

WMO SPICE
SITE COMMISSIONING PROTOCOL

V3.1 (JUL, 23 2013)

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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 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.

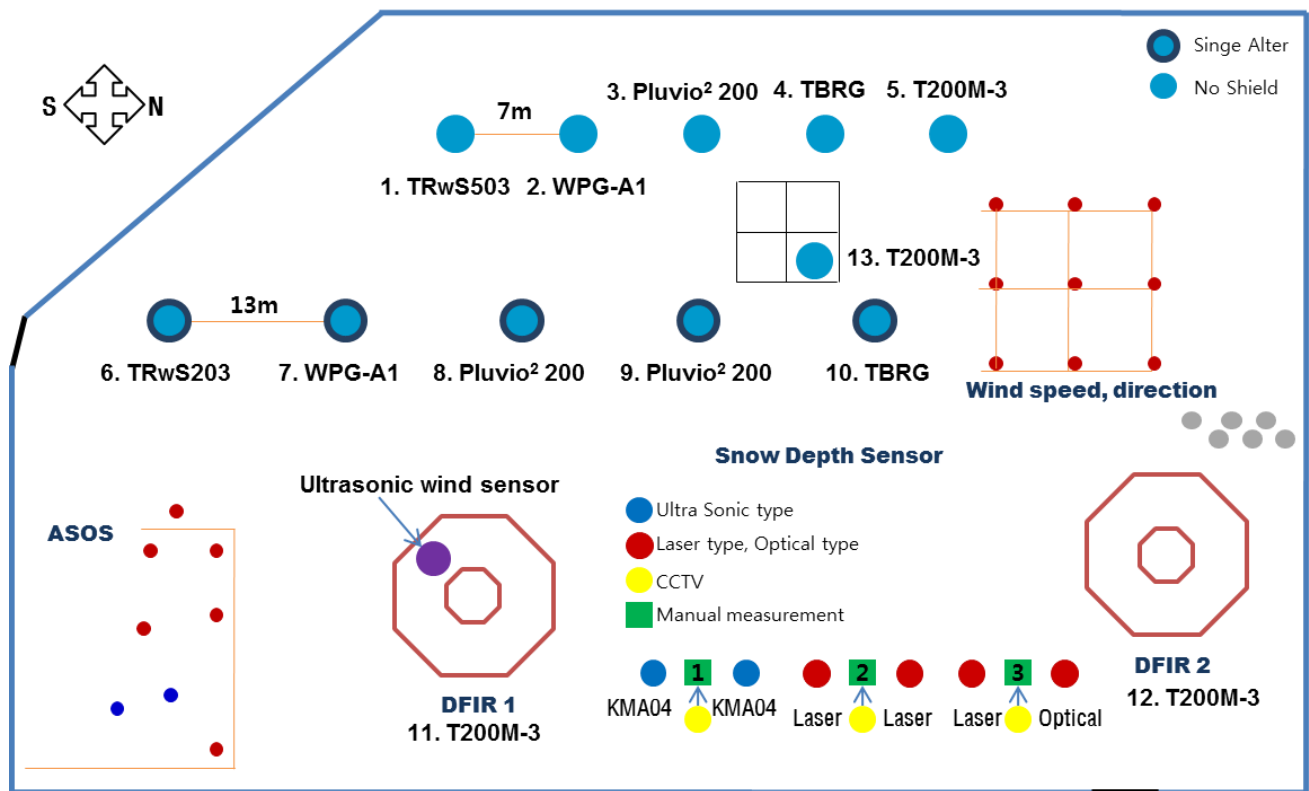
APPENDIX A: PROOF OF PERFORMANCE (POP) FORMS

SECTION A1: STATION INFORMATION

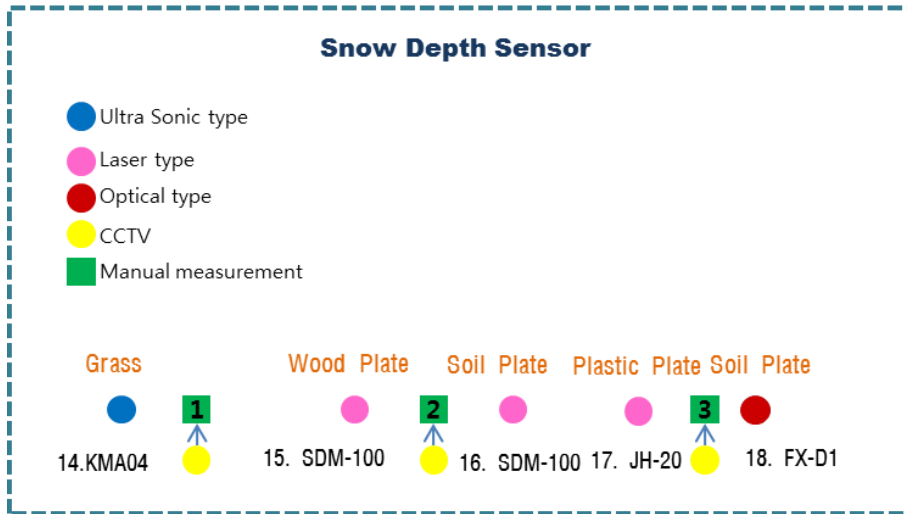
Station name	Gochang
Reference town	Gochang
Station latitude	35.34823068° N
Station longitude	126.59901788° E
Station elevation in metres	52

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

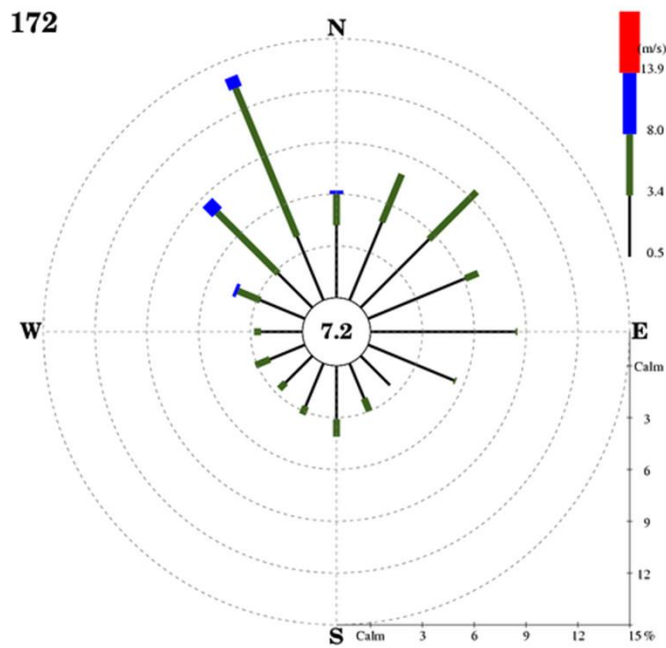
Site Layout - Gochang



Site Layout – Snow Depth



Site Layout – Snow Depth Sensor



2013, Winter

Wind rose plot for the winter of 2013(31/12/2013 to 28/2/2014) from Gochang station.

Site installation photos(5)



Photo 1 : Site overview from Southeast



Photo 2 : View from South



Photo 3 : View from North



Photo 4 : View from East



Photo 5 : View from West

SECTION A2: SPICE FIELD WORKING REFERENCE SYSTEM CONFIGURATION

Field Reference Type R0 – N/A

R0 type	MANUAL <input type="checkbox"/>	AUTOMATIC <input type="checkbox"/>
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>i.e plant species, deciduos leaves or not, etc.</i>
Maintenance details	<i>i.e prune every XX months;</i>

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?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Attached to the post of the weighing gauge?	<input type="checkbox"/> Yes <input type="checkbox"/> 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)

R2(Automatic) unheated on 11. T200M-3 (South)

Configuration of the DFIR fence

Description of surrounding obstacles (including distance/direction from, height, and type)	Distance between 2 DFIRs (R2_South and R2_North) is 53m. Please refer to site layout.
Diameter	12 m
Height of the outer fence (measured at the top)	3.5 m
Height of the inner fence (measured at the top)	3 m
Length of slats	1.5 m
Width of slats	0.05 m
Slat material	Wood

Single Alter shield

According to the SPICE instructions?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Attached to the post of the weighing gauge?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
If different, provide details:	

Weighing gauge (WG)

Make and model	Geonor T-200M3, 1000 mm
Serial number	34310, 34410, 34510
Firmware version (if applicable)	N/A
Number of transducers (if applicable)	3
Height of installation (measured from the top of the gauge)	3 m
Heater configuration and algorithm	Unheated
Output data message format	"TIMESTAMP","RECORD","batt_volt",

	"precip_T200M_1_No13","precip_T200M_2_No13", "precip_T200M_3_No13","avg_precip_T200M_No13"
Frequency of data sampling	6 sec

Precipitation detector

Make and model	Nippon electric instrument Inc. NS-100
output data message format	"TIMESTAMP","RECORD","Precipitation"
Data sampling frequency	1 min
Height of installation. <i>DAT team recommend the following place for an optical precipitation detector or precipitation type sensor inside the DFIR:</i>	1.2 m
<ul style="list-style-type: none"> • Inside the inner fence • 75 cm below the gauge opening, corresponds to half way down the inner fence 	
Location of installation relative to WG in reference system. <i>DAT team recommend to locate the optical precipitation detector or precipitation type:</i> <ul style="list-style-type: none"> • 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 	

Picture. Field Reference Type R2 (Automatic)

Photo of installation – DFIR (South)



Photo of installation – Geonor gauge with Single-alter shield inside DFIR (South)



Table. Field Calibration of Reference Type R2 (Automatic)

