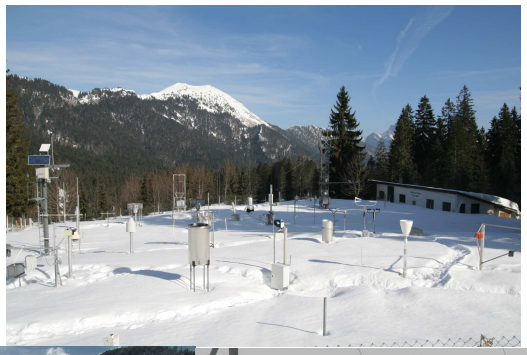
WMO SPICE

SITE COMMISSIONING PROTOCOL

Template V3.1 (Jul, 23 2013)

Col de Porte, France

Version 2014/08/28



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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 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	Col de Porte (CDP)
Reference town	38700 Sarcenas, France
Station latitude	45.30 N
Station longitude	5.77 W
Station elevation in metres	1325 m

A site layout indicating the location of SPICE references and all instruments, is provided on the following page. The total size of the reported area is ~2000m^2. The contours of the measurement field are approximately rectangular and large side is north-south oriented, 55 m (N-S) x 36 m (E-W). Distances are approximately reported to scale and indicated in cm. Prevailing wind direction is along the South/North axis.

The contribution of SPICE to the WMO-SPICE projects is undertaken by several academic and non-academic partners located in Grenoble, France.

The overall coordination of the CDP WMO-SPICE is ensured by Météo-France – CNRS, CNRM-GAME/CEN (CEN) in particular Samuel Morin, Yves Lejeune and Jean-Michel Panel (name.surname@meteo.fr). Most instruments at CDP are operated by CEN. Instruments already present on site prior to the WMP-SPICE experiment are indicated in yellow. WMO-SPICE instruments operated by CEN are indicated in orange.

Other partners operate several instruments :

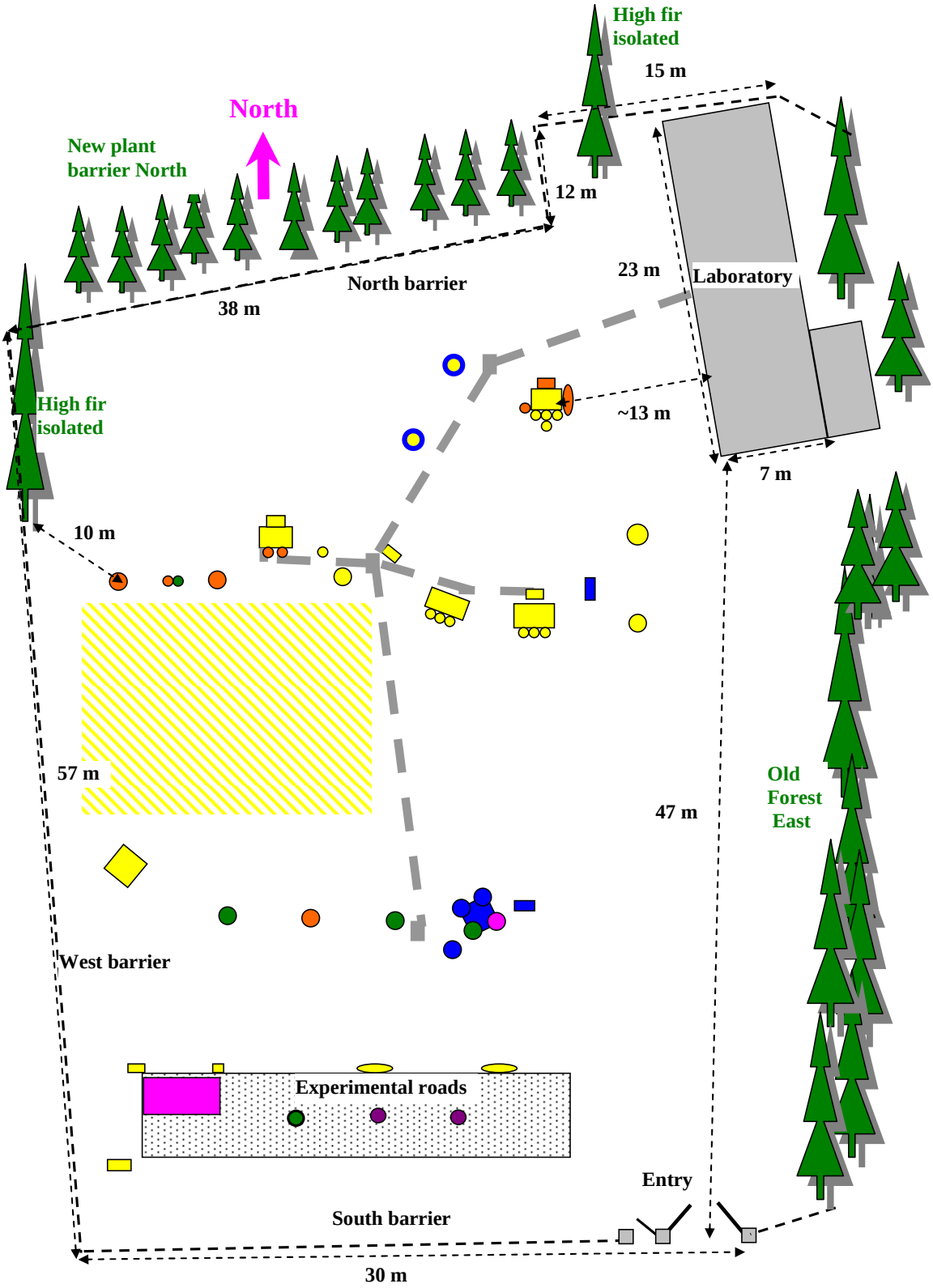
DISDBIR is operated by CNRS – Université Joseph Fourier, LGGE (LGGE), in particular Christophe Genthon and Luc Piard (name.surname@lgge.obs.ujf-grenoble.fr). This instrument is indicated in red on the site map.

PGNH, PGH and PGWEDF are operated by EDF – DTG (EDF), in particular Paul Carrier (name.surname@edf.fr). These instruments are indicated in blue on the site map.

OTT2, PNPA and DISDPWS are operated by Université Joseph Fourier – CNRS – G-INP – IRD, LTHE (LTHE), in particular Romain Biron and Jean-Paul Laurent for OTT2, DISDPWS and Thomas Condom for PNPA (name.surname@ujf-grenoble.fr). These instruments are indicated in green on the site map.

SPC1 and SPC2 are operated by SPC – Alpes du Nord (SPC-AN), in particular Alain Gautheron and Vincent Bontemps (name.surname@developpement-durable.gouv.fr). These instruments are indicated in violet on the site map.

Note that not all instruments indicated on the map contribute to SPICE.



Site layout (global view of the experimental field titled "Prairie, another part of the field is located in the eastern forest)

Site Layout : Color code

Conventional instrumental device deployed on site

Instrumental device (CEN)

Instrumental device (EDF-DTG)

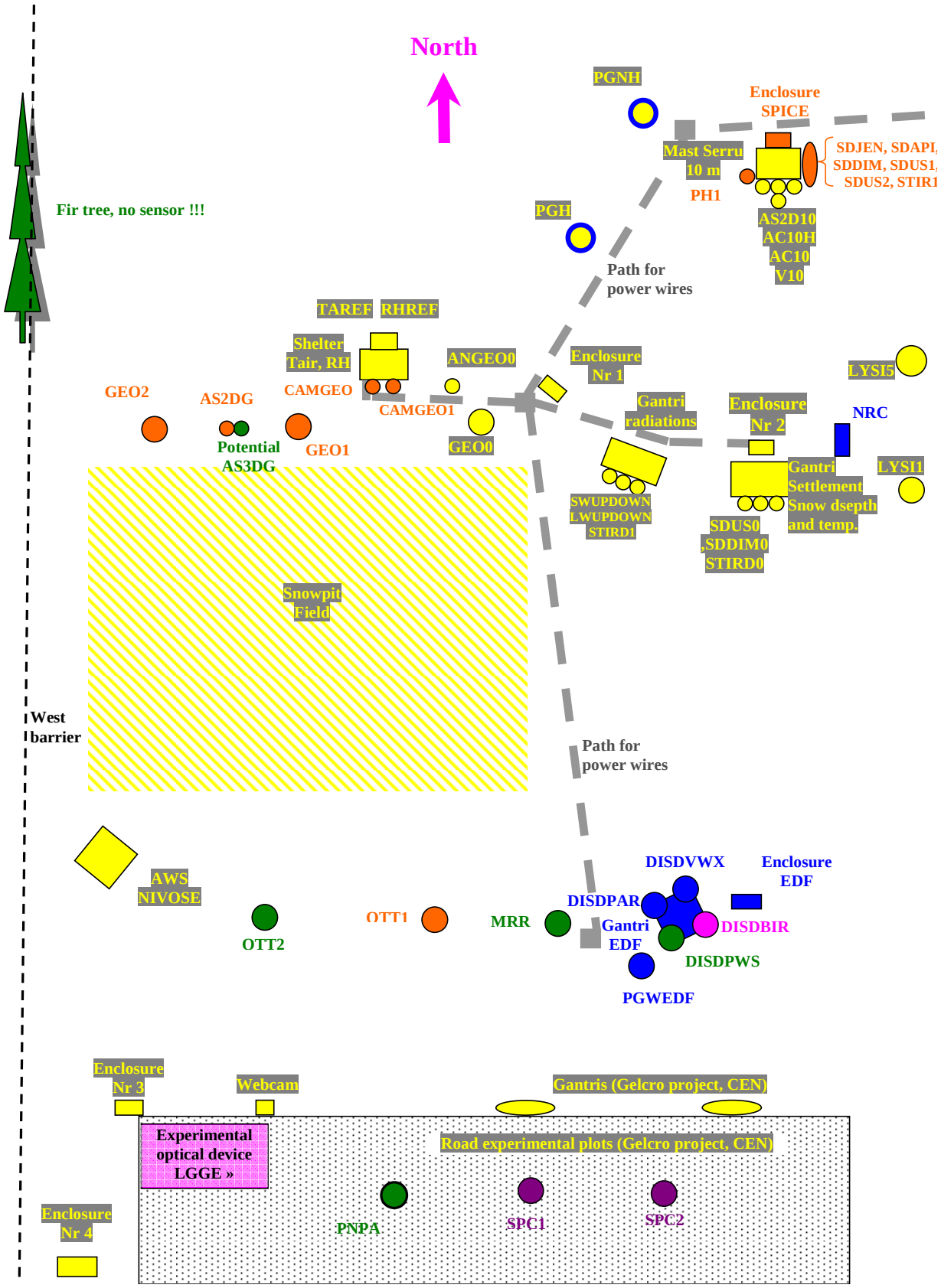
Pluviometers (SPC)

