds will be documented and included as part of the POP Report. Each work-around will be tracked as an open item until resolved.

5.2 APPROVAL OF SITE COMMISSIONING

The Site Manager will notify and update the IOC on the organization and completion of the tests outlined in Appendix A. Once all tests results are verified, the IOC and the Site Manager will agree on the start date of the formal experiment on the site.

In case some of the instruments under test are not ready for the start of the experiment as planned (currently Nov. 15, 2012), the experiment could commence in steps, provided that all field references and key ancillary parameters (wind speed and direction, temperature) have been commissioned.

Commissioning of additional instruments would follow as their configurations are finalized; this will allow for their inclusion in the experiment as early as feasible, with no compromise to the data quality. The Data Analysis Team will take into consideration the commissioning data for each instrument.

5.3 Implementation of Approved SPICE Site Commissioning

Upon commissioning, the site will commence the official collection of the SPICE project dataset and ancillary measurements/observations.

6. Interaction with the Instrument Providers

Instrument Providers are responsible for the delivery of their instruments to the SPICE Sites and for supporting the Site Managers in verifying their proper functioning before and during SPICE.

6.1 Pre-Commissioning Activities: Engagement of the Instrument Providers

During the installation, the Site Manager or a representative will engage the Instrument Provider regarding the preparation of their instruments, to ensure the operation within recommended standards.

The Site Manager would confirm with the Instrument Provider the functioning of the instrument prior to the commissioning of the site. This could be done by the sharing of instrument and/or ancillary data and pictures, coordinated site visits, or any other method agreed upon by the two parties.

The Site Manager should be able to indicate in the Commissioning Report the confirmation from the Instrument Provider that the instrument operates as expected.

6.2 Engagement of Instrument Providers during the Experiment

During the experiment, each Instrument Provider will be given access to the unprocessed output from its own instrument(s), and a minimum set of corresponding ancillary data consisting of air temperature, relative humidity, and wind speed. These data are provided only for ensuring the proper functioning of the instruments, and will neither be reported nor published prior to publication of the SPICE Final Report.

The Site Manager will coordinate the data transfer to the Instrument Provider(s), including such aspects as the frequency, methodology, etc. It is desired that this data transfer is in place prior to the start of the experiment. The Instrument Provider is expected to alert the Site Manager in the event that a malfunction of an instrument is noted, and provide support to the Site Project team (including site visits), if needed, to address the failure.

The Instrument Providers could visit the intercomparison sites, after prior arrangements are made with the Site Manager.

7. SPICE Data Archival

The SPICE Project Team will establish and maintain a SPICE Archive on at least one SPICE designated Server where the Site Intercomparison Datasets and the Input Documentation will be stored. This will facilitate the preparation of data for the individual and comparative data analysis and the preparation of the Final Report. A description of the data levels and datasets for SPICE, as currently defined, is provided in Appendix B.

The National Centre for Atmospheric Research (NCAR), USA, will host the SPICE Archive and provide quick view capabilities of (near) real time data. Options for a second SPICE Archive are being explored by Environment Canada, Canada.

Each Site Manager will work towards preparing the transfer of Level 1 and Level 2a datasets to the SPICE Archive(s). The IOC will provide to the Site Managers the requirements regarding the data transfer to enable the preparation of datasets (format change, setup of data uploads/availability, etc…)

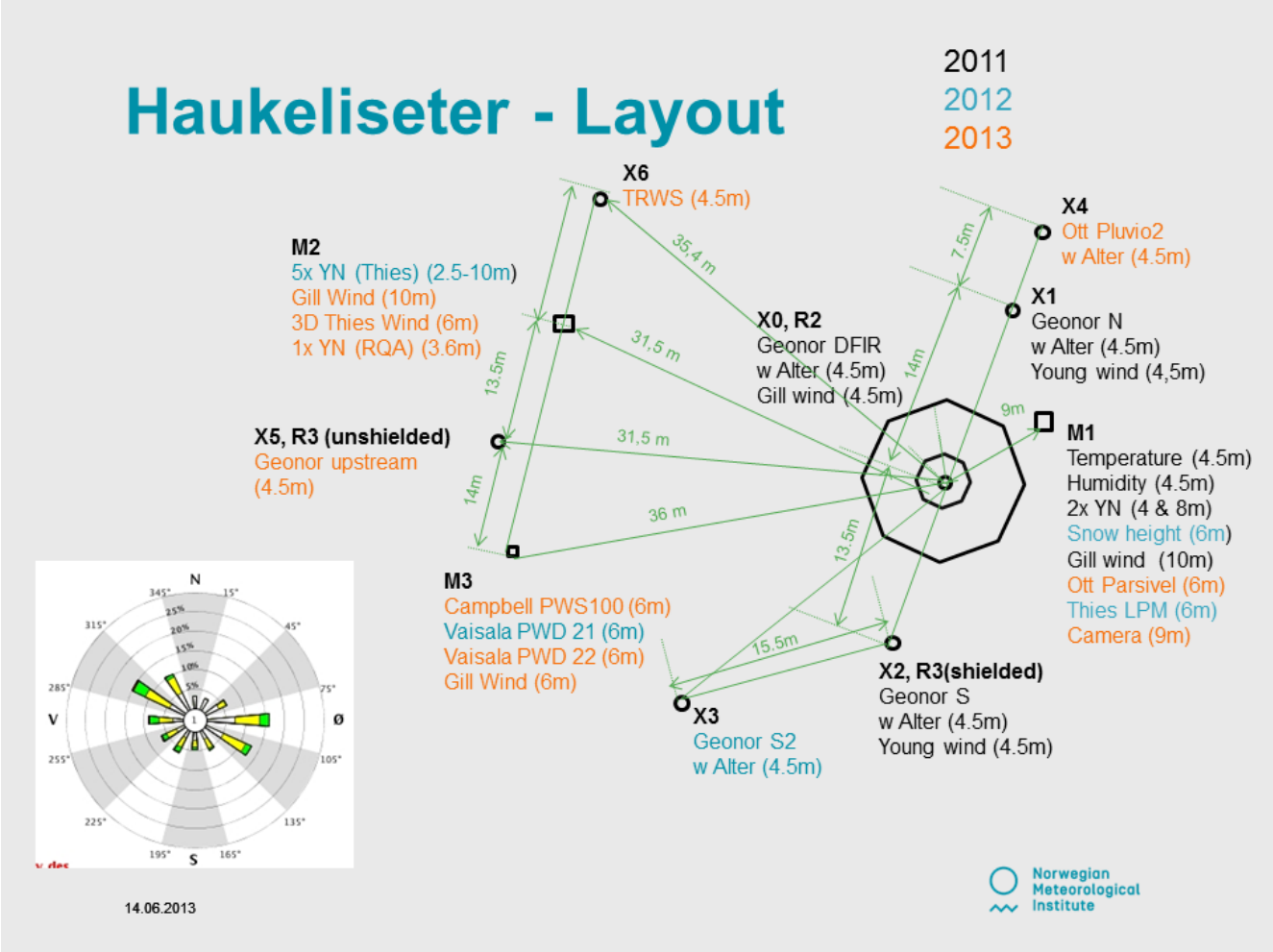
The data transfer between the Site Data Archive and the SPICE Archive is expected to be established and validated within 3 months of the official start of the experiment, and implemented based on site specific conditions and limitations.

APPENDIX A: PROOF OF PERFORMANCE (POP) FORMS

SECTION A1: STATION INFORMATION

Station name	Haukeliseter
Reference town	Vinje
Station latitude	59° 48.71' N
Station longitude	7° 12.86' E
Station elevation in metres	991 m

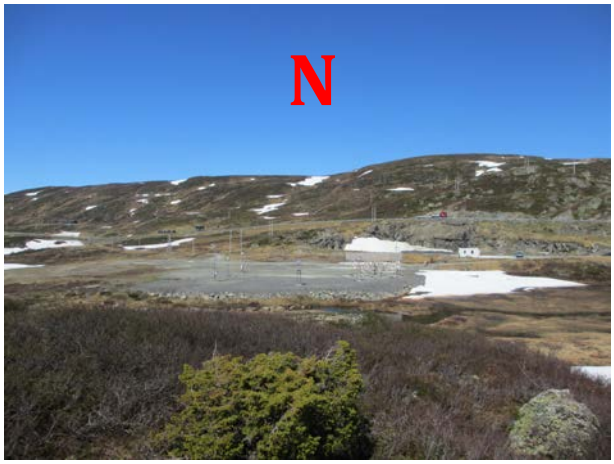
Insert here a Site Layout indicating the location of SPICE references and all instruments, including distances and the direction of the prevailing winter winds.



Figur 1: Site Layout Haukeliseter

Insert here a set of pictures documenting the overall site installation (views from N, E, S, W).

It is suggested to submit here also a horizon / sky view diagram taken with a camera., if available



Figur 3: North View

Figur 2: East View

Figur 5: South View

Figur 4: West View

SECTION A2: SPICE Field Working Reference System configuration

Field Reference Type R0 – N/A

R0 type	MANUAL ☐ AUTOMATIC ☐
Measurement frequency, planned	
Measurement methodology planned (volume, weight, etc)	

Additional information required: Provide details of the planned measurement procedure.

Configuration of the bush

Description of surrounding obstacles (including distance/direction from, height, and type)	
Bush area	
Average height of the bush	
Bush vegetation type	*i.e plant species, deciduos leaves or not, etc.*
Maintenance details	*i.e prune every XX months;*

Collector and shield specifications (manual configuration)

Model	
Inlet area	
Installation height (measured at the top of the collector)	
Number of collectors available for the experiment	
Shield type	

Weighing gauge specifications (automatic configuration)

Make and model	
Serial number	
Firmware version (if applicable)	
Number of transducers (if applicable)	
Height of installation (measured from the top of the gauge)	
Heater configuration and algorithm	
Output data message format	
Frequency of data sampling	

Single Alter shield

According to the SPICE instructions?	☐ Yes ☐ No
Attached to the post of the weighing gauge?	☐ Yes ☐ No
If different, provide details:	

Picture. Field Reference Type R0

Table. Field Calibration of Reference Type R0 (if applicable)

48h Observation Table for Reference Type R0 (Manual) or Plots (Automatic)

Field Reference Type R1 (Manual) – N/A

Measurement frequency, planned	
Measurement methodology planned (volume, weight, etc)	

Additional information required: Provide details of the planned measurement procedure.

Configuration of the DFIR fence

Description of surrounding obstacles (including distance/direction from, height, and type)	
Diameter	
Height of the outer fence (measured at the top)	
Height of the inner fence (measured at the top)	
Length of slats	
Width of slats	
Slat material	

Collector and shield specifications

Model	
Inlet area	
Installation height (measured at the top of the collector)	
Number of collectors available for the experiment	
Shield type	

Picture. Field Reference Type R1 (Manual)

Table. Field Calibration of Reference Type R1 (Manual)

48h Observation Table for Reference Type R1 (Manual)

Field Reference Type R2 (Automatic)

Configuration of the DFIR fence

Description of surrounding obstacles (including distance/direction from, height, and type)	Distance between the outer DFIR-fence and the two closest precipitation gauges is ca. 8 meters. All three sensors are placed on a line perpendicular to the main wind direction (200°). A 10 m meteorological mast is placed in a distance of 9 m (60°), for further information please refer to the layout
Diameter	12 m
Height of the outer fence (measured at the top)	4.55m
Height of the inner fence (measured at the top)	4.05m
Length of slats	1.50m
Width of slats	0.04 m
Slat material	wood

Single Alter shield

According to the SPICE instructions?	☐ Yes ☒ No
Attached to the post of the weighing gauge?	☒ Yes ☐ No
If different, provide details:	The Alter shield is according to SPICE instructions, but the top height of the shield has the same height as the Geonor opening, To be changed in summer 2013

Weighing gauge (WG)

Make and model	Geonor TB200 1000mm
Serial number	N/A
Firmware version (if applicable)	N/A
Number of transducers (if applicable)	3
Height of installation (measured from the top of the gauge)	4.55m
Heater configuration and algorithm	NCAR-heater and algorithm Heater Description:

	Two heatingtapes (received from NOAA (Bruce Baker) are fixed to the Geonor orifice in the following locations: 1. Outside of orifice cylinder at top 2. Outside of orifice cylinder at bottom (inside housing) A pt100 is taped to the orifice cylinder at the top to measure the rim temperature. The air temperature is measured by a pt100 inside a radiation screen in ca. 4 m height, mounted at the meteorological mast, 9 m away from the gauge Heating Control: The heating turns on when the ambient temperature is within -5°C to +2°C . Rim temperature is kept to +2°C. Heating Power: Power Supply: 24VDC Heater power: 50W (each heater), parallel coupled
Output data message format	1 min Raw bucket content in mm: RA1_01, RA2_01 and RA3_01
Frequency of data sampling	Datasampling is 6s by the logger, which produces 1min averages.

Precipitation detector

Make and model	RQA6.1 MPS System (capacitive)
output data message format	X7YN_01
Data sampling frequency	1 min
Height of installation. *DAT team recommend the following place for an optical precipitation detector or precipitation type sensor inside the DFIR:* • *Inside the inner fence* • *75 cm below the gauge opening, corresponds to half way down the inner fence*	3.10m, outside DFIR (will be changed in summer 2013, suggesting installation in DFIR) An optical precipitation detector will be placed inside DFIR as recommended by IOC before the next winter
Location of installation relative to WG in reference system. *DAT team recommend to locate the optical precipitation detector or precipitation type:* • *perpendicular to the main wind direction* • *if possible using two precipitation sensors at different places to account for different wind directions.* • *in the middle between Alter and inner fence*	Distance: 31.5m, direction: 290°,

Picture. Field Reference Type R2 (Automatic)

Figur 6: Haukeliseter R2 - Geonor with Alter inside DFIR

Figur 7: Capacitive Precipitation Sensor, RQA6.1

Table. Field Calibration of Reference Type R2 (Automatic)

Observations:

	Level 1 (before)		level 2 (after flask 1)		Level 3 (after flask 3)	
DFIR, R2	mean	Standard deviation (SD)	mean	SD	mean	SD
RA1	778,755	0,146	783,61	0,149	788,501	0,189
RA2	762,113	0,111	766,744	0,166	771,481	0,137
RA3	781,552	0,138	786,44	0,191	791,374	0,209
RA_mean	774,14	0,22952342	778,931333	0,29366307	783,785333	0,31332252

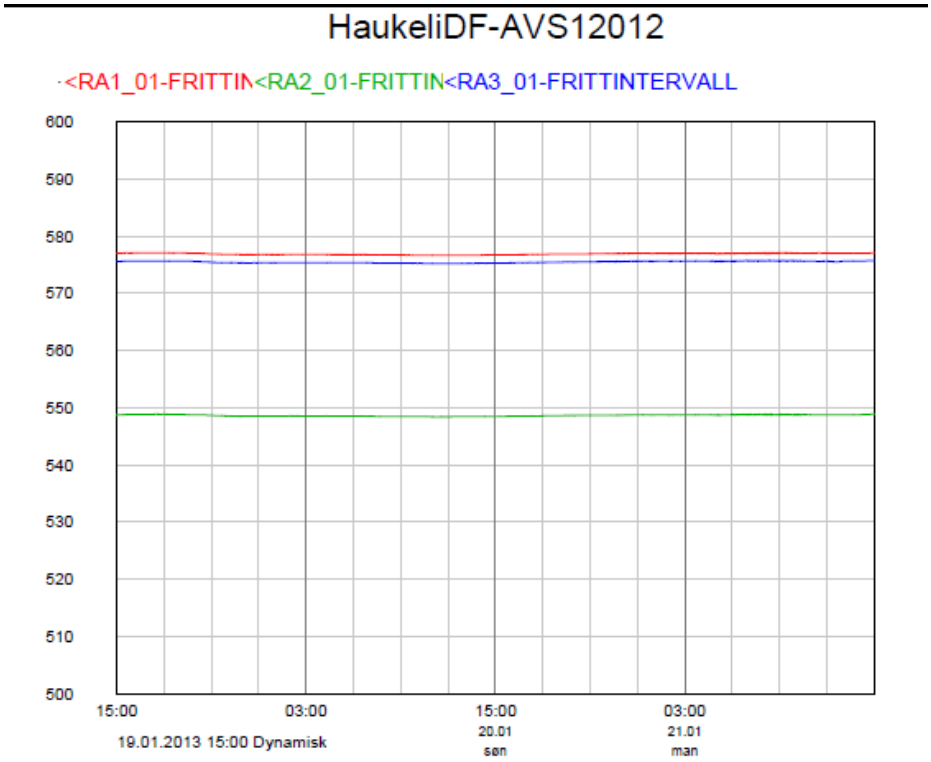
Test 1: level 1 to level 2

DFIR, R2	Measured amount (level 2 – level 1)	SD	Weighed amount (truth)	SD	Mean deviation	SD
RA1	4,855	0,20860729	4,865	0,0005	-0,01	0,04351725
RA2	4,631	0,19969226	4,865	0,0005	-0,234	0,03987725
RA3	4,888	0,23563743	4,865	0,0005	0,023	0,05552525
RA_mean	4,79133333	0,37271839	4,865	0,0005	-0,073666667	0,046306583

