



ACCEPTANCE OF SPICE DATA PROTOCOL

I, (insert your name),
.....(insert your title/function) hereby declare that I and
the organization/company, (insert
your org/co name), shall abide by the SPICE Data Protocol as set out below.

Signature:
(initials of the person are put on each page of the document)

Date: Place:

SPICE DATA PROTOCOL

1. Introduction

1.1 The World Meteorological Organization (WMO) Solid Precipitation Intercomparison Experiment (SPICE) is an international intercomparison project being conducted as part of the work programme of the WMO Commission for Instruments and Methods of Observation (CIMO). A description of SPICE and its objectives is provided at Annex A.

1.2 Achieving the objectives of SPICE will involve the participation of numerous observing sites, and continuous and frequent observations of precipitation, snow depth and ancillary variables over a long period of time, sampled by a number of instruments of different makes supplied by different providers.

1.3 The purpose of this document is to define the protocol governing access to, use of and publication of information regarding the intercomparison sites and instrumentation, the algorithms employed by the instruments, the algorithms used in analysis of the data, the intercomparison data and the results to ensure that all SPICE participants are treated in a fair manner, and to ensure the timely dissemination/publication of SPICE results.

1.4 For clarity, all terms written in bold type in this document are defined in the Glossary provided at Annex B.

2. Project Governance

2.1 Overall project governance is the responsibility of an International Organizing Committee (IOC). The initial membership of the IOC was nominated by the President of CIMO and approved by the Secretary-General of WMO. The IOC membership also includes, as ex-officio members, the Site Manager of each SPICE intercomparison site.

2.2 The IOC is responsible for project governance, organization, overall planning and selection of participants (see Sect. 3.1), including:

- setting of project terms of reference,
- goals and objectives,
- ensuring the scientific integrity of the project,
- taking pragmatic steps to promote the project,
- approval of the project conclusions and output recommendations,
- reviewing the draft Final Report, and
- approving the SPICE Final Report.

2.3 The IOC reports, through its Chair, to CIMO. The IOC is also responsible for the establishment of a SPICE Project Team.

2.4 The SPICE Project Team is responsible for advising the IOC as regard to the detailed technical requirements for SPICE, including data analysis algorithms and methodology to be employed. The Project Team is also responsible for analysis and intercomparison of the data from the different SPICE intercomparison sites, and for drafting the SPICE Final Report.

3. SPICE Participation

3.1 SPICE involves participation in several different roles:

- IOC members;
- Project Team members;
- Intercomparison Sites (represented by Site Managers and their respective Site Teams);
- **Instrument Providers** (instrument manufacturers or WMO Members, and their representatives),
- Other participants, such as experts, computing facilities providers, data analysis contributors, and capacity building observers.

3.2 All SPICE participants (as listed in Sect. 3.1) are selected by the IOC.

3.3 All SPICE participants, and others who are provided future access to SPICE data and information, shall abide by this SPICE Data Protocol.

4. SPICE Project Execution

4.1 Each Intercomparison Site shall nominate a Site Manager and a Site Team. As noted in 2.1, Site Managers will represent their site as ex-officio members of the IOC. Each Site Manager must ensure that all members of their Site Team abide by the SPICE data protocol.

4.2 The IOC will establish guidelines to be followed by each Intercomparison Site for the conduct of SPICE. These will include:

- The configuration (layout) of the Intercomparison Site,
- The configuration, installation, operation and maintenance of instruments (which will be developed in consultation with **Instrument Providers**),
- The data collection setup, data archival and data quality control.