Instrumental device added in SPICE campaign context

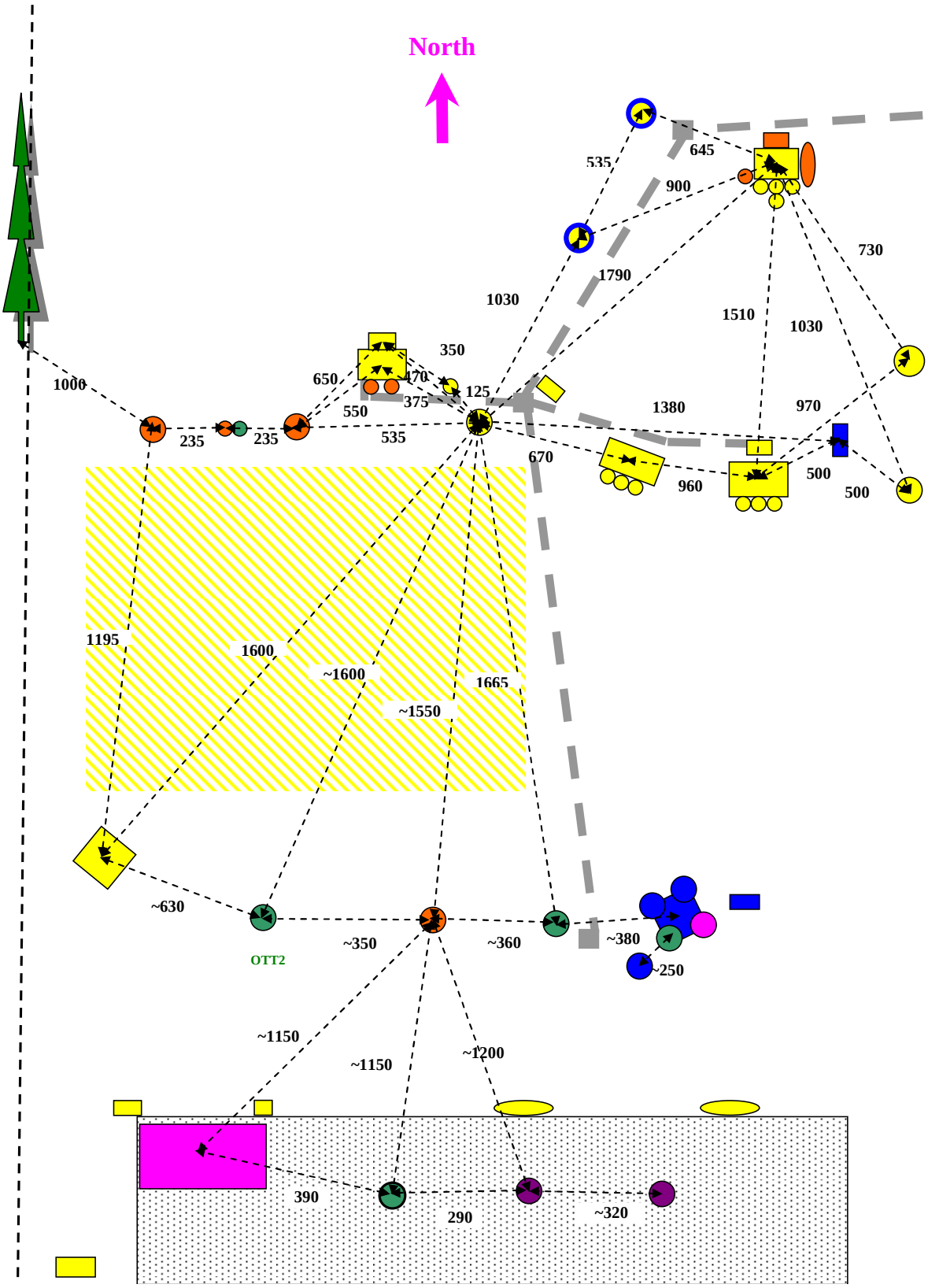
Instrumental device for R3 and new sensors linked to intercomparison Project (CEN)

New sensors linked to intercomparison Project. (LTHE)

New sensors linked to intercomparison Project. (LGGE)



Site layout, focus on the device of the experimental field "Prairie" with names of the instruments



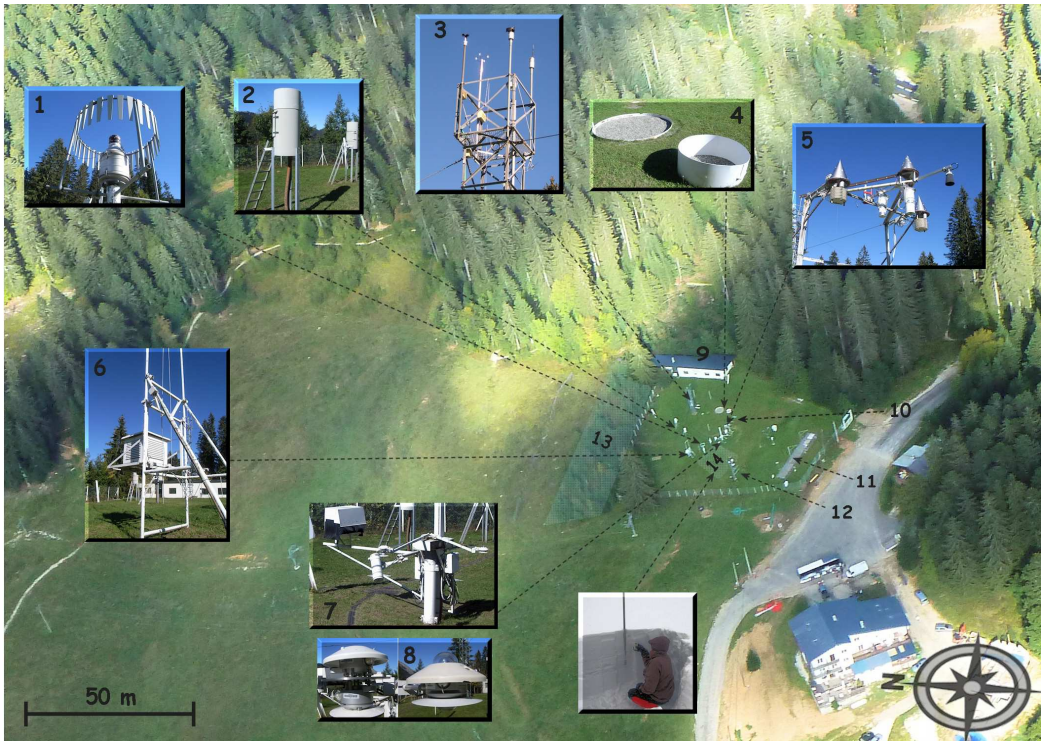
Site layout, view of the experimental field "Prairie" with distances (in centimetres) between the instruments

The site is monitored by a series of webcams. The main one is located on the mast, see below. In addition, two additional webcams monitor the 2 GEONORS GEO1 and GEO2 (constituting the R3). An additional wide angle webcam located on the southern side of the site also takes pictures of instruments.

Main webcam for site overview ; pictures every 15 minutes

View from top of 10 m mast located on the Northern side of the site, to the South (main webcam view) :

View from the air (instrumentation prior to WMO-SPICE)



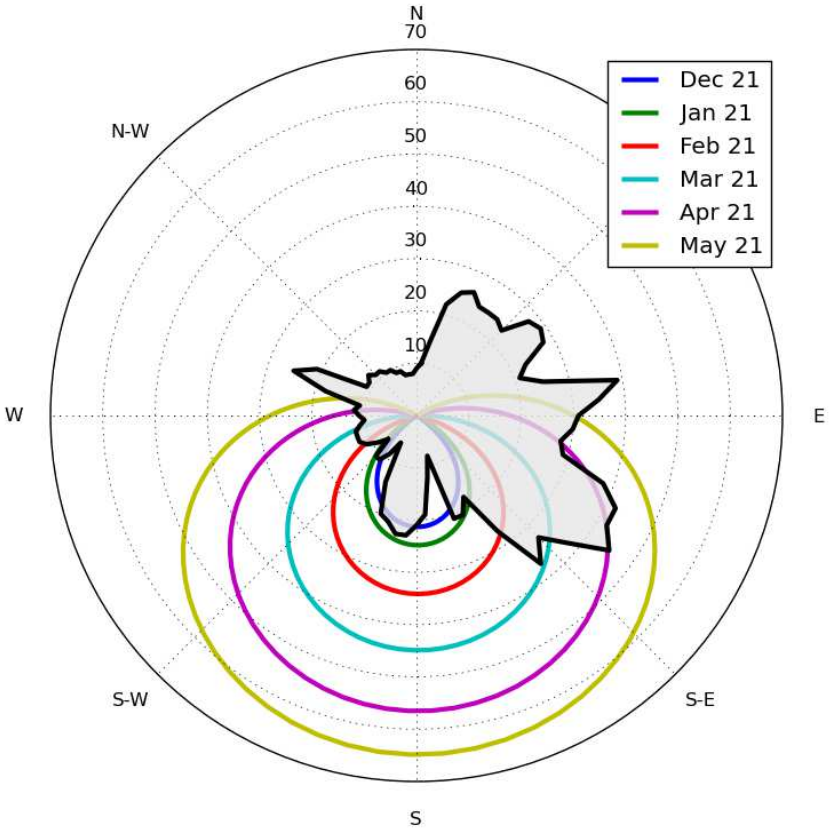
View to the North :

View to the South :

View to the West :

View to the East:

Below is given a graph of the solar mask of the site taken from its middle point (snow pit sampling area) (Morin et al., 2012, ESSD). The black line corresponds to the elevation angle of the top of sun blocking obstacles (trees, mountains, etc.). Coloured lines correspond to the sun course depending on the date of the year. Due to the surrounding forested and relief environment, the site is almost constantly in the shade in mid-winter.



SECTION A2: SPICE FIELD WORKING REFERENCE SYSTEM CONFIGURATION

The site is not equipped with R0, R1 and R2 precipitation references.

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)	*The GEO1 and GEO2 WG, making up the R3 precipitation references, are located in the middle of the experimental site. GEO2 is located 10 m from a neighbouring tree.*
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.	*The GEO1 and GEO2 WG are separated by 4.70 m horizontal distance. In between the two WGs, a vertical mast hosts the AS2DG ultrasonic anemometer.*

Weighing gauge (1 of 2) – GEO1

Make and model	*GEONOR T-200B3 600*
Serial number	*Sensors : 84513, 84613, 84713*
Firmware version (if applicable)	*N. A.*
Number of transducers (if applicable)	*3*
Height of installation (measured from the top of the gauge)	*3.09 m*
Heater configuration and algorithm	*For season 2013-2014 : Manufacturer heating system (200W), turns on when hourly air temperature is below +5°C* *For season 2014-2015 : Regulation of inlet at 2°C*

Output data message format	*N. A. (sampling of the transducers by CS CR1000 datalogger)*
Frequency of data sampling	*Sampling every 1 min (frequency measurement over 1500 cycles spanning approximately 1 s for each transducer).*

Weighing gauge (2 of 2) – GEO2

Make and model	*GEONOR T-200B3 600*
Serial number	*Sensors : 84813, 84913, 85013*
Firmware version (if applicable)	*N. A.*
Number of transducers (if applicable)	*3*
Height of installation (measured from the top of the gauge)	*3.09 m*
Heater configuration and algorithm	*For season 2013-2014 : Manufacturer heating system (200W), turns on when hourly air temperature is below +5°C* *For season 2014-2015 : Regulation of inlet at 2°C*
Output data message format	*N. A. (sampling of the transducers by CS CR1000 datalogger)*
Frequency of data sampling	*Sampling every 1 min (frequency measurement over 1500 cycles spanning approximately 1 s for each transducer).*

Single Alter shield

According to the SPICE instructions?	☒ Yes ☐ No *The single alter shield is associated to GEO1 WG.*
Attached to the post of the weighing gauge?	☐ Yes ☒ No *The single alter shield is attached to the concrete pad to which the vertical mast of the WG is also attached (see pictures below).*
If different, provide details:	