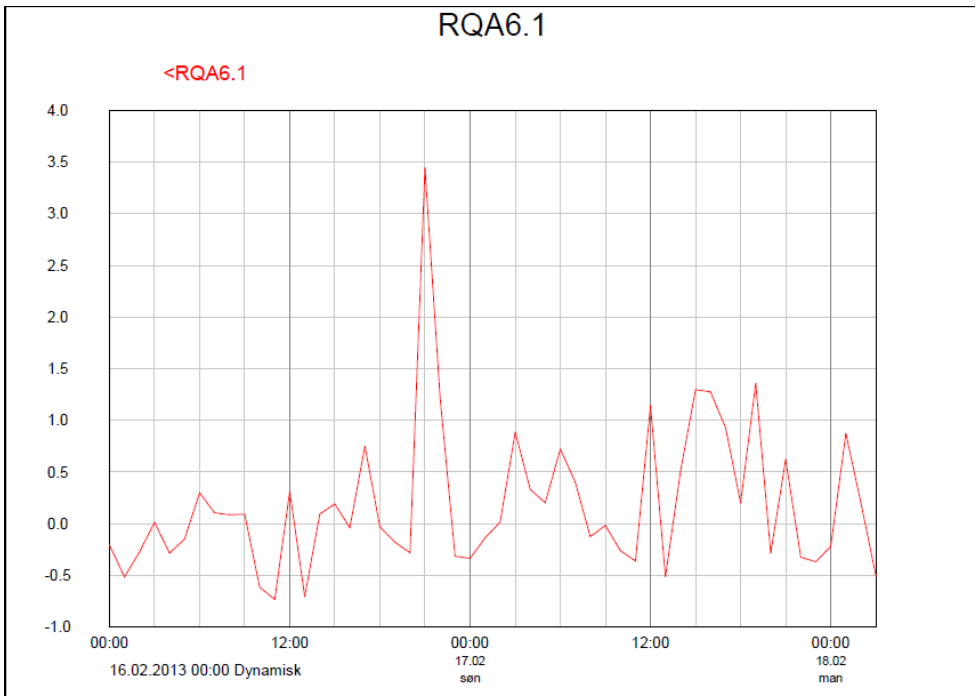
Test 2: level 2 to level 3

DFIR, R2	Measured amount (level 3 – level 2)	SD	Weighed amount (truth)	SD	Mean deviation	SD
RA1	4,891	0,2406699	4,872	0,0005	0,019	0,05792225
RA2	4,737	0,21523243	4,872	0,0005	-0,135	0,04632525
RA3	4,934	0,28312895	4,872	0,0005	0,062	0,08016225
RA_mean	4,854	0,42942869	4,872	0,0005	-0,018	0,061469917

48h Plot. Field Reference Type R2 (Automatic)



Figur 8: 48 hour plot for Haukeliseter R2 (Geonor in DFIR)



Figur 9: 48-hours-plot for Precipitation detector X7YN (RQA6.1), arbitrary units

Field Reference Type R3 (Automatic)

Presence of a WG with a single Alter shield?	☒ Yes ☐ No
Presence of a WG with no shield?	☒ Yes ☐ No
Description of surrounding obstacles (including distance/direction from, height, and type)	**Distance of R3a (with shield) to DFIR outer fence: 7.5m, direction 20°, vertical to main wind directions** **Distance of R3b (without shield) to DFIR: 25m**
Distance between WGs (as close as possible, but exceeding minimum distance between gauges for a Class 1 siting configuration (as per WMO guidelines): Generally a flat area within 10m of instrument. This area surrounded by generally open space with a slope of less than 1:3 (19°) that is considered to be representative of the large scale area.	**28.2 m**

Weighing gauge (1 of 2)

Make and model	Geonor 1000mm
Serial number	N/A
Firmware version (if applicable)	N/A
Number of transducers (if applicable)	3
Height of installation (measured from the top of the gauge)	4.55m
Heater configuration and algorithm	NCAR heater and NCAR algorithm, see description at R2
Output data message format	1 min raw bucket content in mm, X2RA1_01, X2RA2_01, X2RA3_01
Frequency of data sampling	Datasampling is 6s by the logger, which produces 1min averages.

Weighing gauge (2 of 2)

Make and model	Geonor 1000m
Serial number	N/A
Firmware version (if applicable)	N/A
Number of transducers (if applicable)	3
Height of installation (measured from the top of the gauge)	4.55m
Heater configuration and algorithm	NCAR heater, NCAR algorithm, see description at R2
Output data message format	1 min Raw bucket content in mm, X5RA1_01, X5RA2_01, X5RA3_01
Frequency of data sampling	Datasampling is 6s by the logger, which produces 1min averages.

Single Alter shield

According to the SPICE instructions?	☐ Yes ☒ No
Attached to the post of the weighing gauge?	☒ Yes ☐ No
If different, provide details:	shield is mounted at the same height as the Geonor opening, to be changed in summer 2013

Precipitation detector

Make and model	Same as for R2
Data output format	
Data sampling frequency	
Height of installation (at or above gauge height to avoid measuring blowing snow)	
Location of installation relative to WGs in reference system. Close proximity (without obstructing flow) is desired, but central location also possible. IOC recommended installation outside the wind shield, depending on specific configuration employed.	

Pictures. Field Reference Type R3 (Automatic).

Figur 10: R3 - shielded weighing gauge (left) and unshielded weighing gauge (right)

Tables. Field Calibration of Reference Type R3 (Automatic) Weighing Gauges 1 & 2

Observations (Weighing gauge 1, shielded):

Geonor S, R3 shielded	level1 (before)		level 2 (after flask 1)		level3 (after flask 2)	
	mean	SD	mean	SD	mean	SD
X1RA1	589,075	0,131	593,904	0,133	598,816	0,159
X2RA2	584,020	5,231	588,989	4,688	592,622	4,167
X3RA3	590,462	0,112	595,318	0,161	600,185	0,147
X1RA_mean	587,852067	5,23420348	592,737193	4,69299889	597,20748	4,17281073

Test 1 (level 1 to level 2)

Geonor S, R3 shielded	Measured amount (level 2 – level 1)	SD	Weighed amount (true)	SD	Mean deviation	SD
X1RA1	4,829	0,18651585	4,867	0,0005	-0,038	0,034788412
X2RA2	4,969	7,02480974	4,867	0,0005	0,102147368	49,3479521
X3RA3	4,857	0,19592005	4,867	0,0005	-0,010178947	0,038384915
X1RA_mean	4,88512632	7,03001598	4,867	0,0005	0,018126316	16,47370848

Test 2 (level 2 to level 3)

Geonor S, R3 shielded	Measured amount (level 3 – level 2)	SD	Weighed amount (true)	SD	Mean deviation	SD
X1RA1	4,91188703	0,20671937	4,856	0,0005	0,055887035	0,042733149
X2RA2	3,63275995	6,27267673	4,856	0,0005	-1,223240051	39,34647359
X3RA3	4,86621309	0,21767348	4,856	0,0005	0,010213094	0,047381995
X1RA_mean	4,47028669	6,27985573	4,856	0,0005	-0,385713308	13,14552958

Result:

Transducer 2 shows too high variations and can't be used for analysis – several changes have been performed, without resulting in better performance. Continue with debugging.

Suggestion to calculate mean Precipitation Accumulation with transducers 1 and 3.

Observations (Weighing gauge 2, shielded):

R3-unshielded, X5	level1 (before)		level 2 (after flask 1)		level3 (after flask 2)	
	mean	**SD**	**mean**	**SD**	**mean**	**SD**
X5RA1	495,864	0,093	500,684	0,086	505,458	0,095
X5RA2	497,095	0,062	501,910	0,053	506,832	0,080
X5RA3	496,299	0,054	501,093	0,070	505,853	0,070
X5RA_mean	496,419259	0,12366096	501,229275	0,12294637	506,047714	0,14285681

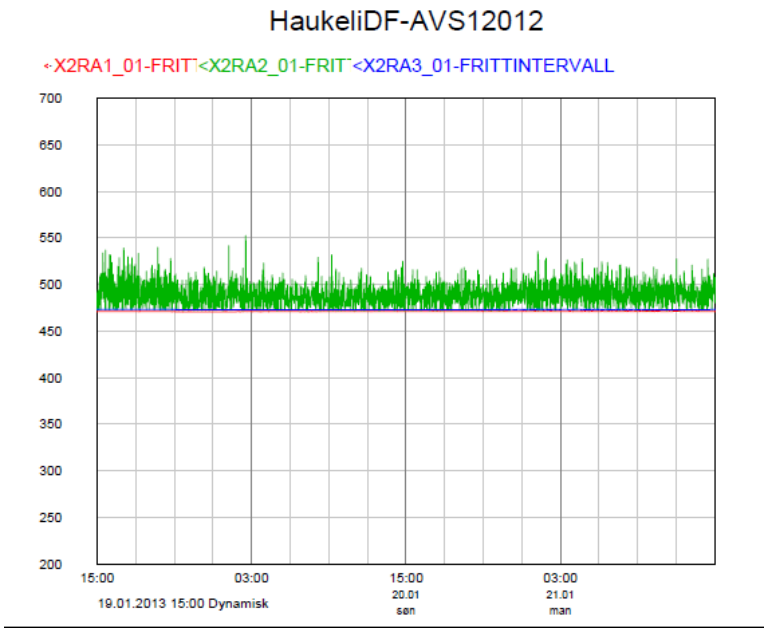
Test 1 (level 1 to level 2)

	Measured amount (level 2 – level 1)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X5RA1	4,820	0,12658601	4,882	0,0005	-0,061	0,016024268
X5RA2	4,816	0,08105611	4,882	0,0005	-0,065880032	0,006570343
X5RA3	4,794	0,08839532	4,882	0,0005	-0,087160225	0,007813983
X5RA_mean	4,8100161	0,17437845	4,882	0,0005	-0,071483897	0,010136198

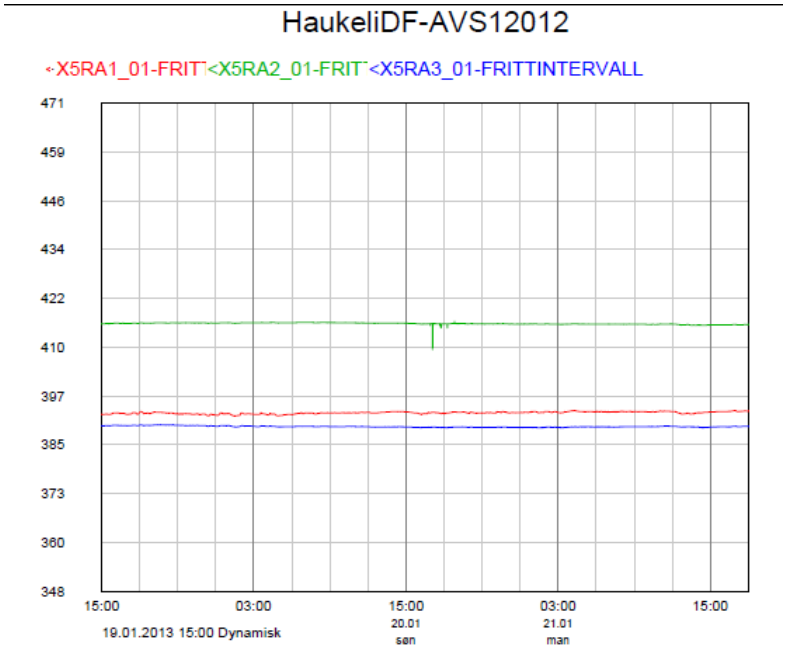
Test 2 (level 2 to level 3)

	Measured amount (level 3 – level 2)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X5RA1	4,77365217	0,12811852	4,8965	0,0005	-0,122847826	0,016414605
X5RA2	4,92156522	0,09620591	4,8965	0,0005	0,025065217	0,009255828
X5RA3	4,76009938	0,09926704	4,8965	0,0005	-0,136400621	0,009854195
X5RA_mean	4,81843892	0,18847779	4,8965	0,0005	-0,078061077	0,011841543

48h Plots. Field Reference Type R3 (Automatic). Weighing Gauges 1 and 2



Figur 11: 48 hour plot R3, shielded gauge



Figur 12: 48 hour plot R3, unshielded gauge

Field Reference for the Measurement of Snow on the Ground

Method used	**N/A**
Equipment used	
Frequency of measurement	

Picture. Field Reference for the Measurement of Snow on the Ground

Table. Field Calibration for the Measurement of Snow on the Ground

48h Observation Table. Field Reference for the Measurement of Snow on the Ground

SECTION A3: INSTRUMENT METADATA REPORT

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: _____GEONOR X1,N_____
Instrument number ____1__ of __25

Manufacturer	Geonor
Model	Geonor 1000m, 3 transducers
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Distance to out er fence of DFIR: 8m, Distance to R2: 14m Direction vertical to main wind direction; on a line with R2-Geonor(DFIR) and R3a-GEONOR (with shield) and Pluvio2 Distance to Pluvio 2: 7m
Orientation	N/A
Height (measured at top)	4.55
Shield (if applicable)	Single Alter wind shield, same height as Geonor opening, to be changed in summer 2013
Heating (if applicable)	1 Geonor-heater and NCAR algorithm Heater Description: One Geonorheater is fixed to the Geonor orifice at the outside of the orifice cylinder at top A pt100 is taped to the orifice cylinder at the top (inbetween the little opening of the heater construction) to measure the rim temperature. The air temperature is measured by a pt100 inside a radiation screen in ca. 4 m height, mounted at the meteorological mast, 9 m away from the gauge Heating Control: The heating turns on when the ambient temperature is within -5°C to +2°C . Rim temperature is kept to +2°C. Power Supply: 24VDC Heater power: 200W

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	1 min bucket content in mm X1RA1_01, X2RA2_01, X3RA3_01
Data sampling frequency	6 sec (stored locally – not continuously, no real time access)

Instrument Picture:

Figur 13: Geonor X1, N

Field Calibration of Geonor X1:

Observations:

Geonor N, X1	Level 1 (before)		Level 2 (after flask 1)		Level 3 (after flask 2)	
	mean	SD	mean	SD	mean	SD
X1RA1	508,177	0,119	512,823	0,116	517,542	0,118
X1RA2	527,916	0,069	532,820	0,077	537,705	0,081
X1RA3	529,372	4,967	533,953	9,596	536,846	4,582
X1RA_Mean	521,822	1,718	526,532	3,263	530,697	1,594