Reference Amount(mm)	Measured Amount(mm)				Difference(%)			
	VW1	VW2	VW3	average	VW1	VW2	VW3	average
10.000	9.849	9.910	9.975	9.911	-1.51	-0.90	-0.25	-0.89
19.995	19.771	20.032	19.935	19.913	-1.12	0.18	-0.30	-0.41
31.400	31.020	31.403	31.208	31.210	-1.21	0.01	-0.61	-0.60

48h Plot. Field Reference Type R2 (Automatic)

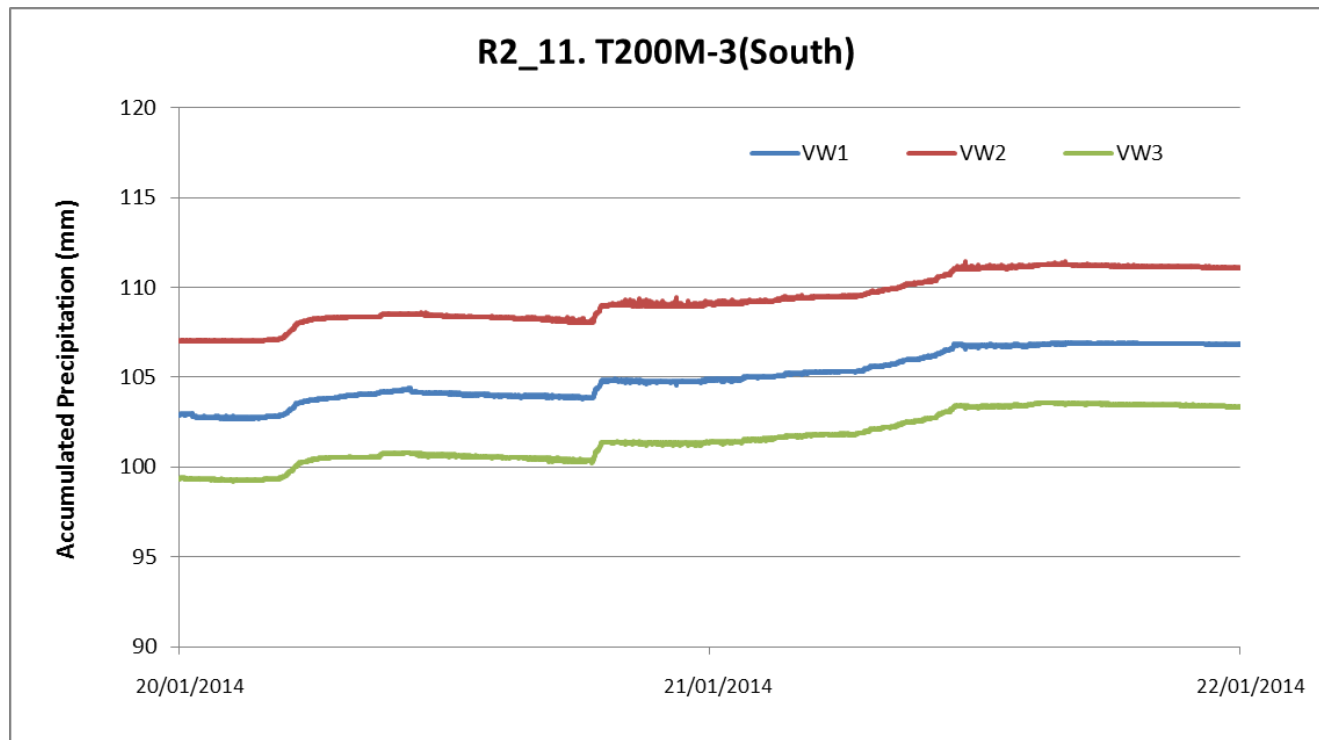


Photo of installation - Precipitation Detector



Field Reference Type R2 (Automatic)

R2(Automatic) unheated on 12. T200M-3 (North)

Configuration of the DFIR fence

Description of surrounding obstacles (including distance/direction from, height, and type)	Distance between 2 DFIRs (R2_South and R2_North) is 53m. Please refer to site layout.
Diameter	12 m
Height of the outer fence (measured at the top)	3.5 m
Height of the inner fence (measured at the top)	3 m
Length of slats	1.5 m
Width of slats	0.05 m
Slat material	Wood

Single Alter shield

According to the SPICE instructions?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Attached to the post of the weighing gauge?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
If different, provide details:	

Weighing gauge (WG)

Make and model	Geonor T-200M3, 1000 mm
Serial number	24810, 24910, 25010
Firmware version (if applicable)	N/A
Number of transducers (if applicable)	3
Height of installation (measured from the top of the gauge)	3 m
Heater configuration and algorithm	Unheated
Output data message format	"TIMESTAMP","RECORD","batt_volt",

	"precip_T200M_1_No14","precip_T200M_2_No14", "precip_T200M_3_No14","avg_precip_T200M_No14"
Frequency of data sampling	6 sec

Precipitation detector

Make and model	Nippon electric instrument Inc. NS-100
output data message format	"TIMESTAMP","RECORD","Precipitation"
Data sampling frequency	1 min
Height of installation. <i>DAT team recommend the following place for an optical precipitation detector or precipitation type sensor inside the DFIR:</i>	1.2 m
<i>• Inside the inner fence</i> <i>• 75 cm below the gauge opening, corresponds to half way down the inner fence</i>	
Location of installation relative to WG in reference system. <i>DAT team recommend to locate the optical precipitation detector or precipitation type:</i>	
<i>• perpendicular to the main wind direction</i> <i>• if possible using two precipitation sensors at different places to account for different wind directions.</i> <i>• in the middle between Alter and inner fence</i>	

Picture. Field Reference Type R2 (Automatic)

Photo of installation - DFIR (North)



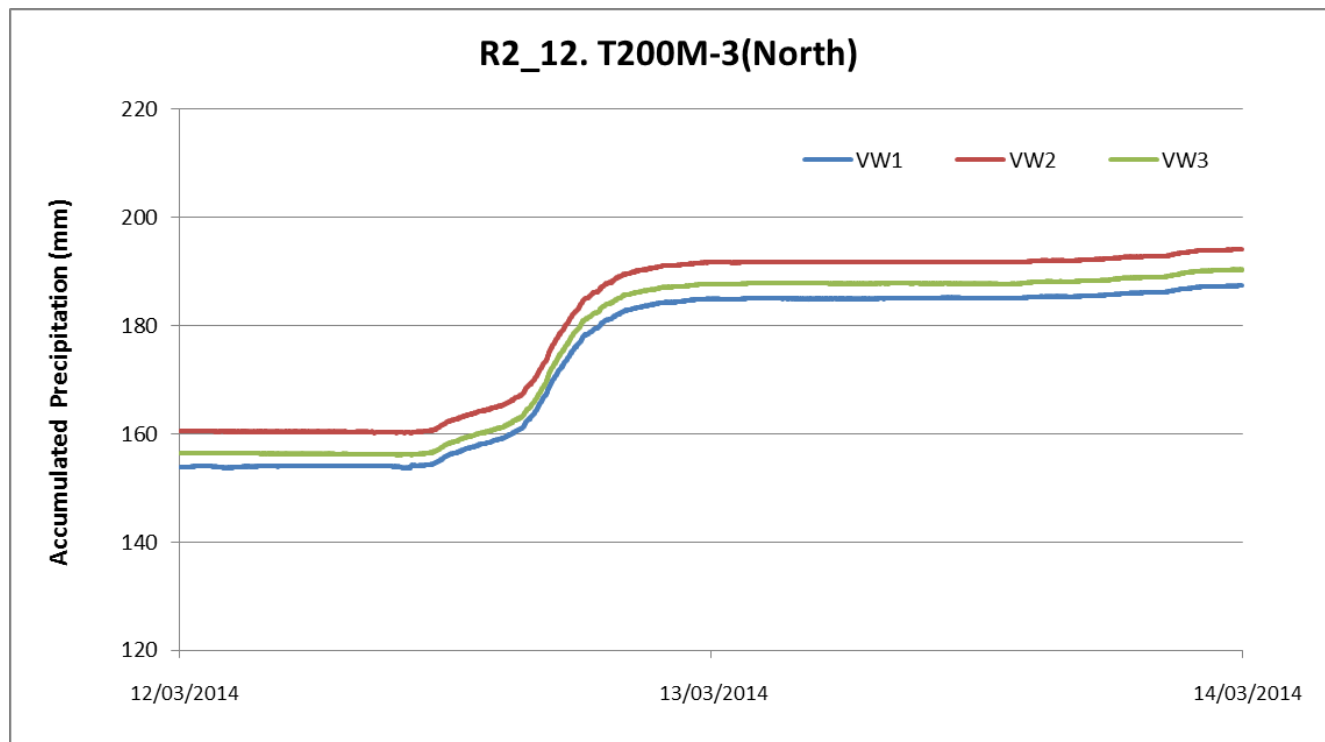
Photo of installation - Geonor gauge with Single-alter shield inside DFIR (North)



Table. Field Calibration of Reference Type R2 (Automatic)

Reference Amount(mm)	Measured Amount(mm)				Difference(%)			
	VW1	VW2	VW3	average	VW1	VW2	VW3	average
9.975	10.559	10.153	9.953	10.222	5.86	1.79	-0.22	2.47
19.930	20.127	20.082	19.889	20.032	0.99	0.76	-0.21	0.51
31.400	30.470	31.443	31.395	31.103	-2.96	0.14	-0.02	-0.95

48h Plot. Field Reference Type R2 (Automatic)



Field Reference Type R3 (Automatic)

Presence of a WG with a single Alter shield?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Presence of a WG with no shield?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Description of surrounding obstacles (including distance/direction from, height, and type)	Distance between 3. Pluvio ² 200 and 4. TBGR is 7 m.
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.	