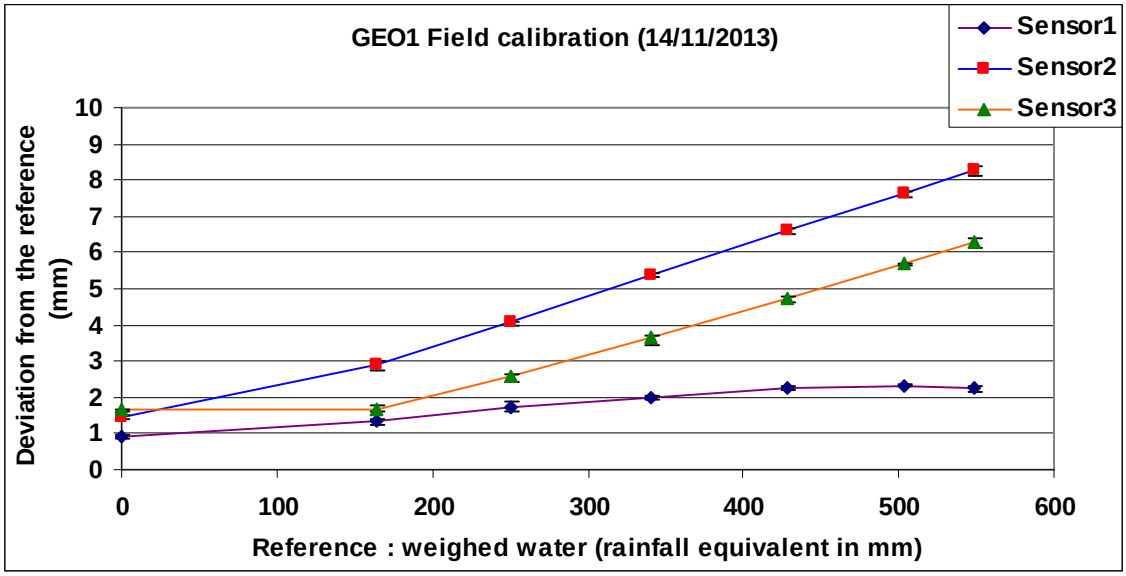
Precipitation detector

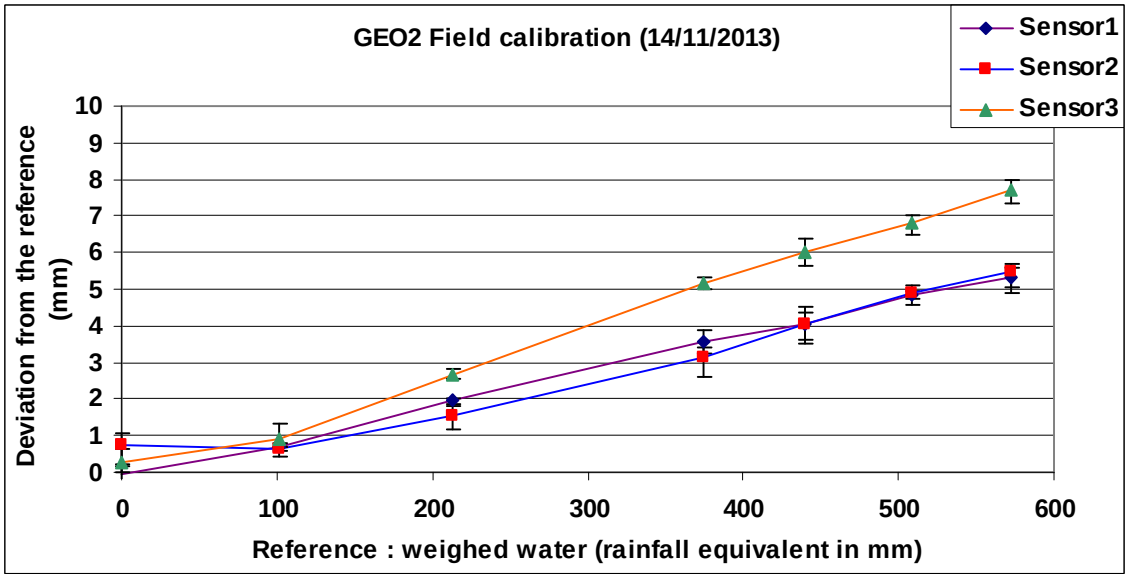
Make and model	The precipitation detectors are referred later in the document as DISDPWS and DISDBIR
Data output format	
Data sampling frequency	
Height of installation.	
Location of installation relative to WGs in reference system.	

Pictures. Field Reference Type R3 (Automatic).

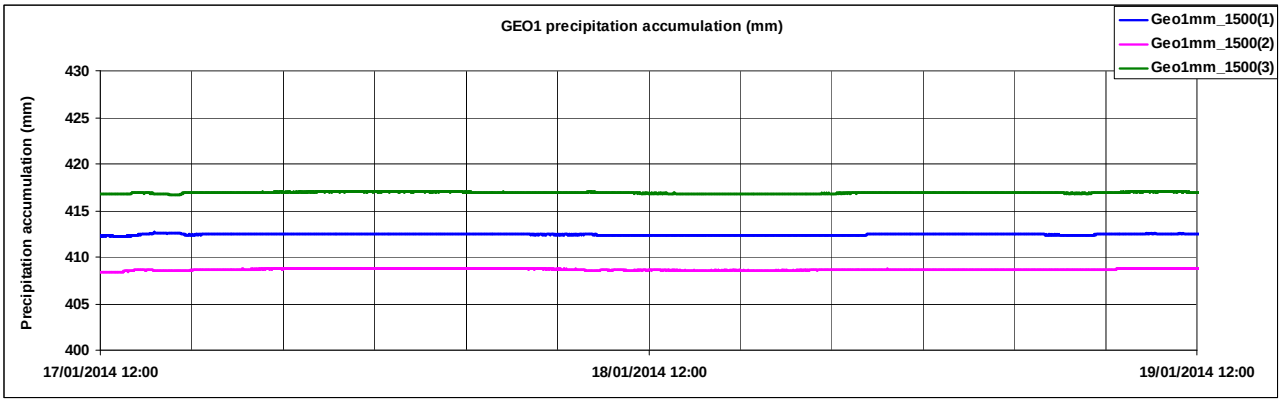
GEO1 is on the left (with single alter shield) ; GEO2 is on the right (without shield)

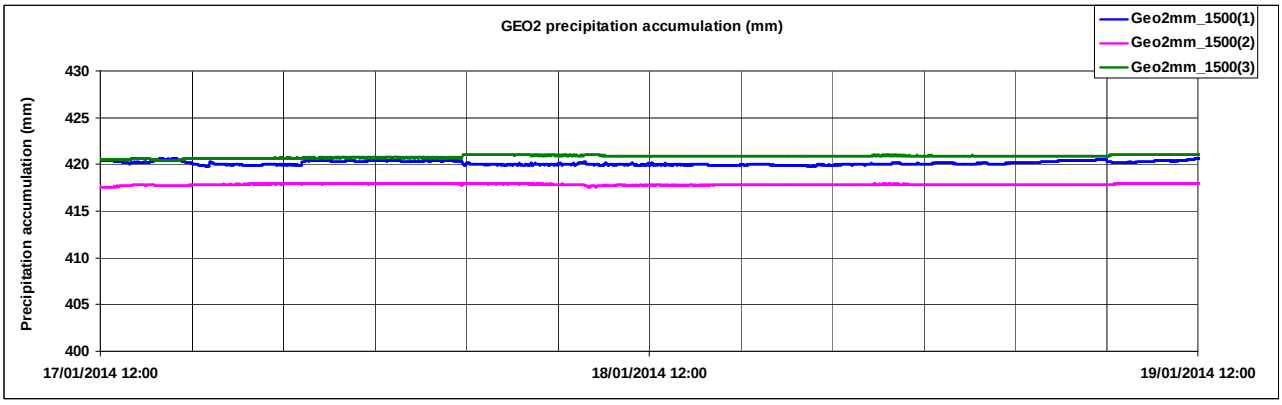
Field Calibration of Reference Type R3 (Automatic) Weighing Gauges 1 and 2





48h Plots. Field Reference Type R3 (Automatic). Weighing Gauges GEO1 and GEO2





Additional notes : GEO1 and GEO2 are filled with an antifreeze mixture following GEONOR recommendations, i.e. 1:1.6 volume mixing ratio for ethylene-glycol and methanol. 0.4 l of Univis J13 oil (Exxon – Esso) oil is added to the mixture (to reduce evaporation). The amount of antifreeze is adjusted depending on the level of protection against freezing. In most cases, at CDP the protection level is set to a value of -10°C (1 l ethylene-glycol and 1.6 l methanol) or –15°C (1.5 l ethylene-glycol and 2.1 methanol).

Field Reference for the Measurement of Snow on the Ground

Method used	*Manual measurements at snowpit site*
Equipment used	*Metal ruler (not permanently on site).*
Frequency of measurement	*Weekly*

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

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

Not applicable.

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

Not applicable.

All Snow on the Ground automated sensors are located on the same horizontal beam attached to the same vertical mast, about 4 m above ground. Manual snow depth measurements are carried out about 17 m from the automated measurements.

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

Instrument Name: __AS2DG___

Instrument number ___3_____ of ___23_____

Manufacturer	*Thies*
Model	*4.3820.30.340*
Serial number	*09137527*
Firmware version (if applicable)	*312*

Field configuration

Location on site	Located between GEO1 and GEO2 R3 WG.
Orientation	N. A.
Height (measured at top)	3.10 m
Shield (if applicable)	N. A.
Heating (if applicable)	Heating on.

Data output

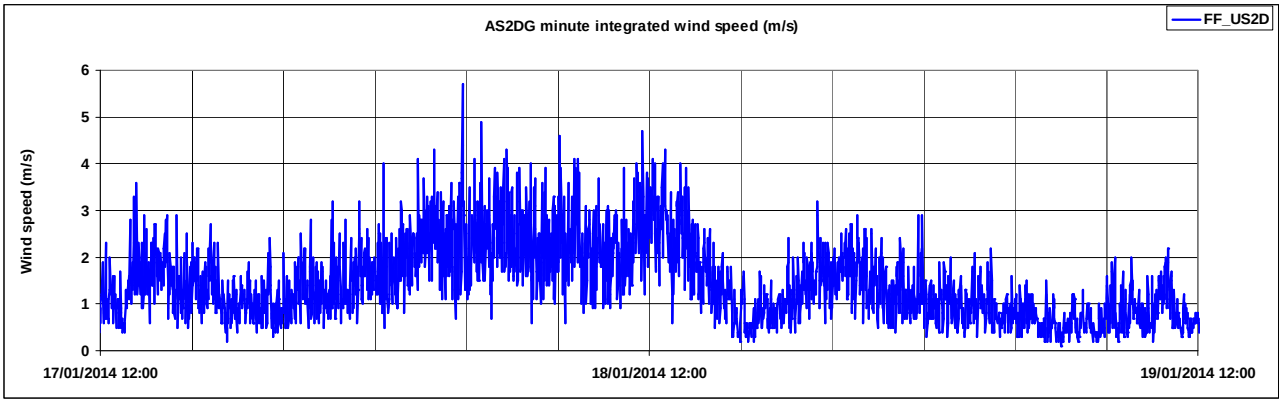
Data communication protocol	RS485
Output data message format (include description of fields)	TT (temperature, °C), DD (direction, °), FF (wind speed, m s^{-1})
Data sampling frequency	1 min average (moving average of high-resolution sampling at about 10 Hz)

Instrument Picture.

Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __GEO0___

Instrument number ___4_____ of ___23_____

Manufacturer	*Geonor*
Model	*T-200 (1 sensor – capacity 600mm)*
Serial number	*Unknown*
Firmware version (if applicable)	*Not applicable*

Field configuration

Location on site	Located besides GEO1 WG (symmetrical to GEO2)
Orientation	N. A.
Height (measured at top)	3.10 m
Shield (if applicable)	Yes.
Heating (if applicable)	*House-made outside heating turns on when hourly air temperature is below +5°*

Data output

Data communication protocol	RS232
Output data message format (include description of fields)	Precipitation accumulation
Data sampling frequency	1 hour average or sampling (16 secondes constant low pass filter)

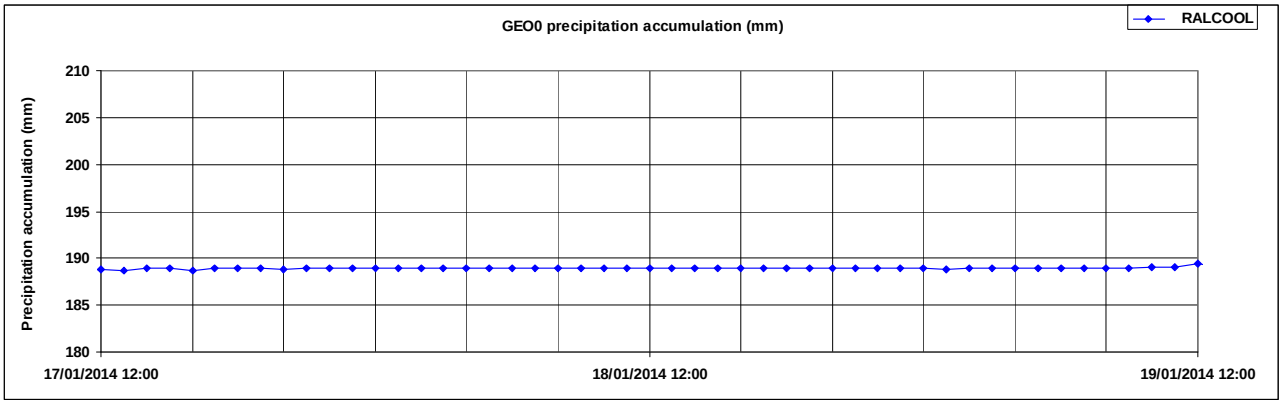
This instrument has been used since 1993 at CDP and is used as the local reference for precipitation at the site since then.