Test 1: Level 1 to Level 2

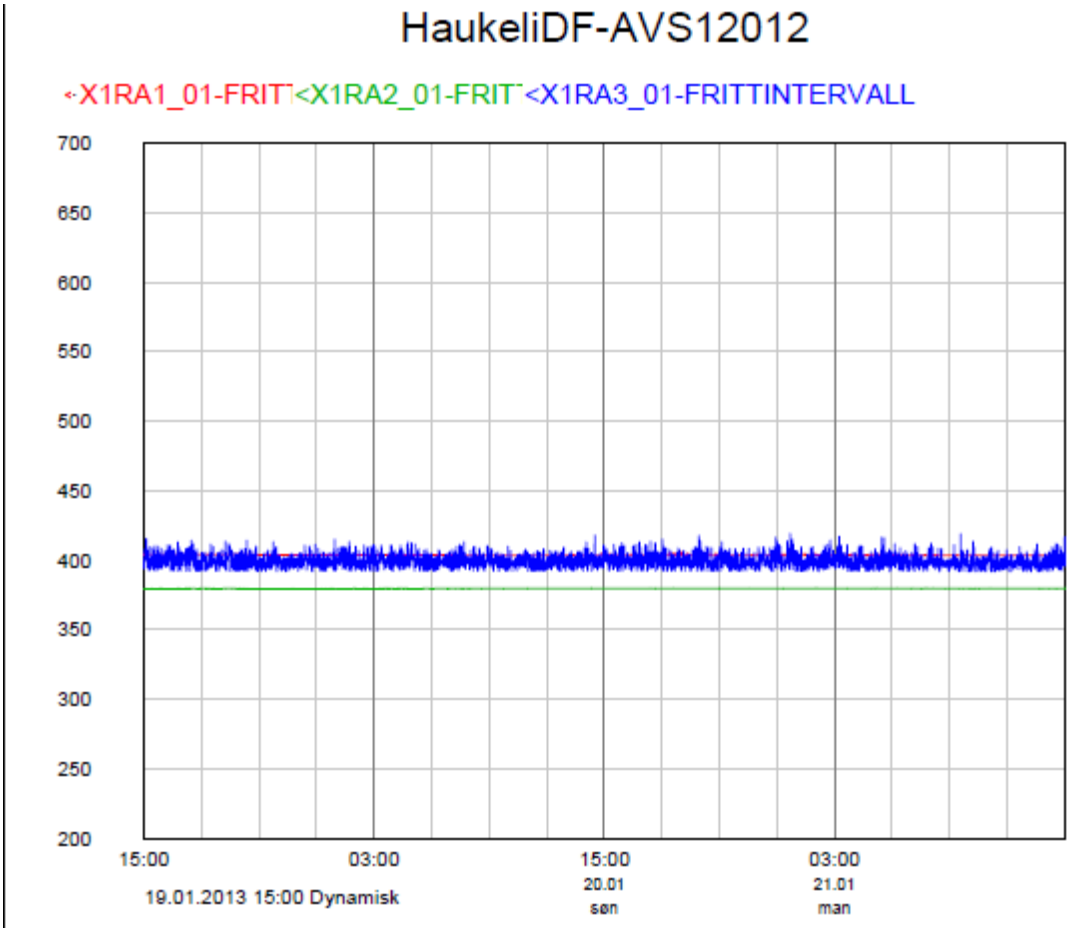
	Measured amount (level 2 – level 1)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X1RA1	4,647	0,16615467	4,869	0,0005	-0,221688406	0,027607623
X1RA2	4,904	0,10351702	4,869	0,0005	0,035451182	0,010716024
X1RA3	4,581	10,8051755	4,869	0,0005	-0,287912662	116,7518188
X1RA_Mean	4,710	3,692	4,869	0,001	-0,158	38,930

Test 2: Level 2 to Level 3

	Measured amount (level 3 – level 2)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X1RA1	4,7180602	0,16524962	4,8815	0,0005	-0,163439799	0,027307686
X1RA2	4,88543478	0,11202996	4,8815	0,0005	0,003934783	0,012550961
X1RA3	2,89272575	10,6336987	4,8815	0,0005	-1,988774247	113,0755492
X1RA_Mean	4,165	3,637	4,882	0,001	-0,716	37,705

Resultat: Transducer 3 shows too high variations and can not be used. Several attempts to change have been performed. Debugging continues. Suggestion: Use only two transducers (1 and 2) to calculate total accumulation of the gauge.

48-hour plot:



Figur 14: 48-hour plot for Geonor X1, N

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: _____GEONOR X3, S2_____
Instrument number _____2_ of ___25____

Manufacturer	Geonor
Model	1000mm, 3 transducers
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Distance to DFIR: 22m Distance to R2: 28 m Distance to R3a:15.5m, distance to R3b: Southwest direction from Geonor (230°)
Orientation	
Height (measured at top)	4.55m
Shield (if applicable)	Single Alter wind shield, mounted at the same height as GEONOR opening, to be changed in summer 2013
Heating (if applicable)	1 Geonor-heater and NCAR algorithm Heater Description: One Geonorheater is fixed to the Geonor orifice at the outside of the orifice cylinder at top A pt100 is taped to the orifice cylinder at the top (inbetween the little opening of the heater construction) to measure the rim temperature. The air temperature is measured by a pt100 inside a radiation screen in ca. 4 m height, mounted at the meteorological mast, 9 m away from the gauge Heating Control: The heating turns on when the ambient temperature is within -5°C to +2°C . Rim temperature is kept to +2°C. Power Supply: 24VDC Heater power: 200W

Data output

Data communication protocol	Digital Output
Output data message format (include	Bucket content in mm

description of fields)	X3RA1_01, X3RA2_01, X3RA3_01
Data sampling frequency	6 sec (stored locally – not continuously, no real time access)

Instrument Picture:

Figur 15: Geonor X3, S2

Field Calibration

Observations

Geonor S2, X3	Level 1 (before)		level 2 (after flask 1)		Level 3 (after flask 2)	
	mean	SD	mean	SD	mean	SD
X3RA1	574,887	0,184	579,588	0,174	584,373	0,184
X3RA2	566,908	0,137	571,691	0,163	576,324	0,163
X3RA3	579,465	0,153	584,339	0,168	589,323	0,189
X3RA_Mittel	573,753582	0,2757356	578,539333	0,29191704	583,34	0,31071934

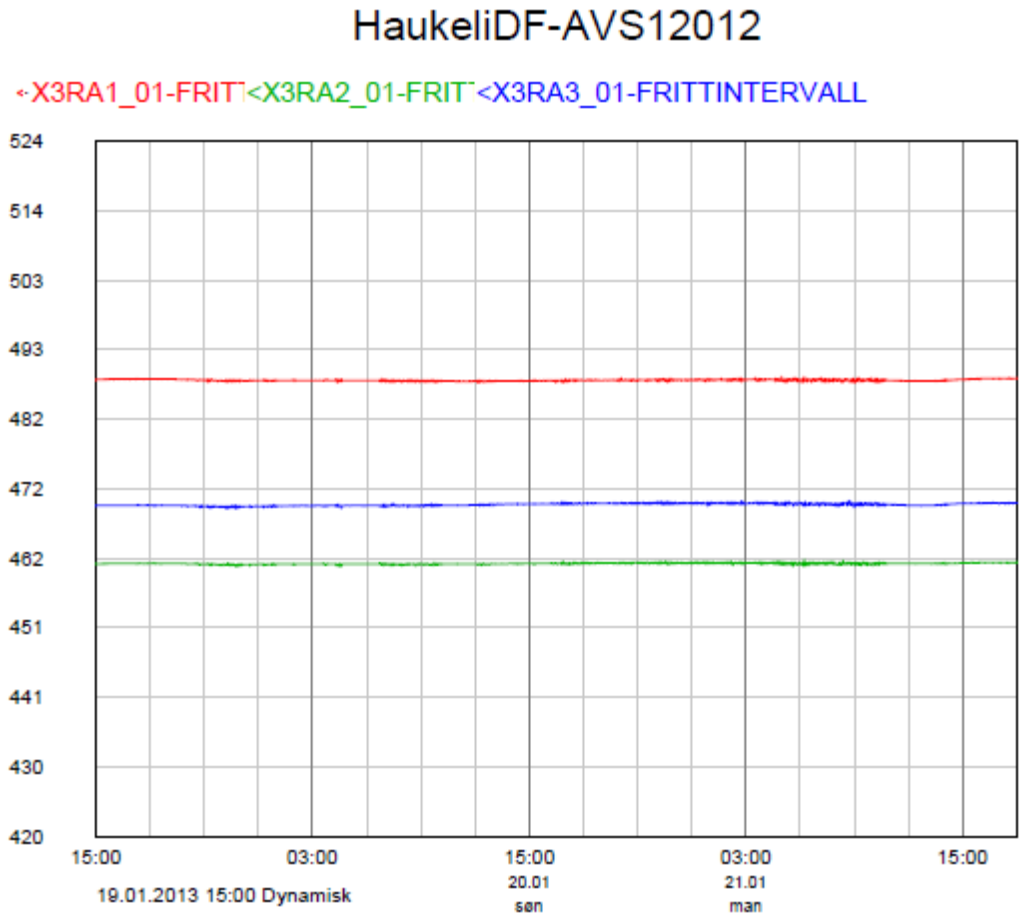
Test 1: Level 1 to Level 2

	Measured amount (level 2 – level 1)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X3RA1	4,701	0,25341036	4,855	0,0005	-0,154	0,064217063
X3RA2	4,783	0,21275179	4,855	0,0005	-0,071858209	0,045263574
X3RA3	4,874	0,22752042	4,855	0,0005	0,019126866	0,05176579
X3RA_Mittel	4,78575124	0,40155408	4,855	0,0005	-0,068748756	0,053748809

Test 2: Level 2 to Level 3

	Measured amount (level 3 – level 2)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X3RA1	4,7845	0,2537445	4,8815	0,0005	-0,097	0,06438652
X3RA2	4,63344444	0,23078163	4,8815	0,0005	-0,248055556	0,053260409
X3RA3	4,98405556	0,25321065	4,8815	0,0005	0,102555556	0,064115885
X3RA_Mittel	4,80066667	0,42633562	4,8815	0,0005	-0,080833333	0,060587604

48 – hour Plot:



Figur 16: 48 hour plot for Geonor X3, S2

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: _____Ott Pluvio_2_____
Instrument number ____3__ of __25_____

Manufacturer	Ott
Model	Pluvio 2
Serial number	291424
Firmware version (if applicable)	

Field configuration

Location on site	15.5m from DFIR outer fence, 7.5m from R3a-Geonor, All three are on a line vertical to the main wind direction
Orientation	N/A
Height (measured at top)	4.55 m
Shield (if applicable)	Alter Wind Shield
Heating (if applicable)	Pluvio Standard heating

Data output

Data communication protocol	digital
Output data message format (include description of fields)	1 min data: X4HEATSTATPLUV (Status heating); STATPLUV (Status pluvio); RA_01 (raw bucket content mm); TIPLUV_01 (instrument temperature); RAPLUVDELAYED_01 (non real time bucket content); RRPLUVDELAYED_01 (non real time accumulation since); RACPLUV_ALGOR_01(corrected non real time bucket content); RRPLUV_01(real time accumulation since)
Data sampling frequency	6 s (not available)

Instrument Picture

Figur 17: Pluvio 2

Field Calibration

Observations:

Pluvio2, X4	Level 1 (before)		Level 2 (after flask 1)		Level 3 (after flask 2)	
	mean	SD	mean	SD	mean	SD
X4RACPLUVALG	109,366	0,028	114,255	0,086	119,186	0,041

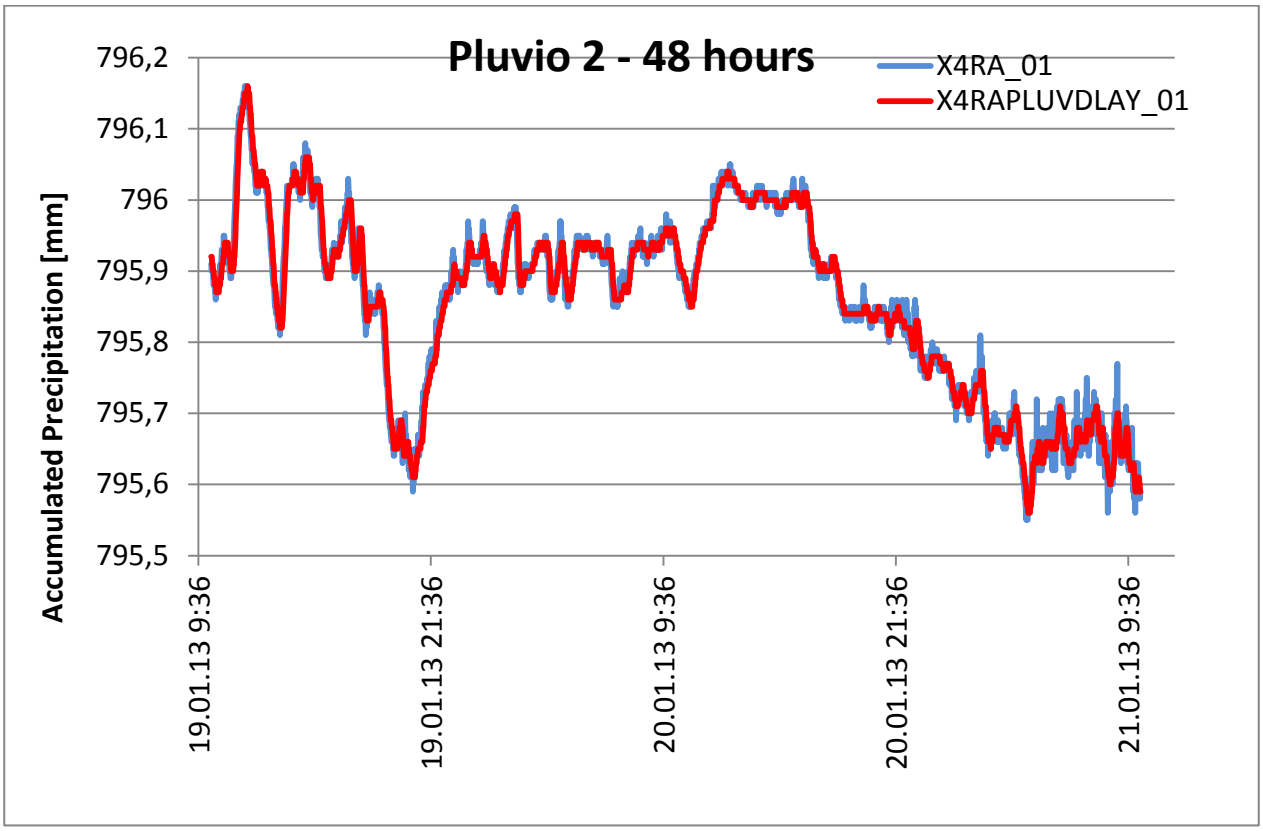
Test 1: Level 1 to Level 2:

	Measured amount (level 2 – level 1)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X4RACPLUVALG	4,889	0,09042967	4,870	0,0005	0,020	0,008177775

Test 2: Level 2 to Level 3:

	Measured amount (level 3 – level 2)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X4RACPLUVALG	4,93107769	0,09518589	4,8955	0,0005	0,035577694	0,009060604

48 – hour plot:


Pluvio 2 - 48 hours
X4RA_01
X4RAPLUVDLAY_01
Accumulated Precipitation [mm]
796,2
796,1
796
795,9
795,8
795,7
795,6
795,5
19.01.13 9:36
19.01.13 21:36
20.01.13 9:36
20.01.13 21:36
21.01.13 9:36

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: _____TRWS 405____
Instrument number _____4 of 25___

Manufacturer	MPS System
Model	TRWS 405
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Distance to DFIR 29m, 310grad distance to mast M2 (upstream mast): 8.5m distance to Geonor R3-b: 30m M2, R3-b and TRWS-405 are on a line, ca. 10 deg from North/South (vertical to main wind direction)
Orientation	
Height (measured at top)	4.5m (TBC during summer)
Shield (if applicable)	N/A
Heating (if applicable)	Rim heating included in the instrument

Data output

Data communication protocol	digital
Output data message format (include description of fields)	X6RA_Gramm_01(raw bucket weight in milligram); X6RACTRWS_ALGOR_01(corrected bucket weight in mm); X6RR_01 (corrected accumulation since)
Data sampling frequency	1 min

Instrument picture

Figur 18: TRWS 405

Field Calibration:

Observations:

TRWS, X6	Level 1 (before)		level 2 (after flask 1)		Level 3 (after flask 2)	
	mean	SD	mean	SD	mean	SD
X6RACTRWSALG	65,050	0,000	70,048	0,004	74,972	0,010