Weighing gauge (1 of 2)

Make and model	OTT, Pluvio ² 200 (3. Pluvio ² 200)
Serial number	314477
Firmware version (if applicable)	1.31.0
Number of transducers (if applicable)	N/A
Height of installation (measured from the top of the gauge)	2 m
Heater configuration and algorithm	Pluvio standard heating
Output data message format	"TIMESTAMP","RECORD","inten_RT_No4", "accu_RT_NRT_No4","accu_NRT_No4", "accu_tot_NRT_No4","bucket_RT_No4", "bucket_NRT_No4","loadcell_temp_No4", "status_plu_No4"
Frequency of data sampling	6 sec

Weighing gauge (2 of 2)

Make and model	OTT, Pluvio ² 200 (8. Pluvio ² 200)
Serial number	334541
Firmware version (if applicable)	1.30.1
Number of transducers (if applicable)	N/A

Height of installation (measured from the top of the gauge)	2 m
Heater configuration and algorithm	Pluvio standard heating
Output data message format	"TIMESTAMP","RECORD","inten_RT_No10", "accu_RT_NRT_No10","accu_NRT_No10", "accu_tot_NRT_No10","bucket_RT_No10", "bucket_NRT_No10","loadcell_temp_No10", "status_plu_No10"
Frequency of data sampling	6 sec

Single Alter shield

According to the SPICE instructions?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Attached to the post of the weighing gauge?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
If different, provide details:	

Precipitation detector

Make and model	
Data output format	
Data sampling frequency	
Height of installation.	
Location of installation relative to WGs in reference system.	

Pictures. Field Reference Type R3 (Automatic).



Weighing Gauge 1 (3. Pluvio² 200)



Weighing Gauge 2 (8. Pluvio² 200)

Table. Field Calibration of Reference Type R3 (Automatic) Weighing Gauges 1 and 2

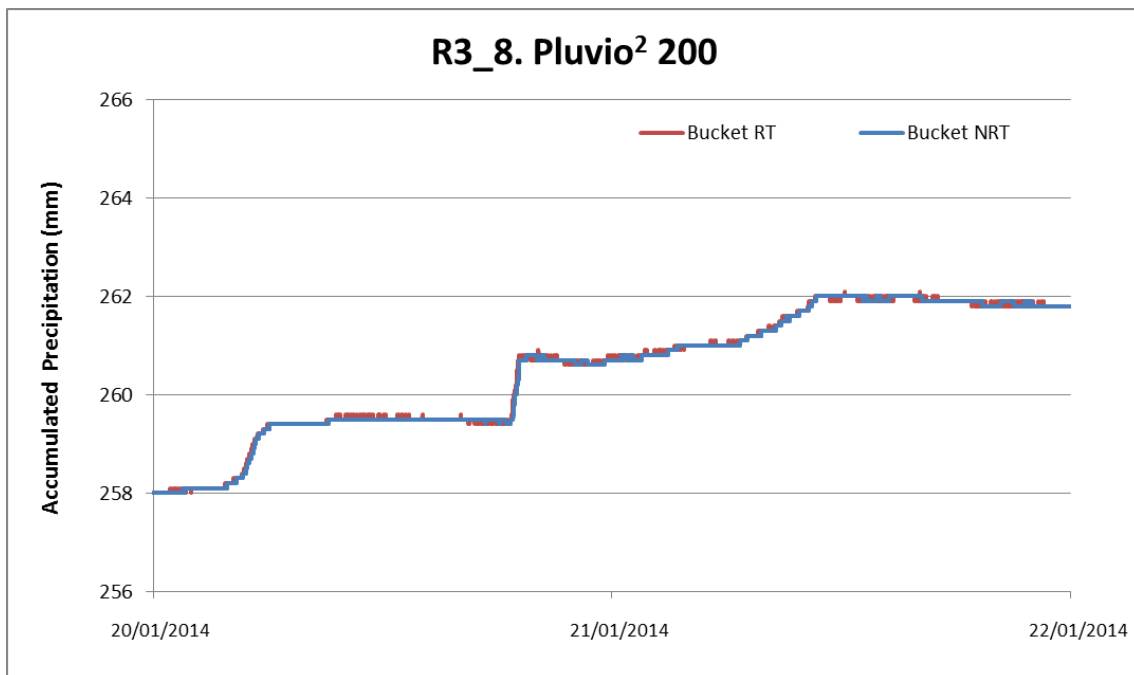
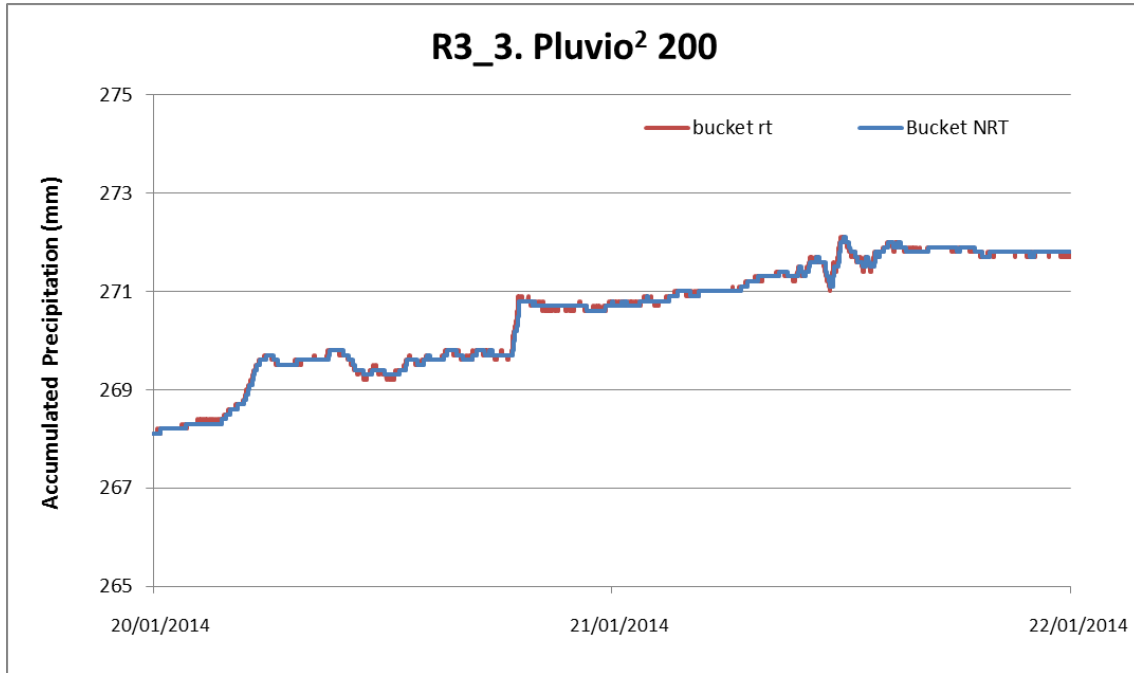
Weighing Gauges 1 : 3. Pluvio² 200

Reference Amount(mm)	Measured Amount(mm)	Difference(%)
31.400	31.200	-0.64
10.000	9.800	-2.00
20.000	19.900	-0.50

Weighing Gauges 2 : 8. Pluvio² 200

Reference Amount(mm)	Measured Amount(mm)	Difference(%)
31.400	31.200	-0.64
20.000	19.800	-1.00
10.000	9.800	-2.00

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



Field Reference for the Measurement of Snow on the Ground

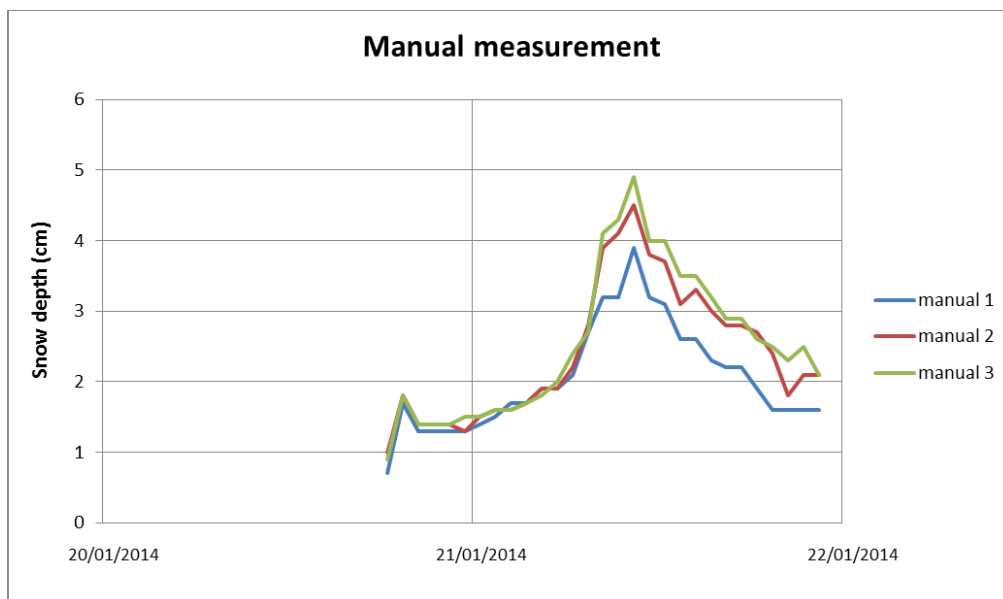
Method used	Manual Readings and Video camera monitoring
Equipment used	Snow ruler(3 point)
Frequency of measurement	Hourly