Instrument Picture.

Field calibration (if any).

Not available.

48h Plot.



Additional notes : GEO0 is filled with an antifreeze mixture following GEONOR recommendations, i.e. 1:1.6 volume mixing ratio for ethylene-glycol and methanol. 0.4 l of Univis J13 oil (Exxon – Esso) oil is added to the mixture (to reduce evaporation). The amount of antifreeze is adjusted depending on the level of protection against freezing. In most cases, at CDP the protection level is set to a value of -10°C (1 l ethylene-glycol and 1.6 l methanol) or –15°C (1.5 l ethylene-glycol and 2.1 methanol).

Instrument Metadata Report

Instrument Name: __ANGEO0___

Instrument number ___5_____ of ___23_____

Manufacturer	*Laumonier*
Model	*W01-1332A-0000*
Serial number	*17*
Firmware version (if applicable)	N. A.

Field configuration

Location on site	Located 2 m horizontally from GEO0 WG
Orientation	N. A.
Height (measured at top)	3.0 m
Shield (if applicable)	N. A.
Heating (if applicable)	Heated anemometer.

Data output

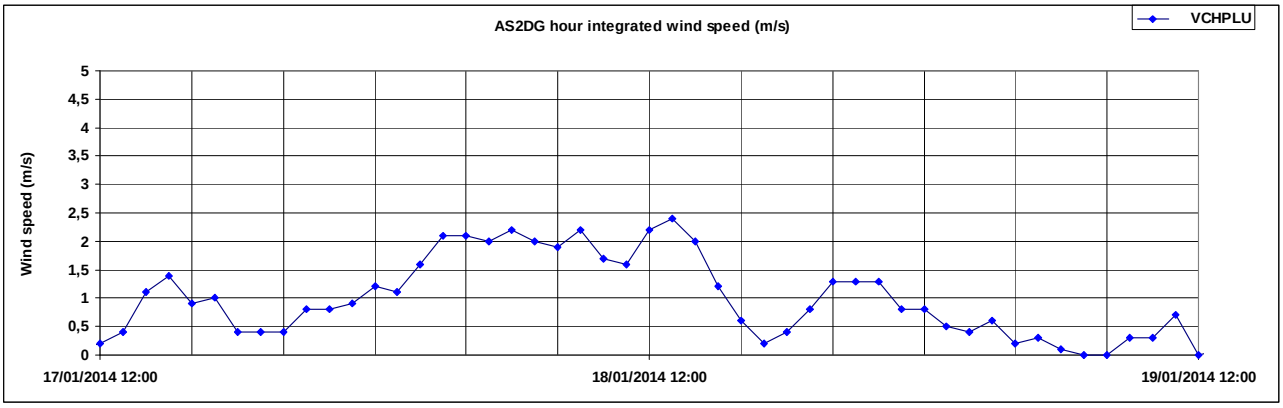
Data communication protocol	Frequency measurement.
Output data message format (include description of fields)	Wind speed, m s^{-1}
Data sampling frequency	1 hour average wind-speed (average from 1 Hz frequency).

Instrument Picture.

Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __PGNH___

Instrument number ___6_____ of ___23_____

Manufacturer	*EDF*
Model	*PG2000*
Serial number	*16023*
Firmware version (if applicable)	N. A.

Field configuration

Location on site	*Located on the Northern end of the site*
Orientation	*N. A.*
Height (measured at top)	*2.75 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Un-heated sensor.*

Data output

Data communication protocol	Mercury switch contact
Output data message format (include description of fields)	*Tipping bucket tops.*
Data sampling frequency	*1 hour integrated precipitation (mm w.e.)*

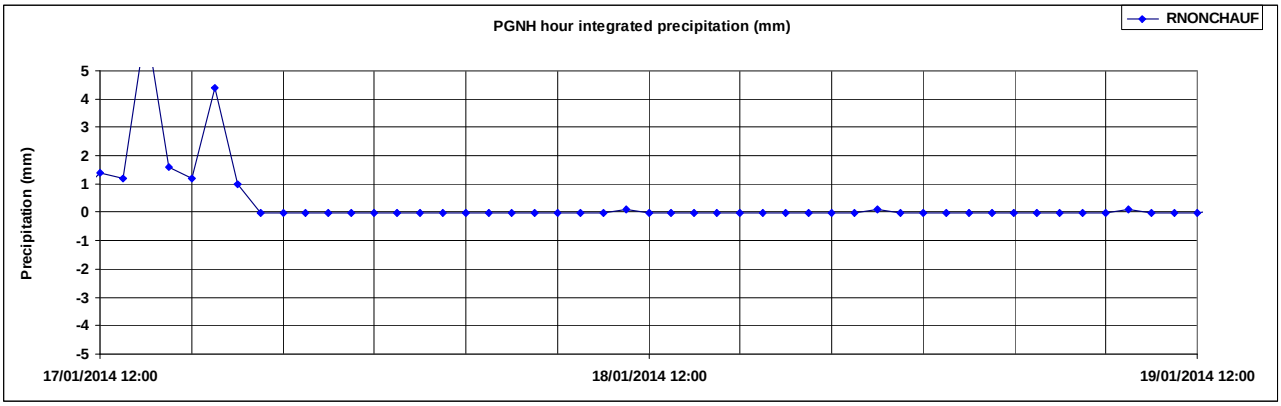
Instrument Picture.

Field calibration (if any).

Field calibrations are performed as follows : 2 litres are water are allowed to drip through a funnel into the collector ; the buckets are 20 g so one expects 100 tips in a given amount of time. What is monitored is the total number of tips (between 96 and 102 is considered OK), total time (should be between 680 and 770 s) and relative time period between each tip (should be within 20%).

On 11 July 2013, PGWEDF characteristics were 100 tips, 737 s total, 4% variation of tipping time period (pass).

48h Plot.



Instrument Metadata Report

Instrument Name: __PGH___

Instrument number ___7_____ of ___23_____

Manufacturer	*EDF*
Model	*PG2000*
Serial number	*4069*
Firmware version (if applicable)	N. A.

Field configuration

Location on site	*Located on the Northern end of the site*
Orientation	*N. A.*
Height (measured at top)	*2.75 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Heated sensor.*

Data output

Data communication protocol	Mercury switch contact
Output data message format (include description of fields)	*Tipping bucket tops.*
Data sampling frequency	*1 hour integrated precipitation (mm w.e.)*

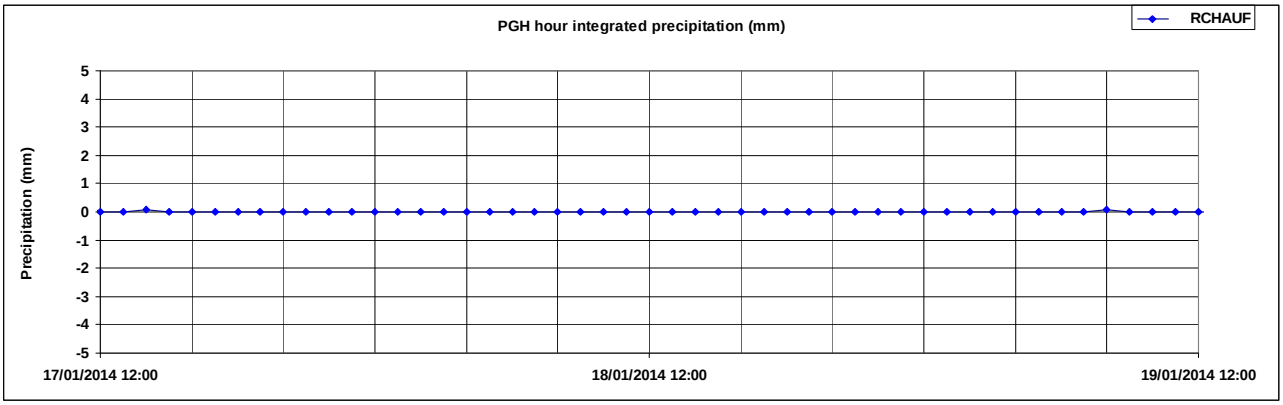
Instrument Picture.

Field calibration (if any).

Field calibrations are performed as follows : 2 litres are water are allowed to drip through a funnel into the collector ; the buckets are 20 g so one expects 100 tips in a given amount of time. What is monitored is the total number of tips (between 96 and 102 is considered OK), total time (should be between 680 and 770 s) and relative time period between each tip (should be within 20%).

On 11 July 2013, PGWEDF characteristics were 97 tips, 739 s total, 3% variation of tipping time period (pass).

48h Plot.



Instrument Metadata Report

Instrument Name: __OTT1___

Instrument number ___8_____ of ___23_____

Manufacturer	*OTT*
Model	*Pluvio2- 400 RH*
Serial number	*328967*
Firmware version (if applicable)	*1.30.1*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*3.1 m*
Shield (if applicable)	*Shield provided by OTT (Tretyakov type)*
Heating (if applicable)	*Heated sensor.*

Data output

Data communication protocol	SDI12
Output data message format (include description of fields)	Ott_Intensite_TR, mm/min, Intensité des précipitations (Precipitation Intensity), Ott_Quantite_TR_NTR, mm, Quantité de précipitations totalisée non filtrée (Total precipitation unfiltered) Ott_Quantite_NTR, mm, Quantité de précipitations totalisée filtrée (Total precipitation filtered) Ott_Quantite_Totale_NTR, mm, Cumul des précipitations (Cumulated precipitation) Ott_Collecteur_TR, mm, Niveau de remplissage du pluviomètre OTT (filtré ?) (Filtered (?) filling level) Ott_Collecteur_NTR, mm, Niveau de remplissage du pluviomètre OTT (non filtré ?) (unfiltered (?) filling level) Ott_Etat_Chauffage, état dispositif de chauffage OTT (heating status) **Questions remain on the actual meaning of the fields collected.**

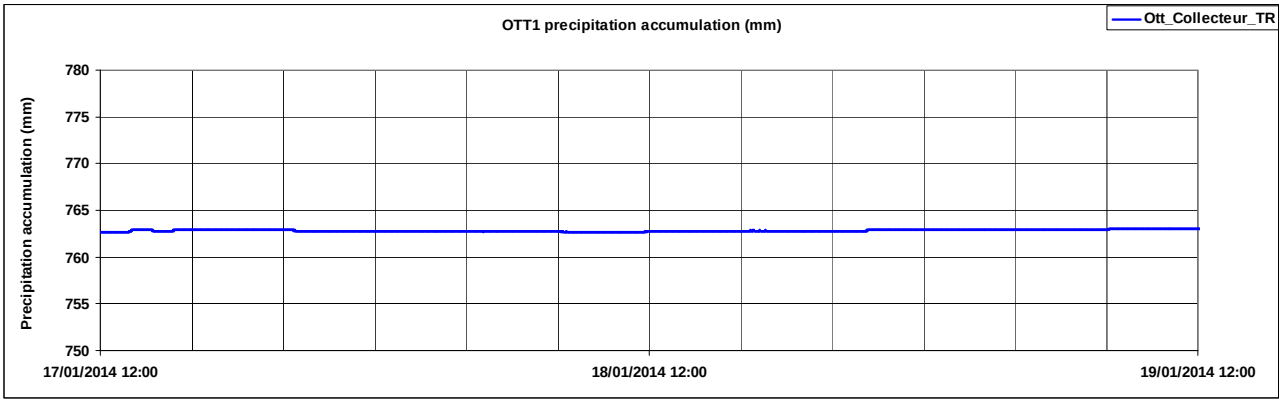
Data sampling frequency	*1 min sampling*

Instrument Picture (instrument in the middle)

Field calibration (if any).