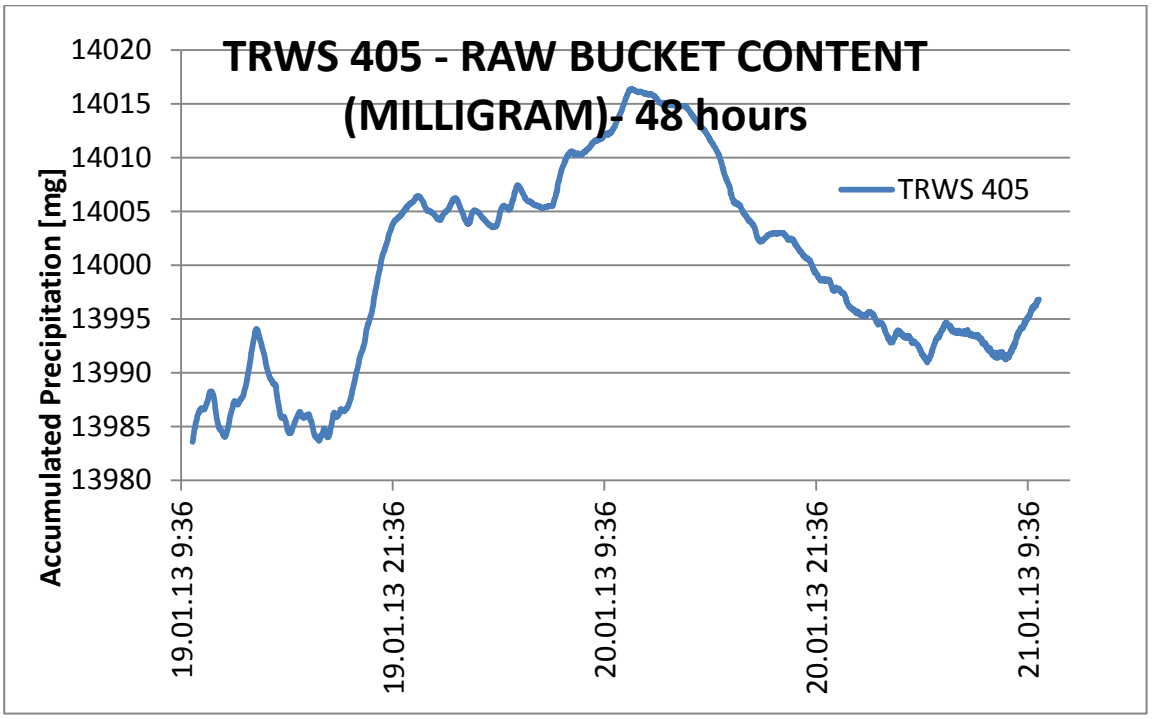
Test 1: From Level 1 to Level 2:

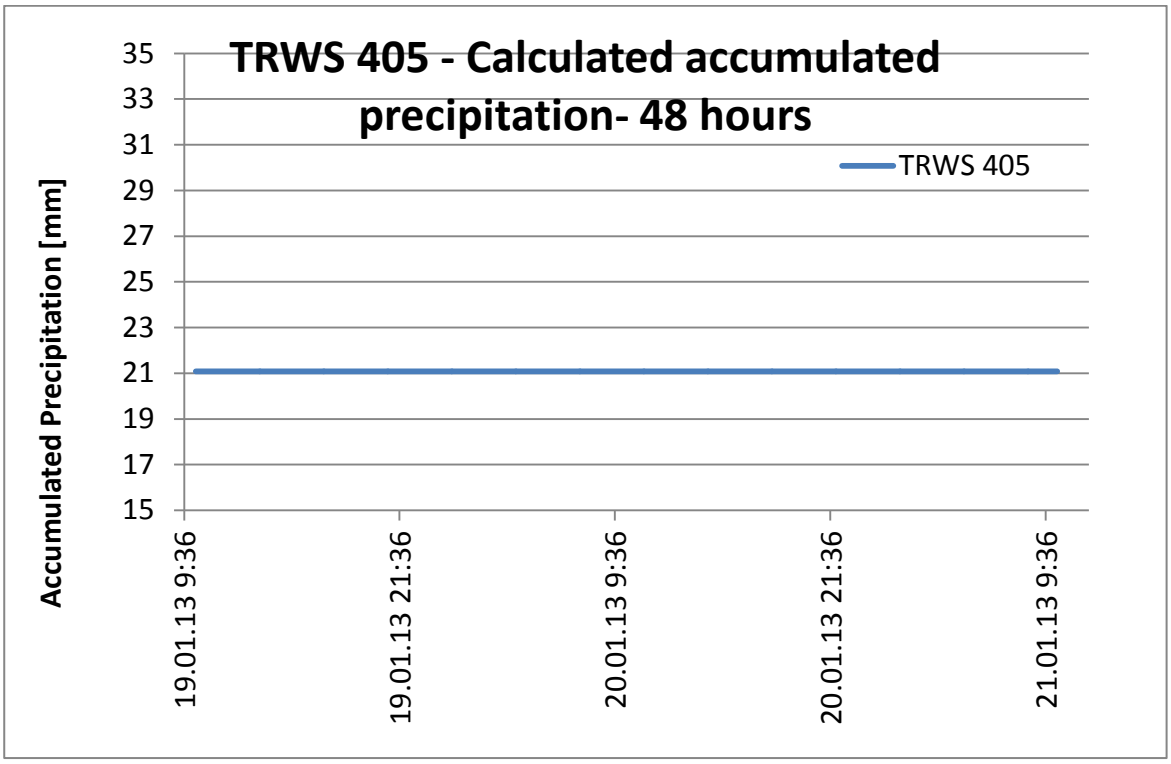
	Measured amount (level 2 - level 1)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X6RACTRWSALG	4,998	0,00414039	4,861	0,0005	0,137	0,0000174

Test 2: From Level 2 to Level 3

	Measured amount (level 3 – level 2)	SD	Weighed amount (truth)	SD	Mean deviation	SD
X6RACTRWSALG	4,9236129	0,01115593	4,8755	0,0005	0,048112903	0,000124705

48-hour plot


TRWS 405 - RAW BUCKET CONTENT (MILLIGRAM)- 48 hours
Accumulated Precipitation [mg]
14020
14015
14010
14005
14000
13995
13990
13985
13980
19.01.13 9:36
19.01.13 21:36
20.01.13 9:36
20.01.13 21:36
21.01.13 9:36
TRWS 405


TRWS 405 - Calculated accumulated precipitation- 48 hours
Accumulated Precipitation [mm]
35
33
31
29
27
25
23
21
19
17
15
19.01.13 9:36
19.01.13 21:36
20.01.13 9:36
20.01.13 21:36
21.01.13 9:36
TRWS 405

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: _Campbell PWS 100_____
Instrument number ____5 of 25_____

Manufacturer	Campbell INC
Model	PWS100
Serial number	E1079
Firmware version (if applicable)	

Field configuration

Location on site	6 m mast M3, South east corner of testsite Distance to Geonor in DFIR:
Orientation	Sensors orientation vertical to main wind direction
Height (measured at top)	6 m
Shield (if applicable)	No
Heating (if applicable)	Yes, internal heating

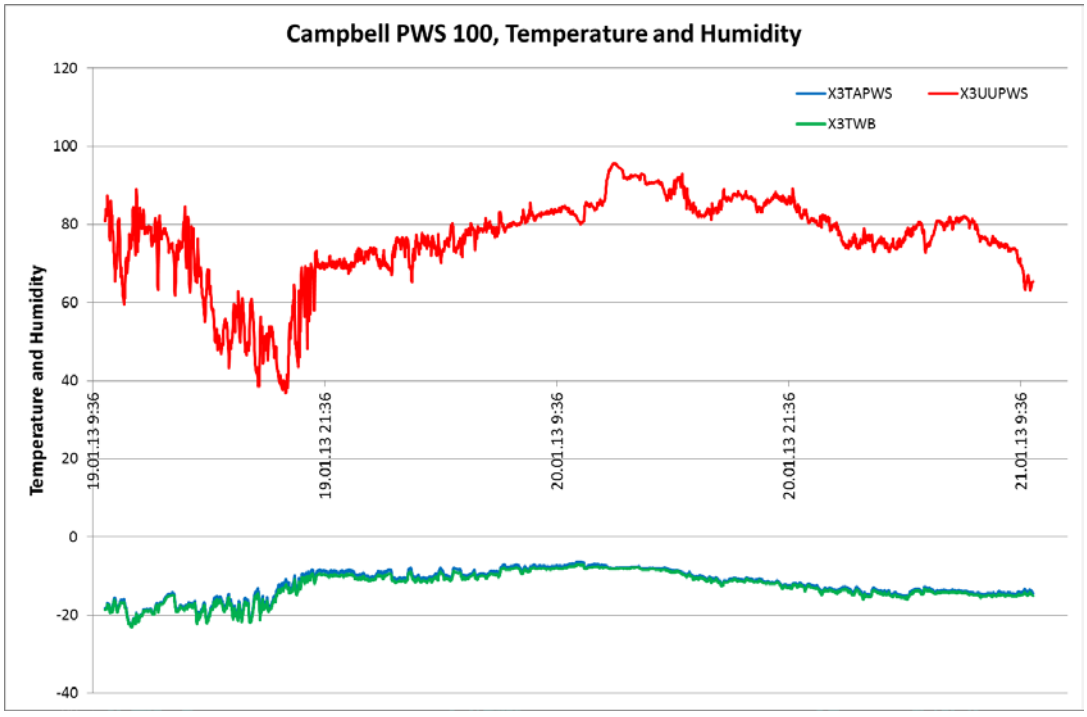
Data output

Data communication protocol	digital
Output data message format (include description of fields)	X3ALARMPWS(Alarm); X3STATPWS(Status); X3TAPWS(Air temperature); X3UUPWS(relative humidity); X3TWB(Wet bulb temperature); X3RI_01(precipitation intensity mm/h); X3RAC_01(accumulated precipitation 1min); X3PARTVEL_01(particle velocity); X3PARTSIZ_01(particle size); X3ADRZZ_01(number of particles drizzle); X3AFRDRZZ_01(number of particles freezing drizzle); X3ARAIN_01(number of particles rain); X3AFRRAIN_01(number of particles freezing rain); X3SNWGR_01(number of particles snow grains); X3ASNWFL_01(number of particles snow flakes); X3ICPL_01(number of particles ice pellets); X3AHAIL_01(number of particles hail); X3AGRAUP (number of particles graupel); X3AERR_01(number of errors); X3AUKNWN_01(number of particles unknown);
Data sampling frequency	1min

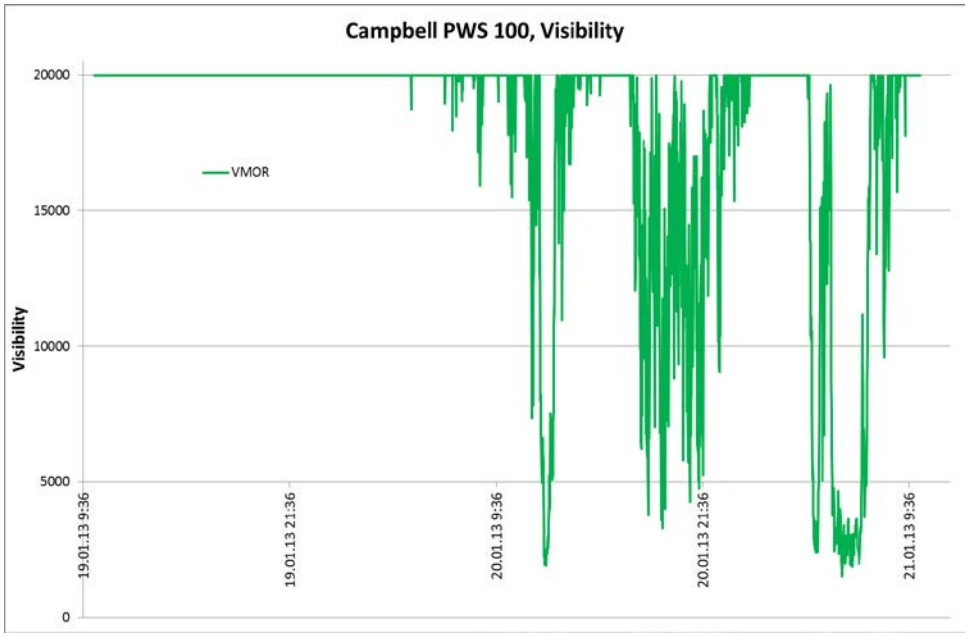
Instrument Picture:

Figur 19: Campbell PWS 100

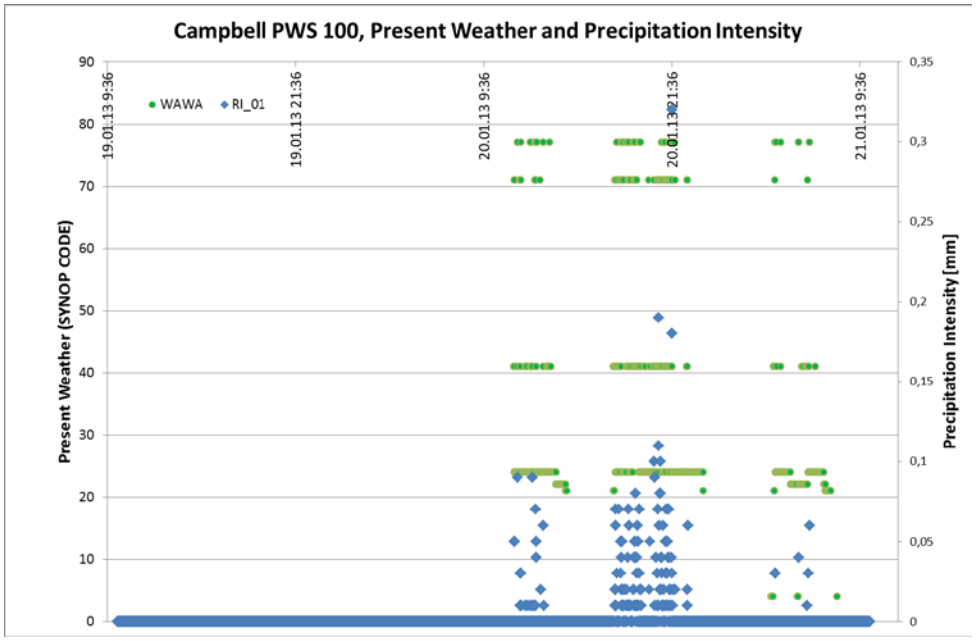
48 – hour plots



Figur 20: 48 hour plot, Campbell PWS 100, Temperature, wetbulb temperature and humidity



Figur 21: 48 hour plot - visibility



Figur 22: 48 hour plot - present weather and precipitation intensity

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Windsensor DFIR_____
Instrument number _____6 of 25 _____

Manufacturer	GILL
Model	Windobserver II (ultrasonic)
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Inside DFIR – mounted outside Alter shield of R2 (Reference Geonor), mounting is facing north
Orientation	
Height (measured at top)	4.7m
Shield (if applicable)	DFIR
Heating (if applicable)	Standard instrument heating

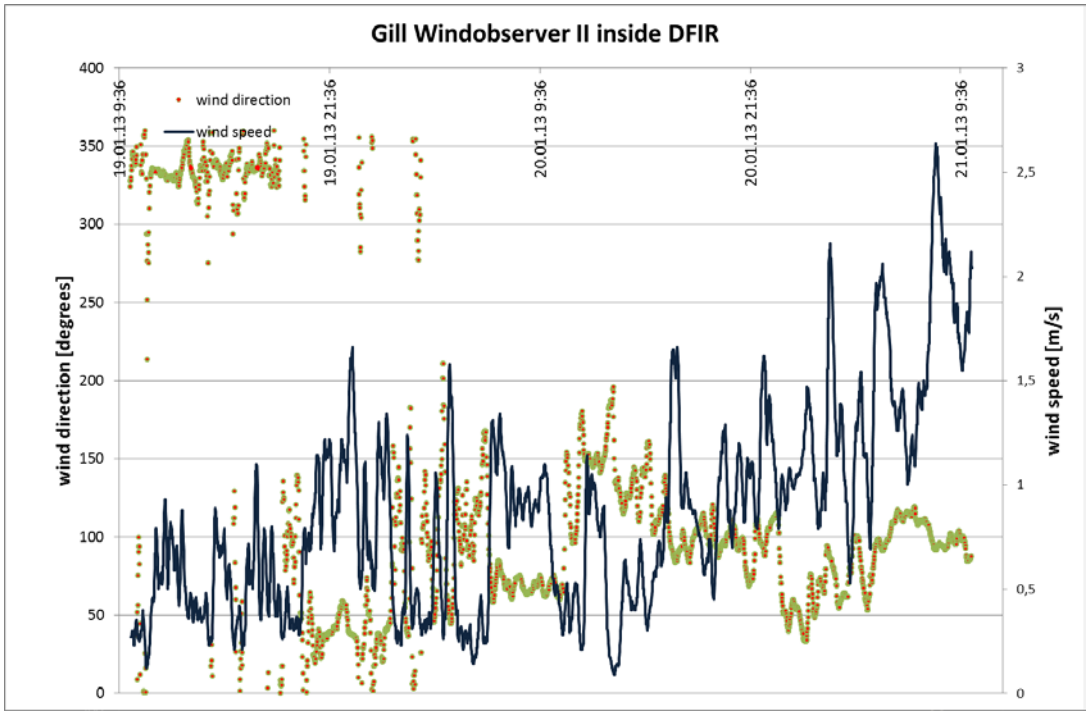
Data output

Data communication protocol	digital
Output data message format (include description of fields)	FF_01L4(wind speed), DD_01L4(wind direction), FG_01L4(max wind gust: 3s in last 10min/1min?)
Data sampling frequency	1-3s (not available)