4.3 Each Site Manager, assisted by the respective Site Team, will be responsible for:

- compliance of the site with all intercomparison guidelines established by the IOC,
- securing the data collected from the Intercomparison Site,
- documentation of a site data protocol which is consistent with the SPICE Data Protocol and which governs access to the **SPICE Site Dataset** by the Site Team and others (such as staff of the site's host organization and staff of **Instrument Providers**),
- liaising with the **Instrument Providers**,

- documentation of the system implemented for managing the **SPICE Site Dataset**,
- preparation of the **SPICE Site Dataset**, and
- preparation of a final intercomparison report for that site (the **SPICE Site Final Report**),

4.4 **Instrument Providers** are responsible for the delivery of their instruments to the intercomparison site, and for supporting the site managers in verifying their proper configuration/functioning before and during SPICE.

5 **SPICE Documentation/Information**

5.1 Pre-existing analysis methodologies and/or instrument algorithms provided by a SPICE participant will remain the property of that participant and may only be used or published with the prior written permission of the owner.

5.2 New analysis methodologies and/or instrument algorithms provided by a SPICE participant will remain the property of that participant, but will be freely available.

5.3 Intercomparison Sites give permission to WMO to use and publish Site Documentation detailing various aspects of the site, including its instrumentation and data handling system.

5.4 **Instrument Providers** give permission to WMO to use and publish **Instrument Documentation** provided throughout SPICE that describes the instrument(s) proposed, in terms of performance specifications, principle of operation, data format, internal data processing, installation requirement, interfaces and synchronization, unless provided in confidence.

6. **SPICE Data, Datasets**

6.1 Each Site Team shall collect and prepare its own **SPICE Site Dataset** that shall include both the data from the instruments under test and the ancillary measurements. These data shall be collected, processed and stored according to guidelines adopted by the IOC.

6.2 Each Intercomparison Site shall retain its **SPICE Site Dataset**, its **Site Documentation** and the **Instrument Documentation** from the participating instruments at that site.

6.3 Each **Instrument Provider** will be given access to 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 shall neither be reported nor published prior to publication of the **SPICE Final Report**.

6.4 Each **SPICE Site Dataset** will be made available by the respective Site Team to the Project Team.

6.5 The Project Team will take all **SPICE Site Datasets** and use them to perform the overall SPICE intercomparison analysis and assessment, to produce the **SPICE Intercomparison Dataset**.

6.6 At the conclusion of SPICE, the Project Team will derive **The SPICE Dataset**.

6.7 After publication of the **SPICE Final Report**, WMO will keep a copy of **The SPICE Dataset** and make it available to whoever may request it, subject to their agreement in writing to abide by this SPICE Data Protocol.

7 Publications and Presentations

In the following, the word “publication” is used for publications as well as for presentations made at conferences (national and international)

7.1 WMO may publish in the **SPICE Final Report** part or all of **The SPICE Dataset**.

7.2 The IOC may develop and approve a set of slides that will be made available to the IOC, the Project Team and Site Teams for general use in presentations on SPICE.

7.3 All reports, presentations and publications using part or all of **The SPICE Dataset**, either before or after the publication of the **SPICE Final Report**, shall acknowledge SPICE as the source of the data. They should also include the general disclaimer: “

Results presented in this work were obtained as part of the Solid Precipitation Inter-Comparison Experiment (SPICE), conducted on behalf of the World Meteorological Organization (WMO) Commission for Instruments and Methods of Observation (CIMO). The analysis and views described herein are those of the author(s) at this time, and do not necessarily represent the official outcome of WMO SPICE. Mention of commercial companies or products is solely for the purposes of information and assessment within the scope of the present work, and does not constitute an endorsement by the author(s) or WMO.

7.4 Site Team(s) are free to publish results from single- or multiple-site experiments that were underway prior to the commencement of SPICE.

7.5 Site Teams, with the permission of their Site Manager, may analyse their **SPICE Site Datasets** and publish this work, prior to the publication of the **SPICE Final Report**, addressing instruments that they own.

7.6 Site Teams, with the permission of their Site Manager, may also publish results of instruments provided to them in the context of SPICE by **Instrument Providers**. However, these **Instrument Providers** shall be invited, through the relevant Site Manager, to provide comments on the planned publication(s) and be given a reasonable time to reply to ensure that the results are fairly reported and correspond to the proper use of the instruments. Site Teams shall consider those comments in finalizing their publication(s).