Not available.

48h Plot.



Additional notes : OTT1 is filled with POWERCOOL antifreeze mixture provided by OTT. Several cases of antifreeze freezing have been observed during the field season 2013-2014 so that POWERCOOL will be replaced by the antifreeze mixture used for the GEONORs starting from the season 2014-2015.

Instrument Metadata Report

Instrument Name: __OTT2___

Instrument number ___9_____ of ___23_____

Manufacturer	*OTT*
Model	*Pluvio2 400 cm2*
Serial number	*319712*
Firmware version (if applicable)	*Not available.*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*3.1 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Un-heated sensor.*

Data output

Data communication protocol	Campbell Scientific CR1000 data acquisition
Output data message format (include description of fields)	Intensite_TR (Intensity Real time) Quantite_TR (Accumulated Real time or Non Real time) Quantite_NTR (Accumulated Non Real time) Quantite_Tot (Accumulated Total Non Real time) Collecteur_TR (Raw bucket signal – Real Time) Collecteur_NTR (Raw bucket signal – Non Real Time) Temp (Load Cell Temperature) Etat_Chauffage (Heating Status) Etat_Pluvio (Status) **Questions remain on the actual meaning of the fields collected.**
Data sampling frequency	*6 min samplings.*

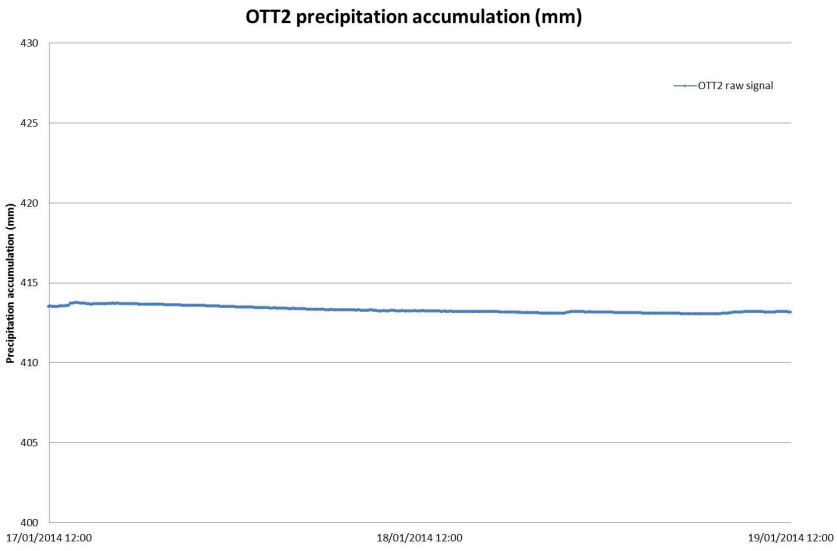
This instrument is operated by LTHE.

Instrument Picture.

Field calibration (if any).

Not available.

48h Plot.



Additional notes : OTT2 is filled with POWERCOOL antifreeze mixture provided by OTT.

Instrument Metadata Report

Instrument Name: __PGWEDF___

Instrument number ___10_____ of ___23_____

Manufacturer	*PG*
Model	*PG2000*
Serial number	*Not available*
Firmware version (if applicable)	*No firmware.*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*3.0 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Heated sensor.*

Data output

Data communication protocol	Mercury switch contact
Output data message format (include description of fields)	Counts of impulsion
Data sampling frequency	*Hourly cumulated precipitation.*

This instrument is operated by EDF-DTG.

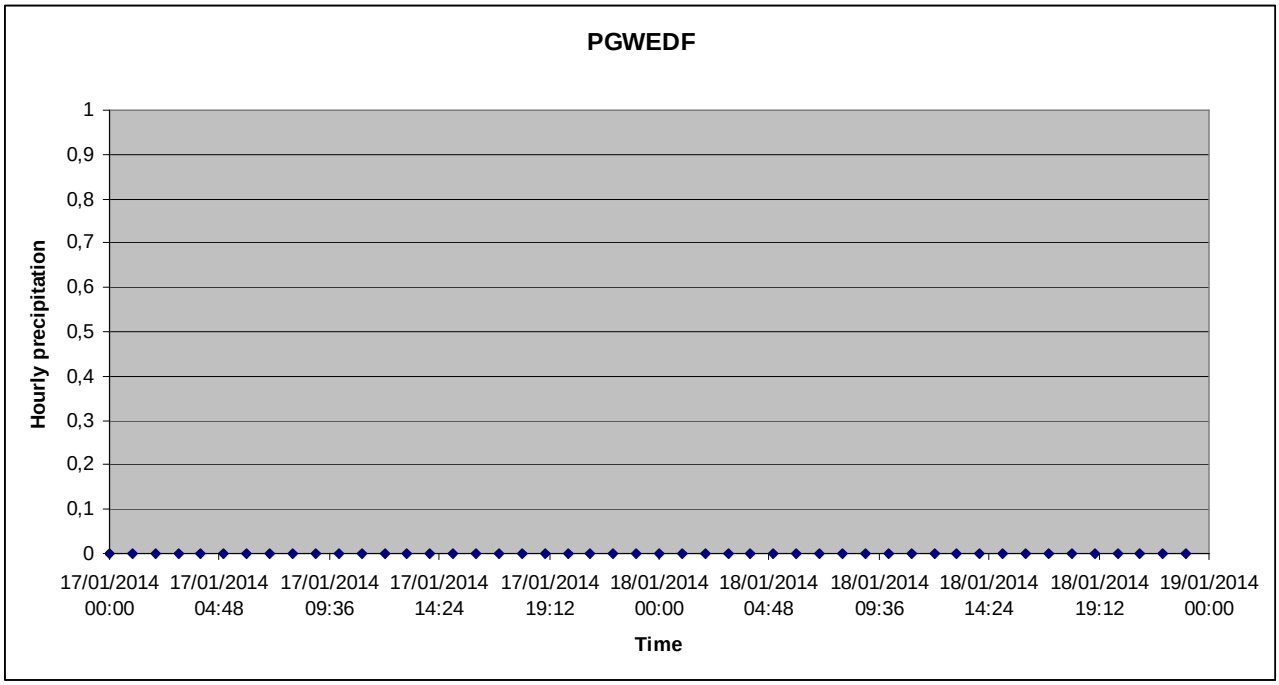
Instrument Picture.

Field calibration (if any).

Field calibrations are performed as follows : 2 litres are water are allowed to drip through a funnel into the collector ; the buckets are 20 g so one expects 100 tips in a given amount of time. What is monitored is the total number of tips (between 96 and 102 is considered OK), total time (should be between 680 and 770 s) and relative time period between each tip (should be within 20%).

On 11 July 2013, PGWEDF characteristics were 98 tips, 742 s total, 5% variation of tipping time period (pass).

48h Plot.



Instrument Metadata Report

Instrument Name: __DISDBIR___

Instrument number ___11____ of ___23_____

Manufacturer	*Biral*
Model	*VPF730*
Serial number	*J0650-01*
Firmware version (if applicable)	*N. A.*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*3.0 m*
Shield (if applicable)	*N. A.*
Heating (if applicable)	*Heated sensor.*

Data output

Data communication protocol	*CS CR1000 data acquisition*
Output data message format (include description of fields)	*Date / time, precipitation (mm/time-step), cumulated precipitation (mm)*
Data sampling frequency	*30 min (until 25/2/2014) then 1 min integrated data and matrices*

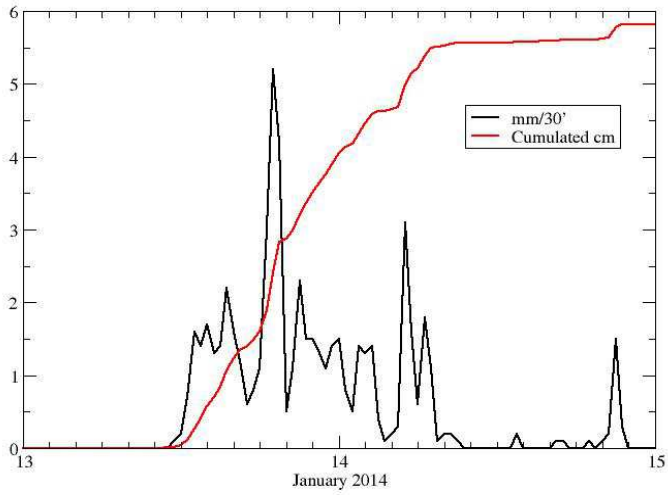
This instrument is operated by LGGE.

Instrument Picture.

Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __DISDPWS___

Instrument number ___12____ of ___23_____

Manufacturer	*Campbell Scientific*
Model	*PWS100*
Serial number	*E1049*
Firmware version (if applicable)	*N. A.*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*3.1 m*
Shield (if applicable)	*Not applicable.*
Heating (if applicable)	*Heated sensor.*

Data output

Data communication protocol	Campbell Scientific CR1000 data acquisition
Output data message format (include description of fields)	PWS100_Visibility (Average visibility (m)) PWS100_WMO (Present weather code (WMO)) PWS100_METAR (Present weather code (METAR)) PWS100_NWS (Present weather code (NWS)) PWS100_Alarms * 16 (Alarms) PWS100_Fault_Status (Fault status of PWS100) PWS100_Avg_temp, Sple_RH, Avg_Wetbulb (Average temperature, RH%, wet bulb) PWS100_Min_Temp, Max_Temp (Minimum and maximum temperature) PWS100_Intensity (Precipitation intensity (mmh -1)) PWS100_Accumulation (Precipitation accumulation) PWS100_VelocityAvg, SizeAvg (Average velocity (ms -1), average size (mm)) PWS100_Drizzle, FreezingDrizzle, Rain, FreezingRain, SnowGrains, SnowFlakes, IcePellets, Hail, Graupel, Error, Unknown (Type distribution)

	PWS100_LED_Temp_U, LED_Temp_L (Internal LED temperatures : upper LED, lower LED) PWS100_DET_Temp_U, DET_Temp_L (Internal detector temperatures : upper, lower) PWS100_LaserHoodTemp, LaserTemp, LaserCurrent (Laser hood temperature, laser temperature & laser current) PWS100_DC _U, DC _LO, DC _LA (DC offsets : upper, lower, laser) PWS100_DI_U, DI_LO, DI_LA (Dirty window : upper, lower, laser) PWS100_Voltage, Hood, Dew (Battery voltage, hood %, dew %) PWS100_U, L_DET_DIFF, CAL_VIS (Upper and lower detector differential voltage (mV) and calibrated visibility voltage (mV)) PWS100_Stat_Periode (Statistics period) PWS100_Watchdog, Max_Particle_Sec, Particles_not, Time_Lag (Watchdog count, maximum particles per second, particles not processed, time lag) PWS100_Process_Stat * 10 (Processing statistics) PWS100_Year, Month, Day (Year, month, day) PWS100_Hour, Min, Sec (Hours, minutes, seconds) PWS100_Avg_Cor_Vis_Volt, Avg_Up_Head_Volt (Averaged corrected visibility voltage (mV) and average upper head voltage (mV)) PWS100_DropSize * 300 (Drop size distribution bin values (0.1 mm increment per value)) PWS100_SizeVelocityMap * 1156 (Campbell Scientific standard size / velocity map (34 × 34)) PWS100_PedDistribution * 50 (Ped ratio distribution)
Data sampling frequency	6 min

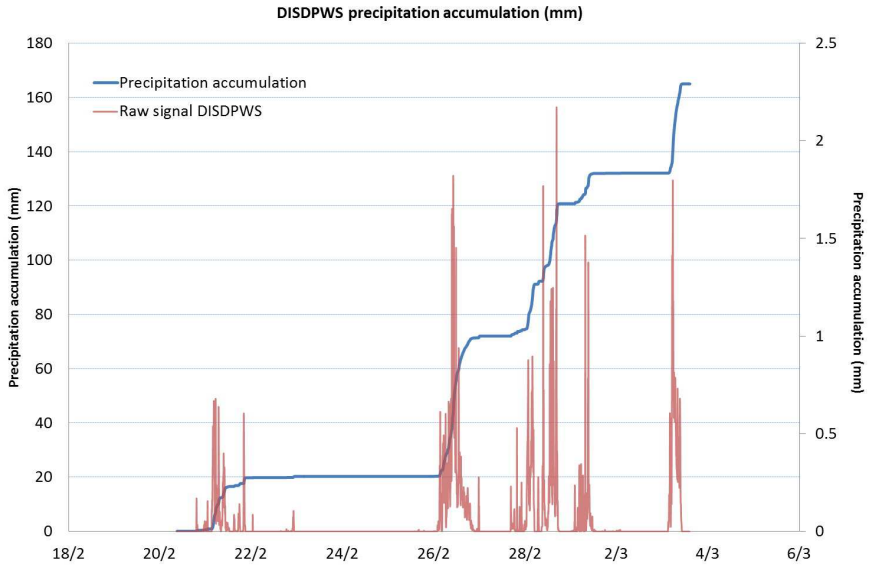
This instrument is operated by LTHE.