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



Table. Field Calibration for the Measurement of Snow on the Ground - N/A

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



Picture. Video camera monitoring for the Measurement of Snow on the Ground



SECTION A3: INSTRUMENT METADATA REPORT

For each instrument under test and each instrument used to provide ancillary measurements, an Instrument Metadata Report should be completed in full and submitted as part of the POP 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: Weighing Gauge_Geonor T200M-3

Instrument number 1 of 2

Manufacturer	Geonor
Model	T200M-3, 1000 mm
Serial number	30708, 30808, 30908
Firmware version (if applicable)	N/A

Field configuration

Location on site	5. T200M-3 (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	No shield
Heating (if applicable)	Unheated

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","batt_volt", "precip_T200M_1_No6","precip_T200M_2_No6", "precip_T200M_3_No6","avg_precip_T200M_No6"
Data sampling frequency	1 min

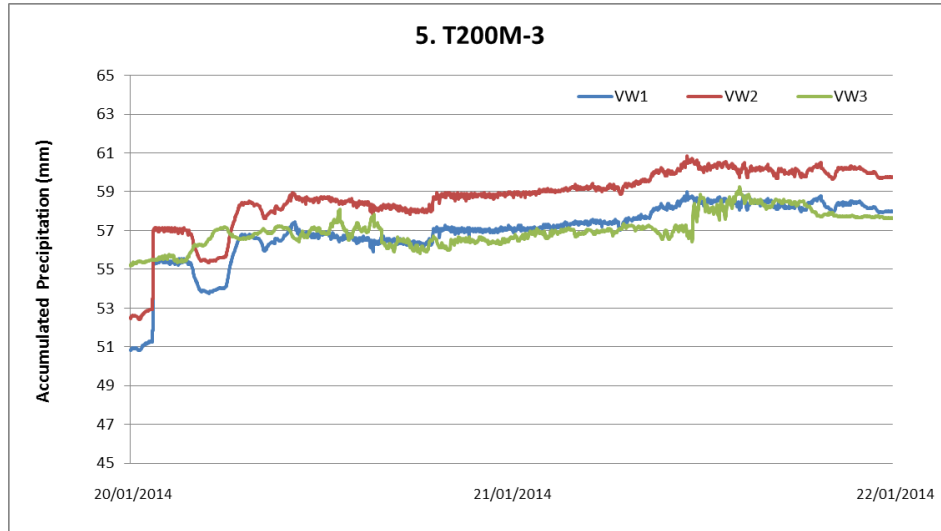
Instrument Picture.



Field calibration (if any).

Reference Amount(mm)	Measured Amount(mm)				Difference(%)			
	VW1	VW2	VW3	average	VW1	VW2	VW3	average
31.400	21.323	23.180	25.138	23.214	-32.09	-26.18	-19.94	-26.07
20.000	22.203	22.144	17.149	20.499	11.02	10.72	-14.26	2.49
19.990	18.371	17.926	17.852	18.050	-8.10	-10.32	-10.69	-9.71
10.005	11.216	11.053	10.739	11.003	12.10	10.48	7.33	9.97

48h Plot.



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: Weighing Gauge_Geonor T200M-3_

Instrument number 2_ of 2_

Manufacturer	Geonor
Model	T200M-3, 1000 mm
Serial number	35208, 35308, 35408
Firmware version (if applicable)	N/A

Field configuration

Location on site	13. T200M-3 (Please refer to site layout) In the pit gauge.
Orientation	N/A
Height (measured at top)	0 m
Shield (if applicable)	No shield
Heating (if applicable)	Unheated

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","batt_volt", "precip_T200M_1_No15","precip_T200M_2_No15", "precip_T200M_3_No15","avg_precip_T200M_No15"
Data sampling frequency	1 min

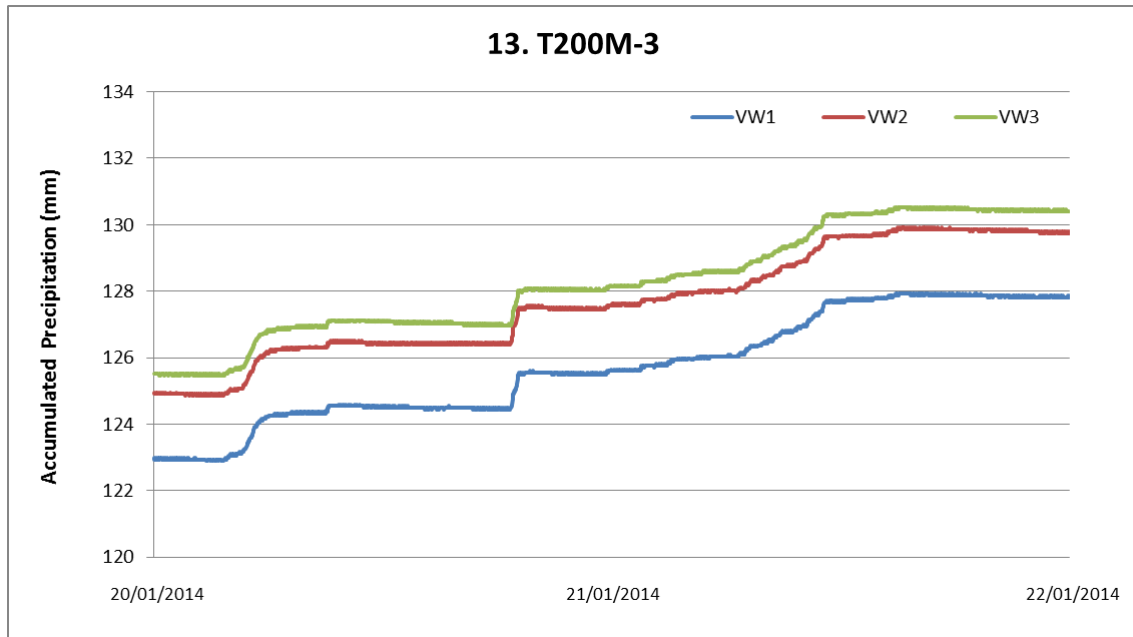
Instrument Picture.



Field calibration (if any).

Reference Amount(mm)	Measured Amount(mm)				Difference(%)			
	VW1	VW2	VW3	average	VW1	VW2	VW3	average
31.400	31.344	31.368	31.525	31.412	-0.18	-0.10	0.40	0.04
31.400	31.399	31.341	31.510	31.417	0.00	-0.19	0.35	0.05
19.990	19.887	19.815	19.911	19.845	-0.52	-0.88	-0.40	-0.73
20.005	19.996	20.001	20.023	20.006	-0.04	-0.02	0.09	0.00
10.015	10.032	10.034	9.964	10.010	0.17	0.19	-0.51	-0.05

48h Plot.



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: Weighing Gauge_OTT Pluvivo² 200

Instrument number 1 of 1

Manufacturer	OTT
Model	Pluvivo ² 200, 1500 mm
Serial number	263702
Firmware version (if applicable)	1.30.0

Field configuration

Location on site	9. Pluvivo ² 200 (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	Single alter shield
Heating (if applicable)	Pluvio standard heating

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","inten_RT_No11", "accu_RT_NRT_No11","accu_NRT_No11", "accu_tot_NRT_No11","bucket_RT_No11", "bucket_NRT_No11","loadcell_temp_No11", "status_plu_No11"
Data sampling frequency	1 min

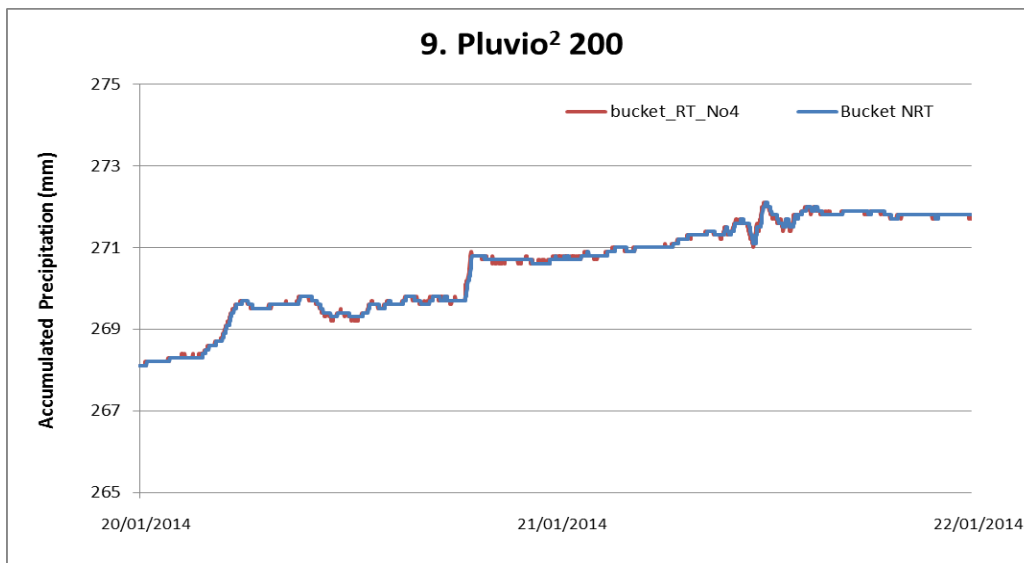
Instrument Picture.



Field calibration (if any).

Reference Amount(mm)	Measured Amount(mm)	Difference(%)
31.400	31.200	-0.64
20.000	19.820	-0.90
10.000	9.820	-1.80

48h Plot.



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: Weighing Gauge_MPS TRwS

Instrument number 1 of 2

Manufacturer	MPS
Model	TRwS503, 750 mm
Serial number	334
Firmware version (if applicable)	N/A

Field configuration

Location on site	1. TRwS503 (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	No shield
Heating (if applicable)	Orifice of TRwS is equipped with heating wire to assure heating during ambient temperature below +10°C and precipitation was detected. Heating control unit is implemented into electronics TRwS itself. Heating power is approximately 12W and can be wired independently to the power for electronics.