Instrument Picture

Figur 23: Gill Windobserver II inside DFIR (left in picture)

48 hour plot



Figur 24: 48-hour plot - wind direction and wind speed

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Windsensor at R3_shielded (X2Geonor, S)_____
Instrument number _____7 of 25_____

Manufacturer	Young
Model	Windmonitor SE
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Outside Alter shield of X2 Geonor, South of DFIR, mounting facing north
Orientation	
Height (measured at top)	Ca. 4.7m
Shield (if applicable)	No
Heating (if applicable)	No heating

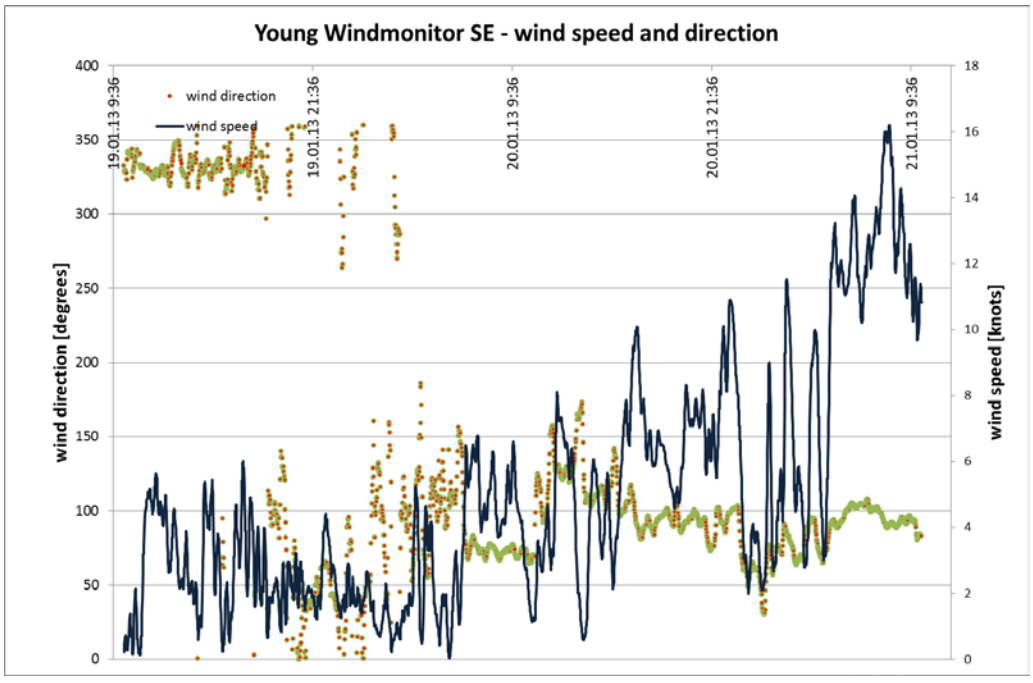
Data output

Data communication protocol	digital
Output data message format (include description of fields)	X2FF_01L4(1 min average wind speed), X2DD_01L4(1 min average wind direction), X2FG_01L4(max wind gust, 3 s in 1 min)
Data sampling frequency	1-3s (not available)

Instrument Picture

Figur 25: Young Windmonitor SE (South)

48 hour plot



Figur 26: 48 hour plot - Young Windmonitor SE (south senor), wind direction and speed

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Windsensor at Geonor N, X1_____
Instrument number _____8 of 25_____

Manufacturer	Young
Model	Wind Monitor SE
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Outside Alter shield of X1 Geonor, North of DFIR, mounting facing north
Orientation	
Height (measured at top)	Ca. 4.7m
Shield (if applicable)	No
Heating (if applicable)	No heating

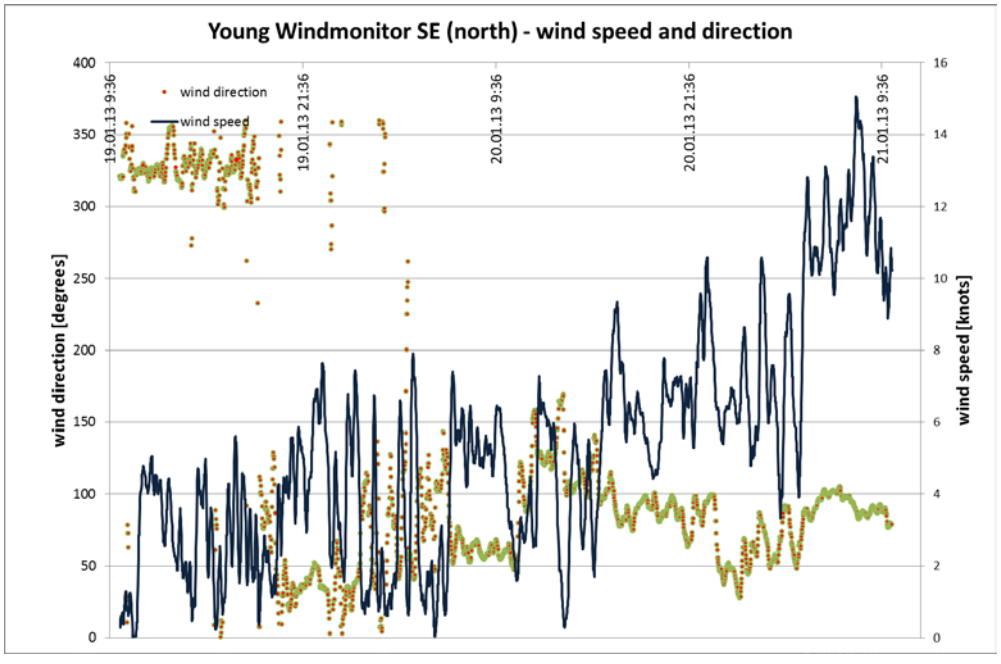
Data output

Data communication protocol	digital
Output data message format (include description of fields)	X1FF_01L4(1 min average wind speed), X1DD_01L4(1 min average wind direction), X1FG_01L4(max wind gust, 3 s in 1min)
Data sampling frequency	1-3s (not available)

Instrument picture

Figur 27: Young Windmonitor SE, North Sensor

48 hour plot



Figur 28: 48-hour plot - Young Windmonitor SE (north sensor), windspeed and direction

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ____Windsensor at 10 m_____
Instrument number _____9 of 25_____

Manufacturer	Gill
Model	Windobserver II, ext. heat (ultrasonic)
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Mounted on top of 10 m mast, ca. 3 m from the outer fence of the DFIR
Orientation	
Height (measured at top)	10 m
Shield (if applicable)	No
Heating (if applicable)	Heated

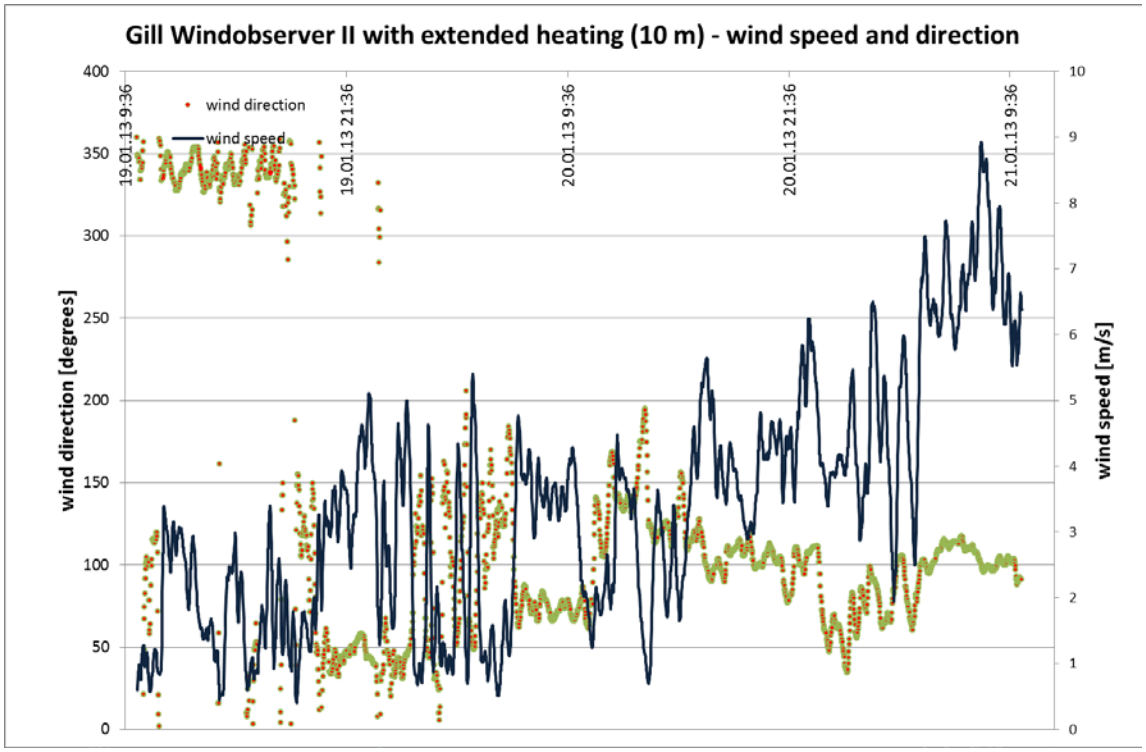
Data output

Data communication protocol	digital
Output data message format (include description of fields)	FF_01(1 min average wind speed), DD_01(1 min average wind direction), FG_01(max wind gust, 3 s in 1min)
Data sampling frequency	1-3s (not available)

Instrument Picture

Figur 29: Gill Windobserver II w extended heating, 10 m

48 hour plot



Figur 30: 48-hour plot - Gill windobserver II (10 m), wind speed and direction

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ____3D Windsensor at upstream mast_____
Instrument number _____10 of 25_____

Manufacturer	Thies
Model	Ultrasonic Anemometer 3D
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	At gauge height (4.5 m), mounted at upstream mast, 31.5 m NW of DFIR
Orientation	
Height (measured at top)	Ca. 4.5 m
Shield (if applicable)	No
Heating (if applicable)	heated

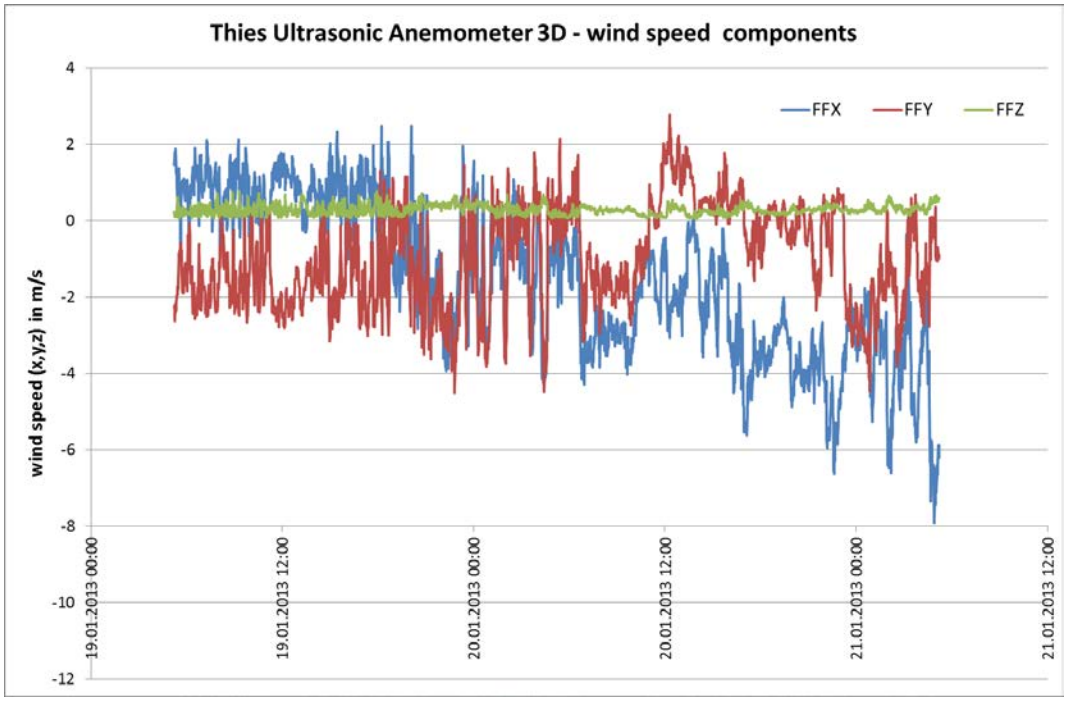
Data output

Data communication protocol	digital
Output data message format (include description of fields)	FFX_01L4 (1 min average 1st horizontal component wind speed), FFY_01L4 (1 min average 2nd horizontal component wind speed), FFZ_01L4 (1 min average vertical component wind speed), STD_FFX_01L4 (1 min standard deviation 1st horizontal component wind speed), STD_FFY_01L4 (1 min standard deviation 2nd horizontal component wind speed), STD_FFZ_01L4 (1 min standard deviation vertical component wind speed), TVIRT_01L4 (virtual temperature, 1 min average), STD_TVIRT_01L4 (virtual temperature, 1 min standard deviation), CHECKTHIES3DL4, STATTHIES3DL4 (status parameters from sensor)
Data sampling frequency	1-3s (not available)

Instrument Picture

Figur 31: Thies Ultrasonic Anemometer 3D

48-hour plot



Figur 32: 48-hour plot - Thies Ultrasonic Anemomenter 3D, wind speed components

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Temperature_____
Instrument number _____11 of 25_____

Manufacturer	
Model	PT100
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at meterological mast, ca. 3 m from outer fence of DFIR, inside radiation screen
Orientation	
Height (measured at top)	Ca. 4.5 m
Shield (if applicable)	No
Heating (if applicable)	N/A

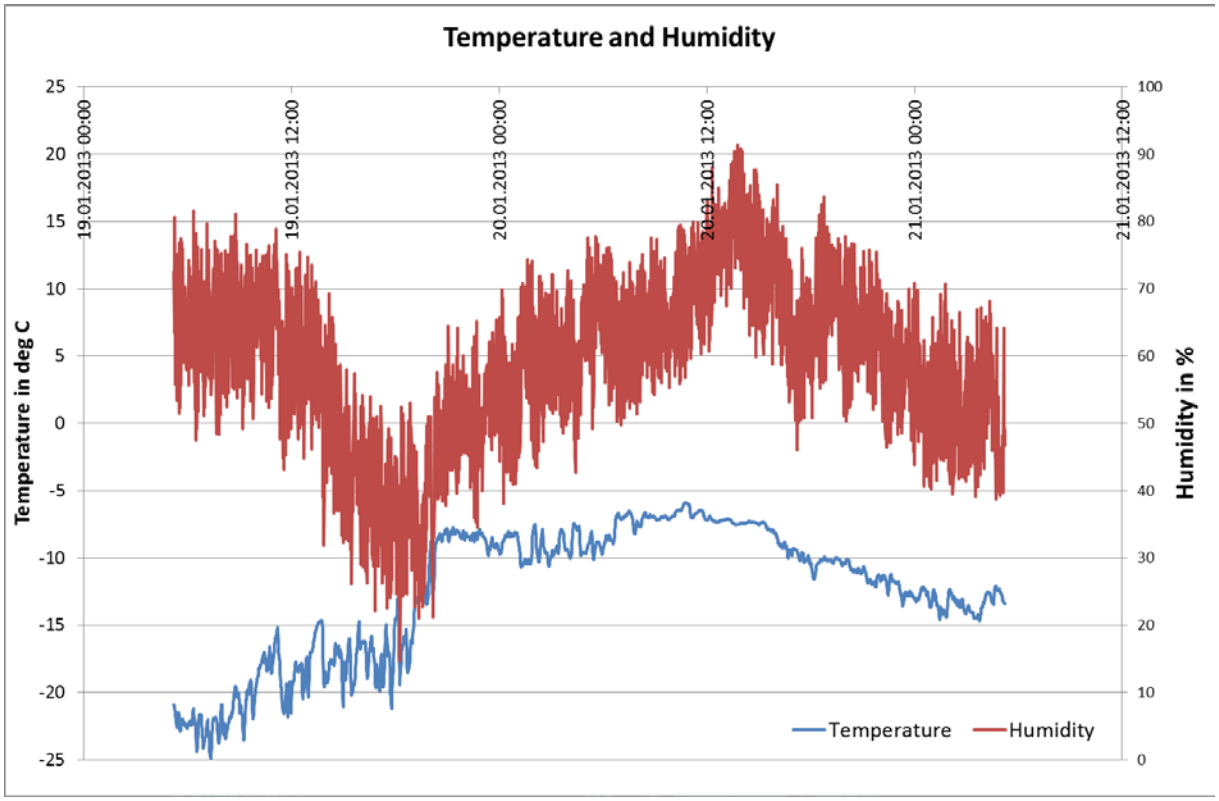
Data output

Data communication protocol	analog
Output data message format (include description of fields)	TA (1 min average)
Data sampling frequency	

Instrument Picture

Figur 33: Radiation screen with temperature and humidity sensor

48-hour Plot



Figur 34: 48 - hour plot Temperature and relative humidity

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Humidity Sensor_____
Instrument number _____12 of 25_____

Manufacturer	Vaisala
Model	HMP155
Serial number	15016
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at meterological mast, ca. 3 m from outer fence of DFIR, inside radiation screen
Orientation	
Height (measured at top)	Ca. 4.5 m
Shield (if applicable)	No
Heating (if applicable)	yes

Data output

Data communication protocol	analog
Output data message format (include description of fields)	UU (1 min average)
Data sampling frequency	

Comments:

Humidity data from the sensors shows unusual high variations. The sensor was changed, but the problem remains. Further debugging is going on.