Instrument Picture.

Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __SPC1___

Instrument number ___13____ of ___23_____

Manufacturer	*Précis-Mécanique*
Model	*3070, 400 cm²*
Serial number	*Not available.*
Firmware version (if applicable)	*No firmware.*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*1.0 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Un-heated sensor.*

Data output

Data communication protocol	*REED relay ; 1 impulsion = 0.2 mm*
Output data message format (include description of fields)	*No message format ; the datalogger simply converts the impulsions into accumulated amounts*
Data sampling frequency	6 min until 21/2/2014 12:20 then 1 min.

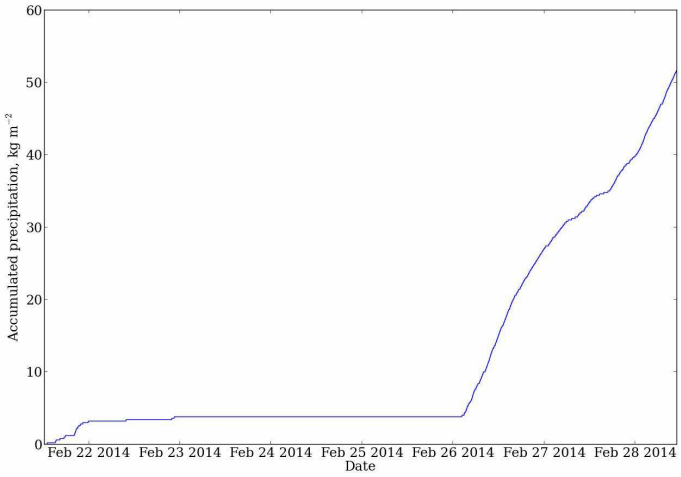
This instrument is operated by SPC-AN.

Instrument Picture.

Field calibration (if any).

Not available.

48h Plot.



Additional notes : The sensor height has been set to 1.0 m deliberately, as an example of things which cannot work in mountain environments. Most data from this sensor will basically be disregarded due to strong capping phenomena.

Instrument Metadata Report

Instrument Name: __SPC2___

Instrument number ___14____ of ___23_____

Manufacturer	*Précis-Mécanique*
Model	*3039/1, 400 cm²*
Serial number	*23516*
Firmware version (if applicable)	*No firmware.*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*3.1 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Heated sensor.*

Data output

Data communication protocol	*REED relay ; 1 impulsion = 0.2 mm*
Output data message format (include description of fields)	*No message format ; the datalogger simply converts the impulsions into accumulated amounts*
Data sampling frequency	6 min until 21/2/2014 12h20 then 1 min

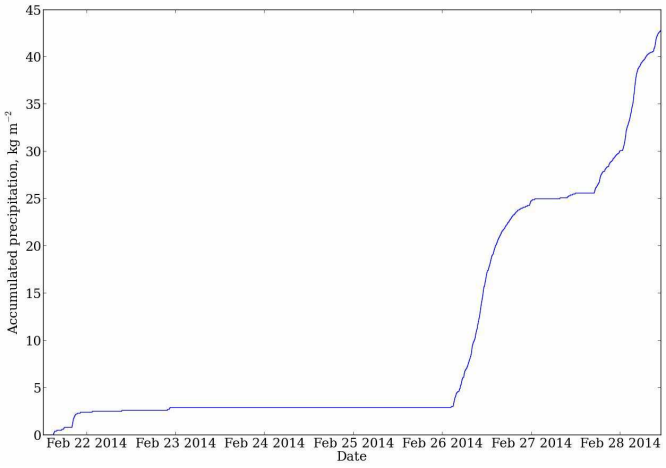
This instrument is operated by SPC-AN.

Instrument Picture.

Field calibration (if any).

Not available.

48h Plot.



Instrument Metadata Report

Instrument Name: __PNPA___

Instrument number ___15____ of ___23_____

Manufacturer	*LTHE*
Model	*PNPA – Rain/Snow totalizer*
Serial number	*P0909*
Firmware version (if applicable)	*Not applicable.*

Field configuration

Location on site	*Located on the Southern end of the site*
Orientation	*N. A.*
Height (measured at top)	*3.0 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Un-heated sensor.*

Data output

Data communication protocol	Laptop and LDM software
Output data message format (include description of fields)	*Level (cm), Temperature (°C)*
Data sampling frequency	10 minutes

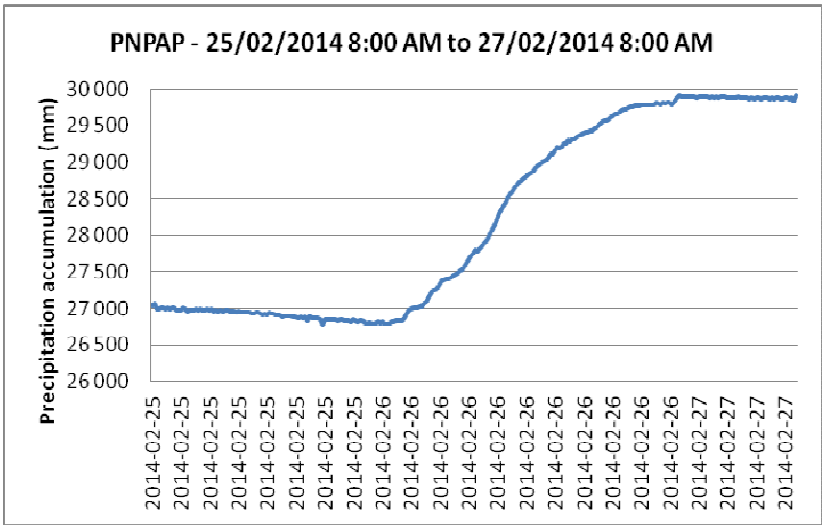
This instrument is operated by LTHE.

Instrument Picture.

Field calibration (if any).

Not available.

48h Plot.



Instrument Metadata Report

Instrument Name: __SDUS0___

Instrument number ___16____ of ___23_____

Manufacturer	*Campbell Scientific*
Model	*SR50A*
Serial number	*Not available*
Firmware version (if applicable)	*N. A.*

Field configuration

Location on site	*Located at long-term Snow depth mast*
Orientation	*N. A.*
Height (measured at top)	*3.0 m*
Shield (if applicable)	*No shield. Overlying shield (conical) and cylindrical protection against snow drift (black – see pictures).*
Heating (if applicable)	*Un-heated sensor.*

Data output

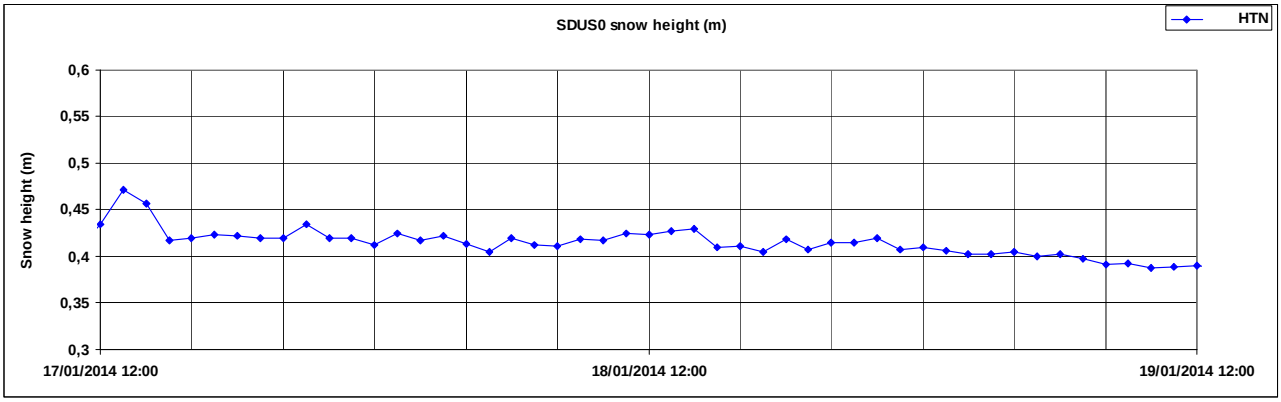
Data communication protocol	SDI12
Output data message format (include description of fields)	*Snow depth*
Data sampling frequency	Hourly Snow depth measurements.

Instrument Picture.

Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __SDDIM0___

Instrument number ___17____ of ___23_____

Manufacturer	*Dimetix*
Model	*DLS-B 15*
Serial number	*60250447*
Firmware version (if applicable)	*N. A.*

Field configuration

Location on site	*Located at long-term Snow depth mast*
Orientation	*N. A.*
Height (measured at top)	*3.0 m*
Shield (if applicable)	*Instrument located in homemade housing (white)*
Heating (if applicable)	*Heated sensor.*

Data output

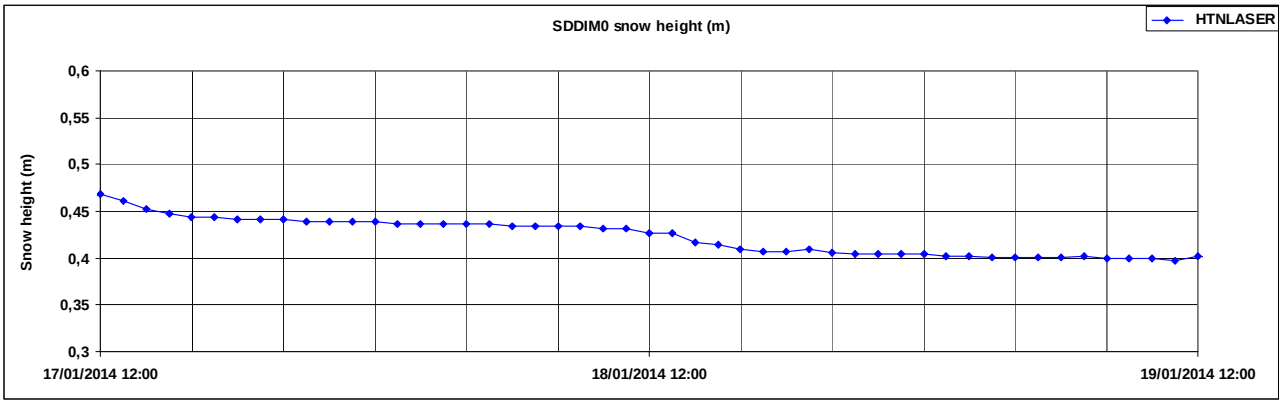
Data communication protocol	RS232
Output data message format (include description of fields)	*Snow depth*
Data sampling frequency	Hourly Snow depth measurements.