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","ADR_203", "PRCP1m_203","RD1m_203","TW1_203", "WA1_203","US1_203"
Data sampling frequency	1 min

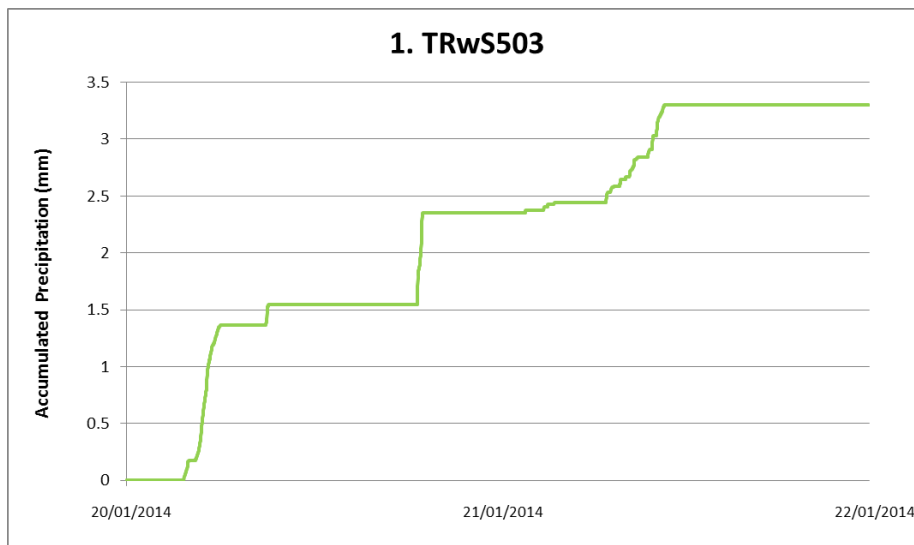
Instrument Picture.



Field calibration (if any).

Reference Amount(mm)	Measured Amount(mm)	Difference(%)
9.960	9.877	-0.83
20.000	19.637	-1.82
20.000	19.715	-1.43

48h Plot.



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: Weighing Gauge_MPS TRwS

Instrument number 2 of 2

Manufacturer	MPS
Model	TRwS203, 300 mm
Serial number	335
Firmware version (if applicable)	N/A

Field configuration

Location on site	6. TRwS203 (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	Single Alter shield
Heating (if applicable)	Orifice of TRwS is equipped with heating wire to assure heating during ambient temperature below +10°C and precipitation was detected. Heating control unit is implemented into electronics TRwS itself. Heating power is approximately 12W and can be wired independently to the power for electronics.

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","ADR_503", "PRCP1m_503","RD1m_503","TW1_503", "WA1_503","US1_503"
Data sampling frequency	1 min

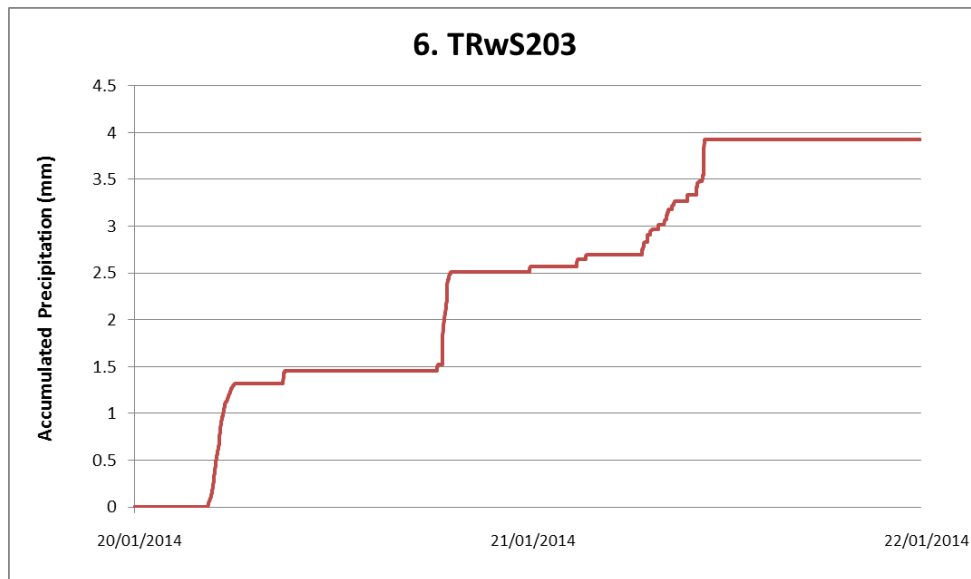
Instrument Picture.



Field calibration (if any).

Reference Amount(mm)	Measured Amount(mm)	Difference(%)
31.400	31.330	-0.22
20.010	19.920	-0.45
10.010	9.941	-0.69

48h Plot.



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.

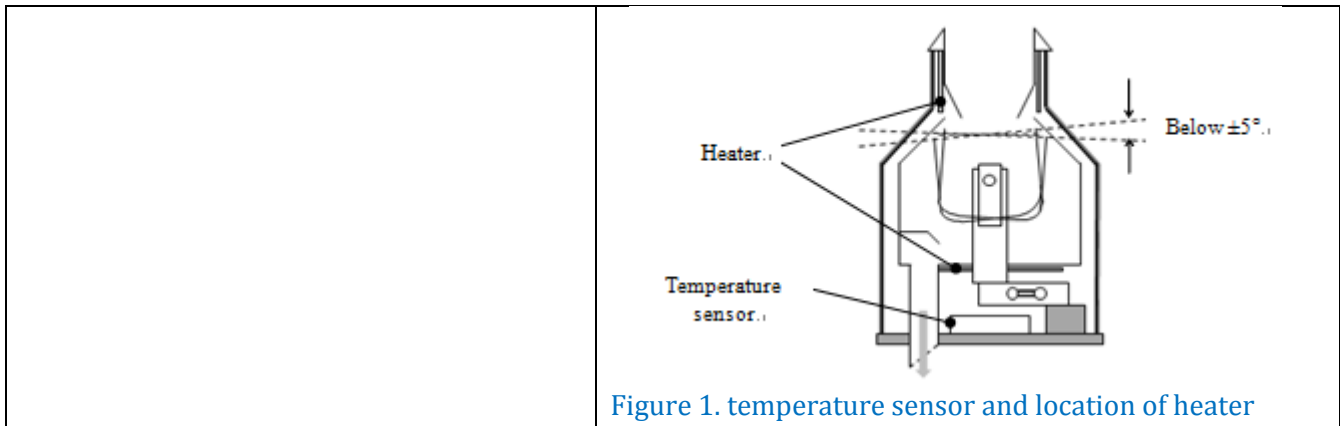
Instrument Name: Auto-Emptying Type Weight Precipitation Gauge

Instrument number 1 of 2

Manufacturer	Wellbian System
Model	WPG-A1
Serial number	P130001
Firmware version (if applicable)	1.4.1

Field configuration

Location on site	2. WPG-A1 (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	No shield
Heating (if applicable)	<p>Like Figure 1, each 150W(220VAC) heater is installed at side of collector and bottom of emptying receiver to prohibit the solid things such as snow from attaching to the collector and to facilitate drainage.</p> <p>This heater is controlled by temperature sensor and program attached in data processing & control module closely at bottom of precipitation gauge. The power of heater is controlled by the logic that if measured temperature of sensor is below 4°C, heater will be turned on but if measured temperature of sensor is over than 6°C, heater will be turned off.</p>



Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","WPG_date_No3", "WPG_time_No3","WPG_1s_data_No3", "WPG_10s_data_No3","WPG_offset_No3", "WPG_10s_diff_No3","WPG_bucket_rain_No3", "WPG_PA_No3","WPG_PO_No3","WPG_PI_No3", "WPG_temp_No3","WPG_R_count_No3"
Data sampling frequency	1 min

Instrument Picture.

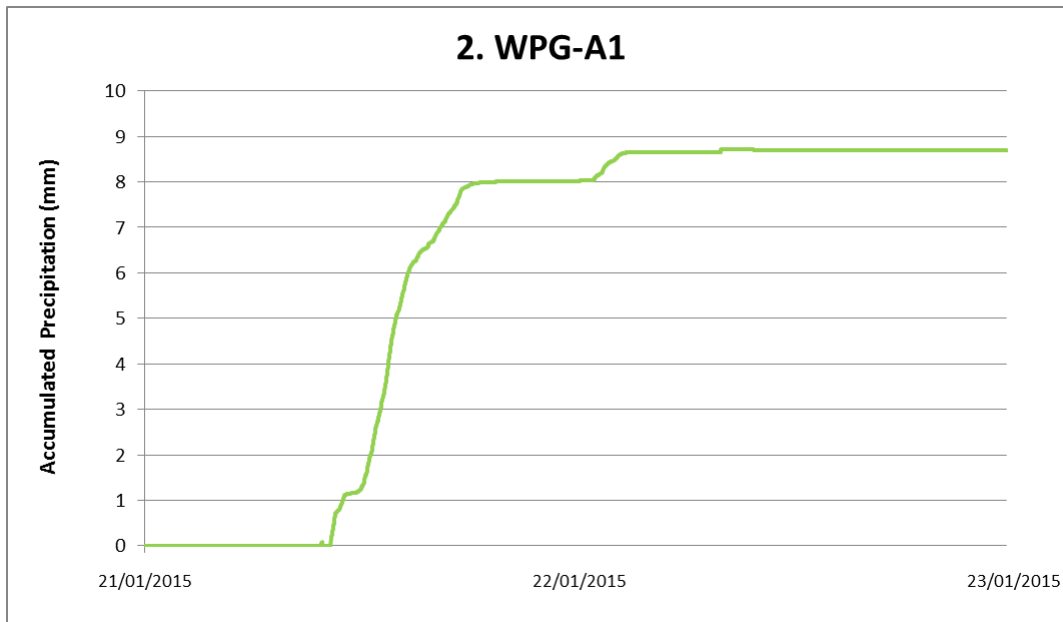




Field calibration (if any).