Instrument Picture

See Figur 31: Radiation screen with temperature and humidity sensor

48-hour plot

See Figur 32: 48 - hour plot Temperature and relative humidity

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ____Ott Parsivel_____
Instrument number _____13 of 25_____

Manufacturer	OTT
Model	Parsivel
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at meterological mast, ca. 3 m from outer fence of DFIR
Orientation	
Height (measured at top)	Ca. 6 m
Shield (if applicable)	No
Heating (if applicable)	yes

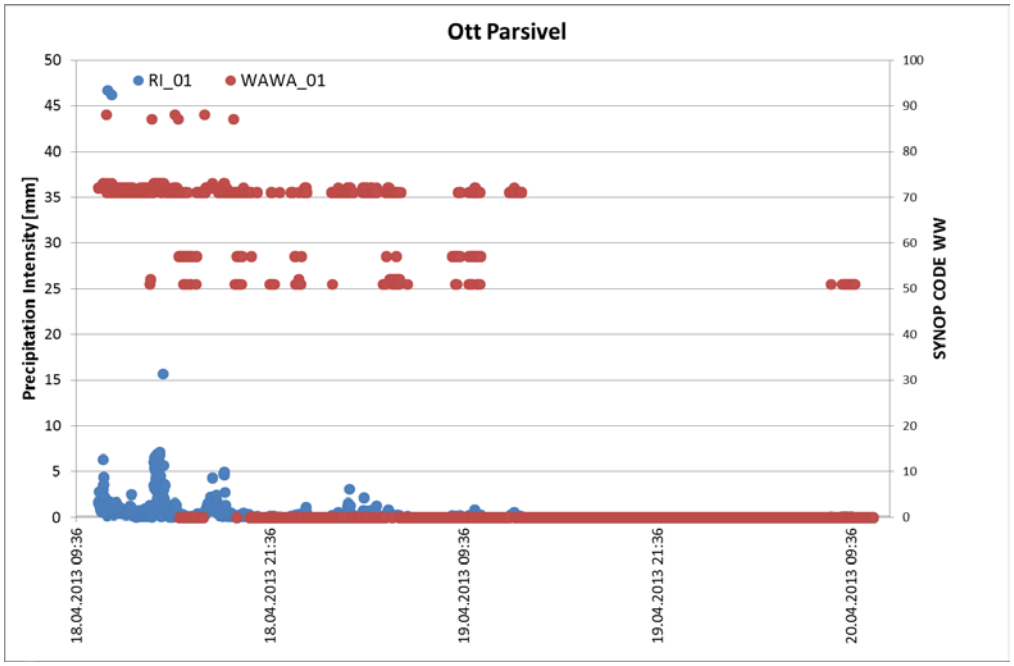
Data output

Data communication protocol	digital
Output data message format (include description of fields)	RI_01 (precipitation intensity), RAC_01(accumulated precipitation), WAWA_01(present weather synop code), RAD_01(radar reflectivity), VMOR_01(visibility during precipitation), AMPLPAR_01(Laser amplitude), ANTP_01(Number of particles), TIPAR_01(Instrument temperature), STATPAR (Status parameter Parsivel)
Data sampling frequency	1 min

Instrument Picture

Figur 35: Ott Parsivel

48-hour plot



Figur 36: 48-hour plot, Ott Parsivel

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Thies LPM_____
Instrument number _____14 of 25_____

Manufacturer	Thies
Model	Laser Precipitation Monitor
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at meterological mast, ca. 3 m from outer fence of DFIR
Orientation	
Height (measured at top)	Ca. 6 m
Shield (if applicable)	No
Heating (if applicable)	yes

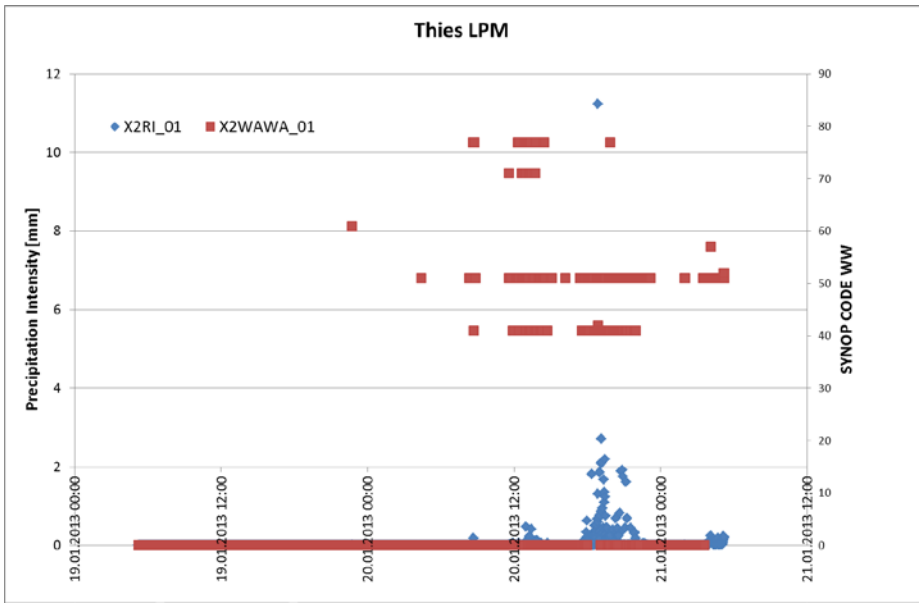
Data output

Data communication protocol	digital
Output data message format (include description of fields)	X2ANTP_01(Number of particles), X2VMOR_01(Visibility during precipitation), X2KVALLPM_01(Quality evaluation of observation), X2OD_01(max hail diameter), X2RAD_01(radar reflectivity), X2RIS_01(1 min snow intensity), X2RI_01(1 min precipitation intensity), X2RIW_01(1 min rain intensity), X2RI_05(5 min precipitation intensity), X2RAC_01(accumulated precipitation), X2STATLPM(Status parameter), X2TILPM_01 (Instrument temperature), X2WAWA_01(present weather synop code, 1 min), X2WAWA_05 (present weather synop code, 5 min)
Data sampling frequency	1 min

Instrument Picture

Figur 37: Thies LPM

48 hour plot



Figur 38: 48-hour plot, Thies LPM

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Vaisala PWD 21_____
Instrument number _____15 of 25_____

Manufacturer	Vaisala
Model	PWD 21
Serial number	X47201
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at upstream mast, ca. 30 m away from DFIR outer fence
Orientation	
Height (measured at top)	Ca. 6 m
Shield (if applicable)	No
Heating (if applicable)	yes

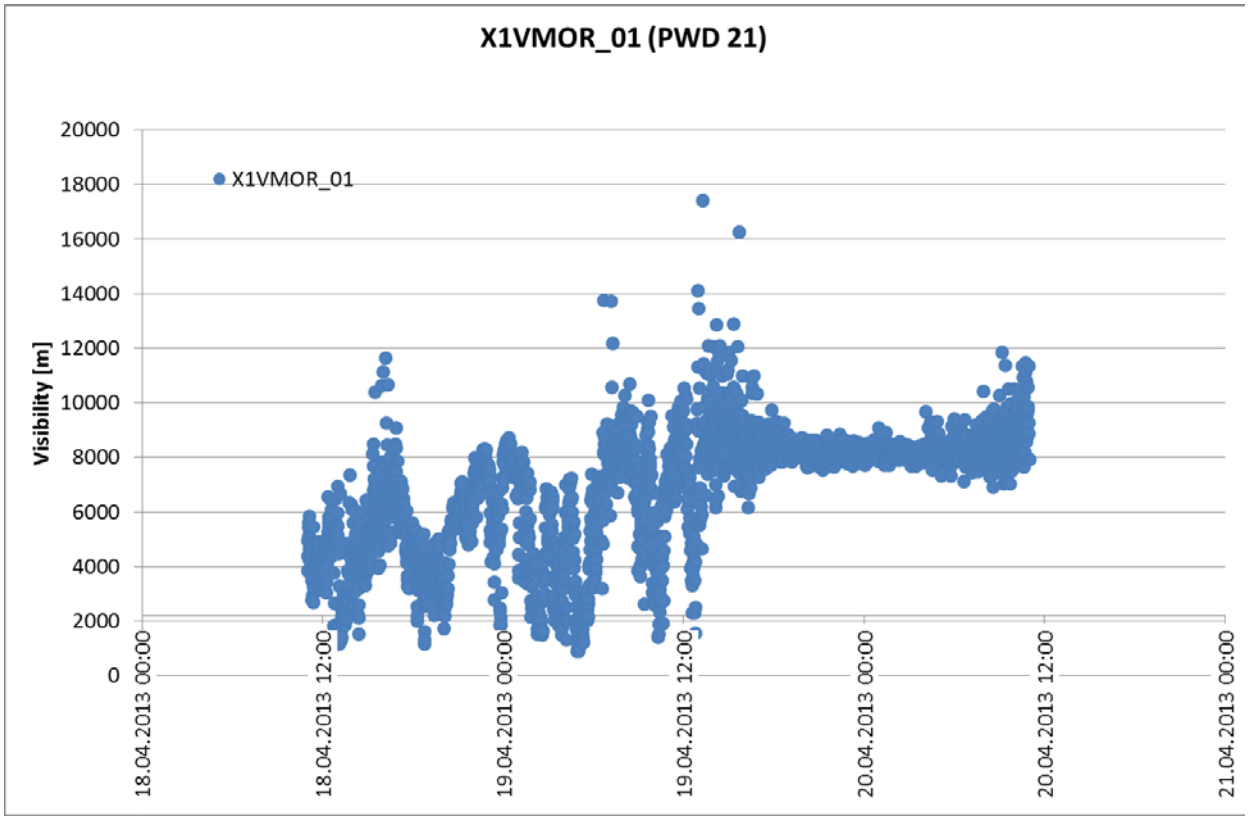
Data output

Data communication protocol	digital
Output data message format (include description of fields)	X1SACMM_01(1 min average accumulated snow (water equivalent)), X1RAC_01(accumulated precipitation), X1RI_01(precipitation intensity, 1 min average), X1STATPWD (Status parameter), X1VMOR_01(visibility, 1 min average), X1VMOR_010 (visibility, 10 min average), X1WAWA_01(present weather synop code, 1 min), X1WAWA_015 (present weather synop code, 15 min), X1WAWA (present weather synopcode, 1 hour)
Data sampling frequency	1 min

Instrument Picture

Figur 39: Vaisala PWD 21 (black) and Vaisala PWD 22 (white)

48 hour plot



Figur 40: 48-hour plot Vaisala PWD 21, Visibility

Attention: Instrument Status 2 when started, needs maintenance!

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Vaisala PWD 22_____
Instrument number _____16 of 25_____

Manufacturer	Vaisala
Model	PWD 22
Serial number	H3610001
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at upstream mast, ca. 30 m away from DFIR outer fence
Orientation	
Height (measured at top)	Ca. 6 m
Shield (if applicable)	No
Heating (if applicable)	yes

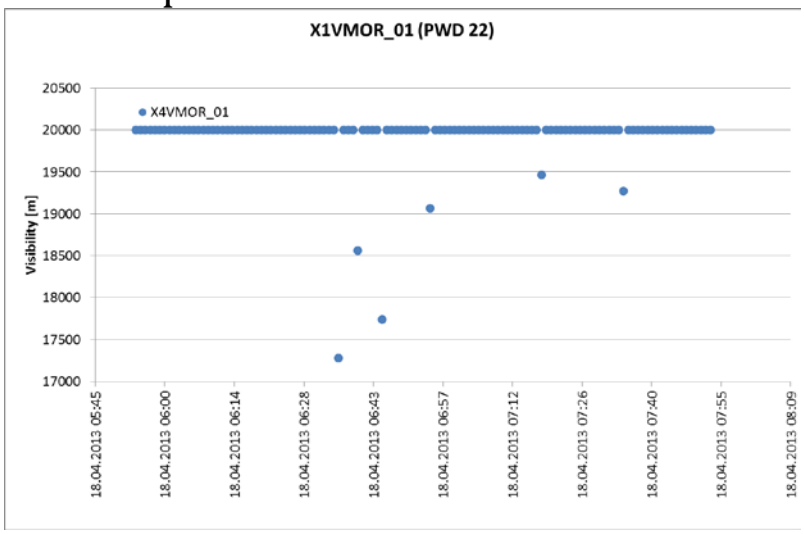
Data output

Data communication protocol	digital
Output data message format (include description of fields)	X4SACMM_01(1 min average accumulated snow (water equivalent)), X4RAC_01(accumulated precipitation), X4RI_01(precipitation intensity, 1 min average), X4STATPWD (Status parameter), X4VMOR_01(visibility, 1 min average), X4VMOR_010 (visibility, 10 min average), X4WAWA_01(present weather synop code, 1 min), X4WAWA_015 (present weather synop code, 15 min), X4WAWA (present weather synopcode, 1 hour)
Data sampling frequency	1 min

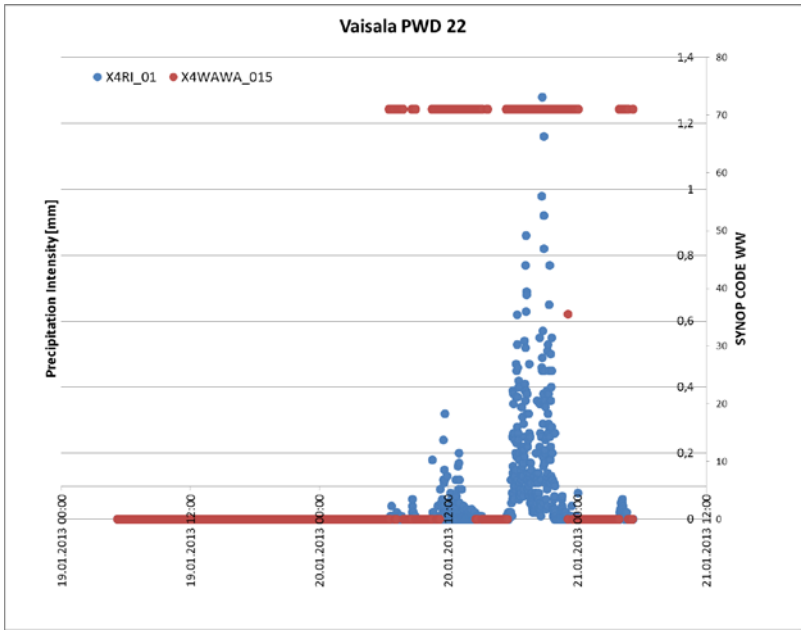
Instrument Picture

See Figur 37: Vaisala PWD 21 (black) and **Vaisala PWD 22 (white)**

48-hour plots



Figur 41: 48-hour plot, Vaisala PWD 22: Visibility



Figur 42: 48-hour plot, Vaisala PWD 22, Precipitation Intensityt and Synop Weather Code

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Precipiation Detector (Yes/No) X0YN_____
Instrument number _____17 of 25_____

Manufacturer	Thies
Model	Precipitation sensor with analogue intensity output (5.4103.20.041)
Serial number	
Firmware version (if applicable)	