Instrument Picture (in the middle)

Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __SDUS1___

Instrument number ___18____ of ___23_____

Manufacturer	*Campbell Scientific*
Model	*SR50ATH-S16SS (provided by CSI)*
Serial number	*5327*
Firmware version (if applicable)	*N. A.*

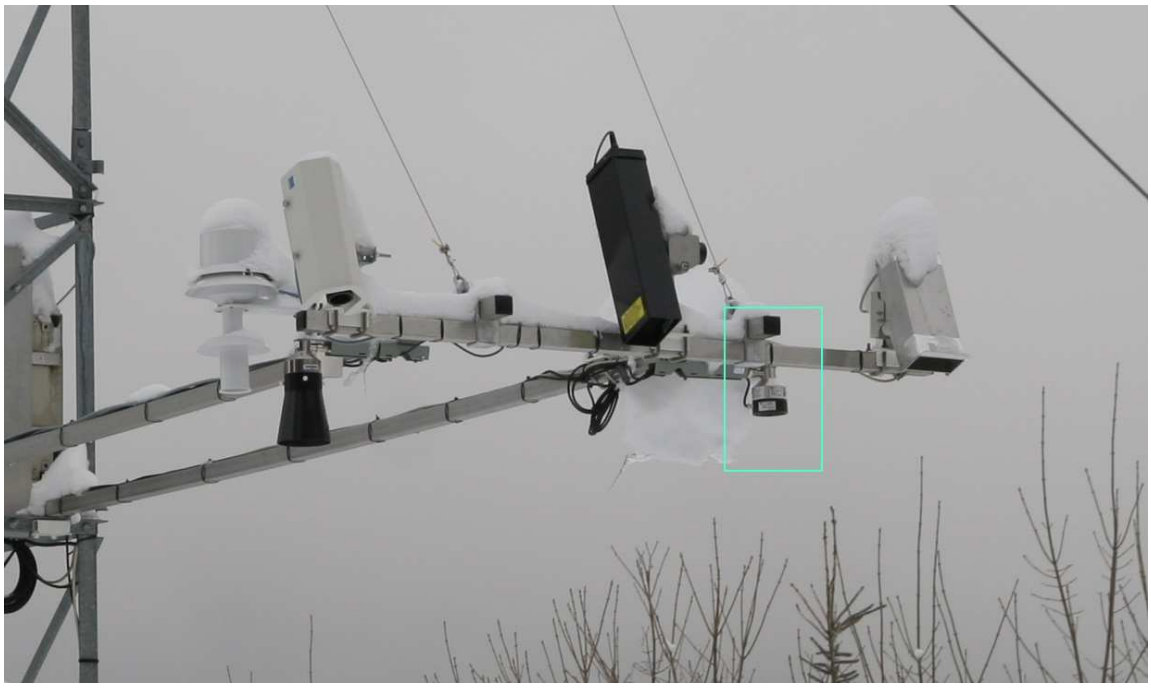
Field configuration

Location on site	*Located on SPICE Snow-on-Ground beam*
Orientation	*N. A.*
Height (measured at top)	*About 4.0 m*
Shield (if applicable)	*No shield.*
Heating (if applicable)	*Heated sensor.*

Data output

Data communication protocol	SDI12
Output data message format (include description of fields)	*Snow depth, air temperature (in SR50AT naturally ventilated shield), Quality number.*
Data sampling frequency	Sensor sampling every 1 min.

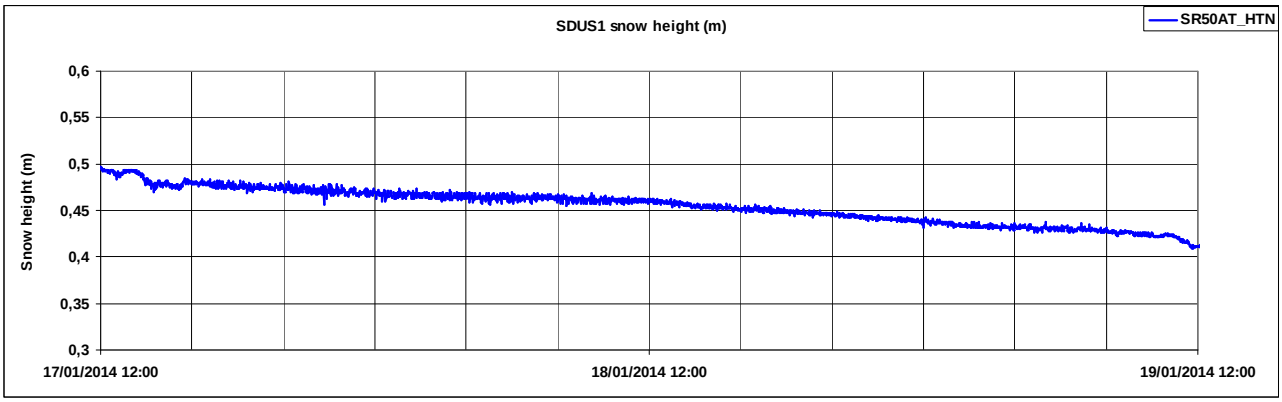
Instrument Picture.



Field calibration (if any).

Not applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __SDUS2___

Instrument number ___19____ of ___23_____

Manufacturer	*Campbell Scientific*
Model	*SR50A*
Serial number	*Not available*
Firmware version (if applicable)	*N. A.*

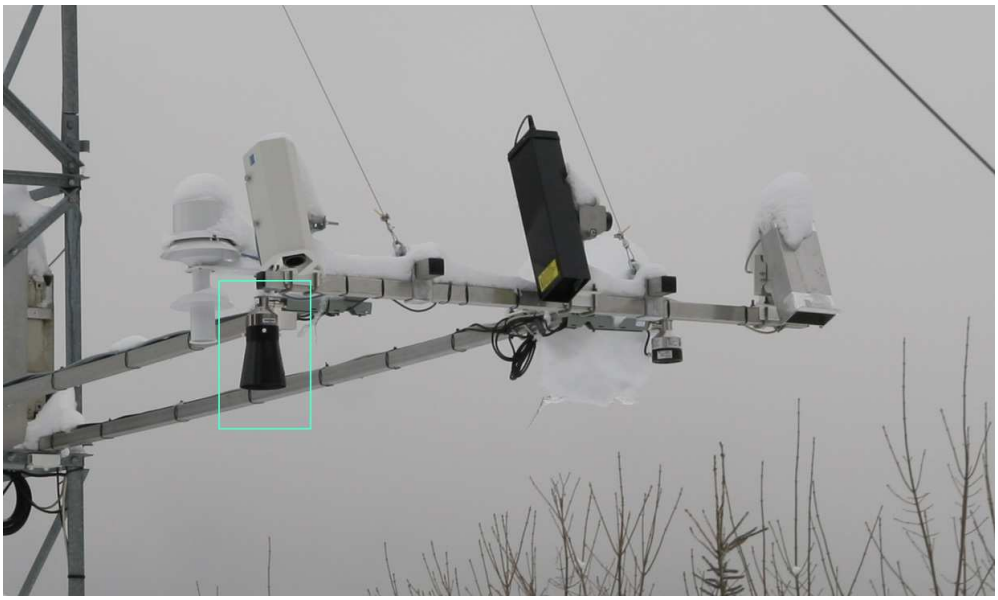
Field configuration

Location on site	*Located on SPICE Snow-on-Ground beam*
Orientation	*N. A.*
Height (measured at top)	*About 4.0 m*
Shield (if applicable)	*cylindrical protection against snow drift (black – see pictures).*
Heating (if applicable)	*Un-heated sensor.*

Data output

Data communication protocol	SDI12
Output data message format (include description of fields)	Distance from sensor to snow without temperature compensation, Quality number
Data sampling frequency	Sensor sampling every 1 min.

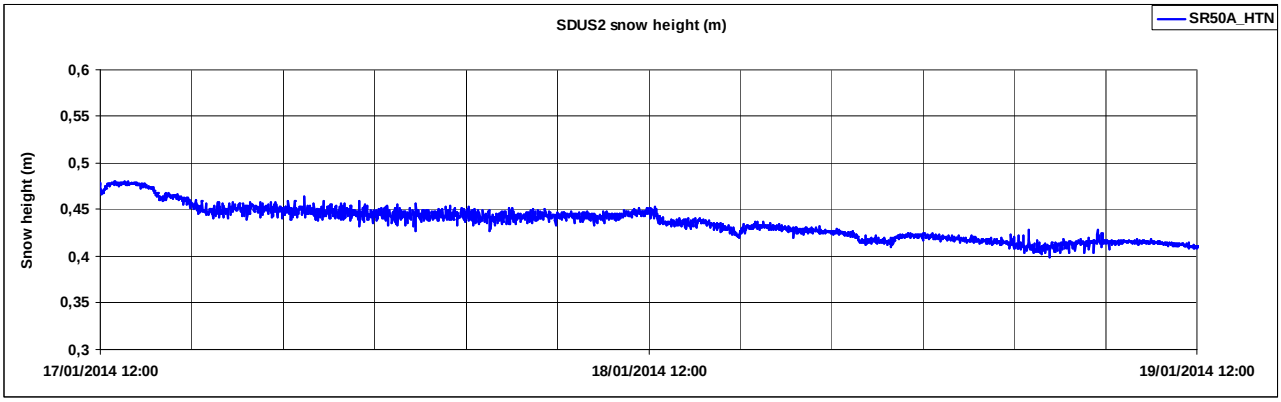
Instrument Picture.



Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __SDJEN___

Instrument number ___20____ of ___23_____

Manufacturer	*Jenoptik*
Model	*SHM 30.11*
Serial number	*120739*
Firmware version (if applicable)	*9.06*

Field configuration

Location on site	*Located on SPICE Snow-on-Ground beam*
Orientation	*N. A.*
Height (measured at top)	*About 4.0 m, tilt : about 20 degrees from vertical*
Shield (if applicable)	*None.*
Heating (if applicable)	*Heated sensor*

Data output

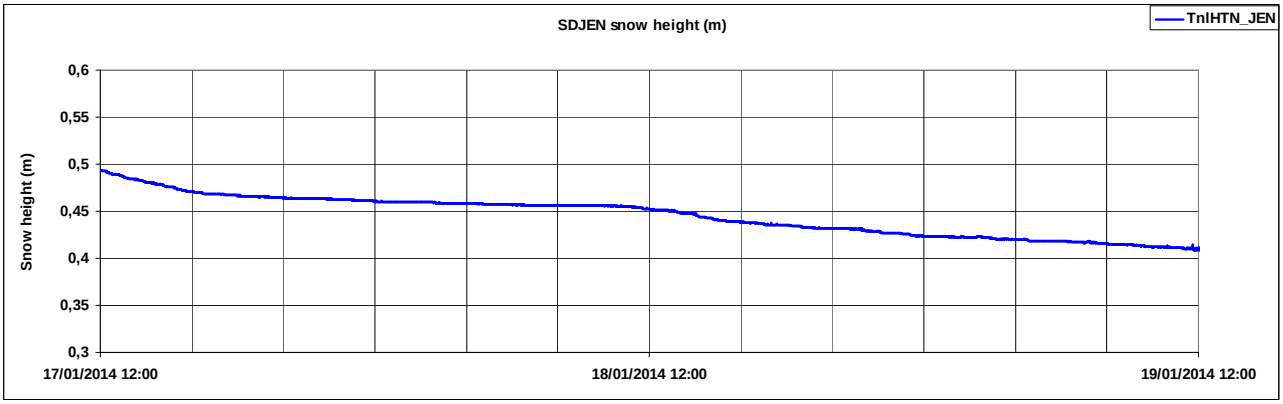
Data communication protocol	RS232
Output data message format (include description of fields)	Snow depth (requires adjustment after complete snow melt)
Data sampling frequency	Sensor sampling every 1 min.