Not done, but will be done in the near future.

48h Plot.



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: Auto-Emptying Type Weight Precipitation Gauge

Instrument number 2 of 2

Manufacturer	Wellbian System
Model	WPG-A1
Serial number	P130002
Firmware version (if applicable)	1.4.1

Field configuration

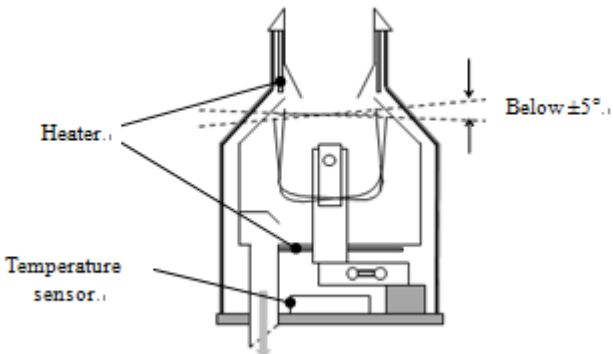
Location on site	7. WPG-A1 (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	Tretyakov shield
Heating (if applicable)	<p>Like Figure 1, each 150W(220VAC) heater is installed at side of collector and bottom of emptying receiver to prohibit the solid things such as snow from attaching to the collector and to facilitate drainage.</p> <p>This heater is controlled by temperature sensor and program attached in data processing & control module closely at bottom of precipitation gauge. The power of heater is controlled by the logic that if measured temperature of sensor is below 4°C, heater will be turned on but if measured temperature of sensor is over than 6°C, heater will be turned off.</p> 

Figure 1. temperature sensor and location of heater

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","WPG_date_No3", "WPG_time_No3","WPG_1s_data_No3", "WPG_10s_data_No3","WPG_offset_No3", "WPG_10s_diff_No3","WPG_bucket_rain_No3", "WPG_PA_No3","WPG_PO_No3","WPG_PI_No3", "WPG_temp_No3","WPG_R_count_No3"
Data sampling frequency	1 min

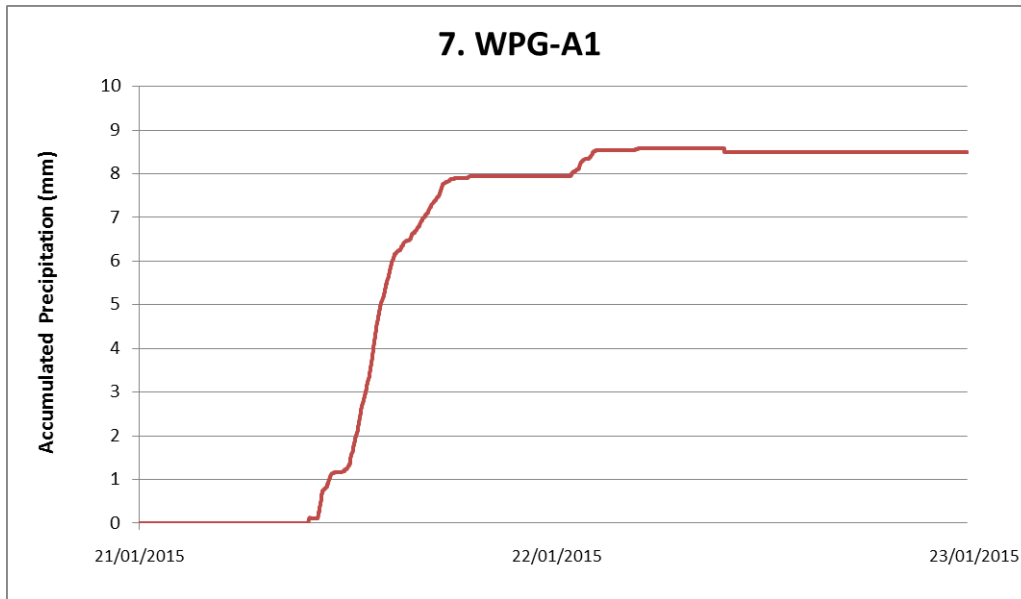
Instrument Picture.



Field calibration (if any).

Not done, but will be done in the near future.

48h Plot.



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: Tipping Bucket Gauge

Instrument number 1 of 2

Manufacturer	Seouljeonggi
Model	
Serial number	9245
Firmware version (if applicable)	N/A

Field configuration

Location on site	4. TBRG (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	No shield
Heating (if applicable)	Rim of gauge is equipped with heating sensor. When temperature falling below +7°C, the heating system becomes "Active". If the temperature exceeds +35°C, the heating system switched off.

Data output

Data communication protocol	Analogue Output - Pulse (Reed Relay)
Output data message format (include description of fields)	"TIMESTAMP","RECORD","rain_No5_Tot"
Data sampling frequency	1 min

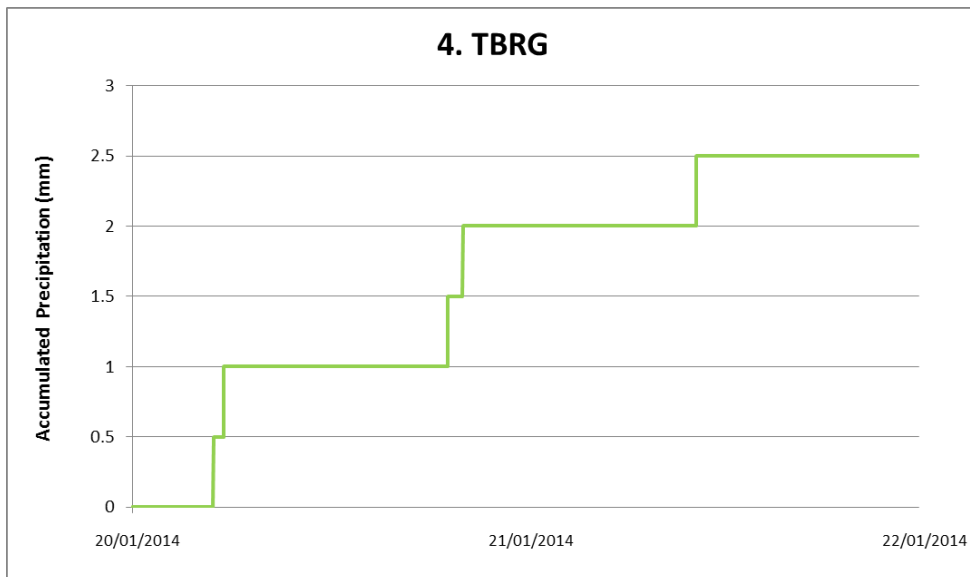
Instrument Picture.



Field calibration (if any).

Reference Amount(mm)	Measured Amount(mm)	Difference(%)
20.200	20.000	-0.99
20.000	19.500	-2.50

48h Plot.



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: Tipping Bucket Gauge

Instrument number 2 of 2

Manufacturer	Seouljeonggi
Model	
Serial number	9244
Firmware version (if applicable)	N/A

Field configuration

Location on site	10. TBRG (Please refer to site layout)
Orientation	N/A
Height (measured at top)	2 m
Shield (if applicable)	Single Alter shield
Heating (if applicable)	Rim of gauge is equipped with heating sensor. When temperature falling below +7°C, the heating system becomes "Active". If the temperature exceeds +35°C, the heating system switched off.

Data output

Data communication protocol	Analogue Output - Pulse (Reed Relay)
Output data message format (include description of fields)	"TIMESTAMP","RECORD","rain_No12_Tot"
Data sampling frequency	1 min

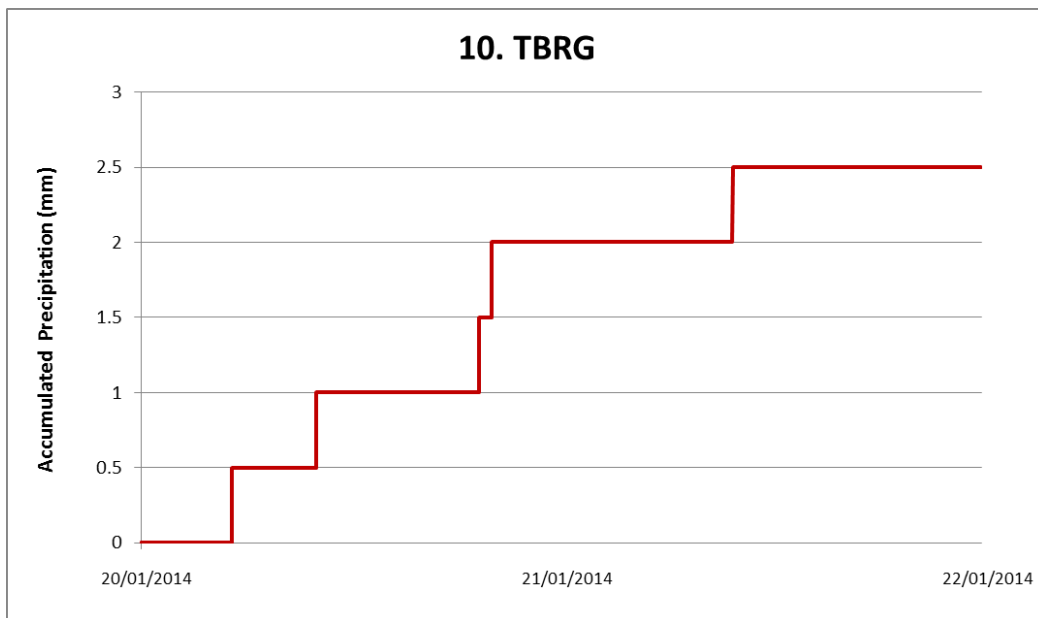
Instrument Picture.