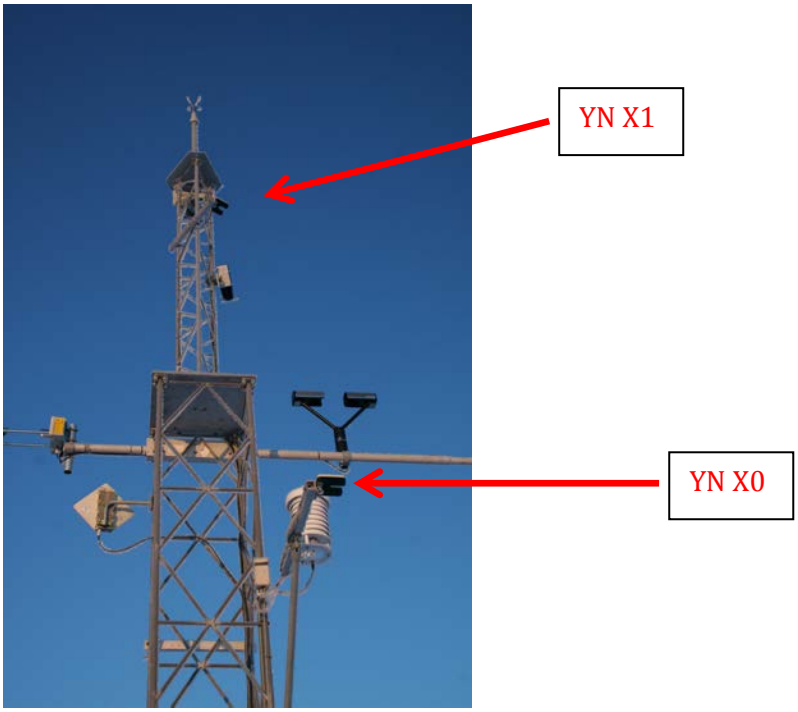
Field configuration

Location on site	Mounted at meteorological mast, ca. 3m from DFIR outer fence
Orientation	40°
Height (measured at top)	Ca. 5 m
Shield (if applicable)	No
Heating (if applicable)	yes

Data output

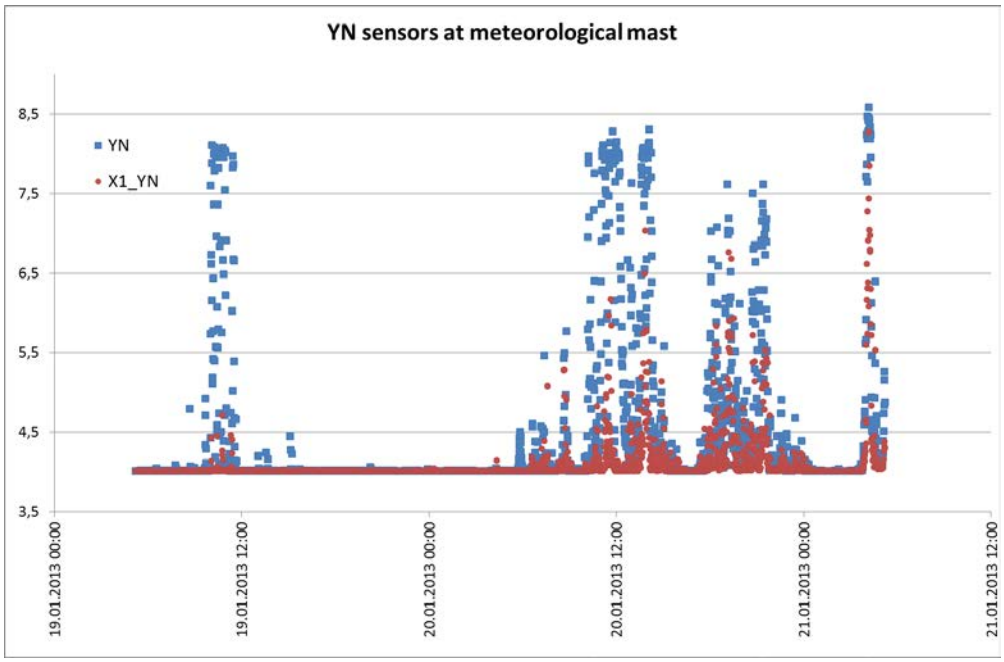
Data communication protocol	analog
Output data message format (include description of fields)	YN (precipitation intensity in mA – uses as yes/no when larger than threshold of 4.6mA)
Data sampling frequency	1 min

Instrument Picture



Figur 43: Thies Precipitation Monitor, two instruments at 10 m mast (M1)

48 hour plot



Figur 44: 48-h-plot of X0YN (5 m) og X1YN (8 m) at meteorological mast (signal is a current in mA).

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Precipiation Detector (Yes/No) X1YN_____
Instrument number _____18 of 25_____

Manufacturer	Thies
Model	Precipitation sensor with analogue intensity output (5.4103.20.041)
Serial number	10100829
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at meteorological mast, ca. 3m from DFIR outer fence
Orientation	40°
Height (measured at top)	Ca. 8 m
Shield (if applicable)	No
Heating (if applicable)	yes

Data output

Data communication protocol	analog
Output data message format (include description of fields)	X1YN (precipitation intensity in mA – uses as yes/no when larger than threshold of 4.6mA)
Data sampling frequency	1 min

Instrument picture

See Figur 41

48 hour plot

See Figur 42

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Precipiation Detector (Yes/No) X2YN_____
Instrument number _____19 of 25_____

Manufacturer	Thies
Model	Precipitation sensor with analogue intensity output (5.4103.20.041)
Serial number	110717
Firmware version (if applicable)	

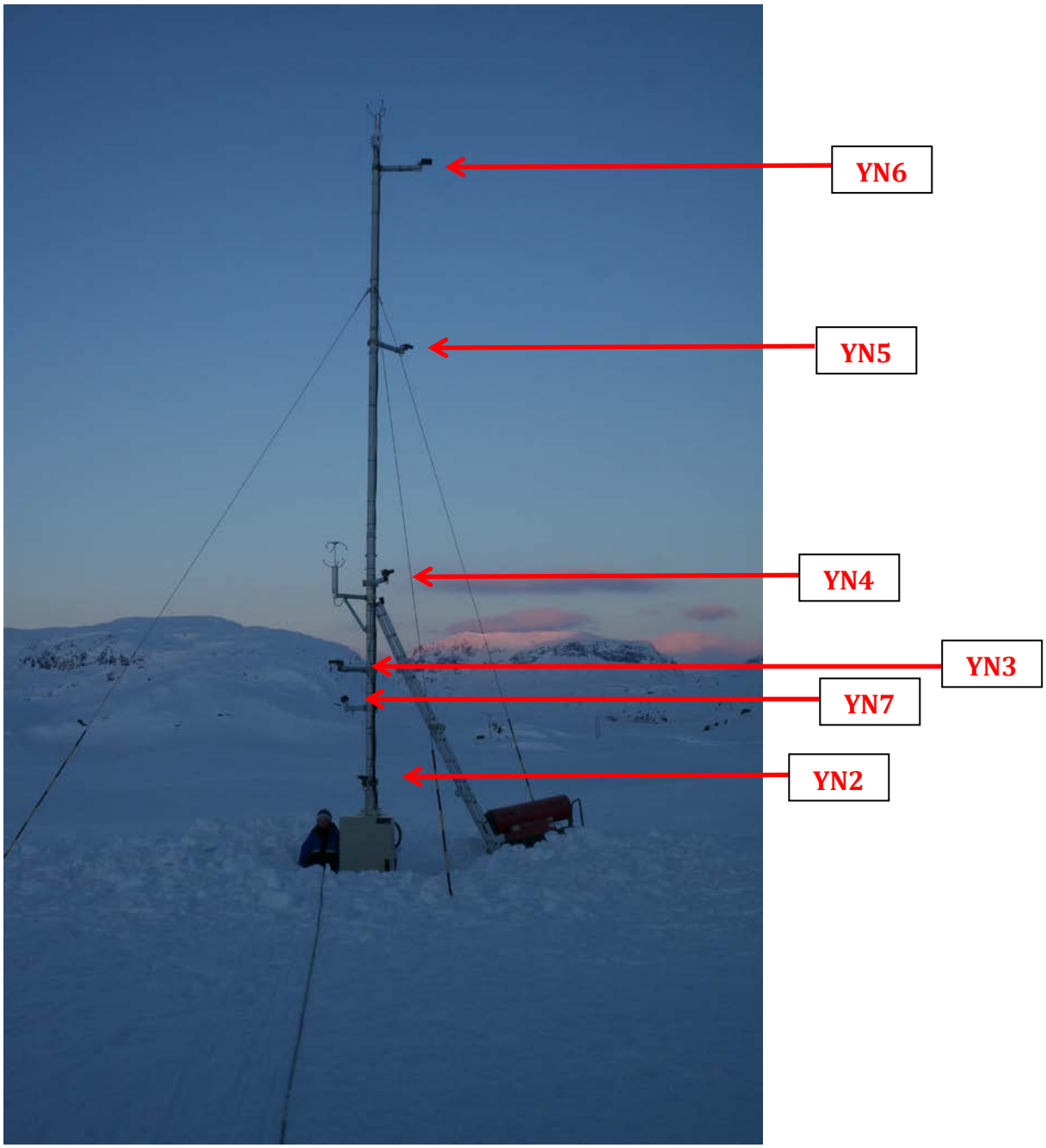
Field configuration

Location on site	Mounted at upstream mast, ca. 25m from DFIR outer fence
Orientation	130°
Height (measured at top)	2.25 m
Shield (if applicable)	No
Heating (if applicable)	yes

Data output

Data communication protocol	analog
Output data message format (include description of fields)	X2YN (precipitation intensity in mA – uses as yes/no when larger than threshold of 4.6mA)
Data sampling frequency	1 min

INSTRUMENT PICTURE



Figur 45: Upstream mast med precipiation detectors: optical (YN2-YN6), capacitive (YN7).

48-HOUR PLOT

See Figur 44.

Instrument Metadata Report

> *IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.*

Instrument Name: ___Precipiation Detector (Yes/No) YN3_____
Instrument number _____20 of 25_____

Manufacturer	Thies
Model	Precipitation sensor with analogue intensity output (5.4103.20.041)
Serial number	1107347
Firmware version (if applicable)	

Field configuration

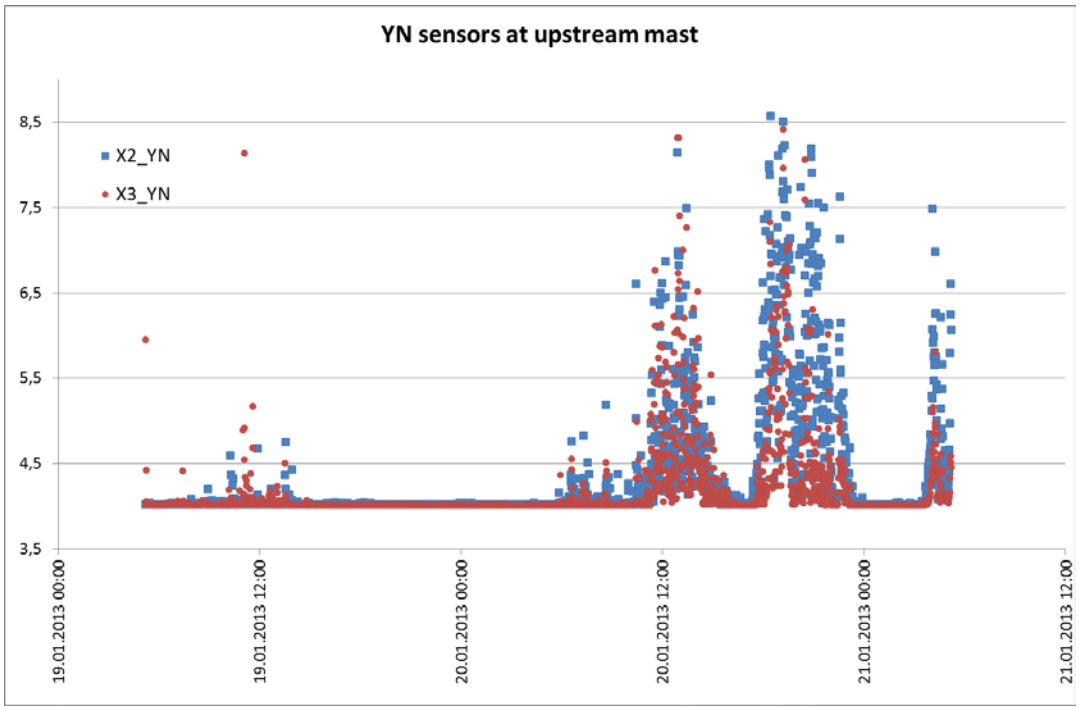
Location on site	Mounted at upstream mast, ca. 25m from DFIR outer fence
Orientation	155°
Height (measured at top)	3.55 m
Shield (if applicable)	No
Heating (if applicable)	Yes

Data output

Data communication protocol	Analog
Output data message format (include description of fields)	X3YN (precipitation intensity in mA – uses as yes/no when larger than threshold of 4.6mA)
Data sampling frequency	1 min

INSTRUMENT PICTURE
See Figur 43

48-HOUR PLOT



Figur 46: 48-hour plot X2YN and X3YN (signal is a current in mA)

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Precipiation Detector (Yes/No) YN4_____
Instrument number _____21 of 25_____

Manufacturer	Thies
Model	Precipitation sensor with analogue intensity output (5.4103.20.041)
Serial number	110726
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at upstream mast, ca. 25m from DFIR outer fence
Orientation	106°
Height (measured at top)	4.55 m
Shield (if applicable)	No
Heating (if applicable)	Yes

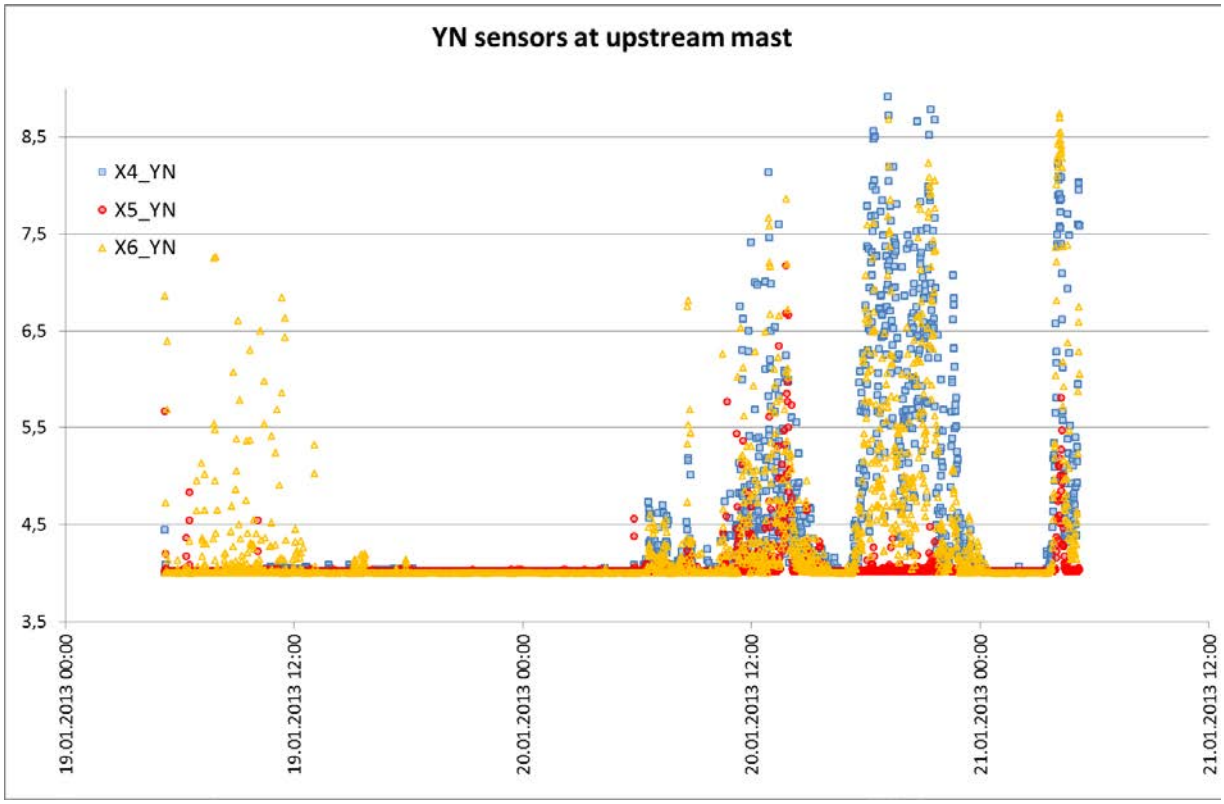
Data output

Data communication protocol	Analog
Output data message format (include description of fields)	X4YN (precipitation intensity in mA – uses as yes/no when larger than threshold of 4.6mA)
Data sampling frequency	1 min

INSTRUMENT PICTURE

See Figur 43.