Instrument Picture.

Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __SDAPI___

Instrument number ___21____ of ___23_____

Manufacturer	*Apical Technologies*
Model	*TLN35-R*
Serial number	*Not available*
Firmware version (if applicable)	*Not available*

Field configuration

Location on site	*Located on SPICE Snow-on-Ground beam*
Orientation	*N. A.*
Height (measured at top)	*About 4.0 m, tilt : about 20 degrees from vertical*
Shield (if applicable)	*Not applicable.*
Heating (if applicable)	*Heated sensor*

Data output

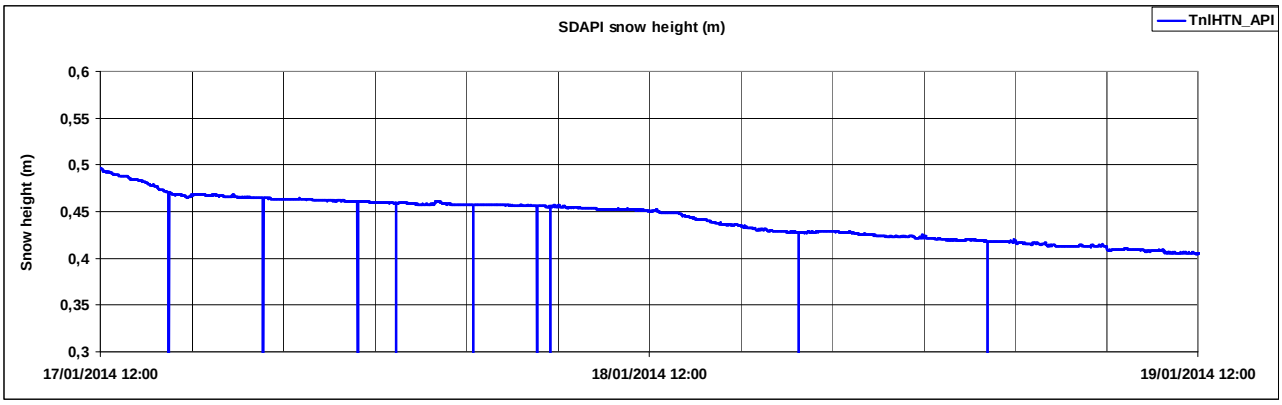
Data communication protocol	Data acquisition using dedicated CR1000
Output data message format (include description of fields)	Snow depth (requires adjustment after complete snow melt)
Data sampling frequency	Sensor sampling every 1 min.

Instrument Picture.

Field calibration (if any).

N. A.

48h Plot.



Negative peaks on this plot correspond to issues with the data acquisition (not the sample itself), which were fixed later in the season.

Instrument Metadata Report

Instrument Name: __SDDIM___

Instrument number ___22____ of ___23_____

Manufacturer	*Dimetix*
Model	*FLS-CH 10*
Serial number	*22260036*
Firmware version (if applicable)	*N. A.*

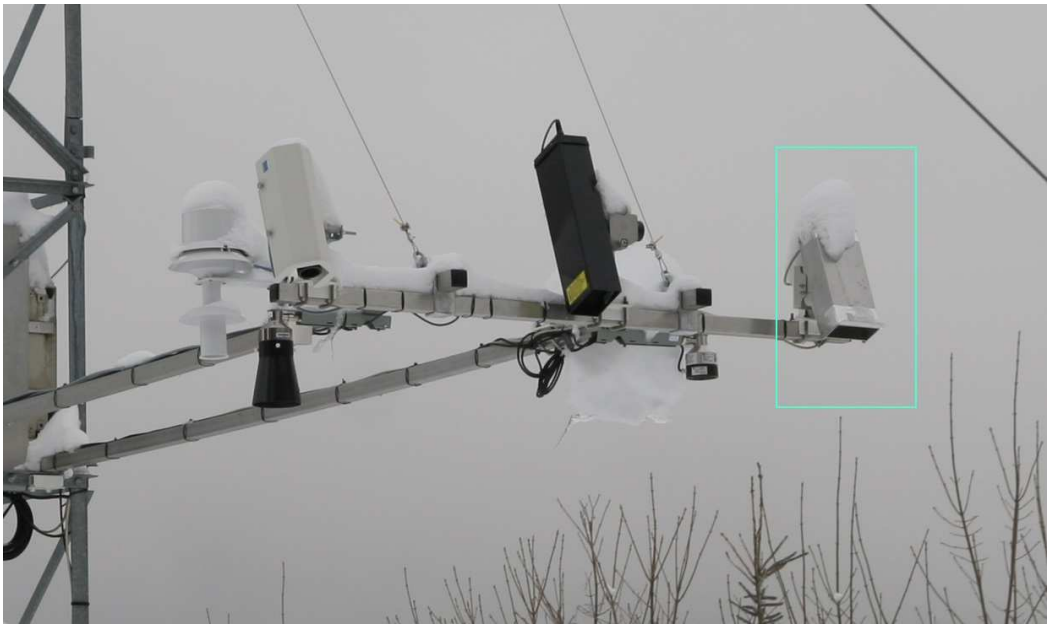
Field configuration

Location on site	*Located on SPICE Snow-on-Ground beam*
Orientation	*N. A.*
Height (measured at top)	*About 4.0 m, tilt : about 20 degrees from vertical*
Shield (if applicable)	*Not applicable.*
Heating (if applicable)	*Heated sensor*

Data output

Data communication protocol	RS232
Output data message format (include description of fields)	Distance from sensor to snow
Data sampling frequency	Sensor sampling every 1 min.

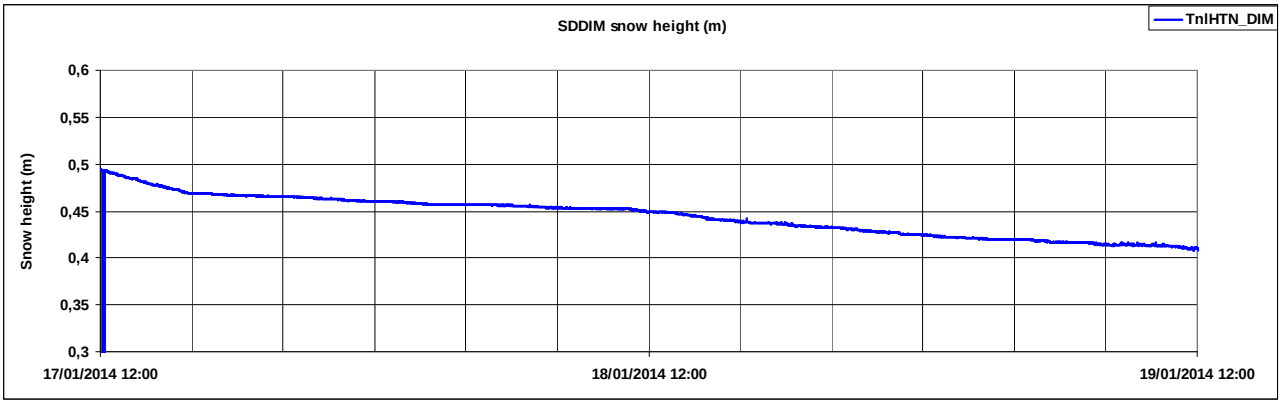
Instrument Picture.



Field calibration (if any).

Not Applicable.

48h Plot.



Instrument Metadata Report

Instrument Name: __SDTair___

Instrument number ___23___ of ___23_____

Manufacturer	*N. A.*
Model	*Pt100*
Serial number	*N. A.*
Firmware version (if applicable)	N. A.

Field configuration

Location on site	*Located on SPICE Snow-on-Ground beam*
Orientation	*N. A.*
Height (measured at top)	*4.0 m*
Shield (if applicable)	*Mechanically ventilated shield.*
Heating (if applicable)	*N. A.*

Data output

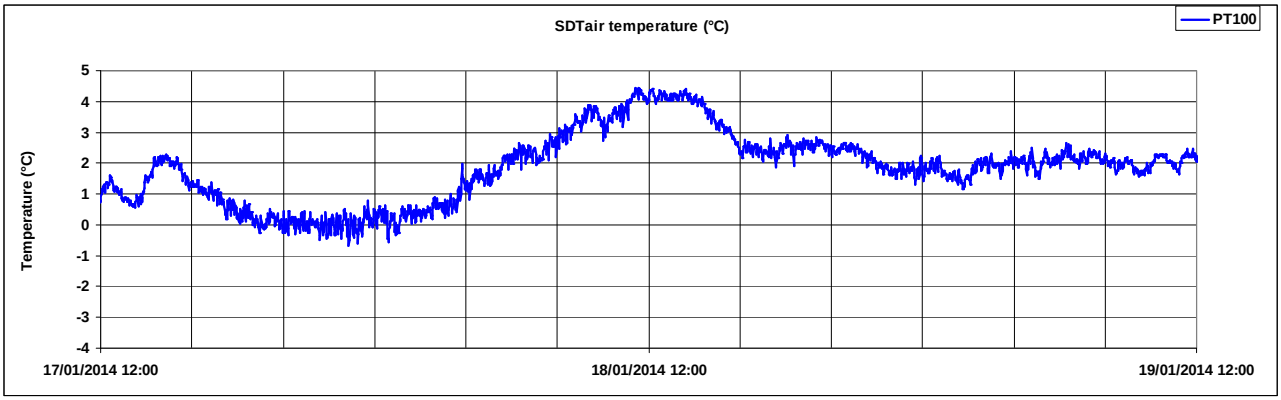
Data communication protocol	4 wires PT100 measurement
Output data message format (include description of fields)	Air temperature.
Data sampling frequency	Sensor sampling every 1 min.

Instrument Picture.

Field calibration (if any).

Not Applicable.

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

Note : Test 3 was not fully completed so far (although data transfer into NCAR servers was performed for most sensors).

Instrument #	Instrument	Readiness	Date	Data transfer to NCAR	Date	Type	Comments
1	GEO1	Yes	16/12/2013	Yes		Precip	CEN
2	GEO2	Yes	16/12/2013	Yes		Precip	CEN
3	AS2DG	Yes	16/12/2013	Yes		Precip	CEN
4	GEO0	Yes	20/09/2013	Yes		Precip	CEN
5	ANGEO0	Yes	20/09/2013	Yes		Precip	CEN
6	PGNH	Yes	20/09/2013	Yes		Precip	CEN / EDF-DTG
7	PGH	Yes	20/09/2013	Yes		Precip	CEN / EDF-DTG
8	OTT1	Yes	16/12/2013	Yes		Precip	CEN
9	OTT2	Yes	16/12/2013	Yes		Precip	LTHE
10	PGWEDF	Yes	20/09/2013	Yes		Precip	EDF-DTG
11	DISDBIR	Yes	31/10/2013	Yes		Precip	LGGE
12	DISDPWS	Yes	16/12/2009	Yes		Precip	LTHE

Instrument #	Instrument	Readiness	Date	Data transfer to NCAR	Date	Type	Comments
13	SPC1	Yes	13/02/2014	Yes		Precip	SPC-AN
14	SPC2	Yes	13/02/2014	Yes		Precip	SPC-AN
15	PNPA	Yes	27/09/2013	Yes		Precip	LTHE
16	SDUS0	Yes	20/09/2013	Yes		SoG	CEN
17	SDDIM0	Yes	20/09/2013	Yes		SoG	CEN
18	SDUS1	Yes	16/01/2014	Yes		SoG	CEN
19	SDUS2	Yes	16/01/2014	Yes		SoG	CEN
20	SDJEN	Yes	16/01/2014	Yes		SoG	CEN
21	SDAPI	Yes	16/01/2014	Yes		SoG	CEN
22	SDDIM	Yes	16/01/2014	Yes		SoG	CEN
23	SDTair	Yes	16/01/2014	Yes		SoG	CEN

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
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
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