Field calibration (if any).

Reference Amount(mm)	Measured Amount(mm)	Difference(%)
20.200	20.500	1.49

48h Plot.



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: Snow depth sensor_Ultrasonic type_

Instrument number 1 of 1

Manufacturer	Kaijo Sonic
Model	KMA-04
Serial number	3NS0705137
Firmware version (if applicable)	

Field configuration

Location on site	14. KMA-04 (Please refer to site layout)
Orientation	The sensor is pointed toward ground.
Height (measured at top)	4 m
Shield (if applicable)	N/A
Heating (if applicable)	N/A

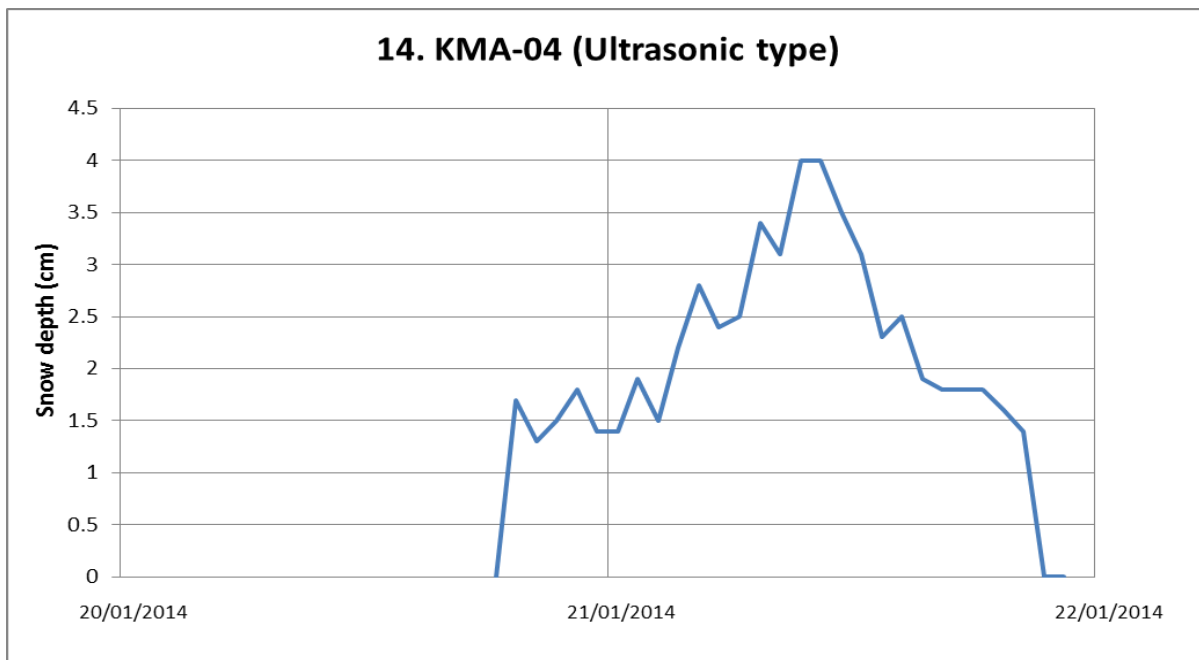
Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP", "RECORD", "Temperature", "Snowdepth"
Data sampling frequency	10 min

Instrument Picture.



48h Plot.



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: Snow depth sensor_ Multipoint Laser type_

Instrument number 1 of 2

Manufacturer	Weatherpia Co. Ltd.
Model	SDM-100
Serial number	2013100-006
Firmware version (if applicable)	1.50

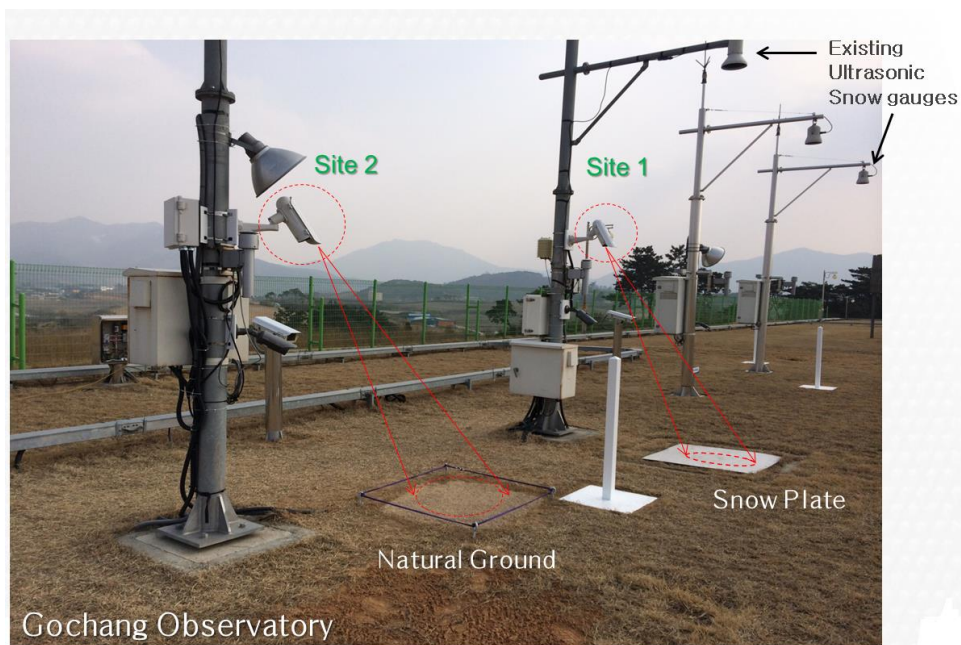
Field configuration

Location on site	15. SDM-100 (Please refer to site layout)
Orientation	Downward approx.. 35 degree from a vertical pole
Height (measured at top)	2 m
Shield (if applicable)	N/A
Heating (if applicable)	Automatic(temperature set at 10 degree Celsius)

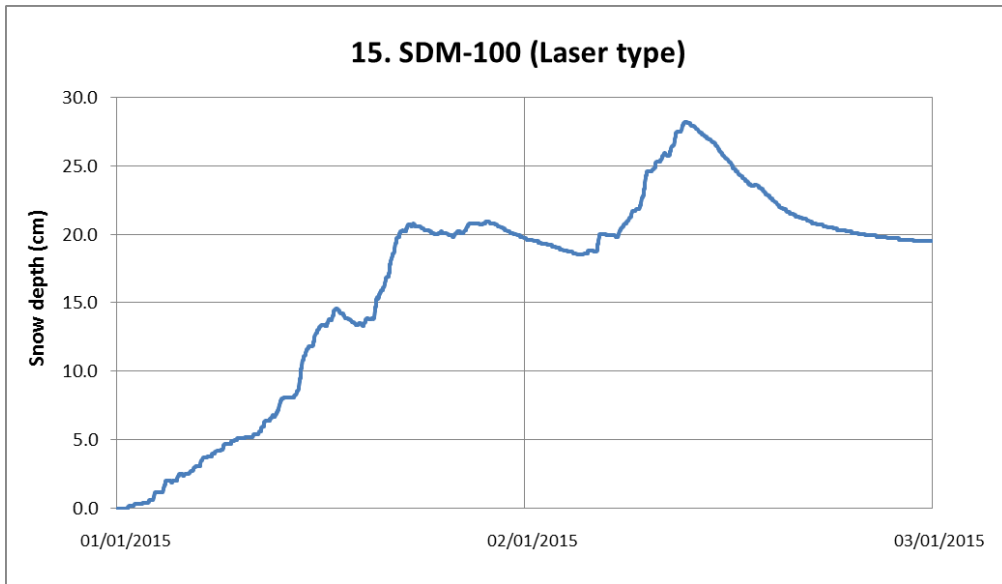
Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD", "SL_37_WP_snowdepth","SL_37_WP_logger_V"
Data sampling frequency	1 min

Instrument Picture.



48h Plot.