48-HOUR PLOT



Figur 47: 48-hour plot for Precipitation detectors YN4, YN5 and YN6 [signal is a current in mA]

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Precipiation Detector (Yes/No) YN5_____
Instrument number _____22 of 25_____

Manufacturer	Thies
Model	Precipitation sensor with analogue intensity output (5.4103.20.041)
Serial number	1107023
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at upstream mast, ca. 25m from DFIR outer fence
Orientation	320°
Height (measured at top)	7.55 m
Shield (if applicable)	No
Heating (if applicable)	Yes

Data output

Data communication protocol	Analog
Output data message format (include description of fields)	X5YN (precipitation intensity in mA – uses as yes/no when larger than threshold of 4.6mA)
Data sampling frequency	1 min

INSTRUMENT PICTURE

See Figur 43

48-HOUR-PLOT

See Figur 45

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Precipiation Detector (Yes/No) YN6_____
Instrument number _____23 of 25_____

Manufacturer	Thies
Model	Precipitation sensor with analogue intensity output (5.4103.20.041)
Serial number	1107022
Firmware version (if applicable)	

Field configuration

Location on site	Mounted at upstream mast, ca. 25m from DFIR outer fence
Orientation	40°
Height (measured at top)	9.75 m
Shield (if applicable)	No
Heating (if applicable)	Yes

Data output

Data communication protocol	Analog
Output data message format (include description of fields)	X6YN (precipitation intensity in mA – uses as yes/no when larger than threshold of 4.6mA)
Data sampling frequency	1 min

INSTRUMENT PICTURE

See Figur 43

48-HOUR-PLOT

See Figur 45

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Laser Snow Height sensor_____
Instrument number _____24of 25_____

Manufacturer	Jenoptik
Model	SHM30
Serial number	
Firmware version (if applicable)	

Field configuration

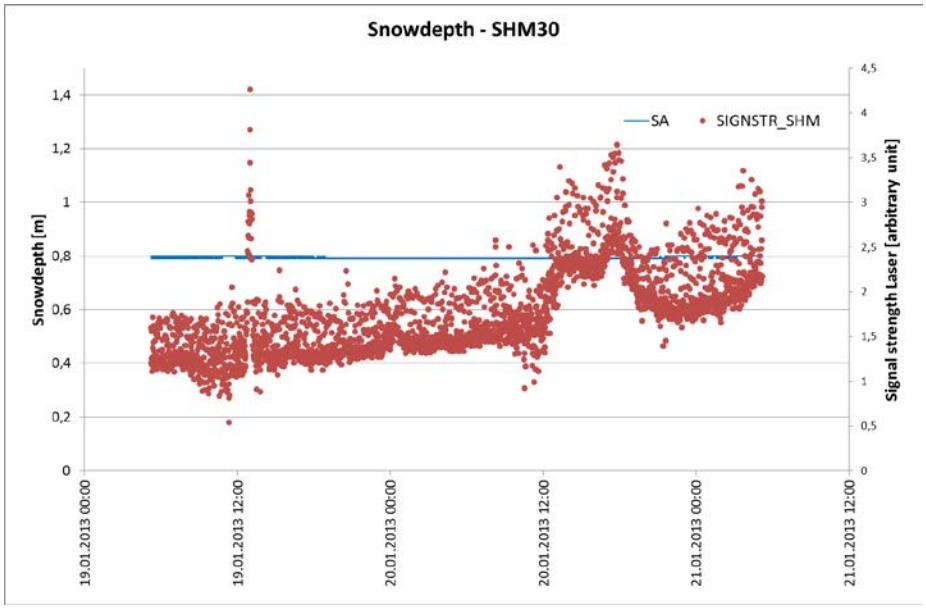
Location on site	Mounted at meteorological mast, ca. 3m from DFIR outer fence
Orientation	
Height (measured at top)	9 m
Shield (if applicable)	No
Heating (if applicable)	Yes

Data output

Data communication protocol	Digital
Output data message format (include description of fields)	SA (Snowdepth in cm), Signstr_shm (signal strength SMH30)
Data sampling frequency	1 min

INSTRUMENT PICTURE

48-HOUR PLOT



Figur 48: 48-hour plot: Snowdepth sensor SHM 30

Instrument Metadata Report

IMPORTANT: Please copy this form (as necessary) and complete separately for each instrument under test and each instrument that will be used to provide ancillary measurements during WMO SPICE.

Instrument Name: ___Web Camera_____
Instrument number _____25 of 25_____

Manufacturer	Axis
Model	Q6032-E Network Camera
Serial number	
Firmware version (if applicable)	

Field configuration

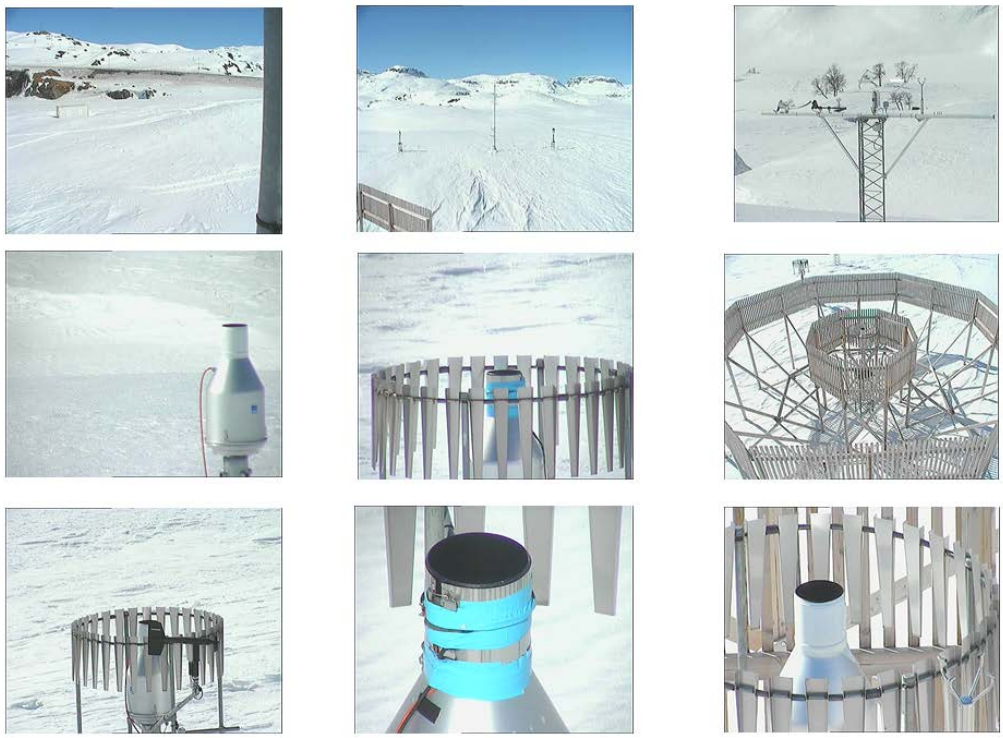
Location on site	Mounted at meteorological mast, ca. 3m from DFIR outer fence
Orientation	
Height (measured at top)	9 m
Shield (if applicable)	No
Heating (if applicable)	Yes

Data output

Data communication protocol	Digital
Output data message format (include description of fields)	Photographs (jpg-file) from 13 different positions
Data sampling frequency	1 hour

INSTRUMENT PICTURE

PICTURES TAKEN BY CAMERA



Figur 49: Picture set which is taken by Camera hourly, shown pictures are taken 5th April 2013, 1:41pm UTC

SECTION A4: CONFIRMATION OF EXPERIMENT CONFIGURATION

TEST 1: INSTRUMENT CALIBRATION AND CHECKS

The Site Manager will organize the check and calibration of each instrument included in the experiment (as part of the reference, or as an instrument under test). The check sheets and calibration results will be included in the designated areas of Sections A2 and A3.

- The calibration and check of the WG used as part of the reference will be conducted based on the guidelines adopted by the SPICE IOC.
- The calibration and check of the instruments under test will be conducted as specified by the manufacturer prior to the installation on the SPICE site, as well as following the installation in the field.

TEST 2: INSTRUMENT VALIDATION

After the field installation of each instrument (both those that are part of the reference and those that are instruments under test), at the minimum, a **continuous 48 hour data set** of the entire test setup will be stored and examined as an indication of instrument performance**.** The data sets for each instrument included in the intercomparison will be reviewed for data integrity and representativeness, against the predefined data format.

The evaluation of the instrument performance at this stage will be conducted using the 48 hour time series plots provided in Sections A2 and A3. The readiness state of each instrument will be reported in the Instrument Data Validation table below.

Any discrepancies will be investigated, addressed, and documented. Following the resolution of the discrepancies, the 48-hour end to end (e2e) test will be repeated. Notes, plots, logs, will be appended to the POP table of the reference/instrument under test, and the readiness state and date will be updated in the Instrument Data Validation table.

TEST 3: SITE-TO-ARCHIVE TRANSFER VALIDATION

Once the transfer of site data files to the SPICE Data Archive at NCAR has been initiated, compare the site data with those received at the SPICE Data Archive for a 24 hour period to ensure that no errors occurred during archival or transmission.
If any errors occur, log them and following the resolution of the discrepancies, repeat the 24-hour validation test.

When the Test 3 is passed mark the check box YES in the Instrument Data Validation table below (this means that they have been also validated), with the starting date of the data transfer.

If Test 3 is not passed at the time of the Commissioning Report tick the checkbox NO and provide the expected date.

(Plots, datasets, errors logs, referred to Test 3 are **NOT** included in this document but archived by the site manager if further tests or analysis are required),

IMPORTANT:
Test 2 and Test 3 may be conducted simultaneously, depending on the site configuration.

Instrument Data Validation

Instrument	Readiness (if Yes, indicate the date)	Data transfer to NCAR archive (**Test 3**) (If the answer is No report the expected date)	Comments
R2: Geonor	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	Alter shield needs to be lowered (summer 2013).
R3: shielded Geonor	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	1 transducer has is not usable due to high noise level, debugging is going on; Alter shield needs to be lowered (summer 2013)
R3: unshielded Geonor	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	
1: Geonor X1, N	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	1 transducer has is not usable due to high noise level, debugging is going on; Alter shield needs to be lowered (summer 2013)
2: Geonor X3, S2	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	Alter shield needs to be lowered (summer 2013)
3: Ott Pluvio2	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	Precipitation data have some strange features, needs to be checked

4: TRWS 405	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	Dataqualitiy not yet checkd with the provider (autumn 2013)
5: Campbell PWS 100	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date:end of 2013	Dataqualitiy not yet checkd with the provider (autumn 2013)
6: Windsensor inside DFIR	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	
7: Windsensor at R3 shielded	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
8: Windsensor at Geonor N	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
9: Windsensor at 10 m	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
10: 3D Windsensor at upstream mast	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
11: Temperature	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
12: Humidity	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	High noise level on humidity data, debugging is ongoing
13: Ott Parsivel	☒ Yes ☐ No Date:19.4.2013	☐ Yes ☒ No Date: end of 2013	Sensor drops out regularly due to an unknown reason; debugging is ungoing
14: Thies LPM	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	
15: Vaisala PWD 21	☒ Yes ☐ No Date: 19.4.2013	☐ Yes ☒ No Date: end of 2013	Sensor since start in Status 2 – needs maintenance.

16: Vaisala PWD 22	☒ Yes ☐ No Date:19.4.2013	☐ Yes ☐ No Date: end of 2013	
17: Precipitation detector X0YN	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
18: Precipitation detector X1YN	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
19: Precipitation detector X2YN	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	
20: Precipitation detector X3YN	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	
21: Precipitation detector X4YN	☒ Yes ☐ No Date:19.1.2013	☐ Yes ☒ No Date: end of 2013	
22: Precipitation detector X5YN	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
23: Precipitation detector X6YN	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
24: Laser Snow Height Sensor	☒ Yes ☐ No Date: 19.1.2013	☐ Yes ☒ No Date: end of 2013	
25: WebCamera	☒ Yes ☐ No Date: 5.4.2013	☐ Yes ☒ No Date: n/a	
Reference Capacitive Precipitation Sensor: X7YN	☒ Yes ☐ No Date: 16.2.2013	☐ Yes ☒ No Date: end of 2013	

SECTION A5: SITE DOCUMENTATION CHECKLIST

A **Site Documentation Checklist** is provided below to track the inclusion of requisite documentation, data plots, and photos in sections A1 to A4.

Site Documentation Checklist

Site information and layout (Section A1)	☒ Included
Complete set of pictures documenting the overall site installation - views from N, E, S, W (Section A1)	☒ Included
Details of manual measurement procedure (Section A2)	☐ Included ☒ Not Applicable
Instrument Metadata Reports for all instruments under test and all instruments used to provide ancillary measurements (Section A3)	☒ Included
Calibration results and check sheets for all instruments (Sections A2, A3)	☒ Included only for all weighing gauges
Instrument data validation:, 48h time series plots (Sections A2, A3)	☒ Included
Instrument data validation table (Section A4)	☒ Included
48h Instrument data validation: discrepancy reports (Section A4)	☒ Included ☐ Not Applicable In Data Validation Table, Section A4
Pictures of installations of all reference instruments, instruments under test, and instruments used to provide ancillary measurements (Sections A2, A3)	☒ Included
End-to-end data validation (Section A4; see Instrument data validation table).	☐ Full (all gauges) ☐ Partial (some gauges) ☒ No
SPICE archive end-to-end data validation: discrepancy reports (Section A4)	☐ Yes ☒ No
Details of any workarounds (Sections A2, A3, A4)	☒ Included ☐ Not Applicable

APPENDIX B: SPICE DATA LEVELS AND DATASETS

Details of the different levels of data and associated datasets for SPICE are included below. **The present document addresses only data up to and including Level 2a.** Data of higher levels, and the associated datasets, are tentatively defined here for completeness.

Data Levels:

Level 1 data: are those collected as the output of each individual instrument, which have been converted into geophysical measurements (e.g. weight, mass, intensity), generally with high temporal resolution, and before any significant data quality control has been applied. A **Level 1** dataset contains data from only one instrument at one site.

Level 2a data: are time-synchronized data resulting from the sampling, averaging or some other signal/data processing having been applied to **Level 1** data from an individual instrument in order to separate signal from noise. These data have not been quality controlled, and should be used only for monitoring an instrument's status. A **Level 2a** dataset contains data from only one instrument at one site.

Level 2b data: are time-synchronized **Level 2a** data after a basic data quality control procedure has been applied. Basic data quality flags for validity and quality have been added. Missing records have been created and filled with a missing data quality indicator. A **Level 2b** dataset contains data from only one instrument at one site.

Level 3 data: derived by combining and further processing all **Level 2b** datasets from a site. At this level, advanced and multiple instrument data quality techniques have been applied. A **Level 3** dataset contains data from all instruments at an individual site.

Level 4 data: derived after performing an intercomparison of the **Level 3** data from one or more sites, taking into account snow climatology, wind regimes, temperatures, etc., and where applicable, differences in these from one site to another.

Datasets:

SPICE Site Dataset: A dataset comprising all **Level 1, 2a, 2b and 3** datasets from that Intercomparison Site.

SPICE Intercomparison Dataset: this is the Level 4 dataset that combines the **Level 3** data from all SPICE intercomparison sites. The **Project Team** will develop the **SPICE Intercomparison Dataset** using the Level 3 datasets from each **Intercomparison Site.** It contains summary Level 3 data and intercomparison data for all instruments and all sites.

The SPICE Dataset: The total SPICE dataset including all **SPICE Site Datasets**, **Site Documentation** and **Instrument Documentation** for all participating sites and instruments, the **SPICE Intercomparison Dataset,** and all SPICE analysis and assessment documentation.

APPENDIX C: ACRONYMS AND ABBREVIATIONS

DFIR	Double-Fence Intercomparison Reference
e2e	End-to-end
ER	Evaluating Representative
IOC	International Organizing Committee
IR	Installation Representative
NCAR	National Center for Atmospheric Research (USA)
POP	Proof of Performance
QC	Quality control
R0	Working field reference configuration 0: manual or automatic precipitation gauge in bush
R1	Working field reference configuration 1: manual precipitation gauge in DFIR
R2	Working field reference configuration 2: automatic weighing gauge in DFIR
R3	Working field reference configuration 3: two automatic weighing gauges; one shielded (single-Alter), one unshielded
SPICE	Solid Precipitation Intercomparison Experiment
SWE	Snow water equivalent
WG	Weighing gauge
WMO	World Meteorological Organization