7.7 Site Teams are encouraged to follow the guidelines provided in Annex C and to share their draft publications with the Project Team.

7.8 Site Managers shall notify the IOC of all reports, presentations and publications made using part or all of **The SPICE Dataset**, to ensure their appropriate inclusion, consideration, and citation in the **SPICE Final Report**.

7.9 Each **Instrument Provider** will be provided with an opportunity to review the analysis and assessment results presented in the draft final report for the instrument(s) it provided, and each will be given a reasonable time to provide comments on the draft final report. Any feedback shall be included in the **SPICE Final Report**.

7.10 All SPICE participants and those subsequently accessing the SPICE Dataset agree to use the data, Final Report and related publications based on SPICE data solely for the purpose of scientific research and development and not in order to make comparative statements to gain commercial advantage.

ANNEX A

SPICE AND ITS OBJECTIVES

Mission statement

To recommend appropriate automated field reference system(s) for the unattended measurement of solid precipitation in a range of cold climates and seasons, and to provide guidance on the performance of modern automated systems for measuring: (i) total precipitation amount in cold climates for all seasons, especially when the precipitation is solid, (ii) snowfall (height of new fallen snow), and (iii) snow depth.

To understand and document the differences between an automatic field reference system and different automatic systems, and between automatic and manual measurements of solid precipitation using equally exposed/shielded gauges, including their siting and configuration.

Scope and Definition

Building on the results and recommendations of previous intercomparisons, the WMO Solid Precipitation Intercomparison Experiment (SPICE) will focus on the performance of modern automated sensors measuring solid precipitation. SPICE will investigate and report the measurement and reporting of the following parameters:

With highest priority:

- a. Precipitation amount, over various time periods (minutes, hours, days, season), as a function of precipitation phase (liquid, solid, mixed);
- b. Snow on the ground (snow depth); as snow depth measurements are closely tied to snowfall measurements, the intercomparison will address the linkages between them.

With lower priority:

- c. Solid and mixed precipitation intensity.

As a key outcome, recommendations will be made to WMO Members, WMO programmes, manufacturers and the scientific community, on the ability to accurately measure solid precipitation, on the use of automatic instruments, and the improvements possible. The results of the experiment will inform those Members that wish to automate their manual observations.

Intercomparison Objectives

WMO-SPICE will focus on the following key objectives:

- I. Recommend appropriate automated field reference system(s) for the unattended measurement of solid precipitation. Define and validate one or more field references using automatic instruments for each parameter being investigated, over a range of temporal resolutions (e.g. from daily to minutes).
- II. Assess/characterize automatic systems (both the hardware and the associated processing) used in operational applications for the measurement of Solid Precipitation (i.e. gauges as “black boxes”):
 - a. Assess the ability of operational automatic systems to robustly perform over a range of operating conditions;
 - b. Derive adjustments to be applied to measurements from operational automatic systems, as a function of variables available at an operational site: e.g., wind, temp, RH;
 - c. Make recommendations on the required ancillary data to enable the derivation of adjustments to be applied to data from operational sites on a regular basis, potentially, in real-time or near real-time;