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: Snow depth sensor_ Multipoint Laser type_

Instrument number 2 of 2

Manufacturer	Weatherpia Co. Ltd.
Model	SDM-100
Serial number	2013100-007
Firmware version (if applicable)	1.50

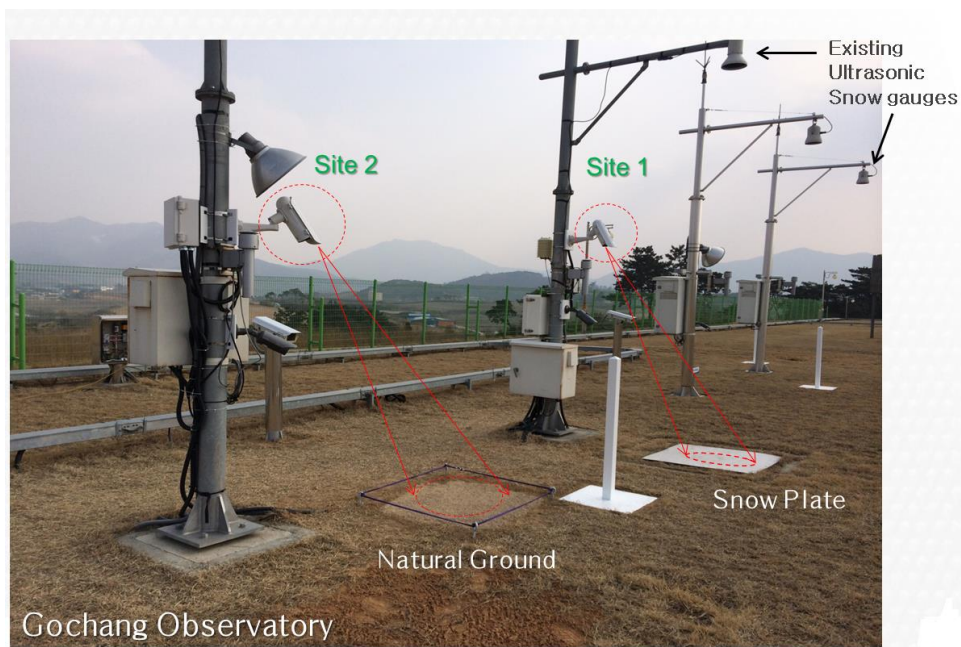
Field configuration

Location on site	16. SDM-100 (Please refer to site layout)
Orientation	Downward approx.. 35 degree from a vertical pole
Height (measured at top)	1.8 m
Shield (if applicable)	N/A
Heating (if applicable)	Automatic(temperature set at 10 degree Celsius)

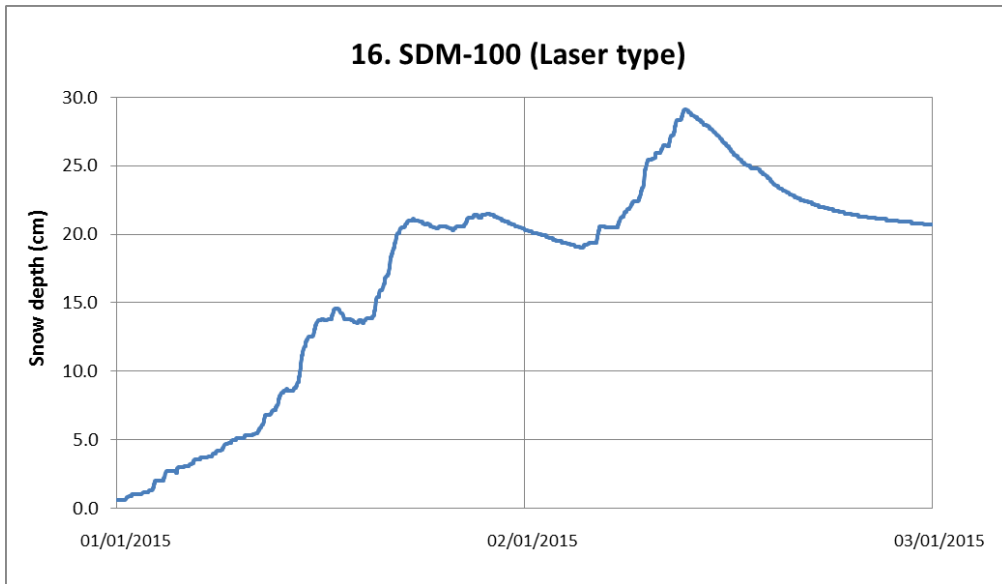
Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD", "SL_37_WP_snowdepth","SL_37_WP_logger_V"
Data sampling frequency	1 min

Instrument Picture.



48h Plot.



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: Snow depth sensor Multipoint Laser type

Instrument number 1 of 1

Manufacturer	Junghan electronics, Inc.
Model	JH-20
Serial number	
Firmware version (if applicable)	

Field configuration

Location on site	17. JH-20 (Please refer to site layout)
Orientation	3 sensors are pointed toward ground.
Height (measured at top)	2.3 m
Shield (if applicable)	N/A
Heating (if applicable)	N/A

Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","jh_snow_smp1_mm", "jh_snow_smp2_mm","jh_snow_smp3_mm", "jh_snow_avg_mm","airtemp"
Data sampling frequency	1 min

Instrument Picture.



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: Snow depth sensor_Optical type

Instrument number 1 of 1

Manufacturer	Sunjintech
Model	FX-D1
Serial number	Sjt-001
Firmware version (if applicable)	N/A

Field configuration

Location on site	18. FX-D1 (Please refer to site layout)
Orientation	The sensor is at a right angle toward ground.
Height (measured at top)	1.2 m
Shield (if applicable)	N/A
Heating (if applicable)	N/A

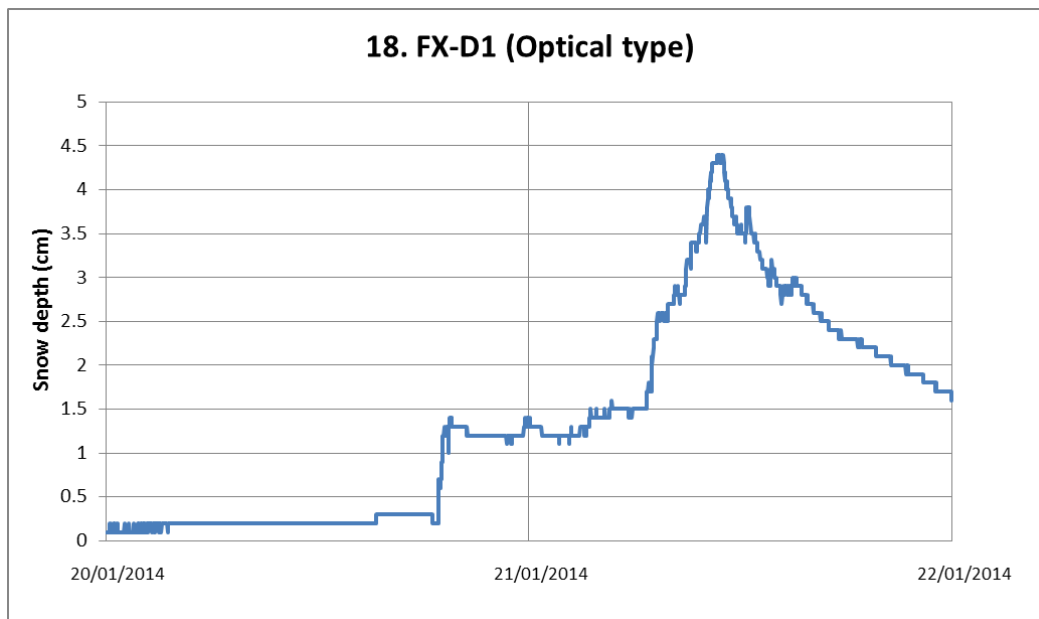
Data output

Data communication protocol	Digital Output
Output data message format (include description of fields)	"TIMESTAMP","RECORD","SJ_snow_depth_mm"
Data sampling frequency	1 min

Instrument Picture.



48h Plot.



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
Geonor T200M-3 (DFIR) on 11	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Geonor T200M-3 (DFIR) on 12	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: February 15, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
OTT Pluvio ² 200 (R3, unshielded) on 3	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
OTT Pluvio ² 200 (R3, shielded) on 8	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	

Geonor T200M-3 (unshielded) on 5	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	Repair for 29/05/2014~27/11/2014
Geonor T200M-3 (in the pit gauge) on 13	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
OTT Pluvio ² 200 (shielded) on 9	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: May 17, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
MPS TRwS503 (unshielded) on 1	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
MPS TRwS203 (shielded) on 6	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Wellbian WPG-A1 (unshielded) on 2	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: November 14, 2014	<input type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Wellbian WPG-A1 (shielded) on 7	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: November 14, 2014	<input type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Seouljeonggi TBRG (unshielded) on 4	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Seouljeonggi TBRG (shielded) on 10	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Kaijo sonic KMA-04			

on 14	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Weatherpia SDM-100 on 15	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: February 1, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Weatherpia SDM-100 on 16	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: February 1, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	
Junghan JH-20 on 17	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Date:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Date: February 1, 2015	Under repair
Sunjintech FX-D1 on 18	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date: January 10, 2014	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Date:	

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)	<input checked="" type="checkbox"/> Included
Complete set of pictures documenting the overall site installation - views from N, E, S, W (Section A1)	<input checked="" type="checkbox"/> Included
Details of manual measurement procedure (Section A2)	<input checked="" type="checkbox"/> Included <input type="checkbox"/> Not Applicable
Instrument Metadata Reports for all instruments under test and all instruments used to provide ancillary measurements (Section A3)	<input checked="" type="checkbox"/> Included
Calibration results and check sheets for all instruments (Sections A2, A3)	<input checked="" type="checkbox"/> Included Most of them.
Instrument data validation:, 48h time series plots (Sections A2, A3)	<input checked="" type="checkbox"/> Included
Instrument data validation table (Section A4)	<input type="checkbox"/> Included
48h Instrument data validation: discrepancy reports (Section A4)	<input type="checkbox"/> Included <input type="checkbox"/> Not Applicable
Pictures of installations of all reference instruments, instruments under test, and instruments used to provide ancillary measurements (Sections A2, A3)	<input checked="" type="checkbox"/> Included
End-to-end data validation (Section A4; see Instrument data validation table).	<input type="checkbox"/> Full (all gauges) <input type="checkbox"/> Partial (some gauges) <input checked="" type="checkbox"/> No
SPICE archive end-to-end data validation:	

discrepancy reports (Section A4)	<input type="checkbox"/> Yes <input type="checkbox"/> No
Details of any workarounds (Sections A2, A3, A4)	<input checked="" type="checkbox"/> Included <input type="checkbox"/> 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-Altair), one unshielded
SPICE	Solid Precipitation Intercomparison Experiment
SWE	Snow water equivalent
WG	Weighing gauge
WMO	World Meteorological Organization