- d. Assess operational data processing and data quality management techniques;
 - e. Assess the minimum practicable temporal resolution for reporting a valid solid precipitation measurement (amount, snowfall, and snow depth on the ground);
 - f. Evaluate the ability to detect and measure trace to light precipitation.
- III. Provide recommendations on best practices and configurations for measurement systems in operational environments:
- a. On the exposure and siting specific to various types of instruments;
 - b. On the optimal gauge and shield combination for each type of measurement, for different collection conditions/climates (e.g., arctic, prairie, coastal snows, windy, mixed conditions);
 - c. On instrument specific operational aspects, specific to cold conditions: use of heating, use of antifreeze (evaluation based on its hygroscopic properties and composition to meet operational requirements);
 - d. On instruments and their power management requirements needed to provide valid measurements in harsh environments;
 - e. on the use of visibility to estimate snowfall intensity
 - f. On appropriate target(s) under snow depth measuring sensors;
 - g. Consideration will be given to the needs of remote locations, in particular those with power and/or communications limitations.
- IV. Assess the achievable uncertainty of the measurement systems evaluated during SPICE and their ability to effectively accurately report solid precipitation.
- a. Assess the sensitivity, uncertainty, bias, repeatability, and response time of operational and emerging automatic systems;
 - b. Assess and report on the sources and magnitude of errors including instrument (sensor), exposure (shielding), environment (temperature, wind, microphysics, snow particle and snow fall density), data collection and associated processing algorithms with respect to sampling, averaging, filtering, and reporting.
- V. Evaluate new and emerging technology for the measurement of solid precipitation (e.g. non-catchment type), and their potential for use in operational applications.
- VI. Configure and collect a comprehensive data set for further data mining or for specific applications. Enable additional studies on the homogenization of automatic/manual observations and the traceability of automated measurements to manual measurements.

Annex B

GLOSSARY OF TERMS

Datasets:

SPICE Site Dataset: A dataset comprising all level datasets from that Intercomparison Site.

SPICE Intercomparison Dataset: this is the dataset that combines the data from all SPICE intercomparison sites and from all instruments. The **Project Team** will develop the **SPICE Intercomparison Dataset** using the datasets from each **Intercomparison Site** and performing additional analysis on them.

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.

SPICE Site Final Report: The final report for SPICE from an Intercomparison Site, derived from all relevant data and information from that site.

SPICE Final Report: The Final Report on SPICE, derived from **The SPICE Dataset**.

Documentation:

Instrument Documentation: Documentation prepared and provided to the IOC by an Instrument Provider, which includes a description of the instrument proposed in terms of performance, principle of operation, data format, installation requirements, interfaces and synchronization.

Instrument Providers: Manufacturers or WMO Members that provide instruments for SPICE but who will not be hosting a SPICE Intercomparison Site(s).

Site Documentation: Documentation prepared and provided to the IOC by an Intercomparison Site, which includes a description of the proposed host site, its location, capacity, the data acquisition system, data acquisition protocol, data archive and data quality control system available to support SPICE.

Annex C

Guidelines for publications:

- All publications shall include the disclaimer provided in the main part of the SPICE Data Protocol.
- Site teams are encouraged to analyse and publish preliminary and partial results of their sites in advance of the Final Report, thus preparing the ground for the SPICE cross-sites analysis.
- Co-authorship of publications is highly encouraged and could include all contributors
- All publications prepared using SPICE data sets, partially or entirely, should include a section describing the configuration of the experiment, the results of which are included in the publication, indicating:
 - o Instruments used, whether part of SPICE, and the instrument ownership;
 - o The field configuration of instruments in the experiment (siting, windshield, heating, data logger used)
 - o Processing of the instrument output into data used for the work presented.
 - o Any information, specific to the experiment, and relevant to the work presented.
 - o Any exceptions from the recommended practices regarding the use and configuration of the instruments.
 - o This information should be reflective of the site participation in SPICE.
- If reference is made to an instrument make and model, the author(s) should:
 - o Identify how the instrument is used for meeting the objectives of work presented in the publication;
 - o avoid any comparative and generalized statements, as well as broad qualifiers which would be perceived as ranking instruments (e.g. better, worse.);
 - o When comparative assessments are required as part of the results presented, the author(s) will indicate the context in which these assessments are made; e.g. a specific application for national purposes, outside the scope of SPICE, studies of a specific feature relevant to the scope of work (heating, shielding, siting, etc), preliminary studies on a SPICE topic, presented from a site only, etc.;
 - o Reflect as far as possible the comments of the involved parties in the subproject.
- Authors should avoid making statements that would imply acceptance or rejection of instruments or inferring any conclusions for the Final Report.